

Determining Treatment Areas For Curlyleaf Pondweed and Eurasian Watermilfoil

(and includes a review of 2 whole lake CLP treatment projects)

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Blue Water Science

November 2010

Do We Have to Treat All Curlyleaf Pondweed and Eurasian Watermilfoil in a Lake?



Curlyleaf Pondweed
(low density <50 stems/m²)



Eurasian Watermilfoil
(low density <50 stems/m²)

Whole Lake Treatments for Curlyleaf Pondweed Have Been Conducted

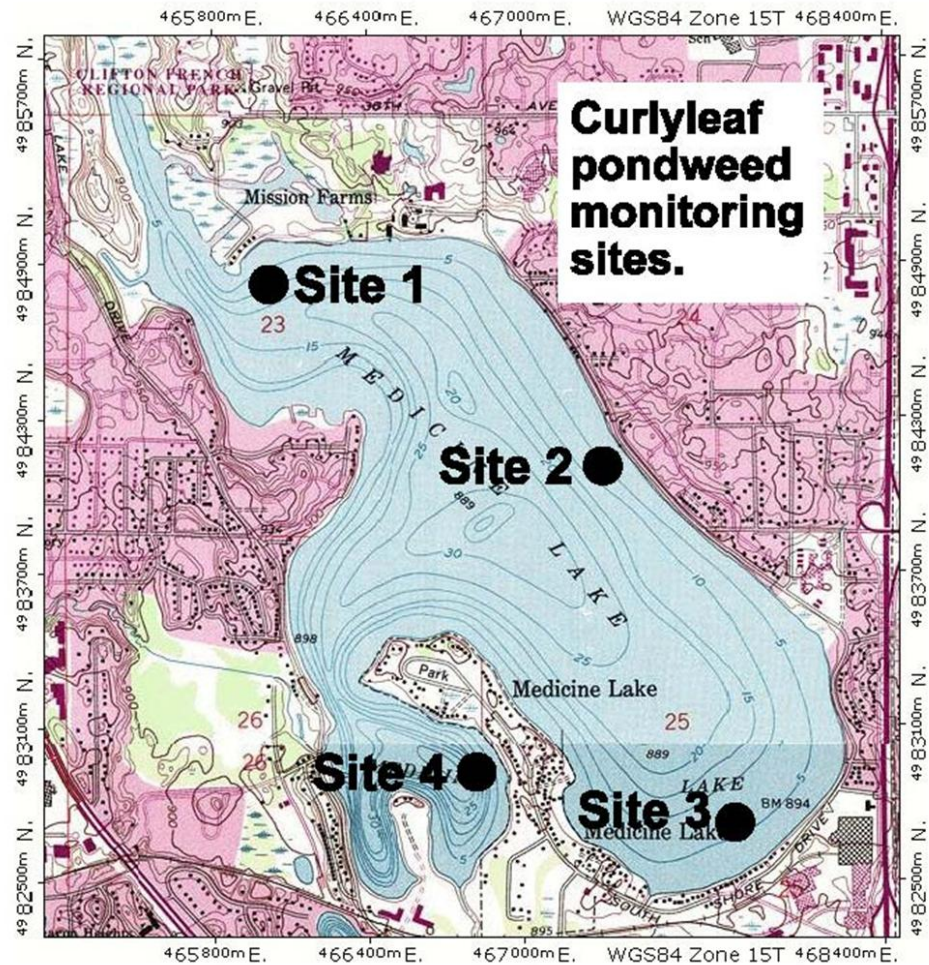
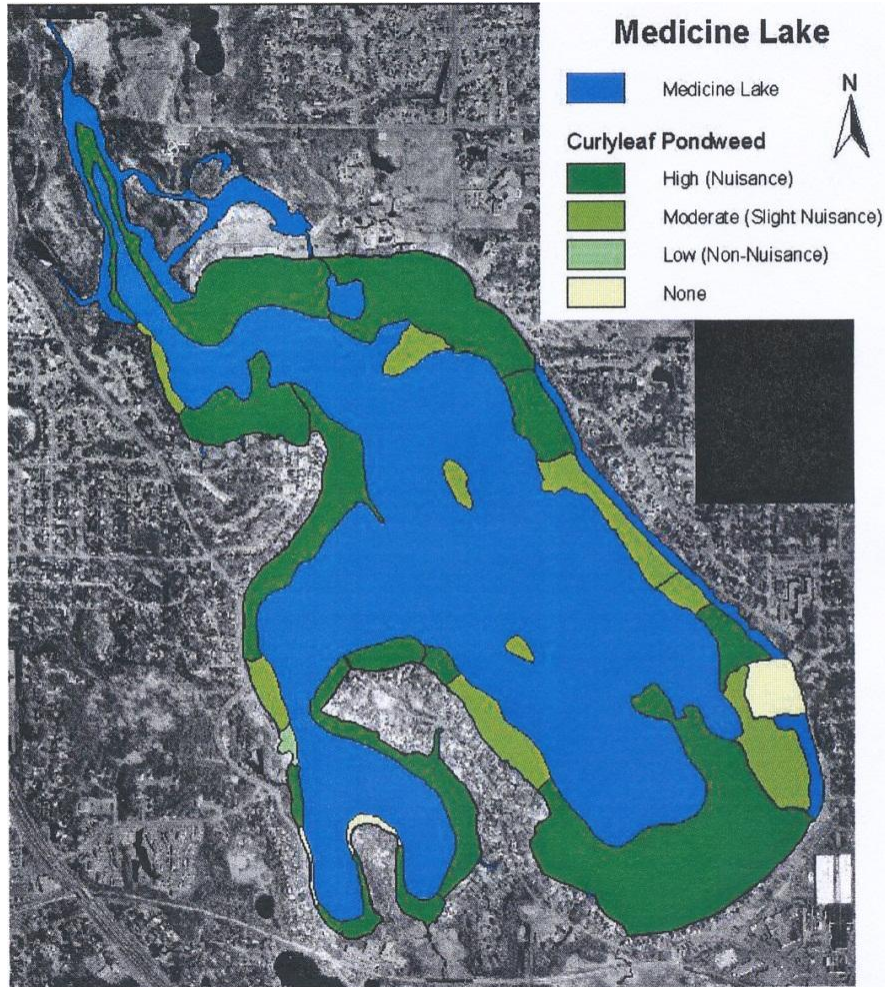
Medicine (886 ac): 3 years (300 ac treated per year)

Reshanau (336 ac): 4 years (336 ac treated per year)

What happens when you stop treatments?

Medicine Lake, Hennepin Co, MN

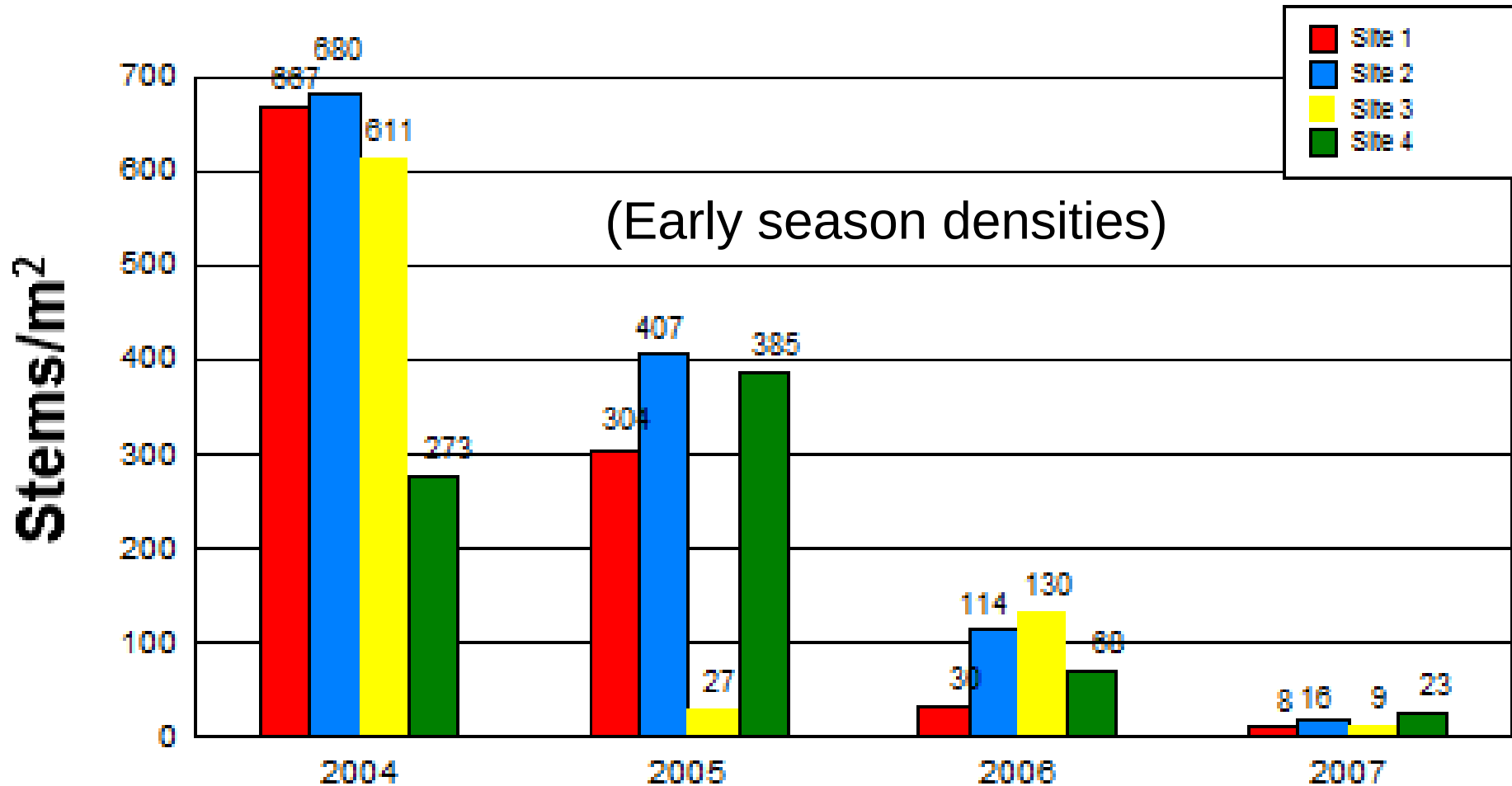
Curlyleaf Distribution in 2004



Stem Densities Determined By A 0.01 m² Quadrat



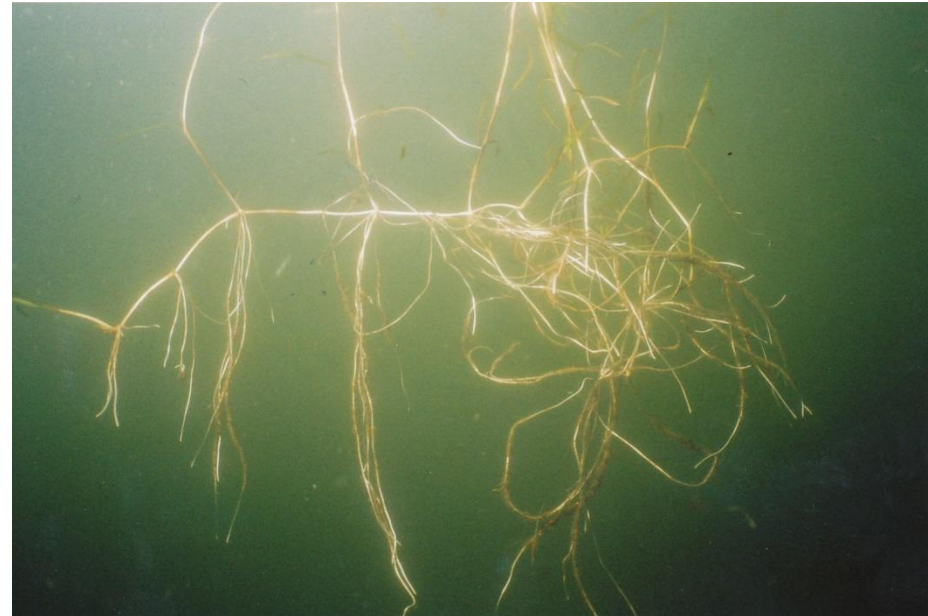
Medicine Lake – 3 Yrs of Treatment (2004, 2005, 2006)



Early Season Scouting Challenge: *(Curlyleaf Pondweed Increases in Density)*



Early (single stem)



Late (runners)

