

**To:** Lauren Koloski, Environmental Supervisor  
Washtenaw County Water Resources  
Commissioner's Office

**Date:** December 30, 2022

**From:** Zach Harrison, Project Scientist  
Mike Foster, Environmental Engineer  
Mark Kieser, Senior Scientist  
Kieser & Associates, LLC

**cc:** Project Files

**RE:** North Lake Phosphorus Loading Mass Balance Analysis

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## 1. Introduction

Both algae and aquatic plants require a wide range of nutrients for growth. The nutrient in shortest supply relative to the demands of aquatic plant and algal growth is termed the "limiting nutrient." In most freshwater ecosystems, the limiting nutrient is typically phosphorus. Increases in phosphorus can lead to nuisance submersed plant and algae growth and increase the potential for harmful blue-green algal blooms. Evaluating the balance of internal phosphorus loading released by lake sediments versus external phosphorus loading is necessary to ensure future source control expenditures are appropriately targeted for providing the best returns on investment. A preliminary internal nutrient loading study was conducted within North Lake to understand these differences including water quality sampling and lake sediment sampling.

## 2. Methods

GPS coordinates, maximum depths and the field and laboratory water quality parameters assessed during each 2022 sampling event of North Lake are compiled in Table 1. Water quality sampling was conducted at two deep locations (D1 and D2; see Figure 1) and at the upstream side of the lake outlet to evaluate the role of internal loading in North Lake's phosphorus budget, and to calculate the phosphorus load exiting through the lake outlet. Sampling was conducted in the late-summer under stratified conditions under which lake bottom hypoxia could potentially induce phosphorus mobilization from lake sediment.

Stormwater runoff sampling at select locations was also targeted as part of this mass balance assessment effort. K&A made four separate trips to North Lake over the course of 2022 during rainy weather in an attempt to collect representative grab samples and flow of surface water runoff to the lake. A dry summer and limited rainfall amounts during visits resulted in no representative runoff conditions at previously identified source locations for this sampling. At the final attempted wet weather visit in early October, K&A opted to collect two outlet samples during the tail end of a limited rain event. These data are reported herein.

Table 1 – North Lake sampling site locations, depths, and field and laboratory analytical parameters for the 2022 K&A water quality sampling events.

Site ID	GPS Coordinates	Max Depth (ft)	Field Parameters	Lab Parameters
D1	42.39308, -84.007202	33	Temperature, Dissolved Oxygen, Specific Conductance, pH, Secchi Disk Depth	Total Phosphorus, Soluble Reactive Phosphorus, Sediment Phosphorus/Iron, Total Suspended Solids
D2	42.39385, -84.005215	53		
Outlet	42.38798, -84.016125	--		

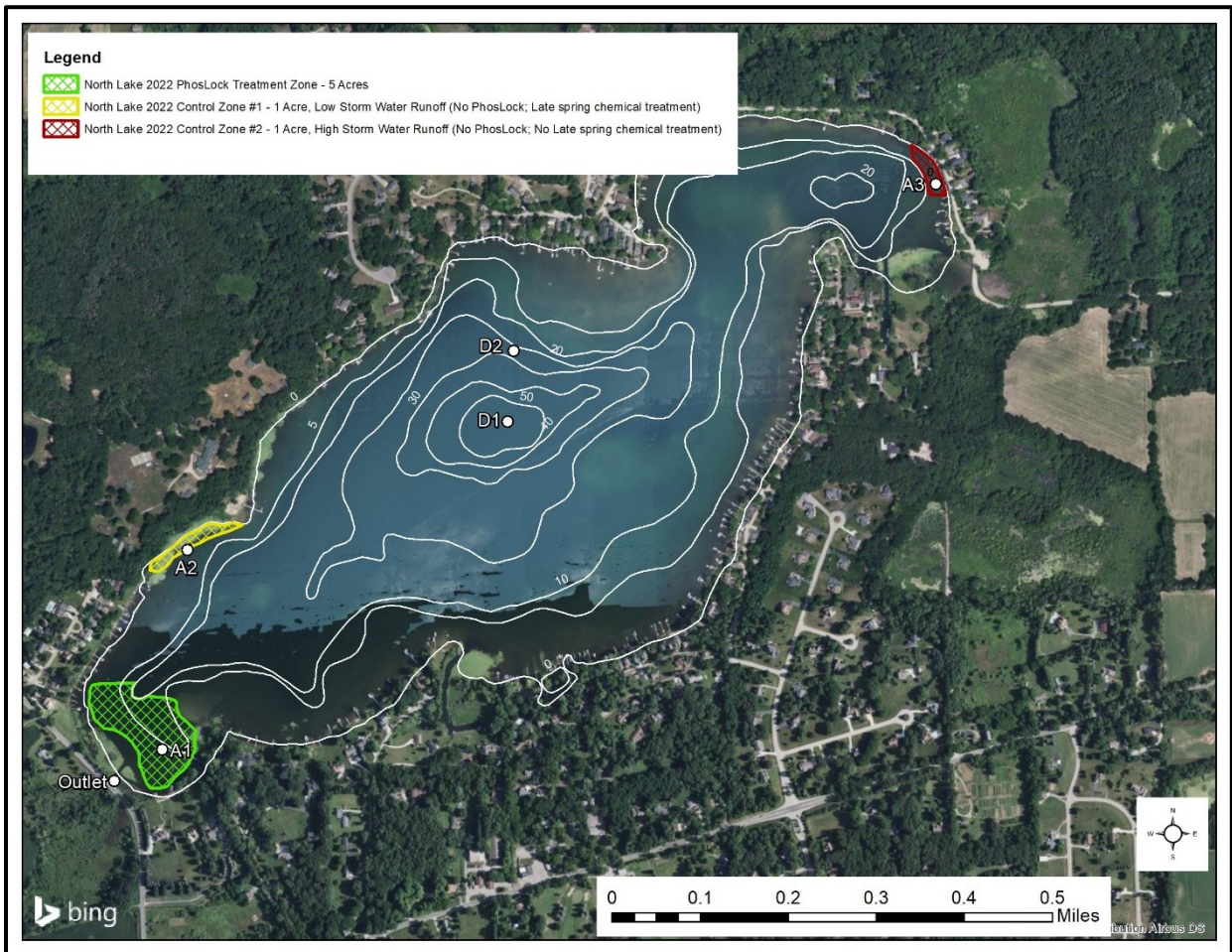


Figure 1 – North Lake water quality sampling stations D1 and D2 for phosphorus mass balance sampling in 2022 (this map also includes Phoslock pilot treatment areas for a study conducted as a parallel to this mass balance).

