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Executive Summary

Since being established in 1958, Metropolitan Mosquito Control District's (MMCD) mission has expanded to include various mosquito-borne and tick-borne diseases and their vectors, as well as black flies (gnats). West Nile virus (WNV) has joined La Crosse encephalitis, eastern equine encephalitis, western equine encephalitis, and Lyme disease as a primary focus of MMCD research, operations, and services as MMCD continues its long-term mission of reducing disease risk and providing the public with the best available information and services.

The presence of West Nile virus (WNV) in Minnesota continues to strongly influence MMCD research, activities, and operations. In 2005, there were 45 WNV cases in Minnesota with three deaths. Nation-wide the Centers for Disease Control tallied 3,000 cases with 116 fatalities.

Efficient transmission and maintenance of WNV involves different mosquito species (mainly *Culex*) with breeding habitats, life cycles, and resting locations that differ from those that District operations were originally developed to combat (primarily *Aedes* and *Coquillettidia*). Partial overlap between breeding habitats is now better understood (primarily between *Culex tarsalis* and *Aedes vexans*) and has been used to modify control strategies. Additionally, mosquito breeding sites, such as urban storm water catch basins, must be continually monitored and treated to control other West Nile vector species (*Culex pipiens* and *Culex restuans)*. As shown in the resolution below, the Technical Advisory Board reviewed our research into WNV and its vectors and recommended that MMCD continue this research.

> "The TAB encourages MMCD to continue research on all aspects of WNV, including biology of vectors, disease risk, and options for and environmental consequences of control, recognizing that only through such research will there be effective control."
>
> *Technical Advisory Board (TAB) Resolution, February 16, 2005*

MMCD maintained its level of surveillance and control services for WNV, and La Crosse, western equine and eastern equine encephalitis in 2005. Breeding source elimination is an effective way to reduce the La Crosse encephalitis vector, *Aedes triseriatus*. In 2005, District staff removed and recycled 10,614 tires. In addition, MMCD worked with the Hennepin County Department of Environmental Services and the Minnesota Pollution Control Agency to remove approximately 1,800 tons of tires from a single site in Hennepin County. District staff also eliminated 2,656 containers, and filled 1,008 treeholes. For the second consecutive year, Minnesota viral activity included a positive western equine encephalitis mosquito pool – this year in Redwood County. One positive La Crosse encephalitis mosquito pool was collected in Scott County.

Larval mosquito control operations began around or just before the spring thaw and continued throughout the summer. Floodwater species emergence is driven by rain events of one or more inches which trigger mosquito hatches, or broods. Precipitation throughout spring and early summer (May through July) resulted in eight District-wide broods of *Aedes vexans*. Four more broods occurred between mid-August and the end of September. A typical season has four such broods. MMCD applied larvicide to 22,275 more acres in 2005 than in 2004. MMCD staff also made 145,386 larvicide treatments to catch basins to control vectors of WNV. In 2005, the District initiated a review of mosquito habitat provided by large underground water-holding

structures that exist with many storm water management systems. Arrangements were made with 10 communities to conduct mosquito surveillance habitat evaluations with assistance from city employees. This effort will expand in 2006.

In 2005, the District initiated a larval treatment strategy that included aerial applications of larvicides (Altosid® pellets and Vectolex®) with a longer field activity than *Bti*. Longer lasting, but less frequent treatments, enabled staff to provide larval control services to an additional 18,478 acres located in Priority Zone 2. Intense post treatment sampling indicated that both Altosid® pellets and Vectolex® achieved effective larval control (including *Aedes* and *Culex*) for four weeks.

Adult mosquito control is performed when surveillance indicates that specific disease-vectoring mosquito populations are increasing, when the District is notified of a mosquito-borne disease case, or when thresholds of adult mosquito catches are exceeded in high-density human-populated areas. In 2005, the District applied adulticides to 73,392 acres – 22,256 fewer acres than in 2004.

A study group of TAB members and MMCD technical staff continued an examination of the nontarget effects of adulticide operations that focused upon monarch butterflies. Previous years' studies showed that residues of the adulticide permethrin on milkweed could result in mortality of monarch larvae feeding on the plants. The 2005 studies showed much less affect from plants in the path of resmethrin ULV treatments, although simultaneous mosquito mortality was high. Other nontarget species (i.e. house flies and milkweed bugs) were not significantly affected. A study of milkweed distribution and adulticide treatments revealed that a very small proportion of milkweed is exposed to either adulticide, suggesting overall population risk from treatments may be low. Work in 2006 will refine measurements to better understand the overall impact of adulticides upon monarch populations and other non-target species.

MMCD maintained its ongoing river nontarget invertebrate monitoring and level of surveillance and control for black flies (biting gnats) with small stream and large river treatments occurring at levels consistent with past years. The South Fork Crow River in Carver County was treated with *Bti* as a result of District services expanding into western Carver County.

Abundance of *Ixodes scapularis*, the tick vector of Lyme disease and human granulocytic anaplasmosis (HGA) appeared to have rebounded from the mixed results (a very high nymph count but a lower larval count) detected in 2003. The overall 2004 season mean of 0.847 *I. scapularis* per mammal was higher than the 2003 average of 0.389 and is more comparable with averages observed in 2000-2002. The conclusion for 2004 was that *I. scapularis* has shown signs of elevated population since 2000. Our 2005 report will be available on the District website – www.mmcd.org – in June 2006.

In 2006, MMCD plans to continue its strategic shift in its large larval breeding site mosquito operations so that operational workloads and helicopter availability can be more evenly distributed if there is yet another consecutive spring with heavy rainfall.

At the end of 2005, the District upgraded its website – www.mmcd.org – as the first phase of a project that could lead to direct public access to map-based larval treatment records.

Chapter 1 Mosquito Surveillance

2005 Highlights

- Reverted to using the traditional genus *Aedes* instead of *Ochlerotatus*
- Above average rainfall in May and June, dry mid-season, heavy storms at end of season
- Rainstorms produced 12 broods of mosquitoes
- Staff identified 19,199 larval samples
- Summer *Aedes* & *Cq. perturbans* most predominant species captured in sweeps and CO_2 traps
- 23 CO_2 traps added
- Highest numbers of *Cx. tarsalis* seen in years with two population peaks evident

2006 Plans

- Continue *Aedes* surveillance strategies as in 2005
- Re-evaluate placements of both CO_2 traps and gravid traps
- Work to improve *Culex* larval and adult surveillance strategies

2005 Mosquito Surveillance Results

Background

The MMCD conducts larval and adult mosquito surveillance to determine levels of mosquitoes present, measure annoyance, and to detect the presence of disease vector species. Since different species of mosquitoes have different habits and habitat preferences, a variety of surveillance methods are used. Knowing what species are present in an area, and at what levels, helps the District direct its control measures effectively.

In 2000, the subgenus *Ochlerotatus* was elevated to the rank of genus. This action transferred the majority of *Aedes* mosquitoes to *Ochlerotatus*. There is disagreement among taxonomists about the validity of the name change however, and until there is a consensus MMCD entomologists will use the traditional genus *Aedes* instead of *Ochlerotatus*.

Rainfall

Rainfall surveillance is an important tool used to estimate the amount of larval breeding and to determine the areas to dispatch work crews following a rain event. The District operates a network of 79 rain gauges from May to September. The Minnesota Department of Natural Resources (MnDNR) also uses this information to augment their rain gauge network.

Average rainfall in the District from May 1 through September 30, 2005 was 22.82 inches (Table 1.1). This is 1.17 inches more than last year and 4 inches above the 47-year District average. The distribution of the rain was fairly even throughout the District with Scott County receiving the most rain.

Typically, a rain event ≥ 1 inch can produce a brood of floodwater mosquitoes. We experienced twelve District-wide broods in 2005 (Figure 1.1). Spring and early summer rain events produced six large broods of mosquitoes. The middle

of the season was dry, with only two broods during July and August. There were four broods late in the season.

Table 1.1 Average rainfall received in each county from May through September, 2001-2005 and 47-year District average.

	Anoka	Carver	Dakota	Hennepin	Ramsey	Scott	Wash.	District
2001	17.40	15.38	16.23	18.98	18.94	15.01	17.78	17.73
2002	26.93	29.96	30.03	30.23	29.28	28.53	28.36	29.13
2003	17.30	14.15	14.72	17.59	18.07	13.34	18.00	16.79
2004	20.26	25.22	21.89	22.18	20.73	23.50	20.62	21.65
2005	22.20	22.75	21.53	22.75	23.00	24.25	23.87	22.82
47-Year Avg	19.06	*20.60	19.86	19.77	20.01	19.48	20.27	19.60

*23-year average

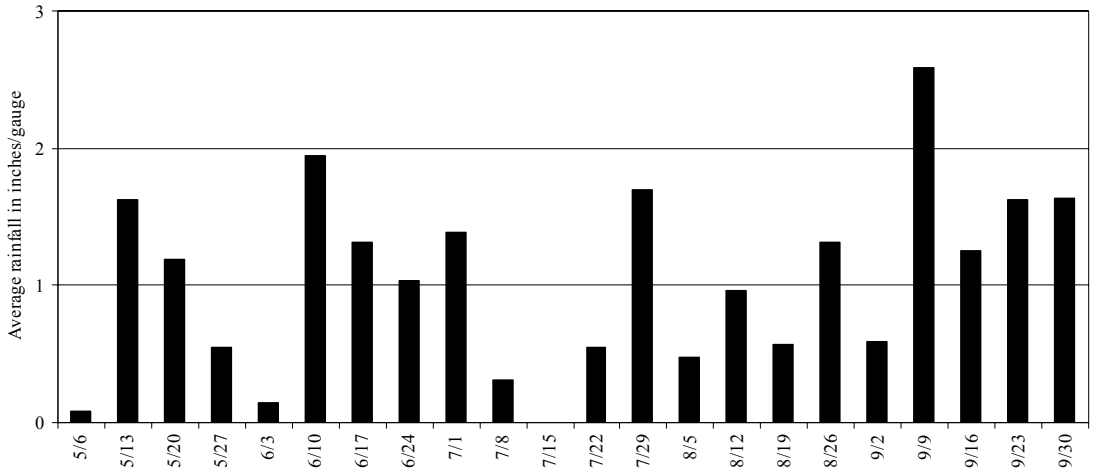


Figure 1.1 Average rainfall per gauge per week, 2005

Larval Collections

Larval mosquito collections are taken to determine if targeted species are present at threshold levels or to obtain species history in a breeding site. In 2005, staff identified 19,199 larval collections. To accelerate the identification of samples from sites to be treated by helicopter, *Culex* larvae were identified to species, but all other larvae were identified to genus only. Lower priority samples were identified to species. Table 1.2 shows the results of the 9,745 samples identified to species.

Aedes vexans and the insidious ankle-biter, *Aedes cinereus,* were the most abundant human-biting species District-wide. The typically non-human biting species, *Culiseta inornata*, had the second highest frequency and *Culex territans* and *Culex restuans* ranked 4th and 5th overall. The spring species, *Aedes stimulans*, edged out the summer species, *Aedes trivittatus*, for 6th place.

Culex tarsalis larvae occurred in 2.8% of the samples, ranking 8th. The high amount of *Aedes* species is normal and represents 1st instar larvae that are unidentifiable to species.

Table 1.2 Frequency of occurrence (%) of larval species in standard dipper collections by county and District total, 2005. The total number of samples processed to species is in parentheses.

	Percent frequency of occurrence by facility						
Species	North (921)	East (1,725)	South Rosemount (1,363)	South Jordan (1,623)	West Plymouth (2,442)	West Maple Grove (1,671)	District (9,745)
Aedes abserratus	1.0	0.7	0.5	0.3	0.2	0.1	0.4
aurifer	0.2	0.1					<
canadensis	0.8	0.6	2.6	1.9	0.9	0.2	1.1
cinereus	33.9	16.1	11.4	22.2	19.2	21.0	19.7
dorsalis	0.4	0.2	0.6	0.9	0.3	1.4	0.6
excrucians	7.2	4.6	5.0	1.7	3.2	1.5	3.5
fitchii	2.0	1.3	1.3	0.4	0.4	0.1	0.8
implicatus	0.1	0.1	0.2	0.1	0.1	0.2	0.1
nigromaculis			0.2				<
punctor	0.7	0.7	0.1	0.1	0.3	0.2	0.3
riparius	0.7	0.4	0.2	0.3	0.6	0.2	0.4
sticticus	1.3	1.3	1.3	0.9	1.4	0.5	1.1
stimulans	6.2	6.3	11.0	6.2	9.2	3.2	7.1
provocans	0.1	0.1	0.2			0.1	0.1
trivittatus	1.3	2.7	3.6	1.4	6.1	3.1	3.4
vexans	39.2	37.6	36.5	34.3	50.4	43.3	41.2
Ae. species	38.9	25.6	28.7	26.9	21.7	26.3	26.6
Anopheles earlei				0.1			<
punctipennis	0.3	0.5	0.9	0.1	0.2	0.4	0.4
walkeri						0.1	<
An. species	0.3	2.8	3.2	1.0	0.7	1.1	1.5
Culex pipiens	0.2	0.7	1.2	0.7	0.2	1.5	0.7
restuans	6.0	12.5	10.4	10.7	11.8	15.4	11.6
salinarius		0.1	0.3	0.1	0.1	0.1	0.1
tarsalis	0.4	2.7	5.7	4.7	1.2	2.7	2.8
territans	8.7	17.9	14.3	13.7	5.6	9.8	11.4
Cx. species	1.3	4.5	4.3	3.4	2.5	4.6	3.5
Culiseta inornata	14.9	18.9	27.8	24.5	21.1	18.6	21.2
minnesotae	1.2	1.9	0.6	1.3	0.7	0.9	1.1
morsitans	0.1	0.1	0.2		0.2	0.1	0.1
Cs. species	3.3	2.5	3.6	8.7	1.8	2.9	2.3
Psorophora ciliata				0.1			<
ferox		0.2			0.1		0.1
Ps. species					0.1		<
Uranotaenia sapphirina	0.2	3.8	2.2	1.0	0.3	1.4	1.5

< = percent of total is less than 0.1%

Adult Collections

There are 50 species of mosquitoes known to occur in Minnesota. About 45 of these species, 20 of which are human biting, occur in the District. Some species prefer to feed on birds, large mammals, reptiles, and amphibians. Species of mosquitoes differ in their peak activity periods and in how strongly they are attracted to humans or trap baits (e.g., light or CO_2). Therefore, a variety of adult mosquito collection methods is used in order to capture targeted species.

Most of the mosquitoes collected are identified to species, but in some cases, species are grouped together to expedite sample processing. *Aedes* mosquitoes can be grouped by their seasonal occurrence (spring, summer). Some vector species are grouped because species-level separation is very difficult (*Cx. pipiens/restuans*). Spring *Aedes* larvae hatch as a result of snow melt and adults emerge in late April to early May. They have one generation each season and adults can live for three months. The summer *Aedes* begin hatching in early May as a result of rainfall; they can have several generations throughout the summer. *Coquillettidia perturbans*, the cattail mosquito, breeds in cattail marshes and has one generation per year, peaking in early July. A more detailed description of the biologies of mosquitoes occurring in the District is in Appendix A.

The sweep net and CO_2 trap data reported in this chapter are weekly collections referred to as the Monday night network. Employees took two-minute sweep net collections and/or set overnight CO_2 traps in their yards every Monday night for 20 weeks.

Sweep Net Collections The District uses sweep net collections to monitor human annoyance during the peak mosquito activity period, which is 35-40 minutes after sunset for most mosquito species. The number of collectors varied from 95-161 per evening. Summer *Aedes* species and *Coquillettidia perturbans* were predominant in the evening sweep net collections (Table 1.3). Summer *Aedes* were the lowest in the past four years. *Culex tarsalis* are uncommon in sweep net collections.

Table 1.3 Average number of mosquitoes collected per evening sweep net collection within the District, 2001-2005.

Year	Summer *Aedes*	*Cq. perturbans*	Spring *Aedes*	*Cx. tarsalis*
2001	2.6	0.3	0.1	0.02
2002	4.2	0.5	0.1	0.01
2003	4.7	0.8	0.2	0.01
2004	3.4	0.3	0.02	0.01
2005	1.1	0.3	0.04	0.01

CO_2 Trap Collections CO_2 traps baited with dry ice are used to monitor mosquito population levels and the presence of disease vector species. In 2005, we added 23 traps to allow maximum coverage of the District. Some of these traps were placed in specific locations to target the vector species *Cx. tarsalis* and *Culiseta melanura*. The number of traps operated varied from 95-109. As in the case of sweep netting, summer *Aedes* and *Cq. perturbans* were the predominant species captured in the traps (Table 1.4). Summer *Aedes* were the lowest in the past

four years, but *Cq. perturbans* and spring *Aedes* populations increased. Spring *Aedes* rebounded from last year's low and *Cx. tarsalis* numbers fell after last year's high.

Table 1.4 Average number of mosquitoes collected in CO_2 traps within the District, 2001-2005.

Year	Summer *Aedes*	*Cq. perturbans*	Spring *Aedes*	*Cx. tarsalis*
2001	253.0	35.2	7.7	1.6
2002	426.3	58.6	7.7	0.6
2003	457.8	103.7	6.9	1.2
2004	391.9	35.3	1.5	2.3
2005	201.5	42.0	6.9	1.6

New Jersey Light Traps Data collected from New Jersey light traps are used to compare mosquito species population levels from year to year. These are the only collections where all adult female mosquitoes are identified to species. Traps are run nightly from May to September. The District operated seven traps in 2005. Trap 1 was located in St. Paul, trap 9 in Lake Elmo, trap 13 in Jordan, trap 16 in Lino Lakes, trap ML in Maple Grove, trap CA in Carlos Avery Wildlife Refuge, and trap AV at the Minnesota Zoo in Apple Valley (Figure 1.2). Traps 1, 9, and 16 have operated each year since 1960.

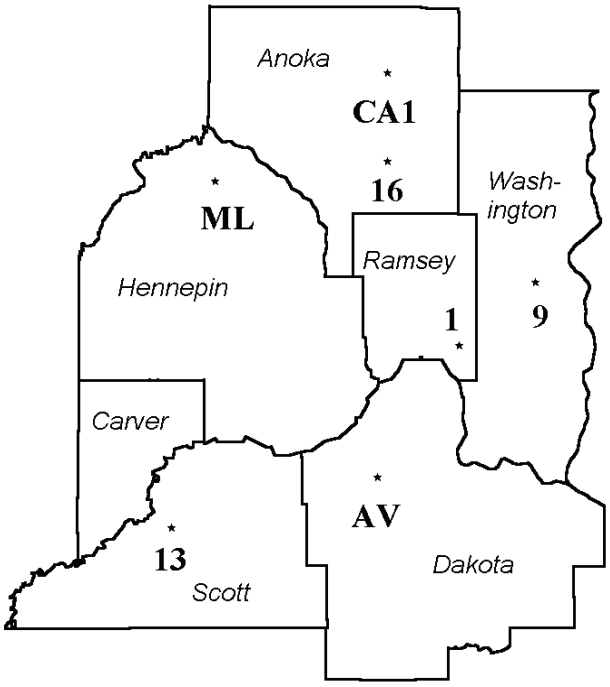


Figure 1.2 New Jersey light trap locations, 2005

A total of 45,176 females were identified in New Jersey traps in 2005 (Table 1.5). *Aedes vexans* was the most numerous comprising 59% of the total and *Cq. perturbans* was the second most numerous at 25%. The number of female mosquitoes collected per night from 1965 to 2005 is shown in Appendix B.

Table 1. 5. Total number and frequency of occurrence for each species collected in New Jersey light traps, May 7-Sept. 23, 2005.

	Trap Code, Location, and Number of Collections							Summary Statistics		
	1	9	13	16	ML	CA1	AV	Season		
	St. Paul	Lk. Elmo	Jordan	Lino Lks.	N. Henn.	Carlos	Apple Valley	Total	% Female	Avg per
Species	138	138	137	132	121	124	128	918	Total	Night
1. Ae abserratus	0	0	0	0	0	25	2	27	0.06%	0.03
3. aurifer	0	0	0	0	0	4	0	4	0.01%	0.00
6. canadensis	0	1	0	0	0	29	0	30	0.07%	0.03
7. cinereus	3	6	16	34	7	1,748	51	1,865	4.13%	2.03
10. dorsalis	1	0	14	2	1	0	0	18	0.04%	0.02
11. excrucians	0	2	0	0	0	31	0	33	0.07%	0.04
12. fitchii	0	1	0	0	0	0	3	4	0.01%	0.00
13. flavescens	0	0	0	0	0	0	0	0	0.00%	0.00
16. nigromaculus	0	1	0	0	0	1	0	2	0.00%	0.00
18. punctor	0	0	0	0	0	21	0	21	0.05%	0.02
19. riparius	0	0	0	0	0	3	0	3	0.01%	0.00
20. spenceri	0	0	0	0	0	0	0	0	0.00%	0.00
21. sticticus	0	3	86	3	0	5	3	100	0.22%	0.11
22. stimulans	0	3	0	0	0	1	1	5	0.01%	0.01
23. provocans	0	0	0	0	0	0	0	0	0.00%	0.00
24. triseriatus	10	7	4	1	0	0	0	22	0.05%	0.02
25. trivittatus	4	24	187	15	18	41	55	344	0.76%	0.37
26. vexans	1,155	2,086	4,082	4,815	2,587	9,743	2,191	26,659	59.01%	29.04
118. abs/punct.	1	1	0	5	0	1,291	4	1,302	2.88%	1.42
261. species	4	6	8	23	2	109	13	165	0.37%	0.18
262. Spring Aedes	1	2	10	0	0	9	2	24	0.05%	0.03
264. Summer Aedes	0	50	5	7	0	7	1	70	0.15%	0.08
27. An. barberi	0	0	0	0	0	0	0	0	0.00%	0.00
28. earlei	1	1	0	1	2	35	0	40	0.09%	0.04
29. punctipennis	11	18	7	6	4	78	8	132	0.29%	0.14
30. quadrimac.	0	0	0	0	0	2	0	2	0.00%	0.00
31. walkeri	0	0	96	22	4	729	2	853	1.89%	0.93
311. An. species	1	0	3	2	0	15	0	21	0.05%	0.02
32. Cx. erraticus	0	0	0	0	0	0	0	0	0.00%	0.00
33. pipiens	0	0	0	0	0	0	0	0	0.00%	0.00
34. restuans	29	27	11	23	18	44	53	205	0.45%	0.22
35. salinarius	5	1	0	2	0	11	0	19	0.04%	0.02
36. tarsalis	8	10	47	29	37	31	7	169	0.37%	0.18
37. territans	2	17	8	13	3	21	20	84	0.19%	0.09
371. Cx. species	2	4	2	3	0	8	1	20	0.04%	0.02
372. Cx. pip/rest	10	19	4	14	5	21	16	89	0.20%	0.10
38. Cs. inornata	76	78	72	54	75	246	106	707	1.56%	0.77
39. melanura	0	0	0	0	0	0	0	0	0.00%	0.00
40. minnesotae	8	19	19	69	7	309	4	435	0.96%	0.47
41. morsitans	6	13	0	2	2	206	5	234	0.52%	0.25
411. Cs. species	4	0	1	5	1	57	0	68	0.15%	0.07
42. Cq. perturbans	35	9	45	222	69	10,764	15	11,159	24.70%	12.16
44. Ps. ciliata	0	0	0	0	0	0	0	0	0.00%	0.00
47. horrida	0	0	0	0	0	0	0	0	0.00%	0.00
471. Ps. species	0	0	0	0	0	0	0	0	0.00%	0.00
48. Ur. sapphirina	3	82	51	19	4	5	20	184	0.41%	0.20
501. Unident.	4	7	5	14	1	23	3	57	0.13%	0.06
Female Total	1,384	2,498	4,783	5,405	2,847	25,673	2,586	45,176	82.05%	49.21
Male Total	371	1,089	1,677	1,046	181	5,013	505	9,882	17.95%	10.76
Grand Total	1,755	3,587	6,460	6,451	3,028	30,686	3,091	55,058	100.00%	59.98

Seasonal and Geographic Distributions

Seasonal Distribution Sweep net and CO_2 trap collections detected two major peaks of *Aedes* mosquitoes in 2005 (Figures 1.3 and 1.4). Population levels of *Aedes* increased sharply at the beginning of June, remained high, peaked again in early July, then declined thereafter. *Coquillettidia perturbans* populations peaked in early July.

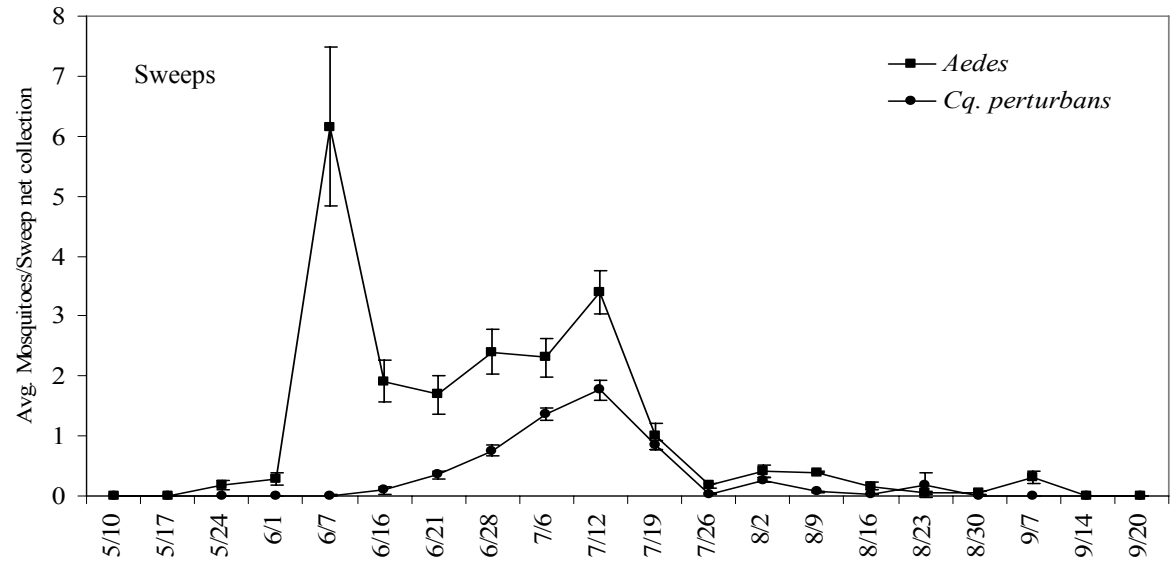


Figure 1.3 Average number of *Aedes* and *Cq. perturbans* per evening sweep net collection, 2005. Error bars equal ± 1 standard error of the mean.

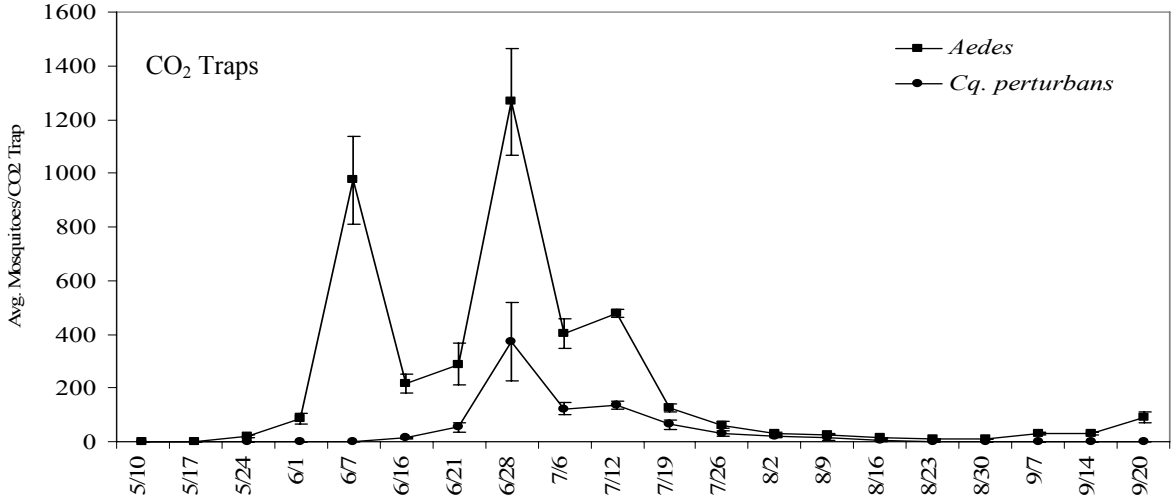


Figure 1.4 Average number of *Aedes* and *Cq. perturbans* per CO_2 trap, 2005. Error bars equal ± 1 standard error of the mean.

Geographic Distribution Figure 1.5 displays the geographic distribution of mosquitoes collected in sweep nets inside and outside the District. White areas are tolerable annoyance levels (0-4), lightest gray is moderate (5-9), darker gray is bad (10-14), and black is extremely bad (>15). Except for the beginning of June, District mosquito levels were at moderate and tolerable levels throughout the season. Figure 1.6 depicts the sweep net collection locations for 2005.

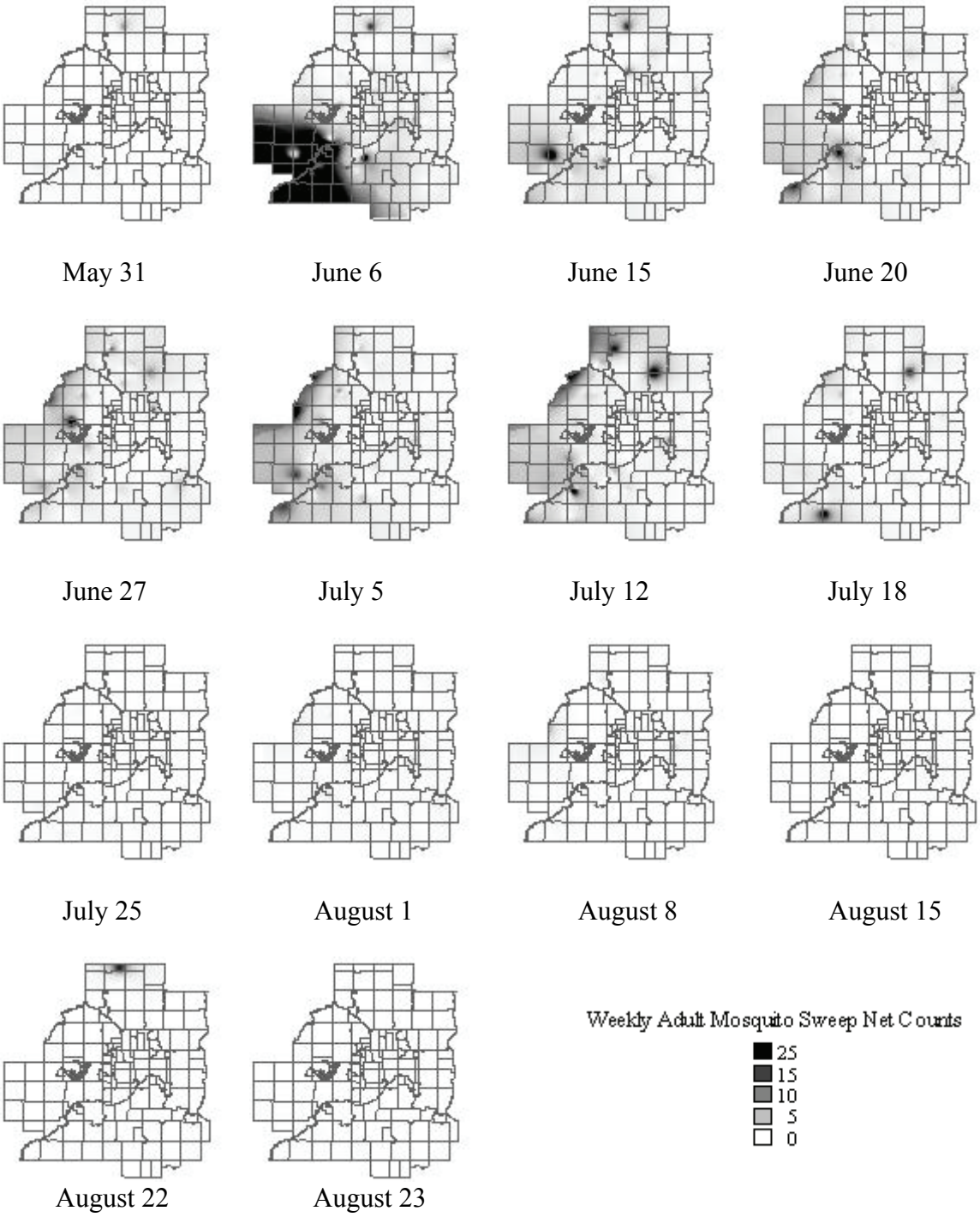


Fig. 1.5 Average number of *Aedes* mosquitoes in sweep net collections, 2005.

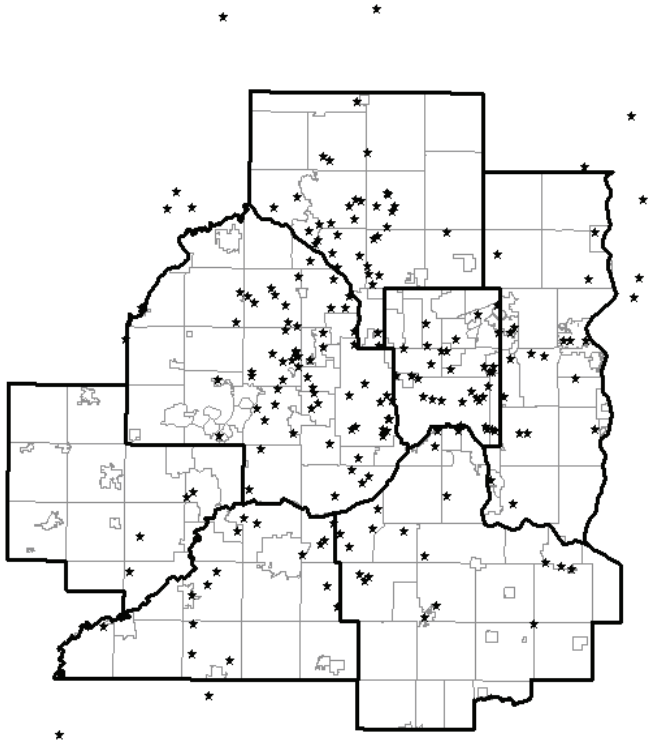


Figure 1.6 Locations of weekly evening sweep net collections, 2005

Vector Mosquito Surveillance

Aedes triseriatus Aspirator surveillance for the La Crosse encephalitis vector *Ae. triseriatus* was initiated during the week of May 29th. The peak rate of capture occurred during the week of June 19th, although similar rates of capture occurred during the first two weeks of July (Figure 1.7). Capture rates fell over the rest of July and stabilized in August before rising toward the end of August then declining at the end of the season.

