Severn Sound

Environmental Association

Farlain Lake Water Levels

January 2019

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Prepared by:
Severn Sound Environmental Association

for the

Township of Tiny

January 2019

Foreword

This document reports on preliminary technical investigations conducted by SSEA in the Farlain Lake area for the Township of Tiny. Data presented in this report are a combination of volunteer observations, SSEA data, and publicly available climate data. The report received technical review from the Lake Simcoe Region Conservation Authority (LSRCA) prior to its publication. This does not necessarily signify that the contents reflect the views and policies of the Corporation of the Township of Tiny or the LSRCA. Mention of trade names or commercial products does not necessarily constitute endorsement or recommendation for use.

Reference to this document should be made with the following citation:
Severn Sound Environmental Association. 2019. Farlain Lake Water Levels.

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Acknowledgements

Special thanks to hydrogeologists Tara Harvey and Mike Wilson from the LSRCA for their input and comments.

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Background

The SSEA has received complaints from concerned residents over the past couple of years regarding high water levels on Farlain Lake and the resulting property damage and shoreline tree dieback (Figure 1). Of particular concern are septic systems that might become inundated with water and contaminate the lake. Up to approximately 190 homes or cottages may be affected by high water, depending on how close structures are located to the shoreline. While definitive answers on the cause of these higher lake levels would require a hydrogeological study of the area and calculation of a water budget for the lake, some information is available that may shed light on the situation. This document summarizes what is known about the area and provides recommendations for further studies.

Figure 1. Photos taken in May 2018 showing shoreline damage and flooded conditions on Farlain Lake. Photos courtesy of Peter Andrews.

Current Lake Conditions

Farlain Lake is a kettle lake, as are downstream Second Lake (also known as Kettle's Lake) and Gignac Lake, and was formed during the last glacial period. Kettle lakes form when a block of ice trapped in glacial debris melts, and the meltwater fills the depression left by debris deposited around the melting ice block (Mackie 2001). Farlain Lake is unique in that has no surface discharge, classifying it as a seepage kettle lake. It is mainly groundwater fed and is in a groundwater recharge zone, with a groundwater fed tributary that flows year round into the lake on the west side (South Georgian Bay Lake Simcoe Watershed Region, 2006). Several other tributaries flow into the lake on an intermittent basis as a result of precipitation.

There is a depression between the north end of Farlain Lake and the south end of Second Lake, and it is possible that these lakes were connected via surface flow at one point when water levels were much higher. It is suspected that Farlain Lake now discharges very slowly to Second Lake via groundwater flow (Figure 2, Figure 3). A hydrogeological study would be needed to determine the direction and rate at which groundwater flows within the area. Since there is no surface discharge, lake levels are susceptible to a higher degree of seasonal and yearly fluctuation. Not having an outlet can lead to high water levels in years with greater than average precipitation, while steady groundwater inputs prevent abnormally low water levels in years with below average precipitation.