Lake phosphorus data were collected during two late-summer sampling events at the deep-water stations D1 and D2. The sampling event on July 29, 2022 included lake bottom water samples analyzed for total phosphorus and sediment samples analyzed for total phosphorus and iron. Additional lake bottom water samples were collected on August 18, 2022 and analyzed for soluble reactive phosphorus. Samples from the lake outlet were collected during the August monitoring event and on October 17, 2022. Outlet samples were analyzed for total suspended

solids, total phosphorus, and soluble reactive phosphorus; observed flows were almost imperceptible.

Analyses of total phosphorus, soluble reactive phosphorus, total suspended solids, and sediment total phosphorus were conducted by Great Lakes Environmental Center of Traverse City, MI. Sediment Iron content was measured by ALS Environmental of Holland, MI. Laboratories were chosen for their specialization in each parameter. Analytical laboratory phosphorus data collected for the phosphorus mass balance are compiled in Table 2. All data collected for this effort are compiled in a data table with lab reports in the Attachment to this Technical Memorandum.

Table 2– Summary results from 2022 phosphorus sampling activities on North Lake (dual data entry for the outlet sampling in October represents two separate samples collected over the course of the visit).

Date	Sample ID	Collection Depth	TSS	TP	SRP	Sediment Fe	Sediment TP	Lab
		(ft)	(mg/L)	(mg/L)	(mg/L)	(mg/kg) DW	(mg/kg) DW	
7/29/2022	D1	50	-	0.0291	-	19000	199	GLEC
7/29/2022	D2	35	-	0.0349	-	3800	219	GLEC
8/18/2022	Outlet	-	24.3/24.5	0.017	0.004	-	-	GLEC
8/18/2022	D1	50	-	-	<0.00213	-	-	GLEC
8/18/2022	D2	35	-	-	<0.00213	-	-	GLEC
10/17/2022	Outlet	-	12.5 / 17.4	0.0204 / 0.0208	0.0045 / 0.0066	-	-	GLEC

“-“ Parameter not measured during this monitoring event

### 3. Total Phosphorus, Soluble Reactive Phosphorus and Total Suspended Solids

TP data collected at the deep-water and outlet monitoring locations are illustrated in Figure 2. Total phosphorus concentrations measured at the lake outlet were lower than those reported at the deep-water locations during the late-summer, but all TP concentrations were relatively low (< 0.035 mg/L) for a small inland Lake. SRP concentrations measured at the lake outlet ranged from 0.004 – 0.007 mg/L. These were slightly higher during the tail end of a rainfall event, than those recorded at the in-lake stations (non-detect) during dry weather, but were still quite low. TP sampling on October 17, 2022 revealed TP near 0.020 mg/L exiting through the lake outlet.

Outlet sample results for total suspended solids (Table 2) show summer-time to early fall concentrations ranging from 12.5 to 24.5 mg/L. These are typical levels for inland lakes that do not have large drainage areas contributing substantial levels of watershed runoff.

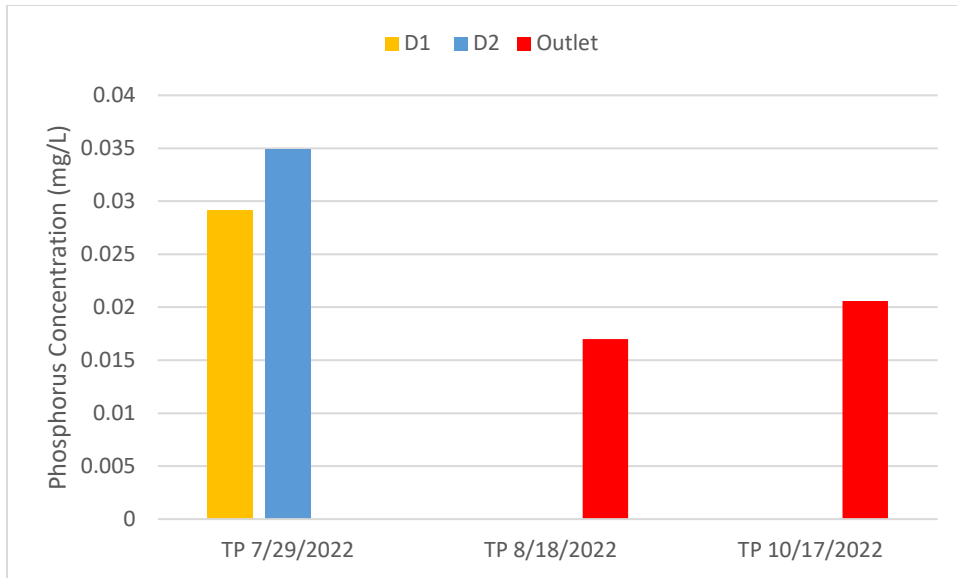


Figure 2 – Total Phosphorus data collected from the lake outlet and deep-water sampling sites.

#### 4. Sediment Iron and Total phosphorus

Sediment samples analyzed for sediment iron and sediment total phosphorus were taken at each sampling at deep-water Sites D1 and D2. Sediment phosphorus concentrations for each site were relatively low (199 and 219 mg/kg for Sites D1 and D2, respectively – see Table 3). A sediment iron to total phosphorus ratio greater than 15:1 indicates sufficient iron concentrations within lake sediments to bind phosphorus and limit mobilization.<sup>1</sup> Sampling results at D1 and D2 revealed iron and phosphorus concentrations that satisfied this ratio, though the ratio at Site D2 (17.4) did not exceed 15 by much and was much lower than the ratio found at Site D1 (95.5).

#### 5. Mass Balance Status and Conclusions

Sample results for the bottom waters and sediment in the deep part of North Lake indicate that sediment phosphorus release is not currently an issue under low dissolved oxygen conditions. SRP concentrations in the hypolimnion for Sites D1 and D2 were non-detect. Along with sediment iron to phosphorus ratios sufficient for limiting phosphorus mobilization, internal loading is minimal. This suggests phosphorus inputs to North Lake are driven primarily by external sources.

