The Orange County Eastern Wetlands Treatment System: 14 Years Later

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The Orange County Eastern Wetlands System is a combination of created and natural wetlands that has been in operation since 1988. A portion of high-quality reclaimed water produced at the Eastern Water Reclamation Facility (EWRF) is distributed through the wetlands. After eight years of research and intensive monitoring, the experimental exemption status was removed and the system was permitted in 1998, based on the Wetlands Application Rule, Chapter 62-611, F.A.C.

A review of 14 years of monitoring program results indicates that the wetlands system is an effective treatment system that is performing as expected and has enhanced the environment of the Econolockhatchee River Basin in east Orange County. The river has been designated an Outstanding Florida Water by the state of Florida. New wetlands have been created, and although there have been modifications in D.O., pH, and vegetation, the macroinvertebrates, fish, and vegetation communities have been maintained in the natural wetlands with the application of reclaimed water.

Wastewater Treatment System

The wastewater treatment system uses the five-stage Bardenpho® advanced biological nutrient removal process with final clarification, sand filtration, and chlorination. It has a total permitted capacity of 19 MGD. The reuse system consists of rapid infiltration basins, power plant reuse, and wetlands application, with permitted annual average or agreement capacities of 2.5 MGD, 10.5 MGD, and 6.2 MGD respectively.

This treatment facility has been producing reclaimed water that exceeds advanced treatment standards. A comparison of the 1995-2001 water-quality data and permit requirements is presented in Table 1.

The current annual average reclaimed water production is 13 MGD. The power plant reuses approximately 11 MGD with the remaining 2 MGD is discharged to the wetlands.

Wetlands System

The wetlands system consists of a unique combination of overland flow, created wetland, and natural wetland areas (**Figure 1, page 35**). Reclaimed water is distributed to a 50-foot wide, overland flow area. The distribution-created wetland is a 35-acre wetland adjacent to the overland flow area. Water flows through this wetland into a pond cypress-dominated swamp referred to as the treatment wetland. It is then recollected and redistributed to the 45-acre redistribution-created wetland. Water then flows to a natural hardwood-dominated swamp, referred to as the jurisdictional wetland, and then to additional natural pond cypress-dominated swamps, referred to as the exit wetlands, with ultimate discharge to the Big Econlockhatchee River via an unnamed tributary.

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Table 3. Wetlands Water Quality Data (1998 – 2001)

Parameters	1998	1999	2000	2001
$CBOD_5$ (mg/L)	**1.4**	**1.2**	**1.3**	**1.6**
TSS (mg/L)	**3**	**2**	**3**	**4.5**
TN (mg/L)	**1.12**	**0.98**	**0.95**	**1.66**
TP(mg/L)	**0.04**	**0.03**	**0.04**	**0.29**
Sulfate (mg/L)	**28.25**	**30.35**	**27.46**	**31.48**
Chlorophyll A (mg/m^3)	**0.87**	**1.57**	**0.62**	**1.13**

System Operation and Monitoring

Due to demand for reclaimed water for other uses, limited flow is now applied to the wetlands. The annual average flows to the wetlands for the past six years are shown in Table 2.

There are seven distribution zones adjacent to the overland flow area. Discharge is rotated weekly to provide for alternating wet and dry periods. The only maintenance performed for the wetland system is cleaning the redistribution channel. Chemical water quality is monitored quarterly at seven sampling stations in the wetland system for DO, pH, $CBOD_5$, TSS, TP, TN, SO_4, Fecal Coliform, and Chlorophyll A. Annual average values of the water-quality data from seven sampling stations for the period 1998-2001 are summarized in Table 3.

Biota is monitored annually in the wetland system. Total phosphorus and nitrogen are monitored weekly for compliance at the final discharge station downstream from the exit wetlands. The Econolockhatchee River is monitored quarterly for $CBOD_5$, TSS, DO, TN, TP, and Chlorophyll A at five stations.

Table 1.

	Permit Limit Annual Averages	1995	1996	1997	1998	1999	2000	2001
$CBOD_5$ (mg/L)	**5**	**1.0**	**2.0**	**1.0**	**1.6**	**1.5**	**1.1**	**1.4**
TSS (mg/L)	**5**	**1.0**	**2.0**	**2.0**	**1.5**	**1.2**	**1.0**	**1.4**
TN (mg/L)	**3**	**1.7**	**2.0**	**1.5**	**2.4**	**2.4**	**2.7**	**2.46**
TP(mg/L)	**1**	**0.07**	**0.09**	**0.27**	**0.25**	**0.29**	**0.38**	**0.20**

Table 2.

	Permit Limit Annual Averages	1995	1996	1997	1998	1999	2000	2001
Flow (MGD)	**6.2**	**2.88**	**1.98**	**2.22**	**1.37**	**1.22**	**1.16**	**2.01**

System Performance

Wetlands have been successfully created onsite. They consist of diverse plant communities that provide wildlife habitat. Constant water supply to the distribution- and redistribution-created wetlands has ensured success in establishing these communities through volunteer colonization of native plants adapted to wet conditions.

