Aquatic Plant Sample from Green Lake, August 2018

Aquatic Plant Point-Intercept Survey for Green Lake, Kandiyohi County, Minnesota, 2018

Point-Intercept Combined with a Meander Survey: August 9-10, 2018

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Aquatic Plant Point-Intercept Survey for Green Lake, Kandiyohi County, Minnesota in 2018

Summary

On August 9 and 10, 2018, a summer point-intercept survey was combined with a meander survey on Green Lake, Kandiyohi County. The most common submerged aquatic plant was chara (Figure S1). Plant growth was found to a depth of 30 feet. The aquatic plant community in 2018 had 10 species of submerged vascular plants in summer. This is a low to moderate plant diversity condition for a lake in this ecoregion setting.

Eurasian watermilfoil (EWM) was the only non-native plant observed. EWM was first found in Green in 2000. In 2018, EWM was widely distributed in Green Lake, but was found primarily in small patches and rarely in extensive beds (Figure S1). It's growth history would indicate it will continue to be widespread with occasional patches or beds of heavy growth that could be treated when necessary. It is not likely to become a significant perennial nuisance.

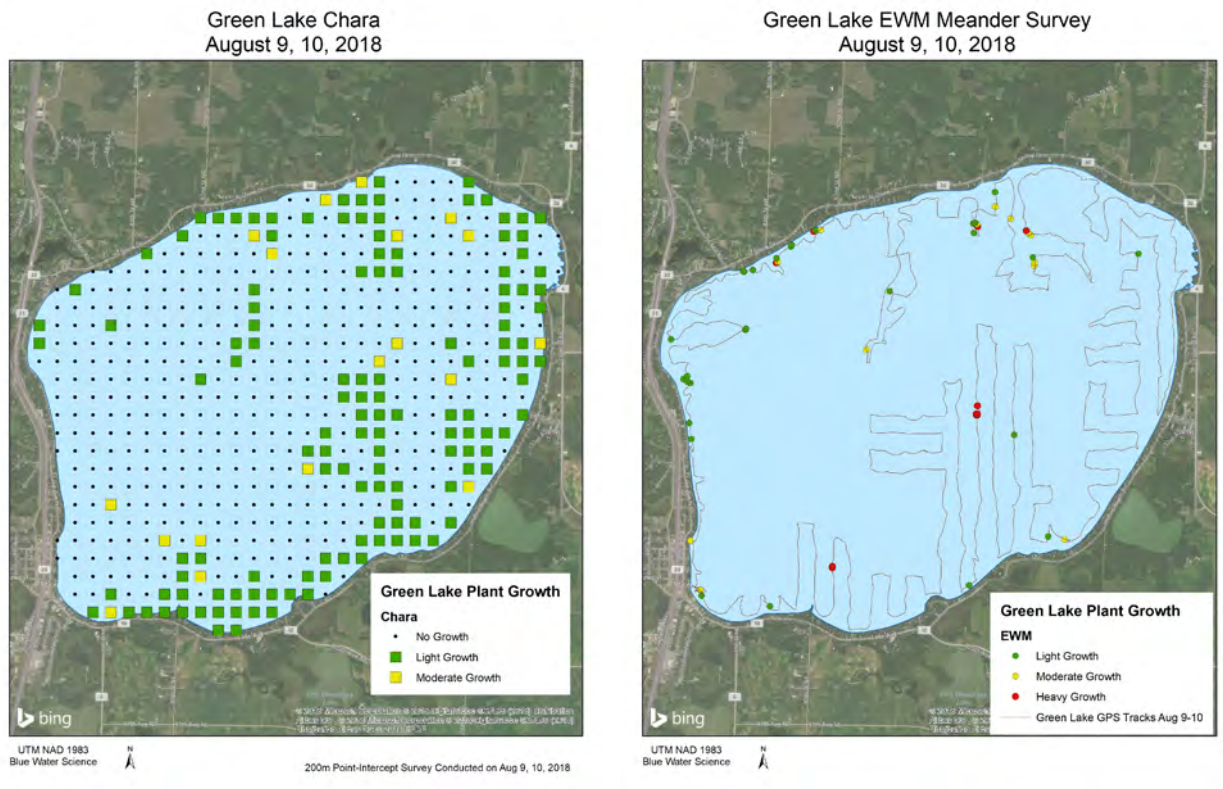


Figure S1. [left] Summer aquatic plant point-intercept survey coverage map for chara on August 9-10, 2018. [right] Eurasian watermilfoil distribution and abundance for August 2018 based on the meandering survey and the point intercept survey.
Key: green = light growth, yellow = moderate growth, and red = heavy growth.

Aquatic Plant Point-Intercept Survey for Green Lake, Kandiyohi County, Minnesota, 2018

Lake ID: 34-007900
Size: 5,569 acres
Littoral area: 2,035 acres
Maximum depth: 110 ft

Introduction

Green Lake is located within the City of Spicer in Kandiyohi County. An aquatic plant point-intercept survey was combined with a meandering survey were conducted in 2018. The aquatic plant community is of interest because the non-native Eurasian watermilfoil is present. Also, aquatic plant surveys characterize distribution of native plants which help to sustain good water quality.

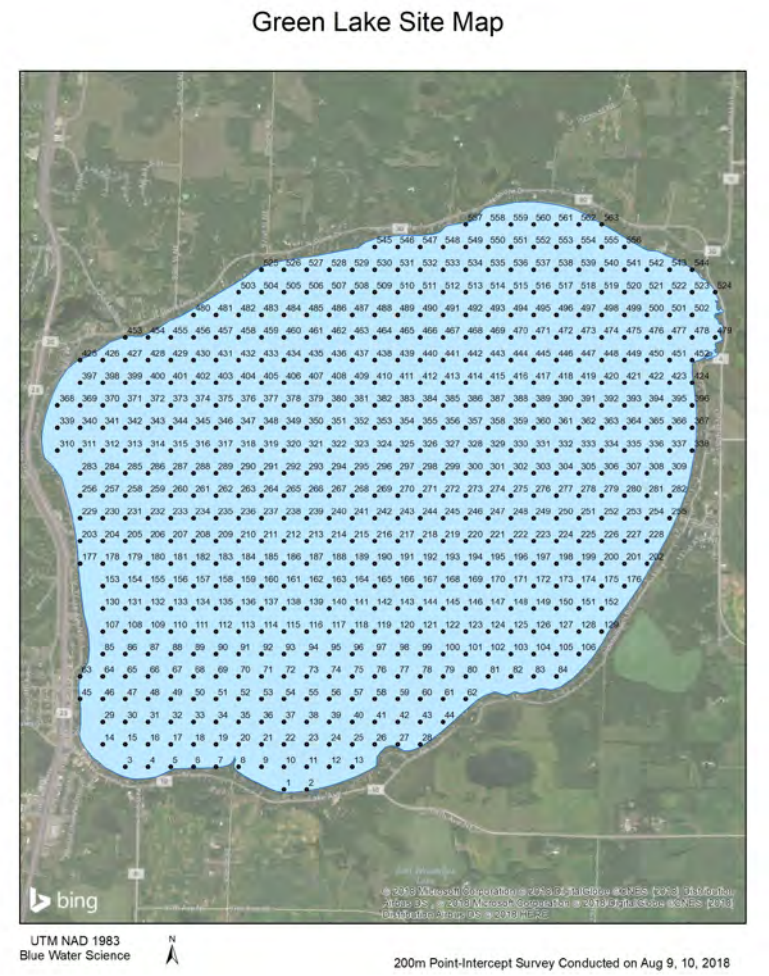


Figure 1. Sample locations for the point-intercept aquatic plant survey.

