



# Miami-Dade Water and Sewer Department

## COASTAL WETLANDS REUSE REHYDRATION DEMONSTRATION PROJECT (CWRRDP)

February 20, 2007

Subconsultants:

***MSA Milian, Swain & Associates, Inc.***



**CH2MHILL**



# Agenda

- Opening Remarks
- Overview
- Technical Presentations
  - Water Reuse Demonstration Plant
  - Constructed Wetlands Conceptual Design
  - Baseline Assessment & Monitoring Program
  - Final Design Phase Plan
    - Schedule
    - Permitting Issues
- Stakeholders Questions/Comments
- Action Items
- Wrap Up



# Project Overview





# CWRRDP Goals and Objectives

- **Test** advanced water reclamation treatment technologies to meet water quality goals established by the CERP reuse pilot project
  - Nutrients
  - Other water quality parameter
- **Evaluate** ecological impact to receiving wetlands
- **Provide Information** to determine technical feasibility of large scale coastal wetlands re-hydration project

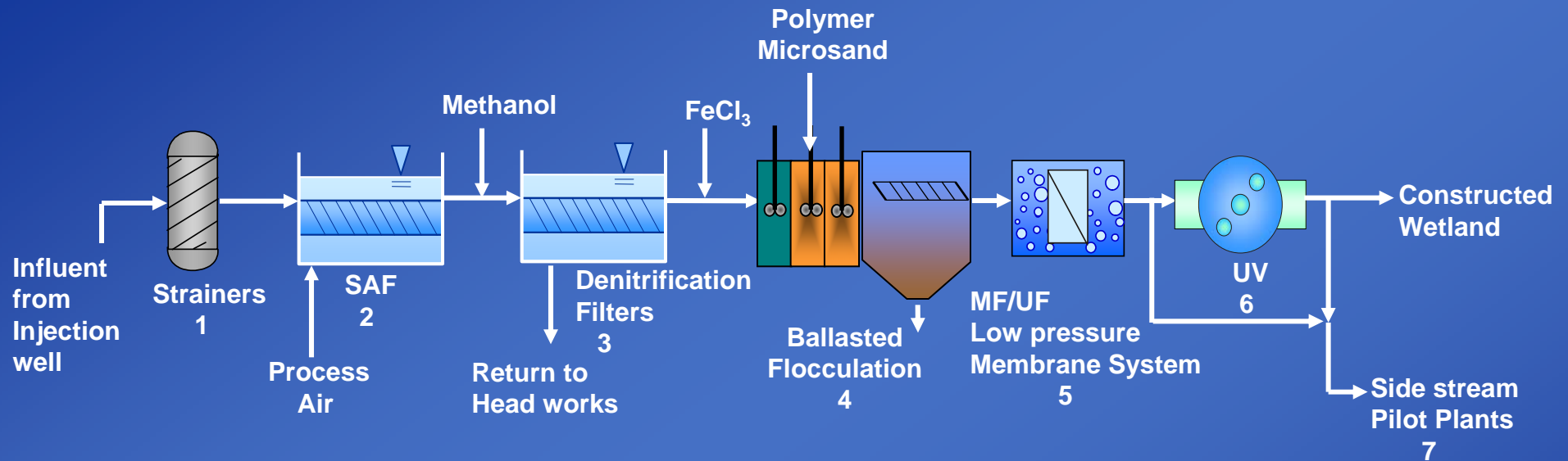


# Water Quality Objectives

| Parameter                        | Reuse Public Access<br>and Irrigation<br>Part III Ch 62-610 | Receiving Wetlands<br>Application<br>Ch 62-6111                | Class III / OFW<br>(USCOE 2004) |
|----------------------------------|---|--|---------------------------------|
| TSS, mg/ L                       | 5(1)  | 5  | 3.5                             |
| CBOD <sub>5</sub> , mg/ L        | 20(2)   | 5  |                                 |
| Total Nitrogen, mg/l as N        |   | 3  | 0.27                            |
| Total Phosph., mg/L as P         |   | 1  | 0.005                           |
| Fecal Coliform, # / 100ml        | <1.0  | <1.0   | <1.0                            |
| Total Ammonia- N, mg/L           |   |  | 0.02 –0.05                      |
| Nitrite/Nitrate-N, mg/L          |   |  | 0.01                            |
| TKN, mg/L                        |   |  | 0.22                            |
| Ortho-P (mg/L)                   |   |  | 0.002                           |
| Dissolved Oxygen range<br>(mg/L) |   |  | 5.0-7.3                         |
| Turbidity, NTU                   |   |  | 0.5                             |
| pH range                         |   |  | 6.5-7.5 (*)                     |
| Heavy Metals                     |   |  | Various                         |
| EPOC, Crypto, Giardia            |   |  | Lowest possible<br>levels(**)   |
| Treatment                        | Deep bed filters and<br>UV disinfection                     | nitrification filters +<br>denit filters +<br>chemical precip. | UF, RO, IX, GAC,<br>AOP         |



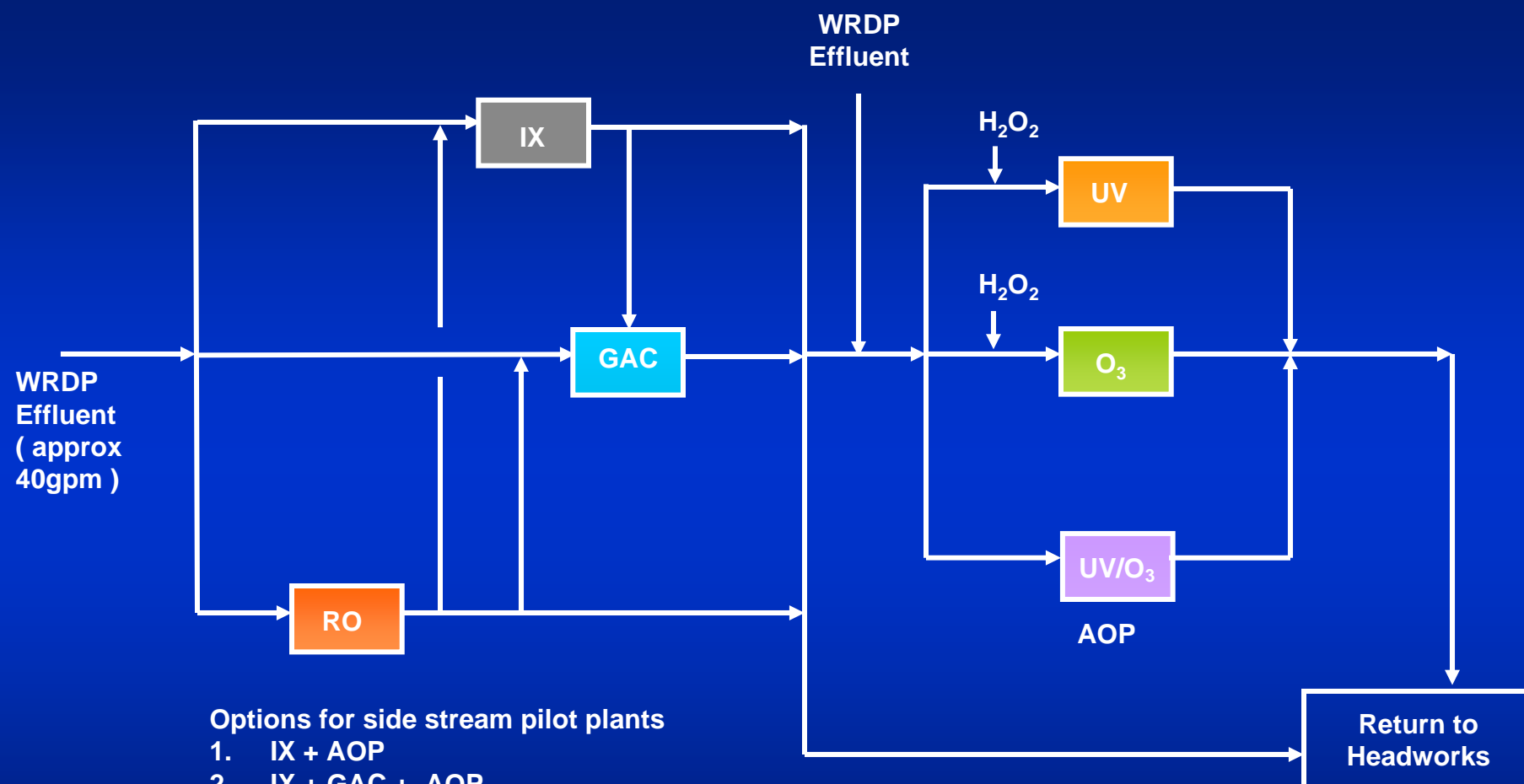
# Water Reuse Demonstration Plant (WRDP)



| Item | Treatment Objectives   |
|------|--|
| 1    | Solids removal of fine particles ( > 3mm)  |
| 2    | Biological nitrification process to convert ammonia to nitrate   |
| 3    | Biological denitrification process to convert nitrates to nitrogen gas   |
| 4    | Chemical and physical processes to remove phosphorus   |
| 5    | Solids separation process to remove suspend solids including particulate TP and TN   |
| 6    | UV radiation for inactivation of microbial contaminants  |
| 7    | SPPs include a combination of GAC, RO, IX, and AOP to test for removal of very low nutrient concentrations (TP < 0.1 mg/L and TN < 3.0 mg/L) and microconstituents |