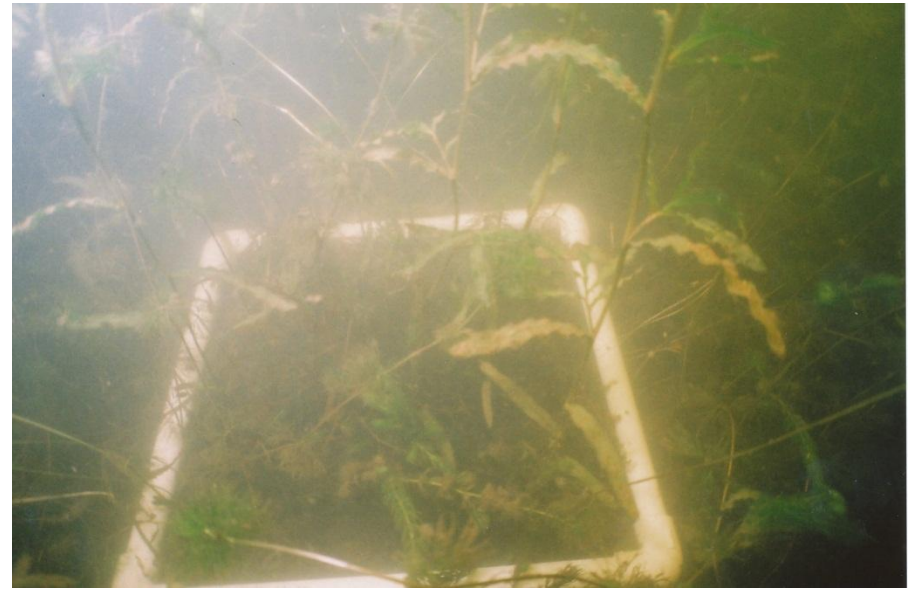
(Curlyleaf pondweed puts out runners from April to May)

Early Season Scouting

(Curlyleaf Pondweed Increases in Density)



Early (April)
Site 3

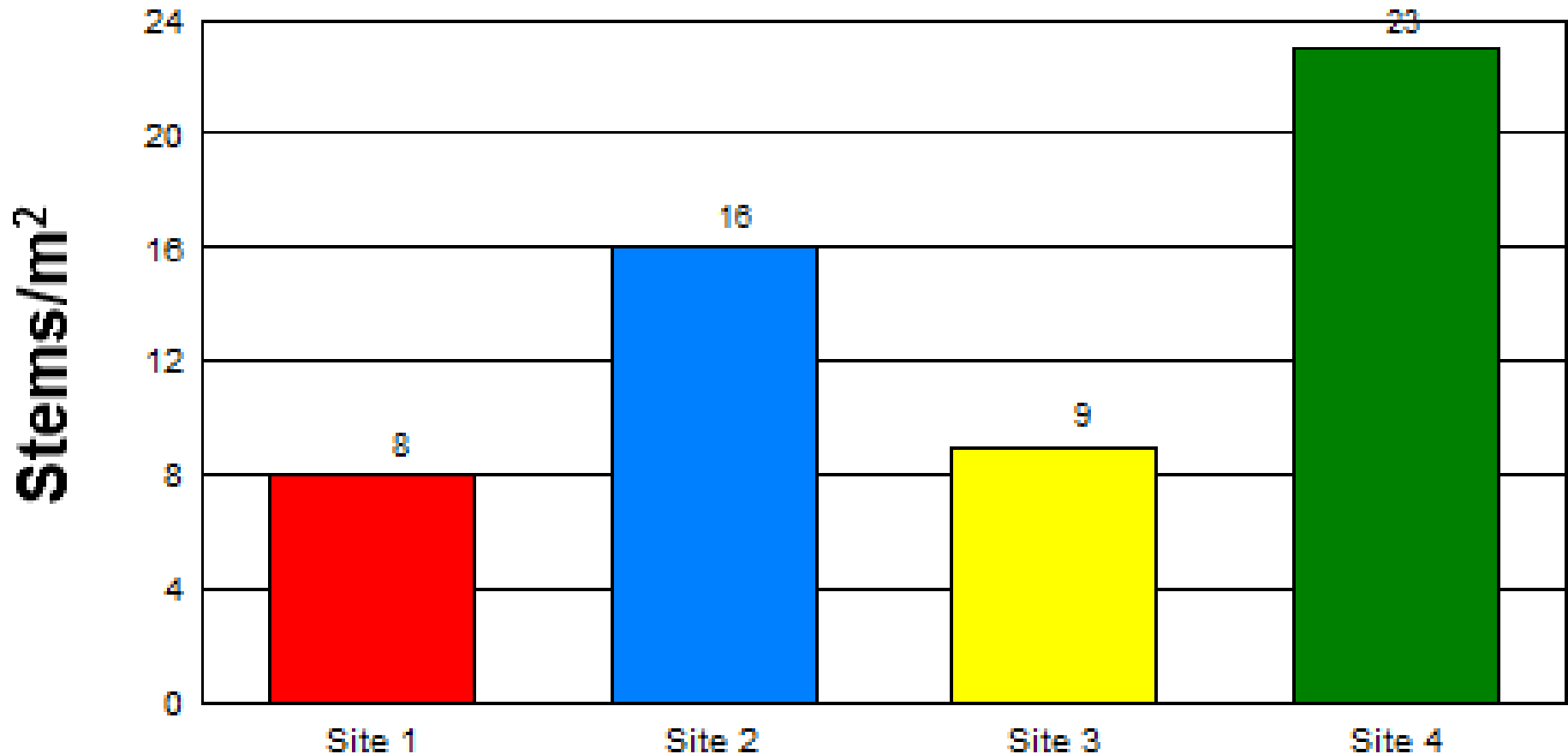


Late (May)
Site 3

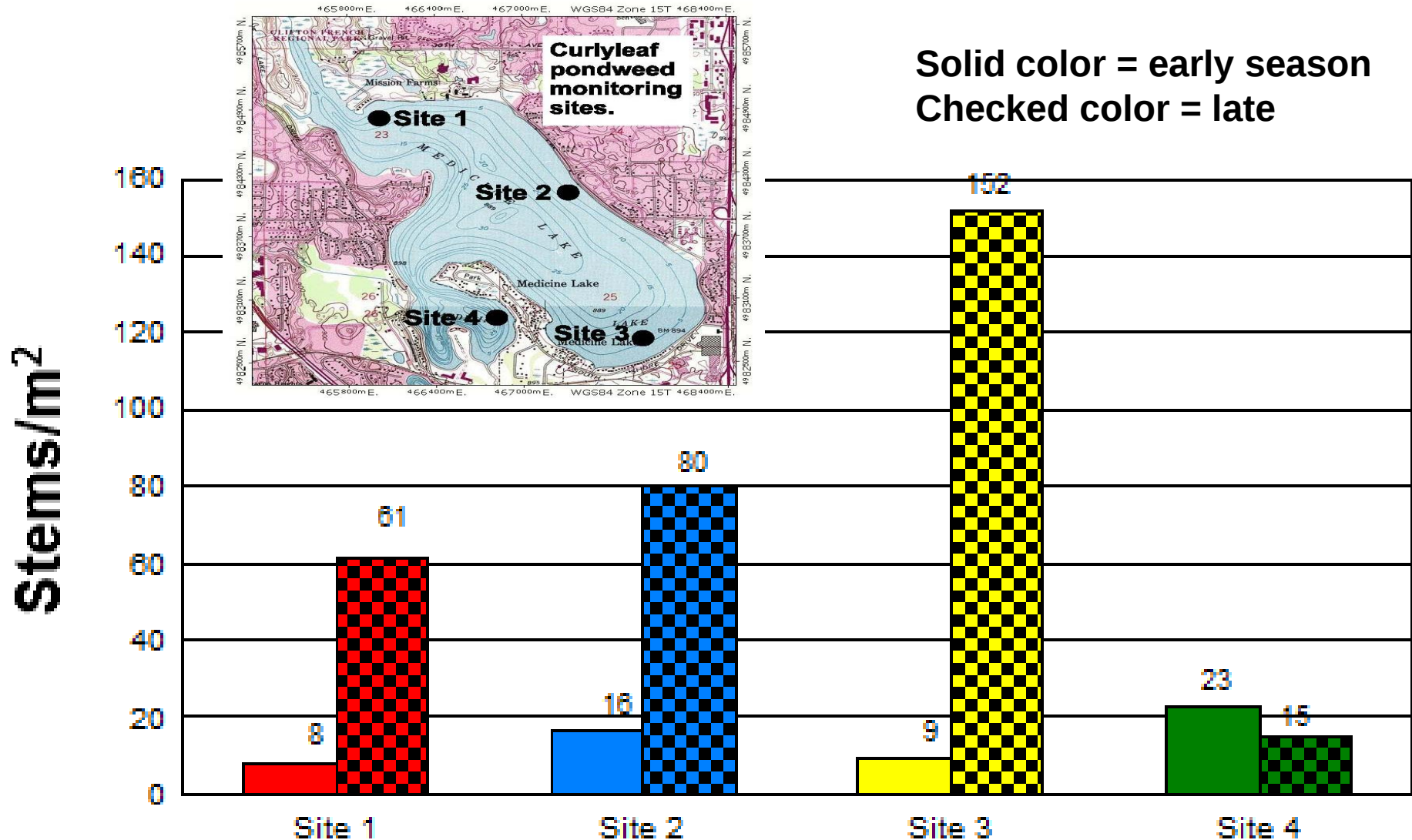
Medicine Lake 4th Yr (No Treatment)

(Early Season Densities)

April 17, 2007



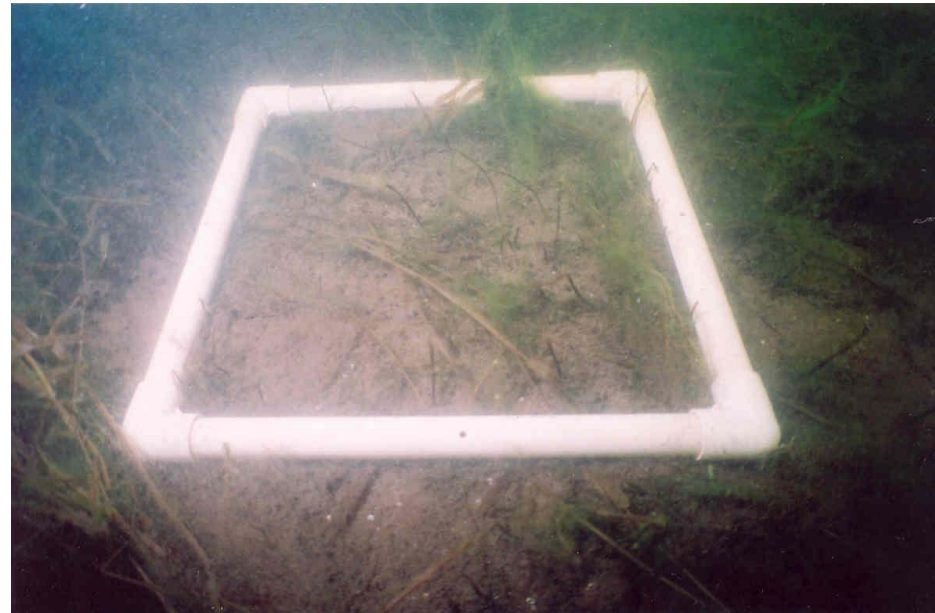
Medicine Lake 4th Yr (No Treatment)



Untreated Areas in Medicine Lake



Site 3: Heavy growth
Late season-May



Site 4: Light growth
Late season-May

Why Was There Heavy Growth and Light Growth in the Same Lake?

- Maybe sediments are important.

