BIOASSAYS OF THE CITY OF TAMPA

WATER TREATMENT PLANT

HILLSBOROUGH COUNTY, FLORIDA

NPDES #FL0035971

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SEPTEMBER 23, 1986

Biology Section
Division of Environmental Programs

BIOASSAYS OF THE CITY OF TAMPA

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HILLSBOROUGH COUNTY, FLORIDA

NPDES #FL0035971

Biology Section
Bureau of Laboratories and
Special Programs
September 23, 1986

EXECUTIVE SUMMARY

City of Tampa Water Treatment Plant Discharge, on 5 to 8 August, 1986.

A sample of discharge collected from the City of Tampa Water Treatment Plant was not toxic at 72 hours to the test organisms, Ceriodaphnia dubia, Daphnia pulex, and Notropis leedsi. No significant mortality was noted during the tests. Both the residual chlorine (0.06 mg/l) and the ammonia (1.2 mg/l total and 0.02 mg/l unionized) measured in the sample were insufficient to have caused any toxicity. Chemical analyses were not performed since the sample was not acutely toxic.

INTRODUCTION

The City of Tampa Water Treatment Plant routinely discharges wastewater consisting of an alum supernatant to the Hillsborough River just below the salinity barrier.

In April, 1984, the Biology Section performed static acute toxicity bioassays on a sample of this discharge to determine its toxicity to aquatic organisms. Results indicated 48 hour LC_{50}'s of 79.6% and 314.2% for the test orgnaisms Mysidopsis bahia (saltwater) and Daphnia pulex (freshwater), respectively (FDER 1984). No mortality occurred in the Notropis leedsi test. The DER Chemistry Section detected aluminum (1990 ug/l) and iron (55 ug/l) in the sample. The presence of these metals may have been responsible for the toxicity noted.

Since the discharge was close to being acutely toxic to freshwater D. pulex, the Southwest District requested additional bioassays be performed. The Biology Section, therefore, performed two additional 72 hour static bioassays on a sample of this discharge on 27 to 30 November, 1984. The results of those tests, however, indicated no toxicity to the freshwater test organisms, Daphnia pulex and Notropis leedsi (FDER 1985a).

To again evaluate the the toxicity of this discharge, the Southwest District requested that further bioassays be performed. Three 72 hour static acute toxicity bioassays were performed on 5 to 8 August, 1986. The results of these latest tests are presented in this report. Those involved in performing the tests and in the preparation of this report were: M. L. Roll and P. G. Weiland.

METHODS AND MATERIALS

Test methods used to conduct these static bioassays are extensively described by Peltier and Weber (1985) and the FDER Biology Section (1985). The organisms selected for this study include species recommended by Peltier and Weber (1985), the U.S. EPA (1978), and the FDER Biology Section (1985b). Additionally, the Biology Section maintains cultures of several species of organisms indigenous to the State of Florida. One of these indigenous species was also selected for testing. Life histories of these test organisms and maintenance procedures used to culture them are detailed below.

History and Maintenance of Bioassay Organisms

Daphnia pulex (water flea) - A breeding culture of Daphnia pulex was obtained from the EPA laboratory in Athens, Georgia, in March, 1979. This culture has been maintained since its arrival in 2 1/2 gallon all-glass aquaria, filled with unchlorinated DER well water, under a 16:8 hour light-dark cycle. Organisms are fed a liquified blend of Purina Trout Chow® and Cerophyl® twice daily, once daily on weekends, and are kept at a constant temperature of 22° ± 2°C. The aquaria are cleaned weekly by siphoning off half the water along with the detritus and excess organisms, and then refilling with fresh aerated well water. Additional measures are taken and/or new cultures started in the event of abnormal circumstances such as: declining populations, ephippia formation, or excessive fungal or bacterial growth.

Ceriodaphnia dubia (water flea) - A breeding culture of Ceriodaphnia dubia was obtained from the EPA laboratory in Athens, Georgia, in June, 1985. The culture is maintained in 2-1/2 gallon all-glass aquaria, filled with unchlorinated DER well water, under a 16:8 hour light-dark cycle. Organisms are fed a liquified blend of Purina Trout Chow®, Cerophyl® and Fleischmann's® yeast twice daily, once daily on weekends, and are kept at a constant temperature of 26° ± 2°C. The aquaria are cleaned weekly by siphoning off half the water along with the detritus and excess organisms, and then refilling with fresh aerated well water. Additional measures are taken and/or new cultures started in the event of abnormal circumstances such as: declining populations, ephippia formation, or excessive fungal or bacterial growth.

