Effluent Biomonitoring at Selected Iowa Industrial and Municipal Wastewater Facilities

September 1988

Report No. 88 — 7

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Environmental Protection Agency
Region VII

by the

Hygienic Laboratory
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Abstract

An evaluation of effluent toxicity on six selected wastewater treatment facilities in Iowa was conducted ıring September 1988. Final effluent grab samples were collected from each facility and tested for toxicity ;ing fathead minnows and Daphnia magna. Chemical analyses performed on the effluent samples indicated e presence of heavy metals, total residual chlorine and ammonia. Two facilities' discharges, the Sioux City lunicipal Wastewater Treatment Plant and the Amax Corporation, tested positive indicating the presence toxic substances in their effluents. The most probable cause of toxicity in the Sioux City sample may be tributed to un-ionized ammonia. Toxicity in the Amax Corporation sample was most probably due to evated levels of sodium and unionized ammonia.

Introduction

In accordance with Public Law 92-500 (as amended by the Clean Water Act of 1977) all wastewater eatment plants in Iowa must have a permit to discharge wastes into Iowa streams or lakes. The Department f Natural Resources (IDNR) issues National Pollutant Discharge Elimination System (NPDES) permits to pproximately 1,200 municipal and industrial wastewater treatment plants (WWTP) in Iowa (1). The IPDES permit specifies the type and quantity of pollutants a WWTP may discharge.

Modifications to the Clean Water Act were recently made by the U.S. Congress. One modification, found ı section 303(c2B) requires that each time a state reviews water quality standards, it also "shall adopt criteria ɔr all toxic pollutants listed pursuant to section 307(a)(1) of the Clean Water Act for which criteria have been ublished under section 304(a), the discharge or presence of which in the affected waters could reasonably e expected to interfere with those designated uses adopted by the State, as necessary to support such esignated uses".

Therefore, the IDNR has on-going activities that provide additional information on the prevalence of ɔxics in Iowa's waters. As part of these activities, the following biomonitoring project was developed which ıcluded the collection of wastewater effluent samples, static 24 hour acute bioassay tests to determine ffluent toxicity; and analysis of effluents for selected potentially toxic analytes. The objectives of the study ere to:

1. Provide information to help determine if the selected facilities discharge toxic wastewater an to determine what types of effluents may be toxic to aquatic organisms even when permit limit are met;
2. Identify if the effluent is acutely toxic;
3. Evaluate the use of biological screening techniques to identify potential sources of toxi pollutants to Iowa waters.

Six wastewater dischargers were selected and their respective effluents tested for toxicity by performin 24 hour acute bioassays using the water flea, Daphnia magna and the fathead minnow, Pimephales promelas The dischargers were selected according to the following criteria:

1. The wastewater discharge would contain industrial waste;
2. The wastewater was discharged to a Class B warm water stream that was noted on th Department's 304(l) short list;
3. The wastewater was suspected of containing a toxic component.

The data obtained in the study will be used to identify if any of the effluents tested are toxic to tes organisms. If positive results are obtained, this will direct efforts to study the wastewater more extensively The ultimate goal of follow-up activities is to reduce toxic levels in order to protect the receiving stream' beneficial use. The information will also be used to direct attention to other facilities having similar wast characteristics.

Sampling and Analytical Methodology

A comprehensive Work/Quality Assurance Project Plan was written by personnel from the IDNR an UHL. Quality Assurance for field and laboratory activities were followed as outlined in the project plan. Al data present in this report meet the quality assurance objectives as specified in the Work/QA plan. A brie discussion of field and laboratory activities follows. For more details of these activities see the Work/Quality Assurance Plan for Effluent Biomonitoring at Selected Industrial and Municipal Wastewater Treatmen Plants (2). Copies of the plan are available from the IDNR or the UHL.

Procedures used in sample collection, preservation and analysis are described in Standard Methods (3) Handbook for Sampling and Sample Preservation of Water and Wastewater (4), and the Manual fo Chemical Analysis of Water and Wastes (5).

Grab samples for bioassay testing and selected chemical analysis were collected at the facilities listed in Table 1. The basic bioassay procedures used conform to the recommended procedures found in Methods fo Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms (6). A brief summary follows; more specific information can be found either in the referenced EPA document or in the Work/QA plan (2).

A single grab sample was collected at each facility at a time that was representative of the normal plant peration and used for bioassay testing. Prior to the bioassay test several chemical analyses were performed n the sample including dissolved oxygen (DO), total residual chlorine (TRC), pH, ammonia, un-ionized nmonia and specific conductance. If the DO concentration was below 40% saturation, the sample was rated using single bubble aeration. If the TRC or un-ionized ammonia concentrations were above the escribed levels(2) they were neutralized or removed and additional bioassays were performed using both djusted" and "unadjusted" sample water. Approximately 20 fish and 20 Daphnia neonates (newborns) per mple were added to 3-5 beakers of the "test water". At the end of a 24 hour period mortality for each ganism was recorded. A sample was considered to be toxic if 20% or greater of either organism died. The oassay test results were invalidated if 10% or greater of either organism died in the control beakers.

Table 1. Wastewater Treatment Facilities Sampled for Biotoxicity Testing

elected acility	Town	Sampled	Chemical Analyses
lunicipal WWTP	Sioux City	9/14/88	Priority Pollutant Metals*
lunicipal WWTP	Newton	9/14/88	Priority Pollutant Metals*
laytag Corporation	Newton	9/20/88	Priority Pollutant Metals*, Cyanide, Iron, Aluminum
lunicipal WWTP	Cedar Rapids	9/21/88	Priority Pollutant Metals*
lunicipal WWTP	Burlington	9/26/88	Priority Pollutant Metals*
MAX Corporation	Ft. Madison	9/26/88	Priority Pollutant Metals*, Molybdenum

Priority Pollutant Metals: Antimony, Arsenic, Beryllim, Cadmium, Chromium, Copper, Lead, Mercury, ickel, Selenium, Silver, Thallium, Zinc

Results and Discussion

The results of the bioassay tests may be found in Table 2. Of the six facilities sampled and tested for acut toxicity, two facilities (Sioux City Municipal WWTP and Amax Corporation at Ft. Madison) tested positive indicating the presence of toxic substances in their effluents. All of the effluents sampled were analyzed fo selected pollutants as determined by the IDNR staff. All data collected may be found in the Appendix Selected data will be found in the individual tables for each facility samples.

Table 2. Bioassay Results

Location	Sample Type	Fish Kills	Daphnia Kills	Sample Rated
Sioux City WWTP	Final effluent	21/21	0/20	Toxic
Sioux City WWTP	Final effluent (adjusted)*	0/20	0/20	Non-toxic
Newton WWTP	Final effluent	0/20	0/21	Non-toxic
Maytag Corp.	Final effluent	0/21	0/21	Non-toxic
Maytag Corp.	Final effluent (adjusuted)**	0/21	0/20	Non-toxic
Cedar Rapids WWTP	Final effluent	0/21	0/20	Non-toxic
Burlington WWTP	Final effluent	0/20	0/20	Non-toxic
Burlington WWTP	Final effluent (adjusted)*	0/19	0/20	Non-toxic
AMAX Corp.	Final effluent	0/20	5/15	Toxic
AMAX Corp.	Final effluent (adjusted)*	20/20	15/15	Toxic***
AMAX Corp.	Final effluent 1:50 dilution	0/20	0/15	Non-toxic

* Adjusted for ammonia
** Adjusted for Total Residual Chlorine
*** See text for explanation

ioux City Municipal WWTP

The first toxic bioassay occurred in the final effluent sample collected from the Sioux City Municipal WWTP. Chemical analyses performed at the laboratory prior to the initiation of the toxicity testing yielded e following information.

