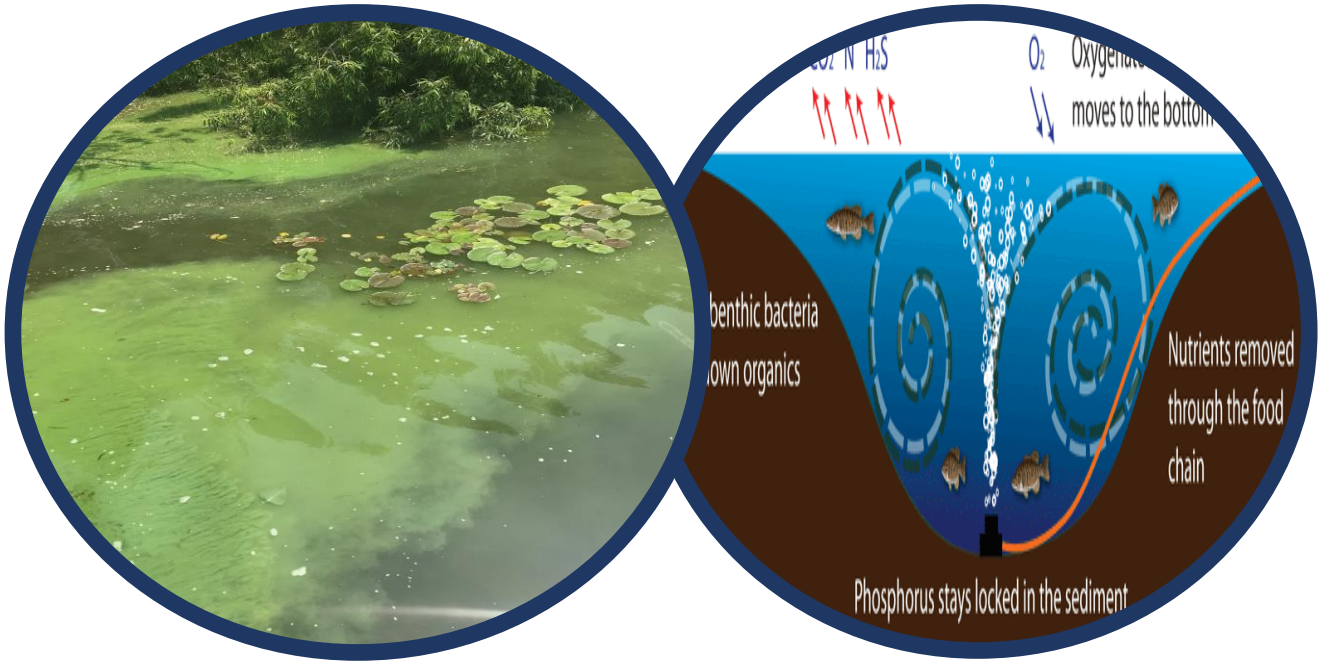
Lake LeAnn 2019 Baseline Inversion Oxygenation Data 2019 and 2021 Year 1 Report Hillsdale County, Michigan



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1.0 PROJECT INTRODUCTION & SUMMARY

Lake LeAnn is located in Somerset Township in Hillsdale County, Michigan (T.5S, R.1W, sections 3,4,5,8,9, and 10; Figures 1 and 2). The north lake basin is comprised of 200.3 acres and the south lake basin consists of 268 acres (RLS, 2019). The lake is a man-made impoundment with a dam located at the north end of the north basin with a second dam on the south lake. The north lake basin has 1 area of water influx which includes 1 drain, and the south lake basin has 3 drainage areas. The north lake basin has nearly 6.4 miles of shoreline and the south lake basin has nearly 7.3 miles of shoreline. The mean depth of the north lake basin is approximately 7.6 feet, and the mean depth of the south lake basin is approximately 9.7 feet. The maximum depth of the north lake basin is approximately 22.5 feet, and the maximum depth of the south lake basin is approximately 39.0 feet (RLS, 2019 bathymetric scan data). The north lake basin also has a fetch (longest distance across the lake) of around 0.8 miles and the south lake basin has a fetch of around 1.2 miles (RLS, 2019). The north basin of Lake LeAnn has an approximate water volume of 1,927.3 acre-feet and the south lake basin has an approximate water volume of 2,555.7 acre-feet (RLS, 2019 bathymetric data).

The immediate watershed (which is the area directly draining into the lakes) differs for each basin with the north being approximately 3,582 acres and the south being approximately 1,515 acres. This is about 7.6 times the size of the lake, which is moderately large. Legal lake levels have been established for both lakes with the summer and winter levels for the north lake at elevations of 1041.25’ and 1040.50 feet, respectively, and summer and winter levels for the south lake at elevations of 1046.85’ and 1046.40 feet, respectively.

Based on the current study, Lake LeAnn contains 5 invasive aquatic plant species which includes the submersed hybrid Eurasian Watermilfoil (EWM), Curly-leaf Pondweed (CLP), and Starry Stonewort and the emergents Purple Loosestrife and Phragmites. Continued surveys and vigilance are needed to assure that additional invasives do not enter Lake LeAnn. Aquatic herbicide treatments are recommended on a spot-treatment basis to effectively reduce the invasives over time. Algaecides should only be used on green algal blooms since many treatments can exacerbate blue-green algae blooms. The blue-green algae, *Microcystis* sp. was the most prevalent algae in the lake which is an

indicator of poor water quality. A bloom in early October 2019 proved to have total microcystins at 55 µg/L which is well above the EPA standard for microcystin at 8.0 µg/L and a no contact advisory was issued by the Michigan Department of Health and Human Services (MDHHS). In 2020-2021 more cyanobacteria blooms were present and toxins were measured in 2021.

It may take years for the LFA technology and bioaugmentation to reduce the prominent cyanobacterial blooms on Lake LeAnn. The lake is highly impaired with multiple nutrient sources that are difficult to reduce—including abundant septic systems, use of lawn fertilizers, numerous drains, and lack of shoreline emergent vegetation. RLS and the LLPOA are working diligently with Lake LeAnn property owners to reduce these sources and assist with maximizing the efficacy of the current LFA program. It is important to realize that the external loading of nutrients to Lake LeAnn has resulted in the condition of internal loading which is exacerbated by reduced dissolved oxygen concentrations in the deep basins.

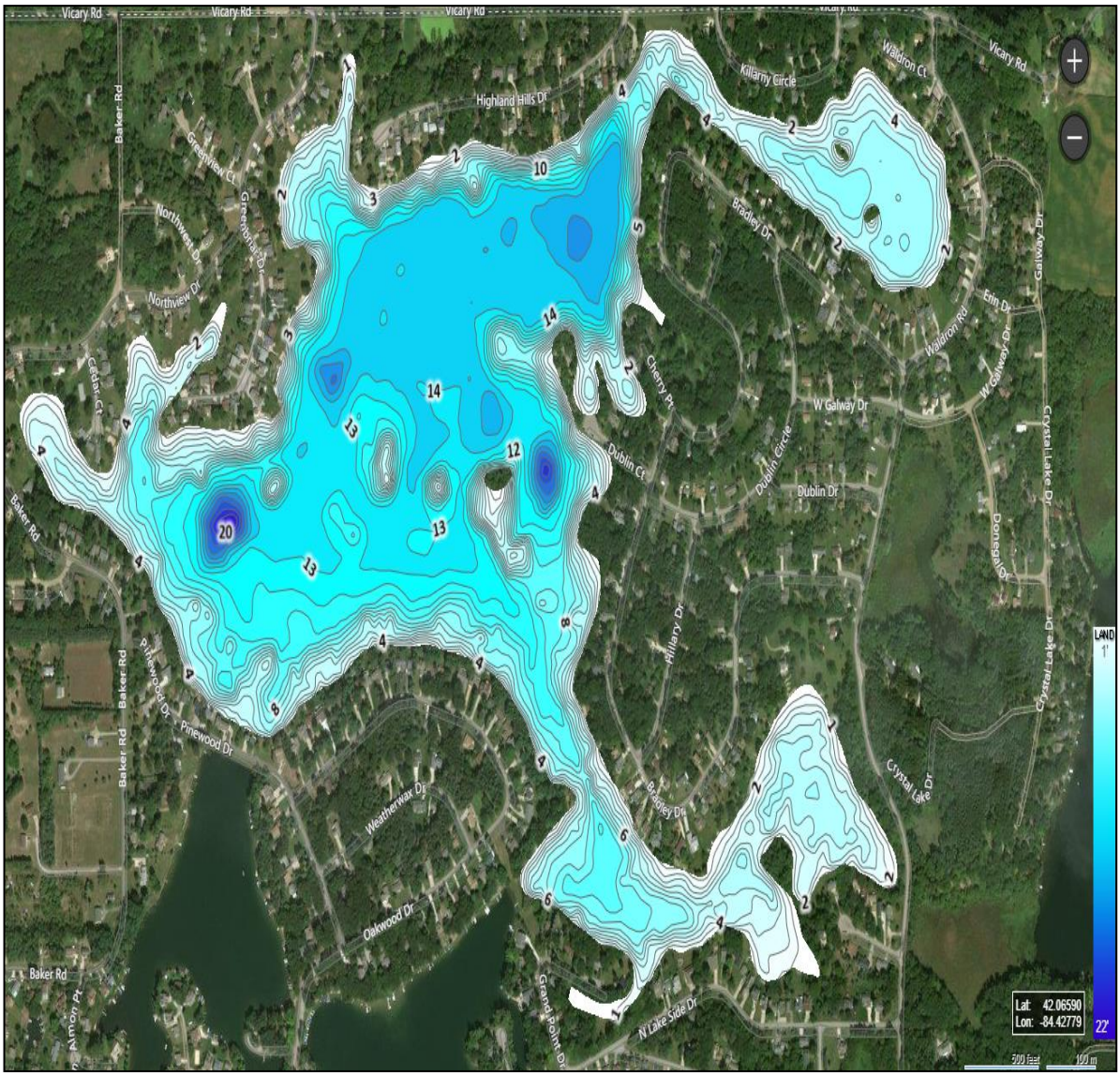

Figure 1. Lake LeAnn (north basin) depth contour map (RLS; 2021).

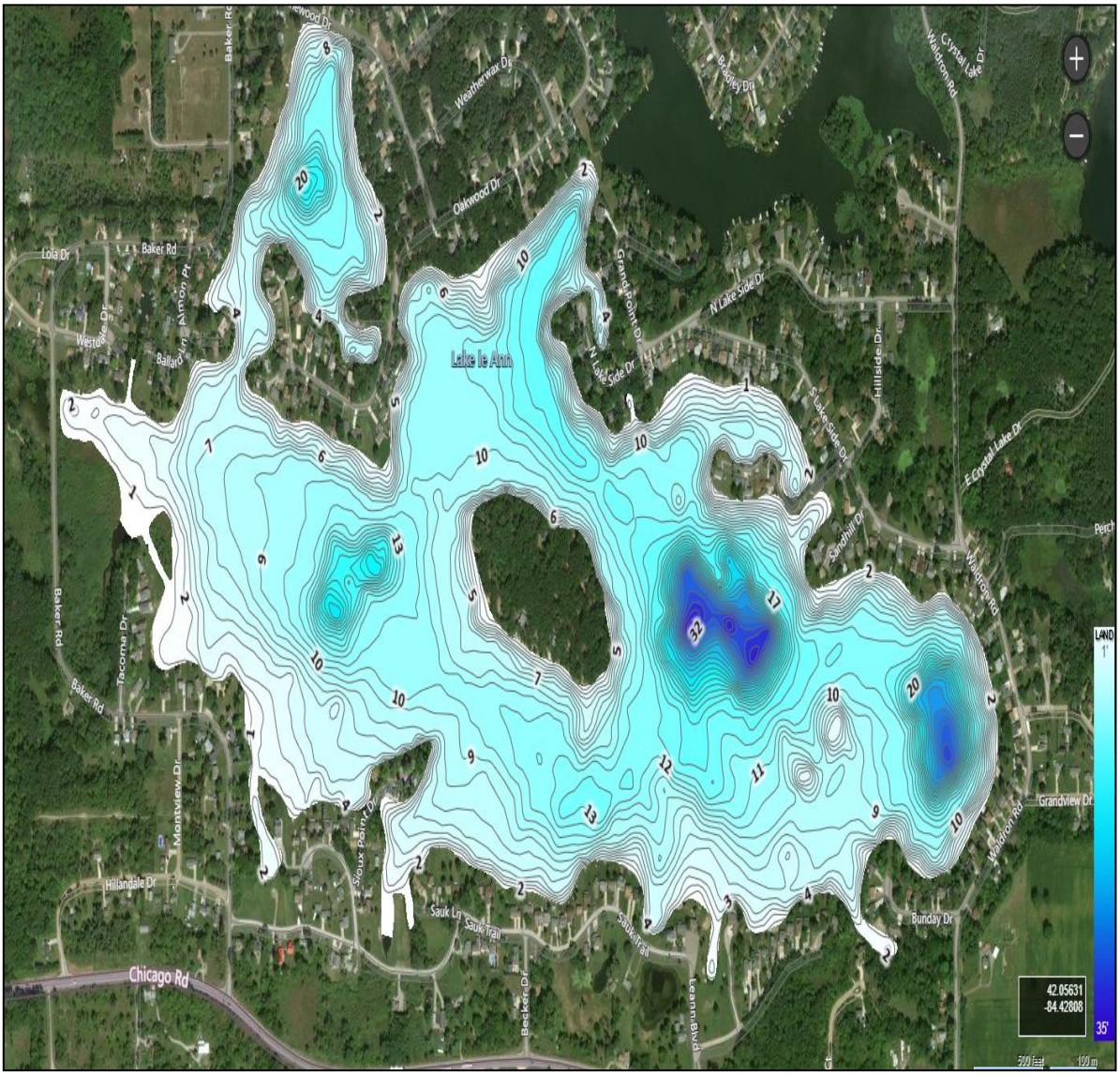

Figure 2. Lake LeAnn (south basin) depth contour map (RLS; 2021).

1.1 Summary of Lake LeAnn Aeration Operations:

This report serves as the baseline data requirement for the EGLE aeration permit for the lake. This sampling guidance protocol is required by the State of Michigan Department of Environment, Great Lakes, and Energy (EGLE). This report represents the first set of baseline data for 2019 and Year 1 (2021). This sampling occurs once in April/May, June/July, and August/September of each year. One sampling location per 50 acres of surface area is recommended in stratified basins and sampling at mid-depth in basins with shallow depths (< 10 feet). The sampling consists of the physical water quality parameters, water depth (measured in 0.5-meter increments), water temperature (measured in °C), dissolved oxygen (measured in mg/L), pH (measured in Standard Units), specific conductivity (measured in mS/cm), and secchi disk transparency (in feet). Additionally, at each site, chemical water quality parameters are included: total and ortho-phosphorus (mg/L), total Kjeldahl nitrogen and total inorganic nitrogen (both in mg/L), total suspended solids (in mg/L), and chlorophyll-a in micrograms per liter. In lakes such as Lake LeAnn with high surface blue-green algae blooms, the use of an *in situ* fluorimeter is much more accurate than a composite chlorophyll-a sampler and thus that metric is used to measure chlorophyll-a in hyper-eutrophic waters. RLS has made recommendations for the use of this instrument in Section 5.0 of this report.

1.2 Summary of Aeration Operation Purpose/Goals:

Lake LeAnn is a well-recreated lake and is utilized by many for fishing, swimming, boating, and waterfront living. In recent years, the lake has become dominated by aggressive invasive aquatic vegetation such as Curly-leaf Pondweed and Eurasian Watermilfoil. In addition, the lake has become mucky in many areas and is also experiencing toxic cyanobacteria blooms and watershed inputs of nutrients and solids. The residents have desired a more holistic approach to addressing both the aquatic plant and algae issues as well as the muck reduction. The residents desired a lake restoration strategy that would make the lake healthier and accomplish the following objectives:

The primary objectives of the implemented LFA/bioaugmentation system for Lake LeAnn include:

1) Reduction of nuisance toxic cyanobacteria algae throughout the lake.
2) Increase in water clarity/transparency
3) Increase in water column dissolved oxygen
4) Reduction of muck in problem areas.
5) Reduction of nuisance rooted submersed aquatic vegetation such as Eurasian Watermilfoil and Curly-leaf Pondweed.
6) Reduction of lake water column nutrients

2.0 LAKE LEANN SAMPLING METHODS & PARAMETERS

2.1 Sampling Dates and Methods:

Restorative Lake Sciences sampled 9 locations for baseline data in 2019 (5 in the south basin and 4 in the north basin) as well as the drains entering both basins. In 2019, the Mirror Lake Outlet was not sampled but was added to the EGLE permit for 2021 and was thus sampled in 2021. The drains will be sampled at least twice per season as RLS recommends continual monitoring of these drains as they contribute significant nutrient loads to both basins. In 2019 (baseline year), both lake basins and drains were sampled on April 26, 2019, July 24, 2019 and September 11, 2019. In 2021, both lake basins were sampled on April 28, 2021, July 19, 2021, and September 16, 2021. In 2019 a total of 9 sediment samples were collected but that number was increased to 13 samples in 2021 by EGLE. In 2021, sediment samples were collected on September 16, 2021. All sampling location maps for the lake basins, sediment sampling, and drains are shown below in Figures 3-5.

All chemical water samples were collected at the specified depths (one each at the top, middle, and bottom depths of the deep basin sampling sites and at mid-depth for shallow sites) using a 4-liter VanDorn horizontal water sampler with weighted messenger (Wildco® brand). Water quality physical parameters (such as water temperature, dissolved oxygen, conductivity, and pH) were measured with a calibrated Eureka Manta 2® multi-probe meter as a profile through the water column at the sampling sites. All water samples were maintained on ice in a large cooler prior to being placed into the laboratory fridge. Total phosphorus was titrated and analyzed in the laboratory according to method SM 4500-P E. Ortho-phosphorus was titrated and analyzed in the laboratory according to method SM 4500-P E. Total suspended solids were analyzed for each sample using SM 2540 D-97. Sediment samples were collected with an Ekman hand dredge and placed into glass jars before being placed on ice and transported to the laboratory for analysis. Sediment organic matter was analyzed using method ASTM D2974. All the aforementioned chemical parameters were analyzed at Trace Analytical Laboratories in Muskegon, Michigan.

Chlorophyll-*a* was analyzed in situ with a calibrated Turner Designs® fluorimeter used to measure algal pigment in lakes with blue-green algal blooms. This gives a more accurate assessment of the actual Chl-a versus a profile reading that may skew Chl-a results to a much lower concentration. Prior to analysis of the samples as described above, water samples were placed in clean, unpreserved polyethylene bottles for ortho-phosphorus and total suspended solids and placed in H_2SO_4-preserved, clean, polyethylene bottles for total phosphorus analysis. Algal community samples were placed in glass brown, amber 1-liter bottles with magnesium carbonate as a preservative and analyzed within 72 hours after collection. Samples used for microscopic analysis of algal community composition were preserved with magnesium carbonate and counted with a Sedgewick Rafter® Counting Cell under high power objective on a bright-field Zeiss® compound microscope. Multiple 1 micro-liter (µL) aliquots were used to determine the relative abundance of algal genera in the samples. Zooplankton samples were rinsed into the collection bottle from the collection tow net, where an Alka

Seltzer® tablet was then placed along with 70% ethyl alcohol solution. The sample was then quantified for zooplankton community composition using a Ward counting wheel under a Zeiss® dissection microscope.

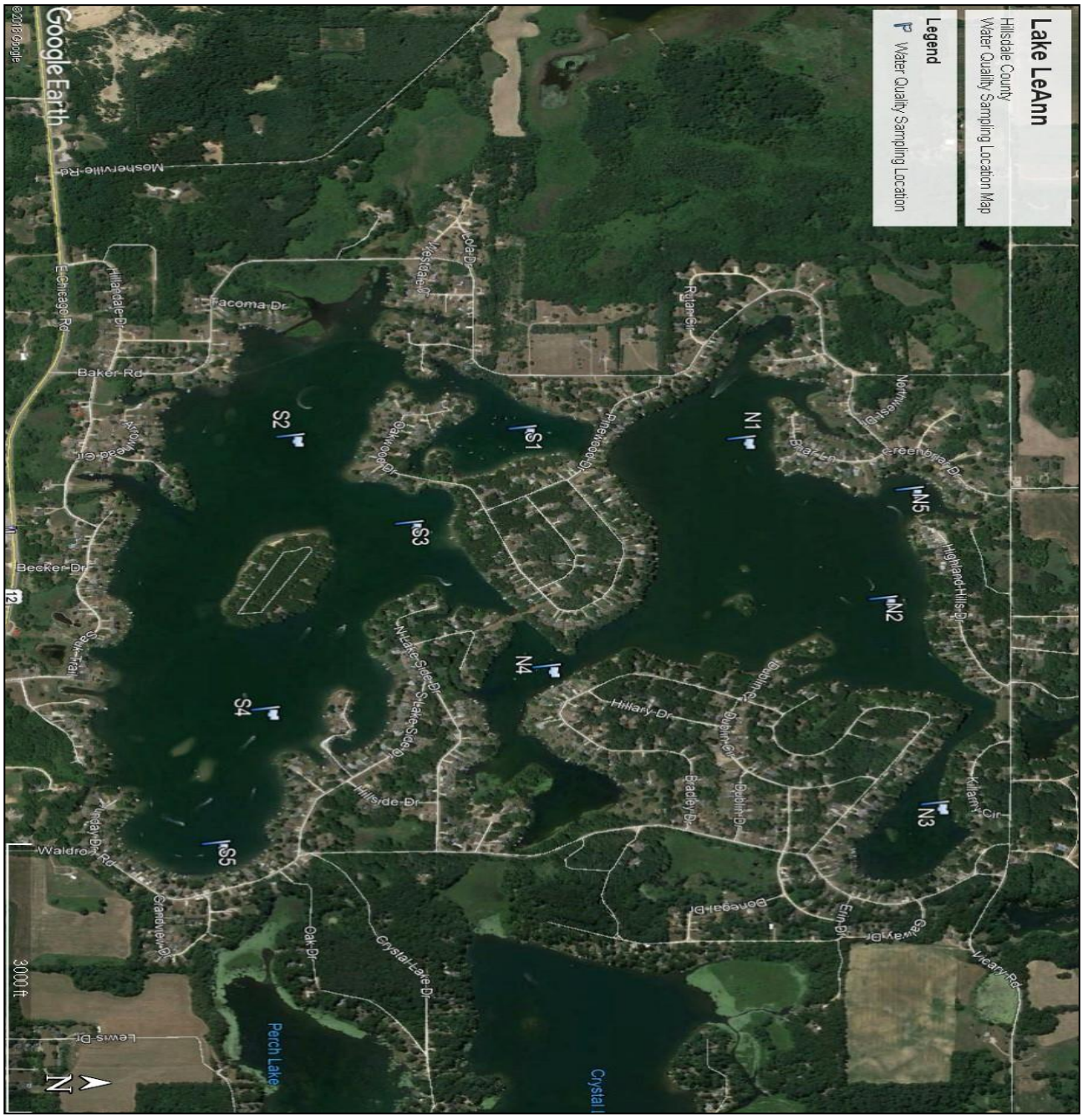

Figure 3. 2021 water quality sampling locations on Lake LeAnn. NOTE: The Mirror Lake outlet was added for 2021 but was not originally sampled in the 2019 baseline lake management plan.

Figure 4. 2021 sediment sampling locations on Lake LeAnn, Hillsdale County, Michigan. Note: Sampling location sites were increased by EGLE in 2021.

