2 Existing Conditions

Climate, soil type, population, geology, water resources and groundwater, and existing infrastructure will greatly determine the feasibility of implementing certain water reuse applications.

Wastewater reuse is not a "one size fits all" practice. Reuse projects that have been successful in other areas may not be suitable for the unique characteristics of Miami-Dade County. Factors such as climate, soil type, population, geology, water resources and groundwater, and existing infrastructure will greatly determine the feasibility of certain reuse applications.

This section provides information describing the regional and local character of the MDWASD Reuse Feasibility Study Area (study area) as outlined in FDEP's *Guidelines for Preparation of Reuse Feasibility Studies* (1991).

2.1 GENERAL CONDITIONS

Miami-Dade County encompasses approximately 2,000 square miles and is comprised of 35 municipalities. It is bounded by Broward County to the north, Collier and Monroe Counties to the west, and the Atlantic Ocean and Biscayne Bay to the south and east, respectively. As presented in Figure 2.1-1, the study area consists of Miami-Dade County as well as other unincorporated areas serviced by MDWASD. As is typical of subtropical areas, the average annual temperature is 75 degrees Fahrenheit (°F) year-round with fluctuations between the winter and summer months. The main seasons are marked by changes in rainfall, which on an annual basis average 52 inches per year (United States Geological Survey [USGS] 1996). Approximately two-thirds of the rainfall occurs during the wet season (May through October). In contrast, during the dry season (November to May), total rainfall averages less than 20 inches. Marl and rocky/gravelly soils are the two main types of soils found throughout Miami-Dade County and both derive from the Miami limestone surface rock. Marl soils are found in low-lying areas, typically in the southeast and southwest portions of Miami-Dade County including the ENP. These less permeable soils are formed from the flooding and drying cycles that occur between the wet and dry seasons, resulting in the swampy, marshy environments typical of the ENP. Natural marl soils have been affected by drainage practices for development

and agriculture. Gravelly/rocky soils are highly permeable and are generally found in the northeast. The Biscayne Aquifer is the primary source of potable water in Southeast Florida. In Miami-Dade County, the highly permeable Biscayne Aquifer is a mere few feet below the ground surface, making it susceptible to contamination.

With approximately 2,000 people per square mile, Miami-Dade County is the most populated county in Florida, yet it supports some of the richest and most sensitive ecosystems in the nation, namely the ENP and BNP. ENP is the only subtropical natural preserve in North America, while BNP is the largest marine park in the National Park System (National Park Service 2000). The preservation of sensitive ecosystems is of great concern for state, local, and federal agencies, as well as for residents. It is an important factor in the development of this Reuse Feasibility Study.

With approximately 2,000 people per square mile, Miami-Dade is the most populated county in Florida, yet it supports some of the richest and most sensitive ecosystems in the nation.