Sioux City Municipal WWTP
Final Effluent • 9/14/88

Inhibited 5 Day BOD	8 mg/L
Dissolved Oxygen	6.0 mg/L*
Ammonia Nitrogen	18 mg/L*
Un-ionized Ammonia	0.43 mg/L*
Total Residual Chlorine	<5 µg/L*
pH	7.7 pH Units*
Specific Conductance	2,300 µmho per cm @25°C*

* Values at start of bioassay

Except for ammonia nitrogen, analyte values were not at toxic levels. The concentration of un-ionized nmonia (the most toxic form of ammonia) was high enough (0.43 mg/L) to potentially cause or contribute any mortality that might be observed during the toxicity testing. Therefore, the sample was divided into vo aliquots with one aliquot being treated using zeolite (an ion exchange resin) to reduce the concentration total and un-ionized ammonia. Two toxicity tests were then conducted in parallel to determine if any ıortality observed in the "unadjusted" sample might be attributed to un-ionized ammonia. Results showed ıat the "adjusted" sample (ammonia removed) exhibited no mortality, however, in the "unadjusted" final fluent sample, 21 out of 21 fish died but no Daphnia had died by the end of the 24 hour test period. herefore, un-ionized ammonia was probably the major contributing factor in the toxicity exhibited by the ioux City Municipal Wastewater Treatment Plant discharge. Analysis of the sample for thirteen priority ollutant metals yielded no reportable data.

lewton Municipal WWTP

The sample collected from the final effluent of the Newton Municipal WWTP and tested for acute toxicity id not exhibit any acute toxicity. Selected chemical analyses of the effluent provided the following ıformation. All data collected may be found in the Appendix.

Newton Municipal WWTP
Final Effluent • 9/20/88

Inhibited 5 Day BOD	9 mg/L
Dissolved Oxygen	8.0 mg/L*
Ammonia Nitrogen	<0.1 mg/L*
Un-ionized Ammonia	<0.01 mg/L*
Total Residual Chlorine	<5 µg/L*
pH	7.3 pH Units*
Specific Conductance	1,000 µmho per cm @25°C*
Zinc	30 µg/L

* Values at start of bioassay

The values for most of the parameters listed above would not be considered toxic levels. Although zinc had a reportable value it was not high enough to cause acute toxicity.

Maytag Corporation at Newton

One sample was collected from the final effluent of the Maytag Corporation at Newton. Analyses performed at the laboratory prior to the initiation of the toxicity testing may be found in the table below. All data collected may be found in the Appendix.

Maytag Corporation at Newton
Final Effluent • 9/20/88

Inhibited 5 Day BOD	3 mg/L
Dissolved Oxygen	8.4 mg/L*
Ammonia Nitrogen	0.2 mg/L*
Un-ionized Ammonia	<0.01 mg/L*
Total Residual Chlorine	25 µg/L*
pH	7.7 pH Units*
Specific Conductance	2,100 µmhos at 25°C*
Nickel	270 µg/L
Aluminum	110 µg/L

* Values at start of bioassay

Because total residual chlorine (which can be toxic) was present, the sample obtained from the final effluent was split into two portions. The total residual chlorine was suppressed (by the addition of sodium thiosulfate) in one portion while the other portion remained unchanged. The two portions were then tested in parallel to ascertain whether or not mortality exhibited in the "unadjusted" sample might be attributed to the total residual chlorine. No mortality was observed in either sample.

Of the sixteen metals analyzed, only nickel and aluminum were found at quantifiable levels and were not high enough to cause acute toxicity to the test organisms.

Cedar Rapids Municipal WWTP

The final effluent sample was collected from the Cedar Rapids Municipal WWTP on 21 September. Results of the toxicity test indicated no acute toxicity to either test organism. Selected chemical analysis yielded the following information. All data collected may be found in the Appendix.

Cedar Rapids Municipal WWTP
Final Effluent • 9/21/88

Inhibited 5 Day BOD	7 mg/L
Dissolved Oxygen	7.9 mg/L*
Ammonia Nitrogen	3 mg/L*
Un-ionized Ammonia	0.01 mg/L*
Total Residual Chlorine	<5 µg/L*
pH	6.9 pH Units
Specific Conductance	2,800 µmho at 25°C*
Zinc	20 µg/L

* Values at start of bioassay

Zinc was the only metal found and its concentration was too low to cause acute toxicity.

Burlington Municipal WWTP

A sample was collected from the final effluent of the Burlington Municipal WWTP on 26 September. nalyses performed at the laboratory prior to initiation of the toxicity testing indicated that total residual ılorine was present. Therefore, the sample was divided into two aliquots with the TRC suppressed (by the ldition of sodium thiosulfate) in one portion and not in the other. The two aliquots were then tested in ırallel to determine if any mortality seen in the "unadjusted" sample might be attributed to the total residual ılorine. No mortality of fish or Daphnia was observed in either sample. Selected chemical data may be ›und in the table below.

Burlington Municipal WWTP
Final Effluent • 9/26/88

Inhibited 5 Day BOD	1 mg/L
Dissolved Oxygen	8.4 mg/L*
Ammonia Nitrogen	<0.1 mg/L*
Un-ionized Ammonia	<0.01 mg/L*
Total Residual Chlorine	90 µg/L*
pH	7.3 Units*
Specific Conductance	710 µmho at 25°C*
Zinc	30 µg/L

* Values at start of bioassay

Zinc was the only metal found and its concentration was too low to cause acute toxicity to the test rganisms.

ımax Corporation at Ft. Madison

The second positive bioassay occurred in the final effluent sample collected from Amax Corporation at t. Madison.

Amax Corporation at Ft. Madison
Final Effluent • 9/26/88

Inhibited 5 Day BOD	2 mg/L
Dissolved Oxygen	7.8 mg/L*
Ammonia Nitrogen	17 mg/L*
Un-ionized Ammonia	5.2 mg/L*
Total Residual Chlorine	<5 µg/L*
pH	8.9 pH Units*
Specific Conductance	1,400 µmho at 25°C*
Molybdenum	12,000 µg/L
Selenium	20 µg/L
Zinc	60 µg/L
Sodium	2,200 mg/L

*Values at start of bioassay

The analytical results indicated the un-ionized ammonia (the most toxic form of ammonia) was high ıough (5.2 mg/L) to cause mortality during the toxicity test. In addition, the metals molybdenum, selenium ıd zinc had reportable values while the sodium concentration in the effluent was quite high. Molybdenum ıs been shown to be toxic to fathead minnows (7) but at much greater levels (70-370 mg/L) than found in ıe Amax effluent (12 mg/L). Toxicity information obtained for selenium (8) and zinc (9) indicate that toxic

concentrations for both organisms are much greater than those measured in the Amax effluent. Information provided to IDNR staff from Amax Corporation indicated toxicity may occur from a compound Amax was using that was high in sodium. As a result the sample was divided into three subsamples and three toxicity tests were performed in parallel; one test on the raw unadjusted sample, one test on a diluted sample (1:50 dilution using synthetic control water for dilution) and one test on a portion of the sample in which the un-ionized ammonia had been suppressed using an ion exchange resin. After the 24 hour test period mortality in the unadjusted sample was 0% for fish (0 out of 10) and 33% for Daphnia (5 out of 15). In the diluted sample no deaths of fish or Daphnia occurred and in the "adjusted" sample, all of the test organisms (both fish and Daphnia) had died. Additional testing on the "adjusted" sample showed that during the adjustment to reduce the un-ionized ammonia, the sodium content of the sample went from an already high 2,200 to 4,700 mg/L. The increase was larger than expected from the stoichiometry of the exchange reaction. The ion exchange resin may not have been thoroughly flushed with water after reconditioning with sodium chloride, thereby providing the additional sodium. This very high sodium is most likely the reason for the deaths of the organisms in the adjusted portion of the sample and should not be considered relevant to the study. The elevated levels of sodium (2,200 mg/L) and/or un-ionized ammonia (5.2 mg/L) are probably responsible for the toxicity seen in the unadjusted sample.