A lack of wet-weather runoff events and the associated sampling that would have gone with them in 2022 limited the ability to fully calculate a mass balance. As internal loading was shown to be minimal, and as there are no tributaries draining to the lake, external loading is likely dominated by localized source area runoff. Extended wet weather representative sampling in 2023 can provide a more complete picture of the phosphorus loads moving into and out of the lake. However, the understanding that internal loading is not a significant driver is a critically

<sup>1</sup> (Jensen, et al. (1992). Iron: phosphorus ratio in surface sediment as an indicator of phosphate release from aerobic sediments in shallow lakes. *Hydrobiologia* 1992-235)

important finding for informing future lake management efforts to address non-point sources. It also suggests a very positive characteristic of the lake where few other inland water bodies have such limited internal phosphorus loading as is now confirmed for North Lake.

# ATTACHMENT

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## **K&A North Lake Phosphorus Mass Balance**

- Data Summary Table
- Laboratory Reports

Date	Sample ID	Collection Depth	TSS	TP	SRP	Sediment Fe	Sediment TP	Lab
		<i>(ft)</i>	<i>(mg/L)</i>	<i>(mg/L)</i>	<i>(mg/L)</i>	<i>(mg/kg) DW</i>	<i>(mg/kg) DW</i>	
7/29/2022	D1	50	-	0.0291	-	19000	199	GLEC
7/29/2022	D2	35	-	0.0349	-	3800	219	GLEC
8/18/2022	Outlet	-	24.3/24.5	0.017	0.004	-	-	GLEC
8/18/2022	D1	50	-	-	<0.00213	-	-	GLEC
8/18/2022	D2	35	-	-	<0.00213	-	-	GLEC
10/17/2022	Outlet	-	12.5 / 17.4	0.0204 / 0.0208	0.0045 / 0.0066	-	-	GLEC



**Project Number: 2592-B09**

**August 26, 2022**

**Kieser & Associates-North Lake  
536 E. Michigan Ave., Suite 300  
Kalamazoo, MI 49007**

**Attention: Josh Kieser**

**Project Description: Water Quality Sampling**

**Dear Client,**

**Enclosed is a copy of your laboratory report relating to samples, as they were received. All tests were performed within the maximum holding times and have met or exceeded QC criteria. Test results are in compliance with The NELAC Institute Standards. Visit our web site for a full list of tests for which GLEC (Lab 2059) is accredited through the New Hampshire Environmental Laboratory Accreditation Program (NH ELAP).**

**Please don't hesitate to call if you have questions or require further information.**

**Data Qualifiers:**

**J = Estimated result below the RL but above the MDL**

**Sincerely,**

**Michelle A. Moore  
Laboratory Coordinator and Research Scientist/Nutrient Chemistry**





# Great Lakes Environmental Center

739 Hastings St., Traverse City MI 49686 - (231) 941-2230 - FAX: (231) 941-2240

Client ID:

Kieser-North Lake

## REPORT OF ANALYSIS

Total Phosphorus

<u>LabSampleID</u>	<u>SampleDescription</u>	<u>Sample Date</u>	<u>Result</u>	<u>Units</u>	<u>Rep Limit</u>	<u>MDL</u>	<u>Lab Qualifie</u>	<u>AnalysisDate</u>	<u>Comments</u>	<u>Initials</u>
2K07290016DL	S5	7/29/2022	188	mg/kg dr	25.73	16.2944		8/25/2022		BSC
2K07290017DL	S5-D1	7/29/2022	199	mg/kg dr	25.57	16.1918		8/25/2022		BSC
2K07290018DL	S5-D2	7/29/2022	219	mg/kg dr	27.73	17.5598		8/25/2022		BSC

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### LabQualifiers:

*U - Analyte not detected.*

*J - Result between MDL and RL should be considered estimated.*

Page 1 of 1

Friday, August 26, 2022

Method: SM 4500-P F

# Great Lakes Environmental Center

739 Hastings St., Traverse City MI 49686 - (231) 941-2230 - FAX: (231) 941-2240

Client ID:

Kieser-North Lake

## REPORT OF ANALYSIS

Total Phosphorus

<u>LabSampleID</u>	<u>SampleDescription</u>	<u>Sample Date</u>	<u>Result</u>	<u>Units</u>	<u>Rep Limit</u>	<u>MDL</u>	<u>Lab Qualifie</u>	<u>AnalysisDate</u>	<u>Comments</u>	<u>Initials</u>
2K07290013	S5-	7/29/2022	0.0313	mg/L	0.003	0.0015		8/17/2022		BSC
2K07290014	S5-D1	7/29/2022	0.0291	mg/L	0.003	0.0015		8/17/2022		BSC
2K07290015	S5-D2	7/29/2022	0.0349	mg/L	0.003	0.0015		8/17/2022		BSC

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LabQualifiers:

U - Analyte not detected.

J - Result between MDL and RL should be considered estimated.

Page 1 of 1

Friday, August 26, 2022

Method: SM 4500-P F

# Great Lakes Environmental Center

739 Hastings St., Traverse City MI 49686 - (231) 941-2230 - FAX: (231) 941-2240

Client ID:

Kieser-North Lake

## REPORT OF ANALYSIS

Soluble Reactive Phosphorus

<u>LabSampleID</u>	<u>SampleDescription</u>	<u>Sample Date</u>	<u>Result</u>	<u>Units</u>	<u>Rep Limit</u>	<u>MDL</u>	<u>Lab Qualifie</u>	<u>AnalysisDate</u>	<u>Comments</u>	<u>Initials</u>
2K07290019	S5	7/29/2022	0.0023	mg/L	0.003	0.00213	J	8/15/2022		BSC

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### LabQualifiers:

*U - Analyte not detected.*

*J - Result between MDL and RL should be considered estimated.*

Page 1 of 1

Friday, August 26, 2022

**Method:** SM 4500-P F

# Great Lakes Environmental Center

739 Hastings St., Traverse City MI 49686 - (231) 941-2230 - FAX: (231) 941-2240

Client ID:

Kieser-North Lake

## REPORT OF ANALYSIS

chla

<u>LabSampleID</u>	<u>SampleDescription</u>	<u>Sample Date</u>	<u>Result</u>	<u>Units</u>	<u>Rep Limit</u>	<u>MDL</u>	<u>Lab Qualifie</u>	<u>AnalysisDate</u>	<u>Comments</u>	<u>Initials</u>
2K07290020	S5	7/29/2022	0.00158	mg/L	0.0002	0.000143		8/10/2022		bcook

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### LabQualifiers:

U - Analyte not detected.