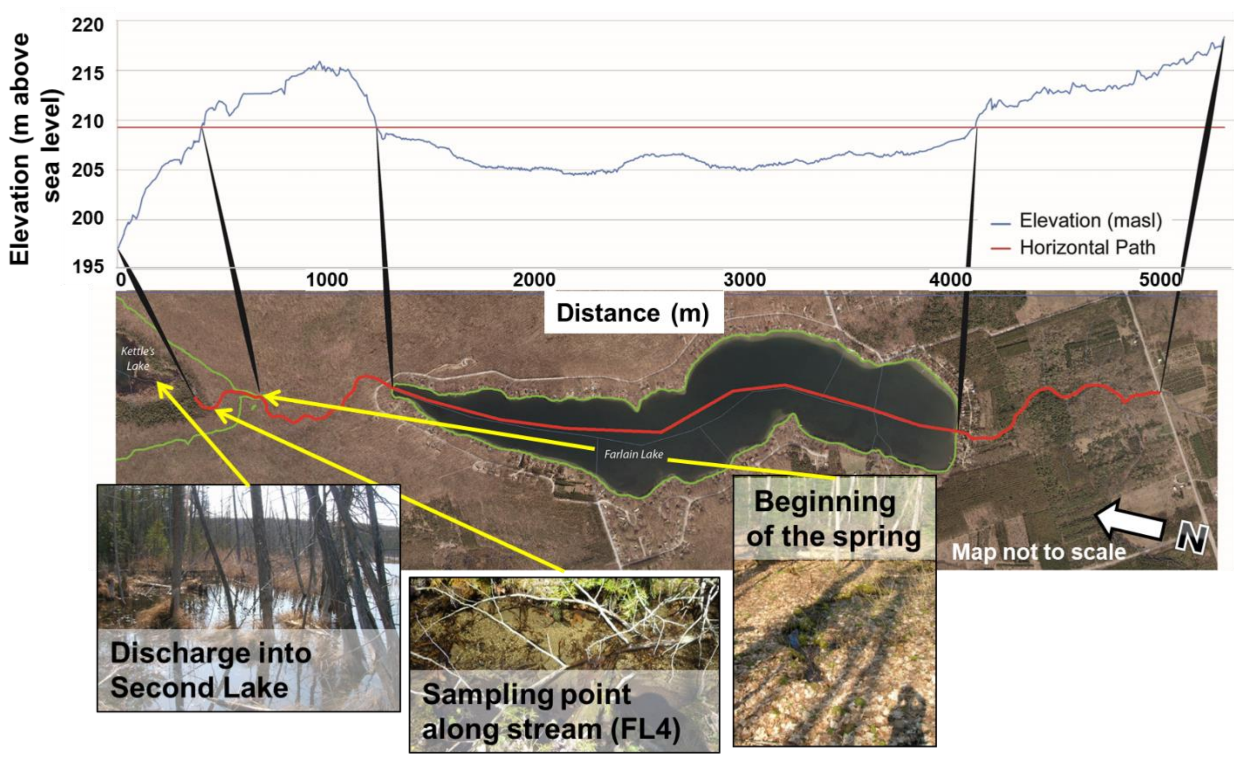
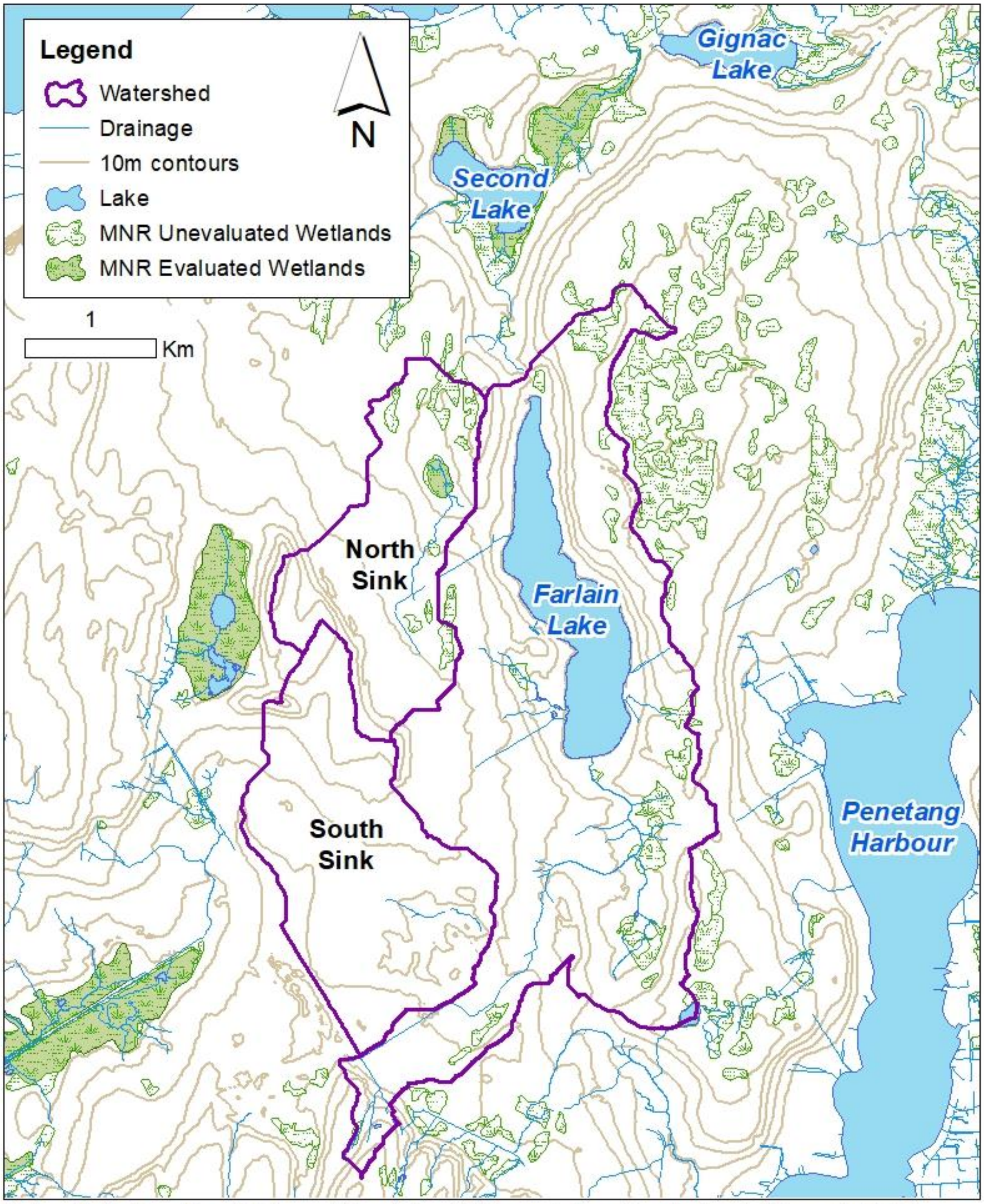


Figure 2. Elevation profile for Farlain Lake. Elevation data is in m above sea level; data from MNRF (Provincial Digital Elevation Model). Vertical exaggeration is 47x. Second Lake is also known as Kettle’s Lake.



