CDM

Miami Dade Water & Sewer Department

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Coastal Wetlands Reuse Rehydration Demonstration Project Phase I

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Technical Memorandum

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Section 1
Introduction
1.1 Background

Biscayne Bay is a shallow subtropical estuary that is an important natural and economic resource. The historic groundwater and surface water flows to Biscayne Bay have been dramatically altered by anthropogenic effects such as farmland drainage and the creation and operation of the Central and Southern Florida (CS&F) Project. Although the total impact of these manmade changes is not fully understood, it is recognized that the freshwater flows necessary for a healthy estuarine system have been altered to the point of causing ecological impact. With the restoration of more natural freshwater flow patterns, including sufficient quantity, timing and distribution of overland flows, it is expected that native flora and fauna, including threatened and endangered species, will benefit.

The Central and Southern Florida Project Comprehensive Review Study Final Integrated Feasibility Report and Programmatic Environmental Impact Statement (Restudy or Yellow Book) recognized the value of Biscayne Bay and the importance of restoring the estuarine ecosystem. The Biscayne Bay Coastal Wetlands (BBCW) Project was thus selected as one of components of the Comprehensive Everglades Restoration Plan (CERP) which was approved by Congress as part of the Water Resource Development Act (WRDA) of 2000. The South Florida Water Management District (SFWMD) also recognized the importance of restoring Biscayne Bay and incorporated Phase 1 of the BBCW, consisting of the Deering Estate and Cutler Wetlands Flow Way components, into one of the SFWMD Acceler8 Program projects.

The Restudy, however determined that there will be insufficient water available in the natural system to restore the coastal wetlands and Southern Biscayne Bay. Because of this lack of freshwater the CERP proposed to provide additional water to Biscayne Bay and the coastal wetlands through the South Miami-Dade Wastewater Reuse project. The South Miami-Dade Wastewater Reuse project proposed to provide a higher quality reuse water through additional treatment capabilities to the existing Miami-Dade Water and Sewer Department's South District Wastewater Treatment Plant (SDWWTP) secondary effluent. Because of concern over water quality and the associated treatment technologies that would be required to attain water quality high enough to discharge into Biscayne Bay's Outstanding Florida Waters (OFW), the Wastewater Reuse Pilot Project was established in CERP.

The CERP Wastewater Reuse Pilot Project proposed researching the level of treatment considered necessary to achieve the water quality criteria needed to discharge reclaimed water (highly treated wastewater) into natural areas, determining the level of advanced treatment necessary to achieve that water quality (Part 1), and the construction of a pilot project to demonstrate that the appropriate level of treatment can be attained on a consistent basis (Part 2). Although Part 1 of the Wastewater Reuse Pilot Project was completed in 2004, Part 2 of the project has been placed on hold by the U.S. Army Corps. of Engineers and the South Florida Water Management

District until at least 2015. In the meantime, the Biscayne Bay Coastal Wetlands (BBCW) Acceler8 project, which is Phase 1 of the full CERP BBCW Project, is continuing with project design and has an anticipated construction completion date of 2009.

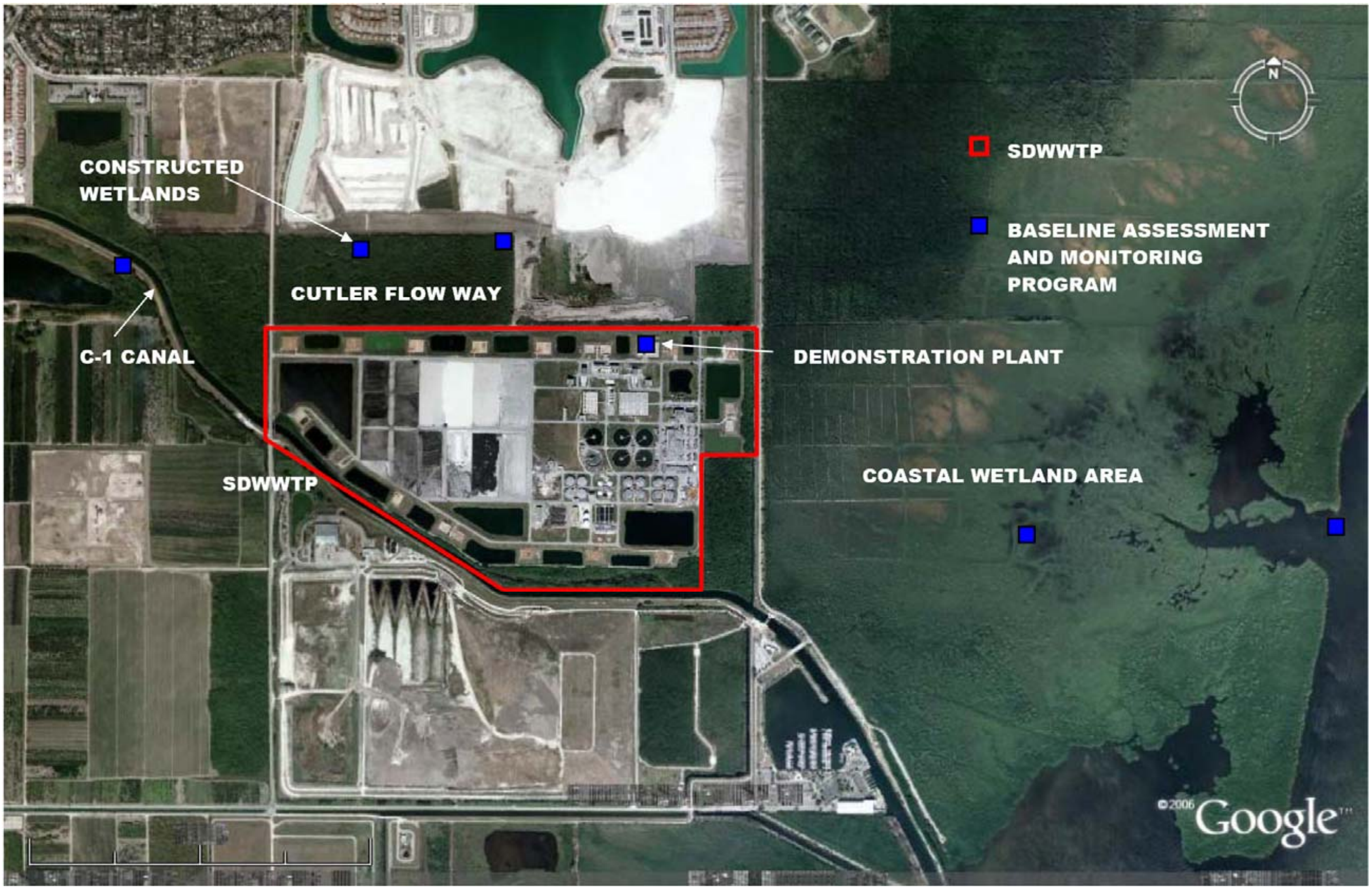
As with many communities in Southeast Florida, Miami-Dade County is developing reclaimed water programs as a means of conserving this resource. One potential reclaimed water project is to rehydrate coastal wetlands with highly treated wastewater, from the SDWWTP to enhance and restore wetlands habitats.

Miami-Dade County has proposed to undertake two pilot reuse projects as part of the Alternative Water Supply Plan of the May 2006 Miami-Dade Interim Consumptive Use Authorization and Agreement (Agreement) with the SFWMD. One of the two pilot projects, the subject of this Technical Memorandum is the Coastal Wetlands Reuse Rehydration Demonstration Project (CWRRDP). The CWRRDP consists of a Water Reuse Demonstration Plant (WRDP) at the SDWWTP, a constructed wetland in the Cutler (formerly Lennar) Flow Way, and a baseline assessment and monitoring program of the C-1 Canal, Cutler Flow Way, the WRDP, the constructed wetland, the coastal wetlands, and Biscayne Bay. An aerial photograph of the site including the Cutler Flow Way and the rehydration area is provided in **Figure 1-1**. According to the Agreement, 90 percent complete designs and permit applications for the construction of the two pilot projects should be submitted by May 5, 2007. In August 2006, CDM was authorized to conduct the initial design (Phase I) of the CWRRDP. This report provides a written summary of the work conducted by CDM and sub-consultants under Phase I of the CWRRDP and sets the stage for final design (Phase II).

1.2 Biscayne Bay Coastal Wetlands Rehydration Overview

The basic information available from the US Army Corps of Engineers (USCOE) description of Alternative O (June 2006), which is the alternative proposed for the Tentatively Selected Plan for the Biscayne Bay Coastal Wetlands CERP project, is that there will be five components for providing so-called "available water" to wetlands in the southeastern part of the County. These components are listed below, in the direction from north to south. The components, as detailed in the alternative description, are numbered sequentially below:

- Deering Estate C-100A Component (No. 1): extend an existing canal from the C-100A spur canal to convey water to a historic slough located on public lands.
- Cutler Wetlands C-100 Component (No. 2): provide a complex pumped system to convey water generally southward to a set of wetlands and remnant creeks. This set of wetlands and remnant creeks is located south of the C-100 Canal's control structure S-123, and north of the C-1 Canal's control structure S-21. The operation of the conveyance system is interlinked with that for the Deering Estate system



CDM

Figure 1-1
Aerial Photograph

(Component No.1) because the C-100A and C-100 canals themselves are connected. One of the sources of available water, besides canal flow, will be reclaimed water from a reuse treatment plant to be built adjacent to the existing SDWWTP. Long-term, 50 CFS (32.5 MGD) of reclaimed water from the reuse plant will be routed to the Cutler Flow Way, which is located just north of the existing SDWWTP, to replace the initial 50 CFS which is to come from available canal stormwater flow.

- Cutler Wetlands C-1 Component (No. 3): provide a complex pumped system to convey water generally northward to the same set of wetlands and remnant creeks mentioned above for the Component No. 2. As mentioned earlier, aside from the available canal flow, 50 CFS of reclaimed water will be routed to the Cutler Flow Way.

- L-31E Canal Component (No. 4): provide a complex pumped system to re-route available surface water from several canals, namely the Goulds Canal, C-102, C-103, Military Canal and North Canal, into the L-31E Canal, to adjacent freshwater wetlands and ultimately to remnant creeks. These wetlands and remnant creeks are located east of L-31E Canal. As in Components No. 2 and No. 3, it is anticipated that there will be reuse water applied in this component, except that the flow will be much greater, namely 150 CFS (99 MGD). The exact location of the wastewater discharge is not known, because it has been determined that wastewater should be first discharged to freshwater wetlands located upstream (west) of the coastal wetlands that are located to the east of L-31E, and additional study is needed to optimize the discharge locations.

- Florida City Canal Southward Component (also known as Barnes Sound Component) (No.5): provide a pumped system (largely already in place) to convey water from the Florida City Canal southward to the Model Lands area. This component requires further study to avoid excessive diversions that might compromise the health of Biscayne Bay in the vicinity of the mouth of the canal.

The District is currently proceeding with one of the Acceler 8 projects which includes Component No 3. Anticipated start of construction for this component is late 2007. This will be the initial application of reclaimed water which will be integrated with Component No. 2. There are many complexities involving how and where the reclaimed water is to be applied, particularly for Component No. 4, which will entail the future portion of the wastewater reuse flow. It is possible that other applications of this reuse flow may be found elsewhere. The point of application and water reuse quantities South of C-1, Component No. 4, will be addressed in other studies.

1.3 Purpose and Scope

The objectives of the CWRRDP project are first to test the performance of advanced treatment technologies in reference to reduction of nutrients and other water quality parameters of interest in the SDWWTP effluent, and second, to evaluate the ecological impact to receiving wetlands from highly treated reclaimed water from the SDWWTP.

The aim of the WRDP process is to meet the water quality goals of Outstanding Florida Waters (OFW) through advanced treatment as presented by the 2004 Comprehensive Everglades Restoration Plan (CERP) Wastewater Reuse Pilot Project. The results of the CWRRP will assist in determining the technological feasibility and cost effectiveness of a large scale reuse project to rehydrate the coastal wetlands.

The scope of Phase I of the CWRRDP is broken down into three main parts: (1) the water reuse demonstration plant, (2) the constructed wetlands test site, and (3) the baseline assessment and monitoring program. Each part is described below:

Part 1 consists of establishing preliminary process design criteria, determination of facility sizing and selection of equipment, preparation of a conceptual design level opinion of construction and operating costs, implementation schedule, and a list of the required permits for construction.

Part 2 consists of the conceptual design of a constructed wetlands system. This part addresses application and distribution of the WRDP effluent to the constructed wetland system, conceptual design of multiple test/demonstration wetland cells to allow assessment of flow and biological response to the WRDP effluent, and return of the constructed wetland outflow/overflow to the SDWWTP site. The discharge of the treated wastewater effluent to the Biscayne Bay Coastal Wetland system is not considered necessary during the initial demonstration project operation.

Part 3 consists of developing a baseline assessment and monitoring program, which will assist in evaluating the treatment efficacy, water quality, vegetative and biological responses of the Cutler Flow Way constructed wetland system receiving effluent from the WRDP. The Phase I design for this part consists on collection and tabulation of existing and readily accessible data to characterize the existing conditions within the Cutler Flow Way and surrounding water bodies (i.e. nearby C-1 canal, coastal wetlands and Biscayne Bay). A data inventory of existing soil, groundwater, surface water, sediment and biological quality will be generated to identify data gaps and information needs. This inventory will provide insight into monitoring activities to be executed during the Phase II final design and/or construction phases to satisfy those data gaps needed to generate a baseline and an effective monitoring program to assess groundwater, surface water and ecological impacts. Stakeholder input will then be solicited during Phase II design and utilized in conjunction with the information contained in the inventory of existing datasets to design a monitoring program.

1.4 Report Organization

This technical memorandum provides a summary of the work conducted to date in support of the Phase I engineering design for the construction of the WRDP. The technical memorandum consists of the following sections:

- Section 1- Introduction

- Section 2- Water Quality Objectives
- Section 3 - Water Reuse Demonstration Plant
- Section 4 –Constructed Wetlands System – Conceptual Design
- Section 5 – Baseline Assessment and Monitoring Program

In addition to these five sections, this technical memorandum includes the following Appendices:

- Appendix A – WRDP Process Calculations
- Appendix B – Review of Regulatory Requirements and Coordination
- Appendix C – Constructed Wetland System – Conceptual Design
- Appendix D – Baseline Assessment and Monitoring Program

Section 2
Water Quality Objectives

2.1 Introduction

During the 2004 CERP Wastewater Reuse Pilot project, the Project Delivery Team (DPT) considered three water quality categories for the pilot project. These categories are described below:

- Reuse Water Quality – Water quality must meet the State of Florida standards for reuse of reclaimed water and land application (Chapter 62-610, FAC). Public access irrigation requires no more than 5.0 mg/L total suspended solids (TSS) and high level disinfection.

- Wetlands Application Standards – Water that meets State of Florida wetlands application rule standards (Chapter 62-611, FAC). Criteria for discharge to receiving wetlands include no more than 5.0 mg/L of TSS, 5.0 mg/L of 5-day carbonaceous biochemical oxygen demand ($CBOD_5$), 3.0 mg/L of total nitrogen (TN), and 1.0 mg/L of total phosphorous (TP).

- Class III / Outstanding Florida Water (OFW) Water Quality – Water quality must be sufficient to prevent degradation of the waters of Biscayne Bay. CERP team established antidegradation targets as treatment objectives to satisfy the OFW antidegradation regulations requirements for Biscayne Bay including associated wetlands.

The three water quality goals are summarized in **Table 2-1**.

2.2 Application of Water Quality Goals

The application of the water quality goals described in Section 2.1 to the Coastal Wetland Reuse Rehydration Demonstration Project (CWRRDP) is discussed in this section.

