The Limbo Question:
How Low Can You Go on Nutrient Removal for Coastal Restoration?

A Case Study of the Biscayne Bay Coastal Wetland Project

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INTRODUCTION

The Miami-Dade Water and Sewer Department (MDWASD) is undertaking a wetlands rehydration pilot project (the BBCWRPP) as part of an attempt to restore estuarine ecosystems and as part of the South Florida Water Management District (SFWMD) Water Use Permit (WUP) No. RE-ISSUE 13-00017-W. The purpose of the BBCWRPP is to evaluate the potential effects of rehydrating the Biscayne Bay Coastal Wetlands with highly treated reclaimed water. This involves evaluating options for treating secondary effluent from the South District Wastewater Treatment Plant (SDWWTP) to produce reclaimed water.

OBJECTIVE

As water supplies become more scarce with competing urban and natural system needs, the reutilization of wastewater to restore ecosystems will grow. This poster highlights a case study of the regulatory drivers, the engineering challenges, and the scientific uncertainties associated with the restoration of the Biscayne Bay Coastal Wetlands.

PROJECT BACKGROUND

This project involved a review of the primary regulations governing receiving waters for the project. Along with water quality standards required by the Florida Department of Environmental Protection (FDEP) and Miami-Dade County Code, the two most applicable regulations are based on Chapter 62-611 of the Florida Administrative Code (FAC) for the application of water into wetlands, and proposed water quality targets developed by the Comprehensive Everglades Restoration Plan (CERP) for Biscayne Bay, as part of Outstanding Florida Waters (OFW). High levels of nutrient reduction, specifically nitrogen and phosphorus, are required under both of these regulations. In addition to sampling the effluent for the required constituents under these regulations, testing will also consider the presence and removal of microconstituents.

TREATMENT TRAINS

Following a review of the regulations, a literature review was performed, focusing on processes that achieved removal of the target compounds, with special focus on the reduction of nitrogen and phosphorus.

Treatment Process

Nitrification → Denitrification → Chemical Phosphorus Removal → Membrane Separation → Advanced Oxidation Process

Principal Constituent Targeted

Ammonia Nitrogen → Nitrite/Nitrate Nitrogen → Phosphorus → TSS/Colloids Nitrogen Phosphorus → Micro-constituents

Recommended Technologies

Biological Aerated Filter → Deep Bed Filter → Ballasted Flocculation/ Hydroferric Oxide Filtration → Microfiltration / Reverse Osmosis → AOP UV-Peroxide UV-Ozone

Membrane Bioreactor (MBR)

TABLE 1: ANTICIPATED NUTRIENT REMOVAL BASED ON LITERATURE REVIEW

Treatment Process	Ammonia (NH_3-N)	Nitrate/Nitrite (NO_x-N)	Total Nitrogen	Total Phosphorus
EVALUATED PROCESSES				
Nitrification Filters (BAF)	98%	(3000)%	--	18%
Denitrification Filters (Deep Bed)	--	98%	92%	15%
Chemical Phosphorus Removal (BluePro; Actiflo)	--	--	16%	95%
MF / UF Membranes	--	--	--	50%
Reverse Osmosis	90%	96%	89%	97%
Activated Carbon	--	--	--	--
Ion Exchange	99%	99%	99%	99%
Advanced Oxidation	--	--	--	--
SELECTED PROCESSES				
Membrane Bioreactor	96%	96%	89%	96%
Reverse Osmosis	90%	96%	89%	97%
Advanced Oxidation	--	--	--	--

Microcosm Studies will Include Acute and Chronic Testing of:

- Bacteria
- Phytoplankton
- Zooplankton
- Vascular Plants
- Benthic Macroinvertebrates
- Fish

Culture Room

Sample Delivery System

Exposure Tanks

Photos Credit: Gary Rand, Florida International University

TABLE 2: FEED WATER QUALITY AND PROPOSED TREATED WATER GOALS

Parameter	Units	SDWWTP Median Effluent Concentration	Reuse / Wetlands Application[1]	Class III / OFW[1]
TSS	mg/L	8.0	5	3.5
$CBOD_5$	mg/L	4.4	5	N/A
Total Nitrogen as N	mg/L	23.5	3	0.27
Total Phosphorous as P	mg/L	1.81	1	0.005
Fecal Coliform	#/100 ml	74,775	<1.0	<1.0
Total Ammonia as N	mg/L	20.9	N/A	0.02 – 0.05[2]
Nitrate/Nitrite as N	mg/L	--[3]	N/A	0.01
TKN	mg/L	23.1	N/A	0.22
Ortho-Phosphate as P	mg/L	--[3]	N/A	0.002
Dissolved Oxygen	mg/L	--[3]	N/A	5.0-7.3
Turbidity	NTU	--[3]	N/A	0.5
Salinity		--[3]	N/A	--[3]
pH range		6.6	N/A	6.5-7.5
Microconstituents		--[3]	N/A	--[4]
Cryptosporidium and Giardia		--[3]	N/A	--[4]

1. Effluent requirements are based on annual average conditions.
2. Treated water goal depends on the method of sample collection and analysis.
3. Background salinity shall not change by more than 5 parts per trillion.
4. There are no established numerical criteria or anti-degradation data.

MBR Membrane Tank (Stainless Steel)

Advanced Oxidation Process Finish Water Stabilization Tanks

MICROCONSTITUENT REMOVAL

Microconstituents are classes of chemical compounds that have the potential to cause harmful effects or alter natural functions in humans and other forms of life. The aim of the advanced oxidation process (AOP) will be to reduce the concentrations of microconstituents from the wastewater. Effluent water from this pilot plant will be tested in a controlled environment to evaluate its effect on a wetlands environment. Although effluent goals for microconstituents have not been previously defined, water quality goals will be futher developed as a result of forthcoming ecological studies.

PROJECT LOCATION

- 8950 SW 232 Street, Miami, Florida, 33190

PROJECT SCHEDULE

- Pilot Plant Design: **Complete**
- Pilot Plant Operation: **2010 – 2011**
- Data Collection and Review: **2010 – 2011**
- Permit Deadline Requirement: **2011**
- Additional Pilot Plant Operation: **2011 – 2013**

UV Generation Pilot Equipment

MBR Pilot System—Overview of Anoxic and Aeration Tanks

SUMMARY

The percent removal of nitrogen, phosphorus and other constituents regulated by the wetlands and Class III/OFW standards drove the selection of the treatment train unit processes. The treatment trains will simulate different water qualities that may be suitable for release into a wetlands environment. Several variations of these trains may be identified and tested as physical data is analyzed during pilot operation. These treatment trains will provide water for laboratory testing to determine suitability for the required wetlands application. This pilot is to be used to test and analyze the treatment processes and not specific vendor equipment.

FOR MORE INFORMATION, CONTACT:

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