Methods - Aquatic Plant Point-Intercept Survey

Point-Intercept Survey: An aquatic plant survey of Green Lake using a point intercept sampling method was conducted by Blue Water Science in 2018. A summer survey was conducted on August 9-10, 2018. A map and sampling grid were prepared by Blue Water Science and a consisted of a total of 563 points that were distributed throughout the lake. Points were spaced 200 meters apart. Each point represented about 9.9 acres. At each sample point, plants were sampled with a rake sampler. In water less than 15 feet, a fixed-head rake sampler was used. In water deeper than 15 feet, a double-ended rake sampler on a rope was tossed into the lake. Plants were sampled to depth of 35 feet. A plant density rating was assigned to each plant species on a scale from 1 to 3 (Figure 2). A density of a “1" indicated sparse growth and a “3" rating indicated heavy plant growth (Figure 2).

Meander Survey: A meandering survey consists of using a meandering path around the nearshore area of the entire lake. At each sample point, plants were sampled with a rake sampler. A plant density rating was assigned to each plant species on a scale from 1 to 3 (Figure 2). A density of a “1" indicated sparse growth and “3" rating indicated heavy plant growth.

Chart of Aquatic Plant Density Ratings

Figure 2. Aquatic plant density ratings from 1 to 3.

Point-Intercept Survey -- August 9-10, 2018

The submerged aquatic plants were common in Green Lake for the August 2018 point-intercept plant survey. Chara was the dominant plant in Green Lake. A total of 10 submerged vascular aquatic plants and 1 emergent plant were found (Figure 3 and Table 1).

A summary of plant density and occurrence for individual sites is shown in Tables 1 and 2.

Table 1. Green Lake aquatic plant occurrences and densities for the August 9-10, 2018 survey based on 257 sites in water depths from 3 to 30 feet. Density ratings are 1-3 with 1 being low and 3 being most dense.

	All Stations (n=257)		
	Occurrence	% Occur	Density
Emergents			
Bulrush (*Scirpus sp*)	1	1	2
Submergents			
Coontail (*Ceratophyllum demersum*)	13	5	1.5
Northern watermilfoil (*Myriophyllum sibiricum*)	1	1	1.0
Eurasian watermilfoil (*Myriophyllum spicatum*)	4	2	1.0
Naiad (*Najas flexilis*)	4	2	1.0
Nitella (*Nitella sp*)	11	4	1.1
Whitestem pondweed (*Potamogeton praelongus*)	7	3	1.0
Claspingleaf pondweed (*P. Richardsonii*)	1	1	1.0
Widgeon grass (*Ruppia occidentalis*)	1	1	2.0
Bladderwort (*Utricularia sp*)	8	3	1.0
Water stargrass (*Zosterella dubia*)	1	1	1.0
Plant-Like Green Algae			
Chara (shallow water) (*Chara contraria*)	150	58	1.1
Chara (deep water) (*Chara globularis*)	43	17	1.8
Number of submerged species	10		

Chara - shallow

Chara - deep

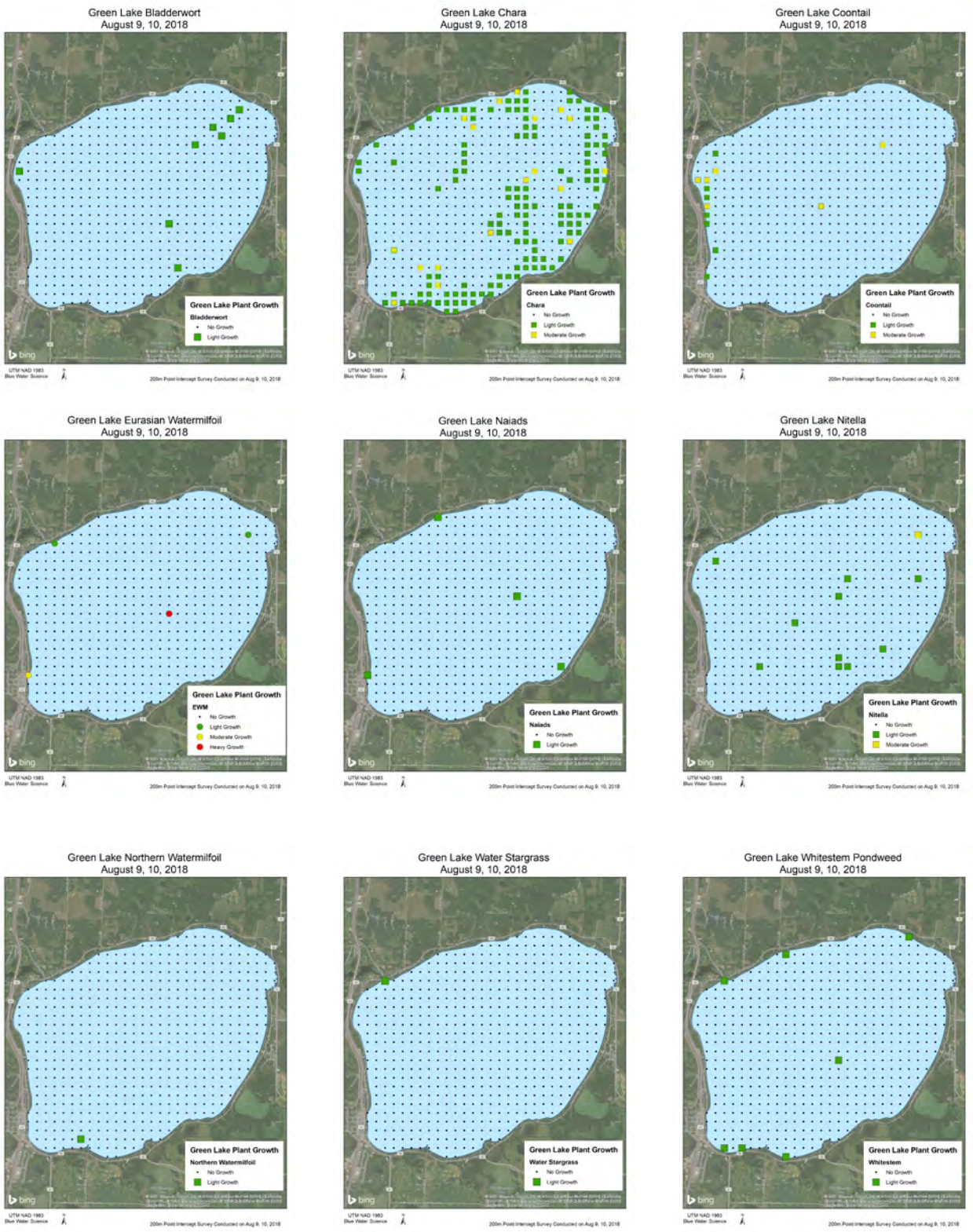


Figure 3. Coverage maps for August, 2018.
[top-left] Bladderwort. [top-middle] Chara. [top-right] Coontail.
[middle-left] Eurasian watermilfoil. [middle-middle] Naiads. [middle-right] Nitella.
[bottom-left] Northern watermilfoil. [bottom-middle] Water stargrass. [bottom-right] Whitestem pondweed.
Key: green = light growth, yellow = moderate growth, and red = heavy growth.

