HIGGINS LAKE WATER ANALYSIS

Report #5 Seventh year

SEPTEMBER 27, 2024

RAVEN ANALYTICAL
104 First Street

Higgins Lake Report

The Higgins Lake Property Owners Association (HLPOA) approached Raven Analytical Laboratory in Roscommon, Michigan in 2018 to provide water testing on Higgins Lake. This was to be a multi year evaluation of the chemistry of the Lake and any changes over time.

This testing began as a project in concert with the Roscommon high school chemistry students (teacher). We have a new group of students for 2024. Raven personnel trained students with all the procedures and testing protocols necessary to complete this study. The actual testing took place in our EPA certified laboratory under the direct supervision of our staff. In this way we help reinforce the chemistry the students are learning and make the community aware of the concern for the total ecology of Higgins Lake.

As this was a first introduction meeting, training was held with the chemistry students at the laboratory. They were very excited and looking forward to begin training and start testing the lake. This group of students performed their first round of training and testing on May 25th. A picture and list of students and grades is provided in Appendix A.

This report covers the testing of water and the results on Higgins Lake on September 27, 2024.

Based on the data provided for testing from USGS suggestions and the concern(s) about the water quality on Higgins Lake, the following testing protocols are suggested.

Water Tests:

1. Phosphorus
    a. Total phosphorus is reported in milligrams/liter (mg/L)
2. Nitrate
    a. Nitrate is reported in milligrams/liter (mg/L)
3. Nitrite
    a. Nitrite is reported in milligrams/liter (mg/L)
4. pH
    a. pH is measured on a 1 to 14 scale with pure water being a pH of 7.0
5. Dissolved Oxygen
    a. Dissolved oxygen is reported in milligrams/liter (mg/L
6. Total dissolved solids (TDS)
    a. measured in parts per million
7. Conductivity
    a. Conductivity is reported in microsiemens per centimeter (uS/cm)
8. Water Temperature
    a. Measured in degrees Centigrade
9. Air Temperature
    a. Measured in degrees Centigrade
10. Beach Plate Count; MPN
    a. Most probable number (MPN) is measured in colonies per 100 milliliters of cultured water
11. Beach Plate count: E-coli
    a. E-coli is measured in colonies per 100 milliliters of cultured water

All water analysis was performed at Raven Analytical Laboratory in Roscommon using EPA approved test methods. This lab is an EPA certified water analysis laboratory (#9954) and has two certified water sanitarians on staff at Roscommon.

The listing of testing areas, such as high human concentration, lagoons, both state parks and boat launches along with the marinas and suggestions from the Team resulted in the following test sites:

1. Water quality tests were performed at:

	Site #		
Gerrish Township Marina	**1**	44.428433	-84.701303
South State Park	**2**	44.425523	-84.684881
Cut river	**3**	44.433023	-84.669963
Sam-O-Set	**4**	44.465303	-84.739635
DNR boat launch	**5**	44.477728	-84.778012
Gold Coast	**6**	44.466471	-84.767884
North State Park	**7**	44.511663	-84.758545
B&B Marina	**8**	44.511237	-84.742792
Camp Cornelia	**9**	44.496694	-84.699217
Treasure Island – 1	**10**	44.477461	-84.727788
Treasure Island – 2	**11**	44.482555	-84.722664
Kennedy Beach	**12**	44.457288	-84.670740
Flag Point	**13**	44.471165	-84.696090

Data collected:

Although there are no maximum limits on Phosphorus and nitrogen for pond and lake waters, as a reference, the EPA regulations for drinking water standards for these are 1 mg/L for Phosphorus and 10 ppm for nitrogen.

Swimming beaches should be tested for water quality before the swimming season begins to get a baseline of contamination resulting from natural wildlife or run-off and tested thereafter until the season ends. Beaches may be regulated by local ordinances or local health standards. The standards developed for the Great Lakes in Michigan and may be used for inland beaches are:

- If the E. coli count is greater than 1000 MPN/100 mL, the beach is closed.
- If the E. coli count is greater than 235 MPN/100 mL but less than 1000 MPN/100 mL, an advisory is issued.
- If the E. coli count is under 235 MPN/100 mL, the beach has no advisories or warnings issued.

The data collected from the thirteen sites in this round of testing on September 27, 2024 is shown in the Tables below.

