Background

CHAPTER 1

Mosquitoes have been a part of Minnesota history since the first Agricultural Experiment Station entomologist, Otto Lugger, began collecting and describing the state's insects in 1888. Minnesota's natural environment of wetlands and ponds, along with plentiful rainfall, provides ample mosquito breeding habitat. A diary of an early Minnesota surveyor stated: "Life (in this township) is almost unindurable, from the torture of insects, and physical discomforts. I have been stung by mosquitoes . . . while standing in snow knee deep."[1]

In this chapter we review the statutory framework under which the Metropolitan Mosquito Control District (MMCD) operates, examine the District's organization and structure, present information on mosquito and black fly biology, and describe what insecticides and methods are used by MMCD to control mosquitoes and black flies. We address these questions:

- **What are the purposes and mission of the Metropolitan Mosquito Control District? How is the District organized, funded, and staffed?**
- **How have the District's revenues and expenditures, and staffing changed since 1995?**
- **How are mosquito control services provided in other parts of Minnesota?**

To answer these questions, we reviewed previous reports and studies about the Metropolitan Mosquito Control District, state statutes and laws, and minutes of Metropolitan Mosquito Control Commission meetings. We also analyzed financial audit reports and District budget documents and interviewed District staff and commissioners.

The Metropolitan Mosquito Control District was created in 1958. Its enabling legislation (*Minn. Stat.* §§473.701-473.716) states that the District "is created to control mosquitoes." The District is also responsible for controlling black flies and monitoring disease-carrying ticks. The enabling legislation gives the Metropolitan Mosquito Control Commission, the District's governing body, discretion in how the District controls mosquitoes.

1 Roger Moon, "A Brief Overview of the Life History, Physiology, and Ecology of Minnesota Mosquitoes," *Journal of the Minnesota Academy of Science* 50:3, 1985: 6.

Mosquito control is the District's principal activity and its primary focus is on 15 mosquito species that are either aggressive human biters or potential carriers of disease. This chapter presents information on the biology of mosquitoes and black flies and it presents information on the methods and insecticides that the District uses to kill them.

HISTORY

In 1959, the Legislature recognized the Metropolitan Mosquito Control District in state law.

The Metropolitan Mosquito Control District was created in 1958 as a joint powers agreement with six metropolitan counties: Anoka, Dakota, Hennepin, Ramsey, Scott, and Washington. Legislation passed in 1959 recognized the District in state law.[2] Originally, the District was created to control mosquitoes. Over the years, the Legislature also gave MMCD authority to control black flies (1983) and disease-carrying ticks (1989).[3]

The District's geographic area remained the same from 1958 to 1982 when the Legislature added the eastern half of Carver County to the District. At the same time, legislation repealed a provision allowing a county to terminate its participation in the District with a 12-month notice.[4] Instead, a county must obtain legislative approval before it may terminate its participation in the District.[5] A contiguous county may participate in the District if its county board petitions to be admitted and the Metropolitan Mosquito Control Commission agrees.[6] No neighboring county has exercised this option.

The District controls mosquitoes and black flies and monitors disease-carrying ticks.

The Metropolitan Mosquito Control District is governed by a 17-member commission composed of county commissioners from participating counties. Commissioners are appointed by their respective county boards and serve one year terms beginning January 1 of each year. There are no term limits. The current commission consists of three representatives each from Anoka, Dakota, Hennepin, and Ramsey counties; two each from Scott and Washington counties; and one from Carver County.[7]

Legislation gives the Metropolitan Mosquito Control Commission discretion in how it carries out control programs in the district. Specifically, legislation authorizes the Commission to:

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2 Codified in *Minn. Stat.* §§473.701-473.716.

3 *Minn. Laws* (1983), ch. 129, secs. 1, 4; and *Minn. Laws* (1989) ch. 146, sec. 1.

4 *Minn. Laws* (1982), ch. 579, secs. 4, 9.

5 State law contains specific procedures for appraisal of property and amounts to be paid to a terminated county. It also contains provisions for disposing of property, assets, and liabilities "if the district is dissolved." *Minn. Stat.* §473.712.

6 *Minn. Stat.* §473.715.

7 *Minn. Stat.* §473.703. Initially, the Commission had two representatives from each county. The Commission's current composition is related to the size of the county board. In 1982, the counties with seven-member boards were given an additional member. Carver County has one representative because only part of the county is in the District.

- undertake control programs in accordance with expert and technical plans;
- employ and fix the duties and compensation of a director and a business administrator;
- employ other persons and contract for services;
- purchase materials, supplies, and equipment; sell and dispose of surplus property; and accept gifts of property;
- prepare and adopt an annual budget, levy taxes, and prepare and submit required financial reports;
- enter into agreements with local jurisdictions outside the district to conduct mosquito control activities in those jurisdictions in order to control mosquitoes within the district; and
- take whatever other acts "are reasonable and necessary to carry out the general and specific powers of the commission."[8]

State law gives the Metropolitan Mosquito Control Commission discretion in how it carries out its responsibilities.

State law also gives the Commission and its employees the authority to:

- enter any property within or outside the district at reasonable times to determine the need for control programs;
- take all necessary and proper steps for the control programs on property within the district; and
- enter property and clean up any stagnant pools of water, the shores of lakes and streams, and other breeding places for mosquitoes within the district, subject to the paramount control of county and state authorities.[9]

The Commission may apply insecticides to mosquito breeding sites found inside or outside the district. Prior to applying insecticides *outside* the district, the Commission is required to give reasonable notice to the governing body of the local unit of government.[10]

A 1982 amendment limited the Commission's access to property by giving *private* landowners the right to refuse the District access to their property "except for control of disease bearing mosquito encephalitis outbreaks." This amendment also required the Commissioner of Natural Resources to allow the District to enter state property for mosquito control purposes.[11]

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8 *Minn. Stat.* §473.704, subds. 2-9, 15-16, 19; *Minn. Stat.* §473.711, subd. 2.

9 *Minn. Stat.* §473.704, subd. 17.

10 *Ibid*.

11 *Minn. Laws* (1982), ch. 579, subd. 6.

Finally, state law requires the Commission to cooperate with certain public agencies for the purposes of research and protection of the public health and welfare. In addition, the commissioners of the departments of Agriculture, Natural Resources, Transportation, and Health, and the head of the Department of Entomology at the University of Minnesota are required to act in an "advisory capacity" to the Commission and its director.[12]

Other Mosquito-Related Provisions in State Law

In addition to the Metropolitan Mosquito Control District's enabling legislation, mosquito control in Minnesota is governed by two statutes: Local Pest Control, *Minn. Stat.* §§18.021-18.022; and Mosquito Abatement, *Minn. Stat.* §§18.041-18.161.[13]

State law governs mosquito control activities outside the Twin Cities area.

The Local Pest Control statutes govern mosquito control activities in Minnesota outside of the Twin Cities area. These statutes were originally enacted in 1935 following an extensive grasshopper control effort. They authorize local units of government to establish and fund programs to "control pests that may be detrimental to the health and welfare of humans or animals and to the environment."[14] Communities are required to submit an annual pest control application to the Department of Agriculture if they intend to engage in any pest control activities.

The Mosquito Abatement statutes provide for governmental units in the state to enter into mosquito abatement districts for "the abatement or suppression of mosquitoes of any kind, whether disease bearing or merely pestiferous."[15] No governmental unit has elected to establish such a district. Based on a review of these statutes, we think that the Legislature has intended mosquito control to be both a public service and a public health issue.

Other History

The Metropolitan Mosquito Control District's operations have been under public scrutiny since the 1970s.[16] The District completed an Environmental Impact Statement (EIS) on the environmental effects of its control programs and use of

12 *Minn. Stat.* §473.716.

13 In addition, state law contains language related to a statewide mosquito research program. In 1984, a Minnesota Mosquito Research and Control Program was established in response to a request by Governor Rudy Perpich. The Minnesota Department of Health, as the lead agency, brought together a group of North American experts to discuss problems related to mosquito research and control. This group recommended establishment of a state-wide research program housed in a research facility at the University of Minnesota supported by field research stations. Legislation was passed related to the research program, but funds were never appropriated to support it. (*Minn. Laws* (1Sp1985), ch. 14, art. 19, sec. 17 codified as *Minn. Stat.* §144.95.)

14 *Minn. Stat.* §18.012. Mosquito control activity reported under this statute is summarized later in this chapter.

15 *Minn. Stat.* §18.051.

