

# Hess Lake Aeration Water Quality Report

Prepared for: The MDEQ  
Prepared by: Savin Lake Services

## Introduction:

The aeration system was installed on September 26<sup>th</sup>, 2014. The system was turned on April 28<sup>th</sup>, 2015, and was turned off prior to December 1<sup>st</sup>, 2015. No bacterial was added to the water body during 2014 or 2015. The purpose of the aeration project is to enhance water clarity and improve water quality.

## Sampling Methods:

Samples were collected from the surface by hand. Samples taken at depth were collected using a Van Dorn Sampler. Samples were collected at two sites in the cove of the aeration system. Site 1: (43°22.81N, 85°46.12W), Site 2: (43°22.95N, 85°46.12W). Samples were collected for each parameter except for Temperature, pH, and Dissolved Oxygen, which were measured by a probe that was calibrated before each sampling event. Sampling dates were 6/3/14, 7/14/14, 9/15/14, 6/8/15, 7/15/15, and 9/14/15. The dates were chosen to ensure sunny to partly cloudy conditions with no or slight wind speeds. Samples were sent to various laboratories for analysis of the required parameters.

## Results:

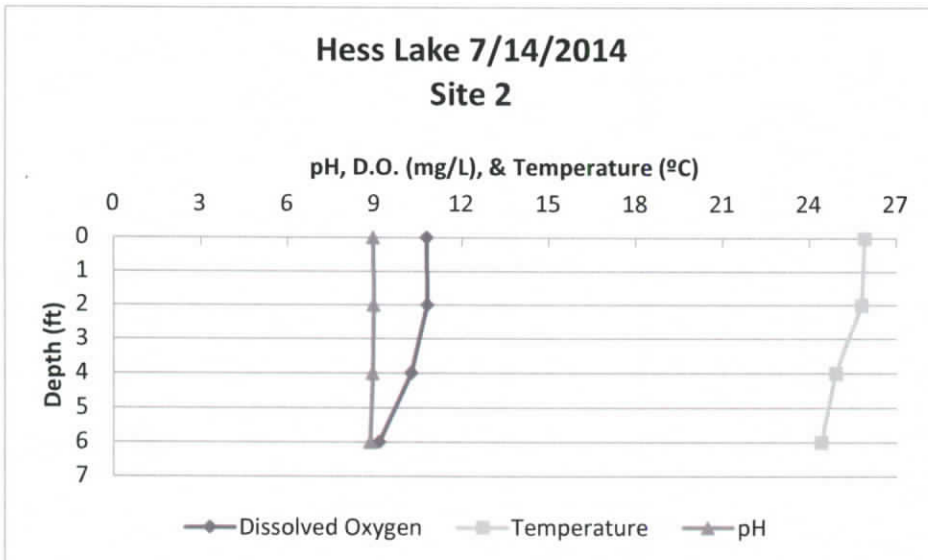
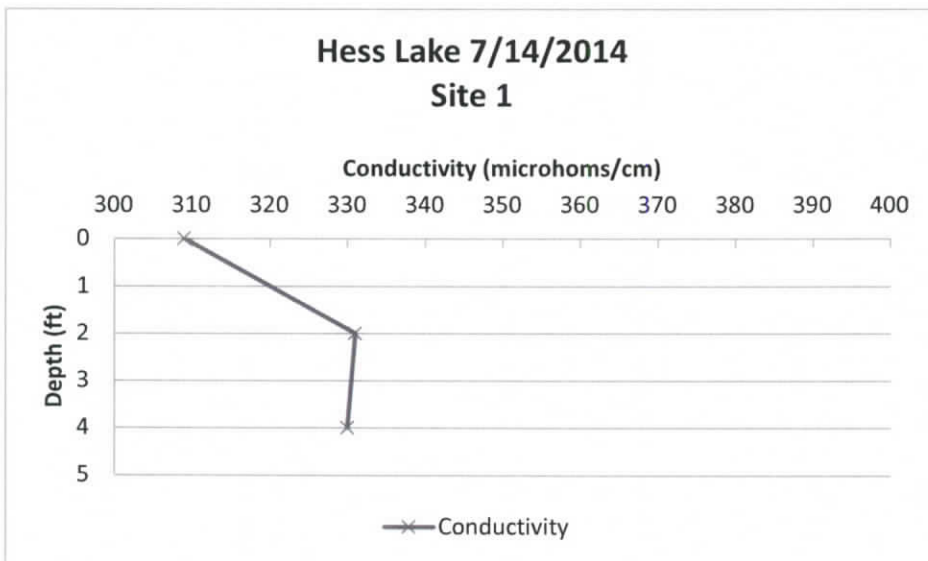
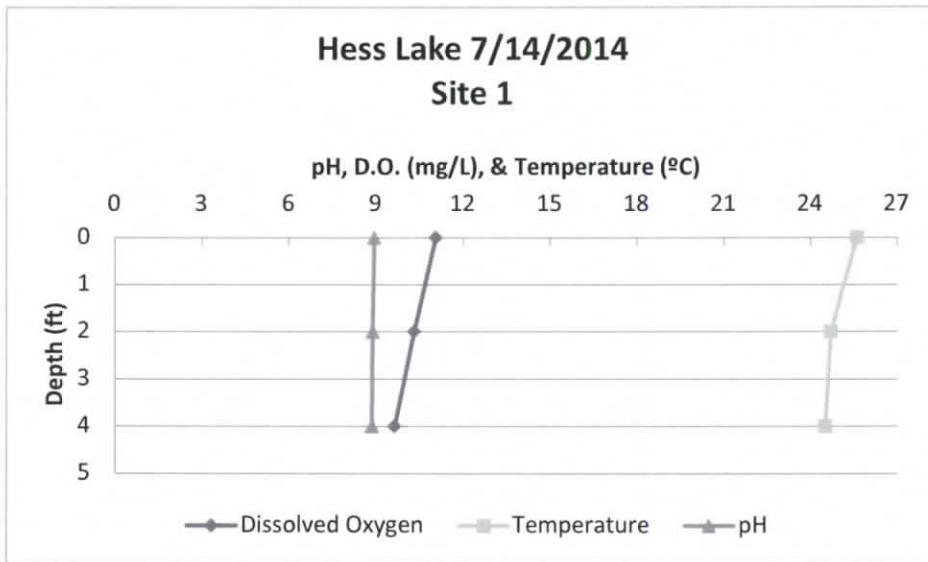
Unfortunately there is no data for the Spring sampling event in 2014. Samples were taken and sent to the lab, however the samples never arrived to the laboratory for analysis. Upon investigating this matter, the mail carrier stated the samples must have gotten lost and should pop up on their grid eventually and be delivered. This never occurred. Similarly, spring samples in 2015 were never tested for algal species as the samples were discarded incorrectly.

2014 Results:

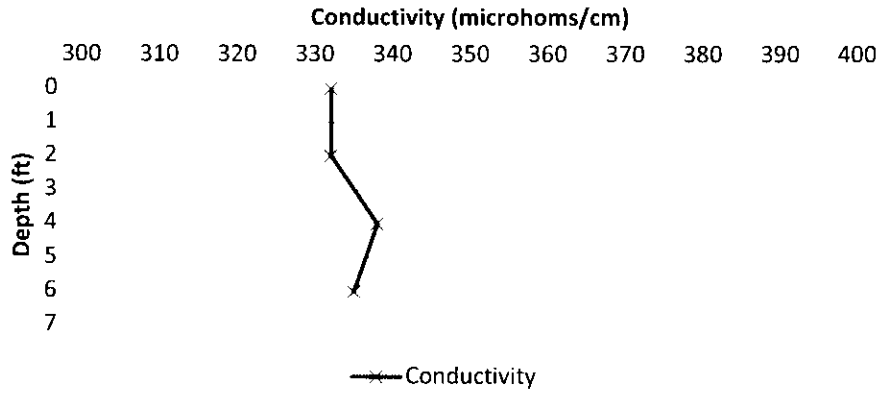
Hess Lake Aeration 2014 Data				
Date	Site	Total Suspended Solids (mg/L)	Total Phosphorus (ug/L)	Orthophosphorus (ug/L)
7/14/2014	1 Surface	10.3	21.5	7.6
7/14/2014	1 Mid	14.8	28.9	11
7/14/2014	1 Deep	104	23.5	9.3
7/14/2014	2 Surface	10.8	18.3	5.9
7/14/2014	2 Mid	11.5	24.1	9.3
7/14/2014	2 Deep	12.8	21.3	10.2
9/15/2014	1 Surface	11	<20	<20
9/15/2014	1 Mid	12	<20	<20
9/15/2014	1 Deep	13	<20	<20
9/15/2014	2 Surface	12	<20	<20
9/15/2014	2 Mid	10	<20	<20
9/15/2014	2 Deep	10	<20	<20

Date	Site	Secchi Disk (ft)	Chlorophyll a (ug/L)
7/14/2014	1	2.5	6.42
7/14/2014	2	3	7.37
9/15/2014	1	2.5	5.23
9/15/2014	2	3	3.01

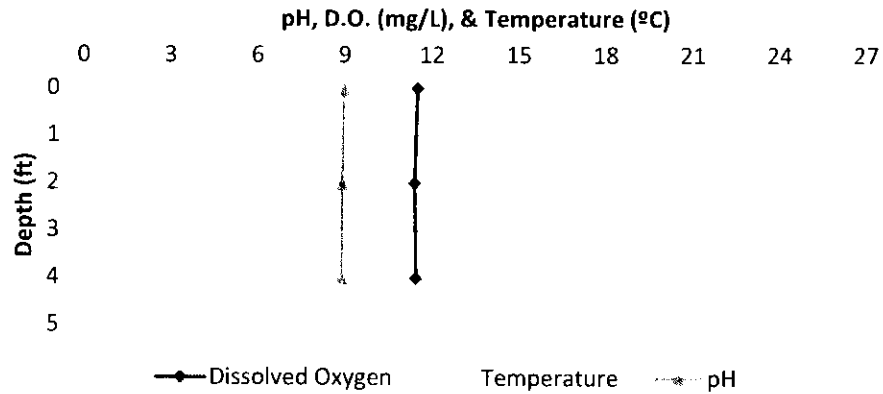
Date	Site	Temperature (°C)	Dissolved Oxygen (mg/L)	pH	Conductivity (microhoms/cm)
7/14/2014	1	25.6	11.06	8.94	309
		24.7	10.31	8.88	331
		24.5	9.63	8.85	330
7/14/2014	2	25.9	10.79	8.95	332
		25.8	10.81	8.96	332
		24.9	10.26	8.93	338
		24.4	9.15	8.84	335
9/15/2014	1	17.6	11.47	8.91	336
		17.3	11.37	8.87	341
		17.1	11.42	8.84	347
9/15/2014	2	17.7	11.13	8.89	338
		17.6	11.19	8.86	339
		17.5	11.23	8.84	343
		17.4	11.24	8.83	339



