

PRELIMINARY REPORT COMPARING THE EFFECTS  
OF THREE FORMULATIONS OF MATAcil®  
INSECTICIDE ON COMPONENTS OF STREAM  
ECOSYSTEMS

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## INTRODUCTION

Field and laboratory studies were conducted by the Environmental Impact Section of the Forest Pest Management Institute in 1981 to assess the effects on aquatic ecosystems of exposure to MATACIL formulations either currently in use, or proposed for use, in spruce budworm control operations. The field studies were conducted in a small, headwater trout stream in the Goulais River watershed approximately 50 km northeast of Sault Ste. Marie, Ontario. A preliminary analysis of the results of these field studies is presented in this report.

## METHODS

### Formulations and Application

Stock solutions of the test materials were prepared as follows:

I.	Sunspray 7-N	25%
	Automate Red Dye	0.5%
	Insecticide Diluent 585	74.5%
II.	Sunspray 7-N	25%
	Atlox 3409 F	1.25%
	Rhodamine B Dye (20% in coal tar)	0.5%
	Water	73.25%
III.	MATACIL 1.8 D	33.3%
	Automate Red Dye	0.5%
	Insecticide Diluent 585	66.2%
IV.	MATACIL 1.8 F	33.3%
	Automate Red Dye	0.5%
	Insecticide Diluent 585	66.2%
V.	MATACIL 1.8 F	33.3%
	Atlox 3409 F	1.25%
	Rhodamine B Dye (20% in coal tar)	0.5%
	Water	64.95%

Solution I was applied first to the furthest downstream section of the treatment stream, approximately 300 m from the mouth. After allowing sufficient time to complete biological and residue sampling, a second application was made approximately 250 m upstream from the first site using Solution II. This procedure was repeated for Solutions III, IV and V with progressive moves upstream for each application. The minimum time between any two consecutive applications was one week, and the minimum distance between treatment sites was 200 m.

A Micron 'ULVA' Sprayer was used to apply the test materials. According to the manufacturer's specifications, this ultra-low-volume applicator is capable of producing a relatively narrow spectrum of droplet sizes centering around 70  $\mu$  diameter. The sprayer was calibrated in the lab to emit approximately 40 ml of water per minute. In actual field use the emission rate varied between 24-52 ml per minute depending on the viscosity of the spray liquid. All applications were 5 minutes in duration. Using the known emission rate and an estimate of stream discharge, it was possible to calculate the expected peak concentrations of aminocarb in water for Applications III, IV and V.

	Emission Rate (ml/min)	Stream Discharge (l/min)	Theoretical Aminocarb Concentration* (mg/l)
Application I	52	20,400	-
II	44	7,200	-
III	30	6,600	0.273
IV	24	1,800	0.800
V	32	600	3.200

\*Emission Rate/Stream Discharge) x 180/3.

#### Insecticide Residue Sampling

Aminocarb residues in water, sediment and fish tissue were monitored following all three insecticide applications by the Analytical Chemistry Section of the Forest Pest Management Institute. A complete description of the sampling routine and analytical techniques will be provided in a separate report.

#### Biological Sampling

#### Drift

Aquatic invertebrate drift was monitored at two locations for each application; a treated site approximately 100 m below the applica-

tion site and a control site 10-250 m above the application site. Drift samples of measured duration were taken at regular intervals at each location (pre-spray, 0h,  $\frac{1}{2}$ , 1,  $1\frac{1}{2}$ , 2, 3, 4, 5 and 6h after application) using a standard 0.47 m x 0.32 m drift net with a No. 54 (363 ) mesh. Additional samples of approximately 24 hours duration were taken at the treated and control sites following the three insecticide applications using drift nets fitted with metal restrictors to reduce the size of the openings to 0.48 m x 0.025 m. Drift nets were placed in the stream to sample a column of water from surface to bottom, including the surface film. Current speed was measured at the opening to each drift net half-way between the surface and bottom using a Teledyne Gurley No. 625 Pygmy Current Meter. Using the above information, the following was calculated:

$$\begin{aligned} & \text{depth at station (m)} \times \text{width of drift net opening (m)} \times \\ & \text{current speed (m/sec)} \times \text{duration of drift sample (sec)} \\ & = \text{m}^3 \text{ of water in drift column.} \end{aligned}$$

Drift samples were sorted to remove extraneous material and the organisms collected were preserved in a 30% methanol solution. Organisms were later counted and identified under a dissecting microscope and the results expressed as:

$$\text{number of aquatic organisms/m}^3 \text{ of water in drift column}$$

#### Benthic Invertebrate Populations

Artificial substrates consisted of 0.5 kg of gravel (12-24 mm screen size) tightly wrapped in seine netting (4 mm x 4 mm aperture size). Samplers were placed near the drift stations at the treated sites and allowed to colonize for at least 19 days before removal. One day before and one day after each application, four artificial substrates and four Surber samples were collected at each site. Additional post-spray samples were collected at Sites I and V to document cumulative effect and recovery, respectively. Samples were also collected at a common control site for Applications I-IV and at a separate control site for Application V. After collection aquatic organisms were separated from other materials in the samples and preserved in a 30% methanol solution. Organisms were later counted and identified under a dissecting microscope.

#### Caged Fish

Prior to each insecticide application a minimum of 25 hatchery-reared rainbow-trout fingerlings were placed in cages at the treatment and control drift stations:

	<u>Treatment</u>	<u>Control</u>
Application III	29	31
IV	25	32
V	32	30

Cages measured 61 cm x 61 cm x 46 cm high, had plywood tops and bottoms and were covered on all sides with 13 mm square screening. Fish were checked periodically up to 3 days after application for mortality and symptoms of pesticide poisoning.

## RESULTS

### Insecticide Residues

The results of analyses of stream water samples for aminocarb residues are presented in Tables 1-3. Peak levels of aminocarb were detected at the biological sampling stations within 1 hour of each application (35.37 ppb detected 10 minutes after the MATACIL 1.8 D + Insecticide Diluent 585 treatment, 127.2 ppb detected 30 minutes after the MATACIL 1.8 F + Insecticide Diluent 585 treatment and 256.1 ppb 1 hour after MATACIL 1.8 F + Atlox 3409 F + water treatment). Residues were no longer detectable in stream water samples 90 minutes after the MATACIL 1.8 D + Insecticide Diluent 585, but were still present in small amounts (less than 0.1 ppb) 5 hours after the MATACIL 1.8 F + Insecticide Diluent 585, and 9 hours after the MATACIL 1.8 F + Atlox 3409 F + water. The progressively slower downstream movement and disappearance of aminocarb residues following successive MATACIL treatment can be explained by the steadily decreasing stream discharge (flow rate) over the experimental period.