# Side Stream Pilot Plant

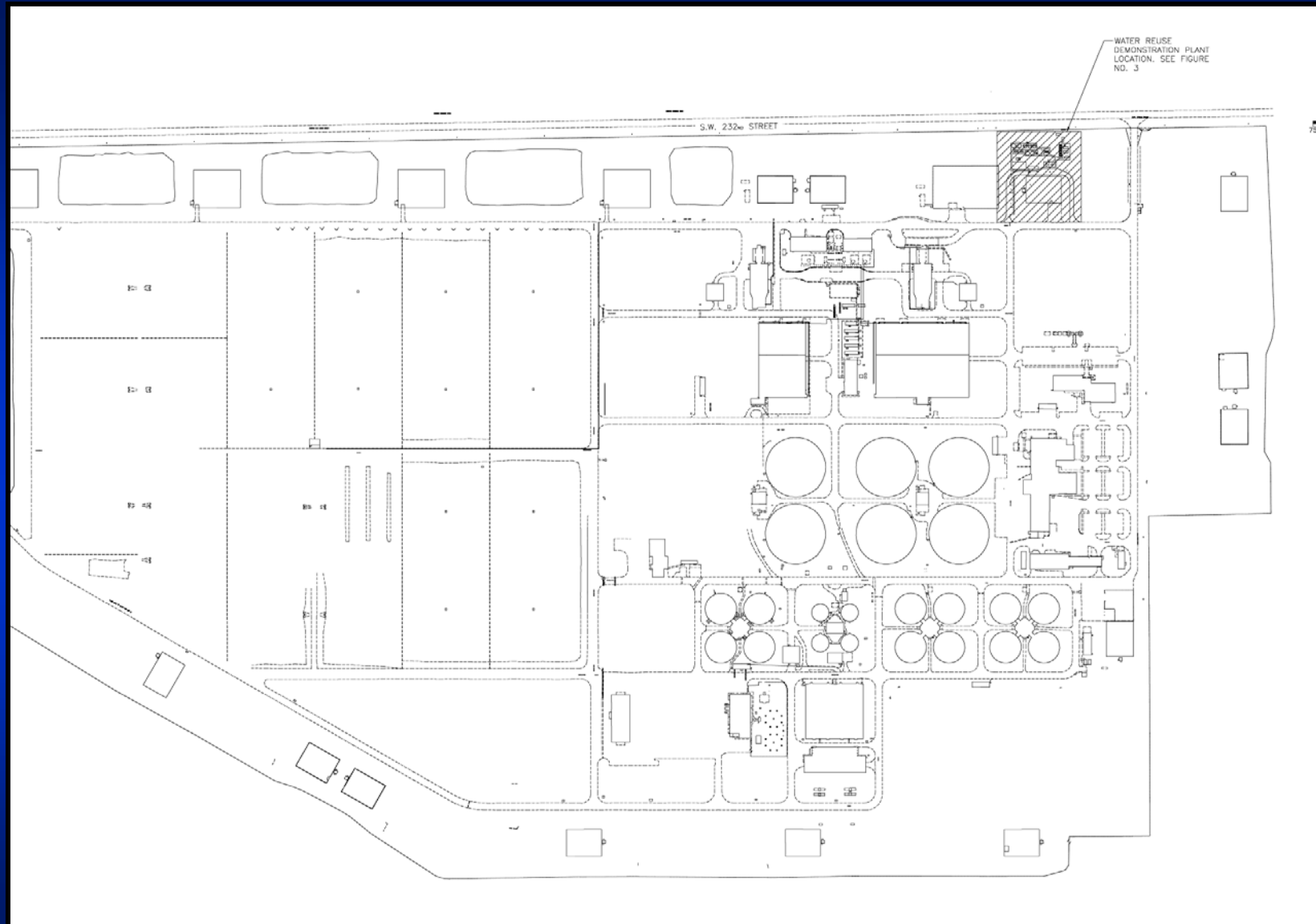


## Options for side stream pilot plants

1. IX + AOP
2. IX + GAC + AOP
3. GAC + AOP
4. RO + AOP
5. RO + GAC + AOP
6. RO + IX + AOP



# WRDP Location Plan





# WRDP Site Layout

## DRAWING HISTORY

| RELEASED FOR | DATE | BY       |
|--------------|------|----------|
| WATER USE    | X    | 09/04/09 |
| WATER USE    |      |          |
| WATER USE    |      |          |
| WATER        |      |          |

## REVISIONS

| NO. | DESCRIPTION | DATE | BY |
|-----|-------------|------|----|
|     |             |      |    |
|     |             |      |    |

## APPROVALS

|                  |                     |
|------------------|---------------------|
| CHIEF ENGINEER   |                     |
| SECTION HEAD     |                     |
| PROJECT MGR:     |                     |
| DESIGNED: K.X.X. | CHECKED: K.X.X.     |
| DRAWN: K.X.X.    | FINAL CHECK: K.X.X. |

XXXXXXXXXXXX  
XXXXXXXXXXXX Engineer  
State of Florida - License No. 00000  
Date:

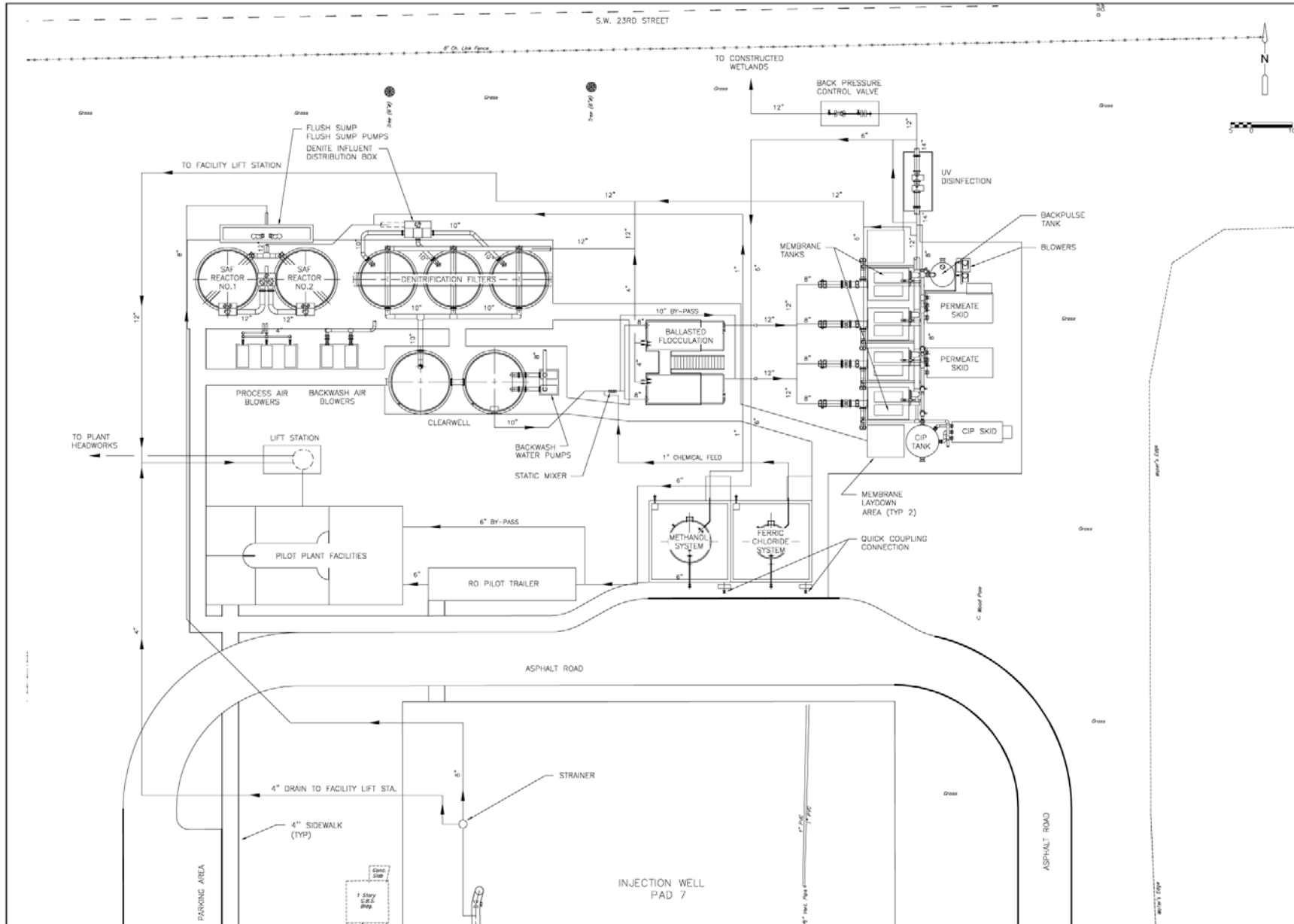
OR No.: 00000

FILE NAME: 4550000.DWG

DATE: OCT 13, 2008 SCALE: 1" = 10'

SHEET FIG 3-B

DWG. No. X-00000-A





# **WRDP Preliminary Design Includes**

- **Water Quality Objectives**
- **Design Criteria**
- **Preliminary Process and Equipment Sizing**
- **Conceptual Design Drawings**
- **Hydraulic Profile and Mass Balance**
- **Conceptual Project and O&M Cost Estimate**
- **P&ID Drawings**





