RAVENNA ARMY AMMUNITION PLANT, OHIO

FACILITY-WIDE SURFACE WATER MONITORING

AUGUST 2002

FACILITY-WIDE SURFACE WATER SAMPLING

The Ohio EPA has requested that surface water be evaluated on a facility-wide basis for CERCLA (environmental) purposes. The Ohio National Guard is preparing criteria to monitor sediment/surface water effects of future training. Also, the RVAAP maintains a NPDES permit. It is prudent to align these efforts with the proposed environmental surface water monitoring. Thus, the surface water sampling effort will be coordinated with the Ohio National Guard and the RVAAP NPDES permit. Also, the public and Ohio EPA have certain needs and expectations that need to be included.

Discussion and Perspective

The major stakeholders identified above have different needs that are to be addressed within the facility-wide surface water sampling effort. Basically, three different general types of information will be gathered, including:

Chemical characteristics, both general water quality and those related to historical production activities,
Biological characteristics, including habitat evaluations and more specific index determinations, and
Stream/pond physical characteristics, as drainage parameters, flow rates/variation, relation to groundwater, etc.

Within these general data needs, the major stakeholders will delineate their specific study requirements, including:

Why is monitoring taking place?

Who will perform the monitoring?

Who will use the data?

What parameters will be monitored?

How good does the monitoring data need to be?

What methods will be used?

Where will monitoring be performed?

When will monitoring be performed?

How will monitoring data be managed and presented?

How will changes/improvements be added?

Is information about the hydrogeology of the surface water of prime importance; gaining or losing streams, relations to groundwater ?

Can NPDES, OH NG, and CERCLA sampling be coordinated and/or consolidated to provide significant cost savings ?

Can any of the historic data be utilized ?

RVAAP SURFACE WATER SAMPLING SUMMARY

	FACILITY-WIDE BACKGRD	CURRENT OHIO EPA NPDES	PROPOSED OHARNG	HISTORIC SAMPLING				RECENT RI'S	(TO BE DECIDED) PROPOSED FACILITY
				FACILITY WIDE	LOAD LINE 6 EFFLUENT	LOAD LINE 7 EFFLUENT	OPEN BURN OPEN DEMO		
DATES	1998	2000 +	2002 +	1980 - 1992	1988	1990	1992	1996 +	2003 +
LOCATIONS AND TABS	A	B	C	D	E	F	G	H	
PHYSICAL PARAMETERS									
STREAM FLOW		x	x						
TEMPERATURE	x	x		x	x	x	x	x	
PRECIPTATION		x	x				x		
DURATION OF STORM		x	x						
INTERVAL BETWEEN STORMS		x	x						
TURBIDITY	x							x	
CHEMICAL PARAMETERS									
pH	x	x	x	x	x	x	x	x	
ALKALINITY		x			x	x	x		
HARDNESS		x			x	x	x		
CHLORIDE							x		
RESIDUAL CHLORINE		x							
SPECIFIC CONDUCTIVITY	x			x	x	x	x	x	
TOTAL SUSPENDED SOLIDS		x		x			x		
TOTAL DISSOLVED SOLIDS		x					x		
SUSPENDED SEDIMENT			x						
OIL & GREASE		x	x	x			x		
TOTAL KJELDAHL NITROGEN		x		x			x		
TOTAL ORGANIC CARBON		x		x	x	x	x		
AMMONIA NITROGEN					x	x	x		
TOTAL PHOSPHOROUS				x			x		
PHENOLS							x		
NITRATES				x					
NITRITES				x					
NITRATE + NITRITE NITROGEN						x	x		
SULFATE							x		
DISSOLVED OXYGEN	x	x			x	x	x	x	
METALS, DISSOLVED		x							
CHROMIUM (TOTAL)	x	x		x			x	x	
CHROMIUM (HEXAVALENT)				x			x		
ARSENIC	x	x					x	x	
BARIUM	x	x					x	x	
CADMIUM	x	x		x			x	x	
COPPER	x			x			x	x	
CYANIDE	x	x					x	x	
LEAD	x	x		x			x	x	
MAGNESIUM (TOTAL)	x	x					x	x	
MAGNESIUM (DISSOLVED)		x					x		
MERCURY	x	x					x	x	
SELENIUM	x	x					x	x	
SILVER	x	x					x	x	
ZINC	x			x			x	x	
FULL TAL or 20 METALS	x						x	x	
DNT		x		x	x	x	x	x	
HMX		x			x	x	x	x	
RDX		x		x	x	x	x	x	
TNT		x		x	x	x	x	x	
PICRIC ACID							x		
NITROGUANIDINE							x		
FULL EXPLOSIVES		x						x	
VOCs					x	x	x	x	
SVOCs					x	x		x	
PCBs/PESTICIDESs								x	
BIOLOGICAL PARAMETERS									
FECAL COLIFORM				x					
TOXICITY TESTS(WET)		x			x	x			
Ceriodaphnia dubia (water flea)		x			x	x			
Pimephales promelas (fathead minnow)		x			x	x			
Selenastrum capricornutum (alga)					x	x			
BENTHIC MACROINVERTIBRATES SURVEY							x		
DIATOMS SURVEY							x		
XYGEN DEMAND, BIOCHEM CARBON (BOD)			x	x					
OXYGEN DEMAND, CHEMICAL (COD)		x	x		x	x	x		
INDEX OF BIOTIC INTEGRITY (IBI)			x						
INVERTEBRATE COMMUM INDEX (ICI)			x						
QUALITATIVE HABITAT EVAL INDEX (QHEI)			x						
PRIMARY HEADWATER HABITAT			x						

RVAAP FACILITY-WIDE

SURFACE WATER AND SEDIMENT BACKGROUND

Table 4-8. Surface Water Background Criteria

Analyte	Results > Detection Limit	Minimum Detect	Maximum Detect	Average[a] Result	Std. Dev.[a]	Distr.[b]	Parametric 95% UTL	Nonparametric 95% UTL	Background Criteria[c]
Metals (µg/L)									
Aluminum	5/ 6	661.00	3370.00	1450.00	1138.00	N	5670.00	3370.00	3370.00
Antimony	0/ 7			2.50	0.0	O		5.00	0.00
Arsenic	1/ 7	3.20	3.20	2.70	0.42	D		6.80	3.20
Barium	7/ 7	12.50	47.50	28.50	10.69	N	64.90	47.50	47.50
Beryllium	0/ 7			2.00	0.0	O		4.00	0.00
Cadmium	0/ 7			2.50	0.0	O		5.00	0.00
Calcium	7/ 7	13500.00	41400.00	23100.00	10554.00	L	92700.00	41400.00	41400.00
Chromium	0/ 7			5.00	0.0	O		10.00	0.00
Cobalt	0/ 7			25.00	0.0	O		50.00	0.00
Copper	4/ 7	3.50	7.90	5.94	3.56	L	62.40	25.00	7.90
Cyanide	0/ 7			0.01	0.0	O		0.01	0.00
Iron	7/ 7	440.00	2560.00	1370.00	715.4	L	8420.00	2560.00	2560.00
Lead	0/ 7			1.50	0.0	O		3.00	0.00
Magnesium	7/ 7	3240.00	10800.00	5520.00	2704.00	L	22300.00	10800.00	10800.00
Manganese	7/ 7	33.60	391.00	153.00	125.3	L	1820.00	391.00	391.00
Mercury	0/ 7			0.10	0.0	O		0.20	0.00
Nickel	0/ 7			20.00	0.0	O		40.00	0.00
Potassium	7/ 7	519.00	3170.00	1670.00	797.7	N	4390.00	3170.00	3170.00
Selenium	0/ 7			2.50	0.0	O		5.00	0.00
Silver	0/ 7			5.00	0.0	O		10.00	0.00
Sodium	6/ 7	4770.00	21300.00	11500.00	8285.00	N	39600.00	21300.00	21300.00
Thallium	0/ 7			0.93	0.0	O		2.00	0.00
Vanadium	0/ 7			25.00	0.0	O		50.00	0.00
Zinc	4/ 7	14.60	42.00	17.40	11.73	X		42.00	42.00

[a]Results less than the detection limit were set to one-half the reported detection limit.

[b]Dist. Codes: L = Distribution most similar to lognormal.
N = Distribution most similar to normal.
X = Distribution significantly different from normal and lognormal.
D = Non-parametric distribution – frequency of detection <50%.
0 = Zero detects – background criteria set to 0.00.

[c]If 95% UTL >max. detect then background criteria = max. detect.
If distribution determined not normal or lognormal or fewer than 3 results then background criteria = max. detect.
Background criteria were set to zero if there were no detects.

Table 4-7. Sediment Background Criteria

Analyte	Results > Detection Limit	Minimum Detect	Maximum Detect	Average[a] Result	Std. Dev.[a]	Distr.[b]	Parametric 95% UTL	Nonparametric 95% UTL	Background Criteria[c]
Metals (mg/kg)									
Aluminum	7/ 7	1710.00	13900.00	6430.00	4801.00	L	75900.00	13900.00	13900.00
Antimony	0/ 7			0.48	0.18	O		1.50	0.00
Arsenic	7/ 7	3.70	19.50	9.34	5.32	L	54.40	19.50	19.50
Barium	7/ 7	15.20	123.00	62.00	46.05	N	219.00	123.00	123.00
Beryllium	2/ 7	0.15	0.38	0.24	0.12	D		0.64	0.38
Cadmium	0/ 7			0.48	0.18	O		1.50	0.00
Calcium	5/ 7	920.00	5510.00	2320.00	2118.00	L	50300.00	5510.00	5510.00
Chromium	7/ 7	2.60	18.10	8.99	6.19	L	91.50	18.10	18.10
Cobalt	7/ 7	2.10	9.10	5.61	2.84	L	34.20	9.10	9.10
Copper	7/ 7	2.50	27.60	12.40	9.27	L	198.00	27.60	27.60
Cyanide	0/ 7			0.48	0.18	O		1.50	0.00
Iron	7/ 7	5170.00	28200.00	15500.00	9329.00	L	123000.00	28200.00	28200.00
Lead	7/ 7	3.40	27.40	13.00	9.13	N	44.00	27.40	27.40
Magnesium	7/ 7	434.00	2760.00	1450.00	854.4	L	11200.00	2760.00	2760.00
Manganese	7/ 7	154.00	1950.00	694.00	636.3	L	12100.00	1950.00	1950.00
Mercury	2/ 7	0.04	0.06	0.07	0.03	D		0.28	0.06
Nickel	5/ 7	4.00	17.70	9.00	5.48	L	68.20	17.70	17.70
Potassium	7/ 7	195.00	1950.00	745.00	607.2	L	8070.00	1950.00	1950.00
Selenium	1/ 7	1.70	1.70	0.62	0.50	D		1.70	1.70
Silver	0/ 7			0.96	0.37	O		3.00	0.00
Sodium	4/ 7	22.40	112.00	56.80	34.01	L	923.00	174.00	112.00
Thallium	1/ 7	0.89	0.89	0.56	0.23	D		1.50	0.89
Vanadium	7/ 7	3.30	26.10	12.50	8.85	L	139.00	26.10	26.10
Zinc	7/ 7	16.20	532.00	123.00	183.06	L	3090.00	532.00	532.00
SVOCs (µg/kg)									
Benzo(*a*)anthracene	2/ 6	73.00	100.00	256.00	178.7	D		980.00	NA
Benzo(*b*)fluoranthene	1/ 6	120.00	120.00	303.00	150.69	D		980.00	NA
Chrysene	1/ 6	95.00	95.00	298.00	156.96	D		980.00	NA
Fluoranthene	4/ 6	47.00	190.00	194.00	144.63	L	10000.00	920.00	NA
Pyrene	3/ 6	86.00	170.00	206.00	133.89	L	7340.00	920.00	NA

Table 4-7 (continued)

Analyte	Results > Detection Limit	Minimum Detect	Maximum Detect	Average Result[a]	Std. Dev.[a]	Distr.[b]	Parametric 95% UTL	Nonparametric 95% UTL	Background Criteria[c]
VOCs (µg/kg)									
Acetone	1/ 3	540.00	540.00	184.00	308.16	D		540.00	NA
Chloromethane	1/ 3	3.00	3.00	5.17	1.89	D		13.00	NA
Toluene	1/ 3	1.10	1.10	2.45	1.18	D		6.50	NA

[a]Results less than the detection limit were set to one-half the reported detection limit.

[b]Dist. Codes: L = Distribution most similar to lognormal.
N = Distribution most similar to normal.
X = Distribution significantly different from normal and lognormal.
D = Non-parametric distribution – frequency of detection <50%.
0 = Zero detects – background criteria set to 0.00.

[c]If 95% UTL >max. detect then background criteria = max. detect.
If distribution determined not normal or lognormal or fewer than 3 samples then background criteria = max. detect.
Background criteria were set to zero if there were no detects.
NA - Not applicable. Background criteria were determined for metals only.

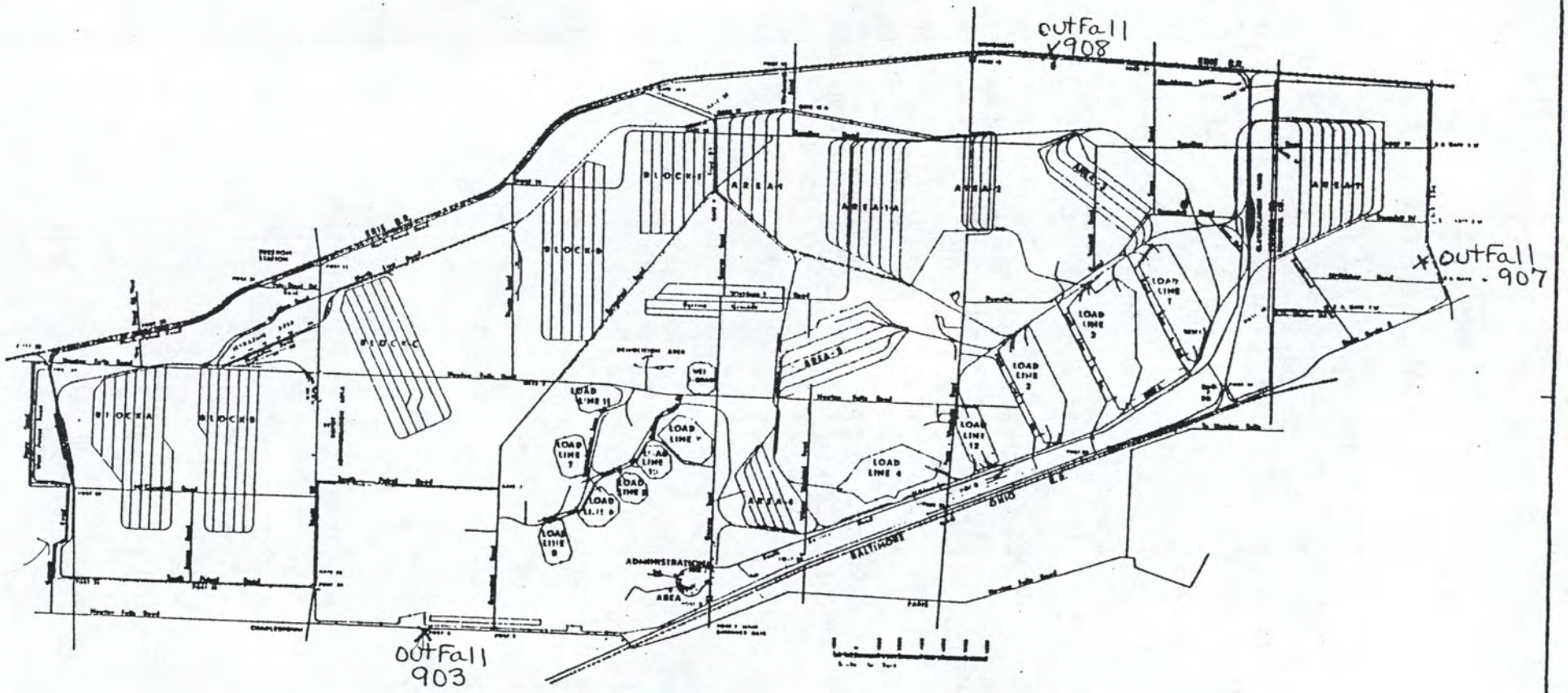
SECTION VI

SAMPLING DATA

Sampling for pollutants from stormwater discharges has been conducted on a monthly basis upstream (NPDES Discharge #800) and downstream (NPDES Discharge #900) in surface drainage adjacent to the Strategic Chromium Ore Pile since November 1, 1992. Beginning in April of 1998, NPDES Outfalls 800 & 900 are no longer included as part of the NPDES permit for this facility and sampling at these two locations is no longer taking place.

Visual inspections of key outfalls within identified major drainage areas, along with institutional knowledge regarding historical production and past disposal activities at RVAAP, has resulted in the decision to collect stormwater samples on an annual basis from three of the outfalls. Historically, samples have been collected from Outfalls 903, 905 and 908. Analytical results from the sampling of those outfalls are also included as part of this plan. Due to the cessation of monthly sampling at NPDES Outfalls 800 and 900, the Stormwater Pollution Prevention Team determined that the annual sampling strategy under this plan should change from sampling at Outfalls 903, 905 and 908 to sampling at Outfalls 903, 907 and 908. This change will allow for inclusion of the drainage from the Chromium Ore piles in the annual sampling event.

A copy of RVAAP's current Ohio EPA General Permit for Storm Water Associated with Industrial Activity, Permit No. OHR000262, is provided in Appendix C.



RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
OPERATED BY RAVENNA ARSENAL, INC.

APPROVED	SIGNATURE	DATE
SAFETY		
PRODUCTION		
ENGINEERING		
QUALITY ASSURANCE		
SECURITY		

TITLE: **GENERAL AREA MAP**

DWG. SHT NO. A-109

OhioEPA
State of Ohio Environmental Protection Agency

STREET ADDRESS:
Lazarus Government Center
2 S. Front Street
Columbus, Ohio 43215

TELE: (614) 644-3020 FAX: (614) 644-2329

MAILING ADDRESS:
P.O. Box 1049
Columbus, OH 43216-1049

RAVENNA ARMY AMMUNITION PLANT - US ARMY
JOHN CICERO JR
8451 SR 5
RAVENNA OH 44266-9297

12/14/2000

RE: Approval for coverage uner Ohio EPA NPDES General Permit for
STORM WATER ASSOCIATED WITH INDUSTRIAL ACTIVITY - OHR000003

Dear Discharger:

The Ohio Environmental Protection Agency has received a Notice of Intent for coverage under the above referenced general permit for:

RAVENNA ARMY AMMUNITION PLANT
8451 SR 5

County: PORTAGE
City: RAVENNA
Township:

Ohio EPA Facility Permit Number: 3GR00112*BG

This site/facility is approved for coverage under the above referenced Ohio EPA general permit. Please use your Ohio EPA facility permit number in all future correspondence. Enclosed is a copy of the general permit regulating your discharge(s).

Please read and review the permit carefully. The permit contains requirements and prohibitions with which you must comply. Coverage remains in effect until a renewal general permit is issued and Ohio EPA has contacted you in writing about submitting a new NOI for continuing coverage.

If you have any further questions, you may contact:

John Morrison at (614) 644-2259 or email john.morrison@epa.state.oh.us
Tim Bartrand at (614) 752-0782 or email: tim.bartrand@epa.state.oh.us
Anthony Robinson at (614) 728-3392 or email: anthony.robinson@epa.state.oh.us
Bob Phelps at (614) 644-2034 or email: bob.phelps@epa.state.oh.us

Thank you for your cooperation in this matter.

Sincerely,

Christopher Jones
Director

cc: File

COPY

NPDES Permit No.: OHR000003
Effective Date: August 1, 2000
Expiration Date: July 31, 2005

OHIO ENVIRONMENTAL PROTECTION AGENCY

GENERAL PERMIT AUTHORIZATION TO DISCHARGE STORM WATER ASSOCIATED WITH INDUSTRIAL ACTIVITY UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 et. seq., hereafter referred to as "the Act"), and the Ohio Water Pollution Control Act (Ohio Revised Code Chapter 6111), discharges of storm water from industrial facilities, as defined in Part I.B of this permit, are authorized by the Ohio Environmental Protection Agency, hereafter referred to as "Ohio EPA", to discharge from the outfalls at the sites and to the receiving waters identified in the applicant's Notice of Intent (NOI) on file with Ohio EPA in accordance with the conditions specified in Parts I through IX of this permit.

Permit coverage is conditioned upon payment of applicable fees, submittal of a complete Notice of Intent, and written approval of coverage from the Director of Ohio EPA in accordance with Ohio Administrative Code Rule 3745-38-06.

This permit and the authorization to discharge shall expire at midnight on the expiration date shown above. In order to receive authorization to discharge beyond the above date of expiration, the permittee shall submit such information and forms as are required by the Ohio EPA.

Christopher Jones
Director

Part I. COVERAGE UNDER THIS PERMIT

A. **Permit Area.** This permit covers the entire state of Ohio.

B. **Applicability.** Storm water discharges associated with industrial activity from a point source to surface waters of the state are unlawful, unless authorized by an NPDES permit. Dischargers with a storm water discharge associated with industrial activity (see definition in Part IX of this permit) which is discharged via a point source (including discharges through a municipal separate storm sewer system) to surface waters of the state are required to submit a permit application in accordance with Ohio EPA regulations. Dischargers that are eligible for coverage under this permit and that submit a Notice of Intent (NOI) in accordance with the requirements of Part II of this permit are in compliance with the NPDES application requirements for such storm water discharges.

C. **Eligibility.**

1. This permit may cover all new and existing point source discharges of storm water associated with industrial activity to surface waters of the state, except for storm water discharges identified under paragraph I.C.3.

2. This permit may authorize storm water discharges associated with industrial activity that are mixed with storm water discharges associated with industrial activity from construction activities provided that the storm water discharge from the construction activity is in compliance with the terms, including applicable NOI or application requirements, of a different NPDES general permit or individual permit authorizing such discharges.

3. Limitations on Coverage. The following storm water discharges associated with industrial activity are not authorized by this permit:

   a. storm water discharges associated with industrial activity that are mixed with sources of non-storm water other than non-storm water discharges that are:

      (i) in compliance with a different NPDES permit; or

      (ii) non-storm water discharges that are identified and in compliance with Attachment II.A.2 of this permit.

   b. storm water discharges associated with industrial activity which are subject to an existing effluent limitation guideline addressing storm water (or a combination of storm water and process water)[1];

---

[1] For the purpose of this permit, the following effluent limitation guidelines address storm water (or a combination of storm water and process water): cement manufacturing (40 CFR 411); feedlots (40 CFR 412); fertilizer manufacturing (40 CFR 418); petroleum refining (40 CFR 419); phosphate manufacturing (40 CFR 422); steam electric (40 CFR 423); coal mining (40 CFR 434); mineral mining and processing (40 CFR 436); ore mining and dressing (40 CFR 440); and asphalt emulsion (40 CFR 443 Subpart A). This permit may authorize storm water discharges associated with industrial activity which are not subject to an effluent limitation

c. storm water discharges associated with industrial activity that are subject to an existing NPDES individual or general permit. Such discharges may be authorized under this permit after an existing permit expires provided the existing permit did not establish numeric limitations for such discharges;

d. storm water discharges associated with industrial activity that the Director has determined to be contributing to a violation of a water quality standard;

e. storm water discharges associated with landfills, standard industrial classification (SIC) code 5171, SIC 14xx, construction activity, and discharges of coal pile runoff that were not authorized to discharge under general permit OHR000002 or OHG000001; and

f. storm water dischargers that discharge to surface waters of the state having a use designation of State Resource Waters or Superior High Quality Waters that have not previously had general permit coverage for its storm water associated with industrial activity and did not previously have coverage under general permit No. OHR000002 or OHG000001.

4. Storm water discharges associated with industrial activity which are authorized by this permit may be combined with other sources of storm water which are not classified as associated with industrial activity pursuant to 40 CFR 122.26(b)(14), so long as the resulting discharge is in compliance with this permit.

D. Authorization.

1. Dischargers of storm water associated with industrial activity must submit an NOI in accordance with the Ohio Administrative Code 3745-38 and the requirements of Part II of this permit, using an NOI form provided by the Director, to be authorized to discharge under this general permit.

2. After the NOI form is reviewed by the Ohio EPA, the permittee shall be notified, in writing as to Ohio EPA's approval or denial for coverage under this general permit.

3. The Director may require submittal of an application for an individual NPDES permit based on a review of the NOI or other information.

Part II. NOTICE OF INTENT, TRANSFER, NOTICE OF TERMINATION REQUIREMENTS AND NO EXPOSURE CERTIFICATION

This part of the permit addresses how to obtain, transfer and terminate general permit coverage. See Attachment I of the permit.

---

guideline even where a different storm water discharge at the facility is subject to an effluent limitation guideline.

Part III. SPECIAL CONDITIONS

This part of the permit addresses what types of non-storm water discharges are prohibited by the permit and what to do in case of a discharge containing pollutants in excess of reportable quantities. See Attachment II of the permit.

Part IV. STORM WATER POLLUTION PREVENTION PLANS

This part of the permit requires the development, implementation and updating of a storm water pollution prevention plan. The plan involves the formation of an in-house storm water pollution prevention team, examining the facility for potential sources of contamination of storm water discharges, and selecting and implementing best management practices for minimizing or eliminating storm water contamination. The plan also requires a Comprehensive Site Compliance Evaluation, additional requirements for storm water discharges associated with industrial activity from facilities subject to Superfund Amendments and Reauthorization Act (SARA) Title III, Section 313 requirements and employee and contractor training requirements. See Attachment III of the permit.

Part V. NUMERIC EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

This part contains numeric effluent limitations for coal pile runoff, monitoring requirements for storm water runoff from 11 industrial categories (defined in Attachment IV), and additional storm water monitoring requirements for facilities required to report under SARA Title III for "Section 313 Water Priority Chemicals." Effluent limitations of 50 mg/l for Total Suspended Solids and a pH range of 6.0 S.U. to 9.0 S.U. apply to coal pile runoff. All facilities required to monitor storm water discharges must monitor for: oil & grease, pH, storm event duration, amount of precipitation, time between storm events, and volume of discharge. There are other parameters where monitoring may be required dependent upon industrial category and whether a discharger is a "Section 313" facility (see Attachment IV for detailed requirements that must be met).

Part VI. REPORTING REQUIREMENTS

This part contains types of certifications and reports required by the permit. (See Attachment V of the permit for detailed requirements which must be met).

Part VII. STANDARD PERMIT CONDITIONS

This part contains a variety of obligations and requirements that govern operating under this permit (see Attachment VI for detailed requirements and conditions that must be met).

Part VIII. REOPENER CLAUSE

This part addresses permit changes that could happen if a storm water discharge was discovered to be impairing water quality. See Attachment VII of the permit.

Part IX. DEFINITIONS

This part gives definitions of terminology used within the permit (see Attachment VIII of the permit for actual definitions).

ATTACHMENT I. NOTICE OF INTENT, TRANSFER, NOTICE OF TERMINATION REQUIREMENTS, AND NO EXPOSURE CERTIFICATION

A. Deadlines for Notification.

1. Except as provided in paragraphs A.4, A.5 and A.6 of Attachment I, individuals who intended to obtain coverage for a storm water discharge associated with industrial activity that was in existence prior to April 1, 1993, under the industrial storm water general permit should have initially submitted a Notice of Intent (NOI) in accordance with the requirements of this part on or before October 1, 1992 or for group applicants in accordance with written instructions provided by Ohio EPA.

2. Except as provided in paragraphs A.3, A.4, A.5 and A.6 of Attachment I, operators of facilities which begin discharging storm water associated with industrial activity after April 1, 1993, shall submit an NOI in accordance with the requirements of this part at least 180 days prior to the commencement of storm water discharge associated with industrial activity at the facility;

3. Operators of oil and gas exploration, production, processing, or treatment operations or transmission facilities, that were not required to submit a permit application as of October 1, 1992 in accordance with 40 CFR 122.26(c)(1)(iii), but that after October 1, 1992 have a discharge of a reportable quantity of oil or a hazardous substance for which notification are required pursuant to either 40 CFR 110.6, 40 CFR 117.21 or 40 CFR 302.6, must submit an NOI in accordance with the requirements of paragraph C of Attachment I of this permit within 14 calendar days of the first knowledge of such release.

4. Storm water discharges associated with industrial activity from a facility that is owned or operated by a municipality that has participated in a timely Part 1 group application and where either the group application is rejected or the facility is denied participation in the group application by U.S. EPA, and that are seeking coverage under this general permit shall submit an NOI in accordance with the requirements of this part on or before the 180th day following the date on which the group is rejected or the denial is made, or October 1, 1992, whichever is later.

5. Where the operator of a facility with a storm water discharge associated with industrial activity which is covered by this permit changes and the new operator wishes to have existing general permit coverage transferred, the new and current operators of the facility must complete and send to Ohio EPA a transfer of responsibility form in accordance with the requirements of this part at least 60 days prior to the change.

6. An operator of a storm water discharge associated with industrial activity may submit an NOI in accordance with the requirements of this part after the dates provided in paragraphs A.1, 2, 3, or 4 of Attachment I of this permit. In such instances, Ohio EPA may bring an enforcement action for any discharges of storm water associated with industrial activity that have occurred on or after the dates specified in paragraphs A.1, 2, 3 or 4 in Attachment I.

B. Contents of Notice of Intent. The applicant shall complete and submit an approved NOI form provided by Ohio EPA.

C. **Where to Submit.** Facilities which discharge storm water associated with industrial activity must use an NOI form provided by the Director. NOIs must be signed in accordance with paragraph G of Attachment VI of this permit. NOIs are to be submitted to the Director at the following address:

Ohio Environmental Protection Agency
Office of Fiscal Administration
P.O. Box 1049
Columbus, Ohio 43216-1049

D. **Additional Notification.** Facilities which discharge storm water associated with industrial activity through large or medium municipal separate storm sewer systems (systems located in an incorporated city with a population of 100,000 or more, or in a county identified as having a large or medium system (see definition in Attachment VIII of this permit)) shall, in addition to filing copies of the Notice of Intent in accordance with paragraph D of Attachment I, also submit signed copies of the Notice of Intent to the operator of the municipal separate storm sewer through which they discharge in accordance with the deadlines in paragraph A of Attachment I of this permit.

E. **Renotification.** Upon issuance of a renewal or alternate general permit, the permittee shall notify the Director of its intent to be covered by the renewal or alternate general permit in accordance with written instructions provided by Ohio EPA. Coverage under this permit (NPDES permit number OHR000003) shall terminate within 90 days of the date of Ohio EPA's written instructions to renotify.

F. **Notice of Termination (NOT).** Where all storm water discharges associated with industrial activity that are authorized by this permit are eliminated, the operator of the facility must submit an NOT form provided by Ohio EPA that is signed in accordance with paragraph G of Attachment VI of this permit.

All Notices of Termination are to be sent, using the form provided by the Director (or a photocopy thereof), to the following address:

Ohio Environmental Protection Agency
Division of Surface Water
General Permit Program-NOT
P.O. Box 1049
Columbus, Ohio 43216-1049

G. **Facilities Eligible for "No Exposure" Exemption for Storm Water Permitting.** By filing a certification of "No Exposure," facilities previously having industrial storm water general permit coverage are automatically removed from permit coverage and an NOT to terminate permit coverage is not required.

ATTACHMENT II. SPECIAL CONDITIONS

A. Prohibition on Non-Storm Water Discharges.

1. Except as provided in paragraph A.2 of Attachment II, all discharges covered by this permit shall be composed entirely of storm water.

2. a. Except as provided in paragraph A.2.b of Attachment II of this permit, discharges of material other than storm water must be in compliance with a NPDES permit (other than this permit) issued for the discharge.

   b. The following non-storm water discharges may be authorized by this permit provided the non-storm water component of the discharge is in compliance with paragraph D.3.g of Attachment III of this permit: discharges from fire fighting activities; fire hydrant flushings; potable water sources including waterline flushings; irrigation drainage; lawn watering; routine external building washdown which does not use detergents; pavement washwaters where spills or leaks of toxic or hazardous materials have not occurred (unless all spilled material has been removed) and where detergents are not used; air conditioning condensate; springs; uncontaminated ground water; and foundation or footing drains where flows are not contaminated with process materials such as solvents.

B. Releases in excess of Reportable Quantities.

1. The discharge of hazardous substances or oil in the storm water discharge(s) from a facility shall be minimized in accordance with the applicable storm water pollution prevention plan for the facility. Except as provided in paragraph B.2 of Attachment II of this permit, where a release containing a hazardous substance in an amount equal to or in excess of a reportable quantity established under either 40 CFR 117 or 40 CFR 302, occurs during a 24 hour period:

   a. Any person in charge of the facility is required to notify the National Response Center (NRC) (800-424-8802); in accordance with the requirements of 40 CFR 110, 40 CFR 117 and 40 CFR 302 as soon as he or she has knowledge of the discharge;

   b. The permittee shall submit within 14 calendar days of knowledge of the release a written description of the release (including the type and estimate of the amount of material released), the date that such release occurred, the circumstances leading to the release, and steps to be taken in accordance with paragraph B.1.c of Attachment II of this permit to the appropriate Ohio EPA District Office; and

   c. The storm water pollution prevention plan required under Part IV (see Attachment III) of this permit must be modified within 14 calendar days of knowledge of the release to: provide a description of the release, the circumstances leading to the release, and the date of the release. In addition, the plan must be reviewed to identify measures to prevent the reoccurrence of such releases and to respond to such releases, and the plan must be modified where appropriate.

2. Multiple Anticipated Discharges - Facilities which have more than one anticipated discharge per year containing a hazardous substance in an amount equal to or in excess of a reportable quantity established under either 40 CFR 117 or 40 CFR 302, which occurs during a 24 hour

period, where the discharge is caused by events occurring within the scope of the relevant operating system shall:

a. submit notifications in accordance with paragraph B.1 of Attachment II of this permit for the first such release that occurs during a calendar year (or for the first year of this permit, after submittal of an NOI); and

b. shall provide in the storm water pollution prevention plan required under Part IV (see Attachment III) a written description of the dates on which such releases occurred, the type and estimate of the amount of material released, and the circumstances leading to the release. In addition, the plan must be reviewed to identify measures to minimize such releases and the plan must be modified where appropriate.

3. Spills. This permit does not authorize the discharge of hazardous substances or oil resulting from an on-site spill.

ATTACHMENT III. STORM WATER POLLUTION PREVENTION PLANS

A storm water pollution prevention plan (plan) shall be developed for each facility covered by this permit. Storm water pollution prevention plans shall be prepared in accordance with good engineering practices. The plan shall identify potential sources of pollution which may reasonably be expected to affect the quality of storm water discharges associated with industrial activity from the facility. In addition, the plan shall describe and ensure the implementation of practices which are to be used to reduce the pollutants in storm water discharges associated with industrial activity at the facility and to assure compliance with the terms and conditions of this permit. Facilities must implement the provisions of the storm water pollution prevention plan required under this part as a condition of this permit.

A. Deadlines for Plan Preparation and Compliance.

1. Except as provided in paragraphs A.3, 4 and 5 of Attachment III, a plan for a storm water discharge associated with industrial activity that existed on or before October 1, 1992, or that commenced prior to April 1, 1993 (group applicants that had initial storm water general permit coverage under OHG000001 had different deadlines):

   a. was to be prepared on or before April 1, 1993 (and updated as appropriate); and

   b. was to provide for initial implementation and compliance with the terms of the plan on or before October 1, 1993.

2. The plan for any storm water discharges associated with industrial activity that commences after April 1, 1993, shall be prepared, and except as provided elsewhere in this permit, shall provide for compliance with the terms of the plan and this permit within 180 days of a timely-submitted NOI (and the plan shall be updated as appropriate);

3. The plan for storm water discharges associated with industrial activity from an oil and gas exploration, production, processing, or treatment operation or transmission facility that is not required to submit a permit application as of October 1, 1992 in accordance with 40 CFR 122.26(c)(1)(iii), but after October 1, 1992 has a discharge of a reportable quantity of oil or a hazardous substance for which notification is required pursuant to either 40 CFR 110.6, 40 CFR 117.21 or 40 CFR 302.6, shall be prepared and except as provided elsewhere in this permit, shall provide for compliance with the terms of the plan and this permit on or before the date 60 calendar days after the first knowledge of such release (and updated as appropriate);

4. The plan for storm water discharges associated with industrial activity from any facility owned or operated by a municipality that has participated in a timely Part 1 group application and where either the group application is rejected or facility is denied participation in the group application by U.S. EPA; or a group applicant to whom Ohio EPA did not contact to apply for coverage under its industrial storm water general permit for group applicants (OHG000001):

   a. shall be prepared on or before the 365th day following the date on which the group is rejected or the denial is made, or by April 1, 1993, whichever was later (and updated as appropriate); or for group applicants Ohio EPA did not previously contact 365 days from the date coverage is granted for this general permit (OHR000003).

b. except as provided elsewhere in this permit, shall provide for compliance with the terms of the plan and this permit on or before the 545th day following the date on which the group is rejected or the denial is made, or by October 1, 1993, whichever is later; or for group applicants Ohio EPA did not previously contact 545 days from the date coverage is granted under this general permit (OHR000003).

5. Upon a showing of good cause, the Director may establish a later date for preparing and compliance with a plan for a storm water discharge associated with industrial activity that submits an NOI in accordance with paragraph A.5 of Attachment I of this permit (and updated as appropriate).

B. Signature and Plan Review.

1. The plan shall be signed in accordance with paragraph G of Attachment VI of this permit and be retained on-site at the facility which generates the storm water discharge.

2. The permittee shall make plans available upon request to the Ohio EPA Director, or authorized representative, or Regional Administrator of U.S. EPA, or in the case of a storm water discharge associated with industrial activity which discharges through a municipal separate storm sewer system, to the operator of the municipal system.

3. The Director may notify the permittee at any time that the plan does not meet one or more of the minimum requirements of this part. Within 30 days of such notification from the Director, the permittee shall make the required changes to the plan and shall submit to the Director a written certification that the requested changes have been made.

4. All storm water pollution prevention plans (SWP3s) required under this permit are considered reports that shall be available to the public under Section 308(b) of the Act. The permittee may claim any portion of a storm water pollution plan as confidential in accordance with 40 CFR Part 2 and does not have to release any portion of the plan describing facility security measures (such as provided for in paragraph D.7.b(8) of Attachment III of this permit). An interested party wishing a copy of a discharger's SWP3 will have to contact Ohio EPA to obtain a copy.

C. Keeping Plans Current.

The permittee shall amend the plan whenever there is a change in design, construction, operation, or maintenance, which has a significant effect on the potential for the discharge of pollutants to the surface waters of the state or if the storm water pollution prevention plan proves to be ineffective in eliminating or significantly minimizing pollutants from sources identified under paragraph D.2 of Attachment III of this permit, or otherwise achieving the general objectives of controlling pollutants in storm water discharges associated with industrial activity. Amendments to the plan may be reviewed by Ohio EPA in the same manner as paragraph B, above, of Attachment III of this permit.

D. Contents of Plan. The plan shall include, at a minimum, the following items:

1. Pollution Prevention Team - Each plan shall identify a specific individual or individuals within the facility organization as members of a Storm Water Pollution Prevention Team that are responsible for developing the storm water pollution prevention plan and assisting the facility

or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

2. Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources which may reasonably be expected to add significant amounts of pollutants to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials which may potentially be significant pollutant sources. Each plan shall include, at a minimum:

   a. Drainage.

      1. A site map indicating an outline of the drainage area of each storm water outfall, each existing structural control measure to reduce pollutants in storm water runoff, surface water bodies, locations where significant materials are exposed to precipitation, locations where major spills or leaks identified under paragraph D.2.c of Attachment III of this permit have occurred, and the locations of the following activities where such activities are exposed to precipitation: fueling stations, vehicle and equipment maintenance and/or cleaning areas, loading/unloading areas, locations used for the treatment, storage or disposal of wastes, liquid storage tanks, processing areas and storage areas.

      2. For each area of the facility that generates storm water discharges associated with industrial activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow, and an estimate of the types of pollutants which are likely to be present in storm water discharges associated with industrial activity. Flows with a significant potential for causing erosion shall be identified.

   b. Inventory of Exposed Materials. An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of three years prior to the date of the issuance of this permit and the present; method and location of on-site storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of three years prior to the date of the issuance of this permit and the present; the location and a description of existing structural and non-structural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives.

   c. Spills and Leaks. A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at the facility after the date of three years prior to the effective date of this permit.

   d. Sampling Data. A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility.

e. Risk Identification and Summary of Potential Pollutant Sources A narrative description of the potential pollutant sources at the following areas: loading and unloading operations; outdoor storage activities; outdoor manufacturing or processing activities; significant dust or particulate generating processes; and on-site waste disposal practices. The description shall specifically list any significant potential source of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., biochemical oxygen demand, etc.) of concerns shall be identified.

3. Measures and Controls. Each facility covered by this permit shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

a. Good Housekeeping - Good housekeeping requires the maintenance of a clean, orderly facility.

b. Preventive Maintenance - A preventive maintenance program shall involve inspection and maintenance of storm water management devices (e.g., cleaning oil/water separators, catch basins) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

c. Spill Prevention and Response Procedures - Areas where potential spills can occur, and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up should be available to personnel.

d. Inspections - In addition to or as part of the comprehensive site evaluation required under paragraph 4 of Attachment III of this permit, qualified facility personnel shall be identified to inspect designated equipment and areas of the facility at appropriate intervals specified in the plan. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained.

e. Employee Training - Employee training programs shall inform personnel at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping and material management practices. The plan shall identify periodic dates for such training.

f. Record-keeping and Internal Reporting Procedures - A description of incidents such as spills, or other discharges, along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan.

g. Non-Storm Water Discharges

1. The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the on-site drainage points that were directly observed during the test. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit which receives the discharge. In such cases, the source identification section of the storm water pollution plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify in accordance with paragraph A of Attachment V of this permit.

2. Except for flows from fire fighting activities, sources of non-storm water listed in paragraph A.2 of Attachment II of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

h. Sediment and Erosion Control - The plan shall identify areas which, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify measures to limit erosion.

i. Management of Runoff - The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those which control the source of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide that measures determined to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity (see paragraphs D.2(b), (d) and (e) of Attachment III of this permit) shall be considered when determining reasonable and appropriate measures. Appropriate measures may include: including vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, and wet detention/retention devices.

4. Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations at appropriate intervals specified in the plan, but, except as provided in paragraph D.4.d of Attachment III of this permit, in no case less than once a year. Such evaluations shall provide:

a. Material handling areas and other potential sources of pollution identified in the plan in accordance with paragraph D.2 in Attachment III of this permit shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Structural storm water management measures, sediment and control measures, and other structural

pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

b. Based on the results of the inspection, the description of potential pollutant sources identified in the plan in accordance with paragraph D.2 of Attachment III of this permit and pollution prevention measures and controls identified in the plan in accordance with paragraph D.3 of Attachment III of this permit shall be revised as appropriate within two weeks of such inspection and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than twelve weeks after the inspection.

c. A report summarizing the scope of the inspection, personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph D.4.b of Attachment III of the permit shall be made and retained as part of the storm water pollution prevention plan for at least three years. The report shall be signed in accordance with paragraph G of Attachment VI of this permit.

d. Where annual site inspections are shown in the plan to be impractical for inactive mining sites due to the remote location and inaccessibility of the site, site inspections required under this part shall be conducted at appropriate intervals specified in the plan, but, in no case less than once in three years. At least one site inspection required under this part shall be conducted prior to October 1, 1994 or, for sites which become inactive after October 1, 1994, the date two years after such site becomes inactive.

5. Additional requirements for storm water discharges associated with industrial activity through municipal separate storm sewer systems serving a population of 100,000 or more. In addition to the applicable requirements of this permit, facilities covered by this permit must comply with applicable requirements in municipal storm water management programs developed under NPDES permits issued for the discharge of the municipal separate storm sewer system that receives the facility's discharge, provided the discharger has been notified of such conditions.

6. Consistency with other plans. Storm water pollution prevention plans may reflect requirements for Spill Prevention Control and Countermeasure (SPCC) plans developed for the facility under section 311 of the Act or Best Management Practices (BMP) Programs otherwise required by a NPDES permit for the facility as long as such requirement is incorporated into the storm water pollution prevention plan.

7. Additional requirements for storm water discharges associated with industrial activity from facilities subject to SARA Title III, Section 313 requirements (these additional requirements are not applicable to Section 313 water priority chemicals in gaseous or non-soluble liquid or solid [at atmospheric pressure and temperature] forms). In addition to the requirements of paragraphs D.1 through 4 of Attachment III of this permit and other applicable conditions of this permit, storm water pollution prevention plans for facilities subject to reporting requirements under SARA Title III, Section 313 for chemicals which are classified as "Section 313 water priority chemicals" in accordance with the definition in Attachment VIII of this permit, shall describe and ensure the implementation of practices which are necessary to provide for conformance with the following guidelines:

a. In areas where Section 313 water priority chemicals are stored, processed or otherwise handled, appropriate containment, drainage control and/or diversionary structures shall be provided. At a minimum, one of the following preventive systems or its equivalent shall be used:

   1. Curbing, culverting, gutters, sewers or other forms of drainage control to prevent or minimize the potential for storm water run-on to come into contact with significant sources of pollutants; or

   2. Roofs, covers or other forms of appropriate protection to prevent storage piles from exposure to storm water, and wind blowing.

b. In addition to the minimum standards listed under paragraph D.7.a of Attachment III of this permit, the storm water pollution prevention plan shall include a complete discussion of measures taken to conform with the following applicable guidelines, other effective storm water pollution prevention procedures, and applicable State rules, regulations and guidelines:

   1. Liquid storage areas where storm water comes into contact with any equipment, tank, container, or other vessel used for Section 313 water priority chemicals.

      a. No tank or container shall be used for the storage of a Section 313 water priority chemical unless its material and construction are compatible with the material stored and conditions of storage such as pressure and temperature, etc.

      b. Liquid storage areas for Section 313 water priority chemicals shall be operated to minimize discharges of Section 313 chemicals. Appropriate measures to minimize discharges of Section 313 chemicals may include secondary containment provided for at least the entire contents of the largest single tank plus sufficient freeboard to allow for precipitation, a strong spill contingency and integrity testing plan, and/or other equivalent measures.

   2. Material storage areas for Section 313 water priority chemicals other than liquids. Material storage areas for Section 313 water priority chemicals other than liquids which are subject to runoff, leaching, or wind blowing shall incorporate drainage or other control features which will minimize the discharge of Section 313 water priority chemicals by reducing storm water contact with Section 313 water priority chemicals.

   3. Truck and rail car loading and unloading areas for liquid Section 313 water priority chemicals. Truck and rail car loading and unloading areas for liquid Section 313 water priority chemicals shall be operated to minimize discharges of Section 313 water priority chemicals. Appropriate measures to minimize discharges of Section 313 chemicals may include: the placement and maintenance of drip pans where spillage may occur (such as hose connections, hose reels and filler nozzles) for use when making and breaking hose connections; a strong spill contingency and integrity testing plan; and/or other equivalent measures.

   4. In facility areas where Section 313 water priority chemicals are transferred, processed or otherwise handled. Processing equipment and materials handling equipment shall

be operated so as to minimize discharges of Section 313 water priority chemicals. Materials used in piping and equipment shall be compatible with the substances handled. Drainage from process and materials handling areas shall be designed as described in paragraphs (a), (b) and (c) of this section. Additional protection such as covers or guards to prevent wind blowing, spraying or releases from pressure relief vents from causing a discharge of Section 313 water priority chemicals to the drainage system, and overhangs or door skirts to enclose trailer ends at truck loading/unloading docks shall be provided as appropriate. Visual inspections or leak tests shall be provided for overhead piping conveying Section 313 water priority chemicals without secondary containment.

5. Discharges from areas covered by paragraphs (1), (2), (3) or (4).

   a. Drainage from areas covered by paragraphs (1), (2), (3) or (4) of this part should be restrained by valves or other positive means to prevent the discharge of a spill or other excessive leakage of Section 313 water priority chemicals. Where containment units are employed, such units may be emptied by pumps or ejectors; however, these shall be manually activated.

   b. Flapper-type drain valves shall not be used to drain containment areas. Valves used for the drainage of containment areas should, as far as is practical, be of manual, open-and-closed design.

   c. If facility drainage is not engineered as above, the final discharge of all in-facility storm sewers shall be equipped to be equivalent with a diversion system that could, in the event of an uncontrolled spill of Section 313 water priority chemicals, return the spilled material to the facility.

   d. Records shall be kept of the frequency and estimated volume (in gallons) of discharges from containment areas.

6. Facility site runoff other than from areas covered by (1), (2), (3) or (4). Other areas of the facility (those not addressed in paragraphs (1), (2), (3) or (4)), from which runoff which may contain Section 313 water priority chemicals or spills of Section 313 water priority chemicals could cause a discharge shall incorporate the necessary drainage or other control features to prevent discharge of spilled or improperly disposed material and ensure the mitigation of pollutants in runoff or leachate.

7. Preventive maintenance and housekeeping. All areas of the facility shall be inspected at specific intervals for leaks or conditions that could lead to discharges of Section 313 water priority chemicals or direct contact of storm water with raw materials, intermediate materials, waste materials or products. In particular, facility piping, pumps, storage tanks and bins, pressure vessels, process and material handling equipment, and material bulk storage area shall be examined for any conditions or failures which could cause a discharge. Inspection shall include examination for leaks, wind blowing, corrosion, support or foundation failure, or other forms of deterioration or non-containment. Inspection intervals shall be specified in the plan and shall be based on design and operational experience. Different areas may require different inspection intervals. Where a leak or other condition is discovered

which may result in significant releases of Section 313 water priority chemicals to the drainage system, corrective action shall be immediately taken or the unit or process shut down until corrective action can be taken. When a leak or non-containment of a Section 313 water priority chemical has occurred, contaminated soil, debris, or other material must be promptly removed and disposed in accordance with Federal, State, and local requirements and as described in the plan.

8. Facility security. Facilities shall have the necessary security systems to prevent accidental or intentional entry which could cause a discharge. Security systems described in the plan shall address fencing, lighting, vehicular traffic control, and securing of equipment and buildings.

9. Training. Facility employees and contractor personnel using the facility shall be trained in and informed of preventive measures at the facility. Employee training shall be conducted at intervals specified in the plan, but not less than once per year, in matters of pollution control laws and regulations, and in the storm water pollution prevention plan and the particular features of the facility and its operation which are designed to minimize discharges of Section 313 water priority chemicals. The plan shall designate a person who is accountable for spill prevention at the facility and who will set up the necessary spill emergency procedures and reporting requirements so that spills and emergency releases of Section 313 water priority chemicals can be isolated and contained before a discharge of a Section 313 water priority chemical can occur. Contractor or temporary personnel shall be informed of facility operation and design features in order to prevent discharges or spills from occurring.

8. Additional Requirements for Salt Storage. Storage piles of salt used for deicing or other commercial or industrial purposes and which generate a storm water discharge associated with industrial activity which is discharged to surface waters of the state shall be enclosed or covered to prevent exposure to precipitation, except for exposure resulting from adding or removing materials from the pile. Piles do not need to be enclosed or covered where storm water from the pile is not discharged to surface waters of the state.

ATTACHMENT IV. NUMERIC EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

A. **Coal Pile Runoff Effluent Limitations.** Any discharge of coal pile runoff to waters of the state in existence and being covered under the general permit for storm water associated with industrial activity as of February 18, 1996 is eligible for coverage under this general permit as long as the permittee complied with the following effluent limitations as expeditiously as practicably but no later than October 26, 1995, if in existence at that time, or if initial discharge commenced after October 26, 1995 then upon commencement of discharge. Coal pile runoff shall not be diluted with storm water or other flow in order to meet these limitations.

Units	Parameter	Daily Minimum	Daily Maximum
mg/l	Total Suspended Solids	---	50
S.U.	pH	6.0	9.0

Any untreated overflow from facilities designed, constructed and operated to treat the volume of coal pile runoff which is associated with a 10 year, 24-hour rainfall event shall not be subject to the limitation for total suspended solids. It is the permittee's responsibility to demonstrate to the Ohio EPA that a 10 year, 24-hour rainfall event has occurred and the volume of the overflow to which the Total Suspended Solids effluent limitation does not apply.

B. **Monitoring Requirements.** Only the activities described in the following matrix and associated definitions are required to conduct monitoring. The monitoring required in the following matrix shall be conducted annually. Monitoring shall be initiated within twelve months of the date that the Director approves the entity for coverage under this general permit and henceforth on an annual basis, weather conditions permitting. A permittee may, in lieu of annual monitoring, certify that industrial materials are not exposed to storm water; such certification shall be submitted to the Ohio EPA upon request of the Director. See paragraph B.2.a of Attachment IV of this permit regarding Section 313 water priority chemicals and associated areas regarding monitoring.

1. Monitoring Requirements Matrix

Reporting Units	Parameter	INDUSTRIAL ACTIVITY CATEGORIES											
		a	b[1]	c	d	e	f	g	h	i[2]	j	k	l[1]
mg/l	Oil and Grease		X	X	X	X	X	X	X	X	X	X	X
mg/l	5-day Biochemical Oxygen Demand		X							X		X	
mg/l	Chemical Oxygen Demand		X	X	X	X	X		X	X			X
mg/l	Total Suspended Solids		X		X	X	X	X	X	X	X	X	X
mg/l	Total Kjeldahl Nitrogen			X								X	
mg/l	Phosphorus											X	
S.U.	pH		X	X	X	X	X	X	X	X	X	X	X
TU_a	Acute Toxicity												
Hours	Duration of Storm Event		X	X	X	X	X	X	X	X	X	X	X
Inches	Precipitation		X	X	X	X	X	X	X	X	X	X	X
Hours	Duration Between Storm Events*		X	X	X	X	X	X	X	X	X	X	X
Gallons	Volume (est)		X	X	X	X	X	X	X	X	X	X	X
ug/l	Lead, Total		X	X					X				

Reporting Units	Parameter	INDUSTRIAL ACTIVITY CATEGORIES											
		a	b[1]	c	d	e	f	g	h	i[2]	j	k	l[1]
µg/l	Cadmium, Total		X[3]	X									
µg/l	Copper, Total		X[3]				X	X	X		X		
µg/l	Arsenic, Total		X[3]	X			X						
µg/l	Chromium, Total		X[3]	X			X						
mg/l	Ammonia												
µg/l	Magnesium, Total			X									
µg/l	Magnesium, Diss.			X									
mg/l	Total Dissolved Solids			X									
mg/l	Total Organic Carbon			X									
µg/l	Barium, Total			X									
mg/l	Cyanide, Total			X									
µg/l	Mercury, Total			X									
µg/l	Selenium, Total			X									
µg/l	Silver, Total			X									
µg/l	Pentachlorophenol				X								
µg/l	Nickel, Total							X			X		
µg/l	Zinc, Total							X			X		
#/100ml	Fecal Coliform											X	

*Time between the storm event when sampling is being conducted and the last storm event producing rainfall greater than 0.1 inches.

1 and any pollutant limited in an effluent guideline or categorical pretreatment standard which the facility is subject.

2 and the primary ingredient used in the deicing materials used at the site (e.g., ethylene glycol, urea, etc.).

3 facilities that are classified as SIC 33 only because they manufacture pure silicon and/or semiconductor grade silicon are not required to monitor for this parameter.

2. Industrial Activity Categories Definitions

a. Section 313 of SARA Title III Facilities. As of the effective date of permit OHR000003, facilities with storm water discharges associated with industrial activity that are subject to requirements to report releases into the environment under Section 313 of SARA Title III for chemicals which are classified as 'Section 313 water priority chemicals' are no longer required to perform monitoring unless required by paragraphs B.2.b through B.2.l. of Attachment IV of this permit.

b. Primary Metal Industries. Facilities with storm water discharges associated with industrial activity classified as Standard Industrial Classification (SIC) 33 (Primary Metal Industry) are required to monitor such storm water that is discharged from the facility.

c. Land Disposal Units/Incinerators/BIFs. Facilities with storm water discharges associated with industrial activity from any active or inactive land application sites that has received any industrial wastes from a facility with a Standard Industrial Classification (SIC) of between 20-39 (manufacturing); and incinerators (including Boilers and Industrial Furnaces (BIFs)) that burn hazardous waste and operate under interim status or a permit under Subtitle C of RCRA, are required to monitor such storm water that is discharged from the facility (see land application unit on page 31).

d. Wood Treatment Using Chlorophenolic Formulations. Facilities with storm water discharges associated with industrial activity from areas that are used for wood treatment, wood surface application or storage of treated or surface protected wood at any wood preserving or wood surface facilities are required to monitor such storm water that is discharged from the facility.

e. Wood Treatment Using Creosote Formulations. Facilities with storm water discharges associated with industrial activity from areas that are used for wood treatment, wood surface application or storage of treated or surface protected wood at any wood preserving or wood surface facilities are required to monitor such storm water that is discharged from the facility.

f. Wood Treatment Using Chromium-Arsenic Formulations. Facilities with storm water discharges associated with industrial activity from areas that are used for wood treatment, wood surface application or storage of treated or surface protected wood at any wood preserving or wood surface facilities are required to monitor such storm water that is discharged from the facility.

g. Coal Pile Runoff. Facilities with storm water discharges associated with industrial activity from coal pile runoff are required to monitor such storm water that is discharged from the facility.

h. Battery Reclaimers. Facilities with storm water discharges associated with industrial activity from areas used for storage of lead acid batteries, reclamation products, or waste products, and areas used for lead acid battery reclamation (including material handling activities) at facilities that reclaim lead acid batteries are required to monitor such storm water that is discharged from the facility.

i. Airports. At airports with over 50,000 flight operations per year, facilities with storm water discharges associated with industrial activity from areas where aircraft or airport deicing operations occur (including runways, taxiways, ramps, and dedicated aircraft deicing stations) are required to monitor such storm water that is discharged from the facility.

j. Coal-fired Steam Electric Facilities. Facilities with storm water discharges associated with industrial activity from coal handling sites at coal fired steam electric power generating facilities (other than discharges in whole or in part from coal piles subject to storm water effluent guidelines at 40 CFR 423 - which are not eligible for coverage under this permit) are required to monitor such storm water that is discharged from the facility.

k. Animal Handling / Meat Packing. Facilities with storm water discharges associated with industrial activity from animal handling areas, manure management (or storage) areas, and production waste management (or storage) areas that are exposed to precipitation at meat packing plants, poultry packing plants, and facilities that manufacture animal and marine fats and oils, are required to monitor such storm water that is discharged from the facility.

l. Additional Facilities. Facilities with storm water discharges associated with industrial activity that:

1. come in contact with storage piles for solid chemicals used as raw materials that are exposed to precipitation at facilities classified as SIC 30 (Rubber and Miscellaneous Plastics Products) or SIC 28 (Chemicals and Allied Products);

2. are from those areas at automobile junkyards with any of the following: (A) over 250 auto/truck bodies with drivelines (engine, transmission, axles, and wheels), 250 drivelines, or any combination thereof (in whole or in parts) are exposed to storm water; (B) over 500 auto/truck units (bodies with or without drive lines in whole or in parts) are stored and exposed to storm water; or (C) over 100 units per year are dismantled and drainage or storage of automotive fluids occurs in areas exposed to storm water;

3. come in contact with lime storage piles that are exposed to storm water at lime manufacturing facilities;

4. are from oil handling sites at oil fired steam electric power generating facilities;

5. are from cement manufacturing facilities and cement kilns (other than discharges in whole or in part from material storage piles subject to storm water effluent guidelines at 40 CFR 411 - which are not eligible for coverage under this permit);

6. are from ready-mixed concrete facilities; or

7. are from ship building and repairing facilities;

are required to monitor such storm water discharged from the facility.

3. When and How to Sample. Take a minimum of one grab sample from the discharge associated with industrial activity resulting from a storm event with at least 0.1 inch of precipitation (defined as "measurable" event), providing the interval from the preceding measurable storm is at least 72 hours. The 72-hour storm interval is waived when the preceding measurable storm did not yield a measurable discharge, or if you are able to document that less than a 72-hour interval is representative for local events during the sampling period. Take the grab sample during the first 30 minutes of the discharge. If it is not practicable to take the sampling during the first 30 minutes, sample during the first hour of discharge and describe why a grab sample during the first 30 minutes was impracticable.

4. Sampling Waiver. When a discharger is unable to collect samples due to adverse climatic conditions, the discharger must prepare, in lieu of sampling data, a description of why

samples could not be collected, including available documentation of the event. Adverse climatic conditions which may prohibit the collection of samples includes weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

5. Representative Discharge. When a facility has two or more outfalls that, based on a consideration of features and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one such outfalls and report that the quantitative data also applies to the substantially identical outfalls. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area (e.g., low (under 40%), medium (40% to 65%) or high (above 65%)) shall be provided.

C. **Toxicity Testing.** As of the effective date of permit OHR000003, acute toxicity testing is no longer required.

D. **Alternative Certification of "Not Present or No Exposure."** You are not subject to the analytical monitoring requirement of this part provided: you make a certification for a given outfall, or on a pollutant-by-pollutant basis in lieu of monitoring required under this part, that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, or significant materials from past industrial activity that are located in areas of the facility within the drainage area of the outfall are not presently exposed to storm water and are not expected to be exposed to storm water for the certification period; and your certification is signed in accordance with Attachment VI.G and retained in the SWP3. If you cannot certify for an entire period, you must note the date exposure was eliminated and perform any monitoring required up until that date.

