

MINNESOTA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF ECOLOGICAL RESOURCES

Aeration Permit Program Annual Report
2008-2009

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**Aeration Permit Program Annual Report
2008-2009**

By

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INTRODUCTION

Minnesota has many lakes with a history of winterkill due to oxygen depletion. However, more significant than the number of lakes that winterkill is their location. The majority of Minnesota's winterkill lakes are in the southern half of the state, an area with the "fewest number of fishing lakes and the majority of the population" (Scidmore 1970). Aeration systems have been used in Minnesota to prevent winterkill for many years. More recently, the uses for aeration have expanded to include shoreline property protection, providing open water for captive waterfowl and water quality improvement.

The Department of Natural Resources has regulated the use of aeration in public waters since 1974 due to the potential for user conflicts and the open water hazard created by winter operation of aeration systems. The two major objectives of the aeration permit program are:

1. To ensure the safe winter operation of aeration systems; and
2. To ensure the appropriate use of aeration technology.

This report summarizes work done under the Aeration Permit Program of the Minnesota Department of Natural Resources during the 2008-09 permit years (1 October 2008– 30 September 2009). Work was partially funded under Federal Aid Project FW-9-T.

For a more detailed explanation of winterkill and the history of aeration in Minnesota, see Enger (1988). Pederson (1982) provides a comprehensive review of the program through 1978-81. Annual staff reports detailing the aeration program are also available (Danks 2010; Danks 2009; Danks 2007; Danks 2006; Danks 2005; Danks 1999; Danks 1998; Danks 1996; Danks 1995; Danks 1994; Danks 1992; Danks, 1992; Enger-Danks 1992).

AERATION EQUIPMENT

Aeration equipment, originally designed for wastewater treatment facilities, has proven to be an effective method of winterkill prevention. The four methods of aeration described below are commonly used in Minnesota:

1. Sub-surface bubblers: Sub-surface bubblers consist of a diffuser(s), weighted air lines and a compressor or high volume, low pressure blower. The diffuser is placed on the lake bottom, near the deepest part of the lake. Air is pumped from the shore-housed compressor or blower through air lines to the diffuser. The diffuser breaks the air stream into small bubbles that rise, lifting warm bottom water to the surface. This warmer water melts the ice cover, exposing a portion of the lake surface to the atmosphere. Oxygen is added to the lake from wind and wave action and photosynthesis. The most efficient and effective method of operation is to group the diffusers so that one open water area is created during normal winter weather (MN Rules Chapter 6116.0020, subp. 3). Sub-surface bubbler systems are best suited to lakes that winterkill frequently. To sustain a gamefish population in these lakes, the aeration system will probably require annual operation for extended periods.

2. Air injection systems: Air injection aeration systems function similarly to sub-surface bubblers. However, the pontoon-mounted injection system introduces air just beneath the surface of the lake. Again, the oxygen is provided by removing ice cover and exposing the surface of the lake to the atmosphere and sunlight. Air injection systems are also well suited to lakes, which winterkill frequently, where annual and lengthy operation is likely.
3. Mechanical surface agitators: Mechanical surface agitators are basically submersible or floating pumps which spray water into the air, producing a fountain-like effect. Oxygen is added to the water sprayed into the air, some oxygen is added as the droplets agitate the lake surface, as well as from the open water area created. These systems affect rather small areas and are best suited to small bodies of water.
4. Pump and baffle systems: Pump and baffle aeration systems usually consist of a pontoon-mounted high-volume pump, about 150 feet of hose and a chute or flume. The pump is placed in the lake as far from the chute as possible. Lake water is pumped to the top of the chute where it cascades over a series of baffles, absorbing oxygen before returning to the lake. This type of aeration system does not create, nor does it require, a large open water area to prevent winterkill. Aeration takes place in the chute and the aerated water is returned to the lake.

Pump and baffle systems are more energy intensive to operate than air pumping systems, but they do not have to be started as early in the winter. Pump and baffle systems are generally best suited to lakes which winterkill infrequently.

All of these systems function by creating a refuge area with adequate dissolved oxygen where fish can survive until ice out in the spring. They do not, nor are they intended to, aerate the entire lake basin.

PROGRAM ADMINISTRATION

The Division of Ecological Resources (MNDNR) has primary responsibility for administration of the Aeration Permit Program. This program allows individuals, organizations and units of government to operate aeration systems on public waters for winterkill prevention, water quality improvement, shoreline property protection and wintering captive waterfowl. An aquatic biologist in St. Paul reviews permit applications, prepares permits for signature and serves as liaison between groups and individuals involved in lake aeration and the department. Regional and area fisheries personnel are often the initial contacts for people interested in lake aeration. Applicants send completed applications to the Regional Fisheries Manager for initial review, the Regional Wildlife Manager, and the Regional Trails and Waterways Manager also review aeration permit applications. Upon completion of regional review, the application is sent to St. Paul with recommendation for issuance or denial. After final review by central office staff, the application is reviewed by the Director of the Division of Ecological Resources and either approved or denied.

REGULATIONS

Aeration system operation in public waters is regulated by Minnesota Statutes Section 103G.611 and Minnesota Rules 1988 parts 6116.0010 to 6116.0070. The statute describes permittee responsibility to post warning signs at access points to the lake, post signs around areas of open water and thin ice, and publish notice of the commencement of operation. The rule describes when permits are required, application procedures, and criteria for permit issuance, permit conditions and other related items.

The aeration rule, which went into effect November 30, 1988, replaced Commissioners' Orders 2194 and 2258. An operational order outlining departmental procedures to ensure rule requirements are met was developed and became effective August 1989 (MN Rules 6116). The Statute, 103G.611 was revised in 2003 to include an annual permit fee for winter time aeration. The Statute was again revised in 2006 to clarify operation of a system on protected waters without public access.

Aeration systems are inspected for compliance with safety regulations by area fisheries personnel and conservation officers. This involves the inspection of all aeration systems, including those operated by private hatchery operators.

DISCUSSION

Area fisheries supervisors monitor the dissolved oxygen concentration of lakes in their areas throughout the winter. When winterkill of fish appears to be imminent, a lake may be opened to "liberalized fishing". Under "liberalized fishing" status, regulations regarding limits and methods of capture are relaxed to allow fish that would probably die due to oxygen depletion to be taken by anglers. The number of lakes opened to "liberalized fishing" is a rough indicator of winter severity. During the worst winterkill season of record (1955-56), 308 lakes were opened to "liberalized fishing" (Scidmore 1970). Due to a recent series of mild winters, on average of five lakes statewide are opened to "liberalized fishing" each year. Last winter (2008-09), seventeen lakes were opened to "liberalized fishing", of which two were permitted for aeration (Figure 1).

A total of 291 aeration permits were issued during the 2008-09 season. This includes 277 renewals (95% of the permits issued) and fourteen (14) new permits. Twenty-two permittees from the previous season (2007-08) did not reapply for an aeration permit in 2008-09.

The overall trend has been a steady increase in the number of permits issued in the last twenty-five years, with a slight decrease in permit numbers occurring last year (Figure 2). The same trend is true for the regions as well, except for regions II and IV that remained steady in permit numbers (Figure 3). Region I experienced a 10% decrease in permits issued.

The 291 permits issued in 2008-09 authorized aeration in 277 lakes, of which 176 permits were issued for public waters with access for winterkill prevention (see MN Rules 1988, part 6116.0010, subpart 6 for definition of public access), for a total of

127,077 acres (Table 1; Figure 4). All acreages listed are from “An inventory of Minnesota Lakes” MN DNR Bulletin 25 (Div. of Waters 1968). Pump and baffle systems were operated in 26 of these lakes, Aire O₂ units were operated in 58 lakes, mechanical surface agitators operated in 20 lakes, a combination of system types was used in 10 lakes, and diffuser systems operated in 55 lakes. Bait dealers and commercial hatchery operations were permitted to operate in 34 public water bodies totaling 1,943 acres. Seventy-four (74) other public waters were aerated for other purposes including: shoreline protection; providing open water for captive waterfowl; and preventing winterkill and improving water quality combined. Table 2 provides a detailed analysis of permit issuance for 2008-09.

Winter inspections of aeration systems were conducted by inspectors from the divisions of Enforcement and Fish and Wildlife (Fisheries). A total of 730 inspections were made in 2008-09. Of these, Enforcement inspectors conducted 271 inspections and Fisheries inspectors conducted 452. The inspectors found a total of 104 discrepancies (17%) out of the 730 inspections completed. Discrepancies included fallen or missing thin ice or warning signs, signs too far apart, open water extending beyond the thin ice signs, or malfunctioning aeration equipment. A total of 156 inspections were completed in Region I of which none showed discrepancies. There were nine (9) inspections completed in Region II with no discrepancies. Inspectors conducted 207 inspections in Region III of which 23% showed discrepancies, and 355 inspections were conducted in Region IV with 45.5% discrepancies.

There have been seven fatalities at aeration system sites, the last occurring in 1999. No deaths resulted from accidents at aeration system sites in 2008-09.

REGIONAL AERATION SUMMARY

REGION I (Bemidji)

There were 64 aeration permits issued in Region 1 during the 2008-09 season, 22% of the total number of permits issued. Of the 64 permits issued, 56 (88%) were renewals and eight were new permits.

The 64 permits issued in Region I authorized aeration in 62 public waters, or 22.4% of the total public waters aerated statewide. Private hatchery operators accounted for 53% of the aeration permitted water bodies in Region I. Private hatchery operators received eight permits for 33(1,866 acres) public waters (11.9% of the statewide total lakes permitted or 1.4% of the total acres permitted) (Figure 5). Appendix 1 lists water bodies under aeration permit issued to private hatchery operators. Private organizations and municipalities were issued 13 aeration permits to prevent winterkill in 13 lakes (5,119 acres) with public access. Thirty-seven aeration permits were issued to private individuals on eleven lakes (28,758 acres) to prevent shoreline property damage due to ice expansion. One permit was issued to the State covering 1,204 acres. Eleven other aeration permits were issued to private groups to prevent winterkill in public waters (782 acres) without public access. One aerated lake was reported to have experienced winterkill according to questionnaire results. For more details,

including acreage of water under aeration permit, permittee, and purpose of operation see Tables 3 and 4.

REGION II (Grand Rapids)

Lakes in Region II are generally deeper and less fertile than in other areas of the state and very few winterkill. The abundance of lakes in this region, which do not winterkill greatly outnumber those lakes that do.

The reorganization of the regions from six to four in 2002 lead to a redistribution of aeration permits between the regions. Region II increased from zero permits in 2001 to ten in 2002 to seven in 2005. There were nine (9) permits issued, of which one permit was new for the 2008-09 season.

Of these nine permits, which represent 3% of the total number of permits issued, six were operated on lakes with access, one was operated on a lake without access, and two were operated to protect marinas. No aerated lakes reported winterkill according to questionnaire results. For more information, see Table 5.

REGION III (St. Paul)

There were 114 aeration permits issued for 112 lakes/ponds (21,289 acres) in Region III last season (39% of the total number of permits issued), 110 renewals (96%), and four new permits. Pine Tree, Alexander, Mitchell, and Moore lakes have two permits each.

