



HIGGINS LAKE WATER ANALYSIS

Report #4



NOVEMBER 1, 2018
RAVEN ANALYTICAL
104 First street

Higgins Lake Report

The Higgins Lake Property Owners Association (HLPOA) approached Raven Analytical Laboratory in Roscommon, Michigan to provide water testing on Higgins Lake.

In discussions with Mr. Fred Swinhart, HLPOA contact, it was suggested that we make this testing a project in concert with the area high school chemistry students (teacher). Raven personnel would train students with all the procedures and testing necessary to complete this study. The actual testing would take place in our EPA certified laboratory under the direct supervision of our staff. We have performed this type of project with a number of high schools in our area. 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. While this is not a necessary component for the project, we have found that it can be very beneficial for the whole project and the community at large. Mr. Chuck Schepke, High school chemistry teacher was contacted along with Ms. Catherine Erickson, Superintendent Roscommon Area Public Schools and Mr. Fred Swinehart, HLPOA. This formed a team to begin effort on water testing at Higgins Lake.

This report covers the fourth (final initial year) round of water testing on Higgins Lake on October 22,23 and 24, 2018 as well as the data from the first and second and third round of testing.

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
 - a. Total dissolved solids (TDS) is measured in percent
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 a certified water sanitarian on staff at Roscommon. Training and testing was performed by the Roscommon High School students under the guidance and direction of certified water chemists.

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	-84.468881
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.

Students from the Roscommon High School under the direction of chemistry teacher Chuck Schepke, were provided water analysis training using EPA standards. This included all necessary training in water collection, chain-of-custody, data logging, safety and actual chemical analysis.

The list of students who are interested in the project from the Roscommon High School under the direction of chemistry teacher, Chuck Schepke include:

* Chem II students, rest Chem I.

Dylan Aubrey	Micheal Ficaj *	Danielle Rhinehart
Brady Briggs	Ethan Gussler	Mac Schultz
JT Cole	Caleb Jacobs *	John Stillwell
Ashley Desmith	Justin Janisse	Jaythn Sylla *
Jessica Disney	Jeff Kuchar	Dominic Tatrai *
Anna Erickson	Lindsey Lewandowski *	Emily Terry
Karlee Erickson	Brandon Mitchell	Zoe Thomas
Ethan Ferency	Taryan Pace	Jennifer Tussey
		Ian Wybraniec

The data collected from the eleven sites in the first round of testing on May 16 – 18, 2018 is shown in Table 1 below.

Table 1: Analytical Test Results:

Lab Number	180518 -6	180518 -5	180518 -7	180517 -2	180517 -4	180517 -3	180518- 3
	<u>Result</u>						
<u>Site</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
Phosphorus	0	0.1	0.25	0.2	0	0.3	2.25
Nitrogen (Nitrate)	0.096	0.124	0.056	0.267	0.126	0.124	0.05
Nitrogen (Nitrite)	0.006	0.006	0.007	0.011	0.007	0.006	0.003
Beach Plate Count; MPN	12.1	13.4	5.2	356	121	914	148
Beach Plate Count; e- coli	<1	<1	<1	31	20	<1	<1
pH	7.46	7.68	7.03	7.5	7.91	6.94	7.12
Dissolved Oxygen	5.1	4.7	4.8	5.7	4.9	7.3	5.3

Total Dissolved Solids	0.0169	0.0149	0.0166	0.0047	0.37	0.005	0.0167
Water Temperature; C	12.9	18.5	11.4	17.7	19.5	17.3	17.3
Air Temperature; C	21.1	21.1	21.1	26.2	21.2	24.7	17.6
Conductivity; uS	278	288	273	309	297	290	297

Comments

Lab Number	180518-2	180518-1	180516-8	180516-9	
	<u>Site</u>	8	9	10	11
Phosphorus	0.25	0.6	0	0	
Nitrogen (Nitrate)	0.085	0.069	0	0	
Nitrogen (Nitrite)	0.006	0.003	0.006	0.007	
Beach Plate Count; MPN	56	201	<1	25.4	
Beach Plate Count; e-coli	13	2	<1	<1	
pH	7.26	7.65	8	7.8	

