

AGENDA

WALLED LAKE LAKE IMPROVEMENT BOARD MEETING

September 12, 2018
2:00 PM

Novi Civic Center
45175 Ten Mile Road

- I. Call Meeting to Order
- II. Roll Call
- III. Public Comment
- IV. Approval of Minutes of May 17, 2018 meeting
- V. Treasurer's Report
- VI. Certification of Delinquent Assessment Reports from Walled Lake and Novi
- VII. Goose Busters Presentation
- VIII. Budget amendment for additional treatment
- IX. 2017 Water Quality Report from Savin Lake Services
- X. Public Comment
- XI. Other Business
- XII. Adjournment

Please visit www.cityofnovi.org/lakeboard for additional information

**WALLED LAKE
LAKE IMPROVEMENT BOARD
MEETING MINUTES
May 17, 2018**

The meeting of the Lake Improvement Board for Walled Lake was held in the Activities Room at the Novi Civic Center at 45175 10 Mile Road on May 17, 2018. The meeting was called to order by Dave Galloway, Chairperson, at 2:06 P.M.

Present:

Casey Ambrose, City of Walled Lake Representative
Hugh Crawford, Oakland County Board of Commissioners' Representative
Dave Galloway, Riparian Owner Representative (Chairperson)
Megan Mikus, City of Novi Representative (Secretary-Treasurer)
Karen Warren, Oakland County Water Resource Commissioner's Representative

Also Present:

Victor Cardenas, City of Novi, Assistant City Manager
Mark Roberts, Attorney, Secrest Wardle

Public comment:

One Walled Lake resident was present, Gabriel Costanzo of 815 Bluffton St., but he had no comments at that time.

**Moved by Crawford, Supported by Ambrose; CARRIED 4-0 (Absent: Warren):
To approve the Minutes of November 14, 2017 meeting.**

Treasurer/ Member Mikus presented the Treasurer's Report for the fourth quarter of 2017, the 2017 annual report, and the first quarter of 2018. The balance on hand as of March 30, 2018 was \$230,422.04. The surplus funding used in 2017 was \$9,569.28

Member Warren arrived.

**Moved by Crawford, Supported by Ambrose; CARRIED 5-0
To approve the fourth quarter 2017 Treasurer's report; 2017 Annual Report, and the first quarter 2018 Treasurer's report.**

Discussion of 2018 Treatment

Chairperson Galloway presented the status of treatment. The bio-base survey had not been completed yet due to the cooler temperatures. The timing of treatment is weather dependent. Chairperson Galloway discussed the possibility of using an alternative treatment for starry stonewort, clipper, as a more effective in the long-term instead of copper sulfate. No action was taken.

The Board approved in 2017 to provide financial support to Chairperson Galloway to attend the Michigan Lakes and Streams Association Conference in Thompsonville, Michigan. Chairperson Galloway attended the 2018 conference and asked for financial support for attending. Treasurer/ Member Mikus presented the cost, which totaled \$761.23 for reimbursement of mileage, hotel, and conference fee.

Moved by Ambrose, Supported by Crawford; CARRIED 5-0:

To reimburse of Chairperson Galloway \$761.23 for conference fee, housing, and mileage to attend the 2018 Michigan Lake and Stream Association Conference on April 20 and April 21.

Lakeshore Park and Pavillion Shore Park Shoreline Erosion Project:

Member Mikus presented that originally the City of Novi's Department of Parks, Recreation and Cultural services had approached the Board for a letter of support of a grant they were pursuing in relation to the shoreline erosion issues at Lakeshore Park and Pavillion Shore Park. After being approached, the department was informed the projects would not be eligible for the grant. Member Mikus mentioned included in the packet were descriptions of the erosion issue along the shoreline at the parks and how the City of Novi planned to address the issue. Chairperson Galloway suggested a natural shoreline design would be more effective along the parks' lakefront area and not cutting the landscaping down to the water line. No action was taken.

Goose Nest Destruction Program:

Chairperson Galloway discussed the lake area homeowner associations had goose nest destruction program for several years and wanted to see if the Board would be interested in collaborating with other HOAs or other Lake Boards. Member Warren said she was not familiar of other Lake Boards with a goose removal program. Attorney Roberts expressed concern about acquiring the permits required to go onto properties to remove the nests. No action was taken.

Other:

Chairperson Galloway discussed on whether the Board would want to provide financial support to riparian owners to attend classes or conferences to educate themselves to help monitor the lake. Attorney Roberts expressed concerned regarding the liability the Board would assume. If more monitoring was necessary, Attorney Roberts suggested some alternatives: contracting the current contractor to monitor the lake, providing an informational packet for residents, and/or establishing a hotline for residents to report findings. No action was taken.

Chairperson Galloway shared with the Board that Michigan State University Extension has a mobile boat wash, which is provided for free at boating tournaments. This service helps prevent boaters the spread of invasive species. No action was taken.

Public comment:

Walled Lake Resident Gaberiel Costanzo brought up the issue of the flooding in the southwestern areas near the lake and if the Boad could do anything about it. Member Warren, the OCWRC representative, said the OCWRC maintains the lake level. If repairs need to be done on the Walled Lake dam, the OCWRC would repair them; however, the repair costs would be assessed on the Walled-Shawood Lake District; otherwise, it would be the property owner's responsibility for any repair on their property.

Member Warren informed the Board of sanitary sewer repairs OCWRC were doing on South Lake Drive on May 14 to 15. One repair was due to a resident boring their sprinkler line into the sewer line.

ADJOURNMENT: There being was no further business to come before the Lake Improvement Board; the meeting was adjourned at 3:03 PM.

The Board next meeting was tentatively scheduled for September 12 at 2:00 PM.

