

Ecological Assessment of

Georgia Pacific's Discharge to Rice Creek

Putnam County

Sampled February 2000

July 2000

Bureau of Laboratories
Division of Administrative and Technical Services

Comprehensive Quality Assurance Plan No's:
Laboratories- 870346G & 870688G
Field- 980028

Executive Summary

The Georgia-Pacific pulp and paper mill in Putnam County, Florida, presently discharges into Rice Creek, approximately 3 miles upstream of the confluence with the St. Johns River (see map). Georgia-Pacific has applied for renewal of its industrial permit (July 1995), and as part of this process had included the possibility of moving its discharge to the St. Johns River. Georgia-Pacific's proposal is to pipe the effluent to the St. Johns River, where greater dilution exists, and thus avoid the direct effects on Rice Creek, a system with lower assimilative capacity than the St. Johns River. The major parameters associated with the effluent include color, reduction in light penetration, and elevated specific conductance.

The purpose of the present survey was to gather more data to guide the Department in the decisions regarding this permit renewal. This survey was conducted on February 14, 2000, by the Bureau of Laboratories and included in-situ measurements of light penetration (Secchi depth and irradiance), physical properties (temperature, pH, conductance, salinity, and dissolved oxygen), and collection of water samples for water quality tests (color, alkalinity, and selected anions and cations). The sampling was done at twelve stations, including reference or "background" sites (upstream of the discharge), stations at the effluent discharge point, and stations affected by the effluent in Rice Creek and the St. Johns River (see Figure 1).

An extended mixing zone for transparency may be justified within Rice Creek, as no SAV would be expected in such a system even absent the effluent. However, the effluent appears to also reduce SAV success in the St. Johns River, where SAV would be expected in shallow (<1 m) depths, to approximately 0.5 miles downstream of the confluence with Rice Creek. An extended mixing zone for specific conductance within portions of Rice Creek may potentially be justified. Apparently, the increase in conductivity due to the discharge is not having significant adverse effects on the invertebrates.

Introduction

The Georgia-Pacific pulp and paper mill in Putnam County, Florida, presently discharges into Rice Creek, approximately 3 miles upstream of the confluence with the St. Johns River (see map). Georgia-Pacific has applied for renewal of its industrial permit (July 1995), and as part of this process had included the possibility of moving its discharge to the St. Johns River. Georgia-Pacific's proposal is to pipe the effluent to the St. Johns River, where greater dilution exists, and thus avoid the direct effects on Rice Creek, a system with lower assimilative capacity than the St. Johns River.

Another alternative to the pipeline project is for DEP to grant an extended mixing zone to the facility, with concomitant efforts to reduce effluent impacts by improvements in the process controls at the plant. In an evaluation to determine the appropriateness of an extended mixing zone, it must be determined that "substantial harm" to the receiving waters would not occur.

The major parameters associated with the effluent include color, reduction in light penetration, and elevated specific conductance. Elevated color and reductions in transparency would have the most significant direct effect on submerged aquatic vegetation (SAV). Elevated specific conductance could affect fish and macroinvertebrates, depending upon the frequency and duration of levels beyond the organisms' tolerance. The facility aerates Rice Creek at two locations to maintain dissolved oxygen levels.

The Department requested a study to assess the pipeline alternative and Georgia-Pacific submitted a report by Water & Air Research, Inc. entitled "A Preliminary Assessment of Biological Baseline Conditions for a Proposed Discharge" in November 1995.

The purpose of the present survey was to gather more data to guide the Department in the decisions regarding this permit renewal. This survey was conducted on February 14, 2000, by the Bureau of Laboratories and included in-situ measurements of light penetration (Secchi depth and irradiance), physical properties (temperature, pH, conductance, salinity, and dissolved oxygen), and collection of water samples for water quality tests (color, alkalinity, and selected anions and cations). The sampling was done at twelve stations, including reference or "background" sites (upstream of the discharge), stations at the effluent discharge point, and stations affected by the effluent in Rice Creek and the St. Johns River (see Figure 1).