ATTACHMENT V. REPORTING REQUIREMENTS

A. **Failure to Certify.** Any facility that is unable to make the certification required under paragraph D.3.g(1) (testing for non-storm water discharges) of Attachment III of this permit, must note in its storm water pollution prevention plan its inability to make the certification by April 1, 1993 or, for facilities which begin to discharge storm water associated with industrial activity after October 1, 1992, within 180 days after submitting an NOI to be covered by this permit. Such notation shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible.

B. **Reporting: Where to Submit.**

1. Permittees shall submit all monitoring data upon request of the Director or Regional Administrator.

2. Signed copies of individual permit applications and all other reports required herein, shall be submitted to the Director of the Ohio EPA at the addresses previously given in this permit for NOTs (see Attachment 1.F).

3. Additional Notification. Facilities with at least one storm water discharge associated with industrial activity through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) in addition to submitting monitoring data in accordance with paragraph B of Attachment V of this permit, must submit signed copies to the operator of the municipal separate storm sewer system at the same time they are submitted to the Ohio EPA.

C. **Retention of Records.**

1. The permittee shall retain the pollution prevention plan developed in accordance with Attachment III of this permit for the life of the permit. The permittee shall retain all records of all monitoring information, copies of all reports required by this permit, and records of all data used to complete the Notice of Intent to be covered by this permit, for a period of at least six years from the date of the measurement, report, or application. This period may be explicitly modified by alternative provisions of this permit (see paragraph C.2 of Attachment V of this permit) or extended by request of the Director at any time.

2. For discharges subject to sampling requirements pursuant to paragraph B of Attachment IV of this permit, in addition to the requirements of paragraph C.1 of Attachment V of this permit, permittees are required to retain for a six year period from the date of sample collection or for the term of this permit, which ever is greater, records of all monitoring information collected during the term of this permit. Permittees must submit such monitoring results to the Director upon the request of the Director.

ATTACHMENT VI. STANDARD PERMIT CONDITIONS

A. **Duty to Comply.**

1. The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Ohio Revised Code Chapter 6111 and Ohio Administrative Code rule 3745-38 and is grounds for enforcement action; for permit coverage termination, revocation and reissuance, or modification; or for denial of coverage under a renewal of this general permit.

2. Penalties for Violations of Permit Conditions.

   a. Criminal

      1. Ohio Revised Code Section 6111.99 provides that any person who violates permit terms or conditions is subject to a fine and/or imprisonment.

      2. Falsification. Ohio Revised Code Chapter 6111 provides that any person who knowingly submits false information or records pertaining to discharges required as a condition of a permit is subject to a fine and/or imprisonment.

   b. Civil Penalties - Ohio Revised Code Chapter 6111 provides that any person who violates permit terms or conditions is subject to a civil penalty for each day of violation.

B. **Continuation of the Expired General Permit.** An expired general permit continues in force and effect until a new general permit is issued.

C. **Need to Halt or Reduce Activity Not a Defense.** It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

D. **Duty to Mitigate.** The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

E. **Duty to Provide Information.** The permittee shall furnish to the Director, within a reasonable time, any information which the Director may request to determine compliance with this permit. The permittee shall also furnish to the Director upon request copies of records required to be kept by this permit.

F. **Other Information.** When the permittee becomes aware that he or she failed to submit any relevant facts or submitted incorrect information in the Notice of Intent or in any other report to the Director, he or she shall promptly submit such facts or information.

G. **Signatory Requirements.** All Notices of Intent, Notices of Termination, storm water pollution prevention plans, reports, certifications or information either submitted to the Director (and/or the operator of a large or medium municipal separate storm sewer system), or that this permit requires be maintained by the permittee, shall be signed.

1. All Notices of Intent shall be signed as follows:

   a. For a corporation: by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means: (1) a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation; or (2) the manager of one or more manufacturing, production or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25,000,000 (in second-quarter 1980 dollars) if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

   b. For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or

   c. For a municipality: State, Federal, or other public agency: by either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes (1) the chief executive officer of the agency, or (2) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of EPA).

2. All reports required by the permit and other information requested by the Director shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

   a. The authorization is made in writing by a person described above and submitted to the Director.

   b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of manager, operator, superintendent, or position of equivalent responsibility or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position).

   c. Changes to authorization. If an authorization under paragraph G.2 of Attachment VI of this permit is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph G.2 of Attachment VI of this permit must be submitted to the Director prior to or together with any reports, information, or applications to be signed by an authorized representative.

   d. Certification. Any person signing documents under this section shall make the following certification:

   "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons

directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

H. **Penalties for Falsification of Monitoring Systems.** Ohio Revised Code Chapter 6111 provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by fines and imprisonment.

I. **Oil and Hazardous Substance Liability.** Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Act.

J. **Property Rights.** The issuance of this permit does not convey any property rights of any sort, nor any exclusive privileges, nor does it authorize any injury to private property nor any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

K. **Severability.** The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit shall not be affected thereby.

L. **Transfers.** This permit is not transferable to any person except as described in Attachment I of this permit. The Director may require the operator to apply for and obtain an individual NPDES permit as stated in paragraph M of Attachment VI of this permit.

M. **Requiring an Individual Permit or an Alternative General Permit.**

1. The Director may require any person authorized by this permit to apply for and/or obtain either an individual NPDES permit or an alternative NPDES general permit. Any interested person may petition the Director to take action under this paragraph. The Director may require any owner or operator authorized to discharge under this permit to apply for an individual NPDES permit only if the owner or operator has been notified in writing that a permit application is required. This notice shall include a brief statement of the reasons for this decision, an application form, a statement setting a deadline for the owner or operator to file the application, and a statement that on the effective date of the individual NPDES permit or the alternative general permit as it applies to the individual permittee, coverage under this general permit shall automatically terminate. Individual permit applications shall be submitted to the address of the appropriate Ohio EPA district office. The Director may grant additional time to submit the application upon request of the applicant. If an owner or operator fails to submit in a timely manner an individual NPDES permit application as required by the Director, then the applicability of this permit to the individual NPDES permittee is automatically terminated at the end of the day specified for application submittal.

2. Any owner or operator authorized by this permit may request to be excluded from the coverage of this permit by applying for an individual permit. The owner or operator shall submit an individual application (Form 1 and Form 2F) with reasons supporting the request to the Director. Individual permit applications shall be submitted to the appropriate Ohio EPA

district office. The request may be granted by the issuance of any individual permit or an alternative general permit if the reasons cited by the owner or operator are adequate to support the request.

3. When an individual NPDES permit is issued to an owner or operator otherwise subject to this permit, or the owner or operator is authorized for coverage under an alternative NPDES general permit, the applicability of this permit to the individual NPDES permittee is automatically terminated on the effective date of the individual permit or the date of authorization of coverage under the alternative general permit, whichever the case may be.

N. **Environmental Laws.** No condition of this permit shall release the permittee from any responsibility or requirements under other environmental statutes or regulations.

O. **Proper Operation and Maintenance.** The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit and with the requirements of storm water pollution prevention plans. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. Proper operation and maintenance requires the operation of backup or auxiliary facilities or similar systems, installed by a permittee only when necessary to achieve compliance with the conditions of the permit.

Monitoring and Records.

1. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

2. The permittee shall retain records of all monitoring information including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of the reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 6 years from the date of the sample, measurement, report or application. This period may be extended by request of the Director at any time.

3. Records Contents. Records of monitoring information shall include:

   a. The date, exact place, and time of sampling or measurements;

   b. The initials or name(s) of the individual(s) who performed the sampling or measurements;

   c. The date(s) analyses were performed;

   d. The time(s) analyses were initiated;

   e. The initials or name(s) of the individual(s) who performed the analyses;

   f. References and written procedures, when available, for the analytical techniques or methods used; and

g. The results of such analyses, including the bench sheets, instrument readouts, computer disks or tapes, etc., used to determine these results.

4. Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit.

Q. **Inspection and Entry.** The permittee shall allow the Director or an authorized representative of Ohio EPA or, in the case of a facility which discharges through a municipal separate storm sewer, an authorized representative of the municipal operator or the separate storm sewer receiving the discharge, upon the presentation of credentials and other documents as may be required by law, to:

1. Enter upon the permittee's premises where a regulated facility or activity is located or conducted or where records must be kept under the conditions of this permit;

2. Have access to and copy at reasonable times, any records that must be kept under the conditions of this permit; and

3. Inspect at reasonable times any facilities or equipment (including monitoring and control equipment).

R. **Permit Actions.** This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.

S. **Upset.** The provisions of 40 CFR Section 122.41(n), relating to "Upset," are specifically incorporated herein by reference in their entirety. For definition of "upset," see Attachment VIII, Definitions, of this permit.

ATTACHMENT VII. REOPENER CLAUSE

A. If there is evidence indicating potential or realized impacts on water quality due to any storm water discharge associated with industrial activity covered by this permit, the owner or operator of such discharge may be required to obtain individual permit or an alternative general permit in accordance with Part I.C of this permit or the permit may be modified to include different limitations and/or requirements.

B. Permit modification or revocation will be conducted according to Ohio Administrative Code 3745-38-06.

ATTACHMENT VIII. DEFINITIONS

"Act" means the Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972) Pub. L. 92-500, as amended Pub. L. 95-217, Pub. L. 95-576, Pub. L. 96-483, Pub. L. 97-117, and Pub. L. 100-4 33 U.S.C. 1251 et. seq.

"Best Management Practices" ("BMPs") means schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of surface waters of the state. BMPs also include treatment requirements, operating procedures, and practices to control facility site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

"Coal pile runoff" means the rainfall runoff from or through any coal storage pile.

"Director" means the director of Ohio EPA or an authorized representative.

"Flow-weighted composite sample" means a composite sample consisting of a mixture of aliquots collected at a constant time interval, where the volume of each aliquot is proportional to the flow rate of the discharge.

"Landfill" means an area of land or an excavation in which wastes are placed for permanent disposal, and which is not a land application unit, surface impoundment, injection well, or waste pile.

"Land application unit" means an area where wastes are applied onto or incorporated into the soil surface (excluding manure spreading operations) for treatment or disposal.

"Large and Medium municipal separate storm sewer system" means all municipal separate storm sewers that are either:

(i) located in an incorporated place (city) with a population of 100,000 or more as determined by the latest Decennial Census by the Bureau of Census (these cities are listed in Appendices F and G of 40 CFR Part 122); or

(ii) located in the counties with unincorporated urbanized populations of 100,000 or more, except municipal separate storm sewers that are located in the incorporated places, townships or towns within such counties (these counties are listed in Appendices H and I of 40 CFR Part 122); or

(iii) owned or operated by a municipality other than those described in paragraph (i) or (ii) and that are designated by the Director as part of the large or medium municipal separate storm sewer system.

"National Pollutant Discharge Elimination System (NPDES)" means the national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits, and enforcing pretreatment requirements, under Sections 307, 402, 318, and 405 of the CWA. The term includes an "approved program".

"NOI" means notice of intent to be covered by this permit (see Attachment I of this permit).

"NOT" means notice of termination (see Attachment I of this permit).

"Point Source" means any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel or other floating craft from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture or agricultural storm water runoff.

"Section 313 water priority chemical" means a chemical or chemical categories which are: 1) are listed at 40 CFR 372.65 pursuant to Section 313 of Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986, also titled the Emergency Planning and Community Right-to-Know Act of 1986; 2) are present at or above threshold levels at a facility subject to SARA Title III, Section 313 reporting requirements; and 3) that meet at least one of the following criteria: (i) are listed in Appendix D of 40 CFR 122 on either Table II (organic priority pollutants), Table III (certain metals, cyanides, and phenols) or Table V (certain toxic pollutants and hazardous substances); (ii) are listed as a hazardous substance pursuant to Section 311(b)(2)(A) of the Act at 40 CFR 116.4; or (iii) are pollutants for which EPA has published acute or chronic water quality criteria.

"Significant materials" includes, but is not limited to: raw materials; fuels; materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; raw materials used in food processing or production; hazardous substances designated under Section 101(14) of CERCLA; any chemical the facility is required to report pursuant to Section 313 of Title III of SARA; fertilizers; pesticides; and waste products such as ashes, slag and sludge that have the potential to be released with storm water discharges.

"Significant spills" includes, but is not limited to: releases of oil or hazardous substances in excess of reportable quantities under Section 311 of the Clean Water Act (see 40 CFR 110.10 and CFR 117.21) or Section 102 of CERCLA (see 40 CFR 302.4).

"Storm Water" means storm water runoff, snow melt runoff, and surface runoff and drainage.

"U.S. EPA Definition of Storm Water Associated with Industrial Activity" (not every activity in this definition is eligible for coverage under this permit; see Part 1.C. for eligibility criteria) means the discharge from any conveyance which is used for collecting and conveying storm water and which is directly related to manufacturing, processing or raw materials storage areas at an industrial plant. The term does not include discharges from facilities or activities excluded from the NPDES program. For the categories of industries identified in subparagraphs (i) through (x) of this subsection, the term includes, but is not limited to, storm water discharges from industrial plant yards; immediate access roads and rail lines used or traveled by carriers of raw materials, manufactured products, waste material, or by-products used or created by the facility; material handling sites; refuse sites; sites used for the application or disposal of process waste waters (as defined at 40 CFR 401); sites used for the storage and maintenance of material handling equipment; sites used for residual treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; storage areas (including tank farms) for raw materials, and intermediate and finished products; and areas where industrial activity has taken place in the past and significant materials remain and are exposed to storm water.

For the categories of industries identified in subparagraph (xi), the term includes only storm water discharges from all areas listed in the previous sentence (except access roads) where material handling equipment or activities, "raw materials, intermediate products, final products, waste materials, by-products, or industrial machinery are exposed to storm water. For the purposes of this paragraph, material handling activities include the: storage, loading and unloading, transportation, or conveyance of

any raw material, intermediate product, finished product, by-product or waste product. The term excludes areas located on plant lands separate from the plant's industrial activities, such as office buildings and accompanying parking lots as long as the drainage from the excluded areas is not mixed with storm water drained from the above described areas. Industrial facilities (including industrial facilities that are Federally or municipally owned or operated that meet the description of the facilities listed in this paragraph (i)-(xi)) include those facilities designated under 40 CFR 122.26(a)(1)(v). The following categories of facilities are considered to be engaging in "industrial activity" for purposes of this subsection:

(i) Facilities subject to storm water effluent limitations guidelines, new source performance standards, or toxic pollutant effluent standards under 40 CFR Subchapter N (except facilities with toxic pollutant effluent standards which are exempted under category (xi) of this paragraph);

(ii) Facilities classified as Standard Industrial Classifications 24 (except 2434), 26 (except 265 and 267), 28 (except 283 and 285) 29, 311, 32 (except 323), 33, 3441, 373;

(iii) Facilities classified as Standard Industrial Classifications 10 through 14 (mineral industry) including active or inactive mining operations (except for areas of coal mining operations meeting the definition of a reclamation area under 40 CFR 434.11(l)) and oil and gas exploration, production, processing, or treatment operations, or transmission facilities that discharge storm water contaminated by contact with or that has come into contact with, any overburden, raw material, intermediate products, finished products, byproducts or waste products located on the site of such operations; inactive mining operations are mining sites that are not being actively mined, but which have an identifiable owner/operator;

(iv) Hazardous waste treatment, storage, or disposal facilities, including those that are operating under interim status or a permit under Subtitle C of RCRA;

(v) Landfills, land application sites, and open dumps that have received any industrial wastes (waste that is received from any of the facilities described under this subsection) including those that are subject to regulation under Subtitle D of RCRA;

(vi) Facilities involved in the recycling of materials, including metal scrapyards, battery reclaimers, salvage yards, and automobile junkyards, including but not limited to those classified as Standard Industrial Classification 5015 and 5093;

(vii) Steam electric power generating facilities, including coal handling sites;

(viii) Transportation facilities classified as Standard Industrial Classifications 40, 41, 42 (except 4221-25), 43, 44, 45, and 5171 which have vehicle maintenance shops, equipment cleaning operations, or airport deicing operations. Only those portions of the facility that are either involved in vehicle maintenance (including vehicle rehabilitation, mechanical repairs, painting, fueling, and lubrication), equipment cleaning operations, airport deicing operations, or which are otherwise identified under paragraphs (i)-(vii) or (ix)-(xi) of this subsection are associated with industrial activity;

(ix) Treatment works treating domestic sewage or any other sewage sludge or wastewater treatment device or system, used in the storage treatment, recycling, and reclamation of municipal or domestic sewage, including land dedicated to the disposal of sewage sludge that are located

within the confines of the facility, with a design flow of 1.0 mgd or more, or required to have an approved pretreatment program under 40 CFR 403. Not included are farm lands, domestic gardens or lands used for sludge management where sludge is beneficially reused and which are not physically located in the confines of the facility, or areas that are in compliance with 40 CFR 503;

(x) Construction activity - including clearing, grading and excavation activities except: operations that result in disturbance of less than five acres of total land area which is not part of a larger common plan of development or sale; and

(xi) Facilities under Standard Industrial Classifications 20, 21, 22, 23, 2434, 25, 265, 267, 27, 283, 285, 30, 31 (except 311), 323, 34 (except 3441), 35, 36, 37 (except 373), 38, 39, 4221-25, (and which are not otherwise included within categories (ii)-(x)).

"SWPPP"or "SWP3" means storm water pollution prevention plan to be completed as a condition of this permit (see Attachment III of this permit).

"Time-weighted composite" means a composite sample consisting of a mixture of equal volume aliquots collected at a constant time interval.

"Waste pile" means any non-containerized accumulation of solid, non-flowing waste that is used for treatment or storage.

"Waste treatment systems," including treatment ponds or lagoons designed to meet the requirements of the CWA are not surface waters of the state.

"10-year, 24-hour precipitation event" means the maximum 24-hour precipitation event with a probable reoccurrence interval of once in 10 years. This information is available in "Weather Bureau Technical Paper No. 40,", May 1961 and "NOAA Atlas 2," 1973 for the 11 Western States, and may be obtained from the National Climatic Center of the Environmental Data Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

"Bypass" means the intentional diversion of waste streams from any portion of the treatment facility.

"Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

"Surface waters of the state" means all streams, lakes, ponds, marshes, watercourses, waterways, springs, irrigation systems, drainage systems, and all other bodies or accumulations of surface water, natural or artificial, which are situated wholly or partly within, or border upon, this state, or are within its jurisdiction, except those private waters which do not combine or effect a junction with natural surface waters.

Notice of Termination (NOT) Form Instructions For Ohio EPA General Permits

W. ere to file NOT form

NOTs must be sent to the following address:

Ohio Environmental Protection Agency
General Permit Program
P.O. Box 1049
Columbus, OH 43216-1049

Completing the Form

All responses must be typewritten in the appropriate areas only. Forms transmitted by FAX will not be accepted. Complete all sections of the NOT form. Incomplete forms will be returned to the applicant for resubmittal.

Please place each character slightly above the appropriate line. Abbreviate if necessary to stay within the space allowed for each item. Use one space for breaks between words but not for punctuation marks unless they are needed to clarify your response.

Section I - Permit Information

Enter the existing Ohio NPDES general permit number ass ed to the facility or site for which you are submitting this NO If you do not know the permit number, contact the Ohio E Storm Water Section at (614) 644-2001.

Section II - Owner/Applicant Information/Mailing Address

This information should appear on the NOT form as it appears on the original Notice of Intent (NOI) form.

Give the legal name of the person, firm, public organization, or any other entity that operates the facility or site described in the application. The name of the operator may or may not be the same as the facility. The operator of the facility is the legal entity which controls the facility's operation rather than the plant or site manager. For construction activities, the responsible party is the owner or the developer of the property. Do not use a colloquial name. Give the name and phone number of a contact person who is responsible for addressing NPDES permit requirements. Enter the complete address and telephone number of the operator (provide phone number as: area code exchange number).

Section III - Facility/Site Location Information

This information should appear on the NOT form as it app s on the original Notice of Intent (NOI) form.

ter the facility's or site's official or legal name and co plete address, including city, state, zip code, county, ownship, and section. If the facility lacks a street address, ndicate the street name and approximate address number.

Section IV - Reason for Termination

Indicate your reason for submitting this NOT by placing an "x" on the appropriate space. You may indicate more than one reason.

Standard Certification

The standard certification should be completed except where a specific certification (listed below) is required.

Industrial Storm Water and Coal Mining Activity Certification Only

This certification should be completed only if you are submitting this NOT to terminate permit coverage under the storm water general permit associated with industrial activity or the general permit associated with coal mining activity.

Construction Certification Only

This certification should be completed only if you are submitting this NOT to terminate permit coverage under the storm water general permit associated with construction activity.

Note for all certifications: provide date as month day year using 2 digits for each space.

Signatory Requirements

Federal statutes provide for severe penalties for submitting false information on this application form. Federal regulations require this application to be signed as follows.

For a corporation; by a responsible corporate officer, which means: 1) president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions; or 2) the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

For a partnership or sole proprietorship; by a general partner or the proprietor; or

For a municipality, state, federal, or other public facility; by either a principal executive officer or ranking elected official

Notice of Termination (NOT) of Coverage Under Ohio Environmental Protection Agency General Permit

(Read accompanying instructions carefully before completing this form)

Submission of this NOT constitutes notice that the party identified in Section II of this form is no longer authorized to discharge into state waters under the NPDES general permit program. Complete all information - THIS FORM MUST BE COMPLETELY TYPEWRITTEN AND ORIGINAL (not a copy) - NOT FOLDED OR STAPLED - FOR PROPER ELECTRONIC SCANNING. Forms transmitted by fax will not be accepted.

I. Permit Information:

NPDES general permit number: OH _____ Facility General Permit Number: _____

II. Owner/Applicant Information/Mailing Address:

Company Name: _____

Contact Person: _____ Phone: _____

Mailing Address: _____

City: _____ State: _____ Zip Code: _____

II. Facility/Site Location Information:

Facility Name: _____

Facility Contact Person: _____ Phone: _____

Facility Address/Location: _____

City: _____ State: _____ Zip Code: _____

County: _____ Township: _____ Section: _____

IV. Reason for Termination:

_____ Transfer of Ownership _____ Cease to Discharge _____ Facility Closed _____ Project Completed

_____ Obtained Individual Permit

Standard Certification:

I certify under penalty of law that all discharges authorized by the NPDES general permit have been eliminated or that I am no longer the operator of the facility. I understand that by submitting this NOT, I am no longer authorized to discharge under this general permit and that discharging pollutants to waters of the state without a NPDES permit is unlawful under ORC 6111.

Name (typed): _____

Signature: _____ Date: _____

Industrial Storm Water and Coal Mining Activity Certification Only:

I certify under penalty of law that all discharges associated with the identified facility that are authorized by the above referenced NPDES general permit have been eliminated, that I am no longer the operator of the facility, or in the case of a coal mine that the SMCRA bond has been released by ODNR-Division of Reclamation. I understand that, by submitting this NOT, I am no longer authorized to discharge storm water associated with industrial activity under this general permit, and that all discharging pollutants in storm water associated with industrial activity to waters of the state is unlawful under ORC 6111 where the discharge is not authorized by a NPDES permit.

Name (typed): _____

Signature: _____ Date: _____

Storm Water Construction Activity Certification Only:

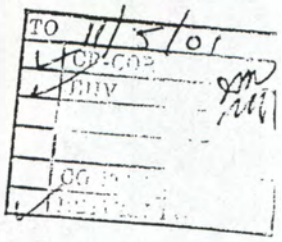
I certify under penalty of law that all elements of the storm water pollution prevention plan have been completed, the disturbed soil at the identified facility have been finally stabilized and temporary erosion and sediment control measures have been removed or will be removed at an appropriate time, or that all storm water discharges associated with construction activity from the identified facility that are authorized by the above referenced NPDES general permit have otherwise been eliminated. I understand that, by submitting this NOT, I am no longer authorized to discharge storm water associated with construction activity by the general permit, and that discharging pollutants in storm water associated with construction activity to waters of the state is unlawful under ORC 6111 where the discharge is not authorized by a NPDES permit.

Name (typed): _____

Signature: _____ *Date:* _____

TOLTEST, INC.

To be <u>the</u> preferred and trusted partner of our clients and associates . . . **PERIOD!**



October 29, 2001

John A. Cicero
OSC Commander's Representative
ATTN: Mark Patterson
8451 State Route 5
Ravenna, OH 44266

Subject: Storm Water Toxicity Test for 2001

Dear Mr. Cicero / Mark Patterson:

This letter is to inform you that the Ravenna Army Ammunition Plant (RVAAP) Storm Water Sampling Event has been completed for the year 2001. The results of this sampling event are attached. The past and the current sampling event results are located at RVAAP bldg. 1037 TolTest, Inc. office.

If you have any questions or comments, please feel free to contact me.

Respectfully submitted,

James D. McGee
Site Manager

8451 State Rte. 5, Ravenna, OH 44266-9297, Phone (330) 358-3005, Fax (330) 358-2021
Solutions for Your Site Development, Construction, and Environmental Projects

September 07, 2001

Mr. Cary Mathias
c/o American Testing Company, Inc.
5475 Perkins Road
Bedford Heights, OH 44146

re: storm water toxicity; Toltest

Dear Mr. Mathias:

Please find enclosed two copies of EnviroScience's report for the following storm water toxicity (WET) tests, which were initiated on September 23, 2001:

(1) 24-hour static screening bioassay using *Ceriodaphnia dubia* (water flea), and
(1) 24-hour static screening bioassay using *Pimephales promelas* (fathead minnow).

Three storm water samples, identified on the C-O-C form as Toltest 903, 907, and908, were received by EnviroScience personnel on 08/23/01 at 1200 hours. Tests were initiated on the 23rd by 1540 hours.

The storm water samples were not acutely toxic to *C. dubia* or *P. promelas* specimens.

According to instructions provided in the OEPA General Storm Water Permit document, your client(s) should record the results of these tests by entering 0 (pass) in the appropriate places on their Annual Monitoring Form (AMF).

Results of storm water toxicity tests for American Testing Company, Inc.
Samples: Toltest 903, 907, and 908
0 = pass, 1 = fail.

Sample ID.	*C. dubia*	*P. promelas*
903	0	0
907	0	0
908	0	0

Please call me if you have any questions.

Sincerely,

Jeffrey G. Hirko

Jeffrey G. Hirko
Laboratory Manager

3781 DARROW ROAD, STOW, OHIO 44224
330-688-0111 / TOLL FREE: 800-940-4025 / FAX: 330-688-3858

ES ENVIRO SCIENCE INCORPORATED

RESULTS OF ACUTE TOXICITY TESTS:

24 Hour - *Ceriodaphnia dubia* (water flea)
24 Hour - *Pimephales promelas* (fathead minnow)

Test date: August 23-24, 2001
Sample date: August 23, 2001
Report date: September 07, 2001

Storm Water Samples: Toltest

Conducted For:

American Testing Company, Inc.
Attn: Mr. Cary Mathias
5475 Perkins Road
Bedford Heights, OH 44146

Conducted and Prepared By:

EnviroScience, Incorporated
3781 Darrow Road
Stow, Ohio 44709
(330) 688-0111

ENVIRO SCIENCE INCORPORATED

Jeffrey D. Hutt, Laboratory Manager

Storm Water Toxicity Test Report

General Information

1. Facility:	Toltest
1b. Client:	American Testing Company, Inc.
2. Report Date:	September 07, 2001
3. Client's Address:	5475 Perkins Road, Bedford Heights, OH 44146
4. OEPA Permit No.:	OHR00 ; type general storm water or other facility id.# _____ describe _____
5. Client Contact:	Cary Mathias
6. Phone No.:	(440) 786-1403
7. Testing Lab:	EnviroScience, Inc., 3781 Darrow Rd.; Stow, OH; 44224
8. Laboratory Contact:	Jeffrey G. Hirko
9. Phone No.:	(330) 688-0111
10. Test Date:	08/23-24/01
11. Outfall(s) Tested: (sample #'s)	903; 907; 908
12. Test Species:	#1 *Ceriodaphnia dubia* **yes** #2 *Pimephales promelas* **yes**
13. Current SOP on file with OEPA?	YES/NO: Yes If YES, date submitted: 11/96

Jeffrey G. Hirko
Signature of Preparer

9/7/01
Date

Jeffrey G. hirko
Name (typed or printed)

EnviroScience Inc., Laboratory Manager
Title

Storm Water Toxicity Test Report 09/07/01 for: American Testing Co. (Toltest samples: 903, 907, 908)

Sampling Summary					
Outfall or (sample #)	Sample Type grab/composite	Volume Received	Sample Collection		Comments
			Begin MM/DD/YY-Time	End or grab MM/DD/YY-Time	
903	grab	2 L		08/23/01	
907	grab	2L		08/23/01	
908	grab	2L		08/23/01	

Dates/Times of Test Performance:

Ceriodaphnia dubia		*Pimephales promelas*	
Start Date: MM/DD/YY	08/23/01	Start Date: MM/DD/YY	08/23/01
Start Time:	1505	Start Time:	1540
End Date: MM/DD/YY	08/24/01	End Date: MM/DD/YY	08/24/01
End Time:	1500	End Time:	1455

The sample was received in the EnviroSciences laboratory on 08/23/01 at 1200 hours; 1.6 - 3.8 °C.

Initial chemistry for 100% storm water sample. DO = dissolved oxygen.

sample #	DO mg/L	pH s.u.	conductivity μmho/cm	alkalinity mg/L $CaCO_3$	hardness mg/L $CaCO_3$	residual chlorine mg/L
903	7.9	7.6	416	130	152	<0.02
907	8.1	7.5	476	194	256	<0.02
908	8.5	7.8	437	176	212	<0.02

Results of static storm water screening, 24-hour Toxicity Test.

Survival Data
Test Endpoint: 24-hour proportion surviving

Test Species: *Ceriodaphnia dubia*

Sample type:	rep. 1	rep. 2	rep. 3	rep. 4	mean prop. survival	pass or fail/ method	OEPA AMF reporting code: 0 or 1
lab water control	1.0	1.0	1.0	1.0	1.0		
903	1.0	1.0	1.0	1.0	1.0	Pass/ none	0
907	1.0	1.0	1.0	1.0	1.0	Pass/ none	0
907	1.0	1.0	1.0	1.0	1.0	Pass/ none	0

Test Species: *Pimephales promelas*

Sample type:	rep. 1	rep. 2	rep. 3	rep. 4	mean prop. survival	pass or fail/method	OEPA AMF reporting code: 0 or 1
lab water control	1.0	1.0	1.0	1.0	1.0		
903	1.0	1.0	1.0	1.0	1.0	Pass/ none	0
907	1.0	1.0	1.0	1.0	1.0	Pass/ none	0
907	1.0	1.0	1.0	1.0	1.0	Pass/ none	0

Note: Additional toxicity test information is provided on page 4.
Copies of bench sheets (including chemistry data) and printouts from statistical analyses are attached.

Additional Toxicity Test Information

1. Test Conditions.

Test Condition	*Ceriodaphnia dubia*	*Pimephales promelas*
Organism origin:	EnviroScience	EnviroScience
Age:	<24 hrs, 08/13/01-1700	13 days, 08/11/01-1420
Test temperature:	25± 1 °C	25± 1 °C
Light quality:	wide spectrum fluorescent	wide spectrum fluorescent
Photoperiod:	16 hrs light / 8 hrs dark	16 hrs light / 8 hrs dark
Size of vessel:	30 ml plastic cup	600 ml glass beaker
Volume/depth of vessel:	15 ml and 24 mm	250 ml and 42 mm
No./vessel:	5	10
No. replicates:	4	4
Total no. organisms/solution:	20	40
Control water:	moderately hard reconstituted	moderately hard reconstituted
Feeding regime:	fed during acclimation	fed during acclimation
Aeration:	none	none
Endpoints:	mortality - no movement with prodding	mortality - no movement with prodding

2. Methods/Instrumentation used in chemical analysis:
   Dissolved oxygen: APHA (1992) 4500-G., Orion model 830A/YSI model 51B
   pH: APHA (1992) 4500-H., Orion model 920A/Orion model SA250
   Conductivity: APHA (1992) 2510-B., Orion model 160
   Total Hardness: APHA (1992) 2340-C.
   Total Alkalinity: APHA (1992) 2320-B.
   Total Residual Chlorine: APHA (1992) 4500-Cl-D
   EPA Manual: Acute EPA-600/4-90/027F

3. Attachments.
   Copy of Chain-of-Custody/Sample Submission form(s).
   Copies of bench sheets/data analyses.
   Standard Reference Toxicant Control Charts.

4. Describe below any additional information/deviations from EPA methodology:

ATTACHMENTS

Chain-of-Custody form.
Bench sheet.
Standard Reference Toxicant (SRT) control charts.

AMERICAN TESTING COMPANY, Inc.

5475 PERKINS ROAD • BEDFORD HEIGHTS, OH 44146
(877) 322-2976 • (440) 786-1403 • FAX (440) 786-1426
www.americantesting.com • E-mail: chemical@americantesting.com

REPORT TO: NAME Enviroscience
ADDRESS
CITY | STATE | ZIP CODE
PHONE NO. | FAX NO.
PROJECT NO./PO NO. | PROJECT NAME/LOCATION ToITest Stormwater

INVOICE TO: NAME
ADDRESS
CITY | STATE | ZIP CODE
PHONE NO. | FAX NO.

NO.	SAMPLING DATE	SAMPLING TIME	Comp	Grab	CUSTOMER SAMPLE IDENTIFICATION	NO. OF CONT.	PRESERVATIVE	PARAMETERS: Storm Bio.	MATRIX TYPE
1	8-23-01	Early A.M.		X	903 3.2°C	2		X	
2									
3	8-23-01	Early A.M.		X	907 1.6°C	2		X	
4									
5	8-23-01	Early A.M.		X	908 1.6°C	2		X	
6									
7									
8									
9									
10									
11									
12									
13									
14									

SPECIAL INSTRUCTIONS: (Please indicate any special detection limits, method numbers, QA/QC requirements, or highly hazardous samples.)

Turnaround Time ☒ Std. (5 day) Rush: ☐ 24 hr. ☐ 48 hr. ☐ 72 hr. Authorizing signature _____

Reports Results in: (circle one) mg/kg ug/kg mg/L ug/L ppm ppb

Analyze Each Phase of Sample _____

Solid samples analyzed: As received ☐ Dry Weight ☐

PRESERVATIVES:
Sulfuric Acid = H_2SO_4 | Nitric Acid = HNO_3
Hydrochloric Acid = HCl | Cool 4°C = C
Sodium Hydroxide = NaOH | NONE = N
Sodium Sulfite = Na_2SO_3

Samplers: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Received for Laboratory by: (Signature)	Date	Time
		8-23-01	1200				
Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)			

WHITE - REMAINS WITH REPORT YELLOW - LAB FILE COPY PINK - CUSTOMER COPY

ENVIRO SCIENCE INCORPORATED

CLIENT: AMERICAN TESTING Co.
SAMPLE IDs: 082301; 903, 907, 908 Amer.
START DATE: 082301 END DATE: 082401 BATCH #: 081101 1420
START TIME: 1540 END TIME: 1455 AGE (H OR D):

ORGANISM: P. promelas
ORIGIN OF ORGANISM: ES Cultures
MHR BATCH: 082201
ORGANISMS PER VESSEL: 10

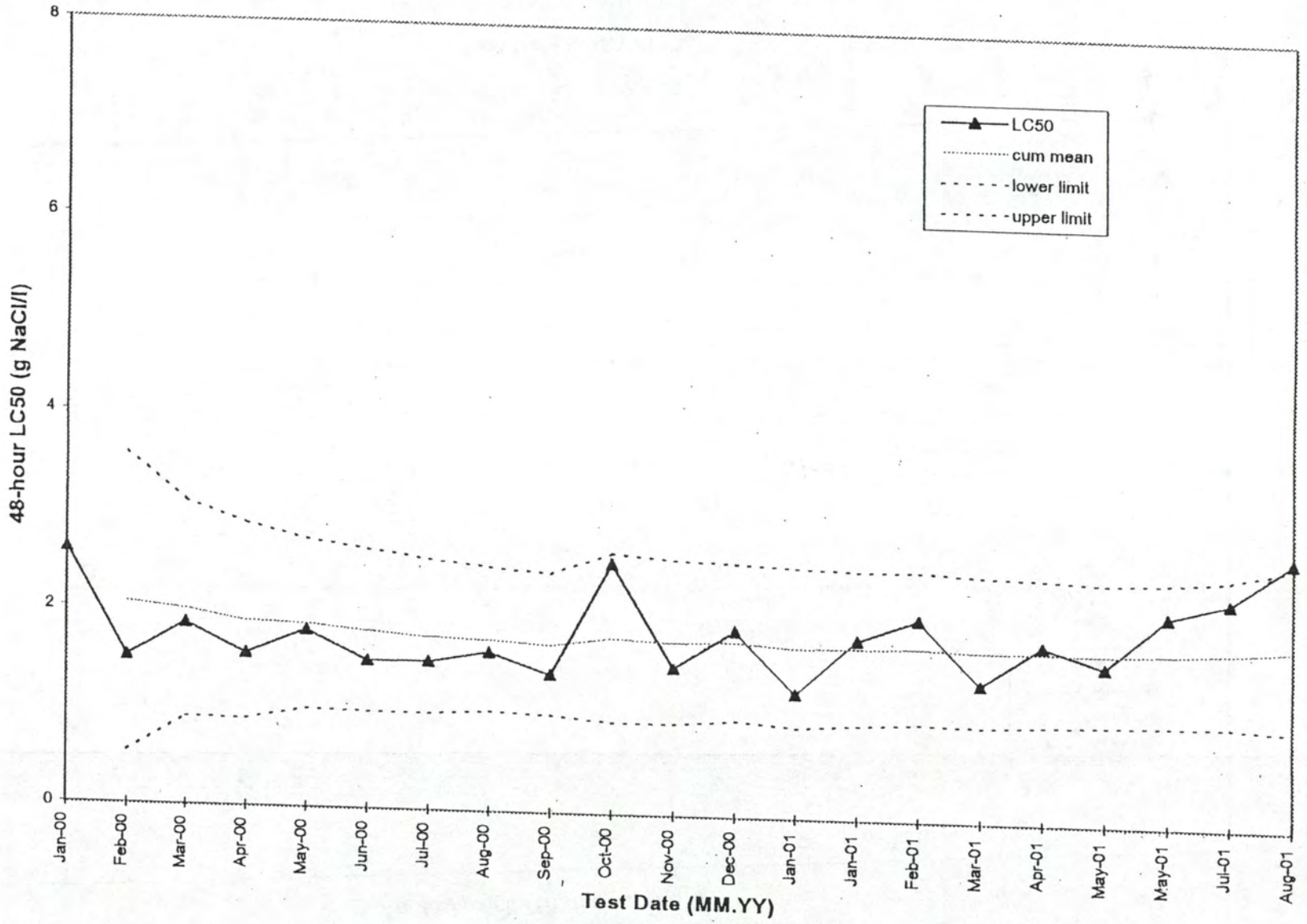
TEST LEVEL	REP.	DEAD / AFFECTED 24 HR	REP.	DEAD / AFFECTED 24 HR	DISSOLVED O_2 (MG/L) 0 HR	DISSOLVED O_2 (MG/L) 24 HR	pH (S.U.) 0 HR	pH (S.U.) 24 HR	CONDUCTIVITY (µMHO/CM) 0 HR	CONDUCTIVITY (µMHO/CM) 24 HR	ADDITIONAL CHEMISTRY (MG/L) ALKALINITY	ADDITIONAL CHEMISTRY (MG/L) HARDNESS	ADDITIONAL CHEMISTRY (MG/L) CHLORINE
CONTROL MHR	A	0/0	C	0/0	8.1	6.9	7.6	7.6	302	311	(7.3) 66	(2.1) 84	<0.02
	B	0/0	D	0/0									
903	A	0/0	C	0/0	7.9	7.2	7.4	7.6	416	425	(6.5) 130	(3.8) 152	<0.02
	B	0/0	D	0/0									
907	A	0/0	C	0/0	8.1	6.8	~~7.4~~ 7.5	7.8	476	496	(9.7) 194	(6.4) 256	<0.02
	B	0/0	D	0/0									
908	A	0/0	C	0/0	8.5	6.9	7.8	7.9	437	449	(8.8) 176	(5.3) 212	<0.02
	B	0/0	D	0/0									
INITIALS	° JL	24 1455			DL	DL	DL	DL	DL	DL	DL	DL	DL
TIME	° 1540	24 24.3											
TEMP. °C	° 24.3	24 JH											

ORGANISM: C. dubia
ORIGIN OF ORGANISM: ES cultures
MHR BATCH: 082201
START DATE: 082301 END DATE: 1505 082401 BATCH #: BB081301A 1700
HRW BATCH: NA
START TIME: 1505 END TIME: 1500 AGE (H OR D): < 24 hr
ORGANISMS PER VESSEL: 5

TEST LEVEL	REP	DEAD / AFFECTED 24 HR	REP.	DEAD / AFFECTED 24 HR	DISSOLVED O_2 (MG/L) 0 HR	DISSOLVED O_2 (MG/L) 24 HR	pH (S.U.) 0 HR	pH (S.U.) 24 HR	CONDUCTIVITY (µMHO/CM) 0 HR	CONDUCTIVITY (µMHO/CM) 24 HR	ADDITIONAL CHEMISTRY (MG/L) ALKALINITY	ADDITIONAL CHEMISTRY (MG/L) HARDNESS	ADDITIONAL CHEMISTRY (MG/L) CHLORINE
CONTROL MHR	A	0/0	C	0/0	8.1	8.0	7.6	7.5	302	318	(3.3) 66	(2.1) 84	<0.02
	B	0/0	D	0/0									
903	A	0/0	C	0/0	7.9	8.0	7.4	7.7	416	437	(6.5) 130	(3.8) 152	<0.02
	B	0/0	D	0/0									
907	A	0/0	C	0/0	8.1	8.1	7.5	7.9	476	475	(9.7) 194	(6.4) 256	<0.02
	B	0/0	D	0/0									
908	A	0/0	C	0/0	8.5	8.1	7.8	8.0	437	472	(8.8) 176	(5.3) 212	<0.02
	B	0/0	D	0/0									
INITIALS	° JM	24 JH			DL	DL	DL	DL	DL	DL			
TIME	° 1505	24 1500											
TEMP. °C	° 24.3	24 24.7											

EnviroScience QC Chart - *Ceriodaphnia dubia*

Acute Toxicity endpoint - 25 C

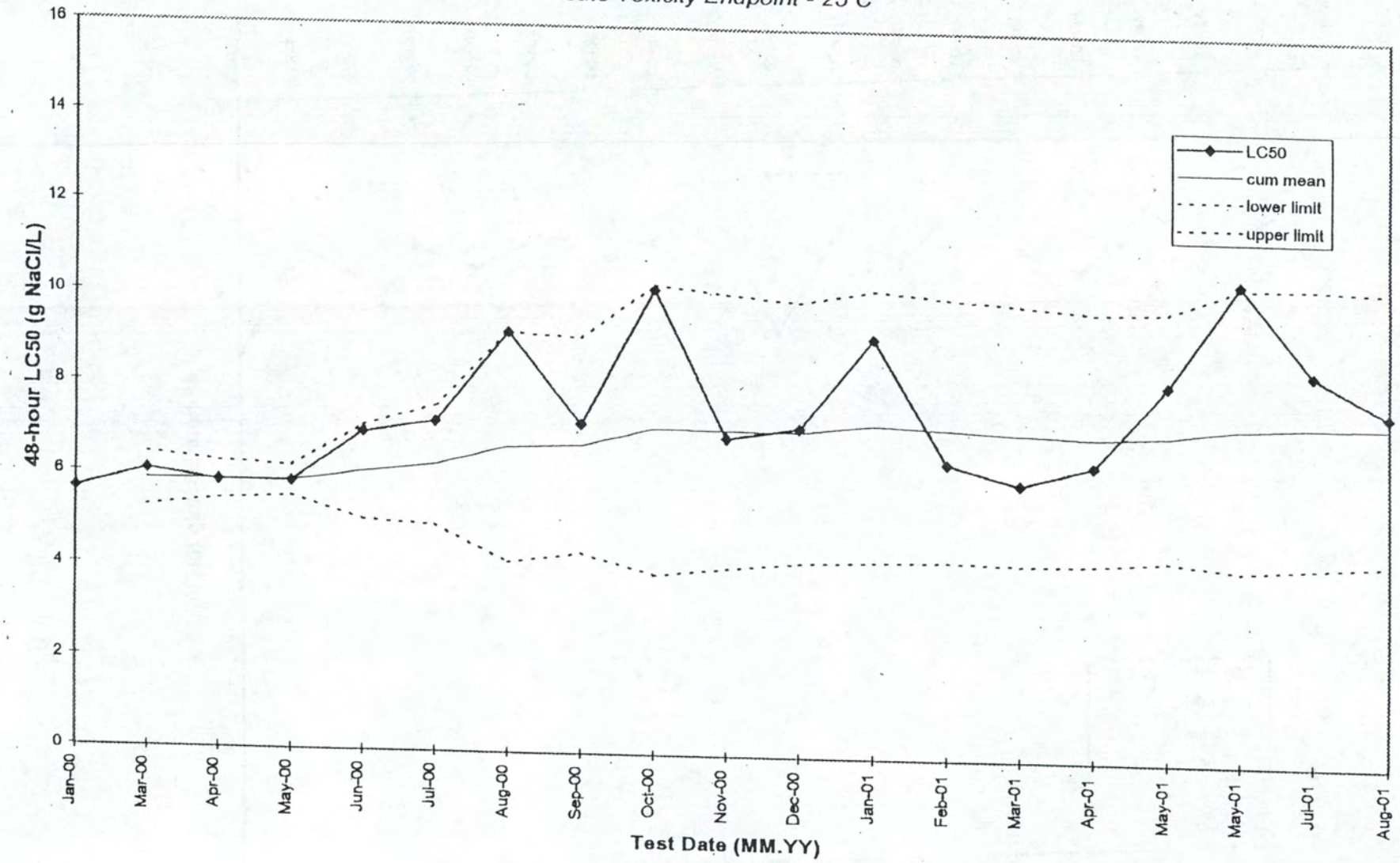


Tests conducted at Stow, OH facility

conc. 0.5, 1, 2, 4, 8 g NaCl/l adopted 3/97

EnviroScience QC Chart - *Pimephales promelas*

Acute Toxicity Endpoint - 25 C



Tests conducted at Stow, OH facility

conc. 1, 2, 4, 8, 16 g NaCl/l adopted 3/97

EnviroScience QC/SRT Chart pp48lc50 rev. 8/29/01

AMERICAN TESTING COMPANY, INC

Laboratory Analytical Report

for

Toltest, Inc.
8451 State Route 5
Ravenna, OH 44266-9297

Attention

Jim McGee

Customer P.O. No.

American Testing Company, Inc. Work Order No.

010823005

Dr. Michael Krasnyansky
Laboratory Director

Karen Bezoski-Davis
QA/QC Manager

Toltest, Inc.

Attn: Jim McGee

Work Order #: 0108-23005
Date Sampled: 08/23/2001
Date Received: 08/23/2001
Date Reported: 10/01/2001

Subject: Stormwater

Sample Description: 903 Flush Lab ID: 001 Date Sampled: 08/23/2001

Test Description	Method	Result	Units	Detection Limit	Analyst	Analysis Date
Oil & Grease	1664	BDL	mg/L	2.0	SL	08/27/2001
Cyanide, Total	335.2	BDL	mg/L	0.01	TK	08/27/2001
pH (Field)	150.1	7.7	S.U.		JM	08/23/2001

Sample Description: 903 Composite Lab ID: 002 Date Sampled: 08/23/2001

Test Description	Method	Result	Units	Detection Limit	Analyst	Analysis Da
Metals					NL	08/27/2001
Arsenic	200.7	BDL	ug/L	10	NL	08/27/2001
Barium	200.7	31	ug/L	10	NL	08/27/2001
Cadmium	200.7	BDL	ug/L	10	NL	08/27/2001
Chromium	200.7	BDL	ug/L	10	NL	08/27/2001
Lead	200.7	BDL	ug/L	10	NL	08/27/2001
Magnesium	200.7	9800	ug/L	10	NL	08/27/2001
Selenium	200.7	BDL	ug/L	10	NL	08/27/2001
Silver	200.7	BDL	ug/L	10	NL	08/27/2001
Mercury	245.1	0.25	ug/L	0.2	MM	08/24/2001
COD	410.4	46	mg/L	20	TK	08/28/2001
Total Kjeldahl Nitrogen	351.3	0.7	mg/L	0.1	TK	08/28/2001
TOC	415.1	11.1	mg/L	0.5	SL	08/30/2001
Solids, Total Dissolved	160.1	236	mg/L	10	FP	08/27/2001
Metals, Dissolved					NL	08/27/2001
Magnesium, Dissolved	6010B	9890	ug/L	10	NL	08/27/2001
Explosives					MF	09/13/2001
HMX	8330	BDL	ug/L	100	MF	09/13/2001
RDX	8330	BDL	ug/L	100	MF	09/13/2001
1,3,5-TNB	8330	BDL	ug/L	100	MF	09/13/2001
1,3-Dinitrotoluene	8330	BDL	ug/L	100	MF	09/13/2001
1,3-Dinitrobenzene	8330	BDL	ug/L	100	MF	09/13/2001
Tetryl	8330	BDL	ug/L	100	MF	09/13/2001
Nitrobenzene	8330	BDL	ug/L	100	MF	09/13/2001

Toltest, Inc.

Attn: Jim McGee

Work Order #: 0108-23005
Date Sampled: 08/23/2001
Date Received: 08/23/2001
Date Reported: 10/01/2001

Project: Stormwater

2,4,6-Trinitrotoluene	8330	BDL	ug/L	100	MF	09/13/2001
4-Am-DNT	8330	BDL	ug/L	100	MF	09/13/2001
2-Am-DNT	8330	BDL	ug/L	100	MF	09/13/2001
2,4-Dinitrotoluene	8330	BDL	ug/L	100	MF	09/13/2001
2,6-Dinitrotoluene	8330	BDL	ug/L	100	MF	09/13/2001
2-Nitrotoluene	8330	BDL	ug/L	100	MF	09/13/2001
3-Nitrotoluene	8330	BDL	ug/L	100	MF	09/13/2001
4-Nitrotoluene	8330	BDL	ug/L	100	MF	09/13/2001

Sample Description: 907 Flush Lab ID: 003 Date Sampled: 08/23/2001

Test Description	Method	Result	Units	Detection Limit	Analyst	Analysis Date
Oil & Grease	1664	BDL	mg/L	2.0	SL	08/27/2001
Cyanide, Total	335.2	BDL	mg/L	0.01	TK	08/27/2001
pH (Field)	150.1	7.6	S.U.		JM	08/23/2001

Sample Description: 907 Composite Lab ID: 004 Date Sampled: 08/23/2001

Test Description	Method	Result	Units	Detection Limit	Analyst	Analysis Date
Metals					NL	08/27/2001
Arsenic	200.7	BDL	ug/L	10	NL	08/27/2001
Barium	200.7	40	ug/L	10	NL	08/27/2001
Cadmium	200.7	BDL	ug/L	10	NL	08/27/2001
Chromium	200.7	BDL	ug/L	10	NL	08/27/2001
Lead	200.7	BDL	ug/L	10	NL	08/27/2001
Magnesium	200.7	17500	ug/L	10	NL	08/27/2001
Selenium	200.7	BDL	ug/L	10	NL	08/27/2001
Silver	200.7	BDL	ug/L	10	NL	08/27/2001
Mercury	245.1	0.24	ug/L	0.2	MM	08/24/2001
COD	410.4	BDL	mg/L	20	TK	08/28/2001
Total Kjeldahl Nitrogen	351.3	BDL	mg/L	0.1	TK	08/28/2001
TOC	415.1	4.0	mg/L	0.5	SL	08/30/2001
Solids, Total Dissolved	160.1	290	mg/L	10	FP	08/27/2001
Metals, Dissolved					NL	08/27/2001
Magnesium, Dissolved	6010B	18100	ug/L	10	NL	08/27/2001
Explosives					MF	09/13/2001
HMX	8330	BDL	ug/L	100	MF	09/13/2001
RDX	8330	BDL	ug/L	100	MF	09/13/2001

3,5-TNB	8330	BDL	ug/L	100	MF	09/13/2001
1,3-Dinitrotoluene	8330	BDL	ug/L	100	MF	09/13/2001
1,3-Dinitrobenzene	8330	BDL	ug/L	100	MF	09/13/2001
Tetryl	8330	BDL	ug/L	100	MF	09/13/2001
Nitrobenzene	8330	BDL	ug/L	100	MF	09/13/2001
2,4,6-Trinitrotoluene	8330	BDL	ug/L	100	MF	09/13/2001
4-Am-DNT	8330	BDL	ug/L	100	MF	09/13/2001
2-Am-DNT	8330	BDL	ug/L	100	MF	09/13/2001
2,4-Dinitrotoluene	8330	BDL	ug/L	100	MF	09/13/2001
2,6-Dinitrotoluene	8330	BDL	ug/L	100	MF	09/13/2001
2-Nitrotoluene	8330	BDL	ug/L	100	MF	09/13/2001
3-Nitrotoluene	8330	BDL	ug/L	100	MF	09/13/2001
4-Nitrotoluene	8330	BDL	ug/L	100	MF	09/13/2001

Sample Description: 908 Flush Lab ID: 005 Date Sampled: 08/23/2001

Test Description	Method	Result	Units	Detection Limit	Analyst	Analysis Date
Oil & Grease	1664	BDL	mg/L	2.0	SL	08/27/2001
nide, Total	335.2	BDL	mg/L	0.01	TK	08/27/2001
(Field)	150.1	7.8	S.U.		JM	08/23/2001

Sample Description: 908 Composite Lab ID: 006 Date Sampled: 08/23/2001

Test Description	Method	Result	Units	Detection Limit	Analyst	Analysis Date
Metals					NL	08/27/2001
Arsenic	200.7	BDL	ug/L	10	NL	08/27/2001
Barium	200.7	31	ug/L	10	NL	08/27/2001
Cadmium	200.7	BDL	ug/L	10	NL	08/27/2001
Chromium	200.7	BDL	ug/L	10	NL	08/27/2001
Lead	200.7	BDL	ug/L	10	NL	08/27/2001
Magnesium	200.7	14400	ug/L	10	NL	08/27/2001
Selenium	200.7	BDL	ug/L	10	NL	08/27/2001
Silver	200.7	BDL	ug/L	10	NL	08/27/2001
Mercury	245.1	BDL	ug/L	0.2	MM	08/24/2001
COD	410.4	26	mg/L	20	TK	08/28/2001
Total Kjeldahl Nitrogen	351.3	0.2	mg/L	0.1	TK	08/28/2001
TOC	415.1	4.2	mg/L	0.5	SL	08/30/2001
Solids, Total Dissolved	160.1	238	mg/L	10	FP	08/27/2001

Toltest, Inc.

Attn: Jim McGee

Work Order #: 0108-23005
Date Sampled: 08/23/2001
Date Received: 08/23/2001
Date Reported: 10/01/2001

Subject: Stormwater

Metals, Dissolved						
Magnesium, Dissolved	6010B	15600	ug/L	10	NL	08/27/2001
Explosives					NL	08/27/2001
HMX	8330	BDL	ug/L	100	MF	09/13/2001
RDX	8330	BDL	ug/L	100	MF	09/13/2001
1,3,5-TNB	8330	BDL	ug/L	100	MF	09/13/2001
1,3-Dinitrotoluene	8330	BDL	ug/L	100	MF	09/13/2001
1,3-Dinitrobenzene	8330	BDL	ug/L	100	MF	09/13/2001
Tetryl	8330	BDL	ug/L	100	MF	09/13/2001
Nitrobenzene	8330	BDL	ug/L	100	MF	09/13/2001
2,4,6-Trinitrotoluene	8330	BDL	ug/L	100	MF	09/13/2001
4-Am-DNT	8330	BDL	ug/L	100	MF	09/13/2001
2-Am-DNT	8330	BDL	ug/L	100	MF	09/13/2001
2,4-Dinitrotoluene	8330	BDL	ug/L	100	MF	09/13/2001
2,6-Dinitrotoluene	8330	BDL	ug/L	100	MF	09/13/2001
2-Nitrotoluene	8330	BDL	ug/L	100	MF	09/13/2001
3-Nitrotoluene	8330	BDL	ug/L	100	MF	09/13/2001
4-Nitrotoluene	8330	BDL	ug/L	100	MF	09/13/2001

Chain-of-Custody Record

AMERICAN TESTING COMPANY, .NC.

5475 PERKINS ROAD • BEDFORD HEIGHTS, OH 44146
(877) 322-2976 • (440) 786-1403 • FAX (440) 786-1426
www.americantesting.com • E-mail: chemical@americantesting.com

FB-230825

INVOICE TO: NAME		
ADDRESS		
CITY	STATE	ZIP CODE
PHONE NO.	FAX NO.	

REPORT TO: NAME	Jim McGee - TolTest		
ADDRESS			
CITY		STATE	ZIP CODE
PHONE NO.	FAX NO.		
PROJECT NO./PO NO.	PROJECT NAME/LOCATION: Stormwater		

NO.	SAMPLING DATE	SAMPLING TIME	Comp	Grab	CUSTOMER SAMPLE IDENTIFICATION	NO. OF CONT.	PRESERVATIVE	Explosives	COD	TKN	TOC	TDS	Tot. Pb, Se, As+	Mg+, Cd, Cr, Ba+	Ag+, Hg	Dissolved Mg	Oil and Grease	Tot. Cyanide	pH (Field)	MATRIX TYPE	
1	8-23-01		X	•	903 Flush	2										X	X	X	pH=7.7		1
2	8-23-01		X		903 Composite	2		X	X	X	X	X	X	X	X	X					2
3																					
4	8-23-01		X		907 Flush	2										X	X	Y	pH= 7.6		3
5	8-23-01		X		907 Composite	2		X	X	X	X	X	X	X	X	X					4
6																					
7	8-23-01		X		908 Flush	6										X	X	X	pH= 7.8		5
8																					
9	8-23-01		X		908 Composite	6		X	X	X	X	X	X	X	X	X					6
10																					
11	Joe	Mat's KD																			
12		440 - 786 - 1403																			
13					440-840-3708 CELL																
14																					

PARAMETERS

SPECIAL INSTRUCTIONS: (Please indicate any special detection limits, method numbers, QA/QC requirements, or highly hazardous samples.)

Turnaround Time | | Std. (5 day) Rush: | | 24 hr. | | 48 hr. | | 72 hr. Authorizing signature _____

Reports Results in: (circle one) mg/kg ug/kg mg/L ug/L ppm ppb Bioassay samples will be dropped off this afternoon at Enviroscience.

