APPENDICES

Tomahawk Lake System

Comprehensive Lake Management Plan

Oneida County, Wisconsin

July 2015

Sponsored By

TOMAHAWK LAKE Association, Inc.

WISCONSIN

Hazelhurst • Lake Tomahawk • Minocqua • Woodruff

List of Appendices

Appendix A. Steering Committee Meetings

Tomahawk Lake Association
Comprehensive Lake Management Plan

Kemp Research Station, Office Conference Room
9161 Kemp Road, Woodruff, WI

Steering Committee Meeting #1
Wednesday, February 11, 2015
7-9 p.m.

AGENDA

7:00 p.m. Introductions and communication check

7:10 p.m. Planning process
Review: TLA CLMP MEETINGS, CLMP GUIDELINES AND ROLES

7:25 p.m. Lake user survey overview
TLA SUMMARY FINAL REPORT

7:40 p.m. Steering Committee concerns (Committee)
What do you want to be sure the plan addresses???
This is a brainstorming session, so your suggestions could be related to process, communication, goals, activities – whatever is on your mind as we enter this process

8:10 p.m. Establishing goals and objectives – Draft goals
REVIEW OF GOALS AND OBJECTIVES

8:40 p.m. AIS education, CBCW (Ned Greedy)
Recommendations

8:55 p.m. Wrap up: next meeting: Wednesday, February 25
Draft plan background distribution

NOTE: ATTACHED DOCUMENTS ARE LISTED IN CAPITAL LETTERS

Tomahawk Lake Association
Comprehensive Lake Management Plan

Kemp Research Station, Office Conference Room
9161 Kemp Road, Woodruff, WI

Steering Committee Meeting #2
Wednesday, February 25, 2015
7-9 p.m.

AGENDA

7:00 p.m. Communication check, draft plan
Page numbers refer to
TOMAHAWK LAKE CLMP BACKGROUND 021915

7:05 p.m. Review of CLMP Goals
DRAFT PLAN GOALS REV2

7:20 p.m. Aquatic Plant Survey results
Page 38-73

7:40 p.m. EWM status report and methods
Page 89-96

8:10 p.m. EWM future management and monitoring

Proposed objectives and actions
AIS PROGRAM DISCUSSION

8:55 p.m. Wrap up: next meeting: Wednesday, March 11

NOTE: ATTACHED DOCUMENTS ARE LISTED IN CAPITAL LETTERS. **MOST IMPORTANT READING IN BOLD**

Tomahawk Lake Association
Comprehensive Lake Management Plan

Kemp Research Station, Office Conference Room
9161 Kemp Road, Woodruff, WI

CONFERENCE CALL INFO	
Meeting ID:	8479
Phone Numbers:	(414) 343-7344 (Milwaukee Metro)
	(800) 882-7344 (Toll Free)

Steering Committee Meeting #3
Wednesday, March 11, 2015
7-9 p.m.

AGENDA

7:00 p.m. TLA capacity/governance
Results of board discussion

7:10 p.m. Proposed objectives and actions
AIS PROGRAM DISCUSSION – review highlighted areas

8:00 p.m. Implementation chart format
Results of board discussion

8:10 p.m. Watershed and water quality information
BACKGROUND INFORMATION/DRAFT PLAN – P12-23

8:40 p.m. Water quality objectives and actions

8:55 p.m. Wrap up: next meeting: Wednesday, April 8

NOTE: BACKGROUND READING IS LISTED IN CAPITAL LETTERS.

Tomahawk Lake Association
Comprehensive Lake Management Plan

Kemp Research Station, Office Conference Room
9161 Kemp Road, Woodruff, WI

Steering Committee Meeting #4
Wednesday, April 8, 2015
7-9 p.m.

CONFERENCE CALL INFO	
Meeting ID:	8479
Phone Numbers:	(414) 343-7344 (Milwaukee Metro)
	(800) 882-7344 (Toll Free)

AGENDA

7:00 p.m. AIS Implementation Plan

7:10 p.m. Goal 2. Water quality objectives and actions
GOAL 2 AND 3 HANDOUT

7:20 p.m. Watershed and shoreline project options
DRAFT PLAN PG. 26-32
PRESENTATION

8:00 p.m. Goal 2. Water quality objectives and actions (review)

8:30 p.m. Goal 3. Objectives and actions

8:55 p.m. Wrap up: next meeting: Wednesday, April 22
Finish Goal 3 Discussion, Education/outreach

NOTE: BACKGROUND READING IS LISTED IN CAPITAL LETTERS.

Tomahawk Lake Association
Comprehensive Lake Management Plan

Kemp Research Station, Office Conference Room
9161 Kemp Road, Woodruff, WI

Steering Committee Meeting #5
Wednesday, April 22, 2015
7-9 p.m.

CONFERENCE CALL INFO	
Meeting ID:	8479
Phone Numbers:	(414) 343-7344 (Milwaukee Metro)
	(800) 882-7344 (Toll Free)

AGENDA
DEVELOPING STEWARDSHIP OUTREACH!!

7:00 p.m. Goal 2. Water quality objectives and actions - review/approve
GOAL 2 AND 3 with STEWARDSHIP

7:10 p.m. Develop water quality stewardship outreach
Identify desired behaviors, barriers, messages, methods

7:40 p.m. Goal 3. Recreation/preservation objectives and actions (review)
GOAL 2 AND 3 with STEWARDSHIP

8:10 p.m. Develop recreation/preservation stewardship outreach
Identify desired behaviors, barriers, messages, methods

8:40 p.m. Review Goal 5. Partnership objectives and actions (review)

8:55 p.m. Wrap up: next meeting: Thursday, May 14
Review/ approve draft implementation plan

NOTE: BACKGROUND READING IS LISTED IN CAPITAL LETTERS.

Tomahawk Lake Association
Comprehensive Lake Management Plan

Kemp Research Station, Office Conference Room
9161 Kemp Road, Woodruff, WI

CONFERENCE CALL INFO	
Meeting ID:	8479
Phone Numbers:	(414) 343-7344 (Milwaukee Metro)
	(800) 882-7344 (Toll Free)

Steering Committee Meeting #6
Thursday, May 14, 2015
7-9 p.m.

AGENDA
MOVING TO IMPLEMENTATION

7:00 p.m. Review final implementation section
TLA CLMP GOALS OBJ ACTIVITIES 051215

7:10 p.m. Review implementation chart
TLA CMPL IMPLEMENTATION CHART 051215

Now that activities are listed in chart, do they make sense?

Will TLA complete them within 5 years? If not, we might want to reconsider.

Need assignments to be sure activities are completed.

How to ensure resources will be available.

7:40 p.m. TLA committee organization

8:10 p.m. Public meeting June 13
Talking points
E-blast announcement
Photos
Maps

8:40 p.m. Finish education topics

8:55 p.m. Wrap up: schedule for plan completion

Draft Plan (steering committee)	May 25
Comments Due	June 1
Public meeting	June 13, 9:30 a.m. Chamber of Commerce
Public comments due	July 6
Final Plan to DNR	July 15

Tomahawk Lake Association
Comprehensive Lake Management Plan

Kemp Research Station, Office Conference Room
9161 Kemp Road, Woodruff, WI

CONFERENCE CALL INFO	
Meeting ID:	8479
Phone Numbers:	(414) 343-7344 (Milwaukee Metro)
	(800) 882-7344 (Toll Free)

Steering Committee Meeting #7
Thursday, May 21, 2015
7-9 p.m.

AGENDA
MOVING TO IMPLEMENTATION

7:00 p.m. Opening comments, introduce timeline

7:10 p.m. Review implementation chart
TLA CLMP IMPLEMENTATION CHART 051515

8:00 p.m. Review timeline
TLA CLMP TIMELINE 2015-20

8:30 p.m. Finish education topics
CLMP GOALS OBJ ACTIVITES 051515

8:55 p.m. Wrap up: schedule for plan completion

Draft Plan (steering committee)	May 25
Comments Due	June 1
Public meeting	June 13, 9:30 a.m. Chamber of Commerce
Public comments due	July 6
Final Plan to DNR	July 15

TOMAHAWK LAKE Association, Inc.

WISCONSIN

Hazelhurst • Lake Tomahawk • Minocqua • Woodruff

Comprehensive Lake Management Plan
Public Meeting

Date: Saturday, June 13, 2015

Time: 9:30 – 10:30 a.m. CDT

Location: Minocqua Area Chamber of Commerce Building
8216 Hwy. 51, Minocqua, WI
New Conference Room

Agenda:

1. Welcome – Paul Shain, President
   Tomahawk Lake Association

2. CLMP Highlights – Jim Kavemeier, Chair
   CLMP Steering Committee

3. CLMP Overview – Cheryl Clemens,
   Harmony Environmental

4. CLMP Question and Answer Period

5. Minocqua/Tomahawk Chain Walleye Rehabilitation Plan. – Dave Walls
   WDNR

6. Minocqua/Tomahawk Chain Rehabilitation Plan Question and Answer Period

Adjournment

Upcoming TLA Events:

July 3, 2015	Hermit Island Swim Challenge
September 26, 2015	Beef-a-Rama

Appendix B. Lake User Survey Results

Number of people invited to submit surveys: 515

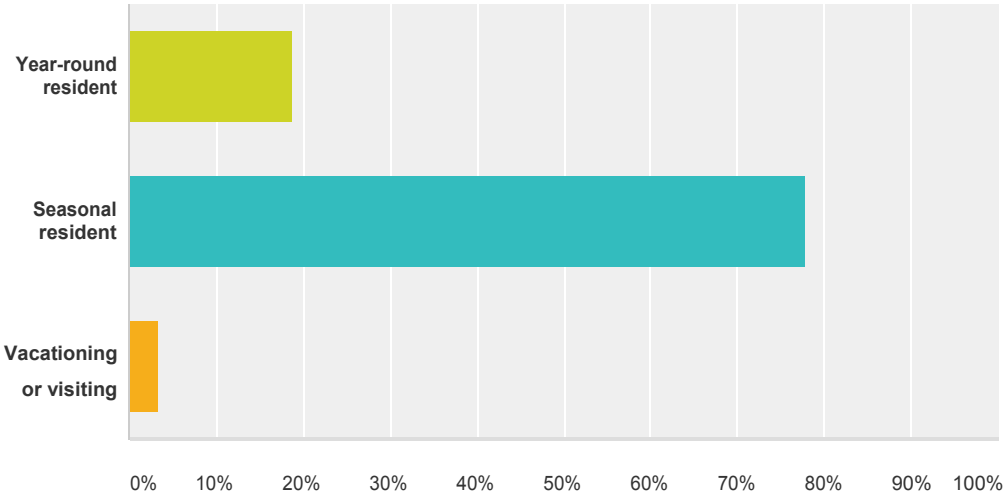
Surveys received through 12/10/14: 216

- Surveys returned via US Mail: 105
- Survey responses submitted online: 111
- Response rate: 42%

Q1 Question 1 is not included because it contained only the survey code, which was used for tracking purposes.

Q2 Which of the following best describes your length of stay?

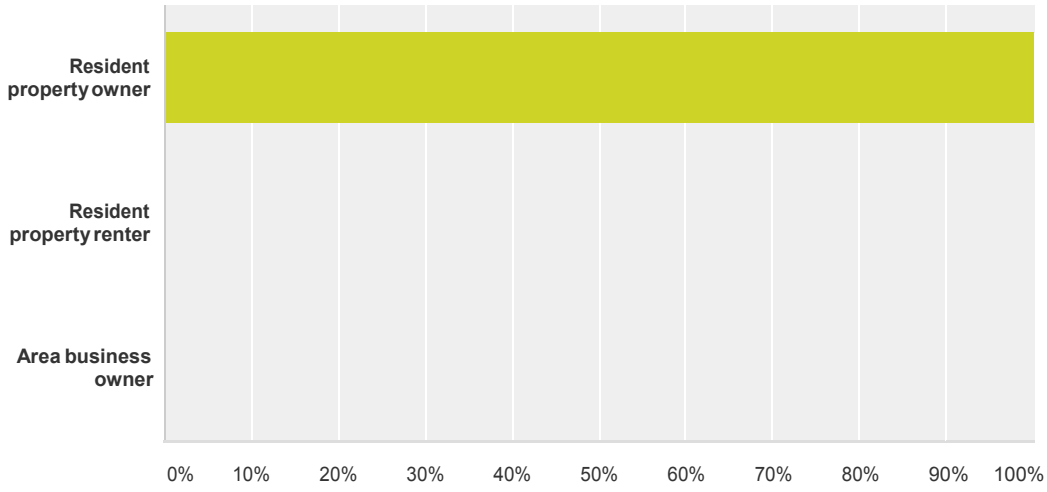
Answered: 212 Skipped: 4



Answer Choices	Responses	
Year-round resident	18.87%	40
Seasonal resident - not my permanent address (Stay seasonally, weekends, vacations and/or holidays)	77.83%	165
Vacationing or visiting (not a TLS property owner or renter)	3.30%	7
Total		212

Q3 Which of the following best describes your ownership or rental situation?

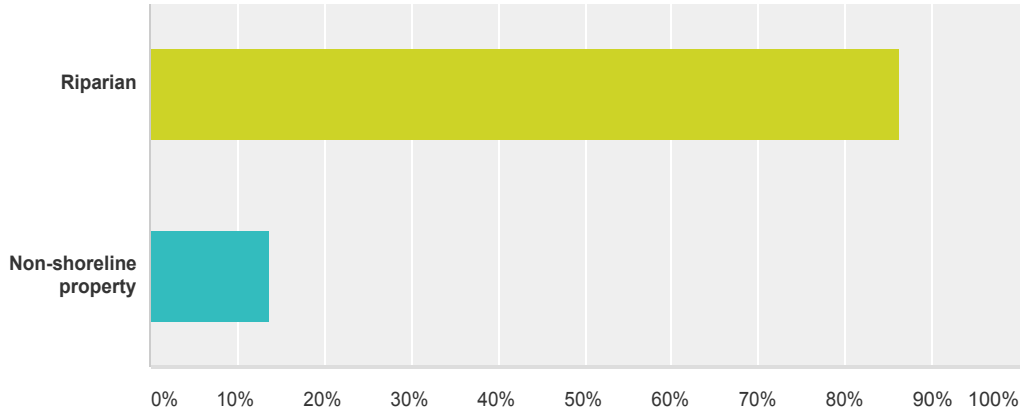
Answered: 204 Skipped: 12



Answer Choices	Responses	
Resident property owner	**98.04%**	200
Resident property renter	**0.98%**	2
Area business owner	**0.98%**	2
Total		**204**

Q4 Which of the following best describes your type of property?

Answered: 204 Skipped: 12

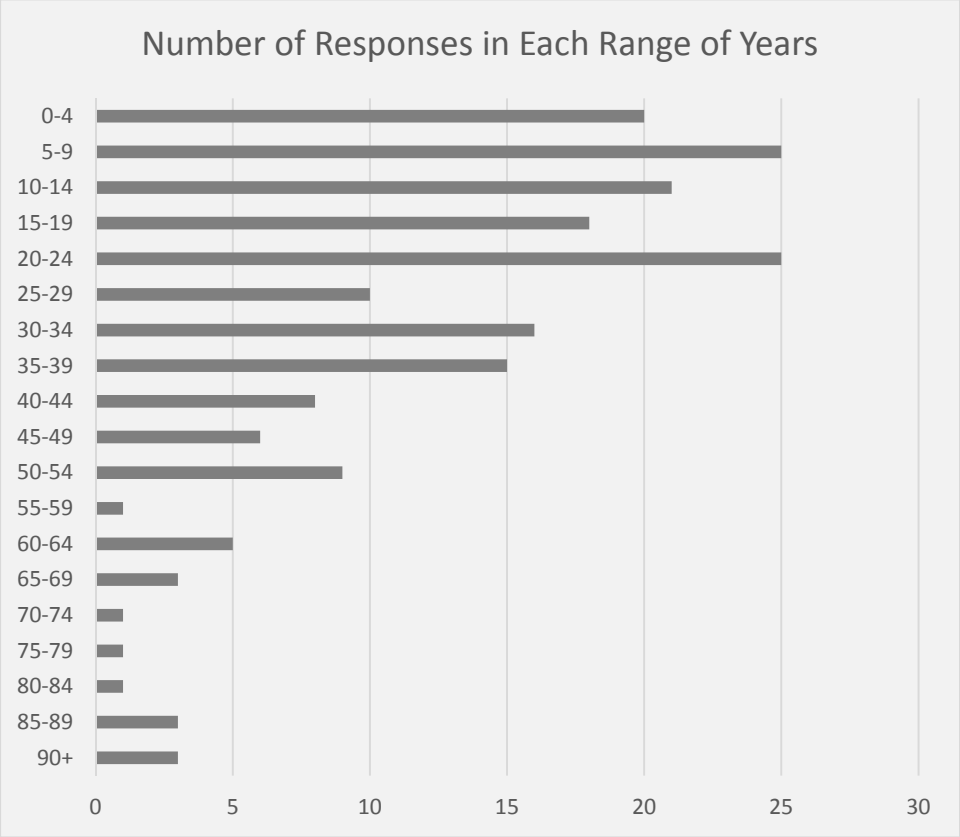


Answer Choices	Responses	
Riparian (shoreline property)	**86.27%**	176
Non-shoreline property	**13.73%**	28
Total		**204**

Q5 How long have you owned or rented property on the Tomahawk Lake System?

(If less than one year, please enter "1")

Answered: 191 Skipped: 25



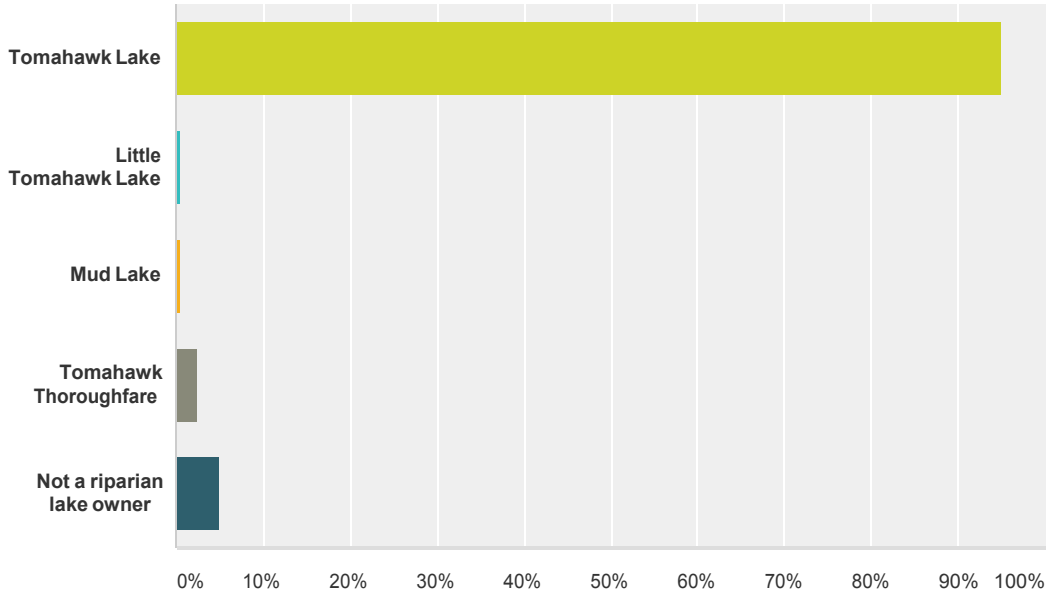
Answer Choices	Average Number	Responses
Number of years	26	191
Total Respondents: 191		

Number of years	Number of Responses in this Range
0-4	20
5- 9	25
10-14	21
15-19	18
20-24	25
25-29	10
30-34	16
35-39	15
40-44	8
45-49	6

Number of years	Number of Responses in this Range
50-54	9
55-59	1
60-64	5
65-69	3
70-74	1
75-79	1
80-84	1
85-89	3
90+	3 (96, 101, 103)

Q6 On which lake do you own property? (Check all that apply.)

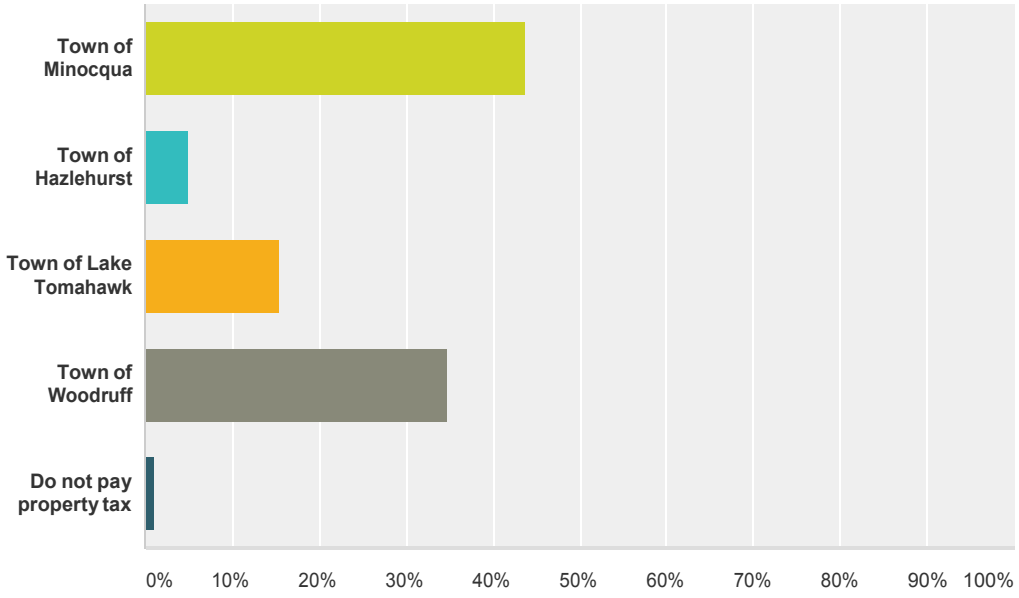
Answered: 203 Skipped: 13



Answer Choices	Responses	
Tomahawk Lake	**95.07%**	193
Little Tomahawk Lake	**0.49%**	1
Mud Lake	**0.49%**	1
Tomahawk Thoroughfare	**2.46%**	5
Not a riparian lake owner (non-shoreline property)	**4.93%**	10
Total Respondents: 203		

Q7 In which municipality do you pay property taxes?