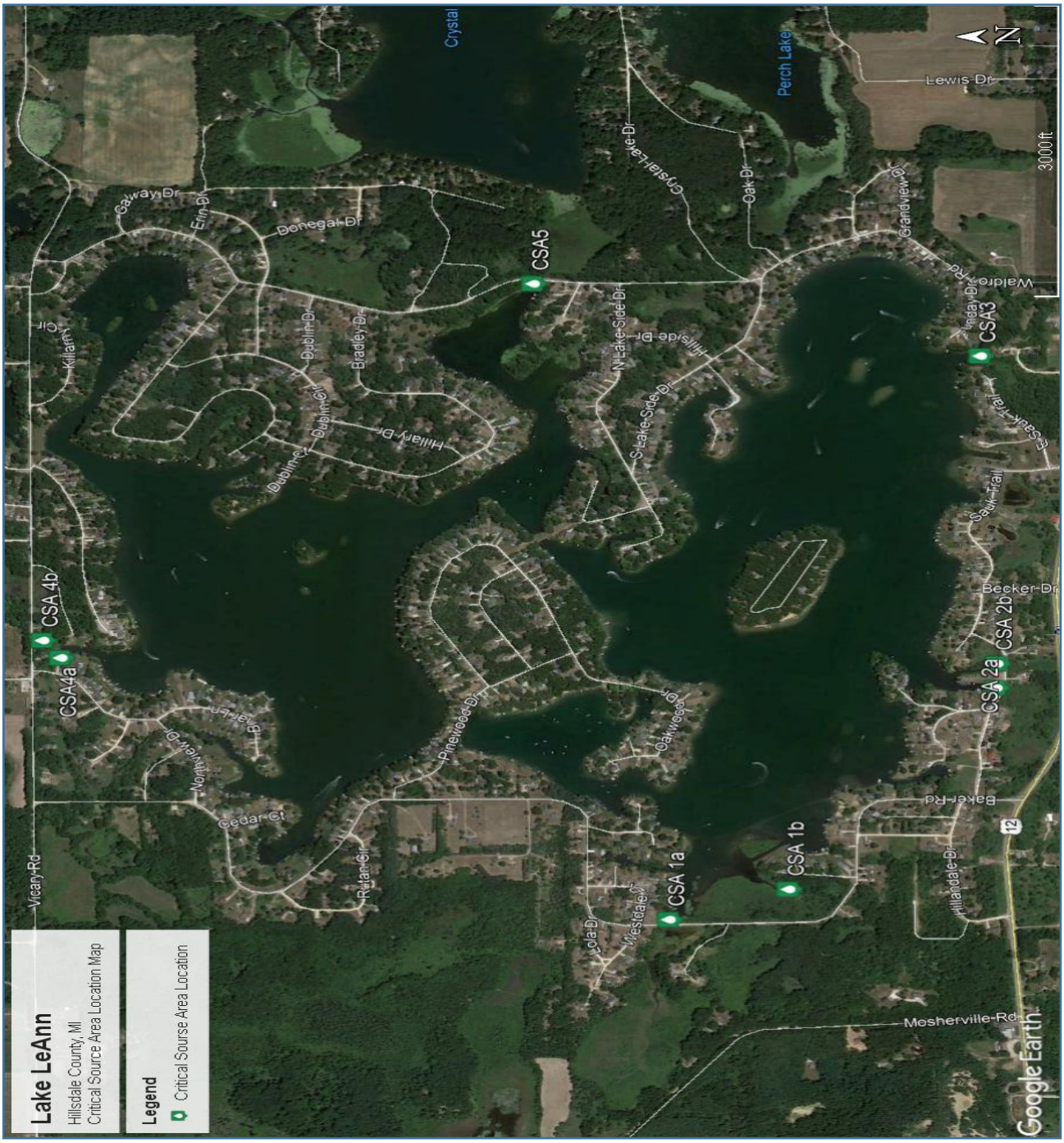

Figure 5. 2019-2021 drain sampling locations on Lake LeAnn, Hillsdale County, Michigan.

3.0 LAKE LEANN 2019 BASELINE WATER QUALITY SAMPLING RESULTS

All baseline deep basin physical water quality data is shown in Tables 1-27 of Section 3.1 below. Baseline chemical water quality data is shown in Tables 28-54 of Section 3.2 below. Baseline drain physical and chemical water quality data is shown below in Tables 55-61 of Section 3.3 below. NOTE: Drain sampling is not usually required as a condition of the LFA permit; however, the data is being collected to evaluate current and future measurements to determine mitigation implementation efficacy.

3.1 Lake LeAnn Baseline Deep Basin Physical Water Quality Data Tables:

Pre-Aeration Data Tables (April 26, 2019): North and South Basins

Table 1. Lake LeAnn physical water quality parameter data collected at deep basin north #1 (April 26, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	13.6	9.9	8.3	509	4.8	325	10.1
0.5	13.6	10.0	8.3	509	4.8	325	
1.0	13.6	10.0	8.3	509	4.8	325	
1.5	13.3	10.1	8.3	509	4.8	326	
2.0	13.2	10.0	8.3	513	4.9	328	
2.5	12.4	9.9	8.2	514	5.1	329	
3.0	12.2	9.5	8.2	514	5.1	329	
3.5	11.9	9.4	8.2	514	5.1	329	
4.0	12.0	9.2	8.2	514	5.1	329	
4.5	11.9	9.2	8.2	514	5.4	329	
5.0	11.9	9.2	8.2	514	5.4	329	
5.5	11.0	9.0	8.1	515	5.4	330	
6.0	10.4	9.0	8.1	515	5.4	329	
6.5	10.4	8.7	8.1	507	5.4	363	

Table 2. Lake LeAnn physical water quality parameter data collected at deep basin north #2 (April 26, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	13.5	10.2	8.3	508	4.7	325	9.4
0.5	13.4	10.2	8.3	508	4.7	325	
1.5	13.4	10.2	8.3	508	4.8	325	
2.0	13.3	10.3	8.3	508	4.8	325	
2.5	13.3	10.3	8.3	508	4.8	325	
3.0	13.2	10.3	8.3	509	5.0	325	
3.5	13.1	10.3	8.3	510	5.0	326	
4.0	12.7	10.4	8.3	511	5.0	327	
4.5	12.4	10.1	8.3	512	5.1	328	
5.0	11.8	9.9	8.2	513	5.2	328	

Table 3. Lake LeAnn physical water quality parameter data collected at deep basin north #3 (April 26, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	13.9	10.5	8.4	503	4.7	322	7.1
0.5	13.9	10.7	8.4	503	4.7	322	
1.0	13.8	10.9	8.4	503	4.8	322	
1.5	13.8	11.0	8.4	504	4.8	322	
2.0	13.7	11.0	8.4	504	4.8	323	
2.5	13.5	11.2	8.4	507	4.8	324	

Table 4. Lake LeAnn physical water quality parameter data collected at deep basin north #4 (April 26, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	13.4	9.8	8.4	507	4.6	325	7.1
0.5	13.4	10.3	8.4	507	4.6	325	
1.0	13.4	10.5	8.4	507	4.7	325	
1.5	13.4	10.7	8.4	507	4.8	325	
2.0	13.3	10.9	8.4	507	4.8	325	
2.5	13.3	11.0	8.4	508	4.8	325	
3.0	13.3	11.1	8.4	508	5.1	325	

Table 5. Lake LeAnn physical water quality parameter data collected at deep basin south #1 (April 26, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	14.3	10.6	8.5	536	4.8	343	5.7
0.5	14.2	10.7	8.5	536	4.8	343	
1.0	14.1	10.7	8.5	536	4.8	343	
1.5	14.1	10.8	8.5	535	4.8	349	
2.0	14.1	10.8	8.5	535	4.9	349	
2.5	12.5	11.0	8.5	533	4.9	342	
3.0	11.6	11.4	8.5	533	4.9	341	
3.5	11.1	11.7	8.5	532	5.1	341	
4.0	10.9	11.8	8.5	533	5.2	341	
4.5	10.8	11.8	8.5	533	5.2	341	
5.0	10.4	11.7	8.4	536	5.4	343	

Table 6. Lake LeAnn physical water quality parameter data collected at deep basin south #2 (April 26, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	13.1	10.0	8.4	548	4.7	351	6.0
0.5	13.1	10.1	8.4	548	4.7	351	
1.0	13.1	10.2	8.4	548	4.7	351	
1.5	13.0	10.2	8.4	548	4.8	351	
2.0	13.0	10.2	8.4	548	4.8	350	
2.5	13.0	10.2	8.4	548	4.8	350	
3.0	12.9	10.2	8.4	548	4.9	350	
3.5	12.5	10.2	8.4	548	4.9	351	
4.0	12.2	10.0	8.3	549	4.9	351	
4.5	12.0	9.8	8.3	549	5.1	351	
5.0	11.9	9.5	8.3	549	5.1	351	
5.5	11.2	9.4	8.2	550	5.3	352	
6.0	10.8	9.0	8.2	551	5.4	352	

Table 7. Lake LeAnn physical water quality parameter data collected at deep basin south #3 (April 26, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	13.0	10.0	8.4	546	4.8	349	5.0
0.5	13.0	10.1	8.4	545	4.8	349	
1.0	13.0	10.3	8.4	545	4.8	349	
1.5	12.9	10.3	8.4	545	4.8	349	
2.0	12.9	10.4	8.4	545	4.9	349	
2.5	12.9	10.4	8.4	545	4.9	349	
3.0	12.7	10.4	8.4	544	5.3	349	

Table 8. Lake LeAnn physical water quality parameter data collected at deep basin south #4 (April 26, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	13.2	10.2	8.5	544	4.5	348	6.0
1.5	13.3	10.3	8.4	544	4.5	348	
3.0	13.3	10.4	8.4	544	4.5	348	
4.5	13.3	10.4	8.4	544	4.7	348	
6.0	13.2	10.4	8.4	544	4.7	348	
7.5	12.4	10.3	8.4	545	4.9	347	
9.0	10.2	9.8	8.3	549	4.9	352	
10.5	9.8	9.4	8.2	550	4.9	352	
12.0	9.4	7.9	7.8	541	5.0	347	

Table 9. Lake LeAnn physical water quality parameter data collected at deep basin south #5 (April 26, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	13.2	10.2	8.4	545	4.7	349	7.5
0.5	13.2	10.3	8.4	545	4.7	349	
1.0	13.3	10.3	8.4	545	4.7	349	
1.5	13.4	10.4	8.4	545	4.7	349	
2.0	13.3	10.4	8.4	545	4.7	349	
2.5	13.4	10.4	8.4	545	4.8	349	
3.0	13.4	10.5	8.4	545	4.8	349	
3.5	13.4	10.4	8.4	545	4.8	349	
4.0	13.4	10.4	8.4	545	4.8	349	
4.5	13.3	10.5	8.4	545	5.0	349	
5.0	13.3	10.5	8.4	545	5.0	349	
5.5	13.3	10.5	8.4	544	5.0	349	

Pre-Aeration Data Tables (July 24, 2019): North and South Basins

Table 10. Lake LeAnn physical water quality parameter data collected at deep basin north #1 (July 24, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	27.5	7.1	8.5	477	4.9	305	6.0
0.5	27.4	6.9	8.5	477	4.9	305	
1.0	27.0	6.8	8.5	476	4.9	305	
1.5	27.0	6.7	8.5	476	4.9	304	
2.0	26.7	6.7	8.5	706	4.9	454	
2.5	26.4	6.7	8.5	699	5.0	446	
3.0	26.3	6.6	8.5	608	5.0	387	
3.5	26.2	6.5	8.4	473	5.0	308	
4.0	25.8	6.5	8.4	472	5.0	304	
4.5	25.7	6.5	8.3	514	5.4	348	
5.0	22.3	4.3	8.3	566	5.4	370	
5.5	21.0	2.2	8.3	625	5.4	303	

Table 11. Lake LeAnn physical water quality parameter data collected at deep basin north #2 (July 24, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	27.1	7.5	8.4	663	4.8	392	6.1
0.5	26.8	6.8	8.4	586	4.8	378	
1.0	26.6	6.5	8.5	616	4.8	391	
1.5	26.5	6.4	8.5	618	4.9	408	
2.0	26.4	6.3	8.5	610	5.1	425	
2.5	26.3	6.1	8.5	649	5.1	422	
3.0	26.3	5.9	8.5	503	5.1	338	
3.5	26.3	5.7	8.5	580	5.0	388	
4.0	26.3	5.6	8.5	477	5.0	305	
4.5	25.6	1.7	8.4	500	5.1	320	

Table 12. Lake LeAnn physical water quality parameter data collected at deep basin north #3 (July 24, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	27.3	9.0	8.6	619	4.6	393	6.1
0.5	27.3	9.5	8.6	600	4.6	386	
1.0	27.1	10.0	8.5	594	4.6	384	
1.5	26.9	10.4	8.5	584	4.6	377	
2.0	26.5	10.3	8.5	489	4.7	379	
2.5	25.9	10.3	8.5	637	4.8	396	

Table 13. Lake LeAnn physical water quality parameter data collected at deep basin north #4 (July 24, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	27.5	8.3	8.5	677	4.5	434	6.0
0.5	27.4	8.6	8.4	675	4.5	492	
1.0	27.2	9.1	8.4	654	4.6	422	
1.5	26.5	9.5	8.4	633	4.7	404	
2.0	26.6	10.2	8.4	633	4.7	405	
2.5	26.0	10.2	8.4	636	5.0	406	
3.0	25.7	9.4	8.4	623	5.0	433	

Table 14. Lake LeAnn physical water quality parameter data collected at deep basin south #1 (July 24, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	27.6	8.9	8.5	435	3.8	278	9.8
0.5	27.7	9.2	8.5	434	3.8	278	
1.0	27.6	9.4	8.5	435	3.7	278	
1.5	27.1	9.5	8.5	436	4.1	279	
2.0	26.9	9.7	8.5	430	4.1	275	
2.5	26.7	9.9	8.5	429	4.1	274	
3.0	26.6	10.0	8.5	437	4.1	280	
3.5	26.6	10.1	8.5	438	4.3	281	
4.0	26.5	10.1	8.4	442	4.6	283	
4.5	26.0	7.8	8.4	482	4.6	308	
5.0	25.6	3.8	8.4	502	4.6	321	
5.5	24.2	1.7	8.3	517	4.8	331	
6.0	22.1	1.1	8.3	520	5.1	334	

Table 15. Lake LeAnn physical water quality parameter data collected at deep basin south #2 (July 24, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	27.5	8.1	8.5	464	4.6	297	8.1
0.5	27.6	8.5	8.5	464	4.6	297	
1.0	27.5	8.6	8.5	464	4.6	297	
1.5	27.0	9.3	8.5	460	4.6	295	
2.0	26.5	9.5	8.5	464	4.6	297	
2.5	26.1	10.1	8.5	455	4.6	292	
3.0	26.0	10.3	8.5	464	4.8	297	
3.5	25.8	10.2	8.5	555	4.8	339	
4.0	25.8	10.0	8.5	463	4.8	296	
4.5	25.8	9.9	8.5	469	4.8	298	
5.0	25.6	9.5	8.4	472	4.8	301	
5.5	24.6	5.4	8.4	505	4.8	323	
6.0	22.0	2.4	8.4	537	4.9	343	
6.5	20.5	1.1	8.4	559	4.9	357	

Table 16. Lake LeAnn physical water quality parameter data collected at deep basin south #3 (July 24, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	27.4	8.8	8.5	466	3.8	298	9.6
0.5	27.4	9.0	8.5	462	3.8	296	
1.0	27.0	9.1	8.5	464	3.8	297	
1.5	26.8	9.1	8.5	464	3.9	297	
2.0	26.6	9.1	8.5	486	3.9	310	
2.5	26.5	9.2	8.4	462	4.0	300	
3.0	26.4	9.5	8.4	459	4.0	293	

Table 17. Lake LeAnn physical water quality parameter data collected at deep basin south #4 (July 24, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	27.5	8.4	8.5	468	4.5	299	8.0
0.5	27.5	8.6	8.5	468	4.5	299	
1.0	27.5	8.7	8.5	468	4.5	299	
1.5	27.3	8.7	8.5	467	4.5	298	
2.0	27.0	8.9	8.5	466	4.6	298	
2.5	27.0	9.0	8.5	466	4.6	298	
3.0	26.5	9.1	8.5	466	4.6	298	
3.5	26.3	8.9	8.4	466	4.6	298	
4.0	26.3	8.7	8.4	463	4.5	296	
4.5	26.2	8.7	8.4	464	4.5	297	
5.0	26.1	8.5	8.4	466	4.5	298	
5.5	25.7	7.9	8.3	474	4.7	303	
6.0	25.5	6.9	8.3	479	4.7	306	
6.5	24.3	4.9	8.5	506	4.7	326	
7.0	20.5	3.7	8.5	537	4.8	343	
7.5	19.5	2.2	8.5	542	4.8	347	
8.0	18.2	1.6	8.5	545	4.6	349	
8.5	17.4	1.0	8.5	548	4.9	351	
9.0	16.7	0.8	8.5	555	4.9	355	
9.5	14.9	0.4	8.5	565	5.0	362	

Table 18. Lake LeAnn physical water quality parameter data collected at deep basin south #5 (July 24, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	28.0	8.3	8.5	469	4.7	300	7.8
0.5	27.9	8.5	8.5	469	4.7	300	
1.0	27.8	8.6	8.5	468	4.7	300	
1.5	27.6	8.7	8.5	468	4.7	300	
2.0	27.2	8.9	8.4	467	4.8	299	
2.5	26.7	8.9	8.4	466	4.9	298	
3.0	26.6	9.0	8.4	466	4.9	298	
3.5	26.6	8.9	8.4	466	5.0	299	
4.0	26.4	8.7	8.4	468	4.8	299	
4.5	26.4	8.7	8.5	506	4.8	299	
5.0	25.8	8.5	8.5	476	5.1	303	
5.5	24.2	6.8	8.5	506	5.0	324	
6.0	22.0	5.4	8.5	534	5.0	343	
6.5	19.5	4.3	8.5	546	5.2	350	
7.0	18.3	3.1	8.5	550	5.2	351	
7.5	17.4	2.1	8.5	551	5.2	353	
8.0	16.4	1.5	8.5	565	5.1	359	
8.5	14.6	1.1	8.5	581	5.2	372	
9.0	13.6	0.7	8.4	599	5.1	384	
9.5	13.1	0.5	8.4	610	5.1	391	

Pre-Aeration Data Tables (September 11, 2019): North and South Basins

Table 19. Lake LeAnn physical water quality parameter data collected at deep basin north #1 (September 11, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	23.0	8.5	8.7	462	8.1	296	3.2
1.0	22.8	9.3	8.6	462	8.1	297	
1.5	22.0	8.9	8.6	466	8.4	299	
2.0	21.7	8.5	8.4	464	8.4	304	
2.5	21.7	7.5	8.4	466	8.4	298	
3.0	21.4	6.9	8.2	465	8.4	298	
3.5	21.4	6.2	8.3	468	8.5	299	
4.0	21.3	4.7	8.3	482	8.4	303	
4.5	21.3	4.1	8.3	472	8.5	302	
5.0	21.3	3.6	8.3	472	8.5	302	
5.5	21.1	3.0	7.8	475	8.5	306	

Table 20. Lake LeAnn physical water quality parameter data collected at deep basin north #2 (September 11, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	24.0	8.4	8.8	462	7.9	295	3.2
0.5	24.1	9.1	8.7	461	7.9	295	
1.0	24.1	9.9	8.5	462	7.9	295	
1.5	23.5	10.2	8.5	461	7.9	295	
2.0	23.4	10.3	8.5	463	8.2	296	
2.5	23.3	10.2	8.5	505	8.2	301	
3.0	21.6	8.7	8.3	465	8.2	297	
3.5	21.4	6.2	8.1	465	8.2	298	
4.0	21.4	5.4	8.1	465	8.4	298	
4.5	21.4	5.4	8.1	465	8.6	298	

Table 21. Lake LeAnn physical water quality parameter data collected at deep basin north #3 (September 11, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	25.0	8.0	8.4	468	8.4	300	3.3
0.5	24.3	8.9	8.4	471	8.4	300	
1.0	23.6	9.1	8.4	469	8.4	300	
1.5	22.1	10.4	8.4	452	8.5	289	
2.0	21.8	10.7	8.4	472	8.5	308	

Table 22. Lake LeAnn physical water quality parameter data collected at deep basin north #4 (September 11, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	24.6	9.1	8.7	472	7.9	300	3.4
0.5	24.3	9.8	8.7	477	7.9	308	
1.0	23.1	11.0	8.7	489	7.9	311	
1.5	22.7	10.0	8.7	496	8.1	314	
2.0	22.2	9.7	8.7	508	8.0	314	
2.5	21.7	8.8	8.4	491	8.1	314	
3.0	21.7	8.8	8.4	495	8.1	314	

Table 23. Lake LeAnn physical water quality parameter data collected at deep basin south #1 (September 11, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	23.5	8.5	8.6	467	8.1	299	3.1
0.5	23.6	8.5	8.6	481	8.1	304	
1.0	23.4	8.6	8.6	496	8.1	338	
1.5	22.4	8.9	8.6	544	8.1	350	
2.0	22.1	8.9	8.6	512	8.1	333	
2.5	21.9	8.9	8.6	489	8.2	337	
3.0	21.8	8.9	8.6	484	8.1	310	
3.5	21.7	8.5	8.6	475	8.1	304	
4.0	21.5	8.2	8.4	478	8.2	306	
4.5	21.4	7.7	8.4	481	8.2	307	
5.0	21.3	7.0	8.4	482	8.2	308	
5.5	21.2	6.2	8.3	484	8.2	310	
6.0	21.1	4.0	8.3	489	8.2	313	

Table 24. Lake LeAnn physical water quality parameter data collected at deep basin south #2 (September 11, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	23.0	8.8	8.5	609	8.0	387	3.0
0.5	23.0	8.7	8.5	619	8.0	398	
1.0	23.0	8.7	8.5	634	8.0	417	
1.5	23.0	8.6	8.5	657	8.0	426	
2.0	23.0	8.6	8.5	688	8.2	441	
2.5	22.7	8.7	8.4	702	8.2	448	
3.0	22.0	8.8	8.4	552	8.2	344	
3.5	21.8	8.9	8.4	489	8.2	313	
4.0	21.6	8.9	8.3	503	8.4	347	
4.5	21.3	8.7	8.3	563	8.2	355	
5.0	21.1	7.7	8.3	572	8.1	366	
5.5	21.0	7.3	8.3	593	8.4	373	
6.0	20.9	6.2	8.2	500	8.4	320	
6.5	20.8	5.9	8.1	628	8.4	362	

Table 25. Lake LeAnn physical water quality parameter data collected at deep basin south #3 (September 11, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	23.2	8.5	8.5	551	4.8	354	7.1
0.5	23.2	8.5	8.5	566	4.9	349	
1.0	23.2	8.5	8.5	572	5.2	369	
1.5	23.2	8.5	8.5	593	5.2	372	
2.0	23.0	8.6	8.5	594	5.4	375	
2.5	22.1	8.7	8.5	575	5.9	368	
3.0	22.0	8.7	8.5	491	5.9	313	

Table 26. Lake LeAnn physical water quality parameter data collected at deep basin south #4 (September 11, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	23.3	8.4	8.5	655	4.9	418	7.2
0.5	23.3	8.5	8.5	643	4.9	411	
1.0	23.3	8.5	8.5	677	4.9	427	
1.5	23.3	8.5	8.5	668	4.9	434	
2.0	23.2	8.5	8.5	681	4.9	435	
2.5	22.2	8.6	8.5	689	4.9	440	
3.0	21.8	8.6	8.4	640	5.0	401	
3.5	21.5	8.1	8.4	489	4.8	432	
4.0	21.4	7.8	8.4	670	4.9	428	
4.5	21.3	7.7	8.5	638	5.0	412	
5.0	21.2	7.6	8.3	622	4.9	397	
5.5	21.2	7.5	8.3	599	4.9	400	
6.0	21.2	7.3	8.3	641	4.9	419	
6.5	21.1	7.2	8.3	606	5.2	382	
7.0	21.1	7.1	8.3	649	5.2	412	
7.5	21.0	6.9	8.3	614	5.2	379	
8.0	20.8	6.3	8.3	659	6.3	365	
8.5	20.8	5.9	8.3	533	6.4	352	
9.0	19.9	4.1	8.3	516	6.4	330	
9.5	16.9	1.5	8.3	582	6.4	372	
10.0	15.2	1.0	8.2	592	7.4	381	
10.5	14.4	0.8	8.1	605	7.5	387	
11.0	13.0	0.5	8.1	618	7.2	396	
11.5	12.7	0.3	8.1	627	7.5	401	

Table 27. Lake LeAnn physical water quality parameter data collected at deep basin south #5 (September 11, 2019).