Green Lake Point Intercept Survey Statistics

A summary of plant statistics from the point intercept survey is shown in Tables 2 and 3 and Figure 4. A total of 300 points were sampled but 257 points were sampled from 0 to 30 feet of depth. Plants were common in depths up to 21 feet where 95% of plant growth was recorded from 3 to 21 feet (Table 2).

Table 2. MnDNR Template Statistics

Total # Points Sampled to 30 feet	257
Depth Range of Vegetation	4-30 feet
Maximum Depth of Growth (95%) in feet	21.0
# Points in Max Depth Range	235
# Points in Littoral Zone (0-15 feet)	203
% Points w/ Native Submersed Taxa	87
Mean Native Submersed Taxa/Point	1.0
Mean Density of Native Submersed Taxa	1.2
# Submersed Native Taxa	9
# Submersed Non-Native Taxa	1

Table 3. Aquatic plants sampled by depth.

Depth (feet)	Number of Sites at that Depth	Number of Sites with Plants at that Depth	Percent Occurrence of Plants at that Depth
3	2	1	50
4	1	1	50
5	14	7	50
6	12	11	92
7	20	17	85
8	24	23	96
9	25	24	96
10	26	25	96
11	21	20	95
12	14	14	100
13	12	11	92
14	14	11	79
15	18	16	89
16	6	6	100
17	7	7	100
18	5	4	80
19	6	6	100
20	4	3	75
21	4	2	50
22	2	1	50
23	2	1	50
24	5	4	80
25	1	1	100
26	0	0	0
27	3	1	33
28	2	0	0
29	1	1	100
30	6	1	17
All sites	257	219	85

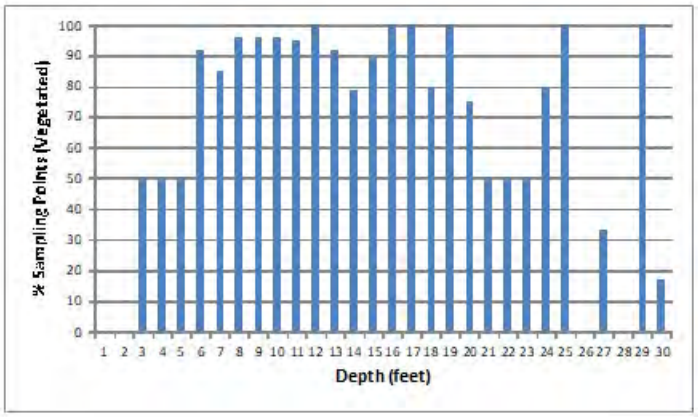


Figure 4. Depth of plant colonization (in feet).

Meandering Survey for Eurasian Watermilfoil

EWM was first observed in Green Lake in 2000. In 2018, the 19th year of EWM in Green Lake, EWM was actively searched using a combination of a point intercept survey and a meadnering survey. EWM was found at 53 sites in Green Lake (Table 4).

Table 4. Green Lake aquatic plant occurrences and densities for the August 9-10, 2018 survey based on the meander and point intercept surveys. Density rates are 1-3 with 1 being low and 3 being most dense.

	Meandering Survey (n=116)		Point Intercept Survey (n=257)	
	Occurrence	Density	Occurrence	Density
Bulrush (*Scirpus sp*)	--	--	1	2.0
Coontail (*Ceratophyllum demersum*)	17	1.1	13	1.5
Chara (shallow water) (*Chara contraria*)	16	1.0	150	1.1
Chara (deep water) (*Chara globularis*)	--	--	43	1.8
Water stargrass (*Heteranthera dubia*)	--	--	1	1.0
Northern watermilfoil (*Myriophyllum sibiricum*)	--	--	1	1.0
Eurasian watermilfoil (*M. spicatum*)	49	1.7	4	1.8
Naiad (*Najas flexilis*)	2	1.0	4	1.0
Nitella (*Nitella sp*)	--	--	11	1.1
Whitestem pondweed (*Potamogeton praelongus*)	2	1.0	7	1.0
Claspingleaf pondweed (*P. Richardsonii*)	--	--	1	1.0
Stringy pondweed (*P. sp*)	1	1.0	--	--
Widgeon grass (*Ruppia occidentalis*)	--	--	1	2.0
Bladderwort (*Utricularia vulgaris*)	--	--	8	1.0

Figure 5. Examples of different aquatic plants found in Green Lake in August 2018.
[top-left] Shallow water chara. [top-right] Deep water chara.
[bottom-left] Nitella.
[bottom-right] Eurasian watermilfoil.

Eurasian Watermilfoil Distribution and Abundance: EWM growth ranged from light to heavy around Green Lake. EWM was typically found in water from 8 to 12 feet deep.