Megan Mikus, Secretary-Treasurer

DRAFT

**WALLED LAKE IMPROVEMENT BOARD
2017 ANNUAL REPORT**

BALANCE ON HAND:	01/01/17	\$175,251.49	
INCOME			
		<u>Annual Total</u>	<u>Notes</u>
Assessments (City of Novi)	\$	43,470.34	1
Assessments (City of Walled Lake)	\$	25,421.39	2
TOTAL INCOME	\$	68,891.73	
EXPENSES			
Harvesting and Herbicide Treatments	\$	75,553.78	
Lake Management Consultant	\$	-	
Permit Fee	\$	1,500.00	3
Administrative & Legal	\$	1,006.80	
Other	\$	764.43	
TOTAL EXPENSES	\$	78,825.01	
BALANCE ON HAND:	12/31/17	\$165,318.21	

Notes

- 1 Novi payment includes assessments paid to date to Novi
- 2 Walled Lake has paid the assessment in full
- 3 Permit for the 2018 season (Approved in the 2018 Budget)

EXPENSE DETAIL FOR 2017

<u>Description</u>	<u>Invoice No.</u>	<u>Vendor</u>	<u>Amount</u>
Herbicide Treatment	3578	Savin Lake Services	4,975.00
Herbicide Treatment	3635	Savin Lake Services	8,540.00
Herbicide Treatment	3711	Savin Lake Services	16,133.13
Herbicide Treatment	3750	Savin Lake Services	11,568.75
Legal Services through 8/31/2017	1316501	Secrest Wardle	52.00
Legal Services through 9/30/2017	1318205	Secrest Wardle	473.80
Conference Reimbursement	20170929-123034	Galloway, David	764.43
Herbicide Treatment	3833	Savin Lake Services	34,336.90
Legal Services through 10/31/2017	1320188	Secrest Wardle	117.00
MDEQ Permit Fee (2018)	3894	Savin Lake Services	1,500.00
Legal Services through 11/30/2017	1322766	Secrest Wardle	364.00
TOTAL EXPENSES			\$ 78,825.01

Submitted by _____

Megan Mikus, Secretary/Treasurer
Walled Lake Improvement Board

**WALLED LAKE IMPROVEMENT BOARD
QUARTERLY TREASURER'S REPORT**

December 31, 2017

BALANCE ON HAND: 10/01/17 \$ 202,350.24						
INCOME		Quarter	YTD	Budget	Variance	Notes
Assessments (City of Novi)	\$	524.10	\$ 43,688.18	\$ 42,014.79	\$ 1,673.39	1
Assessments (City of Walled Lake)	\$	-	\$ 25,421.39	\$ 25,421.00	\$ 0.39	2
TOTAL INCOME	\$	524.10	\$ 69,109.57	\$ 67,435.79	\$ (1,673.78)	
EXPENSES						
Harvesting and Herbicide Treatments	\$	34,336.90	\$ 75,553.78	\$ 80,000.00	\$ (4,446.22)	
Lake Management Consultant	\$	-	\$ -	\$ 5,000.00	\$ (5,000.00)	
Permit Fee	\$	1,500.00	\$ 1,500.00	\$ 2,000.00	\$ (500.00)	3
Administrative & Legal	\$	954.80	\$ 1,006.80	\$ 1,050.00	\$ (43.20)	
Other	\$	764.43	\$ 764.43	\$ -	\$ 764.43	
TOTAL EXPENSES	\$	37,556.13	\$ 78,825.01	\$ 88,050.00	\$ (9,224.99)	
BALANCE ON HAND: 12/31/17 \$ 165,318.21						

Notes

- 1 Novi payment includes assessments paid to date to Novi
- 2 Walled Lake has paid the assessment in full
- 3 Permit for the 2018 season (Approved in the 2018 Budget)

EXPENSE DETAIL

Description	Invoice No.	Vendor	Amount
Legal Services through 9/30/2017	1318205	Secretst Wardle	473.80
Conference Reimbursement	20170929-123034	Galloway, David	764.43
Herbicide Treatment	3833	Savin Lake Services	34,336.90
Legal Services through 10/31/2017	1320188	Secretst Wardle	117.00
MDEQ Permit Fee (2018)	3894	Savin Lake Services	1,500.00
Legal Services through 11/30/2017	1322766	Secretst Wardle	364.00

Submitted by _____
Megan Mikus, Secretary/Treasurer
Walled Lake Improvement Board

**WALLED LAKE IMPROVEMENT BOARD
QUARTERLY TREASURER'S REPORT
March 31, 2018**

BALANCE ON HAND: 12/31/17 \$165,318.21						
INCOME	<u>Quarter</u>		<u>YTD</u>	<u>Budget</u>	<u>Variance</u>	<u>Notes</u>
City of Novi Assessments	\$ 39,318.44	\$	39,318.44	\$42,014.79	\$ (2,696.35)	1
City of Walled Lake Assessments	\$ 25,421.39	\$	25,421.39	\$25,421.00	\$ 0.39	2
TOTAL INCOME	\$ 64,739.83	\$	64,739.83	\$ 67,435.79	\$ (2,695.96)	
EXPENSES						
Harvesting and Herbicide Treatments	\$ -	\$	-	\$80,000.00	\$ (80,000.00)	
Lake Management Consultant	\$ -	\$	-	\$5,000.00	\$ (5,000.00)	
Permit Fee	\$ -	\$	-	\$1,500.00	\$ (1,500.00)	
Administrative & Legal	\$ 31.80	\$	31.80	\$1,000.00	\$ (968.20)	
TOTAL EXPENSES	\$ 31.80	\$	-	\$ 80,000.00	\$ (80,000.00)	
BALANCE ON HAND: 03/31/18 \$230,026.24						

Notes

- 1 Novi payment includes assessments paid to date to Novi
- 2 Walled Lake has paid the assessment in full

