Item 5Cib.
BCWMC 10-17-13
Appendices Online

Trapnet catch from Sweeney Lake, September 2013

Trapnet Fish Surveys for Sweeney Lake (27-0035-01) and Twin Lake (27-0035-02), Hennepin County, September 17 - 19, 2013

MnDNR Permit Number 19414

Submitted to:
Bassett Creek Watershed Management Commission

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October 2013

Trapnet Fish Surveys for Sweeney Lake and Twin Lake, Hennepin County, September 17 - 19, 2013

SUMMARY

Sweeney Lake (MnDNR ID: 27-0035-01) is a 66-acre lake and is connected by way of a channel to Twin Lake (MnDNR ID: 27-0035-02) which is 19 acres in area. In September of 2013, the Bassett Creek Watershed Management Commission contracted for trapnet fish surveys on both lakes with Blue Water Science. The fish surveys were conducted under MnDNR permit number 19414. The last trapnet surveys were conducted by the MnDNR in 1991. A recent electrofishing assessment was conducted on August 28, 2013.

The objectives of the trapnet survey were to characterize the fish community in both lakes and evaluate potential fish effects on lake water quality.

Sweeney Lake: A total of eleven fish species were sampled in Sweeney Lake on September 18 and 19, 2013. Bluegill sunfish and black crappies were the most abundant and the number of fish per net were at the upper end of the MnDNR normal range for a lake like Sweeney (Table 1). Gamefish included largemouth bass and northern pike (Table 1).

Twin Lake: A total of ten fish species were sampled in Twin Lake on September 18 and 19, 2013. The dominant fish were bluegill sunfish and yellow bullheads. Bluegills numbers were lower than Sweeney Lake and below the MnDNR normal range. Yellow bullheads were within the MnDNR normal range (Table 1). No black bullheads or carp were sampled in Twin Lake although they were found in Sweeney Lake. Green sunfish were sampled in Twin Lake but not in Sweeney Lake. The number of fish caught per net was generally lower in Twin Lake compared to Sweeney Lake.

Table S-1. Summary of the Sweeney Lake and Twin Lake fish survey conducted in September, 2013.

Species	SWEENEY Number of Fish per Net	TWIN Number of Fish per Net	MnDNR Normal Range
Black bullhead	1.1	0	1.3 - 26.0
Yellow bullhead	7.9	2.0	0.8 - 5.0
Black crappie	15	0.7	1.8 - 18.1
Bluegill	45	3.7	6.5 - 59.6
Carp	0.3	0	0.3 - 2.6
Gizzard shad	0	0	NA
Green sunfish	0	0.2	0.3 - 2.0
Hybrid sunfish	0.5	0.7	NA
Largemouth bass	0.2	0.2	0.3 - 0.8
Northern pike	0.8	0.2	NA
Pumpkinseed	1.6	0.7	0.8 - 5.3
White sucker	3.6	0.2	0.3 - 1.6
Yellow perch	0.3	0.2	0.3 - 1.5
Painted turtle	2.7	2.7	NA
Snapping turtle	0.2	0.3	NA
Softshell turtle	0.9	0	NA

Potential Impact of Fish on Sweeney and Twin Lakes Water Quality

It has been demonstrated that various fish species can impact water quality in lakes, but typically they need relatively high densities to adversely effect phosphorus and algae concentrations.

It appears the fish community in Sweeney and Twin Lakes does not adversely impact lake water quality (Table S-2).

Bluegill sunfish are omnivores and will feed in the sediments if other food sources are low. Bluegills don't appear to have a direct water quality impact in Sweeney Lake.

Table S-2. Potential impact of fish on water quality in Sweeney and Twin Lakes.

Species	Abundance		Impact on Water Quality
	Sweeney	Twin	
Carp	low to moderate	low	Because aquatic plants are still well distributed in Sweeney and Twin Lakes, carp impacts to plants and on phosphorus loading are probably low.
Black bullheads	low	very low	Low abundance in both lakes and the population in Sweeney is composed of large sizes, not stunted. Impacts on water quality are low.
Yellow bullheads	high	low	Although high density based on typical DNR ranges in Sweeney Lake, the fish per net is 8 fish/net and are not stunted. Should not adversely impact water quality.
Bluegill sunfish	moderate to high	low	At high densities, bluegills feed in sediments and may impact water quality. In Sweeney Lake, bluegills have a good range of lengths and are not stunted. Adverse impacts to water quality should be minor. In Twin Lake, bluegill abundance is low.
Gizzard shad	present but abundance is unknown	unknown	about 4 gizzard shad were found in a trapnet, but likely had been regurgitated from northern pike. Gizzard shad are filter feeders, and can remove zooplankton and algae from the water column. They recycle existing phosphorus, don't add new phosphorus. At high densities can reshape phytoplankton communities to small size algae.

