Appendix G8

2015 Habitat Compensation Monitoring Report

MEADOWBANK GOLD MINE

2015 Habitat Compensation Monitoring Report

In Accordance with

DFO Fisheries Authorizations NU-03-0191.2, NU-03-0191.3 and NU-03-0191.4

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EXECUTIVE SUMMARY

According to Fisheries and Oceans Canada (DFO) Authorizations NU-03-0191.2, NU-03-0191.3 and NU-03-0191.4, AEM maintains a Habitat Compensation Monitoring Plan (HCMP; AEM, 2014a) to ensure that fish habitat compensation features are constructed and functioning as intended. Based on the schedule described in the HCMP, monitoring of compensation features currently occurs every 2 years.

In 2015, monitoring was conducted for the constructed spawning pad, located at stream crossing R02 along the all-weather access road (AWAR), as well as for several mine site habitat compensation features (East Dike, Bay-Goose Dike, Dogleg Ponds). As described in the HCMP, the AWAR study included a visual assessment of stability, as well biological monitoring to confirm use by Arctic grayling. The onsite monitoring included an assessment of interstitial water quality, periphyton growth, and fish use.

The constructed spawning pads at stream crossing R02 along the AWAR were visually confirmed to be stable as designed. Generally, condition factors of adult fish, population size distributions and timing of migration were within the range of values seen in previous years, confirming continued use of this area by Arctic grayling. Larval drift rates of collection continue to exceed those observed prior to construction of the spawning pad, suggesting a net positive increase in Arctic grayling reproduction, either through direct increased use or reduced pressure on upstream spawning areas.

Onsite, interstitial water quality within the dike faces met CCME guidelines for aquatic life (with the exception of TSS in one sample), and healthy periphyton community growth with increasing biomass was observed, compared to values from 2013. Angling and underwater motion camera monitoring proved to be a successful non-lethal program that demonstrated continued fish use of the dikes as habitat. CPUE of dike face monitoring stations was similar to or higher than reference stations. A total of 85 fish were caught through angling and there were no mortalities. A total of 32 fish were captured on camera during the underwater motion camera program. Angling in the Dogleg system identified presence of both lake trout and Arctic char in the previously fishless Dogleg North, as well as Arctic char in Dogleg Pond. Bathymetric surveys were not completed, but fish presence in Dogleg North indicates that access to this pond has been established. In particular, presence of char suggests a seasonal connection to Second Portage Lake, since Dogleg Pond and NP-2 were previously determined to be inhabited by lake trout and round whitefish. Water levels and connectivity will be confirmed during the next monitoring event.

Overall, the constructed spawning pads at R02 have not only increased the quantity of high-value habitat, but appear to be effectively increasing production rates in the local population. Angling and underwater camera were found to be effective at demonstrating fish presence, and fish appear to be using habitat created by dikes and diversion channels around the mine site.

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SECTION 1 • INTRODUCTION

1.1 BACKGROUND

In accordance with Fisheries and Oceans Canada (DFO) Authorizations NU-03-0191.2, NU-03-0191.3 and NU-03-0191.4, AEM maintains a Habitat Compensation Monitoring Plan (AEM, 2014a and AEM, 2016) to ensure that fish habitat compensation described in Meadowbank's No Net Loss Plans (Cumberland, 2008; AEM, 2012) is constructed and functioning as intended. This program is carried out as a targeted monitoring plan under the Meadowbank Aquatic Effects Monitoring Program (AEMP).

1.2 SUMMARY OF COMPENSATION FEATURES

Habitat compensation features have been implemented or are planned to be constructed in three general areas: along the All Weather Access Road (NU-0191.2), in the Portage (main minesite) area (NU-03-0191.3), and in the Vault area (NU-03-0191.4). A brief description of habitat compensation features in each area is provided below. Further details are available in the recently submitted revised Draft Habitat Compensation Monitoring Plan (which includes Phaser Pit offsetting measures monitoring) (AEM, 2016).

1.2.1 AWAR Compensation

Construction of the 110 km All Weather Access Road (AWAR) between the Hamlet of Baker Lake and the Meadowbank Mine was completed in the spring of 2008, under DFO Authorization NU-03-0190-2. Four AWAR crossings were found to impact fish-bearing streams, so habitat compensation was required by DFO to account for any potential reductions in productivity.

In 2009, a habitat compensation project consisting of four gravel spawning pads was constructed at crossing R02 according to design specifications that met biological criteria aimed at enhancing Arctic grayling productivity. The construction focused on creating high value spawning and nursery habitat to compensate for the loss of the low and medium value habitat affected by bridge abutment construction at the four crossings.

Per Condition 5 of the Authorization, monitoring studies have been conducted to evaluate fish migrations at the four AWAR crossings where “harmful alteration, disruption or destruction” (HADD) of fish habitat occurred (R02, R06, R09, and R15), and where compensation was implemented (R02). The details of this program are described in the original HCMP (Azimuth, 2007). In 2013, AEM and DFO reviewed the information collected to date, and determined that conditions of the Authorization pertaining to monitoring of HADD sites were fulfilled, and that further monitoring would focus on the habitat compensation features. Updates to the scheduled monitoring activities at R02 were made in 2013 (AEM, 2014a).

1.2.2 Portage Area Compensation

Fish habitat losses in the Portage area are largely due to the dewatering of the northwest arm of Second Portage Lake for the mine's tailings storage facility (TSF), and the Bay-Goose Basin of Third Portage Lake for construction of the Portage and Goose Island pits. These areas were impounded from the rest of their lakes using dewatering dikes constructed from material quarried onsite. Compensation consists largely of re-flooding the de-watered basins, and gains from land-to-lake conversion. Minor gains are achieved through surface water diversion channels which increase the flooded area of the nearby Dogleg Ponds.

1.2.2.1 Bay-Goose Basin Re-Flooding

While the TSF area will be a permanent loss, the Bay-Goose dike will be breached post-closure and the impounded pit areas will be gradually re-flooded to re-gain the temporarily lost habitat.

Prior to re-flooding, a number of habitat improvement measures will be implemented to increase the productive capacity of this area. Construction of a boulder garden feature along the west side of the soft-sediment Bay-Goose Basin will increase habitat suitability in this area. This feature will consist of at least 2.97 ha of heterogeneous, coarse substrate habitat in the <4 m depth zone, just west of the Goose Pit. Construction of mine-related features (pit caps, roads and dikes) from coarse rock material throughout the basin will create shoals and reefs after re-flooding. In addition, approximately 30% of the area of Portage Pit will be partially backfilled reducing the amount of ultra-deep water areas, and increasing habitat suitability in this area.

1.2.2.2 Dogleg Pond Enhancements

Dogleg Pond and the "North Portage" ponds, Dogleg North Pond and NP-2, were isolated ponds located near the waste rock area, just north of Second Portage Lake. Since drainage of NP-2 into Second Portage Lake became blocked by the waste rock pile on the northern edge of the TSF, a connecting channel was excavated to direct flow from NP-2 to Dogleg North, effectively increasing the drainage area of Dogleg and Dogleg North Pond. The accompanying increase in wetted area was estimated at 5% for Dogleg Pond, 15% for Dogleg North Pond (NP-1), and 5% for NP-2. Through construction of a diversion channel, connectivity between the ponds has been improved, and previously inaccessible habitat in Dogleg North Pond has become available for use by lake trout, Arctic char and round whitefish currently inhabiting Dogleg Pond.

1.2.2.3 Finger Dikes

In keeping with the original NNLP, finger dikes will also be constructed on the Bay-Goose Dike extending into Third Portage Lake. These features will provide additional "shoreline" habitat that is used by most species for spawning, and will have a total area of 1 ha at their base.

1.2.3 Vault Area Compensation

Vault Lake, located north of the Portage area, drains into the adjacent Wally Lake, but the connection is not passable to fish. To allow construction of the Vault pit, Vault Lake has been separated from Wally Lake with a dike and has been dewatered.

1.2.3.1 Vault Lake Re-Flooding

Post-closure, Vault Lake will be re-flooded and the connection to Wally Lake re-established with a deeper channel to permit better fish passage. Vault Lake will be expanded by construction of the Vault pit, a portion of which is in a terrestrial zone. Alterations of the basin area outside the pit will improve habitat through the development of shoals and mixed substrate areas.

1.3 OBJECTIVES

The following describes the monitoring objectives for compensation features by location. These objectives are fulfilled according to the methods and schedule described in detail in Section 2, below, and in the HCMP.

1.3.1 AWAR Monitoring Objectives

Based on Condition 5.2 of DFO Authorization NU-03-0190.2, the objectives of the AWAR monitoring program are as follows:

- Assess the stability and successful utilization of all compensation features during the spawning and nursery period for Arctic grayling (Condition 5.2.1)

Additional Conditions pertaining to monitoring of HADD sites were no longer required as per the HCMP (that was designed in consultation with DFO) and as part of the DFO authorization amendment process.

1.3.2 Portage and Vault Area Monitoring Objectives

Based on Condition 6 of DFO Authorizations NU-03-0190.3 and NU-03-0191.4, the objectives of the Portage area monitoring program are as follows:

- Assess the stability and successful utilization of all fish habitat compensation features according to the methodology and schedule detailed in the Habitat Compensation Monitoring Plan

- Provide a photographic record before, during and after construction, during decommissioning and post-restoration to indicate that all works and undertakings have been completed according to the conditions of the Authorization and the NNLP

1.4 SCHEDULE OF MONITORING

Please refer to the schedule of monitoring events from the HCMP (AEM, 2014a). Monitoring activities conducted in 2015 follow the schedule therein.

SECTION 2 • CURRENT-YEAR MONITORING METHODOLOGY

As per the schedule of monitoring events (AEM, 2014a), monitoring was conducted in 2015 for the AWAR compensation feature (Authorization NU-0191.2; Condition 5.2.1) and for the Portage area compensation features (Authorizations NU-0191.3 and NU-0191.4; Condition 6).

A description of the methods used to monitor each habitat compensation feature according to the objectives of DFO Authorizations is provided in the HCMP. Specific details (e.g. dates, locations) and any adjustments to standard methods in the reporting year's monitoring events are described below.

2.1 AWAR MONITORING

2.1.1 Stability

The compensation features were visually assessed to determine general stability in comparison to previous years. In particular, signs of any significant movement of the coarse substrate material used to construct the berms were noted. Significant movement would be identified as any changes prohibiting the berms from functioning as intended to reduce water flow rates and improve spawning habitat in this area.

2.1.2 Larval Drift Traps

In total, 12 larval drift traps (DT) were set at R02 from June 18 – July 17, 2015 (UTM coordinates provided in Table 1; locations shown in Figure 1). Four traps (DT A1 to A4) were upstream of the R02 habitat compensation area. Four traps (DT B1 – B4) were immediately downstream of the R02 habitat compensation, and four traps (DT C1 – C4) were set slightly upstream of the bridge in locations identical to previous and baseline monitoring. Six of the larval drift traps consisted of a square sided cone with a ridged frame that funnelled into a 0.5 mm nitex mesh bag. Attached at the back of the nitex bag was a Nalgene®-type container where the drift was collected. Four traps consisted of a ~60cm x 30cm square frame which has a 0.5 mm nitex mesh bag, attached to a hard plastic container where the drift was collected. One was similarly constructed, with a size of 47 x 30 cm. The frame was submerged at least halfway under water and secured by poles on each side. Drift traps were checked at least every three days, but most commonly every day. Larval drift was identified in the field and preserved in vials of diluted formalin.

Table 1. UTM coordinates for drift traps at R02, 2015. All traps were set from June 18 – July 17, 2015.

Drift Trap ID	GPS Coordinates
A1	14W 0643438
	UTM 7143416
A2	14W 0643452
	UTM 7143426
A3	14W 0643444
	UTM 7143432
A4	14W 0643449
	UTM 7143430
B1	14W 0643682
	UTM 7143529
B2	14W 0643699
	UTM 7143520
B3	14W 0643716
	UTM 7143574
B4	14W 0643728
	UTM 7143540
C1	14W 0643762
	UTM 7143400
C2	14W 0643770
	UTM 7143406
C3	14W 0643778
	UTM 7143412
C4	14W 0643786
	UTM 7143418

2.1.3 Hoopnets

Hoopnets were set upstream of HADD crossing R02 to monitor the passage of fish and evaluate population structure. Nets consisted of either a 4 ft (1.22 m) or 3 ft (0.9 m) diameter front hoop, with interior hoops and traps that prevent fish from escaping but provide enough space for fish to survive. Wings were attached to the front hoop to direct fish into the net. The captured fish were gently removed by field technicians, placed in large tubs filled on location with stream water for biological processing and then placed in a recovery tub. The fish were released up or downstream of the hoopnets, depending on the fish's migration direction. The Animal Use Protocol Report for this work is provided in Appendix A.

Biological processing included:

- measurement of fork length
- measurement of weight using a Pesola field scale (+/-2 to 5 g)
- classification of maturity by gently palpitating the abdomen and visually identifying distinguishable male or female features

Hoopnets were first deployed on June 17, 2015 and were removed on July 17, 2015. Without jeopardizing the safety of the field personnel, the nets were placed in the thalweg of the streams depending on ice-flow conditions and stream velocities, to ensure the maximum effort to capture migrating fish.

Hoopnet locations (Table 2) were selected upstream (R02A) and downstream (R02B) of the constructed spawning pads as in previous years to provide evidence of use of this compensation feature.

Table 2. Approximate hoopnet locations, net orientation (upstream-moving fish, US; downstream-moving fish, DS), dates of deployment and approximate stream coverage at crossings R02 in 2015.

Location	GPS Coordinates	Dates	# Nets		% Coverage
			US	DS	
R02A	14W 0643511	June 17-18	1	0	20
	UTM 7143458	June 18 – 24	1	1	40
		Jun 24 – Jul 2	2	1	60
		Jul 2 – 10	2	2	80
		Jul 10 - 17	3	2	90
R02B	14W 0643745	June 17 - 20	2	0	20
	UTM 7143596	June 20 – 24	2	1	25
		Jun 24 – Jul 17	3	2	35

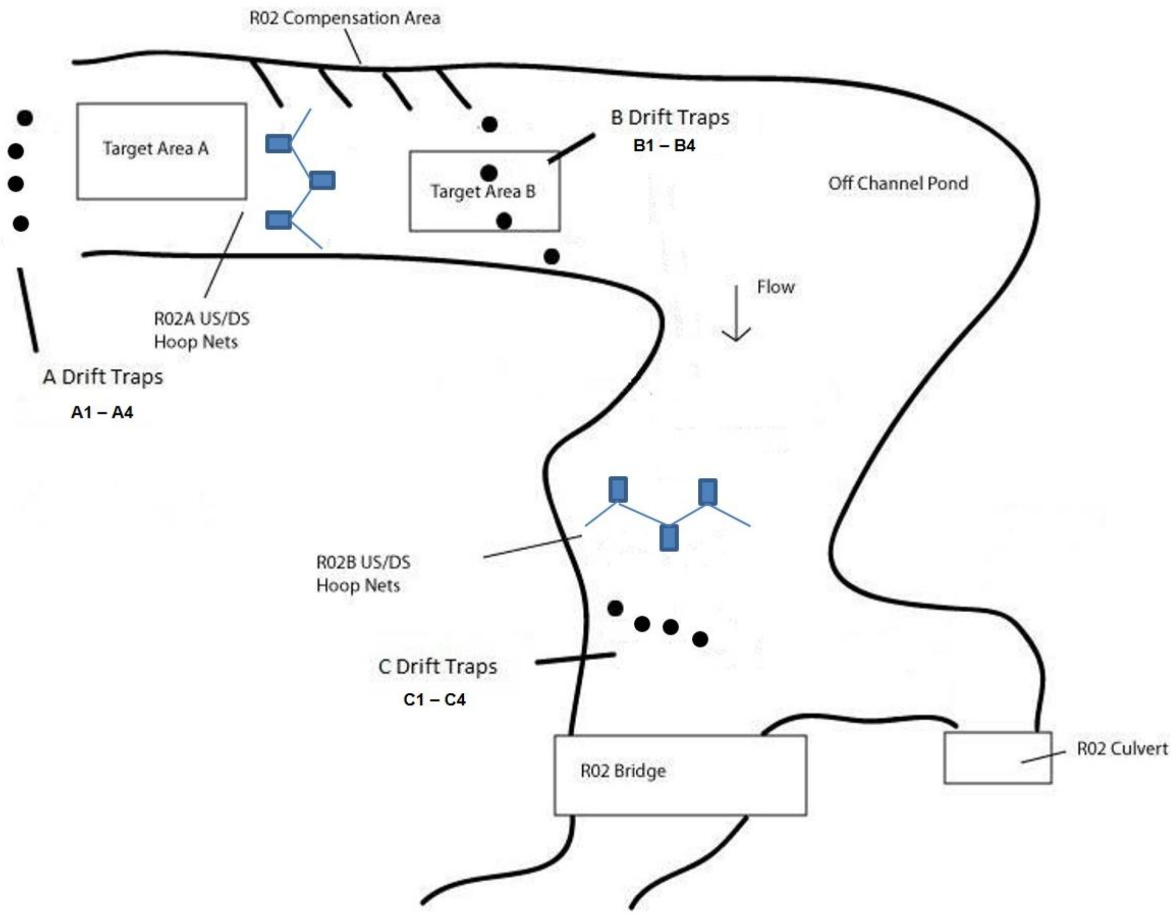

Figure 1. Locations of hoopnets and larval drift traps in 2013 with respect to the R02 habitat compensation feature.

2.1.4 Angling

In addition to the use of hoopnets to survey fish use, a small amount of angling was conducted in target areas around the spawning berms. On each of 6 dates, two anglers completed one hour of angling each by casting small lures with barbless hooks.

2.1.5 Underwater Video

In addition to the use of hoopnets and angling, underwater camera video was taken in attempts to directly identify use of the berms by spawning Arctic grayling. The focus areas for the underwater video cameras were the R02 compensation berms, Target Area A, and Target Area B. Cameras were set between June 27 – July 14, and approximately 24 hours of footage were recorded. Due to the cold water, battery life of each camera was limited to 1.5hrs.

The cameras were deployed in the deeper slow moving water within the spawning berms. The cameras were mounted on a ½" x 12" L shaped piece of rebar which was welded to a 4" x 12" steel "C" beam. The "C" beam acted as a base for the camera mount. A rope with a buoy at one end was attached to the rebar and lowered into the water. The buoy was used a locater once the camera was deployed under water.

2.1.6 Water Temperature

Water temperature measurements were recorded using a standard mercury thermometer. Although these are not a component of compensation monitoring, they help to provide a record of the environmental setting under which migrations are occurring.

2.2 PORTAGE AREA MONITORING

2.2.1 Interstitial Water Quality

Modeling during the EIA process indicated that metals leaching from quarried rock used in dike construction would not significantly impact the aquatic environment. Nevertheless, interstitial water quality of constructed habitat compensation features is assessed through the HCMP to verify predictions.

In order to collect a representative sample from the bioactive zone between the rocks, an electric diaphragm pump with food-grade silicon tubing was used. Samples were taken at depths between 1 and 2 m at previously established locations (Table 3), and analyzed at ALS laboratory for total suspended solids, phosphate, hardness, and total and dissolved metals. Results are compared to background (reference station) concentrations and CCME guidelines where available.

Samples were collected in two locations along the East Dike exterior, and three locations along the Bay-Goose Dike exterior. Sampling locations are shown in Figure 2 and GPS coordinates are provided in Table 3.

Table 3. UTM coordinates for interstitial water sampling locations (approximate locations of underwater video monitoring and angling).

Location	Station ID	UTM Coordinates	Depth
East Dike	ED-PW-1	14W 0639382 7214257	1.8 m
	ED-PW-4	14W 0639381 7213846	1.5 m
Bay Goose Dike	BG-PW-2	14W 0638993 7212783	1.9 m
	BG-PW-4	14W 0639001 7212509	1.6 m
	BG-PW-6	14W 0638592 7211820	1.7 m
Third Portage Lake Reference Station	TPL-REF	14W 0639289 7210860	1.9 m
Second Portage Lake Reference Station	SP-REF	14W 0640510 7213187	1.7 m

QA/QC procedures were followed to ensure that the data collected are representative of the material sampled. Data quality is assured throughout the collection and analysis of samples using standard procedures, certified laboratories and by staffing of trained technicians. A target of 10% field duplicates or at least one sample per event are to be submitted for QA/QC analysis to assess the variability and sample homogeneity for this monitoring program (one duplicate sample was therefore collected for water quality in 2015). Field QA/QC duplicate results were assessed using the relative percent difference (RPD) between measurements: The equation used to calculate a RPD is:

$$RPD= [(A-B)/((A+B)/2)] \times 100$$

As outlined in AEM (2014a) RPDs were considered unacceptable when the RPD value of 50% for concentrations that were greater than 10x the Method Detection Limits (MDL) were exceeded.

2.2.2 Periphyton Growth

Periphyton monitoring was conducted by AEM technicians with the assistance of Azimuth Consulting Group. Methods and detailed results for this component are provided in Appendix B.

2.2.3 Fish Use

Angling and underwater motion camera monitoring was performed by AEM technicians between August 6 and November 22, 2015. Both the angling and underwater motion camera monitoring took place in and around the interstitial water sampling locations, as shown on Figure 1. The Animal Use Protocol Report for this work is provided in Appendix A.

A total angling effort of 42 h was completed. This included 16 h at locations along the East Dike and the Second Portage Lake reference station, 10 h at locations along the Bay-Goose Dike and the Third Portage Lake reference station, and 10 h in Dogleg Pond. All fish caught by angling were recorded, and the majority were weighed, measured, tagged, and released. A small number of fish were not tagged due to a mechanical issue with the tagging gun. To minimize stress, each fish was processed quickly and then released, by holding underwater until it was able to swim away on its own. For Dogleg ponds, all fish were caught using a jigging method with a small jigging spoon with barbless hooks. To prevent minimize stress due to the extreme cold, fish were not weighed or tagged for that area.

This was the first year of underwater motion camera monitoring, and a total effort of 78 h of video footage was collected. This included 28 h in Second Portage Lake (including East Dike stations and reference), 40 h in Third Portage Lake (including the Bay-Goose Dike stations and reference), and 10 h in Dogleg Pond. Cameras were attached to custom-made heavy metal stands (see photos, Appendix C) and lowered by rope by AEM technicians along the face of the dikes and reference areas. Cameras were collected approximately 2 – 4 h later. Due to the cold water temperatures, the battery life on the underwater motion cameras was restricted to 2 h. Furthermore, the steepness of the dike face and the method of deployment resulted in a large proportion of unclear video footage. Several specific problems were noted:

- Camera was not deployed at proper depth creating too much interference from surface water and or wave action which would create sediment disturbance
- Camera had tipped over and or the view was obstructed by rocks
- Camera was not deployed facing the proper direction and so the view was obstructed by rocks and or surface water

These issues are addressed with recommendations for improvements in the next monitoring year in Section 5.

2.2.4 Structure

Design intent of the East and Bay-Goose Dikes was incorporated into the 2012 NNLP and no additional monitoring is planned in the HCMP.

Design intent of the access improvements for the Dogleg system were planned to be monitored beginning in 2015 to confirm whether construction of the diversion channel from NP-2 to Dogleg North is increasing the wetted area of these ponds as assumed, and to confirm the potential for fish movement, especially between Dogleg Pond and Dogleg North Pond.

Planned monitoring included bathymetric surveys to determine the water depth or area of each pond, and an assessment of water depth in connecting channels. These surveys could not be completed in 2015 and will be conducted in the subsequent monitoring year (2017).

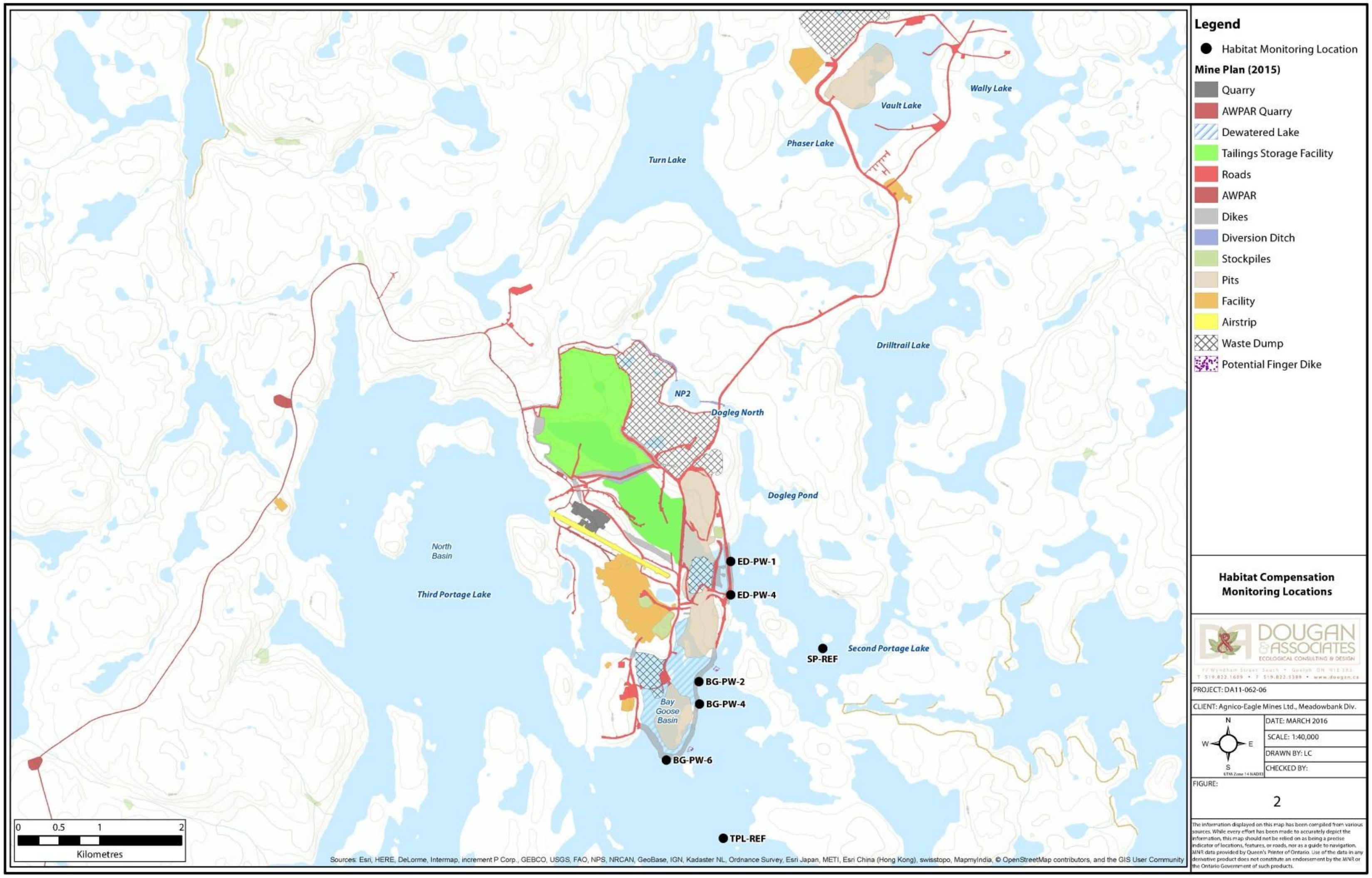

Figure 2. Portage area habitat compensation monitoring locations.

SECTION 3 • RESULTS

3.1 AWAR MONITORING

3.1.1 Stability

Visual observations indicated little movement of the spawning berm material since 2013. The berms appear to be functioning as intended to reduce water flow rates and depths. Gravel substrate on the downstream side of each berm is intact.

3.1.2 Larval Drift Traps

In 2015, 2272 Arctic grayling larvae (young of the year) were collected in the R02 reach studied. As in previous years, the majority of larvae (1091) were collected in traps A1 – A4, which were placed upstream of the compensation area and downstream of natural spawning habitat (Table 4). In total, 675 Arctic grayling larvae were collected in traps B1 – B4, which were located just downstream of the habitat compensation area. Drift traps C1 – C4 were placed further downstream, and collected a total of 506 larvae. Maximum collection in one day occurred at drift trap A4 (94 larvae).

Table 4. Total, daily average and daily maximum catch of Arctic grayling larvae at R02 in 2015.

Drift Trap ID	Total	Average	Max
A1	167	7.6	44
A2	370	16.8	73
A3	237	10.8	48
A4	317	14.4	94
Total	1091		
B1	149	6.8	27
B2	132	6.0	21
B3	237	10.8	46
B4	157	7.5	26
Total	675		
C1	102	4.6	18
C2	127	5.8	22
C3	149	6.8	29
C4	128	5.8	28
Total	506		

Arctic grayling are spring spawners that migrate from lakes and large rivers to smaller streams to spawn over gravel or rocky bottoms (Evans et al. 2002). The literature suggests that spawning occurs between 7 and 10°C (Evans et al. 2002, McPhail and Lindsey, 1970, & Scott and Crossman, 1973). Young are thought to hatch within 16-18 days at water temperatures of 9°C or within 8 to 32 days of water temperature of 15.5°C (McPhail and Lindsey, 1970 and Krueger, 1981). At R02, the peak larval drift catch occurred around June 24 in 2015, when the water temperature was approximately 8 - 9°C (Figure 3). This is similar to 2013, when peak catch occurred on June 22. As was found in previous studies at R02, and contrary to the cited literature, the primary Arctic grayling spawning run may be occurring at temperature less than 5°C, below the ice or immediately at ice off since larvae are always caught immediately upon study initiation.

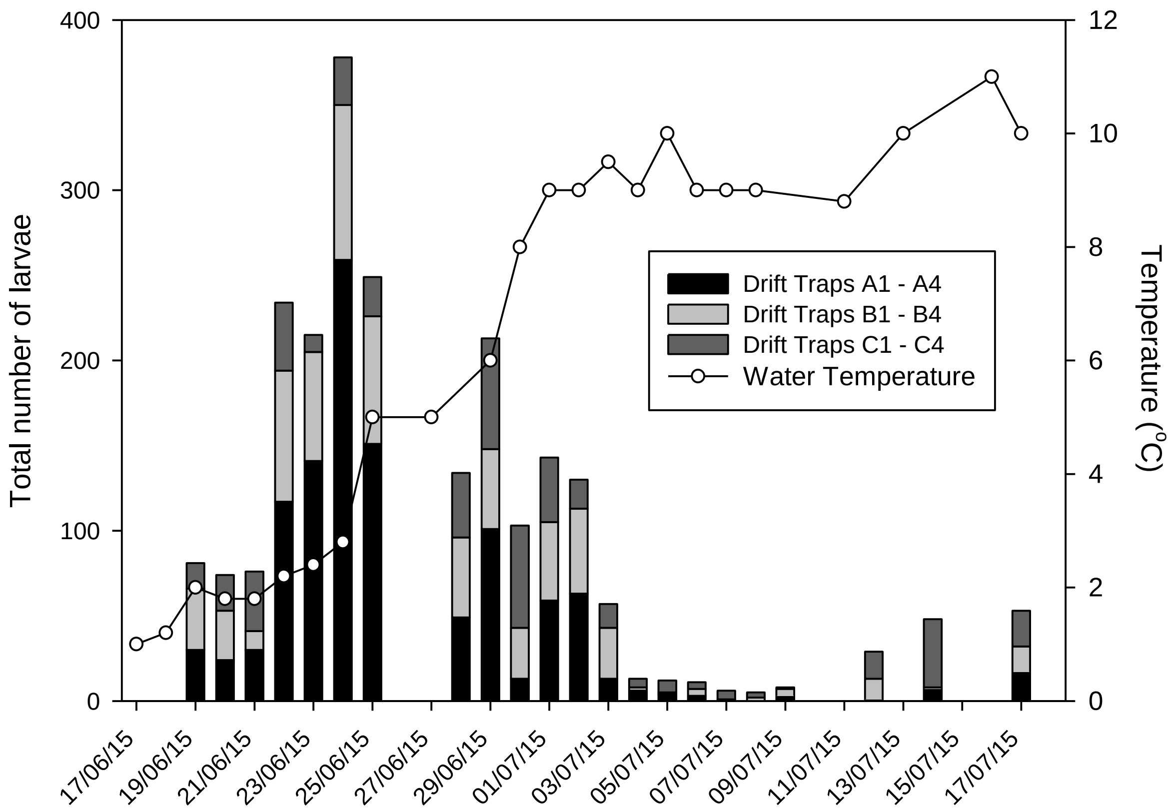

Figure 3. Water temperature and total number of Arctic grayling larvae collected at drift trap areas A, B and C from June 18 – July 17, 2015.