Region III, the Metropolitan area, is the most densely populated region of the state. Lakes and ponds receive nutrient run-off from a variety of sources. As a result, many lakes are hypereutrophic. Aeration has been employed to serve a variety of purposes in Region III. Seventy-eight permits were issued to municipalities for operation of aeration systems in 68 lakes (8,696 acres) with public access. Three permits (21 acres) were issued to municipalities for lakes without public access. Seventeen permits (6,935 acres) were issued to clubs for lakes with public access, and five permits (317 acres) were issued to clubs operating aeration systems in lakes without public access. Eighteen permits for 16 lakes (5,116 acres) were issued to private individuals. The Minnesota Zoological Garden received one permit to operate three aeration systems (17 acres) for waterfowl and water quality. One permit was issued to Fort Snelling State Park for prevention of winterkill in Snelling Lake. One permit was issued to a private hatchery operator to aerate one (77 acres) public water. Two lakes experienced winterkill in Region III according to questionnaire results. For a more detailed breakdown of permit issuance in Region III, see Table 6.

REGION IV (New Ulm)

Region IV has 35.7% of the permits issued statewide. Last season, 104 permits (69,396 acres) were issued in Region IV; 103 were renewals (99%). One new permit was issued. The 104 aeration permits issued in Region IV authorized the aeration of 97 public waters. Lakes are less common in this area of the state and many are small and shallow. Soils are fertile and agriculture is extensive. Erosion deposits large amounts of soil, fertilizer and agricultural chemicals into lakes, accelerating eutrophication and

creating high oxygen demand. These conditions are typical of Midwestern lakes (Schneberger, 1970). Many anglers reside in this area of the state and winterkill lakes are an important fisheries resource. Ninety-four permits were issued to private organizations and municipalities to prevent winterkill of fish in 88 lakes (53,745 acres) with public access. Two permits were issued to prevent winterkill in two protected water without public access. Four permits were issued to municipalities and clubs to improve water quality. Albert Lea and Hanska lakes have two permits each.

According to the questionnaires returned, two aerated lakes experienced winterkill last season in Region IV. For a detailed breakdown of permit issuance in Region IV including acreages, purpose of operation, permittees (private, clubs, municipalities) and lake location (county), see Table 7.

QUESTIONNAIRE RESULTS

Completed questionnaires were received from 189 of 291 permittees, a 65% return. Operational information is summarized in Table 8, whereas, Appendix 2 lists operational information for individual aerated lakes. Questionnaire information is incomplete and subjective, making it difficult to determine specific system efficiency in preventing winterkill. Thirty-nine (39) respondents indicated their aeration system was not operated last winter.

The average cost for insurance (n=46) was \$544.00. This figure includes all permittees operating an aeration system in lakes with or without public access. The range of insurance premiums for the 2008-09 season was \$5.00-\$3,200.00. Two respondents indicated there was difficulty in acquiring the required insurance.

One hundred fifty (150) of the respondents indicated their aeration system was operated last winter and 40 of those indicated that waterfowl overwintered on the lake. Of these, nine respondents are located in Region I, 24 in Region III, and seven in Region IV. An estimated 2,750 waterfowl used the open water areas provided by aeration systems (range 2-400). Most of the birds were mallards and Canada geese.

Of the 150 permittees that responded and operated their systems last winter, 138 (92 %) indicated they were satisfied with system performance. Of these, 16% were Helixor systems, 14 % were Clean-Flo systems, 10% were pump and baffles, 17% were AireO2 and Aeromix systems, 26% were other types of bubbler systems, and 9% were mechanical surface agitators. Complaints ranged from mechanical failures to undersized and ineffective equipment. Five respondents indicated safety problems with their aeration systems.

Some aerated lakes experienced partial winterkill last season. Five of the 150 respondents that operated their aeration systems last winter reported some evidence of winterkill at ice out. Of these, one was a Helixor system, one was a bubbler system, two were pump and baffles, and one was a surface agitator system.

Based on the responses to the questionnaire as summarized in Table 8, some systems, such as the Aire-0₂ and the Aeromix tornado, were on average the least expensive to

operate per acre, with Helixor systems a close second. Pump and baffle systems were the most expensive to operate per acre and had the most horsepower per acre. Helixors were the least expensive to operate based on the horsepower of the system and the length of time they were operated. Helixor systems were on average used on larger sized lakes, up to 2,000 acres. Clean Flo systems were used on smaller lakes up to 250 acres in size. Air injector systems and mechanical surface agitators were used on lakes up to 1,500 acres in size.

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Table 1. Aerated Acres 2008-09.

ACRES	REGION 1	REGION 2	REGION 3	REGION 4	OVERALL
Lakes with public access	37,440	1,100	20,406	68,131	127,077
Lakes without public access	1,665	260	883	1,265	4,073
TOTAL	39,105	1,360	21,289	69,396	131,150

Table 2. 2008-09 Aerated Lakes/Permits.

Region	Lakes w/access	Winterkill Permits				Bait Dealers		Shoreline		Other		Total Permits
		C	M	S	P	Ponds	Permits	Lakes	Permit	Lakes	Permit	
I	14	9	4	1	0	33	8	10	37	4	5	64 (22%)
II	3	2	0	0	1	0	0	0*	2	3	4	9 (3.1%)
III	65	12	51	1	1	1	1	2	3	44	45	114 (39%)
IV	88	44	49	0	1	0	0	1	1	8	9	104 (35.7%)
Totals	170	67	104	2	3	34	9	13	43	59	63	291

		Lakes	Acres	Permits
Protected waters with access for winterkill prevention	=	169	71,752	176
Protected waters under permit to Bait Dealers	=	34	1,943	9
Shoreline Protection	=	13	34,220	43
Other**	=	<u>61</u>	<u>23,235</u>	<u>63</u>
		277	131,150	291

Total number of permits for protected waters with access for winterkill prevention = 176

Total number of permits for protected waters without access for winterkill prevention = 17

291 total permits, new permits = 14

07-08 permits not reissued = 22

Other includes – Protected waters with no public access.
Protected waters with public access for wintering waterfowl, and water quality.
Summer only systems.

* = Marinas along Lake Superior

C = Clubs; M = Municipalities; S = State; P = Privately Operated

Table 3. Region I lakes with public access aerated to prevent winterkill, 2008-09.

County	Permittee			Total No. of lakes	Total Acres	Average Size (acres)
	C	M	S			
Becker	2	0	0	2	1,168	584
Clay	1	1	0	2	139	69.5
Clearwater	0	1	0	1	1,465	1465
Douglas	0	0	0	0	0	0
Marshall	0	1	0	1	42	42
Otter Tail	2	1	0	3	1,165	388.3
Polk	2	0	0	2	376	188
Pope	0	0	1	1	1,204	1,204
Stevens	1	0	0	1	488	488
Wadena	1	0	0	1	356	356
Totals	9	4	1	14	6,403	N/A

# lakes with public access aerated to prevent winterkill	=	14 (C = 9; M = 4; S = 1)
Total Acreage	=	6,403
Average lake size (acres)	=	457.4
Permits issued to Municipalities for lakes with access	=	4 (1,767 acres)
Permits issued to Clubs for lakes with access	=	9 (3,432 acres)
Permits issued to the State w/access	=	1 (1,204 acres)
Permits issued for shoreline protection	=	37 (11 lakes; 28,758 acres)
Melissa Lake – 1,827 acres – 8 permits		Fish Lake – 284 acres – 1 permit
Lida Lake – 7,277 acres – 6 permits		Big Cormorant Lake – 3,380 acres – 5 permits
Big McDonald – 3,096 acres – 2 permit		
Eunice Lake – 370 acres – 1 permit		Pelican – 4,314 acres – 8 permits
Lizzie Lake – 4,145 acres – 3 permits		Sallie – 1,246 acres – 1 permit
Island Lake – 1,209 acres – 1 permit		Marion Lake – 1,610 acres – 1 permit
Permits issued to Bait Dealers, & P. Hatchery operators	=	8 (33 ponds, 1,866 acres)
Permits issued to private individuals to prevent winterkill for lakes without access	=	11 (782 acres)
Permits issued to the State without access	=	0 (0 acres)
Permits issued to private individuals to improve water quality for lakes with access	=	2 (1,892 acres)
Total Permits issued	=	64 (39,105 acres) in 62 lakes and ponds

*C = Club; M = Municipality; S = State

Table 4. Summary by county of protected waters in Region I, under aeration permit issued to private hatchery operators in 2008-09.

County	Total No. of Ponds	Total Acres	Average Size Pond (Acres) Per County
Becker	1	242	242.0
Douglas	3	47	15.6
Grant	5	456	91.2
Otter Tail	14	642	45.9
Polk	6	242	40.3
Pope	2	90	45.0
Stevens	1	78	39.0
Todd	1	69	69.0
Totals	33	1,866	N/A

Averages:

Bait dealers permitted	=	8 (8 permits)
Average number of ponds/permit	=	4.1
Average size of ponds	=	56.5 acres (range 6 to 242 acres)
Average number of acres/permit	=	233.3

Table 5. Region II lakes with public access aerated to prevent winterkill, 2008-09.

County	Permittee			Total No. of lakes	Total Acres	Average Size (acres)
	C	M	P			
Aitkin	0	0	0	0	0	0
Cass	2	0	1	3	373	124.3
Crow Wing	0	0	0	0	0	0
Lake	0	0	0	0	0	0
Totals	2	0	1	3	373	N/A

Lakes with public access aerated to prevent winterkill	=	3
Total Acreage	=	373
Average lake size (acres)	=	124.3
Permits issued to Municipalities for lakes without access	=	0
Permits issued to Municipalities for lakes with access	=	0
Permits issued to Clubs for lakes with access	=	3 (844 acres)
Permits issued to Clubs for lakes without access	=	1 (260 acres)
Privately operated systems for lakes with access (2 permits for Nisswa Lake)	=	3 (256 acres)
Privately operated systems for lakes without access	=	0 (0 acres)
Permits issued to State with access (2 – protect dock stations)	=	2 (on Lake Superior)
Total Permits issued	=	9 (1,360 total acres in 6 lakes/ponds)

C = Club; M = Municipality; P = Privately Operated, S = State

Table 6. Region III lakes with public access aerated to prevent winterkill, 2008-09.

County	Permittee				Total No. of lakes	Total Acres	Average Size (acres)
	C	M	P	S			
Anoka	0	8	0	0	8	3,082	385.3
Carver	0	2	0	0	2	323	161.5
Crow Wing/Morrison	0	0	0	0	0	0	0
Dakota	0	19	0	0	19	1,198	63.1
Hennepin	1	5	0	1	7	757	108.1
Kanabec	1	0	0	0	1	1,127	1,127
Pine	0	0	0	0	0	0	0
Ramsey	0	7	0	0	7	806	115.1
Scott	4	5	0	0	9	1,545	171.7
Sherburne	1	1	1	0	3	841	280.3
Stearns	0	1	0	0	1	222	222.0
Washington	0	3	0	0	3	213	71.0
Wright	5	0	0	0	5	1,117	223.4
Totals	12	51	1	1	65	11,231	N/A

Lakes with public access aerated to prevent winterkill	=	65
Total Acreage	=	11,231
Average lake size (acres)	=	172.8
Permits issued to Municipalities for lakes without access	=	3 (21 acres)
Permits issued to Municipalities for lakes with access (2 permits in Moore Lake)	=	68 (8,696 acres)
Permits issued to Clubs for lakes with access	=	17 (6,935 acres)
Permits issued to Clubs for lakes without access	=	5 (317 acres)
Privately operated systems for lakes with access (Shoreline protection – 3 permits/2 lakes (4,443))	=	6 (4,665 acres)
Privately operated systems for lakes without access (2 permits in Pine Tree Lake)	=	12 (451 acres)
Private Hatchery Operator permits for lakes with access	=	1 (77 acres)
Permits issued to State with access	=	1 (0 acres)
Permits issued to State without access	=	1 (17 acres)
Total Permits issued	=	114 (21,289 total acres in 112 lakes/ponds)

C = Club; M = Municipality; P = Privately Operated, S = State

Table 7. Region IV lakes with public access aerated to prevent winterkill 2008-09.