Depth (m)	Water Temp (°C)	DO (mg/L)	pH (S.U.)	Conduc. (mS/cm)	Turb. (NTU)	TDS (mg/L)	Secchi Depth (ft)
0	23.4	8.5	8.5	483	4.9	309	7.1
0.5	23.5	8.5	8.5	483	4.8	309	
1.0	23.0	8.5	8.5	489	4.8	313	
1.5	22.5	8.4	8.5	489	4.9	313	
2.0	21.5	8.3	8.5	488	4.9	312	
2.5	21.2	8.0	8.5	487	4.9	312	
3.0	21.2	7.7	8.3	487	5.4	312	
3.5	21.0	6.8	8.3	489	6.0	313	
4.0	20.7	4.2	8.3	494	6.0	316	
4.5	16.5	2.3	8.1	622	6.0	398	
5.0	14.1	0.8	8.1	688	6.1	440	
5.5	14.1	0.8	8.0	689	6.1	441	

3.2 Lake LeAnn Baseline 2019 Deep Basin Chemical Water Quality Data Tables:

Pre-Aeration Data Tables (April 26, 2019): Sites Deep Basin #1-#3

Table 28. Lake LeAnn chemical water quality parameter data collected at deep basin north #1 (April 26, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	0.6	0.260	0.093	0.170	<0.10	38	0.017	<0.010	0
3.5	0.7	0.250	0.089	0.160	<0.10	<10	0.033	<0.010	
6.5	0.6	0.280	0.087	0.190	<0.10	<10	0.027	<0.010	

Table 29. Lake LeAnn chemical water quality parameter data collected at deep basin north #2 (April 26, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	<0.5	0.260	0.088	0.170	<0.10	28	0.013	<0.010	0
2.5	0.7	0.250	0.091	0.160	<0.10	<10	0.032	<0.010	
5.0	0.7	0.260	0.096	0.160	<0.10	18	0.035	<0.010	

Table 30. Lake LeAnn chemical water quality parameter data collected at deep basin north #3 (April 26, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	--	--	--	--	--	--	--	--	--
1.0	0.9	0.210	0.046	0.170	<0.10	36	0.034	0.010	0
2.5	--	--	--	--	--	--	--	--	--

Table 31. Lake LeAnn chemical water quality parameter data collected at deep basin north #4 (April 26, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3- (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	<0.5	0.210	0.046	0.160	<0.10	34	0.020	<0.010	0.534
1.5	<0.5	0.220	0.053	0.160	<0.10	36	0.022	<0.010	
3.0	<0.5	0.200	0.041	0.160	<0.10	30	0.018	<0.010	

Table 32. Lake LeAnn chemical water quality parameter data collected at deep basin south #1 (April 26, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	<0.50	0.150	<0.010	0.150	<0.10	<10	0.015	<0.010	1.78
2.5	<0.50	0.170	0.017	0.160	<0.10	<10	0.015	<0.010	
5.0	<0.50	0.190	0.024	0.160	<0.10	<10	0.015	<0.010	

Table 33. Lake LeAnn chemical water quality parameter data collected at deep basin south #2 (April 26, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	<0.50	0.180	0.028	0.160	<0.10	14	0.025	<0.010	0
3.0	0.6	0.190	0.048	0.140	<0.10	36	0.024	<0.010	
6.0	<0.50	0.160	<0.010	0.160	<0.10	<10	0.013	<0.010	

Table 34. Lake LeAnn chemical water quality parameter data collected at deep basin south #3 (April 26, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	<0.50	0.180	0.024	0.160	<0.10	<10	0.017	<0.010	1.07
1.5	<0.50	0.200	0.025	0.180	<0.10	<10	0.018	<0.010	
3.0	<0.50	0.190	0.017	0.180	<0.10	<10	0.013	<0.010	

Table 35. Lake LeAnn chemical water quality parameter data collected at deep basin south #4 (April 26, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	<0.50	0.560	0.023	0.540	<0.10	<10	0.018	<0.010	0
6.0	<0.50	0.330	0.170	0.160	<0.10	<10	0.020	<0.010	
12.0	<0.50	0.160	0.014	0.150	<0.10	36	0.032	<0.010	

Table 36. Lake LeAnn chemical water quality parameter data collected at deep basin south #5 (April 26, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	<0.50	0.200	0.021	0.180	<0.10	42	0.017	<0.010	6.05
2.5	<0.50	0.280	0.074	0.210	<0.10	<10	0.015	<0.010	
5.5	<0.50	0.200	0.024	0.180	<0.10	14	0.016	<0.010	

Pre-Aeration Data Tables (July 24, 2019): North and South Deep Basins

Table 37. Lake LeAnn chemical water quality parameter data collected at deep basin north #1 (July 24, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	<0.5	<0.010	<0.010	<0.10	<0.10	10	0.026	<0.010	1.34
3.5	0.63	0.022	0.022	<0.10	<0.10	<10	0.033	0.13	
5.5	2.8	1.2	1.2	<0.10	<0.10	14	0.160	0.017	

Table 38. Lake LeAnn chemical water quality parameter data collected at deep basin north #2 (July 24, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	<0.50	<0.010	<0.010	<0.10	<0.10	<10	0.023	<0.010	0
2.5	0.89	0.028	0.028	<0.10	<0.10	10	0.032	<0.010	
4.5	2.4	0.076	0.076	<0.10	<0.10	10	0.037	<0.010	

Table 39. Lake LeAnn chemical water quality parameter data collected at deep basin north #3 (July 24, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0									
1.0	0.93	0.020	0.020	<0.10	<0.10	<10	0.028	<0.010	0
2.5									

Table 40. Lake LeAnn chemical water quality parameter data collected at deep basin north #4 (July 24, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3- (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0									
1.5	0.69	0.011	0.011	<0.10	<0.10	10	0.033	<0.010	0
3.0									

Table 41. Lake LeAnn chemical water quality parameter data collected at deep basin south #1 (July 24, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	0.52	<0.010	<0.010	<0.10	<0.10	<10	0.014	<0.010	0.801
3.0									
6.0	0.55	<0.010	<0.010	<0.10	<0.10	<10	0.019	<0.010	

Table 42. Lake LeAnn chemical water quality parameter data collected at deep basin south #2 (July 24, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	<0.5	<0.010	<0.010	<0.10	<0.10	<10	0.014	<0.010	0
3.5	0.63	<0.010	<0.010	<0.10	<0.10	<10	0.019	<0.010	
6.5	2.0	0.240	0.240	<0.10	<0.10	12	0.086	<0.010	

Table 43. Lake LeAnn chemical water quality parameter data collected at deep basin south #3 (July 24, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	<0.50	<0.010	<0.010	<0.10	<0.10	<10	0.014	<0.010	0.534
1.5	0.86	0.023	0.023	<0.10	<0.10	<10	0.020	<0.010	
3.0	0.61	0.011	0.011	<0.10	<0.10	<10	0.019	<0.010	

Table 44. Lake LeAnn chemical water quality parameter data collected at deep basin south #4 (July 24, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	<0.50	<0.010	<0.010	<0.10	<0.10	<10	0.012	<0.010	1.34
6.0	0.62	0.078	0.078	<0.10	<0.10	<10	0.016	<0.010	
12.0	4.9	3.0	3.0	<0.10	<0.10	50	0.190	0.041	

Table 45. Lake LeAnn chemical water quality parameter data collected at deep basin south #5 (July 24, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	0.71	<0.010	<0.010	<0.10	<0.10	<10	0.017	<0.010	0
2.5	<0.50	<0.010	<0.010	<0.010	<0.10	<10	0.016	<0.010	
5.5	1.9	0.110	0.110	<0.10	<0.10	20	0.096	<0.010	

Pre-Aeration Data Tables (September 11, 2019): North and South Deep Basins

Table 46. Lake LeAnn chemical water quality parameter data collected at deep basin north #1 (September 11, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	1.1	0.012	0.012	<0.10	<0.010	16	0.035	<0.010	0
3.5	<0.5	0.087	0.087	<0.10	<0.10	<10	0.035	<0.010	
5.5	0.7	0.250	0.250	<0.10	<0.10	<10	0.040	<0.010	

Table 47. Lake LeAnn chemical water quality parameter data collected at deep basin north #2 (September 11, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	1.3	0.025	0.025	<0.10	<0.10	<10	0.034	<0.010	0
2.5	0.95	<0.010	<0.010	<0.10	<0.10	10	0.034	<0.010	
4.5	0.89	0.100	0.100	<0.10	<0.10	<10	0.032	<0.010	

Table 48. Lake LeAnn chemical water quality parameter data collected at deep basin north #3 (September 11, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0									
1.0	0.59	0.014	0.014	<0.10	<0.10	<10	0.030	<0.010	0
2.0									

Table 49. Lake LeAnn chemical water quality parameter data collected at deep basin north #4 (September 11, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3-(mg/L)	NO3-(mg/L)	NO2-(mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	0.88	<0.010	<0.010	<0.10	<0.10	<10	0.031	<0.010	0
1.5	1.2	0.013	0.013	<0.10	<0.10	<10	0.036	<0.010	
3.0	1.4	0.049	0.049	<0.10	<0.10	<10	0.060	<0.010	

Table 50. Lake LeAnn chemical water quality parameter data collected at deep basin south #1 (September 11, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3-(mg/L)	NO2-(mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	0.75	0.010	0.010	<0.10	<0.10	<10	0.017	<0.010	0
3.0	1.2	0.011	0.011	<0.10	<0.10	<10	0.017	<0.010	
6.0	0.56	0.077	0.077	<0.10	<0.10	<10	0.019	<0.010	

Table 51. Lake LeAnn chemical water quality parameter data collected at deep basin south #2 (September 11, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3-(mg/L)	NO2-(mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	0.62	<0.010	<0.010	<0.10	<0.10	<10	0.015	<0.010	0
3.5	0.75	<0.010	<0.010	<0.10	<0.10	<10	0.020	<0.010	
6.5	0.72	0.045	0.045	<0.10	<0.10	<10	0.021	<0.010	

Table 52. Lake LeAnn chemical water quality parameter data collected at deep basin south #3 (September 11, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3-(mg/L)	NO2-(mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	0.62	0.100	<0.010	0.100	<0.10	<10	0.015	<0.010	0
1.5	0.76	<0.010	<0.010	<0.10	<0.10	<10	0.017	<0.010	
3.0	0.74	0.026	0.026	<0.10	<0.10	<10	0.017	<0.010	

Table 53. Lake LeAnn chemical water quality parameter data collected at deep basin south #4 (September 11, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	0.65	0.015	0.015	<0.10	<0.10	<10	0.029	<0.010	0
5.5	0.76	0.066	0.066	<0.10	<0.10	<10	0.020	<0.010	
11.5	3.8	3.1	3.1	<0.10	<0.10	10	0.061	0.026	

Table 54. Lake LeAnn chemical water quality parameter data collected at deep basin south #5 (September 11, 2019).

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
0	0.60	0.032	0.032	<0.10	<0.10	<10	0.015	0.027	0
2.5	1.2	0.042	0.042	<0.10	<0.10	<10	0.019	<0.010	
5.5	3.2	2.4	2.4	<0.10	<0.10	10	0.047	<0.010	

3.3 Lake LeAnn 2019 Baseline Drain Physical & Chemical Water Quality Data Tables:

RLS has collected water quality samples from Lake LeAnn in 2019 and has characterized the lake as eutrophic. However, recent evidence suggests that the CSA's around the lake are contributing nutrient and sediment loads to the lake which could lead to water quality degradation over time if these areas are not identified and mitigated. Such degradation has currently resulted in the occurrence of internal loading within the lake. RLS has identified impaired CSA sites and the data is presented here.

Water quality is highly variable among the CSA's and this variability is due to land use practices and climatic events. Climatic factors (i.e. spring runoff, heavy rainfall) may alter water quality in the short term; whereas, anthropogenic (man-induced) factors (i.e. shoreline development, lawn fertilizer use) alter water quality over longer time periods. Since many lakes have a fairly long hydraulic residence time, the water may remain in the lake for years and is therefore sensitive to nutrient loading and pollutants.

CSA Water Quality Parameters Measured:

Water quality parameters such as dissolved oxygen, water temperature, pH, conductivity, total dissolved solids, total suspended solids, total phosphorus, ortho-phosphorus, total inorganic nitrogen (specifically ammonia, nitrate, and nitrite), and total Kjeldahl nitrogen were measured at each of the CSA areas under flowing conditions. Samples consisted of preserved grab bottles which were placed on ice and transported to the NELAC-certified laboratory for analysis. The data for the CSA's are discussed below and are presented in Tables 55-60 with descriptive statistics for all data shown in Table 61. Samples and water quality measurements were collected on April 26, 2019, July 24, 2019 and September 11, 2019. Measurements were taken with a calibrated Eureka Manta II® multi-parameter probe. A discussion of each parameter and how they are collected and measured follows. Note: CSA #N4 was eventually split into two measurable sites due to the observed presence of two inlets at that location. N4 then became known as 4a and 4b. When 4N was sampled, it is denoted as such. Where 4a or 4b were sampled, they are denoted as such.

Table 55. Lake LeAnn CSA physical water quality parameter data collected on April 26, 2019.

Lake LeAnn CSA Site	*Water Temp °C*	*DO mg/L*	*pH S.U.*	*Cond. µS/cm*	*TDS mg/L*
CSA #S1	9.6	7.8	8.0	660	389
CSA #S2	9.6	8.0	7.7	552	377
CSA #S3	8.8	7.9	7.6	607	379
CSA #N4	9.2	8.2	8.2	588	390

Table 56. Lake LeAnn CSA chemical water quality parameter data collected on April 26, 2019.

Lake LeAnn CSA Site	*NO2 mg/L*	*NO3 mg/L*	*NH3 mg/L*	*TIN mg/L*	*TKN mg/L*	*SRP mg/L*	*TP mg/L*	*TSS mg/L*
CSA #S1	<0.10	2.2	0.025	2.2	1.0	0.035	0.075	<10
CSA #S2	<0.10	0.270	0.011	0.280	<0.5	<0.010	0.026	26
CSA #S3	<0.10	<0.10	<0.010	<0.010	<0.5	<0.010	0.010	36
CSA #N4	<0.10	0.160	0.048	0.200	<0.5	<0.010	0.015	34

Table 57. Lake LeAnn CSA physical water quality parameter data collected on July 24, 2019.

Lake LeAnn CSA Site	*Water Temp ºC*	*DO mg/L*	*pH S.U.*	*Cond. µS/cm*	*TDS mg/L*
CSA #S1	26.0	10.6	8.7	543	347
CSA #S2	14.4	9.1	8.6	731	468
CSA #S3	14.5	8.5	7.3	925	592
CSA #N4	18.0	7.9	7.9	1,267	812

Table 58. Lake LeAnn CSA chemical water quality parameter data collected on July 24, 2019.

Lake LeAnn CSA Site	*NO2 mg/L*	*NO3 mg/L*	*NH3 mg/L*	*TIN mg/L*	*TKN mg/L*	*SRP mg/L*	*TP mg/L*	*TSS mg/L*
CSA #S1	<0.10	<0.10	0.036	0.036	0.5	<0.010	<0.010	<10
CSA #S2	<0.10	0.460	0.015	0.480	<0.5	<0.010	0.018	<10
CSA #S3	<0.10	<0.10	<0.010	0.180	<0.5	<0.010	0.022	10
CSA #N4	<0.10	1.90	0.050	1.90	<0.5	<0.010	0.021	<10

Table 59. Lake LeAnn CSA physical water quality parameter data collected on September 11, 2019. *Note: CSA #4 could not be collected due to lack of flow.

Lake LeAnn CSA Site	*Water Temp ºC*	*DO mg/L*	*pH S.U.*	*Cond. µS/cm*	*TDS mg/L*
CSA #S1	20.6	7.5	8.0	658	501
CSA #S2	21.2	8.1	8.1	558	472
CSA #S3	21.0	9.1	8.1	562	477
CSA #N4*	--	--	--	--	--

Table 60. Lake LeAnn CSA chemical water quality parameter data collected on September 11, 2019. *Note: CSA #4 could not be collected due to lack of flow.

Lake LeAnn CSA Site	*NO2 mg/L*	*NO3 mg/L*	*NH3 mg/L*	*TIN mg/L*	*TKN mg/L*	*SRP mg/L*	*TP mg/L*	*TSS mg/L*
CSA #S1	<0.10	<0.10	0.031	0.031	0.6	<0.010	<0.010	<10
CSA #S2	<0.10	0.500	0.017	0.520	<0.5	<0.010	0.016	<10
CSA #S3	<0.10	<0.10	0.019	0.019	1.7	0.021	0.110	84
CSA #N4*	--	--	--	--	--	--	--	--

Table 61. Descriptive statistics of all water quality parameters in the CSA's of Lake LeAnn for parameters collected on April 26, July 24, and September 11, 2019.

Water Quality Parameter	CSA #S1	CSA #S2	CSA #S3	CSA #N4
Water temp (°C)	18.7±8.4	15.1±5.8	14.8±6.1	13.6±6.0
pH (S.U.)	8.2±0.4	8.1±0.5	7.7±0.4	8.1±0.2
Dissolved oxygen (mg/L)	8.6±1.7	8.4±0.6	8.5±0.6	8.1±0.2
Conductivity (mS/cm)	620±67	614±102	698±198	928±480
Total dissolved solids (mg/L)	412±80	439±54	483±107	601±298
Total Kjeldahl nitrogen (mg/L)	0.7±0.3	0.5±0.0	0.9±0.7	0.5±0.0
Total inorganic nitrogen (mg/L)	0.800±1.3	0.427±0.1	0.070±0.1	1.1±1.2
Ammonia nitrogen (mg/L)	0.031±0.0	0.014±0.0	0.013±0.0	0.049±0.0
Nitrate nitrogen (mg/L)	0.8±1.2	0.410±0.1	0.10±0.0	1.03±1.2
Nitrite nitrogen (mg/L)	0.10±0.0	0.10±0.0	0.10±0.0	0.10±0.0
Total phosphorus (mg/L)	0.032±0.1	0.020±0.0	0.047±0.1	0.018±0.0
Ortho-Phosphorus (mg/L)	0.018±0.1	0.010±0.0	0.014±0.0	0.010±0.0
Total suspended solids (mg/L)	10±0.0	15.3±9.2	43±38	22±17

3.4 Lake LeAnn Baseline Phytoplankton Community:

Algal Community Composition Data:

The algal genera were determined from a 500-ml composite water sample collected over the 9 deep basins of Lake LeAnn on September 11, 2019. Sub-samples were collected from the 500-ml sample and placed in a Sedgewick Rafter counting chamber for analysis under a Zeiss® compound bright field microscope. Tables 62-63 below shows a breakdown by algal group of what was present in the algal samples collected on the sampling date. Figures 6-7 graphically demonstrate the relative abundance by algal category. Figure 8 shows a significant blue-green algal bloom in the north lake basin in 2019.

Table 62. Counts (# cells per 1 mL sub-sample) for each genera of algae found at each sampling location (n=4) in the north lake basin of Lake LeAnn (September 11, 2019).

Taxa Present	Type	N1	N2	N3	N4
Chlorella sp.	G	9	4	12	6
Scenedesmus sp.	G	2	1	0	0
Pediastrum sp.	G	4	7	1	0
Mougeotia sp.	G	9	12	14	7
Ulothrix sp.	G	6	17	24	1
Oocystis sp.	G	6	1	1	0
Staurastrum sp.	G	4	2	2	1
Closterium sp.	G	3	7	9	4
Cladophora sp.	G	26	37	15	20
Rhizoclonium sp.	G	37	25	18	4
Pithophora sp.	G	6	7	0	0
Microcystis sp.	BG	462	385	267	318
Anabaena sp.	BG	12	26	4	0
Oscillatoria sp.	BG	5	24	12	7
Navicula sp.	D	6	10	17	13
Synedra sp.	D	22	13	16	28
Rhoicosphenia sp.	D	2	1	0	0
Cymbella sp.	D	0	0	5	0
Fragillaria sp.	D	1	4	1	1

Note: G = green algae (Chlorophyta); BG = blue-green algae (Cyanophyta); D = diatoms (Bacillariophyta).

Table 63. Counts (# cells per 1 mL sub-sample) for each genera of algae found at each sampling location (n=5) in the south lake basin of Lake LeAnn (September 11, 2019).

Taxa Present	Type	S1	S2	S3	S4	S5
Chlorella sp.	G	10	2	18	6	14
Scenedesmus sp.	G	2	13	4	7	9
Pediastrum sp.	G	1	1	0	0	0
Mougeotia sp.	G	0	0	0	0	0
Ulothrix sp.	G	1	8	4	0	0
Oocystis sp.	G	0	0	0	0	0
Staurastrum sp.	G	2	7	2	0	1
Closterium sp.	G	6	4	15	0	4
Cladophora sp.	G	12	0	5	1	0
Rhizoclonium sp.	G	9	14	1	0	0
Pithophora sp.	G	1	1	0	0	0
Microcystis sp.	BG	400	128	344	160	18
Anabaena sp.	BG	12	36	5	0	7
Oscillatoria sp.	BG	26	48	0	0	7
Navicula sp.	D	15	6	0	2	11
Synedra sp.	D	8	19	0	1	0
Rhoicosphenia sp.	D	5	0	0	0	0
Cymbella sp.	D	7	0	1	0	1
Fragillaria sp.	D	4	1	1	0	0

Note: G = green algae (Chlorophyta); BG = blue-green algae (Cyanophyta); D = diatoms (Bacillariophyta).

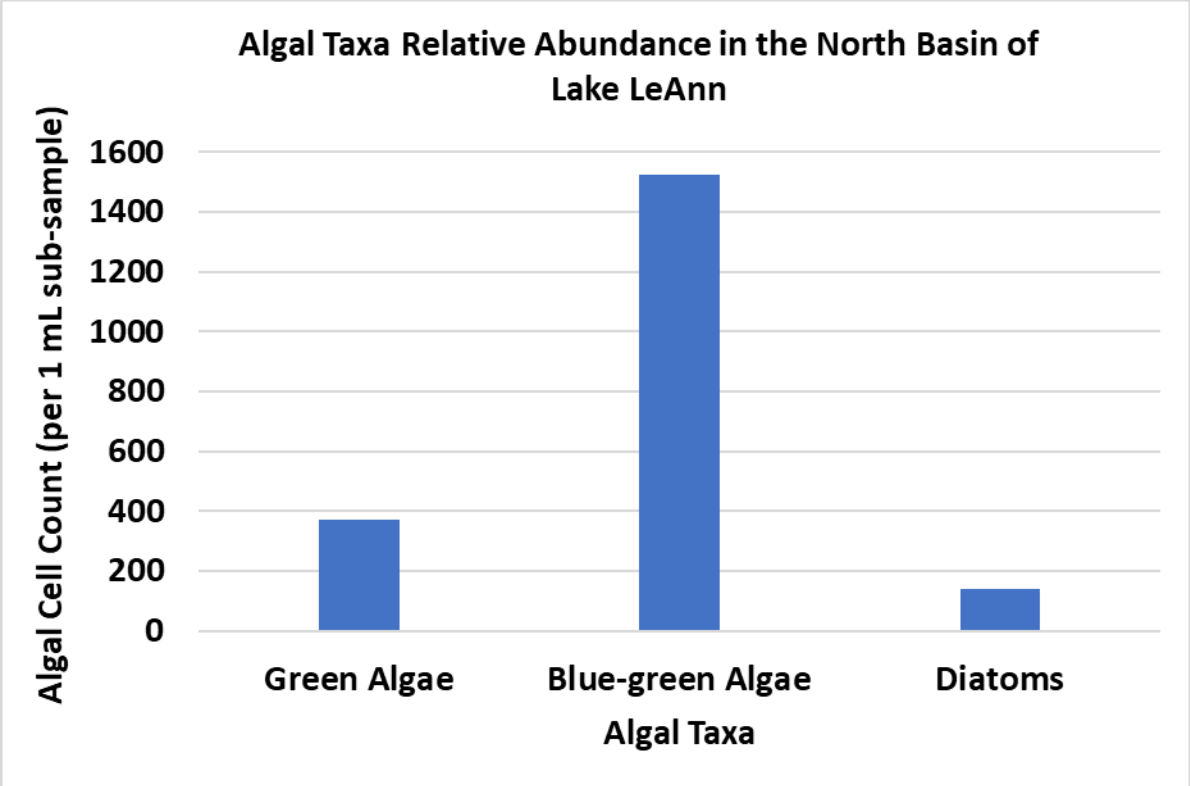

Figure 6. Algal relative abundance by taxa in the north lake basin (September 11, 2019).

