

Biological Assessment of

Arrowhead International Campground Wastewater Treatment Plant

Jackson County

NPDES #FL0028738

Sampled September 1994

February 1995

Biology Section
Division of Administrative and Technical Services

Comprehensive Quality Assurance Plan No. 870346G

Department of Environmental Protection
Results of Fifth Year Inspections

Discharger: Arrowhead International Campground WWTP
County Jackson
NPDES Number: FL0028738
State Permit Expiration Date: 26 June 1995

Toxics Sampling Inspection (XSI)

Date Sampled: 19 September 1994

Results: No organic constituents or metals were found at levels which exceeded Class III standards.

Compliance Biomonitoring Inspection (CBI)

Date Sampled: 19 September 1994

Results: The effluent sample was not toxic to the fish, *Cyprinella leedsi,* however, 40% of the invertebrate, *Ceriodaphnia dubia*, were killed during the 48 hour test. While this is not a violation of toxicity standards, it may be cause for concern.

Impact Bioassessment Inspection (IBI)

Date Sampled: 19 September 1994

Results: The results of the benthic community analyses suggested that both sites were disturbed, but that conditions were somewhat worse at the test site. Taxa richness, the macroinvertebrate component of Hulbert's Lake Condition Index, and Shannon-Weaver diversity were less than that expected for a healthy North Florida lake at both sites. The reference site community was composed of more clean water indicators (*i.e., Pseudochironomus* sp. and *Oecetis* sp.) than the test site. However, pollution tolerant forms (*e.g., Limnodrilus hoffmeisteri*) were common at both sites. Phytoplankton communities were not adversely affected by the campground discharge. Algal biomass was very low at both sites (probably due to nutrient uptake by the nuisance *Hydrilla* population.

Water Quality Inspection (WQI)

Date Sampled: 19 September 1994

Results: Nutrient levels found in the effluent were elevated, particularly total phosphorus and nitrate-nitrite. Nitrate-nitrite was an order of magnitude higher than 95% of typical Florida lakes at both the reference and test sites. This nitrogen enrichment is probably attributable to the discharge, which may be directed to these areas via wind driven currents. Algal growth potential of the effluent was elevated (68.0 mg algal dry wt/L), corresponding to the nutrient content. In contrast, receiving water values were very low. This suggests that the excess bioavailable nutrients (especially phosphorus) were being used in the production of nuisance growth of *Hydrilla,* which was extremely abundant throughout the study area. Dissolved oxygen of the effluent was 1.9 mg/L, a violation of the facility's permit and of ambient standards, Rule 62-302.530(31) FAC. Total and fecal coliform bacteria were within standards at both the reference and test sites. In the effluent, fecal coliforms were within permit limits, but total coliforms exceeded Class III standards. Because the holding time for this analysis was exceeded, a water quality violation could not be cited. This indicates, however that the facility may not be adequately disinfecting the discharge.

Introduction

The Arrowhead International Campground Wastewater Treatment Facility is located in Jackson County, Florida. This is an extended aeration sewage treatment plant with a design flow of 0.015 MGD. During this survey, the facility was discharging 0.006 MGD, which is its average flow. Effluent is discharged to Merritts Mill Pond, a Class III waterway formed by the impoundment of Spring Creek. Spring Creek is a tributary of the Chipola River.

Permit limits are as follows: flow (0.015 MGD annual average), BOD and TSS (20 mg/L annual average), pH (6.5 to 8.5 S.U.'s), fecal coliform bacteria (200 organisms/100 mL), TKN (15 mg/L maximum), NH_3 (5 mg/L maximum), total phosphorus (5 mg/L maximum), dissolved oxygen (2 mg/L minimum), and chlorine residual (minimum of 0.5 mg/L for disinfection, maximum of 0.01 mg/L at discharge) (see Facility Summary in Appendix).

This facility has experienced some problems in the past few years, such as sewage spills and violations of total phosphorus and TSS permit limits. However, all reported parameters for 1994 were within permit requirements, and there is an improving trend in phosphorous levels. The plant operates between 33% and 46% of design capacity. There are no previous or current enforcement actions on file for this facility.

Methods

The focus of this investigation was to determine the discharger's effects on the receiving waters. A comparison of biological community health was made between a reference site (located in Merritts Mill Pond, 200 meters northeast of the discharge) and a test site (also located in Merritts Mill Pond, 30 meters southwest of the discharge) (see maps in Appendix). Habitat assessment was performed *in situ* to establish comparability between sites. Supplemental physical/chemical data were also collected on the effluent and study sites. Acute screening toxicity bioassays, using *Ceriodaphnia dubia* and *Cyprinella leedsi* as test organisms, were performed on an effluent sample (Weber 1991). The effluent was analyzed for metals and for organic constituents (base neutral and acid extractables, and pesticide extractables). Additionally, nutrient analyses were performed on the ef-

Major characteristics of community structure of control and test sites.

	Reference Site	Test Site
Macroinvertebrate Quantitative		
Number of Taxa	15	14
Shannon-Weaver Diversity	0.8	2.1
LCI Index	6	1
% Oligochaeta	3.3	25.5
% Diptera	0.9	4.5
% Amphipoda	89.8	64.5
% Hirudinea	4.5	3.6
% Pelecypoda	1.1	1.6
% Other	0.3	0.3
% Above Surface Deposit Feeders	30.5	19.8
% Below Surface Deposit Feeders	3.8	48.2
% Suspension Feeders	1.5	2.0
% Shredders	30.0	16.0
% Scavengers	30.0	10.0
% Parasites	3.1	2.2
% Other	2.1	1.5
Phytoplankton Algae		
Number of Taxa	6	10
Shannon-Weaver Diversity	2.4	2.6
Algal Density (#/mL)	745	1,570
Chlorophyll a (µg/L)	0.4	0.6
% Blue-green	27.0	63.6
% Green	45.5	18.0
% Diatoms	27.0	18.0
Algal Growth Potential (mg dry wt/l)	1.2	0.1

fluent, the reference site, and the test site. Methods used for all chemical analyses are on file at the Tallahassee DEP Chemistry Laboratory.

Benthic macroinvertebrate communities were evaluated at the reference and test sites. Invertebrates were collected via three Ponar grabs per site (Ross 1990). Phytoplankton was sampled at reference and test sites by subsurface grabs. Chlorophyll *a* was also determined for phytoplankton communities (Ross 1990). Bacterial populations were analyzed for total and fecal coliforms following the methods of APHA (1989). Algal Growth Potential tests, using *Selenastrum capricornutum* as the test organism, followed Miller *et al.* (1978).

Explanation of Measurements of Community Health

Several different measurements of macroinvertebrate and algal community health have been employed to determine the effects of a discharge. These are briefly discussed here.

Taxa richness: It is generally accepted that taxa richness is among the most robust measures of benthic community health. Anthropogenic stress has a tendency to reduce the number of different types of invertebrates present in a system. Algal taxa richness may increase with moderate nutrient enrichment, compared to an oligotrophic natural background, but become reduced with extreme nutrient enrichment or toxicity.

Shannon-Weaver diversity: This index is specified in the Florida Administrative Code as a measure of biological integrity. Low diversity scores are undesirable, in that they represent conditions where only a few organisms are abundant, to the exclusion of other taxa. Such scores may be associated with organic/nutrient enrichment and decreased dissolved oxygen. Excessive numerical dominance of a single type of organism (a high % contribution of the dominant taxon) is also associated with disturbance.