Methods

Field measurements, including temperature, pH, conductance, salinity, dissolved oxygen, and Secchi depth, were made at all twelve stations using a HydroLab Surveyor 4 and Secchi disk. Whenever applicable, surface and mid-depth or bottom measurements were made with the Hydro lab. The light penetration measurements (at stations 1, 2, 3, 4, 6, 7, 10, and 12) were conducted with a Kahlsico Irradiometer (model 268WA310). The compensation point for photosynthetic activity was determined graphically at the depth corresponding to 99% adsorption [*i.e.* depth at which one percent of the light intensity entering the surface remains unabsorbed, D (1%)]. Water chemistry samples were collected directly into containers by immersion just below the surface, either by wading or from boat. These samples were taken at

sites 1, 3, 4, 6, 7, 10 and 12. They were analyzed at the DEP Central Laboratory for the following parameters: alkalinity by EPA 310.1, color by EPA 110.2; chloride, nitrate and sulfate by EPA 300.0; and calcium, magnesium, potassium, and sodium by EPA 200.7 Mod. A standard frodus was deployed in Simms Creek, and the St. Johns River to determine the presence of SAV. The frodus was cast approximately 20 times in each of these two systems.

Throughout the sampling day the weather conditions changed from slightly overcast, to light rain, to clear in the afternoon (last few stations).

Study Site Descriptions

A map of the study area is shown in Figure 1.

Site 1: Georgia Pacific Effluent @ Rice Creek
Site 2: Etonia Creek @ Pumping Station
Site 3: Rice Creek @ Bardin Rd.
Site 4: Etonia Creek @ Saunders Rd.
Site 5: Simms Creek off Comer Rd.
Site 6: Rice Creek below Georgia Pacific Discharge
Site 7: Rice Creek @ Hwy. 17 Bridge
Site 8: Rice Creek near St. Johns River
Site 9: St. Johns River at West Bank 1 mi. downstream of Rice Creek
Site 10: St. Johns River at East Bank opposite Rice Creek
Site 11: Rice Creek 0.5 mi. below Etonia Creek
Site 12: St. Johns River at West Bank 0.5 mi. downstream of Rice Creek