Much higher residue levels were measured at the application sites (peak levels of 1862.2 ppb for the MATACIL 1.8 D + Insecticide Diluent 585 treatment, 15,000 ppb for the MATACIL 1.8 F + Insecticide Diluent 585 treatment and 1306.5 ppb for the MATACIL 1.8 F + Atlox F + water treatment). These samples were taken from the top 1 centimetre of the stream approximately 5 metres downstream from the application sites. This distance is too short to allow for thorough mixing, and consequently the insecticides were probably still concentrated near the surface. The insecticide residues would have been more evenly distributed throughout the water column by the time the spray products were carried 100 metres downstream to the biological sampling stations.

Analysis of sediment and fish tissue samples are not yet completed.

Table 1. Residues of aminocarb in stream water following an experimental application of MATAcil 1.8 D.

<u>Time after application*</u>	<u>Aminocarb Concentration (ppb)</u>	
	<u>Application Site</u>	<u>Biological Sampling Site</u>
1 min.	380.4	ND
3	1862.3	ND
5	30.1	0.85
5 (post-application)	8.42	0.10
10	3.73	35.37
15	0.83	3.40
30	0.12	2.42
60	ND	0.13
90	ND	ND
2 hr	ND	ND
3	ND	ND
4	ND	ND
5	ND	ND
6	ND	ND
9	ND	ND
25	ND	ND
0	ND	ND

\*application commenced at 0 min and finished at 5 min.

ND 0.05 ppb

Table 2. Residues of aminocarb in stream water following an experimental application of MATAcil 1.8 F formulated in Insecticide Diluent 585.

<u>Time after application*</u>	<u>Aminocarb Concentration (ppb)</u>	
	<u>Application Site</u>	<u>Biological Sampling Site</u>
1 min	301.9	ND
3	3823.2	ND
5	15000.0	ND
5 (post-application)	481.4	ND
10	136.0	ND
15	21.7	0.13
30	3.27	127.20
60	0.64	29.1
90	0.15	3.77
2 hr	0.17	1.53
3	ND	0.08
4	ND	0.13
5	ND	0.09
6	ND	ND
9	ND	ND
25	ND	ND
50	ND	ND

\*application commenced at 0 min and finished at 5 min.

ND 0.05 ppb

Table 3. Residues of aminocarb in stream water following an experimental application of MATACIL 1.8 F formulated in water.

Time after application*	Aminocarb Concentration (ppb)	
	Application Site	Biological Sampling Site
1 min	0.07	ND
3	800.8	ND
5	1306.5	ND
5 (post-application)	959.3	ND
10	451.3	ND
15	163.9	ND
30	28.5	ND
60	2.20	256.1
90	1.10	162.1
2 hr	0.45	33.5
3	0.26	3.58
4	0.17	1.33
5	0.15	0.60
6	0.08	0.23
9	ND	0.08
25	ND	ND
50	ND	ND

\*application commenced at 0 min and finished at 5 min

ND 0.05 ppb

#### Biological Sampling

#### Drift

Of the two Sunspray 7-N applications, only the first had any significant effect on aquatic invertebrate drift. Collembola and Plecoptera: Leuctridae appeared to be most affected by the Sunspray 7-N + Insecticide Diluent 585 application (18 x increase in drift immediately after application for Collembola and 14 x increases in drift 1 hour after application for Leuctridae). Some slight effect was also indicated for Ephemeroptera: Baetidae and possibly also Coleoptera: Dytiscidae. No obvious increases in drift were noted following the Sunspray 7-N + Altox 3409 + water application.

Collembola, Hemiptera: Gerridae and Trichoptera: Philopotamidae all drifted in increased numbers following the MATACIL 1.8 D + Insecticide Diluent 585 application (109 and 13 x increases for Collembola and Gerridae respectively) with the peak of impact occurring 0-½ hour after after treatment. Hydracarina and Baetidae may also have been slightly affected. The MATACIL 1.8 F + Insecticide Diluent 585 application on the other hand, appeared to have little if any effect on aquatic invertebrate drift. Increased drifts of Philopotamidae and Diptera: Chironomidae were noted 2-3 hours treatment, but these were very small and may not have been

spray related. Of the three insecticide formulations tested, MATACIL 1.8 F + Atlox 3409 F + water had the greatest observed effect on drift. Diptera: Simuliidae, Ephemeroptera: Baetidae, Plecoptera: Leuctridae and Chloroperlidae and Trichoptera: Philopotamidae and Hydroptilidae all drifted in increased numbers following application (289 x increase for Simuliidae, 18 x increase for Baetidae and 21 x increase for Leuctridae) with the peak of impact occurring 1-2 hours after treatment. A number of other aquatic invertebrate groups including Ephemeroptera: Leptophlebiidae and several families of Trichoptera may also have been slightly affected.

#### Benthic Invertebrate Populations

Neither Sunspray 7-N application appeared to have any very significant effect on bottom fauna populations. Trichoptera: Limnephilidae and Diptera: Tabanidae were slightly reduced in numbers following the Sunspray 7-N + Insecticide Diluent 585 application, as were Ephemeroptera: Baetidae and Ephemereellidae and Diptera: Empididae following the Sunspray 7-N + Atlox 3409 F + water application. Likewise, there do not appear to have been any severe depletions in the benthos following any of the three insecticide applications. Small reductions were noted for Baetidae, Ephemereellidae, Chironomidae and Simuliidae following the MATACIL 1.8 D + Insecticide Diluent 585 application, for Turbellaria: Tricladida following the MATACIL 1.8 F + Insecticide Diluent 585 application, and for Tricladida, Chloroperlidae and Simuliidae following the MATACIL 1.8 F + Atlox 3409 F + water application. Because none of the control samples have been identified to date, it is not possible at this time to state with certainty whether any of these observed reductions are indicative of an impact or merely the result of natural variations and fluctuations in benthic invertebrate population samples.

#### Caged Fish

No mortality or unusual behaviour was observed for rainbow-trout fingerlings held in cages in the treated portions of the stream up to 3 days after each insecticide application.

#### SUMMARY AND CONCLUSIONS

- 1) Aminocarb residues disappeared very rapidly from the treated portions of the stream after all three MATACIL applications. The rate of disappearance was related to the total stream discharge at the time of application (i.e., residues disappeared most rapidly when discharge was highest).