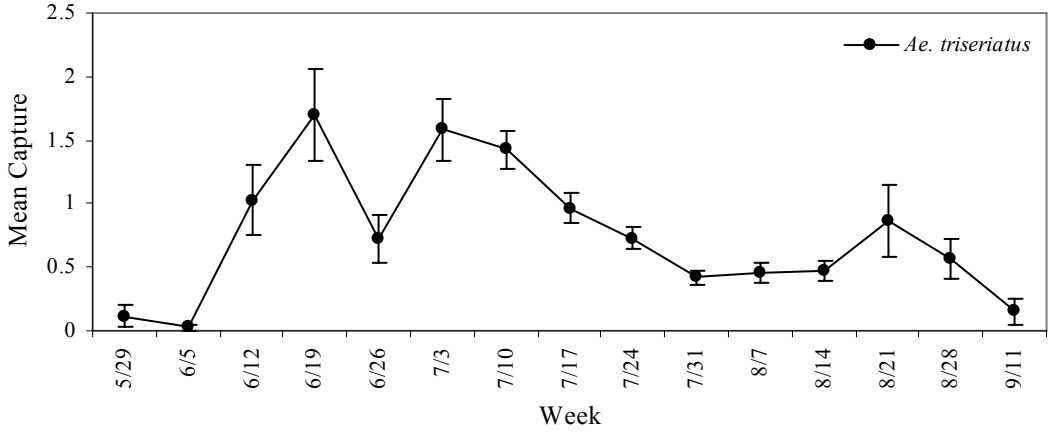


Figure 1.7 Mean number of *Ae. triseriatus* adults in aspirator samples, plotted by week. Dates listed are the first sampling day of each week. Sites sampled varied by week, although several locations were monitored repeatedly during the season. Error bars equal ± 1 standard error of the mean.

Culiseta melanura 2005 was the first year of what is expected to be an established routine for surveillance of this species. District staff monitored 6 locations for *Cs. melanura* using 7 CO_2 traps. Adult *Cs. melanura* have been detected at three locations in the past; the other three locations are near wetlands where *Cs. melanura* larvae have been collected. Three of the sites are located in Anoka County, two in Washington County and one site in Hennepin County. The Hennepin County location had a ground level trap and a canopy level trap. In addition, 76 aspirator samples were collected from wooded habitats surrounding potential *Cs. melanura* larval habitat (i.e. tamarack bogs).

Culiseta melanura adults were collected in CO_2 traps at both of the Washington County sites and one Anoka County site. Only one aspirator sample, from Washington County, contained one *Cs. melanura* adult.

The rate of capture was low in 2005 compared to previous CO_2 trap surveillance at some of these locations. It does appear, however, that three generations emerged as has been observed in previous seasons (Figure 1.8). The emergence of the overwintering generation extended from mid-June to early July, the second generation appeared at the end of July, and the third at the end of August.

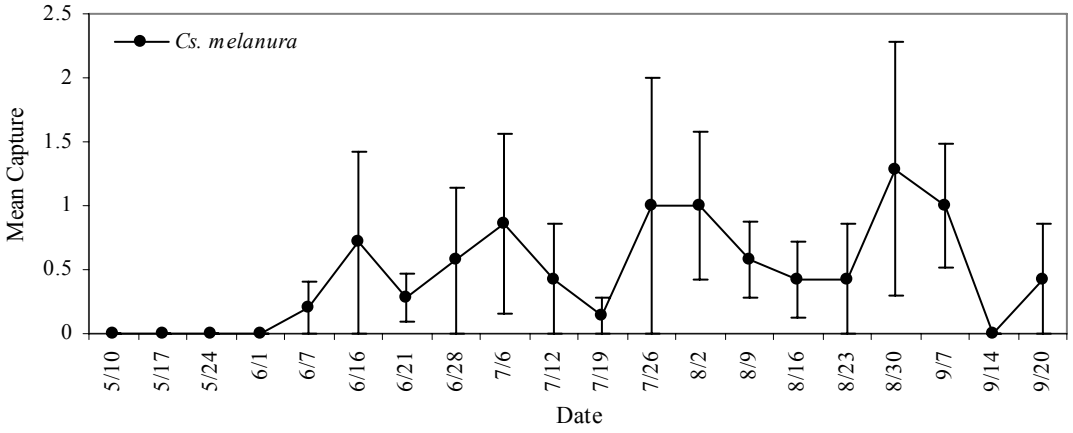


Figure 1.8 Mean number of *Cs. melanura* adults in CO_2 trap samples, plotted by week. Error bars equal ± 1 standard error of the mean.

***Culex* Surveillance** Since *Culex* species can transmit West Nile virus (WNV) as well as WEE, surveillance for these species has been refined in recent years. In addition to CO_2 traps, gravid traps are used to monitor *Culex* adults. The gravid trap is designed to attract female mosquitoes that are seeking oviposition sites while the CO_2 trap is used for collecting female mosquitoes in their host seeking phase. The District operated 125 CO_2 traps and 35 gravid traps in 2005.

Culex tarsalis has been identified as the most likely vector of WNV to humans in our area. Because of this, MMCD took measures to improve surveillance for the species in 2004. In 2005, we added 23 traps to the Monday night CO_2 trap network, in part to further improve surveillance for this species. All of the *Cx. tarsalis* captured in Monday night sweeps, Monday night CO_2

traps, and gravid traps were submitted to Minnesota Department of Health (MDH) for viral analysis (see Chapter 2, Table 2.3). As is typical, very few *Cx. tarsalis* were collected by gravid trap in 2005. Monday night CO_2 trap surveillance indicated the seasonal peak in host seeking by the species occurred during the week of July 19 (Figure 1.9). The population appeared to stabilize at moderate levels until mid-September.

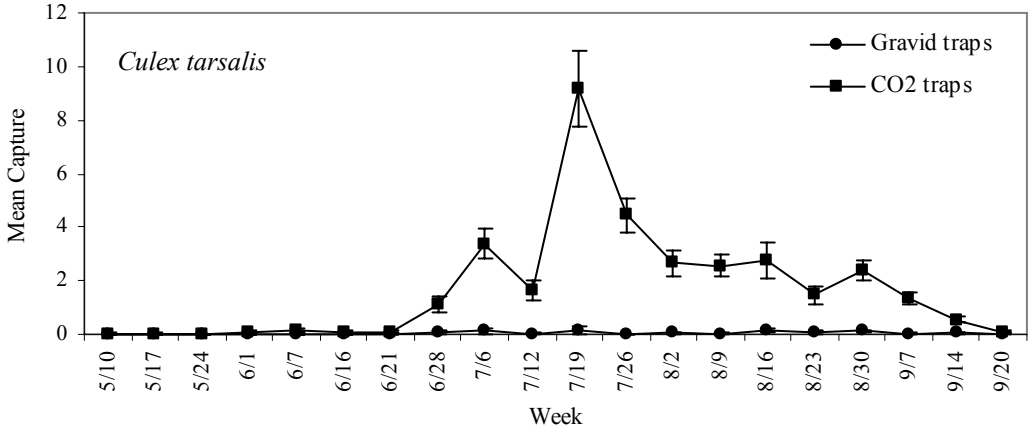


Figure 1.9 Average number of *Cx. tarsalis* in CO_2 traps and gravid traps, 2005. Error bars equal ± 1 standard error of the mean.

Culex restuans is another important vector of WNV in Minnesota. The species appears to be largely responsible for the early season amplification of the virus and possibly for season-long maintenance of the WNV cycle. *Culex restuans* collected in CO_2 traps were low for the entire season (Figure 1.10), which is common for this trap type. *Culex restuans* collected in gravid traps peaked during the second week of July; we observed a steady decline of this mosquito after the week of August 9.

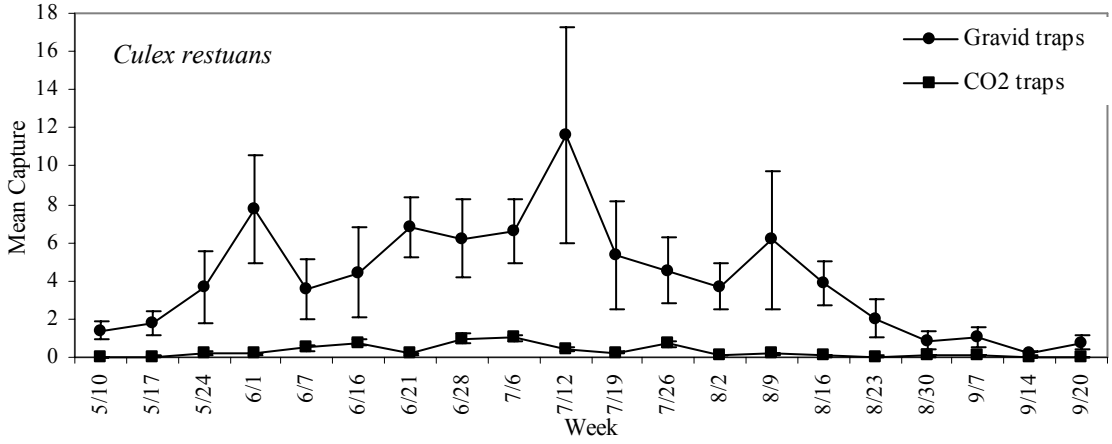


Figure 1.10 Average number of *Cx. restuans* in CO_2 traps and gravid traps, 2005. Error bars equal ± 1 standard error of the mean.

Culex pipiens has been an important vector of WNV in much of the United States. The species prefers warmer temperatures than *Cx. restuans*; therefore, populations of *Cx. pipiens* in the District tend to peak late in the summer when temperatures are typically warmer. The one unusually high collection period in 2005 was from gravid traps during the week of June 28 which followed a slight increase in CO_2 trap collections by two weeks. A single trap with a high collection that week influenced the June 28th elevated gravid trap mean, however. There were slight increases in CO_2 trap captures when expected, during two weeks in August and one week in September (Figure 1.11).

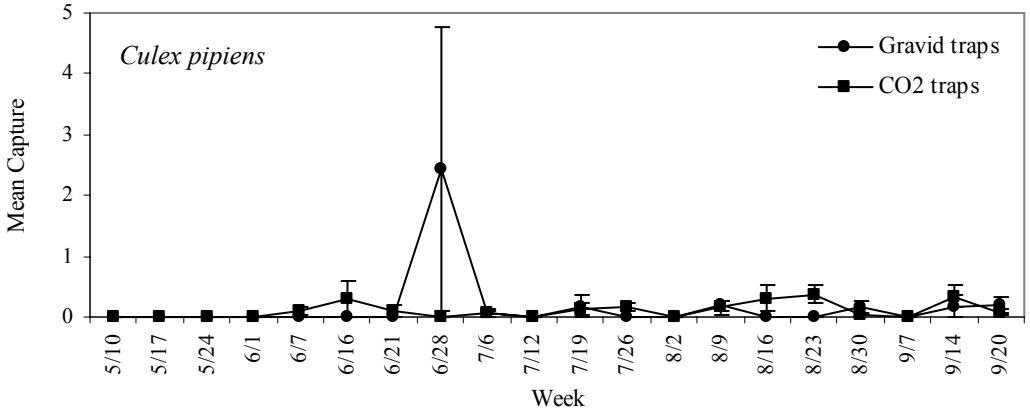


Figure 1.11 Average number of *Cx. pipiens* in CO_2 traps and gravid traps, 2005. Error bars equal ± 1 standard error of the mean.

Exotic Species Each season MMCD staff are watchful for exotic or introduced mosquito species. MMCD laboratory staff are trained to recognize exotic species in their adult and larval forms so that the mosquitoes can be spotted in any of the thousands of samples processed each year. In addition, field staff place ovitraps at possible points of introduction. The two exotic species most likely to be found in the District are *Ae. albopictus* and *Ae. japonicus*. Both are native to Asia and both have adapted to survival in tires and other artificial containers. This allows them to be transported over great distances. Both of these species have the potential to transmit disease. *Aedes albopictus* has been established in the continental United States since 1985 and is now common in the southeastern states, along the East Coast, as well as in southern portions of the Midwest. *Aedes japonicus* was first identified in the United States in 1999 in New Jersey and has been spreading rapidly, as far west as Michigan and Missouri in 2005. Another *Ae. japonicus* introduction occurred in the Pacific Northwest, the species was found in the Seattle area.

In 2005, *Ae. albopictus* was collected in the District for the first time since 1999. Larvae of the species were identified on November 11th from two ovitrap samples, both collected on September 19th in Scott County near a tire recycling facility. Property inspections in November yielded one sample of *Cx. pipiens* larvae. Three small containers and one tire were collected and flooded with water indoors. No mosquito larvae were observed in the containers or the tire. During the November inspections, staff observed numerous large or inaccessible containers and tires that could potentially harbor *Ae. albopictus* until spring. Thorough inspections of the area

will occur again early in 2006 and intensive adult mosquito surveillance will be necessary to determine if the species survived the winter.

This was the fourth introduction of *Ae. albopictus* identified in Scott County (1991, 1996, 1999) and the fifth in Minnesota (Wright County,1997). Sampling in years following previous introductions has yielded no *Ae. albopictus* specimens.

Plans for 2006

Surveillance strategies for *Aedes* mosquitoes will remain unchanged. Staff will continue to research surveillance strategies for adult and larval *Culex* mosquitoes. We will continue to review the distribution and type of CO_2 trap locations. We will continue to operate CO_2 traps and collect aspirator samples in known *Cs. melanura* habitat to monitor the species.

Chapter 2 Vector-borne Disease

2005 Highlights

- There were two La Crosse encephalitis cases in the District
- WNV illness confirmed in 45 Minnesotans, 7 are District residents
- WNV detected in 13 District mosquito samples and 50 other samples statewide
- Conducted surveillance projects to evaluate natural and constructed *Culex* larval habitats.
- Made 145,386 catch basin treatments
- Initiated mechanisms for routine monitoring of adult *Cs. melanura*, the EEE vector
- Collected and recycled 10,614 waste tires
- *I. scapularis* results from 2005 not yet available. In 2004, *I. scapularis* collections were higher than in 2003. We have detected signs of an elevated *I. scapularis* population since 2000.
- Lyme disease cases totaled 1,023 in 2004, the highest number of yearly cases ever recorded
- There were 139 human granulocytic anaplasmosis cases in 2004. Incomplete blood work prevented a complete count
- Updated tick-related publications

Background

District staff provides a variety of disease surveillance and control services, as well as public education, to reduce the risk of mosquito-borne illnesses such as La Crosse encephalitis (LAC), western equine encephalitis(WEE), eastern equine encephalitis (EEE), and West Nile (WN) encephalitis, and tick-borne illnesses such as Lyme disease and human granulocytic anaplasmosis. Past District efforts have also included determining metro-area risk for infections of Jamestown Canyon virus, babesiosis, Rocky Mountain spotted fever, and Sin Nombre virus (a hantavirus).

La Crosse encephalitis prevention services began in 1987 to identify areas within the District where significant risk of acquiring this disease exists. High-risk areas are defined as having high populations of the primary vector *Aedes triseriatus* (eastern tree-hole mosquito) and a history of LAC cases. MMCD targets these areas for intensive control efforts including public education, mosquito breeding site removal, and limited adult mosquito treatments. Additionally, routine surveillance and control activities are conducted at past LAC case sites. Surveillance for the exotic species *Aedes albopictus* (Asian tiger mosquito) and *Aedes japonicus* routinely occurs to detect infestations of these potential disease vectors.

MMCD monitors adult mosquitoes of the species *Culex tarsalis* for presence of WEE, which can cause severe illness in Minnesota horses and humans.

Eastern equine encephalitis was detected for the first time in Minnesota in 2001. Since then, MMCD has conducted surveillance for the enzootic vector, *Cs. melanura.*

MMCD is continuing to refine surveillance and response plans in anticipation of yearly detections of West Nile virus (WNV). Since its introduction to North America, WNV has caused illness in humans, domestic animals, and wildlife each transmission season.

2006 Plans

- Continue to provide surveillance and control for La Crosse encephalitis prevention
- Survey larval habitats for *Culex* mosquitoes to design control strategies
- Continue catch basin larvicide treatments and expand surveillance and control in other stormwater structures
- Communicate treatment strategies to other local governments
- Continue surveillance for WNV and other mosquito-borne viruses
- Refine a model to direct WNV response in the District
- Be watchful for *Ae. albopictus* and *Ae. japonicus*
- Continue *I. scapularis* surveillance at 100 sampling locations
- Continue tick-borne disease education activities and services
- Expand tick-related presence on new MMCD web site

MMCD is involved in a national effort to identify the mosquitoes responsible for transmitting WNV. Additionally, MMCD is investigating a variety of mosquito control procedures to be used in enhancing a comprehensive integrated mosquito management system for the prevention of West Nile illness.

In 1989, the District was mandated by the state legislature "to consult and cooperate with the MDH in developing management techniques to control disease vectoring ticks." The District responded by beginning tick surveillance and forming the Lyme Disease Tick Advisory Board (LDTAB) in 1990. The LDTAB includes MMCD and MDH staff, local scientists, and agency representatives who offer their expertise to the tick-borne effort.

MMCD initiated tick surveillance to determine the range and abundance of the black-legged tick (*Ixodes scapularis*, also known as the deer tick) and the Lyme disease spirochete, *Borrelia burgdorferi,* within the District. To date, MMCD has mapped the current distribution of black-legged ticks (545 total sites sampled) and continues to monitor their populations in the metropolitan area. Additionally, District employees have assisted with spirochete and ehrlichiosis (now known as anaplasmosis) studies with the University of Minnesota. All collected data are summarized and given to the MDH for their risk analysis.

Because wide-scale tick control is neither ecologically nor economically feasible, tick control is limited to public education activities which emphasize tick-borne disease awareness and prevention. District employees continue to provide tick identifications upon request and are used as a tick referral resource by agencies such as the MDH and the Minnesota Department of Natural Resources (MnDNR).

2005 Mosquito-borne Disease Services

Breeding Source Reduction

Small water-holding containers provide developmental habitat for many mosquito species including the La Crosse virus vector *Ae. triseriatus*, the exotic species *Ae. albopictus* and *Ae. japonicus*, and other probable vectors of WNV. In 2005, MMCD recycled 10,614 tires that were collected from the field. Since 1988, the District has recycled 429,852 tires. In addition, MMCD cooperated with the Hennepin County Department of Environmental Services and the Minnesota Pollution Control Agency to remove approximately 1,800 tons of tires from a site in Hennepin County. District staff eliminated another 2,656 container breeding sources and filled 1,008 tree holes. This reduction of breeding sources occurred while conducting a variety of mosquito, tick, and black fly surveillance and control activities, including the 2,185 property inspections performed by MMCD staff in 2005.

La Crosse Encephalitis (LAC)

***Aedes triseriatus* Surveillance and Control** As in the past, intensive surveillance of adult *Ae. triseriatus* populations occurred throughout the District. MMCD sampled wooded mosquito habitats by vacuum aspirator to monitor adult *Ae. triseriatus* populations and to direct adult and larval control efforts.

In 2005, MMCD staff collected 2,617 aspirator samples for the purpose of monitoring *Ae. triseriatus*. The District's threshold of at least two adult *Ae. triseriatus* was met in 412 of these samples. Inspections of wooded areas and surrounding residential properties were provided as follow-up service when samples reached threshold. Additionally, 265 adulticide applications to wooded areas were prompted by collections of *Ae. triseriatus* in aspirator samples.

Adult *Ae. triseriatus* were captured in 700 of 1,993 individual wooded areas sampled. This ratio falls within the range of recent year's results, however the average number of *Ae. triseriatus* captured per sample was comparatively lower this year (Table 2.1).

Table 2.1 Individual wooded areas sampled by aspirator and the number of those where *Ae. triseriatus* were captured, 2000 – 2005.

Year	Total areas surveyed	Number with *Ae. triseriatus*	Percent with *Ae. triseriatus*	Avg. number per aspirator sample
2000	1,037	575	55.4	1.94
2001	1,222	567	46.4	1.32
2002	1,343	573	42.7	1.70
2003	1,558	470	30.2	1.20
2004	1,850	786	42.5	1.34
2005	1,993	700	35.1	0.84

La Crosse Encephalitis in Minnesota Two cases of La Crosse illness were reported to MDH in 2005. Both of the children are siblings living in the same Scott County household. This is the first documentation of two simultaneous LAC cases in one Minnesota residence. A four year-old boy was diagnosed with La Crosse encephalitis after an August 14th onset of illness. His one year-old sister was ill earlier in that same week. A convalescent blood sample from her indicated that she had also been infected with the La Crosse virus.

La Crosse Case Response MMCD was notified of the first La Crosse encephalitis case on August 24th. The District's response was initiated that same day. On August 25th surveillance for *Ae. triseriatus* and its larval and adult habitats began with an intense focus on the area lying within one-half mile of the case residence. On that day, inspectors collected 43 aspirator samples, 20 of which contained *Ae. triseriatus*. Staff subsequently applied adulticides to 11 wooded habitats to reduce the high number of adult *Ae. triseriatus*.

Three aspirator samples were collected from the wooded area surrounding the case residence, all three contained *Ae. triseriatus* adults. At the time of the initial response, *Ae. triseriatus* were observed to be the most prevalent pest mosquito on the case property. A 30-second sweep net sample collected six *Ae. triseriatus*.

Staff eliminated 416 larval mosquito habitats in the area surveyed including 156 tires, 150 containers, and 110 tree holes. Ninety-three of 168 habitats inspected contained mosquito larvae. Thirty-eight live larval samples were collected and transported to the MMCD lab on August 25th to be reared and submitted for viral analysis. *Aedes triseriatus* were present in 30 of the samples and adults emerged from 26. From these samples, 44 pools of *Ae. triseriatus* were submitted to MDH for analysis. The La Crosse virus was not detected.

The La Crosse virus was detected in a sample of *Ae. triseriatus* adults that was collected elsewhere in Scott County by gravid trap as part of the District's WNV surveillance network. The sample consisted of 3 *Ae. triseriatus* and was collected on July 13th in St. Lawrence Township.

Eastern Equine Encephalitis (EEE)

In 2005, EEE virus was detected in 19 states, primarily on the East Coast and along the Gulf of Mexico. Fourteen human EEE cases were diagnosed in seven states. EEE illnesses of horses were documented in 17 states. The nearest EEE detection to Minnesota was a horse illness in Michigan. EEE virus is most common in areas near the habitat of the virus' primary vector, *Culiseta melanura*. These include many coastal wetlands, as well as tamarack bogs in the interior of North America.

***Culiseta melanura* Surveillance** Following four seasons of habitat evaluation and systematic surveillance of habitats possessing characteristics attractive to *Cs. melanura*, we have determined that the species is relatively rare in the District and in fact is restricted to a few larval habitats. Larval surveillance over the course of those four years resulted in larvae being detected in only 16 wetlands.

For 2005, we began routine monitoring of adult *Cs. melanura* using CO_2 traps supplemented with aspirator collections taken near potential larval habitats. Results are discussed in Chapter 1.

Western Equine Encephalitis (WEE)

This year, for the second consecutive year, western equine encephalitis virus was detected in Minnesota. One pool of *Cx. tarsalis* collected in Redwood County by the University of Minnesota on July 6th was positive for the virus.

In 2005, all *Cx. tarsalis* adults collected in the District during weekly CO_2 trap, gravid trap, and sweep net sampling were submitted to MDH for viral analysis. Additional samples collected by aspirator were also submitted. In total, 934 pools of *Cx. tarsalis* containing 4,334 mosquitoes were tested. Western equine encephalitis virus was not detected from any of the MMCD samples. The last record of WEE in the District was from a sentinel chicken sample collected in September of 2001.

West Nile Virus (WNV)

WNV in North America West Nile virus transmission was documented in 48 states in 2005. Only Alaska and Hawaii went without detections of local transmission of the virus. The U.S. Centers for Disease Control and Prevention received reports of 3,000 WN illnesses from 42 states. Fatalities were registered in 116 of the cases. California led the nation with 871 cases; however, South Dakota had the highest per capita case load with 228 cases. Other focal areas of WNV transmission in 2005 included the Gulf Coast region, Chicago and surrounding counties, and the Great Plains neighbors of South Dakota. Screening of the American blood supply detected WNV in 395 donors from 32 states. West Nile illness was later confirmed in 99 of the 395 donors. West Nile illness was also diagnosed in 1,094 horses from 35 states.

In Canada, 226 WNV illnesses were diagnosed in residents of eight provinces. More than 90 percent of the cases occurred in Ontario (101), Manitoba (54), and Saskatchewan (53). In 2003, 1,338 Canadians were diagnosed with WN illness, in 2004 there were only 29 cases.

There were no human WNV illnesses confirmed in Mexico in 2005. However, 814 equines of 2,281 tested in Mexico were seropositive for WNV.

WNV in Minnesota The MDH reported 45 WNV illnesses in residents of 29 Minnesota counties. There were three fatalities related to WNV infections. The first WNV case was confirmed on July 14th. The earliest onset of a WNV illness in the state was June 29th. Nine Minnesota blood donors from seven counties screened positive for WNV in 2005. Additional WNV detections in Minnesota included 21 illnesses in horses plus one asymptomatic horse, 93 birds, and 63 mosquito samples. The WNV positive mosquito samples consisted of 51 pools of *Cx. tarsalis*, five pools of *Cx. restuans*, two mixed pools of *Cx. restuans* and *Cx. pipiens*, two pools of *Culex* species, two pools of *Ae. vexans*, and one pool of *Cs. inornata*.

West Nile Illness in the District Seven residents of the District were diagnosed with WNV illnesses. Three of the individuals may have been exposed to the virus while traveling outside the

District. Three of the seven cases occurred in Dakota County residents, two in Carver County residents, and two in Hennepin County residents. Sadly, one of the Hennepin County residents infected with WNV passed away due to the illness. This was the first WNV related fatality among District residents.

Surveillance for WNV In 2005, MMCD conducted surveillance for WNV in mosquitoes and wild birds. Selected mosquitoes from 33 CO_2 traps (12 elevated into the tree canopy) and 35 gravid traps were submitted for viral analysis weekly. In addition, all *Cx. tarsalis* collected in Monday night CO_2 trap and sweep collections were submitted for viral analysis. MMCD submitted 3,309 mosquito pools to the MDH for viral analysis. Thirteen pools returned positive results for WNV and one returned a positive result for La Crosse virus (Table 2.2). Table 2.3 is a complete list of mosquitoes MMCD submitted to MDH for viral analysis.

Table 2.2 MMCD mosquito pools returning virus positive results

City	County	Collection Date	Trap Type	Species	No. of Mosquitoes	Virus
North St. Paul	Ramsey	7/13/2005	Gravid	*Cx. restuans*	4	WNV
St. Lawrence	Scott	7/13/2005	Gravid	*Ae. triseriatus*	3	LAC
St. Lawrence	Scott	7/27/2005	Gravid	*Cx. restuans*	1	WNV
St. Louis Park	Hennepin	7/27/2005	Gravid	*Cx. pip/rest*	16	WNV
St. Louis Park	Hennepin	8/3/2005	Gravid	*Cx. restuans*	16	WNV
Corcoran	Hennepin	8/9/2005	CO_2	*Cx. tarsalis*	11	WNV
St. Louis Park	Hennepin	8/10/2005	Gravid	*Cx. restuans*	25	WNV
St. Louis Park	Hennepin	8/10/2005	Gravid	*Cx. restuans*	25	WNV
St. Louis Park	Hennepin	8/10/2005	Gravid	*Cx. species*	26	WNV
St. Louis Park	Hennepin	8/17/2005	Gravid	*Cx. species*	14	WNV
Lauderdale	Ramsey	8/17/2005	Gravid	*Cx. pip/rest*	15	WNV
Blaine	Anoka	8/30/2005	Elevated CO_2	*Cx. tarsalis*	2	WNV
Vermillion	Dakota	9/7/2005	CO_2	*Cx. tarsalis*	1	WNV
Corcoran	Hennepin	9/7/2005	CO_2	*Cx. tarsalis*	2	WNV

In addition to mosquito surveillance for WNV, MMCD also contributed to Minnesota's surveillance for WNV in wild birds. In 2005, MMCD staff collected 114 birds for viral analysis. Forty-eight of the birds collected by MMCD returned positive results for WNV (Figure 2.1).

It appears from surveillance for WNV in wild birds that amplification of the virus occurred later in 2005 than in previous seasons. We observed only sporadic WNV positive birds until the end of July when there was an increase in the ratio of birds returning positive results. In 2003, a similar increase was observed in late June and in 2004 in mid-June.

Table 2.3 Number of MMCD mosquito samples submitted for viral analysis by species and collection method.

	Pools by Collection Method					
Species	CO_2	Gravid	Aspir.	Sweep	Larvae	No. mosquitoes
Aedes cinereus	1	0	0	0	0	1
Ae. hendersoni	3	0	0	0	0	3
Ae. triseriatus	49	53	2	0	49	920
Ae. vexans	0	0	1	0	0	5
Anopheles punctipennis	2	0	0	0	0	4
Coquillettidia perturbans	559	115	0	0	0	11,474
Culiseta inornata	86	69	1	0	0	317
Cs. melanura	24	0	1	0	0	63
Cs. minnesotae	59	45	0	0	0	305
Cs. morsitans	51	33	0	0	0	287
Cs. species	12	21	0	0	0	70
Culex pipiens	32	14	0	0	1	129
Cx. restuans	117	344	3	1	0	3,169
Cx. salinarius	32	2	0	0	0	70
Cx. tarsalis	852	24	46	12	0	4,334
Cx. territans	0	0	1	0	0	1
Cx. pipiens/restuans	92	226	0	0	0	1,732
Cx. species	46	226	1	0	0	1,537
Uranotaenia sapphirina	0	0	1	0	0	1
Total	2,017	1,172	57	13	50	24,422

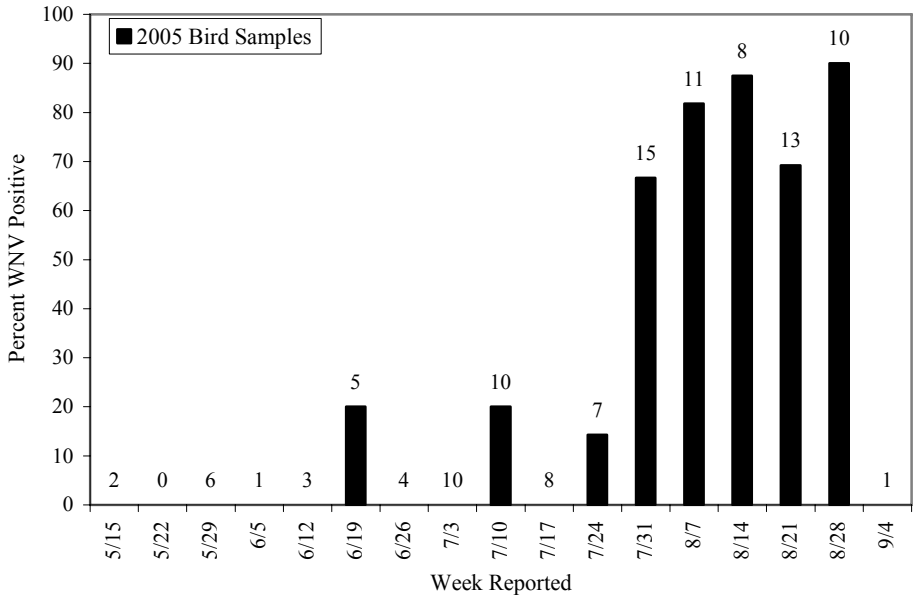


Figure 2.1 Percentage of birds collected by MMCD for WNV analysis returning positive results by week. Labels above bars are the total number of birds collected.

West Nile Virus (WNV) Research

Researching WNV vector habits, habitat preferences, and surveillance techniques for locating these species remained an important focus of MMCD staff in 2005. As in 2004, efforts were directed toward improving the District's understandings of some of the more likely vectors, amplifying and bridging, that had not previously been targets of control programs. These include *Cx. tarsalis, Cx. restuans, Cx. pipiens,* and *Cx. salinarius*. In addition to work aimed at improving vector surveillance, MMCD staff conducted adult control experiments that investigated material efficacy at tree canopy elevations. Adult mosquito surveillance shows that some *Culex* species actively feed at these elevations, especially during evening and night hours. Staff also worked on developing a model for directing WNV response that is based on "real-time" observations of WNV presence in the District.

Larval Mosquito Surveillance – Natural Habitats

Biology Background *Culex tarsalis, Cx. restuans, Cx. pipiens,* and *Cx. salinarius* lay rafts of eggs on the surface of standing water. To find larvae, adult females must have been recently active, and the area must have been wet and attractive to an egg-laying female. Larvae will tend to clump near where the female laid the egg raft.

District-Wide Sampling for *Culex*: "Dip Day" On July 7, 2005, approximately 2/3 of MMCD field staff spent the day checking wetlands specifically for *Culex* larvae. Target areas were sections containing a CO_2 or gravid trap; this allowed for a variety of habitats to be sampled. Instructions were to dip all wetlands encountered, including natural sites, constructed ponds, ditches, and other storm water management structures. July 7th was selected because the date followed a wet period at the end of June including significant rainfalls on June 27th and June 30th. Also, we observed a tenfold increase in *Cx. tarsalis* collections from the previous week in our June 28th CO_2 trap surveillance.

Inspectors were instructed to categorize each habitat that was inspected. There were four categories from which to choose based primarily on vegetation, water depth, and human alteration:

1) Grasses, sedges, shallow/semi-permanent water
2) Cattails, broadleaf plants, *Lemna*, deeper/permanent water
3) Open water, no vegetation
4) Stormwater structure or part of wetland influenced by stormwater outflow

A set of photos was distributed to help staff define each habitat category. If a site contained more than one habitat, separate samples were to be taken from each habitat within the site.

A total of 3,023 areas of 1,997 wetlands were inspected. Mosquito larvae were collected from only 450 of 2,256 areas that were wet when inspected. *Culex restuans* was the most common WNV vector collected followed by *Cx. tarsalis* (Table 2.4). The likelihood of finding *Cx. restuans* or *Cx. territans* significantly differed between habitat type (chi-square test, $p<0.001$), but *Cx. tarsalis* was not related strongly to habitat (chi-square test, $p=0.10$).

Table 2.4 *Culex* dip day surveillance results

	Habitat group					
	1 Grass	2 Cattail	3 Open	4 Struct.	Not specif.	Total
Total Inspections	1182	1051	479	194	117	3023
Number wet	641	960	422	165	68	2256
Percent wet	54%	91%	88%	85%	58%	75%
of those wet:						
Contained larvae (any sp.)	23%	22%	11%	26%	4%	20%
Cx. 4*	8%	4%	6%	17%	1%	6%
Cx. restuans	6%	2%	4%	12%	0%	4%
Cx. tarsalis	3%	2%	1%	1%	1%	2%
Cx. territans	13%	16%	5%	6%	3%	12%
Aedes larvae	6%	2%	3%	10%	3%	4%

**Cx*. 4 are the likely WNV vectors, including *Cx. tarsalis*, *Cx. restuans*, *Cx. pipiens* (very few found), and *Cx. salinarius* (none found); includes unidentifiable *Culex* larvae (1st instar).

Results were similar to 2004 in some ways but differed in others. For example, in 2004, *Cx. restuans* was found in 4% to 8% of dip day sites (two dates), and in repeatedly-sampled sites it was most often found in sedge or grasses, not in cattails or open water. The 2005 data suggests *Cx. restuans* is most likely to be found in stormwater structures, but can also occur in grass or other habitats. In 2004, *Cx. tarsalis* was found in about 2% of dip day sites and in repeated sites was most common in upland grass but also found in reed canary grass and sedge, seldom found in cattail, broadleaf or open areas. In 2005, *Cx. tarsalis* was found in cattail and open areas almost as often as in grass or sedge. *Culex territans*, not considered a likely WNV vector, was more common than any of the vector species in grass or especially cattail, similar to 2004, and was less common than *Cx. restuans* in stormwater structures.