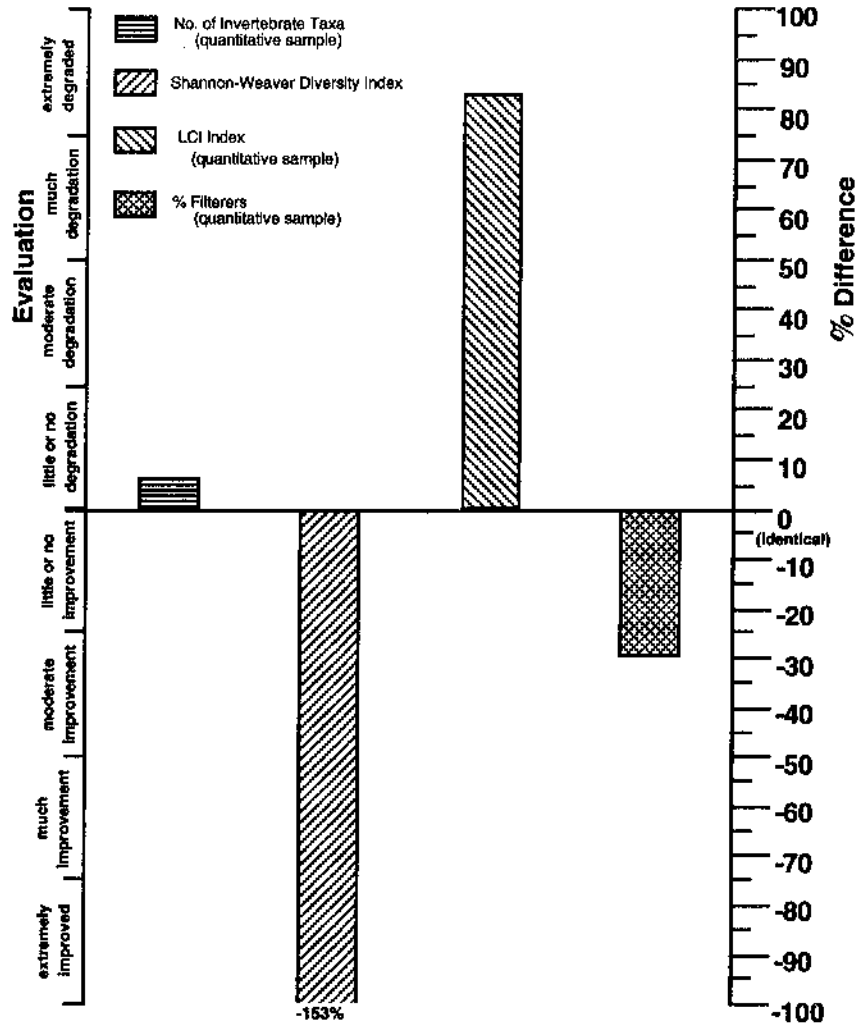
Numbers of pollution sensitive taxa: Unpolluted sites have characteristic numbers and types of taxa which are sensitive to anthropogenic stress. These organisms become rare or absent as the intensity or duration of the disturbance increases. For example, the Florida Index assigns points to stream-dwelling macroinvertebrates based on their sensitivity to pollution (see Ross 1990). A site with a high Florida Index score is considered healthy (*e.g.*, around 20 or more in the Panhandle, around 15 or more in the Peninsula). For this study, we employed the macroinvertebrate component of the Lake Condition Index (LCI_m) as a gauge of benthic community health (Hulbert 1990). Taxa are assigned either zero, one, or two points based on their relative sensitivity to pollution. A minimum of 12 points for the macroinvertebrate component of the Lake Condition Index (LCI_m) is currently considered necessary for a lake to be deemed unaltered by human activities. Species sensitivity data from other sources, such as Hudson *et al.* (1990), Lenat (1993), Farrell (1992), Chang *et al.* (1992), and Whitmore (1989), are used as appropriate.

Ephemeroptera/Plecoptera/Trichoptera Index: To calculate the index, one simply sums the number of EPT taxa present at a station. Higher EPT scores (*e.g.*, 7 or more in the Panhandle, 4 or more in the Peninsula) are associated with healthier systems, while lower scores indicate stressed conditions.

Community structure: A system is generally considered degraded if a substantial shift in the proportions of the major taxonomic groups (*e.g.*, mayflies, riffle beetles, etc.) is observed when compared to a reference site. In marine systems, an increase in the % tubificid oligochaetes, a decrease in the % pelecypods, and a decrease in the number of polychaete taxa are all considered indicators of disturbance.

Algal biomass: The density of algal cells and the chlorophyll *a* concentration are used as estimators of biomass. A system has traditionally been considered nutrient stressed when biomass exceeds problem threshold levels, often resulting in visible algal blooms, nuisance scums, and low dissolved oxygen from the decomposition of the decaying algal tissue. A decreased diatom to blue-green algae ratio (calculated by dividing the number of individuals in the Bacillariophyta by the number of individuals in the Bacillariophyta + Cyanophyta) is often indicative of nutrient enriched conditions in flowing streams.

Trophic composition/feeding guilds: Undisturbed aquatic systems possess characteristic proportions of organisms using various functional feeding strategies, and human disturbance shifts these established feeding strategies. In Florida for example, pollution is known to reduce the numbers of filter-feeders (FDEP 1994) and shredders (EA Engineering 1994).



Effect of discharge on the benthic macroinvertebrate community.

The Stream Invertebrate Index for Florida (SIIF) is a composite metric which is based upon the macroinvertebrate communities found at Florida Eco-regional reference sites sampled with dip net sweeps (EA Engineering 1994). The SIIF assigns 5, 3, or 1 point(s) to a variety of invertebrate parameters, depending on how closely that parameter approaches the expected Eco-regional reference condition. Five points is the best score for metrics which are particularly strong at discriminating between healthy and impaired sites (see SIIF calculation table in Appendix). The following parameters are used in calculating the SIIF for the Panhandle: taxa richness, EPT Index, % contribution of the dominant taxa, % Diptera, Florida Index, % suspension feeders/filterers, and % shredders (EA Engineering 1994). In the Panhandle, 23-29 SIIF points indicates no impairment, 15-22 points indicates moderate impairment, and 7-14 points is clear evidence of severe degradation. In the Florida Peninsula, these same parameters, along with the number of crustacean and mollusk taxa and the % of crustacean and mollusk taxa, are used to calculate the SIIF. In the Peninsula, 27-33 SIIF points indicates no impairment, 17-26 points indicates moderate impairment, and 9-16 points is clear evidence of severe degradation. Although the SIIF is based on samples collected during the summer, similar relationships should apply in other seasons.

For graphical purposes, the percent differences between the reference and test sites involving the number of taxa, the diversity index, the LCI Index, and the % filter-feeders are measured as the reference site minus test site divided by the reference site. The percent differences between sites involving algal density, chlorophyll *a*, and algal growth potential are measured as the test site minus reference site divided by the reference site.

The following personnel were involved in this investigation: Glenn Butts, Martin Gawronski, and Josie Penton (DEP Northwest District) and Lyn Burton, Marshall Faircloth, Russel Frydenborg, Christy LeDuc, Kathleen Lurding, Tina Mikulski, Elizabeth Miller, Urania Quintana, Landon Ross, David Whiting, Vicki Whiting, Greg Wynn, and David Young (Tallahassee Biology Laboratory). The report was reviewed by the Point Source Studies Review Committee, consisting of Wayne Magley, Jan Mandrup-Poulsen, and Michael Tanski, as well as District representatives.

Results and Discussion

Merritts Mill Pond was created by the impoundment of Spring Creek, a deep aquifer fed system. Both the test and reference sites were dominated by aquatic vegeta-

tion (*i.e., Hydrilla*), with the sediments consisting of mud, sand, and clay. Approximately 30% of the land surrounding the study area was used for residential purposes, and the rest was either forested (reference site), or commercial (the campground operation at the test site). Potential runoff from nonpoint sources (roadways and lawns) was noted at both sites. The observed water velocity was minimal, being wind driven at both sites. The depth of the impoundment was approximately 3 m in this area, and little tree canopy was present. Surface dissolved oxygen (7.4 mg/L at both sites) was adequate to support aquatic life, and specific conductance was essentially identical at the two study stations (242 to 248 µmhos/cm). The pH of the water was 7.5 S.U.'s at the reference site and 7.0 S.U.'s at the test site. Temperature (23° C), BOD (< 1 mg/L), and TSS (5 mg/L), were the same at both sites (Appendix).