J - Result between MDL and RL should be considered estimated.

Page 1 of 1

Friday, August 26, 2022

Method: SM 10200 H



GREAT LAKES ENVIRONMENTAL CENTER, INC.

Traverse City, MI - Laboratory  
739 Hastings Street  
Traverse City, MI 49686

www.glec.com  
Phone (231)941-2230  
Fax (231)941-2240

CHAIN OF CUSTODY RECORD

2 of 7

<b>Section I.</b>			<b>Section II.</b>					<b>Section IV.</b>													
Submitting Company: <u>Kieser &amp; Associates</u>			Project Name: <u>North Lake</u>					Requested Analysis													
Report Results To: <u>Zach Harrison</u>			Project Number:					TP	Sediment TP	Sediment IRON	SRP	Chl.a	pH of Sample Upon Receipt								
Address: <u>536 E. Michigan Ave Kalamazoo MI 49004</u>			P.O.#:																		
Phone: <u>(269) 344-7117</u> E-mail: <u>Zharrison@Kieser-associates.com</u>			Sampled by: (initials) <input type="checkbox"/> GLEC <input checked="" type="checkbox"/> Client <u>JU/AM</u>																		
<b>Section III. Sample Information at Collection</b>																					
#	GLEC No.	Sample Identification	Sample Information			Grab or Composite	Preservative	Filtered Y or N	Sample Containers												
			Date	Time	Matrix				Type	Size	No.										
1		<u>SS -</u>	<u>7-29-22</u>	<u>12:00</u>	<u>SW</u>	<u>G</u>	<u>H2SO4</u>	<u>N</u>	<u>Plastic</u>	<u>250ml</u>	<u>1</u>	<u>X</u>					<u>&lt;2</u>				
2		<u>SS - D1</u>		<u>12:35</u>	<u>SW</u>	<u>G</u>					<u>1</u>	<u>X</u>					<u>&lt;2</u>				
3		<u>SS - D2</u>		<u>13:05</u>	<u>SW</u>	<u>G</u>					<u>1</u>	<u>X</u>					<u>&lt;2</u>				
4		<u>SS</u>		<u>12:10</u>	<u>S</u>	<u>G</u>			<u>Glass</u>	<u>500ml</u>	<u>1</u>		<u>X</u>	<u>X</u>							
5		<u>SS - D1</u>		<u>12:45</u>	<u>S</u>	<u>G</u>					<u>1</u>		<u>X</u>	<u>X</u>							
6		<u>SS - D2</u>		<u>13:15</u>	<u>S</u>	<u>G</u>					<u>1</u>		<u>X</u>	<u>X</u>							
7		<del>SS</del> <u>SS</u>	<u>7-29-22</u>	<u>12:00</u>	<u>SW</u>	<u>G</u>	<u>-</u>	<u>Y</u>	<u>Glass</u>	<u>250ml</u>	<u>1</u>				<u>X</u>						
8		<u>SS</u>	<u>7-29-22</u>	<u>12:05</u>	<u>SW</u>	<u>C</u>	<u>-</u>	<u>Y</u>	<u>Plastic</u>	<u>1gal</u>	<u>1</u>					<u>X</u>					
Client Notes: <u>Run all samples if over temp</u>																					
RELEASED BY / ORGANIZATION						DATE	TIME	RECEIVED BY / ORGANIZATION						DATE	TIME						
Print Name & Organization: <u>Mark S. Kieser K&amp;A</u>						<u>8/5/22</u>	<u>15:35</u>	Print Name & Organization: <u>CHRIS YOUNG GLEC</u>						<u>8/5/22</u>	<u>3:51 PM</u>						
Signature: <u>[Signature]</u>								Signature: <u>[Signature]</u>													
Print Name & Organization								Print Name & Organization													
Signature								Signature													
<b>FOR LAB USE ONLY</b>																					
Temperature of Samples: <u>5.2</u> °C Initials: <u>CT</u> Bottle ID #, if applicable <u>S2M</u> <input checked="" type="checkbox"/> Received on Wet Ice																					
Notes/Anomalies/Discrepancies:																					
GLEC may subcontract out analyses that we do not perform.																					
<b>MATRIX CODES:</b> <span style="margin-left: 100px;">S = SEDIMENT</span> <span style="margin-left: 100px;">E = EFFLUENT</span> <span style="margin-left: 100px;">SL = SLUDGE</span> <span style="margin-left: 100px;">SW = SURFACE WATER</span> <span style="margin-left: 100px;">GW = GROUNDWATER</span> <span style="margin-left: 100px;">AO = AQUATIC ORGANISM</span>																					



31-Aug-2022

Ben Cook  
Great Lakes Environmental Center  
739 Hastings St  
Traverse City, MI 49686

Re: **Kieser (2k + 7k)**

Work Order: **22082257**

Dear Ben,

ALS Environmental received 8 samples on 23-Aug-2022 09:00 AM for the analyses presented in the following report.

The analytical data provided relates directly to the samples received by ALS Environmental - Holland and for only the analyses requested.

Sample results are compliant with industry accepted practices and Quality Control results achieved laboratory specifications. Any exceptions are noted in the Case Narrative, or noted with qualifiers in the report or QC batch information. Should this laboratory report need to be reproduced, it should be reproduced in full unless written approval has been obtained from ALS Environmental. Samples will be disposed in 30 days unless storage arrangements are made.

The total number of pages in this report is 18.