Sweeney Lake, Day 1, Net 3

Twin Lake, Day 1, Net 1

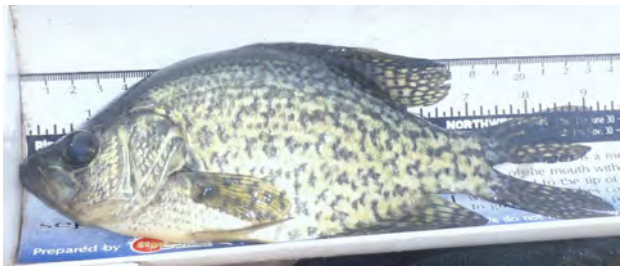
Trapnet Fish Surveys for Sweeney Lake and Twin Lake, Hennepin County, September 17-19, 2013

Introduction

Sweeney Lake (MnDNR ID: 27-0035-01) is a 66-acre lake and is connected by way of a channel to Twin Lake (MnDNR ID: 27-0035-02) which is 19 acres in area. In September of 2013, the Bassett Creek Watershed Management Commission contracted for trapnet fish surveys on both lakes with Blue Water Science. The fish surveys were conducted under MnDNR permit number 19414. The last trapnet surveys were conducted by the MnDNR in 1991. A recent electrofishing assessment was conducted on August 28, 2013.

The objectives of the trapnet survey were to characterize the fish community in both lakes and evaluate potential fish effects on lake water quality.

Bluegill sunfish



Black crappie

Figure 1. Bluegill sunfish (left) and black crappie (right) were the most common fish sampled in the 2013 trapnet surveys.

Methods

Five standard trapnets were set in Sweeney Lake and three standard trapnets were set in Twin Lake on September 17, 2013 and then were sampled daily on September 18 and 19, 2013. Each trapnet was a MnDNR style with two 4x6 foot square frames followed by two funnel mouth openings. A 50-foot lead net was staked on shore which led to the opening in the square frames. Net mesh size was 3/8 inch. Trapnet locations were shown in Figure 2. In Sweeney Lake, Net 5-1 was moved after the first day to a new location for the second day of sampling and the location is shown as Net 5-2. In Twin Lake, Nets 2-1 and 3-1 were moved after sampling on the first day to new locations and were sampled there on Day 2. The locations on Day 2 are shown as Net 2-2 and Net 3-2 (Figure 2).