Table 2-1: Effluent Water Quality Goals [a]

Parameter	Reuse	Wetlands Application	Class III / OFW
TSS, mg/ L	5(1)	5	3.5
$CBOD_5$, mg/ L	20(2)	5	NA
Total Nitrogen, mg/l as N	NA	3	0.27
Total Phosphorous, mg/L as P	NA	1	0.005
Fecal Coliform, # / 100ml	<1.0	<1.0	<1.0
Total Ammonia- N, mg/L			0.02 –0.05 mg/L(depends on method of collection and analysis)
Nitrite/Nitrate-N, mg/L			0.01 mg/L
TKN, mg/L			0.22 mg/L
Ortho-P (mg/L)			0.002 mg/L
Dissolved Oxygen range (mg/L)			5.0-7.3
Turbidity, NTU			0.5 NTU
Salinity			Shall not change salinity in test site by more than 5 ppt
pH range			6.5-7.5 (*)
Heavy Metals			See **Table 2.2**
Emerging Pollutant of Concerns (EPOC)			Lowest possible levels(**)
Cryptosporidium and Giardia			Lowest possible levels(**)

(1) Single sample maximum

(2) Annual average

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

(**) 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)

Table 2-2: Treatment Objectives and Method Detection Limit (MDL)/Practical Quantitation Limit (PLQ) for Metals of Interest [(a)]

Heavy Metals Except for those listed with **	Methodology Required or Equivalent	Required MDL (ug/L)	Required PQL (ug/L)	Sea Water Composition (ug/L) [1,2]	Target Levels (ug/L)
Aluminum*	EPA 200.9	7.8	30	10	10
Antimony	EPA 200.9	0.8	3	0.5	0.8
Arsenic, tot	EPA 200.9	0.5	2	3	3
Barium*	EPA 200.7	1	4	30	30
Cadmium	EPA 200.9	0.05	0.2	0.1	0.1
Chromium, total	EPA 200.9	0.1	0.4	0.05	0.1
Copper	EPA 200.9	0.7	3	3	3
Iron	EPA 200.7	7	30	10	10
Lead	EPA 200.9	0.7	3	0.03	0.7
Manganese	EPA 200.9	0.3	1	2	2
Mercury, total	EPA 1631C	0.0001	0.0005	0.03	0.03
Mercury, methyl	EPA 1630 Draft	0.00002	0.00005		0.03
Nickel	EPA 200.9	0.6	2	2	2
Selenium*	EPA 200.9	0.6	2	4	4
Silver	EPA 200.9	0.5	2	0.04	0.5
Thallium	EPA 200.9	0.7	3	< 0.01	0.7
Tin	EPA 200.9	1.7	7	3	3
Zinc	EPA 200.7	2	8	10	10
Bolded Metals: Indicates typical parameters monitored in waste water					
Bolded and Italic Metals Metal added because it was part of the Class III Surface Water FDEP Rule					
Italic Metals: Total Mercury is monitored in waste water and it is part of the Class III Surface Water FDEP Rule. Methyl and total mercury at low levels are not, but were added to be consistent with current District monitoring.					
1 - Geological Survey Water-Supply Paper 1473, Study and Interpretation of the Chemical Characteristics of Natural Water, Second Edition, p. 11 (1971) 2 - Horne R.A. , Marine Chemistry The Structure of Water and the Chemistry of the Hydrosphere, Wiley-Interscience, 1969					

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

2.2.1 State of Florida Reuse Standards

Part III of Chapter 62-610, FAC contains the rules governing reclaimed water for areas of public access and irrigation. This section regulates water quality for irrigation of areas such as golf courses, parks, landscape, and edible crops. Under these standards, reclaimed water receives high-level disinfection (HLD) and meets, at a minimum, secondary treatment water quality standards. Moreover, the reclaimed water shall not contain more than 5.0 mg/L of total suspended solids (TSS) before the application of a disinfectant. NPDES permits issued by the FDEP typically include a requirement for continuous on-line monitoring of effluent turbidity to demonstrate the safety of the reclaimed water. Compliance with the TSS limit is monitored using grab samples. Continuous on-line monitoring is used in conjunction with an approved operating protocol for operational control and to ensure that only acceptable quality reclaimed water goes to the reuse system application sites.

The WRDP will provide filtration of the secondary effluent from the South District WWTP with deep bed filters and disinfection with ultraviolet (UV) light to meet reuse standards.

2.2.2 State of Florida Wetlands Application (Receiving Wetlands Discharge) Standards

Discharge to wetlands systems is governed by Chapter 62-611, FAC. Treatment criteria prior to discharge are dependent on the type of wetland. Wetlands are categorized as herbaceouse or woody, hydrologically altered or unaltered, treatment or receiving and natural or man made. Reclaimed water discharged to a receiving wetland must contain no more than, 5.0 mg/L TSS, 5.0 mg/L $CBOD_5$, 3.0 mg/L total nitrogen (TN), and 1.0 mg/L total phosphorus (TP) on an annual average basis.

The existing treatment at the SD WWTP provides secondary treatment which has no standard for either TN or TP; therefore, additional treatment technologies to comply with the receiving wetland standards for total nitrogen and total phosphorous are required.

The WRDP will provide tertiary treatment processes such as nitrification filters, denitrification filters, and chemical phosphorus precipitation for reduction of TN and TP to meet wetlands application standards.

2.2.3 Class III / Outstanding Florida Waters (OFW) Standards

Discharge to OFW is regulated by Chapter 62-302.700 FAC. The standard is stringent with respect to new or expanded surface water discharges. Discharges must not degrade the ambient water quality in Outstanding Florida Waters (OFW). The ambient water quality for discharge to the Biscayne Bay coastal wetlands has not been established. However, as indicated in Table 2-1, antidegradation goals for nutrients presented in the 2004 USACE study, are stricter than standards for receiving wetlands, requiring additional treatment. In addition, goals for EPOC are indicated as the "lowest possible".

There are a diverse number of treatment technologies that when used in combinations have the potential for meeting the antidegradation goals. It is important to note that these goals are stricter than national standards. Thus, there is certain uniqueness of applying best available technologies to meet such low water quality goals on a routine, daily basis. There is not much historical or documented data from other large capacity treatment facilities in operation with similar water quality goals.

In addition to the treatment technologies mentioned in Section 2.2.1 and 2.2.2 above, the WRDP will include membrane treatment such as ultrafiltration (UF) and optimization of chemical phosphorus removal to further reduce total phosphorus concentrations. Based on the data available for these technologies, the UF membrane and optimization of chemical phosphorus removal should be able to reduce the total phosphorus concentration to less than 0.1 mg/L. Total nitrogen concentrations after UF, are not expected to be lower than 2.5 mg/L TN due to the presence of refractory organic nitrogen.

In addition to the WRDP treatment technologies, provisions will be made for a sidestream of the demonstration plant effluent to flow through additional treatment steps at a pilot scale level to investigate their effectiveness and performance in further removing nutrients and microconstituents {Endrocrine Disruptors (EDC) and Pharmaceuticals and Personal Care Products (PPCPs)}. The sidestream pilot plants (SPP) with flows ranging from 40 to 5 gpm will consider the following technologies:

- Reverse Osmosis (RO) to further remove orthophosphorus, refractory organic nitrogen, and microconstituents,
- Ion Exchange (IX) to further remove refractory organic nitrogen,
- Granular Activated Carbon (GAC) to further remove microconstituents, and
- Advanced oxidation process (AOP) to further remove microconstituents.

The SPP will also evaluate additional treatment benefits considering incremental capital and operational costs as well as the adverse effects of potentially hazardous by products and concentrated disposal of reject water.

A more detailed discussion of the proposed treatment processes at the WRDP and the SPP are presented in Section 3.

The CWRRDP anticipates that a baseline assessment and monitoring program would be undertaken concurrently with the WRDP final design and construction. The program would include a full suite of chemical analysis including traditional pollutants, nutrients, micropollutants, metals, and pesticides. Sampling points should include the C1 canal, the Cutler Flow Way, the WRDP, the constructed wetlands, the coastal wetlands, and Biscayne Bay. This sampling effort should demonstrate that Biscayne Bay coastal wetlands would not be degraded by discharge of the reclaimed water and assist in determine water quality concentrations target in the future full-scale reuse plant effluent.

Section 3
Water Reuse Demonstration Plant

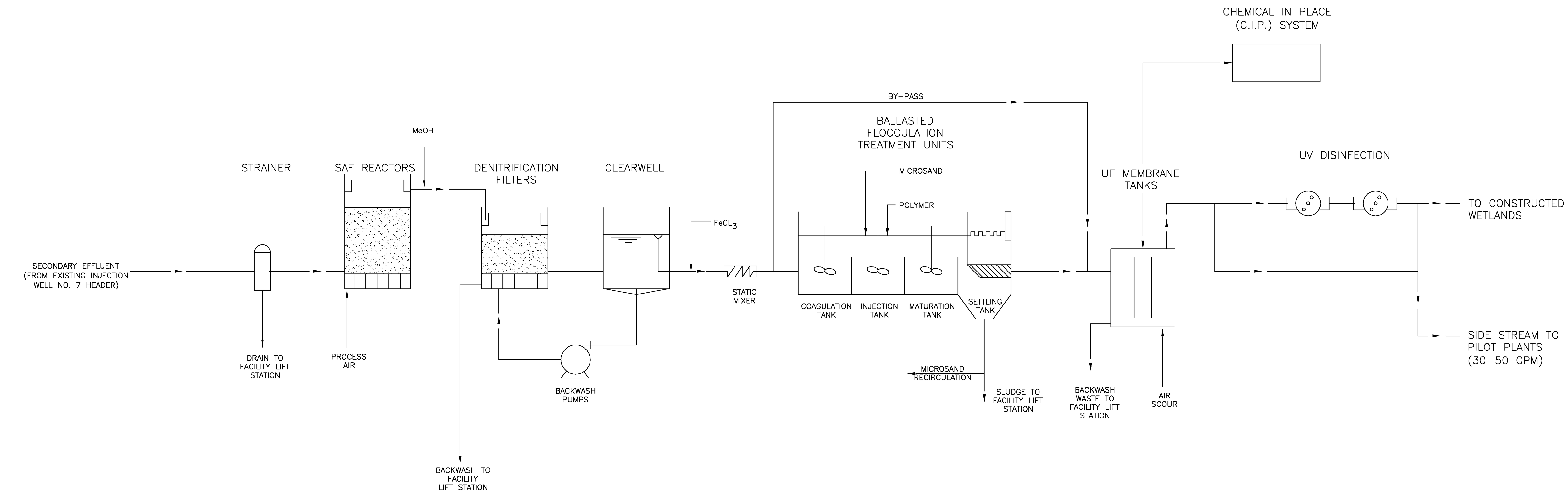
3.1 General

The 2004 CERP Wastewater Reuse Pilot Project recommended that the reuse pilot plant process be nitrification biological aerated filters, denitrification filters, chemical addition, membranes (microfiltration or ultrafiltration), and UV disinfection. Although reverse osmosis was evaluated, it was not recommended due to concerns over concentrate disposal and high incremental costs versus the anticipated water quality improvements with the other treatment processes. Nonetheless, in the WRDP provisions will be made for a sidestream of the demonstration plant effluent to flow through additional treatment steps (e.g., RO, advanced oxidation, and others) to evaluate additional treatment benefits and concentrate characteristics. The demonstration plant takes into account the existing process at the SDWWTP and the proposed high level disinfection (HLD) facilities.

The WRDP will provide additional treatment of the SDWWTP secondary effluent to further reduce $CBOD_5$, TSS, to reduce nitrogen and phosphorus levels, to provide disinfection, and to remove selected microconstituents. The facility is designed to produce a constant nominal flow of about 1 MGD of highly treated reclaimed water. The effluent of the WRDP will be conveyed to a constructed wetland in the Cutler Flow Way. Return flows will be conveyed back to the head of the plant for treatment and disposal. The effluent from the constructed wetland will be sent to a holding pond at SDWWTP. The WRDP consists of the following main components:

- Pipe connection of the SDWWTP secondary effluent
- Strainer
- Submerged Aerated Filters (SAF) for nitrification
- Denitrification filters
- Ballasted flocculation treatment (BFT) unit with chemical addition
- Ultrafiltration (UF) submerged membranes
- Ultraviolet (UV) light disinfection
- Sidestream Pilot Plant (SPP)
- Conveyance system which include pipeline from the WRDP to the constructed wetland and a discharge header assembly

A process schematic of the WRDP and SPP are presented on **Figure 3-1**.

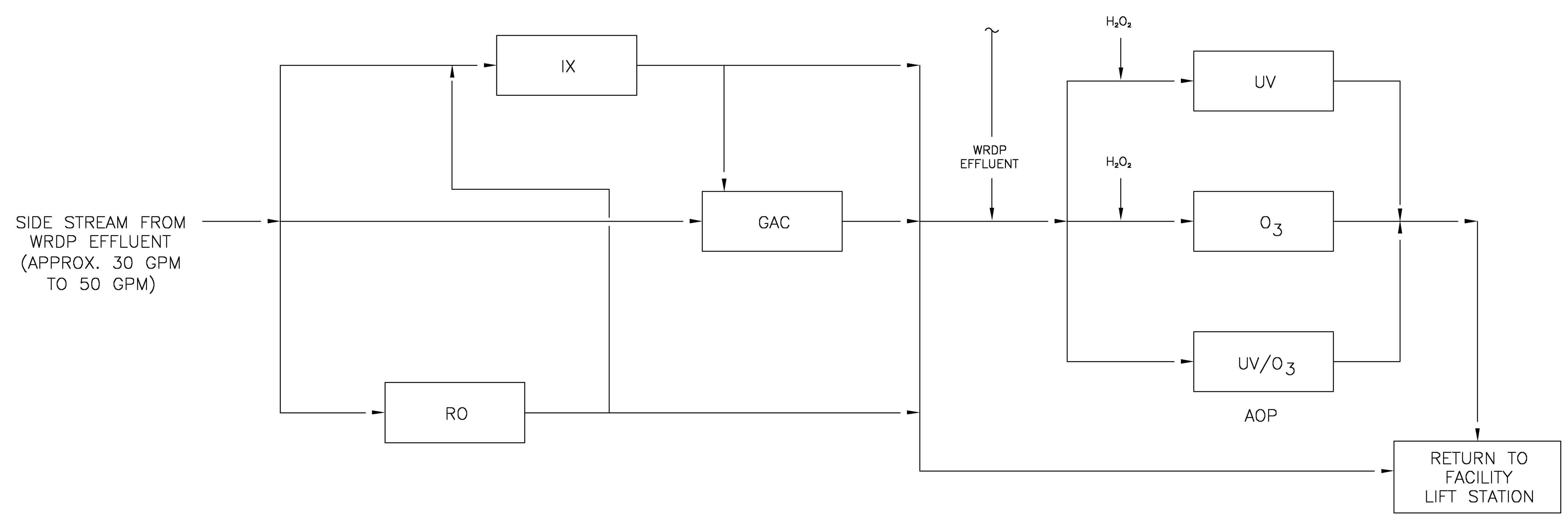


LEGEND OF ABBREVIATIONS

AOP	ADVANCED OXIDATION PROCESS
GAC	GRANULATED ACTIVATED CARBON
IX	ION EXCHANGE
RO	REVERSE OSMOSIS
SAF	SUBMERGED AERATED FILTERS
SDWWTP	SOUTH DADE WASTEWATER TREATMENT PLANT
UF	ULTRAFILTRATION
UV	ULTRAVIOLET
WRDP	WATER REUSE DEMONSTRATION PLANT

NOMINAL 1-MGD WATER REUSE DEMONSTRATION PLANT (WRDP) PROCESS DIAGRAM

NTS



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

SIDE STREAM PILOT (SPP) PLANTS

NTS

MIAMI-DADE COUNTY
Delivering Excellence Every Day

WATER AND SEWER DEPARTMENT
ENGINEERING DIVISION

3071 SW 38TH AVENUE
MIAMI, FLORIDA 33146-2221
305-665 7471
miamidade.gov

COASTAL WETLANDS REUSE REHYDRATION PROJECT
23300 S.W. 88 AVE. MIAMI, FLORIDA 33190-0000
WATER REUSE DEMONSTRATION PLANT
CONTRACT/ ER No. X-000

PROCESS DIAGRAMS

DRAWING HISTORY

RELEASED FOR		DATE	BY
REVIEW 30%	X	00/00/05	XX
REVIEW 70%			
REVIEW 100%			
PERMIT			

REVISIONS

No.	DESCRIPTION	DATE	BY
1	XXXXXX	00/00/05	XX

APPROVALS

CHIEF ENGINEER:

SECTION HEAD:

PROJECT MGR.:

DESIGNED: X.X.X.	CHECKED: X.X.X.
DRAWN: X.X.X.	FINAL CHECK: X.X.X.

