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MINNESOTA DEPARTMENT OF NATURAL RESOURCES

DIVISION OF ECOLOGICAL RESOURCES

Aeration Permit Program Annual Report 2007-2008

STAFF REPORT 46

2010

Aeration Permit Program Annual Report
2007-2008

by

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2010

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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 2007-08 permit years (1 October 2007 – 30 September 2008). 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 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 (2007-08), two lakes were opened to "liberalized fishing" (Figure 1).

A total of 299 aeration permits were issued during the 2007-08 season. This includes 275 renewals (97% of the permits issued) and twenty-four (24) new permits. Eight permittees from the previous season (2006-07) did not reapply for an aeration permit in 2007-08.

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

The 299 permits issued in 2007-08 authorized aeration in 284 lakes, of which 174 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 129,081 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 30 of these lakes, Aire 0_2 units were operated in 59 lakes, mechanical surface agitators operated in 14 lakes, and diffuser systems operated in 56 lakes. Bait dealers and commercial hatchery operations were permitted to operate in 34 public water bodies totaling 1,747 acres. Ninety-one (91) 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 2007-08.

Winter inspections of aeration systems were conducted by inspectors from the divisions of Enforcement and Fish and Wildlife (Fisheries). A total of 1,033 inspections were made in 2007-08. Of these, Enforcement inspectors conducted 305 inspections and Fisheries inspectors conducted 728. The inspectors found a total of 76 discrepancies (9.7%) out of the 1033 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 207 inspections were completed in Region I of which 7% showed discrepancies. There were eleven (11) inspections completed in Region II with 9% discrepancies. Inspectors conducted 226 inspections in Region III of which 20% showed discrepancies, and 589 inspections were conducted in Region IV with 7% 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 2007-08.

REGIONAL AERATION SUMMARY

REGION I (Bemidji)

There were 71 aeration permits issued in Region 1 during the 2007-08 season, 24% of the total number of permits issued. Of the 71 permits issued, 59 (83%) were renewals and twelve were new permits.

The 71 permits issued in Region I authorized aeration in 69 public waters, or 24.3% of the total public waters aerated statewide. Private hatchery operators accounted for 48% of the aeration permitted water bodies in Region I. Private hatchery operators received seven permits for 33(1,670 acres) public waters (11.7% of the statewide total lakes permitted or 1.2% 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 15 aeration permits to prevent winterkill in 15 lakes (8,097 acres) with public access. Thirty-eight aeration permits were issued to private individuals on twelve lakes (27,182 acres) to prevent shoreline property damage due to ice expansion. Two permits were issued to the State covering 1,245 acres. Seven other aeration permits were issued to private groups to prevent winterkill in public waters (394 acres) without public access. No aerated lakes were 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 eight (8) permits issued in 2007.

Of these eight permits, which represent 3% of the total number of permits issued, five 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 117 aeration permits issued for 111 lakes/ponds (23,892 acres) in Region III last season (39% of the total number of permits issued), 107 renewals (91%), and ten 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-one permits were issued to municipalities for operation of aeration systems in 57 lakes (8,815 acres) with public access. Three permits (15 acres) were issued to municipalities for lakes without public access. Thirteen permits (5,414 acres) were issued to clubs for lakes with public access, and six permits (322 acres) were issued to clubs operating aeration systems in lakes without public access. Twenty-two permits for 20 lakes (9,232 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. Seven 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 34.5% of the permits issued statewide. Last season, 103 permits (68,095 acres) were issued in Region IV; 102 were renewals (99%). One new permit was issued. The 103 aeration permits issued in Region IV authorized the aeration of 98 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-three permits were issued to private organizations and municipalities to prevent winterkill of fish in 88 lakes (50,547 acres)

with public access. Two permits were issued to prevent winterkill in two protected water without public access. Five 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, four 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 202 of 299 permittees, a 68% 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-one (31) respondents indicated their aeration system was not operated last winter.

The average cost for insurance (n=50) was $535.00. This figure includes all permittees operating an aeration system in lakes with or without public access. The range in insurance premiums for the 2007-08 season was $17.24-$1496.00. No respondents indicated there was difficulty in acquiring the required insurance.

One hundred seventy-one (171) of the respondents indicated their aeration system was operated last winter and 44 of those indicated that waterfowl over wintered on the lake. Of these, five respondents are located in Region I, 22 in Region III, and 17 in Region IV. An estimated 3,900 waterfowl used the open water areas provided by aeration systems (range 6-500). Most of the birds were mallards and Canada geese.

Of the 171 permittees that responded and operated their systems last winter, 154 (90 %) indicated they were satisfied with system performance. Of these, 10% were Helixor systems, 12 % were Clean-Flo systems, 13% were pump and baffles, 20% were AireO2 and Aeromix systems, and 7% were mechanical surface agitators. Complaints ranged from mechanical failures to undersized and ineffective equipment. Three respondents indicated safety problems with their aeration systems.

Some aerated lakes experienced partial winterkill last season. Twelve of the 171 respondents that operated their aeration systems last winter reported some evidence of winterkill at ice out. Of these, one was a Helixor system, five were Clean-Flo systems, one was a pump and baffle, 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-0_2 and the Aeromix tornado, were on average the least expensive to operate per acre, with Helixor systems a close second. Whereas, pump and baffle systems had the most horsepower per acre and were the most expensive to operate 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 and AireO2 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.

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Table 1. Aerated Acres 2007-08.

ACRES	REGION 1	REGION 2	REGION 3	REGION 4	OVERALL
Lakes with public access	39,076	2,134	22,938	64,933	129,081
Lakes without public access	1,404	260	954	3,132	5,750
TOTAL	40,480	2,394	23,892	68,065	134,831

Table 2. 2007-08 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	17	11	4	2	0	33	7	11	38	8	9	71 (24%)
II	2	2	0	0	0	0	0	0*	2	4	4	8 (2.7%)
III	62	10	52	0	1	1	1	3	4	45	49	117 (39%)
IV	88	43	48	0	1	0	0	1	1	9	10	103 (34.4%)
Totals	169	66	104	2	2	34	8	15	45	66	72	299

		Lakes	**Acres**	**Permits**
Protected waters with access for winterkill prevention	=	169	72,290	174
Protected waters under permit to Bait Dealers	=	34	1,747	8
Shoreline Protection	=	15	35,353	45
Other**	=	66	25,441	72
		284	134,831	299

Total number of permits for protected waters with access for winterkill prevention	=	174
Total number of permits for protected waters without access for winterkill prevention	=	20
299 total permits, new permits	=	7
06-07 permits not reissued	=	20

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, 2007-08.