Dissolved Oxygen	5.3	6	8.1	7.74	
Total Dissolved Solids	0.02	0.013	0.0005	0.015	
Water Temperature; C	17.3	16.6	11.3	11.3	
Air Temperature; C	27.5	25	17.8	17.8	
Conductivity; uS	292	277	280	278	

Comments

The list of students who participated in the second round of testing on this project from the Roscommon High School under the direction of chemistry teacher, Chuck Schepke included:

Schedule (D) =drivers

<u>June 13th Wed</u>	<u>June 14th Thurs</u>	<u>June 15th Fri</u>
Brady Briggs	(D) Jon Suvada	(D) Jeff Kuchar
Zoe Tomes	(D) Justin Janisse	(D) Etan Ferency
(D) Dylan Aubrey	Mac Schultz	Anna Erikison
Ian Wybraniec	Jennifer Tussey	JT Cole
(D) Caleb Jacob (& Mom)	Ashley Desmith	Karlee Erikison
Brandon Mitchell	Dominic Tatrai	
	Micheal Ficaj	

The testing and data collection at each of the 12 sights on June 13 – 15, 2018 are shown in Table 2:

Round 2 Analytical Test Results:

Lab Number	180615 -2	180615 -3	180615 -4	180614 -4	180614 -6	180614 -5	180613 -1
	<u>Result</u>						
<u>Site</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
Phosphorus	0.05	0.11	0.11	0.1	2.4	0.35	0.25
Nitrogen (Nitrate)	0.048	0.032	0.01	0.064	0.068	0.029	0.61
Nitrogen (Nitrite)	0.003	0.005	0.008	0.005	0.006	0.006	0.008
Beach Plate Count; MPN	206	284	315	68.3	436	53.8	457
Beach Plate Count; e-coli	11.8	<1	3	1	3	<1	2
pH	7.97	7.72	7.35	7.12	6.89	6.98	6.43
Dissolved Oxygen	5.2	5.1	5.4	4.3	5.1	5.2	4.2

Total Dissolved Solids	0.001	0.003	0.012	0.011	0.005	0.002	0.006
Water Temperature; C	17.5	18.5	11.4	18	17.7	18.2	18.3
Air Temperature; C	12.2	12.2	13.3	13.3	15	12.7	13.5
Conductivity; uS	315	282	282	280	206	277	308

Comments

Lab Number	180613 -2	180613 -3	180614 -3	180614 -2	180614 -1
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<u>Site</u>	8	9	10	11	12
Phosphorus	0.05	0.55	0.024	0.041	0.005
Nitrogen (Nitrate)	0.14	0.05	0.03	0.024	0.118
Nitrogen (Nitrite)	0.008	0.006	0.006	0.003	0.007
Beach Plate Count; MPN	143	416	194	186	689
Beach Plate Count; e-coli	37	4	1	2	43

pH	6.35	6.24	7.29	7.53	7.77
Dissolved Oxygen	4.5	5	4.4	4.5	4.5
Total Dissolved Solids	0.004	0.002	0.008	0.016	0.011
Water Temperature; C	17.8	17.2	16.7	16.7	15.4
Air Temperature; C	14	14.8	14.4	14.4	14.6
Conductivity; uS	308	281	282	284	156

Comments

The list of students who participated in the third round of testing on this project from the Roscommon High School under the direction of chemistry teacher, Chuck Schepke included:

Schedule (D) =drivers

<u>July 18th Wed</u>	<u>July 19th Thurs</u>	<u>July 20th Fri</u>
(D) Jon Suvada	(D) Jessica Disney	(D) Ethan Ferency
Brady Briggs	Karlee Erikson	
(D) Dylan Aubrey	Jennifer Tussey	Mac Schultz
Dominic Tatrai	Justin Janisse	Brandon Mitchell
Michael Ficaj		
Ian Wybraniac		

The testing and data collection at each of the 13 sights on July 18 – 20, 2018 are shown in Table 3:

**Round 3 Analytical
Test Results:**

Lab Number	180720 -4	180720 -3	180720 -2	180719 -20	180719 -18	180719 -19	180718- 7
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Result