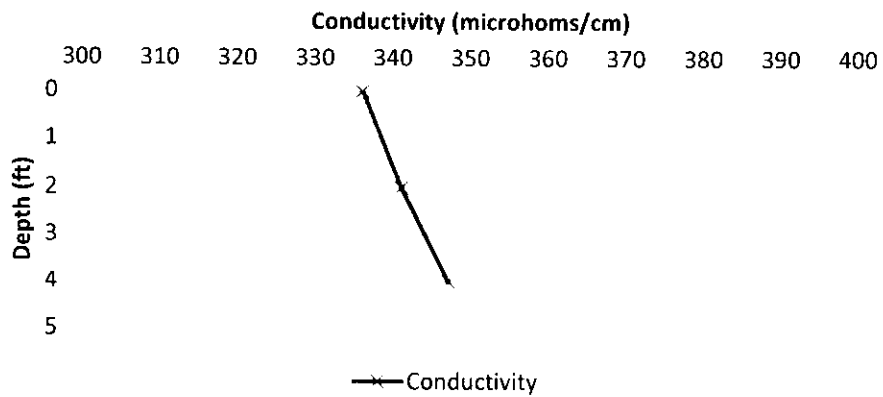
### Hess Lake 7/14/2014 Site 2



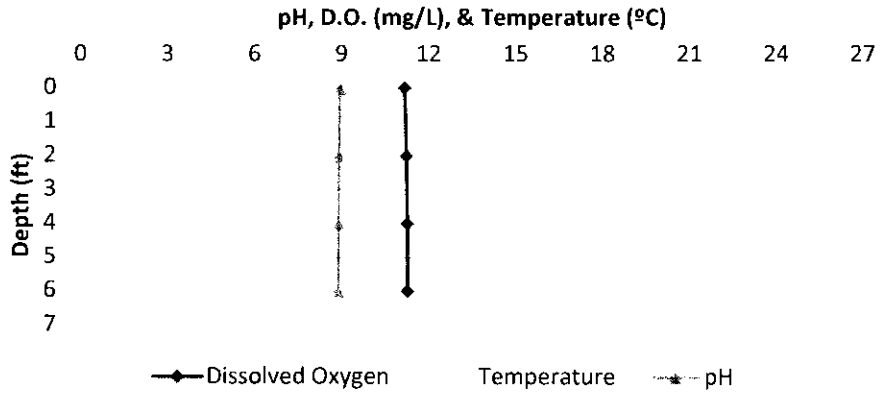
### Hess Lake 9/15/2014 Site 1



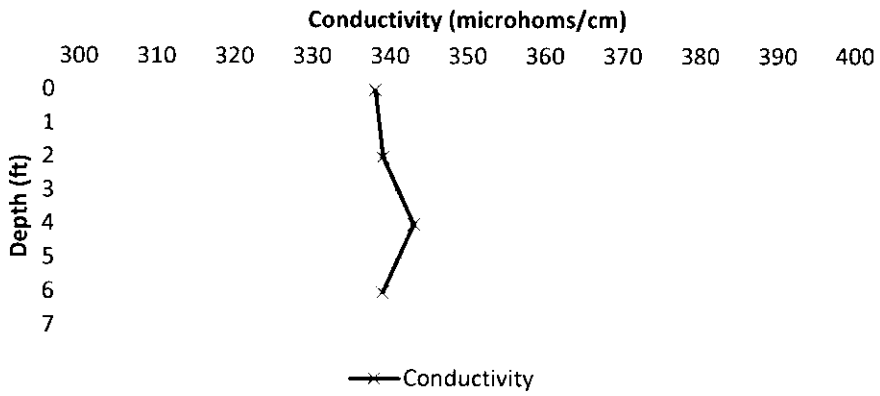
### Hess Lake 9/15/2014 Site 1



### Hess Lake 9/15/2014 Site 2



### Hess Lake 9/15/2014 Site 2

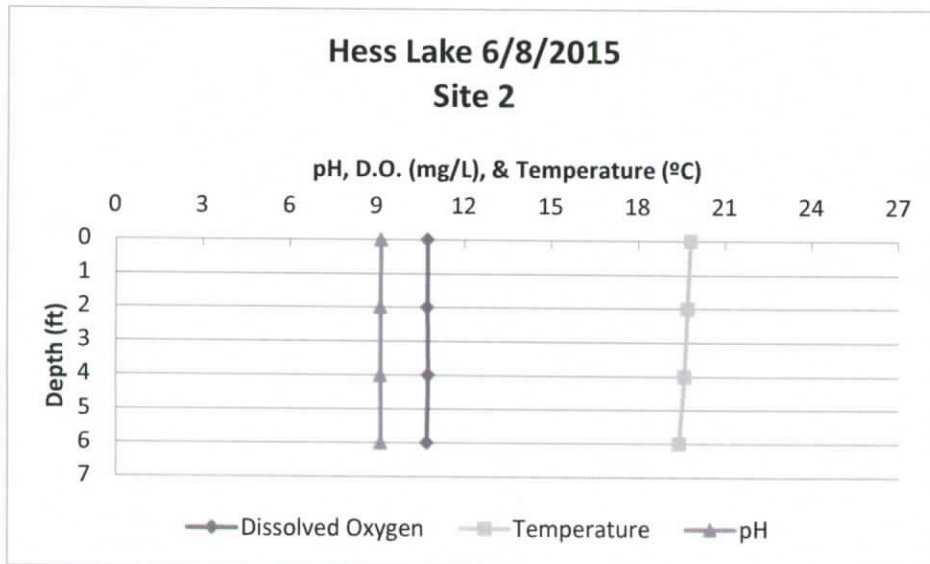
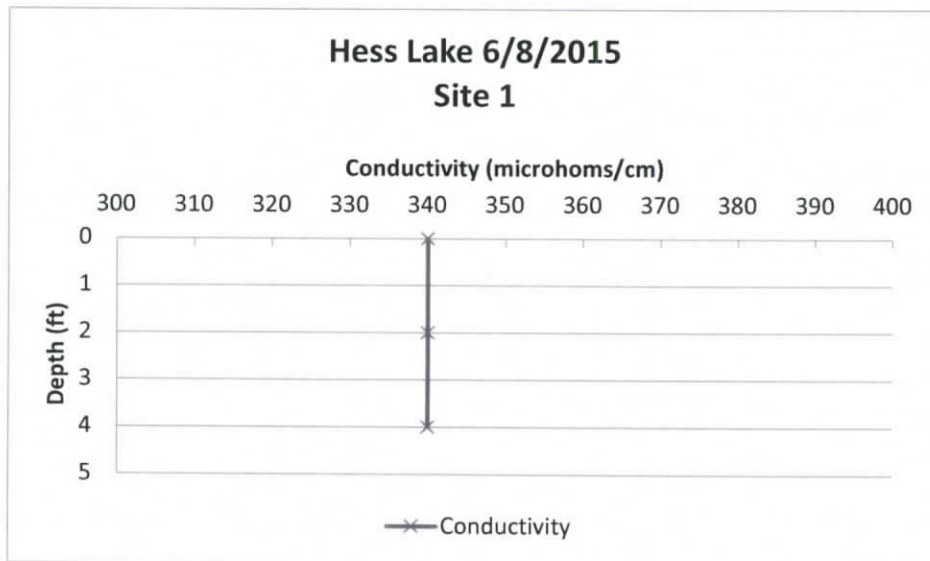
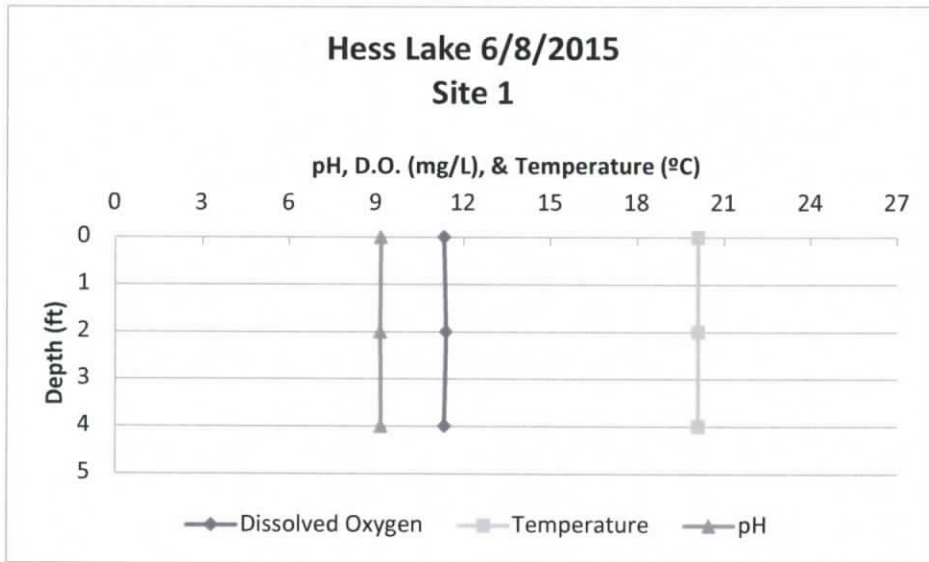


2015 Results:

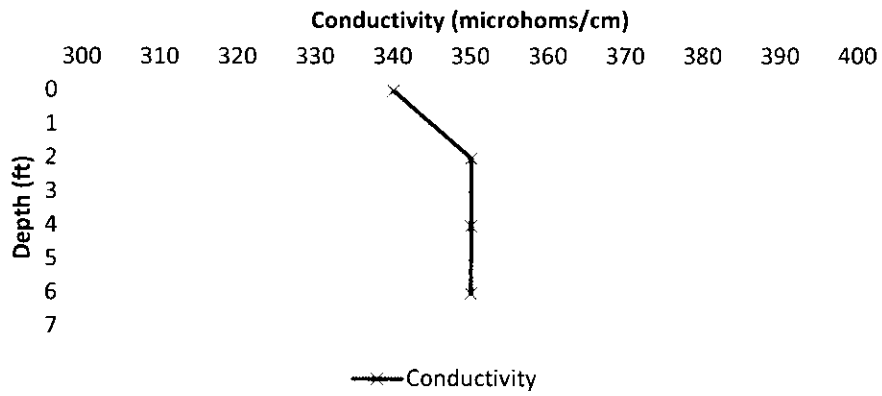
Hess Lake Aeration 2015 Data				
Date	Site	Total Suspended Solids (mg/L)	Total Phosphorus (ug/L)	Orthophosphorus (ug/L)
6/8/2015	1 Surface	19	50	6
6/8/2015	1 Mid	23	47	5
6/8/2015	1 Deep	20	48	5
6/8/2015	2 Surface	15	43	6
6/8/2015	2 Mid	22	53	6
6/8/2015	2 Deep	21	59	6
7/15/2015	1 Surface	18	30	6
7/15/2015	1 Mid	19	30	ND
7/15/2015	1 Deep	18	30	ND
7/15/2015	2 Surface	19	20	ND
7/15/2015	2 Mid	15	30	ND
7/15/2015	2 Deep	17	50	ND
9/14/2015	1 Surface	24	30	4.4
9/14/2015	1 Mid	23	40	5
9/14/2015	1 Deep	24	40	8.6
9/14/2015	2 Surface	21	40	4.8
9/14/2015	2 Mid	21	40	6.1
9/14/2015	2 Deep	29	50	4.4

Date	Site	Secchi Disk (ft)	Chlorophyll a (ug/L)
6/8/2015	1	2	22
6/8/2015	2	2.5	15
7/15/2015	1	1.5	13
7/15/2015	2	2	14
9/14/2015	1	2	8.5
9/14/2015	2	2	29

