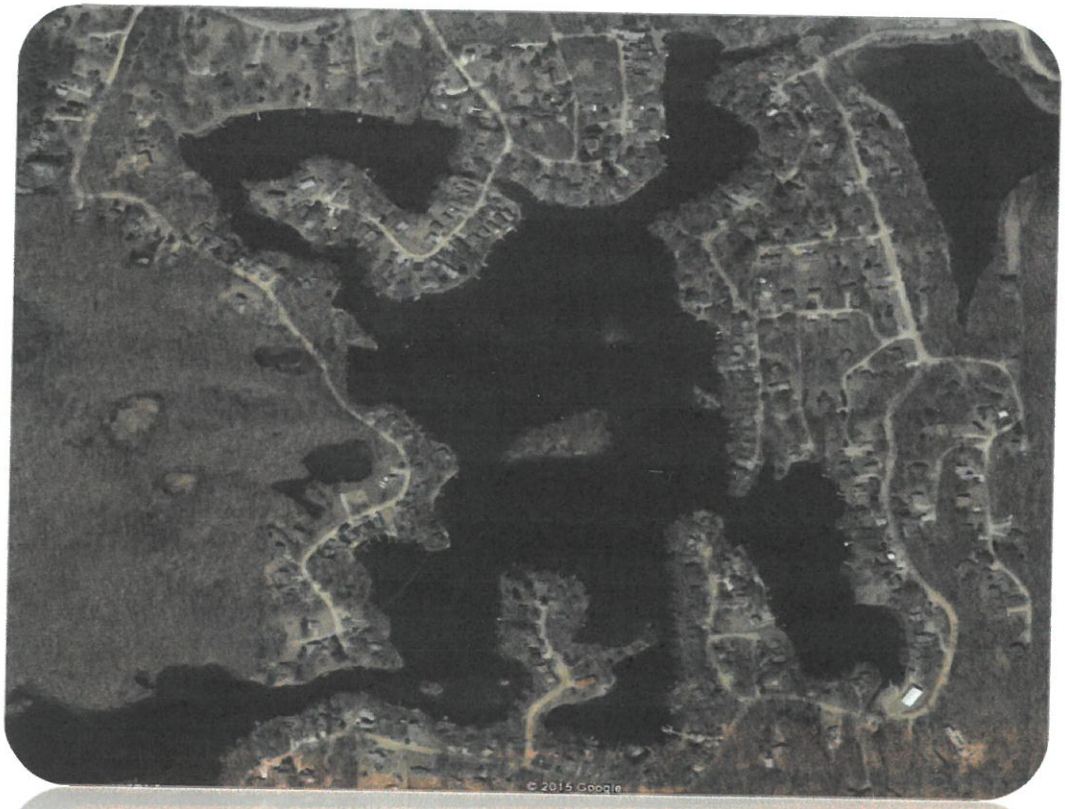

Hiland Lake

Lake Management Plan Update 2015

Submitted By:

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Lake Management Plan Update

Introduction

Purpose of the Update

This management plan updates and documents management activities during 2015, examines current conditions in the lake, and provides management recommendations for 2016. The plan will detail an integrated approach to lake management including but not limited to exotic weed control, water quality monitoring and aquatic vegetation surveying.

Characteristics of the lake

Hiland Lake is a 123 acre lake located in Livingston and Washtenaw Counties, Putnam and Dexter Townships, Michigan. There is a public access site on the western basin of the lake and a private access on the eastern basin. Rooted vegetation is moderately dense in a majority of the shoreline areas with a diversity of emergent and submerged aquatic plants. Aquatic vegetation is also found at a medium density along drop off areas and shallow flats. The lake has recently experienced some aquatic plant changes, especially since the introduction of the exotic invasive species, Starry stonewort.

Management Goals for Hiland Lake

- The primary goal of aquatic plant management in Hiland Lake is the control of exotic aquatic plants. The exotic plant species, Eurasian watermilfoil, curly leaf pondweed and starry stonewort should be controlled throughout Hiland Lake. The abundance of these species should be reduced to the maximum extent possible, and efforts should be made to reduce their recovery after treatment.
- Aquatic plant management should preserve species diversity and cover of native plants sufficient to provide habitat for fish and other aquatic organisms. Native plants should be managed to encourage the growth of plants that support the Hiland Lake fishery (by creating structure and habitat) provided that they do not excessively interfere with recreational uses of the lake (e.g., swimming and fishing) in high-use areas. Where they must be managed, management techniques that reduce the stature of native plants without killing them (e.g., harvesting, contact herbicides) should be used whenever possible. Specific areas should be set aside where native plants will not be managed, to provide habitat for fish and other aquatic organisms. Muskgrass (*Chara*) should be allowed to grow throughout the lake, except in where it grows so tall as to interfere with boating and swimming.