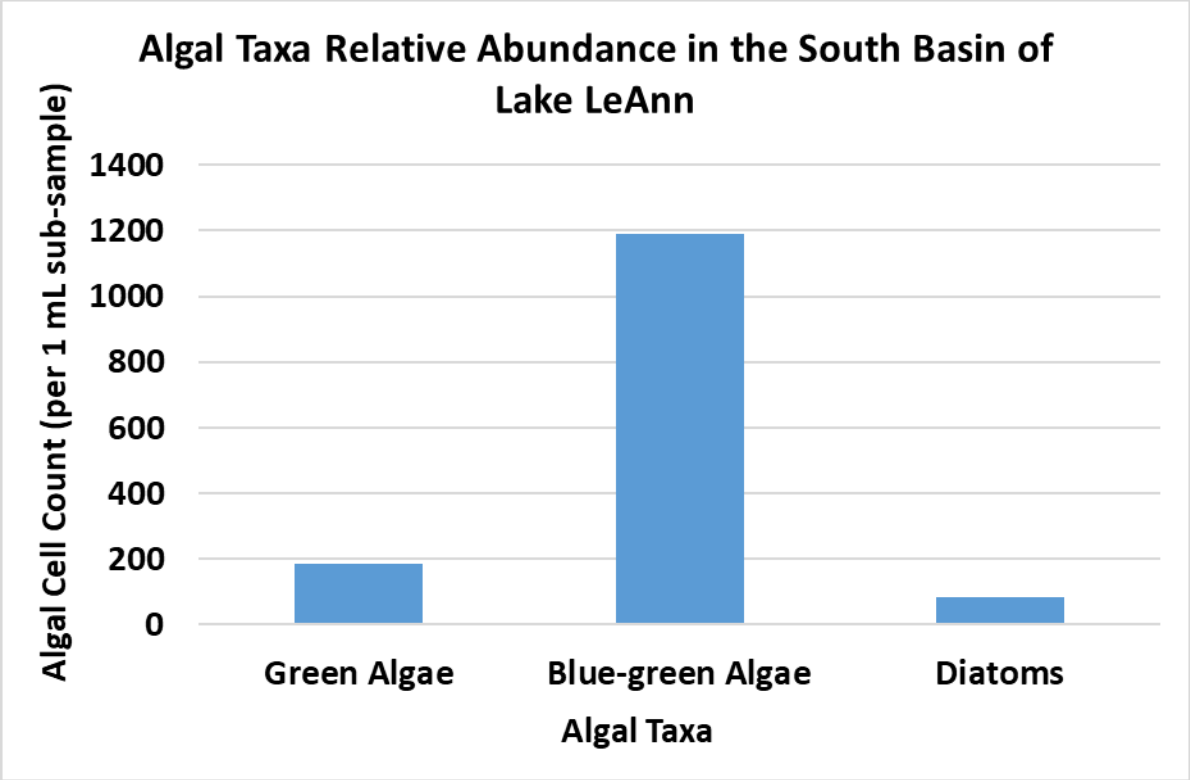

Figure 7. Algal relative abundance by taxa in the south lake basin (September 11, 2019).

Figure 8. Dense blue-green algae forming along the shoreline of North Lake LeAnn (October, 2019).

3.5 Lake LeAnn Baseline Zooplankton Community:

A zooplankton tow was conducted over the deep basin of Lake LeAnn on April 26, 2019 and September 21, 2020 using a plankton tow net (Figure 9). The net was lowered into the hypolimnion and carefully pulled through the water column at an approximate rate of ~4 feet per second and up to the surface to yield a full 125-ml sample. The plankton net was then rinsed into the collection bottle where an Alka Seltzer® tablet was then placed along with 70% ethyl alcohol solution. The sample was then quantified for zooplankton community composition using a Ward counting wheel under a Zeiss® dissection microscope (Tables 64-67).

Table 64. Zooplankton taxa and count data from the north basin of Lake LeAnn (April 26, 2019).

Zooplankton Taxa	N1	N2	N3	N4
Cladocerans				
Daphnia parvula	2	8	1	0
D. retrocurva	3	2	0	1
Bosmina longirostris	0	0	5	1
Chydorus sp.	0	0	1	0
Copepods/Cyclopods				
Diaptomus copepodites	2	6	1	0
Mesocyclops edax	7	11	2	1
Rotifers				
Keratella	6	16	1	7
Kellicotia	1	0	0	0

Table 65. Zooplankton taxa and count data from the north basin of Lake LeAnn (September 11, 2019).

Zooplankton Taxa	N1	N2	N3	N4
Cladocerans				
Daphnia parvula	1	4	13	0
D. retrocurva	2	6	1	0
Bosmina longirostris	1	1	0	0
Chydorus sp.	0	5	1	1
Copepods/Cyclopods				
Mesocyclops edax	2	2	1	0
Rotifers				
Keratella	1	7	2	0

Table 66. Zooplankton taxa and count data from the south basin of Lake LeAnn (April 26, 2019).

Zooplankton Taxa	S1	S2	S3	S4	S5
Cladocerans					
Daphnia parvula	4	11	2	0	1
D. retrocurva	1	8	13	9	0
Bosmina longirostris	0	0	5	0	0
Chydorus sp.	0	0	4	1	0
Copepods/Cyclopods					
Diaptomus copepodites	2	4	0	0	4
Rotifers					
Keratella	0	5	7	2	1

Table 67. Zooplankton taxa and count data from the south basin of Lake LeAnn (September 11, 2019).

Zooplankton Taxa	S1	S2	S3	S4	S5
Cladocerans					
Daphnia parvula	6	2	2	4	1
D. retrocurva	18	4	9	2	0
Chydorus sp.	0	0	0	0	1
Copepods/Cyclopods					
Diaptomus copepodites	2	0	0	4	8
Mesocyclops edax	0	0	5	1	0
Rotifers					
Keratella	6	2	1	0	0

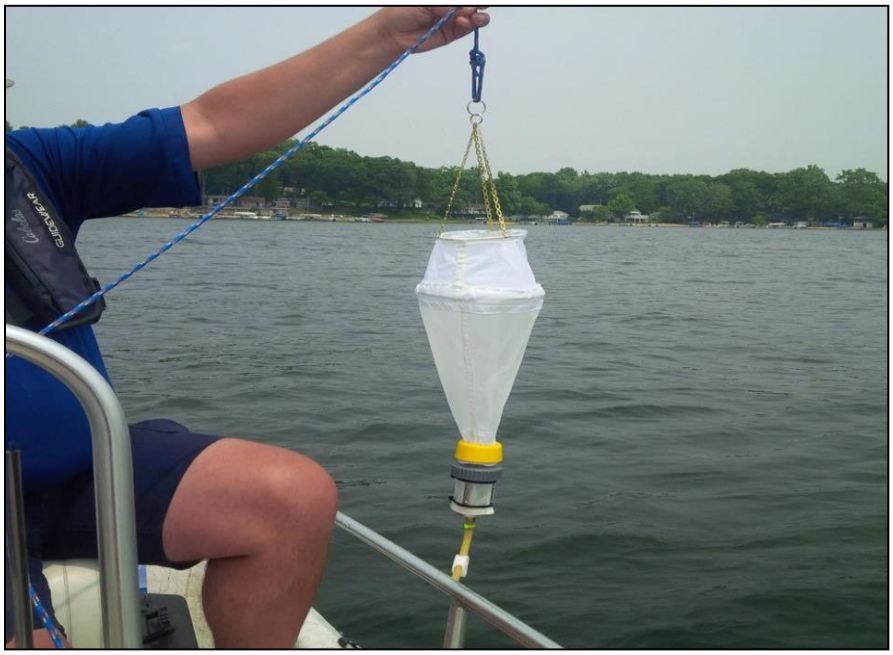

Figure 9. A zooplankton sampling net. ©RLS

3.6 Lake LeAnn Aquatic Vegetation Biovolume Data (September 11, 2019)

A whole-lake scan of the aquatic vegetation in Lake LeAnn was conducted on September 11, 2019 with a WAAS-enabled Lowrance HDS 9 GPS with variable frequency transducer. This data included 11,739 data points in the north basin and 16,872 data points in the south basin. Points were then uploaded into a cloud software program to reveal maps that displayed depth contours, sediment hardness, and aquatic vegetation biovolume (Figures 10-11). On these maps, the color blue refers to areas that lack vegetation. The color green refers to low-lying vegetation. The colors red/orange refer to tall-growing vegetation. There are many areas around the littoral (shallow) zone of the lake that contain low-growing plants like Chara or Coontail. In addition, any emergent canopies or lily pads will show as red color on the map. For this reason, the scans are conducted in conjunction with a whole lake GPS survey to account for individual species identification of all aquatic plants in the lake. Tables 63 and 64 show the biovolume categories by plant cover during the September 11, 2019 scan and survey.

The Point-Intercept Survey method is used to assess the presence and percent cumulative cover of submersed, floating-leaved, and emergent aquatic vegetation within and around the littoral zones of inland lakes. With this survey method, sampling locations are geo-referenced (via GPS waypoints) and assessed throughout the entire lake to determine the species of aquatic macrophytes present and density of each macrophyte which are recorded onto a data sheet.

Each separate plant species found in each sampling location is recorded along with an estimate of each plant density. Each macrophyte species corresponds to an assigned number. There are designated density codes for the aquatic vegetation surveys, where a = found (occupying < 2% of the surface area of the lake), b = sparse (occupying 2-20% of the surface area of the lake), c = common, (occupying 21-60% of the surface area of the lake), and d = dense (occupying > 60% of the surface area of the lake).

The survey of the north basin of Lake LeAnn consisted of 370 sampling locations around the littoral zone and the survey of the south basin consisted of 314 sampling locations and was conducted in spring during May 10, 2019 with follow-up post treatment surveys later in the season to confirm treatment efficacy. Data were placed in a table showing the relative abundance of each aquatic plant species found and a resultant calculation showing the frequency of each plant, and cumulative cover.

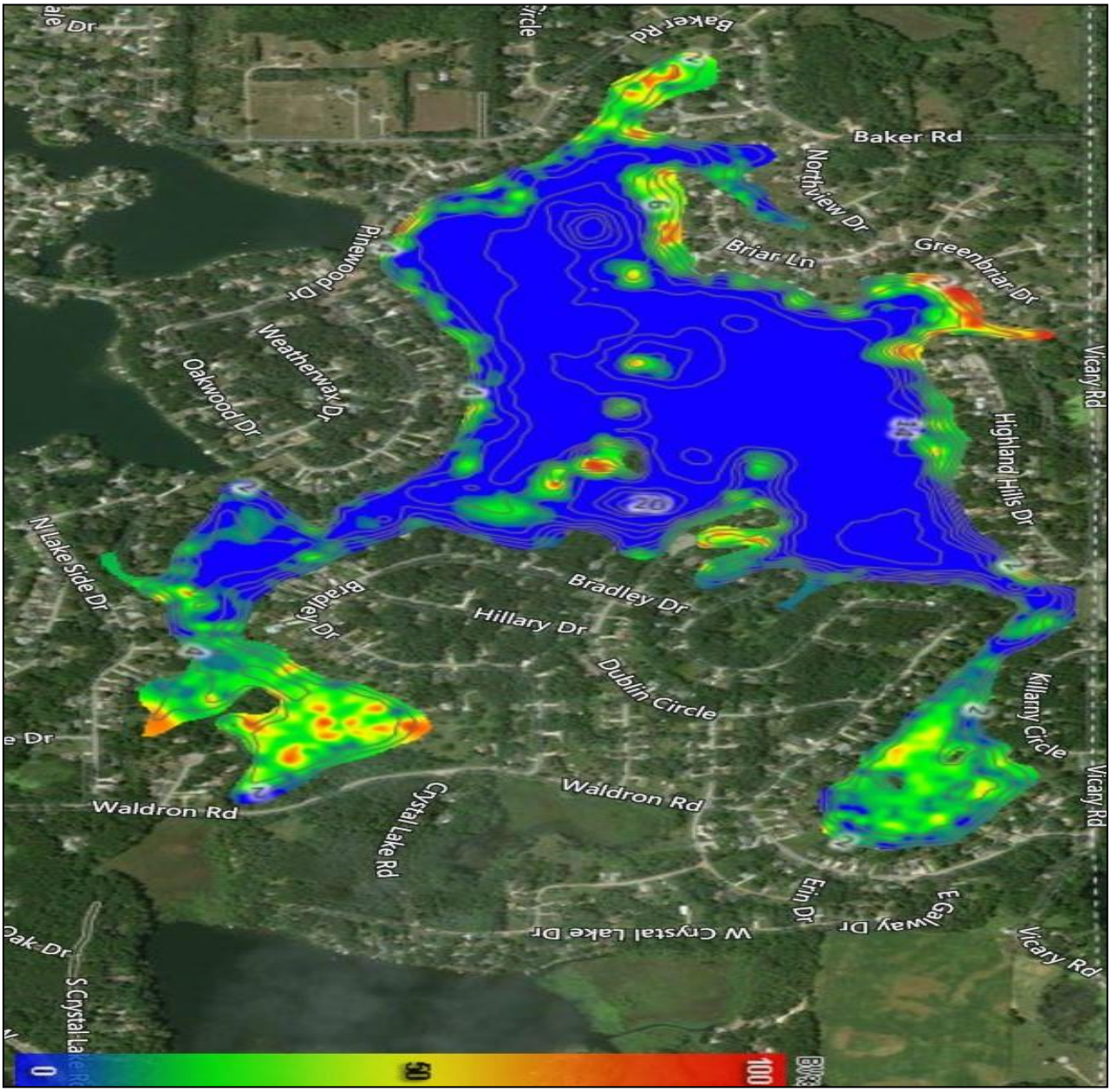

Figure 10. Aquatic plant biovolume of all aquatic plants in north Lake LeAnn, Hillsdale County, Michigan (September 11, 2019). Note: Red color denotes high-growing aquatic plants, green color denoted low-growing aquatic plants, and blue color represents a lack of aquatic vegetation.

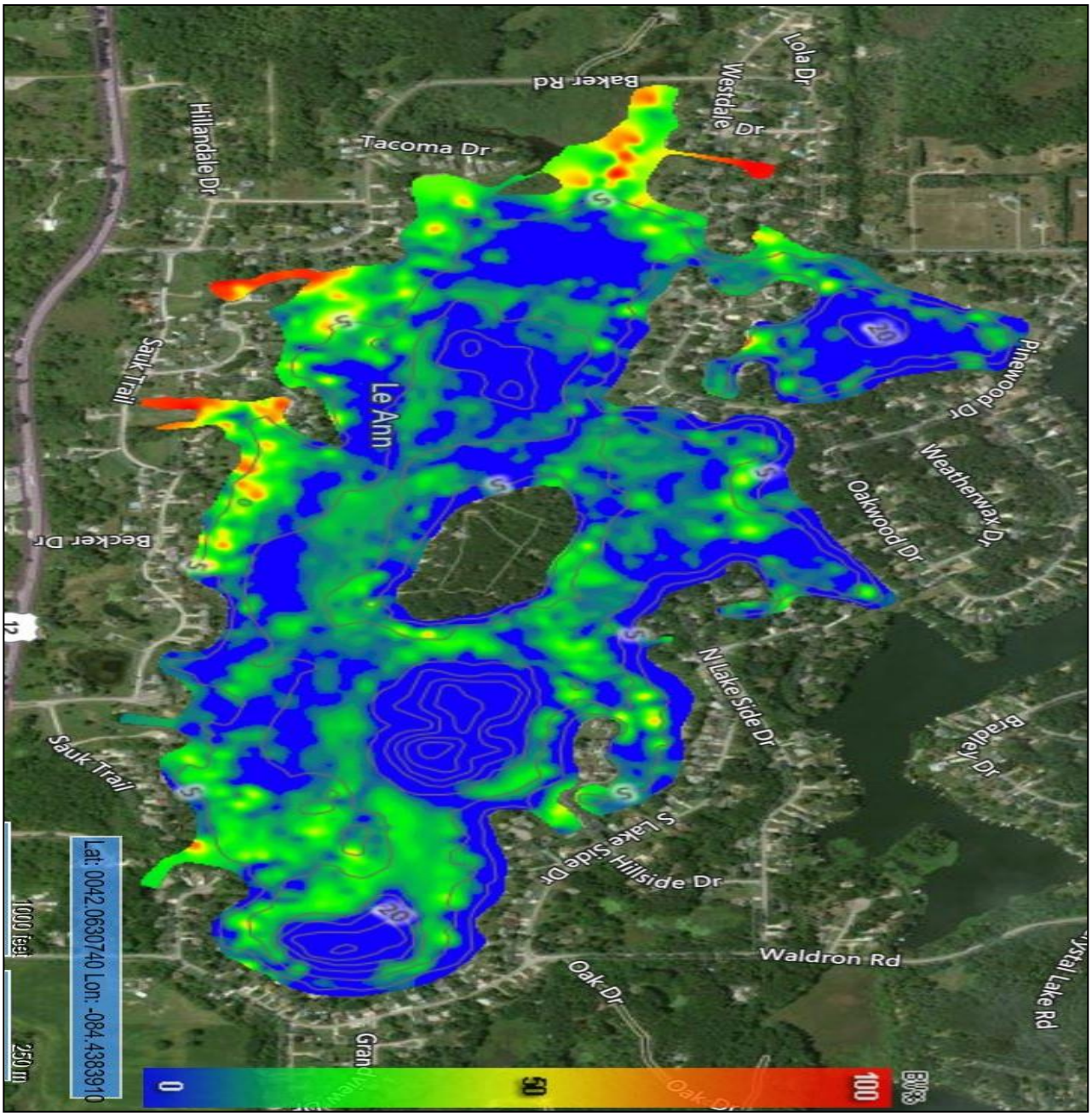

Figure 11. Aquatic plant biovolume of all aquatic plants in south Lake LeAnn, Hillsdale County, Michigan (September 11, 2019). Note: Red color denotes high-growing aquatic plants, green color denoted low-growing aquatic plants, and blue color represents a lack of aquatic vegetation.

Table 68. Lake LeAnn north basin aquatic vegetation biovolume by category percent over of each category (relative cover on September 11, 2019).

Biovolume Cover Category	% Relative Cover of Bottom by Category
<5%	59.7
5-20%	15.7
20-40%	9.9
40-60%	5.5
60-80%	3.4
>80%	5.7

Table 69. Lake LeAnn south basin aquatic vegetation biovolume by category percent over of each category (relative cover on September 11, 2019).

Biovolume Cover Category	% Relative Cover of Bottom by Category
<5%	58.0
5-20%	22.3
20-40%	12.3
40-60%	3.2
60-80%	1.8
>80%	2.4

The north basin of Lake LeAnn contained 8 native submersed, 3 floating-leaved, and 2 emergent aquatic plant species, for a total of 13 native aquatic macrophyte species (Table 70). The south basin of Lake LeAnn contained 7 native submersed, 2 floating-leaved, and 2 emergent aquatic plant species, for a total of 11 native aquatic macrophyte species (Table 71). The majority of the emergent macrophytes may be found along the shoreline of the lake. Additionally, the majority of the floating-leaved macrophyte species can be found near the shoreline and wetland areas.

The dominant native aquatic plants in the north basin of the lake included the Chara (23.5% of the sampling sites), and Coontail (5.9% of the sampling sites). The dominant native aquatic plants in the south basin of the lake included the Chara (36.0% of the sampling sites), and Thin-leaf Pondweed (6.1% of the sampling sites). The Pondweeds grow tall in the water column and serve as excellent fish cover. In dense quantities, they can be a nuisance for swimming and boating and can be controlled with selective herbicide management or with mechanical harvesting.

The relative abundance of rooted aquatic plants (relative to non-rooted plants) in the lake suggests that the sediments are the primary source of nutrients (relative to the water column), since these plants obtain most of their nutrition from the sediments. The emergent plants, such as (Cattails) are critical for shoreline stabilization as well as for wildlife and fish spawning habitat.

Table 70. Lake LeAnn north basin native aquatic plants (May 10, 2019).

Aquatic Plant Common Name	Aquatic Plant Latin Name	A level	B level	C level	D level	# Sites Found (% of total)
Muskgrass	*Chara vulgaris*	16	71	0	0	23.5
Thin-leaf Pondweed	*Stuckenia pectinatus*	3	9	2	2	4.3
Flat-stem Pondweed	*Potamogeton zosteriformis*	1	5	0	0	1.6
White-stem Pondweed	*Potamogeton praelongus*	1	0	0	0	0.2
Large-leaf Pondweed	*Potamogeton amplifolius*	3	1	2	0	1.6
Coontail	*Ceratophyllum demersum*	2	19	0	1	5.9
Bladderwort	*Utricularia vulgaris*	1	2	0	0	0.8
Whorled Watermilfoil	*Myriophyllum verticillatum*	2	5	0	0	1.9
Duckweed	*Lemna minor*	0	1	0	0	0.2
White Waterlily	*Nymphaea odorata*	0	18	3	0	5.7
Yellow Waterlily	*Nuphar variegata*	1	3	0	0	1.1
Cattails	*Typha latifolia*	2	2	1	1	1.6
Iris sp.	*Iris* sp.	2	2	0	0	1.1

Table 71. Lake LeAnn south basin native aquatic plants (May 10, 2019).

Aquatic Plant Common Name	Aquatic Plant Latin Name	A level	B level	C level	D level	# Sites Found (% of total)
Muskgrass	*Chara vulgaris*	17	92	4	0	36.0
Thin-leaf Pondweed	*Stuckenia pectinatus*	10	5	1	3	6.1
Variable-leaf Pondweed	*Potamogeton gramineus*	0	1	0	0	0.3
Large-leaf Pondweed	*Potamogeton amplifolius*	2	5	1	0	2.5
Coontail	*Ceratophyllum demersum*	2	6	0	0	2.5
Northern Watermilfoil	*Myriophyllum sibiricum*	0	4	3	0	2.2
Whorled Watermilfoil	*Myriophyllum verticillatum*	1	2	0	0	1.0
White Waterlily	*Nymphaea odorata*	0	5	0	0	1.6
Yellow Waterlily	*Nuphar variegata*	1	3	0	0	1.3
Cattails	*Typha latifolia*	1	1	4	1	2.2
Swamp Loosestrife	*Decodon verticillatus*	0	0	1	0	0.3

3.7 Lake LeAnn Bottom Hardness Scan and Substrate Data:

A bottom sediment hardness scan was conducted of the entire lake bottom on September 11-12, 2019. The bottom hardness maps show (Figure 12-13) that most of the lake bottom consists of fairly consolidated sediment throughout the lake with a few areas with soft organic bottom. This is not surprising given the amount of sandy loams in the region which contribute to lake geology. Tables 72-73 below show the categories of relative bottom hardness with 0.0-0.1 referring to the softest and least consolidated bottom and >0.4 referring to the hardest, most consolidated bottom for the two lake basins. This scale does not mean that any of the lake contains a truly "hard" bottom but rather a bottom that is more cohesive and not flocculent.

Table 72. Lake LeAnn north basin relative hardness of the lake bottom by category or hardness and percent cover of each category (relative cover).

Lake Bottom Relative Hardness Category	# GPS Points in Each Category (Total =10,804)	% Relative Cover of Bottom by Category
0.0-0.1	75	0.69
0.1-0.2	1987	18.39
0.2-0.3	5229	48.40
0.3-0.4	3511	32.50
>0.4	2	0.02

Table 73. Lake LeAnn south basin relative hardness of the lake bottom by category or hardness and percent cover of each category (relative cover).