XXXXXXX XXXXX
XXXXXXXXXX Engineer
State of Florida - License No. 00000
Date:________

ER No. : 00000

FILE NAME: 4698G04.DWG

DATE: OCT. 13, 2006 SCALE: AS NOTED

SHEET Fig 3-1

DWG. No. X-00000-A

DWG: P:\6430\53684\30p\Report\FIG 3-1.dwg USER: sonalmingp
DATE: Feb 15, 2007 1:04pm XREFS: IMAGES:

3.1.1 SDWWTP

The SDWWTP is a conventional secondary treatment plant with effluent disposal via deep-well injection. The SDWWTP is currently treating an average annual daily flow of approximately 90 MGD. Treatment processes at the facility include screening, grit removal, pure oxygen activated sludge process, secondary clarification and return activated sludge pumping, and standby chlorine disinfection prior to deep-well injection. The biosolids treatment facilities include gravity thickening, anaerobic digesters, dewatering, and composting. A process flow diagram of the existing SDWWTP plant is shown on **Figure 3-2**.

The physical capacity of the plant is 112.5 MGD AADF. This capacity will be permitted after the construction of High Level Disinfection (HLD) facilities to treat annual average and peak flows being injected to deep wells. MDWASD is currently under final design for the HLD facilities consisting of deep bed filters and disinfection facilities to comply with the Florida Department of Environmental Protection (FDEP) regulations. The flow is anticipated to reach 131 MGD by the year 2025

The plant currently operates under the National Pollutant Discharge Elimination System (NPDES) Permit No. FLA-042137, which rates the facility at 97 MGD annual average daily flow (AADF). The NPDES Permit No. FLA042137 provides limits for $CBOD_5$, TSS, and pH prior to deep well injection, as outlined in **Table 3-1**.

Table 3-1: Existing SDWWTP Permit Effluent Limits

Parameter	Maximum Effluent Concentrations			
	Annual Average	Monthly Average	Weekly Average	Single Sample
$CBOD_5$ (mg/L)	20	30	45	60
TSS (mg/L)	20	30	45	60
pH	-	-	-	6.0 to 8.5

There are no requirements for removal of nitrogen or phosphorus prior to injection well disposal. Effluent disinfection is not normally required; however, chlorination facilities must be maintained in service and capable of providing basic disinfection in the event of well testing or emergency conditions. The future HLD facilities will need to comply with TSS of 5 mg/L and non detectable fecal coliforms.

Average water quality for the SDWWTP effluent from January 2001 to May 2006 is presented in **Table 3-2**.

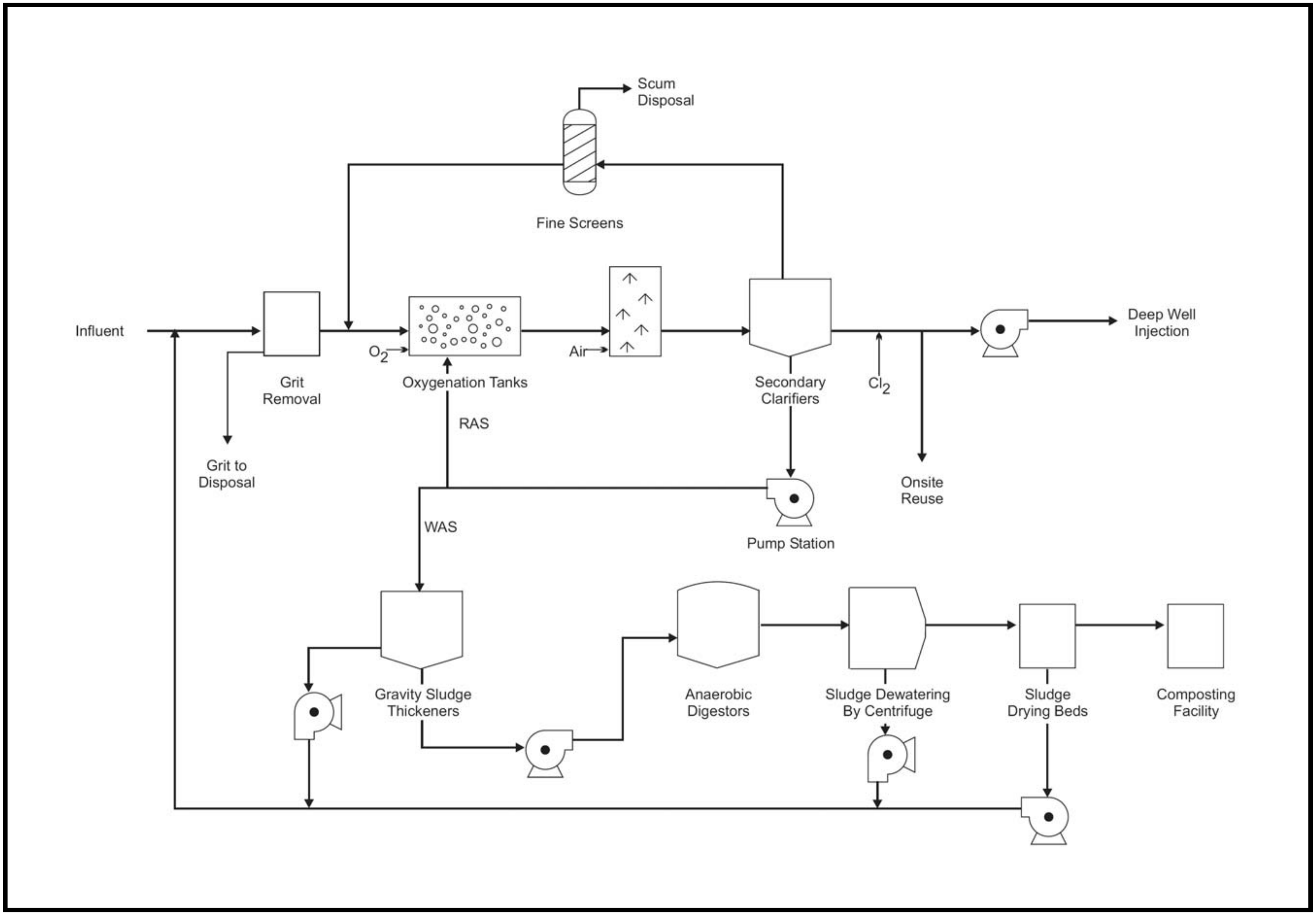


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Figure 3-2
SDWWTP Process Schematic

Table 3-2: SDWWTP Average Effluent Water Quality (2001-2006)

Parameter	Secondary Effluent
BOD_5, mg/L	4.85
TOC, mg/L	11.28
TSS, mg/L	9.89
TDS, mg/L	374
TKN, mg/L	21
Nitrate nitrogen, mg/L	0.25
Ammonia nitrogen, mg/L	17
TP, mg/L	1.52
Alkalinity, mg/L $CaCO_3$	213
Minimum wastewater temperature, ^oC	23
Maximum wastewater temperature, ^oC	31
pH	6.67
Chloride, mg/L	83
Sulfate, mg/L	27.11
Fecal coliform #/100 ml	838,600
Conductivity, µmho/cm	773

3.1.2 South Dade Advanced Wastewater Treatment Alternative (2004 USACE Study)

In the final report dated November 9, 2004 titled “Final Report South Dade Advanced Wastewater Treatment Alternative”, several conclusions and recommendations were made by the Project Delivery Team, experts in the field and other stakeholders. These conclusions were considered in the design of the WRDP. Some of the conclusions and recommendations are provided below:

- The recommended treatment train for testing in the pilot plant consists of nitrification/denitrification filters followed by chemical addition, microfiltration/ultrafiltration membranes and UV disinfection.

- Ballasted flocculation treatment has proven to be effective to achieve low concentrations of phosphorus. The technology was also recommended to be tested in the pilot plant.

- The use of UV, though energy intensive, eliminates the formation of toxic compounds formed due to chlorination, known as disinfection by-products, including tri-halomethanes and N-nitrosodimethylamine. Further reduction of microcontaminants can be accomplished through the addition/modification of the disinfection process using commercially available/emerging technologies, whether incorporating hydrogen peroxide (H_2O_2) with UV (at higher UV doses), utilizing ozone and H_2O_2, and/or incorporating low pressure biologically active reductive membranes.

- A review of literature for various wastewater treatment facilities indicates that activated carbon, (advanced) oxidation processes and membrane filtration are showing promising results for efficient removal of many non-regulated organic compounds during treatment.

- To control the monitoring costs for the pilot plant, surrogate chemicals should be selected for monitoring that will represent those constituents, including toxics and EPOCs considered representing the greatest ecological risks. These chemicals should then be monitored during the pilot plant operation using appropriate analytical methods that provide sufficiently low detection limits to verify adequate removal in the pilot plant.

- A better understanding is needed of EPOC removal processes in wastewater treatment and methods to improve their efficiency. The pilot plant should be used to verify that EPOCs present at ppb or even ppt levels will be removed to the extent necessary to meet the OFW non-degradation requirements. In the event that the proposed treatment process does not remove EPOCs to the desired level, more information is needed on the removal efficacy of EPOCs through advanced treatment processes, including membrane filtration, activated carbon filtration, and advanced oxidation.

- UV was selected because no disinfection by products are created and UV does not need post disinfection (i.e. dechlorination) before discharging to surface waters.

- Based on a literature review for technologies to remove EPOC, it was concluded that a combination of UV-O3 and RO-carbon filtration should be considered best available technologies for a wide variety of EPOCs.

3.2 WRDP Conceptual Design

This section covers the design criteria and facility requirements for the nominal 1-MGD WRDP. The SPP is included in Section 3.3. Process calculations related to the conceptual design are included in **Appendix A.**

3.2.1 Design Criteria

The design flow of the WRDP is 1 MGD of highly treated water product. To produce 1 MGD product water, approximately 1.25 MGD feedwater is needed to account for water losses in the filter backwash water, BFT sludge, and UF membranes.

Though the facilities are designed to operate at 1 MGD, the plant might also be operated at various flows to stress the performance of the treatment technologies.

The different flow ranges will be determined during Phase II design when a demonstration pilot plant protocol and sampling program will be developed.

The design influent concentrations to the WRDP are derived, in large part, from analysis of historical effluent concentrations at the SDWWTP. Appendix A illustrates historical effluent concentrations from 2001 to 2006. Values for calcium, magnesium, and sodium were assumed based on typical secondary effluent characteristics. **Table 3-3** summarizes the water quality used as the basis of design for the WRDP.

Table 3-3: WRDP Design Flow and Influent Wastewater Characteristics

Parameter	Secondary Effluent Design Values
Average influent flow, mgd	1.25
$CBOD_5$, mg/L	20
TOC, mg/L	12
TSS, mg/L	20
TDS, mg/L	450
TKN, mg/L	27
Nitrate nitrogen, mg/L	0
Ammonia nitrogen, mg/L	23
TP, mg/L	2.7
Alkalinity, mg/L $CaCO_3$	200
Minimum wastewater temperature, ^oC	23
Maximum wastewater temperature, ^oC	32
Maximum air temperature, ^oC	34
pH	6.6
Chloride, mg/L	90
Sulfate, mg/L	33
Conductivity, µmho/cm	800
Calcium, mg/L	20
Magnesium, mg/L	5
Sodium, mgL	60

3.2.2 Description of Treatment Processes

Secondary effluent from the SDWWTP will be obtained from tapping with an 8-inch line into the pressurized 24–inch line feeding Injection Well No. 7. Secondary effluent will go first through an automatic strainer and then to submerged aerated filters followed by denitrification filters (with methanol addition) for nitrogen reduction. After the biological filters, ferric chloride ($FeCl_3$) will be added to chemically precipitate phosphorus in ballasted flocculation treatment units where polymer and microsand are added to enhance sedimentation performance. The effluent from the BFT units will be sent to UF submerged membranes followed by UV disinfection. The WRDP's configuration provides pipeline arrangement to by-pass the ballasted flocculation units to evaluate phosphorus removal in the UF membranes. After disinfection, the treated water is conveyed to the constructed wetlands located in the eastern part of the Cutler Flow Way. The backwash water from the strainer, denitrification filters and UF membranes is combined with the sludge waste stream of the ballasted flocculation units in a lift station designed to convey the reject water to the head of the SDWWTP.

3.2.2.1 Connection to SDWWTP

At the SDWWTP, secondary treated effluent is transferred to 17 deep injection wells by an effluent pump station. The effluent pump station operates at a discharge pressure between 35 to 80 psi. Based on the site available to locate the WRDP, MDWASD staff proposed to tap into the pressurized line feeding Injection Well No. 7. An 8-inch pipeline will supply secondary effluent to the WRDP. The influent flow will be controlled with a flow meter and flow control valve after the strainer to obtain the desired minimum pressure through the strainer.

The secondary effluent is not normally chlorinated; however, every month for a period of 4 hours the effluent is chlorinated to comply with injection well testing requirements.

3.2.2.2 Automatic Strainer

An automatic self cleaning strainer will be used to screen the secondary effluent before entering the submerged aerated filters. The strainer is designed to remove particles larger than 3 mm to prevent clogging of the SAF air distribution system.

The design criteria and sizing requirements for the strainer are presented in **Table 3-4**

Table 3-4: Automatic Self Cleaning Strainer

Parameter	Units	Value
Design Criteria		
Velocity	ft/sec	6 to 10
Minimum operating pressure	psi	20
Suspended solids	ppm	< 200
Sizing Requirement		
Number on duty		1
Number standby		0
Pressure vessel diameter	feet	2.16
Pressure vessel height	feet	5.5
Opening size	micron	3175
	mm	3.175
Nominal unit flow capacity	gpm	868
Headloss through screens		
clean	psig	0.5
dirty	psig	5
Motor power	HP	1/3
Nominal Motor speed	rpm	3600

3.2.2.3 Submerged Aerated Filters (SAF) and Denitrification Filters

Submerged aerated filters are an attached growth biological treatment process that is well suited for tertiary nitrification. The term filter is somewhat of a misnomer in that are not filters, but biological reactors whose configuration resembles conventional deep bed filters. The major differences between SAF and conventional deep bed filters are: the flow is typically upwards through the filter medium, the filter medium is much coarser, and process air is added to meet the oxygen demands of the biomass that grows on and between the granular media. In a SAF, the medium is not backwashed; therefore, additional treatment is required to remove accumulated biomass and suspended solids. At the WRDP, denitrification filters will be provided after the SAF for further suspended solids treatment and removal of nitrates.