- The species Starry stonewort, should be actively controlled and managed. Starry stonewort is in the same family as Muskgrass (Chara) but is considered to be an exotic invasive species. Starry stonewort, which looks very similar to the beneficial species Chara, is appearing in more and more lakes. Chara is a highly desired plant because it is typically low growing, keeps the water clear and can slow down the invasion of exotic weed species. Starry stonewort also forms dense mats, but unlike chara, it can grow from 5 to 7 feet tall. Starry stonewort can be very detrimental to a lake's ecosystem and has the ability to kill off native plants and have a negative impact on a lake's fisheries.

Starry stonewort

- The invasive terrestrial plants, Purple loosestrife and Phragmities should be controlled along the shoreline and adjacent wetlands where present. Both species are exotic and have the ability to displace beneficial native vegetation. Purple loosestrife grows 2 -4 feet tall and is a vibrant magenta color. It is very aggressive and can quickly become the dominant wetland vegetaion. Phragmites (common reed) is a wetland grass that ranges in height from 6 to 15 feet tall. "Phrag" quickly becomes the dominant feature in aquatic ecosystems, aggressively invading shorelines, wetlands, and ditches. This plant creates dense "strands" - walls of weeds crowding out beneficial native wetland vegetation and indigenous waterfowl habitats. Spreading by fragmentation and an extensive root system, Phragmites ultimately out-competes native plant life for sun, water and nutrients.

Phragmites

- Conditions in Hiland Lake should not be allowed to deteriorate below present levels. Expansion of aquatic plant problems should trigger an adjustment in the aquatic vegetation management strategy. To support such responses, an annual record of vegetation and management should be maintained.
- Preventative measures that protect the lake from further nutrient enrichment should be identified and implemented.

Lake Management Activities Conducted in 2015

Water Quality

Water quality in the lake was evaluated on May 5, and August 25, 2015. On each occasion, a depth profile of water temperature and dissolved oxygen concentrations was measured at one-meter (approximately three foot) intervals and the Secchi disk depth was measured in the deepest part of the lake (Deep Hole Site). LakeCheck™ analysis was collected from the deep part of the lake. LakeCheck measures conductivity, total dissolved solids, pH, alkalinity, total phosphorus, soluble reactive phosphorus, nitrates and ammonia. A complete water quality report is attached

Planning/Evaluation

A complete surveys of the aquatic vegetation of the lake was conducted on August 25, 2015. Brief checks of the lake were made throughout the summer months.

Vegetation surveys determine the locations of target and non-target plant species. The results of the surveys are used to determine the most appropriate management strategy. The vegetation surveys also document the success of the prescribed management program. An AVAS survey is the State of Michigan's method for conducting a complete aquatic vegetation survey. The Aquatic Vegetation Assessment Site (AVAS) survey divides the parts of the lake capable of growing plants (littoral zone) into subareas and records the cover of each aquatic plant found in each "site". This method of surveying takes into account not only the types of plant species present in the lake but also the densities of those species. AVAS surveys are also an excellent way to track plant species trends over time. A goal of invasive plant management is to have native plants increase while exotic plants decrease over time. The success of this goal can be illustrated through the use of the AVAS data collected over several years.

Since different native plants grow at varying times throughout the season it is important to evaluate the lake multiple times to account for *all* species in the lake. The first evaluation is typically

conducted in the spring and is used to determine areas that will require treatment or management. The second survey is conducted in late summer or fall and is used to determine management success.

Current Conditions in the Lake

Aquatic Vegetation

Hiland Lake supports a relatively diverse community of aquatic plants. Seven species of native aquatic plants were encountered in the August 2015. Rooted plant growth was moderate in most shoreline areas. The native plant species in Hiland Lake benefit the lake, performing such functions as stabilizing sediments and providing habitat for fish and other aquatic organisms. In general, native species cause few problems, compared with those caused by exotic plants. Three native species commonly found in higher densities in Hiland Lake are water lilies, wild celery and coontail.

(See attached survey map and information)

Eurasian watermilfoil and starry stonewort were also found during the August survey. They are non-indigenous aquatic nuisance species, i.e., plants from other places. These exotic plants cause considerably more problems than most native species. Eurasian watermilfoil can attain nuisance levels of growth at almost any time of year. Starry stonewort has been shown to be the most aggressive and troublesome exotic species we have encountered, spreading vigorously within lakes it invades. Starry stonewort was found in 37 of the 50 AVAS sites during the fall survey.

Aquatic Plant Control

Treatments during the 2015 season were conducted on May 11th, June 9th, June 29th, July 8th , July 16th, July 27th, August 11th, August 25th & September 3rd. A table with treatment dates and target species, including acres treated is attached.

Water Quality Monitoring

Water quality monitoring is a critical part of lake management. Water quality monitoring provides an ongoing record of conditions in a waterbody. Changes in water quality can indicate threats from sources such as failed or inadequate septic systems, agricultural and lawn runoff, burgeoning development and erosion from construction site. Prompt identification of threats to water quality makes it possible to remedy them before irreversible harm has been done. Riparian's enjoyment of the water resource and the value of their property depend on maintaining water quality.