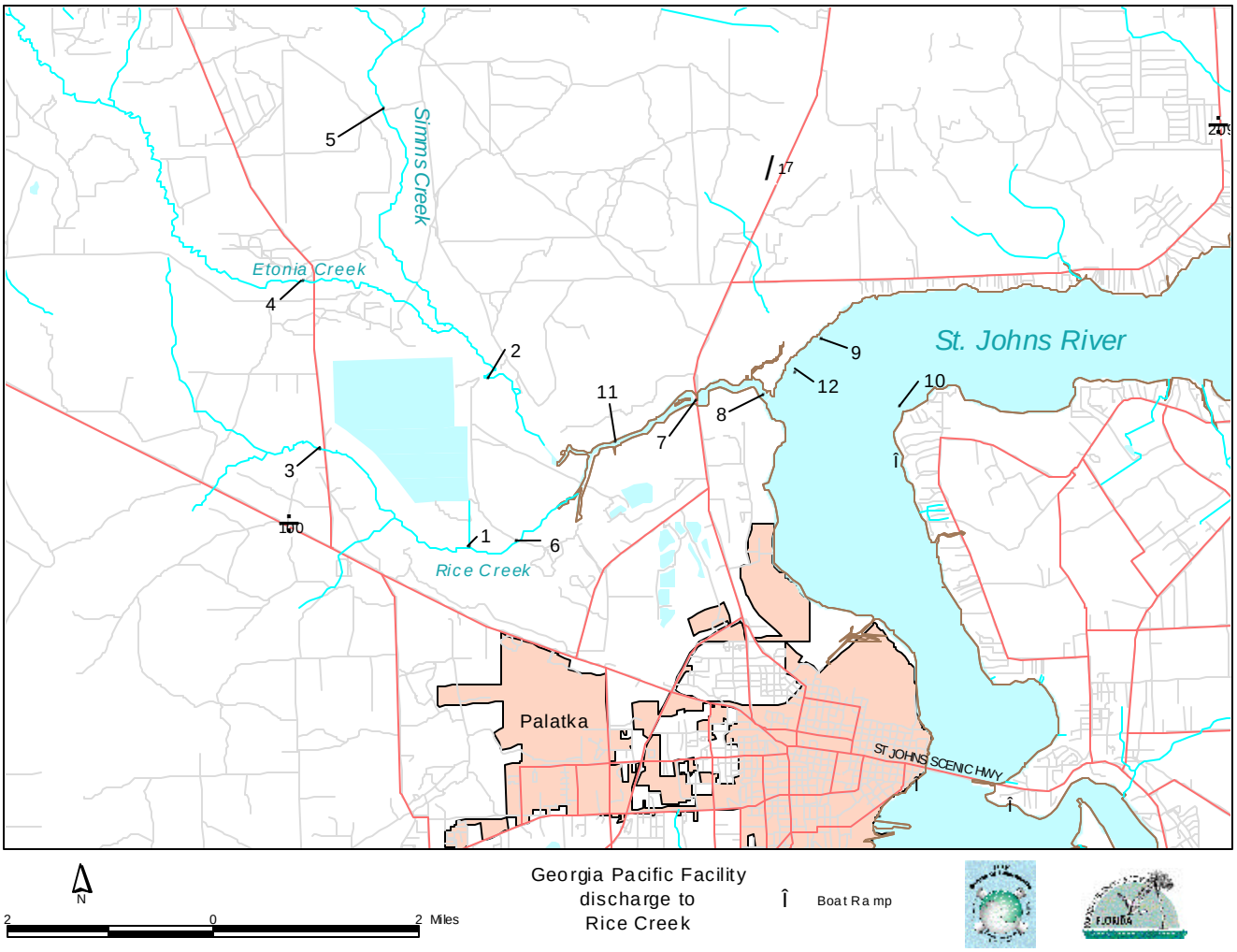

Simms Creek
Etonia Creek
St. Johns River
Rice Creek
Palatka
ST JOHNS SCENIC HWY
1
2
3
4
5
6
7
8
9
10
11
12
17
N
2
0
2 Miles
Georgia Pacific Facility
discharge to
Rice Creek
Boat Ramp

Figure 1

Results and Discussion

Light Penetration and Color

The intensity and depth of light availability in a water column limits the extent to which SAV and algae can grow in an ecosystem. This study measured several parameters to investigate light availability: color, Secchi depth, and compensation point (D (1%) irradiance). Color values sharply increased from the background sites (sites 4, 3, and 10, where color ranged from 50 PCU to 200 PCU) to the effluent input site (Site 1, where color was 2000 PCU). (See Figure 2.) The increased color persisted downstream, with no reduction in color at Site 6 (2000 PCU), some reduction (yet still above background) at Site 7 (500 PCU), and reduction to within the background range at Site 12 (150 PCU). Secchi depth decreased from background levels (up to 200 cm) to a low of 8 cm at the effluent input site (see Figure 3.) Secchi depth increased to only 40 cm at the furthest downstream site, in the St. Johns River approximately 0.5 miles below the confluence with Rice Creek (site 9). Note however, that the background Secchi in the St. Johns River (site 10) was only 60 cm. Depth of light penetration equal to 1% of surface irradiance (D (1%)) dropped sharply from a high of 120 cm at the background sites to 6 cm at the effluent input site (see Figure 4.) D (1%) increased to only 58 cm by the furthest downstream site sampled for this parameter (site 12.) Note the significant relationship between Secchi depth and compensation point (D (1%)), as shown by linear regression in Figure 5 (r^2 of 0.72).