<u>Site</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
Phosphorus	0	n.d.	n.d.	0.07	0.1	0.06	0.02
Nitrogen (Nitrate)	0.081	0.051	0.068	0.061	0.105	0.081	0.105
Nitrogen (Nitrite)	0.001	n.d.	0.005	0.003	0.005	0.007	0.009
Beach Plate Count; MPN	579	436	307	228	870	260	285
Beach Plate Count; e- coli	<1	8.6	<1	1	1	<1	1
pH	7.64	7.94	7.9	7.74	8	7.7	7.93
Dissolved Oxygen	4	3.7	3.7	4.1	3.8	4	6.6
Total Dissolved Solids	0.034	0.0028	0.0011	0.0013	0.0026	0.0029	0.001
Water Temperature; C	22.3	22.1	23.2	22.6	22	22.6	19.8
Air Temperature; C	18.9	19.4	19.4	13.9	13.9	13.9	10
Conductivity; uS	275	292	273	2832.75	283	283	311

Comments

Lab Number	180718 -8	180718 -9	180718 -10	180718 -11	180718 -12	180717- 17
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<u>Site</u>	8	9	10	11	12	13
Phosphorus	0.01	0.01	n.d.	n.d.	0.01	0.01
Nitrogen (Nitrate)	0.101	0.118	0.109	0.092	0.104	0.105
Nitrogen (Nitrite)	0.004	0.005	0.004	0.004	0.005	0.005
Beach Plate Count; MPN	474	478	378	260	285	397
Beach Plate Count; e- coli	2	2	<1	<1	<1	1
pH	7.46	7.38	7.33	7.24	7.17	8
Dissolved Oxygen	7.5	7.5	7	7.1	6.8	3.8
Total Dissolved Solids	0.0013	0.0017	0.0025	0.0018	0.002	0.002
Water Temperature; C	21.7	19.9	19.6	19.7	21	20.5
Air Temperature; C	10.6	10	13.9	13.9	14.4	13.9
Conductivity; uS	311	270	275	272	272	283

Comments

n.d. = nondetect

The list of students who participated in the fourth round of testing on this project from the Roscommon High School under the direction of chemistry teacher, Chuck Schepke included:

Schedule (D) =drivers

October 22 Mon

Ian Wybraniec

Emily Terry

Jessica Disney

Brady Briggs

Zoe Tomes

October 23 Tues

Karlee Erickson

Anna Erickson

Dominic Tatrai

JT Cole

Ashley Desmith

October 24 Wed

Jeffery Kochar

Jon Suvada

Mac Schultz

Caleb Jacobs

The testing and data collection at each of the 13 sights on October 22, 23 and 24, 2018 are shown in Table 4

**Round 4 Analytical
Test Results:**

Lab Number	18102 2-3	18102 2-2	18102 2-4	18102 3-2	18102 3-4	18102 3-3	18102 4-3
<u>Site</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
Phosphorus	0.4	0.31	0.23	0.2	0.24	0.17	0.83
Nitrogen (Nitrate)	0	0.01	N.D.	0.029	0.048	0.16	0.044
Nitrogen (Nitrite)	N.D.	n.d.	N.D.	0.001	N.D.	0.002	0.001
Beach Plate Count; MPN	1011	64	68	31.9	36.8	47.3	43
Beach Plate Count; e- coli	0	1	1	1	2	3	2
pH	8.1	8.08	7.94	7.4	7.39	7.31	7.15
Dissolved Oxygen	11.8	13	10	12.4	12	12.4	11.4
Total Dissolved Solids	0.0041	0.0069	0.0019	0.0054	0.003	0.007	0.002
Water Temperature; C	4.7	8.7	8.7	8.2	8.8	8.2	6.7
Air Temperature; C	-0.1	-0.1	-0.1	1	1	1	1.2
Conductivity; uS	281	278	279	316	310	332	304