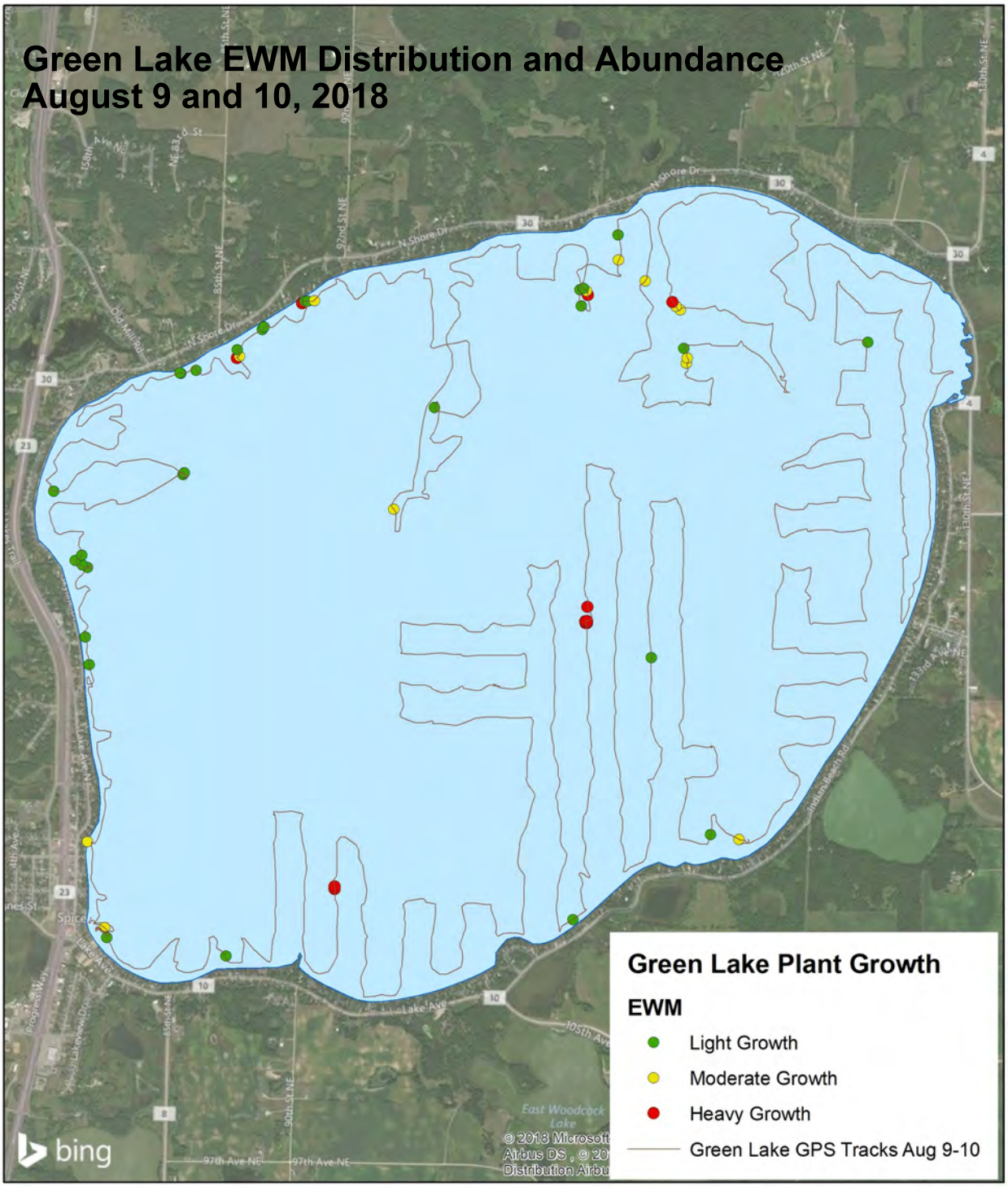


Figure 6. Eurasian watermilfoil coverage map for August, 2018 for the meandering survey. Key: green = light growth, yellow = moderate growth, and red = heavy growth.

Comparison of Two Point-Intercept Surveys: 2009 and 2018

The 2009 point intercept survey was conducted by the MnDNR. Plants were found to a depth of 28 feet. Zebra mussels were first observed in 2014 in Green Lake. In the 2018 point intercept survey the plant community did not appear to change in a significant way. The maximum depth of plant colonization in 2018 was 30 feet which is comparable to 28 feet in 2009. It does not appear the impact of zebra mussels has a significant impact on Green Lake aquatic plants.

Table 5. Aquatic plants present in Green Lake in August 2009. In 2009, there were 287 sample sites in the 0-30 ft water depth spaced 200 meters apart. In 2018, there were 257 sample sites in the 0-30 ft depth range also spaced 200 meters apart.

	2009 MnDNR % Occur	2018 BWS % Occur
Emergents		
Arrowhead (*Sagittaria sp*)	<1	--
Bulrush (*Scirpus sp*)	1	1
Submergents		
Coontail (*Ceratophyllum demersum*)	1	5
Northern watermilfoil (*Myriophyllum sibiricum*)	<1	1
Eurasian watermilfoil (*Myriophyllum spicatum*)	1	2
Naiad (*Najas flexilis*)	<1	2
Illinois pondweed (*Potamogeton illinoensis*)	1	--
Whitestem pondweed (*Potamogeton praelongus*)	--	3
Claspingleaf pondweed (*P. Richardsonii*)	<1	1
Narrowleaf pondweed (*P. sp*)	<1	--
Widgeon grass (*Ruppia occidentalis*)	1	1
Bladderwort (*Utricularia sp*)	<1	3
Water stargrass (*Zosterella dubia*)	<1	1
Plant-Like Green Algae		
Chara (*Chara sp.*)	54	58
Chara-2 (*Chara sp.*)	--	17
Nitella (*Nitella sp*)	9	4
Number of submerged species	10	9

*Other Species present in the MnDNR surveys from 2008 and 2009: water moss, river pondweed, Robbins pondweed, flatstem pondweed, fries pondweed, sago pondweed, curlyleaf pondweed, water celery, Canada waterweed, mare's tail, water buttercup, floatingleaf pondweed, narrowleaf cattail, needle spikerush.

Previous MnDNR Aquatic Plant Surveys from 1946 to 2002

Table 6. Green Lake aquatic plant survey results from 1946-2002 conducted by the MnDNR. Key: R=rare, O=occasional, P=present, C=common, and A = abundant.

COMMON NAME	SCIENTIFIC NAME	1946 10/7	1956 8/15	1979 8/	1990 8/1	1991 7/31	1992 8/26	1994 7/26	2002 10/5 & 11/1
Emergents									
Spike rush	*Eleocharis smallii*						R	R	
Manna Grass	*Glyceria*		P						
Reed Canary Grass	*Phalaris arundinacea*	P		O			R	R	
Reed Grass (Cane)	*Phragmites maximus*	P				O	R	R	
Water Smartweed	*Polygonum amphibium*						R		
Arrowhead	*Sagittaria spp*							R	
Stiff Wapato	*Sagittaria rigida*					P			
Hardstem Bulrush	*Scirpus acutus*	P	P	O	P	R	R	R	
Common Cattail	*Typha latifolia*			O		P	R	R	
Submergents									
Coontail	*Ceratophyllum demersum*			O	R	R	R		R
Canada Waterweed	*Elodea canadensis*			R	R	P	R	R	R
Water Star Grass	*Heteranthera*					P			R
Marestail	*Hippuris vulgaris*			R			R	R	R
Northern Watermilfoil	*Myriophyllum sibiricum*			O	O	P	R	R	R
Eurasian Watermilfoil	*Myriophyllum spicatum*								O
Bushy Pondweed	*Najas flexilis*	P		A	O		R	R	R
Largeleaf Pondweed	*Potamogeton amplifolius*		P	O	P	P	R		R
Curlyleaf Pondweed	*P. crispus*			C	O	P	R		
Nuttall's (Leafy) Pondweed	*P. epihydrus*				P			R	
Fries Pondweed	*P. Friesii*			O	P				
Variable Pondweed	*P. gramineus*					P		R	
Illinois Pondweed	*P. illinoensis*				P	P	R		O
Floatingleaf Pondweed	*P. natans*	P		O	P		R	R	R
Sago Pondweed	*P. pectinatus*		P	A	P	P	R	R	R
Whitestem Pondweed	*P. praelongus*	P		R					R
Claspingleaf Pondweed	*P. Richardsonii*			C	P	P	R	R	R
Narrowleaf Pondweed	*P. strictifolius*			C			R		
Flatstem Pondweed	*P. zosteriformis*				P	P	R	R	
Widgeon Grass	*Ruppia occidentalis*	P						R	O
Bladderwort	*Utricularia minor*			O	P	P		R	R
Wild Celery	*Vallisneria americana*			A	P	P	R	R	R
Floating									
Lesser Duckweed	*Lemna minor*						R		
Star Duckweed	*Lemma trisulca*				C				
Plant-like Green Algae									
Musk Grass (Stonewort)	*Chara*	P			C	A	C	R	A
	Nitella	P		O				R	R
Water Moss	*Drepanocladus spp*					O	R	R	
Number of submerged species		4	2	15	15	13	14	13	16