Sediment Mapping Has Been Done

- Lake sediments were sampled in areas of low density and high density curlyleaf pondweed growth



Light growth
<50 stems/m²



Heavy growth
>150 stems/m²

Several Sediment Parameters Influence CLP Growth

- pH
- Fe/Mn
- Bulk Density (muck, etc)
- Organic matter

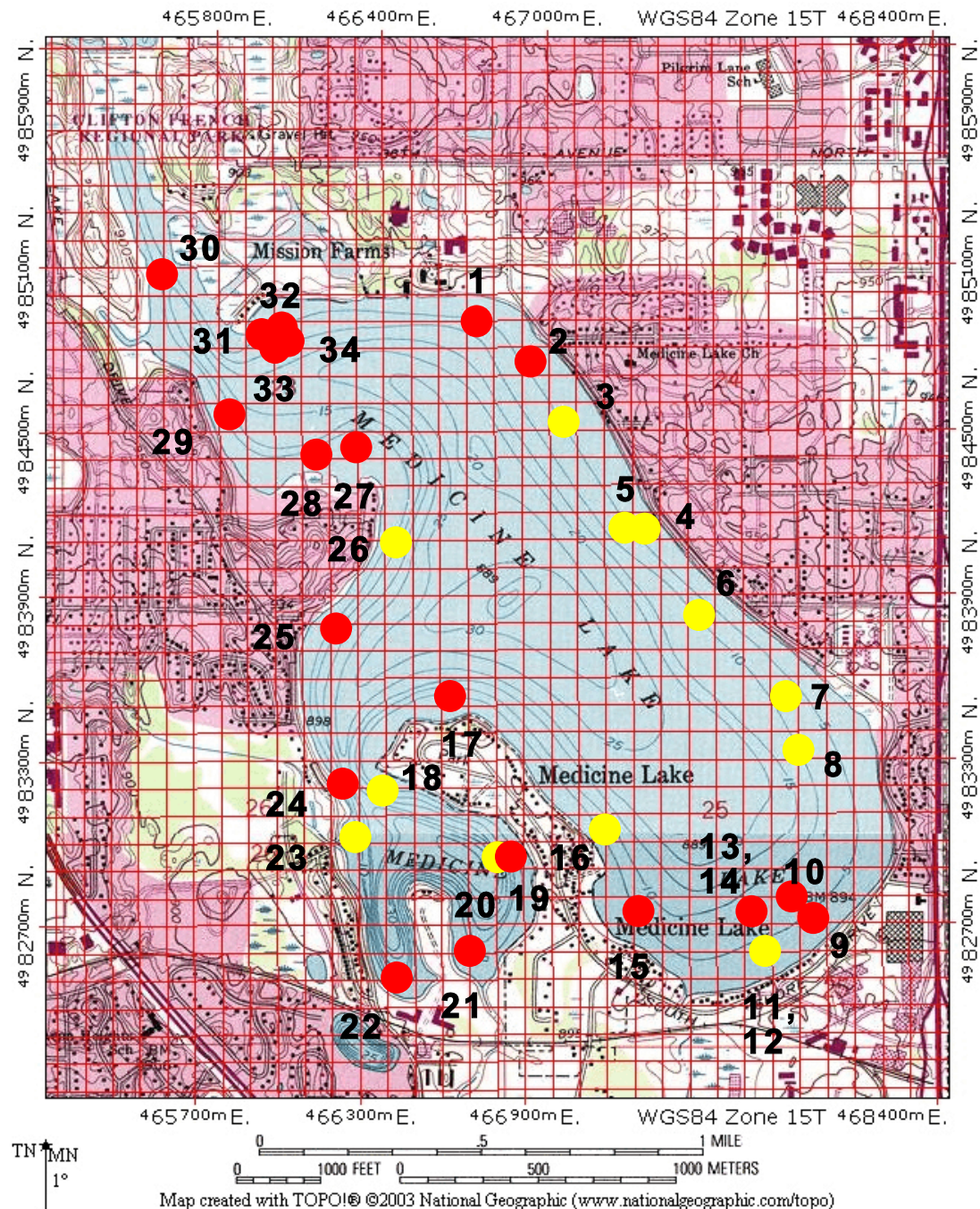
	Light Growth (n=45)	Heavy Growth (n=20)	t-test (p < value)
pH*	6.8	7.7	0.00000000008
Fe (µg/cm ³)	150	48.8	0.000000000009
Mn	24.7	20.5	0.16 (ns)
Fe/Mn*	5.3	1.6	0.00000004
Bulk density (g/cm ³ -dry)*	1.0	0.51	0.00002
Organic matter (%)	7.27	20.2	0.001

Sediment Mapping for Medicine Lake Shows CLP Growth Potential

Green = low

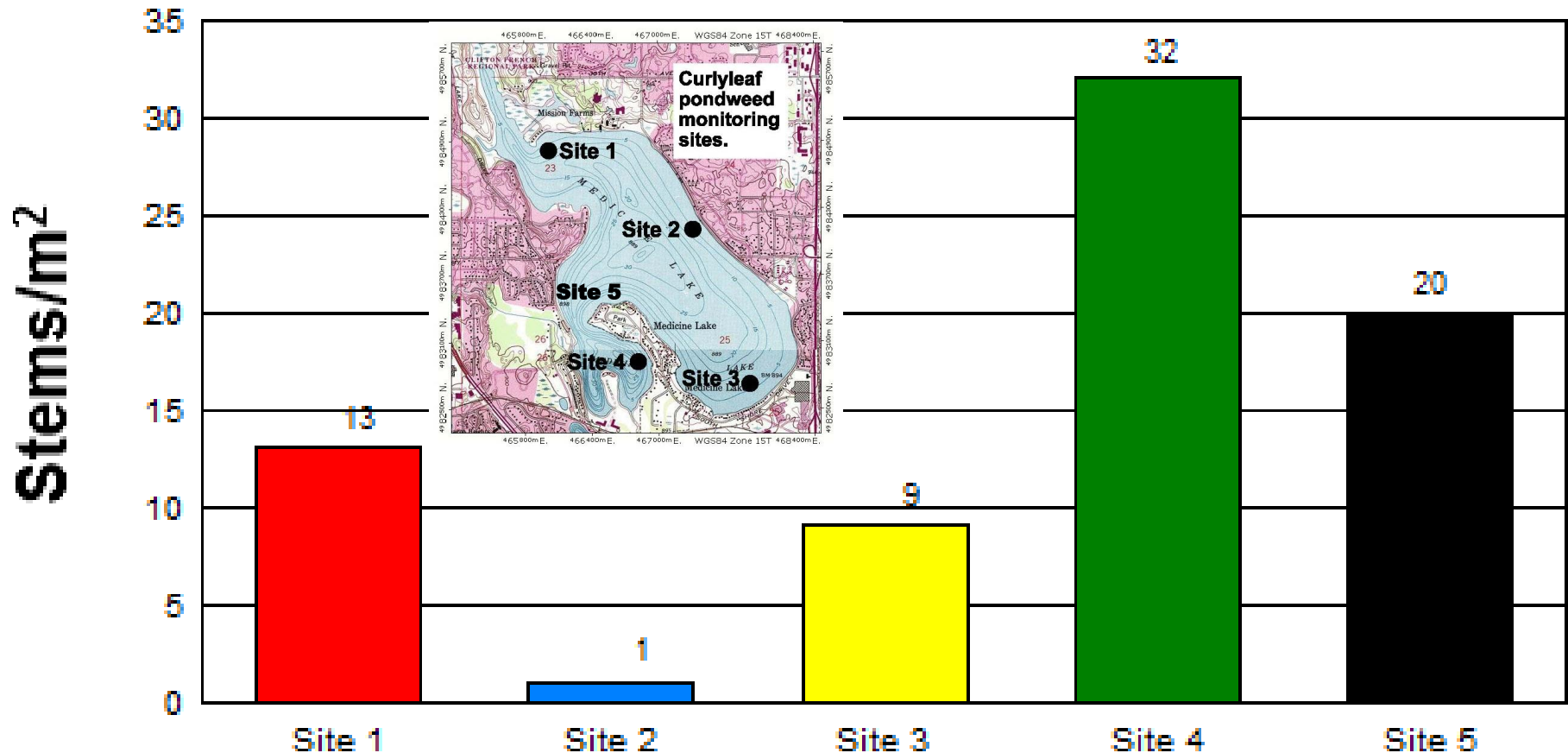
Yellow = moderate

Red = high

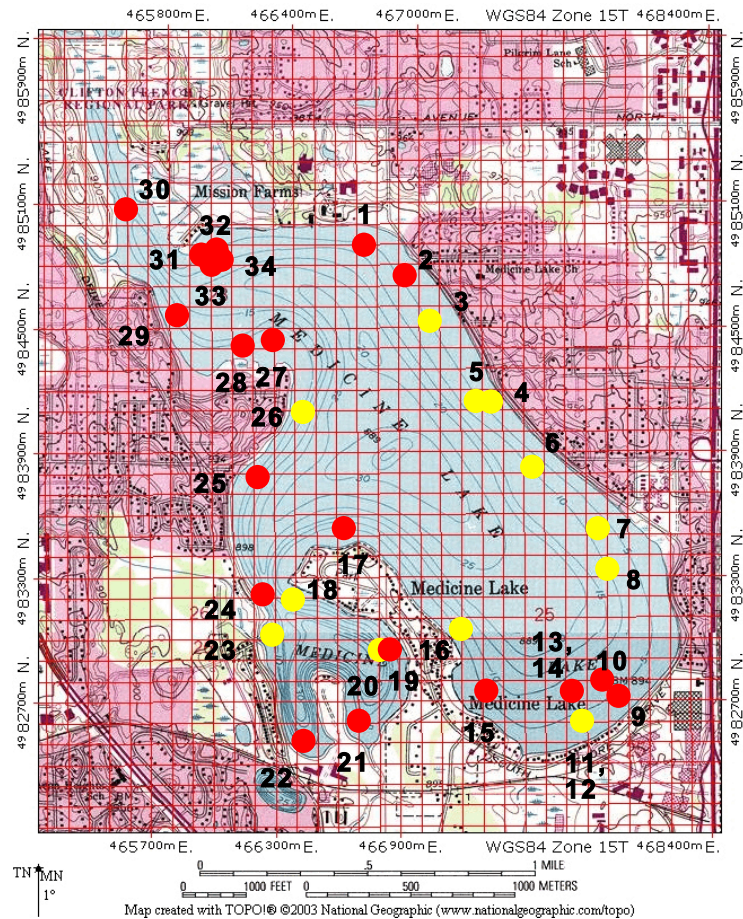


Medicine Lake 2010 (Early Season Densities)