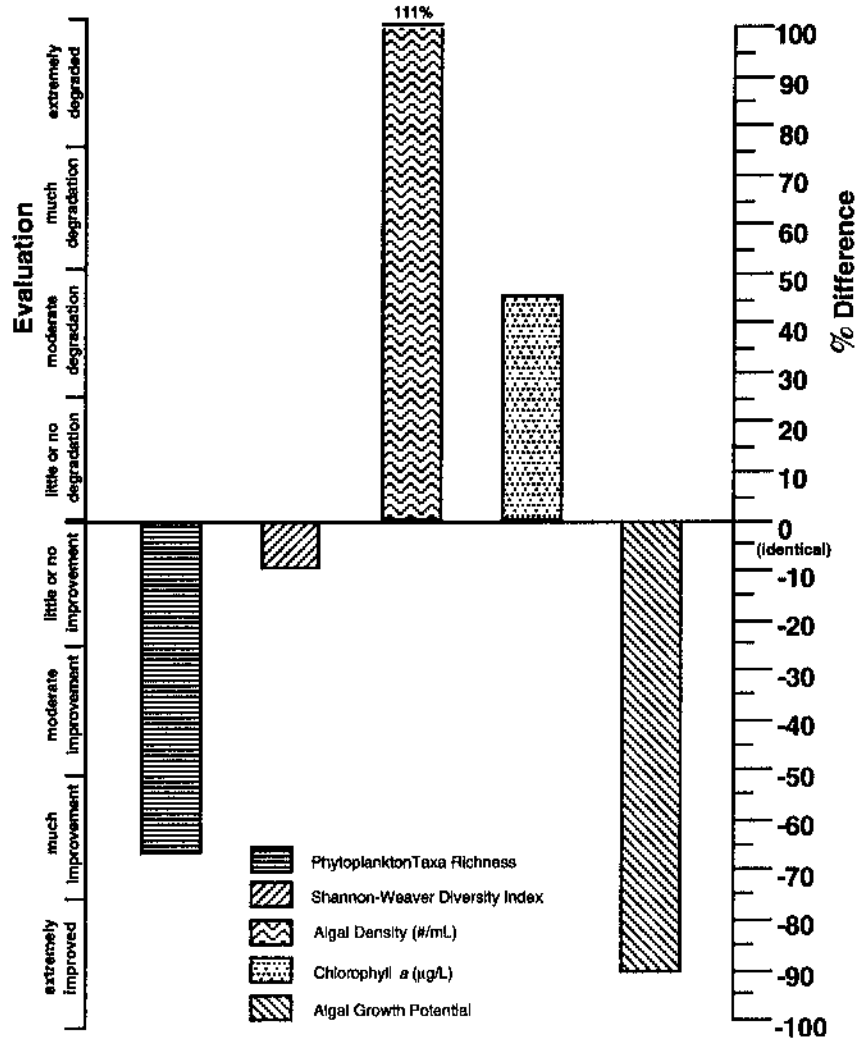
The effluent sample was not toxic to the fish, *Cyprinella leedsi,* however, 40% of the invertebrate, *Ceriodaphnia dubia*, were killed during the 48 hour test (Appendix). This is not in violation of toxicity standards, but is a cause for concern.

No organic pollutants were detected in the discharge. Of the metals analyzed for, only iron (38 µg/L) and zinc (15 µg/L) were found in the effluent at concentrations above the practical quantitation limit. None of these levels exceeded Class III standards.

The concentration of dissolved oxygen in the effluent was 1.9 mg/L. This is a violation of the facility's permit, as well as Class III standards, Rule 62-302.530(31) FAC.

Fecal coliform bacteria at the reference site (80 organisms/100 mL) and at the test site (40 organisms/100 mL) were within Class III water quality standards. Similarly, total coliform bacteria at the reference and test sites (240 organisms/100 mL and 255 organisms/100 mL, respectively) were also within standards. In the effluent, fecal coliforms (130 organisms/100 mL) were within permit limits. However, total coliforms (4600 organisms/100 mL) were in excess of Class III standards. Because sample holding times for these analyses were exceeded, a water quality violation could not be cited. This indicates, however that the facility may not be adequately disinfecting the discharge.

Effluent concentrations of nitrate-nitrite (3.4 mg/L) were elevated. Nitrate-nitrite was extremely elevated at both receiving water sites, with 5.0 mg/L found at the reference site and 3.8 mg/L at the test site. These values are an order of magnitude higher than those found in 95% of typical Florida lakes (see Table of Typical Water Quality Parameters in the Appendix). The nitrogen enrichment at the test site is clearly attributed to



Effect of discharge on the algal community.

the discharge. High nitrate-nitrite at the reference site may also be related to the discharge, which could have been directed to this location via wind driven currents. Ortho-phosphate, total phosphorus, and TKN were very low at both study sites. Ammonia was slightly above average, 0.10 and 0.11 mg/L at reference and test sites, respectively.

Algal growth potential (AGP) of the effluent was elevated, at 68.0 mg algal dry wt/L. This is not surprising, given the nutrient content. Values for the study sites were very low, 1.2 mg dry wt/L and 0.1 mg dry wt/L at the reference site and test sites, respectively. This suggests that the excess bioavailable nutrients are being used in the production of *Hydrilla*, which was abundant to the point of becoming a nuisance, throughout the study area.

The results of the benthic community analyses suggested that both sites were disturbed, but that conditions were somewhat worse at the test site. The figure on p. 3 indicates the degree of difference between the invertebrate populations of the reference and test sites. Larger differences (that is, higher percentages) correspond with greater degrees of degradation. Negative values mean that the test site is better than the reference.

Taxa richness (15 taxa at the reference site, 14 at the test site) was less than that expected (19 taxa) for a healthy North Florida lake (FDEP 1994). Similarly, the macroinvertebrate component of Hulbert's Lake Condition Index was 6 points at the reference site and 1 point at the test site. A score of 12 is usually indicative of a healthy lake system. Shannon-Weaver diversity was extremely low at the reference site (0.83) and, although higher at the test site (2.1), it was still below the value expected for a healthy lake (2.8) (FDEP 1994).

This low diversity at the reference site was due to the overwhelming dominance (88% of the population) of the amphipod, *Hyalella azteca*, usually considered somewhat sensitive to pollution. The remainder of the reference site community was composed of some clean water indicators (*i.e., Pseudochironomus* sp. and *Oecetis* sp.) as well as more tolerant forms such as *Limnodrilus hoffmeisteri* and *Helobdella* spp.

Although the most numerous organism at the test site was the pollution tolerant oligochaete, *Limnodrilus hoffmeisteri* (45%), it did not make up as great a proportion of the population as did the dominant taxon at the reference site. *Hyalella azteca* was the second most dominant, comprising 32% of the test site population. Other taxa which are generally associated with poor water quality (*e.g., Chironomus* sp. and *Goeldichironomus holoprasinus*) were present in fair quantities, making up 15% of the test site community.

The figure on page 4 represents changes in the algal community. As was noted with the macroinvertebrates, larger differences (that is, higher percentages) correspond with greater degrees of degradation. Phytoplankton communities were depauperate throughout the study area. Although the percent differences on the graph seem to indicate a substantial improvement below the discharge, taxa richness was low at both sites, with only 6 taxa collected from the reference site, and 10 from the test site. Phytoplankton density and chlorophyll *a* were very low at both sites. The "degradation" shown on the graph is only an artifact of the graphing procedure, since the absolute values were clearly in the "no impairment" range. As was noted in the AGP results, the excess nutrients are probably being utilized by the *Hydrilla* population in this impoundment.