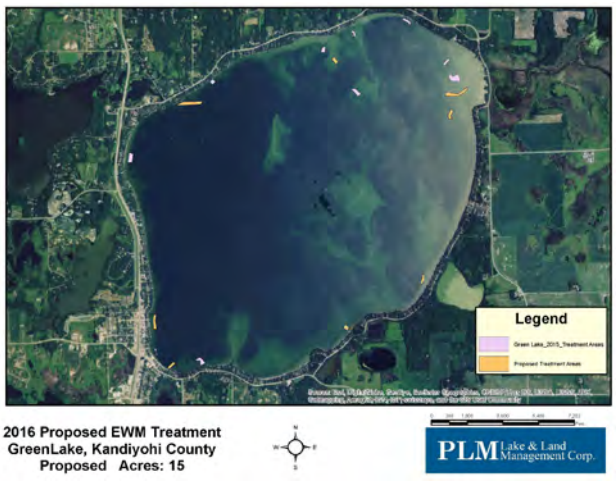
Comparison of Line Transect Surveys from 1994 and 2001

Table 7. Green Lake submerged aquatic plant percent occurrences based on a transect basis.

	1994 (MnDNR) (52 transects) (7.26, 28)	2001 (Blue Water Science) (50 transects) (10.5, 11.1)	Change from 1994 to 2001
Submergents			
Coontail (*Ceratophyllum demersum*)		2	0
Spike rush (*Eleocharis palustris*)	2		0
Elodea (*Elodea canadensis*)	2	2	0
Marestail (*Hippuris vulgaris*)	2	2	0
Northern watermilfoil (*Myriophyllum sibiricum*)	2	2	0
Eurasian watermilfoil (*M. spicatum*)		4	+
Naiads (*Najas sp*)	13	2	—
White water lilies (*Nymphaea tuberosa*)	2		0
Largeleaf pondweed (Cabbage) (*Potamogeton amplifolius*)		4	+
Leafy pondweed (*P. foliosus*)	6		—
Variable pondweed (*P. gramineus*)	23		—
Illinois pondweed (*P. illinoensis*)		14	+
Floatingleaf pondweed (*P. natans*)	2	2	0
Whitestem pondweed (*P. praelongus*)		2	0
Claspingleaf pondweed (*P. richardsonii*)	19	4	—
Flatstem pondweed (*P. zosteriformis*)	13		—
Buttercup (*Ranunculus sp*)	2		0
Widgeon grass (*Ruppia occidentalis*)		8	+
Sago pondweed (*Stuckenia pectinata*)	21	4	—
Bladderwort (*Utricularia sp*)	6	2	—
Water celery (*Vallisneria americana*)	4	2	0
Water stargrass (*Zosterella dubia*)		2	0
Plant-like Green Algae			
Chara (*Chara sp*)	94	94	0
Water moss (Drepanocladus sp)	25	0	—
Nitella (*Nitella sp*)	27	2	—
Number of submerged species	15	16	

Previous EWM Treatments

2013: 7.25 acres
2014: 2.6 acres
2016: 15 acres (proposed)
2017: 15.5 acres



Potential for EWM Growth Based on Lake Sediments

In 2000 (Sites 1-25) and in 2001 (Sites 26-33) a total of 33 lake sediment samples were collected and analyzed for parameters associated with EWM growth (Table 8). The potential for EWM in Green Lake ranges from light to heavy with 22 out of 33 sites associated with moderate growth potential.

The north side of Green Lake has the long term potential for lighter growth than the rest of the lake (Figure 7).

Table 8. Lake sediment data and rating for potential growth of Eurasian watermilfoil.

Site	Sample Depth (ft)	NH_4 Conc (ppm)	Organic Matter (%)	Potential for EWM Growth
		<4	<0.5 and >20	Light (green)
		4-10	0.6-2 and 18-20	Moderate (yellow)
		>10	3-17	Heavy (red)
1	8	3.30	0.5	1
2	8	3.54	0.7	2
3	8	3.01	0.7	3
4	5.5	11.56	1.1	4
5	6	10.0	0.9	5
6	5	14.4	1.7	6
7	5	8.38	3.9	7
8	6	8.63	2	8
9	6.5	13.1	2.4	9
10	5	5.09	0.5	10
11	6.5	4.92	0.6	11
12	8	4.86	1.4	12
13	5	6.15	1	13
14		4.60	1.1	14
15	6	14.1	1.6	15
16	5.5	11.29	2.6	16
17	5	6.46	2.4	17
18	5	5.55	0.8	18
19	6	3.32	1.1	19
20	5	3.95	0.7	20
21	4	6.03	1.3	21
22	6.5	3.28	1	22
23	6.5	2.90	0.6	23
24	6	3.10	0.6	24
25	7	4.45	1.0	25
26	7	4.49	0.7	26
27	6	12.2	2.8	27
28	6	7.69	1.5	28
29	6	7.88	1.1	29
30	5	9.19	1.6	30
31	8	6.70	1.2	31
32	8	5.35	1.5	32
33	5	5.19	0.7	33