2.1.1 Current Land Use

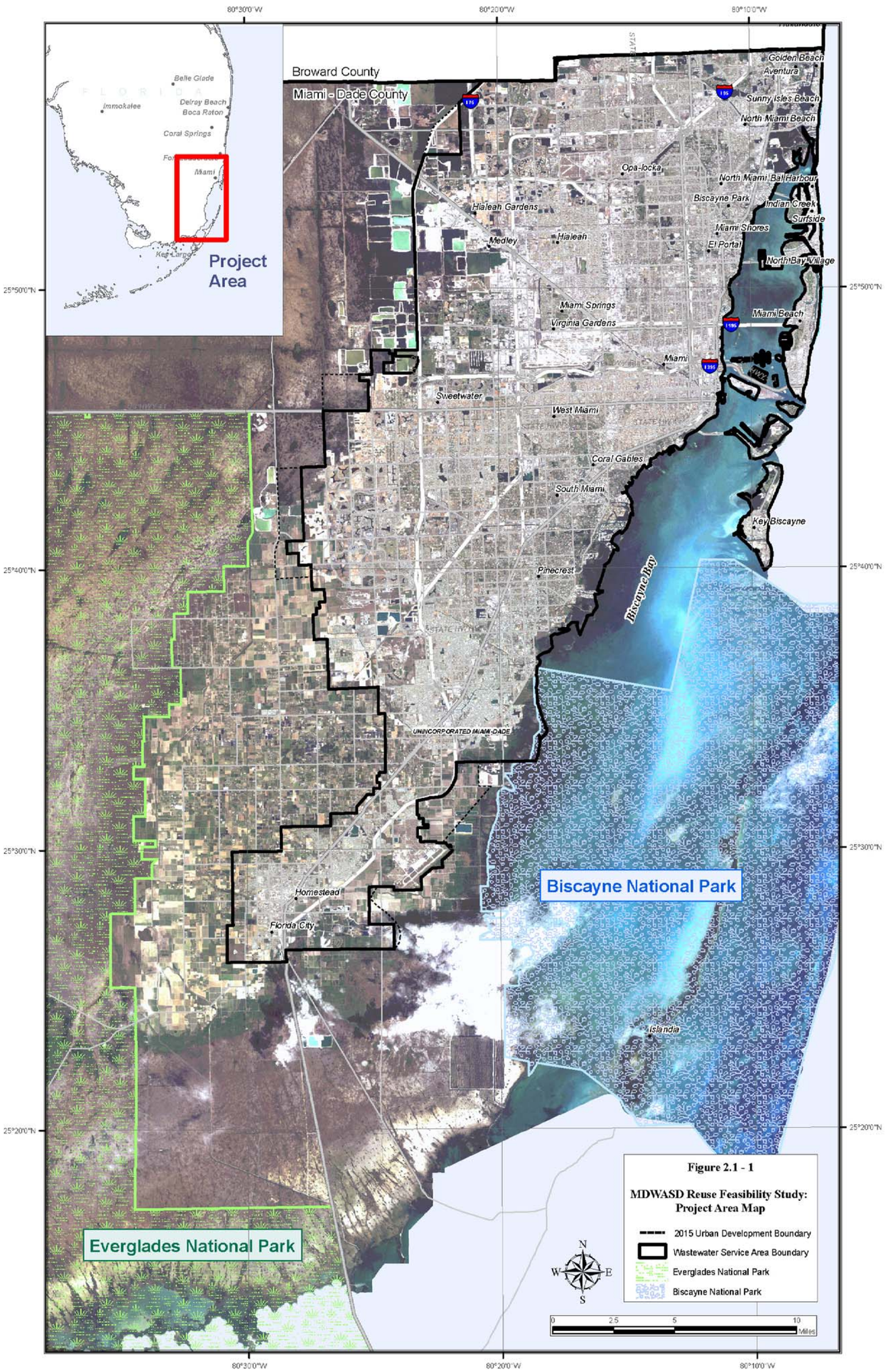
Geographical Information System (GIS) land use coverage for Miami-Dade County was obtained from the SFWMD. Table 2.1.1-1 summarizes the existing land use coverage.

Table 2.1.1-1. Summary of Land Use Classifications for Miami-Dade County

Land Use	Area (acres)	Area (sq mi)	Percent Land Cover
Wetlands	861,440	1,346.00	68.1%
Open Water	33,573	52.00	2.7%
Residential	139,766	218.38	11.1%
Agricultural	82,559	129.00	6.5%
Commercial	45,960	71.81	3.6%
Transportation/Utilities	27,370	42.77	2.2%
Institutional	11,775	18.40	0.9%
Recreational	10,979	17.16	0.9%
Open Land	51,299	80.15	4.1%

Source: SFWMD 1999.
Key:
sq mi = square miles.

More than 70% of Miami-Dade County consists of wetlands and open water as seen in Figure 2.1.1-1. These areas are concentrated in the southwestern and southeastern portions of Miami-Dade County and along the eastern coast in Biscayne Bay. Wetlands found in Miami-Dade County are very rich and unique ecosystems, and are protected by local, federal, and state entities.