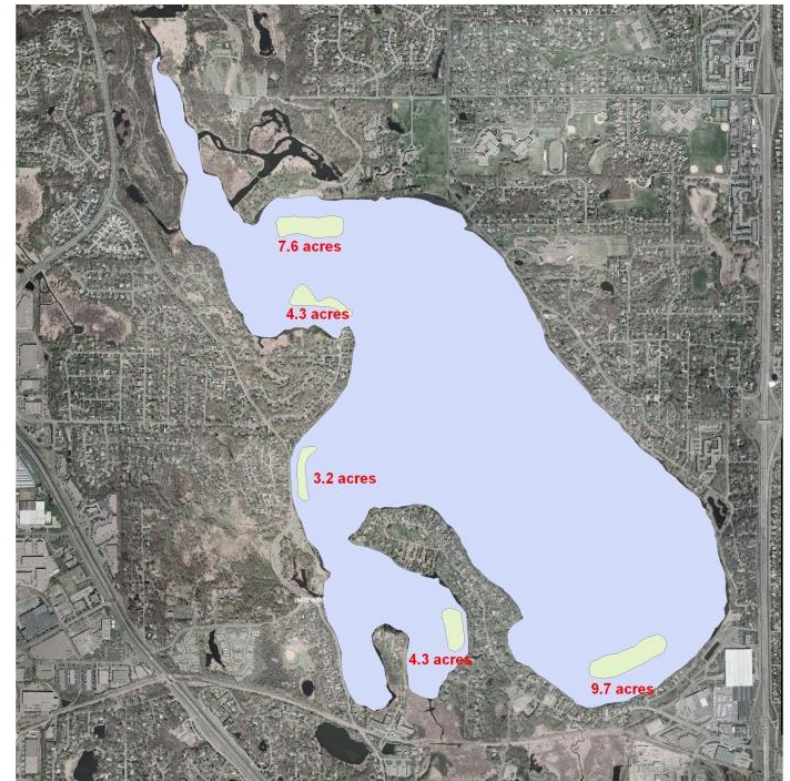
April 20, 2010



Medicine Lake Treatment Map 2010



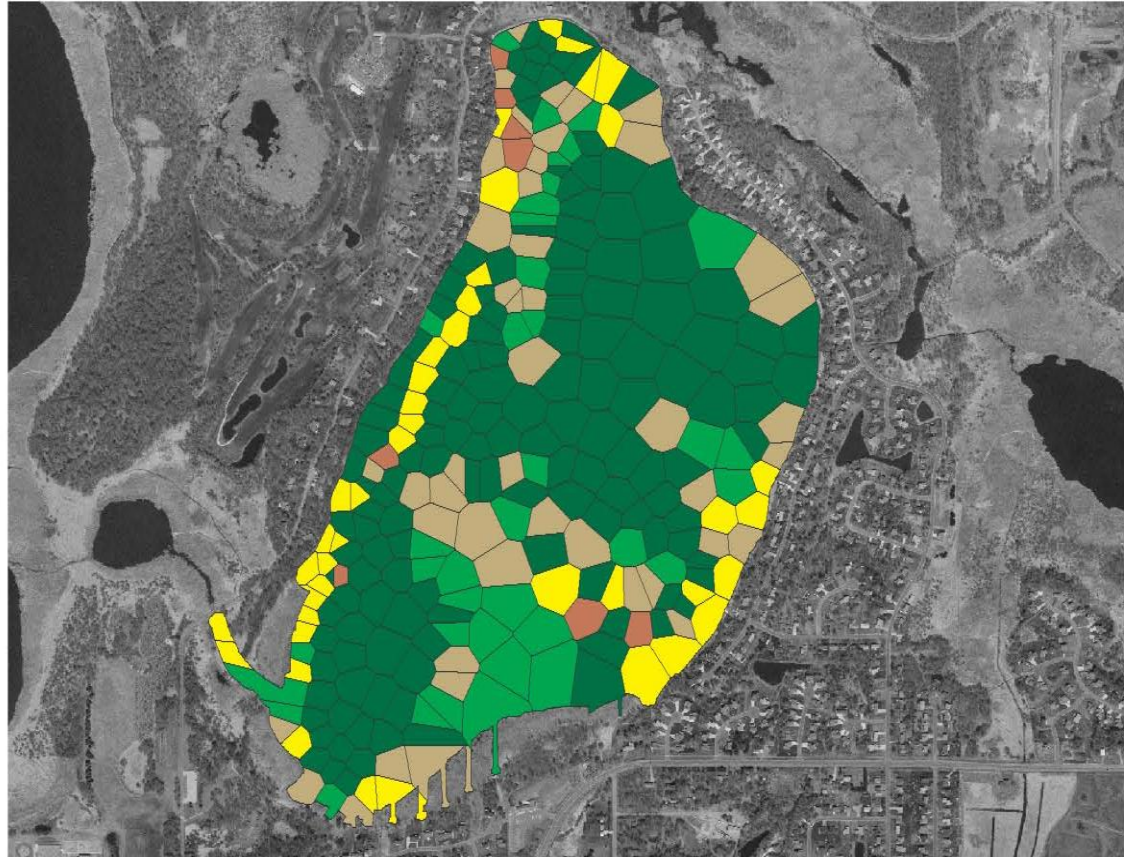
2010 Curleaf Treatment Area
29.1 Acres



**For Curlyleaf Pondweed, Scouting
and Lake Sediment Surveys Help
Delineate Areas to Treat for
Partial Lake Treatments**

Reshanau Lake, Anoka Co, MN

Reshanau Lake Curly leaf pondweed distribution May 10, 2005



336 ac

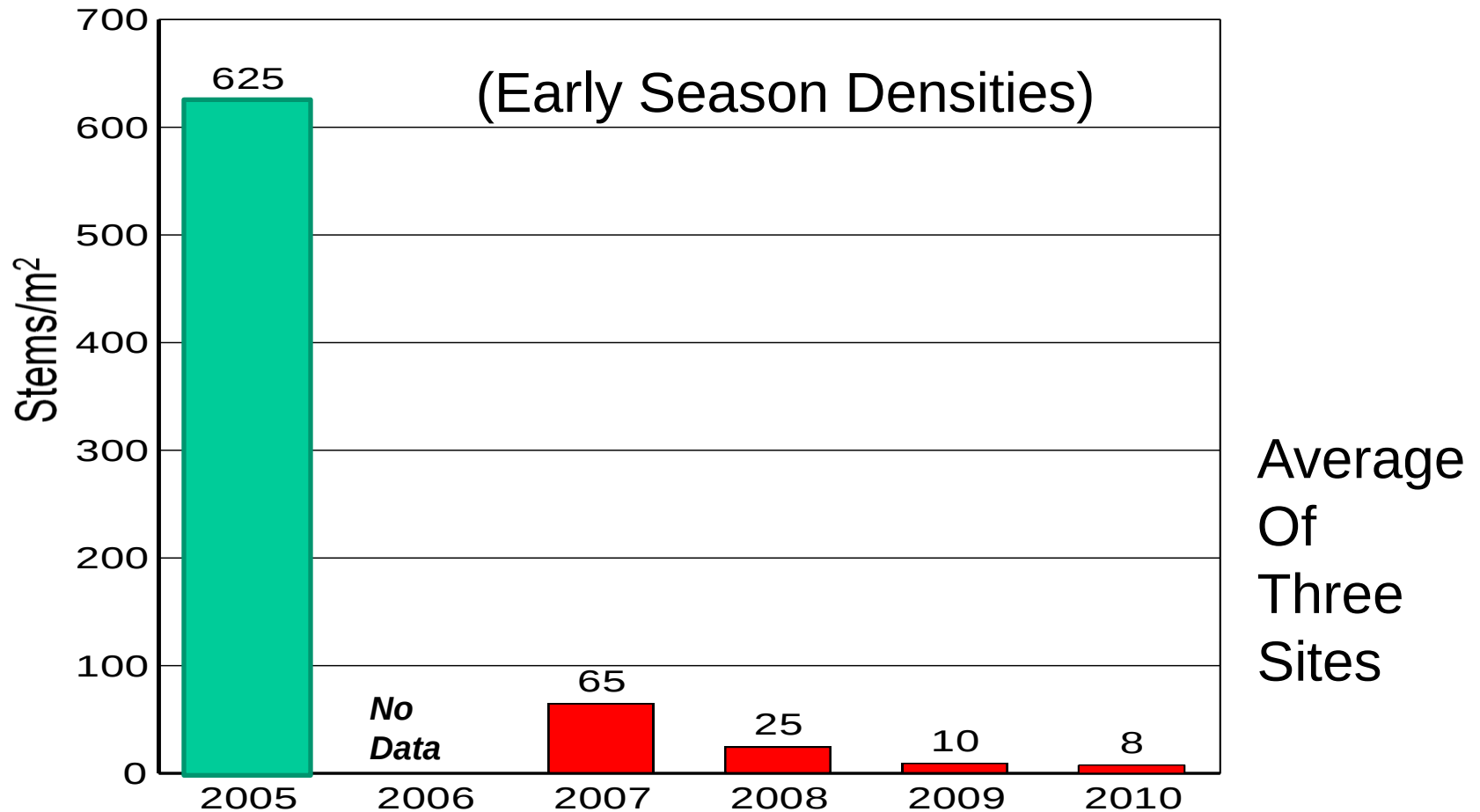


0.2 0 0.2 0.4 Miles

Plant cover 51005.shp
0
25
50
75
100
Lakes
Island
Open Water



Reshanau Lake – 4 Yrs of Treatment (2006, 2007, 2008, 2009)



Reshanau Lake – 5th Year

No Treatment Scheduled— was curlyleaf controlled?

- (130 points checked, representative points shown below)

Point Intercept Site	Early Season (stems/m ²)
1	0
2	0
3	20
4	0
5	30
6	10
7	0
8	0

Should Any
Of These
Sites Be
Treated?

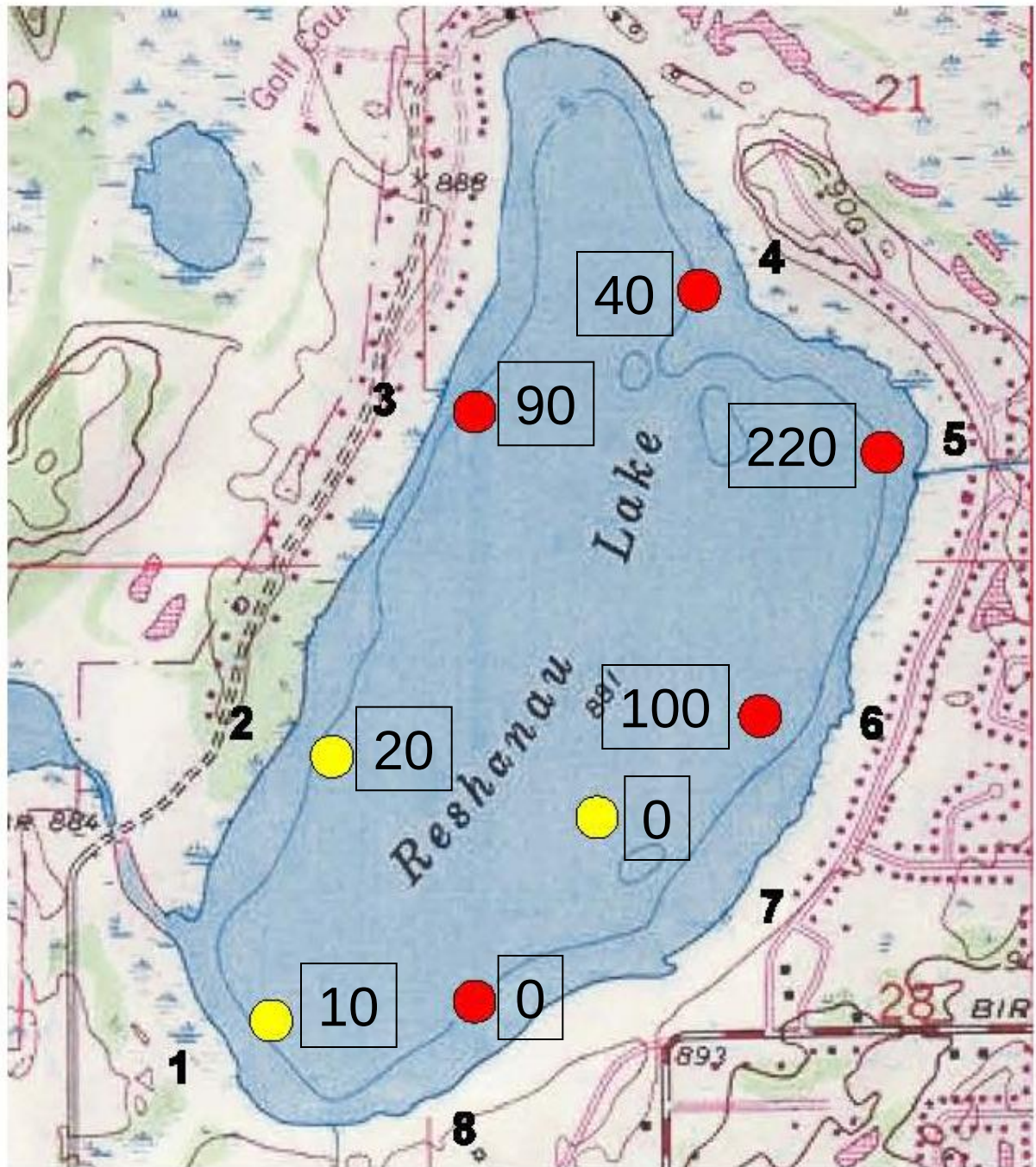
Reshanau Lake – 5th Year (No Treatment in 2010)

Point Intercept Site	Early Season (stems/m ²)	Late Season (stems/m ²)
1	0	10
2	0	20
3	20	90
4	0	40
5	30	220
6	10	100
7	0	0
8	0	0

Reshanau Lake Sediment Mapping

Key:
Yellow = moderate
potential for growth

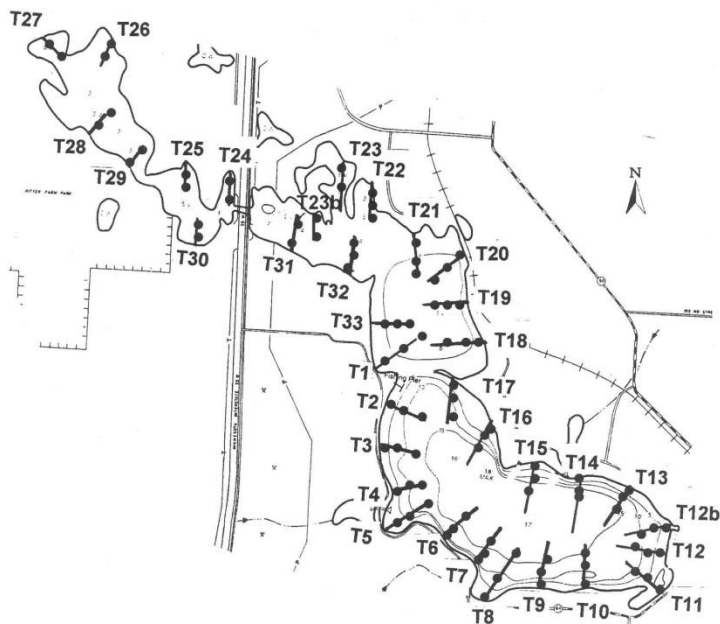
Red = high
potential



Reshanau Lake

- Combine scouting data with lake sediment survey data.
- Next year consider treating areas with heavy potential growth criteria