If you have any questions regarding this report, please feel free to contact me:

ADDRESS: 3352 128th Avenue, Holland, MI, USA  
PHONE: +1 (616) 399-6070 FAX: +1 (616) 399-6185

Sincerely,

Electronically approved by: Jodi Blouw

Jodi Blouw

## Report of Laboratory Analysis

Certificate No: MN 026-999-449

ALS GROUP USA, CORP Part of the ALS Laboratory Group A Campbell Brothers Limited Company



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**Client:** Great Lakes Environmental Center  
**Project:** Kieser (2k + 7k)  
**WorkOrder:** 22082257

**QUALIFIERS,  
ACRONYMS, UNITS**

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<u>Qualifier</u>	<u>Description</u>
*	Value exceeds Regulatory Limit
**	Estimated Value
a	Analyte is non-accredited
B	Analyte detected in the associated Method Blank above the Reporting Limit
E	Value above quantitation range
H	Analyzed outside of Holding Time
Hr	BOD/CBOD - Sample was reset outside Hold Time, value should be considered estimated.
J	Analyte is present at an estimated concentration between the MDL and Report Limit
n	Analyte accreditation is not offered
ND	Not Detected at the Reporting Limit
O	Sample amount is > 4 times amount spiked
P	Dual Column results percent difference > 40%
R	RPD above laboratory control limit
S	Spike Recovery outside laboratory control limits
U	Analyzed but not detected above the MDL
X	Analyte was detected in the Method Blank between the MDL and Reporting Limit, sample results may exhibit background or reagent contamination at the observed level.

<u>Acronym</u>	<u>Description</u>
DUP	Method Duplicate
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LOD	Limit of Detection (see MDL)
LOQ	Limit of Quantitation (see PQL)
MBLK	Method Blank
MDL	Method Detection Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
PQL	Practical Quantitation Limit
RPD	Relative Percent Difference
TDL	Target Detection Limit
TNTC	Too Numerous To Count
A	APHA Standard Methods
D	ASTM
E	EPA
SW	SW-846 Update III

<u>Units Reported</u>	<u>Description</u>
% of sample	Percent of Sample
mg/Kg-dry	Milligrams per Kilogram Dry Weight

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**Client:** Great Lakes Environmental Center  
**Project:** Kieser (2k + 7k)  
**Work Order:** 22082257

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**Case Narrative**

Samples for the above noted Work Order were received on 08/23/2022. The attached "Sample Receipt Checklist" documents the status of custody seals, container integrity, preservation, and temperature compliance.

Samples were analyzed according to the analytical methodology previously transmitted in the "Work Order Acknowledgement". Methodologies are also documented in the "Analytical Result" section for each sample. Quality control results are listed in the "QC Report" section. Sample association for the reported quality control is located at the end of each batch summary. If applicable, results are appropriately qualified in the Analytical Result and QC Report sections. The "Qualifiers" section documents the various qualifiers, units, and acronyms utilized in reporting. A copy of the laboratory's scope of accreditation is available upon request.

With the following exceptions, all sample analyses achieved analytical criteria.

**Metals:**

No deviations or anomalies were noted.

**Wet Chemistry:**

Batch R351793, Method SW3550C, all samples: Sample analyzed after hold time due to being received after expiration date.

No other deviations or anomalies were noted.

# ALS Group, USA

Date: 31-Aug-22

**Client:** Great Lakes Environmental Center  
**Project:** Kieser (2k + 7k)  
**Sample ID:** North Lake - S5  
**Collection Date:** 7/29/2022 12:10 PM

**Work Order:** 22082257  
**Lab ID:** 22082257-01  
**Matrix:** SOIL

Analyses	Result	Qual	MDL	Report Limit	Units	Dilution Factor	Date Analyzed
<b>METALS BY ICP-MS</b>			Method: <b>SW6020B</b>		Prep: SW3050B / 8/26/22		Analyst: <b>DSC</b>
Iron	11,000		150	190	mg/Kg-dry	1	8/26/2022 21:03
<b>MOISTURE</b>			Method: <b>SW3550C</b>				Analyst: <b>ALG</b>
Moisture	92	H	0.10	0.10	% of sample	1	8/23/2022 15:26

**Note:** See Qualifiers page for a list of qualifiers and their definitions.

# ALS Group, USA

Date: 31-Aug-22

**Client:** Great Lakes Environmental Center  
**Project:** Kieser (2k + 7k)  
**Sample ID:** North Lake - S5 - DI  
**Collection Date:** 7/29/2022 12:45 PM

**Work Order:** 22082257  
**Lab ID:** 22082257-02  
**Matrix:** SOIL

Analyses	Result	Qual	MDL	Report Limit	Units	Dilution Factor	Date Analyzed
<b>METALS BY ICP-MS</b>			Method: SW6020B			Prep: SW3050B / 8/26/22	Analyst: DSC
Iron	19,000		240	290	mg/Kg-dry	1	8/26/2022 21:05
<b>MOISTURE</b>			Method: SW3550C				Analyst: ALG
Moisture	95	H	0.10	0.10	% of sample	1	8/23/2022 15:26

**Note:** See Qualifiers page for a list of qualifiers and their definitions.

# ALS Group, USA

Date: 31-Aug-22

**Client:** Great Lakes Environmental Center  
**Project:** Kieser (2k + 7k)  
**Sample ID:** North Lake - S5 - D2  
**Collection Date:** 7/29/2022 01:15 PM

**Work Order:** 22082257  
**Lab ID:** 22082257-03  
**Matrix:** SOIL

Analyses	Result	Qual	MDL	Report Limit	Units	Dilution Factor	Date Analyzed
<b>METALS BY ICP-MS</b>			Method: <b>SW6020B</b>		Prep: SW3050B / 8/26/22		Analyst: <b>DSC</b>
Iron	3,800		18	22	mg/Kg-dry	1	8/26/2022 21:07
<b>MOISTURE</b>			Method: <b>SW3550C</b>				Analyst: <b>ALG</b>
Moisture	34	H	0.10	0.10	% of sample	1	8/23/2022 15:26

**Note:** See Qualifiers page for a list of qualifiers and their definitions.

**Client:** Great Lakes Environmental Center  
**Work Order:** 22082257  
**Project:** Kieser (2k + 7k)

**QC BATCH REPORT**

Batch ID: **202113** Instrument ID **ICPMS4** Method: **SW6020B**

MBLK		Sample ID: <b>MBLK-202113-202113</b>				Units: <b>mg/Kg</b>		Analysis Date: <b>8/28/2022 09:51 AM</b>			
Client ID:		Run ID: <b>ICPMS4_220828B</b>				SeqNo: <b>8745452</b>		Prep Date: <b>8/26/2022</b>		DF: <b>1</b>	
Analyte	Result	MDL	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Iron	U	8	10								

