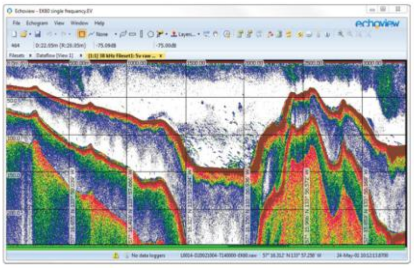
Appendix E-2
LimnoTech Report - Results of 2017 Aquatic Sampling









Report: Results of 2017 Aquatic Sampling

Icebreaker Wind

Prepared for:
Icebreaker Windpower, Inc.

February 8, 2018

LimnoTech

Water | Scientists
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1 Introduction

The purpose of this report is to document the field methods, results, and analysis carried out in 2017 to support the Icebreaker Wind project. LimnoTech, under contract to Icebreaker Windpower, Inc., led a multi-disciplinary team of researchers to collect site specific data at the site of and in the vicinity of the proposed Offshore Wind (OSW) demonstration project in Lake Erie.

The report includes the following major sections:

- Project introduction (Section 1)
- Sampling methods (Section 2)
- Results and discussion (Section 3)
- Conclusion (Section 4)
- References (Section 5)
- Appendices

1.1 Project Description

The proposed Icebreaker Wind demonstration project will include installation of six wind turbines, 8 to 10 miles offshore of Cleveland, Ohio in the Central Basin of Lake Erie. The turbines will be placed in water depths ranging from 58 feet to 63 feet, each with a nameplate capacity of 3.45 megawatts (MW) for a total generating capacity of 20.7 MW. A 2.3-mile buried electric cable will connect the six turbines, and an approximate 9.3-mile buried electric cable will connect the turbines to the Cleveland Public Power Lake Road substation. Figure 1 shows the project location within the Central Basin of Lake Erie offshore of Cleveland and the bathymetric contours.

1.2 Project Team

This section describes the project team in further detail. The project team is led by LimnoTech, an environmental engineering and science firm headquartered in Ann Arbor, MI. As a leader in environmental science and water quality management for nearly three decades, LimnoTech has helped clients assess, create and implement workable strategies for identifying and addressing aquatic impacts on scales both large and small. Our experts offer diverse technical skills, experience, and expertise that enable us to provide a full range of services for monitoring and evaluating these complex environments. The LimnoTech team is led by Ed Verhamme with support from Greg Peterson, Jen Daley, Cathy Whiting, John Bratton, and Greg Cutrell. Additional staff from the Ann Arbor office supported the fieldwork as needed. LimnoTech is responsible for all project deliverables, communication with Icebreaker Windpower, and management of additional team members.

The Ohio State University (OSU) – Stone Lab was established in 1895, and is the oldest freshwater biological field station in the United States. It is the center of Ohio State University's teaching and research on Lake Erie. The lab serves as a base for more than 65 researchers from 12 agencies and academic institutions, all working year-round to solve the most pressing problems facing the Great Lakes.

Justin Chaffin, Chris Winslow and other team members supported the collection of juvenile fish and also process the nutrient and water samples.

The Cornell University Bioacoustics Research Program develops and uses digital technology, including equipment and software, to record and analyze the sounds of fish and wildlife. By listening to wildlife, their research advances the understanding of animal communication and monitors the health of wildlife populations. Policy makers, industries, and governments use this information to minimize the impact of human activities on fish and wildlife and natural environments. Aaron Rice assists with the development of the underwater soundscape/noise survey as well as with data processing and interpretation.

BSA Environmental Services, Inc. is an environmental consulting firm specializing in aquatic plankton and larval taxonomy. John Beaver of BSA assists LimnoTech with processing and identifying organisms from the phytoplankton, zooplankton, and larval fish surveys.

Biosonics is an environmental company that specializes in hydroacoustics. They offer a wide range of scientific equipment for fisheries research and aquatic habitat assessments. They are experts in understanding and post-processing acoustics data and have a wide range of experience throughout the country.

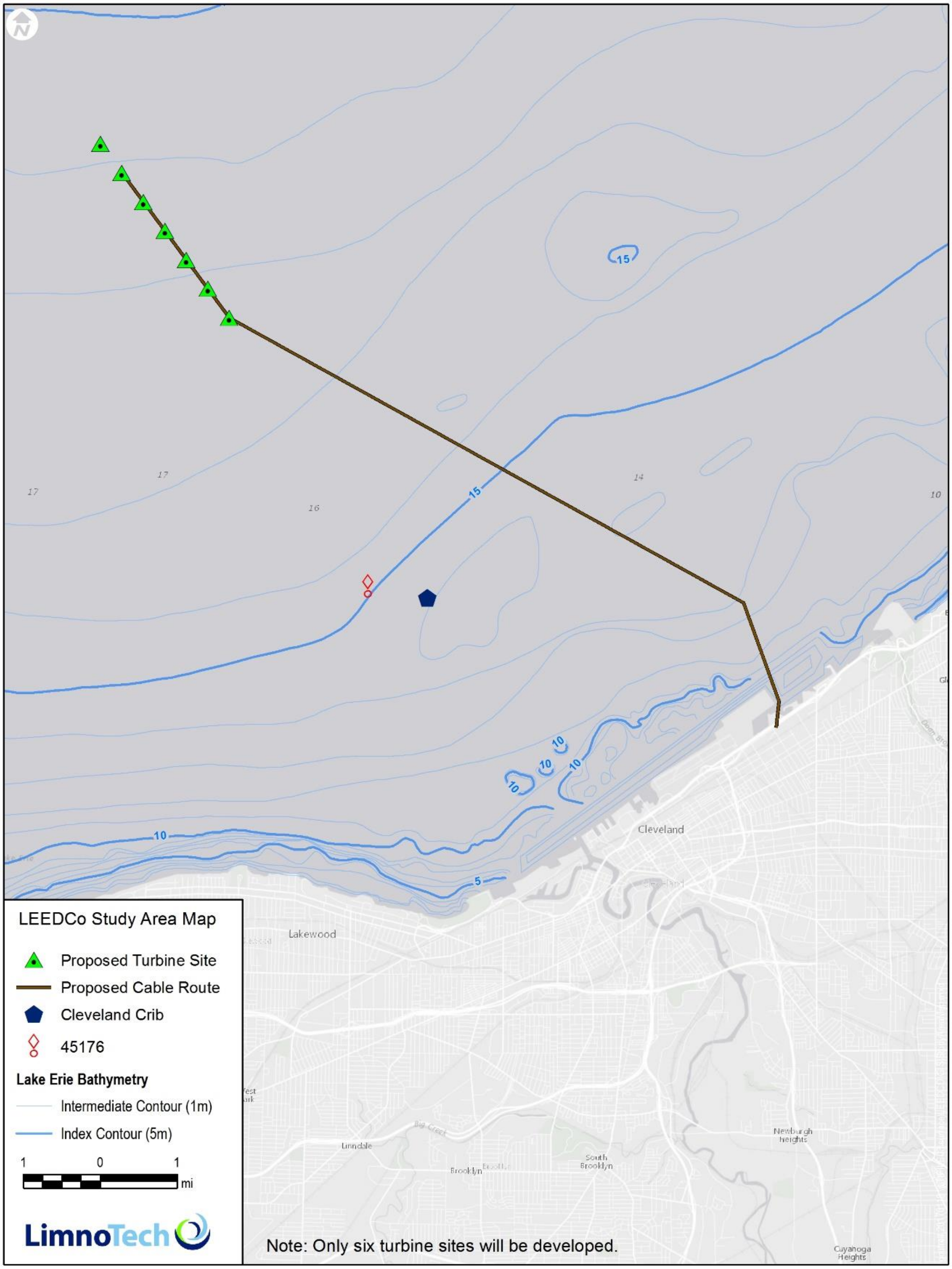


Figure 1. Project location map showing 7 turbine sites (only 6 will be developed).

1.3 Agency Coordination

Since April 2016, Icebreaker Windpower Inc. with support from LimnoTech has collaborated with the Ohio Department of Natural Resources (ODNR) and U.S. Fish and Wildlife Service (USFWS) to develop a monitoring program to assess ecological resources at the proposed project site and initiate the baseline characterization monitoring.

LimnoTech prepared The Lake Erie Monitoring Plan (LEMP), dated January 25, 2017, to serve as the basis for the aquatic resources and fisheries pre, during, and post-construction monitoring effort by Icebreaker Windpower Inc. By letter dated February 1, 2017, the ODNR Division of Wildlife indicated that all of its comments were addressed in the LEMP (Appendix A). The USFWS participated in discussions to design the study protocol and 2016 Monitoring Plan. The LEMP is considered a living document that will serve as a template for future aquatic monitoring work related to the Project.

On June 8, 2017 Icebreaker Windpower and the ODNR formally entered into a Memorandum of Understanding (MOU), which set forth that an agreement had been reached on the monitoring protocols for fisheries and aquatic resources. The MOU includes provisions for an annual performance review, and an option to adjust the monitoring plan based on changes in project design and/or results-driven knowledge gained from the monitoring work. The monitoring conducted in 2016 and 2017 forms the basis for the pre-construction monitoring program.

1.4 Reports and Memorandum

The following reports were completed in 2017. Copies of each item were emailed to ODNR and USFWS throughout the season. The list is presented here to document the deliverables completed as part of the 2017 sampling season.

- Report: Lake Erie Monitoring Plan –January 25, 2017
- Report: Annual Aquatic Data Report for 2016 Sampling Season - March 9 2017
- Report: Quarterly Status Report #1 – August 7, 2017
- Report: Quarterly Status Report #2 – December 8, 2017
- Report: Annual Data Report for 2017 Sampling Season (this document)

2
Sampling Methods

This section reviews the sampling methods for each major monitoring category. The methods presented in this section were included in the Lake Erie Monitoring Plan (LimnoTech, 2017) and approved by ODNR. A copy of the approval letter from ODNR is included in Appendix A. Any deviation from the sampling plan is noted in each section.

2.1 Stations

Sampling stations are listed below in Table 1 and a graphical depiction of the stations is shown in Figure 2. Table 2 lays out, by category, which stations or transects were sampled for each type of monitoring. The GPS coordinates for each sampling station are included in Table 2. The transects are located down the center (C) of the project grid, and to the east (E), and west (W) in adjacent Reference areas. The transects have a southeast to northwest orientation, and are aligned down the axis and parallel to the proposed turbines. Transect C extends from stations ICE1 to ICE7, transect W extends from stations REF2 to REF3, and transect E extends from stations REF4 to REF6.

Table 1. Sampling stations by sample type.

Task Description		Reference Stations (REF)						Turbine Stations (ICE)							Transects		
		1	2	3	4	5	6	1	2	3	4	5	6	7	C	E	W
Fish Community	Mobile Acoustic														x	x	x
	Larval Fish	x							x				x				
	Juvenile	x							x				x				
	Zooplankton	x	x	x	x	x	x		x		x		x				
	Phytoplankton	x	x	x	x	x	x		x		x		x				
	Benthos	x							x				x				
Physical	Chemistry (discrete)	x	x	x	x	x	x		x		x		x				
	Chemistry (discrete sonde profiles)	x	x	x	x	x	x	x	x	x	x	x	x	x			
	Chemistry (continuous)	x						x (DO)	x (DO)		x			x (DO)			
	Substrate Mapping	See substrate mapping section															
	Hydrodynamic	x									x						
Fish Behavior	Acoustic telemetry	See acoustic telemetry section for map															
	Fixed Acoustic	x								x							
	Noise	x									x						
	Aerial Surveys	See aerial survey section for description of locations															

Table 2. Table of sampling stations and latitude and longitude.

Turbine Station	Latitude	Longitude	Depth (feet)	Reference Station	Latitude	Longitude	Depth (feet)
ICE1	41.60072	-81.80055	58	REF1	41.60867	-81.8255	61
ICE2	41.60616	-81.80602	59	REF2	41.62539	-81.8421	63
ICE3	41.61159	-81.8115	60	REF3	41.59184	-81.8089	58
ICE4	41.61702	-81.81697	61	REF4	41.60899	-81.7915	58
ICE5	41.62246	-81.82245	61	REF5	41.62493	-81.8081	61
ICE6	41.62789	-81.82793	62	REF6	41.6399	-81.8237	63
ICE7	41.63333	-81.8334	63	Nearshore*	41.55016	-81.76528	53

*Nearshore station was selectively sampled in 2017. See notes in each section.

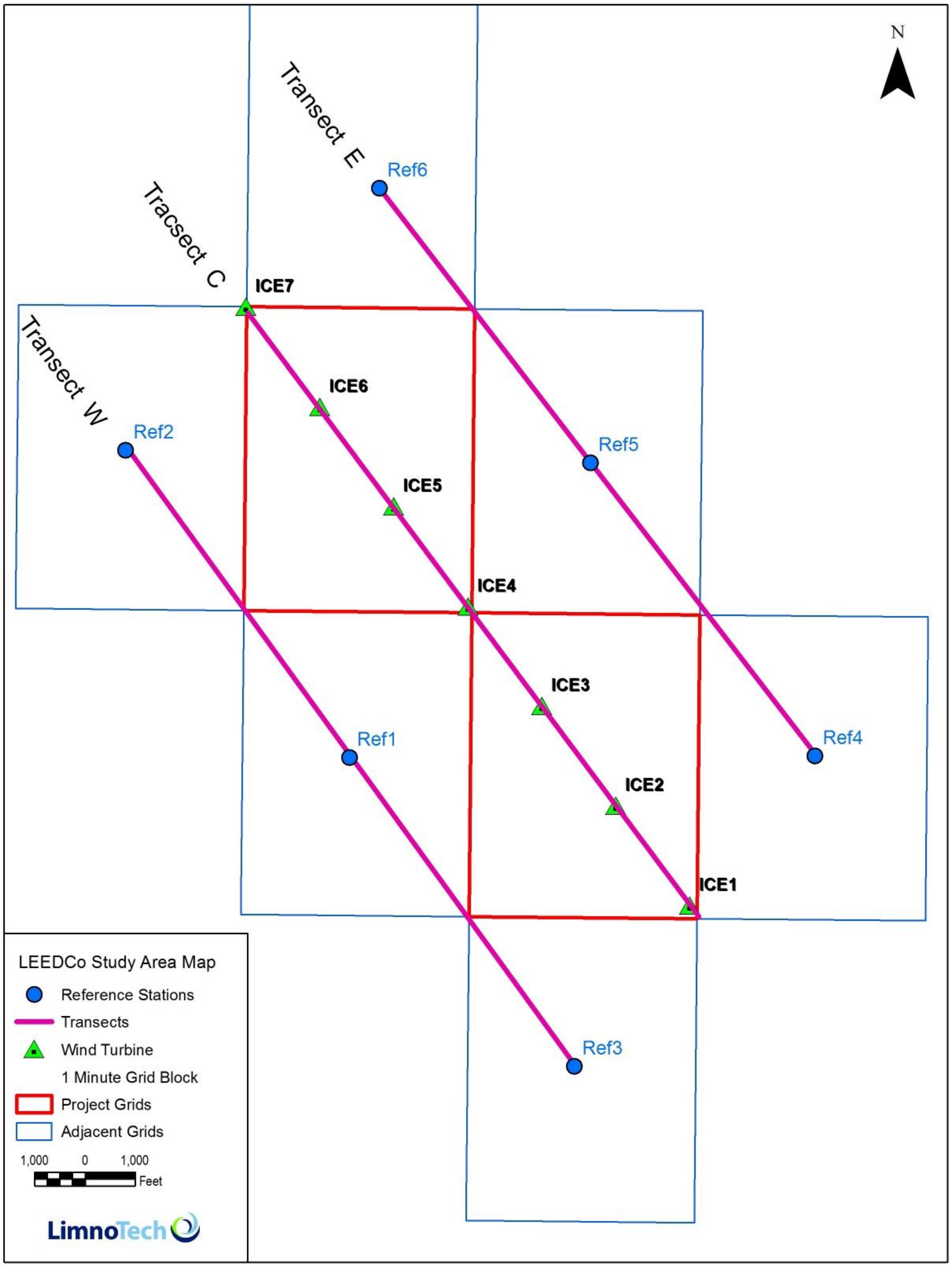


Figure 2. Map of project area, proposed turbine locations, sampling stations, and transects.

2.2 Field Events Summary

Table 3 provides a listing of the exact dates that each of the field tasks were completed for each month. Copies of field notes for each date are included in Appendix B.

Table 3. Dates of field main activities performed in 2017 by sample type

Sampling Category		May	June	July	August	September	October
Fish Community							
	Hydroacoustic	25-May	21-Jun	18-Jul	20-Aug	18-Sep	20-Oct
	Larval Fish	9-May	21-Jun	19-Jul			
	Juvenile	13-May			7-Aug		10-Oct
	Zooplankton	10-May	8-Jun	12-Jul	2-Aug	6-Sep	3-Oct
	Phytoplankton	10-May	8-Jun	12-Jul	2-Aug	6-Sep	3-Oct
	Benthos	9-May					2-Oct
Physical							
	Chemistry (discrete)	10-May	8-Jun	12-Jul	2-Aug	6-Sep	3-Oct
	Chemistry (continuous)	3-May	9-Jun	11-Jul	1-Aug	7-Sep	2-Oct, 20-Oct
	Substrate Mapping						
	Hydrodynamic	10-May	8-Jun	11-Jul	1-Aug	6-Sep	2-Oct, 20-Oct
Fish Behavior							
	Fixed acoustics	25-May	21-Jun	18-Jul	20-Aug	18-Sep	20-Oct
	Noise	3-May	8-Jun	11-Jul	1-Aug	7-Sep	2-Oct, 20-Oct
	Acoustic Telemetry	Deployed and recording			15-Aug	Deployed and recording	
	Aerial Surveys	29-May	2-Jun, 20-Jun, 24-Jun	15-Jul, 19-Jul	3-Aug, 6-Aug, 21-Aug, 27-Aug	14-Sep, 17-Sep	6-Oct, 8-Oct, 20-Oct, 29-Oct

2.3 Fish Community/Lower Trophic

LimnoTech undertook sampling of the fish and lower trophic community (zooplankton, phytoplankton, benthos) throughout the spring, summer and fall of 2017 to gain a second year of baseline data on existing conditions. This data can be compared to sampling conducted during and post construction project phases to determine if the project is having any potential impacts on the fish and lower trophic communities in the project area.

2.3.1 Hydroacoustic

Hydroacoustic monitoring was conducted monthly from May to October 2017 to assess the density and seasonal abundance of juvenile and adult fish. Sampling was completed on three transects, one down the center of the project grid and turbine locations, and two transects in adjacent grid cells to serve as reference areas. The map in Figure 2 shows the location of the acoustic transects (Transects W, C and E). Collection methods and sampling design followed the Standard Operating Procedure for Fisheries Acoustic Surveys in the Great Lakes (FASGL; Parker-Stetter et al., 2009). A BioSonics DT-X portable echo sounder surface unit with an emitting frequency of 120kHz with a 6° split beam transducer was pole-mounted and towed along the sampling transects at appropriate speeds (~4-5 mph). Equipment was calibrated prior to each survey following manufacturer protocols. Whenever possible the event was completed in calm conditions, a half hour after sunset and within five days of the new moon. A detailed analysis of acoustic data was performed in 2016 to ensure correct sampling methods were used. The 2017 data will be archived for comparison with during and post-construction data. All raw data files will be submitted in Appendix C.

Photo 1. Hydroacoustic data collection.

Photo 2. Biosonics DT-X instrument.