Conclusions

The effluent sample was not toxic to the fish, *Cyprinella leedsi*, however, 40% of the invertebrate, *Ceriodaphnia dubia*, were killed during the 48 hour test. While this is not a violation of toxicity standards, it may be a cause for concern.

No organic pollutants were detected in the effluent. Only iron (38 µg/L) and zinc (15 µg/L) were found in the effluent at concentrations above the practical quantitation limit. Neither of these levels exceeded Class III standards.

The concentration of dissolved oxygen in the effluent was 1.9 mg/L. This is a violation of the facility's permit, as well as Class III standards, Rule 62-302.530(31) FAC.

Total and fecal coliform bacteria were below standards at both the reference and test sites. In the effluent, fecal coliforms were within permit limits but total coliforms were in excess of ambient standards (4600 organisms/100 mL). Because the sample holding time for this analysis was exceeded, a water quality violation could not be cited. This indicates, however that the facility may not be adequately disinfecting the discharge.

Nutrient levels found in the effluent were elevated, particularly total phosphorus and nitrate-nitrite. Nitrate-nitrite was an order of magnitude higher than 95% of typical Florida lakes at both the reference and test sites. In contrast, ortho-phosphate, total phosphorus, and TKN were very low at both study sites, but ammonia was slightly above average. While the bioavailable nitrogen enrichment at the test site is attributable to the facility, high nitrate-nitrite at the reference site may also be related to the discharge, which could have been directed to this location via wind driven currents.

Algal growth potential of the effluent was elevated (68.0 mg algal dry wt/L), corresponding to the nutrient content. In contrast, receiving water AGP's were very low. This suggests that the excess bioavailable nutrients were being used in the production of nuisance growths of *Hydrilla*, which was extremely abundant throughout the study area.

The results of the benthic community analyses suggested that both sites were disturbed, but that conditions were somewhat worse at the test site. Taxa richness, the macroinvertebrate component of Hulbert's Lake Condition Index, and Shannon-Weaver diversity were less than that expected for a healthy North Florida lake at both sites. The reference site community was composed of more clean water indicators (*i.e., Pseudochironomus* sp. and *Oecetis* sp.) than the test site. However, pollution tolerant forms (*e.g., Limnodrilus hoffmeisteri*) were common at both sites.

Phytoplankton communities were not adversely affected by the campground discharge. Although excess bioavailable nutrients were present in the discharge, they appeared to be utilized in the production of nuisance growths of *Hydrilla* rather than phytoplankton.

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Chemistry summary table for

Arrowhead WWTP	Effluent	Reference Site	Test Site
Organic Constituents			
None Detected			
Metals (ug/L)			
Aluminum	150 I		
Arsenic	10 U		
Cadmium	0.08 U		
Copper	3 U		
Chromium	10 U		
Iron	38 A		
Lead	10 U		
Mercury	0.10 U		
Nickel	4 U		
Selenium	30 U		
Silver	0.05 U		
Zinc	15 A		
Nutrients (mg/L)			
Ortho-phosphate	.19	.01	.005 I
Total phosphorus	.32	.01	.02
Ammonia	1.0	.10 A	.11 A
Nitrate+Nitrite	3.4	5.0 A	3.8
TKN	2.4	.30	.34
Other Parameters			
D.O. (mg/L)	1.9	7.4	7.4
pH (SU's)	6.9	7.5	7.0
Conductivity (µmhos/cm)	538	242	248
Temperature (°C)	25.8	23.2	23.5
AGP (mg dry wt/L)	68.0	1.2	0.1
BOD (mg/L)	3.9	0.5	0.5
TSS (mg/L)	5	5	5
Turbidity (mg/L)	5.1	2.0	2.0
Color (PCU's)	25	15	15
Hardness (mg/L CaCO3)	166.1		
Bioassay Fish	Not Toxic		
Bioassay Invertebrate	40% mortality		
Fecal coliform (org/100 mL)	130 Q	80 Q	40 Q
Total coliform (org/100 mL)	4600 Q	240 Q	255 Q

A - Value reported is the mean of two or more determinations

I - Value reported is less than the minimum quantitation limit and greater than or equal to the minimum detection limit

U - Material analyzed for but not detected; value reported is the minimum detection limit

Q - Sample held beyond the accepted holding time.

Typical Values for Selected Parameters in Florida Waters

Adapted from Joe Hand, FDER, personal communication, 1991
(data was collected between 1980 and 1989)

Percentile Distribution

Parameter	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%
STREAMS (1617 stations)											
Phytoplankton Chlorophyll *a*	0.22	0.52	0.94	1.60	3.02	4.63	6.72	9.87	14.68	27.35	48.70
Periphyton Chlorophyll *a*	0.31	0.43	0.77	1.04	2.16	2.94	6.45	10.51	17.00	39.51	60.85
H-D Diversity	0.84	2.12	2.48	2.74	2.88	3.09	3.25	3.40	3.52	3.76	3.90
Qualitative Taxa Richness	9.00	12.00	17.00	20.00	22.00	24.50	26.00	28.00	31.00	37.00	53.00
H-D Taxa Richness	6.00	6.50	9.00	11.50	13.00	15.00	17.00	21.50	26.00	29.00	32.00
TKN	0.30	0.39	0.56	0.73	0.87	1.00	1.11	1.26	1.49	1.93	2.80
Ammonia	0.02	0.02	0.04	0.05	0.06	0.08	0.11	0.14	0.20	0.34	0.60
NO2-NO3	0.01	0.01	0.03	0.05	0.07	0.10	0.14	0.20	0.32	0.64	1.05
Total Phosphorus	0.02	0.03	0.05	0.06	0.10	0.13	0.18	0.25	0.39	0.74	1.51
Ortho Phosphorus	0.01	0.01	0.03	0.04	0.05	0.08	0.11	0.17	0.27	0.59	1.37
Turbidity	0.60	0.90	1.20	1.45	2.10	2.80	3.60	4.50	6.65	10.45	16.30
LAKES (477 stations)											
Phytoplankton Chlorophyll *a*	0.80	1.71	2.88	4.28	10.06	13.40	20.00	30.10	47.20	65.44	113.90
Dredge Diversity	0.71	0.97	1.43	1.74	1.98	2.12	2.21	2.59	2.85	3.15	3.17
Dredge Taxa Richness	3.00	5.00	6.50	7.00	9.00	10.00	11.00	13.00	15.00	17.00	21.00
TKN	0.36	0.49	0.67	0.83	1.08	1.26	1.40	1.51	1.68	2.11	3.46
NH3+NH4	0.01	0.02	0.02	0.03	0.04	0.06	0.08	0.12	0.15	0.21	0.28
NO2-NO3	0.00	0.00	0.01	0.01	0.01	0.02	0.04	0.05	0.10	0.14	0.23
Total Phosphorus	0.01	0.02	0.02	0.03	0.05	0.07	0.09	0.11	0.14	0.23	0.42
Ortho-Phosphorus	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.08	0.21	0.32
Turbidity	1.00	1.25	1.55	2.05	2.75	4.50	6.45	9.60	14.10	26.00	40.00
ESTUARIES (690 stations)											
Phytoplankton Chlorophyll *a*	2.14	3.28	4.49	5.13	6.00	6.93	7.94	9.60	12.40	17.60	22.20
Dredge Diversity	1.34	1.53	1.91	2.28	2.56	2.90	3.15	3.59	4.01	4.53	4.98
Dredge Taxa Richness	4.00	6.00	9.00	11.00	15.00	18.50	25.00	35.00	41.00	62.00	90.00
TKN	0.26	0.34	0.42	0.50	0.59	0.69	0.76	0.82	0.95	1.30	1.49
NH3+NH4	0.01	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.13	0.22	0.28
NO2-NO3	0.00	0.00	0.01	0.01	0.01	0.02	0.03	0.05	0.08	0.17	0.23
Total Phosphorus	0.01	0.02	0.06	0.07	0.10	0.11	0.14	0.17	0.23	0.43	0.59
Ortho-Phosphorus	0.01	0.02	0.03	0.04	0.04	0.05	0.07	0.09	0.12	0.21	0.44
Turbidity	3.50	4.00	4.50	5.05	5.40	5.60	6.30	6.80	8.00	11.40	11.75