16 This historical summary relies on information from the Environmental Quality Board, Mosquito Control Technical Work Group, *Final Report*, April 1994: 1.

insecticides in 1977. In 1985, environmental groups filed a lawsuit and a petition with the Environmental Quality Board (EQB) expressing concerns about the effects of the District's program and use of insecticides. As a result of additional concerns raised in the environmental review process, the District began a Supplemental Environmental Impact Statement which was completed in 1987.[17] The Supplemental EIS addressed the effects of changes in operations that the District had implemented since the original EIS.

In 1985, as a result of the lawsuit and petition, MMCD created and funded an independent Scientific Peer Review Panel (SPRP) to carry out an external research program on the effects of the District's larval insecticides. The 10-member panel was composed of experts in biology and toxicology from several universities in the United States and Canada, as well as state and federal researchers. Two panel members were named by environmental groups; the others were appointed by the MMCD.

The Metropolitan Mosquito Control District's operations have been under public scrutiny for many years.

EQB determined that the Supplemental EIS was adequate in June 1988, but also noted that potential impacts to certain nontarget species were unknown because of limited data. Therefore, EQB directed the District to prepare an addendum report on the SPRP research activities.

When MMCD did not complete the addendum report as expected in 1990, the environmental community prompted EQB to question the District about its research work in 1993. After a number of meetings, EQB decided that there were legitimate reasons for the delays, reaffirmed the need for information on environmental impacts of the mosquito control program, and raised issues concerning MMCD's effectiveness in reducing mosquito populations. In November 1993, EQB created the Mosquito Control Technical Work Group and directed it to identify and scope issues that should be addressed if the board were to hold a public hearing.[18] The work group consisted of staff members of EQB, MMCD, and other state agencies. After holding public meetings, the work group recommended, among other things, that EQB not hold hearings on the efficacy and environmental impacts of mosquito control because there were gaps in information. It also recommended that the District establish an interagency panel to review its effectiveness.

In the meantime, the SPRP conducted a variety of research projects, relying on a budget that ranged from $210,000 to $245,000 each year—2.5 percent of the MMCD budget.[19] Initially, the SPRP did laboratory studies on the effects of insecticides on mosquitoes and other species. It also examined the effects of insecticides in the field. In 1987, the SPRP began the Wright County Long-Term Experiment to study the effects of *Bti* and methoprene, the larval insecticides used by MMCD. The Natural Resources Research Institute (NRRI), a branch of the

17 Metropolitan Mosquito Control District, *Supplemental Environmental Impact Statement* [Draft], November 1986: ix-xiii.

18 The Environmental Quality Board can hold hearings under authority of *Minn. Stat.* §116C.06 on matters of environmental significance.

19 Scientific Peer Review Panel, "Interim Report," unpublished report to the Minnesota Environmental Quality Board, May 1993: 1, 3. Between 1987 and 1998, SPRP expenditures totaled over $2 million.

University of Minnesota Duluth, worked closely with the SPRP to design the experiment. In December 1996, the District made presentations to EQB on the preliminary results of the SPRP research and the interagency panel's work on effectiveness. No action was taken by EQB. The SPRP issued its final report in January 1996 and then formally disbanded.[20]

A subgroup of the SPRP, the Continuation Panel, continues to meet but does not receive funding from MMCD. MMCD provided funding for continued treatment and sampling of the Wright County sites in 1997 and 1998. In 1997, a follow-up to the long-term study was done under contract by the Lake Superior Research Institute of the University of Wisconsin at Superior.

For some people, the results of this research eased concerns about the District's use of insecticides to control mosquito larvae. More recent criticisms of the District have focused on the insecticides it uses to control adult mosquitoes and whether people are provided with enough information about the District's operations.

DISTRICT ORGANIZATION, FINANCING, AND STAFFING

The Metropolitan Mosquito Control District's mission is:

> To promote health and well being by protecting the public from disease and annoyance caused by mosquitoes, black flies and ticks, in an environmentally sensitive manner.[21]

The Metropolitan Mosquito Control Commission is the District's governing board.

The District's primary emphasis is on mosquito control, which includes monitoring and control of human biting mosquitoes that can carry diseases or cause annoyance. The District emphasizes the control of mosquito larvae, with localized adult mosquito control to prevent disease transmission and reduce mosquito annoyance in public parks and at public events. MMCD also monitors and controls for black flies that cause human annoyance. Finally, it monitors deer ticks, which can carry disease, in the Twin Cities area.

Figure 1.1 shows the organization of the Metropolitan Mosquito Control Commission and the District. The Metropolitan Mosquito Control Commission sets policy for the District, delegating implementation to a professional staff. The Commission appoints a director who is responsible for managing the staff and operations of the District. By law, the director must be an entomologist.[22]

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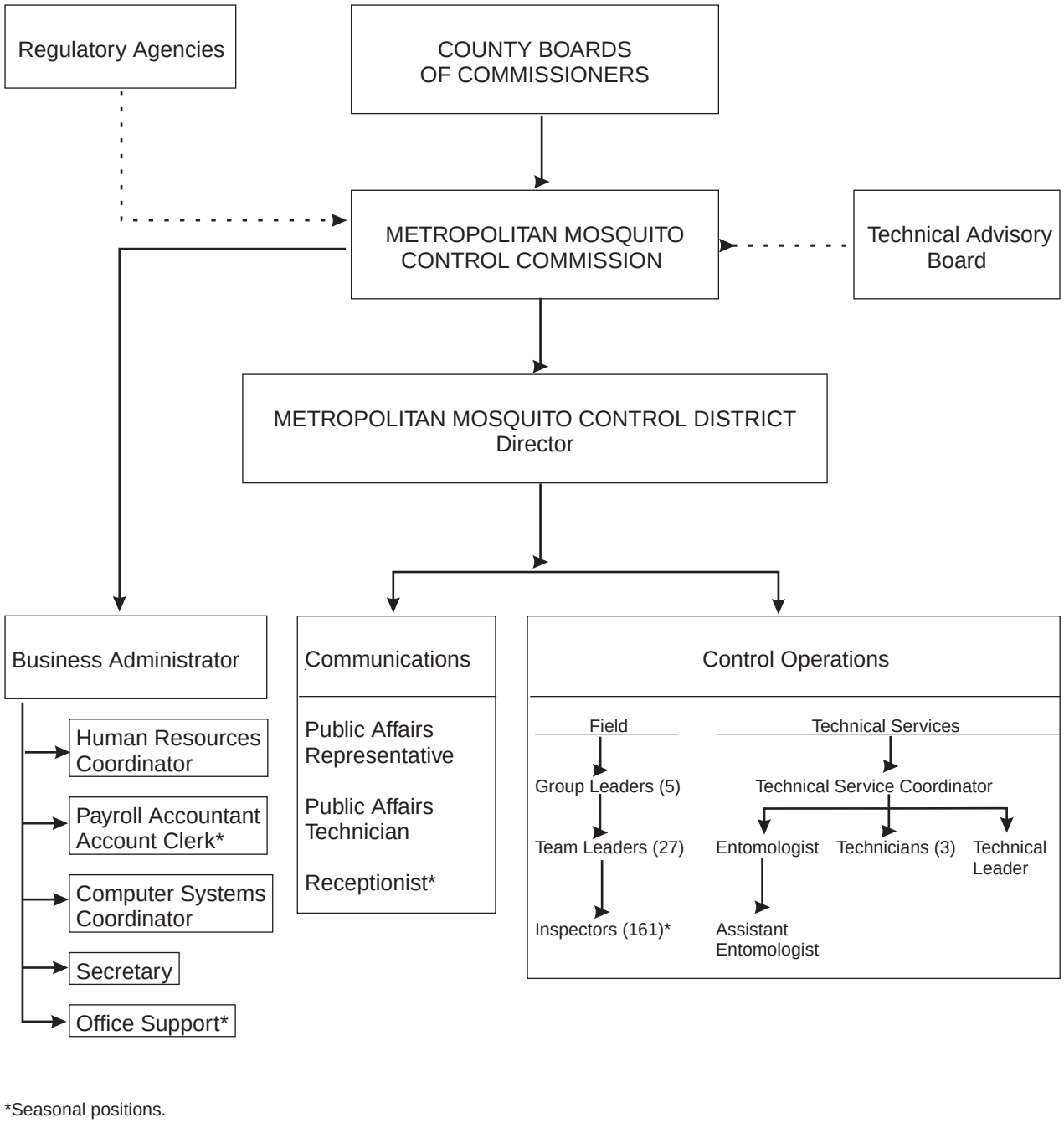
20 Results of the first few years of the Scientific Peer Review Panel long-term study were published in peer-reviewed journals in 1997 and 1998. The results of these and other studies are discussed in Chapter 2.