2.3.2 Larval Fish

Larval fish sampling was conducted once per month during 2017, in May, June and July. Three replicate 5-minute tows were completed at two Turbine Stations (ICE2 and ICE6) and one Reference Station (REF1). A 1X2m frame, 500 micron neuston net was used to collect the fish according to the ODNR ichthyoplankton sampling protocols. Following collection, samples were concentrated and preserved in 95% ethanol. Samples were brought to the BSA Environmental lab, where they were separated for total count but the taxonomic identification was not completed due to the low numbers. The main output from this task was an assessment of the density within the project area and the adjacent areas.

Photo 3. Larval fish monitoring using the neuston net.

2.3.3 Juvenile Fish

Juvenile fish sampling was conducted once per month in May, August and October. Three replicate 10 minutes tows were conducted at two Turbine Stations (ICE2, ICE6) and one Reference Station (REF1). A flat-bottom otter trawl with a 10.7 meter head rope and 12-mm bar mesh in the cod end was used to complete the bottom trawls according to ODNR bottom trawl techniques. Trawl catches were sorted by species and where appropriate age-category (AC 0-3, based on the ODNR Age Break protocol) and enumerated. A subsample of 30 individuals per species and age category were measured for total length (nearest mm) and weight (nearest 0.1 g). During days with larger waves, weights were estimated in the field and a subset of species, preserved in formalin, were brought back to the lab for more precise measurements.

Photo 4. Juvenile fish trawling.

2.3.4 Zooplankton

Zooplankton sampling was conducted monthly from May to October 2017. Samples were collected at six Reference Stations and three Turbine Stations. Sampling protocols followed the Lake Erie Coordinated Lower Trophic Level Assessment. Briefly, a weighted zooplankton net (0.5 m in diameter, 64 micron mesh), with a flow meter was used to complete the sampling. The net was lowered to the lake bottom and then pulled up so the plankton were collected along the way down and up. The net was washed with filtered water so all plankton were within the collection jar. Samples were concentrated through a 64 micron screen and preserved with 5% Lugols's Iodine solution, which was the preservative recommended by BSA Environmental. Samples were stored in 200 mL jars and three 2 to 5 mL sub-samples were removed for plankton identification to taxonomic genus and enumerated. Any exotic species were identified to species level. Laboratory protocols for identification, enumeration and biomass estimates followed the methods that BSA Environmental Services has been using for several years.

Photo 5. Sample of fish collected during juvenile trawling.

2.3.5 Phytoplankton

Phytoplankton sampling was conducted monthly from May to October 2017. Samples were collected at six Reference stations and three Turbine stations. Sampling and laboratory protocols followed the Lake Erie Coordinated Lower Trophic Level Assessment. An integrated tube sampler at two times the Secchi depth was used to complete the sampling. Samples were concentrated and preserved with 4% Lugols solution. Samples were processed according to the BSA Environmental Services Laboratory method, which follows the (OSU) Aquatic Ecological Lab processing protocols.

2.3.6 Benthos

Sampling was conducted at one Reference Station and two Turbine Stations, in May and October of 2017. Sampling and laboratory protocols followed the Lake Erie Coordinated Lower Trophic Level Assessment. Three replicate grabs of bottom sediment were collected using a PONAR grab sampler. Benthos were removed, preserved, sorted to the nearest taxonomic order or aquatic functional group and enumerated.

Photo 6. Samples of benthos collected in project area.

2.4 Physical Habitat

Physical habitat sampling included characterizing bottom sediments, water currents, nutrients, and trends of light attenuation, temperature, and dissolved oxygen. These parameters are being monitored to track changes in environmental conditions to assist with interpretation of trends that might be occurring in other biological data collected as part of this study. The trends reflect the dynamic nature of Lake Erie and not necessarily the impact from the Icebreaker Wind project.

2.4.1 Water Chemistry: Discrete

Discrete water sampling was conducted simultaneously with the collection of zooplankton and phytoplankton by three researchers. During each sampling event one researcher recorded and took integrated samples of water chemistry while another researcher prepped bottles for water samples, made notes, and measured photosynthetic active radiation (PAR). PAR measures the intensity of light in the band that are used by phototrophs (e.g. can excite chlorophyll). The third researcher measured Secchi depth and collected zooplankton.

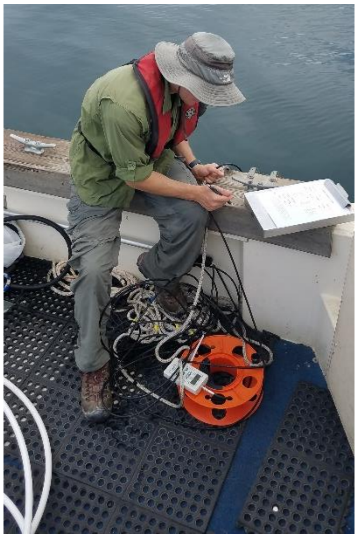


Photo 7. Water quality sampling.

Sampling was conducted using a crosslinked polyethylene pipe sampler lowered to the lake bottom to obtain an integrated water column sample. The tube was lowered to the lake bottom and emptied into a stainless steel bucket to sub-sample water for two-1L bottles for chlorophyll-*a* and two-250 mL bottles for total phosphorus (TP) and total nitrogen (TN). Samples were collected at six reference stations (Ref 1 to 6) and three turbines stations (ICE2, ICE4, ICE6). The samples were collected monthly from May to October 2017. Sampling and laboratory protocols followed the Lake Erie Coordinated Lower Trophic Level Assessment. Samples were bottled and placed in an iced cooler along with a chain of custody form before sending the coolers overnight to the OSU's Stone Laboratory. Once the samples arrived at Stone Laboratory chlorophyll-*a* was immediately filtered through a Whatman GF-C filter using low vacuum pressure and initially measured using a fluoroprobe. Final chlorophyll-*a* concentrations were determined by placing the filtered samples into dimethyl sulfoxide "DMSO", heated, centrifuged, with absorbance being measured at 665, 649, and 580.

Each water chemistry sampling station was supplemented with water clarity measurements using a Secchi disk and PAR. A Secchi disk was lowered into the water column until it was not visible to measure water transparency. A LI-COR LI-193 spherical submersible light meter was lowered on a LI-2009S lowering mount from the water surface at 0.5 -1.0 meters increments. PAR was displayed on a LI-250A and written in the field form to calculate light extinction.

From May through October, profiles of temperature, dissolved oxygen, pH, conductivity, turbidity, chlorophyll-a, and blue-green algae were measured from the lake surface to the bottom by using an YSI EXO2 sonde at every sampling station. The only exception was on May 10, when the sonde did not log at REF1, REF3, REF4, REF6, ICE2, and ICE6 (Table 12).

All field probes were calibrated prior to the first measurement of each sampling day. All sampling containers were new or cleaned in a five percent diluted acid bath and rinsed thoroughly with deionized water prior to each collection.

2.4.2 Water Chemistry: Continuous

Replicated stations were installed at ICE4 and REF1 in May to measure continuous dissolved oxygen, PAR, and water temperature.

HOBO water temperature Pro V2's were deployed at stations ICE4 and REF1 to measure temperature at the water surface and one meter from the lake bottom once every ten minutes. Paired with the bottom water temperature both stations were equipped with YSI 600 OMS loggers with a DO sensor to record once every hour. To measure PAR at ICE4 and REF1 a submersible Odyssey logger was deployed approximately 14.3 meters above the lake bottom at both stations and recorded measurements every ten minutes. MiniDO$_2$T sensors deployed at ICE1, ICE2, and ICE7 measured and recorded temperature and DO every ten minutes one meter from the lake bottom.

All field probes were calibrated prior to the first measurement and maintained throughout the field season.

The REF1 dissolved oxygen sensor (YSI 600 OMS) sonde began to exhibit mechanical problems during 2017 that resulted in intermittent loss of data. Gaps in DO data exist in May, from June 1 to June 9, and between June 26 to July 2. A brand new unit (PME miniDOT) was placed at this site on July 12, 2017. As discussed further in section 3.2.2 other nearby dissolved oxygen sensors showed values between 11 mg/L and 2 mg/L, which are above the threshold for hypoxic conditions. Data from the other functioning sensors as well as the trend in values recovered from the faulty sensor provide adequate information to describe DO conditions at the reference site.

The mooring of the PAR sensors were also modified between 2016 and 2017. During 2016 each PAR sensor was installed on a rope between a surface buoy and its anchor at a depth of approximately 14.3 meters. For 2017 a small underwater float was used to suspend the PAR sensors on a rope that only attached to anchor and not a surface buoy.

2.4.3 Substrate Mapping

There was no additional substrate mapping completed for the 2017 field season.

2.4.4 Hydrodynamic

Two ADCPs were deployed from October 31st 2016 to October 20th 2017. One ADCP (Nortek AWAC AST 1MHz Aquadopp Z-cell) was deployed at the center turbine location (ICE4) and the second ADCP (RDI Workhorse Sentinel 1200kHz) was deployed at REF 1. Both ADCPs were attached to an anchor and placed in a cage mount with buoys attached to keep the ADCP vertical. The ADCPs measured lake currents on an hourly basis in one meter increments from the surface to the bottom of the lake. On July 11 the ADCP deployed at ICE4 stopped recording due to water egress in the battery canister. This failure was the result of a bad o-ring seal. The failure was discovered in early August during the routine maintenance event. A replaced was immediately ordered from the manufacturer and was redeployed on August 20. This gap in data is not significant as the instrument collected current data for the months of November 14, 2016 to July 11, 2017 and from August 20, 2017 to October 20, 2017. This is a significant amount of data to compare against current data collected at the reference site. Both ADCPs were re-deployed November 14th, 2017 for the winter to sample water movement prior to and during the presence of ice, once every three hours.

Photo 8. REF1 ADCP mooring.

2.5 Fish Behavior

Fish behavior and movements are driven by several factors. Fish often make daily movements between feeding and resting habitats, seasonal movements to summer and winter habitat and annual movements to spawning areas. Fish also respond to direction and rate of water movement by their lateral line which contains nerve endings and acts as radar, allowing the fish to detect the size, shape, direction and speed of objects. Fishes may trade-off food acquisition to decrease the risk of predation, so that a habitat with lower food availability may be used to reduce risk. Understanding normal fish behavior and movement is critical to being able to predict how a population may respond to variable environmental conditions. The purpose of the sampling in this case is to understand whether the turbines and associated structures have any impact on fish behavior and movement.

2.5.1 Acoustic Telemetry

In the fall of 2016 (October 31st 2016), 26 receivers were deployed along two transects beginning near the Cleveland shore out past the farthest turbine location (Figure 3). Each receiver was suspended above the bottom using a 75 pound anchor, underwater floats, and a 200 feet drag line placed on the lake bottom. The drag line is used for annual instrument retrieval and data downloading. To ensure ongoing testing and verification of the system, two acoustic (sentinel) tags were installed permanently within the receiver array, roughly 500 meters apart from the closest receiver. These tags will allow continual range testing to occur. The receiver array was designed to have two rows of hydrophones (26 total), one on each side of the turbine/transmission line. This configuration was designed to monitor the behavior of tagged fish in and around the turbine site and transmission line with sufficient density to capture fish moving through the project and transmission sites. This array configuration minimizes monitoring gaps within the study area and the double line of receivers array provides a better understanding of individual fish track as it moves from one side of the project site to the other. The distance between receivers along each transect is approximately 1,350 meters. The distance between the two parallel receiver lines is approximately 1,000-1,200 meters. Two additional real-time receivers were added to the two buoys (45176, 45169) and provided real-time fish tag information throughout the buoy deployment season (March-October).

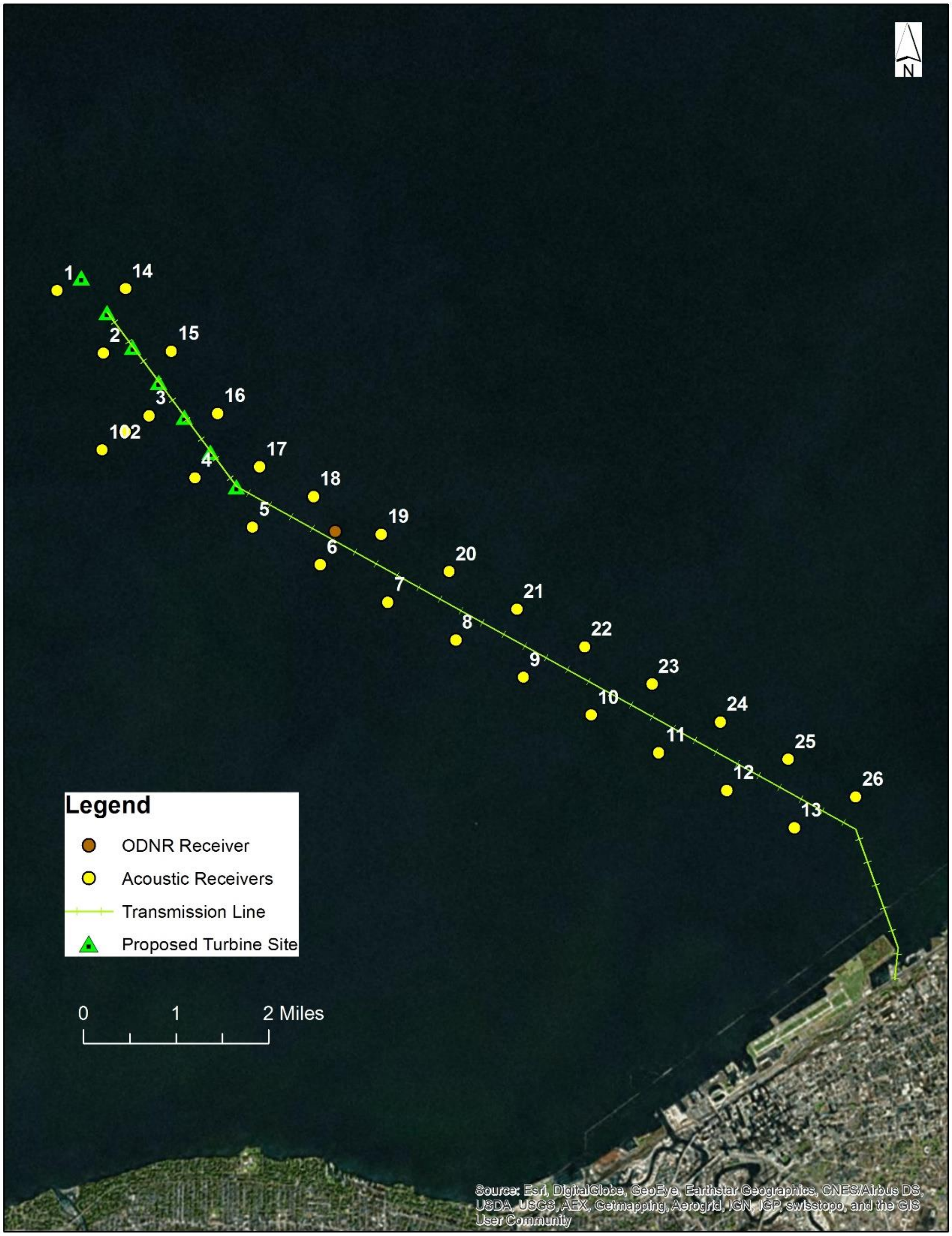


Figure 3. Map of the deployed array configuration. The yellow dots represent the receivers, the green triangles the turbines and the green line the transmission line. Receiver #102 is the location of the test transmitters.

The 26 receivers, plus the two real-time receivers, were retrieved, cleaned, downloaded, and batteries replaced on August 15, 2017. Data from each of the receiver units was uploaded to Great Lakes Acoustic Telemetry Observing System using their form system.

2.5.2 Fixed Acoustics

Fixed hydroacoustic sampling was conducted on the same nights the mobile acoustic surveys were conducted. Fixed surveys were completed by anchoring the boat for one hour at ICE3 and for one hour at REF1. The equipment and data settings remained the same as the mobile survey (section 2.3.1), with the exception that the collection ping rate was increased from five pings per second to 10 pings per second. Fixed acoustic data was collected monthly from May through October 2017. A detailed analysis of acoustic data was performed in 2016 to ensure correct sampling methods were used. The 2017 data will be archived for comparison with the during-construction and post-construction data. All raw data files will be submitted in Appendix C.

2.5.3 Noise Production

Two underwater sound recorders were deployed on May 11, 2016 two meters from the bottom of the lake using Ocean Instruments Smart Hydrophone Soundtraps at stations REF1 and ICE4. At the request of Aaron Rice of Cornell University the hydrophones recording frequency was change from 72 kHz to 24 kHz. The recording interval of 30 continuous minutes each hour was not changed. The hydrophones were attached to an anchored four meter suspended rope to limit sound from mooring hardware.

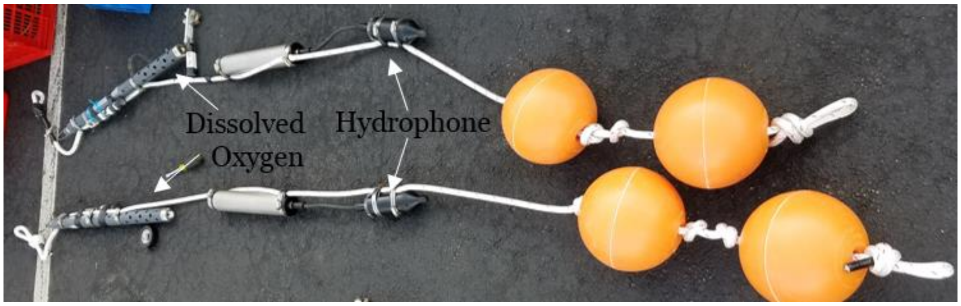


Photo 9. DO and hydrophone sensor setup.

Table 4 below shows each dataset that was collected from each site.

Table 4. Recording durations, recording unit and sensitivity of audio data collected in Lake Erie.

Recording Start	Recording Stop	Sound Trap Serial Number	Sensitivity
REF1			
5/2/17	6/8/17	671100952	171.3 dB re: 1 µPa
6/9/17	7/11/17	671100952	171.3 dB re: 1 µPa
7/12/17	8/1/17	671100952	171.3 dB re: 1 µPa
8/2/17	9/6/17	671100952	171.3 dB re: 1 µPa
9/6/17	10/20/17	671100952	171.8 dB re. 1 µPa
ICE4			
5/2/17	6/8/17	671117327	171.8 dB re: 1 µPa
6/9/17	7/11/17	671117327	171.8 dB re: 1 µPa
7/12/17	8/1/17	671117327	171.8 dB re: 1 µPa
8/2/17	10/2/17	671117327	171.8 dB re: 1 µPa
10/2/17	10/20/17	671117327	171.3 dB re: 1 µPa

A detailed analysis of acoustic data was performed in 2016 to ensure correct sampling methods were used. The 2017 data will be archived for comparison during and post-construction data.

2.5.4 Aerial Surveys of Boating

Aerial surveys were conducted to monitor use of the project site and surrounding areas by recreational boaters.

Aerial surveys were scheduled offshore of Cleveland two times a week (one weekday and one weekend day), roughly every three weeks from May 1 to November 1, 2017. Survey days were selected to coincide with days that ODNR was conducting creel surveys at area boat launches as well as when weather was adequate to fly safely, which generally were days suitable for boating. Aerial Associates Photography departed from Ann Arbor Municipal Airport to count commercial and recreational boats while taking high quality photographs to reference their location. Each 5-minute survey block has an ID and the numeric part of the ID (911 and 912) corresponds to the 10-minute size survey blocks that are used by ODNR to conduct boating surveys in Lake Erie. Boat activity was spatially grouped into 5-minute grids over Lake Erie with all Turbines falling within grid “911-NW” (Figure 44).