Units:
Phytoplankton Chlorophyll *a* (ug/L), Periphyton Chlorophyll *a* (mg/m^2), Nutrients (mg/L), Turbidity (NTU), Taxa richness and diversity values are for macroinvertebrates

Facility Summary

Facility Name:
ARROWHEAD CAMP GROUND

Date Summary Prepared:
9/18/1994

Location map: County: JACKSON District: NW

NPDES Permit #FL0028738 State GMS #1032P00913
Facility Type: Ind.
expiration date expiration date JUL 15, 95 XDomX. Fed. Agric.

Function of facility: SEWAGE TREATMENT FOR ARROWHEAD INTERNATIONAL CAMP GROUND

Description of treatment process: 0.015 MGD EXTENED AREATION WWTP

Receiving waters: TO MERRITT MILL POND TO SPRING CREEK TO CHIPOLA RIVER
Classification: I II III CLASS III

Design Flow:	Mean Flow:	Flow during survey:
0.015 MGD	0.0059	0.006

Discharge is: Continuous Intermittent Seasonal Rainfall dependent
Other (describe) CONTINNUOUS
best time to sample is: ANY TIME

If facility has a mixing zone, give details (size, parameters, etc.)
NO MIXING ZONE INDICATED BY THE PERMIT

List effluent limits (attach relevant paperwork):

Parameter	Limit (units)
FLOW	.015 MGD MAX.ANNUAL AVG.
pH	6.5-8.5 STU
CHLORINE RESIDUAL	MIN. 0.5 MG/L MAX. 0.01 MG/L
BOD5	20 MG/L
TSS	20 MG/L
FECAL	200/#100 ML
TKN	15 MG/L MAX.
AMONIA	5 MG/L MAX.
TOTAL P	5 MG/L MAX.
DO	2 MG/L MIN.

List permit violations (from MOR data or other source) and plant upsets within past year: SEWER SPILLS:

1. NOV. 93 TSS 26 MG/L
2. AUG. 93 TOTAL P 8.29 MG/L
3. JUL. 93 TOTAL P 6.70 MG/L
4. JUN. 93 TOTAL P 7.79 MG/L

THE OPERATOR DID NOT REPORT ALL REQUIRED PARAMETRS ON THE FRONT PAGE OF MONTHLY OPERATING REPORTS.

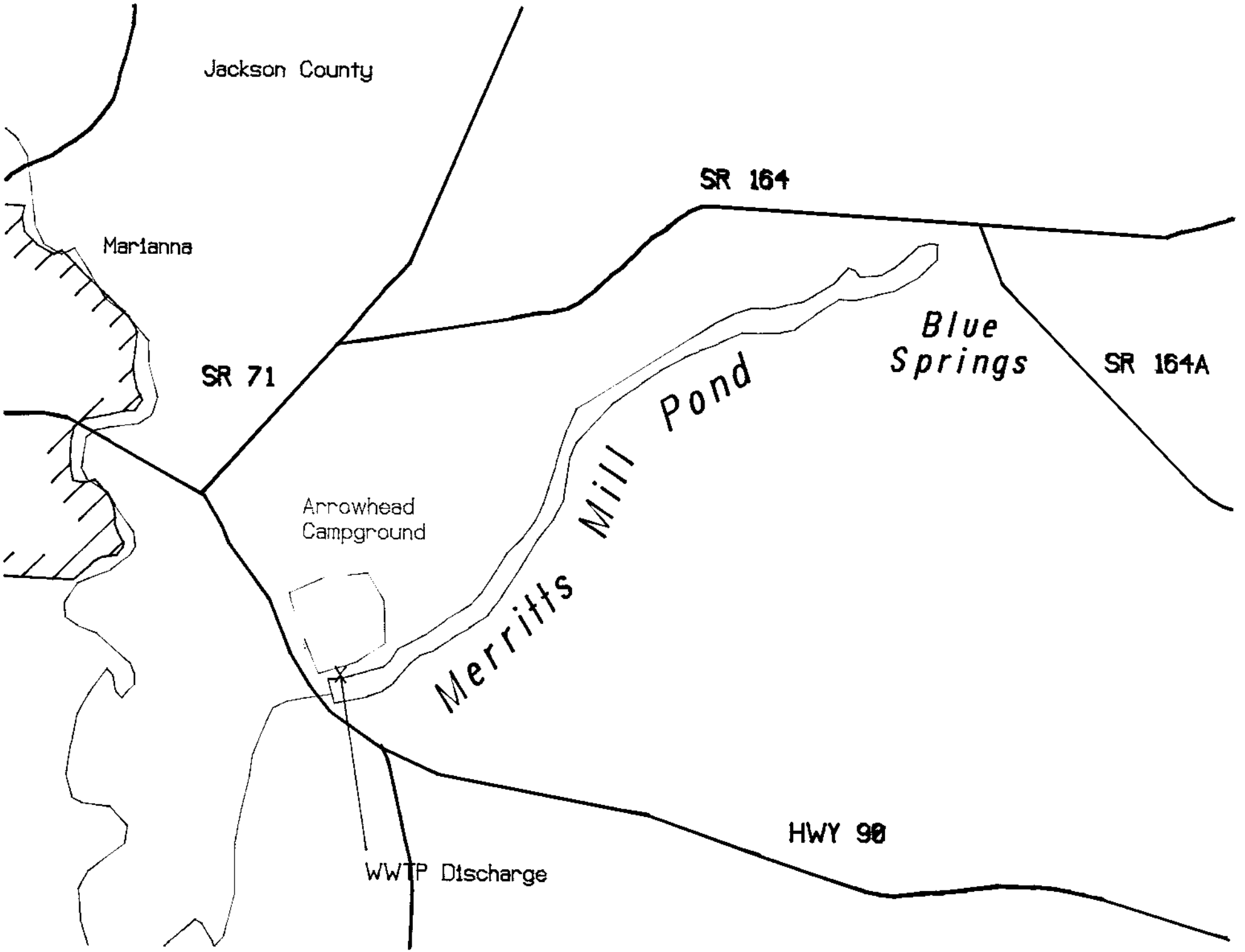
Describe previous impact bioassessments, WQBEL's and previous or current enforcement actions:
NO PREVIOUS OR CURRENT ENFORCEMENT ACTIONS ON FILE.