- 2) Neither the Sunspray 7-N + Atlox 3409 F + water nor the MATACIL 1.8 F + Insecticide Diluent 585 application had any significant effect on aquatic invertebrate drift. Increased drifts were noted following the Sunspray 7-N + Insecticide Diluent 585, MATACIL 1.8 D + Insecticide Diluent 585 and MATACIL 1.8 F + Atlox 3409 F + water applications.
- 3) None of the five applications resulted in severe depletion of the benthos.
- 4) Of the three MATACIL formulations tested, MATACIL 1.8 F + Atlox + water apparently had the greatest effect on aquatic invertebrates. The peak level of aminocarb in water was, however, over 7 times higher after this application than after the MATACIL 1.8 D + Insecticide Diluent 585 and twice as high as after the MATACIL 1.8 F + Insecticide Diluent 585 applications because of reductions in stream discharge over the experimental period. Even though peak residues were close to four times higher after the MATACIL 1.8 F + Insecticide Diluent 585 than after the MATACIL 1.8 D + Insecticide Diluent 585 application, only the MATACIL 1.8 D formulation demonstrated any obvious effect on aquatic invertebrates.
- 5) Sunspray 7-N + Atlox 3409 F + water was applied at a higher rate (6.1 ml/1000 l) than Sunspray 7-N + Insecticide Diluent 585 (2.5 ml/1000 l), but apparently had less of an impact, at least in terms of aquatic invertebrate drift. Collembola were particularly affected by the Sunspray 7-N + Insecticide Diluent 585 application, and it may be that these surface-dwelling organisms were affected by the diluent oil slick on the surface of the stream. The MATACIL 1.8 D + Insecticide Diluent 585 application also had a significant effect on Collembola, but the MATACIL 1.8 F + Insecticide Diluent 585 application did not.
- 6) Rainbow trout fingerlings did not appear to be adversely affected by any of the three MATACIL field formulations at the application rates tested.

Aquatic invertebrates collected in drift net sets,\*  
 First Application\*\* Treated Site,  
 4-5 June 1981

Sample	Pre	0	+1h	+1h	+1h	+2h	+3h	+4h	+5h	+6h	RES
Volume of Drift Column (m <sup>3</sup> )	60.1	60.1	60.1	60.1	60.1	60.1	60.1	40.1	40.1	40.1	289.6
Nematomorpha	0.03		0.02	0.03		0.03	0.02		0.02	0.02	<0.01
Annelida: Oligochaeta	0.03	0.03		0.02		0.02	0.03	0.02	0.02	0.02	<0.01
Ostracoda	0.08			0.02		0.02	0.05		0.02	0.02	<0.01
Hydracarina	0.18	0.17	0.15	0.07	0.02	0.12	0.15	0.22	0.17	0.20	<0.01
Collembola	0.12	2.26	0.28	0.25	0.18	0.08	0.22	0.15	0.45	0.10	0.05
Plecoptera: Leuctridae	N	0.03	0.07	0.27	0.42	0.32	0.22	0.27	0.12	0.17	0.07
Nemouridae	N		0.02								
Ephemeroptera: Baetidae	N		0.07	0.07		0.02					0.02
Ephemerellidae	N										<0.01
Leptophlebiidae	N	0.03		0.02							
Hemiptera: Gerridae							0.02				
Trichoptera: Brachycentridae	L		0.02								
Hydropsychidae	L				0.02		0.02				
Hydropsytilidae	L	0.08	0.13	0.27	0.02	0.02	0.15	0.08	0.10	0.10	0.05
Limnephilidae	L	0.03	0.07	0.15	0.15	0.10	0.03	0.05	0.07	0.07	0.01
Lepidostomatidae	L	0.05	0.02	0.02	0.02	0.03	0.03				0.05
Psychomyiidae	L			0.02							
Rhyacophilidae	L							0.02			
Unidentified	L	0.02									
Coleoptera: Bythicidae	L		0.03	0.10		0.03	0.02		0.02		0.01
A	A								0.02	<0.01	
Elmidae	A	0.02			0.02						
Cyrinidae	A					0.02					
Haloplidae	A								0.02		
Helodidae	L		0.03		0.03			0.02		0.02	0.01
A	A										
Hydraenidae	L	0.02					0.02				
A	A										
Diptera: Noteridae	A	0.02									
Chironomidae	L	0.17	0.28	0.10	0.20	0.30	0.25	0.13	0.30	0.05	0.15
P	P	0.13	0.35	0.23	0.15	0.13	0.08	0.12	0.17	0.30	0.15
Dixidae	L	0.02	0.02	0.02		0.02					<0.01
Empididae	L	0.02	0.03	0.02			0.02				
P	P										
Heleidae	L	0.07	0.02	0.03		0.02		0.02			0.03
P	P	0.08	0.07		0.02	0.02	0.03	0.02	0.02		
Muscidae	L	0.02	0.07	0.03	0.03		0.02	0.02			0.07
Simuliidae	L	0.02	0.02						0.02		0.02
P	P	0.02									
Tabanidae	P						0.02				
Tipulidae	L	0.02	0.02		0.08	0.02		0.02	0.05	0.05	0.02
P	P	0.02									0.03
Total		1.15	3.81	1.88	1.46	1.31	1.05	1.30	1.45	1.45	1.02
											0.31

\* Expressed as number of organisms/m<sup>3</sup> of water in drift column.

\*\* Sumspray 7-N + Insecticide Diluent 585 + Automate Red Dye applied at 0745-0750 EST on 4 June 1981.

RES restrictor drift left overnight, 4-5 June 1981.

L larvae

P pupae

N nymphs

A adults

Aquatic invertebrates collected in drift net sites,\*  
 First application\*\*, Control Site,  
 4-5 June 1981

