GUIDING SOLUTIONS IN THE NATURAL ENVIRONMENT

# 2019 Water Quality Monitoring & Aquatic Habitat Characterization Report
# Lakeview Village, Mississauga

*Prepared For:*

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# 1. Introduction

Beacon Environmental Limited (Beacon) was retained by Lakeview Community Partners Limited (LCPL) in 2018 to initiate a field program to characterize water quality, aquatic habitat and fish communities within the intake and discharge channels at the former Lakeview Generating Station site located at 800 Hydro Road in the City of Mississauga (**Figure 1**).

When the Lakeview Generating Station was constructed in the 1960's, the Lake Ontario shoreline was extensively modified. Lake filling was undertaken to extend the site further south by approximately 75 m to 175 m. To protect the generating station intake pumps, a 375 m long breakwall was constructed to form the 40 m wide intake channel. Two jetties were also constructed to accommodate lake freighters delivering coal. These jetties extend the intake channel an additional 500 m into the lake. The jetties are constructed with a combination of rock mounds and steel cells with rock and concrete. The shoreline along the western boundary was also extensively modified to create a 22 m wide and 130 m long discharge channel. The shoreline was reinforced with gravel and rock, and parts of the breakwater were re-vegetated with trees, grasses and shrubs (OPG 2013).

LCPL is proposing to redevelop the former Lakeview Generating Station site into a progressive and sustainable community comprised of mixed uses including residential, commercial, institutional and open space. Approximately 27.24 ha or 40% of the site located immediately adjacent to Lake Ontario will be converted to public open space. The former intake and discharge channels will be integrated into the design of this public waterfront space. The City and its agency partners have requested that opportunities be examined to soften the constructed channels to provide ecological and recreational benefits.

The goal of this study is to determine ecosystem health in both the intake and discharge channels. More specifically, the objectives of the program are as follows:

a) To establish baseline water quality conditions in the intake and discharge channels using standard parameters including Provincial Water Quality Objectives (PWQO) and Canadian Environmental Quality Guidelines (CCME) to allow for future comparative analyses; and
b) To characterize the existing the aquatic habitat and fish communities of the intake and discharge channels.

The information collected through this study will be used to identify any potential water quality issues so that appropriate management solutions can be considered through the design of Lakeview Village and its environmental management systems. Additionally, the program will help identify enhancement opportunities that could be implemented to improve aquatic habitat and attract a more diverse fish community.

# 2. Methodology

During the spring and summer of 2019, water levels in Lake Ontario were highest on record, which delayed the field program by several weeks. By August, water levels in the intake and discharge channels started to slowly decline, allowing safe access to the channel.

## 2.1 Aquatic Habitat

Aquatic habitat assessments of the intake and discharge channels connected to Lake Ontario were completed in September and November 2018 (**Figure 1**). Since habitat is unlikely to change over a period of one year, these assessments were not repeated in 2019 although incidental observations were recorded. The aquatic habitat assessment was completed by boat and involved a visual assessment of the following characteristics of each channel:

- Channel width and depth profile, bank height, bank stability;
- Substrate types and distribution;
- Fish barriers;
- Riparian vegetation type and cover; and
- In-stream cover type and extent.

## 2.2 Water Quality

Water quality sampling was completed in 2018, as part of the baseline program. Beacon deployed four (4) YSI EXO2 Multiparameter Sondes on September 28th, 2018 at two locations in the intake channel (SW-I1, SW-I2) and 2 locations in the discharge channel (SW-D1, SW-D2). The sondes recorded continuous measurements of Dissolved Oxygen (DO), pH, turbidity and temperature until they were removed on November 14th, 2018. Water samples were also collected manually at all four locations on September 28th and November 14th, 2018 for lab analysis.

On August 30th, 2019, one YSI 6600 Multiparameter Sonde was installed in the intake channel and another in the discharge channel (**Photograph 1**). The sondes were installed approximately 2.5 m below the water surface and anchored to the channel bed. The sondes recorded continuous measurements of Dissolved Oxygen (DO), pH, turbidity and temperature until they were removed on October 4, 2019.

**Photograph 1. Water quality multiparameter sonde.**

Water samples were also collected at both locations on August 30th and October 4th, 2019. Water quality samples were collected using a Van Dorn water sampler, approximately 2.0 m below the surface and decanted into pre-labelled bottles. Water samples were sent to an accredited laboratory for analysis of the following parameters:

- Total Ammonia ($NH_4$);
- Nitrate ($NO_3$);
- Nitrite ($NO_2$); and
- Total Phosphorus (P).

A handheld multi parameter water quality probe (YSI) was used for *in situ* measurements on August 30th and October 4th, 2019. The following parameters were recorded:

- Water temperature (°C);
- Conductivity (µs/cm);
- Conductance (mS/cm);
- pH;
- Percent Dissolved oxygen (DO%);
- Dissolved oxygen (mg/L); and
- Oxidation reduction potential (ORP).

The water quality data were compared against the Provincial Water Quality Objectives (PWQO) and Canadian Environmental Quality Guidelines (CEQG) and graphed to explore relationships between the various parameters. The results are presented below in **Section 3.2.**

## 2.3 Fish Community

Beacon obtained fish community records from Credit Valley Conservation (CVC). Since 1992, 28 species of fish have been collected from Lake Ontario sampling stations within the vicinity of the Study Area. Over half of these species (18) were still present in 2017. It should also be noted that sampling in 2017 resulted in the highest number of different fish species caught over the sampling years. Additionally, three new fish species were captured in 2017 which have not been recorded in previous sampling years. Species recorded included Brook Silverside (*Labidesthes sicculus*), Rainbow Smelt (*Osmerus mordax*) and Brown Trout (*Salmo trutta*). Coho Salmon (*Oncorhynchus kisutch*) which is an introduced uncommon species, was recorded in 1992 but not in subsequent sampling. As the sampling programs are infrequent and irregular, the observed differences should not be interpreted as a reduction or increase in overall species diversity.

Data from the CVC sampling program suggests that the nearshore habitat along the subject property may support a diverse fish community. Several species were recorded that are known to be sensitive to environmental degradation, such as siltation and pollution, including four species of salmonids and Rainbow Smelt. There are no CVC records of provincially endangered American Eel or other Species at Risk (SAR) within the vicinity of the Study Area.

Fish community sampling of the intake and discharge channels was completed on September 17, 2019 using a SmithRoot Cataraft Electrofisher fishing boat (**Photograph 2**). Fish were caught, identified, measured, photographed and then returned to the channels.

**Photograph 2. Electrofishing in the discharge channel.**

# 3. Findings

## 3.1 Aquatic Habitat

In general, the aquatic habitat within the intake and discharge channels is similar as both channels were similarly designed and constructed. Descriptions of the aquatic habitat characteristics associated with these channels is provided below.