Larval Mosquito Surveillance – Catch Basins

Catch Basin Larval Habitats Stormwater catch basins, or street drains, have long been identified as mosquito habitat in North America. Prior to the arrival of WNV the main concern of mosquito production from catch basins was the potential for contribution to St. Louis encephalitis epidemics, something that has not been experienced in the MMCD service area. Therefore, MMCD did not provide mosquito larval control in catch basins until the arrival of WNV.

The primary criterion for assuming a catch basin could provide larval habitat and thus should be treated with a larvicide was its capacity to hold water. Questions arose regarding the accuracy of the initial 2002 & 2003 inspections and mapping of catch basins and whether most water-holding catch basins would actually produce mosquitoes:

1. How many catch basins mapped as dry are dry?
2. How many catch basins mapped as wet are wet?
3. Of the wet catch basins, how many have mosquito larvae at any one time?
4. In the catch basins where larvae are found, what is the progression of species composition over the season?

Similar to work done in 2004, we carried out plans for two separate, concurrent projects to re-inspect catch basins each day that catch basin work occurs (answers Q 1, 2) and to sample selected catch basins several times during the summer (answers Q 3, 4).

Confirmation of Water-holding Status A sample of mapped catch basins were visually inspected to determine if they could potentially hold water and produce mosquitoes (worth treating, "Wet"; may include sediment-filled sumps), or were not capable of holding significant amounts of standing water (not worth treating, "Dry"; may include flowing water). Results from these re-inspections were compared with the original wet/dry determinations for these catch basins done at the time of mapping.

The sample was drawn by asking staff to re-inspect the first catch basin that was identified as wet on their maps and the first catch basin that was identified as dry at the start of each day's work. Results were entered in field PDAs daily.

Overall, 11% of catch basins mapped as "Dry" were found to be capable of holding water, and 8% of those mapped as "Wet" were considered not actually worth treating (Table 2.5).

Table 2.5 Catch basin mapping wet/dry quality assurance results, 2005

		Observed as:				
		Wet	Dry	Total	error	2SE
Mapped as:	"Wet"	801	69	870	8%	1.8%
	"Dry"	84	685	769	11%	2.2%
				1639		

Results varied in different areas, suggesting that treatment efficacy and efficiency in some areas could be improved by re-inspecting and remapping. In 2004, 15% mapped as wet were considered dry on re-inspection, and 5% originally mapped as dry were found to be wet.

Repeat Sampling of Selected Catch Basins The selection of catch basins for repetitive sampling was done randomly from the entire MMCD database of sites mapped as wet or requiring treatment. The study design required inspections during six periods: one in June, two in July, two in August, and one in September. A total of 132 catch basins were inspected repeatedly, 72 (54.55%) of which contained larvae at least once. Only 73 of the sites were inspected during each of the six periods, 48 (65.75%) of which contained larvae at least once. No site was sampled fewer than two times.

Surveillance for mosquitoes in catch basins was impacted by the frequency of rainfall in 2005. Even moderate amounts of rainfall have a tendency to flush larvae out of the catch basins. Based upon our own observations, it generally takes two to three days before egg rafts begin to reappear. Five of the six selected periods were impacted by rainfall. Still, nearly 2/3 of the sites sampled during each of the six periods contained mosquitoes.

Staff collected 178 larval samples from the randomly selected catch basins. *Culex restuans* was the predominant species found (Table 2.6 and Figure 2.2). *Culex pipiens* were found more frequently than in 2004, but less so than in 2003 when the species was present in over 27 percent of samples. Small numbers of *Cx. tarsalis, Cx. territans*, and *Ae. vexans* were also encountered. It is unlikely that catch basins are a major source of any of these species yet they may contribute to local populations if left unchecked.

Table 2.6 Species occurrences in catch basin larval samples from repeat surveillance in 2005.

Species Present	Number of samples
Cx. pipiens	9
Cx. restuans	134
Cx. tarsalis	8
Cx. territans	8
Cx. species (1st instar)	71
Ae. vexans	15
Total samples	178

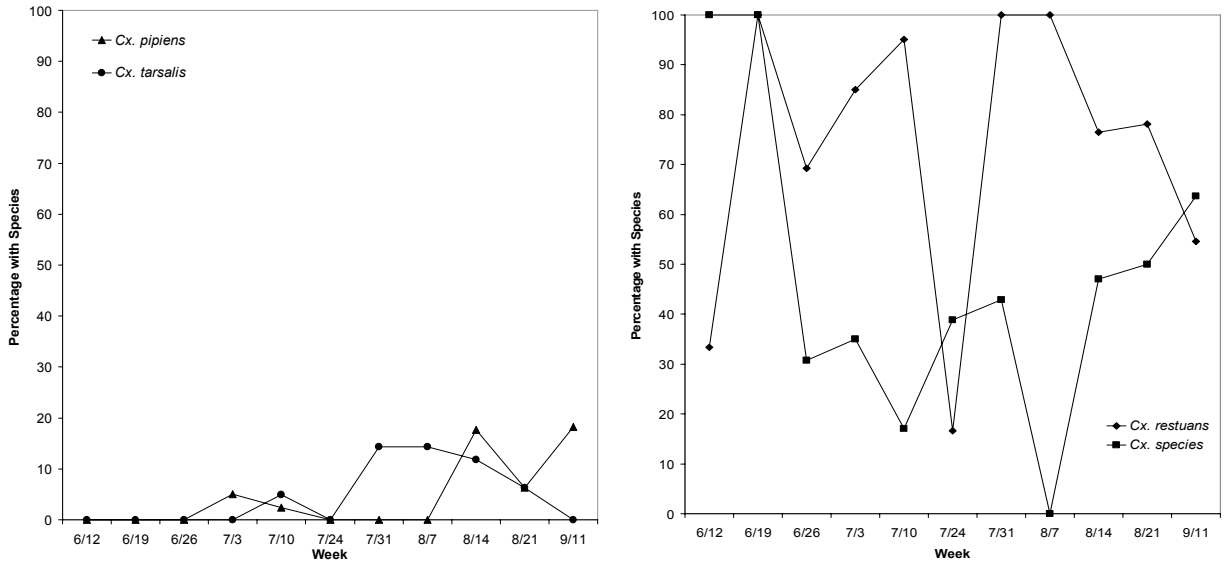


Figure 2.2 *Culex* larvae found in catch basins that were sampled repeatedly through the 2005 season by week samples were collected.

Underground Stormwater Structure Larval Habitats In 2005, the District initiated a review of mosquito habitat provided by underground water-holding structures that exist within many storm water management systems. These are typically larger than catch basins, but vary greatly in size and design. Nearly all of the structures we are concerned with as providers of mosquito habitat are designed to function similarly to catch basins, but are designed to handle larger volumes of water than a catch basin. They are often used in place of sumped catch basins and serve a large drainage area that would otherwise be served by many sumped catch basins. The primary function of the underground structure is to act as a receptacle for sediments and other pollutants prior to the discharge of the storm water into surface waters. The design terminology we encountered included water quality manhole, sump, vault, environmental chamber, vortex, and storm scepter.

In March, 2005 we mailed a short survey to 89 municipalities in the District requesting information regarding their maintenance of these sorts of structures. Fifty communities responded, 40 of which said they do maintain underground structures. We then made arrangements with 10 communities to conduct mosquito surveillance habitat evaluations with the assistance of city employees.

District staff visited 37 structures. Most were visited at least twice. There were 63 inspections in total. Thirty-two of the 63 inspections produced mosquito larval samples, while mosquito larvae were collected from 23 of the 37 structures. A list of mosquito species collected follows in Table 2.7.

It is assumed that most of the *Culex* larvae found resulted from direct oviposition on the surface of the impounded water. Most of the structures observed allow adult mosquitoes to access the impounded water through either an inlet pipe, an outlet pipe, or the cover over the structure. In fact, most allow mosquitoes to enter via all three routes. Adult mosquitoes were excluded from entering a few structures, the inlets and outlets were below water level and no access was available through the cover. Some of the mosquito larvae observed may have been washed into the structures by rainfall. Nine samples contained *Ae. vexans*. Also, it appeared that mosquitoes might be concentrated in some of the structures, the vortex chambers in particular, as large numbers of pupae and older larvae were found days after two heavy rainfall events.

Table 2.7 Mosquito species from 32 larval samples collected in underground stormwater structures in 2005.

Species	No. samples
Aedes vexans	9
Ae. triseriatus	3
Ae. species	4
Culex restuans	23
Cx. tarsalis	1
Cx. species	5
Anopheles species	1
Pupae	4

From our observations and considering the willingness to work cooperatively by all of the cities that responded to our survey, it seems worthwhile to continue to explore methods for controlling mosquito larvae in underground structures. Some of the structures allow for easy access and could be treated by MMCD staff along with catch basins in the area. Other structures are difficult to access, but are cleaned or otherwise maintained at least once each year by city employees. We will be exploring options for cooperative larval control with the municipalities in many of those instances. Left to determine are just how many publicly maintained structures will require larval control and beyond that, how many privately owned structures exist that will require treatments.

Adult Mosquito Research

Adulticide efficacy at canopy elevations Please see Chapter 5, Product and Equipment Tests, New Control Material Evaluations – section on Scourge® 2+2**.**

Modeling MMCD's Response to WNV Findings

In 2005, the District developed a model designed to aid in planning responses to WNV findings. The model uses MapInfo® software to calculate a value for each square mile of the District based on a number of inputs. These include densities of various mosquito species, dead bird reports, hospital and veterinary reports of WNV cases, and other WNV surveillance results. The output is in the form of a map of the District with a color-coded indication of the need for mosquito control activities to attempt to disrupt WNV transmission. Since much of the final value attributed to a square mile resulted from the dead bird reports and results of WNV analysis of submitted birds in 2004, model outputs displayed a low need for activities in response to WNV this season. Reports of dead birds declined in 2005. This might have been the result of a lower degree of WNV amplification through July than in previous years, but it could also be related to other factors such as a relaxed awareness of WNV by citizens or reduced corvid populations due to previous WNV impacts. Regardless of the cause, adjustments to the model in 2006 should account for an expectation of continued low numbers of bird reports.

Plans for 2006 – Mosquito-borne Disease

We will continue to develop and implement a model for assisting the direction of WNV responses within the District. Adjustments of the weighting of each type of data may be required to produce useful output.

District staff will continue to provide mosquito surveillance and control services for the prevention of La Crosse encephalitis. Preventive measures include adult sampling, adult control, property inspections, and breeding source reduction.

MMCD staff will review and revise the District's surveillance and control strategies for adult *Culex* mosquitoes. We will continue to survey aquatic habitats for *Culex* larvae for use in design and improvement of larval control strategies. *Culex tarsalis* will remain a species of particular interest.

District staff will look for ways to refine catch basin larviciding operations. We are especially interested in improving efficiency.

In 2006, we will be working with municipalities within the District to evaluate and treat the underground stormwater structures that produce mosquitoes.

MMCD will continue to conduct surveillance for WNV and other mosquito-borne viruses in coordination with MDH, MDA, the University of Minnesota, and other local authorities.

District staff will continue to monitor *Cs. melanura* in the District, with attention focused on areas in Anoka and Washington counties where the species has been encountered in the past.

MMCD staff will remain watchful for the introduction of exotic mosquito species, especially *Ae. albopictus* and *Ae. japonicus.*

2005 Tick-borne Disease Services

Ixodes scapularis Distribution

The District continued to sample the network of 100 sites set up in 1991-1992 to monitor potential changes in tick distribution over time. As in previous years, the primary sampling method involved capturing small mammals from each site and removing any attached ticks from them. Collections from the northeastern metropolitan area (primarily Anoka and Washington counties) have consistently detected *I. scapularis*, and in 1998 *I. scapularis* was detected in Hennepin and Scott counties for the first time using this study methodology. Our 2005 report will be available on our web site (www.mmcd.org) in June 2006, and reported here the latest data compilations available, which are from 2004.

The 2004 distribution study results seemed to indicate that *I. scapularis* populations had rebounded from the mixed results (a very high nymph count but a lower larval count) detected in 2003. The overall 2004 season mean of .847 *I. scapularis* per mammal was higher than the 2003 average of 0.389 and more comparable with the averages observed in 2000 – 2002 (all $\geq$ 0.806). *Ixodes scapularis* also comprised $\geq$ 50% of overall collections for only the 2nd time since the inception of the study (Table 2.8), with the 2004 tabulation of 55% being the highest recorded total in our databases. The previous highest percentage of 50% occurred in 2002. Our conclusion for 2004 was that *I. scapularis* has shown signs of an elevated population level since 2000.

Table 2.8 Numbers and percentages of tick species collected by stage and year

Year	No. sites	Total ticks collected	*Dermacentor variabilis* Percent larvae (n)	*Dermacentor variabilis* Percent nymphs (n)	*Ixodes scapularis* Percent larvae (n)	*Ixodes scapularis* Percent nymphs (n)	Other species[b] percent (n)
1990[a]	250	9957	83 (8289)	10 (994)	6 (573)	1 (74)	0% (27)
1991	270	8452	81 (6807)	13 (1094)	5 (441)	1 (73)	0% (37)
1992	200	4130	79 (3259)	17 (703)	3 (114)	1 (34)	0% (20)
1993	100	1785	64 (1136)	12 (221)	22 (388)	1 (21)	1% (19)
1994	100	1514	53 (797)	11 (163)	31 (476)	4 (67)	1% (11)
1995	100	1196	54 (650)	19 (232)	22 (258)	4 (48)	1% (8)
1996	100	724	64 (466)	20 (146)	11 (82)	3 (20)	1% (10)
1997	100	693	73 (506)	10 (66)	14 (96)	3 (22)	0% (3)
1998	100	1389	56 (779)	7 100)	32 (439)	5 (67)	0% (4)
1999	100	1594	51 (820)	8 128)	36 (570)	4 (64)	1% (12)
2000	100	2207	47 (1030)	10 (228)	31 (688)	12 (257)	0% (4)
2001	100	1957	54 (1054)	8 (159)	36 (697)	2 (44)	0% (3)
2002	100	2185	36 (797)	13 (280)	42 (922)	8 (177)	0% (9)
2003	100	1293	52 (676)	11 (139)	26 (337)	11 (140)	0% (1)
2004	100	1773	37 (653)	8 (136)	51 (901)	4 (75)	0% (8)

[a] 1990 data excludes one *Tamias striatus* with 102 *I. scapularis* larvae and 31 nymphs
[b] other species mostly *Ixodes muris.* 1999—second adult *I. muris* collected

Similarly, since 2000 the Minnesota Department of Health (MDH) has been consistently tabulating record-setting human tick-borne disease case totals. Their previous all-time high statewide tabulations occurred in 2002 (Lyme 867 and human granulocytic anaplasmosis 152), with the Lyme case totals of 2000, 2001, and 2003 being comparable (all $\geq$ 463). In the same period, human granulocytic anaplasmosis [also called human anaplasmosis or human granulocytic ehrlichiosis (HGE)] cases ranged from 78 to 152 compared with an average of roughly 15 cases per year through 1999.

In 2004, the MDH recorded another new all-time high of Lyme disease cases (1,023) as well as their 2nd highest human granulocytic anaplasmosis case totals (139). The human granulocytic anaplasmosis cases for 2004 likely would have exceeded the 2002 all-time high, but the case count is presumed artificially low due to incomplete blood work preventing a more complete count (56 potential cases were not counted compared with 10-20 in a typical year.) Preliminary 2005 human disease case data is not yet available.

Tick Identification Services/Outreach

The overall scope of tick-borne disease education activities and services (including tick identifications and homeowner consultations) were maintained in 2005 using previously described methods and tools. We also expanded our outreach by setting up information booths at several county park and city events.

2006 Plans for Tick-borne Services

Metro Surveillance

The metro-based *I. scapularis* distribution study that began in 1990 is planned to continue unchanged.

Tick Identification Services/Outreach

We plan to maintain our tick-borne disease education activities and services (e.g. tick identifications and homeowner consultations). Since our *I. scapularis* collections, as well as the MDH's human tick-borne disease case totals, have continued to be elevated, we plan to continue to set up information booths at events as opportunities arise. As in past years, we will continue to offer an encompassing slide presentation as well as to stock local parks and other appropriate venues with tick cards and brochures. Staff will also distribute materials at local fairs and the Minnesota State Fair.

We also plan to expand our tick presence on a newly re-designed MMCD web site. A new District web site will be launched in early 2006 and server space was added in late 2005 to allow room for additional graphics and materials to be available on the site. In addition, we intend to display links to tick items in more than one location on this new web site.

Chapter 3 Mosquito Control

2005 Highlights

- 22,275 more acres worth of larvicides were applied to wetlands than in 2004
- 9,810 acres worth of aerial Altosid® pellets and Vectolex® CG enabled us to provide larval control service to an extra 18,478 acres in Priority Zone 2
- 22,256 fewer acres worth of adulticides were applied in 2005 than in 2004
- A cumulative total of 145,386 catch basin treatments were made in three rounds to control vectors of WNV

2006 Plans

- Continue aerial applications of larvicides with a longer field activity than *Bti* (Altosid® pellets, Vectolex® CG) to control successive *Aedes* and *Culex* broods that develop more than 24 hr after treatment in the same site
- Provide larval control services to a greater area by more effectively using the 7th helicopter
- Review the catch basin treatment program to maintain efficacy and reduce workload to enable staff to provide additional mosquito control services

Background

The mosquito control program targets the principal summer pest mosquito *Aedes vexans*, several species of spring *Aedes*, the cattail mosquito *Coquillettidia perturbans*, the eastern treehole mosquito *Aedes triseriatus* (La Crosse encephalitis vector), and the vector of western equine encephalitis *Culex tarsalis*. The arrival of West Nile virus (WNV) in Minnesota in 2002 elevated the importance of controlling *Cx. tarsalis* and three other *Culex* species (*Culex pipiens, Culex restuans,* and *Culex salinarius*) which are potential vectors of WNV. Larval control is the main focus of the program but is supplemented by adult mosquito control when necessary.

Aedes larvae hatch in response to snow melt or rain with adults emerging at various times during the spring and summer. Cattail mosquito larvae develop in cattail marshes over twelve months and emerge as adult mosquitoes in June and July. *Culex* species also breed during periods of greater precipitation but inhabit more permanent waters and therefore are not as dependent upon rainfall. Stormwater catch basins can also support breeding of *Cx. pipiens* and *Cx. restuans.* This type of mosquito habitat can be the primary source of WNV vectors in heavily urbanized areas. Such was the case in the WNV epidemics in Chicago in 2002 and 2005.

MMCD uses "Priority Zones" to focus service in areas where it will benefit the highest number of citizens. Priority Zone 1 contains the majority of the population of the Twin Cities metro area and has boundaries similar to the Metropolitan Urban Service Area (MUSA, Metropolitan Council). Priority Zone 2 includes sparsely populated and rural parts of the District. Small towns or population centers in Priority Zone 2 are considered satellite communities and receive services similar to Priority Zone 1.

Adult mosquito control supplements the larval control program. Adulticide applications are performed after sampling detects mosquito populations meeting threshold levels, primarily in high use park and recreation areas, for public events, or in response to citizen mosquito annoyance reports. Three synthetic pyrethroids are used: resmethrin, permethrin, and sumithrin. A description of the control materials is found in Appendix C. Appendix D indicates the dosages of control materials used by MMCD, both in terms of amount of formulated (and in some cases diluted) product applied per acre and the amount of active ingredient (AI) applied per acre. Appendix E contains a historical summary of the number of acres treated with each control material. Pesticide labels are located in Appendix F.

2005 Mosquito Control

Larval Mosquito Control

Beginning in April 2005, the threshold for treatment with *Bti* was 0.1 larvae per dip for spring *Aedes* in Priority Zone 1. A higher threshold of 0.5 larvae per dip was used in Priority Zone 2 to target limited control materials to sites with the most intense breeding. After mid-May, the threshold was increased to control the summer floodwater mosquitoes and *Culex*. For sites with only *Culex* (*Cx. restuans*, *Cx. pipiens*, *Cx. salinarius*, *Cx. tarsalis*), the threshold was 1 per dip in all priority zones. For sites with both *Culex* and floodwater mosquitoes, the threshold was 2 per dip in Priority Zone 1 and 5 per dip in Priority Zone 2.

Precipitation throughout spring and early summer (May through July) resulted in eight District-wide broods of *Aedes vexans*. Four more broods occurred between mid-August and the end of September (Fig. 3.1). A typical season has four such broods. MMCD applied larvicide to 22,275 more acres in 2005 than in 2004 (Table 3.1). From June through August 2005, MMCD staff made 145,386 larvicide treatments to catch basins to control vectors of WNV.

In 2005, the larval treatment strategy included aerial applications of larvicides with a longer field activity than *Bti* (Altosid® pellets, Vectolex® CG) to decrease the number of times air sites are repeatedly treated in May, June, and July. This also enabled one larvicide treatment to control *Culex* that develop later in the same site. Less frequent treatments enabled staff to inspect and treat additional sites. In 2005, MMCD increased its ability to more rapidly treat air sites by contracting seven helicopters for mosquito control, one more than in 2004.

By treating 9,000 acres aerially with Altosid® pellets and 810 acres with Vectolex® CG (half applied in mid-May and the remainder in mid-June), we were able to provide larval control services to an additional 18,478 acres (9.9%) in Priority Zone 2 (10,207 acres mid-May through mid-June and 8,271 acres mid-June through mid-July).

Stormwater catch basin treatments began in early June and ended in late August. Most catch basins were treated three times with Altosid® pellets (3.5 grams per catch basin) to control *Culex* mosquitoes from June through mid-September. We treated 4,867 catch basins with Altosid® briquets (1 briquet per catch basin) to investigate whether briquets could reduce the number of catch basin treatments per season and maintain effective control of *Culex* mosquitoes from June

through mid-September. Results are summarized in Chapter 5 Product and Equipment Tests.

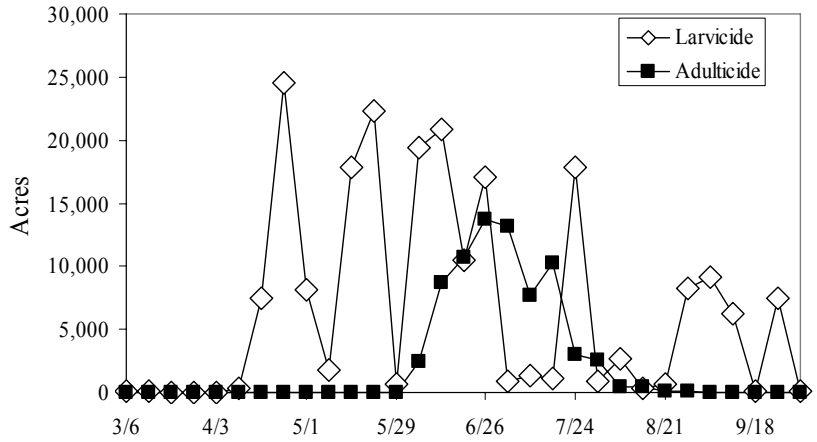


Figure 3.1 Acres of larvicide and adulticide treatments each week (March-September 2005).

Table 3.1 Comparison of larval control material usage in wetlands and stormwater catch basins for 2004 and 2005.

	2004		2005	
Material	Amount used	Area treated	Amount used	Area treated
Wetlands				
Altosid® briquets	550 cases	398 acres	618 cases	389 acres
Altosid® pellets	56,897.34 lb	19,139 acres	99,972.77 lb	29,965 acres
Vectolex® CG	0.00 lb	0 acres	6,480.00 lb	810 acres
Bti corncob	1,330,442.20 lb	166,299 acres	1,415,630.51 lb	176,947 acres
Larvicide subtotals		185,836 acres		208,111 acres
Catch basins				
Altosid® briquets	0 cases	0 CB[1]	24.36 cases	4,867 CB
Altosid® pellets	1,215.51 lb	148,023 CB	1,259.05 lb	140,519 CB
Larvicide subtotals		148,023 CB		145,386 CB

[1]CB=catch basin treatments

Adult Mosquito Control

In 2005, MMCD applied adulticides to 22,256 fewer acres than in 2004 (Table 3.2). Adulticide treatments began in early June, peaked in late June, and continued until late July with a few treatments being applied in August (Fig. 3.1). Adult mosquito control operations were considered when mosquito levels rose above established thresholds of two mosquitoes in a 2-minute sweep or 2-minute slap count or 130 mosquitoes in an overnight CO_2 trap. In 2004, we established surveillance thresholds for adult control specific to four *Culex* species: *Cx. restuans*, *Cx. pipiens*, *Cx. salinarius*, and *Cx. tarsalis*. The thresholds are one of any of these *Culex* species in a 2-minute sweep, five in an overnight CO_2 trap, five in an overnight gravid trap, and one

Cx. tarsalis in a vacuum aspirator sample. Adulticide treatments were also considered when two or more *Ae. triseriatus* were captured in a vacuum aspirator sample.

Table 3.2 Comparison of adult control material usage in 2004 and 2005.

	2004		2005	
Material	Amount used	Area treated	Amount used	Area treated
Permethrin	1,608.19 gal	8,292 acres	1,333.29 gal	7,982 acres
Resmethrin	841.96 gal	71,847 acres	453.64 gal	40,343 acres
Sumithrin	383.41 gal	15,508 acres	541.85 gal	25,067 acres
Total		95,647 acres		73,392 acres

2006 Plans for Mosquito Control Services

Larval Control

Cattail Mosquitoes Control of *Cq. perturbans* in 2006 will use the same strategy as in 2005. MMCD will focus control activities on the most productive cattail marshes near human population centers. Briquet applications will start in early March to frozen sites (e.g., floating bogs, deep water cattail sites, remotely located sites). Beginning in late May, staff will treat with pellets applied by helicopter at a rate of 4 lbs/acre.

Floodwater Mosquitoes and *Culex* Species MMCD has expanded control of four *Culex* species since the arrival of WNV in 2002. Ground and aerial larvicide treatments of wetlands have been increased to control *Culex*. Catch basin treatments control *Cx. restuans* and *Cx. pipiens* breeding in urban areas.

The primary control material will again be *Bti* corn cob granules. Forecasted *Bti* (Vectobac® G), Altosid® pellet, and Vectolex® CG needs in 2006 are similar to 2005 requirements. As in previous years, to minimize shortfalls, control material use may be more strictly rationed during the second half of the season, depending upon the amount of the season remaining and control material supplies. Regardless of annoyance levels, MMCD will maintain sufficient resources to protect the public from potential disease risk.

Staff will treat ground sites (<3 acres) with methoprene products (Altosid® pellets, Altosid® briquets) or *Bti* corn cob granules. Breeding sites in highly populated areas will receive treatments first during a wide-scale mosquito brood. The District will then expand treatments into less populated areas where treatment thresholds are higher. In 2006, larval treatment thresholds will be the same as in 2005.

We intend to provide larval control services to a greater area by more effectively using the 7th helicopter, especially early during a brood. We also plan to explore more widespread use of Vectolex® CG to treat wetlands that potentially breed *Culex* later in the season, wetlands that previously have been treated with *Bti*. Using Vectolex® CG will decrease the number of times these sites need treatment because Vectolex® CG has a longer filed life than *Bti* (4 weeks vs 24 hrs).

In 2006, catch basins will be treated with Altosid® pellets and briquets. Catch basins selected for treatment include those found holding water, those that potentially could hold water based on their design, and those for which we have insufficient information to determine whether they will hold water. Treatments could begin as early as the end of May and no later than the third week of June. We have tentatively planned to complete a first round of pellet treatments by June 26 with subsequent Altosid® pellet treatments every 30 days. Catch basins treated with Altosid® briquets will be treated once by June 26.

Adult Mosquito Control

Forecasted permethrin, resmethrin, and sumithrin requirements in 2006 are similar to 2005. MMCD will direct adult mosquito control treatments to provide the greatest customer benefit, generally higher risk disease areas, and human populated areas that have high levels of mosquitoes. Also, MMCD will provide service in high-use park and recreation areas and for public functions.

Vector Mosquito Control

Employees will routinely monitor and control *Ae. triseriatus*, *Cs. melanura*, *Cx. tarsalis*, *Cx. pipiens*, *Cx. restuans*, *Cx. salinarius*, and *Ae. albopictus* populations. See Chapter 2 Vector-Borne Disease of this report for more details**.**

Chapter 4 Black Fly Control

2005 Highlights

- Treated the South Fork Crow River with *Bti* in the Carver County expansion area
- 2003 non-target sampling report completed
- Collected multiplate samples in Mississippi River for the non-target monitoring program

2006 Plans

- Threshold for treatments are the same as previous years
- Continue monitoring larval and adult black fly populations in Carver County expansion area
- Analyze multiplate samples collected in 2005

Background

The goal of the black fly program is to reduce pest populations of adult black flies within the MMCD to tolerable levels. Black fly larval populations are monitored at about 140 small stream and 27 large river sites using standardized sampling techniques during the spring and summer. Liquid *Bti* is applied to sites when the target species reaches the treatment threshold.

The small stream program began in 1984. The large river program began with experimental treatments and non-target impact studies in 1987. A full-scale large river treatment program did not go into effect until 1996.

2005 Program

Small Stream Program - *Simulium venustum* Control

One human biting species of black fly that is targeted for control and breeds in small streams is *Simulium venustum*. It has one early spring generation. Larvae are found in small streams throughout the District, although the largest populations generally are found in Anoka County.

One hundred thirteen potential *S. venustum* breeding sites were sampled in mid-April to determine larval abundance using the standard grab sampling technique developed by the MMCD in 1990. The treatment threshold was 100 *S. venustum* per sample. A total of 30 sites on 9 streams met the threshold and were treated once with Vectobac® 12AS formulation of *Bti*. A total of 12.5 gallons of *Bti* was used (Table 4.1).

Table 4.1 Summary of *Bti* treatments for black fly control by the MMCD in 2005.

Water body	No. treatment sites	No. treatments	Gallons of *Bti* used
Small streams	30	30	12.5
Mississippi River	3	13	1,445.0
Crow River	2	5	80.0
South Fork Crow River	6	26	224.4
Minnesota River	7	11	1,322.9
Rum River	4	22	144.8
Total	52	107	3,229.6

Large River Program

There are 3 large river-breeding black fly species that the MMCD targets for control. *Simulium luggeri* breeds mainly in the Rum and Mississippi rivers, although it also breeds in smaller numbers in the Minnesota and Crow rivers. *Simulium luggeri* is abundant from mid-May through September. *Simulium meridionale* and *Simulium johannseni* breed primarily in the Crow, South Fork Crow, and Minnesota rivers. These species are most abundant in May and June, although *S. meridionale* populations will remain high throughout the summer if stream flow is also high.

The black fly larval population was monitored weekly between May and early September using artificial substrates at the 27 sites permitted by the Minnesota Department of Natural Resources on the Rum, Mississippi, Crow, South Fork Crow and Minnesota rivers. The treatment thresholds were the same as those used since 1990. Seventy-seven treatments totaling 3,217.1 gallons of Vectobac® 12AS (*Bti*) were used to control large river-breeding black fly larvae in 2005 (Table 4.1). New in 2005 was the inclusion of 6 treatment locations on the South Fork Crow River. Studies conducted by the District in 2004 indicated high breeding potential for *S. meridionale* and *S. johannseni* on the South Fork Crow River. The MnDNR approved the District's request in its 2005 permit application to include 6 sites on the South Fork Crow River in the large river program.

Bti treatment effectiveness was excellent in 2005. The average post-*Bti* treatment larval mortality (measured at least 250 m downstream of the point of the *Bti* application) was 99% on the Crow River, 96% on the Minnesota River, 97% on the Mississippi River, 83% on the Rum River, and 72% on the South Fork Crow River. The average post-treatment mortality was lower on the Rum and South Fork Crow rivers compared to the other rivers due to several treatments with poor efficacy in the early season. The poor efficacy was attributed primarily to low water temperatures.

Adult Population Sampling

The adult black fly population was monitored in 2005 at the 53 standard locations throughout the MMCD using the District's standard black fly over-head net-sweep monitoring technique, which was established in 1984. Samples were taken once weekly from early May to mid-September,

generally between 8 AM and 10 AM. The average number of all species of adult black flies captured in 2005 was 0.74 (Table 4.2). The only year that had a lower number of black fly adults was in 2002 when an average of 0.61 adults per sample was collected (Table 4.2). The average number of adult black flies captured per sample between 1984 and 1986 when no large river *Bti* treatments were done was 14.8. Between 1987 and 1995 when experimental treatments were done on the large rivers to varying degrees, the average number of adult black flies captured per sample was 3.6. The average number of adult black flies captured per sample since 1996 when the District's full large river larval black fly control program began operation is 1.6.

The most abundant black fly collected in the sweep samples in 2005 was *S. luggeri*, comprising 78% of the total black flies captured. The overall average number of *S. luggeri* captured per net-sweep sample in 2005 was 0.58 (Table 4.2). This was the third lowest number of *S. luggeri* collected in the net-sweep samples since the black fly program began in 1984. *Simulium luggeri* was most abundant in Anoka County in 2005, as it has been since the program began in 1984. The average number of *S. luggeri* captured in Anoka County was 2.74 in 2005 compared to averages of 1.65, 8.92, and 1.82 in 2002, 2003, and 2004 respectively. The higher number of *S. luggeri* captured in Anoka County compared to other counties within the MMCD is most likely due to its close proximity to the prime larval habitat in the nearby Rum and Mississippi rivers. Peaks in the *S. luggeri* population occurred in late May, late July, and late August.

The second most abundant adult black fly species captured in 2005 was *S. meridionale*, comprising 11% of the total collected (Table 4.2). The average number of *S. meridionale* captured per sample in 2005 was 0.08, which is the lowest number collected since 2000 (Table 4.2). *Simulium meridionale* was most abundant in Carver County in 2005 where an average of 0.26 adults collected per sample. Five additional adult net sweep sample stations were added to Carver County beginning in 2004 in anticipation of the inclusion of all of Carver County to the MMCD black fly control program in 2005. The most abundant black fly species collected at these five stations both in 2004 and 2005 was *S. meridionale*. The average number of *S. meridionale* captured per sample was 1.41 in 2004 and 0.41 in 2005. The reason for the reduced number of *S. meridionale* captured in 2005 compared to 2004 is not known for certain. It could be a consequence of the *Bti* treatments that were done for the first time in 2005 on the nearby South Fork Crow River. *Simulium meridionale* is the most abundant black fly found in this river. It may also be related to the fact that the population of *S. meridionale* may have been above average in 2004 due to the higher than normal flows that occurred during the summer on the Minnesota River. The long-term trend of the *S. meridionale* population in this region of the MMCD will be interesting to track.

Adult black fly populations were also monitored between mid-May and late June with CO_2-baited light traps in 2005 at a total of 13 sites in Anoka, Scott, and Carver counties. The sites in Anoka and Scott counties have been monitored by this method since 1998; monitoring in the Carver County expansion area began in 2004. *Simulium meridionale* and *S. johannseni* are the two most abundant black fly species captured in the CO_2 traps. The largest larval populations of both species occur in the Minnesota and Crow river systems. The number of *S. meridionale* captured per trap in the Carver County expansion area in 2004 was 327 compared to 188 per trap in 2005. The number of *S. johannseni* captured per trap in Carver County in 2004 was 33 compared to 99 per trap in 2005. In the Scott County traps, the average number of

S. meridionale captured in 2004 was 0.65 and 23 in 2005. The average number of *S. johannseni* collected per trap in Scott County was 0.2 in 2004 and 4 in 2005. The average number of *S. meridionale* captured per trap in Anoka County was 14 in 2004 and 1 in 2005. The average number of *S. johannseni* captured per trap in the Anoka County traps was five in 2004 and 0.03 in 2005.