21 Metropolitan Mosquito Control District, *1998 Budget*: 4. The Metropolitan Mosquito Control Commission amended the District's mission statement on May 22, 1996.

22 *Minn. Stat.* §473.704, subd. 3.

Figure 1.1: Metropolitan Mosquito Control District Organizational Chart, 1998



*Seasonal positions.

A Technical Advisory Board (TAB) reviews the goals, plans, operations, and research of the District and reports its recommendations to the Commission. The TAB is composed of technically-oriented professionals representing state agencies, the University of Minnesota, and industry and environmental groups. MMCD established the TAB in 1981 as a forum for cooperating with and obtaining advice from other public agencies as required by law.[23]

As a user of insecticides, the District is regulated by several federal and state agencies. The U.S. Environmental Protection Agency, the primary federal regulator, enforces the Federal Insecticide, Fungicide, and Rodenticide Act which provides for the registration, distribution, and use of pesticides.[24] In Minnesota, the Department of Agriculture regulates the registration, labeling, storage, and use of insecticides and the licensing of applicators pursuant to federal and state laws and rules. It also investigates citizen complaints and incidents involving the use of insecticides.

Other agencies that have a smaller role in insecticide regulation include: the Federal Aviation Administration for aerial applications; the Minnesota Department of Natural Resources for use in public waters; the Minnesota Department of Transportation for shipping of materials and signs on refueling vehicles; federal and state Occupational Safety and Health Administration for worker safety and protection; the Minnesota Pollution Control Agency for disposal of materials; and various local jurisdictions that have ordinances such as fire codes.

MMCD employed 47 full-time staff and 164 seasonal staff in 1998. Figure 1.1 illustrates the breakdown of staff by activity and shows that:

- **The majority of the District's staff have worked in insect control operations.**

The largest number of staff were responsible for monitoring and controlling insects from regional field offices: 32 full-time staff and 161 seasonal staff. The next largest group of staff was the technical services staff, consisting of seven entomologists and technicians, who provided scientific and technical support to the field operations. Under the supervision of the business administrator, four full-time staff provided personnel, accounting, and computer support to the District. Two full-time staff were responsible for communications, providing public information and education services and managing telephone calls from citizens. Three seasonal staff provided support to the administration and communication functions during the summer of 1998.

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23 Chapter 5 examines governance issues related to the Metropolitan Mosquito Control Commission and the Technical Advisory Board.

24 U. S. Environmental Protection Agency, *The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and Federal Food, Drug, and Cosmetic Act (FFDCA) As Amended by the Food Quality Protection Act (FQPA) of August 3, 1996* (Washington, D.C.: March 1997).

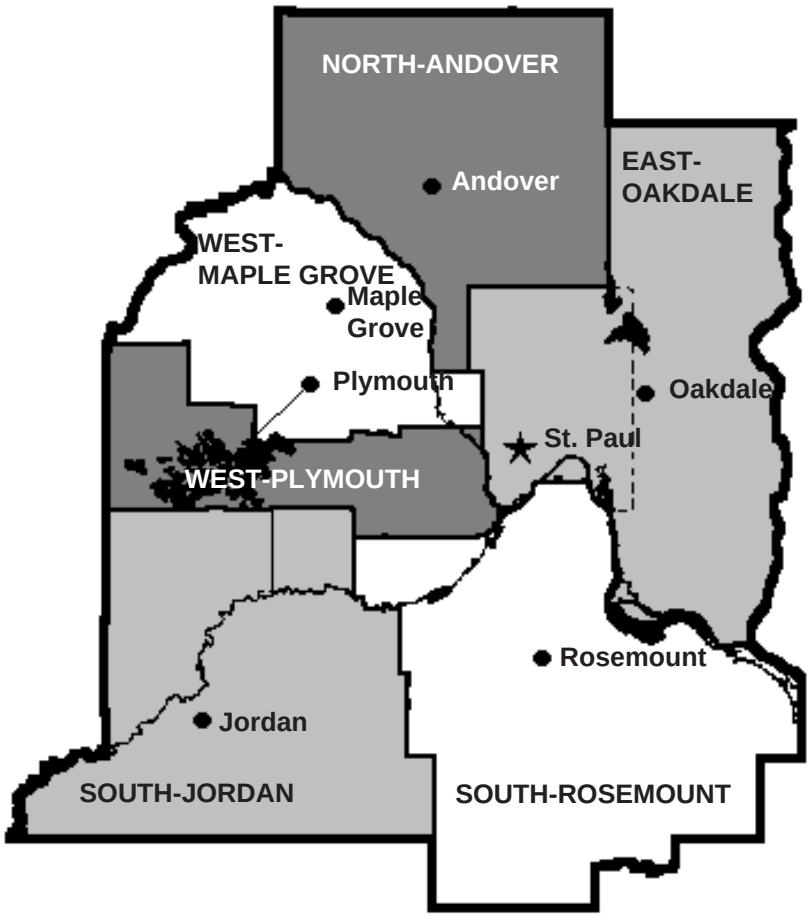
The District's six regional offices and the areas they serve are shown in Figure 1.2. The District has divided the Twin Cities area into four regions: North, South, West, and East. The North and East regions each have a field office while the West and South regions have two offices each. Administration, communication, and technical services staff work out of the headquarters office in St. Paul.

Changes in Revenues and Expenditures

The Metropolitan Mosquito Control Commission is a special taxing district, authorized to levy property taxes since 1982.[25] In 1998, MMCD had a budget of approximately $8.6 million. The property tax levy accounted for 72 percent of

Six regional offices serve the District's four regions.

Figure 1.2: Metropolitan Mosquito Control District Regions and Offices, 1998



SOURCE: Metropolitan Mosquito Control District.

25 Minn. Stat. §473.711. Prior to 1982, each county in the District levied a special tax each year to defray its per capita share of the District's costs.

1998 revenues, while state Homestead and Agricultural Credit Aid (HACA) accounted for 13 percent, and other miscellaneous revenues funded 4 percent.[26] In addition, about $900,000 of the District's fund balance supported its 1998 operations. Hennepin County provided most of the District's property tax revenues (50 percent) in 1998 (see Table 1.1). The proportion of property tax revenues from each county has remained relatively consistent in recent years.

The District's 1998 budget of $8.6 million was financed primarily from property taxes.

Table 1.1: Metropolitan Mosquito Control District Bugeted Property Tax Revenues by County, 1998

County	Property Taxes	Share
Anoka	$ 525,800	8%
Carver	95,300	2
Dakota	801,300	13
Hennepin	3,129,500	50
Ramsey	1,056,400	17
Scott	159,100	3
Washington	437,900	7
Total	$6,205,300	100%

SOURCE: Metropolitan Mosquito Control District, *1998 Budget*: 17.

Figure 1.3 shows the breakdown of MMCD's budget by activity for 1998. Insect control activities accounted for the largest share (89 percent) of the budget in 1998, of which about 44 percent funded salaries and wages.

Figure 1.4 shows the District's expenditures since 1990. In 1995, the Legislature reduced the District's revenues by 28 percent by reducing its property tax levy and state aid payments by 50 percent.[27] This resulted in a 22 percent reduction in actual expenditures in 1996. The District responded by laying off staff and reducing mosquito control services. The District's 1996 budget contained the following reductions: 16 percent for control operation salaries, 21 percent for administrative salaries, 40 percent for insecticides, and 76 percent for helicopter services. Since the budget reduction in 1996, the District's actual expenditures increased 11 percent between 1996 and 1997 and its approved 1998 budget increased 11 percent. As a result, the District's 1998 budget has approached its spending level in 1995, when its actual expenditures were $8.8 million. This has been possible because in the past the District has not levied its maximum property tax levy and it has relied on its fund balance to support its operations.