INCOME DETAIL

<u>Description</u>	<u>Ref. Number</u>	<u>Entity</u>	<u>Amount</u>
Assessment (City of Walled Lake)- 2017 Installment	1800008539	City of Walled Lake	\$25,421.39

EXPENSE DETAIL

<u>Description</u>	<u>Invoice No.</u>	<u>Vendor</u>	<u>Amount</u>
Legal Fees through 12/31/2017	1324868	Secrest Wardle	\$ 31.80

Submitted by _____
Megan Mikus, Secretary/Treasurer
Walled Lake Improvement Board

**WALLED LAKE IMPROVEMENT BOARD
QUARTERLY TREASURER'S REPORT**

June 30, 2018

BALANCE ON HAND: 03/31/18 \$230,026.24				
INCOME	Quarter	YTD	Budget	Variance
Assessments (City of Novi)	\$ 1,282.57	\$ 40,601.01	\$42,014.79	(\$1,413.78)
Assessments (City of Walled Lake)	\$ -	\$ 25,421.39	\$25,421.00	\$0.39
TOTAL INCOME	\$ 1,282.57	\$ 66,022.40	\$ 67,435.79	(\$1,413.39)
EXPENSES				
Harvesting and Herbicide Treatments	\$ 29,578.85	\$ 29,578.85	\$80,000.00	(\$50,421.15)
Lake Management Consultant	\$ -	\$ -	\$5,000.00	(\$5,000.00)
Permit Fee	\$ -	\$ -	\$1,500.00	(\$1,500.00)
Administrative & Legal	\$ 572.00	\$ 603.80	\$1,000.00	(\$396.20)
TOTAL EXPENSES	\$ 30,150.85	\$ 30,182.65	\$ 88,050.00	(\$57,867.35)

BALANCE ON HAND: 06/30/18 \$201,157.96				
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Notes

- 1 Novi payment includes assessments paid to date to Novi
- 2 Walled Lake has paid the assessment in full
- 3 2017 Delinquent Taxes (City of Novi)

INCOME DETAIL

<u>Description</u>	<u>Ref. Number</u>	<u>Entity</u>	<u>Amount</u>
Assessment (City of Novi)- 2017 Delinquent Taxes	19459	Oakland County	\$856.45

EXPENSE DETAIL

<u>Description</u>	<u>Invoice No.</u>	<u>Vendor</u>	<u>Amount</u>
Legal Fees through 3/31/2018	1333976	Secrest Wardle	\$ 169.00
Legal Fees through 4/30/2018	1336108	Secrest Wardle	\$ 78.00
Legal Fees through 5/31/2018	1339513	Secrest Wardle	\$ 325.00
Herbicide Treatment	4078	Savin Lake Services, Inc.	\$ 29,578.85

Submitted by _____

Megan Mikus, Secretary/Treasurer
Walled Lake Improvement Board

Mikus, Megan

From: Mikus, Megan
Sent: Thursday, August 16, 2018 3:06 PM
To: 'treasurer@walledlake.com'; 'sbarlass@walledlake.com'; Glenn, Tina; Johnson, Carl
Cc: 'D Galloway'; Cardenas, Victor
Subject: Walled Lake Improvement Board Delinquent Assessments
Attachments: 2015 Resolution Confirming Assessment Roll.pdf

Good afternoon,

I am writing to remind you that according to [MCL 324.30916](#), the Treasurer for each City is required to provide a sworn statement listing the names of delinquent Lake Board Assessments and the amount of the delinquency including accrued interest and penalties to the Lake Board by September 1 for certification by the Board.

324.30916 Special assessments; collections.

Sec. 30916.

When any special assessment roll is confirmed, the lake board shall direct the assessments made in the roll to be collected. The clerk of each local unit of government involved shall then deliver to the treasurer of each local unit of government the special assessment roll, to which he or she shall attach his or her warrant commanding the treasurer to collect the assessments in the roll in accordance with the directions of the lake board. The warrant shall further require the treasurer, on September 1 following the date when any assessments or any part of an assessment have become due, to submit to the lake board a sworn statement setting forth the names of delinquent persons, if known, a description of the parcels of land upon which there are delinquent assessments, and the amount of the delinquency, including accrued interest and penalties computed to September 1 of the year. Upon receiving the special assessment roll and warrant, the treasurer shall collect the amounts assessed as they become due.

The attached Lake Board resolution provides additional information in this regard.

The Lake Board will meet September 12 to act on the delinquent roll.

Please let me know if you have any questions.

Kind regards,

Megan
Secretary/ Treasurer, City of Novi Representative
Walled Lake Improvement Board



Megan Mikus | Public Works Budget Analyst

City of Novi | 26300 Lee BeGole Drive | Novi, MI 48375 USA

t: 248.347.0453 f: 248.735.5659

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STATE OF MICHIGAN

COUNTY OF OAKLAND

WALLED LAKE IMPROVEMENT BOARD

WALLED LAKE IMPROVEMENT BOARD SPECIAL ASSESSMENT DISTRICT

RESOLUTION CONFIRMING ASSESSMENT ROLL

RECITATIONS:

It has been determined that the Walled Lake Improvement Board will implement a five year aquatic weed control program for Walled Lake (the Project).

The Project is intended to make annual improvements to Walled Lake through the year 2015 at a total cost estimated to be \$518,615.00 for the benefit of the properties identified in Exhibit 1, which properties together shall constitute The Walled Lake Improvement Board Special Assessment District, hereinafter referred to as the "Lake Board SAD", and for administrative purposes to be known as SAD 175 in the City of Novi and SAD 175 in the City of Walled Lake.

Plans for the Project, the estimated cost of the Project, and the special assessment district boundaries were approved by Resolution of the Walled Lake Improvement Board following a public hearing on November 5, 2009. The Lake Board resolution further directed the Assessors for the City of Novi and for the City of Walled Lake to prepare a proposed assessment roll, which was considered by the Lake Board at its March 25, 2010 public hearing and the continuation of the public hearing on May 20, 2010.

