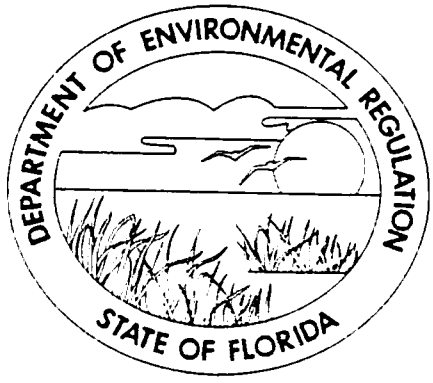


BIOASSAYS OF THE LAKELAND-McINTOSH POWER PLANT NO. 3, OUTFALL #001 LAKELAND, POLK COUNTY, FLORIDA NPDES #FL0026301

Biological Section
Bureau of Water Analysis
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INTRODUCTION

The City of Lakeland-McIntosh Power Plant is located on the northeast shore of Lake Parker, in Lakeland, Polk County, Florida (Fig. 1). This facility currently has two operational discharges, consisting of once-through cooling water (Outfall #001-115 MGD), and, cooling tower blowdown (Outfall #003-0.2 MGD). Each discharge empties to a common canal, which opens to Lake Parker. Chlorine may be added, as needed, to the #003 discharge to control algae.

The Biological Section previously performed static acute toxicity bioassays on effluent collected from these outfalls in August, 1981. The results of these indicated that the effluent collected from Outfall #001 apparently was toxic to the test organism, Daphnia pulex, while effluent collected from Outfall #003 was not toxic. A chlorine residual was detected in the #001 effluent, which may have accounted for some of the toxicity. However, the chlorine residual detected in effluent from #001 seemed to have contradicted information from the NPDES file and from district personnel, that indicated only effluent from #003 may be chlorinated. As a result of that confusion, the bioassays were invalidated and the Biological Section recommended that the bioassays be repeated.

In May, 1982, the Biological Section performed additional bioassays on effluent collected from Outfall #003 from this facility. The results indicated that the effluent was not toxic to Daphnia pulex or to Heterandria formosa (FDER 1982). Unfortunately, effluent from Outfall #001 was not collected at that time. In July, 1982, effluent from Outfall #001 was collected after mixing with the receiving waters (Lake Parker), since no prior access point was available. Two 48 hour static acute toxicity bioassays were performed on this effluent, on 13 to 15 July, 1982. The results of these latest tests are presented in this report.