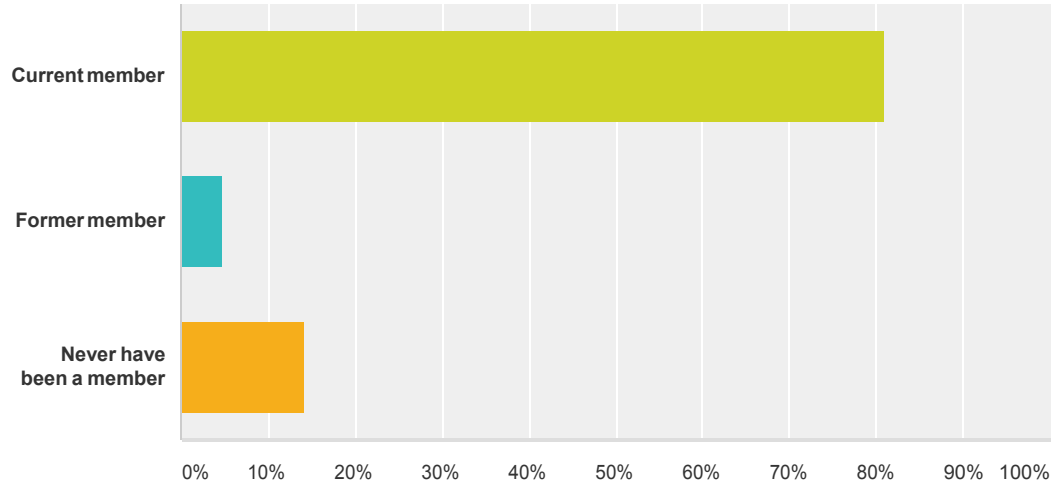
Answered: 201 Skipped: 15



Answer Choices	Responses	
Town of Minocqua	**43.78%**	88
Town of Hazlehurst	**4.98%**	10
Town of Lake Tomahawk	**15.42%**	31
Town of Woodruff	**34.83%**	70
Do not pay property tax	**1.00%**	2
Total		**201**

Q8 What is your affiliation with the Tomahawk Lake Association?

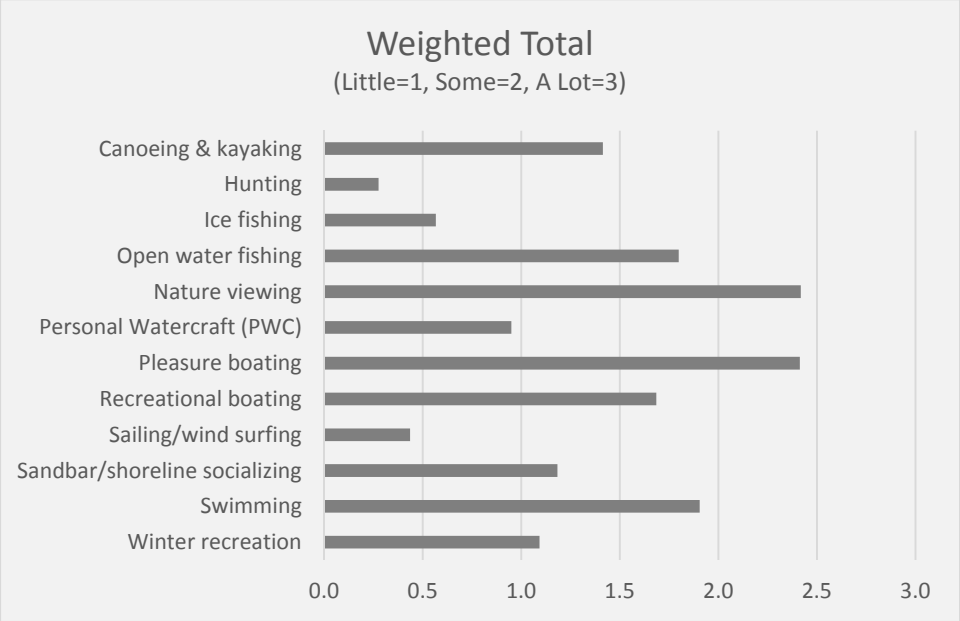
Answered: 210 Skipped: 6



Answer Choices	Responses	
Current member	**80.95%**	170
Former member	**4.76%**	10
Never have been a member	**14.29%**	30
Total		**210**

Q9 Please indicate how often you and/or your family participate in each of the following activities on the Tomahawk Lake System. (Please choose one answer per row.)

Answered: 212 Skipped: 4



	None	Little	Some	A lot	Total
Canoeing & kayaking	**28.79%** 57	**19.70%** 39	**32.83%** 65	**18.69%** 37	198
Hunting	**83.85%** 161	**7.29%** 14	**6.25%** 12	**2.60%** 5	192
Ice fishing	**62.24%** 122	**20.92%** 41	**14.80%** 29	**2.04%** 4	196
Open water fishing	**13.24%** 27	**20.10%** 41	**40.20%** 82	**26.47%** 54	204
Nature viewing	**3.48%** 7	**7.96%** 16	**31.84%** 64	**56.72%** 114	201
Personal Watercraft (PWC)	**54.77%** 109	**11.56%** 23	**17.59%** 35	**16.08%** 32	199
Pleasure boating (sightseeing, cruising, etc.)	**2.88%** 6	**9.13%** 19	**31.73%** 66	**56.25%** 117	208
Recreational boating (waterskiing, tubing, etc.)	**19.00%** 38	**25.50%** 51	**23.50%** 47	**32.00%** 64	200
Sailing/wind surfing	**73.33%** 143	**13.33%** 26	**9.74%** 19	**3.59%** 7	195
Sandbar/shoreline socializing	**31.68%** 64	**29.21%** 59	**28.22%** 57	**10.89%** 22	202
Swimming	**10.00%** 20	**19.00%** 38	**41.50%** 83	**29.50%** 59	200
Winter recreation (snowmobiling, cross-country skiing, snowshoeing, etc.)	**41.03%** 80	**22.56%** 44	**22.56%** 44	**13.85%** 27	195

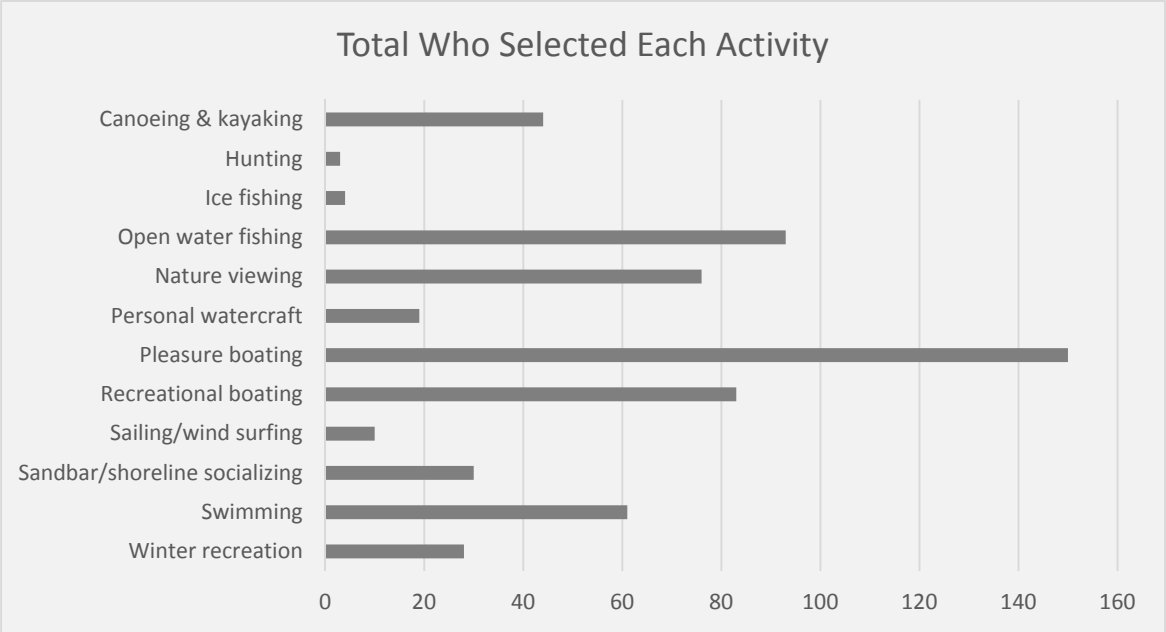
Q9 (Continued)

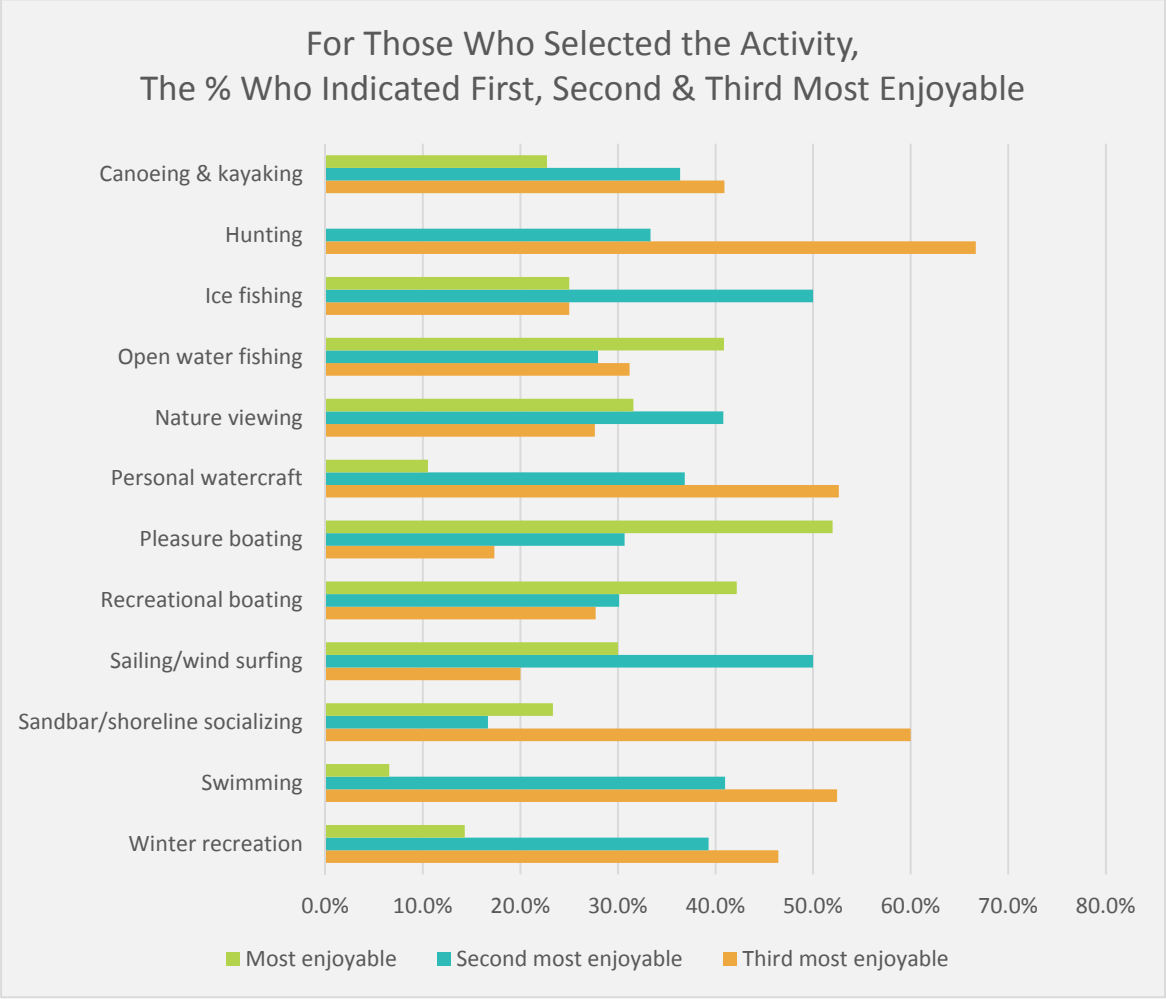
Other (please specify)
Sitting on top of our boathouse enjoying our party deck and lake.
Hiking back woods trails.
Clearing and maintaining trails on our 80 acres.
Transportation to/from our island

Comments
Family member uses our property. I don’t use it at this time.

Q10 Rank the three activities you and/or your family most enjoy.

Answered: 207 Skipped: 9



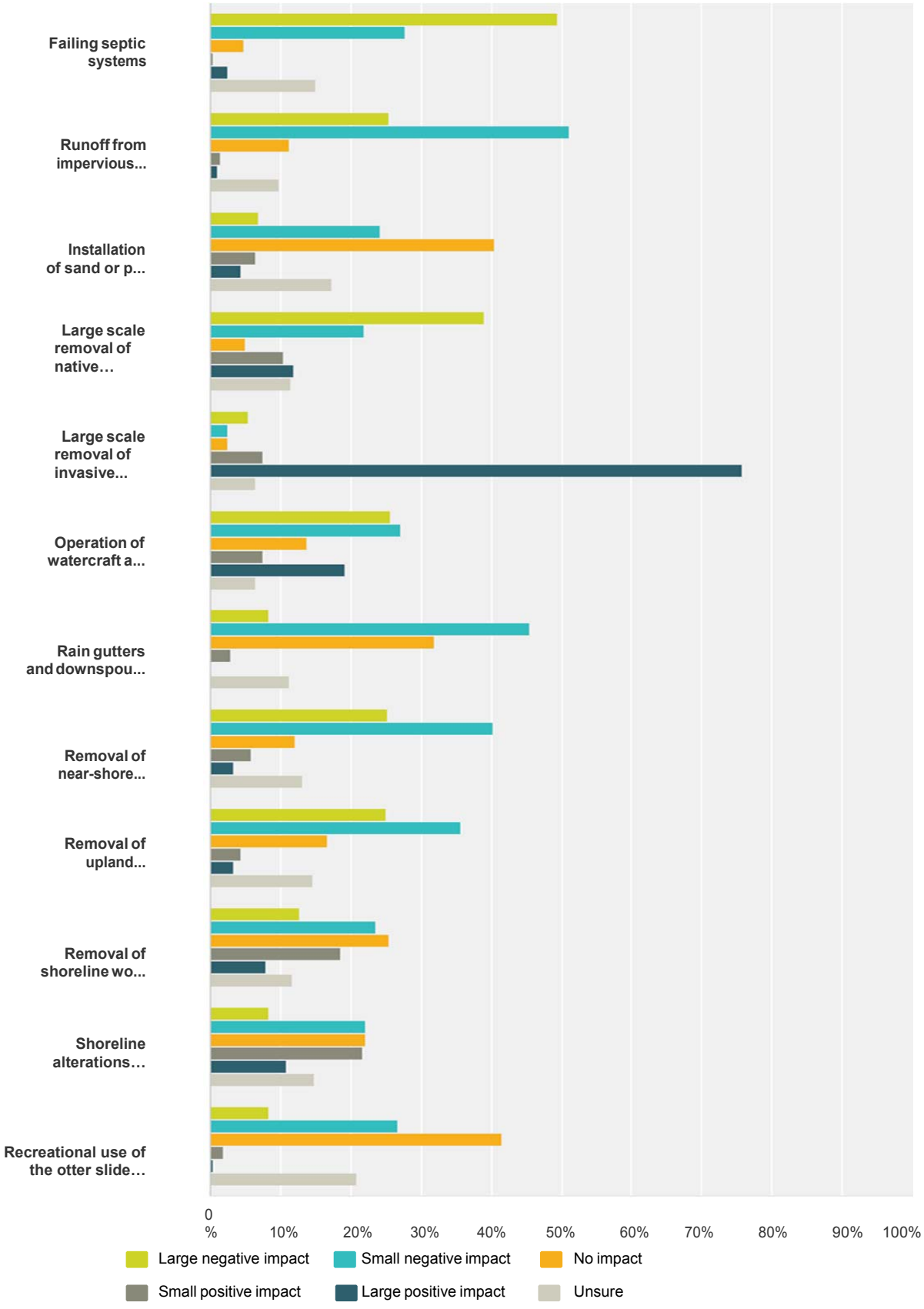


Q10 (Continued)

	Most enjoyable	Second most enjoyable	Third most enjoyable	Total	Weighted Average
Canoeing & kayaking	**22.73%** 10	**36.36%** 16	**40.91%** 18	44	2.18
Hunting	**0.00%** 0	**33.33%** 1	**66.67%** 2	3	2.67
Ice fishing	**25.00%** 1	**50.00%** 2	**25.00%** 1	4	2.00
Open water fishing	**40.86%** 38	**27.96%** 26	**31.18%** 29	93	1.90
Nature viewing	**31.58%** 24	**40.79%** 31	**27.63%** 21	76	1.96
Personal watercraft	**10.53%** 2	**36.84%** 7	**52.63%** 10	19	2.42
Pleasure boating (sightseeing, cruising, etc.)	**52.00%** 78	**30.67%** 46	**17.33%** 26	150	1.65
Recreational boating (waterskiing, tubing, etc.)	**42.17%** 35	**30.12%** 25	**27.71%** 23	83	1.86
Sailing/wind surfing	**30.00%** 3	**50.00%** 5	**20.00%** 2	10	1.90
Sandbar/shoreline socializing	**23.33%** 7	**16.67%** 5	**60.00%** 18	30	2.37
Swimming	**6.56%** 4	**40.98%** 25	**52.46%** 32	61	2.46
Winter recreation (snowmobiling, cross-country skiing, snowshoeing, etc.)	**14.29%** 4	**39.29%** 11	**46.43%** 13	28	2.32

Q11 Using the following scale, what impact, if any, do you believe each of the following practices have on the water quality of the Tomahawk Lake System?

Answered: 208 Skipped: 8

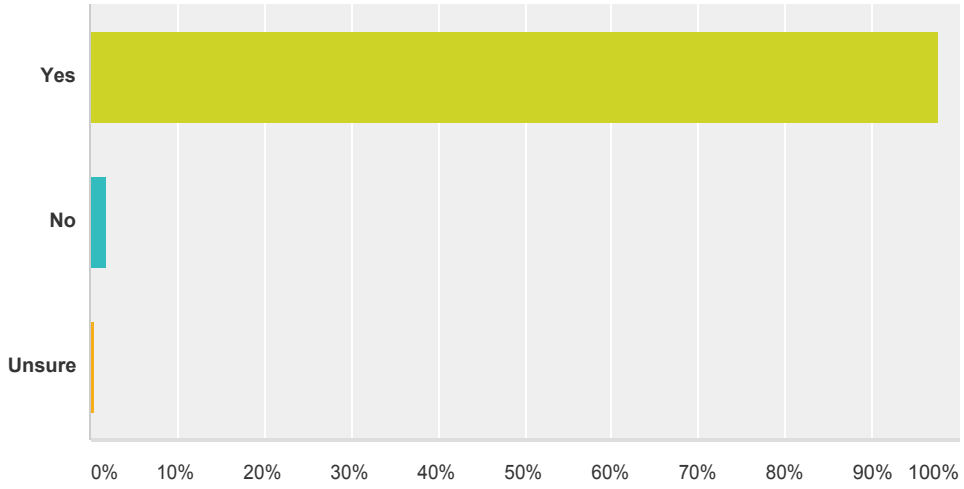


Q11 (Continued)

	Large negative impact	Small negative impact	No impact	Small positive impact	Large positive impact	Unsure	Total
Failing septic systems	**49.51%** 102	**27.67%** 57	**4.85%** 10	**0.49%** 1	**2.43%** 5	**15.05%** 31	206
Runoff from impervious surfaces, such as blacktop or concrete driveways	**25.37%** 52	**51.22%** 105	**11.22%** 23	**1.46%** 3	**0.98%** 2	**9.76%** 20	205
Installation of sand or pea gravel swimming beaches	**6.93%** 14	**24.26%** 49	**40.59%** 82	**6.44%** 13	**4.46%** 9	**17.33%** 35	202
Large scale removal of native aquatic plants	**39.00%** 78	**22.00%** 44	**5.00%** 10	**10.50%** 21	**12.00%** 24	**11.50%** 23	200
Large scale removal of invasive aquatic plants	**5.45%** 11	**2.48%** 5	**2.48%** 5	**7.43%** 15	**75.74%** 153	**6.44%** 13	202
Operation of watercraft at wake speeds in shallow water areas	**25.74%** 52	**27.23%** 55	**13.86%** 28	**7.43%** 15	**19.31%** 39	**6.44%** 13	202
Rain gutters and downspouts draining toward the lake	**8.33%** 17	**45.59%** 93	**31.86%** 65	**2.94%** 6	**0.00%** 0	**11.27%** 23	204
Removal of near-shore emergent vegetation, such as bulrushes, lily pads and cattails	**25.24%** 52	**40.29%** 83	**12.14%** 25	**5.83%** 12	**3.40%** 7	**13.11%** 27	206
Removal of upland vegetation in shoreline buffer areas	**25.00%** 51	**35.78%** 73	**16.67%** 34	**4.41%** 9	**3.43%** 7	**14.71%** 30	204
Removal of shoreline woody debris in the lake	**12.75%** 26	**23.53%** 48	**25.49%** 52	**18.63%** 38	**7.84%** 16	**11.76%** 24	204
Shoreline alterations (riprap retaining walls)	**8.37%** 17	**22.17%** 45	**22.17%** 45	**21.67%** 44	**10.84%** 22	**14.78%** 30	203
Recreational use of the otter slide near Big Sandy on Windy Point	**8.42%** 17	**26.73%** 54	**41.58%** 84	**1.98%** 4	**0.50%** 1	**20.79%** 42	202

Q12 Prior to receiving this survey, have you heard of aquatic invasive species?

Answered: 211 Skipped: 5

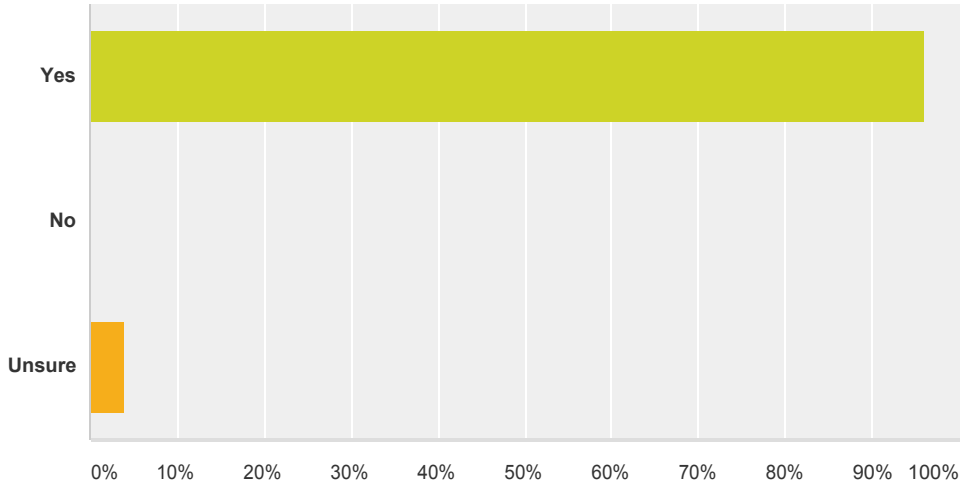


Answer Choices	Responses	
Yes	**97.63%**	206
No	**1.90%**	4
Unsure	**0.47%**	1
Total		**211**

Comments
Regarding large scale removal of native aquatic plants: If near the water, might be significant.

Q13 Do you believe aquatic invasive species are present in the Tomahawk Lake System?