Produced by the Severn Sound Environmental Association with Data supplied in part from the County of Simcoe, the Ontario Ministry of Natural Resources and Forestry (© Queen's Printer 2018) and under License with Members of the Ontario Geospatial Data Exchange, 2018. While every effort has been made to accurately depict the data, errors may exist. Any party relying on this information does so at their own risk. Not for navigational purposes.

Figure 3. Topographic map showing the Farlain Lake watershed. Also included are the north and south sinks, which could potentially drain to the lake via groundwater flow.

Spring water level measurements have been recorded by a shoreline resident at their waterfront residence from 2015-2018. Measurements were made from the water surface to the top of the concrete pad of their boathouse. The graph below shows water levels taken in mid-April to early May. These data show that levels have risen steadily over the past 4 years, with a substantial increase of approximately 40 cm from 2015 to 2016 (Table 1 and Figure 4). Note that because only one spring measurement was taken and snowpack data is not available, it is difficult to relate the timing of spring melt to the annual water levels. The timing of spring melt is important as there would be a large difference in water levels if a measurement was taken before compared with after the spring melt, or if a measurement was taken immediately following compared with several weeks following a melt event.

Table 1. Water level measurements taken by volunteer on Farlain Lake. The same measuring point was used each year.

Date	Julian Date	Depth at benchmark (cm)
07/05/2015	127	4.4
15/04/2016	106	45.0
05/05/2017	125	55.0
11/05/2018	131	65.6

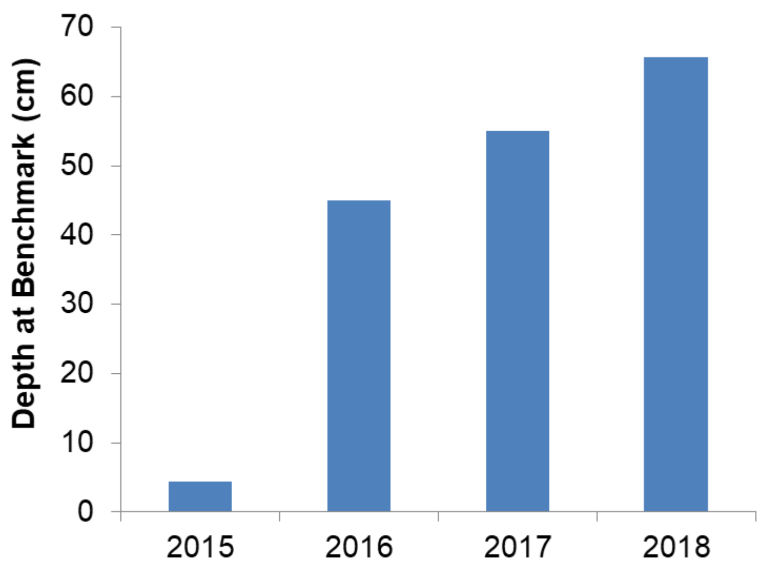


Figure 4. Spring water levels for Farlain Lake.

There are no lake water level measurements available prior to 2015 that are taken from the same location, but based on anecdotal observations from residents, it seems that the high spring levels over the last 3 years do not represent normal conditions for the lake. The SSEA monitors water levels on other inland lakes in the Severn Sound watershed, however each of these lakes has an outflow, so conditions are not directly comparable to Farlain Lake.

In order to give context to recent climate conditions, it is useful to refer to data from the Environment and Climate Change Canada (ECCC) weather station (operational from 1889-2016) and more recently, SSEA's Davis weather station, both located at the Midland Wastewater Treatment Plant (data available to Aug 2018, data gaps exist). Shown below are monthly average temperatures (Figure 5), total monthly rainfall (Figure 6) and total annual snowfall (Figure 7) from 2010-2016. Lower summer temperatures can cause decreased evaporation rates, while higher total rain and snowfall contribute to greater surface runoff. The summers of 2014, 2015 and 2017 were cooler than normal, while total annual rainfall was high in 2014 and 2017. Snowfall amounts in the 2013/14 and 2014/15 seasons were moderately high. Note that the methods used to measure rain and snowfall at the Midland station changed in 2010, so data prior to that year are not comparable to those taken after 2010. Snowfall data for the 2016/17 and 2017/18 seasons are not available. While useful as background information, it is difficult to fully relate snowfall data to water levels. A given snowfall event could have been followed by a melt period and therefore would not have contributed to overall snow accumulation and corresponding spring melt event, which has the greatest effect on water levels. Local snow accumulation data would give better information to relate to water levels.