### *3.1.1 Intake Channel*

The total length of the constructed intake channel is about 1000 m as measured from the intake headwall to the tip of the jetties. The average width of the channel is 35 m. The depth of the channel, measured at its centre, is approximately 6.0 m and is excavated into natural bedrock. The channel is connected to Lake Ontario and provides relatively sheltered lacustrine (lake like) fish habitat without currents or extreme wave action. The channel is straight, and its banks are lined with angular cobble and boulders (rip rap stone) at a 2:1 incline. The intake headwall structure is made of concrete and is vertical. The only vegetation present consists of shrubs and trees which are growing at the top of the constructed banks (**Photograph 3**). These shrubs and trees do not provide cover for fish or shading to the channel. Within the channel, aquatic vegetation is very sparse and consists of non-native Eurasian water-milfoil (*Myriophyllum spicatum*), curly-leaved pondweed (*Potamogeton crispus*), as well as sago pondweed (*Potamogeton pectinatus*) and Canada water weed (*Elodea canadensis*). Overall, the intake channel provides minimal habitat structure and vegetation cover for fish. This is due to the flat structureless bedrock bottom and uniform rip rap banks.

**Photograph 3. Bank conditions along intake channel.**

### *3.1.2 Discharge Channel*

The constructed discharge channel is approximately 140 m long and has a width of approximately 20 m. The channel is excavated into bedrock and is approximately 6.0 m deep at its centre. The discharge channel outlets to the marina basin at Lakefront Promenade Park. The basin in largely enclosed by a 630 m long groyne wall. Like the intake channel, the discharge channel also provides relatively sheltered lacustrine (lake like) fish habitat without flow or extreme wave action. Its structure is also similar to the intake channel. The channel is straight with banks constructed of rip rap stone at a 2:1 incline. Sections of the channel are lined with gabion baskets filled with angular stone and other parts are lined with large concrete slabs (**Photograph 4**). The discharge headwall structure is made of concrete and is vertical. There are several abandoned industrial structures along the shoreline some of which are partially sub-merged including metal steps, metal pipe, a floating walkway, etc. No aquatic macrophytes were observed, however algal growth is evident during the summer and fall.

**Photograph 4. Armoured banks in discharge channel.**

Vegetation consisted of shrubs and trees growing at the top of the constructed banks. These shrubs and trees do not provide cover for fish or shading to the channel, however the abandoned industrial structures along the banks provide some cover to fish. Overall, this constructed channel provides minimal cover for fish due to its uniformly shaped banks and channel bottom.

## 3.2 Water Quality

Two sampling methods were used to collect water quality data from the intake and discharge channels. Multi-parameter sondes were installed in the channels to continuously record data on various water quality parameters. Manual measurements and water quality samples for laboratory analysis were also collected on August 30th and October 4th, 2019.

### *3.2.1 Continuous Water Quality Data*

Water quality sondes were deployed on August 30th, 2019 and retrieved October 4th, 2019 from each of the surface water stations (**Figure 1**). The sondes were programmed to record water temperature, dissolved oxygen, pH and conductivity every 15 minutes.

### *3.2.2 Water Temperature*

Monitoring water temperatures in aquatic environments is important for management as vertical stratification in these environments can affect the spatial distribution of fish and oxygen levels. When waterbodies stratify, they form layers of water with different temperatures which occurs due to different densities of warm and cold water. In the nearshore areas, summer mixing in the water column results in near uniform temperatures through the depth. In the protected channels, water temperature is often higher because of the shallower water and the absence of wave and wind exposure.

The sondes recorded water temperatures from the end of August to October 2019 capturing the transition from late summer to fall temperatures (**Figure 2**). Water temperatures in both the intake and discharge channels followed the same seasonal trend, with warmer temperatures recorded in September 2019 and a gradual decline during the colder fall months. Daily average water temperatures in the discharge channel were generally warmer from the end of August 2019 to the beginning of October 2019.

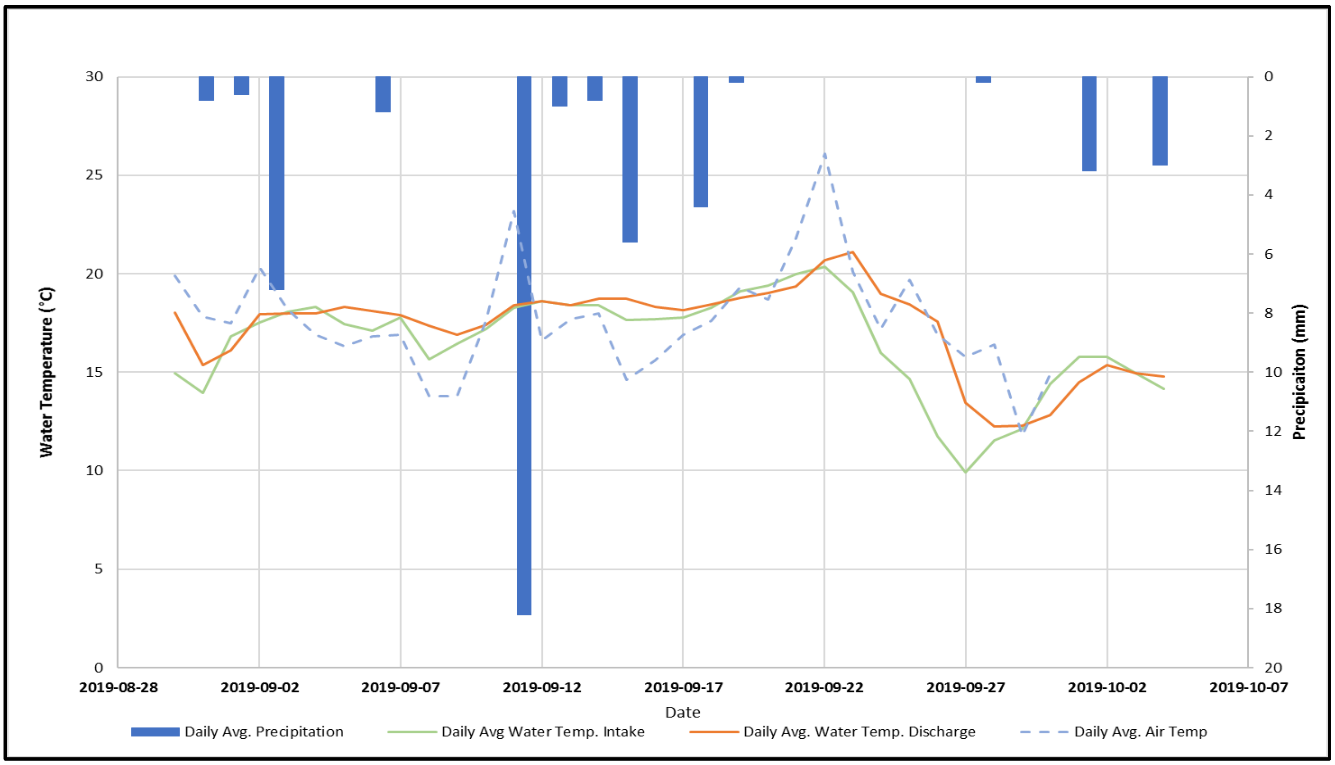



**Figure 2. Daily Average Water and Air Temperature (August 30 – October 4, 2019) at Intake and Discharge Channel**

The maximum temperature observed at the intake channel was 20.8ºC (September 22, 2019) and the lowest temperature was approximately 8.6ºC (September 27, 2019). The maximum temperature of the discharge channel was 21.9ºC (September 22, 2019), and the lowest temperature of the discharge channel was 12.1ºC (September 29, 2019). Similar to the findings in 2018, the discharge channel remained slightly warmer than the intake channel during the monitoring period except for a week in

October when it was cooler than the intake channel. Warmer temperatures in the discharge channel are likely attributable to it being sheltered from the lake by the Lakefront Promenade embayment.