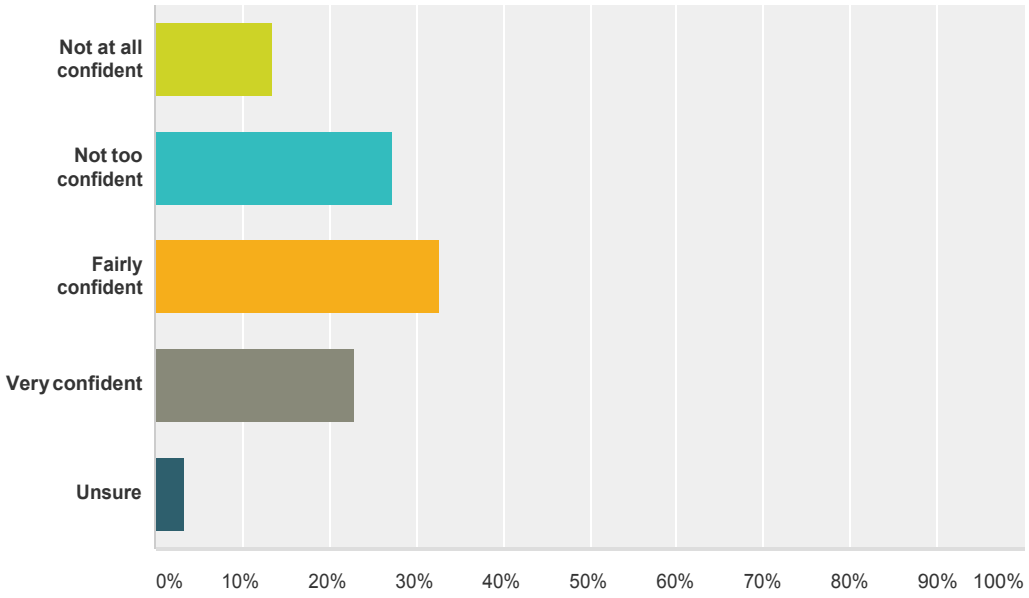
Answered: 204 Skipped: 12



Answer Choices	Responses	
Yes	**96.08%**	196
No	**0.00%**	0
Unsure	**3.92%**	8
Total		**204**

Q14 How confident are you that you could identify aquatic invasive species, such as Eurasian water milfoil, or curly-leaf pondweed?

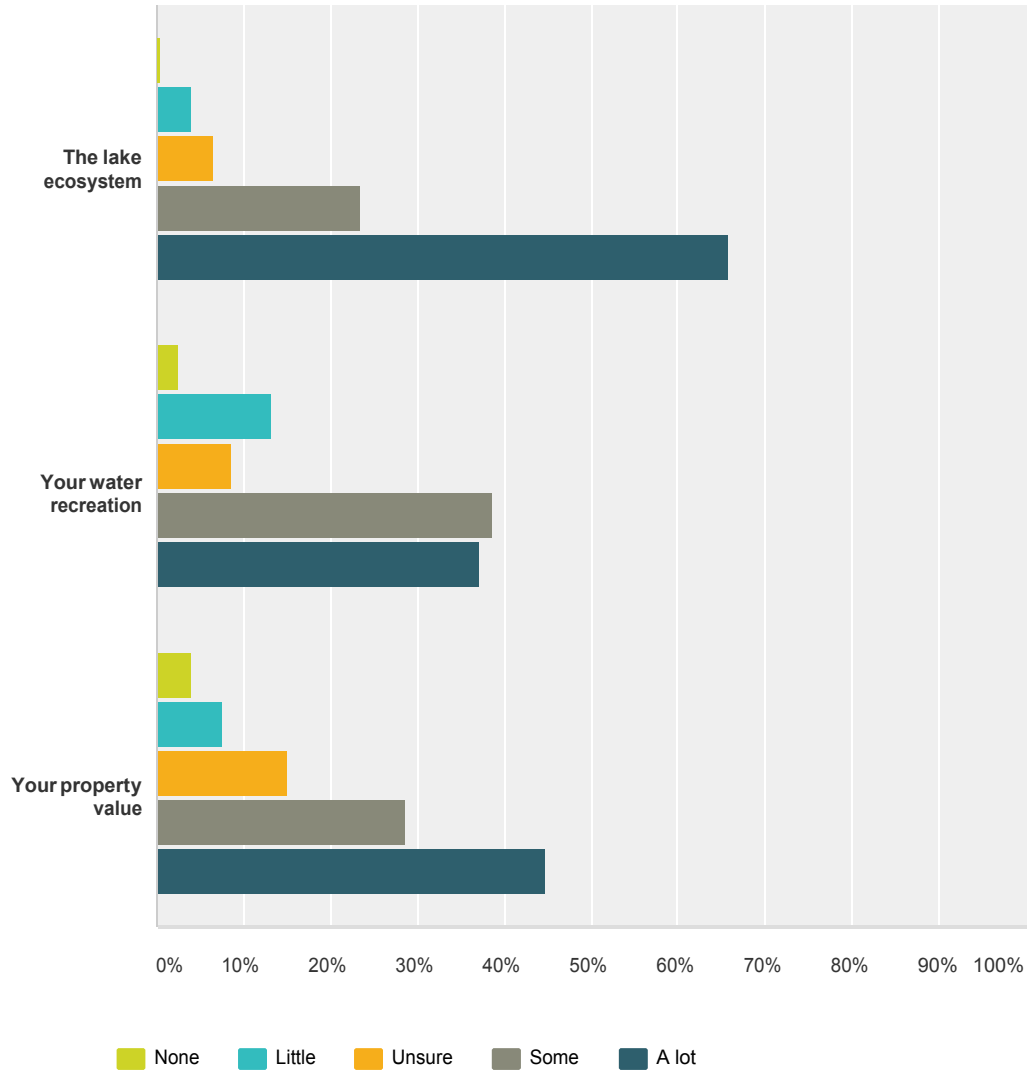
Answered: 205 Skipped: 11



Answer Choices	Responses	
Not at all confident	**13.66%**	28
Not too confident	**27.32%**	56
Fairly confident	**32.68%**	67
Very confident	**22.93%**	47
Unsure	**3.41%**	7
Total		**205**

Q15 Using the following scale, what impact, if any, do aquatic invasive species have on the Tomahawk Lake System?

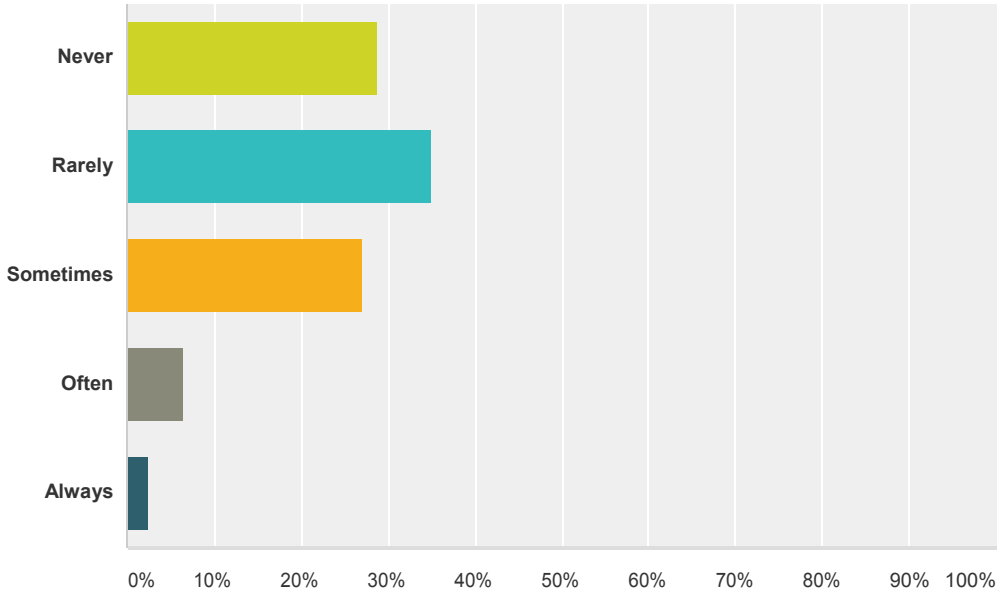
Answered: 204 Skipped: 12



	None	Little	Unsure	Some	A lot	Total
The lake ecosystem	**0.50%** 1	**3.98%** 8	**6.47%** 13	**23.38%** 47	**65.67%** 132	201
Your water recreation	**2.51%** 5	**13.07%** 26	**8.54%** 17	**38.69%** 77	**37.19%** 74	199
Your property value	**4.02%** 8	**7.54%** 15	**15.08%** 30	**28.64%** 57	**44.72%** 89	199

Q16 During open water season, how often, if at all, do aquatic invasive species affect your use of the Tomahawk Lake System?

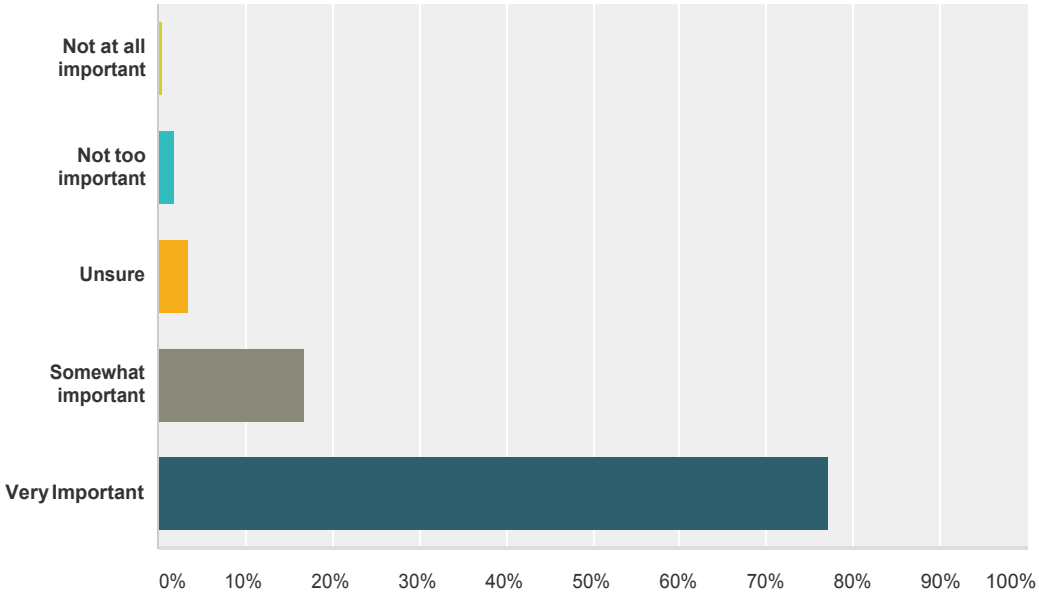
Answered: 202 Skipped: 14



Answer Choices	Responses	
Never	**28.71%**	58
Rarely	**35.15%**	71
Sometimes	**27.23%**	55
Often	**6.44%**	13
Always	**2.48%**	5
Total		**202**

Q17 How important to you is the control of aquatic invasive species?

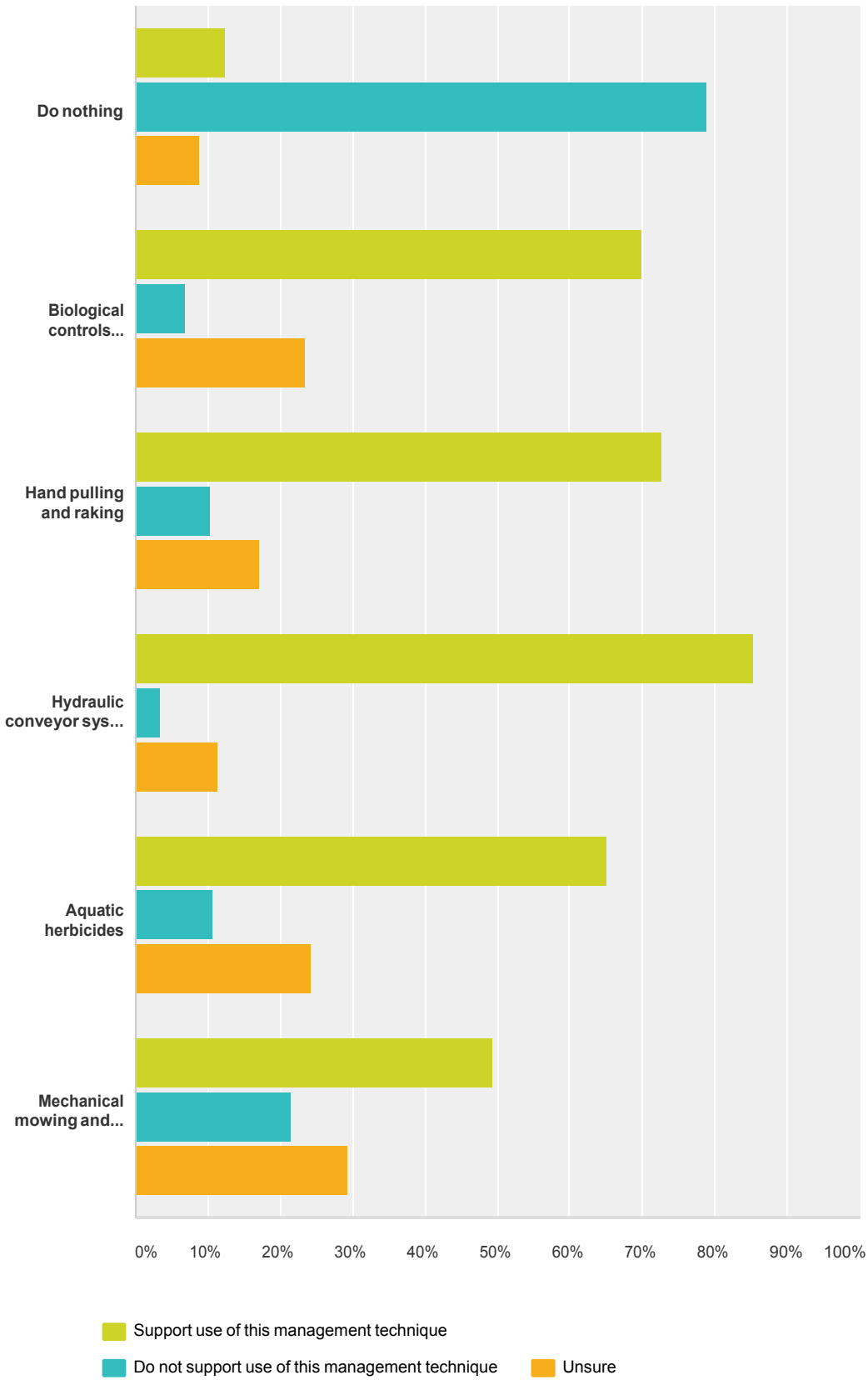
Answered: 202 Skipped: 14



Answer Choices	Responses	
Not at all important	**0.50%**	1
Not too important	**1.98%**	4
Unsure	**3.47%**	7
Somewhat important	**16.83%**	34
Very Important	**77.23%**	156
Total		**202**

Q18 Using the following scale, please indicate your support or opposition for the following invasive aquatic plant management control techniques by the Tomahawk Lake Association.

Answered: 209 Skipped: 7



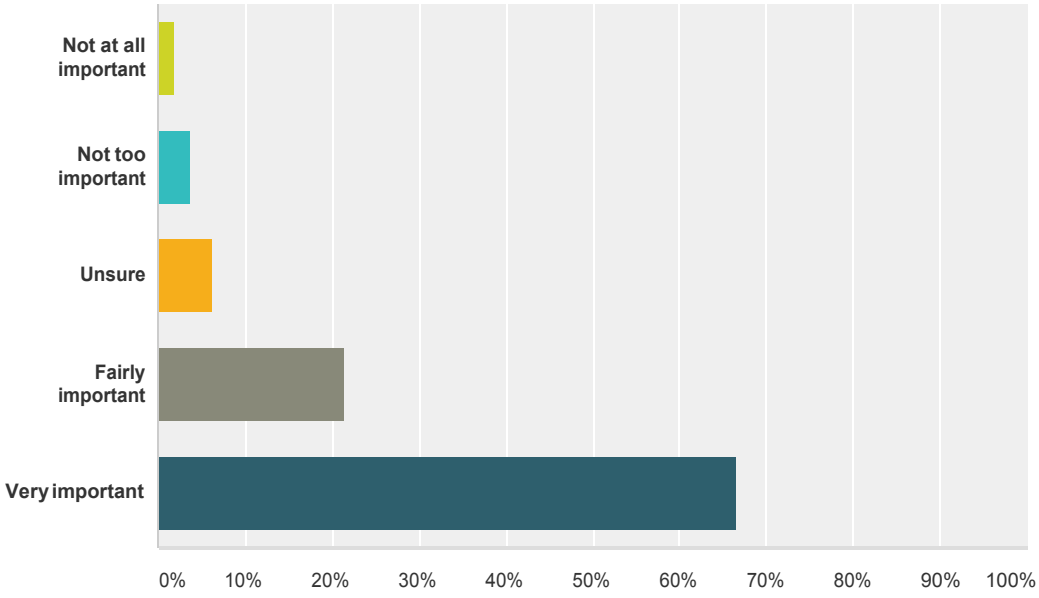
Q18 (Continued)

	Support use of this management technique	Do not support use of this management technique	Unsure	Total
Do nothing	**12.32%** 25	**78.82%** 160	**8.87%** 18	203
Biological controls (Eurasian water milfoil weevils)	**69.90%** 144	**6.80%** 14	**23.30%** 48	206
Hand pulling and raking	**72.55%** 148	**10.29%** 21	**17.16%** 35	204
Hydraulic conveyor system (Diver hand removes invasive plant and system conveys plant to water surface)	**85.37%** 175	**3.41%** 7	**11.22%** 23	205
Aquatic herbicides	**65.22%** 135	**10.63%** 22	**24.15%** 50	207
Mechanical mowing and harvesting	**49.27%** 101	**21.46%** 44	**29.27%** 60	205

Other (please specify)
Removal of building materials debris by residents.
Whatever it takes to control/remove invasive species is important
I am more worried about purple loosestrife and Kentucky blue grass in the riparian areas.
Please consider more conveyor, less herbicides
Whatever it takes to get rid of it.
Anything that will successfully rid the invasive problems
Swimmers itch is a BIG problem

Q19 How important to you, if at all, is having a diverse, high-quality fishery on the Tomahawk Lake System?

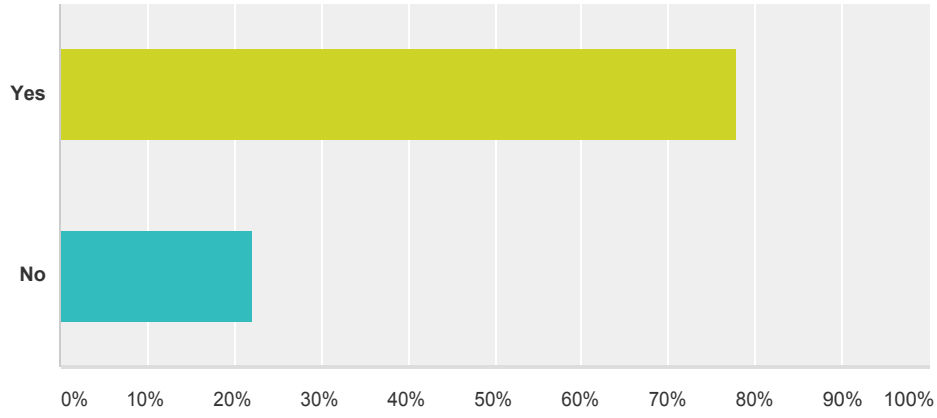
Answered: 210 Skipped: 6



Answer Choices	Responses	
Not at all important	**1.90%**	4
Not too important	**3.81%**	8
Unsure	**6.19%**	13
Fairly important	**21.43%**	45
Very important	**66.67%**	140
Total		**210**

Q20 Have you fished the Tomahawk Lake System in the last three years?

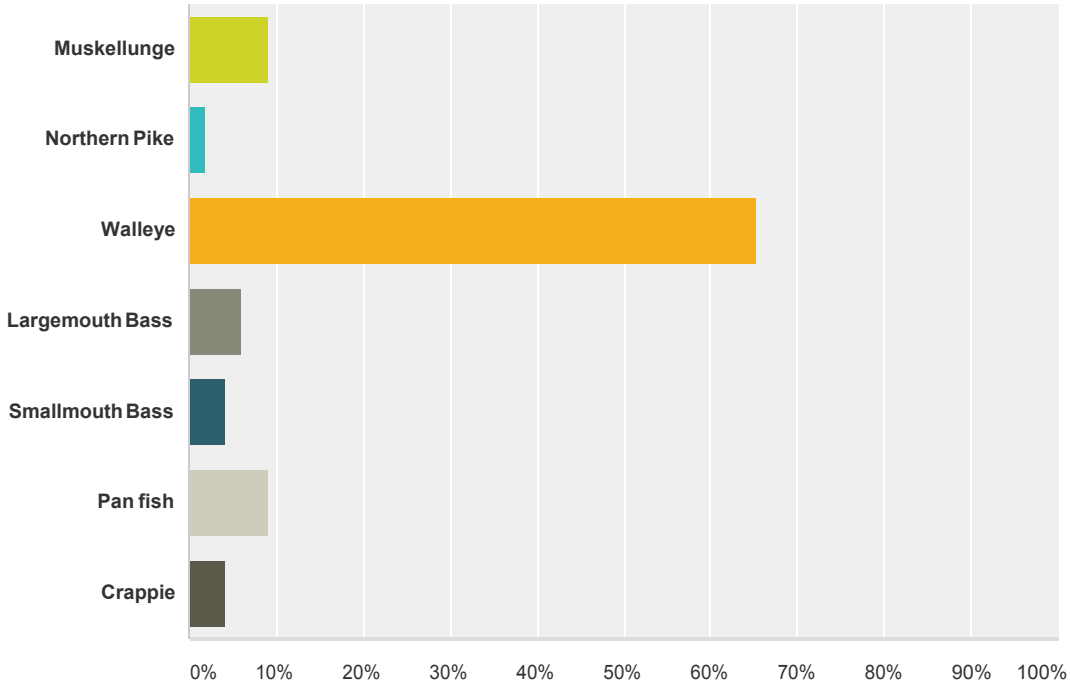
Answered: 204 Skipped: 12



Answer Choices	Responses	
Yes	**77.94%**	159
No	**22.06%**	45
Total		**204**

Q21 What is the most important fish species for you?

