Exploring the potential of water reuse for the restoration of habitat and hydrologic systems in Pasco County

Analysis of Land Use, Hydrology, and Water Quality of Beneficial Reuse for Natural Systems Restoration

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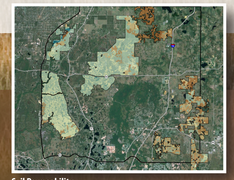
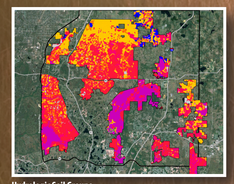
Abstract

The **Southwest Florida Water Management District** (SWFWMD) and **Pasco County,** Florida, are exploring the use of reclaimed water from the Pasco County Master Reuse System (PCMRS) to improve water resources in Pasco County. The **feasibility of using constructed wetlands, natural wetlands, infiltration basins, and upland application systems** to enhance hydrologic systems was evaluated for two projects. Implementation would **provide benefits to hydrologically altered water resources, create habitat and recreational facilities,** and **increase water reuse opportunities**.

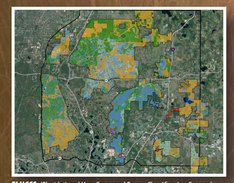
The investigation included an innovative combination of the U.S. Department of Agriculture (USDA) **Soil-Plant-Air-Water (SPAW) model** with **Kadlec and Wallace's P-k-C* wetlands treatment model** to establish expected ranges of water level restoration to both constructed wetland and natural wetland systems while **preserving water quality**.



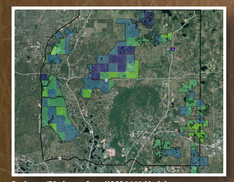
Soil Permeability



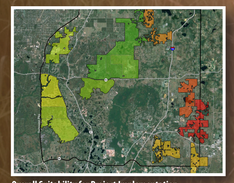
Hydrologic Soil Groups



FLUCCS (Florida Land Use, Cover and Forms Classification System)



Recharge/Discharge from USGS 2002 Model



Overall Suitability for Project Implementation

Central Pasco GIS Site Selection Modeling

Creating new wetlands

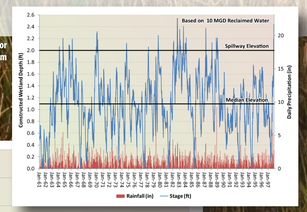
The **Central Pasco County Beneficial Water Reuse Project** considered the construction of large-scale treatment/infiltration wetlands sized to:

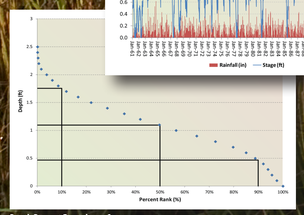
- **reduce nitrogen to background concentrations**;
- **maximize the area of recharge**;
- **maximize wetland habitat diversity**; and
- **minimize disposal facilities**.

Screening analysis using Geographical Information System (GIS) data identified areas with the most suitable physical and hydrological characteristics for constructed wetlands and land application systems.

Water balance results yielded hydroperiods suitable for establishing wetland communities with a median wetland depth of 1.15 feet, and ranging from 0.5 ft (90th percentile) to 1.75 ft (10th percentile).

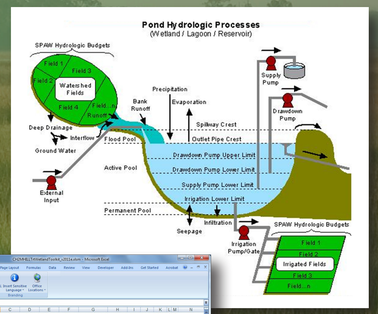
Infiltration from the constructed wetlands would **sustain wetland communities while contributing to the recharge of local aquifers**. Feasible alternatives must meet the County's proposed total maximum daily load (TMDL) requirements, a critical project constraint.





Depth Percent Exceedance Curve

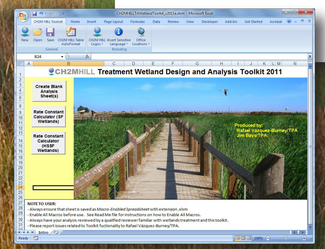
Central Pasco Water Balance Results



Source: USDA/NRCS

SPAW (Soil – Plant – Air – Water)

- Period of record 1961 – 1997
- Trapezoidal wetland cells
- Discharge elevation: 2 ft depth
- Discharge through 24 in riser
- Berm elevation: 4 ft depth
- Infiltration rate
  - — Lined wetland: 0 cm/d
  - — Unlined wetland: 2 cm/d