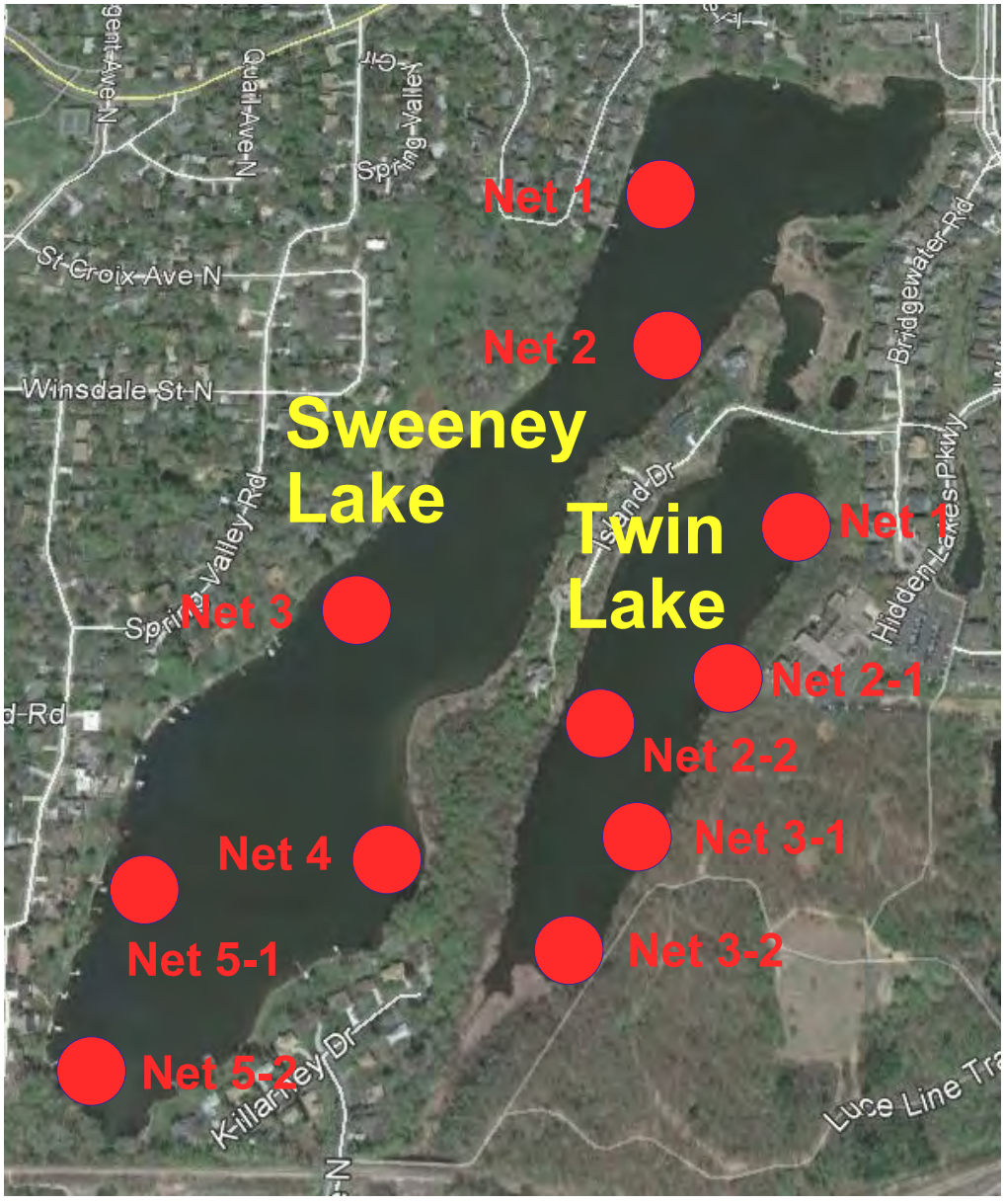


Figure 2. Locations of the trapnet sets on Sweeney and Twin Lakes on September 17-19, 2013.

A trapnet is a live fish trap. Fish run into the 50-foot lead net and follow it back through a series of hoops with funnel mouths. Fish end up in the back hoop.

The back hoop of the trapnet is propped up on the bow (front end) of the survey boat. A dip net is used to remove the fish from the back of the trapnet.

Fish are transferred to tubs, then they are counted and measured and released.

Figure 3. Trapnet set and fish sampling in the Sweeney Lake fish survey.

Results

Fish Caught Per Net

Sweeney Lake: A total of eleven fish species were sampled in Sweeney Lake on September 18 and 19, 2013. Bluegill sunfish and black crappies were the most abundant and the number of fish per net were at the upper end of the MnDNR normal range for a lake like Sweeney (Table 1). Gamefish included largemouth bass and northern pike (Table 1).

Twin Lake: A total of ten fish species were sampled in Twin Lake on September 18 and 19, 2013. The dominant fish were bluegill sunfish and yellow bullheads. Bluegills numbers were lower than Sweeney Lake and below the MnDNR normal range. Yellow bullheads were within the MnDNR normal range (Table 1). No black bullheads or carp were sampled in Twin Lake although they were found in Sweeney Lake. Green sunfish were sampled in Twin Lake but not in Sweeney Lake. The number of fish caught per net was generally lower in Twin Lake compared to Sweeney Lake.

Table 1. Summary of the Sweeney Lake and Twin Lake fish survey conducted on September 18 and 19, 2013.

Species	SWEENEY Number of Fish per Net	TWIN Number of Fish per Net	MnDNR Normal Range
Black bullhead	1.1	0	1.3 - 26.0
Yellow bullhead	7.9	2.0	0.8 - 5.0
Black crappie	15	0.7	1.8 - 18.1
Bluegill	45	3.7	6.5 - 59.6
Carp	0.3	0	0.3 - 2.6
Gizzard shad	0	0	NA
Green sunfish	0	0.2	0.3 - 2.0
Hybrid sunfish	0.5	0.7	NA
Largemouth bass	0.2	0.2	0.3 - 0.8
Northern pike	0.8	0.2	NA
Pumpkinseed	1.6	0.7	0.8 - 5.3
White sucker	3.6	0.2	0.3 - 1.6
Yellow perch	0.3	0.2	0.3 - 1.5
Number of fish species	11	10	--
Painted turtle	2.7	2.7	NA
Snapping turtle	0.2	0.3	NA
Softshell turtle	0.9	0	NA

Turtles were common in the nets. Turtle on top is a softshell turtle, on bottom is a painted turtle.

Fish caught for each net on each day in Sweeney and Twin Lakes are shown in Table 2. In Sweeney Lake, Net 2, had the highest catch rate for sunfish and crappies and Net 4 had the highest yellow bullhead catch. In Twin Lake, Net 3 was productive on both days, but catch rates were generally lower than Sweeney Lake.

Table 2. Summary of Sweeney Lake and Twin Lake trapnet survey results from September, 2013.