Summary and Conclusions

Six industrial and municipal wastewater treatment plant effluents were sampled and tested for acute toxicity. Two facilities' discharges, the Sioux City Wastewater Treatment Plant and the Amax Corporation tested positive, indicating the presence of toxic substances in their effluents. Chemical analyses performed on the effluent samples indicated the presence of heavy metals, total residual chlorine and un-ionized ammonia. The most probable cause of toxicity in the Sioux City sample may be attributed to un-ionized ammonia. Toxicity in the Amax Corporation sample was most probably due to elevated levels of sodium and un-ionized ammonia.

Literature Cited

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Appendix

UNIVERSITY HYGIENIC LABORATORY
BIOSCREEN

Site Sioux City WWTP Source Final Effluent

EPA Sample No. _____ Collected 9/14/88 Received 9/15/88

DMBL Lab No. 8860587 Age: Minnows 17 days Daphnids <24 hrs.

Reference Toxicant Cadmium Chloride

Minnow LC_{50} 0.128 mg/L Daphnia LC_{50} 0.121 mg/L

RAW SAMPLE

Temperature 21 °C, Dissolved Oxygen 6.0 mg/L, pH 7.7 Units

Total Ammonia 21.9 mg/L, Unionized Ammonia (calculated) 0.43 mg/L

Total Residual Chlorine <0.005 mg/L, Specific Conductance 2,300 umhos

ADJUSTED SAMPLE

Temperature _____ °C, Dissolved Oxygen _____ mg/L, pH _____ Units

Total Ammonia _____ mg/L, Unionized Ammonia (calculated) _____ mg/L

Total Residual Chlorine _____ mg/L, Specific Conductance _____ umhos

BIOSCREEN DATA

Test Begun: 9/15/88 @1400 hrs. Test Ended: 9/16/88 @1400 hrs.

	Fathead Minnow Kills				Daphnia magna Kills		
Concentration	Beaker 1	Beaker 2	Beaker 3	Total*	Beaker 1	Beaker 2	Total*
100%	7/7	7/7	7/7	21/21	0/10	0/10	0/20
Control	0/7	0/7	0/6	0/20	0/10	0/10	0/20

Sample Rated: Toxic

Toxic Because Of: Ammonia

Other:

Notes: See Attachment
*Number of organisms dead/number of organisms tested.

Analyst: JOK/JGM Verified: JOK Date Reported: 11/29/88

UNIVERSITY OF IOWA - HYGIENIC LABORATORY

Analytical Report for Sample Number 8860587

Iowa City Laboratory
Oakdale Hall
Iowa City, IA 52242
(319) 335-4500

Des Moines Branch
900 East Grand
H.A. Wallace Building
Des Moines, IA 50319
(515) 281-5371

Date Received: 09/15/88 Date of Report: 11/22/88

Submitter: UHL LIMNOLOGY
Address: OAKDALE CAMPUS
City: IOWA CITY, IA 52240

Sample Location: SIOUX CITY Sample Description: WATER
Date Collected: 09/14/88 11:30:00 Client Reference:
Collected By: LDA

Comments

WWTP FINAL EFFL,GRAB
BODI,N-SERIES,PH,BIOSCREEN,PB,HG,CU,CR,CD,ZN,NI,AS,SB,BE,AG,
TL,SE-TOTALS

--- Listing of Analyses Performed and Results ---

Analyte	Concentration		Method Used	Analyst
TOTAL RESIDUAL CL	<0.005	MG/L	EPA 330.1	
DISSOLVED OXYGEN	6.0	MG/L	SM 16-421F	
TEMPERATURE	21.0	DEGREES C	SM 16-212	
pH VALUE (LAB)	7.5	pH UNITS	EPA 150.1	PMA
SPEC. CONDUCTANCE	2300	uMHOS @ 25 C	EPA 120.1	
AMMONIA (AS N)	18	MG/L	TIM #780-86	RVD
NO2+NO3 AS NO3-N	3.0	MG/L	EPA 353.2	JAG
TKN	20	MG/L	TIM #786-86	RVD
INHIBITED 5 DAY BOD	8	MG/L	SM 16-507	JAG
TOTAL ANTIMONY	<0.01	MG/L	EPA 204.2	ML
TOTAL ARSENIC	<0.01	MG/L	EPA 206.2	ML
TOTAL BERYLLIUM	<0.02	MG/L	EPA 200.7	SR
TOTAL CADMIUM	<0.02	MG/L	EPA 200.7	SR
TOTAL CHROMIUM	<0.02	MG/L	EPA 200.7	SR
TOTAL COPPER	<0.05	MG/L	EPA 200.7	SR
TOTAL LEAD	<0.1	MG/L	EPA 200.7	SR
TOTAL MERCURY	<0.001	MG/L	EPA 245.1	KF
TOTAL NICKEL	<0.05	MG/L	EPA 200.7	SR
TOTAL SELENIUM	<0.01	MG/L	EPA 270.2	ML
TOTAL SILVER	<0.01	MG/L	EPA 272.1	ML
TOTAL THALLIUM	<0.001	MG/L	EPA 279.2	ML
TOTAL ZINC	<0.02	MG/L	EPA 200.7	SR

Verified:

PPM - Parts/Million MG/L - Milligrams/Liter MG/KG - Milligrams/Kilogram
PPB - Parts/Billion uG/L - Micrograms/Liter uG/KG - Micrograms/Kilogram
< - Less than > - Greater than pCi/L - pico Curies/Liter

UNIVERSITY HYGIENIC LABORATORY
BIOSCREEN

Site Sioux City WWTP Source Final Effluent (Ammonia Removal)

EPA Sample No. _____ Collected 9/14/88 Received 9 /15/88

DMBL Lab No. 8860587 Age: Minnows 17 days Daphnids <24 hrs.

Reference Toxicant Cadmium Chloride

Minnow LC_{50} 0.128 mg/L Daphnia LC_{50} 0.121 mg/L

RAW SAMPLE

Temperature _____ °C, Dissolved Oxygen _____ mg/L, pH _____ Units

Total Ammonia _____ mg/L, Unionized Ammonia (calculated) _____ mg/L

Total Residual Chlorine _____ mg/L, Specific Conductance No Data umhos

ADJUSTED SAMPLE

Temperature 21 °C, Dissolved Oxygen 8.7 mg/L, pH 7.9 Units

Total Ammonia 0.43 mg/L, Unionized Ammonia (calculated) 0.01 mg/L

Total Residual Chlorine <0.005 mg/L, Specific Conductance _____ umhos

BIOSCREEN DATA

Test Begun: 9/15/88 @1400 hrs. Test Ended: 9/16/88 @1400 hrs.