LCS		Sample ID: <b>LCS-202113-202113</b>				Units: <b>mg/Kg</b>		Analysis Date: <b>8/28/2022 09:52 AM</b>			
Client ID:		Run ID: <b>ICPMS4_220828B</b>				SeqNo: <b>8745453</b>		Prep Date: <b>8/26/2022</b>		DF: <b>1</b>	
Analyte	Result	MDL	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Iron	494.9	8	10	500	0	99	80-120	0			

MS		Sample ID: <b>22081901-06CMS</b>				Units: <b>mg/Kg</b>		Analysis Date: <b>8/26/2022 08:28 PM</b>			
Client ID:		Run ID: <b>ICPMS3_220826B</b>				SeqNo: <b>8743799</b>		Prep Date: <b>8/26/2022</b>		DF: <b>1</b>	
Analyte	Result	MDL	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Iron	16630	13	16	794.9	14710	243	75-125	0			SEO

MSD		Sample ID: <b>22081901-06CMSD</b>				Units: <b>mg/Kg</b>		Analysis Date: <b>8/26/2022 08:30 PM</b>			
Client ID:		Run ID: <b>ICPMS3_220826B</b>				SeqNo: <b>8743800</b>		Prep Date: <b>8/26/2022</b>		DF: <b>1</b>	
Analyte	Result	MDL	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Iron	18110	13	16	794.9	14710	428	75-125	16630	8.5	20	SEO

The following samples were analyzed in this batch:

22082257-01A	22082257-02A	22082257-03A
22082257-04A	22082257-05A	22082257-06A

**Note:** See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Great Lakes Environmental Center  
 Work Order: 22082257  
 Project: Kieser (2k + 7k)

# QC BATCH REPORT

Batch ID: **202115** Instrument ID **ICPMS3** Method: **SW6020B**

MBLK		Sample ID: <b>MBLK-202115-202115</b>				Units: <b>mg/Kg</b>		Analysis Date: <b>8/26/2022 08:01 PM</b>			
Client ID:		Run ID: <b>ICPMS3_220826B</b>				SeqNo: <b>8743784</b>		Prep Date: <b>8/26/2022</b>		DF: <b>1</b>	
Analyte	Result	MDL	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Iron	U	8	10								

LCS		Sample ID: <b>LCS-202115-202115</b>				Units: <b>mg/Kg</b>		Analysis Date: <b>8/26/2022 08:02 PM</b>			
Client ID:		Run ID: <b>ICPMS3_220826B</b>				SeqNo: <b>8743785</b>		Prep Date: <b>8/26/2022</b>		DF: <b>1</b>	
Analyte	Result	MDL	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Iron	527.3	8	10	500	0	105	80-120	0			

MS		Sample ID: <b>22082368-01AMS</b>				Units: <b>mg/Kg</b>		Analysis Date: <b>8/26/2022 08:15 PM</b>			
Client ID:		Run ID: <b>ICPMS3_220826B</b>				SeqNo: <b>8743792</b>		Prep Date: <b>8/26/2022</b>		DF: <b>1</b>	
Analyte	Result	MDL	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Iron	6632	11	14	703.2	5703	132	75-125	0			SO

MSD		Sample ID: <b>22082368-01AMSD</b>				Units: <b>mg/Kg</b>		Analysis Date: <b>8/26/2022 08:17 PM</b>			
Client ID:		Run ID: <b>ICPMS3_220826B</b>				SeqNo: <b>8743793</b>		Prep Date: <b>8/26/2022</b>		DF: <b>1</b>	
Analyte	Result	MDL	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Iron	6861	11	14	700.3	5703	165	75-125	6632	3.41	20	SO

The following samples were analyzed in this batch: 22082257-07A 22082257-08A

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Great Lakes Environmental Center

# QC BATCH REPORT

Work Order: 22082257

Project: Kieser (2k + 7k)

Batch ID: **R351793**

Instrument ID **MOIST**

Method: **SW3550C**

<b>MBLK</b>		Sample ID: <b>WBLKS-R351793</b>				Units: % of sample		Analysis Date: <b>8/23/2022 03:26 PM</b>			
Client ID:		Run ID: <b>MOIST_220823D</b>				SeqNo: <b>8731868</b>		Prep Date:		DF: <b>1</b>	
Analyte	Result	MDL	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Moisture	U	0.1	0.10								

<b>LCS</b>		Sample ID: <b>LCS-R351793</b>				Units: % of sample		Analysis Date: <b>8/23/2022 03:26 PM</b>			
Client ID:		Run ID: <b>MOIST_220823D</b>				SeqNo: <b>8731867</b>		Prep Date:		DF: <b>1</b>	
Analyte	Result	MDL	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Moisture	99.99	0.1	0.10	100	0	100	98-102	0			

<b>DUP</b>		Sample ID: <b>22082047-06A DUP</b>				Units: % of sample		Analysis Date: <b>8/23/2022 03:26 PM</b>			
Client ID:		Run ID: <b>MOIST_220823D</b>				SeqNo: <b>8731846</b>		Prep Date:		DF: <b>1</b>	
Analyte	Result	MDL	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Moisture	17.99	0.1	0.10	0	0	0	0-0	16.99	5.72	10	

<b>DUP</b>		Sample ID: <b>22082047-07A DUP</b>				Units: % of sample		Analysis Date: <b>8/23/2022 03:26 PM</b>			
Client ID:		Run ID: <b>MOIST_220823D</b>				SeqNo: <b>8731848</b>		Prep Date:		DF: <b>1</b>	
Analyte	Result	MDL	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Moisture	24.12	0.1	0.10	0	0	0	0-0	24.48	1.48	10	

The following samples were analyzed in this batch:

22082257-01A	22082257-02A	22082257-03A
22082257-04A	22082257-05A	22082257-06A
22082257-07A	22082257-08A	

Note: See Qualifiers Page for a list of Qualifiers and their explanation.