Analyze Each Phase of Sample _____

Solid samples analyzed: As received | | Dry Weight | |

PRESERVATIVES:

Sulfuric Acid	= H_2SO_4	Sodium Sulfite	= Na_2SO_3
Hydrochloric Acid	= HCl	Nitric Acid	= HNO_3
Sodium Hydroxide	= NaOH	Cool 4°C	= C
		NONE	= N

Samplers: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Received for Laboratory by: (Signature)	Date	Time
		8/27/01	1100				
Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)			
						8/28/01	9:28 pm

American Testing Company
Storm Water Summary Report

Client: Toltest

Location ID 903

Rainfall Data:

Start Time: 21:05 Date: 8/22/01

Stop Time: 22:15 Date: 8/22/01

Rainfall Duration: 1.125 Hours

Rainfall Amount: 0.18 Inches

Comments:

Flow Data:

Maximum Flow Rate: 148 GPM Time: 22:35

Total Measured Flow During Sampling: 52,800 Gallons

Comments: Based on shift from Baseline in stream flow

Sampling Data:

Flush Sample

Begin Time: 2130 Date: 8/22/01

End Time: 2200 Date: 8/22/01

No. of Samples: 6 Frequency: 5 min

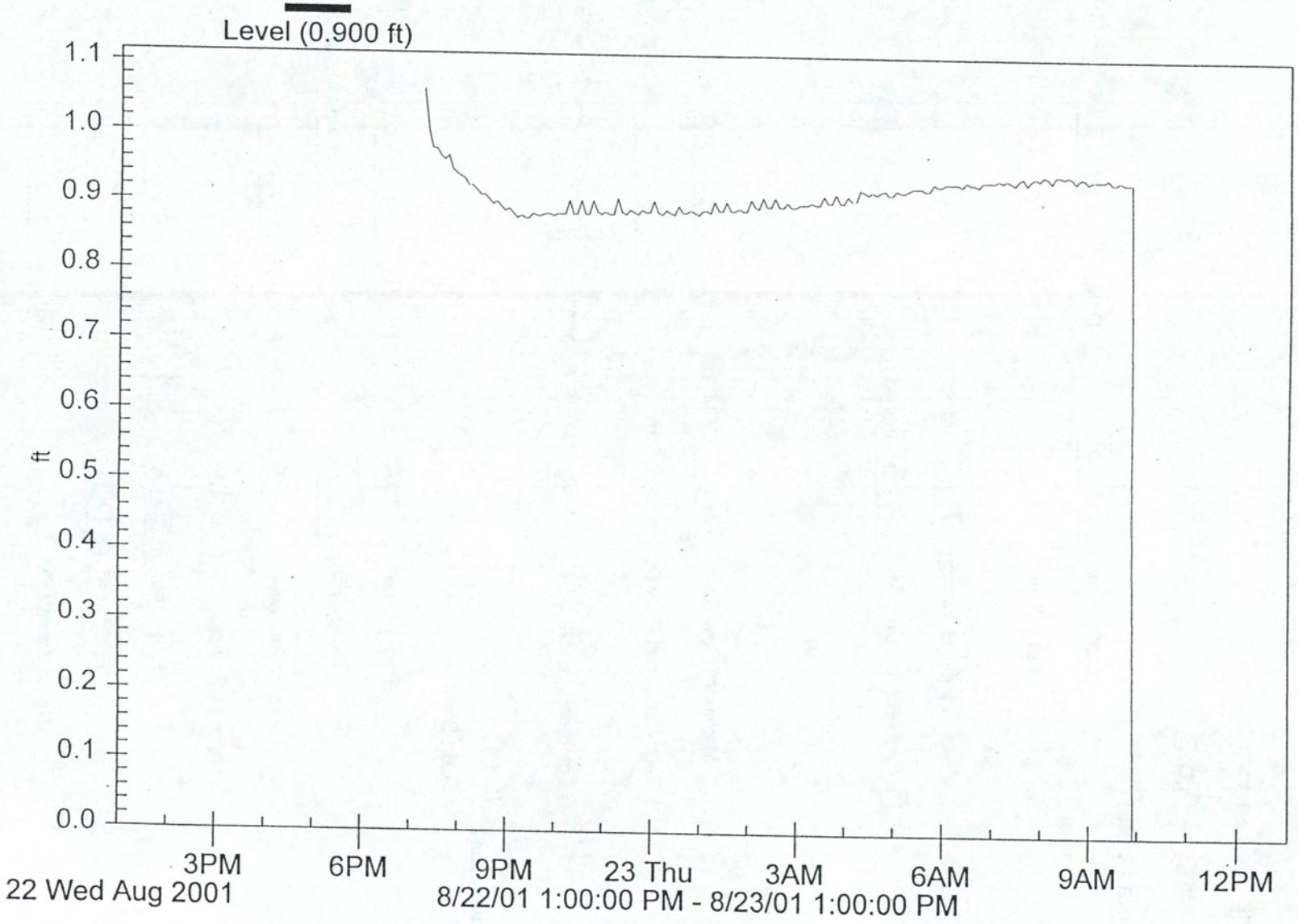
Composite Sample:

Begin Time: 2210 Date: 8/22

End Time: 0030 Date: 8/23

No. of Samples: 15 Frequency: 10 min

Flowlink 4 for Windows



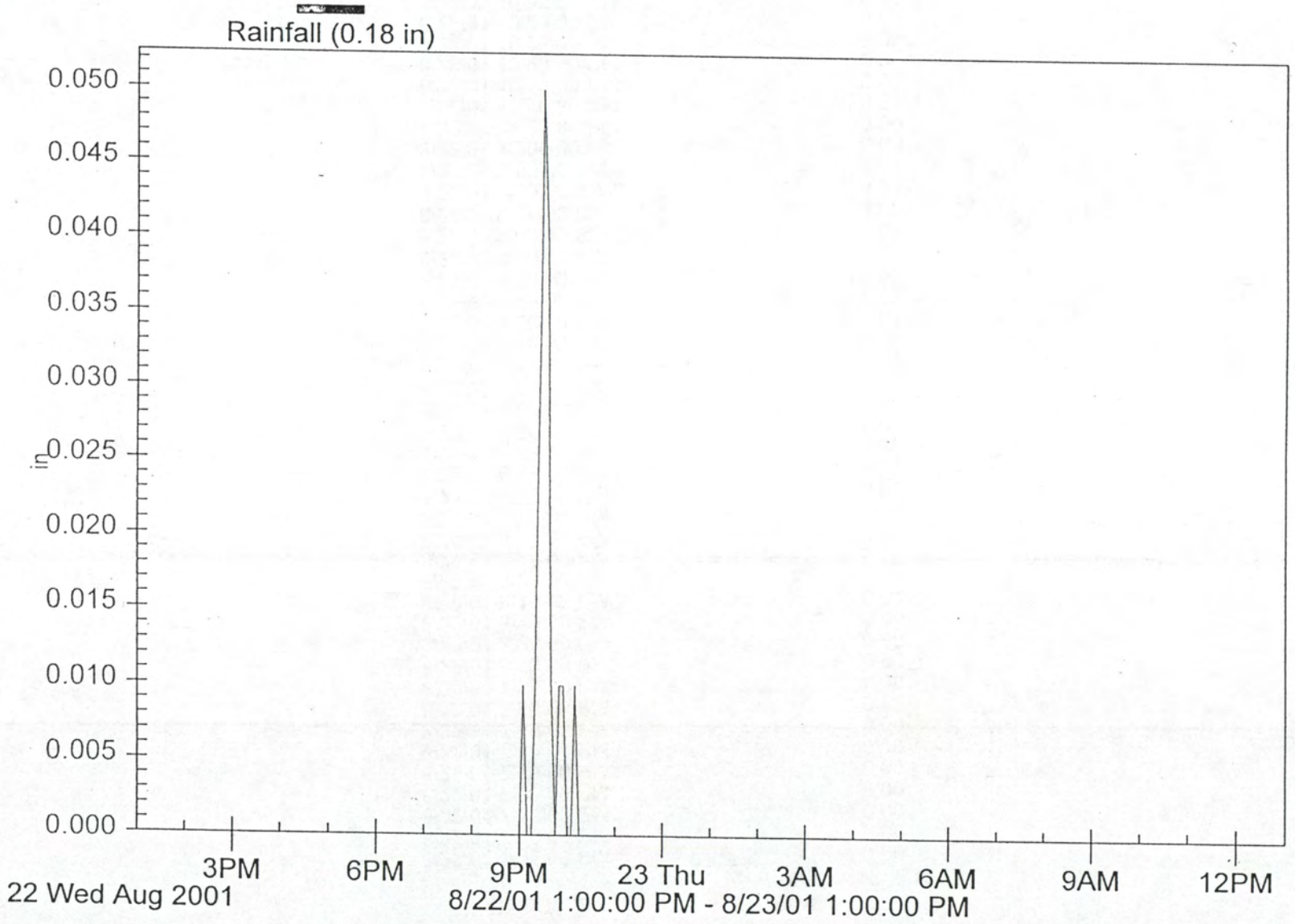
Date/Time	Level (ft)
8/22/01 7:15:00 PM	1.063
8/22/01 7:20:00 PM	1.002
8/22/01 7:25:00 PM	0.977
8/22/01 7:30:00 PM	0.977
8/22/01 7:35:00 PM	0.967
8/22/01 7:40:00 PM	0.961
8/22/01 7:45:00 PM	0.967
8/22/01 7:50:00 PM	0.948
8/22/01 7:55:00 PM	0.941
8/22/01 8:00:00 PM	0.938
8/22/01 8:05:00 PM	0.934
8/22/01 8:10:00 PM	0.925
8/22/01 8:15:00 PM	0.925
8/22/01 8:20:00 PM	0.918
8/22/01 8:25:00 PM	0.911
8/22/01 8:30:00 PM	0.911
8/22/01 8:35:00 PM	0.905
8/22/01 8:40:00 PM	0.898
8/22/01 8:45:00 PM	0.902
8/22/01 8:50:00 PM	0.895
8/22/01 8:55:00 PM	0.888
8/22/01 9:00:00 PM	0.892
8/22/01 9:05:00 PM	0.885
8/22/01 9:10:00 PM	0.879
8/22/01 9:15:00 PM	0.882
8/22/01 9:20:00 PM	0.879
8/22/01 9:25:00 PM	0.879
8/22/01 9:30:00 PM	0.885
8/22/01 9:35:00 PM	0.882
8/22/01 9:40:00 PM	0.882
8/22/01 9:45:00 PM	0.885
8/22/01 9:50:00 PM	0.885
8/22/01 9:55:00 PM	0.882
8/22/01 10:00:00 PM	0.885
8/22/01 10:05:00 PM	0.885
8/22/01 10:10:00 PM	0.885
8/22/01 10:15:00 PM	0.905
8/22/01 10:20:00 PM	0.885
8/22/01 10:25:00 PM	0.885
8/22/01 10:30:00 PM	0.905
8/22/01 10:35:00 PM	0.885
8/22/01 10:40:00 PM	0.885
8/22/01 10:45:00 PM	0.905
8/22/01 10:50:00 PM	0.888
8/22/01 10:55:00 PM	0.885
8/22/01 11:00:00 PM	0.888

Date/Time	Level (ft)
8/22/01 11:05:00 PM	0.885
8/22/01 11:10:00 PM	0.885
8/22/01 11:15:00 PM	0.908
8/22/01 11:20:00 PM	0.888
8/22/01 11:25:00 PM	0.885
8/22/01 11:30:00 PM	0.892
8/22/01 11:35:00 PM	0.888
8/22/01 11:40:00 PM	0.885
8/22/01 11:45:00 PM	0.892
8/22/01 11:50:00 PM	0.888
8/22/01 11:55:00 PM	0.888
8/23/01 12:00:00 AM	0.905
8/23/01 12:05:00 AM	0.888
8/23/01 12:10:00 AM	0.885
8/23/01 12:15:00 AM	0.892
8/23/01 12:20:00 AM	0.888
8/23/01 12:25:00 AM	0.885
8/23/01 12:30:00 AM	0.898
8/23/01 12:35:00 AM	0.888
8/23/01 12:40:00 AM	0.888
8/23/01 12:45:00 AM	0.892
8/23/01 12:50:00 AM	0.888
8/23/01 12:55:00 AM	0.885
8/23/01 1:00:00 AM	0.892
8/23/01 1:05:00 AM	0.892
8/23/01 1:10:00 AM	0.888
8/23/01 1:15:00 AM	0.905
8/23/01 1:20:00 AM	0.892
8/23/01 1:25:00 AM	0.892
8/23/01 1:30:00 AM	0.905
8/23/01 1:35:00 AM	0.892
8/23/01 1:40:00 AM	0.892
8/23/01 1:45:00 AM	0.895
8/23/01 1:50:00 AM	0.892
8/23/01 1:55:00 AM	0.892
8/23/01 2:00:00 AM	0.908
8/23/01 2:05:00 AM	0.898
8/23/01 2:10:00 AM	0.895
8/23/01 2:15:00 AM	0.911
8/23/01 2:20:00 AM	0.898
8/23/01 2:25:00 AM	0.898
8/23/01 2:30:00 AM	0.911
8/23/01 2:35:00 AM	0.898
8/23/01 2:40:00 AM	0.898
8/23/01 2:45:00 AM	0.905
8/23/01 2:50:00 AM	0.898
8/23/01 2:55:00 AM	0.898
8/23/01 3:00:00 AM	0.902
8/23/01 3:05:00 AM	0.902
8/23/01 3:10:00 AM	0.902

Date/Time	Level (ft)
8/23/01 3:15:00 AM	0.905
8/23/01 3:20:00 AM	0.902
8/23/01 3:25:00 AM	0.902
8/23/01 3:30:00 AM	0.915
8/23/01 3:35:00 AM	0.905
8/23/01 3:40:00 AM	0.905
8/23/01 3:45:00 AM	0.918
8/23/01 3:50:00 AM	0.905
8/23/01 3:55:00 AM	0.905
8/23/01 4:00:00 AM	0.915
8/23/01 4:05:00 AM	0.908
8/23/01 4:10:00 AM	0.908
8/23/01 4:15:00 AM	0.925
8/23/01 4:20:00 AM	0.921
8/23/01 4:25:00 AM	0.918
8/23/01 4:30:00 AM	0.921
8/23/01 4:35:00 AM	0.918
8/23/01 4:40:00 AM	0.921
8/23/01 4:45:00 AM	0.925
8/23/01 4:50:00 AM	0.918
8/23/01 4:55:00 AM	0.918
8/23/01 5:00:00 AM	0.925
8/23/01 5:05:00 AM	0.921
8/23/01 5:10:00 AM	0.921
8/23/01 5:15:00 AM	0.925
8/23/01 5:20:00 AM	0.928
8/23/01 5:25:00 AM	0.928
8/23/01 5:30:00 AM	0.928
8/23/01 5:35:00 AM	0.925
8/23/01 5:40:00 AM	0.925
8/23/01 5:45:00 AM	0.934
8/23/01 5:50:00 AM	0.931
8/23/01 5:55:00 AM	0.931
8/23/01 6:00:00 AM	0.934
8/23/01 6:05:00 AM	0.934
8/23/01 6:10:00 AM	0.934
8/23/01 6:15:00 AM	0.934
8/23/01 6:20:00 AM	0.931
8/23/01 6:25:00 AM	0.938
8/23/01 6:30:00 AM	0.934
8/23/01 6:35:00 AM	0.934
8/23/01 6:40:00 AM	0.931
8/23/01 6:45:00 AM	0.938
8/23/01 6:50:00 AM	0.938
8/23/01 6:55:00 AM	0.938
8/23/01 7:00:00 AM	0.938
8/23/01 7:05:00 AM	0.941
8/23/01 7:10:00 AM	0.938
8/23/01 7:15:00 AM	0.941
8/23/01 7:20:00 AM	0.938

Date/Time	Level (ft)
8/23/01 7:25:00 AM	0.934
8/23/01 7:30:00 AM	0.941
8/23/01 7:35:00 AM	0.944
8/23/01 7:40:00 AM	0.934
8/23/01 7:45:00 AM	0.941
8/23/01 7:50:00 AM	0.944
8/23/01 7:55:00 AM	0.941
8/23/01 8:00:00 AM	0.948
8/23/01 8:05:00 AM	0.944
8/23/01 8:10:00 AM	0.938
8/23/01 8:15:00 AM	0.948
8/23/01 8:20:00 AM	0.948
8/23/01 8:25:00 AM	0.944
8/23/01 8:30:00 AM	0.948
8/23/01 8:35:00 AM	0.944
8/23/01 8:40:00 AM	0.938
8/23/01 8:45:00 AM	0.944
8/23/01 8:50:00 AM	0.944
8/23/01 8:55:00 AM	0.938
8/23/01 9:00:00 AM	0.941
8/23/01 9:05:00 AM	0.941
8/23/01 9:10:00 AM	0.941
8/23/01 9:15:00 AM	0.941
8/23/01 9:20:00 AM	0.944
8/23/01 9:25:00 AM	0.938
8/23/01 9:30:00 AM	0.938
8/23/01 9:35:00 AM	0.941
8/23/01 9:40:00 AM	0.938
8/23/01 9:45:00 AM	0.938
8/23/01 9:50:00 AM	0.938
8/23/01 9:55:00 AM	0.000
8/23/01 10:00:00 AM	0.000
8/23/01 10:05:00 AM	0.000

Average Level (ft)
0.900


Rainfall (0.18 in)
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
in
3PM
6PM
9PM
23 Thu
3AM
6AM
9AM
12PM
22 Wed Aug 2001
8/22/01 1:00:00 PM - 8/23/01 1:00:00 PM

Date/Time	Rainfall (in)
8/22/01 7:15:00 PM	0.00
8/22/01 7:20:00 PM	0.00
8/22/01 7:25:00 PM	0.00
8/22/01 7:30:00 PM	0.00
8/22/01 7:35:00 PM	0.00
8/22/01 7:40:00 PM	0.00
8/22/01 7:45:00 PM	0.00
8/22/01 7:50:00 PM	0.00
8/22/01 7:55:00 PM	0.00
8/22/01 8:00:00 PM	0.00
8/22/01 8:05:00 PM	0.00
8/22/01 8:10:00 PM	0.00
8/22/01 8:15:00 PM	0.00
8/22/01 8:20:00 PM	0.00
8/22/01 8:25:00 PM	0.00
8/22/01 8:30:00 PM	0.00
8/22/01 8:35:00 PM	0.00
8/22/01 8:40:00 PM	0.00
8/22/01 8:45:00 PM	0.00
8/22/01 8:50:00 PM	0.00
8/22/01 8:55:00 PM	0.00
8/22/01 9:00:00 PM	0.00
8/22/01 9:05:00 PM	0.01
8/22/01 9:10:00 PM	0.00
8/22/01 9:15:00 PM	0.00
8/22/01 9:20:00 PM	0.01
8/22/01 9:25:00 PM	0.03
8/22/01 9:30:00 PM	0.05
8/22/01 9:35:00 PM	0.04
8/22/01 9:40:00 PM	0.01
8/22/01 9:45:00 PM	0.00
8/22/01 9:50:00 PM	0.01
8/22/01 9:55:00 PM	0.01
8/22/01 10:00:00 PM	0.00
8/22/01 10:05:00 PM	0.00
8/22/01 10:10:00 PM	0.01
8/22/01 10:15:00 PM	0.00
8/22/01 10:20:00 PM	0.00
8/22/01 10:25:00 PM	0.00
8/22/01 10:30:00 PM	0.00
8/22/01 10:35:00 PM	0.00
8/22/01 10:40:00 PM	0.00
8/22/01 10:45:00 PM	0.00
8/22/01 10:50:00 PM	0.00
8/22/01 10:55:00 PM	0.00
8/22/01 11:00:00 PM	0.00

Date/Time	Rainfall (in)
8/22/01 11:05:00 PM	0.00
8/22/01 11:10:00 PM	0.00
8/22/01 11:15:00 PM	0.00
8/22/01 11:20:00 PM	0.00
8/22/01 11:25:00 PM	0.00
8/22/01 11:30:00 PM	0.00
8/22/01 11:35:00 PM	0.00
8/22/01 11:40:00 PM	0.00
8/22/01 11:45:00 PM	0.00
8/22/01 11:50:00 PM	0.00
8/22/01 11:55:00 PM	0.00
8/23/01 12:00:00 AM	0.00
8/23/01 12:05:00 AM	0.00
8/23/01 12:10:00 AM	0.00
8/23/01 12:15:00 AM	0.00
8/23/01 12:20:00 AM	0.00
8/23/01 12:25:00 AM	0.00
8/23/01 12:30:00 AM	0.00
8/23/01 12:35:00 AM	0.00
8/23/01 12:40:00 AM	0.00
8/23/01 12:45:00 AM	0.00
8/23/01 12:50:00 AM	0.00
8/23/01 12:55:00 AM	0.00
8/23/01 1:00:00 AM	0.00
8/23/01 1:05:00 AM	0.00
8/23/01 1:10:00 AM	0.00
8/23/01 1:15:00 AM	0.00
8/23/01 1:20:00 AM	0.00
8/23/01 1:25:00 AM	0.00
8/23/01 1:30:00 AM	0.00
8/23/01 1:35:00 AM	0.00
8/23/01 1:40:00 AM	0.00
8/23/01 1:45:00 AM	0.00
8/23/01 1:50:00 AM	0.00
8/23/01 1:55:00 AM	0.00
8/23/01 2:00:00 AM	0.00
8/23/01 2:05:00 AM	0.00
8/23/01 2:10:00 AM	0.00
8/23/01 2:15:00 AM	0.00
8/23/01 2:20:00 AM	0.00
8/23/01 2:25:00 AM	0.00
8/23/01 2:30:00 AM	0.00
8/23/01 2:35:00 AM	0.00
8/23/01 2:40:00 AM	0.00
8/23/01 2:45:00 AM	0.00
8/23/01 2:50:00 AM	0.00
8/23/01 2:55:00 AM	0.00
8/23/01 3:00:00 AM	0.00
8/23/01 3:05:00 AM	0.00
8/23/01 3:10:00 AM	0.00

Date/Time	Rainfall (in)
8/23/01 3:15:00 AM	0.00
8/23/01 3:20:00 AM	0.00
8/23/01 3:25:00 AM	0.00
8/23/01 3:30:00 AM	0.00
8/23/01 3:35:00 AM	0.00
8/23/01 3:40:00 AM	0.00
8/23/01 3:45:00 AM	0.00
8/23/01 3:50:00 AM	0.00
8/23/01 3:55:00 AM	0.00
8/23/01 4:00:00 AM	0.00
8/23/01 4:05:00 AM	0.00
8/23/01 4:10:00 AM	0.00
8/23/01 4:15:00 AM	0.00
8/23/01 4:20:00 AM	0.00
8/23/01 4:25:00 AM	0.00
8/23/01 4:30:00 AM	0.00
8/23/01 4:35:00 AM	0.00
8/23/01 4:40:00 AM	0.00
8/23/01 4:45:00 AM	0.00
8/23/01 4:50:00 AM	0.00
8/23/01 4:55:00 AM	0.00
8/23/01 5:00:00 AM	0.00
8/23/01 5:05:00 AM	0.00
8/23/01 5:10:00 AM	0.00
8/23/01 5:15:00 AM	0.00
8/23/01 5:20:00 AM	0.00
8/23/01 5:25:00 AM	0.00
8/23/01 5:30:00 AM	0.00
8/23/01 5:35:00 AM	0.00
8/23/01 5:40:00 AM	0.00
8/23/01 5:45:00 AM	0.00
8/23/01 5:50:00 AM	0.00
8/23/01 5:55:00 AM	0.00
8/23/01 6:00:00 AM	0.00
8/23/01 6:05:00 AM	0.00
8/23/01 6:10:00 AM	0.00
8/23/01 6:15:00 AM	0.00
8/23/01 6:20:00 AM	0.00
8/23/01 6:25:00 AM	0.00
8/23/01 6:30:00 AM	0.00
8/23/01 6:35:00 AM	0.00
8/23/01 6:40:00 AM	0.00
8/23/01 6:45:00 AM	0.00
8/23/01 6:50:00 AM	0.00
8/23/01 6:55:00 AM	0.00
8/23/01 7:00:00 AM	0.00
8/23/01 7:05:00 AM	0.00
8/23/01 7:10:00 AM	0.00
8/23/01 7:15:00 AM	0.00
8/23/01 7:20:00 AM	0.00

Date/Time	Rainfall (in)
8/23/01 7:25:00 AM	0.00
8/23/01 7:30:00 AM	0.00
8/23/01 7:35:00 AM	0.00
8/23/01 7:40:00 AM	0.00
8/23/01 7:45:00 AM	0.00
8/23/01 7:50:00 AM	0.00
8/23/01 7:55:00 AM	0.00
8/23/01 8:00:00 AM	0.00
8/23/01 8:05:00 AM	0.00
8/23/01 8:10:00 AM	0.00
8/23/01 8:15:00 AM	0.00
8/23/01 8:20:00 AM	0.00
8/23/01 8:25:00 AM	0.00
8/23/01 8:30:00 AM	0.00
8/23/01 8:35:00 AM	0.00
8/23/01 8:40:00 AM	0.00
8/23/01 8:45:00 AM	0.00
8/23/01 8:50:00 AM	0.00
8/23/01 8:55:00 AM	0.00
8/23/01 9:00:00 AM	0.00
8/23/01 9:05:00 AM	0.00
8/23/01 9:10:00 AM	0.00
8/23/01 9:15:00 AM	0.00
8/23/01 9:20:00 AM	0.00
8/23/01 9:25:00 AM	0.00
8/23/01 9:30:00 AM	0.00
8/23/01 9:35:00 AM	0.00
8/23/01 9:40:00 AM	0.00
8/23/01 9:45:00 AM	0.00
8/23/01 9:50:00 AM	0.00
8/23/01 9:55:00 AM	0.00
8/23/01 10:00:00 AM	0.00
8/23/01 10:05:00 AM	0.00

Average Rainfall (in)
0.00

Total
0.18 in

American Testing Company
Storm Water Summary Report

Client: TolTest

Location ID 907

Rainfall Data:

Start Time: 19:45 Date: 8-22-01

Stop Time: 00:35 Date: 8-23-01

Rainfall Duration: 5 Hours

Rainfall Amount: .20 Inches

Comments:

Flow Data:

Maximum Flow Rate: 243 GPM Time: 5AM 8/23

Total Measured Flow During Sampling: 30600 Gallons

Comments:

Sampling Data:

Flush Sample

Begin Time: 2005 Date: 8-22-01

End Time: 2030 Date: 8-22-01

No. of Samples: 6 Frequency: 5 min.

Composite Sample:

Begin Time: 2040 Date: 8-22-01

End Time: 2250 Date: 8-22-01

No. of Samples: 15 Frequency: 10 min

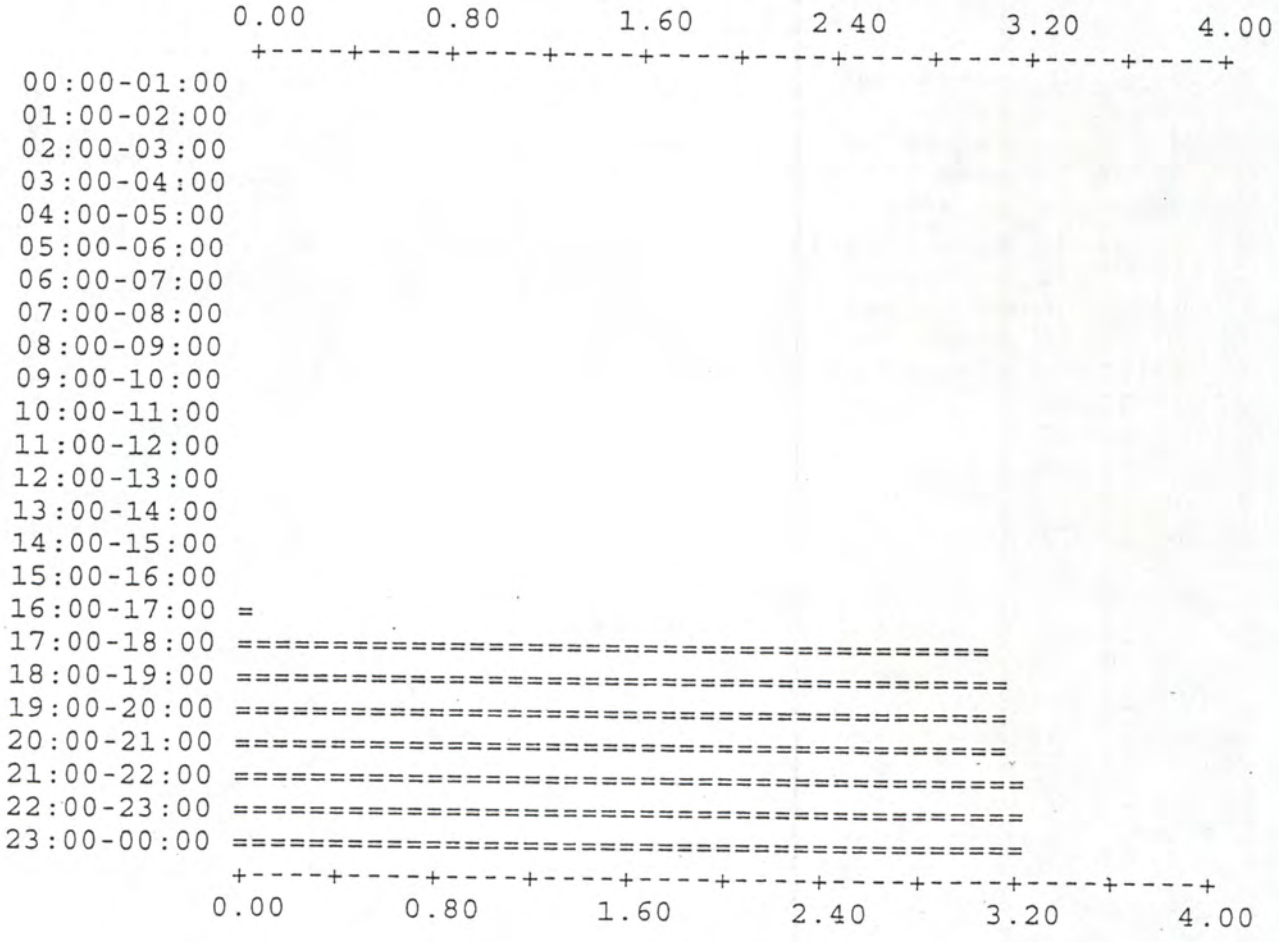
DAILY SUMMARY Site #781352676 908 Wed 22 Aug 2001

Part B Level

Average Level: 3.02 ft
Minimum Level: 0.01 ft @ 16:40
Maximum Level: 3.27 ft @ 23:50

Hourly Average Level

00:00-01:00:		12:00-13:00:	
01:00-02:00:		13:00-14:00:	
02:00-03:00:		14:00-15:00:	
03:00-04:00:		15:00-16:00:	
04:00-05:00:		16:00-17:00:	0.01 ft
05:00-06:00:		17:00-18:00:	3.05 ft
06:00-07:00:		18:00-19:00:	3.20 ft
07:00-08:00:		19:00-20:00:	3.19 ft
08:00-09:00:		20:00-21:00:	3.20 ft
09:00-10:00:		21:00-22:00:	3.21 ft
10:00-11:00:		22:00-23:00:	3.25 ft
11:00-12:00:		23:00-00:00:	3.27 ft



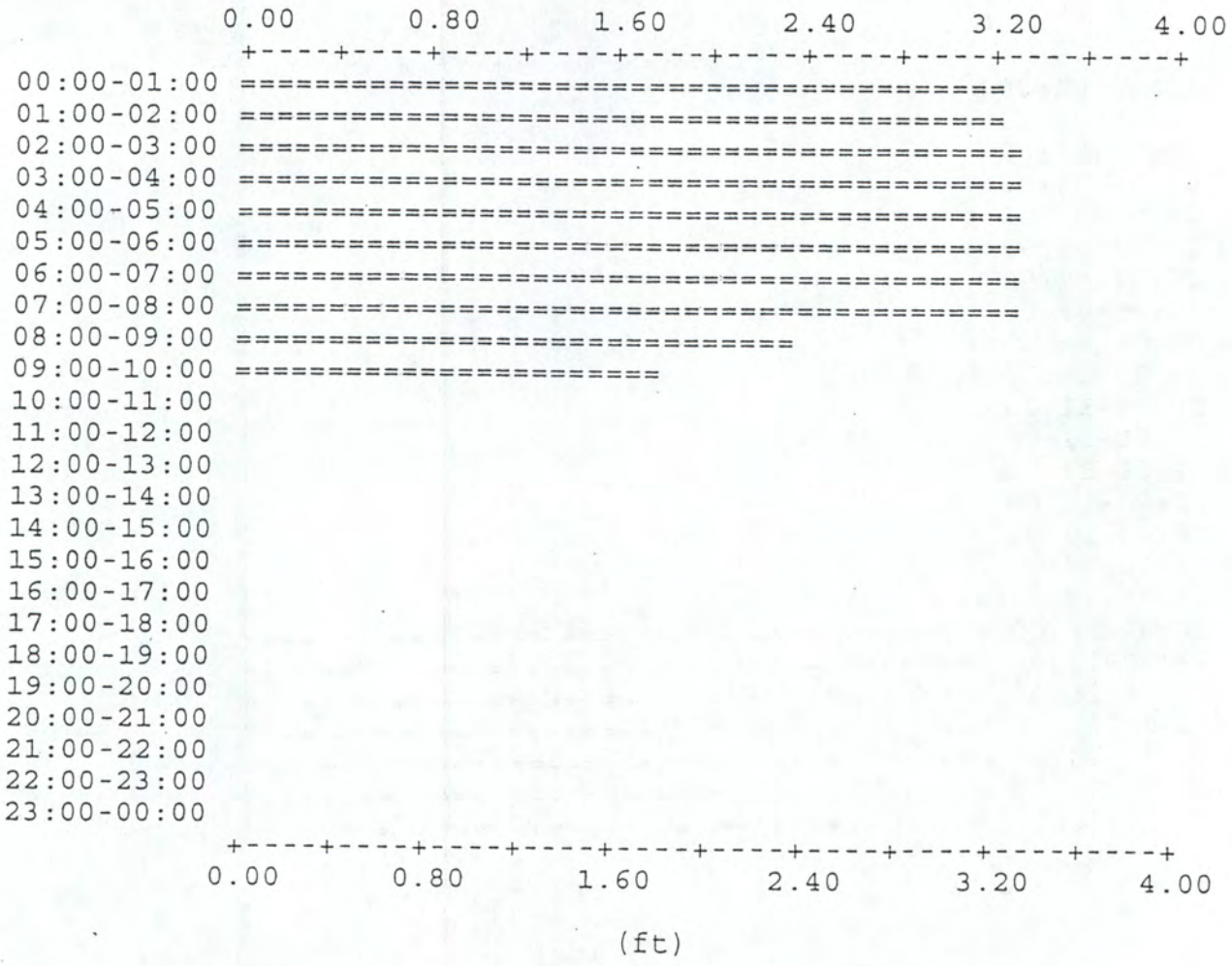
DAILY SUMMARY Site #781352676 908 Thu 23 Aug 2001

Part B Level

Average Level: 3.18 ft
Minimum Level: 1.78 ft @ 09:00
Maximum Level: 3.31 ft @ 05:55

Hourly Average Level

00:00-01:00:	3.27 ft	12:00-13:00:	
01:00-02:00:	3.28 ft	13:00-14:00:	
02:00-03:00:	3.29 ft	14:00-15:00:	
03:00-04:00:	3.29 ft	15:00-16:00:	
04:00-05:00:	3.30 ft	16:00-17:00:	
05:00-06:00:	3.31 ft	17:00-18:00:	
06:00-07:00:	3.31 ft	18:00-19:00:	
07:00-08:00:	3.31 ft	19:00-20:00:	
08:00-09:00:	2.36 ft	20:00-21:00:	
09:00-10:00:	1.79 ft	21:00-22:00:	
10:00-11:00:		22:00-23:00:	
11:00-12:00:		23:00-00:00:	



American Testing Company
Storm Water Summary Report

Client: Tol Test

Location ID 908

Rainfall Data:

Start Time: 20:34 Date: 8-22-01

Stop Time: 01:32 Date: 8-23-01

Rainfall Duration: 5 Hours

Rainfall Amount: .20 Inches

Comments:

Flow Data:

Maximum Flow Rate: 129 GPM Time: 20:05

Total Measured Flow During Sampling: 17,300 Gallons

Comments: estimated flow based on rain fall, depth calculation

Sampling Data:

Flush Sample

Begin Time: 01:19 Date: 8-23-01

End Time: 01:49 Date: 8-23-01

No. of Samples: 6 Frequency: 5min

Composite Sample:

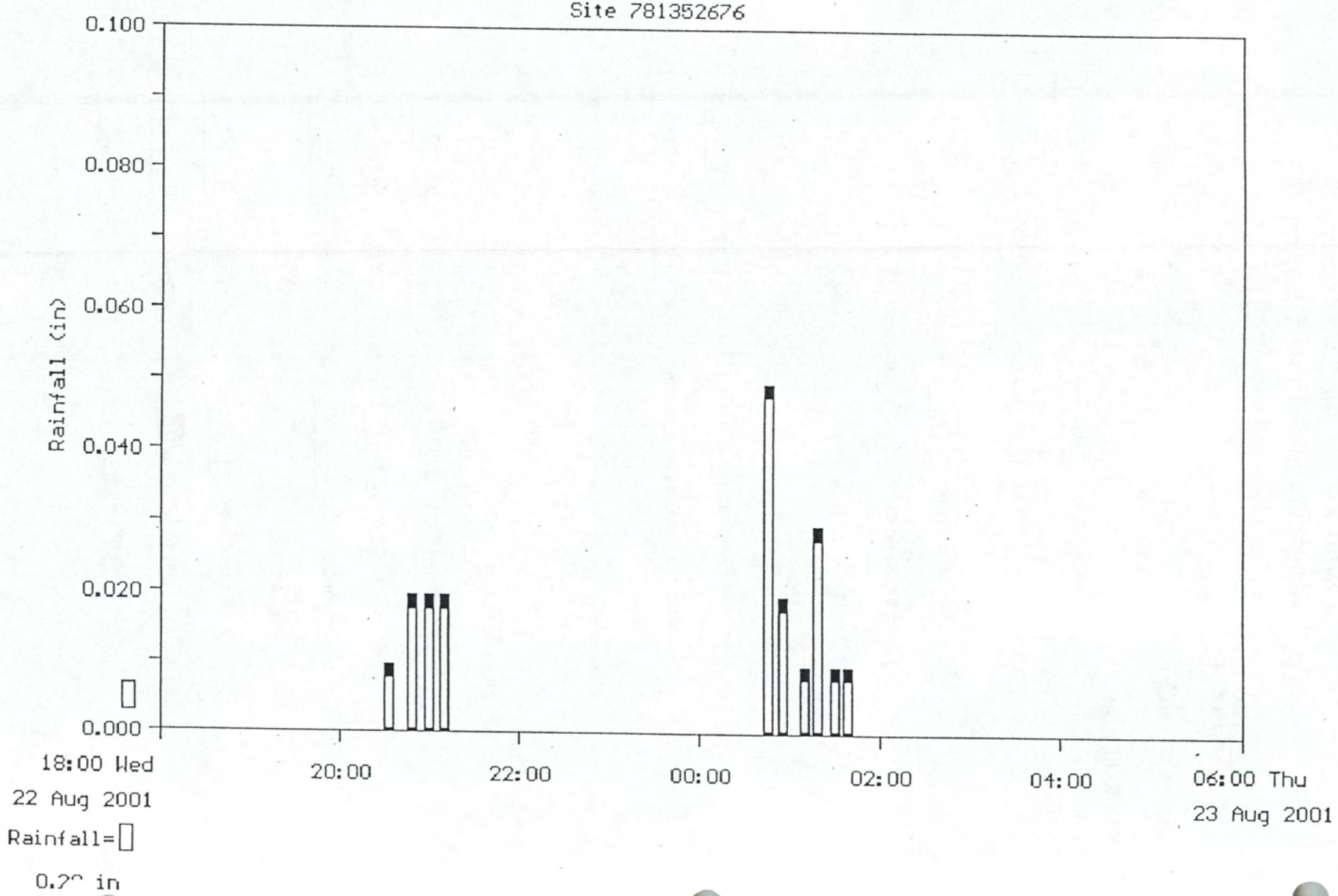
Begin Time: 01:59 Date: 8-23-01

End Time: 03:29 Date: 8-23-01

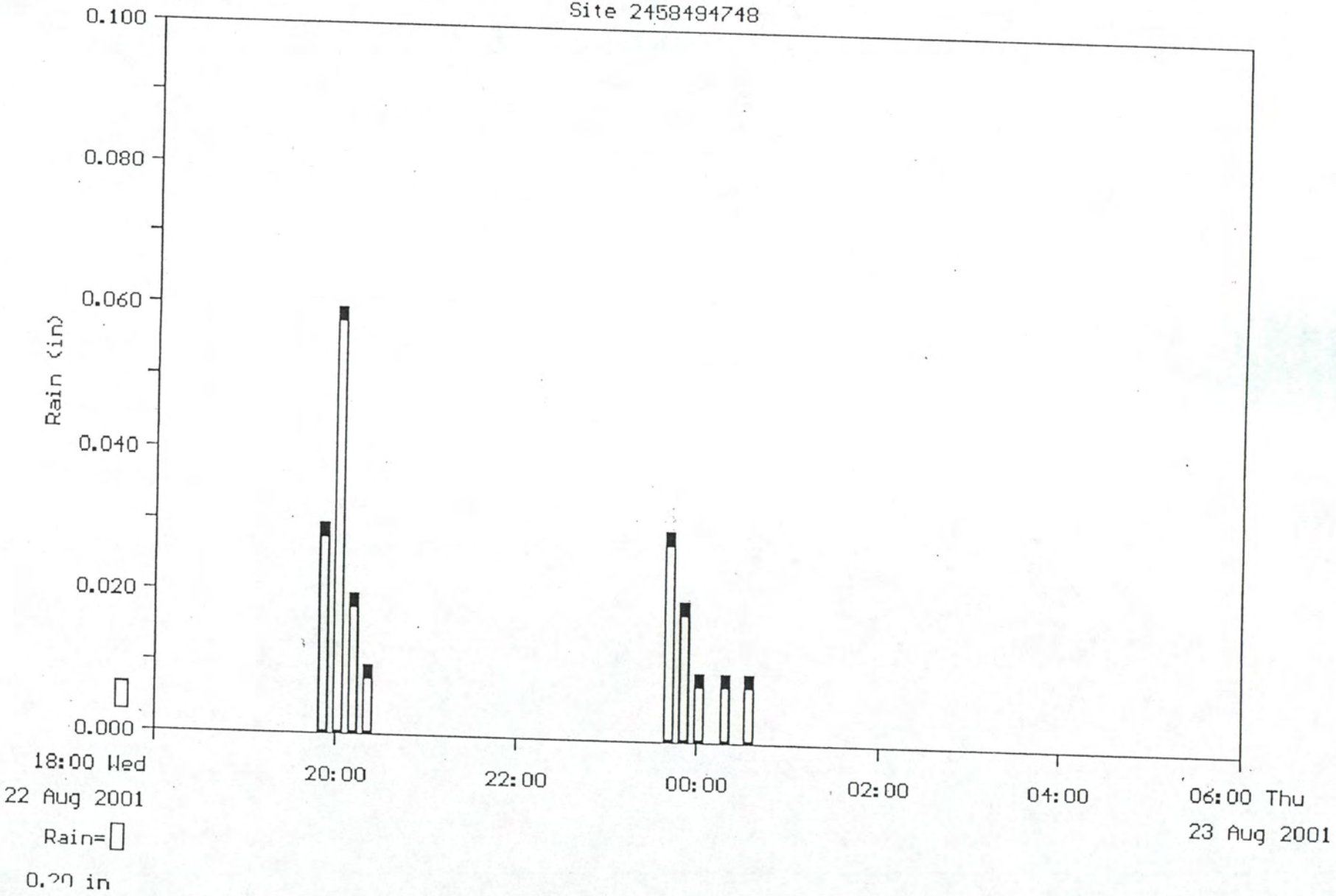
No. of Samples: 15 Frequency: 10min

908

Site 781352676



907


Site 2458494748
0.100
0.080
0.060
0.040
0.020
0.000
Rain (in)
18:00 Wed
22 Aug 2001
Rain=
0.20 in
20:00
22:00
00:00
02:00
04:00
06:00 Thu
23 Aug 2001

Ohio National Guard (RTLS)

Water-Quality Sampling

The Ohio National Guard (OHARNG) is preparing a program to monitor the impact of training on surface water quality. The OHARNG will establish sampling locations and follow agreed upon protocols and criteria to be coordinated with the Ohio EPA. The baseline of water-quality conditions will be determined over a period of 3 years. Physical, chemical, and biological samples will be collected tentatively at nine (9) sample stations, shown on the following figure. These locations were selected for reasons including : location relative to training areas in the watershed, representation of adjacent land use, and previous data available.

PARAMETER	UNITS	USEPA Cross Reference
Discharge, stream	ft^3/sec	n/a
Sediment, suspended	tons/day	160 or 160.3
pH, whole water, field	Standard Units	150.1
Oil and Grease	mg/L	1664
Oxygen demand, biochemical carbon	mg/L	405.1
Oxygen demand, chemical	mg/L	410.4
Precipitation for a storm event	inches	n/a
Duration of storm event producing measurable precipitation	hours	n/a
Interval between storm events	hours	n/a
Index of Biotic Integrity (Ohio EPA)	n/a	n/a
Invertebrate Community Index (Ohio EPA)	n/a	n/a
Qualitative Habitat Evaluation Index(Ohio EPA)	n/a	n/a
Primary Headwater Habitat (Ohio EPA)	n/a	n/a

RVAAP HISTORIC

SURFACE WATER
SEDIMENT
BIOLOGICAL SAMPLING

RVAAP HISTORIC

SURFACE WATER AND SEDIMENT SAMPLING

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
P.O. BOX 59
LOUISVILLE, KENTUCKY 40201-0059

March 15, 2000

TO: Ravenna Army Ammunition Plant
Mr. Mark Patterson, Environmental Coordinator
8451 State Route 5, Bldg. 1037
Ravenna, Ohio 44266-9297

SUBJECT: Data Submittal, Surface Water /Groundwater Historic Data
Metals and Select Constituents
Ravenna Army Ammunition Plant
Ravenna, Ohio

Dear Mr. Patterson:

The attached information represents a compilation of historical groundwater and surface water analytical data related to operations at the Ravenna Army Ammunition Plant (RVAAP). This data is being presented in relation to background monitoring well data obtained during the determination of Facility Wide Background Levels. Data obtained from the sampling of off-plant residential water supply wells by the Ohio EPA are also included in this comparison. The historical data, some of which is over twenty years old, has been compiled with the understanding that while it may not stand up to the rigorous data validation of today, it is valuable in attempting to understand historical groundwater and surface water quality values.

The information contained herein has been divided into four groups, broken down as follows:

1. Stream Sampling: This data was obtained from eight sampling points on the RVAAP grounds between June 1980 and December 1992 as part of the plant's NPDES permit requirements. This data is summarized on Table 1.

2. Site Water Supply: This data was obtained from up to 13 RVAAP water supply wells between September 1977 and August 1991. This data was collected during several early studies of the plant and its potable water supply by the US Army Toxic and Hazardous Materials Agency (USTHMA) and its successor the US Army Environmental Hygiene Agency (USAEHA), as well as data collected during RVAAP's internal wellhead monitoring program. This data is summarized on Table 2.

3. Facility Wide Background Monitoring Wells: This data was obtained from fourteen monitoring wells installed on the RVAAP grounds in 1998. These monitoring wells were installed in 1998 at locations mutually selected by the RVAAP Environmental Team (RVAAP, Ohio EPA, Ohio Army National Guard, US Army Corps of Engineers and the AE, SAIC) to represent areas that had a high probability of being unaffected by former plant operations. Seven of the wells are completed in unconsolidated sediments and seven are completed in bedrock. Of those wells completed in bedrock, four were completed in sandstone and three were completed in shale. Laboratory testing was performed on both filtered and un-filtered samples. This data is summarized on Table 3.

4. Residential Wells: This data was obtained from 25 off-site residential water supply wells sampled by the Ohio EPA Northeast District Office (NEDO) in November 1997. Re-sampling and analysis of select wells for thorium only was performed in March 1998, these results are also included in the data set. This data is summarized on Table 4.

For the purpose of this study, only that data which could be readily compared to the other data sets was selected for use. Volatile and semi-volatile organic constituents that are contained in the some of the data sets were not used due to the lack of similar sampling suites between data sets. A map showing locations of the sampling points used in this submission is presented on Figure 1.

In addition to the summary tables prepared for this submittal, a series of comparative graphs have also been prepared to illustrate relative relationships between similar data sets (groundwater and surface water). Graphs, presented by constituent, for the various stream sampling points are included in Appendix A. Graphs, presented by constituent, comparing the various groundwater sampling points are included in Appendix B. Appendix C contains a listing of current primary maximum contaminant levels (MCLs) and secondary maximum contaminant levels (SMCLs) for public drinking water as adopted by the Ohio EPA.

The following sections detail the methodology used in the preparation of the various graphs.

Stream Sampling Graphs

For each parameter, the historical sampling results shown on Table 1 were used to calculate the average and standard deviation values. Many of the results are reported with less than symbols indicating that the concentration of the analyzed constituent was below the method reporting limit for the particular sampling event (in some cases reporting levels varied for some parameters between sampling events). For results that were reported as being "less than" a particular reporting limit, the value used to calculate average and standard deviation values was set to equal to the respective reporting limit. It should be noted that using the value of the method reporting limit as the reported concentration for a given sampling event will likely yield a higher than actual average value for the particular constituent. Likewise, the average and standard deviation calculations performed using the "reporting level" values are also likely biased to a higher than actual result. For cadmium, trivalent chromium, lead and TNT there were no samples on any date that were greater that the method limit for the particular constituent.

Where appropriate, the facility wide background values have been generated for surface water and have been included on the graphs. For the purpose of this presentation, background level concentrations of constituents that had no reported result were set equal to the method reporting limit. Graphs depicting concentrations by constituent are included in Appendix A.

Of the eight sampling points for which analytical data is available, six represent data pairs that were obtained where a stream enters and exits the RVAAP grounds (Eagle Creek, Hinkley Creek and Sand Creek). The two remaining sampling locations (PF 8 and PF 534) are situated where an unnamed stream originating on the facility exits the RVAAP grounds.

Groundwater Sampling Graphs

Graphical presentations of groundwater data were prepared using analytical results obtained from three sources, off-plant residential supply wells (Group 1), RVAAP water supply wells (Group 2) and RVAAP facility wide background monitoring wells (Groups 3 through 6). The RVAAP facility wide background monitoring well network included a total of 14 wells screened in both unconsolidated soils and bedrock. Additionally, analysis of both filtered and unfiltered of samples was performed. For this submittal the facility wide data has been grouped as follows:

Group 3: Bedrock, filtered
Group 4: Bedrock, unfiltered
Group 5: Unconsolidated, filtered
Group 6: Unconsolidated, unfiltered

The graphs presented in Appendix B depict data sets as described above. The following sections detail rationale and methods used in the preparations of the groundwater graphs for the respective data sets.

Group 1: Off Plant Residential Wells

For each metal, the results shown on Table 2 were used to calculate the average and standard deviation values. Results reported as "non detect" were set to the reporting limit for the particular constituent.

Because many of the sampling points in this data set had laboratory values reported as non-detect and thus used the reporting limit as the result, the resulting average concentration values are likely biased to a higher than actual result for the particular constituent. Conversely many of the data were reported with a value less than the reporting limit (data flagged with a "B" qualifier which is considered by the laboratory as an estimate) which would tend to bias the average value downward. For the metals beryllium, mercury, silver and vanadium, the average equals the detection level due to all results being non-detect (no "B" flagged data).

Map Showing Wells Identified by Completion Zones

A map has been prepared in conjunction with this study that has identified wells located on the RVAAP grounds as well as those in the immediate vicinity on the basis of the completion zone of a particular well. The wells were identified as being completed in one of three zones of groundwater availability (sandstone, shale, or unconsolidated sand and gravel). Of the 300 wells for which logs from ODNR were obtained, approximately 154 were completed in sandstone, 91 in shale and 51 were completed in unconsolidated sand and gravel. Additionally, four of the wells were identified as being completed in limestone. The map is presented on Figure 2. Presented on Table 5 is a draft version of a summary table of residential well construction data. This table, when finalized will contain all residential and RVAAP wells along with additional pertinent data that can be obtained from available logs.

If you have any questions or need clarification of the data presented or methods used for comparison purposes, please contact me at (502) 582-5572.

Paul L. Zorko, P.G.
Geologist

John P. Jent, P.E.
Civil/Environmental Engineer

Attached:
Table 1 – Summary of Historic Stream Sampling Analytical Results
Table 2 – Summary of Residential Well Sampling Analytical Results
Table 3 – Summary of Historic Facility Supply Well Analytical Results
Table 4 – Summary of Background Monitoring Well Sampling Analytical Results
Table 5 – Draft Summary of Residential Well Construction Data
Figure 1 – Sampling Location Map
Figure 2 – Area Map Showing Onsite and Offsite Wells Identified by Completion Zone
Appendix A - Stream Sampling Concentration Plots
Appendix B - Groundwater Sampling Concentration Plots
Appendix C - Ohio EPA DDAGW Public Drinking Water Standards

Cc:
Mr. Robert Whelove, Jr. - IOC
Mr. Tim Morgan - RVAAP
LTC Thomas Tadsen - OHARNG
Ms. Eileen Mohr - Ohio EPA, NE District Office DEER
Mr. Todd Fischer - Ohio EPA, NE District Office DEER
Mr. Kevin Jasper – CELRL-DL-B

TABLES

TABLE 1

Summary of Historic Stream Sampling Analytical Results
Ravenna Army Ammunition Plant
Ravenna, Ohio

Sample Location/Date of Sampling	pH (standard units)	Specific Conductivity (uhmos/cm)	Total Suspended Solids (mg/l)	Biochemical Oxygen Demand (mg/l)	Fecal Colliform (colonies/100 ml)	Total Organic Carbon (mg/l)	Total Kjeldahl Nitrogen (mg/l)	Oil & Grease (mg/l)	Nitrate (mg/l)	Nitrite (mg/l)	Total Phosphorous (mg/l)	Cadmium (mg/l)	Copper (mg/l)	Total Chromium (mg/l)	Hexavalent Chromium (mg/l)	Trivalent Chromium (mg/l)	Lead (mg/l)	Zinc (mg/l)	DNT (ug/l)	RDX (ug/l)	TNT (ug/l)
EC-1 Influent																					
6/12/80	7.7	410	10	3	110	21	0.088	<1	0.5	<0.01	0.11										
9/4/80	6.7	440	12	2	1200	32	0.2	<1	0.69	0.016	<0.03		0.008	<0.005			<0.039	0.044			
12/4/80	7	560	4	<1	1120			1													
3/31/81	6.2	230	1	5	<1.2			1													
10/30/81																					
8/4/83	7.6	<110	4	3		4	0.14	4	0.71	<0.01	0.03		<0.02	<0.024	<0.01		<0.05	<0.02			
10/30/85	7.9	470	3	<1	7000	<1	0.23	<1	0.62	<0.01	0.01		<0.02	<0.02	0.12		<0.05	<0.02			
9/4/87	7.8	500	12		90	5.7	0.44	2	<0.01	<0.01	0.062		<0.01	<0.03	<0.01	<0.03	<0.02	<0.01		15	<1.6
12/14/88		510	<1	<1		1.4	0.72	1.9	0.58	<0.05	0.92	<1	<0.01	<0.03			<0.05	<0.02		<1.0	<1.0
11/30/89		530	<1	<1	1700	14	1.7	2	<0.01	<0.01	0.02	<0.01	<0.01	<0.03			<0.02	<0.01		<1.0	<1.0
6/20/91	8	549	5	2	140	2	<1	<1	0.89	0.05	<0.01	<0.01	<0.01	<0.03			<0.02	<0.01		<1.0	<1.0
12/3/92	7.41	324	3	2	104	2.8	<1	1	0.2	<0.01	<0.01	<0.01	<0.01	<0.03			<0.02	<0.01		<1.0	<1.0
Average	**7.4**	**452**	**5.1**	**2.1**	**1274**	**9.3**	**0.61**	**1.5**	**0.468**	**0.02**	**0.13**	**0.26**	**0.012**	**0.024**	**0.047**	**0.03**	**0.034**	**0.018**		**4.5**	**1.2**
Std. Dev.	**0.6**	**106**	**4.3**	**1.29**	**2237**	**10.9**	**0.54**	**0.93**	**0.319**	**0.017**	**0.3**	**0.5**	**0.005**	**0.009**	**0.064**	**0**	**0.015**	**0.012**		**7.0**	**0.3**
EC-2 Effluent																					
6/12/80	7.5	390	11	4	190	36	0.44	<1	0.29	<0.01	0.21										
9/4/80	7.4	150	3	<1	1400	11	<0.01	<1	0.11	<0.01	0.072		0.039	<0.005	<0.01		<0.039	0.05			
12/4/80	6.9	320	4	<1	2000			<1													
3/31/81	7.1	220	3	<1	31			<1													
10/30/81	8.1	330	<1	1	320	2	0.55	<1	0.85	<0.01	<0.01		<0.01	<0.02	<0.01		<0.2	0.036		<10	<0.18
8/4/83	7.5	360	22	2	320	3	0.14	3	0.45	<0.01	0.02		<0.02	<0.04	<0.01		<0.02	<0.02		<10	<10
10/30/85	7.8	430	3	<0.05	4200	<1	0.16	<1	0.13	<0.01	0.13		<0.02	0.02	0.08		<0.05	0.02		<10	<10
9/4/87	7.8	430	13		500	3.5	0.65	2	<0.01	<0.01	0.054		<0.01	<0.03	<0.01	<0.03	<0.02	<0.01		<1.5	<1.6
12/14/88		420	<1	<1			0.36	3.2	0.14	<0.05	0.42	<1	<0.01	<0.03			<0.05	<0.02			
11/30/89		360	3	<1	1600	12	2.3	1	<0.01	<0.01	0.02	<0.01	<0.01	<0.03			<0.02	<0.01	<1.0	<1.0	<1.0
6/20/91	8	472	7	1	445	4	<1	<1	0.39	<0.01	<0.01	<0.01	<0.01	<0.03			<0.02	<0.01	<1.0	<1.0	<1.0
12/3/92	7.39	299	1	<1	324	2.6	<1	<1	0.09	<0.01	<0.01	<0.01	<0.01	<0.03			<0.02	<0.01	<1.0	<1.0	<1.0
Average	**7.5**	**348**	**6**	**1.3**	**1030**	**8.3**	**0.66**	**1.4**	**0.171**	**0.014**	**0.1**	**0.26**	**0.015**	**0.026**	**0.024**	**0.03**	**0.049**	**0.021**	**1.0**	**4.9**	**3.5**
Std. Dev.	**0.38**	**93**	**6.4**	**1**	**1236**	**11.11**	**0.67**	**0.83**	**0.154**	**0.013**	**0.13**	**0.5**	**0.01**	**0.01**	**0.031**	**0**	**0.058**	**0.014**	**0.0**	**4.7**	**4.4**

TABLE 1
Summary of Historic Stream Sampling Analytical Results
Ravenna Army Ammunition Plant
Ravenna, Ohio

Sample Location/Date of Sampling	pH (standard units)	Specific Conductivity (uhmos/cm)	Total Suspended Solids (mg/l)	Biochemical Oxygen Demand (mg/l)	Fecal Colliform (colonies/100 ml)	Total Organic Carbon (mg/l)	Total Kjeldahl Nitrogen (mg/l)	Oil & Grease (mg/l)	Nitrate (mg/l)	Nitrite (mg/l)	Total Phosphorous (mg/l)	Cadmium (mg/l)	Copper (mg/l)	Total Chromium (mg/l)	Hexavalent Chromium (mg/l)	Trivalent Chromium (mg/l)	Lead (mg/l)	Zinc (mg/l)	DNT (ug/l)	RDX (ug/l)	TNT (ug/l)
HC-1 Influent																					
6/12/80	7.5	360	15	3	710	11	0.088	<1	0.21	0.017	0.16										
9/4/80	7.2	480	3	4	>2700	28	0.22	<1	0.065	0.015	0.14		0.067	<0.005	<0.01		<0.039	0.066			
12/4/80	6.6	380	3	<1	3600			<1													
3/31/81	6.6	170	<1	7	12			<1													
10/30/81	7.4	380	4	6	300	8	0.86	1	0.044	0.029	0.04		<0.01	<0.02	<0.01		<0.2	<0.01		<10	<0.18
8/4/83	7.4	380	13	5		4	0.15	3	0.1	<0.01	0.08		<0.02	<0.04	<0.01		<0.05	<0.02			
10/30/85	7.5	490	17	<1	3400	<1	0.27	3	0.08	0.01	0.09		<0.02	0.02	0.11		<0.05	<0.02			
9/4/87	7.6	590	10		880	4.6	0.96	<1	<0.01	<0.01	0.15		<0.01	<0.03	<0.01	<0.03	<0.02	<0.01		45	<1.6
12/14/88		480	41	<1		1.4	0.3	1.3	0.32	<0.05	0.66	<0.01	<0.01	<0.03			<0.05	<0.02			
11/30/89		480	6	<1	4500	17	2.1	2	<0.01	<0.01	0.09	<0.01	<0.01	<0.03			<0.02	<0.01	<1.0	<1.0	<1.0
6/20/91	7.6	628	10	3	300	4	<1	<1	0.52	<0.01	0.04	<0.01	<0.01	<0.03			<0.02	<0.01	<1.0	<1.0	<1.0
12/3/92	6.39	336	3	2	480	4.1	<1	<1	0.41	0.02	0.029	<0.01	<0.01	<0.03			<0.02	<0.01	<1.0	<1.0	<1.0
Average	**7.2**	**430**	**10.5**	**3.10**	**1,576**	**8.30**	**0.690**	**1.400**	**0.177**	**0.018**	**0.150**	**0.010**	**0.019**	**0.026**	**0.030**	**0.030**	**0.052**	**0.020**	**1.0**	**11.6**	**0.960**
Std. Dev.	**0.5**	**122**	**11.0**	**2.17**	**1,736**	**8.40**	**0.620**	**0.780**	**0.181**	**0.013**	**0.190**	**0.000**	**0.019**	**0.010**	**0.045**	**0.000**	**0.057**	**0.018**	**0.0**	**19.1**	**0.510**
HC-2 Effluent																					
6/12/80	7.5	310	16	6	260	12	0.41	<1	0.4	<0.01	0.19										
9/4/80	7.4	420	19	2	2700	12	0.091	<1	0.19	0.015	<0.03		0.011	<0.005	<0.01		<0.039				
12/4/80	6.8	370	4	<	620			<1													
3/31/81	6.6	145	3	<1	4			2													
10/30/81	7.7	250	60	3	400	5	1	<1	0.028	<0.01	0.15		<0.01	<0.02	<0.01		<0.2			<10	<0.18
8/4/83	7.3	290	8	3	220	5	0.27	2	0.07	<0.01	0.06		<0.02	<0.04	<0.01		<0.005				
10/30/85	7.6	373	9	<1	5200	<1	0.34	<1	0.01	<0.01	0.15		<0.02	<0.02	0.12		<0.005				
9/4/87	7.9	390	15		130	4.9	0.52	2	<0.01	<0.01	0.064		<0.01	<0.03	<0.01	<0.03	<0.02			4.8	<1.6
12/14/88		410	<1	<1		2.1	0.33	<1	0.23	<0.05	0.16	<0.01	0.01	<0.03			<0.05				
11/30/89		360	<1	<1	2600	53	2.2	2	<0.01	<0.01	0.02	<0.01	<0.01	<0.03			<0.02	<0.01	<1.0	<1.0	<1.0
6/20/91	7.8	385	12	2	370	7	<1	<1	0.13	<0.01	<0.01	<0.01	<0.01	<0.03			<0.02	<0.01	<1.0	<1.0	<1.0
12/3/92	7.17	275	3	2	480	3.8	<1	<1	0.17	<0.01	0.016	<0.01	<0.01	<0.03			<0.02	<0.01	<1.0	<1.0	<1.0
Average	**7.4**	**332.0**	**13**	**2.100**	**1180**	**11.70**	**0.720**	**1.300**	**0.125**	**0.015**	**0.090**	**0.010**	**0.012**	**0.026**	**0.032**	**0.030**	**0.052**	**0.016**	**1.0**	**3.6**	**1.0**
Std. Dev.	**0.4**	**80.0**	**16**	**1.510**	**1637**	**15.80**	**0.620**	**0.490**	**0.127**	**0.013**	**0.070**	**0.000**	**0.004**	**0.010**	**0.049**	**0**	**0.057**	**0.008**	**0.0**	**4.0**	**0.5**