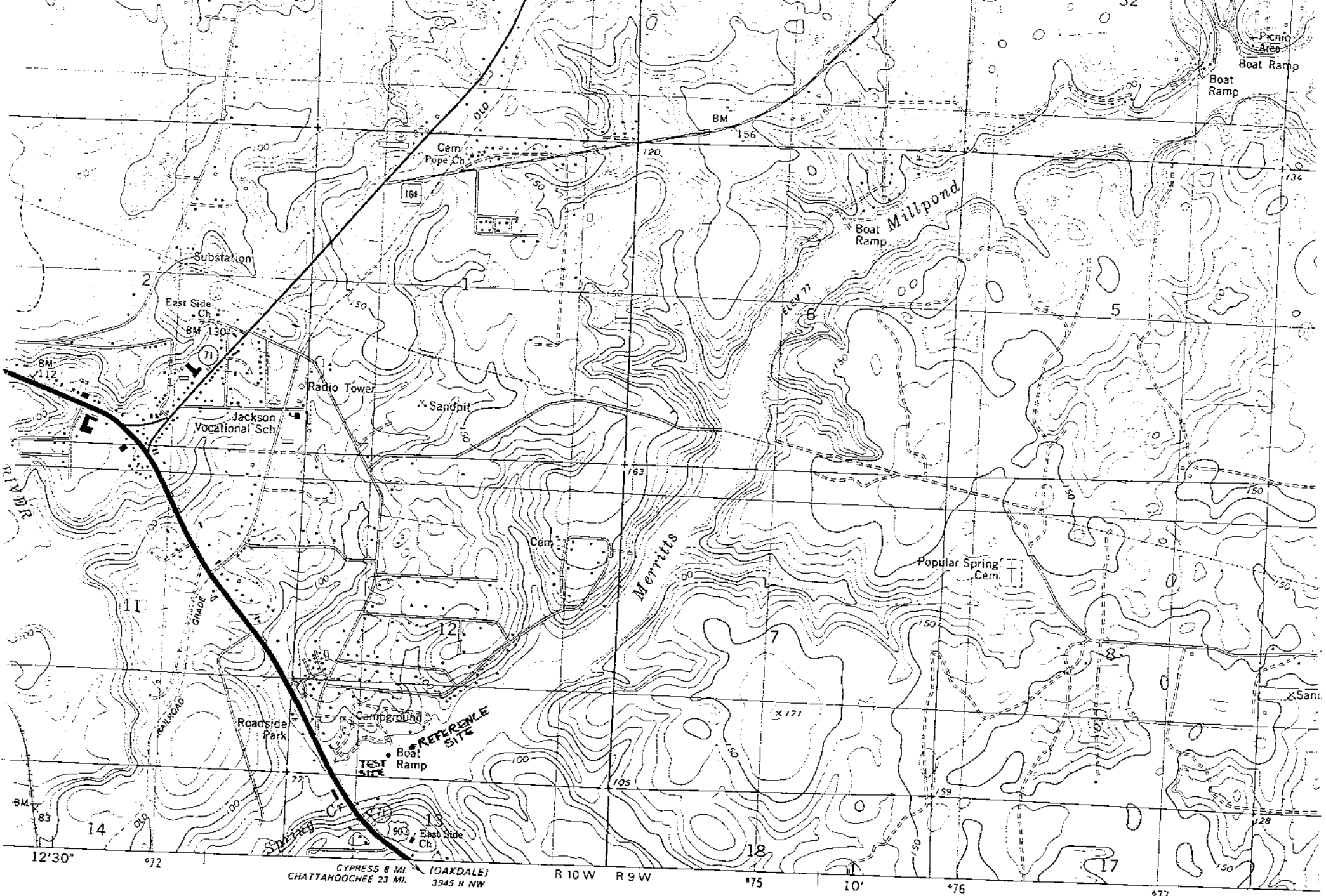
Discuss comparability of MOR results to past FDER results and whether there are trends (improving, declining) in the data set:
THE PLANT OPERATES BETWEEN 33 AND 46% OF DESIGN CAPACITY AND ALL REPORTED PARAMETERS FOR 1994 ARE WITHIN PERMIT REQUIREMENTS. THERE IS AN IMPROVING TREND IN PHSPHRUS LEVELS SINCE MIDDLE OF 1993 (REST OF THE PARAMETERS ARE WITIN LIMITS). DATA COLLECTED BY DEP INSPECTORS CORRESPONDS WITH THAT SUBMITTED BY ARROWHED WWTP.

Additional information:

Staff contributing to this review (signature)

Glenn Butts — Biologist
Inspector
Engineer
Mardis Gawkowski — Other
Other


Jackson County
Marianna
SR 164
SR 71
Blue
Springs
SR 164A
Merritts Mill Pond
Arrowhead
Campground
HWY 90
WWTP Discharge


Picnic Area
Boat Ramp
Boat Ramp
BM 156
Cem
Pope Ch
OLD
Millpond
Boat Ramp
Substation
East Side Ch
BM 130
BM 112
Radio Tower
Sandpit
Jackson Vocational Sch
ELEV 77
Cem
Merritts
Popular Spring Cem
GRADE
RAILROAD
Roadside Park
Campground
REFERENCE SITE
TEST SITE
Boat Ramp
Spring Cr
East Side Ch
CYPRESS 8 MI.
CHATTAHOOCHEE 23 MI.
(OAKDALE) 3945 II NW
R 10 W
R 9 W
12'30"
10'
SCALE 1:24 000
1 MILE
7000 FEET
1 KILOMETER
Primary high
hard surface

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

PHYSICAL/CHEMICAL CHARACTERIZATION FIELD DATA SHEET (Version 4)

SUBMITTING AGENCY CODE: 8010 / SUBMITTING AGENCY NAME: FDEP	STORET STATION NUMBER:	DATE (M/D/Y): 09-19-94	TIME	RECEIVING BODY OF WATER: MERRIT MILL POND

REMARKS: CONTROL SITE	LOCATION: ABOVE ARROWHEAD WWTP	FIELD ID/NAME: # 3

RIPARIAN ZONE/INSTREAM FEATURES

Predominant Surrounding Land-Use (specify relative percent in each category):

Forest	Field/Pasture	Agricultural	Residential	Commercial	Industrial	Other (Specify)
70			30			

Local Watershed Erosion (check box): None [X] Moderate [ ] Heavy [ ]

Local Watershed NPS Pollution (check box): No evidence [ ] Some potential sources [X] Obvious sources [ ]

Point-Source Pollution (list location and describe): MINOR POTENTIAL (AT PRESENT) OF LAWN RUNOFF

Estimated System Width (range, m): 240	Estimated System Depth (range, m): 3.0	yes
High Water Mark (m above bed): 0.5	Velocity (range, m/s): N/A	Impounded [ ] Channelized [ ]

Canopy Cover % : Open : [ ] Lightly Shaded (11-45%): [X] Moderately Shaded (46-80%): [ ] Heavily Shaded: [ ]

SEDIMENT/SUBSTRATE

Sediment Odors: Normal: [X] Sewage: [ ] Petroleum: [ ] Chemical: [ ] Anaerobic: [ ] Other: [ ] _____

Sediment Oils: Absent: [X] Slight: [ ] Moderate: [ ] Profuse: [ ]

Sediment Deposits: Sludge: [ ] Paper Fiber: [ ] Mud: [ ] Sand: [X] Shell: [ ] Other: [X] Clay

Substrate Types	% coverage	# times sampled	method	Substrate Types	% coverage	# times sampled	method
Woody Debris (Snags)				Riffles			
Leaf Packs				Sand	20	2	POMAR
Aquatic Vegetation	50	2	POMAR	Mud/Muck/Silt	20	1	POMAR
Rock or Shell Rubble				Benthic leaf mats			
Undercut Banks/Roots				Other: Clay	10	1	POMAR

WATER QUALITY

	Depth (m):	Temp. (°C):	pH (SU):	D.O. (mg/l):	Cond. (µmho/cm):			Secchi (m):
Top	1.0	23.18	7.46	7.37	242			>2.5
Mid-depth								
Bottom								

System Type : Stream: [ ] (Sand Bottomed, Sand Bot w/ Spring, Swamp & Bog, Calcareous, Alluvial, Misc.) Lake: [ ] Wetland: [ ] Estuary: [ ] Other: [X] POND