Sample Receipt Checklist

Client Name: **GLEC**

Date/Time Received: **23-Aug-22 09:00**

Work Order: **22082257**

Received by: **KRW**

Checklist completed by Keith Wierenga 23-Aug-22  
eSignature Date

Reviewed by: Jadi Blawie 24-Aug-22  
eSignature Date

Matrices: **Soil**  
Carrier name: **FedEx**

Shipping container/cooler in good condition?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	Not Present <input type="checkbox"/>
Custody seals intact on shipping container/cooler?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Not Present <input checked="" type="checkbox"/>
Custody seals intact on sample bottles?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Not Present <input checked="" type="checkbox"/>
Chain of custody present?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Chain of custody signed when relinquished and received?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Chain of custody agrees with sample labels?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Samples in proper container/bottle?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Sample containers intact?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Sufficient sample volume for indicated test?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
All samples received within holding time?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Container/Temp Blank temperature in compliance?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Sample(s) received on ice?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Temperature(s)/Thermometer(s):	<input type="text" value="3.0/4.0 C"/>		<input type="text" value="IR3"/>
Cooler(s)/Kit(s):	<input type="text"/>		
Date/Time sample(s) sent to storage:	<input type="text" value="8/23/2022 2:43:11 PM"/>		
Water - VOA vials have zero headspace?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	No VOA vials submitted <input checked="" type="checkbox"/>
Water - pH acceptable upon receipt?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
pH adjusted?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	N/A <input checked="" type="checkbox"/>
pH adjusted by:	<input type="text"/>		

Login Notes:

-----

Client Contacted: Date Contacted: Person Contacted:

Contacted By: Regarding:

Comments:

CorrectiveAction:



**Project Number: 2592-B09**

**September 15, 2022**

**Kieser & Associates-North Lake  
536 E. Michigan Ave., Suite 300  
Kalamazoo, MI 49007**

**Attention: Josh Kieser**

**Project Description: Water Quality Sampling**

**Dear Client,**

**Enclosed is a copy of your laboratory report relating to samples, as they were received. All tests were performed within the maximum holding times and have met or exceeded QC criteria. Test results are in compliance with The NELAC Institute Standards. Visit our web site for a full list of tests for which GLEC (Lab 2059) is accredited through the New Hampshire Environmental Laboratory Accreditation Program (NH ELAP).**

**Please don't hesitate to call if you have questions or require further information.**

**Data Qualifiers:**

**U = Analyte not detected**

**HT = Received Past Holding Time**

**Sincerely,**

**Michelle A. Moore  
Laboratory Coordinator and Research Scientist/Nutrient Chemistry**



# Great Lakes Environmental Center

739 Hastings St., Traverse City MI 49686 - (231) 941-2230 - FAX: (231) 941-2240

Client ID:

Kieser-North Lake

## REPORT OF ANALYSIS

Total Suspended Solids

<u>LabSampleID</u>	<u>SampleDescription</u>	<u>Sample Date</u>	<u>Result</u>	<u>Units</u>	<u>Rep Limit</u>	<u>MDL</u>	<u>Lab Qualifie</u>	<u>AnalysisDate</u>	<u>Comments</u>	<u>Initials</u>
2K08180023A	Outlet	8/18/2022	24.3	mg/L	0.5	0.45	HT	8/29/2022	Past Hold	BSC
2K08180023B	Outlet	8/18/2022	24.5	mg/L	0.5	0.45	HT	8/29/2022	Past Hold	BSC

---

LabQualifiers:

U - Analyte not detected.

J - Result between MDL and RL should be considered estimated.

Page 1 of 1

Thursday, September 15, 2022

Method: SM 2540 D

# Great Lakes Environmental Center

739 Hastings St., Traverse City MI 49686 - (231) 941-2230 - FAX: (231) 941-2240

Client ID:

Kieser-North Lake

## REPORT OF ANALYSIS

Total Phosphorus

<u>LabSampleID</u>	<u>SampleDescription</u>	<u>Sample Date</u>	<u>Result</u>	<u>Units</u>	<u>Rep Limit</u>	<u>MDL</u>	<u>Lab Qualifie</u>	<u>AnalysisDate</u>	<u>Comments</u>	<u>Initials</u>
2K08180022	Outlet	8/18/2022	0.0170	mg/L	0.003	0.0015		9/9/2022		BSC

---

**LabQualifiers:**

*U - Analyte not detected.*

*J - Result between MDL and RL should be considered estimated.*

Page 1 of 1

Thursday, September 15, 2022

**Method:** SM 4500-P F

# Great Lakes Environmental Center

739 Hastings St., Traverse City MI 49686 - (231) 941-2230 - FAX: (231) 941-2240

Client ID:

Kieser-North Lake

## REPORT OF ANALYSIS

Soluble Reactive Phosphorus

<u>LabSampleID</u>	<u>SampleDescription</u>	<u>Sample Date</u>	<u>Result</u>	<u>Units</u>	<u>Rep Limit</u>	<u>MDL</u>	<u>Lab Qualifie</u>	<u>AnalysisDate</u>	<u>Comments</u>	<u>Initials</u>
2K08180021	Outlet	8/18/2022	0.0040	mg/L	0.003	0.00213		9/8/2022		BSC
2K08180024	D1	8/18/2022	<0.00213	mg/L	0.003	0.00213	U	9/8/2022		BSC
2K08180025	D2	8/18/2022	<0.00213	mg/L	0.003	0.00213	U	9/8/2022		BSC

---

### LabQualifiers:

U - Analyte not detected.

J - Result between MDL and RL should be considered estimated.

Page 1 of 1

Thursday, September 15, 2022

Method: SM 4500-P F



GREAT LAKES ENVIRONMENTAL CENTER, INC.