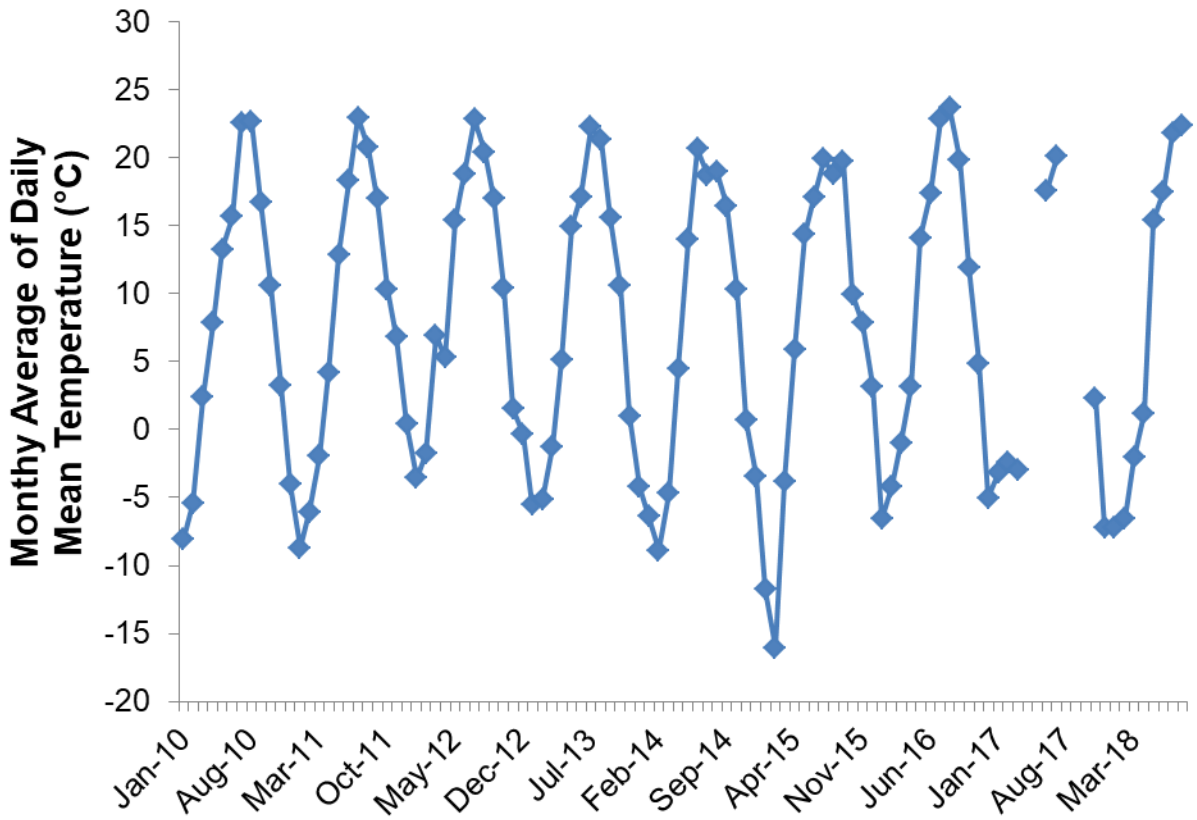


Figure 5. Monthly average temperature as recorded at the ECCC weather station at the Midland WWTP, 2010-2016, and the SSEA Davis weather station at the Midland WWTP, 2017-2018.