Photo 10. Photo taken from Aerial Associates Photography on August 6, 2017.

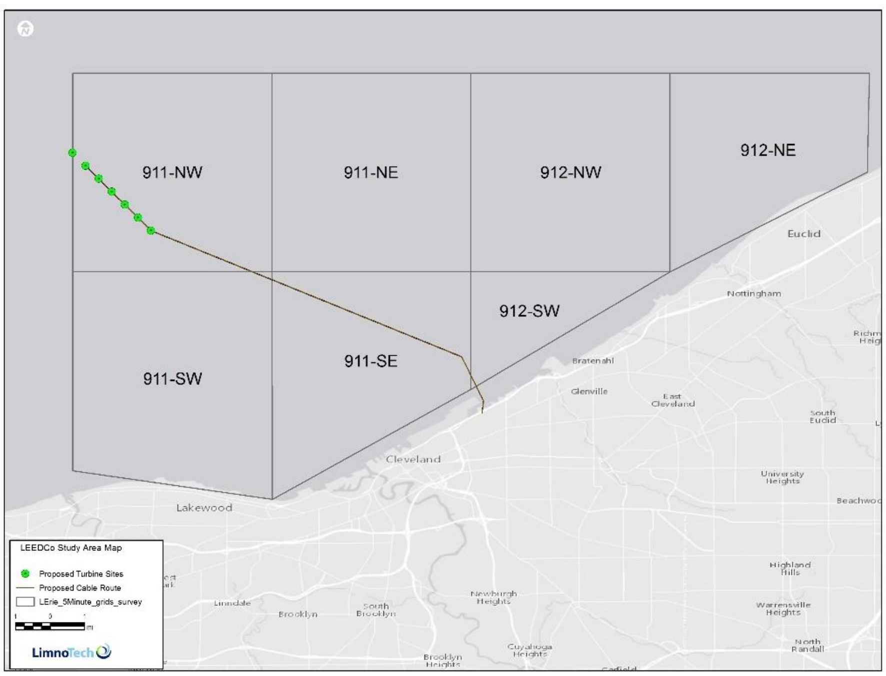


Figure 4. 5-minute grids offshore Cleveland for grouping boat activity.

2.6 Minor Sampling Plan Modifications

During 2017 there were several minor deviations from the environmental sampling plan that were caused by malfunctioning instrumentation and equipment. None of the following items represent significant loss of data that would prevent characterization of site conditions. The following list is a composite of changes that were addressed in greater detail in prior subsections.

- During the May 10 water quality sampling event, the profiling sonde did not record values at REF1, REF3, REF4, REF6, ICE2, and ICE6 (Section 2.4.1).
- Gaps in dissolved oxygen data exist at REF1 during May, from June 1 to June 9, and from June 26 to July 2 (Section 2.4.2).
- On July 11 the ICE4 ADCP stopped recording water current data and did not resume recording until August 20 (Section 2.4.4).

2.7 Other Activities

Bat Monitoring

LimnoTech worked with WEST to install two microphones and data loggers throughout 2017 on the Cleveland Crib and LEEDCo buoy, as well as on the lower portion of the Cleveland Crib and at the top of the crib tower. The buoys were deployed on March 21, 2017 and were retrieved November 14th 2017. Collaborating with AAron Godwin of Conserve First LLC and approval of the City of Cleveland the microphones and loggers were installed in March 2017. Every two to three weeks LimnoTech visited each logger to download data and ensure the logger and microphone was working directly. Additional backup recorders were added to the all stations in April, May, and June. LimnoTech also constructed and deployed a buoy at the project site on July 12th 2017 with a 10-meter pole mounted to the buoy base to allow a bat microphone to be installed 10-meters above the water surface. The 10-meter pole buoy was deployed until August 31st. After each visit to the bat monitoring equipment data was sent to WEST for processing. WEST was responsible for all data processing and reporting. The activities here are only mentioned for completeness to account for the coordination that occurred between the aquatics and bird/bat sampling teams.

Sediment Transport Memorandum

Electric transmission cable installation for the Icebreaker Wind Demonstration Project could resuspend sediments and temporarily increase water turbidity near the installation site. To assess the potential for increases in suspended sediment, LimnoTech reviewed existing modeling results from a similar project in Lake Erie as well as site specific sediment and water current data collected at the proposed project site. Icebreaker Wind expects the selected cable installation contractor will utilize a jet plow installation method, which should minimize the amount of resuspended material over traditional side-casting or open trench dredging. A memorandum was prepared (July 13, 2017) describing the major physical processes that can affect the fate and transport of suspended material.

City of Cleveland Water Department Letter

LimnoTech met with representatives from the City of Cleveland Water Department on August 24, 2017. The purpose of the meeting was to understand the water treatment process and what historical events Cleveland Water has encountered that might be similar to the LEEDCo construction activities. As a result of the meeting, Cleveland Water submitted a letter to LEEDCo (dated September 22, 2017) that lays out the specific communication and monitoring that will take place during installation of the electric cable, as well as describes how Cleveland Water is able to handle changes in turbidity with advance warning, similar to large storms. The Water Department did not think that project construction poses any significant risk to drinking water. A copy of the letter is attached in Appendix A.

3
Results and Discussion

3.1 Fish Community/Lower Trophic

3.1.1 Hydroacoustic

The hydroacoustic raw files for each survey are included in Appendix C. Bottom depth maps are presented in Figure 5 showing the transects completed near the project location (Transects W, C and E). The map in Figure 6 shows the location of the acoustic transects at the project location compared to the nearshore transect (sampled during select months).

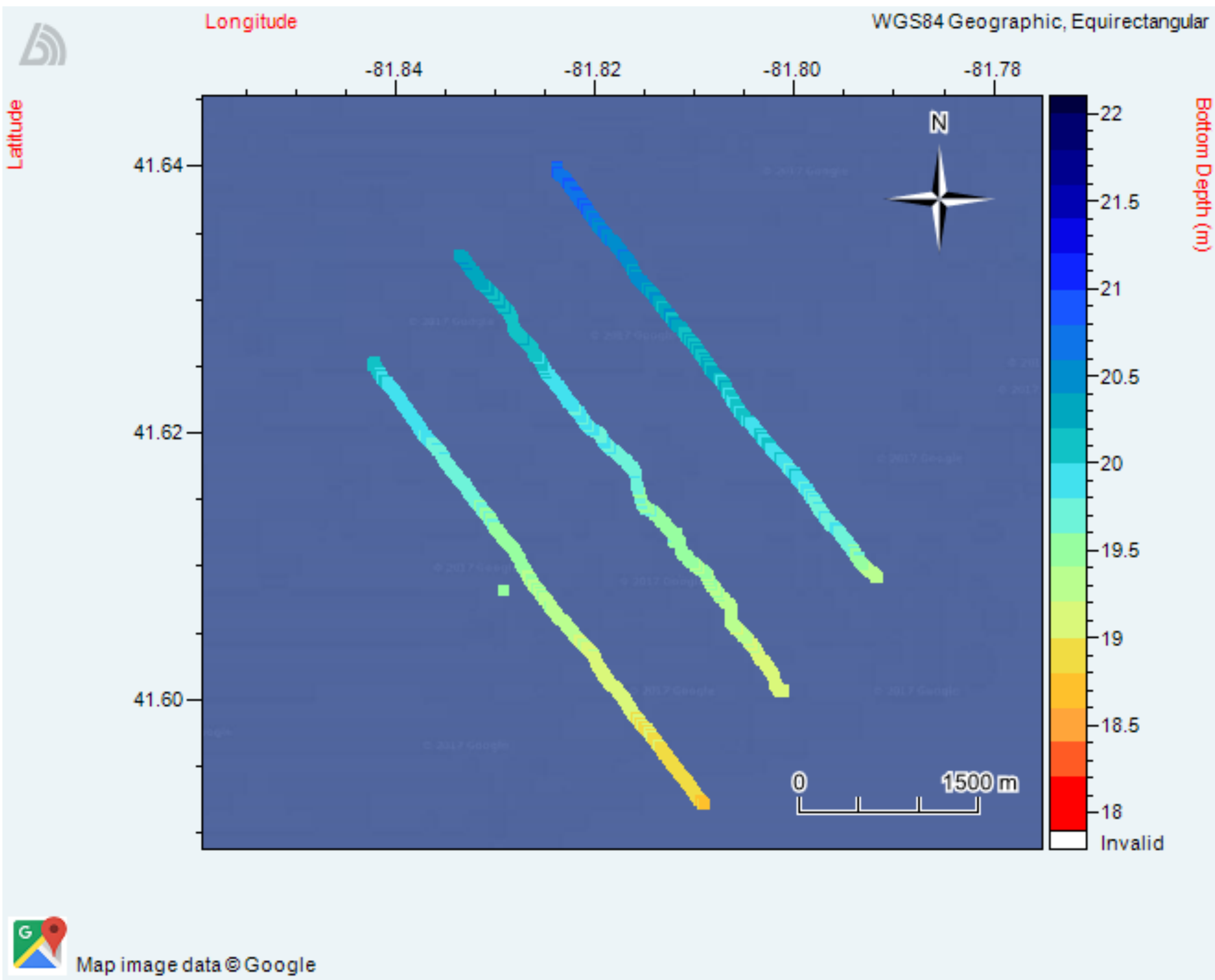


Figure 5.Bottom depth map of the project location transects.

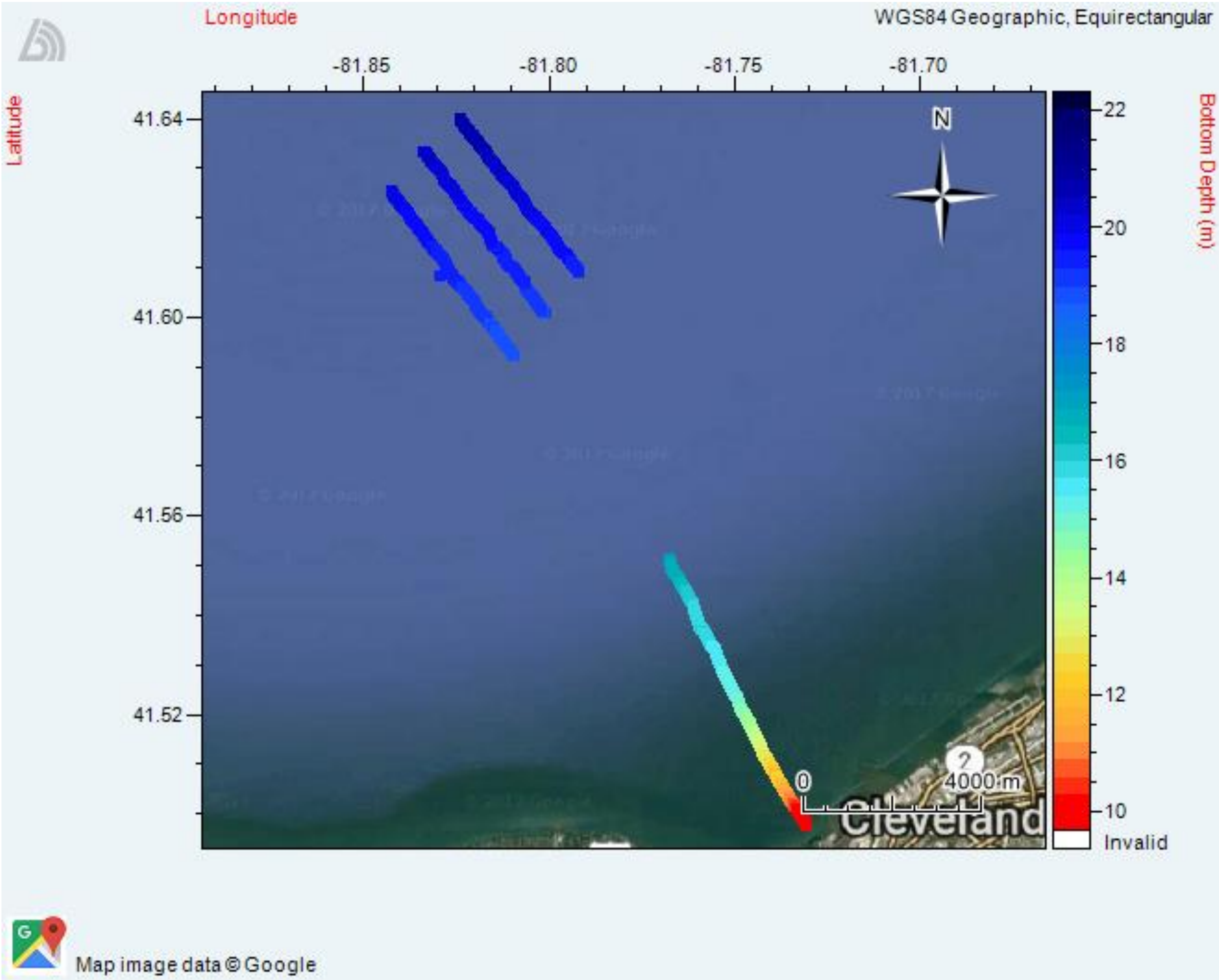


Figure 6. Bottom depth map of the project location compared to the nearshore transect.

Screenshots from each event are included in Figures 7 to 9. In 2016, adult and juvenile fish densities were similar between the three mobile transects, which included one transect down the center of the project location and two transects in nearby areas to serve as a reference. Although transects were similar within months, there was a significant decline in total density across months. The raw files for 2017 will be analyzed in the future to compare years when the turbines are deployed.

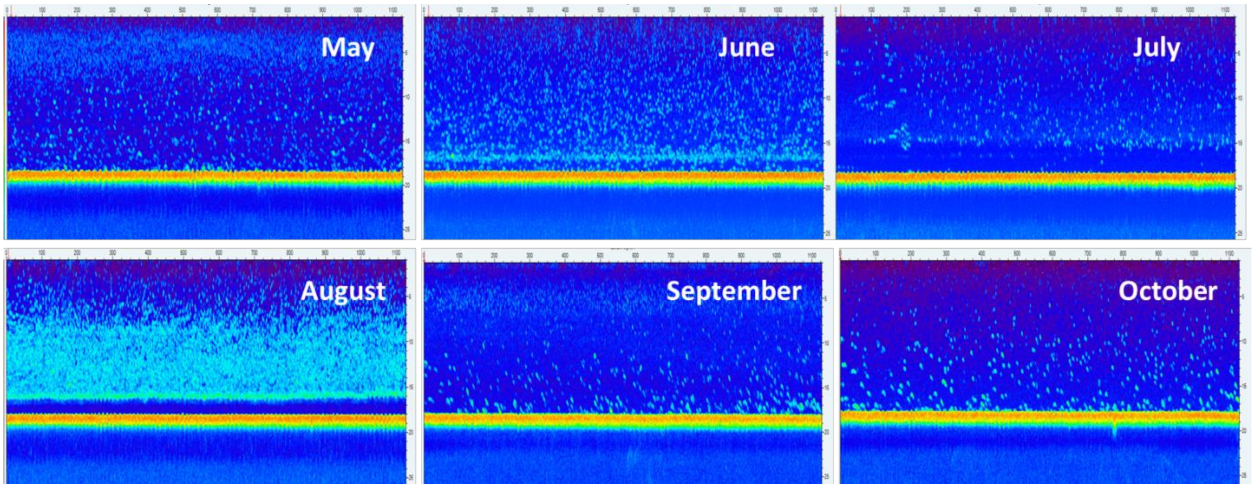


Figure 7. Screenshots of the Visual Acquisition software used for hydroacoustics across all sampling months in 2017 near the Turbine 1 location.

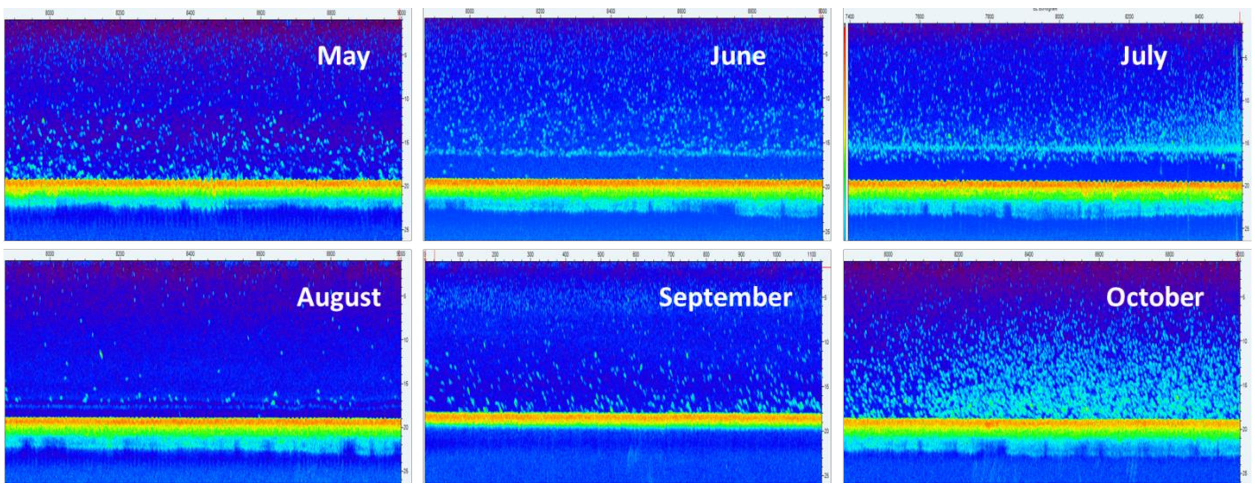


Figure 8. Screenshots of the Visual Acquisition software used for hydroacoustics across all sampling months in 2017 near the Turbine 7 location.

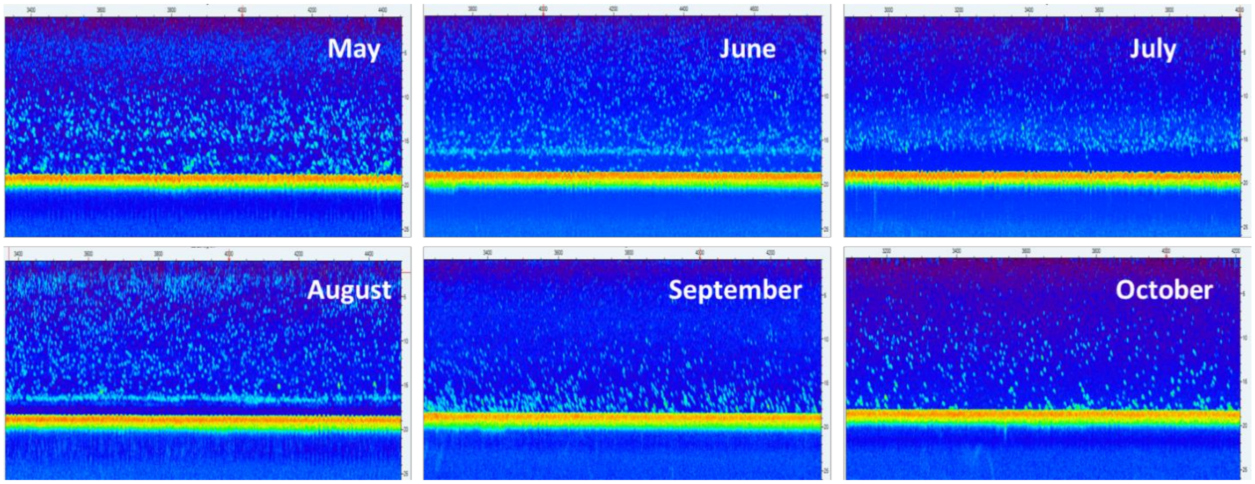


Figure 9. Screenshots of the Visual Acquisition software used for hydroacoustics across all sampling months in 2017 near the Turbine 4 location.