Denitrification filters are deep bed gravity sand filters that are both filters and biological reactors. Flow is downwards through a filter medium that has an effective size of about 3 mm. When influent containing nitrate (produced in the SAFs) and a carbon source (usually methanol from an outside source) are passed through the filter, a biomass of facultative heterotrophic bacteria grows on and between the sand particles that converts nitrate to nitrogen gas. The filter is periodically “bumped” with a pulse of water to remove accumulated gas in the filter bed. The denitrification filters need to be regularly backwashed with a combination of backwash water and air to remove accumulated suspended solids.

The design for the WRDP consists of two SAF tanks each 14 feet in diameter and 20 feet of media depth, three denitrification filters each 13 feet in diameter and 6 feet of media depth, and two 14 feet diameter clearwells. The clearwells are used to provide the water needed for one denitrification filter backwash volume. Major equipment includes process blowers for the SAF, methanol system, backwash blowers and pumps for the denitrification filters. Backwash waste is sent to the SDWWTP headworks through a lift station. The design criteria for the SAF and denitrification filters are summarized in **Table 3-5**. The facility requirements are summarized in **Table 3-6.**

Table 3-5: Design Criteria

Nitrifying Submerged Aerated Filters	**Units**	**Value**
SAF Volumetric Loading, Nox	lb/d/kcf	50.0
SAF Volumetric Loading, $CBOD_5$	lb/d/kcf	240
SAF Hydraulic Loading	gpm/sf	2.9
Media Depth	ft	20.0
Media Specific Surface Area	ft^2/ft^3	100.0
Aeration System		
Oxygen Demand for Total CBOD	lb. O2/lb. $CBOD_5$ removed	1.2
Oxygen Demand for NH_4-N	lb. O2/lb. N oxidized	4.6
Oxygen Transfer Efficiency (OTE)	%	12.0
Denitrification Filters		
Nominal Hydraulic Loading Rate (Average Flow)	gpm/ft^2	< 3
Volumetric Mass Loading	lb NO_3-N/kcf/day	108
Backwash Air Rate Requirements	$scfm/ft^2$	5.0
Backwash Water Requirements	gpm/ft^2	6.0
Methanol Feed		
Methanol Ratio	CH3OH:N Ratio	3.00
Methanol Dosage	gpd	117

Table 3-6: Facility Requirements

SAF	Units	Value
Type		Submerged Aerated Filter Reactor
Media Type		Coarse 40 mm dia. Gravel media
Number of Tanks		2
Type		Vertical, circular. high carbon steel construction
Diameter	feet	14
Height	feet	26
Surface area per unit	ft^2	154
Media depth	feet	20
Process Air Compressors		
Type		Positive displacement
Number		1 duty + 1 standby
Unit capacity	scfm	274
Discharge pressure	psig	13.2
Motor size	HP	25
Sump Pumps		
Type		Vertical, centrifugal, submersible
Number		2 duty + 1 standby
Unit capacity	gpm	20
TDH	ft	15
Motor size	HP	0.5
Denitrification Filters		
Type		Deep bed granular media
Media Type		6 x 9 mesh silica sand
Number		3
Type		Vertical, circular. high carbon steel construction
Diameter	feet	13
Height	feet	20
Surface area	ft^2	133
Media depth	feet	6
Backwash Pumps		
Type		Horizontal End Suction Centrifugal
Number		1 duty + 1 standby
Unit capacity	gpm	796
TDH	feet	25
Motor size	HP	10

Continuation Table 3-6: Facility Requirements

Backwash Air Compressors	Units	Value
Type		Positive displacement
Number		1 duty + 1 standby
Unit capacity	icfm	665
Discharge pressure	psig	10.3
Motor size	HP	50
Clearwell Tanks		
Number		2
Type		Vertical, circular. high carbon steel construction
Diameter	feet	14
Height	feet	12
Methanol Feed Pumps		
Type		Positive Displacement Type
Number		1 duty + 1 standby
Unit capacity (max)	gph	7.14
Discharge pressure	psig	90
Motor size	HP	0.01
Methanol Storage System		
Type		Vertical, cylindrical, carbon steel
Diameter	ft	10
Straight side	ft	14 ft - 3in
Storage Capacity	gal	8000
Miscellaneous Equipment		
Nitrate Analyzer		1
Analyzer Sample Pumps		2 @ 15 gpm, 3/4 hp
Control System Equipment		1

3.2.2.4 Ballasted Flocculation Treatment Units

Removal of phosphorus from the wastewater will be accomplished by chemical and physical methods. Chemical precipitation using either ferric, lime or alum is the most widespread method to remove phosphorus from waste stream. When combined with phosphate, those chemicals produce insoluble or low solubility salts. Ferric compounds combine minimum toxicity and minimum cost with maximum effectiveness, which accounts for their widespread acceptance and use. Ferric chloride is used in design of the WRDP; however, during plant operations other ferric compounds should be tested to determine chemical effectiveness and appropriate dosages. Ferric chloride will be added to the denitrification filter effluent using a static mixer before entering the ballasted flocculation units or the UF membranes.

The ballasted flocculation unit is divided into four compartments: coagulation, injection, maturation, and settling tanks. The first compartment is the coagulation tank, where additional mixing and coagulation will occur. The coagulated water then enters a second tank called the injection tank, where microsand and polymer are added. The microsand provides a large contact area and acts as a ballast, therefore accelerating the settling flocs. The destabilized suspended solids will bind to the microsand particles by polymer bridges. In the third tank, the maturation tank, the particles agglomerate and grow into high density flocs know as microsand ballasted flocs, which settle quickly to the bottom of the settling tank. The efficiency of settling is further increased by the use of the lamella tubes. The sludge/microsand mixture collected at the bottom of the tube settler is pumped to hydrocyclones where the sludge is separated from the micro-sand by the centrifugal force of the vortex action. The recovered clean microsand is then recycled to the injection tank whereas the separated sludge is continuously discharged by gravity to a lift station.

The design for the WRDP consists of two ballasted flocculation tanks each with a design capacity of 0.5 MGD. Major equipment includes the ferric chloride system, mixers, sand recirculation pumps, hydrocyclones, and polymer system. The design criteria and facility requirements for ferric chloride system and ballasted flocculation units are included in **Table 3-7** and **Table 3-8**.

Table 3-7: Design Criteria

Chemical (Ferric Chloride) System		
	Units	Value
Ferric chloride dose	mg/L	25
Solution concentration	%	38.0
Specific gravity		1.43
Static Mixer		
Ballasted Flocculation Units		
Coagulation tank		
hydraulic detention time	min	2
Injection tank		
hydraulic detention time	min	2
Maturation tank		
hydraulic detention time	min	6
Settling Tank		
Overflow velocity	gpm/ft^2	16
Additives		
Polymer dose	mg/L	1
Microsand	mg/L	1
Sludge Production		
Estimated sludge concentration	%TS	0.1 - 0.5
Sludge volume	%Q	1 -4

Table 3-8: Facility Requirements

Chemical (Ferric Chloride) System		
Ferric Chloride	Units	Values
Metering Pumps		
Type		Diaphragm Type
Number		1 duty + 1 standby
Unit capacity (max)	gph	2.22
Discharge pressure	psig	
Motor size	HP	0.25
Static Mixer		
Number of units		1
Unit capacity	gpm	916
Pressure	psi	0.8
Ferric Chloride Storage System		
Type		
Diameter	ft	8
Length	ft	10.50
Storage Capacity	gal	3,946
Ballasted Flocculation Units		
Type		Package Plant
Number of Trains		2
Design Flow per Train	MGD	0.5
Overall dimensions (L x W x H)	ft	19 x 7.42 x 10.42
Total Height to the top of Hydrocyclone	ft	17.42
Coagulation Tank		
Number on duty		2
Number on standby		0
Design Flow /Unit	MGD	0.5
Unit mixer power	HP	1
Length	ft	4.42
Width	ft	3.42
SWD	ft	6.75
Unit Volume	gal	763
Injection Tank		
Number on duty		2
Number on standby		0
Unit Power	HP	1
Length	ft	4.42
Width	ft	3.42
SWD	ft	6.75

Continuation Table 3-8: Facility Requirement

Maturation Tank	**Units**	**Values**
Number on duty		2
Number on standby		0
Unit mixer power	HP	1.5
Length	ft	6.58
Width	ft	7.17
SWD	ft	6.75
Settling Tank		
Number on duty		2
Number on standby		0
Length	ft	5.08
Length lamella zone	ft	3
Width	ft	7.17
Width lamella zone	ft	7.00
SWD	ft	6.75
Unit rake power	HP	0.5
Sand Recirculation System		
Recirculation Pumps		
Type		Centrifugal
Number		2 duty + 2 standby
Unit capacity	gpm	18.0
TDH	ft	173.3
Motor size	HP	3.0
Hydrocyclones		
Number		2 duty + 2 standby
Unit capacity	gpm	18.0
Polymer		
Type		Automatic polymer activation and feed system, skid mounted packaged assembly
Number		2 duty + 2 standby
Polymer Storage		
Type		55 gallon drums
Number		2.0

3.2.2.5 Ultrafiltration (UF) Membranes

Low-pressure membrane treatment systems are broadly categorized by the size of the particles rejected by the membranes. The two main types of low pressure membranes used are the microfiltration (MF) and ultrafiltration (UF). Microfiltration (MF) can be considered as any semi-permeable membrane with pore sizes between 0.1 and 1 micrometers (micron, μm) while UF membranes have pore sizes between 0.002 and 0.01 μm. MF systems will remove nearly all suspended particles including particulates, large colloids, oils, and about 3-6 log removal (99.9 percent – 99.9999 percent) of bacteria. UF membranes have smaller pore sizes than MF membranes, and will provide complete removal of bacteria and protozoan cysts, and 4-6 log removal for virus. Since size exclusion is the primary mechanism to remove contaminates from MF and UF membranes, a higher quality effluent is expected from UF membranes.

The selected type of membranes in this design is the Submerged Zee Weed 500 UF membranes which utilize "Outside-In" flow, through a hollow fiber membrane that has nominal and absolute pore sizes of 0.04 and 0.1 microns respectively. The membranes are made from a polyvinyl difluoride (PVDF) material, which has a high resistance to both oxidants and biological foulants. The membranes operate under a vacuum, drawing treated water through the membrane pores into the inside of the hollow fibers. Periodically, filtered water (filtrate) is backwashed through the membrane fibers from "inside-out" while air is introduced at the bottom of the membrane modules to create turbulence along the membrane surface, scouring and cleaning the outside of the membrane fibers. Chemical back pulsing is another cleaning strategy done about once per day to further restore permeability and involves back pulsing membranes with a chemical such as sodium hypochlorite. Finally, recovery cleaning is performed every month and involves in-tank chemical soaking to remove organic and inorganic contaminants from the fibers using sodium hypochlorite and citric acid.

Provisions will be included at the WRDP to feed treated water either from the denitrification filters or the ballasted flocculation units after ferric chloride addition to evaluate the performance of membranes in removing phosphorus.

Treated water is drawn through the membrane pores and enters the inside of the hollow fibers. Water then flows through permeate pump which conveys UF treated water to a UV disinfection system and then to the constructed wetlands. A portion of the effluent water from the membrane system will be sent to the side stream pilot plant units for further treatment evaluation.

The design for the WRDP consists of two Z-Box L-128 units, each with two Zee Weed 500 cassettes. The major equipment includes permeate pumps, membrane aeration blower, back pulse tank, Clean In Place (CIP) tank and system. The design criteria and facility requirements are detailed in **Tables 3-9 and 3-10**

Table 3-9: Design Criteria

Membranes Design Criteria		
Membrane Treatment Units	Units	Value
Membrane type		Ultrafiltration (UF) Immersed, Hollow-Fiber
Pore Size	microns	0.1
Nominal pore size	microns	0.040
Design flux	gfd	25 - 30
Module Surface Area	ft^2	340
Number of Modules in Cassette	#	48
Scour Airflow Requirements	scfm/cassette	495
Typical Backpulse Cycles	minutes	15 to 60
Cleaning Solution		
Daily Maintenance Clean (NaOCL)		
Recovery Clean Frequency	days	30.0
Sodium Hypochlorite		
Citric Acid		

Table 3-10: Facility Requirements

Membrane Facility Requirements		
Membrane Treatment Units	Units	Value
Number of Units		2
Number of Trains		4
Number of Standby Train		1
Number of Cassettes per Train		1
Total Number of Cassettes		4
Number of Modules per Cassette		36
Total Number of Modules		144
Total Membrane Surface Area	ft^2	48,960
Design Flux Rate	gfd	27
Membrane Tank Dimensions (L X W X H)	ft	10' x 7' 10" x 10' 6"
Nominal capacity per cassette	MGD	0.330
Membrane Aeration Blowers		
Type		Positive displacement
Number		2 duty + 1 standby
Unit capacity	scfm	360
Discharge Pressure	psig	3.7
Motor Size	HP	15
Permeate / Backpulse Pump		
Type		Centrifugal
Number		3 duty + 1 standby
Unit capacity	gallon	240
TDH	Ft	10 - 60
Motor Size	HP	30
Air Compressor with Motor & Receiver		
Number		2 duty + 2 standby
Air Compressor, Unit Capacity	acfm	23
Air Receiver, Unit Capacity	gallon	240
Motor Size	HP	7.5
Control System Equipment		
Clean-In-Place (CIP) System		
CIP Storage Tank		
Number		1.0
Tank Diameter	ft	5.8
Height	ft	8.1
Backpulse Tank		
Number		
Tank Diameter	ft	8.0
Height	ft	12.7

3.2.2.6 Ultraviolet (UV) Disinfection

During the 2004 USACE study, UV disinfection was the recommended technology for the pilot plant, since it does not produce regulated disinfection byproducts, eliminates the need of dechlorination, and eliminates the burden of dealing with safety and regulatory issues. In addition, medium-pressure, high intensity lamp in a closed-vessel (in-line) reactor was recommended in the treatment alternative study.

Ultraviolet disinfection systems transfer electromagnetic energy using mercury vapor lamps to an organism's genetic material. UV systems use wavelengths of electromagnetic radiation between 250 and 270 nanometers (nm) to inactivate microorganism and viruses by altering their DNA and RNA. The effectiveness of a UV disinfection system depends on the characteristics of the wastewater, the intensity of UV radiation (dose), the amount of time the microorganism is exposed to the radiation (contact time), and the reactor configuration. Important wastewater characteristics that influence UV disinfection efficiency include the percent transmittance, turbidity, and TSS. These three parameters will affect the penetration capability of UV radiation, where UV disinfection is directly proportional to UV penetration while maintaining a constant UV dose. The UV dose is measured as the product of intensity and exposure time, as milliwatt-seconds per square centimeter ($mW\text{-}s/cm^2$).

To meet the Florida high-level disinfection criteria, the Florida Department of Environmental Protection (FDEP) requires that UV designs comply with the 2003 National Water Research Institute (NWRI) guidelines. Resembling a multiple barrier approach, the NWRI has devised a systematic method to UV design where the most treated effluent (e.g. RO) will require the least UV radiation and the least treated (granular filtration) will require the most UV radiation. For the WRDP, sizing of the UV system was based on 65 percent transmissivity and minimum dose of 80 $mW\text{-}s/cm^2$ associated with MF/UF membrane effluent.