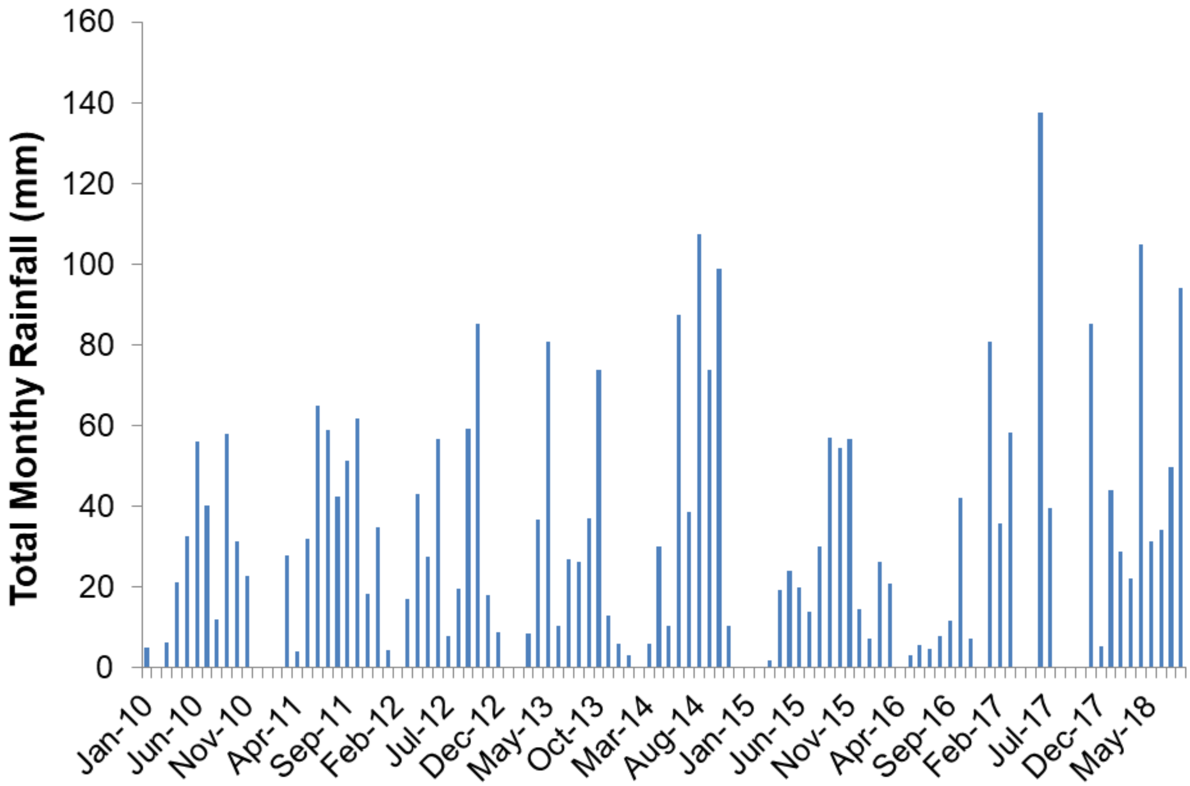


Figure 6. Total monthly rainfall as recorded at the ECCC weather station at the Midland WWTP, 2010-2016, and the SSEA Davis weather station at the Midland WWTP, 2017-2018.