The thermocline was present in the June, July and August sampling events but had dissipated in September. These results are consistent with the temperature and dissolved oxygen profiles near the project location (Section 3.2.2). On June 21st, the thermocline was present but the bottom DO was still between 4-5 mg/L, which is why biota were present below the thermocline. Whereas, during the July 18th and August 20th events, DO was between 0-2mg/L. This coincides with fish physiology estimates, which state that fish become distressed between 2-4 mg/L and DO levels less than 2 mg/L may be lethal to many species. It is therefore not surprising that fish stayed above the thermocline or moved away from the location during the late summer-early fall due to the presence of hypoxic waters.

3.1.2 Larval Fish

The results from the larval fish collections are summarized in Table 5 below. There were no larval fish collected in May, four larval fish were collected in June and three in July. Overall, across all 27 trawls at the project location conducted in 2017, only seven fish were collected. This was similar to the 2016 trawling events where only five fish were collected. We also collected a sample near the Cleveland intake crib each month, which did not contain any larval fishes. This differed from the 2016 sampling where there were 16 fish collected nearshore in one trawl. The results suggest that larval fish densities are low at the project site due to its distance from shore.

Table 5. Ichthyoplankton results from the May, June and July 2017 sampling events.

Site	Rep	Date	Time	Tally
Nearshore	1a	5/9/2017	16:30	0
Nearshore	1b	5/9/2017	16:30	0
Turbine 2	1	5/9/2017	15:30	0
Turbine 2	2	5/9/2017	15:49	0
Turbine 2	3	5/9/2017	16:09	0
Reference 1	1	5/9/2017	14:30	0
Reference 1	2	5/9/2017	14:47	0
Reference 1	3	5/9/2017	15:07	0
Turbine 6	1	5/9/2017	12:35	0
Turbine 6	2	5/9/2017	12:56	0
Turbine 6	3	5/9/2017	13:20	0
Nearshore	1	6/21/2017	15:17	0
Turbine 2	1	6/21/2017	13:20	0
Turbine 2	2	6/21/2017	13:33	1
Turbine 2	3	6/21/2017	13:46	1
Reference 1	1	6/21/2017	12:31	1
Reference 1	2	6/21/2017	12:50	1
Reference 1	3	6/21/2017	13:04	0
Turbine 6	1	6/21/2017	14:27	0
Turbine 6	2	6/21/2017	14:39	0
Turbine 6	3	6/21/2017	14:50	0
Nearshore	1	7/19/2017	17:13	0
Turbine 2	1	7/19/2017	14:35	1
Turbine 2	2	7/19/2017	14:53	0
Turbine 2	3	7/19/2017	15:11	0
Reference 1	1	7/19/2017	13:39	0
Reference 1	2	7/19/2017	13:55	0
Reference 1	3	7/19/2017	14:13	0
Turbine 6	1	7/19/2017	12:50	0
Turbine 6	2	7/19/2017	12:55	1
Turbine 6	3	7/19/2017	13:15	1

3.1.3 Juvenile Fish

In total, across all nine replicate tows 240 fish were caught on May 13 2017, as compared to 1,716 fish caught in May 2016. The species composition was fairly consistent across all locations and replicates. Smelt dominated most trawls, followed by White Perch, Yellow Perch, Freshwater Drum and Round Goby. Lake Whitefish and White Sucker were collected in select trawls in low numbers (n=1). The thermocline did not appear to be present during the May event, and the results from this sampling event are summarized in Figure 1010.

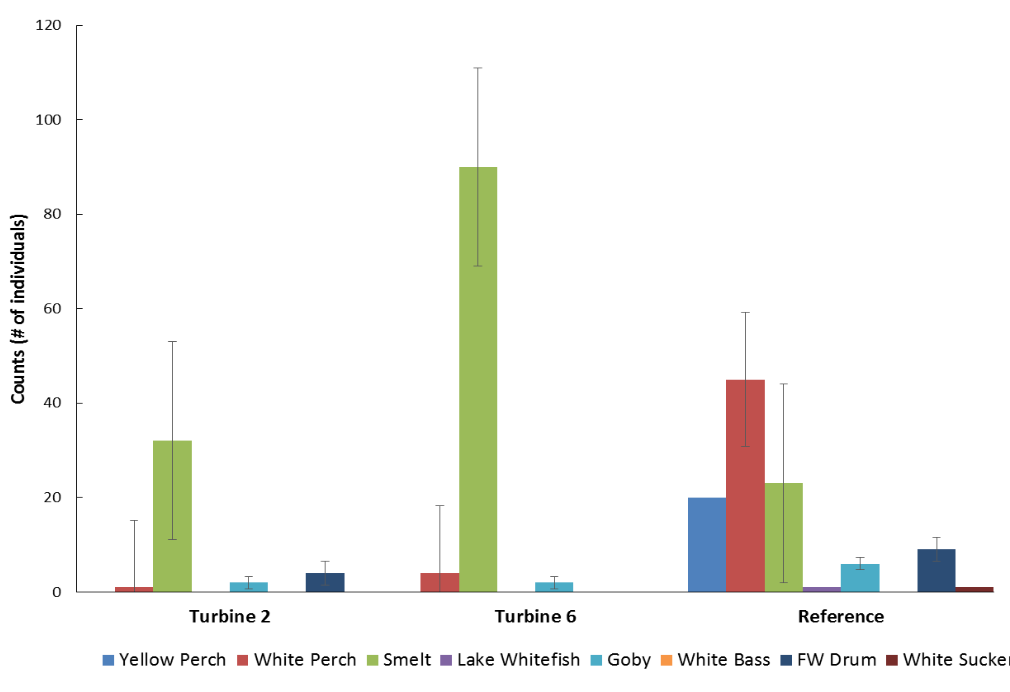


Figure 10. The mean (± SD) for each species collected at each location (n=3 replicate trawls) on the May 13, 2017 event.

The August event occurred when the thermocline was located roughly 1 meter off the bottom. Across all nine replicate tows 37 total fish were caught, compared to only 7 fish in August 2016. The increase in fish was likely due to the location and thickness of the thermocline, in 2016 it was 3-4 meters off the bottom compared to only one meter in 2017. Smelt made up most of the trawls (n=26) followed by Yellow Perch and White Perch, with a single Walleye caught at ICE2 (Replicate 3). The results from this sampling event are summarized in Figure 11.

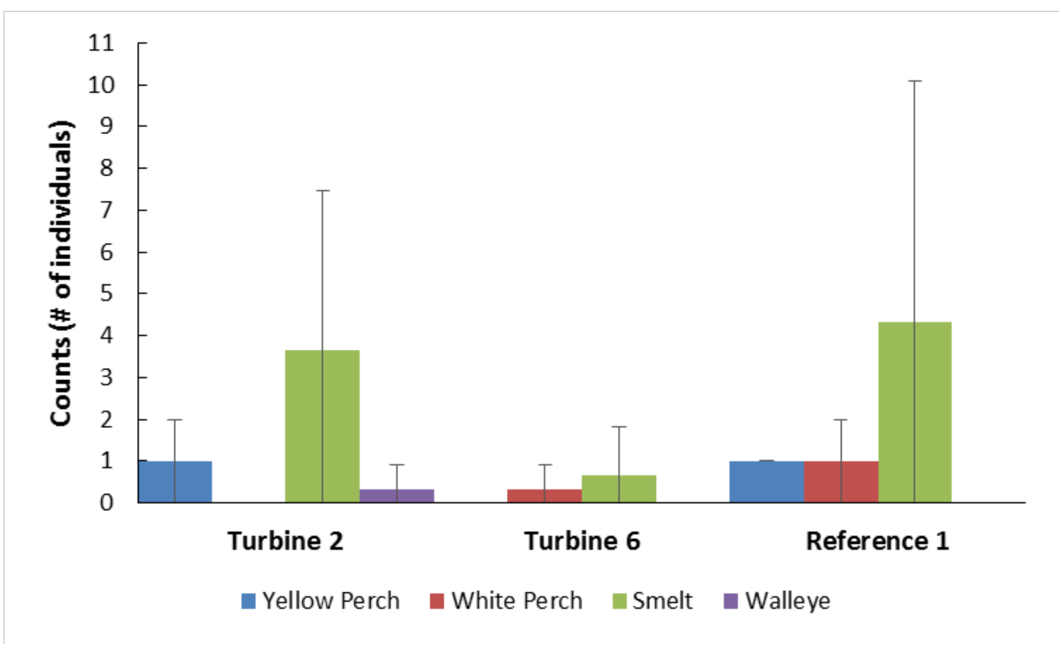


Figure 11. The mean (± SD) for each species collected at each location (n=3 replicate trawls) on the August 7, 2017 event.

The thermocline and associated bottom hypoxia had mostly dissipated for the October 10, 2017 event. The species composition for this last event was variable across locations, with a total of 1,770 fish collected across nine trawls. There was significantly less fish at Turbine 2 (n=50) compared to Turbine 6 (n=620), and Reference 1 (n= 1100). Variability in fish abundance is common, and could be due to a number of factors including, the time of the day, the presence of a large school, or a significant change in physical parameters etc. Smelt dominated all trawls, followed by white perch, and yellow perch. Freshwater drum, walleye, goby, ghost shiner and white bass were collected in select trawls in lower numbers. The abundance of smelt was higher in 2016 but the species composition was the same. The results from the three replicate surveys at each location are summarized in Figure 12.

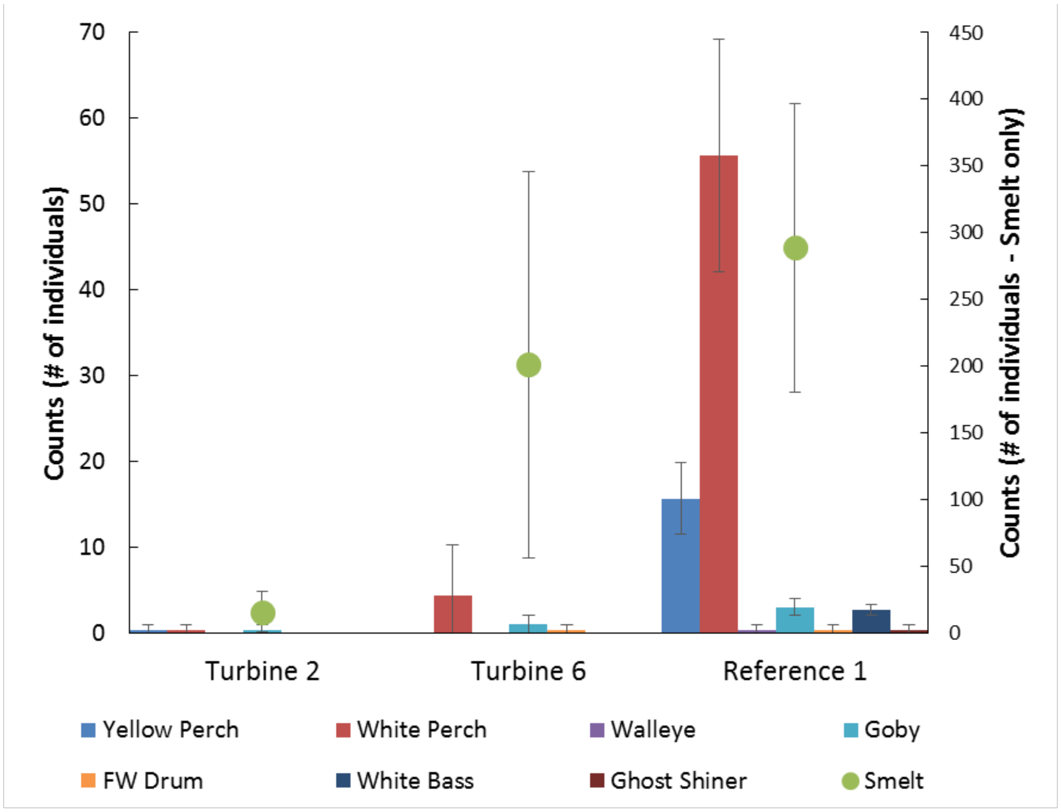


Figure 12. The mean (± SD) for each species collected at each location (n=3 replicate trawls) on the October 10, 2017 event. NOTE: Smelt values are on the right y-axis.

The combined results from the three replicate surveys at each location across the three events are summarized in Table 6 below.

Table 6. Summary of the juvenile fish sampling results from the 2017 spring, summer and fall events.

MAY, 2017	REPLICATE	Yellow Perch	White Perch	Smelt	Lake Whitefish	Goby	White Bass	FW Drum	White Sucker	Walleye	Ghost Shiner	Total
ICE2	1			27				2				29
	2			4		2						6
	3		1	1				2				4
ICE6	1			11								11
	2		1	49		1						51
	3		3	30		1						34
REF6	1	4	12	5		1		3				25
	2	9	21	2		2		4	1			39
	3	7	12	16	1	3		2				41
Total		20	50	145	1	10	0	13	1	0	0	240
AUGUST, 2017	REPLICATE	Yellow Perch	White Perch	Smelt	Lake Whitefish	Goby	White Bass	FW Drum	White Sucker	Walleye	Ghost Shiner	Total
ICE2	1	1	0	8						0		9
	2	0	0	1						0		1
	3	2	0	2						1		5
ICE6	1	0	0	0						0		0
	2	0	0	2						0		2
	3	0	1	0						0		1
REF6	1	1	0	1						0		2
	2	1	2	11						0		14
	3	1	1	1						0		3
Total		6	4	26	0	0	0	0	0	1	0	37
OCTOBER, 2017	REPLICATE	Yellow Perch	White Perch	Smelt	Lake Whitefish	Goby	White Bass	FW Drum	White Sucker	Walleye	Ghost Shiner	Total
ICE2	1	0	0	17		0	0	0		0	0	17
	2	0	0	30		0	0	0		0	0	30
	3	1	1	0		1	0	0		0	0	3
ICE6	1	0	0	114		0	0	0		0	0	114
	2	0	2	121		1	0	0		0	0	124
	3	0	11	368		2	0	1		0	0	382
REF6	1	17	56	215		2	3	0		0	0	293
	2	19	42	413		3	2	0		1	1	481
	3	11	69	238		4	3	1		0	0	326
Total		48	181	1516	0	13	8	2	0	1	1	1770

3.1.4 Zooplankton

The results from each event summarized, in Table 7, by common numerical metrics, including number of species, numbers/L and the biomass for each month and station. The results were variable across all sites for biomass and numbers/L; however, in general, the species composition remained similar.

Table 7. The number of species, number of organisms/L and the biomass for all zooplankton in each sample - May through October 2017.

	Turbine 2					
	May	June	July	August	September	October
Number/L	177	127	706	583	523	423
Biomass (ug d.w./L)	124	143	54	46	121	49
	Turbine 6					
	May	June	July	August	September	October
Number/L	151	364	2146	344	442	387
Biomass (ug d.w./L)	25	419	221	26	162	56
	Reference 2					
	May	June	July	August	September	October
Number/L	212	361	855	231	407	201
Biomass (ug d.w./L)	80	245	74	15	190	42
	Reference 4					
	May	June	July	August	September	October
Number/L	157	120	686	347	553	465
Biomass (ug d.w./L)	68	184	37	205	81	89
	Reference 6					
	May	June	July	August	September	October
Number/L	1089	262	666	367	480	145
Biomass (ug d.w./L)	496	451	28	32	41	85
	Turbine 4					
	May	June	July	August	September	October
Number/L	148	177	1361	252	343	418
Biomass (ug d.w./L)	27	199	442	34	76	68
	Reference 1					
	May	June	July	August	September	October
Number/L	155	181	1416	293	359	300
Biomass (ug d.w./L)	28	181	154	42	45	44
	Reference 3					
	May	June	July	August	September	October
Number/L	180	544	920	277	473	547
Biomass (ug d.w./L)	55	513	77	25	103	576
	Reference 5					
	May	June	July	August	September	October
Number/L	383	341	973	206	351	249
Biomass (ug d.w./L)	104	457	66	75	134	71
	Nearshore					
	May	June	July	August	September	October
Number/L	94	230	467	341	-	849
Biomass (ug d.w./L)	15	283	80	13	-	159

The species composition across each month is summarized in Table 8. The native predatory water flea (*Leptodora kindtii*) was present in select June, August, September October samples and the invasive, predatory spiny water flea (*Bythotrephes longimanus*) was present in select June samples and most July, August, September and October samples. This is consistent with the Forage Task Group's findings (FTG, 2016), which stated the densities of the invasive water flea are generally higher from July through September.

Table 8. Taxonomic groups present across all locations from the May through October 2017 sampling events are summarized.

Sub-class-Genus-Species	Sub-class-Genus-Species
Asplanchna priodonta	*Gastropoda stylifer*
Acanthocyclops robustus	*Hexarthra mira*
Alona guttata	*Kellicottia longispina*
Anuraeopsis fissa	*Keratella cochlearis*
Ascomorpha ecaudis	*Keratella cochlearis var.tecta*
Ascomorpha ovalis	*Keratella crassa*
Bosmina longirostris	*Keratella earlinae*
calanoid copepodid	*Keratella quadrata*
Ceriodaphnia lacustris	*Leptodiaptomus ashlandi*
Collotheca sp.	*Leptodora kindtii*
Colurella spp.	*Mesocyclops edax*
Conochilus unicornis	nauplii
cyclopoid copepodid	*Notholca laurentiae*
Daphnia galeata	*Ploespma lenticulare*
Daphnia retrocurva	*Ploespma truncatum*
Daphnia sp.	*Polyarthra eurptera*
Daphnia spp.	*Polyarthra vulgaris*
Diacyclops thomasi	*Pompholyx sulcata*
Diaphanosoma brachyurum	*Skistodiaptomus oregonenis*
Dreissena veliger	*Skistodiaptomus oregonensis*
Epischura nevadensis	*Synchaeta spp.*
Eubosmina maritima	*Synchaeta spp.*
Eubosmina coregoni	*Trichocerca multicrinus*
Euchlanis spp.	*Trichocerca similus*
Eurytemora affinis	*Tropocyclops prasinus*

In 2017, we identified an error in the formulation of the Number/L and Biomass in the 2016 raw and reported files in 2016 for zooplankton. The trends across months and locations, as well as the species specific information did not change but the raw numbers did change. These updated numbers are included in Appendix D.

Overall, zooplankton biomass and composition in the project area is consistent with the ongoing Great Lakes Fisheries Commission (GLFC) monitoring across the basin, suggesting there is no unique zooplankton structure at the project site. Alterations to zooplankton community composition and structure are not anticipated as part of the construction or operation of the Icebreaker Wind project. An ongoing monitoring program will continue to monitor zooplankton populations through all phases of the project.

3.1.5 Phytoplankton

The results from each event are summarized in Table 9, including the numerical metrics, including number of cells/L and the total biovolume for each month and station.

Table 9. The number of cells per liter and the total biovolume for all phytoplankton in each sample are summarized from May through October 2017.