Comments

Lab Number	18102 4-1	18102 4-2	18101 9-1	18101 9-2	18101 9-3	18101 9-4
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<u>Site</u>	8	9	10	11	12	13
Phosphorus	0.26	0.22	0.25	0.47	0.19	0.21
Nitrogen (Nitrate)	0.187	0.206	N.D.	N.D.	N.D.	N.D.
Nitrogen (Nitrite)	0.001	N.D.	N.D.	0.013	0.19	0.027
Beach Plate Count; MPN	70	1011	1011	1011	91	22
Beach Plate Count; e- coli	3	1	1	1	1	1
pH	7.56	7.3	8.45	8.39	8.23	8.16
Dissolved Oxygen	11.2	12.8	11.5	9.9	9.8	9.5
Total Dissolved Solids	0.001	0.004	0.0003	0.006	0.004	0.012
Water Temperature; C	6.7	7.6	5.2	7.4	7.4	7.2
Air Temperature; C	1.2	1.3	7.2	7.2	7.2	7.2
Conductivity; uS	362	323	305	279	284	285

Comments

Building on the first year analysis from May to October is beginning to form the basis to determine subsequent changes in Higgins Lake water quality over time. This first year “base line” will be combined with previous testing to form a larger

base of data once the first year testing is complete. As this is the fourth round of water testing, this will conclude the first year of testing baseline.

Acknowledgments:

This project would not be a success without being generously supported by:

The Higgins Lake Foundation

The Higgins Lake Property Owners Association

Roscommon Rotary Club

John Ogren, Roscommon High Graduate and HLPOA member

Special recognition goes to:

Ms. Catherine Erickson, Superintendent Roscommon Area Public Schools and Mr. Fred Swinehart of the Higgins Lake Property Owners Association for their enthusiastic support for the students.

I would be remiss if I did not comment on the Roscommon High School students involved with this project. As an industrial chemist for approximately 50 years, I have not found a more enthusiastic, involved and inquisitive group of students. They pay attention to detail and are eager to learn and perform to the best of their abilities. They are also a great fun group of students to work with.

One of the most noted comments was that as the students progressed, their lab skills and comfort level working in an industrial laboratory improved significantly. Additionally, the students presented a poster session at The Midland Section American Chemical Society Poster presentation at Saginaw Valley State University October 13, 2018. They demonstrated a significant level of professionalism as they presented their effort on this project. This was a great reflection of the education and instruction they are receiving at the Roscommon High School.

Submitted by:

John Blizzard
R&D Director
QuadSil/Raven Analytical

Appendix A

Fred with the high school students at Raven Analytical







The Midland Section American Chemical Society Poster presentation at Saginaw Valley State University October 13, 2018

1st Row-left to right.

Justin Janisse, Jessica Disney, Zoe Tomes, Emily Terry, John Blizzard (Owner of Raven Analytical) , Karlee Erikson, Jon Suvada, Domonic Tatrai, and Mac Schultz.

2nd Row-left to right.

Brady Briggs and J.T. Cole.

Higgins Lake Watershed Study: A Community-School Based Surface Water Monitoring Program

John Blizzard (Quadsil and Raven Analytical), Chuck Schepke (Roscommon High School Chemistry Teacher) , and Student Researchers- Dylan Aubrey, Brady Briggs, J.T. Cole, Ashley Desmith, Jessica Disney, Anna Erikson, Karlee Erickson, Ethan Ferency, Micheal Ficaj, Caleb Jacobs, Justin Janisse, Jeff Kuchar, Brandon Mitchell, Mac Schultz, Dominic Tatrai, Emily Terry, Zoe Tomes, Jennifer Tussey, and Ian Wybraniec.

Abstract

This program utilizes high school chemistry and physics students to sample, test and evaluate the Higgins Lake Watershed and tributaries in Michigan. Students would sample water from a number of sites within the land watershed and test for inorganics, bacteria and physical characteristics of the test sites. Sampling has been done 12 times over the last year and will continue to be performed each month during 2018. The first year of testing at each site is to obtain a base line of each test site for continued testing over the next five years. Each site database has been combined together to provide a complete, systematic picture of the quality of water in this important watershed over an extended period of time. Water analysis included a variety of EPA certified chemical analysis techniques.