	Fathead Minnow Kills				Daphnia magna Kills		
Concentration	Beaker 1	Beaker 2	Beaker 3	Total*	Beaker 1	Beaker 2	Total*
100%	0/7	0/7	0/6	0/20	0/10	0/10	0/20
Control	0/7	0/7	0/6	0/20	0/10	0/9	0/19

Sample Rated: Non-Toxic

Toxic Because Of:

Other:

Notes: See Attachment
*Number of organisms dead/number of organisms tested.

Analyst: JOK/JGM Verified: jgb Date Reported: 11/29/88.

UNIVERSITY OF IOWA - HYGIENIC LABORATORY

Analytical Report for Sample Number 8860761

Iowa City Laboratory
Oakdale Hall
Iowa City, IA 52242
(319) 335-4500

Des Moines Branch
900 East Grand
H.A Wallace Building
Des Moines, IA 50319
(515) 281-5371

Date Received: 09/16/88 Date of Report: 11/22/88

Submitter: UHL LIMNOLOGY
Address: OAKDALE CAMPUS
City: IOWA CITY, IA 52240

Sample Location: SIOUX CITY Sample Description: WATER
Date Collected: 09/14/88 Client Reference:
Collected By: JOK

Comments

WWTP FINAL EFFL TREATED WITH ZEOLITE

--- Listing of Analyses Performed and Results ---

Analyte	Concentration		Method Used	Analyst
TOTAL ANTIMONY	<0.01	MG/L	EPA 204.2	ML
TOTAL ARSENIC	0.02	MG/L	EPA 206.2	ML
TOTAL BERYLLIUM	<0.02	MG/L	EPA 200.7	SR
TOTAL CADMIUM	<0.02	MG/L	EPA 200.7	SR
TOTAL CHROMIUM	<0.02	MG/L	EPA 200.7	SR
TOTAL COPPER	<0.05	MG/L	EPA 200.7	SR
TOTAL LEAD	<0.1	MG/L	EPA 200.7	SR
TOTAL MERCURY	<0.001	MG/L	EPA 245.1	KF
TOTAL NICKEL	<0.05	MG/L	EPA 200.7	SR
TOTAL SELENIUM	<0.01	MG/L	EPA 270.2	ML
TOTAL SILVER	<0.01	MG/L	EPA 272.1	ML
TOTAL THALLIUM	<0.001	MG/L	EPA 279.2	ML
TOTAL ZINC	<0.02	MG/L	EPA 200.7	SR

Verified LAF

PPM - Parts/Million MG/L - Milligrams/Liter MG/KG - Milligrams/Kilogram
PPB - Parts/Billion uG/L - Micrograms/Liter uG/KG - Micrograms/Kilogram
< - Less than > - Greater than pCi/L - pico Curies/Liter

UNIVERSITY HYGIENIC LABORATORY
BIOSCREEN

Site Newton WWTP Source Final Effluent

EPA Sample No. _____ Collected 9/20/88 Received 9/20/88

DMBL Lab No. 8860864 Age: Minnows 23 days Daphnids <24 hrs.

Reference Toxicant Cadmium Chloride

Minnow LC_{50} 0.128 mg/L Daphnia LC_{50} 0.121 mg/L

RAW SAMPLE

Temperature 20 °C, Dissolved Oxygen 8.0 mg/L, pH 7.3 Units

Total Ammonia <0.12 mg/L, Unionized Ammonia (calculated) <0.01 mg/L

Total Residual Chlorine <0.005 mg/L, Specific Conductance 1,000 umhos

ADJUSTED SAMPLE

Temperature _____ °C, Dissolved Oxygen _____ mg/L, pH _____ Units

Total Ammonia _____ mg/L, Unionized Ammonia (calculated) _____ mg/L

Total Residual Chlorine _____ mg/L, Specific Conductance _____ umhos

BIOSCREEN DATA

Test Begun: 9/20/88 @1445 hrs. Test Ended: 9/21/88 @1445 hrs.

	Fathead Minnow Kills				Daphnia magna Kills		
Concentration	Beaker 1	Beaker 2	Beaker 3	Total*	Beaker 1	Beaker 2	Total*
100%	0/6	0/7	0/7	0/20	0/11	0/10	0/21
Control	0/7	0/7	0/7	0/20	0/10	0/10	0/20

Sample Rated: Non-Toxic

Toxic Because Of:

Other:

Notes: See Attachment
*Number of organisms dead/number of organisms tested.

Analyst: JGM/LDA Verified: JK Date Reported: 11/29/88

UNIVERSITY OF IOWA - HYGIENIC LABORATORY

Analytical Report for Sample Number 8860864

Iowa City Laboratory
Oakdale Hall
Iowa City, IA 52242
(319) 335-4500

Des Moines Branch
900 East Grand
H.A. Wallace Building
Des Moines, IA 50319
(515) 281-5371

Date Received: 09/20/88 Date of Report: 11/22/88

Submitter: UHL LIMNOLOGY
Address: OAKDALE CAMPUS
City: IOWA CITY, IA 52240

Sample Location: NEWTON Sample Description: WATER
Date Collected: 09/20/88 08:45:00 Client Reference:
Collected By: LDA

Comments

NEWTON WWTP FINAL EFFL.
N-SERIES,BIO,BOD_1,SB,AS,BE,PB,HG,NI,SE,AG,TL,ZN,CD,CR,CU
DO=7.7 PH_F=7.4 TEMP=20 FLOW=2.33 MGD

--- Listing of Analyses Performed and Results ---

Analyte	Concentration		Method Used	Analyst
TOTAL RESIDUAL CL	<0.005	MG/L	EPA 330.1	JGM,LDA
DISSOLVED OXYGEN	8.0	MG/L	SM 16-421F	JGM,LDA
TEMPERATURE	20.0	DEGREES C	SM 16-212	
pH VALUE (LAB)	7.3	pH UNITS	EPA 150.1	
SPEC. CONDUCTANCE	1000	uMHOS @ 25 C	EPA 120.1	
AMMONIA (AS N)	<0.1	MG/L	TIM #780-86	RVD
NO2+NO3 AS NO3-N	8.7	MG/L	EPA 353.2	JAG
ORGANIC NITROGEN (N)	1.8	MG/L	TIM #786-86	RVD
INHIBITED 5 DAY BOD	9	MG/L	SM 16-507	JAG
TOTAL ANTIMONY	<0.01	MG/L	EPA 204.2	ML
TOTAL ARSENIC	<0.01	MG/L	EPA 206.2	ML
TOTAL BERYLLIUM	<0.02	MG/L	EPA 200.7	SR
TOTAL CADMIUM	<0.02	MG/L	EPA 200.7	SR
TOTAL CHROMIUM	<0.02	MG/L	EPA 200.7	SR
TOTAL COPPER	<0.05	MG/L	EPA 200.7	SR
TOTAL LEAD	<0.1	MG/L	EPA 200.7	SR
TOTAL MERCURY	<0.0001	MG/L	EPA 245.1	KF
TOTAL NICKEL	<0.05	MG/L	EPA 200.7	SR
TOTAL SELENIUM	<0.01	MG/L	EPA 270.2	ML
TOTAL SILVER	<0.01	MG/L	EPA 272.1	LAP
TOTAL THALLIUM	<0.001	MG/L	EPA 279.2	ML
TOTAL ZINC	0.03	MG/L	EPA 200.7	SR

Verified

PPM - Parts/Million MG/L - Milligrams/Liter MG/KG - Milligrams/Kilogram
PPB - Parts/Billion uG/L - Micrograms/Liter uG/KG - Micrograms/Kilogram
< - Less than > - Greater than pCi/L - pico Curies/Liter

UNIVERSITY HYGIENIC LABORATORY
BIOSCREEN

Site Maytag, Newton Source Maytag Effluent 001

EPA Sample No. _____ Collected 9/20/88 Received 9/20/88

DMBL Lab No. 8860865 Age: Minnows 23 days Daphnids <24 hrs.