# Coastal Wetlands Reuse Rehydration Project

*Constructed Wetlands*

**February 2007**



# C-1 Flow Way Components





# C-1 Flow Way Existing and Proposed Use



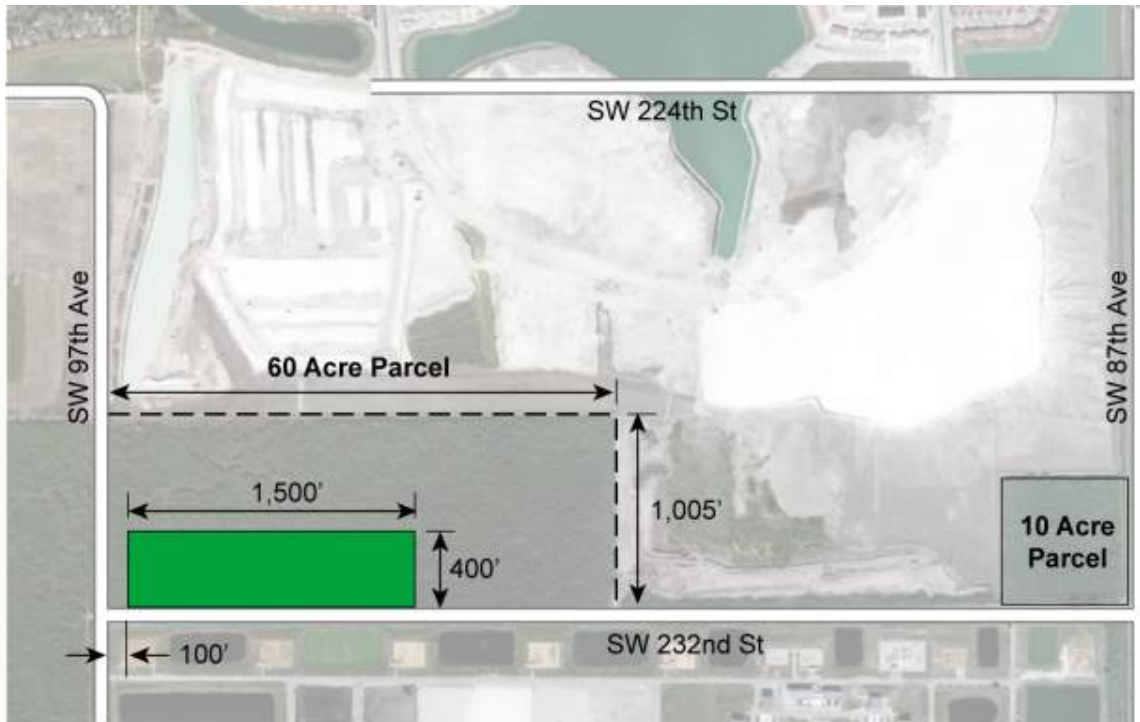


# Project Facility Siting



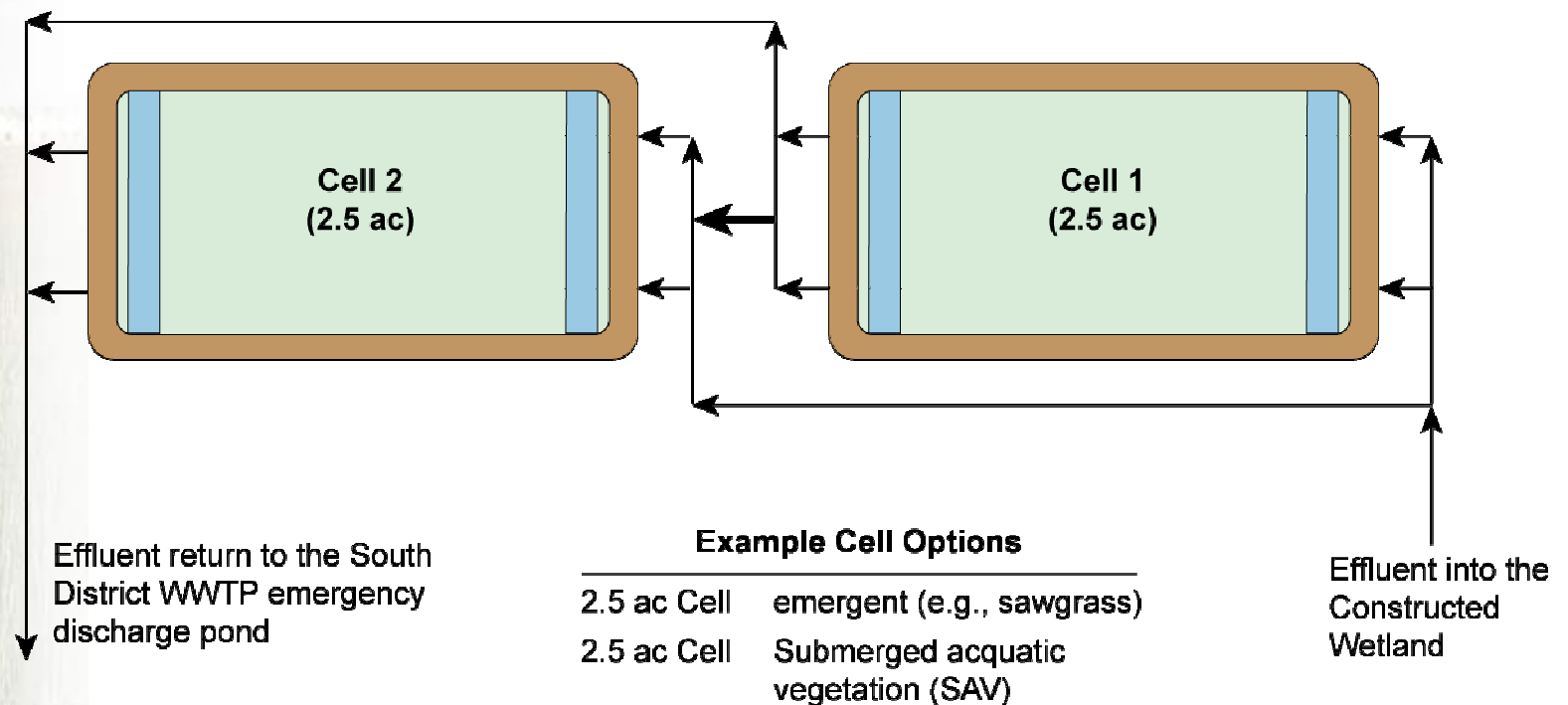


# Constructed Wetland Site



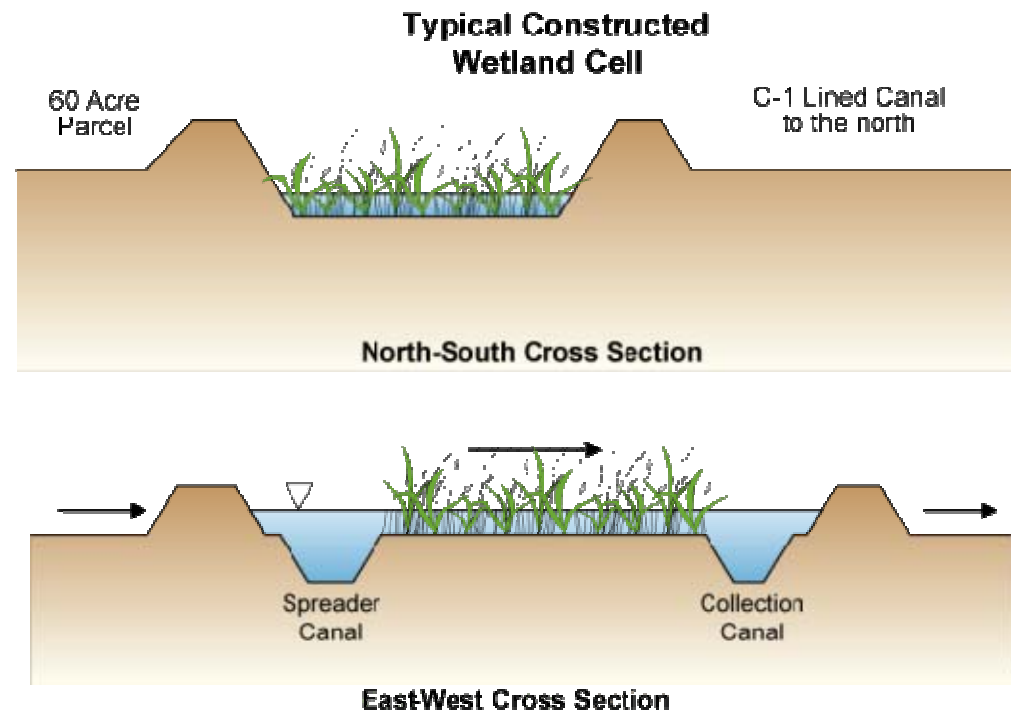


# Demonstration Cell Operational Flexibility



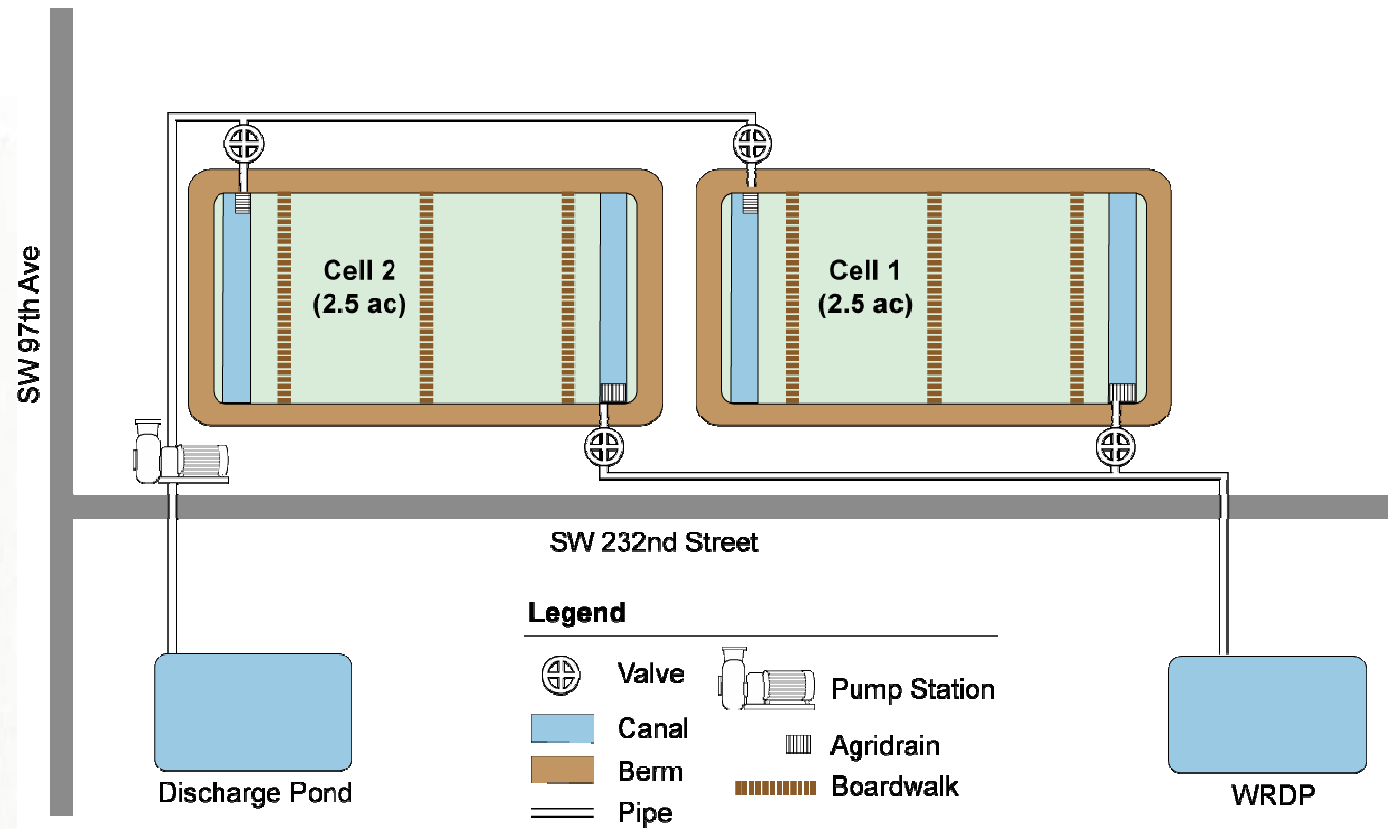


# Wetland Cell Cross Sections





# Wetland Cell Infrastructure





# Lennar Mitigation Wetland





## Lennar Mitigation Wetland – Dry Season



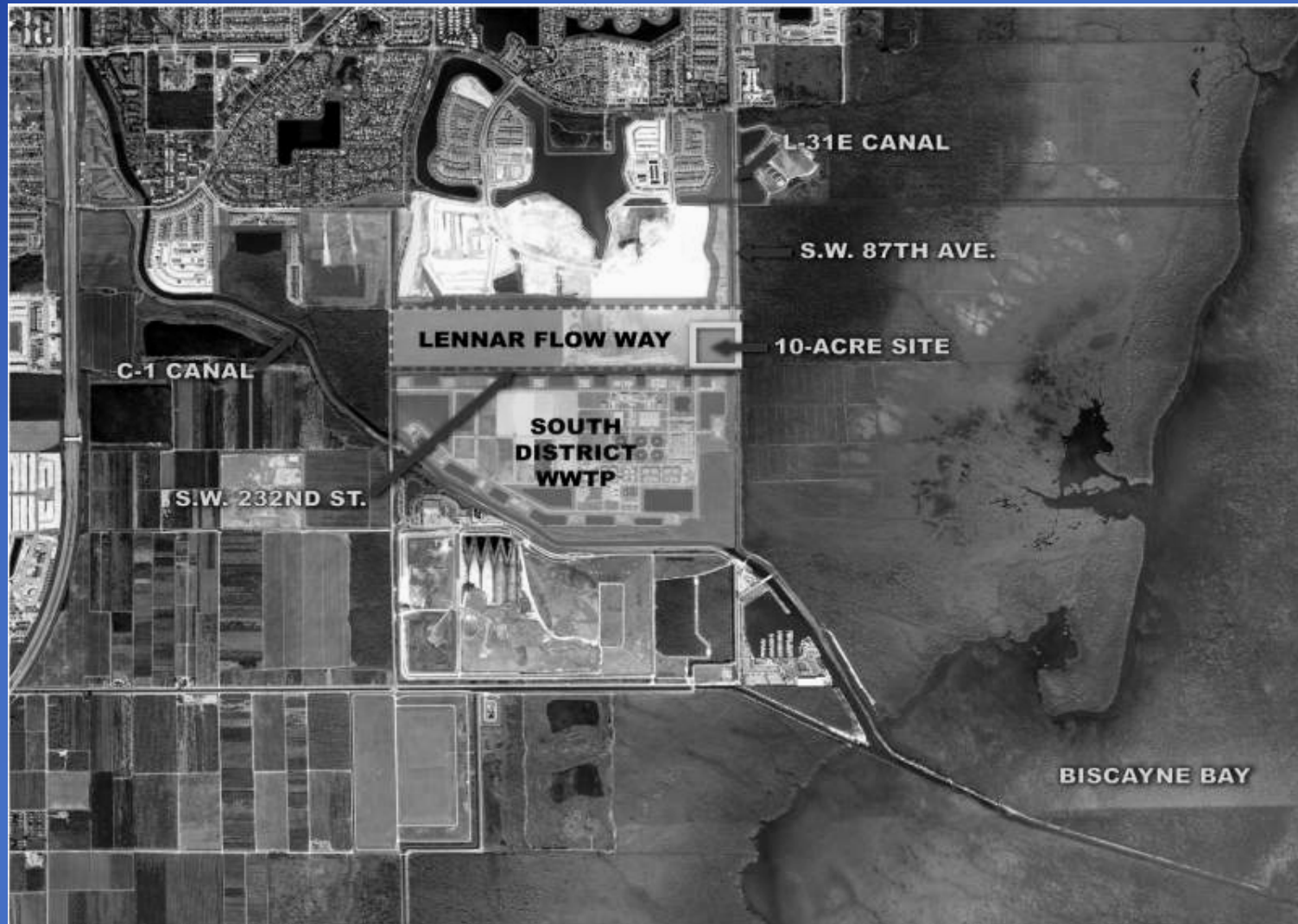