These three parameters show that the Georgia Pacific effluent input to Rice Creek reduces light availability as far downstream as 0.5 mile into the St. Johns River from the Rice Creek confluence. No SAV was found in any of the background sites in Simms, Rice or Etonia Creeks during a systematic search for SAV in these systems. Therefore, the reduced light penetration is not a factor until reaching the St. Johns River, where SAV would be expected in depths of approximately 1 m or less. The effluent color appeared responsible for reducing SAV growth on the west bank of the St. Johns for approximately 0.5 mile downstream of the confluence with Rice Creek.

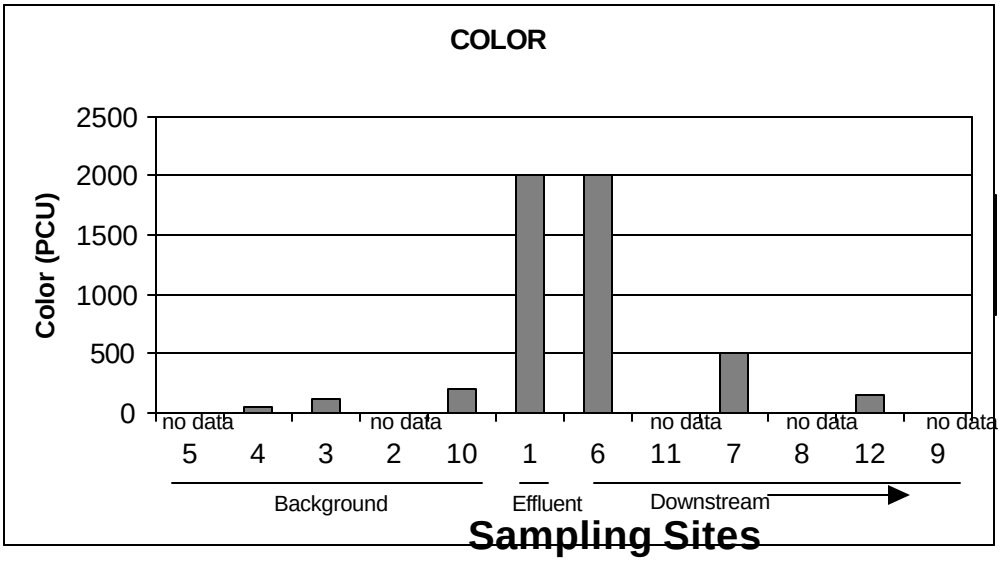


Figure 2

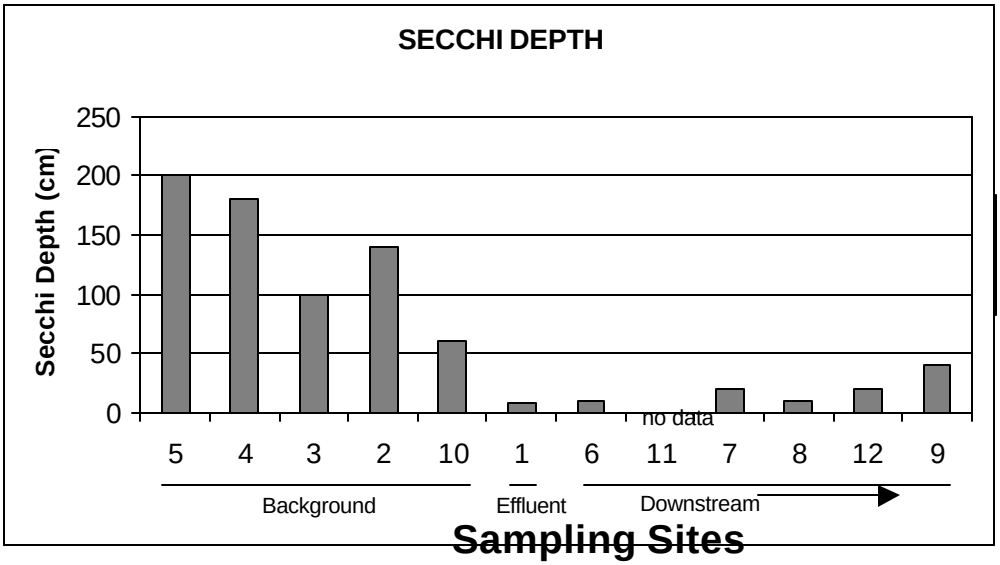