Species	Sweeney Lake												Twin Lake							
	Net 1		Net 2		Net 3		Net 4		Net 5		Total (2 days)	Number/ net (n=10)	Net 1		Net 2		Net 3		Total (2 days)	Number/ net (n=6)
	1st Day	2nd Day	1st Day	2nd Day	1st Day	2nd Day	1st Day	2nd Day	1st Day	2nd Day			1st Day	2nd Day	1st Day	2nd Day	1st Day	2nd Day		
Black bullhead	3		1		2		3	2			11	1.1							0	0
Yellow bullhead	4	5	12	3	11	2	23	19			79	7.9					9	3	12	2.0
Black crappie	21	20	43	15	5	11	20	11	6		152	15			1		2	1	4	0.7
Bluegill	48	56	134	46	43	31	53	35	1		447	45	6	6			2	8	22	3.7
Carp	1		1		1						3	0.3							0	0
Gizzard shad		4*									0	0							0	0
Green sunfish											0	0	1						1	0.2
Hybrid sunfish			3		2						5	0.5						4	4	0.7
Large-mouth bass			1			1					2	0.2						1	1	0.2
Northern pike	3	3			2						8	0.8						1	1	0.2
Pumpkin-seed	3	4	4	1	1		3				16	1.6	2	3				2	7	1.2
White sucker	10	8	2	2	2	2	6	2	2		36	3.6						1	1	0.2
Yellow perch	1			1			1				3	0.3					1		1	0.2
Total Fish	94	96	201	68	69	47	109	69	9	0	762	76	9	9	1	0	14	21	54	9
Painted turtle	1	1	3	3		3	3			13	27	2.7		1				15	16	2.7
Snapping turtle				1		1					2	0.2	1					1	2	0.3
Softshell turtle	1				1	1	1		5		9	0.9							0	0

*gizzard shad were regurgitated by Northern pike in the trapnet and are not included in the statistics.

Figure 4. Four gizzard shad were found in trapnet 1 on the second day of monitoring but they were in various states of decomposition and were likely regurgitated from northern pike that were also trapped in Net 1. Gizzard shad were not included in the catch statistics.

Fish Length

Sweeney Lake: Bluegill lengths ranged from less than 3 inches up to 8 inches with the majority of the population between 5 to 6.5 inches. The range of lengths indicates bluegills are not stunted. Black crappies were present with lengths up to 11 inches but the most common size was in the 7 to 8 inch range (Table 3). Several carp were sampled and measured from 19 to 26 inches. No young of the year carp were caught.

Twin Lake: The number of fish sampled in Twin Lake was less than Sweeney Lake however, fish lengths were generally within range of lengths found in Sweeney Lake (Table 3). Fish travel between the two lakes is likely, but fish in Sweeney appear to be more abundant. The channel between the two lakes is shown in Figure 5.

Figure 5. The channel between Sweeney Lake and Twin Lake, heading toward Twin Lake.

Table 3. Length frequency of fish species (as total length) for Sweeney and Twin Lakes fish survey for September 2013.

Length (inches)	Black bullhead		Yellow bullhead		Black crappie		Bluegill		Carp		Green sunfish		Hybrid sunfish		Largemouth bass		Northern pike		Pumpkin-seed		White sucker		Yellow perch	
	Sweeney	Twin	Sweeney	Twin	Sweeney	Twin	Sweeney	Twin	Sweeney	Twin	Sweeney	Twin	Sweeney	Twin	Sweeney	Twin	Sweeney	Twin	Sweeney	Twin	Sweeney	Twin	Sweeney	Twin
<3							3	4																
3					1		8																	
3.5					2		3								1				2					
4							3	1								1								
4.5							35	1				1	1						4	1				1
5							86	3											4				2	
5.5							77	5					1						4					
6					3		97	4						2					1	6				
6.5			1		18		74	2						1					1					
7			4		36	3	59	3					2										1	
7.5				1	48		4	3																
8			7		32	1	1							1										
8.5			4		5								1											
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9.5			10	1	2																			
10	3		10	1	1																			
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11.5			7	1																				
12			5	1																				
12.5	1			1																				
13	1		1	1																	1			
13.5																					1			
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33.5																	1							
34																								
Total	**11**	**0**	**79**	**12**	**152**	**4**	**447**	**22**	**3**	**0**	**0**	**1**	**5**	**4**	**2**	**1**	**8**	**1**	**16**	**7**	**36**	**1**	**3**	**1**

Representative Fish Species of Sweeney and Twin Lakes

Black bullhead

Yellow bullhead

Carp

Gizzard shad

Largemouth bass

Northern pike

Figure 6. Representative fish species sampled during the trapnet survey conducted in September 2013.

Comparison of 1991 and 2013 Fish Surveys

Most of the fish species found in Sweeney and Twin Lakes in 1991 were found in 2013 except for smallmouth buffalo and golden shiner. The number of fish per net were generally lower in 2013 compared to 1991, especially for bluegill sunfish and carp. However, black crappies and yellow bullheads in Sweeney Lake were higher in 2013 compared to 1991.

Table 4. Summary of the Sweeney Lake fish surveys conducted by the MnDNR in 1991 and by Blue Water Science in 2013.