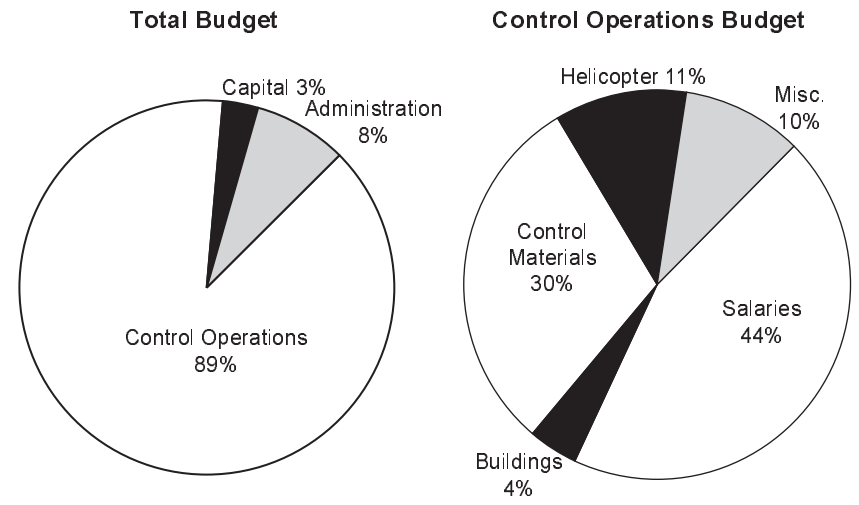
In the late 1980s and early 1990s, the District had maintained a substantial fund balance—over $15 million in 1989. MMCD has been criticized for using its fund balance to finance construction of a new headquarters building and regional offices between 1989 and 1994. Table 1.2 summarizes the District's 1989-94 construction projects and represents the current configuration of District offices.

26 Other revenues include investment income, delinquent tax income, and miscellaneous. MMCD has a January 1 to December 31 fiscal year.

27 *Minn. Laws* (1995), ch. 255, art. 2, sec. 9.

Mosquito control operations accounted for most of the District's 1998 budget.

Figure 1.3: Metropolitan Mosquito Control District 1998 Budget

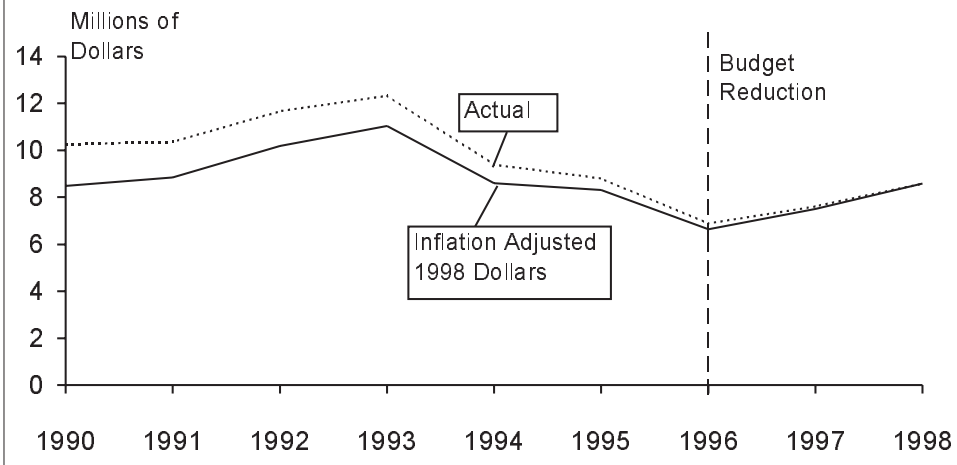


NOTE: Percentages do not sum due to rounding.

SOURCE: Metropolitan Mosquito Control District, *1998 Budget*: 17-18.

In 1995, the Legislature reduced MMCD's revenues by 28 percent, but current spending is close to pre-reduction levels.

Figure 1.4: Metropolitan Mosquito Control District Expenditures, 1990-98



NOTES: Actual dollars were adjusted for inflation (to 1998 dollars) using the national price deflator for state and local government expenditures and gross investment. The 1998 data represent the District's approved 1998 budget.

SOURCE: Office of the Legislative Auditor, Metropolitan Mosquito Control District Financial Audits, 1990-97; and Metropolitan Mosquito Control District, *1998 Budget*.

Table 1.2: Metropolitan Mosquito Control District Buildings

Owned:	Square Feet	Year Construction/ Remodeling Completed	Capital Cost of Land and Building
St. Paul Headquarters	36,284	1993	$3,233,700
North Region - Andover[a]	16,090	1992	723,600
South Region - Jordan	23,600	1991	826,000
South Region - Rosemount	21,550	1994	1,044,370
West Region - Maple Grove[b]	20,800	1994	1,055,430
West Region - Plymouth[c]	23,810	1994	1,017,000
Total	142,134		$7,900,100
Leased:			
East Region - Oakdale	30,680	--	--

[a]The District has a long-term lease with Anoka County for the land. Capital costs were for construction of a 10,250 square foot addition to an existing building.

[b]Capital costs were for land acquisition and remodeling of an 18,200 square foot existing building.

[c]Capital costs were for land acquisition and remodeling of an existing building.

SOURCES: Office of the Legislative Auditor, *Metropolitan Mosquito Control District Financial Audit for Fiscal Year Ending December 31, 1997*: 10-11; and R. Richard Gauger, "Metropolitan Mosquito Control District Construction Projects, 1989-1994: Final Report," December 30, 1994.

The District used its fund balance to finance capital projects in the early 1990s.

The District's unreserved fund balance had declined to $6.1 million in 1997.[28] The District had designated about $2 million of its fund balance for control materials inventory, emergency disease control, and facility repair and maintenance.[29] However, these funds were not reserved (funds for which there is a legally-binding commitment). Comparing the District's unreserved fund balance with current expenditures helps place the fund balance in perspective. In 1997, the District's unreserved fund balance was 80 percent of its 1997 expenditures. The District's dependence on property taxes means that it receives most of its revenues in May and October of each year. State aid payments are distributed in July. District staff argue that the agency needs to maintain a sizable fund balance for cash flow purposes. Minnesota counties, with the same fiscal year and similar financing sources as MMCD, had unreserved general fund balances that averaged only 22 percent of total current expenditures in 1995, the most recent year data were available.[30]

The District's unreserved fund balance was $6.1 million in 1997.

28 Office of the Legislative Auditor, *Metropolitan Mosquito Control District Financial Audit for the Year Ended December 31, 1997*, June 1998: 1.

29 In addition, $500,000 for employee benefits is recorded in the general long-term debt account group.

30 Office of the State Auditor, *A Guide to City and County General Fund Balances as of December 31, 1995*, July 1997: 2.

In December 1998, the Commission approved a 1999 budget of $9.2 million, 7.4 percent higher than its 1998 budget. The Commission agreed to levy 100 percent of its property tax levy. The property tax levy will account for about 83 percent of total revenues, its highest share since 1990. The Commission also proposes to use a portion of its fund balance (about $624,000) to make up the difference between the levy and the budget.

Changes in Staffing

Between 1994 and 1996, the District changed its organizational and operational structure. Previously, staff had been assigned to individual programs, such as the cattail mosquito, black fly, and Lyme disease programs. Staff knowledge was specialized, assignments were focused on narrow, well-defined functions, and operations were highly compartmentalized.[31] MMCD used a continuous quality improvement process to move to a decentralized, team-based organization. Currently, there are 18 teams organized around 4 core process areas—control strategies management, technical support/resource management, public affairs, and human resources. Management and administrative teams provide support to other teams.

The reorganization was designed to streamline the agency, make more efficient use of resources, and provide more effective services. The goals of the reorganization were to make staff knowledgeable in many technical areas, provide the same knowledge in each regional office, increase ability of staff to address multiple problems, and create a more fluid and flexible organization. Another goal was to decentralize the agency. Instead of being managed out of the St. Paul headquarters, group leaders would coordinate the control activities from regional offices.

The District's 1996 budget cut resulted in a 29 percent reduction in full-time staff positions.

While the reorganization was initiated in 1994, the budget cut in 1996 accelerated its implementation and also required reductions in staff. Table 1.3 shows the change in staff complement by function since 1994. Full-time staff were reduced 19.5 positions (29 percent) between 1995 and 1996. Full-time staff in control activities were reduced 31 percent, with technical services staff and group leaders being cut. Legislation has protected 27 team leaders represented by a collective bargaining agreement from being laid off. In 1998, the District added 15 seasonal staff as it attempted to return to its pre-1996 service levels. The 1999 budget adds one full-time administrative support staff, for total employment of 48 full-time and 164 seasonal staff.