Figure 3

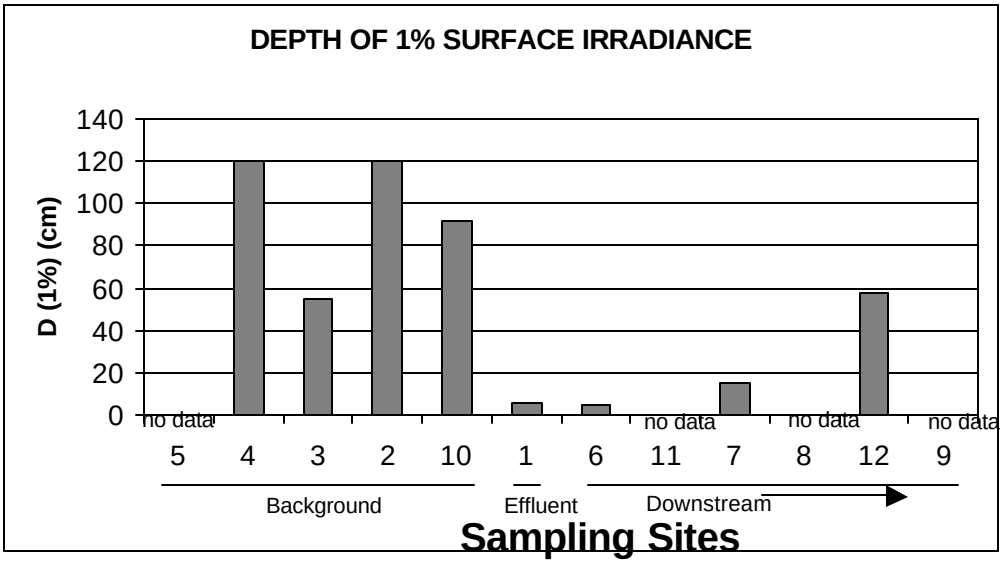


Figure 4

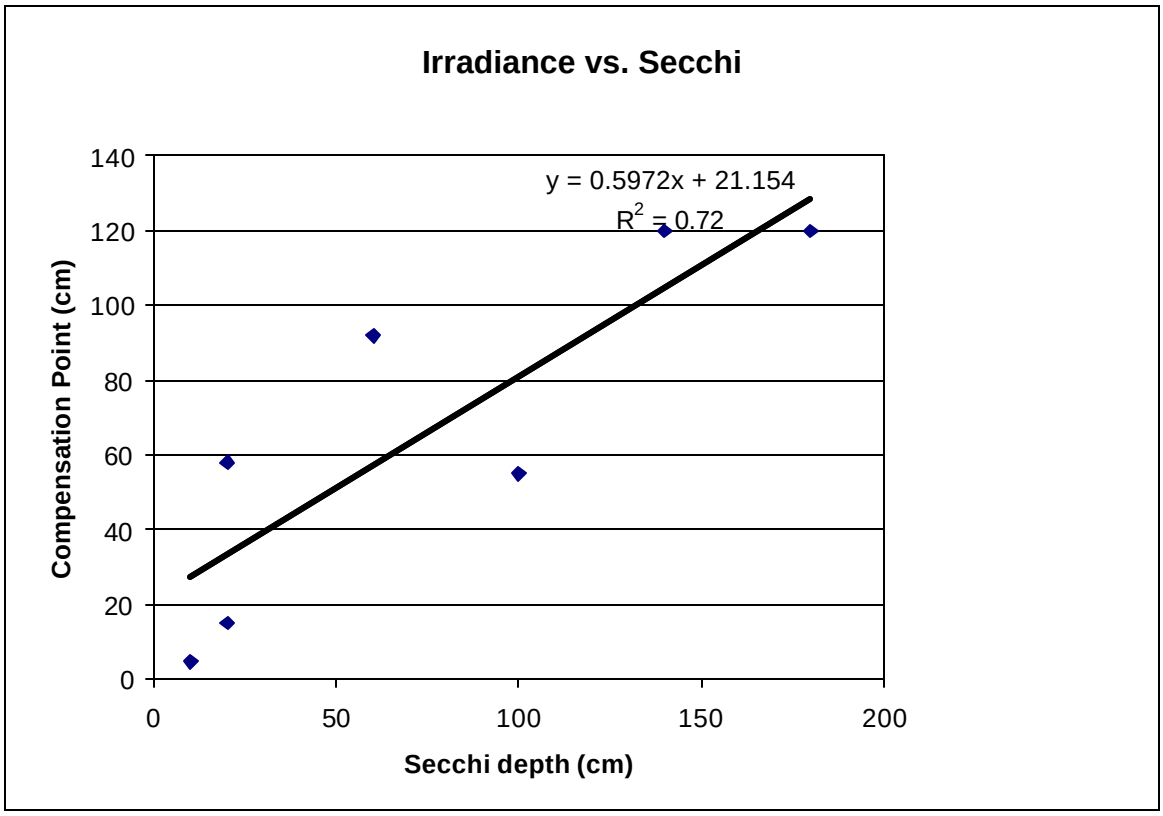


Figure 5

Dissolved Oxygen and Conductivity

Dissolved oxygen concentrations exceeded 5.0 mg/L at all sites except the effluent, where it was 4.3 mg/L (See Figure 6; see Tables 1 and 2 in Appendix for a summary of water chemistry data for this study).