Water Odors (check box): Normal: [X] Sewage: [ ] Petroleum: [ ] Chemical: [ ] Other: [ ] _____

Water Surface Oils (check box): None: [X] Sheen: [ ] Globs: [ ] Slick: [ ]

Clarity (check box): Clear: [X] Slightly turbid: [ ] Turbid: [ ] Opaque: [ ] SPRING FED

Color (check box): Tannic: [ ] Green (algae): [ ] Clear: [X] Other: [ ] _____

Weather Conditions: Cool, Partly Cloudy

Abundance:	Absent	Rare	Common	Abundant
Periphyton	[ ]	[ ]	[X]	[ ]
Fish	[ ]	[ ]	[X]	[ ]
Aquatic Macrophytes Hydrilla	[ ]	[ ]	[ ]	[X]
Iron/sulfur Bacteria	[X]	[ ]	[ ]	[ ]

SAMPLING TEAM: G. Butts, Josie Penton	SIGNATURE: Glenn Butts	DATE: 09-20-94

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

PHYSICAL/CHEMICAL CHARACTERIZATION FIELD DATA SHEET (Version 4)

SUBMITTING AGENCY CODE: 8010 / SUBMITTING AGENCY NAME: FDEP	STORET STATION NUMBER:	DATE (M/D/Y): 09-20-94	TIME: 1100	RECEIVING BODY OF WATER: MERRIT MILL POND

REMARKS:	LOCATION: BELOW ARROWHEAD CAMPGROUND	FIELD ID/NAME:
TEST SITE		# 2

RIPARIAN ZONE/INSTREAM FEATURES

Predominant Surrounding Land-Use (specify relative percent in each category):

Forest	Field/Pasture	Agricultural	Residential	Commercial	Industrial	Other (Specify)
			30	70		

Local Watershed Erosion (check box): None [X] Moderate [ ] Heavy [ ]

Local Watershed NPS Pollution (check box): No evidence [ ] Some potential sources [X] Obvious sources [ ]

Point-Source Pollution (list location and describe): MINOR EVIDENCE OF RUNOFF FROM ARROWHEAD CAMPGROUND, RESIDENTIAL LAWNS

Estimated System Width (range, m): 240	Estimated System Depth (range, m): 3.0		yes
High Water Mark (m above bed): 0.5	Velocity (range, m/s): N/A	Impounded [X] / Channelized [ ]	

Canopy Cover %: Open: [X] Lightly Shaded (11-45%): [ ] Moderately Shaded (46-80%): [ ] Heavily Shaded: [ ]

SEDIMENT/SUBSTRATE

Sediment Odors: Normal: [ ] Sewage: [ ] Petroleum: [ ] Chemical: [ ] Anaerobic: [ ] Other: [X] Slight organic

Sediment Oils: Absent: [X] Slight: [ ] Moderate: [ ] Profuse: [ ]

Sediment Deposits: Sludge: [ ] Paper Fiber: [ ] Mud: [ ] Sand: [X] Shell: [ ] Other: [X] Clay

Substrate Types	% coverage	# times sampled	method	Substrate Types	% coverage	# times sampled	method
Woody Debris (Snags)				Riffles			
Leaf Packs				Sand	20	2	PONAR
Aquatic Vegetation	50	2	PONAR	Mud/Muck/Silt	20	1	PONAR
Rock or Shell Rubble				Benthic leaf mats			
Undercut Banks/Roots				Other: Clay	10	1	PONAR

WATER QUALITY

	Depth (m):	Temp. (°C):	pH (SU):	D.O. (mg/l):	Cond. (µmho/cm):			Secchi (m):
Top	1.0	23.5	7.03	7.4	248			>2.5
Mid-depth								
Bottom								

System Type: Stream: [ ] (Sand Bottomed, Sand Bot w/ Spring, Swamp & Bog, Calcareous, Alluvial, Misc.) Lake: [ ] Wetland: [ ] Estuary: [ ] Other: [X] POND

Water Odors (check box): Normal: [X] Sewage: [ ] Petroleum: [ ] Chemical: [ ] Other: [ ] _____

Water Surface Oils (check box): None: [X] Sheen: [ ] Globs: [ ] Slick: [ ]

Clarity (check box): Clear: [X] Slightly turbid: [ ] Turbid: [ ] Opaque: [ ] SPRING FED

Color (check box): Tannic: [ ] Green (algae): [ ] Clear: [X] Other: [ ] _____

Weather Conditions: Cool, Partly Cloudy

Abundance:	Absent	Rare	Common	Abundant
Periphyton	[ ]	[ ]	[X]	[ ]
Fish	[ ]	[ ]	[X]	[ ]
Aquatic Macrophytes Hydrilla	[ ]	[ ]	[ ]	[X]
Iron/sulfur Bacteria	[X]	[ ]	[ ]	[ ]

SAMPLING TEAM:	SIGNATURE:	DATE:
G. Butts, Josie Penton	Glenn Butts	09-20-94

FDEP Biology Section — Acute Bioassay Bench Sheet

Sample Source: Arrowhead WWTP
County:
Contact / District: Glenn Butts / NW
NPDES Permit #: FL0028738
LIMS Sample #: 89638 **LIMS Job #:** 94-Sep 20-13

Sample Collection: Date 9/19/94 Time 1050
Test Beginning: Date 9/20/94 Time 1430
Test Ending: Date 09/27/94 Time 1430
Organism Batch #: 35 **Diluent Batch #:** 36
Organism Age: < 24 hrs.
Test Organism: Ceriodaphnia dubia

Test Type: ~~Screening~~ / Definitive
~~Static~~ / Static Renewal / Flow-through

Test Number: 1 of 2

Remarks:

Instrument Calibrations:

	pH	Temperature °C	D.O. mg/L	Conductivity µmhos/cm
meter #	7851	90H018262	90H018262	G9005749
0 hr	7.0 @ 7.0 9.0 @ 9.0	22.8 @ 22.9	8.4 @ 23.5 °C	104 @ 101.1 1025 @ 1047 @ 23.7 °C
24 hr	7.0 @ 7.0 9.0 @ 9.0	24.3 @ 24.4	8.4 @ 23.4 °C	104 @ 101.1 1025 @ 1047 @ 23.8 °C
48 hr	7.0 @ 7.0 9.0 @ 9.0	23.3 @ 23.3	8.3 @ 24.4 °C	104.5 @ 101.1 1025 @ 1047 @ 24.4 °C

MF 9/30/94 Accordingly

Conc.	Chamber #	Number Live			pH			Temperature (°C)			D.O. (mg/L)			UNCORRECTED Cond. (mmhos/cm) Cond. (µmhos/cm)		
		0 hr	24 h	48 h	0 hr	24 h	48 h	0 hr	24 h	48 h	0 hr	24 h	48 h	0 hr	24 h	48 h
Control	A	5	5	5	8.4		8.3	23.3		23.5	8.3		8.4	165		175
Control	B	5	5	5			8.3			23.5			8.5			170
Control	C	5	5	5			8.3			23.5			8.6			180
Control	D	5	5	5			8.3			23.6			8.6			185
100%	A	5	5	2	7.6		8.7	23.8		23.8	5.6		8.6	670		650
100%	B	5	5	1			8.7			23.8			8.6			650
100%	C	5	5	4			8.7			23.8			8.6			650
100%	D	5	5	5			8.7			23.9			8.7			660
Measured/Loaded by:		MF	TM	TM	MF		TM	MF		TM	MF		TM	MF		TM
Recorded by:		TM	TM	MF	TM		MF	TM		MF	TM		MF	TM		MF