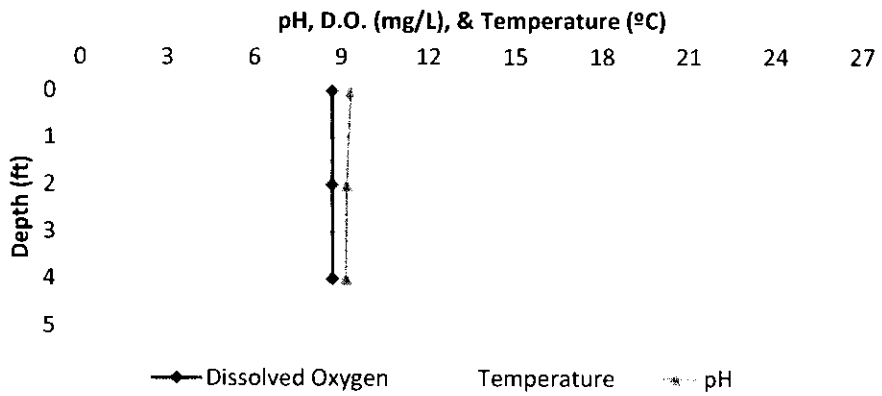
Date	Site	Temperature (°C)	Dissolved Oxygen (mg/L)	pH	Conductivity (microhoms/cm)
6/8/2015	1	20.1	11.33	9.15	340
		20.1	11.4	9.13	340
		20.1	11.34	9.15	340
6/8/2015	2	19.8	10.73	9.13	340
		19.7	10.73	9.11	350
		19.6	10.76	9.11	350
		19.4	10.7	9.11	350
7/15/2015	1	23.7	8.64	9.26	320
		23.5	8.65	9.13	320
		23.4	8.67	9.12	320
7/15/2015	2	23.8	8.97	9.12	320
		24	8.93	9.1	320
		23.6	8.93	9.09	320
		23.2	8.58	9.06	320
9/14/2015	1	20	9.72	8.95	330
		19.9	9.77	8.95	330
		19.7	9.65	8.95	330
9/14/2015	2	20.3	9.74	8.94	330
		20.3	9.71	8.94	330
		20	9.37	8.92	330
		19.9	8.62	8.88	330



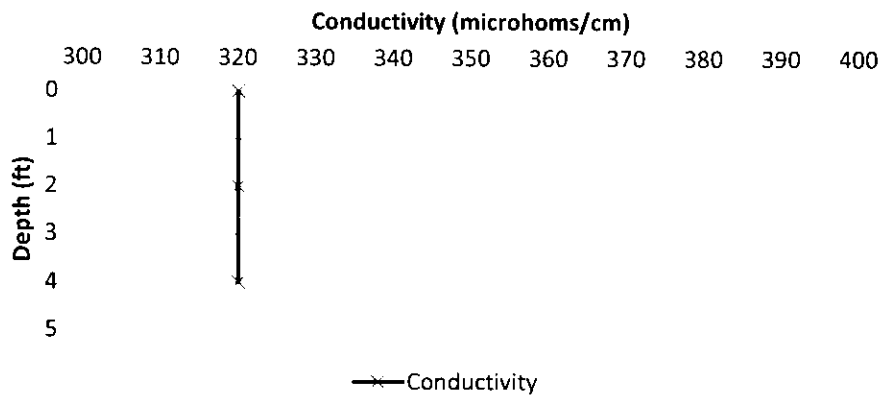
### Hess Lake 6/8/2015 Site 2



### Hess Lake 7/15/2015 Site 1

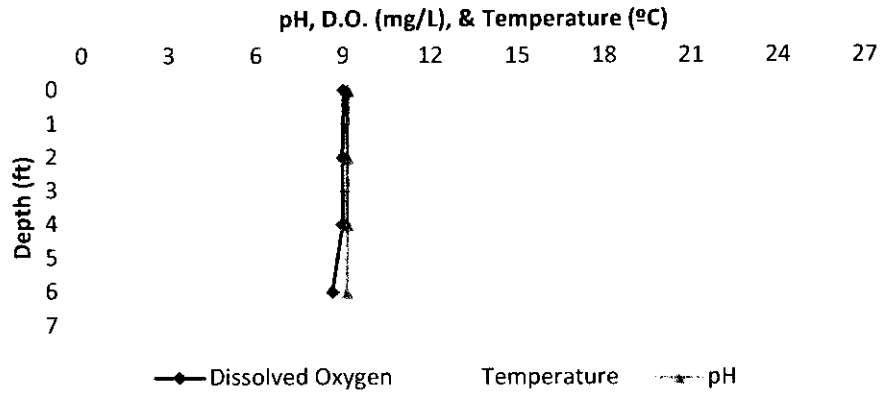


### Hess Lake 7/15/2015 Site 1

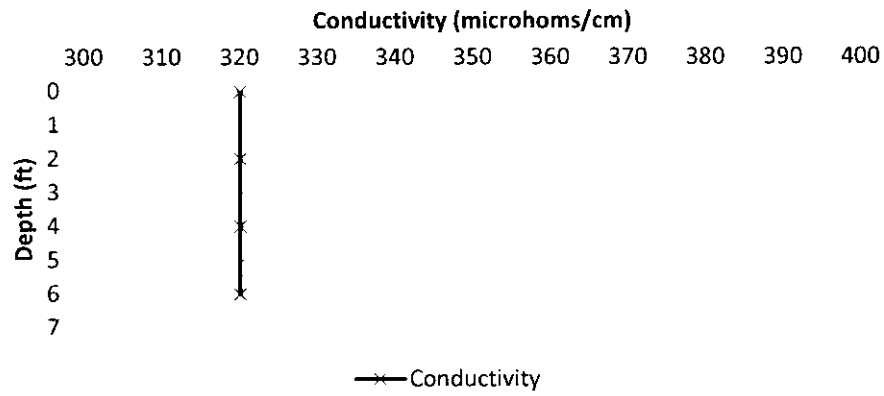




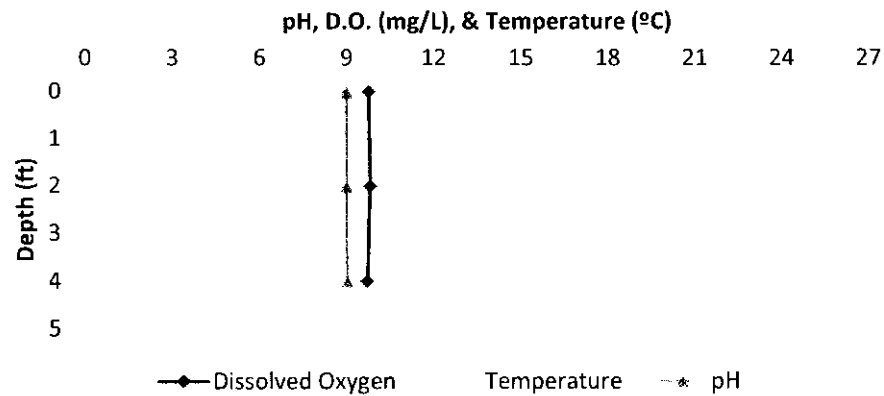
### Hess Lake 7/15/2015 Site 2



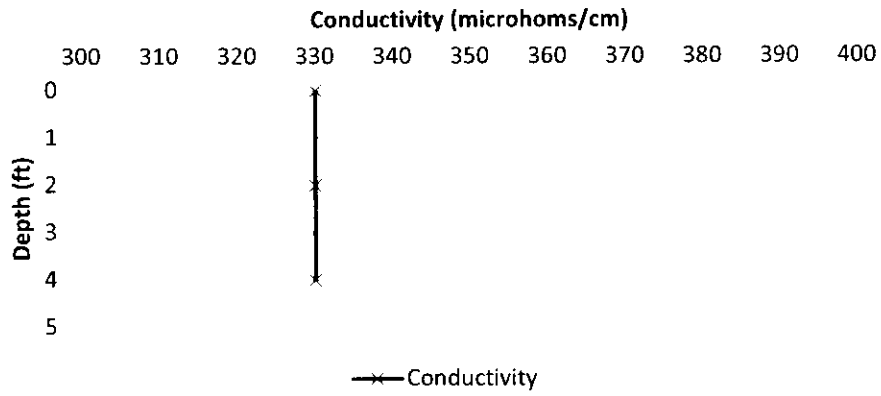
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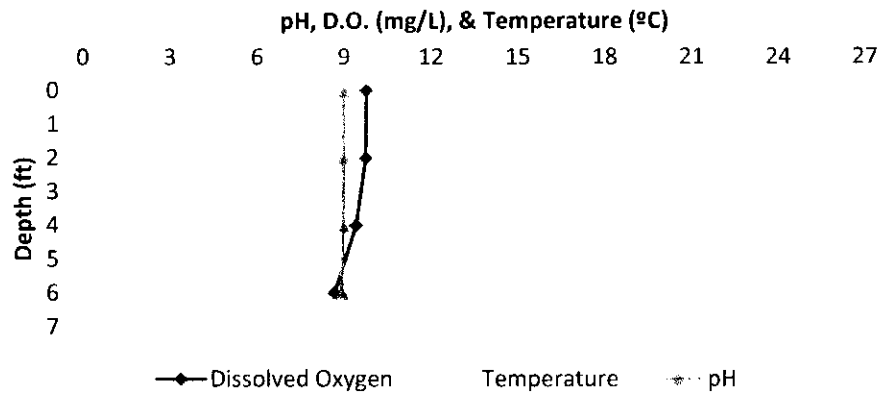
### Hess Lake 9/14/2015 Site 1



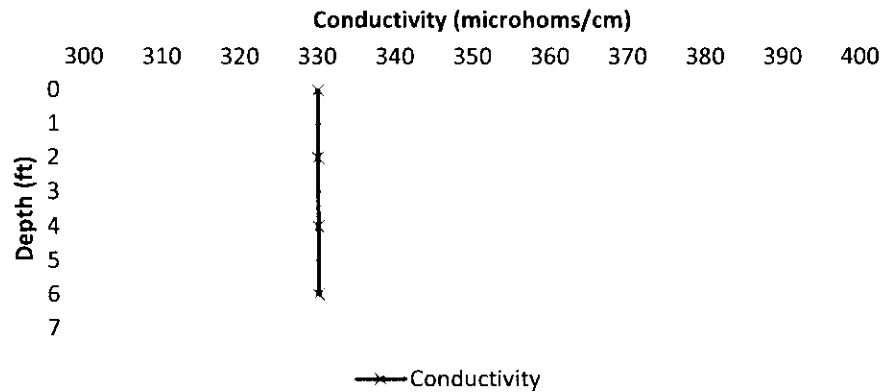
### Hess Lake 9/14/2015 Site 1



### Hess Lake 9/14/2015 Site 2



### Hess Lake 9/14/2015 Site 2



**Conclusions:**

There were some noticeable changes from having the aeration system be active for one year. However many of these parameters are linked together and thus the change is expected. Total Suspended Solids increased from about 12 mg/L to 20 mg/L. With this Total Phosphorus also increased from about 20 ug/L to 40 ug/L. Noticing these two it is not unexpected that secchi disk values slightly decreased and Chlorophyll a values increased (6 ug/L to 16 ug/L). Orthophosphorus decreased from about 9 ug/L to 6 ug/L. pH only slightly increased and there was no noticeable change with Conductivity.


Due to the changes in chlorophyll, total phosphorus, and secchi disk, the trophic state index values for Hess Lake also changed. Secchi Disk values related to Eutrophic lakes in both 2014 and 2015. Total phosphorus values were mesotrophic in 2014, but changed to eutrophic in 2015. Chlorophyll a values were mesotrophic in 2014 and in 2015 they were on the border of mesotrophic and eutrophic.

The water temperatures never exceeded Michigan's Water Quality Standards temperature criteria during any sampling event.

Herbicides were not used in the same area the aeration systems were installed and running. Therefore they did not influence sampling events as they were also in the area where the aeration systems were.

Based on one year's worth of water quality testing, the immediate results show that water quality has become worse, as well as the water clarity. However in the scope of what an aeration system is supposed to accomplish, the results are as expected and planned. Immediate results of any new aeration system will display negative water quality figures. The movement of water releases bottom sediments, which will push increased nutrient figures and decrease clarity. However with the increased availability of oxygen at depth and mixing of water the water column will lead to the desired goals. More time and testing is needed in the future in order to determine whether the aeration system is causing an adverse impact.