	Turbine 2					
	May	June	July	August	September	October
Cells/L	5.92E+07	3.95E+07	7.36E+07	9.51E+07	1.60E+08	1.40E+08
Total Biovolume (um^3/L)	5.02E+09	3.75E+08	5.35E+09	1.14E+10	5.39E+09	6.45E+09
	Turbine 6					
	May	June	July	August	September	October
Cells/L	9.12E+07	4.69E+07	6.95E+07	9.46E+07	1.67E+08	1.19E+08
Total Biovolume (um^3/L)	5.68E+09	1.01E+09	4.08E+09	7.02E+09	1.49E+09	9.81E+09
	Reference 2					
	May	June	July	August	September	October
Cells/L	5.63E+07	3.66E+07	1.15E+08	7.86E+07	8.63E+07	1.95E+08
Total Biovolume (um^3/L)	1.28E+10	7.29E+09	9.95E+09	6.06E+09	8.39E+09	7.06E+09
	Reference 4					
	May	June	July	August	September	October
Cells/L	2.00E+08	4.48E+07	7.06E+07	9.02E+07	2.22E+08	7.91E+07
Total Biovolume (um^3/L)	7.97E+08	3.76E+08	7.23E+08	1.38E+09	1.01E+10	2.54E+09
	Reference 6					
	May	June	July	August	September	October
Cells/L	8.45E+07	5.13E+07	1.65E+08	1.14E+08	6.73E+07	8.86E+07
Total Biovolume (um^3/L)	8.32E+08	4.11E+08	8.71E+08	7.26E+09	2.35E+09	1.93E+09
	Turbine 4					
	May	June	July	August	September	October
Cells/L	4.25E+07	2.85E+07	3.24E+07	5.83E+07	1.75E+08	1.87E+08
Total Biovolume (um^3/L)	2.54E+09	2.23E+09	2.79E+09	2.89E+09	8.51E+09	7.20E+09
	Reference 1					
	May	June	July	August	September	October
Cells/L	1.09E+08	7.47E+07	1.44E+08	7.30E+07	1.62E+08	2.06E+08
Total Biovolume (um^3/L)	4.09E+09	4.17E+09	1.42E+09	3.85E+09	9.17E+09	8.14E+09
	Reference 3					
	May	June	July	August	September	October
Cells/L	6.45E+07	3.40E+07	2.83E+07	5.38E+07	1.43E+08	1.57E+08
Total Biovolume (um^3/L)	2.36E+09	2.74E+09	7.29E+08	4.48E+09	9.73E+09	5.85E+09
	Reference 5					
	May	June	July	August	September	October
Cells/L	8.53E+07	3.57E+07	4.04E+07	3.97E+07	1.67E+08	8.36E+07
Total Biovolume (um^3/L)	4.34E+08	2.21E+09	9.92E+08	8.59E+08	3.99E+09	3.99E+09
	Nearshore					
	May	June	July	August	September	October
Cells/L	1.68E+08	7.53E+07	5.02E+07	9.77E+07	-	1.61E+08
Total Biovolume (um^3/L)	2.11E+10	7.75E+08	5.73E+09	5.04E+09	-	5.14E+09

A summary of the composition of Genus across all months is found in Table 10. Across all months (May-October) cyanobacteria (blue-green algae) were the dominant (e.g. density) group. Microcystis were only present in August and September samples.

Table 10. The genera present across all locations from the May through October 2017.

Achnanthidium minutissimum	Aphanocapsa spp.	Aulacoseira spp.	Microcystis sp.
Achnanthidium sp.	Aphanothece sp.	Botryosphaerella sudetica	Monactinus simplex
Ankistrodesmus arcuatus	Ceratium sp.	Carteria sp.	Mougeotia sp.
Aphanizomenon sp.	cf. Aphanothece sp.	Ceratium cornutum	Nitzschia acicularis
Asterionella formosa	cf. Carteria sp.	Ceratium hirundinella	Nitzschia cf. acicularis
Aulacoseira sp.	cf. Chlamydomonas sp.	cf. Achnanthidium sp.	Nitzschia fruticosa
Chlamydomonas globosa	cf. Chlorella spp.	cf. Aphanocapsa sp.	Ochromonas spp.
Chlamydomonas sp.	cf. Chrysochromulina sp.	cf. Chlorella sp.	Pedinomonas sp.
Chlorella sp.	cf. Chrysochromulina spp.	cf. Cyanodictyon sp.	Peridiniopsis sp.
Chlorella vulgaris	cf. Crucigenia sp.	cf. Cyclotella sp.	Peridinium sp.
Chroococcus microscopicus	cf. Dictyosphaerium sp.	cf. Cylindrospermopsis sp.	Pseudanabaena endophytica
Chroococcus minimus	cf. Dolichospermum sp.	cf. Dinobryon sp.	Pseudanabaena spp.
cf. Chroomonas sp.	cf. Elakatothrix sp.	cf. Drepanochloris nannoselene	Romeria sp.
Coelastrum cf. microporum	cf. Gymnodinium sp.	cf. Eudorina sp.	Scenedesmus spp.
Cryptomonas erosa	cf. Klebsormidium sp.	cf. Fragilaria sp.	Selenastrum sp.
Cryptomonas ovata	cf. Leptosira sp.	cf. Glaucospira sp.	Staurastrum sp.
Cryptomonas sp.	cf. Melosira sp.	cf. Kephyrion sp.	Stephanodiscus cf. medius
Cyclotella sp.	cf. Ochromonas sp.	cf. Kirchneriella sp.	Stephanodiscus medius
Dinobryon sp.	cf. Ochromonas spp.	cf. Lagerheimia sp.	Stephanodiscus niagarae
Drepanochloris nannoselene	cf. Oocystis sp.	cf. Lagynion sp.	Stephanodiscus parvus
cf. Euglena sp.	cf. Planktolyngbya sp.	cf. Merismopedia sp.	Synura sp.
Fragilaria brevistriata	cf. Planktothrix sp.	cf. Microcystis sp.	Urosolenia sp.
Fragilaria capucina	cf. Pseudanabaena sp.	cf. Monoraphidium sp.	Woronichinia sp.
Fragilaria crotonensis	cf. Snowella sp.	cf. Pantocsekiella ocellata	Actinastrum hantzschii
Fragilaria sp.	cf. Tetrastrum sp.	cf. Peridinium sp.	Actinocyclus cf. normanii
cf. Geitlerinema sp.	Chlorella spp.	cf. Phormidium sp.	Asterionella sp.
Glaucospira sp.	Chroococcus minor	cf. Radiococcus sp.	cf. Aphanizomenon sp.
cf. Gloeocystis sp.	Chrysochromulina sp.	cf. Romeria sp.	cf. Chroococcus sp.
Gymnodinium sp.	Chrysococcus sp.	cf. Scenedesmus sp.	cf. Gloeoactinium limneticum
Kirchneriella sp.	Cocconeis sp.	cf. Sphaerocystis sp.	cf. Gloeocapsa sp.
Mallomonas sp.	Cyclotella meneghiniana	cf. Stephanodiscus sp.	cf. Kirchneriella spp.
Melosira varians	Cyclotella ocellata	cf. Synechococcus sp.	cf. Mougeotia sp.
Monoraphidium contortum	Diatoma sp.	cf. Woronichinia sp.	cf. Myxobaktron sp.
Monoraphidium minutum	Diatoma tenuis	Chroococcus cf. dispersus	cf. Ochromonas nana
Navicula sp.	Dinobryon spp.	Chroococcus cf. minimus	Chroococcus spp.
cf. Nitzschia sp.	Dolichospermum sp.	Chroococcus sp.	Crucigenia sp.
Ochromonas sp.	Dolichospermum spp.	Chroomonas sp.	Crucigenia tetrapedia
Oocystis sp.	Eudorina sp.	Coelastrum sp.	Desmodesmus cf. communis
cf. Pandorina sp.	Fragilaria spp.	Cosmarium sp.	Dichotomococcus curvatus
Pantocsekiella ocellata	Golenkinia sp.	Cryptomonas spp.	Dictyosphaerium pulchellum
Plagioselmis nannoplanctica	Golenkiniopsis sp.	Cuspidothrix sp.	Encyonema sp.
Plagioselmis sp.	Kephyrion sp.	Cyanodictyon	Lagerheimia genevensis
Planktolyngbya sp.	Lagynion sp.	Cyanodictyon sp.	Monoraphidium sp.
Planktothrix sp.	Melosira sp.	Cyclotella spp.	Myochloris sp.
cf. Pyramimonas sp.	Nephroselmis sp.	Cylindrospermopsis sp.	Nitzschia spp.
Quadrigula sp.	Nitzschia linearis	Dictyosphaerium sp.	Planktolyngbya spp.
Rhodomonas lacustris	Nitzschia sp.	Elakatothrix sp.	Skeletonema cf. potamos
Scenedesmus sp.	Oocystis spp.	Fragilaria cf. tenera	Skeletonema sp.
Scourfieldia sp.	Plagioselmis spp.	Fragilaria tenera	Surirella sp.
cf. Scourfieldia sp.	Planktolyngbya limnetica	Golenkiniopsis	Synechococcus spp.
cf. Skeletonema potamos	Planktosphaeria gelatinosa	Gyrosigma sp.	Tetraselmis sp.
Snowella sp.	Pseudanabaena limnetica	Kirchneriella cf. obesa	
Stephanodiscus sp.	Pseudanabaena sp.	Kirchneriella obesa	
Stephanodiscus binderanus	Sphaerocystis sp.	Kirchneriella spp.	
Stephanodiscus cf. niagarae	Tabellaria sp.	Lagerheimiella genevensis	
Synechococcus sp.	Tetrastrum sp.	Limnothrix sp.	
Tabellaria flocculosa	Achnanthidium catenatum	Lyngbya sp.	
Tetrastrum staurogeniaeforme	Actinocyclus normanii	Merismopedia cf. tenuissima	
Trachelomonas sp.	Aulacoseira cf. granulata	Merismopedia sp.	
Aphanocapsa sp.	Aulacoseira granulata	Merismopedia tenuissima	

3.1.6 Benthos

The counts (mean ±SD) for each genus are summarized in Table 11. Most of the benthos collected fell into three main groups, Bivalves, Insecta, and Oligochaeta, with a few crustaceans, mollusks and leeches. Their densities were relatively consistent across the three locations but densities in May were nearly double the density in October 2017. This difference was partially driven by Chironomid density. The May 9th, 2017 sampling event was likely just prior to the emergence of benthos (e.g. chironomids) from sediment, maximizing the size and number of individuals present.

Table 11. The mean density (#/m²) and standard deviation (in parentheses) are presented of each taxa across three replicate at each location for the May and October 2017 events.

Taxa	MAY		
	Turbine 2	Turbine 6	Reference 1
Oligochaeta	637.86 (612)	982.31 (437)	1001.44 (467)
*Pisidiidae sp.**	484.77 (130)	618.73 (228)	529.42 (72)
Chironomus sp.	401.85 (298)	267.90 (83)	223.25 (22)
Caecidotea sp.	6.38 (11)	0	0
Dreisseniidae sp.	0	6.38 (11)	0
Procladius sp.	121.19 (86)	19.14 (33)	19.14 (0)9.57 (11)
Glossiphoniidae sp.		0	6.38 (11)
Pleuroceridae sp.		0	28.70 (33)
Tanytarsini sp.		19.14 (19)	6.38 (11)
Valvata sp.		0	0
Total	1543.05	1913.6	1792.39
Taxa	October		
	Turbine 2	Turbine 6	Reference 1
Oligochaeta	478.40 (138)	459.26 (239)	223 (72)
*Pisidiidae sp.**	401.85 (282)	440.12 (191)	210.49 (116)
Chironomus sp.	165.84 (40)	140.33 (22)	165.84 (67)
Caecidotea sp.	76.54 (33)	0	63.79 (40)
Dreisseniidae sp.	12.76 (11)	19.14 (19)	6.38 (11)
Procladius sp.	0	0	0
Glossiphoniidae sp.	19.14 (33)	0	38.27 (38)
Pleuroceridae sp.	0	0	0
Tanytarsini sp.	0	0	0
Valvata sp.	6.38 (11)	6.38 (11)	6.38 (11)
Total	1160.91	1065.23	714.15

*Pisidiidae was previously listed as Sphaeriidae sp

Substrate type is often a key factor in controlling the composition and diversity of the benthic community. The offshore project site (~20 m) consists of primarily silty clay sediments and provides few natural, permanent structures for benthic invertebrates to attach to. While the featureless, silty bottom sediment is likely limiting taxa diversity, the absence of intolerant species (e.g., Mayflies) is also driven by the extended period of hypoxia. Dreissenids (e.g. zebra and quagga mussels) were found as part of this study in low numbers. These mussels can cause significant biofouling of structures, however low summer DO prevents permanent populations to accumulate below the thermocline.

3.2 Physical Habitat

3.2.1 Water Chemistry: Discrete

Discrete grab sampling for water chemistry and water clarity measurements were conducted on May 10, June 8, July 12, August 1, September 7, and October 3, 2017 at REF1-6 and ICE2, ICE4 and ICE6 (Table 12). Total Kjeldahl (TKN), TN, nitrate-nitrite, TP, and chlorophyll-*a* are summarized in Table 13. Water clarity results are summarized in Table 14. Unlike 2016 there were no yearly trends in chemistry parameters from May to October 2017. Average monthly water clarity was 7.6 feet in May before increasing to 18.8 feet in July and afterwards decreasing to 8.3 feet in October. An example of a water quality and photosynthetic active radiation profiles at REF 1 are shown in Figure 133 and Figure 144.

Table 12. Reference, Turbine, and Nearshore locations where discrete chemistry samples were taken from May to October 2017.

		Reference Stations 1 - 3																	
Task Description		1						2						3					
		May	June	July	Aug	Sep	Oct	May	June	July	Aug	Sep	Oct	May	June	July	Aug	Sep	Oct
Discrete Chemistry	Chlorophyll	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Nitrate+NO2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Total P	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	TKN	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	PAR Extinction	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Secchi Depth	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	DO/Temp Profile		x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x

		Reference Stations 4 - 6																	
Task Description		4						5						6					
		May	June	July	Aug	Sep	Oct	May	June	July	Aug	Sep	Oct	May	June	July	Aug	Sep	Oct
Discrete Chemistry	Chlorophyll	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Nitrate+NO2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Total P	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	TKN	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	PAR Extinction	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Secchi Depth	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	DO/Temp Profile		x	x	x	x	x	x	x	x	x	x			x	x	x	x	x

		Turbine Stations																		Nearshore					
Task Description		2						4						6											
		May	June	July	Aug	Sep	Oct	May	June	July	Aug	Sep	Oct	May	June	July	Aug	Sep	Oct	May	June	July	Aug	Sep	Oct
Discrete Chemistry	Chlorophyll	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x
	Nitrate+NO2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x
	Total P	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x
	TKN	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x
	PAR Extinction	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	-	x
	Secchi Depth	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	-	x
	DO/Temp Profile		x	x	x	x	x		x	x	x	x	x		x	x	x	x	x		x	x	x	-	x

Table 13. 2017 monthly results for Total Kjedahl Nitrogen, Total Nitrogen, Chlorophyll-a, Nitrate+Nitrite, and Total Phosphorus.

2017 Water Chemistry Results

	Total Kjeldahl Nitrogen(mg/L)						Total Nitrogen (mg/L)					
Station ID	May	June	July	August	Sept	Oct	May	June	July	August	Sept	Oct
Ref 1	0.254	0.285	0.212	0.214	0.407*	0.342	0.326	0.627	0.390	0.308	0.506*	0.412
Ref 2	0.279	0.269	0.170	0.206	0.446	0.361	0.343	0.573	0.388	0.289	0.545	0.379
Ref 3	0.249*	0.308	0.238*	0.192*	0.391	0.338*	0.371*	0.656	0.409*	0.287*	0.456	0.417*
Ref 4	0.236	0.260	0.451	0.194	0.367	0.315	0.377	0.539	0.636	0.282	0.499	0.364
Ref 5	0.266	0.253	0.310	0.199	0.441	0.297	0.340	0.539	0.492	0.304	0.565	0.329
Ref 6	0.232	0.196*	0.393	0.218	0.397	0.344	0.322	0.454*	0.578	0.335	0.506	0.371
Ice 2	0.389	0.204	0.345	0.232	0.399	0.342	0.487	0.502	0.506	0.322	0.440	0.393
Ice 4	0.301	0.272	0.356	0.097	0.378	0.311	0.369	0.583	0.535	0.199	0.440	0.363
Ice 6	0.224	0.215	0.398	0.172	0.386	0.314	0.290	0.500	0.576	0.288	0.457	0.357
Near Shore	0.401	0.277	0.372	0.183		0.365	0.872	0.738	0.505	0.271		0.473
Field Blank	0.022	0.057	0.060	0.005	0.139	0.036	0.021	0.059	0.062	0.002	0.148	0.054
	MDL: 0.036 mg/L						MDL: 0.038					

	Chlorophyll-a (µg/L)						Nitrate+Nitrite (mg/L)					
Station ID	May	June	July	August	Sept	Oct	May	June	July	August	Sept	Oct
Ref 1	4.25	1.93	2.16	4.57	14.90*	10.61	0.072	0.342	0.177	0.094	0.099*	0.070
Ref 2	3.57	1.96	2.70	4.13	12.54	10.58	0.064	0.304	0.218	0.083	0.098	0.018
Ref 3	6.00*	1.95	2.57*	4.40*	24.39	8.42*	0.121*	0.348	0.171*	0.095*	0.064	0.078*
Ref 4	6.40	1.59	2.47	5.91	16.60	8.93	0.142	0.279	0.184	0.089	0.132	0.049
Ref 5	4.07	2.18	2.67	4.05	13.62	9.91	0.073	0.286	0.183	0.105	0.125	0.032
Ref 6	3.33	1.69*	2.30	3.93	23.59	9.47	0.090	0.258*	0.185	0.117	0.109	0.027
Ice 2	4.88	1.96	2.40	4.13	18.19	8.79	0.098	0.299	0.161	0.090	0.041	0.051
Ice 4	3.63	2.03	2.33	3.86	13.66	10.38	0.068	0.311	0.180	0.103	0.061	0.052
Ice 6	3.26	2.06	3.25	4.23	11.16	10.31	0.066	0.285	0.178	0.116	0.071	0.043
Near Shore	9.31	1.32	1.96	4.23		8.42	0.471	0.461	0.133	0.088		0.109
Field Blank	0.20	0.10	0.01	0.03	4.43	0.07	0.000	0.002	0.001	-0.002	0.009	0.019
	MDL: 1.00 µg/L						MDL: 0.002 mg/L					

	Total Phosphorus (µg/L)					
ID	May	June	July	August	Sept	Oct
Ref 1	11.60	8.32	6.94	8.42	21.17*	17.93
Ref 2	7.33	11.74	6.09	7.09	22.86	17.92
Ref 3	8.44*	9.11	7.20*	8.32*	24.27	16.23*
Ref 4	10.08	8.75	8.53	10.61	22.32	16.69
Ref 5	7.94	11.92	9.32	7.37	20.97	17.10
Ref 6	20.54	12.37*	5.59	8.67	30.06	18.89
Ice 2	14.25	8.27	6.40	7.28	24.41	16.15
Ice 4	9.28	9.52	5.98	7.65	23.23	19.11
Ice 6	7.82	8.64	5.78	8.61	25.55	19.68
Near Shore	27.26	6.26	6.72	7.65		17.52
Field Blank	-0.589	0.619	0.836	0.279	-0.108	1.394
	MDL: 3.15 µg/L					
	Values lower than the method detection level					
	* indicates sites with a dupulicate					

Table 14. 2017 water clarity and light extinction results.