Species	Sweeney Lake (Number of Fish per Net)		
	1991 - July MnDNR	2013 - Sept BWS	MnDNR Normal Range
Black crappie	0.5	15	1.8 - 18.1
Bluegill	124.5	45	6.5 - 59.6
Smallmouth buffalo	1.5	0	NA
Black bullhead	11.0	1.1	1.3 - 26.0
Yellow bullhead	2.8	7.9	0.8 - 5.0
Carp	4.8	0.3	0.3 - 2.6
Gizzard shad*	0	0	NA
Green sunfish	0.7	0	0.3 - 2.0
Hybrid sunfish	0.5	0.5	NA
Largemouth bass	0.3	0.2	0.3 - 0.8
Northern pike	1.5	0.8	NA
Pumpkinseed	4.0	1.6	0.8 - 5.3
White sucker	3.7	3.6	0.3 - 1.6
Yellow perch	0.2	0.3	0.3 - 1.5
Painted turtle		2.7	NA
Snapping turtle		0.2	NA
Softshell turtle		0.9	NA

*four gizzard shad were regurgitated by Northern pike in the sample net.

Table 5. Summary of the Twin Lake fish surveys conducted by the MnDNR in 1991 and by Blue Water Science in 2013.

Species	Twin Lake (Number of Fish per Net)		
	1991 MnDNR	2013 - Sept BWS	MnDNR Normal Range
Black crappie	1.4	0.7	1.8 - 18.1
Bluegill	29.8	3.7	6.5 - 59.6
Smallmouth buffalo	0.6	0	NA
Black bullhead	3.0	0	1.3 - 26.0
Yellow bullhead	1.2	2.0	0.8 - 5.0
Carp	0.8	0	0.3 - 2.6
Gizzard shad	0	0	NA
Golden shiner	0.2	0	0.2 - 1.4
Green sunfish	0.2	0.2	0.3 - 2.0
Hybrid sunfish	1.4	0.7	NA
Largemouth bass	0.4	0.2	0.3 - 0.8
Northern pike	0.2	0.2	NA
Pumpkinseed	1.4	0.7	0.8 - 5.3
White sucker	0.4	0.2	0.3 - 1.6
Yellow perch	0	0.2	0.3 - 1.5
Painted turtle		2.7	NA
Snapping turtle		0.3	NA
Softshell turtle		0	NA

Summary of Electrofishing Assessment in 2013 by the MnDNR

The MnDNr conducted an electrofishing assessment on Sweeney Lake on August 28, 2013. Results of their catch are shown in Table 6 and the entire report is found in Appendix D. The MnDNR found nearly the same species as the trapnet survey, but in addition, found golden shiners in Sweeney Lake with electrofishing.

Table 6. Electrofishing catch summary for Sweeney Lake conducted on August 28, 2013 (Table is from the Draft report).

STANDARD LAKE SURVEY REPORT
SPECIAL ASSESSMENT DATED 08/28/2013 FOR DOW NUMBER 27-0035-01

DRAFT

Electrofishing Catch Summary for EF

Standard electrofishing

Total run-time for all stations: 01:37:00
Total on-time for all stations: 01:30:00
First Sampling Date: 08/28/2013
Last Sampling Date: 08/28/2013
Daylight Sampling: Yes
Target Species: N/A

		Summary By Numbers			Summary By Weight (pounds)			
		Total	Number per Hour		Total	Lbs per Hour		Mean
Abbr	Species	Number	Run-Time	On-Time	Weight	Run-Time	On-Time	Weight
BLB	Black Bullhead	3	1.86	2.00	1.45	0.89	0.96	0.48
BLC	Black Crappie	17	10.52	11.33	3.65	2.26	2.43	0.21
BLG	Bluegill	86	53.20	57.33	9.97	6.17	6.65	0.12
CAP	Common Carp	7	4.33	4.67	57.91	35.82	38.61	8.27
GOS	Golden Shiner	5	3.09	3.33	0.48	0.30	0.32	0.10
GSF	Green Sunfish	3	1.86	2.00	0.35	0.22	0.23	0.12
HSF	Hybrid Sunfish	3	1.86	2.00	0.39	0.24	0.26	0.13
LMB	Largemouth Bass	42	25.98	28.00	31.96	19.77	21.31	0.76
NOP	Northern Pike	1	0.62	0.67	5.97	3.69	3.98	5.97
PMK	Pumpkinseed	1	0.62	0.67	0.15	0.09	0.10	0.15
WTS	White Sucker	8	4.95	5.33	13.05	8.07	8.70	1.63
YEB	Yellow Bullhead	17	10.52	11.33	8.87	5.49	5.91	0.52
YEP	Yellow Perch	2	1.24	1.33	0.08	0.05	0.05	0.04

Figure 7. Gizzard shad caught during the electrofishing assessment conducted in August 2013. Source: MnDNR fisheries.