Investigators' Signatures

Tina Mikulski
Marshall Faulkner

Reviewer

form updated 4/27/94

Water Quality Parameters	Salt Water / Well Water	20% Min Water	Sample	Method	Measured by
Field Total Residual Cl2:			<.02	—	GB
Lab Total Residual Cl2:		<0.03	<0.03	DR-100	TM
Alkalinity:		75	165	Hach	TM
Hardness:		85	170	Hach	TM
Total Ammonia:		<0.017	1.10	Orion	MF

Ammonia Meter #98136 Ammonia Meter Slope: -55.6 Ammonia Blank: 40.017 Control Salinity: ( ) ppt Sample Salinity: ( ) ppt

FDEP Biology Section — Acute Bioassay Bench Sheet

Sample Source: Arrowhead WWTP
County:
Contact / District: Glenna Butts / NW
NPDES Permit #: FL00 28738
LIMS Sample #: 89638 **LIMS Job #:** 94-Sep 20-13

Sample Collection: Date 09/19/94 Time 1050
Test Beginning: Date 09/20/94 Time 1430
Test Ending: Date 09/22/94 Time 1430
Organism Batch #: 38 **Diluent Batch #:** well
Organism Age: 11 days old
Test Organism: Cyprinella leedsi

Test Type: (Screening) / Definitive
(Static) / Static Renewal / Flow-through

Test Number: 2 of 2

Remarks:

Instrument Calibrations:

	pH	Temperature °C	D.O. mg/L	Conductivity µmhos/cm
meter #	7851	90H018262	90H018262	G9005749
0 hr	7.0 @ 7.0 9.0 @ 9.0	22.8 @ 22.9	8.4 @ 23.5 °C	104 @ 101.1 1025 @ 1047 @ 23.7 °C
24 hr	7.0 @ 7.0 9.0 @ 9.0	24.3 @ 24.4	8.4 @ 23.4 °C	104 @ 101.1 1025 @ 1047 @ 23.8 °C
48 hr	7.0 @ 7.0 9.0 @ 9.0	23.3 @ 23.3	8.3 @ 24.4 °C	104.5 @ 101.1 1025 @ 1047 @ 24.1 °C

Conc.	Chamber #	Number Live 0 hr	Number Live 24 h	Number Live 48 h	pH 0 hr	pH 24 h	pH 48 h	Temperature (°C) 0 hr	Temperature (°C) 24 h	Temperature (°C) 48 h	D.O. (mg/L) 0 hr	D.O. (mg/L) 24 h	D.O. (mg/L) 48 h	UNCORRECTED Cond. (mmhos/cm) (Cond. (µmhos/cm)) 0 hr	24 h	48 h
Control A	85	5	5	5	8.0	8.3	8.4	23.6	22.7	23.3	~~7.9~~	8.3	8.8	245	245	250
Control B	41	5	5	5	8.0	8.3	8.4			23.1	~~8.0~~	8.4	8.8	245	240	245
Control C	10	5	5	5	8.0	8.3	8.4			23.1	8.3	8.4	8.8	245	245	250
Control D	13	5	5	5	8.0	8.3	8.4			23.1	8.3	8.5	8.8	245	245	250
100% A	77	5	5	5	7.6	8.1	8.3	24.0	22.7	23.5	5.0	7.6	8.6	700	685	695
100% B	28	5	5	5	7.6	8.1	8.3			23.2	5.0	7.6	8.5	700	685	695
100% C	333	5	5	5	7.6	8.1	8.3			23.2	5.1	7.6	8.5	700	685	695
100% D	183	5	5	5	7.6	8.1	8.3			23.5	5.1	7.7	8.4	700	685	700
											~~8.3~~ recorded wrong					
											8.3	TM				
Measured/Loaded by:		TM	TM	TM	MF	MF	TM	MF	MF	TM	MF	MF	TM	MF	MF	TM
Recorded by:		TM	TM	MF	TM	TM	MF	TM	TM	MF	TM	TM	MF	TM	TM	MF

Investigators' Signatures

Tina Mikulski
Marshall Faircloth

Reviewer

form updated 4/27/94

Water Quality Parameters	Salt Water / (Well Water) 20% Min Water	Sample	Method	Measured by
Field Total Residual Cl2:		<.02	—	GB
Lab Total Residual Cl2:	<0.03	<0.03	DR-EE	TM
Alkalinity:	125	165	Hach	TM
Hardness:	120	170	Hach	TM
Total Ammonia:	<0.017	1.10	Orion	MF

Ammonia Meter #98136 Meter Slope: -58.6 Ammonia Blank: <0.017 Control Salinity: ( ) ppt Sample Salinity: ( ) ppt

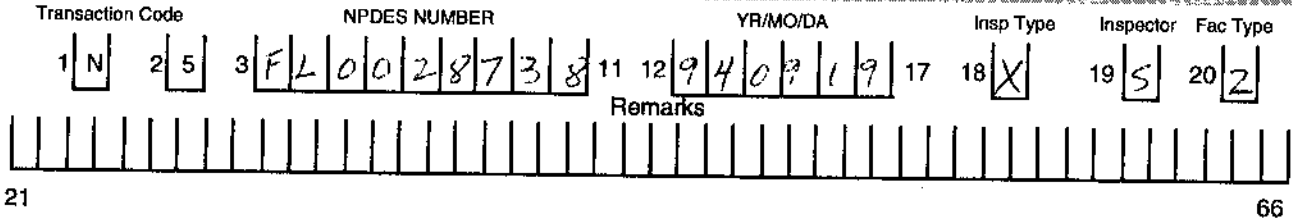
Benthic macroinvertebrate taxa list for Arrowhead WWTP, collected via Ponar grab samples in Merritts Mill Pond, on 19 September, 1994. Densities, in number/m^2, represent the mean of three replicates.

	Reference Site	Test Site
Acarina		
Hydrodroma sp.	–	75
Amphipoda		
Hyalella azteca	14,134	8034
Diptera		
Beardius truncatus	12	–
Chironomus sp.	–	2857
Cladotanytarsus sp.	50	–
Cryptochironomus sp.	–	12
Dicrotendipes modestus	162	–
Goeldichironomus holoprasinus	–	898
Palpomyia grp. sp.	50	–
Polypedilum illinoense	50	–
Pseudochironomus sp.	12	–
Undetermined dipteran pupae	–	75
Gastropoda		
Elimia sp.	–	12
Pomacea paludosa	12	–
Hemiptera		
Neoplea sp.	12	–
Hirudinea		
Helobdella sp.	487	524
Helobdella elongata	250	162
Helobdella triserialis	–	25
Mooreobdella tetragon	12	–
Oligochaeta		
Dero trifida	–	599
Haber sp.	–	75
Limnodrilus hoffmeisteri	599	11,502
Pelecypoda		
Corbicula sp.	62	262
Sphaerium or *Musculium* sp.	75	237
Trichoptera		
Oecetis sp.	12	–
Total	**15, 991**	**25,349**

Phytoplankton taxa list and densities (#/mL) for Arrowhead WWTP, collected via subsurface grab in Merritts Mill Pond, on 19 September, 1994.

	Reference Site	Test Site
Bacillariophyta		
Cocconeis sp.	–	71
Cymbella sp.	–	143
Navicula sp.	203	–
Nitzschia sp.	–	71
Chlorophyta		
Closterium sp.	–	71
Coelastrum sp.	–	71
Kirchneriella sp.	–	71
Oocystis sp.	68	–
Scenedesmus sp.	136	–
Tetraedron sp.	68	–
Unknown chlorophyte flagellate	68	71
Cyanophyta		
Anabaena sp.	–	71
Aphanothece sp.	–	214
Chroococcus sp.	203	714
Total	**746**	**1568**

Fill Out This Section For All Surface Water Discharger Inspections (CEI, CSI, CBI, PAI, XSI - RI Optional)



Fill Out This Section For All Surface Water Discharger Inspections (CEI, CSI, CBI, PAI, XSI - RI Optional)