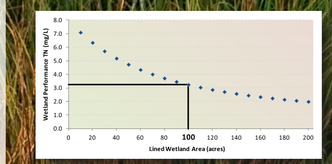
CH2M HILL Treatment Wetlands Toolkit

- Treatment Wetlands performance modeling
- P-k-C* Model (based on Kadlec and Knight, 1996; updated by Kadlec and Wallace, 2009)

$$A = \frac{QP}{k} * \left(\frac{(C_e - C^*)}{(C_i - C^*)} \right)^{-\left(\frac{1}{P}\right)}$$

$$k = k_{20}\theta^{(T-20)}$$

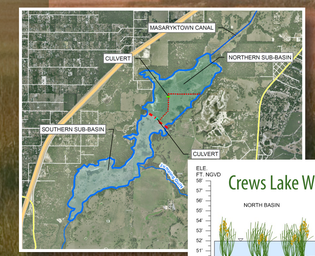
- Wetland area requirement to achieve water quality goal
- Performance estimated under average monthly temperature, rainfall, and water flow

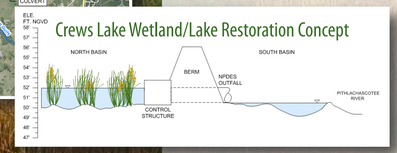


Central Pasco Wetland Performance Modeling

Central Pasco Predicted System Performance (mg/L)

Water Quality Parameter	Background Concentration Assumptions	Influent Concentration	Effluent Concentration
Total Nitrogen TN	0.9	8	0.9 89%
Total Phosphorus TP	0.002	2	0.5 75%
Biochemical Oxygen Demand BOD	2	20	<5 75%
Total Suspended Solids TSS	2	20	<5 75%





Bringing a lake back to life

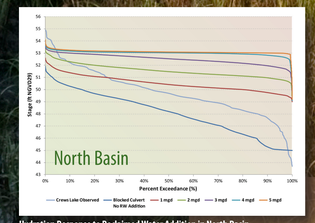
The **Crews Lake Natural Systems Restoration** (CLNSR) project would use reclaimed water from the PCMRS to **recover and enhance natural aquatic ecosystems and increase water reuse capacity for Pasco County**.

Crews Lake was added to the SWFWMD list of stressed lakes in 1991 because of its chronically low water levels. Earthen berms constructed decades ago functionally subdivided this shallow lake into North and South Basins.

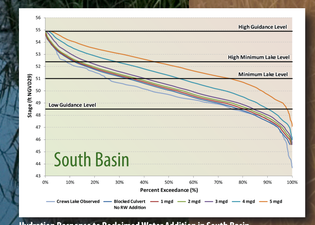
Planning-level results of a feasibility study on the use of natural wetlands in the North Basin of Crews Lake for receiving and treating reclaimed water and **restoring lake water levels** were developed. Predicted wetland outflow concentrations were compared to existing and proposed numeric nutrient criteria.

Water balance results for the North and South basins indicated that increased hydration would be expected while retaining the natural seasonal fluctuation dynamics of the lake.

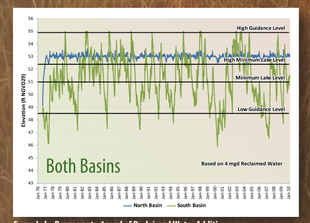
Restoration of dehydrated wetlands within the hydrologically altered lake provides **a solution that balances the critical need for treatment and reuse of reclaimed water, a rejuvenation of water levels and public use of the lake**, and an assurance of **continued lake water quality**.



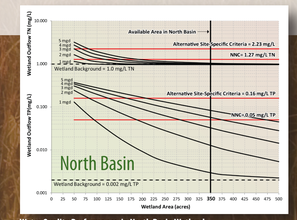
Hydration Response to Reclaimed Water Addition in North Basin



Hydration Response to Reclaimed Water Addition in South Basin



Crews Lake Response to 4 mgd of Reclaimed Water Addition



Water Quality Performance in North Basin Wetland

Conclusions

Calibrated SPAW modeling and conservative treatment rate constants yielded reliable results for evaluating the feasibility of several alternatives. The Central Pasco Project analysis showed that a 760-acre wetland system with suitable median depths for wetland habitat establishment and typical seasonal depth fluctuations would augment local groundwater resources while preserving water quality. The Crews Lake Project analysis showed that up to 4 mgd of reclaimed water could be applied to the North Basin while achieving water quality goals in the South Basin. The additional water would enhance lake ecosystem productivity while meeting minimum guidance lake levels and water quality objectives.