## Lennar Mitigation Wetland – Wet Season





# Baseline Assessment and Monitoring Program





# How do we Determine the Success of the Project?

- Water Quality Monitoring
- Ecological Monitoring
- Hydrologic Monitoring
- Water Control Plan
- Operations Manual





# **Monitoring Program Baseline Assessment**

- **Provide information needed to design, construct, and develop a monitoring plan for the CWRD project.**
- **Characterize an environmental baseline for assessment of physical, chemical and biological responses**

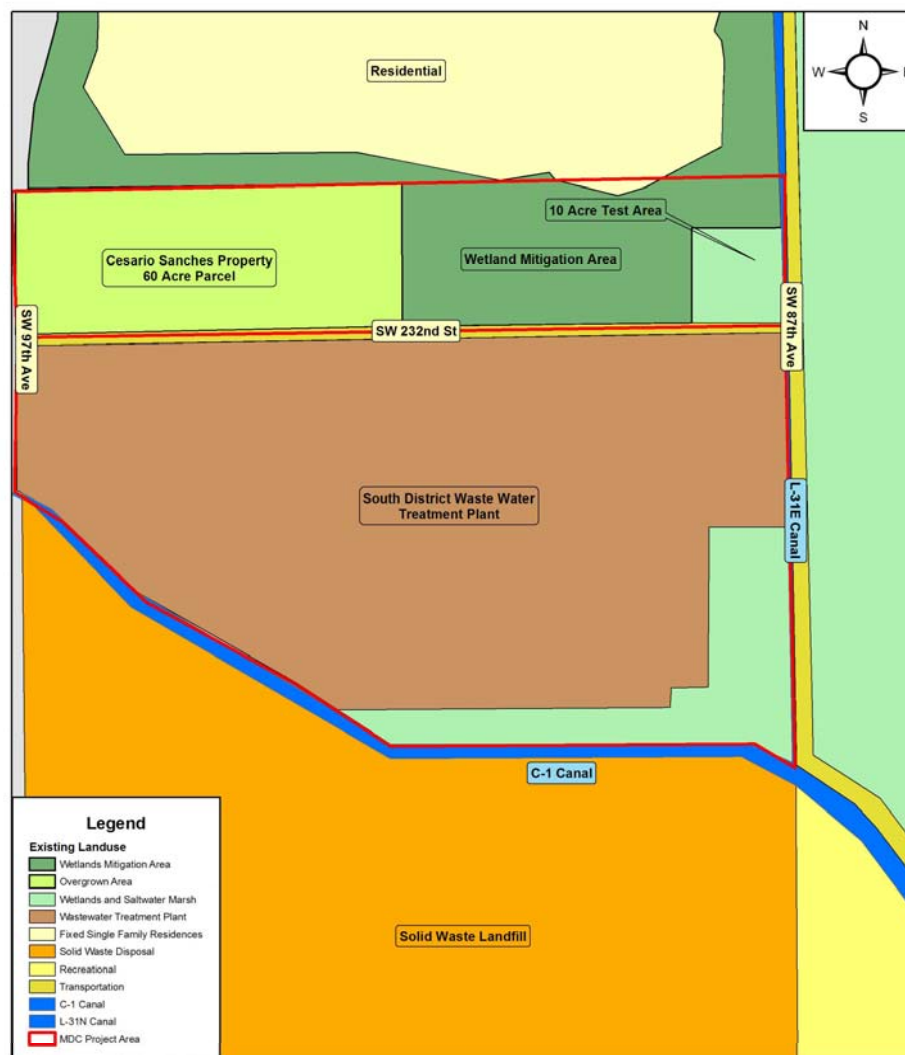


# Project Area and Existing Conditions

- Land Use
- Soils
  - Perrine Marl
  - Saline groundwater
- Topography (NGVD)
  - +8 feet at SW 87th Ave.
  - +3 feet in areas to East, sloping West to East (Biscayne Bay)