County	Permittee				Total No. of lakes	Total Acres	Average Size (acres)
	C	M	P	S			
Big Stone	2	1	0	0	3	2,561	853.7
Blue Earth	4	0	0	0	4	2,714	678.5
Brown	2	2	0	0	3	2,459	819.7
Cottonwood	6	0	0	0	5	1,716	343.2
Faribault	1	0	0	0	1	268	268.0
Freeborn	0	4	0	0	3	3,230	1,076.7
Jackson	6	0	0	0	6	2,948	491.3
Kandiyohi	0	9	0	0	8	7,627	953.4
Le Sueur	4	0	0	0	4	1,768	442.0
Lincoln	5	0	0	0	5	6,327	1,265.4
Lyon	0	9	0	0	9	2,518	279.8
Martin	3	3	0	0	6	1,768	294.7
McLeod	2	1	0	0	3	1,505	501.6
Meeker	1	0	1	0	2	774	387.0
Murray	1	10	0	0	10	6,450	645.0
Nobles	1	5	0	0	6	3,903	650.5
Pipestone	0	1	0	0	1	80	80.0
Rice	2	0	0	0	2	1,233	616.5
Sibley	0	0	0	0	0	0	0
Steele	0	1	0	0	1	11	11.0
Waseca	2	1	0	0	2	2,581	1,290.5
Watonwan	2	0	0	0	2	640	320
Yellow Medicine	0	2	0	0	2	664	332.0
Totals	44	49	1	0	88	53,745	N/A

Lakes with public access aerated to prevent winterkill	=	94
Total Acreage	=	53,745
Average lake size (acres)	=	571.8
Permits issued to Municipalities for lakes with access	=	51 (27,732 acres)
		(2 permits for Albert Lea & Wilson lakes)
Permits issued to Clubs for lakes with access	=	45 (26,066 acres)
		(2 permits for Double & Hanska lakes)
Permits issued to Clubs for lakes without access	=	2 (120 acres)
Private Hatchery Operator	=	0
Privately Owned Systems with public access	=	2 (1,239 acres)
Privately Owned Systems without public access	=	1 (18 acres)
Permits issued to State for lakes with public access	=	1 (13,094 acres)
Permits issued to Municipalities for lakes without access	=	0 (0 acres)
Permits issued to State for lakes without public access	=	2 (1,127 acres)
Total Permits Issued	=	104 (69,396 acres; 97 lakes)

C=Club; M=Municipality; P=Privately Operated, S=State

Table 8. Operational Characteristics of Some Aeration Systems, Winter 2008-09.

		Total hp	Lake Area (A)	hp/A	\$/A/mo	\$/hp/mo	KWH/hp/mo	KWH/hp/A
Helixor	Range	3-30	21-2,462	0.01-0.14	\$ 0.05 – 6.99	\$ 5.82-65.82	45.29-686.18	0.32-108.33
	Mean (x)	12.75	664.5	0.045	\$ 1.76	\$ 40.40	498.96	11.05
	n	21	21	21	18	18	14	14
Clean-Flo	Range	0.5-9.0	10-1,263	0.007-0.40	\$ 0.03-27.60	\$ 20.30-142.90	33.8-1,324.3	1.35-34.0
	Mean (x)	3.1	196.7	0.07	\$ 4.61	\$ 79.23	597.84	15.15
	n	18	18	18	11	11	5	5
Aire-0₂	Range	2.0-30.0	3-1,507	0.001-0.667	\$ 0.11-5.37	\$ 30.0-136.83	330.70-1,103.75	0.60-28.98
	Mean (x)	5.2	344.5	0.048	\$ 1.48	\$ 74.73	614.51	7.38
	n	26	26	26	18	18	14	14
Pump & Baffle	Range	3.0-20.0	3-500	0.020-1.67	\$ 1.06-190.48	\$ 14.67-124.54	91.43-2,374.25	9.59-163.94
	Mean (x)	9.21	106.0	0.24	\$ 23.52	\$ 51.25	617.75	52.23
	n	17	17	17	13	13	7	8
Mechanical Surface Agitators	Range	0.75-3.00	17-1,778	0.001-0.044	\$ 0.61-6.32	\$ 23.85-143.20	339.47-1,362.7	3.44-200.39
	Mean (x)	1.75	491	0.015	\$ 2.36	\$ 77.05	758.06	70.4
	n	7	7	7	n = 3	n = 3	n = 3	n = 3

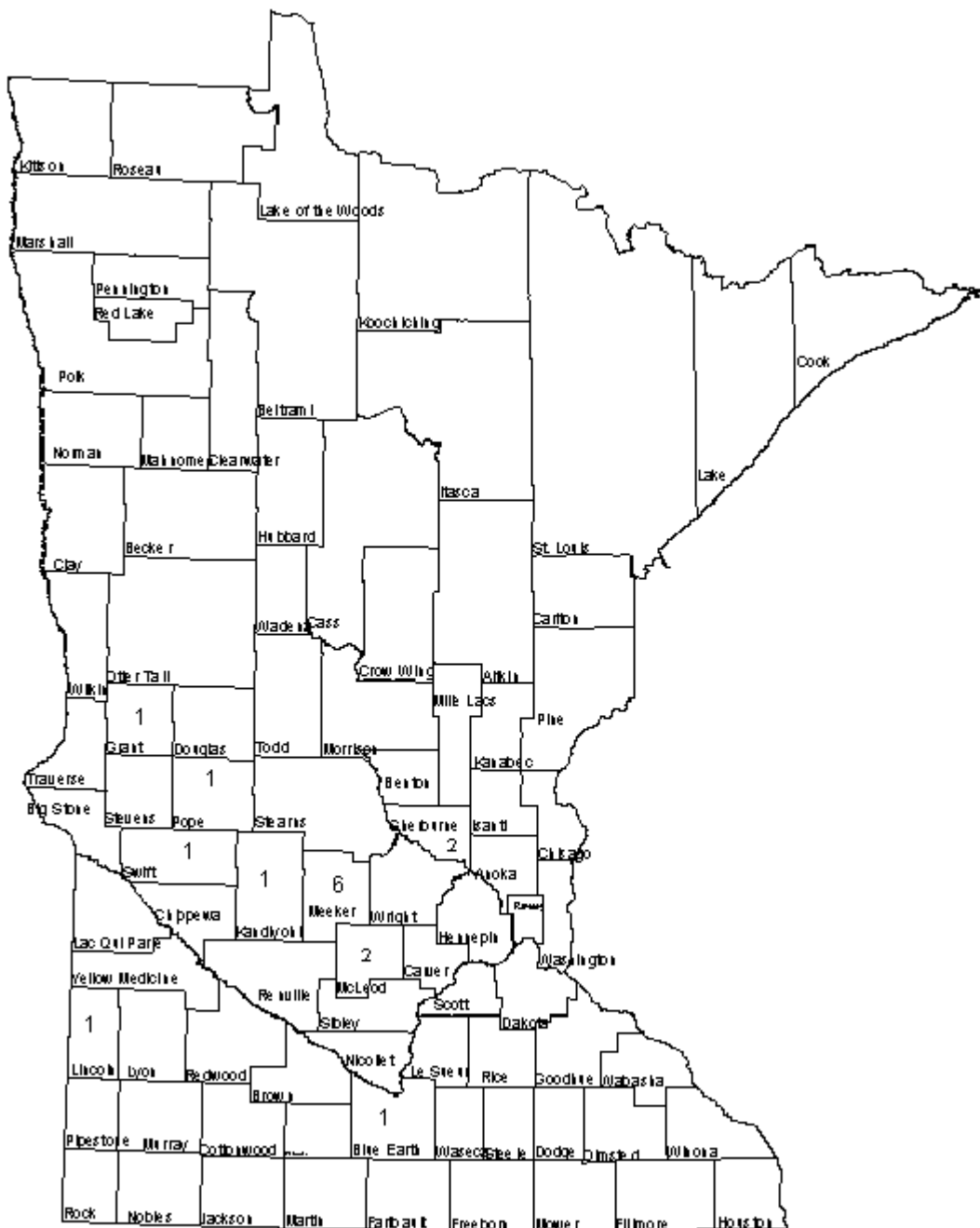


Figure 1. Number of lakes opened to “liberalized” fishing, by county, for the winter of 2008-09.