### 3.2.3 Dissolved Oxygen

Dissolved oxygen (DO) is a fundamental parameter in water because it is vital to the metabolism of all aerobic aquatic organisms. Major sources of DO are the atmosphere and photosynthesis by aquatic vegetation. DO levels are influenced by winds, currents and inflows as well as aquatic vegetation which release oxygen into the water column during the daytime when plants are photosynthesizing and consumes oxygen during the night when plants are respiring. Aquatic vegetation also consumes oxygen during decomposition, especially late in the year, contributing to seasonal fluctuations. Temperature also drives seasonal DO fluctuations, especially at different depths in lakes, because solubility increases considerably in cold water. In the spring, DO saturation is very high throughout the water column of most lakes. As lakes become thermally stratified, DO stratification occurs as well; DO increases in the epilimnion and decreases in the metalimnion and hypolimnion. Reduced DO concentrations cause a number of physiological and behavioural effects on a variety of organisms and affect the solubility of nutrients.

Dissolved oxygen was comparatively graphed with water temperature for the intake and discharge channels. The intake channel followed the expected trend of decreasing water temperature with increasing dissolved oxygen with this transition occurring near the end of September 2019.

In 2019, the DO sensor in the discharge channel sonde malfunctioned resulting in loss of data and is the reason this data is not presented in this report.

The CCME guidelines suggest that for the protection of aquatic life the lowest acceptable dissolved oxygen concentration should be 6 mg/L for warmwater biota and 9.5 mg/L for coldwater biota (CCME, 1999). **Figure 3** shows that the DO in the intake channel fluctuated above and below the coldwater threshold indicating that the intake channel can support coldwater species. The lowest DO level in the intake channel was 4.1 mg/L (September 23, 2019) with the highest being 11.78 mg/L (September 29, 2019).

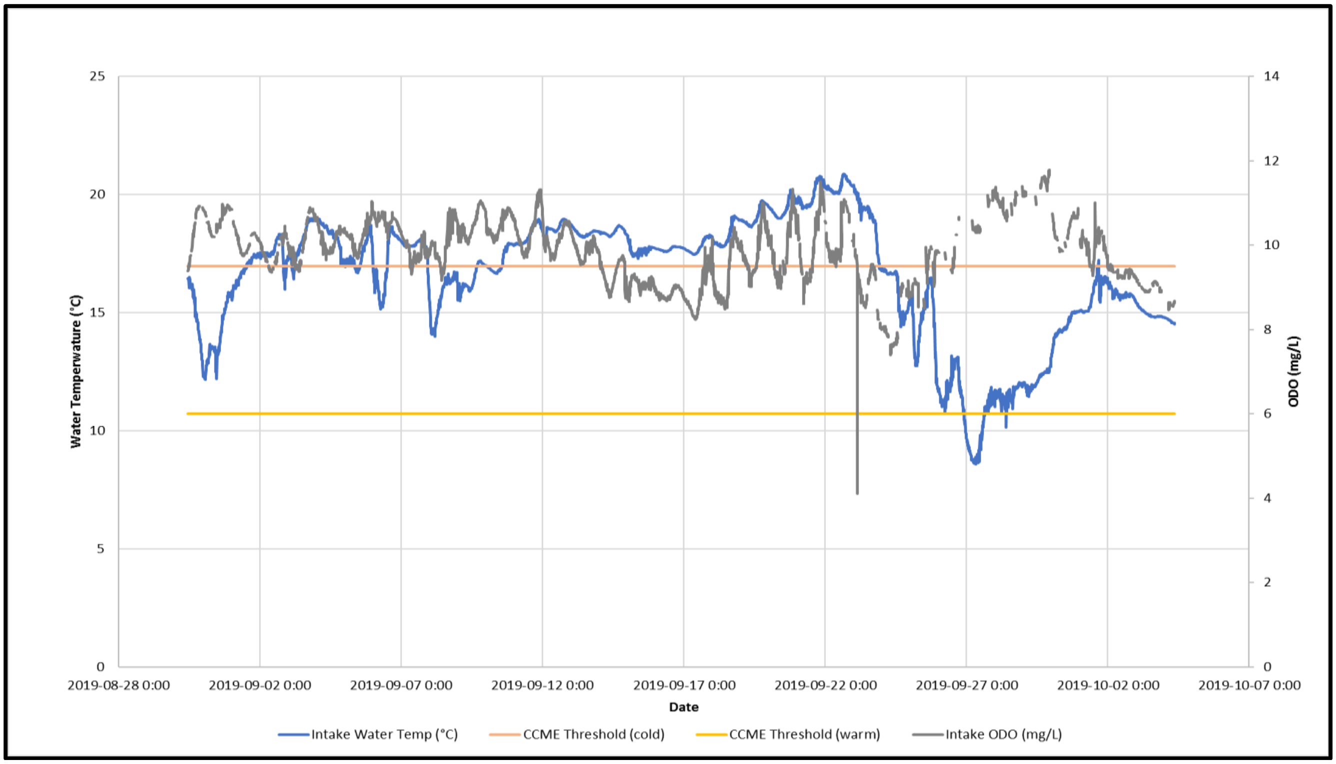



**Figure 3. Water Temperature and Dissolved Oxygen (mg/L) (August 30 – October 4, 2019) for Intake Channel**

As was recommended in the 2018 monitoring report, two dissolved oxygen profiles were completed in August and October 2019, in both the intake and discharge channels. The results of this profile are presented in **Figures 4** and **5**.

The intake DO profile, shows that dissolved oxygen levels increase with depth as temperatures decrease, during the summer profile, which is indicative of an oligotrophic lake. On August 30th, the water column was clear in most locations and the bottom of the channel was visible. No algal growth was observed in the intake channel. The clear water column and lack of algal growth allows for deeper light penetration and less oxygen uptake for decomposition. Therefore, DO levels increase as the depth increases.

During October 2019, the water column was well mixed and uniform as both temperature and dissolved oxygen have only minor changes in their readings. This trend is indicative of fall turnover.