A slight but not significant increase occurred in the BOD_5 measured in the wetlands system, but the average BOD_5 concentrations were below 3 mg/L. Overall there was no net change in TSS concentrations in the floodwaters with flow through the wetland system. Based on residual chlorine levels and total and fecal coliform numbers, there was no microbiological contamination of surface waters by the reclaimed water. Background iron levels in the wetlands system have been diluted by reclaimed water and rainfall. None of the metals detected in the wetlands system exceeded the Florida Class III quality criteria for surface water. The nitrate + nitrite concentrations were steadily reduced as water moved through the wetlands system. Low average total phosphorus concentrations in the inflow diluted phosphorus in the wetland floodwaters to background levels.

There is a definite trend showing that pH in the jurisdictional wetland has increased with continued reclaimed water application. Photosynthesis in the created wetlands may also contribute to increased pH in downstream natural wetlands within the system. DO concentrations were higher in the jurisdictional wetland than in the control wetland during the background period, and during the operational period due to reclaimed water application. DO concentrations in the created wetlands were higher than in the natural wetlands as reclaimed water was modified by passage across these created wetlands. It is clear from the data that the levels of DO, including daily and seasonal fluctuations, have been maintained throughout the operational monitoring period.

Results of the water budget indicate that reclaimed water was the largest hydrologic inflow to the system and surface discharge was the largest outflow component from the system. Vertical percolation, groundwater flow, changes in soil storage, and detention storage were relatively minor components of the annual water budgets for this system.

The application of reclaimed water makes the wetlands system a flow-through hydrologic system that has shown no decrease in surface outflow water quality. Results of the water budget, coupled with water-quality monitoring, provide the basis for mass balance analyses that indicate that on a cumulative basis the system has assimilated 31% of the applied nitrogen and 35% of the applied phosphorus during the operational period. These levels of assimilation reflect the high quality of the reclaimed water applied to the wetlands system. The discharge water-quality performance goals have been met throughout the operational period, as indicated in Table 4.

Table 4. Wetlands Compliance Monitoring Data (1995-2001)

	Permit Limit Annual Averages	1995	1996	1997	1998	1999	2000	2001
Flow(MGD)	Report	1.96	2.35	2.99	2.24	2.14	2.01	4.24
TN (mg/L)	2.20	0.79	0.74	0.78	0.76	0.79	0.77	0.45
TP(mg/L)	0.20	0.03	0.04	0.03	0.02	0.03	0.03	0.04

The discharge from the wetland treatment system is meeting or exceeding the performance goals for total nitrogen (2 mg/L as N) and total phosphorus (0.2 mg/L as P) required by the permit. Based on the water-quality data in the receiving stream, the discharge from the wetlands system is having no adverse affect on the water quality of the Big Econlockhatchee River.

Summary

Results from the 14 years of monitoring and research programs indicate that the experimental wetlands system has met permitting and design expectations. The wetlands system is an effective treatment system, as indicated by the compliance with permitted discharge limits. New wetlands have been created, and although there have been modifications in pH, DO, and vegetation, the macroinvertebrate, fish and vegetation diversities have been maintained in the natural wetlands with the application of reclaimed water.

The system is functioning well and is a successful component of the integrated multiple reuse program. As an additional benefit, the wetlands provide a habitat for wildlife, including more than a dozen threatened and endangered species. The monitoring and research programs have provided important data that will contribute to our knowledge of wetlands in general and to the refinement of performance guidelines for reclaimed-water applications for natural and constructed wetland systems.

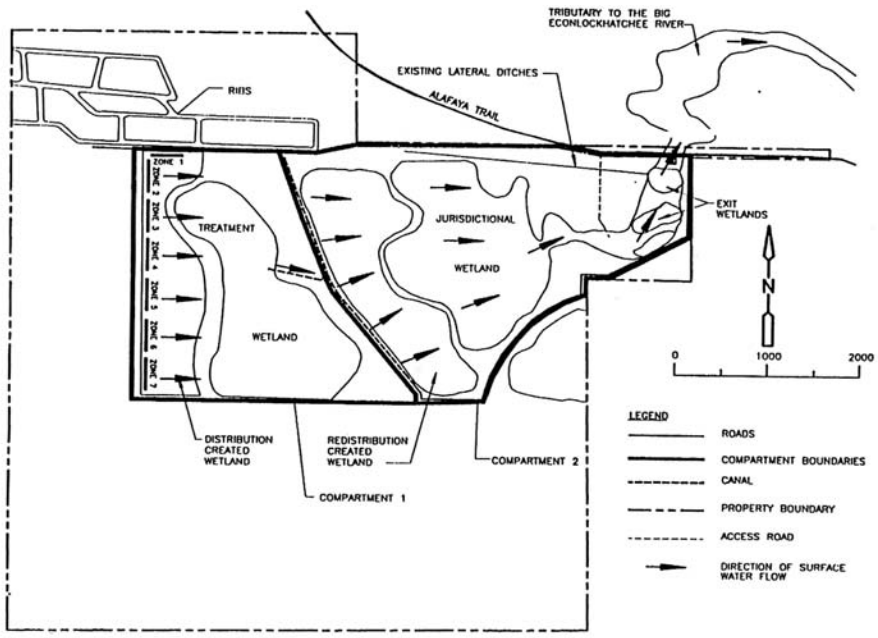

Figure 1 Reclaimed water wetlands system layout.