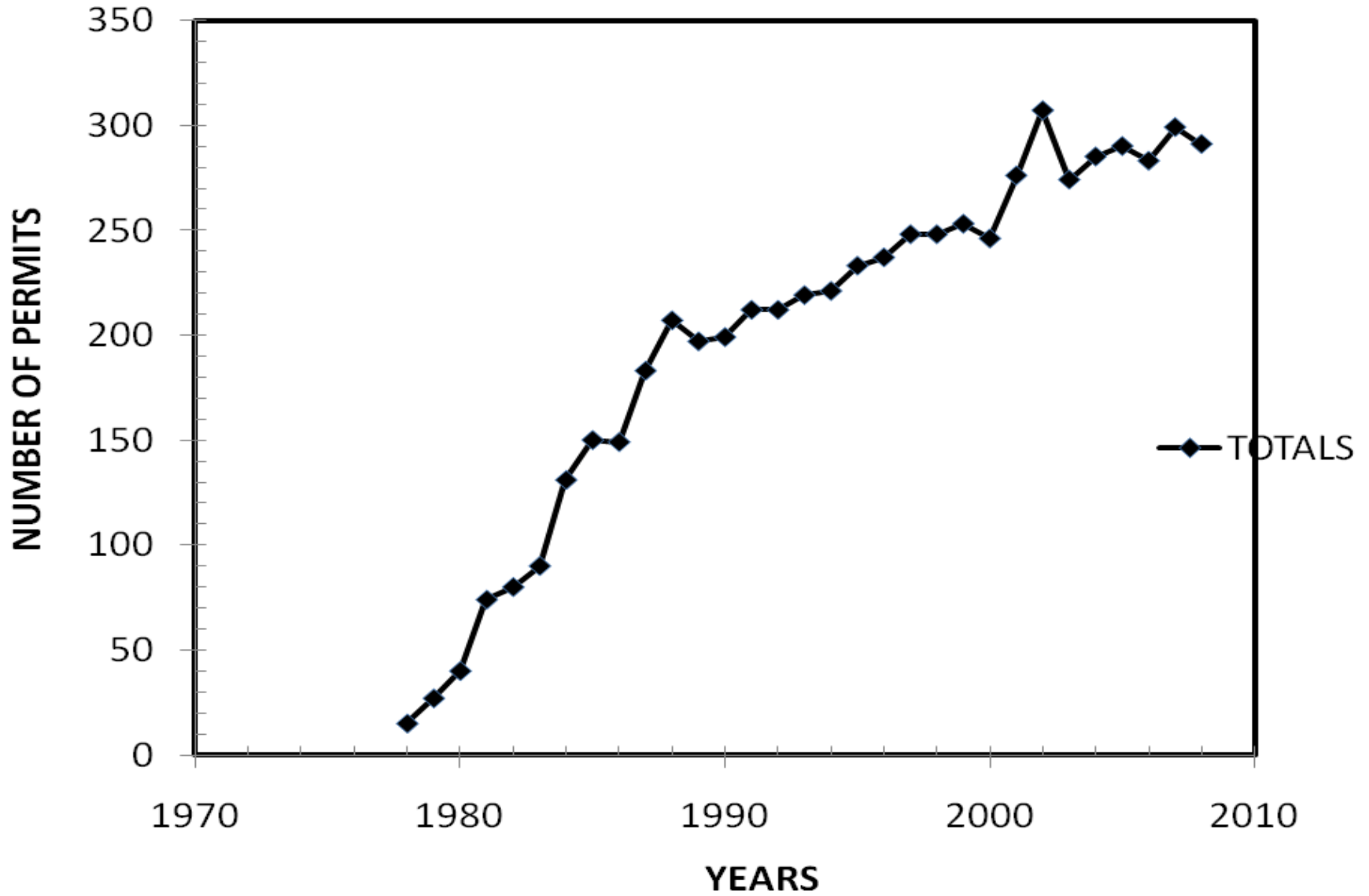


Figure 2. Trends in lake aeration permits issued 1978-2008.

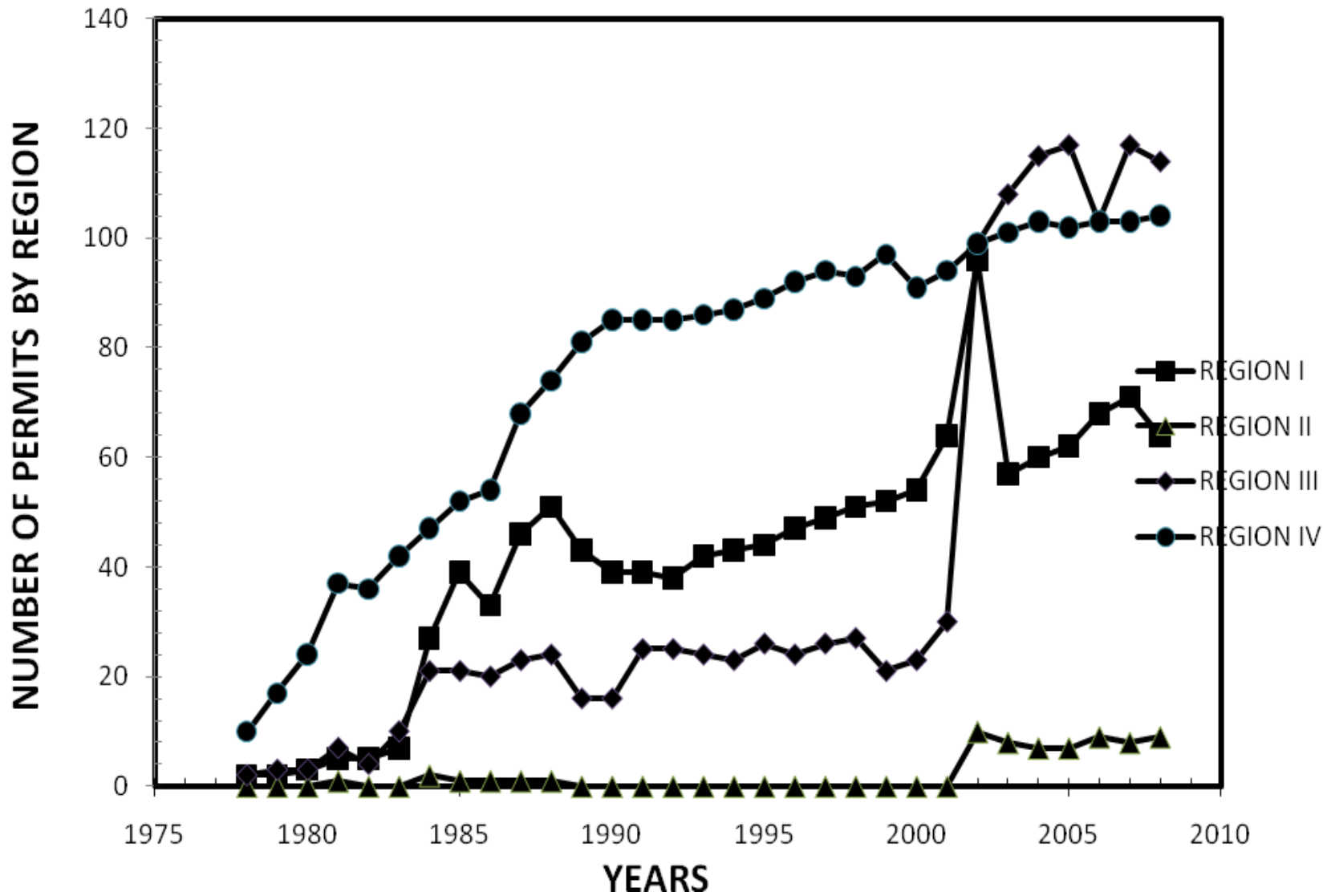


Figure 3. Aeration permits issued by DNR region, 1978-2008.

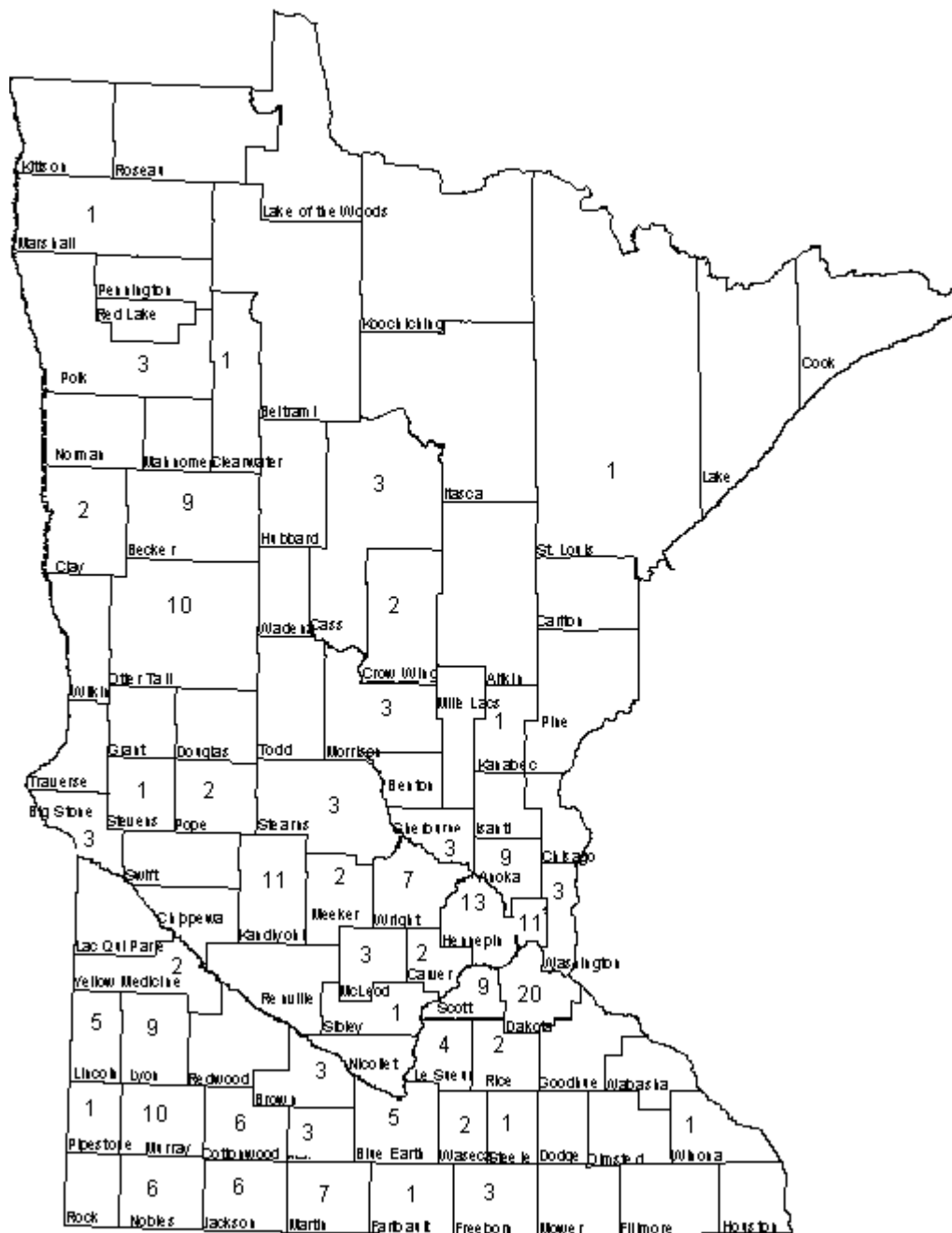


Figure 4. Number of lakes with public access, by county, issued aeration permits in 2008-2009.