2017 Water Clarity Results												
	Secchi Depth (m)						PAR Extinction Coeff. (m^{-1})					
Station ID	May	June	July	August	Sept	Oct	May	June	July	August	Sept	Oct
Ref 1	3.0	3.6	6.4	5.1	2.3	2.7	-0.157	-0.164	-0.079	-0.107	-0.206	-0.234
Ref 2	2.7	4.0	5.5	5.0	2.4	2.4	-0.136	-0.142	-0.095	-0.109	-0.206	-0.256
Ref 3	1.4	4.0	5.5	5.6	2.2	2.6	-0.315	-0.157	-0.087	-0.105	-0.240	-0.229
Ref 4	0.9	4.4	4.3	5.0	2.4	2.6	-0.374	-0.149	-0.094	-0.101	-0.242	-0.229
Ref 5	2.5	4.4	5.8	5.0	2.4	2.2	-0.185	-0.119	-0.090	-0.097	-0.218	-0.252
Ref 6	2.4	5.4	6.1	4.9	2.4	0.0	-0.121	-0.114	-0.091	-0.129	-0.193	-0.259
Ice 2	2.4	2.4	5.5	5.2	2.3	2.8	-0.210	-0.210	-0.078	-0.098	-0.221	-0.234
Ice 4	2.5	4.3	6.1	4.9	2.4	2.5	-0.133	-0.143	-0.081	-0.106	-0.223	-0.252
Ice 6	3.0	4.6	6.4	5.1	2.4	2.3	-0.154	-0.124	-0.073	-0.111	-0.200	-0.259
Near Shore	*	2.8	5.5	4.6	*	3.1	*	-0.181	-0.085	-0.115	*	-0.204

Note: * denotes no data taken.

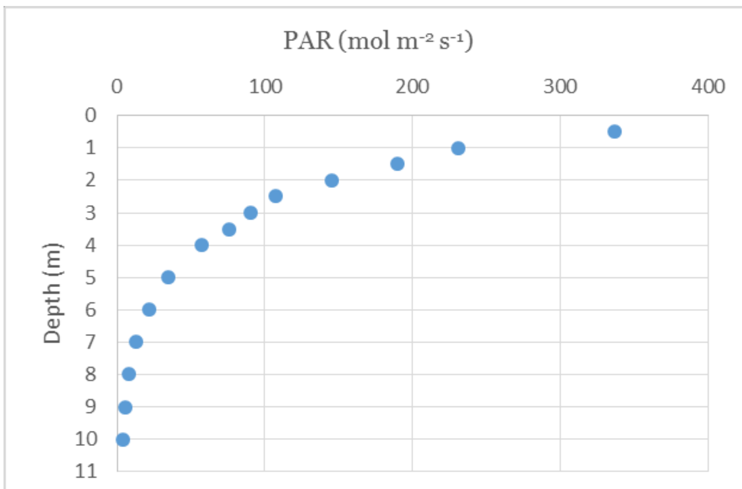


Figure 13. PAR measurements taken on 9/6/2017 at REF1.

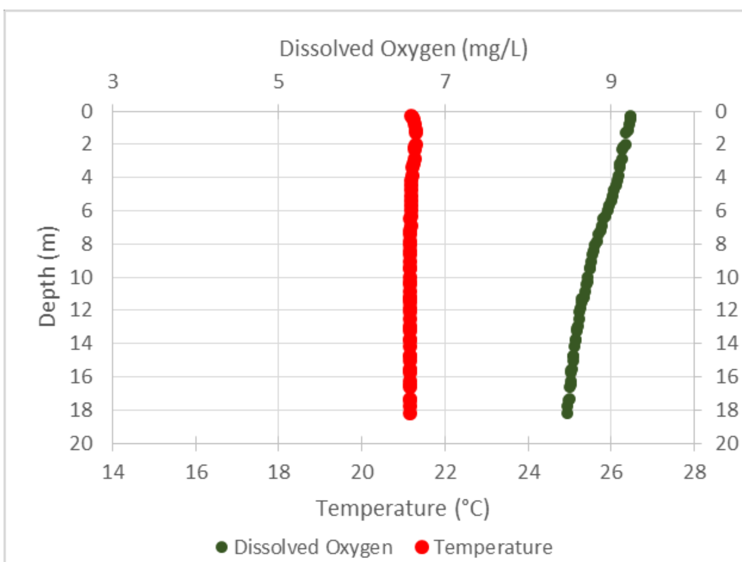


Figure 14. Water temperature and DO profile taken at REF1 on 8/2/2017.

3.2.2 Water Chemistry: Continuous

A summary of the number of days when data was collected by continuous sensors is provided in Table 5 and 16. DO and temperature data were also retrieved from nearby buoys 45164 and 45176 to provide additional data from nearshore and offshore locations. Buoy 45164 was deployed ten miles northeast of the central turbine location in 70 feet of water and provided hourly water temperature from the surface to 60 feet below the surface at two meter increments. Buoy 45176 was located six miles southeast of the central turbine and measured lake bottom DO and temperature every ten minutes.

PAR data for 2017 are shown in Figure 15. PAR was generally similar between the two sites (ICE4 and REF1), with PAR values slightly higher at the reference site. This may be due to differences in the exact positioning of the sensor in the water column resulting in a further distance and more light attention from the water surface. There was a 99% correlation between both sites, indicating PAR was influenced by the same physical dynamics.

Lake bottom DO and temperature from May 10, 2017 to November 7, 2017 are illustrated in Figure 166 and Figure 177. Bottom DO continually dropped until water became anoxic first in late-July and did not permanently oxygenate until October 1. Bottom lake temperature increased ten degrees Celsius at ICE4 and REF1 throughout the 2017 deployment with daily fluctuations due to strong wind events that mixed the water column. (Figure 177).

Deviations in temperature between the nearshore to offshore sites was a response to the location and of the thermocline and thickness of the hypolimnion. Throughout 2017 surface water temperatures from nearshore to offshore had little deviation (Figure 188). Figure 199 illustrates the increase in the thermoclines as the temperature gradient from June through August increases. While the hypolimnion still reached a depth of two meters in 2017, there was only a maximum temperature change over one meter of 8.5 °C in early-August compared to 11 °C from 2016.

Table 15. Number of days each month data was collected by continuous sensors at REF1 and ICE4.

	Reference 1						Turbine 4					
Task Description	May	June	July	August	Sept	Oct	May	June	July	August	Sept	Oct
Surface Water Temperature	29	30	31	31	30	20	29	30	31	31	30	20
Bottom Water Temperature	29	30	31	31	30	20	29	30	31	31	30	20
Bottom Dissolved Oxygen	0	17	30	31	30	20	29	30	31	31	30	20
Photosynthetic Active Radiation	29	30	31	31	30	20	29	30	31	31	30	20
Water Current Profile	29	30	31	31	30	20	29	30	30	21	30	20
Background Noise	29	30	31	31	30	20	29	30	31	31	30	20

Table 16. Number of days each month data was collected by continuous sensors at ICE1, ICE2, ICE7.

	Ice 1				Ice 2			Ice 7			
Task Description	July	August	Sept	Oct	August	Sept	Oct	July	August	Sept	Oct
Bottom Water Temp	11	31	30	31	13	30	31	11	30	30	19
Bottom DO	11	31	30	31	13	30	31	11	30	30	19

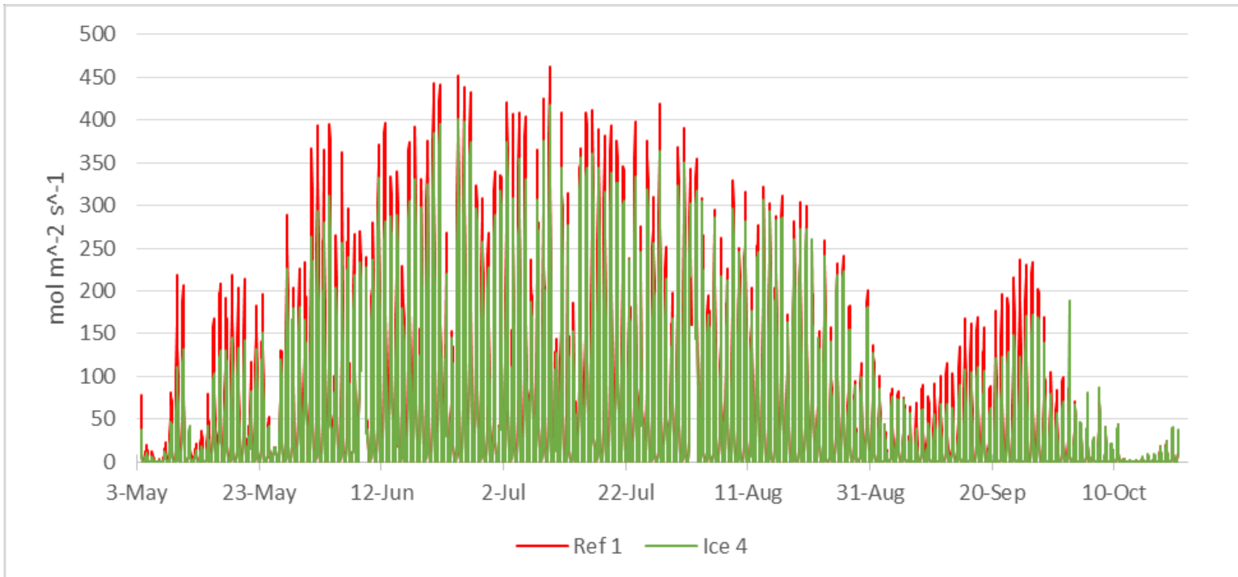


Figure 15. 2017 photosynthetic active radiation at ICE4 and REF1.

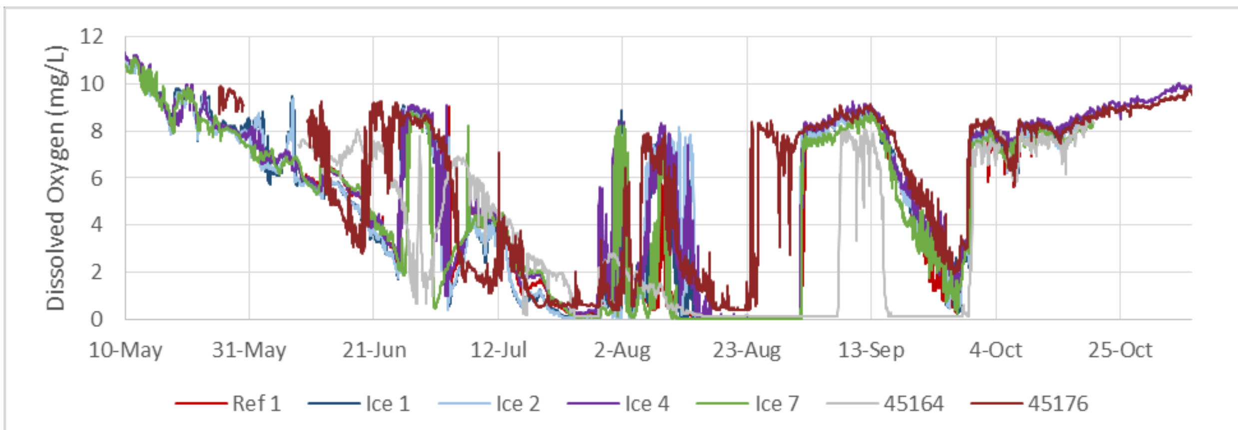


Figure 16. 2017 lake bottom DO at ICE1, ICE2, ICE4, ICE7, REF1, and buoy 45164 and 45176.

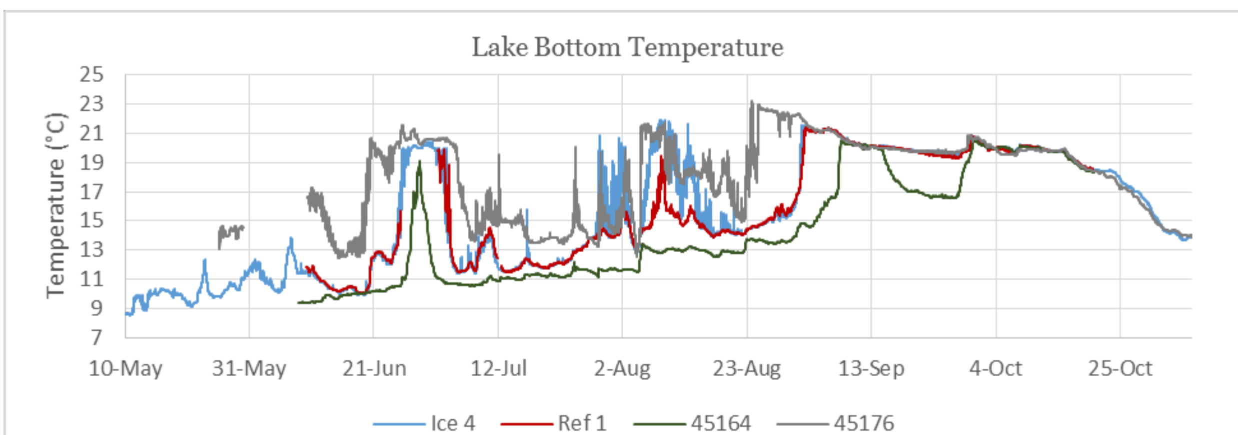


Figure 17. 2017 lake bottom temperature at ICE4, REF1, and buoys 45164 and 45176.

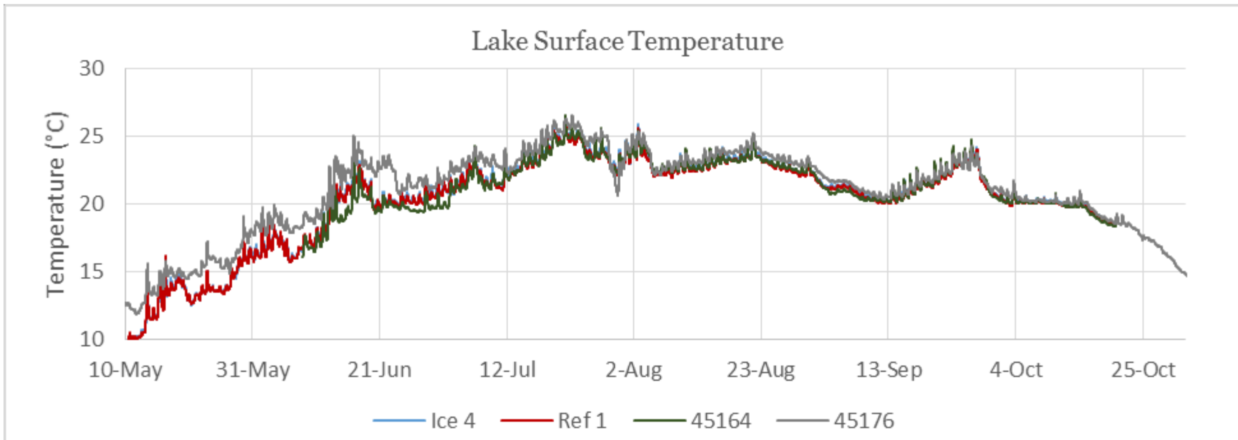


Figure 18. 2017 surface lake temperature at ICE4, REF1, and buoys 45164 and 45176.

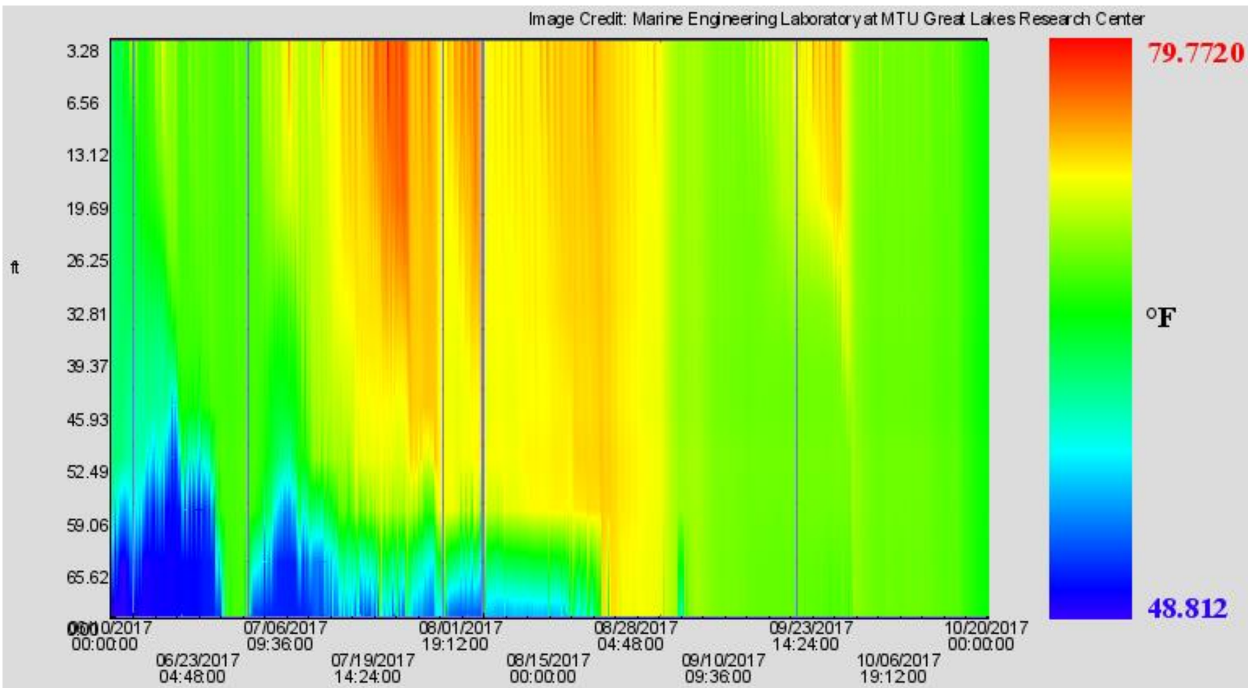
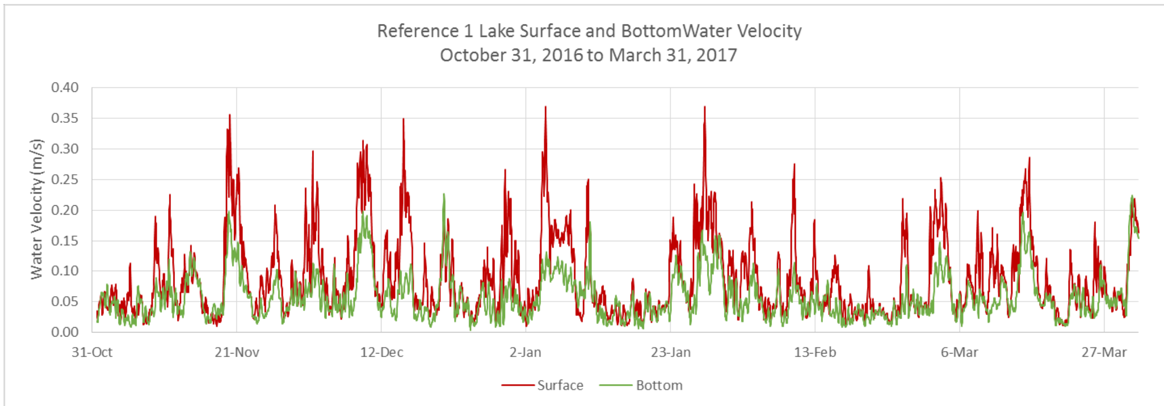


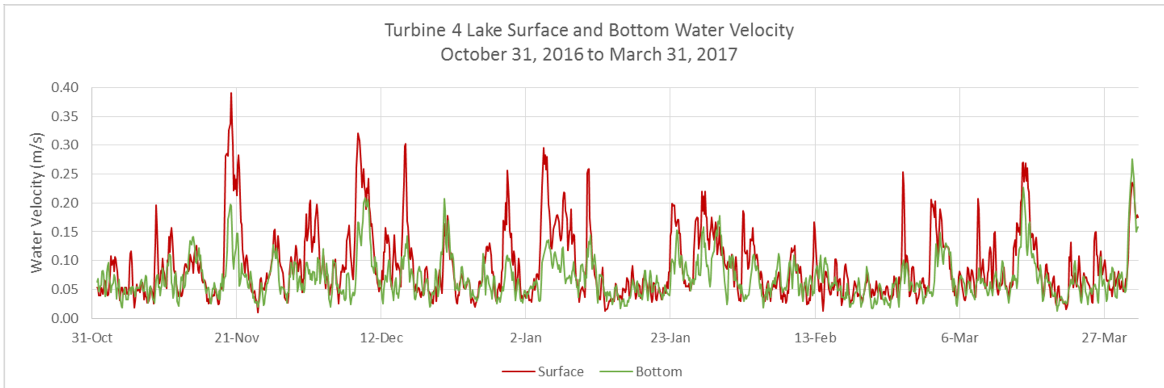
Figure 19. Buoy 45164 water temperature profile from June 1, 2017 to October 20, 2017.