Sincerely,



Matthew Novotny  
Savin Lake Services

Appendix A  
Raw Data for Water Quality

Savin Lakes Services - Results Summary (July 2014 Samples)

Sample ID#	Sample Location	Sample Site & Depth	pH	mg-CaCO <sub>3</sub> /L Alkalinity	µS Conductivity	µg-N/L NO <sub>3</sub> -N	rep or BDL*	µg-P/L TP	rep or BDL*
4	Hess Lake	Site 1 - Surface	N/A	N/A	309	N/A		21.5	
5	Hess Lake	Site 1 - 2ft	N/A	N/A	331	N/A		28.9	
6	Hess Lake	Site 1 - 4ft	N/A	N/A	330	N/A		23.5	
7	Hess Lake	Site 2 - Surface	N/A	N/A	332	N/A		18.3	
8	Hess Lake	Site 2 - 2ft	N/A	N/A	332	N/A		N/A	
9	Hess Lake	Site 2 - 4/3.5ft	N/A	N/A	338	N/A		24.1	
10	Hess Lake	Site 2 - 6/7.5ft	N/A	N/A	335	N/A		21.3	

		µg-P/L PO4-P	rep or BDL*	mg/L TSS	BDL*	µg/L Chl-A
Hess Lake	Site 1 - Surface	7.6		10.3		6.4
Hess Lake	Site 1 - 2ft	11.0	11.0	14.8		N/A
Hess Lake	Site 1 - 4ft	9.3		104.0		N/A
Hess Lake	Site 2 - Surface	5.9		10.8		7.4
Hess Lake	Site 2 - 2ft	N/A		9.5		N/A
Hess Lake	Site 2 - 4/3.5ft	9.3		11.5		N/A
Hess Lake	Site 2 - 6/7.5ft	10.2		12.8		N/A

Analysis	Method Detection Limits*	
PO4-P	< 0.6	µg-P/L
TP	< 1.3	µg-P/L
NO <sub>3</sub> -N	< 1.4	µg-N/L
TSS	< 2.0	mg/L

BDL\* = below the method's detection limit



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www.karlabs.com

**Savin Lake Services, Inc.**  
**3088 Hottis Road**  
**Hale, MI 48739**

**KAR Project No. : 407124**  
**Date Reported : 10/07/14**  
**Date Activated : 09/19/14**  
**Date Due : 10/08/14**  
**Date Validated : 10/07/14**

**Attn : Mr. Matt Novotny**

**Project**  
**Description : Analysis of 39 lake water samples.**

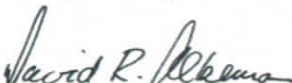
Dear Client,

Your laboratory data is presented to you in this report. Unless otherwise stated under the "Comments" heading, all tests were performed within the maximum allowable holding times, have met or exceeded QC requirements and the result represents the sample as it was received. If a sample was identified as drinking water under the Safe Drinking Water Act, the "Comments" column may also contain federal drinking water information including MCL which is the Maximum Contaminant Level set by USEPA. Values enclosed in brackets ([]) are Secondary MCL's and are non-enforceable guidelines for aesthetic quality.

If you wish to contact us about this work please mention KAR Project No. 407124. To arrange additional sampling or testing please contact our Client Services Department. If you have any questions regarding quality assurance please contact us.

Thank you for the opportunity to serve you. Please do not hesitate to call if we can provide additional assistance.

Respectfully submitted,

  
David R. Alkema  
Laboratory Manager

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## LABORATORY DETAIL REPORT

Client: *Savin Lake Services, Inc.*

KAR Project No. : **407124**

Date Reported : **10/07/14**

Attest:   
David R. Alkema, Lab Manager

### Project

Description: *Analysis of 39 lake water samples.*

Sample ID : **"Hess Lake Site 1"**

Sampled By : *MN of Savin Lake Services, Inc.*

Date Received : **09/19/14**

Sample Date : **09/18/14**

Sample Type : **aqueous**

Sample Time : **1700**

KAR Sample No. : **407124-01**

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Alkalinity (as CaCO <sub>3</sub> )	145	mg/L	SM 2320 B	09/26/14	JWW	
Conductivity	361	micromhos/cm	EPA 120.1	09/26/14	JWW	
Nitrogen, nitrate	<0.1	mg/L	EPA 353.2	09/19/14	ALK	
Phosphorus, total (as P)	0.02	mg/L	SM 4500-P B5,E	09/30/14	JHB	

Sample ID : **"Hess Lake Site 2"**

Sampled By : *MN of Savin Lake Services, Inc.*

Date Received : **09/19/14**

Sample Date : **09/18/14**

Sample Type : **aqueous**

Sample Time : **1700**

KAR Sample No. : **407124-02**

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Alkalinity (as CaCO <sub>3</sub> )	155	mg/L	SM 2320 B	09/26/14	JWW	
Conductivity	356	micromhos/cm	EPA 120.1	09/26/14	JWW	
Nitrogen, nitrate	<0.1	mg/L	EPA 353.2	09/19/14	ALK	
Phosphorus, total (as P)	<0.02	mg/L	SM 4500-P B5,E	09/30/14	JHB	

Sample ID : **"Hess Lake Site 3"**

Sampled By : *MN of Savin Lake Services, Inc.*

Date Received : **09/19/14**

Sample Date : **09/18/14**

Sample Type : **aqueous**

Sample Time : **1700**

KAR Sample No. : **407124-03**

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Alkalinity (as CaCO <sub>3</sub> )	165	mg/L	SM 2320 B	09/26/14	JWW	
Conductivity	346	micromhos/cm	EPA 120.1	09/26/14	JWW	
Nitrogen, nitrate	<0.1	mg/L	EPA 353.2	09/19/14	ALK	
Phosphorus, total (as P)	<0.02	mg/L	SM 4500-P B5,E	09/30/14	JHB	

Sample ID : **"Hess Lake Site 1, Surface"**

Sampled By : *MN of Savin Lake Services, Inc.*

Date Received : **09/19/14**

Sample Date : **09/18/14**

Sample Type : **aqueous**

Sample Time : **1500**

KAR Sample No. : **407124-04**

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Conductivity	336	micromhos/cm	EPA 120.1	09/26/14	JWW	

## LABORATORY DETAIL REPORT

Client: *Savin Lake Services, Inc.*

KAR Project No. : **407124**

Date Reported : **10/07/14**

Attest:   
David R. Alkema, Lab Manager

### Project

Description: *Analysis of 39 lake water samples.*

Sample ID : **"Hess Lake Site 1, Surface"**

Sampled By : *MN of Savin Lake Services, Inc.*

Date Received : **09/19/14**

Sample Date : **09/18/14**

Sample Type : **aqueous**

Sample Time : **1500**

KAR Sample No. : **407124-04**

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Phosphate, ortho (as P)	<0.02	mg/L	SM 4500-P E	09/19/14	JHB	
Phosphorus, total (as P)	<0.02	mg/L	SM 4500-P B5,E	09/30/14	JHB	
Suspended solids, total	11	mg/L	SM 2540 D	09/22/14	JWW	

Sample ID : **"Hess Lake Site 1, Middle"**

Sampled By : *MN of Savin Lake Services, Inc.*

Date Received : **09/19/14**

Sample Date : **09/18/14**

Sample Type : **aqueous**

Sample Time : **1500**

KAR Sample No. : **407124-05**

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Phosphate, ortho (as P)	<0.02	mg/L	SM 4500-P E	09/19/14	JHB	
Phosphorus, total (as P)	<0.02	mg/L	SM 4500-P B5,E	09/30/14	JHB	
Suspended solids, total	12	mg/L	SM 2540 D	09/22/14	JWW	

Sample ID : **"Hess Lake Site 1, Bottom"**

Sampled By : *MN of Savin Lake Services, Inc.*

Date Received : **09/19/14**

Sample Date : **09/18/14**

Sample Type : **aqueous**

Sample Time : **1500**

KAR Sample No. : **407124-06**

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Phosphate, ortho (as P)	<0.02	mg/L	SM 4500-P E	09/19/14	JHB	
Phosphorus, total (as P)	<0.02	mg/L	SM 4500-P B5,E	09/30/14	JHB	
Suspended solids, total	13	mg/L	SM 2540 D	09/22/14	JWW	

Sample ID : **"Hess Lake Site 1, 2 feet"**

Sampled By : *MN of Savin Lake Services, Inc*

Date Received : **09/19/14**

Sample Date : **09/18/14**

Sample Type : **aqueous**

Sample Time : **1500**

KAR Sample No. : **407124-07**

Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Conductivity	341	micromhos/cm	EPA 120.1	09/26/14	JWW	



**LABORATORY DETAIL REPORT**

Client: *Savin Lake Services, Inc.*

KAR Project No. : **407124**

Attest:   
David R. Alkema, Lab Manager

Date Reported : **10/07/14**

**Project**

Description: *Analysis of 39 lake water samples.*

Sample ID : <b><u>"Hess Lake Site 1, 4 feet"</u></b>						
Sampled By : <i>MN of Savin Lake Services, Inc</i>				Date Received : <b>09/19/14</b>		
Sample Date : <b>09/18/14</b>				Sample Type : <b>aqueous</b>		
Sample Time : <b>1500</b>				KAR Sample No. : <b>407124-08</b>		
Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Conductivity	347	micromhos/cm	EPA 120.1	09/26/14	JWW	

Sample ID : <b><u>"Hess Lake Site 2, Surface"</u></b>						
Sampled By : <i>MN of Savin Lake Services, Inc</i>				Date Received : <b>09/19/14</b>		
Sample Date : <b>09/18/14</b>				Sample Type : <b>aqueous</b>		
Sample Time : <b>1500</b>				KAR Sample No. : <b>407124-09</b>		
Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Conductivity	338	micromhos/cm	EPA 120.1	09/26/14	JWW	
Phosphate, ortho (as P)	<0.02	mg/L	SM 4500-P E	09/19/14	JHB	
Phosphorus, total (as P)	<0.02	mg/L	SM 4500-P B5,E	09/30/14	JHB	
Suspended solids, total	12	mg/L	SM 2540 D	09/22/14	JWW	

Sample ID : <b><u>"Hess Lake Site 2, Middle"</u></b>						
Sampled By : <i>MN of Savin Lake Services, Inc</i>				Date Received : <b>09/19/14</b>		
Sample Date : <b>09/18/14</b>				Sample Type : <b>aqueous</b>		
Sample Time : <b>1500</b>				KAR Sample No. : <b>407124-10</b>		
Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Phosphate, ortho (as P)	<0.02	mg/L	SM 4500-P E	09/19/14	JHB	
Phosphorus, total (as P)	<0.02	mg/L	SM 4500-P B5,E	09/30/14	JHB	
Suspended solids, total	10	mg/L	SM 2540 D	09/22/14	JWW	

Sample ID : <b><u>"Hess Lake Site 2, Bottom"</u></b>						
Sampled By : <i>MN of Savin Lake Services, Inc</i>				Date Received : <b>09/19/14</b>		
Sample Date : <b>09/18/14</b>				Sample Type : <b>aqueous</b>		
Sample Time : <b>1500</b>				KAR Sample No. : <b>407124-11</b>		
Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Phosphate, ortho (as P)	<0.02	mg/L	SM 4500-P E	09/19/14	JHB	
Phosphorus, total (as P)	<0.02	mg/L	SM 4500-P B5,E	09/30/14	JHB	
Suspended solids, total	10	mg/L	SM 2540 D	09/22/14	JWW	

## LABORATORY DETAIL REPORT

Client: *Savin Lake Services, Inc.*

KAR Project No. : **407124**

Attest:   
David R. Alkema, Lab Manager

Date Reported : **10/07/14**

**Project**

Description: *Analysis of 39 lake water samples.*

Sample ID : <b><u>"Hess Lake Site 2, 2 Feet"</u></b>						
Sampled By : <i>MN of Savin Lake Services, Inc</i>				Date Received : <b>09/19/14</b>		
Sample Date : <b>09/18/14</b>				Sample Type : <b>aqueous</b>		
Sample Time : <b>1500</b>				KAR Sample No. : <b>407124-12</b>		
Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Conductivity	339	micromhos/cm	EPA 120.1	09/26/14	JWW	