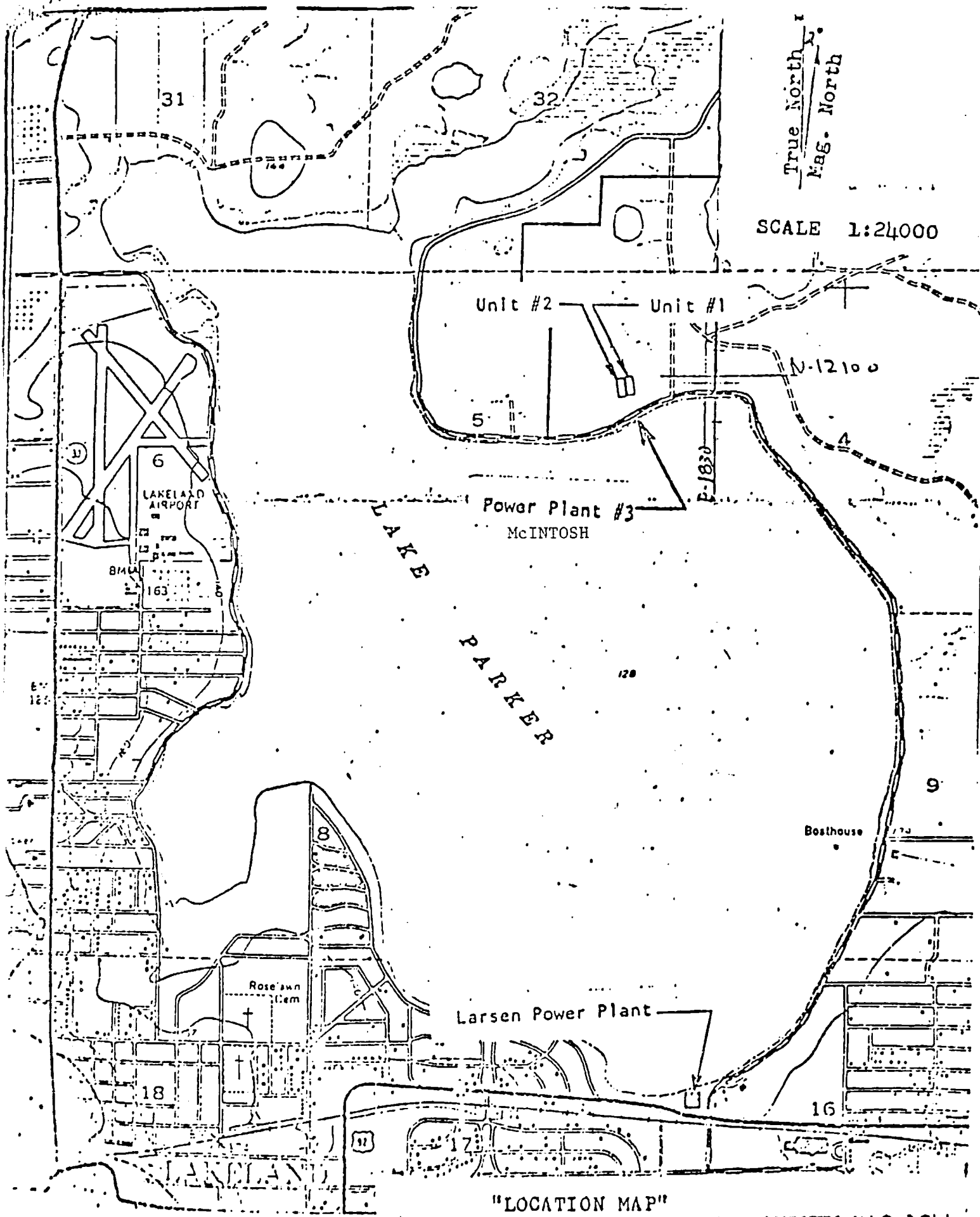


Figure 1

"LOCATION MAP"
FROM U.S. GEOLOGICAL SURVEY MAP 1944
POWER PLANT 3
LAKELAND, POLK, FLORIDA

METHODS AND MATERIALS

Test methods used to conduct these static bioassays are extensively described by Peltier (1978). The organisms selected for this study include a species recommended by Peltier (1978) and the U.S. EPA (1978). Additionally, the Biological 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, and are kept at a constant temperature of 22° plus or minus 1°C. The aquaria are cleaned weekly by siphoning off half the water along with the detritus and excess organisms. They are then refilled 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.

Heterandria formosa (least killifish) - Approximately 100 adult least killifish were obtained from a wild population in the St. Marks Wildlife Refuge (Wakulla County, Florida) during August, 1980. The fish are maintained in two and one-half to 15 gallon all glass aquaria equipped with a flow through water exchange system. Water for this system is unchlorinated and is pumped from a deep well near the DER laboratory. The least killifish are reared at 22° plus or minus 2°C under a 16:8 hour light-dark cycle and are fed freshly hatched Artemia (brine shrimp) twice daily. New born fish are initially maintained in the adult tanks, but are removed at weekly intervals, thereby segregating fish into even age groups. The fish used in this test were 2 to 3 weeks old.

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

Test Methods

Two separate 48 hour static acute toxicity bioassays were performed on a sample of Lakeland-McIntosh's Outfall #001 effluent, after mixing with the receiving waters. The tests were performed from 1005 hours on 13 July to 1020 hours on 15 July, 1982.

The sample was collected by Ms. Janice Hager of DER's Southwest District at 1115 hours on 12 July, 1982, using standard wastewater sampling procedures. The sample was iced and transported to the DER laboratory in Tallahassee for analysis within 24 hours of collection.

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 that recommended by APHA (1980).

Two replicates, each with six concentrations and a control, were used to test with the water flea, 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 siphoned into a large culture dish to isolate the proper size and age organisms (neonates). To accomplish this, the Daphnia 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 this test.

Two replicates, of six concentrations and a control, were used for the Heterandria formosa (least killifish) 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.

Dissolved oxygen, pH, temperature, and the number of live organisms were recorded for each test chamber at 0 hours, 24 hours, and 48 hours. The specific conductance of each test concentration was recorded at the beginning and end of the test. Ammonia concentrations, including total and unionized fractions (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 determined 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 and 3.

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

Daphnia pulex (water flea)

Concentration	Dilution Water	Effluent	Total Volume
Control	200 ml	---	200 ml
5.6%	188.8 ml	11.2 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
100.0%	--	200 ml	200 ml

Heterandria formosa (least killifish)

Concentration	Dilution Water	Effluent	Total Volume
Control	500 ml	---	500 ml
5.6%	472 ml	28 ml	500 ml
10.0%	450 ml	50 ml	500 ml
18.0%	410 ml	90 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, Daphnia pulex, static acute toxicity bioassay of Lakeland-McIntosh Power Plant, Outfall #001, Lakeland, Polk County, Florida, NPDES #FL0026301, on 13 to 15 July, 1982.