Answered: 164 Skipped: 52

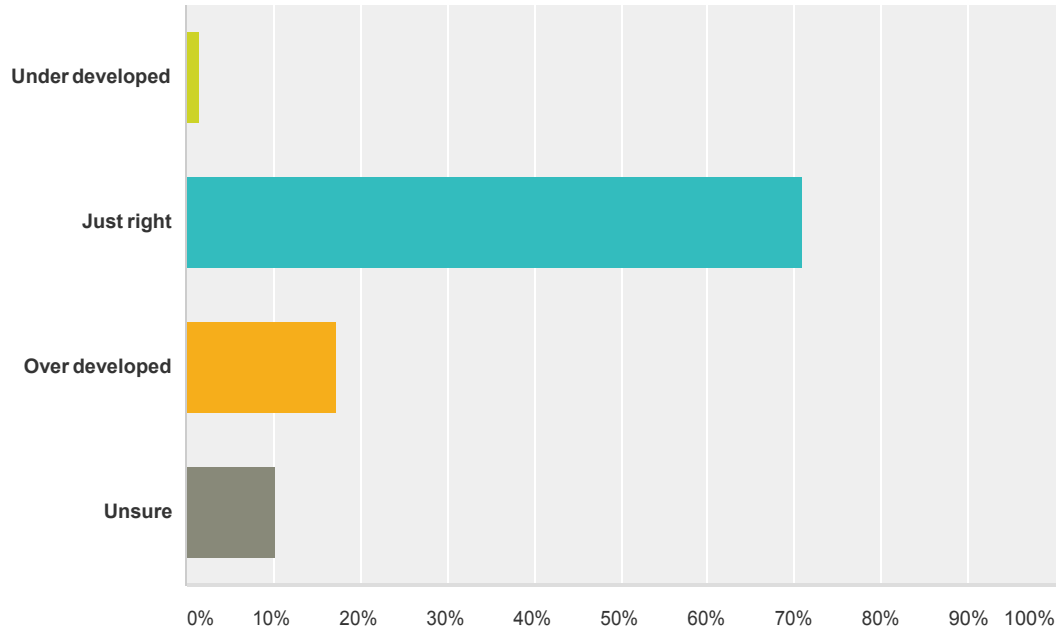


Answer Choices	Responses	
Muskellunge	**9.15%**	15
Northern Pike	**1.83%**	3
Walleye	**65.24%**	107
Largemouth Bass	**6.10%**	10
Smallmouth Bass	**4.27%**	7
Pan fish	**9.15%**	15
Crappie	**4.27%**	7
Total		**164**

Comments
It's impossible to check only one" and he also checked "Walleye.

Q22 Which of the following statements do you believe most accurately describes the development of the Tomahawk Lake System shoreline?

Answered: 207 Skipped: 9

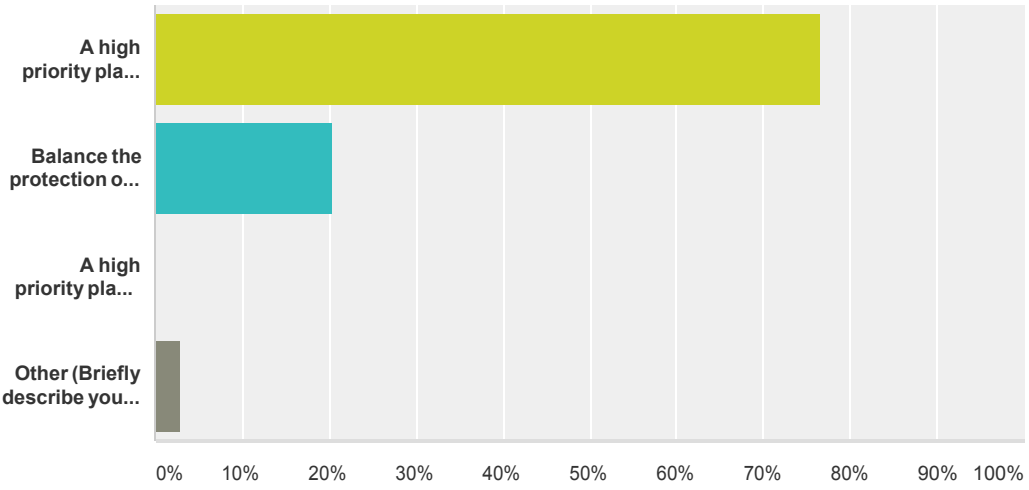


Answer Choices	Responses	
Under developed	**1.45%**	3
Just right	**71.01%**	147
Over developed	**17.39%**	36
Unsure	**10.14%**	21
Total		**207**

Comments
Next to "Over developed." "Because of lawns."

Q23 Which one of the following statements about the Tomahawk Lake System would you say most closely reflects your vision for the future of the Tomahawk Lake System? (Check the one you most would like to see.)

Answered: 206 Skipped: 10

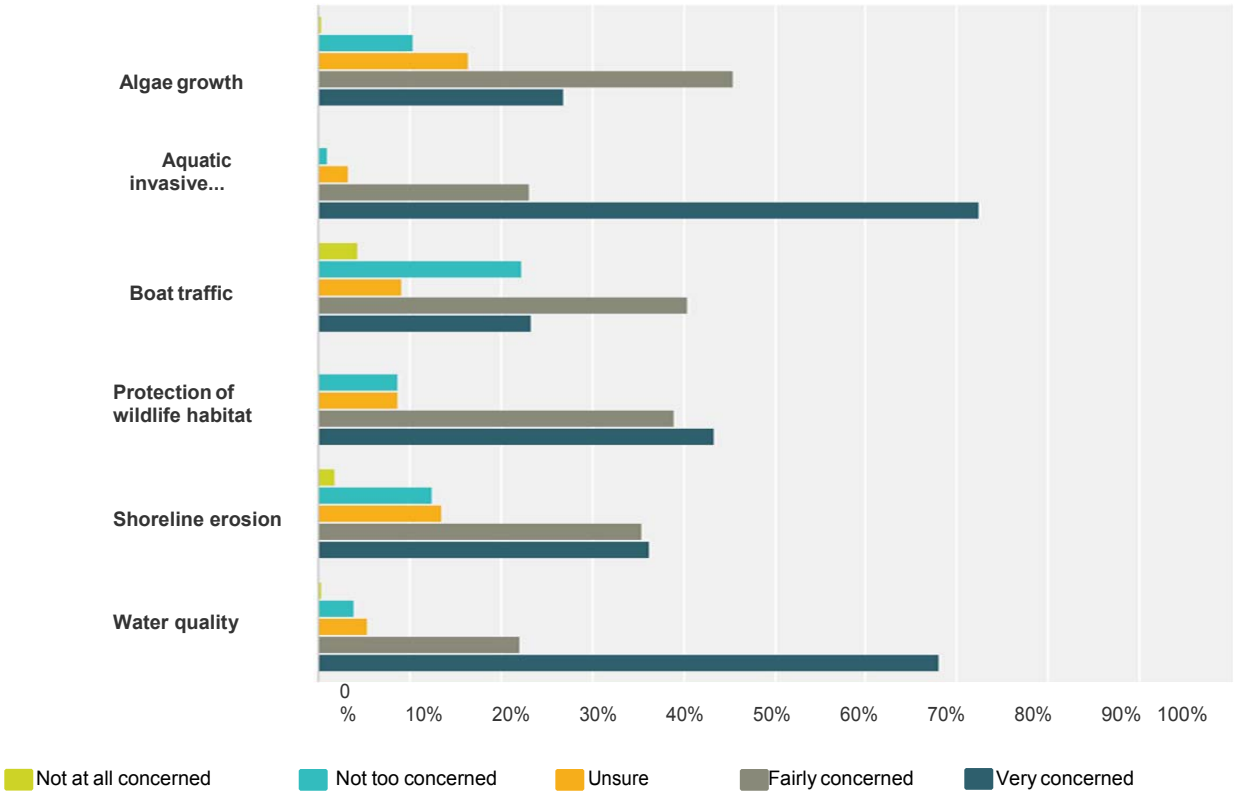


Answer Choices	Responses
A high priority placed on protecting the natural beauty of the Tomahawk Lake System, preservation and enhancement of wildlife habitat, and the implementation of clean water initiatives.	76.70% 158
Balance the protection of the natural beauty of the Tomahawk Lake System, preservation and enhancement of the wildlife habitat and the implementation of clean water initiatives along with greater recreational use and increased development of its shoreline.	20.39% 42
A high priority placed on greater recreation use of the Tomahawk Lake System and increased development of its shoreline.	0.00% 0
Other (Briefly describe your vision.)	2.91% 6
Total	**206**

Other (Briefly describe your vision.)
Establish a commercial site to accommodate more restaurants, rental equipment, more high-end hotels. Create trails for ATV's that would connect the lakeland community.
A lake where, as promised by TLA, cancer causing chemical and herbicide use will be tapered to zero use rather than the increasing use and application levels approach currently under practice. "Read the Label." 24D at directed dosage effects a lake's bio base. Increased levels have very clear, and currently ignored, effects.
For who we don't need all the traffic from the other lakes. Every boat should have a sticker, including the boat landing people. (I pay such high taxes.) They all buy all that stuff from the Cheruel and awful mic tak. Anyone who uses the lake should pay something.
Less encouragement of weekender boat traffic at the Town of Lake Tomahawk boat landing.
Indian Shores has effectively created over 200 lake front owners, should not have been allowed to happen. We need to protect the natural beauty of our lake
The first option; however, clean water initiatives can get out of hand and too restrictive
Do not oppose some development.

Q24 Using the following scale, please indicate your level of concern for the listed item's impact on the Tomahawk Lake System.

Answered: 208 Skipped: 8

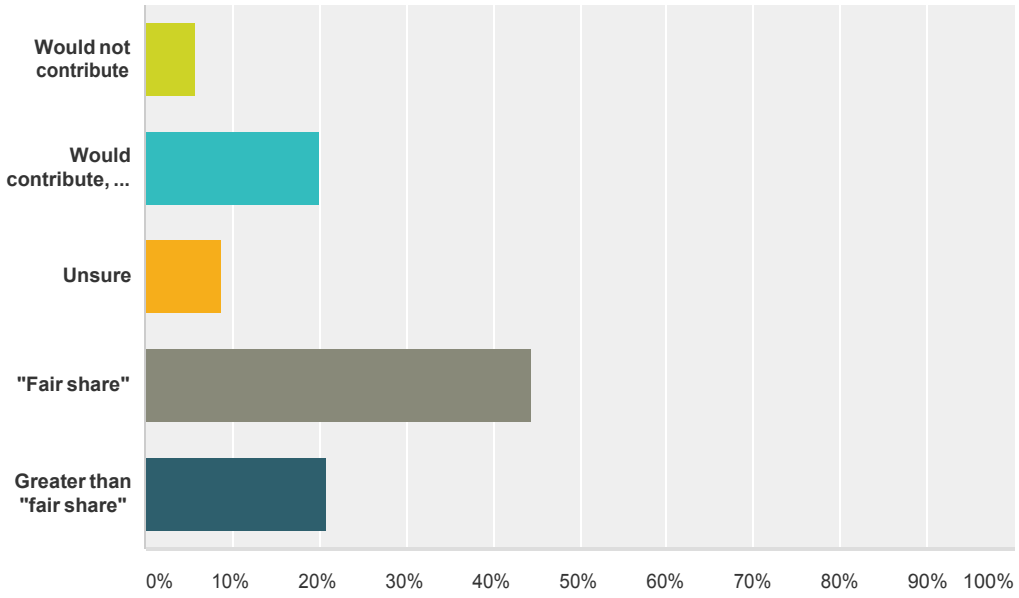


	Not at all concerned	Not too concerned	Unsure	Fairly concerned	Very concerned	Total
Algae growth	**0.50%** 1	**10.50%** 21	**16.50%** 33	**45.50%** 91	**27.00%** 54	
Aquatic invasive species	**0.00%** 0	**0.97%** 2	**3.38%** 7	**23.19%** 48	**72.46%** 150	207
Boat traffic	**4.39%** 9	**22.44%** 46	**9.27%** 19	**40.49%** 83	**23.41%** 48	205
Protection of wildlife habitat	**0.00%** 0	**8.70%** 18	**8.70%** 18	**39.13%** 81	**43.48%** 90	207
Shoreline erosion	**1.94%** 4	**12.62%** 26	**13.59%** 28	**35.44%** 73	**36.41%** 75	206
Water quality	**0.49%** 1	**3.92%** 8	**5.39%** 11	**22.06%** 45	**68.14%** 139	204

Other (please specify)
Very concerned: Immediate invasive aquatic plant management control techniques.
Swimmer's itch.
Over use of chemical deterrents; lack of education about "lake nutrification" restrict nitrogen & phosphate.
specifically, fertilized lawns at the shoreline

Q25 How much, if anything, would you be willing to contribute, on an annual basis, for Tomahawk Lake Association lake management programs? Your response is not a measure of commitment, but rather will help us to gauge potential support from property owners.

Answered: 205 Skipped: 11

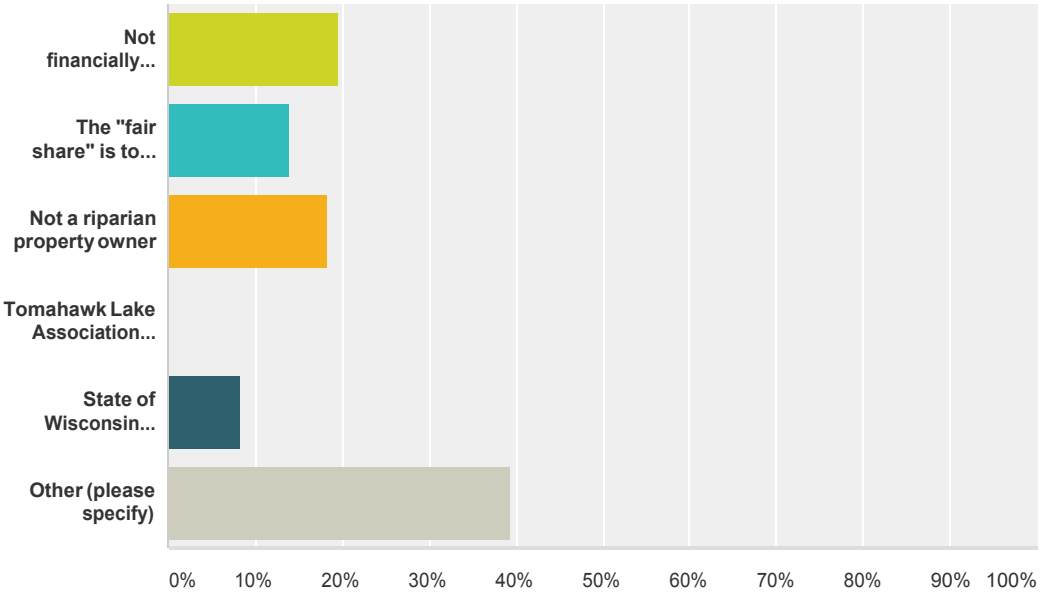


Answer Choices	Responses	
Would not contribute	**5.85%**	12
Would contribute, but less than "fair share"	**20.00%**	41
Unsure	**8.78%**	18
"Fair share"	**44.39%**	91
Greater than "fair share"	**20.98%**	43
Total		**205**

Comments
Would contribute labor.

Q26 Please help us understand your answer to the previous question.

Answered: 71 Skipped: 145



Answer Choices	Responses	
Not financially able	**19.72%**	14
The "fair share" is too high	**14.08%**	10
Not a riparian property owner	**18.31%**	13
Tomahawk Lake Association lake management projects are not important to me	**0.00%**	0
State of Wisconsin responsibility	**8.45%**	6
Other (please specify)	**39.44%**	28
Total		**71**

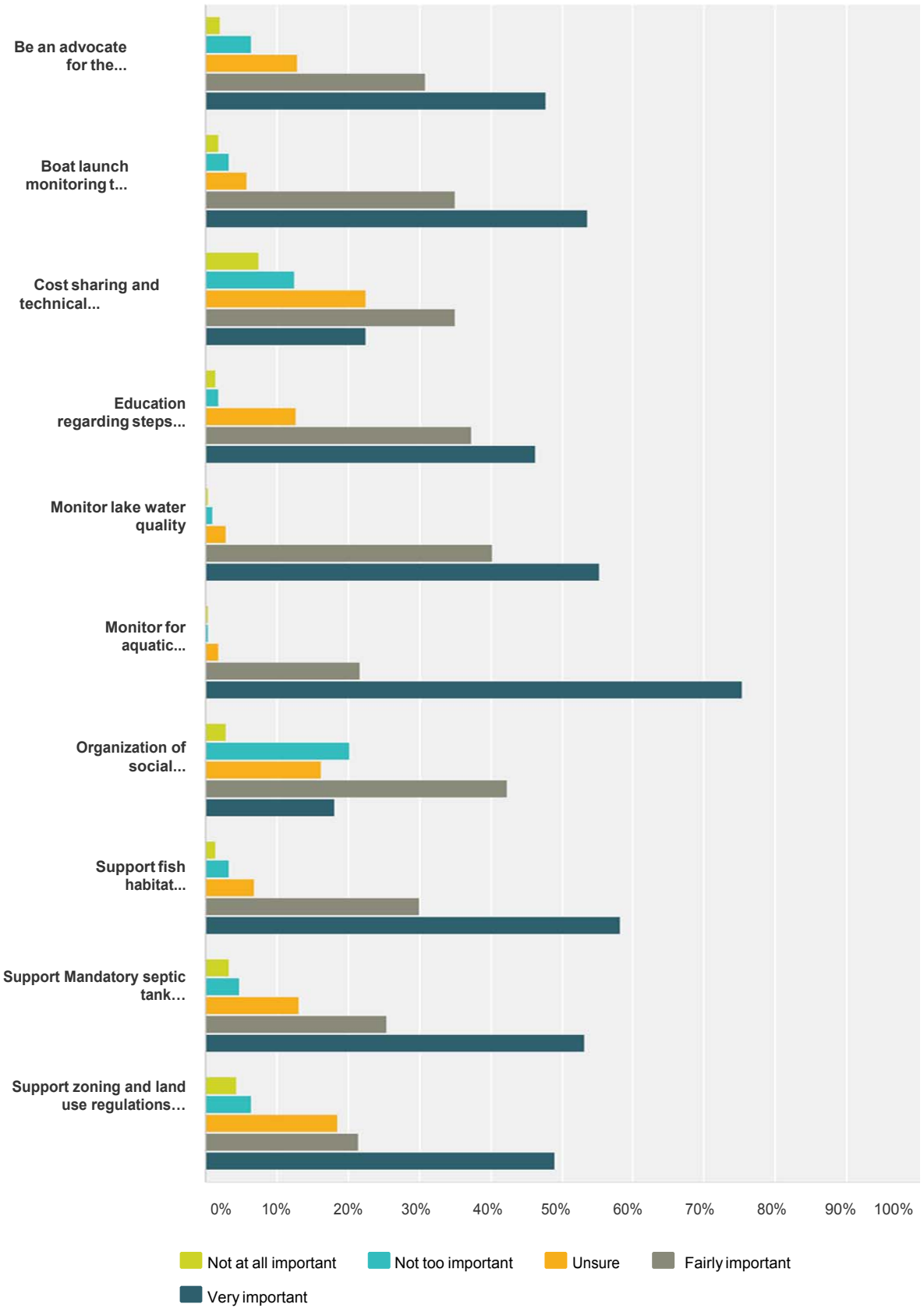
Q26 (Continued)

Other (please specify)
Family-owned property; cannot get others to match.
$270.00 What is "fair share"?
Amount should be voluntary. Charge a daily use fee for all boat launches, i.e., $25.00. All property (local & out of state are exempt) riparian owners.
Charge launch fee to help with costs. Launch fee for non-property owners. Our lake is heavily used by non- property owners, and I would like to see that group fund the operations.
Checked 2: "Not financially able" and "The 'fair share' is too high."
Checked all except for "State of Wisconsin Responsibility."
This is not clear.
Put a higher fee on the boats put in at boat landings.
Not sure
Too many others using lakes that would not be included to contribute.
Part time resident.
If all property owners would contribute the share price would more evenly reduced!
Lake assoc. is just a foot in the door to becoming a "lake district." Non-elected or self-elected officials will unconstitutionally be able to create and add a special tax to riparian owners. State funding is like a drug and just wait till the state pulls the plug on these funding sources. TLA will be scrambling to tax riparians! (Also checked State of Wisconsin responsibility.)
Family members did not want to belong.
Fair share should be assessed by property value.
Another family member pays for our property.
What is the difference in how much the fair share is between a Lake Tomahawk riparian land owner and a non- riparian owner? Who decides what a fair share is?
Because I am retired and live on a fixed income.
We could be more involved May-Oct.
Would like to know expenses, divided among how many property owners, basic info regarding finances.
I think the boat launch fees should be raise to cover more of the costs and might discourage the "weekend water rippers"
Would like to see more priority placed on conservation of the shore land habitats and wetlands in the watershed and less focus on Aquatic Invasive. I feel there too much focus on EWM. I wonder if the board members are focused on other goals in the comp plan and if members even know what they are.
I stated fair share or volunteer hours
Care giver for son
Fair share is too high for weekend residents
condo association belongs at more than fair share; I also contribute on my own
Not enough emphasis on improving walleye fishery
my wife has a crippling stroke condition

Comments
Wish I had the money for more.
Split between other family members using the facility. I appreciate your concerns for these extremely important issues.

Q27 Using the following scale, please indicate how important you feel it is for the Tomahawk Lake Association to pursue each of the following activities in the Tomahawk Lake System.