Since 2005, the number of drift traps and dates of monitoring have varied at R02 (Table 5). Therefore, the larval drift observed in annual monitoring programs is best compared if values are standardized to the number of traps and number of days monitored. The trapping period in 2015 was average, with traps set for approximately one month (29 days) from mid-June to mid-July. This is similar to 2006, 2008 and 2011, when the monitoring period was about 24 days during this period. In 2007, 2009 and 2010, the trapping period was extended to late July or early August, and was 37 – 45 days long. In late July of each year, larval drift was essentially reduced to nil, and including these days in the total relative count distorts values in 2007, 2009 and 2010 compared to other years. In order to make a more appropriate comparison, the first 24 days of each monitoring period are examined. In 2005, no Arctic grayling larvae were collected at R02, likely because only one drift trap was set and trapping began at least 5 days later than other years. This is not considered to be a representative sample, so is excluded from the comparison.

Table 5. Summary of larval drift trap sets at R02 from 2005 to 2015.

Drift Traps	2005	2006	2007	2008	2009	2010	2011	2013	2015
Date in	Jun 29	Jun 24	Jun 23	Jun 21	Jun 24	Jun 24	Jun 22	Jun 14	Jun 18
Date out	Jul 17	Jul 19	Jul 29	Jul 16	Aug 07	Aug 01	Jul 17	Jun 29	Jul 17
Max # traps	1	2	7	8	9	12	12	9	12
# trap days	19	46	259	160	405	468	288	117	348

Total catch per trap day in 2015 was slightly higher than previous years indicating increased spawning within this stream reach (Figure 4).

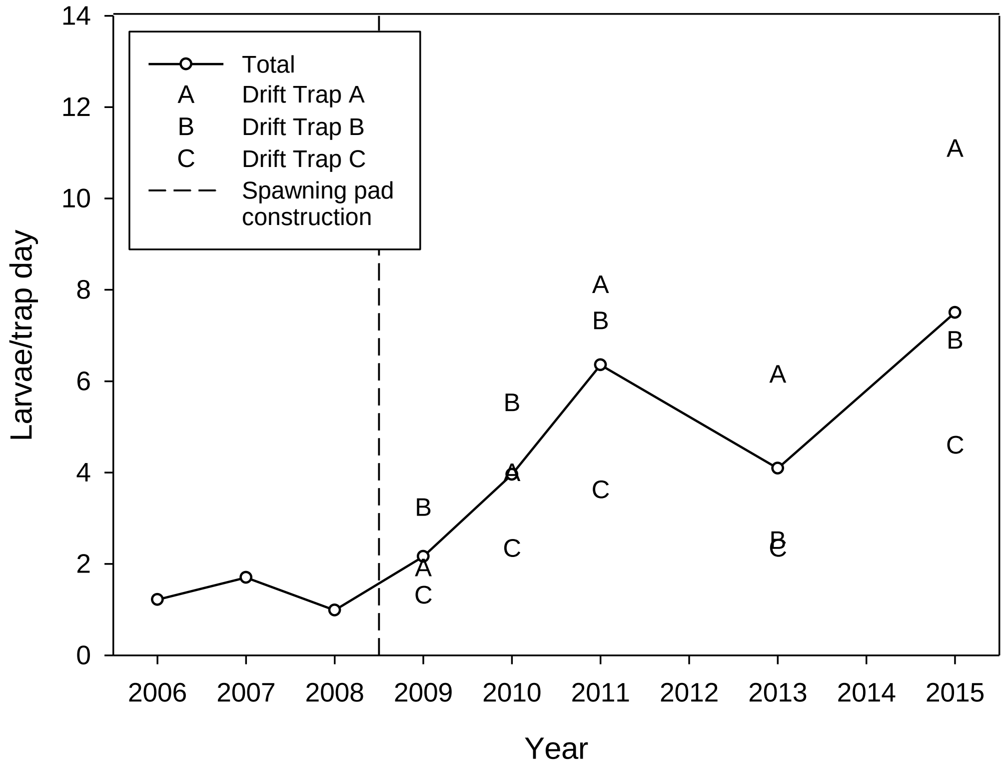

Figure 4. Total relative larval drift count (# larvae/trap day for the first 24 study days), and relative larval drift count upstream and downstream of the constructed spawning pad area at R02 from 2006 to 2015.

3.1.3 Hoopnets and Angling

3.1.3.1 Total Catch

All records of hoopnet and angling catch are provided in Appendix D. As in the past, the predominant species of adult fish collected in 2015 along the AWAR were Arctic grayling (*Thymallus arcticus*) (73 fish). Four of these fish were captured through angling. Several round whitefish (*Prosopium cylindraceum)* and lake trout (*Salvelinus namaycush)* were caught, as well as one burbot. A summary of the total number of adult fish collected is provided in Table 5. Since Arctic grayling are the primary species of concern in this study, the majority of the data analysis includes only individuals of that species (as indicated).

Table 6. Total number of fish collected by species.

Species	Total Catch
Arctic Grayling	73
Lake Trout	2
Round Whitefish	16
Burbot	1
Total	92

By standardizing the catch to the number of nets or % stream coverage and number of days fished, a cursory comparison of inter-annual trends can be performed. It should be noted, however, that longer study periods involve a greater proportion of days on which fewer fish are migrating. If the study continues beyond the actual migration period, the total number of fish per unit effort is reduced when compared with shorter studies conducted only while migration is occurring. This potentially confounding factor is not taken into account here.

Study effort in 2015 was similar to 2009, 2010, and 2011, with up to 10 nets deployed over the one-month study period resulting in 237 net-days (Table 7). Catch per unit effort based on % stream coverage in 2015 was also similar to 2009, 2010, and 2011 (Figure 5). As indicated above, this metric describes the overall catch per unit effort, or the catch efficiency, and is not necessarily an accurate description of the total migrating population. Since Arctic grayling migrate during a certain time frame, it is expected that fish caught per unit of stream coverage will decrease if timing of maximum effort does not coincide with peak migration. In 2015, maximum effort (up to 10 nets and 90% stream coverage) occurred towards mid-July, which is considered to be the tail of the migration, whereas in previous years, coverage was substantially higher earlier in the study period (e.g. up to 75% in June 2011 and 2013, compared to 20-60% in 2015 at R02A) when fish are generally considered most active due to lower water temperatures. The peak efficiency observed in 2013 was likely a result of a high proportion of coverage and a short study timeline. These trends will continue to be monitored in subsequent years in order to assist in timing the study to maximize efficiency.

Table 7. Summary of dates and number of nets (upstream and downstream) used at R02 from 2005 to 2015.

Hoop Nets	2005	2006	2007	2008	2009	2010	2011	2013	2015
Date in	Jun 29	Jun 24	Jun 24	Jun 17	Jun 26	Jun 25	Jun 24	Jun 14	Jun 17
Date out	Jul 18	Jul 19	Jul 20	Jul 16	Aug 02	Aug 01	Jul 19	Jun 29	Jul 17
Max # nets	2	2	5	4	9	7	9	10	10
# net days	42	50	132	124	234	227	219	122	237

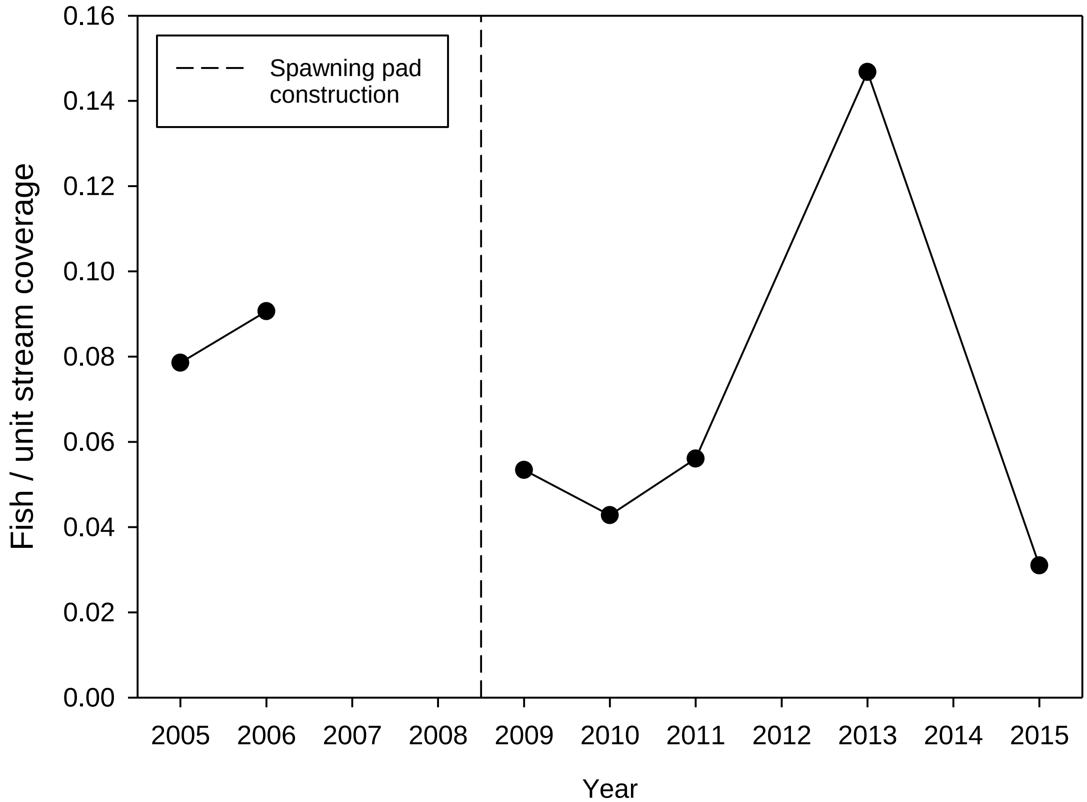

Figure 5. Number of fish captured per unit of stream coverage (% coverage x days) at R02 from 2005 to 2015.

3.1.3.2 Movements

A total of 27 Arctic grayling were captured moving upstream and 46 moving downstream. Fish were caught on the first sampling day (June 18), when temperatures were 1.2°C. The lowest water temperature observed was 1°C (June 17). The bi-modal distribution of captures over time observed in previous years was not as distinct in 2015 (Figure 6), potentially due to the lower total stream coverage and overall catch.

Peak larval drift (June 24; Section 3.1) occurred five days prior to the observed peak adult migration (June 29), indicating that although large mature fish were still moving upstream during the collection period, migration and spawning also occurred prior to the study initiation (likely under the ice or immediately at ice-off).

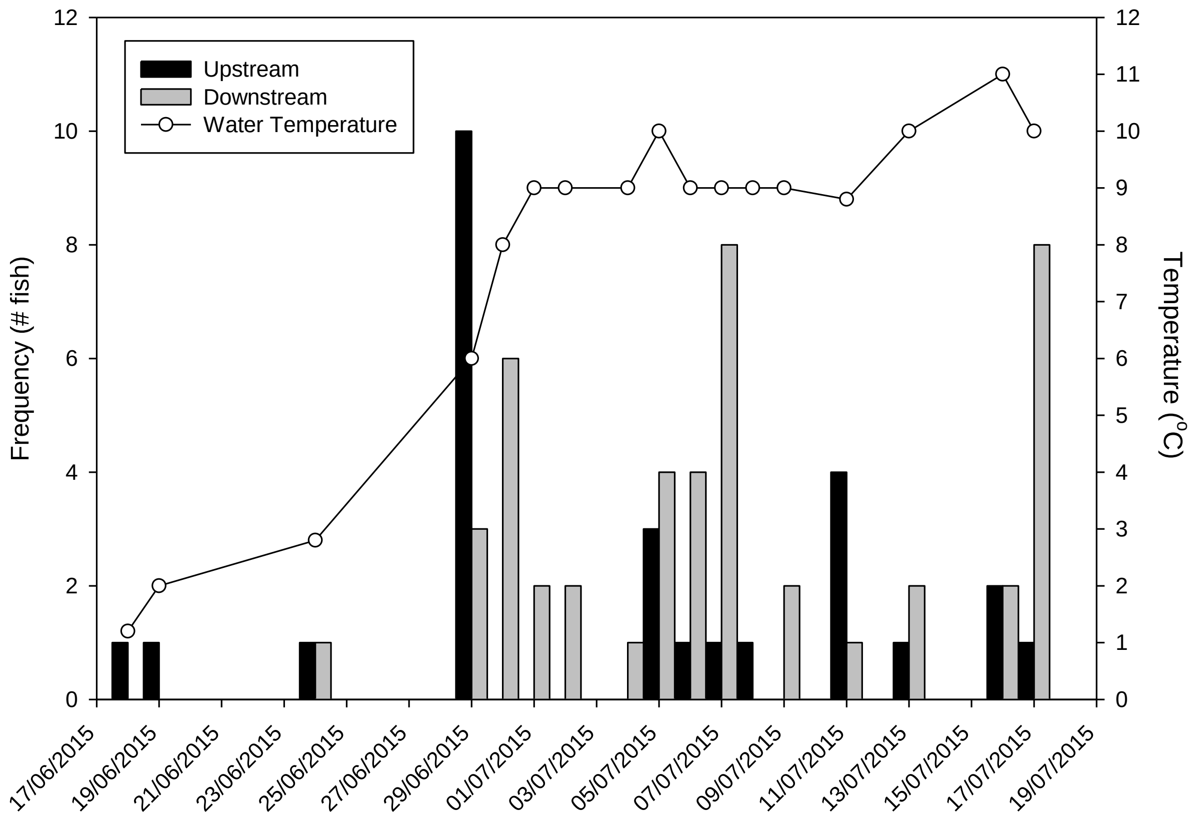

Figure 6. Upstream and downstream movements of Arctic grayling at R02 in 2015.

The R02 nets were set in two locations - just upstream (R02A) and downstream of the habitat compensation area (R02B). As in previous years, more fish (51) were collected at R02A than R02B (22) (see Table 8), potentially due to the higher proportion of stream coverage at this location (Section 2.1.3).

Table 8. Upstream and downstream movements of Arctic grayling by net location since 2010.

R02 Hoopnet ID	Fish Movement	2010	2011	2013	2015
A	US	61	175	81	19
	DS	58	13	41	32
B	US	103	25	33	8
	DS	8	16	5	14
C	US	3	1		
	DS	11	25		
Total	US	167	201	114	27
	DS	77	54	46	46

3.1.3.3 Condition Factor

Table 8 provides a summary of the average, maximum and minimum length and weight, and the average condition factor of Arctic grayling collected. Lengths and weights are similar to previous years. The average condition factor (K) was greater than 1.00, which demonstrates a healthy population.**Error! Reference source not found.** Two fish were lost in transfer rior to recording data, and weight was omitted for one fish, resulting in a sample size of 70 fish.

Table 9. Average, maximum and minimum Arctic grayling length, weight and average condition factor (K).

	Length (mm)			Weight (g)			K*
n	Avg	Max	Min	Avg	Max	Min	Avg
70	278	370	210	243	575	85	1.10

* K = (weight/((length/10)^3)) x 100

Condition factors for years 2006 – 2015 are shown in Figure 7. Condition factor and variability are similar to previous years.

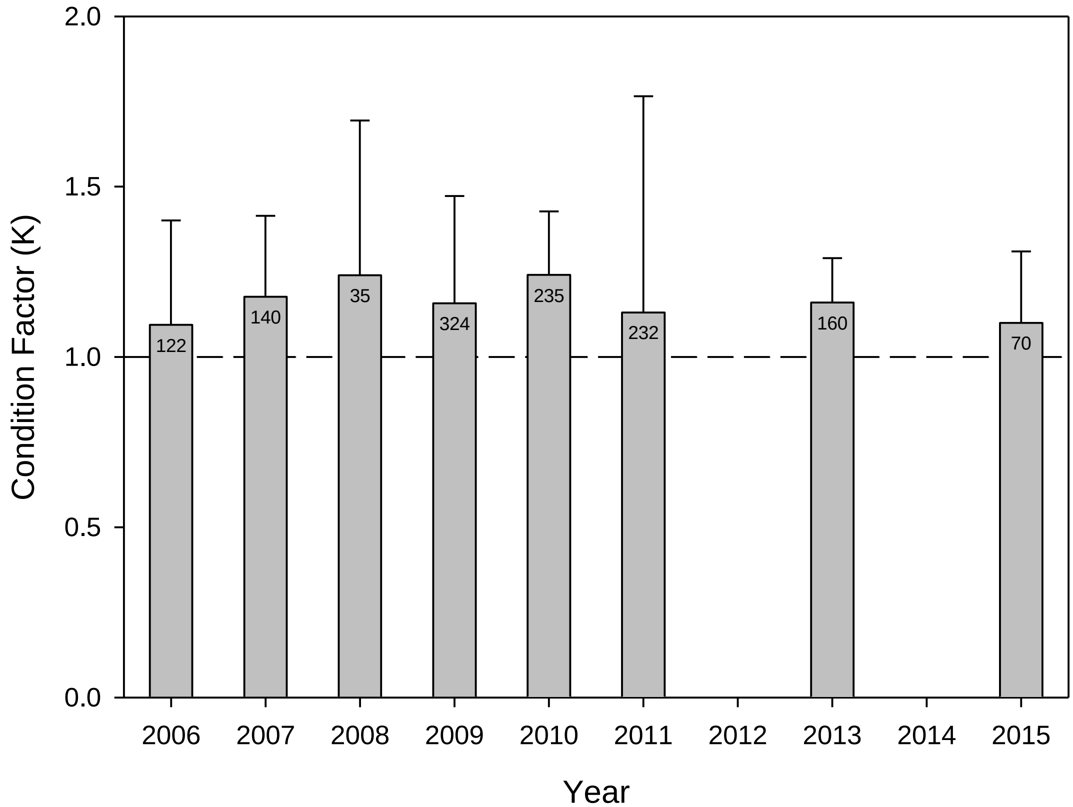

Figure 7. Average condition factor of Arctic grayling captured at R02. Error bars indicate standard deviation. Values indicate total number of fish.

3.1.3.4 Size Distribution and Maturity

As in the past, the length-frequency distribution (Figure 8) of fish collected at R02 is approximately normally distributed with the largest number of fish collected in the 300-319 mm size class (16 fish). This data demonstrates that recruitment is occurring as would be expected.

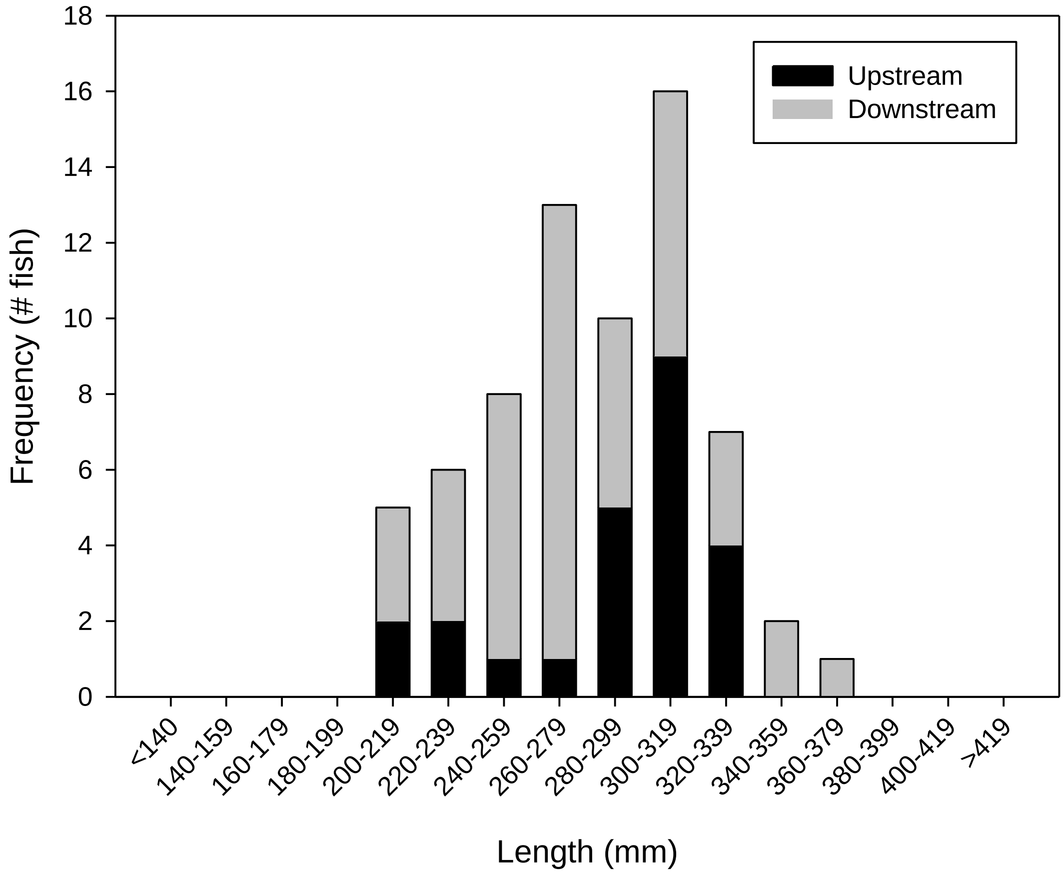

Figure 8. Length-frequency distribution of Arctic grayling captured at R02 in 2015.

The total numbers of male and female fish captured by spawning classification are shown in Table 10. Numbers of male and female fish were approximately equal.

Table 10. Number of fish by spawning classification caught at R02 in 2015.

Classification	Catch
Female	*Total = 30*
Immature	3
Ready	11
Waiting	4
Spent	13
Male	*Total = 36*
Immature	7
Ready	12
Waiting	10
Spent	0
Unknown	7
Unknown	7

3.1.3.5 Current Year Recaptures

Floy tags are commonly used to provide population density measurements, but they are also very useful in tracking the activities of migrating fish. Table 11 provides the results of the current year tagging program, or “recaptures” at each crossing. In 2015, 3 fish were re-captured at R02 including one round whitefish (tag 70). The other two were spawning females.

Table 11. Arctic grayling captured and re-captured in the current year at R02.

Fish	Date Collected	Net	US/DS	Tag #	Length	Weight	Sex	Maturity
1	6/29/15	R02A	US	7	320	290	F	ripe
	7/17/15	R02A	DS	7	320	260	F	ripe
2	6/30/15	R02B	DS	23	275	230	F	spent
	7/05/15	R02B	US	23	275	210	F	ripe
3	6/30/15	R02A	DS	70	310	270	-	-
	7/06/15	R02A	DS	70	310	270	-	-

3.1.3.6 Previous Year Recaptures

In 2015, one fish caught at R02 as a previous year recapture (Table 12). This fish was previously captured at R02 on June 18, 2013. It has gained approximately 56 mm in length and 15 g in weight.

Table 12. Arctic grayling captured in 2015 that were captured in previous years.

Fish	Date	US/DS	Tag #	Length	Weight	Sex	Maturity
1	6/29/15	US	102346	350	305	F	spent

3.1.4 Underwater Video

No fish were captured on underwater camera during the monitoring period. However, approximately 6 of the 24 hours of recording did not contain high enough quality footage to make observations. After some troubleshooting, it was determined that the underwater camera needs to be set at least 2 ft below the surface to record decent video footage. Even at this depth, the video footage can be poor due to the high surface water disturbance (current, waves, sunlight). To reduce the amount of poor quality video footage, a low profile mount will be built for each camera. With the low profile mount the camera will be able to sit on the floor of the riverbed where surface water disturbance will be less of an issue.

3.2 PORTAGE AREA MONITORING

3.2.1 Interstitial Water Quality

3.2.1.1 Results

Analytical results of the interstitial water quality sampling are provided in Appendix E with CCME Water Quality Guidelines for the Protection of Aquatic Life (2007). During sampling, care was taken not to disturb sediment, but TSS was elevated (15 mg/L) compared to the CCME guideline (6 mg/L) and previous results (4.8 mg/L) at Bay-Goose Station 4, suggesting sediment may have become suspended during sampling. TSS at all other stations was below detection limits (1 mg/L) except for the Second Portage Lake reference site (2.3 mg/L).

No other values exceeded the CCME guidelines, and overall results for dike stations were similar to reference stations. These results indicate that the water quality in the interstitial spaces along the East Dike and Bay-Goose Dike continues to be suitable for egg incubation and periphyton growth.

3.2.1.2 QA/QC

All laboratory analyses were completed by ALS Laboratories: Vancouver, B.C. which is an accredited laboratory by the Canadian Association for Laboratories Accreditation (CALA) Inc. The results met laboratory QA/QC internal data quality objectives for precision and completeness. During the interstitial water quality sampling, one duplicate sample was taken. The field QA/QC results are summarized in Appendix E. The results of this evaluation indicate a high level of consistency between the original field sample and the field duplicate sample. None of the samples exceeded an RPD of 50% for concentrations that were greater than 10x the Method Detection Limits (MDL).

3.2.2 Periphyton Growth

Results for this component are provided in Appendix B. The results indicate that periphyton community succession has progressed from diatom-dominated early-stage communities to a more heterogeneous mix of cyanobacteria, diatoms and to a lesser extent, chlorophyte taxa. Biomass has also steadily increased on the dike faces. This year-over-year increase in biomass and abundance demonstrates a healthy establishment of the periphyton community.

3.2.3 Fish Use

Unlike previous years, analysis of fish use of the habitat compensation features (dike faces and Dogleg Ponds) was assessed through the minimally invasive techniques of angling and underwater motion video prescribed in the 2014 HCMP. This proved to be a successful non-lethal program which demonstrated continued fish presence in and around the study areas.

3.2.3.1 Angling

A total of 85 fish were caught through angling (10 were lost in transfer) and there were no mortalities. Fishing effort was varied between 2 – 6 hr per station, and catch per unit effort (CPUE) was similar in all cases, or slightly higher at dike stations compared to reference stations (Table 13), indicating that fish use of dike face habitat is not reduced compared to reference stations, which was also observed in 2011.

Table 13. Angling time, # fish caught and catch per unit effort (CPUE) per station.

Station	# Fish	Time	CPUE
BG-2	10	4	2.5
BG-4	11	6	1.8
BG-6	13	6	2.2
TPL-REF	0	2	0.0
ED-2	14	6	2.3
ED-4	13	4	3.3
SP-REF	16	6	2.7

A summary of the fishing effort and data recorded for each fish is provided in Tables 14 - 16.

For Third Portage Lake, a total of 34 fish were caught in 16 h of angling. All fish were captured at Bay-Goose dike stations, and none at the reference station. One fish (tag 98357) was previously captured. The majority of fish caught were lake trout, with two Arctic char and three fish lost in transfer prior to recording data.

For Second Portage Lake, a total of 43 fish were caught in 16 h of angling. Of these, 16 fish were caught at the reference station. All fish were lake trout.

Table 14. Summary of fish caught through angling at HCMP stations along the Bay-Goose Dike.

Date	Water Temperature (°C)	Station	Fish #	Tag #	Fork Length (mm)	Weight (g)	Species
8/06/15	10	BG-2	1	-	310	-	Lake Trout
8/06/15	10	BG-2	2	-	-	-	-
8/06/15	10	BG-4	3	-	-	-	Lake Trout
8/08/15	10	BG-4	4	-	370	480	Lake Trout
8/08/15	10	BG-4	5	-	430	510	Lake Trout
8/09/15	10.4	BG-6	6	-	-	-	Lake Trout
8/09/15	10.4	BG-6	7	-	-	-	Lake Trout
8/10/15	10.1	BG-6	8	-	368	450	Lake Trout
8/10/15	10.1	BG-6	9	-	430	500	Lake Trout
8/10/15	10.1	BG-6	10	-	452	520	Lake Trout
8/10/15	10.1	BG-6	11	-	490	610	Lake Trout
9/09/15	9.4	BG-2	12	98357	667	2720	Lake Trout
9/09/15	9.4	BG-2	13	102934	425	816	Lake Trout
9/09/15	9.4	BG-2	14	102935	530	1770	Lake Trout
9/09/15	9.4	BG-4	15	102936	510	1590	Lake Trout
9/09/15	9.4	BG-4	16	-	-	-	-
9/09/15	9.2	BG-6	17	102938	380	680	Lake Trout
9/09/15	9.2	BG-6	18	-	540	1315	Lake Trout
9/09/15	9.2	BG-6	19	-	550	1815	Lake Trout
9/09/15	9.2	BG-6	20	-	570	1680	Lake Trout
9/09/15	9.2	BG-6	21	-	-	-	-
9/11/15	9	BG-4	22	28	610	2720	Arctic Char
9/11/15	9	BG-4	23	29	605	1590	Lake Trout
9/11/15	9	BG-4	24	31	680	2950	Lake Trout
9/11/15	9	BG-4	25	32	630	2270	Lake Trout
9/11/15	9	BG-2	26	33	405	1.5	Lake Trout
9/11/15	9	BG-2	27	34	648	2490	Arctic Char
9/11/15	9	BG-2	28	36	483	680	Lake Trout
9/15/15	8.8	BG-4	29	38	572	1815	Lake Trout
9/16/15	8.7	BG-2	30	39	432	680	Lake Trout
9/16/15	8.7	BG-2	31	40	635	1590	Lake Trout
9/16/15	8.7	BG-4	32	43	559	1135	Lake Trout
9/16/15	8.7	BG-6	33	44	788	4535	Lake Trout
9/18/15	8.90	BG-6	34	45	521	1360	Lake Trout

Table 15. Summary of fish caught through angling at HCMP stations along the East Dike and Second Portage Lake reference station.

Date	Water Temperature (°C)	Station	Fish #	Tag #	Fork Length (mm)	Weight (g)	Species
8/08/15	12	ED-2	1	-	376	490	Lake Trout
8/08/15	12	ED-2	2	-	510	600	Lake Trout
8/08/15	12	ED-2	3	-	320	400	Lake Trout
8/08/15	12	ED-4	4	-	295	390	Lake Trout
8/08/15	12	ED-4	5	-	-	-	-
8/08/15	12	ED-4	6	-	-	-	-

Date	Water Temperature (°C)	Station	Fish #	Tag #	Fork Length (mm)	Weight (g)	Species
8/08/15	12	ED-4	7	-	380	480	Lake Trout
8/08/15	12	ED-4	8	-	345	470	Lake Trout
8/10/15	12	ED-2	9	-	-	-	Lake Trout
8/10/15	12	SP-REF	10	102871	365	400	Lake Trout
8/10/15	12	SP-REF	11	102870	780	3630	Lake Trout
8/10/15	12	SP-REF	12	102869	447	750	Lake Trout
8/10/15	12	SP-REF	13	102868	434	550	Lake Trout
8/12/15	12.6	ED-4	14	102866	330	450	Lake Trout
8/12/15	12.6	ED-4	15	-	-	-	-
8/12/15	12.6	ED-4	16	102865	337	260	Lake Trout
8/12/15	12.6	ED-2	17	102864	290	250	Lake Trout
8/12/15	12.6	ED-2	18	-	475	700	Lake Trout
9/02/15	10.4	SP-REF	19	102863	400	750	Lake Trout
9/02/15	10.4	SP-REF	20	102862	410	775	Lake Trout
9/02/15	10.4	SP-REF	21	-	-	-	
9/02/15	10.4	SP-REF	22	102861	420	700	Lake Trout
9/02/15	10.4	SP-REF	23	102860	380	510	Lake Trout
9/02/15	10.4	SP-REF	24	102859	410	950	Lake Trout
9/02/15	10.2	ED-2	25	102858	770	4535	Lake Trout
9/02/15	10.4	ED-2	26	102857	580	1700	Lake Trout
9/02/15	10.4	ED-4	27	-	475	1250	Lake Trout
9/02/15	10.4	ED-4	28	102856	380	570	Lake Trout
9/06/15	9.8	ED-2	29	102855	434	910	Lake Trout
9/06/15	9.8	ED-2	30	102854	799	4990	Lake Trout
9/06/15	9.8	ED-2	31	102853	329	585	Lake Trout
9/06/15	9.9	SP-REF	32	102852	476	1360	Lake Trout
9/06/15	9.9	SP-REF	33	102851	470	1360	Lake Trout
9/06/15	9.9	SP-REF	34	-	400	910	Lake Trout
9/06/15	9.9	SP-REF	35	102930	480	1250	Lake Trout
9/06/15	9.9	SP-REF	36	102931	446	1090	Lake Trout
9/06/15	9.9	SP-REF	37	102932	443	910	Lake Trout
9/09/15	9.4	ED-2	38	-	395	520	Lake Trout
9/09/15	9.4	ED-2	39	-	290	380	Lake Trout
9/09/15	9.4	ED-2	40	-	460	980	Lake Trout
9/09/15	9.4	ED-4	41	-	315	410	Lake Trout
9/09/15	9.4	ED-4	42	-	385	450	Lake Trout
9/09/15	9.4	ED-4	43	-	480	1050	Lake Trout

Length-frequency distributions for lake trout in each location are provided in Figure 9. While the small number of fish caught precludes substantial analysis of this data, size classes containing the greatest number of fish per station were similar, suggesting that dike face habitat is not used only by smaller less competitive fish.