Sample ID : <b><u>"Hess Lake Site 2, 4 Feet"</u></b>						
Sampled By : <i>MN of Savin Lake Services, Inc</i>				Date Received : <b>09/19/14</b>		
Sample Date : <b>09/18/14</b>				Sample Type : <b>aqueous</b>		
Sample Time : <b>1500</b>				KAR Sample No. : <b>407124-13</b>		
Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Conductivity	343	micromhos/cm	EPA 120.1	09/26/14	JWW	

Sample ID : <b><u>"Hess Lake Site 2, 6 Feet"</u></b>						
Sampled By : <i>MN of Savin Lake Services, Inc</i>				Date Received : <b>09/19/14</b>		
Sample Date : <b>09/18/14</b>				Sample Type : <b>aqueous</b>		
Sample Time : <b>1500</b>				KAR Sample No. : <b>407124-14</b>		
Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Conductivity	339	micromhos/cm	EPA 120.1	09/26/14	JWW	

Sample ID : <b><u>"Walled Lake, Site 1"</u></b>						
Sampled By : <i>MN of Savin Lake Services, Inc.</i>				Date Received : <b>09/24/14</b>		
Sample Date : <b>09/23/14</b>				Sample Type : <b>aqueous</b>		
Sample Time : <b>0800</b>				KAR Sample No. : <b>407124-15</b>		
Test	Result	Units of Measure	Method	Analyzed	Analyst	Comments
Alkalinity (as CaCO3)	110	mg/L	SM 2320 B	10/03/14	JWW	
Conductivity	1100	micromhos/cm	EPA 120.1	09/26/14	JWW	
Nitrogen, nitrate	<0.1	mg/L	EPA 353.2	09/24/14	MHK	
Phosphorus, total (as P)	0.03	mg/L	SM 4500-P B5,E	09/30/14	JHB	



Project Number: 2293-00

October 28, 2014

Savin Lake Services  
3088 Hottis Rd..  
Hale, MI 48739  
Attention: Matt Novotny

Project Description: Chlorophyll-a Analysis

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 requirements of the National Environmental Laboratory Accreditation Conference (NELAC). Visit our web site for a full list of tests for which we are accredited.

Data Qualifiers:

J = Estimated result below the RL but above the MDL

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

Sincerely,

A handwritten signature in cursive script that reads "Michelle A. Moore".

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



QC  
MB  
10/28/14

<i>LabSampleID</i>	<i>SampleDescription</i>	<i>Sample Date</i>	<i>Result</i>	<i>Units</i>	<i>Rep Limit</i>	<i>Lab Qualifier</i>	<i>AnalysisDate</i>	<i>Comments</i>	<i>Initials</i>
SA09290009	Lake Isabella-Site 3	9/29/2014	0.00056	mg/L	0.0007	J	10/21/2014		BSC
SA09300010	Lake Avalon-Site 1	9/30/2014	0.00082	mg/L	0.0007		10/21/2014		BSC
SA09300011	Lake Avalon-Site 2	9/30/2014	0.00098	mg/L	0.0007		10/21/2014		BSC
SA09300012	Lake Avalon-Site 3	9/30/2014	0.00098	mg/L	0.0007		10/21/2014		BSC
SA09300013	Big Bass Lake-Site 1	9/30/2014	0.00164	mg/L	0.0007		10/21/2014		BSC
SA09300014	Big Bass Lake-Site 2	9/30/2014	0.00131	mg/L	0.0007		10/21/2014		BSC
SA09300015	Big Bass Lake-Site 3	9/30/2014	0.00131	mg/L	0.0007		10/21/2014		BSC
SA09300016	Sage Lake-Site 1	9/30/2014	0.00098	mg/L	0.0007		10/21/2014		BSC
SA09300017	Sage Lake-Site 2	9/30/2014	0.00196	mg/L	0.0007		10/21/2014		BSC
SA09300018	Sage Lake-Site 3	9/30/2014	0.00183	mg/L	0.0007		10/21/2014		BSC
SA10010019	Hess Lake-Site 1	10/1/2014	0.00376	mg/L	0.0007		10/21/2014		BSC
SA10010020	Hess Lake-Site 2	10/1/2014	0.00411	mg/L	0.0007		10/21/2014		BSC

**LabQualifiers:**

*U - Analyte not detected.*

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

<i>LabSampleID</i>	<i>SampleDescription</i>	<i>Sample Date</i>	<i>Result</i>	<i>Units</i>	<i>Rep Limit</i>	<i>Lab Qualifier</i>	<i>AnalysisDate</i>	<i>Comments</i>	<i>Initials</i>
SA10010021	Hess Lake-Site 3	10/1/2014	0.00196	mg/L	0.0007		10/21/2014		BSC
SA10010022	Hess Lake AIR-Site 1	10/1/2014	0.00523	mg/L	0.0007		10/21/2014		BSC
SA10010023	Hess Lake AIR-Site 2	10/1/2014	0.00301	mg/L	0.0007		10/21/2014		BSC
SA10010024	Lake James-Site 1	10/1/2014	0.00098	mg/L	0.0007		10/21/2014		BSC
SA10010025	Lake James-Site 2	10/1/2014	0.00065	mg/L	0.0007	J	10/21/2014		BSC
SA10010026	Lake James-Site 3	10/1/2014	0.00294	mg/L	0.0007		10/21/2014		BSC
SA10010027	Fife Lake Site 1	10/1/2014	0.00301	mg/L	0.0007		10/21/2014		BSC
SA10010028	Fife Lake Site 2	10/1/2014	0.00218	mg/L	0.0007		10/21/2014		BSC
SA10010029	Fife Lake Site 3	10/1/2014	0.00240	mg/L	0.0007		10/21/2014		BSC

**LabQualifiers:**

*U - Analyte not detected.*

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



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**Cover Page**

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**Client:** Savin Lake Services

**WWA Job #:** 57915

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**Project:** Monitoring

**Date Received:** 6/22/2015

**Date Reported:** 7/16/2015

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<b>Sample Number</b>	<b>Client Sample ID</b>	<b>Date Sampled</b>	<b>Sample Matrix</b>
57915-001	Hess Lake	06/15/15	Water
57915-002	Hess Lake	06/15/15	Water
57915-003	Hess Lake	06/15/15	Water
57915-004	Hess Lake	06/15/15	Water
57915-005	Hess Lake	06/15/15	Water
57915-006	Hess Lake	06/15/15	Water
57915-007	Hess Lake	06/15/15	Water
57915-008	Hess Lake	06/15/15	Water
57915-009	Hess Lake	06/15/15	Water
57915-010	Hess Lake	06/15/15	Water
57915-011	Hess Lake	06/15/15	Water



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**Cover Page..continued**

**Client:** Savin Lake Services

**WWA Job #:** 57915

**Comments (if any):**

**Key to Laboratory Flags:**

- \*: RPD exceeds limits.
- B: The analyte was found in the associated blank as well as in the sample.
- J: The quantitation is an estimated value because the result is less than the sample quantitation limit but greater than the detection limit.
- M: A matrix effect was present.
- Q: Batch QC data associated with the analysis does not meet the stated objectives
- H: Indicates analytical holding time exceedance.
- U: The analyte was analyzed for, but not detected.
- P: A manual peak selection or manual integration was performed to correct an erroneous software selection.

ND = Not Detected, MDL = Method Detection Limit, MQL = Method Quantitation Limit  
ppm = mg/L (liquid) or mg/kg (solid), ppb = ug/L (liquid) or ug/kg (solid)  
For coliform, Negative = No coliform bacteria detected, Positive = Coliform bacteria detected

**Sample Types:**

S = Solids, DW = Drinking water, D = Dissolved, T = Total, TC = TCLP extract, SP = SPLP extract

All samples were received intact and properly preserved unless otherwise noted. The results reported relate only to the samples tested. This report shall not be reproduced, except in full, without the written approval of this laboratory. The Chain of Custody is attached.

This report satisfies the requirements of your project but has not been prepared to comply with NELAP reporting requirements.

I certify that the data contained in this Final Report has been generated and reviewed in accordance with approved methods and White Water Associates Standard Operating Procedures. Exceptions, if any, are discussed in the accompanying sample narrative. Release of this Final Report is authorized by White Water Associates management, as is verified by the following signature.

**Approved By:**

WI DNR Lab Certification Number: 999971280  
MI DEQ Certification Number: 9306  
DoD-ELAP Accreditation Number: 65802  
ISO/IEC 17025:2005 Accredited



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Client: Savin Lake Services

WWA Job #: 57915

Project: Monitoring

Date Received: 6/22/2015

Date Reported: 7/16/2015

### Sample Results

Sample No. / ID / Description / Matrix	Result	Flags	Units	Date	Method	MDL	MQL
<b>57915-001 / Hess Lake / Site 1- Surface / Water</b>							
<b>General Chemistry Parameters</b>							
chlorophyll a	22		mg/m3	6/25/2015	10200H	NA	NA
Conductivity	340		umho/cm	6/23/2015	2510B	1	2
o-Phosphorus	0.006	H	mg/L	6/22/2015	4500-P F	0.001	0.025
Total Phosphorus (t)	0.050		mg/L	6/24/2015	365.4	0.001	0.04
Total Suspended Solids	19		mg/L	6/22/2015	2540D	2	2
<b>57915-002 / Hess Lake / Site 1- 2 feet / Water</b>							
<b>General Chemistry Parameters</b>							
Conductivity	340		umho/cm	6/23/2015	2510B	1	2
<b>57915-003 / Hess Lake / Site 1- 4 feet / Water</b>							
<b>General Chemistry Parameters</b>							
Conductivity	340		umho/cm	6/23/2015	2510B	1	2
<b>57915-004 / Hess Lake / Site 2- Surface / Water</b>							
<b>General Chemistry Parameters</b>							
chlorophyll a	15		mg/m3	6/25/2015	10200H	NA	NA
Conductivity	340		umho/cm	6/23/2015	2510B	1	2
o-Phosphorus	0.006	H	mg/L	6/22/2015	4500-P F	0.001	0.025
Total Phosphorus (t)	0.043		mg/L	6/24/2015	365.4	0.001	0.04
Total Suspended Solids	15		mg/L	6/22/2015	2540D	2	2

ND = Not Detected, MDL = Method Detection Limit, MQL = Method Quantitation Limit,  
ppm = mg/l (liquid) or mg/kg (solid), ppb = ug/l (liquid) or ug/kg (solid)





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Client: Savin Lake Services

WWA Job #: 57915

Project: Monitoring

Date Received: 6/22/2015

Date Reported: 7/16/2015

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**Sample Results**


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Sample No. / ID / Description / Matrix	Result	Flags	Units	Date	Method	MDL	SQL
<b>57915-005 / Hess Lake / Site 2- 2 feet / Water</b>							
<b>General Chemistry Parameters</b>							
Conductivity	350		umho/cm	6/23/2015	2510B	1	2
<b>57915-006 / Hess Lake / Site 2- 4 feet / Water</b>							
<b>General Chemistry Parameters</b>							
Conductivity	350		umho/cm	6/23/2015	2510B	1	2
<b>57915-007 / Hess Lake / Site 2- 6 feet / Water</b>							
<b>General Chemistry Parameters</b>							
Conductivity	350		umho/cm	6/23/2015	2510B	1	2
<b>57915-008 / Hess Lake / Site 1- Middle / Water</b>							
<b>General Chemistry Parameters</b>							
o-Phosphorus	0.005	H	mg/L	6/22/2015	4500-P F	0.001	0.025
Total Phosphorus (t)	0.047		mg/L	6/24/2015	365.4	0.001	0.04
Total Suspended Solids	23		mg/L	6/22/2015	2540D	3	3
<b>57915-009 / Hess Lake / Site 1- Deep / Water</b>							
<b>General Chemistry Parameters</b>							
o-Phosphorus	0.005	H	mg/L	6/22/2015	4500-P F	0.001	0.025
Total Phosphorus (t)	0.048		mg/L	6/24/2015	365.4	0.001	0.04
Total Suspended Solids	20		mg/L	6/22/2015	2540D	3	3