Answered: 207 Skipped: 9



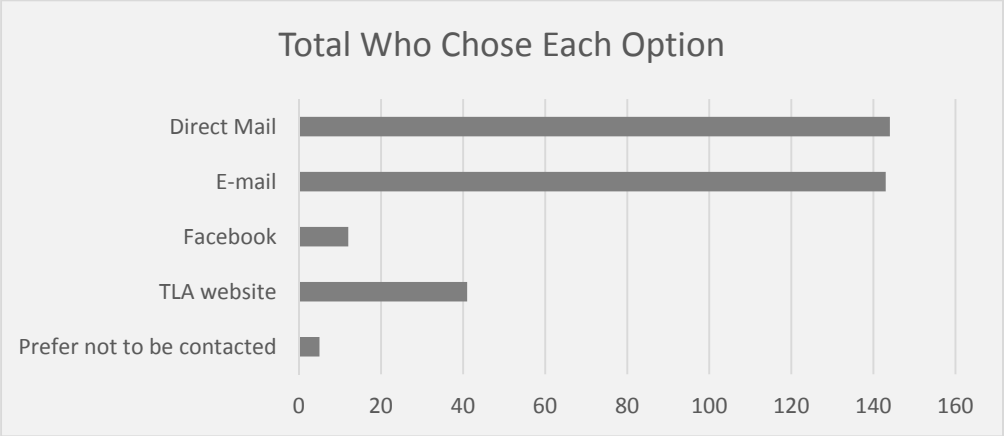
Q27 (Continued)

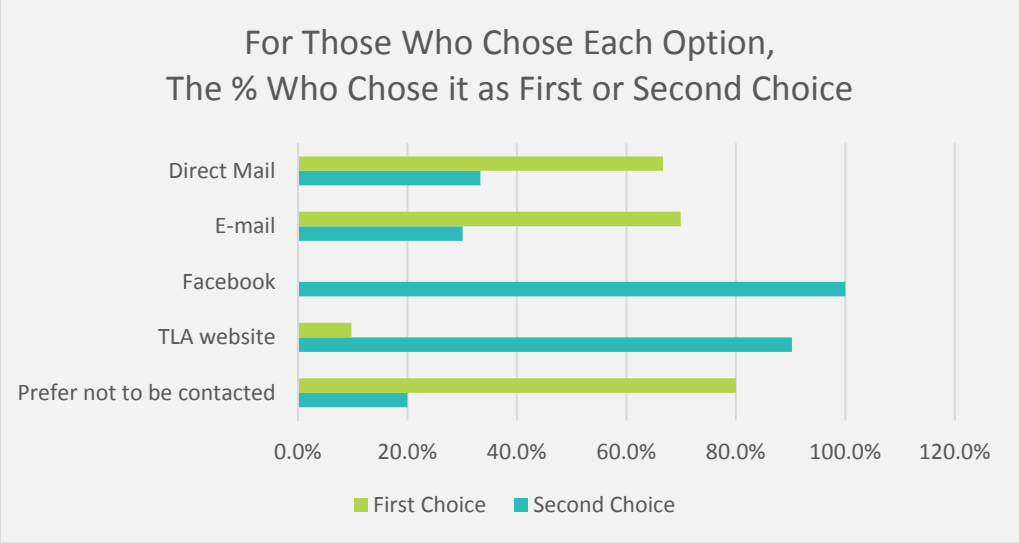
	Not at all important	Not too important	Unsure	Fairly important	Very important	Total
Be an advocate for the protection of wetlands	**1.99%** 4	**6.47%** 13	**12.94%** 26	**30.85%** 62	**47.76%** 96	201
Boat launch monitoring to prevent spread of aquatic invasive species	**1.95%** 4	**3.41%** 7	**5.85%** 12	**35.12%** 72	**53.66%** 110	205
Cost sharing and technical assistance to assist waterfront owners with shoreline restoration	**7.50%** 15	**12.50%** 25	**22.50%** 45	**35.00%** 70	**22.50%** 45	200
Education regarding steps that individual property owners can take to reduce water pollution	**1.48%** 3	**1.97%** 4	**12.81%** 26	**37.44%** 76	**46.31%** 94	203
Monitor lake water quality	**0.49%** 1	**0.97%** 2	**2.91%** 6	**40.29%** 83	**55.34%** 114	206
Monitor for aquatic invasive species	**0.48%** 1	**0.48%** 1	**1.93%** 4	**21.74%** 45	**75.36%** 156	207
Organization of social activities to encourage community building and education	**2.96%** 6	**20.20%** 41	**16.26%** 33	**42.36%** 86	**18.23%** 37	203
Support fish habitat preservation and improvement	**1.46%** 3	**3.40%** 7	**6.80%** 14	**30.10%** 62	**58.25%** 120	206
Support mandatory septic tank inspections for all properties	**3.41%** 7	**4.88%** 10	**13.17%** 27	**25.37%** 52	**53.17%** 109	205
Support zoning and land use regulations that would protect lake water quality	**4.41%** 9	**6.37%** 13	**18.63%** 38	**21.57%** 44	**49.02%** 100	204

Comments
Re: Education that individual property owners can take - "Manicured lawn run-offs." Re: Septic tank inspections - "Thought this was already in place." Am learning about three newsletter. Have concern with fertilized/manicured lawn runoff and weed growth.

Q28 Check the two best ways to communicate with you regarding proposed planning, management or educational projects related to the Tomahawk Lake system?

Answered: 205 Skipped: 11



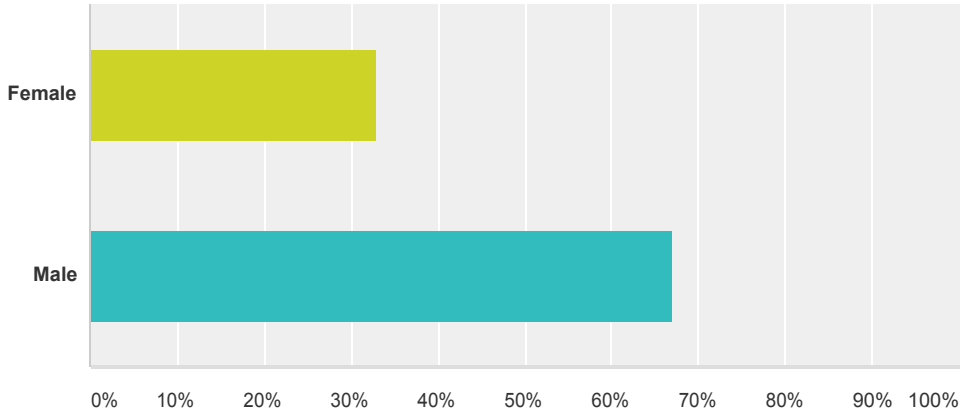


	First choice	Second choice	Total	Weighted Average
Direct mail (letters, newsletters, brochures)	**66.67%** 96	**33.33%** 48	144	1.33
E-mail	**69.93%** 100	**30.07%** 43	143	1.30
Facebook	**0.00%** 0	**100.00%** 12	12	2.00
Tomahawk Lake Association website	**9.76%** 4	**90.24%** 37	41	1.90
I prefer not to be contacted	**80.00%** 4	**20.00%** 1	5	1.20

Other (please specify)
Phone

Q29 What is your gender?

Answered: 203 Skipped: 13

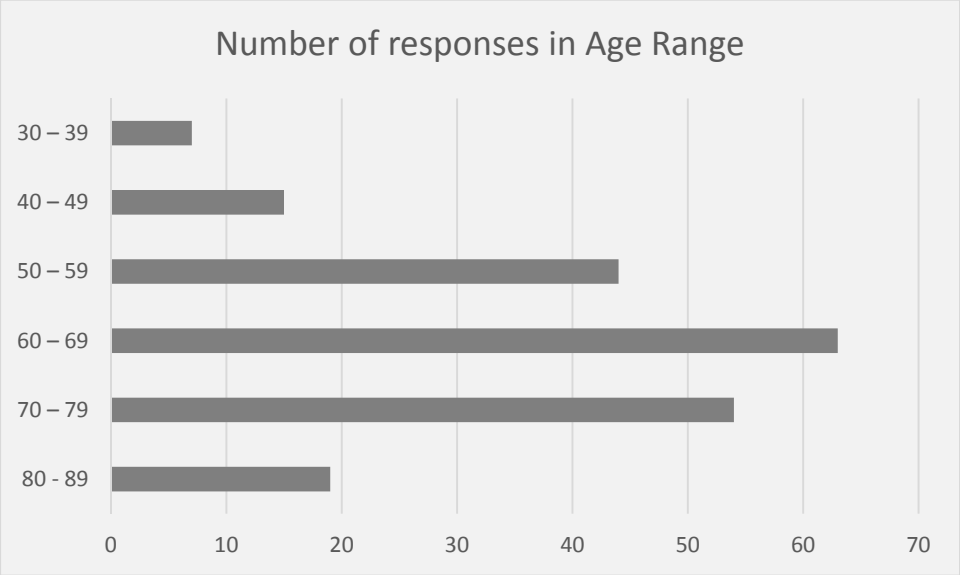


Answer Choices	Responses	
Female	**33.00%**	67
Male	**67.00%**	136
Total		**203**

Comments
Regarding gender: "Joint consensus."

Q30 Please indicate your age.

Answered: 202 Skipped: 14



Answer Choices	Average Number	Responses
Age:	64	202
Total Respondents: 202		

Age	Number of responses in Range
30 – 39	7
40 – 49	15
50 – 59	44
60 – 69	63
70 – 79	54
80 - 89	19

Q31 In the space below, please include any other comments you may have regarding the Tomahawk Lake System, or the activities of the Tomahawk Lake Association.

Answered: 80 Skipped: 136

Responses
COMPLIMENTS AND THANK YOUS
The evolution of the TSPA has been admirable and outstanding - wish we could spend more time in the great North woods to enjoy.
Love our lake and property. Thank you for helping to maintain and preserve.
Thank you for your efforts to protect this great gift. We do not own property on Lake Tomahawk, but stay at our children's cottage.
You're doing a great job.
I think the association should be commended!
Thanks for all your efforts.
Thank you to the volunteers that work on behalf of the association. We have a beautiful lake and your efforts to maintain and improve it are appreciated.
Keep up the good work.
Keep up the good work. We commend you for your contributions to the health of our great lake
Keep up the good work. We need to stay proactive.
Keep up the good work!!
Appreciate all the effort to keep our lakes clean. Thanks.
Thanks for doing a good job!
We are very thankful for the volunteers who make up TLA. We are passionate about TLS and need to protect this valuable resource.
THANKS FOR THE WORK MANY OF YOU HAVES BEEN DOING--
Keep up the good work protecting our Lake.
Thanks you guys!!!
You are doing a great job. Keep up the good work and Thank you!
Good job!
I am proud of what TLA has accomplished to date and their commitment to preserving the Lake Tom.
Keep up the good work, thank you!
Thank you for your hard work.
Keep Up The Good Work
They are doing a very good job.
Thanks for taking the time and effort for this IT is great to have the water quality we do on Lake Tomahawk.
Thank you and keep trying- we have a beautiful resource and are so fortunate to be on Lake Tomahawk- lets be good custodians!
I am pleased with the Tomahawk Lake Association and the steps it has taken regarding the reduction and control of the invasive Eurasian Milfoil. My only disappoint is in regards to the lack of participation of our property owners in the "fair share" campaign. Thanks you TLA for all you have done and are doing to keep our lake beautiful!! Our family has been blessed to have owned property on Lake Tomahawk for almost 40 years. Words cannot describe how much this lake means to us! I hope other property owners realize just how blessed we are to have such a beautiful lake to enjoy and how blessed we are to have a dedicated lake association that is working hard to keep it so beautiful for ALL of us!! Thanks again TLA!!

WATER QUALITY
I see the water quality down from when we first owned property on Lake Tomahawk 1965-1975.
DEVELOPMENT AND RELATED REGULATIONS
I would not like to see any further condominium developments, and I would love to see a 200 foot lakeshore minimum on any future residential lots.
There are several areas of property that are over developed. I would hold any further development to a minimum.
Appreciate all the work you have done. We need to control the use of our lake and shoreline. Uncontrolled development and development that does not fall within the county and DNR zoning should be stopped, reversed, and fined. I see too much development that is not legal but ignored. (Francois on the S shore by the canal to Lake Katherine is a perfect example of illegal activity. That was a heavily wooded lot before they built, now it is a perfectly manicured and landscaped property, contrary to DNR and Oneida county zoning, there are many more examples of this type of development on the lake).
In traveling the world there are some beautiful spots that the DNR would consider over developed.
Oppose zoning laws relating to "impervious surfaces" and proposed limitations on dry boathouses, boathouses with flat roofs, dry boathouse setbacks, etc. Support property owners' rights.
I would hate for this to turn into some DNR type jack booted thug group, but issues have to be addressed and steps to keep everything right are necessary.
Indian Shores is putting the lake in peril with its many camp areas and boat slips.
I have tried to restore my shoreline but cannot get through the bureaucracy to get a permit. Drives me crazy so I am just doing it slowly. Removing an old wood wall and moving in small boulder by hand. I also do not believe large docks hurt anything. In fact, I believe they provide shelter for bass and the sunfish while giving kids a chance to learn to enjoy fishing.
DNR zoning or land use regulations do not appear to have proper restrictions based on real data. They seem to be created by a few individuals who have a misunderstanding of specific issues that can affect water quality and the health of the lake system. The 'one size fits all' regulations are horrible. Rain water coming off roofs or parking surfaces contain little to no damaging or unnatural chemicals any more than acid rain would affect the water.
FAIR SHARE AND MEMBERSHIP
Out of work. Hope to contribute in future.
My property is not on the shoreline. We are part of Indian Shores Condo Resort. Fair Share seems a bit high for not owning frontage.
In order to be fair - we must all financially support.
Every year there is confusion about Fair Share payment for properties with multiple owners. We share all of our costs among owners equally so also share our Fair Share payment. If the intent is that every owner, not every property is expected to pay the full amount, that is unclear. I pay on behalf of both owners, but TLA then sends the second owner unpleasant messages about their lack of support. Please be more clear on the expectations.
I feel that everyone that uses the lake should be required to give $1.00 each time they launch their boat to the fight of the aquatic invasion. At least a box should be put at every launch for donations, it should not be just the land owners' problems. EVERYONE should have to be responsible for the beauty of LAKE TOMAHAWK!
I have some concern about maintenance of giving records, as we get occasional conflicting messages about whether we are current donors. We need to be more confrontational with those properties putting larger amounts of nitrogen into the lake.
Publish a list of property owners with their tax base and how much they paid or didn't pay. Never been a member because of the fair share attitude. Rethink fair share. I don't have a dock or boat lift on any of the lake system.
TLA activities are very important & need to be supported by more property owners.
I am not sure I am a member of the TLA. If I am not a member, how may I join?
SEPTIC
This regulation is important. I think is questionable if the inspection by septic companies is adequate or the regulation has created a system to gauge the consumer.
There are too many lakefront properties that do not have working septic systems.

SURVEY LOGISTICS
Filled out on behalf of 15 Tomahawk Shore owners. Some questions don't fit, call Jeff Morris if needed for further explanation (715-595-6670).
In the "how long have you owned property" section, I put 70 years...property has been in family that long...not personally owned by me that long. I've only owned since early 1990s.
We formerly owned and lived on riparian property on TL. We have lived on riparian property on another lake located in the Town of Lake Tomahawk for the last several years. We rent a slip on TL and make use of our boat often to enjoy the TLS. The construct of this Survey has made its completion difficult at times.
This was sent to my 29 year old son, but since he is not the property owner, I answered the questions.
CHEMICAL CONTROL
Stop the poisoning! 24D causes cancer everywhere except the U.S.A.
BIOLOGICAL CONTROL
Better know if there may be any unintended consequences.
INVASIVE PLANT CONTROL
Why not place some effort into controlling purple loosestrife? There are some areas of the Tomahawk and Minocqua watersheds where loosestrife is crowding out native plants and developing into a monoculture. I believe that I have become somewhat of a lay expert on this subject. Something should be done.
FISHERY
Restocking important and spearing eliminated.
Priority restore walleye fishery; reduce bass population. Support fishing ban for 1-2 years to support restocking efforts.
I would like to see more walleye stocking and more fish cribs as well.
NATURAL FEATURES
We purchased our property a year ago. The population of loons and eagles was a pleasant surprise. I would like to see the association do whatever they can to preserve this natural treasure.
While I no longer am able to spend time at the lake, I still own property in the area and care greatly about the lake systems, natural environment and wildlife. Having spent many years as a summer resident and a few years as a year-round resident, I feel closely connected to the lakes and woods.
Thanks for all the hard work. I believe that it is important to conserve the habitat of all native species and try to keep them in a balance (dynamic equilibrium) similar to their historical levels. Seem to be a lot of focus on "weed growth" instead of water quality and habitat protection. I know it is hard not to alienate neighbors by talking about land use and recreations practices but I believe they threaten the lake more than EWM.
WATER REGULATIONS
Protect the shore from wakeboard boats, let the owners improve their properties, and put some fish back in the lake.
The no wake buoy at the opening of Lake Tomahawk needs to be moved out further to disperse the wave action. The boats are getting bigger, motors are getting bigger and the waves crashing into the shore are eroding the shoreline. This is a big concern for me.
I believe it would be fair to initiate certain hours of the day for water skiing and personal watercraft use to allow more peaceful time on the water.
TLA FOCUS/ACTIVITIES
They do a great job at managing our lake, but need to do a better job of changing nonmember attitudes about taking responsibility for our lake. Nonmember apathy will spoil our lake.
I am sensing the desire to take on ALL lake issues--this association has done an excellent job on the invasive issues-- Be careful not to over reach and lose your support from some of us---your starting to give the impression that your heading in the direction of a lake taxing body which most would not support--KEEP YOUR FOCUS
We feel that all the lakes in the Minocqua should be one association. Travel occurs throughout the chain, and all our water is impacted by these concerns.

I have been coming to the lake since I was 12 years old; I'm now 76. What fund raisers were held during the past year and how much was raised from each? Please give me a breakdown.
1) Consider a campaign to raise funds for a second pontoon effort to double down on Conveyor Milfoil removal, & elimination of the use of Herbicides noting the potential risks of 2-4-D http://www.sierraclub.ca/national/programs/health-environment/pesticides/2-4-D-overview.pdf 2) Consider reviewing/auditing, then enforcing Indian Shores' compliance with its contractual commitment to TLA. Indian Shores is now selling Permanent Condos (instead of only the seasonal lots required by its TLA contract) and renting wave runners. Neither Permanent Condos nor wave runner rentals are permitted under its contract with TLA. 3) Even if TLA individuals are Republican or Democrats, TLA as a Lake Association should be an advocate for clean water policies. Within the TLA watershed, that could mean advocating for county and township zoning policies that minimize the # of large parking lots, require vegetation/tree coverage around parking lots/self-storage facilities etc. Outside of the watershed, consider being an advocate against the proposed mine to the north (which is only 45mi as a bird flies). Minnesota has 3600 lakes and 40% of its waters (per the states DNR) that are designated "Impaired, unsuitable to support life" b/c of pollutants associated in part with comparable mining activity (see http://www.mprnews.org/story/2012/01/13/lake-river-impaired . Wisconsin laws did a great job protecting its waters until the most recent administrations legal efforts changing the rules and eliminating protections. 4) Consider encouraging residents to use (and Indian Shores store to sell) only organic detergents instead of products that may include Phosphates, and to avoid selling/using antibacterial soaps that include Triclosan. 5) Consider a long-term campaign that may be able to assist landowners with the largest amount of lake frontage with preserving their frontage rather than selling their property in smaller lots. I am most concerned with Daniel's Point. The This may include a public/private fundraising campaign, educating landowners on the tax benefits of perhaps donating frontage land to a TLA conservation entity etc.
MISCELLANEOUS
Our needs have always been quiet beauty, safety. Lake patrol would help with unsafe boaters! Over our 50 years plus being on Lake Tomahawk, we are all dismayed by: rude boaters, neighbor noise, clearing near shoreline, ruder fishermen.
Think of the future.
Just a thought – God is not making any more lakes.
Lake Tomahawk is on a chain, therefore I feel it almost impossible to control many of the concerns unless water flow access through the chain was halted.
I appreciate the support of the WDNR in helping TLA efforts to maintain the quality of the lake watershed. Without their support this would be very difficult.
This year we noticed more algae than usual at our shore line. We also have lots of native species growing in the lake near our shoreline which does impact our use of the area. We also felt there was an increase in reckless PWC behavior this year
we have been summer residents for 29 years with our children now grandchildren, have seen the Lake hurt by spearing and other things such as Indian Shores ugly boat slips that no one else could put that many in on that much frontage. Also nothing looks worse than shore stations and nothing better than the old wet boat houses on the lake system why property owners no longer have that option is nut's to me think that rule should be overruled spend time and money to keep the lake free of weeds and stop the spearing RR we have a great lake but the DNR would work half as hard trying to help rather than just one dumb regulation after another is beyond me. RR if some on wishes to call would be happy to talk with them 217-766-5897
The family cottage has been in the family for years. It is critical for the future generations that we continue to maintain the water quality and get rid of the invasive plants!
Unfortunately, our family has not been able to spend as much time on our property as we'd like over the years, but we still love the experience of being there when we can and would like to preserve the property and the experience for generations to come.

Appendix C. Aquatic Plant Survey Methods

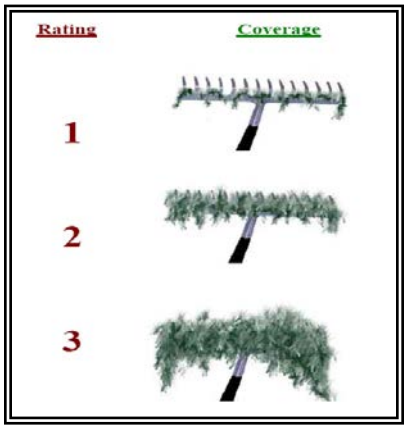
A point intercept method was employed for the aquatic macrophyte sampling. The Wisconsin Department of Natural Resources (WDNR) generated the sampling point grid for each lake.

A handheld Global Positioning System (GPS) located the sampling points in the field. The WDNR guidelines for point location accuracy were followed with the location arrow touching the point using an 80 foot resolution window. Only plants sampled at predetermined sampled points were used in the statistical analysis. If no plants were sampled at a particular depth, one point beyond that depth was sampled.

At each sample point, a double-sided 14-tine rake was used to rake a one meter tow off the bow of the boat. All plants contained on the rake and those that fell off of rake were identified and rated for rake density. The rake density value criteria are shown in the diagram and table below. Those plants that were within six feet were recorded as "viewed," but no rake density rating was given.

A boat survey was conducted in areas that appeared to be under-sampled, such as bays. Plants viewed and/or sampled during boat surveys were recorded along with the type of habitat. Boat survey data were not used in the statistical analysis nor was the density recorded.

Rake Density Criteria



	Criteria for rake density rating
1	Plant present, occupies less than ½ of tine space
2	Plant present, occupies more than ½ tine space
3	Plant present, occupies all or more than tine space
v	Plant not sampled but observed within 6 feet of boat

The depth and predominant bottom type was also recorded for each sample point. Caution must be used in using the sediment type in deeper water as it is difficult to discern between muck and sand with a rope rake. All plants needing verification were bagged and cooled for later examination. Each species was mounted and pressed for a voucher collection and submitted to the WDNR for review. On rare occasions a single plant may be needed for verification, not

allowing it to be used as a voucher specimen, and this species may be missing from the collection.

Data analysis methods

Data collected was entered into a spreadsheet for analysis. The following statistics were generated from the spreadsheet:

- Frequency of occurrence
- Relative frequency
- Total points in sample grid
- Total points sampled
- Sample points with vegetation
- Simpson's diversity index
- Maximum plant depth
- Species richness
- Floristic Quality Index

An explanation of each of these statistics is provided below.

Frequency of occurrence: Frequency is expressed as a percentage by dividing the number of sites the plant is sampled by the number of sites. Frequency of occurrence can be calculated for the entire littoral zone - depths at or less than the maximum depth plants were found, regardless if vegetation was present. Frequency of occurrence can also be calculated for only the percentage of sample points where the plant was sampled for only points containing vegetation. In either case, the greater this value, the more frequent the plant is in the lake. If one wants to compare how frequent a plant is in the littoral zone, we look at the frequency of all points below maximum depth with plants. This frequency value allows the analysis of how common plants are where they could grow based upon depth. If one wants to focus only on where plants are actually present, then one would look at frequency at points in which plants were present. Frequency of occurrence is usually reported using sample points where vegetation was present.