In accordance with the direction of the Walled Lake Improvement Board following the March 25, 2010 public hearing and the continuation of the public hearing on May 20, 2010, the

City Assessors have prepared a revised special assessment roll allocating the total cost of the Project, less the City of Novi's voluntary contribution to the Project in the amount of \$30,000.00, to the property within the Lake Board SAD and the Assessors have filed such roll with the Lake Board.

A public hearing to review the revised special assessment roll was set and duly noticed in accordance with law for the purpose of hearing objections to the revised assessment roll.

The public hearing was conducted in accordance with the notice, and the Walled Lake Improvement Board determined that it would be appropriate to approve and confirm the revised assessment roll.

NOW, THEREFORE, BE IT RESOLVED AS FOLLOWS:

1. The revised special assessment roll for the Walled Lake improvement Board Project, the Lake Board SAD, in the total amount of \$488,615.00 (\$97,723.00 annually for years 2011 through 2015), attached as Exhibit 1 to this resolution, shall be and is hereby adopted and confirmed, and shall be collected from the properties benefited within the Lake Board District.

2. The Walled Lake Improvement Board Secretary/Treasurer is directed to endorse on the assessment roll the date of this confirmation.

3. All amounts of an assessment shall be assessed against each parcel of land in the Lake Board SAD as described on the Special Assessment Roll (Exhibit 1) to be due and payable in five installments, the first to be due on the 14th day of February, 2011, and the several subsequent installments shall be due and payable successively in intervals of twelve (12) months from the due date of the first installment.

4. The Clerks for the Cities of Novi and Walled Lake are directed to attach their warrants as required by law to the roll and to direct the roll, with their warrants attached, to the respective

City Treasurer. The City Treasurer for the Cities of Novi and Walled Lake shall thereupon collect the special assessment from those properties listed in Exhibit 1 which are located within each City's jurisdiction in accordance with the terms of this Resolution, the warrant, and the statutes of the State of Michigan.

5. Any portion of an assessment which has not been paid on or before the **14th** day of **February** of the tax year shall be considered delinquent by the City Treasurer for the City in which the property is located and shall accrue penalties at the rate of $\frac{1}{2}$ of 1% for each month or fraction of a month that the assessment remains unpaid before being reported to the City Council for reassessment upon the City tax roll.

6. The City Treasurer shall report to the Lake Board on September 1 following the date when the assessment or any part of the assessment became due any delinquencies by submitting a sworn statement listing the names of the delinquent persons, if known, a description of the parcels of land upon which there are delinquent assessments, and the amount of the delinquency, including accrued penalties computed to September 1 of the year.

7. If the City Treasurer reports as delinquent any assessment or part of an assessment, the Lake Board shall certify the delinquency to the City Assessing official for the City in which the property is located, who shall then report the delinquency to the City Council in which the property is located to reassess on the City's annual tax roll of that year the delinquent sum and accrued penalties plus an additional penalty of six percent of the total amount reported.

AYES: Burke, Coburn, Galloway

NAYS: Potter

ABSTENTIONS: none

ABSENT: Warren

Walled Lake 2017 Water Quality Report

Summary:

Water Quality Testing was completed 2 times on Walled Lake in 2017 at 3 different locations around the lake. Of the parameters tested, Temperature, Dissolved Oxygen, Secchi Disk, and pH were sampled while on the lake. Chlorophyll α , Nitrate-N, Phosphorus, Alkalinity, and Conductivity were sampled by sending the water in sample bottles to an independent laboratory, White Water Associates located in Amasa, MI, where the analysis was ran.

A well known limnologist named Wally Fusilier developed a grading scale for various parameters of water quality. Data collected in 2017 is shown below and given a grade based on Fusilier's scale. Additionally, historical data and parameter descriptions are provided at the end of this report.

Because herbicide treatment of aquatic vegetation has occurred on Walled Lake, it should be noted that the application of herbicide no direct impact to the water quality of Walled Lake.

Overall in 2017 based on the analysis results, Walled Lake had great water quality figures. In both the spring and the fall Walled Lake had an average grade of either A or B for all 3 sites. Excellent chlorophyll a, secchi disk, and phosphorus values all stood out in 2017. The historically high conductivity did not change this year either. All of the values are constant with years past, nothing stands out as being unique this year. Walled Lake looks great.



(Walled Lake Sampling Sites)