Other Staffing Issues

One criticism of MMCD has been that it employs too many full-time staff given the seasonal nature of its work. We reviewed the responsibilities of full-time, year-round employees. In 1996, the District reduced its staffing and flattened its organization. In 1998, the District had eight administrative staff positions,

31 Metropolitan Mosquito Control Commission Meeting, August 23, 1995, Agenda Item 5: Reorganization of MMCD.

Table 1.3: Metropolitan Mosquito Control District Staff Complement, 1994-99

	Full-Time Staff				Seasonal Staff	
Year	Administrative	Percent Change	Control Operations	Percent Change	Control Operations	Percent Change
1994	10	NA	62	NA	177	NA
1995	9	-10%	58	-6%	169	-5%
1996	7.5	-17	40	-31	141	-17
1997	8	7	39	-3	149	6
1998	8	0	39	0	164	10
1999 (proposed)	9	13	39	0	164	0

SOURCE: Metropolitan Mosquito Control District 1994-98 Budgets and 1999 Budget.

including the director, business administrator, and other administrative staff responsible for human resources, payroll, computer systems, public affairs, and office support. In addition, the District contracted for services that it either did not require on a full-time basis (such as legal and lobbying services) or that required certain technical expertise (such as black fly research and human resources policy work).[32] We concluded that:

- **It does not appear that the District has been over-staffed in its administrative area.**

Control operations staff are divided between technical services staff located in the headquarters office and field staff housed in regional offices (see Figure 1.1). In 1998, seven technical services staff were responsible for collecting and analyzing the information essential to the District's operations. Since the 1996 budget cut, the responsibilities of individual technical services staff have been expanded to absorb the responsibilities of terminated staff. The primary responsibilities of technical services staff include: 1) managing the laboratory which identifies mosquito and black fly larvae by species and development stage and analyzes the numbers and species of adult mosquitoes collected; 2) collecting and analyzing rainfall data; 3) staying up-to-date on scientific literature; 4) working with vendors and operating the control material certification program; 5) testing the efficacy of insecticides used by MMCD; and 6) testing new control materials.

The District employed 32 full-time field staff responsible for insect control activities in 1998: 5 group leaders responsible for managing 6 regional offices and 27 team leaders—between 4 and 7 in each regional office. One group leader managed both the Maple Grove and Plymouth regional offices. The group leader in the Rosemount office was also the District's specialist on insect-transmitted diseases. Each team leader was responsible for supervising between 4 and 6

32 The District contracted for the following services in 1997: legal counsel, government relations/lobbying, accounting, black fly research and technical support, and human resources. The District spent approximately $125,000 on consultant contracts in 1997.

seasonal staff during the summer. The team leaders are represented by Local 132 Construction and General Laborers Union of the AFL-CIO. A 1995 state law prevented the District from terminating employees covered under the terms of a collective bargaining agreement, except for cause, before January 1, 1999.[33]

While we cannot say whether MMCD employs too many full-time field staff, we did ask staff what tasks are accomplished in off-season periods. Full-time staff in the regional offices are discouraged from taking time off during the summer. Consequently, group leaders and team leaders take between four and six weeks of time in the winter through a combination of earned vacation and compensatory time off. Other off-season activities include: 1) LaCrosse encephalitis monitoring in fall and spring when foliage is gone; 2) cattail mosquito activities—breeding sites are monitored from September to November and insecticides are applied in February and March; 3) equipment repair and maintenance; 4) updating breeding site maps; 5) analysis of the past season's activities and updating breeding site section cards and computer files; 6) meetings for teams that do not meet regularly during the summer; and 7) computer training.

Seasonal staff begin working in April and May and stop working in late August or September.

Each year MMCD hires people to work on a temporary or seasonal basis. Most seasonal staff begin working in April and May and stop working in late August or September depending on weather conditions, mosquito populations, and budget. Some seasonal staff treat cattail mosquito breeding sites in February and March and monitor sites into October and November.

Seasonal staff are responsible for a number of different functions. Mosquito inspectors working out of the regional offices monitor and control mosquitoes. Technical services inspectors work in the laboratory at the headquarters office counting and identifying mosquito larvae and adults. In the past, some people have criticized the District for using its seasonal positions to provide political favors. Although we were not able to check every case,

- **We found no evidence that MMCD has used seasonal positions to provide political favors.**

Since 1996, responsibility for hiring seasonal staff has been decentralized; group leaders in each regional office are responsible for interviewing and selecting seasonal employees, with administrative support from the human resources coordinator at the headquarters office. Given the tight labor market in 1998, the Commission increased seasonal mosquito inspector salaries and aggressively recruited employees using a variety of advertising and outreach techniques.[34] State law forbids family members of Commission members from working at MMCD, and financial audit reviews of personnel records in 1996 and 1997 did not find a problem in this area.[35] However, in two instances over the past two summers, children of MMCD staff have worked as seasonal staff. We do not

33 *Minn. Laws* (1995), ch. 255, art. 2, sec. 14.

34 In 1998, new hires started at $8.35 per hour and employees with three or more years of experience were paid $10.10 per hour. These wage rates were $1.00 per hour higher than 1997 rates. Seasonal employees earned one paid holiday for every summer worked, were eligible for a shift differential for working evenings, and could earn overtime.

35 *Minn. Stat.* §473.704, subd. 5.

know if any favoritism was involved in their hiring. In any case, the state law cited above does not apply to District staff. In neither instance was the individual assigned to work in the same office as their parent.

BACKGROUND ON DISTRICT OPERATIONS

Mosquito control is MMCD's principal activity. Although there are about 50 species of mosquitoes in Minnesota, fewer than 34 occur in the Twin Cities metropolitan area.[36] The District's mosquito control efforts target about 15 mosquito species that are either aggressive human biters or potential carriers of disease. The mosquito control season starts May 1 and ends September 1.

The District's mosquito control efforts target 15 mosquito species that are aggressive human biters or potential carriers of disease.

Each mosquito species has a scientific Latin name and some species also have "common names." The characteristics of mosquitoes—such as breeding sites, number of generations, flight and feeding habits—vary by species. Each species requires unique environmental conditions to maintain its life cycle. Knowing the characteristics of each species is critical to using the proper control techniques. Figure 1.5 describes some characteristics of the mosquito species that are the focus of MMCD operations, including:

- the floodwater mosquito (or *Aedes vexans*), the primary, most numerous human-biting mosquito species;
- the cattail mosquito (or *Coquillettidia perturbans*), which has the most persistent human-biting characteristics;
- the tree hole mosquito (or *Aedes triseriatus*), the primary carrier for LaCrosse encephalitis, a viral disease to which children are susceptible; and
- the *Culex tarsalis*, a carrier for Western Equine encephalitis, a viral disease affecting humans and horses and other livestock.

To understand how the District's control methods work, it is helpful to be familiar with the biology of the mosquito.[37] All mosquitoes need water to complete their life cycle. Different species of female adult mosquitoes show a distinct preference for breeding habitats in which to lay their eggs. The type of breeding habitat where mosquito larvae are found can be an aid to identifying what species they are.

36 Metropolitan Mosquito Control District, *Self-Assessment of Performance, 1994*, October 1994, 13.

37 Metropolitan Mosquito Control District, *Field Operations Manual*, Chapter V, Mosquito Habitat, Biology and Terminology, Spring 1992; Roger Moon, "A Brief Overview": 7-9.

Only the female mosquitoes feed on humans and other animals because they require blood before they can develop eggs. Female mosquitoes feed on humans, domesticated animals, birds, and wild animals. Male mosquitoes feed on plant juices.