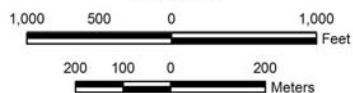


# Land Use



SOURCE: SFWMD, FGDL, & Milan, Swain & Associates, Inc., 2006

Scale 1:10,000



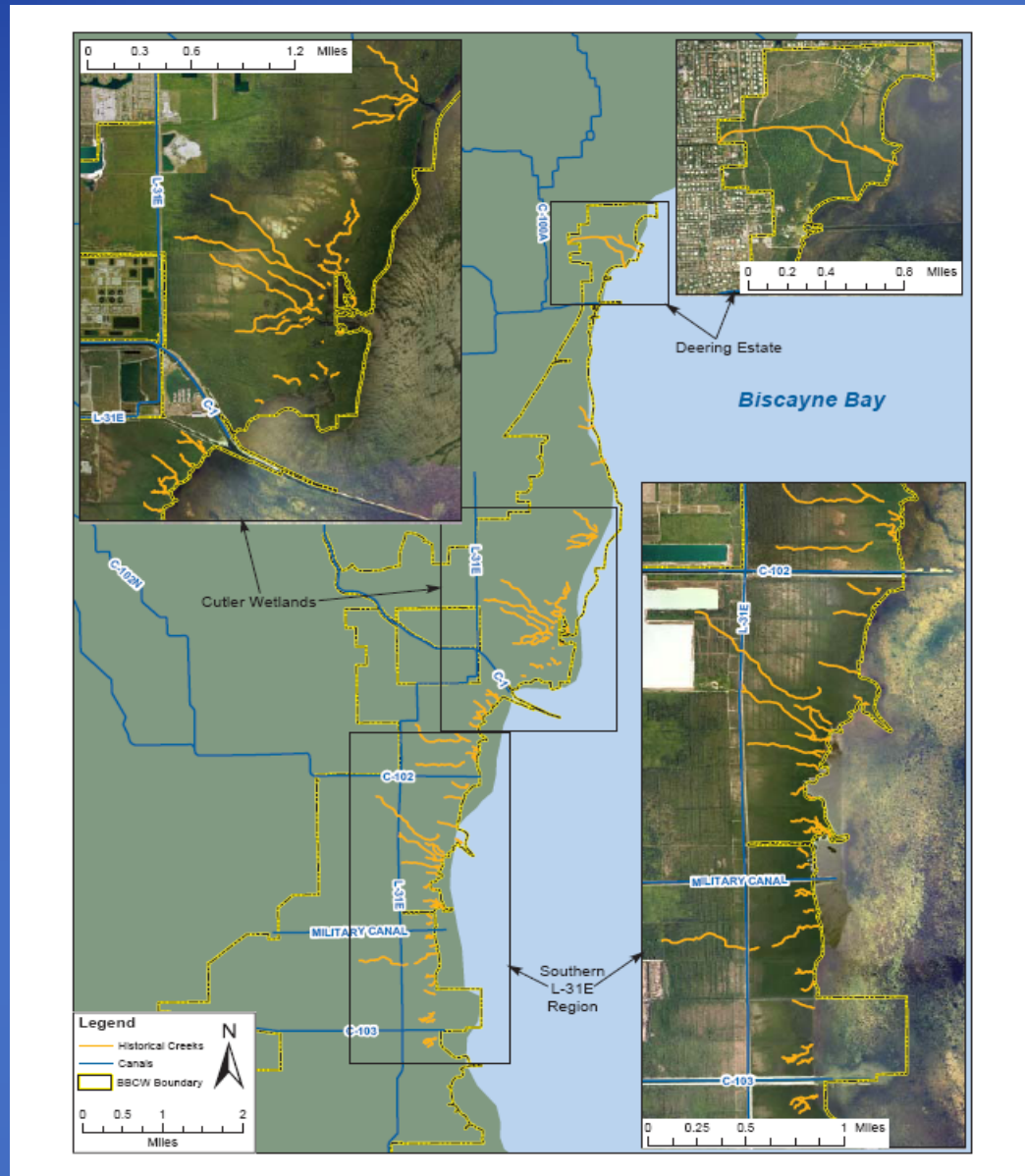


# Hydrology

- Historical sheet flow to Southeast via traverse glades
- C-1, C-100, C-012 and C-103 Canals drained respective basins
- Groundwater table lowered 5 to 6 ft.
- Cut-off headwaters to Biscayne Bay Coastal Wetlands
- Water Managed for Water Supply and Flood Protection