Sample		Pre	0	+½h	+1h	+1½h	+2h	+3h	+4h	+5h	+6h	RES
Volume of Drift Column (m³)		43.1	43.1	41.7	41.7	41.7	41.7	40.3	26.8	26.4	25.9	190.6
Nematomorpha		0.02			0.07	0.02	0.05			0.08	0.08	
Annelida: Oligochaeta		0.02								0.04		<0.01
Ostracoda		0.26	0.02	0.12	0.12	0.14	0.34	0.17	0.26	0.08	0.23	
Hydracarina		0.26	0.23	0.10	0.24	0.14	0.14	0.12	0.07		0.35	<0.01
Collembola		0.02						0.02	0.04		0.08	0.04
Plecoptera: Chloroperlidae	N			0.02								0.01
Leuctridae	N	0.02	0.02									0.01
Perlidae	N											<0.01
Ephemeroptera: Baetidae	N				0.02		0.05				0.12	<0.01
Leptophlebiidae	N											<0.01
Trichoptera: Hydropsychidae	L	0.02			0.02		0.02					
Hydroptilidae	L	0.14	0.12	0.05	0.14	0.14	0.02	0.22	0.15		0.08	
Lepidostomatidae	L	0.02	0.02	0.02	0.05	0.02	0.02	0.02			0.04	<0.01
Limnephilidae	L	0.05	0.09	0.02	0.10	0.10	0.12	0.17	0.04		0.15	0.01
Psychomyiidae	L			0.02								
Rhyacophilidae	L		0.05			0.02			0.02	0.04	0.04	
Unidentified	L								0.04			
Coleoptera: Elmidae	L					0.02						
Curculionidae	A					0.02						
Diptera: Chironomidae	L	0.49	0.30	0.31	0.24	0.22	0.29	0.42	0.22	0.23	0.39	0.14
Empididae	P	0.14	0.30	0.19	0.07	0.19	0.31	0.15	0.45	0.08	0.42	0.02
Heleidae	L	0.02	0.02	0.02		0.07					0.04	
Polichopodidae	L		0.02			0.05	0.02	0.02	0.04	0.04	0.08	0.02
Simuliidae	L	0.02				0.05	0.07	0.05	0.04	0.04	0.04	0.01
Tipulidae	L			0.02								
Gastropoda		0.02				0.02						<0.01
Total		1.60	1.23	0.91	1.15	1.17	1.51	1.41	1.42	0.61	2.12	0.28

\* Expressed as number of organisms/m³ of water in drift column.

\*\* Sunspray 7-N + Insecticide Diluent 585 + Automate Red Dye applied at 0745-0750 EDT 4 June 1981.

RES restrictor drift left overnight, 4-5 June 1981.

L larvae

P pupae

N nymphs

A adults

Aquatic invertebrates collected in Surber samples\*,  
 First Application\*\*, Treated Site  
 3 and 5 June 1981

		Pre-spray	Post-spray
Nematamorpha		-	0.50 + 0.58
Hydracarina		0.25 + 0.50	-
Plecoptera: Leuctridae	N	0.50 + 1.00	0.25 + 0.50
Ephemeroptera: Ephemerellidae	N	0.25 + 0.50	-
Odonata: Cordulegastridae	N	0.75 + 0.96	-
Trichoptera: Hydroptilidae	L	0.50 + 0.58	-
Lepidostomatidae	L	-	0.50 + 0.58
Limnephilidae	L	2.25 + 2.63	0.50 + 0.58
Rhyacophilidae	L	0.25 + 0.50	-
Unidentified	P	0.75 + 1.50	-
Coleoptera: Elmidae	L	-	0.25 + 0.50
Diptera: Chironomidae	L	26.5 + 11.93	12.75 + 7.63
	P	2.00 + 0.82	0.25 + 0.50
Dolichopodidae	L	0.25 + 0.50	-
Empididae	L	1.75 + 1.26	0.75 + 0.50
Heleidae	L	0.75 + 0.96	-
	P	-	0.25 + 0.50
Tabanidae	L	1.50 + 1.29	-
Tipulidae	L	0.50 + 0.58	0.25 + 0.50
Total		39.00 + 7.35	16.25 + 9.11

\*mean numbers and standard deviations of organisms collected in four Surber samples.

\*\*Sunspray 7-N + Automate Red Dye + Insecticide Diluent 585 applied at 0745-0750 EDT on 4 June 1981.

Aquatic invertebrates collected from artificial substrates\*,  
 First Application\*\*, Treated Site  
 3 and 5 June 1981

		Pre-spray	Post-spray
Nematomorpha		-	0.25 + 0.50
Ostracoda		0.75 + -	-
Hydracarina		0.50 + 1.00	0.50 + 0.58
Plecoptera: Chloroperlidae	N	0.50 + 0.58	0.50 + 0.58
Leuctridae	N	2.00 + 1.41	3.25 + 0.50
Perlodidae	N	0.25 + 0.50	-
Ephemeroptera: Baetidae	N	1.50 + 1.73	2.00 + 1.83
Ephemerellidae	N	1.00 + 0.82	1.75 + 0.50
Leptophlebiidae	N	0.50 + 1.00	0.25 + 0.50
Odonata: Cordulegastridae	N	-	0.25 + 0.50
Trichoptera: Hydroptilidae	N	4.50 + 2.38	5.00 + 2.90
Lepidostomatidae	N	0.50 + 0.58	0.50 + 0.58
Coleoptera: Dytiscidae	L	-	0.25 + 0.50
Diptera: Chironomidae	L	48.00 + 8.60	103.50 + 119.63
P	P	1.00 + 0.82	1.75 + 1.26
Empididae	L	0.50 + 0.58	1.00 + 1.15
Heleidae	L	-	1.00 + 1.15
Tipulidae	L	0.25 + 0.50	0.25 + 0.50
Total		61.75 + 12.39	122.00 + 124.57

\*mean numbers and standard deviations of organisms collected from four artificial substrates.

\*\*Sunspray 7-N + Automate Red Dye + Insecticide Diluent 585 applied at 0745-0750 EDT on 4 June 1981.

Aquatic invertebrates collected in drift net sets\*  
 Second application\*\*, Treated Site (Lower Site #2)  
 10-11 June 1981

Sample	Pre	0	+½h	+1h	+1½h	+2h	+3h	+4h	+5h	+6h	RES
Volume of drift column (m³)	19.2	29.6	20.2	19.2	19.7	19.7	19.7	19.7	20.7	20.7	180.4
Nematomorpha		0.03				0.05					<0.01
Annelida: Oligochaeta		0.03									0.01
Ostracoda									0.05		
Hydracarina	0.05	0.10	0.05	0.05	0.05		0.10		0.10		0.01
Collembola	0.05		0.05						0.05		
Plecoptera: Leuctridae	0.05						0.05			0.05	<0.01
Ephemeroptera: Baetidae	N					0.05	0.10				0.01
Ephemerellidae	N		0.05								
Trichoptera: Hydropsychidae	L									0.05	<0.01
Hydroptilidae	L				0.05	0.05					
Lepidostomatidae	L	0.07									
Diptera: Chironomidae	L	0.10	0.10	0.10	0.05		0.10	0.15			0.03
	P	0.05		0.20	0.05	0.05	0.05	0.10	0.05		
Empididae	L								0.05		
Heleidae	P				0.05				0.05		
Simuliidae	L	0.10	0.03	0.10					0.10		0.03
Tipulidae	L						0.05				<0.01
	P										
Total	0.42	0.37	0.54	0.21	0.20	0.15	0.41	0.25	0.34	0.19	0.12

\* Expressed as number of organisms/m³ of water in drift column.