Mosquitoes have four life stages or cycles: egg, larva, pupa, and adult. Female mosquitoes lay eggs either on water or in damp soil that is likely to become submerged later. When conditions are right, the larvae emerge from the hatched eggs in the water. Mosquito larvae develop in still, shallow water and have four

Figure 1.5: Mosquito Species, Breeding Sites, and Habitats

Species/Common Name	Nature	Breeding Sites	Habits and Habitats
Aedes vexans[1] Floodwater mosquito	Primary annoyance pest, accounting for 40-80 percent of mosquitoes caught on humans.	Margins of grassy depressions, marsh edges, along river floodplains and woodland pools, damp ground.	Eggs hatch beginning in late April and early May; adult populations peak in June. More than one generation per year. A rainfall of one inch or more will raise water levels enough to cause eggs to hatch. Adults fly great distances (up to 40-50 miles). Depending on humidity and temperature, adults live between two and four weeks. Peak biting activity is at dusk.
Coquillettidia perturbans Cattail mosquito	Second most abundant annoyance pest, accounting for half of mosquitoes caught on humans.	Cattail marshes.	Summer species that produces one brood per season. Larvae develop in cattail marshes over 12 months. Adults begin emerging in late June with peak emergence during the first week in July. Adults may fly up to five miles from breeding sites. Aggressive human biters with peak activity at dusk and dawn.
Aedes (Ae) stimulans, Ae. abserratus, Ae. excrucians Spring *Aedes*	Annoyance pest.	Woodland pools, bogs, marshes.	Develop in snowmelt water beginning in early April and emerge beginning in mid-May. First to emerge. One generation per year. Adult females live throughout the summer taking up to four blood meals. Do not fly far from breeding site.
Anophlese, Culex, Culiseta Permanent water species	Annoyance pest.	Permanent and semipermanent water.	Several hatches each summer. Adults prefer to feed on birds and livestock but will bite humans.
Aedes triseriatus Tree hole mosquito	Primary carrier for LaCrosse encephalitis.	Tree holes and artificial containers, such as waste tires.	Adults found in wooded and shaded areas. Stay within 1/4 to 1/2 mile from where they emerge. Typically do not leave the woodlot. Most active in the daytime. Not aggressive biters.
Culex tarsalis	Carrier for Western equine encephalitis.	Permanent and semipermanent water.	Produces several generations a year. In late summer, feeding shifts from birds to horses or humans.
Aedes albopictus Asian tiger mosquito	Carrier for several diseases.	Artificial containers.	Not yet established in the Twin Cities area. MMCD discovered in Scott County in Sept. 1996 at a used truck tire business.

[1]Other species of summer *Aedes* are also annoyance pests including *Ae. sticticus* and *Ae. trivittatus*.

SOURCES: Metropolitan Mosquito Control District, *Field Operations Manual*, Chapter V, Spring 1992; Metropolitan Mosquito Control District, *1996 Operational Review and Plans for 1997*, 15-17, 20-21.

growth stages known as "instars." At the end of the fourth larval instar, larvae molt into pupae. During the cocoon-like pupal stage, the adult mosquito develops within the pupal skin. The pupae stay in the water and do not feed. This is important because it affects when insecticides can be applied to be effective. After about one week in the pupal stage, adults are fully formed. They break through and emerge from the pupal skin, resting for a short time on the water surface while their wings expand and dry. Then adult female mosquitoes fly off in search of blood. After taking a blood meal, adult female mosquitoes will search for a breeding site to lay their eggs and the cycle begins again. The aquatic life cycle takes 7 to 10 days, depending on weather conditions.

A number of factors influence the adult female mosquito's blood feeding activities: humidity, wind, temperature, light, respiration, and body heat, among others. The primary blood feeding activity is between sundown and midnight during the summer, depending on the species. Optimum feeding conditions are temperatures above 55º F and humidity of 70 percent or higher. A second feeding period occurs around sunrise. Mosquitoes are active when favorable conditions exist through the night or when daytime conditions are overcast and humid.

The life span of adult mosquitoes depends on several factors, such as temperature, humidity, sex of the mosquito, and time of year. Most males live about a week; females survive between two and six weeks.

The District targets its black fly control efforts at four species that are considered pests.

The District also controls black fly (or biting gnat) larvae which develop in Twin Cities area rivers and streams. Biting gnats do not transmit disease but they bite and annoy humans. In Minnesota, there are four species of black flies that are considered pests: *Simulium* (*S.*) *venustum, S. luggeri, S. meridionale,* and *S. johansenni*. Black flies need well-oxygenated water, found in moving rivers and streams, for survival. *S. luggeri*, the primary pest, breeds in the Crow, Rum and Mississippi rivers. *S. venustum*, the most aggressive human biter, breeds primarily in small streams, though some breeding sites have been identified on the Rum River. *S. meridionale* and *S. johansenni* breed in large rivers, primarily the Crow and Minnesota rivers. Figure 1.6 compares black fly species in Minnesota.

Black flies lay eggs on the surface of moving water or on submerged vegetation. The larvae attach to rocks, logs, or vegetation in the water and feed on suspended materials that flow to them. Depending on the species, black flies have four to eight instars, or developmental stages. Black fly larvae stop feeding in the last larval stage right before pupation.

Black flies emerge as adults throughout the spring and summer. *S. venustum*, the small stream species, typically emerges in April and has only one generation. *S. johansenni* emerges in May or June, and also has only one generation. The other two black fly species emerge as adults in May through August, and can have several generations if climatic and river conditions are favorable. Female black flies bite animals or humans because the flies need blood to develop their eggs. Different species prefer different hosts.

Finally, the District monitors the presence and distribution of deer ticks in the Twin Cities area and shares this information with the Minnesota Department of Health. The bite of an infected black-legged tick (*Ixodes scapularis*) can transmit

Figure 1.6: Black Fly Species and Habitats

	Simulium venustum	*Simulium luggeri*	*Simulium meridionale*	*Simulium johansenni*
Primary habitat	Small streams	Crow, Rum and Mississippi rivers	Crow and Minnesota rivers	Crow and Minnesota rivers
Emergence	April	May-August	May-August	May-June
Generations	One	Three or more	Three or more	One
Number of treatments	One in spring	Several	Several	One or two
Primary location(s) of adults	Anoka	Anoka, Hennepin, Ramsey	Scott, Carver, south Hennepin	Scott, Carver, south Hennepin

SOURCES: Program Evaluation Division telephone interview with Ken Simmons, Black Fly Program Consultant, September 24, 1998 and interview with John Walz, Black Fly Coordinator, June 8, 1998; Metropolitan Mosquito Control District, Orientation Information, April 1, 1998; Metropolitan Mosquito Control District, *Self-Assessment of Performance, 1994*, October 27, 1994: 24.

Lyme disease to humans. At the present time, there are no effective methods available to control deer ticks.

Mosquito Breeding Sites and Priority Areas

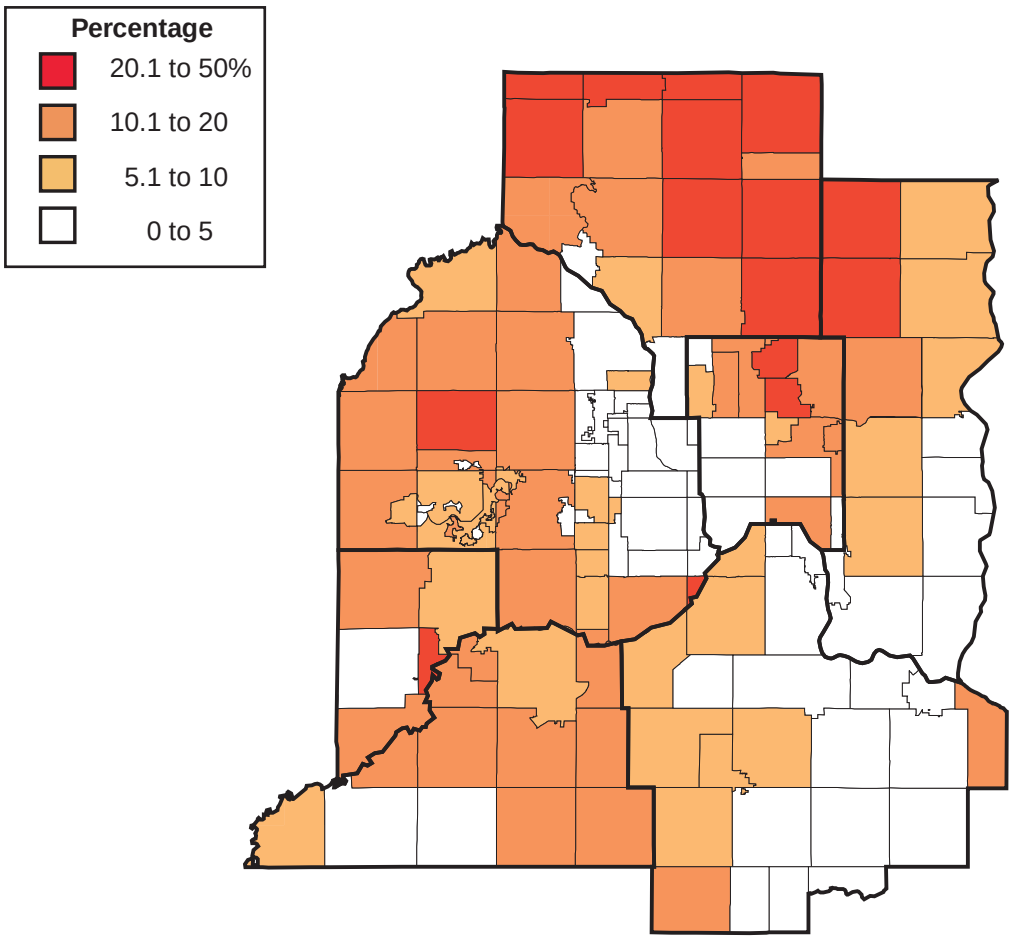
The District has identified over 65,000 potential mosquito breeding sites covering about 189,000 acres.