2017 Results:

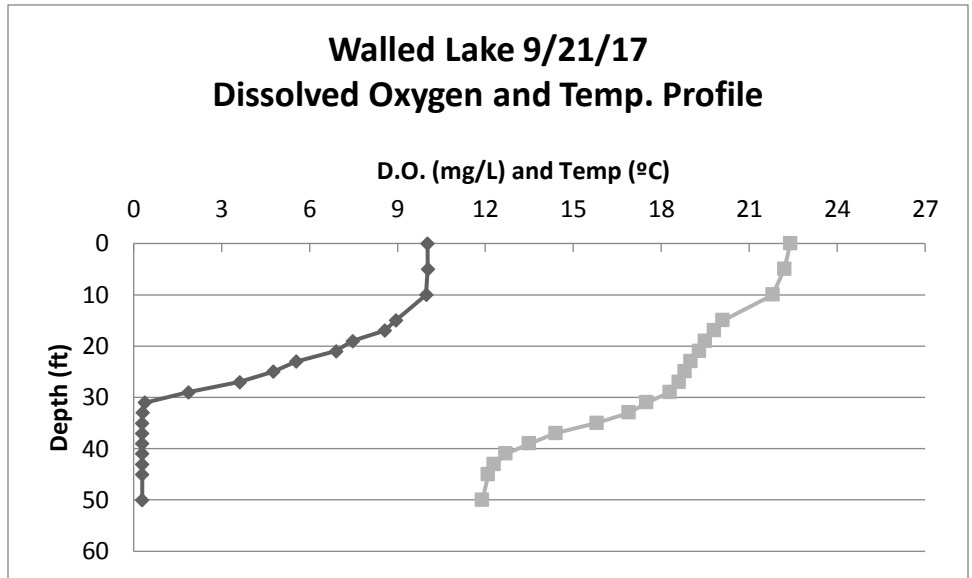
Date	5/11/2017			5/11/2017			5/11/2017			9/21/2017			9/21/2017			9/21/2017		
Station Number	1			2			3			1			2			3		
Temp (°C)	14.1	A		13.4	A		13.0	A		22.4	A		22.8	A		21.6	A	
Dissolved Oxygen (mg/L)	10.3			10.26			10.21			10.02			9.86			9.88		
Dissolved Oxygen (%saturation)	100.1	A		97.5	A		97.1	A		114.9	A		115.2	B		113.3	A	
Chlorophyll a (ug/L)	0.4	A		0.0	A		0.4	A		0.7	A		0.4	A		0.0	A	
Secchi Disk Depth (ft)	17.0	B		19.5	A		20.5	A		20.0	A		20.5	A		19.5	A	
Total Nitrate Nitrogen (ug/L)	110.0	A		70.0	A		100.0	A		<60	A		<60	A		<60	A	
Alkalinity (mg/L)	130.0	A		140	A		140	A		110	A		110	A		120	A	
pH	8.2	A		7.99	A		7.98	A		8.47	B		8.42	B		8.47	B	
Conductivity (umhos/cm)	1100.0	F		1100	F		1000	F		1000	F		1000	F		1000	F	
Total Phosphorus (ug/L)	12.0	A		9	A		18	A		<8	A		<8	A		<8	A	
Overall Grade		B			A			A			B			B			B	

Scale:

Grade	Temp	Dissolved Oxygen	Chlorophyll α	Secchi Disk Depth	Total Nitrate Nitrogen	Alkalinity	pH	Conductivity	Total Phosphorus
A	0-26.5	85-115	0-2	>19	0-275	50-225	5.75-8.27	0-380	0-20
B	26.5-28.5	85-77; 115-122	2-3	19-16	275-360	50-35; 225-255	5.75-5.55; 8.27-8.47	380-590	20-28
C	28.5-30	77-69; 122-131	3-4	16-12	360-450	35-23; 255-280	5.55-5.33; 8.47-8.69	590-720	28-39
D	30-31.5	69-62; 131-140	4-5	12-9	450-540	23-17; 280-310	5.33-5.14; 8.69-8.88	720-800	39-46
F	>31.5	<62; >140	>5	<9	>540	<17; >310	<5.14; >8.88	>800	>46

Temp and D.O.:

Temp (°C)	D.O. (mg/L)	Depth (ft)
22.4	10.02	0
22.2	10.03	5
21.8	9.98	10
20.1	8.94	15
19.8	8.56	17
19.5	7.47	19
19.3	6.90	21
19.0	5.54	23
18.8	4.76	25
18.6	3.61	27
18.3	1.87	29
17.5	0.38	31
16.9	0.30	33
15.8	0.29	35
14.4	0.28	37
13.5	0.28	39
12.7	0.28	41
12.3	0.29	43
12.1	0.29	45
11.9	0.29	50

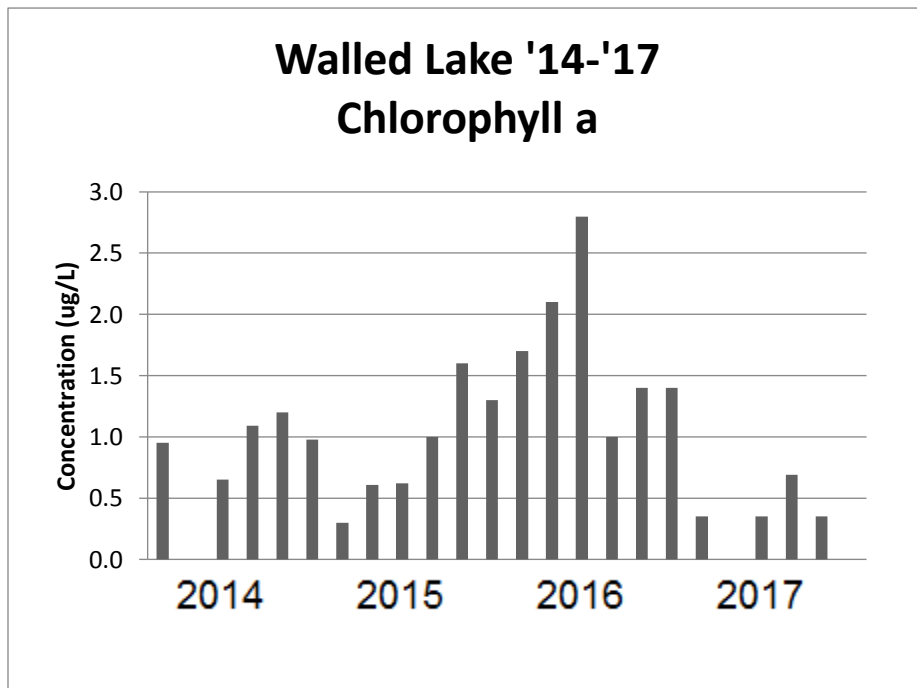
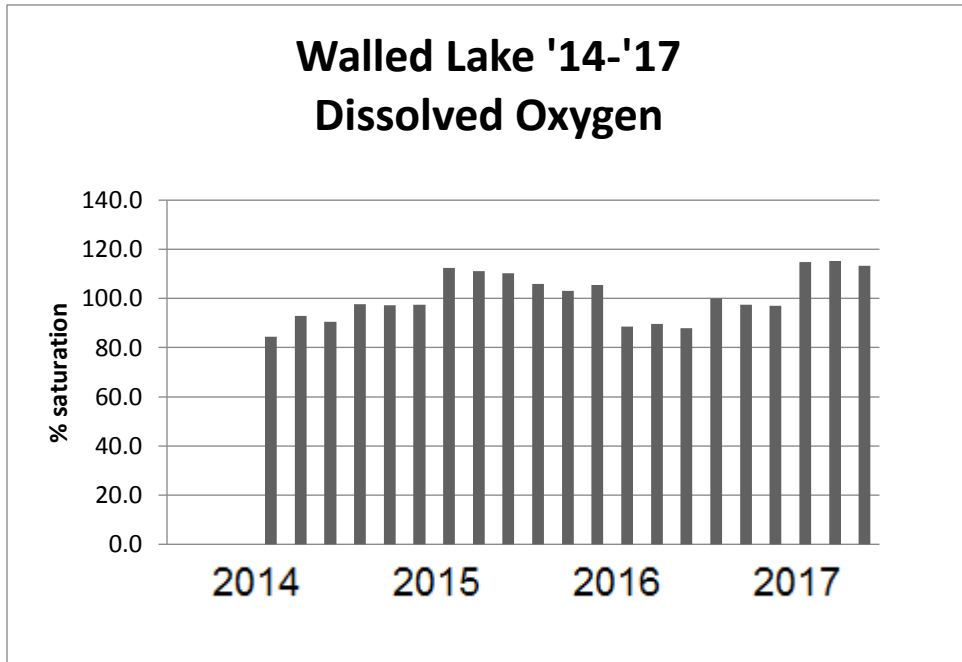