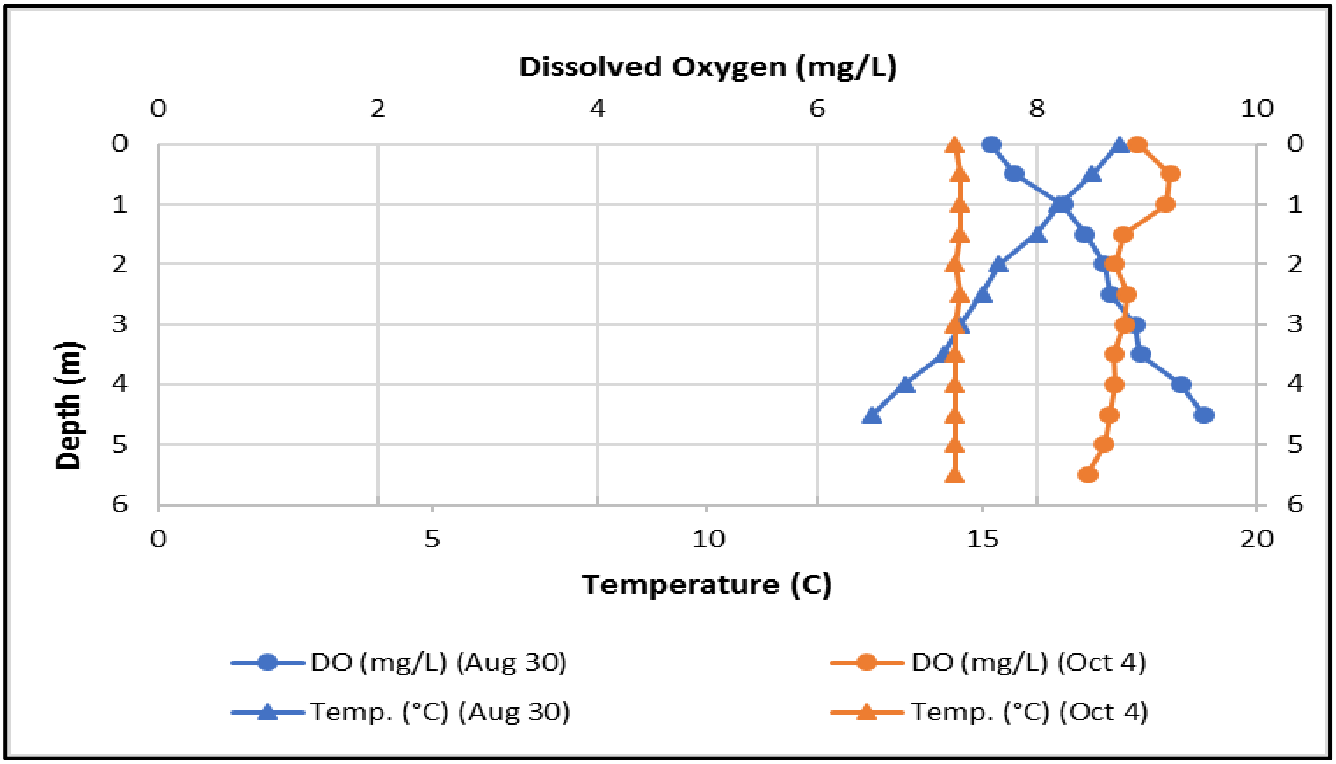



**Figure 4. Dissolved Oxygen and Temperature Profile for Intake Channel (August 30 and October 4, 2019)**

The profile for the discharge channel shows different results to the intake channel. The August 2019 profile shows a trend which is referred to as a clinograde. This is a result of the oxygen content in the hypolimnion (lower level of water) being depleted rapidly by oxidative processes (Wetzel 2001). This type of profile is typically seen in eutrophic lakes (high in nutrients). This can result in anoxic conditions along the bottom of the lake as DO declines as a result of biological oxidation of organic matter and oxygen consumption by organisms (Wetzel 2001).

During October 2019, the profile shows that the water column was well mixed and mostly uniform as both temperature and dissolved oxygen have minor changes in their readings. This trend is indicative of fall turnover.

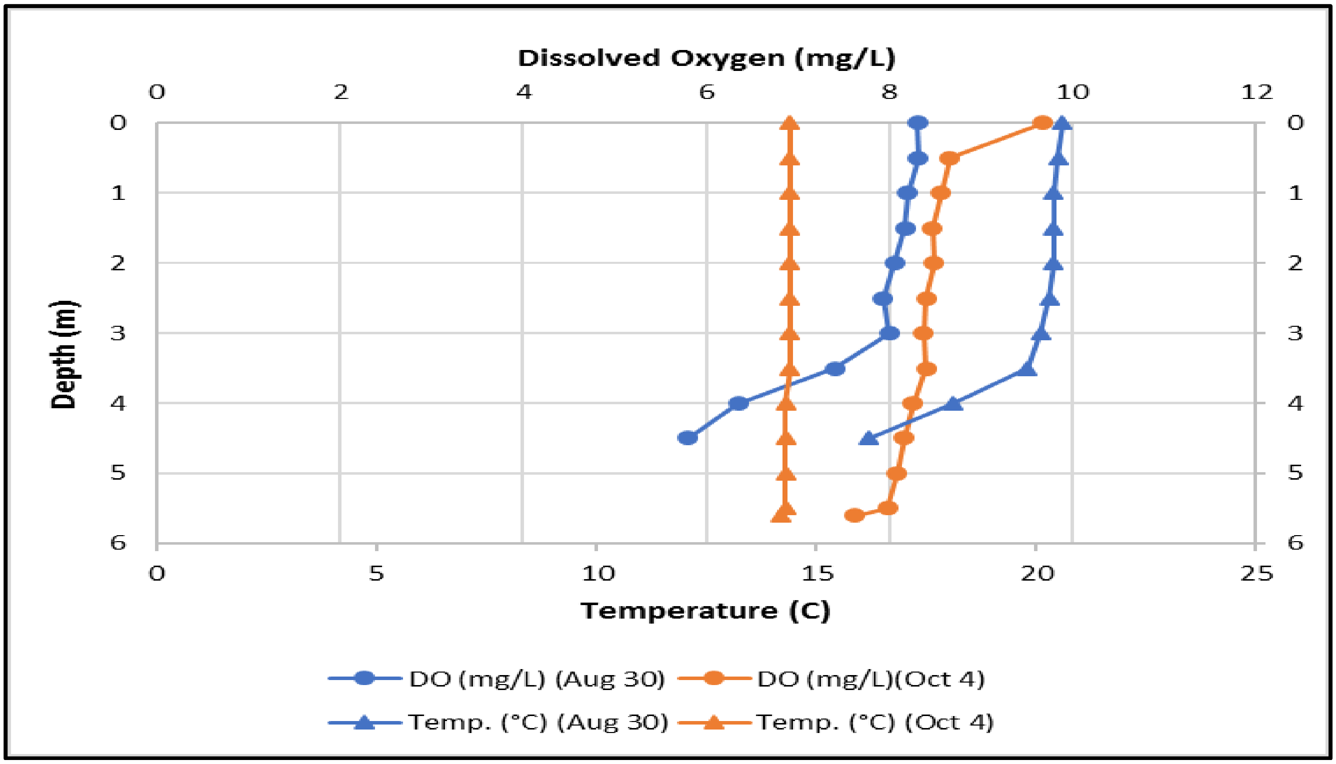



**Figure 5. Dissolved Oxygen and Temperature Profile for Discharge Channel (August 30 and October 4, 2019)**

### *3.2.4 pH*

pH is a measure of the concentration of hydrogen ions in a solution. It is measured on a logarithmic scale between <2 and 12 where low pH values indicate less hydrogen activity and therefore acidic conditions; the opposite is true for higher pH values, resulting in basic conditions. Dissolved organic matter contains organic acids which lowers pH values; these types of acids are abundant in wetlands and in water bodies with many wetlands in their watersheds.

The pH of the discharge channel remained around the maximum recommended PWQO guideline of 8.5, which is alkaline. Both the intake and discharge channel stayed within the recommended limits from September 23rd, 2019 onwards (**Figure 5**). Prior to this, the intake channel pH was generally above the recommended limit.

