BIOASSAY OF THE CITY OF ORLANDO BENNETT ROAD

SEWAGE TREATMENT PLANT

ORANGE COUNTY, FLORIDA

NPDES PERMIT #FL0022128

SAMPLED 5/12/80

Biological Section
Bureau of Water Analysis
13 May 1980

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INTRODUCTION

The Bennett Road Sewage Treatment Plant is owned and operated by the City of Orlando. The facility is located at 900 Bennett Road in Orlando (Fig. 1). The plant provides secondary sewage treatment for approximately 96,000 residents and the T.G. Lee Dairy Farm. It has a design capacity of 12.0 MGD and a permitted discharge of 10.6 MGD. The #001 NPDES discharge point is located on Crane Creek (Fig. 1) which eventually connects to the Econlockhatchee River and ultimately to the St. Johns River. The plant was built in 1950 and is expected to cease discharging to Crane Creek when the new Iron Bridge Road STP begins operating in 1982.

On 13 May 1980, the Biological Section obtained an effluent sample from the Bennett Road STP prior to chlorination and performed a static bioassay to determine the existance and extent of toxicity to the biota of the receiving waters.

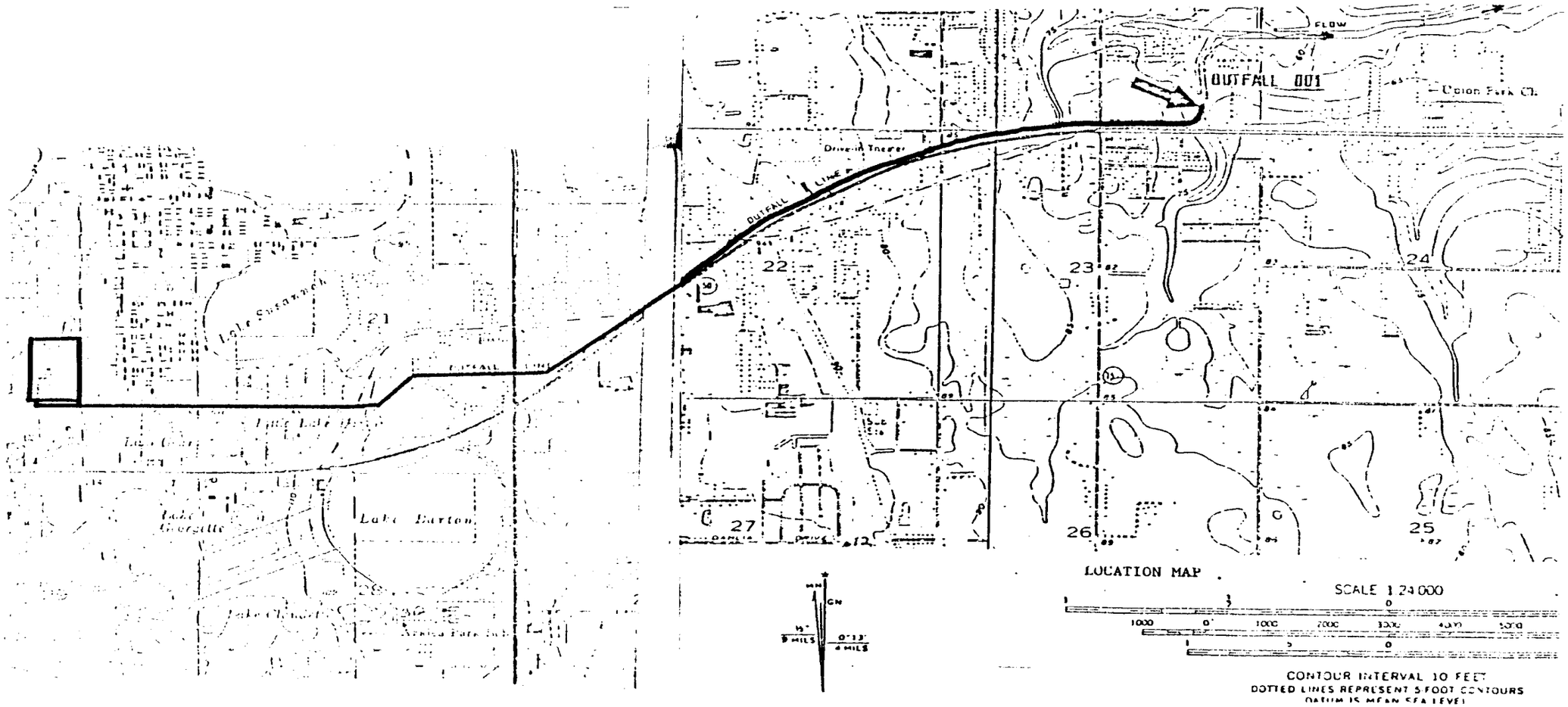


Figure 1. Location map, Bennett Road Sewage Treatment Plant, Orlando, Florida

METHODS AND MATERIALS

Test methods used for conducting this static bioassay are extensively described by Peltier (1978). The organism selected for this study is among those recommended by Peltier (1978) and the U.S. EPA (1978). Life histories of this test organism and maintenance procedures used to culture it are detailed below.

History and Maintenance of Bioassay Organisms

A breeding culture of Daphnia pulex (water flea) was obtained from the EPA laboratory in Athens, Georgia on 9 March 1979. This culture has been maintained since its arrival, in 2½ gallon all glass aquaria using a 16:8 hour light-dark cycle. Organisms have been fed a liquified blend of Purina Trout Chow® and Cerophyl® twice daily. Daphnia used in this bioassay were siphoned into a large culture dish through a series of nested stainless steel screens to isolate the proper size and age organisms (neonates). These neonates were then pipetted individually from the culture dish and placed into the test chambers at the beginning of the test.

Test Methods

A 48 hour static bioassay was conducted from 1400 hours 13 May 1980, to 1400 hours 15 May 1980 on a grab sample of effluent from outfall #001. The sample was collected by Mr. Guy Hadley and Mr. Louis Ley of the St. Johns River District Office on 1430 hours 12 May 1980 using standard wastewater sampling procedures.