Lake Bottom Relative Hardness Category	# GPS Points in Each Category (Total =11,579)	% Relative Cover of Bottom by Category
0.0-0.1	63	0.54
0.1-0.2	2111	18.23
0.2-0.3	5779	49.91
0.3-0.4	3619	31.25
>0.4	7	0.06

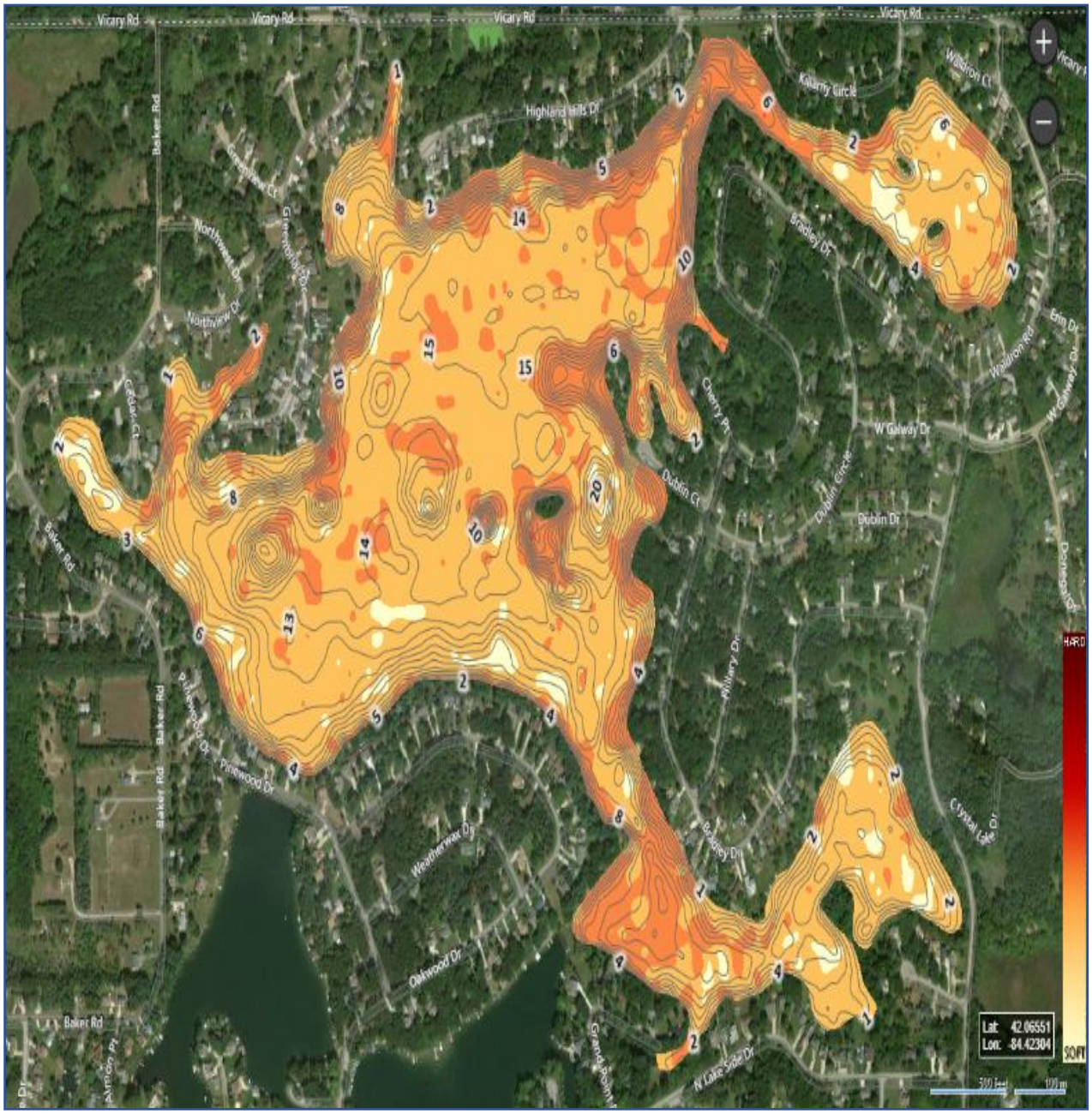

Figure 12. Lake LeAnn north basin sediment relative hardness map (September 11, 2019).

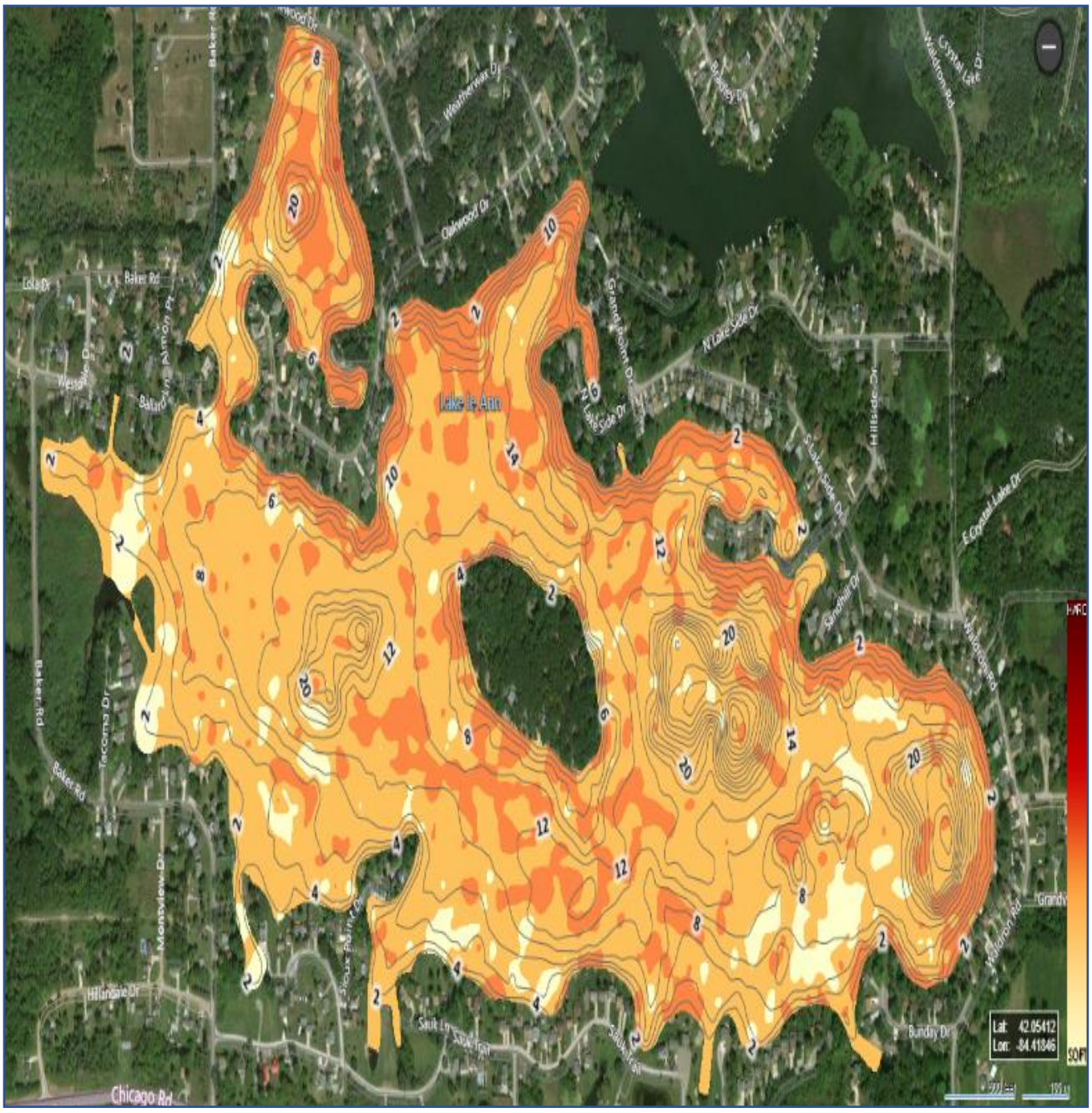

Figure 13. Lake LeAnn south basin sediment relative hardness map (September 11, 2019).

Table 74. Lake LeAnn sediment nutrient data collected at n= 9 locations (September 11, 2019). NOTE: There was no gravel components in the data set.

Site	%OM	Total Sand Fractional Components	Total Fines Fractional Components
N1	39	64.6	35.4
N2	39	61.3	38.7
N3	38	46.3	53.7
N4	20	50.2	49.8
S1	34	62.6	37.4
S2	14	40.0	60.0
S3	27	59.7	40.3
S4	19	51.1	48.9
S5	19	54.9	45.1

3.8 Lake LeAnn Destratification Ice Sampling Data:

It is recommended that a through the ice sample over the deepest basin be conducted. RLS will collect through-the-ice sampling in 2022 over the deepest basin as long as safe ice conditions are present. As a requirement of the LFA permit, a profile with all physical data as well as chemical data would be collected. The ice conditions on the sampling date and air temperature and weather conditions will be recorded. If ice is not safe, then no samples will be collected. Ice conditions were not safe for sampling in 2019.

4.0 LAKE LEANN 2021 YEAR 1 WATER QUALITY SAMPLING RESULTS

All Year 1 deep basin physical water quality data is shown in Tables 1-27 of Section 4.1 below. Year 1 chemical water quality data is shown in Tables 28-54 of Section 4.2 below. Year 1 drain physical and chemical water quality data is shown below in Tables 55-61 of Section 4.3 below. NOTE: Drain sampling is not usually required as a condition of the LFA permit; however, the data is being collected to evaluate current and future measurements to determine mitigation implementation efficacy.

4.1 Lake LeAnn Baseline Deep Basin Physical Water Quality Data Tables:

Pre-Aeration Data Tables (April 28, 2021): North and South Basins

Table 75. North Lake LeAnn Basin Year 1 Physical Water Quality Data (April 28, 2021).

Site	Depth (m)	Water Temp (°C)	DO (mg/L)	pH (SU)	Conductivity (mS/cm)	Secchi Depth (ft)
N1	0	13.18	11.04	8.45	507.0	13.3
	0.5	13.15	11.10	8.44	507.2	
	1.0	13.15	11.26	8.44	507.1	
	1.5	12.97	11.33	8.44	506.9	
	2.0	12.82	11.34	8.44	507.2	
	2.5	12.76	11.36	8.43	507.5	
	3.0	12.66	11.34	8.44	507.4	
	3.5	12.48	11.35	8.42	507.9	
	4.0	12.26	11.30	8.40	508.0	
	4.5	12.12	11.09	8.38	508.3	
	5.0	12.11	10.97	8.38	508.5	
	5.5	11.99	10.87	8.39	508.1	
	6.0	11.97	10.78	8.33	509.4	
N2	0	13.41	10.34	8.44	507.8	10.3
	0.5	13.42	10.83	8.43	507.6	
	1.0	13.40	10.91	8.43	507.8	
	1.5	13.34	11.02	8.43	507.8	
	2.0	13.33	11.04	8.43	507.8	
	2.5	13.23	11.12	8.44	507.8	
	3.0	13.19	11.14	8.44	507.7	
	3.5	13.18	11.16	8.44	507.6	
	4.0	13.16	11.18	8.44	507.7	
	4.5	13.12	11.19	8.43	507.9	
N3	0	14.62	12.57	8.73	480.0	6.7
	0.5	14.53	12.57	8.72	479.9	
	1.0	14.47	13.05	8.73	480.5	
	1.5	14.34	13.27	8.75	480.2	
	2.0	13.93	13.29	8.76	477.9	
N4	0	13.95	11.71	8.62	497.4	9.7
	0.5	13.91	12.23	8.62	497.7	
	1.0	13.64	12.80	8.61	498.5	
	1.5	13.57	13.02	8.61	499.0	
	2.0	13.49	13.05	8.60	498.9	
	2.5	13.07	13.19	8.63	492.3	

	3.0	12.37	13.5	8.52	493.2	
N5	0	13.45	11.00	8.45	506.7	11.3
	0.5	13.49	11.19	8.45	507.2	
	1.0	13.34	11.26	8.46	506.7	
	1.5	13.14	11.31	8.44	507.6	
	2.0	13.08	11.29	8.43	507.7	
	2.5	13.02	11.26	8.43	507.7	
	3.0	12.96	11.23	8.43	507.5	

Table 76. North Lake LeAnn Outlet Year 1 Physical Water Quality Data (April 28, 2021).

Site	Depth (m)	Water Temp (°C)	DO (mg/L)	pH (SU)	Conduct (mS/cm)	Secchi (ft)
0	NA	14.31	10.54	8.49	500.0	NA

Table 77. South Lake LeAnn Basin Year 1 Physical Water Quality Data (April 28, 2021).

Site	Depth (m)	Water Temp (°C)	DO (mg/L)	pH (SU)	Conductivity (mS/cm)	Secchi Depth (ft)
S1	0	14.17	10.15	8.41	530.9	8.0
	0.5	14.15	10.31	8.41	531.0	
	1.0	14.08	10.35	8.40	530.9	
	1.5	13.78	10.41	8.40	531.0	
	2.0	13.66	10.40	8.40	530.6	
	2.5	13.58	10.40	8.40	530.6	
	3.0	13.46	10.42	8.40	530.7	
	3.5	13.36	10.42	8.40	530.5	
	4.0	13.04	10.39	8.40	531.7	
	4.5	12.54	10.40	8.40	529.2	
	5.0	12.46	10.34	8.38	530.1	
	5.5	12.37	10.14	8.35	530.1	
S2	0	13.44	10.47	8.42	542.6	7.1
	0.5	13.33	10.70	8.43	542.5	
	1.0	13.36	10.76	8.42	542.6	
	1.5	13.29	10.78	8.42	542.4	
	2.0	13.21	10.77	8.42	542.8	
	2.5	13.24	10.76	8.42	542.9	
	3.0	13.16	10.76	8.41	542.7	
	3.5	13.04	10.75	8.41	542.7	
	4.0	12.72	10.63	8.40	542.8	
	4.5	12.14	10.59	8.39	542.7	
	5.0	11.92	10.55	8.37	542.8	
	5.5	11.91	10.40	8.37	542.7	

	6.0	11.82	10.31	8.36	542.8	
	6.5	11.80	10.19	8.37	542.9	
S3	0	13.50	10.56	8.42	542.7	7.4
	0.5	13.42	10.62	8.42	542.9	
	1.0	13.45	10.64	8.42	542.7	
	1.5	13.46	10.65	8.42	542.8	
	2.0	13.42	10.65	8.43	542.7	
	2.5	13.30	10.67	8.42	543.0	
	3.0	12.93	10.71	8.42	542.1	
	3.5	12.92	10.62	8.40	542.3	
S4	0	13.41	10.19	8.42	542.1	6.9
	0.5	13.40	10.37	8.42	542.0	
	1.0	13.45	10.50	8.42	542.1	
	1.5	13.46	10.55	8.42	542.1	
	2.0	13.38	10.60	8.42	542.3	
	2.5	13.27	10.62	8.42	542.0	
	3.0	13.25	10.62	8.42	542.1	
	3.5	13.23	10.62	8.42	542.1	
	4.0	13.23	10.62	8.42	542.2	
	4.5	13.21	10.61	8.42	542.1	
	5.0	13.06	10.65	8.41	541.9	
	5.5	12.62	10.75	8.41	542.3	
	6.0	11.88	10.72	8.41	541.6	
	6.5	11.81	10.46	8.41	541.6	
	7.0	11.65	10.47	8.41	542.0	
	7.5	11.51	10.43	8.40	541.9	
	8.0	11.46	10.34	8.40	541.9	
	8.5	11.44	10.30	8.39	542.0	
	9.0	11.38	10.24	8.38	542.3	
	9.5	11.34	10.13	8.36	542.5	
	10.0	11.29	9.98	8.32	543.3	
	10.5	11.27	9.72	8.31	543.3	
	11.0	11.21	9.47	8.29	543.5	
	11.5	11.18	9.31	8.28	543.8	
	12.0	11.10	9.05	8.22	544.8	
	12.5	10.90	8.07	8.10	546.4	
S5	0	13.51	9.74	8.43	542.2	7.9
	0.5	13.52	10.34	8.43	542.2	
	1.0	13.52	10.47	8.43	542.2	
	1.5	13.52	10.57	8.43	542.3	
	2.0	13.51	10.61	8.43	542.3	
	2.5	13.49	10.61	8.43	542.3	
	3.0	13.44	10.62	8.43	542.2	
	3.5	13.44	10.62	8.43	542.5	
	4.0	13.42	10.63	8.43	542.2	

	4.5	13.16	10.69	8.42	542.2	
	5.0	11.87	10.58	8.42	543.2	
	5.5	11.45	10.60	8.42	541.8	
	6.0	11.33	10.55	8.39	542.1	
	6.5	11.23	10.38	8.38	542.4	
	7.0	11.11	10.23	8.38	542.2	
	7.5	10.70	9.98	8.20	545.0	
	8.0	10.64	8.47	8.18	544.9	
	8.5	10.40	8.04	8.01	548.4	
	9.0	10.21	7.46	7.85	549.5	
	9.5	10.12	7.63	7.66	538.5	

Table 78. North Lake LeAnn Basin Year 1 Physical Water Quality Data (July 19, 2021).

Site	Depth (m)	Water Temp (°C)	DO (mg/L)	pH (SU)	Conductivity (mS/cm)	Secchi Depth (ft)
N1	0	25.81	9.77	8.55	474.1	7.0
	0.5	25.82	9.89	8.55	474.0	
	1.0	25.79	9.97	8.55	473.8	
	1.5	25.43	10.07	8.61	472.9	
	2.0	25.32	9.42	8.60	476.5	
	2.5	25.18	9.08	8.37	475.9	
	3.0	25.10	8.73	8.35	476.1	
	3.5	25.06	8.54	8.32	476.4	
	4.0	25.01	8.01	8.24	477.1	
	4.5	24.74	7.39	8.11	478.0	
	5.0	24.67	6.42	8.00	480.5	
N2	0	25.43	9.51	8.52	473.2	6.3
	0.5	25.53	9.86	8.60	473.0	
	1.0	25.49	9.87	8.56	473.3	
	1.5	25.43	9.85	8.57	473.0	
	2.0	25.41	9.87	8.55	473.4	
	2.5	25.42	9.73	8.56	473.4	
	3.0	25.27	9.72	8.53	473.9	
	3.5	25.09	9.37	8.47	474.0	
	4.0	25.03	9.12	8.48	473.8	
	4.5	24.86	8.42	8.35	475.1	
N3	0	26.05	9.99	8.53	278.3	6.1
	0.5	26.01	10.70	8.55	278.1	
	1.0	26.04	10.93	8.55	278.2	
	1.5	25.99	11.00	8.54	276.4	
	2.0	25.85	11.52	8.69	274.0	
N4	0	25.76	8.33	8.24	483.9	5.3

	0.5	25.88	8.30	8.24	483.9	
	1.0	25.81	8.30	8.25	483.6	
	1.5	25.61	8.32	8.24	482.1	
	2.0	25.54	8.37	8.22	481.9	
	2.5	25.39	8.37	8.18	483.3	
	3.0	25.11	7.12	7.88	499.5	
N5	0	25.86	9.74	8.65	302.5	6.2
	0.5	25.68	10.23	8.67	302.2	
	1.0	25.54	10.76	8.68	302.1	
	1.5	25.52	10.88	8.67	302.0	
	2.0	25.39	11.16	8.73	301.2	
	2.5	25.30	11.18	8.67	301.7	

Table 79. North Lake LeAnn Outlet Year 1 Physical Water Quality Data (July 19, 2021)

Site	Depth (m)	Water Temp (°C)	DO (mg/L)	pH (SU)	Conduct (mS/cm)	Secchi (ft)
0	NA	26.04	10.52	8.67	469.0	NA

Table 80. South Lake LeAnn Basin Year 1 Physical Water Quality Data (July 19, 2021).

Site	Depth (m)	Temp (°C)	DO (mg/L)	pH (SU)	Conductivity (mS/cm)	Secchi Depth (ft)
S1	0	26.39	9.64	8.58	512.2	2.8
	0.5	26.64	10.26	8.57	512.9	
	1.0	26.25	10.52	8.58	511.7	
	1.5	25.62	10.59	8.53	512.2	
	2.0	25.31	10.26	8.43	514.7	
	2.5	25.21	9.57	8.40	514.4	
	3.0	25.14	9.28	8.37	515.7	
	3.5	24.79	8.80	8.24	517.3	
	4.0	24.44	6.80	7.97	521.7	
	4.5	24.38	5.13	7.82	523.7	
S2	0	26.32	9.95	8.49	519.5	2.8
	0.5	26.26	10.20	8.49	519.5	
	1.0	26.13	10.30	8.50	518.9	
	1.5	26.08	10.37	8.50	518.8	
	2.0	25.52	10.30	8.47	517.8	
	2.5	25.22	10.41	8.44	519.0	
	3.0	24.77	10.03	8.33	523.4	
	3.5	24.35	9.02	8.24	527.0	

	4.0	24.05	8.17	8.11	528.7	
	4.5	23.47	6.94	7.89	534.1	
	5.0	22.66	5.17	7.76	539.6	
	5.5	20.34	3.66	7.58	561.3	
	6.0	18.36	1.41	7.48	579.7	
	6.5	16.79	0.90	7.42	593.4	
S3	0	26.34	9.73	8.48	518.6	3.1
	0.5	26.13	10.05	8.49	518.5	
	1.0	25.70	10.22	8.48	518.2	
	1.5	25.58	10.24	8.47	518.3	
	2.0	25.47	10.17	8.45	518.8	
	2.5	25.04	9.94	8.37	521.2	
	3.0	24.82	9.10	8.31	521.9	
	3.5	24.80	8.54	8.31	522.3	
S4	0	26.44	9.58	8.51	519.1	2.8
	0.5	26.39	10.02	8.51	518.9	
	1.0	26.41	10.23	8.51	519.0	
	1.5	26.35	10.33	8.52	519.3	
	2.0	25.89	10.36	8.51	518.9	
	2.5	25.77	10.29	8.49	519.1	
	3.0	25.62	10.20	8.49	519.2	
	3.5	25.38	9.63	8.46	519.7	
	4.0	24.87	8.37	8.24	524.6	
	4.5	24.56	7.15	8.20	525.2	
	5.0	24.14	5.78	8.04	528.0	
	5.5	23.90	5.23	7.93	530.9	
	6.0	22.41	3.45	7.80	538.1	
	6.5	19.48	1.61	7.73	554.4	
	7.0	16.24	0.82	7.72	556.2	
	7.5	15.43	0.44	7.72	557.1	
	8.0	14.29	0.28	7.69	560.4	
	8.5	13.37	0.14	7.65	566.7	
	9.0	12.87	0.09	7.63	569.0	
	9.5	12.65	0.06	7.59	573.3	
	10.0	12.33	0.04	7.55	576.7	
	10.5	12.10	0.03	7.52	580.0	
	11.0	12.02	0.02	7.50	582.2	
	11.5	11.83	0.02	7.43	602.1	
S5	0	26.72	10.16	8.52	519.6	2.6
	0.5	26.75	10.29	8.52	519.4	
	1.0	26.71	10.33	8.53	519.4	
	1.5	26.63	10.37	8.53	519.9	
	2.0	26.30	10.41	8.53	518.8	

	2.5	26.11	10.45	8.51	519.4	
	3.0	25.93	10.47	8.50	519.1	
	3.5	25.38	10.46	8.46	519.7	
	4.0	25.06	10.01	8.34	522.6	
	4.5	24.68	8.51	8.25	524.7	
	5.0	24.55	7.89	8.17	525.7	
	5.5	24.48	7.09	8.16	527.3	
	6.0	23.23	3.19	7.84	537.1	
	6.5	19.89	1.64	7.73	553.0	
	7.0	17.15	0.70	7.65	563.4	
	7.5	15.39	0.53	7.62	569.7	
	8.0	13.71	0.37	7.56	576.9	
	8.5	13.26	0.24	7.52	582.9	
	9.0	12.71	0.16	7.47	588.7	
	9.5	12.41	0.12	7.41	599.5	

Table 81. North Lake LeAnn Basin Year 1 Physical Water Quality Data (September 16, 2021).

Site	Depth (m)	Water Temp (°C)	DO (mg/L)	pH (SU)	Conductivity (mS/cm)	Secchi Depth (ft)
N1	0	24.47	9.23	8.67	479.0	3.3
	0.5	24.45	9.43	8.71	478.8	
	1.0	24.34	9.44	8.70	479.0	
	1.5	23.96	9.07	8.62	481.5	
	2.0	23.41	8.69	8.56	480.7	
	2.5	23.32	8.09	8.54	481.1	
	3.0	23.18	8.02	8.51	481.5	
	3.5	23.11	7.67	8.50	482.0	
	4.0	23.08	7.45	8.44	482.6	
	4.5	22.98	7.24	8.4	481.6	
	5.0	22.84	6.74	8.32	483.2	
N2	0	24.68	9.18	8.75	477.7	4.0
	0.5	24.57	9.60	8.76	477.7	
	1.0	24.24	9.69	8.75	477.5	
	1.5	23.63	9.31	8.66	478.1	
	2.0	23.45	8.77	8.65	478.2	
	2.5	23.39	8.56	8.63	478.4	
	3.0	23.25	8.01	8.58	479.1	
	3.5	23.19	7.56	8.54	479.5	
	4.0	22.16	7.19	8.51	480.0	
	4.5	22.13	6.67	8.47	480.3	
N3	0	25.25	10.50	8.80	477.9	2.8
	0.5	24.96	10.64	8.81	478.5	
	1.0	24.41	10.79	8.81	476.4	

	1.5	23.49	10.54	8.73	477.5	
	2.0	23.21	10.43	8.65	477.5	
N4	0	24.29	10.13	8.66	480.0	3.9
	0.5	24.13	9.87	8.66	480.2	
	1.0	24.00	9.79	8.68	480.1	
	1.5	23.38	9.67	8.65	480.2	
	2.0	23.12	9.53	8.56	482.4	
	2.5	22.98	8.66	8.52	481.8	
	3.0	22.87	8.22	8.46	482.2	
N5	0	24.89	9.48	8.73	478.9	3.6
	0.5	24.58	9.59	8.75	478.1	
	1.0	24.56	9.77	8.76	477.8	
	1.5	24.43	9.77	8.75	477.9	
	2.0	24.23	9.79	8.75	477.9	
	2.5	23.52	9.49	8.71	480.0	

Table 82. North Lake LeAnn Outlet Year 1 Physical Water Quality Data (September 16, 2021).