Notropis leedsi (bannerfin shiner) - Approximately 40 adult bannerfin shiners were obtained from an indigenous population in the upper Suwannee River during October, 1981. The breeding stock-is maintained in 30 and 125 gallon all-glass aquaria equipped with a flow-through water exchange system. Water for this system is unchlorinated and is pumped from the DER deep well. The bannerfin shiners are reared at 22° ± 2°C under a 16:8 hour light-dark cycle and are fed Tetra-Min® and frozen Artemia (brine shrimp) twice daily, and once daily on weekends. Breeding and egg hatching are encouraged at 25°C. The eggs are laid between stacked red ceramic tiles separated by a 3mm bead of silicone. Most of the eggs adhere to the tiles and are easily removed to heated, aerated hatching tanks. The narrow space between the tiles eliminates egg predation by

adult fish. New hatching tanks are started regularly to segregate fry into even age groups. Newly hatched fry are fed a liquefied blend of Purina Trout Chow® and Cerophyl® twice daily. After one week, feeding is augmented with newly hatched Artemia nauplii and finely crushed Tetra Min®. The fish used in this test were approximately 23 days old at the time of the test.

To ensure the uniform sensitivity of these test organisms to toxic substances, the Biology Section conducts monthly standard reference toxicant bioassays using sodium lauryl sulfate as the reference toxicant.

Test Methods

Methods used to perform acute toxicity bioassays are described by Peltier and Weber (1985) and the FDER Biology Section (1985b). Some of the methods described below are more specific than those of Peltier and Weber. These will be noted in more detail.

Sampling Methods and Test Dates

Three separate 72 hour static acute toxicity bioassays were performed on a sample of discharge (Outfall #001) from Tampa's Water Treatment Plant. The tests were performed from 0930 hours on 5 August to 0930 hours on 8 August, 1986.

The sample was collected by Mr. David Killingsworth of DER's Southwest District at 1100 hours on 4 August, 1986 using standard wastewater sampling procedures. Separate samples were obtained for chemical and biological testing. Samples for metal analyses were preserved with HNO_3. Samples for organic chemical analyses and for the bioassays were unpreserved. The samples were iced and transported to the DER laboratory in Tallahassee for analyses within 24 hours of collection.

Test Temperature

Upon arrival of the iced (4°C) bioassay samples in the Tallahassee laboratory, the containers were placed in warm water and the temperature of the samples allowed to rise to 20° $\pm$ 2°C. Although this temperature may be different than the temperature of the sample during collection, it is the temperature range to which the test organisms are acclimatized and is the range recommended in the above referenced bioassay protocols. This avoids stressful effects caused by exposure to unusually cold or warm samples.

Freshwater Tests

Freshwater for dilution of the effluent sample was obtained from the same DER deep well that is used to culture the test organisms. The concentration series selected for this study (Table 1) is an abbreviated version of that recommended by APHA (1980).

Two replicates, of each concentration and a control, were used to test with the water fleas, Ceriodaphnia dubia and Daphnia pulex. Flint glass jars of 250 ml capacity were used as test chambers, and 200 ml of the appropriate test concentration was placed in each chamber. Ceriodaphnia were siphoned into a large culture dish and neonates were transferred by glass pipette, and loaded 10 per chamber, resulting in 20 per test concentration. Daphnia were siphoned into a large culture dish to isolate the proper size and age organisms (neonates). To accomplish this, the water fleas were siphoned through a stainless steel screen. The trapped adults were then discarded. These neonates were then transferred by glass pipette, examined for injury, and were loaded 10 per chamber, resulting in 20 per test concentration. Water fleas were not fed during these tests.

Two replicates, of each concentration and a control, were used for the Notropis leedsi (bannerfin shiner) bioassay. The fish were transferred individually or by twos, into wide mouth quart jars containing 500 ml each of the appropriate test concentration, and were loaded 5 per chamber, resulting in 10 per concentration. Fish were not fed during this test.