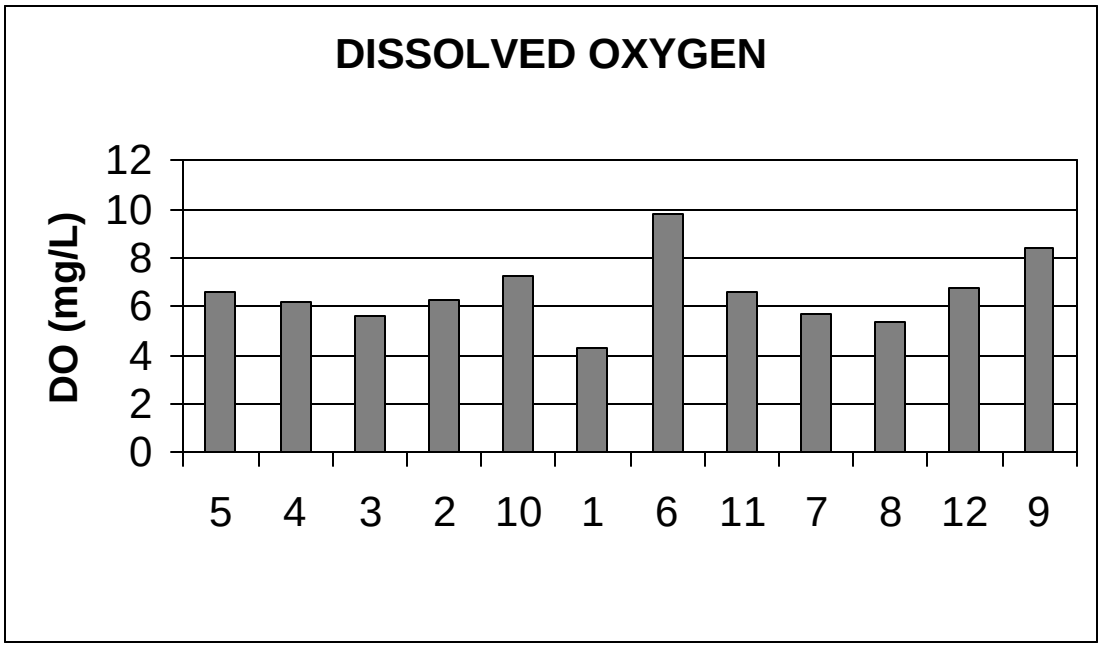
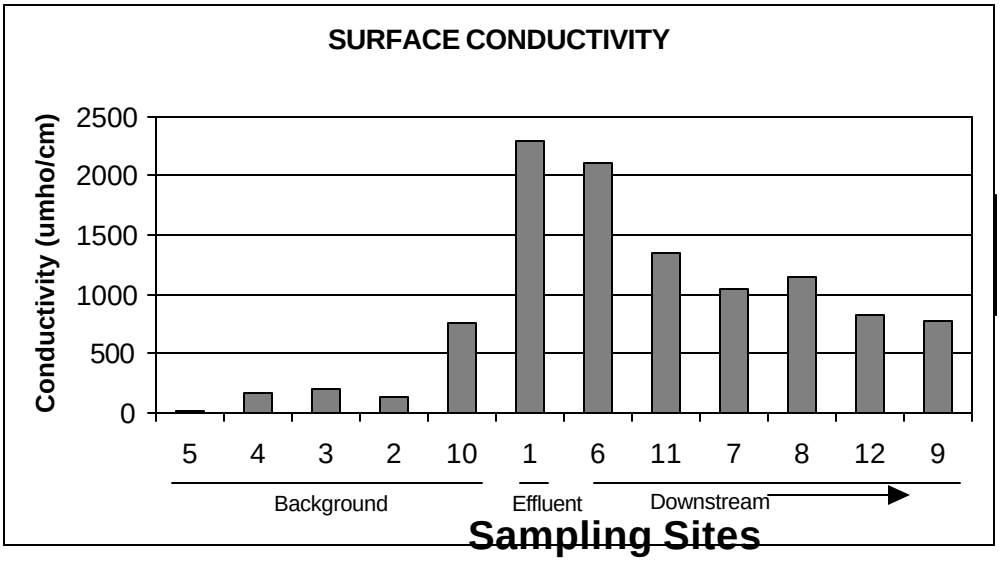


Figure 6

Surface conductivity increased above the Class III water quality standard (1275 umhos/cm) at Sites 6 and 11, below the effluent, but returned to levels that comply with the water quality standard at all other stations (see Figure 7). Conductivity was higher at the bottom depths, as shown in Table 2.

Figure 7



Ionic Content

Major ions increased in Rice Creek as a result of the effluent discharge. Proportions of chloride, sulfate, calcium, potassium, and sodium were checked to determine whether these effluent seawater ions were beyond the tolerance of freshwater organisms using the Gas Research Institute's STR program which models the toxicity effect of different combinations of seawater ions on freshwater species typically used for toxicity testing. The results indicated that the effluent has some acute toxicity from the seawater-type ions, with expected survival in whole effluent from this cause being:

Ceriodaphinia dubia (water flea) = 80% after 48 hr
Daphnia pulex (water flea) = 87% after 48 hr
Pimephales promelas (fathead minnow) = 97% after 48 hr and 84% after 96 hr.

Ion imbalance, per se, probably would not be useful to examine in this case, it being a concern only in saltwater systems.