County	Permittee C	Permittee M	Permittee S	Total No. of lakes	Total Acres	Average Size (acres)
Becker	3	0	0	3	2,621	873.7
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	3	0	0	3	1,821	607
Pope	0	0	2	2	1,245	622.5
Stevens	1	0	0	1	488	488
Wadena	1	0	0	1	356	356
Totals	11	4	2	17	9,342	N/A

# lakes with public access aerated to prevent winterkill	=	17 (C = 11; M = 4; S = 2)
Total Acreage	=	9,342
Average lake size (acres)	=	549.5
Permits issued to Municipalities for lakes with access	=	4 (1,767 acres)
Permits issued to Clubs for lakes with access	=	11 (6,330 acres)
Permits issued to the State w/access	=	2 (1,245 acres)
Permits issued for shoreline protection	=	38 (12 lakes; 27,182 acres)
Melissa Lake – 1,827 acres – 7 permits		Fish Lake – 284 acres – 1 permit
Lida Lake – 7,277 acres – 6 permits		Big Cormorant Lake – 3,380 acres – 4 permits
Big McDonald – 3,096 acres – 1 permit		Pelican – 4,314 acres – 10 permits
Eunice Lake – 370 acres – 1 permit		Sallie – 1,246 acres – 1 permit
Lizzie Lake – 4,145 acres – 4 permits		Marion Lake – 34 acres – 1 permit
Island Lake – 1,209 acres – 1 permit		Leech Lake – 1 permit
Permits issued to Bait Dealers, & P. Hatchery operators	=	7 (33 ponds, 1,670 acres)
Permits issued to private individuals to prevent winterkill for lakes without access	=	7 (394 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	=	71 (40,480 acres) in 69 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 2007-08.

County	Total No. of Ponds	Total Acres	Average Size Pond (Acres) Per County
Becker	1	242	242.0
Douglas	3	47	15.6
Grant	4	230	57.5
Otter Tail	15	672	44.8
Polk	6	242	40.3
Pope	2	90	45.0
Stevens	1	78	39.0
Todd	1	69	69.0
Totals	33	1,670	N/A

Averages:

Bait dealers permitted	=	7 (7 permits)
Average number of ponds/permit	=	4.7
Average size of ponds	=	50.6 acres (range 6 to 242 acres)
Average number of acres/permit	=	238.57

Table 5. Region II lakes with public access aerated to prevent winterkill, 2007-08.

County	Permittee C	Permittee M	Permittee P	Total No. of lakes	Total Acres	Average Size (acres)
Aitkin	0	0	0	0	0	0
Cass	2	0	0	2	330	165
Crow Wing	0	0	0	0	0	0
Lake	0	0	0	0	0	0
Totals	2	0	0	2	330	N/A

Lakes with public access aerated to prevent winterkill	=	2
Total Acreage	=	330
Average lake size (acres)	=	165

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 (1,290 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	=	8 (2,394 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, 2007-08.

County	Permittee C	M	P	S	Total No. of lakes	Total Acres	Average Size (acres)
Anoka	0	9	0	0	8	3,082	385.3
Carver	0	2	0	0	2	323	161.5
Crow Wing/Morrison	0	0	1	0	1	1,486	1,486
Dakota	0	19	0	0	19	1,198	63.1
Hennepin	1	5	0	0	6	647	107.8
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	2	5	0	0	7	1,158	165.4
Sherburne	1	1	0	0	2	692	346
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	10	52	1	0	62	12,071	N/A

Lakes with public access aerated to prevent winterkill	=	62
Total Acreage	=	12,071
Average lake size (acres)	=	194.7
Permits issued to Municipalities for lakes without access	=	3 (15 acres)
Permits issued to Municipalities for lakes with access (2 permits in Moore Lake)	=	71 (8,815 acres)
Permits issued to Clubs for lakes with access	=	13 (5,414 acres)
Permits issued to Clubs for lakes without access	=	6 (322 acres)
Privately operated systems for lakes with access (Shoreline protection – 4 permits/3 lakes (7,152)	=	7 (8,709 acres)
Privately operated systems for lakes without access (2 permits in Pine Tree Lake)	=	15 (523 acres)
Private Hatchery Operator permits for lakes with access	=	1 (77 acres)
Permits issued to State with access	=	0 (0 acres)
Permits issued to State without access	=	1 (17 acres)
Total Permits issued	=	117 (23,892 total acres in 111lakes/ponds)

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

Table 7. Region IV lakes with public access aerated to prevent winterkill 2007-08.

County	Permittee C	M	P	S	Total No. of lakes	Total Acres	Average Size (acres)
Big Stone	0	1	0	0	1	440	440
Blue Earth	5	0	0	0	5	2,834	566.8
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	3	0	0	2	2,675	1,337.5
Jackson	6	0	0	0	6	2,948	491.3
Kandiyohi	0	9	0	0	8	7,627	953.4
LeSueur	4	0	0	0	4	1,768	442.0
Lincoln	4	0	0	0	4	4,693	1,173.3
Lyon	0	9	0	0	9	2,518	279.8
Martin	4	3	0	0	7	1,884	269.1
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	1	0	0	0	1	697	697.0
Steele	0	1	0	0	1	11	11.0
Waseca	1	1	0	0	2	2,581	1,290.5
Watonwan	3	0	0	0	3	819	273.0
Yellow Medicine	0	2	0	0	2	664	332.0
Totals	44	48	1	0	88	50,547	N/A

Lakes with public access aerated to prevent winterkill	=	88
Total Acreage	=	50,547
Average lake size (acres)	=	574.4
Permits issued to Municipalities for lakes with access	=	50 (27,177 acres) (2 permits for Albert Lea & Wilson lakes)
Permits issued to Clubs for lakes with access	=	45 (23,423 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 (2,994acres)
Total Permits Issued	=	103 (68,065 acres; 98 lakes)

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

Table 8. Operational Characteristics of Some Aeration Systems, Winter 2007-08.