A comparison of fish lengths recorded from the trapnet survey and from the electrofishing assessment are shown in Table 7. The lengths found in the trapnet survey are fairly similar to the electrofishing assessment. However, largemouth bass were more abundant and had a wider length distribution in the electrofishing assessment compared to the trapnet survey (Table 7). It is common for electrofishing to more effectively sample largemouth bass than trapnet surveys.

Table 7. Percentage of fish caught per length for Sweeney and Twin Lakes fish surveys conducted in 2013 by trapnet survey (September)(Blue Water Science) and for electrofishing (August)(MnDNR). Key: TN = trapnet survey; E = electrofishing survey; S = Sweeney Lake; and T = Twin Lake.

Length (inches)	Black bullhead			Yellow bullhead			Black crappie			Bluegill			Carp			Golden shiner			Green sunfish			Hybrid sunfish			Largemouth bass			Northern pike			Pumpkin-seed			White sucker			Yellow perch		
	TN		E	TN		E	TN		E	TN		E	TN		E	TN		E	TN		E	TN		E	TN		E	TN		E	TN		E	TN		E	TN		E
	S	T	S	S	T	S	S	T	S	S	T	S	S	T	S	S	T	S	S	T	S	S	T	S	S	T	S	S	T	S	S	T	S	S	T	S	S	T	S
<3										1	1							20									5												
3							1			2		1															3												
3.5							2			1		2													50		5				13								
4										1	5	5														100	3												50
4.5										8	5	27								100	33	20					5				25	14						100	50
5										19	14	26									33										25		100				67		
5.5										17	23	21						20			33	20		100							25								
6							2			22	18	7						20					50								6	86							
6.5				1			12		6	17	9	8						20					25								6								
7				5			24	75	35	13	14	1										40					3										33		
7.5					8		32		53	1	14							20																					
8			33	9		6	21	25	6	1													25			5													
8.5				5		12	3															20				3												
9				13	17	18	2																				5												
9.5			33	13	8	18	1																				8												
10	27		33	13	8	12	1																				10												
10.5	9			13		29						1															10												
11	45			13	17	6	1																				10												
11.5				9	8																						5												
12	9			6	17																						8												
13	9			1	8																						3								6				
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Total	**11**	**0**	**3**	**79**	**12**	**17**	**152**	**4**	**17**	**447**	**22**	**88**	**3**	**0**	**7**	**0**	**0**	**5**	**0**	**1**	**3**	**5**	**4**	**1**	**2**	**1**	**40**	**7**	**1**	**1**	**16**	**7**	**1**	**36**	**1**	**8**	**3**	**1**	**2**

Discussion

Impact of Fish on Sweeney and Twin Lake Water Quality: It has been demonstrated that various fish species can impact water quality in lakes, but typically they need relatively high densities to adversely effect phosphorus and algae concentrations.

Based on the trapnet survey results, it appears the fish community in Sweeney Lake has a relatively low to moderate impact on lake water quality and the fish community has little impact on lake water quality in Twin Lake (Table 8).

Table 8. Potential impact of fish on water quality in Sweeney and Twin Lakes.

Species	Abundance		Impact on Water Quality
	Sweeney	Twin	
Carp	moderate (est 77 lbs/ac)	low	Because aquatic plants are still well distributed in Sweeney and Twin Lakes, carp impacts to plants and on phosphorus loading are probably low.
Black bullheads	low	very low	Low abundance in both lakes and the population in Sweeney is composed of large sizes, not stunted. Impacts on water quality are low.
Yellow bullheads	high	low	Although high density based on typical DNR ranges in Sweeney Lake, the fish per net is 8 fish/net and they are not stunted. Yellow bullheads should not adversely impact water quality.
Bluegill sunfish	moderate to high	low	At high densities, bluegills feed in sediments and may impact water quality. In Sweeney Lake, bluegills have a good range of lengths and are not stunted. Adverse impacts to water quality should be minor. In Twin Lake, bluegill abundance is low.
Gizzard shad	present but abundance is unknown	unknown	About 4 gizzard shad were found in a trapnet, but likely had been regurgitated from northern pike. Gizzard shad are filter feeders, and can remove zooplankton and algae from the water column. They recycle existing phosphorus, and don't add new phosphorus to the water column. At high densities, they can reshape phytoplankton communities to small size algae. It appears the gizzard shad have a relatively low impact on water quality in the lakes.

Aquatic Plants: In some cases, aquatic plants can be used to determine if fish are adversely impacting lake water quality. Aquatic plant maps for Sweeney and Twin Lakes for 2008 are shown in Figure 8. Submerged aquatic plants were found to grow to water depths of 10 feet in Sweeney and to 16 feet in Twin and plant coverage was nearly 100% to these depths. If fish were impacting aquatic plants, there would be either no plants in each lake or plants with minimal coverage. It appears the fish community has not adversely impacted aquatic plants and probably is not adversely impacting water quality at this time.