TABLE 1
Summary of Historic Stream Sampling Analytical Results
Ravenna Army Ammunition Plant
Ravenna, Ohio

Sample Location/Date of Sampling	pH (standard units)	Specific Conductivity (uhmos/cm)	Total Suspended Solids (mg/l)	Biochemical Oxygen Demand (mg/l)	Fecal Colliform (colonies/100 ml)	Total Organic Carbon (mg/l)	Total Kjeldahl Nitrogen (mg/l)	Oil & Grease (mg/l)	Nitrate (mg/l)	Nitrite (mg/l)	Total Phosphorous (mg/l)	Cadmium (mg/l)	Copper (mg/l)	Total Chromium (mg/l)	Hexavalent Chromium (mg/l)	Trivalent Chromium (mg/l)	Lead (mg/l)	Zinc (mg/l)	DNT (ug/l)	RDX (ug/l)	TNT (ug/l)
SC-1 Influent																					
6/12/80	7.1	340	7	2	620	19	1.1	1	0.19	0.017	0.16										
9/4/80	7.4	320	7	2	1200	8	<0.01	<1	0.024	<0.01	<0.03		0.012	<0.005	<0.01		<0.039				
12/4/80	7	7400	7	<1	620			<1	0.024	<0.01	<0.03		0.012	<0.005	<0.01		<0.039				
3/31/81	7	175	1	<1	4			1													
10/30/81	7.9	260	10	1	210	3	0.72	<1	0.097	0.097	<0.01		<0.01	<0.02	<0.01		<0.2	<0.01		<10	<0.18
8/4/83	7.5	290	7	2	590	5	0.12	<1	0.01	0.01	0.02		<0.02	<0.04	<0.01		<0.05	<0.02			
10/30/85	8	370	3	<1	8000	<1	0.3	1			0.08		<0.02	<0.02	0.11		<0.05	<0.02			
9/4/87	7.9	470	9		160	5.9	0.6	9	<0.01	<0.01	0.044		<0.01	<0.03	<0.01	<0.03	<0.02	<0.01		5.4	
12/14/88		21000	2	<1		1.6	0.33	1.1	0.07	0.07	1.46	<1	<0.01	<0.03			<0.05	<0.02		<1.6	
11/30/89		300	<1	<1	900	19	1.7	2	<0.01	<0.01	0.01	<0.01	<0.01	<0.03			<0.02	<0.01	<1.0	<1.0	<1.0
6/20/91	7.9	369	7	10	3800	7	<1	<1	0.25	0.25	<0.01	<0.01	<0.01	<0.03			<0.02	<0.01	<1.0	<1.0	<1.0
12/3/92	7.25	264	1	1	60	2.7	<1	<1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.03			<0.02	<0.01	<1.0	<1.0	<1.0
Average	**7.5**	**2630**	**5.2**	**1.3**	**1469**	**7.2**	**0.7**	**1.8**	**0.075**	**0.031**	**0.180**	**0.260**	**0.012**	**0.026**	**0.030**	**0.030**	**0.052**	**0.014**	**1.0**	**3.7**	**1.0**
Std. Dev.	**0.4**	**6134**	**3.3**	**0.47**	**2411**	**6.6**	**0.5**	**2.3**	**0.089**	**0.043**	**0.450**	**0.500**	**0.004**	**0.010**	**0.045**	**0.000**	**0.057**	**0.005**	**0.0**	**4.0**	**0.5**
SC-2 Effluent																					
6/12/80	7.6	330	11	2	310	4	0.12	<1	0.062	<0.01	0.075										
9/4/80	7.5	420	4	<1	1200	22	0.15	<1	0.029	<0.01	0.041		0.025	<0.005	<0.01		<0.05	0.051			
12/4/80	6.8	370	4	<1	520			<1													
3/31/81	7	190	6	<1	<1.2			1													
10/30/81	7.9	320	3	1	160	3	0.62	<1	<0.01	<0.01	<0.01		<0.02	<0.02	<0.01		<0.02	<0.01		<10	
8/4/83	7.6	360	4	4	400	2	0.093	2	0.11	<0.01	0.07		<0.02	<0.04	<0.01		<0.05	<0.02		<0.18	
10/30/85	7.8	450	4	<1	1500	<1	0.14	<1	0.21	<0.01	0.22		<0.02	0.02	0.07		<0.05	0.23			
9/4/87	8	460	8		78	4.3	0.52	1	<0.01	0.015	0.054		<0.01	<0.03	<0.01	<0.03	<0.02	<0.01		18	
12/14/88		25000	<1	<1		1.6	0.21	<1	0.07	<0.05	0.44	<0.01	<0.01	<0.03			<0.05	<0.02		<1.6	
11/30/89		330	<1	<1	1600	18	1.6	2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.03			<0.02	<0.01	<1.0	<1.0	<1.0
6/20/91	8.1	482	4	2	305	2	<1	<1	0.17	0.02	<0.01	<0.01	<0.01	0.035			<0.02	<0.01	<1.0	<1.0	<1.0
12/3/92	7.21	310	1	1	88	2.1	<1	<1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.03			<0.02	<0.01	<1.0	<1.0	<1.0
Average	**7.60**	**2419**	**4.3**	**1.5**	**560**	**6.0**	**0.550**	**1.2**	**0.069**	**0.016**	**0.090**	**0.010**	**0.014**	**0.027**	**0.022**	**0.027**	**0.033**	**0.041**	**1.0**	**6.2**	**1.0**
Std. Dev.	**0.43**	**7112**	**3.0**	**0.9**	**588**	**7.5**	**0.510**	**0.4**	**0.073**	**0.013**	**0.140**	**0.000**	**0.006**	**0.010**	**0.027**	**0.000**	**0.016**	**0.072**	**0.0**	**7.7**	**0.5**

TABLE 1

Summary of Historic Stream Sampling Analytical Results

Ravenna Army Ammunition Plant

Ravenna, Ohio

Sample Location/Date of Sampling	pH (standard units)	Specific Conductivity (uhmos/cm)	Total Suspended Solids (mg/l)	Biochemical Oxygen Demand (mg/l)	Fecal Colliform (colonies/100 ml)	Total Organic Carbon (mg/l)	Total Kjeldahl Nitrogen (mg/l)	Oil & Grease (mg/l)	Nitrate (mg/l)	Nitrite (mg/l)	Total Phosphorous (mg/l)	Cadmium (mg/l)	Copper (mg/l)	Total Chromium (mg/l)	Hexavalent Chromium (mg/l)	Trivalent Chromium (mg/l)	Lead (mg/l)	Zinc (mg/l)	DNT (ug/l)	RDX (ug/l)	TNT (ug/l)
PF-8 Effluent																					
6/12/80	7.5	370	10	5	260	23	0.73	<1	0.18	<0.01	0.19										
9/4/80	7.4	420	4	1	2700	25	<0.01	<1	0.12	0.012	0.069		0.006	<0.005	<0.01		<0.039	0.034			
12/4/80	6.8	360	14	<1	>4000			3													
3/31/81	7	225	4	5	15			1													
10/30/81																					
8/4/83	7	140	13	2	120	9	0.95	3	0.1	<0.01	0.04		<0.02	<0.04	<0.01		<0.05	<0.02			
10/30/85	8	500	7	3	4200	4	0.46	<	0.03	<0.01	0.35		<0.02	0.03	0.07		<0.05	<0.02			
9/4/87	7.9	430	12		340	606	0.7	1	<0.01	<0.01	0.054		<0.01	<0.03	<0.01	<0.03	<0.02	<0.01		<1.5	<1.6
12/14/88	7.9	22000	15	<1		2.1	0.26	<	0.07	<0.05	0.5	<0.01	<0.01	0.03			<0.05	<0.02			
11/30/89		310	4	<1	1600	18	2.8	1	<0.01	<0.01	0.02	<0.01	<0.01	<0.03			<0.02	0.013	<1.0	<1.0	<1.0
6/20/91	8	626	4	1	2800	2	<1	<1	0.37	<0.01	<0.01	<0.01	<0.01	<0.03			<0.02	<0.01	<1.0	<1.0	<1.0
12/3/92	7.44	330	4	1	224	4.9	<1	0.02	0.15	<0.01	0.02	<0.01	<0.01	<0.03			<0.02	<0.01	<1.0	<1.0	<1.0
Average	**7.5**	**2337**	**8.3**	**2.1**	**1626**	**10.5**	**0.9**	**1.3**	**0.116**	**0.015**	**0.140**	**0.010**	**0.012**	**0.028**	**0.025**	**0.030**	**0.034**	**0.017**	**1.0**	**1.1**	**1.2**
Std. Dev.	**0.45**	**6523**	**4.6**	**1.66**	**1671**	**9.1**	**0.8**	**0.9**	**0.113**	**0.013**	**0.170**	**0.000**	**0.005**	**0.010**	**0.030**	**0.000**	**0.015**	**0.008**	**0.0**	**0.3**	**0.3**
PF-534 Effluent																					
6/12/80	7.3	340	5	2	680	9	0.42	1	0.055	<0.01	0.35										
9/4/80	7.3	400	4	2	1000	6	<0.01	<1	0.04	<0.01	<0.03		0.025	<0.005	<0.01		<0.039	0.035			
12/4/80	6.6	370	16	<1	500			<1													
3/31/81	6.8	130	5	<1	13			1													
10/30/81	7.7	315	2	3	32	6	0.67	<1	0.021	0.019	0.36		<0.01	<0.02	<0.01		<0.2	<0.01		<10	<0.18
8/4/83	7.5	390	7	3	120	4	0.057	2	0.02	<0.01	0.06		<0.02	<0.04	<0.01		<0.05	<0.02			
10/30/85	6.8	430	4	<1	1400	<1	0.14	<1	0.04	<0.01	0.35		<0.02	<0.02	0.11		<0.05	0.02			
9/4/87	7.9	460	8		81	1.8	1.6	4	<0.01	0.012	0.04		<0.01	<0.03	<0.01	<0.03	<0.02	0.099		64	<1.6
12/14/88	7.6	420	2	<1		3	0.34	<1	0.07	<0.05	0.35	<0.01	0.01	<0.03			<0.05	0.02			
11/30/89		520	4	<1	710	15	1.4	2	<0.01	<0.01	0.04	<0.01	<0.01	<0.03			<0.02	<0.01	<1.0	<1.0	<1.0
6/20/91	8	469	5	3	150	3	<1	<1	0.14	<0.01	<0.01	<0.01	<0.01	<0.03			<0.02	<0.01	<1.0	<1.0	<1.0
12/3/92	7.08	285	8	1	71	5.9	<1	<1	0.01	<0.01	0.06	<0.01	<0.01	<0.03			<0.02	<0.01	<1.0	<1.0	<1.0
Average	**7.3**	**377**	**5.8**	**1.7**	**432**	**5.5**	**0.7**	**1.4**	**0.042**	**0.015**	**0.170**	**0.010**	**0.014**	**0.026**	**0.030**	**0.030**	**0.052**	**0.026**	**1.0**	**15.4**	**1.0**
Std. Dev.	**0.47**	**103**	**3.8**	**0.9**	**466**	**4.1**	**0.6**	**0.9**	**0.040**	**0.013**	**0.160**	**0.000**	**0.006**	**0.010**	**0.045**	**0.000**	**0.057**	**0.029**	**0.0**	**27.4**	**0.5**

Notes: The data used in this table collected by RVAAP between 1980 and 1992 and was apparently used in various NPDES submissions

The original laboratory data sheets were not readily available for data validation

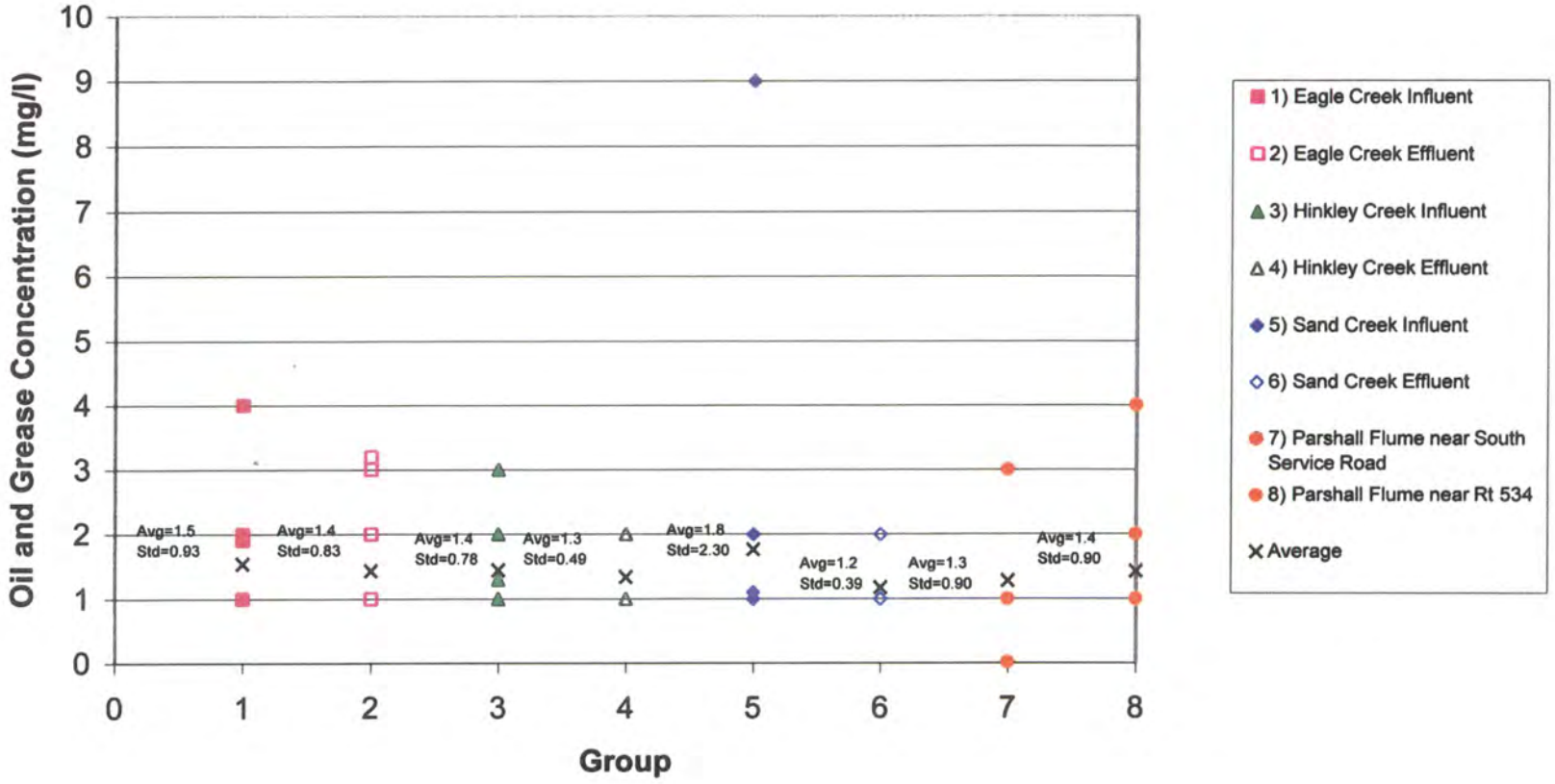
Sampling Locations

EC-1: Eagle Creek Influent
EC-2: Eagle Creek Effluent
SC-1: Sand Creek Influent
SC-2: Sand Creek Effluent
HC-1: Hinkley Crek Influent
HC-2: Hinkley Creek Effluent
PF-8: Parshall Flume No. 8
PF-534: Parshall Flume No. 534

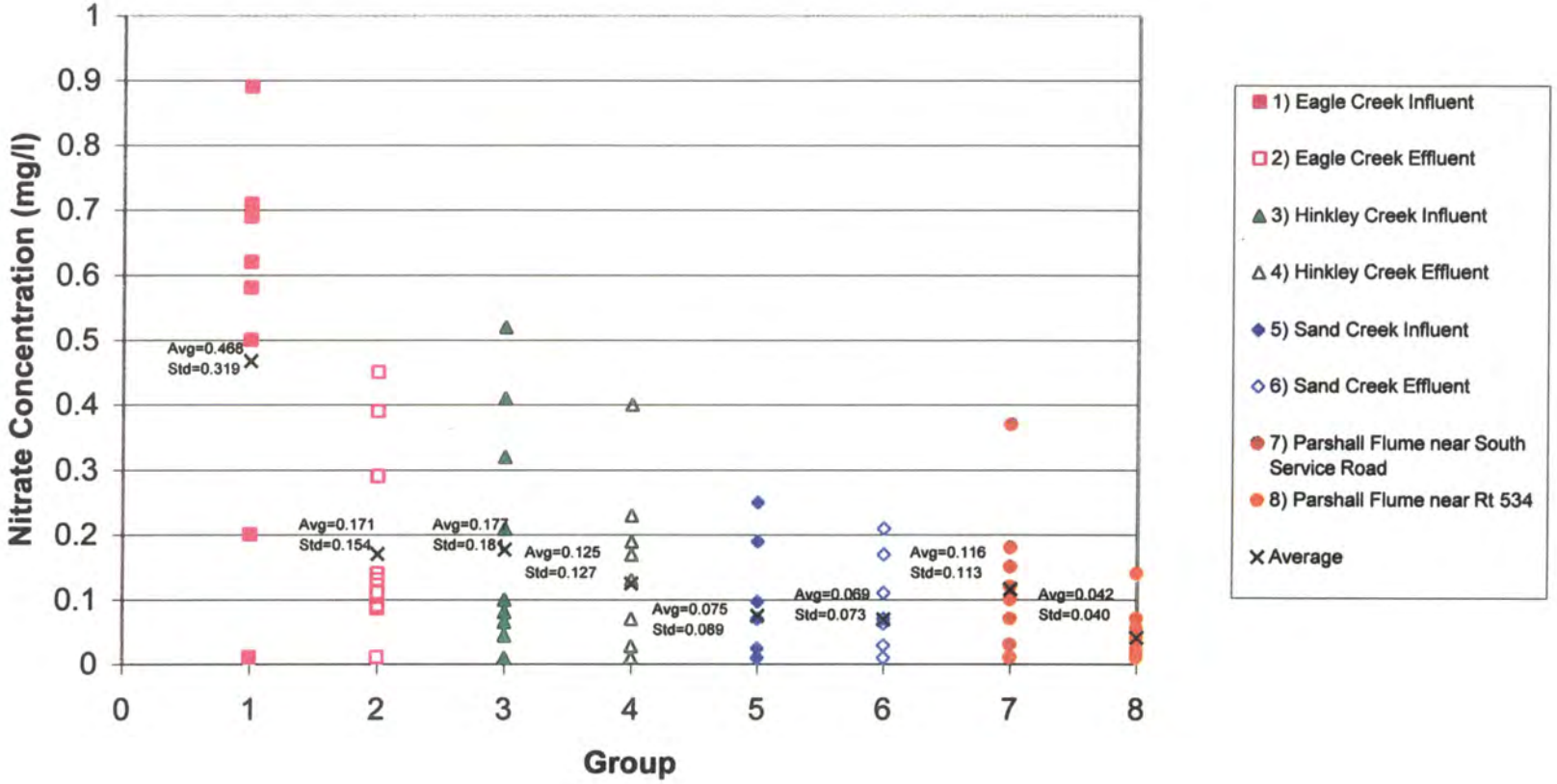
APPENDIX A

Stream Sampling Concentration Plots

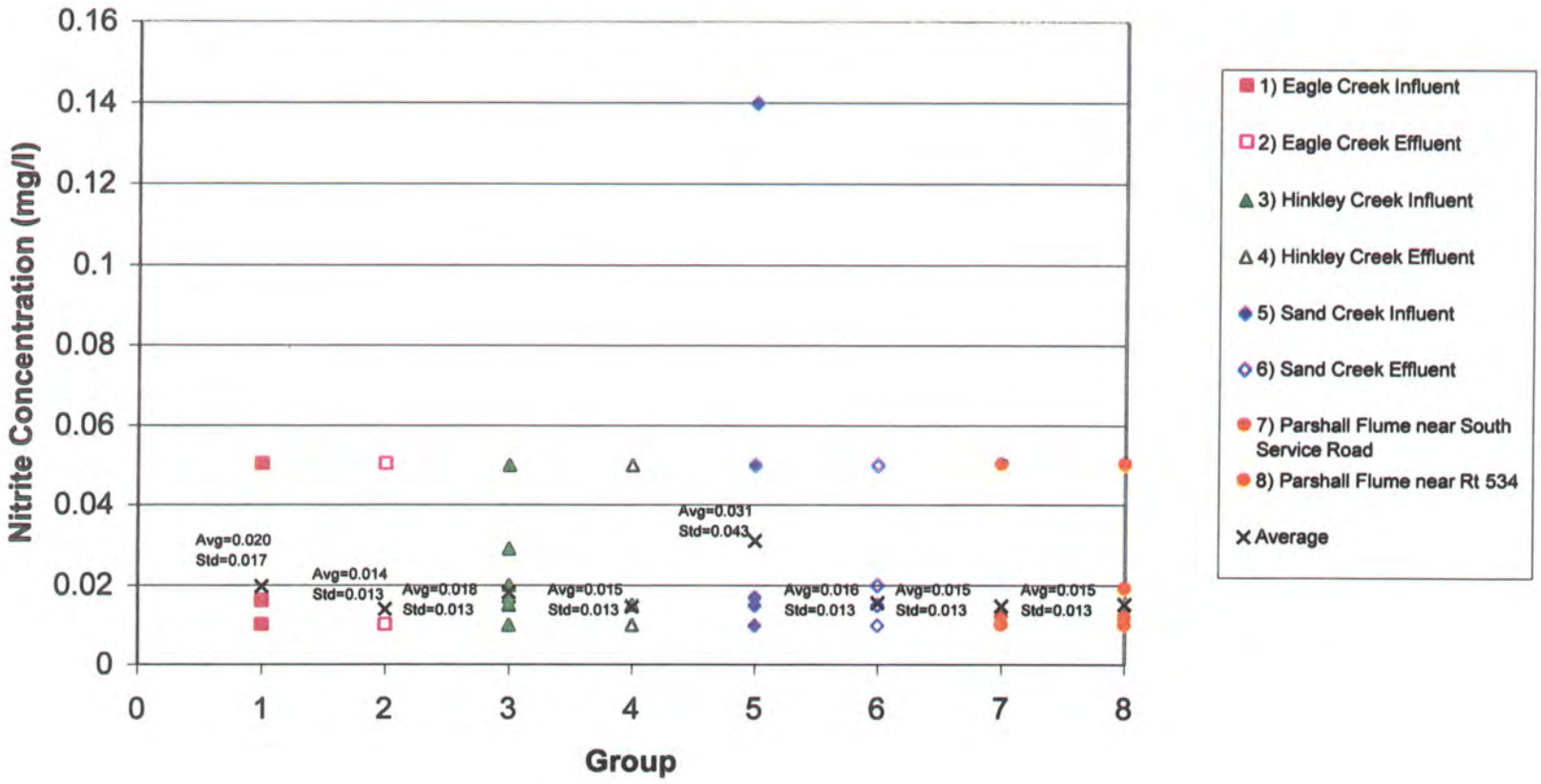
Ravenna Army Ammunition Plant (RVAAP), Ohio
Stream Sampling - Oil and Grease



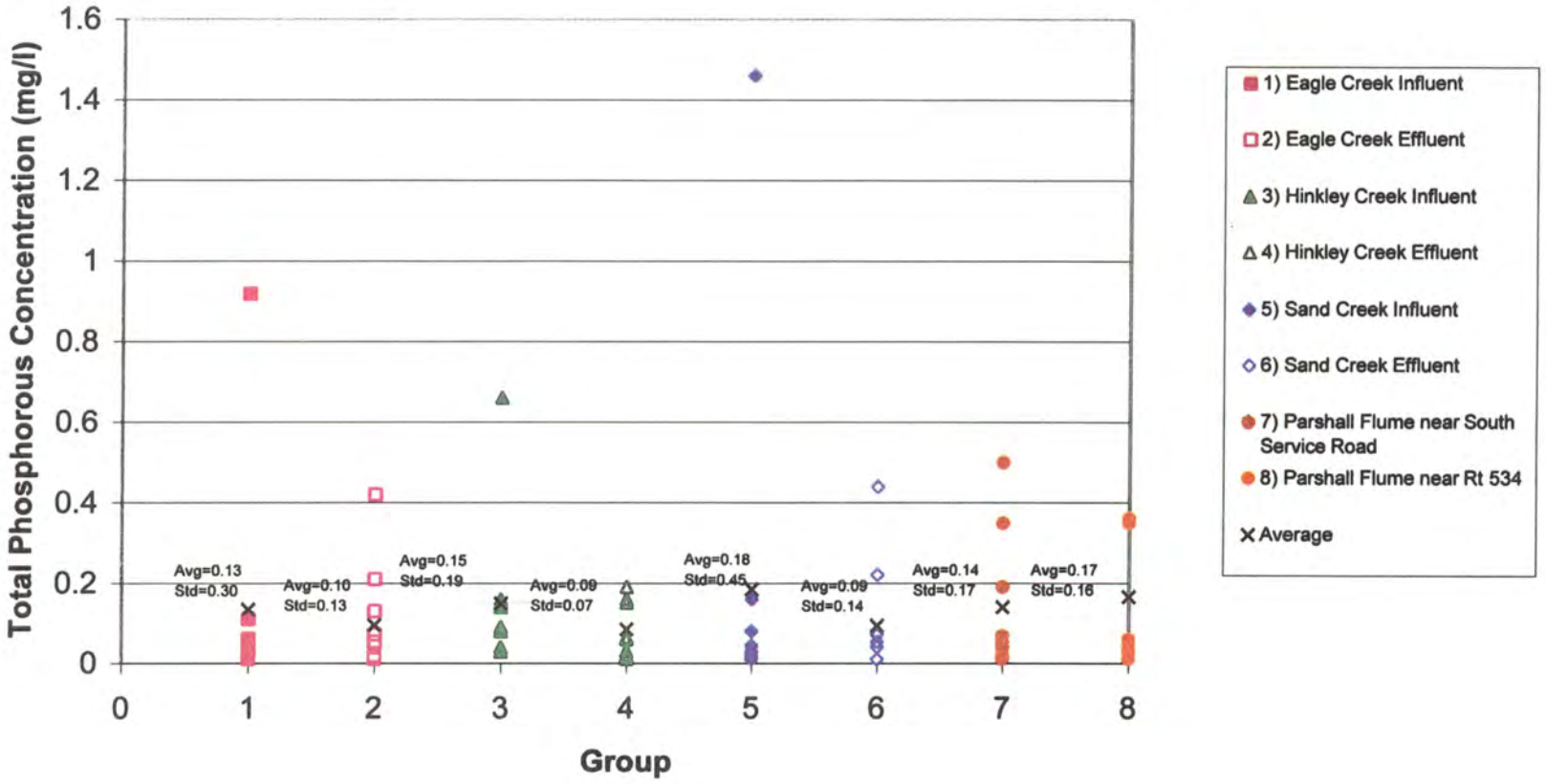
Ravenna Army Ammunition Plant (RVAAP), Ohio
Stream Sampling - Nitrates



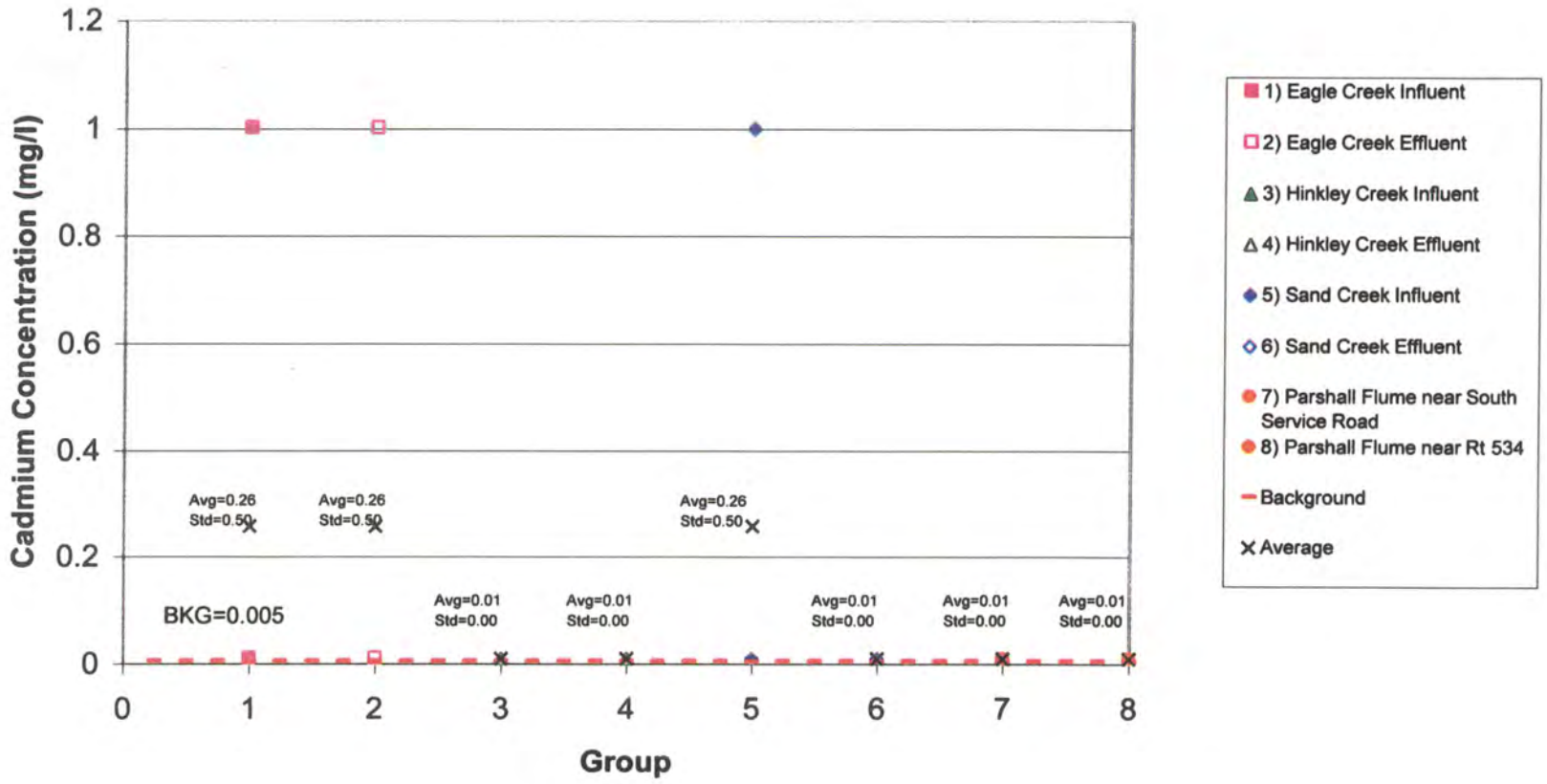
Ravenna Army Ammunition Plant (RVAAP), Ohio
Stream Sampling - Nitrites



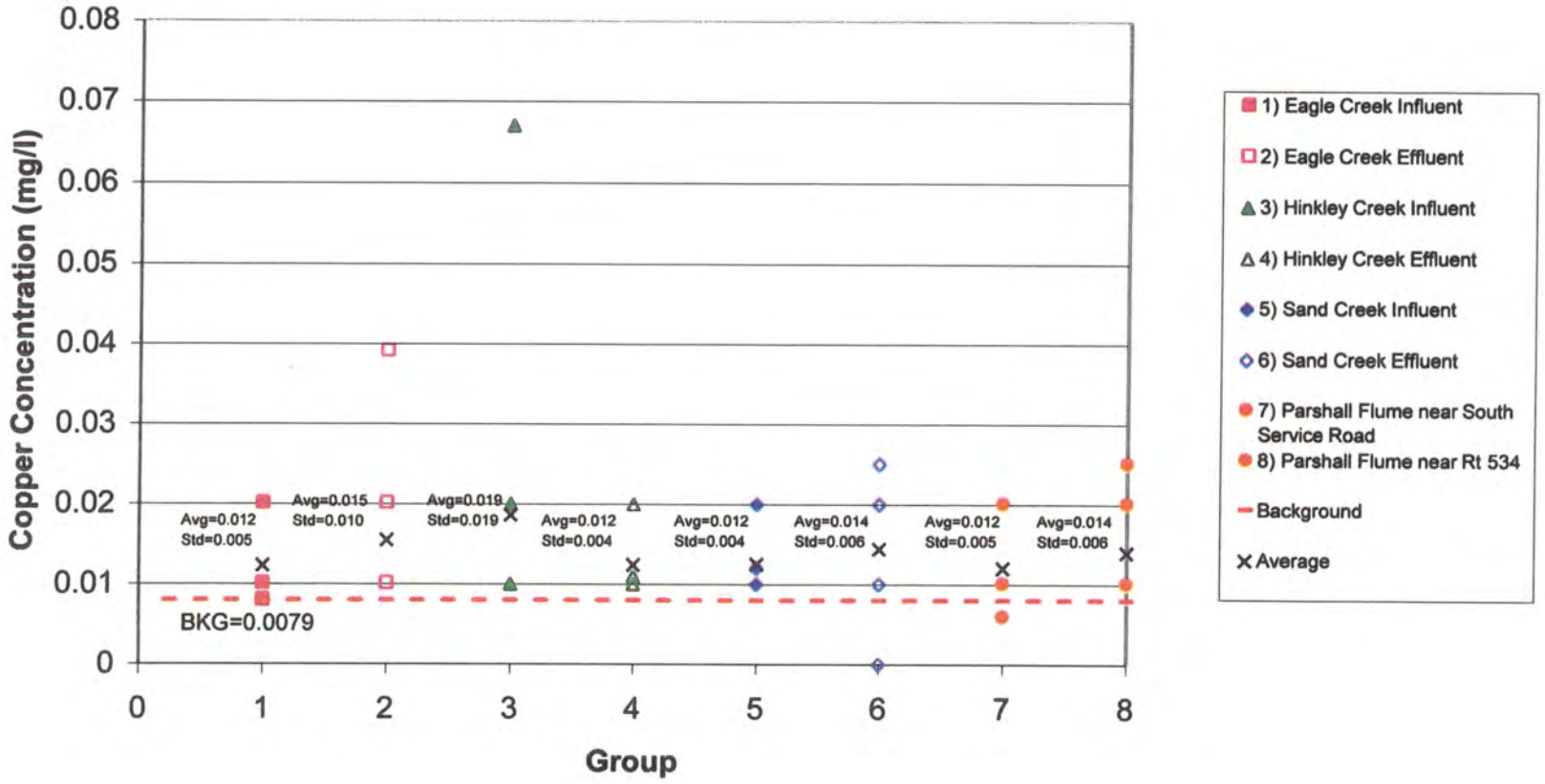
Ravenna Army Ammunition Plant (RVAAP), Ohio
Stream Sampling - Total Phosphorous



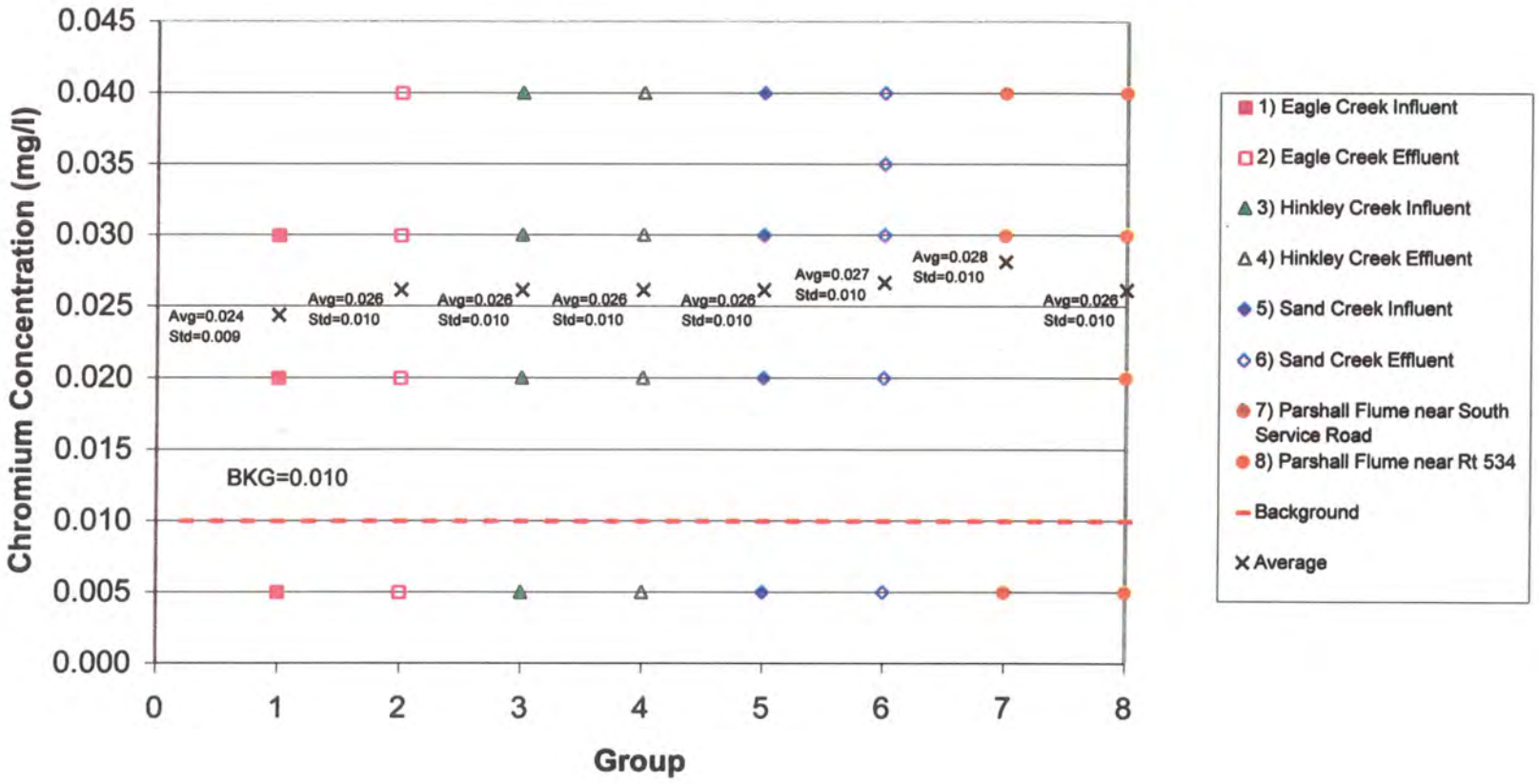
Ravenna Army Ammunition Plant (RVAAP), Ohio
Stream Sampling - Cadmium



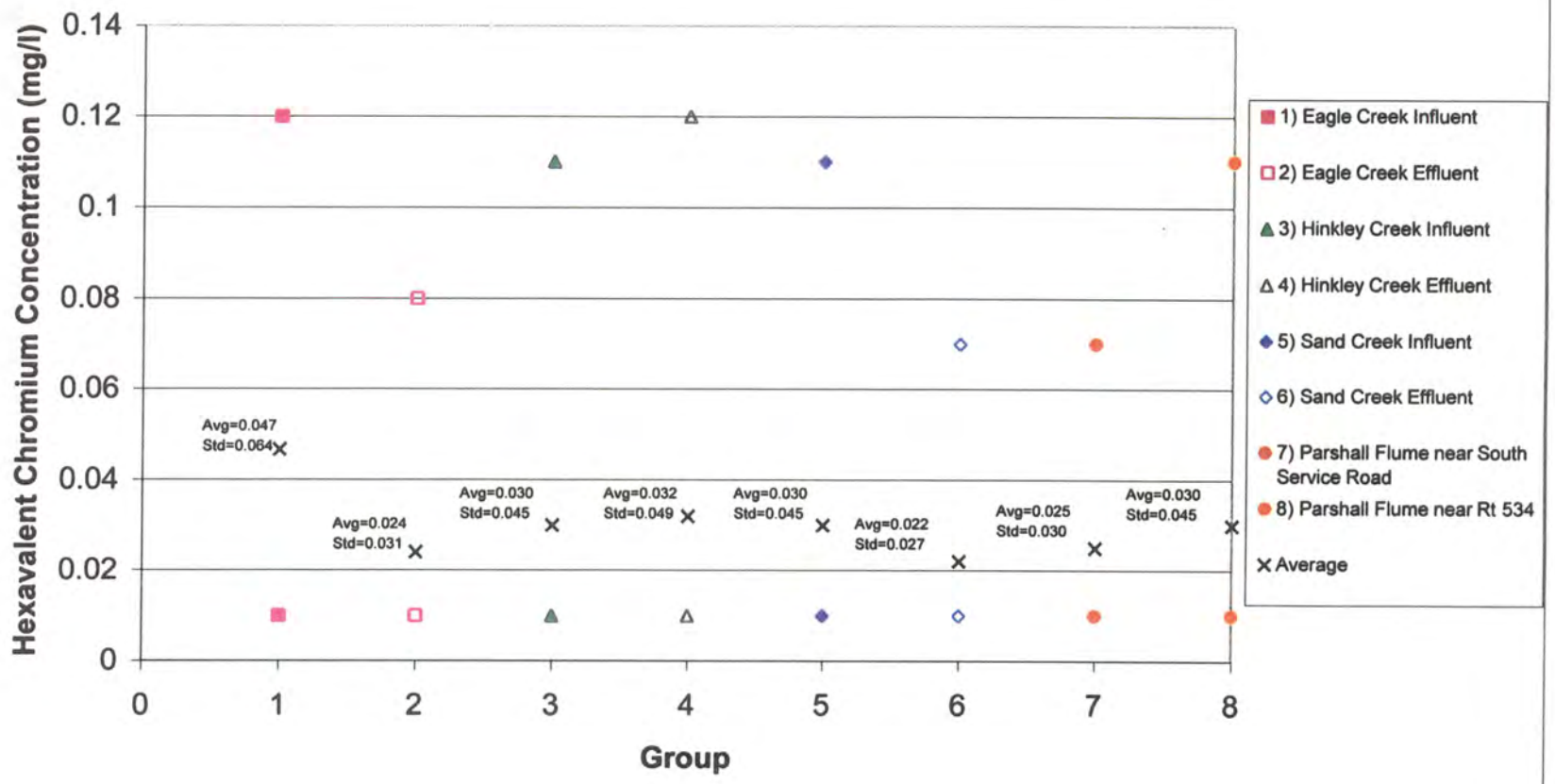
Ravenna Army Ammunition Plant (RVAAP), Ohio
Stream Sampling - Copper



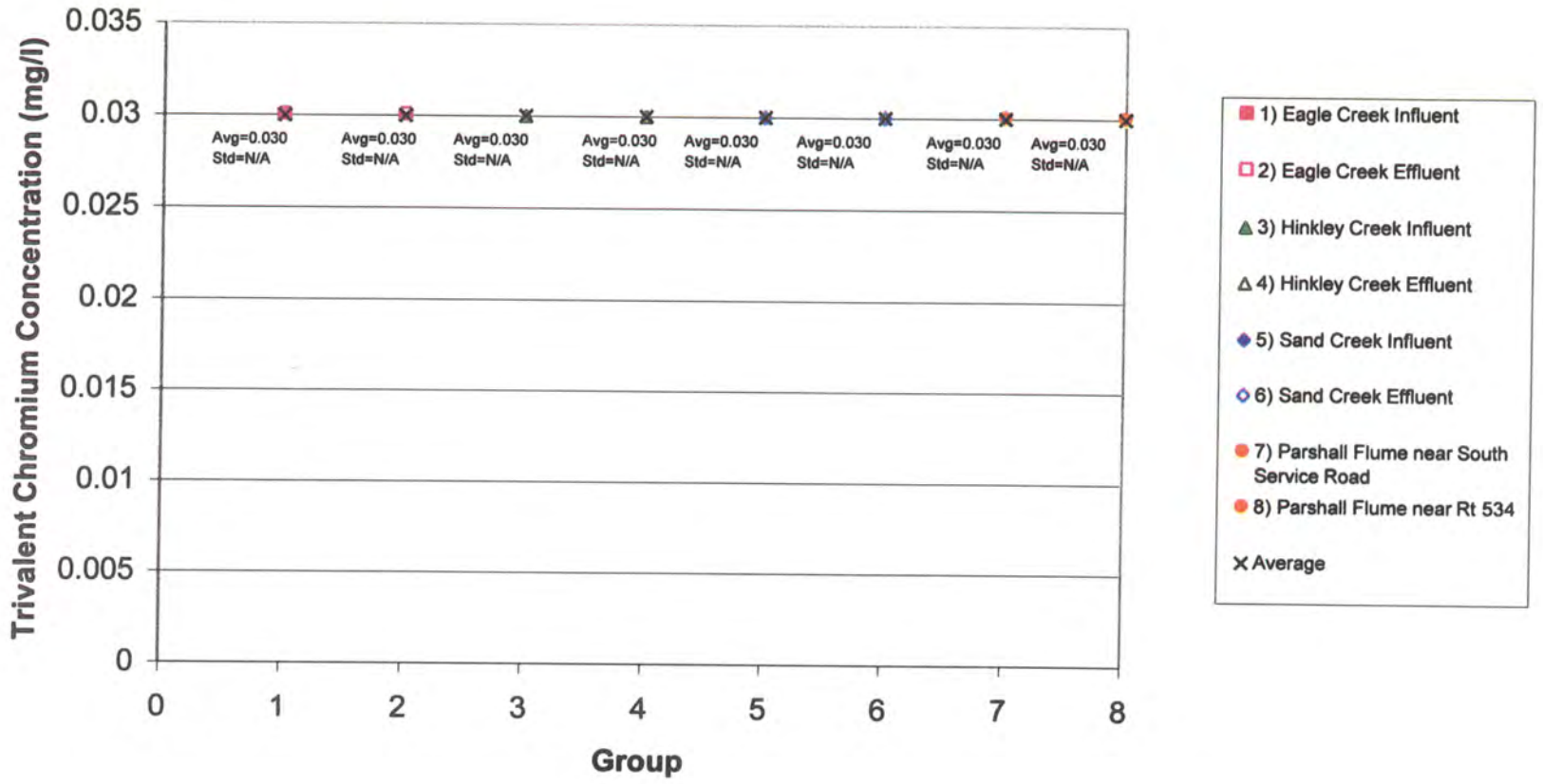
Ravenna Army Ammunition Plant (RVAAP), Ohio
Stream Sampling - Chromium



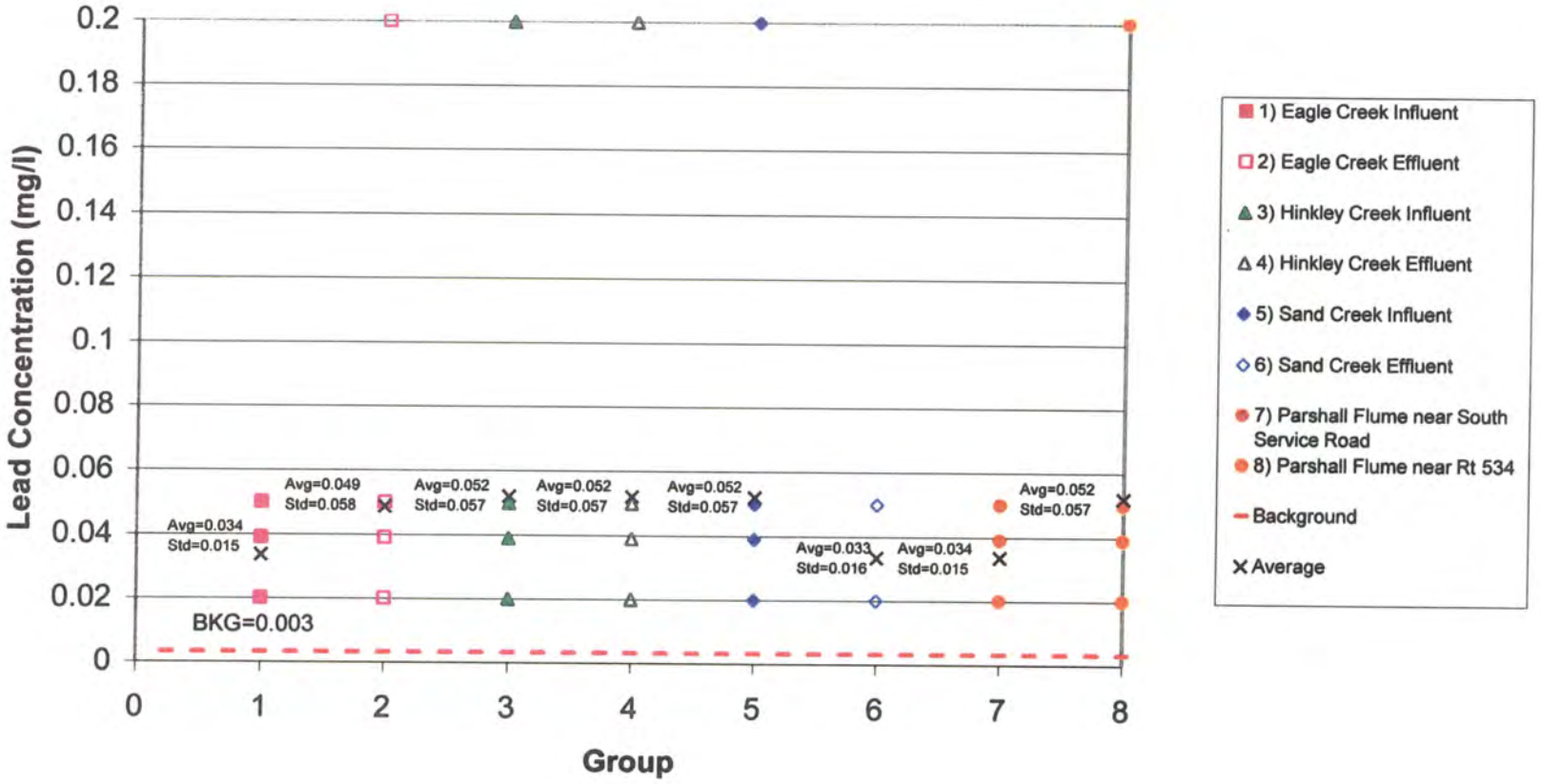
Ravenna Army Ammunition Plant (RVAAP), Ohio
Stream Sampling - Hexavalent Chromium



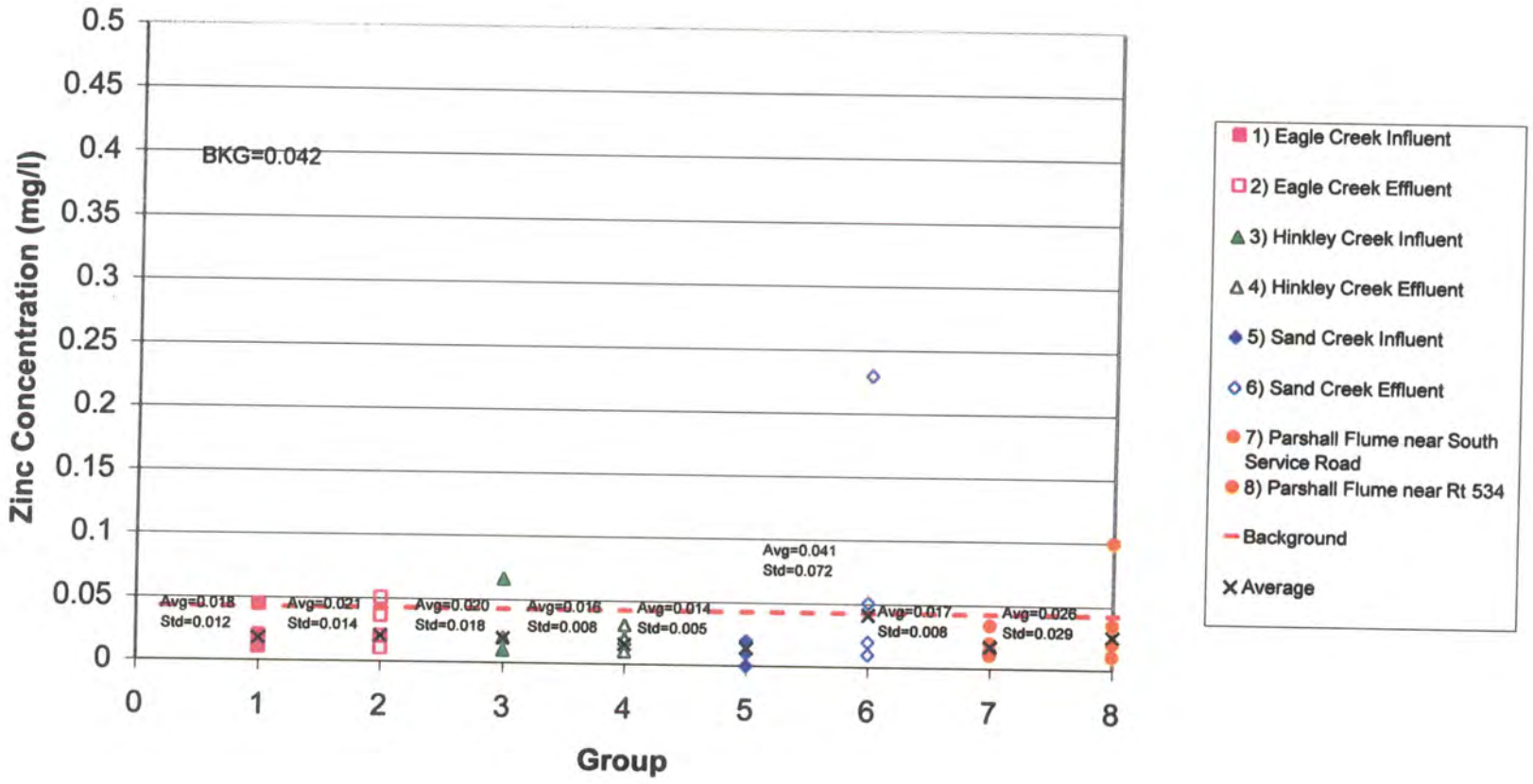
Ravenna Army Ammunition Plant (RVAAP), Ohio
Stream Sampling - Trivalent Chromium



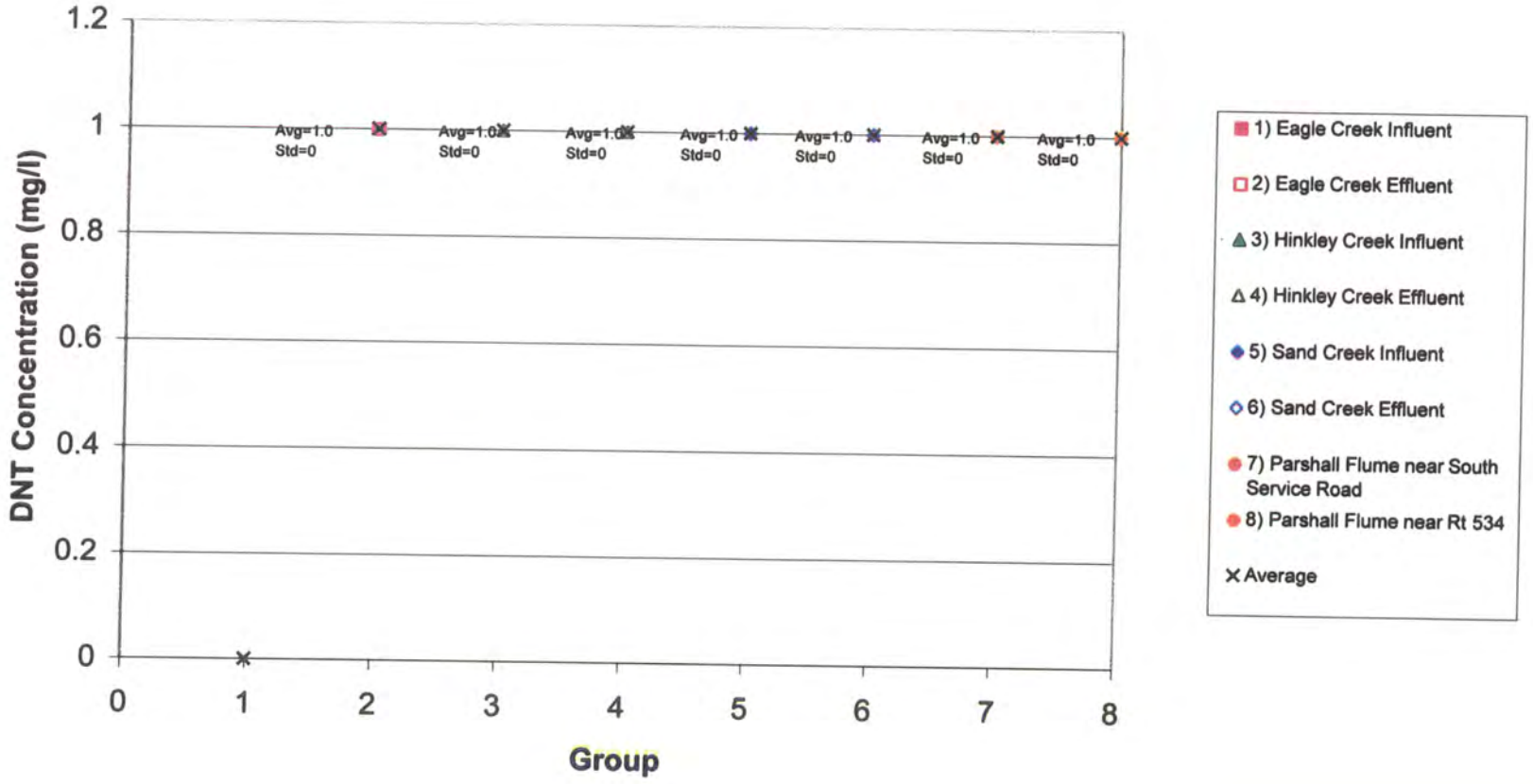
Ravenna Army Ammunition Plant (RVAAP), Ohio
Stream Sampling - Lead



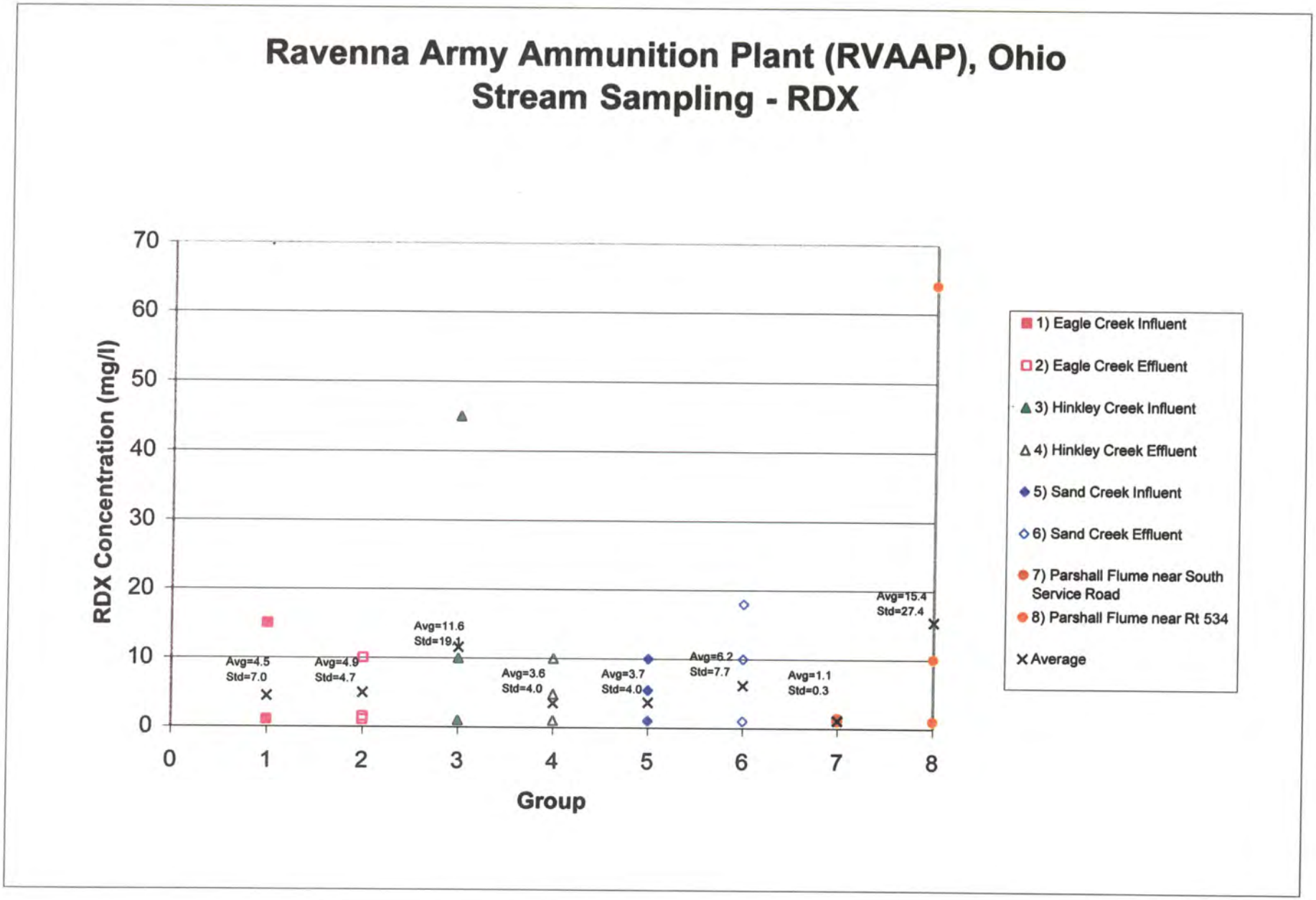
Ravenna Army Ammunition Plant (RVAAP), Ohio
Stream Sampling - Zinc



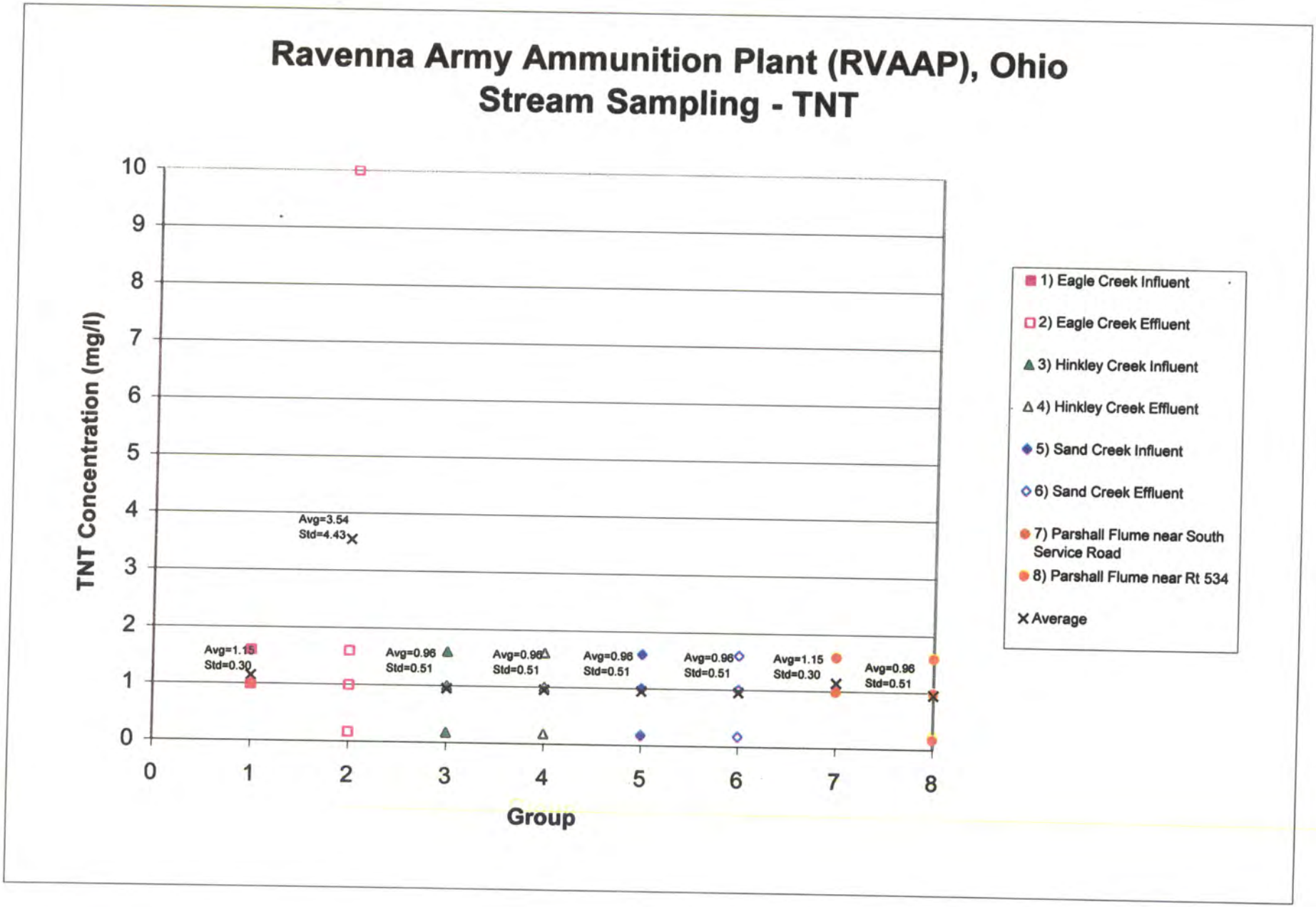
Ravenna Army Ammunition Plant (RVAAP), Ohio
Stream Sampling - DNT



Ravenna Army Ammunition Plant (RVAAP), Ohio
Stream Sampling - RDX



Ravenna Army Ammunition Plant (RVAAP), Ohio
Stream Sampling - TNT



APPENDIX B-3

SELECTED PORTIONS FROM
PREVIOUS ENVIRONMENTAL INVESTIGATIONS
at
ERIE BURNING GROUNDS
DEMOLITON AREA #1
NACA TEST AREA

WATER QUALITY SURVEILLANCE PROGRAM RESULTS (1980 - 1992)

Re: Water Quality Surveillance Program

PARAMETER	SAMPLE STATION								
	EC-1	EC-2	SC-1	SC-2	HC-1	HC-2	PF #8	PF #6	PF #5
pH	Q	Q	Q	Q	Q	Q	Q	Q	Q
Temperature	Q	Q	Q	Q	Q	Q	Q	Q	Q
Specific Conductance	Q	Q	Q	Q	Q	Q	Q	Q	Q
Total Suspended Solids	Q	Q	Q	Q	Q	Q	Q	Q	Q
Biochemical Oxygen Demand -5 day	Q	Q	Q	Q	Q	Q	Q	Q	Q
Total Organic Carbon	S	S	S	S	S	S	S	S	S
Total Kjehldal Nitrogen	S	S	S	S	S	S	S	S	S
Nitrate	S	S	S	S	S	S	S	S	S
Nitrite	S	S	S	S	S	S	S	S	S
Phosphorous	S	S	S	S	S	S	S	S	S
Oil & Grease	Q	Q	Q	Q	Q	Q	Q	Q	Q
Dissolved Oxygen	Q	Q	Q	Q	Q	Q	Q	Q	Q
TNT		A		A		A	A	A	A
RDX		A		A		A	A	A	A
Copper	A	A	A	A	A	A	A	A	A
Chromium, Total (Hex & Tri)	A	A	A	A	A	A	A	A	A
Zinc	A	A	A	A	A	A	A	A	A
Lead	A	A	A	A	A	A	A	A	A
Fecal Coliform	Q	Q	Q	Q	Q	Q	Q	Q	Q

Q = Quarterly - 4/times a year (March, June, September & December)
S = Semi-Annually - 2 times a year (June (June & September
A = Annual - Once a year (September).