Frequency of Occurrence Example

Plant A sampled at 35 of 150 littoral points = 35/150 = 0.23 = 23%

Plant A's frequency of occurrence = 23% considering littoral zone depths

Plant A sampled at 12 of 40 vegetated points = 12/40 = 0.30 = 30%

Plant A's frequency of occurrence = 30% in vegetated areas

These two frequencies can tell us how commonly the plant was sampled in the littoral zone or how commonly the plant was sampled at points plants actually grow. Generally, the second will have a higher frequency.

Relative frequency: This value shows the frequency of a particular plant relative to other plants as a percentage. Relative frequency is not dependent on the number of points sampled. The relative frequency of all plants will add to 100%. This means that if plant A had a relative frequency of 30%, it occurred 30% of the time compared to all plants sampled or makes up 30% of all plants sampled. This value allows us to see which plants are the dominant species in the lake. The higher the relative frequency, the more common the plant is compared to the other plants, and therefore, the more frequent in the plant community.

Relative Frequency Example

Suppose we were sampling 10 points in a very small lake and got the following results:

	Frequency sampled
Plant A present at 3 sites	3 of 10 sites
Plant B present at 5 sites	5 of 10 sites
Plant C present at 2 sites	2 of 10 sites
Plant D present at 6 sites	6 of 10 sites

So one can see that Plant D is the most frequently sampled at all points with 60% (6/10) of the sites having plant D. However, the relative frequency allows us to see what the frequency is compared the other plants. It is calculated by dividing the number of times a plant is sampled by the total times all plants are sampled. If we add all frequencies (3+5+2+6), we get a sum of 16. We can calculate the relative frequency by dividing the individual frequency by the total.

Plant A = 3/16 = 0.1875 or 18.75%
Plant B = 5/16 = 0.3125 or 31.25%
Plant C = 2/16 = 0.125 or 12.5%
Plant D = 6/16 = 0.375 or 37.5%

Now we can compare the plants to one another. Plant D is still the most frequent, but the relative frequency tells us that of all plants sampled at those 10 sites, 37.5% of them are Plant D. This is much lower than the frequency of occurrence (60%) because although we sampled Plant D at 6 of 10 sites, we were sampling many other plants too thereby giving a lower frequency when compared to those other plants. This then gives a true measure of the dominant plants present.

Total point in sample grid: The WDNR establishes a sample point grid that covers the entire lake. GPS coordinates are provided to locate the points.

Number of points sampled: This may not be the same as the total points in the sample grid. When doing a survey, we do not sample at depths outside of the littoral zone (the area where plants can grow). Once the maximum depth of plants is established, many of the points deeper than this are eliminated to save time and effort.

Sample sites with vegetation: The number of sites where plants were actually sampled. This gives a good idea of the plant coverage of the lake. If 10% of all sample points had vegetation, it implies about 10% coverage of plants in the whole lake, assuming an adequate number of sample points have been established. We also look at the number of sample sites with vegetation in the littoral zone. If 10% of the littoral zone had sample points with vegetation, then the plant coverage in the littoral zone would be estimated at 10%.

Simpson's diversity index: Simpson's diversity index measures plant community diversity. This value can run from 0 to 1.0. The greater the value, the more diverse the plant community is in a particular lake. In theory, the value is the chance that two species sampled will be different. An index of "1" means that the two will always be different (very diverse) and a "0" would indicate that they will never be different (only one species found). The higher the diversity in the native plant community, the healthier the lake ecosystem.

Simpson's Diversity Example

If one sampled a lake and found just one plant, the Simpson's diversity would be "0". This is because if we randomly sampled two plants, there would be a 0% chance of them being different, since there is only one plant.

If every plant sampled were different, then the Simpson's diversity would be "1". This is because if two plants were randomly sampled, there would be a 100% chance they would be different, since every plant is different.

These are extreme and theoretical scenarios, but they demonstrate how this index works. The greater the Simpson's index is for a lake, the greater the diversity, since it represents a greater chance of two randomly sampled plants being different.

Maximum depth of plants: This depth indicates the deepest that plants were sampled. Generally, clearer lakes have a greater maximum depth of plants while lower water clarity limits light penetration and reduces the depth at which plants are found.

Species richness: The number of different individual species found in the lake. There is a number for the species richness of plants sampled and another number that takes into account plants viewed but not actually sampled during the survey.

Floristic Quality Index: The Floristic Quality Index (FQI) is an index developed by Dr. Stanley Nichols of the University of Wisconsin-Extension. This index is a measure of the plant community response to development (and human influence) on the lake. It takes into account the species of aquatic plants sampled and their tolerance for changing water quality and habitat

quality. The index uses a conservatism value assigned to various plants ranging from 1 to 10. A high conservatism value indicates that a plant is intolerant while a lower value indicates tolerance. Those plants with higher values are more apt to respond adversely to water quality and habitat changes that are largely due to human influence (Nichols, 1999). The FQI is calculated using the number of species and the average conservatism value of all species used in the index.

The Floristic Quality Index formula is:

FQI = Mean C ·√N

Where C is the conservatism value and N is the number of species (only species sampled on rake).
Therefore, a higher FQI indicates a healthier aquatic plant community, which is an indication of better plant habitat. This value can be compared to the median for other lakes in the assigned eco-region. There are four eco-regions used throughout Wisconsin. These are Northern Lakes and Forests, Northern Central Hardwood Forests, Driftless Area, and Southeastern Wisconsin Till Plain.

Summary of Northern Lakes and Forests and Flowages Median Values for Floristic Quality Index:
(Nichols, 1999)

	Northern Lakes	Flowages
Median species richness	13	23.5
Median conservatism	6.7	6.2
Median Floristic Quality	24.3	28.3

*Floristic Quality has a significant correlation with area of lake (+), alkalinity (-), conductivity(-), pH(-) and Secchi depth (+). In a positive correlation, as a value rises so will FQI, while with a negative correlation, as a value rises, the FQI will decrease.

Appendix D. Invasive Species Information

Curly Leaf Pondweed

Curly leaf pondweed is specifically designated as an invasive aquatic plant (along with Eurasian water milfoil and purple loosestrife) to be the focus of a statewide program to control invasive species in Wisconsin. Invasive species are defined as a "non-indigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health (23.22(c)."

The Wisconsin Comprehensive Management Plan for Aquatic Invasive Species describes curly leaf pondweed impacts as follows:

> It is widely distributed throughout Wisconsin lakes, but the actual number of waters infested is not known. Curly leaf pondweed is native to northern Europe and Asia where it is especially well adapted to surviving in low temperature waters. It can actively grow under the ice while most plants are dormant, giving it a competitive advantage over native aquatic plant species. By June, curly leaf pondweed can form dense surface mats that interfere with aquatic recreation. By mid-summer, when other aquatic plants are just reaching their peak growth for the year, it dies off. Curly leaf pondweed provides habitat for fish and invertebrates in the winter and spring when most other plants are reduced to rhizomes and buds, but the mid-summer decay creates a sudden loss of habitat. The die-off of curly leaf pondweed also releases a surge of nutrients into the water column that can trigger algal blooms and create turbid water conditions. In lakes where curly leaf pondweed is the dominant plant, the summer die-off can lead to habitat disturbance and degraded water quality. In other waters where there is a diversity of aquatic plants, the breakdown of curly leaf may not cause a problem.[29]

The state of Minnesota DNR web site explains that curly leaf pondweed often causes problems due to excessive growth. At the same time, the plant provides some cover for fish, and some waterfowl species feed on the seeds and winter buds.[30]

[29] Wisconsin's Comprehensive Management Plan to Prevent Further Introductions and Control Existing Populations of Aquatic Invasive Species. Prepared by Wisconsin DNR. September 2003.

[30] Information from Minnesota DNR (www.dnr.state.mn.us/aquatic_plants).

The following description is taken from a Great Lakes Indian Fish and Wildlife Commission handout.

Curly Leaf Pondweed (*Potamogeton crispus*)[31]

Identification

Curly leaf pondweed is an invasive aquatic species found in a variety of aquatic habitats, including permanently flooded ditches and pools, rivers, ponds, inland lakes, and even the Great Lakes. Curly leaf pondweed prefers alkaline or high nutrient waters one to three meters deep. Its leaves are strap-shaped with rounded tips and undulating and finely toothed edges. Leaves are not modified for floating, and are generally alternate on the stem. Stems are somewhat flattened and grow to as long as two meters. The stems are dark reddish-green to reddish-brown, with the mid-vein typically tinged with red. Curly leaf pondweed is native to Eurasia, Africa, and Australia and now spread throughout most of the United States and southern Canada.

Characteristics

New plants typically establish in the fall from freed turions (branch tips). The winter form is short, with narrow, flat, relatively limp, bluish-green leaves. This winter form can grow beneath the ice and is highly shade-tolerant. Rapid growth begins with warming water temperatures in early spring – well ahead of native aquatic plants.

Reproduction and Dispersal

Curly leaf pondweed reproduces primarily vegetatively. Numerous turions are produced in the spring. These turions consist of modified, hardened, thorny leaf bases interspersed with a few to several dormant buds. The turions are typically 1.0 to 1.7 cm long and 0.8 to 1.4 cm in diameter. Turions separate from the plant by midsummer and may be carried in the water column supported by several leaves. Humans and waterfowl may also disperse turions. Stimulated by cooler water temperatures, they germinate in the fall, over-wintering as a small plant. The next summer they mature, producing reproductive tips of their own. Curly leaf pondweed rarely produces flowers.

Ecological Impacts

Rapid early season growth may form large, dense patches at the surface. This canopy overtops most native aquatic plants, shading them and significantly slowing their growth. The canopy lowers water temperature and restricts absorption of atmospheric oxygen into the water. The dense canopy formed often interferes with recreational activities such as swimming and boating.

In late spring, curly leaf pondweed dies back, releasing nutrients that may lead to algae blooms. Resulting high oxygen demand caused by decaying vegetation can adversely affect fish populations. The foliage of curly leaf pondweed is relatively high in alkaloid compounds possibly making it unpalatable to insects and other herbivores.

[31] Information from GLIFWC Plant Information Center (http://www.glifwc.org/epicenter).

Curly Leaf Pondweed Control[32]

Small populations of curly leaf pondweed in otherwise un-infested water bodies should be attacked aggressively. Hand pulling, suction dredging, or spot treatments with contact herbicides are recommended. Cutting should be avoided because fragmentation of plants may encourage their re-establishment. In all cases, care should be taken to remove all roots and plant fragments, to keep them from re-establishing.

Control of large populations requires a long-term commitment that may not be successful. A prudent strategy includes a multi-year effort aimed at killing the plant before it produces turions, thereby depleting the seed bank over time. It is also important to maintain, and perhaps augment, native populations to retard the spread of curly leaf and other invasive plants. Invasive plants may aggressively infest disturbed areas of the lake, such as those where native plant nuisances have been controlled through chemical applications.

Purple Loosestrife[33]

Purple loosestrife (*Lythrum salicaria)* is a non-native plant common in Wisconsin. By law, purple loosestrife is a nuisance species in Wisconsin. It is illegal to sell, distribute, or cultivate the plants or seeds, including any of its cultivars.

Purple loosestrife is a perennial herb 3 to7 feet tall with a dense bushy growth of 1 to50 stems. The stems, which range from green to purple, die back each year. Showy flowers vary from purple to magenta, possess 5 to6 petals aggregated into numerous long spikes, and bloom from July to September. Leaves are opposite, nearly linear, and attached to four-sided stems without stalks. It has a large, woody taproot with fibrous rhizomes (underground stems) that form a dense mat.

Characteristics

Purple loosestrife is a wetland herb that was introduced as a garden perennial from Europe during the 1800s. It is still promoted by some horticulturists for its beauty as a landscape plant, and by beekeepers for its nectar-producing capability. Currently, about 24 states have laws prohibiting its importation or distribution because of its aggressively invasive characteristics. It has since extended its range to include most temperate parts of the United States and Canada. The plant's reproductive success across North America can be attributed to its wide tolerance of physical and chemical conditions characteristic of disturbed habitats, and its ability to reproduce prolifically by both seed dispersal and vegetative propagation. The absence of natural predators,

[32] Information from GLIFWC Plant Information Center (http://www.glifwc.org/epicenter).
[33] Wisconsin DNR Invasive Species Factsheets from http:/dnr.wi.gov/invasives.

like European species of herbivorous beetles that feed on the plant's roots and leaves, also contributes to its proliferation in North America.

Purple loosestrife was first detected in Wisconsin in the early 1930s, but remained uncommon until the 1970s. It is now widely dispersed in the state, and has been recorded in 70 of Wisconsin's 72 counties. This plant's optimal habitat includes marshes, stream margins, river flood plains, sedge meadows, and wet prairies. It is tolerant of moist soil and shallow water sites such as pastures and meadows, although established plants can tolerate drier conditions. Purple loosestrife has also been planted in lawns and gardens, which is often how it has been introduced to many of our wetlands, lakes, and rivers.

Reproduction and Dispersal
Purple loosestrife spreads mainly by seed, but it can also spread vegetatively from root or stem segments. A single stalk can produce from 100,000 to 300,000 seeds per year. Seed survival is up to 60-70%, resulting in an extensive seed bank. Most of the seeds fall near the parent plant, but water, animals, boats, and humans can transport the seeds long distances. Vegetative spread through local disturbance is also characteristic of loosestrife; clipped, trampled, or buried stems of established plants may produce shoots and roots. It is often very difficult to locate non-flowering plants, so monitoring for new invasions should be done at the beginning of the flowering period in mid-summer.

Any sunny or partly shaded wetland is susceptible to purple loosestrife invasion. Vegetative disturbances such as water drawdown or exposed soil accelerate the process by providing ideal conditions for seed germination. When the right disturbance occurs, loosestrife can spread rapidly, eventually taking over the entire wetland.

Ecological Impacts
Purple loosestrife displaces native wetland vegetation and degrades wildlife habitat. As native vegetation is displaced, rare plants are often the first species to disappear. Eventually, purple loosestrife can overrun wetlands thousands of acres in size and almost entirely eliminate the open water habitat. The plant can also be detrimental to recreation by choking waterways.

Mechanical Control
Purple loosestrife can be controlled by cutting, pulling, digging and drowning. Cutting is best done just before plants begin flowering. Cutting too early encourages more flower stems to grow than before. If done too late, seed may have already fallen. Since lower pods can drop seed while upper flowers are still blooming, check for seed. If none, simply bag all cuttings (to prevent them from rooting). If there is seed, cut off each top while carefully holding it upright, then bend it over into a bag to catch any dropping seeds. Dispose of plants/seeds in a capped landfill, or dry and burn them. Composting will not kill the seeds. Keep clothing and equipment seed-free to prevent its spread. Rinse all equipment used in infested areas before moving into uninfested areas, including boats, trailers, clothing, and footwear.

Pulling and digging can be effective but can also create disturbed bare spots, which are good sites for PL seeds to germinate, or leave behind root fragments that grow into new plants. Use these methods primarily with small plants in loose soils, since they do not usually leave behind

large gaps, nor root tips. Large plants with multiple stems and brittle roots often do. Dispose of plants as described above.

Mowing has not been effective with loosestrife unless the plants can be mowed to a height where the remaining stems will be covered with water for a full 12 months. Burning has also proven largely ineffective. Mowing and flooding are not encouraged because they can contribute to further dispersal of the species by disseminating seeds and stems.

Follow-up treatments are recommended for at least three years after removal.

Chemical Control
This is usually the best way to eliminate PL quickly, especially with mature plants. Chemicals used have a short soil life. Timing is important: Treat in late July or August but before flowering to prevent seed set. Always back away from sprayed areas as you go to prevent getting herbicide on your clothes. Generally, the formula designed for use on wet sites should be used. The best method is to cut stems and paint the stump tops with herbicide. The herbicide can be applied with a small drip bottle or spray bottle, which can be adjusted to release only a small amount. Try to cover the entire cut portion of the stem but not let the herbicide drip onto other plants since it is non-selective and can kill any plant it touches.

Glyphosate herbicides: Roundup and Glyfos are typically used, but if there is any open water in the area use Rodeo, a glyphosate formulated and listed for use over water. Currently, glyphosate is the most commonly used chemical for killing loosestrife. Glyphosate must be applied in late July or August to be most effective. Since you must treat at least some stems of each plant and they often grow together in a clump, all stems in the clump should be treated to be sure all plants are treated.

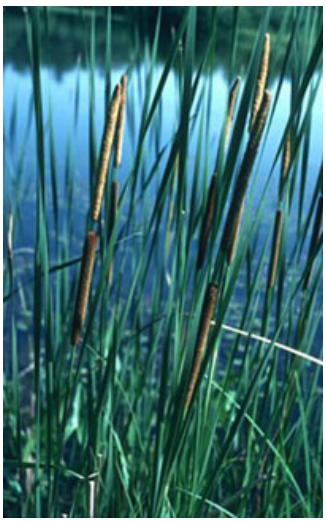
Another method is using very carefully targeted foliar applications of herbicide (NOT broadcast spraying). This may reduce costs for sites with very high densities of PL, since the work should be easier, and there will be few other plant species to hit accidentally. Use a glyphosate formulated for use over water. A weak solution of around 1% active ingredient can be used, and it is generally necessary to wet only 25% of the foliage to kill the plant.

You must obtain a permit from WDNR before applying any herbicide over water. The process has been streamlined for control of purple loosestrife, and there is no cost. Contact your regional Aquatic Plant Management Coordinator for a permit. He will want to know about your site, may make control suggestions, and will issue the permit.

Biological Control
Conventional control methods like hand pulling, cutting, flooding, herbicides, and plant competition have only been moderately effective in controlling purple loosestrife. Biocontrol is now considered the most viable option for more complete control for heavy infestations. The WDNR, in cooperation with the U.S. Fish and Wildlife Service, is introducing several natural insect enemies of purple loosestrife from Europe. A species of weevil (*Hylobius transversovittatus*) has been identified that lays eggs in the stem and upper root system of the plant; as larvae develop, they feed on root tissue. In addition, two species of leaf eating beetles

(*Galerucella calmariensis* and *G. pusilla*) are being raised and released in the state, and another weevil that feeds on flowers (*Nanophyes marmoratus*) is being used to stress the plant in multiple ways. Research has shown that most of these insects are almost exclusively dependent upon purple loosestrife and do not threaten native plants, although one species showed some cross-over to native loosestrife. These insects will not eradicate loosestrife, but may significantly reduce the population so cohabitation with native species becomes a possibility.

Narrow-leaf Cattail (*Typha angulstifolia*)[34]



Ecological Threat
Narrow-leaved cattail can invade freshwater marshes, wet meadows, fens, roadsides, ditches, shallow ponds, stream, and lake shores. While cattails play an important role as a source of food and shelter for some marsh-dwelling animals, large mono-specific stands of invasive cattails exclude some less common species. Narrow-leaved cattail is listed as a restricted species in Wisconsin. Restricted invasive species are already established in the state and cause or have the potential to cause significant environmental or economic harm or harm to human health.

Identification
Leaves are erect, linear, and flat with leaf blades 0.15-0.5" wide, and up to 3' long. About 15 leaves emerge per shoot. They are dark green in color and rounded on the back of the blade.

The plant has numerous tiny flowers densely packed into a cylindrical spike at end of stem, divided into upper section of yellow, male flowers and lower brown, sausage-shaped section of female flowers. The gap between male and female sections is about 0.5-4" in narrow-leaved cattail.

The plants reproduce vegetatively by means of starchy underground rhizomes to form large colonies.

Control
Narrow-leaved cattail can be controlled mechanically by cutting all stems, both green and dead in mid to late summer or early fall. If possible, maintain a water level of a minimum of three inches above the cut stems for the entire growing season. Chemical control is by a foliar spray with an aquatic approved imazypr.

[34] http://dnr.wi.gov/topic/Invasives/fact/NarrowLeavedCattail.html. Photo by Robert Frechman.

Yellow Flag Iris (*Iris pseudacorus*)

Yellow flag iris is a showy perennial plant that can grow in a range of conditions from drier upland sites, to wetlands, to floating aquatic mats. A native plant of Eurasia, it can be an invasive garden escapee in Wisconsin's natural environments.

Ecological threat

- Yellow flag iris can produce many seeds that can float from the parent plant or plants can spread vegetatively via rhizome fragments. Once established it forms dense clumps or floating mats that can alter wildlife habitat and species diversity.
- All parts of this plant are poisonous, which results in lowered wildlife food sources in areas where it dominates.
- This species has the ability to escape water gardens and ponds and grow in undisturbed and natural environments. It can grow in wetlands, forests, bogs, swamps, marshes, lakes, streams, and ponds.
- Dense areas of this plant may alter hydrology by trapping sediment.

Yellow iris a proposed restricted plant in Wisconsin. Restricted invasive species are already established in the state and cause, or have the potential to cause, significant environmental or economic harm or harm to human health.

Identification

Yellow flag iris is easily identified by its appearance when flowering. The plant has broad, sword-shaped leaves which grow upright, tall and stiff. They are green with a slight blue-grey tint and are very difficult to distinguish from other ornamental or native iris species. Flowers are produced on a stem that can grow 3-4 feet tall amongst leaves that are usually as tall or taller.

The flowers are **s**howy and variable in color from almost white to a vibrant dark yellow. Flowers are between 3-4 inches wide and bloom from April to June.

Control

Small populations may be successfully removed using physical methods. Care should be taken if hand-pulling plants, as some people show skin sensitivity to plant sap and tissues. All parts of the plant should be dug out – particularly rhizomes and disposed of in landfill or burned. Cutting the seed heads may help decrease spreading.

Aquatic formulas of herbicides may be used to control yellow flag iris, however, permits may be needed. Foliar spray, cut stem/leaf and application and hand swiping of herbicide have all shown effectiveness.

Eurasian Water Milfoil[35]

The following Eurasian water milfoil information is taken from a Wisconsin DNR fact sheet.

Identification
Eurasian water milfoil is a submersed aquatic plant native to Europe, Asia, and northern Africa. It is the only non-native milfoil in Wisconsin. Like the native milfoils, the Eurasian variety has slender stems whorled by submersed feathery leaves and tiny flowers produced above the water surface. The flowers are located in the axils of the floral bracts, and are either four-petaled or without petals. The leaves are threadlike, typically uniform in diameter, and aggregated into a submersed terminal spike. The stem thickens below the inflorescence and doubles its width further down, often curving to lie parallel with the water surface. The fruits are four-jointed nut-like bodies. Without flowers or fruits, Eurasian water milfoil is nearly impossible to distinguish from northern water milfoil. Eurasian water milfoil has 9-21 pairs of leaflets per leaf, while Northern milfoil typically has 7-11 pairs of leaflets. Coontail is often mistaken for the milfoils, but does not have individual leaflets.