Reference Toxicant Cadmium Chloride

Minnow LC_{50} 0.128 mg/L Daphnia LC_{50} 0.121 mg/L

RAW SAMPLE

Temperature 20 °C, Dissolved Oxygen 8.4 mg/L, pH 7.7 Units

Total Ammonia 0.24 mg/L, Unionized Ammonia (calculated) <0.01 mg/L

Total Residual Chlorine 0.025 mg/L, Specific Conductance 2,100 umhos

ADJUSTED SAMPLE

Temperature _____ °C, Dissolved Oxygen _____ mg/L; pH _____ Units

Total Ammonia _____ mg/L, Unionized Ammonia (calculated) _____ mg/L

Total Residual Chlorine _____ mg/L, Specific Conductance _____ umhos

BIOSCREEN DATA

Test Begun: 9/20/88 @1445 hrs. Test Ended: 9/21/88 @1445 hrs.

	Fathead Minnow Kills				Daphnia magna Kills		
Concentration	Beaker 1	Beaker 2	Beaker 3	Total*	Beaker 1	Beaker 2	Total*
100%	0/7	0/7	0/7	0/21	0/10	0/11	0/21
Control	0/7	0/7	0/7	0/21	0/10	0/10	0/20

Sample Rated: Non-Toxic

Toxic Because Of:

Other:

Notes: See Attachment
*Number of organisms dead/number of organisms tested.

Analyst: JGM/LDA Verified: JGM Date Reported: 11/29/88

UNIVERSITY OF IOWA - HYGIENIC LABORATORY

Analytical Report for Sample Number 8860865

Iowa City Laboratory
Oakdale Hall
Iowa City, IA 52242
(319) 335-4500

Des Moines Branch
900 East Grand
H.A. Wallace Building
Des Moines, IA 50319
(515) 281-5371

Date Received: 09/20/88 Date of Report: 11/22/88

Submitter: UHL LIMNOLOGY
Address: OAKDALE CAMPUS
City: IOWA CITY, IA 52240

Sample Location: NEWTON Sample Description: WATER
Date Collected: 09/20/88 10:30:00 Client Reference:
Collected By: LDA

Comments

MAYTAG CO FINAL EFFL TO CULVERT
N-SERIES,BIO,BOD_I,CN_T,AL,PB,HG,NI,CD,CR,CU,FE,AG,SB,AS,BE,
SE,V. DO=4.7 PH_F=8.0 TEMP=25 FLOW=575 GPM

--- Listing of Analyses Performed and Results ---

Analyte	Concentration		Method Used	Analyst
TOTAL RESIDUAL CL	0.025	MG/L	EPA 330.1	JGM,LDA
DISSOLVED OXYGEN	8.4	MG/L	SM 16-421F	
TEMPERATURE	20.0	DEGREES C	SM 16-212	
pH VALUE (LAB)	7.7	pH UNITS	EPA 150.1	
SPEC. CONDUCTANCE	2100	uMHOS @ 25 C	EPA 120.1	
AMMONIA (AS N)	0.2	MG/L	TIM #780-86	RVD
NO2+NO3 AS NO3-N	9.7	MG/L	EPA 353.2	JAG
ORGANIC NITROGEN (N)	2.7	MG/L	TIM #786-86	RVD
INHIBITED 5 DAY BOD	3	MG/L	SM 16-507	JAG
TOTAL CYANIDE	<0.01	MG/L	EPA 335.2	ESA
TOTAL ALUMINUM	0.11	MG/L	EPA 200.7	
TOTAL ANTIMONY	<0.01	MG/L	EPA 204.2	ML
TOTAL ARSENIC	<0.01	MG/L	EPA 206.2	ML
TOTAL BERYLLIUM	<0.02	MG/L	EPA 200.7	
TOTAL CADMIUM	<0.02	MG/L	EPA 200.7	
TOTAL CHROMIUM	<0.02	MG/L	EPA 200.7	
TOTAL COPPER	<0.05	MG/L	EPA 200.7	
TOTAL IRON	<0.02	MG/L	EPA 200.7	
TOTAL LEAD	<0.1	MG/L	EPA 200.7	
TOTAL MERCURY	<0.001	MG/L	EPA 245.1	KF
TOTAL NICKEL	0.27	MG/L	EPA 200.7	
TOTAL SELENIUM	<0.01	MG/L	EPA 270.2	ML

PPM - Parts/Million MG/L - Milligrams/Liter MG/KG - Milligrams/Kilogram
PPB - Parts/Billion uG/L - Micrograms/Liter uG/KG - Micrograms/Kilogram
< - Less than > - Greater than pCi/L - pico Curies/Liter

Analytical Report for Sample Number 8860865

	Concentration		Method Used	Analyst
ILVER	<0.01	MG/L	EPA 272.1	
ANADIUM	<0.1	MG/L	EPA 200.7	

Verified: JH

arts/Million MG/L - Milligrams/Liter MG/KG - Milligrams/Kilogram
arts/Billion uG/L - Micrograms/Liter uG/KG - Micrograms/Kilogram
ess than > - Greater than pCi/L - pico Curies/Liter

UNIVERSITY HYGIENIC LABORATORY
BIOSCREEN

Site Maytag, Newton Source Maytag Effluent 001 (Chlori

EPA Sample No. _____ Collected 9/20/88 Received 9/20/88

DMBL Lab No. 8860865 Age: Minnows 23 days Daphnids <24 hrs.

Reference Toxicant Cadmium Chloride

Minnow LC_{50} 0.128 mg/L Daphnia LC_{50} 0.121 mg/L

RAW SAMPLE

Temperature _____ °C, Dissolved Oxygen _____ mg/L, pH _____ Units

Total Ammonia _____ mg/L, Unionized Ammonia (calculated) _____ mg/L

Total Residual Chlorine _____ mg/L, Specific Conductance _____ umho

ADJUSTED SAMPLE

Temperature 21 °C, Dissolved Oxygen 8.4 mg/L, pH 7.7 Units

Total Ammonia 0.24 mg/L, Unionized Ammonia (calculated) <0.01 mg/L

Total Residual Chlorine <0.005 mg/L, Specific Conductance 2,100 umho

BIOSCREEN DATA

Test Begun: 9/20/88 @1445 hrs. Test Ended: 9/21/88 @1445 hrs.

	Fathead Minnow Kills				Daphnia magna Kills		
Concentration	Beaker 1	Beaker 2	Beaker 3	Total*	Beaker 1	Beaker 2	Total*
100%	0/8	0/7	0/6	0/21	0/10	0/10	0/20
Control with Thiosulfate	0/8	0/6	0/7	0/21	0/10	0/10	0/20
Control	0/7	0/7	0/7	0/21	0/10	0/10	0/20

Sample Rated: Non-Toxic

Toxic Because Of:

Other:

Notes: See Attachment
*Number of organisms dead/number of organisms tested.