Temperature and Dissolved Oxygen Profiles

Depth profiles of temperature and dissolved oxygen indicate that on May 5th the lake was not thermally stratified. The lake was well oxygenated, with an oxygen concentration of 12.4 mg/L (120% saturation) at the surface and 12.8 mg/L (128% saturation at 3 meters).

On August 25, the lake was not thermally stratified. Dissolved oxygen was at normal levels at the surface and down to 3 meters. August dissolved oxygen concentrations at the surface were 7.3 mg/L (74 % saturation), and the concentration at 3 meters depth was 7.2 mg/L (73 % saturation).

Conductivity Total Dissolved Solids, pH and Alkalinity

Conductivity and Total Dissolved Solids (TDS) measure the total concentration of dissolved salts in the water. Values for Hiland Lake indicate moderate concentrations of dissolved materials. Alkalinity and pH measure the amount of dissolved bases and the balance of acids and bases in the water. Alkalinity and pH values were within normal ranges for a hard water lake.

Secchi Disk Depths

The Secchi disk depth is a measure of water clarity, determined by measuring the depth to which a black and white disk can be seen from the surface. (Larger numbers represent greater water clarity.) In May, the Secchi disk depth was 2.3 meters. The August Secchi disk depth declined to 3.0 meters.

Total Phosphorus

Total phosphorus measures the total amount of phosphorus in the water. Phosphorus is an important plant nutrient (i.e., fertilizer) and the nutrient most likely to limit algal growth. Elevated phosphorus inputs to lakes caused by human activities are a major cause of cultural eutrophication. The total phosphorus concentration at the surface in Mayl was 12 µg P/L. By August, the concentrations were slightly less than those found in May at a concentration of 8 µg P/L.

The concentration of phosphorus encountered in Hiland Lake during 2015 indicates a low to moderate phosphorus concentration of the lake. Overall, the phosphorus concentrations observed during the 2015 season are similar to other lakes in the area with similar physical characteristics.

Nitrates

Nitrates measure the total amount of in-organic nitrogen in the water. Nitrogen is an important plant nutrient (i.e., fertilizer) and the nutrient most likely to limit the growth of rooted plants. Overall, nitrate concentrations in the lake were moderate to low. In April the nitrate concentrations was 300 µg N/L at the surface. The August concentration was 250 µg N/L. Nitrates values observed during the 2015 season continue to indicate low to moderate levels in the lake.

Evaluation of Trophic Status

Carlson's Trophic State Index (TSI) calculated from Secchi disk depth total phosphorus and chlorophyll measurements made in April and August yielded values between 26 and 54 (see Table 2). These values overall rate Hiland Lake as oligotrophic to moderately eutrophic.

Table 2. Trophic State Index (TSI) Values

Site: Deep Hole	TSI from Secchi Disk	TSI from Total Phosphorus	TSI from Chlorophyll
May	48	36	NA
August	44	30	NA

Management Recommendations for 2016

Management options are dependent on many factors, including but not limited too, species abundance (density), species richness, species location and many lake characteristics. Whenever an exotic species is found within an aquatic environment, action needs to be taken to prevent long term ecological damage as well as recreational and aesthetic loss that will take place.

Submersed Aquatic Plants

Conventional Herbicide treatments

The 2016 aquatic plant management program should detect and treat any areas where exotic species are detected, particularly starry stonewort. Areas of starry stonewort, once detected should be promptly treated using herbicides. Treatments with the copper sulfate and Hydrothol conducted at the

first stages of growth (4-6 inches tall) should be conducted. Several other options for starry stonewort treatment, including Komeen crystals and Clipper, have shown promising results on controlling starry stonewort, although the cost are much higher than copper sulfate and the duration of effects are not completely understood. It is our recommendation to again treat some test plots during the 2016 season to test the effectiveness of these other herbicides on starry stonewort in Hiland Lake.

Treatments for Eurasian watermilfoil and Curlyleaf pondweed should continue as before to keep their abundance low as to not interfere with recreational activities and limit their ecological effects in the lake.

Nuisance native plant management can also be incorporated into a lake management program with conventional herbicide treatments if needed. Native plant treatments are completed using only contact herbicides in shoreline residential areas.

Monitoring

Aquatic vegetation and water quality will be monitored to document the condition of the lake and to provide warning of any changes in the condition of the lake that need to be addressed by additional lake management activities.