Ecology & Environment, Inc. GIS Department
Project #001202.MD47.01 R:\Miami\Miami Dade Reuse\mxds\Figure_2.1_1_Vicinity.mxd 3-2006
80°30'0"W
80°20'0"W
80°10'0"W
25°50'0"N
25°40'0"N
25°30'0"N
25°20'0"N
Broward County
Miami - Dade County
Project Area
Belle Glade
Immokalee
Delray Beach
Boca Raton
Coral Springs
Miami
Key Largo
Golden Beach
Aventura
Sunny Isles Beach
North Miami Beach
Opa-locka
North Miami
Bal Harbour
Biscayne Park
Indian Creek
Surfside
Hialeah Gardens
Hialeah
Medley
Miami Shores
El Portal
North Bay Village
Miami Springs
Virginia Gardens
Miami Beach
Miami
Sweetwater
West Miami
Coral Gables
South Miami
Key Biscayne
Pinecrest
Biscayne Bay
UNINCORPORATED MIAMI-DADE
Homestead
Florida City
Biscayne National Park
Islandia
Everglades National Park
Figure 2.1 - 1
MDWASD Reuse Feasibility Study:
Project Area Map
2015 Urban Development Boundary
Wastewater Service Area Boundary
Everglades National Park
Biscayne National Park
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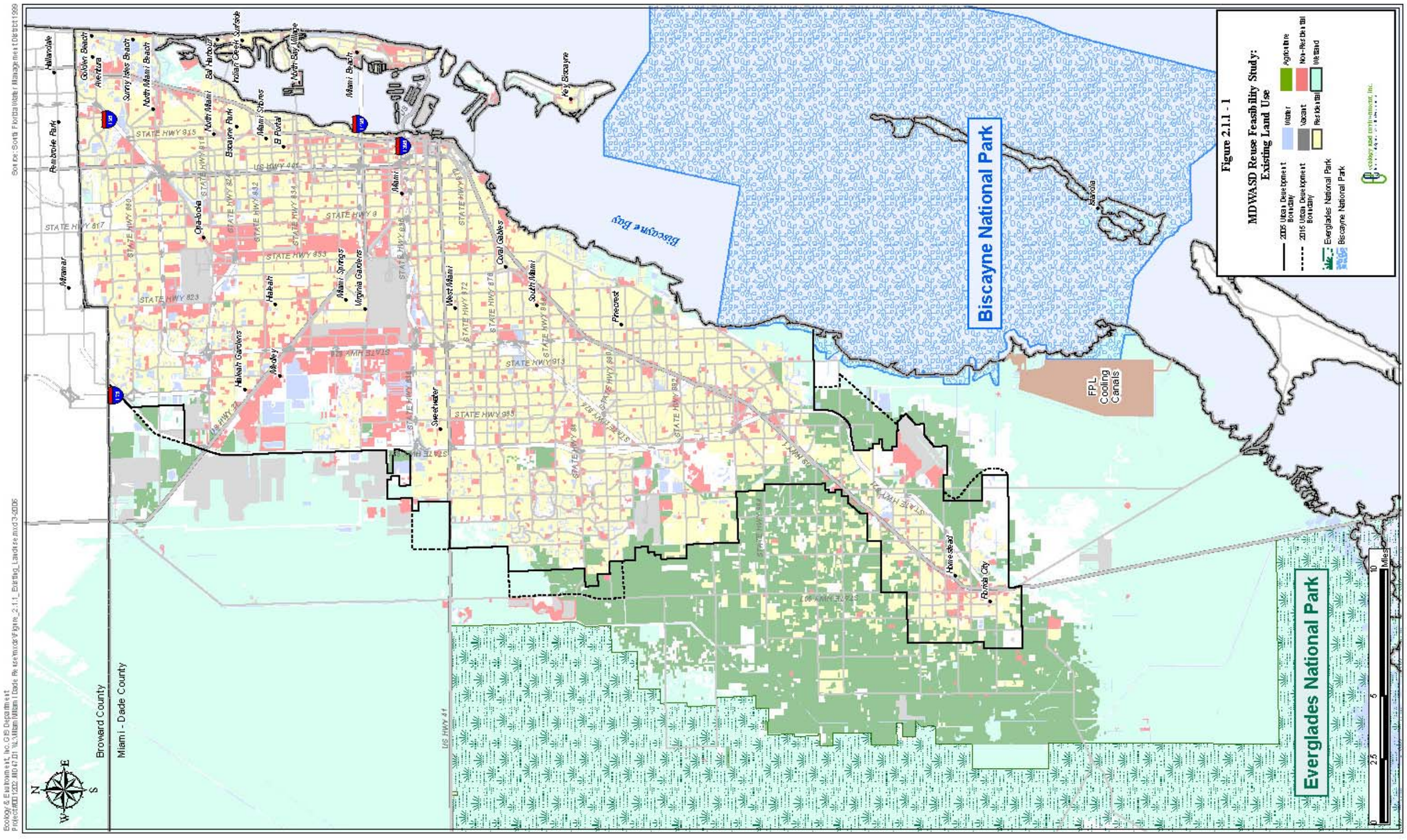
Figure 2.1.1 - 1
MDWASD Reuse Feasibility Study:
Existing Land Use
2015 Urban Development Boundary
2015 Urban Development Boundary
Everglades National Park
Biscayne National Park
Agriculture
Non-Residential
Vacant
Residential
Wetland
Biscayne Bay
Biscayne National Park
Everglades National Park
FPL Cooling Canals
Broward County
Miami - Dade County
Hialeah
Miami Springs
Virginia Gardens
West Miami
Coral Gables
South Miami
Precinct
Sweetwater
Homestead
Florida City
Miami Beach
Key Biscayne
Miles

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Based on the above data, residential developments account for approximately 11% (220 square miles) of Miami-Dade County and agricultural developments account for approximately 6.6% (129 square miles) of Miami-Dade County, for a total of 349 square miles, or 17.6% of the total land area. In their 2005 Comprehensive Development Master Plan (CDMP), Miami-Dade County Planning and Zoning reported that "almost 500 square miles have been developed for urban or agricultural use." Existing residential areas are concentrated in the northeastern and coastal portions of Miami-Dade County, while agricultural areas are situated farther south and west, mostly between the existing urban development boundary (UDB) line and protected wetland areas of the ENP.