Matt Novotny

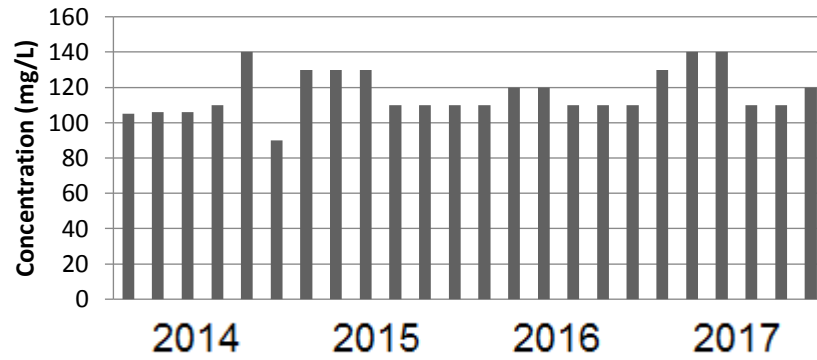
Matthew Novotny

Environmental Scientist

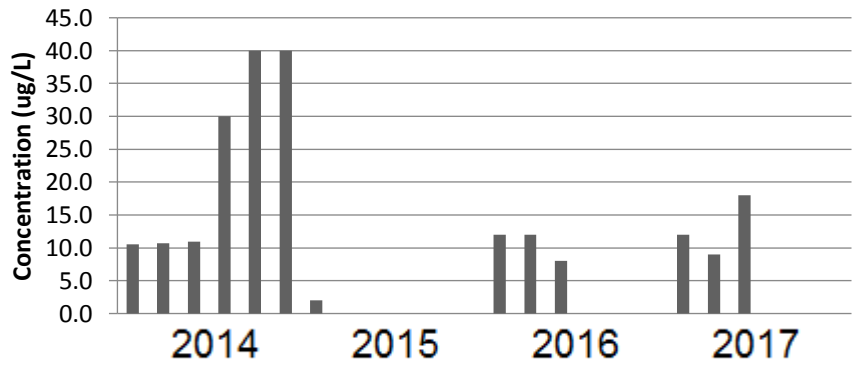
Historical Data:



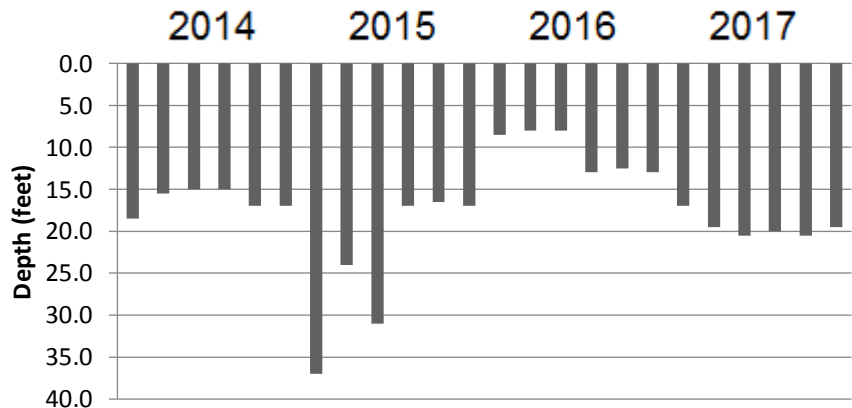
Walled Lake '14-'17 Alkalinity



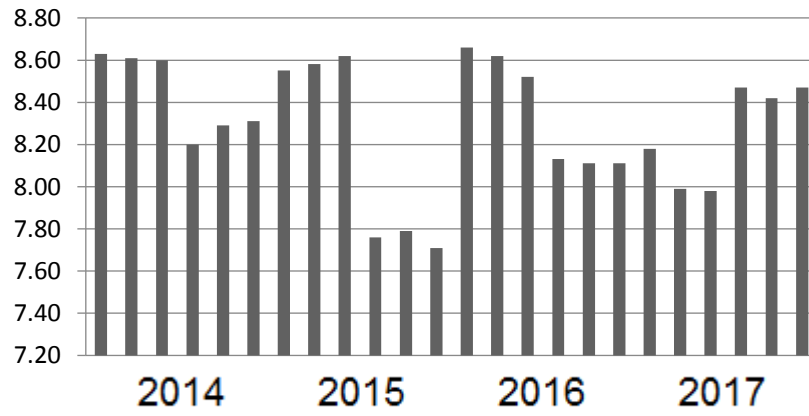
Walled Lake '14-'17 Phosphorus



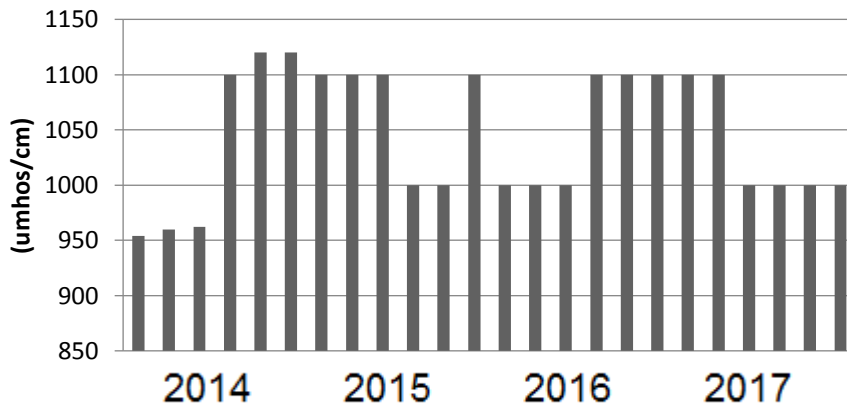
Walled Lake '14-'17 Secchi Disk Depth



Walled '14-'17 pH



Walled Lake '14-'17 Conductivity



Walled Lake Water Quality Data

Date	Sample Station Number	Temperature (°C)	Dissolved Oxygen		Chlorophyll α (ug/L)	Secchi Disk Depth (ft)	Total Nitrate-N (ug/L)	Alkalinity (mg/L)	pH	Conductivity umhos per cm at 25 °C	Total Phosphorus (ug/L)	Grade
			(mg/L)	Percent Saturation								
6/5/2014	1	22.8	N/A	N/A	1.0	18.5	3.4	105	8.63	954	10.5	B
6/5/2014	2	22.2	N/A	N/A	N/A	15.5	3.7	106	8.61	960	10.7	B
6/5/2014	3	22.1	N/A	N/A	0.7	15.0	3.2	106	8.60	962	10.9	B
9/21/2014	1	17.7	7.99	84.6	1.1	15.0	<100	110	8.20	1100	30.0	B
9/21/2014	2	17.5	8.78	92.9	1.2	17.0	<100	140	8.29	1120	40.0	B
9/21/2014	3	17.3	8.74	90.6	1.0	17.0	<100	90	8.31	1120	40.0	B
5/20/2015	1	17.9	9.23	97.7	0.3	37	<60	130	8.55	1100	2	B
5/20/2015	2	17.7	9.18	97.1	0.61	24	<60	130	8.58	1100	<1	B
5/20/2015	3	17.9	9.22	97.6	0.62	31	<60	130	8.62	1100	<1	B
8/31/2015	1	24.5	9.5	112.5	1.0	17.0	<60	110.0	7.76	1000	<5	B
8/31/2015	2	23.7	9.3	111.1	1.6	16.5	<60	110.0	7.79	1000	<5	B
8/31/2015	3	23.4	9.4	110.2	1.3	17.0	<60	110.0	7.71	1100	<5	B
5/17/2016	1	14.7	10.67	106.0	1.7	8.5	<60	110.0	8.66	1000	12.0	B
5/17/2016	2	14.4	10.61	103.1	2.1	8.0	<60	120.0	8.62	1000	12.0	B
5/17/2016	3	14.8	10.63	105.6	2.8	8.0	<60	120.0	8.52	1000	8.0	B
9/29/2016	1	16.6	8.54	88.5	1	13.0	<60	110.0	8.13	1100.0	<9	B
9/29/2016	2	16.6	8.66	89.7	1.4	12.5	<60	110.0	8.11	1100.0	<9	B
9/29/2016	3	16.4	8.66	87.9	1.4	13.0	<60	110.0	8.11	1100.0	<9	B
5/11/2017	1	14.1	10.30	100.1	0.35	17.0	110.0	130.0	8.18	1100.0	12.0	B
5/11/2017	2	13.4	10.26	97.5	0.00	19.5	70.0	140.0	7.99	1100.0	9.0	A
5/11/2017	3	13.0	10.21	97.1	0.35	20.5	100.0	140.0	7.98	1000.0	18.0	A
9/21/2017	1	22.4	10.02	114.9	0.69	20.0	<60	110.0	8.47	1000.0	<8	B
9/21/2017	2	22.8	9.86	115.2	0.35	20.5	<60	110.0	8.42	1000.0	<8	B
9/21/2017	3	21.6	9.88	113.3	0.00	19.5	<60	120	8.47	1000	<8	B

Parameter Descriptions:

TEMPERATURE AND DISSOLVED OXYGEN

Temperature exerts a wide variety of influences on most lakes, such as the separation of layers of water (stratification), solubility of gases, and biological activity.

Dissolved oxygen is the parameter most often selected by lake water quality scientists as being important. Besides providing oxygen for aquatic organisms in natural lakes, dissolved oxygen is involved in phenomena such as phosphorus precipitation to, and release from, the lake bottom sediments and decomposition of organic material in the lake.