Table 4.2 Annual mean number of black fly adults captured in over-head net sweeps in bi-weekly samples taken at standard sampling locations throughout the MMCD between mid-May and mid-September. Samples were taken once weekly beginning in 2004 and twice weekly in previous years. The first operational treatments of the Mississippi River began in 1990 at the Coon Rapids Dam. 1988 was a severe drought year and limited black fly production occurred.

Year	All species[1]	*Simulium luggeri*	*Simulium johannseni*	*Simulium meridionale*
1984	17.95	16.12	0.01	1.43
1985	14.56	13.88	0.02	0.63
1986	11.88	9.35	0.69	1.69
1987	6.53	6.33	0.02	0.13
1988	1.60	1.54	0.05	0.00
1989	6.16	5.52	0.29	0.18
1990	6.02	5.70	0.01	0.24
1991	2.59	1.85	0.09	0.60
1992	2.63	2.19	0.12	0.21
1993	3.00	1.63	0.04	1.24
1994	2.41	2.31	0.00	0.03
1995	1.77	1.34	0.32	0.01
1996	0.64	0.51	0.01	0.07
1997	2.91	2.49	0.00	0.25
1998	2.85	2.64	0.04	0.04
1999	1.63	1.34	0.04	0.06
2000	2.38	2.11	0.01	0.02
2001	1.30	0.98	0.04	0.18
2002	0.61	0.43	0.01	0.14
2003	1.96	1.65	0.01	0.20
2004	0.97	0.35	0.02	0.39
2005	0.74	0.58	0.01	0.08

[1]All species includes *S. luggeri*, *S. meridionale*, *S. johannseni*, *S. vittatum* and *S. venustum*

Non-target Monitoring

The District conducts biennial monitoring of the non-target invertebrate population in the Mississippi River as a requirement of its permit from the MnDNR. The study was designed to provide a long-term assessment of the invertebrate community in *Bti*-treated reaches of the Mississippi River. The results from the monitoring work conducted in 1995, 1997, 1999, 2001, and 2003 have not indicated that any large-scale changes have occurred within the invertebrate community in the *Bti*-treated reaches of the Mississippi River. Monitoring sampling was repeated as scheduled on the Mississippi River in 2005. Samples are in the process of being identified and enumerated with a report due in spring 2007.

2006 Plans

Our goal is to continue to effectively control black flies in the large rivers and small streams. The larval population monitoring program and thresholds for treatment will continue as in previous years. Six new larval treatment sites on the South Fork Crow River will continue to be monitored and treated if the treatment threshold is reached. The 2006 black fly control permit application request has been submitted to the MnDNR. Taxonomic identification and enumeration of the non-target samples collected in 2005 are in the process of being analyzed.

Chapter 5 Product & Equipment Tests

2005 Highlights

- Vectobac® G *Bti* achieved the same high level of control of *Ae. vexans* in air sites as in previous years
- Larger scale aerial applications of Vectolex® CG and Altosid® pellets effectively controlled *Aedes* and *Culex* mosquitoes for four weeks
- Altosid® briquets effectively controlled *Culex* and other mosquitoes in catch basins
- Scourge® effectively controlled adult mosquitoes at ground level and higher in trees

2006 Plans

- Refine strategies for larger scale applications of Vectolex® CG and Altosid® pellets to control *Aedes* and *Culex* mosquitoes
- Continue testing control materials in catch basins with the goal of decreasing the number of treatments per season while maintaining efficacy
- Further test Pyrenone® and Pyrocide® for adult mosquito control in croplands
- Expand evaluation of the effectiveness of adulticide treatments against vectors of WNV or other mosquito-borne diseases

Background

Quality assurance (QA) is an integral part of MMCD services. The QA process focuses on control material evaluations, label compliance, application analysis, calibration, and exploration of new technologies to improve our operations. The Technical Services team provides project management and technical support. The Regional Process teams coordinate field testing and data collection.

2005 Projects

Quality assurance processes focused on equipment, product evaluations, and waste reduction. Before being used operationally, all products must complete a certification process that consists of tests to demonstrate how to use the product to effectively control mosquitoes. The District continued certification testing of four larvicides and one new adulticide. All four larvicides have been tested in different control situations in the past. Three larvicides were tested to control *Culex* breeding in catch basins, two to control *Culex* developing in wetlands, and one to control the cattail mosquito. The adulticide was tested for use in croplands. These additional materials will provide MMCD with more tools to use in its operations.

Acceptance Testing of Altosid® (methoprene) Briquets and Pellets

Warehouse staff collected random Altosid® product samples for methoprene content analysis from shipments received from Wellmark International. MMCD contracts an independent testing laboratory, Legend Technical Services, to complete the active ingredient (AI) analysis. Zoecon

Corporation, Dallas, Texas, provided the testing methodologies. The laboratory protocol used was CAP No. 311, "Procedures for the Analysis of S-Methoprene in Briquets and Premix." All 2005 samples were within acceptable values of the label claim of percent methoprene (Table 5.1).

Table 5.1 Methoprene content of Altosid® (methoprene) briquets and pellets

Methoprene Product	Samples Analyzed	Methoprene Content: Label Claim	Methoprene Content: Analysis Average	SE
XR-Briquet	14	2.10%	2.06%	0.013
Pellets	69	4.25%	4.26%	0.012

Development of New Protocol for Preparing Methoprene Briquets for Laboratory Analysis

Zoecon's laboratories continued to work on lessening the preparation time of individual methoprene samples. The laboratory procedure CAP No. 311 directs the laboratory analyst to prepare a powdered sample for extraction by hand scraping the methoprene-impregnated plaster matrix. In 2005, Zoecon developed an equivalent method for breaking down the plaster matrix. The new method incorporates a wood boring bit to quickly breakdown the briquet matrix and provides the necessary powdered sample. The drill bit method significantly reduces the preparation time of each briquet sample. Zoecon approved this new method and incorporated it into CAP No. 311. Zoecon forwarded the new protocol to Legend Technical Services and this new protocol was used for analyzing MMCD briquet samples in the 2005.

Evaluation of Storage on Active Ingredient Levels of Briquets & Pellets

Carrying over control materials from one season to the next is always a possibility. Technical Services staff evaluated Altosid® briquets and pellets for long-term viability during storage. In previous seasons, we looked at the amount of active ingredient (AI) breakdown over one-year and two-year periods.

To continue to increase our knowledge of the rate of AI breakdown, we looked at stored samples at the end of the 2005 treatment season. Briquets lost approximately 6% of its AI after being stored for 8 months (Table 5.2). Pellets similarly lost 8% in a similar time frame. Technical Services would recommend to minimize the amount of methoprene products carried over and to use remaining quantities first in the upcoming treatment season.

Table 5.2 Active ingredient (methoprene) breakdown in stored briquets and pellets in 2005. Initial shipment of product was analyzed in February and remaining inventory was analyzed in October, 2005.

Material	Initial methoprene content	End methoprene content	AI breakdown
XR briquet	2.06%	1.94%	6%
Pellets	4.26%	3.93%	8%

Evaluation of Active Ingredient Levels in Adult Mosquito Control Products

MMCD has requested the certificates of Active Ingredient (AI) analysis from the manufacturers to verify product AI levels at the time of manufacture. All of the products received by MMCD in 2005 were guaranteed by the manufacturer to contain label required AI levels. MMCD has incorporated AI analysis as part of our product evaluation procedures and will submit randomly selected samples of adulticide control materials to an independent laboratory for AI level verification. This process will assure that all adulticides (purchased, formulated, and/or stored) meet the necessary quality standards. All 2005 samples were within acceptable values of the label claim of their active ingredients (Table 5.3). In 2006, analyses of resmethrin and sumithrin will expand to include AI levels of the synergist, piperonyl butoxide (PBO).

Table 5.3 Active ingredient analysis of adulticide materials

Control Material	Samples Analyzed	Active Ingredient: Label Claim	Active Ingredient: Analysis Average	SE
Permethrin 57-OS Concentrate	4	57%	58.50%	0.65
Permethrin 5.7% Mixture	4	5.7%	6.25%	0.05
Resmethrin Scourge 4+12	2	4%	4.45%	0.05
Sumithrin Anvil 2+2	2	2%	2.30%	0.00

Development of New Permethrin Pallet System

A new permethrin pallet system was developed to improve the physical inventory process. Historically, permethrin has been packaged in 55-gallon drums and the quantity has been measured with a Liquid Measuring Device (LMD) inserted into the barrel. The retirement of the LMD creator has led to a lack of support for this apparatus and most of these measurement tools are in disrepair. Accuracy of the LMD has been scrutinized and converting the inventory process to a system based upon actual weight is seen as an improvement.

The rationale of this new system was based upon five main points: creation of an inventory system based upon a weighable 2.5-gallon container, creation of a standardized delivery quantity (50-gallons), ease of inventory measurement, safer transportation of liquid materials, and use of jugs that can be used directly in the field.

This new system was well received and it increased our operational efficiency. Field and inventory staffs were able to spend less time transferring, weighing, and estimating this control material's use. Technical Services is exploring using similar pallet systems for other adulticides.

Recycling of Pesticide Containers

MMCD continued to use the Minnesota Department of Agriculture's (MDA) pesticide container recycling program. This project focuses on properly disposing of agricultural pesticide waste containers thereby protecting the environment from the related pesticide contamination of ground and water. MDA used Tri-Rinse, Inc., St. Louis, MO for disposal services of their plastic pesticide container-recycling program.

Warehouse personnel arranged for all of MMCD's plastic containers to be collected and properly stored until they could be processed. MMCD staff collected over 6,284 jugs for this recycling program. The control materials that use plastic 2.5-gallon containers are sumithrin (216 jugs), *Bti* liquid (1,292 jugs), and Altosid® pellets (4,776 jugs). Twelve MMCD staff members (two employees from each regional facility) assisted in the jug grinding process which was completed in one day and resulted in approximately 5,300 lbs of recycled shredded plastic.

In addition, the warehouse recycles numerous steel drums and steel containers each season. These 55- or 30-gallon drums are brought to a local company to be refurbished and reused.

Reduced Production of Hazardous Waste

To properly handle and dispose of pesticide containers, each oil-based adulticide container had to be triple-rinsed with mineral spirits. This process creates a rinsate that MMCD manages as hazardous waste.

MMCD's centralized triple-rinsing process used our warehouse personnel expertise to maintain low quantities of hazardous waste created by our operations. By rinsing all the containers at the same time, warehouse staff was able to use a minimal amount of mineral spirits in the recycling process. MMCD produced three gallons of mineral spirit rinsate in 2005.

Efficacy of Control Materials

Vectobac® G Applications Vectobac® G brand *Bti* (5/8 inch mesh size corncob granules) from Valent BioSciences was the primary *Bti* product applied by helicopter in 2005. Efficacy as calculated in terms of pre-treatment and post-treatment larval counts was similar in 2004 and 2005 (Table 5.4).

Table 5.4 Efficacy of aerial Vectobac® G applications in 2004 and 2005. SE=standard error.

Year	n	Mean % mortality	Median % mortality	SE	Min % mortality	Max % mortality
2004	294	89.5	100.0	1.6 %	0.0	100.0
2005	171	89.3	100.0	2.2 %	0.0	100.0

Vectolex® CG treatments Efficacy of aerial treatments of Vectolex® CG (*Bacillus sphaericus*) was high throughout the 28-day control period (Table 5.5, Figure 5.1). Efficacy was comparable to that observed in 2004 in ground sites (87.7% - 100.0%) treated with the same dosage (8 lb/acre). Statistical analysis confirmed that efficacy remained high for over four weeks (Linear Regression; slope = 0.00333, F = 1.015, p = 0.677; df = 105).

Table 5.5 Efficacy of aerial Vectolex® CG applications in 2005. SE=standard error.

Year	n	Mean % EI	Median % EI	SE	Min % EI	Max % EI
2005	107	90.8	100.0	2.5%	0.0	100.0

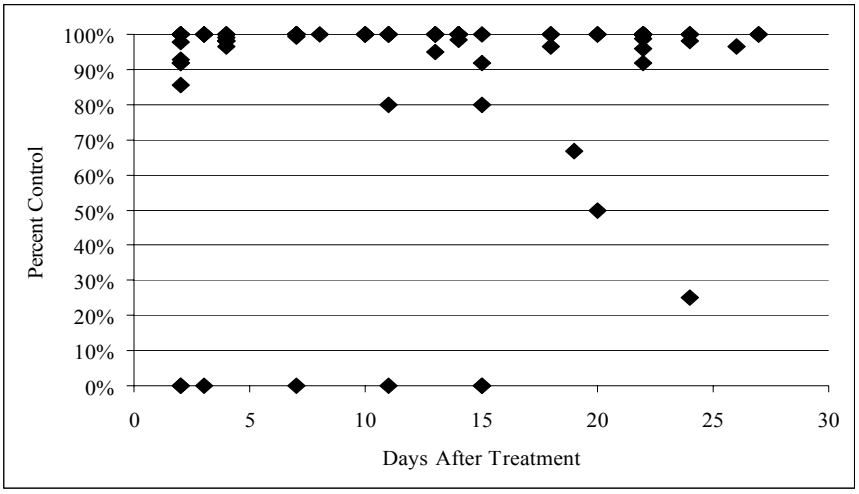


Figure 5.1 Mean efficacy calculated in terms of pre-treatment and post-treatment larval counts in sites treated aerially with Vectolex® CG in 2005.

Altosid® Pellet Treatments In 2005, MMCD applied Altosid® pellets aerially to control *Ae. vexans* and *Culex* mosquitoes in sites which historically produce multiple mosquito broods from May though July. Untreated control emergence in 2005 from wetlands similar to those treated aerially with Altosid® pellets averaged around 80% (Table 5.6).

Bioassays from sites treated aerially with Altosid® pellets in 2005 indicated high efficacy throughout the four weeks following treatment (Table 5.7, Figure 5.2). Statistical analysis confirmed that efficacy remained high for over four weeks (Linear Regression: slope = 0.00296, F = 0.287, p = 0.934; df = 82).

Table 5.6 Bioassay results for untreated control breeding sites in 2005. SE=standard error.

Year	n	Mean % emergence	Median % emergence	SE	Min % emergence	Max % emergence
2005	29	78.9	84.6	5.6%	5.6	100.0

Table 5.7 Results of bioassays from sites treated aerially with Altosid® pellets in 2005. Emergence inhibition (EI) is corrected for untreated control mortality. SE=standard error.

Year	n	Mean % EI	Median % EI	SE	Min % EI	Max % EI
2005	84	73.7	96.2	4.1%	0.0	100.0

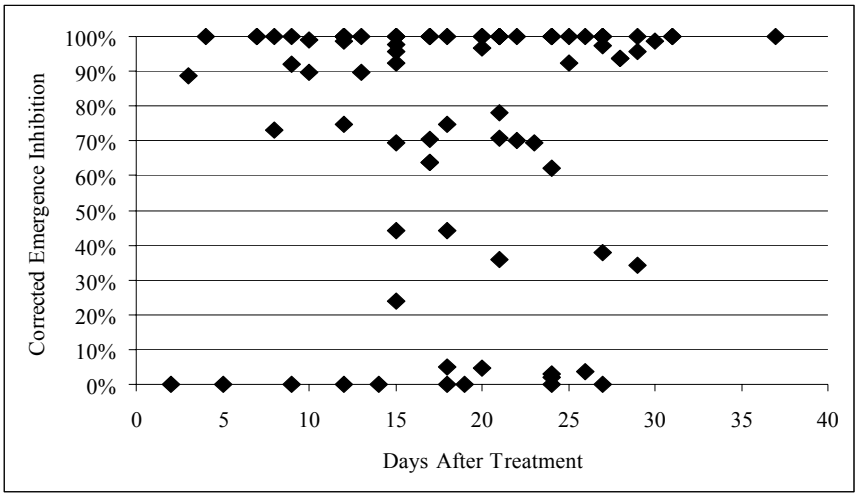


Figure 5.2 Results of bioassays from sites treated aerially with Altosid® pellets in 2005. Emergence inhibition (EI) is corrected for untreated control mortality.

Altosid® Briquets in Catch Basins In 2005, MMCD applied Altosid® 150-day briquets to 4,867 catch basins to control WNV vectors (i.e. *Cx. restuans* and *Cx. pipiens*). Our long term goal is to reduce the amount of work required to treat catch basins while maintaining effective control. In 2004, it was very difficult for staff to locate pupae in catch basins treated with Altosid® pellets. That year, only 17 Altosid® pellet bioassays were done after 206 inspections and only 11 Altosid® briquet bioassays were done after 103 inspections. Larvae were observed frequently but not quantified in 2004. In 2005, staff recorded larval dip counts to evaluate efficacy of Altosid® briquets in catch basins.

Again in 2005 we were unable to make many bioassay evaluations. Staff conducted only six bioassays after 195 inspections of catch basins. Results ranged between zero and 100% efficacy (Table 5.8). Pupal samples were collected between 20 and 40 days after treatment, well within the 150-day field life of Altosid® briquets.

Table 5.8 Results of bioassays from catch basins treated with Altosid® briquets in 2005. Emergence inhibition (EI) is corrected for untreated control mortality. SE=standard error (pupae collected between 6/20 and 7/19).

Year	n	Mean % EI	Median % EI	SE	Min % EI	Max % EI
2005	6	34.7	23.7	17.0%	0.0	100.0

Larval inspections were more successful. The mean larval dip count in catch basins treated with Altosid® briquets early in the season (6/6-7/1) was lower than the mean pre-treatment dip count from catch basins (Table 5.9, Fig. 5.3). During this time period, a significantly higher percentage of catch basins treated with Altosid® briquets had dip counts of zero when compared to pre-treatment dip counts collected during a similar period (Table 5.10, Fisher's Exact Test, p=0.023).

The mean larval dip count in catch basins treated with Altosid® briquets later in the season (7/5-7/19) was lower than the mean dip count from untreated control catch basins (7/5-7/20) (Table 5.9, Fig. 5.3). During this time period, a significantly higher percentage of catch basins treated with Altosid® briquets had dip counts of zero compared to dip counts collected from control catch basins during a similar period (Table 5.9, Fisher's Exact Test, $p=7x10^{-6}$).

Table 5.9 Larval dip counts from catch basins treated with Altosid® briquets in 2005. SE=standard error. Control=untreated catch basins

Group (period)	n	Mean	Median	SE	Min	Max	Samples with zero larvae (%)
Pre-treat (5/31-6/24)	33	8.7	0.0	4.2	0.0	100.0	21 (63.6%)
Briquet (6/6-7/1)	50	1.3	0.0	0.7	0.0	30.0	42 (84.0%)
Control (7/5-7/20)	9	20.7	5.0	11.2	0.2	100.0	0 (0.0%)
Briquet (7/5-7/19)	103	3.4	0.0	1.4	0.0	100.0	79 (76.7%)

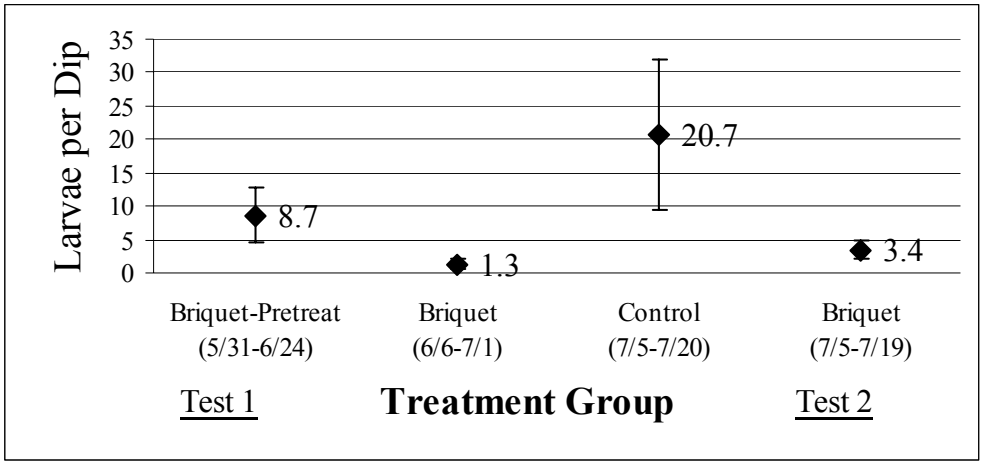


Figure 5.3 Mean larval counts from untreated catch basins and catch basins treated with Altosid® briquets in 2005. Error bars equal ± 1 standard error of the mean.

Over two-thirds of the larvae in samples collected from catch basins before treatment (5/31-6/24) were first instars. No larvae in samples collected from briquet-treated catch basins during a similar period (6/6-7/1) were first instars (Table 5.10). Larval samples collected from untreated control and briquet-treated catch basins later in July (7/5-7/20) contained a majority of larvae older than first instar. Samples from briquet-treated catch basins contained fewer larvae (Fig. 5.3).

Table 5.10 Developmental stage of larvae in samples from catch basins treated with Altosid® briquets in 2005. SE=standard error. Control=untreated catch basins.

Group (period)	n	Mean	Median	SE	Min	Max	Stage
Pre-treat (5/31-6/24)	11	17.7	6.0	9.2	0.0	100.0	Instar 1
		7.7	1.0	4.6	0.0	50.0	Instar 2+
Briquet (6/6-7/1)	6	0.0	0.0	0.0	0.0	0.0	Instar 1
		6.5	1.3	4.8	0.3	30.0	Instar 2+
Control (7/5-7/20)	9	3.3	0.0	3.3	0.0	30.0	Instar 1
		17.3	5.0	8.4	0.1	70.0	Instar 2+
Briquet (7/5-7/19)	18	0.1	0.0	0.1	0.0	2.0	Instar 1
		5.7	1.5	1.7	0.0	20.0	Instar 2+

Virtually all of the larvae in samples collected from catch basins before treatment (5/31-6/24) were *Culex*. About 20% of larvae in samples collected from briquet-treated catch basins during a similar period (6/6-7/1) were *Culex* (Table 5.11); the rest were *Ae. vexans*. Larval samples collected from untreated control and briquet-treated catch basins later in July (7/5-7/20) both contained mostly *Culex* larvae.

Table 5.11 Species of mosquito larvae in samples from catch basins treated with Altosid® briquets in 2005. SE=standard error. Control=untreated catch basins.

Group (period)	n	Mean	Median	SE	Min	Max	Species
Pre-treat (5/31-6/24)	11	24.9	10.0	11.3	0.3	100.0	*Culex**
		0.1	0.0	0.1	0.0	1.0	*Ae. vexans*
Briquet (6/6-7/1)	6	1.4	0.6	0.9	0.0	6.0	*Culex*
		5.1	0.1	5.0	0.0	30.0	*Ae. vexans*
Control (7/5-7/20)	9	20.1	5.0	11.3	0.0	100.0	*Culex*
		0.2	0.0	0.2	0.0	2.0	*Ae. vexans*
Briquet (7/5-7/19)	18	10.9	1.5	5.5	0.0	100.0	*Culex*
		0.5	0.0	0.3	0.0	6.0	*Ae. vexans*

**Culex* includes *Cx. restuans*, *Cx. pipiens*, *Cx. salinarius*, and *Cx. tarsalis*

In summary, compared to not-yet-treated (pre-treat) or untreated (control) catch basins, catch basins treated with Altosid® briquets during both time periods contained fewer larvae, both in terms of mean dip counts and the proportion of catch basins in which larvae were found.

Altosid® briquets seemed to be effectively controlling mosquitoes. Except for catch basins sampled before treatment (5/31-6/24), most larvae in samples were older than first instars. Larval samples contained mainly *Culex* except for samples from briquet-treated catch basins collected in June (6/6-7/1).

New Control Material Evaluations

The District, as part of its Continuous Quality Improvement philosophy, desires to continually improve its control methods. Much testing has focused upon controlling potential vectors of WNV since its arrival to Minnesota in 2002. Surveillance tests conducted in 2004 demonstrated that *Culex* mosquitoes (especially *Cx. restuans*) can occur high (20-30 feet) in the tree canopy. We designed a test to evaluate how well a ULV truck-mounted fogger adulticide application made at ground level could control adult mosquitoes both at ground level and higher in trees.

Scourge® 2+2 A test of Scourge® in July that included high and low CO_2 traps demonstrated that ULV applications made using a truck-mounted sprayer effectively controlled mosquitoes at ground level and higher in trees (20-25 feet) (Table 5.12). Efficacy was evaluated using Mulla's equation (a correction that accounts for changes in the control as well as the treatment) that compares mean mosquito captures the first night of trapping (pre-treatment counts) with mean mosquito captures the second and third nights of trapping (post-treatment counts). Staff applied test materials the evening of the second night of trapping; CO_2-traps placed 30 minutes after the treatments were done at both treated locations and the untreated control location. An additional set of post-treatment collections were made the following evening.

Table 5.12 Results of a test of Scourge® efficacy using low and high CO_2 traps. Mulla's formula incorporates untreated control trap counts to correct for changes in the treated traps that are not due to the treatment. SE=standard error.

Treatment	Collection	Efficacy	Ave. mosquitoes per trap	SE
Low traps Scourge®	Pre-treat	---	324	103.5
	Treatment*	86%	85	23.0
	Post-treatment	-197%	747	13.0
Untreated control	Pre-treat	---	992	24.0
	Treatment day*	---	1,846	566.0
	Post-treatment	---	772	558.0
High traps Scourge®	Pre-treat	---	76	17.0
	Treatment*	78%	32	12.5
	Post-treatment	60%	91	13.5
Untreated control	Pre-treat	---	130	46.5
	Treatment day*	---	243	169.5
	Post-treatment	---	382	312.5

* Traps placed ½ hour after treatment application

Caged mosquitoes included in the test indicated that control of both low and high mosquitoes was due to direct contact with ULV droplets (Table 5.13). Too few *Culex* mosquitoes were captured to evaluate *Culex*-specific efficacy.

Table 5.13 Mortality of caged mosquitoes in a Scourge® efficacy test. Low and high cages were positioned at the same places as low and high CO_2 traps reported in Table 5.13. Cages placed 10-20 ft from spray were positioned for optimal contact with the ULV spray cloud.

	% Mortality			
Hours after treatment	Control N=3	Scourge® (10-20 ft away) N=4	Scourge® low N=2	Scourge® high N=2
0.5 hr	0	0	0	40
1.5 hr	0	22	17	44
10.0 hr	4	66	61	63

Natural Pyrethrum Products The District is continuing to look at the applicability of non-synthetic or natural pyrethrum products in our operations. These products do not have label restrictions prohibiting use in agricultural areas and would give us some added flexibility to apply adulticides in rural areas of the District. In addition, a natural product might be more accepted in areas where citizens might have concerns over synthetic products. The District is continuing to work to certify these products and plans to conduct efficacy trials in 2006.

Equipment Evaluations

Helicopter Swath Analysis and Calibration Procedures for Larvicides Technical Services and field staff conducted seven aerial calibration sessions for dry, granular materials during the 2005 season. These computerized calibrations directly calculate application rates and swath patterns for each pass so each helicopter's dispersal characteristics are optimized. All sessions were held at the municipal airport in LeSueur, MN. Staff completed calibrations for four different operational and experimental control materials. In total, seven helicopters were calibrated and each helicopter was configured to apply an average of three different control materials.

The number of trials increased significantly due to the use of pre-hatch materials (Altosid® pellets) in 2005. Altosid® pellets are challenging to apply at our low dosage rates primarily due to the designs of the control material (extruded pellet) and the application equipment (gravity-fed hoppers). The pellets inter-lock, bridge, and do not flow freely through metering gates. Therefore, equipment settings must be accurately re-adjusted just prior to application to apply the desired treatment rate.

GPS-Tracking of Helicopters conducting Altosid® Pellet Applications To assist in the evaluation of pre-hatch pellet applications, Technical Services staff placed a hand-held GPS unit in each of the application helicopters. These GPS units (Garmin-12) recorded the overall flight paths of the aircraft and provided a time-stamped tracking record of the helicopter's route. These units did not provide hopper on/off or swath information but did confirm if and when the

helicopter was over the predetermined site. When combined with each helicopter's optimized swath pattern, this information provided a relative confirmation that the site had been properly treated. Since it is very hard to determine if the site was treated by ground inspection (i.e. sinking black pellets are difficult to see) and to predict which sites would receive adequate rain events, validation of these assumptions of proper treatment was difficult. See Table 5.7 for efficacy data.

After the pellet application flights, staff downloaded GPS data and compared it with site boundaries and photos in MMCD's GIS to assure the proper sites were treated. This tracking information was provided to the helicopter pilots for review.

The Garmin-12 GPS units were initially used because we had multiple units available in each of the field facilities. Units were set to record points at 1, 5, 10, 20, or 40 seconds or "auto" (recording points when turns in flight path were made). We soon found that the "auto" setting was the most effective and efficient for showing flight path, but the number of points needed to record a full day of treatment could exceed the memory of these units. Each facility purchased Garmin eTrex Legend GPS units, which significantly increased data storage capacity, provided much more clarity to the flight paths, and estimated pellet applications.

MMCD can see many advantages in using GPS-tracking in our operations and will continue to work with the helicopter contractor to upgrade his aircraft with the latest data tracking systems. We hope to be able to use this technology to track actual hopper on/off paths and estimate swath patterns in breeding sites to improve our control operations, increase flight efficiency within the District, assist in treatment documentation, and to have real-time flight data to assist our public information staff answer any questions or concerns.

Evaluation of Fixed Wing Aircraft for Use in Northern Regions of MMCD

Historically, MMCD has utilized helicopters for its larval mosquito applications for most of the existence as an organization. Many years ago, MMCD did use fixed wing aircraft in large continuous breeding sites such as those found along the Mississippi and Minnesota rivers. Since MMCD no longer treats many of these large areas that are now managed by the Minnesota Department of Natural Resources (MnDNR) and the US Department of Fish and Wildlife (USFW), we have shifted our aerial applications to the more versatile helicopters. These maneuverable aircraft have worked very well in the wide variety of wetlands found in the Twin Cities area and will continue to be a useful tool in the expanding urban environment.

As MMCD continues to expand, the District must meet the growing need to treat additional acreage with our current structure and resources. The most significant barrier to completing this mission of mosquito control is time. Biologically, mosquito reproduction is a race through the aquatic life cycle before the habitat dries down or predation occurs. Thus said, for MMCD to be operationally effective, we need to correctly apply larvicides/pupicides in as many productive breeding areas as possible before the mosquito leaves its aquatic environment. Under summer conditions there are usually 7-10 days in which MMCD has to complete its aerial applications. This assumes that we have good weather conditions to conduct our operations. We rarely get this extended treatment window due to changing weather fronts, additional rains, and windy conditions. Our staff must usually complete their applications within 3-6 days. Therefore, ways of increasing the efficiencies and speed of our operations are critical to future success.

The northernmost portion of the District (Washington, Anoka and Hennepin counties) contains many large areas of continuous mosquito breeding acreage. If MMCD continues to expand to the county borders, these huge breeding areas, previously left untreated, will require control.

With the evolution of new aircraft technologies, fixed wing aircraft might again become a viable tool. Fixed wing aircraft might offer several advantages to these regions over the currently used Bell 47 helicopters. Faster flight speeds might allow us to cover more acres per hour, a larger hopper can carry more control materials per flight and GPS-guided operations could give MMCD more control over where materials are placed in a breeding site.

Any of these perceived advantages might be negated; higher speeds will require the aircraft to make larger turnarounds, use of airports might increase ferrying times, fuel/control material consumption ratios might make the overall costs unfeasible, or the high application speeds might cause inaccurate treatments. Therefore, MMCD needs to explore the many aspects of this form of aerial application. Technical Services has started to review this methodology for applicability for use in our northern regions.

In February 2005, MMCD brought in an experienced fixed wing operator for an initial discussion on the feasibility of fixed wing aerial applications within the District. This introductory meeting was educational for both parties and we determined that we should complete some preliminary work to get a feel for the possibilities. We discussed conducting a test flight using the applicator's navigation system and incorporating our digitized breeding site map layer within the evaluation. This flight was scheduled for early spring or early fall, 2005.

In October 2005, we were able to conduct a test flight in Anoka County outlining the scope of the project to the applicator, providing examples of mosquito breeding sites, and to evaluate the feasibility of these flights for mosquito control.

The introductory flight was successful and GPS tracking equipment worked well to easily guide the applicator to the breeding areas. We found that due to the high flight speeds (140-160 mph) it may be advantageous to utilize the guidance system to control the actual material distribution system (i.e. on/off). Computer control of the system would greatly simplify the application for the pilot and allow him to concentrate on the guidance system. Many factors, such as swath setback, would still have to be calculated and incorporated into the flight systems.

The next step is to determine if the aircraft can satisfactorily put out control materials at our application rates. We can evaluate the fixed wing's granular distribution by the same method used in our helicopter calibrations. Once we determine if the aircraft can put out the proper rate of control materials, then we can conduct evaluations to determine if we can properly place the material in the breeding sites. Other parameters (speed, capacity, etc.) currently viewed as benefits of the fixed wing aircraft would also be analyzed at this time.

Besides determining the aircraft capabilities, we need to determine if these fixed wing applications are economically feasible for both the applicator and the District. We are working with the applicator to determine a reasonable cost per acre at the various degrees of scale. The

applicator is working with other fixed wing operators in the industry to help determine these costs.

Other items that need to be determined are loading methodologies, loading/refueling areas, parameters/restrictions of utilizing public airports as staging areas, FAA requirements of rural/urban applications, and MMCD public relations policy regarding fixed wing flights.

Aerial Adulticide Applications MMCD continues to evaluate various spray systems for their applicability in our adult mosquito control program. Technical Services has worked directly with our helicopter contractor, manufacturers, and other mosquito control professionals to develop an appropriate application system for our control materials.

Staff continued to work with our helicopter contractor to evaluate the Beecomist 360A Electric rotary atomizers. Aerial trials were scheduled for September, 2005 but evaluations were postponed due to late season helicopter usage of our mosquito larvicide program. Weather conditions further delayed additional trials until the 2006 season.

Droplet Analysis of Ground-based Spray Equipment Technical Service staff optimized forty-eight Ultra Low Volume (ULV) insecticide generators (truck-mounted, ATV-mounted or handheld) using the KLD Model DC-III portable droplet analyzer. Employees use this analyzer to fine-tune equipment to produce an ideal droplet spectrum of 8-20 microns. Adjusting our ULV sprayers to produce a more uniform droplet range maximizes efficacy by creating droplets of the correct size to impinge upon flying mosquitoes. In addition, more uniform swaths allow staff to better predict ULV application patterns and swath coverage throughout the District.

Additional data on each piece of equipment was recorded to better understand all of the physical parameters that affect droplet production. MMCD continues to gain expertise in adjusting equipment attributes by using new techniques and measuring devices (i.e. meters, gauges) to gain more control of the many variables which contribute to the spray quality. By further standardizing these variables, we have the ability to adjust and regulate equipment to produce the proper droplet range. Further equipment analysis has facilitated the replacement of worn or missing parts to advance additional MMCD equipment improvements.

Staff worked directly with a new vendor to install truck-mounted electric cold fog units to gain practical knowledge of this equipment and to fully understand its maintenance requirements. In addition, we worked with the vendor to provide in-depth training directly to the field staff that would be using the equipment.

Database for Evaluating Equipment Performance The equipment database evolved to combine spray equipment performance information with other fixed asset equipment databases. MMCD's equipment team expanded the data collection so that everyone who uses a piece of equipment has the opportunity to record pertinent information. An equipment grading system was developed to provide a better overall picture for staff making equipment replacement decisions. The rating system helped to standardize all of the six regional facilities equipment which in turn, improved staff ability to wisely replace the correct equipment on an organizational level.