		Total hp	Lake Area (A)	hp/A	$/A/mo	$/hp/mo	KWH/hp/mo	KWH/hp/A
Helixor	Range	3-30	21-1,792	0.01-0.61	$ 0.36 – 7.98	$ 6.03-126.32	0.33-10,714.59	0.004-137.33
	Mean (x)	12.06	516.8	0.092	$ 2.20	$ 48.40	1,010.35	12.09
	n	24	22	22	21	21	18	18
Clean-Flo	Range	0.5-6.8	10-257	0.008-0.40	$ 0.31-16.55	$ 7.82-215.20	50.31-1,392.68	4.23-34.51
	Mean (x)	2.45	75.0	0.07	$ 4.01	$ 85.20	446.38	17.08
	n	20	19	19	12	12	5	5
Aire-0_2	Range	1.0-12.0	3-2,462	0.003-0.667	$ 0.12-2.33	$ 12.90-158.85	175.40-2,092.19	1.72-38.70
	Mean (x)	4.60	389.8	0.053	$ 0.91	$ 50.37	704.49	8.72
	n	30	30	30	16	16	11	11
Pump & Baffle	Range	3.0-30.0	3-1,445	0.020-1.67	$ 0.67-150.00	$ 10.42-144.06	80.00-1,532.21	0.89-137.90
	Mean (x)	10.90	192.6	0.23	$ 15.34	$ 50.61	544.62	43.58
	n	20	20	20	16	16	12	12

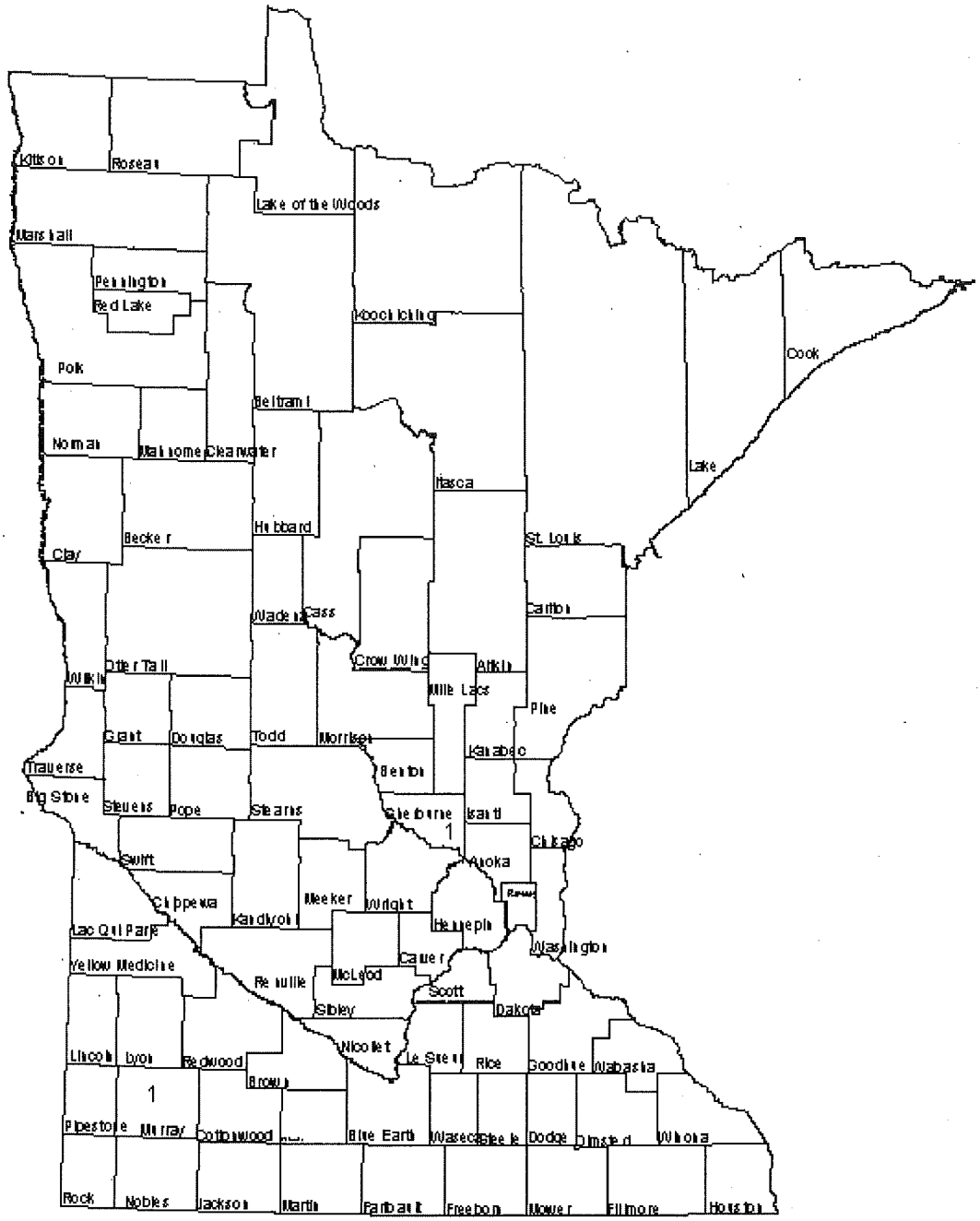

Figure 1. Number of lakes opened to “liberalized” fishing, by county, for the winter of 2007-08.