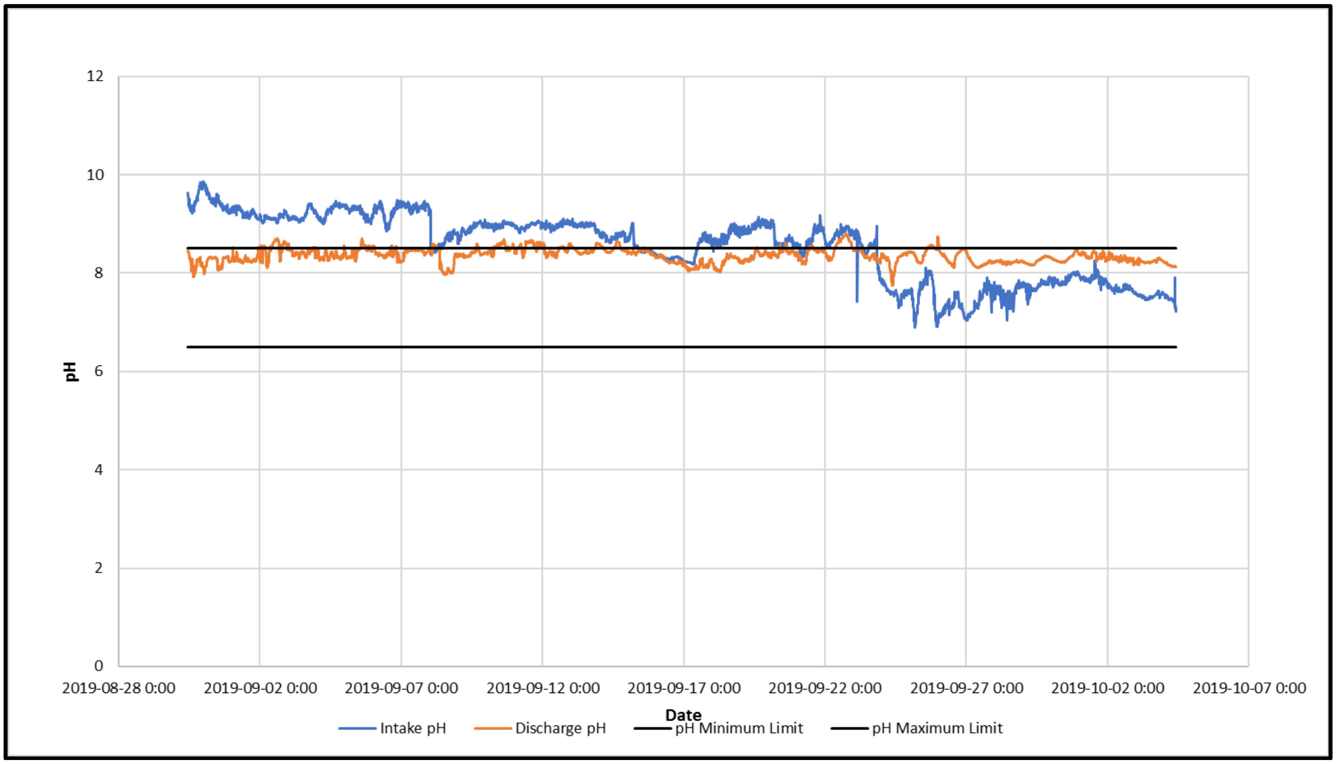



**Figure 6. pH Values for Intake and Discharge Channel**

### *3.2.5 Conductivity*

Conductivity is the measure of the resistance of a solution to electrical flow. It is dependent on the number of dissolved substances in water; major contributing ions include calcium, potassium, bicarbonate, sodium, sulphate and chloride. It declines with increasing ion content. The ions are introduced to water bodies through leaching of sediments. Where smaller sediments are abundant, greater surface areas allow for more leached solution.

Similar conductivity values were recorded in both the intake and discharge channels. The intake station ranged from 301- 450 µS/cm while conductivity at the discharge channel ranged from 313-357 µS/cm. There were two arbitrary spikes in conductivity in the intake channel occurring on September 23rd and September 25th, 2019 however there was no precipitation leading up to or on the day of the elevated reading. Currently no PWQO or CCME guideline standards are available for conductivity. **Figure 7** shows the conductivity readings for the intake and discharge channels.

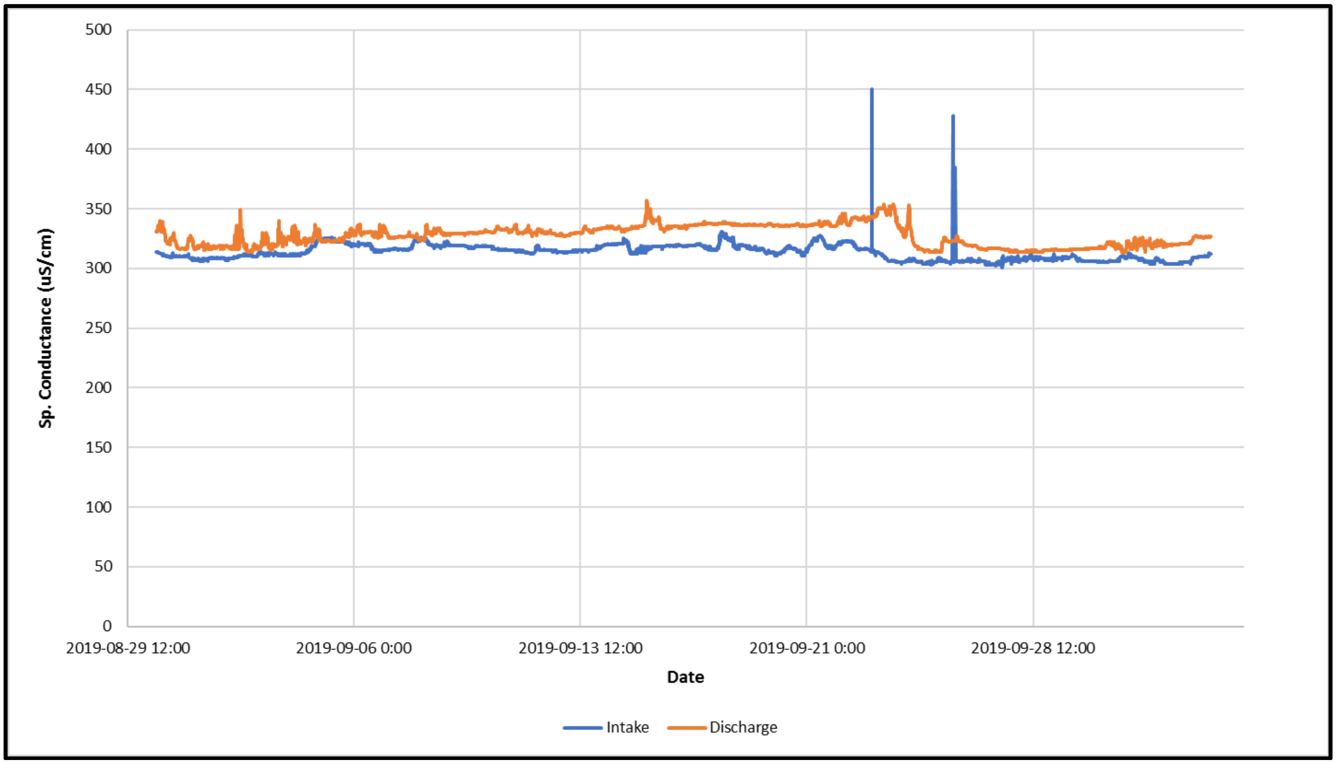



**Figure 7. Conductivity Values for Intake and Discharge Channel**

Overall conductivity in the intake channel was lower than the conductivity levels in the discharge channel.