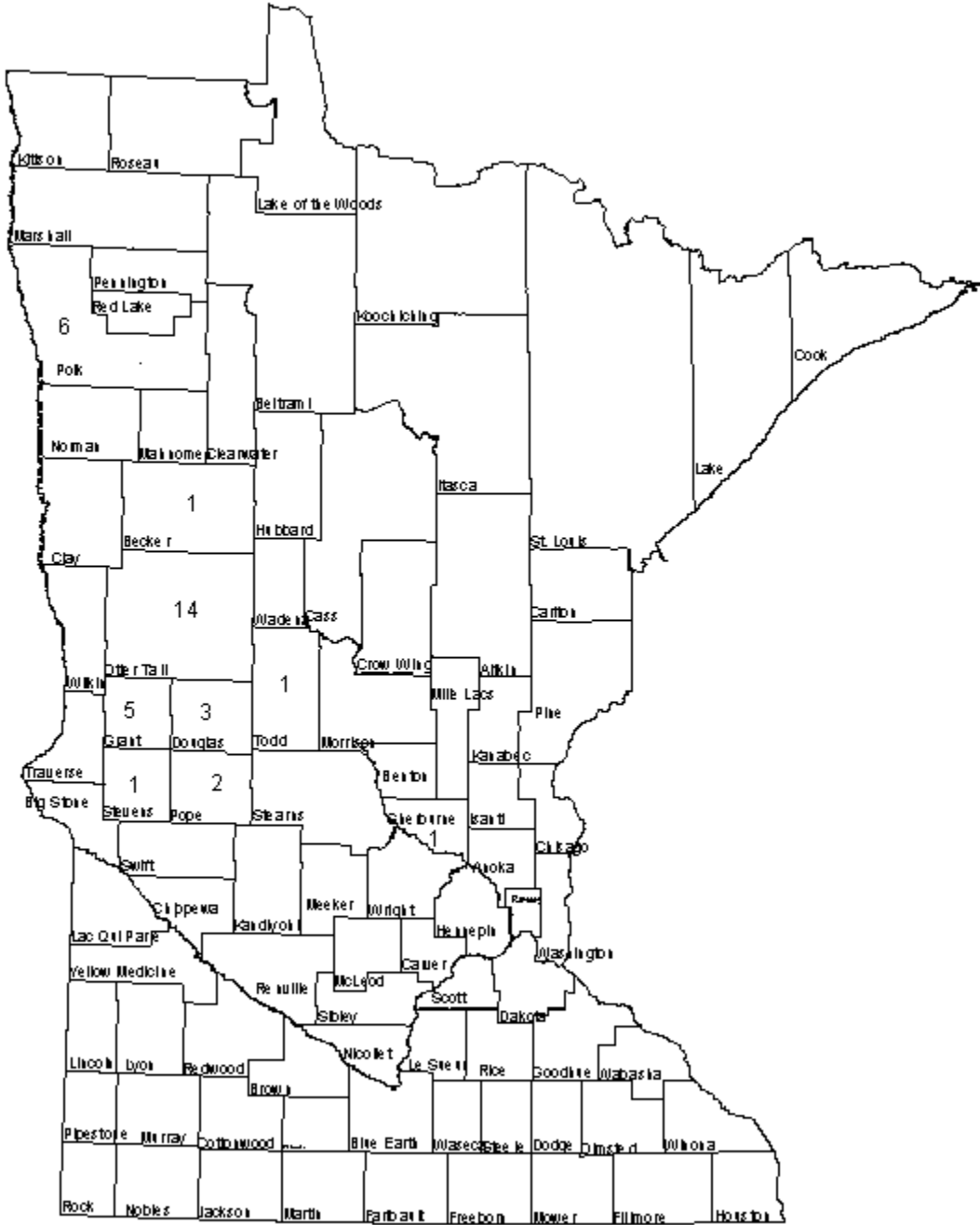


Figure 5. Distribution by County of ponds aerated under permits issued to private hatchery operators in 2008-09.

APPENDICES

Appendix 1. Private hatchery operators and protected waters under permit for 2008-09.

Permit #	Last Name	County	D.O.W.	Acres
Region 1				
F0891032	P. Koep	Douglas	21-74	17
			21-116	24
		Grant	26-141	62
			56-136	34
		Otter Tail	56-85	19
			56-155	21
			56-234	34
			56-1074	12
			56-883	21
F0891038	Jeff Koep	Douglas	Gravel Pit	6
			Grant	26-8
		Otter Tail		26-33
			56-1183	10
			56-23	87
			56-25	73
			56-29	53
			56-49	43
			56-858	43
		Pope	56-1182	12
			61-63	28
			61-22	62
		Todd	77-52	69
		F0891042	Wertish	Polk
60-157	41			
60-172	48			
60-141	46			
F0891061	Spartz	Polk	60-53	30
			60-288	67
F0891092	Joe Koep	Otter Tail	56-149	180
F0891103	Goeden	Becker	3-269	242
		Grant	26-114	93
F0891199	Lint	Stevens	75-25	28
			75-26	50
F0891213	Jost	Grant	26-216	226
Region 3				
F0893100	McDonald	Sherburne	71-129	77

Appendix 2. Questionnaire results of aeration systems operated to prevent winterkill in lakes with or without public access, 2008-09.

Lake (DOW #)	County	Lake Area (A)	Permittee	System description (No. of units, rating)	Electrical Consumption (KWH)	Electrical costs (\$)	Number Months operated	Winterkill (Y or N)
<u>Polcon Helixors</u>								
Artichoke (6-2)	Big Stone	2,011	Save A Lake Aeration	2-15 HP motor/blowers 12 diffusers				did not return questionnaire
Clear (8-11)	Brown	325	New Ulm Area Sport fisherman	1-10 HP motor/blower 7 diffusers	5,410	534.00	2.8	N
Hanska (8-26)	Brown	1,844	Brown Co. Park Dept.	1-15 HP blower 6 diffusers	14,904	1,210.00	1.6	N
Hanska (8-26)	Brown	1,844	Lake Hanska Area Association	1-15 HP Helixor	17,570	1,624.97	1.8	N
Sleepy Eye (8-45)	Brown	290	City of Sleepy Eye	2-5 HP motor/blowers 4 diffusers	-	-	1.7	N
Bingham (17-7)	Cottonwood	274	Cottonwood County Game & Fish League	1-5 HP blower 4 diffusers	-	-	2.7	N
Cottonwood (17-22)	Cottonwood	146	Cottonwood County Game & Fish League	1-5 HP motor/blower 3 diffusers	-	-	2.8	N
Rebecca (19-3)	Dakota	35	City of Hastings	1-5 HP blower 2 diffusers	770	103.67	3.4	N
Fountain (24-18)	Freeborn	555	City of Albert Lea	2-7.5 HP blowers 6 diffusers				did not return questionnaire
Morin (24-43)	Freeborn	21	City of Alden	1-3 HP blower 1 diffuser	6,825	514.00	3.5	N
Round (27-71)	Hennepin	34	City of Eden Prairie	1-7.5 HP blower 1 diffuser				did not return questionnaire
Loon (32-20)	Jackson	738	Jackson County Conservation League	2-7.5 HP motor/blowers 9 diffusers	-	850.00	2.4	N

Appendix 2. (Con't.)

Lake (DOW #)	County	Lake Area (A)	Permittee	System description (No. of units, rating)	Electrical Consumption (KWH)	Electrical costs (\$)	Number Months operated	Winterkill (Y or N)
<u>Polcon Helixors (Con't.)</u>								
Pearl (32-33)	Jackson	117	Jackson County Conservation League	1-7.5 HP blower 3 diffusers	-	1,000.00	2.5	N
Round (32-69)	Jackson	947	Round Lake Sportsmen's Club	2-7.5 HP motor/blowers 9 diffusers		did not return questionnaire		
East Solomon (34-246)	Kandiyohi	733	Kandiyohi County	1-10 HP motor 6 diffusers	19,213	1,834.00	2.8	N
Foot (34-181)	Kandiyohi	576	Willmar Parks Department	1-25 HP motor/blower 6 diffusers	31,971	2,492.61	3.0	N
Long (34-192)	Kandiyohi	1,715	Kandiyohi County	2-10 HP motors 12 diffusers	37,531	3,503.00	3.0	N
Mud (Monongalia) M Fk Crow R. (34-158)	Kandiyohi	2,516	Kandiyohi County	1-15 HP motor 6 diffusers	15,164	1,675.00	3.0	Y
Ringo (34-172)	Kandiyohi	774	Kandiyohi County	1-10 HP motor 9 diffusers	18,346	1,772.00	2.9	N
Swenson (34-321)	Kandiyohi	123	Kandiyohi County	1-7.5 HP motor 5 diffusers	12,201	1,225.00	3.0	N
Wakanda (34-169)	Kandiyohi	1,792	Kandiyohi County	2-15 HP blowers 12 diffusers	17,040	1,702.00	1.2	Y
Willmar (34-180)	Kandiyohi	761	Willmar Public Works	1-15 HP blower 6 diffusers	20,537	1,642.43	3.0	N
Clear (40-79)	LeSueur	282	Lexington Sportsmen's Club	1-7.5 HP motor 3 diffusers		did not return questionnaire		

Appendix 2. (Con't.)

Lake (DOW #)	County	Lake Area (A)	Permittee	System description (No. of units, rating)	Electrical Consumption (KWH)	Electrical costs (\$)	Number Months operated	Winterkill (Y or N)
<u>Polcon Helixors (Con't.)</u>								
Gorman (40-32)	LeSueur	590	Izaak Walton League	1-7.5 HP compressor 3 diffusers				did not return questionnaire
Greenleaf (40-20)	LeSueur	306	Montgomery Sportsmen's Club	1-5 HP compressor 3 diffusers				did not return questionnaire
Cottonwood (42-14)	Lyon	383	Lyon County	1-15 HP motor 6 diffusers				did not return questionnaire
East Twin (42-70)	Lyon	280	Lyon County	1-7 HP blower 2 diffusers				did not return questionnaire
West Twin (42-74)	Lyon	237	Lyon County	1-7.0 HP motor/blower 2 diffusers				did not return questionnaire
George (46-24)	Martin	82	City of Fairmont	1-5 HP blower 2 diffusers	4,468	424.01	1.4	N
Sisseton (46-25)	Martin	139	City of Fairmont	1-15 HP blower 2 diffusers	7,573	719.38	1.2	N
Swan (43-41)	McLeod	482	Silver Lake Sportsmen's Club	1-7HP blower 3 diffusers				did not return questionnaire
Bloody (51-40)	Murray	248	Murray County	1-7.5 HP blower 2 diffusers				did not return questionnaire
First Fulda (South) (51-21)	Murray	122	Murray County	2-7.5 HP motor/blowers 4 diffusers				did not return questionnaire
Sarah (51-83)	Murray	1,176	Murray County	1-7.5 HP motor/blower 4 diffusers				did not return questionnaire

Appendix 2. (Con't.)

Lake (DOW #)	County	Lake Area (A)	Permittee	System description (No. of units, rating)	Electrical Consumption (KWH)	Electrical costs (\$)	Number Months operated	Winterkill (Y or N)
<u>Polcon Helixors (Con't.)</u>								
Indian (53-7)	Nobles	204	Round Lake Sportsmen's Club	1-10 HP blower 4 diffusers			did not return questionnaire	
Okabena (53-28)	Nobles	785	City of Worthington	2-7.5 HP blowers 9 diffusers	18,090	1,248.21	2.1	N
Cedar (70-91)	Scott	749	New Prague Sportsmen's Club	1-20 HP pump 12 Helixor diffusers			did not return questionnaire	
Becker (73-156)	Stearns	222	Sauk River Watershed District	1-15 HP blower 9 diffusers	-	961.71	2.8	N
Elysian (81-95)	Waseca	2,462	Smith's Mill-Janesville Sportsmen's Club	3-7.5 HP blowers 15 diffusers	-	275.00	2.1	N
Winona (85-11)	Winona	318	City of Winona	3-7.5 HP compressors 6 diffusers			did not return questionnaire	
Wood (87-30)	Yellow Medicine	484	Yellow Medicine County	1-15 HP compressor 6 diffusers			did not return questionnaire	
<u>Clean-Flo Systems</u>								
Shack Eddy (2-109)	Anoka	22	Armstrong Kennels	1-0.5 HP blower 1 diffuser	-	-	2.5	N
Crystal (7-98)	Blue Earth	396	Crystal and Loon Lake Rec., Inc.	2-0.75 HP compressors 4 diffusers	-	450.00	2.2	N
Ida (7-90)	Blue Earth	120	Lura Lake Aeration Corp.	1-5 HP compressor 8 diffusers	-	-	1.9	N
Loon (7-96)	Blue Earth	818	Crystal and Loon Lake Rec., Inc.	4-0.75 HP compressors 8 diffusers	-	600.00	2.2	N

Appendix 2. (Con't.)