Electrofishing Results: Additional support is based on the electrofishing assessment. A carp capture rate of four carp per hour (Table 6) is equivalent to nearly 20 carp per hectare based on an equation from Bajer and Sorensen (2012)[number of carp per hectare = 4.71 x number of carp captured per hour of electrofishing + 3.04, $r^2 = 0.83$]. With an average weight of 8.27 pounds per fish, this is equivalent to nearly 77 pounds of carp/acre. This is close a critical threshold value of about 100 pounds/acre or more where carp have been found to have adverse impacts on water quality.

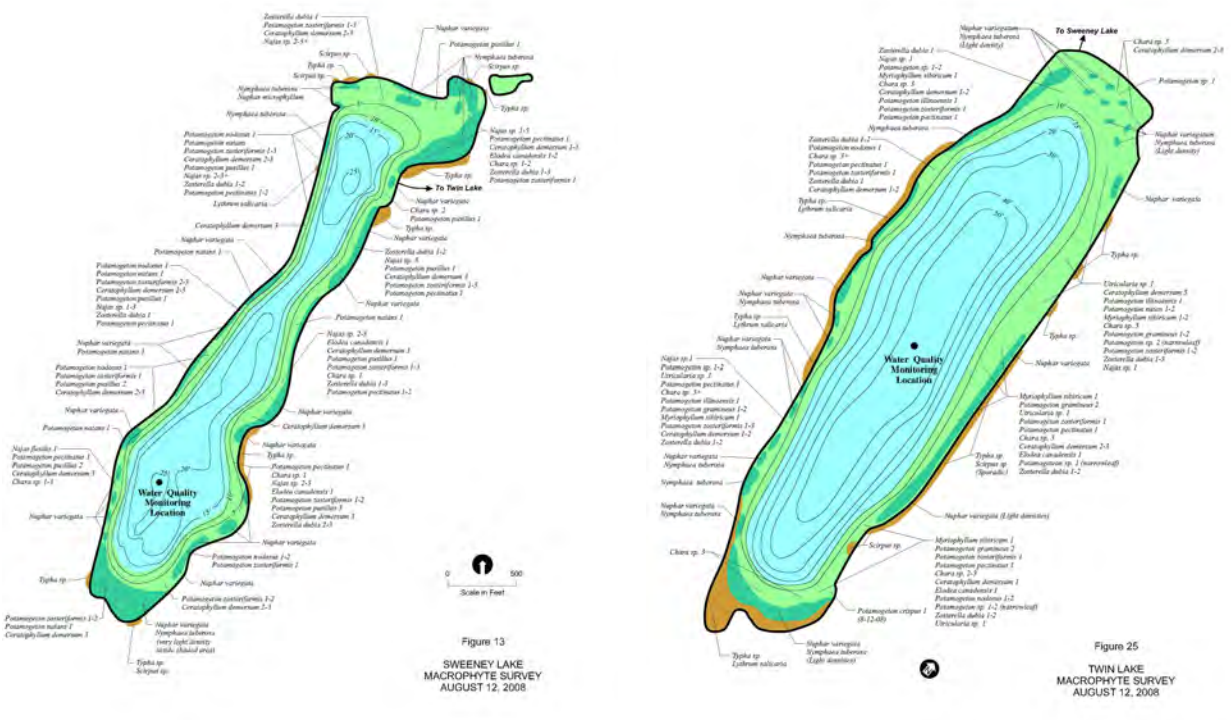

Figure 8. Aquatic macrophyte surveys conducted on August 12, 2008 for Sweeney Lake (left) and Twin Lake (right). Source: *Bassett Creek Watershed Management Commission, February 2009. 2008 Lake water quality study, Sweeney Lake and Twin Lake*. Maps prepared by Barr Engineering Co.

Zooplankton as Indicators: Gizzard shad were also found in Sweeney Lake although they did not show up in the catch statistics. At high densities, they have been found to adversely impact water quality (Schaus et al 1997). However, gizzard shad density appears to be below a threshold that would produce elevated phosphorus in Sweeney and Twin Lakes. No live gizzard shad were captured in trapnets and a number of gizzard shad were captured by eleoctrofishing, but not on defined transects (Appendix D). At significant gizzard shad densities, slow swimming cladocerans are easily captured and are often absent in lakes (Drenner and McComas 1980). In 2008, in Sweeney and Twin Lakes, cladocerans were found throughout the summer (Figure 9). Therefore, the density of gizzard shad appears to be low to moderate and the impacts of gizzard shad on phosphorus loading to Sweeney and Twin Lakes appear to be minor.