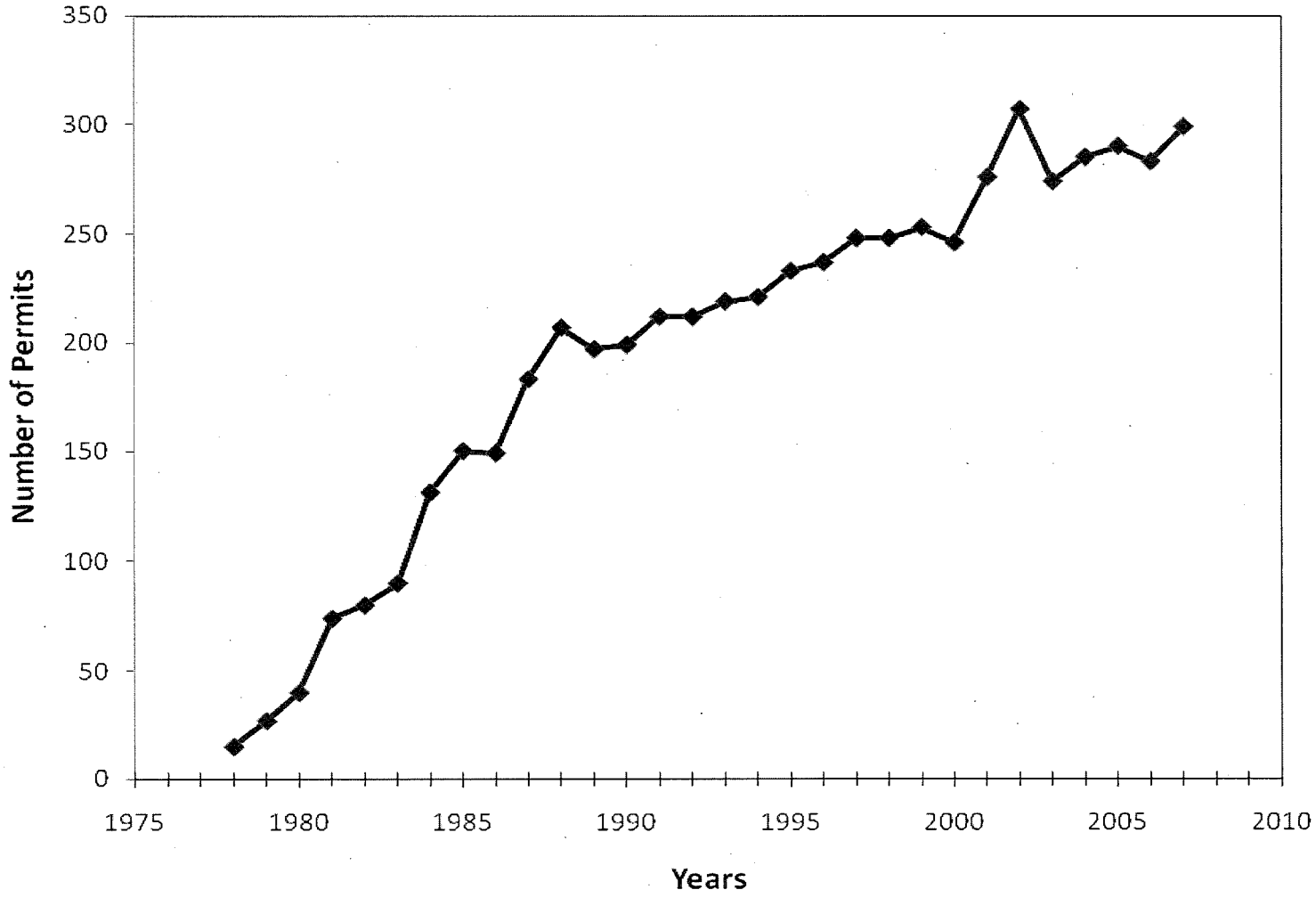

Figure 2. Trends in lake aeration permits issued 1978-2007.