Lake (DOW #)	County	Lake Area (A)	Permittee	System description (No. of units, rating)	Electrical Consumption (KWH)	Electrical costs (\$)	Number Months operated	Winterkill (Y or N)
Clean-Flo Systems (Con't.)								
Lura (7-79)	Blue Earth	1,263	Lura Lake Aeration Corp.	1-5 HP & 1-4 HP Clean Flo, 12 diffusers	-	-	2.3	N
Alimagnet (19-21)	Dakota	113	City of Apple Valley	1-2 HP compressor 6 diffusers	7,681	668.42	2.9	N
Arrowhead (27-45)	Hennepin	23	City of Edina	1-1.5 HP compressor 3 diffusers	-	-	3.5	N
Crystal (27-34)	Hennepin	74	City of Robbinsdale	8-0.5 HP compressors 16 diffusers		did not operate		
Indianhead (27-44)	Hennepin	13	City of Edina	4-0.5 HP compressors 4 diffusers	-	-	3.5	N
Gleason (27-95)	Hennepin	167	Gleason Lake Improvement Assn	4-0.5 HP compressors 16 diffusers		did not operate		
Hadley (27-109)	Hennepin	39	Hadley Lake Improvement Assn	6-0.5 HP compressors 7 diffusers	-	-	3.1	N
Irene (27-189)	Hennepin	29		2-0.5 HP compressors 4 diffusers		did not return questionnaire		
Sweeney-Twin (27-35)	Hennepin	96	Sweeney Lake Assn	3-0.5 HP to 7-0.75 HP compressors, 18 diffusers	-	600.00	4.1	N
Unnamed (Upper) (34-28)	Kandiyohi	22	City of Atwater	2-2 HP compressors 4 diffusers	1,302	236.00	2.9	N
Unnamed (Tadd) (34-376)	Kandiyohi	10	City of Atwater	2-2 HP compressors 4 diffusers	54	110.53	0.4	N

Appendix 2. (Con't.)

Lake (DOW #)	County	Lake Area (A)	Permittee	System description (No. of units, rating)	Electrical Consumption (KWH)	Electrical costs (\$)	Number Months operated	Winterkill (Y or N)
Clean-Flo Systems (Con't.)								
Mabel (40-11)	LeSueur	103	Lucky 13 Sportsmen's Club	2-0.5 compressors 4 diffusers	-	210.00	2.8	N
Unnamed (40-58)	LeSueur	18		1-0.75 compressor 2 diffusers		did not return questionnaire		
Unnamed (58-141)	Pine	23		1-0.75 compressor 2 diffusers	-	160.00	3.8	N
Birch (62-24)	Ramsey	127	Birch Lake Improvement Assn	1-1 HP compressor 3 diffusers		did not return questionnaire		
Willow (62-40)	Ramsey	75	Natural Preserve Foundation	3-0.5 compressors 6 diffusers	-	-	3.1	N
Cody (66-61)	Rice	257	Wheatland Twin Lakes Sportsmen's Club	4-0.5 and 2-0.75 HP compressors, 12 diffusers	8,999	1,170.00	3.0	N
Krenz (Sunset) (70-09)	Scott	15		1-HP compressor 2 diffusers		did not return questionnaire		
Unnamed (Fawn) (71-110)	Sherburne	33	Carefree Country Club	2-0.5 HP – 4 diffusers 1-0.75 HP – 2 diffusers	-	550.00	2.2	N
Loon (81-15)	Waseca	119	City of Waseca	1-5 HP compressor 9 diffusers	9,266	964.71	2.8	N
Benz (82-120)	Washington	36	Benz Lake Homeowners Association	3-0.75 HP, 1-0.33 HP 8 diffusers		did not operate		
Pine tree (82-122)	Washington	174		1-0.5 HP compressor 2 diffusers	-	200.00	4.0	N

Appendix 2. (Con't.)

Lake (DOW #)	County	Lake Area (A)	Permittee	System description (No. of units, rating)	Electrical Consumption (KWH)	Electrical costs (\$)	Number Months operated	Winterkill (Y or N)
Clean-Flo Systems (Con't.)								
Sunset (82-153)	Washington	124	Sunset Lake Homeowners Association	2-0.5 HP compressor 4 diffusers			did not return questionnaire	
Other Bubblers								
Bijou (3-638)	Becker	229	Cormorant Lake Sportsmen's Club	4-Wifle Webber diffusers 2-pumps			did not return questionnaire	
Ellison (3-484)	Becker	79	Cormorant Lake Sportsmen's Club	1-1.0 HP pump 2 diffusers			did not return questionnaire	
Little Cormorant (3-506)	Becker	939	Cormorant Lake Sportsmen's Club	3-1 Hp pumps 6 ceramic brick diffusers			did not return questionnaire	
Ewert's (4-205)	Beltrami	34		2-2 HP compressors 4 diffusers	-	-	4.0	N
Mills (7-97)	Blue Earth	237	Crystal and Loon Lake Recreation	2-0.75 HP compressors 4 diffusers			did not operate	
Oak (10-93)	Carver	185		4-1 HP compressors 8 diffusers	-	-	3.8	N
Eagle (11-342)	Cass	110	Eagle Lake Association	1-0.5 HP pump 2 diffusers	2,070	219.42	2.5	N
Meadow (11-419)	Cass	43	Wilderness Park Assn.	1-1.0 HP pump 2 diffusers			did not return questionnaire	
Blue Eagle (14-93)	Clay	11	City of Barnesville	2-1/2 HP pumps 4 diffusers	-	-	5.0	N
Lake Fifteen (14-30)	Clay	128	Cormorant Lake Sportsmen's Club	2-1 HP motor 4 ceramic diffusers			did not return questionnaire	

Appendix 2. (Con't.)

Lake (DOW #)	County	Lake Area (A)	Permittee	System description (No. of units, rating)	Electrical Consumption (KWH)	Electrical costs (\$)	Number Months operated	Winterkill (Y or N)
Other Bubblers (Con't.)								
Pine (15-149)	Clearwater	1,465	Red Lake Watershed District	Bubbler			did not return questionnaire	
Rice (22-7)	Faribault	268	Wells Rifle & Pistol Club	2-0.75 compressors 9 diffusers	-	-	2.4	N
Albert Lea (24-14)	Freeborn	2,654	Freeborn County	2-1 HP compressors diffuser tubing	-	2,160.00	2.9	Y
Pottery Pond (25-38)	Goodhue	8	City of Red Wing	1-0.75 HP Vane compressor 2 diffusers	-	-	3.1	N
Marion (43-84)	McLeod	616	Brownston Rod and Gun Club	1-5 HP blower 3 mat diffusers	8,519	870.07	2.5	N
Alexander	Morrison	2,990		1-3 HP Vein pump 500 pt diffuser hose	-	600.00	3.5	N
Shamaineau (49-127)	Morrison	1,453		Regiair Vane blower 1.5 HP	-	712.00	-	N
Perch (56-95)	Otter Tail	57		1-0.75 HP compressor			did not return questionnaire	
Unnamed (56-549)	Otter Tail	17		1-0.25 HP motor and diffuser hose	-	-	2.7	N
Lena (58-18)	Pine	50	Lake Lena Acres Assn	2-0.25 HP bubbler			did not return questionnaire	
Cable (60-293)	Polk	129	Cable Lake Association	3-0.25 HP pump	2,844	201.92	2.8	N

Appendix 2. (Con't.)

Lake (DOW #)	County	Lake Area (A)	Permittee	System description (No. of units, rating)	Electrical Consumption (KWH)	Electrical costs (\$)	Number Months operated	Winterkill (Y or N)
<u>Other Bubblers (Con't.)</u>								
Pleasant (62-46)	Ramsey	585	City of St. Paul Water Utility	2-30 HP compressors 2 diffusers			did not return questionnaire	
Ann (71-69)	Sherburne	226	Ann Lake Improvement Club, Inc.	1-.5 HP compressor 2 copper diffusers	-	120.00	2.2	N
Kohlmeier (74-19)	Steele	11	City of Owatonna	2-0.75 HP compressors 3 diffusers	-	-	3.5	N
Stocking (80-37)	Wadena	356	Stocking Lake Boosters, Inc.	2 Gast compressors 5 diffusers	-	-	4.0	N
Mud (Battle Creek) (82-91)	Washington	103	City of Woodbury	2-1 HP compressors 6 diffusers	2,500	300.00	3.0	N
Unnamed Pond (82-257)	Washington	7		0.25 HP blower 2 diffusers	-	-	4.6	N
<u>Pump and Baffle</u>								
Centerville (2-6)	Anoka	464	Anoka County Parks and Recreation Dept.	1-20 HP pump and baffle			did not operate	
Crooked (2-84)	Anoka	130	City of Coon Rapids	1-10 HP pump and baffle	-	-	2.6	N
Golden (2-45)	Anoka	50	City of Circle Pines	1-7.5 HP permanent pump and baffle	26,234	2,784.00	-	N
Martin (2-34)	Anoka	218	Anoka County Parks and Recreation	1-10 HP pump and baffle	-	-	1.9	N

Appendix 2. (Con't.)

Lake (DOW #)	County	Lake Area (A)	Permittee	System description (No. of units, rating)	Electrical Consumption (KWH)	Electrical costs (\$)	Number Months operated	Winterkill (Y or N)
<u>Pump and Baffle (Con't.)</u>								
Moore, West (2-75)	Anoka	110	City of Fridley	1-10 HP pump and baffle			did not operate	
Peltier (2-4)	Anoka	483	Anoka County Parks and Recreation	1-20 HP pump and baffle			did not return questionnaire	
Wolf (3-101)	Becker	1,453	Wolf Lake Sportsmen's Club	2-10 HP pump and baffle			did not return questionnaire	
Susan (10-13)	Carver	93	City of Chanhassen	1-7.5 HP pump and baffle	-	-	1.4	N
Marion (19-26)	Dakota	489	City of Lakeville	1 pump and baffle 20 HP homemade			did not operate	
Roger's (19-80)	Dakota	116	City of Mendota Heights	1-10 HP pump and baffle	-	1,430.00	2.2	N
Hyland (27-48)	Hennepin	87	Three Rivers Park District	Permanently install. 7.5 HP pumps			did not return questionnaire	
Mitchell (27-70)	Hennepin	116	City of Eden Prairie	1-7.5 HP Crisafulli pump and baffle			did not return questionnaire	
Penn (27-4)	Hennepin	47	City of Bloomington	15 HP pump and baffle	6,764	800.25	3.6	N
Powderhorn (27-14)	Hennepin	11	Mpls. Park & Recr. Board	Pump and baffle 4HP	-	100.00	0.6	Y
Red Rock (27-76)	Hennepin	83	City of Eden Prairie	1-7.5 HP pump and baffle			did not return questionnaire	
Wirth (7-37)	Hennepin	37	Mpls. Park & Recr. Board	1-5.0 HP pump and baffle	-	400.00	3.7	Y

Appendix 2. (Con't.)