The Metropolitan Mosquito Control District covers an area of 2,600 square miles. The District has developed an extensive mapping system identifying over 65,000 mosquito breeding sites covering approximately 189,000 acres in the Twin Cities area. Mosquitoes breed in standing water, either temporary water or along the edges of permanent water. Mosquitoes are known to breed locally in the following areas: ponds which form as a result of snowmelt or rainfall; low areas that hold water and are dry for some of the year, such as woodland pools, ditches with wild grass, and areas with low grass; meadows and marsh sites that hold water all year; and cattail margins of permanent water sites. For those mosquitoes that develop in temporary water, a "breeding site" can be just about any place which will hold water for 10 to 15 days after a rainfall.[38] The mapped breeding sites within District boundaries range in size from about 400 square feet to 600 acres, with the average size of 2.87 acres. Figure 1.7 shows the percentage of acres in each township that were mosquito breeding acres in 1997.

The number of breeding sites and acres is not the same as the number of sites and acres MMCD treats to kill mosquito larvae. Other factors, such as whether Minnesota is having a wet year or whether the breeding site is in a refused treatment area, will affect the frequency with which sites will be treated or if they will be treated at all. The identified number of breeding sites may change as the Twin Cities area continues to develop, with some being created while others are destroyed.

38 Metropolitan Mosquito Control District, *Field Operations Manual*, Chapter V; Metropolitan Mosquito Control District, *Supplemental Environmental Impact Statement* [Draft], November 1986: xi.

Figure 1.7: Mosquito Breeding Acres As a Percentage of Each Township, 1997

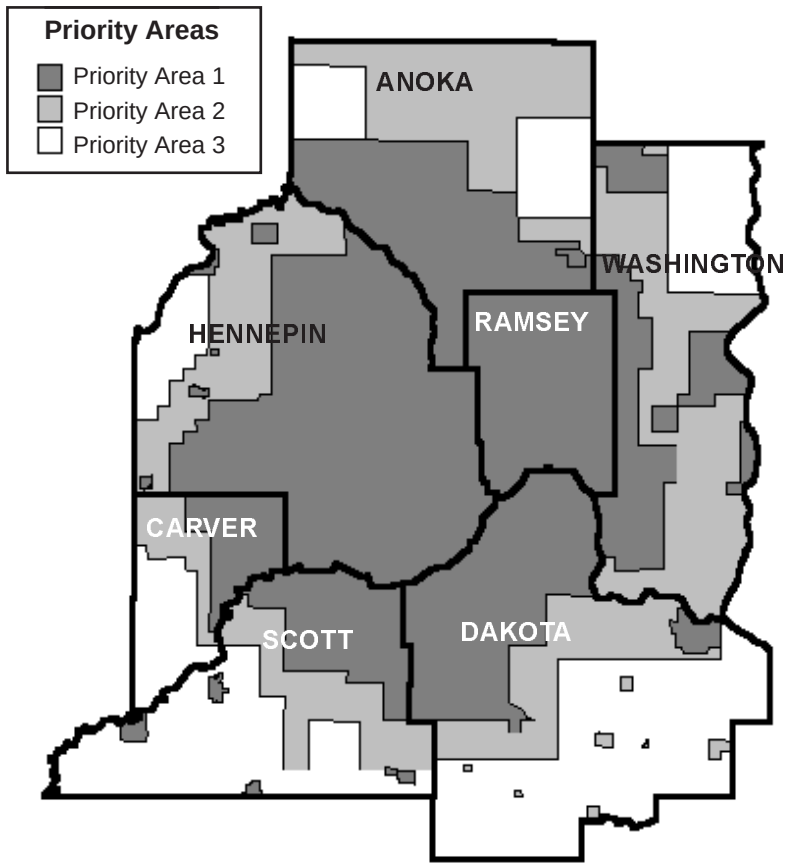


SOURCE: Metropolitan Mosquito Control District.

To help focus its mosquito control efforts, the District has established "priority areas" based on the location of mosquito breeding sites and human population density. Figure 1.8 shows the District's priority areas for 1998, and Table 1.4 shows the distribution of mosquito breeding sites and acres by county in 1997. Most of the mosquito breeding acres were located in Anoka and Hennepin counties (northern and western sections of the Twin Cities area). Priority Area 1,

Based on the location of mosquito breeding sites and human population density, the District focuses its control efforts on three priority areas.

Figure 1.8: Metropolitan Mosquito Control District Priority Areas, 1998



SOURCE: Metropolitan Mosquito Control District.

the highest priority, accounted for over one-third of all breeding acres. Hennepin and Anoka counties accounted for most of the acres in Priority Area 1, 35 percent and 19 percent, respectively. However, all of Ramsey County's mosquito breeding acres were in Priority Area 1.

The location of priority areas has changed over the years to correspond with changes in District control strategies and changes in population. For instance, the District used two priority areas in 1995. In 1996, the District added Priority Area 3 and Priority Area 1 and 2 "satellites," which include population centers located in Priority Areas 2 and 3 such as Jordan, Hastings, Forest Lake, Rogers, Randolph, and Hampton. In 1997 and 1998, the District modified but did not significantly change the priority areas.

Table 1.4: Mosquito Breeding Sites and Acres by County and Priority Area, 1997

County	Total Sites	Acres			
		Total	Priority Area 1	Priority Area 2	Priority Area 3
Anoka	11,185	58,815	12,977	31,340	14,498
Carver	3,133	8,191	2,058	3,117	3,016
Dakota	6,633	15,986	6,702	2,883	6,401
Hennepin	18,694	41,522	23,901	15,168	2,453
Ramsey	4,925	10,840	10,840	0	0
Scott	9,490	27,177	8,489	8,331	10,357
Washington	11,797	26,431	3,034	18,137	5,260
Total	65,857	188,962	68,001	78,976	41,985

SOURCE: Program Evaluation Division analysis of the Metropolitan Mosquito Control District master breeding site data file.

Control Methods and Insecticides Used by MMCD

In the mid-1980s, MMCD switched to insecticides better targeted to mosquito and black fly larvae.

MMCD uses *Bacillus thuringiensis israelensis* (*Bti*) and methoprene to kill mosquito larvae and resmethrin and permethrin to kill adult mosquitoes. MMCD began using these insecticides in the mid-1980s.[39] Prior to that, it had used the organophosphates temephos (sold under the trade name Abate), and chlorpyrifos (sold as Dursban), malathion, and petroleum oil. These products are still on the market. Until 1968, MMCD spread DDT and oil on water at breeding sites to kill mosquito larvae.[40] According to District staff, the District has chosen to use *Bti* and methoprene to kill mosquito and black fly larvae because these insecticides are less likely to harm nontarget species than broad spectrum synthetic chemical pesticides. This section presents information on how MMCD applies each material. Chapter 2 reviews scientific literature on the effects of these insecticides.

Bti

Bti is a natural soil bacteria that kills mosquito and black fly larvae when they eat it. MMCD uses a dry formulation of *Bti* that is attached to corncob granules to kill mosquito larvae. To be effective, *Bti* must be applied during the first three instars of the mosquito life cycle before the larvae stop feeding. Given the development of mosquito larvae, after a rainfall of one inch or more MMCD has between 7 and 10 days to treat breeding sites. Prior to applying *Bti* to a mosquito breeding site, a MMCD inspector verifies that human-biting mosquito larvae are

39 John Genereux and Michelle Genereux, "Minnesotans Flee for Cover When Mosquito Season Opens," *Pest Control*, March 1985.

40 Citizens League, *Citizens League Report on Metropolitan Mosquito Control District*, 1966.

present in sufficient numbers and that they are not yet in the fourth instar. If these conditions are met, MMCD staff spread *Bti* in the water. Generally, areas over three acres are treated by helicopter and smaller areas are treated by ground crews using seeders or power backpacks. Dosage rates of five or eight pounds per acre are used.