\*\* Sunspray 7-N + Atlox 3409 F + Rhodamine B Dye and Water applied at 0800-0805 EDT on 10 June 1981.

RES restrictor left overnight, 10-11 June 1981.

L larvae

P pupae

N nymphs

A adults

Aquatic invertebrates collected in drift net sets,\*  
 Second application\*\*, Control Site  
 10-11 June 1981

Sample		Pre	0	+½h	+1h	+1½h	+2h	+3h	+4h	+5h	+6h	RES
Volume of drift column (m <sup>3</sup> )		29.9	30.8	31.6	30.8	31.6	31.6	32.4	31.6	32.4	32.4	221.7
Ostracoda									0.03	0.03		
Hydracarina		0.03	0.19			0.03	0.06	0.03	0.16		0.25	
Collembola		0.03							0.03		0.09	0.04
Plecoptera: Chloroperlidae	N								0.03			0.01
Leuctridae	N								0.03			0.03
Ephemeroptera: Baetidae	N						0.03		0.03			0.01
Hemiptera	N											<0.01
Trichoptera: Hydropsychidae	L								0.06		0.06	<0.01
Hydroptilidae	L										0.03	
Lepidostomatidae	L											<0.01
Limnephilidae	L	0.03				0.03		0.03				
Psychomyiidae	L											<0.01
Coleoptera: Elmidae	A					0.03						
Hedobiidae	A				0.03							
Diptera: Chironomidae	L		0.03	0.03			0.09		0.06	0.03	0.06	0.15
P	P		0.03						0.03		0.06	0.01
Heleidae	P						0.03				0.03	
Simuliidae	L		0.03	0.03				0.06				0.02
Tipulidae	L								0.03			0.01
Total		0.10	0.29	0.09	0.03	0.06	0.22	0.15	0.44	0.06	0.59	0.29

\* Expressed as number of organisms/m<sup>3</sup> of water in drift column.

\*\* Sunspray 7-N + Atlox 3409 F + Rhodamine B Dye and water applied at 0800-0805 EDT on 10 June 1981.

RES restrictor drift left overnight, 10-11 June 1981.

L larvae

P pupae

N nymphs

A adults

Aquatic invertebrates collected in Surber samples\*,  
 Second Application\*\*, Treated Site,  
 9 and 11 June 1981.

		Pre-spray		Post-spray
Annelida: Oligochaeta		1.50 +	1.73	1.00 +
Plecoptera: Chloroperlidae		-		0.25 +
Ephemeroptera: Baetidae	N	-		0.50 +
Trichoptera: Hydropsychidae	L	-		0.50 +
Hydroptilidae	L	0.25 +	0.50	0.25 +
Rhyacophilidae	L	-		0.50 +
Diptera: Chironomidae	L	3.50 +	4.51	7.25 +
P		0.25 +	0.50	0.75 +
Empididae	L	0.25 +	0.50	-
Heleidae	L	0.75 +	0.50	0.50 +
Tabanidae	L	0.25 +	0.50	-
Tipulidae	L	0.25 +	0.50	-
Total		7.00 +	6.68	11.50 +
				7.05

\*mean numbers and standards deviations of organisms collected in four Surber samples.

\*\*Sunspray 7-N + Atlox 3409 F + Rhodamine B Dye + Water applied at 0800-0805 EDT on 10 June 1981.

Aquatic invertebrates collected from artificial substrates\*,  
 Second Application\*\*, Treated Site,  
 9 and 11 June 1981.

		Pre-spray	Post-spray
Turbellaria: Tricladida		-	0.50 + 0.58
Nematoda		0.25 + 0.50	-
Nematomorpha		-	0.25 + 0.50
Annelida: Oligochaeta		0.50 + 0.58	
Hydracarina		7.75 + 4.65	7.25 + 7.63
Plecoptera: Chloroperlidae	N	1.00 + 0.82	1.00 + 1.15
Leuctridae	N	7.25 + 2.75	8.00 + 9.13
Nemouridae	N	1.25 + 0.50	1.75 + 2.06
Perlodidae	N	0.75 + 0.96	-
Ephemeroptera: Baetidae	N	6.25 + 5.50	1.50 + 1.29
Ephemerellidae	N	3.00 + 2.16	1.00 + 2.00
Odonata: Cordulegastridae	N	0.25 + 0.50	-
Trichoptera: Hydropsychidae	L	1.50 + 1.73	1.75 + 1.71
Hydroptilidae	L	28.00 + 6.06	17.75 + 13.72
Lepidostomatidae	L	0.75 + 1.50	-
Limnephilidae	L	0.25 + 0.50	-
Rhyacophilidae	L	0.25 + 0.50	0.50 + 0.58
Coleoptera: Unidentified	P	0.25 + 0.50	-
Diptera: Chironomidae	L	178.75 + 60.07	114.50 + 75.54
Empididae	P	2.00 + 2.16	1.00 + 0.82
Heleidae	L	2.00 + 1.41	0.75 + 0.50
Simuliidae	L	4.25 + 4.27	2.00 + 2.83
Tipulidae	L	5.25 + 6.70	13.25 + 11.98
Total		254.00 + 63.86	174.50 + 100.31

\*mean numbers and standard deviations of organisms collected from four artificial substrates.

\*\*Sunspray 7-N + Atlox 3409 F + Rhodamine B Dye + Water applied at 0800-0805 EDT on 10 June 1981.

Aquatic Invertebrates collected in drift net sets\*

Third Application\*\*, Treated Site (Site #4)

7-8 July 1981

Sample	Pres	0	+½h	+1h	+1½h	+2h	+3h	+4h	+5h	+6h	RES
Volume of drift column ( $m^3$ )	23.3	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	182.3
Annelida: Hirudinea											<0.01
Oligochaeta	0.04										
Hydracarina		0.17	0.06				0.03	0.03	0.03		0.01
Collembola		4.38	1.03	0.40	0.09	0.06					
Plecoptera: Leuctridae		0.03	0.03				0.03				<0.01
Ephemeroptera: Baetidae	N	0.04	0.11	0.03		0.03	0.09	0.06	0.03	0.03	0.09
Ephemerellidae	N										
Leptophlebiidae	N						0.03				
Odonata: Aeshnidae								0.03			
Hemiptera: Corixidae											<0.01
Gerridae		0.52	0.20	0.03	0.11	0.06	0.03	0.03	0.03		
Trichoptera: Brachycentridae	L		0.03						0.03		
Glossosomatidae	L										
Hydropsychidae	L	0.03			0.06						0.03
Lepidostomatidae	L				0.03						0.03
Limnephilidae	L					0.03					0.05
Philopotamidae	L	0.03	0.17	0.09	0.03	0.03	0.11				<0.01
Polycentropodidae	L										0.01
Rhyacophilidae	L										
Coleoptera: Dytiscidae	L	0.03		0.06							<0.01
Elmidae	A										<0.01
Haliplidae	A										<0.01
Hedobiidae	A										
Hydrophilidae	L										
Diptera: Chironomidae	L	0.49	0.43	0.52	0.34	0.06	0.17	0.20	0.20	0.11	0.08
P	P	0.06		0.03	0.06	0.03	0.03		0.11		0.01
Dixidae	L								0.03		
Heleidae	P	0.04	0.03	0.06			0.03				
Muscidae	L	0.04									
Simuliidae	L				0.03		0.03	0.03	0.03	0.06	
Tipulidae	L	0.04	0.06	0.03							
Total		0.21	5.67	2.09	1.23	0.69	0.37	0.52	0.34	0.54	0.17
											0.31

\* Expressed as number of organisms/ $m^3$  of water in drift column.