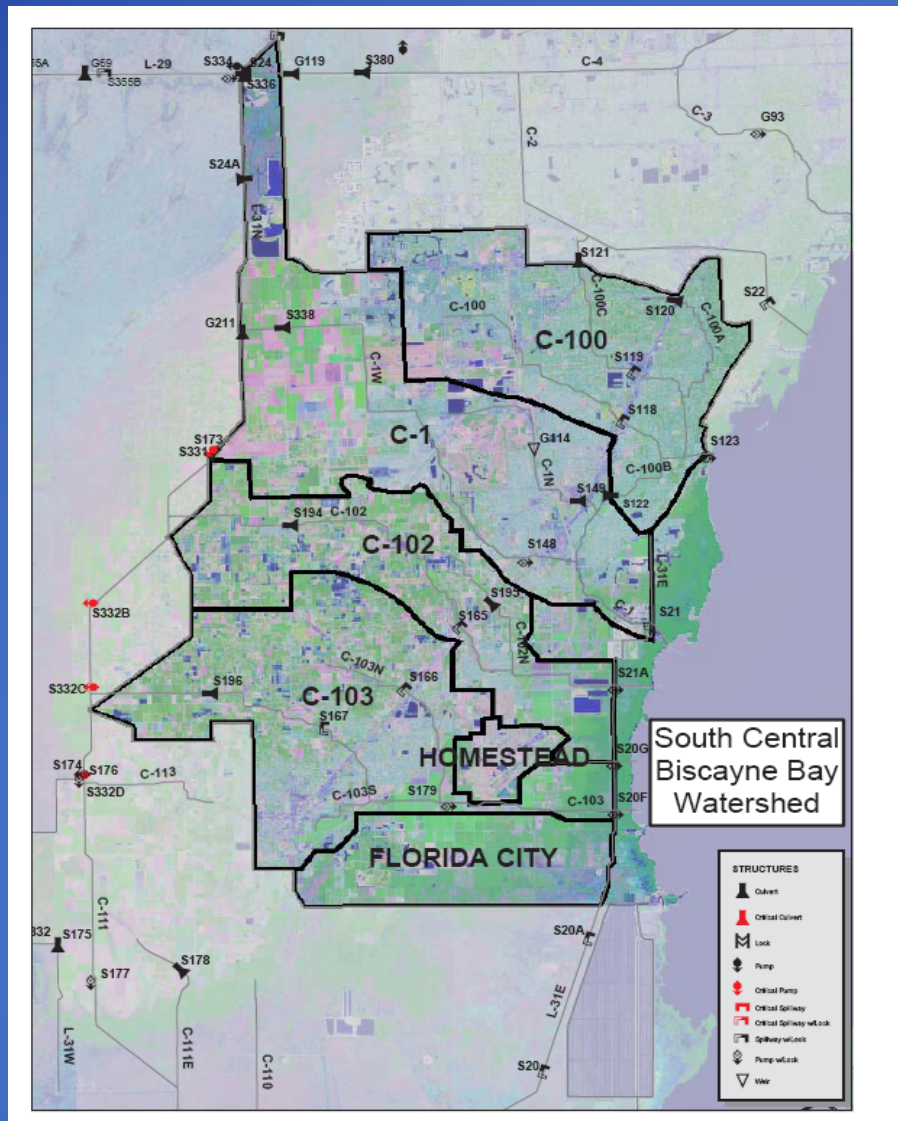


# Historical Sheet Flow



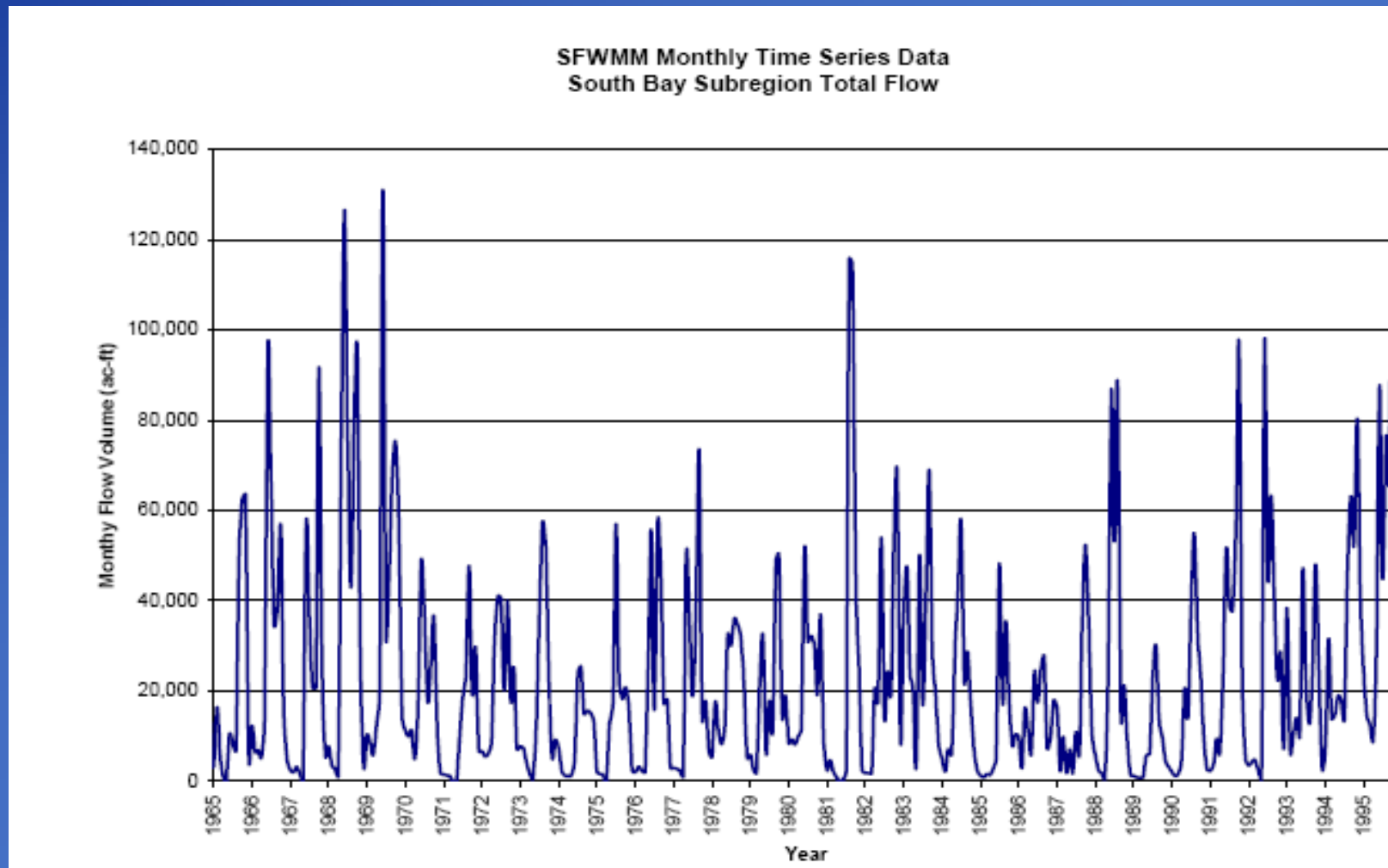


# Canal Basins





# Simulated Flows to Biscayne Bay





# Vegetation

(9.25 and 60 Acre Plots)

- Historically coastal mangrove, salt and freshwater marshes with hammocks and pine rocklands
- Agricultural production between 1900 and 1970
- Currently overgrown by predominantly Brazilian pepper, vines, castor bean





# Vegetation

(Lakes by the Bay South Commons – Mitigation Area)

- Constructed and planted 138-Acre Mitigation Area
- Shallow, cat-tail dominated, fresh water marsh



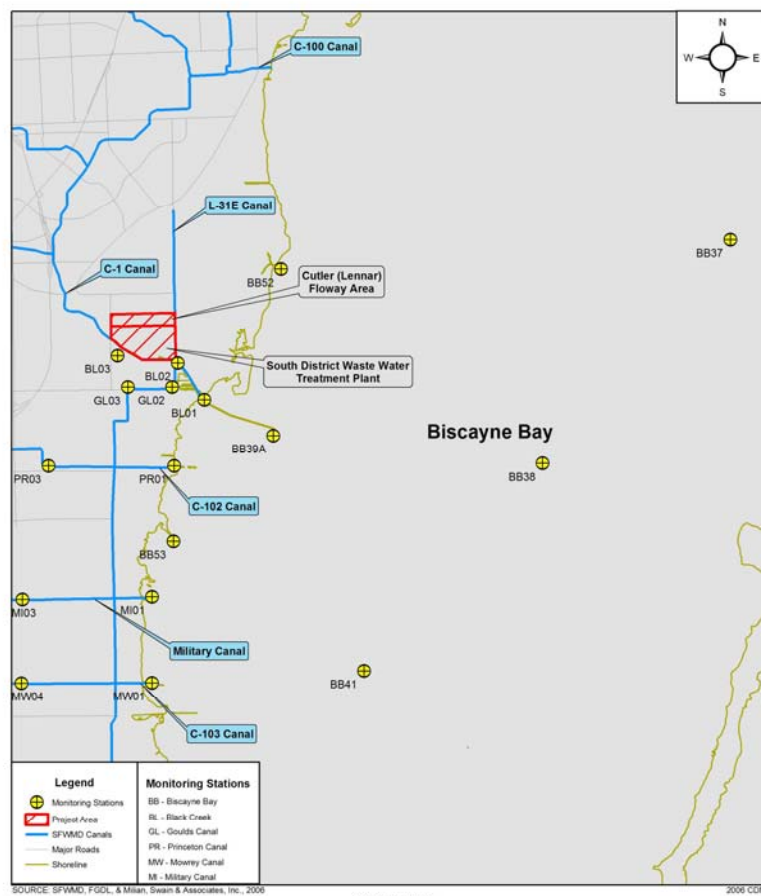


# Water Quality

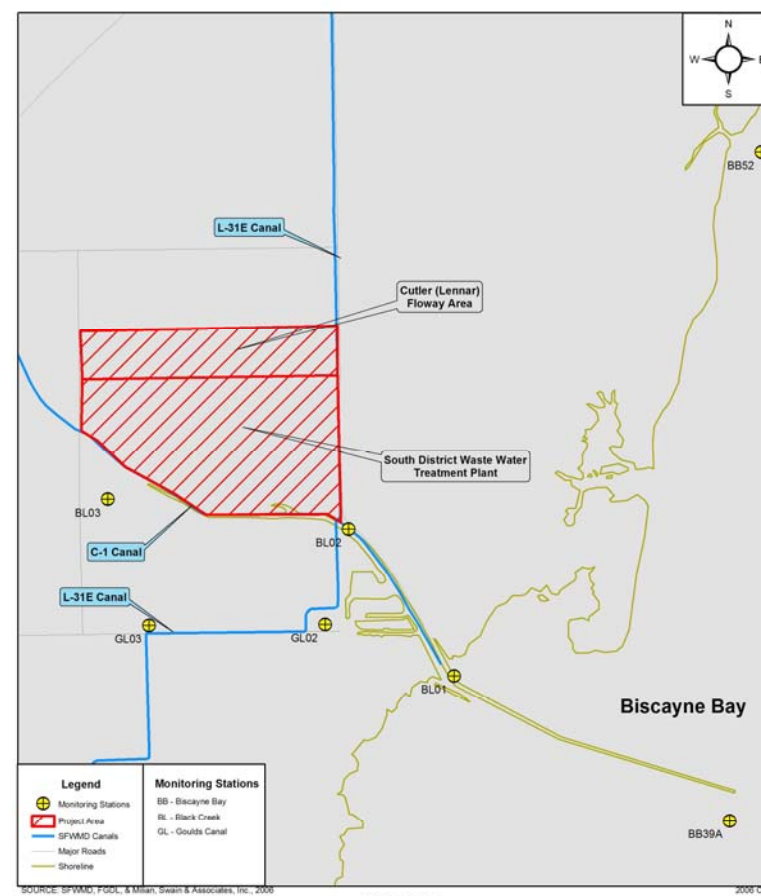
- Biscayne Bay Coastal Wetlands & Biscayne Bay Stations
- DERM Status and Trends Report
  - POR 1988 to 2003 – Adequate for WQ characterization
  - TKN, NH<sub>3</sub>, Nitrate/Nitrite
  - TPO<sub>4</sub>, OPO<sub>4</sub>
  - Fecal Coliform, Total Coliform
  - TSS, pH, DO, Salinity
  - Lead, Zinc, Cadmium<sup>1</sup>



# Location of Water Quality Stations



Coastal Wetlands Reuse Rehydration Demonstration Pilot Project  
Monitoring Station Locations



Coastal Wetlands Reuse Rehydration Demonstration Pilot Project  
Monitoring Station Locations







# Water Quality Characterization

- NH<sub>3</sub> and TPO<sub>4</sub> concentrations levels were higher in the C-1 and Goulds Canal
- C-1, Goulds, and C-102 Canals have higher Fecal and Total Coliform, and slightly lower DO concentrations
- TPO<sub>4</sub> was higher in the C-1 and Goulds canal (less than 0.020 mg/L)
- C-102 and C-103 Canals were higher in Nitrate/Nitrite
- Bay concentrations in all parameters indicate good nearshore mixing
- Shoreline nutrient survey confirmed that ammonium concentrations were highest in waters near the C-1, and C-103 (Meeder, 1997)