## 3.3 Laboratory Analysis

Baseline water quality samples were collected on August 30th and October 4th, 2019 from each of the surface water stations (**Figure 1**). Measurements were taken for both sampling events with minimal precipitation in the preceding 48 hours. Water quality samples were collected, and *in-situ* water quality parameters were recorded during each of the two site visits. *In-situ* water quality results are presented in **Table 1**.

### Table 1. In-Situ Water Quality Parameters

| Location | Date | Parameters | | | | | |
|---|---|---|---|---|---|---|---|
| | | Water Temp. (°C) | Conductivity (µs/cm) | Dissolved Oxygen (%) | Dissolved Oxygen (mg/L) | pH | ORP |
| Intake | 2019-08-30 | 17.5 | 261.8 | 78 | 7.7 | 8.23 | 253.7 |
| | 2019-10-04 | 14.5 | 327 | 87.2 | 8.88 | 8.12 | 261.3 |
| Discharge | 2019-08-30 | 20.6 | 294.3 | 89.4 | 8.31 | 8.54 | n/a |
| | 2019-10-04 | 14.4 | 267 | 82.6 | 8.26 | 8.25 | 261.5 |

The laboratory baseline water quality results are presented in **Table 2** and summarized below. The intake channel exceeded the CEQG nitrate guideline limits during both sampling events. The discharge channel also exceeded the nitrate limit on both sampling events and the Total Phosphorous PWQO limit on August 30$^{th}$.

## Table 2. Lab Analysis Results

| Parameter | Units | Reportable Detection Limit (RDL) | Guideline Limit | | Intake | | Discharge | |
|---|---|---|---|---|---|---|---|---|
| **Inorganics** | | | **PWQO** | **CEQG** | **2019-08-30** | **2019-10-04** | **2019-08-30** | **2019-10-04** |
| **Total Ammonia-N** | mg/L | 0.050 | n/a | n/a | 0.081 | 0.10 | 0.084 | 0.10 |
| **Un-ionized Ammonia** | mg/L | n/a | 0.02 | 0.019 | 0.00263 | 0.0027 | 0.00924 | 0.0027 |
| **Total Phosphorus** | mg/L | 0.020 | 0.01 | n/a | ND | ND | **0.024** | ND |
| **Nitrite (N)** | mg/L | 0.010 | n/a | n/a | ND | - | ND | - |
| **Nitrate (N)** | mg/L | 0.10 | n/a | 550 | 0.24 | 0.27 | 0.18 | 0.25 |
| **Nitrite + Nitrate** | mg/L | 0.1 | n/a | n/a | 0.24 | - | 0.18 | - |

Notes: ND- not detected, RDL exceeds Guideline Limit
*Total Ammonia converted to Un-ionized ammonia from PWQO table

### 3.3.1 Phosphorus

Phosphorus is usually the nutrient that limits biological productivity and as such, is the primary driver of eutrophication. Phosphorus is prevalent naturally in many types of sediment, but a variety of anthropogenic sources exist such as fertilizers and human waste. Human practices also contribute indirectly to increased phosphorus levels; these practices include forestry and the clearing of vegetation which limits the retention of phosphorus before it reaches the waterbody. Phosphorus is strongly adsorbed onto soil particles and therefore, phosphorus contamination of ground water is generally not a problem. Most of the phosphorus transported to surface waters is attached to eroded soil particles, particularly from fine-textured soils (e.g. clay and silt) near watercourses.

Eutrophication increases plant and algal productivity which can cause a decrease in biodiversity, decline in sensitive taxa, increase in turbidity and an increase in organic matter and anoxic conditions due to the oxygen requirements of decomposition. Sediment typically contains more total phosphorus (TP) than the adjacent water column, and under aerobic conditions, the exchange is unidirectional from water to sediment. However, in anerobic conditions, phosphorus can be leached from the sediments into the water column through redox reactions, which causes a reduction in DO levels. This process compromises habitat for cold water fish species such as Lake Trout (*Salvelinus namaycush*). The impacts of increased TP on humans are also widespread and include challenges in treatment of potable water, decline in recreational value of water, and impediments to water flow and navigation. The decline in recreational value is usually attributed to the presence of aquatic plants and algae. It should be noted that macrophytes and algae occur naturally, and therefore should not be inherently viewed as an anthropogenically induced problem.

The PWQO suggest that to avoid nuisance concentrations of algae in lakes, average total phosphorus concentrations for the ice-free period should not exceed 20 µg/L. A high level of protection against aesthetic deterioration will be provided by a total phosphorus concentration for the ice-free period of 10 µg/L or less. This should apply to all lakes naturally below this value. Excessive plant growth in rivers and streams should be eliminated at a total phosphorus concentration below 30 µg/L.

In this case, the laboratory detection limit (0.02 mg/L) was higher than the PWQO guideline (0.01 mg/L), which means the laboratory is unable to detect concentrations less than 0.02 mg/L. Therefore, TP was reported as not detected for all samples except the August 30$^{th}$ discharge sample. This sample slightly exceeded the guideline (0.024 mg/L), however it was non-detect during the October 4$^{th}$ sampling event.

### 3.3.2 Ammonia

Ammonia is a large source of nitrogen to aquatic environments. Un-ionized ammonia refers to all forms of ammonia in water except the ammonium ion, which is measured by ionized ammonia. The ratio between the two forms is highly dependent on pH and temperature. Ammonia commonly enters aquatic environments from organic waste and atmospheric exchange, through transformation of nitrogenous material in soil and water, nitrogen fixation of DO and excretion by biota. Sewage treatment plants, agricultural run-off and industrial effluents are major anthropogenic sources.

Unionized ammonia was calculated from Total Ammonia using temperature and pH values because guideline values for both the PWQO and CEQG are expressed as unionized ammonia. All stations were below both guidelines. The highest ammonia reading was 0.0027 mg/L at the intake and discharge stations on October 4th, 2019. The lowest was 0.00263 mg/L at the intake station on August 30th, 2019. PWQO and CEQG levels are 0.02 and 0.019 mg/L, respectively.

### *3.3.3 Nitrate*

Nitrate results from the oxidation of other nitrogen compounds, especially ammonia. Nitrate sources include fertilizers, human waste and agricultural run-off. Nitrates can be the limiting nutrient during eutrophication when phosphorus supply is abundant as nitrate increases the productivity of plant and algal species. Total nitrogen to total phosphorus ratios are calculated to determine which nutrient limits productivity within a water body. A ratio greater than 10 suggests a phosphorus-limited system.