The Recommended Management Schedule for 2016:

- A spring vegetation survey and water quality monitoring (to evaluate conditions in the lake and direct management efforts)
- Early summer herbicide treatment (to control any Eurasian watermilfoil and/or curly leaf pondweed areas that are found)
- Starry stonewort should be monitored and treated as needed to keep it from spreading and creating recreational and ecological issues.
- Treatments as needed throughout the summer for exotic species and nuisance algae
- Mid-summer water quality sampling
- A fall vegetation survey
- Fall water quality sampling

TREATMENTS CONDUCTED DURING THE 2015 SEASON

May 11- 8 acres Algae, 22.5 acres EWM/Curlyleaf pondweed

June 9 - 6.5 acres algae, 7 acres EWM, 15 acres Starry w/ copper & 2 acres with Komeen

June 29 - 21 acres Starry with Copper, 2 acres Starry with Komeen

July 8 - 8 acres algae, 2.5 acres Starry with chelated copper, 5 acres Starry with copper & Hydrothol, 2 acres Starry with Komeen

July 16 - 3 acres Starry with copper & Hydrothol

July 27 - 20 acres Starry with copper & Hydrothol

August 11 - 12 acres Starry with copper & Hydrothol

August 25 - 15 acres Starry with copper & Hydrothol

September 3- 5 acres Starry with copper & Hydrothol, 5 acres EWM with Diquat

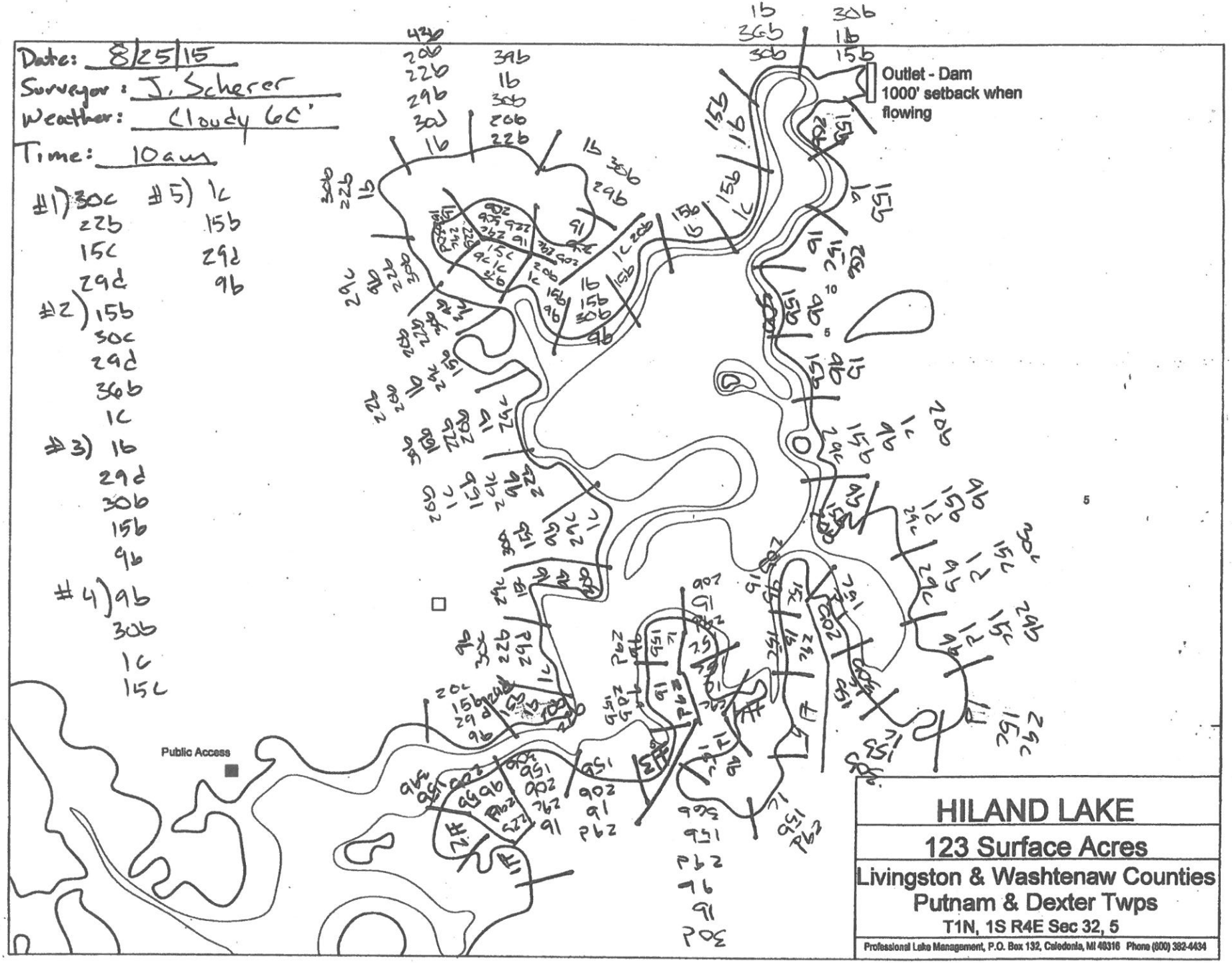
Lake:HiLand Lake County: Livingston Washtenaw Survey Date : 8/25/2015