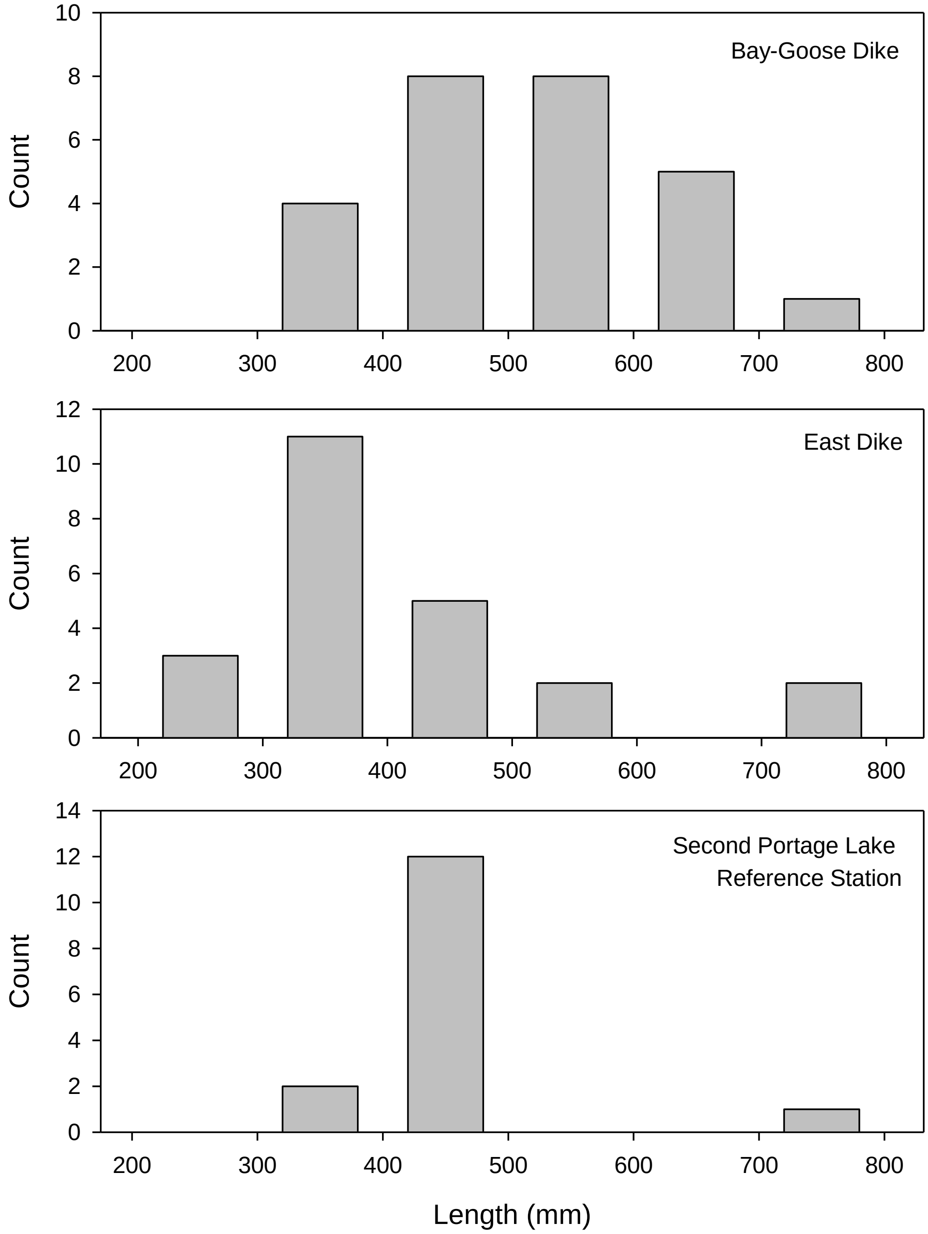

Figure 9. Length-frequency distribution of lake trout captured through angling in Second and Third Portage Lakes in 2015. No fish were caught at the Third Portage Lake reference station.

Two fish were caught in Dogleg Pond (Table 16) with 6.5 h of effort. Both fish were Arctic char, which have not previously been identified in this pond. An additional 4 fish (2 Arctic char and 2 lake trout) were caught in Dogleg North Pond with 2.5 h of effort. Dogleg North Pond was previously determined to be fishless (see 2012 NNLP) and access to this habitat for lake trout and round whitefish was identified as part of the onsite habitat compensation through construction of a diversion channel from NP-2 Pond, which occurred in 2013. These results therefore indicate that the planned compensation was successful at providing access to habitat in Dogleg North Pond (NP-1) for lake trout. While it was suggested that Arctic char may also eventually inhabit this pond, they were conservatively excluded from habitat compensation calculations for the Dogleg system, as they were not identified in these ponds despite fish surveys in 2003, 2010, 2011 and 2012. However, it was suggested that Arctic char may eventually access this area from Second Portage Lake. During the next monitoring event, the channel connecting Dogleg Pond to Second Portage Lake will be observed to determine whether fish passage is now possible.

Table 16. Summary of fish caught through angling in Dogleg Pond and Dogleg North Pond in 2015.

Location	Date	Fish #	Length	Species
Dogleg Pond	10/30/15	1	430	Arctic Char
	10/31/15	2	458	Arctic Char
Dogleg North Pond (NP- 1)	11/04/15	1	488	Arctic Char
		2	431	Arctic Char
		3	280	Lake Trout
	11/22/15	4	370	Lake Trout

3.2.3.2 Underwater Camera

A total of 32 fish were captured on camera during the underwater motion camera monitoring program. See photo stills, Appendix C. All species were identified as lake trout. The most fish were captured on camera at BG-4 (16 fish). The current software program did not allow determination of weight, length or sex. The number of fish observed in each location are provided in Table 17.

Table 17. Dates and # fish captured on underwater camera at Portage area monitoring stations.

Station	Date	Species	# of Fish Captured on Camera
ED-2	8/09/15	Lake trout	1
	9/02/15	Lake trout	1
	9/05/15	Lake trout	2
ED-4	8/09/15	Lake trout	1
	9/06/15	Lake trout	1
SP-REF	8/12/15	Lake trout	1
	9/02/15	Lake trout	1
	9/06/15	Lake trout	1
BG-2	9/18/15	Lake trout	3
	9/22/15	Lake trout	1

BG-4	9/15/15	Lake trout	9
	9/18/15	Lake trout	7
BG-6	9/18/15	Lake trout	3
TPL-REF	-	-	0

SECTION 4 • SUMMARY

4.1 AWAR MONITORING

The intention of the constructed spawning pad feature was to decrease flow rates and water depths, and provide suitable substrate for Arctic grayling spawning. Stability of the feature was visually confirmed, with minor shifting of material as anticipated at construction.

Data collected in 2015 indicate that fish migrating at R02 continue to have a well distributed population structure (greatest number of fish in the middle size class) and are generally a good body weight (K > 1). Sex and maturity distribution is also similar to previous years for comparable water temperatures. The number of fish caught per unit effort (% stream coverage) was in the range of CPUE observed in previous years with similar study designs (2009 – 2011). These data confirm continued use of the R02 reach by Arctic grayling.

In the HCMP, no specific criteria are established for determining success of the spawning pads constructed at R02 based on fish use metrics (hoopnet catch, larval drift). Although the successful utilization of the spawning pads is difficult to quantify, the larval drift data collected in 2015 continues to provide evidence of increased Arctic grayling spawning in this reach since construction occurred. Comparing equal catch per unit effort, the number of larvae caught throughout the R02 reach has increased since 2009. Overall, the constructed spawning pads have not only increased the quantity of high-value habitat, but appear to be effectively increasing production rates in the local population.

4.2 PORTAGE AREA MONITORING

As described in Meadowbank's 2012 NNLP, outer faces of the dewatering dikes (Bay Goose and East Dike) are assumed to provide simulated reef habitat for fish in Second and Third Portage Lakes. Monitoring goals for these features as described in the HCMP include assessment of interstitial water quality, periphyton growth and fish use every two years, initially. In 2015, interstitial water quality met CCME guidelines with the exception of TSS at one location (likely due to disturbance during sampling). Periphyton coverage continues to develop compared to values observed in 2011, indicating healthy periphyton community growth with increasing biomass. Fish use of habitat in and around the dike faces was confirmed, and data did not indicate usage was any lower than reference stations. Angling with barbless hooks and underwater motion cameras were determined to be a viable and non-lethal approach to confirming fish presence.

Construction of a diversion channel between NP-2 and Dogleg Pond North was planned to result in slightly increased water levels, provide improved connectivity between these ponds, and especially to open previously inaccessible habitat in Dogleg North Pond (NP-1) for use by lake trout and round whitefish from Dogleg Pond and NP-2. It was noted that eventually these ponds may be seasonally accessible from Second Portage Lake, theoretically providing access for Arctic char. However, access for char was conservatively excluded from habitat gain calculations. Fish use of Dogleg North was confirmed in 2015 through angling surveys, which also indicated presence of Arctic char in both Dogleg North and Dogleg Pond. Bathymetric surveys were not completed, but presence of char suggests a seasonal connection to Second Portage Lake has been established. Water levels and connectivity will be confirmed during the next monitoring event.

SECTION 5 • ACTIONS

5.1 AWAR MONITORING

The following actions were planned for 2015. AEM's responses are indicated below each action.

- Hoop nets and larval drift traps should be set as early as possible and kept in the stream for no less than 4 weeks. This will ensure that Arctic grayling are captured through the end of the upstream migration and nearly all of the downstream migration, and will provide the best possible inter-annual comparison of data.
    - Hoop nets and drift traps were set at ice-off (as early as possible) and maintained for 4 weeks.
- Additional drift traps should be purchased to maintain a consistent larval drift count effort in each area.
    - Additional drift traps were purchased so that 4 traps were maintained in each area.

The following actions are recommended for AWAR monitoring in 2017:

- To reduce the amount of poor quality video footage, a low profile mount will be built for each camera.

5.2 PORTAGE AREA MONITORING

The following actions are recommended for subsequent Portage area monitoring events:

- Revise underwater motion camera methods to improve proportion of usable footage.

- Investigate software to facilitate video processing and potentially allow a more precise identification of fish species.
- Conduct surveys of water levels in the Dogleg system to determine any increase in wetted area.
- Assess flow in connecting channels within the Dogleg system to confirm potential for improved fish passage.
- Record angling effort specifically by monitoring station to facilitate catch-per-unit effort calculations.

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APPENDIX A

Animal Use Protocol Report

Pêches et Océans Canada | Fisheries and Oceans Canada

Freshwater Institute Animal Care Committee
Animal Use Protocol Report Form

AUP #:	**FWI-ACC-2015 - 021**
Project Title:	Meadowbank Mine: Fisheries Habitat Compensation Monitoring (All-Weather Access Road (AWAR) and Mine Site Authorization Monitoring
Was this project new or a renewal?	Renewal
Last Year's AUP # (if applicable):	FWI-ACC-2013-033
Project Lead: **Phone** **E-mail**	Jeffrey Pratt 819-759-3555 Ext.3928 Jeffrey.pratt@agnicoeagle.com
Contact Person: **Phone** **E-mail**	Jeffrey Pratt 819-759-3555 Ext.3928 Jeffrey.pratt@agnicoeagle.com
Project end date:	November 30th 2015

1. Did the project deviate from the approved AUP?

No, the project did not deviate from the approved AUP.

2. Fill the chart out below, per species

	Numbers Approved in AUP		**Actual Numbers**		
Species	**Live sampled and released**	**Dead sampled**	**Live sampled and released, AUP approved**	**Dead sampled, AUP approved**	**Euthanized due to injury from capture**
Arctic Grayling	200	50	64	5	0
Lake Trout	200	Near Zero	72	0	0
Whitefish			15	0	0
Arctic Char			6	0	0
Burbot			1	0	0

3. if you did not euthanize any animals or have any mortalities, skip to question 4.
a. Describe how the animal died during capture?

There were 5 unexpected mortalities in total. The arctic grayling mortalities were small fish (year 1-2). They were the result of incidental injury in an attempt to escape through the hoop net mesh.

b. What were the causes?

The arctic grayling were caught in the fine mesh nets and did not survive.

c. Where these mortalities expected?

In previous years, a number of smaller grayling have been caught in the hoop net mesh.

d. What methods could be changed to decrease death to animals?

Smaller hoop nets have been purchased for future use. They also have smaller mesh size. This should optimize net deployment and contribute to a lower number of small fish getting caught in the nets.

AEM's method could be changed to decrease death to fish by ensuring that all hoop nets placed by field staff are not deployed in areas where fast moving water is present.

e. Were any post mortems done on the animal(s)?

All 5 fish had their stomachs opened and checked for egg sacs, parasites, and stomach contents.

f. What was done with the carcasses?

All 5 fish were disposed of at the onsite incinerator.

4. Where there any injuries to animals? If no, skip to question 5.
a. How many animals were injured?

Three (3) Arctic Grayling and one (1) Whitefish were caught in the 1" mesh of the hoop nets.

b. What injuries occurred?

The 4 injured fish were very fatigued. It took approximately 5-10 min in a recovery bin before they were strong enough to be released.

c. Were any treatments given to the injured animals?

The injured fish were individually placed in a recovery bin. The fish remained in the containment bin until they were strong enough to be released. The injured fish were not tagged.

d. What methods could be changed to decrease injury to animals?

Smaller hoop nets have been purchased for future use. They also have smaller mesh size. This should optimize net deployment and contribute to a lower number of small fish getting caught in the nets.

AEM's method could be changed to decrease injury to fish by ensuring that all hoop nets placed by field staff are not deployed in areas where fast moving water is present.

5. Were any non-target species captured? If no, skip to questions 6.
a. what species were captured?
b. what was done with the non-target species?
c. what methods could be changed to decrease the capture of non-target species?
No.

6. Were there any incidents? If no, skip to question 7.
Fish facility incidents include; problems with tanks or water systems, water quality issues, problems with methods etc.
Field incidents include; problems with equipment used, problems with field staff, problems with methods, weather issues etc.

a. Describe what happened.

High winds caused weather delays and disrupted the field work on Third Portage, Second Portage and, Dogleg pond. During high winds, a number of stationary underwater cameras were tipped over. The video footage on the cameras that were tipped over was very poor. Also, the battery life on the cameras was limited due to the cold water temperatures.

b. Can anything be done to mitigate these incidents for future projects?

Due to other projects on site, the fisheries work on Third Portage Lake, Second Portage Lake, and Dogleg pond were not scheduled until August. In the future AEM will strive to conduct it at an earlier date when the weather tends to be more co-operative.

Additional batteries will be ordered for the underwater cameras. AEM will build stands with a wider base for the underwater cameras. This should prevent the cameras from tipping over during high winds. Different camera techniques such as trolling with the camera mounted to the boat transom will be used in addition to the stationary cameras.

7. How could your methods be changed to reduce pain, injury and suffering of animals? (3 R's and endpoints)

The nature of this project requires AEM to capture fish in order to determine its presence/absence in the environment. Fish cannot be replaced by a non-animal alternative.

AEM, to reduce the number of fish being used during the Fish Monitoring Studies, is and will continue to mainly use underwater camera to verify presence/absence of fish habitat usage in the environment. To minimize the effects on fish, AEM will conduct its next Fish Monitoring Studies sampling program in 2020.

AEM, to minimize pain and/or distress to fish will continue to use best management practices. Smaller hoop nets have been purchased for future use. They also have

smaller mesh size. This should optimize net deployment and contribute to a lower number of small fish getting caught in the nets.
Also, AEM will ensure that all hoop nets placed by field staff are not deployed in areas where fast moving water is present.

December 17, 2015

Project Lead **Date**

APPENDIX B

2015 HCM Periphyton Report

Technical Memorandum

Date: **February 24th, 2016**

To: **Kevin Buck, Erika Voyer, Manon Turmel (AEM)**

Cc: **Ryan VanEngen (AEM)**

From: **Eric Franz, Gary Mann**

RE: **Habitat Compensation Monitoring Program 2015: East Dike and Bay-Goose Dike Periphyton**

OVERVIEW

Under terms of the Department of Fisheries and Oceans Canada *Fisheries Act* Authorization (NU-03-0191), long-term monitoring following the Habitat Compensation Monitoring Program (HCMP) is designed to document the functionality of habitat compensation features (HCFs) constructed to offset habitat losses associated with development of the Meadowbank Mine. The monitoring strategy of the HCMP (Azimuth, 2008) describes both the physical and ecological monitoring requirements, and presents the schedule for monitoring implementation and decision criteria for evaluating the success of HCF functionality. The monitoring strategy for ecological components follows a tiered framework consisting of both quantitative and qualitative tools (**Figure 1**). The first tier focuses on identifying constraints to HCF functionality (e.g., metals release); higher tiers involve more specialized tools that are only triggered if the success criteria specified in the HCMP are not met.

In 2015, tier 1 quantitative and qualitative ecological components were monitored for both the East Dike HCF (year C+7) and for the Bay-Goose Dike HCF (year C+5). Note that C denotes year of construction completion; 2008 for the East Dike and 2010 for the Bay-Goose Dike. Azimuth was contracted to support AEM with reporting on the periphyton component of the program (i.e., qualitative periphyton community monitoring in shallow [rock sampling] zones only); the results of which are documented herein.

OBJECTIVES

Periphyton species composition and biomass are indirect indicators of lake productivity, reflecting nutrient concentrations in the lake, and are sometimes indicators of the presence of contaminants. This community serves as the base of the hard-bottom benthic food chain, which ultimately leads up to fish. As described in the HCMP (Azimuth, 2008), success criteria for periphyton monitoring focus on the capability of

HCFs to function as fish habitat. The HCFs are expected to provide good substrate for periphyton to colonize. The intent of this component is to document periphyton community colonization and development on the dike face HCFs. As per the HCMP, methods for periphyton assessment differ by depth zone:

- *Shallow (0 – 1 m)* – direct methods (described below) are used to sample periphyton on rocks ("Rock Sampling"). Samples are analyzed for density (cells/cm^2) and biomass (µg/cm^2), but a greater emphasis is placed on the latter as it is more ecologically relevant and is derived from the density counts (see methods). The results are compared to the baseline community data to determine whether there are any gross differences in composition. Reported herein.
- *Deeper (1 – 4 m)* – AEM completed the underwater surveys at the same time as periphyton sampling. The survey results were archived for potential future use, but are not reported as part of the 2015 HCMP.

METHODS

Periphyton Community Sampling – Shallow Zone

Periphyton community sampling was completed by AEM staff between August 19th and 23rd. An Azimuth staff member provided training on the sampling method on August 19th. Periphyton samples were collected in the following areas in relation to each dike HCF (sampling locations are shown in **Figure 2**):

- East Dike HCF (Second Portage Lake)
    - East Dike (SP-ED)
    - Drilltrail Arm reference area (SP-DT)
- Bay-Goose Dike HCF (Third Portage Lake – East basin)
    - Bay-Goose Dike – North section (TPE-BGN)
    - Bay-Goose Dike – South section (TPE-BGS)
    - Reference area (TPE-G)

Five replicate samples were collected from each area and analyzed independently. UTM coordinates for each replicate sample are presented in **Table 1**. Sampling locations were chosen according to the following criteria: a sufficient number of large, flat rocks from a water depth of approximately 0.5 m with a flat surface facing upwards as much as possible, and with uniform algal coverage, not particularly dense or sparse. Periphyton growth is naturally variable due to differences in wave action, aspect to sun, water depth and clarity, nutrient availability, rock type, water temperature and other factors.

Periphyton samples were collected using a specially designed algae 'scrubber'. The procedures for collecting the samples are outlined in detail in the standard operating procedure (COP) for Periphyton Sampling (**Appendix A**). In general, the scrubbers were used to remove and retain periphyton from a 20 cm^2 area on each rock; three rocks were composited for each replicate sample (i.e., each of the 5 replicates at a sampling area consisted of 3 rocks). Periphyton samples were preserved in the field with a small amount of Lugol's solution and sent to Plankton R Us Inc. (Winnipeg, MB) for taxonomic identification and biomass (µg/cm^2) estimation.

In the laboratory, each periphyton sample was well mixed and 2 mL sub-samples of suspension were sonicated for 10 to 20 seconds using a Sonifer Cell Disruptor (model w140) and gravity settled for 24 h in an Ütermohl chamber (Findlay et al., 1999). Counts were performed on an inverted microscope at magnifications of 125X, 400X, and 1200X with phase contrast illumination. Cells were identified, counted and measured from random fields until 100 cells of the dominant species were found. Cell counts were converted to wet weight biomass by approximating cell volume. Estimates of cell volume for each species were obtained by measurements of up to 50 cells of an individual species and applying the geometric formula best fitted to the shape of the cell (Vollenweider, 1968; Rott, 1981). For comparison between stations and among years, the individual species density (cells/cm^2) and biomass (µg/cm^2) data were summarized at the level of major taxa group (cyanobacteria, chlorophytes, chrysophytes, diatoms, and dinoflagellates). The laboratory data are included in **Appendix B**.

Simpson's diversity index was calculated for each replicate sample to quantify periphyton species diversity among areas and replicates (Washington, 1984). Simpson's diversity index takes into account both the abundance patterns and taxonomic richness of the community. It measures the probability that two individuals randomly selected from a sample will belong to the same species. This is calculated by determining, for each taxonomic group at a site, the proportion of individuals that it contributes to the total at the site. This diversity index can range from 0 to 1, with a value of 1 representing the highest diversity. Simpson's diversity (D) is calculated as follows:

$$\mathrm{D} = 1 - \sum \frac{n_i(n_i - 1)}{N(N - 1)}$$

where:
N is the total number of organisms/replicate sample;
n_i is the total number of organisms of the i^{th} taxa/replicate sample.

The number of species occurring per replicate sample was calculated to measure the species richness among replicates, areas and sampling events.

Quality Assurance / Quality Control

One field duplicate was collected and field replicates (5 per area) were collected for periphyton to test consistency in field methods and to determine natural variability and spatial heterogeneity within and among areas. When collection of each replicate sample was completed, the 'scrubber' was rinsed in lake water to ensure that no debris remained in the bristles. An RPD of 50% is targeted for total density and total biomass while acknowledging small-scale spatial variability in the periphyton community may result in RPDs outside this range. As a measure of laboratory QA/QC on the enumeration method, replicate counts were performed on 10% of the samples. Laboratory replicate samples were chosen at random and processed at different times from the original analysis to reduce biases. The laboratory replicate is a new aliquot (10 ml) from the sample jar and is counted from the start in the same manner as the original aliquot (10 ml) taken from the jar. An RPD of 25% for total density and total biomass concentrations is considered acceptable.

RESULTS

Quality Assurance/Quality Control

Periphyton samples collected from prescribed areas of rock surface were quantified by density (cells/cm^2) and biomass (µg/cm^2). RPDs for total density and total biomass met the DQOs for the field duplicate and laboratory duplicate samples (**Table 2**). The highest RPD (40%) was observed in the biomass estimate for the field duplicate sample collected at TPE-BGS replicate station 3. Some minor differences in species richness were observed in the field duplicate sample and one of the laboratory duplicates, but in both cases there was only one taxa difference between the sample and its duplicate. Lastly, the Simpson's diversity calculations between the original samples and their duplicates show very little variability (less than 5%). Overall, the variability in density, biomass, richness, and Simpson's diversity is considered minor and within the range of acceptability.

East Dike HCF

Periphyton samples were collected from rock surfaces at 5 locations each along the East Dike face (SP-ED) and at the reference location (SP-DT). Total cell density and biomass were lower at SP-ED compared to SP-DT in 2015. Density and biomass were both highly variable within each location in 2015, but mean estimates of cell density and biomass were both approximately 4-fold lower at the SP-ED area compared to SP-DT (**Table 3**, **Figure 3**). Relative to the 2011 survey, the 2015 results show increases in mean cell density of 40% (from 168,000 to 235,000 cells/cm^2) and in mean biomass of 83% (from 43 to 79 µg/cm^2) along the East Dike.

Despite absolute differences in cell density between the East Dike and the reference areas, the proportion of cell densities by major taxa group was similar between SP-ED and SP-DT in 2015 (**Figure 3**). Cyanobacteria and diatoms accounted for over 99% of the cell density at each location. At SP-ED, cyanobacteria comprised 63% of the periphyton community compared with 69% at SP-DT (**Table 3**). Diatoms were the next most abundant major taxa group, accounting for 36% of the cell density at SP-ED compared with 30% at SP-DT. In contrast to cell density, the species composition for periphyton biomass was different between SP-ED and SP-DT. Similar to 2011, diatoms were the dominant major taxa group in terms of biomass on along the East Dike (88%), while the biomass at the reference was comprised equally of cyanobacteria (48%) and diatoms (50%). Biomass differences between the East Dike and reference areas are primarily due to the presence of cyanobacteria species at SP-DT that have a larger cell volume, in particular, *Petalonema alatum* Berk and *Rivularia dura* Roth (see **Appendix C** for information on the species cell volumes and presence/absence by replicate area). The shift in community composition at SP-ED to include a greater proportion of cyanobacteria is indicative of an overall trend towards a periphyton community structure similar to SP-DT. Differences in species composition within major taxa group (i.e., cyanobacteria) suggest community succession at SP-ED is likely still on-going.

Community diversity indices (Simpson's Diversity and taxa richness) were similar at all sampling areas (**Table 3**). Taxa richness in 2015 was between 16 and 19 at SP-ED and between 16 and 21 at SP-DT, consistent with the number of taxa observed in 2011 (Azimuth, 2012). Simpson's Diversity was also similar between the two areas: 0.75 at SP-ED and 0.73 at SP-DT.

Bay-Goose Dike HCF

Periphyton samples were collected from rock surfaces at 5 locations each along the north and south sections of the Bay-Goose Dike face (TPE-BGN; TPE-BGS) and at the reference location TPE-G (**Table 4**, **Figure 4**). The 2015 event was the second cycle of habitat compensation monitoring along the Bay-Goose Dike, with the first conducted in 2011. Periphyton cell density at TPE-BGN and TPE-BGS was approximately 62,000 cells/cm^2 and 70,000 cell/cm^2, respectively in 2015. These results are within the range of cell densities reported in the 2011 survey (Azimuth, 2012). Furthermore, both Bay-Goose Dike locations were approximately 10-fold lower in cell density compared to the reference area (TPE-G) in 2015, consistent the ratio that was observed in the 2011 survey. Despite overall similar periphyton cell densities between 2011 and 2015, mean total biomass increased by 45% at TPE-BGN and 170% at TPE-BGS in 2015 relative to 2011 (**Table 5**).

The periphyton community composition at TPE-BGN and TPE-BGS was composed mainly of diatoms in 2015 (81% and 66% by cell density, respectively), whereas rocks at TPE-G were composed primarily of cyanobacteria (70%) and diatoms (26%) (**Table 4**, **Figure 4**). Biomass by major taxa group was generally more evenly distributed between diatoms and cyanobacteria, although there was a high degree of within-station variability in 2015 (**Table 4**). On average, the percent distribution of biomass by major taxa group was similar at the Bay-Goose Dike locations compared to the reference location TPE-G.

Compared to the 2011 results, the 2015 periphyton community data along the Bay-Goose Dike had lower proportions of diatoms and higher proportions of cyanobacteria, both in terms of cell density and biomass. The temporal trend towards a heterogeneous periphyton community comprised of cyanobacteria and diatom species is consistent with the pattern of colonization and succession observed at SP-ED. A more even distribution of species density and biomass among cyanophytes, diatoms, and to a lesser extent chlorophytes is also characteristic of reference areas in the region. A full list of periphyton species with a presence/absence matrix for the Third Portage sampling locations in 2015 is presented in **Appendix C**.

The periphyton community at the Bay-Goose Dike was less diverse than the reference area as indicated by lower Simpson's Diversity scores and fewer taxa (**Table 4**). Mean taxa counts at TPE-BGN (10 taxa) and TPE-BGS (15 taxa) were noticeably lower than those at TPE-G (19 taxa). Relative to TPE-BGN, TPE-BGS showed greater improvement in 2015, with higher taxa richness and Simpson's Diversity scores relative to 2011. At TPE-BGN, richness was 10 in 2015 compared to 11 in 2011, and Simpson's Diversity was 0.57 in 2015 compared to 0.56 in 2011. Overall, TPE-BGN had lower diversity measures, biomass, and density compared to TPE-BGS in 2015.

It's unclear what factors/variables have contributed to a more abundant (biomass and density) and diverse (taxa richness and Simpson's Diversity) periphyton community at the southern extent of Bay-Goose Dike compared to the northern portion of the Dike. One possibility is that the southern aspect at TPE-BGS provides better growing conditions (i.e., exposure to sunlight) than the eastern aspect at TPE-BGN. While less important at the reference areas due to the lower profile natural shorelines, aspect might be more important with the steeper and higher dike faces at the HCF stations. That said, the temporal biomass trajectory seen at the SP-ED (eastern aspect) is more similar to that seen at TPE-BGS (southern aspect) (**Table 5**). Interestingly, while TPE-BGN's mean performance was lower than TPE-BGS's, some of the results for individual replicates were actually higher, highlighting the influence of high natural variability in periphyton data.

OVERALL DISCUSSION AND CONCLUSIONS

Cell density and biomass in early stage periphyton communities at the East Dike HCF (in 2009) and Bay-Goose Dike HCF (in 2011) were predictably low in the year after construction. Periphyton community development is dependent on a number of factors, including nutrient availability (Bonilla et al., 2005), light (Kiffney et al., 2003) and the capacity of different taxa to colonize, grow, compete, tolerate stress, and resist loss processes (Cox, 1990). Analysis of the early-stage periphyton communities at the East Dike and Bay-Goose Dike HCFs showed diatoms were the predominant taxa group responsible for early colonization of the HCFs. In general, periphyton community succession has progressed from diatom-dominated early-stage communities to a more heterogeneous mix of cyanobacteria, diatoms, and to a lesser extent, chlorophyte taxa in the mid-stage communities (≥ 5 years post construction).

The shift from a diatom-dominated to heterogeneous periphyton community on the HCFs is characterized by increased species diversity measures (i.e., increased taxa richness and Simpson's Diversity). At the East Dike HCF, taxa richness and Simpson's Diversity values are nearly identical to the reference area in Second Portage Lake indicating the presence of community similar to background conditions. Increased community diversity (i.e., greater proportion of cyanobacteria) was also observed at the Bay-Goose Dike HCFs in 2015 relative to 2011, and the same trend of increased diversity is anticipated based on the community composition changes at the East Dike. Biomass has also steadily increased on the HCFs in Second Portage and Third Portage Lakes in the post-dike construction phase, but total biomass is still lower compared to the reference areas. It is now apparent that 3 to 5 years is not a sufficient amount of time for full colonization of new barren rock surfaces to background levels of biomass as was first postulated (Azimuth, 2010). The presence of a structurally similar periphyton community at each of the HCFs relative to their respective reference areas indicates a healthy periphyton community. Biomass growth is expected to continue as periphyton community succession progresses.

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Table 1. Periphyton rock sampling locations, 2015.

HCF	Sampling Area ID	Date	Replicate #	UTM Coordinates	
				Easting	Northing
East Dike HCF	SP-ED	19-Aug-15	1	14W 639371	7214359
		20-Aug-15	2	14W 639380	7214257
		20-Aug-15	3	14W 639400	7214057
		20-Aug-15	4	14W 639413	7213948
		20-Aug-15	5	14W 639378	7213846
	SP-DT	21-Aug-15	1	15W 358698	7213919
			2	15W 358703	7213958
			3	15W 358731	7214014
			4	14W 641326	7213862
			5	14W 641305	7213774
Bay-Goose Dike HCF	TPE-BGN	20-Aug-15	1	14W 639195	7213027
		20-Aug-15	2	14W 639110	7212917
		20-Aug-15	3	14W 639012	7212819
		21-Aug-15	4	14W 638983	7212679
		21-Aug-15	5	14W 639004	7212522
	TPE-BGS	21-Aug-15	1	14W 638945	7212166
		21-Aug-15	2	14W 638845	7211968
		24-Aug-15	3	14W 638529	7211831
		24-Aug-15	4	14W 638453	7211967
		21-Aug-15	5	14W 638361	7212098
	TPE-G	23-Aug-15	1	14W 637940	7210751
			2	14W 637947	7210747
			3	14W 637960	7210745
			4	14W 637967	7210740
			5	14W 637975	7210732

Table 2. QA/QC results for the field and laboratory duplicate periphyton samples.

	Field Duplicate		
	TPE-BGS-3 21-Aug-15	**Field Duplicate**	**RPD (%)**
Total Density	59575	61728	-3.6
Total Biomass	19.3	12.8	40.5
# Taxa	15	14	6.9
Simpsons Diversity	0.79	0.79	-0.2

	Laboratory Duplicates								
	SP-DT-4 21-Aug-15	**Lab Duplicate**	**RPD (%)**	**TPE-BGS-3 24-Aug-15**	**Lab Duplicate**	**RPD (%)**	**SP-ED-2 20-Aug-15**	**Lab Duplicate**	**RPD (%)**
Total Density	925926	1008470	-8.5	59575	63164	-5.8	241351	245837	-1.8
Total Biomass	286	296	-3.5	19.3	20.6	-6.4	109	105	3.8
# Taxa	18	18	0.0	15	14	6.9	19	19	0.0
Simpsons Diversity	0.78	0.79	-1.0	0.79	0.83	-5.0	0.78	0.78	0.5

Notes:
RPD = Relative Percent Difference (%) = ((original - duplicate) / (original + duplicate)/2) x 100.
Shaded RPDs exceed 50% (field duplicates) or 25% (lab duplicates).
NA = Not Applicable for rare species.