Lake (DOW #)	County	Lake Area (A)	Permittee	System description (No. of units, rating)	Electrical Consumption (KWH)	Electrical costs (\$)	Number Months operated	Winterkill (Y or N)
<u>Pump and Baffle (Con't.)</u>								
Wolfe (27-664)	Hennepin	3	City of St. Louis Park	Built in waterfall– 5 HP	1,600	2,000.00	3.5	N
Wolf (29-81)	Hubbard	274		1-5 HP pump and baffle		did not return questionnaire		
Knife (33-28)	Kanabec	1,127	Knife Lake Improvement District	1-10 HP pump and baffle 1-20 HP pump and baffle		did not return questionnaire		
Unnamed (Florian Res.) (45-119)	Marshall	42	Marshall County Park Board	1-9 HP pump and baffle	61,968	4,764.00	2.9	N
Jennie (47-15)	Meeker	1,089	Lake Jennie Improvement Corp.	1 pump and baffle system 2,000 gpm pump		did not return questionnaire		
Wilson (51-81)	Murray	164	Murray County	1-10 HP pump and baffle		did not return questionnaire		
Adley (56-31)	Otter Tail	249	Parker's Prairie Sportsmen's Club	1-15 HP pump and baffle	-	1,300.00	3.0	N
Fish (56-66)	Otter Tail	500	Parkers Prairie Sportsmen's Club	10-HP pump and baffle	-	1,800.00	3.4	N
Maple (60-305)	Polk	1,445	Maple Lake Improvement District	3-5 HP pump and baffle		did not operate		
Beaver (62-16)	Ramsey	65	Ramsey County Public Works Dept.	1-7.5 HP pump and baffle	13,969	12,700.00	2.8	N
Island (62-75)	Ramsey	63	Ramsey County Public Works Dept.	1-20 HP pump and baffle	25,274	2,300.00	2.2	N

Appendix 2. (Con't.)

Lake (DOW #)	County	Lake Area (A)	Permittee	System description (No. of units, rating)	Electrical Consumption (KWH)	Electrical costs (\$)	Number Months operated	Winterkill (Y or N)
<u>Pump and Baffle (Con't.)</u>								
Loeb (62-231)	Ramsey	10	City of St. Paul	1-5 HP pump and baffle				did not return questionnaire
Owasso (62-56)	Ramsey	360	Ramsey County Public Works Dept.	1-20 HP pump and baffle				did not operate
Silver (East) (62-1)	Ramsey	68	Ramsey County Public Works Dept.	1-15 HP pump and baffle	14,251	1,290.00	3.2	N
Silver (62-83)	Ramsey	67	City of Columbia Heights	1-10 HP pump and baffle				did not return questionnaire
Cleary (70-22)	Scott	137	Three Rivers Park District	1-7.5 HP pump and baffle				did not return questionnaire
McMahon (Carls) (70-50)	Scott	136	New Market Sportsmen's Club	1-10 HP pump and baffle				did not operate
Hattie (75-200)	Stevens	488	Save A Lake Aeration, Inc.	1-10 HP pump and baffle				did not return questionnaire
Goose (82-59)	Washington	83	Town of New Scandia	1-3 HP pump and baffle	1,240	281.11	2.1	N
Shields (82-162)	Washington	27	City of Forest Lake	CORE pump and baffle 3 HP	-	635.16	1.7	N
<u>Subsurface Aspirating Systems (Aire-0₂, Aeromix Tornado)</u>								
Cedar (1-165)	Aitkin	260	Cedar Lake Assn	3-2 HP Aeromix tornado	11,739	1,385.00	3.3	N
Coon (2-42)	Anoka	1,507	Anoka County Parks	3-2 HP Aeromix tornadoes	-	-	1.7	N

Appendix 2. (Con't.)

Lake (DOW #)	County	Lake Area (A)	Permittee	System description (No. of units, rating)	Electrical Consumption (KWH)	Electrical costs (\$)	Number Months operated	Winterkill (Y or N)
<u>Subsurface Aspirating Systems (Aire-0₂ Aeromix Tornado (Con't.))</u>								
Ham (2-53)	Anoka	193	Anoka County Parks	3-2 HP Aeromix tornadoes			did not operate	
Spring (2-71)	Anoka	37	City of Spring Lake Park	1-2 HP Aeromix			did not operate	
Long Tom (6-29)	Big Stone	110	Save A Lake Aeration	2-2 HP Aqua tornadoes			did not return questionnaire	
Eagle (10-121)	Carver	230	Carver County Public Works Dept.	4-2 HP Aire-02 aerators	2,709	351.70	1.7	-
Loon (11-226)	Cass	220	Loon Lake Property Owners	2-2 HP Aeromix tornadoes			did not return questionnaire	
Platte (18-88)	Crow Wing	1,486	Platte Lake Association	1-2 HP Aeromix tornado	1,776	400.00	2.5	N
Birch Pond (19-202)	Dakota	3	School of Environmental Studies	Neptune air injection system	-	-	3.6	N
Blackhawk (19-59)	Dakota	39	City of Eagan	1-2 HP air injection system			did not return questionnaire	
Burr Oaks (19-259)	Dakota	19	City of Eagan	1-2 HP pump			did not return questionnaire	
Cliff (19-68)	Dakota	16	City of Eagan	1-2 HP air injection system			did not return questionnaire	
Farquar (19-23)	Dakota	74	City of Apple Valley	1-2 HP air injection system	4,289	445.58	2.3	N
Fish (19-57)	Dakota	28	City of Eagan	1-2 HP air injection system			did not return questionnaire	

Appendix 2. (Con't.)

Lake (DOW #)	County	Lake Area (A)	Permittee	System description (No. of units, rating)	Electrical Consumption (KWH)	Electrical costs (\$)	Number Months operated	Winterkill (Y or N)
<u>Subsurface Aspirating Systems (Aire-0₂ Aeromix Tornado (Con't.))</u>								
Gun Club (19-245)	Dakota	8	City of Inver Grove Heights	1-2 HP Aeromix tornado				did not return questionnaire
Hay (19-62)	Dakota	20	City of Eagan	1-2 HP air pump				did not return questionnaire
Heine (19-153)	Dakota	7	City of Eagan	1-2 HP pump				did not return questionnaire
LeMay (19-55)	Dakota	44	City of Eagan	1-2 HP air injection system				did not return questionnaire
Manor (19-64)	Dakota	14	City of Eagan	1-2 HP air injection system				did not return questionnaire
Pickerel (19-79)	Dakota	51	City of St. Paul	1-2 HP Neptune pump				did not return questionnaire
East Thomas (19-161)	Dakota	39	City of Eagan	1-0.1 HP solar powered pump				did not return questionnaire
Thomas (19-67)	Dakota	56	City of Eagan	1-2 HP air injection pump				did not return questionnaire
Thompson (19-48)	Dakota	10	Dakota County Parks	1-2 HP Neptune pump				did not return questionnaire
Unnamed (Schwartz) (19-63)	Dakota	13	City of Eagan	1-2 HP air injection pump				did not return questionnaire
Aldrich (21-222)	Douglas	173		2-2 HP Aeromix tornadoes	-	1,500.00	4.1	N

Appendix 2. (Con't.)

Lake (DOW #)	County	Lake Area (A)	Permittee	System description (No. of units, rating)	Electrical Consumption (KWH)	Electrical costs (\$)	Number Months operated	Winterkill (Y or N)
<u>Subsurface Aspirating Systems (Aire-0₂ Aeromix Tornado (Con't.))</u>								
Albert Lea (24-14)	Freeborn	2,654	Shellrock River Watershed District	2-Aeromix systems			did not operate	
Bass (27-98)	Hennepin	175	Bass Lake Improvement Assn	2-2 HP Aire-02	6,989	754.49	2.4	N
Rebecca (27-192)	Hennepin	290	Three Rivers Park District	3-2 HP Aire-02 aerators			did not return questionnaire	
Rice (27-116)	Hennepin	306	Rice Lake Area Association	1-2 HP Aire-02			did not return questionnaire	
Petite (29-147)	Hubbard	58	Wonewok Conference Center	1-2 HP air injection system	-	-	5.0	N
Crow River (34-158)	Kandiyohi	2,516	City of New London	2-2 HP Aeromix systems			did not return questionnaire	
Elizabeth (34-22)	Kandiyohi	1,153	Kandiyohi County	2-2 HP Aeromix tornadoes			did not operate	
Dead Coon (41-21)	Lincoln	555	Tyler Rod & Gun Club	2-2 HP Aire-02			did not operate	
Hendricks (41-110)	Lincoln	1,634	Lake Hendricks Improvement Assn	4-2 HP Aire-02 aerators			did not return questionnaire	
Shaokotan (41-89)	Lincoln	1,043	Shaokotan Sportsmen's Club	2-2 HP Power House Aerators			did not return questionnaire	
Stay (41-34)	Lincoln	220	Arco Sportsmen's Club	2-2 HP Aqua tornadoes	-	1,625.00	3.0	N
Clear (42-55)	Lyon	68	Lyon County	1-2 HP Aire-02			did not return questionnaire	

Appendix 2. (Con't.)

Lake (DOW #)	County	Lake Area (A)	Permittee	System description (No. of units, rating)	Electrical Consumption (KWH)	Electrical costs (\$)	Number Months operated	Winterkill (Y or N)
<u>Subsurface Aspirating Systems (Aire-0₂, Aeromix Tornado) (Con't.)</u>								
East Goose (42-93)	Lyon	151	Lyon County	2-2 hp Aire-02				did not return questionnaire
Lady Slipper (42-20)	Lyon	262	Lyon County	2-2 HP Aeromix tornadoes				did not return questionnaire
Rock (42-52)	Lyon	422	Lyon County	2-2 HP Aire-02				did not return questionnaire
School Grove (42-2)	Lyon	333	Lyon County	2-3 HP Aire-02				did not return questionnaire
Yankton (42-27)	Lyon	382	Lyon County	3-3 HP Aire-02				did not return questionnaire
Big Twin (46-133)	Martin	457	Trimont Area Conservation Club	2-1 HP Aire-02				did not return questionnaire
Buffalo (46-146)	Martin	116	Mt. Lake-Odin-Ormsby Sportsmen's Club	1-3 HP Aire-02	2,630	240.38	1.8	N
Cedar (46-121)	Martin	710	Trimont Area Conservation Club	1-2 HP Aire-02				did not return questionnaire
Fish (46-145)	Martin	156	Watowan Game and Fish	1-2 HP Aire-02	4,050	384.67	2.0	N
Winsted (43-12)	McLeod	407	City of Winsted	6-2 HP Aire-02	-	7,000.00	3.2	N
Star (47-129)	Meeker	554	Star Lake Association	3-2 HP Aire-02	-	723.00	2.1	N
Corabelle (51-54)	Murray	99	Murray County	1-2 HP Aire-02				did not return questionnaire

Appendix 2. (Con't.)