5/22/2024

Site	Result 1	2	3	4	5	6	7
Phosphorus	N.D.	0.29	0.17	0.37	0.24	0.04	0.19
Nitrogen (Nitrate)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Nitrogen (Nitrite)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Beach Plate Count; MPN	689	1011	629	792	830	659	549
Beach Plate Count; e-coli	6.3	6.3	4	6	1	12.6	2
pH	8.23	8.8	8.39	8.68	8.77	8.89	8.7
Dissolved Oxygen	8.57	8.89	8.93	8.7	8.6	8.2	8.42
Total Dissolved Solids	142	144	142	143	145	143	143
Water Temperature; C	16.3	16.3	16.3	16.3	16.3	16.3	16.3
Air Temperature; C	23.3	23.3	23.3	23.3	23.3	23.3	23.3
Conductivity; uS	257	256	258	285	284	287	286

Site	8	9	10	11	12	13
Phosphorus	N.D.	N.D.	N.D.	N.D.	N.D.	0.15
Nitrogen (Nitrate)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Nitrogen (Nitrite)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Beach Plate Count; MPN	515	659	629	689	658	792
Beach Plate Count; e-coli	3	9.7	7.5	3	14.8	8.5
pH	8.46	8.62	8.51	8.89	8.55	8.42
Dissolved Oxygen	8.32	8.52	8.36	8.27	9.19	8.57
Total Dissolved Solids	143	148	145	143	142	144
Water Temperature; C	16.3	16.3	16.3	16.3	16.3	16.3
Air Temperature; C	23.3	23.3	23.3	23.3	23.3	23.3
Conductivity; uS	286	286	291	286	284	286

6/22/2024

Site	Result 1	2	3	4	5	6	7
Phosphorus	N.D.	0.21	0.1	0.05	0.23	0.11	0.09
Nitrogen (Nitrate)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Nitrogen (Nitrite)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Beach Plate Count; MPN	1011	1011	1011	1011	961	1011	1011
Beach Plate Count; e-coli	21	10.6	29	30	16	29	13.5
pH	7	7.2	6.6	7.1	7.22	7.3	7.78
Dissolved Oxygen	6.54	6.41	6.41	6.53	6.37	6.35	6.37
Total Dissolved Solids	257	144	147	143	143	143	143
Water Temperature; C	18.8	18.8	18.8	18.8	18.8	18.8	18.8
Air Temperature; C	18.8	18.8	18.8	18.8	20.5	20.5	20.5
Conductivity; uS	513	287	294	286	286	286	286

Site	8	9	10	11	12	13
Phosphorus	N.D.	N.D.	0.03	0.04	0.02	0.01
Nitrogen (Nitrate)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Nitrogen (Nitrite)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Beach Plate Count; MPN	1011	914	1011	914	1011	1011
Beach Plate Count; e-coli	27	34	23	18	28	28
pH	7.36	7.47	7.55	7.57	7.6	7.69
Dissolved Oxygen	6.42	6.02	6.3	6.44	6.97	7.05
Total Dissolved Solids	144	143	143	143	143	143
Water Temperature; C	19.3	19.3	19.3	19.3	19.3	19.3
Air Temperature; C	22.2	22.2	22.2	22.2	22.2	22.2
Conductivity; uS	288	285	286	285	285	285

7/25/2024	Result						
Site	**1**	2	3	4	5	6	7
Phosphorus	0.21	0.07	0.1	0.11	0.11	0.23	0.22
Nitrogen (Nitrate)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Nitrogen (Nitrite)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Beach Plate Count; MPN	1011	1011	1011	1011	1011	1011	1011
Beach Plate Count; e-coli	4	3	1	2	1	1	1
pH	7.03	7.17	7.15	7.43	7.17	7.49	7.53
Dissolved Oxygen	6.5	6.2	6.1	6.7	6.5	5.8	6.2
Total Dissolved Solids	143	140	138	139	139	142	140
Water Temperature; C	25.5	25.5	25.5	25.5	25.5	25.5	25.5
Air Temperature; C	18.9	18.9	18.9	18.9	18.9	18.9	18.9
Conductivity; uS	285	279	277	278	279	282	280

Site	8	9	10	11	12	13
Phosphorus	0.12	0.05	0.11	0.23	0.02	0.08
Nitrogen (Nitrate)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Nitrogen (Nitrite)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Beach Plate Count; MPN	1011	1011	1011	1011	1011	1011
Beach Plate Count; e-coli	1	3	1	1	1	4
pH	7.56	7.58	7.71	7.57	7.73	7.75
Dissolved Oxygen	6	5.9	5.8	5.7	6	5.8
Total Dissolved Solids	145	139	140	140	138	144
Water Temperature; C	25.5	25.5	25.5	25.5	25.5	25.5
Air Temperature; C	18.9	18.9	18.9	18.9	18.9	18.9
Conductivity; uS	281	278	278	282	276	291