\*\* HATACIL 1.8 D + Automate Red Dye + Insecticide Diluent 585 applied at 0740-0745 EDT on 7 July 1981.

RES restrictor drift left overnight, 7-8 July 1981.

L larvae

P pupae

N nymphs

A adults

**Aquatic invertebrates collected in drift net sets\***  
**Third application \*\*, Control Site**  
**7-8 July 1981**

Sample	Pre	0	+½h	+1h	+1½h	+2h	+3h	+4h	+5h	+6h	RES
Volume of drift column (m <sup>3</sup> )	18.6	18.6	18.6	27.8	27.8	27.8	27.8	27.8	27.8	27.8	119.5
Annelida: Oligochaeta								0.04			
Hydracarina					0.04				0.04	0.01	
Collembola					0.11					0.04	
Plecoptera: Leuctridae					0.04						
Nemouridae					0.04			0.04			
Ephemeroptera: Baetidae	N				0.04			0.04		0.04	0.01
Ephemerellidae	N										0.01
Odonata: Comphidae					0.07						
Megaloptera: Sialidae					0.04						
Trichoptera: Glossosomatidae	L				0.04				0.04		
Limnephilidae	L										
Philopotamidae	L								0.04		
Coleoptera: Dytiscidae	L				0.04						
Diptera: Chironomidae	L	0.75	0.22	0.16	0.36	0.36	0.18	0.07	0.18	0.18	0.13
	P	0.11	0.05		0.04			0.04			0.01
Dixidae	L									0.04	
Empididae	L	0.05			0.04					0.43	
Heleidae	L					0.07				0.04	
Simuliidae	L	0.05			0.04		0.07				0.08
Total		0.97	0.27	0.16	0.58	0.78	0.25	0.14	0.29	0.29	0.29

\* Expressed as number of organisms/m<sup>3</sup> of water in drift column.

\*\* MATAcil 1.8 D + Automate Red Dye + Insecticide Diluent 585 applied at 0740-0745 EDT on 7 July 1981.

RES restrictor drift left overnight, 7-8 July 1981.

L larvae

P pupae

N nymphs

A adults

Aquatic invertebrates collected in Surber samples\*,  
 Third Application, Treated Site  
 6 and 8 July 1981.

		Pre-spray	Post-spray
Nematomorpha		0.50 + 0.58	1.25 + 1.50
Annelida: Oligochaeta		3.50 + 2.52	2.50 + 1.29
Hydracarina		1.00 + 1.41	1.00 + 0.82
Plecoptera: Chloroperlidae	N	0.25 + 0.50	-
Ephemeroptera: Baetidae	N	-	0.25 + 0.50
Trichoptera: Rhyacophilidae	L	0.25 + 0.50	0.50 + 0.58
Unidentified	P	0.25 + 0.50	-
Diptera: Chironomidae	L	17.25 + 11.27	23.75 + 19.55
	P	0.50 + 1.00	-
Dolichopodidae	L	-	0.25 + 0.50
Empididae	L	-	0.25 + 0.50
	P	0.50 + 1.00	-
Heleidae	L	2.50 + 1.91	5.25 + 5.32
Simuliidae	L	1.25 + 2.50	0.25 + 0.50
Tipulidae	L	0.50 + 0.58	1.25 + 1.89
Total		28.25 + 18.59	36.50 + 27.96

\*mean numbers and standard deviations of organisms collected in four Surber samples.

\*\*MATAcil 1.8 D + Automate Red Dye + Insecticide Diluent 585 applied at 0740-0745 EDT on 7 July 1981.

Aquatic invertebrates collected from artificial substrates\*,  
 Third Application Treated Site  
 6 and 8 July 1981.

		Pre-spray	Post-spray
Annelida: Oligochaeta		-	0.50 + 0.58
Hydraearina		1.00 + 0.82	2.75 + 2.06
Plecoptera: Chloroperlidae	N	1.00 + 1.15	0.50 + 0.58
Leuctridae	N	4.50 + 2.38	1.75 + 1.26
Nemouridae	N	2.75 + 2.87	1.00 + 0.82
Ephemeroptera: Baetidae	N	5.75 + 5.56	1.25 + 1.26
Ephemerellidae	N	5.75 + 2.87	1.75 + 1.50
Trichoptera: Hydropsychidae	L	-	0.25 + 0.50
Hydroptilidae	L	0.25 + 0.50	0.50 + 0.58
Philopotamidae	L	0.25 + 0.50	0.50 + 0.58
Rhyacophilidae	L	0.50 + 1.00	0.75 + 0.50
Unidentified	P	-	0.25 + 0.50
Diptera: Chironomidae	L	299.00 + 154.78	73.75 + 63.55
Empididae	P	2.00 + 1.41	2.00 + 2.71
Heleidae	L	6.00 + 8.04	10.50 + 8.81
Simuliidae	L	11.25 + 13.30	2.25 + 0.96
Tipulidae	P	2.00 + 3.37	-
	L	0.50 + 0.58	1.00 + 0.82
Total		341.75 + 158.13	101.50 + 71.38

\*mean numbers and standard deviations of organisms collected from four artificial substrates.

\*\*MATAKIL 1.8 D® + Automate Red Dye + Insecticide Diluent 585 applied at 0740-0745 EDT on 7 July 1981.