Evaluation of Truck-mounted ULV Generators Using GPS-Tracking Technology
MMCD continues to evaluate new methods of tracking adulticide treatments using data collection systems which use GPS location technology. These systems are able to electronically plot applications on our treatment maps and assist in determining the exact locations of our adulticide treatments. These systems will eliminate the need for field staff to physically record the applications on maps and will provide an electronic record of all activities of the vehicle during any given timeframe. These records are immediately available as soon as the information is uploaded from the cold fog vehicle to our computer system. These records should eliminate recording errors and is seen as an improvement in many areas: operation efficiency, driver safety, treatment records, inventory calculations, and legal documentation. MMCD will continue to evaluate these systems in 2006 and incorporate these data into our operations.

Plans for 2006

Quality assurance processes will continue to be incorporated into the everyday operations of the regional process teams. Technical Services will continue to support field operations to improve their ability to complete their responsibilities most effectively. A primary goal will be to continue to assure the collection of quality information for all evaluations so decisions are based upon good data. We will continue to improve our calibration techniques to optimize all of our mosquito control equipment.

In 2006, MMCD plans to refine larger scale applications of Vectolex® CG (*B. sphaericus*) and Altosid® pellets to control *Aedes* and *Culex* mosquitoes breeding in wetlands. Tests of Altosid® XR-G sand against the cattail mosquito (*Cq. perturbans*) will be repeated if sampling for larvae in the spring detects sufficient larval densities. We will continue testing control materials in catch basins with the goal of decreasing the number of treatments per season while maintaining efficacy. Finally, we plan to continue evaluating the effectiveness of adulticide treatments against vectors of WNV or other mosquito-borne diseases, potentially including more tests with high and low traps and repeat tests of Pyrenone® and Pyrocide® in croplands.

References

Mulla's Formula: Percent Efficacy = $100 - \left(100 \times \left(\frac{Cntl\,\mathrm{Pr}\,e}{Trt\,\mathrm{Pr}\,e}\right) \times \left(\frac{TrtPost}{CntlPost}\right)\right)$

CntlPre = Mean pretreatment count of untreated control
TrtPre = Mean pretreatment count of treated group
CntlPost = Mean post treatment count of untreated control
TrtPost = Mean post treatment count of treated group

Mir S. Mulla, R. Lee Norland, Dean M. Fanara, Husam A. Darwazeh and Donald W. McKean. 1971. Control of Chironomid Midges in Recreational Lakes. J. Econ. Ent. 64(1): 300-307.

Chapter 6 Supporting Work

2005 Highlights

- Completed conversion to electronic lab data entry and reporting
- Received new aerial photos for updating wetland maps
- Presented stormwater management implications for mosquito control to professional groups
- Dr. Karen Oberhauser continued tests of adulticide toxicity to monarch butterfly larvae
- Surveyed milkweed occurrence relative to MMCD adulticide treatments for risk evaluation
- Requests for service from the public dropped sharply
- Upgraded MMCD web site to enhance notification and set the stage for direct public access to maps and records

2006 Plans

- Finish physical inventory data recording tools for PDA/DataGate
- Update map data and start NWI pilot project
- Continue involvement in stormwater management re: mosquito production
- Continue adulticide nontarget impact studies

2005 Projects

Field & Lab Data Entry and Reporting

After the success of electronic field data entry last year, we completed the cycle and converted lab data entry to electronic as well. The entomology laboratory space was remodeled and personal computers installed at each microscope station. MMCD's custom data management system, "DataGate," was set up at each station to allow lab access to field collection data and immediate entry of ID results, which field staff could then access from computers in their offices. Field and lab databases were synchronized daily (overnight) or updated on demand if needed. Field staff were able to directly print reports of ID results which eliminated the need for Lab staff to fax results to the field offices.

Field data for larval inspections and control continue to be entered using Palm OS-based Personal Digital Assistants (PDAs). In 2005, the PDA data entry screens were improved and additional screens added for entry of Black Fly inspection and treatments, including dose calculation for small streams (replacing the multi-page tables used). Screens were also developed to record adult mosquito treatments. Development and early testing were done on new PDA and DataGate screens for recording physical inventory and reconciling those records with treatment records.

Mapping

New metro aerial photos were flown by MarkHurd Inc. for the Metropolitan Council in spring 2005, replacing the flight attempted but not completed in 2004. MMCD contributed monetarily to this effort and obtained licensed use rights to the delivered photos by the end of 2005. The complete set of photography includes black & white, 2 ft-pixel resolution, true color, and color infrared. Staff are using the photos to update wetland maps in the winter of 2005-2006.

Digital wetland files have been provided on request to other units of government, including:

- City of Minnetonka – catch basins
- Arden Hills Army Training Site – wetland inventory and treatment records
- City of Ramsey Environmental Policy Board – wetland inventory and typing
- Ramsey-Washington Watershed District – inspection and treatment history on selected wetlands

An article by Dr. Will Craig from the University of Minnesota (U of M) featured MMCD data and mapping as an example of the benefits of regional cooperation in data sharing. MMCD continues to participate in MetroGIS, including currently serving as chair of the Coordinating Committee and working with local governments on addressing issues.

The cooperative project with United States Fish and Wildlife Service (USFWS), Metro Council Environmental. Services, MnDNR, and the Ramsey Conservation District to use MMCD and other data to update the metro-area National Wetlands Inventory was delayed by problems with the aerial photography, but has begun again with the photography delivery in December.

A pilot project on web access to MMCD wetland information was completed as part of a U of M MapServer class project by Jim Nichols and Ed DeSousa. We plan to continue development of web access in 2006, in conjunction with other upgrades to MMCD's web site.

Stormwater Management and Mosquitoes

Many local units of government are expanding their interest in stormwater management in order to meet federal requirements and reduce effects on state impaired waters. Concerns about mosquitoes, especially West Niles virus vectors, have led to continued dialog on designs for stormwater management structures.

MMCD continued outreach efforts to stormwater and wetland designers to provide information on mosquito biology, prevention, and control.

- "Stormwater & Mosquitoes" presentation (see MMCD web site) was given at the American Society of Civil Engineering local Environmental Engineering committee, and Brainerd Lakes Environmental Learning Network
- "Mosquitoes in Underground Structures" (see this report, Chapter 2) poster presented at MN Water Resources Conference (civil engineers, city & watershed district staff)

Probably the most important achievement for getting the word out was the inclusion of information in the *Minnesota Stormwater Manual*, a Best Management Practices guidance document produced by Minnesota Pollution Control Agency (MPCA), MnDNR, Minnesota Department of Transportation (MnDOT), MDH, and soil and water conservation districts for meeting runoff pollution requirements. Chapter 6, page 14, includes a section on "Stormwater & Mosquitoes" based on MMCD's outreach information and staff input, and references to mosquito problems are included in other parts of the document when they apply to particular BMPs. The *Manual* can be viewed at http://www.pca.state.mn.us/water/stormwater/stormwater-manual.html.

MMCD appreciates assistance from Randy Neprash, Bonestroo & Associates, in finding out about this opportunity, and Gary Oberts, Emmons & Olivier Resources Inc. (contractor for the *Manual*), for writing the chapter section.

We continue to seek ways to communicate with designers and engineers on this issue and appreciate any suggestions from TAB members.

Nontarget Studies

As requested by the Technical Advisory Board, MMCD has continued to support efforts to evaluate possible adulticide nontarget effects. A TAB subgroup (Karen Oberhauser, Roger Moon, Nancy Read, and Stephen Manweiler) reported last year on tests done by Dr. Karen Oberhauser's lab showing toxicity of permethrin, as applied by MMCD as a barrier treatment, or resmethrin, applied as a ULV fog, to monarch, *Danaus plexippus* (L.), larvae exposed directly or fed treated leaves (see 2004 TAB report). Results in 2004 included:

- 1st and 3rd instar monarch larvae 75 ft or less directly downwind of field dose resmethrin applications suffered higher mortality than control or upwind larvae.
- Wind direction variability affected distance that mortality difference could be detected.
- Field doses of resmethrin were also related to adult mortality.
- Residue of resmethrin on leaves could cause larval mortality when collected immediately after treatment (no exposure to UV light in experiment).

Four additional studies were planned for 2005:

- Oviposition choice – will monarch females lay eggs on treated leaves?
- Effects of environmental factors - exposure to UV light and other factors - on persistence of resmethrin or permethrin on leaves.
- Toxicity of resmethrin ULV spray treatments to monarch eggs.
- Spatial overlap of milkweed distribution with areas treated – evaluate exposure risk.

In 2005, Dr. Oberhauser continued research on resmethrin and on the first 3 items listed. Resmethrin exposure effects:

- Expanded transect test of resmethrin ULV fog demonstrated larval mortality as far as 250 feet downwind of spray truck; mosquitoes were killed 300 feet downwind. Larval mortality was more variable and lower overall than in the 2004 test.
- Resmethrin residue on leaves ceases to cause mortality within 24 hours on plants exposed to sunlight.
- Other non-target insects (flies, milkweed bugs) were not killed by ULV resmethrin.
- Adult monarch mortality high 1 day after spraying in cages containing permethrin treated plants; no mortality 8 or 15 days after treatment.
- Fewer eggs on plants in cages with permethrin-treated plants 1 day after treatment (probably due to female mortality); no difference between treated and untreated plants 8 or 15 days after treatment.

A survey of milkweed distribution compared to MMCD adulticide treatments was designed by the TAB subgroup and carried out by MMCD staff. Preliminary results showed rural and suburban areas with close to four milkweed patches per hectare, while urban areas had a mean of

two (least squares estimate of means, 41 df, p=0.08). Urban areas also tended to have smaller patches (around 5 sq m/ha vs. >30 in rural stratum). However, milkweed density was not statistically different in treated and untreated areas. Given that, it is estimated that the proportion of milkweed in the metro area treated at least once with ULV resmethrin or sumithrin was about 5%, and the proportion treated by backpack with permethrin (barrier spray) was 0.5%.

The subgroup is reviewing research publications of these results being assembled by Dr. Karen Oberhauser.

Previous Larvicide Nontarget Impact Studies We continue to get requests for earlier publications, including reports on Wright County Long-term Study and other studies on *Bti* and methoprene done under the direction of the Scientific Peer Review Panel assembled by MMCD. Reports were sent as requested to the following:

- Cashin Associates, Hauppauge, NY, for preparation of Suffolk County Long-term Plan (see www.suffolkmosquitocontrolplan.org)
- University of Washington, WA Cooperative Fish & Wildlife Research Unit

As of December 2005, the reports are summarized and available for download on the MMCD web site, and will be featured on the newly-designed site in 2006. No further progress has been made on assembling a peer-reviewed journal publication from the 1997-1998 results of the Wright County *Bti* and methoprene non-target study.

Public Information

Notification The District continues to post daily adulticide information on its web site (www.mmcd.org) and on its "Bite Line" (651-643-8383), a pre-recorded telephone message interested citizens can call to get the latest information on scheduled treatments. The District also publishes a three column by nine-inch ad in local newspapers each spring advising citizens how they can find out where and when adulticiding will take place throughout the season. The District continues to distribute a public service announcement, aired on local radio stations, directing people to the web or phone notification services. Staff also contacted cities to encourage them to put a link on their web sites to MMCD's mosquito treatment notices.

Web Site Upgrade/Notification At the end of 2005, the District upgraded its web site as the first phase of a project that could lead to direct public access to map-based larval treatment records. A team of District staff worked with Concept Group, a St. Paul based web design group with extensive experience designing web sites for local government units and non-profits. MMCD continued to work with GovDelivery, for its direct email notification service. Citizens can subscribe to direct email notification by visiting MMCD's web site and are offered a choice from among the eight lists published daily by the District (North Hennepin, South Hennepin, Anoka, Dakota, Carver, Scott, Ramsey, and Washington facilities). Email notices are identical to notices posted each day on the District's web site. Subscriptions to this service increased to 732 during mid-summer 2004, compared to 440 in mid-summer of 2003. In 2005, subscriptions increased to 884.

Calls Requesting Service As in years past, calls reporting annoyance generally followed the seasonal pattern shown by sweep net counts for human-biting mosquitoes (Figure 6.1). Increases in calls followed major floodwater mosquito broods, indicated by larvicide activity, and were in turn followed by adulticide activity (Figure 6.2 and Chapter 3).

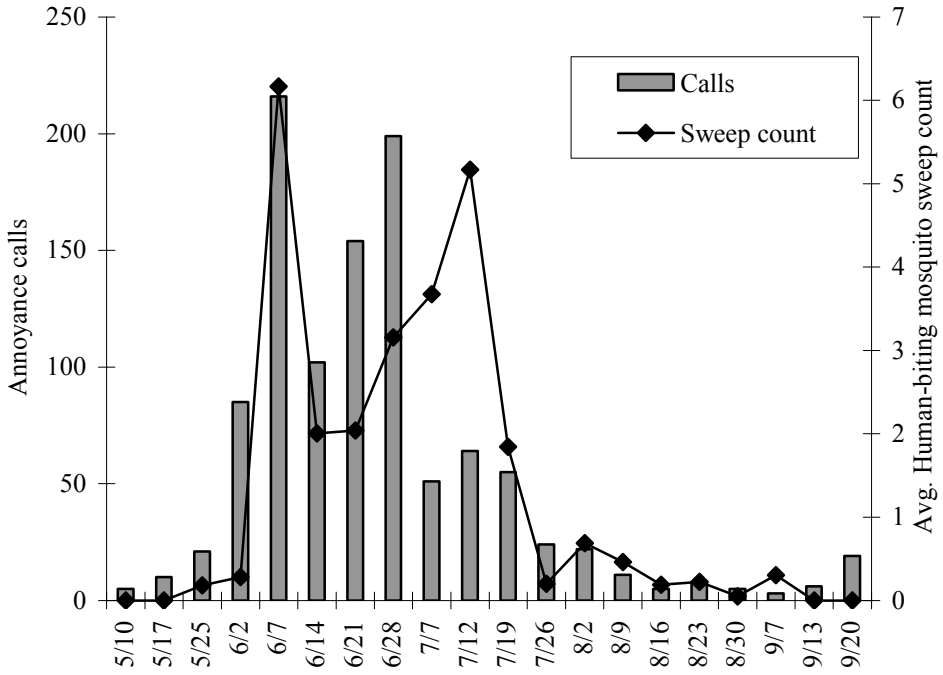


Figure 6.1 Calls requesting adulticide service and sweep net counts by week, 2005.

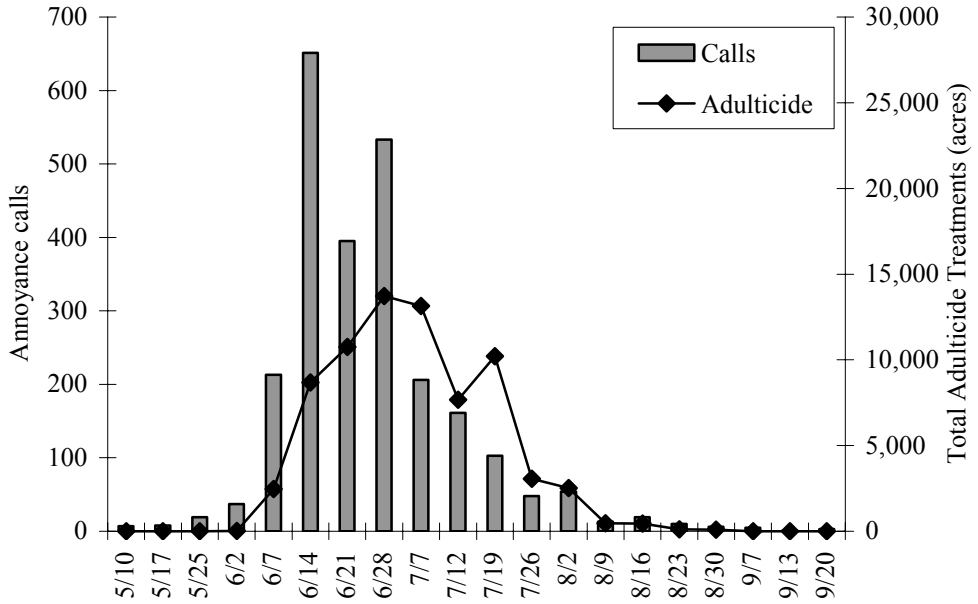


Figure 6.2 Calls requesting adulticide service and adulticide treatment acreage by week, 2005

Other calls received are listed in Table 6.1. Call volume declined sharply in 2005 to 2,344 calls. During 2004, 3,469 calls were recorded, down from 4,185 calls recorded during 2003. Lower than average mosquito levels again precipitated fewer calls, and low WNV activity appeared to produce less anxiety among District citizens. Calls requesting a dead bird pick-up for WNV testing were not included in this table; most of these were directed to the MDH and referred back to MMCD if action was needed.

Table 6.1 Yearly comparison of citizen calls tallied by service request from 2002 to 2005.

	# Calls/Year			
Caller Concern	2005	2004	2003	2002
Check a breeding site	634	984	1516	1307
Request adult treatment	1096	2506	2714	3062
Public event, request treatment	102	135	132	171
Request tire removal	242	255	236	321
Request or confirm limited or no treatment	86	38	60	190

2006 Plans

Physical inventory data recording will be fully implemented and evaluated for effectiveness. Other work will focus on tools for recording aerial larvicide treatments, and pre-packaged reports to allow easier data access for decision-makers.

Development will continue towards providing web-based access to MMCD wetland data. With the arrival of the 2005 aerial photography, we will be able to begin work on the cooperative project with USFWS and Metro Council Environmental Services on updating the National Wetlands Inventory.

Staff will continue to develop and disseminate information on how stormwater management designs affect mosquito production for target audiences such as engineers and watershed managers. We are hoping to develop closer relationships with Watershed Districts.

TAB subgroup members and Dr. Karen Oberhauser's lab will continue to develop reports on tests and risk evaluation of adulticides. Some additional testing or milkweed surveys may be done if needed.

The biennial public opinion survey will be conducted in 2006.

The District will continue its emphasis on public notification. A newly refurbished District web site (www.mmcd.org) is the first step in a process that will lead to better direct citizen access to information about treatment schedules and site history. Although call volume decreased significantly in 2005, email queries continue to increase. The District will continue to encourage use of email by highlighting a "Report Mosquito Problems" form on its web site.

APPENDICES

APPENDIX A Mosquito Biology

There are 50 species of mosquitoes in Minnesota. Thirty-nine species are found within the MMCD. Species can be grouped according to their habits and habitat preferences. For example, the District uses the following categories when describing the various species: disease vectors, spring snow melt species, summer flood water species, permanent water species, and the cattail mosquito.

Disease Vectors

Aedes triseriatus Also known as the eastern treehole mosquito, *Ae. triseriatus*, is the vector of La Crosse encephalitis. It breeds in tree holes and artificial containers, especially discarded tires. The adults are found in wooded or shaded areas and stay within ¼ to ½ miles from where they emerged. They are not aggressive biters and are not attracted to light. Vacuum aspirators are best for collecting this species.

Culex tarsalis *Culex tarsalis* is the vector of western equine encephalitis (WEE) and a vector of West Nile virus (WNV). In late summer, egg laying spreads to temporary pools and artificial containers, and feeding shifts from birds to horses or humans. MMCD monitors this species using New Jersey light traps and CO_2 traps.

Other *Culex* Three additional species of *Culex* (*Cx. pipiens, Cx. restuans, Cx. salinarius*) are vectors of WNV. All three breed in permanent and semipermanent sites and *Cx. pipiens* and *Cx. restuans* breed in storm sewers and catch basins as well. Gravid traps and CO_2 traps are used to monitor these mosquitoes.

Culiseta melanura *Culiseta melanura* is the enzootic vector of eastern equine encephalitis (EEE). Its preferred breeding sites are spruce tamarack bogs. Adults do not fly far from their breeding sources. MMCD monitors *Cs. melanura* abundance with CO_2 traps and vacuum aspirators. Adults are tested for EEE virus.

Floodwater Mosquitoes

Spring Snow Melt *Aedes* Spring snow melt mosquitoes are the earliest mosquitoes to hatch in the spring. They breed in woodland pools, bogs, and marshes that are flooded with snow melt water. There is only one generation per year and overwintering is in the egg stage. Adult females live throughout the summer and can take up to four blood meals. These mosquitoes do not fly very far from their breeding sites, so localized hot spots of biting can occur both day and night. Our most common spring species are *Ae. abserratus*, *Ae. excrucians,* and *Ae. stimulans*. Adults are not attracted to light; human or CO_2-baited trapping is recommended.

Summer Flood Water *Aedes* Summer flood water eggs hatch in late April and early May. Eggs are laid at the margins of grassy depressions, marshes, and along river flood plains. There are multiple generations per year resulting from rainfalls greater than one inch. Overwintering is

in the egg stage. Adult females live about three weeks. Most species can fly great distances and are highly attracted to light. Peak biting activity is at dusk.

The floodwater mosquito, *Ae. vexans*, is our most numerous pest. Other summer species are *Ae. cinereus*, *Ae. sticticus,* and *Ae. trivittatus*. New Jersey light traps, CO_2-baited traps, and human-baited sweep net collections are effective methods for adult surveillance of these species.

Cattail Mosquito

Coquillettidia perturbans This summer species breeds in cattail marshes and is called the cattail mosquito. A unique characteristic of this mosquito is that it can obtain oxygen by attaching its specialized siphon to the roots of cattails and other aquatic plants. They overwinter in this manner. Adults begin to emerge in late June, with peak emergence around the first week of July. They are very aggressive biters, even indoors, and will fly up to five miles from the breeding site. Peak biting activity is at dusk and dawn. Surveillance of adults is best achieved with CO_2 traps.

Permanent water species

Other mosquito species not previously mentioned breed in permanent and semipermanent sites. These mosquitoes comprise the remaining *Anopheles*, *Culex*, and *Culiseta* species. These mosquitoes are multi-brooded and lay their eggs in rafts on the surface of the water. The adults prefer to feed on birds or livestock but will bite humans. The adults overwinter in places like caves, hollow logs, stumps, or buildings. The District targets four *Culex* species and one *Culiseta* species for surveillance and/or control.

APPENDIX B Average Number of Common Mosquito Species Collected per Night in New Jersey Light Traps 1965-2005

Year	*Aedes abs/punc*	*Aedes cinereus*	*Aedes sticticus*	*Aedes trivittatus*	*Aedes vexans*	*Culex tarsalis*	*Coquillettidia perturbans*	All species	Average Rainfall
1965	1.03	0.77	0.19	0.08	89.00	4.70	1.43	111.74	27.97
1966	1.29	0.13	0.00	0.02	33.70	0.69	17.66	61.78	14.41
1967	0.64	0.24	0.65	0.12	75.40	1.61	14.37	101.55	15.60
1968	0.14	1.60	0.04	0.77	119.30	1.25	2.43	136.54	22.62
1969	0.70	0.19	0.02	0.17	19.90	0.65	4.27	30.82	9.75
1970	0.17	0.57	0.06	0.33	73.10	0.76	2.78	83.16	17.55
1971	0.69	0.55	0.15	0.33	52.10	0.28	3.51	62.93	17.82
1972	0.98	2.13	0.41	0.35	124.50	0.39	8.12	142.35	18.06
1973	1.29	0.70	0.11	0.06	62.20	0.41	25.86	95.14	17.95
1974	0.17	0.32	0.14	0.12	30.30	0.15	7.15	40.09	14.32
1975	0.28	0.63	0.44	0.17	40.10	6.94	4.93	60.64	21.47
1976	0.10	0.05	0.04	0.00	2.30	0.23	4.42	9.02	9.48
1977	0.20	0.16	0.01	0.02	17.50	2.44	1.16	25.17	20.90
1978	0.17	0.74	0.33	0.24	51.40	1.35	1.04	62.63	24.93
1979	0.07	0.24	0.10	0.21	18.30	0.13	4.39	25.59	19.98
1980	0.02	0.26	0.33	0.77	47.40	0.25	13.87	65.28	19.92
1981	0.01	0.10	0.25	1.03	57.00	0.44	3.98	65.30	19.08
1982	0.01	0.21	0.08	0.03	23.10	0.15	8.63	34.60	15.59
1983	0.03	0.24	0.08	0.14	55.60	0.58	8.72	69.71	20.31
1984	0.08	0.16	0.14	0.35	65.40	1.82	1.60	92.42	21.45
1985	0.05	0.17	0.05	0.02	21.20	0.21	5.07	28.51	20.73
1986	0.40	0.23	0.12	0.03	25.80	0.92	2.61	34.30	23.39
1987	0.00	0.11	0.01	0.15	29.10	0.96	3.37	37.77	19.48
1988	0.01	0.51	0.00	0.00	21.00	0.72	1.40	27.28	12.31
1989	0.66	1.60	0.01	0.12	14.40	1.01	0.12	26.35	16.64
1990	0.83	11.37	1.22	0.34	125.80	2.65	0.99	159.45	23.95
1991	1.17	2.67	1.55	0.51	90.80	1.37	6.03	14.44	26.88
1992	0.09	0.09	0.02	0.24	36.00	0.49	38.31	79.81	19.10
1993	0.54	0.50	1.01	1.50	71.20	1.20	34.10	120.45	27.84
1994	0.70	0.47	0.46	0.33	29.70	0.15	68.45	104.52	17.72
1995	2.13	1.62	0.25	0.40	129.01	0.37	48.28	193.26	21.00
1996	0.82	0.62	0.58	0.47	25.82	0.09	40.65	72.05	13.27
1997	1.53	1.91	0.19	4.46	72.66	0.10	48.47	132.48	21.33
1998	1.86	0.66	0.08	0.54	53.93	0.05	36.16	89.89	19.43
1999	2.48	0.93	0.31	0.37	60.73	0.04	28.71	82.64	22.41
2000	0.38	0.30	0.00	1.33	56.61	0.15	20.61	89.85	17.79
2001	1.20	2.65	1.38	6.05	76.77	0.23	10.93	114.23	17.73
2002	0.30	1.07	0.07	2.18	92.77	0.39	5.07	108.35	29.13
2003	6.54	1.69	1.00	2.31	76.80	0.17	51.13	149.75	16.79
2004	0.49	1.79	0.53	0.72	29.91	0.14	11.39	48.34	21.65
2005	1.42	2.03	0.11	0.37	29.04	0.18	12.16	49.21	23.60

APPENDIX C Description of Control Materials

The following is an explanation of the control materials currently in use by MMCD. The specific names of products used in 2005 are given. The generic products will not change in 2006, although the specific formulator may change.

Altosid® (methoprene) 150-day briquets Wellmark International/Zoecon - Altosid® XR Extended Residual Briquet

Altosid® briquets are typically applied to mosquito breeding sites that are three acres or less. Briquets are applied to the lowest part of the site on a grid pattern of 14-16 ft apart at 220 briquets per acre. Sites which may flood and then dry up (Types 1 and 2) are treated completely. Sites which are somewhat permanent (Types 3, 4, and 5) are treated with briquets to the perimeter of the site in the grassy areas. Pockety ground sites (i.e. sites without a dish type bottom) may not be treated with briquets due to spotty control achieved in the uneven drawdown of the site.

Cattail mosquito (*Cq. perturbans*) breeding sites are treated at 330 briquets per acre in rooted sites or 440 briquets per acre in floating cattail stands. Applications are made during winter and early spring.

Altosid® (methoprene) pellets Wellmark International/Zoecon-Altosid® Pellets

Altosid® pellets consist of methoprene formulated in a pellet shape. Altosid® pellets are designed to provide up to 30 days control but trials have indicated control up to 40 days. Applications will be made to ground sites (less than three acres in size) at a rate of 2.5 lbs per acre for *Aedes* control and 4-5 lbs per acre for *Cq. perturbans* control. Applications will also be done by helicopter in sites which are greater than three acres in size at the same rate as ground sites, primarily for *Cq. perturbans* control.

Altosid® (methoprene) SR-20 liquid Wellmark International/Zoecon-Altosid® Liquid Larvicide Concentrate-A.L.L. Liquid

Altosid® liquid is mixed with water and applied in the spring to mosquito breeding sites containing spring *Aedes* mosquito larvae. Typical applications are to woodland pools. Sites which are greater than three acres in size are treated by helicopter at a rate of twenty milliliters of concentrate per acre. The dilution is adjusted to achieve the best coverage of the site. Altosid® liquid treatments are ideally completed by June 1 of each season.

Altosid® (methoprene) XR-G sand Wellmark International/Zoecon-Altosid® XR-G Sand

Altosid® XR-G Sand consists of methoprene formulated in a sand-sized granule designed to provide up to 20 days control. Applications will be made to ground sites (less than three acres in size) at a rate of five lbs per acre for *Aedes* control. Experimental applications for control of *Cq. perturbans* are being evaluated at 10 lbs per acre.

***Bacillus thuringiensis israelensis* (*Bti*) corn cob** Valent Biosciences-Vectobac® G

Bti corn cob may be applied in all types of mosquito breeding sites. *Bti* can be effectively applied during the first three instars of the mosquito breeding cycle. Typical applications are by helicopter in sites which are greater than three acres in size at a rate of 5-10 lbs per acre. In sites less than three acres, *Bti* is applied to pockety sites with cyclone seeders or power backpacks.

***Bacillus thuringiensis israelensis* (*Bti*) liquid** Valent Biosciences-Vectobac® 12AS

Bti liquid is applied directly to small streams and large rivers to control black fly larvae. Treatments are applied when standard Mylar sampling devices collect threshold levels of black fly larvae. Maximum dosage rates are not to exceed 25 ppm of product as stipulated by the MnDNR. *Bti* is applied at pre-determined sites, usually at bridge crossings applied from the bridge, or by boat.

Bacillus sphaericus Valent Biosciences-Vectolex® CG

Bs corn cob may be experimentally applied in all types of *Culex* mosquito breeding. *Bs* can be effectively applied during the first three instars of the mosquito breeding cycle. Typical experimental applications are by helicopter in sites that are greater than three acres in size at a rate of 5-10 lbs per acre. In sites less than three acres, *Bs* is applied to pockety sites with cyclone seeders or power backpacks at rates of 7 lbs per acre. This product is also being evaluated as a control material for catch basin applications.

Agnique® Mono-Molecular Film (MMF) liquid Cognis Corporation-Agnique® MMF

Agnique® liquid is applied directly to small mosquito breeding sites to control pupae. Experimental treatments are applied when mosquito larvae are no longer actively feeding or affected by other larvicides. Application rates are 0.2-0.3 gals per acre. Using a squirt bottle or pressurized sprayer, staff apply Agnique® to the surface of the water creating a thin self-spreading film layer. The material lowers the surface tension of the water. This loss of surface tension does not allow the pupae to easily access the water's surface and breathe without significant effort. Therefore, pupae will eventually drown and control is obtained.

Permethrin Clarke Mosquito Control Products-Permethrin 57% OS

Permethrin is used by the District to treat adult mosquitoes in known daytime resting or harborage areas. Harborage areas are defined as wooded areas with good ground cover to provide a shaded, moist area for mosquitoes to rest during the daylight hours.

Adult control is initiated when MMCD surveillance (sweep net and/or light trap collections) indicates nuisance levels of mosquitoes, when employee-conducted landing rate collections document high numbers of mosquitoes, or when a large number of citizen complaints of mosquito annoyance are received from an area. In the case of citizen complaints, MMCD staff evaluates mosquito levels to determine if treatment is warranted. MMCD also treats functions

open to the public and public owned park and recreation areas upon request and at no charge if the event is not-for-profit.

The District mixes permethrin with soybean and food grade mineral oil and applies it to wooded areas with a power backpack mister at a rate of 25 ounces of mixed material per acre (0.0977 lb active ingredient per acre).

Resmethrin Bayer-Scourge® 4+12

Resmethrin is used by the District to treat adult mosquitoes in known areas of concentration or nuisance. Resmethrin is applied from truck or all-terrain-vehicle mounted ULV machines that produce a fog that contacts mosquitoes when they are flying. Fogging may also be done with hand-held cold fog machines that enable the applications in smaller areas than can be reached by truck. Cold fogging is done either in the early morning or at dusk when mosquitoes become more active. Resmethrin is applied at a rate of 1.5 ounces of mixed material per acre (0.0035 lb active ingredient per acre). Resmethrin is a restricted used compound and is applied by Minnesota Department of Agriculture licensed applicators only.

Sumithrin Clarke-Anvil® 2+2

Sumithrin is used by the District to treat adult mosquitoes in known areas of concentration or nuisance. Sumithrin is applied from truck or all-terrain-vehicle mounted ULV machines that produce a fog that contacts mosquitoes when they are flying. Fogging may also be done with hand held cold fog machines that enable applications in smaller areas than can be reached by truck. Cold fogging is done either in the early morning or at dusk when mosquitoes become more active. Sumithrin is applied at rates of 1.5 and 3.0 ounces of mixed material per acre (0.00175 and 0.0035 lb active ingredient per acre). Sumithrin is a non-restricted use compound.

Natural Pyrethrin Bayer-Pyrenone® 25-5

Pyrenone® is used by the District to treat adult mosquitoes in known areas of concentration or nuisance where crop restrictions prevent treatments with resmethrin or sumithrin. Pyrenone® is applied from truck or all-terrain-vehicle mounted ULV machines that produce a fog that contacts mosquitoes when they are flying. Fogging may also be done with hand-held cold fog machines that enables the applications in smaller areas than can be reached by truck. Cold fogging is done either in the early morning or at dusk when mosquitoes become more active. Pyrenone® is applied at a rate of 1.5 ounces of mixed material per acre (0.00172 lb active ingredient per acre). Pyrenone® is a non-restricted used compound.

Natural Pyrethrin MGK-Pyrocide® 7396 (5+25)

Pyrocide® is used by the District to treat adult mosquitoes in known areas of concentration or nuisance where crop restrictions prevent treatments with resmethrin or sumithrin. Pyrocide® is applied from truck or all-terrain-vehicle mounted ULV machines that produce a fog that contacts mosquitoes when they are flying. Fogging may also be done with hand-held cold fog machines that enables the applications in smaller areas than can be reached by truck. Cold fogging is done either in the early morning or at dusk when mosquitoes become more active. Pyrocide® is applied at a rate of 1.5 ounces of mixed material per acre (0.00217 lb active ingredient per acre). Pyrocide® is a non-restricted used compound.