08/27/2024

Site	Result 1	2	3	4	5	6	7
Phosphorus	0.30	0.07	0.02	0.38	0.06	0.10	0.14
Nitrogen (Nitrate)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Nitrogen (Nitrite)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Beach Plate Count; MPN	1011	1011	601.5	1011	1011	1011	1011
Beach Plate Count; e-coli	4.1	4.1	3.1	4.1	1.0	7.5	2.0
pH	7.38	7.44	7.49	7.60	7.58	7.63	7.65
Dissolved Oxygen	5.4	5.3	6.1	5.9	6.0	5.9	6.0
Total Dissolved Solids	147	136	141	136	135	136	136
Water Temperature; C	25.2	25.2	25.2	25.2	25.2	25.2	25.2
Air Temperature; C	25.6	25.6	25.6	25.6	25.6	25.6	25.6
Conductivity; uS	294	271	282	272	270	273	272

Site	8	9	10	11	12	13
Phosphorus	0.17	0.06	0.01	0.01	0.03	0.01
Nitrogen (Nitrate)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Nitrogen (Nitrite)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Beach Plate Count; MPN	1011	1011	1011	1011	238.2	193.5
Beach Plate Count; e-coli	1.0	5.2	2.0	1.0	<1	<1
pH	7.70	7.67	7.74	7.71	7.75	7.77
Dissolved Oxygen	5.6	5.8	5.7	5.4	5.3	5.5
Total Dissolved Solids	136	135	138	135	136	135
Water Temperature; C	25.2	25.2	25.2	25.2	25.2	25.2
Air Temperature; C	25.6	25.6	25.6	25.6	25.6	25.6
Conductivity; uS	271	270	277	270	271	270

9/25/2024

Site	Result 1	2	3	4	5	6	7
Phosphorus	0.04	0.04	0.48	0.75	0.05	0.85	0.02
Nitrogen (Nitrate)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Nitrogen (Nitrite)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Beach Plate Count; MPN	397	266	328	218	299	272	361
Beach Plate Count; e-coli	2	2	2	3	3	1	1
pH	7.9	7.75	7.81	7.8	7.76	7.75	7.18
Dissolved Oxygen	6.7	5.5	5.8	6.0	5.6	5.6	6.0
Total Dissolved Solids	150	139	139	141	138	138	126
Water Temperature; C	25.2	25.2	25.2	25.2	25.2	25.2	25.2
Air Temperature; C	17.2	17.2	17.2	17.2	17.2	17.2	17.2
Conductivity; uS	277	291	293	281	276	279	250

Site	8	9	10	11	12	13
Phosphorus	0.06	0.03	0.03	0.02	0.04	0.03
Nitrogen (Nitrate)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Nitrogen (Nitrite)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Beach Plate Count; MPN	416	285	361	272	328	328
Beach Plate Count; e-coli	1	4	2	1	2	4
pH	7.35	8.27	7.23	7.34	7.54	7.71
Dissolved Oxygen	5.6	6.2	6.0	6.5	6.4	7.0
Total Dissolved Solids	138	126	127	127	126	139
Water Temperature; C	25.2	25.2	25.2	25.2	25.2	25.2
Air Temperature; C	17.2	17.2	17.2	17.2	17.2	17.2
Conductivity; uS	274	253	252	254	252	278

A couple of comment points concerning this project that are important for everyone involved.

The key to this project is the students. The students were very quick and eager to learn. They would take over responsibility for the testing, helping each other to complete all the tasks. This demonstrates the team building and win/win attitude to critical thinking problem solving.

One of the main goals of this project was not so much "teaching" them chemistry but demonstrating how to incorporate their education into a life experience. A unique method of testing was instituted. The methodology was:

> The laboratory personnel would train one student for each test performed.
>
> This student would perform the test with lab certified personnel.
>
> The student would then train the next student in line on each test.
>
> This technique would continue until each student had the opportunity to perform all the testing as well as train each other on each of the tests.

It is a privilege to work with these students and I trust this life experience will continue to motivate and encourage them further in whatever and where ever they go in life.

Another significant key to this project is that none of this could be accomplished without the support of our sponsors. Additionally, this project was not possible without the support of the Roscommon High School superintendent, Ms. Cathy Erickson, and the dedicated educator Greg Neville at the High School. A few of our sponsors are cited below under Acknowledgments.

Like their motto says,

"Life is all about testing the waters".

An annual report covering the last seven years of testing will be published and distributed by the end of this year. This report will contain statistics, Raw data, and graphs.

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Life is about

Testing the waters

Roscommon High School


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