Test Parameters

Dissolved oxygen (YSI Model 57 oxygen meter), pH (Corning Model 7 pH meter with Orion Ross® combination electrode), temperature (NBS calibrated glass thermometer), and the number of live organisms were recorded for each test concentration at 0 hours, 24 hours, and 48 hours. The number of live organisms was recorded again at 72 hours. Total alkalinity and total hardness (measured as $CaCO_3$ using HACH Chemical Company reagents) were recorded at the beginning of the test for the controls and the 100% effluent concentration. The specific conductance (YSI Model 33 S-C-T meter) of each test concentration was recorded at the beginning and end of the test. All instruments were calibrated daily according to manufacturer's recommendations. Ammonia concentrations, including the total and unionized fraction (expressed in mg/l as N and as NH_3, respectively), were recorded in the controls and the 100% effluent test concentration at the beginning of the test. Total ammonia concentrations were determined using an Orion® specific ion probe and an Orion Ionalyzer®. The unionized fraction was then calculated based on the total ammonia concentration, and the pH, temperature, and salinity of the sample. These values were recorded on the bioassay data forms and are presented in Tables 2, 3, and 4.

Table 1. Concentration Series and Volumes Used for These Static Bioassays.

Ceriodaphnia dubia (water flea)

Daphnia pulex (water flea)

Concentration	Dilution Water	Effluent	Total Volume
Control	200.0 ml	--------	200 ml
10.0%	180.0 ml	20.0 ml	200 ml
32.0%	136.0 ml	64.0 ml	200 ml
56.0%	88.0 ml	112.0 ml	200 ml
100.0%	--------	200.0 ml	200 ml

Notropis leedsi (bannerfin shiner)

Concentration	Dilution Water	Effluent	Total Volume
Control	500 ml	--------	500 ml
10.0%	450 ml	50 ml	500 ml
32.0%	340 ml	160 ml	500 ml
56.0%	220 ml	280 ml	500 ml
100.0%	------	500 ml	500 ml

Table 2. Data recorded during 48 hour, Ceriodaphnia dubia, static acute toxicity bioassay of Tampa's Water Treatment Plant Discharge, NPDES #FL0035971, on 5 to 8 August, 1986.

Concentration or %	Number of Live Organisms				Dissolved Oxygen (mg/l)			pH			Temperature (°C)			Conductivity (umhos)	
	0	24	48	72	0	24	48	0	24	48	0	24	48	0	48
Control	10	10	10	10	9.0	8.4	8.7	8.0	8.0	8.1	20.8	19.6	20.1		
Control	10	10	10	10	9.0	8.4	8.7	8.0	8.0	8.1				195	195
10.0%	10	9	9	9	9.1	8.5	8.7	8.0	8.0	8.0	20.7	19.6	20.0		
10.0%	10	10	10	10	9.1	8.4	8.7	8.0	8.0	8.0				212	208
32.0%	10	10	10	10	9.0	8.5	8.5	7.9	8.0	8.0	20.6	19.5	18.8		
32.0%	10	10	10	10	9.0	8.5	8.5	7.9	8.0	8.0				248	245
56.0%	10	10	10	10	8.8	8.5	8.5	7.7	8.0	8.0	20.4	19.5	18.7		
56.0%	10	10	10	10	8.8	8.4	8.5	7.7	8.0	8.0				283	282
100.0%	10	10	10	10	8.7	8.5	8.6	7.5	7.9	7.9	20.5	19.6	18.7		
100.0%	10	10	10	10	8.7	8.4	8.6	7.5	7.9	7.9				350	350

Control Water

NH_3(as NH_3)(mg/l) 0.002

Total ammonia (as N)(mg/l) 0.05

Total Alkalinity 112 (mg/l $CaCO_3$)

Total Hardness 115 (mg/l $CaCO_3$)

100% Effluent

NH_3(as NH_3)(mg/l) 0.019

Total ammonia (as N)(mg/l) 1.2

Total Alkalinity 88 (mg/l $CaCO_3$)

Total Hardness 170 (mg/l $CaCO_3$)

Total Residual Chlorine: 0.06 mg/l (HACH).

Table 3. Data recorded during 48 hour, Daphnia pulex, static acute toxicity bioassay of Tampa's Water Treatment Plant Dishcarge, NPDES #FL0035971, on 5 to 8 August, 1986.