Aquatic invertebrates collected in drift net sets\*  
 Fourth Application\*\*, Treatment Site  
 14-17 July 1981

Sample	Pre	0	+½h	+1h	+1½h	+2h	+3h	+4h	+5h	+6h	RES 1	RES 2
Volume of drift column (m <sup>3</sup> )	12.7	13.0	13.6	13.6	13.6	13.3	13.0	13.3	13.0	13.3	33.8	70.2
Hydracarina	0.31			0.15						0.23		0.03
Collembola	0.08	0.08	0.07			0.07		0.23	0.15	0.07	0.47	0.31
Ephemeroptera: Baetidae	N		0.15					0.07	0.08	0.07	0.86	
Trichoptera: Hydroptilidae	L						0.15		0.07			0.01
Philopotamidae	L											
Diptera: Chironomidae	L			0.07	0.07	0.23	0.23	0.07	0.08		0.32	0.04
Dixidae	L								0.08			
Simuliidae	L	0.08	0.08								0.03	0.03
Total	0.47	0.15	0.22	0.22	0.07	0.45	0.23	0.45	0.38	0.38	1.69	0.43

\* Expressed as number of organisms/m<sup>3</sup> of water in drift column.

\*\* MATAFIL 1.8 F® + Automate Red Dye + Insecticide Diluent 585 applied at 0755-0800 EDT on 14 July 1981.

RES 1 restrictor drift left overnight, 14-15 July 1981.

RES 2 restrictor drift left over two nights, 15-17 July 1981.

L larvae

P pupae

N nymphs

A adults

Aquatic invertebrates collected in drift net sets\*  
 Fourth Application\*\*, Control Site  
 14-17 July 1981

Sample	Pre	0	+½h	+1h	+1½h	+2h	+3h	+4h	+5h	+6h	RES 1	RES 2
Volume of drift column (m <sup>3</sup> )	8.9	14.8	14.8	14.8	14.8	15.5	15.5	14.8	14.8	14.8	43.9	106.0
Nematomorpha		0.07										
Hydracarina		0.11										
Collembola		0.11										0.01
Plecoptera: Leuctridae		0.11										
Ephemeroptera: Baetidae	N		0.07			0.06	0.06			0.07	0.11	0.05
Ephemerellidae	N											0.01
Trichoptera: Glossosomatidae	L			0.07								
Hydroptilidae	L		0.07	.					0.07		0.02	
Coleoptera: Elmidae	A				0.07							
Diptera: Chironomidae	L	0.20	0.20	0.20		0.06	0.13	0.14		0.14	0.25	0.06
	P					0.13						
Simuliidae	L		0.07				0.07			0.07		0.02
Total		0.34	0.27	0.40	0.27	0.07	0.13	0.32	0.20	0.07	0.20	0.43
												0.14

\* Expressed as number of organisms/m<sup>3</sup> of water in drift column.

\*\* MATAFIL 1.8 F + Automate Red Dye + Insecticide Diluent 585 applied at 0755-0800 EDT on 14 July 1981.

RES 1 restrictor drift left overnight, 14-15 July 1981.

RES 2 restrictor drift left over two nights, 15-17 July 1981.

L larvae

P pupae

N nymphs

A adults

Aquatic invertebrates collected in Surber samples\*,  
 Fourth Application, Treated Site,  
 13 and 15 July, 1981

		Pre-spray	Post-spray
Turbellaria: Tricladida		0.50 + 0.58	-
Plecoptera: Leuctridae	N	0.50 + 1.00	0.25 + 0.58
Nemouridae	N	0.25 + 0.50	-
Ephemeroptera: Baetidae	N	0.50 + 1.00	0.25 + 0.58
Trichoptera: Lepidostomatidae	L	0.25 + 0.50	-
Philopotamidae	L	0.50 + 1.00	-
Rhyacophilidae	L	-	0.50 + 0.58
Coleoptera: Dytiscidae	L	-	0.25 + 0.50
Diptera: Chironomidae	L	2.50 + 3.11	3.25 + 9.57
Heleidae	L	-	0.25 + 0.50
Muscidae	L	0.25 + 0.50	-
Tabanidae	L	0.25 + 0.50	-
Tipulidae	L	-	0.25 + 0.50
Total		5.50 + 4.43	5.25 + 1.50

\*mean numbers and standard deviations of organisms collected in four Surber samples.

\*\*MATACIL 1.8 F® + Automate Red Dye + Insecticide Diluent 585 applied at 0755-0800 EDT on 14 July 1981.

Aquatic invertebrates collected from artificial substrates\*,  
 Fourth Application\*\*, Treated Site,  
 13 and 15 July 1981.

		Pre-spray	Post-spray
Turbellaria: Tricladida		12.75 +	1.75 +
Annelida: Oligochaeta		-	1.25 +
Ostracoda		-	0.25 +
Hydracarina		1.50 +	6.00 +
Plecoptera: Chloroperlidae	N	1.50 +	1.25 +
Leuctridae	N	3.50 +	14.50 +
Nemouridae	N	0.25 +	0.25 +
Ephemeroptera: Baetidae	N	0.25 +	0.25 +
Ephemerellidae	N	-	0.50 +
Leptophlebiidae	N	0.50 +	1.00 +
Megaloptera: Sialidae	L	-	0.25 +
Trichoptera: Hydropsychidae	L	0.25 +	-
Limnephilidae	L	-	0.25 +
Rhyacophilidae	L	0.75 +	0.75 +
Unidentified	P	0.50 +	-
Coleoptera: Dytiscidae	L	-	0.25 +
Diptera: Chironomidae	L	88.00 +	101.00 +
P	P	0.75 +	1.00 +
Empididae	L	0.75 +	1.00 +
P	P	-	0.25 +
Heleidae	L	2.25 +	9.75 +
Muscidae	L	0.25 +	-
Simuliidae	P	-	0.25 +
Tipulidae	L	1.75 +	0.50 +
Total		115.5 + 52.89	142.25 + 74.56

\*mean numbers and standard deviations of organisms collected from four artificial substrates.

\*\*MATICIL 1.8 F® + Automate Red Dye + Insecticide Diluent 585 applied at 0755-0800 EDT on 14 July 1981.