Standard Aquatic Vegetation Summary Sheet

		Total number of AVAS's for each Density Category					Calculations				Sum of Columns 5-8	Total No. of AVAS	Col 9 divided by Col 10
Code No		A	B	C	D		A x 1	B x 10	C x 40	D x 80			
	Plant Name	1	2	3	4		5	6	7	8	9	10	11
1	Eurasian watermilfoil	1	26	17	6		1	260	680	480	1421	50	28.42
2	Curly leaf pondweed	0	0	0	0		0	0	0	0			
3	Chara	0	0	0	0		0	0	0	0			
4	Thinleaf pondweed	0	0	0	0		0	0	0	0			
5	Flatstem pondweed	0	1	0	0		0	10	0	0	10	50	0.20
6	Robbins pondweed	0	0	0	0		0	0	0	0			
7	Variable pondweed	0	0	0	0		0	0	0	0			
8	White stem pondweed	0	0	0	0		0	0	0	0			
9	Richardsons pondweed	1	24	0	0		1	240	0	0	241	50	4.82
10	Illinois pondweed	0	0	0	0		0	0	0	0			
11	Large leaf pondweed	0	0	0	0		0	0	0	0			
12	American pondweed	0	0	0	0		0	0	0	0			
13	Floating leaf pondweed	0	0	0	0		0	0	0	0			
14	Water stargrass	0	0	0	0		0	0	0	0			
15	Wild celery	0	32	14	0		0	320	560	0	880	50	17.60
16	Sagittaria (submersed)	0	0	0	0		0	0	0	0			
17	Northern watermilfoil	0	0	0	0		0	0	0	0			
18	Green watermilfoil	0	0	0	0		0	0	0	0			
19	Two-leaved watermilfoil	0	0	0	0		0	0	0	0			
20	Coontail	0	24	1	0		0	240	40	0	280	50	5.60
21	Elodea	0	0	0	0		0	0	0	0			
22	Bladderwort	0	14	0	0		0	140	0	0	140	50	2.80
23	Mini Bladderwort	0	0	0	0		0	0	0	0			
24	Buttercup	0	0	0	0		0	0	0	0			
25	Naiad	0	0	0	0		0	0	0	0			
26	Brittle naiad	0	0	0	0		0	0	0	0			
27	Sago Pondweed	0	0	0	0		0	0	0	0			
28	Cabomba	0	0	0	0		0	0	0	0			
29	Starry Stonewort	0	5	17	15		0	50	680	1200	1930	50	38.60
30	Water Lily	1	17	4	3		1	170	160	240	571	50	11.42
31	Spatterdock	0	0	0	0		0	0	0	0			
32	Water shield	0	0	0	0		0	0	0	0			
33	Lemna minor	0	0	0	0		0	0	0	0			
34	Greater duckweed	0	0	0	0		0	0	0	0			
35	Watermeal	0	0	0	0		0	0	0	0			
36	Arrowhead	0	3	0	0		0	30	0	0	30	50	0.60
37	Pickerelweed	0	0	0	0		0	0	0	0			
38	Arrow arum	0	0	0	0		0	0	0	0			
39	Cattail	0	2	0	0		0	20	0	0	20	50	0.40
40	Bulrush	0	0	0	0		0	0	0	0			
41	Iris	0	0	0	0		0	0	0	0			
42	Swamp loosestrife	0	0	0	0		0	0	0	0			
43	Purple loosestrife	0	1	0	0		0	10	0	0	10	50	0.20
44	Phragmites	0	0	0	0		0	0	0	0			
45		0	0	0	0		0	0	0	0			

Total cumulative cover **110.66**

A = 1-2% -3
B = 3-20% -149
C = 21-60% -53
D = 61-100% -24


Date: 8/25/15
Surveyor: J. Scherer
Weather: Cloudy 60°
Time: 10am
#1) 30c 22b 15c 29d
#2) 15b 30c 29d 36b 1c
#3) 1b 29d 30b 15b 9b
#4) 9b 30b 1c 15c
#5) 1c 15b 29d 9b
Outlet - Dam
1000' setback when flowing
Public Access
HILAND LAKE
123 Surface Acres
Livingston & Washtenaw Counties
Putnam & Dexter Twps
T1N, 1S R4E Sec 32, 5
Professional Lake Management, P.O. Box 132, Caledonia, MI 49316 Phone (800) 382-4434

2015165

LAKE CHECK Water Quality Monitoring Report

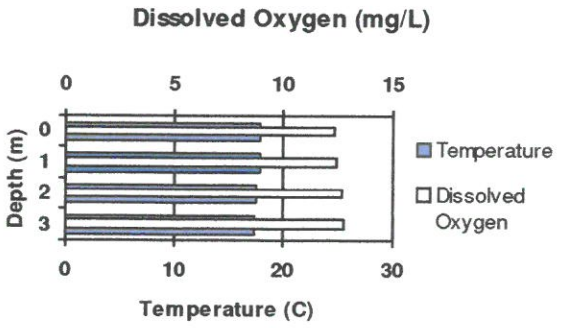
Customer	Waterbody	Sample Information
Hiland Lake	Hiland Lake	Date: 5/5/2015
		Site: Deep Hole