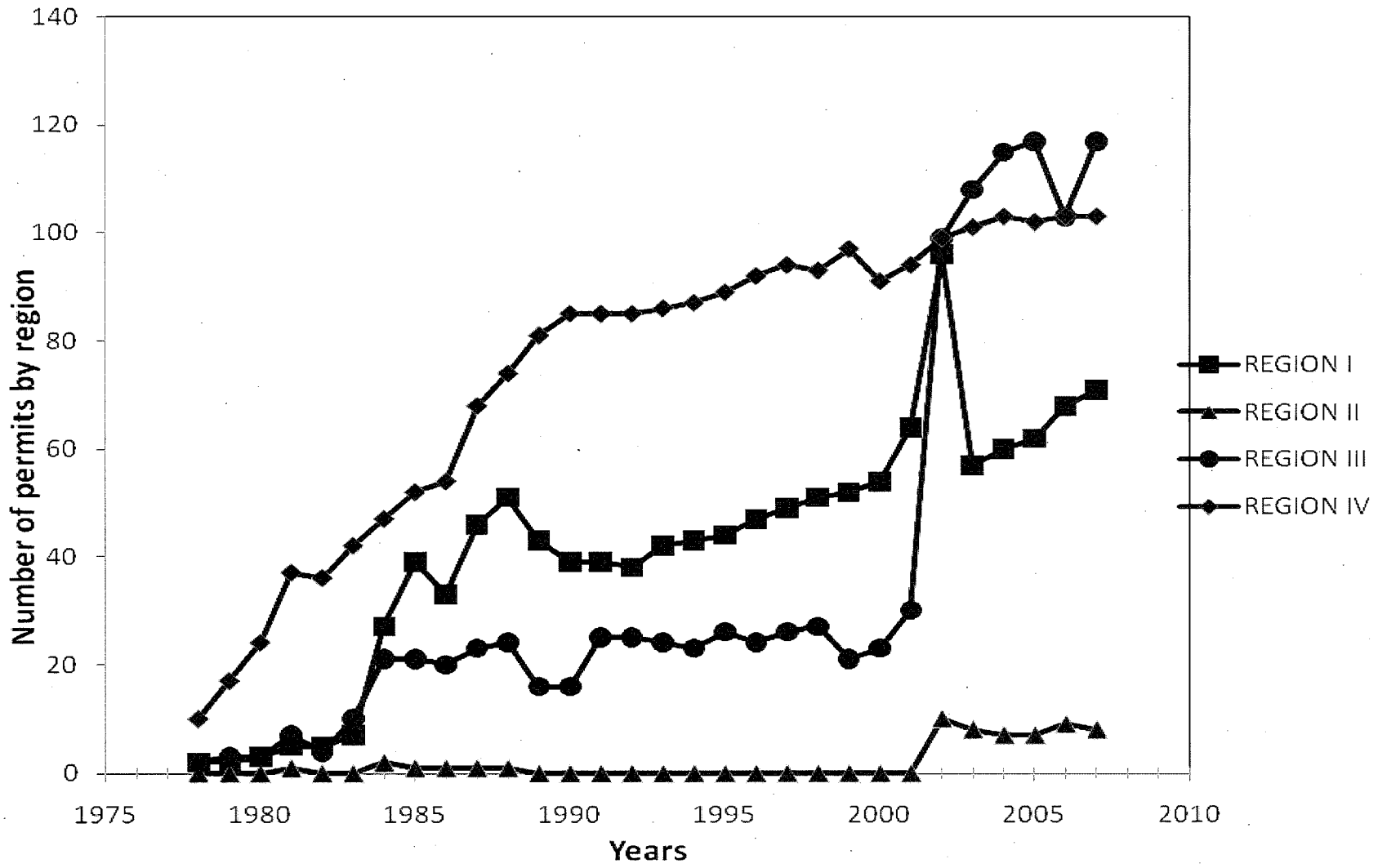

Figure 3. Aeration permits issued by DNR region, 1978-2007.

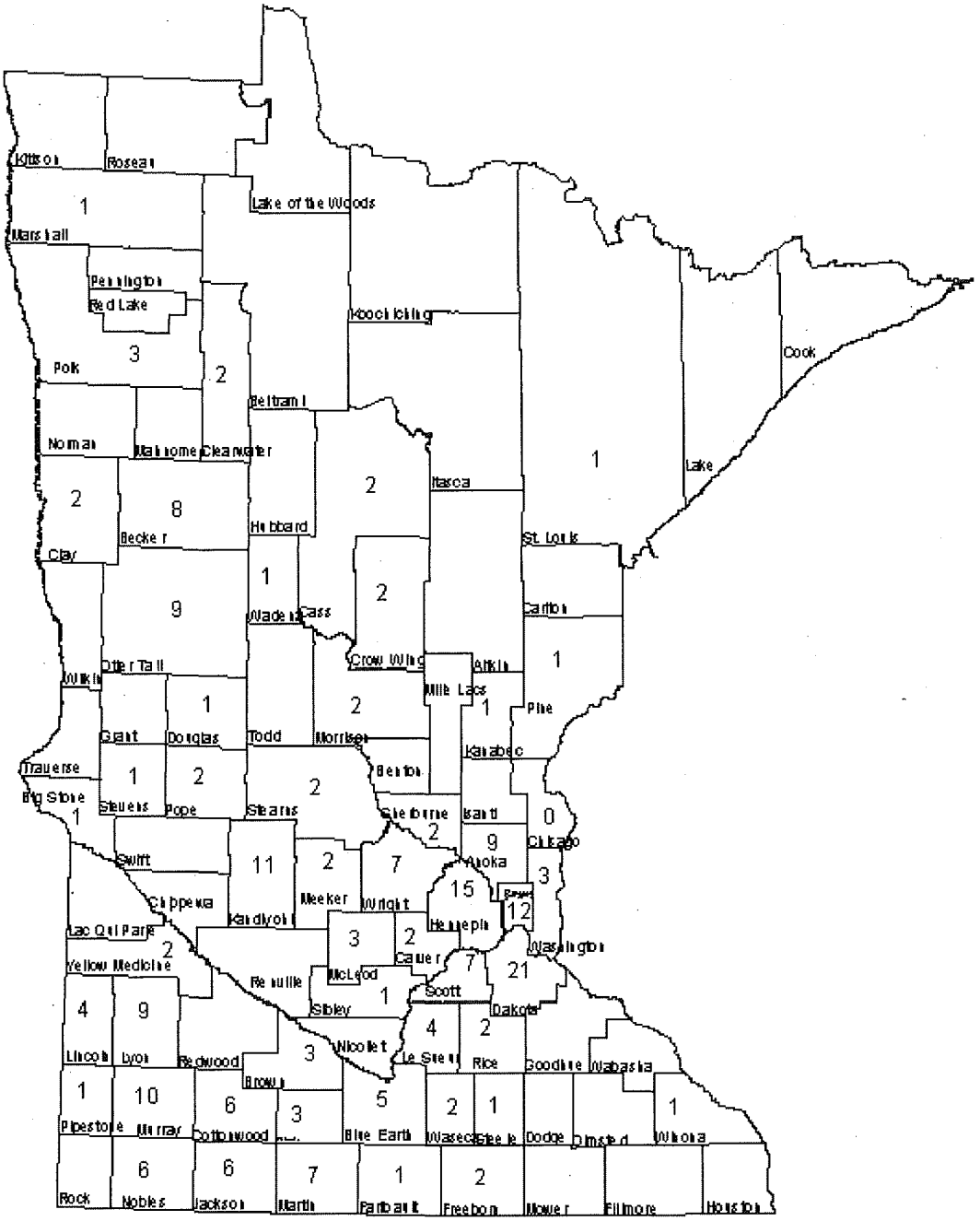

Figure 4. Number of lakes with public access, by county, issued aeration permits in 2007-2008.