APPENDIX D 2005 Control Materials: AI Identity, Percent Active Ingredient (AI), Per Acre Dosage, AI Applied Per Acre and Field Life

Material	AI	Percent AI	Per acre dosage	AI per acre (lbs)	Field life (days)
Altosid® briquets [a]	Methoprene	2.10	220	0.4481	150
			330	0.6722	150
			440	0.8963	150
			1*	0.0020*	150
Altosid® pellets	Methoprene	4.25	2.5 lb	0.1063	30
			4 lb	0.1700	30
			0.0077 lb* (3.5 g)	0.0003*	30
Altosid® SR-20 [b]	Methoprene	20.00	20 ml	0.0091	10
Altosid® XR-G	Methoprene	1.50	5 lb	0.0750	20
Altosand	Methoprene	0.05	5 lb	0.0025	10
Vectobac® G	*Bti*	0.20	5 lb	0.0100	1
			8 lb	0.0160	1
Vectolex® CG	*Bs*	7.50	8 lb	0.6000	7-28
			0.0077 lb* (3.5 g)	0.0006*	7-28
Permethrin 57%OS [c]	Permethrin	5.70	25 fl oz	0.0977	5
Scourge® [d]	Resmethrin	4.14	1.5 fl oz	0.0035	<1
Anvil® [e]	Sumithrin	2.00	3.0 fl oz	0.0035	<1
			1.5 fl oz	0.00175	<1
Pyrenone® [f]	Pyrethrins	2.00	1.5 fl oz	0.00172	<1
Pyrocide® [g]	Pyrethrins	2.50	1.5 fl oz	0.00217	<1

[a] 44 g per briquet total weight (220 briquets=21.34 lb total weight)
[b] 1.72 lb AI per 128 fl oz (1 gal); 0.45 lb AI per 1000 ml (1 liter)
[c] 0.50 lb AI per 128 fl oz (1 gal) (product diluted 1:10 before application, undiluted product contains 5.0 lb AI per 128 fl oz)
[d] 0.30 lb AI per 128 fl oz (1 gal)
[e] 0.15 lb AI per 128 fl oz (1 gal)
[f] 0.147 lb AI per 128 fl oz (1 gal) (product diluted 1:1.5 before application, undiluted product contains 0.367 lb AI per 128 fl oz)
[g] 0.185 lb AI per 128 fl oz (1 gal) (product diluted 1:1 before application, undiluted product contains 0.37 lb AI per 128 fl oz)
* Catch basin treatments: dosage is the amount of product per catch basin.

APPENDIX E Acres Treated with Control Materials Used by MMCD for Mosquito and Black Fly Control for 1997-2005. The actual geographic area treated is smaller because some sites are treated more than once

Control Material	1997	1998	1999	2000	2001	2002	2003	2004	2005
Altosid® XR Briquet 150-day	501	371	533	533	589	628	323	398	389
Altosid® XR Briquet 90-day	0	961	0	0	0	0	0	0	0
Altosid® Sand-Products	1,096	1,868	3,968	786	1,889	1,822	0.5	0	0
Altosid® Pellets 30-day	8,851	10,432	13,775	11,121	14,791	16,521	18,458	19,139	29,965
Altosid® XR Briquet Catch Basins	0	0	0	0	0	0	0	0	4,867
Altosid® Pellets Catch Basins	0	0	0	0	0	0	135,978	148,023	140,519
Altosid® SR-20 liquid	1,645	529*	355	29	91	51	33	0	0
Vectolex® CG granules	0	0	0	0	0	0	0	0	810
Bti Corn Cob granules	106,755	113,539*	118,733	84,521	90,527	202,875	113,198	166,299	176,947
Bti Liquid Black Fly (gallons used)	5,445	4,233	4,343	821	4,047	3,169	3,408	2,813	3,230
Permethrin Adulticide	6,340	6,164	4,865	4,066	3,444	5,734	6,411	8,292	7,982
Resmethrin Adulticide	106,065	65,356	51,582	42,986	41,311	43,302	68,057	71,847	40,343
Sumithrin Adulticide	0	0	0	0	8,423	32,230	14,447	15,508	25,067

* These values are updated; therefore, some values may differ from similar values in earlier publications.

APPENDIX F Control Material Labels

Altosid® XR Extended Residual Briquets

Altosid® Pellets

Altosid®Liquid Larvicide Concentrate

Altosid®XR-G

VectoBac® 12AS

VectoBac® G

Vectobac® WDG

VectoLex® CG

Agnique® MMF

Permethrin 57% OS

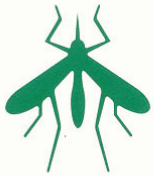
Scourge®

Anvil® 2+2 ULV

Pyrenone® 25-5

Pyrocide®

Altosid® XR
EXTENDED RESIDUAL BRIQUETS



A SUSTAINED RELEASE PRODUCT TO PREVENT ADULT MOSQUITO EMERGENCE

SPECIMEN LABEL

ACTIVE INGREDIENT:

(S)-Methoprene (CAS #65733-16-6) (Dry Weight Basis)	2.1%
OTHER INGREDIENTS:	97.9%
Total	100.0%

This product contains water; therefore the weight of the briquet and percent by weight of active ingredient will vary with hydration. The ingredient statement is expressed on a dry weight basis.

EPA Reg No. 2724-421

KEEP OUT OF REACH OF CHILDREN
CAUTION

INTRODUCTION

ALTOSID® XR BRIQUETS are designed to release effective levels of methoprene insect growth regulator over a period up to 150 days in mosquito breeding sites. Release of methoprene insect growth regulator occurs by dissolution of the briquet. Soft mud and loose sediment can cover the briquets and inhibit normal dispersion of the active ingredient. The product may not be effective in those situations where the briquet can be removed from the site by flushing action.

ALTOSID XR BRIQUETS prevent the emergence of adult mosquitoes including: *Anopheles, Culex, Culiseta, Coquillettidia,* and *Mansonia* spp., as well as those of the floodwater mosquito complex (*Aedes* and *Psorophora* spp.) from treated water. Treated larvae continue to develop normally to the pupal stage where they die.

NOTE: Methoprene insect growth regulator has no effect on mosquitoes which have reached the pupal or adult stage prior to treatment.

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
CAUTION
ENVIRONMENTAL HAZARDS

This product is toxic to aquatic dipteran. Using it in a manner other than that described by the label could result in harm to aquatic dipteran. Do not contaminate water when disposing of rinsate or equipment washwaters.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

APPLICATION TIME

Placement of **ALTOSID XR BRIQUETS** should be at or before the beginning of the mosquito season. **ALTOSID XR BRIQUETS** can be applied prior to flooding when sites are dry, or on snow and ice in breeding sites prior to spring thaw. Under normal conditions, 1 application should last the entire mosquito season, or up to 150 days, whichever is shorter. Alternate wetting and drying will not reduce their effectiveness.

APPLICATION RATES

Aedes and *Psorophora* spp.: For control in non-(or low-) flow shallow depressions (≤ 2 feet in depth), treat on the basis of surface area, placing 1 briquet per 200 ft^2. Briquets should be placed in the lowest areas of mosquito breeding sites to maintain continuous control as the site alternately floods and dries up.

Culex, Culiseta, and *Anopheles* spp.: Place one **ALTOSID XR BRIQUET** per 100 ft^2.

Coquillettidia and *Mansonia* spp.: For application to cattail marshes and water hyacinth beds. For control of these mosquitoes, place 1 briquet per 100 ft^2.

Culex sp. in storm water drainage areas, sewers, and catch basins: For catch basins, place 1 briquet into each basin. In cases of large catch basins, follow the chart below to determine the number of briquets to use. For storm water drainage areas, place 1 briquet per 100 feet square of surface area up to 2 ft deep. In areas that are deeper than 2 feet, use 1 additional briquet per 2 feet of water depth.

Large water flows may increase the dissolution of the briquet thus reducing the residual life of the briquet. Regular inspections (visual or biological) in areas of heavy water flow may be necessary to determine if the briquet is still present. The retreatment interval may be adjusted based on the results of an inspection.

Altosid XR Briquets Application Chart

Number of Briquets	Catch Basin Size (Gallons)	Surface Area/ Water Depth (ft)
1	0 – 1500	0 – 2
2	1500 – 3000	2 – 4
3	3000 – 4500	4 – 6
4	4500 – 6000	6 – 8

APPLICATION SITES

ALTOSID XR BRIQUETS are designed to control mosquitoes in treated areas. Examples of application sites are: storm drains, catch basins, roadside ditches, fish ponds, ornamental ponds and fountains, other artificial water-holding containers, cesspools and septic tanks, waste treatment and settling ponds, flooded crypts, transformer vaults, abandoned swimming pools, tires, construction and other manmade depressions, cattail marshes, water hyacinth beds, vegetation-choked phospate pits, pastures, meadows, rice fields, freshwater swamps and marshes, salt and tidal marshes, treeholes, woodland pools, floodplains, and dredging spoil sites. For application sites connected by a water system, i.e., storm drains or catch basins, all of the water-holding sites in the system should be treated to maximize the efficiency of the treatment program.

STORAGE AND DISPOSAL

STORAGE

Store in a cool place. Do not contaminate water, food, or feed by storage or disposal. Do not reuse empty container.

DISPOSAL

Dispose of empty bag in a sanitary landfill or by incineration, or if allowed by state and local authorities, by burning. If burned, stay out of smoke.

WARRANTY AND CONDITIONS OF SALE

Seller makes no warranty, express or implied, concerning the use and handling of this product other than indicated on the label. Buyer assumes all risks of use and handling of this material when such use and handling are contrary to label instructions.

Always read the label before using this product.

For information, or in case of an emergency, call **1-800-248-7763** or visit our web site: **www.altosid.com**

Wellmark

ZOËCON Professional Products

Wellmark International
Schaumburg, Illinois U.S.A.

22 - 24 - 001

Made in the U.S.A.

January 2002
Schaumburg, IL

Altosid® Pellets
MOSQUITO GROWTH REGULATOR

A GRANULAR PRODUCT TO PREVENT ADULT MOSQUITO EMERGENCE

SPECIMEN LABEL

ACTIVE INGREDIENT:	
(S)-Methoprene (CAS #65733-16-6)	4.25%
OTHER INGREDIENTS:	95.75%
Total	100.00%

EPA Reg No. 2724-448
EPA EST. NO. 39578-TX-1

KEEP OUT OF REACH OF CHILDREN
CAUTION

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
CAUTION
ENVIROMENTAL HAZARDS

This product is toxic to aquatic dipteran (mosquitoes) and chironomid (midge) larvae. Using it in a manner other than that described by the label could result in harm to aquatic dipteran. Do not contaminate water when disposing of rinsate or equipment washwaters.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

INTRODUCTION

ALTOSID® Pellets release ALTOSID® Insect Growth Regulator as they erode. The pellets prevent the emergence of adult standing water mosquitoes, including *Anopheles*, *Culex*, *Culiseta*, *Coquillettidia*, and *Mansonia* spp., as well as adults of the floodwater mosquitoes, such as *Aedes* and *Psorophora* spp. from treated sites.

GENERAL DIRECTIONS

ALTOSID Pellets release effective levels of ALTOSID Insect Growth Regulator for up to 30 days under typical environmental conditions. Treatment should be continued through the last brood of the season. Treated larvae continue to develop normally to the pupal stage where they die. NOTE: This insect growth regulator has no effect on mosquitoes which have reached the pupal or adult stage prior to treatment.

APPLICATION SITES AND RATES

MOSQUITO HABITAT	RATES (Lb/Acre)
Floodwater sites	
Pastures, meadows, ricefields, freshwater swamps and marshes, salt and tidal marshes, cattail marshes, woodland pools, flood-plains, tires, other artificial water-holding containers	2.5-5.0
Dredging spoil sites, waste treatment and settling ponds, ditches and other manmade depressions	5.0-10.0
Permanent water sites	
Ornamental ponds and fountains, fish ponds, cattail marshes, water hyacinth beds, flooded crypts, transformer vaults, abandoned swimming pools, construction and other manmade depressions, treeholes, other artificial water-holding containers	2.5-5.0
Storm drains, catch basins, roadside ditches, cesspools, septic tanks, waste settling ponds, vegetation-choked phosphate pits	5.0-10.0

Use lower rates when water is shallow, vegetation and/or pollution are minimal, and mosquito populations are low. Use higher rates when water is deep (>2 ft), vegetation and/or pollution are high, and mosquito populations are high.

APPLICATION METHODS

Apply ALTOSID Pellets up to 15 days prior to flooding, or at any stage of larval development after flooding, or in permanent water sites. Fixed wing aircraft or helicopters equipped with granular spreaders capable of applying rates from 2.5 to 10.0 lb/acre may be used to apply ALTOSID Pellets. The pellets may also be applied using ground equipment which will achieve good even coverage at the above rates. ALTOSID Pellets may be applied to artificial containers, such as tires and catch basins, etc.

Do not contaminate water, food, or feed by storage or disposal.

STORAGE

Store closed containers of ALTOSID Pellets in a cool dry place.

PESTICIDE DISPOSAL

Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

CONTAINER DISPOSAL

Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or if allowed by state and local authorities, by burning. If burned, stay out of smoke.

WARRANTY AND CONDITIONS OF SALE

Seller makes no warranty, express or implied, concerning the use and handling of this product other than indicated on the label. Buyer assumes all risks of use and handling of this material when such use and handling are contrary to label instructions.

Always read the label before using this product.

For information call 1-800-248-7763 or visit our web site: www.altosid.com.

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Schaumburg, Illinois U.S.A.

Zoecon®, A Wellmark International Brand
ALTOSID® Pellets, ALTOSID® Insect Growth Regulator and ZOECON® are registered trademarks of Wellmark International.

20 - 24 - 001

Made in the USA

November 1999
Bensenville, IL

Altosid® Liquid Larvicide CONCENTRATE

PREVENTS EMERGENCE OF ADULT FLOODWATER MOSQUITOES

SPECIMEN LABEL

ACTIVE INGREDIENT:	
(S)-Methoprene*	20.0%
OTHER INGREDIENTS:	80.0%
Total	100.0%

* CAS # 65733-16-6

Formulation contains 1.72 lb/gal (205.2 g/l) active ingredient.

EPA Reg No. 2724-446

KEEP OUT OF REACH OF CHILDREN

CAUTION

SEE ADDITIONAL PRECAUTIONARY STATEMENTS

Because of the unique mode of action of **A.L.L.**™, successful use requires familiarity with special techniques recommended for application timing and treatment evaluation. **See Guide to Product Application** or consult local Mosquito Abatement Agency.

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS

CAUTION

Causes moderate eye irritation. Avoid contact with eyes or clothing. Wash thoroughly with soap and water after handling. Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.

ENVIRONMENTAL HAZARDS

This product is toxic to aquatic dipteran. Using it in a manner other than that described by the label could result in harm to aquatic dipteran. Do not contaminate water when disposing of rinsate or equipment washwaters.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

CHEMIGATION

Refer to supplemental labeling entitled "**Guide to Product Application**" for use directions for chemigation. Do not apply this product through any irrigation system unless the supplemental labeling on chemigation is followed.

MIXING AND HANDLING INSTRUCTIONS

1. **SHAKE WELL BEFORE USING. A.L.L.** may separate on standing and must be thoroughly agitated prior to dilution.
2. Do not mix with oil; use clean equipment.
3. Partially fill spray tank with water; then add the recommended amount of **A.L.L.**, agitate and complete filling. Mild agitation during application is desirable.
4. Spray solution should be used within 48 hours; always agitate before spraying.

RECOMMENDED APPLICATIONS

INTRODUCTION

A.L.L. must be applied to 2nd, 3rd, or 4th larval instars of floodwater mosquitoes to prevent adult emergence. Treated larvae continue normal development to the pupal stage where they die. This insect growth regulator **has no effect when applied to pupae or adult mosquitoes. A.L.L.** has sufficient field life to be effective at recommended rates when applied to larval stages under varying field conditions. For further information, see **Guide to Product Application**.

METHODS OF APPLICATION

AERIAL
Use the recommended amount of **A.L.L.** listed below in sufficient water to give complete coverage. One-half to 5 gallons of spray solution per acre is usually satisfactory. Do not apply when weather conditions favor drift from areas treated.

GROUND
Determine the average spray volume used per acre by individual operators and/or specific equipment. Mix **A.L.L.** in the appropriate volume of water to give the rate per acre recommended below.

APPLICATION RATE
Apply ¾ to 1 fl oz of **A.L.L.** per acre (55 to 73 ml/hectare) in water as directed.

APPLICATION SITES

PASTURES
A.L.L. may be applied after each flooding without removal of grazing livestock.

RICE
A.L.L. must be applied to 2nd, 3rd, and/or 4th instar larvae of mosquitoes found in rice, usually within 4 days after flooding. **A.L.L.** treatment may be repeated with each flooding.

INTERMITTENTLY FLOODED NONCROP AREAS
A.L.L. may be applied as directed above when flooding may result in floodwater mosquito hatch. Typical sites include: freshwater swamps and marshes, salt marshes, woodland pools and meadows, dredging spoil sites, drainage areas, waste treatment and settling ponds, ditches and other natural and manmade depressions.

CROP AREAS
A.L.L. may be applied to irrigated croplands after flooding to control mosquito emergence. Examples of such sites are: vineyards, rice fields (including wild rice), date palm orchards, fruit and nut orchards, and berry fields and bogs. Irrigated pastures may be treated after each flooding **without** the removal of livestock.

DENSE VEGETATION OR CANOPY AREAS
Apply an **A.L.L.** sand mixture using standard granular dispersal equipment. For detailed preparation instructions, refer to **Guide to Product Application**.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE
Store in cool place away from other pesticides, food, and feed. In case of leakage or spill, soak up with sand or another absorbent material

PESTICIDE DISPOSAL
Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

CONTAINER DISPOSAL
Triple rinse or equivalent. Then offer for recycling or reconditioning or puncture and dispose of in a sanitary landfill, or incineration, or if allowed by state and local authorities, by burning. If burned, stay out of smoke.

For information call 1-800-248-7763

Always read the label before using the product.

Wellmark

ZOËCON Professional Products

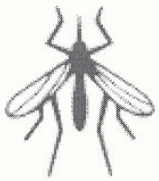
Wellmark International
Schaumburg, Illinois U.S.A.

21-24-004

Made in the U.S.A.

October 2000
Schaumburg, IL

Altosid® XR-G



AN EXTENDED RESIDUAL GRANULAR PRODUCT TO PREVENT ADULT MOSQUITO EMERGENCE

SPECIMEN LABEL

ACTIVE INGREDIENT:	
(S)-Methoprene (CAS #65733-16-6)	1.5%
OTHER INGREDIENTS:	98.5%
Total	100.0%

EPA Reg No. 2724-451

EPA Est. No. 2724-TX-1

KEEP OUT OF REACH OF CHILDREN

CAUTION

PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

Avoid contact with skin or eyes. Due to the size and abrasiveness of the granule, use protective eyewear and clothing to minimize exposure during loading and handling.

FIRST AID

In case of contact, immediately flush eyes or skin with plenty of water. Get medical attention if irritation persists.

ENVIRONMENTAL HAZARDS

This product is toxic to aquatic dipteran (mosquitoes) and chironomid (midges). Using it in a manner other than that described by the label could result in harm to aquatic dipteran (mosquitoes) and chironomid (midges). Do not contaminate water when disposing of rinsate or equipment washwaters.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

GENERAL DIRECTIONS

ALTOSID® XR-G releases effective levels of ALTOSID® insect growth regulator for up to 21 days after application. Applications should be continued throughout the entire season to maintain adequate control. Treated larvae continue to develop normally to the pupal stage where they die.

Rotary and fixed-wing aircraft equipped with granular spreaders capable of applying rates listed below may be used to apply ALTOSID XR-G. Ground equipment which will achieve even coverage at these rates may also be used. Apply ALTOSID XR-G uniformly and repeat application as necessary.

NOTE

ALTOSID insect growth regulator has no effect on mosquitoes which have reached the pupal or adult stage prior to treatment.

APPLICATION TIME

Apply ALTOSID XR-G at any stage of larval mosquito development. Granules may be applied prior to flooding (i.e., "pre-hatch" or "pre-flood") in areas which flood intermittently. In such areas, one application of ALTOSID XR-G can prevent adult mosquito emergence from several subsequent floodings. The actual length of control depends on the duration and frequency of flooding events.

APPLICATION RATES

Aedes, Anopheles, and *Psorophora* spp.: Apply ALTOSID XR-G at 5-10 lb/acre (5.6-11.2 kg/ha). *Culex, Culiseta, Coquillettidia,* and *Mansonia* spp.: Apply ALTOSID XR-G at 10-20 lb/acre (11.2-22.4 kg/ha). Within these ranges, use lower rates when water is shallow [<2 feet (60 cm)] and vegetation and/or pollution are minimal. Use higher rates when water is deep [≥2 feet (60 cm)] and vegetation and/or pollution are heavy.

APPLICATION SITES

NON-CROP AREAS

ALTOSID XR-G may be applied as directed above to temporary and permanent sites which support mosquito larval development. Examples of such sites include: snow pools, salt and tidal marshes, freshwater swamps and marshes (cattail, red cedar, white maple marshes), woodland pools and meadows, dredging spoil sites, drainage areas, ditches, wastewater treatment facilities, livestock runoff lagoons, retention ponds, harvested timber stacks, swales, storm water drainage areas, sewers, catch basins, tree holes, water-holding receptacles (e.g., tires, urns, flower pots, cans, and other containers), and other natural and manmade depressions.

CROP AREAS

ALTOSID XR-G may be applied as directed above to temporary and permanent sites which support mosquito larval development. Examples of such sites include: irrigated croplands, pastures, rangeland, vineyards, rice fields (domestic and wild), date palm, citrus, fruit, nut orchards, berry fields and bogs.

NOTE

Application of ALTOSID XR-G to sites subject to water flow or exchange will diminish the product's effectiveness and may require higher application rates and/or more frequent applications.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE

Store closed containers of ALTOSID XR-G in a cool dry place.

PESTICIDE DISPOSAL

Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

CONTAINER DISPOSAL

Completely empty bag into application equipment. Then dispose of empty bag in a sanitary landfill or by incineration, or if allowed by state and local authorities, by burning. If burned, stay out of smoke.

WARRANTY AND CONDITIONS OF SALE

Seller makes no warranty, express or implied, concerning the use and handling of this product other than indicated on the label. Buyer assumes all risks of use and handling of this material when such use and handling are contrary to label instructions.

Always read the label before using this product.

For information call 1-800-248-7763 or visit our web site: www.altosid.com.

Wellmark

ZOECON Professional Products

Wellmark International
Bensenville, Illinois U.S.A.

Zoecon A Wellmark International Brand.
ALTOSID® Insect Growth Regulator, ALTOSID® XR-G and ZOECON® are registered trademarks of Wellmark International.

20 - 24 - 023

Made in the USA

January, 2000
Bensenville, IL

VectoBac® 12AS

Biological Larvicide
Aqueous Suspension

Active Ingredient:
Bacillus thuringiensis, subspecies *israelensis*, 1200 International Toxic Units (ITU) per mg (Equivalent to 4.84 billion ITU per gallon; 1.279 billion ITU per liter) 1.2%
Inert Ingredients 98.8%
Total 100.0%

EPA Reg. No.73049-38
EPA Est. No. 33762-IA-001 List No. 5605

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KEEP OUT OF REACH OF CHILDREN

CAUTION

For MEDICAL and TRANSPORT Emergencies ONLY Call 24 Hours A Day 1-877-315-9819. For All Other Information Call 1-800-323-9597.

1.0 STATEMENT OF PRACTICAL TREATMENT

If In Eyes: Flush with plenty of water. Get medical attention if signs of irritation persists.

If on Skin: Wash thoroughly with plenty of soap and water. Get medical attention if signs of irritation persists.

2.0 PRECAUTIONARY STATEMENTS

2.1 HAZARD TO HUMANS (AND DOMESTIC ANIMALS)

CAUTION

Hazards to Humans

Harmful if absorbed through skin. Causes moderate eye irritation. Avoid contact with skin, eyes, or clothing. Wash thoroughly with soap and water after handling. Remove contaminated clothing and wash contaminated clothing before reuse.

2.2 Physical and Chemical Hazards

Diluted or undiluted VectoBac 12AS can cause corrosion if left in prolonged contact with aluminum spray system components. Rinse spray system with plenty of clean water after use. Care should be taken to prevent contact with aluminum aircraft surfaces, structural components and control systems. In case of contact, rinse thoroughly with plenty of water. Inspect aluminum aircraft components regularly for signs of corrosion.

3.0 DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling. Do not apply directly to finished drinking water reservoirs or drinking water receptacles.

Do not apply when weather conditions favor drift from treated areas. Do not apply to metallic painted objects, such as automobiles, as spotting may occur. If spray is deposited on metallic painted surfaces, wash immediately with soap and water to avoid spotting.

3.1 Chemigation

Do not apply this product through any type of irrigation system unless labeling on chemigation is followed.

4.0 STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: Store in a cool [59°-86° F (15°-30° C)], dry place.

PESTICIDE DISPOSAL: Wastes resulting from use of this product may be disposed of on site or at an approved waste disposal facility.

CONTAINER DISPOSAL: Triple rinse (or equivalent). Then puncture and dispose of in a sanitary landfill, or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke. Do not reuse container.

5.0 GROUND AND AERIAL APPLICATION

VectoBac 12AS may be applied in conventional ground or aerial application equipment with quantities of water sufficient to provide uniform coverage of the target area. The amount of water needed per acre will depend on weather, spray equipment, and mosquito habitat characteristics. Do not mix more VectoBac 12AS than can be used in a 72-hour period.

For most ground spraying, apply in 5-100 gallons per acre using hand-pump, airblast, mist blower, etc., spray equipment.

For aerial application, VectoBac 12AS may be applied either undiluted or diluted with water. For undiluted applications, apply 0.25 to 2.0 pt/acre of VectoBac 12AS through fixed wing or helicopter aircraft equipped with either conventional boom and nozzle systems or rotary atomizers.

For diluted application, fill the mix tank or plane hopper with the desired quantity of water. Start the mechanical or hydraulic agitation to provide moderate circulation before adding the VectoBac 12AS. VectoBac 12AS suspends readily in water and will stay suspended over normal application periods. Brief recirculation may be necessary if the spray mixture has sat for several hours or longer. AVOID CONTINUOUS AGITATION OF THE SPRAY MIXTURE DURING SPRAYING.

CONTINUED

Rinse and flush spray equipment thoroughly following each use.

For blackfly aerial applications, VectoBac 12AS can be applied undiluted via fixed wing or helicopter aircraft equipped with either conventional boom and nozzle systems or open pipes. Rate of application will be determined by the stream discharge and the required amount of VectoBac 12AS necessary to maintain a 0.5 - 25 ppm concentration for VectoBac 12AS in the stream water. VectoBac 12AS can also be applied diluted with similar spray equipment. Do not mix more VectoBac 12AS than can be used in a 72 hour period.

6.0 APPLICATION DIRECTIONS

Do not apply when wind speed favors drift beyond the area of treatment.

Suggested Rate Range*

Mosquito Habitat	VectoBac 12AS
(Such as the following examples):	
Irrigation ditches, roadside ditches, flood water, standing ponds, woodland pools, snow melt pools, pastures, catch basins, storm water retention areas, tidal water, salt marshes and rice fields.	0.25 - 1 pt/acre

In addition, standing water containing mosquito larvae, in fields growing crops such as: Alfalfa, almonds, asparagus, corn, cotton, dates, grapes, peaches and walnuts, may be treated at the recommended rates.

When applying this product to standing water containing mosquito larvae in fields growing crops, do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application.

Polluted water (such as sewage lagoons, animal waste lagoons).	1 - 2 pts/acre

*Use higher rate range in polluted water and when late 3rd and early 4th instar larvae predominate, mosquito populations are high, water is heavily polluted, and/or algae are abundant.

Suggested Rate Range*

Black flies Habitat	VectoBac 12AS
Streams	
stream water** (=ppm) for 1 minute exposure time	0.5 - 25 mg/liter
stream water** (=ppm) for 10 minutes exposure time	0.05 - 2.5 mg/liter

**Use higher rate range when stream contains high concentration of organic materials, algae, or dense aquatic vegetation.

**Discharge is a principal factor determining carry of Bti. Use higher rate or increase volume by water dilution in low discharge rivers or streams under low volume (drought) conditions.

7.0 CHEMIGATION

Apply this product through flood (basin) irrigation systems. Do not apply this product through any other type of irrigation system.

Crop injury, lack of effectiveness, or illegal pesticide residues in the crop can result from nonuniform distribution of treated water.

If you have any questions about calibration, you should contact State Extension Service Specialists, equipment manufacturers or other experts.

A person knowledgeable of this chemigation system and responsible for its operation, or under the supervision of the responsible person, shall shut the system down and make necessary adjustments should the need arise.

7.1 RICE-FLOOD (BASIN) CHEMIGATION

Systems using a gravity flow pesticide dispensing system must meter the pesticide into the water at the head of the field and downstream of a hydraulic discontinuity such as a drop structure or weir box to decrease potential for water source contamination from backflow if water flow stops.

VectoBac 12AS is metered or dripped into rice floodwater at application stations positioned at the point of introduction (levee cut) of water into each rice field or pan. Two to three pints of VectoBac 12AS are diluted in water to a final volume of 5 gallons. The diluted solution is contained in a 5 gallon container and metered or dispersed into the irrigation water using a constant flow device at the rate of 80 ml per minute. Introduction of the solution should begin when 1/3 to 1/2 of the pan or field is covered with floodwater. Delivery of the solution should continue for a period of approximately 4-1/2 hours. Floodwater depth should not exceed 10-12 inches to prevent excessive dilution of VectoBac 12AS which could result in reduced larval kill.

Agitation is not required during the period in which the VectoBac 12AS solution is being dispersed.

Application of VectoBac 12AS into rice floodwater is not permitted using a pressurized water and pesticide injection system.

8.0 SMALL QUANTITY DILUTION RATES

Gallons Spray Solution/Acre
(Ounces Needed per Gallon of Spray)

VectoBac 12AS Rate in Pints Per Acre	10 Gal/A	25 Gal/A	50 Gal/A
0.25 (4 oz)	0.4	0.16	0.08
0.5 (8 oz)	0.8	0.32	0.16
1.0 (16 oz)	1.6	0.64	0.32
2.0 (32 oz)	3.2	1.28	0.64

9.0 NOTICE TO USER

SELLER MAKES NO WARRANTY, EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS OR OTHERWISE CONCERNING USE OF THIS PRODUCT OTHER THAN AS INDICATED ON THE LABEL. USER ASSUMES ALL RISKS OF USE, STORAGE OR HANDLING NOT IN STRICT ACCORDANCE WITH ACCOMPANYING DIRECTIONS.

VALENT BIOSCIENCES CORPORATION
870 TECHNOLOGY WAY
LIBERTYVILLE, IL 60048 • 800-323-8597

Valent BioSciences Corporation

VectoBac® G

Biological Larvicide Granules

ACTIVE INGREDIENT:
Bacillus thuringiensis, subspecies *israelensis*, 200 International Toxic Units (ITU) per mg
(Equivalent to 0.091 billion ITU per pound) 0.2%
INERT INGREDIENTS 99.8%
TOTAL 100.0%

EPA Reg. No. 73049-10
EPA Est. No. 33762-IA-001 List No. 5108

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CAUTION
For MEDICAL and TRANSPORT Emergencies ONLY Call 24 Hours A Day 1-877-315-9819. For All Other Information Call 1-800-323-9597.

1.0 STATEMENT OF PRACTICAL TREATMENT

If in Eyes: Flush eyes with plenty of water. Get medical attention if irritation persists.

2.0 DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling. Do not apply directly to treated, finished drinking water reservoirs or drinking water receptacles.

3.0 STORAGE AND DISPOSAL

Do not contaminate potable water, food or feed by storage or disposal.

Storage: Store in a cool, dry place.

Pesticide Disposal: Wastes resulting from use of this product may be disposed of on site or at an approved waste disposal facility.

Container Disposal: Completely empty bag into application equipment. Then dispose of empty bag in a sanitary landfill or by incineration, or, if allowed by State and local authorities, by burning. If burned, stay out of smoke.

4.0 APPLICATION DIRECTIONS

VectoBac G is an insecticide for use against mosquito larvae.

Mosquitoes Habitat (Such as the following examples):	Suggested Range Rate*
Irrigation ditches, roadside ditches, flood water, standing ponds, woodland pools, snow melt pools, pastures, catch basins, storm water retention areas, tidal water, salt marshes and rice fields	2.5 - 10 lbs / acre

In addition, standing water containing mosquito larvae, in fields growing alfalfa, almonds, asparagus, corn, cotton, dates, grapes, peaches and walnuts may be treated at the recommended rates.

* Use 10-20 lbs. / acre when late 3rd and early 4th instar larvae predominate, mosquito populations are high, water is heavily polluted (sewage lagoons, animal waste lagoons), and/or algae are abundant.

Apply uniformly by aerial or ground conventional equipment.

A 7 to 14 day interval between applications should be employed.

5.0 NOTICE TO USER

SELLER MAKES NO WARRANTY, EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS OR OTHERWISE CONCERNING THE USE OF THIS PRODUCT OTHER THAN AS INDICATED ON THE LABEL. USER ASSUMES ALL RISKS OF USE, STORAGE OR HANDLING NOT IN STRICT ACCORDANCE WITH ACCOMPANYING DIRECTIONS.

VALENT BIOSCIENCES CORPORATION
870 TECHNOLOGY WAY
LIBERTYVILLE, IL 60048 - 800-323-9597

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VectoBac® WDG

Biological Larvicide

ACTIVE INGREDIENT:

Bacillus thuringiensis, subsp. *israelensis* fermentation solids and solubles	37.4%
INERT INGREDIENTS	62.6%
TOTAL	100.0%

[potency: 3000 International toxic units (ITU) per mg]
Equivalent to 1.36 billion ITU/lb.

EPA Reg. No. 73049-56
EPA Est. No. 33762-IA-001 List No. 60215

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KEEP OUT OF REACH OF CHILDREN

CAUTION

For MEDICAL and TRANSPORT Emergencies ONLY Call 24 Hours A Day 1-877-315-9819. For All Other Information Call 1-800-323-9597.

1.0 STATEMENT OF PRACTICAL TREATMENT

Inhaled: Remove victim to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. Get medical attention.

If in Eyes: Flush eyes with plenty of water. Call a physician if irritation persists.

2.0 PRECAUTIONARY STATEMENTS

2.1 HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

Harmful if inhaled. Avoid breathing dust. Remove contaminated clothing and wash before reuse. Causes moderate eye irritation. Avoid contact with eyes or clothing. Wash thoroughly with soap and water after handling.

As a general precaution when exposed to potentially high concentrations of living microbial products such as this, all mixer/loaders and applicators not in enclosed cabs or aircraft must wear a dust/mist filtering respirator meeting NIOSH standards of at least N-95, R-95, or P-95.

2.2 ENVIRONMENTAL HAZARDS

Do not apply directly to treated finished drinking water reservoirs or drinking water receptacles when water is intended for human consumption.

3.0 DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

3.1 Chemigation

Do not apply this product through any type of irrigation system.

4.0 STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

Storage: Store in cool [59-86°F (15-30°C)], dry place.

Pesticide Disposal: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

Container Disposal: Triple rinse (or equivalent). Then puncture and dispose of in a sanitary landfill, or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

5.0 APPLICATION DIRECTIONS

Do not apply when wind speed favors drift beyond the area of treatment.

Mosquito Habitat (Such as the following examples):	Suggested Rate Range*
Irrigation ditches, roadside ditches, flood water, standing pools, woodland pools, snow melt pools, pastures, catch basins, storm water retention areas, tidal water, salt marshes and rice fields.	1.75 - 7.0 oz/acre (50 - 200 g/acre) (125 - 500 g/ha)

In addition, standing water containing mosquito larvae, in fields growing crops such as: Alfalfa, almonds, asparagus, corn, cotton, dates, grapes, peaches and walnuts, may be treated at the recommended rates.

When applying this product to standing water containing mosquito larvae in fields growing crops, do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application.

Polluted water (such as sewage lagoons, animal waste lagoons)	7.0 - 14.0 oz/acre (200 - 400 g/acre) (0.5 - 1.0 kg/ha)

[redacted]

* Use higher rate range in polluted water and when late 3rd and early 4th instar larvae predominate, mosquito populations are high, water is heavily polluted, and/or algae are abundant.