NOTE: (1) All samples will be taken as a grab sample unless otherwise notified at a future date.
(2) The Wastewater Treatment Plant Operator will be responsible for obtaining the Grab Samples.

RAVENNA ARMY AMMUNITION PLANT

WATER QUALITY SURVEILLANCE PROGRAM

March 12, 1980

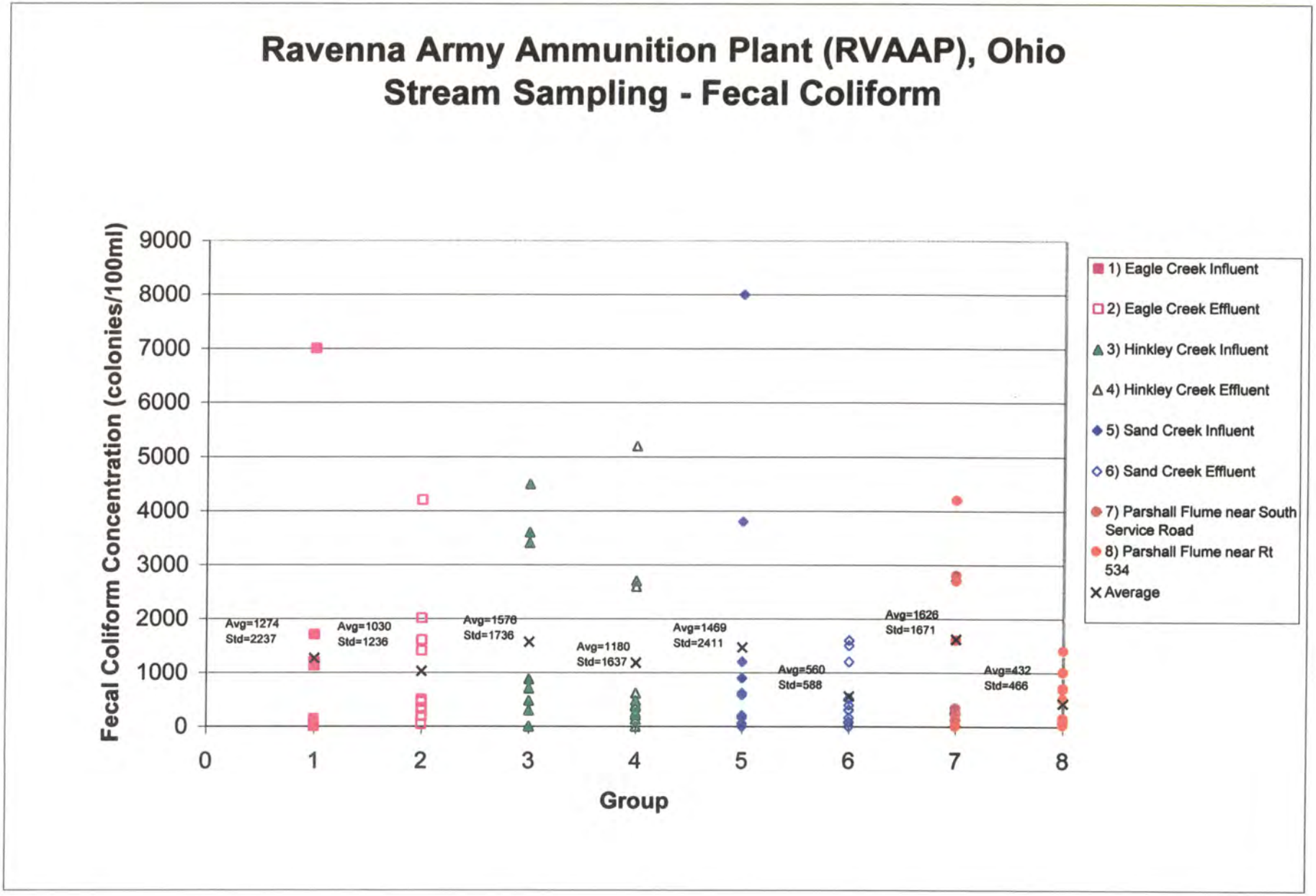
Ravenna Arsenal, Inc.

SAMPLING STATIONS

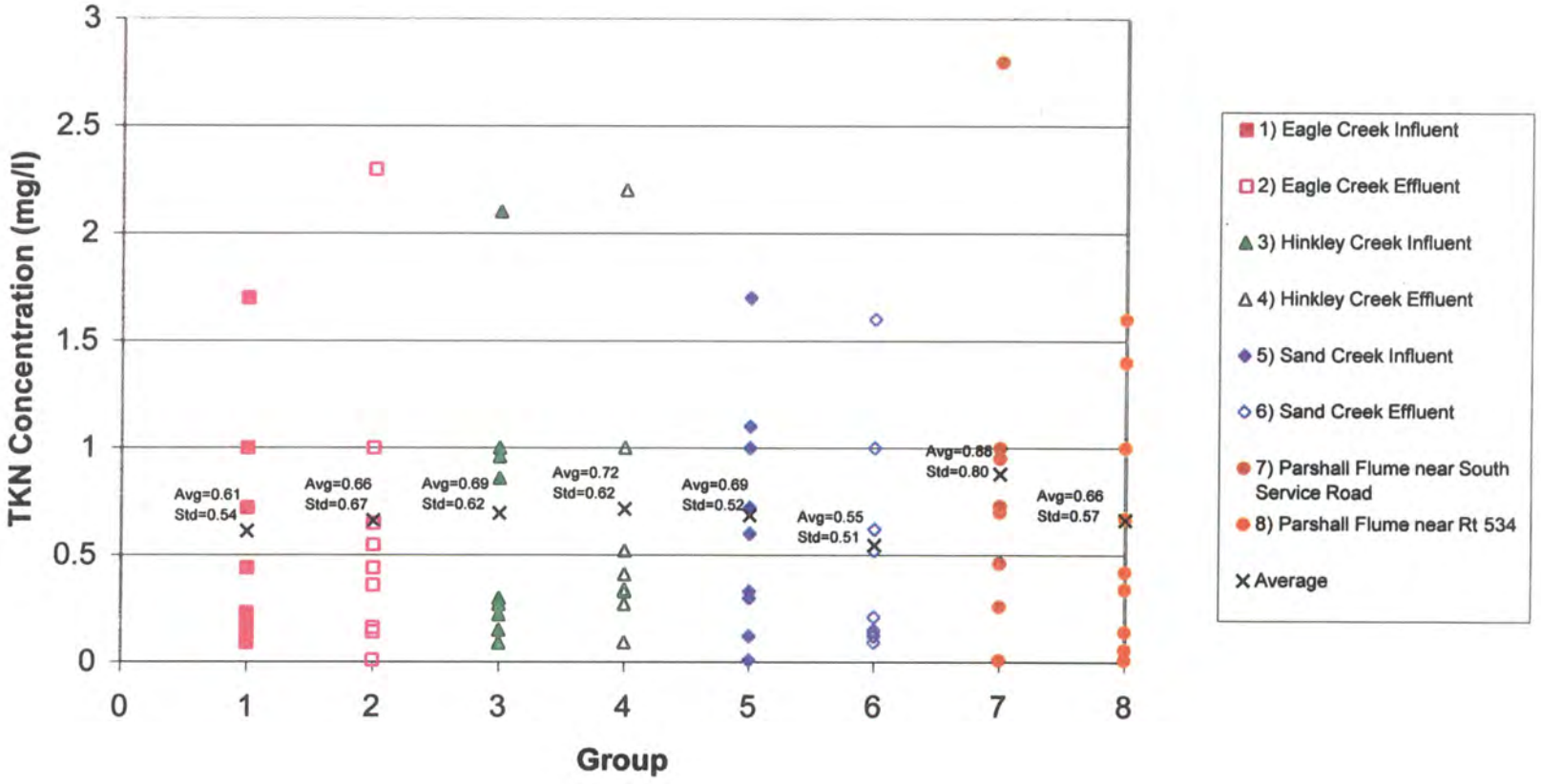
A.	EAGLE CREEK	Influent	(North of Area #1 & Block E)
	" "	Effluent	(North of Area #3)
B.	SAND CREEK	Influent	(1/2 Mi. West of Slagle Rd.)
	" "	Effluent	(Smalley Road Bridge)
C.	HINCKLEY CREEK	Influent	(500 Ft. West of Post #32 - Rte. 80)
	" "	Effluent	(East of Post #24 - Charleston Perimeter Rd.)
D.	PARSHALL FLUME (Area #8)	Effluent	(Between Wayland-Wilcox and Parris Windham Rds on South Perimeter Fence Line Rd.)
E.	PARSHALL FLUME (Area #6)	Effluent	(South of Kelly's Pond and East of Post #20 on South Perimeter Fence Line Rd.)
F.	PARSHALL FLUME	Effluent	(Rte. #534)

Nomenclature:		Sampling Station:
EC-1	Influent	Eagle Creek
EC-2	Effluent	Eagle Creek
SC-1	Influent	Sand Creek
SC-2	Effluent	Sand Creek
HC-1	Influent	Hinckley Creek
HC-2	Effluent	Hinckley Creek
PF #8	Effluent	Parshall Flume - Area #8
PF #6	Effluent	Parshall Flume - Area #6
PF #534	Effluent	Parshall Flume - Rte. #534.

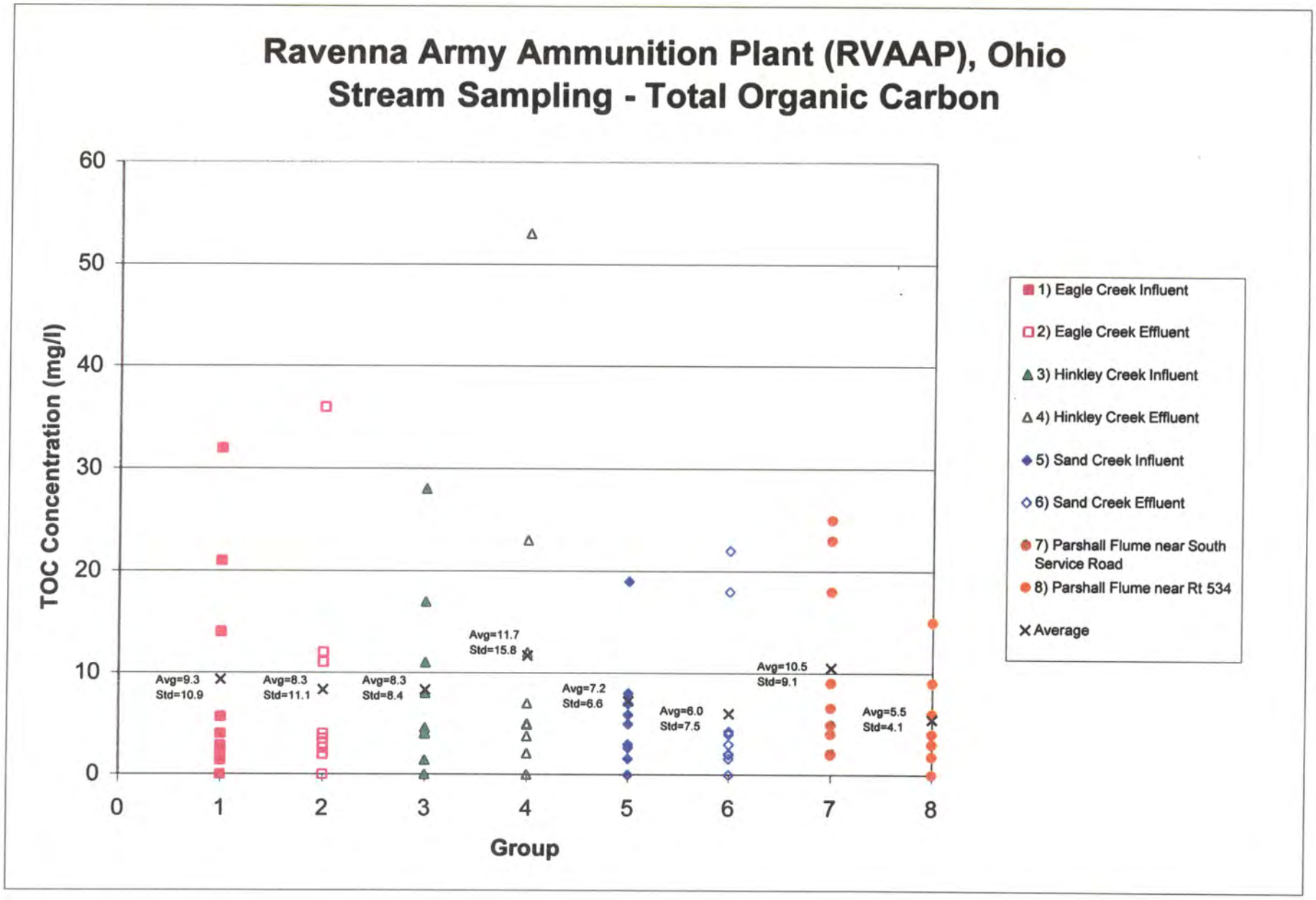
Ravenna Army Ammunition Plant (RVAAP), Ohio
Stream Sampling - Fecal Coliform



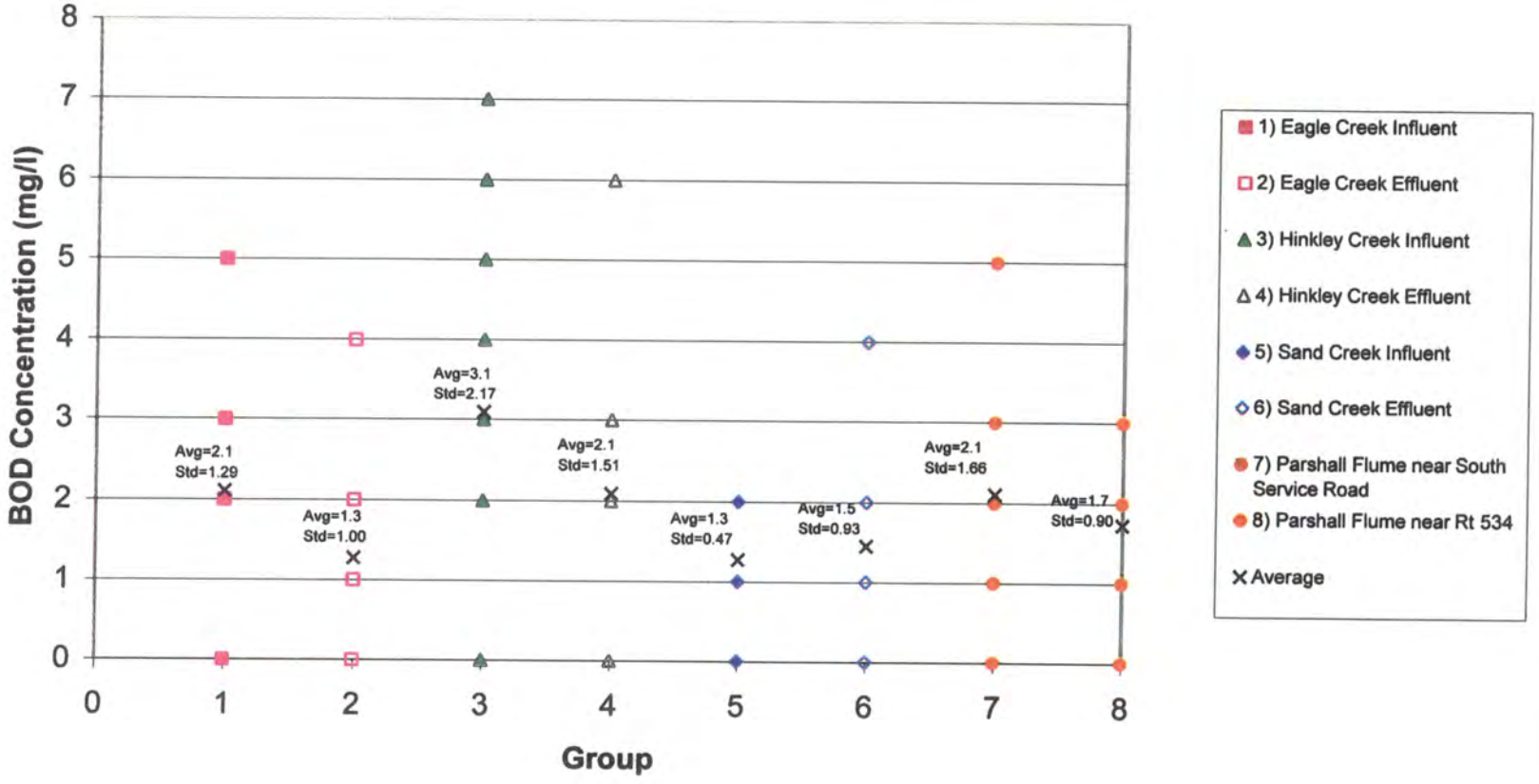
Ravenna Army Ammunition Plant (RVAAP), Ohio
Stream Sampling - Total Kjeldahl Nitrogen



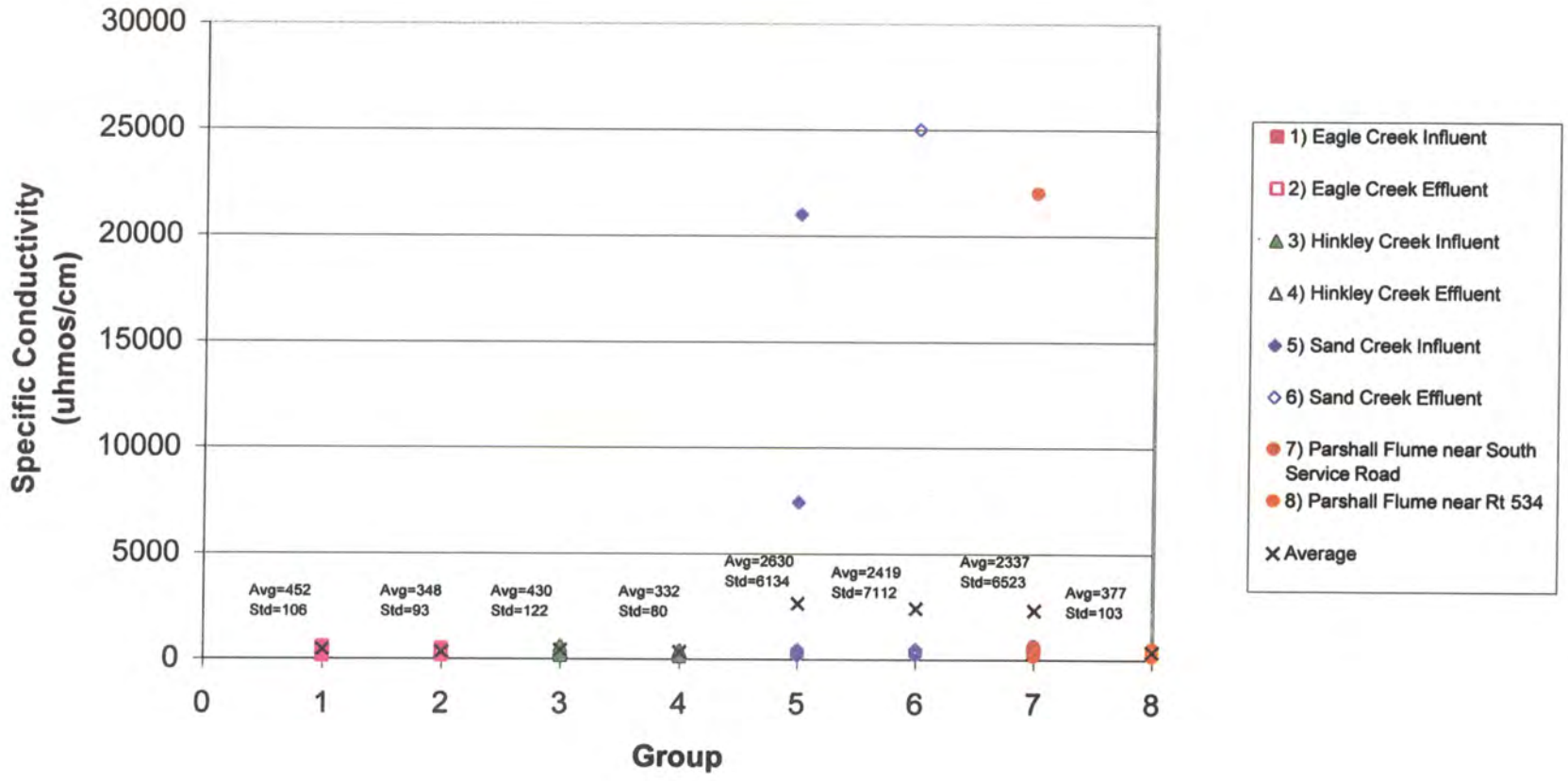
Ravenna Army Ammunition Plant (RVAAP), Ohio
Stream Sampling - Total Organic Carbon



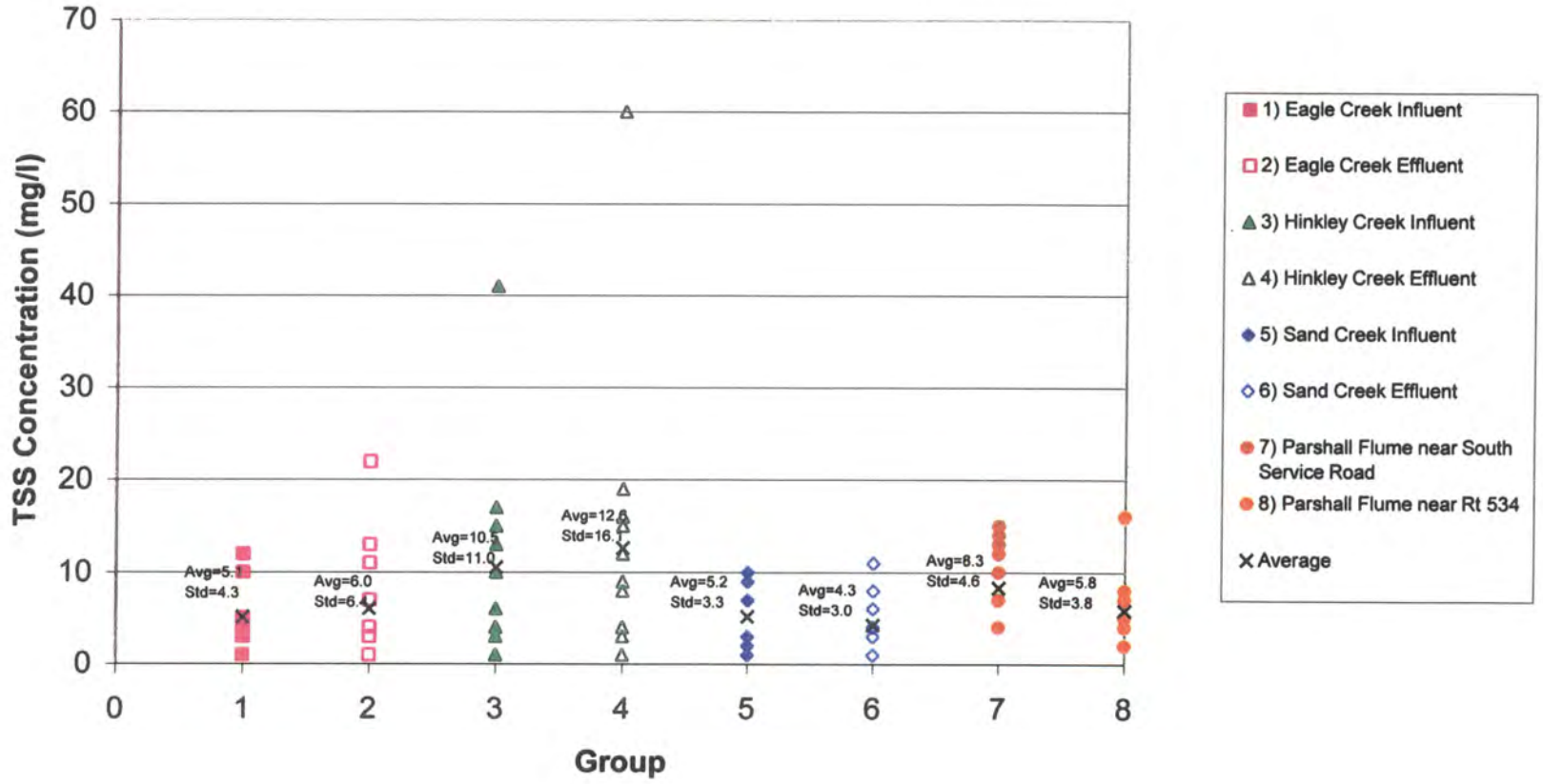
Ravenna Army Ammunition Plant (RVAAP), Ohio
Stream Sampling - Biochemical Oxygen Demand

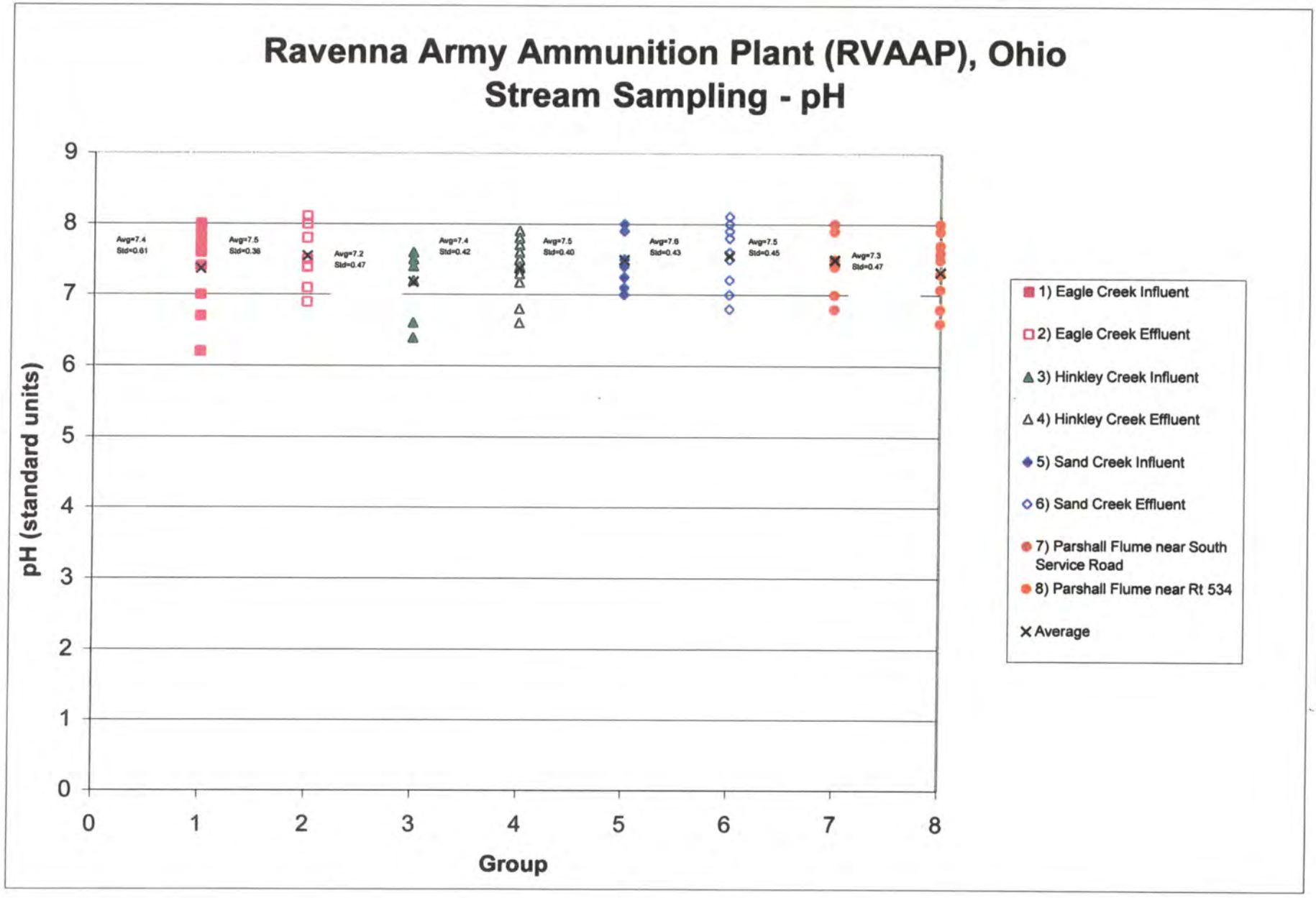


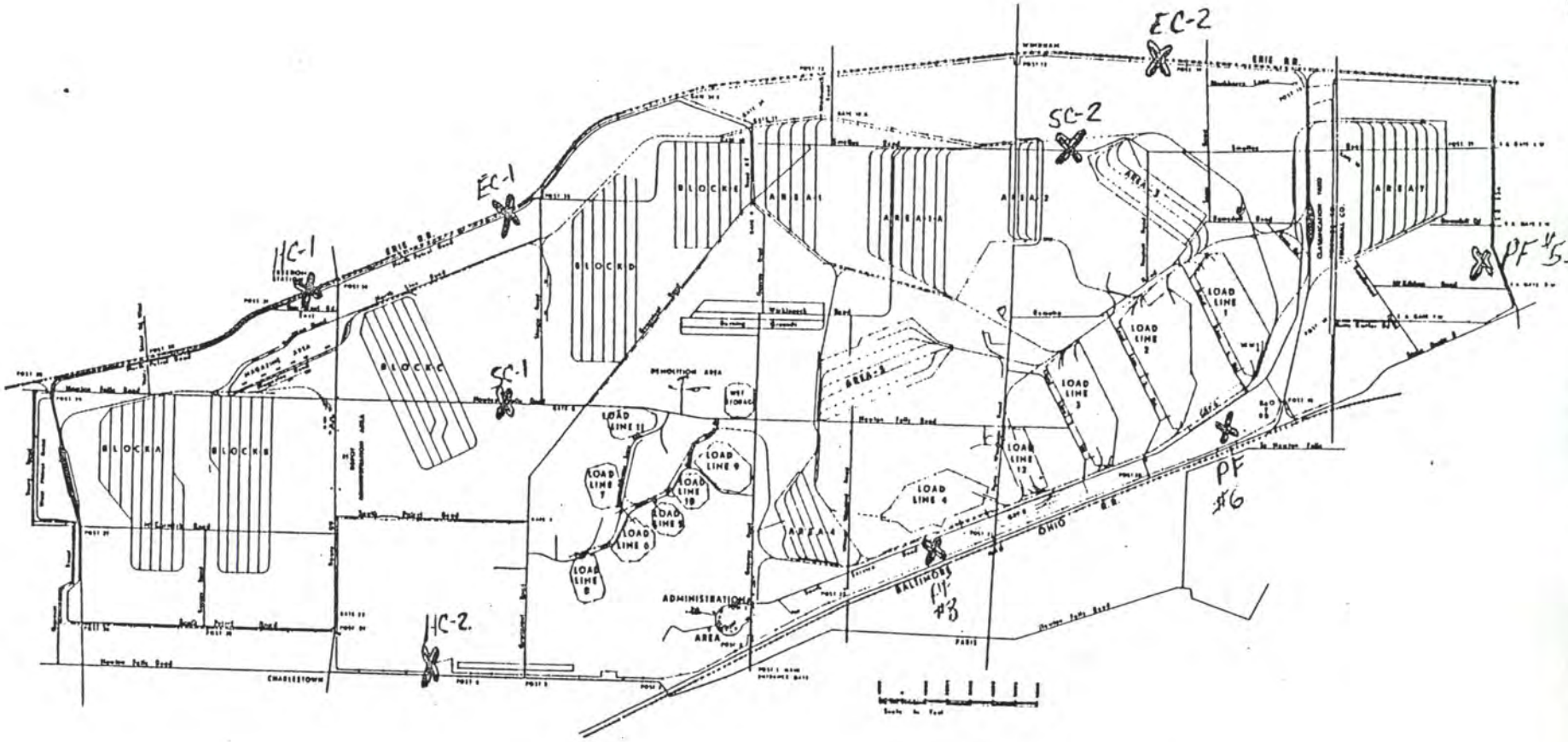
Ravenna Army Ammunition Plant (RVAAP), Ohio
Stream Sampling - Specific Conductivity



Ravenna Army Ammunition Plant (RVAAP), Ohio
Stream Sampling - Total Suspended Solids (TSS)




Ravenna Army Ammunition Plant (RVAAP), Ohio
Stream Sampling - pH
pH (standard units)
Group
0
1
2
3
4
5
6
7
8
9
Avg=7.4
Std=0.61
Avg=7.5
Std=0.36
Avg=7.2
Std=0.47
Avg=7.4
Std=0.42
Avg=7.5
Std=0.40
Avg=7.6
Std=0.43
Avg=7.5
Std=0.45
Avg=7.3
Std=0.47
1) Eagle Creek Influent
2) Eagle Creek Effluent
3) Hinkley Creek Influent
4) Hinkley Creek Effluent
5) Sand Creek Influent
6) Sand Creek Effluent
7) Parshall Flume near South Service Road
8) Parshall Flume near Rt 534
Average



RAVENNA ARMY AMMUNITION PLANT RAVENNA, OHIO OPERATED BY RAVENNA ARSENAL, INC.			
APPROVED	SIGNATURE	DATE	TITLE
			GENERAL AR MAP
			REF. DWG NO.
			DRWN CHKD. ENGR
			DATE A-109
			SCALE As Noted

RVAAP HISTORIC

BIOLOGICAL SAMPLING

86

UNITED STATES ARMY ENVIRONMENTAL HYGIENE AGENCY

ABERDEEN PROVING GROUND, MD 21010-5422

WATER QUALITY ENGINEERING CONSULTATION
NO. 32-24-0896-89
TOXICITY IDENTIFICATION EVALUATION
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
25 JULY - 18 OCTOBER 1988

Distribution limited to U.S. Government agencies only; protection of privileged information evaluating another command, Mar 89. Requests for this document must be referred to Commander, Ravenna Army Ammunition Plant, Ravenna, OH 44266-9297.

DESTRUCTION NOTICE - Destroy by any method that will prevent disclosure of contents or reconstruction of the document.

DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO ATTENTION OF

21 March 1989

HSHB-ME-WS (40)

MEMORANDUM FOR Commander, U.S. Army Materiel Command, ATTN: AMCSG, 5001 Eisenhower Avenue, Alexandria, VA 22333-0001

SUBJECT: Water Quality Engineering Consultation No. 32-24-0896-89, Toxicity Identification Evaluation, Ravenna Army Ammunition Plant, Ravenna, Ohio, 25 July - 18 October 1988

EXECUTIVE SUMMARY

The purpose and summary of the recommendations of the enclosed report follow:

a. Purpose. To evaluate the aquatic toxicity of Ravenna Army Ammunition Plant pink water treatment system effluent.

b. Recommendations. None are required.

FOR THE COMMANDER:

Roy D Miller

Encl

ROY D. MILLER, P.E.
LTC, MS
Chief, Water Quality Engineering Division

CF:
HQDA(SGPS-PSP) (wo/encl)
HQDA(ENVR-E) (w/encl)
DA, USAEHSC, ATTN: CEHSC-F (w/encl)
Cdr, AMCCOM, ATTN: AMSMC-SG (w/encl)
Cdr, RVAAP, ATTN: Mr. Tom Chanda (2 cy) (w/encl)
Cdr, MEDDAC, Ft Knox, ATTN: PVNTMED Svc (2 cy) (w/encl)
Cdr, WRAMC, ATTN: PVNTMED Svc (w/encl)
Cdr, USAEHA-N (w/encl)

32-24-0896-89
COMPLETED
21 Mar 89

DEPARTMENT OF THE ARMY
U.S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO ATTENTION OF

HSHB-ME-WS

WATER QUALITY ENGINEERING CONSULTATION NO. 32-24-0896-89 TOXICITY IDENTIFICATION EVALUATION RAVENNA ARMY AMMUNITION PLANT RAVENNA, OHIO 25 JULY-18 OCTOBER 1988

1. REFERENCES. A list of all references used in this report is located in Appendix A.

2. AUTHORITY.

a. USAEHA Form 250-R AMC, 17 June 1988.

b. Meeting with USAEHA and with MACOM representatives, 12-14 July 1988, subject: USAEHA Field Services.

3. PURPOSE. To evaluate the aquatic toxicity of Ravenna Army Ammunition Plant (RVAAP) pink water treatment system effluent.

4. GENERAL.

a. Background. Ravenna Army Ammunition Plant is preparing to reactivate an explosives loading operation (Load Line 7). As part of this reactivation, RVAAP is operating a pilot-scale Octol melt and pour operation, Load Line 6. Octol is a high explosive mixture of 25-30 percent Trinitrotoluene (TNT) and 70-75 percent Cyclo-tetra-methylene-tetra-nitramine (HMX). Wastewaters are generated by the washdown of equipment and loading facilities. This wastewater, known as "pink water," is treated in a filtration/activated carbon adsorption system which discharges to the RVAAP sanitary sewer. As part of the National Pollutant Discharge Elimination System (NPDES) permit modification process the Ohio Environmental Protection Agency (OEPA) required RVAAP to conduct two acute bioassays on the pink water treatment effluent within the first 2 months of operation (reference 1). The pilot-scale operation (Load Line 6) is identical to the Load Line 7 operation which is to be reactivated. Load Line 6 and Load Line 7 have similar wastewater characteristics. The OEPA has approved the use of wastewater samples from Load Line 6 to conduct the bioassays. This consultation fulfills that requirement.

b. Study Plan. A complete study plan summarizing sample types, locations, analytical methodologies, and biomonitoring techniques is included in Appendix B.

5. FINDINGS AND DISCUSSION.

a. Methods. The sampling and bioassays were conducted as outlined in the Study Plan included in Appendix B. Wastewater samples were collected from the final effluent of the RVAAP (Load Line 6) pink water treatment system on 25 July 1988 and 27 September 1988.

b. 25 July 1988 Sampling.

(1) Chemical Analyses. Analytical results for ammonia-nitrogen, total alkalinity and total hardness are contained in Tables C-1 and C-2, Appendix C. Water temperature, dissolved oxygen, pH, and specific conductivity were recorded daily during each assay. All collected data are reported in the Toxicity Data Tables for each test (Appendix C, Tables C-1 and C-2).

(2) Bioassay Results. Bioassays were conducted on larval fathead minnows (Pimephales promelas), daphnia (Ceriodaphnia dubia), and algae (Selenastrum capricornutum). The results of the bioassays are presented in Tables C-1 through C-3, Appendix C. Statistical analyses are included in Appendix D. During this test, the effluent exerted a moderately toxic effect on the larval fathead minnows (Pimephales promelas), and a slightly toxic effect on the daphnia (Ceriodaphnia dubia). It was not toxic to the algae (Selenastrum capricornutum). These results, expressed as the LC_{50} (effluent concentration which causes 50 percent mortality) are summarized in Table 1 below. A "not calculable" indicates that the sample did not cause a sufficient number of mortalities to calculate an LC_{50}.

TABLE 1. BIOASSAY RESULTS SUMMARY, PINK WATER TREATMENT EFFLUENT, RVAAP, 25 JULY - 18 OCTOBER 1988.

Assay	LC_{50} at 95% Confidence Interval 25 July 88	27 September 88
Larval Fathead Minnows (Pimephales promales)	38.06±1.44%	NC
Daphnia (Ceriodaphnia dubia)	94.13±8.55%	NC
Alga (Selenastrum capricornutum)	NC	NC

NC: Not Calculable

c. 27 September 1988 Sampling.

(1) Chemical Analyses. Analytical results for ammonia-nitrogen, total alkalinity and total hardness are contained in Tables C-6 and C-7, Appendix C. Water temperature, dissolved oxygen, pH, and specific conductivity were recorded daily during each assay and are also reported in Tables C-6 and C-7, Appendix C. Effluent screening results are contained in Tables C-4 and C-5, Appendix C. Overall, the effluent was of good chemical quality with few compounds detected. The methylene chloride measured in both the wastewater sample and the field blank resulted from analytical interferences in the laboratory and not from contamination in the wastewater sample.

(2) Bioassay Results. Bioassays were conducted on larval fathead minnows (Pimephales promelas), daphnia (Ceriodaphnia dubia), and algae (Selenastrum capricornutum). The results of the bioassays are presented in Tables C-6 through C-8, Appendix C. Statistical analyses are included in Appendix D. No effluent concentrations were found to cause significantly lower survival than the control in the above assays. The statistical analyses (Dunnett's Procedure) for the Pimephales promelas, Ceriodaphnia dubia, and Selenastrum capricornutum assays showed that there was no correlation of effluent concentration to death of the test organisms. Therefore, any deaths of test organisms can be considered to be random deaths. These results, expressed as the LC_{50}, are summarized in Table 1. A "not calculable" indicates that the sample did not cause a sufficient number of mortalities to calculate an LC_{50}.

d. Reference Toxicants. A set of bioassays on a reference toxicant (Sodium Lauryl Sulfate) were conducted to evaluate the quality control of the biomonitoring laboratory procedures. The results are summarized in Table 2. The complete data is included as Tables C-9 through C-11, Appendix C. Results for the reference toxicant assays were within the acceptable ranges as illustrated in Table 2, (reference 3).

6. CONCLUSIONS. The RVAAP pink water treatment effluent exhibited moderate acute toxicity during the first phase of this study but was not acutely toxic during the second phase. The overall chemical quality of the effluent was good.

TABLE 2. BIOASSAY RESULTS SUMMARY, REFERENCE TOXICANT (SODIUM LAURYL SULFATE), RVAAP, 18 OCTOBER 1988.

Species	LC_{50} (mg/L)	Acceptable Range (mg/L)
Fathead Minnow (Pimephales promelas)	7.19±1.13	6.97-8.96
Daphnia (Ceriodaphnia dubia)	3.82±3.44	7.3-13.3*
Algae+12 (Selenastrum capricornutum)	NOEC 5.8	NOEC 5.0

*Results are for 48 hour Daphnia magna assay.

+Result is a 96-hour no observed effect concentration (NOEC), obtained using Dunnett's Procedure on data.

LC_{50} calculated by Trimmed Spearman-Karber

7. RECOMMENDATIONS. None are required.

JOHN J. RESTA, P.E.
Environmental Engineer
Water Quality Engineering
Division

BRUCE C. KOVAK
CPT, MS
Environmental Science Officer
Water Quality Engineering
Division

APPROVED:

LYNN R. SHERMAN
Acting Chief, Water Quality Studies Branch
Water Quality Engineering Division

APPENDIX A

REFERENCES

1. Letter, Northeast District Office, State of Ohio Environmental Protection Agency (OEPA), to Ravenna Army Ammunition Plant, 3 June 1988.

2. Letter, Northeast District Office, State of Ohio Environmental Protection Agency (OEPA) to Ravenna Army Ammunition Plant, 14 June 1988.

3. United States Environmental Protection Agency (EPA), Environmental Monitoring and Support Laboratory, Quality Control Samples, Instruction For Reference Toxicants-Sodium Lauryl Sulfate.

4. EPA 600/4-79-020, Revised March 1983, Methods for Chemical Analysis of Water and Wastes.

5. EPA 600/4-85/013, March 1985, Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms (3rd Edition).

6. EPA 600/4-85/014, December 1985, Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms.

7. EPA-600/9-78-018, July 1978, The Selenastrum Capricornutum Printz Algal Assay Bottle Test.

8. OEPA, QA Manual-Bioassay, 0327d/0003d, 1 October 1987.

9. Bongiovanni, R., G.E. Podolak, L.D. Clark, and D.T. Scarbough, "Analysis of Trace Amounts of Six Selected Poly-Nitro Compounds in Soil, American Industrial Hygiene Association J 45(4): 222-086, 1984.

APPENDIX B

STUDY PLAN

1. WATER SAMPLINGS. After grab samples of the wastewater were collected, the samples were distributed into the proper container and preserved according to the EPA procedures [40 CFR 136.3 (e)]. The samples for biomonitoring were stored in 5-gallon, flexible plastic cubetainers. Samples were packed with ice packs and transported to the laboratories at the USAEHA, APG-EA, Maryland. The bioassays were started within 24 hours of sample collection.

2. CHEMICAL ANALYSES. The following chemical parameters were analyzed on the wastewater collected 27 September.

a. Purgeable Organics (EPA Method 624, reference 4).

b. Base/Neutral Extractable Organics (EPA Method 625, reference 4).

c. Acid Extractable Organics (EPA Method 625, reference 4).

d. Ammonia-Nitrogen (EPA Method 350.2, reference 4).

e. Chemical Oxygen Demand (EPA Method 410.4, reference 4).

f. Total Organic Carbon (EPA Method 415.1, reference 4).

g. Explosives (HMX, RDX, TNT, 2,6-DNT, 2,4-DNT) (Liquid Chromatography/Gas Chromatography, reference 9).

h. Alkalinity (EPA Method 310.1, reference 4).

i. Hardness (EPA, atomic absorption, calculated, reference 4).

3. FACILITIES.

a. Mobile and permanent laboratories owned and operated by the USAEHA were used to conduct the biomonitoring. The algal assays were conducted in the permanent laboratory. The fish and daphnia assays were conducted in the mobile laboratory.

b. The environmental control for the algae was a New Brunswick environmental shaker set at 24 $\pm$ 2 oC. The illumination intensity at flask level was 400 $\pm$ 10 foot candles anywhere on the platform. The fish and the daphnia were conducted on 16/8 hour light/dark cycles and the temperature was maintained by a temperature controlled water bath held at 20 $\pm$ 2 oC.

4. DILUTION WATER. Dilution water was deionized water reconstituted according to the guidelines in reference 5, not the receiving waters, as the pink water treatment system discharges to the sanitary sewer. The dilution water had a conductivity of 180-200 umhos/cm, hardness of 40-50 mg/L, pH of 7.2-7.6, and an alkalinity of 30-35 mg/L.

5. TEST ORGANISMS. All organisms are from the EPA Region III Biological Monitoring Laboratory in Wheeling, West Virginia. Five to seven days prior to the test, the algae, (Selenastrum capricornutum) were transferred to nutrient medium prepared according to references 6 and 7 and then centrifuged, decanted and resuspended in sterile distilled water to a concentration convenient for inoculation of the test vessels for an initial concentration of 10,000 cells per mL. Nutrients were added to both distilled water and effluent except for the EDTA, as described in reference 6. The Ceriodaphnia were cultured in the USAEHA laboratory. Then 24 hours before the test, the adults were transferred to isolation containers and the newly hatched young were used for the test. The fathead minnows (Pimephales promelas) were newly hatched young sent next-day-delivery from EPA.

6. QUALITY ASSURANCE. Sodium lauryl sulfate was used as a reference toxicant. Each day prior to taking readings in the bioassay containers the meters were calibrated for conductivity, temperature, pH, and dissolved oxygen. All chemical analyses were conducted under the direction of the Directorate of Laboratory Services, USAEHA. Analytical quality assurance data for the various analyses can be provided upon request. The laboratories are accredited or certified by the following organizations: American Industrial Hygiene Association, American Association for Laboratory Accreditation, the State of Maryland, and EPA Regions III, V, VII, VIII and X. The laboratories are also certified in 45 other states via reciprocity with the certification program of the State of Maryland.

7. TOXICITY TESTING METHODOLOGY. Bioassays were conducted twice on the effluent from the Load Line 6 pink water treatment system. The tests followed methods outlined in references 5-7. A summary of specific methods is presented in Table B-1. These methods are analogous to those specified by the Ohio EPA in reference 8. All assays were started the same day as the effluent samples were received (within 24 hours from the end of the grab sampling period).

TABLE B-1. METHODS FOR CONDUCTING BIOASSAYS FOR RVAAP, JULY - OCTOBER 1988

Species	Time of Exposure	Type Assay	Temperature (°C)	Determination*	Loading	Replicates	Methods
Fathead minnows (Pimephales promelas)	96 hrs	Static	20	LC_{50}	<0.4g/L	2	Ref 5
Daphnia (Ceriodaphnia dubia)	48 hrs	Static	20	LC_{50}	<0.4g/L	2	Ref 5
Algae (Selenastrum capricornutum)	96 hrs	Static	24	EC_{50}	10,000/mL	3	Ref 6 and 7

* LC_{50} - % effluent concentration that causes lethality to 50% of the fathead minnows, or loss of movement upon gentle probing in Ceriodaphnia.

EC_{50} - % effluent concentration that causes a 50% reduction of cell growth in Selenastrum.

APPENDIX C

CHEMICAL ANALYSES AND BIOASSAY DATA

Table C-1. Bioassay Results, Pimephales promelas, Pink Water Treatment Effluent, RVAAP, 25 July 1986

DATA SHEET FOR BIOASSAY TOXICITY TEST

CONTACT Duke Horak	EFFLUENT SERIAL NUMBER	EFFLUENT RAVENNA AAP	ADDRESS Ravenna, OH
SUPERVISOR Lynn Thomas	BEGINNING DATE 27 Jul 86 TIME 1400	NPDES PERMIT NUMBER	TEST CONDUCTED BY Kovak / Kubale
TEST ORGANISM FATHEAD MINNOW	ENDING DATE 31 Jul 86 TIME 1400		AERATION ADDED YES ___ NO X RATE ___
SOURCE OF FISH EPA	TEST ORGANISM SIZE LENGTH MAX ___ MIN ___ AVE ___	TEST ORGANISM SIZE NET WEIGHT MAX ___ MIN ___ AVE ___	
	ACCLIMATION ___ % LOSS AFTER ___ DAYS		

NOTES

	AMMONIA	CONDUCTIVITY	TOTAL ALKALINITY mg/L or $CaCO_3$	TOTAL HARDNESS mg/L as $CaCO_3$	SALINITY 0/00
INITIAL	16 mg/L	1000 µmhos/cm	260 mg/L	86.2	N/A
FINAL	9.4 mg/L	934 µmhos/cm	250 mg/L	88.6	

CONC OR %EFFLUENT	TANK NUMBER	NUMBER OF LIVE ORGANISMS 0	24	48	72	96	TEMPERATURE °C 0	24	48	72	96	DISSOLVED OXYGEN (mg/l) 0	24	48	72	96	pH 0	24	48	72	96	CONDUCTIVITY 0	24	48	72	96
0	A	10	10	10	10	10	21	20	20	20.5	21	7.2	7.8	8.0	8.7	8.5	7.3	6.0	6.1	6.4	6.6	64	54	43	48	52
0	B	10	10	10	10	9						7.3	7.9	7.7	8.6	8.2	7.1	6.0	6.8	6.4	6.6	62	57	47	48	50
10	A	10	10	10	10	10						8.1	8.2	8.7	8.4	8.4	7.8	7.2	7.5	7.2	7.4	135	133	136	141	144
10	B	10	10	10	10	10						8.2	8.2	8.7	8.6	8.4	7.7	7.3	7.5	7.4	7.4	128	134	135	150	143
20	A	10	10	10	10	10						7.3	8.0	8.2	8.5	8.0	8.1	7.8	8.0	7.8	7.9	217	210	214	223	225
20	B	10	10	9	8	8						7.6	8.0	8.2	8.6	7.9	7.9	7.7	7.6	7.8	7.5	214	217	220	225	228
30	A	10	10	10	10	9						8.1	8.5	8.6	8.6	8.5	8.1	7.8	8.0	7.8	7.9	297	310	313	315	289
30	B	10	10	9	9	9						8.1	8.5	8.6	8.5	8.4	8.1	7.8	8.0	7.7	7.9	318	326	327	333	323
40	A	10	4	3	2	2						8.1	8.0	8.3	8.3	8.1	8.1	8.0	8.0	8.1	8.0	386	345	410	410	414
40	B	10	5	5	5	5						8.2	8.1	8.4	8.2	8.4	8.2	8.0	7.9	8.1	8.1	391	404	410	411	410
60	A	10	0	0	0	0						8.0					8.2	8.1				544	575			
60	B	10	0	0	0	0						8.0					8.3	8.1				581	595			
80	A	10	0	0	0	0						7.9					8.3	8.2				255	258			
80	B	10	0	0	0	0						7.9					8.3	8.2				753	765			
100	A	10	0	0	0	0						7.7					9.3	8.3				916	920			
100	B	10	0	0	0	0	↓	↓	↓	↓	↓	7.8					8.3	8.3				934	935			

AEHA Form 215, 1 Nov 82 (HSHB-EW)

Replaces HSHB-EW Form 108, 1 Sep 80, which will be used.