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 ND = Not Detected, MDL = Method Detection Limit, MQL = Method Quantitation Limit,  
 ppm = mg/l (liquid) or mg/kg (solid), ppb = ug/l (liquid) or ug/kg (solid)



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Client: Savin Lake Services

WWA Job #: 57915

Project: Monitoring

Date Received: 6/22/2015

Date Reported: 7/16/2015

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**Sample Results**


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Sample No. / ID / Description / Matrix	Result	Flags	Units	Date	Method	MDL	SQL
<b>57915-010 / Hess Lake / Site 2- Middle / Water</b>							
<b>General Chemistry Parameters</b>							
o-Phosphorus	0.006	H	mg/L	6/22/2015	4500-P F	0.001	0.025
Total Phosphorus (t)	0.053		mg/L	6/24/2015	365.4	0.001	0.04
Total Suspended Solids	22		mg/L	6/22/2015	2540D	3	3
<b>57915-011 / Hess Lake / Site 2- Deep / Water</b>							
<b>General Chemistry Parameters</b>							
o-Phosphorus	0.006	H	mg/L	6/22/2015	4500-P F	0.001	0.025
Total Phosphorus (t)	0.059		mg/L	6/24/2015	365.4	0.001	0.04
Total Suspended Solids	21		mg/L	6/22/2015	2540D	3	3

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**Cover Page**

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**Client:** Savin Lake Services

**WWA Job #:** 58706

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**Project:** Lake Studies

**Date Received:** 7/31/2015

**Date Reported:** 8/20/2015

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<b>Sample Number</b>	<b>Client Sample ID</b>	<b>Date Sampled</b>	<b>Sample Matrix</b>
58706-001	Site 1 - Surface	07/15/15	Water
58706-002	Site 1 - Middle	07/15/15	Water
58706-003	Site 1 - Deep	07/15/15	Water
58706-004	Site 1 - 2 ft	07/15/15	
58706-005	Site 1 - 4 ft	07/15/15	
58706-006	Site 2 - Surface	07/15/15	Water
58706-007	Site 2 - Middle	07/15/15	Water
58706-008	Site 2 - Deep	07/15/15	Water
58706-009	Site 2 - 2 ft	07/15/15	
58706-010	Site 2 - 4 ft	07/15/15	
58706-011	Site 2 - 6 ft	07/15/15	



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**Cover Page..continued**

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**Client:** Savin Lake Services

**WWA Job #:** 58706

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**Comments (if any):**

**Key to Laboratory Flags:**

- \*: RPD exceeds limits.
- B: The analyte was found in the associated blank as well as in the sample.
- J: The quantitation is an estimated value because the result is less than the sample quantitation limit but greater than the detection limit.
- M: A matrix effect was present.
- Q: Batch QC data associated with the analysis does not meet the stated objectives
- H: Indicates analytical holding time exceedance.
- U: The analyte was analyzed for, but not detected.
- P: A manual peak selection or manual integration was performed to correct an erroneous software selection.

ND = Not Detected, MDL = Method Detection Limit, MQL = Method Quantitation Limit  
ppm = mg/L (liquid) or mg/kg (solid), ppb = ug/L (liquid) or ug/kg (solid)  
For coliform, Negative = No coliform bacteria detected, Positive = Coliform bacteria detected

**Sample Types:**

S = Solids, DW = Drinking water, D = Dissolved, T = Total, TC = TCLP extract, SP = SPLP extract

All samples were received intact and properly preserved unless otherwise noted. The results reported relate only to the samples tested. This report shall not be reproduced, except in full, without the written approval of this laboratory. The Chain of Custody is attached.

This report satisfies the requirements of your project but has not been prepared to comply with NELAP reporting requirements.

I certify that the data contained in this Final Report has been generated and reviewed in accordance with approved methods and White Water Associates Standard Operating Procedures. Exceptions, if any, are discussed in the accompanying sample narrative. Release of this Final Report is authorized by White Water Associates management, as is verified by the following signature.

**Approved By:**

---

WI DNR Lab Certification Number: 999971280  
MI DEQ Certification Number: 9306  
DoD-ELAP Accreditation Number: 65802  
ISO/IEC 17025:2005 Accredited



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Client: Savin Lake Services

WWA Job #: 58706

Project: Lake Studies

Date Received: 7/31/2015

Date Reported: 8/20/2015

### Sample Results

Sample No. / ID / Description / Matrix	Result	Flags	Units	Date	Method	MDL	MQL
<b>58706-001 / Site 1 - Surface / Hess Lake / Water</b>							
<b>General Chemistry Parameters</b>							
chlorophyll a	13		mg/m3	8/6/2015	10200H	NA	NA
Conductivity	320		umho/cm	7/31/2015	2510B	1	2
o-Phosphorus	0.006		mg/L	7/31/2015	4500-P F	0.005	0.025
Total Phosphorus (t)	0.03	J	mg/L	8/5/2015	365.4	0.005	0.04
Total Suspended Solids	18	H	mg/L	8/4/2015	2540D	3	3
<b>58706-002 / Site 1 - Middle / Water</b>							
<b>General Chemistry Parameters</b>							
o-Phosphorus	ND		mg/L	7/31/2015	4500-P F	0.005	0.025
Total Phosphorus (t)	0.03	J	mg/L	8/5/2015	365.4	0.005	0.04
Total Suspended Solids	19	H	mg/L	8/4/2015	2540D	3	3
<b>58706-003 / Site 1 - Deep / Water</b>							
<b>General Chemistry Parameters</b>							
o-Phosphorus	ND		mg/L	7/31/2015	4500-P F	0.005	0.025
Total Phosphorus (t)	0.03	J	mg/L	8/5/2015	365.4	0.005	0.04
Total Suspended Solids	18	H	mg/L	8/4/2015	2540D	3	3
<b>58706-004 / Site 1 - 2 ft</b>							
<b>General Chemistry Parameters</b>							
Conductivity	320		umho/cm	7/31/2015	2510B	1	2

ND = Not Detected, MDL = Method Detection Limit, MQL = Method Quantitation Limit,  
ppm = mg/l (liquid) or mg/kg (solid), ppb = ug/l (liquid) or ug/kg (solid)



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Client: Savin Lake Services

WWA Job #: 58706

Project: Lake Studies

Date Received: 7/31/2015

Date Reported: 8/20/2015

### Sample Results

Sample No. / ID / Description / Matrix	Result	Flags	Units	Date	Method	MDL	MQL
<b>58706-005 / Site 1 - 4 ft</b>							
<b>General Chemistry Parameters</b>							
Conductivity	320		umho/cm	7/31/2015	2510B	1	2
<b>58706-006 / Site 2 - Surface / Hess Lake / Water</b>							
<b>General Chemistry Parameters</b>							
chlorophyll a	14		mg/m3	8/6/2015	10200H	NA	NA
Conductivity	320		umho/cm	7/31/2015	2510B	1	2
o-Phosphorus	ND		mg/L	7/31/2015	4500-P F	0.005	0.025
Total Phosphorus (t)	0.02	J	mg/L	8/5/2015	365.4	0.005	0.04
Total Suspended Solids	19	H	mg/L	8/4/2015	2540D	3	3
<b>58706-007 / Site 2 - Middle / Water</b>							
<b>General Chemistry Parameters</b>							
o-Phosphorus	ND		mg/L	7/31/2015	4500-P F	0.005	0.025
Total Phosphorus (t)	0.03	J	mg/L	8/5/2015	365.4	0.005	0.04
Total Suspended Solids	15	H	mg/L	8/4/2015	2540D	3	3
<b>58706-008 / Site 2 - Deep / Water</b>							
<b>General Chemistry Parameters</b>							
o-Phosphorus	ND		mg/L	7/31/2015	4500-P F	0.005	0.025
Total Phosphorus (t)	0.05		mg/L	8/5/2015	365.4	0.005	0.04
Total Suspended Solids	17	H	mg/L	8/4/2015	2540D	3	3

ND = Not Detected, MDL = Method Detection Limit, MQL = Method Quantitation Limit,  
ppm = mg/l (liquid) or mg/kg (solid), ppb = ug/l (liquid) or ug/kg (solid)



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Client: Savin Lake Services

WWA Job #: 58706

Project: Lake Studies

Date Received: 7/31/2015

Date Reported: 8/20/2015

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**Sample Results**


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Sample No. / ID / Description / Matrix	Result	Flags	Units	Date	Method	MDL	MQL
<b>58706-009 / Site 2 - 2 ft</b>							
<b>General Chemistry Parameters</b>							
Conductivity	320		umho/cm	7/31/2015	2510B	1	2
<b>58706-010 / Site 2 - 4 ft</b>							
<b>General Chemistry Parameters</b>							
Conductivity	320		umho/cm	7/31/2015	2510B	1	2
<b>58706-011 / Site 2 - 6 ft</b>							
<b>General Chemistry Parameters</b>							
Conductivity	320		umho/cm	7/31/2015	2510B	1	2

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**Cover Page**

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**Client:** Savin Lake Services

**WWA Job #:** 59554

---

**Project:** Lake Studies

**Date Received:** 9/21/2015

**Date Reported:** 10/12/2015

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<b>Sample Number</b>	<b>Client Sample ID</b>	<b>Date Sampled</b>	<b>Sample Matrix</b>
59554-001	Site 1 Surface	09/14/15	Water
59554-002	Site 2 Surface	09/14/15	Water
59554-003	Site 1 Middle	09/14/15	Water
59554-004	Site 1 Deep	09/14/15	Water
59554-005	Site 1 2-Feet	09/14/15	Water
59554-006	Site 1 4-Feet	09/14/15	Water
59554-007	Site 2 Middle	09/14/15	Water
59554-008	Site 2 Deep	09/14/15	Water
59554-009	Site 2 2-Feet	09/14/15	Water
59554-010	Site 2 4-Feet	09/14/15	Water
59554-011	Site 2 6-Feet	09/14/15	Water
59554-012	Site 1	09/09/15	Water
59554-013	Site 2	09/09/15	Water
59554-014	Site 3	09/09/15	Water
59554-015	Site 1	09/10/15	Water
59554-016	Site 2	09/10/15	Water
59554-017	Site 3	09/10/15	Water
59554-018	Site 1	09/08/15	Water
59554-019	Site 2	09/08/15	Water
59554-020	Site 3	09/08/15	Water

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**Cover Page..continued**

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**Client:** Savin Lake Services

**WWA Job #:** 59554

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**Comments (if any):**

**Key to Laboratory Flags:**

- \*: RPD exceeds limits.
- B: The analyte was found in the associated blank as well as in the sample.
- J: The quantitation is an estimated value because the result is less than the sample quantitation limit but greater than the detection limit.
- M: A matrix effect was present.
- Q: Batch QC data associated with the analysis does not meet the stated objectives
- H: Indicates analytical holding time exceedance.
- U: The analyte was analyzed for, but not detected.
- P: A manual peak selection or manual integration was performed to correct an erroneous software selection.