Analyst: JGM/LDA Verified: JK Date Reported: 1

UNIVERSITY HYGIENIC LABORATORY
BIOSCREEN

Site Cedar Rapids WWTP Source Final Effluent

EPA Sample No. _____ Collected 9/21/88 Received 9/22/88

DMBL Lab No. 8860962 Age: Minnows 11 days Daphnids <24 hrs.

Reference Toxicant Cadmium Chloride

Minnow LC_{50} 0.137 mg/L Daphnia LC_{50} 0.121 mg/L

RAW SAMPLE

Temperature 21 °C, Dissolved Oxygen 7.9 mg/L, pH 6.9 Units

Total Ammonia 3.6 mg/L, Unionized Ammonia (calculated) 0.01 mg/L

Total Residual Chlorine <0.005 mg/L, Specific Conductance 2,800 umhos

ADJUSTED SAMPLE

Temperature _____ °C, Dissolved Oxygen _____ mg/L, pH _____ Units

Total Ammonia _____ mg/L, Unionized Ammonia (calculated) _____ mg/L

Total Residual Chlorine _____ mg/L, Specific Conductance _____ umhos

BIOSCREEN DATA

Test Begun: 9/22/88 @1115 hrs. Test Ended: 9/23/88 @1115 hrs.

	Fathead Minnow Kills				Daphnia magna Kills		
Concentration	Beaker 1	Beaker 2	Beaker 3	Total*	Beaker 1	Beaker 2	Total*
100%	0/6	0/8	0/7	0/21	0/10	0/10	0/20
Control	0/7	0/7	0/7	0/21	0/10	0/10	0/20

Sample Rated: Non-Toxic

Toxic Because Of:

Other:

Notes: See Attachment
*Number of organisms dead/number of organisms tested.

Analyst: JOK/JGM Verified: JGM Date Reported: 11/29/88

UNIVERSITY OF IOWA - HYGIENIC LABORATORY

Analytical Report for Sample Number 8860962

Iowa City Laboratory
Oakdale Hall
Iowa City, IA 52242
(319) 335-4500

Des Moines Branch
900 East Grand
H.A. Wallace Building
Des Moines, IA 50319
(515) 281-5371

Date Received: 09/22/88 Date of Report: 11/22/88

Submitter: UHL LIMNOLOGY
Address: OAKDALE CAMPUS
City: IOWA CITY, IA 52240

Sample Location: CEDAR RAPIDS Sample Description: WATER
Date Collected: 09/21/88 14:05:00 Client Reference:
Collected By: DWC

Comments

WWTP,FINAL EFFL
BIO,CBOD,N-SERIES,PP METALS,DO,PH_F,TEMP

--- Listing of Analyses Performed and Results ---

Analyte	Concentration		Method Used	Analyst
TOTAL RESIDUAL CL	<0.005	MG/L	EPA 330.1	
DISSOLVED OXYGEN	7.9	MG/L	SM 16-421F	
TEMPERATURE	21.0	DEGREES C	SM 16-212	JGM,JOK
pH VALUE (LAB)	6.9	pH UNITS	EPA 150.1	JOK,JGM
SPEC. CONDUCTANCE	2800	uMHOS @ 25 C	EPA 120.1	JGM,JOK
AMMONIA (AS N)	3.0	MG/L	TIM #780-86	RVD
NO2+NO3 AS NO3-N	9.5	MG/L	EPA 353.2	JAG
TKN	5.5	MG/L	TIM #786-86	RWW
INHIBITED 5 DAY BOD	7	MG/L	SM 16-507	JAG
TOTAL ANTIMONY	<0.01	MG/L	EPA 204.2	ML
TOTAL ARSENIC	<0.01	MG/L	EPA 206.2	ML
TOTAL BERYLLIUM	<0.02	MG/L	EPA 200.7	SR
TOTAL CADMIUM	<0.02	MG/L	EPA 200.7	SR
TOTAL CHROMIUM	<0.02	MG/L	EPA 200.7	SR
TOTAL COPPER	<0.05	MG/L	EPA 200.7	SR
TOTAL LEAD	<0.1	MG/L	EPA 200.7	SR
TOTAL MERCURY	<0.001	MG/L	EPA 245.1	KF
TOTAL NICKEL	<0.05	MG/L	EPA 200.7	SR
TOTAL SELENIUM	<0.01	MG/L	EPA 270.2	ML
TOTAL SILVER	<0.01	MG/L	EPA 272.1	LAF
TOTAL THALLIUM	<0.001	MG/L	EPA 279.2	ML
TOTAL ZINC	0.02	MG/L	EPA 200.7	SR

Verified JAC

PPM - Parts/Million MG/L - Milligrams/Liter MG/KG - Milligrams/Kilogram
PPB - Parts/Billion uG/L - Micrograms/Liter uG/KG - Micrograms/Kilogram
< - Less than > - Greater than pCi/L - pico Curies/Liter

UNIVERSITY HYGIENIC LABORATORY
BIOSCREEN

Site Burlington WWTP Source Final Effluent

EPA Sample No. _____ Collected 9/26/88 Received 9/27/88

DMBL Lab No. 8861131 Age: Minnows 29 days Daphnids <24 hrs.

Reference Toxicant Cadmium Chloride

Minnow LC_{50} 0.128 mg/L Daphnia LC_{50} 0.121 mg/L

RAW SAMPLE

Temperature 21 °C, Dissolved Oxygen 8.4 mg/L, pH 7.3 Units

Total Ammonia <0.1 mg/L, Unionized Ammonia (calculated) <0.01 mg/L

Total Residual Chlorine 0.090 mg/L, Specific Conductance 710 umhos

ADJUSTED SAMPLE

Temperature _____ °C, Dissolved Oxygen _____ mg/L, pH _____ Units

Total Ammonia _____ mg/L, Unionized Ammonia (calculated) _____ mg/L

Total Residual Chlorine _____ mg/L, Specific Conductance _____ umhos

BIOSCREEN DATA

Test Begun: 9/27/88 @1415 hrs. Test Ended: 9/28/88 @1415 hrs.

	Fathead Minnow Kills				Daphnia magna Kills		
Concentration	Beaker 1	Beaker 2	Beaker 3	Total*	Beaker 1	Beaker 2	Total*
100%	0/7	0/6	0/7	0/20	0/10	0/10	0/20
Control	0/7	0/7	0/6	0/20	0/10	0/10	0/20

Sample Rated: Non-Toxic

Toxic Because Of:

Other:

Notes: See Attachment
*Number of organisms dead/number of organisms tested.

Analyst: JGM/LDA Verified: JGM Date Reported: 11/29/88

UNIVERSITY OF IOWA - HYGIENIC LABORATORY

Analytical Report for Sample Number 8861131

Iowa City Laboratory
Oakdale Hall
Iowa City, IA 52242
(319) 335-4500

Des Moines Branch
900 East Grand
H.A. Wallace Building
Des Moines, IA 50319
(515) 281-5371

Date Received: 09/27/88 Date of Report: 11/22/88

Submitter: UHL LIMNOLOGY
Address: OAKDALE CAMPUS
City: IOWA CITY, IA 52240

Sample Location: BURLINGTON Sample Description: WATER
Date Collected: 09/26/88 13:45:00 Client Reference:
Collected By: LDA/CEILLEY

Comments

WWTP FINAL EFFL GRAB SAMPLE DO=8.5 PH_F=7.4 TEMP=23.0
BIO,N-SERIES,BOD_I,PP METALS PLUS MO.