Fresh water for dilution of the effluent sample was obtained from the same City of Tallahassee well that is used to culture the test organisms. The concentration series selected for this study are those recommended by APHA (1976) (Table 1).

Two replicates, each with six concentrations and a control, were used to test with 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. Daphnia were transferred individually by glass pipette and were loaded 10 per chamber, resulting in 20 per test concentration.

Dissolved oxygen, pH, and the number of live organisms were recorded for each test chamber at 0 hours, 24 hours, and 48 hours. Total alkalinity, total hardness and conductivity were recorded at the beginning of the test for the controls and the 100% effluent concentration. These values were recorded daily on the bioassay data forms and are presented in Table 2. Organisms were not fed during these tests.

Table 1.

CONCENTRATION SERIES AND VOLUMES
USED FOR THIS STATIC BIOASSAY

CONCENTRATION	DILUTION WATER	EFFLUENT	TOTAL VOL.
Control	200 ml	-	200 ml
5.6%	189 ml	11 ml	200 ml
10.0%	180 ml	20 ml	200 ml
18.0%	164 ml	36 ml	200 ml
32.0%	136 ml	64 ml	200 ml
56.0%	88 ml	112 ml	200 ml
100 %	-	200 ml	200 ml

Table 2. . Data recc ded during 48 hour, *Daphnia pulex*, static acute toxicity bioassay performed on the City of Orlando Bennett Road Sewage Treatment Plant, Orange County, Florida. 13 May 1980 to 15 May 1980. NPDES Permit #FL0022128. Outfall #001.

Conc. or %	Test Container Number	Number of Live Organisms					Dissolved Oxygen (mg/l)					pH					Total Alkalinity (mg/l as $CaCO_3$)					Total Hardness (mg/l as $CaCO_3$)					Conductivity (Umhos/cm)				
		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	24	48	72	96
Control	A	10	10	10			9.3	8.5	8.1			8.9	8.1	8.3			120					120					310				
Control	B	10	10	10			9.3	8.5	8.3			8.1	8.1	8.3																	
5.6%	A	10	10	10			9.3	8.4	8.4			8.1	8.1	8.2																	
5.6%	B	10	10	10			9.3	8.5	8.5			8.1	8.1	8.2																	
10.0%	A	10	10	10			9.4	8.4	8.5			8.0	8.0	8.1																	
10.0%	B	10	10	10			9.3	8.5	8.6			8.0	8.0	8.1																	
18.0%	A	10	10	10			9.2	8.4	8.7			8.0	8.0	8.1																	
18.0%	B	10	10	10			9.3	8.4	8.7			7.9	8.0	8.1																	
32.0%	A	10	8	5			9.0	8.3	8.4			7.8	7.9	8.0																	
32.0%	B	10	9	2			8.9	8.3	8.6			7.7	7.9	8.0																	
56.0%	A	10	1	0			8.2	8.1	8.7			7.5	7.8	8.0																	
56.0%	B	10	0	-			8.1	8.1	-			7.4	7.8	-																	
100%	A	10	0	-			6.5	7.8	-			7.1	7.7	-																	
100%	B	10	0	-			6.4	7.8	-			7.1	7.6	-			120					110					550				