Table 3. Density (cells/cm^2), biomass (µg/cm^2) and diversity of major periphyton taxa groups for East Dike HCF sampling areas.

Area-Replicate ID	Date	Cyanobacteria	Chlorophyte	Chrysophyte	Diatom	Dinoflagellate	Total	# Taxa	Simpson's Diversity
Periphyton Density (cells/cm^2)									
SP-ED-1	19-Aug-15	300912	0	0	168400	0	469312	19	0.83
SP-ED-2	20-Aug-15	122021	897	0	118432	0	241351	19	0.78
SP-ED-3	20-Aug-15	81108	0	2871	40913	0	124892	18	0.65
SP-ED-4	20-Aug-15	132070	0	0	48091	0	180161	16	0.72
SP-ED-5	20-Aug-15	109819	0	2153	48091	0	160063	18	0.76
	station mean	***149186***	***179***	***1005***	***84785***	***0***	***235156***	***18***	***0.75***
	as %	***63%***	***0.08%***	***0.4%***	***36%***	***0%***			
SP-DT-1	21-Aug-15	717772	0	0	139068	0	856840	16	0.63
SP-DT-2	21-Aug-15	663939	7178	0	222509	0	893626	17	0.73
SP-DT-3	21-Aug-15	657958	0	0	209350	0	867308	20	0.78
SP-DT-4	21-Aug-15	358886	0	0	567040	0	925926	18	0.78
SP-DT-5	21-Aug-15	714781	2991	0	230285	0	948057	21	0.73
	station mean	***622667***	***2034***	***0***	***273651***	***0***	***898352***	***18***	***0.73***
	as %	***69%***	***0.2%***	***0%***	***30%***	***0%***			
Periphyton Biomass (µg/cm^2)									
SP-ED-1	19-Aug-15	23	0.0	0.0	143	0	165		
SP-ED-2	20-Aug-15	7	1	0.0	101	0	109		
SP-ED-3	20-Aug-15	6.7	0.0	0.6	41	0	48		
SP-ED-4	20-Aug-15	4.8	0.0	0.0	33	0	38		
SP-ED-5	20-Aug-15	3.5	0.0	0.4	29	0	33		
	station mean	***9.0***	***0.1***	***0.2***	***69***	***0***	***79***		
	as %	***11%***	***0.2%***	***0.3%***	***88%***	***0%***			
SP-DT-1	21-Aug-15	376	0.0	0.0	171	0	547		
SP-DT-2	21-Aug-15	77	27.6	0.0	67	0	172		
SP-DT-3	21-Aug-15	121	0.0	0.0	160	0	281		
SP-DT-4	21-Aug-15	73	0.0	0.0	212	0	286		
SP-DT-5	21-Aug-15	178	14.1	0.0	243	0	435		
	station mean	***165***	***8.3***	***0***	***171***	***0***	***344***		
	as %	***48%***	***2.4%***	***0%***	***50%***	***0%***			

Table 4. Density (cells/cm²), biomass (µg/cm²) and diversity of major periphyton taxa groups at Bay-Goose Dike HCF sampling areas.

Area-Replicate ID	Date	Cyanobacteria	Chlorophyte	Chrysophyte	Diatom	Dinoflagellate	Total	# Taxa	Simpson's Diversity
Periphyton Density (cells/cm²)									
TPE-BGN-1	20-Aug-15	9331	1436	2153	85415	0	98335	13	0.47
TPE-BGN-2	20-Aug-15	5024	2871	4307	64599	0	76802	9	0.44
TPE-BGN-3	20-Aug-15	5742	0	0	43066	0	48808	7	0.62
TPE-BGN-4	21-Aug-15	2871	2153	0	33735	718	39477	9	0.55
TPE-BGN-5	21-Aug-15	21533	2153	0	22969	0	46655	10	0.78
	station mean	***8900***	***1723***	***1292***	***49957***	***144***	***62016***	***10***	***0.57***
	as %	***14%***	***2.8%***	***2.1%***	***81%***	***0.2%***			
TPE-BGS-1	21-Aug-15	23686	0	718	29429	0	53833	11	0.76
TPE-BGS-2	21-Aug-15	20098	0	4307	46655	718	71777	16	0.70
TPE-BGS-3	24-Aug-15	21533	0	1436	36606	0	59575	15	0.79
TPE-BGS-4	24-Aug-15	19380	718	0	45937	718	66753	15	0.66
TPE-BGS-5	21-Aug-15	30146	8613	2871	55268	0	96899	16	0.87
	station mean	***22969***	***1866***	***1866***	***42779***	***287***	***69767***	***15***	***0.75***
	as %	***33%***	***2.7%***	***2.7%***	***61%***	***0.4%***			
TPE-G-1	23-Aug-15	334417	1631	4894	156605	0	497547	20	0.78
TPE-G-2	23-Aug-15	728026	56396	0	251220	0	1035643	18	0.83
TPE-G-3	23-Aug-15	472533	5981	0	289103	0	767617	21	0.85
TPE-G-4	23-Aug-15	758788	15381	0	184570	0	958738	17	0.83
TPE-G-5	23-Aug-15	278735	2393	4785	40674	1196	327783	20	0.78
	station mean	***514500***	***16357***	***1936***	***184434***	***239***	***717465***	***19***	***0.82***
	as %	***72%***	***2.3%***	***0.3%***	***26%***	***0.03%***			
Periphyton Biomass (µg/cm²)									
TPE-BGN-1	20-Aug-15	1.2	4.1	0.5	23.0	0.0	28.7		
TPE-BGN-2	20-Aug-15	4.1	0.0	1.0	7.5	0.0	12.6		
TPE-BGN-3	20-Aug-15	0.5	0.0	0.0	5.6	0.0	6.1		
TPE-BGN-4	21-Aug-15	0.3	1.5	0.0	4.2	6.7	12.7		
TPE-BGN-5	21-Aug-15	44.3	1.7	0.0	7.6	0.0	54		
	station mean	***10.1***	***1.5***	***0.3***	***9.6***	***1.3***	***22.7***		
	as %	***44%***	***6.4%***	***1.3%***	***42%***	***5.9%***			
TPE-BGS-1	21-Aug-15	8.7	0.0	0.2	7.5	0.0	16.4		
TPE-BGS-2	21-Aug-15	17.5	0.0	1.1	14.7	6.5	39.8		
TPE-BGS-3	24-Aug-15	2.1	0.0	0.4	16.9	0.0	19.3		
TPE-BGS-4	24-Aug-15	1.4	0.1	0.0	10.0	6.5	17.9		
TPE-BGS-5	21-Aug-15	101	2.8	0.7	20.3	0.0	125		
	station mean	***26.2***	***0.6***	***0.5***	***13.9***	***2.6***	***43.7***		
	as %	***60%***	***1.3%***	***1.0%***	***32%***	***5.9%***			
TPE-G-1	23-Aug-15	150	8.1	1.1	80	0.0	239		
TPE-G-2	23-Aug-15	117	198	0.0	130	0.0	446		
TPE-G-3	23-Aug-15	99	7.0	0.0	112	0.0	218		
TPE-G-4	23-Aug-15	185	76	0.0	68	0.0	329		
TPE-G-5	23-Aug-15	96	4.9	1.2	4.9	10.8	118		
	station mean	***130***	***59***	***0.5***	***79***	***2.2***	***270***		
	as %	***48%***	***22%***	***0.2%***	***29%***	***0.8%***			

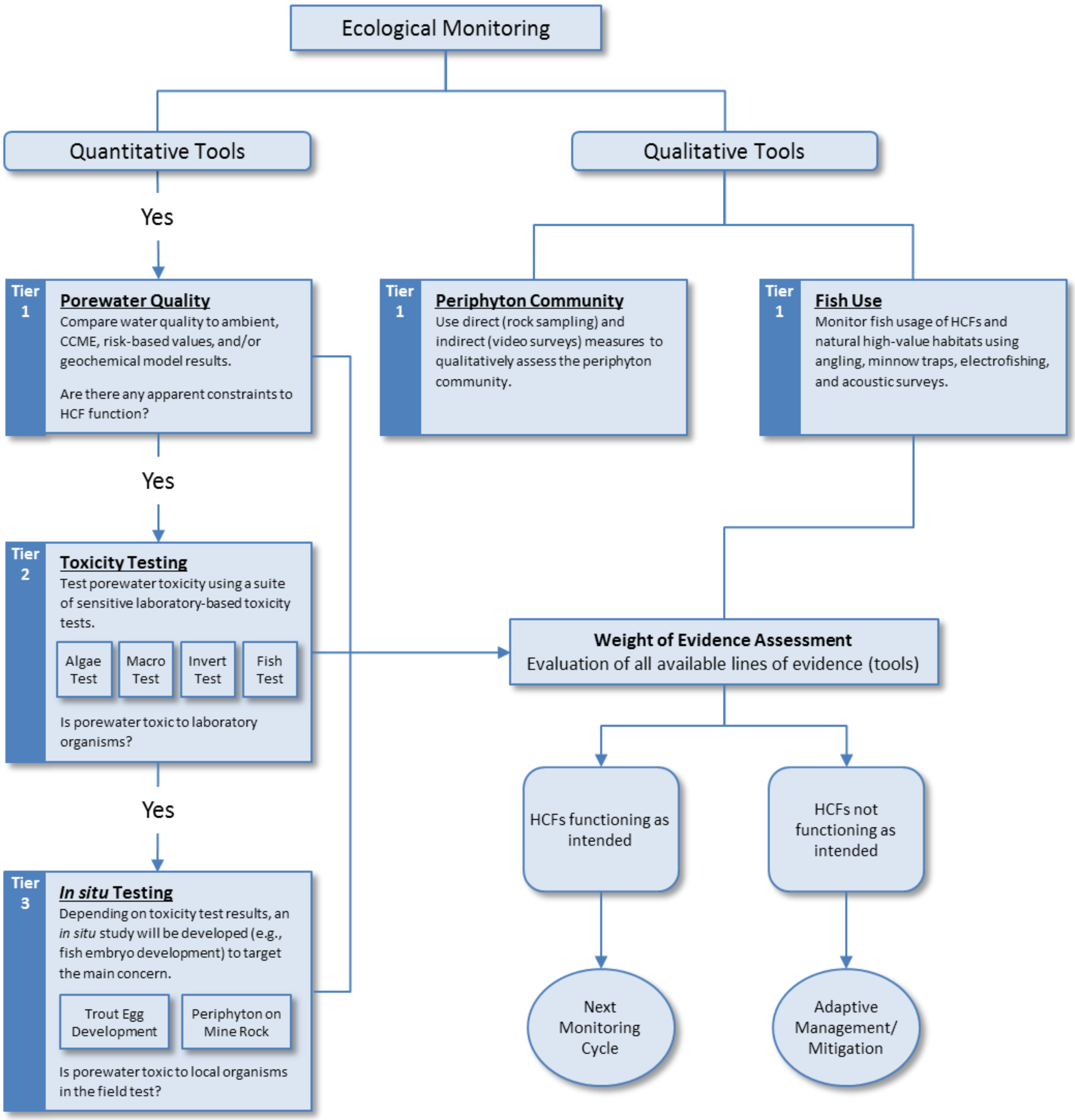
Table 5. Mean total (±SD) periphyton biomass (µg/cm²) at the East Dike and Bay-Goose Dike habitat compensation feature (HCF) areas since 2007.

Year	East Dike HCF Areas			Bay-Goose Dike HCF Areas			
	SP-ED	**SP-CREMP**	**SP-DT**	**TPE- BGN**	**TPE-BGS**	**TPE-CREMP**	**TPE-G**
2007		628 ± 352				482 ± 235	
2008		546 ± 183				372 ± 148	
2009	23 ± 13	549 ± 256	438 ± 265				
2010		270 ± 98	308 ± 113				
2011	43 ± 16	316 ± 35	316 ± 61	16 ± 13	16 ± 15	855 ± 332	480 ± 138
2012							
2013							
2014							
2015	79 ± 57		344 ± 147	22 ± 19	44 ± 46		270 ± 124

Notes:

The red dashed line indicates when dike construction was finished in each area (i.e., the year above the red line).

Figure 1. Ecological monitoring strategy for habitat compensation features (HCFs), Meadowbank Mine (adapted from Azimuth, 2008).



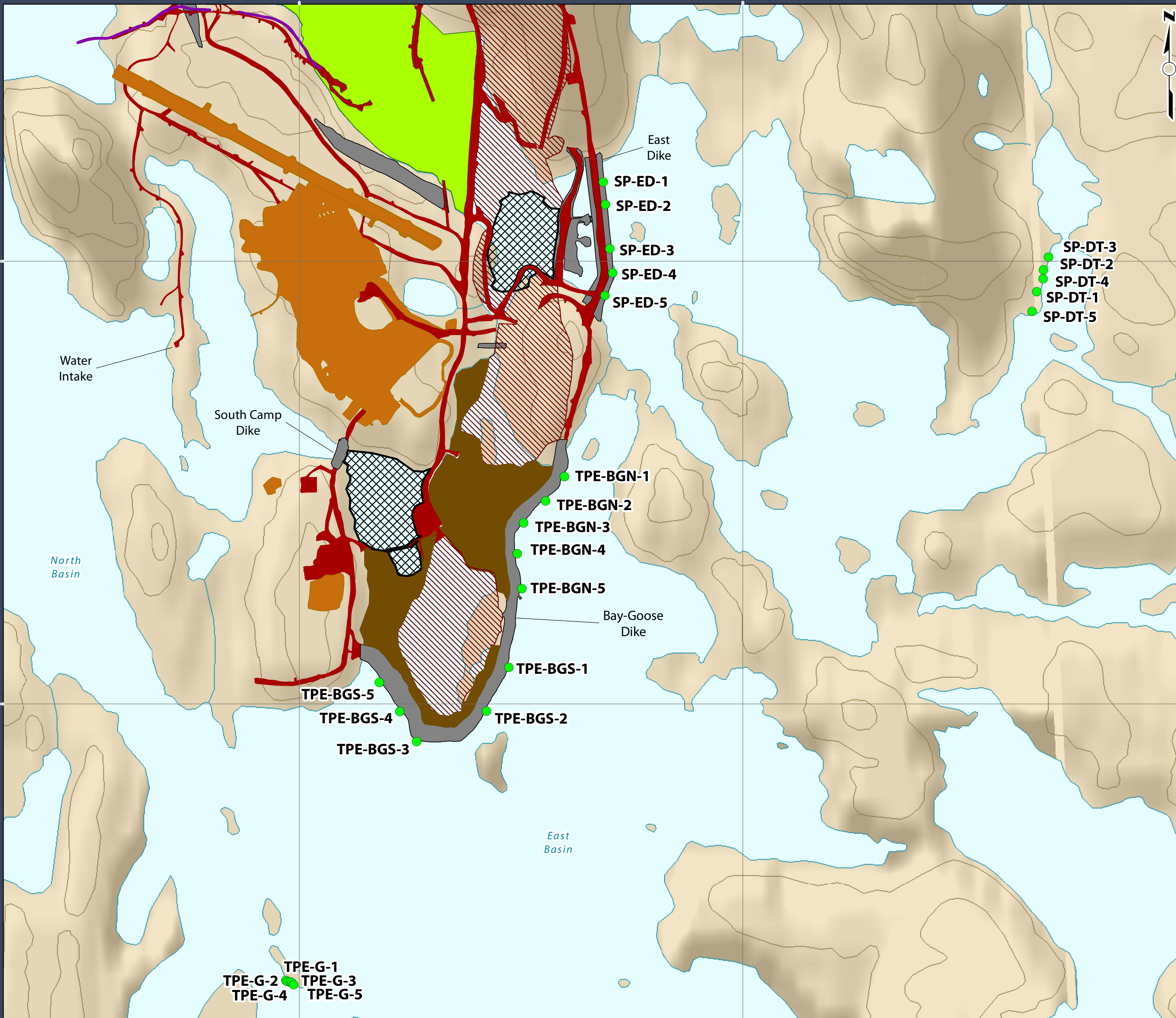


Figure 2: Periphyton Rock Sampling Locations for the 2015 Survey

Legend

- Periphyton Sampling Location
- All Weather Access Road

Mine Features

- Dewatering Pipe Discharge
- Facilities
- Road
- Dike
- Diversion Ditch
- Waste Dump
- Pit
- Dewatered Lake
- Portage Attenuation Facility
- Tailings Storage Facility

Area of Detail

0 200 400 600

Metres

Projection: UTM Zone 14 NAD83

Data Sources:
Natural Resources Canada, GeoBase®
National Topographic Database
Agnico-Eagle Mines Limited.
Azimuth Consulting Group Inc.

Meadowbank Gold Project

Prepared for: AGNICO EAGLE

By: CASLYS CONSULTING

February 19, 2016

Figure 3. Mean and relative periphyton biomass (µg/cm^2) and density (cells/cm^2) for major taxa groups at East Dike HCF sampling areas.

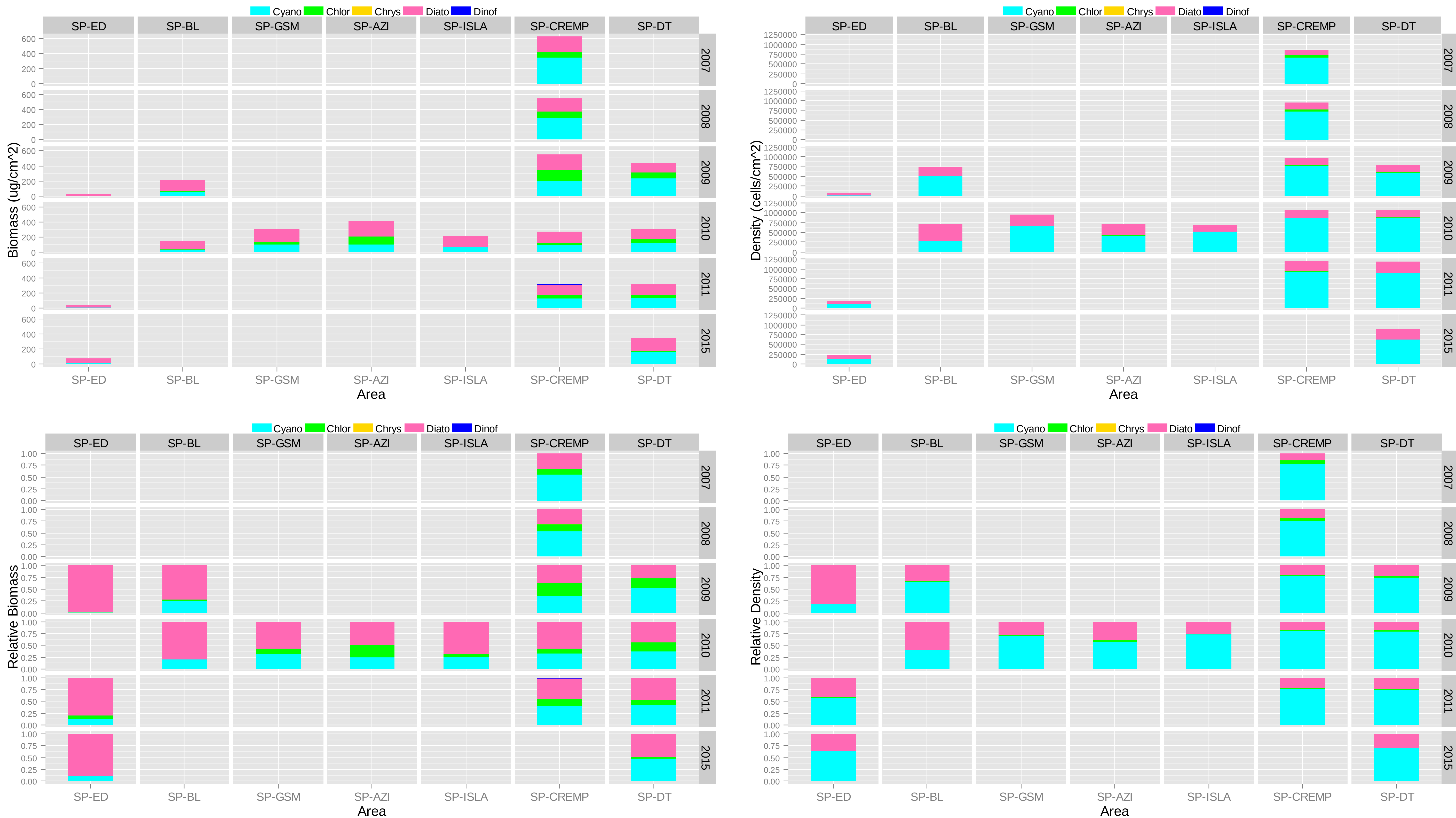
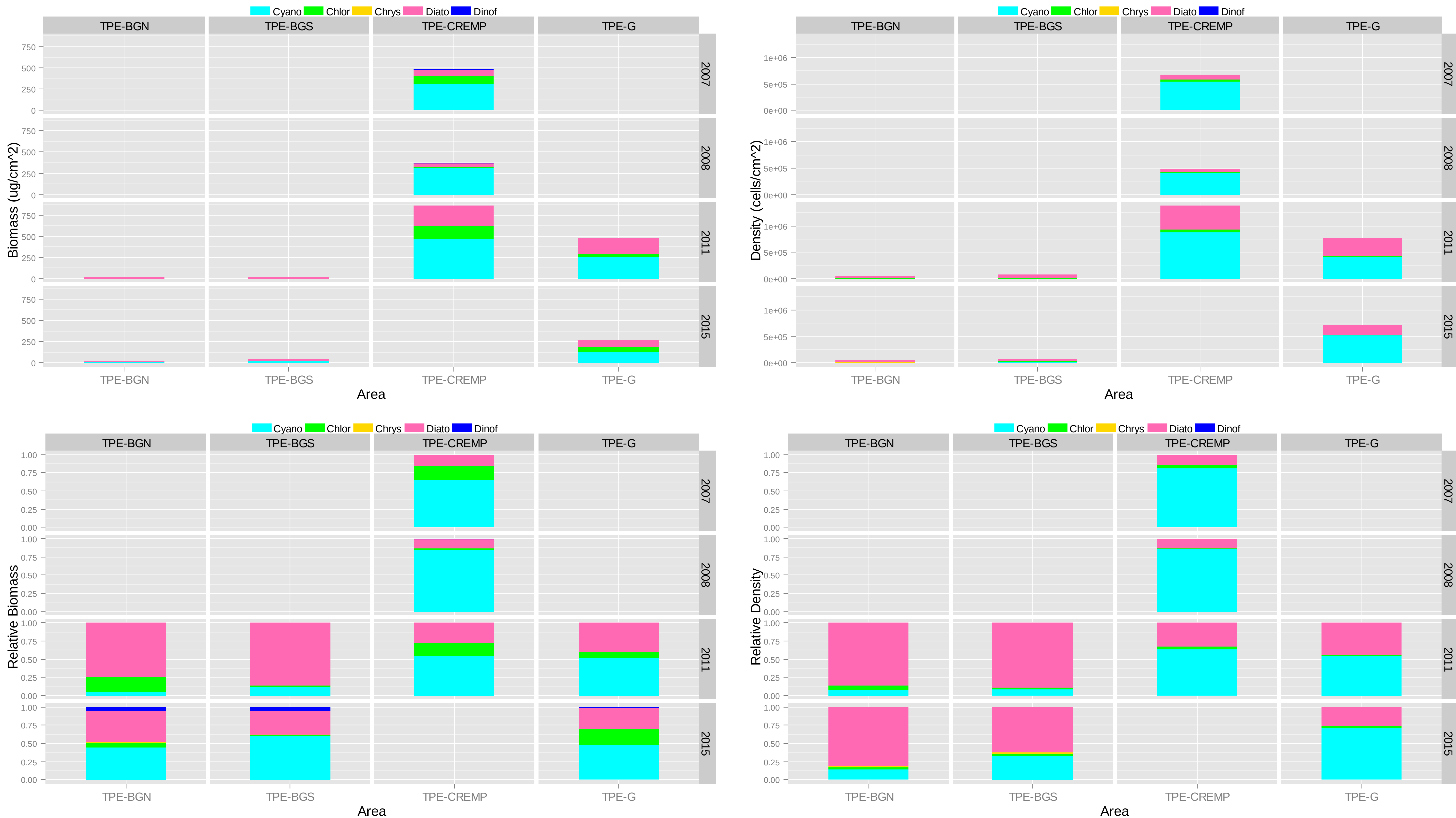


Figure 4. Mean and relative periphyton biomass (μg/cm^2) and density (cells/cm^2) for major taxa groups at Bay-Goose Dike HCF sampling areas.



LIST OF APPENDICES

Appendix A

Standard Operating Procedure - HCMP Periphyton Sampling

Standard Operating Procedure
Meadowbank Project Lakes
HCM Periphyton Sampling

Equipment:

- Field collection data forms, pencils, waterproof markers & clipboard
- GPS unit, batteries
- Periphyton sampler, syringes & plastic tubes
- Binder clips (to pinch tubes on periphyton sampler)
- Shoulder gloves (with 5 cm increments marked from fingertip to shoulder)
- Large tote
- Field sample bottles & preservative (per replicate):
  - 1 – 500 mL plastic jar
  - 1 syringe & Lugol's solution
- Cooler(s) or action packer(s) (for storing and shipping samples)
- Address labels for cooler(s)/action packer(s)
- Chain-of-custody forms
- Large Ziploc bag (for sending chain-of-custody form in cooler)
- Packing tape (for sealing cooler)

General Procedures:

- Before going into the field, **label** all **sampling containers**. Using a permanent waterproof marker, print the following information directly onto both the jar and jar lid:
  - Azimuth company name
  - Station abbreviation (e.g. SP-CREMP) and replicate number (e.g. SP-CREMP -1, TPE-CREMP-2)
  - Date of sample collection

- Before and during sampling fill in the requested information on the **field data form**. Forms are made of waterproof paper; **print** all information on the form using a **lead pencil** or write-in-the-rain pen.

- Access to the area may be by boat or foot; in either event, ensure the sampling area is not impacted by boat (launch) or other anthropogenic activities. Record the **UTM coordinates** for each sampling station, measured using a GPS unit in NAD 83, on the field data form. In future sampling events, sample periphyton from the same locations.

- **Select a rock** with a **flat surface**, no more than 0.5 meter below the water surface, with the following criteria:
  - Facing up as much as possible; if not, with a small slope

    - Uniform algal coverage, not uniformly dense or sparse

- The periphyton sampler is a specially designed **scrubber**, consisting of a plexiglass tube with a plunger that fits snugly inside and a distal wire brush that is in direct contact with the rock surface. Press the tube against the rock to form a tight seal. To **detach** the **periphyton colonies**, depress the plunger and twist for approximately 30 half turns. The periphyton mixture is suspended (i.e. by opening the plunger approximately ¼ of the device volume) and drawn into a syringe that is attached to the tube (pinch intake tube closed when drawing suspension into syringe). Empty the syringe (pinch output tube closed prior to detaching the syringe) into the pre-labeled replicate 1 sampling container (i.e. TPE-CREMP-1). Continue scraping and syringing (approximately 2 times: another 20 half turns of the sampler, then 10 half turns, then a final rinse of sampler) until all visible periphyton are completely removed from the rock surface. This procedure works well with two people; one to scrub the rocks and clamp the intake tube, the other to operate the syringe and clamp the output tube. The number of turns in this SOP errs on the side of caution and may be too many for the average sampling site. Use discretion and examine each sampled rock to ensure it has been fully cleaned where the scrubber was used.

- **Repeat** rock selection and scrubbing steps **two more times**, selecting undisturbed flat rocks in less than 0.5 meter of water. Put the collected periphyton samples from each rock into the same pre-labeled replicate 1 sampling container (i.e. TPE-1) as above. These 3 rocks are composited into one replicate sample; approximately 500 mL of water/periphyton are collected in total.

- **Repeat** above steps for each replicate required at the station. For every 125 mL of periphyton mixture in each sampling container, **add 1 mL of Lugol's solution** to preserve the sample (the sample should look the colour of weak tea). Seal the sampling containers and store in a cooler at **room temperature**.

- Fill out a **chain-of-custody** form completely and place into a sealed ziploc plastic bag inside the shipping container. If using digital COC form, print 2 copies of the document in the field (one for the laboratory, one for Azimuth). Questions about COCs can be directed to Maggie McConnell.

HCM Periphyton Scrubbing

- Collect periphyton scrubbing samples from **7 stations** within SP and TPE
- Stations in SP that will be revisited are: SP-CREMP, SP-DT and SP-ED
- Stations in TPE will include: TPE-CREMP, TPE-BGN, TPE-BGS and TPE-G (reference site)
- Each station consists of 5 replicate samples (these are close together for 4 stations but spread out for the 3 dike stations)
- Each replicate will consist of scrubbings from 3 rocks and will be placed in 1 x 500mL jar and preserved with Lugol's solution
- Ship samples and COC to David Findlay at Plankton R Us

  David Findlay
  Plankton R Us Inc.
  39 Alburg Drive
  Winnipeg, MB
  R2N 1M1
  Tel: 204-254-7952

NOTE: Along the dike face it may be necessary to set up a tote to receive the rock. If the aspect of the dike face is too steep to safely or properly sample in-situ place the rock in the tote in the boat. It must hold enough water to cover the sampled rock so that the plunger works properly. Make sure the tote is clean after each sample.