The design for the WRDP consists of two in-line medium pressure UV disinfection units in series. Each unit consists of a stainless steel chamber containing 12 medium pressure lamps mounted horizontal and perpendicular to flow. The units include an automatic quartz sleeve cleaning system, manual lamp power level control, UV monitor, and access hatch. The design criteria and facility requirements for the UV system are detailed in **Table 3-11**

Table 3-11: Design Criteria and Facility Requirement

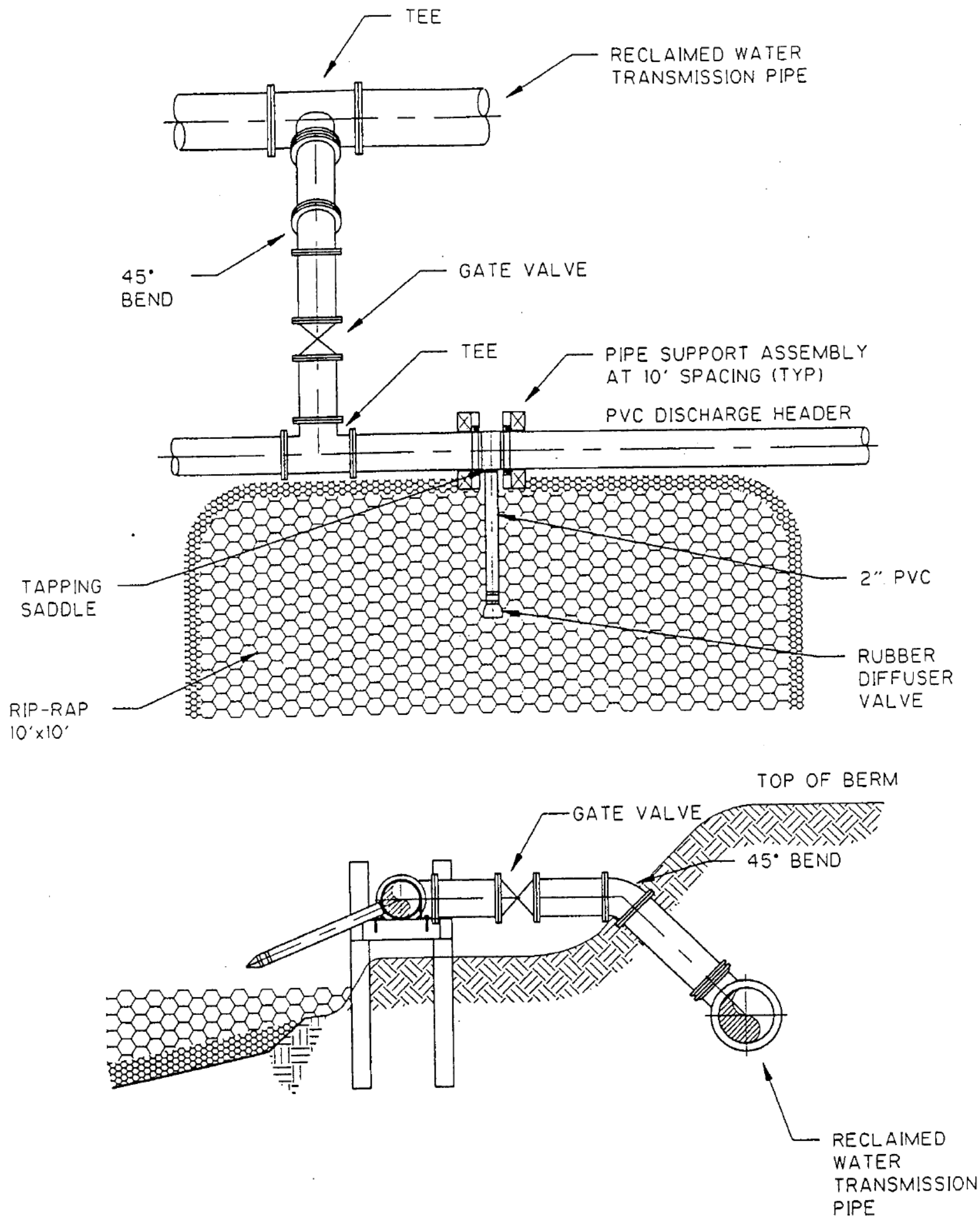
DESIGN CRITERIA	Units	Values
Bulb type		Medium pressure
Minimum transmittance	%	65
Minimum dose	mJ/cm2	80
Disinfection	fc/100 ml	non detectable
FACILITY REQUIREMENT		
Type		In-line, medium pressure
Number of Units		2
Configuration		series
Number pipes		1
Number of lamps per unit		12
Total number of lamps		24
Average power per lamp	kW	3.6
Maximum Power per Unit	kW	54
Pipe diameter	inch	14

3.2.2.7 Conveyance System

After the UV system, the highly quality water produced at the 1-MG WRDP will be sent to the constructed wetland located at the eastern end of the Cutler Flow Way. The conveyance system includes a 12-inch diameter pipeline of approximately 400 ft and a discharge header assembly, as shown on **Figure 3-3**

3.2.2.8 Return Flows

Return flows refers to flows from the WRDP and sidestream pilot plants that are sent back to the SDWWTP's headworks. The return flows from the WRDP include the backwash waste from the strainer, denitrification filters, and UF filters, in addition to the sludge from the ballasted flocculation units. The return flows from the SPP include the effluent form the different pilot units and their respectively waste streams. These flows will be collected in a lift station to be pumped back to the SDWWTP headworks. **Table 3-12** provides a summary of the return flow contributions. **Figure 3-4** shows a typical layout of a 3-pump lift station with wet well and submersible pumps.



CDM

Figure 3-3
Typical Wetlands
Discharge Header Assembly

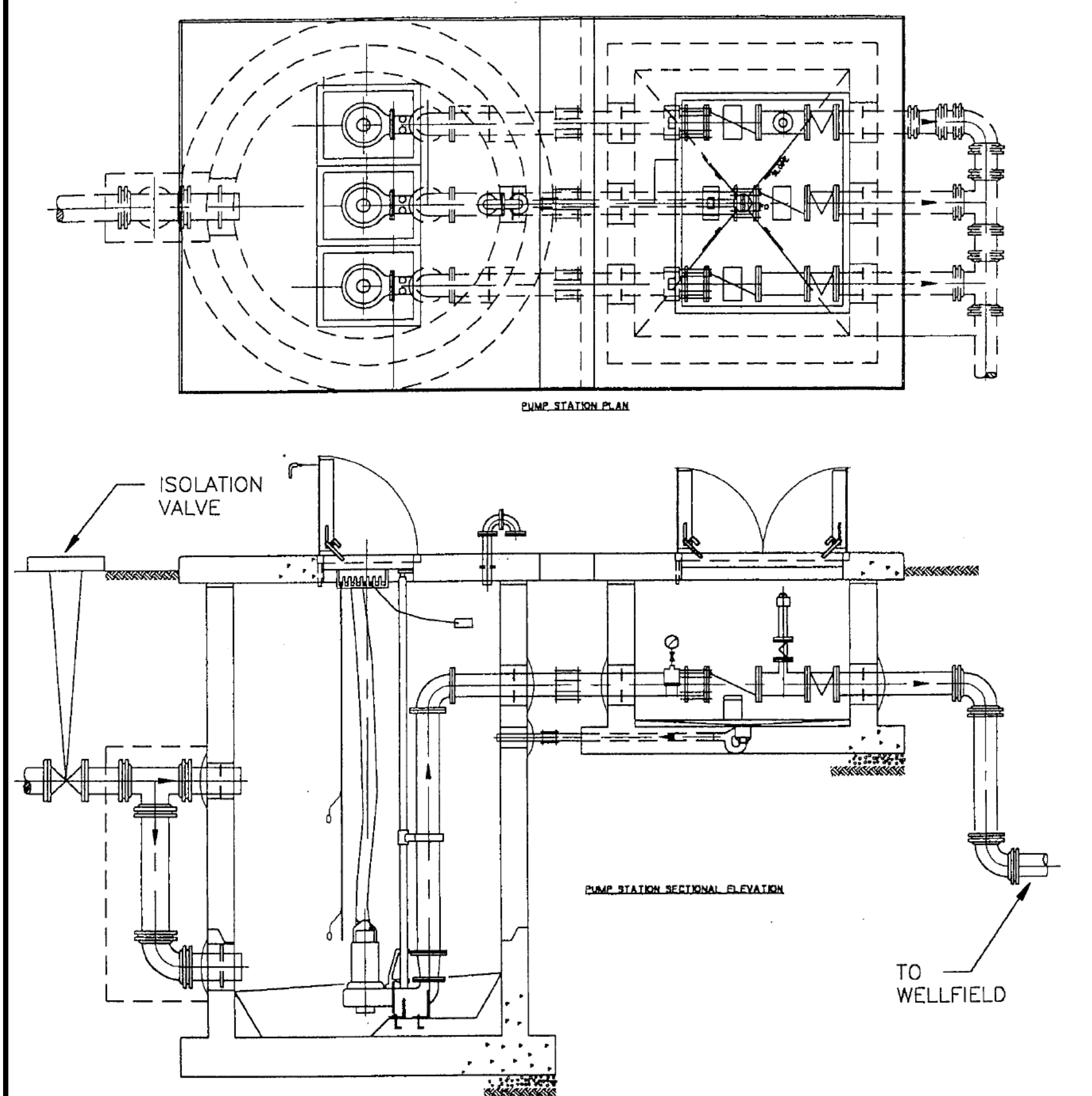


Figure 3-4
Lift Station

Table 3-12: Return Flows to SDWWTP

Parameter	Strainer	Filters Denitrification	Ballasted Flocculation	UF Filter
Flow, MGD	0.06	0.04	0.04	0.08
TSS, mg/L	100	1000	1000	30
TSS, lb/day	50	337	337	20

3.3 Sidestream Pilot Plant Conceptual Design

As mentioned earlier, provisions will be made for a sidestream of the WRDP demonstration plant effluent to flow through additional advanced treatment units. According to the scope of work, three treatment technologies will be selected during the Phase I design for the sidestream pilot plant (SPP). The technologies to be considered in the evaluation were:

- RO membranes
- UV disinfection with hydrogen peroxide (H_2O_2)
- Ozone and/or ozone with H_2O_2
- Granular Activated Carbon (GAC), and
- Ion Exchange (IX)

After considering the recommendations presented in the 2004 technology evaluation report and evaluating the performance of the technologies through literature review, the project team decided to prepare conceptual designs for RO, advance oxidation processes (AOP), GAC, and IX and to provide provisions in the pilot plant to test for various process train options, since there is not a "comprehensive" treatment technology that will remove all the compounds indicated in the OFW water quality goals. The objective of the SPP is to evaluate the performance of the technologies and process train options in removing microconstituents, total nitrogen, total phosphorus, and N-nitrosodimethylamine (NDMA). The technologies were conceptually designed with the information currently available.

It is important to note that there may be a large number of microconstituents in the wastewater; and therefore monitoring efforts can become impractical. A monitoring program needs to consider surrogate chemicals and selected microconstituents. In Phase II design, a monitoring and program will be proposed for the SPP.

The process train options are included on Figure 1-1. **Table 3-13** provides a summary of the design criteria, technology objectives, and facility requirements for RO, AOP, IX, and GAC. Appendix A provides equipment manufacture's cut sheets and descriptive literature for SPP technologies.

3.4 Water Reuse Demonstration Plant Phase I Design

This section includes the initial design work conducted during Phase I and consists of site layout, hydraulic profile, mass balance, and drawings including process and instrumentation diagrams (PID).

3.4.1 Site Layout

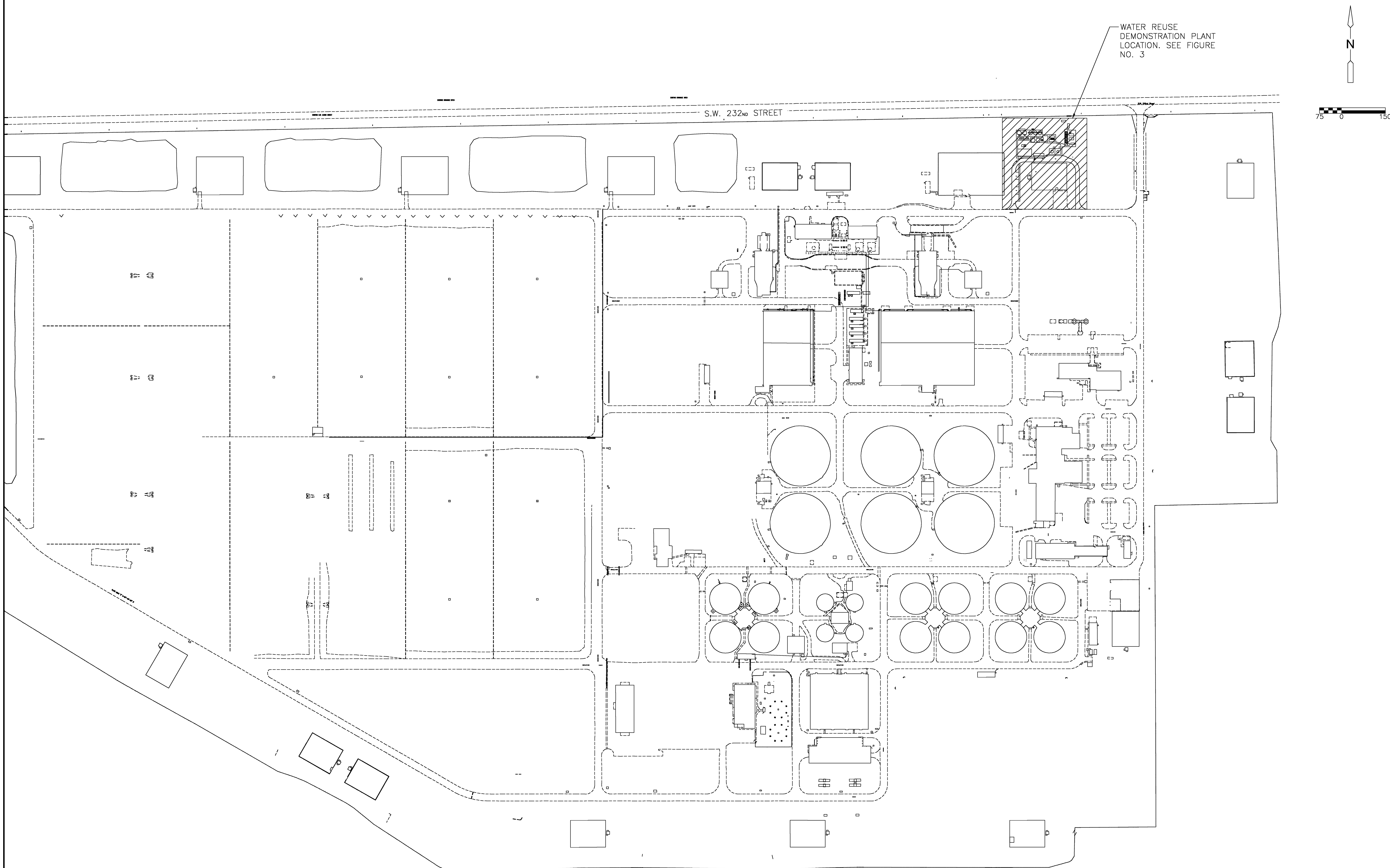
Several locations at the SDWWTP were discussed with MDWASD staff and with the HLD engineering consultant. Meeting minutes summarizing these discussions are included in Appendix A. After evaluating the potential options and considering existing piping and utilities, the open green site located between the FPL substation and holding pond No.7 was selected as the location for the WRDP. The area available is approximately 30,800 ft^2. This site is close to Injection Well No. 7 and in proximity to the Lennar Flow Way. A site location plan is included in **Figure 3-5**.

The WRDP site will include the SAF reactors, denitrification filters, clearwell tanks, ballasted flocculation treatment units, membrane system, chemical handling area, back pressure control valve, RO pilot trailer, lift station, and a building for the pilot plant facilities. The building will include a pilot testing area, electrical room, restroom, office/control room, and a laboratory area. The strainer will be located in the Injection Well No. 7 concrete pad. A site plan depicting the location of the facilities is shown on **Figure 3-6.** A building layout for the SPP is included on **Figure 3-7**. **Figure 3-8** depicts a proposed piping plan for the WRDP.