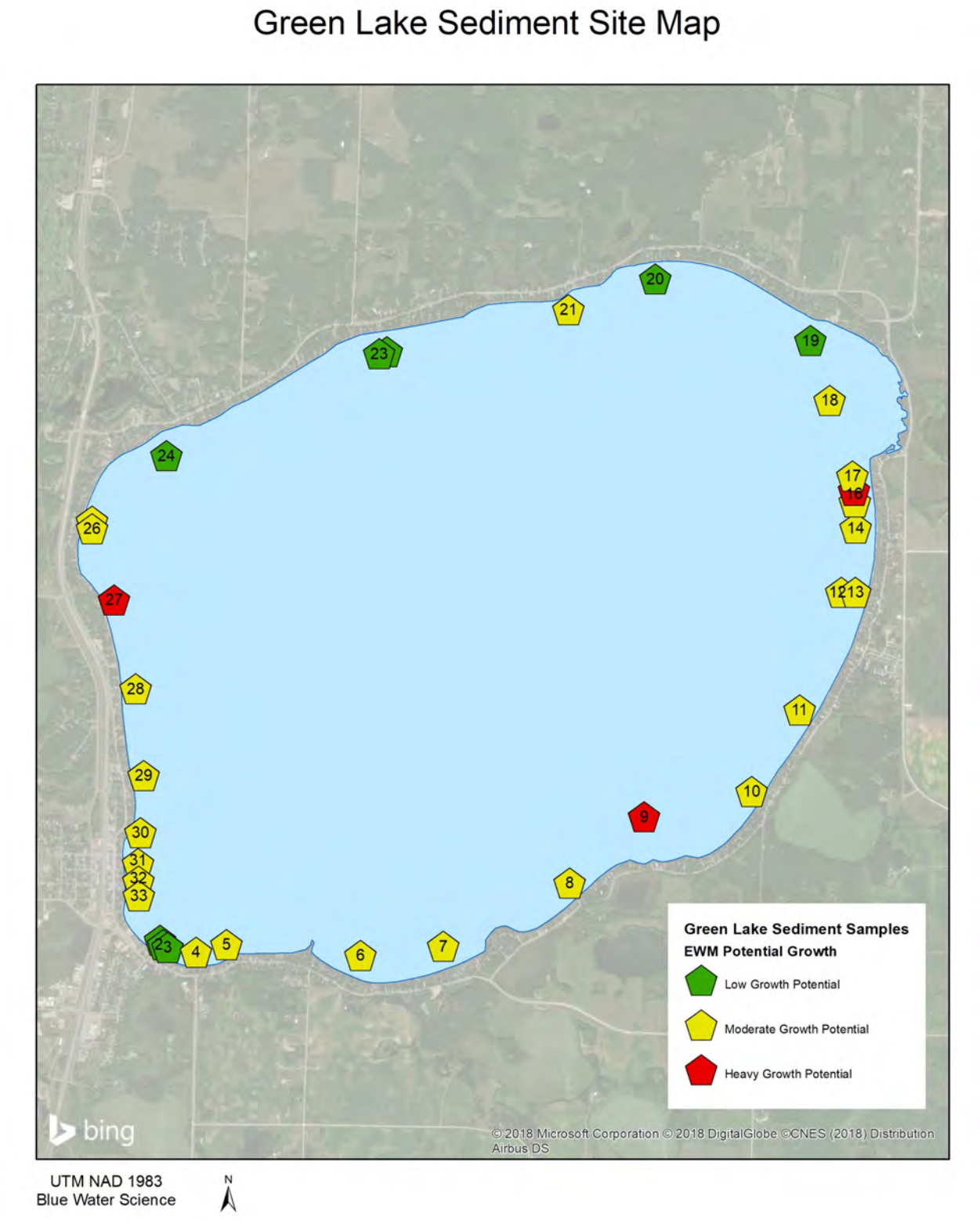


Figure 7. Eurasian watermilfoil potential growth map.

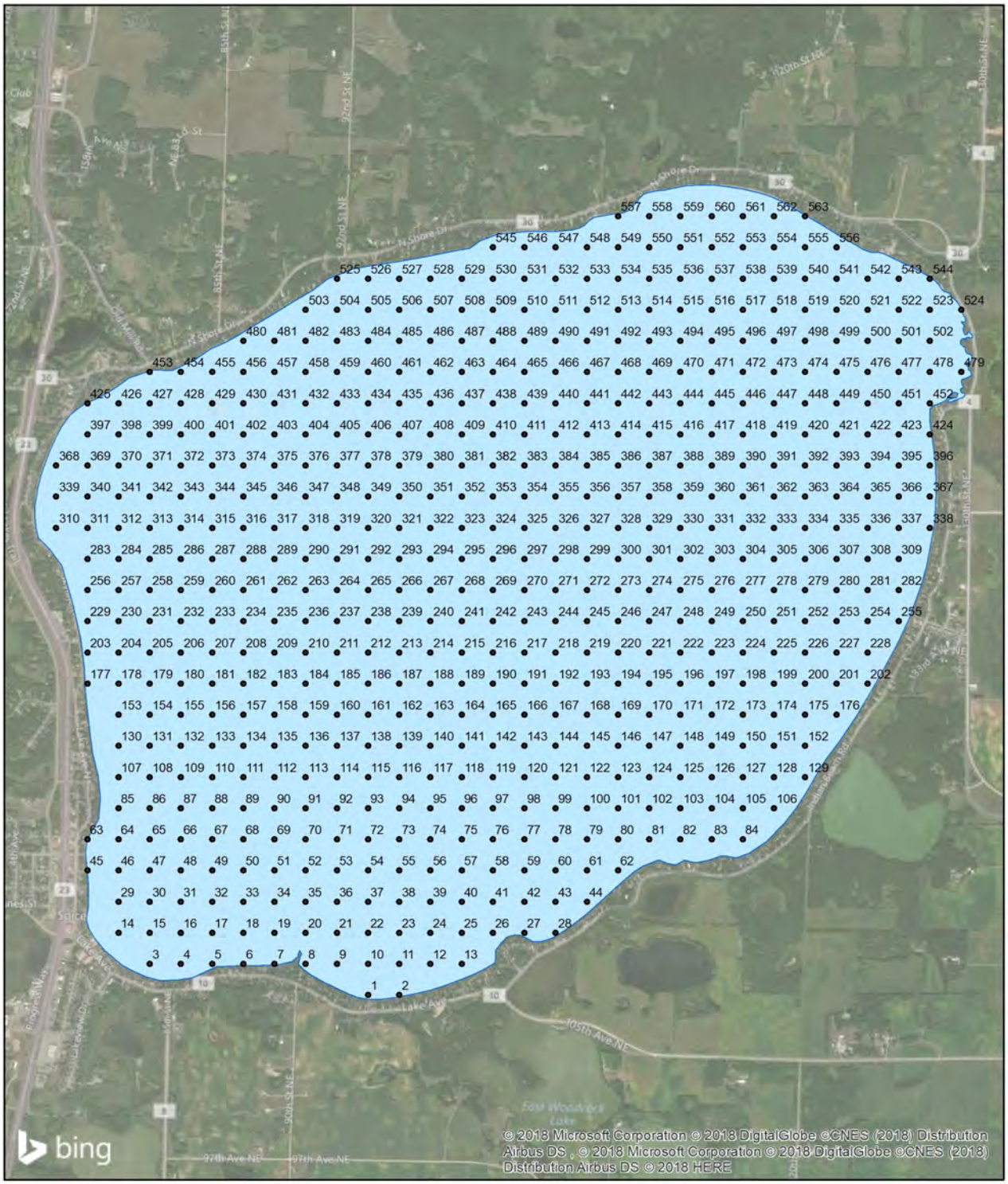
Additional sediment data are shown in Table 9. Lake sediments are dominated by sand and sandy-silt and lake sediment phosphorus is generally low.

Table 9. Green Lake soil data. Samples 1-25 were collected on October 27, 2000 and samples 26-33 were collected in October, 2001. Soil chemistry results are reported as ppm except for organic matter (%) and pH (standard units). EWM density is given on a scale from 1 to 5 with 5 representing nuisance growth. Sediments were analyzed by Eco-Agri Labs in Willmar.