Low dissolved oxygen concentrations (below 4 milligrams per liter) are generally insufficient to support fish life. In most Michigan lakes, there is no dissolved oxygen below the thermocline in late summer. Some experts like to see some dissolved oxygen in the bottom water of a lake, even if it is almost zero. This is because as long as there is some dissolved oxygen in the water at the bottom of the lake, phosphorus precipitated by iron to the bottom sediments will remain there. Once a lake runs out of dissolved oxygen in the water at the bottom iron comes back into solution. When that happens, it releases the phosphorus back into the water. This can cause additional algae to grow when the lake mixes.

DISSOLVED OXYGEN, PERCENT SATURATION

Because the amount of dissolved oxygen a water can hold is temperature dependent with cold water holding more than warm water, dissolved oxygen saturation is often a better way to determine if oxygen supplies are adequate. The best is between 90 and 110 percent.

CHLOROPHYLL α

Chlorophyll α is used by lake scientists as a measure of the biological productivity of the water. Generally, the lower the chlorophyll α , the better. High concentrations of chlorophyll α are indicative of an algal bloom in the lake, an indication of poor lake water quality. The highest surface chlorophyll α concentration found by Wallace Fusilier (Water Quality Investigators, WQI) in a Michigan lake was 216 micrograms per liter. Best is below one microgram per liter.

SECCHI DISK TRANSPARENCY (originally Secchi's disk)

In 1865, Angelo Secchi, the Pope's astronomer in Rome, Italy devised a 20-centimeter (8 inch) white disk for studying the transparency of the water in the Mediterranean Sea. Later an American limnologist (lake scientist) named Whipple divided the disk into black and white quadrants which many are familiar with today.

The Secchi disk transparency is a lake test widely used and accepted by limnologists. The experts generally felt the greater the Secchi disk depth, the better quality the water. However, one Canadian scientist pointed out acid lakes have very deep Secchi disk readings. (Would you consider a very clear lake a good quality lake, even if it had no fish in it? It would be almost like a swimming pool.) Most lakes in southeast Michigan have Secchi disk transparencies of less than ten feet. On the other hand, Elizabeth Lake in Oakland County had 34 foot Secchi disk readings in summer 1996, evidently caused by a zebra mussel invasion a couple of years earlier.

Most limnology texts recommend the following: to take a Secchi disk transparency reading, lower the disk into the water on the shaded side of an anchored boat to a point where it disappears. Then raise it to a point where it's visible. The average of these two readings is the Secchi disk transparency depth.

Secchi disk measurements should be taken between 10 AM and 4 PM. Rough water will give slightly shallower readings than smooth water. Sunny days will give slightly deeper readings than cloudy days. However, roughness influences the visibility of the disk more than sunny or cloudy days.

TOTAL PHOSPHORUS

Although there are several forms of phosphorus found in lakes, the experts selected total phosphorus as being most important. This is probably because all forms of phosphorus can be converted to the other forms. Currently, most lake scientists feel phosphorus, which is measured in parts per billion (1 part per billion is one second in 31 years) or micrograms per liter ($\mu\text{g/L}$), is the one nutrient which might be controlled. If its addition to lake water could be limited, the lake

might not become covered with the algal communities so often found in eutrophic lakes.

Based on WQI's studies of many Michigan inland lakes, they've found many lakes were phosphorus limited in spring (so don't add phosphorus) and nitrate limited in summer (so don't add nitrogen).

10 parts per billion is considered a low concentration of phosphorus in a lake and 50 parts per billion is considered a high value in a lake by many limnologists.

NITRATE NITROGEN

Nitrate, also measured in the parts per billion range, has traditionally been considered by lake scientists to be a limiting nutrient. The experts felt any concentration below 200 parts per billion was excellent in terms of lake water quality. The highest value found by Fusilier was 48,000 parts per billion in an Ottawa County river which flowed into Lake Macatawa in Holland, Michigan

On the other hand, WQI has studied hundreds of Michigan inland lakes, and many times they find them nitrate limited (very low nitrate nitrogen concentrations), especially in summer.

WQI was finding many lakes have lower nitrate nitrogen concentrations in summer than in spring. This is probably due to two factors. First, plants and algae growing in lakes as water warms can remove nitrates from the water column. And second, bacterial denitrification (where nitrates are converted to nitrogen gas by bacteria) also occurs at a much faster rate in summer when the water is warmer.

Generally limnologists feel optimal nitrate nitrogen concentrations (which encourage maximum plant and algal growth) are about 10-20 times higher than phosphorus concentrations. The reason more nitrogen than phosphorus is needed is because nitrogen is one of the chemicals used in the production of plant proteins, while phosphorus is used in the transfer of energy, but is not used to create plant material. If the nitrate concentration is less than 10-20 times the phosphorus concentration, the lake is considered nitrogen limited. If the nitrate concentration is higher than 10-20 times the phosphorus concentration, the lake is considered phosphorus limited.

TOTAL ALKALINITY

Alkalinity is a measure of the ability of the water to absorb acids (or bases) without changing the hydrogen ion concentration (pH). It is, in effect, a chemical sponge. In most Michigan lakes, alkalinity is due to the presence of carbonates and bicarbonates which were introduced into the lake from ground water or streams which flow into the lake. In lower Michigan, acidification of most lakes should not be a problem because of the high alkalinity concentrations.

HYDROGEN ION CONCENTRATION (pH)

pH has traditionally been a measure of water quality. Today it is an excellent indicator of the effects of acid rain on lakes. About 99% of the rain events in southeastern Michigan are below a pH of 5.6 and are thus considered acid. However, there seems to be no lakes in southern Michigan which are being affected by acid rain. Most lakes have pH values between 7.5 and 9.0.

SPECIFIC CONDUCTIVITY

Conductivity, measured with a meter, detects the capacity of a water to conduct an electric current. More importantly however, it measures the amount of materials dissolved in the water, since only dissolved materials will permit an electric current to flow. Theoretically, pure water will not conduct an electric current. It is the perception of the experts that poor quality water has more dissolved materials than does good quality water