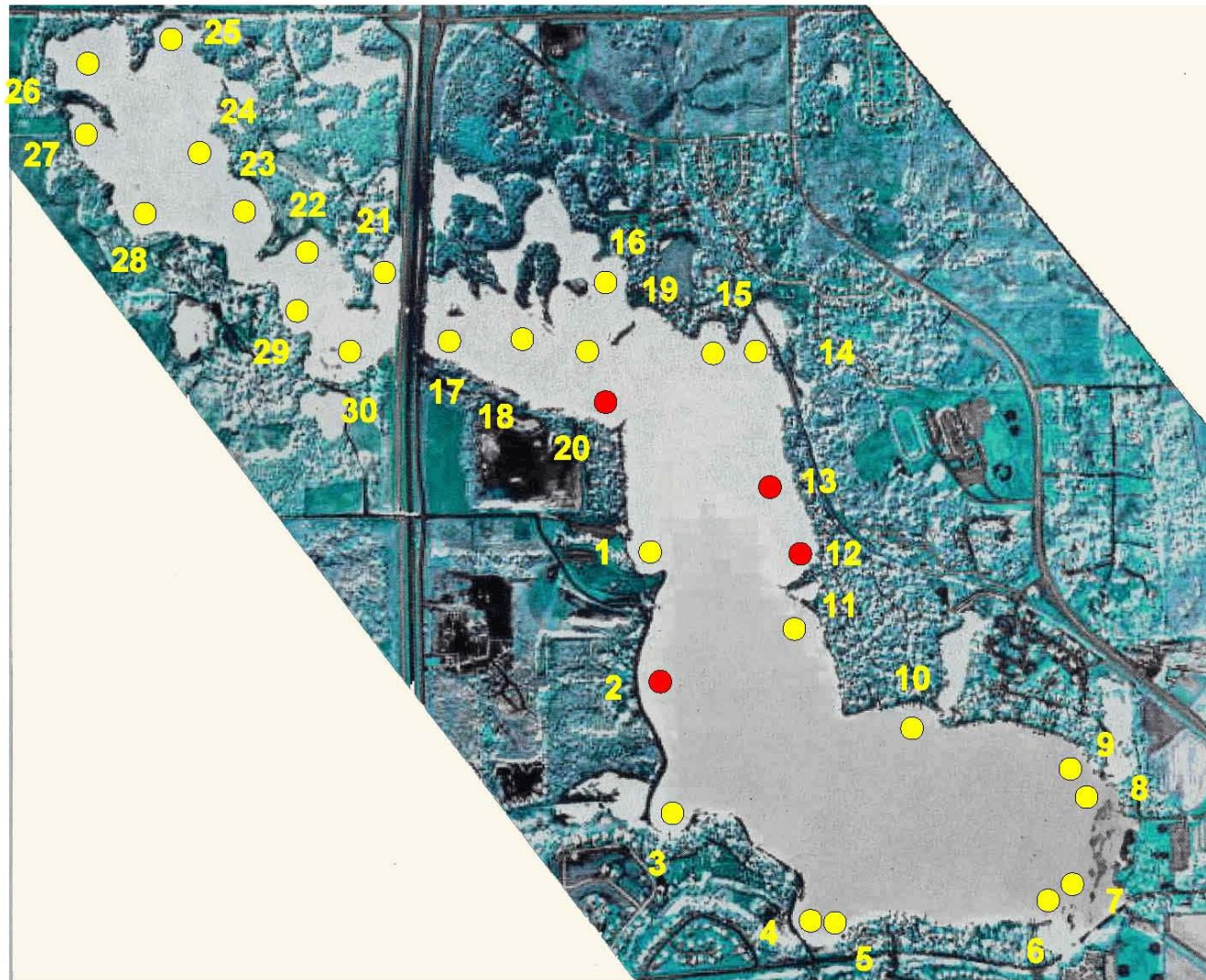
Curlyleaf Pondweed Assessment For Lake Marion



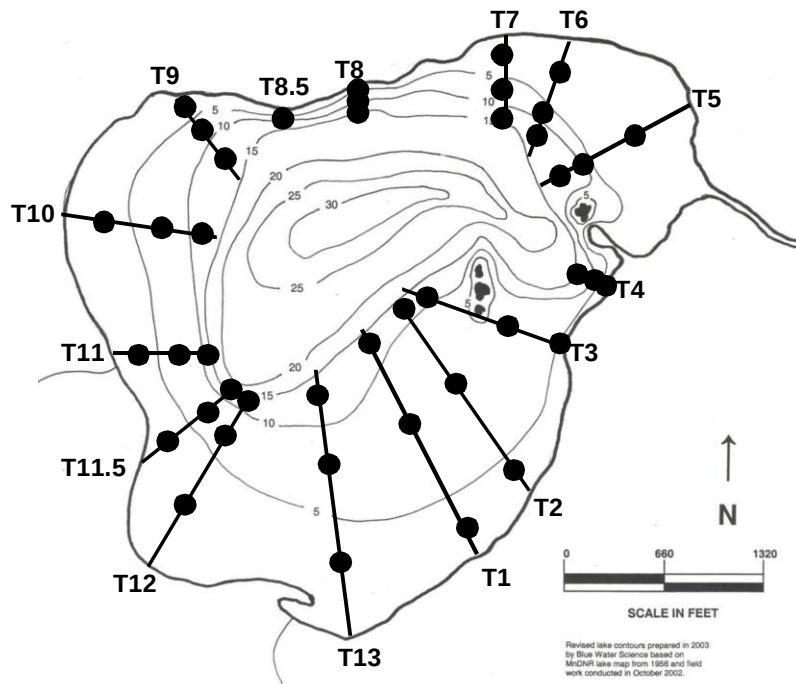
Lake Marion - Curlyleaf Pondweed Density Summary

Transect	Depth	1998 June 26	1999 June 6	2000 May 26	2001 June 8	2002 June 9	2003 May 17	2004 May 31	2005 May 22	2006 May 27	2007 May 2	2008 May 26	Average	% Red >50%
1	S	1	0	4	1	3	1	1	0.5	4.5	5	2	2.1	30
	M	2	3	2.5	1	3.5	0.5	0	2	2.8	4.5	2	2.2	10
	D	1	4	2	0	1	1.5	1.5	2	2	3	1.8	1.8	10
2	S	0	2	0	0.5	3	0.5	2.5	1	1	1	1	1.1	0
	M	0	4	3	3	2	4	2.5	1.8	3	5	2.5	2.8	30
	D	0	3	2.5	1	0.5	2.5	2	1.5	1.3	2.5	2.5	1.8	0
3	S	0	0	0	0	1	0.5	0	0	0	1	3	0.5	0
	M	0	0	2	2.5	1.5	0	1.5	2	1.5	5	1	1.5	0
	D	0	4	2	0.5	1.5	1.5	0.5	1.3	2	2.8	2	1.6	10
4	S	0	1	1	0	0	0	0.5	0	1	0	3	0.6	0
	M	1	2	2	2.5	2	2	2.5	1	2	3.5	2	2.0	0
	D	0	4	3	0.5	2	0	1.5	1	1	1	2	1.5	10
5	S	2	1	2	2	5	1	5	5	5	3	1	2.9	40
	M	2	2	2.5	3	1	2	1.5	0.5	3.5	4	1	2.1	10
	D	0	5	2.5	1.5	1	1	1.5	2	3	3.3	2.9	2.2	10
6	S	0	0	0	0	0	0	0	0.5	0	1	0	0.1	0
	M	0	2	0.5	1	1	1	0.5	1	0	1.5	1	0.9	0
	D	0	2	1	1	0.5	1	0	0.5	1	2.5	1	1.0	0
7	S	0	0	0	0	0	0	1	0	0	1.5	0	0.2	0
	M	2	2	1	1	1	0.5	2	0.5	0	1	0	1.0	0
	D	0	1	1	0	1	0.5	1	1	0	2	0	0.7	0
8	S	2	4	0	2	5	0.5	1.5	2	1	1	0	1.7	20
	M	0	5	0	3	4	0.5	2	2.5	2.8	3.2	2.5	2.3	20
	D	0	5	0	1	1.5	3.5	3	3	1.5	3.7	3	2.3	10
9	S	0	0	0	0	0	0	0	0	0	0	0	0.0	0
	M	1	0	1	0.5	1.5	0	0.5	1.5	0	2.5	0	0.8	0
	D	0	3	1.5	1.5	1	1	2	2	1	1	2	1.5	0
10	S	0	0	0	0	0	0	0	0	0	0	0	0.0	0
	M	0	1	1	0	1	0	1.5	0	0	0.5	0	0.5	0
	D	0	1	1	0.5	1	0	2.5	2	2	0	0.5	1.0	0
11	S	0	0	1	0.5	0	0.5	0.5	0	0	0	0	0.2	0
	M	0	0	0	0	0.5	0	0.5	0	0	0	0.5	0.1	0
	D	0	4	1	0	0	1	1	1	0	1	0	0.8	10
12	S	0	0	0	0	0	0	0	0	0	0	0	0.0	0
	M	1	0	1	0	0	0	2.5	1	0	0	1	0.6	0
	D	0	4	2.5	0	1	1	0.5	1	0	1	0.5	1.0	10
13	S	0	1	0	0	0	0	0	0	0	0	0	0.1	0
	M	0	2	2	2	0.5	0	2	0	0.5	0	0	0.8	0
	D	0	3	2	1	1	1	2.5	1	0.8	3	2	1.6	0
14	S	0	0	0	0	1	0.5	2.5	0	0	0	0	0.4	0
	M	0	2	1	3	2	1	2	1	1	0	0	1.2	0
	D	0	4	1	1.5	2	1	0.5	1	3	2.5	2	1.7	10
15	S	0	1	1	0	0.5	0.5	2	0	0	1	2	0.7	0
	M	0	4	3	2	4	1	3.7	3	3	2.5	3	2.7	30
	D	0	3	2	1	3	2	2.5	2	2	2	1.5	1.9	0
16	S	0	0	0	0	0.5	0.5	0.5	0.5	0	2	0.5	0.4	0
	M	1	2	2.5	1.5	2	2	2	1	1	2.3	1.3	1.7	0
	D	0	0	2	3	2	1.5	1.5	2	2	1.5	1	1.5	0
17	S	0	1	1	0	2	0.5	1	0.5	1	3.5	0	1.0	10
	M	1	1	3	1.5	1	2.5	1	1	1	2	0.5	1.4	0
	D	0	3	1.5	1	1	2	2	1	2	0	1	1.3	0
18	S	1	2	3	0	2	0	0	0	1	1	0	0.9	0
	M	2	2	1	0	0.5	0	2	2	3	3	2	1.6	0
	D	2	1	1	0	0	0.5	2	2.5	1	2	1	1.2	0

Lake Marion Sediment Mapping



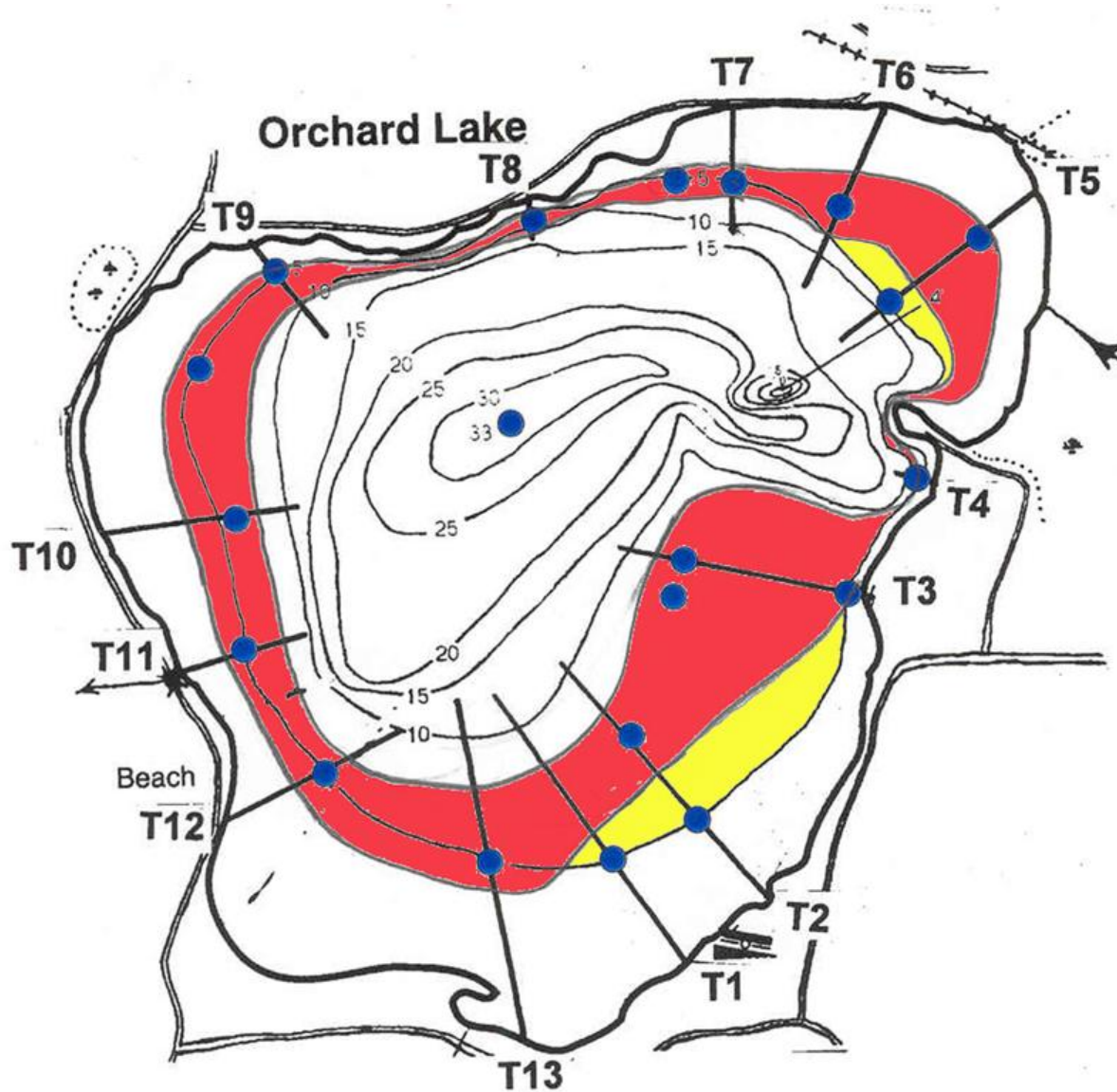
Curlyleaf Pondweed Assessment for Orchard Lake