Access to the site will be provided with roadway extensions off of existing plant access roads as shown on Figure 3-5. This new road will provide access to the WRDP for plant operation and maintenance personnel as well as for deliveries of chemicals such as ferric chloride, polymer, and methanol.

3.4.2 Hydraulic Profile

The WRDP is designed to provide gravity flow from the SAF reactors to the UF membranes. The permeate pumps included in the membrane system will convey treated water to the UV disinfection system and then to the constructed wetlands. A preliminary evaluation of the gravity hydraulics for the WRDP was



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23300 S.W. 88 AVE. MAIMI, FLORIDA 33190-0000
WATER REUSE DEMONSTRATION PLANT
CONTRACT/ ER No. X-000

LOCATION PLAN

DRAWING HISTORY

RELEASED FOR		DATE	BY
REVIEW 30%	X	00/00/05	XX
REVIEW 70%			
REVIEW 100%			
PERMIT			

REVISIONS

No.	DESCRIPTION	DATE	BY

APPROVALS

CHIEF ENGINEER:	
SECTION HEAD:	
PROJECT MGR.:	
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SHEET FIG 3-5

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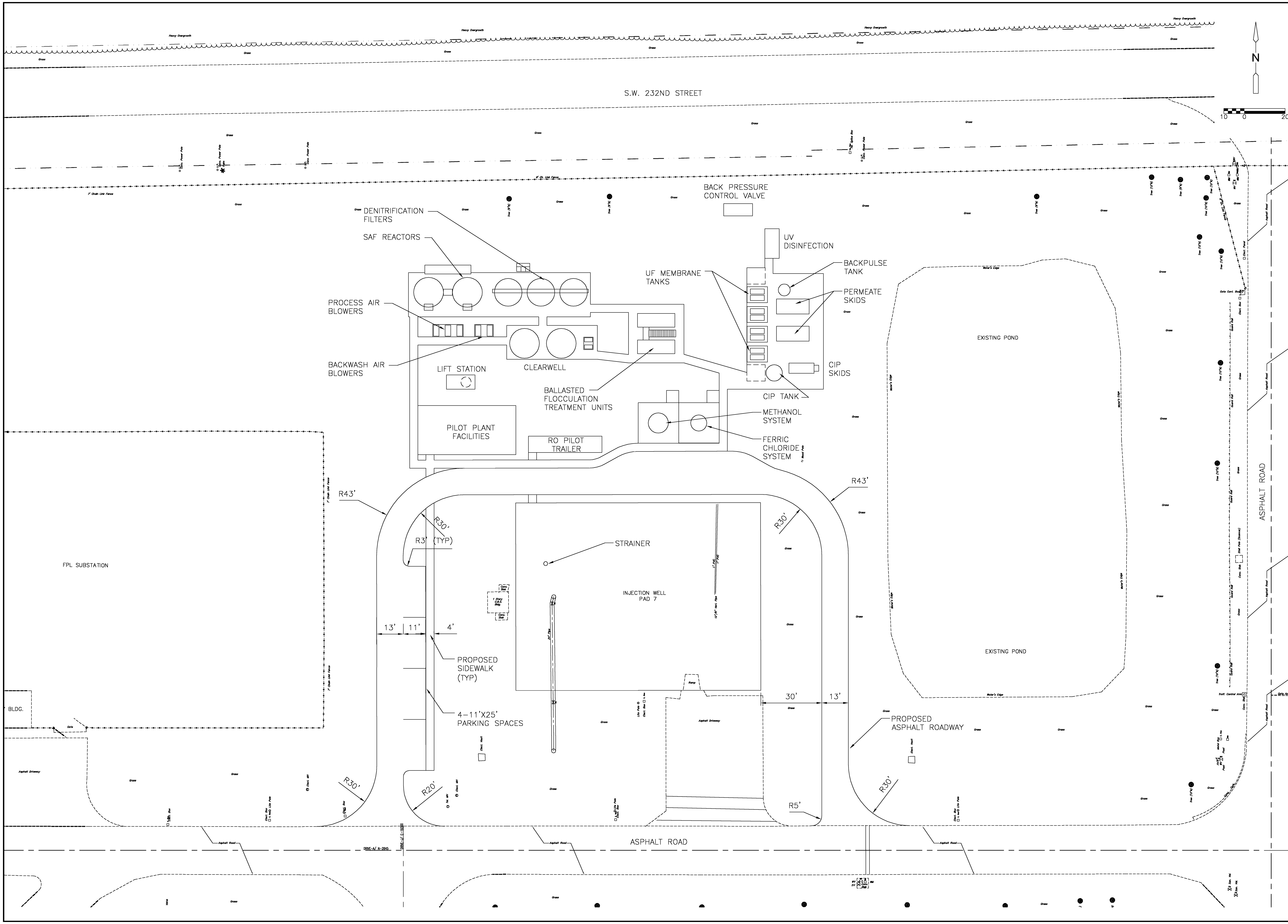

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WATER REUSE DEMONSTRATION PLANT
CONTRACT/ ER No. X-000

SITE PLAN

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SHEET FIG 3-6

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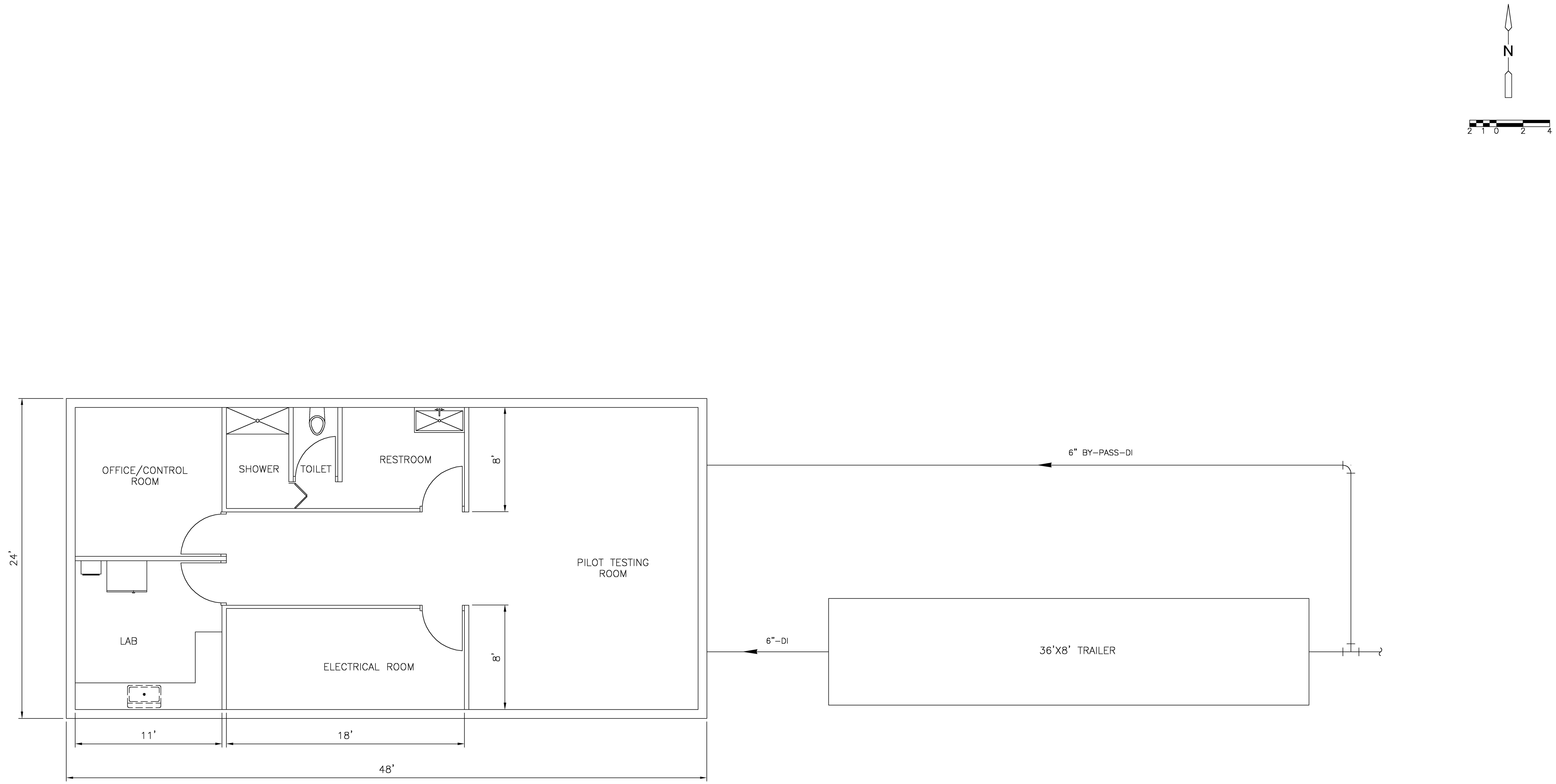

PILOT PLANT FACILITIES

RO PILOT TRAILER

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PILOT PLANT SIDESTEAM AND BUILDING LAYOUT

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SHEET FIG 3-7

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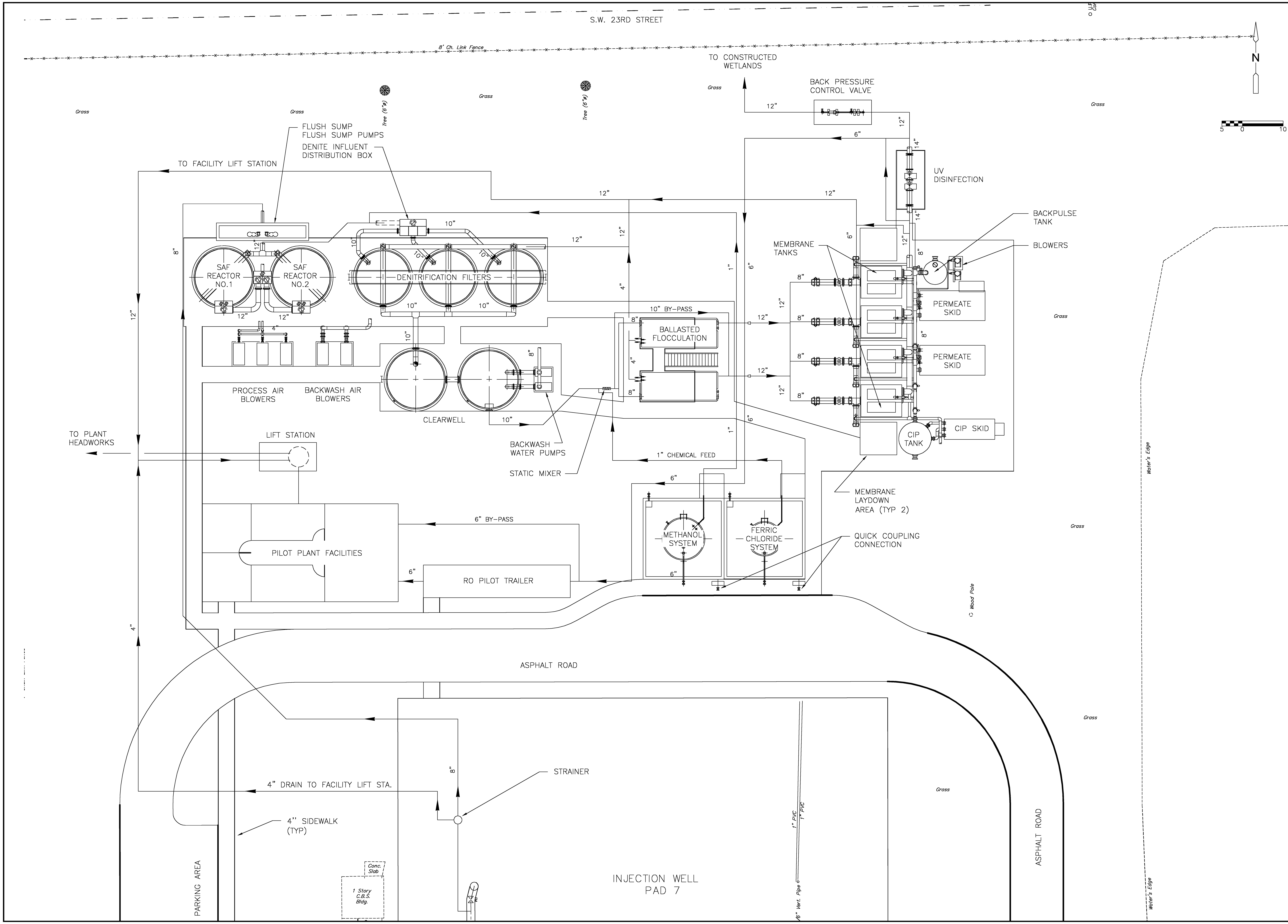

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WATER REUSE DEMONSTRATION PLANT YARD PIPING PLAN

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SHEET FIG 3-8

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Table 3-13: Sidestream Pilot Plant Design Criteria and Facility Requirements

Reverse Osmosis (RO)	**Units**	**Values**
Treatment objective		TP < 0.005, TN < 0.27, lowest possible EDC and PPCPS
No of skid (trains)		1
Production	Gpm	30
No. vessels		6
Membrane per vessel		7
Array		4:2
Average flux	Gfd	12
Nominal production per element	Gfd	1020
Recovery stages 1 & 2	%	75%
Pressure Vessels		
Diameter	In	4
Length	In	287
Ports - Feed/Concentrate	In	1" IPS
Ports - Permeate	In	3/4" FPT
Maximum working pressure rating	Psig	300
Membranes		
Manufacturer		HYDRANAUTICS, FILMTEC, KOCH OR APPROVED EQUAL
Number		42
Type		Low fouling
Nominal diameter	In	4
Nomical length	In	40
Area per element	ft^2	85
Material		POYAMIDE (THIN FILM COMPOSITE)
Type		SPIRAL WOUND
Design membrane flux average	Gfd	12
Area per element	ft^2	85
Maximum feed pressure	Psi	250
Granular Adsorption Carbon (GAC)		
Treatment objective		lowest possible EDC and PPCPS
GAC Type		Flowsorb
Flow	gpm	5
Number of contactors		2 duty in series
Diameter	Ft	1.87
Depth	Ft	2.93

Continuation Table 3-13: Sidestream Pilot Plant Design Criteria and Facility Requirements

Area	ft^2	2.7
Hydraulic loading rate	gpm/ft^2	1.8
Contact time	min	12.0
Operating pressure	lb/in 2	<5
Ion Exchange		
Treatment objective		Removal of TOC, TN < 0.27
Type		(1)Organic Scavenging + (1) Nitrate Removal
low	gpm	10
Number of units		2 in series
Diameter	ft	1.5
Area	ft^2	1.8
Hydraulic loading rate	gpm/ft^2	5.7
Depth	ft	9.0
Advanced Oxidation Process		
Ozone / H2O2		
Treatment objective		lowest possible EDC and PPCPS
Model		(1)HiPOx Cabinet Unit (HCU)
Flow	gpm	6 to 10
Ozone concentration	mg/L	2 to 40
Ozone capacity	lbs/day	Upto 20
Maximum H2O2 (5%-35%)dose	mg/L	20
Power required at full flow and oxidant dose	KW	2.1
UV/H2O2		
Treatment objective		lowest possible EDC and PPCPS
Model		(1)LBX90
Number of lamps		4
Peak flow	gpm	20
UV dose at peak flow	mJ/cm2	600
H2O2 dosage	mg/l	5
UV		
Treatment objective		NDMA
Model		(1)Inline 400 +
Number of lamps		4
UV dosage	mJ/cm2	500-750
Maximum power consumption	KW	10

performed. The estimated water surface elevation in each treatment unit for a 1 MGD constant flow is shown on **Figure 3-9**

3.4.3 Mass Balance

A mass balance was developed for TSS, BOD5, total nitrogen and total phosphorus loadings for a 1 MGD WRDP. A process schematic and the mass balance calculations are presented on **Figure 3-10**