On-Site Results

Depth (m)	Temperature (degrees C)	Dissolved Oxygen mg/L	Dissolved Oxygen %
0	17.9	12.4	120
1	17.9	12.4	121
2	17.5	12.6	122
3	17.3	12.8	128

62°

Secchi Disk Depth	2.3 meters
Thermocline Depth	meters



Analytical Results

Parameter	Result	Units	Interpretation
Fecal Bacteria (E. coli		CFU/100 mL	N/A
Conductivity	537	uS/cm	Moderate concentration of dissolved salts
Total Dissolved Solids	349	mg/L	
pH	8.4	S.U.	Water is slightly alkaline
Alkalinity	212	mg CaCO3/L	Water is very hard
Total Phosphorus	12	ug/L	Moderately phosphorus enriched
Nitrates	1470	ug/L	Nitrogen enriched
Chlorophyll	N/A		

Trophic State Evaluation

	TSI	Trophic Status
Based on Secchi Disk Depth	48	moderately eutrophic
Based on Total Phosphorus	36	meso-oligotrophic
Based on Chlorophyll	N/A	

Conclusions

- Conditions are good for fish growth.
- Minimum dissolved oxygen is adequate for good fish production.
- pH is within acceptable limits.
- Sample is somewhat phosphorus enriched. Create natural buffer between lawn & lakeshore.
- Sample is nitrogen enriched. Consider nutrient abatement measures.
- Repeat LakeCheck in Fall.

- WARNING. condition requires immediate attention.
- CAUTION. condition requires further evaluation.
- OK. condition within acceptable limits.
- NEUTRAL. condition neither good nor bad.

Notes

Report describes conditions at the time the sample was collected.

Approved by Jaimee Conroy Date 11/9/2015

Mrs. Jaimee Conroy, Technical Services Manager

FROM YOUR WQ PRO DEALER

PLM Lake & Land Management Corp
P.O. Box 132
Caledonia MI 49316-
Phone: (616) 891-1294

2015166

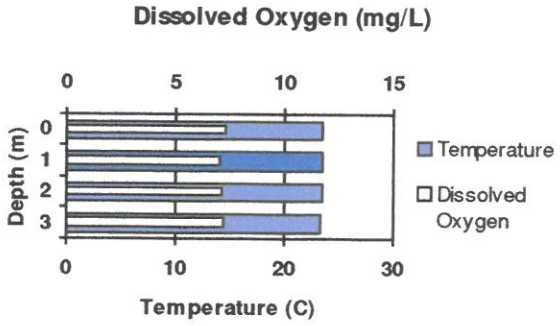
LAKE CHECK Water Quality Monitoring Report

Customer	Waterbody	Sample Information
Hiland Lake	Hiland Lake	Date: 8/25/2015
		Site: Deep Hole

On-Site Results

Depth (m)	Temperature (degrees C)	Dissolved Oxygen mg/L	Dissolved Oxygen %
0	23.5	7.3	74
1	23.4	7.1	72
2	23.4	7.1	72
3	23.3	7.2	73

73°



Secchi Disk Depth	3.0	meters
Thermocline Depth		meters

Analytical Results

Parameter	Result	Units	Interpretation
Fecal Bacteria (E. coli		CFU/100 mL	N/A
Conductivity	452	uS/cm	Moderate concentration of dissolved salts
Total Dissolved Solids	294	mg/L	
pH	8.2	S.U.	Water is slightly alkaline
Alkalinity	175	mg CaCO3/L	Water is hard
Total Phosphorus	8	ug/L	Slightly phosphorus enriched
Nitrates	270	ug/L	Slightly nitrogen enriched
Chlorophyll	N/A		

Trophic State Evaluation

	TSI	Trophic Status
Based on Secchi Disk Depth	44	mesotrophic
Based on Total Phosphorus	30	oligotrophic
Based on Chlorophyll	N/A	

Conclusions

- Conditions are good for fish growth.
- Minimum dissolved oxygen is adequate for good fish production.
- pH is within acceptable limits.
- Phosphorus and Nitrogen are within acceptable limits.
- REPEAT LakeCheck NEXT YEAR!

- WARNING. condition requires immediate attention.
- CAUTION. condition requires further evaluation.
- OK. condition within acceptable limits.
- NEUTRAL. condition neither good nor bad.

Notes

Report describes conditions at the time the sample was collected.

Approved by Jaimee Conroy Date 11/9/2015

Mrs. Jaimee Conroy, Technical Services Manager

FROM YOUR WQ PRO DEALER

PLM Lake & Land Management Corp
P.O. Box 132
Caledonia MI 49316-
Phone: (616) 891-1294

7/8/15

INSTITUTE FOR FISHERIES RESEARCH

DIVISION OF FISHERIES — MICHIGAN CONSERVATION DEPT.