Orchard Lake - Curlyleaf Pondweed Density Summary

Transect	Depth	1999 Jun 5	2000 May 26	2001 Jun 8	2002 May 31	2003 May 17	2004 Jun 7	2005 May 21	2006 May 26	2007 May 22	2008 May 30	Average	% Red >50%
1	S	5	5	2	5	5	2.5	4	3	1.5	2	3.5	50
	M	5	5	2	3.5	4.5	3.5	4	3.5	2.5	3	3.6	40
	D	3	2	2	X	4	X	X	X	X	1	2.4	10
2	S	5	5	4	5	2.5	0	2	4	3.3	0	3.1	50
	M	5	5	4	4	3	2	4	3.8	4	2	3.7	70
	D	4	2	4	X	3	X	X	X	X	0	2.6	20
3	S	5	4	2	4	2	0.5	1	4	1	1	2.5	40
	M	0	5	2.5	4	5	2	2	3.3	3	2	2.9	30
	D	0	3	2.5	4	4	X	X	X	X	0	2.3	20
4	S	3	3	3	1	3	2	0.5	2	2	1	2.1	0
	M	5	4	3	3.5	4	1	1.3	2.3	3.3	2	2.9	30
	D	4	3	3	1	3	X	X	X	X	2	2.5	10
5	S	5	0	3	4	4	4.5	0	5	5	4.5	3.5	70
	M	5	4	3.5	4.5	4	4	3	3.6	2.5	4	3.8	60
	D	0	2	3.5	2	3	X	X	X	X	1	1.9	0
6	S	5	5	0	5	4	4.5	3	2.5	4	1	3.4	60
	M	0	5	3	4.5	4	3.5	4	2	2.5	4	3.2	50
	D	0	1.5	3	2	3	X	X	X	X	X	1.9	0
7	S	1	5	0	3	5	0.5	2	5	4.5	4	3.0	50
	M	4	3	3	4	4.5	2	3.5	4	2	4	3.4	50
	D	0	2	3	X	2	X	X	X	X	X	1.8	0
8	S	2	3	0	2	1	X	3	5	5	3	2.7	20
	M	5	2	1	2.5	2	X	1.5	2.5	1	2	2.2	10
	D	4	2	1	1	1	X	X	X	X	1	1.7	10
9	S	1	5	1	4	5	1.5	3	5	4.5	4	3.4	60
	M	4	3	3	4.5	4	2.5	4	3.3	3	4	3.6	50
	D	4	2	3	X	2	X	X	X	X	3	2.8	10
10	S	4	2	1	5	4	0	1	4	4	5	3.0	60
	M	5	2.5	3	5	4	2.5	4	2.5	3	4	3.6	50
	D	4	2	3	X	2	X	X	X	X	X	2.8	10
11	S	1	1	2	3	4	2	2	4	4	1	2.4	30
	M	4	4	3	4	4	2	3.5	3.2	2.5	4	3.4	50
	D	0	3	3	X	2	X	X	X	X	X	2.0	0
12	S	4	5	4	5	4	2	3	2.3	4.5	2	3.6	60
	M	5	5	4	5	4.5	2	4	2.8	2.8	4	3.9	70
	D	0	2	4	X	2	X	X	X	X	X	2.0	10
13	S	0	0	2.5	4	2	0.5	1	1	4	1.5	1.7	20
	M	4	5	1	5	4	3.5	4	4	3	2	3.6	60
	D	0	2	1	X	3	X	X	X	X	X	1.5	0
Number of Reds		23	16	6	20	21	3	8	11	10	11		
Avg CLP Density		4.0	3.4	2.7	3.6	3.4	2.3	2.6	3.4	3.3	2.8		

Orchard Lake Sediment Mapping



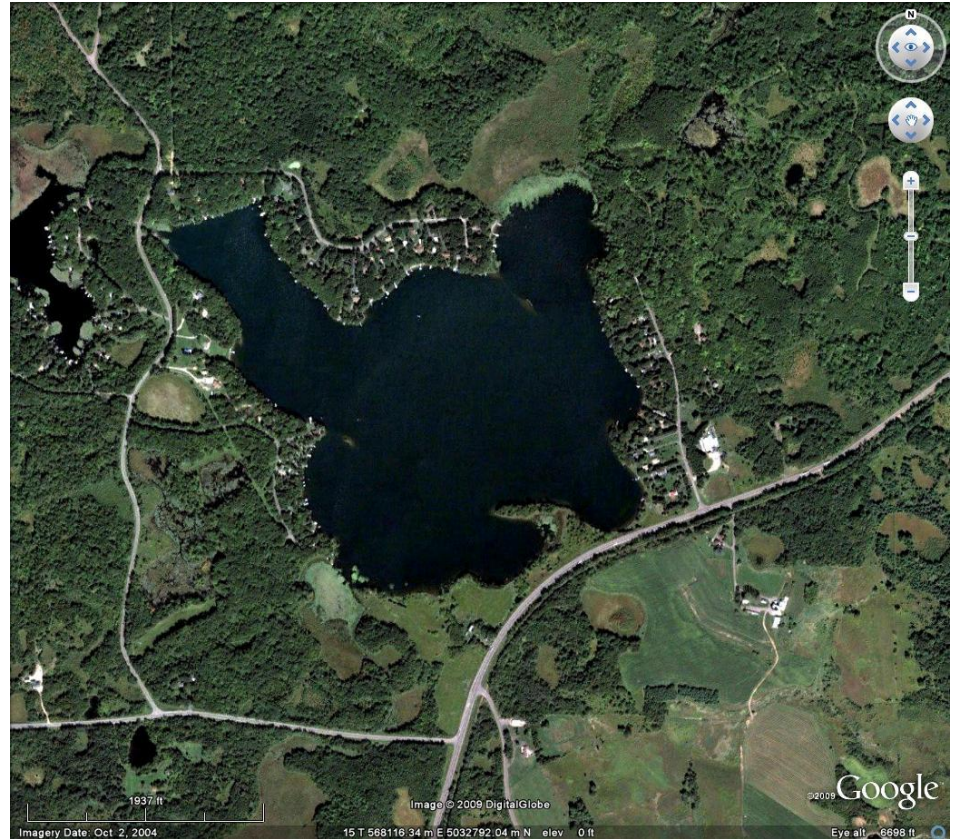
Curlyleaf Pondweed Assessments

- Scouting
- Sediment survey
- Plant history

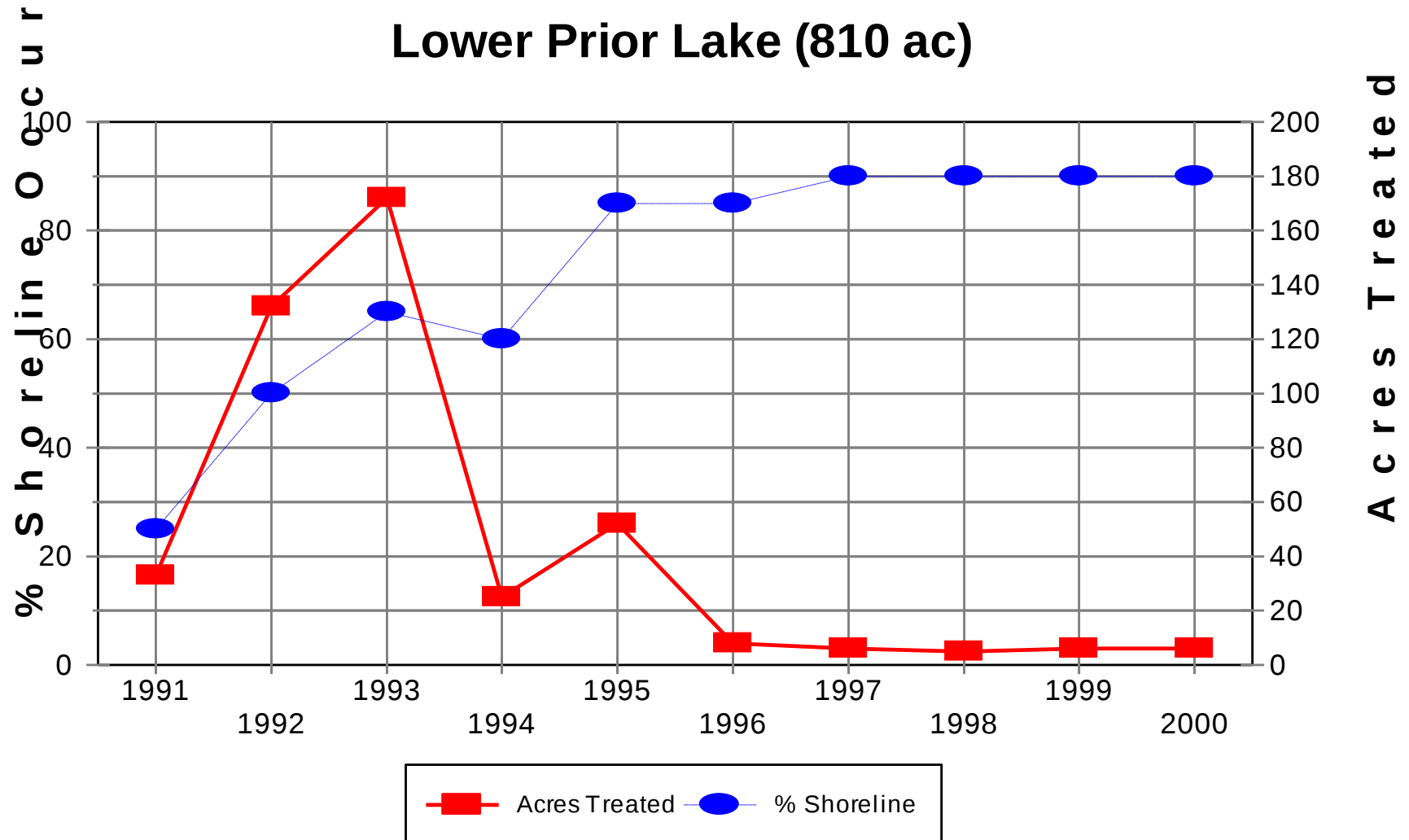
Eurasian Watermilfoil Assessments

Echo Lake, Barron
County, WI

(milfoil first observed
in 2003)



Eurasian Watermilfoil Spreads Throughout a Lake in 6-8 years



Sediment Surveys Sampled Lakes With Low Density and High Density Eurasian Watermilfoil



Light Growth



Heavy Growth

Sediments Influenced Eurasian Watermilfoil Growth (for sediments <20% OM)

	Light Growth (n=27)	Heavy Growth (n=14)	t-test (p < value)
Nitrogen (NH ₄ -N)(ug/cm ³)*	5.77	15.3	0.0002
Organic matter (%)(<20%)	5.09	7.74	0.22 (ns)
Bulk density (g/cm ³ -dry)	0.92	1.00	0.49 (ns)
pH	7.30	6.99	0.34 (ns)
Fe (👉 g/cm ³)	81.1	99.8	0.92 (ns)
Fe/Mn	7.39	14.2	0.06 (ns)