Site	Depth (m)	Water Temp (°C)	DO (mg/L)	pH (SU)	Conduct (mS/cm)	Secchi (ft)
0	NA	25.85	10.16	8.74	478.8	n/a

Table 83. South Lake LeAnn Basin Year 1 Physical Water Quality Data (September 16, 2021). NOTE: TDG is total dissolved gas (in mmHg units) which was sampled where depths were greater than 30 feet per EGLE requirements.

Site	Depth (m)	Temp (°C)	DO (mg/L)	pH (SU)	Conductivity (mS/cm)	TDG (mmHG)	Secchi Depth (ft)
S1	0	24.77	9.59	8.64	500.1		3.0
	0.5	24.26	9.43	8.61	500.3		
	1.0	23.71	9.31	8.58	500.1		
	1.5	23.82	9.23	8.59	499.6		
	2.0	23.86	9.23	8.59	500.5		
	2.5	23.85	9.24	8.59	500.2		
	3.0	22.81	9.23	8.59	500.1		
	3.5	22.72	9.22	8.59	500.2		
	4.0	22.41	9.20	8.59	499.4		
	4.5	22.29	9.18	8.53	500.0		
S2	0	23.90	9.44	8.56	509.2		2.8
	0.5	23.71	9.51	8.58	509.9		
	1.0	23.74	9.60	8.58	508.8		
	1.5	23.73	9.61	8.57	508.8		

	2.0	23.66	9.61	8.57	509.1		
	2.5	23.64	9.62	8.57	509.4		
	3.0	23.54	9.63	8.57	508.2		
	3.5	23.04	9.55	8.52	511.6		
	4.0	22.73	9.43	8.48	512.5		
	4.5	22.74	9.25	8.49	512.2		
	5.0	22.69	9.10	8.49	512.6		
	5.5	21.62	9.03	8.46	513.3		
	6.0	20.59	8.90	8.44	514.2		
	6.5	20.56	8.65	8.42	515.3		
S3	0	24.35	9.59	8.60	502.4		3.3
	0.5	24.33	9.60	8.60	507.3		
	1.0	24.29	9.61	8.60	507.2		
	1.5	24.23	9.61	8.60	506.8		
	2.0	24.01	9.64	8.60	506.8		
	2.5	23.63	9.68	8.59	506.4		
	3.0	23.08	9.67	8.53	508.3		
	3.5	22.06	7.11	8.45	514.1		
S4	0	23.92	9.22	8.60	506.1	712.2	3.0
	0.5	23.92	9.29	8.60	506.2	715.2	
	1.0	23.88	9.45	8.60	506.2	718.7	
	1.5	23.85	9.54	8.60	506.0	721.0	
	2.0	23.75	9.55	8.59	506.2	724.3	
	2.5	26.64	9.57	8.58	506.0	727.5	
	3.0	23.19	9.25	8.52	506.8	729.5	
	3.5	23.13	8.90	8.52	507.0	731.7	
	4.0	23.10	8.75	8.52	507.0	733.4	
	4.5	23.09	8.69	8.52	507.4	735.9	
	5.0	23.03	8.59	8.49	508.3	737.1	
	5.5	22.96	8.46	8.46	509.7	739.9	
	6.0	22.92	8.34	8.44	511.1	741.7	
	6.5	22.77	8.12	8.36	513.2	743.1	
	7.0	21.71	6.11	7.99	531.9	744.2	
	7.5	18.98	3.71	7.64	563.0	741.0	
	8.0	16.28	2.08	7.50	586.6	738.6	
	8.5	14.76	1.48	7.45	593.2	739.8	
	9.0	14.08	1.08	7.42	600.7	741.8	
	9.5	13.54	0.68	7.38	611.9	744.9	
	10.0	13.05	0.51	7.35	618.9	749.0	
	10.5	12.79	0.41	7.34	625.4	753.4	
	11.0	12.52	0.28	7.31	632.9	757.8	
	11.5	12.42	0.22	7.29	638.3	762.8	
S5	0	23.64	9.63	8.61	505.2		2.7

	0.5	23.67	9.61	8.61	505.2		
	1.0	23.56	9.64	8.59	506.1		
	1.5	23.45	9.60	8.59	505.6		
	2.0	23.31	9.45	8.58	505.5		
	2.5	23.20	9.35	8.57	506.0		
	3.0	23.16	9.25	8.54	507.1		
	3.5	23.12	9.05	8.52	507.9		
	4.0	23.11	8.84	8.51	507.8		
	4.5	23.10	8.72	8.51	507.6		
	5.0	23.08	8.60	8.49	507.3		
	5.5	23.03	8.48	8.48	507.5		
	6.0	22.91	8.18	8.40	509.9		
	6.5	22.75	7.49	8.29	511.4		
	7.0	21.68	4.66	7.95	520.8		
	7.5	20.36	2.83	7.56	566.1		
	8.0	17.04	1.35	7.28	627.3		
	8.5	15.35	0.88	7.23	648.0		
	9.0	14.68	0.63	7.20	659.6		

4.2 Lake LeAnn Year 1 2021 Deep Basin Chemical Water Quality Data Tables:

Table 84. Lake LeAnn North Chemical Water Quality Data (April 28, 2021)

Deep Basin Site	Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a µg/L
N1	0	<0.50	0.035	0.035	<0.10	<0.10	<10	<0.010	<0.010	0.356
	3.0	0.56	0.029	0.029	<0.10	<0.10	<10	0.015	<0.010	
	6.0	<0.50	0.033	0.033	<0.10	<0.10	<10	0.014	<0.010	
N2	0	<0.50	0.028	0.028	<0.10	<0.10	<10	0.010	<0.010	0.178
	2.5	<0.50	0.026	0.026	<0.10	<0.10	<10	0.018	<0.010	
	4.5	0.52	0.027	0.027	<0.10	<0.10	<10	0.018	<0.010	
N3	1.0	0.68	0.024	0.024	<0.10	<0.10	<10	0.036	<0.010	0.890
N4	1.5	<0.50	0.016	0.016	<0.10	<0.10	<10	0.013	<0.010	0.534
N5	1.5	<0.50	0.022	0.022	<0.10	<0.10	<10	0.012	<0.010	1.07

Table 85. Lake LeAnn North Outlet Chemical Water Quality Data (April 28, 2021)

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)
0	<0.50	0.017	0.017	<0.10	<0.10	<10	0.010	<0.010

Table 86. Lake LeAnn South Chemical Water Quality Data (April 28, 2021).

Deep Basin Site	Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
S1	0	<0.50	0.065	0.065	<0.10	<0.10	<10	0.017	<0.010	1.25
	2.5	<0.50	0.064	0.064	<0.10	<0.10	<10	0.020	<0.010	
	5.5	<0.50	0.068	0.068	<0.10	<0.10	<10	0.018	<0.010	
S2	0	<0.50	0.066	0.066	<0.10	<0.10	<10	0.010	<0.010	0
	3.5	<0.50	0.076	0.076	<0.10	<0.10	<10	0.012	<0.010	
	6.5	<0.50	0.079	0.079	<0.10	<0.10	<10	0.011	<0.010	
S3	0	<0.50	0.058	0.058	<0.10	<0.10	<10	0.010	<0.010	0
	1.5	<0.50	0.066	0.066	<0.10	<0.10	<10	0.012	<0.010	
	3.5	<0.50	0.073	0.073	<0.10	<0.10	<10	0.011	<0.010	
S4	0	<0.50	0.064	0.064	<0.10	<0.10	<10	0.010	<0.010	1.60
	5.5	<0.50	0.064	0.064	<0.10	<0.10	<10	0.013	<0.010	
	12.5	0.77	0.230	0.230	<0.10	<0.10	10	0.032	<0.010	
S5	0	<0.50	0.065	0.065	<0.10	<0.10	<10	<0.010	<0.010	1.25
	4.5	<0.50	0.066	0.066	<0.10	<0.10	10	0.013	<0.010	
	9.5	0.71	0.450	0.450	<0.10	<0.10	10	0.030	<0.010	

Table 87. Lake LeAnn North Chemical Water Quality Data (July 19, 2021)

Deep Basin Site	Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
N1	0	0.54	<0.010	<0.010	<0.10	<0.10	<10	0.022	<0.010	7.83
	3.0	0.63	<0.010	<0.010	<0.10	<0.10	<10	0.044	<0.010	
	5.0	0.50	<0.010	<0.010	<0.10	<0.10	<10	0.037	<0.010	
N2	0	<0.50	0.013	0.013	<0.10	<0.10	<10	0.029	<0.010	4.27
	2.0	<0.50	0.012	0.012	<0.10	<0.10	<10	0.028	<0.010	
	4.5	<0.50	0.014	0.014	<0.10	<0.10	<10	0.029	<0.010	
N3	1.0	<0.50	0.015	0.015	<0.10	<0.10	<10	0.033	<0.010	3.20
N4	1.5	<0.50	0.017	0.017	<0.10	<0.10	<10	0.057	<0.010	1.07
N5	1.5	<0.50	0.010	0.010	<0.10	<0.10	<10	0.029	<0.010	2.49

Table 88. Lake LeAnn North Outlet Chemical Water Quality Data (July 19, 2021)

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)
0	<0.50	0.019	0.019	<0.10	<0.10	<10	0.036	<0.010

Table 89. Lake LeAnn South Chemical Water Quality Data (July 19, 2021)

Deep Basin Site	Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
S1	0	0.65	0.036	0.036	<0.10	<0.10	10	0.036	<0.010	0
	2.5	<0.50	0.027	0.027	<0.10	<0.10	<10	0.047	<0.010	
	4.5	0.81	0.130	0.130	<0.10	<0.10	<10	0.053	<0.010	
S2	0	0.99	0.012	0.012	<0.10	<0.10	10	0.027	<0.010	4.63
	3.5	<0.50	0.030	0.030	<0.10	<0.10	<10	0.036	<0.010	
	6.5	2.3	1.9	1.9	<0.10	<0.10	<10	0.085	<0.010	
S3	2.0	0.71	0.017	0.017	<0.10	<0.10	<10	0.030	<0.010	3.92
S4	0	0.72	0.012	0.012	<0.10	<0.10	<10	0.032	<0.010	3.92
	6.0	0.70	0.110	0.110	<0.10	<0.10	<10	0.037	<0.010	
	12.0	1.7	1.6	1.6	<0.10	<0.10	<10	0.043	<0.010	
S5	0	0.58	0.014	0.014	<0.10	<0.10	<10	0.032	<0.010	0
	5.0	0.57	0.041	0.041	<0.10	<0.10	10	0.035	<0.010	
	9.5	2.5	2.0	2.0	<0.10	<0.10	10	0.057	<0.010	

Table 90. Lake LeAnn North Chemical Water Quality Data (September 16, 2021)

Deep Basin Site	Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
N1	0	0.75	<0.10	0.012	<0.10	<0.10	16	0.037	<0.010	0
	3.0	1.80	<0.10	0.061	<0.10	<0.10	30	0.072	0.019	
	5.0	1.10	<0.10	0.089	<0.10	<0.10	22	0.047	0.012	
N2	0	0.69	<0.10	<0.010	<0.10	<0.10	<10	0.037	0.018	3.74
	2.0	0.95	<0.10	0.031	<0.10	<0.10	36	0.043	0.015	
	4.5	1.2	<0.10	0.063	<0.10	<0.10	34	0.068	<0.010	
N3	1.0	1.1	<0.10	0.010	<0.10	<0.10	14	0.040	<0.010	3.20
N4	1.5	0.88	<0.10	0.022	<0.10	<0.10	10	0.039	<0.010	5.34
N5	1.5	0.082	<0.10	0.025	<0.10	<0.10	18	0.041	<0.010	1.87

Table 91. Lake LeAnn North Outlet Chemical Water Quality Data (September 16, 2021)

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)
0	1.1	<0.10	0.021	<0.10	<0.10	22	0.048	0.011

Table 92. Lake LeAnn South Chemical Water Quality Data (September 16, 2021)

Deep Basin Site	Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)	Chl-a (µg/L)
S1	0	0.75	<0.10	<0.010	<0.10	<0.10	38	0.020	<0.010	3.47
	2.5	0.93	<0.10	0.010	<0.10	<0.10	16	0.025	0.012	
	4.5	1.0	<0.10	0.010	<0.10	<0.10	46	0.030	0.011	
S2	0	0.73	<0.10	<0.010	<0.10	<0.10	24	0.019	<0.010	17.6
	3.5	0.82	<0.10	0.013	<0.10	<0.10	26	0.020	<0.010	
	6.5	7.2	<0.10	0.074	<0.10	<0.10	510	0.039	<0.010	
S3	2.0	0.74	<0.10	<0.010	<0.10	<0.10	10	0.018	<0.010 0	0
S4	0	0.59	<0.10	0.016	<0.10	<0.10	<10	0.013	<0.010	3.74
	5.5	0.69	<0.10	0.015	<0.10	<0.10	24	0.018	<0.010	
	11.5	3.9	3.8	3.8	<0.10	<0.10	<10	0.032	<0.010	
S5	0	0.57	<0.10	<0.010	<0.10	<0.10	10	0.014	<0.010	
	4.5	0.95	<0.10	0.013	<0.10	<0.10	10	0.019	<0.010	
	9.0	5.4	4.9	4.9	<0.10	<0.10	44	0.040	<0.010	

4.3 Lake LeAnn Year 1 2021 Drain Physical & Chemical Water Quality Data Tables:

Table 93. Lake LeAnn Drain Physical Data (April 28, 2021).

Tributary	Water Temp (°C)	DO (mg/L)	pH (SU)	Conduct. (mS/cm)	Flow Rate (cfs)
North CSA 4B-No FLOW	--	--	--	--	--
South CSA 5-No FLOW	--	--	--	--	--
South CSA 3	13.61	8.82	7.68	824.3	0.28
South CSA 1A	19.99	11.19	8.35	519.1	1.57
South CSA 4A	19.75	8.90	7.34	708.7	0.01
South CSA 2A	16.23	9.09	8.14	670.5	0.78
South CSA 2B	15.90	9.24	7.95	701.1	1.57
South CSA 1B	14.29	9.13	7.69	758.7	0.68

Table 94. Lake LeAnn Drain Chemical Data (April 28, 2021).

Tributary	TP (mg/L)	SRP (mg/L)	TIN (mg/L)	NH3- (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TKN (mg/L)	TSS (mg/L)
North CSA 4B-No FLOW								
South CSA 5-No FLOW								
South CSA 3	0.024	<0.010	0.014	0.014	<0.10	<0.10	<0.50	<10
South CSA 1A	0.014	<0.010	0.022	0.022	<0.10	<0.10	0.63	<10
South CSA 4A	0.050	0.013	2.4	0.094	2.3	<0.10	0.96	<10
South CSA 2A	<0.010	<0.010	0.460	0.016	0.450	<0.10	<0.50	<10
South CSA 2B	0.013	<0.010	1.1	0.013	1.1	<0.10	0.89	38
South CSA 1B	<0.010	<0.010	1.2	<0.10	1.2	<0.10	<0.50	<10

Table 95. Lake LeAnn Drain Physical Data (July 19, 2021).

Tributary	Water Temp (°C)	DO (mg/L)	pH (SU)	Conduct. (mS/cm)	Flow Rate (cfs)
North CSA 4B-No FLOW	--	--	--	--	--
South CSA 5-No FLOW	--	--	--	--	--
South CSA 3-No FLOW	--	--	--	--	--
South CSA 1A	28.77	9.63	8.32	469.9	11.02
North CSA 4A-NO FLOW					
South CSA 2A	19.69	9.32	8.14	677.0	0.45
South CSA 2B	16.60	9.01	7.94	689.9	0.77
South CSA 1B	13.11	9.08	7.71	766.1	0.19

Table 96. Lake LeAnn Drain Chemical Data (July 19, 2021).

Tributary	TP (mg/L)	TIN (mg/L)	NH3- (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TKN (mg/L)	TSS (mg/L)
North CSA 4B-No FLOW							
South CSA 5-No FLOW							
South CSA 3							
South CSA 1A	<0.010	0.032	0.032	<0.10	<0.10	<0.50	<10
North CSA 4A							
South CSA 2A	0.044	0.470	0.017	0.450	<0.10	0.54	22
South CSA 2B	0.012	1.4	<0.10	1.4	<0.10	<0.50	<10
South CSA 1B	<0.010	1.2	<0.10	1.2	<0.10	<0.50	<10

Table 97. Lake LeAnn Drain Physical Data (September 16, 2021).

Tributary	Water Temp (°C)	DO (mg/L)	pH (SU)	Conduct. (mS/cm)	Flow Rate (cfs)
North CSA 4B-No FLOW					
South CSA 5-No FLOW					
South CSA 3-No FLOW					
South CSA 1A	23.81	8.04	8.03	486.3	0.49
North CSA 4A-NO FLOW					
South CSA 2A	18.41	9.09	8.16	667.1	0.61
South CSA 2B	16.14	9.12	7.98	715.0	0.75
South CSA 1B	13.86	9.52	7.98	715.0	0.14

Table 98. Lake LeAnn Drain Chemical Data (September 16, 2021).

Tributary	TP (mg/L)	TIN (mg/L)	NH3- (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TKN (mg/L)	TSS (mg/L)
North CSA 4B-No FLOW							
South CSA 5-No FLOW							
South CSA 3-No FLOW							
South CSA 1A	<0.010	0.15	0.034	<0.10	0.12	<0.50	18
North CSA 4A-No FLOW							
South CSA 2A	<0.010	0.36	0.021	0.33	<0.10	<0.50	10
South CSA 2B	<0.010	1.60	0.017	1.60	<0.10	<0.50	14
South CSA 1B	<0.010	0.86	<0.010	0.86	<0.10	<0.50	38

4.4 Lake LeAnn Year 1 Phytoplankton Data:

Algal Community Composition Data:

The algal genera were determined from a 500-ml composite water sample collected over the 9 deep basins of Lake LeAnn on September 16, 2021. Sub-samples were collected from the 500-ml sample and placed in a Sedgewick Rafter counting chamber for analysis under a Zeiss® compound bright field microscope. Tables 99-100 below shows a breakdown by algal group of what was present in the algal samples collected on the sampling date. Figure 14 shows a significant blue-green algal bloom in the north lake basin in 2021.

Table 99. Counts (# cells per 1 mL sub-sample) for each genera of algae found at each sampling location (n=4) in the north lake basin of Lake LeAnn (September 16, 2021).

Taxa Present	Type	N1	N2	N3	N4
Chlorella sp.	G	13	6	21	4
Scenedesmus sp.	G	3	0	1	0
Pediastrum sp.	G	1	1	0	0
Mougeotia sp.	G	6	8	4	2
Ulothrix sp.	G	2	7	9	6
Oocystis sp.	G	10	6	5	2
Staurastrum sp.	G	3	3	1	0
Closterium sp.	G	9	2	0	5
Cladophora sp.	G	12	16	4	7
Rhizoclonium sp.	G	22	15	4	0
Pithophora sp.	G	1	2	4	1
Microcystis sp.	BG	388	251	187	195
Anabaena sp.	BG	6	2	1	1
Oscillatoria sp.	BG	7	5	2	2
Navicula sp.	D	8	10	5	8
Synedra sp.	D	29	42	9	13
Rhoicosphenia sp.	D	3	5	1	0
Cymbella sp.	D	6	2	2	0
Fragillaria sp.	D	7	6	3	5

Note: G = green algae (Chlorophyta); BG = blue-green algae (Cyanophyta); D = diatoms (Bacillariophyta).

Table 100. Counts (# cells per 1 mL sub-sample) for each genera of algae found at each sampling location (n=5) in the south basin of Lake LeAnn (September 16, 2021).

Taxa Present	Type	S1	S2	S3	S4	S5
Chlorella sp.	G	18	9	12	4	7
Scenedesmus sp.	G	4	2	0	0	2
Pediastrum sp.	G	2	2	1	0	1
Mougeotia sp.	G	5	7	6	1	0
Ulothrix sp.	G	2	2	0	0	4
Oocystis sp.	G	6	9	2	1	1
Staurastrum sp.	G	3	0	0	2	0
Closterium sp.	G	8	6	5	4	7
Cladophora sp.	G	19	12	8	13	7
Rhizoclonium sp.	G	11	5	6	2	1
Pithophora sp.	G	0	0	0	2	0
Microcystis sp.	BG	391	168	297	102	111
Anabaena sp.	BG	5	0	0	0	1
Oscillatoria sp.	BG	12	9	6	2	2
Navicula sp.	D	19	9	7	2	5
Synedra sp.	D	16	12	9	6	2
Rhoicosphenia sp.	D	2	7	7	2	0
Cymbella sp.	D	3	9	5	1	0
Fragillaria sp.	D	8	5	0	0	4

Note: G = green algae (Chlorophyta); BG = blue-green algae (Cyanophyta); D = diatoms (Bacillariophyta).

Figure 14. A Blue-green algal bloom on South Lake LeAnn (July, 2021).

4.5 Lake LeAnn Year 1 Zooplankton Data:

A zooplankton tow was conducted over the deep basin of Lake LeAnn on April 28, 2021 and September 16, 2021 using a plankton tow net. The net was lowered into the hypolimnion and carefully pulled through the water column at an approximate rate of ~4 feet per second and up to the surface to yield a full 125-ml sample. The plankton net was then rinsed into the collection bottle where an Alka Seltzer® tablet was then placed along with 70% ethyl alcohol solution. The sample was then quantified for zooplankton community composition using a Ward counting wheel under a Zeiss® dissection microscope (Tables 101-104).

Table 101. Zooplankton taxa and count data from the north basin of Lake LeAnn (April 28, 2021).

Zooplankton Taxa	N1	N2	N3	N4
Cladocerans				
Daphnia sp.	8	1	6	2
D. retrocurva	1	5	2	0
Bosmina longirostris	3	1	1	4
Chydorus sp.	1	0	0	1
Copepods/Cyclopods				
Diaptomus copepodites	7	2	4	3
Mesocyclops sp.	2	6	4	2
Rotifers				
Keratella	5	4	2	0
Asplanchna sp.	3	2	0	1
TOTAL	**30**	**21**	**19**	**13**

Table 102. Zooplankton taxa and count data from the north basin of Lake LeAnn (September 16, 2021).

Zooplankton Taxa	N1	N2	N3	N4
Cladocerans				
Daphnia sp.	9	2	7	4
D. retrocurva	6	1	0	5
Bosmina longirostris	2	2	1	0
Chydorus sp.	0	0	3	1
Copepods/Cyclopods				
Mesocyclops sp.	6	4	4	1
Rotifers				
Keratella	4	2	1	2
TOTAL	**27**	**11**	**16**	**13**

Table 103. Zooplankton taxa and count data from the south basin of Lake LeAnn (April 28, 2021).

Zooplankton Taxa	S1	S2	S3	S4	S5
Cladocerans					
Daphnia sp.	8	5	3	4	0
D. retrocurva	3	3	6	2	2
Bosmina longirostris	1	3	1	2	2
Chydorus sp.	1	0	1	2	0
Copepods/Cyclopods					
Diaptomus sp.	1	2	1	2	1
Rotifers					
Keratella	3	2	2	0	0
Asplanchna sp.	1	0	0	0	0
TOTAL	**18**	**15**	**14**	**12**	**5**

Table 104. Zooplankton taxa and count data from the south basin of Lake LeAnn (September 16, 2021).