Nitrate was below the CEQG guideline limit at all stations. The highest nitrate level found was 0.55 mg/L at station SW-D2 on November 14th, 2018. The lowest level of 0.18 mg/L was found at the discharge station on August 30th, 2019.

## 3.4 Fish Community

The results of the fish community sampling are presented in **Table 3.** It is important to note that Common Carp (*Cyprinus carpio)* were observed in the intake and discharge channels but were not caught. Due to the depth of the channels, smaller fish at the bottom of the channels were observed but were not affected by the electric current.

## Table 3. Fish Community Sampling Results

| Family | Common Name | Scientific Name | Thermal Regime | General Abundance | Ontario Origin | Tolerance | Preferred Habitat | Intake Channel | Discharge Channel |
|---|---|---|---|---|---|---|---|---|---|
| *Centrarchidae* | Bluegill | *Lepomis macrochirus* | Warmwater | Common | Native | Intermediate | Lacustrine/ riverine - shallow weedy bays of larger lakes | **1** | |
| | Pumpkinseed | *Lepomis gibbosus* | Warmwater | Common | Native | Intermediate | Lacustrine/ riverine - warm, shallows of lakes | **5** | |
| | Rock Bass | *Ambloplites rupestris* | Coolwater | Common | Native | Intermediate | Lacustrine/ riverine - rocky or vegetated shallows of lakes | | **3** |
| | Smallmouth Bass | *Micropterus dolomieu* | Coolwater | Common | Native/ Introduced | Intermediate | Lacustrine/ riverine - rocky and sandy areas of lakes | | **3** |
| *Cyprinidae* | Bluntnose Minnow | *Pimephales notatus* | Warmwater | Common | Native | Intermediate | Lacustrine/ riverine - sand and gravel bottomed shallows of clear lakes | | **1** |
| | Common Carp* | *Cyprinus carpio* | Warmwater | Common | Introduced | Tolerant | Lacustrine/ riverine - Lakes with abundant aquatic vegetation | **1** | **1** |
| | Spottail Shiner | *Notropis hudsonius* | Coolwater | Common | Native | Intermediate | Lacustrine/ riverine - Lakes with sand, gravel, mud or silt substrates | **1** | |
| *Ictaluridae* | Brown Bullhead | *Ameiurus nebulosus* | Warmwater | Common | Native | Intermediate | Lacustrine/ riverine - lake embayments | **8** | |

Notes: Thermal regime, abundance, Ontario origin, tolerance and preferred habitat taken from the Ontario Freshwater Fishes Life History Database - http://www.ontariofishes.ca/home.htm

Abundance - The relative likelihood or frequency of occurrence of a species assuming suitable habitat conditions.

Tolerance – Ability of a species to adapt to environmental perturbations or anthropogenic stresses.

* observation only

Based on the fish community results, the intake and discharge channels support both coolwater and warmwater fish species. There was a total of fifteen (15) fish caught in the intake channel and seven (7) fish caught in the discharge channel. Brown Bullhead (**Photograph 5**), Pumpkinseed (**Photograph 6**), Bluegill, Common Carp and Spottail Shiner were recorded in the intake channel. Bluntnose Minnow (**Photograph 7**), Rockbass, and Smallmouth Bass were found in the discharge channel. All of these species are common in Ontario, found in lacustrine habitat and tolerant to environmental perturbations or anthropogenic stresses.

**Photograph 5. Brown Bullhead.**

**Photograph 6. Pumpkinseed.**

**Photograph 7. Bluntnose Minnow.**

# 4. Discussion

Due to issues with the water quality sonde that was deployed in the discharge channel in 2019, continuous turbidity and dissolved oxygen data were not obtained. Despite the absence of this data, it was possible to use manual measurements and therefore this did not impact the findings of the water quality sampling program.

Dissolved oxygen in the intake channel showed the typical trend of an oligotrophic lake. With decreasing temperatures there was an observed increase in DO, indicating that there was sufficient oxygen to support aquatic life at the bottom of the channel. The DO depth profile in the discharge channel was indicative of eutrophic conditions, which may indicate that this channel experiences anoxic conditions during the summer months. These similar trends were observed in 2018. The oxygen levels in the intake channel were higher as it receives input directly from Lake Ontario, and therefore more mixing of the water column occurs. This mixing causes the dissolved oxygen to be replenished at a higher rate and explains the fluctuation in DO levels. Conversely, the discharge station had the lowest DO as it probably receives the least amount of input from Lake Ontario due to the breakwater.

The cause of the pH readings that surpassed the PWQO guideline limit of 8.5 is not known. It is evident that the intake and discharge channels are alkaline (>7.0 pH) as the average pH is approximately 8.5.

Phosphorous was very low and therefore, undetectable in both the intake and discharge channels, with the exception of the October 2019 reading in the discharge channel which was slightly above PWQO. This could help to explain the lack of aquatic vegetation within the channels as low phosphorous levels can limit plant growth.

Overall, the results of the baseline water quality data collected for both the intake and discharge channels indicate water quality that is within the range of acceptable limits for both PWQO and CEQG.

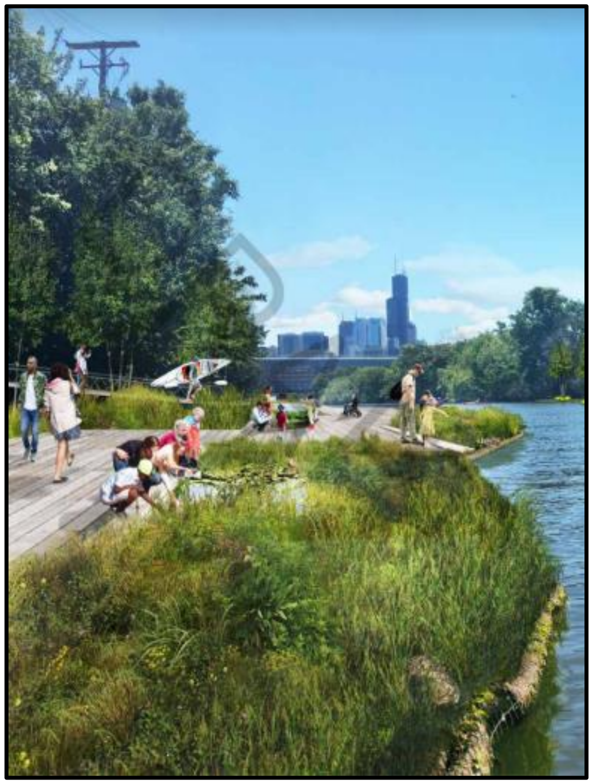
# 5. Proposed Enhancement Opportunities

Based on the existing baseline water quality information and results of the fish community survey, several enhancement opportunities are available to improve water quality and fish habitat in both the intake and discharge channels. A list of possible considerations is provided below, and it is anticipated that these will be further explored as the design progresses.

**Floating Wetlands**

There are several benefits to the installation of floating wetlands from both a water quality and fish habitat perspective. Floating wetlands consist of floating structures for plants that are placed in water of any depth (**Photograph 3**). They provide treatment for water quality by suspending solids, taking up nutrients and providing shade to discourage algae growth. In addition, floating wetlands provide important cover for fish and other aquatic life.