Lake (DOW #)	County	Lake Area (A)	Permittee	System description (No. of units, rating)	Electrical Consumption (KWH)	Electrical costs (\$)	Number Months operated	Winterkill (Y or N)
<u>Subsurface Aspirating Systems (Aire-0₂, Aeromix Tornado) (Con't.)</u>								
Kinbrae (53-16)	Nobles	87	Nobles County Park	1-1 HP Aeromix tornado	8,500	931.45	2.4	N
Tamarac (59-931)	Otter Tail	416	Tamarac Lake Association	2-2 HP aspirating aerators	7,109	726.06	3.1	N
Split Rock (59-1)	Pipestone	80	Split Rock Creek State Park	2-2 HP Aeromix tornadoes	-	-	3.4	N
Johanna (61-6)	Pope	1,204	DNR Fisheries	2-5 HP Aire-02's		did not operate		
Signalness (61-149)	Pope	41	Glacial Lakes State Park	1-2 HP Aire-02		did not operate		
Unnamed (21-71)	Pope	21		1-2 HP Tornado		did not return questionnaire		
Otter (2-3)	Ramsey/Anoka	173	Ramsey County Public Works	3-2 HP Aeromix tornadoes	3,307	300.00	2.5	N
Circle (66-27)	Rice	976	Tri-Lakes Sportsmen's Club	3-2 HP Aeromix tornadoes	11,040	1,496.00	2.8	N
O'Dowd (70-95)	Scott	256	O'Dowd Lakes Chain Assn	3-2 HP Aire-02	9,350	1,100.00	2.2	N
Thole (70-120)	Scott	131	O'Dowd Lakes Chain Association	1-2 HP Aire-02		did not operate		
McColl (70-17)	Scott	20	City of Savage	2-2 HP Aeromix tornadoes		did not return questionnaire		
Murphy (70-10)	Scott	70	Hennepin Parks	2-2 HP Aeromix tornadoes		did not return questionnaire		

Appendix 2. (Con't.)

Lake (DOW #)	County	Lake Area (A)	Permittee	System description (No. of units, rating)	Electrical Consumption (KWH)	Electrical costs (\$)	Number Months operated	Winterkill (Y or N)
<u>Subsurface Aspirating Systems (Aire-0₂, Aeromix Tornado) (Con't.)</u>								
Birch (71-57)	Sherburne	149	Birch Lake Association	1-2 HP Aire-02				did not return questionnaire
Fremont (71-16)	Sherburne	466	City of Zimmerman	2-2 HP Aire-02's				did not return questionnaire
Silver (72-13)	Sibley	697	Silver Lake Conservation Club	3-2 HP Aire-02				did not return questionnaire
Black Oak (73-241)	Stearns	121	Green Grove Sportsmen's Club	1-2 HP Aire-02				did not return questionnaire
Elysian (81-95)	Waseca	2,462	So. Lakes Chain Dark House Anglers Association	3-3 HP Aire-02's	-	325.00	3.0	N
Unnamed (Clover) (82-9)	Washington	39	Cloverdale Farms	2-1 HP Aeromix systems				did not return questionnaire
McDonald (82-10)	Washington	37		1-1 HP Aeromix tornado				did not return questionnaire
Sand (82-67)	Washington	46	Sand Lake Lakeshore Association	1-2 HP Aeromix tornado	-	-	-	N
Kansas (83-36)	Watonwan	388	Watonwan Game and Fish Club	3-2 HP Aire-02	8,500	931.45	2.4	N
St. James (83-43)	Watonwan	252	Watonwan Game and Fish Club	2-2 HP Aire-02	3,887	497.68	3.2	N
Crawford (86-46)	Wright	117	Crawford Lake Improvement Assn	2-2 HP Aire-02	2,659	268.73	2.0	N

Appendix 2. (Con't.)

Lake (DOW #)	County	Lake Area (A)	Permittee	System description (No. of units, rating)	Electrical Consumption (KWH)	Electrical costs (\$)	Number Months operated	Winterkill (Y or N)
<u>Subsurface Aspirating Systems (Aire-0₂, Aeromix Tornado) (Con't.)</u>								
Dean (86-41)	Wright	204	Dean Lake Club Assn	2-2 HP Aire-02			did not operate	
Little Waverly (86-106)	Wright	336	Little Waverly Lake Association	1-2 HP Propeller aspirator	5,298	656.80	2.4	N
Mink (86-229)	Wright	304	Assn of Mink & Somers Lakes	1-2 HP Aire-02			did not operate	
Somers (86-230)	Wright	156	Assn of Mink & Somers Lakes	1-2 HP Aire-02			did not operate	
Tyson (87-19)	Yellow Medicine	180	Yellow Medicine County	2-2 HP Aire-02	-	-	2.2	N
Wood (87-30)	Yellow Medicine	484	Yellow Medicine County	2-2 HP Aire-02	-	-	2.2	N
<u>Sprayers</u>								
Crystal (70-61)	Scott	33	City of Prior Lake	3 HP Otterbine	6,125	488.82	3.3	N
Lakefront Park Pond (70-169)	Scott	13	City of Prior Lake	3 HP Otterbine	435	95.76	3.3	N
Dullinger (73-103)	Stearns	21		1-1 HP Kallep floating aerator			did not return questionnaire	
<u>Mixed Systems</u>								
East Toqua (6-138)	Big Stone	440	City of Graceville	1-10 HP Helixor 2-2.5 HP Tornadoes	-	350.00	1.9	N

Appendix 2. (Con't.)

Lake (DOW #)	County	Lake Area (A)	Permittee	System description (No. of units, rating)	Electrical Consumption (KWH)	Electrical costs (\$)	Number Months operated	Winterkill (Y or N)
Mixed Systems (Con't.)								
Mountain (17-3)	Cottonwood	241	Mountain Lakes Area Sportsmen's Club	5-0.5 HP compressors 2-2 HP Aeromix Tornadoes	17,570	950.48	2.8	N
Carlson (19-66)	Dakota	14	City of Eagan	1-3 HP lift station Air injection pump		did not return questionnaire		
Snelling (27-1)	Hennepin	110	Fort Snelling State Park	2-5 HP sump pumps	10,593	1,021.38	2.4	N
Clear (32-22)	Jackson	415	Jackson County Conservation League	2-5 HP motor/blowers 6 diffusers, 3-3 HP Ice Eaters	10,330	829.92	2.6	N
Independence (32-17)	Jackson	97	Jackson County Conservation League	1-5 HP Helixor 3-3 HP Ice Eater	6,710	541.04	2.6	N
Little Spirit (32-24)	Jackson	634	Little Spirit Lake Conservation Club	2-7.5 HP motors 6 diffusers; 3-3 HP Ice Eaters	11,130	858.28	2.6	N
Scotch (40-109)	LeSueur	590	German-Jefferson Sportsmen's Club	2-0.75 compressors, 1-10 HP Helixor, 9 diffusers	-	725.00	2.4	N
Thompson (47-159)	Meeker	220	Meeker County Parks	1-20 HP pump and baffle 2-2 HP Tornadoes	7,944	1,075.00	2.5	N
Shetek (51-63)	Murray	3,596	Murray County	3-7.5 HP motor/blowers 12 diffusers, 2 Ice Eaters		did not return questionnaire		
Bennett (62-48)	Ramsey	41	Roseville Parks and Recr.	3-0.5 HP blower and 6 diffusers, baffle system		did not return questionnaire		

Appendix 2. (Con't.)

Lake (DOW #)	County	Lake Area (A)	Permittee	System description (No. of units, rating)	Electrical Consumption (KWH)	Electrical costs (\$)	Number Months operated	Winterkill (Y or N)
<u>Hypolimnetic Aerators</u>								
Moore (East) (2-75)	Anoka	110	City of Fridley	1-7.5 HP Palatek compressor	-	-	-	N
Como (62-55)	Ramsey	69	Ramsey County Public Works Dept.	1-7.5 HP Hypo system	24,376	2,185.00	3.9	N
Vadnais (62-38)	Ramsey	477	City of St. Paul Water Utility	2-30.0 HP Atlas Copco			did not return questionnaire	
Marie (Maria) (73-14)	Stearns	145	Clearwater River Watershed District	1-15 HP Atlas Copco			did not operate	
Augusta (86-284)	Wright	186	Clearwater River Watershed District	1-20 HP Atlas Copco			did not operate	
Louisa (86-282)	Wright	183	Clearwater River Watershed District	1-10 HP Atlas Copco			did not operate	
<u>Other (Mechanical Surface Agitators, homemade, etc.)</u>								
Bean (17-54)	Cottonwood	141	Red Rock Sportsmen's Club	1-5 HP Ice Eater			did not return questionnaire	
Double (17-56)	Cottonwood	227	Red Rock Sportsmen's Club	1-5 HP Ice Eater			did not return questionnaire	
South Double (17-56)	Cottonwood	227	Red Rock Sportsmen's Club	1-5 HP Ice Eater			did not return questionnaire	
Talcott (17-60)	Cottonwood	928	Red Rock Sportsmen's Club	1-5 HP Ice Eater			did not return questionnaire	
Nisswa (18-399)	Crow Wing	213		20-3/4 HP Ice Eaters			did not return questionnaire	

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Lake (DOW #)	County	Lake Area (A)	Permittee	System description (No. of units, rating)	Electrical Consumption (KWH)	Electrical costs (\$)	Number Months operated	Winterkill (Y or N)
Other (Con't.)								
Nest (34-154)	Kandiyohi	1,019	North Shore Estates	Morgan Winds Windmill			did not return questionnaire	
Silver (40-48)	LeSueur	17	N. Elysian Silver Lakers Sportsmen's Club	1-0.75 HP motored propeller	2,555	268.48	2.5	N
Benton (41-43)	Lincoln	2,875	Lake Benton Sportsmen's Club	5-0.25 HP Ice Eaters	11,310	599.00	3.5	N
Budd (46-30)	Martin	224	City of Fairmont	Water plant pumps			did not return questionnaire	
Buffalo (51-18)	Murray	124	Murray County	2-0.75 HP Ice Eaters			did not return questionnaire	
Currant (51-82)	Murray	394	Murray County	3-0.75 HP Ice Eaters			did not return questionnaire	
Lime (51-24)	Murray	316	Murray County	3-0.75 HP Ice Eaters			did not return questionnaire	
Louisa (51-6)	Murray	211	Murray County	1-0.75 HP Ice Eater			did not return questionnaire	
Mitchell (27-07)	Hennepin	116	Riley Purgatory Bluff Creek Watershed District	2-Solarbee Units			did not return questionnaire	
Wilson (51-81)	Murray	164	Murray County	1-0.75 HP Ice Eater			did not return questionnaire	
Wilson (South) (51-81)	Murray	164	Murray County	1-0.75 HP Ice Eater			did not return questionnaire	
East Graham (53-20)	Nobles	523	Nobles County Parks Department	3-0.75 HP Powerhouse	-	-	2.5	N

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Lake (DOW #)	County	Lake Area (A)	Permittee	System description (No. of units, rating)	Electrical Consumption (KWH)	Electrical costs (\$)	Number Months operated	Winterkill (Y or N)
Other (Con't.)								
West Graham (53-21)	Nobles	526	Nobles County Parks Department	3-0.75 HP Powerhouse	-	-	2.5	N
Ocheda (53-24)	Nobles	1,778	Nobles County	2-0.75 HP portable powerhouse motors	-	-	2.5	N
Badger (60-214)	Polk	247	City of Erskine	2-0.75 HP Kasco agitators	1,273	89.45	2.5	Y
Community Center Pond (62-63)	Ramsey	2	City of Shoreview	3-1 HP Kasco agitators		did not return questionnaire		
Legends (70-287)	Scott	29	Legends Club	1-HP Aqua control surface pump	-	-	4.6	N
Fedji (83-21)	Watonwan	179	Madelia Sportsmen's Club	3-1 HP Powerhouse systems		did not return questionnaire		