New Site Number	Depth (ft)	EWM Density	# of Other Plant Species	NH_4 by volume	% OM	Bray P ppm	Olsen P ppm	Potassi. ppm	Zinc ppm	Sulfur ppm	Iron ppm	Copper ppm	Mang ppm	Boron ppm	pH unit	Calcium ppm	Magn. ppm	Sodium ppm
1	8	4		3.30	0.5	19	7	22	0.94	58	33	0.34	9.1	0.15	7.3	1880	83	62
2	8	4		3.54	0.7	2	1	45	0.88	78	43.2	0.4	13	0.32	7.6	2200	103	96
3	8	4		3.01	0.7	2	1	25	1.54	0	39.9	0.48	7.3	0.21	7.8	2280	108	72
4	5.5	1		11.56	1.1	1	3	44	0.46	41	45	1.10	9	0.33	8.1	4480	330	24
5	6			10.0	0.9	2	4	136	1.06	0	51.8	2.64	12.7	0.21	8	2360	308	38
6	5			14.4	1.7	2	1	134	1	34	22.8	2.22	17.6	0.21	8	2640	293	82
7	5			8.38	3.9	2	4	49	0.68	48	74	1.12	20.4	0.68	7.7	2600	310	32
8	6			8.63	2	2	2	42	0.62	49	37.1	0.98	10.3	0.34	7.7	2440	193	22
9	6.5			13.1	2.4	2	1	195	1.9	0	28.6	4	19.2	0.22	7.8	2760	345	72
10	5			5.09	0.5	2	1	11	0.34	4	27.9	0.2	3.4	0.22	8.3	1680	95	54
11	6.5			4.92	0.6	6	1	16	0.38	52	18.5	0.24	5.7	0.15	8	1360	80	80
12	8			4.86	1.4	2	6	14	0.44	44	15.6	0.28	6.2	0.34	8	2240	103	62
13	5			6.15	1	2	4	15	0.52	45	36.6	0.26	4	0.23	8.1	1880	108	26
14				4.60	1.1	1	2	18	0.36	65	18	0.32	6.3	0.29	8.0	3760	215	56
15	6		1	14.1	1.6	2	5	81	0.62	48	24.6	1.08	5.2	0.19	8	2160	255	38
16	5.5			11.29	2.6	3	2	65	0.54	41	55	1.50	11	0.25	8.1	5280	450	20
17	5			6.46	2.4	1	6	30	0.34	42	37	0.54	7.8	0.25	8.1	4640	255	112
18	5			5.55	0.8	2	3	21	0.46	33	30	0.64	6.5	0.32	7.9	2240	110	94
19	6			3.32	1.1	2	2	12	0.44	32	15.1	0.44	7.5	0.28	8	2320	103	114
20	5			3.95	0.7	2	4	19	0.4	51	31.9	0.32	9.8	0.32	8	2080	100	88
21	4			6.03	1.3	2	2	39	0.58	30	39.2	1.34	11.1	0.22	8	2360	148	24
22	6.5		2	3.28	1	2	4	19	0.56	37	25	0.44	8.6	0.31	8	2200	98	88
23	6.5		2	2.90	0.6	2	3	15	0.52	64	23.9	0.46	7.9	0.26	7.9	2080	98	62
24	6			3.10	0.6	2	8	15	0.5	55	15.7	0.42	7.4	0.34	8	2160	103	80
25	7	1	3	4.45	1.0	1	6	18	0.52	72	16	0.28	6.8	0.27	8.0	4480	215	32
26	7			4.49	0.7	4	5	15	0.32	58	11	0.20	4.6	0.45	8.1	3280	165	62
27	6			12.2	2.8	2	4	122	1.24	26	73.9	2.64	12.6	0.15	8	2880	318	34
28	6			7.69	1.5	2	2	93	1.06	15	56.6	1.62	7.7	0.13	8	2640	213	86
29	6			7.88	1.1	2	4	65	1.2	27	75.1	1.58	11.2	0.13	8	2640	178	52
30	5			9.19	1.6	2	1	75	1.12	26	57.4	0.24	9	0.13	8.1	2040	200	136
31	8		2	6.70	1.2	1	7	15	0.56	53	22	0.30	7.6	0.27	7.9	4320	210	88
32	8		2	5.35	1.5	2	8	37	0.46	62	34	0.30	12.6	0.33	7.9	4720	235	132
33	5			5.19	0.7	4	3	16	0.48	66	16.7	0.38	5.2	0.21	7.9	1800	95	38

APPENDIX

Green Lake Site Map



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Blue Water Science

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200m Point-Intercept Survey Conducted on Aug 9, 10, 2018

Table A1. Individual site data for August 9-10, 2018. Numbers indicate plant density.

Grid Point	Depth (ft)	Bulrush	Bladder wort	Chara	Chara -2	Clasping leaf	Coontail	EWM	Naiad	Nitella	NWM	Water star-grass	White-stem	Widgeon	No plants
479	3														1
524	3	2													
20	4			1											
28	5														1
44	5														1
45	5						1								
129	5														1
255	5			1		1									
351	5			1											
425	5														1
452	5			1											
523	5														1
544	5			1											
545	5														1
546	5														1
557	5			2											
558	5			1											
1	6			1									1	2	
8	6			1											
35	6			1											
63	6							2	1						
350	6			1											
424	6			1											
478	6			1											
502	6														1
525	6			1					1						
533	6			1											
543	6			1											
550	6			1											
2	7			1											
3	7			1									1		
7	7			1											
27	7			1											
52	7			1											
83	7			1											
177	7						1								
202	7														1
203	7						1								
274	7			1											
282	7														1
338	7			1											
436	7			1											
454	7							1							
477	7														1
500	7							1							
501	7			1											
522	7			1											
548	7			1											
563	7			1									1		
5	8			1									1		
6	8			1											
9	8			1											
10	8			1											
11	8			1											
12	8			1											
13	8			1											
23	8			1											
62	8			1											

Table A1. Individual site data for August 9-10, 2018. Numbers indicate plant density.

Grid Point	Depth (ft)	Bulrush	Bladder wort	Chara	Chara -2	Clasping leaf	Coontail	EWM	Naiad	Nitella	NWM	Water star-grass	White-stem	Widgeon	No plants
82	8			1											
84	8			1											
248	8			1											
273	8			1											
310	8						2								
367	8			2											
368	8			1											
408	8			1											
423	8														1
451	8			1											
453	8											1	1		
494	8			1											
535	8			1											
547	8			2											
556	8			1											
4	9			2											
53	9			1											
61	9			1											
104	9			1											
106	9			1					1						
107	9						1								
125	9			1											
152	9			2											
229	9						2								
246	9			1											
247	9			1											
272	9			1											
300	9			1					1						
301	9			1											
396	9														1
468	9			1											
470	9			1											
476	9			1											
493	9			1											
503	9			1											
508	9			1											
521	9			1											
527	9			1											
528	9			1											
549	9			1											
26	10			1											
43	10			1											
81	10			1											
103	10			1											
147	10			1											
148	10			1											
167	10			1											
168	10			1											
175	10			1											
176	10			1											
195	10			1											
200	10			1											
201	10			1											
221	10			1											
226	10			1											
227	10			1											
228	10			1											
283	10						1								

Table A1. Individual site data for August 9-10, 2018. Numbers indicate plant density.