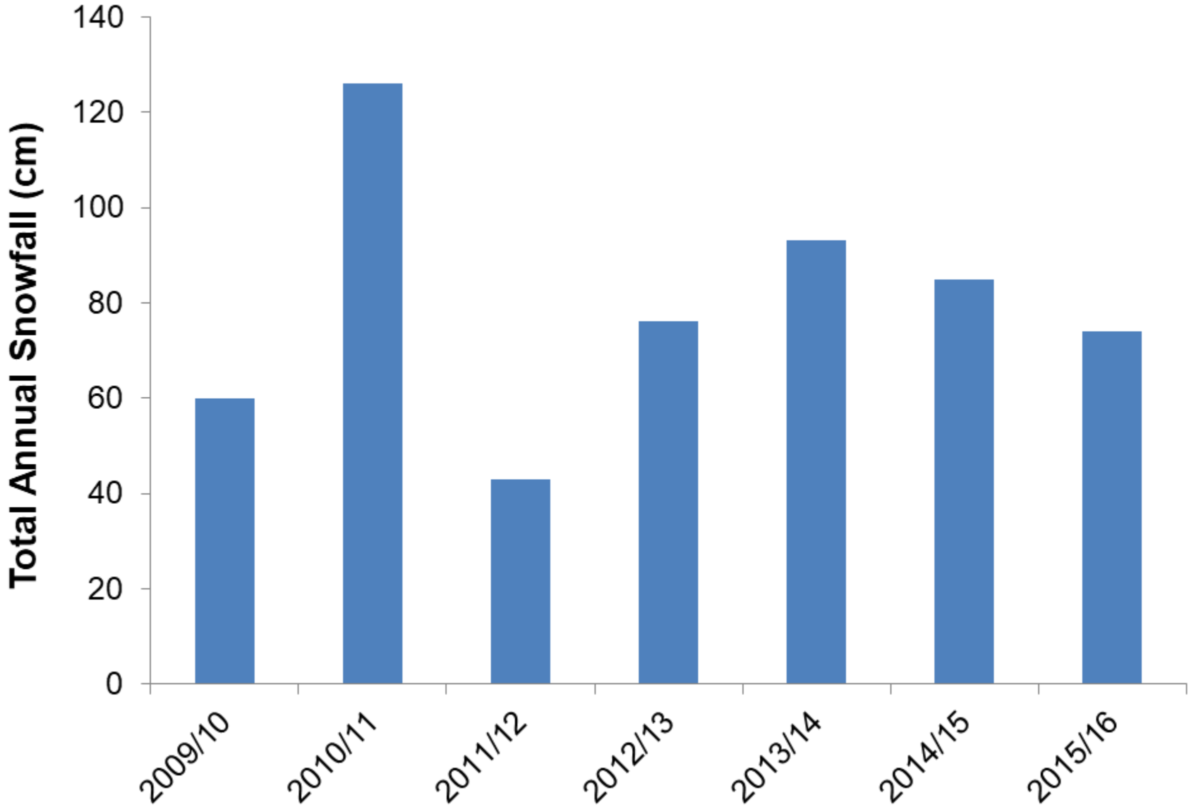


Figure 7. Annual snowfall as recorded at the ECCC weather station at Midland, 2010-2016.

Factors Influencing Lake Levels

Lake water levels are determined by the balance of water inputs and outputs. For a generalized lake system (Figure 8), inputs include precipitation in its various forms, inflowing tributaries, inflowing groundwater and surface runoff. Outputs include evapotranspiration of water by terrestrial plants, evaporation from the lake surface, and discharge via surface flow (river) and/or groundwater. In the case of Farlain Lake, all components of the hydrological cycle are present with the exception of a surface outlet.

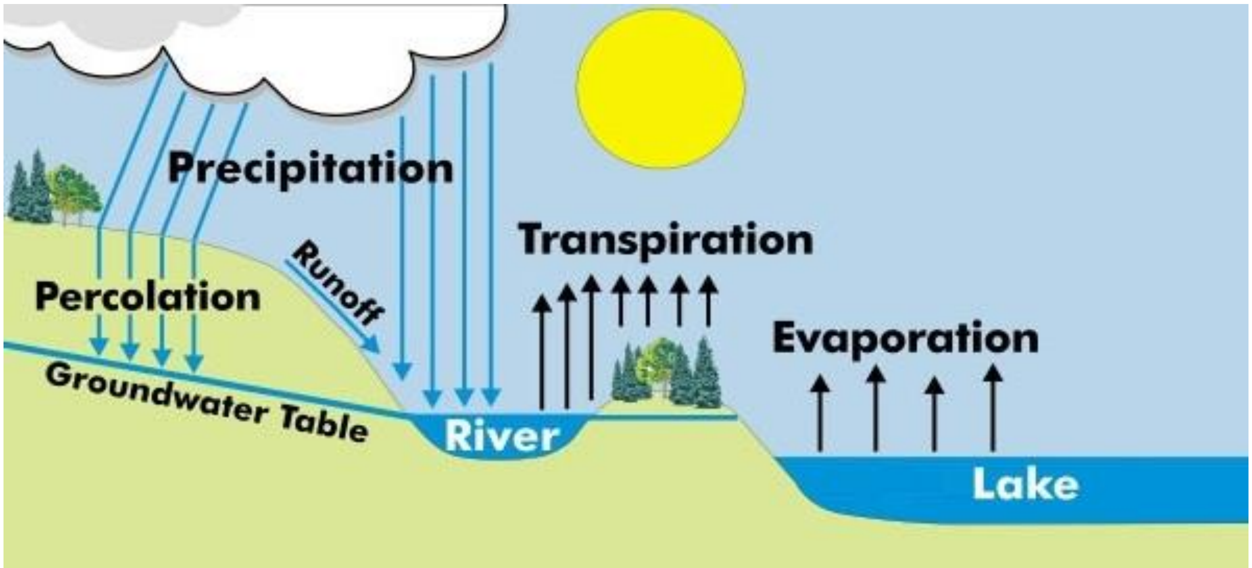


Figure 8. Generalized hydrologic cycle (modified from US Army Corps of Engineers, Creative Commons).

Changes in precipitation and timing/intensity of snow melt may have a large impact on water levels in the lake, especially since there is no outflow. The exact impact will be determined partially by the local geology/physiography so this along with hydrological variables (precipitation, timing and intensity of snow melt) are important to consider in the determination of possible causes of the increased water levels.

Factors Leading to Lake Level Rise for Farlain Lake

The recent increases in water levels observed on Farlain Lake are likely related to changes in precipitation and snow melt. An increase in snow melt could be a result of an increase in snowfall amount and/or warmer days earlier in the season that cause the snow to melt all at once instead of over a longer period of time. Since there is no record of water levels over the entire summer season, or for a longer historical period, it is currently difficult to determine if the recent high water levels are related to larger precipitation events or snow melt events, or if they represent long term changes in the water levels.