The water testing is performed along with EPA certified standards to ensure accurate results. Using EPA certified standards emphasizes the importance of using standards to compare testing technique, procedures and analyst ensuring quality data collection. This reinforces and connects the academic realm to real world job potentials. This is also part of a job-shadowing program with the watershed program to expose the students to potential employment opportunities available to qualified trained individuals.

Introduction

The first year of testing at each site is to obtain a base line of each test site for comparison over the next five years. Each site database has been combined together to provide a complete, systematic picture of the quality of water in this important water shed over an extended period of time. Water analysis includes:

1. air temperature
2. water temperature
3. flow rate
4. hardness (alkalinity)
5. dissolved oxygen
6. pH
7. nitrate
8. phosphate
9. turbidity
10. total hardness
11. Bacteria - e-coli - coliform

A grant from Higgins Lake Foundation, the Higgins Lake Property Owners Association and the Higgins Lake Rotary provided the funding for this watershed study project with contributions from their members. The High School involved in the program was also provided with all of the necessary equipment, water analysis training and supplies to perform the water quality tests in concert with the EPA certified Raven Analytical Laboratory in Roscommon.

- Some of the results of this longer-term project include:
- Student awareness of the environment
 - School science clubs started
 - Outreach events to local communities
 - Business coalition strengthened with area schools
 - School participation continues to grow



Methodology

The following locations were sampled in May and July of 2018, with a follow-up this seasonal planning to be done this October so we can establish a baseline for comparative analysis in the proceeding years.

Sample Locations

Rocky Point Park

Car River

Shoe Box

Raven Analytical

Gold Coast

North Bay Park

Bald Mtns

Cape Center

Swimmer Model - 1

Swimmer Model - 2

Swimmer Model - 3

Dingy Point

Higgins Lake Sample Sites Map



Results

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 (#9554) and has a certified water sanitarian on staff at Roscommon. Training and testing was performed by the Roscommon High School students under the guidance and direction of certified water chemists.

Water Tests:
 Phosphate - Total phosphate is reported in milligrams/liter(mg/L)
 Nitrate - Nitrate is reported in milligrams/liter(mg/L)
 Nitrite - Nitrite is reported in milligrams/liter(mg/L)
 pH - pH is measured on a 1 to 14 scale with pure water being a pH of 7.0
 Dissolved Oxygen - Dissolved oxygen is reported in milligrams/liter(mg/L)
 Total Dissolved Solids - TDS is reported in milligrams/liter(mg/L)
 Conductivity - Conductivity is reported in microsiemens per centimeter(μS/cm)
 Water Temperature - Measured in degrees Centigrade
 All Temperature measurements are in degrees Centigrade
 Beach Plate Count - CFN
 Most probable number (MPN) is measured in colonies per 100 milliliters of cultured water
 Beach Plate count - E-coli - E-coli is measured in colonies per 100 milliliters of cultured water

Analytical Results of the May 19-18th - 2018 Sampling Data

Location	Site	pH	TDS	Conductivity	Temp	DO	Phosphate	Nitrate	Nitrite	CFN	E-coli
Phosphate	1	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	2	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	3	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	4	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	5	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	6	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	7	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	8	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	9	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	10	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	11	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	12	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	13	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	14	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	15	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	16	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	17	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	18	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	19	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	20	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	21	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	22	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	23	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	24	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	25	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	26	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	27	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	28	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	29	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	30	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	31	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	32	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	33	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	34	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	35	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	36	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	37	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	38	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	39	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	40	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	41	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	42	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	43	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	44	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	45	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	46	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	47	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	48	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	49	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	50	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	51	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	52	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	53	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	54	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	55	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	56	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	57	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	58	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	59	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	60	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	61	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	62	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	63	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	64	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	65	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	66	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	67	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	68	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	69	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	70	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	71	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	72	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	73	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	74	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	75	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	76	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	77	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	78	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	79	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	80	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	81	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	82	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	83	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	84	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	85	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	86	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	87	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	88	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	89	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	90	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	91	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	92	8.1	1.9	1.2	1.2	1.2	0.0	0.0	0.0	0	0
Phosphate	93	8.1	1.9	1.2	1.2	1					