Appendix B

Periphyton Laboratory Data

Epilithic (El) algal biomass (µg/cm²) for CREMP 2015 (for Azimuth consulting group)
----- samples sorted by station , date
**********R specifies a replicate count for QA/QC**

Location	Station	Date	Cyanobacteria µg/cm²	Chlorophyte µg/cm²	Chrysophyte µg/cm²	Diatom µg/cm²	Dinoflagellate µg/cm²	Total µg/cm²
SP-DT	1	18/Aug/15	376.49	0.00	0.00	170.63	0.00	547.12
SP-DT	2	18/Aug/15	77.27	27.62	0.00	67.02	0.00	171.92
SP-DT	3	18/Aug/15	120.76	0.00	0.00	160.47	0.00	281.23
SP-DT	4	18/Aug/15	73.43	0.00	0.00	212.13	0.00	285.56
SP-DT	4R	18/Aug/15	47.14	0.00	0.00	248.71	0.00	295.85
SP-DT	5	18/Aug/15	178.32	14.09	0.00	242.67	0.00	435.08
SP-ED	1	18/Aug/15	22.60	0.00	0.00	142.81	0.00	165.40
SP-ED	2	18/Aug/15	7.36	0.74	0.00	100.68	0.00	108.77
SP-ED	2R	18/Aug/15	7.42	3.65	0.00	93.66	0.00	104.73
SP-ED	3	18/Aug/15	6.68	0.00	0.65	40.74	0.00	48.07
SP-ED	4	18/Aug/15	4.76	0.00	0.00	32.90	0.00	37.66
SP-ED	5	18/Aug/15	3.48	0.00	0.42	28.69	0.00	32.60
TPE-G	1	18/Aug/15	149.96	8.07	1.11	79.58	0.00	238.72
TPE-G	2	18/Aug/15	117.31	198.31	0.00	130.22	0.00	445.83
TPE-G	3	18/Aug/15	99.33	7.05	0.00	111.97	0.00	218.35
TPE-G	4	18/Aug/15	185.18	76.10	0.00	68.15	0.00	329.43
TPE-G	5	18/Aug/15	95.76	4.93	1.17	4.94	10.82	117.62
TPE-BGN	1	18/Aug/15	1.18	4.06	0.49	22.97	0.00	28.70
TPE-BGN	2	18/Aug/15	4.07	0.00	0.97	7.51	0.00	12.56
TPE-BGN	3	18/Aug/15	0.49	0.00	0.00	5.63	0.00	6.12
TPE-BGN	4	18/Aug/15	0.26	1.51	0.00	4.21	6.71	12.69
TPE-BGN	5	18/Aug/15	44.28	1.70	0.00	7.59	0.00	53.58
TPE-BGS	1	18/Aug/15	8.74	0.00	0.18	7.48	0.00	16.40
TPE-BGS	2	18/Aug/15	17.47	0.00	1.06	14.74	6.49	39.76
TPE-BGS	3	18/Aug/15	2.08	0.00	0.35	16.91	0.00	19.34
TPE-BGS	3R	18/Aug/15	1.76	0.12	0.00	18.75	0.00	20.63
TPE-BGS	4	18/Aug/15	1.40	0.06	0.00	9.96	6.49	17.92
TPE-BGS	5	18/Aug/15	101.07	2.84	0.67	20.31	0.00	124.90
TPE-BGS	DUP	18/Aug/15	4.54	0.14	0.00	8.15	0.00	12.83

Epilithic (El) algal density (cells/cm2) for CREMP 2015 (for Azimuth consulting group)

**********R specifies a replicate count for QA/QC**

Location	Station	Date	Cyanobacteria cells/cm^2	Chlorophyte cells/cm^2	Chrysophyte cells/cm^2	Diatom cells/cm^2	Dinoflagellate cells/cm^2	Total cells/cm^2
SP-DT	1	18/Aug/15	717772	0	0	139068	0	856840
SP-DT	2	18/Aug/15	663939	7178	0	222509	0	893626
SP-DT	3	18/Aug/15	657958	0	0	209350	0	867308
SP-DT	4	18/Aug/15	358886	0	0	567040	0	925926
SP-DT	4R	18/Aug/15	409130	0	0	599340	0	1008470
SP-DT	5	18/Aug/15	714781	2991	0	230285	0	948057
SP-ED	1	18/Aug/15	300912	0	0	168400	0	469312
SP-ED	2	18/Aug/15	122021	897	0	118432	0	241351
SP-ED	2R	18/Aug/15	122021	5383	0	118432	0	245837
SP-ED	3	18/Aug/15	81108	0	2871	40913	0	124892
SP-ED	4	18/Aug/15	132070	0	0	48091	0	180161
SP-ED	5	18/Aug/15	109819	0	2153	48091	0	160063
TPE-G	1	18/Aug/15	334417	1631	4894	156605	0	497547
TPE-G	2	18/Aug/15	728026	56396	0	251220	0	1035643
TPE-G	3	18/Aug/15	472533	5981	0	289103	0	767617
TPE-G	4	18/Aug/15	758788	15381	0	184570	0	958738
TPE-G	5	18/Aug/15	278735	2393	4785	40674	1196	327783
TPE-BGN	1	18/Aug/15	9331	1436	2153	85415	0	98335
TPE-BGN	2	18/Aug/15	5024	2871	4307	64599	0	76802
TPE-BGN	3	18/Aug/15	5742	0	0	43066	0	48808
TPE-BGN	4	18/Aug/15	2871	2153	0	33735	718	39477
TPE-BGN	5	18/Aug/15	21533	2153	0	22969	0	46655
TPE-BGS	1	18/Aug/15	23686	0	718	29429	0	53833
TPE-BGS	2	18/Aug/15	20098	0	4307	46655	718	71777
TPE-BGS	3	18/Aug/15	21533	0	1436	36606	0	59575
TPE-BGS	3R	18/Aug/15	22251	1436	0	39477	0	63164
TPE-BGS	4	18/Aug/15	19380	718	0	45937	718	66753
TPE-BGS	5	18/Aug/15	30146	8613	2871	55268	0	96899
TPE-BGS	DUP	18/Aug/15	20098	1436	0	40195	0	61728

Epilithic (El) algal species data for CREMP 2015 (for Azimuth consulting group)

**** 1st number in species code = group 1=cyanobacteria 2=chlorophyte 5=diatoms 7=Dinoflagellates**
**** total daily biomass is sum of all species on a given date**
**********R specifies a replicate count for QA/QC**

Location	Station	Date	Species code	Speceis name	density cells/cm^2	biomass µg/cm^2	length µ	width µ	cell volume µ^3
SP-DT	1	18/Aug/15	5702	Achnanthes minutissima Kutzing	40375	3.04	18.00	4.00	75.40
SP-DT	1	18/Aug/15	5882	Anomoenies vitrea Ross	4486	1.49	35.30	6.00	332.70
SP-DT	1	18/Aug/15	5509	Cyclotella ocellata Pant.	4486	1.20	8.80	8.80	267.60
SP-DT	1	18/Aug/15	5865	Cymbella prostrata (Berkeley) Cleve	4486	69.14	89.00	21.00	15413.00
SP-DT	1	18/Aug/15	5728	Epithemia argus Kutzing	8972	10.81	46.00	10.00	1204.30
SP-DT	1	18/Aug/15	1084	Gloeocapsa punctata	71777	1.75	3.60	3.60	24.40
SP-DT	1	18/Aug/15	1084	Gloeocapsa punctata	17944	41.49	69.00	8.00	2312.20
SP-DT	1	18/Aug/15	5884	Gomphonema angustum Agardh	22430	25.84	44.00	10.00	1151.90
SP-DT	1	18/Aug/15	5873	Gomphonema minutum	13458	6.54	29.00	8.00	485.90
SP-DT	1	18/Aug/15	5546	Gyrosigma sp	4486	5.77	91.00	6.00	1286.50
SP-DT	1	18/Aug/15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostic	17944	5.98	106.00	2.00	333.00
SP-DT	1	18/Aug/15	1136	Lyngbya mucicola Lemmermann	502440	37.08	94.00	1.00	73.80
SP-DT	1	18/Aug/15	5767	Nitzschia fonticola Grunow	4486	0.30	16.00	4.00	67.00
SP-DT	1	18/Aug/15	1124	Petalonema alatum Berk	98694	287.43	103.00	6.00	2912.30
SP-DT	1	18/Aug/15	1077	Pseudoanabaena sp.	8972	2.76	36.00	3.30	307.90
SP-DT	1	18/Aug/15	5513	Tabellaria fenestrata (Lyngbye) Kutzing	8972	17.15	73.00	10.00	1911.10
SP-DT	1	18/Aug/15	5514	Tabellaria flocculsa (Roth) Kutzing	22430	29.35	25.50	14.00	1308.50
SP-DT	2	18/Aug/15	1077	Pseudoanabaena sp.	50244	0.65	3.40	2.20	12.90
SP-DT	2	18/Aug/15	1084	Gloeocapsa punctata	226098	5.52	3.60	3.60	24.40
SP-DT	2	18/Aug/15	1124	Petalonema alatum Berk	14355	41.81	103.00	6.00	2912.30
SP-DT	2	18/Aug/15	1136	Lyngbya mucicola Lemmermann	373241	29.30	100.00	1.00	78.50
SP-DT	2	18/Aug/15	2205	Mougeotia sp.	7178	27.62	49.00	10.00	3848.50
SP-DT	2	18/Aug/15	5460	Gomphonema truncatum Ehrenberg	3589	3.07	51.00	8.00	854.50
SP-DT	2	18/Aug/15	5514	Tabellaria flocculsa (Roth) Kutzing	14355	19.15	26.00	14.00	1334.10
SP-DT	2	18/Aug/15	5518	Synedra acus Kutzing	3589	0.44	116.00	2.00	121.50
SP-DT	2	18/Aug/15	5551	Cyclotella michiganiana Skvortzow	3589	0.18	5.00	5.00	49.10
SP-DT	2	18/Aug/15	5702	Achnanthes minutissima Kutzing	139966	10.55	18.00	4.00	75.40
SP-DT	2	18/Aug/15	5768	Nitzschia linearis W. Smith	3589	1.79	53.00	6.00	499.50
SP-DT	2	18/Aug/15	5820	Eunotia arcus Ehrenberg	7178	6.70	44.00	9.00	933.10
SP-DT	2	18/Aug/15	5870	Navicula radiosa Kutzing	3589	5.73	61.00	10.00	1597.00
SP-DT	2	18/Aug/15	5871	Cymbella lapponica	7178	3.16	26.30	8.00	440.70
SP-DT	2	18/Aug/15	5871	Cymbella lapponica	3589	3.65	38.90	10.00	1018.40
SP-DT	2	18/Aug/15	5882	Anomoenies vitrea Ross	21533	7.39	36.40	6.00	343.10
SP-DT	2	18/Aug/15	5884	Gomphonema angustum Agardh	3589	3.85	41.00	10.00	1073.40
SP-DT	2	18/Aug/15	5916	Fragilaria capucina Grunow	7178	1.36	41.00	4.20	189.30
SP-DT	3	18/Aug/15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostic	8972	1.38	49.00	2.00	153.90
SP-DT	3	18/Aug/15	1077	Pseudoanabaena sp.	2991	0.43	27.00	2.60	143.40
SP-DT	3	18/Aug/15	1084	Gloeocapsa punctata	119629	3.72	3.90	3.90	31.10
SP-DT	3	18/Aug/15	1102	Gloeothece sp.	188415	0.90	2.10	2.10	4.80
SP-DT	3	18/Aug/15	1124	Petalonema alatum Berk	5981	19.62	116.00	6.00	3279.80
SP-DT	3	18/Aug/15	1136	Lyngbya mucicola Lemmermann	314025	26.16	106.00	1.00	83.30
SP-DT	3	18/Aug/15	1220	Rivularia dura Roth	17944	68.55	76.00	8.00	3820.20
SP-DT	3	18/Aug/15	5514	Tabellaria flocculsa (Roth) Kutzing	29907	39.90	26.00	14.00	1334.10
SP-DT	3	18/Aug/15	5518	Synedra acus Kutzing	5981	0.69	110.00	2.00	115.20
SP-DT	3	18/Aug/15	5541	Nitzschia clausii Hantzsch	2991	8.23	73.00	12.00	2752.00
SP-DT	3	18/Aug/15	5702	Achnanthes minutissima Kutzing	110657	9.23	19.90	4.00	83.40
SP-DT	3	18/Aug/15	5720	Cyclotella bodanica Eulenst.	2991	37.06	31.60	31.60	12391.40
SP-DT	3	18/Aug/15	5726	Eucocconeis sp.	8972	31.20	41.00	18.00	3477.70
SP-DT	3	18/Aug/15	5728	Epithemia argus Kutzing	5981	9.51	31.00	14.00	1590.70
SP-DT	3	18/Aug/15	5821	Eunotia exigua (Brebisson) Grunow	5981	4.41	44.00	8.00	737.20
SP-DT	3	18/Aug/15	5836	Encyonema silesiacum (Bleisch) D.G. Mann	5981	6.58	28.00	10.00	1099.60
SP-DT	3	18/Aug/15	5870	Navicula radiosa Kutzing	2991	5.56	71.00	10.00	1858.80
SP-DT	3	18/Aug/15	5882	Anomoenies vitrea Ross	5981	1.76	31.30	6.00	295.00
SP-DT	3	18/Aug/15	5884	Gomphonema angustum Agardh	2991	3.26	41.60	10.00	1089.10
SP-DT	3	18/Aug/15	5916	Fragilaria capucina Grunow	17944	3.08	41.00	4.00	171.70
SP-DT	4	18/Aug/15	1077	Pseudoanabaena sp.	3589	0.59	31.00	2.60	164.60
SP-DT	4	18/Aug/15	1084	Gloeocapsa punctata	143554	4.81	4.00	4.00	33.50
SP-DT	4	18/Aug/15	1122	Phormidium autumnale Agardh	3589	9.23	91.00	6.00	2573.00
SP-DT	4	18/Aug/15	1124	Petalonema alatum Berk	14355	45.72	99.00	6.40	3184.80
SP-DT	4	18/Aug/15	1131	Heteroleibeinia profunda Komarek	82544	4.95	19.10	2.00	60.00
SP-DT	4	18/Aug/15	1136	Lyngbya mucicola Lemmermann	111255	8.12	93.00	1.00	73.00
SP-DT	4	18/Aug/15	5507	Cyclotella stelligera Cleve and Grunow	3589	13.43	21.20	21.20	3741.70
SP-DT	4	18/Aug/15	5513	Tabellaria fenestrata (Lyngbye) Kutzing	3589	9.58	102.00	10.00	2670.40
SP-DT	4	18/Aug/15	5514	Tabellaria flocculsa (Roth) Kutzing	21533	29.39	26.60	14.00	1364.90
SP-DT	4	18/Aug/15	5702	Achnanthes minutissima Kutzing	380419	30.74	19.30	4.00	80.80

Location	Station	Date	Species code	Speceis name	density cells/cm^2	biomass µg/cm^2	length µ	width µ	cell volume µ^3
SP-DT	4	18/Aug/15	5726	Eucocconeis sp.	3589	16.99	41.00	21.00	4733.60
SP-DT	4	18/Aug/15	5728	Epithemia argus Kutzing	21533	22.55	40.00	10.00	1047.20
SP-DT	4	18/Aug/15	5767	Nitzschia fonticola Grunow	21533	1.08	12.00	4.00	50.30
SP-DT	4	18/Aug/15	5768	Nitzschia linearis W. Smith	3589	1.35	40.00	6.00	377.00
SP-DT	4	18/Aug/15	5778	Stauroneis anceps Ehrenberg	7178	21.92	81.00	12.00	3053.60
SP-DT	4	18/Aug/15	5873	Gomphonema minutum	32300	14.61	27.00	8.00	452.40
SP-DT	4	18/Aug/15	5881	Diatoma elongatum Agardh	25122	4.26	18.00	6.00	169.60
SP-DT	4	18/Aug/15	5884	Gomphonema angustum Agardh	43066	46.23	41.00	10.00	1073.40
SP-DT	4R	18/Aug/15	1077	Pseudoanabaena sp.	10767	1.46	25.60	2.60	135.90
SP-DT	4R	18/Aug/15	1084	Gloeocapsa punctata	96899	3.25	4.00	4.00	33.50
SP-DT	4R	18/Aug/15	1124	Petalonema alatum Berk	7178	22.86	99.00	6.40	3184.80
SP-DT	4R	18/Aug/15	1131	Heteroleibeinia profunda Komarek	147143	8.83	19.10	2.00	60.00
SP-DT	4R	18/Aug/15	1136	Lyngbya mucicola Lemmermann	147143	10.74	93.00	1.00	73.00
SP-DT	4R	18/Aug/15	5507	Cyclotella stelligera Cleve and Grunow	7178	26.86	21.20	21.20	3741.70
SP-DT	4R	18/Aug/15	5513	Tabellaria fenestrata (Lyngbye) Kutzing	3589	9.58	102.00	10.00	2670.40
SP-DT	4R	18/Aug/15	5514	Tabellaria flocculsa (Roth) Kutzing	35889	48.98	26.60	14.00	1364.90
SP-DT	4R	18/Aug/15	5702	Achnanthes minutissima Kutzing	398363	32.19	19.30	4.00	80.80
SP-DT	4R	18/Aug/15	5726	Eucocconeis sp.	3589	16.57	40.00	21.00	4618.10
SP-DT	4R	18/Aug/15	5728	Epithemia argus Kutzing	28711	30.07	40.00	10.00	1047.20
SP-DT	4R	18/Aug/15	5767	Nitzschia fonticola Grunow	14355	0.72	12.00	4.00	50.30
SP-DT	4R	18/Aug/15	5778	Stauroneis anceps Ehrenberg	7178	21.92	81.00	12.00	3053.60
SP-DT	4R	18/Aug/15	5825	Fragilaria pinata Ehrenberg	7178	0.68	10.00	6.00	94.20
SP-DT	4R	18/Aug/15	5873	Gomphonema minutum	17944	8.12	27.00	8.00	452.40
SP-DT	4R	18/Aug/15	5881	Diatoma elongatum Agardh	21533	3.65	18.00	6.00	169.60
SP-DT	4R	18/Aug/15	5882	Anomoenies vitrea Ross	10767	3.15	31.00	6.00	292.20
SP-DT	4R	18/Aug/15	5884	Gomphonema angustum Agardh	43066	46.23	41.00	10.00	1073.40
SP-DT	5	18/Aug/15	1084	Gloeocapsa punctata	317016	7.74	3.60	3.60	24.40
SP-DT	5	18/Aug/15	1124	Petalonema alatum Berk	35889	126.46	103.00	6.60	3523.80
SP-DT	5	18/Aug/15	1136	Lyngbya mucicola Lemmermann	358886	29.03	103.00	1.00	80.90
SP-DT	5	18/Aug/15	1220	Rivularia dura Roth	2991	15.08	91.00	8.40	5043.00
SP-DT	5	18/Aug/15	2178	Cosmarium sp.	2991	14.09	30.00	30.00	4712.40
SP-DT	5	18/Aug/15	5311	Cymbella minuta Kutzing	2991	1.17	15.60	8.00	392.10
SP-DT	5	18/Aug/15	5514	Tabellaria flocculsa (Roth) Kutzing	44861	56.86	24.70	14.00	1267.40
SP-DT	5	18/Aug/15	5518	Synedra acus Kutzing	2991	0.34	110.00	2.00	115.20
SP-DT	5	18/Aug/15	5523	Synedra ulna (Nitzsch) Ehrenberg	2991	21.92	280.00	10.00	7330.40
SP-DT	5	18/Aug/15	5702	Achnanthes minutissima Kutzing	83740	6.81	19.40	4.00	81.30
SP-DT	5	18/Aug/15	5726	Eucocconeis sp.	2991	11.27	36.00	20.00	3769.90
SP-DT	5	18/Aug/15	5768	Nitzschia linearis W. Smith	2991	0.66	53.00	4.00	222.00
SP-DT	5	18/Aug/15	5778	Stauroneis anceps Ehrenberg	2991	9.13	81.00	12.00	3053.60
SP-DT	5	18/Aug/15	5836	Encyonema silesiacum (Bleisch) D.G. Mann	5981	6.25	26.60	10.00	1044.60
SP-DT	5	18/Aug/15	5865	Cymbella prostrata (Berkeley) Cleve	5981	80.67	106.00	18.00	13486.90
SP-DT	5	18/Aug/15	5870	Navicula radiosa Kutzing	2991	15.35	100.00	14.00	5131.30
SP-DT	5	18/Aug/15	5871	Cymbella lapponica	8972	9.16	39.00	10.00	1021.00
SP-DT	5	18/Aug/15	5873	Gomphonema minutum	14954	7.27	29.00	8.00	485.90
SP-DT	5	18/Aug/15	5882	Anomoenies vitrea Ross	20935	6.71	34.00	6.00	320.40
SP-DT	5	18/Aug/15	5884	Gomphonema angustum Agardh	5981	5.64	36.00	10.00	942.50
SP-DT	5	18/Aug/15	5916	Fragilaria capucina Grunow	17944	3.46	46.00	4.00	192.70
SP-ED	1	18/Aug/15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostic	20705	7.54	116.00	2.00	364.40
SP-ED	1	18/Aug/15	1084	Gloeocapsa punctata	34508	0.84	3.60	3.60	24.40
SP-ED	1	18/Aug/15	1102	Gloeothece sp.	153217	0.64	2.00	2.00	4.20
SP-ED	1	18/Aug/15	1122	Phormidium autumnale Agardh	1380	5.92	210.00	5.10	4289.90
SP-ED	1	18/Aug/15	1131	Heteroleibeinia profunda Komarek	16564	1.61	31.00	2.00	97.40
SP-ED	1	18/Aug/15	1136	Lyngbya mucicola Lemmermann	74538	6.03	103.00	1.00	80.90
SP-ED	1	18/Aug/15	5507	Cyclotella stelligera Cleve and Grunow	2761	6.98	18.60	18.60	2527.00
SP-ED	1	18/Aug/15	5509	Cyclotella ocellata Pant.	5521	1.24	8.30	8.30	224.50
SP-ED	1	18/Aug/15	5514	Tabellaria flocculsa (Roth) Kutzing	60735	81.03	26.00	14.00	1334.10
SP-ED	1	18/Aug/15	5518	Synedra acus Kutzing	1380	0.16	110.00	2.00	115.20
SP-ED	1	18/Aug/15	5702	Achnanthes minutissima Kutzing	57974	7.87	21.60	4.00	135.70
SP-ED	1	18/Aug/15	5720	Cyclotella bodanica Eulenst.	1380	19.48	33.00	33.00	14112.40
SP-ED	1	18/Aug/15	5726	Eucocconeis sp.	4141	14.40	41.00	18.00	3477.70
SP-ED	1	18/Aug/15	5751	Navicula incerta Grunow	4141	0.45	26.00	4.00	108.90
SP-ED	1	18/Aug/15	5767	Nitzschia fonticola Grunow	5521	0.46	20.00	4.00	83.80
SP-ED	1	18/Aug/15	5768	Nitzschia linearis W. Smith	4141	0.71	41.00	4.00	171.70
SP-ED	1	18/Aug/15	5871	Cymbella lapponica	2761	2.89	40.00	10.00	1047.20
SP-ED	1	18/Aug/15	5874	Nitzschia palea (Kutzing) W. Smith	2761	2.42	93.00	6.00	876.50
SP-ED	1	18/Aug/15	5882	Anomoenies vitrea Ross	15184	4.72	33.00	6.00	311.00
SP-ED	2	18/Aug/15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostic	4486	1.14	81.00	2.00	254.50
SP-ED	2	18/Aug/15	1077	Pseudoanabaena sp.	2692	0.27	29.00	2.10	100.40
SP-ED	2	18/Aug/15	1084	Gloeocapsa punctata	14355	0.45	3.90	3.90	31.10
SP-ED	2	18/Aug/15	1102	Gloeothece sp.	8972	0.04	2.00	2.00	4.20
SP-ED	2	18/Aug/15	1136	Lyngbya mucicola Lemmermann	91516	5.46	76.00	1.00	59.70
SP-ED	2	18/Aug/15	2205	Mougeotia sp.	897	0.74	29.00	6.00	820.00
SP-ED	2	18/Aug/15	5509	Cyclotella ocellata Pant.	1794	0.40	8.30	8.30	224.50
SP-ED	2	18/Aug/15	5514	Tabellaria flocculsa (Roth) Kutzing	55627	74.21	26.00	14.00	1334.10
SP-ED	2	18/Aug/15	5518	Synedra acus Kutzing	897	0.10	106.00	2.00	111.00
SP-ED	2	18/Aug/15	5546	Gyrosigma sp	897	0.48	86.00	4.00	540.40
SP-ED	2	18/Aug/15	5551	Cyclotella michiganiana Skvortzow	897	0.05	5.10	5.10	52.10

Location	Station	Date	Species code	Speceis name	density cells/cm^2	biomass µg/cm^2	length µ	width µ	cell volume µ^3
SP-ED	2	18/Aug/15	5702	Achnanthes minutissima Kutzing	29608	2.68	21.60	4.00	90.50
SP-ED	2	18/Aug/15	5720	Cyclotella bodanica Eulenst.	897	11.12	31.60	31.60	12391.40
SP-ED	2	18/Aug/15	5836	Encyonema silesiacum (Bleisch) D.G. Mann	2692	2.75	26.00	10.00	1021.00
SP-ED	2	18/Aug/15	5857	Nitzschia filiformis (W. Smith) Hustedt	2692	0.41	36.00	4.00	150.80
SP-ED	2	18/Aug/15	5871	Cymbella lapponica	2692	2.82	40.00	10.00	1047.20
SP-ED	2	18/Aug/15	5873	Gomphonema minutum	5383	2.34	26.00	8.00	435.60
SP-ED	2	18/Aug/15	5882	Anomoenies vitrea Ross	5383	1.78	35.00	6.00	329.90
SP-ED	2	18/Aug/15	5916	Fragilaria capucina Grunow	8972	1.54	41.00	4.00	171.70
SP-ED	2R	18/Aug/15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostic	1794	0.52	93.00	2.00	292.20
SP-ED	2R	18/Aug/15	1077	Pseudoanabaena sp.	1794	0.19	30.00	2.10	103.90
SP-ED	2R	18/Aug/15	1084	Gloeocapsa punctata	20636	0.64	3.90	3.90	31.10
SP-ED	2R	18/Aug/15	1136	Lyngbya mucicola Lemmermann	97796	6.06	79.00	1.00	62.00
SP-ED	2R	18/Aug/15	2205	Mougeotia sp.	5383	3.65	24.00	6.00	678.60
SP-ED	2R	18/Aug/15	5507	Cyclotella stelligera Cleve and Grunow	897	2.38	18.90	18.90	2651.20
SP-ED	2R	18/Aug/15	5509	Cyclotella ocellata Pant.	897	0.20	8.30	8.30	224.50
SP-ED	2R	18/Aug/15	5514	Tabellaria flocculsa (Roth) Kutzing	52936	70.62	26.00	14.00	1334.10
SP-ED	2R	18/Aug/15	5518	Synedra acus Kutzing	1794	0.20	106.00	2.00	111.00
SP-ED	2R	18/Aug/15	5524	Asterionella formosa Hassall	1794	0.18	96.00	2.00	100.50
SP-ED	2R	18/Aug/15	5551	Cyclotella michiganiana Skvortzow	897	0.05	5.10	5.10	52.10
SP-ED	2R	18/Aug/15	5702	Achnanthes minutissima Kutzing	20636	1.87	21.60	4.00	90.50
SP-ED	2R	18/Aug/15	5781	Eunotia sp.	6281	7.23	44.00	10.00	1151.90
SP-ED	2R	18/Aug/15	5836	Encyonema silesiacum (Bleisch) D.G. Mann	1794	1.83	26.00	10.00	1021.00
SP-ED	2R	18/Aug/15	5854	Pinnularia borealis Ehrenberg	897	1.62	69.00	10.00	1806.40
SP-ED	2R	18/Aug/15	5857	Nitzschia filiformis (W. Smith) Hustedt	5383	0.81	36.00	4.00	150.80
SP-ED	2R	18/Aug/15	5873	Gomphonema minutum	6281	2.74	26.00	8.00	435.60
SP-ED	2R	18/Aug/15	5882	Anomoenies vitrea Ross	5383	1.78	35.00	6.00	329.90
SP-ED	2R	18/Aug/15	5916	Fragilaria capucina Grunow	12561	2.16	41.00	4.00	171.70
SP-ED	3	18/Aug/15	1084	Gloeocapsa punctata	10049	0.21	3.40	3.40	20.60
SP-ED	3	18/Aug/15	1136	Lyngbya mucicola Lemmermann	71059	6.47	116.00	1.00	91.10
SP-ED	3	18/Aug/15	4388	Dinobryon sertularia Ehrenberg	2871	0.65	12.00	6.00	226.20
SP-ED	3	18/Aug/15	5306	Navicula minima Grunow	718	0.03	11.00	4.00	46.10
SP-ED	3	18/Aug/15	5507	Cyclotella stelligera Cleve and Grunow	718	2.25	20.00	20.00	3141.60
SP-ED	3	18/Aug/15	5514	Tabellaria flocculsa (Roth) Kutzing	10767	14.09	25.50	14.00	1308.50
SP-ED	3	18/Aug/15	5518	Synedra acus Kutzing	4307	0.46	103.00	2.00	107.90
SP-ED	3	18/Aug/15	5551	Cyclotella michiganiana Skvortzow	1436	0.08	5.20	5.20	55.20
SP-ED	3	18/Aug/15	5702	Achnanthes minutissima Kutzing	8613	0.72	19.90	4.00	83.40
SP-ED	3	18/Aug/15	5720	Cyclotella bodanica Eulenst.	718	8.89	31.60	31.60	12391.40
SP-ED	3	18/Aug/15	5726	Eucocconeis sp.	1436	6.01	40.00	20.00	4188.80
SP-ED	3	18/Aug/15	5733	Eunotia pectinalis (Kutzing) Rabenhorst	718	0.62	91.00	6.00	857.70
SP-ED	3	18/Aug/15	5792	Neidium iridis (Ehrenberg) Cleve	718	2.19	81.00	12.00	3053.60
SP-ED	3	18/Aug/15	5836	Encyonema silesiacum (Bleisch) D.G. Mann	1436	1.69	30.00	10.00	1178.10
SP-ED	3	18/Aug/15	5870	Navicula radiosa Kutzing	718	1.56	83.00	10.00	2172.90
SP-ED	3	18/Aug/15	5871	Cymbella lapponica	718	0.75	40.00	10.00	1047.20
SP-ED	3	18/Aug/15	5873	Gomphonema minutum	718	0.30	25.00	8.00	418.90
SP-ED	3	18/Aug/15	5916	Fragilaria capucina Grunow	7178	1.08	36.00	4.00	150.80
SP-ED	4	18/Aug/15	1084	Gloeocapsa punctata	2871	0.06	3.40	3.40	20.60
SP-ED	4	18/Aug/15	1102	Gloeothece sp.	81108	0.39	2.10	2.10	4.80
SP-ED	4	18/Aug/15	1131	Heteroleibeinia profunda Komarek	2153	0.13	19.00	2.00	59.70
SP-ED	4	18/Aug/15	1136	Lyngbya mucicola Lemmermann	45937	4.18	116.00	1.00	91.10
SP-ED	4	18/Aug/15	5507	Cyclotella stelligera Cleve and Grunow	718	1.64	18.00	18.00	2290.20
SP-ED	4	18/Aug/15	5514	Tabellaria flocculsa (Roth) Kutzing	10767	14.09	25.50	14.00	1308.50
SP-ED	4	18/Aug/15	5518	Synedra acus Kutzing	1436	0.17	110.00	2.00	115.20
SP-ED	4	18/Aug/15	5702	Achnanthes minutissima Kutzing	19380	1.56	19.20	4.00	80.40
SP-ED	4	18/Aug/15	5720	Cyclotella bodanica Eulenst.	718	10.13	33.00	33.00	14112.40
SP-ED	4	18/Aug/15	5767	Nitzschia fonticola Grunow	4307	0.51	28.00	4.00	117.30
SP-ED	4	18/Aug/15	5821	Eunotia exigua (Brebisson) Grunow	1436	0.63	26.00	8.00	435.60
SP-ED	4	18/Aug/15	5836	Encyonema silesiacum (Bleisch) D.G. Mann	718	0.85	30.00	10.00	1178.10
SP-ED	4	18/Aug/15	5873	Gomphonema minutum	1436	0.63	26.00	8.00	435.60
SP-ED	4	18/Aug/15	5875	Cocconies disculus Schum.	718	0.97	26.30	14.00	1349.50
SP-ED	4	18/Aug/15	5882	Anomoenies vitrea Ross	4307	1.42	35.00	6.00	329.90
SP-ED	4	18/Aug/15	5916	Fragilaria capucina Grunow	2153	0.32	36.00	4.00	150.80
SP-ED	5	18/Aug/15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostic	1436	0.42	93.00	2.00	292.20
SP-ED	5	18/Aug/15	1102	Gloeothece sp.	68906	0.33	2.10	2.10	4.80
SP-ED	5	18/Aug/15	1131	Heteroleibeinia profunda Komarek	17944	0.99	17.60	2.00	55.30
SP-ED	5	18/Aug/15	1136	Lyngbya mucicola Lemmermann	21533	1.74	103.00	1.00	80.90
SP-ED	5	18/Aug/15	4381	Dinobryon mucronutom Nygaard	718	0.09	10.00	5.00	130.90
SP-ED	5	18/Aug/15	4388	Dinobryon sertularia Ehrenberg	1436	0.32	12.00	6.00	226.20
SP-ED	5	18/Aug/15	5507	Cyclotella stelligera Cleve and Grunow	2871	6.91	18.30	18.30	2406.70
SP-ED	5	18/Aug/15	5514	Tabellaria flocculsa (Roth) Kutzing	7895	10.53	26.00	14.00	1334.10
SP-ED	5	18/Aug/15	5518	Synedra acus Kutzing	718	0.08	110.00	2.00	115.20
SP-ED	5	18/Aug/15	5551	Cyclotella michiganiana Skvortzow	718	0.04	5.00	5.00	49.10
SP-ED	5	18/Aug/15	5702	Achnanthes minutissima Kutzing	20098	1.77	21.00	4.00	88.00
SP-ED	5	18/Aug/15	5767	Nitzschia fonticola Grunow	1436	0.19	31.00	4.00	129.90
SP-ED	5	18/Aug/15	5821	Eunotia exigua (Brebisson) Grunow	718	0.14	30.00	5.00	196.30
SP-ED	5	18/Aug/15	5836	Encyonema silesiacum (Bleisch) D.G. Mann	2871	3.19	28.30	10.00	1111.30
SP-ED	5	18/Aug/15	5854	Pinnularia borealis Ehrenberg	718	3.43	93.00	14.00	4772.10
SP-ED	5	18/Aug/15	5873	Gomphonema minutum	2153	0.97	27.00	8.00	452.40