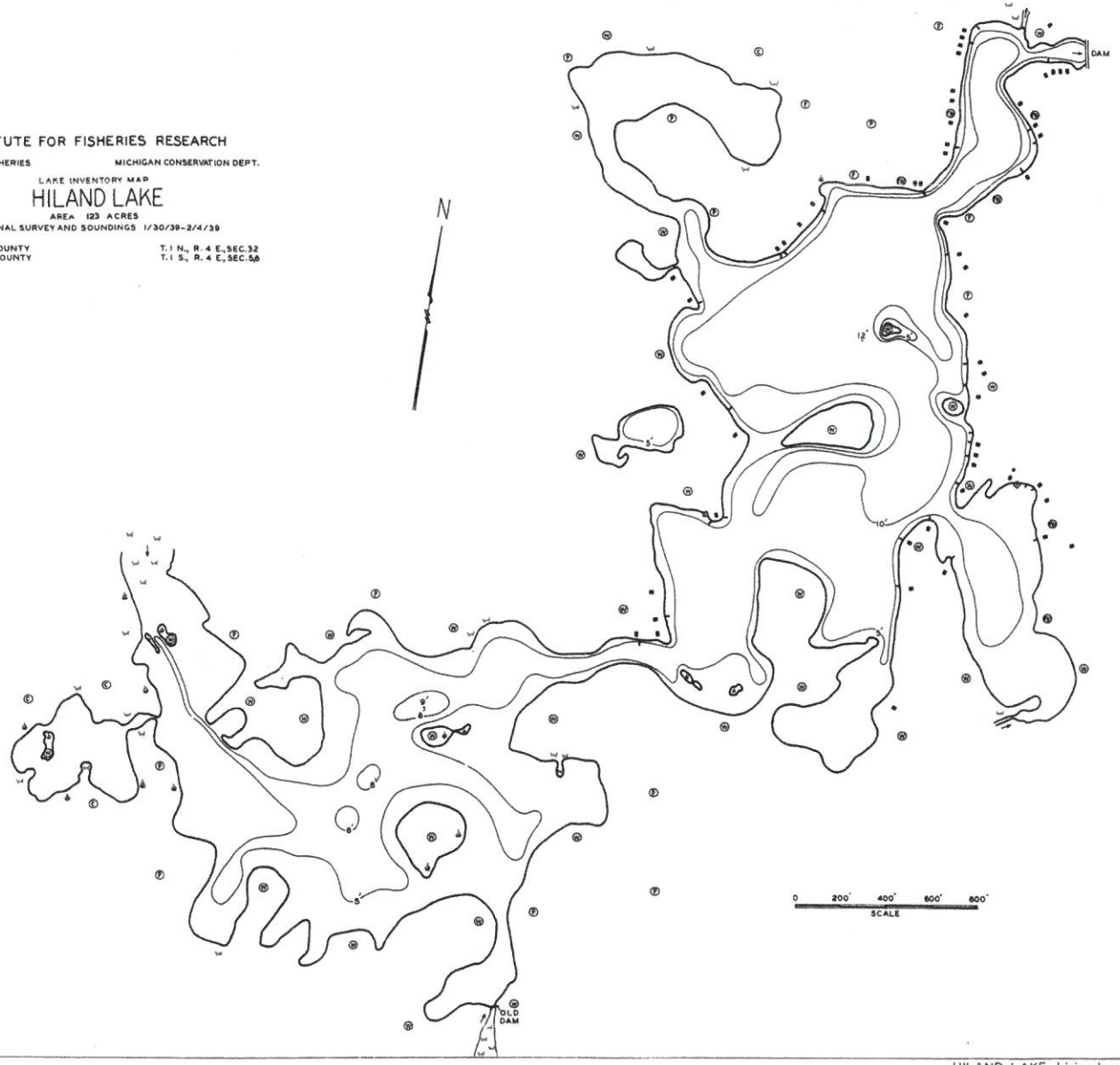
LAKE INVENTORY MAP

HILAND LAKE

AREA 123 ACRES

MARGINAL SURVEY AND SOUNDINGS 1/30/39-2/4/39

LIVINGSTON COUNTY — T. 1 N., R. 4 E., SEC. 32
WASHTENAW COUNTY — T. 1 S., R. 4 E., SEC. 5,6



LEGEND

BOTTOM
- Sand
- Marl
- Muck
- Pulpy peat
- Fibrous peat

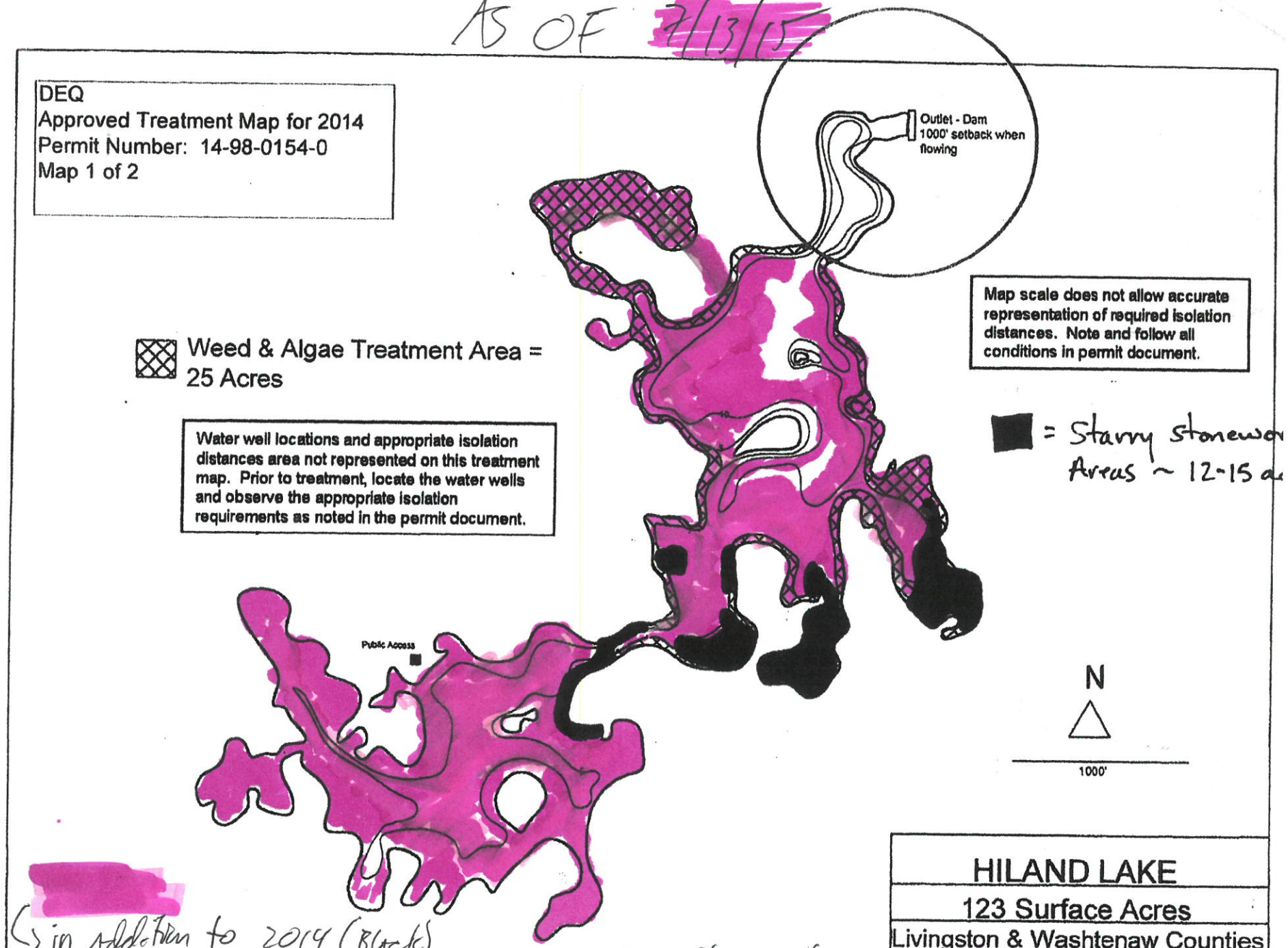
OUTLINE & CONTOURS
- Shoreline
- Contours

SHORE FEATURES
- Cottage
- Dock
- Brush
- Marsh
- Boathouse
- Wooded
- Partly wooded
- Cultivated
- Pasture
- Inlet
- Outlet

HILAND LAKE Livingston County T. 1 N., R. 4 E., Sec. 32
Washtenaw County T. 1 S., R. 4 E., Sec. 5,6

AS OF 7/13/15

DEQ
Approved Treatment Map for 2014
Permit Number: 14-98-0154-0
Map 1 of 2



Weed & Algae Treatment Area = 25 Acres

Water well locations and appropriate isolation distances area not represented on this treatment map. Prior to treatment, locate the water wells and observe the appropriate isolation requirements as noted in the permit document.

Map scale does not allow accurate representation of required isolation distances. Note and follow all conditions in permit document.

■ = Starry stonewor
Areas ~ 12-15 a

(5) in addition to 2014 (Black) these areas are now infested/invaded by Starry Stonewort

HILAND LAKE

123 Surface Acres

Livingston & Washtenaw Counties
Putnam & Dexter Twps
T1N, 1S R4E Sec 32, 5

Professional Lake Management, P.O. Box 132, Caledonia, MI 49316 Phone (800) 382-4434