Characteristics
Eurasian water milfoil grows best in fertile, fine-textured, inorganic sediments. In less productive lakes, it is restricted to areas of nutrient-rich sediments. It has a history of becoming dominant in eutrophic, nutrient-rich lakes, although this pattern is not universal. It is an opportunistic species that prefers highly disturbed lakebeds, lakes receiving nitrogen and phosphorous-laden runoff, and heavily used lakes. Optimal growth occurs in alkaline systems with a high concentration of dissolved inorganic carbon. High water temperatures promote multiple periods of flowering and fragmentation.

Reproduction and Dispersal
Unlike many other plants, Eurasian water milfoil does not rely on seed for reproduction. Its seeds germinate poorly under natural conditions. It reproduces vegetatively by fragmentation, allowing it to disperse over long distances. The plant produces fragments after fruiting once or twice during the summer. These shoots may then be carried downstream by water currents or inadvertently picked up by boaters. Milfoil is readily spread attached to boats, motors, trailers, bilges, live wells, and bait buckets. It can stay alive for weeks if kept moist.

Once established in an aquatic community, milfoil reproduces from shoot fragments and stolons (runners that creep along the lake bed). As an opportunistic species, Eurasian water milfoil is adapted for rapid growth early in spring.

[35] Wisconsin DNR Invasive Species Factsheets from http:/dnr.wi.gov/invasives. Photo by Elizabeth Czarapata.

Ecological Impacts
Eurasian water milfoil's ability to spread rapidly by fragmentation and effectively block out sunlight needed for native plant growth often results in monotypic stands. Monotypic stands of Eurasian milfoil provide only a single habitat and threaten the integrity of aquatic communities in a number of ways. For example, dense stands disrupt predator-prey relationships by fencing out larger fish and reducing the number of nutrient-rich native plants available for waterfowl.

Dense stands of Eurasian water milfoil also inhibit recreational uses like swimming, boating, and fishing. Some stands have been dense enough to obstruct industrial and power generation water intakes. The visual impact that greets the lake user on milfoil-dominated lakes is the flat yellow-green of matted vegetation, often prompting the perception that the lake is "infested" or "dead". Cycling of nutrients from sediments to the water column by Eurasian water milfoil may lead to deteriorating water quality and algae blooms in infested lakes.

Control Methods
Preventing a Eurasian water milfoil invasion requires various efforts. The first component is public awareness of the necessity to remove weed fragments at boat landings. Inspection programs should provide physical inspections as well as a direct educational message. Native plant beds must be protected from disturbance caused by boaters and indiscriminate plant control that disturbs these beds. A watershed management program should decrease nutrients reaching the lake and reduce the likelihood that Eurasian milfoil colonies will establish and spread.

Monitoring is also important, so introduced plants can be controlled immediately. The lake district and lakeshore owners should check for new colonies and control them before they spread. The plants can be hand pulled or raked. It is imperative that all fragments be removed from the water and the shore.

Because Eurasian water milfoil has been introduced into Tomahawk Lake, additional control methods should (and have been) considered including mechanical control, chemical control, and biological control. As always, prevention is the best approach to invasive species management.

A good strategy for a systematic monitoring program is to target areas where the native northern water milfoil (*Myriophyllum sibiricum)* is found. This plant is often confused with Eurasian water milfoil, which looks somewhat similar. Unlike Eurasian water milfoil (EWM), northern water milfoil is native and a desirable plant to have in the lake. It has very fine leaves that provide habitat for small planktonic organisms, which make up an important part of the food chain. From a management perspective, the location of northern water milfoil can be important, because EWM and northern water milfoil grow in similar conditions.

Appendix E. References

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Appendix F. DNR Northern Region Aquatic Plant Management Strategy

AQUATIC PLANT MANAGEMENT STRATEGY

Northern Region WDNR
Summer, 2007

AQUATIC PLANT MANAGEMENT STRATEGY
Northern Region WDNR

ISSUES

- Protect desirable native aquatic plants.
- Reduce the risk that invasive species replace desirable native aquatic plants.
- Promote "whole lake" management plans
- Limit the number of permits to control native aquatic plants.

BACKGROUND

As a general rule, the Northern Region has historically taken a protective approach to allow removal of native aquatic plants by harvesting or by chemical herbicide treatment. This approach has prevented lakes in the Northern Wisconsin from large-scale loss of native aquatic plants that represent naturally occurring high quality vegetation. Naturally occurring native plants provide a *diversity of habitat* that *helps maintain water quality*, helps *sustain the fishing* quality known for Northern Wisconsin, supports common lakeshore wildlife from loons to frogs, and helps to provide the *aesthetics* that collectively create the "up-north" appeal of the northwoods lake resources.

In Northern Wisconsin lakes, an inventory of aquatic plants may often find 30 different species or more, whereas a similar survey of a Southern Wisconsin lake may often discover less than half that many species. Historically, similar species diversity was present in Southern Wisconsin, but has been lost gradually over time from stresses brought on by cultural land use changes (such as increased development, and intensive agriculture). Another point to note is that while there may be a greater variety of aquatic vegetation in Northern Wisconsin lakes, the vegetation itself is often *less dense*. This is because northern lakes have not suffered as greatly from nutrients and runoff as have many waters in Southern Wisconsin.

The newest threat to native plants in Northern Wisconsin is from invasive species of aquatic plants. The most common include Eurasian Water Milfoil (EWM) and CurlyLeaf Pondweed (CLP). These species are described as *opportunistic invaders*. This means that these "invaders" benefit where an opening occurs from removal of plants, and without competition from other plants may successfully become established in a lake. Removal of native vegetation not only diminishes the natural qualities of a lake, it *may increase the risk that an invasive species can successfully invade onto the site where native plants have been removed*. There it may more easily establish itself without the native plants to compete against. This concept is easily observed on land where bared soil is quickly taken over by replacement species (often weeds) that crowd in and establish themselves as new occupants of the site. While not a providing a certain guarantee against invasive plants, protecting and allowing the native plants to remain may reduce the success of an invasive species becoming established on a lake. Once established, the invasive species cause far more inconvenience for all lake users, riparian and others included; can change many of the natural features of a lake; and often lead to *expensive annual control plans*. Native vegetation may cause localized concerns to some users, but as a natural feature of lakes, they generally do not cause harm.

To the extent we can maintain the normal growth of native vegetation, Northern Wisconsin lakes can continue to offer the water resource appeal and benefits they've historically provided. A regional position on removal of aquatic plants that carefully recognizes how native aquatic plants benefit lakes in Northern Region can help prevent a gradual decline in the overall quality and recreational benefits that make these lakes attractive to people and still provide abundant fish, wildlife, and northwoods appeal.

GOALS OF STRATEGY:

1. Preserve native species diversity which, in turn, fosters natural habitat for fish and other aquatic species, from frogs to birds.
2. Prevent openings for invasive species to become established in the absence of the native species.
3. Concentrate on a" whole-lake approach" for control of aquatic plants, thereby fostering systematic documentation of conditions and specific targeting of invasive species as they exist.
4. Prohibit removal of wild rice. WDNR – Northern Region will not issue permits to remove wild rice unless a request is subjected to the full consultation process via the Voigt Tribal Task Force. We intend to discourage applications for removal of this ecologically and culturally important native plant.
5. To be consistent with our WDNR Water Division Goals (work reduction/disinvestment), established in 2005, to "not issue permits for chemical or large scale mechanical control of native aquatic plants – develop general permits as appropriate or inform applicants of exempted activities." This process is similar to work done in other WDNR Regions, although not formalized as such.

BASIS OF STRATEGY IN STATE STATUTE AND ADMINISTRATIVE CODE

State Statute 23.24 (2)(c) states:

"The requirements promulgated under par. (a) 4. may specify any of the following:

1. The **quantity** of aquatic plants that may be managed under an aquatic plant management permit.
2. The **species** of aquatic plants that may be managed under an aquatic plant management permit.
3. The **areas** in which aquatic plants may be managed under an aquatic plant management permit.
4. The **methods** that may be used to manage aquatic plants under an aquatic plant management permit.
5. The **times** during which aquatic plants may be managed under an aquatic plant management permit.
6. The **allowable methods** for disposing or using aquatic

plants that are removed or controlled under an aquatic plant management permit.

7. The requirements for plans that the department may require under sub. (3) (b). “

State Statute 23.24(3)(b) states:
“The department may require that an application for an aquatic plant management permit contain a plan for the department’s approval as to how the aquatic plants will be introduced, removed, or controlled.“

Wisconsin Administrative Code NR 109.04(3)(a) states:
“The department may require that an application for an aquatic plant management permit contain an aquatic plant management plan that describes how the aquatic plants will be introduced, controlled, removed or disposed. Requirements for an aquatic plant management plan shall be made in writing stating the reason for the plan requirement. In deciding whether to require a plan, the department shall consider the potential for effects on protection and development of diverse and stable communities of native aquatic plants, for conflict with goals of other written ecological or lake management plans, for cumulative impacts and effect on the ecological values in the body of water, and the long-term sustainability of beneficial water use activities.”

AQUATIC PLANT MANAGEMENT STRATEGY
Northern Region WDNR

APPROACH

1. After January 1, 2009* no individual permits for control of native aquatic plants will be issued. Treatment of native species may be allowed under the auspices of an approved lake management plan, and only if the plan clearly documents "impairment of navigation" and/or "nuisance conditions". Until January 1, 2009, individual permits will be issued to previous permit holders, only with adequate documentation of "impairment of navigation" and/or "nuisance conditions". No new individual permits will be issued during the interim.

2. Control of aquatic plants (if allowed) in documented sensitive areas will follow the conditions specified in the report.

3. Invasive species must be controlled under an approved lake management plan, with two exceptions (these exceptions are designed to allow sufficient time for lake associations to form and subsequently submit an approved lake management plan):
   a. Newly-discovered infestations. If found on a lake with an approved lake management plan, the invasive species can be controlled via an amendment to the approved plan. If found on a lake without an approved management plan, the invasive species can be controlled under the WDNR's Rapid Response protocol (see definition), and the lake owners will be encouraged to form a lake association and subsequently submit a lake management plan for WNDR review and approval.
   b. Individuals holding past permits for control of *invasive* aquatic plants and/or "mixed stands" of native and invasive species will be allowed to treat via individual permit until January 1, 2009 if "impairment of navigation" and/or "nuisance conditions" is adequately documented, unless there is an approved lake management plan for the lake in question.

4. Control of invasive species or "mixed stands" of invasive and native plants will follow current best management practices approved by the Department and contain an explanation of the strategy to be used. Established stands of invasive plants will generally use a control strategy based on Spring treatment. (typically, a water temperature of less than 60 degrees Fahrenheit, or approximately May 31st, annually).

5. Manual removal (see attached definition) is allowed (Admin. Code NR 109.06).

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* *Exceptions to the Jan. 1, 2009 deadline will be considered only on a very limited basis and will be intended to address unique situations that do not fall within the intent of this approach.*

AQUATIC PLANT MANAGEMENT STRATEGY
Northern Region WDNR

DOCUMENTATION OF IMPAIRED NAVIGATION AND/OR NUISANCE CONDITIONS

Navigation channels can be of two types:

- Common use navigation channel. This is a common navigation route for the general lake user. It often is off shore and connects areas that boaters commonly would navigate to or across, and should be of public benefit.

- Individual riparian access lane. This is an access lane to shore that normally is used by an individual riparian shore owner.

Severe impairment or nuisance will generally mean vegetation grows thickly and forms mats on the water surface. Before issuance of a permit to use a regulated control method, a riparian will be asked to document the problem and show what efforts or adaptations have been made to use the site. (This is currently required in NR 107 and on the application form, but the following helps provide a specific description of what impairments exist from native plants).

Documentation of *impairment of navigation* by native plants must include:

a. Specific locations of navigation routes (preferably with GPS coordinates)
b. Specific dimensions in length, width, and depth
c. Specific times when plants cause the problem and how long the problem persists
d. Adaptations or alternatives that have been considered by the lake shore user to avoid or lessen the problem
e. The species of plant or plants creating the nuisance (documented with samples or a from a Site inspection)

Documentation of the *nuisance* must include:

a. Specific periods of time when plants cause the problem, e.g. when does the problem start and when does it go away.
b. Photos of the nuisance are encouraged to help show what uses are limited and to show the severity of the problem.
c. Examples of specific activities that would normally be done where native plants occur naturally on a site but can not occur because native plants have become a nuisance.

AQUATIC PLANT MANAGEMENT STRATEGY
Northern Region WDNR

DEFINITIONS

Manual removal:	Removal by hand or hand-held devices without the use or aid of external or auxiliary power. Manual removal cannot exceed 30 ft. in width and can only be done where the shore is being used for a dock or swim raft. The 30 ft. wide removal zone cannot be moved, relocated, or expanded with the intent to gradually increase the area of plants removed. Wild rice may not be removed under this waiver.
Native aquatic plants:	Aquatic plants that are indigenous to the waters of this state.
Invasive aquatic plants:	Non-indigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health.
Sensitive area:	Defined under s. NR 107.05(3)(i) (sensitive areas are areas of aquatic vegetation identified by the department as offering critical or unique fish and wildlife habitat, including seasonal or lifestage requirements, or offering water quality or erosion control benefits to the body of water).
Rapid Response protocol:	This is an internal WDNR document designed to provide guidance for grants awarded under NR 198.30 (Early Detection and Rapid Response Projects). These projects are intended to control pioneer infestations of aquatic invasive species before they become established.

TLA CLMP WORK PLAN (2016-20)

Goal 1 Maintain a diverse, native aquatic plant community.
Objectives.
a. Avoid a trend of long-term increase in dense growth of Eurasian water milfoil.
b. Manage invasive species using the most appropriate, effective method.

Actions[1]	**Timeline** (each year if not indicated)	**Board/Committee Assignment**	**$ Estimate (annually)**	**Vol. Hours (annually)**	**Funding Sources**	**Partners**[2]
Train and support Sentinel volunteer program	Annually	Executive Director Sentinel Program Coordinator	$160		ACEI[3]	GIS Contractor
Sentinel monitoring	2X / year	Sentinel Program Coordinator		408	ACEI	GIS Contractor
Assign appropriate EWM treatment method and prepare maps		Executive Director			ACEI	WDNR
Chemical Treatment		**Executive Director**				GIS Contractor Herbicide Contractor
Conduct detailed pre-treatment monitoring and mapping	Late summer, year preceding treatment	Executive Director	$5,450		ACEI	GIS Contractor
Apply for plant management permits	February/ March	Executive Director	w/treatment costs		ACEI	Herbicide Contractor

[1] See CLMP implementation strategy for action item detail. Estimates are for annual budgets once implementation begins.
[2] WDNR = Wisconsin Department of Natural Resources
[3] ACEI (Established population control grant) Current grant funds Eurasian water milfoil management for 2015 only. The grant provides $79,505.25, and is matched by TLA volunteer time and donated support at 25%.

TLA CLMP WORK PLAN (2016-20)

Goal 1 Maintain a diverse, native aquatic plant community.
Objectives.
a. Avoid a trend of long-term increase in dense growth of Eurasian water milfoil.
b. Manage invasive species using the most appropriate, effective method.

Actions[1]	**Timeline** **(each year if not indicated)**	**Board/Committee Assignment**	**$ Estimate (annually)**	**Vol. Hours (annually)**	**Funding Sources**	**Partners**[2]
Conduct pre and post treatment monitoring	May and June	Executive Director	$5,450		ACEI	
Implement early season herbicide treatment	May/June each year	Executive Director	Varies		ACEI	Herbicide Contractor WDNR, Towns
Write Aquatic Plant Management Report	December	Executive Director	$5,145		ACEI	
Hydraulic Conveyor System (HCS)		**Executive Director**	$5,675			
Map high risk EWM areas	February/ March	Executive Director			ACEI	GIS Contractor
Apply for APM harvesting permit	February/ March	Executive Director			ACEI	
Conduct HCS harvesting	June to mid-September	Executive Director	$30,118		ACEI	Diver Employees
Write HCS Annual Report	November	Executive Director	$5,145		ACEI	

TLA CLMP WORK PLAN (2016-20)

Goal 1 Maintain a diverse, native aquatic plant community.
Objectives.
a. Avoid a trend of long-term increase in dense growth of Eurasian water milfoil.
b. Manage invasive species using the most appropriate, effective method.

Actions[1]	Timeline (each year if not indicated)	Board/Committee Assignment	$ Estimate (annually)	Vol. Hours (annually)	Funding Sources	Partners[2]
EWM Education		**Executive Director Environmental and Education**			ACEI	
Website, Facebook updates	Ongoing	Marketing	$600		ACEI	
Seminar, direct mail, lake maps with EWM beds	Ongoing	Marketing Executive Director Environmental and Education			ACEI	UWEX Lakes GIS Contractor
Purple loosestrife control and other AIS control activities		Environmental and Education		92	ACEI	
Beetle release	Summer to early Fall	Environmental and Education				
Purple loosestrife control	July/August	Environmental and Education			ACEI	Riparian Owners Northern Highlands American Legion Superintendent
Map purple loosestrife locations	July to Fall	Environmental and Education			ACEI	
Train volunteers for AIS monitoring	July	Environmental and Education				Oneida County AIS Coordinator

TLA CLMP WORK PLAN (2016-20)

Goal 1 Maintain a diverse, native aquatic plant community.
Objectives.
a. Avoid a trend of long-term increase in dense growth of Eurasian water milfoil.
b. Manage invasive species using the most appropriate, effective method.

Actions[1]	**Timeline** **(each year if not indicated)**	**Board/Committee Assignment**	**$ Estimate (annually)**	**Vol. Hours (annually)**	**Funding Sources**	**Partners**[2]
Monitor and map purple loosestrife, yellow-flag iris, narrow-leaf cattail	July to Fall	Environmental and Education				
Investigate new control methods	Ongoing	Executive Director Environmental and Education				WDNR

TLA CLMP WORK PLAN (2016-20)
Goal 1 Maintain a diverse, native aquatic plant community.
Objective c. Preserve native plant communities

Actions[4]	Timeline (each year if not indicated)	Board/Committee Assignment	$ Estimate (annually)	Vol. Hours (annually)	Funding Sources	Partners[5]
Use control methods which minimize damage to native plants	Ongoing	Executive Director	$0	$0		WDNR
Track native species in post treatment surveys	Late summer	Executive Director	$0	$0		WDNR
Map high quality aquatic plant communities Develop protocol/write grant Conduct mapping	2016 2017	Executive Director	?	?	ACEI AEPP Small Scale Planning Grant	WDNR GIS Contractor
Identify and implement aquatic plant protection	2018	?			ACEI AEPP Small Scale Planning Grant	WDNR
Complete point intercept survey	2019				AEPP	Plant Monitoring Contractor

[4] See CLMP implementation strategy for action item detail. Estimates are for annual budgets once implementation begins.
[5] AEPP grants are Aquatic Invasive Species Education, Planning, and Prevention grants.

TLA CLMP WORK PLAN (2016-20)
Goal 1 Maintain a diverse, native aquatic plant community.
Objective d. Prevent new aquatic invasive species infestation

Actions[6]	Timeline (each year if not indicated)	Board/Committee Assignment	$ Estimate (annually)	Vol. Hours (annually)	Funding Sources	Partners
Clean Boats, Clean Waters Program	May to Mid-September	Executive Director Staffing	$4,000 $11,808	256		
Private landing AIS information and plant disposal containers	2016	Executive Director				Private Owners
Identify and address AIS introduction pathways	Ongoing	Environmental and Education				
Recruit and train "special forces" volunteers for target AIS identification	2016	Executive Director Environmental and Education				
Prevent runoff of sediment and nutrients		Included with Goal 2				See Goal 2, objectives a and b
AIS Education: signs, promotional materials	Ongoing	Marketing				

[6] See previous pages for action item detail. Estimates are for annual budgets once implementation begins.

TLA CLMP WORK PLAN (2016-2020)

Goal 2 Preserve the quality of Tomahawk Lake System waters.
Objectives
a. Support watershed land use practices which limit nutrient and soil runoff.
b. Encourage the preservation, enhancement, and restoration of natural shorelines.

Actions[7]	Timeline (each year if not indicated)	Board/Committee Assignment	$ Estimate (annually)	Vol. Hours (annually)	Funding Sources	Partners
Initiate demonstration projects and provide design and assistance for shoreland restoration and stormwater projects Planning/grant Initiate	 2016 2017	Environmental and Education Marketing	?	?	Healthy Lakes Program Lake Protection Grant Lake Planning Grant	Oneida County Land and Water Conservation WDNR
Participate in public dialog regarding land use policy and zoning and stormwater regulations	Ongoing	Board		?		Oneida County Planning and Zoning Oneida County Lakes and Rivers Association WDNR
Help to identify and implement stormwater management projects	Ongoing	Environment and Education	?	?	Lake Planning Grant	Towns Oneida County Land and Water Conservation WDNR

[7] See CLMP implementation strategy for action item detail. Estimates are for annual budgets once implementation begins.

TLA CLMP WORK PLAN (2016-2020)

Goal 2 Preserve the quality of Tomahawk Lake System waters.

Objectives

a. Support watershed land use practices which limit nutrient and soil runoff.

b. Encourage the preservation, enhancement, and restoration of natural shorelines.

Actions[7]	**Timeline** (each year if not indicated)	**Board/Committee Assignment**	**$ Estimate (annually)**	**Vol. Hours (annually)**	**Funding Sources**	**Partners**
Educate and communicate about the importance of shoreland restoration and stormwater projects: shoreline inventory maps, promote demo sites, U-tube video, brochures, website, Facebook page	Ongoing	Environment and Education Marketing	?	?	Lake Planning Grant	Oneida County Land and Water Conservation WDNR Oneida County Lakes and Rivers Association
Citizen Lake Monitoring Add locations	2016	Environment and Education				

TLA CLMP WORK PLAN (2016-2020)

Goal 3. Balance recreational use with preservation of the natural lake environment.
Objective a. Promote an environmental which encourages a quality Tomahawk Lake System fishery.

Actions[8]	Timeline (each year if not indicated)	Board/Committee Assignment	$ Estimate (annually)	Vol. Hours (annually)	Funding Sources	Partners[9]
Identify and map critical spawning and nursery areas	2018	Environmental and Education	?	?	Lake Planning Grant	WDNR GIS Contractor
Participate in public dialog in support of a sustainable fishery	Ongoing	Ad-hoc Fisheries Environmental and Education	?	?	?	WDNR
Encourage fisheries stewardship behavior - Develop "spring clean-up checklist"	2016 Ongoing	Marketing	?	?	Lake Planning Grant	WDNR UWEX
Objective b. Promote safe boating and minimize recreation conflicts						
Use TLA educational methods to promote safe boating	Ongoing	Marketing	?	?	Lake Planning Grant	WDNR UWEX

[8] See CLMP implementation strategy for action item detail. Estimates are for annual budgets once implementation begins.

TLA CLMP WORK PLAN (2016-2020)

Goal 3. Balance recreational use with preservation of the natural lake environment.
Objectives
c. Preserve natural communities and scenic beauty in the Tomahawk Lake System Watershed.
d. Better define and encourage appreciation of natural scenic beauty.