Location	Station	Date	Species code	Speceis name	density cells/cm^2	biomass µg/cm^2	length µ	width µ	cell volume µ^3
SP-ED	5	18/Aug/15	5882	Anomoenies vitrea Ross	1436	0.47	35.00	6.00	329.90
SP-ED	5	18/Aug/15	5916	Fragilaria capucina Grunow	6460	0.97	36.00	4.00	150.80
TPE-BGN	1	18/Aug/15	1131	Heteroleibeinia profunda Komarek	5742	0.29	16.00	2.00	50.30
TPE-BGN	1	18/Aug/15	1136	Lyngbya mucicola Lemmermann	1436	0.14	126.00	1.00	99.00
TPE-BGN	1	18/Aug/15	1239	Homoeothrix varians Komarek & Kalina	2153	0.75	46.00	3.10	347.20
TPE-BGN	1	18/Aug/15	2205	Mougeotia sp.	1436	4.06	36.00	10.00	2827.40
TPE-BGN	1	18/Aug/15	4388	Dinobryon sertularia Ehrenberg	2153	0.49	12.00	6.00	226.20
TPE-BGN	1	18/Aug/15	5509	Cyclotella ocellata Pant.	1436	0.36	8.60	8.60	249.80
TPE-BGN	1	18/Aug/15	5514	Tabellaria flocculsa (Roth) Kutzing	6460	8.05	24.30	14.00	1246.90
TPE-BGN	1	18/Aug/15	5547	Frustulia rhomboides (Ehrenberg) de Toni	718	1.78	63.00	10.00	2474.00
TPE-BGN	1	18/Aug/15	5551	Cyclotella michiganiana Skvortzow	3589	0.19	5.10	5.10	52.10
TPE-BGN	1	18/Aug/15	5702	Achnanthes minutissima Kutzing	71059	5.95	20.00	4.00	83.80
TPE-BGN	1	18/Aug/15	5792	Neidium iridis (Ehrenberg) Cleve	718	6.09	81.00	20.00	8482.30
TPE-BGN	1	18/Aug/15	5874	Nitzschia palea (Kutzing) W. Smith	718	0.35	51.00	6.00	480.70
TPE-BGN	1	18/Aug/15	5882	Anomoenies vitrea Ross	718	0.21	31.00	6.00	292.20
TPE-BGN	2	18/Aug/15	1122	Phormidium autumnale Agardh	1436	3.77	93.00	6.00	2629.50
TPE-BGN	2	18/Aug/15	1136	Lyngbya mucicola Lemmermann	3589	0.29	103.00	1.00	80.90
TPE-BGN	2	18/Aug/15	2145	Crucigenia quadrata Morr.	2871	0.00	2.00	2.00	1.40
TPE-BGN	2	18/Aug/15	4388	Dinobryon sertularia Ehrenberg	4307	0.97	12.00	6.00	226.20
TPE-BGN	2	18/Aug/15	5509	Cyclotella ocellata Pant.	5024	1.39	8.90	8.90	276.80
TPE-BGN	2	18/Aug/15	5514	Tabellaria flocculsa (Roth) Kutzing	718	0.88	24.00	14.00	1231.50
TPE-BGN	2	18/Aug/15	5702	Achnanthes minutissima Kutzing	56704	4.66	19.60	4.00	82.10
TPE-BGN	2	18/Aug/15	5882	Anomoenies vitrea Ross	1436	0.45	33.00	6.00	311.00
TPE-BGN	2	18/Aug/15	5887	Navicula pupula Kutzing	718	0.14	20.00	6.00	188.50
TPE-BGN	3	18/Aug/15	1077	Pseudoanabaena sp.	1436	0.14	31.00	2.00	97.40
TPE-BGN	3	18/Aug/15	1136	Lyngbya mucicola Lemmermann	4307	0.35	104.00	1.00	81.70
TPE-BGN	3	18/Aug/15	5311	Cymbella minuta Kutzing	718	0.20	14.60	7.00	280.90
TPE-BGN	3	18/Aug/15	5509	Cyclotella ocellata Pant.	10049	2.78	8.90	8.90	276.80
TPE-BGN	3	18/Aug/15	5551	Cyclotella michiganiana Skvortzow	2153	0.08	4.60	4.60	38.20
TPE-BGN	3	18/Aug/15	5702	Achnanthes minutissima Kutzing	27993	2.15	18.30	4.00	76.70
TPE-BGN	3	18/Aug/15	5874	Nitzschia palea (Kutzing) W. Smith	2153	0.41	46.00	4.00	192.70
TPE-BGN	4	18/Aug/15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostic	718	0.13	56.00	2.00	175.90
TPE-BGN	4	18/Aug/15	1136	Lyngbya mucicola Lemmermann	2153	0.14	81.00	1.00	63.60
TPE-BGN	4	18/Aug/15	2205	Mougeotia sp.	2153	1.51	24.00	6.10	701.40
TPE-BGN	4	18/Aug/15	5509	Cyclotella ocellata Pant.	4307	1.36	9.30	9.30	315.90
TPE-BGN	4	18/Aug/15	5551	Cyclotella michiganiana Skvortzow	1436	0.07	5.00	5.00	49.10
TPE-BGN	4	18/Aug/15	5702	Achnanthes minutissima Kutzing	25840	2.17	20.00	4.00	83.80
TPE-BGN	4	18/Aug/15	5874	Nitzschia palea (Kutzing) W. Smith	718	0.14	46.00	4.00	192.70
TPE-BGN	4	18/Aug/15	5882	Anomoenies vitrea Ross	1436	0.47	35.00	6.00	329.90
TPE-BGN	4	18/Aug/15	7641	Peridinium aciculiferum Lemmermann	718	6.71	31.00	24.00	9349.40
TPE-BGN	5	18/Aug/15	1124	Petalonema alatum Berk	15073	43.90	103.00	6.00	2912.30
TPE-BGN	5	18/Aug/15	1136	Lyngbya mucicola Lemmermann	6460	0.39	76.00	1.00	59.70
TPE-BGN	5	18/Aug/15	2205	Mougeotia sp.	2153	1.70	28.00	6.00	791.70
TPE-BGN	5	18/Aug/15	5514	Tabellaria flocculsa (Roth) Kutzing	2153	2.76	25.00	14.00	1282.80
TPE-BGN	5	18/Aug/15	5518	Synedra acus Kutzing	718	0.08	110.00	2.00	115.20
TPE-BGN	5	18/Aug/15	5551	Cyclotella michiganiana Skvortzow	1436	0.05	4.60	4.60	38.20
TPE-BGN	5	18/Aug/15	5702	Achnanthes minutissima Kutzing	13638	1.20	21.00	4.00	88.00
TPE-BGN	5	18/Aug/15	5836	Encyonema silesiacum (Bleisch) D.G. Mann	2153	2.37	28.00	10.00	1099.60
TPE-BGN	5	18/Aug/15	5882	Anomoenies vitrea Ross	2153	0.73	36.00	6.00	339.30
TPE-BGN	5	18/Aug/15	5916	Fragilaria capucina Grunow	718	0.39	58.00	6.00	546.60
TPE-BGS	1	18/Aug/15	1131	Heteroleibeinia profunda Komarek	1436	0.09	19.00	2.00	59.70
TPE-BGS	1	18/Aug/15	1136	Lyngbya mucicola Lemmermann	12920	0.84	83.00	1.00	65.20
TPE-BGS	1	18/Aug/15	1220	Rivularia dura Roth	2871	7.55	93.00	6.00	2629.50
TPE-BGS	1	18/Aug/15	1238	Clastidium cylindricum Whelden	6460	0.26	7.60	3.20	40.70
TPE-BGS	1	18/Aug/15	4388	Dinobryon sertularia Ehrenberg	718	0.18	13.00	6.00	245.00
TPE-BGS	1	18/Aug/15	5507	Cyclotella stelligera Cleve and Grunow	718	1.84	18.70	18.70	2567.90
TPE-BGS	1	18/Aug/15	5509	Cyclotella ocellata Pant.	1436	0.32	8.30	8.30	224.50
TPE-BGS	1	18/Aug/15	5702	Achnanthes minutissima Kutzing	21533	1.80	20.00	4.00	83.80
TPE-BGS	1	18/Aug/15	5873	Gomphonema minutum	4307	1.95	27.00	8.00	452.40
TPE-BGS	1	18/Aug/15	5884	Gomphonema angustum Agardh	718	0.89	39.00	11.00	1235.40
TPE-BGS	1	18/Aug/15	5916	Fragilaria capucina Grunow	718	0.68	100.00	6.00	942.50
TPE-BGS	2	18/Aug/15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostic	3589	0.97	86.00	2.00	270.20
TPE-BGS	2	18/Aug/15	1122	Phormidium autumnale Agardh	718	2.84	140.00	6.00	3958.40
TPE-BGS	2	18/Aug/15	1124	Petalonema alatum Berk	718	1.89	93.00	6.00	2629.50
TPE-BGS	2	18/Aug/15	1136	Lyngbya mucicola Lemmermann	12202	0.97	101.00	1.00	79.30
TPE-BGS	2	18/Aug/15	1220	Rivularia dura Roth	2871	10.80	110.00	6.60	3763.30
TPE-BGS	2	18/Aug/15	4388	Dinobryon sertularia Ehrenberg	4307	1.06	13.00	6.00	245.00
TPE-BGS	2	18/Aug/15	5507	Cyclotella stelligera Cleve and Grunow	718	1.73	18.30	18.30	2406.70
TPE-BGS	2	18/Aug/15	5514	Tabellaria flocculsa (Roth) Kutzing	3589	4.60	25.00	14.00	1282.80
TPE-BGS	2	18/Aug/15	5551	Cyclotella michiganiana Skvortzow	718	0.04	5.00	5.00	49.10
TPE-BGS	2	18/Aug/15	5702	Achnanthes minutissima Kutzing	36606	3.07	20.00	4.00	83.80
TPE-BGS	2	18/Aug/15	5726	Eucocconeis sp.	718	3.01	40.00	20.00	4188.80
TPE-BGS	2	18/Aug/15	5857	Nitzschia filiformis (W. Smith) Hustedt	718	0.11	36.00	4.00	150.80
TPE-BGS	2	18/Aug/15	5873	Gomphonema minutum	2153	0.94	26.00	8.00	435.60
TPE-BGS	2	18/Aug/15	5884	Gomphonema angustum Agardh	718	0.77	41.00	10.00	1073.40
TPE-BGS	2	18/Aug/15	5916	Fragilaria capucina Grunow	718	0.49	72.00	6.00	678.60
TPE-BGS	2	18/Aug/15	7641	Peridinium aciculiferum Lemmermann	718	6.49	30.00	24.00	9047.80

Location	Station	Date	Species code	Speceis name	density cells/cm^2	biomass µg/cm^2	length µ	width µ	cell volume µ^3
TPE-BGS	3	18/Aug/15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostic	1436	0.66	146.00	2.00	458.70
TPE-BGS	3	18/Aug/15	1131	Heteroleibeinia profunda Komarek	2871	0.15	17.00	2.00	53.40
TPE-BGS	3	18/Aug/15	1136	Lyngbya mucicola Lemmermann	17227	1.27	94.00	1.00	73.80
TPE-BGS	3	18/Aug/15	4388	Dinobryon sertularia Ehrenberg	1436	0.35	13.00	6.00	245.00
TPE-BGS	3	18/Aug/15	5507	Cyclotella stelligera Cleve and Grunow	718	1.70	18.20	18.20	2367.40
TPE-BGS	3	18/Aug/15	5514	Tabellaria flocculsa (Roth) Kutzing	5742	7.16	24.30	14.00	1246.90
TPE-BGS	3	18/Aug/15	5547	Frustulia rhomboides (Ehrenberg) de Toni	718	1.58	56.00	10.00	2199.10
TPE-BGS	3	18/Aug/15	5551	Cyclotella michiganiana Skvortzow	718	0.04	5.00	5.00	49.10
TPE-BGS	3	18/Aug/15	5702	Achnanthes minutissima Kutzing	20098	1.68	20.00	4.00	83.80
TPE-BGS	3	18/Aug/15	5767	Nitzschia fonticola Grunow	1436	0.20	30.00	4.20	138.50
TPE-BGS	3	18/Aug/15	5857	Nitzschia filiformis (W. Smith) Hustedt	1436	0.20	33.00	4.00	138.20
TPE-BGS	3	18/Aug/15	5873	Gomphonema minutum	1436	0.63	26.00	8.00	435.60
TPE-BGS	3	18/Aug/15	5875	Cocconies disculus Schum.	718	1.04	28.20	14.00	1447.00
TPE-BGS	3	18/Aug/15	5884	Gomphonema angustum Agardh	718	0.77	41.00	10.00	1073.40
TPE-BGS	3	18/Aug/15	5916	Fragilaria capucina Grunow	2871	1.92	71.00	6.00	669.20
TPE-BGS	3R	18/Aug/15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostic	718	0.33	146.00	2.00	458.70
TPE-BGS	3R	18/Aug/15	1131	Heteroleibeinia profunda Komarek	7895	0.42	17.00	2.00	53.40
TPE-BGS	3R	18/Aug/15	1136	Lyngbya mucicola Lemmermann	13638	1.01	94.00	1.00	73.80
TPE-BGS	3R	18/Aug/15	2138	Monoraphidium komarkovae (Nyg.) Komarko	1436	0.12	51.00	1.80	86.50
TPE-BGS	3R	18/Aug/15	5507	Cyclotella stelligera Cleve and Grunow	718	1.65	18.10	18.00	2302.90
TPE-BGS	3R	18/Aug/15	5514	Tabellaria flocculsa (Roth) Kutzing	8613	10.74	24.30	14.00	1246.90
TPE-BGS	3R	18/Aug/15	5551	Cyclotella michiganiana Skvortzow	2153	0.11	5.00	5.00	49.10
TPE-BGS	3R	18/Aug/15	5702	Achnanthes minutissima Kutzing	18662	1.56	20.00	4.00	83.80
TPE-BGS	3R	18/Aug/15	5767	Nitzschia fonticola Grunow	718	0.10	30.00	4.20	138.50
TPE-BGS	3R	18/Aug/15	5857	Nitzschia filiformis (W. Smith) Hustedt	2871	0.40	33.00	4.00	138.20
TPE-BGS	3R	18/Aug/15	5873	Gomphonema minutum	2153	0.94	26.00	8.00	435.60
TPE-BGS	3R	18/Aug/15	5875	Cocconies disculus Schum.	718	1.04	28.20	14.00	1447.00
TPE-BGS	3R	18/Aug/15	5884	Gomphonema angustum Agardh	718	0.77	41.00	10.00	1073.40
TPE-BGS	3R	18/Aug/15	5916	Fragilaria capucina Grunow	2153	1.44	71.00	6.00	669.20
TPE-BGS	4	18/Aug/15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostic	2153	0.78	116.00	2.00	364.40
TPE-BGS	4	18/Aug/15	1136	Lyngbya mucicola Lemmermann	5742	0.42	94.00	1.00	73.80
TPE-BGS	4	18/Aug/15	1223	Chamaesiphon incrustans Smith	11484	0.19	5.60	2.40	16.90
TPE-BGS	4	18/Aug/15	2138	Monoraphidium komarkovae (Nyg.) Komarko	718	0.06	53.00	1.80	89.90
TPE-BGS	4	18/Aug/15	5311	Cymbella minuta Kutzing	718	0.27	15.10	8.00	379.50
TPE-BGS	4	18/Aug/15	5507	Cyclotella stelligera Cleve and Grunow	718	1.90	18.90	18.90	2651.20
TPE-BGS	4	18/Aug/15	5514	Tabellaria flocculsa (Roth) Kutzing	2153	2.76	25.00	14.00	1282.80
TPE-BGS	4	18/Aug/15	5516	Fragilaria construens (Ehrenberg) Grunow	1436	0.13	22.00	4.00	92.20
TPE-BGS	4	18/Aug/15	5702	Achnanthes minutissima Kutzing	36606	3.22	21.00	4.00	88.00
TPE-BGS	4	18/Aug/15	5753	Navicula sp.	1436	0.31	23.00	6.00	216.80
TPE-BGS	4	18/Aug/15	5821	Eunotia exigua (Brebisson) Grunow	718	0.41	34.00	8.00	569.70
TPE-BGS	4	18/Aug/15	5860	Diatoma vulgare Bory	718	0.16	24.00	6.00	226.20
TPE-BGS	4	18/Aug/15	5873	Gomphonema minutum	718	0.31	26.00	8.00	435.60
TPE-BGS	4	18/Aug/15	5916	Fragilaria capucina Grunow	718	0.47	70.00	6.00	659.70
TPE-BGS	4	18/Aug/15	7641	Peridinium aciculiferum Lemmermann	718	6.49	30.00	24.00	9047.80
TPE-BGS	5	18/Aug/15	1077	Pseudoanabaena sp.	6460	0.69	31.00	2.10	107.40
TPE-BGS	5	18/Aug/15	1078	Planktothrix agardhii (Gom.) Anagnostidis an	12202	99.67	104.00	10.00	8168.10
TPE-BGS	5	18/Aug/15	1136	Lyngbya mucicola Lemmermann	11484	0.71	79.00	1.00	62.00
TPE-BGS	5	18/Aug/15	2226	Ulothrix sp.	7178	2.23	11.00	6.00	311.00
TPE-BGS	5	18/Aug/15	2954	Stigeoclonium sp.	1436	0.61	15.00	6.00	424.10
TPE-BGS	5	18/Aug/15	4388	Dinobryon sertularia Ehrenberg	2871	0.67	12.40	6.00	233.70
TPE-BGS	5	18/Aug/15	5311	Cymbella minuta Kutzing	2153	0.87	16.00	8.00	402.10
TPE-BGS	5	18/Aug/15	5507	Cyclotella stelligera Cleve and Grunow	718	1.76	18.40	18.40	2446.30
TPE-BGS	5	18/Aug/15	5514	Tabellaria flocculsa (Roth) Kutzing	6460	8.29	25.00	14.00	1282.80
TPE-BGS	5	18/Aug/15	5518	Synedra acus Kutzing	718	0.08	103.00	2.00	107.90
TPE-BGS	5	18/Aug/15	5702	Achnanthes minutissima Kutzing	25122	2.11	20.00	4.00	83.80
TPE-BGS	5	18/Aug/15	5836	Encyonema silesiacum (Bleisch) D.G. Mann	1436	1.58	28.00	10.00	1099.60
TPE-BGS	5	18/Aug/15	5871	Cymbella lapponica	718	0.77	41.00	10.00	1073.40
TPE-BGS	5	18/Aug/15	5873	Gomphonema minutum	718	0.31	26.00	8.00	435.60
TPE-BGS	5	18/Aug/15	5881	Diatoma elongatum Agardh	13638	1.88	33.00	4.00	138.20
TPE-BGS	5	18/Aug/15	5916	Fragilaria capucina Grunow	3589	2.67	79.00	6.00	744.60
TPE-BGS	DUP	18/Aug/15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostic	7178	3.70	164.00	2.00	515.20
TPE-BGS	DUP	18/Aug/15	1131	Heteroleibeinia profunda Komarek	2153	0.12	17.40	2.00	54.70
TPE-BGS	DUP	18/Aug/15	1136	Lyngbya mucicola Lemmermann	10767	0.73	86.00	1.00	67.50
TPE-BGS	DUP	18/Aug/15	2138	Monoraphidium komarkovae (Nyg.) Komarko	1436	0.14	56.00	1.80	95.00
TPE-BGS	DUP	18/Aug/15	5514	Tabellaria flocculsa (Roth) Kutzing	2153	2.68	24.30	14.00	1246.90
TPE-BGS	DUP	18/Aug/15	5516	Fragilaria construens (Ehrenberg) Grunow	2871	0.23	19.00	4.00	79.60
TPE-BGS	DUP	18/Aug/15	5518	Synedra acus Kutzing	718	0.08	110.00	2.00	115.20
TPE-BGS	DUP	18/Aug/15	5551	Cyclotella michiganiana Skvortzow	5024	0.23	4.90	4.90	46.20
TPE-BGS	DUP	18/Aug/15	5702	Achnanthes minutissima Kutzing	24404	2.05	20.00	4.00	83.80
TPE-BGS	DUP	18/Aug/15	5753	Navicula sp.	718	0.07	23.00	4.00	96.30
TPE-BGS	DUP	18/Aug/15	5857	Nitzschia filiformis (W. Smith) Hustedt	1436	0.20	33.00	4.00	138.20
TPE-BGS	DUP	18/Aug/15	5860	Diatoma vulgare Bory	718	0.17	25.00	6.00	235.60
TPE-BGS	DUP	18/Aug/15	5873	Gomphonema minutum	718	0.31	26.00	8.00	435.60
TPE-BGS	DUP	18/Aug/15	5875	Cocconies disculus Schum.	1436	2.13	28.90	14.00	1482.90
TPE-G	1	18/Aug/15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostic	17944	5.81	103.00	2.00	323.60
TPE-G	1	18/Aug/15	1102	Gloeothece sp.	26101	0.11	2.00	2.00	4.20
TPE-G	1	18/Aug/15	1122	Phormidium autumnale Agardh	4894	19.51	141.00	6.00	3986.70

Location	Station	Date	Species code	Speceis name	density cells/cm^2	biomass µg/cm^2	length µ	width µ	cell volume µ^3
TPE-G	1	18/Aug/15	1131	Heteroleibeinia profunda Komarek	197387	22.32	36.00	2.00	113.10
TPE-G	1	18/Aug/15	1136	Lyngbya mucicola Lemmermann	60358	7.53	94.00	1.30	124.80
TPE-G	1	18/Aug/15	1220	Rivularia dura Roth	27732	94.67	94.00	6.80	3413.80
TPE-G	1	18/Aug/15	2205	Mougeotia sp.	1631	8.07	63.00	10.00	4948.00
TPE-G	1	18/Aug/15	4388	Dinobryon sertularia Ehrenberg	4894	1.11	12.00	6.00	226.20
TPE-G	1	18/Aug/15	5514	Tabellaria flocculsa (Roth) Kutzing	37520	50.63	26.30	14.00	1349.50
TPE-G	1	18/Aug/15	5551	Cyclotella michiganiana Skvortzow	3263	0.17	5.10	5.10	52.10
TPE-G	1	18/Aug/15	5702	Achnanthes minutissima Kutzing	86459	6.37	17.60	4.00	73.70
TPE-G	1	18/Aug/15	5726	Eucocconeis sp.	1631	5.53	40.00	18.00	3392.90
TPE-G	1	18/Aug/15	5768	Nitzschia linearis W. Smith	4894	1.89	41.00	6.00	386.40
TPE-G	1	18/Aug/15	5825	Fragilaria pinata Ehrenberg	1631	0.11	10.00	5.00	65.40
TPE-G	1	18/Aug/15	5836	Encyonema silesiacum (Bleisch) D.G. Mann	3263	3.84	30.00	10.00	1178.10
TPE-G	1	18/Aug/15	5871	Cymbella lapponica	3263	4.36	51.00	10.00	1335.20
TPE-G	1	18/Aug/15	5873	Gomphonema minutum	8157	3.42	25.00	8.00	418.90
TPE-G	1	18/Aug/15	5882	Anomoenies vitrea Ross	3263	1.05	34.00	6.00	320.40
TPE-G	1	18/Aug/15	5884	Gomphonema angustum Agardh	1631	1.75	41.00	10.00	1073.40
TPE-G	1	18/Aug/15	5901	Denticula sp	1631	0.46	30.00	6.00	282.70
TPE-G	2	18/Aug/15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostic	64087	22.75	113.00	2.00	355.00
TPE-G	2	18/Aug/15	1084	Gloeocapsa punctata	61523	1.77	3.80	3.80	28.70
TPE-G	2	18/Aug/15	1102	Gloeothece sp.	271728	1.14	2.00	2.00	4.20
TPE-G	2	18/Aug/15	1131	Heteroleibeinia profunda Komarek	261474	25.47	31.00	2.00	97.40
TPE-G	2	18/Aug/15	1136	Lyngbya mucicola Lemmermann	48706	2.41	63.00	1.00	49.50
TPE-G	2	18/Aug/15	1220	Rivularia dura Roth	20508	63.77	103.00	6.20	3109.60
TPE-G	2	18/Aug/15	2205	Mougeotia sp.	41016	183.62	57.00	10.00	4476.80
TPE-G	2	18/Aug/15	2231	Bulbochaete sp.	15381	14.69	19.00	8.00	955.00
TPE-G	2	18/Aug/15	5306	Navicula minima Grunow	2563	0.12	11.00	4.00	46.10
TPE-G	2	18/Aug/15	5514	Tabellaria flocculsa (Roth) Kutzing	53833	71.82	26.00	14.00	1334.10
TPE-G	2	18/Aug/15	5519	Synedra acus v. radians (Kutzing) Hustedt	2563	0.26	81.00	2.20	102.60
TPE-G	2	18/Aug/15	5551	Cyclotella michiganiana Skvortzow	12817	0.63	5.00	5.00	49.10
TPE-G	2	18/Aug/15	5702	Achnanthes minutissima Kutzing	143554	10.22	17.00	4.00	71.20
TPE-G	2	18/Aug/15	5726	Eucocconeis sp.	7690	32.21	40.00	20.00	4188.80
TPE-G	2	18/Aug/15	5768	Nitzschia linearis W. Smith	7690	2.97	41.00	6.00	386.40
TPE-G	2	18/Aug/15	5857	Nitzschia filiformis (W. Smith) Hustedt	2563	0.44	41.00	4.00	171.70
TPE-G	2	18/Aug/15	5871	Cymbella lapponica	7690	8.25	41.00	10.00	1073.40
TPE-G	2	18/Aug/15	5882	Anomoenies vitrea Ross	10254	3.29	34.00	6.00	320.40
TPE-G	3	18/Aug/15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostic	25920	8.22	101.00	2.00	317.30
TPE-G	3	18/Aug/15	1077	Pseudoanabaena sp.	27913	4.14	39.00	2.20	148.30
TPE-G	3	18/Aug/15	1084	Gloeocapsa punctata	19938	0.49	3.60	3.60	24.40
TPE-G	3	18/Aug/15	1102	Gloeothece sp.	97697	0.41	2.00	2.00	4.20
TPE-G	3	18/Aug/15	1124	Petalonema alatum Berk	5981	14.04	83.00	6.00	2346.80
TPE-G	3	18/Aug/15	1131	Heteroleibeinia profunda Komarek	205363	20.00	31.00	2.00	97.40
TPE-G	3	18/Aug/15	1136	Lyngbya mucicola Lemmermann	69783	4.17	76.00	1.00	59.70
TPE-G	3	18/Aug/15	1220	Rivularia dura Roth	15950	46.45	103.00	6.00	2912.30
TPE-G	3	18/Aug/15	1239	Homoeothrix varians Komarek & Kalina	3988	1.41	44.00	3.20	353.90
TPE-G	3	18/Aug/15	2231	Bulbochaete sp.	5981	7.05	15.00	10.00	1178.10
TPE-G	3	18/Aug/15	5311	Cymbella minuta Kutzing	9969	4.01	16.00	8.00	402.10
TPE-G	3	18/Aug/15	5507	Cyclotella stelligera Cleve and Grunow	1994	7.25	21.00	21.00	3636.80
TPE-G	3	18/Aug/15	5513	Tabellaria fenestrata (Lyngbye) Kutzing	5981	8.12	100.00	7.20	1357.20
TPE-G	3	18/Aug/15	5514	Tabellaria flocculsa (Roth) Kutzing	53833	69.89	25.30	14.00	1298.20
TPE-G	3	18/Aug/15	5551	Cyclotella michiganiana Skvortzow	7975	0.39	5.00	5.00	49.10
TPE-G	3	18/Aug/15	5702	Achnanthes minutissima Kutzing	167480	13.33	19.00	4.00	79.60
TPE-G	3	18/Aug/15	5768	Nitzschia linearis W. Smith	15950	2.94	44.00	4.00	184.30
TPE-G	3	18/Aug/15	5857	Nitzschia filiformis (W. Smith) Hustedt	11963	1.62	40.00	3.60	135.70
TPE-G	3	18/Aug/15	5873	Gomphonema minutum	1994	0.84	25.00	8.00	418.90
TPE-G	3	18/Aug/15	5882	Anomoenies vitrea Ross	9969	3.29	35.00	6.00	329.90
TPE-G	3	18/Aug/15	5901	Denticula sp	1994	0.30	36.00	4.00	150.80
TPE-G	4	18/Aug/15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostic	35889	11.95	106.00	2.00	333.00
TPE-G	4	18/Aug/15	1084	Gloeocapsa punctata	266601	8.29	3.90	3.90	31.10
TPE-G	4	18/Aug/15	1102	Gloeothece sp.	212768	0.89	2.00	2.00	4.20
TPE-G	4	18/Aug/15	1124	Petalonema alatum Berk	35889	104.52	103.00	6.00	2912.30
TPE-G	4	18/Aug/15	1131	Heteroleibeinia profunda Komarek	56396	5.49	31.00	2.00	97.40
TPE-G	4	18/Aug/15	1136	Lyngbya mucicola Lemmermann	135864	8.97	84.00	1.00	66.00
TPE-G	4	18/Aug/15	1220	Rivularia dura Roth	15381	45.07	94.00	6.30	2930.20
TPE-G	4	18/Aug/15	2216	Zygnema sp.	15381	76.10	63.00	10.00	4948.00
TPE-G	4	18/Aug/15	5311	Cymbella minuta Kutzing	2563	0.80	15.00	7.30	313.90
TPE-G	4	18/Aug/15	5514	Tabellaria flocculsa (Roth) Kutzing	23071	30.78	26.00	14.00	1334.10
TPE-G	4	18/Aug/15	5551	Cyclotella michiganiana Skvortzow	5127	0.25	5.00	5.00	49.10
TPE-G	4	18/Aug/15	5702	Achnanthes minutissima Kutzing	133301	10.00	17.90	4.00	75.00
TPE-G	4	18/Aug/15	5726	Eucocconeis sp.	2563	10.74	40.00	20.00	4188.80
TPE-G	4	18/Aug/15	5836	Encyonema silesiacum (Bleisch) D.G. Mann	7690	8.46	28.00	10.00	1099.60
TPE-G	4	18/Aug/15	5871	Cymbella lapponica	5127	5.18	38.60	10.00	1010.50
TPE-G	4	18/Aug/15	5873	Gomphonema minutum	2563	1.12	26.00	8.00	435.60
TPE-G	4	18/Aug/15	5882	Anomoenies vitrea Ross	2563	0.82	34.00	6.00	320.40
TPE-G	5	18/Aug/15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostic	10767	3.42	101.00	2.00	317.30
TPE-G	5	18/Aug/15	1077	Pseudoanabaena sp.	9570	1.02	34.00	2.00	106.80
TPE-G	5	18/Aug/15	1084	Gloeocapsa punctata	19141	0.43	3.50	3.50	22.40
TPE-G	5	18/Aug/15	1102	Gloeothece sp.	136377	0.57	2.00	2.00	4.20

Location	Station	Date	Species code	Speceis name	density cells/cm^2	biomass µg/cm^2	length µ	width µ	cell volume $µ^3$
TPE-G	5	18/Aug/15	1124	Petalonema alatum Berk	21533	56.62	93.00	6.00	2629.50
TPE-G	5	18/Aug/15	1131	Heteroleibeinia profunda Komarek	33496	3.26	31.00	2.00	97.40
TPE-G	5	18/Aug/15	1136	Lyngbya mucicola Lemmermann	39477	1.83	59.00	1.00	46.30
TPE-G	5	18/Aug/15	1220	Rivularia dura Roth	7178	27.99	114.00	6.60	3900.20
TPE-G	5	18/Aug/15	1239	Homoeothrix varians Komarek & Kalina	1196	0.62	41.00	4.00	515.20
TPE-G	5	18/Aug/15	2205	Mougeotia sp.	2393	4.93	41.00	8.00	2060.90
TPE-G	5	18/Aug/15	4388	Dinobryon sertularia Ehrenberg	4785	1.17	13.00	6.00	245.00
TPE-G	5	18/Aug/15	5306	Navicula minima Grunow	2393	0.10	9.60	4.00	40.20
TPE-G	5	18/Aug/15	5551	Cyclotella michiganiana Skvortzow	1196	0.06	5.10	5.10	52.10
TPE-G	5	18/Aug/15	5702	Achnanthes minutissima Kutzing	26318	1.98	18.00	4.00	75.40
TPE-G	5	18/Aug/15	5767	Nitzschia fonticola Grunow	1196	0.14	12.00	6.00	113.10
TPE-G	5	18/Aug/15	5768	Nitzschia linearis W. Smith	2393	0.92	41.00	6.00	386.40
TPE-G	5	18/Aug/15	5882	Anomoenies vitrea Ross	3589	1.08	32.00	6.00	301.60
TPE-G	5	18/Aug/15	5901	Denticula sp	1196	0.35	31.00	6.00	292.20
TPE-G	5	18/Aug/15	5916	Fragilaria capucina Grunow	2393	0.30	30.00	4.00	125.70
TPE-G	5	18/Aug/15	7641	Peridinium aciculiferum Lemmermann	1196	10.82	30.00	24.00	9047.80

Appendix C

Presence (+) / Absence (-) Matrix of Periphyton Species

Appendix C. Presence (+) / absence (-) matrix of periphyton species 2015.