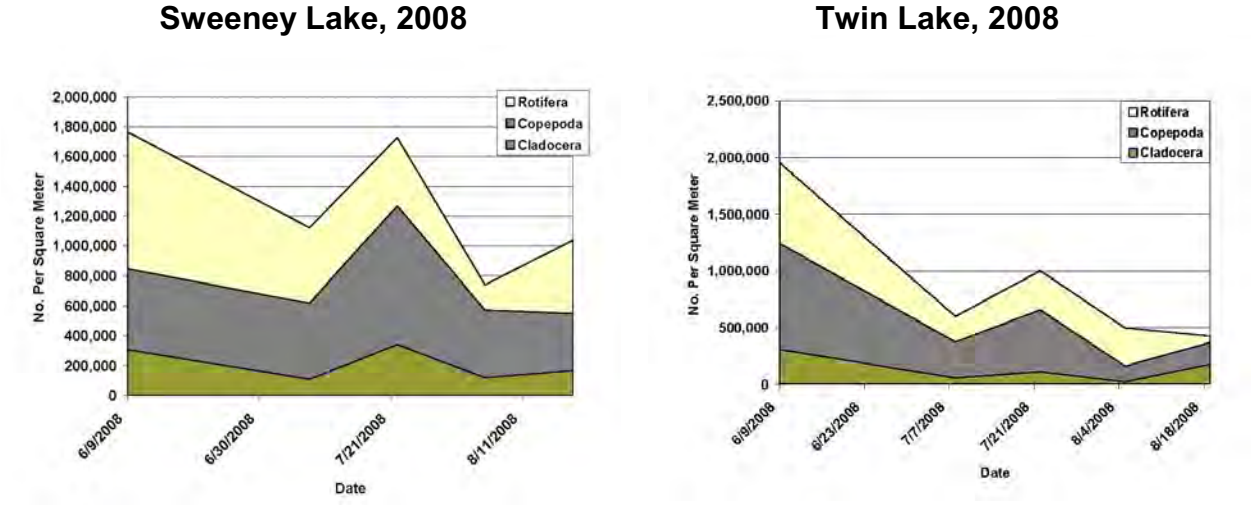

Figure 9. Zooplankton for 2008 in Sweeney Lake (left) and Twin Lake (right). Source: *Bassett Creek Watershed Management Commission, February 2009. 2008 Lake water quality study, Sweeney Lake and Twin Lake*. Maps prepared by Barr Engineering Co.

Fish Impacts on Water Quality in Other Lakes: For centuries (going back to Chinese fish farmer reports), it's been known fish have impacts on water quality. In Minnesota, as early as 1916, carp were being seined out of lakes because of their deleterious effect on aquatic plants and water clarity (McComas 2003a).

More recently, experiments in eutrophic Swedish lakes showed dense fish populations of planktivorous and benthivorous fish resulted in high concentrations of chlorophyll, blooms of blue-green algae and low transparency (Andersson et al 1978)(Table 9).

A variety of fish species can cause adverse water quality impacts, and a summary of fish species that can impact water quality is shown in Table 8. Based on the fish surveys in Sweeney and Twin Lakes, the impacts of fish on water quality would appear to be low to moderate.

Table 9. List of fish that have been documented to cause poor water clarity.

Species	Situation	Reference
Carp	Adverse water quality and plant impacts have been known for some time.	Braband et al 1990; Lamarra 1975; Zambrano et al 2001; Parkos et al 2003
Black bullheads	Eagle Lake, Cottonwood County, cleared up after a rotenone treatment	McComas, unpublished
Smallmouth buffalo	Mesocosm experiments found smallmouth buffalo enhanced turbidity, algae, nitrogen, and phosphorus.	Shormann and Cotner 1997
Crucian carp	Fish density: 1,960 lb/ac (in mesocosm) produces excessive algae.	Andersson et al 1978
Gizzard shad	Nutrient excretion by bottom-feeding fish, in this case gizzard shad, produces nutrients for algae growth. Fish density was 370 lbs per acre.	Schaus et al 1997
Bream and roach	Fish density: 800 lb/ac (in mesocosm) produces excessive algae.	Andersson et al 1978
Young of year walleye	Larval walleye (9 mm TL) stocked at 50 fish/m^3 produced lower clarity and more algae than ponds stocked at 10 fish/m^3.	Qin and Culver 1995
Mosquitoe fish	Water quality improves dramatically when a fungal infection kills more than 80% of the *Gambusia* (Mosquitoe Fish).	Nagdali and Gupta 2002
Fathead minnows	Ponds with fathead minnows had poorer water clarity and fewer aquatic plants than fishless ponds.	Zimmer et al 2001; Zimmer et al 2006
Bluegill sunfish	High density of over 1,400 fish per trapnet was correlated with poor clarity and no submerged aquatic plants.	McComas, 2003b
Bluegill sunfish and black bullheads	High density of bluegill sunfish (465/lift) and black bullheads (97/lift) were suspected of causing poor water quality in Lee Lake, Minnesota.	McComas 2004

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Sampling crew on the second day of monitoring.