Table C-2. Bioassay Results, Ceriodaphnia, Pink Water Treatment Effluent, RVAAP, 25 July 1988

DATA SHEET FOR BIOASSAY TOXICITY TEST

EFFLUENT: RAVENNA AAP
ADDRESS: Ravenna OH
CONTACT: Dave Kovak
EFFLUENT SERIAL NUMBER:
NPDES PERMIT NUMBER:
TEST CONDUCTED BY: Kovak / Kubala
SUPERVISOR: Lynn Shannon
BEGINNING DATE 27 July 88 TIME 1130
ENDING DATE 29 Jul 88 TIME 1130
AERATION ADDED YES __ NO X RATE __
TEST ORGANISM: Ceriodaphnia
TEST ORGANISM SIZE LENGTH MAX ____ MIN ____ AVE ____
TEST ORGANISM SIZE NET WEIGHT MAX ____ MIN ____ AVE ____
SOURCE OF FISH: EPA Region III
ACCLIMATION ____ % LOSS AFTER ____ DAYS

NOTES

	AMMONIA	CONDUCTIVITY	TOTAL ALKALINITY mg/L or $CaCO_3$	TOTAL HARDNESS mg/L as $CaCO_3$	SALINITY 0/00
INITIAL	18 mg/L	1000 µmho/cm	240 mg/L	616 mg/L	
FINAL	9.4 mg/L	994 µmho/cm	250 mg/L	568 mg/L	X

CONC. OR % EFFLUENT	TANK NUMBER	NUMBER OF LIVE ORGANISMS 0	24	48	72	96	TEMPERATURE °C 0	24	48	72	96	DISSOLVED OXYGEN (mg/l) 0	24	48	72	96	pH 0	24	48	72	96	CONDUCTIVITY 0	24	48		
0	A	10	9	9			21.0	20.0	20.0			8.6	8.0	8.5			6.7	6.3	7.3			53	43	32		
0	B	10	9	9								8.2	8.5	8.5			6.6	6.2	6.2			48	43	33		
20	A	10	6	8								7.8	8.5	8.5			7.8	7.7	7.7			190	196	196		
20	B	10	4	4								7.8	8.5	8.5			7.9	7.7	7.7			202	220	213		
40	A	10	7	9								7.8	8.5	8.7			8.1	8.1	8.0			378	386	393		
40	B	10	8	4								7.7	8.4	8.6			8.2	8.1	8.0			391	409	410		
60	A	10	3	2								7.8	8.6	8.5			8.3	8.3	8.2			582	574	583		
60	B	10	10	10								7.3	8.5	8.6			8.3	8.2	8.2			568	560	587		
80	A	10	8	5								7.2	8.3	8.5			8.3	8.3	8.3			741	732	733		
80	B	10	4	5								7.2	8.4	8.7			8.3	8.3	8.3			762	768	769		
100	A	10	7	4								7.1	8.5	8.4			8.3	8.3	8.3			914	900	918		
100	B	10	3	1			↓	↓	↓			7.0	8.4	8.8			8.3	8.3	8.3			931	830	932		

AEHA Form 215, 1 Nov 82 (HSHB-EW)

Replaces HSHB-EW Form 108, 1 Sep 80, which will be used.

TABLE C-3. BIOASSAY DATA, Algae (*Selenastrum capricornutum*), PINK WATER TREATMENT EFFLUENT, RVAAP, 25 JULY 1988

Dilution (% Effluent)	Cell Counts 1	2	3	Cells/mL (Data are adjusted for dilution at 95% Confidence Interval).
Control	2032	1951	992	
	385	367	405	
	322	342	299	
				$0.18 \pm 0.10 \times 10^6$
20%	309	314	285	
	357	359	321	
	238	172	181	
				$0.06 \pm 0.01 \times 10^6$
40%	289	208	186	
	322	301	288	
	145	102	88	
				$0.04 \pm 0.01 \times 10^6$
60%	253	257	230	
	345	398	342	
	429	388	376	
				$0.07 \pm 0.01 \times 10^6$
80%	193	175	179	
	249	203	184	
	169	162	148	
				$0.04 \pm 0.01 \times 10^6$
100%	629	611	609	
	1639	1730	1741	
	775	732	786	
				$0.21 \pm 0.06 \times 10^6$

TABLE C-4. CHEMICAL ANALYTICAL RESULTS, PINK WATER TREATMENT EFFLUENT RVAAP, 27 SEPTEMBER 1988

Parameter	Concentration
Conventional Pollutants	
Chemical Oxygen Demand	<25.0 mg/L
Total Organic Carbon	0.60 mg/L
Ammonia Nitrogen	0.08 mg/L
Explosives	
HMX (Cyclo-tetramethylene-tetranitramine)	<100 ug/L
RDX (Cyclo-trimethylene-trinitramine)	<30 ug/L
TNT (Trinitrotoluene)	1 ug/L
2,6 DNT (Dinitrotoluene)	<1 ug/L
2,4 DNT (Dinitrotoluene)	<1 ug/L
Volatile Organics	
Chloromethane	<3.0 ug/L
Bromomethane	<3.0 ug/L
Vinyl Chloride	<3.0 ug/L
Chloroethane	<3.0 ug/L
Methylene Chloride	10.0 ug/L
Trichlorofluoromethane	<3.0 ug/L
1,1-Dichloroethene	<3.0 ug/L
1,1-Dichloroethane	<3.0 ug/L
trans-1,2-Dichloroethene	<3.0 ug/L
Chloroform	<3.0 ug/L
1,2-Dichlorethane	<3.0 ug/L
1,1,1-Trichloroethane	<3.0 ug/L
Carbon Tetrachloride	<3.0 ug/L
Bromodichloromethane	<3.0 ug/L
1,1,2,2-Tetrachloroethane	<3.0 ug/L
1,2-Dichloropropane	<3.0 ug/L
trans-1,3-Dichloropropene	<3.0 ug/L
Trichloroethene	<3.0 ug/L
Dibromochloromethane	<3.0 ug/L
1,1,2-Trichloethane	<3.0 ug/L
Benzene	<3.0 ug/L
cis-1,3-Dichloropropene	<3.0 ug/L
2-Chloroethylvinyl ether	<3.0 ug/L
Bromoform	<3.0 ug/L
Tetrachloroethene	<3.0 ug/L
Toluene	<3.0 ug/L
Chlorobenzene	<3.0 ug/L
Ethylbenzene	<3.0 ug/L

Base/Neutral Extractable Organics	Concentration
N-nitrosodimethlamine	<10.0 ug/L
bis (2-chloroethyl) ether	<10.0 ug/L
1,3-Dichlorobenzene	<10.0 ug/L
2,4-Dichlorobenzene	<10.0 ug/L
1,2-Dichlorobenzene	<10.0 ug/L
bis (2-chloroisopropyl) ether	<10.0 ug/L
Hexachloroethane	<10.0 ug/L
N-nitrosodi-n-propylamine	<10.0 ug/L
Nitrobenzene	<10.0 ug/L
Isophorone	<10.0 ug/L
bis (2-chloroethoxy) methane	<10.0 ug/L
1,2,4-trichlorobenzene	<10.0 ug/L
Naphthalene	<10.0 ug/L
Hexachlorobutadiene	<10.0 ug/L
Hexachlorocyclopentadiene	<10.0 ug/L
2-Chloronaphthalene	<10.0 ug/L
Acenaphthylene	<10.0 ug/L
Dimethyl Phthalate	<10.0 ug/L
2,6-Dinitrotoluene	<10.0 ug/L
Acenaphthene	<10.0 ug/L
2,4-Dinitrotoluene	<10.0 ug/L
Fluorene	<10.0 ug/L
4-Chlorophenyl phenyl ether	<10.0 ug/L
Diethyl phthalate	<10.0 ug/L
1,2-Diphenylhydrazine	<10.0 ug/L
N-nitrosodiphenylamine	<10.0 ug/L
4-Bromophenyl phenyl ether	<10.0 ug/L
Hexachlorobenzene	<10.0 ug/L
Phenanthrene	<10.0 ug/L
Anthracene	<10.0 ug/L
Di-n-butyl phthalate	<10.0 ug/L
Fluoranthene	<10.0 ug/L
Pyrene	<10.0 ug/L
Benzidine	<25.0 ug/L
Butyl benzyl phthalate	<10.0 ug/L
Benzo (a) anthracene	<10.0 ug/L
Chrysene	<10.0 ug/L
3,3'-Dichlorobenzidine	<25.0 ug/L
bis (2-ethylhexyl) phthalate	<10.0 ug/L
Di-n-octyl phthalate	<10.0 ug/L
Benzo (b) fluoranthene	<10.0 ug/L
Benzo (K) fluoranthene	<10.0 ug/L
Benzo (a) pyrene	<10.0 ug/L
Indeno (1,2,3-cd) pyrene	<10.0 ug/L
Dibnezo (a,h) anthracene	<10.0 ug/L
Benzo (ghi) perylene	<10.0 ug/L

Acid Extractables Organics	Concentration
2-Chlorophenol	<10.0 ug/L
Phenol	<10.0 ug/L
2-Nitrophenol	<10.0 ug/L
2,4-Dimethylphenol	<10.0 ug/L
2,4-Dichlorophenol	<10.0 ug/L
4-Chloro-3-methylphenol	<10.0 ug/L
2,4,6-Trichlorphenol	<10.0 ug/L
2,4-Dinitrophenol	<25.0 ug/L
4-Nitrophenol	<25.0 ug/L
2-Methyl-4,6-dinitrophenol	<25.0 ug/L
Pentachlorophenol	<25.0 ug/L

TABLE C-5. CHEMICAL ANALYTICAL RESULTS, PINK WATER TREATMENT EFFLUENT VOLATILE ORGANIC FIELD BLANK, RVAAP, 27 SEPTEMBER 1988

Parameter	Concentration
Chloromethane	<3.0 ug/L
Bromomethane	<3.0 ug/L
Vinyl Chloride	<3.0 ug/L
Chloroethane	<3.0 ug/L
Methylene Chloride	8.0 ug/L
Trichlorofluoromethane	<3.0 ug/L
1,1-Dichloroethene	<3.0 ug/L
1,1-Dichloroethane	<3.0 ug/L
trans-1,2-Dichloroethene	<3.0 ug/L
Chloroform	<3.0 ug/L
1,2-Dichlorethane	<3.0 ug/L
1,1,1-Trichlorcethane	<3.0 ug/L
Carbon Tetrachloride	<3.0 ug/L
Bromodichloromethane	<3.0 ug/L
1,1,2,2-Tetrachloroethane	<3.0 ug/L
1,2-Dichloropropane	<3.0 ug/L
trans-1,3-Dichloropropene	<3.0 ug/L
Trichloroethene	<3.0 ug/L
Dibromochloromethane	<3.0 ug/L
1,1,2-Trichloethane	<3.0 ug/L
Benzene	<3.0 ug/L
cis-1,3-Dichloropropene	<3.0 ug/L
2-Chloroethylvinyl ether	<3.0 ug/L
Bromoform	<3.0 ug/L
Tetrachloroethene	<3.0 ug/L
Toluene	<3.0 ug/L
Chlorobenzene	<3.0 ug/L
Ethylbenzene	<3.0 ug/L

Table C-6. Bioassay Results Pimephales promelas, Pink Water Treatment Effluent, RVAAP, 27 September 1988

DATA SHEET FOR BIOASSAY TOXICITY TEST

CONTACT: BRUCE KOVAK	EFFLUENT SERIAL NUMBER	EFFLUENT: RAVENNA AD	ADDRESS: RAVENNA OH
SUPERVISOR: Lynn SHERMAN	BEGINNING DATE 27 SEPT TIME 1056	NPDES PERMIT NUMBER	TEST CONDUCTED BY: Kovak / Bowsher / Nichols
TEST ORGANISM: FATHEAD MINNOW	TEST ORGANISM SIZE LENGTH MAX ____ MIN ____ AVE ____	ENDING DATE 28 SEPT TIME 1300	AERATION ADDED YES ___ NO X RATE ___
SOURCE OF FISH: EPA	ACCLIMATION ____ % LOSS AFTER ____ DAYS	TEST ORGANISM SIZE NET WEIGHT MAX ____ MIN ____ AVE ____	

NOTES

	AMMONIA	CONDUCTIVITY	TOTAL ALKALINITY mg/L or $CaCO_3$	TOTAL HARDNESS mg/L as $CaCO_3$	SALINITY O/OO
INITIAL	0.08 mg/L	217 µmho/cm	160 mg/L	96.5 mg/L	N/S
FINAL	0.22 mg/L	252 µmho/cm	170 mg/L	93.8 mg/L	

CONC. OR %EFFLUENT	TANK NUMBER	NUMBER OF LIVE ORGANISMS 0	24	48	72	96	TEMPERATURE °C 0	24	48	72	96	DISSOLVED OXYGEN (mg/l) 0	24	48	72	96	pH 0	24	48	72	96	CONDUCTIVITY 0	24	48	72	96
0	A	10	10	10	10	10	21.0	20.0	20.0	20.0	21.0	8.2	9.6	6.9	8.2	8.1	7.9	7.6	7.4	7.6	7.6	217	215	192	224	252
0	B	10	10	10	10	10						8.1	8.6	7.1	8.2	8.1	7.8	7.5	7.3	7.5	7.5	179	182	178	189	195
20	A	10	10	10	10	10						7.6	8.5	6.8	7.8	8.2	7.5	7.4	7.3	7.5	7.5	255	253	260	260	257
20	B	10	10	10	10	10						7.6	8.2	6.8	7.9	8.3	7.5	7.4	7.4	7.6	7.6	258	256	261	263	260
40	A	10	10	10	10	10						7.1	8.3	6.6	7.8	8.3	7.5	7.4	7.5	7.7	7.7	341	343	348	344	340
40	B	10	10	10	10	10						7.0	8.1	6.6	7.9	8.3	7.4	7.4	7.5	7.8	7.8	345	339	349	350	349
60	A	10	10	9	9	9						6.7	8.2	6.6	7.9	8.4	7.5	7.4	7.5	7.8	7.9	428	424	435	435	414
60	B	10	10	10	10	10						6.8	8.1	6.6	7.8	8.5	7.5	7.4	7.6	7.8	7.9	432	428	434	437	434
80	A	10	10	10	10	10						6.3	8.0	6.4	7.7	8.1	7.5	7.4	7.7	7.8	8.6	517	512	520	520	516
80	B	10	10	10	10	10						6.0	7.9	6.2	7.6	8.1	7.4	7.4	7.6	7.9	7.9	525	517	525	527	527
100	A	10	10	10	10	10						5.3	7.5	6.4	7.6	8.4	7.4	7.5	7.8	8.0	8.0	606	616	627	630	625
100	B	10	10	10	10	10						5.5	7.6	6.6	7.8	8.3	7.4	7.5	7.9	8.1	4.2	610	602	608	612	614

AEHA Form 215, 1 Nov 82 (HSHB-EW)

Replaces HSHB-EW Form 108, 1 Sep 80, which will be used.

Table C-7. Bioassay Results, *Ceriodaphnia*, Pink Water Treatment Effluent, RVAAP, 27 September 1988

DATA SHEET FOR BIOASSAY TOXICITY TEST

CONTACT: Bruce Kovak
SUPERVISOR: Lynne Sherman
TEST ORGANISM: Cerio Daphnia
SOURCE OF FISH:
EFFLUENT SERIAL NUMBER:
BEGINNING DATE 29 Sept TIME 0930
TEST ORGANISM SIZE LENGTH MAX ____ MIN ____ AVE ____
ACCLIMATION ____ % LOSS AFTER ____ DAYS
EFFLUENT: Ravenna AD
NPDES PERMIT NUMBER:
ENDING DATE 1 Oct TIME 0930
TEST ORGANISM SIZE NET WEIGHT MAX ____ MIN ____ AVE ____
ADDRESS: Ravenna Ohio
TEST CONDUCTED BY: Kovak / Bowskamp / Kuhak
AERATION ADDED YES ___ NO X RATE ___

	AMMONIA	CONDUCTIVITY	TOTAL ALKALINITY mg/L as $CaCO_3$	TOTAL HARDNESS mg/L as $CaCO_3$	SALINITY 0/00
INITIAL	0.08 mg/L	210 µmho/cm	160 mg/L	46.6 mg/L	N/S
FINAL	0.22 mg/L	[illegible] µmho/cm	170 mg/L	93.6 mg/L	

CONC. OR % EFFLUENT	TANK NUMBER	Live 0	Live 24	Live 48	Live 72	Live 96	Temp 0	Temp 24	Temp 48	Temp 72	Temp 96	DO 0	DO 24	DO 48	DO 72	DO 96	pH 0	pH 24	pH 48	pH 72	pH 96	Conductivity 0	Conductivity 24	Conductivity 48
0	A	10	10	10			21.0	20.0	20.0			8.3	9.0	7.7			8.0	7.7	7.4			210	237	190
0	B	10	10	10								8.2	8.8	7.7			7.7	7.6	7.4			185	195	188
20	A	10	10	10								7.8	8.7	7.8			7.6	7.6	7.7			250	257	261
20	B	10	10	10								7.9	8.7	7.8			7.5	7.7	7.7			259	263	266
40	A	10	10	10								7.4	8.5	7.7			7.5	7.8	7.9			338	338	350
40	B	10	10	10								7.9	8.4	7.8			7.5	7.8	7.9			348	348	356
60	A	10	10	10								6.8	8.1	7.8			7.4	7.7	8.0			427	427	440
60	B	10	10	10								6.9	8.0	7.7			7.4	7.7	8.0			429	427	433
80	A	10	10	10								6.5	8.0	7.7			7.4	7.7	8.1			505	510	521
80	B	10	10	10								6.8	8.0	7.7			7.4	7.8	8.1			524	525	531
100	A	10	10	10								6.4	7.6	7.7			7.4	7.8	8.2			606	611	612
100	B	10	10	7								6.7	7.5	7.7			7.4	7.4	8.1			609	607	627

NOTES

AEHA Form 215, 1 Nov 82 (HSHB-EW)

Replaces HSHB-EW Form 108, 1 Sep 80, which will be used.

TABLE C-8. BIOASSAY DATA, Algae (*Selenastrum capricornutum*), PINK WATER TREATMENT EFFLUENT, RVAAP, 27 SEPTEMBER 1988

Dilution (% Effluent)	Cell Counts 1	2	3	Cells/mL (Data are adjusted for dilution at 95% Confidence Interval).
Control	12078	12108	12179	
	8962	8934	8958	
	9216	8995	9502	
				$2.02 \pm 0.19 \times 10^6$
20%	7302	7152	7168	
	8137	8204	8019	
	8092	8715	8505	
				$1.58 \pm 0.07 \times 10^6$
40%	2348	2360	2457	
	4848	4732	4797	
	5229	5386	5301	
				$0.83 \pm 0.17 \times 10^6$
60%	8930	9932	9541	
	7828	8264	8355	
	10956	10751	11281	
				$1.91 \pm 0.25 \times 10^6$
80%	4920	5149	5105	
	4476	4330	4364	
	5125	5365	5549	
				$0.99 \pm 0.06 \times 10^6$
100%	6080	6057	6004	
	9898	9933	10061	
	6115	6592	6825	
				$1.50 \pm 0.23 \times 10^6$

Table C-9. Bioassay Results, Pimephales promelas, Reference Toxicant (Sodium Lauryl Sulfate) RVAAP, 13 October 1988

DATA SHEET FOR BIOASSAY TOXICITY TEST

EFFLUENT: P.L.F. Tox

ADDRESS

NOTES

CONTACT: Bruce Kovak

EFFLUENT SERIAL NUMBER

NPDES PERMIT NUMBER

TEST CONDUCTED BY: Kovak / Kubala

SUPERVISOR: Lynn Shekman

BEGINNING DATE 13 Oct TIME 1490

ENDING DATE 18 Oct TIME 1500

AERATION ADDED YES ___ NO X RATE ___

TEST ORGANISM: FATHEAD MINNOW

TEST ORGANISM SIZE LENGTH MAX ___ MIN ___ AVE ___

TEST ORGANISM SIZE NET WEIGHT MAX ___ MIN ___ AVE ___

SOURCE OF FISH: EPA

ACCLIMATION ___ % LOSS AFTER ___ DAYS

	AMMONIA	CONDUCTIVITY	TOTAL ALKALINITY mg/L or $CaCO_3$	TOTAL HARDNESS mg/L as $CaCO_3$	SALINITY 0/00
INITIAL					
FINAL					

CONC. OR % EFFLUENT	TANK NUMBER	NUMBER OF LIVE ORGANISMS 0	24	48	72	96	TEMPERATURE °C 0	24	48	72	96	DISSOLVED OXYGEN (mg/l) 0	24	48	72	96	pH 0	24	48	72	96	CONDUCTIVITY 0	24	48	72	%
C	A	10	10	10	10	10	19°	17°	19°C	20°C	21°C	10.4	8.3	8.7	8.5	7.8	7.7	7.8	7.3	7.7	7.6	237	229	198	218	280
C	B	12	10	10	10	10		17°	19°C		21°C	10.1	8.7	8.8	8.5	7.9	7.6	7.7	7.3	7.7	7.6	191	195	191	199	211
2.9	A	12	10	10	10	10		17°	19°C		21°	9.8	8.4	7.4	7.1	7.2	7.5	7.7	7.4	7.5	7.5	187	192	192	195	199
2.9	B	10	10	10	10	10		17°	19°		21°	9.7	8.5	7.8	8.1	7.7	7.5	7.6	7.3	7.5	7.5	183	190	190	193	195
5.8	A	10	6	2	2	2		17°	19°C		21°C	9.5	8.5	6.7	5.6	5.6	7.5	7.6	7.4	7.3	7.7	185	190	191	194	195
5.8	B	10	10	10	9	9		17°	19°		21°C	9.4	8.7	7.8	7.5	6.8	7.5	7.6	7.4	7.4	7.4	184	189	190	192	193
8.7	A	10	0	0	0	0		17°	19°		21°C	9.1	8.4	5.5	4.7	4.6	7.5	7.5	7.3	7.2	7.4	186	191	193	195	197
8.7	B	10	9	9	9	9		17°	19°C		21°C	9.7	8.6	7.5	7.0	6.0	7.5	7.5	7.4	7.3	7.3	184	190	191	194	195
11.6	A	10	0	0	0	0		17°	19°		21°	9.6	8.4	4.9	4.0	3.0	7.3	7.4	7.2	7.1	7.2	186	192	194	196	197
11.6	B	10	8	8	8	7		17°	19°		21°C	9.7	8.6	7.3	6.8	6.1	7.3	7.4	7.3	7.2	7.1	184	192	191	193	195
14.5	A	10	0	0	0	0		17°	19°		21°	9.6	8.3	4.4	4.1	3.4	7.3	7.4	7.3	7.1	7.0	186	196	196	198	200
14.5	B	10	2	1	1	1	↓	17°	19°	↓	21°C	9.2	8.7	5.9	4.6	5.3	7.3	7.4	7.4	7.0	7.0	185	189	192	194	195

AEHA Form 215, 1 Nov 82 (HSHB-EW)

Replaces HSHB-EW Form 108, 1 Sep 80, which will be used.

Table C-10. Bioassay Results, Ceriodaphnia, Reference Toxicant (Sodium Lauryl Sulfate) RVAAP, 13 October 1988

DATA SHEET FOR BIOASSAY TOXICITY TEST

EFFLUENT: P.E Test

ADDRESS

NOTES

CONTACT: Bruce Kovak

EFFLUENT SERIAL NUMBER

NPDES PERMIT NUMBER

TEST CONDUCTED BY

SUPERVISOR: Lynn Sherman

BEGINNING DATE: 12 Oct TIME: 1430

ENDING DATE: 13 Oct TIME: 1500

AERATION ADDED: YES ___ NO X RATE ___

TEST ORGANISM: CERIO DAPHNIA

TEST ORGANISM SIZE: LENGTH MAX ___ MIN ___ AVE ___

TEST ORGANISM SIZE: NET WEIGHT MAX ___ MIN ___ AVE ___

SOURCE OF FISH

ACCLIMATION: ___ % LOSS AFTER ___ DAYS

	AMMONIA	CONDUCTIVITY	TOTAL ALKALINITY mg/L or $CaCO_3$	TOTAL HARDNESS mg/L as $CaCO_3$	SALINITY 0/00
INITIAL					
FINAL					

CONC. OR %EFFLUENT	TANK NUMBER	NUMBER OF LIVE ORGANISMS					TEMPERATURE °C					DISSOLVED OXYGEN (mg/l)					pH					CONDUCTIVITY				
		0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
0	A	10	10	10			19°C	17°C	19°C			9.7	9.7	9.3			7.3	7.9	8.0			187	319	283		
0	B	10	10	10				17°C	19°C			8.6	10.0	9.5			7.4	7.9	7.9			227	203	227		
2.9	A	10	10	5				17°C	19°C			8.0	8.9	8.5			7.3	7.8	7.8			184	189	196		
2.9	B	10	10	7				17°C	19°C			9.0	9.2	8.9			7.3	7.7	7.8			185	191	193		
5.8	A	10	9	3				17°C	19°C			8.6	9.3	8.8			7.3	7.7	7.7			184	190	191		
5.8	B	10	10	4				17°C	19°C			8.6	9.2	8.9			7.3	7.7	7.7			183	191	193		
5.7	A	10	6	3				17°C	19°C			9.3	9.1	8.6			7.3	7.7	7.7			184	190	192		
5.7	B	10	7	3				17°C	19°C			9.0	9.2	8.8			7.2	7.7	7.7			184	190	191		
11.6	A	10	5	2				17°C	19°C			9.1	9.1	8.7			7.2	7.4	7.7			183	196	199		
11.6	B	10	8	1				17°C	19°C			9.6	9.1	8.7			7.2	7.5	7.7			184	190	192		
14.5	A	10	0	0				17°C	19°C			9.3	9.2	8.6			7.2	7.2	5.6			194	340	340		
14.5	B	10	8	1				17°C	19°C			9.6	9.2	8.6			7.2	5.6	6.9			202	200	205		

AEHA Form 215, 1 Nov 82 (HSHB-EW)

Replaces HSHB-EW Form 108, 1 Sep 80, which will be used.

TABLE C-11. BIOASSAY DATA, Algae (Selenastrum capricornutum), REFERENCE TOXICANT (SODIUM LAURYL SULFATE), RVAAP, 13 OCTOBER 1988.

Dilution (mg/L Sodium Lauryl Sulfate)	Cell Counts 1	2	3	Cells/mL (Data are adjusted for dilution at 95% Confidence Interval).
Control	28087	27831	29323	
	24363	25077	25037	
	20962	20889	21098	
				$4.95 \pm 0.40 \times 10^6$
2.9	19151	19308	19338	
	19667	19887	19803	
	23665	23692	24007	
				$4.19 \pm 0.27 \times 10^6$
5.8	18258	18638	18748	
	15320	15406	15652	
	20502	20248	20208	
				$3.62 \pm 0.27 \times 10^6$
8.7	8960	9143	9122	
	13741	13618	13935	
	13356	13459	13545	
				$2.42 \pm 0.28 \times 10^6$
11.6	7642	7822	7505	
	5934	6036	6092	
	9506	9401	9399	
				$1.54 \pm 0.18 \times 10^6$
14.5	8980	8841	8879	
	8061	8078	8189	
	850	805	835	
				$1.19 \pm 0.48 \times 10^6$

APPENDIX D

STATISTICAL ANALYSES

Table D-1. Statistical Analyses, Bioassay Data, Pimephales promelas, Pink Water Treatment Effluent, RVAAP, 25 July 1988

PROBIT ANALYSIS
USED FOR CALCULATING LC VALUES FROM LC0.1 TO LC99.99
IN FISH ANALYSIS

100 CYCLES HAVE BEEN COMPLETED. B(100) - B(99) = -2.080917E-03
CHI SQUARED NOT SIGNIFICANT. EXPECTED NUMBERS NOT CHECKED

P R O B I T T A B L E

CONCENTRATION	PERCENT	PROBABILITY
10.0000	0.0000	0.0000
20.0000	10.0000	0.0000
30.0000	10.0000	0.0486
40.0000	65.0000	0.6353
60.0000	100.0000	0.9992
80.0000	100.0000	1.0000
100.0000	100.0000	1.0000

THE CONSTANTS USED IN THIS PROBLEM WERE :
HETEROGENEITY FACTOR = 2.097533
NUMBER OF POINTS = 7
DEGREES OF FREEDOM = 5
DEVIATE = 1.96
G = 9.912707E-02
NUMBER OF CYCLES = 100
THE STATISTICS ARE:
AVG Y = 5.070708
AVG X = 1.584678
AVG T = 2.270747
SLOPE = 16.04055
WITH A STANDARD ERROR = 2.576744
INTERCEPT = -20.35261
CHI SQUARED = 10.48768

POINT	CONCENTRATION	95% CONFIDENCE LIMITS LOWER	UPPER
LC 0.10	24.43	19.63	27.41
LC 0.50	26.30	21.67	29.02
LC 1.00	27.26	23.03	29.64
LC 5.00	30.06	26.51	32.20
LC10.00	31.67	28.56	33.56
LC15.00	32.80	30.02	34.53
LC50.00	38.06	36.56	39.45
LC85.00	44.17	42.26	47.48
LC90.00	45.75	43.51	49.66
LC95.00	48.20	45.38	53.68
LC99.00	53.15	49.01	61.76
LC99.50	55.09	50.39	65.03
LC99.90	59.31	53.35	72.36
LC99.99	64.91	57.19	82.49

N O T E : IF THE LC VALUE (LC1,LC2. . . . LC99) IS ABOVE/BELOW THE HIGHEST/LOWEST CONCENTRATION TESTED, EXTREME CAUTION SHOULD BE EXERCISED IN REGARD TO USING SUCH VALUE(S) BECAUSE IT/THEY LIE(S) OUTSIDE THE KNOWN RANGE AND IS ONLY AN EXTRAPOLATED ESTIMATED VALUE. SIMILAR PRECAUTIONS SHOULD ALSO BE USED IN REGARD TO THE UPPER AND LOWER 95% CONFIDENCE LIMITS FOR LIKE REASONS.

Table D-2. Statistical Analyses, Bioassay Data, Ceriodaphnia, Pink Water Treatment Effluent, RVAAP, 25 July 1988

PROBIT ANALYSIS
USED FOR CALCULATING LC VALUES FROM LC0.1 TO LC99.99
IN FISH ANALYSIS

CHI SQUARED NOT SIGNIFICANT. EXPECTED NUMBERS NOT CHECKED

P R O B I T T A B L E

CONCENTRATION	PERCENT	PROBABILITY
20.0000	40.0000	0.0000
40.0000	35.0000	0.0001
60.0000	40.0000	0.0248
80.0000	50.0000	0.2391
100.0000	75.0000	0.6041

THE CONSTANTS USED IN THIS PROBLEM WERE :
HETEROGENEITY FACTOR = 2.312667
NUMBER OF POINTS = 5
DEGREES OF FREEDOM = 3
DEVIATE = 1.96
G = .3717625
NUMBER OF CYCLES = 29
THE STATISTICS ARE:
AVG Y = 4.920036
AVG X = 1.965735
AVG T = 1.e**694
SLOPE = 10.643e7
WITH A STANDARD ERROR = 3.134186
INTERCEPT = -14.62336
CHI SQUARED = 6.[illegible]

POINT	CONCENTRATION	95% CONFIDENCE LIMITS LOWER	UPPER
LC 0.10	46.39	15.14	61.07
LC 0.50	52.15	20.46	65.79
LC 1.00	55.22	23.67	68.22
LC 5.00	64.56	35.20	76.41
LC10.00	70.16	43.45	79.65
LC15.00	74.22	50.05	82.73
LC50.00	94.13	85.74	102.84
LC85.00	119.37	107.57	174.96
LC90.00	126.28	111.54	201.41
LC95.00	137.24	117.63	248.55
LC99.00	160.45	130.26	369.66
LC99.50	169.89	135.08	427.68
LC99.90	191.16	145.52	577.85
LC99.99	220.80	159.31	835.16

* N O T E : IF THE LC VALUE (LC1,LC2. . . . LC99) IS ABOVE/BELOW THE HIGHEST/LOWEST CONCENTRATION TESTED, EXTREME CAUTION SHOULD BE EXERCISED IN REGARD TO USING SUCH VALUE(S) BECAUSE IT/THEY LIE(S) OUTSIDE THE KNOWN RANGE AND IS ONLY AN EXTRAPOLATED ESTIMATED VALUE.SIMILAR PRECAUTIONS SHOULD ALSO BE USED IN REGARD TO THE UPPER AND LOWER 95% CONFIDENCE LIMITS FOR LIKE REASONS.

Table D-3. Statistical Analyses, Bioassay Data, Selenastrum capricornutum, Pink Water Treatment Effluent, RVAAP, 25 July 1988

PROBIT ANALYSIS
USED FOR CALCULATING EC VALUES FROM EC0.1 TO EC99.99
IN ALGAL ANALYSIS

CHI SQUARED ESTIMATE OBTAINED BY SUBTRACTION = 194.0388

P R O B I T T A B L E

CONCENTRATION	PERCENT	PROBABILITY
20.0000	68.7801	0.8352
40.0000	76.4182	0.6413
60.0000	82.7735	0.5014
80.0000	79.5699	0.4010
100.0000	-14.3122	0.3270

THE CONSTANTS USED IN THIS PROBLEM WERE :
HETEROGENEITY FACTOR = 64.6796
NUMBER OF POINTS = 5
DEGREES OF FREEDOM = 3
DEVIATE = 3.162
G = .1574178
NUMBER OF CYCLES = 5
THE STATISTICS ARE:
AVG Y = 5.081436
AVG X = 1.739862
AVG T = 1.286714
SLOPE = -2.036163
WITH A STANDARD ERROR = .2036863
INTERCEPT = 8.624122
CHI SQUARED = 194.0388

POINT	CONCENTRATION	95% CONFIDENCE LIMITS LOWER	UPPER
EC-VALUE	U N C A L C U L A B L E		
EC-VALUE	U N C A L C U L A B L E		
EC-VALUE	U N C A L C U L A B L E		
EC-VALUE	U N C A L C U L A B L E		
EC-VALUE	U N C A L C U L A B L E		
EC-VALUE	U N C A L C U L A B L E		
EC-VALUE	U N C A L C U L A B L E		
EC-VALUE	U N C A L C U L A B L E		
EC-VALUE	U N C A L C U L A B L E		
EC-VALUE	U N C A L C U L A B L E		
EC-VALUE	U N C A L C U L A B L E		
EC-VALUE	U N C A L C U L A B L E		
EC-VALUE	U N C A L C U L A B L E		
EC-VALUE	U N C A L C U L A B L E		
EC-VALUE	U N C A L C U L A B L E		

N O T E : IF THE EC VALUE (EC1,EC2. . . . EC99) IS ABOVE/BELOW THE HIGHEST/LOWEST CONCENTRATION TESTED, EXTREME CAUTION SHOULD BE EXERCISED IN REGARD TO USING SUCH VALUE(S) BECAUSE IT/THEY LIE(S) OUTSIDE THE 'KNOWN' RANGE AND IS ONLY AN EXTRAPOLATED ESTIMATED VALUE. SIMILAR CAUTIONS SHOULD ALSO BE USED IN REGARD TO THE UPPER AND LOWER 95% CONFIDENCE LIMITS FOR LIKE REASONS.

Table D-4. Statistical Analyses, Bioassay data, Pimephales promelas, Pink Water Treatment Effluent, RVAAP, 27 September 1988

ANOVA-WITH THE DUNNETT COMPARISON OF EACH CONCENTRATION MEAN VS THE CONTROL MEAN. UP TO EIGHT CONCENTRATIONS (INCLUDING THE CONTROL) MAY BE USED.

A ONE SIDED 'T' AT 95% IS ASSUMED IN ALL CASES.

THE TRANSFORMATIONS WHICH MAY BE USED ON THE DATA ARE:

NUMBER	TRANSFORMATION
0	NONE
1	SQUARE ROOT(X)
3	LOG10(X)
5	(ARCSIN(SQ. RT(X)/(N+1)+ ARCSIN(SQ. RT(X+1)/(N+1)))/2
6	ARCSIN((X)^0.5)

NOTE : THE LIMITS OF SIN ARE +/- 1.

RESULTS OF SEQUENTIAL COMPARISONS USING THE DUNNETT'S TEST

For this set of data, the minimum significant difference is 0.08363.
This represents a 0.4181% reduction of the mean response from the control (at 95%).
T = 2.83

There is NO SIGNIFICANT DIFFERENCE between concentration 2 and CONTROL.
There is NO SIGNIFICANT DIFFERENCE between concentration 3 and CONTROL.
There is NO SIGNIFICANT DIFFERENCE between concentration 4 and CONTROL.
There is NO SIGNIFICANT DIFFERENCE between concentration 5 and CONTROL.
There is NO SIGNIFICANT DIFFERENCE between concentration 6 and CONTROL.

INPUT DATA TABLE

A	B
10.000000	10.000000
10.000000	10.000000
10.000000	10.000000
9.000000	10.000000
10.000000	10.000000
10.000000	10.000000

TRANSFORMED DATA TABLE

(NOTE: TRANSFORMATION NUMBER 5 WAS USED FOR THIS SET OF DATA.)

A	B
1.417658	1.417658
1.417658	1.417658
1.417658	1.417658
1.197402	1.417658
1.417658	1.417658
1.417658	1.417658

ANOVA TABLE

Source	DF	Sum of Sq.	Mean Sq.	Calc F	Tab.F(0.05))
AMONG	5	0.02022	0.00404	1.0002	4.3900
WITHIN	6	0.02426	0.00404		
TOTAL	11	0.04447			

Table D-5. Statistical Analyses, Bioassay Data, Ceriodaphnia dubia, Pink Water Treatment Effluent, RVAAP, 27 September 1988

ANOVA-WITH THE DUNNETT COMPARISON OF EACH CONCENTRATION MEAN VS THE CONTROL MEAN. UP TO EIGHT CONCENTRATIONS (INCLUDING THE CONTROL) MAY BE USED.

A ONE SIDED 'T' AT 95% IS ASSUMED IN ALL CASES.

THE TRANSFORMATIONS WHICH MAY BE USED ON THE DATA ARE:

NUMBER	TRANSFORMATION
0	NONE
1	SQUARE ROOT(X)
3	LOG10(X)
5	(ARCSIN(SQ. RT(X)/(N+1))+ ARCSIN(SQ. RT(X+1)/(N+1)))/2
6	ARCSIN((X)^0.5)

NOTE : THE LIMITS OF SIN ARE /- 1.

RESULTS OF SEQUENTIAL COMPARISONS
USING THE DUNNETT'S TEST

For this set of data, the minimum significant difference is 0.22093.
This represents a 1.1047% reduction of the mean response from the control (at 95%).
T = 2.83

There is NO SIGNIFICANT DIFFERENCE between concentration 2 and CONTROL.
There is NO SIGNIFICANT DIFFERENCE between concentration 3 and CONTROL.
There is NO SIGNIFICANT DIFFERENCE between concentration 4 and CONTROL.
There is NO SIGNIFICANT DIFFERENCE between concentration 5 and CONTROL.
There is NO SIGNIFICANT DIFFERENCE between concentration 6 and CONTROL.

INPUT DATA TABLE

A	B
10.000000	10.000000
10.000000	10.000000
10.000000	10.000000
10.000000	10.000000
10.000000	10.000000
10.000000	7.000000

TRANSFORMED DATA TABLE

(NOTE: TRANSFORMATION NUMBER 5 WAS USED FOR THIS SET OF DATA.)

A	B
1.417658	1.417658
1.417658	1.417658
1.417658	1.417658
1.417658	1.417658
1.417658	1.417658
1.417658	0.972420

ANOVA TABLE

Source	DF	Sum of Sq.	Mean Sq.	Calc F	Tab.F(0.05))
AMONG	5	0.08260	0.01652	1.0000	4.3900
WITHIN	6	0.09912	0.01652		
TOTAL	11	0.18172			

Table D-6. Statistical Analyses, Bioassay Data, Selenastrum capricornutum, Pink Water Treatment Effluent, RVAAP, 27 September 1988

ANOVA-WITH THE DUNNETT COMPARISON OF EACH CONCENTRATION MEAN VS THE CONTROL MEAN. UP TO EIGHT CONCENTRATIONS (INCLUDING THE CONTROL) MAY BE USED.

A ONE SIDED 'T' AT 95% IS ASSUMED IN ALL CASES.

THE TRANSFORMATIONS WHICH MAY BE USED ON THE DATA ARE:

NUMBER	TRANSFORMATION
0	NONE
1	SQUARE ROOT(X)
3	LOG10(X)
5	(ARCSIN(SQ. RT(X)/(N+1)+ ARCSIN(SQ. RT(X+1)/(N+1)))/2
6	ARCSIN((X)^0.5)

NOTE : THE LIMITS OF SIN ARE +/- 1.

RESULTS OF SEQUENTIAL COMPARISONS USING THE DUNNETT'S TEST

For this set of data, the minimum significant difference is %3897.90900.
This represents a 38.5827% reduction of the mean response from the control (at 95%).
T = 2.5

There is NO SIGNIFICANT DIFFERENCE between concentration 2 and CONTROL.

=> There IS SIGNIFICANT DIFFERENCE between concentration 3 and CONTROL.
There is NO SIGNIFICANT DIFFERENCE between concentration 4 and CONTROL.

=> There IS SIGNIFICANT DIFFERENCE between concentration 5 and CONTROL.
There is NO SIGNIFICANT DIFFERENCE between concentration 6 and CONTROL.

INPUT DATA TABLE

A	B	
12121.580000	8951.327000	9235.330000
7207.017000	8119.638000	8433.333000
2387.838000	4792.097000	5304.942000
9458.611000	8145.723000	10993.840000
5056.692000	4389.562000	5343.502000
6046.913000	9963.760000	6503.866000

TRANSFORMED DATA TABLE

(NOTE: TRANSFORMATION NUMBER 3 WAS USED FOR THIS SET OF DATA.)

A	B	
4.083559	3.951887	3.965453
3.857756	3.909537	3.926000
3.378005	3.680526	3.724681
3.975828	3.910930	4.041150
3.703866	3.642421	3.727826
3.781534	3.998423	3.813172

ANOVA TABLE

Source	DF	Sum of Sq.	Mean Sq.	Calc F	Tab.F(0.05))
AMONG	5	0.39139	0.07828	7.5701	3.1100
WITHIN	12	0.12408	0.01034		
TOTAL	17	0.51547			

Table D-7. Statistical Analyses, Reference Toxicant, Pimephasles promelas, RVAAP, 13 October 1988

BURLINGTON RESEARCH, INC.
TRIMMED SPEARMAN-KARBER METHOD FOR CALCULATION OF
EC50 AND LC50 VALUES IN BIOASSAYS

FOR REFERENCE. CITE
M.A. HAMILTON, R.C. RUSSO, AND R.V. THURSTON, 1977.
TRIMMED SPEARMAN-KARBER METHOD FOR ESTIMATING MEDIAN
LETHAL CONCENTRATIONS IN TOXICITY BIOASSAYS.
ENVIRON. SCI. TECHNOL. 11(7) 714-719
CORRECTION 12(4) 417 (1978).

DATE_____13 Oct 88
TEST #_____2
CHEMICAL_____Sodium lauryl sulfate
SPECIES_____promelas
DURATION_____ 96 hours

RAW DATA

CONCENTRATION(mg/l)	2.90	5.80	8.70	11.60	14.50
NUMBER EXPOSED	20	20	20	20	20
MORTALITIES	0	9	11	13	19

SPEARMAN-KARBER TRIM 5.00
SPEARMAN-KARBER ESTIMATES LC50 7.1903477
95% LOWER CONFIDENCE 6.06
95% UPPER CONFIDENCE 8.53

~~20687~~
~~7031~~
~~19323~~
~~GEOMETRIC MEAN = 12.50~~

Table D-8. Statistical Analyses, Reference Toxicant, Ceriodaphnia dubia, RVAAP, 13 October 1988

BURLINGTON RESEARCH, INC.
TRIMMED SPEARMAN-KARBER METHOD FOR CALCULATION OF
EC50 AND LC50 VALUES IN BIOASSAYS

FOR REFERENCE. CITE
M.A. HAMILTON, R.C. RUSSO, AND R.V. THURSTON, 1977.
TRIMMED SPEARMAN-KARBER METHOD FOR ESTIMATING MEDIAN
LETHAL CONCENTRATIONS IN TOXICITY BIOASSAYS.
ENVIRON. SCI. TECHNOL. 11(7) 714-719
CORRECTION 12(4) 417 (1978).

DATE_____13 Oct 88
TEST #_____2
CHEMICAL_____Sodium lauryl sulfate
SPECIES_____Ceriodaphnia
DURATION_____ 48 hours

RAW DATA

CONCENTRATION(mg/l)	2.90	5.80	8.70	11.60	14.50
NUMBER EXPOSED	20	20	20	20	20
MORTALITIES	8	13	14	17	19

SPEARMAN-KARBER TRIM 40.00
SPEARMAN-KARBER ESTIMATES LC50 3.8265731
95% LOWER CONFIDENCE 2.02
95% UPPER CONFIDENCE 7.26

Table D-9. Statistical Analyses, Reference Toxicant, Selenastrum capricornutum, RVAAP, 13 October 1988

R E S U L T S O F S E Q U E N T I A L C O M P A R I S O N S
U S I N G T H E D U N N E T T ' S T E S T

For this set of data, the minimum significant difference is %7206.17000.
This represents a 29.1305% reduction of the mean response from the control (a
95%).
T = 2.5

There is NO SIGNIFICANT DIFFERENCE between concentration 2 and CONTROL.
There is NO SIGNIFICANT DIFFERENCE between concentration 3 and CONTROL.

=> There IS SIGNIFICANT DIFFERENCE between concentration 4 and CONTROL.

=> There IS SIGNIFICANT DIFFERENCE between concentration 5 and CONTROL.

=> There IS SIGNIFICANT DIFFERENCE between concentration 6 and CONTROL.

I N P U T D A T A T A B L E

A	B	
28406.260000	24823.460000	20982.810000
19263.490000	19785.470000	23787.510000
18546.810000	15458.690000	20318.910000
9074.624000	13764.050000	13433.110000
7655.232000	6020.315000	9435.200000
8899.807000	8109.136000	8297.874000

T R A N S F O R M E D D A T A T A B L E

(NOTE: TRANSFORMATION NUMBER 3 WAS USED FOR THIS SET OF DATA.)

A	B	
4.453414	4.394863	4.321864
4.284780	4.296346	4.376349
4.268270	4.189173	4.307901
3.957829	4.138746	4.128823
3.883958	3.779619	3.974751
3.949381	3.908975	3.918967

A N O V A T A B L E

Source	DF	Sum of Sq.	Mean Sq.	Calc F	Tab.F(0.05))
AMONG	5	0.67758	0.13552	26.4059	3.1100
WITHIN	12	0.06158	0.00513		
TOTAL	17	0.73917			

PROBIT ANALYSIS
USED FOR CALCULATING EC VALUES FROM EC0.1 TO EC99.99
IN ALGAL ANALYSIS

CHI SQUARED NOT SIGNIFICANT. EXPECTED NUMBERS NOT CHECKED

P R O B I T T A B L E

CONCENTRATION	PERCENT	PROBABILITY
2.9000	15.3263	0.1302
5.8000	26.7989	0.3385
8.7000	51.0975	0.4992
11.6000	68.8587	0.6150
14.5000	65.8995	0.6986

THE CONSTANTS USED IN THIS PROBLEM WERE :
HETEROGENEITY FACTOR = 1.926773
NUMBER OF POINTS = 5
DEGREES OF FREEDOM = 3
DEVIATE = 1.96
G = 4.815494E-02
NUMBER OF CYCLES = 5
THE STATISTICS ARE:
AVG Y = 4.923713
AVG X = .9079471
AVG T = 1.638415
SLOPE = 2.354786
WITH A STANDARD ERROR = .2636427
INTERCEPT = 2.785692
CHI SQUARED = 5.780319

POINT	CONCENTRATION	LOWER 95% CONFIDENCE LIMITS	UPPER 95% CONFIDENCE LIMITS
EC 0.10	0.42	0.18	0.73
EC 0.50	0.70	0.35	1.10
EC 1.00	0.90	0.48	1.35
EC 5.00	1.75	1.11	2.34
EC10.00	2.49	1.74	3.15
EC15.00	3.16	2.36	3.86
EC50.00	8.72	7.77	9.85
EC85.00	24.01	19.24	33.46
EC90.00	30.52	23.52	45.30
EC95.00	43.54	31.61	71.10
EC99.00	84.77	54.86	166.15
EC99.50	108.19	67.08	226.85
EC99.90	178.92	101.52	431.34
EC99.99	330.89	168.34	946.78

N O T E : IF THE EC VALUE (EC1,EC2, . . . EC99) IS ABOVE/BELOW THE HIGHEST/LOWEST CONCENTRATION TESTED, EXTREME CAUTION SHOULD BE EXERCISED IN REGARD TO USING SUCH VALUE(S) BECAUSE IT/THEY LIE(S) OUTSIDE THE 'KNOWN' RANGE AND IS ONLY AN EXTRAPOLATED ESTIMATED VALUE. SIMILAR CAUTIONS SHOULD ALSO BE USED IN REGARD TO THE UPPER AND LOWER 95% CONFIDENCE LIMITS FOR LIKE REASONS.

1070

UNITED STATES ARMY ENVIRONMENTAL HYGIENE AGENCY

ABERDEEN PROVING GROUND, MD 21010-5422

RECEIVING WATER BIOLOGICAL STUDY
NO. 32-24-0041-90
EFFLUENT TOXICITY TESTING
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
22 JANUARY - 25 FEBRUARY 1990

DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO
ATTENTION OF

HSHB-ME-WM (40)

21 JUN 1990

MEMORANDUM FOR Commander, U.S. Army Materiel Command, ATTN: AMCSG, 5001 Eisenhower Avenue, Alexandria, VA 22333-0001

SUBJECT: Receiving Water Biological Study No. 32-24-0041-90, Effluent Toxicity Testing, Ravenna Army Ammunition Plant, Ravenna, Ohio, 22 January - 25 February 1990

Copies of report with Executive Summary are enclosed.

FOR THE COMMANDER:

Roy D. Miller

ROY D. MILLER, P.E.
LTC, MS
Chief, Water Quality Engineering Division

Encl

CF:
HQDA(SGPS-PSP) (wo/encl)
HQDA(ENVR-E) (w/encl)
DA, USAEHSC, ATTN: CEHSC-F (w/encl)
Cdr, AMCCOM, ATTN: AMSMC-SG (w/encl)
Cdr, HSC, ATTN: HSCL-P (w/encl)
Cdr, RVAAP, ATTN: Mr. Tom Chanda (2 cy) (w/encl)
Cdr, MEDDAC, Ft Knox, ATTN: PVNTMED Svc (2 cy) (w/encl)
Cdr, WRAMC, ATTN: PVNTMED Svc (w/encl)
Cdr, USATHAMA, ATTN: CETHA-TE-E (w/encl)
Cdr, USATHAMA, ATTN: CETHA-RM(TIC) (2 cy) (w/encl)
Cdr, USAEHA-N (w/encl)

EXECUTIVE SUMMARY
RECEIVING WATER BIOLOGICAL STUDY
NO. 32-24-0041-90
EFFLUENT TOXICITY TESTING
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
22 JANUARY - 25 FEBRUARY 1990

1. PURPOSE. The purpose of this study is to assist Ravenna Army Ammunition Plant by conducting aquatic toxicity tests on the effluent from their pink water treatment system.

2. CONCLUSIONS. The Load Line 7 pink water treatment system effluent was sampled on 22 January and 19 February 1990. The effluent was nontoxic to fathead minnows (*Pimephales promelas*), daphnids (*Ceriodaphnia dubia*), and algae (*Selenastrum capricornutum*). The chemical water quality was excellent.

DEPARTMENT OF THE ARMY
U.S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO ATTENTION OF

HSHB-ME-WM

RECEIVING WATER BIOLOGICAL STUDY NO. 32-24-0041-90 EFFLUENT TOXICITY TESTING RAVENNA ARMY AMMUNITION PLANT RAVENNA, OHIO 22 JANUARY - 25 FEBRUARY 1990

1. REFERENCES. A list of all references used in this report is located in Appendix A.

2. AUTHORITY. AEHA Form 250-R, AMC, 10 October 1989.

3. PURPOSE. The purpose of this study is to assist Ravenna Army Ammunition Plant (RVAAP) by conducting aquatic toxicity tests on the effluent from their pink water treatment system.

4. GENERAL.

a. Background. Ravenna Army Ammunition Plant was preparing to reactivate an explosives loading operation (Load Line 7). As part of this reactivation, RVAAP was operating a pilot-scale Octol melt and pour operation, Load Line 6. Octol is a high explosive mixture of 25-30 percent trinitrotoluene (TNT) and 70-75 percent cyclo-tetra-methylene-tetra-nitramine (HMX). Wastewaters generated by the wash down of equipment and loading facilities are known as "pink water." This wastewater is treated in a filtration/activated carbon adsorption system which discharges to the RVAAP's sanitary sewer. The Ohio Environmental Protection Agency (OEPA) required RVAAP to conduct two acute bioassays on the pink water treatment effluent within the first 2 months of operation (references 1 and 2). The pilot-scale operation (Load Line 6) was identical to the Load Line 7 operation which was to be reactivated. Load Line 6 and Load Line 7 have similar wastewater characteristics. The OEPA had approved the use of wastewater samples from Load Line 6 to fulfill the bioassay requirements for Load Line 7. This Agency conducted the bioassays on Load Line 6 effluent and found toxicity in one of the two bioassays (reference 3). Therefore, instead of allowing the bioassays from Load Line 6 to be representative of Load Line 7, OEPA required that the bioassays be repeated when Load Line 7 became operational. This study reports the results of the bioassays conducted on the effluent from Load Line 7.

b. Study Plan. A complete study plan summarizing sample types, locations, analytical methodologies, and biomonitoring techniques is included in Appendix B.

5. FINDINGS AND DISCUSSION. Wastewater samples were collected from the final effluent of the RVAAP (Load Line 7) pink water treatment system on 22 January 1990 and 19 February 1990. A reference toxicant was used to test reliability of organisms and laboratory procedures.

a. 22 January 1990 Sampling.

(1) Chemical Analyses. The analytical results for the effluent sample are presented in Table C-1, Appendix C. The effluent was extremely high quality.

(2) Bioassay Results. Bioassays were conducted on larval fathead minnows (Pimephales promelas), daphnids (Ceriodaphnia dubia), and algae (Selenastrum capricornutum). The results of the bioassays are presented in Tables C-2 through C-4 Appendix C. During this test, the effluent was nontoxic to all three species.

b. 19 February 1990 Sampling.

(1) Chemical Analyses. Analytical results for the effluent sample are presented in Table D-1, Appendix D. The effluent was extremely high quality.

(2) Bioassay Results. Bioassays were conducted on one week old fathead minnows (Pimephales promelas), daphnids (Ceriodaphnia dubia), and algae (Selenastrum capricornutum). The results of the bioassays are presented in Tables D-2 through D-4, Appendix D. No effluent concentrations were found to cause significantly lower survival than the control in the above assays. The statistical analyses (Dunnett's Procedure) for the Pimephales promelas, Ceriodaphnia dubia, and Selenastrum capricornutum assays showed that there was no correlation between effluent concentration and deaths of the test organisms. Therefore, any deaths of test organisms can be considered to be random.

c. Reference Toxicant. A reference toxicant (Cadmium Chloride) was used to evaluate the quality control of the biomonitoring laboratory procedures (reference 4). The results are summarized in Table E-1, Appendix E. The complete data are included in Tables E-2 through E-4, Appendix E. Results for the reference toxicant assays were within the acceptable ranges.

6. CONCLUSIONS. The effluent from RVAAP's pink water treatment system was nontoxic during both sets of toxicity tests. The overall chemical quality of the effluent was excellent.

Carl A. Bouwkamp

CARL A. BOUWKAMP
Aquatic Biologist
Water Quality Engineering
Division

APPROVED:

William F. Fifty

WILLIAM F. FIFTY, P.E.
Chief, Wastewater Management Branch
Water Quality Engineering Division

APPENDIX A

REFERENCES

1. Letter, Northeast District Office, State of Ohio Environmental Protection Agency (OEPA), to Ravenna Army Ammunition Plant, 3 June 1988.

2. Letter, Northeast District Office, State of Ohio Environmental Protection Agency (OEPA) to Ravenna Army Ammunition Plant, 14 June 1988.

3. Memorandum, USAEHA, HSHB-ME-WS, 21 March 1889, subject: Water Quality Engineering Consultation No. 32-24-0896-89, Toxicity Identification Evaluation, Ravenna Army Ammunition Plant, Ravenna, Ohio, 25 July -18 October 1988.

4. United States Environmental Protection Agency (EPA), Environmental Monitoring and Support Laboratory, Quality Control Samples, Instruction For Reference Toxicants-Cadmium Chloride.

5. Title 40, Code of Federal Regulations (CFR), 1988 rev, Part 136, Guidelines Establishing Test Procedures for the Analysis of Pollutants.

6. EPA 600/4-79-020, March 1983, Methods for Chemical Analysis of Water and Wastes.

7. Bongiovanni, R., G.E. Podolak, L.D. Clark, and D.T. Scarbough, "Analysis of Trace Amounts of Six Selected Poly-Nitro Compounds in Soil," American Industrial Hygiene Association Journal, 45(4): 222-086, 1984.

8. EPA 600/4-85/013, March 1985, Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms (3rd Edition).

9. EPA 600/4-89/001, March 1989, Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, (Second Edition).

10. EPA-600/9-78-018, July 1978, The Selenastrum Capricornutum Printz Algal Assay Bottle Test.

11. OEPA, QA Manual-Bioassay, 0327d/0003d, 1 October 1987.

APPENDIX B

STUDY PLAN

1. WATER SAMPLING. After grab samples of the wastewater were collected, the samples were distributed into the proper containers and preserved according to the EPA procedures [40 CFR 136.3 (e)reference 5]. The samples for biomonitoring were stored in 5-gallon, flexible plastic cubetainers. Samples were packed with ice packs and shipped via next-day-delivery to laboratories at the USAEHA, APG-EA, Maryland. The bioassays were started within 24 hours of sample collection except for the fat head minnow test on the 19 February sampling. It was delayed to 48 hours because of problems with shipment.

2. CHEMICAL ANALYSES. The following chemical parameters were analyzed on the wastewater collected 22 January and 19 February 1990.

a. Purgeable Organics (EPA Method 624, reference 5).

b. Base/Neutral Extractable Organics (EPA Method 625, reference 5).

c. Acid Extractable Organics (EPA Method 625, reference 5).

d. Nitrate+Nitrite-Nitrogen (EPA Method 350.1, reference 6).

e. Ammonia-Nitrogen (EPA Method 350.2, reference 6).

f. Chemical Oxygen Demand (EPA Method 410.4, reference 6).

g. Total Organic Carbon (EPA Method 415.1, reference 6).

h. Explosives (HMX, RDX, TNT, 2,6-DNT, 2,4-DNT) (Liquid Chromatography/Gas Chromatography, reference 7.

i. Alkalinity (EPA Method 310.1, reference 6).

j. Hardness (EPA, atomic absorption, calculated, reference 6).

3. FACILITIES.

a. Mobile and permanent laboratories owned and operated by the USAEHA were used to conduct the bioassays. The algal assays were conducted in the permanent laboratory. The fish and daphnid assays were conducted in the mobile laboratory.

b. The environmental control for the algae was a New Brunswick environmental shaker set at 24 ± 2 °C. The illumination intensity at flask level was 400 ± 10 foot candles anywhere on the platform. The fish and the daphnids were conducted on 16/8 hour light/dark cycles and the temperature was maintained by a temperature controlled water bath held at 20 ± 2 °C.

4. DILUTION WATER. Dilution water was deionized water reconstituted according to the guidelines in reference 8, not the receiving waters, as the pink water treatment system discharges to the sanitary sewer. The dilution water had a conductivity of 233-333 µmhos/cm, hardness of 34-68 mg/L, pH of 7.2-7.6, and an alkalinity of 21-53 mg/L.

5. TEST ORGANISMS. All organisms are from the EPA Biological Monitoring Laboratory in Wheeling, West Virginia. Five to seven days prior to the test, the algae, (Selenastrum capricornutum) were transferred to nutrient medium prepared according to references 9 and 10 and allowed to grow. Then centrifuged, decanted and resuspended in sterile distilled water to a concentration convenient for inoculation of the test vessels for an initial concentration of 10,000 cells per mL. Nutrients were added to both distilled water and effluent except for the EDTA, as described in reference 8. The Ceriodaphnia were cultured in the USAEHA laboratory. Then 24 hours before the test, the adults were transferred to isolation containers and the newly hatched young were used for the test. The fathead minnows (Pimephales promelas) were newly hatched young sent via next-day delivery from EPA Wheeling, West Virginia.

6. QUALITY ASSURANCE. Cadmium Chloride was used as a reference toxicant. Each day prior to taking readings in the bioassay containers, the meters were calibrated for conductivity, temperature, pH, and dissolved oxygen. All chemical analyses were conducted under the direction of the Directorate of Laboratory Services, USAEHA. Analytical quality assurance data for the various analyses can be provided upon request. The laboratories are accredited or certified by the following organizations: American Industrial Hygiene Association, American Association for Laboratory Accreditation, the State of Maryland, and EPA Regions III, V, VII, VIII and X. The laboratories are also certified in 45 other states via reciprocity with the certification program of the State of Maryland.

7. TOXICITY TESTING METHODOLOGY. Bioassays were conducted twice on the effluent from Load Line 7 pink water treatment system. The tests followed methods outlined in references 8-10. A summary of specific methods is presented in the Table. These methods are analogous to those specified by the OEPA in reference 11. All assays were started the same day as the effluent samples were received (within 24 hours from the end of the grab sampling period, except for the second fathead minnow test that was not started until 48 hours).