		Species Measurements			Second Portage Lake Drilltrail Arm (Reference Area) SP-DT					
		length	width	cell volume						
Species code	*Species name*	μ	μ	μ^3	1	2	3	4	4R	5
	Cyanobacteria									
1057	*Leptolyngbya lemnetica* (Anaga.) Anagnostidis and Komarek	106	2	333	+	-	+	-	-	-
1077	*Pseudoanabaena sp.*	36	3.3	307.9	+	+	+	+	+	-
1078	*Planktothrix agardhii* (Gom.) Anagnostidis and Komarek	104	10	8168.1	-	-	-	-	-	-
1084	*Gloeocapsa punctata*	3.6	3.6	24.4	+	+	+	+	+	+
1102	*Gloeothece sp.*	2.1	2.1	4.8	-	-	+	-	-	-
1122	*Phormidium autumnale* Agardh	91	6	2573	-	-	-	+	-	-
1124	*Petalonema alatum* Berk	103	6	2912.3	+	+	+	+	+	+
1131	*Heteroleibeinia profunda* Komarek	19.1	2	60	-	-	-	+	+	-
1136	*Lyngbya mucicola* Lemmermann	94	1	73.8	+	+	+	+	+	+
1220	*Rivularia dura* Roth	76	8	3820.2	-	-	+	-	-	+
1223	*Chamaesiphon incrustans* Smith	5.6	2.4	16.9	-	-	-	-	-	-
1238	*Clastidium cylindricum* Whelden	7.6	3.2	40.7	-	-	-	-	-	-
1239	*Homoeothrix varians* Komarek & Kalina	46	3.1	347.2	-	-	-	-	-	-
	Chlorophyte									
2138	*Monoraphidium komarkovae* (Nyg.) Komarkova-Legnerova	51	1.8	86.5	-	-	-	-	-	-
2145	*Crucigenia quadrata Morr.*	2	2	1.4	-	-	-	-	-	-
2178	*Cosmarium sp.*	30	30	4712.4	-	-	-	-	-	+
2205	*Mougeotia sp.*	49	10	3848.5	-	+	-	-	-	-
2216	*Zygnema sp.*	63	10	4948	-	-	-	-	-	-
2226	*Ulothrix sp.*	11	6	311	-	-	-	-	-	-
2231	*Bulbochaete sp.*	19	8	955	-	-	-	-	-	-
2954	*Stigeoclonium sp.*	15	6	424.1	-	-	-	-	-	-
	Chrysophyte									
4381	*Dinobryon mucronutom* Nygaard	10	5	130.9	-	-	-	-	-	-
4388	*Dinobryon sertularia* Ehrenberg	12	6	226.2	-	-	-	-	-	-
	Diatom									
5306	*Navicula minima* Grunow	11	4	46.1	-	-	-	-	-	-
5311	*Cymbella minuta* Kutzing	15.6	8	392.1	-	-	-	-	-	+
5460	*Gomphonema truncatum* Ehrenberg	51	8	854.5	-	+	-	-	-	-
5507	*Cyclotella stelligera* Cleve and Grunow	21.2	21.2	3741.7	-	-	-	+	+	-
5509	*Cyclotella ocellata* Pant.	8.8	8.8	267.6	+	-	-	-	-	-
5513	*Tabellaria fenestrata* (Lyngbye) Kutzing	73	10	1911.1	+	-	-	+	+	-
5514	*Tabellaria flocculsa* (Roth) Kutzing	25.5	14	1308.5	+	+	+	+	+	+
5516	*Fragilaria construens* (Ehrenberg) Grunow	22	4	92.2	-	-	-	-	-	-
5518	*Synedra acus* Kutzing	116	2	121.5	-	+	+	-	-	+
5519	*Synedra acus v. radians* (Kutzing) Hustedt	81	2.2	102.6	-	-	-	-	-	-
5523	*Synedra ulna* (Nitzsch) Ehrenberg	280	10	7330.4	-	-	-	-	-	+
5524	*Asterionella formosa* Hassall	96	2	100.5	-	-	-	-	-	-
5541	*Nitzschia clausii* Hantzsch	73	12	2752	-	-	+	-	-	-
5546	*Gyrosigma sp*	91	6	1286.5	+	-	-	-	-	-
5547	*Frustulia rhomboides* (Ehrenberg) de Toni	63	10	2474	-	-	-	-	-	-
5551	*Cyclotella michiganiana* Skvortzow	5	5	49.1	-	+	-	-	-	-
5702	*Achnanthes minutissima* Kutzing	18	4	75.4	+	+	+	+	+	+
5720	*Cyclotella bodanica Eulenst.*	31.6	31.6	12391.4	-	-	+	-	-	-
5726	*Eucocconeis sp.*	41	18	3477.7	-	-	+	+	+	+
5728	*Epithemia argus* Kutzing	46	10	1204.3	+	-	+	+	+	-
5733	*Eunotia pectinalis* (Kutzing) Rabenhorst	91	6	857.7	-	-	-	-	-	-
5751	*Navicula incerta* Grunow	26	4	108.9	-	-	-	-	-	-
5753	*Navicula sp.*	23	6	216.8	-	-	-	-	-	-
5767	*Nitzschia fonticola* Grunow	16	4	67	+	-	-	+	+	-
5768	*Nitzschia linearis* W. Smith	53	6	499.5	-	+	-	+	-	+
5778	*Stauroneis anceps* Ehrenberg	81	12	3053.6	-	-	-	+	+	+
5781	*Eunotia sp.*	44	10	1151.9	-	-	-	-	-	-
5792	*Neidium iridis* (Ehrenberg) Cleve	81	12	3053.6	-	-	-	-	-	-
5820	*Eunotia arcus* Ehrenberg	44	9	933.1	-	+	-	-	-	-
5821	*Eunotia exigua* (Brebisson) Grunow	44	8	737.2	-	-	+	-	-	-
5825	*Fragilaria pinata* Ehrenberg	10	6	94.2	-	-	-	-	+	-
5836	*Encyonema silesiacum* (Bleisch) D.G. Mann	28	10	1099.6	-	-	+	-	-	+
5854	*Pinnularia borealis* Ehrenberg	69	10	1806.4	-	-	-	-	-	-
5857	*Nitzschia filiformis* (W. Smith) Hustedt	36	4	150.8	-	-	-	-	-	-
5860	*Diatoma vulgare* Bory	24	6	226.2	-	-	-	-	-	-
5865	*Cymbella prostrata* (Berkeley) Cleve	89	21	15413	+	-	-	-	-	+
5870	*Navicula radiosa* Kutzing	61	10	1597	-	+	+	-	-	+
5871	*Cymbella lapponica*	26.3	8	440.7	-	+	-	-	-	+
5873	*Gomphonema minutum*	29	8	485.9	+	-	-	+	+	+
5874	*Nitzschia palea* (Kutzing) W. Smith	93	6	876.5	-	-	-	-	-	-
5875	*Cocconies disculus* Schum.	26.3	14	1349.5	-	-	-	-	-	-
5881	*Diatoma elongatum* Agardh	18	6	169.6	-	-	-	+	+	-
5882	*Anomoenies vitrea* Ross	35.3	6	332.7	+	+	+	-	+	+
5884	*Gomphonema angustum* Agardh	44	10	1151.9	+	+	+	+	+	+
5887	*Navicula pupula* Kutzing	20	6	188.5	-	-	-	-	-	-
5901	*Denticula sp*	30	6	282.7	-	-	-	-	-	-
5916	*Fragilaria capucina* Grunow	41	4.2	189.3	-	+	+	-	-	+
	Dinoflagellate									
7641	*Peridinium aciculiferum* Lemmermann	30	24	9047.8	-	-	-	-	-	-
	Total Richness				**16**	**17**	**20**	**18**	**18**	**21**

Appendix C. Presence (+) / absence (-) matrix of periphyton species 2015.

		Species Measurements			Second Portage Lake East Dike SP-ED					
		length	width	cell volume						
Species code	*Species name*	μ	μ	μ^3	1	2	2R	3	4	5
	Cyanobacteria									
1057	*Leptolyngbya lemnetica* (Anaga.) Anagnostidis and Komarek	106	2	333	+	+	+	-	-	+
1077	*Pseudoanabaena sp.*	36	3.3	307.9	-	+	+	-	-	-
1078	*Planktothrix agardhii* (Gom.) Anagnostidis and Komarek	104	10	8168.1	-	-	-	-	-	-
1084	*Gloeocapsa punctata*	3.6	3.6	24.4	+	+	+	+	+	-
1102	*Gloeothece sp.*	2.1	2.1	4.8	+	+	-	-	+	+
1122	*Phormidium autumnale* Agardh	91	6	2573	+	-	-	-	-	-
1124	*Petalonema alatum* Berk	103	6	2912.3	-	-	-	-	-	-
1131	*Heteroleibeinia profunda* Komarek	19.1	2	60	+	-	-	-	+	+
1136	*Lyngbya mucicola* Lemmermann	94	1	73.8	+	+	+	+	+	+
1220	*Rivularia dura* Roth	76	8	3820.2	-	-	-	-	-	-
1223	*Chamaesiphon incrustans* Smith	5.6	2.4	16.9	-	-	-	-	-	-
1238	*Clastidium cylindricum* Whelden	7.6	3.2	40.7	-	-	-	-	-	-
1239	*Homoeothrix varians* Komarek & Kalina	46	3.1	347.2	-	-	-	-	-	-
	Chlorophyte									
2138	*Monoraphidium komarkovae* (Nyg.) Komarkova-Legnerova	51	1.8	86.5	-	-	-	-	-	-
2145	*Crucigenia quadrata Morr.*	2	2	1.4	-	-	-	-	-	-
2178	*Cosmarium sp.*	30	30	4712.4	-	-	-	-	-	-
2205	*Mougeotia sp.*	49	10	3848.5	-	+	+	-	-	-
2216	*Zygnema sp.*	63	10	4948	-	-	-	-	-	-
2226	*Ulothrix sp.*	11	6	311	-	-	-	-	-	-
2231	*Bulbochaete sp.*	19	8	955	-	-	-	-	-	-
2954	*Stigeoclonium sp.*	15	6	424.1	-	-	-	-	-	-
	Chrysophyte									
4381	*Dinobryon mucronutom* Nygaard	10	5	130.9	-	-	-	-	-	+
4388	*Dinobryon sertularia* Ehrenberg	12	6	226.2	-	-	-	+	-	+
	Diatom									
5306	*Navicula minima* Grunow	11	4	46.1	-	-	-	+	-	-
5311	*Cymbella minuta* Kutzing	15.6	8	392.1	-	-	-	-	-	-
5460	*Gomphonema truncatum* Ehrenberg	51	8	854.5	-	-	-	-	-	-
5507	*Cyclotella stelligera* Cleve and Grunow	21.2	21.2	3741.7	+	-	+	+	+	+
5509	*Cyclotella ocellata* Pant.	8.8	8.8	267.6	+	+	+	-	-	-
5513	*Tabellaria fenestrata* (Lyngbye) Kutzing	73	10	1911.1	-	-	-	-	-	-
5514	*Tabellaria flocculsa* (Roth) Kutzing	25.5	14	1308.5	+	+	+	+	+	+
5516	*Fragilaria construens* (Ehrenberg) Grunow	22	4	92.2	-	-	-	-	-	-
5518	*Synedra acus* Kutzing	116	2	121.5	+	+	+	+	+	+
5519	*Synedra acus v. radians* (Kutzing) Hustedt	81	2.2	102.6	-	-	-	-	-	-
5523	*Synedra ulna* (Nitzsch) Ehrenberg	280	10	7330.4	-	-	-	-	-	-
5524	*Asterionella formosa* Hassall	96	2	100.5	-	-	+	-	-	-
5541	*Nitzschia clausii* Hantzsch	73	12	2752	-	-	-	-	-	-
5546	*Gyrosigma sp*	91	6	1286.5	-	+	-	-	-	-
5547	*Frustulia rhomboides* (Ehrenberg) de Toni	63	10	2474	-	-	-	-	-	-
5551	*Cyclotella michiganiana* Skvortzow	5	5	49.1	-	+	+	+	-	+
5702	*Achnanthes minutissima* Kutzing	18	4	75.4	+	+	+	+	+	+
5720	*Cyclotella bodanica Eulenst.*	31.6	31.6	12391.4	+	+	-	+	+	-
5726	*Eucocconeis sp.*	41	18	3477.7	+	-	-	+	-	-
5728	*Epithemia argus* Kutzing	46	10	1204.3	-	-	-	-	-	-
5733	*Eunotia pectinalis* (Kutzing) Rabenhorst	91	6	857.7	-	-	-	+	-	-
5751	*Navicula incerta* Grunow	26	4	108.9	+	-	-	-	-	-
5753	*Navicula sp.*	23	6	216.8	-	-	-	-	-	-
5767	*Nitzschia fonticola* Grunow	16	4	67	+	-	-	-	+	+
5768	*Nitzschia linearis* W. Smith	53	6	499.5	+	-	-	-	-	-
5778	*Stauroneis anceps* Ehrenberg	81	12	3053.6	-	-	-	-	-	-
5781	*Eunotia sp.*	44	10	1151.9	-	-	+	-	-	-
5792	*Neidium iridis* (Ehrenberg) Cleve	81	12	3053.6	-	-	-	+	-	-
5820	*Eunotia arcus* Ehrenberg	44	9	933.1	-	-	-	-	-	-
5821	*Eunotia exigua* (Brebisson) Grunow	44	8	737.2	-	-	-	-	+	+
5825	*Fragilaria pinata* Ehrenberg	10	6	94.2	-	-	-	-	-	-
5836	*Encyonema silesiacum* (Bleisch) D.G. Mann	28	10	1099.6	-	+	+	+	+	+
5854	*Pinnularia borealis* Ehrenberg	69	10	1806.4	-	-	+	-	-	+
5857	*Nitzschia filiformis* (W. Smith) Hustedt	36	4	150.8	-	+	+	-	-	-
5860	*Diatoma vulgare* Bory	24	6	226.2	-	-	-	-	-	-
5865	*Cymbella prostrata* (Berkeley) Cleve	89	21	15413	-	-	-	-	-	-
5870	*Navicula radiosa* Kutzing	61	10	1597	-	-	-	+	-	-
5871	*Cymbella lapponica*	26.3	8	440.7	+	+	-	+	-	-
5873	*Gomphonema minutum*	29	8	485.9	-	+	+	+	+	+
5874	*Nitzschia palea* (Kutzing) W. Smith	93	6	876.5	+	-	-	-	-	-
5875	*Cocconies disculus* Schum.	26.3	14	1349.5	-	-	-	-	+	-
5881	*Diatoma elongatum* Agardh	18	6	169.6	-	-	-	-	-	-
5882	*Anomoenies vitrea* Ross	35.3	6	332.7	+	+	+	-	+	+
5884	*Gomphonema angustum* Agardh	44	10	1151.9	-	-	-	-	-	-
5887	*Navicula pupula* Kutzing	20	6	188.5	-	-	-	-	-	-
5901	*Denticula sp*	30	6	282.7	-	-	-	-	-	-
5916	*Fragilaria capucina* Grunow	41	4.2	189.3	-	+	+	+	+	+
	Dinoflagellate									
7641	*Peridinium aciculiferum* Lemmermann	30	24	9047.8	-	-	-	-	-	-
	Total Richness				**19**	**19**	**19**	**18**	**16**	**18**

Appendix C. Presence (+) / absence (-) matrix of periphyton species 2015.

		Species Measurements			Third Portage Lake - East Basin Bay-Goose Dike - North Section TPE-BGN				
		length	width	cell volume					
Species code	***Species name***	**μ**	**μ**	**μ^3**	1	2	3	4	5
	Cyanobacteria								
1057	*Leptolyngbya lemnetica* (Anaga.) Anagnostidis and Komarek	106	2	333	-	-	-	+	-
1077	*Pseudoanabaena sp.*	36	3.3	307.9	-	-	+	-	-
1078	*Planktothrix agardhii* (Gom.) Anagnostidis and Komarek	104	10	8168.1	-	-	-	-	-
1084	*Gloeocapsa punctata*	3.6	3.6	24.4	-	-	-	-	-
1102	*Gloeothece sp.*	2.1	2.1	4.8	-	-	-	-	-
1122	*Phormidium autumnale* Agardh	91	6	2573	-	+	-	-	-
1124	*Petalonema alatum* Berk	103	6	2912.3	-	-	-	-	+
1131	*Heteroleibeinia profunda* Komarek	19.1	2	60	+	-	-	-	-
1136	*Lyngbya mucicola* Lemmermann	94	1	73.8	+	+	+	+	+
1220	*Rivularia dura* Roth	76	8	3820.2	-	-	-	-	-
1223	*Chamaesiphon incrustans* Smith	5.6	2.4	16.9	-	-	-	-	-
1238	*Clastidium cylindricum* Whelden	7.6	3.2	40.7	-	-	-	-	-
1239	*Homoeothrix varians* Komarek & Kalina	46	3.1	347.2	+	-	-	-	-
	Chlorophyte								
2138	*Monoraphidium komarkovae* (Nyg.) Komarkova-Legnerova	51	1.8	86.5	-	-	-	-	-
2145	*Crucigenia quadrata Morr.*	2	2	1.4	-	+	-	-	-
2178	*Cosmarium sp.*	30	30	4712.4	-	-	-	-	-
2205	*Mougeotia sp.*	49	10	3848.5	+	-	-	+	+
2216	*Zygnema sp.*	63	10	4948	-	-	-	-	-
2226	*Ulothrix sp.*	11	6	311	-	-	-	-	-
2231	*Bulbochaete sp.*	19	8	955	-	-	-	-	-
2954	*Stigeoclonium sp.*	15	6	424.1	-	-	-	-	-
	Chrysophyte								
4381	*Dinobryon mucronutom* Nygaard	10	5	130.9	-	-	-	-	-
4388	*Dinobryon sertularia* Ehrenberg	12	6	226.2	+	+	-	-	-
	Diatom								
5306	*Navicula minima* Grunow	11	4	46.1	-	-	-	-	-
5311	*Cymbella minuta* Kutzing	15.6	8	392.1	-	-	+	-	-
5460	*Gomphonema truncatum* Ehrenberg	51	8	854.5	-	-	-	-	-
5507	*Cyclotella stelligera* Cleve and Grunow	21.2	21.2	3741.7	-	-	-	-	-
5509	*Cyclotella ocellata* Pant.	8.8	8.8	267.6	+	+	+	+	-
5513	*Tabellaria fenestrata* (Lyngbye) Kutzing	73	10	1911.1	-	-	-	-	-
5514	*Tabellaria flocculsa* (Roth) Kutzing	25.5	14	1308.5	+	+	-	-	+
5516	*Fragilaria construens* (Ehrenberg) Grunow	22	4	92.2	-	-	-	-	-
5518	*Synedra acus* Kutzing	116	2	121.5	-	-	-	-	+
5519	*Synedra acus v. radians* (Kutzing) Hustedt	81	2.2	102.6	-	-	-	-	-
5523	*Synedra ulna* (Nitzsch) Ehrenberg	280	10	7330.4	-	-	-	-	-
5524	*Asterionella formosa* Hassall	96	2	100.5	-	-	-	-	-
5541	*Nitzschia clausii* Hantzsch	73	12	2752	-	-	-	-	-
5546	*Gyrosigma sp*	91	6	1286.5	-	-	-	-	-
5547	*Frustulia rhomboides* (Ehrenberg) de Toni	63	10	2474	+	-	-	-	-
5551	*Cyclotella michiganiana* Skvortzow	5	5	49.1	+	-	+	+	+
5702	*Achnanthes minutissima* Kutzing	18	4	75.4	+	+	+	+	+
5720	*Cyclotella bodanica Eulenst.*	31.6	31.6	12391.4	-	-	-	-	-
5726	*Eucocconeis sp.*	41	18	3477.7	-	-	-	-	-
5728	*Epithemia argus* Kutzing	46	10	1204.3	-	-	-	-	-
5733	*Eunotia pectinalis* (Kutzing) Rabenhorst	91	6	857.7	-	-	-	-	-
5751	*Navicula incerta* Grunow	26	4	108.9	-	-	-	-	-
5753	*Navicula sp.*	23	6	216.8	-	-	-	-	-
5767	*Nitzschia fonticola* Grunow	16	4	67	-	-	-	-	-
5768	*Nitzschia linearis* W. Smith	53	6	499.5	-	-	-	-	-
5778	*Stauroneis anceps* Ehrenberg	81	12	3053.6	-	-	-	-	-
5781	*Eunotia sp.*	44	10	1151.9	-	-	-	-	-
5792	*Neidium iridis* (Ehrenberg) Cleve	81	12	3053.6	+	-	-	-	-
5820	*Eunotia arcus* Ehrenberg	44	9	933.1	-	-	-	-	-
5821	*Eunotia exigua* (Brebisson) Grunow	44	8	737.2	-	-	-	-	-
5825	*Fragilaria pinata* Ehrenberg	10	6	94.2	-	-	-	-	-
5836	*Encyonema silesiacum* (Bleisch) D.G. Mann	28	10	1099.6	-	-	-	-	+
5854	*Pinnularia borealis* Ehrenberg	69	10	1806.4	-	-	-	-	-
5857	*Nitzschia filiformis* (W. Smith) Hustedt	36	4	150.8	-	-	-	-	-
5860	*Diatoma vulgare* Bory	24	6	226.2	-	-	-	-	-
5865	*Cymbella prostrata* (Berkeley) Cleve	89	21	15413	-	-	-	-	-
5870	*Navicula radiosa* Kutzing	61	10	1597	-	-	-	-	-
5871	*Cymbella lapponica*	26.3	8	440.7	-	-	-	-	-
5873	*Gomphonema minutum*	29	8	485.9	-	-	-	-	-
5874	*Nitzschia palea* (Kutzing) W. Smith	93	6	876.5	+	-	+	+	-
5875	*Cocconies disculus* Schum.	26.3	14	1349.5	-	-	-	-	-
5881	*Diatoma elongatum* Agardh	18	6	169.6	-	-	-	-	-
5882	*Anomoenies vitrea* Ross	35.3	6	332.7	+	+	-	+	+
5884	*Gomphonema angustum* Agardh	44	10	1151.9	-	-	-	-	-
5887	*Navicula pupula* Kutzing	20	6	188.5	-	+	-	-	-
5901	*Denticula sp*	30	6	282.7	-	-	-	-	-
5916	*Fragilaria capucina* Grunow	41	4.2	189.3	-	-	-	-	+
	Dinoflagellate								
7641	*Peridinium aciculiferum* Lemmermann	30	24	9047.8	-	-	-	+	-
	Total Richness				**13**	**9**	**7**	**9**	**10**

Appendix C. Presence (+) / absence (-) matrix of periphyton species 2015.

		Species Measurements			Third Portage Lake - East Basin Bay-Goose Dike - South Section TPE-BGS						
		length	width	cell volume							
Species code	*Species name*	μ	μ	μ^3	1	2	3	4	5	3R	DUP
	Cyanobacteria										
1057	*Leptolyngbya lemnetica* (Anaga.) Anagnostidis and Komarek	106	2	333	-	+	+	+	-	+	+
1077	*Pseudoanabaena sp.*	36	3.3	307.9	-	-	-	-	+	-	-
1078	*Planktothrix agardhii* (Gom.) Anagnostidis and Komarek	104	10	8168.1	-	-	-	-	+	-	-
1084	*Gloeocapsa punctata*	3.6	3.6	24.4	-	-	-	-	-	-	-
1102	*Gloeothece sp.*	2.1	2.1	4.8	-	-	-	-	-	-	-
1122	*Phormidium autumnale* Agardh	91	6	2573	-	+	-	-	-	-	-
1124	*Petalonema alatum* Berk	103	6	2912.3	-	+	-	-	-	-	-
1131	*Heteroleibeinia profunda* Komarek	19.1	2	60	+	-	+	-	-	+	+
1136	*Lyngbya mucicola* Lemmermann	94	1	73.8	+	+	+	+	+	+	+
1220	*Rivularia dura* Roth	76	8	3820.2	+	+	-	-	-	-	-
1223	*Chamaesiphon incrustans* Smith	5.6	2.4	16.9	-	-	-	+	-	-	-
1238	*Clastidium cylindricum* Whelden	7.6	3.2	40.7	+	-	-	-	-	-	-
1239	*Homoeothrix varians* Komarek & Kalina	46	3.1	347.2	-	-	-	-	-	-	-
	Chlorophyte										
2138	*Monoraphidium komarkovae* (Nyg.) Komarkova-Legnerova	51	1.8	86.5	-	-	-	+	-	+	+
2145	*Crucigenia quadrata Morr.*	2	2	1.4	-	-	-	-	-	-	-
2178	*Cosmarium sp.*	30	30	4712.4	-	-	-	-	-	-	-
2205	*Mougeotia sp.*	49	10	3848.5	-	-	-	-	-	-	-
2216	*Zygnema sp.*	63	10	4948	-	-	-	-	-	-	-
2226	*Ulothrix sp.*	11	6	311	-	-	-	-	+	-	-
2231	*Bulbochaete sp.*	19	8	955	-	-	-	-	-	-	-
2954	*Stigeoclonium sp.*	15	6	424.1	-	-	-	-	+	-	-
	Chrysophyte										
4381	*Dinobryon mucronutom* Nygaard	10	5	130.9	-	-	-	-	-	-	-
4388	*Dinobryon sertularia* Ehrenberg	12	6	226.2	+	+	+	-	+	-	-
	Diatom										
5306	*Navicula minima* Grunow	11	4	46.1	-	-	-	-	-	-	-
5311	*Cymbella minuta* Kutzing	15.6	8	392.1	-	-	-	+	+	-	-
5460	*Gomphonema truncatum* Ehrenberg	51	8	854.5	-	-	-	-	-	-	-
5507	*Cyclotella stelligera* Cleve and Grunow	21.2	21.2	3741.7	+	+	+	+	+	+	-
5509	*Cyclotella ocellata* Pant.	8.8	8.8	267.6	+	-	-	-	-	-	-
5513	*Tabellaria fenestrata* (Lyngbye) Kutzing	73	10	1911.1	-	-	-	-	-	-	-
5514	*Tabellaria flocculsa* (Roth) Kutzing	25.5	14	1308.5	-	+	+	+	+	+	+
5516	*Fragilaria construens* (Ehrenberg) Grunow	22	4	92.2	-	-	-	+	-	-	+
5518	*Synedra acus* Kutzing	116	2	121.5	-	-	-	-	+	-	+
5519	*Synedra acus v. radians* (Kutzing) Hustedt	81	2.2	102.6	-	-	-	-	-	-	-
5523	*Synedra ulna* (Nitzsch) Ehrenberg	280	10	7330.4	-	-	-	-	-	-	-
5524	*Asterionella formosa* Hassall	96	2	100.5	-	-	-	-	-	-	-
5541	*Nitzschia clausii* Hantzsch	73	12	2752	-	-	-	-	-	-	-
5546	*Gyrosigma sp*	91	6	1286.5	-	-	-	-	-	-	-
5547	*Frustulia rhomboides* (Ehrenberg) de Toni	63	10	2474	-	-	+	-	-	-	-
5551	*Cyclotella michiganiana* Skvortzow	5	5	49.1	-	+	+	-	-	+	+
5702	*Achnanthes minutissima* Kutzing	18	4	75.4	+	+	+	+	+	+	+
5720	*Cyclotella bodanica Eulenst.*	31.6	31.6	12391.4	-	-	-	-	-	-	-
5726	*Eucocconeis sp.*	41	18	3477.7	-	+	-	-	-	-	-
5728	*Epithemia argus* Kutzing	46	10	1204.3	-	-	-	-	-	-	-
5733	*Eunotia pectinalis* (Kutzing) Rabenhorst	91	6	857.7	-	-	-	-	-	-	-
5751	*Navicula incerta* Grunow	26	4	108.9	-	-	-	-	-	-	-
5753	*Navicula sp.*	23	6	216.8	-	-	-	+	-	-	+
5767	*Nitzschia fonticola* Grunow	16	4	67	-	-	+	-	-	+	-
5768	*Nitzschia linearis* W. Smith	53	6	499.5	-	-	-	-	-	-	-
5778	*Stauroneis anceps* Ehrenberg	81	12	3053.6	-	-	-	-	-	-	-
5781	*Eunotia sp.*	44	10	1151.9	-	-	-	-	-	-	-
5792	*Neidium iridis* (Ehrenberg) Cleve	81	12	3053.6	-	-	-	-	-	-	-
5820	*Eunotia arcus* Ehrenberg	44	9	933.1	-	-	-	-	-	-	-
5821	*Eunotia exigua* (Brebisson) Grunow	44	8	737.2	-	-	-	+	-	-	-
5825	*Fragilaria pinata* Ehrenberg	10	6	94.2	-	-	-	-	-	-	-
5836	*Encyonema silesiacum* (Bleisch) D.G. Mann	28	10	1099.6	-	-	-	-	+	-	-
5854	*Pinnularia borealis* Ehrenberg	69	10	1806.4	-	-	-	-	-	-	-
5857	*Nitzschia filiformis* (W. Smith) Hustedt	36	4	150.8	-	+	+	-	-	+	+
5860	*Diatoma vulgare* Bory	24	6	226.2	-	-	-	+	-	-	+
5865	*Cymbella prostrata* (Berkeley) Cleve	89	21	15413	-	-	-	-	-	-	-
5870	*Navicula radiosa* Kutzing	61	10	1597	-	-	-	-	-	-	-
5871	*Cymbella lapponica*	26.3	8	440.7	-	-	-	-	+	-	-
5873	*Gomphonema minutum*	29	8	485.9	+	+	+	+	+	+	+
5874	*Nitzschia palea* (Kutzing) W. Smith	93	6	876.5	-	-	-	-	-	-	-
5875	*Cocconies disculus* Schum.	26.3	14	1349.5	-	-	+	-	-	+	+
5881	*Diatoma elongatum* Agardh	18	6	169.6	-	-	-	-	+	-	-
5882	*Anomoenies vitrea* Ross	35.3	6	332.7	-	-	-	-	-	-	-
5884	*Gomphonema angustum* Agardh	44	10	1151.9	+	+	+	-	-	+	-
5887	*Navicula pupula* Kutzing	20	6	188.5	-	-	-	-	-	-	-
5901	*Denticula sp*	30	6	282.7	-	-	-	-	-	-	-
5916	*Fragilaria capucina* Grunow	41	4.2	189.3	+	+	+	+	+	+	-
	Dinoflagellate										
7641	*Peridinium aciculiferum* Lemmermann	30	24	9047.8	-	+	-	+	-	-	-
	Total Richness				**11**	**16**	**15**	**15**	**16**	**14**	**14**

Appendix C. Presence (+) / absence (-) matrix of periphyton species 2015.