The fact that there is no outlet from the lake would impact the response of the lake to precipitation/runoff/snow melt events. This impact would result in higher water levels as all the inputs are stored within the lake then slowly discharged via groundwater. The speed of this discharge via groundwater depends on the local geology. If the geology is sandy then the discharge will occur faster and the increase in water levels would be less, but if the geology is more silt or clay-rich then the impact to water levels would likely be much greater as it takes longer for the water to move through the ground. The surface geology around Farlain Lake is mostly coarse sandy deposits with some areas of silty to sandy till deposits from the Tioga and Vasey Series, respectively (MOE 1973; Oak Ridges Moraine Groundwater Project, 2018; Figure 9). However, the underlying geology is dominated by the Sunnybrook drift which is a lower permeability layer that is rich in silt and clay, and allows groundwater to flow much more slowly (Oak Ridges Moraine Groundwater Project, 2018; Figure 10).

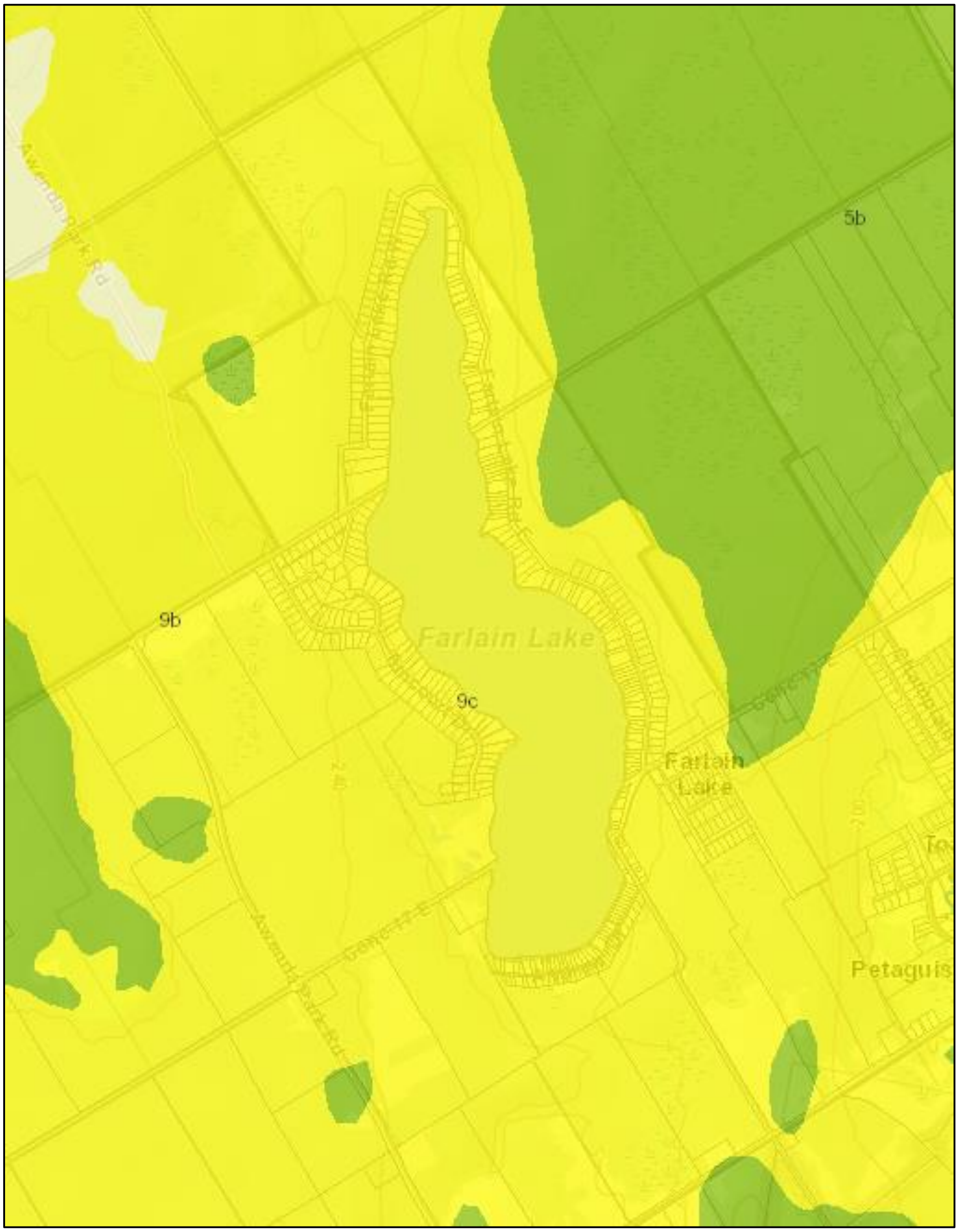


Figure 9. Surface geology (Ontario Geological Survey). Yellow represents coarse sandy deposits, green represents till deposits (finer sediments with silt/clay). Data use permission granted from the YPDT-CAMC partnership.