# Monitoring Program Elements

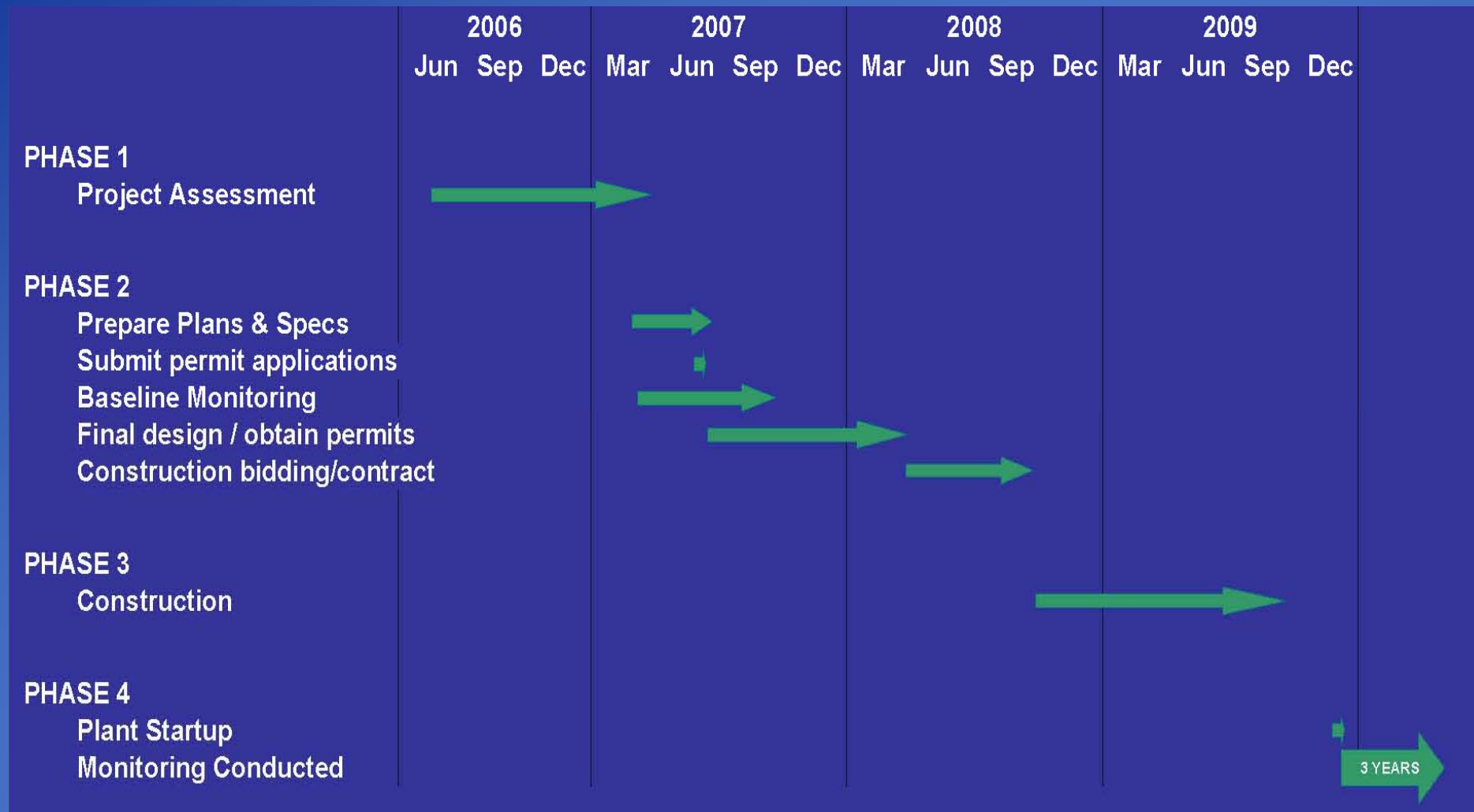
- Water Quality
- Vegetation
- Soils

## May also Include:

- Algae (periphyton)
- Benthic Invertebrates
- Wildlife
- EPOCs
- Fish
- Mesocosms



# Schedule





# Anticipated Permits

## Pre-bid Coordination & Approvals:

- Department of Public Works - ROW
- County Planning & Zoning - Notification only
- County Review Committee and OCI (Approval)
- Water Reuse Demonstration Plant

## Permitting Assistance:

- MD Building Department - (Review sections: Building, Electrical, Mechanical, Plumbing, Structural, Fire)
- FDEP / DERM - Request for Application for a Domestic Wastewater Facility Permit
- SFWMD - Initiate Dewatering Permit Application
- DERM - Accidental Release Prevention Program (for on site chemical storage)
  - Paving & Drainage (potential revisions to ERP permit)
  - Tree Clearing Permit (site photos indicate not necessary)



# Anticipated Permits, con't

## For the Wetlands:

- FDEP - Request for Approval of Monitoring Plans for Discharge of Domestic Wastewater to Wetlands
- SFWMD - ERP stormwater permit, dewatering (by contractor)
- USACOE - 404 permit (coincident with the ERP)
- DERM - Class IV Wetlands, Class II



# QUESTIONS / COMMENTS



# **Water Quality Targets**

- **NH3 Biscayne Bay National Park and the Biscayne Bay Aquatic Preserve are classified as an Outstanding Florida Water (OFW) under Section 17-302.530(48)(b), Florida Administrative Code (F.A.C.)**
- **Project water quality targets are expected to exceed that of surrounding canals**



# Effluent Water Quality Goals and Canal Conditions



| Parameter                             | Effluent Water Quality Goals <sup>(a)</sup> |                      |              |                              | Other Targets |            | Canal Stations    |       |       |       |       |       |
|---------------------------------------|---|----------------------|--------------|------------------------------|---------------|------------|-------------------|-------|-------|-------|-------|-------|
|                                       | Reuse                                       | Wetlands Application | Heavy Metals | Class III & OFW              | BBPI          | WWRU P D T | BL03*             | GL03* | PR03  | MI03  | MW04  | Mean  |
| Total Nitrogen (mg/L)                 | -   | 3                    | -            | 0.27                         | -             | -          | 0.80              | 3.26  | 4.72  | 1.13  | 2.85  | 2.55  |
| Total Kjeldahl Nitrogen (mg/L)        | -   | -                    | -            | 0.22                         | -             | 0.36       | 0.51              | 1.23  | 0.59  | 0.49  | 0.48  | 0.66  |
| Nitrite/ Nitrate (mg/L)               | -   | -                    | -            | 0.01                         | 0.01          | 0.01       | 0.22              | 1.57  | 4.09  | 0.60  | 2.34  | 1.76  |
| Ammonia Nitrogen (mg/L)               | -   | -                    | -            | 0.02 - 0.05                  | 0.05          | 0.05       | 0.07              | 0.47  | 0.04  | 0.05  | 0.03  | 0.13  |
| Total Phosphorus (mg/L)               | -   | 1.000                | -            | 0.005                        | 0.005         | 0.005      | 0.012             | 0.018 | 0.009 | 0.015 | 0.009 | 0.013 |
| Orthophosphate (mg/L)                 | -   | -                    | -            | 0.002                        | -             | -          | 0.006             | 0.012 | 0.006 | 0.008 | 0.006 | 0.008 |
| Total Coliform (cfu/100ml)            | <1.0  | <1.0                 | -            | <1.0                         | -             | <10.0      | 334               | 432   | 602   | 166   | 331   | 373   |
| Fecal Coliform (cfu/100ml)            |   |                      | -            |                              | -             |            | 105               | 99    | 128   | 39    | 60    | 86    |
| Cadmium (ug/L)                        | -   | -                    | 0.1          | -                            | -             | -          | 0.1               | 0.1   | 0.1   | 0.1   | 0.1   | 0.1   |
| Lead (ug/L)                           | -   | -                    | 0.7          | -                            | -             | -          | 1.2               | 2.0   | 1.0   | 1.1   | 1.0   | 1.3   |
| Zinc (ug/L)                           | -   | -                    | 10.0         | -                            | -             | -          | 4.8               | 5.0   | 4.6   | 6.0   | 4.6   | 5.0   |
| DO Surface (mg/L)                     | -   | -                    | -            | 5.0 to 7.3                   | -             | 6.43       | 5.7               | 6.9   | 5.7   | 6.5   | 6.4   | 6.2   |
| DO Bottom (mg/L)                      | -   | -                    | -            |                              | -             |            | 5.1               | 6.7   | 5.6   | 6.1   | 5.8   | 5.9   |
| Surface Salinity (ppt)                | -   | -                    | -            | No change > 5 ppt            | -             | -          | 0.5               | 0.5   | 0.3   | 0.3   | 0.4   | 0.4   |
| Bottom Salinity (ppt)                 | -   | -                    | -            |                              | -             | -          | 0.7               | 0.5   | 0.5   | 0.5   | 1.2   | 0.7   |
| Total Suspended Solids (mg/L)         | 5.0**                                       | 5.0                  | -            | 3.5                          | -             | -          | 3.1               | 5.5   | 3.7   | 2.9   | 3.7   | 3.8   |
| pH                                    | -   | -                    | -            | 6.5 to 7.5*                  | -             | -          | 7.0               | 6.7   | 6.6   | 5.8   | 6.0   | 6.4   |
| Emerging Pollutants of Concern (EPOC) | -   | -                    | -            | Lowest Possible Level*<br>** | -             | -          | No Data Available |       |       |       |       |       |
| Cryptosporidium and Giardia           | -   | -                    | -            |                              | -             | -          |                   |       |       |       |       |       |

\* Appropriate limits for pH in the estuarine zone will require further evaluation.

\*\* Single sample maximum

\*\*\* Even though, currently there are no established numerical criteria or antidegradation targets for these parameters, available information shall be gathered on removal efficiency of various treatment technologies and detectable levels after advanced treatment for these parameters for comparative assessment. In practical terms, the objective would be to identify the technology that reduces such contaminants to the lowest level.