Conc. or %	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH			Total Alkalinity (mg/l as $CaCO_3$)		Total Hardness (mg/l as $CaCO_3$)		Temperature (°C)			NH_3/NH_3+NH_4 (mg/l)		Conductivity (µmhos)	
	0	24	48[a]	0	24	48	0	24	48	0	48	0	48	0	24	48	0	48	0	48
Control	10	10	6	8.3	8.6	8.5	7.3	8.1	8.1					21.9	19.5	21.1	0/0	---		
Control	10	10	4	8.4	8.6	8.5	7.3	8.1	8.1										200	215
5.6%	10	10	10	8.4	8.7	8.5	7.4	8.2	8.2					21.7	19.3	21.0				
5.6%	10	10	10	8.5	8.7	8.5	7.5	8.3	8.2										205	215
10.0%	10	10	10	8.5	8.7	8.5	7.5	8.3	8.3					21.5	19.3	20.9				
10.0%	10	10	10	8.5	8.7	8.5	7.5	8.3	8.3										205	215
18.0%	10	10	9[b]	8.4	8.7	8.5	7.6	8.3	8.3					21.4	19.3	20.9				
18.0%	10	10	10	8.4	8.7	8.5	7.6	8.3	8.3										210	230
32.0%	10	10	10	8.5	8.7	8.4	7.8	8.3	8.3					21.1	19.2	20.9				
32.0%	10	10	10	8.5	8.7	8.4	7.9	8.3	8.3										215	228
56.0%	10	10	10	8.4	8.7	8.5	8.1	8.3	8.2					20.3	19.2	21.0				
56.0%	10	10	10	8.4	8.7	8.4	8.2	8.3	8.2										216	230
100.0%[c]	10	10	10	8.4	8.7	8.3	8.7	8.3	8.1					19.8	19.2	21.0	0/0	---		
100.0%	10	10	10	8.4	8.7	8.3	8.8	8.3	8.1										225	248

Remarks:

[a] The 48 hour test is invalidated due to excessive control mortality (>20%).

[b] One organism not found.

[c] Total Residual Chlorine: 0.0 mg/l (HACH DPD Method).

Table3 . Data recorded during 48 hour, Heterandria formosa, static acute toxicity bioassay of Lakeland-McIntosh Power Plant, Outfall #001, Lakeland, Polk County, Florida, NPDES #FL0026301, on 13 to 15 July, 1982.

Conc. or %	Number of Live Organisms			Dissolved Oxygen (mg/ℓ)			pH			Total Alkalinity (mg/ℓ as $CaCO_3$)		Total Hardness (mg/ℓ as $CaCO_3$)		Temperature (°C)			NH_3/NH_3+NH_4 (mg/ℓ)		Conductivity (μmhos)	
	0	24	48	0	24	48	0	24	48	0	48	0	48	0	24	48	0	48	0	48
Control	5	5	5	8.3	8.1	7.9	7.7	8.1	8.1					21.9	19.8	20.9	0/0	---		
Control	5	5	5	8.2	8.2	8.0	7.6	8.1	8.1										210	205
5.6%	5	5	5	8.3	8.2	7.9	7.6	8.1	8.1					21.7	19.5	20.8				
5.6%	5	5	5	8.2	8.2	7.9	7.6	8.1	8.1										215	210
10.0%	5	5	5	8.2	8.1	7.8	7.7	8.1	8.1					21.6	19.3	20.8				
10.0%	5	5	5	7.9	8.2	7.8	7.7	8.1	8.1										215	210
18.0%	5	5	5	8.1	8.2	7.8	7.7	8.1	8.1					21.6	19.1	20.7				
18.0%	5	5	5	8.2	8.2	7.8	7.8	8.1	8.1										215	212
32.0%	5	5	5	8.2	8.0	7.7	8.0	8.1	8.1					21.5	19.1	20.7				
32.0%	5	5	5	8.2	8.1	7.7	8.0	8.1	8.1										220	218
56.0%	5	5	5	8.2	8.1	7.7	8.2	8.2	8.0					21.0	19.1	20.7				
56.0%	5	5	5	8.2	8.1	7.7	8.3	8.2	8.0										220	220
100.0%	5	5	5	8.2	8.1	7.7	8.8	8.2	8.0					19.0	19.1	20.7	0/0	---		
100.0%	5	5	5	8.2	8.1	7.7	8.8	8.2	7.9										230	240

Remarks:

[a] Weight of fish: 1.3 mg each, average of 10 fish.

[b] Total Residual Chlorine: 0.0 mg/l (HACH DPD Method).

RESULTS AND DISCUSSION

The sample of cooling water effluent from the Lakeland-McIntosh Power Plant (Outfall #001), collected after mixing with the receiving waters, was not toxic to either Daphnia pulex or to Heterandria formosa. Not a single dead organism was observed during the 48 hour static tests, except in the Daphnia controls, where mortality (>20%) resulted in invalidation of that test at 48 hours.

LITERATURE CITED

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