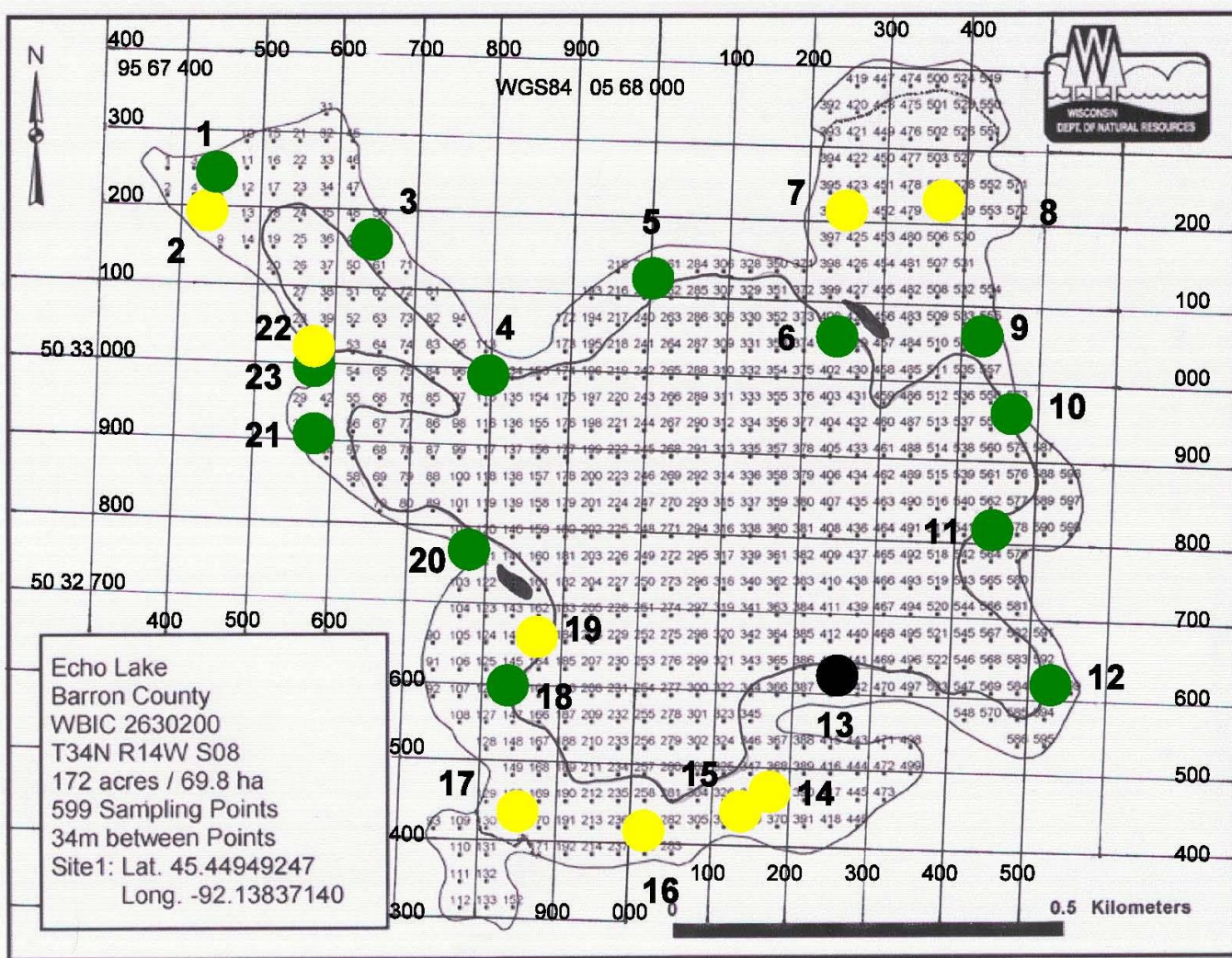
High Organic Matter Limits Eurasian Watermilfoil Growth Even If Nitrogen Is High

*[Poor growth found in sediments > 20% OM,
Barko and Smart 1986]*

Results for high organic matter sediments.

	Light Growth (n=9)	Heavy Growth (n=14)	t-test (p < value)
Nitrogen (NH ₄ -N)(ug/cm ³)	19.6	15.3	0.31 (ns)
Organic matter (%)(>20%)*	62.0	7.74	0.0000002
Bulk density	0.30	1.00	<0.05

Echo Lake Sediment Map

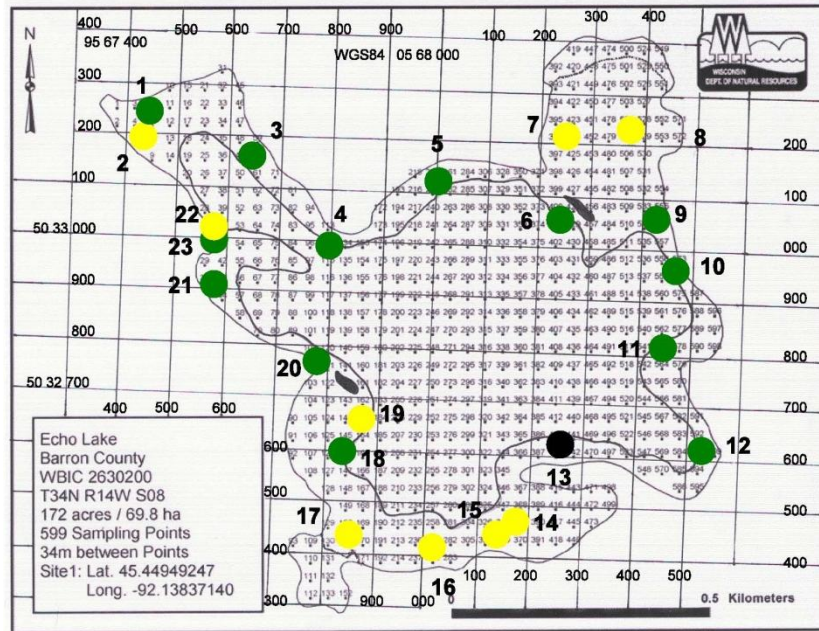


172 ac

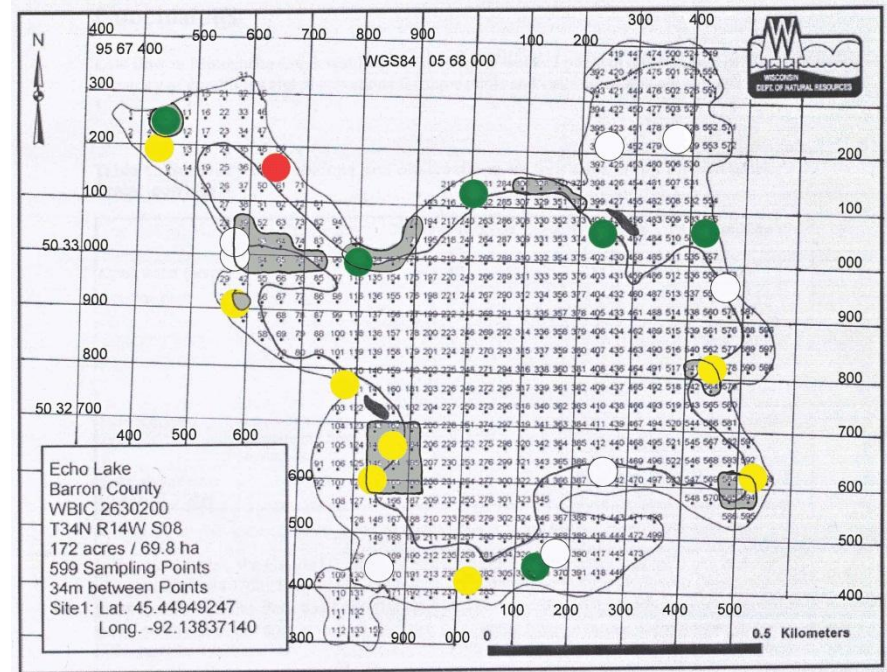
Green = light growth; Yellow = moderate growth; and Red = heavy growth

Echo Lake EWM Conditions in 2008

Sediment Survey from 2008



EWM Densities in Sept 2008 At Sediment Sample Sites



Echo Lake (172 acres), Barron Co, WI

EWM Treatment History

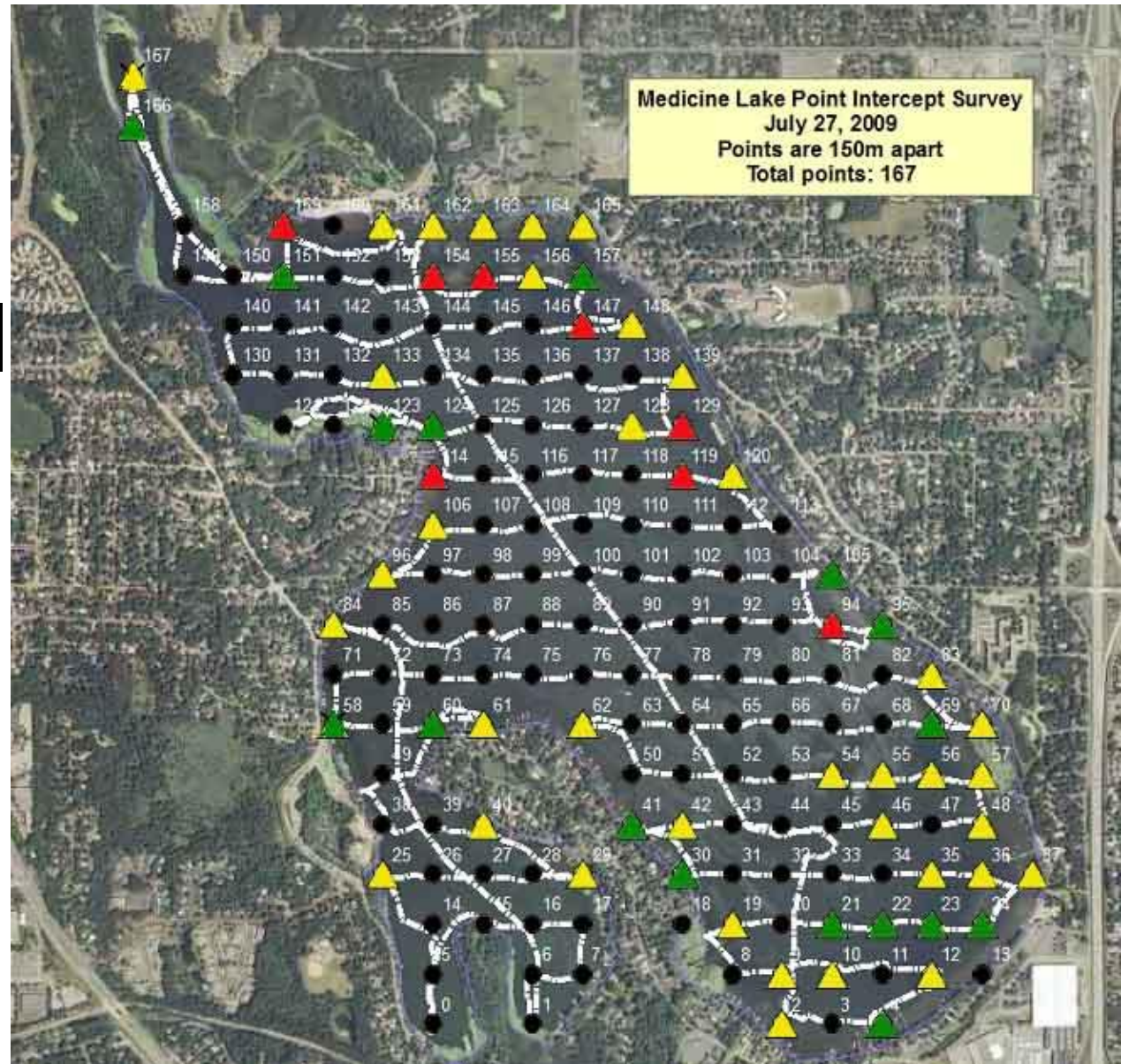
	Treatment (ac)
2007	Landing area
2008	9.9
2009	28.1
2010	5.3