ND = Not Detected, MDL = Method Detection Limit, MQL = Method Quantitation Limit  
ppm = mg/L (liquid) or mg/kg (solid), ppb = ug/L (liquid) or ug/kg (solid)  
For coliform, Negative = No coliform bacteria detected, Positive = Coliform bacteria detected

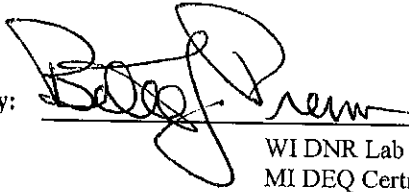
**Sample Types:**

S = Solids, DW = Drinking water, D = Dissolved, T = Total, TC = TCLP extract, SP = SPLP extract

All samples were received intact and properly preserved unless otherwise noted. The results reported relate only to the samples tested. This report shall not be reproduced, except in full, without the written approval of this laboratory. The Chain of Custody is attached.

This report satisfies the requirements of your project but has not been prepared to comply with NELAP reporting requirements.

I certify that the data contained in this Final Report has been generated and reviewed in accordance with approved methods and White Water Associates Standard Operating Procedures. Exceptions, if any, are discussed in the accompanying sample narrative. Release of this Final Report is authorized by White Water Associates management, as is verified by the following signature.

Approved By: 

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WI DNR Lab Certification Number: 999971280  
MI DEQ Certification Number: 9306  
DoD-ELAP Accreditation Number: 65802  
ISO/IEC 17025:2005 Accredited



429 River Lane • PO Box 27 Amasa, MI 49903 • Ph (906) 822-7889 • Fax -7977

Client: Savin Lake Services

WWA Job #: 59554

Project: Lake Studies

Date Received: 9/21/2015

Date Reported: 10/12/2015

### Sample Results

Sample No. / ID / Description / Matrix	Result	Flags	Units	Date	Method	MDL	MQL
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#### 59554-001 / Site 1 Surface / Hess Lake / Water

##### General Chemistry Parameters

chlorophyll a	8.5	*	mg/m3	9/30/2015	10200H	NA	NA
Conductivity	330		umho/cm	9/23/2015	2510B	1	2
o-Phosphorus	0.0044		mg/L	9/21/2015	4500-P F	0.005	0.025
Total Phosphorus (t)	0.03	J	mg/L	9/25/2015	365.4	0.005	0.04
Total Suspended Solids	24		mg/L	9/21/2015	2540D	9	9

#### 59554-002 / Site 2 Surface / Hess Lake / Water

##### General Chemistry Parameters

chlorophyll a	29	*	mg/m3	9/30/2015	10200H	NA	NA
Conductivity	330		umho/cm	9/23/2015	2510B	1	2
o-Phosphorus	0.0048		mg/L	9/21/2015	4500-P F	0.005	0.025
Total Phosphorus (t)	0.04	J	mg/L	9/25/2015	365.4	0.005	0.04
Total Suspended Solids	21	*	mg/L	9/21/2015	2540D	9	9

#### 59554-003 / Site 1 Middle / Hess Lake / Water

##### General Chemistry Parameters

o-Phosphorus	0.0050		mg/L	9/21/2015	4500-P F	0.005	0.025
Total Phosphorus (t)	0.04	J	mg/L	9/25/2015	365.4	0.005	0.04
Total Suspended Solids	23		mg/L	9/21/2015	2540D	9	9

ND = Not Detected, MDL = Method Detection Limit, MQL = Method Quantitation Limit,  
ppm = mg/l (liquid) or mg/kg (solid), ppb = ug/l (liquid) or ug/kg (solid)



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Client: Savin Lake Services

WWA Job #: 59554

Project: Lake Studies

Date Received: 9/21/2015

Date Reported: 10/12/2015

### Sample Results

Sample No. / ID / Description / Matrix	Result	Flags	Units	Date	Method	MDL	MQL
<b>59554-004 / Site 1 Deep / Hess Lake / Water</b>							
<b>General Chemistry Parameters</b>							
o-Phosphorus	0.0086		mg/L	9/21/2015	4500-P F	0.005	0.025
Total Phosphorus (t)	0.04	J	mg/L	9/25/2015	365.4	0.005	0.04
Total Suspended Solids	24		mg/L	9/21/2015	2540D	10	10
<b>59554-005 / Site 1 2-Foot / Hess Lake / Water</b>							
<b>General Chemistry Parameters</b>							
Conductivity	330		umho/cm	9/23/2015	2510B	1	2
<b>59554-006 / Site 1 4-Foot / Hess Lake / Water</b>							
<b>General Chemistry Parameters</b>							
Conductivity	330		umho/cm	9/23/2015	2510B	1	2
<b>59554-007 / Site 2 Middle / Hess Lake / Water</b>							
<b>General Chemistry Parameters</b>							
o-Phosphorus	0.0061		mg/L	9/21/2015	4500-P F	0.005	0.025
Total Phosphorus (t)	0.04	J	mg/L	9/25/2015	365.4	0.005	0.04
Total Suspended Solids	21		mg/L	9/21/2015	2540D	9	9

ND = Not Detected, MDL = Method Detection Limit, MQL = Method Quantitation Limit,  
ppm = mg/l (liquid) or mg/kg (solid), ppb = ug/l (liquid) or ug/kg (solid)



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Client: Savin Lake Services

WWA Job #: 59554

Project: Lake Studies

Date Received: 9/21/2015

Date Reported: 10/12/2015

### Sample Results

Sample No. / ID / Description / Matrix	Result	Flags	Units	Date	Method	MDL	MQL
<b>59554-008 / Site 2 Deep / Hess Lake / Water</b>							
<b>General Chemistry Parameters</b>							
o-Phosphorus	0.0044		mg/L	9/21/2015	4500-P F	0.005	0.025
Total Phosphorus (t)	0.05		mg/L	9/25/2015	365.4	0.005	0.04
Total Suspended Solids	29		mg/L	9/21/2015	2540D	11	11
<b>59554-009 / Site 2 2-Feet / Hess Lake / Water</b>							
<b>General Chemistry Parameters</b>							
Conductivity	330		umho/cm	9/23/2015	2510B	1	2
<b>59554-010 / Site 2 4-Feet / Hess Lake / Water</b>							
<b>General Chemistry Parameters</b>							
Conductivity	330		umho/cm	9/23/2015	2510B	1	2
<b>59554-011 / Site 2 6-Feet / Hess Lake / Water</b>							
<b>General Chemistry Parameters</b>							
Conductivity	330		umho/cm	9/23/2015	2510B	1	2

ND = Not Detected, MDL = Method Detection Limit, MQL = Method Quantitation Limit,  
ppm = mg/l (liquid) or mg/kg (solid), ppb = ug/l (liquid) or ug/kg (solid)

The water sample analyzed from this water body exceeded a threshold cyanobacteria level and consequently produced a SeSCRIPT Cyanobacteria Alert (Table 1). This SeSCRIPT Alert Index highlights potential risks associated with toxic cyanobacteria and provides general management options for consideration.

**Table 1.** Alert levels of cyanobacteria in freshwaters (modified from World Health Organization 1999).

SeSCRIPT ALERT INDEX	EXPOSURE RISK	CYANOBACTERIA LEVELS (cells/mL)	POTENTIAL EXPOSURE RISKS
★	Low	< 20,000	Although cyanobacteria may currently be at low levels, presence is an indicator the water body may support conditions that could fuel levels of health concern for animals and humans.
★★	Moderate	20,000 - 100,000	Moderate probability of short-term adverse health outcomes (skin irritations, gastrointestinal illness). Potential for long-term illness with chronic exposures.
★★★	High	>100,000	High probability of short-term adverse health outcomes (skin irritations, gastrointestinal illness). Potential for long-term illness with chronic exposures.
★★★★	Extreme	>100,000 with scums/mats	High potential for significant respiratory, gastrointestinal and neurological impacts. Potential for acute poisonings. Potential for long-term illness with chronic exposures.

### Cyanobacteria Facts

Cyanobacteria, also known as blue-green algae, are readily present in freshwaters throughout the United States. Cyanobacteria blooms often appear as bluish-green surface scums or thick mats (Images 1 and 2), although some infestations are dispersed through the water and provide slight discoloration (Image 3). With rapid growth rates under certain conditions, these organisms have the ability to achieve levels of ecological and human health concern in short order. Some cyanobacteria have the ability to form surface scums through buoyancy regulation and become highly concentrated in static or windblown areas of water bodies. Caution should be taken around cyanobacteria infestations to avoid exposure and resultant potential health risks.



Image 1. Cyanobacteria scum



Image 2. Cyanobacteria mat



Image 3. Discolored water

## Cyanobacteria Impacts

Cyanobacteria are capable of producing toxins that can pose significant risks to humans and wildlife. Common cyanobacteria associated toxins includes; hepatotoxins (impacts liver/kidney), neurotoxins (impacts brain), dermatitis toxins (impacts skin, digestive system) and gastrointestinal toxins (impacts digestive system). Animal mortalities from cyanobacteria toxin exposure have, in part, included: cows, dogs, pigs, and ducks (Cook et al. 1989; Mez et al. 1997; Wood et al. 2007). Human exposure is commonly from inhalation of aerosolized toxins, ingestion/consumption of contaminated water/ algae cells, or recreational skin contact with cyanobacteria infestations. A summary of toxins groups and exposure signs and symptoms is presented in Table 2. Correlations have been made between chronic cyanotoxin exposure and neurodegenerative diseases, such as ALS and Alzheimer's (Bradley & Mash 2009), and human mortalities have been observed (Carmichael 2001) in extreme exposure scenarios.

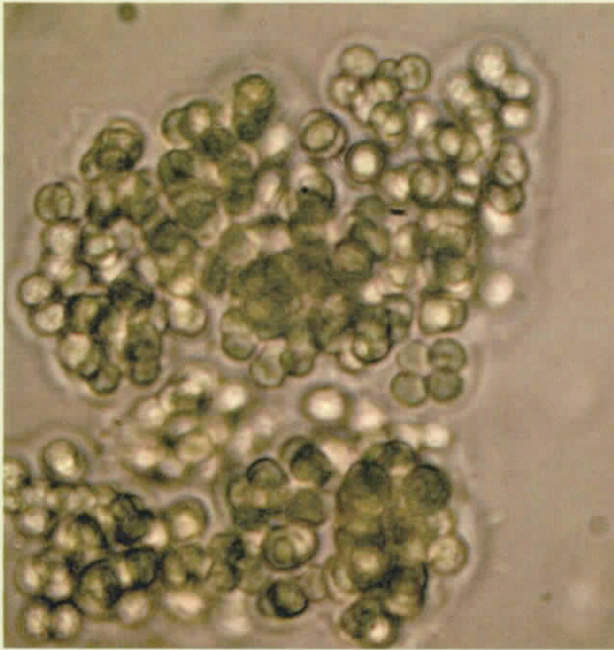
**Table 2.** Partial summary of cyanobacteria toxin types and associated exposure signs and symptoms (modified Codd et al. 1999; WHO 1999; Graham 2007, Jewet et al. 2008).

Toxin Group	Toxin Name	Exposure Signs & Symptoms
Hepatotoxins (liver/kidney)	Microcystins Nodularins Cylindrospermopsin	Numbness of lips, tingling in fingers/toes, dizziness, headache, diarrhea, jaundice, shock, abdominal pain/distention, weakness, nausea/vomiting, severe thirst, rapid/weak pulse, acute pneumonia
Neurotoxins (brain)	Anatoxins Saxitoxins $\beta$ -Methylamino-L-alanine	Tingling, burning, numbness, drowsiness, incoherent speech, paralysis, weakness, staggering, convulsions, difficulty in breathing, vomiting, muscle twitching, gasping, backward arching of neck in birds, and death
Dermatitis/Gastrointestinal (skin/digestive)	Aplysiatoxins Lipopolysaccharides Lyngbyatoxin	Rash, redness, burning, skin irritation, acute dermatitis, hives, blisters, abdominal pain, vomiting, diarrhea

## Cyanobacteria Management

Even if toxins are not at detectable levels, we cannot conclusively say there are no risks associated with cyanobacteria infestations due to, 1) the continued discoveries of new toxins and other secondary metabolites and consequent lack of knowledge regarding their toxicological effects or analytical detection, and 2) the production of toxins is intermittent (some algae may not produce today, though may tomorrow or next week). Therefore, source control of the potential toxin producing culprits (i.e. cyanobacteria) is recommended to shut off the toxin source, remove the exposure and offset consequent risks. Management can be proactive (phosphorus mitigation) to prevent further growth and/or reactive (algaecides). Management programs are developed on a site specific basis by incorporating characteristics of the algae (density, structure, location etc.), characteristics of the water (nutrient levels, hardness, pH etc.) and the designed formulation of solutions (phosphorus inactivation, copper formulation, surfactant presence, etc.). See the Treatment Guidance section of your SeSCRIPT report for a customized, site-specific management program and contact your SePRO Aquatic Specialist for additional assistance.