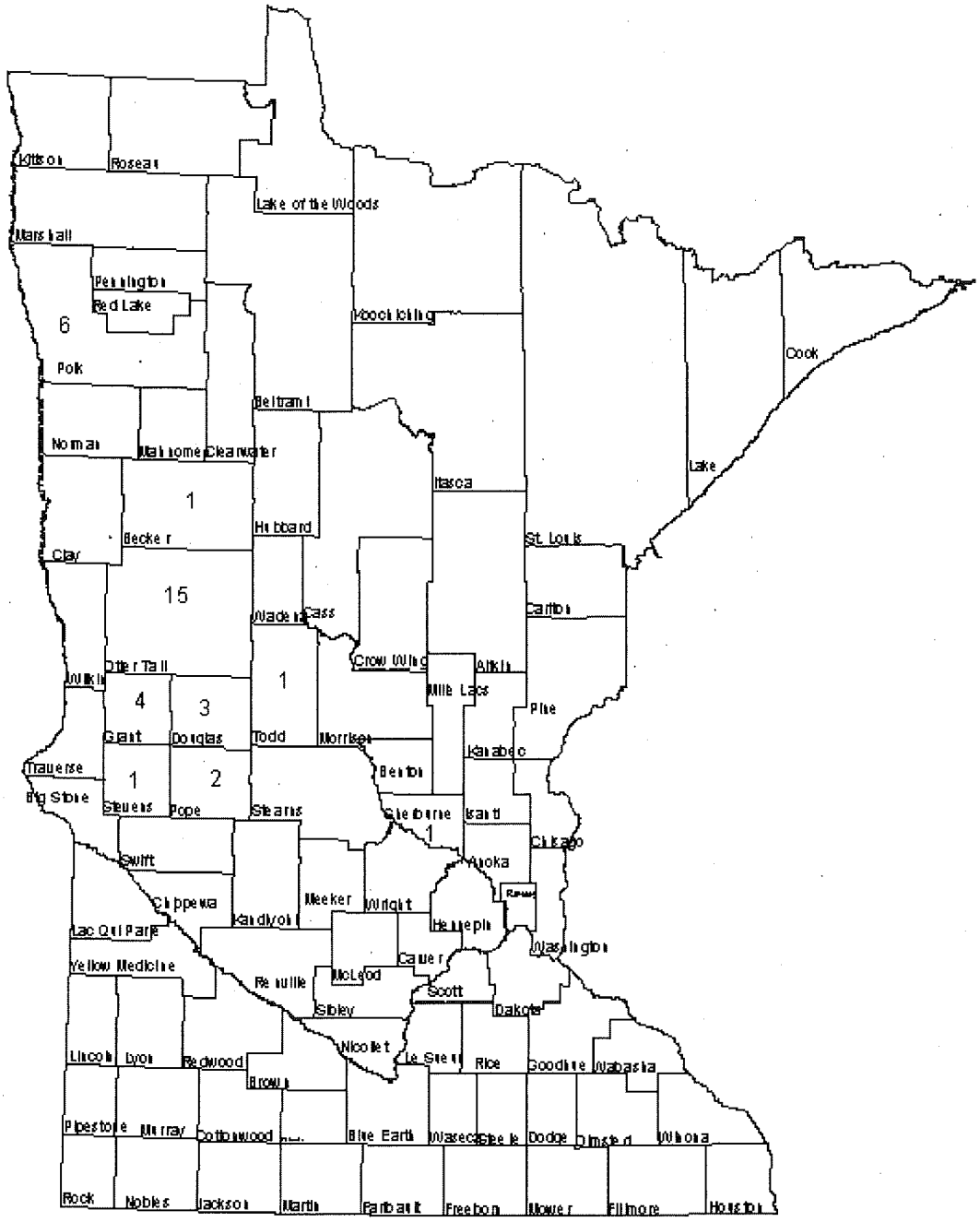

Figure 5. Distribution by County of ponds aerated under permits issued to private hatchery operators in 2007-08.

APPENDICES

Appendix 1. Private hatchery operators and protected waters under the permits 2007-08.

Permit #	Last Name	County	D.O.W.	Acres
Region 1				
F0781032	P. Koep	Douglas	21-74	17
			21-116	24
		Grant	26-141	62
		Otter Tail	56-720	30
			56-136	34
			56-85	19
			56-258	21
			56-155	21
			56-234	34
			56-1074	12
F0781038	Jeff Koep	Douglas	Gravel Pit	6
		Grant	26-8	31
			26-33	44
		Otter Tail	56-1183	10
			56-23	87
			56-25	73
			56-29	53
			56-49	43
			56-858	43
			56-1182	12
		Pope	61-63	28
			61-22	62
		Todd	77-52	69
F0781042	Wertish	Polk	60-392	10
			60-157	41
			60-172	48
			60-141	46
F0781061	Spartz	Polk	60-53	30
			60-288	67
F0781092	Joe Koep	Otter Tail	56-149	180
F0781103	Goeden	Becker	3-269	242
		Grant	26-114	93
F0781199	Lint	Stevens	75-25	28
			75-26	50
Region 3				
F0783100	McDonald	Sherburne	71-129	77

Appendix 2. Questionnaire results of aeration systems operated to prevent winterkill in lakes with or without public access, 2007-08.