These structures can be custom-made for any size or type of waterbody and can be specifically designed to ensure the appropriate plants are selected to treat water quality concerns.



**Photograph 8. Example of a floating wetland.**
Source: Wild Mile, City of Chicago
https://www.wildmilechicago.org/

## Fish Habitat Structures

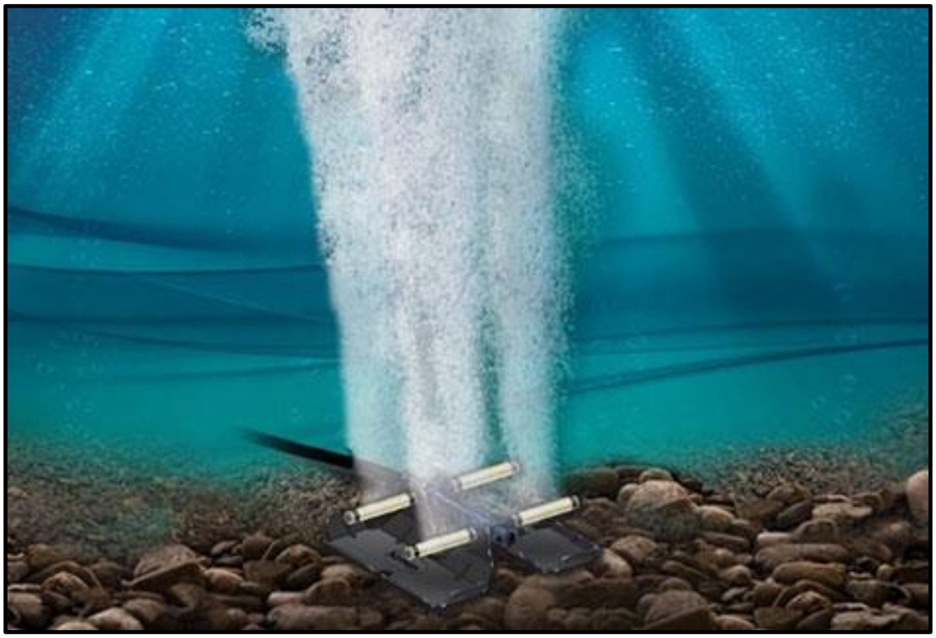
Opportunities to naturalize the Lake Ontario shoreline could be explored to enhance the nearshore aquatic habitat, which would be consistent with the Fish Community Objectives for Lake Ontario (Stewart *et al.* 2017) to maintain a healthy and diverse fishery. Underwater structures would provide areas to protect fish from predators and also carry out other life processes such as feeding and spawning. Possible enhancements include:

- Anchored logs installed along the bottom of the lakebed in shallow areas;
- Brush piles/log cribs that can be anchored or left to drift in the channel;
- Boulder and rock piles/shoals along the littoral areas of the channel, which are ideal for spawning areas for a variety of sunfish species; and
- Brush bundles and rootwads anchored to the littoral areas of the channel would provide habitat for a variety of the species that were captured in both the intake and discharge channels.


**Photograph 9. Example of fish habitat enhancements.**

**Aeration Systems**

The intake and discharge channels are both isolated from the main body of Lake Ontario, by way of breakwaters and structures. These areas likely lack water movement associated with natural lake currents as well as wind and wave action. One solution to ensure movement and increase oxygen within the water column is through the use of an aeration system. These systems improve water quality by cycling oxygen rich waters through the water column to reduce anoxic conditions which are unfavourable for aquatic life. Aeration can also reduce algae that may accumulate due to stagnant waters.



**Photograph 10. Example of an aeration system.**
Source: Airmax, Pond and Lake Aeration Systems
https://www.airmaxeco.com/category/aeration

**Nuisance Waterfowl & E. Coli Management**

Waterfowl are not presently abundant on the property due to the lack of suitable habitat. It is however expected that once the shoreline and adjacent parklands become landscaped, that management will be required to reduce their impact on the community. In large numbers, waterfowl can create a nuisance due to their aggressive behaviour, impact on vegetation through grazing, and can also present a health risk through their droppings.

Waterfowl are known to be a primary source for *Escherichia coli (E. coli)* in urbanized lakeshore environments and *E.coli* contamination of waterbodies is one of the more common reasons for beach closures. Waterfowl are generally attracted to open areas and mown lawns that are in close proximity to waterbodies as these areas allow for better detection of potential predators. By reducing the amount of open and turfed areas and replacing these with landscaping using taller vegetation, it is possible to discourage their recruitment and limit the size of the local population. Consideration should be given to this when developing landscaping plans.

In areas that must remain open, additional management measures such as egg-oiling can be employed to control resident populations and reduce their impact on the community **(Photograph 11**). It is anticipated that a nuisance waterfowl management strategy will need to be implemented at Lakeview Village to reduce impacts on local water quality.

**Photograph 11. Egg oiling as a waterfowl management technique.**

# 6. Next Steps

Based on the information collected to date, several recommendations are provided below to continue sampling to establish a robust water monitoring program.

**Dissolved Oxygen Profiles**

High lake levels in the spring and summer of 2019 precluded water quality sampling in both the intake and discharge channels during the summer months. It is recommended that dissolved oxygen profiles be monitored at the same locations in 2020 to confirm if these areas are habitable for fish during the warmer summer months when water quality may be compromised.

Both the intake and discharge channels are partially isolated from Lake Ontario by the breakwater, groyne and jetties which results in little mixing which consequently leads to increased temperatures, lower dissolved oxygen levels and unsuitable habitat conditions for the cool water fishes that inhabit the lake. Understanding which factors present limitations to recruitment of lake species is important for identifying opportunities to improve water quality and fish habitat. It is recommended that depth profiles be completed in June, July, August and September 2020.

***E. coli* Sampling**

Under the proposed Lakeview Village Draft Plan, public access will be provided to Lake Ontario and the former intake and discharge channels for recreation. The Region of Peel currently monitors water quality and *E. coli* during the summer months at the Lakefront Promenade for the purposes of issuing beach health safety advisories. It is anticipated that when Lakeview Village is completed that this monitoring program will be expanded to also include the subject property.

**Nutrient Sampling**

It is recommended that nutrient sampling be continued at the surface water sites, at the same time as the *E. coli* samples and depth profiles.

# 7. Conclusion

Overall, water quality within the intake and discharge channels is indicative of lake embayment areas. The intake channel appears to receive enough movement such that dissolved oxygen does not appear to be affected within the fall season. The dissolved oxygen profile within the discharge channel does indicate that the lower depths of the channel may go anoxic and would not provide suitable habitat for aquatic life during the warm summer months. Consideration of additional studies to confirm *E.coli* and dissolved oxygen levels is recommended during the 2020 season. Habitat enhancement measures to recruit cool or cold-water fish species to the channel should be further considered in the design.

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# Baseline Water Quality Sampling Locations

# Figure 1

Lakeview Aquatic Sampling Program


**Legend**

- Subject Property
- Aquatic Study Area
- Surface Water Sampling Sites
- Serson Creek (MNRF 2019)


UTM Zone 17 N, NAD 83

First Base Solutions
Web Mapping Service 2018

0 75 150 Metres

1:4,500

BEACON ENVIRONMENTAL

Project 217424.2
January, 2020

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