Grid Point	Depth (ft)	Bulrush	Bladder wort	Chara	Chara -2	Clasping leaf	Coontail	EWM	Naiad	Nitella	NWM	Water star-grass	White-stem	Widgeon	No plants
299	10			1											
309	10			1											
337	10			1											
366	10			1											
395	10														1
422	10			1											
507	10			2											
529	10			1											
42	11			1											
69	11			2											
146	11			1											
151	11			1											
174	11														1
199	11			1											
218	11			1									1		
252	11			1											
321	11			1											
329	11			2											
339	11		1	1											
372	11			1											
380	11			1											
394	11			1											
450	11			1											
469	11			1											
480	11			1											
487	11			2											
526	11			1									1		
542	11			1											
555	11			1											
24	12			1											
25	12			1											
60	12			1											
102	12			1											
191	12			1											
225	12			1											
245	12							3							
251	12			1											
256	12						1								
365	12			1											
426	12			1											
515	12			2											
534	12			1											
539	12			2											
36	13			2											
80	13		1	1											
170	13			1											
220	13			1											
291	13			1											
311	13						2								
359	13			2	1										
362	13			1											
512	13														1
514	13			1											
531	13			1											
19	14			1							1				
22	14			1											
38	14														1
79	14														1

Table A1. Individual site data for August 9-10, 2018. Numbers indicate plant density.

Grid Point	Depth (ft)	Bulrush	Bladder wort	Chara	Chara -2	Clasping leaf	Coontail	EWM	Naiad	Nitella	NWM	Water star-grass	White-stem	Widgeon	No plants
166	14			2											
169	14				3										
192	14			1	1										
193	14		1		3										
358	14				2										
443	14				1										
496	14		1		3										
520	14														1
532	14				1										
541	14		1		2										
16	15			1											
34	15														1
109	15			2											
145	15				3										
194	15				2										
216	15				1										
244	15				1										
305	15			2											
328	15				3										
336	15			1											
397	15				1										
409	15				2										
421	15				2										
444	15		1		1										
449	15				1										
455	15														1
486	15				1										
519	15		1	2											
143	16				1										
144	16				3										
219	16				3										
357	16				3										
370	16				1										
495	16				1										
120	17				2										
123	17				3										
171	17				2										
330	17				3										
341	17						2								
473	17		1		1										
475	17				2										
78	18				2										
163	18				1										
165	18				2										
242	18						2								
340	18														1
59	19				2										
71	19			2											
101	19				2										
217	19				2										
275	19				1										
445	19				2		2								
188	20														1
189	20				2										
215	20				1										
334	20			1											
37	21														1
41	21														1

Table A1. Individual site data for August 9-10, 2018. Numbers indicate plant density.

Grid Point	Depth (ft)	Bulrush	Bladder wort	Chara	Chara -2	Clasping leaf	Coontail	EWM	Naiad	Nitella	NWM	Water star-grass	White-stem	Widgeon	No plants
364	21				1					1					
398	21						1			1					
39	22			1											
190	22														1
77	23														1
99	23									1					
90	24									1					
213	24									1					
356	24									1					
499	24									2					
540	24														1
100	25									1					
149	27									1					
278	27														1
369	27														1
18	28														1
333	28														1
121	29									1					
279	30														1
298	30									1					
308	30														1
392	30														1
471	30														1
562	30														1
98	31														1
164	31														1
271	31														1
21	32														1
124	32														1
132	32														1
51	33														1
130	33														1
270	33														1
17	34														1
14	35														1
15	35														1
91	35														1
153	35														1
243	35														1
40	36														1
363	36														1
70	37														1
239	37														1
312	38														1
516	39														1
371	40														1
385	40														1
393	40														1
517	40														1
126	41														1
214	41														1
327	41														1
187	42														1
222	43														1
233	43														1
297	43														1
306	43														1
196	44														1

Table A1. Individual site data for August 9-10, 2018. Numbers indicate plant density.

Grid Point	Depth (ft)	Bulrush	Bladder wort	Chara	Chara -2	Clasping leaf	Coontail	EWM	Naiad	Nitella	NWM	Water star-grass	White-stem	Widgeon	No plants
54	46														1
162	46														1
335	46														1
241	48														
281	49														1
240	50														1
254	50														1
302	50														1
386	50														1
72	55														1
Average		2.0	1.0	1.1	1.8	1.0	1.5	1.8	1.0	1.1	1.0	1.0	1.0	2.0	
Occur (300 sites)		1	8	150	43	1	13	4	4	11	1	1	7	1	74
% occur		0	3	50	14	0	4	1	1	4	0	0	2	0	

Meander Survey

Table A2. Individual site data for August 9-10, 2018. Numbers indicate plant density.

WayPoint	Depth (ft)	Chara	Coontail	EWM	Naiad	Stringy	Whitestem	No plants
1	7		1					
2	7		1					
3	7		1					
4	8		2		1			
5	8		1					
6	8		1					
7	6				1			
8	7		1					
9	7		1				1	
10	6		1					
11	8		1					
12	10		1					
13	7		1					
14	7		1					
15	5						1	
16	8			1				
17	7		1					
18				1				
19	7		1					
20	8		1					
21	11			1				
22	10			1				
23	10		1					
24	10			1				
25	10							
26	8			1				
27	10	1						
28	9	1						
29	11			1				
30	11			1				
31	11	1						
32	12	1				1		
33	12			1				
34	5	1						
35	6	1						
36	7	1						
37	13							
38	12							
39	11							
40	8							
41	7							
42	6							
43	9							
44	8							
45	7			1				
46	7	1						
47	7							
48	7			1				
49	8							
50	9							
51	13							
52	12			3				
53	13			2				
54	12			1				
55								
56	9			1				
57	9			1				
58	10							
59	14							
60	8			3				
61	8			1				
62	9			1				
63	9			2				
64	8							
65	6							
66	10							

Table A2. Individual site data for August 9-10, 2018. Numbers indicate plant density.

WayPoint	Depth (ft)	Chara	Coontail	EWM	Naiad	Stringy	Whitestem	No plants
67								
68								
70	11			1				
71	10			2				
79	10	1						
80	7							
81	5							1
82	8	1						
83	13	1						
87	8			1				
88								
89	9			1				
90	10			3				
91	9			2				
92	9			1				
94	8			2				
95	7			1				
99	10			2				
100	8			2				
101	8			2				
102	7							
103	9			1				
104	11			2				
105	10			2				
106	10			3				
107	11							1
112	5							
113	6							
114	6	1						
121	6							
125	4							
126	6	1						
127	10			2				
128	8	1						
129	10			1				
130	10			1				
131	10	1						
132	10			3				
133	10			3				
134	10	1						
135	4			1				
136	12			3				
137	12			3				
138	12			3				
139	11							
140	11			3				
141	10			1				
142	9			1				
143	9			2				
144								
Average		1.0	1.1	1.7	1.0	1.0	1.0	
Occurrence (116 sites)		16	17	49	2	1	2	2
% Occurrence		14	15	42	2	1	2	