**Echo Lake: Scouting and a Sediment
Survey Indicate Eurasian
Watermilfoil Should Not Be a
Widespread Problem.**

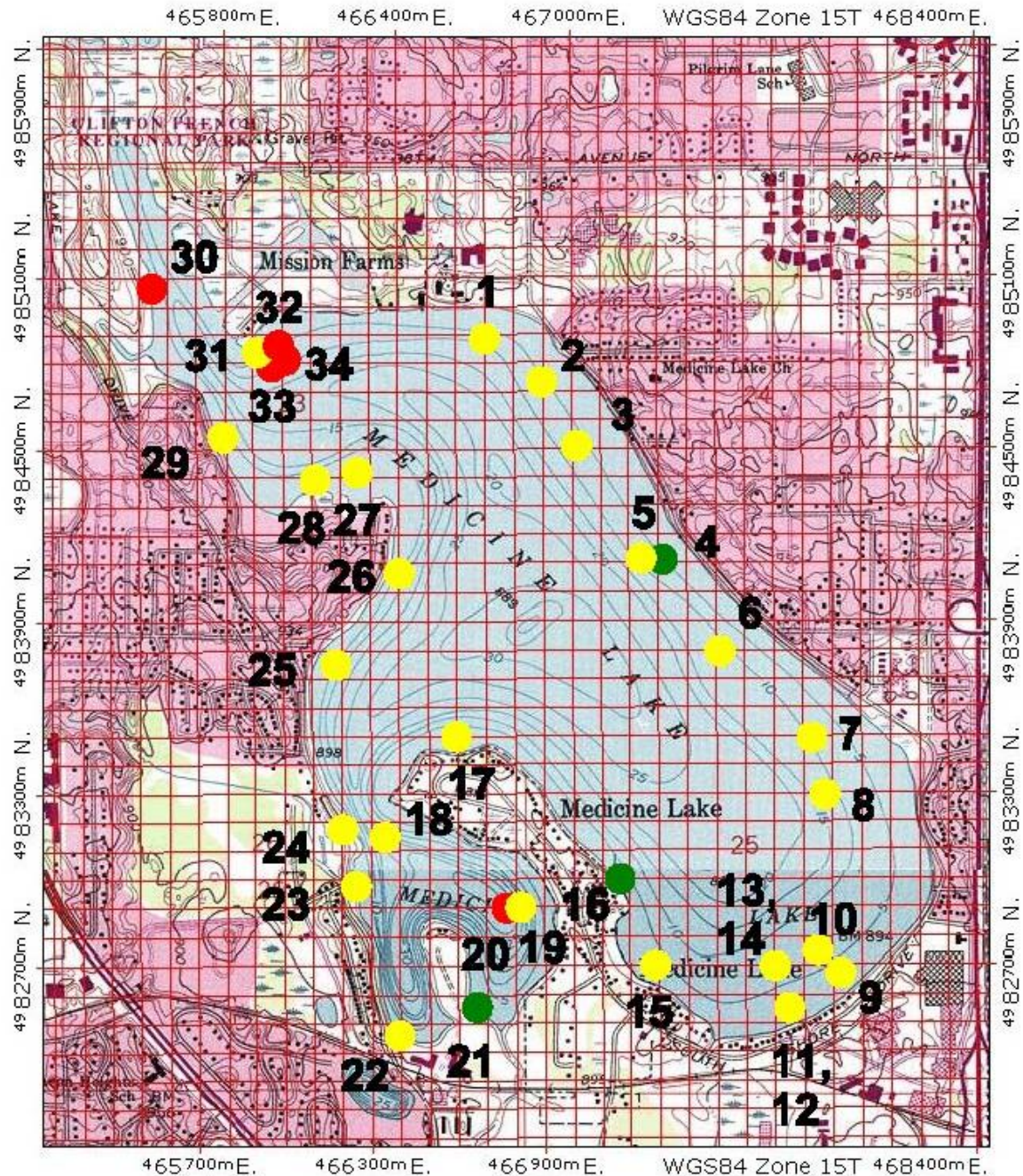
***Spot Treatments Should Be
Adequate in the Future.***

Medicine Lake Eurasian Watermilfoil Explosion In 2009

(EWM first observed in 1989. Some EWM treatment in the past, but minor)

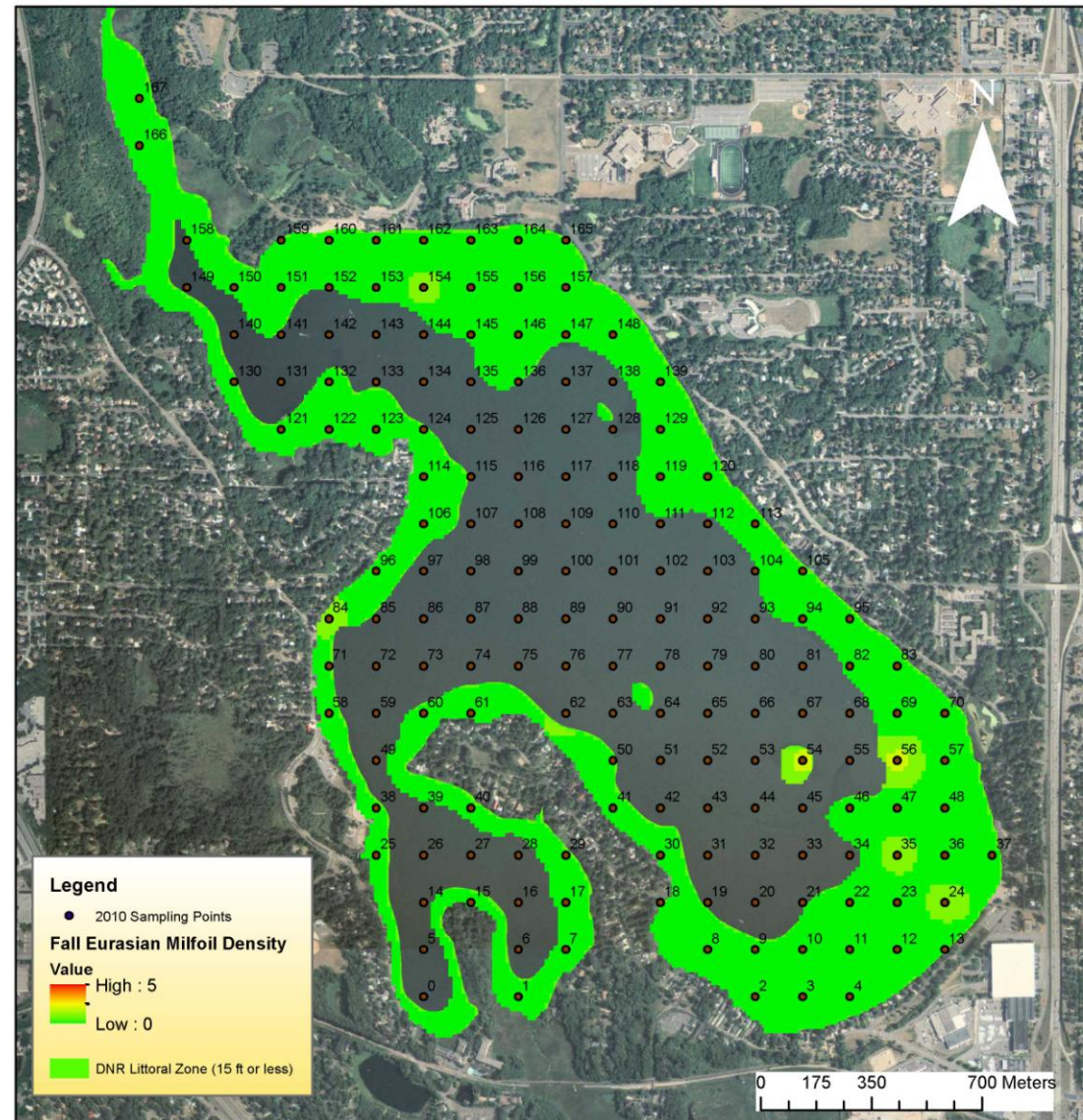


Medicine Lake Sediment Map for Eurasian Watermilfoil



Medicine Lake: No Treatment for Eurasian Watermilfoil In 2010

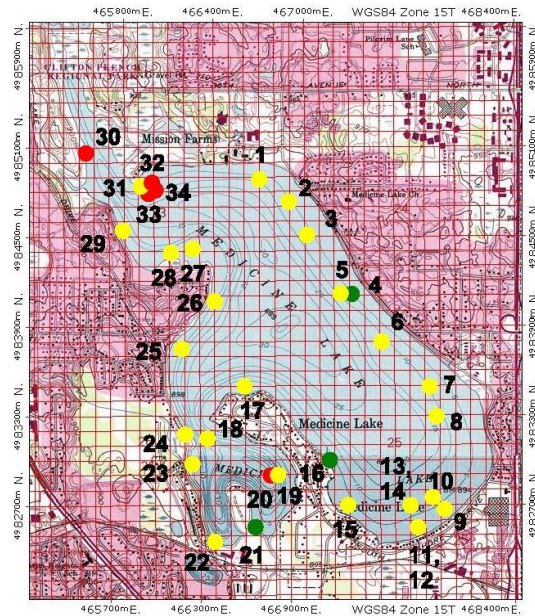
Turns out EWM had
mostly light growth in
2010



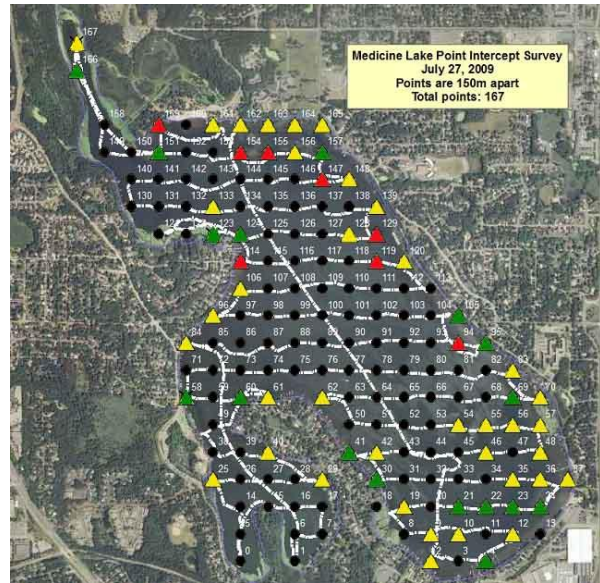
Medicine Lake Eurasian Milfoil Density 8-26-10

Survey conducted by Three Rivers Park District,
Water Resources Department, Chris Jurek
Map created on October 26, 2010

Eurasian Watermilfoil Distribution in Medicine Lake in 2009 And 2010. Sediment Surveys Help Predict Areas of Growth.

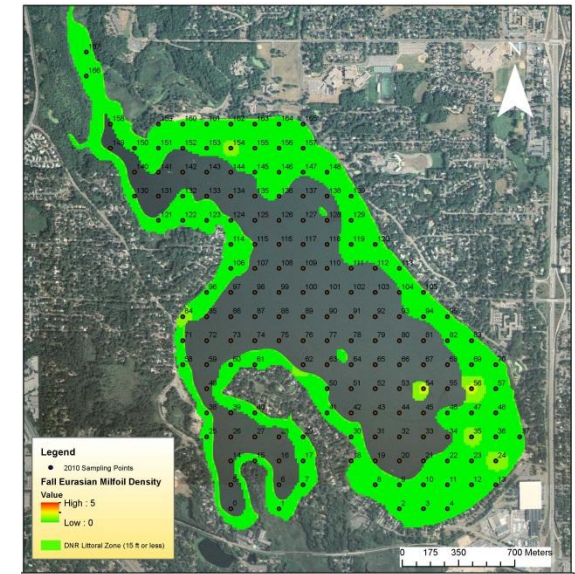


(Green dots = light growth; Yellow dots = moderate growth and Red dots = heavy growth).



Source: MnDNR

(Green triangles = light growth; Yellow = moderate growth; and Red = heavy growth).



Three Rivers
PARK DISTRICT

Medicine Lake
Eurasian Milfoil Density
8-26-10

Survey conducted by Three Rivers Park District,
Water Resources Department, Chris Jurek
Map created on October 26, 2010

[illegible]

**For Eurasian Watermilfoil,
Scouting and Lake Sediment
Surveys Help Delineate Areas to
Treat for Partial Lake Treatments**

Lakes with Sediment Surveys

Minnesota

Lakes

Alimagnet*
Bald Eagle*
Bass
Birch
Buck
Calhoun
Cedar Island
Circle
Clear
Crystal*
Eagle
Eagle
Earley
East
Edward
Farquar
Fish
Fish
Gleason
Green
Green
Keller*
Kingsley
Knife
Lac Lavon
Lee*
Little Pelican
Long

Minnesota

Lakes

Marion*
Medicine
Monogalia
Mountain
Nest
Nokomis
Orchard*
Otter
Parkers
Pelican
Peltier
Pike
Powers
Prior - Upper
Prior - Lower
Ravine
Rice
Rush - east
Rush - west
Schmidt
Spring
Sylvia
Valley
Volney*
Weaver
White Bear

n = 54

Wisconsin

Lakes

Amik
Ballard
Bear
Big Round
Cedar
Echo
Irving
Minocqua
Minong
Nancy
Pike
Round
Turner
Van Vliet
White Birch

n = 15

Conclusions

- If you have a 20' x 20' patch of curlyleaf pondweed or Eurasian watermilfoil, do you have to treat it? (no)
- If lake sediments are conducive to growth, plants will grow
- Heavy growth and light growth can be defined, however, treating moderate growth is a subjective call
- How do you decide what to treat?
 - Scouting
 - Sediment surveys
 - Plant history

Conclusions - Continued

- If the whole lake is treated, why wouldn't the plants come back when the treatments stopped?
- If the whole lake is treated and CLP or EWM don't come back, sediments probably weren't conducive to growth anyway.