--- Listing of Analyses Performed and Results ---

Analyte	Concentration		Method Used	Analyst
TOTAL RESIDUAL CL	0.090	MG/L	EPA 330.1	
DISSOLVED OXYGEN	8.4	MG/L	SM 16-421F	
TEMPERATURE	21.0	DEGREES C	SM 16-212	
pH VALUE (LAB)	7.3	pH UNITS	EPA 150.1	JGM
SPEC. CONDUCTANCE	710	uMHOS @ 25 C	EPA 120.1	
AMMONIA (AS N)	<0.1	MG/L	TIM #780-86	
NO2+NO3 AS NO3-N	10	MG/L	EPA 353.2	JAG
ORGANIC NITROGEN (N)	1.6	MG/L	TIM #786-86	RVD
INHIBITED 5 DAY BOD	1	MG/L	SM 16-507	JAG
TOTAL ANTIMONY	<0.01	MG/L	EPA 204.2	ML
TOTAL ARSENIC	<0.01	MG/L	EPA 206.2	ML
TOTAL MERCURY	<0.001	MG/L	EPA 245.1	KF
TOTAL SELENIUM	<0.01	MG/L	EPA 270.2	ML
TOTAL SILVER	<0.01	MG/L	EPA 272.1	LAF
TOTAL THALLIUM	<0.001	MG/L	EPA 279.2	ML

Verified: JGM

PPM - Parts/Million MG/L - Milligrams/Liter MG/KG - Milligrams/Kilogram
PPB - Parts/Billion uG/L - Micrograms/Liter uG/KG - Micrograms/Kilogram
< - Less than > - Greater than pCi/L - pico Curies/Liter

UNIVERSITY HYGIENIC LABORATORY
BIOSCREEN

Site Burlington WWTP Source Final Effluent (Chlorine Removal)

EPA Sample No. _____ Collected 9/26/88 Received 9/27/88

DMBL Lab No. 8861131 Age: Minnows 29 days Daphnids <24 hrs.

Reference Toxicant Cadmium Chloride

Minnow LC_{50} 0.128 mg/L Daphnia LC_{50} 0.121 mg/L

RAW SAMPLE

Temperature _____ °C, Dissolved Oxygen _____ mg/L, pH _____ Units

Total Ammonia _____ mg/L, Unionized Ammonia (calculated) _____ mg/L

Total Residual Chlorine _____ mg/L, Specific Conductance _____ umhos

ADJUSTED SAMPLE

Temperature 21 °C, Dissolved Oxygen 8.4 mg/L, pH 7.3 Units

Total Ammonia <0.1 mg/L, Unionized Ammonia (calculated) <0.01 mg/L

Total Residual Chlorine <0.005 mg/L, Specific Conductance 710 umhos

BIOSCREEN DATA

Test Begun: 9/27/88 @1415 hrs. Test Ended: 9/28/88 @1415 hrs.

	Fathead Minnow Kills				Daphnia magna Kills		
Concentration	Beaker 1	Beaker 2	Beaker 3	Total*	Beaker 1	Beaker 2	Total*
100%	0/7	0/6	0/6	0/19	0/10	0/10	0/20
Control with Thiosulfate	0/7	0/7	0/7	0/21	0/10	0/10	0/20
Control	/7	0/7	0/6	0/20	0/10	0/10	0/20

Sample Rated: Non-Toxic

Toxic Because Of:

Other:

Notes: See Attachment
*Number of organisms dead/number of organisms tested.

Analyst: JGM/LDA Verified: JGM Date Reported: 11/29/88

UNIVERSITY HYGIENIC LABORATORY
BIOSCREEN

Site Amax, Ft. Madison Source Final Effluent

EPA Sample No. _____ Collected 9/26/88 Received 9/27/88

DMBL Lab No. 8861130 Age: Minnows 29 days Daphnids <24 hrs.

Reference Toxicant Cadmium Chloride

Minnow LC_{50} 0.128 mg/L Daphnia LC_{50} 0.121 mg/L

RAW SAMPLE

Temperature 21 °C, Dissolved Oxygen 7.8 mg/L, pH 8.9 Units

Total Ammonia 20.7 mg/L, Unionized Ammonia (calculated) 5.24 mg/L

Total Residual Chlorine <0.005 mg/L, Specific Conductance 11,000 umhc

ADJUSTED SAMPLE

Temperature _____ °C, Dissolved Oxygen _____ mg/L, pH _____ Units

Total Ammonia _____ mg/L, Unionized Ammonia (calculated) _____ mg/L

Total Residual Chlorine _____ mg/L, Specific Conductance _____ umhc

BIOSCREEN DATA

Test Begun: 9/27/88 @1415 hrs. Test Ended: 9/28/88 @1415 hrs.

	Fathead Minnow Kills				Daphnia magna Kills		
Concentration	Beaker 1	Beaker 2	Beaker 3	Total*	Beaker 1	Beaker 2	Total*
100%	0/7	0/6	0/7	0/20	2/8	3/7	5/15
Control	0/7	0/7	0/6	0/20	0/8	0/7	0/15

Sample Rated: Toxic

Toxic Because Of: Ammonia & Sod possibly toxic

Other:

Notes: See Attachment
*Number of organisms dead/number of organisms tested.

Analyst: JGM/LDA Verified: JGK Date Reported: 1

UNIVERSITY OF IOWA - HYGIENIC LABORATORY

Analytical Report for Sample Number 8861130

ty Laboratory
Hall
ty, IA 52242
35-4500

Des Moines Branch
900 East Grand
H.A. Wallace Building
Des Moines, IA 50319
(515) 281-5371

ceived: 09/27/88 Date of Report: 11/22/88

er: UHL LIMNOLOGY
: OAKDALE CAMPUS
IOWA CITY, IA 52240

Location: FT MADISON Sample Description: WATER
llected: 09/26/88 11:40:00 Client Reference:
ed By: LDA/CEILLEY

s

NAL EFFL GRAB SAMPLE. DO=8.0 PH_F=8.7 TEMP=21.5
ERIES,BOD_I,PP METALS PLUS MO

--- Listing of Analyses Performed and Results ---

	Concentration		Method Used	Analyst
ESIDUAL CL	<0.005	MG/L	EPA 330.1	
ED OXYGEN	7.8	MG/L	SM 16-421F	
TURE	21.0	DEGREES C	SM 16-212	
E (LAB)	8.9	pH UNITS	EPA 150.1	
ONDUCTANCE	11000	uMHOS @ 25 C	EPA 120.1	
(AS N)	17	MG/L	TIM #780-86	
AS NO3-N	6.0	MG/L	EPA 353.2	JAG
NITROGEN (N)	<0.1	MG/L	TIM #786-86	RVD
ED 5 DAY BOD	2	MG/L	SM 16-507	JAG
NTIMONY	<0.01	MG/L	EPA 204.2	ML
RSENIC	<0.01	MG/L	EPA 206.2	ML
ERCURY	<0.001	MG/L	EPA 245.1	KF
OLYBDENUM	12000	uG/L	ONE	SR
ELENIUM	0.02	MG/L	EPA 270.2	ML
ILVER	<0.01	MG/L	EPA 272.1	LAF
HALLIUM	0.002	MG/L	EPA 279.2	ML

Verified:

arts/Million MG/L - Milligrams/Liter MG/KG - Milligrams/Kilogram
arts/Billion uG/L - Micrograms/Liter uG/KG - Micrograms/Kilogram
ess than > - Greater than pCi/L - pico Curies/Liter

UNIVERSITY HYGIENIC LABORATORY
BIOSCREEN

Site Amax, Ft. Madison Source Final Effluent (1:50 Dilut

EPA Sample No. _____ Collected 9/26/88 Received 9/27/88

DMBL Lab No. 8861133 Age: Minnows 29 days Daphnids <24 hrs.