6.0 SMALL QUANTITY DILUTION RATES

Gallons Spray Mixture/Acre
(Ounces Needed per Gallon of Spray)

VectoBac WDG

Rates in		Final concentration, ounces/gallon spray		
Ounces/Acre	Grams/A	10 Gal/A	25 Gal/A	50 Gal/A
1.75	50	0.175	0.07	0.04
3.5	100	0.35	0.14	0.07
7	200	0.7	0.28	0.14
14	400	1.4	0.565	0.28

7.0 GROUND AND AERIAL APPLICATION

VectoBac WDG may be applied using conventional ground or aerial application equipment with quantities of water sufficient to provide uniform coverage of the target area. For application, first add the VectoBac WDG to water to produce a final spray mixture.

The amount of water will depend on weather, spray equipment, and mosquito habitat characteristics. For application, fill the mix tank or plane hopper with the desired quantity of water. **Start the mechanical or manual agitation to provide moderate circulation of water before adding the VectoBac WDG.** Backpack and compressed air sprayers may be agitated by shaking after adding VectoBac WDG to the water in the sprayer. VectoBac WDG suspends readily in water and will stay suspended over normal application periods. Brief recirculation may be necessary if the spray mixture has sat for several hours or longer. Do not mix more VectoBac WDG than can be used in a 48 hour period. AVOID CONTINUOUS AGITATION OF THE SPRAY MIXTURE DURING SPRAYING.

For ground spraying, apply 1.75-14 oz/acre (50-400 g/acre; 123-988 g/ha) of VectoBac WDG in 5-100 gallons of water per acre (47-950 liters/ha) using hand-pump, airblast, mist blower, or other spray equipment.

For aerial application, apply 1.75 - 14 oz/acre (50-400 g/acre; 123-988 g/ha) of VectoBac WDG in 0.25-10 gallons of water per acre (2.4-9.5 liters/ha) through fixed wing or helicopter aircraft equipped with either conventional boom and nozzle system or rotary atomizers to provide uniform coverage of the target area.

7.1 AERIAL APPLICATION

Avoiding spray drift at the application site is the responsibility of the applicator. The interaction of many equipment-and-weather-related factors determine the potential for spray drift. The applicator and the grower are responsible for considering all of these factors when making decisions.

Rinse and flush spray equipment thoroughly following each use.

8.0 NOTICE TO USER

SELLER MAKES NO WARRANTY, EXPRESS OR IMPLIED OF MERCHANTABILITY, FITNESS OR OTHERWISE CONCERNING USE OF THIS PRODUCT OTHER THAN AS INDICATED ON THE LABEL. USER ASSUMES ALL RISKS OF USE, STORAGE OR HANDLING NOT IN STRICT ACCORDANCE WITH ACCOMPANYING DIRECTIONS.

VALENT BIOSCIENCES CORPORATION
870 TECHNOLOGY WAY
LIBERTYVILLE, IL 60048 - 800-323-9597

Valent BioSciences Corporation

VectoLex® CG

Biological Larvicide
Granules

ACTIVE INGREDIENT:
Bacillus sphaericus Serotype H5a5b, strain 2362 Technical Powder (670 BsITU/mg) ..... 7.5% w/w
INERT INGREDIENTS ..... 92.5% w/w
TOTAL ..... 100.0% w/w

Potency: This product contains 50 BsITU/mg or 0.023 Billion BsITU/lb.

EPA Reg. No.73049-20
EPA Est. No. 33762-IA-001 List No. 5722

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1.0 STATEMENT OF PRACTICAL TREATMENT

If In Eyes: Immediately flush eyes with plenty of water. Get medical attention if irritation persists.

If on Skin: Wash thoroughly with plenty of soap and water. Get medical attention if irritation persists.

2.0 PRECAUTIONARY STATEMENTS

2.1 HAZARDS TO HUMANS AND DOMESTIC ANIMALS CAUTION

Harmful if absorbed through the skin. Causes moderate eye irritation. Avoid contact with skin, eyes or clothing. Wash thoroughly with soap and water after handling.

2.2 Environmental Hazards

Do not contaminate water when disposing of equipment washwaters or rinsate.

3.0 DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

4.0 STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal. Do not contaminate water when disposing of equipment washwaters.

Pesticide Storage: Store in a cool, dry place.

Pesticide Disposal: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

Container Disposal: Completely empty bag into application equipment. Then dispose of empty bag in a sanitary landfill or by incineration, or if allowed by state and local authorities, by burning. If burned, stay out of smoke.

5.0 APPLICATION DIRECTIONS

MOSQUITO CONTROL

I. For control of mosquito larvae species* in the following non-crop sites:

Habitat	Rate Range
Wastewater: Sewage effluent, sewage lagoons, oxidation ponds, septic ditches, animal waste lagoons, impounded wastewater associated with fruit and vegetable processing	5-20 lbs/acre**
Stormwater/Drainage Systems: Storm sewers, catch basins, drainage ditches, retention, detention and seepage ponds	5-20 lbs/acre**
Marine/Coastal Areas: Salt marshes, mangroves, estuaries	5-20 lbs/acre**
Water Bodies: Natural and manmade aquatic sites such as lakes, ponds, rivers, canals and streams	5-20 lbs/acre**
Dormant Rice Fields: Impounded water in dormant rice fields. (For application only during the interval between harvest and preparation of the field for the next cropping cycle.)	5-20 lbs/acre**
Waste Tires: Tires stockpiled in dumps, landfills, recycling plants, and other similar sites.	20-80 lbs/acre(1)

(1) .5-2 lbs/1000 sq. ft

II. For the control of mosquito larvae species* in agricultural/crop sites where mosquito breeding occurs:

Habitats:	Rate Range
Rice, pastures/hay fields, orchards, citrus groves, irrigated crops.	5-20 lbs/acre**

Apply uniformly by aerial or conventional ground equipment. Reapply as needed after 1-4 weeks.

* Mosquito species effectively controlled by VectoLex CG:

Culex spp.	*Psorophora columbiae*
Aedes vexans	*Psorophora ferox*
Aedes melanimon	*Aedes triseriatus*
Aedes stimulans	*Aedes sollicitans*
Aedes nigromaculis	*Anopholos quadrimaculatus*
	Coquillettidia perturbans

**Use higher rates (10 to 20 lbs/acre) in areas where extended residual control is necessary, or in habitats having deep water or dense surface cover.

CONTINUED

[redacted]

6.0 NOTICE TO USER

SELLER MAKES NO WARRANTY, EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS OR OTHERWISE CONCERNING THE USE OF THIS PRODUCT OTHER THAN AS INDICATED ON THE LABEL. USER ASSUMES ALL RISKS OF USE, STORAGE OR HANDLING NOT IN STRICT ACCORDANCE WITH ACCOMPANYING DIRECTIONS.

VALENT BIOSCIENCES CORPORATION
870 TECHNOLOGY WAY
LIBERTYVILLE, IL 60048 - 800-323-8597

AGNIQUE® MMF

MOSQUITO LARVICIDE & PUPICIDE

MONOMOLECULAR SURFACE FILM FOR CONTROL OF IMMATURE MOSQUITOES AND MIDGES

ACTIVE INGREDIENT

Poly(oxy-1,2-ethanediyl),α-isooctadecyl-ω-hydroxyl (100%)

CAUTION

KEEP OUT OF THE REACH OF CHILDREN

FIRST AID TREATMENT

IF ON SKIN: Wash with plenty of soap and water. Get medical attention if irritation develops.

IF IN EYES: Flush with plenty of water. Get medical attention if irritation develops.

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION: Avoid contact with skin, eyes or clothing. Wash thoroughly with soap and water after handling.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling. To be used in governmental mosquito control programs, by professional pest control operators, or in other mosquito or midge control operations.

This product is for the control of immature mosquitoes and midges in ponds, lakes, swamps, ditches, floodwater areas and many other areas where they breed and develop. This product may be used in potable and irrigation waters, permanent and semi-permanent waters, and in croplands and pastures.

STORAGE AND DISPOSAL

DO NOT CONTAMINATE WATER, FOOD, OR FEED BY STORAGE OR DISPOSAL.

PESTICIDE STORAGE: Do not allow storage containers to rust. Rust contamination may clog spray nozzles. Do not allow product to freeze.

PESTICIDE DISPOSAL: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

CONTAINER DISPOSAL: Triple rinse, then offer for recycling or reconditioning; or puncture and dispose of in a sanitary landfill, or by other procedures approved by state or local authorities.

APPLICATION DIRECTIONS

This product may be applied by both ground and aerial applications. To use, spray the desired rate of neat MMF onto the surface of the water. No dilution is required. The MMF will spread to cover hard to access areas. A fan spray is recommended. Do not pour or inject a stream spray directly into water.

AGNIQUE® MMF is not visible on the surface of the water. Excess MMF on the water surface will form a globule.

APPLICATION NOTES

Rate of kill: The rate of kill when using MMF is dependent on the species, the life stage, the habitat and the temperature. Pupicidal action will typically result in 24 hours. Larvicidal action will usually result in 24 – 72 hours. If the film is present, as indicated by the Indicator Oil, control will be achieved.

Indicator Oil: AGNIQUE® MMF is not visible on the surface of the water. To check the habitat for the presence and persistence of the product, add a drop of AGNIQUE® MMF Indicator Oil to several locations in the habitat. If the Indicator Oil forms a tight bead on the surface of the water, then the MMF is present for control.

Persistence: The AGNIQUE® MMF surface film typically persists on the water's surface for 5 – 22 days. Polluted waters will cause more rapid degradation of the film. Higher application rates will prolong film life and extend the interval between retreatment.

Species: Mosquitoes and midges that require little or no surface contacts for breathing will be affected by the product during the pupae and emerging adult life stages.

Winds: The high end of the dosage rate is recommended when spraying habitats where multi-directional winds of 10 mph (16 km/hr) or greater are expected to persist. While the film will be pushed by the winds, it will re-spread quickly once the winds have subsided. If persistent unidirectional winds of 10 mph (16 km/hr) or greater are expected, the displacement of the surface film may result in poor control.

Spray Tank: Thoroughly clean the spray system of contaminants such as petroleum oils, water, detergents and conventional toxicants prior to adding AGNIQUE® MMF. Detergents will destroy the film-forming of the MMF; other contaminants (water and oil) will result in the formation of an unsprayable paste.

Dilution: AGNIQUE® MMF is typically applied to the water's surface without dilution. However, if it is desired to spray higher volumes of liquid, AGNIQUE® MMF may be diluted using a high shear injection system, that dilutes the MMF at the nozzle to a maximum of 10% in water. Do not add AGNIQUE® MMF to water in non-agitated spray systems. Conventional bypass recirculation will not provide adequate agitation to effectively mix MMF with water.

Expanding Waters: Significant expansion of the habitat's surface area due to rain or tidal fluxes can be compensated for by using a dosage that is based on the largest expected surface area. This will ensure complete coverage, and eliminate the need for re-treatment of the flooded area.

NOTICE

Cognis Corporation makes no warranty, express or implied of merchantability, fitness or otherwise concerning the use of this product other than as indicated on the label. User assumes all risks, storage or handling not in strict accordance with the label.

MOSQUITO HABITAT	Suggested Rate Range*
Fresh and brackish waters Examples include salt marshes, ponds, storm water and retention & detention basins, roadside ditches, grassy swales, fields, pastures, potable water containers, reservoirs, irrigated croplands, woodland pools, tidal water, etc...	**0.2 – 0.5 gallons/acre** **2 – 5 liters/hectare**
Polluted waters Examples include sewage lagoons, animal waste effluent lagoons, septic ditches, etc...	**0.35 – 1.0 gallons/acre** **3.5 – 10 liters/hectare**

* Use higher rates when emergent or surface vegetation is present, due to the wicking action of the product. The more vegetation or the drier the vegetation, the higher the rate.

* The lower rates may be used when only pupae are present.

MIDGE HABITAT	Suggested Rate Range^
Fresh water Examples include ponds and lakes	**0.5 gallons/acre** **5 liters/hectare**
Polluted waters Examples include sewage lagoons and percolation ponds	**0.5 – 1.0 gallons/acre** **5 – 10 liters/hectare**

^ Reapplication is recommended every two weeks during the midge season.

cognis agrosolutions

COGNIS CORPORATION,
4900 ESTE AVENUE
CINCINNATI, OH 45232-1419
1-800-254-1029

24 HOUR EMERGENCY PHONE
CHEMTREC 1-800-424-9300

For information on this pesticide product (including health concerns, medical emergencies, or pesticide incidents), call the National Pesticide Telecommunications Network at 1-800-858-7378.

EPA REG NO. 53263-28 EPA Establishment Number 53263-SC-01

PERMETHRIN 57% OS

CLARKE

For Application Only By Public Health Officials and Trained Personnel of Mosquito Abatement Districts and Other Mosquito Control Programs. A SYNTHETIC PYRETHROID FOR EFFECTIVE CONTROL AND REPELLENCY OF ADULT MOSQUITOES. For Use As An Effective ULV and Barrier Spray for Control of Adult Mosquitoes. Gnats. Biting and Non-Biting Midges. Blackflies. Deer Flies and Other Biting Flies.

Precautionary Statements

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

Harmful if swallowed or absorbed through skin. Avoid contact with skin, eyes or clothing. Wash thoroughly after handling.

STATEMENT OF PRACTICAL TREATMENT

If Swallowed: call a physician or Poison Control Center. Do not induce vomiting. This product contains aromatic petroleum solvent. Aspiration may be a hazard.

ENVIRONMENTAL HAZARDS

This product is highly toxic to fish and aquatic invertebrates. Do not apply directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark. Do not apply when weather conditions favor drift from treated areas. Drift and runoff from treated ares may be hazardous to aquatic organisms in neighboring areas. Do not allow spray treatment to drift on pastureland, cropland, poultry ranges or water supplies. Do not contaminate water when disposing of equipment washwaters.

PHYSICAL OR CHEMICAL HAZARDS

Do not use or store near heat or open flame.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its' labeling.

CONDITIONS and RATES to USE for MOSQUITO CONTROL FOR A BARRIER SPRAY

This product is effective for reducing mosquito annoyance and control of mosquitoes that may transmit diseases such as La Crosse encephalitis, dog heartworm, dengue fever and western encephalitis. Apply product with mist blower, power backpack or ULV machine. If ULV machine is used, adjust pressure to deliver particles from 35-200 microns. Do not allow spray treatment to drift on pasture land, crop land, poultry ranges or water supplies. Do not use on crops used for food, forage or pasture.

Normal use pattern of product requires a residual application on plant and other surfaces where mosquitoes may rest. Product commonly provides sustained control in wooded areas lasting up to 14 days in shaded areas. Secondary activity of product is through repellency. Apply product by ground application equipment such as mist blower, ULV equipment, power backpack or pressure sprayer. Not to be used within 100 feet (30 meters) of lakes and streams. To kill or repel mosquitoes, midges, deer flies and other biting flies, mix with enough oil mixture so as to easily apply 0.1 pounds of Permethrin per acre. The oil-mixture is obtained by mixing one part of soybean oil to two parts of mineral oil. Non-phytotoxic oils must be used. The following chart represents some possible dilutions based on a 2 MPH walking speed with a fifty (50) foot swath. If a different dilution ratio or walking speed is used, adjust flow rate accordingly so as to achieve 0.1 pounds of Permethrin per acre.

For A Two (2) Mile Per Hour Walking Speed And A 50 Foot Application Swath—The Following Are Typical Field Dilutions.

Permethrin 57%	Oil	Fl. oz. Finished Spray Per Acre	Fl. oz./Min.
1 Part	9.0 Parts	25.0	5.0
1 Part	5.8 Parts	17.5	3.5
1 Part	4.0 Parts	12.5	2.5

ACTIVE INGREDIENT:	
Permethrin (3-Phenoxyphenyl)methyl (±) cis, trans-3-(2,2-dichlorethenyl)-2,2-dimethyl-cyclopropanecarboxylate	57.00%
INERT INGREDIENTS	43.00%
	100.00%

Contains petroleum distillates.

Cis/trans isomers ratio: min. 35%(+)cis and max. 65%(+)trans.

Contains 5 lb./gal. Permethrin

CAUTION

KEEP OUT OF REACH OF CHILDREN

MANUFACTURED BY

CLARKE MOSQUITO CONTROL PRODUCTS, INC.
159 N. GARDEN AVENUE
ROSELLE, ILLINOIS 60172

E.P.A. EST. No. 8329IL01
EPA Reg. No. 8329-44

NET CONTENTS_____

LOT NO. _____

NOTICE: Seller makes no warranty, expressed or implied concerning the use of this product other than indicated on the label. Buyer assumes all risk of use and/or handling of this material when use and/or handling is contrary to label instructions.

This is equivalent to 0.1 lb. of Permethrin/Acre. Apply the product with sufficient carrier to allow distribution over the area to be treated using particle sizes from 35-200 microns mmd. To obtain optimum results, cover the immediate surroundings of housing, buildings including plant surfaces where mosquitoes may rest. For large recreational areas such as football fields, stadiums, racetracks, and public parks, spray the insecticide-oil mixture at the above mentioned application rate on the interface of woods surrounding the main area where the event is to take place. Spray may also be applied in any vegetated area where mosquitoes may rest causing infestations in residential areas.

To Kill Gypsy Moths and Tentcaterpillars infesting woodland and forest areas: Apply the insecticide-oil mixture (as described above) directly to insect nests and vegetation by backpack applicator using 62 Fl. Oz./acre at a walking speed of 2 MPH over a swath of 50 feet, applying 12.6 Fl. Oz./minute. This is equivalent to 0.25 lb. of Permethrin/acre. Apply thoroughly to all foliage and insect nests.

TRUCK MOUNTED –ULV– EQUIPMENT

PERMETHRIN 57% is recommended for application as an ultra low volume (U.L.V.) nonthermal aerosol (cold fog) to control adult mosquitoes in residential and recreational areas where these insects are a problem, such as but not limited to parks, campsites, woodlands, athletic fields, golf courses, residential areas and municipalities, gardens, playgrounds, recreational areas and overgrown waste areas. Do not apply this product within 100 feet (30 Meters) of lakes and streams. Do not allow spray treatment to drift on pastureland, cropland, poultry ranges, or water supplies. For best results treat when mosquitoes are most active and weather conditions are conducive to keeping the fog close to the ground, e.g. cool temperatures and wind speed not greater than 10 mph. Applications during the cool hours of the night or early morning is usually preferable. Repeat treatment as needed.

U.L.V. Nonthermal Aerosol (Cold Fog) Application: To control Mosquitoes, Midges and Blackflies, apply PERMETHRIN 57% using any standard U.L.V. ground applicator capable of producing a nonthermal aerosol spray with droplets ranging in size from 5 to 30 microns and a mass median diameter (MMD) of 10 to 20 microns. Apply the product undiluted at a flow rate of 0.54 to 3.25 fluid ounces per minute at an average vehicle speed of 10 mph. If a different vehicle speed is used, adjust rate accordingly. These rates are equivalent to 0.0035 to 0.021 pounds of Permethrin per acre. Vary flow rate according to vegetation density and mosquito population. Use higher flow rate in heavy vegetation or when populations are high. An accurate flow meter must be used to ensure the proper flow rate. PERMETHRIN 57% may also be applied by diluting with a suitable solvent such as a non-phytotoxic mineral oil. The following charts represent some suggested dilution and application rates for ground U.L.V. applications. If an alternate dilution rate is used, adjust flow rate accordingly.

FOR A 1:4 PERMETHRIN 57%/SOLVENT DILUTION RATIO
Mix one (1) part PERMETHRIN 57% with four (4) parts solvent and apply at the following rates.

Permethrin pounds/acre	Application Rates Fl. oz./Min. 5MPH	10MPH	15MPH	Fl. oz. finished spray per acre
0.007	2.70	5.40	8.1	0.90
0.0035	1.35	2.70	4.0	0.45
0.00175	.68	1.35	2.0	0.23

FOR A 1:9 PERMETHRIN 57%/SOLVENT DILUTION RATIO
Mix one (1) part PERMETHRIN 57% with nine (9) parts solvent and apply at the following rates.

Permethrin pounds/acre	Application Rates Fl. oz./Min. 5MPH	10MPH	Fl. oz. finished spray per acre
0.007	5.40	10.75	1.80
0.0035	2.70	5.40	0.90
0.00175	1.35	2.70	0.45

FOR A 1:14 PERMETHRIN 57%/SOLVENT DILUTION RATIO
Mix one (1) part PERMETHRIN 57% with fourteen (14) parts solvent and apply at the following rates.

Permethrin pounds/acre	Application Rates Fl. oz./Min. 5MPH	10MPH	15MPH	Fl. oz. finished spray per acre
0.007	8.0	16.0	32.0	2.70
0.0035	4.0	8.0	16.0	1.35
0.00175	2.0	4.0	8.0	0.68

For proper application, mount the fog applicator so that the nozzle is at least 4½ feet above ground level and directed out the back of the vehicle. Failure to follow the above directions may result in reduced effectiveness. Aerial applications should be done by suitable aerial U.L.V. equipment capable of producing droplets with an MMD of 50 microns or less with no more than 2.5% exceeding 100 microns. Flow rate and swath width should be set so as to achieve 0.2 to 0.6 fluid ounces of PERMETHRIN 57% per acre. PERMETHRIN 57% may also be diluted with a suitable diluent such as mineral oil and applied by aerial ULV equipment so long as 0.6 fluid ounces per acre of PERMETHRIN 57% is not exceeded. Both aerial and ground applications should be made when wind is less than 10 MPH.

FOR FLORIDA: Do not apply by aircraft except in emergency situations and with the approval of the Florida Department of Agriculture and Consumer Services.

STORAGE & DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

PESTICIDE STORAGE AND SPILL PROCEDURES: Do not store at temperatures below 40°F (4.5°C). If this material has been exposed to temperatures below 40°F (4.5°C), there may be precipitation. Check for crystallization. If evident, warm to 80°F (26.5°C) and thoroughly mix before using. DO NOT USE OPEN FLAME. Store upright at room temperature. Avoid exposure to extreme temperatures. In case of spill or leakage, soak up with an absorbent material such as sand, sawdust, earth, fuller's earth, etc. Dispose of with chemical waste.

PESTICIDE DISPOSAL: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

CONTAINER DISPOSAL: Triple rinse (or equivalent) then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other approved state and local procedures.

CONTAINERS ONE GALLON AND SMALLER: Do not reuse container. Wrap containers in several layers of newspaper and discard in trash.

CONTAINERS LARGER THAN ONE GALLON: Metal Containers—Triple rinse or equivalent. Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities. Plastic Containers—Triple rinse or equivalent. Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by incineration, or if allowed by state and local authorities, by burning. If burned, stay out of smoke. Then dispose of in a sanitary landfill or by other approved state and local procedures.

IN CASE OF EMERGENCY, CALL INFO TRAC 1-800-535-5053

FOR MORE INFORMATION CALL:
1-800-323-5727

12/97

RESTRICTED USE CLASSIFICATION
Due to Acute Fish Toxicity
For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicators Certification.

SCOURGE® INSECTICIDE

with SBP-1382®/PIPERONYL BUTOXIDE 4% + 12% MF FORMULA II

Specimen Label

- *A READY TO USE SYNTHETIC PYRETHROID FOR EFFECTIVE ADULT MOSQUITO (INCLUDING ORGANOPHOSPHATE RESISTANT SPECIES), MIDGE (BITING AND NON-BITING), AND BLACK FLY CONTROL*
- *TO BE APPLIED BY MOSQUITO ABATEMENT DISTRICTS, PUBLIC HEALTH OFFICIALS AND OTHER TRAINED PERSONNEL IN MOSQUITO CONTROL PROGRAMS.*
- *CONTAINS 0.3 lb/gal (36 g/L) OF SBP-1382 AND 0.9 lb/gal (108 g/L) OF PIPERONYL BUTOXIDE*
- *FOR AERIAL AND GROUND APPLICATION*

ACTIVE INGREDIENTS:	
* Resmethrin	4.14%
**Piperonyl Butoxide Technical	12.42%
INERT INGREDIENTS†:	83.44%
	100.00%

*Cis/trans isomers ratio: max. 30% (±) cis and min. 70% (±) trans.
**Equivalent to 9.94% (butylcarbityl) (6-propylpiperonyl) ether and 2.48% related compounds.
†Contains Petroleum Distillates.

PRECAUCION AL CONSUMIDOR: Si usted no lee ingles, no use este producto hasta que la etiqueta le haya sido explicada ampliamente.
(TO THE USER: If you cannot read English, do not use this product until the label has been fully explained to you.)

EPA REG. NO. 432-716 EPA EST. NO.

KEEP OUT OF REACH OF CHILDREN

CAUTION

FIRST AID

IF SWALLOWED: Call a doctor or get medical attention. Do not induce vomiting. Do not give anything by mouth to an unconscious person. Avoid Alcohol. This product contains aromatic petroleum solvent. Aspiration may be a hazard.
IF ON SKIN: Wash with soap and plenty of water. Get medical attention.

See Side Panel For Additional Precautionary Statements

For product information Call Toll-Free: 1-800-331-2867

In case of *Medical* emergencies or health and safety inquiries or in case of fire, leaking or damaged containers, information may be obtained by calling 1-800-334-7577.

NET CONTENTS:

BAYER ENVIRONMENTAL SCIENCE
A Business Group of Bayer CropScience LP
95 Chestnut Ridge Road • Montvale, NJ 07645

PRECAUTIONARY STATEMENTS
Hazards To Humans & Domestic Animals

CAUTION

Harmful if swallowed or absorbed through skin. Avoid contact with skin, eyes, or clothing. Wash thoroughly with soap and water after handling.

Environmental Hazards

This pesticide is highly toxic to fish. For terrestrial uses, do not apply directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark. Drift and runoff from treated sites may be hazardous to fish in adjacent waters. Consult your State's Fish and Wildlife Agency before treating such waters. Do not contaminate water by cleaning of equipment or disposal of equipment wash waters.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

Storage: Store product in original container in a locked storage area.

Pesticide Disposal: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

Container Disposal: Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other procedures approved by State and Local authorities.

READ ENTIRE LABEL FOR DIRECTIONS

For use only by certified applicators or under the supervision of such applicators, for the reduction in annoyance from adult mosquito infestations and as a part of a mosquito abatement program.

IN THE STATE OF CALIFORNIA: For use only by local districts or other public agencies which have entered into and operate under a cooperative agreement with the Department of Public Health pursuant to Section 2426 of the Health and Safety Code.

This product is to be used for control of adult mosquitoes (including organophosphate resistant species), midges (biting and non-biting) and blackflies by specially designed aircraft capable of applying ULTRA LOW VOLUME of finished spray formulation or by ground application with non-thermal or mechanical spray equipment that can deliver spray particles within the aerosol size range and at specified dosage levels.

NOTICE: This concentrate cannot be diluted in water. Mix well before using. Avoid storing excess formulation in spray equipment tank beyond the period needed for application.

ULTRA LOW VOLUME APPLICATIONS

For use in nonthermal ULV portable backpack equipment similar to the Hudson B.P., mix 70 fl oz (2068 ml) of this product with 1 gal (3.79 L) of refined soybean oil, light mineral oil of 54 second viscosity or other suitable solvent or diluent. Adjust equipment to deliver fog particles of 18-50 microns mass median diameter. Apply at the rate of 4.25-8.50 fl oz of finished formulation per acre (311-621 ml/ha) as a 50 ft (15.2 m) swath while walking at a speed of 2 mph (3.2 kph). This is equivalent to 0.0035-0.0070 lb ai SBP-1382/A (3.92- 7.85 gm/ha) plus 0.0105- 0.0210 lb ai piperonyl butoxide tech./A (11.77-23.54 gm/ha). Where dense vegetation is present, the higher rate is recommended.

For truck mounted nonthermal ULV equipment similar to LECO HD or MICRO-GEN or WHISPERMIST-XL, adjust equipment to deliver fog particles of 8-20 microns mass median diameter. Consult the following chart for application rates.

Treatment lb ai/A of Scourge Wanted SBP-1382/PBO	Fl oz/A of Undiluted Spray to be Applied	Application Rate-Fl oz/Min	
		5 MPH	10 MPH
0.007/0.021	3.0(90 ml)	9.0(266.2ml)	18.0(532.3ml)
0.0035/0.0105	1.5(45 ml)	4.5(133.1 ml)	9.0(266.2 ml)
0.00175/0.00525	0.75(22.5 ml)	2.25(66.6 ml)	4.5(133.1 ml)
0.00117/0.00351	0.50(15 ml)	1.50(45 ml)	3.0(90 ml)

Where dense vegetation is present, the use of the higher rates and/or slower speed is recommended.

For best results, fog only when air currents are 2-8 mph (3.2-12.9 kph). It is preferable to fog during early morning and evening when there is less breeze and convection currents are minimal. Arrange to apply the fog in the direction with breeze to obtain maximum swath length and better distribution. Direct spray head of equipment in a manner to insure even distribution of the fog throughout the area to be treated. Avoid prolonged inhalation of fog.

Where practical, guide the direction of the equipment so that the discharge nozzle is generally maintained at a distance of more than 6 feet (1.83 m) from ornamental plants and 5-15 feet (1.5-4.5 m) or more from painted objects. Temperature fluctuations will require periodical adjustment of equipment to deliver the desired flow rate at the specified speed of travel. The flow rate must be maintained to insure the distribution of the proper dosage of finished formulation.

Spray parks, campsites, woodlands, athletic fields, golf courses, swamps, tidal marshes, residential areas and municipalities around the outside of apartment buildings, restaurants, stores and warehouses. Do not spray on cropland, feed or foodstuffs. Avoid direct application over lakes, ponds and streams.

DIRECTIONS FOR STABLE FLY, HORSE FLY, DEER FLY CONTROL:

Treat shrubbery and vegetation where the above flies may rest. Shrubbery and vegetation around stagnant pools, marshy areas, ponds and shore lines may be treated. Application of this product to any body of water is prohibited.

For control of adult flies in residential and recreational areas, apply this product undiluted at a rate of 178 fl oz/hr (5.26 L/hr) by use of a suitable ULV generator travelling at 5 mph (8 kph) or at a rate of 356 fl oz/hr (10.53 L/hr) while travelling at 10 mph (16 kph). When spraying, apply across wind direction approximately 300 ft (91.4 m) apart.

Apply when winds range from 1-10 mph (1.6-16.0 kph). Repeat for effective control.

DIRECTIONS FOR AERIAL APPLICATIONS
FOR USE WITH FIXED-WING AND ROTARY AIRCRAFT

This product is used in specially designed aircraft capable of applying ultra low volume of undiluted spray formulation for control of adult mosquitoes (including organophosphate resistant species), midges (biting and non-biting) and blackflies.

Aerial application should be made preferably in the early morning or evening. Application should be made preferably when there is little or no wind.

It is not recommended to make application when wind speeds exceed 10 mph (16 kph). Repeat applications should be made as necessary. Apply preferably when temperatures exceed 50°F (10°C).

May be used as a mosquito adulticide in recreational and residential areas, and in municipalities, around the outside of apartment buildings, golf courses, athletic fields, parks, campsites, woodlands, swamps, tidal marshes, and overgrown waste areas.

Do not spray on cropland, feed or foodstuffs. Avoid direct application over lakes, ponds and streams.

lb ai/A Wanted SBP-1382/PBO	Fl oz/A of Undiluted Spray to be Applied
0.007/0.021	3.0 (90 ml)
0.0035/0.0105	1.5 (45 ml)
0.00175/0.00525	0.75 (22.5 ml)
0.00117/0.00351	0.50 (15 ml)

IMPORTANT: READ BEFORE USE

Read the entire Directions for Use, Conditions, Disclaimer of Warranties and Limitations of Liability before using this product. If terms are not acceptable, return the unopened product container at once.

By using this product, user or buyer accepts the following conditions, disclaimer of warranties and limitations of liability.

CONDITIONS: The directions for use of this product are believed to be adequate and should be followed carefully.However, because of manner of use and other factors beyond Bayer Environmental Science's control, it is impossible for Bayer Environmental Science to eliminate all risks associated with the use of this product. As a result, crop injury or Ineffectiveness is always possible. All such risks shall be assumed by the user or buyer.

DISCLAIMER OF WARRANTIES: BAYER ENVIRONMENTAL SCIENCE MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE OR OTHERWISE, THAT EXTEND BEYOND THE STATEMENTS MADE ON THIS LABEL. No agent of Bayer Environmental Science is authorized to make any warranties beyond those contained herein or to modify the warranties contained herein. Bayer Environmental Science disclaims any liability whatsoever for special, incidental or consequential damages resulting from the use or handling of this product.

LIMITATIONS OF LIABILITY: THE EXCLUSIVE REMEDY OF THE USER OR BUYER FOR ANY AND ALL LOSSES, INJURIES OR DAMAGES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT, WHETHER IN CONTRACT, WARRANTY, TORT, NEGLIGENCE, STRICT LIABILITY OR OTHERWISE, SHALL NOT EXCEED THE PURCHASE PRICE PAID, OR AT BAYER ENVIRONMENTAL SCIENCE'S ELECTION, THE REPLACEMENT OF PRODUCT.

Bayer Environmental Science
A Business Group of Bayer CropScience LP
95 Chestnut Ridge Road
Montvale, NJ 07645
S4-12-SL-9/02

CLARKE

ANVIL® 2+2 ULV

Contains An Oil Soluble Synergized Synthetic Pyrethroid For Control of Adult Mosquitoes (Including Organophosphate-Resistant Species) Midges, and Black Flies in Outdoor Residential and Recreational Areas.

Precautionary Statements
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

Harmful if absorbed through the skin. Do not induce vomiting because of aspiration pneumonia hazard. Avoid contact with skin, eyes or clothing. In case of contact flush with plenty of water. Wash with soap and water after use. Obtain medical attention if irritation persists. Avoid contamination of food and feedstuffs.

ENVIRONMENTAL HAZARDS

Do not contaminate untreated water by cleaning of equipment. Cleaning of equipment or disposal of wastes must be done in a manner that avoids contamination of bodies of water or wetlands. This product is toxic to fish. For terrestrial uses, do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark.

PHYSICAL OR CHEMICAL HAZARDS

Do not use or store near heat or open flame.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

USE AREAS: For use in mosquito adulticiding programs Involving outdoor residential and recreational areas where adult mosquitoes are present in annoying numbers in vegetation surrounding parks, woodlands, swamps, marshes, overgrown areas and golf courses.

IN CALIFORNIA: This product is to be applied by County Health Department, State Department of Health Services, Mosquito and Vector Control or Mosquito Abatement District personnel only.

For best results, apply when mosquitoes are most active and weather conditions are conducive to keeping the fog close to the ground. i.e. cool temperatures and wind speed not greater than 10 mph.

E.P.A. EST. No. 8329-IL-01
EPA Reg. No.1021-1687-8329

NET CONTENTS

LOT NO.

ACTIVE INGREDIENTS:	
3-Phenoxybenzyl-(1RS, 3RS; 1RS, 3SR)-2,2-dimethyl-3-(2-methylprop-1-enyl) cyclopropanecarboxylate	2.00%
* Piperonyl Butoxide, Technical	2.00%
** INERT INGREDIENTS	96.00%
	100.00%

* Equivalent to 1.60% (butylcarbityl) (6-propylpiperonyl) ether and .40% related compounds

** Contains a petroleum distillate

Contains 0.15 pounds of Technical SUMITHRIN®/Gallon and 0.15 pounds Technical Piperonyl Butoxide/Gallon

SUMITHRIN®- Registered trademark of Sumitomo Chemical Company, Ltd.