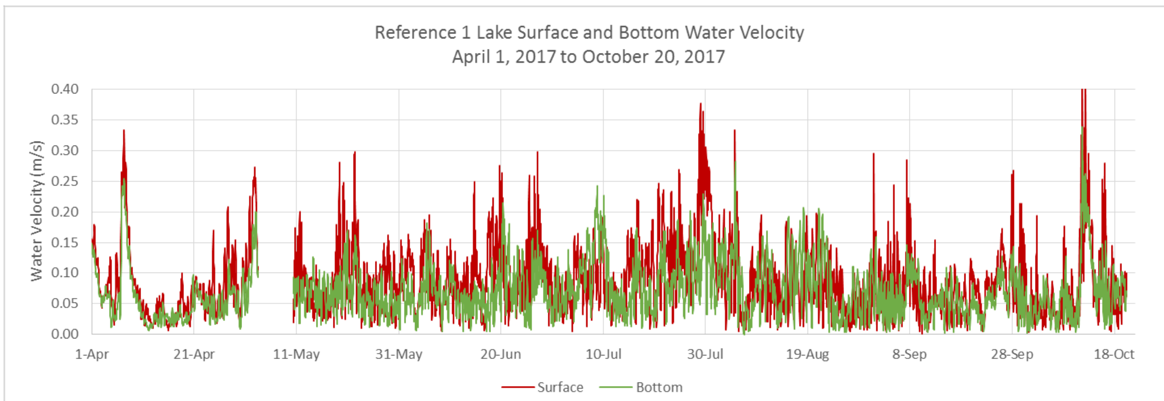
3.2.3 Hydrodynamic

ICE4 exhibited small deviations between the top and bottom water velocity and direction throughout the year (Figure 20 and Figure 21). As summarized in Table 17, the average current velocity from April 1 to October 20, 2017 at the bottom of Lake Erie was 0.075 m/s while the surface was only slightly faster at 0.08 to 0.09 m/s. During the same period average significant wave height and mean wave period for 2017 was 0.38 meters and 2.6 seconds.

Winter data, defined as October 31, 2016 to March 31, 2017, exhibited average wave heights that were 52% higher than the warmer period from April 1 to October 20, 2017. While there was little change in water velocity between both periods at ICE4 and REF1 there was a significant increase in the percentage of water moving from west to east rather than east to west that was measured during the warm period.







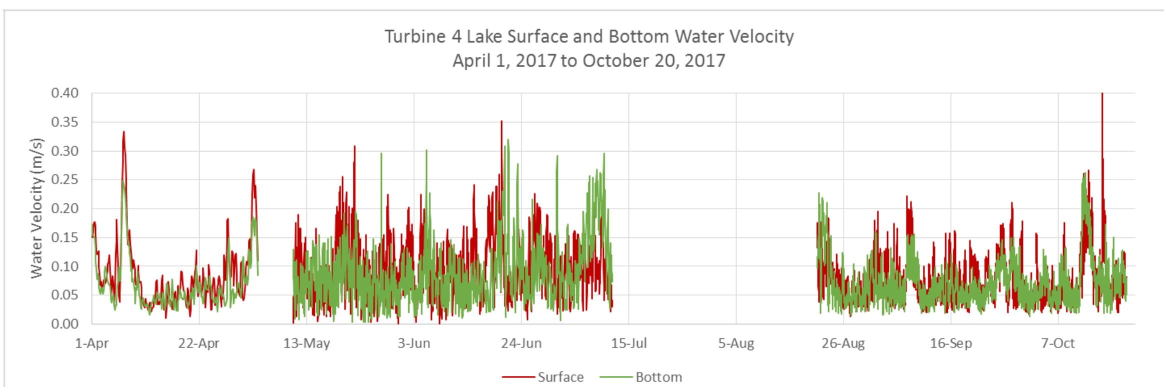
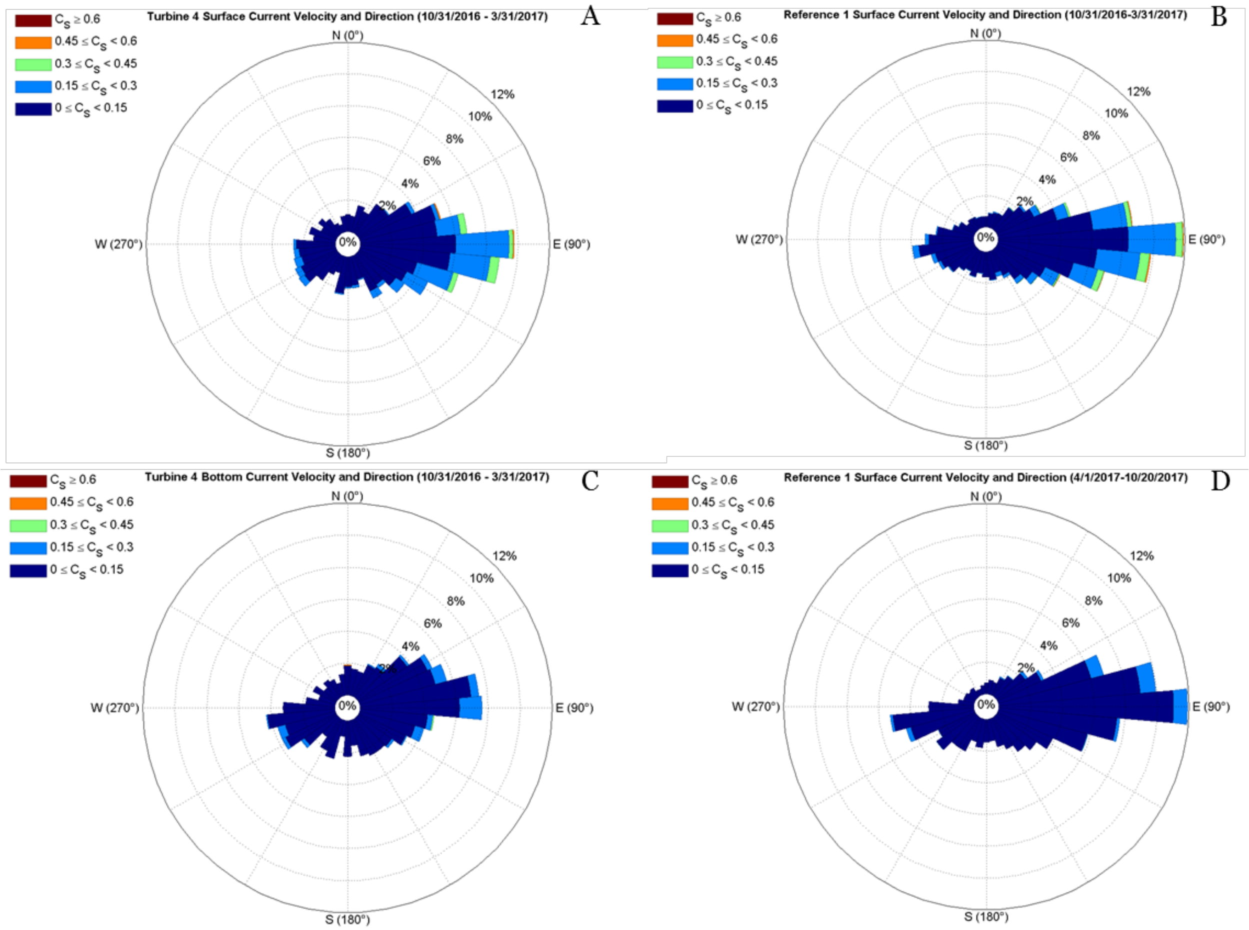


Figure 20. 2017 lake surface and bottom water velocity at ICE4 and REF1.


A
Turbine 4 Surface Current Velocity and Direction (10/31/2016 - 3/31/2017)
B
Reference 1 Surface Current Velocity and Direction (10/31/2016-3/31/2017)
C
Turbine 4 Bottom Current Velocity and Direction (10/31/2016 - 3/31/2017)
D
Reference 1 Surface Current Velocity and Direction (4/1/2017-10/20/2017)
C$_S$ ≥ 0.6
0.45 ≤ C$_S$ < 0.6
0.3 ≤ C$_S$ < 0.45
0.15 ≤ C$_S$ < 0.3
0 ≤ C$_S$ < 0.15
N (0°)
E (90°)
S (180°)
W (270°)
0%
2%
4%
6%
8%
10%
12%

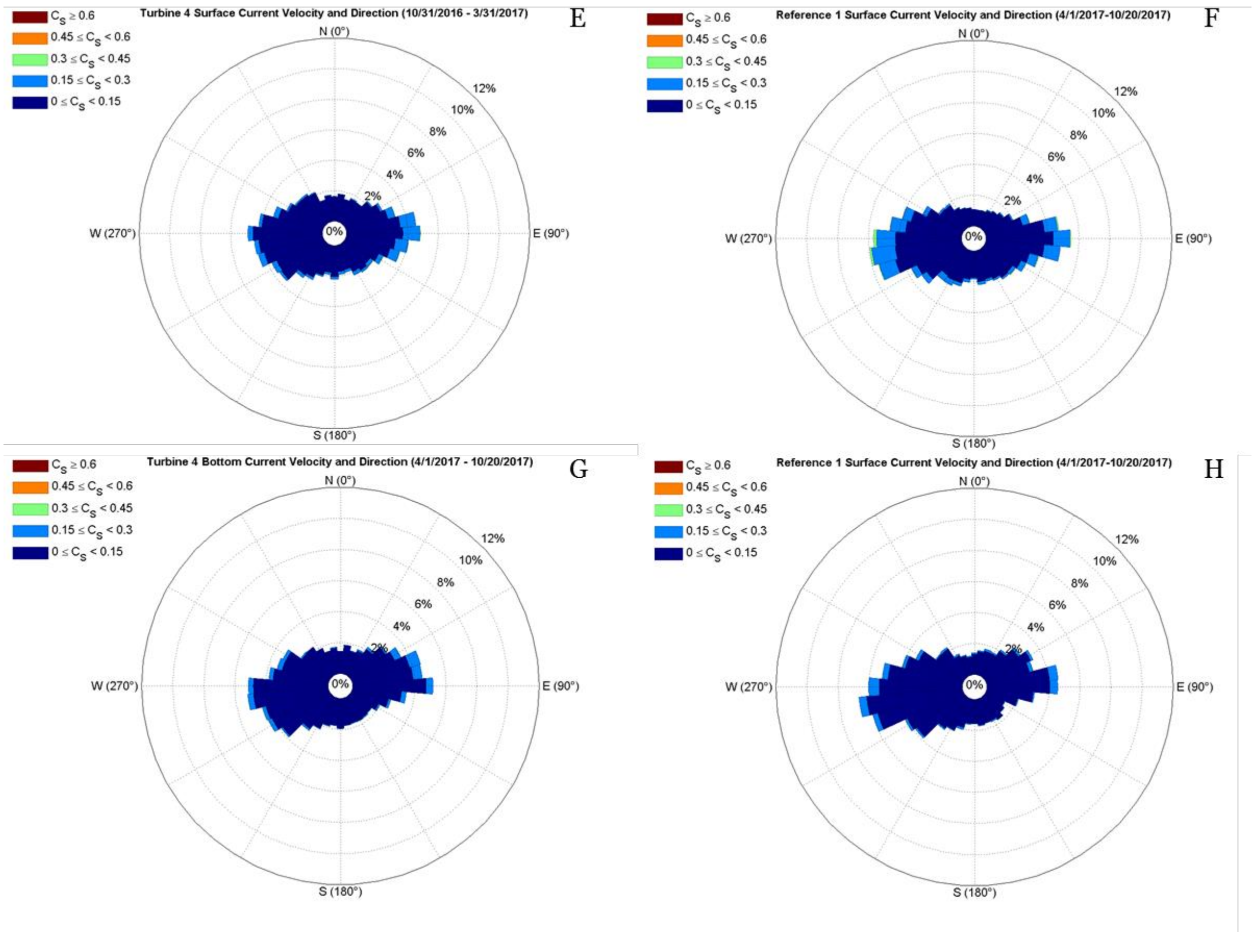


Figure 21. 2017 lake surface and bottom current velocity and direction at ICE4 (A, C) and REF1 (B, D). Spokes represent the frequency of currents moving towards a particular direction.

Table 17. 2017 average and maximum current velocity, wave height, and period at ICE4 and REF1 from October 31, 2016 to March 31, 2017 (top) and April 1 to October 20, 2017 (bottom).

October 31, 2016 to March 31, 2017								
	Current Velocity (m/s)				Wave Height (m)		Period (sec)	
	Bottom		Surface					
	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.
Ice 4	0.070	0.302	0.085	0.414	0.65	3.26	2.93	33.11
Ref 1	0.058	0.245	0.089	0.518	*	*	*	*

April 1, 2017 to October 20, 2017								
	Current Velocity (m/s)				Wave Height (m)		Period (sec)	
	Bottom		Surface					
	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.
Ice 4	0.074	0.444	0.079	0.510	0.38	2.87	2.58	42.7
Ref 1	0.073	0.339	0.093	0.494	*	*		*

Note: * denotes no data taken

3.3 Fish Behavior

3.3.1 Acoustic Telemetry

A brief summary of the detections for reach receiver location are shown below. The data presented were filtered by removing the unknown transmissions and any single detections for a single tag (Table 18).

Table 18. Summary of raw acoustic tag data from November 2016 to August 2017.

Station ID	Distance to Shore	Walleye	Lake Whitefish	Lake Sturgeon	Grass Carp
#	(km)	Unique fish count (total transmission received)			
26	2.96	54 (9493)	2 (119)	0 (0)	1 (4)
13	3.10	51 (9791)	1 (105)	0 (0)	1 (9)
25	4.10	52 (10256)	2 (21)	0 (0)	1 (9)
12	4.41	54 (11455)	2 (86)	0 (0)	1 (11)
24	5.34	64 (10958)	3 (31)	1 (6)	0 (0)
11	5.74	56 (8815)	4 (82)	0 (0)	0 (0)
23	6.63	57 (8823)	5 (123)	0 (0)	0 (0)
10	7.08	56 (8688)	7 (162)	0 (0)	0 (0)
22	7.92	59 (7658)	8 (202)	1 (3)	0 (0)
9	8.42	58 (11058)	8 (374)	1 (1)	0 (0)
21	9.24	55 (6645)	9 (485)	0 (0)	0 (0)
8	9.76	54 (6655)	10 (692)	1 (6)	0 (0)
20	10.57	49 (6859)	11 (904)	1 (7)	0 (0)
7	11.10	48 (6718)	9 (1627)	1 (46)	0 (0)
19	11.90	46 (5034)	10 (541)	1 (37)	0 (0)
6	12.44	52 (5968)	14 (778)	1 (73)	0 (0)
18	13.23	45 (4531)	14 (795)	1 (25)	0 (0)
5	13.79	51 (5211)	13 (1515)	1 (18)	0 (0)
17	14.29	45 (4614)	11 (1608)	1 (12)	0 (0)
4	15.10	49 (4426)	12 (2106)	1 (13)	0 (0)
16	15.43	47 (4702)	12 (1773)	1 (5)	0 (0)
3	16.37	42 (3964)	11 (1448)	1 (2)	0 (0)
15	16.74	33 (9944)	11 (1095)	0 (0)	0 (0)
2	17.66	39 (5279)	11 (1521)	0 (0)	0 (0)
14	18.05	41 (6702)	12 (2100)	0 (0)	0 (0)
1	18.95	34 (3264)	9 (1570)	0 (0)	0 (0)
45176	7.28	48 (2680)	8 (202)	0 (0)	0 (0)
45169	17.237	39 (1822)	10 (394)	0 (0)	0 (0)

Walleye were the most abundant species present within the array followed by Lake Whitefish. Walleye are the most commonly tagged species in Lake Erie, so it is not surprising that they appeared in the highest numbers around the array. The relationship between Walleye and Whitefish counts against the distance from shore is presented in Figure 22. Walleye were highest closest to shore whereas Whitefish decreased. Similarly, the relationship between the number of transmissions for both species is presented in Figure 23.