TABLE. METHODS FOR CONDUCTING BIOASSAYS FOR RVAAP, JANUARY - FEBRUARY 1990

Species	Time of Exposure	Type Assay	Temperature (°C)	Determination*	Loading	Replicates	Methods
Fathead minnows (Pimephales promelas)	96 hrs	Static	20	LC_{50}	<0.4g/L	2	Ref 8
Daphnia (Ceriodaphnia dubia)	48 hrs	Static	20	LC_{50}	<0.4g/L	2	Ref 8
Algae (Selenastrum capricornutum)	96 hrs	Static	24	EC_{50}	10,000/mL	3	Ref 9 and 10

* LC_{50} = % effluent concentration that causes lethality to 50% of the fathead minnows, or loss of movement upon gentle probing in Ceriodaphnia.

EC_{50} = % effluent concentration that causes a 50% reduction of cell growth in Selenastrum.

APPENDIX C

CHEMICAL ANALYSES AND BIOASSAY DATA

22 JANUARY 1990 SAMPLING

TABLE C-1. CHEMICAL ANALYTICAL RESULTS, PINK WATER TREATMENT EFFLUENT, RVAAP, 22 JANUARY 1990

Parameter	Concentration
Conventional Pollutants	
Chemical Oxygen Demand	29 mg/L
Total Organic Carbon	<1.0 mg/L
Nitrate+Nitrite Nitrogen	1.7 mg/L
Ammonia Nitrogen	<0.1 mg/L
Alkalinity	270 mg/L
Hardness	174 mg/L
Explosives	
HMX (Cyclo-tetramethylene-tetranitramine)	<100 µg/L
RDX (Cyclo-trimethylene-trinitramine)	<30 µg/L
TNT (Trinitrotoluene)	<1 µg/L
2,6 DNT (Dinitrotoluene)	<1 µg/L
2,4 DNT (Dinitrotoluene)	<1 µg/L
Volatile Organics	
Chloromethane	<3.0 µg/L
Bromomethane	<3.0 µg/L
Vinyl Chloride	<3.0 µg/L
Chloroethane	<3.0 µg/L
Methylene Chloride	<3.0 µg/L
Trichlorofluoromethane	<3.0 µg/L
1,1-Dichloroethene	<3.0 µg/L
1,1-Dichloroethane	<3.0 µg/L
trans-1,2-Dichloroethene	<3.0 µg/L
Chloroform	<3.0 µg/L
1,2-Dichlorethane	<3.0 µg/L
1,1,1-Trichloroethane	<3.0 µg/L
Carbon Tetrachloride	<3.0 µg/L
Bromodichloromethane	<3.0 µg/L
1,1,2,2-Tetrachloroethane	<3.0 µg/L
1,2-Dichloropropane	<3.0 µg/L
trans-1,3-Dichloropropene	<3.0 µg/L
Trichloroethene	<3.0 µg/L
Dibromochloromethane	<3.0 µg/L
1,1,2-Trichloroethane	<3.0 µg/L
Benzene	<3.0 µg/L
cis-1,3-Dichloropropene	<3.0 µg/L
2-Chloroethylvinyl ether	<3.0 µg/L
Bromoform	<3.0 µg/L
Tetrachloroethene	<3.0 µg/L
Toluene	<3.0 µg/L
Chlorobenzene	<3.0 µg/L
Ethylbenzene	<3.0 µg/L

Base/Neutral Extractable Organics	Concentration
Benzyl alcohol	<10.0 µg/L
bis (2-chloroethyl) ether	<10.0 µg/L
1,3-Dichlorobenzene	<10.0 µg/L
1,4-Dichlorobenzene	<10.0 µg/L
1,2-Dichlorobenzene	<10.0 µg/L
bis (2-chloroisopropyl) ether	<10.0 µg/L
Hexachloroethane	<10.0 µg/L
N-nitrosodi-n-propylamine	<10.0 µg/L
Nitrobenzene	<10.0 µg/L
Isophorone	<10.0 µg/L
bis (2-chloroethoxy) methane	<10.0 µg/L
1,2,4-trichlorobenzene	<10.0 µg/L
Naphthalene	<10.0 µg/L
Hexachlorobutadiene	<10.0 µg/L
Hexachlorocyclopentadiene	<10.0 µg/L
2-Chloronaphthalene	<10.0 µg/L
Acenaphthylene	<10.0 µg/L
Dimethyl phthalate	<10.0 µg/L
2,4-Dinitrotoluene	<10.0 µg/L
2,6-Dinitrotoluene	<10.0 µg/L
Acenaphthene	<10.0 µg/L
2,4-Dinitrotoluene	<10.0 µg/L
Fluorene	<10.0 µg/L
4-Chlorophenyl phenyl ether	<10.0 µg/L
Diethyl phthalate	<10.0 µg/L
2-Methylnaphthalene	<10.0 µg/L
N-nitrosodiphenylamine	<10.0 µg/L
4-Bromophenyl phenyl ether	<10.0 µg/L
Hexachlorobenzene	<10.0 µg/L
Phenanthrene	<10.0 µg/L
Anthracene	<10.0 µg/L
Di-n-butyl phthalate	<10.0 µg/L
Fluoranthene	<10.0 µg/L
Pyrene	<10.0 µg/L
Dibenzofuran	<10.0 µg/L
Butyl benzyl phthalate	<10.0 µg/L
Benzo (a) anthracene	<10.0 µg/L
Chrysene	<10.0 µg/L
3,3'-Dichlorobenzidine	<20.0 µg/L
bis (2-ethylhexyl) phthalate	<10.0 µg/L
Di-n-octyl phthalate	<10.0 µg/L
Benzo (b) fluoranthene	<10.0 µg/L
Benzo (k) fluoranthene	<10.0 µg/L
Benzo (a) pyrene	<10.0 µg/L
Indeno (1,2,3-cd) pyrene	<10.0 µg/L
Dibnezo (a,h) anthracene	<10.0 µg/L
Benzo (ghi) perylene	<10.0 µg/L

Acid Extractables Organics	Concentration
2-Chlorophenol	<10.0 µg/L
Phenol	<10.0 µg/L
2-Nitrophenol	<10.0 µg/L
2,4-Dimethylphenol	<10.0 µg/L
2,4-Dichlorophenol	<10.0 µg/L
4-Methylphenol	<10.0 µg/L
4-Chloro-3-methylphenol	<10.0 µg/L
4-Chloroaniline	<10.0 µg/L
2,4,6-Trichlorophenol	<10.0 µg/L
2,4,5-Trichlorophenol	<10.0 µg/L
2,4-Dinitrophenol	<50.0 µg/L
4-Nitrophenol	<50.0 µg/L
2-Methyl-4,6-dinitrophenol	<50.0 µg/L
Pentachlorophenol	<50.0 µg/L
2-Nitroaniline	<50.0 µg/L
3-Nitroaniline	<50.0 µg/L
4-Nitroaniline	<50.0 µg/L
Benzoic acid	<50.0 µg/L

TABLE C-2. BIOASSAY RESULTS, FAT HEAD MINNOW, PINK WATER TREATMENT EFFLUENT, RVAAP, 22 JANUARY 1990

DATA SHEET FOR BIOASSAY TOXICITY TEST

CONTACT: Carl Bowkamp	EFFLUENT SERIAL NUMBER: Ravenna, AAP, OH	EFFLUENT: Load line 7 Pink water Treatment Effluent	ADDRESS
SUPERVISOR: Bill Fifty	BEGINNING DATE: 1/23/90 TIME: 1430	NPDES PERMIT NUMBER	TEST CONDUCTED BY: Ed Kubala
TEST ORGANISM: Fat head minnow	TEST ORGANISM SIZE: LENGTH MAX ____ MIN ____ AVE ____ Larval	ENDING DATE: 1/27/90 TIME: 1430	AERATION ADDED: YES ____ NO X RATE ____
SOURCE OF FISH: EPA Wheeling, WV	ACCLIMATION: ____ % LOSS AFTER ____ DAYS	TEST ORGANISM SIZE: NET WEIGHT MAX ____ MIN ____ AVE ____	

NOTES

	AMMONIA mg/L	CONDUCTIVITY	TOTAL ALKALINITY mg/L or $CaCO_3$	TOTAL HARDNESS mg/L as $CaCO_3$	SALINITY 0/00
INITIAL	D = <0.1 E = <0.1		D = 53 E = 220	D = 61.8 E = 174	
FINAL	D = <0.1 E = <0.1		D = 60 E = 280	D = 68.5 E = 189	

CONC. OR % EFFLUENT	TANK NUMBER	NUMBER OF LIVE ORGANISMS 0	24	48	72	96	TEMPERATURE °C 0	24	48	72	96	DISSOLVED OXYGEN (mg/l) 0	24	48	72	96	pH 0	24	48	72	96	Conductivity µmohs/cm 0	24	48	72	96
0	A	10	10	10	10	10	20.0	20.5	21.0	20.0	20.0	9.3	9.4	9.2	9.3	9.3	7.6	7.8	7.9	8.1	8.3	289	288	313	334	351
0	B	10	10	10	10	10						9.3	9.2	9.1	9.2	9.3	7.6	7.4	7.9	8.0	8.0	333	324	387	417	423
20	A	10	10	10	10	10						8.9	9.2	8.9	9.2	9.2	7.5	7.6	7.7	8.0	8.1	393	406	414	415	418
20	B	10	10	10	10	10						8.7	9.1	8.9	9.3	9.3	7.5	7.6	7.7	8.0	8.2	387	399	397	393	399
40	A	10	10	10	10	10						8.3	8.7	8.7	9.0	9.2	7.5	7.7	7.9	8.1	8.2	477	495	494	503	517
40	B	10	10	10	10	10						8.3	8.7	8.7	9.1	9.2	7.5	7.7	8.0	8.2	8.2	491	501	511	516	538
60	A	10	10	10	10	10						8.10	8.6	8.7	9.1	9.2	7.5	7.7	8.0	8.3	8.4	613	612	609	608	622
60	B	10	10	10	10	10						7.8	8.5	8.6	9.1	9.2	7.5	7.7	8.0	8.3	8.3	611	601	619	624	638
80	A	10	10	10	10	10						7.5	8.4	8.6	8.9	9.2	7.5	7.8	8.1	8.3	8.4	716	712	723	716	741
80	B	10	10	10	10	10						7.4	8.4	8.5	8.8	9.1	7.5	7.8	8.1	8.4	8.3	709	724	726	738	763
100	A	10	10	10	10	10						6.5	8.2	8.3	8.8	9.0	7.4	7.9	8.1	8.4	8.4	833	822	829	841	858
100	B	10	10	10	10	10	↓	↓	↓	↓	↓	6.5	8.2	8.3	8.8	9.0	7.4	7.9	8.2	8.4	8.4	842	828	845	846	867

AEHA Form 215, 1 Nov 82 (HSHB-EW)

Replaces HSHB-EW Form 108, 1 Sep 80, which will be used.

BIOASSAY RESULTS, *Ceriodaphnia*, PINK WATER TREATMENT EFFLUENT, RVAAP,
22 JANUARY 1990

DATA SHEET FOR BIOASSAY TOXICITY TEST

EFFLUENT	Load Line 7 Pink water Treatment Effluent
ADDRESS	
CONTACT	Carl Bouwkamp
EFFLUENT SERIAL NUMBER	Ravenna, AAP, OH
NPDES PERMIT NUMBER	
TEST CONDUCTED BY	Ed Kubala
SUPERVISOR	Bill Fifty
BEGINNING DATE	1/23/90 TIME 1330
ENDING DATE	1/25/90 TIME 1330
AERATION ADDED	YES ___ NO X RATE ___
TEST ORGANISM	Ceriodaphnia
TEST ORGANISM SIZE LENGTH MAX ___ MIN ___ AVE ___	< 24 hours old
TEST ORGANISM SIZE NET WEIGHT MAX ___ MIN ___ AVE ___	
SOURCE OF FISH	EPA wheeling, wv current lab culture (AEHA)
ACCLIMATION	___ % LOSS AFTER ___ DAYS

	AMMONIA mg/L	CONDUCTIVITY	TOTAL ALKALINITY mg/L or $CaCO_3$	TOTAL HARDNESS mg/L as $CaCO_3$	SALINITY O/OO
INITIAL	D = <0.1 E = <0.1		D = 53 E = 270	D = 61.8 E = 174	
FINAL	D = <0.1 E = <0.1		D = 60 E = 280	D = 68.5 E = 189	

NOTES

CONC. OR % EFFLUENT	TANK NUMBER	Live organisms 0	24	48	72	96	Temperature °C 0	24	48	72	96	Dissolved oxygen (mg/l) 0	24	48	72	96	pH 0	24	48	72	96	Conductivity µmhos 0	24	48
0	A	10	10	10			20.0	20.5	21.0			9.3	9.4	9.1			7.7	7.8	7.9			336	325	342
0	B	10	10	10								9.3	9.2	9.1			7.7	7.4	7.9			397	325	387
20	A	10	10	10								8.9	9.2	8.9			7.3	7.6	7.7			430	412	411
20	B	10	10	8								8.7	9.1	8.9			7.4	7.6	7.7			382	399	397
40	A	10	10	10								8.3	8.7	8.7			7.4	7.7	7.9			486	495	494
40	B	10	10	10								8.3	8.7	8.7			7.4	7.7	8.0			491	501	511
60	A	10	10	10								8.0	8.6	8.7			7.4	7.7	8.0			588	612	609
60	B	10	10	10								7.8	8.5	8.6			7.5	7.7	8.0			605	601	619
80	A	10	10	10								7.5	8.4	8.5			7.5	7.8	8.1			699	712	723
80	B	10	10	10								7.4	8.4	8.5			7.5	7.8	8.1			716	724	726
100	A	10	10	10								6.5	8.2	8.3			7.4	7.9	8.1			828	822	829
100	B	10	10	10								6.5	8.2	8.3			7.4	7.9	8.2			827	828	835

AEHA Form 215, 1 Nov 82 (HSHB-EW)

Replaces HSHB-EW Form 108, 1 [illegible] 80, which will be used.

TABLE C-4. BIOASSAY DATA, ALGAE (*Selenastrum capricornutum*), PINK WATER TREATMENT EFFLUENT, RVAAP, 23-27 JANUARY 1990

Dilution (% Effluent)	Cell Counts 1	2	3	Cells/mL (Data are adjusted for dilution with 95% Confidence Interval).
Control	23380	26259	26688	
	21899	22428	22403	
	35723	37458	33296	
				$5.55 \pm 0.88 \times 10^6$
20%	33277	33278	34266	
	15702	15956	15742	
	35918	35790	34320	
				$5.65 \pm 1.35 \times 10^6$
40%	30630	35202	35501	
	54389	52848	54418	
	21830	24212	20388	
				$7.35 \pm 2.02 \times 10^6$
60%	38942	39816	39761	
	42608	42945	42752	
	39276	39408	39483	
				$8.11 \pm 0.24 \times 10^6$
80%	74640	75336	77251	
	13111	13456	13359	
	27253	27183	26859	
				$7.74 \pm 4.10 \times 10^6$
100%	40282	39971	39914	
	38092	36533	38661	
	22526	22947	23606	
				$6.72 \pm 1.16 \times 10^6$

APPENDIX D

CHEMICAL ANALYSES AND BIOASSAY DATA

19 FEBRUARY 1990 SAMPLING

TABLE D-1. CHEMICAL ANALYTICAL RESULTS, PINK WATER TREATMENT EFFLUENT RVAAP, 19 FEBRUARY 1990

Parameter	Concentration
Conventional Pollutants	
Chemical Oxygen Demand	<25 mg/L
Total Organic Carbon	<1.0 mg/L
Ammonia Nitrogen	<0.1 mg/L
Alkalinity	100 mg/L
Hardness	121 mg/L
Explosives	
HMX (Cyclo-tetramethylene-tetranitramine)	<100 µg/L
RDX (Cyclo-trimethylene-trinitramine)	<30 µg/L
TNT (Trinitrotoluene)	<1 µg/L
2,6 DNT (Dinitrotoluene)	<1 µg/L
2,4 DNT (Dinitrotoluene)	<1 µg/L
Volatile organics	
Chloromethane	<3.0 µg/L
Bromomethane	<3.0 µg/L
Vinyl Chloride	<3.0 µg/L
Chloroethane	<3.0 µg/L
Methylene Chloride	<3.0 µg/L
Trichlorofluoromethane	<3.0 µg/L
1,1-Dichloroethene	<3.0 µg/L
1,1-Dichloroethane	<3.0 µg/L
trans-1,2-Dichloroethene	<3.0 µg/L
Chloroform	<3.0 µg/L
1,2-Dichlorethane	<3.0 µg/L
1,1,1-Trichloroethane	<3.0 µg/L
Carbon Tetrachloride	<3.0 µg/L
Bromodichloromethane	<3.0 µg/L
1,1,2,2-Tetrachloroethane	<3.0 µg/L
1,2-Dichloropropane	<3.0 µg/L
trans-1,3-Dichloropropene	<3.0 µg/L
Trichloroethene	<3.0 µg/L
Dibromochloromethane	<3.0 µg/L
1,1,2-Trichloethane	<3.0 µg/L
Benzene	<3.0 µg/L
cis-1,3-Dichloropropene	<3.0 µg/L
2-Chloroethylvinyl ether	<3.0 µg/L
Bromoform	<3.0 µg/L
Tetrachloroethene	<3.0 µg/L
Toluene	<3.0 µg/L
Chlorobenzene	<3.0 µg/L
Ethylbenzene	<3.0 µg/L

Base/Neutral Extractable Organics	Concentration
Benzyl alcohol	<10.0 µg/L
bis (2-chloroethyl) ether	<10.0 µg/L
1,3-Dichlorobenzene	<10.0 µg/L
1,4-Dichlorobenzene	<10.0 µg/L
1,2-Dichlorobenzene	<10.0 µg/L
bis (2-chloroisopropyl) ether	<10.0 µg/L
Hexachloroethane	<10.0 µg/L
N-nitrosodi-n-propylamine	<10.0 µg/L
Nitrobenzene	<10.0 µg/L
Isophorone	<10.0 µg/L
bis (2-chloroethoxy) methane	<10.0 µg/L
1,2,4-trichlorobenzene	<10.0 µg/L
Naphthalene	<10.0 µg/L
Hexachlorobutadiene	<10.0 µg/L
Hexachlorocyclopentadiene	<10.0 µg/L
2-Chloronaphthalene	<10.0 µg/L
Acenaphthylene	<10.0 µg/L
Dimethyl phthalate	<10.0 µg/L
2,4-Dinitrotoluene	<10.0 µg/L
2,6-Dinitrotoluene	<10.0 µg/L
Acenaphthene	<10.0 µg/L
2,4-Dinitrotoluene	<10.0 µg/L
Fluorene	<10.0 µg/L
4-Chlorophenyl phenyl ether	<10.0 µg/L
Diethyl phthalate	<10.0 µg/L
2-Methylnaphthalene	<10.0 µg/L
N-nitrosodiphenylamine	<10.0 µg/L
4-Bromophenyl phenyl ether	<10.0 µg/L
Hexachlorobenzene	<10.0 µg/L
Phenanthrene	<10.0 µg/L
Anthracene	<10.0 µg/L
Di-n-butyl phthalate	<10.0 µg/L
Fluoranthene	<10.0 µg/L
Pyrene	<10.0 µg/L
Dibenzofuran	<10.0 µg/L
Butyl benzyl phthalate	<10.0 µg/L
Benzo (a) anthracene	<10.0 µg/L
Chrysene	<10.0 µg/L
3,3'-Dichlorobenzidine	<20.0 µg/L
bis (2-ethylhexyl) phthalate	<10.0 µg/L
Di-n-octyl phthalate	<10.0 µg/L
Benzo (b) fluoranthene	<10.0 µg/L
Benzo (k) fluoranthene	<10.0 µg/L
Benzo (a) pyrene	<10.0 µg/L
Indeno (1,2,3-cd) pyrene	<10.0 µg/L
Dibnezo (a,h) anthracene	<10.0 µg/L
Benzo (ghi) perylene	<10.0 µg/L

Acid Extractables Organics	Concentration
2-Chlorophenol	<10.0 µg/L
Phenol	<10.0 µg/L
2-Nitrophenol	<10.0 µg/L
2,4-Dimethylphenol	<10.0 µg/L
2,4-Dichlorophenol	<10.0 µg/L
4-Methylphenol	<10.0 µg/L
4-Chloro-3-methylphenol	<10.0 µg/L
4-Chloroaniline	<10.0 µg/L
2,4,6-Trichlorophenol	<10.0 µg/L
2,4,5-Trichlorophenol	<10.0 µg/L
2,4-Dinitrophenol	<50.0 µg/L
4-Nitrophenol	<50.0 µg/L
2-Methyl-4,6-dinitrophenol	<50.0 µg/L
Pentachlorophenol	<50.0 µg/L
2-Nitroaniline	<50.0 µg/L
3-Nitroaniline	<50.0 µg/L
4-Nitroaniline	<50.0 µg/L
Benzoic acid	<50.0 µg/L

TABLE D-2. BIOASSAY RESULTS, FAT HEAD MINNOW, PINK WATER TREATMENT EFFLUENT, RVAAP, 21-25 FEBRUARY 1990

DATA SHEET FOR BIOASSAY TOXICITY TEST

CONTACT: Carl Bausekamp	EFFLUENT SERIAL NUMBER: Ravenna AAP, OH	EFFLUENT: Load Line 7 Pink water treatment	ADDRESS: Effluent
SUPERVISOR: Bill Fifty	BEGINNING DATE 2/21/90 TIME 1430	NPDES PERMIT NUMBER	TEST CONDUCTED BY: Ed Kubala
TEST ORGANISM: Fat head minnow	TEST ORGANISM SIZE LENGTH MAX ____ MIN ____ AVE ____ 1 week old	ENDING DATE 2/25/90 TIME 1430	AERATION ADDED YES ___ NO ✓ RATE ___
SOURCE OF FISH: EPA Wheeling, WV	ACCLIMATION ____ % LOSS AFTER ____ DAYS		TEST ORGANISM SIZE NET WEIGHT MAX ____ MIN ____ AVE ____

NOTES

	AMMONIA	CONDUCTIVITY	TOTAL ALKALINITY mg/L or $CaCO_3$	TOTAL HARDNESS mg/L as $CaCO_3$	SALINITY O/OO
INITIAL	D = <0.10 E = <0.10		D = 21 E = 95	D = 46 E = 101	
FINAL	D = 0.25 E = <0.10		D = 15 E = 100	D = 34 E = 121	

CONC. OR % EFFLUENT	TANK NUMBER	NUMBER OF LIVE ORGANISMS 0	24	48	72	96	TEMPERATURE °C 0	24	48	72	96	DISSOLVED OXYGEN (mg/l) 0	24	48	72	96	pH 0	24	48	72	96	Conductivity µmohs/cm 0	24	48	72	96
0	A	10	10	9	9	8	20.0	21.0	20.0	21.0	21.0	7.8	7.6	7.7	7.5	7.6	7.7	7.6	7.6	7.8	7.7	233	245	260	266	294
0	B	10	9	9	9	8						7.8	7.7	7.8	7.6	7.5	7.6	7.5	7.5	7.6	7.6	236	244	270	274	273
20	A	10	10	9	9	8						8.0	7.8	7.5	7.6	7.6	7.4	7.4	7.4	7.5	7.6	261	253	275	284	294
20	B	10	10	10	9	8						8.0	7.8	7.6	7.6	7.7	7.4	7.4	7.4	7.4	7.5	262	268	270	288	319
40	A	10	10	10	10	9						8.3	7.9	6.5	7.0	7.4	7.4	7.5	7.4	7.5	7.5	282	293	296	314	341
40	B	10	9	9	7	7						8.3	8.0	7.0	7.1	7.5	7.4	7.5	7.4	7.5	7.6	298	301	305	322	358
60	A	10	10	9	9	9						8.5	8.3	7.1	7.1	7.5	7.4	7.6	7.5	7.7	7.6	313	328	335	361	386
60	B	10	10	10	10	9						8.5	8.5	8.0	7.3	7.3	7.4	7.7	7.6	7.8	7.6	323	346	332	338	372
80	A	10	10	10	10	10						8.7	8.5	7.0	6.8	6.8	7.4	7.8	7.6	7.8	7.6	348	362	382	399	428
80	B	10	10	10	10	10						8.9	8.6	7.4	6.6	6.8	7.6	7.9	7.7	7.8	7.7	362	381	365	384	409
100	A	10	10	7	7	7						8.9	8.6	8.0	8.1	7.7	7.5	8.0	7.7	7.9	7.7	374	388	420	436	463
100	B	10	10	9	9	9	↓	↓	↓	↓	↓	9.0	8.6	7.6	8.0	7.8	7.4	8.0	7.8	8.0	7.7	376	392	403	415	474

AEHA Form 215, 1 Nov 82 (HSHB-EW)

Replaces HSHB-EW Form 108, 1 Sep 80, which will be used.

20-22 FEBRUARY 1990

DATA SHEET FOR BIOASSAY TOXICITY TEST				NOTES
CONTACT: Carl Bowkamp	EFFLUENT SERIAL NUMBER: Ravenna AAP, OH	NPDES PERMIT NUMBER:	TEST CONDUCTED BY: Ed Kubala	
SUPERVISOR: Bill Fifty	BEGINNING DATE: 2/20/90 TIME: 1315	ENDING DATE: 2/22/90 TIME: 1315	AERATION ADDED: YES ___ NO X RATE ___	
TEST ORGANISM: Ceriodaphnia	TEST ORGANISM SIZE: LENGTH MAX ___ MIN ___ AVE ___ (< 24 hours old)	TEST ORGANISM SIZE: NET WEIGHT MAX ___ MIN ___ AVE ___		
SOURCE OF FISH: EPA, Wheeling, WV; AEHA lab culture	ACCLIMATION: ___ % LOSS AFTER ___ DAYS			

	AMMONIA	CONDUCTIVITY	TOTAL ALKALINITY mg/L or $CaCO_3$	TOTAL HARDNESS mg/L as $CaCO_3$	SALINITY 0/00
INITIAL	D=<0.10 E=<0.10		D=21 E=95	D=46 E=101	
FINAL	D=0.25 E=<0.10		D=15 E=100	D=34 E=171	

CONC. OR %EFFLUENT	TANK NUMBER	NUMBER OF LIVE ORGANISMS 0	24	48	72	96	TEMPERATURE °C 0	24	48	72	96	DISSOLVED OXYGEN (mg/l) 0	24	48	72	96	pH 0	24	48	72	96	Conductivity µmhos/c 0	24	48		
0	A	10	10	10			21.0	20.0	21.0			8.4	8.7	8.5			7.5	6.7	7.5			245	293	297		
0	B	10	10	10								8.4	8.7	8.5			7.5	6.7	7.5			238	252	297		
80	A	10	10	10								8.8	8.9	8.4			7.7	7.3	7.5			347	340	353		
80	B	10	10	10								8.8	9.0	8.4			7.7	7.5	7.6			357	374	380		
100	A	10	10	10								8.8	9.0	7.9			7.9	7.7	7.8			370	386	401		
100	B	10	10	10								8.8	9.0	7.9			7.9	7.7	7.9			372	384	399		

AEHA Form 215, 1 Nov 82 (HSHB-EW)

Replaces HSHB-EW Form 108, 1 Sep 80, which will be used.

TABLE D-4. BIOASSAY DATA, ALGAE (*Selenastrum capricornutum*), PINK WATER TREATMENT EFFLUENT, RVAAP, 20-24 FEBRUARY 1990

Dilution (% Effluent)	Cell Counts 1	2	3	Cells/mL (Data are adjusted for dilution at 95% Confidence Interval).
Control	30049	34282	36707	
	34865	33836	34589	
	28128	28158	28148	
				$6.42 \pm 0.49 \times 10^6$
20%	58100	64881	63489	
	62557	59481	65021	
	19713	19854	19646	
				$9.62 \pm 3.09 \times 10^6$
40%	35372	36055	35563	
	33236	33261	33189	
	34707	35039	34358	
				$6.91 \pm 0.15 \times 10^6$
60%	33998	33806	34179	
	28077	28641	28109	
	35681	35814	35380	
				$6.53 \pm 0.48 \times 10^6$
80%	35783	35303	35882	
	38823	38164	38628	
	34502	34993	34751	
				$7.26 \pm 0.25 \times 10^6$
100%	32418	32011	32216	
	35449	35320	35350	
	18927	19027	19062	
				$5.77 \pm 1.08 \times 10^6$

APPENDIX E

REFERENCE TOXICANT BIOASSAY DATA

TABLE E-1. BIOASSAY RESULTS SUMMARY, REFERENCE TOXICANT (CADMIUM CHLORIDE), RVAAP, 29 NOVEMBER - 3 DECEMBER 1989

Species	LC_{50} (µg/L)	Acceptable Range (µg/L)
Fathead Minnow (Pimephales promelas)	166±40	100-410
Daphnia (Ceriodaphnia dubia)	20.35±6	10-90*
Algae (Selenastrum capricornutum)	11.93±0.8	10.1-16.6

*Range is for 48 hour Daphnia magna assay.
LC_{50} calculated by Trimmed Spearman-Karber Method.

TABLE E-2. ACUTE BIOASSAY RESULTS, FATHEAD MINNOW, CADMIUM CHLORIDE (REFERENCE TOXICANT), 29 NOVEMBER - 3 DECEMBER 1989

DATA SHEET FOR BIOASSAY TOXICITY TEST

CONTACT: Carl Baumkamp	EFFLUENT SERIAL NUMBER: 1	EFFLUENT: Cadmium Chloride	ADDRESS:
SUPERVISOR: Bill Fifty	BEGINNING DATE 29 NOV TIME 1400	NPDES PERMIT NUMBER	TEST CONDUCTED BY: Ed Kuhala
TEST ORGANISM: Fathead minnow	ENDING DATE 3 Dec TIME 1400		AERATION ADDED YES ___ NO X RATE ___
SOURCE OF FISH: EPA, Wheeling WV	TEST ORGANISM SIZE LENGTH MAX ___ MIN ___ AVE ___ 24 hours old	TEST ORGANISM SIZE NET WEIGHT MAX ___ MIN ___ AVE ___	
	ACCLIMATION ___ % LOSS AFTER ___ DAYS		

NOTES

	AMMONIA mg/L	CONDUCTIVITY	TOTAL ALKALINITY mg/L or $CaCO_3$	TOTAL HARDNESS mg/L as $CaCO_3$	SALINITY 0/00
INITIAL	<0.05	290	41	69.4	
FINAL	0.08	298	48	77.4	

CONC. OR %EFFLUENT	TANK NUMBER	NUMBER OF LIVE ORGANISMS 0	24	48	72	96	TEMPERATURE °C 0	24	48	72	96	DISSOLVED OXYGEN (mg/l) 0	24	48	72	96	pH 0	24	48	72	96
0	A	10	10	10	10	10	21.5	20.5	21.0	21.0	20.0	8.5	8.1	8.1	8.2	8.2	7.2	7.5	7.4	7.9	8.1
0	B	10	10	10	10	10						8.5	8.1	8.1	8.2	8.2	7.3	7.5	7.5	7.8	8.1
100	A	10	10	10	9	7						8.4	8.1	8.1	8.0	8.0	7.5	7.4	7.8	7.8	8.1
100	B	10	10	10	10	9						8.4	8.2	8.3	8.0	8.0	7.6	7.4	7.9	7.8	8.1
300	A	10	10	8	3	0						8.4	8.3	8.2	8.2	8.2	7.5	7.5	7.9	7.8	8.0
300	B	10	10	8	6	3						8.5	8.2	8.2	8.2	8.2	7.5	7.5	7.8	7.7	8.0
500	A	10	4	4	0	0						8.2	8.3	8.2	8.3	—	7.5	7.5	7.4	7.9	—
500	B	10	3	0	0	0						8.4	8.3	8.3	8.4	—	7.5	7.5	7.5	7.8	—
1000	A	10	2	2	0	0						8.3	8.4	8.2	8.4	—	7.5	7.4	7.5	7.6	—
1000	B	10	2	1	0	0						8.4	8.4	8.3	8.4	—	7.5	7.5	7.4	7.4	—
2000	A	10	0	0	0	0						8.5	8.4	8.3	—	—	7.5	7.4	7.5	—	—
2000	B	10	0	0	0	0	↓	↓	↓	↓	↓	8.5	8.4	8.3	—	—	7.5	7.5	7.5	—	—

AEHA Form 215, 1 Nov 82 (HSHB-EW)

Replaces HSHB-EW Form 108, 1 Sep 80, which will be used.

TABLE E-3. ACUTE BIOASSAY RESULTS, Ceriodaphnia, CADMIUM CHLORIDE, (REFERENCE TOXICANT), 29 NOVEMBER - 1 DECEMBER 1989

DATA SHEET FOR BIOASSAY TOXICITY TEST

EFFLUENT: Cadmium Chloride

ADDRESS:

NOTES:

CONTACT: Carl Bouwkamp
SUPERVISOR: Bill Fifty
TEST ORGANISM: Ceriodaphnia
SOURCE OF FISH: EPA original in house culture

EFFLUENT SERIAL NUMBER:
NPDES PERMIT NUMBER:
BEGINNING DATE 29NOV TIME 1300
ENDING DATE 1 DEC TIME 1300
TEST ORGANISM SIZE LENGTH MAX ____ MIN ____ AVE ____
ACCLIMATION ____ % LOSS AFTER ____ DAYS

TEST CONDUCTED BY: Ed Kubala
AERATION ADDED YES ___ NO X RATE ___
TEST ORGANISM SIZE NET WEIGHT MAX ____ MIN ____ AVE ____

	AMMONIA mg/l	CONDUCTIVITY	TOTAL ALKALINITY mg/L or $CaCO_3$	TOTAL HARDNESS mg/L as $CaCO_3$	SALINITY O/OO
INITIAL	<0.05	290	41	69.4	
FINAL	0.08	299	48	77.4	

CONC. OR %EFFLUENT	TANK NUMBER	NUMBER OF LIVE ORGANISMS 0	24	48	72	96	TEMPERATURE °C 0	24	48	72	96	DISSOLVED OXYGEN (mg/l) 0	24	48	72	96	pH 0	24	48	72	96
0	A	10	10	10			21.5	20.9	21.0			8.4	8.3	8.4			8.0	7.8	7.7		
0	B	10	10	10								8.3	8.2	8.4			7.9	7.6	7.7		
10	A	10	7	6								8.4	8.2	8.3			7.6	7.6	7.6		
10	B	10	9	9								8.3	8.2	8.4			7.5	7.7	7.8		
20	A	10	8	5								8.2	8.3	8.5			7.4	7.6	7.8		
20	B	10	4	6								8.4	8.2	8.5			7.4	7.6	7.8		
40	A	10	2	2								8.5	8.3	8.5			7.3	7.7	7.9		
40	B	10	6	1								8.4	8.3	8.5			7.3	7.7	7.9		
80	A	10	1	0								8.2	8.4	8.2			7.3	7.7	7.9		
80	B	10	0	0								8.4	8.4	8.3			7.3	7.7	8.0		
160	A	10	0	0								8.2	8.4	8.4			7.2	7.7	8.0		
160	B	10	0	0			↓	↓	↓			8.3	8.4	8.6			7.2	7.7	8.0		

AEHA Form 215, 1 Nov 82 (HSHB-EW)

Replaces HSHB-EW Form 108, 1 S[illegible]0, which will be used.

TABLE E-4. BIOASSAY RESULTS, ALGAE (Selenastrum capricornutum), REFERENCE TOXICANT (CADMIUM CHLORIDE), RVAAP, 29 NOVEMBER - 3 DECEMBER 1989

Dilution (µg/L Cadmium Chloride)	Cell Counts 1	2	3	Cells/mL (Data are adjusted for dilution at 95% Confidence Interval).
Control	13163	12414	12706	
	12597	12820	12701	
	13219	12888	12986	
				$2.57 \pm 0.03 \times 10^6$
3	14043	14128	14462	
	13618	13528	13518	
	11369	11345	12014	
				$2.62 \pm 0.17 \times 10^6$
6	10208	10338	10248	
	10320	10406	10652	
	10502	10248	10208	
				$2.07 \pm 0.02 \times 10^6$
12	7931	8035	7999	
	7724	7648	7731	
	6978	6899	6945	
				$1.51 \pm 0.06 \times 10^6$
24	969	993	1017	
	1015	1197	1167	
	1024	997	1055	
				$0.21 \pm 0.01 \times 10^6$
48	639	691	681	
	453	489	488	
	713	765	682	
				$0.12 \pm 0.10 \times 10^6$

APPENDIX F

STATISTICAL ANALYSES

TABLE F-1. LC_{50} CALCULATIONS FOR THE REFERENCE TOXICANT TESTS (CADMIUM CHLORIDE)

Burlington Research, Inc.
Trimmed Spearman-Karber Method for Calculation of EC_{50} and LC_{50} Values in Bioassays

For Reference, Cite
M. A. Hamilton, R. C. Russo, and R. V. Thurston, 1977.
Trimmed Spearman-Karber Method for Estimating Median Lethal Concentrations in Toxicity Bioassays.
Environ. Sci. Technol. 11(7) 714-719
Correction 12(4) 417 (1978).

Date.....29 Nov - 1 Dec 1989
Test #.....: 1
Chemical.....Cadmium Chloride
Species.....Fathead Minnow
Duration.....96 hours

Raw Data

Concentration(µg/L)	100.00	300.00	500.00	1000.00	2000.00
Number Exposed	20	20	20	20	20
Mortalities	4	17	20	20	20

Spearman-Karber Trim 20.00
Spearman-Karber Estimates LC_{50} 166.0389252
95% Lower Confidence 126.23
95% Upper confidence 218.41

Burlington Research, Inc.
Trimmed Spearman-Karber Method for Calculation of EC_{50} and LC_{50} Values in Bioassays

For Reference, Cite
M. A. Hamilton, R. C. Russo, and R. V. Thurston, 1977.
Trimmed Spearman-Karber Method for Estimating Median Lethal Concentrations in Toxicity Bioassays.
Environ. Sci. Technol. 11(7) 714-719
Correction 12(4) 417 (1978).

Date.....29 November - 1 December 1989
Test #.....: 1
Chemical.....Cadmium Chloride
Species.....Ceriodaphnia
Duration.....48 hours

Raw Data

Concentration(µg/L)	10.00	20.00	40.00	80.00	160.00
Number Exposed	20	20	20	20	20
Mortalities	5	9	17	20	20

Spearman-Karber Trim 25.00
Spearman-Karber Estimates LC_{50} 20.3495941
95% Lower Confidence 14.58
95% Upper confidence 28.40

TABLE F-2. EC_{50} CALCULATIONS FOR THE REFERENCE TOXICANT TEST (CADMIUM CHLORIDE)

Burlington Research, Inc.
Trimmed Spearman-Karber Method for Calculation of EC_{50} and LC_{50} Values in Bioassays

For Reference, Cite
M. A. Hamilton, R. C. Russo, and R. V. Thurston, 1977.
Trimmed Spearman-Karber Method for Estimating Median Lethal Concentrations in Toxicity Bioassays.
Environ. Sci. Technol. 11(7) 714-719
Correction 12(4) 417 (1978).

Date.....29 November 1989
Test #.....: 1
Chemical.....Cadmium Chloride
Species.....Selenastrum
Duration.....96 hours

Raw Data

Concentration(µg/L)	3.00	6.00	12.00	24.00	48.00
Number Exposed	257	257	257	257	257
Mortalities	0	50	106	236	245

Spearman-Karber Trim 4.67

Spearman-Karber Estimates LC_{50} 11.9309425
95% Lower Confidence 11.17
95% Upper confidence 12.74

DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO ATTENTION OF

HSHB-ME-WM

GEOHYDROLOGIC STUDY NO. 38-26-KF95-92
SOILS, GROUND WATER, AND SURFACE WATER CHARACTERIZATION FOR THE OPEN BURNING AND OPEN DETONATION AREAS RAVENNA ARMY AMMUNITION PLANT RAVENNA, OHIO 23-27 MARCH 1992 AND 20 APRIL - 5 MAY 1992

APPENDIX B
SURFACE WATER CHARACTERIZATION

I. REFERENCES. Refer to Annex B-1.

II. PURPOSE. This study was conducted to investigate and characterize surface water and surface water runoff at two sites: the open burning ground (OBG) and the open detonation area (ODA) at Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio.

III. GENERAL.

A. Personnel Contacted. See Appendix C.

B. Study Team Personnel. This study was conducted by a team of project officers from the water Quality Engineering Division.

1. Mr. Richard A. Valcourt, Lead Project Officer, Environmental Engineer.

2. 1LT Emil Dzuray, Sanitation Engineer.

3. Mr. Carl A. Bouwkamp, Aquatic Biologist.

4. 2LT Richard W. Garodnick, Sanitation Engineer.

C. Background.

1. Climatology. The climate at RVAAP is continental, but the proximity of Lake Erie provides a moderating effect. The annual mean rainfall is 86 centimeters and the annual mean snowfall is 121 centimeters. The mean temperature in the winter is -2.1 °C and the mean temperature in the summer is 21.4 °C. The lowest temperature on record is -28.9 °C with the highest recorded temperature being 40.6 °C. Precipitation patterns of RVAAP are summarized in Table B-1.

Table B–1. Precipitation Patterns

Month	Average Temperature Degrees Celsius (C)	Average Precipitation Centimeters (cm)
January	–2.5	6.53
February	–2.3	6.02
March	2.1	7.32
April	8.3	7.09
May	14.6	7.80
June	19.9	8.18
July	22.4	8.59
August	21.4	7.52
September	18.2	7.77
October	12.1	6.63
November	5.3	6.55
December	–0.4	5.99

Average annual rainfall: 86 cm

Average annual snowfall: 91 cm

Average temperature (winter): –1.7 (C)

Average temperature (summer): 21.2 (C)

2. Storm Water Collection Systems. Surface runoff from the ODA and OBG flows over land at each site. There is no storm water collection system for either the OD or OB area. However, silt screens are used in the ODA to reduce sediments from reaching the creek, and peripheral berms are used at the OB area to divert runoff to an intermittent stream.

3. Flood Plain. Neither the OB area nor the ODA are located within the 100-year flood plain. Flood plain boundaries for these areas are shown on Figure B-1.

4. Surface Hydrology.

a. The RVAAP is situated within the Ohio River Drainage Basin. The largest surface water body in the RVAAP area is the Michael J. Kirwan Reservoir, located 0.5 miles south of RVAAP's southern boundary. This reservoir is 6 miles long and 1 mile wide at its widest point.

b. The West Branch of the Mahoning River is the major surface stream in the RVAAP area. The West Branch flows in a southerly direction outside the installation's western border before flowing into the M.J. Kirwan Reservoir. The West Branch exits the east side of the reservoir and continues in an easterly direction until joining the Mahoning River east of RVAAP.

c. The gently rolling terrain of RVAAP is marked with marshy areas and both intermittent and flowing streams whose headwaters are located within the installation's hills.

d. Approximately 45 ponds or small reservoirs are scattered throughout the installation. Many were built in the natural drainage ways and incorporated into the plant operations as holding and settling ponds. Others were caused by beaver activity or resulted from glacial features.

5. Surface Drainage.

a. ODA. The ODA sits on an inclined grade sloping towards Sand Creek. Sand Creek flows parallel to the OD's southern most boundary. A 150-foot wide strip of grass and small shrubbery separates the creek and the OD's southern boundary. Because the ODA is regraded often, surface runoff from the area enters the creek at numerous and changing locations.

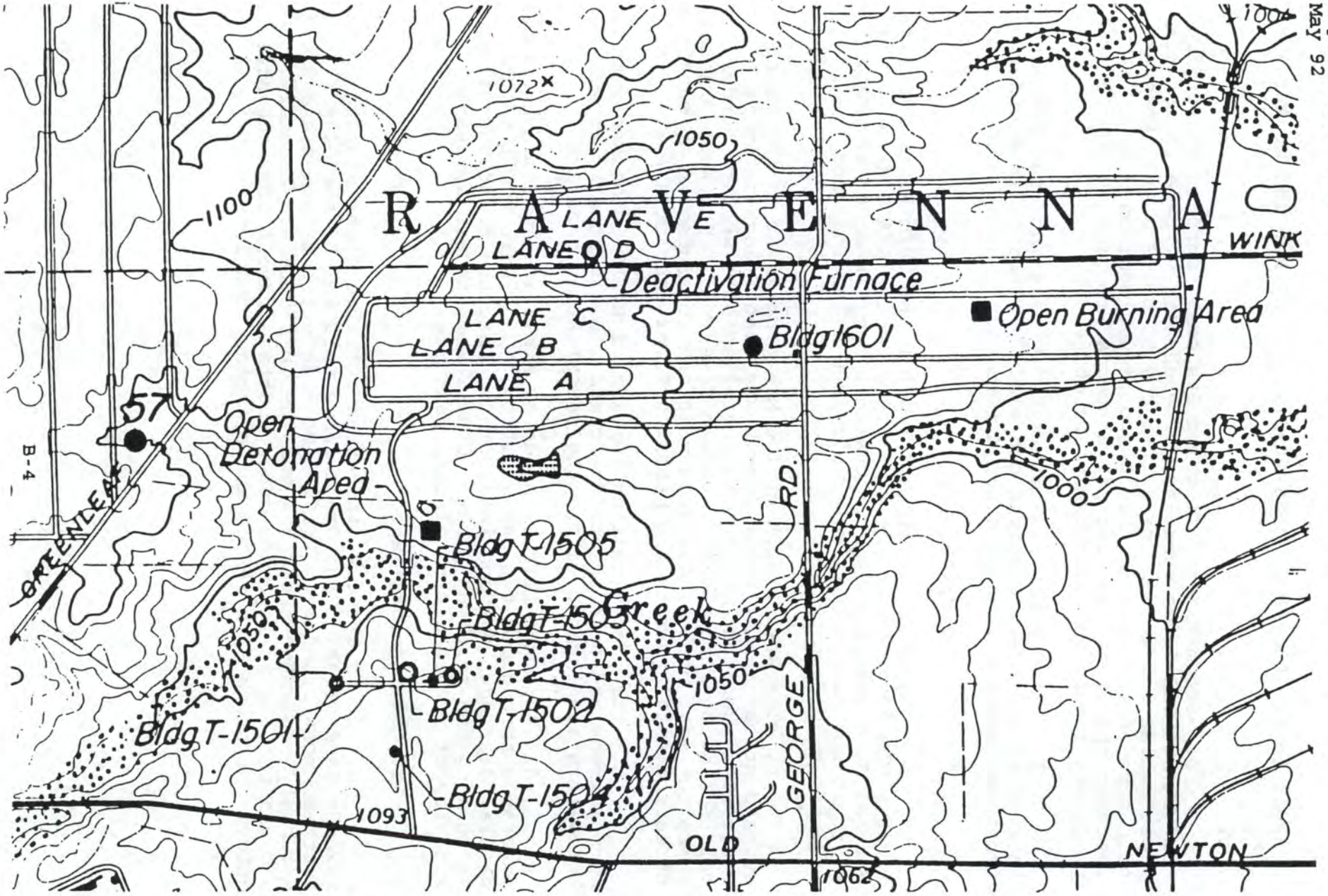


Figure B-1. Flood Plain Boundaries for Open Detonation and Opening Burning Areas.

b. OB Area. The OB area is relatively flat and has no significant changes in contour. This area is bermed on three sides. Surface runoff accumulates along the southern berm and drains into an intermittent stream through a 3-foot wide break constructed in the berm. This intermittent stream flows west to east along side the OB areas southern most boundary before its confluence with Sand Creek, approximately 1 mile downstream from the ODA.

c. Sand Creek. The creek originates within installation boundaries and has a drainage area of 13.9 square miles, including both the OB and OD areas. It flows in an east-to-northeast direction through the central portion of the installation to its confluence with the South Fork of Eagle Creek.

6. Regulatory Concerns.

a. Ambient water quality criteria for RVAAP are set forth by the State of Ohio (reference 1). These criteria establish water use designations and numeric water quality criteria for Sand Creek.

b. Water hardness dependent parameters were established using the "Outside Mixing Zone 30-day Average" criteria as outlined in Chapter 3745-1-7, Table 7-11 of the Administrative Code (reference 1) and a water hardness of 50 mg/L.

c. Sand Creek is classified as a state resource water and cannot be degraded by any substance determined to be toxic or known to interfere with any designated use. It is designated as a warm water, recreational water, and as an agricultural and industrial water supply. Sand Creek must be capable of supporting and maintaining: a balanced, integrated, adaptive community of warm water aquatic organisms; it must be suitable for full body contact recreation such as, but not limited to, swimming, canoeing, and scuba diving with a minimal threat to public health as a result of water quality; it must be suitable for irrigation and livestock watering without pretreatment; and finally, it must be suitable for commercial and industrial uses, with or without pretreatment depending on the type of industry involved.

d. Surface water runoff at RVAAP is not regulated by state ambient water quality criteria, since it is not ambient water.

IV. FINDINGS AND DISCUSSION.

A. ODA.

1. Sampling Scheme. Water and sediment samples were taken up and downstream of the ODA. The upstream samples (QC1 and OD1) were the controls. Sample sites are shown on Figure B-2. We sampled on three separate days. We collected sediment samples on 25 March; grab and composite water samples on 26 March (during a rain event); and grab water samples, not influenced by a rain event, on 30 April. Two downstream samples were collected (OD2 and OD3). These samples were collected simultaneously side by side in the stream. All downstream samples were taken outside mixing zones as defined by state criteria (reference 1). A grab sample of surface runoff (OD runoff) was taken during the rain event on 26 March at approximately the same time grab samples from the creek were taken. This sample was taken to characterize runoff before it entered Sand Creek.

2. Analytical Results. Tables B-2-1 through B-2-5 in Annex B-2 list analytical results for sample sites QC1, OD1, OD2, OD3, and OD runoff. Pertinent findings are detailed below.

a. Water.

(1) Analyses reveal low levels of 2,4-DNT (1.1 µg/L) and 2,4,6-TNT (14 µg/L) and elevated levels of RDX (230 µg/L) migrating offsite through surface runoff. These contaminants were not detected in Sand Creek samples. This is likely due to dilution factors.

(2) During dry weather conditions, lead (0.08 mg/L) was detected in one downstream sample (OD2) at levels higher than the state ambient water quality criteria (0.0028 mg/L) for warmwater habitats. However, lead was not detected in the duplicate sample (OD3). A laboratory split was performed on both samples and the results corroborated the original analyses. A possible explanation is that the OD2 grab sample received a slug of lead stirred up from the sediment during sampling.

(3) Copper was detected downstream at levels (0.03 mg/L) that exceeded state ambient water quality criteria (0.006 mg/L) for warmwater habitats. Copper was also detected at similar levels in all upstream samples and appears to be naturally occurring.

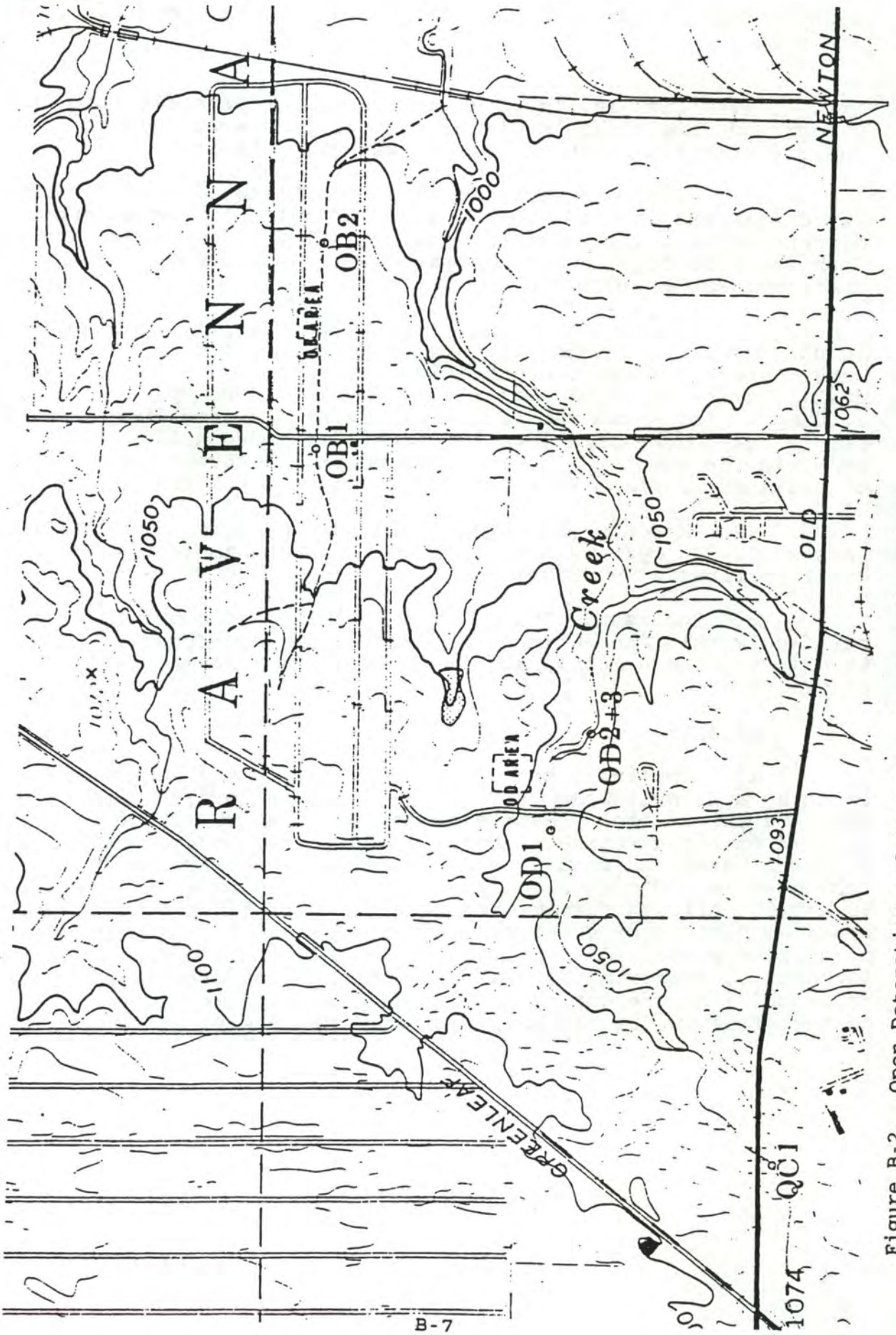


Figure B-2. Open Detonation and Open Burn Area Sample Points.

(4) High levels of zinc (0.10 mg/L) were detected in background samples at levels exceeding state ambient water quality criteria (0.059 mg/L) for warmwater habitats.

(5) Iron was detected at 2.4 mg/L and 3.3 mg/L in the two downstream samples (OD2, OD3). These levels exceed state ambient water quality criteria (1.0 mg/L) for warmwater habitats. Iron was also detected at similar levels (1.9 mg/L) in both upstream samples (QC1, OD1).

(6) Zinc (0.18 mg/L), copper (0.16 mg/L), cadmium (0.0011 mg/L), and iron (28.0 mg/L) were detected in surface water runoff. These concentrations exceeded state ambient water quality criteria (0.059 mg/L; 0.006 mg/L; 0.0008 mg/L; and 1.00 mg/L) for warmwater habitats. These elevated levels may be partly due to the high level of total suspended solids (1000 mg/L) in the sample. There are no numerical water quality criteria for surface water runoff to ambient waters.

(7) Mercury was detected in one upstream sample (QC1) at levels (0.0004 mg/L) which exceeded the state ambient water quality criteria (0.0002 mg/L).

b. Sediment. There was no evidence of contamination build-up within the sediments; iron levels were found to be high in all sediment samples, and it is thought to be naturally occurring.

B. OB Area.

1. Sampling Scheme. Water and sediment samples were taken up and downstream of the OB area. The upstream sample (OB1) is the control. Sample sites are shown on Figure B-2. We sampled on three separate days. We collected sediment samples on 25 March; grab and composite water samples on 26 March (during a rain event); and grab samples, not influenced by a rain event, on 30 April. All downstream samples (OB2) were taken outside mixing zones as defined by state criteria (reference 1). A grab sample of surface runoff (OB-runoff) was taken during the rain event on 26 March at approximately the same time as the grab samples were collected from the stream. This sample was collected to characterize runoff before it entered the receiving stream.

2. Analytical Results. Tables B-2-6 through B-2-8 in Annex B-2 list analytical results for sample sites OB1, OB2, and OB runoff.

a. Water.

(1) Analyses revealed low levels of 2,4-DNT (2.8 µg/L); 2,6-DNT (2.2 µg/L); 2,4,6-TNT (4.0 µg/L); nitroguanidine (38 µg/L); and elevated levels of RDX (120 µg/L) migrating offsite through surface runoff. Except for RDX (6.8 µg/L), these contaminants were not detected in the stream samples. This is likely due to dilution factors. The level of RDX detected in the stream was below the LC_{50} for aquatic organisms (4-6 mg/L for flow through conditions) and should not be toxic to aquatic organisms within the stream (reference 7).

(2) Cadmium (0.016 mg/L), copper (0.05 mg/L), lead (0.01 mg/L), iron (4.6 mg/L), and zinc (0.22 mg/L) were detected in the surface runoff. These concentrations exceeded the state ambient water quality criteria (0.0026 mg/L; 0.0088 mg/L; 0.0028 mg/L; 1.0 mg/L, 0.085 mg/L) for warmwater habitats. However, copper and zinc were detected in upstream samples and appear to be naturally occurring within the stream.

(3) Cyanide (0.09 mg/L) was detected in surface runoff at levels which exceed state ambient water quality criteria (0.012 mg/L); however, it was not detected in the stream samples.

(4) Visual observations indicated substantial amounts of unburned propellent fragments around burn trays. These fragments of propellants are potentially the source of the detected runoff contamination.

b. Sediments.

(1) Extremely high levels of Chemical Oxygen Demand (53,000 µg/g) were detected in upstream sediment samples and high levels of Total Organic Carbon (17,000 µg/g) were detected in both upstream and downstream sediment samples. These high levels reveal organic buildup in the intermittent stream within the OBG. This buildup of organics is probably due to the deposition of organics from surface runoff.

(2) Not all sediment analyses for explosives could be quantitated in the laboratory due to very poor extraction. Most likely, this is the result of a matrixing effect within the sediment.

C. Benthic Macroinvertebrates.

1. Sampling Effort.

a. Benthic macroinvertebrates (bottom dwelling aquatic insects, crustaceans, and other invertebrates) were collected from Sand Creek above and below the ODA (OD1 and OD2) and also in the intermittent stream above and below the OB area (OB1 and OB2).

b. Six Hester Dendy multiple plate artificial substrate samplers were placed at each sampling location on 25 March 1992. The colonized samplers were collected on 4 May 1992. The number of organisms were so low that all six Hester Dendy samples were combined.

c. Surber sampling was performed on 4 May 1992. In order to obtain sufficient amount of sample for statistical analysis, three samples (each comprised of organisms from four Surber samples) were collected at each sample site. The Surber sampler has a 30 mesh net on a frame that delineates 1 square foot of stream bottom. The sampler was placed on the creek bed in a riffle area (a stretch of choppy water caused by a rocky shoal just below the waters surface), and the organisms within the frame were dislodged and collected in the trailing net.

d. The intermittent stream in the OB area was so small (less than 1-foot wide) that a Surber sampler could not be used. A 30 mesh dip net (kicknet) was used in place of the Surber sampler to collect organisms from approximately 4 square feet of stream bottom.

e. All Hester Dendy and Surber samples were preserved in 6-10 percent formalin with Rose Bengal dye. The organisms were later sorted and identified to species.

2. Diversity. The diversity ($\bar{H}$) was calculated according to Brillouins (reference 8) Diversity Index as modified by Patten (reference 17), incorporating Stirling's approximation for logarithms of factorials, in order to minimize the bias resulting from rare species (reference 14).

$$\bar{H} = C/N \left[N(\ln N - 1) + 1/2 \ln 2\pi N - \sum_{i=1}^{S} \{n_i(\ln n_i - 1) + 1/2 \ln 2\pi n_i\}\right]$$

where: n_i = total number of individuals in the i_{th} species
N = the total number of individuals
C = 1.442695 for conversion of natural logarithms
S = number of species

This treatment results in diversity values ranging from 0 to 3.321928 log N (reference 21), where numbers $\bar{H} > 3$ generally represents clean water streams; $1 < \bar{H} < 3$ intermediate quality; and $H < 1$, polluted streams (reference 22).

3. Analytical Results. Macroinvertebrate data are summarized in Table B-2 and complete data are presented in Annex B-3.

a. ODA. The macroinvertebrate data indicate that water quality increases downstream of the ODA. The data from the combined Hester Dendy multiple plate samples had slightly higher diversity, taxa (classification) richness, and number of individuals below the ODA than above. The Surber data showed a more pronounced increase in diversity, taxa richness, and number of individuals below the ODA than the Hester Dendy samples. Because of variability in the data, one cannot say with 95 percent confidence that the macroinvertebrate population did indeed improve below the ODA; however, one could be confident that the ODA did not adversely affect the macroinvertebrate community.

b. OB Area. The macroinvertebrate populations indicate that there could be a reduction in water quality below the OB area. The Hester Dendy samplers were very sparsely colonized. Even though the diversity of macroinvertebrates on the Hester Dendy samplers actually increased below the OB area, little reliability can be placed on the results because only 18 organisms were collected. The semiquantitative kicknet samples had a more reliable sample size. Therefore, the kicknet samples should better portray the macroinvertebrate population within the intermittent stream. Much of the difference in diversity in the kicknet samples was caused by high numbers of stoneflies that are generally considered cool, clean water organisms. Thus, the decrease in diversity below the OB area may not be totally from decreased water quality.