3.4.4 Electrical System Design

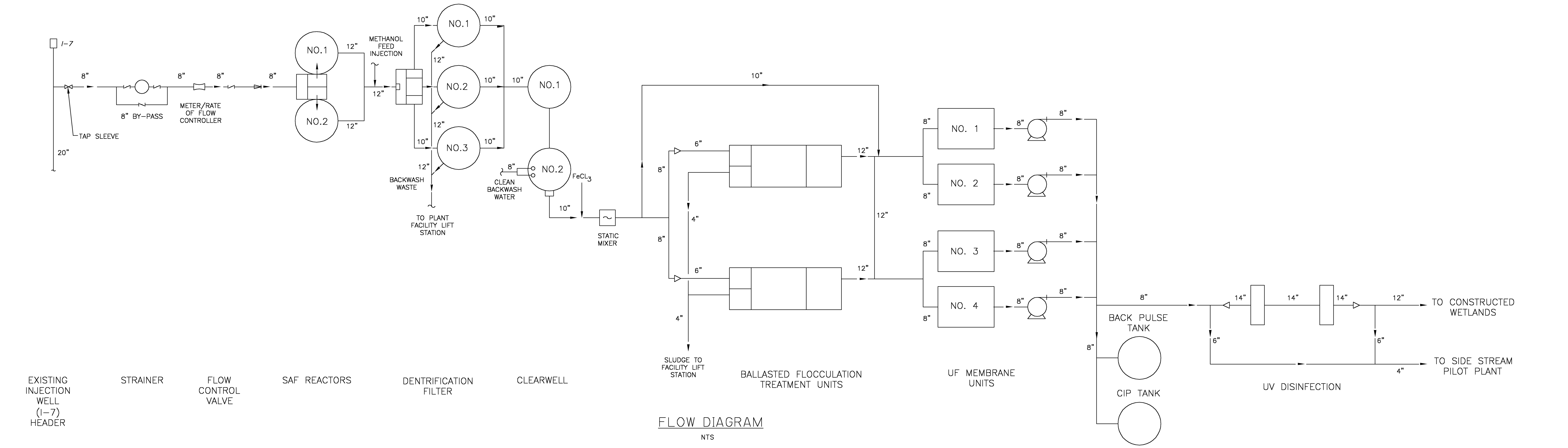
The expected system voltage for the WRDP is 480 volt, 3 phase and based on preliminary equipment sizing the expected demand will be 400 kVA. Electrical power for the WRDP can potentially be provided from the electrical system in Grit Building No. 1 at the SDWWTP. A preliminary power requirement is included in Appendix A. During Phase II design, the location of electrical feed and additional electrical design will be defined.

3.4.5 Instrumentation and Process Control

The WRDP is composed of several treatment processes such as SAFs, denitrification filters, ballasted flocculation treatment system UF membranes and UV disinfection, each with their corresponding equipment, such as blowers, pumping systems, cleaning systems, and controls. Preliminary P&ID figures included at the end of Section 3 indicate major equipment and controls to monitor the process and water quality at the WRDP.

These processes will have their own local control panels for automatic control, in addition to the remote monitoring and control. The automatic control will include but not be limited to filter backwashing sequencing, backwash water pumping, UV disinfection system monitoring, lamp output control, and pump controls.

In addition to each of the local automatic monitoring and control panels, we propose a Main Control Panel (MCP) located in the office/contrpl room of the SSP building. This panel will be a central monitoring, control and data storage center, for monitoring and control of the entire process and any related equipment and monitoring devices. The MCP will provide monitoring, control and functionality to assist engineers and staff with the WRDP information including collection and storage of historical data. The proposed MCP will consist of an open-architecture monitoring and control system with programmable logic controllers (PLC) and an industrial computer for process monitoring and control. The MCP will be connected to other local control panels via fiber optic Ethernet network and/or hard wired. Also, all the process monitoring devices will be hard wired directly to the MCP or through a junction cabinet. The industrial computer workstations will run Microsoft Windows operating system and Human Machine Interface (HMI) graphical software for monitoring and control. Additional software applications such as historical data management, storage, retrieval, reporting, and other functions will be furnished.



FLOW DIAGRAM

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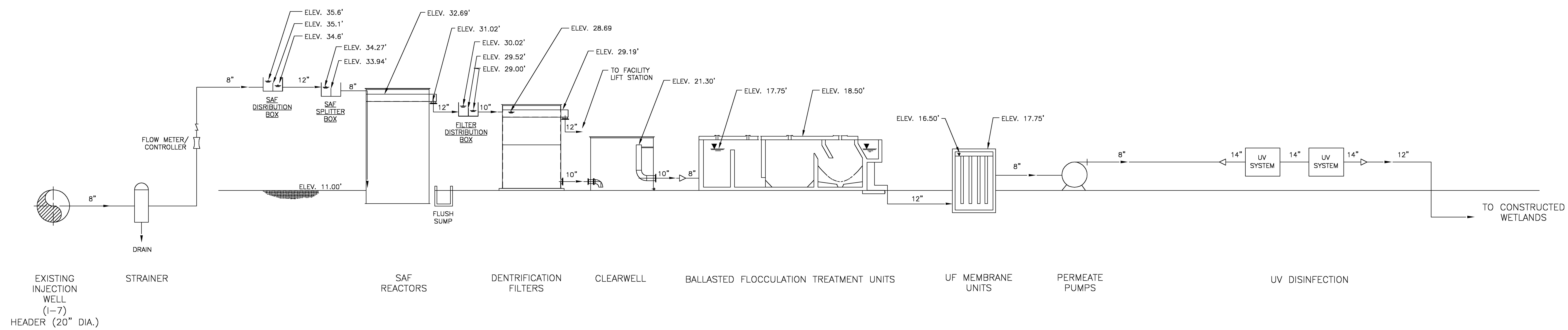

HYDRAULIC PROFILE

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FLOW DIAGRAM AND HYDRAULIC PROFILE

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SHEET FIG 3-9

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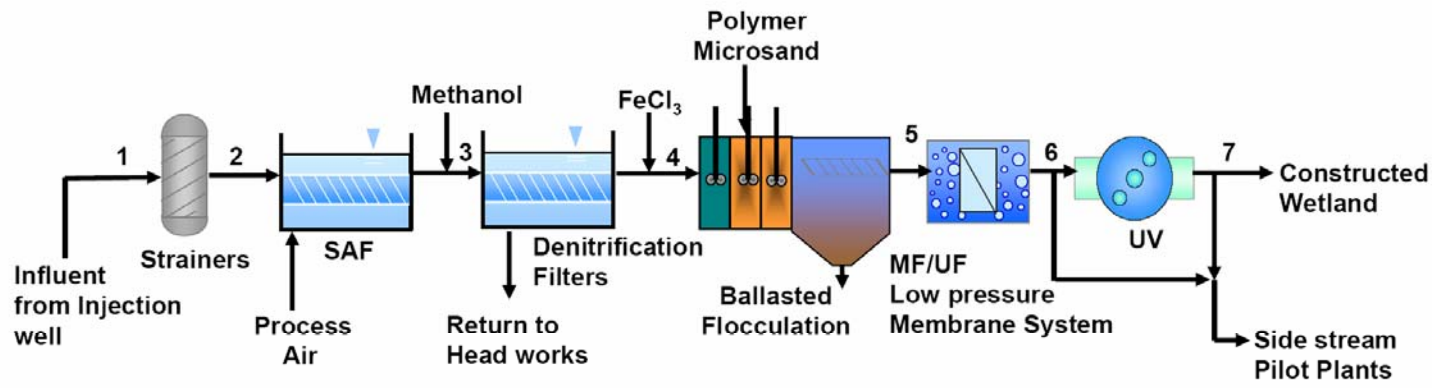


FACILITY LOADING AND CONCENTRATION		AVERAGE VALUES AT LOCATION POINTS*						
		1	2	3	4	5	6	7
FLOW (mgd)		1.25	1.19	1.19	1.1	1.02	1	1
BOD	(mg/l)	20	20	10	5	5	2	2
	(lb/d)	209	198	99	50	46	17	17
TSS	(mg/l)	20	20	30	5	5	2	2
	(lb/d)	209	198	297	50	46	17	17
TN	(mg/l)	27	27	26.7	3	3	2.5	2.5
	(lb/d)	281	281	264	30	28	21	21
TP	(mg/l)	2.7	2.7	2.7	2.7	0.1	0.1 -0.05	0.1 - 0.05
	(lb/d)	26.7	26.7	26.7	26.7	0.92	0.42	0.42

* The average values are estimated values based on reported technology performance. The actual values will depend on influent wastewater characteristics coming to the WRDP and technology performance during operation.

Figure 3-10
Mass Balance

3.5 Project Implementation

The design of the WRDP is divided in two phases. Phase I design is presented in this report and includes conceptual design and preliminary drawings. Phase II includes the preparation of final design drawings and specifications as well as permits for the construction of the WRDP. The permit application process begins in Phase I with a review of the permits required for construction of the facilities and will continue in Phase II with the preparation and submittal of permits.

This section includes a preliminary capital cost estimate, operation and maintenance (O&M) cost, preliminary review of permits requirements, and a project schedule.

3.6 Estimated Capital Cost

Preliminary capital cost estimate has been prepared for each element of the WRDP. The capital cost estimate includes the probable cost of construction for the work described in this report for the nominal 1-MGD WRDP and SPP.

The estimated cost of the WRDP is summarized in **Table 3-14**. The preliminary construction cost summary is based on budget cost estimates for equipment from manufacturer's representatives and estimates for installation, site work, yard piping, electrical work, and instrumentation and controls. The construction cost estimate also includes considerations for permits, sales tax, bond and insurance, general requirements, contractor overhead and profit, and contingency. The estimated cost of construction is **$9,108,000.** The total WRDP capital cost, including engineering, legal, and administration services, is estimated to be approximately **$ 11,385,000.**

Table 3-14: WRDP Capital Cost Estimate[1]

Description	Allowance Factor	Cost
Strainer		$39,000
Submerged Aerated Filters/Denitrification Filters		$1,969,000
Ferric Chloride System		$56,000
Ballasted Flocculation Treatment Unit		$1,038,000
UF Membranes		$1,250,000
UV Disinfection		$225,000
Sidestream Pilot Plant Processes Equipment		$438,000
Lift Station		$175,000
Building		$288,000
Subtotal:		**$5,478,000**
Yard piping	5%	$274,000
Mechanical	5%	$274,000
Electrical	8%	$438,000
Instrumentation and Controls	5%	$274,000
Site work	10%	$548,000
Subtotal:		**$7,286,000**
General Conditions (mobilization, bonds, insurance, taxes, permits, licenses, overhead, profit, etc.)	25%	$1,822,000
Opinion of Probable Construction Cost:		**$9,108,000**
Contingency	10%	$911,000
Technical Engineering, Legal and Administration	15%	$1,366,000
Opinion of Probable Capital Cost:		**$11,385,000**

[1] ENR Construction Cost, December 2006 = 7888

3.7 Estimated Operation and Maintenance Cost

An estimate of the operation and maintenance (O&M) cost for the WRDP has been prepared considering average operating conditions. The assumptions used in the development of the O&M costs are presented in **Table 3-15.** The estimates include labor, chemicals, electricity, equipment replacements and repairs. The O&M estimate is summarized in **Table 3-16**

The estimated annual O&M cost is approximately $502,000 annually.

Table 3-15: O&M Assumptions

Description	Assumptions/Values
Labor	The estimate includes labor for 2 full-time operators. Salary rates are based on hourly rates posted in Florida Water and Pollution Control Operators Association and The 2005 NACWA Financial Survey. The hourly rates were increased by 25 percent to account for benefits.
Electric power	
Power cost, $/kw-hour	0.10
Chemical Cost	
Sodium Hypochlorite (10.8%), $/gal (55 gal drum)	4.70
Citric Acid Cost, $/lb	0.71
Polymer Cost, $/lb	2.0
Methanol, $/gal	1.15
Ferric Chloride, $/ton	275
Replacement	
Membrane replacement, $/module	811
Membrane replacement	The replacement cost is obtained assuming that 20 percent of the membranes would need to be replaced in a 5 year period.
UV lamp replacement	Replacement UV parts include lamps, sleeves, rings expected lamp life is 8,000 hours UV lamp cost = $375/lamp
Other equipment replacement (except Membrane and UV)	2 percent of equipment cost

Table 3-16: Estimated Operation and Maintenance Cost Estimate

Description	US $
Power	$187,000
Labor	$109,000
Chemicals	$87,000
Replacement parts and materials	
Membrane Replacement	$3,504
Other equipment parts replacement	$45,790
Water Quality Monitoring	$70,000
Total Estimated Yearly O&M Costs	**$502,000**

3.8 Project Schedule

A preliminary schedule for WRDP is provided on **Figure 3-11**. This schedule depicts the permitting and design tasks in two phases. Phase II Design which includes 90 percent design should be completed by May 2007 according to the interim agreement with SFWMD. The demonstration plant and the monitoring program are estimated to operate for 3-5 years, based on information reported by SFWMD and the USACE. Assuming the milestones indicated in the preliminary schedule are met, start-up of WRDP should be completed in October 2009.

3.9 Regulatory Permits

A preliminary list of regulatory permits for the construction and operation of the WRDP are provided below:

- Miami-Dade County permitting process which includes seven approvals entities: Building Department, Department of Planning and Zoning, Department of Environmental Resources Management, Public Works Department, Fire Rescue Department, Water and Sewer Department, and Florida Department of Health

- Florida Department of Environmental Protection Request for Approval of Monitoring Plans for Discharge of Domestic Wastewater to Wetlands

- Florida Department of Environmental Protection Request for Application for a Domestic Wastewater Facility Permit

In 2003, USACE and SFWMD prepared a document entitled "Review of Regulatory Requirement and Coordination" in where provide a summary of the potential regulatory requirements for the construction and operation of the CERP Wastewater Reuse Technology Pilot Project with ultimate discharge to the Biscayne Bay Coastal