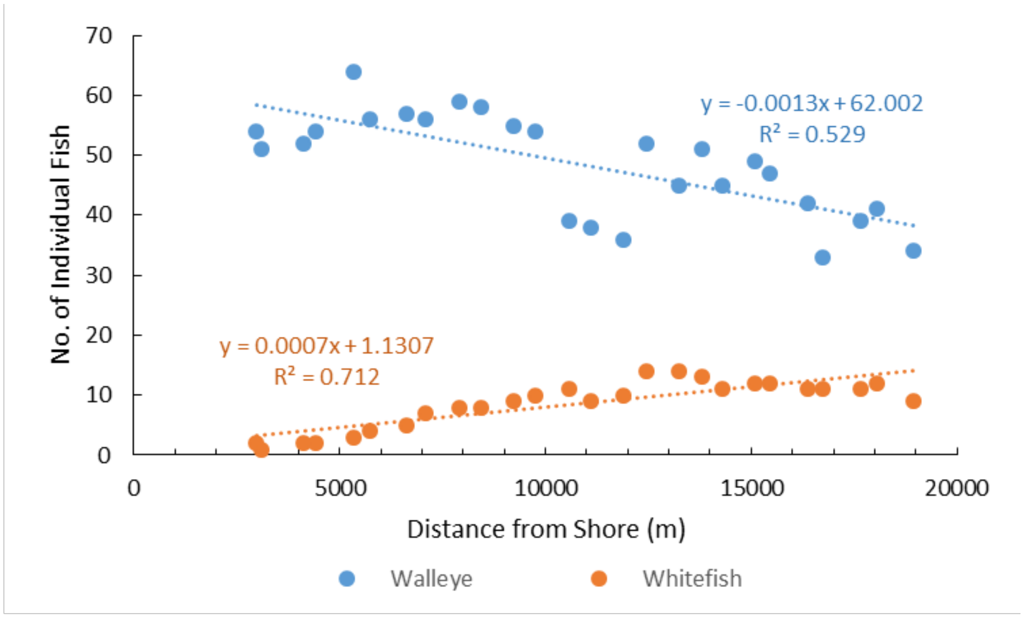


Figure 22. The number of Walleye and Whitefish plotted against distance from shore (m) from October 31 2016 through August 2017. (note: data has not been filtered for false positives)

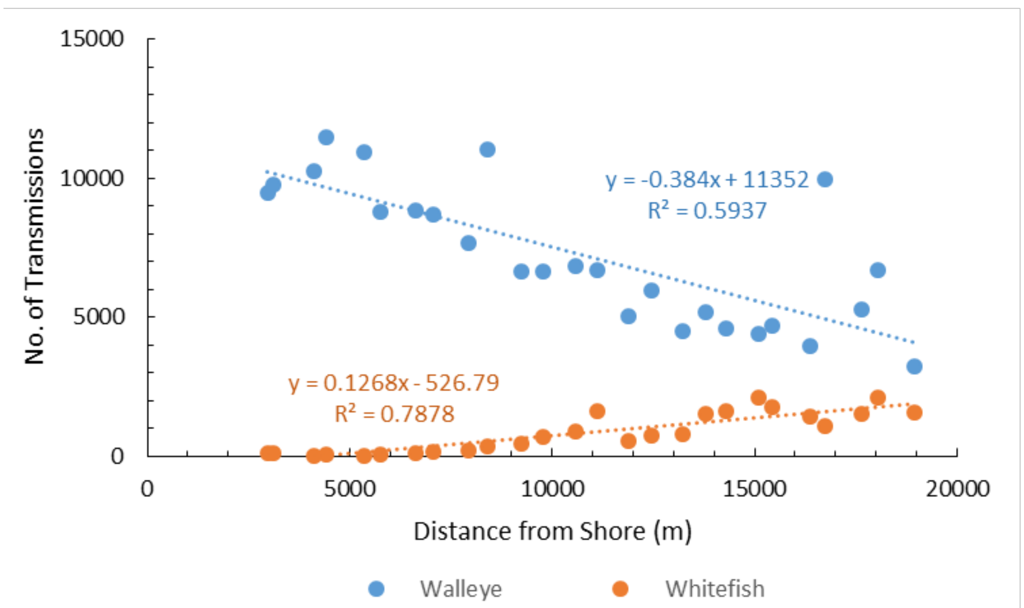


Figure 23. The number of total transmissions for Walleye and Whitefish plotted against distance from shore (m) from October 31 2016 through August 2017 (note: data has not been filtered for false positives)

3.3.2 Fixed Acoustics

The hydroacoustic raw files for each survey are included in Appendix C. In 2016, adult and juvenile fish densities were similar between the two fixed locations, which included one at the project location and one to serve as a reference. Although transects were similar within months in 2016, there was a significant decline in total density across months. The raw files will be analyzed in the future to compare years when the turbines are deployed.

3.3.3 Noise Production

The underwater sound was recorded at ICE4 and REF1 from 5/2/17 to 10/20/17 and was transformed into acoustic pressure (µP). The first standard deviation of acoustic pressure was derived from each 30-minute recording to illustrate sound fluctuations underwater (Figure 24). Noise fluctuations was then compared to LimnoTech's environmental monitoring activity to determine which significant sounds were produced by a single outboard motor, represented by arrows in Figure 24. The 2017 data will be further analyzed for comparison with during and post-construction data. Due to the large data storage for the recordings, the data will not be included in Appendix C. Noise data from 2017 can be obtained by contacting LimnoTech.

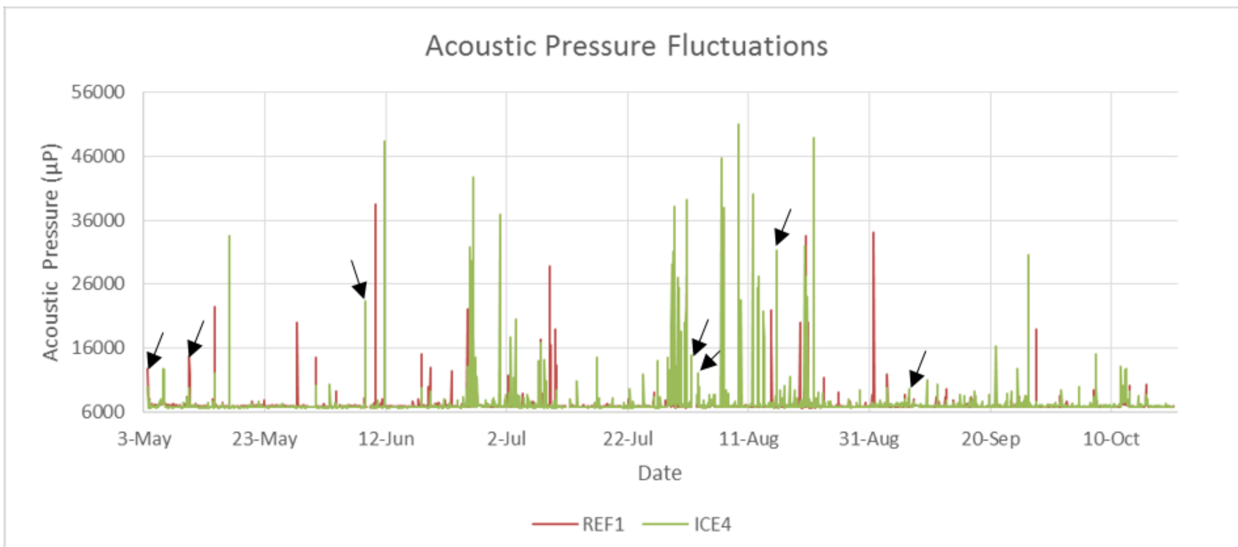


Figure 24. Acoustic pressure fluctuations (µP) at REF1 and ICE4 from 5/2/17 to 10/20/17. Arrows represent noise produced from LimnoTech during environmental monitoring.

3.3.4 Aerial Surveys of Boating

Results from all of the boat surveys by 5-minute survey block are summarized in Table 19 below. Data from the aerial survey shows that boating activity and recreational fishing effort occurs closer to shore than is depicted in the ODNR developed sport fishery maps shown in Figure 25. Each 5-minute survey block has an ID and the numeric part of the ID (911 and 912) corresponds to the 10-minute size survey blocks that are used by ODNR to conduct boating surveys in Lake Erie. Across all dates, only 3% of the total boats counted were in the 5-minute block covering the project area. This data shows that boating activity and recreational fishing effort occurs closer to shore and well away from the project site.

Table 19. Summary of all offshore boat counts from 2017 plane flyovers.

Date	911-NW	911-NE	912-NW	912-NE	911-SW	911-SE	912-SW	Total
5/29/2017	0	0	2	3	40	12	7	64
6/2/2017	0	0	3	2	7	5	8	25
6/22/2017	0	0	0	0	1	0	0	1
6/24/2017	0	0	3	3	84	3	12	105
7/15/2017	0	1	7	18	25	12	11	74
7/19/2017	4	2	8	10	23	5	11	63
8/3/2017	1	2	3	2	17	6	8	39
8/6/2017	0	4	10	7	92	26	23	162
8/21/2017	2	9	6	5	22	14	11	69
8/27/2017	4	6	12	7	49	5	12	95
9/14/2017	0	4	2	1	3	2	7	19
9/17/2017	11	24	14	17	12	16	10	104
10/5/2017	1	7	6	1	6	1	3	25
10/8/2017	1	0	0	1	14	24	0	40
10/26/2017	2	1	1	0	6	7	5	22
10/29/2017	0	0	1	0	5	1	0	7
Total	26	60	78	77	406	139	128	907
% of Total	3	7	9	8	45	15	14	100

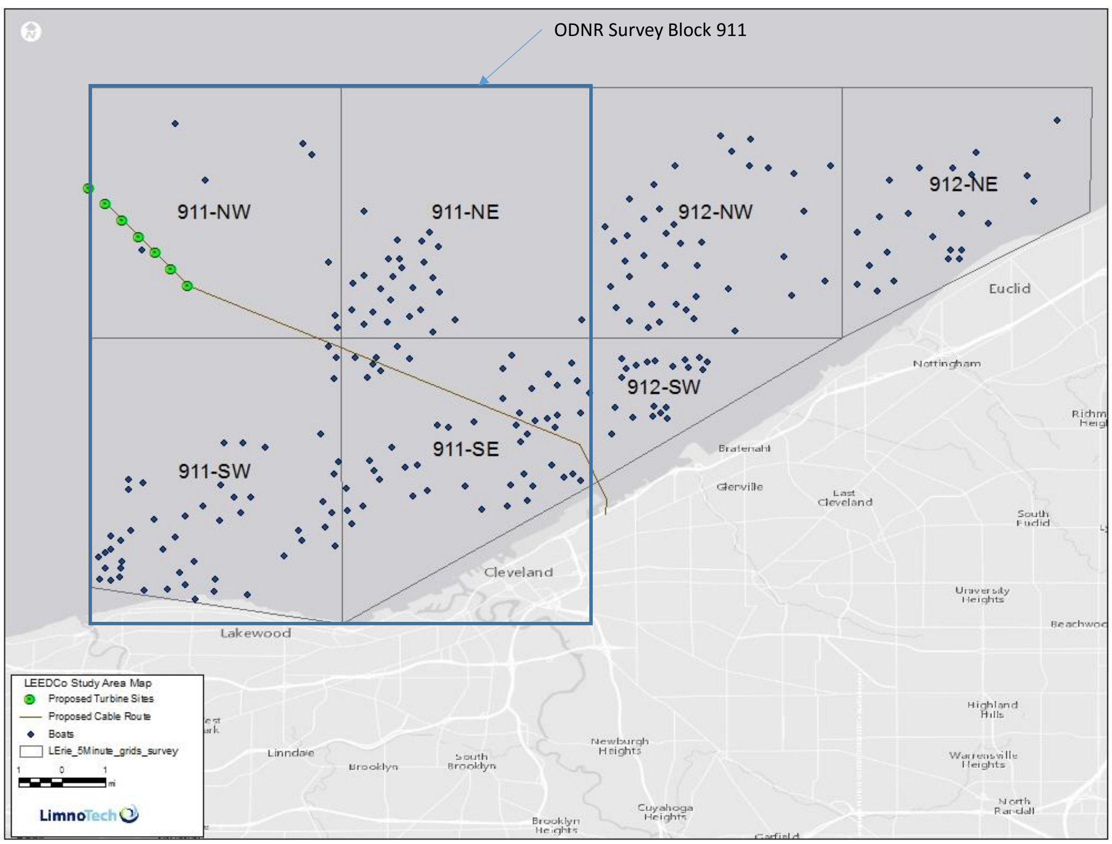


Figure 25. Example map of recreational boats (dots) as counted by plane and turbine location (green dots) on July 3, 2016.

4 Conclusion

The 2017 sampling program was the second year of data collection to support the characterization of the aquatic and biological environment at the proposed site of the nation's first freshwater offshore wind farm near Cleveland, OH in Lake Erie. The 2017 sampling results confirm what was found during the first year of sampling in 2016. These results do not reveal any unusual site conditions that differ from the previous understanding of the aquatic and biological make-up of this portion of Lake Erie. Observed trends in lake currents, temperature, dissolved oxygen, nutrients, water clarity, water quality conditions, sediments, benthic macroinvertebrates, phytoplankton, zooplankton, and larval and juvenile fish were all within ranges observed by others for this area of Lake Erie. Seasonal patterns were evident in almost every physical and biological parameter measured during the 2016 and 2017 field seasons. The data presented in this report do provide fine scale and specificity to the range of values observed at the project site in 2016 and 2017. These data can serve to represent baseline conditions that existed at these sites prior to the initiation of any construction activities. Comparisons can be made between the data collected in 2016/2017 with data collected during and after installation of wind turbines.

5
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6
Appendices

Appendix A
Attached Letters

Ohio Department of Natural Resources

JOHN R. KASICH, GOVERNOR JAMES ZEHRINGER, DIRECTOR

Ohio Division of Wildlife
Raymond W. Petering, Chief
2045 Morse Road, Bldg. G
Columbus, OH 43229-6693
Phone: (614) 265-6300

February 1, 2017

Mr. Edward Verhamme
Project Engineer
LimnoTech
501 Avis Drive
Ann Arbor, MI 48108

Re: LimnoTech Lake Erie Monitoring Plan

Dear Mr. Verhamme:

The purpose of this letter is to formally acknowledge that the January 25, 2017 version of the *LimnoTech Lake Erie Monitoring Plan for the Offshore Wind Project: Icebreaker Wind* received via email on January 25, 2017 meets the requirements of the Ohio Department of Natural Resources (ODNR) Division of Wildlife (Division) Fish Management & Research Group. All Division comments have been addressed in this version of the plan.

The Division will work to develop adaptive language in a forthcoming Memorandum of Understanding (MOU) between ODNR, the United States Fish & Wildlife Service (USFWS), LEEDCo, and LimnoTech that obligates LEEDCo and LimnoTech to fully implement the agreed-to monitoring plan. The MOU will include provisions for an annual performance review, a comprehensive analysis of data, and an option to adjust the monitoring plan based on changes in project design and/or results-driven knowledge gained from the monitoring work.

Please feel free to contact me by email at rich.carter@dnr.state.oh.us or phone at (614) 265-6345 if you have any questions.

Sincerely,

Rich Carter

Rich Carter
Executive Administrator
Fish Management and Research
ODNR-Division of Wildlife

cc: Robert Boyles, Deputy Director – ODNR
Raymond Petering, Chief, Division of Wildlife – ODNR
Scott Hale, Assistant Chief, Division of Wildlife - ODNR
Dr. Scudder Mackey, Chief, Office of Coastal Management – ODNR
Dave Kohler, Wildlife Administrator, Division of Wildlife - ODNR
Travis Hartman, Division of Wildlife - ODNR
Dr. Janice Kerns, Division of Wildlife - ODNR
Megan Seymour, Wildlife Biologist - USFWS

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Frank G. Jackson, Mayor
Department of Public Utilities
Division of Water
1201 Lakeside Avenue
Cleveland, Ohio 44114-1175
216/664-2444 Fax: 216/664-3330
www.clevelandwater.com

September 22, 2017

Ms. Beth A. Nagusky
Director of Sustainable Development
Lake Erie Energy Development Corporation
1938 Euclid Avenue, Suite 200
Cleveland, Ohio 44115

Dear Ms. Nagusky:

Cleveland Water offers this letter to summarize our meeting on August 24th, 2017 at your office. The meeting was between LEEDCo, CWD, and LimnoTech to discuss the planned construction of wind turbines located offshore from Cleveland and potential, if unlikely, impacts on raw water quality for two of our four plants, specifically the Morgan and Baldwin plants.

Construction of the 7-mile length of parallel lines is the portion of the project we are most interested in. Since it has been determined by LEEDCo that no known areas of toxic material or areas of open lake placement for dredging material exists in the construction corridor, turbidity is the contaminant of concern to Cleveland Water. While we believe this potential to be low, LEEDCo has agreed to the following to ensure the safety of the raw water:

- LEEDCo will provide Cleveland Water a minimum three-day notice before commencing construction of the export cable.
- LEEDCo will communicate with Cleveland Water on a daily basis during the cable laying operations. This construction is anticipated to last approximately one week in the area of concern.
- The cables will not be placed in any area of open lake placement.
- LEEDCo or their agent will monitor for turbidity during construction activities and will provide turbidity sensors for the Morgan buoy/sonde installation. The turbidity sensors will be located at the surface and at the bottom elevations.

Based upon our review of historical turbidity levels in Lake Erie, we have observed natural, storm-induced turbidity spikes up to 300 Nephelometric Turbidity Units

(NTU). Therefore, if turbidity is observed to exceed 300 NTU during construction-related activities, we would have to attribute this to LEEDCo activities. It is likely we would seek some type of relief if significant treatment adjustments are required to meet regulatory limits for potable water. For a number of reasons we discussed during the meeting, we do not anticipate this being a realistic concern.

Finally, as a matter of policy, we request LEEDCo refrain from identifying exact locations of key infrastructure near this project. While we understand much of this information is in the public realm, we try to protect this information at every opportunity. Specifically, we request you refrain from identifying the location of our submerged crib for the Morgan water plant and the locations/direction of the raw water intake tunnels extending from the Kirtland Crib and the Morgan Crib. These tunnels are inconsequential to the overall project and should not be identified.

We appreciate the opportunity to work with LEEDCo, LimnoTech, and your partners on this very important project. If you have any questions, please feel free to contact Maggie Rodgers at 216-664-2444 x75584 or Scott Moegling at 215-664-2444 x75583.

Sincerely,

Alex Margevicius, P.E.
Commissioner
Cleveland Water

ec: Maggie Rodgers, Plant Operations Manager
Scott Moegling, Water Quality Manager

An Equal Opportunity Employer

Appendix B
Field Notes, Chain of Custodies, and Field Photos

This appendix will be transmitted to ODNR and USFWS via email.

Appendix C
Electronic Copy of Field Data

This appendix will be included on a thumb drive delivered to ODNR and USFWS.

Appendix D
2016 Zooplankton Correction

In 2017, we identified an error in the formulation of the Number/L and Biomass in the 2016 raw and reported files in 2016 for zooplankton. The trends across months and locations, as well as the species specific information did not change but the raw numbers did change. An updated table is shown below in Table D-1 of Appendix D. Additionally, the updated raw data files from the sampling year 2016 are being submitted with the 2017 data file submission (Appendix C).

Table D-1. 2016 Zooplankton Correction

	Turbine 2					
	May	June	July	August	September	October
Number/L	207.3	177.0	166.1	460.5	166.0	na
Biomass (ug d.w./L)	75.9	111.7	30.6	318.5	60.2	na
	Turbine 6					
	May	June	July	August	September	October
Number/L	509.7	63.2	499.6	485.9	356.3	149.2
Biomass (ug d.w./L)	237.5	132.7	113.1	86.3	141.5	68.1
	Reference 2					
	May	June	July	August	September	October
Number/L	304.5	480.0	180.5	390.8	274.1	na
Biomass (ug d.w./L)	164.8	241.2	22.7	72.0	48.8	na
	Reference 4					
	May	June	July	August	September	October
Number/L	182.5	95.9	279.1	315.0	182.2	na
Biomass (ug d.w./L)	77.7	90.0	35.1	53.4	142.6	na
	Reference 6					
	May	June	July	August	September	October
Number/L	286.8	180.6	155.7	450.1	422.9	189.1
Biomass (ug d.w./L)	110.0	184.7	29.9	61.3	8.9	74.3
	Turbine 4					
	May	June	July	August	September	October
Number/L	na	118.2	132.6	932.0	100.0	152.4
Biomass (ug d.w./L)	na	108.5	11.2	46.7	11.2	66.0
	Reference 1					
	May	June	July	August	September	October
Number/L	213.3	107.0	107.3	84.4	211.7	156.4
Biomass (ug d.w./L)	52.3	180.4	47.5	17.3	77.0	42.7
	Reference 3					
	May	June	July	August	September	October
Number/L	316.5	248.9	69.2	208.3	189.9	155.3
Biomass (ug d.w./L)	122.9	196.6	27.7	68.3	49.1	40.4
	Reference 5					
	May	June	July	August	September	October
Number/L	453.8	60.3	450.8	383.5	140.6	na
Biomass (ug d.w./L)	134.4	76.4	63.9	120.6	18.3	na