Table B-2. Summary of Macroinvertebrate Data, 4 May 1992

Sample Site *	Diversiy Index ($\bar{H}$)	Number of Taxa	Number of Individuals
OB-1 (Hester Dendy)	1.84	10	64
OB-1 (Kicknet)	2.75	16	201
OB-2 (Hester Dendy)	2.15	10	18
OB-2 (Kicknet)	1.06	13	215
OD-1 (Hester Dendy)	1.51	15	394
OD-1 A (Surber)	1.52	15	160
OD-1 B (Surber)	2.32	13	74
OD-1 C (Surber)	2.32	16	249
OD-1 (Total Surber)	2.62	24	483
OD-2 (Hester Dendy)	1.78	16	426
OD-2 A (Surber)	1.70	18	206
OD-2 B (Surber)	3.53	26	351
OD-2 C (Surber)	1.98	20	182
OD-2 (Total Surber)	3.03	30	739

* See Figure B-2 for Sample Site Location

D. Diatoms.

1. Sampling Effort.

a. Periphyton-containing diatoms (a form of algae with a silicon skeleton) were collected using Diatometers (glass slides floated in a frame about 1-inch below the water's surface). On 25 March 1992, Diatometers were placed in Sand Creek above and below the ODA and also in the intermittent stream above and below the OB area. Sample sites are shown on Figure B-2. These Diatometers were collected on 4 May 1992 after 6 weeks of colonization.

b. The glass slides were then placed in hydrogen peroxide and potassium permanganate solution to clear away the organic matter and leave behind the inorganics and diatom frustules (silicon shells or skeletons) (reference 10). The samples were then centrifuged and decanted several times to remove the oxidizing agents, after which a portion of the sample was mounted on a microscope slide with permanent mounting media. Transects were counted across the slide until 300 diatoms from each sample were identified according to species (references 15, 18, and 20).

2. Diversity. The diversity index ($\overline{H}$) was calculated using the same formula used for macroinvertebrates (see paragraph IVC2). The diatom diversities generally run slightly higher than the macroinvertebrate diversities. Therefore, the two indices are not directly comparable (reference 22).

3. Analytical Results. Diatom data are summarized in Table B-3 and complete data are presented in Annex B-3.

a. ODA. The diatom data indicate reduced water quality below the ODA. There was a reduction in diatom diversity and taxa richness. One can only speculate as to the reason for these changes in the diatom populations when the macroinvertebrates were not affected. Possibly turbidity, nutrients, toxicity, and/or biological variability contributed to the difference. Chemical analysis of the water samples indicated nothing; during periods of runoff from the ODA, the dilution factor in Sand Creek should be overwhelming.

b. OB Area. The diatom population in the drainage ditch in the OB area showed no reduction in water quality. The species diversity and taxa richness were essentially the same above and below the OB area.

Table B-3. Summary of Diatom Data, 4 May 1992

Sample Site *	Diversiy Index ($\bar{H}$)	Number of Taxa	Number of Individuals
OD-1	3.00	27	300
OD-2	1.66	20	300
OB-1	1.23	13	300
OB-2	1.27	12	300

* See Figure B-2 for Sample Site Location

V. CONCLUSIONS.

A. Except for high iron concentrations measured below the ODA, the surface water in Sand Creek is not adversely impacted by the ODA. The high iron concentrations which were detected downstream of the ODA, might be ascribed to the iron contamination in the surface water runoff.

B. The surface water in the intermittent stream is not adversely impacted by the OB area. The explosive compound RDX was detected downstream of the OB area, but the concentration was below the literature values for aquatic toxicity.

C. Surface water runoff samples from the OBG and ODA contained high concentrations of explosive compounds (2,4-DNT, 2,4,6-DNT, 2,4,6-TNT, RDX, and nitroguanidine), metals (cadmium, copper, iron, and zinc), and cyanide. These contaminant concentrations exceeded state ambient water quality criteria. However, there are no numerical water quality criteria for surface water runoff for the State of Ohio.

D. The sediments within Sand Creek and the intermittent stream are not adversely impacted by the OD or OB areas. Extremely high levels of Total Organic Carbon (TOC) and Chemical Oxygen Demand (COD) were detected in sediment samples taken from the intermittent stream both above and below the OB area. These high levels reveal organic buildup in the intermittent stream. This buildup of organics is probably due to the deposition of organics from surface runoff.

E. The macroinvertebrate population in Sand Creek was not adversely affected by the ODA. However, the macroinvertebrate population within the intermittent stream experienced a reduction in species diversity and taxa richness below the OB area. Much of the difference was from the dominance of a species of stonefly (Amphinemura sp) that is generally considered a cool clean water organism.

F. The diatom population in the intermittent stream was not adversely affected by the OB area. However, the diatom population in Sand Creek experienced a reduction in species diversity and taxa richness below the ODA. Since a single sample was analyzed, it could not be determined if variability or other factors contributed to the reduction.

VI. RECOMMENDATION. Improve measures to control surface water runoff in the OBG and ODA areas. Improvement measures include repairing a break in the OBG berm and installing sedimentation screens in the ODA.

Richard A Valcourt

RICHARD A. VALCOURT
Environmental Engineer
Water Quality Engineering Division

Carl A. Bouwkamp

CARL A. BOUWKAMP
Aquatic Biologist
Water Quality Engineering Division

APPROVED:

William F. Fifty

WILLIAM F. FIFTY, P.E.
Chief, Wastewater Management Branch
Water Quality Engineering Division

ANNEX B-1

REFERENCES

1. State of Ohio, Environmental Protection Agency Water Quality Standards, Administrative Code 3745, Chapter 1, Rules 01-25, 1 May 1990.

2. Title 40, Code of Federal Regulations (CFR), 1991 rev, Part 264, Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities.

3. Letter, Ohio EPA, 11 July 1991, subject: Assistance in Preparing Geologic/Hydrogeologic Report for Ravenna Arsenal.

4. Letter, Ravenna Arsenal, Inc., 14 August 1991, subject: Amended 13 August 1991 Ravenna Army Ammunition Plant Geohydrological Study Milestone Schedule.

5. Letter, USAEHA, HSHB-ME-SH, 29 May 1987, subject: Hazardous Waste Consultation No. 37-26-1330-87, Resource Conservation and Recovery Act Part B Permit Writers' Guidance Manual for Department of Defense Open Burning/Open Detonation Units.

6. EPA 440/5-86-001, May 1986, Quality Criteria for Water.

7. Bently, R.E., Dean, J.W., Ells, S.J., Hollister, T.A., LeBlanc, G.A., Suater, S., Sleight, B.H. III: Laboratory Evaluation of the Toxicity of RDX to Aquatic Organisms. Final Report prepared for the U.S. Army Medical Research and Development Command by EG&G Bionomics, Wareham, Massachusetts, Contract No. DAMD17-74-C-4101, 1978.

8. Brillouin, L., "Science and Information Theory," Academic Press, New York (1956).

9. Gaufin, A.R., and C.M. Tarzwell, "Aquatic Invertebrates as Indicators of Stream Pollution," Public Health Reports, 67(1), 57-64 (1952).

10. Hancock, F.D., "The Ecology of Diatoms of the Klip River, Southern Transval," Hydrobiologia, 42, 243-284 (1973).

11. Hynes, H.B.N., The Biology of Polluted Waters, University of Toronto Press, Toronto (1960).

12. Kolkwitz, R., and M. Marrson, "Ecology of Animal Saprobia," Biology of Water Pollution (Lowell E. Keup, W.M. Ingrahm, and K.M. Mackenthun, compilers), United States Federal Water Pollution Control Administration, pp 85-95 (1967).

13. Kolkwitz, R., and M. Marrson, "Ecology of Plant Saprobia," Biology of Water Pollution (Lowell E. Keup, W.M. Ingrahm, and K.M. Mackenthun, compilers), United States Federal Water Pollution Control Administration, pp 47-52 (1967).

14. Lloyd, M., J.H. Zar, and J.R. Karr, "On the Calculation of Information-Theoretical Measures of Diversity," American Midland Naturalist, 79: 257-272 (1968).

15. Patrick, C., and C.W. Reimer, The Diatoms of the United States, Vol 1-III, Sutler House, Lititz, Pennsylvania (1966).

16. Patrick, R., "Use of Algae, Especially Diatoms, in the Assessment of Water Quality," American Society for Testing and Materials, ASTM No. 528, pp 76-95 (1973).

17. Patten, B.C., "The Diversity of Species in Net Phytoplankton of the Raritan Estuary," Ph.D. Thesis, Rutgers University, New Brunswick, New Jersey (1959).

18. Schmidt, A., Atlas der Diatomaceen-Kude, I-IV, VEB Druckwerke zwickau, Leipzig, DDR (1972).

19. Turobyski, L., "The Indicator Organisms and Their Ecological Variability," Acta Hydrobiologia, 15(3): 259-274 (1973).

20. Weber, C.I., A Guide to the Common Diatoms at Water Pollution Surveillance System Stations, U.S. Environmental Protection Agency, Cincinnati, Ohio (1971).

21. Weber, C.I. (ed), Biological Field and Laboratory Methods for Measuring the Quality of Surface Waters and Effluents, EPA-670/4-73-001, Cincinnati, Ohio (1973).

22. Wilhm, J.L., and T.C. Dorris, "Biological Parameters for Water Quality Criteria," Bioscience 18: 477-481 (1968).

23. Wilhm, J.L., "Graphic and Mathematical Analysis of Biotic Communities in Polluted Streams," Annual Review of Entomology, 223-252 (1972).

ANNEX B-2

DATA TABLES

Table B-2-1. Quality Control (QC1) Sample Site Analysis

Parameter Group	Analyte(s)	Rain Grab (3/26)		Rain Composite (3/26)		Dry weather Grab (4/30)		Sediment † (3/25)	
Explosives	2,4-DNT	<1	ug/L	<1	ug/L	<1	ug/L	<1	ug/g
	2,6-DNT	<1		<1		<1		<1	
	1,3,5-TNB	<2		<2		<2		<2	
	2,4,6-TNT	<1		<1		<1		<1	
	RDX	<3		<3		<3		<1	
	HMX	<100		<100		<100		<1	
	* Nitroguanidine	<100		<50		<10		<0.9	
	Picric Acid	<200		<200		<200		<0.4	
Metals	Antimony	<0.005	mg/L	<0.005	mg/L	<0.005	mg/L	<1.0	ug/g
	Arsenic	<0.005		0.007		<0.005		14	
	Barium	0.03		0.02		0.02		15	
	Beryllium	<0.005		<0.005		<0.005		<0.5	
	Cadmium	<0.0005		<0.0005		<0.0005		<0.25	
	Calcium	17		16		30		4594	
	Chromium	0.002		0.002		<0.001		3.8	
	Copper	0.02		0.02		<0.01		7.7	
	Iron	1.9		1.4		0.30		11670	
	Lead	<0.001		<0.001		0.002		9.4	
	Magnesium	4.0		3.9		6.8		2233	
	Manganese	0.10		0.08		0.06		226	
	Mercury	<0.0002		0.0004		<0.0002		<0.10	
	Nickel	<0.05		<0.05		<0.05		7.9	
	Potassium	1.3		1.1		0.9		308	
	Selenium	<0.001		<0.001		<0.001		<0.50	
	Silver	<0.01		<0.01		<0.01		<0.50	
	Sodium	6.7		6.7		6.8		120	
	Thallium	<0.001		<0.001		<0.001		<0.50	
	Zinc	0.10		0.06		0.02		39	

TNT Trinitrotoluene
DNT Dinitrotoluene
TNB Trinitrobenzene
RDX Hexahydro-1,3,5-trinitro-1,3,5-tritrazocine
HMX Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine

Table B–2–1. Quality Control (QC1) – continued

Parameter Group	Analyte(s)	Rain Grab (3/26)		Rain Composite (3/26)		Dry weather Grab (4/30)		Sediment † (3/25)	
Non–Metals	Chloride	14	mg/L	14	mg/L	11	mg/L	22	ug/g
	COD	<25		<25		<25		9100	
	Conductivity (UMHOS/CM)	190		140		280		–	
	Cyanide	<0.01		<0.01		<0.01		<0.25	
	Grease and Oil	<1.0		–		2.0		<1.0	
	Hardness	58.9		56		–		–	
	Nitrate/Nitrite	0.17		0.25		<0.05		1.0	
	Phosphorus	0.13		<0.10		<0.10		190	
	Phenols	<0.01		–		<0.01		0.48	
	Sulfate	37		35		37		160	
	TDS	120		120		170		–	
	TKN	0.46		0.35		<0.20		300	
	TOC	3.9		4.1		4.0		4300	
	TSS	45		42		<1.0		–	
	Ammonia–N	<0.10		<0.10		<0.10		2.1	
	T–Alkalinity	26		25		75		<10	
	Dissolved Oxygen	12		12		11.25		–	
	pH	6.8		6.8		6.5		7.5	
	Temperature (C)	3		3		12		–	
Volatiles		ND		–		ND		–	

ND Not Detected / See Table B–2–9 for parameters analyzed
† Results reported on a dry weight basis
* Dilution was required to detect peak accurately, detection limit was modified accordingly
COD Carbon Oxygen Demand
TDS Total Dissolved Solids
TKN Total Kjeldahl Nitrogen
TOC Total Organic Carbon
TSS Total Suspended Solids

Table B-2-2. Above OD Area (OD1) Sample Site Analysis

Parameter Group	Analyte(s)	Rain Grab (3/26)		Rain Composite (3/26)		Dry weather Grab (4/30)		Sediment † (3/25)	
Explosives	2,4-DNT	<1	ug/L	<1	ug/L	<1	ug/L	<1	ug/g
	2,6-DNT	<1		<1		<1		<1	
	1,3,5-TNB	<2		<2		<2		<2	
	2,4,6-TNT	<1		<1		<1		<1	
	RDX	<3		<3		<3		<1	
	HMX	<100		<100		<100		<1	
	* Nitroguanidine	<100		<10		<10		<0.9	
	Picric Acid	<200		<200		<200		<0.4	
Metals	Antimony	<0.005	mg/L	<0.005	mg/L	<0.005	mg/L	<1.0	ug/g
	Arsenic	<0.005		<0.005		<0.005		6.2	
	Barium	0.02		0.02		0.02		12	
	Beryllium	<0.005		<0.005		<0.005		<0.5	
	Cadmium	<0.0005		<0.0005		<0.0005		<0.25	
	Calcium	17		16		31		1100	
	Chromium	0.002		0.002		<0.001		2.6	
	Copper	0.02		0.02		<0.01		5.6	
	Iron	1.9		1.8		0.43		7700	
	Lead	<0.001		<0.001		<0.001		4.6	
	Magnesium	4.0		3.9		6.8		740	
	Manganese	0.10		0.09		0.09		100	
	Mercury	<0.0002		<0.0002		<0.0002		<0.10	
	Nickel	<0.05		<0.05		<0.05		4.6	
	Potassium	1.3		1.2		1.0		210	
	Selenium	<0.001		<0.001		<0.001		<0.50	
	Silver	<0.01		<0.01		<0.01		<0.50	
	Sodium	6.8		6.7		7.2		96	
	Thallium	<0.001		<0.001		<0.001		<0.50	
	Zinc	0.08		0.05		0.013		29	

Table B–2–2. Above OD Area (OD1) – continued

Parameter Group	Analyte(s)	Rain Grab (3/26)		Rain Composite (3/26)		Dry weather Grab (4/30)		Sediment † (3/25)	
Non–Metals	Chloride	14	mg/L	13	mg/L	11	mg/L	30	ug/g
	COD	<25		<25		<25		7600	
	Conductivity (UMHOS/CM)	190		160		290		–	
	Cyanide	<0.01		<0.01		<0.01		<0.25	
	Grease and Oil	<1.0		–		1.2		<1.0	
	Hardness	58.9		56		–		–	
	Nitrate/Nitrite	0.14		0.21		<0.05		1.0	
	Phosphorus	<0.10		<0.10		<0.10		120	
	Phenols	<0.01		–		<0.01		0.36	
	Sulfate	35		36		41		120	
	TDS	110		110		180		–	
	TKN	0.28		0.49		<0.20		380	
	TOC	6.5		4.5		3.8		2900	
	TSS	50		42		3.2		–	
	Ammonia–N	<0.10		<0.10		<0.10		2.7	
	T–Alkalinity	24		25		76		<10	
	Dissolved Oxygen	12		12		11.25		–	
	pH	6.6		6.5		6.5		7.2	
	Temperature (C)	3		3		12		–	
Volatiles		ND		–		ND		–	

ND Not Detected / See Table B–2–9 for parameters analyzed

† Results reported on a dry weight basis

* Dilution was required to detect peak accurately, detection limit was modified accordingly

Table B-2-3. Below OD Area (OD2) Sample Site Analysis

Parameter Group	Analyte(s)	Rain Grab (3/26)		Rain Composite (3/26)		Dry weather Grab (4/30)		Sediment † (3/25)	
Explosives	2,4-DNT	<1	ug/L	<1	ug/L	<1	ug/L	<1	ug/g
	2,6-DNT	<1		<1		<1		<1	
	1,3,5-TNB	<2		<2		<2		<2	
	2,4,6-TNT	<1		<1		<1		<1	
	RDX	<3		<3		<3		<1	
	HMX	<100		<100		<100		<1	
	* Nitroguanidine	<100		<10		<10		<0.9	
	Picric Acid	<200		<200		<200		<0.4	
Metals	Antimony	<0.005	mg/L	<0.005	mg/L	<0.005	mg/L	<1.0	ug/g
	Arsenic	<0.005		<0.005		<0.005		6.5	
	Barium	0.04		0.02		0.02		20	
	Beryllium	<0.005		<0.005		<0.005		<0.5	
	Cadmium	<0.0005		<0.0005		<0.0005		<0.25	
	Calcium	17		16		31		570	
	Chromium	0.002		0.002		<0.001		3.2	
	Copper	0.03		0.02		<0.01		8.1	
	Iron	2.4		1.5		0.46		9100	
	Lead	<0.001		<0.001		0.08		6.4	
	Magnesium	4.2		3.9		6.9		770	
	Manganese	0.08		0.08		0.09		310	
	Mercury	NA		<0.0002		<0.0002		<0.10	
	Nickel	<0.05		<0.05		<0.05		5.8	
	Potassium	1.3		1.2		1.0		310	
	Selenium	<0.001		<0.001		<0.001		<0.50	
	Silver	<0.01		<0.01		<0.01		<0.50	
	Sodium	8.2		6.8		7.5		85	
	Thallium	<0.001		<0.001		<0.001		<0.50	
	Zinc	0.04		0.04		0.02		34	

Table B–2–3. Below OD Area (OD2) – continued

Parameter Group	Analyte(s)	Rain Grab (3/26)		Rain Composite (3/26)		Dry weather Grab (4/30)		Sediment † (3/25)	
Non–Metals	Chloride	13	mg/L	12	mg/L	12	mg/L	25	ug/g
	COD	<25		<25		<25		9900	
	Conductivity (UMHOS/CM)	200		160		300		–	
	Cyanide	<0.01		<0.01		<0.01		<0.25	
	Grease and Oil	<1.0		–		2.7		<1.0	
	Hardness	60		56		–		–	
	Nitrate/Nitrite	0.08		0.22		<0.05		1.2	
	Phosphorus	0.27		0.20		<0.10		130	
	Phenols	<0.01		–		<0.01		0.30	
	Sulfate	33		35		44		28	
	TDS	110		120		180		–	
	TKN	0.76		0.44		<0.20		340	
	TOC	4.8		4.5		5.0		3300	
	TSS	150		26		2.4		–	
	Ammonia–N	<0.10		<0.10		<0.10		1.5	
	T–Alkalinity	26		25		76		<10	
	Dissolved Oxygen	12.2		12.2		11.25		–	
	pH	6.7		6.6		6.5		7.4	
	Temperature (C)	3		3		12		–	
Volatiles		ND		–		ND		–	

NA Not Analyzed
ND Not Detected / See Table B–2–9 for parameters analyzed
† Results reported on a dry weight basis
* Dilution was required to detect peak accurately, detection limit was modified accordingly

Table B-2-4. Below OD Area (OD3-dup) Sample Site Analysis

Parameter Group	Analyte(s)	Rain Grab (3/26)		Rain Composite (3/26)		Dry weather Grab (4/30)		Sediment † (3/25)	
Explosives	2,4-DNT	<1	ug/L	<1	ug/L	<1	ug/L	<1	ug/g
	2,6-DNT	<1		<1		<1		<1	
	1,3,5-TNB	<2		<2		<2		<2	
	2,4,6-TNT	<1		<1		<1		<1	
	RDX	<3		<3		<3		<1	
	HMX	<100		<100		<100		<1	
	* Nitroguanidine	<50		<50		<10		<0.8	
	Picric Acid	<200		<200		<200		<0.3	
Metals	Antimony	<0.005	mg/L	<0.005	mg/L	<0.005	mg/L	<1.0	ug/g
	Arsenic	<0.005		<0.005		<0.005		8.3	
	Barium	0.03		0.03		0.02		25	
	Beryllium	<0.005		<0.005		<0.005		<0.5	
	Cadmium	<0.0005		<0.0005		<0.0005		<0.25	
	Calcium	17		16		31		710	
	Chromium	0.002		0.002		<0.001		4.6	
	Copper	0.02		<0.01		<0.01		9.6	
	Iron	3.3		1.9		0.40		12000	
	Lead	<0.001		<0.001		<0.001		6.0	
	Magnesium	4.3		3.9		7.1		1000	
	Manganese	0.12		0.10		0.09		560	
	Mercury	<0.0002		<0.0002		<0.0002		<0.10	
	Nickel	<0.05		<0.05		<0.05		9.3	
	Potassium	1.6		1.4		1.1		380	
	Selenium	<0.001		<0.001		<0.001		<0.50	
	Silver	<0.01		<0.01		<0.01		<0.50	
	Sodium	6.3		6.7		7.7		110	
	Thallium	<0.001		<0.001		<0.001		<0.50	
	Zinc	0.04		0.03		<0.01		44	

Table B–2–4. Below OD Area (OD3–dup) – continued

Parameter Group	Analyte(s)	Rain Grab (3/26)		Rain Composite (3/26)		Dry weather Grab (4/30)		Sediment † (3/25)	
Non–Metals	Chloride	14	mg/L	14	mg/L	11	mg/L	12	ug/g
	COD	<25		<25		<25		9100	
	Conductivity (UMHOS/CM)	180		170		290		–	
	Cyanide	<0.01		<0.01		<0.01		<0.25	
	Grease and Oil	<1.0		–		7.1		<1.0	
	Hardness	60.1		56.0		–		–	
	Nitrate/Nitrite	0.14		0.20		<0.05		1.3	
	Phosphorus	<1.0		0.17		<1.0		190	
	Phenols	<0.01		–		<0.01		0.31	
	Sulfate	32		31		42		26	
	TDS	110		110		180		–	
	TKN	0.52		0.47		<0.20		210	
	TOC	4.5		4.5		3.4		5000	
	TSS	110		51		1.8		–	
	Ammonia–N	<0.10		<0.10		<0.10		1.5	
	T–Alkalinity	26		25		76		<10	
	Dissolved Oxygen	12.2		12.2		11.25		–	
	pH	6.8		6.6		6.5		7.4	
	Temperature (C)	3		3		12		–	
Volatiles		ND		–		ND		–	

ND Not Detected / See Table B–2–9 for parameters analyzed
† Results reported on a dry weight basis
* Dilution was required to detect peak accurately, detection limit was modified accordingly

Table B-2-5. Above OB Area (OB1) Sample Site Analysis

Parameter Group	Analyte(s)	Rain Grab (3/26)		Rain Composite (3/26)		Dry weather Grab (4/30)		Sediment † (3/25)	
Explosives	2,4-DNT	<1	ug/L	<1	ug/L	<1	ug/L	**	ug/g
	2,6-DNT	<1		<1		<1		**	
	1,3,5-TNB	<2		<2		<2		**	
	2,4,6-TNT	<1		<1		<1		**	
	RDX	<3		<3		<3		<2	
	HMX	<100		<100		<100		<1	
	* Nitroguanidine	<100		<50		<10		<0.9	
	Picric Acid	<200		260		<200		<0.4	
Metals	Antimony	<0.005	mg/L	<0.005	mg/L	<0.005	mg/L	<1.0	ug/g
	Arsenic	<0.005		<0.005		<0.005		9.6	
	Barium	0.02		0.017		0.02		66	
	Beryllium	<0.005		<0.005		<0.005		<0.5	
	Cadmium	<0.0005		<0.0005		<0.0005		0.35	
	Calcium	14		14		30		2200	
	Chromium	0.001		0.001		<0.001		8.6	
	Copper	0.02		0.022		<0.01		15	
	Iron	0.47		0.43		0.16		21000	
	Lead	<0.001		<0.001		<0.001		50	
	Magnesium	2.9		3.337		7.1		1500	
	Manganese	0.02		0.025		0.02		460	
	Mercury	<0.0002		<0.0002		<0.0002		<0.10	
	Nickel	<0.05		<0.05		<0.05		15	
	Potassium	1.1		0.8		0.7		510	
	Selenium	<0.001		<0.001		<0.001		<0.50	
	Silver	<0.01		<0.01		<0.01		<0.50	
	Sodium	3.3		2.8		3.1		190	
	Thallium	<0.001		<0.001		<0.001		<0.50	
	Zinc	0.07		0.042		0.02		80	

Table B–2–5. Above OB Area (OB1) – continued

Parameter Group	Analyte(s)	Rain Grab (3/26)		Rain Composite (3/26)		Dry weather Grab (4/30)		Sediment † (3/25)	
Non–Metals	Chloride	4.5	mg/L	2.5	mg/L	3.0	mg/L	16	ug/g
	COD	<25		<25		<25		53000	
	Conductivity (UMHOS/CM)	140		140		260		–	
	Cyanide	<0.01		<0.01		<0.01		<0.25	
	Grease and Oil	<1.0		–		1.5		<1.0	
	Hardness	46.9		48.5		–		–	
	Nitrate/Nitrite	0.86		0.42		<0.05		1.9	
	Phosphorus	<0.10		0.12		<0.10		330	
	Phenols	<0.01		–		<0.01		1.9	
	Sulfate	33		31		33		59	
	TDS	93		87		160		–	
	TKN	0.53		0.29		0.24		840	
	TOC	4.4		3.9		1.9		17000	
	TSS	5.2		4.2		<1.0		–	
	Ammonia–N	<0.10		<0.10		<0.10		40	
	T–Alkalinity	20		22		83		<10	
	Dissolved Oxygen	11.8		11.8		10.8		–	
	pH	6.4		6.6		7.5		7.0	
	Temperature (C)	4		4		15		–	
Volatiles		ND		–		ND		–	

ND Not Detected / See Table B–2–9 for parameters analyzed

† Results reported on a dry weight basis

* Dilution was required to detect peak accurately, detection limit was modified accordingly

** These values could not be accurately quantitated due to very poor extraction. This is suspected to be due to a matrix effect in the sediment.

Table B-2-6. Below OB Area (OB2) Sample Site Analysis

Parameter Group	Analyte(s)	Rain Grab (3/26)		Rain Composite (3/26)		Dry weather Grab (4/30)		Sediment † (3/25)	
Explosives	2,4-DNT	<1	ug/L	<1	ug/L	<1	ug/L	**	ug/g
	2,6-DNT	<1		<1		<1		**	
	1,3,5-TNB	<2		<2		<2		**	
	2,4,6-TNT	<1		<1		<1		**	
	RDX	6.8		5.8		<3		<1	
	HMX	<100		<100		<100		<1	
	* Nitroguanidine	<50		<20		<10		<0.8	
	Picric Acid	<200		<200		<200		<0.3	
Metals	Antimony	<0.005	mg/L	<0.005	mg/L	<0.005	mg/L	<1.0	ug/g
	Arsenic	<0.005		<0.005		<0.005		14	
	Barium	0.02		0.02		0.02		79	
	Beryllium	<0.005		<0.005		<0.005		<0.53	
	Cadmium	<0.0005		<0.0005		<0.0005		<0.38	
	Calcium	15		15		30		1100	
	Chromium	0.002		0.002		<0.001		11	
	Copper	0.02		<0.01		<0.01		13	
	Iron	0.61		0.62		0.55		25000	
	Lead	<0.001		<0.001		0.01		27	
	Magnesium	3.3		3.1		6.6		1600	
	Manganese	0.03		0.03		0.22		570	
	Mercury	<0.0002		<0.0002		<0.0002		<0.10	
	Nickel	<0.05		<0.05		<0.05		13	
	Potassium	1.5		1.6		0.9		610	
	Selenium	<0.001		<0.001		<0.001		<0.50	
	Silver	<0.01		<0.01		<0.01		<0.50	
	Sodium	2.8		2.8		3.0		210	
	Thallium	<0.001		<0.001		<0.001		<0.50	
	Zinc	0.05		0.02		0.02		69	

Table B–2–6. Below OB Area (OB2) – continued

Parameter Group	Analyte(s)	Rain Grab (3/26)		Rain Composite (3/26)		Dry weather Grab (4/30)		Sediment † (3/25)	
Non–Metals	Chloride	2.5	mg/L	2.5	mg/L	3.0	mg/L	18	ug/g
	COD	<25		<25		<25		46000	
	Conductivity (UMHOS/CM)	85		150		250		–	
	Cyanide	<0.01		<0.01		<0.01		<0.25	
	Grease and Oil	<1.0		–		2.6		<1.0	
	Hardness	51		50.2		–		–	
	Nitrate/Nitrite	0.79		0.74		<0.05		0.26	
	Phosphorus	<1.0		<1.0		<1.0		360	
	Phenols	<0.01		–		<0.01		1.4	
	Sulfate	35		35		38		51	
	TDS	89		94		160		–	
	TKN	0.36		0.33		<0.10		770	
	TOC	3.1		4.0		3.0		17000	
	TSS	9.5		10		8.0		–	
	Ammonia–N	<0.10		<0.10		<0.10		20	
	T–Alkalinity	22		25		78		<10	
	Dissolved Oxygen	12		12		10.8		–	
	pH	6.7		6.5		7.5		6.8	
	Temperature (C)	4		4		16.5		–	
Volatiles		ND		–		ND		–	

ND Not Detected / See Table B–2–9 for parameters analyzed
† Results reported on a dry weight basis
* Dilution was required to detect peak accurately, detection limit was modified accordingly
** These values could not be accurately quantitated due to very poor extraction. This is suspected to be due to a matrix effect in the sediment.

Table B-2-7. OD Runoff Sample Site Analysis

Parameter Group	Analyte(s)	Rain Grab (3/26)	
Explosives	2,4-DNT	1.1	ug/L
	2,6-DNT	<1	
	1,3,5-TNB	<2	
	2,4,6-TNT	14	
	RDX	230	
	HMX	<100	
	* Nitroguanidine	<20	
	Picric Acid	<200	
Metals	Antimony	<0.005	mg/L
	Arsenic	<0.005	
	Barium	0.14	
	Beryllium	<0.005	
	Cadmium	0.0011	
	Calcium	36	
	Chromium	0.017	
	Copper	0.16	
	Iron	28	
	Lead	0.002	
	Magnesium	11	
	Manganese	0.24	
	Mercury	NA	
	Nickel	<0.05	
	Potassium	3.9	
	Selenium	<0.001	
	Silver	<0.01	
	Sodium	6.5	
	Thallium	<0.001	
	Zinc	0.18	

Table B–2–7. OD Runoff – continued

Parameter Group	Analyte(s)	Rain Grab (3/26)	
Non–Metals	Chloride	8.5	mg/L
	COD	28	
	Conductivity (UMHOS/CM)	250	
	Cyanide	<0.01	
	Grease and Oil	<1.0	
	Hardness	135	
	Nitrate/Nitrite	1.0	
	Phosphorus	0.87	
	Phenols	<0.01	
	Sulfate	62	
	TDS	240	
	TKN	2.3	
	TOC	45	
	TSS	1000	
	Ammonia	0.10	
	T–Alkalinity	76	
	Dissolved Oxygen	12	
	pH	7.3	
	Temperature (C)	4	
Volatiles		ND	

NA Not Analyzed
ND Not Detected / See Table B–2–9 for parameters analyzed
*. Dilution was required to detect peak accurately, detection limit was modified accordingly

Table B-2-8. OB Runoff Sample Site Analysis

Parameter Group	Analyte(s)	Rain Grab (3/26)	
Explosives	2,4-DNT	2.8	ug/L
	2,6-DNT	2.2	
	1,3,5-TNB	<2	
	2,4,6-TNT	4.0	
	RDX	120	
	HMX	<100	
	* Nitroguanidine	38	
	Picric Acid	<200	
Metals	Antimony	<0.005	mg/L
	Arsenic	0.008	
	Barium	0.09	
	Beryllium	<0.005	
	Cadmium	0.016	
	Calcium	46	
	Chromium	0.11	
	Copper	0.05	
	Iron	4.6	
	Lead	0.01	
	Magnesium	15	
	Manganese	0.27	
	Mercury	<0.0002	
	Nickel	<0.05	
	Potassium	74	
	Selenium	0.003	
	Silver	<0.01	
	Sodium	7.3	
	Thallium	<0.001	
	Zinc	0.22	

Table B-2-8. OB Runoff – continued

Parameter Group	Analyte(s)	Rain Grab (3/26)	
Non-Metals	Chloride	17	mg/L
	COD	49	
	Conductivity (UMHOS/CM)	700	
	Cyanide	0.09	
	Grease and Oil	<1.0	
	Hardness	177	
	Nitrate/Nitrite	4.1	
	Phosphorus	0.27	
	Phenols	0.07	
	Sulfate	150	
	TDS	490	
	TKN	5.8	
	TOC	28	
	TSS	56	
	Ammonia	1.5	
	T-Alkalinity	92	
	Dissolved Oxygen	12.1	
	pH	7.0	
	Temperature (C)	3	
Volatiles		ND	

ND Not Detected / See Table B-2-9 for parameters analyzed

Table B-2-9. ANALYTICAL RESULTS, SAMPLE POINTS: QC1, OD1, OD2, OD3, OB1, OB2, OD RUNOFF, OB RUNOFF

Parameter Group	Analyte(s)	Rain Grab (3/26)	Rain Composite (3/26)	Low-Flow Grab (4/30)
Volatile Organic Compounds	Benzene	<2. ug/L	<2. ug/L	<2. ug/L
	Bromobenzene	<2.	<2.	<2.
	Bromochloromethane	<2.	<2.	<2.
	Bromodichloromethane	<2.	<2.	<2.
	Bromoform	<2.	<2.	<2.
	Bromomethane	<2.	<2.	<2.
	n-Butylbenzene	<2.	<2.	<2.
	sec-Butylbenzene	<2.	<2.	<2.
	tert-Butylbenzene	<2.	<2.	<2.
	Carbon tetrachloride	<2.	<2.	<2.
	Chlorobenzene	<2.	<2.	<2.
	Chloroethane	<2.	<2.	<2.
	Chloroform	<2.	<2.	<2.
	Chloromethane	<2.	<2.	<2.
	2-Chlorotoluene	<2.	<2.	<2.
	4-Chlorotoluene	<2.	<2.	<2.
	Dibromochloromethane	<2.	<2.	<2.
	1,2-Dibromo-3-chloropropane	<2.	<2.	<2.
	1,2-Dibromoethane	<2.	<2.	<2.
	Dibromoethane	<2.	<2.	<2.
	1,2-Chlorobenzene	<2.	<2.	<2.
	1,3-Chlorobenzene	<2.	<2.	<2.
	1,4-Chlorobenzene	<2.	<2.	<2.
	Dichlorodifluoromethane	<2.	<2.	<2.
	1,1-Dichloroethane	<2.	<2.	<2.
	1,2-Dichloroethane	<2.	<2.	<2.
	1,1-Dichloroethene	<2.	<2.	<2.
	c-1,2-Dichloroethene	<2.	<2.	<2.
	t-1,1-Dichloroethene	<2.	<2.	<2.
	1,2-Dichloropropane	<2.	<2.	<2.

Table B-9. (Continued)

Parameter Group	Analyte(s)	Rain Grab (3/26)	Rain Composite (3/26)	Low-Flow Grab (4/30)
Volatile Organic Compounds	1,2-Dichloropropane	<2. ug/L	<2. ug/L	<2. ug/L
	2,2-Dichloropropane	<2.	<2.	<2.
	1,1-Dichloropropene	<2.	<2.	<2.
	c-1,3,Dichloropropane	<2.	<2.	<2.
	t-1,3-Dichloropropene	<2.	<2.	<2.
	Ethylbenzene	<2.	<2.	<2.
	Hexachlorobutadiene	<2.	<2.	<2.
	Isopropylbenzene	<2.	<2.	<2.
	p-Isopropyltoluene	<2.	<2.	<2.
	Methylene-chloride	<2.	<2.	<2.
	Naphthalene	<2.	<2.	<2.
	n-propylbenzene	<2.	<2.	<2.
	Styrene	<2.	<2.	<2.
	1,1,2,2-Tetrechloroethane	<2.	<2.	<2.
	1,1,1,2-Tetrechloroethane	<2.	<2.	<2.
	Tetrachloroethene	<2.	<2.	<2.
	Toluene	<2.	<2.	<2.
	1,2,3-Trichlorobenzene	<2.	<2.	<2.
	1,2,4-Trichlorobenzene	<2.	<2.	<2.
	1,1,1-Trichloroethane	<2.	<2.	<2.
	1,1,2-Trichloroethane	<2.	<2.	<2.
	Trichloroethene	<2.	<2.	<2.
	Trichlorofluoromethane	<2.	<2.	<2.
	1,2,3-Trichloropropane	<2.	<2.	<2.
	1,2,4-Trimethylbenzene	<2.	<2.	<2.
	1,3,5-Trimethylbenzene	<2.	<2.	<2.
	Vinyl chloride	<2.	<2.	<2.
	O-Xylene	<2.	<2.	<2.
	M&P-Xylene	<2.	<2.	<2.

ANNEX B-3

BIOLOGICAL RATIONALE

Biological Rationale. It is widely recognized that biota accurately reflect the quality of their environment. Many biological indices/indicator organisms have been used to evaluate pollutional stress (references 9, 11, 12, 13, 16, 19, and 23). The usefulness of biota as indicators of environmental quality results from a number of biological characteristics.

a. Ecological Importance. An ecosystem is a natural unit of living and environmental components which interact to form a stable system. A change in one component normally disturbs the balance and causes changes throughout the ecosystem.

b. Mobility. Many organisms are either attached to the substrate or have limited mobility. When these organisms are exposed to environmental changes, e.g., pollution, they are forced to seek an environment suited for their survival, adapt, or perish. Thus, the organisms present in an ecosystem are dependent on physical, chemical, and biological environmental factors.

c. Sensitivity to Pollutants. Many members of these communities are very sensitive to physical and/or chemical stresses and, depending on the nature and concentration of pollutants, are often eliminated or reduced in number. Conversely, a limited number of more tolerant species often become more abundant. These tolerant or sensitive organisms can indicate either healthy or polluted conditions, e.g., certain species of mayflies indicate healthy conditions and tubifex worms indicate polluted conditions.

d. Community Structure. Environmental impact is also reflected by changes in community structure. Communities impacted by environmental stress are typically composed of a small number of species represented by large numbers of individuals (low diversity), whereas those unimpacted have many different species with relatively few individuals (high diversity) in a given species. Diversity can be quantified using a diversity formula. Formula values determine the extent of impact of environmental stress upon the ecosystem. This comparative use of community diversity quantifies pollutional impact.

Table 1. Counts of diatoms from diatometers set at four locations near the Ravenna Army Ammunition Plant, Ohio.

	OD1	OD2	OB1	OB2
Achnanthes lanceolata	2	2		
Achnanthes linearis				12
Achnanthes minutissima	135	224	241	236
Amphora submontana			1	
Caloneis bacillum var. fontinalis	2			
Cymbella affinis	2	1		
Cymbella minuta	4	6		
Cymbella sp. K	2		4	14
Gomphonema acuminatum	6	2		
Gomphonema angustatum var. angustatum	13	13	8	18
Gomphonema angustatum var. sarcophagus		2	4	
Gomphonema olivaceum	16	9		
Gomphonema parvulum	4	8	4	4
Melosira varians			1	
Meridion circulare	4	2	13	
Navicula cryptocephala var. veneta	2	1		2
Navicula cryptocephala v. cryptocephala	2			2
Navicula gregaria	2			
Navicula lanceolata	2			2
Navicula tripunctata		2		
Nitazshia tryblionella var. debilis				2
Nitzschia acula	2			
Nitzschia agnita	6	4		
Nitzschia amphibia	2			
Nitzschia delognei		1		
Nitzschia frustulum var. perminuta			2	
Nitzschia subcapitellata	2	4		
Reimeria sinuata	2		2	
Surirella ovalis		2		
Surirella ovata var. minuta	31	7		2
Synedra acus	9	5	15	2
Synedra parasitica	2			
Synedra tabulata	2			
Synedra ulna	24	1	2	
Synedra vaucheriae var. capitellata	10	4	3	4
Synedra vaucheriae var. vaucheriae	10			
	300	300	300	300

Species	Kick Net Site OB1	OB2
PLATYHELMINTHES		
Tricladida		
Dugesia tigrina	5	
BIVALVIA		
Corbiculidae		
Corbicula manilensis		
GASTROPODA		
Hygrobiidae		
Amnicola limnosa	24	
Planorbidae		
Heliosoma sp.		
Physidae		
Physa sp.	22	2
ANNELIDA		
Oligochaeta		
Lumbriculidae		
Lumbriculis variegatus	1	
Tubificidae		
Tubifex kessleri	6	1
Hirudinea		
Placobdella papillifera		
Errobdella punctata punctata		
CRUSTACEA		
Amphipoda		
Crangonyx gracilus		3
Decapoda		
Procambarus sp.		3
INSECTA		
Odonata		
Aeschna verticalis		
Ephemeroptera		
Baetisca lacustris		
Baetis sp.	5	1
Stenonema vicarium		
Stenonema terminatum		
Stenonema sp.		1
Caenis sp.		
Ephemerella sp.		1
Plecoptera		
Perlidae		
Acroneuria evoluta		
Eccoptura xanthenes		
Chloroperlidae		
Alloperla sp.	32	4

Species	Kick Net Site OB1	OB2
Nemouridae		
Amphinemura sp.	76	178
Hemiptera		
Corixidae larva		
Trichoptera		
Chimarra sp.	1	
Cheumatopsyche sp.		
Frenesia missa	5	
Ochrotrichia sp.		
Ptilostomis sp.	6	
Polycentropus sp.		
Coleoptera		
Dytiscidae		
Hydroporus undulatus gp.		
Haliplidae		
Peltodytes lengi		
Dryopidae		
Helichus basalus		
Optioservus sp.		
Elmidae		
Stenelmis crenata adult	1	
Stenelmis crenata larva		
Psephenidae		
Psephenus hetricki		
Diptera		
Tipulidae		
Tipula sp.		
Ceratopogonidae		
Culicoides sp.		
Simuliidae		
Metacnephia sp.	1	3
Chironomidae		
Ablabesmyia mallochi	5	2
Sympotthastia sp.		
Eukieffiella bavarica gp.		1
Chironomus riparius		
Endochironomus subtendens	8	15
Paratanytarsus sp.	3	
Tabanidae		
Tabanus sp.		

Benthic Macroinvertebrate Samples from
Ravenna Army Ammunition Plant, Ravenna, OH
Collected May 4, 1992

TAXONOMIC LISTING

Species	Hester-Dendy Site			
	OD1	OD2	OB1	OB2
PLATYHELMINTHES				
Tricladida				
Dugesia tigrina		2		
BIVALVIA				
Corbiculidae				
Corbicula manilensis			34	
GASTROPODA				
Hygrobiidae				
Amnicola limnosa		120	2	
Planorbidae				
Heliosoma sp.		1		
Physidae				
Physa sp.			1	
ANNELIDA				
Oligochaeta				
Lumbriculidae				
Lumbriculis variegatus				
Tubificidae				
Tubifex kessleri	241	6	16	
Hirudinea				
Placobdella papillifera				1
Errobdella p. punctata	1		2	
CRUSTACEA				
Amphipoda				
Crangonyx gracilus				1
Decapoda				
Procambarus sp.				
INSECTA				
Odonata				
Aeschna verticalis				

Species	Hester-Dendy Site			
	OD1	OD2	OB1	OB2
Ephemeroptera				
Baetisca lacustris	1			
Baetis sp.	1	2	2	1
Stenonema vicarium		13		
Stenonema terminatum	1			
Stenonema sp.		4		
Caenis sp.	1			
Ephemerella sp.				
Plecoptera				
Perlidae				
Acroneuria evoluta		1		
Eccoptura xanthenes				
Chloroperlidae				
Alloperla sp.				
Nemouridae				
Amphinemura sp.				
Hemiptera				
Corixidae larva				
Trichoptera				
Chimarra sp.		1		
Cheumatopsyche sp.	1			
Frenesia missa				
Ochrotrichia sp.				
Ptilostomis sp.				3
Polycentropus sp.	2	1		1
Coleoptera				
Dytiscidae				
Hydroporus undulatus gp.			1	1
Haliplidae				
Peltodytes lengi				1
Dryopidae				
Helichus basalus				
Optioservus sp.				
Elmidae				
Stenelmis crenata adult				
Stenelmis crenata larva	1	1		
Psephenidae				
Psephenus hetricki				
Diptera				
Tipulidae				
Tipula sp.	2			
Ceratopogonidae				
Culicoides sp.				
Simuliidae				
Metacnephia sp.		12	1	1

Species	Hester-Dendy Site			
	OD1	OD2	OB1	OB2
Chironomidae				
Ablabesmyia mallochi	3	14	3	1
Sympotthastia sp.	114	242		
Eukieffiella bavarica gp.	5	5		7
Chironomus riparius	8			
Endochironomus subtendens	12		2	
Paratanytarsus sp.		1		
Tabanidae				
Tabanus sp.				

Species	Surber Site OD1 A	B	C
PLATYHELMINTHES			
Tricladida			
Dugesia tigrina		1	
BIVALVIA			
Corbiculidae			
Corbicula manilensis			
GASTROPODA			
Hygrobiidae			
Amnicola limnosa			
Planorbidae			
Heliosoma sp.			
Physidae			
Physa sp.			
ANNELIDA			
Oligochaeta			
Lumbriculidae			
Lumbriculis variegatus		2	
Tubificidae			
Tubifex kessleri		25	6
Hirudinea			
Placobdella papillifera			
Errobdella punctata punctata			
CRUSTACEA			
Amphipoda			
Crangonyx gracilus			
Decapoda			
Procambarus sp.			
INSECTA			
Odonata			
Aeschna verticalis			
Ephemeroptera			
Baetisca lacustris			
Baetis sp.	5	1	28
Stenonema vicarium	1		2
Stenonema terminatum	2		8
Stenonema sp.			1
Caenis sp.	2		
Ephemerella sp.			
Plecoptera			
Perlidae			
Acroneuria evoluta			
Eccoptura xanthenes	1		
Chloroperlidae			
Alloperla sp.	6	1	13

Species	Surber Site A	Surber Site B	OD1 C
Nemouridae			
Amphinemura sp.	4		11
Hemiptera			
Corixidae larva			
Trichoptera			
Chimarra sp.	1		
Cheumatopsyche sp.	1		1
Frenesia missa		2	
Ochrotrichia sp.	1		
Ptilostomis sp.			
Polycentropus sp.			
Coleoptera			
Dytiscidae			
Hydroporus undulatus gp.			
Haliplidae			
Peltodytes lengi			
Dryopidae			
Helichus basalus	2	1	1
Optioservus sp.			
Elmidae			
Stenelmis crenata adult			
Stenelmis crenata larva			
Psephenidae.			1
Psephenus hetricki			
Diptera			
Tipulidae			
Tipula sp.	1		5
Ceratopogonidae			
Culicoides sp.		1	
Simuliidae			
Metacnephia sp.		3	9
Chironomidae			
Ablabesmyia mallochi	2	2	1
Sympotthastia sp.	118	15	27
Eukieffiella bavarica gp.	13	19	133
Chironomus riparius			
Endochironomus subtendens			
Paratanytarsus sp.		1	2
Tabanidae			
Tabanus sp.			

Species	Surber Site OD2 A	B	C
PLATYHELMINTHES			
Tricladida			
Dugesia tigrina	3	51	1
BIVALVIA			
Corbiculidae			
Corbicula manilensis	6	62	6
GASTROPODA			
Hygrobiidae			
Amnicola limnosa		20	1
Planorbidae			
Heliosoma sp.			
Physidae			
Physa sp.			
ANNELIDA			
Oligochaeta			
Lumbriculidae			
Lumbriculis variegatus		5	
Tubificidae			
Tubifex kessleri			
Hirudinea			
Placobdella papillifera			
Errobdella punctata punctata			
CRUSTACEA			
Amphipoda			
Crangonyx gracilus			
Decapoda			
Procambarus sp.			
INSECTA			
Odonata			
Aeschna verticalis	1		
Ephemeroptera			
Baetisca lacustris		1	
Baetis sp.	7	15	8
Stenonema vicarium	4	11	2
Stenonema terminatum	2	4	1
Stenonema sp.	3	7	5
Caenis sp.	1		
Ephemerella sp.			
Plecoptera			
Perlidae			
Acroneuria evoluta		1	
Eccoptura xanthenes			
Chloroperlidae			
Alloperla sp.	2	10	5

Species	Surber Site OD2 A	B	C
Nemouridae			
Amphinemura sp.	2	7	6
Hemiptera			
Corixidae larva		1	
Trichoptera			
Chimarra sp.	1	12	4
Cheumatopsyche sp.	2	7	1
Frenesia missa			
Ochrotrichia sp.			
Ptilostomis sp.			
Polycentropus sp.	1	4	
Coleoptera			
Dytiscidae			
Hydroporus undulatus gp.			
Haliplidae			
Peltodytes lengi			
Dryopidae		4	2
Helichus basalus		2	2
Optioservus sp.			
Elmidae		1	
Stenelmis crenata adult	4	17	3
Stenelmis crenata larva			
Psephenidae		2	1
Psephenus hetricki			
Diptera			
Tipulidae		1	3
Tipula sp.			
Ceratopogonidae	1		
Culicoides sp.			
Simuliidae	13	33	3
Metacnephia sp.			
Chironomidae	4	2	
Ablabesmyia mallochi			
Sympotthastia sp.	149	66	123
Eukieffiella bavarica gp.			
Chironomus riparius			
Endochironomus subtendens			1
Paratanytarsus sp.			
Tabanidae		5	4
Tabanus sp.			

Ecological and Taxonomic Notes

The sample sites are coded as follows:

Site Number	Location
2	Above Open Detonation Area
3	Below Open Detonation Area
4	Above Open Burn Area
5	Below Open Burn Area

Dugesia tigrina -- A generally distributed and common planarian. It is usually found in pools and ponds, in woodland areas, with leaf litter. (10)

Corbicula manilensis -- This introduced species is sometimes so abundant that it is a nuisance, plugging waterways in pumping plants, etc. It has spread throughout most of the Atlantic and Mississippi drainage area. (18)

Amnicola limnosa -- This species, and its subspecies, are found in the United States and Canada as far west as Utah. (3)

Heliosoma sp. -- This large genus is found in a wide variety of habitats throughout the United States. (3)

Physa sp. -- Physa is common throughout North America and is typical of eutrophic environments. (18)

Lumbriculis variegatus -- This earthworm-like Lumbriculid is common and has been the subject of many studies. It is usually found in shallow water where sticks, leaves, rocks, roots, and other debris are present. (26)

Tubifex kessleri -- This species burrows in the soft sediments and is able to tolerate environmental stress. (26)

Placobdella papillifera -- This species is widely distributed and locally common. It has been reported as feeding on turtles. (11)

Errobdella punctata punctata -- This species is common throughout most of the United States and Canada, especially the Great Lakes region. (11)

Crangonyx gracilus -- A common amphiopod in streams in the central United States. (9)

Procamberus sp. - All specimens were too small to identify to the species level. Procambarus is a general feeder, omnivorous. (8)

Aeschna verticalis -- Larvae of this species are usually climbers

in lentic water. They are found clinging to submerged stems and sticks. (17,25)

Baetisca lacustris -- This species is found partially buried, usually in sand or silty sand. (23)

Baetis sp. -- This large genus is common through the United States. The nymphs live under stones and debris. It is extremely tolerant of high temperatures. (6,13)

Stenonema vicarium -- This species is usually found in the pool areas of streams but is less resistant to organic pollution than the most species of Stenonema. (12)

Stenonema terminatum -- Usually found on the lower surfaces of stones. (12)

Stenonema sp. -- Specimens placed in this group were too small to identify, but were not either of the above two species.

Caenis sp. -- The specimens were in the Hilaris Group and all species in this group are found on a broad range of substrates in slow to moderate currents. (20)

Ephemerella sp. -- This very large genus is common in lotic water. They usually feed on diatoms and algae. (6)

Acroneuria evoluta -- This stream dwelling stonefly is a predator on chironomid larvae. (24)

Eccoptura xanthenes -- A predatory stonefly (24)

Alloperla sp. -- This large genus is common in fast moving water. Most species are predators or collector-gatherers. (7)

Amphinemura sp. --Members of this genus are detritivores. (7)

Corixidae larva -- The single specimen was too small for generic identification.

Chimarra sp.-- a tube spinning caddisfly common in the northeast under stones in riffle areas. It feeds mostly on algae. (27)

Cheumatopsyche sp. -- A large genus of net spinning caddisflies. They are reported to be able to survive in streams too polluted for most other caddisflies. (27)

Frenesia missa -- This species is generally found in cold streams and seapage areas where it feeds on leaves and decaying wood. (27)

Ochrotrichia sp. -- A very large genus with only a few species in the Northeast. They are generalized herbivores on materials in stream systems. (27, 28)

Ptilostomis sp. -- Larvae of this small genus cannot be identified to the specific level at this time. (27)

Polycentropus sp. - Members of this large genus feed on decomposing vascular plant material. (27)

Hydroporus undulatus - This species is common throughout the northeastern United States. Adults are probably generalized detritivoures, larvae are predators on small crustaceans. (14)

Peltodytes lengi -- A common water crawling beetle in the northern United States. Both the larvae and adults are associated with filamentous algae. (15)

Helichus basalus -- A common stream dwelling Dryopoid which is found throughout the eastern and central United States. (1)

Optioservus sp. -- Larvae are usually found in gravel or coarse sand in fast, shallow water. (1)

Stenelmis crenata adult and larva-- This species is found in riffle streams from Canada to Alabama and west to Texas. It is frequently associated with submerged wood and is tolerant of chlorides but sensitive to sewage and phosphate waste. (1)

Psephenus hetricki -- The larvae graze on diatoms and other algae which coat rocks in riffle areas (2)

Tipula sp. - This large genus is found in a wide variety of aquatic habits. A shredder active in the breakdown of leaf packs and other organic material. (4)

Culicoides sp. - The genus Culicoides is a large and diverse genus which inhabits a wide variety of habitats. The adults are blood feeders and are frequently found biting man. The larvae are predators on mieofauna. (16)

Metacnephia sp. - This filter feeding Simuliid is only found in moving water, usually clinging to the upper surfaces of rocks. (19)

Ablabesmyia mallochi - A widespread and pollution tollerant species. Frequently found in sluggish rivers but also in a wide variety of other environmental conditions.(21,22)

Sympotthastia sp. -- Members of this genus are collector-gatherers in the lotic-erosional zone. (5)

Eukieffiella bavarica gp. - This species prefers small rivers, streams and tributaries. (22)

Chironomus riparius -- This common species can tolerate adverse water quality conditions. (22)

Endochironomus subtendens -- This species has a possible affinity to enriched water. (22)

Paratanytarsus sp. -- Specimens placed in this genus cannot be identified to the species level as yet. The genus has a wide range of environmental preferences and tolerances. (5)

Tabanus sp. - The larvae of this large genus are predators in the aquatic and semiaquatic environments. They are relatively tolerant of organic pollution. (16)

LITERATURE CITED

1 Brown, H. P. 1972. Aquatic dryopoid beetles of the United States. EP1.16:18050 ELD 04/72/No. 6.

2 Brown, H. P. and C. M. Murvosh. 1974. A revision of the genus psephenus (Water-Penny Beetles) of the United States and Canada. (Coleoptera, Dryopoidea, Psephenidae). Trans. Amer. Ent. Soc. 100:289-340.

3 Burch, J.B. 1982. Freshwater Snails (Mollusca: Gastropoda) of North America. EPA 600/3-82-026.

4 Byers, G. W. 1978. Tipulidae in Merritt and Cummins (eds.) Aquatic Insects of North America. Kendall Hunt Publ. Co., Dubuque, Iowa. 441 pp.

5 Coffman, W. P. 1978. Chironomidae in Merrit and Cummins (eds.) Aquatic Insects of North America. Kendall Hunt Publ. Co., Dubuque, Iowa. 441 pp.

6 Edmonds, G. F., Jr., S. L. Jensen and L. Berner. 1976. The mayflies of North and Central America. Univ. Minn. Press. 330 pp.

7 Harper, P. P. 1978. Plecoptera in Merrit and Cummins (eds.) Aquatic Insects of North America. Kendall Hunt Publ. Co., Dubuque, Iowa. 441 pp.

8 Hobbs, H. H. 1976. Crayfish (Astacidae) of North and Middle America. EPA Water Pollution Control Research Series 18050 ELD05/72. 173 pp.

9 Holsinger, J. R. 1972. The freshwater amphipod crustaceans of North America. ELD 04/72/No.

10 Kent, R. 1976. Freshwater Planarians (Turbellaria) of North America. Biota of Freshwater Ecosystems Identification Manual ELD02/72.

11 Klem, D. J. 1982. Leeches (Annelida: Hirudinea) of North America. EPA-600/3-82-025.

12 Lewis, P.A. 1974. Taxonomy and ecology of Stenonema mayflies. EPA-670/4-74-006. 80 pgs.

13 McCafferty, W.P. 1990. Revisionary synopsis of the Baetidae (Ephemeroptera) of North and Middle America. Trans. Amer. Ent. Soc. 116:769-799.

14 Matta, J. F. 1992. The Hydroporine Dytiscidae of Virginia. (unpublished)

15 Matta, J. F. 1976. The Haliplidae of Virginia (Coleoptera: Adephaga). VPI+SU Research Div. BUll. #109. 26 pp.

16 Merrit and Cummins (eds.) 1978. Aquatic Insects of North America. Kendal Hunt Publ. Co. Dubuque, Iowa. 441 p.

17 Needham, J. G. and M. J. Westfall. 1955. Dragonflies of North America. Univ. Cal. Press., Berkley. 615 pp.

18 Pennak, R. W. 1978. Freshwater invertebrates of the United States. Wiley - interscience. NY. 803 pp.

19 Peterson, B. V. 1978. Simuliidae in Merritt and Cummins (eds.) Aquatic Insects of North America. Kendall Hunt Publ. Co., Dubuque, Iowa. 441 pp.

20 Provonsha, A.V. 1990. A revision of the genus Caenis in North America (Ephemeroptera: Caenidae). Trans. Amer. Ent. Soc. 116:801-884.

21 Simpson, K. W. 1982. A guide to basic taxonomic literature for the general of North American Chironomidae - adults, pupae and larvae. NY State Museum Bull. No. 447.

22 Simpson, K. W. and R. W. Bode. 1980. Common larvae of Chironomidae (Diptera) from New York States streams and rivers. NY State Museum Bull. No. 439.

23 Unzicker, J. D. and P. H. Carlsonl 1982. Ephemeroptera. in Brigham, Brigham, and Gnilka (eds.) Aquatic Insects and Oligochaetes of North and South Carolina. Midwest Aquatic Enterprises, Mahomet, Illinois. 97 pp.

24 Unzicker, J. D. and V. H. McCaskill 1982. Plecoptera. in Brigham, Brigham, and Gnilka (eds.) Aquatic Insects and Oligochaetes of North and South Carolina. Midwest Aquatic Enterprises, Mahomet, Illinois. 100 pp.

25 Westfall, M. J. 1978. Odonata in Merrit and Cummins (eds.) Aquatic Insects of North America. Kendall Hunt Publ. Co., Dubuque, Iowa. 441 pp.

26 Whitley, L. S. 1982. Aquatic oligochaeta in Brigham, Brigham, and Gnilka (eds.) Aquatic Insects and Oligochaetes of North and South Carolina. Midwest Aquatic Enterprises, Mahomet, Illinois. 29 pp.

27 Wiggins, G. B. 1977. Larvae of the North American caddisfly genera (Trichoptera). Univ. Toronto Press. 401 pp.

28 Woodall, W. R. and J. B. Wallace. 1972. The benthic fauna in four small southern Appalachian streams. Am. Midl. Nat. 89:360-368.