### Algae Pictures



## SeSCRIPT Analysis Report: *Hess Lake*

**Company:** Savin Lake Services

**Water Body Name:** Hess Lake: Site 2

**Address:** 3088 Hottis Rd. Hale, MI 48739

**Surface Area:** 755 acres

**Contact Person:** Matthew Novotry

**Average depth:** 5 feet

**Phone:** 989-728-2200

**Date Sample Received:** 7/16/14

**Email:** mattnovotry@lakeandpond.com

**SeSCRIPT Analysis Performed:** Algae ID

### Algae ID Results *Hess Lake Site 2*

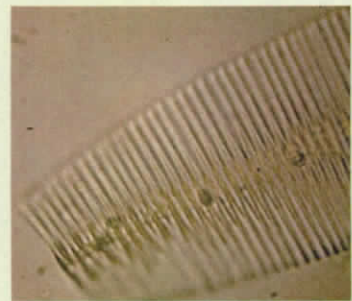
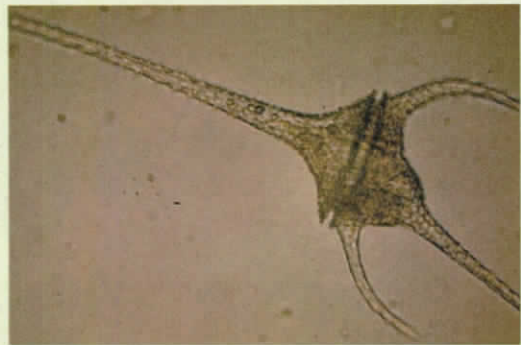
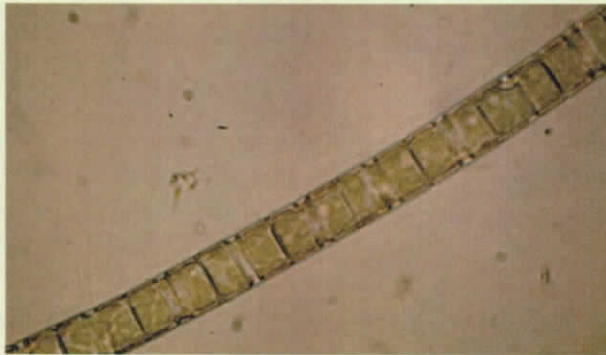
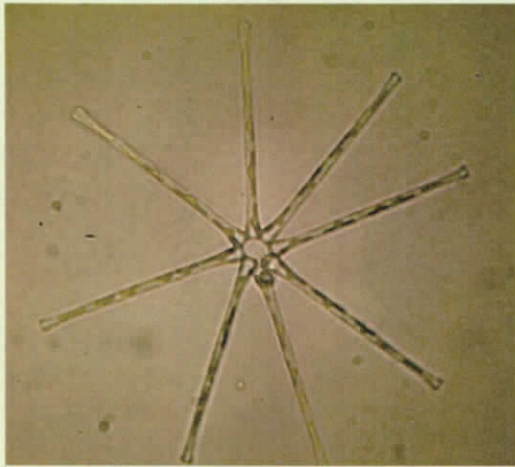
Identification	Classification	Description	Density/Biomass (cells/mL)
<i>Microcystis</i> spp. (dominant)	Cyanophyta- Blue-green algae	Colonial, scum-former, potential toxin producer	2,400 ★
<i>Aulacoseira</i> sp. (low density)	Bacillariophyta- Diatoms	Filamentous, planktonic	1,200
<i>Pediastrum</i> sp. (low density)	Chlorophyta- Green algae	Colonial, planktonic	800

Other algae in the sample, at densities below 400 cells/mL, include: *Aphanocapsa* (Cyanophyta); *Ceratium* (Pyrrophyta); *Asterionella*, *Fragillaria* (Bacillariophyta)

SeSCRIPT* ALERT INDEX	EXPOSURE RISK	CYANOBACTERIA LEVELS (cells/mL)
★	Low	<20,000
★★	Moderate	20,000 to 100,000
★★★	High	>100,000
★★★★	Extreme	>100,000 with scums/mats
See the following Cyanobacteria Alert Guide for additional information		



### Algae Pictures



## References

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## SeSCRIPT Analysis Report: *Hess Lake*

**Company:** Savin Lake Services

**Water Body Name:** Hess Lake

**Address:** 3088 Hortis Rd, Hale, MI

**Surface Area:** 755 acres

**Contact Person:** Matt Novotny

**Average depth:** Not reported

**Phone:** 989-728-2200

**Date Sample Received:** 7/30/15

**Email:** mattnovotny@LakeandPond.com

**SeSCRIPT Analysis Performed:** Algae Identification and Enumeration

### Algae ID Results *Hess Lake Site 1*

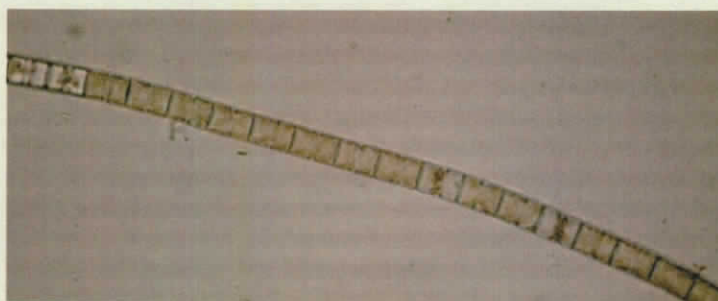
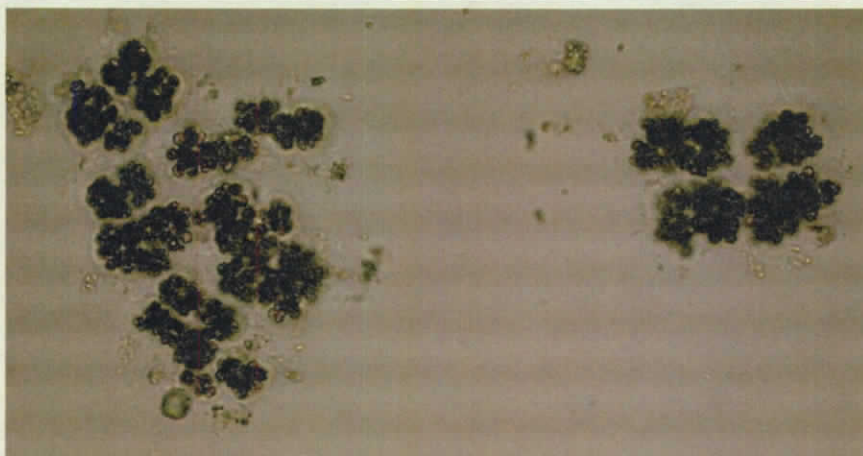
Identification	Classification	Description	Density/Biomass (cells/mL)
<i>Microcystis</i> sp. (little present)	Cyanophyta- blue-green algae	scum-former, colonial, potential toxin and taste and odor producer	< 40
<i>Stephanodiscus</i> sp. (little present)	Bacillariophyta- Diatom	Single-celled, planktonic	< 40
<i>Scenedesmus</i> sp. (little present)	Chlorophyta- Green algae	Colonial, planktonic	< 40
<i>Oocystis</i> sp. (little present)	Chlorophyta- Green algae	Colonial, planktonic	< 40



### Algae ID Results Hess Lake Site 2

Identification	Classification	Description	Density/Biomass (cells/mL)
<i>Microcystis</i> sp. (little present)	Cyanophyta- blue-green algae	scum-former, colonial, potential toxin and taste and odor producer	280
<i>Oocystis</i> sp. (little present)	Chlorophyta- Green algae	Colonial, planktonic	90

Other algae in the sample, at densities below 40 cells/mL, include: *Scenedesmus* (Chlorophyta); *Asterionella*, *Aulacoseria*, *Stephanodiscus* (Bacillariophyta)



SeSCRIPT Analysis Report: *Hess Lake*

Company: Savin Lake Services

Water Body Name: Hess Lake

Address: 3088 Hottis Rd., Hale, MI

Surface Area: 755 acres

Contact Person: Matt Novotny

Average depth: 7 feet

Phone: 989-728-2200

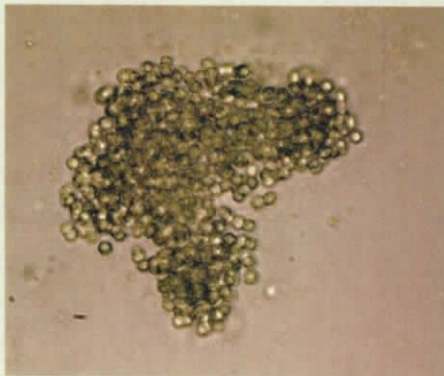
Date Sample Received: 9/18/15

Email: mattnovotny@LakeandPond.com

SeSCRIPT Analysis Performed: Algae Identification  
and EnumerationAlgae ID Results  
*Hess Lake Site 1*

Identification	Classification	Description	Density/ Biomass (cells/mL)
<i>Microcystis</i> sp. (much present)	Cyanophyta- Blue-green algae	Colonial, planktonic/ scum-former, potential toxin and taste and odor producer	3,900
<i>Cyanodictyon</i> sp. (much present)	Cyanophyta- Blue-green algae	Colonial, planktonic	1,980
<i>Planktothrix</i> sp. (much present)	Cyanophyta- Blue-green algae	Filamentous, planktonic/ scum-former, potential toxin and taste/odor producer	1,260

Other algae in the sample, at densities below 40 cells/mL, include: *Scenedesmus*, *Pediastrum*, *Oocystis*, *closterium*, *Crucigenia* (Chlorophyta); *Stephanodiscus*, *Aulacoseria* (Bacillariophyta); *Lyngbya* (Cyanophyta)



## Algae ID Results Hess Lake Site 2

Identification	Classification	Description	Density/ Biomass (cells/mL)
<i>Planktothrix</i> sp. (much present)	Cyanophyta- Blue-green algae	Filamentous, planktonic/ scum-former, potential toxin and taste/odor producer	36,200 ★★
<i>Microcystis</i> sp. (much present)	Cyanophyta- Blue-green algae	Colonial, planktonic/ scum-former, potential toxin and taste and odor producer	6,600
<i>Cyanodictyon</i> sp. (much present)	Cyanophyta- Blue-green algae	Colonial, planktonic	1,200

Other algae in the sample, at densities below 40 cells/mL, include: *Tetraedron*, *Pediastrum* (Chlorophyta); *Aulacoseira*, *Achnanthes* (Bacillariophyta); *Chroococcus*, *Aphanocapsa* (Cyanophyta)

SeSCRIPT* ALERT INDEX	EXPOSURE RISK	CYANOBACTERIA LEVELS (cells/mL)
★	Low	<20,000
★★	Moderate	20,000 to 100,000
★★★	High	>100,000
★★★★	Extreme	>100,000 with scums/mats

See the following *Cyanobacteria Alert Guide* for additional information