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)
Polcon Helixors								
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	6,100	568.00	2.1	N
Hanska (8-26)	Brown	1,844	Brown Co. Park Dept.	1-15 HP blower 6 diffusers	did not return questionnaire			
Hanska (8-26)	Brown	1,844	Lake Hanska Area Association	1-15 HP Helixor	12,790	1,098.51	2.6	N
Sleepy Eye (8-45)	Brown	290	City of Sleepy Eye	2-5 HP motor/blowers 4 diffusers	6,342	591.00	2.1	N
Bingham (17-7)	Cottonwood	274	Cottonwood County Game & Fish League	1-5 HP blower 4 diffusers	did not return questionnaire			
Cottonwood (17-22)	Cottonwood	146	Cottonwood County Game & Fish League	1-5 HP motor/blower 3 diffusers	did not return questionnaire			
Rebecca (19-3)	Dakota	35	City of Hastings	1-5 HP blower 2 diffusers	693	93.41	3.1	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	8,652	597.00	3.9	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	9,470	732.00	2.6	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)
Polcon Helixors (Con't.)								
Pearl (32-33)	Jackson	117	Jackson County Conservation League	1-7.5 HP blower 3 diffusers	14,080	1,060	3.1	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	22,159	2,804.00	3.2	N
Foot (34-181)	Kandiyohi	576	Willmar Parks Department	1-25 HP motor/blower 6 diffusers	41,185	3,185.63	3.5	N
Long (34-192)	Kandiyohi	1,715	Kandiyohi County	2-10 HP motors 12 diffusers	51,158	4,679.00	3.2	N
Mud (Monongalia) M Fk Crow R. (34-158)	Kandiyohi	2,516	Kandiyohi County	1-15 HP motor 6 diffusers	19,060	2,079.00	3.7	Y
Ringo (34-172)	Kandiyohi	774	Kandiyohi County	1-10 HP motor 9 diffusers	19,981	1,890.00	3.2	N
Swenson (34-321)	Kandiyohi	123	Kandiyohi County	1-7.5 HP motor 5 diffusers	12,808	1,274.00	3.2	N
Wakanda (34-169)	Kandiyohi	1,792	Kandiyohi County	2-15 HP blowers 12 diffusers	57,566	5,239.00	3.2	N
Willmar (34-180)	Kandiyohi	761	Willmar Public Works	1-15 HP blower 6 diffusers	26,130	2,060.05	3.5	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)
Polcon Helixors (Con't.)								
Gorman (40-32)	LeSueur	590	Izaak Walton League	1-7.5 HP compressor 3 diffusers	8,600	713.80	2.1	N
Greenleaf (40-20)	LeSueur	306	Montgomery Sportsmen's Club	1-5 HP compressor 3 diffusers	-	400.00	1.0	N
Cottonwood (42-14)	Lyon	383	Lyon County	1-15 HP motor 6 diffusers	-	2,000.00	2.0	N
East Twin (42-70)	Lyon	280	Lyon County	1-7 HP blower 2 diffusers	7	300.00	3.0	N
West Twin (42-74)	Lyon	237	Lyon County	1-7.0 HP motor/blower 2 diffusers	7	300.00	3.0	N
George (46-24)	Martin	82	City of Fairmont	1-5 HP blower 2 diffusers	-	1,200.00	1.9	N
Sisseton (46-25)	Martin	139	City of Fairmont	1-15 HP blower 2 diffusers	did not operate			
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)
Polcon Helixors (Con't.)								
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	273,222	2,053.40	1.7	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	11,557	758.79	1.6	N
Elysian (81-95)	Waseca	2,462	Smith's Mill-Janesville Sportsmen's Club	3-7.5 HP blowers 15 diffusers	-	-	-	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	-	-	2.3	N
Clean-Flo Systems								
Shack Eddy (2-109)	Anoka	22	Armstrong Kennels	1-0.5 HP blower 1 diffuser	-	-	3.0	N
Crystal (7-98)	Blue Earth	396	Crystal and Loon Lake Rec., Inc.	2-0.75 HP compressors 4 diffusers	did not return questionnaire			
Ida (7-90)	Blue Earth	120	Lura Lake Aeration Corp.	1-5 HP compressor 8 diffusers	-	-	2.3	N
Loon (7-96)	Blue Earth	818	Crystal and Loon Lake Rec., Inc.	4-0.75 HP compressors 8 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)
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	7,799	625.14	2.8	N
Arrowhead (27-45)	Hennepin	23	City of Edina	1-1.5 HP compressor 3 diffusers	-	-	3.0	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	-	-	3.0	Y
Gleason (27-95)	Hennepin	167	Gleason Lake Improvement Assn	4-0.5 HP compressors 16 diffusers	-	-	3.8	N
Hadley (27-109)	Hennepin	39	Hadley Lake Improvement Assn	6-0.5 HP compressors 7 diffusers	-	2,195.00	3.4	N
Irene (27-189)	Hennepin	29		2-0.5 HP compressors 4 diffusers	-	-	4.5	N
Sweeney-Twin (27-35)	Hennepin	96	Sweeney Lake Assn	3-0.5 HP to 7-0.75 HP compressors, 18 diffusers	2,738	248.00	4.7	N
Unnamed (Upper) (34-28)	Kandiyohi	22	City of Atwater	2-2 HP compressors 4 diffusers	717	172.26	3.0	Y
Unnamed (Tadd) (34-376)	Kandiyohi	10	City of Atwater	2-2 HP compressors 4 diffusers	805	203.35	4.0	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)
Clean-Flo Systems (Con't.)								
Mabel (40-11)	LeSueur	103	Lucky 13 Sportsmen's Club	2-0.5 compressors 4 diffusers	-	195.00	1.7	N
Unnamed (40-58)	LeSueur	18		1-0.75 compressor 2 diffusers	-	300.00	4.0	N
Unnamed (58-141)	Pine	23		1-0.75 compressor 2 diffusers	-	-	3.3	N
Birch (62-24)	Ramsey	127	Birch Lake Improvement Assn	1-1 HP compressor 3 diffusers	-	200.00	7.3	N
Willow (62-40)	Ramsey	75	Natural Preserve Foundation	3-0.5 compressors 6 diffusers	did not return questionnaire			
Cody (66-61)	Rice	257	Wheatland Twin Lakes Sportsmen's Club	4-0.5 and 2-0.75 HP compressors, 12 diffusers	6,927	741.89	1.3	Y
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	-	800.00	3.2	N
Loon (81-15)	Waseca	119	City of Waseca	1-5 HP compressor 9 diffusers	10,929	1,005.47	3.4	N
Benz (82-120)	Washington	36	Benz Lake Homeowners Association	3-0.75 HP, 1-0.33 HP 8 diffusers	-	500.00	4.5	Y
Pine tree (82-122)	Washington	174		1-0.5 HP compressor 2 diffusers	-	250.00	4.6	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 operate		
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	-	100.00	4.5	N
Mills (7-97)	Blue Earth	237	Crystal and Loon Lake Recreation	2-0.75 HP compressors 4 diffusers		did not return questionnaire		