MMCD uses liquid *Bti* to kill black fly larvae in rivers and streams. The *Bti* is poured into a stream or river if larval numbers meet or exceed thresholds established by MMCD and DNR and the larvae are at the right stage of development. The amount of *Bti* liquid used in a treatment depends on the river flow level on the day of treatment. MMCD uses *Bti* products with the trade names VectoBac G (the corncob granules) and VectoBac 12AS (the liquid) supplied by Abbott Laboratories.[41]

MMCD uses *Bti* (a natural soil bacteria) and methoprene (a synthetic growth regulator) to kill mosquito larvae.

Methoprene

Methoprene is a synthetic growth regulator (or juvenile growth hormone) used to kill mosquito larvae. MMCD uses several different formulations of methoprene including: 150-day and 90-day timed-release briquets, 30-day timed-release pellets, and liquid.[42] In its timed-release forms, methoprene will kill successive mosquito broods without requiring staff to revisit a site, and it can be used in breeding sites that are difficult to reach with a timely application of *Bti*. Unlike *Bti*, methoprene can be placed on dry areas. Rains that flood mosquito eggs, permitting them to hatch, will also flood the methoprene briquets or pellets releasing the active ingredient.

MMCD uses methoprene to control both cattail and floodwater mosquitoes. The briquets are applied by hand to sites that are three acres or less in size and are hard to access. Sites that may flood and then dry up are treated completely, while permanent wetland sites are treated with briquets to the perimeter. For cattail mosquitoes, briquets are applied in the winter and early spring when water is still frozen. Application rates are 220 briquets per acre for a floodwater mosquito breeding site and 330 or 440 briquets per acre for cattail mosquitoes.

Pellets may be applied by helicopter to sites larger than three acres to kill both floodwater and cattail mosquitoes. The application rates vary by species—2.5 pounds per acre for floodwater mosquitoes and 5 pounds per acre for cattail mosquitoes. Sites smaller than three acres are treated by ground crews by hand, seeder, or power backpack. MMCD uses methoprene products supplied by Sandoz Agro, Inc. under the trade name Altosid.

Resmethrin

Resmethrin is a synthetic pyrethroid insecticide used to kill adult mosquitoes. MMCD applies resmethrin using ultra-low-volume foggers mounted on a truck or all-terrain vehicle or hand-held fog machines. The application rates vary by type

41 MMCD issues competitive bids each spring for the purchase of insecticides. The District also follows quality assurance standards to test insecticides. See discussion in Chapter 4.

42 The 90-day timed-release pellets were used in 1998 only.

of application—1.5 ounces per acre by fogger and 2.5 ounces per acre by hand-held machine. The insecticide fog contacts mosquitoes as they are flying, causing immediate knock down. Fogging is done either at dusk or in the early morning when mosquitoes are active. Resmethrin degrades rapidly in ultraviolet light.

MMCD uses resmethrin and permethrin (synthetic chemicals) to kill adult mosquitoes.

MMCD uses a resmethrin product with the trade name of Scourge supplied by Clarke Mosquito Control Products. The U.S. Environmental Protection Agency (EPA) classifies Scourge as a restricted-use pesticide. Only certified applicators may purchase and use restricted-use pesticides for community mosquito control. Piperonyl butoxide (PBO) is an active ingredient in Scourge. When combined with resmethrin, PBO acts as an insecticide synergist and enhances the effectiveness of resmethrin by blocking detoxifying enzymes in an insect. EPA classifies PBO as a Group C carcinogenic risk, using the scale summarized in Figure 1.9.

Figure 1.9: EPA Categories of Carcinogen Risk

Group A	Human carcinogen. Sufficient evidence from epidemiologic studies supports a causal association between exposure to a product and cancer. Federal law prohibits registration and use of any pesticide that has been classified as a "human carcinogen."
Group B	Probable human carcinogen. Human and/or animal studies support a statistical linkage between exposure to a product and cancer. This is often expressed as statistical odds (such as 1 in a million) of developing cancer as a result of contact with the product. Group B has two subgroups: B1 -- based on limited evidence from human epidemiologic studies. B2 -- based on sufficient evidence from laboratory animal studies.
Group C	Possible human carcinogen. Limited evidence of carcinogencity in animals in the absence of human data. The link is weak and additional research may be warranted.
Group D	Not classifiable as a human carcinogen. Inadequate human or animal evidence of cancer-causing link or no data are available. Preliminary routine testing does not show a link to justify additional research.
Group E	Evidence of noncarcinogenicity for humans. No evidence supports an association between exposure to a product and an increased risk of cancer.

SOURCE: Guidelines for Carcinogen Risk Assessment, *Federal Register* 51 (185): 33992-34003, Sept. 24, 1986.

Permethrin

Permethrin is also a synthetic pyrethroid used to kill adult mosquitoes in known daytime resting or harborage areas, such as wooded areas with good ground cover that provide a shaded, moist area. MMCD mixes permethrin with soybean and a food-grade mineral oil and applies it with a power backpack mister. The application rate is 25 ounces of diluted mixture per acre. Permethrin is applied and adheres to foliage; mosquitoes become exposed to it as they enter and leave the harborage area or land on the foliage. The product label says that permethrin provides control for up to 14 days; however MMCD research concluded that the control achieved by permethrin was significant for up to five days.[43] EPA classifies permethrin as a Group C possible human carcinogen. MMCD uses a product with the trade name Permethrin 57% OS supplied by Clarke Mosquito Control Products.

MOSQUITO CONTROL IN OTHER PARTS OF MINNESOTA

The Local Pest Control laws (*Minn. Stat.* §§18.021-18.022) authorize local units of government in Minnesota outside the Twin Cities area to fund pest control activities, including mosquito control. The Department of Agriculture requires that communities submit a pest control application each year if they intend to provide pest control. Reviewing these applications, we found that:

- **Relatively few Minnesota cities outside the Twin Cities area have provided mosquito control services.**

Forty-nine cities outside the Twin Cities area said they intended to provide mosquito control services in 1998.

Mosquito control services have been provided at the discretion of local government. A total of 44 cities with at least 171,000 in population indicated an intent to control pests in 1997 and 49 cities with about 168,500 in population were going to control pests in 1998. (Thirty-eight cities provided mosquito control services both years.) The largest cities were Moorhead, Faribault, and Red Wing. Most cities providing services are located in northwestern and central Minnesota. All but one city directed control efforts at mosquitoes during the years examined. Of these, all controlled for adult mosquitoes, while about one-third (16) of the cities also conducted some larval control each year. Mosquito control was conducted in these cities to minimize public discomfort from mosquito annoyance.

In the majority of cities (58 percent), the public works departments were responsible for mosquito control services in 1997 and 1998, followed by general government offices (21 percent). In most cities (77 percent), applicators were city employees.

43 Merry L. Holliday-Hanson, Chris E. Boxmeyer, Susan L. Palchick, "Residual Effects of Punt Applied as a Barrier Treatment Against *Aedes Vexans* in Wooded Areas in Minnesota," unpublished, Proceedings from 1992 California Mosquito Vector Control Association, 1992. These time limits apply to how long the insecticide will provide effective control. Neither the resmethrin nor permethrin product labels contain reentry limits.

SUMMARY

The Metropolitan Mosquito Control District includes Anoka, Dakota, Hennepin, Ramsey, Scott, and Washington counties and the eastern half of Carver County. While originally created to address mosquito control, the Legislature has given the District responsibility for controlling black flies and monitoring disease carrying ticks in the Twin Cities area. Based on a review of the statutes, it appears that the Legislature has intended mosquito control to be both a public service and a public health issue.

The District's mission is "to promote health and well being by protecting the public from disease and annoyance caused by mosquitoes, black flies and ticks, in an environmentally sensitive manner." The Environmental Quality Board has reviewed several environmental impact statements related to MMCD's mosquito control programs. The District uses *Bti* and methoprene to kill mosquito larvae, and resmethrin and permethrin to kill adult mosquitoes. Recent criticisms have focused on the insecticides the District uses to kill adult mosquitoes.

The Metropolitan Mosquito Control Commission—composed of 17 commissioners from participating counties—sets policy for the District. MMCD provides mosquito control through six field offices located in four regions of the Twin Cities metropolitan area. In 1998, the District employed 47 full-time and 164 seasonal staff, the majority of whom worked in insect control operations. District operations and staff were cut in 1996 after the Legislature reduced the District's revenue by 28 percent. In each subsequent year, the District's budget has increased; the budget's current level of $8.6 million is close to its 1995 level of spending, $8.8 million.

We examined municipal pest control applications submitted to the Department of Agriculture and found that fewer than 50 Minnesota cities outside the District provided mosquito control services in 1997 and 1998. Usually public works departments were responsible for these services.