Zooplankton Taxa	S1	S2	S3	S4	S5
Cladocerans					
Daphnia sp.	4	6	3	1	2
D. retrocurva	9	5	4	1	0
Chydorus sp.	1	0	0	0	0
Copepods/Cyclopods					
Mesocyclops sp.	1	0	0	2	0
Rotifers					
Keratella	4	3	0	1	0
Asplanchna sp.	2	1	0	1	1
TOTAL	**21**	**15**	**7**	**6**	**3**

4.6 Lake LeAnn Aquatic Vegetation Biovolume and Aquatic Vegetation Communities

A whole-lake scan of the aquatic vegetation in Lake LeAnn was conducted on September 16, 2021 with a WAAS-enabled Lowrance HDS 9 GPS with variable frequency transducer. This data included 13,420 data points in the north basin and 14,850 data points in the south basin. Points were then uploaded into a cloud software program to reveal maps that displayed depth contours, sediment hardness, and aquatic vegetation biovolume (Figures 15-16). On these maps, the color blue refers to areas that lack vegetation. The color green refers to low-lying vegetation. The colors red/orange refer to tall-growing vegetation. There are many areas around the littoral (shallow) zone of the lake that contain low-growing plants like Chara or Coontail. In addition, any emergent canopies or lily pads will show as red color on the map. For this reason, the scans are conducted in conjunction with a whole lake GPS survey to account for individual species identification of all aquatic plants in the lake. Tables 105 and 106 show the biovolume categories by plant cover during the September 16, 2021 scan and survey.

The Point-Intercept Survey method is used to assess the presence and percent cumulative cover of submersed, floating-leaved, and emergent aquatic vegetation within and around the littoral zones of inland lakes.

With this survey method, sampling locations are geo-referenced (via GPS waypoints) and assessed throughout the entire lake to determine the species of aquatic macrophytes present and density of each macrophyte which are recorded onto a data sheet. Each separate plant species found in each sampling location is recorded along with an estimate of each plant density. Each macrophyte species corresponds to an assigned number. There are designated density codes for the aquatic vegetation surveys, where a = found (occupying < 2% of the surface area of the lake), b = sparse (occupying 2-20% of the surface area of the lake), c = common, (occupying 21-60% of the surface area of the lake), and d = dense (occupying > 60% of the surface area of the lake).

The survey of the north basin of Lake LeAnn consisted of 372 sampling locations around the littoral zone and the survey of the south basin consisted of 269 sampling locations and was conducted in spring during April 27, 2021 with follow-up post treatment surveys later in the season to confirm treatment efficacy. Data were placed in a table showing the relative abundance of each aquatic plant species found and a resultant calculation showing the frequency of each plant, and cumulative cover.

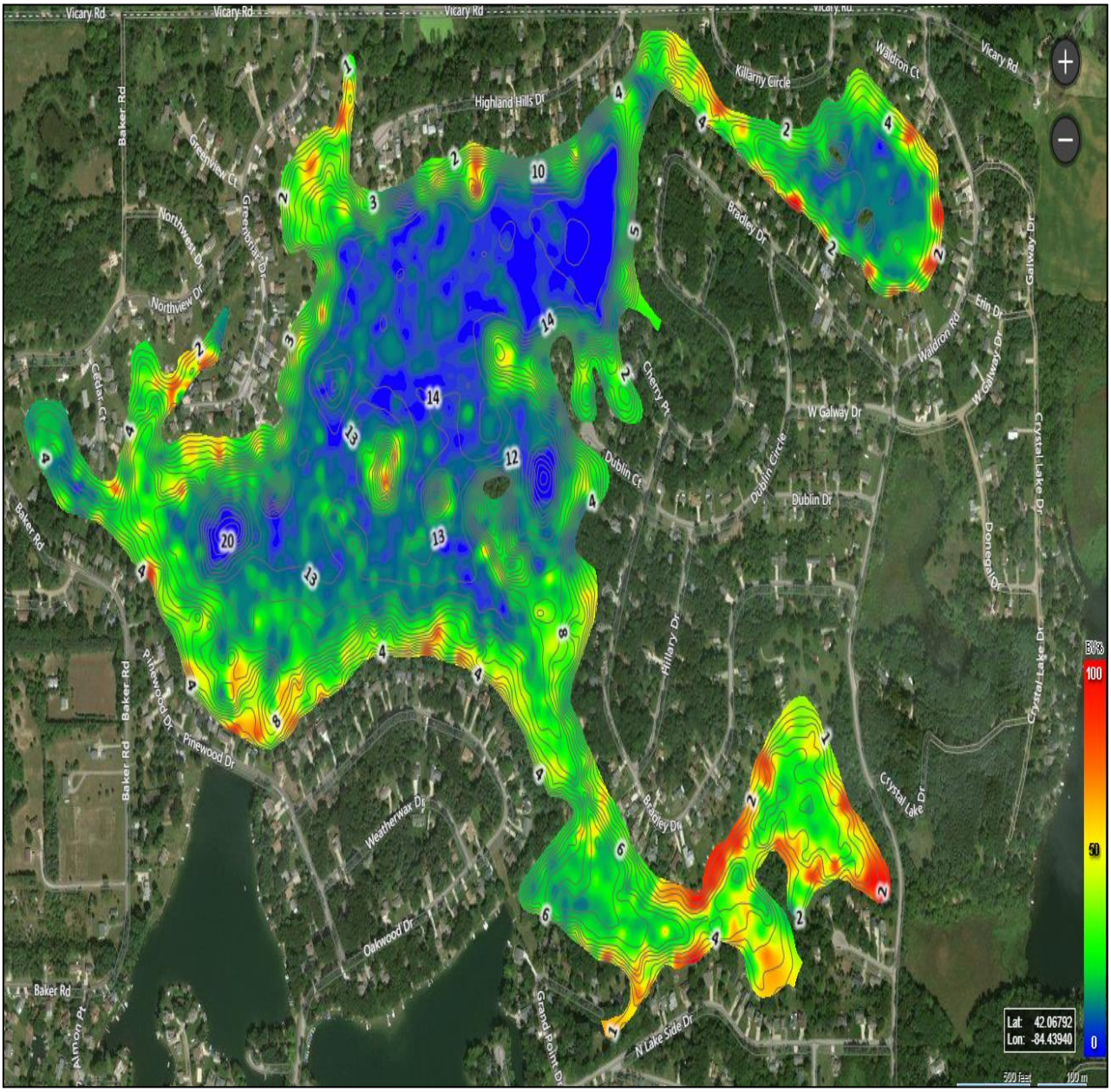

Figure 15. Aquatic plant biovolume of all aquatic plants in north Lake LeAnn, Hillsdale County, Michigan (September 16, 2021). Note: Red color denotes high-growing aquatic plants, green color denoted low-growing aquatic plants, and blue color represents a lack of aquatic vegetation.

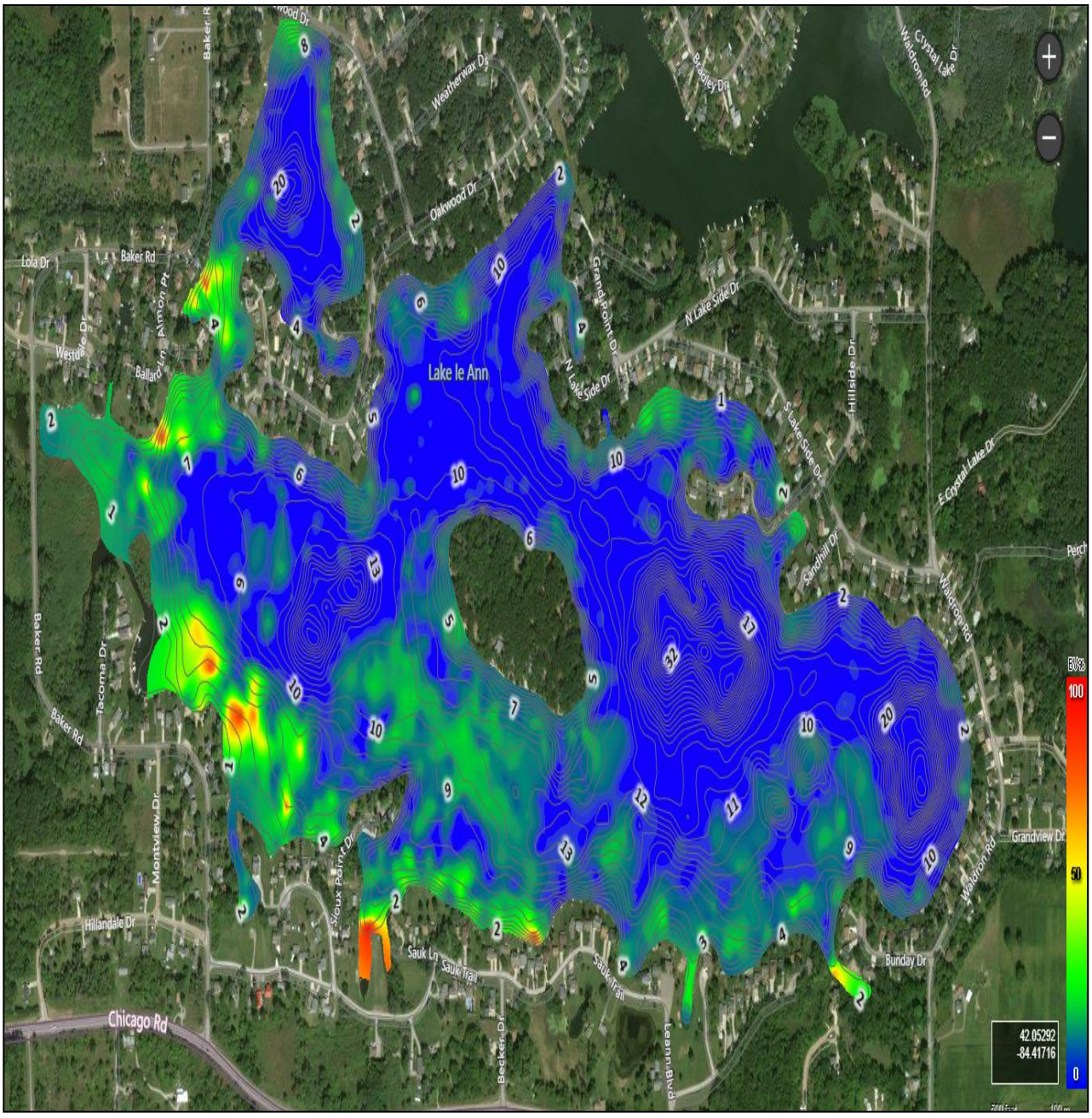

Figure 16. Aquatic plant biovolume of all aquatic plants in south Lake LeAnn, Hillsdale County, Michigan (September 16, 2021). Note: Red color denotes high-growing aquatic plants, green color denoted low-growing aquatic plants, and blue color represents a lack of aquatic vegetation.

Table 105. Lake LeAnn north basin aquatic vegetation biovolume by category percent over of each category (relative cover on September 16, 2021).

Biovolume Cover Category	% Relative Cover of Bottom by Category
<5%	32.1
5-20%	29.1
20-40%	19.8
40-60%	12.0
60-80%	2.0
>80%	4.3

Table 106. Lake LeAnn south basin aquatic vegetation biovolume by category percent over of each category (relative cover on September 16, 2021).

Biovolume Cover Category	% Relative Cover of Bottom by Category
<5%	70.3
5-20%	22.7
20-40%	5.0
40-60%	1.0
60-80%	0.3
>80%	0.6

In 2021, the north basin of Lake LeAnn contained 7 native submersed, 1 floating-leaved, and 2 emergent aquatic plant species, for a total of 10 native aquatic macrophyte species (Table 107). The south basin of Lake LeAnn contained 7 native submersed, 1 floating-leaved, and 2 emergent aquatic plant species, for a total of 10 native aquatic macrophyte species (Table 108). The majority of the emergent macrophytes may be found along the shoreline of the lake. Additionally, the majority of the floating-leaved macrophyte species can be found near the shoreline and wetland areas.

The dominant native aquatic plants in the north basin of the lake included the Chara (13.4% of the sampling sites), and Coontail (9.7% of the sampling sites). The dominant native aquatic plants in the south basin of the lake included the Chara (12.7% of the sampling sites), and Northern Watermilfoil (8.6% of the sampling sites). The Pondweeds grow tall in the water column and serve as excellent fish cover. In dense quantities, they can be a nuisance for swimming and boating and can be controlled with selective herbicide management or with mechanical harvesting.

The relative abundance of rooted aquatic plants (relative to non-rooted plants) in the lake suggests that the sediments are the primary source of nutrients (relative to the water column), since these plants obtain most of their nutrition from the sediments. There is an abundance of rootless Coontail in both lakes, which is common in impoundments and this plant utilizes nutrients in the water column for growth. The emergent plants, such as (Cattails) are critical for shoreline stabilization as well as for wildlife and fish spawning habitat.

In the north basin, there were 3 invasive aquatic plant species. These included Eurasian Watermilfoil, Curly-leaf Pondweed, and Starry Stonewort. Eurasian watermilfoil was found in 88.4% of the sampling sites. Curly-leaf Pondweed was found in 74.2% of the sampling sites. Starry Stonewort was found in 2.7% of the sampling sites.

In the south basin, there were 3 invasive aquatic plant species. These included Eurasian Watermilfoil, Curly-leaf Pondweed, and Starry Stonewort. Eurasian watermilfoil was found in 54.6% of the sampling sites. Curly-leaf Pondweed was found in 47.2% of the sampling sites. Starry Stonewort was found in 12.3% of the sampling sites.

Aquatic herbicides were conducted in 2019-2021 with an EGLE ANC permit. The treatments are solely for management of invasives and very small areas of dense nuisance natives.

Table 107. Lake LeAnn north basin native aquatic plants (April 27, 2021).

Aquatic Plant Common Name	Aquatic Plant Latin Name	A level	B level	C level	D level	# Sites Found (% of total)
Muskgrass	*Chara vulgaris*	33	7	1	9	13.4
Thin-leaf Pondweed	*Stuckenia pectinatus*	1	0	0	0	0.3
White-stem Pondweed	*Potamogeton praelongus*	1	0	0	0	0.3
Large-leaf Pondweed	*Potamogeton amplifolius*	4	3	0	0	1.9
Coontail	*Ceratophyllum demersum*	22	9	3	2	9.7
Mini Bladderwort	*Utricularia minor*	2	3	0	0	1.3
Nitella	*Nitella sp.*	6	0	4	0	2.7
White Waterlily	*Nymphaea odorata*	12	0	0	0	3.2
Cattails	*Typha latifolia*	0	2	0	0	0.5
Iris sp.	*Iris* sp.	1	1	0	0	0.5

Table 108. Lake LeAnn south basin native aquatic plants (April 27, 2021).

Aquatic Plant Common Name	Aquatic Plant Latin Name	A level	B level	C level	D level	# Sites Found (% of total)
Muskgrass	*Chara vulgaris*	14	5	2	13	12.7
Nitella	*Nitella* sp.	0	1	0	0	0.4
Large-leaf Pondweed	*Potamogeton amplifolius*	2	0	0	0	0.7
Coontail	*Ceratophyllum demersum*	8	4	2	0	5.2
Mini Bladderwort	*Utricularia minor*	2	0	0	0	0.7
Northern Watermilfoil	*Myriophyllum sibiricum*	21	2	0	0	8.6
Flat-stem Pondweed	*Potamogeton zosteriformis*	1	0	0	0	0.4
White Waterlily	*Nymphaea odorata*	2	1	0	0	1.1
Cattails	*Typha latifolia*	0	2	0	0	0.7
Swamp Loosestrife	*Decodon verticillatus*	1	0	0	0	0.4

4.7 Lake LeAnn Sediment Bottom Hardness and Sediment Data

A bottom sediment hardness scan was conducted of the entire lake bottom on September 16, 2021. The bottom hardness maps show (Figure 17-18) that most of the lake bottom consists of fairly consolidated sediment throughout the lake with a few areas with soft organic bottom. This is not surprising given the amount of sandy loams in the region which contribute to lake geology. Tables 109-110 below show the categories of relative bottom hardness with 0.0-0.1 referring to the softest and least consolidated bottom and >0.4 referring to the hardest, most consolidated bottom for the two lake basins. This scale does not mean that any of the lake contains a truly "hard" bottom but rather a bottom that is more cohesive and not flocculent. In addition to the sediment hardness scans, sediment samples were collected with an Ekman hand dredge and placed into glass jars and transferred to the laboratory for analysis of sediment organic matter percentage and sediment particle size. The sediment organic matter data and particle size data are shown below in Table 111.

Table 109. Lake LeAnn north basin relative hardness of the lake bottom by category or hardness and percent cover of each category (relative cover).

Lake Bottom Relative Hardness Category	# GPS Points in Each Category (Total =5,048)	% Relative Cover of Bottom by Category
0.0-0.1	17	0.34
0.1-0.2	328	6.50
0.2-0.3	3213	63.65
0.3-0.4	1486	29.44
>0.4	4	0.08

Table 110. Lake LeAnn south basin relative hardness of the lake bottom by category or hardness and percent cover of each category (relative cover).

Lake Bottom Relative Hardness Category	# GPS Points in Each Category (Total =8323)	% Relative Cover of Bottom by Category
0.0-0.1	2	0.02
0.1-0.2	723	8.70
0.2-0.3	5400	64.88
0.3-0.4	2196	26.38
>0.4	2	0.02

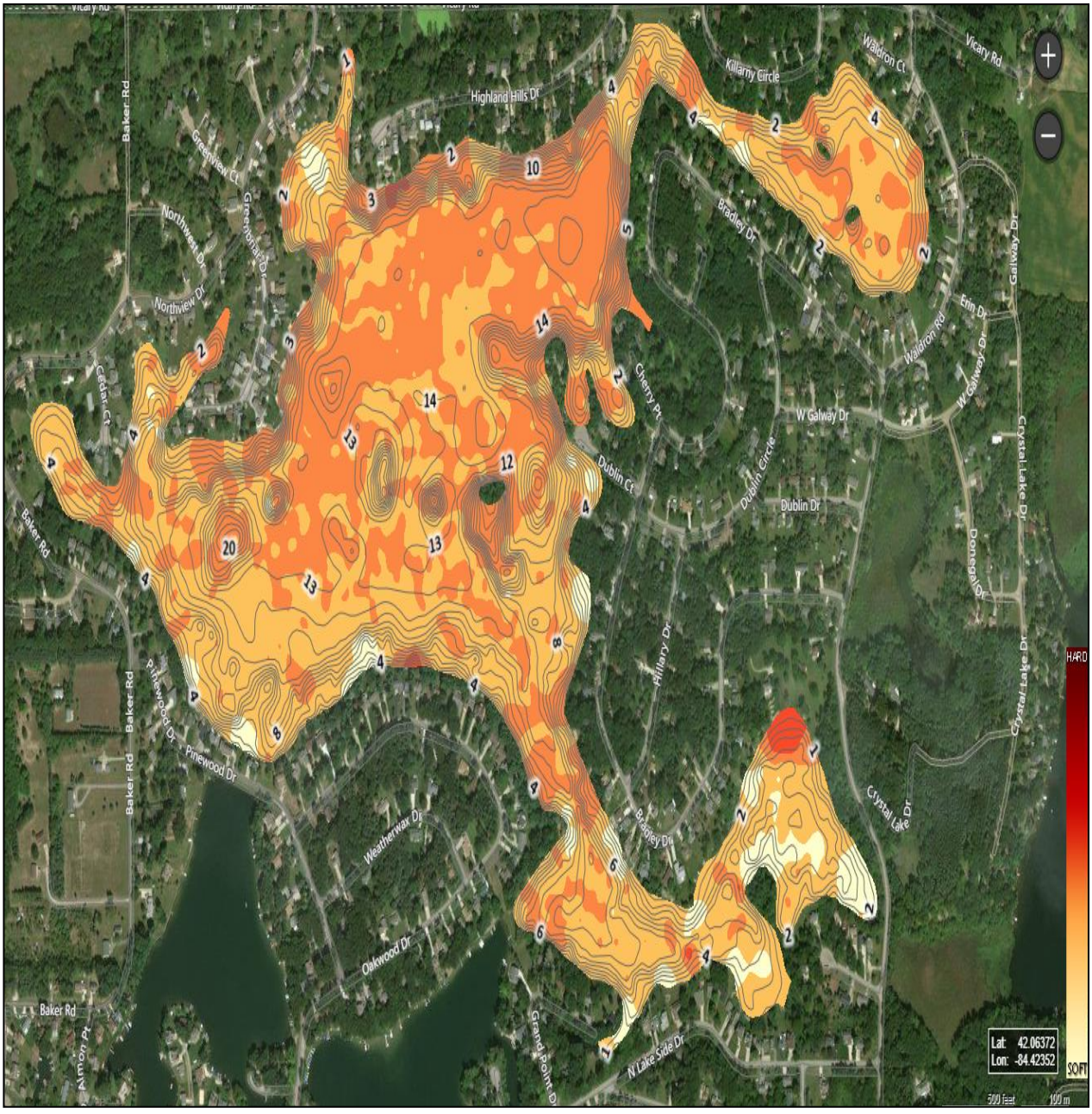

Figure 17. Lake LeAnn north basin sediment relative hardness map (September 16, 2021).

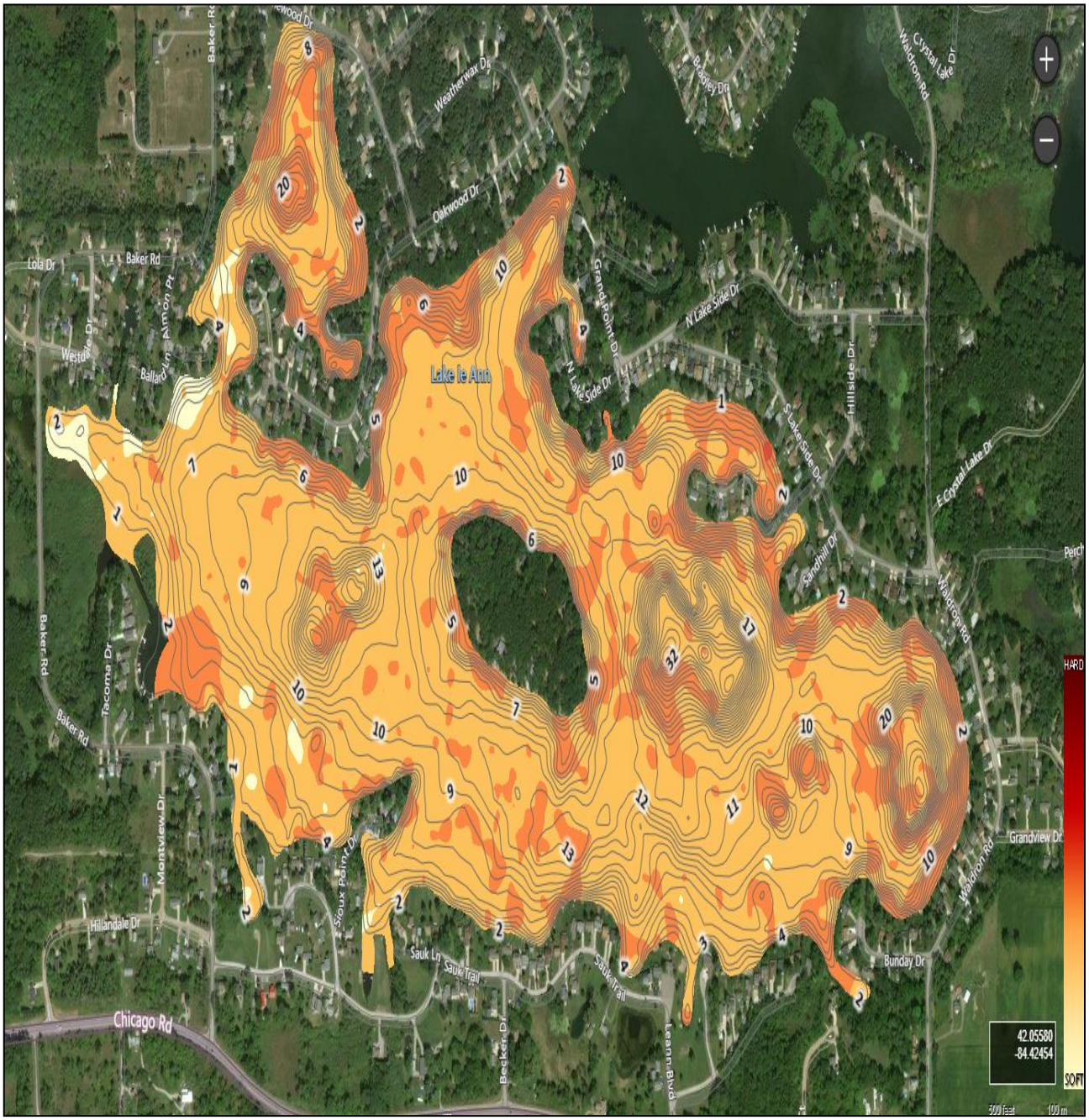

Figure 18. Lake LeAnn south basin sediment relative hardness map (September 16, 2021).