Concentration or %	Number of Live Organisms				Dissolved Oxygen (mg/l)			pH			Temperature (°C)			Conductivity (umhos)		
	0	24	48	72	0	24	48	0	24	48	0	24	48	0	48	
Control	10	10	10	10	9.1	8.2	8.7	8.1	8.0	8.1	21.1	19.6	19.6			Control Water
Control	10	10	10	10	9.1	8.3	8.7	8.1	8.0	8.1				195	195	NH_3(as NH_3)(mg/l) 0.003 / Total Alkalinity 112 ($mg/l\ CaCO_3$)
10.0%	10	10	10	10	9.0	8.4	8.6	8.1	8.0	8.0	21.1	19.4	19.5			
10.0%	10	10	10	10	9.0	8.5	8.6	8.1	8.0	8.0				212	208	
32.0%	10	10	10	10	9.0	8.5	8.4	8.0	8.0	7.9	21.0	19.4	19.4			Total ammonia (as N)(mg/l) 0.05 / Total Hardness 115 ($mg/l\ CaCO_3$)
32.0%	10	10	10	10	9.0	8.5	8.4	8.0	8.0	7.9				248	245	
56.0%	10	10	10	10	8.8	8.5	8.4	7.8	7.9	7.9	20.9	19.4	19.3			
56.0%	10	10	10	10	8.8	8.5	8.4	7.8	7.9	7.9				285	282	
100.0%	10	10	10	10	8.7	8.5	8.4	7.5	7.9	7.9	20.8	19.6	19.5			
100.0%	10	10	10	10	8.7	8.3	8.4	7.5	7.9	7.9				350	350	100% Effluent
																NH_3(as NH_3)(mg/l) 0.019 / Total Alkalinity 88 ($mg/l\ CaCO_3$)
																Total ammonia (as N)(mg/l) 1.2 / Total Hardness 170 ($mg/l\ CaCO_3$)

Total Residual Chlorine: 0.06 mg/l (HACH).

Table 4. Data recorded during 48 hour, Notropis leedsi, static acute toxicity bioassay of Tampa's Water Treatment Plant Discharge, NPDES #FL0035971, on 5 to 8 August, 1986.

Concentration or %	Number of Live Organisms				Dissolved Oxygen (mg/l)			pH			Temperature (°C)			Conductivity (umhos)	
	0	24	48	72	0	24	48	0	24	48	0	24	48	0	48
Control	5	5	5	5	8.8	8.2	8.3	7.6	7.9	7.9	21.7	19.5	19.5		
Control	5	5	5	5	8.8	8.2	8.3	7.6	7.9	7.9				210	202
10.0%	5	5	5	5	8.8	8.3	8.3	7.6	7.9	7.9	21.6	19.4	19.4		
10.0%	5	5	5	5	8.8	8.3	8.3	7.6	7.9	7.9				223	220
32.0%	5	5	5	5	8.7	8.3	8.4	7.6	7.8	7.8	21.5	19.4	19.4		
32.0%	5	5	5	5	8.7	8.3	8.4	7.6	7.8	7.8				260	252
56.0%	5	5	5	5	8.7	8.4	8.4	7.6	7.8	7.8	21.3	19.5	19.4		
56.0%	5	5	5	5	8.7	8.3	8.4	7.6	7.8	7.8				297	290
100.0%	5	5	5	5	8.6	8.3	8.3	7.5	7.7	7.8	21.3	19.5	19.7		
100.0%	5	5	5	5	8.6	8.2	8.3	7.5	7.7	7.8				360	352

Control Water	
NH_3(as NH_3)(mg/l) 0.001	Total Alkalinity 112 (mg/l $CaCO_3$)
Total ammonia (as N)(mg/l) 0.02	Total Hardness 115 (mg/l $CaCO_3$)

100% Effluent	
NH_3(as NH_3)(mg/l) 0.02	Total Alkalinity 88 (mg/l $CaCO_3$)
Total ammonia (as N)(mg/l) 1.2	Total Hardness 170 (mg/l $CaCO_3$)

Total Residual Chlorine: 0.06 mg/l (HACH).

RESULTS AND DISCUSSION

The sample of wastewater dishcarge collected from the City of Tampa's Water Treatment Plant was not acutely toxic to the freshwater test organisms, Ceriodaphnia dubia, Daphnia pulex, and Notropis leedsi. No significant mortality occurred during the 72 hour static tests (Tables 2, 3, and 4). Neither the residual chlorine (0.06 mg/l) nor the ammonia (1.2 mg/l total and 0.02 mg/l unionized) was sufficient to have caused any toxicity. Since the sample was not acutely toxic, further chemical analyses were not performed.

Recommendation

Due to the absence of toxicity, we recommend normal routine inspection and monitoring of this facility.

LITERATURE CITED

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