Remarks:

1. Test temperature range 21.5 to 23.0°C.
2. Total residual chlorine of 100% effluent = 0.0 mg/l (Hatch).
3. Effluent is slightly turbid.

RESULTS AND DISCUSSION

This particular sample from the Bennett Road Sewage Treatment Plant demonstrated measurable toxicity to Daphnia pulex (Table 3.). The LC_{50} was determined to be 40% at 24 hours exposure and 29% at 48 hours exposure. The 96 hour LC_{50} for this facility would, therefore, be $\leq$ 29%.

Chemical analyses (Table 4.) indicated that Lindane, a benzene hexachloride pesticide, commonly used in dairy farms, was present in the effluent at 0.07 µg/l. Daphnids, however, are known to be relatively tolerant of Lindane (e.g., 11 µg/l was "safe" over three generations of exposure with Daphnia magna) (U.S. EPA 1976). Copper was also found in "safe" concentrations (U.S. EPA 1977). Since Daphnia are especially sensitive to cadmium (U.S. EPA 1977), this metal (at 20 µg/l) may be partially responsible for the mortality noted in this bioassay.

Chapter 17-3.051, Florida Administrative Code, indicates that "all waters of the State shall at all places and at all times be free from...components of discharges which...are acutely toxic." "Acute toxicity" is defined in Chapter 17-3 .021(1) to mean "the presence of one or more substances...in amounts which are greater than one-third (1/3) of the amount lethal to 50% of the test organisms in 96 hours (96 hour LC_{50})...". In the absence of a mixing zone, this 1/3 of the 96 hour LC_{50} applies at the point of discharge. Chapter 17-4.244(4) states that "in no event shall the maximum concentration of wastes in the mixing zone exceed the amount lethal to 50% of the test organisms in 96 hours (96 hour LC_{50}) for a species significant to the indigenous aquatic community..." This criterion applies at the point of discharge if there is a mixing zone. The distinction between presence or absence of a mizing zone is not relevant here, however, since the testing procedure used does not involve effluent concentration. The 1/3 of the 96 hour LC_{50} criterion is three times as stringent as the 96 hour LC_{50} criterion and, therefore, in the absence of a mizing zone, the procedure used is very lenient. The procedure followed is also lenient in that testing is only done for 48 hours. The 96 hour LC_{50} derived from this testing is therefore reported as "less than or equal to" the 48 hour measurement. The value found after 48 hours can never be more restrictive than the value found after 96 hours. It must be noted that all organisms used in these tests are significant to the indigenous aquatic community since they are sensitive to toxic substances which may be expected to impact the indigenous community.

The toxicity reported here is in excess of allowable limits.

Table 3.

LC_{50} DATA FOR BIOASSAY OF
BENNETT ROAD SEWAGE TREATMENT PLANT

ORGANISM	METHOD OF DATA ANALYSIS	24-HOUR LC_{50} AND 95% CONFIDENCE INTERVALS	48-HOUR LC_{50} AND 95% CONFIDENCE INTERVALS
Daphnia pulex	Binomial	40.3% (32-56)	28.9% (18-56)
	Moving Average	39.9% (34-49)	*
	Probit	39.7% (35-45)	*

* When there are less than two concentrations which contain partial kills (percent dead is between 0 and 100), neither the moving average nor the probit method can give statistically sound results.

Table 4.

RESULTS OF CHEMICAL ANALYSIS PERFORMED ON EFFLUENT SAMPLES
FROM THE CITY OF ORLANDO BENNETT ROAD SEWAGE TREATMENT PLANT

Parameter	Mean Value
Cadmium	20 µg/l
Chromium	< 10 µg/l
Copper	30 µg/l
Mercury	<0.2 µg/l
Lindane	0.07 µg/l

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