Oak (10-93)	Carver	185		4-1 HP compressors 8 diffusers	-	-	4.0	N
Eagle (11-342)	Cass	110	Eagle Lake Association	1-0.5 HP pump 2 diffusers		did not return questionnaire		
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	-	-	3.5	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	-	-	2.8	N
Albert Lea (24-14)	Freeborn	2,654	Freeborn County	2-1 HP compressors diffuser tubing	-	300.00	0.4	N
Pottery Pond (25-38)	Goodhue	8	City of Red Wing	1-0.75 HP Vane compressor 2 diffusers	-	-	3.4	N
Marion (43-84)	McLeod	616	Brownton Rod and Gun Club	1-5 HP blower 3 mat diffusers	12,969	1,311.12	3.0	N
Alexander	Morrison	2,990		1-3 HP Vein pump 500 pt diffuser hose	-	550.00	-	N
Shamineau (49-127)	Morrison	1,453		Regiair Vane blower 1.5 HP	6,050	671.00	3.0	N
Perch (56-95)	Otter Tail	57		1-0.75 HP compressor	did not return questionnaire			
Pete (56-294)	Otter Tail	34		1-0.75 HP compressor	-	-	3.9	N
Unnamed (56-549)	Otter Tail	17		1-0.25 HP motor and diffuser hose	did not return questionnaire			
Lena (58-18)	Pine	50	Lake Lena Acres Assn	2-0.25 HP bubbler	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.)								
Cable (60-293)	Polk	129	Cable Lake Association	3-0.25 HP pump	3,276	219.49	3.0	N
Pleasant (62-46)	Ramsey	585	City of St. Paul Water Utility	2-30 HP compressors 2 diffusers		did not operate		
Ann (71-69)	Sherburne	226	Ann Lake Improvement Club, Inc.	1-.5 HP compressor 2 copper diffusers	-	120.00	2.7	N
Kohlmeier (74-19)	Steele	11	City of Owatonna	2-0.75 HP compressors 3 diffusers	-	-	3.9	N
Stocking (80-37)	Wadena	356	Stocking Lake Boosters, Inc.	2 Gast compressors 5 diffusers	-	250.00	4.5	N
Mud (Battle Creek) (82-91)	Washington	103	City of Woodbury	2-1 HP compressors 6 diffusers	3,261	351.60	4.0	N
Unnamed Pond (82-257)	Washington	7		0.25 HP blower 2 diffusers	-	-	4.6	Y
Pump and Baffle								
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	-	-	1.1	N
Golden (2-45)	Anoka	50	City of Circle Pines	1-7.5 HP permanent pump and baffle	51,712	4,862.03	4.5	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)
Pump and Baffle (Con't.)								
Martin (2-34)	Anoka	218	Anoka County Parks and Recreation	1-10 HP pump and baffle	-	-	1.8	N
Moore, West (2-75)	Anoka	110	City of Fridley	1-10 HP pump and baffle	-	-	1.0	N
Peltier (2-4)	Anoka	483	Anoka County Parks and Recreation	1-20 HP pump and baffle	did not operate			
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	-	-	2.1	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	16,760	1,630.00	2.8	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	17,000	1,300.00	3.2	N
Powderhorn (27-14)	Hennepin	11	Mpls. Park & Recr. Board	Pump and baffle 4HP	did not return questionnaire			
Red Rock (27-76)	Hennepin	83	City of Eden Prairie	1-7.5 HP pump and baffle	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)
Pump and Baffle (Con't.)								
Wirth (7-37)	Hennepin	37	Mpls. Park & Recr. Board	1-5.0 HP pump and baffle	-	886.00	3.4	Y
Wolfe (27-664)	Hennepin	3	City of St. Louis Park	Built in waterfall– 5 HP	1,800	2,025.00	4.5	N
Wolf (29-81)	Hubbard	274		1-5 HP pump and baffle	-	750.00	2.5	N
Knife (33-28)	Kanabec	1,127	Knife Lake Improvement District	1-10 HP pump and baffle 1-20 HP pump and baffle		did not operate		
Unnamed (Florian Res.) (45-119)	Marshall	42	Marshall County Park Board	1-9 HP pump and baffle	42,420	3,145.38	5.6	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	-	2,400.00	3.3	N
Fish (56-66)	Otter Tail	500	Parkers Prairie Sportsmen's Club	10-HP pump and baffle	-	1,800.00	3.4	N
Badger (60-214)	Polk	247	Erskine Lions Club	CORE Project pump and baffle	3,336	312.63	3.0	N
Maple (60-305)	Polk	1,445	Maple Lake Improvement District	3-5 HP pump and baffle	38,673	2,907.76	3.0	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)
Pump and Baffle (Con't.)								
Pelican (61-111)	Pope	516	Pelican Lake Association, Inc.	1-20 HP pump and baffle	did not return questionnaire			
Beaver (62-16)	Ramsey	65	Ramsey County Public Works Dept.	1-7.5 HP pump and baffle	25,776	1,350.00	3.7	N
Island (62-75)	Ramsey	63	Ramsey County Public Works Dept.	1-20 HP pump and baffle	36,680	3,400.00	3.2	N
Loeb (62-231)	Ramsey	10	City of St. Paul	1-5 HP pump and baffle	-	-	2.8	N
Owasso (62-56)	Ramsey	360	Ramsey County Public Works Dept.	1-20 HP pump and baffle	11,096	1,050.00	1.6	N
Silver (East) (62-1)	Ramsey	68	Ramsey County Public Works Dept.	1-15 HP pump and baffle	14,086	1,305.00	3.1	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	3,665	385.55	2.8	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)
Pump and Baffle (Con't.)								
Shields (82-162)	Washington	27	City of Forest Lake	CORE pump and baffle 3 HP	-	188.52	2.7	Y
Subsurface Aspirating Systems (Aire-0_2, Aeromix Tornado)								
Cedar (1-165)	Aitkin	260	Cedar Lake Assn	3-2 HP Aeromix tornado	5,262	789.00	5.0	N
Coon (2-42)	Anoka	1,507	Anoka County Parks	3-2 HP Aeromix tornadoes	-	-	2.3	Y
Ham (2-53)	Anoka	193	Anoka County Parks	3-2 HP Aeromix tornadoes	10,150	944.48	2.1	N
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	3,604	410.49	1.8	N
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	did not return questionnaire			
Birch Pond (19-202)	Dakota	3	School of Environmental Studies	Neptune air injection system	-	-	2.0	N
Blackhawk (19-59)	Dakota	39	City of Eagan	1-2 HP air injection system	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)
Subsurface Aspirating Systems (Aire-0_2, Aeromix Tornado) (Con't.)								
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		did not operate		
Fish (19-57)	Dakota	28	City of Eagan	1-2 HP air injection system		did not return questionnaire		
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							