Table 111. Lake LeAnn sediment organic matter and particle size data collected at n= 13 locations (September 16, 2021).

Site	% Organic Matter	Total Gravel Fractional Components	Total Sand Fractional Components	Total Fines Fractional Components
S1 (397)	5.5	0	59.6	40.4
S2 (398)	0.84	0	92.1	7.9
S3 (399)	39.0	0	42.0	58.0
S4 (400)	0.42	11.1	83.0	5.9
S5 (401)	1.2	9.9	76.0	14.4
S6 (402)	0.47	0	96.1	3.9
S7 (403)	0.68	0	94.1	5.9
S8 (404)	0.87	0	88.2	11.8
S9 (405)	18.0	0	37.0	63.0
S10 (406)	0.76	23.5	66.7	9.8
S11 (407)	22.0	0.0	83.4	6.7
S12 (408)	1.2	9.9	83.4	6.7
S13 (409)	1.7	19.2	67.2	13.6

4.8 Lake LeAnn Through the Ice Water Quality Sampling

Ice conditions were safe in 2021 to allow for successful water quality sampling in the deep basins of Lake LeAnn through winter ice on February 18, 2021. Tables 112-115 below show the physical and chemical water quality data collected for the two basins. Since such measurements were not possible due to unsafe ice in 2019, RLS will collect samples again in 2022 for later comparisons.

Table 112. Lake LeAnn North Ice Sampling Physical Water Quality Data (February 18, 2021)

Depth (m)	Water Temp (°C)	pH (SU)	Conductivity (mS/cm)	Dissolved Oxygen (mg/l)	Secchi (ft)
0	0.91	7.9	568	12.8	10.2
0.5	0.91	8.1	541	12.8	
1.0	3.56	8.1	541	12.6	
1.5	3.79	8.1	541	12.2	
2.0	3.82	8.1	541	12.2	
2.5	3.87	8.1	542	12.2	
3.0	3.87	8.1	542	11.7	
3.5	3.92	8.1	542	11.6	
4.0	3.92	8.0	542	10.9	
4.5	3.92	8.0	542	10.9	
5.0	3.99	8.0	542	10.5	
5.5	4.11	8.0	543	10.2	
6.0	4.11	8.0	543	9.9	
6.5	4.12	8.0	557	9.7	

Table 113. Lake LeAnn North Ice Sampling Chemical Water Quality Data (February 18, 2021)

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)
0	0.64	0.290	0.070	0.220	<0.10	<10	0.018	<0.010
3.5	0.50	0.450	0.071	0.380	<0.10	<10	0.022	<0.010
6.5	0.50	0.290	0.071	0.210	<0.10	<10	0.020	<0.010

Table 114. Lake LeAnn South Ice Sampling Physical Water Quality Data (February 18, 2021).

Depth (m)	Water Temp (°C)	pH (SU)	Conductivity (mS/cm)	Dissolved Oxygen (mg/l)	Secchi (ft)
0	0.92	7.8	559	12.4	11.5
0.5	0.92	7.8	552	12.1	
1.0	3.50	8.0	552	12.1	
1.5	3.68	8.0	553	11.9	
2.0	3.85	8.0	549	11.8	
2.5	3.89	8.0	549	10.9	
3.0	3.89	8.0	549	10.9	
3.5	3.94	8.0	550	10.9	
4.0	3.94	8.0	548	10.2	
4.5	3.94	8.0	548	10.2	
5.0	3.96	8.0	548	10.2	
5.5	3.96	8.0	548	10.1	
6.0	3.96	8.0	548	10.0	
6.5	3.96	8.0	548	10.0	
7.0	3.96	8.0	555	10.0	
7.5	3.96	8.0	555	10.1	
8.0	3.98	8.0	555	10.1	
8.5	3.98	8.0	551	9.8	
9.0	3.99	8.1	547	9.8	
9.5	3.99	8.1	542	9.8	
10.0	3.99	8.1	549	9.6	
10.5	4.08	8.1	556	9.4	
11.0	4.11	8.1	556	9.4	
11.5	4.15	8.1	556	9.4	

Table 115. Lake LeAnn South Ice Sampling Chemical Water Quality Data (February 18, 2021)

Depth (m)	TKN (mg/L)	TIN (mg/L)	NH3 (mg/L)	NO3- (mg/L)	NO2- (mg/L)	TSS (mg/L)	TP (mg/L)	Ortho-P (mg/L)
0	0.50	0.380	0.160	0.220	<0.10	<10	0.010	<0.010
5.5	0.68	0.370	0.160	0.220	<0.10	<10	0.012	<0.010
11.5	<0.50	0.380	0.150	0.230	<0.10	<10	<0.010	<0.010

5.0 LAKE LEANN CONCLUSIONS AND RECOMMENDATIONS FOR 2022

The implementation of the LFA technology and concomitant use of bioaugmentation (beneficial bacteria and enzymes) in Lake LeAnn occurred in 2021. This was to begin initiation of the primary goals addressed in the earlier sections above. Specifically, the lake needs more native aquatic vegetation, less invasive aquatic plant species, less cyanobacteria, and less nutrients. The nutrient concentrations in the lake are indicative of eutrophic waters with elevated phosphorus, nitrogen, and chlorophyll-a. Additional impairments include low dissolved oxygen with depth and reduced water clarity through low secchi transparency readings. These nutrients have multiple sources which include drains entering the lake, septic systems, and other land uses. RLS will measure all of the same parameters listed in this report in 2022 at three different sampling dates and then prepare another technical report at the end of 2022 that compares the 2019 baseline data set to the post-LFA data sets (2021-2022). The following sub-sections below summarize an analysis of all collected data from 2019 and 2021 with comparisons. Note that the Mirror Lake Outlet data will need to be analyzed in 2022 since it was added post 2019 by EGLE. In addition, RLS will collect through the ice sampling in 2022 for comparisons given that the conditions were unsafe for sampling in 2019.

All data collected has been analyzed and is summarized below with descriptive statistic tables. 2022 will be a critical year for determining the efficacy of the LFA system.

Statistical Summary of Baseline (2019) and Year 1 (2021) Lake LeAnn LFA Data

I. Lake Basins:

Table 116. Descriptive statistics of all water quality parameters in the North Basin of Lake LeAnn for LFA baseline parameters collected on April 26, July 24, and September 11, 2019.

Water Quality Parameter	Baseline April 26 Means ± SD	Baseline July 24 Means ± SD	Baseline Sept 11 Means ± SD
Water temp (°C)	12.9±0.9	26.3±1.3	22.6±1.2
pH (S.U.)	8.3±0.1	7.3±2.1	8.4±0.2
Dissolved oxygen (mg/L)	10.1±0.6	8.5±0.1	8.2±2.2
Conductivity (mS/cm)	509±3.6	584±75	472±13
Secchi transparency (ft.)	8.4±1.6	6.1±0.1	3.3±0.1
Chlorophyll-a (µg/L)	0.134±0.3	0.335±0.7	0.0±0.0
Total Kjeldahl nitrogen (mg/L)	0.6±0.1	1.2±0.9	1.0±0.3
Total inorganic nitrogen (mg/L)	0.240±0.0	0.172±0.4	0.057±0.1
Total phosphorus (mg/L)	0.025±0.0	0.047±0.0	0.037±0.0
Ortho-Phosphorus (mg/L)	0.010±0.0	0.026±0.0	0.010±0.0
Total suspended solids (mg/L)	25.0±11.8	10.5±1.4	10.0±0.0

Table 117. Descriptive statistics of all water quality parameters in the North Basin of Lake LeAnn for LFA Year 1 parameters collected on April 28, July 19, and September 16, 2021.

Water Quality Parameter	Baseline April 28 Means ± SD	Baseline July 19 Means ± SD	Baseline Sept 16 Means ± SD
Water temp (°C)	13.2±0.6	25.5±0.4	23.7±0.8
pH (S.U.)	8.5±0.1*	8.5±0.2	8.6±0.1
Dissolved oxygen (mg/L)	11.6±0.9*	9.4±1.2*	9.0±1.1
Conductivity (mS/cm)	503±9.5	425±86	480±1.8
Secchi transparency (ft.)	10.3±2.4	6.2±0.6	3.5±0.5
Chlorophyll-a (µg/L)	0.606±0.4*	3.8±2.5*	2.83±2.0*
Total Kjeldahl nitrogen (mg/L)	0.5±0.1*	0.5±0.0	1.0±0.5
Total inorganic nitrogen (mg/L)	0.027±0.0*	0.012±0.0*	0.100±0.0*
Total phosphorus (mg/L)	0.016±0.0*	0.034±0.0*	0.047±0.0*
Ortho-Phosphorus (mg/L)	0.010±0.0	0.010±0.0*	0.013±0.0*
Total suspended solids (mg/L)	10.0±0.0*	10±0.0	21.0±0.0*

Conclusions for North Basin:

1. **pH increased in April 2021**
2. **DO increased in April and July 2021**
3. **Secchi declined from April to September 2019 and 2021. Marginally higher in 2021 but with calculated standard deviations likely not significant**
4. **Chl-a increased in all 3 months in 2021**
5. **TKN declined in April 2021**
6. **TIN declined in April and July but increased in September**
7. **TP declined in April and July but increased in September**
8. **Ortho-P declined in July but increased in September**
9. **TSS increased in September, 2021 but was below detection in prior months**

Table 118. Descriptive statistics of all water quality parameters in the South Basin of Lake LeAnn for LFA baseline parameters collected on April 26, July 24, and September 11, 2019.

Water Quality Parameter	Baseline April 26 Means ± SD	Baseline July 24 Means ± SD	Baseline Sept 11 Means ± SD
Water temp (°C)	12.7±1.1	23.9±4.8	21.2±2.6
pH (S.U.)	8.4±0.1	8.5±0.1	8.4±0.1
Dissolved oxygen (mg/L)	10.3±0.7	6.7±3.5	7.1±2.5
Conductivity (mS/cm)	544±5.3	494±48.7	570±74.2
Secchi transparency (ft.)	6.0±0.9	8.7±1.0	5.5±2.2
Chlorophyll-a (µg/L)	1.78±2.5	0.535±0.6	0.0±0.0
Total Kjeldahl nitrogen (mg/L)	0.50±0.0	1.1±1.2	1.1±1.0
Total inorganic nitrogen (mg/L)	0.223±0.1	0.253±0.8	0.397±1.0
Total phosphorus (mg/L)	0.018±0.0	0.039±0.1	0.023±0.0
Ortho-Phosphorus (mg/L)	0.010±0.0	0.010±0.0	0.012±0.0
Total suspended solids (mg/L)	16.1±11.5	13.7±10.8	10.0±0.0

Table 119. Descriptive statistics of all water quality parameters in the South Basin of Lake LeAnn for LFA Year 1 parameters collected on April 28, July 19, and September 16, 2021.

Water Quality Parameter	Baseline April 28 Means ± SD	Baseline July 19 Means ± SD	Baseline Sept 16 Means ± SD
Water temp (°C)	12.6±1.1	22.4±5.0	21.9±3.4
pH (S.U.)	8.4±0.1	8.1±0.4	8.3±0.5
Dissolved oxygen (mg/L)	10.3±0.7	6.8±4.2	7.7±3.1*
Conductivity (mS/cm)	541±4.6	536±25	526±42
Secchi transparency (ft.)	7.5±0.5	2.8±0.2	3.0±0.2
Chlorophyll-a (µg/L)	0.8±0.8	2.5±2.3*	6.2±7.8*
Total Kjeldahl nitrogen (mg/L)	0.53±0.1	1.0±0.7	1.9±2.2
Total inorganic nitrogen (mg/L)	0.104±0.1*	0.456±0.8*	0.754±1.6*
Total phosphorus (mg/L)	0.015±0.0*	0.042±0.0*	0.024±0.0*
Ortho-Phosphorus (mg/L)	0.010±0.0	0.010±0.0	0.010±0.0*
Total suspended solids (mg/L)	10.0±0.0*	10±0.0*	60±136*

Conclusions for South Basin:

1. **DO increased in September 2021**
2. **Secchi was higher in spring 2021 but low and stable later in the season**
3. **TIN declined in April but increased in July and September 2021**
4. **TP declined in April but increased in July and September 2021**
5. **Ortho-P declined in September 2021**
6. **TSS declined in April but increased in September 2021**

II. Drains/CSA's

Table 120. Descriptive statistics of all water quality parameters in the CSA's of Lake LeAnn for parameters collected on April 26, July 24, and September 11, 2019.

Water Quality Parameter	CSA #S1	CSA #S2	CSA #S3	CSA #N4
Water temp (°C)	18.7±8.4	15.1±5.8	14.8±6.1	13.6±6.0
pH (S.U.)	8.2±0.4	8.1±0.5	7.7±0.4	8.1±0.2
Dissolved oxygen (mg/L)	8.6±1.7	8.4±0.6	8.5±0.6	8.1±0.2
Conductivity (mS/cm)	620±67	614±102	698±198	928±480
Total dissolved solids (mg/L)	412±80	439±54	483±107	601±298
Total Kjeldahl nitrogen (mg/L)	0.7±0.3	0.5±0.0	0.9±0.7	0.5±0.0
Total inorganic nitrogen (mg/L)	0.800±1.3	0.427±0.1	0.070±0.1	1.1±1.2
Ammonia nitrogen (mg/L)	0.031±0.0	0.014±0.0	0.013±0.0	0.049±0.0
Nitrate nitrogen (mg/L)	0.8±1.2	0.410±0.1	0.10±0.0	1.03±1.2
Nitrite nitrogen (mg/L)	0.10±0.0	0.10±0.0	0.10±0.0	0.10±0.0
Total phosphorus (mg/L)	0.032±0.1	0.020±0.0	0.047±0.1	0.018±0.0
Ortho-Phosphorus (mg/L)	0.018±0.1	0.010±0.0	0.014±0.0	0.010±0.0
Total suspended solids (mg/L)	10±0.0	15.3±9.2	43±38	22±17

Table 121. Descriptive statistics of all water quality parameters in the CSA's of Lake LeAnn for parameters collected on April 28, July 19, and September 16, 2021. Note: Due to lack of flow beyond April, CSA #S3 was omitted from means. CSA #4 (N) was also not measurable in 2021 due to lack of flow.

Water Quality Parameter	CSA #S1A		CSA #S2A	CSA #S2B	CSA #S1B
Water temp (°C)	24.2±4.4		18.1±1.7	16.2±0.4	13.8±0.6
pH (S.U.)	8.2±0.2		8.1±0.0	8.0±0.0	7.8±0.2
Dissolved oxygen (mg/L)	9.6±1.6		9.2±0.1	9.1±0.1	9.2±0.2
Conductivity (mS/cm)	492±25		672±0.0	702±12.6	747±28
Total Kjeldahl nitrogen (mg/L)	0.5±0.1		0.5±0.0	0.6±0.2	0.5±0.0
Total inorganic nitrogen (mg/L)	0.068±0.1		0.430±0.1	1.4±0.3	1.1±0.2
Ammonia nitrogen (mg/L)	0.029±0.0		0.018±0.0	0.043±0.0	0.100±0.2
Nitrate nitrogen (mg/L)	0.107±0.0		0.410±0.1	1.4±0.3	1.09±0.2
Nitrite nitrogen (mg/L)	--		--	--	--
Total phosphorus (mg/L)	0.011±0.0		0.021±0.0	0.012±0.0	0.010±0.0
Total suspended solids (mg/L)	12.7±4.6		14±6.9	21±15.1	19.3±16.2
Flow Rate (cfs)	4.4±5.8		0.6±0.2	1.0±0.5	0.3±0.3

Conclusions:

1. CSA 4N and S2B and S1B require urgent mitigation. CSA 4N was noted to have high nitrogen concentrations in 2019 when flow was present. These drains are experiencing high total inorganic nitrogen loads and elevated total suspended solids. These parameters can lead to enhanced cyanobacteria blooms.

III. Aquatic Vegetation Biovolume

Conclusions:

1. In the north basin, there was a decline in the lowest growing biovolume category and an increase in the moderate-growing category (20-40%) and a very slight decline in the highest biovolume category (>80%).
2. In the south basin, there was a significant increase in the lower-growing category and modest declines in the higher-growing category.

IV. Sediment Relative Hardness & Particle Size:

Conclusions:

1. In the north basin, there was a significant increase in the secondary and moderate sediment hardness category and a not much change in the firm bottom categories.
2. In the south basin, there was a significant increase in the moderate sediment hardness category and not much change in the firm bottom categories.
3. The mean % organic matter in 2019 was 27.7% and 7.1% in 2021.
4. In 2019, there was no gravel fractional component.
5. The sand fractional component increased from 54.5% in 2019 to 74.5% in 2021.
6. The fines fractional component decreased from 45.5% in 2019 to 19.1% in 2021.

V. Phytoplankton:

Conclusions:

1. In the north basin, both green algae and blue-green algae declined since 2019 but diatoms slightly increased. The blue-green algae in the north basin is still elevated but shows prominent blooms after mid-summer.
2. In the south basin, blue-green algae was similar to 2019 but the diatoms and green algae both increased. The south basin experienced excessive blue-green blooms in 2021 and this may be exacerbated by the drains entering the lake.

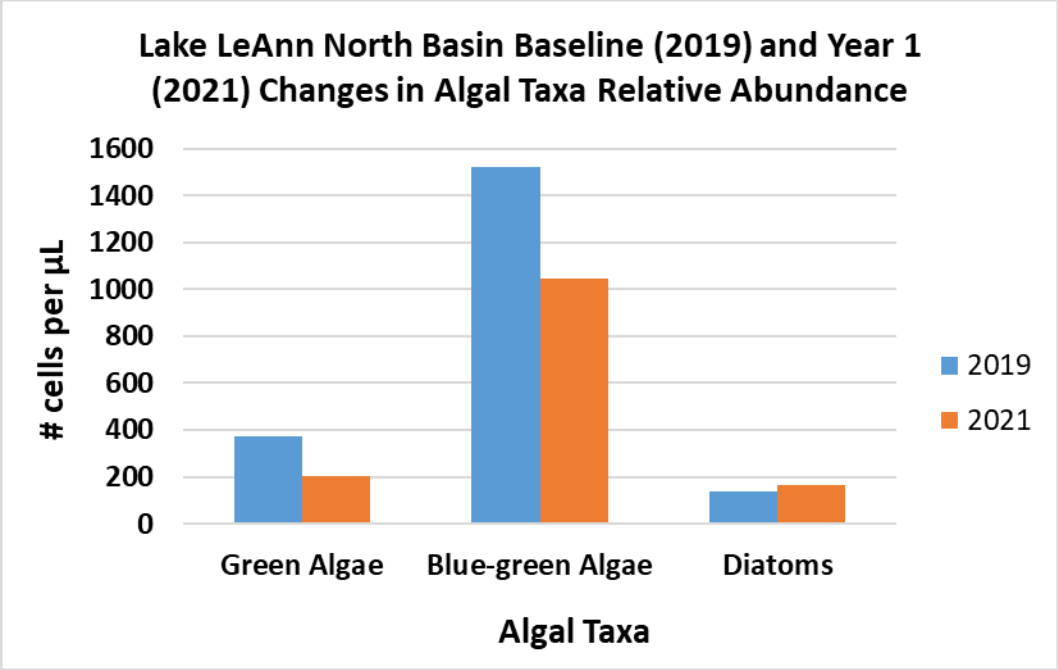

Figure 19. Lake LeAnn north baseline and Year 1 algal relative abundance.

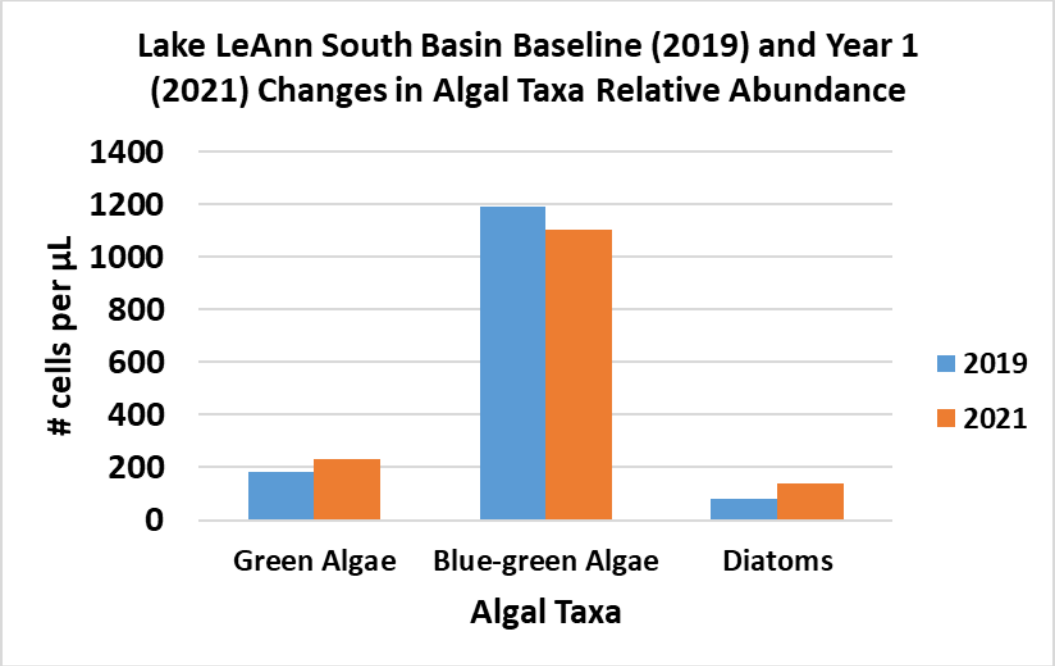

Figure 20. Lake LeAnn south baseline and Year 1 algal relative abundance.

V1. Zooplankton:

Conclusions:

1. In the north basin, the zooplankton count was similar in April but increased in September 2021 after LFA.
2. In the south basin, the zooplankton count declined in April 2021 and also September 2021 relative to 2019.

VII. Management Recommendations for 2022:

Urgent and sustainable control of the invasive Eurasian Watermilfoil, Curly-leaf Pondweed, and Starry Stonewort are needed to allow for germination and colonization of native aquatic plant species to improve biodiversity in Lake LeAnn. The Eurasian Watermilfoil in particular is showing strong signs of herbicide resistance and thus a new systemic herbicide product called ProcellaCOR® is proposed to be used in 2022 given its evaluated efficacy and longer-lasting control. RLS will continue to map all aquatic vegetation and provide specific treatment maps for the herbicide applicators. RLS is also present to oversee the herbicide applications. Care must be taken to avoid removal of too much aquatic vegetation as this can exacerbate blue-green algal blooms by allowing for less competition from plants for nutrients.

The current BioBlast® bioaugmentation methodology is uncertain. RLS is cautious about the inability of this solution to effectively reduce blue-green algal blooms, especially in the south lake basin in 2022. RLS has recommended possible petri dish media to allow for samples to be collected to determine what is growing in the BioBlast® tanks and in what quantity. This is an important scientific question to address in order to make an assumption that BioBlast® is actively competing with resident blue-green blooms. If the results of 2022 applications are unfavorable, another bioaugmentation control agent may be necessary.

As previously stated, RLS encourages the LLPOA to work with its residents to follow lakeshore best management practices (BMP's) such as proper annual inspection and pumping of septic systems and drain fields, protection of lakeshore emergent vegetation, preventing usage of lawn fertilizers and watering with lake water instead, and public education and outreach.

APPENDIX A

LAKE LEANN 2021 FIELD DATA SHEETS

APPENDIX B

LAKE LEANN 2021 LABORATORY REPORTS