		Species Measurements			Third Portage Lake - East Basin Reference Area TPE-G				
		length	width	cell volume					
Species code	***Species name***	**μ**	**μ**	**μ^3**	1	2	3	4	5
	Cyanobacteria								
1057	*Leptolyngbya lemnetica* (Anaga.) Anagnostidis and Komarek	106	2	333	+	+	+	+	+
1077	*Pseudoanabaena sp.*	36	3.3	307.9	-	-	+	-	+
1078	*Planktothrix agardhii* (Gom.) Anagnostidis and Komarek	104	10	8168.1	-	-	-	-	-
1084	*Gloeocapsa punctata*	3.6	3.6	24.4	-	+	+	+	+
1102	*Gloeothece sp.*	2.1	2.1	4.8	+	+	+	+	+
1122	*Phormidium autumnale* Agardh	91	6	2573	+	-	-	-	-
1124	*Petalonema alatum* Berk	103	6	2912.3	-	-	+	+	+
1131	*Heteroleibeinia profunda* Komarek	19.1	2	60	+	+	+	+	+
1136	*Lyngbya mucicola* Lemmermann	94	1	73.8	+	+	+	+	+
1220	*Rivularia dura* Roth	76	8	3820.2	+	+	+	+	+
1223	*Chamaesiphon incrustans* Smith	5.6	2.4	16.9	-	-	-	-	-
1238	*Clastidium cylindricum* Whelden	7.6	3.2	40.7	-	-	-	-	-
1239	*Homoeothrix varians* Komarek & Kalina	46	3.1	347.2	-	-	+	-	+
	Chlorophyte								
2138	*Monoraphidium komarkovae* (Nyg.) Komarkova-Legnerova	51	1.8	86.5	-	-	-	-	-
2145	*Crucigenia quadrata Morr.*	2	2	1.4	-	-	-	-	-
2178	*Cosmarium sp.*	30	30	4712.4	-	-	-	-	-
2205	*Mougeotia sp.*	49	10	3848.5	+	+	-	-	+
2216	*Zygnema sp.*	63	10	4948	-	-	-	+	-
2226	*Ulothrix sp.*	11	6	311	-	-	-	-	-
2231	*Bulbochaete sp.*	19	8	955	-	+	+	-	-
2954	*Stigeoclonium sp.*	15	6	424.1	-	-	-	-	-
	Chrysophyte								
4381	*Dinobryon mucronutom* Nygaard	10	5	130.9	-	-	-	-	-
4388	*Dinobryon sertularia* Ehrenberg	12	6	226.2	+	-	-	-	+
	Diatom								
5306	*Navicula minima* Grunow	11	4	46.1	-	+	-	-	+
5311	*Cymbella minuta* Kutzing	15.6	8	392.1	-	-	+	+	-
5460	*Gomphonema truncatum* Ehrenberg	51	8	854.5	-	-	-	-	-
5507	*Cyclotella stelligera* Cleve and Grunow	21.2	21.2	3741.7	-	-	+	-	-
5509	*Cyclotella ocellata* Pant.	8.8	8.8	267.6	-	-	-	-	-
5513	*Tabellaria fenestrata* (Lyngbye) Kutzing	73	10	1911.1	-	-	+	-	-
5514	*Tabellaria flocculsa* (Roth) Kutzing	25.5	14	1308.5	+	+	+	+	-
5516	*Fragilaria construens* (Ehrenberg) Grunow	22	4	92.2	-	-	-	-	-
5518	*Synedra acus* Kutzing	116	2	121.5	-	-	-	-	-
5519	*Synedra acus v. radians* (Kutzing) Hustedt	81	2.2	102.6	-	+	-	-	-
5523	*Synedra ulna* (Nitzsch) Ehrenberg	280	10	7330.4	-	-	-	-	-
5524	*Asterionella formosa* Hassall	96	2	100.5	-	-	-	-	-
5541	*Nitzschia clausii* Hantzsch	73	12	2752	-	-	-	-	-
5546	*Gyrosigma sp*	91	6	1286.5	-	-	-	-	-
5547	*Frustulia rhomboides* (Ehrenberg) de Toni	63	10	2474	-	-	-	-	-
5551	*Cyclotella michiganiana* Skvortzow	5	5	49.1	+	+	+	+	+
5702	*Achnanthes minutissima* Kutzing	18	4	75.4	+	+	+	+	+
5720	*Cyclotella bodanica Eulenst.*	31.6	31.6	12391.4	-	-	-	-	-
5726	*Eucocconeis sp.*	41	18	3477.7	+	+	-	+	-
5728	*Epithemia argus* Kutzing	46	10	1204.3	-	-	-	-	-
5733	*Eunotia pectinalis* (Kutzing) Rabenhorst	91	6	857.7	-	-	-	-	-
5751	*Navicula incerta* Grunow	26	4	108.9	-	-	-	-	-
5753	*Navicula sp.*	23	6	216.8	-	-	-	-	-
5767	*Nitzschia fonticola* Grunow	16	4	67	-	-	-	-	+
5768	*Nitzschia linearis* W. Smith	53	6	499.5	+	+	+	-	+
5778	*Stauroneis anceps* Ehrenberg	81	12	3053.6	-	-	-	-	-
5781	*Eunotia sp.*	44	10	1151.9	-	-	-	-	-
5792	*Neidium iridis* (Ehrenberg) Cleve	81	12	3053.6	-	-	-	-	-
5820	*Eunotia arcus* Ehrenberg	44	9	933.1	-	-	-	-	-
5821	*Eunotia exigua* (Brebisson) Grunow	44	8	737.2	-	-	-	-	-
5825	*Fragilaria pinata* Ehrenberg	10	6	94.2	+	-	-	-	-
5836	*Encyonema silesiacum* (Bleisch) D.G. Mann	28	10	1099.6	+	-	-	+	-
5854	*Pinnularia borealis* Ehrenberg	69	10	1806.4	-	-	-	-	-
5857	*Nitzschia filiformis* (W. Smith) Hustedt	36	4	150.8	-	+	+	-	-
5860	*Diatoma vulgare* Bory	24	6	226.2	-	-	-	-	-
5865	*Cymbella prostrata* (Berkeley) Cleve	89	21	15413	-	-	-	-	-
5870	*Navicula radiosa* Kutzing	61	10	1597	-	-	-	-	-
5871	*Cymbella lapponica*	26.3	8	440.7	+	+	-	+	-
5873	*Gomphonema minutum*	29	8	485.9	+	-	+	+	-
5874	*Nitzschia palea* (Kutzing) W. Smith	93	6	876.5	-	-	-	-	-
5875	*Cocconies disculus* Schum.	26.3	14	1349.5	-	-	-	-	-
5881	*Diatoma elongatum* Agardh	18	6	169.6	-	-	-	-	-
5882	*Anomoenies vitrea* Ross	35.3	6	332.7	+	+	+	+	+
5884	*Gomphonema angustum* Agardh	44	10	1151.9	+	-	-	-	-
5887	*Navicula pupula* Kutzing	20	6	188.5	-	-	-	-	-
5901	*Denticula sp*	30	6	282.7	+	-	+	-	+
5916	*Fragilaria capucina* Grunow	41	4.2	189.3	-	-	-	-	+
	Dinoflagellate								
7641	*Peridinium aciculiferum* Lemmermann	30	24	9047.8	-	-	-	-	+
	Total Richness				**20**	**18**	**21**	**17**	**20**

APPENDIX C

2015 HCM Photos

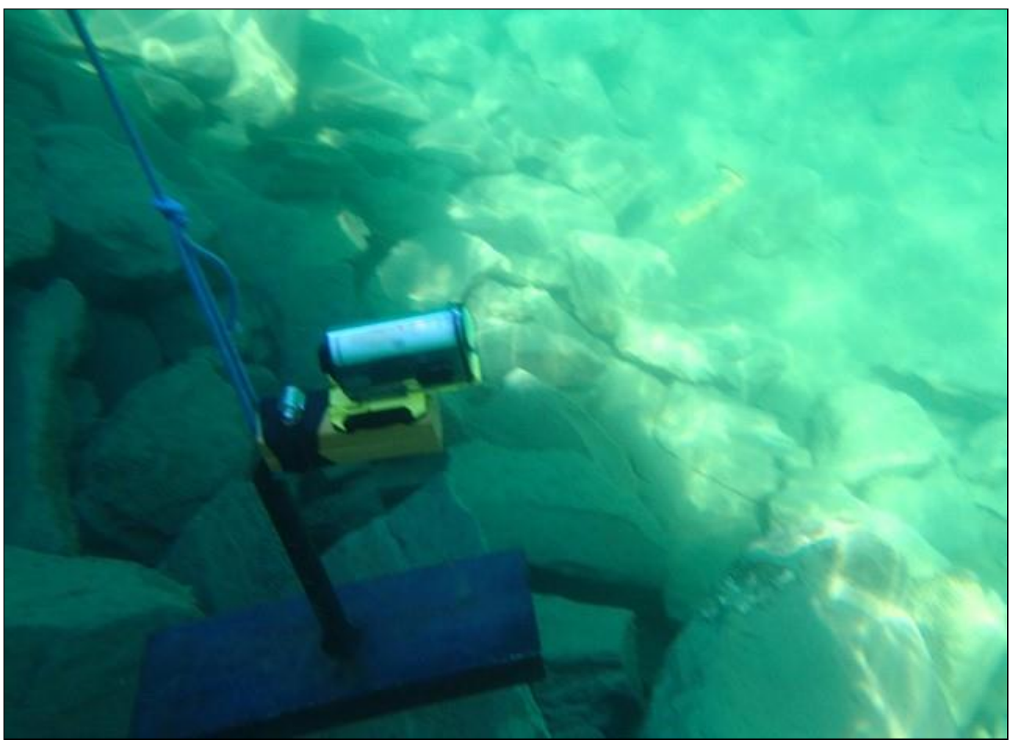
Arctic Char caught on Dogleg Pond

Female Lake Trout caught on Second Portage Lake being weighed

Lake Trout caught on Second Portage Lake being measured

Lake Trout being released near Second Portage Dike

Lake Trout caught on Third Portage Lake being measured



Underwater Video Camera being deployed along Dike face

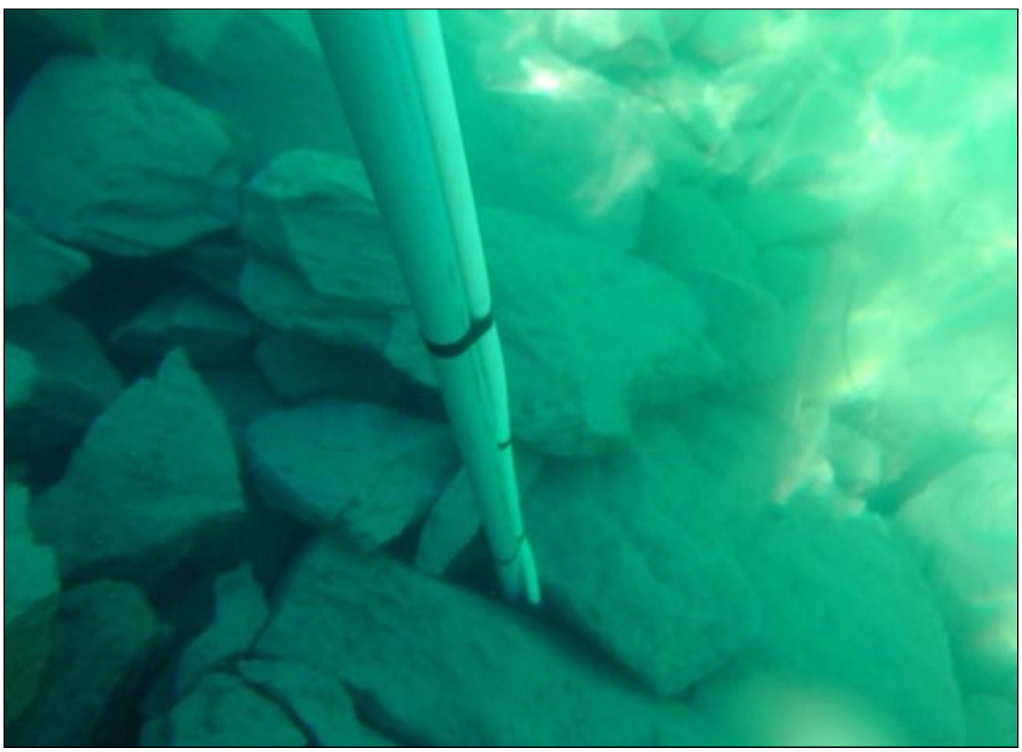
Camera on bottom of Dike Face near station ED-PW-2

Underwater camera - Lake Trout swimming along bottom of Dike Face near at Station ED-PW-2

Undewater camera - Two Lake Trout captured on camera at station BG-PW-4

Underwater camera - Lake Trout captured on camera at station BG-PW-2

Underwater Camera - Lake Trout caught on camera at station BG-PW-6



Underwater photo of pore water sampling pole

Underwater camera still - Still image from underwater pheriphyton video

APPENDIX D

2015 AWAR Fisheries Data

Apx A - Table 1. Data collected for fish captured through hoopnets at location R02 in 2015. US = upstream; DS = downstream; PYRC = previous year recapture; CYRC = current year recapture; ARGR = Arctic grayling; WTF = round whitefish; LTR = lake trout.

Date/Time	Water Temp	Staff Gauge	Direction (US or DS)	Net ID	Fish #	Tag #	Fork Length (mm)	Weight (g)	Sex/ Maturity	PYRC/ CYRC	Species
6/17/15	1	-	-	R02A	-	-	-	-	-	-	-
6/17/15	1	-	-	R02B	-	-	-	-	-	-	-
6/18/15	1.2	0.68	US	R02A	1	1	300	289	F3	-	ARGR
6/18/15	1.2	0.65	US	R02B	-	-	-	-	-	-	-
6/19/15	2	0.63	US	R02A	-	-	-	-	-	-	-
6/19/15	2	0.63	DS	R02A	-	-	-	-	-	-	-
6/19/15	2	0.63	US	R02B	2	3	256	170	M6	-	ARGR
6/20/15	1.8	0.65	US	R02A	-	-	-	-	-	-	-
6/20/15	1.8	0.65	DS	R02A	-	-	-	-	-	-	-
6/20/15	1.8	0.65	US	R02B	-	-	-	-	-	-	-
6/20/15	1.8	0.65	DS	R02B	-	-	-	-	-	-	-
6/21/15	1.8	0.6	US	R02A	-	-	-	-	-	-	-
6/21/15	1.8	0.62	DS	R02A	-	-	-	-	-	-	-
6/21/15	1.8	0.62	US	R02B	-	-	-	-	-	-	-
6/21/15	1.8	0.62	DS	R02B	-	-	-	-	-	-	-
6/22/15	2.2	0.58	US	R02A	-	-	-	-	-	-	-
6/22/15	2.2	0.58	DS	R02A	-	-	-	-	-	-	-
6/22/15	2.2	0.58	US	R02B	-	-	-	-	-	-	
6/22/15	2.2	0.58	DS	R02B	3	-	625	1700	-	-	Burbot
6/23/15	2.4	0.58	US	R02A	-	-	-	-	-	-	
6/23/15	2.4	0.58	DS	R02A	-	-	-	-	-	-	
6/23/15	2.4	0.58	US	R02B	-	-	-	-	-	-	
6/23/15	2.4	0.58	DS	R02B	-	-	-	-	-	-	
6/24/15	2.8	0.57	US	R02A	-	-	-	-	-	-	
6/24/15	2.8	0.57	DS	R02A	-	-	-	-	-	-	
6/24/15	2.8	0.57	US	R02B	4	4	310	330	M7	-	ARGR
6/24/15	2.8	0.57	DS	R02B	5	5	285	240	M7	-	ARGR
6/25/15	5	0.56	US	R02A	-	-	-	-	-	-	
6/25/15	5	0.56	DS	R02A	-	-	-	-	-	-	

Date/Time	Water Temp	Staff Gauge	Direction (US or DS)	Net ID	Fish #	Tag #	Fork Length (mm)	Weight (g)	Sex/ Maturity	PYRC/ CYRC	Species
6/25/15	5	0.56	US	R02B	-	-	-	-	-	-	
6/25/15	5	0.56	DS	R02B	-	-	-	-	-	-	
6/27/15	5	0.59	US	R02A	-	-	-	-	-	-	
6/27/15	5	0.59	DS	R02A	-	-	-	-	-	-	
6/27/15	5	0.59	US	R02B	-	-	-	-	-	-	
6/27/15	5	0.59	DS	R02B	-	-	-	-	-	-	
6/29/15	6	0.54	US	R02A	6	7	320	290	F2	-	ARGR
6/29/15	6	0.54	US	R02A	7	8	355	-	M10	-	ARGR
6/29/15	6	0.54	US	R02A	8	9	330	450	M10	-	ARGR
6/29/15	6	0.54	US	R02A	9	11	292	275	F5	-	ARGR
6/29/15	6	0.54	US	R02A	10	12	317	325	F5	-	ARGR
6/29/15	6	0.54	US	R02A	11	13	330	450	F5	-	ARGR
6/29/15	6	0.54	US	R02A	12	102346	305	350	F5	PYRC	ARGR
6/29/15	6	0.54	US	R02A	13	14	280	250	F5	-	ARGR
6/29/15	6	0.54	US	R02A	14	-	305	310	M10	-	ARGR
6/29/15	6	0.54	US	R02A	15	-	330	220	-	-	ARGR
6/29/15	6	0.54	DS	R02A	16	-	225	120	-	-	ARGR
6/29/15	6	0.54	DS	R02A	17	-	255	230	-	-	ARGR
6/29/15	6	0.54	DS	R02A	18	-	235	140	-	-	ARGR
6/30/15	8	49.5	DS	R02B	19	22	320	400	M10	-	ARGR
6/30/15	8	49.5	DS	R02B	20	23	275	230	F5	-	ARGR
6/30/15	8	49.5	DS	R02B	21	24	305	350	F5	-	ARGR
6/30/15	8	49.5	DS	R02B	22	25	355	450	M10	-	ARGR
6/30/15	8	49.5	DS	R02B	23	74	300	300	F5	-	ARGR
6/30/15	8	49.5	DS	R02A	24	71	370	575	F5	-	ARGR
6/30/15	8	49.5	DS	R02A	25	70	310	270	-	-	WTF
6/30/15	8	49.5	DS	R02A	26	69	295	225	-	-	WTF
6/30/15	8	49.5	DS	R02A	27	68	320	300	-	-	WTF
7/01/15	9	47	DS	R02B	28	67	245	180	M6	-	ARGR
7/01/15	9	47	DS	R02B	29	66	249	115	M6	-	ARGR
7/02/15	9	45	DS	R02A	30	64	245	180	M7	-	ARGR
7/02/15	9	45	DS	R02A	31	60	250	200	M7	-	ARGR
7/03/15	9.5	45	DS	R02A	32	55	300	250	-	-	WTF
7/03/15	9.5	45	DS	R02A	33	54	295	200	-	-	WTF

Date/Time	Water Temp	Staff Gauge	Direction (US or DS)	Net ID	Fish #	Tag #	Fork Length (mm)	Weight (g)	Sex/ Maturity	PYRC/ CYRC	Species
7/03/15	9.5	45	DS	R02A	34	53	305	240	-	-	WTF
7/04/15	9	44	DS	R02A	35	-	250	170	F2	-	ARGR
7/04/15	9	44	DS	R02A	36	-	-	-	-	-	WTF
7/04/15	9	44	DS	R02B	37	-	320	240	M7	-	WTF
7/05/15	10	43	DS	R02A	38	102894	310	240	M8	-	ARGR
7/05/15	10	43	DS	R02A	39	102892	314	290	M8	-	ARGR
7/05/15	10	43	US	R02B	40	23	275	210	F2	CYRC	ARGR
7/05/15	10	43	US	R02B	41	102888	305	315	F2	-	ARGR
7/05/15	10	43	US	R02B	42	102886	290	260	M7	-	ARGR
7/05/15	10	43	DS	R02B	43	-	220	110	F5	-	ARGR
7/05/15	10	43	DS	R02B	44	-	210	85	M10	-	ARGR
7/06/15	9	42	US	R02B	45	102882	210	100	M6	-	ARGR
7/06/15	9	42	DS	R02A	46	102881	260	200	F3	-	ARGR
7/06/15	9	42	DS	R02A	47	70	310	260	-	CYRC	WTF
7/06/15	9	42	DS	R02A	48	102890	340	310	M7	-	ARGR
7/06/15	9	42	DS	R02A	49	102879	305	240	M8	-	ARGR
7/06/15	9	42	DS	R02A	50	102878	330	290	M9	-	ARGR
7/07/15	9	43	DS	R02A	51	102877	320	330	-	-	WTF
7/07/15	9	43	DS	R02A	52	102876	220	120	M6	-	ARGR
7/07/15	9	43	DS	R02A	53	82	280	210	F4	-	ARGR
7/07/15	9	43	DS	R02A	54	76	275	210	M8	-	ARGR
7/07/15	9	43	DS	R02A	55	77	285	290	M7	-	ARGR
7/07/15	9	43	DS	R02A	56	81	270	200	M9	-	ARGR
7/07/15	9	43	DS	R02A	57	78	290	280	F3	-	ARGR
7/07/15	9	43	DS	R02A	58	79	300	320	F3	-	ARGR
7/07/15	9	43	DS	R02A	59	80	298	290	F3	-	ARGR
7/07/15	9	43	US	R02B	60	-	210	190	F5	-	ARGR
7/08/15	9	44	US	R02B	61	-	220	110	M10	-	ARGR
7/09/15	9	43	DS	R02A	62	-	278	220	-	-	ARGR
7/09/15	9	43	DS	R02A	63	86	225	120	M6	-	ARGR
7/11//2015	8.8	44	US	R02A	64	87	310	320	F4	-	ARGR
7/11//2015	8.8	44	US	R02A	65	-	-	-	-	-	-
7/11//2015	8.8	44	US	R02A	66	-	-	-	-	-	-
7/11//2015	8.8	44	US	R02A	67	-	310	300	M9	-	ARGR

Date/Time	Water Temp	Staff Gauge	Direction (US or DS)	Net ID	Fish #	Tag #	Fork Length (mm)	Weight (g)	Sex/ Maturity	PYRC/ CYRC	Species
7/11//2015	8.8	44	DS	R02B	68	-	215	120	F1	-	ARGR
7/13/15	10	40	DS	R02B	69	90	223	130	F1	-	ARGR
7/13/15	10	40	DS	R02B	70	91	271	230	M9	-	ARGR
7/13/15	10	40	US	R02A	71	-	300	270	-	-	WTF
7/13/15	10	40	US	R02A	72	-	220	140	-	-	WTF
7/13/15	10	40	US	R02A	73	-	230	135	F1	-	ARGR
7/13/15	10	40	US	R02	74	-	560	2250	-	-	LTR
7/16/15	11	38	DS	R02A	75	-	211	110	M6	-	ARGR
7/16/15	11	38	DS	R02A	76	92	264	225	M9	-	ARGR
7/16/15	11	38	US	R02A	77	-	289	220	-	-	WTF
7/16/15	11	38	US	R02A	78	93	286	230	M9	-	ARGR
7/16/15	11	38	US	R02A	79	94	300	270	M9	-	ARGR
7/17/15	10	38	DS	R02B	80	95	300	500	-	-	LTR
7/17/15	10	38	DS	R02B	81	96	310	200	M9	-	ARGR
7/17/15	10	38	US	R02B	82	-	310	240	-	-	WTF
7/17/15	10	38	US	R02A	83	97	280	200	F5	-	ARGR
7/17/15	10	38	DS	R02A	84	-	240	140	-	-	WTF
7/17/15	10	38	DS	R02A	85	-	220	120	-	-	WTF
7/17/15	10	38	DS	R02A	86	98	270	240	M7	-	ARGR
7/17/15	10	38	DS	R02A	87	7	320	260	F3	CYRC	ARGR
7/17/15	10	38	DS	R02A	88	99	260	170	F5	-	ARGR
7/17/15	10	38	DS	R02A	89	100	270	290	F2	-	ARGR
7/17/15	10	38	DS	R02A	90	102874	270	290	M9	-	ARGR
7/17/15	10	38	DS	R02A	91	102973	260	290	M9	-	ARGR
7/17/15	10	38	DS	R02A	92	102872	250	180	F4	-	ARGR

APPENDIX E

2015 Interstitial Water Quality Results

Apx A - Table 2. Interstitial water quality results for Bay-Goose Dike, East Dike, Second Portage Lake reference station and Third Portage Lake reference station. Results exceeding CCME Water Quality Guidelines for Aquatic Life (2007) are highlighted in grey.

Sample ID	Detection Limit	Units	CCME (2007)	BG-PW-6	BG-PW-4	BG-PW-2	BG-PW-DUP	RPD	TPL-REF	ED-PW-1	ED-PW-4	SP-REF
Physical Tests (Water)												
Hardness (as CaCO3)	0.50	mg/L		10.4	10.5	10.9	10.7	1.85	10.7	13.9	13.6	13.7
Total Suspended Solids	1.0	mg/L	6	<1.0	15.1	<1.0	<1.0		<1.0	<1.0	<1.0	2.3
Anions and Nutrients (Water)												
Orthophosphate-Dissolved (as P)	0.0010	mg/L		0.0013	0.0011	0.0011	<0.0010		0.0014	0.0011	0.0012	0.0013
Phosphorus (P)-Total Dissolved	0.0020	mg/L		<0.0020	<0.0020	<0.0020	<0.0020		<0.0020	<0.0020	0.0022	0.0027
Phosphorus (P)-Total	0.0020	mg/L	0.004	<0.0020	0.0041	<0.0020	<0.0020		<0.0020	<0.0020	<0.0020	<0.020
Total Metals (Water)												
Aluminum (Al)-Total	0.0030	mg/L	0.1	0.0096	0.0985	0.0102	0.0091	11.40	0.0109	0.0120	0.0125	0.0161
Antimony (Sb)-Total	0.00010	mg/L		<0.00010	<0.00010	<0.00010	<0.00010		<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Total	0.00010	mg/L	0.005	0.00056	0.00062	0.00081	0.00079	2.50	0.00068	0.00037	0.00037	0.00033
Barium (Ba)-Total	0.000050	mg/L		0.00303	0.00361	0.00318	0.00318	0.00	0.00314	0.00287	0.00293	0.00272
Beryllium (Be)-Total	0.000020	mg/L		<0.000020	<0.000020	0.000022	<0.000020		0.000026	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Total	0.000050	mg/L		<0.000050	<0.000050	<0.000050	<0.000050		<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Total	0.010	mg/L		<0.010	<0.010	<0.010	<0.010		<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Total	0.0000050	mg/L	0.00017	<0.0000050	0.0000055	<0.0000050	<0.0000050		<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Total	0.050	mg/L		2.62	2.59	2.82	2.80	0.71	2.77	3.66	3.76	3.68
Chromium (Cr)-Total	0.00010	mg/L	0.001	0.00015	0.00053	0.00013	0.00011	16.67	0.00016	0.00011	0.00014	0.00016
Cobalt (Co)-Total	0.00010	mg/L		<0.00010	0.00013	<0.00010	<0.00010		<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Total	0.00050	mg/L	0.002	<0.00050	0.00090	0.00054	<0.00050		<0.00050	0.00070	0.00072	0.00075
Iron (Fe)-Total	0.010	mg/L		0.015	0.173	0.017	0.014	19.35	0.017	0.021	0.027	0.035
Lead (Pb)-Total	0.000050	mg/L	0.001	<0.000050	0.000133	<0.000050	<0.000050		<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Total	0.0010	mg/L		<0.0010	<0.0010	<0.0010	<0.0010		<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)-Total	0.10	mg/L		0.94	0.96	1.01	1.00	1.00	1.01	1.15	1.18	1.18
Manganese (Mn)-Total	0.00010	mg/L		0.00176	0.0127	0.00182	0.00175	3.92	0.00164	0.00148	0.00160	0.00195
Mercury (Hg)-Total	0.0000050	mg/L		<0.0000050	<0.0000050	<0.0000050	<0.0000050		<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total	0.000050	mg/L		0.000172	0.000204	0.000200	0.000185	7.79	0.000193	0.000142	0.000146	0.000131
Nickel (Ni)-Total	0.00050	mg/L	0.025	0.00064	0.00147	0.00067	0.00065	3.03	0.00064	0.00052	0.00053	<0.00050
Phosphorus (P)-Total	0.050	mg/L		<0.050	<0.050	<0.050	<0.050		<0.050	<0.050	<0.050	<0.050
Potassium (K)-Total	0.10	mg/L		0.52	0.52	0.54	0.53	1.87	0.58	0.51	0.53	0.52
Selenium (Se)-Total	0.000050	mg/L	0.001	<0.000050	0.000053	<0.000050	<0.000050		0.000053	<0.000050	<0.000050	<0.000050
Silicon (Si)-Total	0.050	mg/L		0.089	0.189	0.094	0.093	1.07	0.100	0.209	0.212	0.238
Silver (Ag)-Total	0.000010	mg/L	0.0001	<0.000010	<0.000010	<0.000010	<0.000010		<0.000010	<0.000010	<0.000010	<0.000010

Sample ID	Detection Limit	Units	CCME (2007)	BG-PW-6	BG-PW-4	BG-PW-2	BG-PW-DUP	RPD	TPL-REF	ED-PW-1	ED-PW-4	SP-REF
Sodium (Na)-Total	0.050	mg/L		0.973	1.02	0.985	0.978	0.71	0.958	0.778	0.792	0.734
Strontium (Sr)-Total	0.00020	mg/L		0.0116	0.0115	0.0121	0.0119	1.67	0.0120	0.0164	0.0168	0.0160
Sulfur (S)-Total	0.50	mg/L		1.50	1.44	1.53	1.55	1.30	1.54	1.43	1.46	1.38
Thallium (Tl)-Total	0.000010	mg/L	0.0008	<0.000010	<0.000010	<0.000010	<0.000010		<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total	0.00010	mg/L		<0.00010	<0.00010	<0.00010	<0.00010		<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total	0.00030	mg/L		<0.00030	0.00208	<0.00030	<0.00030		<0.00030	<0.00030	<0.00030	0.00038
Uranium (U)-Total	0.000010	mg/L		0.000057	0.000080	0.000063	0.000062	1.60	0.000060	0.000057	0.000058	0.000062
Vanadium (V)-Total	0.00050	mg/L		<0.00050	<0.00050	<0.00050	<0.00050		<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Total	0.0030	mg/L	0.03	<0.0030	<0.0030	<0.0030	<0.0030		<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)-Total	0.00030	mg/L		<0.00030	<0.00030	<0.00030	<0.00030		<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals (Water)												
Aluminum (Al)-Dissolved	0.0010	mg/L		0.0031	0.0043	0.0037	0.0039	5.26	0.0032	0.0039	0.0043	0.0038
Antimony (Sb)-Dissolved	0.00010	mg/L		<0.00010	<0.00010	<0.00010	<0.00010		<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved	0.00010	mg/L		0.00047	0.00048	0.00070	0.00067	4.38	0.00060	0.00029	0.00029	0.00026
Barium (Ba)-Dissolved	0.000050	mg/L		0.00290	0.00300	0.00313	0.00309	1.29	0.00303	0.00284	0.00272	0.00261
Beryllium (Be)-Dissolved	0.000020	mg/L		<0.000020	<0.000020	<0.000020	<0.000020		<0.000020	<0.000020	<0.000020	0.000025
Bismuth (Bi)-Dissolved	0.000050	mg/L		<0.000050	<0.000050	<0.000050	<0.000050		<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved	0.010	mg/L		<0.010	<0.010	<0.010	<0.010		<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Dissolved	0.0000050	mg/L		<0.0000050	<0.0000050	<0.0000050	<0.0000050		<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Dissolved	0.050	mg/L		2.63	2.66	2.74	2.72	0.73	2.71	3.70	3.62	3.63
Chromium (Cr)-Dissolved	0.00010	mg/L		<0.00010	<0.00010	<0.00010	<0.00010		<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)-Dissolved	0.00010	mg/L		<0.00010	<0.00010	<0.00010	<0.00010		<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Dissolved	0.00020	mg/L		0.00038	0.00044	0.00041	0.00042	2.41	0.00040	0.00072	0.00071	0.00074
Iron (Fe)-Dissolved	0.010	mg/L		<0.010	<0.010	<0.010	<0.010		<0.010	<0.010	<0.010	<0.010
Lead (Pb)-Dissolved	0.000050	mg/L		<0.000050	0.000098	<0.000050	<0.000050		<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved	0.0010	mg/L		<0.0010	<0.0010	<0.0010	<0.0010		<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)-Dissolved	0.10	mg/L		0.94	0.95	0.97	0.95	2.08	0.96	1.14	1.12	1.13
Manganese (Mn)-Dissolved	0.00010	mg/L		0.00087	0.00214	0.00100	0.00096	4.08	0.00094	0.00079	0.00069	0.00076
Mercury (Hg)-Dissolved	0.0000050	mg/L		<0.0000050	<0.0000050	<0.0000050	<0.0000050		<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved	0.000050	mg/L		0.000161	0.000161	0.000175	0.000181	3.37	0.000165	0.000134	0.000126	0.000131
Nickel (Ni)-Dissolved	0.00050	mg/L		0.00051	0.00053	0.00051	0.00055	7.55	0.00051	<0.00050	<0.00050	<0.00050
Phosphorus (P)-Dissolved	0.050	mg/L		<0.050	<0.050	<0.050	<0.050		<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved	0.10	mg/L		0.50	0.50	0.53	0.51	3.85	0.51	0.49	0.49	0.47
Selenium (Se)-Dissolved	0.000050	mg/L		<0.000050	<0.000050	<0.000050	<0.000050		<0.000050	<0.000050	<0.000050	<0.000050
Silicon (Si)-Dissolved	0.050	mg/L		0.075	0.078	0.080	0.079	1.26	0.083	0.190	0.185	0.211
Silver (Ag)-Dissolved	0.000010	mg/L		<0.000010	<0.000010	<0.000010	<0.000010		<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved	0.050	mg/L		0.954	0.949	0.962	0.949	1.36	0.954	0.777	0.763	0.748
Strontium (Sr)-Dissolved	0.00020	mg/L		0.0112	0.0112	0.0115	0.0116	0.87	0.0114	0.0161	0.0158	0.0160
Sulfur (S)-Dissolved	0.50	mg/L		1.49	1.49	1.49	1.49	0.00	1.49	1.42	1.41	1.36
Thallium (Tl)-Dissolved	0.000010	mg/L		<0.000010	<0.000010	<0.000010	<0.000010		<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved	0.00010	mg/L		<0.00010	<0.00010	<0.00010	<0.00010		<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved	0.00030	mg/L		<0.00030	<0.00030	<0.00030	<0.00030		<0.00030	<0.00030	<0.00030	<0.00030

Sample ID	Detection Limit	Units	CCME (2007)	BG-PW-6	BG-PW-4	BG-PW-2	BG-PW-DUP	RPD	TPL-REF	ED-PW-1	ED-PW-4	SP-REF
Uranium (U)-Dissolved	0.000010	mg/L		0.000039	0.000050	0.000047	0.000036	26.51	0.000047	0.000051	0.000051	0.000049
Vanadium (V)-Dissolved	0.00050	mg/L		<0.00050	<0.00050	<0.00050	<0.00050		<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved	0.0010	mg/L		<0.0010	<0.0010	<0.0010	<0.0010		<0.0010	<0.0010	<0.0010	<0.0010
Zirconium (Zr)-Dissolved	0.00030	mg/L		<0.00030	<0.00030	<0.00030	<0.00030		<0.00030	<0.00030	<0.00030	<0.00030