Aquatic invertebrates collected in drift net sets\*  
 Fifth Application\*\*, Treatment Site #6  
 21-24 July 1981

Sample	Pre	0	+1h	+1h	+1h	+2h	+3h	+4h	+5h	+6h	RES 1	RES 2
Volume of drift column (m <sup>3</sup> )	16.9	17.8	17.8	19.5	19.5	19.5	19.5	17.8	17.8	18.6	57.5	154.3
Nematozoa											0.06	
Nematomorpha											0.38	0.07
Hydracarina	0.24	0.11		0.46	0.36	0.26	0.15	0.28	0.56	0.16	0.02	
Collembola				0.11		0.05					0.05	
Plecoptera: Chloroperlidae					0.10	0.10	0.20				0.05	
Leuctridae				0.06		0.56	1.28	0.56	0.11		0.02	
Nemouridae					0.10							
Ephemeroptera: Baetidae	N			0.06	0.56	1.13	0.10				0.31	0.03
Ephemerellidae	N			0.06			0.05				0.07	0.01
Leptophlebiidae	N			0.11	0.05						0.16	
Odonata: Cordulegastridae	N							0.06				
Hemiptera: Gerridae											0.03	
Megaloptera: Sialidae											0.02	
Trichoptera: Glossosomatidae	L				0.05							
Hydroptilidae	L				0.10	0.05	0.31					
Limnephilidae	L					0.10					0.02	
Philopotamidae	L				0.46				0.05			
Phryganeidae	L					0.10	0.05					
Psychomyiidae	L				0.05							
Rhyacophilidae	L					0.05						
Unidentified	L				0.05	0.10						
Coleoptera: Dytiscidae	A										0.02	
Elmidae	A										0.02	
Diptera: Chironomidae	L	0.11	0.11	0.36	0.10	0.20	0.20	0.06	0.06	0.05	0.37	0.13
Empididae	L					0.05			0.06			
Heleidae	L	0.06									0.02	
Simuliidae	L				17.38	0.67	0.15		0.06	0.11		0.01
Tipulidae	L				0.05	0.05			0.06			
Total		0.30	0.22	0.51	19.74	3.44	2.67	0.97	0.56	0.79	0.48	1.50
												0.25

\* Expressed as number of organisms/m<sup>3</sup> of water in drift column.

\*\* MATACIL 1.8 kg + Atlox 3409 F + Rhodamine B Dye + Water applied at 0755-0800 EDT on 21 July 1981.

RES 1 restrictor drift left overnight, 21-22 July 1981.

RES 2 restrictor drift left over two nights, 22-24 July 1981.

L larvae

P pupae

N nymphs

A adults

Aquatic invertebrates collected in drift net sets\*  
 Fifth Application \*\*, Control Site  
 21-24 July 1981

Sample	Pre	0	+½h	+1h	+1½h	+2h	+3h	+4h	+5h	+6h	RES 1	RES 2
Volume of drift column (m <sup>3</sup> )	27.1	28.7	29.9	31.4	30.2	29.1	29.1	29.1	27.1	27.1	72.7	135.4
Hydracarina	0.15	0.14	0.03			0.03		0.03	0.07	0.11	0.04	0.13
Collembola	0.74	0.24	0.10			0.21		0.24		0.07	0.25	0.18
Plecoptera: Chloroperlidae											0.03	0.01
Ephemeroptera: Baetidae	N	0.04	0.03	0.03	0.03				0.04		0.12	0.08
Ephemerellidae	N					0.03			0.04			
Hemiptera: Gerridae											0.03	0.01
Trichoptera: Hydropsychidae	L								0.04			
Hydroptilidae	L								0.04			
Coleoptera: Elmidae	A						0.03					
Diptera: Chironomidae	L	0.11		0.03	0.03		0.14		0.18		0.37	0.14
Simuliidae	L	0.07			0.06	0.03	0.10		0.04	0.14	0.14	0.04
Total		1.11	0.42	0.20	0.13	0.10	0.24	0.27	0.27	0.37	0.26	0.98
												0.59

\* Expressed as number of organisms/m<sup>3</sup> of water in drift column.

\*\* MATAFIL 1.8 F® + Atlox 3409 F + Rhodamine B Dye + Water applied at 0755-0800 EDT on 21 July 1981.

RES 1 restrictor drift left overnight, 21-22 July 1981.

RES 2 restrictor drift left over two nights, 22-24 July 1981.

L larvae

P pupae

N nymphs

A adults

Aquatic invertebrates collected in Surber samples\*\*,  
 Fifth Application, Treated Site,  
 20 and 22 July 1981.

		Pre-spray	Post-spray
Turbellaria: Tricladida		2.25 +	3.30
Nematoda		0.50 +	1.00
Annelida: Oligochaeta		0.75 +	0.96
Hydracarina		-	0.75 +
Plecoptera: Chloroperlidae	N	1.50 +	2.38
Leuctridae	N	0.50 +	1.00
Ephemeroptera: Ephemerellidae	N	0.50 +	1.00
Trichoptera: Lepidostomatidae	L	-	0.25 +
Limnephilidae	L	0.50 +	1.00
Psychomyiidae	L	0.25 +	0.50
Rhyacophilidae	L	0.25 +	0.50
Diptera: Chironomidae	L	23.25 +	15.59
Empididae	L	0.75 +	0.50
Heleidae	L	0.50 +	0.58
Simuliidae	L	2.25 +	1.71
Tabanidae	L	1.00 +	0.82
Tipulidae	L	2.50 +	1.29
Gastropoda		0.25 +	0.50
Total		37.50 +	9.68
		23.25 +	15.92

\*mean numbers and standard deviations of organisms collected in four  
 Surber samples.

\*\*MATAFIL 1.8 F® + Atlox 3409 F + Rhodamine B Dye + Water applied at 0755-  
 0800 EDT on 21 July 1981.

Aquatic invertebrates collected from artificial substrates\*,  
 Fifth Application, Treated Site.  
 20 and 22 July 1981.

		Pre-spray	Post-spray
Turbellaria: Tricladida		3.75 +	3.86
Nematoda		-	0.50 +
Annelida: Oligochaeta.		-	0.25 +
Hydracarina		3.75 +	2.87
Plecoptera: Chloroperlidae	N	2.25 +	1.26
Leuctridae	N	12.50 +	7.14
Nemouridae	N	0.25 +	0.50
Ephemeroptera: Baetidae	N	1.75 +	1.71
Ephemerellidae	N	0.25 +	0.50
Megaloptera: Sialidae	L	0.25 +	0.50
Trichoptera: Hydropsychidae	L	0.25 +	0.50
Hydroptilidae	L	-	0.25 +
Limnephilidae	L	-	0.25 +
Philopotamidae	L	-	0.25 +
Rhyacophilidae	L	0.50 +	0.58
Diptera: Chironomidae	L	364.75 +	192.93
P	P	0.75 +	0.96
Empididae	P	-	0.25 +
Heleidae	L	16.50 +	5.20
Rhagionidae	L	0.25 +	0.50
Simuliidae	L	0.50 +	0.58
Tabanidae	L	-	0.25 +
Tipulidae	L	2.50 +	1.73
Total		410.75 +	201.43
		427.00 +	247.30

\*mean numbers and standard deviations of organisms collected from four artificial substrates.

\*\*MATACIL 1.8 F® + Atlox 3409 F + Rhodamine B Dye + Water applied at 0755-0800 EDT on 21 July 1981.