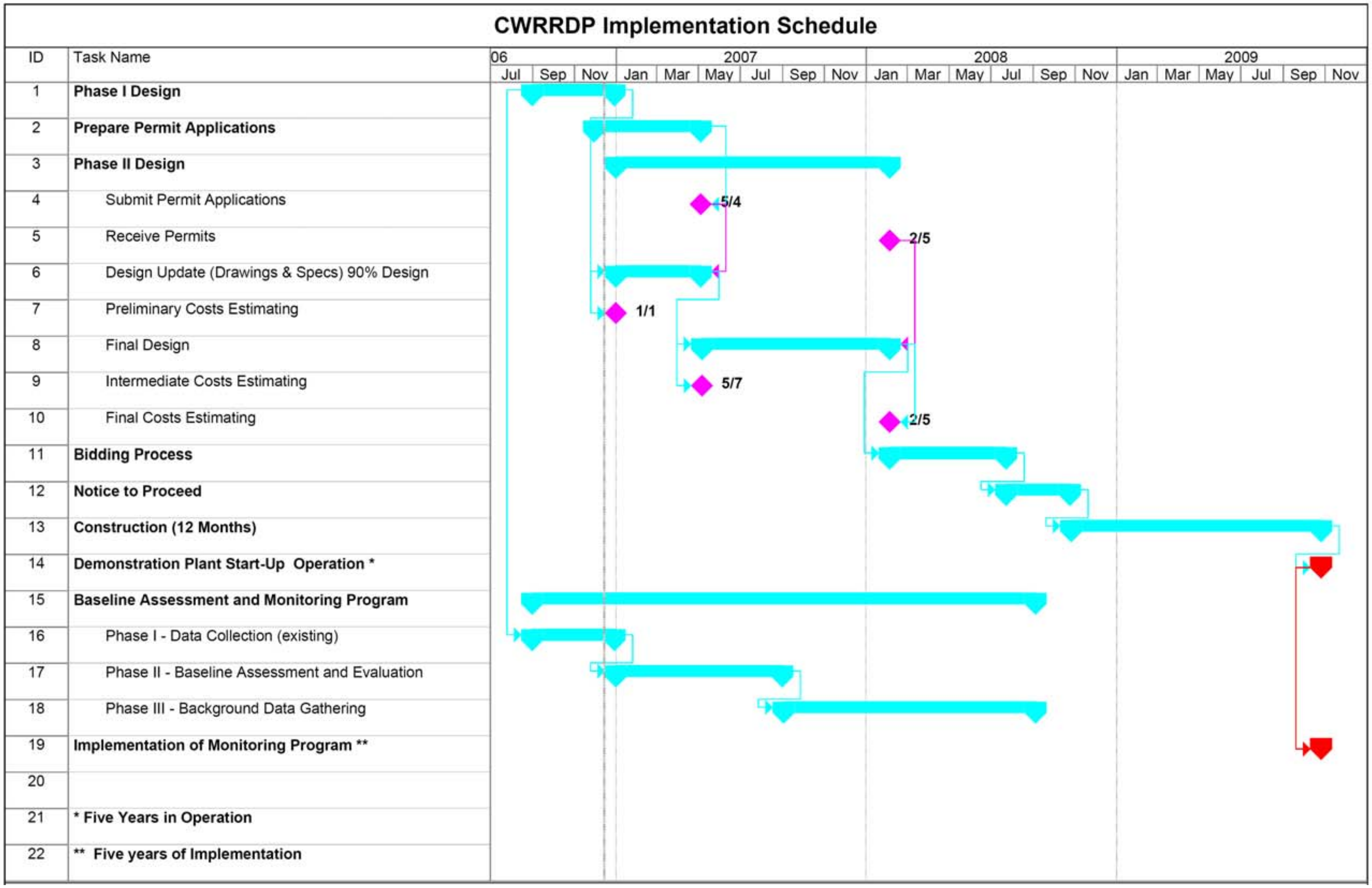


Figure 3-11
CWRRDP Implementation Schedule

Wetlands. A copy of this document is included in **Appendix B.** The regulatory requirements and permits discussed in the 2003 report will be considered in the Phase II of the Water Reuse Demonstration Plant. The initial intent is for the WRDP effluent to be returned to the SDWWTP after passing through the conducted wetlands and not discharged to the Bay.

Section 4
Constructed Wetlands System – Conceptual Design

4.1 General

There is a need to rehydrate the Biscayne Bay Coastal Wetlands with freshwater to return the system to a historically lower salinity environment. The introduction of highly treated reclaimed water from the South District Wastewater Treatment Plant (SDWWTP) could provide a source of additional freshwater to rehydrate the coastal wetlands. To demonstrate the feasibility of this approach, the Coastal Wetlands Reuse Rehydration Demonstration Project (CWRRDP) will investigate the biological response of coastal wetland vegetation hydrated with reuse water from the proposed Wastewater Reuse Demonstration Pilot (WRDP). The results of this demonstration project are needed prior to committing to full-scale reuse of effluent from the SDWWTP.

The demonstration project includes the construction of a wetland located in a parcel of land contiguous to and north of the SDWWTP. The constructed wetland is proposed to be designed as a series of two 2½-acre (1-hectare) wetland cells with flexibility in flow distribution to determine realistic responses to varying hydraulic loading rate, hydraulic residence time, depth of inundation, vegetation type, and seasonality. The wetland system will be configured as shown in **Figure 4-1**. **Figure 4-2** illustrates the design cross-sections for the constructed wetland cells, and **Figure 4-3** presents the site plan with the spreader and collection canals, and inflow and outflow systems.

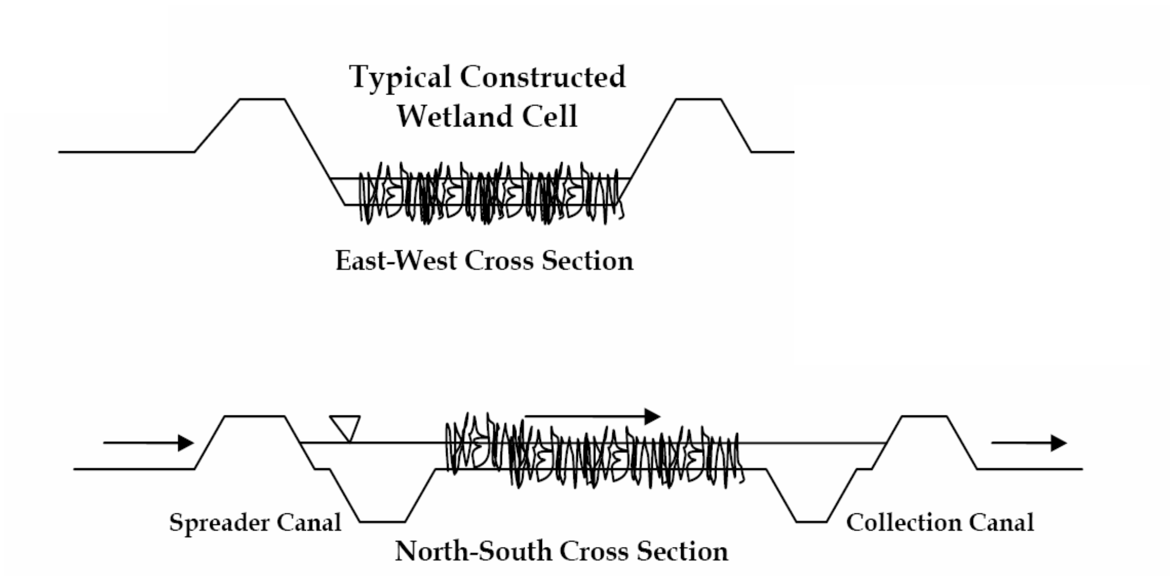
Site specific topographic and geotechnical data will be gathered to support the constructed wetland design. An initial review of the Phase I/II ESA and subsequent Additional Assessment Report for the selected site indicates that the parcel is acceptable for use in the demonstration project.

The biological response investigation will focus on vegetation typical of the Biscayne Bay coastal wetlands. The characterization of native Biscayne Bay coastal wetland vegetation types and density will be used in designing the planting plan for the constructed wetland cells. The coastal vegetation plants type and diversity to be used in the demonstration project will be determined through the use of a control wetland transect. The control wetland transect will be monitored during the project life to identify natural vegetation changes not related to the reuse water testing. The design phase of the project will include a coastal wetland site inspection to select the location of the control wetland transect and assist in the definition of the "biological response" parameters to be monitored, and the probable range of values.

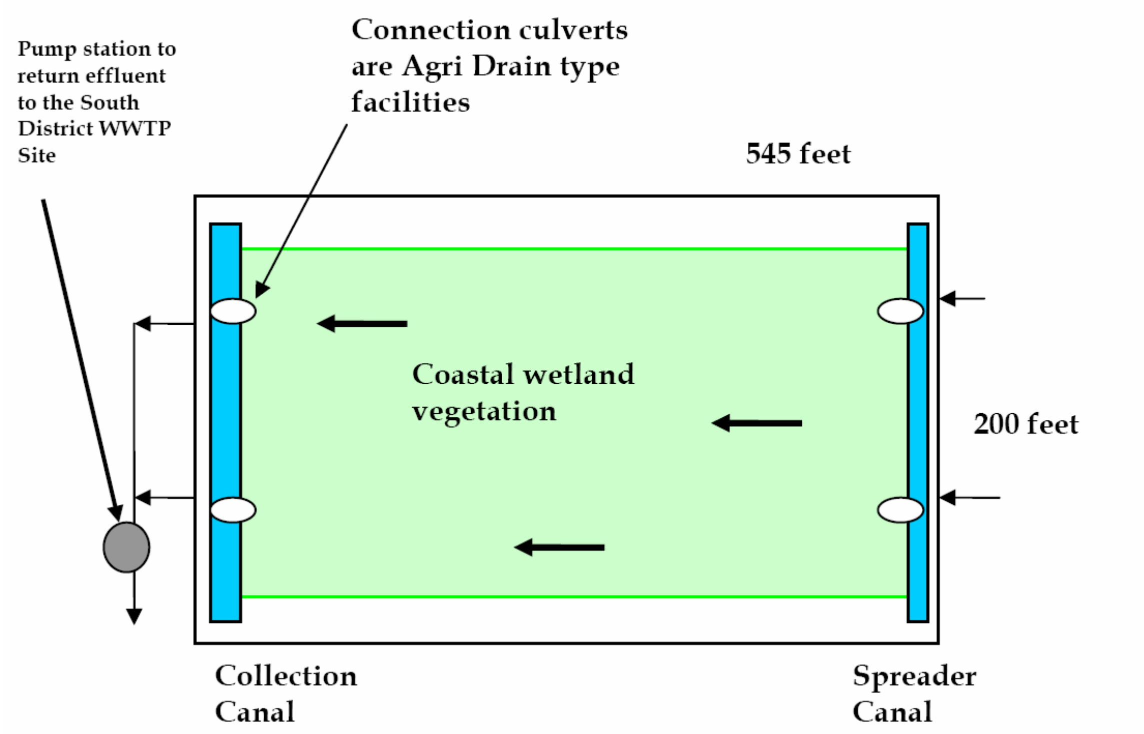
The detailed design of the constructed wetland will be enhanced through use of first order spreadsheet models for sizing the wetland cells and the site groundwater seepage analysis, and use of conventional proprietary and public domain hydrology models. The schedule for the constructed wetland will include a two season (summer

CH2MHill

Figure 4-1
Proposed Constructed Wetland Demonstration Site Configuration



Typical Constructed Wetland Cell Cross Sections



Constructed Wetland Cell Site Plan – Typical Layout season) grow-in and start-up period, and the initiation of "biological response" monitoring in the third season.

Planning-level cost estimate for the Constructed Wetland, based on the best available unit cost information (in December 2006 dollars), is estimated at approximately $1,587,500. The 60 percent and 90 percent cost estimates will refine the reliability of the estimate and incorporate more recent bidding experience.

Phase 2 of the CWRRDP includes a detail design of the constructed wetland, and preparation and submittal of the permitting applications.

A technical memorandum was prepared by CH2MHILL, a subconsultant to CDM, detailing the conceptual design of the constructed wetlands and the information obtained to assist in the conceptual design. A copy of this technical memorandum can be found in **Appendix C.**

Section 5
Baseline Assessment Monitoring Program

5.1 General

As part of the May 10, 2006 Interim Water Use Agreement with the South Florida Water Management District (District), the Miami Dade County Water and Sewer department (MDWASD) agreed to undertake a coastal wetlands reuse (rehydration) demonstration project in South Dade.

Milian, Swain & Associates., Inc. (MSA) performed a review of readily available water quality, vegetation, soil, wetlands hydrologic, topographic, land use, and utility data to characterize the existing conditions of the subject areas, including the Cutler (formerly Lennar) Flow Way and nearby water bodies. To identify this baseline information, specific tasks performed included conducting a site visit of the subject areas to determine existing site conditions; obtaining and reviewing existing reports, investigations, and data regarding the subject area; and developing an inventory of existing conditions data including identification of data gaps.

This investigation served two primary purposes:

- Provide information needed to design, construct, and develop a monitoring plan for the Coastal Wetlands Reuse Demonstration Project (CWRRDP). The project will use advanced treated reuse water from the South District Wastewater Treatment Plant (SDWWTP)

- Characterize an environmental baseline, where physical, chemical and biological responses to the constructed wetlands demonstration project can be assessed.

There were no significant findings that would indicate that the proposed test area would be unsuitable for project implementation. However, it should be noted that there was no environmental data available to provide baseline information for the proposed constructed wetland site specifically.

Although multiple datasets for the surrounding canals, the coastal wetland fringe, and the Bay were provided, no data was readily available for the coastal wetlands specifically. Available datasets were provided to characterize the surrounding water quality and to provide existing conditions of the surrounding water bodies. Existing datasets consistent with the parameters anticipated for testing during the pilot testing were included.

Tables 5-1, 5-2, and **5-3**, are presented to compare the water quality at stations in canal, canal/bay Interface and Biscayne Bay waters, to the demonstration plant effluent water quality goals, as outlined in the Final Report South Dade Advanced Wastewater Treatment Alternatives (USCOE, 2004). The water quality goals included in this table include targets for standard public access reuse projects, wetland applications, heavy metals, Class III & OFW standards, and other targets outlined by the Biscayne Bay

Table 5-1: Effluent Water Quality Standards/Goals and Canal Conditions

Parameter	Effluent Water Quality Standards / Goals[a]						Canal Stations					
	Irrigation Reuse	Wetlands Application	Heavy Metals	Class III Goal OFW	BBPI[b]	WWRU PDT[c]	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***	-	-	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)
(b) Biscayne Bay Partnership Initiative (BBPI)
(c) Waste Water Reuse Pilot Project Delivery Team (WWRU PDT)

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

Table 5-2: Effluent Water Quality Standards/Goals and Canal/Bay Interface Conditions

Parameter	Effluent Water Quality Standards / Goals[a]						Canal/Bay Interface (Brackish) Stations						
	Irrigation Reuse	Wetlands Application	Heavy Metals	Class III Goal OFW	BBPI[b]	WWRU PDT[c]	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.

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(c) Waste Water Reuse Pilot Project Delivery Team (WWRU PDT)

Table 5-3: Effluent Water Quality Standards/Goals and Biscayne Bay Conditions

Parameter	Effluent Water Quality Standards / Goals[a]						Biscayne Bay Stations						
	Irrigation Reuse	Wetlands Application	Heavy Metals	Class III Goal OFW	BBPI[b]	WWRU PDT[c]	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.

(a) Task 5 – Final Report South Dade Advanced Wastewater Treatment Alternatives, (USCOE, 2004)
(b) Biscayne Bay Partnership Initiative (BBPI)
(c) Waste Water Reuse Pilot Project Delivery Team (WWRU PDT)

Partnership Initiative (BBPI), and baseline water quality in Biscayne Bay recommended by the Waste Water Reuse Pilot Project Delivery Team (WWRU PDT).

The mean datasets for those parameters listed in Tables 1A, 1B, and 1C, were separated into three location categories based on station salinity levels. Canal Stations show no visible evidence of prolonged saltwater influence from Biscayne Bay, containing salinity levels between 0 and 1.5 parts per thousand (ppt.). Canal/Bay Interface Stations show some visible evidence of saltwater influence from Biscayne Bay, containing salinity levels between 7 and 27 ppt. Biscayne Bay Stations listed are all located within the Bay and have salinity levels between 20 and 36 ppt. These tables demonstrate that the water surrounding the project area exceeds the effluent water quality goals being considered for this reuse project.

No data was readily available for Emerging Pollutants of Concern (EPOCs) in the vicinity of the project area.

Vegetation data has also been provided to characterize the existing conditions within the proposed constructed wetland site. It is not anticipated that any of the current vegetation will be used in the constructed wetland. Vegetation consistent with that found in the Biscayne Bay Coastal Wetlands and the proposed control site will need to be planted in the constructed wetland areas. This vegetation will need an establishment period of more than a year in order to stabilize so that the response evaluations can begin in a "mature" system.

Specific recommendations for water quality and biological data collection will be outlined in the CWRRDP Monitoring Plan and will be based on monitoring plans implemented during other reuse pilots, the operations schedule of the plant, and physical site conditions dictated through design and construction.

A technical memorandum was prepared by MSA, a subconsultant to CDM, to summarize the data available as well as any data gaps. A copy of this technical memorandum can be found in **Appendix D.**