Recommendations

An extended mixing zone for transparency may be justified within Rice Creek, as no SAV would be expected in such a system even absent the effluent. However, the effluent appears to also reduce SAV success in the St. Johns River, where SAV would be expected in shallow (<1 m) depths, to approximately 0.5 miles downstream of the confluence with Rice Creek. One alternative is to provide alternate habitat (snags) in this area to compensate for habitat loss due

to lack of SAV. Releasing the effluent via a multi-port diffuser at the mid portion of the St. Johns River (below the depth where SAV is expected) is also a possible solution, since the color may be diluted to acceptable levels (for SAV) prior to approaching shallow water.

An extended mixing zone for specific conductance within portions of Rice Creek may potentially be justified. Recent bioassessment studies show no significant decreases in the Stream Condition Index, where the SCI was in the "good" category downstream of the effluent (DEP, 2000b). Apparently, the increase in conductivity due to the discharge is not having significant adverse effects on the invertebrates. Further, this area of the St. Johns River is approaching estuarine conditions (bottom conductivities near 1000 umhos/cm), making low specific conductance less critical to the area biota.

The above recommendations are based on this single sampling event, previous studies (Water and Air Research, 1995 and SJRWMD, 1997) and take into account proposed improvements, including reduction in flow and color, from the facility. Further study and monitoring may be required.

Literature Cited

FDEP. 2000a. Standard Operating Procedures IZ-20, Physical/Chemical Characterization. Fla. Dept. Environ. Prot., Bureau of Laboratories. Unpaginated.

FDEP. 2000b. Biological Assessment of Georgia Pacific, Co. Palatka Plant. Fla. Dept. Environ. Prot., Bureau of Laboratories. Unpaginated.

SJRWMD. 1997. Submerged Aquatic Vegetation of the Lower St. Johns River. St. Johns River Water Management District. 212 p.

Water and Air Research. 1995. A Preliminary Assessment of Biological Baseline Conditions for a Proposed Discharge. Unpaginated.

APPENDIX

Table 1. Chemical parameters for selected study sites.							
Site	**4**	**3**	**10**	**1 (Effluent)**	**6**	**7**	**12**
Temp. (oC)	19.9	16.14	16.5	16.4	16.5	16.8	16.6
pH	7.8	7.46	7.7	7.8	7.64	7.4	7.5
DO (mg/L)	6.2	5.66	7.3	4.3	9.77	5.7	6.8
Cond. (umho/cm)	170	207	762	2301	2113	1042	832
Alkalinity (mg/L)	69	44	67	434	410	152	95
Chloride (mg/L)	7.7	33	160	410	390	190	180
Nitrate (mg/L)	0.092	bld	0.18	0.032	0.068	0.19	0.22
Sulfate (mg/L)	6.6	16	46	97	94	47	47
Calcium (mg/L)	20.6	20.5	40.8	70.9	65.6	41.1	39.5
Magnesium (mg/L)	6.0	6.5	13.7	11.1	10.6	10.5	12.3
Potassium (mg/L)	0.61	0.5	4.4	11.7	10.6	5.1	4.5
Sodium (mg/L)	5.0	17.9	87.8	428	395	155	108
(Measurements are surface values where applicable.)							
(bld = below limits of detection)							

Table 2. Depth profiles of selected parameters at selected study sites.				
Depth Profiles				
Rice Creek bl. Etonia (Site 11)				
Depth (m)	Cond. (umho/cm)	DO (mg/L)	Temp. (oC)	pH
0.1	1355	6.6	16.0	7.4
2.8	1517	6.7	15.8	7.4
Rice Creek @ 17 (Site 7)				
Depth (m)	Cond. (umho/cm)	DO (mg/L)	Temp. (oC)	pH
0.4	1042	5.7	16.8	7.4
2.2	1147	4.9	15.6	7.4
4.9	1349	4.4	14.8	7.3
Rice Creek nr. St. Johns (Site 8)				
Depth (m)	Cond. (umho/cm)	DO (mg/L)	Temp. (oC)	pH
0.1	1140	5.4	16.2	7.5
3.8	1414	4.5	14.8	7.3