Traverse City, MI - Laboratory  
739 Hastings Street  
Traverse City, MI 49686

www.glec.com  
Phone (231)941-2230  
Fax (231)941-2240

CHAIN OF CUSTODY RECORD

<b>Section I.</b>						<b>Section II.</b>						<b>Section IV.</b>								
Submitting Company: <i>Kieser &amp; Associates</i>						Project Name: <i>North Lake</i>						Requested Analysis								
Report Results To: <i>Zach Harrison</i>						Project Number:														
Address: <i>536 E Michigan Ave Kalamazoo, MI 49007</i>						P.O.#:														
Phone: <i>(269) 344-7117</i> E-mail: <i>Zharrison@Kieser-associates.com</i>						Sampled by: (initials) <input type="checkbox"/> GLEC <input checked="" type="checkbox"/> Client <i>ZH / JU</i>														
<b>Section III. Sample Information at Collection</b>												TP SRP TSS	pH of Sample Upon Receipt							
#	GLEC No.	Sample Information			Grab or Composite	Preservative	Filtered Y or N	Sample Containers												
		Date	Time	Matrix				Type	Size	No.										
1		<i>Outlet</i>	<i>8-14-22</i>	<i>3:00 pm</i>	<i>Sw</i>	<i>G</i>	<i>Yes</i>	<i>Yes</i>	<i>glass</i>	<i>250</i>	<i>1</i>				<i>X</i>					
2		<i>Outlet</i>	<i>8-18-22</i>	<i>3:00 pm</i>	<i>Sw</i>	<i>G</i>	<i>No / <del>Yes</del></i>	<i>No/No</i>	<i>plastic</i>	<i>1L/500ml</i>	<i>2</i>			<i>X</i>		<i>X</i>				<i>2</i>
3		<i>DI</i>	<i>8-18-22</i>	<i>2:15 pm</i>	<i>Sw</i>	<i>G</i>	<i>NO</i>	<i>Yes</i>	<i>glass</i>	<i>250ml</i>	<i>1</i>				<i>X</i>					
4		<i>OZ</i>	<i>8-18-22</i>	<i>2:30 pm</i>	<i>Sw</i>	<i>G</i>	<i>NO</i>	<i>Yes</i>	<i>glass</i>	<i>250ml</i>	<i>1</i>				<i>X</i>					
5																				
6																				
7																				
8																				
Client Notes: <i>TP + TSS are diff bottles for outlet. TSS received past holding time. Client notified on 8-30-22</i>																				
RELEASED BY / ORGANIZATION						DATE	TIME	RECEIVED BY / ORGANIZATION						DATE	TIME					
Print Name & Organization: <i>Mark Kieser K: A</i>						<i>8-26-22</i>	<i>4:15</i>	Print Name & Organization: <i>John Bachman</i>						<i>8/26/22</i>	<i>9:14</i>					
Signature: <i>[Signature]</i>								Signature: <i>[Signature]</i>												
Print Name & Organization								Print Name & Organization												
Signature								Signature												
<b>FOR LAB USE ONLY</b>																				
Temperature of Samples: _____ °C Initials: _____ Bottle ID #, if applicable _____ <input type="checkbox"/> Received on Wet Ice																				
Notes/Anomalies/Discrepancies: _____																				
GLEC may subcontract out analyses that we do not perform.																				
<b>MATRIX CODES:</b>				S = SEDIMENT				E = EFFLUENT				SL = SLUDGE								
				SW = SURFACE WATER				GW = GROUNDWATER				AO = AQUATIC ORGANISM								



Great Lakes Environmental Center

**Project Number: 2592-B09**

**November 18, 2022**

**Kieser & Associates-North Lake  
536 E. Michigan Ave., Suite 300  
Kalamazoo, MI 49007**

**Attention: Josh Kieser**

**Project Description: Water Quality Sampling**

**Dear Client,**

**Enclosed is a copy of your laboratory report relating to samples, as they were received. All tests were performed within the maximum holding times and have met or exceeded QC criteria. Test results are in compliance with The NELAC Institute Standards. Visit our web site for a full list of tests for which GLEC (Lab 2059) is accredited through the New Hampshire Environmental Laboratory Accreditation Program (NH ELAP).**

**Please don't hesitate to call if you have questions or require further information.**

**Data Qualifiers:**

**IST = Samples received above temp**

**Sincerely,**

**Michelle A. Moore  
Laboratory Coordinator and Research Scientist/Nutrient Chemistry**





# Great Lakes Environmental Center

739 Hastings St., Traverse City MI 49686 - (231) 941-2230 - FAX: (231) 941-2240

Client ID:

Kieser-North Lake

## REPORT OF ANALYSIS

Total Suspended Solids

<u>LabSampleID</u>	<u>SampleDescription</u>	<u>Sample Date</u>	<u>Result</u>	<u>Units</u>	<u>Rep Limit</u>	<u>MDL</u>	<u>Lab Qualifie</u>	<u>AnalysisDate</u>	<u>Comments</u>	<u>Initials</u>
2K10170031	S1	10/17/2022	12.5	mg/L	0.5	0.45	IST	10/24/2022	Over Temp	BSC
2K10170032	S1	10/17/2022	17.4	mg/L	0.5	0.45	IST	10/24/2022	Over Temp	BSC

---

### LabQualifiers:

*U - Analyte not detected.*

*J - Result between MDL and RL should be considered estimated.*

Page 1 of 1

Friday, November 18, 2022

**Method:** SM 2540 D

# Great Lakes Environmental Center

739 Hastings St., Traverse City MI 49686 - (231) 941-2230 - FAX: (231) 941-2240

Client ID:

Kieser-North Lake

## REPORT OF ANALYSIS

Total Phosphorus

<u>LabSampleID</u>	<u>SampleDescription</u>	<u>Sample Date</u>	<u>Result</u>	<u>Units</u>	<u>Rep Limit</u>	<u>MDL</u>	<u>Lab Qualifie</u>	<u>AnalysisDate</u>	<u>Comments</u>	<u>Initials</u>
2K10170029	S1	10/17/2022	0.0204	mg/L	0.003	0.0015	IST	10/25/2022	Over Temp	BSC
2K10170030	S1	10/17/2022	0.0208	mg/L	0.003	0.0015	IST	10/25/2022	Over Temp	BSC

---

LabQualifiers:

U - Analyte not detected.

J - Result between MDL and RL should be considered estimated.

Page 1 of 1

Friday, November 18, 2022

Method: SM 4500-P F

# Great Lakes Environmental Center

739 Hastings St., Traverse City MI 49686 - (231) 941-2230 - FAX: (231) 941-2240

Client ID:

Kieser-North Lake

## REPORT OF ANALYSIS

Soluble Reactive Phosphorus

<u>LabSampleID</u>	<u>SampleDescription</u>	<u>Sample Date</u>	<u>Result</u>	<u>Units</u>	<u>Rep Limit</u>	<u>MDL</u>	<u>Lab Qualifie</u>	<u>AnalysisDate</u>	<u>Comments</u>	<u>Initials</u>
2K10170027	S1-Outlet	10/17/2022	0.0045	mg/L	0.003	0.00213	IST	11/9/2022	Over Temp	BSC
2K10170028	S1-Outlet	10/17/2022	0.0066	mg/L	0.003	0.00213	IST	11/9/2022	Over Temp	BSC

---

### LabQualifiers:

*U - Analyte not detected.*

*J - Result between MDL and RL should be considered estimated.*

Page 1 of 1

Friday, November 18, 2022

**Method:** SM 4500-P F