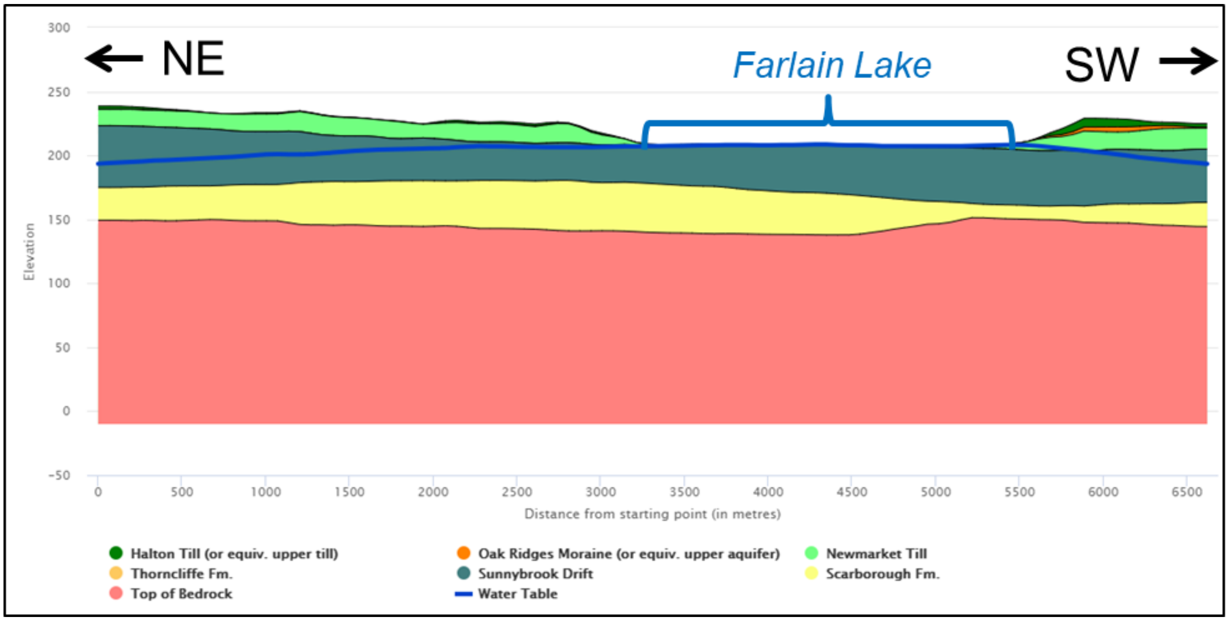


Figure 10. Geologic cross section, approximately NE-SW through Farlain Lake. Sunnybrook Drift underlies Farlain Lake and is a lower permeability layer (contains silt and clay). Data use permission granted from the YPDT-CAMC partnership.

Based on the local geology, it is expected that any precipitation would result in large water level increases as the lake receives runoff from a large catchment relative to the lake's size (the lake is 1 km^2 and drains a watershed that is 14 km^2). Due to the sandy nature of the top sediments this runoff and shallow groundwater may be transmitted quickly to the lake resulting in a larger total amount of precipitation entering the lake over a shorter time period. However, the Sunnybrook drift underlying the lake would result in slow discharge of the water from the lake. Therefore, larger water level increases following precipitation would be expected as a result of the local geology.

If increased precipitation events are occurring recently (precipitation events that are higher intensity or longer lasting etc.), then these may be a big contributor to the higher water levels within the lake. More investigation of the climate conditions are required to look into the timing and intensity of precipitation and melt events to determine if they are in fact increasing over the years in question. It is also important to further investigate lake water levels and groundwater levels to better determine if this is a seasonal water level increase or a long term increase in groundwater and surface water levels.

Recommendations

There has been a suggestion by residents that an artificial channel should be created to help manage lake levels and alleviate current flood conditions. SSEA does not recommend that the natural drainage of the lake be altered. This likely wouldn't be feasible under provincial and federal legislation such as the Fisheries Act and Drainage Act. Draining the lake north to Second Lake (into Awenda Provincial Park) or east to

Penetang Harbour could have unintended consequences for both Farlain Lake and the receiving water body including: impacts on receiving water quality and water temperature, reduced water level fluctuation necessary for native aquatic plants, and potential movement of invasive species.

It would be beneficial to conduct a hydrogeology study of the lake to determine the balance of inputs and outputs, also known as a water budget. This would involve quantifying precipitation using rain and snow gauges, and measuring tributary flow and infiltration rates. Inflowing and outflowing groundwater, surface runoff and evapotranspiration can be modelled using regional models, aided by digital elevation models (DEMs) and groundwater level data collected from local wells.

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