(a) Task 5 – Final Report South Dade Advanced Wastewater Treatment Alternatives, (USCOE, 2004)



# Effluent Water Quality Goals and Canal/Bay Interface Conditions

| Parameter                             | Effluent Water Quality Goals <sup>(a)</sup> |                      |              |                          | Other Targets |            | Canal/Bay Interface (Brackish) Stations |       |       |       |       |       |       |
|---------------------------------------|---|----------------------|--------------|--------------------------|---------------|------------|---|-------|-------|-------|-------|-------|-------|
|                                       | Reuse                                       | Wetlands Application | Heavy Metals | Class III & OF W         | BBPI          | WWRU P D T | BL01*                                   | BL02* | GL02* | PR01  | MI01  | MW01  | Mean  |
| Total Nitrogen (mg/L)                 | -   | 3                    | -            | 0.27                     | -             | -          | -                                       | -     | -     | 1.92  | -     | 1.00  | 1.46  |
| Total Kjeldahl Nitrogen (mg/L)        | -   | -                    | -            | 0.22                     | -             | 0.36       | -                                       | -     | -     | 0.32  | -     | 0.44  | 0.38  |
| Nitrite/ Nitrate (mg/L)               | -   | -                    | -            | 0.01                     | 0.01          | 0.01       | 0.13                                    | 0.14  | 0.13  | 1.46  | 0.17  | 0.50  | 0.42  |
| Ammonia Nitrogen (mg/L)               | -   | -                    | -            | 0.02 - 0.05              | 0.05          | 0.05       | 0.26                                    | 0.25  | 3.00  | 0.14  | 0.09  | 0.07  | 0.63  |
| Total Phosphorus (mg/L)               | -   | 1.000                | -            | 0.005                    | 0.005         | 0.005      | 0.012                                   | 0.012 | 0.021 | 0.010 | 0.012 | 0.010 | 0.013 |
| Orthophosphate (mg/L)                 | -   | -                    | -            | 0.002                    | -             | -          | -                                       | -     | -     | 0.006 | -     | 0.007 | 0.007 |
| Total Coliform (cfu/100ml)            | <1.0  | <1.0                 | -            | <1.0                     | -             | <10.0      | 380                                     | 247   | 2828  | 407   | 121   | 197   | 697   |
| Fecal Coliform (cfu/100ml)            |   |                      | -            |                          | -             |            | 104                                     | 90    | 1254  | 74    | 29    | 26    | 263   |
| Cadmium (ug/L)                        | -   | -                    | 0.1          | -                        | -             | -          | 0.1                                     | 0.2   | 0.1   | 0.2   | -     | 0.2   | 0.1   |
| Lead (ug/L)                           | -   | -                    | 0.7          | -                        | -             | -          | 0.6                                     | 1.0   | 1.0   | 0.8   | 0.1   | 0.8   | 0.7   |
| Zinc (ug/L)                           | -   | -                    | 10.0         | -                        | -             | -          | 3.3                                     | 1.5   | 3.2   | 2.5   | 6.1   | 2.4   | 3.2   |
| DO Surface (mg/L)                     | -   | -                    | -            | 5.0 to 7.3               | -             | 6.43       | 5.0                                     | 5.0   | 3.6   | 5.6   | 4.2   | 5.6   | 4.8   |
| DO Bottom (mg/L)                      | -   | -                    | -            |                          | -             |            | 5.4                                     | 4.7   | 3.3   | 5.5   | 5.0   | 5.5   | 4.9   |
| Surface Salinity (ppt)                | -   | -                    | -            | No change > 5 ppt        | -             | -          | 18.5                                    | 17.2  | 15.5  | 7.8   | 15.8  | 16.0  | 15.1  |
| Bottom Salinity (ppt)                 | -   | -                    | -            |                          | -             | -          | 24.5                                    | 24.4  | 17.9  | 20.1  | 22.9  | 26.5  | 22.7  |
| Total Suspended Solids (mg/L)         | 5.0**                                       | 5.0                  | -            | 3.5                      | -             | -          | 9.7                                     | 7.0   | 12.3  | 14.5  | -     | 9.4   | 10.5  |
| pH                                    | -   | -                    | -            | 6.5 to 7.5*              | -             | -          | 7.0                                     | 7.0   | 6.0   | 7.0   | 7.0   | 7.0   | 6.8   |
| Emerging Pollutants of Concern (EPOC) | -   | -                    | -            | Lowest Possible Level*** | -             | -          | No Data Available                       |       |       |       |       |       |       |
| Cryptosporidium and Giardia           | -   | -                    | -            |                          | -             | -          |   |       |       |       |       |       |       |

\* Appropriate limits for pH in the estuarine zone will require further evaluation.

\*\* Single sample maximum

\*\*\* Even though, currently there are no established numerical criteria or antidegradation targets for these parameters, available information shall be gathered on removal efficiency of various treatment technologies and detectable levels after advanced treatment for these parameters for comparative assessment. In practical terms, the objective would be to identify the technology that reduces such contaminants to the lowest level.



# Effluent Water Quality Goals and Biscayne Bay Conditions

| Parameter                             | Effluent Water Quality Goals <sup>(a)</sup> |                      |              |                          | Other Targets |            | Biscayne Bay Stations |      |       |      |      |      |       |
|---------------------------------------|---|----------------------|--------------|--------------------------|---------------|------------|-----------------------|------|-------|------|------|------|-------|
|                                       | Reuse                                       | Wetlands Application | Heavy Metals | Class III & OFW          | BBPI          | WWRU P D T | BB39A*                | BB52 | BB53  | BB38 | BB41 | BB37 | Mean  |
| Total Nitrogen (mg/L)                 | -   | 3                    | -            | 0.27                     | -             | -          | -                     | -    | -     | -    | -    | -    | -     |
| Total Kjeldahl Nitrogen (mg/L)        | -   | -                    | -            | 0.22                     | -             | 0.36       | -                     | -    | -     | -    | -    | -    | -     |
| Nitrite/ Nitrate (mg/L)               | -   | -                    | -            | 0.01                     | 0.01          | 0.01       | 0.09                  | 0.03 | 0.31  | 0.01 | 0.03 | -    | 0.09  |
| Ammonia Nitrogen (mg/L)               | -   | -                    | -            | 0.02-0.05                | 0.05          | 0.05       | 0.07                  | 0.08 | 0.08  | 0.07 | 0.07 | -    | 0.07  |
| Total Phosphorus (mg/L)               | -   | 1.000                | -            | 0.005                    | 0.005         | 0.005      | -                     | -    | 0.008 | -    | -    | -    | 0.01  |
| Orthophosphate (mg/L)                 | -   | -                    | -            | 0.002                    | -             | -          | -                     | -    | -     | -    | -    | -    | -     |
| Total Coliform (cfu/100ml)            | <1.0  | <1.0                 | -            | <1.0                     | -             | <10.0      | 121                   | 15   | 59    | 5    | 5    | 7    | 35.25 |
| Fecal Coliform (cfu/100ml)            |   |                      | -            |                          | -             |            | 65                    | 6    | 13    | 5    | 5    | 6    | 16.65 |
| Cadmium (ug/L)                        | -   | -                    | 0.1          | -                        | -             | -          | -                     | 0.0  | 0.0   | -    | -    | -    | 0.04  |
| Lead (ug/L)                           | -   | -                    | 0.7          | -                        | -             | -          | 0.1                   | 0.1  | 0.1   | -    | -    | -    | 0.11  |
| Zinc (ug/L)                           | -   | -                    | 10.0         | -                        | -             | -          | 6.1                   | 6.1  | 6.1   | -    | -    | -    | 6.10  |
| DO Surface (mg/L)                     | -   | -                    | -            | 5.0 to 7.3               | -             | 6.43       | 6.2                   | 6.3  | 7.6   | 5.9  | 6.3  | 6.1  | 6.39  |
| DO Bottom (mg/L)                      | -   | -                    | -            |                          | -             |            | 6.4                   | 6.5  | 8.5   | 6.0  | 6.6  | 6.3  | 6.69  |
| Surface Salinity (ppt)                | -   | -                    | -            | No change > 5 ppt        | -             | -          | 28.7                  | 24.4 | 20.8  | 35.6 | 33.7 | 35.4 | 29.75 |
| Bottom Salinity (ppt)                 | -   | -                    | -            |                          | -             | -          | 29.2                  | 24.5 | 21.6  | 35.7 | 33.9 | 35.4 | 30.05 |
| Total Suspended Solids (mg/L)         | 5.0**                                       | 5.0                  | -            | 3.5                      | -             | -          | -                     | -    | -     | 9.4  | 11.0 | 10.3 | 10.23 |
| pH                                    | -   | -                    | -            | 6.5 to 7.5*              | -             | -          | 7.6                   | 8.1  | 7.9   | 7.0  | 7.0  | 7.0  | 7.42  |
| Emerging Pollutants of Concern (EPOC) | -   | -                    | -            | Lowest Possible Level*** | -             | -          | No Data Available     |      |       |      |      |      |       |
| Cryptosporidium and Giardia           | -   | -                    | -            |                          | -             | -          |                       |      |       |      |      |      |       |

\* Appropriate limits for pH in the estuarine zone will require further evaluation.

\*\* Single sample maximum

\*\*\* Even though, currently there are no established numerical criteria or antidegradation targets for these parameters, available information shall be gathered on removal efficiency of various treatment technologies and detectable levels after advanced treatment for these parameters for comparative assessment. In practical terms, the objective would be to identify the technology that reduces such contaminants to the lowest level.