Reference Toxicant Cadmium Chloride

Minnow LC_{50} 0.128 mg/L Daphnia LC_{50} 0.121 mg/L

RAW SAMPLE

Temperature _____ °C, Dissolved Oxygen _____ mg/L, pH _____ Units

Total Ammonia _____ mg/L, Unionized Ammonia (calculated) _____ mg/L

Total Residual Chlorine _____ mg/L, Specific Conductance _____ umho

ADJUSTED SAMPLE

Temperature 21 °C, Dissolved Oxygen 8.0 mg/L, pH 7.6 Units

Total Ammonia 0.49 mg/L, Unionized Ammonia (calculated) <0.01 mg/L

Total Residual Chlorine <0.005 mg/L, Specific Conductance 470 umho

BIOSCREEN DATA

Test Begun: 9/27/88 @1415 hrs. Test Ended: 9/28/88 @1415 hrs.

	Fathead Minnow Kills				Daphnia magna Kills		
Concentration	Beaker 1	Beaker 2	Beaker 3	Total*	Beaker 1	Beaker 2	Total*
100%	0/7	0/6	0/7	0/20	0/7	0/8	0/15
Control	0/7	0/7	0/6	0/20	0/8	0/7	0/15

Sample Rated: Non-Toxic

Toxic Because Of:

Other:

Notes: See Attachment
*Number of organisms dead/number of organisms tested.

Analyst: JGM/LDA Verified: JGK Date Reported:

UNIVERSITY OF IOWA - HYGIENIC LABORATORY

Analytical Report for Sample Number 8861133

ty Laboratory
Hall
ty, IA 52242
35-4500

Des Moines Branch
900 East Grand
H.A. Wallace Building
Des Moines, IA 50319
(515) 281-5371

ceived: 09/27/88 Date of Report: 11/22/88

er: UHL LIMNOLOGY
OAKDALE CAMPUS
IOWA CITY, IA 52240

Location: FT MADISON Sample Description: WATER
llected: 09/26/88 11:30:00 Client Reference:
ed By: LDA/CEILLEY

s

FL 1.50 DILUTION. LAB TIME 11:30
LS PLUS MO,NH3,NA

--- Listing of Analyses Performed and Results ---

	Concentration		Method Used	Analyst
	54	MG/L	EPA 200.7	SR
(AS N)	0.4	MG/L	TIM #780-86	RWW
NTIMONY	<10	uG/L	EPA 204.2	ML
RSENIC	<10	uG/L	EPA 206.2	ML
ERYLLIUM	<20	uG/L	EPA 200.7	SR
ADMIUM	<20	uG/L	EPA 200.7	SR
HROMIUM	<20	uG/L	EPA 200.7	SR
OPPER	<50	uG/L	EPA 200.7	SR
EAD	<100	uG/L	EPA 200.7	SR
ERCURY	<1	uG/L	EPA 245.1	KF
OLYBDENUM	240	uG/L	EPA 200.7	SR
ICKEL	<50	uG/L	EPA 200.7	SR
ELENIUM	<10	uG/L	EPA 270.2	ML
ILVER	<10	uG/L	EPA 272.1	LAF
HALLIUM	1	uG/L	EPA 279.2	ML
INC	<20	uG/L	EPA 200.7	SR

Verified:

arts/Million MG/L - Milligrams/Liter MG/KG - Milligrams/Kilogram
arts/Billion uG/L - Micrograms/Liter uG/KG - Micrograms/Kilogram
ess than > - Greater than pCi/L - pico Curies/Liter

UNIVERSITY HYGIENIC LABORATORY
BIOSCREEN

Site Amax, Ft. Madison Source Final Effluent (Ammonia Rem

EPA Sample No. _____ Collected 9/26/88 Received 9/27/88

DMBL Lab No. 8861158 Age: Minnows 29 days Daphnids <24 hrs.

Reference Toxicant Cadmium Chloride

Minnow LC_{50} 0.128 mg/L Daphnia LC_{50} 0.121 mg/L

RAW SAMPLE

Temperature _____ °C, Dissolved Oxygen _____ mg/L, pH _____ Units

Total Ammonia _____ mg/L, Unionized Ammonia (calculated) _____ mg/L

Total Residual Chlorine _____ mg/L, Specific Conductance _____ umho

ADJUSTED SAMPLE

Temperature 21 °C, Dissolved Oxygen 8.2 mg/L, pH 7.1 Units

Total Ammonia 2.1 mg/L, Unionized Ammonia (calculated) 0.01 mg/L

Total Residual Chlorine <0.005 mg/L, Specific Conductance 22,000 umhc

BIOSCREEN DATA

Test Begun: 9/27/88 @1415 hrs. Test Ended: 9/28/88 @1415 hrs.

	Fathead Minnow Kills				Daphnia magna Kills		
Concentration	Beaker 1	Beaker 2	Beaker 3	Total*	Beaker 1	Beaker 2	Total*
100%	7/7	6/6	7/7	20/20	8/8	7/7	15/15
Control	0/7	0/7	0/6	0/20	0/8	0/7	0/15

Sample Rated: Toxic

Toxic Because Of: Possibly high Sodium content.

Other:

Notes: See Attachment
*Number of organisms dead/number of organisms tested.

Analyst: JGM/LDA Verified: gdl Date Reported:

UNIVERSITY OF IOWA - HYGIENIC LABORATORY

Analytical Report for Sample Number 8861158

ty Laboratory
Hall
ty, IA 52242
35-4500

Des Moines Branch
900 East Grand
H.A. Wallace Building
Des Moines, IA 50319
(515) 281-5371

ceived: 09/27/88 Date of Report: 11/22/88

er: UHL LIMNOLOGY
: OAKDALE CAMPUS
IOWA CITY, IA 52240

Location: FT MADISON
llected: 09/26/88
ed By: LDA/CEILLEY

Sample Description: WATER
Client Reference:

s

NAL EFFL,ADJUSTED W/ZEO AND ACID.
LS PLUS MO,NH3,NA.

--- Listing of Analyses Performed and Results ---

	Concentration		Method Used	Analyst
	4700	MG/L	EPA 200.7	SR
(AS N)	1.7	MG/L	TIM #780-86	
NTIMONY	<10	uG/L	EPA 204.2	ML
RSENIC	<10	uG/L	EPA 206.2	ML
ERYLLIUM	<20	uG/L	EPA 200.7	SR
ADMIUM	<20	uG/L	EPA 200.7	SR
HROMIUM	<20	uG/L	EPA 200.7	SR
OPPER	<50	uG/L	EPA 200.7	SR
EAD	120	uG/L	EPA 200.7	SR
ERCURY	<1	uG/L	EPA 245.1	KF
OLYBDENUM	12000	uG/L	EPA 200.7	SR
ICKEL	<50	uG/L	EPA 200.7	SR
ELENIUM	20	uG/L	EPA 270.2	ML
ILVER	<10	uG/L	EPA 272.1	LAF
HALLIUM	2	uG/L	EPA 279.2	ML
INC	30	uG/L	EPA 200.7	SR

Verified JK

arts/Million MG/L - Milligrams/Liter MG/KG - Milligrams/Kilogram
arts/Billion uG/L - Micrograms/Liter uG/KG - Micrograms/Kilogram
ess than > - Greater than pCi/L - pico Curies/Liter