Actions[10]	Timeline (each year if not indicated)	Board/Committee Assignment	$ Estimate (annually)	Vol. Hours (annually)	Funding Sources	Partners[11]
Map critical habitats for shoreland and aquatic species	2018	Executive Director	?	?	Lake Planning Grant	GIS Contractor Oneida County Land Information WDNR
Participate in public dialog and promote the identification of primary and secondary environmental corridors Initiate discussions w/ county	2016	Board	?	?	?	North Central Regional Planning Commission Oneida County Planning and Zoning Land Information
Identify potential threats to mapped habitat areas. Consider collaborative preservation projects.	2018	Environment and Education				Oneida County Planning and Zoning Northwoods Land Trust Lakeland Conservancy

[10] See CLMP implementation strategy for action item detail. Estimates are for annual budgets once implementation begins.

TLA CLMP WORK PLAN (2016-2020)

Goal 3. Balance recreational use with preservation of the natural lake environment.
Objectives
c. Preserve natural communities and scenic beauty in the Tomahawk Lake System Watershed.
d. Better define and encourage appreciation of natural scenic beauty.

Actions[10]	Timeline (each year if not indicated)	Board/Committee Assignment	$ Estimate (annually)	Vol. Hours (annually)	Funding Sources	Partners[11]
Hold photo, poetry, and/or essay contest emphasizing scenic beauty	Ongoing	Marketing				

TLA CLMP WORK PLAN (2016-20)

Goal 3. Balance recreational use with preservation of the natural lake environment.
Objective e. Monitor Southern Naiad growth for potential impacts on recreation and navigation.

Actions[12]	Timeline (each year if not indicated)	Board/Committee Assignment	$ Estimate (annually)	Vol. Hours (annually)	Funding Sources	Partners[13]
Monthly monitoring in Thoroughfare Bay	6 months/year Ongoing	Executive Director				UW Trout Lake Research Station

[12] See CLMP implementation strategy for action item detail. Estimates are for annual budgets once implementation begins.

TLA CLMP WORK PLAN (2016-2020) **Goal 4. Engage the lake community in lake and watershed stewardship practices.**						
Actions[14]	**Timeline** (each year if not indicated)	**Board/Committee Assignment**	**$ Estimate (annually)**	**Vol. Hours (annually)**	**Funding Sources**	**Partners**[15]
Website	Ongoing	Marketing				
Newsletter	Ongoing	Marketing				
Facebook page, email blasts	Ongoing	Marketing				
Brochures, kiosks, displays	Ongoing	Marketing				
Shoreland management guide	2017	Marketing			Lake Planning Grant	
New property owner information	2017	Marketing			Lake Planning Grants	
Lake stewardship awards or recognition program	2018	Marketing			Lake Planning Grants	

[14] See CLMP implementation strategy for action item detail. Estimates are for annual budgets once implementation begins.

TLA CLMP WORK PLAN (2016-2020)

Goal 5. Partner with area organizations, government agencies, and local businesses to support the goals of the lake management plan.
Objective. Understand and share information and solutions regarding local lake-related issues.

Actions[16]	Timeline (each year if not indicated)	Board/Committee Assignment	$ Estimate (annually)	Vol. Hours (annually)	Funding Sources	Partners[17]
Meet with lake representatives and government agencies Review with towns each fall	Ongoing	Board Executive Director				WDNR UWEX Oneida County LRA
Provide media information	Ongoing	Marketing				
Meet with local government to share information	Ongoing	Executive Director Board				
Participate in Oneida County Lakes and Rivers Association	Ongoing	Executive Director				Oneida County LRA
Participate in AIS Partnership	Ongoing	Executive Director				Oneida County Land and Water Conservation

[16] See CLMP implementation strategy for action item detail. Estimates are for annual budgets once implementation begins.
[17] Oneida County LRA = Lakes and Rivers Association

TLA CLMP WORK PLAN (2016-2020)

Actively implement and update the TLA Comprehensive Lake Management Plan

Actions[18]	**Timeline** (each year if not indicated)	**Board/Committee Assignment**	**$ Estimate (annually)**	**Vol. Hours (annually)**	**Funding Sources**	**Partners**
Review goals and objectives, update actions, and develop annual budget	November/December Annually	Committees				
Develop project scope and write grant application	2018	Board Executive Director				WDNR
Conduct point intercept survey	2019	Consultant				
Develop project scope and hire consultant	2020	CLMP Steering Committee Board				

[18] See CLMP implementation strategy for action item detail. Estimates are for annual budgets once implementation begins.

TLA Board Committee Assignments: 2014-2015

Executive Committee
Paul Shain - President
Jim Andersen - Secretary
Margo Oppenheim - VP
Scott Harmsen - Treasurer
Kris Hunt – At Large

Marketing Committee
Rebecca Bortner - Chair
Bob McDonald
Tom Anderson

Events Committee
Margo Oppenheim – Co-Chair
Lindsey Oppenheim-Maki – Co-Chair
Meg Daly
Adam Redman
Louis Molepske

Fundraising/Membership
Kris Hunt – Chair
Jim Andersen
Lorri Wanserski

Compensation Committee
Paul Shain – Chair
Jim Andersen
Tom Anderson

Environmental and Education
Noah Lottig - Chair
Jim Kavemeier

Legislative
Louis Molepske

AIS, Clean Boats, Clean Waters, Hydraulic Conveyor and the Sentinels
Ned Greedy, Executive Director

Sentinel Program Coordinator
Roger Cote, Coordinator

Appendix H. Glossary

Aeration — To add air (oxygen) to the water supply. Generally used in lake management to reduce the release of phosphorus from lake sediments or to prevent fish kills.

Algae — Small aquatic plants without roots that contain chlorophyll and occur as single cells or multi-celled colonies. Algae form the base of the food chain in aquatic environments.

Algal bloom — Heavy growth of algae in and on a body of water resulting from high nutrient concentrations.

Alluvium — Clay, silt, sand, gravel, or similar detrital material deposited by running water.

Alkalinity — The acid combining capacity of a (carbonate) solution, also describes its buffering capacity.

Animal waste management — A group of practices including barnyard runoff management, nutrient management, and manure storage facilities designed to minimize the effects of animal manure on surface and groundwater resources.

Aquatic plant survey — A systematic mapping of types and location of aquatic plants in a water body, usually conducted in a boat. Survey information is presented on an aquatic plant map.

Aquifer — A water-bearing stratum of permeable rock, sand, or gravel.

BMP's (Best Management Practices) — Practices or methods used to prevent or reduce amounts of nutrients, sediments, chemicals or other pollutants from entering water bodies from human activities. BMP's have been developed for agricultural, silvicultural, construction, and urban activities.

Bathymetric map — A map showing depth contours in a water body. Bottom contours are usually presented as lines of equal depth, in meters or feet.

Benchmark — A mark of reference indicating elevation or water level.

Benthal — Bottom area of the lake (Gr. *benthos* depth).

Biocontrol — Management using biological organisms, such as fish, insects or micro-organisms like fungus.

Biomass — The total organic matter present (Gr. *bios* life).

Bottom barriers — Synthetic or natural fiber sheets of material used to cover and kill plants growing on the bottom of a water body; also called sediment covers.

Buffer strips - Strips of grass, shrubs, trees, and other vegetation between disturbed areas and a stream, lake, or wetland.

Cluster development - Grouping homes on part of a property while maintaining a large amount of open space on the remaining land.

Chlorophyll — The green pigments of plants (Gr. *chloros* green, *phyllon* leaf).

Conservation easement — A legal document that restricts the use of land to farming, open space, or wildlife habitat. A landowner may sell or donate an easement to a government agency or a private land trust.

Consumers — Organisms that nourish themselves on particulate organic matter (Lat. *consumere* to take wholly).

Contact herbicide — An herbicide that causes localized injury or death to plant tissues it contacts. Contact herbicides do not kill the entire plant.

Cost effective — A level of treatment or management with the greatest incremental benefit for the money spent.

Decomposers — Organisms, mostly bacteria or fungi, that break down complex organic material into its inorganic constituents.

Detritus — Settleable material suspended in the water. Organic detritus comes from the decomposition of the broken down remains of organisms. Inorganic detritus comes from settleable mineral materials.

Dissolved oxygen — A measure of the amount of oxygen gas dissolved in water and available for use by microorganisms and fish.

Drainage basin — The area drained by, or contributing to, a stream, lake, or other water body (see watershed).

Drawdown — Decreasing the level of standing water in a water body to expose bottom sediments and rooted plants. Water level drawdown can be accomplished by physically releasing a volume of water through a controlled outlet structure or by preventing recharge of a system from a primary external source.

Dredging — Physical methods of digging into the bottom of a water body to remove sediment, plants, or other material. Dredging can be performed using mechanical or hydraulic equipment.

Ecology — Scientific study of relationships between organisms and their surroundings (environment).

Ecosystems — The interacting system of a biological community and its nonliving surroundings.

Emergent plants — Aquatic plants that are rooted or anchored in the sediment around shorelines, but have stems and leaves extending well above the water surface. Cattails and bulrushes are examples of emergent plants.

Endothall — The active chemical ingredient of the aquatic contact herbicide Aquathol®.

Environmental corridors — Elongated areas in the landscape that encompass most of the best remaining woodland, wetlands, prairie, wildlife habitat, and surface water and attendant floodlands and shorelands, together with many related historic, scenic, and recreational sites. It is recommended that these corridors be preserved in essentially natural, open uses.

Environmental Protection Agency — The federal agency responsible for enforcing federal environmental regulations. The Environmental Protection Agency delegates some of its responsibilities for water, air, and solid waste pollution control to state agencies.

Epilimnion — The uppermost, warm, well-mixed layer of a lake (Gr. *epi* on, *limne* lake).

Eradication — Complete removal of a specific organism from a specified location, usually refers to a noxious, invasive species. Under most circumstances, eradication of a population is very difficult to achieve.

Erosion — The wearing away of the land surface by wind or water.

Eutrophic — Refers to a nutrient-rich lake. Large amounts of algae and weeds characterize a eutrophic lake (see also "Oligotrophic" and "Mesotrophic").

Eutrophication — The process of nutrient enrichment of a lake leading to increased production of aquatic organisms. Eutrophication can be accelerated by human activity such as agriculture and improper waste disposal.

Exotic — Refers to species of plants or animals that are not native to a particular region into which they have moved or invaded. Eurasian watermilfoil is an exotic plant invader.

Fecal coliform — A group of bacteria used to indicate the presence of other bacteria that cause disease. The number of coliform is particularly important when water is used for drinking and swimming.

Floating-leafed plant — Plants with oval or circular leaves floating on the water surface, but are rooted or attached to sediments by long, flexible stems. Waterlilies are examples of rooted floating-leafed plants.

Fluridone — The active chemical ingredient of the systemic aquatic herbicide SONAR®.

Flushing rate — Term describing rate of water volume replacement of a water body, usually expressed as basin volume per unit time needed to replace the water body volume with inflowing water. The inverse of the flushing rate is the (hydraulic) detention time. A lake with a flushing rate of 1 lake volume per year has a detention time of 1 year.

Food chain — A sequence of organisms where each uses the next as a food source.

Freely-floating plants — Plants that float on or under the water surface, unattached by roots to the bottom. Some have small root systems that simply hang beneath the plant. Water hyacinth and tiny duckweed are examples of freely-floating plants.

Glyphosate — The active chemical ingredient of the systemic herbicide RODEO®.

Ground-truthing — Close or on-the-ground observation used to test the validity of observations made at a distance as in aerial or satellite photography

Groundwater — Underground water-bearing areas generally within the boundaries of a watershed, which fill internal passageways of porous geologic formations (aquifers) with water that flows in response to gravity and pressure. Often used as the source of water for communities and industries.

Habitat — The place or type of site where a plant or animal naturally lives and grows.

Herbicide — A chemical used to suppress the growth of or kill plants.

Habitat — The physical place where an organism lives.

Hydraulic detention time — The period of detention of water in a basin. The inverse of detention time is flushing rate. A lake with a detention time of one year has a flushing rate of 1 lake volume per year.

Hypolimnion — The cold, deepest layer of a lake that is removed from surface influences (Gr. *hypo* under, *limne* lake).

Integrated aquatic plant management — Management using a combination of plant control methods that maximizes beneficial uses, minimizes environmental impacts and optimizes overall costs.

Limiting nutrient — Essential nutrient needed for growth of plant organism which is the most scarce in the environment. Oftentimes, in freshwater systems, either phosphorus or nitrogen may be the limiting nutrient for plant growth.

Limnology — The study of inland waters (Gr. *limne* lake).

Littoral — The region of a body of water extending from shoreline outward to the greatest depth occupied by rooted aquatic plants.

Loam — A soil consisting of varying proportions of sand, clay, and silt. Generally well-suited for agriculture.

Loess — A loamy soil deposited by wind.

Macrophyte — Large, rooted or floating aquatic plants that may bear flowers and seeds. Some plants, like duckweed and coontail, are free-floating and are not attached to the bottom. Occasionally, filamentous algae like *Nitella* sp. can form large, extensive populations and be an important member of the aquatic macrophyte community.

Mesotrophic — Refers to a moderately fertile nutrient level of a lake between the oligotrophic and eutrophic levels. (See also "Eutrophic" and "Oligotrohpic.")

Milligrams per liter (mg/l) — A measure of the concentration of substance in water. For most pollution measurements this is the equivalent of "parts per million" (ppm).

Mitigation — The effort to lessen the damages from a particular project through modifying a project, providing alternatives, compensating for losses, or replacing lost values.

Morphology — Study of shape, configuration, or form.

Navigable waters — A water body with a bed and a bank that can float a watercraft at any point in the year.

Niche — The position or role of an organism within its community and ecosystem.

Nitrogen — A chemical constituent (nutrient) essential for life. Nitrogen is a primary nutrient necessary for plant growth.

Nonpoint source pollution (NSP) — Pollution whose sources cannot be traced to a single point such as a municipal or industrial wastewater treatment plant discharge pipe. Nonpoint sources include eroding farmland and construction sites, urban streets, and barnyards. Pollutants from these sources reach water bodies in runoff. They can best be controlled by proper land management.

Non-target species — A species not intentionally targeted for control by a pesticide or herbicide.

Nutrient — Any chemical element, ion, or compound required by an organism for the continuation of growth, reproduction, and other life processes.

Nutrient management plan — A guidance document that provides fertilizer and manure spreading recommendations for crop fields based upon soil test results and crop needs. Plans are sometimes referred to as NRCS 590 plans for the Natural Resources Conservation Service Standard that guides their preparation.

Oligotrophic — Refers to an unproductive and nutrient-poor lake. Such lakes typically have very clear water. (See also "Eutrophic" and "Mesotrophic.")

Ordinary high water mark — The point on the bank or shore up to which the water leaves a distinct mark on the shore or bank from its presence, wave action, or flow. The mark may be indicated by erosion, destruction of or change in vegetation, or another easily recognizable characteristic.

Oxidation — A chemical process that can occur in the uptake of oxygen.

pH — The negative logarithm of the hydrogen ion activity. pH values range from 1-10 (low pH values are acidic and high pH levels are alkaline).

Peat — Soil material formed by partial decomposition of plant material.

Pesticide — Any chemical agent used to control specific organisms, such as insecticides, herbicides, fungicides, etc.

Phosphorus — A chemical constituent (nutrient) essential for life. Phosphorus is a primary nutrient necessary for plant growth. When phosphorus reaches lakes in excess amounts, it can lead to over-fertile conditions and algae blooms.

Photosynthesis — Production of organic matter (carbohydrate) from inorganic carbon and water in the presence of light (Gr. *phos, photos* light, *synthesis* placing together).

Phytoplankton — Free floating microscopic plants (algae).

Point (pollutant) source — A source of pollutants or contaminants that discharges through a pipe or culvert. Point sources, such as an industrial or sewage outfall, are usually readily identified.

Pollution — The presence of materials or energy whose nature, location, or quantity produces undesired environmental effects. Pollutants can be chemicals, disease-producing organisms, silt, toxic metals, oxygen-demanding materials, to name a few.

Primary environmental corridors — Concentrations of significant natural resources at least 400 acres in area, at least two miles in length, and at least 200 feet in width.

Primary production — The rate of formation of organic matter or sugars in plant cells from light, water, and carbon dioxide (Lat. *primus* first, *producere* to bring forward). Algae are primary producers.

Priority watershed — A drainage area selected to receive state money to help pay the cost of controlling nonpoint source pollution.

Problem statement — A written description of important uses of a water body that are being affected by the presence of problem aquatic plants.

Producers — Organisms able to build up their body substance from inorganic materials.

Productivity — A measure of the amount of living matter which is supported by an environment over a specific period of time. Often described in terms of algae production for a lake.

Public Awareness/Outreach — Programs designed to share technical information and data on a particular topic, usually associated with activities on or around a water body.

Recruitment — The process of adding new individuals to a population.

Residence time — The average length of time that water or a chemical constituent remains in a lake.

Riparian — Belonging or relating to the bank of a lake, river, or stream.

Riprap — Broken rock, cobbles, or boulders placed on the bank of a stream to protect it against erosion.

Rotovation — A mechanical control method of tilling lake or river sediments to physically dislodge rooted plants. Also known as bottom tillage or derooting.

Runoff — Water from rain, snowmelt, or irrigation that flows over the ground surface and returns to streams and lakes. Runoff can collect pollutants from air or land and carry them to receiving waters.

Secchi depth — A measure of transparency of water (the ability of light to penetrate water) obtained by lowering a secchi disc into the water until it is no longer visible. Measured in units of meters or feet.

Secchi disc — A 20-cm (8-inch) diameter disc painted white and black in alternating quadrants. It is used to measure light transparency in lakes.

Secondary environmental corridors — Concentrations of significant natural resources at least 100 acres in area and at least one mile in length.

Sediment — Soil particles suspended in and carried by water as a result of erosion.

Sensitive areas — Plant communities and other elements that provide important fish and wildlife habitat as designated by the Wisconsin Department of Natural Resources.

Septic system — Sewage treatment and disposal for homes not connected to sewer lines usually with a tank and drain field. Solids settle to the bottom of the tank. Liquid percolates through the drain field.

Standing crop — The biomass present in a body of water at a particular time.

Storm sewers — A system of sewers that collect and transport rain and snow runoff. In areas that have separated sewers, such stormwater is not mixed with sanitary sewage.

Stratification — Horizontal layering of water in a lake caused by temperature-related differences in density. A thermally stratified lake is generally divided into the epilimnion (uppermost, warm, mixed layer), metalimnion (middle layer of rapid change in temperature and density) and hypolimnion (lowest, cool, least mixed layer).

Submersed plants — An aquatic plant that grows with all or most of its stems and leaves below the water surface. Submersed plants usually grow rooted in the bottom and have thin, flexible stems supported by the water. Common submersed plants are milfoil and pondweeds.

Susceptibility — The sensitivity or level of injury demonstrated by a plant to effects of an herbicide.

Suspended solids (SS) — Small particles of solid pollutants suspended in water.

Systemic herbicide — An herbicide in which the active chemicals are absorbed and translocated within the entire plant system, including roots. Depending on the active ingredient, systemic herbicides affect certain biochemical reactions in the plant and can cause plant death. SONAR® and RODEO® are systemic herbicides.

Thermal stratification — Horizontal layering of water in a lake caused by temperature-related differences in density. A thermally stratified lake is generally divided into the epilimnion (uppermost, warm, mixed layer), metalimnion (middle layer of rapid change in temperature and density), and hypolimnion (lowest, cool, least mixed layer).

Thermocline — (Gr. *therme* heat, *klinein* to slope.) Zone (horizontal layer) in water body in which there is a rapid rate of temperature decrease with depth. Also called metalimnion, it lies below the epilimnion.

Tolerable soil loss — The tolerable soil loss rate, commonly referred to as “T,” is the maximum average annual rate of soil erosion for each soil type that will permit a high level of crop productivity to be sustained economically and indefinitely (ATCP 50.01(16)).

Topographic map — A map showing elevation of the landscape in contours of equal height (elevation) above sea level. This can be used to identify boundaries of a watershed.

Total maximum daily loads — The maximum amount of a pollutant that can be discharged into a stream without causing a violation of water quality standards.

Transect lines — Straight lines extending across an area to be surveyed.

Tributaries — Rivers, streams, or other channels that flow into a water body.

Trophic state — The level of growth or productivity of a lake as measured by phosphorus content, algae abundance, and depth of light penetration. Lakes are classified as oligotrophic (low productivity, "good" water quality), mesotrophic (moderate productivity), or eutrophic (high productivity; "poor" water quality).

Turbid — Lack of water clarity. Turbidity is closely related to the amount of suspended materials in water.

Uniform dwelling code — A statewide building code specifying requirements for electrical, heating, ventilation, fire, structural, plumbing, construction site erosion, and other construction related practices.

University of Wisconsin Extension (UWEX) — A special outreach and education branch of the state university system.

Vascular plant— A vascular plant possesses specialized cells that conduct fluids and nutrients throughout the plant. The xylem conducts water and the phloem transports food.

Variance — Government permission for a delay or exception in the application of a given law, ordinance, or regulation. Also, see water quality standard variance.

Waste — Unwanted materials left over from manufacturing processes; refuse from places of human or animal habitation.

Water body usage map — A map of a water body showing important human use areas or zones (such as swimming, boating, fishing) and habitat areas for fish, wildlife and waterfowl.

Water quality criteria — A measure of the physical, chemical, or biological characteristics of a water body necessary to protect and maintain different water uses (fish and aquatic life, swimming, etc.).

Water quality standards — The legal basis and determination of the use of a water body and the water quality criteria; physical, chemical, or biological characteristics of a water body, that must be met to make it suitable for the specified use.

Water quality management area (WQMA) — The area within 1,000 feet from the ordinary high water mark of navigable waters that consists of a lake, pond or flowage; the area within 300 feet from the ordinary high water mark of navigable waters that consist of a river or stream; and a site that is susceptible to groundwater contamination, or that has the potential to be a direct conduit for contamination to reach groundwater. (NR 151.015(24))

Water quality standard variance — When natural conditions of a water body preclude meeting all conditions necessary to maintain full fish and aquatic life and swimming, a variance may be granted.

Watershed — The entire surface landscape that contributes water to a lake or river.

Watershed management — The management of the natural resources of a drainage basin for the production and protection of water supplies and water-based resources.

Wetland — Areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support a variety of vegetative or aquatic life. Wetland vegetation requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas.

Wisconsin administrative code — The set of rules written and used by state agencies to implement state statutes. Administrative codes are subject to public hearing and have the force of law.

Zooplankton — Microscopic animal plankton in water (Gr. *zoion* animal). *Daphnia* sp. or water fleas are freshwater zooplankton.

Glossary sources: Washington State Department of Ecology; Maribeth Gibbons Jr.; Wisconsin priority watershed planning guidance; and Southeastern Wisconsin Regional Planning Commission.