KEEP OUT OF REACH OF CHILDREN

CAUTION

PRECAUCION AL USUARIO: Si usted no lee ingles, no use este producto hasta que la etiqueta haya sido explicado ampliamente.

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: Call a physician or Poison Control Center immediately. Do not induce vomiting because of aspiration pneumonia hazard.

IF IN EYES: Flush eyes with plenty of water. Call a physician if irritation persists.

IF ON SKIN OR CLOTHING: Remove contaminated clothing and wash before reuse. Wash skin with soap and warm water. Get medical attention if irritation persists.

IF INHALED: Remove victim to fresh air. If not breathing, give artificial respiration, preferably mouth to mouth.

For information regarding medical emergencies or pesticide incidents, call the International Poison Center at 1-888-740-8712.

DISTRIBUTED BY

CLARKE MOSQUITO CONTROL PRODUCTS, INC.

159 N. GARDEN AVENUE • ROSELLE, ILLINOIS 60172

NOTICE: Seller makes no warranty, expressed or implied concerning the use of this product other than indicated on the label. Buyer assumes all risk of use and/or handling of this material when use and/or handling is contrary to label instructions.

GROUND ULV APPLICATION

APPLICATION AND DILUTION DIRECTIONS: Consult the following table for examples of various dosage rates using a swath width of 300 feet for acreage calculations. This product should be used in cold aerosol generators capable of producing droplets with a MMD of 5 to 25 microns.

Dosage Rate	Flow Rates in fluid oz./minute at truck speeds of:			
lbs.A.I./acre	5MPH	10MPH	15MPH	20MPH
0.0036	9.3 oz.	18.6 oz	27.9 oz	37.2 oz
0.0024	6.2 oz	12.4 oz	18.6 oz	24.8 oz
0.0012	3.1 oz	6.2 oz	9.3 oz	12.4 oz

ANVIL 2 + 2 ULV may be applied undiluted with a non-thermal ULV portable "backpack" spray unit capable of delivering particles in the 5 to 25 micron range. Apply at a walking speed 2 mph, making sure that the same amount of A.I. is applied per acre.

ANVIL 2 + 2 ULV may be applied with suitable thermal fogging equipment. Do not exceed the maximum rates listed above. May be applied at speeds of 5 to 20 mph.

Prohibition on aerial use: Not for aerial application in Florida unless specifically authorized by the Bureau of Entomology, Florida Department of Agriculture and Consumer Services.

AERIAL APPLICATION

Prohibition on aerial use: Not for aerial application in Florida unless specifically authorized by the Bureau of Entomology, Florida Department of Agriculture and Consumer Service.

Dosage Rate	Flow Rates in fluid oz./acre
lbs.A.I./acre	ANVIL® 2 + 2 ULV
0.0036	3.0 oz
0.0024	2.0 oz
0.0012	1.0 oz

Aerial applications should be done by suitable aerial ULV equipment capable of producing droplets with an MMD of 50 microns or less with no more than 2.5% exceeding 100 microns. Flow rate and swath width should be set so as to achieve 1.0 to 3.0 fluid ounces of ANVIL® 2+2 ULV per acre. Both aerial and ground applications should be made when wind is less than 10 MPH. For application by Public Health Officials and personnel of Mosquito Abatement Districts and other mosquito control programs.

ANVIL 2 + 2 ULV cannot be diluted in water. Dilute this product with light mineral oil if dilution is preferred.

STORAGE & DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

STORAGE: Store in a cool, dry place. Keep container closed.

CONTAINER DISPOSAL: Triple rinse (or equivalent) then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other approved state and local procedures.

PESTICIDE DISPOSAL: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

FOR MORE INFORMATION CALL: 1-800-323-5727

12/11/00

PYRENONE® 25-5

PUBLIC HEALTH INSECTICIDE

Specimen Label

* *FOR USE BY TRAINED PERSONNEL ONLY.*
* *TO BE APPLIED ONLY BY OR UNDER THE SUPERVISION OF PEST CONTROL OPERATORS, MOSQUITO ABATEMENT DISTRICTS, PUBLIC HEALTH ORGANIZATIONS AND OTHER TRAINED PERSONNEL RESPONSIBLE FOR INSECT CONTROL PROGRAMS.*
* *FOR INDOOR AND OUTDOOR APPLICATION AS A SPACE, AREA OR CONTACT SPRAY.*
* *DEPENDENT UPON PESTS TO BE CONTROLLED AND THE AREA TO BE TREATED, MAY BE APPLIED THROUGH MECHANICAL AEROSOL GENERATORS (ULV) OR THERMAL FOGGING EQUIPMENT AS WELL AS CONVENTIONAL FOGGING OR SPRAYING EQUIPMENT.*
* *MAY BE USED OVER ALL CROPS.*
* *THE ACTIVE INGREDIENTS ARE EXEMPT FROM TOLERANCES WHEN APPLIED TO GROWING CROPS [see 40 CFR § 180.1001 (b)]*

ACTIVE INGREDIENTS	
♦Pyrethrins	5.0%
*▲Piperonyl Butoxide, Technical	25.0%
†OTHER INGREDIENTS	70.0%
	100.0%

*Equivalent to 20% (butylcarbityl) (6-propylpiperonyl) ether and 5% related compounds.
†Contains Petroleum Distillate
♦Contains 0.367 pounds of Pyrethrins per gallon.
▲Contains 1.83 pounds of Piperonyl Butoxide per gallon.

KEEP OUT OF REACH OF CHILDREN

CAUTION

See Rear Panel For Additional Precautions

EPA REG. NO. 432-1050

EPA EST. NO.

NET CONTENTS:

BAYER ENVIRONMENTAL SCIENCE
A Business Group of Bayer CropScience LP
95 Chestnut Ridge Road • Montvale, NJ 07645

FIRST AID

IF SWALLOWED: Call a doctor or get medical attention. Do not induce vomiting. Do not give anything by mouth to an unconscious person. Avoid Alcohol.

IF INHALED: Remove victim to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. Get medical attention.

IF IN EYES: Flush eyes with plenty of water. Call a physician if irritation persists.

IF ON SKIN: Wash with plenty of soap and water. Get medical attention if irritation persists.

In case of Medical emergencies or health and safety inquiries or in case of fire, leaking or damaged containers, information may be obtained by calling 1-800-471-0660.

For Product Information Call Toll-Free: 1-800-331-2867

PRECAUTIONARY STATEMENTS
Hazards To Humans & Domestic Animals

CAUTION

Harmful if swallowed or inhaled. Avoid breathing spray mist. Avoid contact with skin, eyes or clothing. Wash thoroughly with soap and water after handling. Remove contaminated clothing and wash clothing before re-use. Remove pets, birds and cover fish aquaria before spraying.

Do not apply as a space spray while food processing is underway. Except in Federally inspected meat and poultry plants, when applied as a surface spray with care and in accordance with the directions and precautions given above, food processing operations may continue. Foods should be removed or covered before treatments. In food processing areas all surfaces must be washed and rinsed in potable water after spraying.

When using in animal quarters, do not apply directly to food, water or food supplements. Wash teats of dairy animals before milking.

Environmental Hazards

This product is toxic to fish. For terrestrial uses, do not apply directly to water, to areas where surface water is present, or to intertidal areas below the mean high water mark. Do not apply when weather conditions favor drift from areas treated. Do not contaminate water by cleaning of equipment or disposal of wastes. Shrimp and crab may be killed at application rates recommended on this label. Do not apply where these are important resources. Apply this product only as specified on this label.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

Pesticide Storage And Spill Procedures: Store upright at room temperature. Avoid exposure to extreme temperatures. In case of spill or leakage, soak up with an absorbent material such as sand, sawdust, earth, fuller's earth, etc. Dispose of with chemical waste.

Pesticide Disposal: Pesticide, spray mixture or rinse water that cannot be used according to label instructions may be disposed of on site or at an approved waste disposal facility.

Container Disposal: Triple rinse (or equivalent) then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other approved State and local procedures.

CONTAINERS ONE GALLON AND SMALLER: Do not re-use container. Wrap container in several layers of newspaper and discard in trash.

SPACE AND/OR CONTACT USE AREAS:

Homes	Poultry Houses
Horse Barns	Schools
Hotels	Supermarkets
Industrial Installations	Swine Houses
Motels	Truck Trailers
Office Buildings	Wineries

OUTDOOR USE AREAS:

Recreational areas	Golf courses	Corrals
Drive-in Restaurants	Municipalities	Zoos
Drive-in Theaters	Swine Yards	Parks
Residences	Feedlots	Playgrounds
Vineyards		

PYRENONE® 25-5 Public Health Insecticide is effective in the control of the indicated insects if the applicator follows directions for use as enumerated below:

All Common Diptera	
Deer Flies	***Lice***
Fruit Flies	***Mosquitoes***
Gnats	***Small Flying Moths***
Horn Flies	***Stable Flies***
Horse Flies	***Wasps***
House Flies	

INDOOR USE AS A SPACE SPRAY, DILUTED:
For use in conventional mechanical fogging equipment, to kill ***Flies, Fruit Flies, Mosquitoes and Gnats.*** Cover or remove exposed food and food handling surfaces. Close room and shut off all air conditioning or ventilating equipment. Dilute 1 part of Pyrenone 25-5 plus 49 parts of oil or suitable solvent and mix well. Apply at the rate of 1-2 fl. oz. per 1000 cu. ft. filling the room with mist. Keep area closed for at least 15 minutes. Vacate treated area and ventilate before reoccupying. Repeat treatment when reinfestation occurs.

SURFACE SPRAY: As an aid in the control of ***Mosquitoes, Gnats and Wasps.*** Treat walls, ceilings, moldings, screens, door and window frames, light cords and similar resting places.

ANIMAL QUARTER USE: (cattle barns, horse barns, poultry houses, swine houses, zoos): As a space spray diluted for use in conventional mechanical fogging equipment to kill ***Flies, Mosquitoes, Small Flying Moths and Gnats.*** Dilute 1 part of Pyrenone 25-5 Public Health Insecticide plus 49 parts oil or suitable solvent and mix well. Apply at a rate of 2 fl. oz. per 1,000 cu. ft. of space above the animals. Direct spray towards the upper portions of the enclosure. Keep area closed for at least 15 minutes. Vacate treated area and ventilate before reoccupying. Repeat treatment when reinfestation occurs.

TEMPORARY REDUCTION OF ANNOYANCE from ***Flies, Mosquitoes and Small Flying Moths*** outdoors. The directions for outdoor ground application noted below will afford temporary reduction of annoyance from

these pests in public theaters, golf courses, municipalities, parks, playgrounds and recreational areas. Direct application into tall grass, shrubbery and around lawns where these pests may hover or rest. Apply while air is still. Avoid wetting foliage. Application should be made prior to attendance. Repeat as necessary.
In additional outdoor areas (corrals, feedlots, swine lots and zoos), cover water, drinking fountains and animal feed before use. Treat area with mist, directing application into tall grass, shrubbery and around lawns where these pests may hover or rest. Apply while air is still. Avoid wetting foliage. In zoos, avoid exposure of reptiles to the product. Repeat as necessary.

FOR USE ON ANIMALS: To protect beef and dairy cattle and horses from ***Horn Flies, House Flies, Mosquitoes and Gnats,*** dilute 1 part of Pyrenone 25-5 plus 49 parts oil or suitable solvent, mix well and apply a light mist sufficient to wet the tips of the hair. To control ***Stable Flies, Horse Flies and Deer Flies*** on beef and dairy cattle and horses, apply 2 oz. per adult animal, sufficient to wet the hair but not to soak the hide. Repeat treatment once or twice daily or at intervals to give continued protection.

USE IN MOSQUITO CONTROL

Pyrenone 25-5 Public Health Insecticide may be used for mosquito control programs involving residential, industrial, recreational and agricultural areas as well as swamps, marshes, overgrown waste areas, roadsides and pastures where adult mosquitoes occur. Pyrenone 25-5 Public Health Insecticide may be used over agricultural crops because the ingredients are exempt from tolerance when applied to growing crops. For best results, apply when meteorological conditions create a temperature inversion and wind speed does not exceed 10 miles per hour. The application should be made so the wind will carry the insecticidal fog into the area being treated. Treatment may be repeated as necessary to achieve the desired level of control.

When used in cold aerosol generators that produce a fog with the majority of droplets in the 10-25 micron VMD range, Pyrenone 25-5 Public Health Insecticide should be diluted with light mineral oil or suitable solvent (specific gravity of approximately 0.8 at 60°F; boiling point: 500-840°F). An N.F. grade oil is prefered.

GROUND APPLICATION: To control adult mosquitoes and all common diptera, apply up to 0.0025 pounds of pyrethrins per acre (use a 300 foot swath width for acreage calculations).

Truck-Mounted ULV Application: The delivery rate and truck speed may be varied as long as the application rate does not exceed 0.0025 pounds of pyrethrins per acre (use a 300 foot swath width for acreage calculations).

Backpack Spray Application: Dilute 1 part Pyrenone 25-5 Public Health Insecticide with 10 parts oil or suitable solvent and apply at the rate of 7 ounces per acre (based on a 50 foot swath, 7 ounces should be applied while walking 870 feet).

AERIAL APPLICATION (FIXED WING AND HELICOPTER): To control adult mosquitoes and biting flies, apply up to 0.0025 pounds of pyrethrins per acre with equipment designed and operated to produce a ULV spray application.

IMPORTANT: READ BEFORE USE

By using this product, user or buyer accepts the following conditions, disclaimer of warranties and limitations of liability.

CONDITIONS: The directions for use of this product are believed to be adequate and should be followed carefully. However, because of manner of use and other factors beyond Bayer Environmental Science's control, it is impossible for Bayer Environmental Science to eliminate all risks associated with the use of this product. As a result, crop injury or ineffectiveness is always possible. All such risks shall be assumed by the user or buyer.

DISCLAIMER OF WARRANTIES: THERE ARE NO WARRANTIES, EXPRESS OR IMPLIED, OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE OR OTHERWISE, WHICH EXTEND BEYOND THE STATEMENTS MADE ON THIS LABEL. No agent of Bayer Environmental Science is authorized to make any warranties beyond those contained herein or to modify the warranties contained herein. Bayer Environmental Science disclaims any liability whatsoever for incidental or consequential damages, including, but not limited to, liability arising out of breach of contract, express or implied warranty (including warranties of merchantability and fitness for a particular purpose), tort, negligence, strict liability or otherwise.

LIMITATIONS OF LIABILITY: THE EXCLUSIVE REMEDY OF THE USER OR BUYER FOR ANY AND ALL LOSSES, INJURIES OR DAMAGES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT, WHETHER IN CONTRACT, WARRANTY, TORT, NEGLIGENCE, STRICT LIABILITY OR OTHERWISE, SHALL NOT EXCEED THE PURCHASE PRICE PAID, OR AT BAYER ENVIRONMENTAL SCIENCE'S ELECTION, THE REPLACEMENT OF PRODUCT.

Bayer Environmental Science
A Business Group of Bayer CropScience LP
95 Chestnut Ridge Road
Montvale, NJ 07645

Py 25-5 PH-SL-9/02 Bayer

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7396-902

PYROCIDE® Mosquito Adulticiding
Concentrate for ULV Fogging 7396

Recommended for use by Commercial or Governmental Mosquito Control Personnel

	ACTIVE INGREDIENTS:	
	Pyrethrins	5.00%
*	Piperonyl butoxide, Technical	25.00%
**	OTHER INGREDIENTS	70.00%
		100.00%

* Equivalent to 20.00% (butylcarbityl) (6-propylpiperonyl) ether and 05.00% related compounds.
** Contains petroleum distillate
PYROCIDE® - Registered trademark of McLaughlin Gormley King Co.

KEEP OUT OF REACH OF CHILDREN

CAUTION

FIRST AID	
IF SWALLOWED:	▪ Immediately call a poison control center or doctor. ▪ Do not give any liquid to the person. ▪ Do not induce vomiting unless told to do so by a poison control center or a doctor. ▪ Do not give anything by mouth to an unconscious person.
IF IN EYES:	▪ Hold eye open and rinse slowly and gently with water for 15-20 minutes. ▪ Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eyes. ▪ Call a poison control center for treatment advice.
IF ON SKIN OR CLOTHING:	▪ Take off contaminated clothing. ▪ Rinse skin immediately with plenty of water for 15-20 minutes. ▪ Call a poison control center or doctor for treatment advice.
IF INHALED:	▪ Move person to fresh air. ▪ If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth if possible. ▪ Call a poison control center or doctor for further treatment advice.
NOTE TO PHYSICIAN: This product contains petroleum distillate and may pose an aspiration pneumonia hazard. Have the product container or label with you when calling a poison control center or doctor, or going for treatment. For information regarding medical emergencies or pesticide incidents, call the International Poison Center at 1-888-740-8712.	

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

Harmful if swallowed, inhaled, or absorbed through skin. Causes eye irritation. Avoid contact with skin, eyes, or clothing. Avoid breathing vapors or spray mist. Wash thoroughly with soap and water after handling. Remove contaminated clothing and wash before reuse.

ENVIRONMENTAL HAZARDS

This product is toxic to fish and other aquatic invertebrates. For terrestrial uses, do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water by cleaning of equipment or disposal of wastes. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance contact your State Water Board or Regional Office of the EPA.

PHYSICAL OR CHEMICAL HAZARDS

Do not use or store near heat or open flame.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product
in a manner inconsistent with its labeling.

This concentrate is formulated to be diluted with a suitable oil diluent, such as (but not restricted to) light mineral oil, deodorized kerosene or petroleum distillate, for use in cold fog aerosol generators.

This concentrate may be diluted or used as supplied for mosquito control programs involving residential, industrial, recreational and agricultural areas, swamps, marshes, overgrown waste areas, roadsides and pastures where adult mosquitoes occur.

Use in agricultural areas should be in such a manner as to avoid residues in excess of established tolerances for pyrethrins and piperonyl butoxide on crops or commodities.

Best results are expected from application when the meteorological conditions favor an inversion of air temperatures in the area treated, and when the wind is not excessive. Repeated applications may be made as necessary to obtain the desired reduction in adult mosquitoes.

This pesticide may be applied with equipment designed and operated to produce a suitable ultra low (ULV) spray application, which meets the dosage per acre objective of not more than .0025 pounds of pyrethrins and .0125 pounds of piperonyl butoxide per acre.

Back pack application may require a greater rate of dilution than the dilution used for vehicle or aircraft mounted sprayers, in order to achieve the desired rate of application of active ingredients per acre.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage and disposal.

STORAGE: Store in a cool, dry place. Keep container closed.

PESTICIDE DISPOSAL: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

CONTAINER DISPOSAL: Triple rinse (or equivalent) and offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill or by other approved State and Local procedures.

Net Contents _____
Manufactured by:
Mc LAUGHLIN GORMLEY KING COMPANY
8810 Tenth Avenue North

EPA Reg. No. 1021-1569

Minneapolis, MN
55427
EPA Est. No. 1021-

MN-2

Appendix G Technical Advisory Board Meeting Notes February 15, 2006

Present:	**MMCD Representatives**
Gary Montz, Chair, MN Dept of Natural Resources	Morris Anderson
Susan Palchick, Hennepin Co. Community Health	Stephen Manweiler
Steven Hennes, MN Pollution Control Agency	Nancy Read
Robert Sherman, Independent Statistician	Mike McLean
Terry Schreiner, US Fish & Wildlife Service	Kirk Johnson
Rick Bennett, US Environmental Protection Agency	Mark Smith
Karen Oberhauser, University of Minnesota	Carey LaMere
Roger Moon, University of Minnesota	Janet Jarnefeld
Sarma Straumanis, MN Dept of Transportation	Diann Crane
Val Cervenka, MN Dept of Agriculture	John Walz
Dave Neitzel, MN Dept of Health	Jim Stark
Larry Gillette, Three Rivers Park District	Sandy Brogren

Welcome and Call to Order - Chair Gary Montz (12:35 pm)

Welcome from Interim Director Morris Anderson
Morris Anderson welcomed the TAB members to this meeting as a great opportunity for MMCD, as an agency, to pause and take a look at what we're doing and get review from other agencies.

Introduction of new TAB members
Gary Montz introduced Rick Bennett who assumed the US EPA seat held by outgoing TAB member, Danny Tanner. Sarma Straumanis replaces Greg Busacker for the MN Department of Transportation on the TAB.

2005 Season Overview
Stephen Manweiler reviewed the new larvicide strategy used during 2005 and MMCD's response to 2005 TAB resolution on WNV research. This resolution encouraged MMCD "to continue research and communication on all aspects of WNV, including biology of vectors, disease risk, and options for and environmental consequences of control, recognizing that only through such effort will there be effective control."

The District's 2005 larvicide strategy used more Altosid® pellets and Vectolex® (*Bacillus sphaericus*). A seventh helicopter was also used enabling the District to expand larvicide treatments into Zone 2. The larvicide strategy was designed to help mitigate the effects of intense early season rainfall and enable MMCD to expand the area receiving larval control. One emphasis of the expanded larval treatment strategy was to treat sites known to breed often with Altosid® pellets or Vectolex®. Time and resources saved by not needing to retreat these sites as often could be used to apply more *Bti* and do other work as needed. Catch basin treatments were again done three times.

Adult mosquito populations were elevated from early June through mid-July, after which they dropped to levels much lower than in the summer of 2004. Earlier rains in 2004 than in 2005 and the 2005 larvicide strategy could account for the difference between mosquito abundance patterns in 2004 and 2005. Total average District-wide rainfall (May-Sept) in 2005 was more than one inch higher than 2004.

Before the 2006 season, MMCD will review its larvicide strategy focusing upon improved use of the seventh helicopter and opportunities to expand use of Vectolex®. Bob Sherman asked what Vectolex® contained. Stephen Manweiler replied that Vectolex® contains *Bacillus sphaericus*, another biological larvicide similar to *Bti*.

Mosquito and Tick-borne Disease in 2005

Kirk Johnson outlined MMCD disease risk response, including:

- LAC case counts and locations, including an unusual positive mosquito sample.
- Continued surveillance for *Culiseta melanura*, a relatively rare EEE vector,
- WNV cases in US – focal points in the northern great plains, Chicago, Gulf states, California; each of 48 states had documented WNV activity and reports are still coming in,
- Regional, local case distributions, evidence of virus activity
- Possible involvement of *Culiseta inornata* in early spring WNV in horses
- MMCD's seven-county area experienced seven human cases, four were probably exposed locally (see Chapter 2 of report)
- Graph – distribution of positive birds per week as % of season total; 2005 had later date of peak of positive birds, which could mean later amplification,
- Tick surveillance – Dave Neitzel reported elevated numbers of Lyme and human granulocytic anaplasmosis (formerly called ehrlichiosis). Cases were also found further north and west in the state suggesting that tick-borne disease distributions are changing.
- Karen Oberhauser asked if Lyme vaccines were still available. Dave Neitzel indicated that an approved vaccine was withdrawn, because of possible side effects, and that there are no known new providers.
- Dave Neitzel asked about the impact of cooler temperatures in early summer. Kirk Johnson said that cool, wet weather may have delayed the start of WNV, but we may also have seen a dip in carry-over from 2004 due to much cooler than average late summer conditions.

Adult Mosquito Surveillance

Stephen Manweiler discussed surveillance issues, including:

- A brief update of the taxonomy debate over *Ochlerotatus* vs *Aedes*. MMCD is using *Aedes* in agreement with the Journal of Medical Entomology. (Susan Palchick noted that *triseriatus* was listed both ways in the draft TAB report. This will be fixed.)
- Adulticide is not applied without verifying that mosquito abundance meets or exceeds threshold.
- Described different mosquito surveillance methods used, which species are targeted, and treatment thresholds.
- In general, one-third or more CO_2 trap counts met the *Culex* threshold and the District has collected WNV positive mosquito pools.

- More CO_2 trap counts contained below-threshold numbers of *Culex* along with threshold levels of other mosquitoes so it is hard to say that control based on these samples is "only for annoyance."
- In many situations, CO_2 trap counts alert District staff to areas of high mosquito abundance. Additional adult mosquito surveillance (usually a two-minute slap count) is commonly conducted immediately preceding an adulticide application to verify the presence of threshold levels of mosquitoes. MMCD needs to modify its databases to record all surveillance associated with an adulticide treatment, not only surveillance conducted immediately before the treatment.

Larry Gillette asked what radius is represented by monitoring samples. Stephen Manweiler indicated that treatments are usually very close to surveillance, but some surveillance can be collected up to a mile away. In most cases, this is initial surveillance with additional surveillance conducted at the site of the treatment immediately before the treatment.

Karen Oberhauser asked if MMCD treats every time a threshold is met. Stephen Manweiler responded that meeting the threshold is required before treatment will be considered but does not automatically trigger a treatment.

Roger Moon asked if CDC traps are more attractive to *Culex* species. Stephen Manweiler replied that CDC traps collect adult mosquitoes for several hours and are more likely to collect less abundant *Culex* mosquitoes compared to two-minute sweeps or slaps.

Bob Sherman asked if MMCD has ever correlated species distribution in samples to get at the disease vs annoyance question. Roger Moon suggested that MMCD examine the motivation for adulticiding by breaking it down three ways: adulticide treatments specifically for disease risk reduction, specifically for annoyance reduction, and treatments for both reasons.

Rick Bennett asked if there was a way to compare MMCD's use of control materials with that of the general public. Stephen Manweiler and Nancy Read responded that MMCD uses far more larvicides than the general public. Comparing adulticide use by MMCD and others is harder because mosquito control adulticides are readily available to the public, who do not keep usage records. Nancy Read said that some information could be gleaned from MMCD's public survey data (e.g., 1% of respondents report hiring a professional to spray for mosquitoes) (see 2004 Operational Review).

Dave Neitzel indicated that *Culex* are driving West Nile virus, but there continues to be some concern about non human-biters. He was not sure how well adult control in response to non-human biters reduced disease risk compared to adult control in response to threshold levels of vectors. Stephen Manweiler noted that if the District didn't respond to high *Ae. vexans* counts, we would be open to criticism. In many situations, both vector and nuisance mosquitoes are present together.

Karen Oberhauser asked if these data were in the Draft report and asked for more solid answers in the final draft. Stephen Manweiler responded that we need to be able to better associate all

surveillance (not only that conducted immediately before the treatment) with adult control to more accurately relate vector and nuisance thresholds to adult control.

Review of Efficacy Testing
Stephen Manweiler discussed efficacy data (see Chapter 5 of report), including:

- Aerially applied Altosid® pellets – Bioassay results indicated pellets achieved four weeks of excellent control.
- Vectolex® – Pre/post treatment counts from 29 sites dipped showed that Vectolex® achieved four weeks of excellent control. Susan Palchick asked what species were used. Stephen Manweiler said that pupae were mixed species but that the majority was *Ae. vexans*.
- Altosid® briquets in catch basins – Collecting a large enough number of bioassays was very difficult (only six successful bioassays out of over 100 attempted pupal collections). We also conducted larval dip counts before and after treatment for more evidence that briquets suppressed larvae. Also, a much lower percentage of briquet-treated catch basins contained larvae than control catch basins.
- Roger Moon suggested that MMCD use a lab bioassay of Altosid® briquets to determine if briquets will kill larvae. He also asked if catch basins themselves may be islands. Does control affect the likelihood of re-colonization by *Culex* (therefore fewer larvae)?
- Kirk Johnson noted that untreated control catch basins are in same area as those treated with briquets. One would expect both control and briquet-treated catch basins to have the same chance of containing larvae. If fewer females came from treated catch basins, this should result in less oviposition throughout control and treated catch basins.

TAB members expressed satisfaction with the efficacy tests. They would like to see exact larval counts for all samples, not just exact counts up to a maximum of 100 larvae per dip. An artificial maximum number renders mean values hard to interpret. We will modify sampling protocols.

- Adulticides – Scourge – Low & High tests, average reduction of 78-86% (corrected for changes in trap catch at the untreated control site using Mulla's formula). Inclusion of caged mosquitoes demonstrated that Scourge droplets reached heights of 20+ feet in trees and directly killed mosquitoes (including *Culex*) at these heights.
- Larry Gillette noted that the test indicates that Scourge worked the night of treatment but has little residual effect. Larry Gillette asked if Scourge use was best for special events, not necessarily for a neighborhood. Stephen Manweiler suggested that, in a neighborhood, we would want more traps to see what is going on spatially; this test was designed to determine if ULV Scourge treatments can control mosquitoes higher in trees thereby impacting mosquitoes potentially feeding on birds and involved in WNV amplification.

Break – 5 min

Nontarget Studies – Monarch Research
Adulticides permethrin and resmethrin were studied in relation to monarch butterflies.
Karen Oberhauser outlined the risk assessment framework:
Risk = Probability of exposure x probability of a toxic effect.

- Exposure – temporal overlap. Monarchs oviposit and develop during the season when adulticides are applied.
- Toxicity – related to size/age of insect, and pesticide dose.
- Permethrin studies
    - Field dose studies – exposure from normal spray operations saw high mortality in larvae fed leaves, with a small decrease in effect over time, but still 61% mortality from leaves eaten by larvae 21 days after spray date.
    - Sublethal effect study – dilutions – had to get down to 0.1 or 0.5% of normal dose to get less mortality; used 0.1 (less than 50% mortality); larvae that survived diluted pemethrin treatments took longer to reach adulthood (difference about 2 days); did not detect a statistically significant difference in body mass.
    - Persistence – potted plants, sprayed next to a trail by MMCD (operational dose), tested inside or outside (UV difference), watering from above (simulated rain), tested 1, 7, 14 days after treatment, almost all larvae that fed on treated plants in any treatment died. Conclusion: UV, rain doesn't reduce effect in first 14 days.
- Resmethrin studies
    - Field exposure, distance from spray path, placed larvae and mosquito adults; trials showed variable effect on monarchs (highest was 70% mortality at 75 ft downwind); all downwind locations had 100% mortality of caged mosquitoes.
    - Persistence (2005)- exposed plants to fog, later fed to larvae, up to 550 ft from treatment path, results highly variable relative to distance – some close larvae survived, some at 100 to 250 ft downwind were affected. Mortality was highest on day of treatment (about 35%) and declined over four days to about 10%.
    - No sublethal effects found with resmethrin.
    - Caged house flies and milkweed bugs were not affected at any distance up or downwind from the spray.

Steven Hennes asked if these results were surprising given toxicity of these materials to Lepidoptera. Karen Oberhauser responded that resmethrin degrades faster; permethrin is surprisingly persistent.

- Probability of exposure
    - Temporal overlap – have nine years of citizen observations on time that monarchs are in the environment. Late summer important because they migrate to Mexico.
    - Oviposition – if females avoid plant, then only have to worry about death of larvae on plant at time of treatment; put females on treated plants, females died on treated plants at 1 day ("dead females don't lay eggs"), no female mortality at days 8 and 15, no difference in oviposition on treated vs untreated in later dates (females did not avoid treated plants).
    - Permethrin – long persistence, no ovisposition avoidance, longer period of exposure risk.
    - Resmethrin – short persistence, variable effect of distance, overall lower mortality.

Karen Oberhauser said that an assessment of the milkweed-adulticide spatial overlap is required to evaluate the effect of MMCD operations on monarchs by estimating what proportion of

monarch habitat is exposed to adulticides. This should be followed by more detailed studies of the effect of these materials on adult monarchs. Additional questions involve potential effects on other herbivores.

Milkweed-Adulticide Spatial Overlap

Nancy Read showed TAB members results of a study of milkweed distribution in the District. She determined milkweed distribution by randomly choosing quarter-quarter sections to inspect for presence of milkweed plants which were mapped using a GPS unit. She compared milkweed distribution to District treatment records and found:

Of 1,901,412 total acres in the seven-county metro area, less than 80,000 were treated with adulticides. Some of the 73,392 acres worth of adulticide treatments apply to areas treated more than once, so the actual figure is less. By overlapping milkweed distribution and permethrin treatments, Nancy demonstrated that less than one percent (maximum of 0.8%) of milkweed was treated with permethrin.

Terry Schreiner asked about the swath width used in determining how much treatment was done. Nancy Read replied that the swath designated on the product label was used unless our treatment maps indicated a larger swath.

Roger Moon asked about the difference in exposure rates in rural, urban, and suburban areas. Nancy Read replied that we are still analyzing the data.

Bob Sherman said he appreciated the way MMCD data was employed in the study.

Roger Moon asked if we should be in the business of encouraging milkweed. Is milkweed density a predictor of monarch density? Karen Oberhauser noted that per plant density of eggs drops as plant density increases.

Terry Schreiner asked if the effects of treatment are cumulative. He noted that it's hard to see a single treatment as a significant impact, but all impacts need to be considered.

At that point, Gary Montz asked if the meeting should be extended. The group approved.

Karen Oberhauser said she wanted to commend MMCD for decrease in adulticide use during 2005 after five years of increases.

Bob Sherman said "I would endorse that we commend MMCD for its review and careful attention to the issues within the TAB sphere of influence."

Gary Montz didn't disagree, but thought that one week was insufficient time for thorough review of the draft report. He strongly recommended that the TAB be given more time for review and thought that 2 to 3 weeks would be ideal.

Susan Palchick asked if a single report per year was sufficient. Perhaps some type of interim communication would be useful and that much of the information could be somehow placed online.

Roger Moon noted that there were interest groups within the TAB already functioning (i.e. the environmental assessment group). Perhaps the TAB could adopt a sub-committee structure around the interests of individual TAB members.

Dave Neitzel reported that there is ongoing communication between his office and MMCD around issues critical to the Department of Health.

Karen Oberhauser said that she would like to see more efficacy studies. She appreciated the larval efficacy data and would like to see the same attention to adulticide studies, particularly permethrin. More detailed studies could make a real contribution to the entire mosquito control world.

Steven Hennes said that efficacy studies need to be refined to the species level so that we can get a better handle of species and disease risk factor impacts. Stephen Manweiler responded that MMCD does identify all adult mosquitoes collected in efficacy studies to species. These data are available. In many tests the numbers of many species collected are too low to evaluate species-specific efficacy; most samples are comprised of one or two species. Species-specific results have been and will continue to be reported when samples contain enough of the mosquito species in question to permit valid analyses.

Bob Sherman asked if additional tests were possible, and Morris Anderson said that, within reason, this would be desirable. "The pressure is continuing to prove efficacy. The more we do, the better off we are."

Resolution moved by Karen Oberhauser, seconded by Terry Schreiner:

> Resolve that MMCD carry out more studies of adulticide efficacy with focus on permethrin usage and species specific information, and seek input of interested TAB members and other interested parties in the design of these studies.

Passed unanimously

Gary Montz asked about points of contact between TAB and MMCD. For non-target issues, the contact is Roger Moon, for health risk issues the contact is Dave Neitzel.

Other ways of communicating were discussed including expanded use of MMCD website, perhaps expanding the site to include more information for TAB members.

Susan Palchick said that TAB members were a real resource for staff in areas of efficacy, non-target impacts, and health risk questions.

Resolution moved by Karen Oberhauser, seconded by Larry Gillette

> Resolve that the TAB commend MMCD on the reduction in use of adulticides in 2005, and its continued emphasis on the effectiveness of larval control.

Terry Schreiner asked if the TAB was concerned with the non-target effects of larvicides. Steve Hennes suggested that, given effects over time, larvicides may actually have more effects than adulticides.

Passed 7 yes, 2 no, 1 abstain

Bob Sherman moved and Susan Palchick seconded, that the meeting adjourn.

Gary Montz adjourned the meeting at 3:55 pm.

Next chair: Dave Neitzel (Minnesota Department of Health)