There has been a trend of converting agricultural and open land to urban development. This trend is expected to continue as development pressures mount to meet a growing population, particularly in those areas within or in close proximity to the UDB.

2.1.2 Existing Wetlands

Freshwater wetlands in Miami-Dade County are part of the historical Everglades ecosystem. This ecosystem was once a free-flowing, flat, shallow, and grassy body of water that flowed from Lake Okeechobee to Florida Bay. Since then, drainage patterns have greatly modified this freshwater system and it is currently connected by canals, wetlands and streams. While currently stressed, the Everglades is still of very high ecological significance and is protected under federal, state, and local agencies. Flow of water into the ENP via canals and other structures is under SFWMD jurisdiction.

The Comprehensive Everglades Restoration Plan (CERP), a federal plan to restore the Everglades, has identified several wetland areas in Miami-Dade County to potentially use reclaimed water for wetlands rehydration. Two of these CERP wetland areas include the Biscayne Bay Coastal Wetlands and the Bird Drive Recharge Area, as shown on Figure 2.1.2-1. To date, reclaimed water has not been used for wetland rehydration due to a number of uncertainties surrounding water quality requirements, existing background levels, and technical feasibility for achieving antidegradation standards.

2.1.3 Surface Water

Surface water flows in South Florida are part of the SFWMD's system of canals, levees, and man-made structures. In Miami-Dade, the SFWMD operates 17 primary canals and structures including the South Dade Conveyance System, two major pump stations, and Water Conservation Area (WCA) 3. Figure 2.1.2-1 shows the major canals in Miami-Dade County. WCA 3 is located between Broward and Miami-Dade Counties. It is divided into WCA 3A, located entirely within Broward County, and WCA 3B, located mostly within Miami-Dade County.

The canals and supporting structures provide surface water flow throughout the regional system from Lake Okeechobee to Florida Bay and maintain flows going into the Everglades ecosystem. They also provide aquifer recharge, protection from saltwater intrusion, urban, agricultural and environmental water supply, and essential habitat for a

number of species. WCA 3 receives water from the regional system and also provides wetland habitat, aquifer recharge, flood protection, and dry season water storage.

The Biscayne Bay Aquatic Preserve, BNP, and ENP, including their natural tributaries (but not artificial portions of canals), are designated OFWs under F.A.C. 62-302.700. This includes waters of north Biscayne Bay and the Oleta River that extends north, close to the Miami-Dade-Broward County line, and waters of Card Sound, Barnes Sound, and Florida Bay to the Monroe County line. As such, they are subject to the most stringent water quality criteria. Ambient water quality in the OFWs is high and is superior to most Class III numerical standards, except within the mouths of some canals. In particular, these water bodies exhibit extremely low nutrient and turbidity levels, and many contaminants occur at concentrations below detection limits. Thus, when considering reuse opportunities that impact OFWs, water quality is of utmost importance.

2.1.4 Geology

South Florida is underlain by a huge volume of shallow marine carbonate sediments (McPherson and Halley 1996). In Southeast Florida, the Biscayne Aquifer is positioned just below the ground surface and occurs within the Miami Limestone and the Fort Thompson Formations (Post-Miocene, Quaternary formations). Miami Limestone is sandy and oolitic in nature. Fort Thompson consists of permeable sandy soils, and of alternating beds of marine, brackish and freshwater limestones (Harvey *et al.* 2002). The Caloosahatchee Marl and Anastasia Formations are transitional areas between quaternary and tertiary rocks. These areas are characterized by less sandy soils, more silty marl, and shell fragments. The Tamiami Formation overlays the Hawthorn Group, which forms the upper confining unit, and represents tertiary period rock formations between the Miocene and Pliocene era. Impermeable and semi-permeable calcareous clays form the top upper confining unit and act as the base of the Biscayne Aquifer. Deeper sediments are composed primarily of limestone.

2.1.5 Hydrogeology/Groundwater

There are several main aquifer features in South Florida. The surficial system lies just below the ground surface, the intermediate system acts as a confining unit, and the Floridan Aquifer is deep beneath the ground surface and is divided into Upper Floridan and the Boulder Zone.

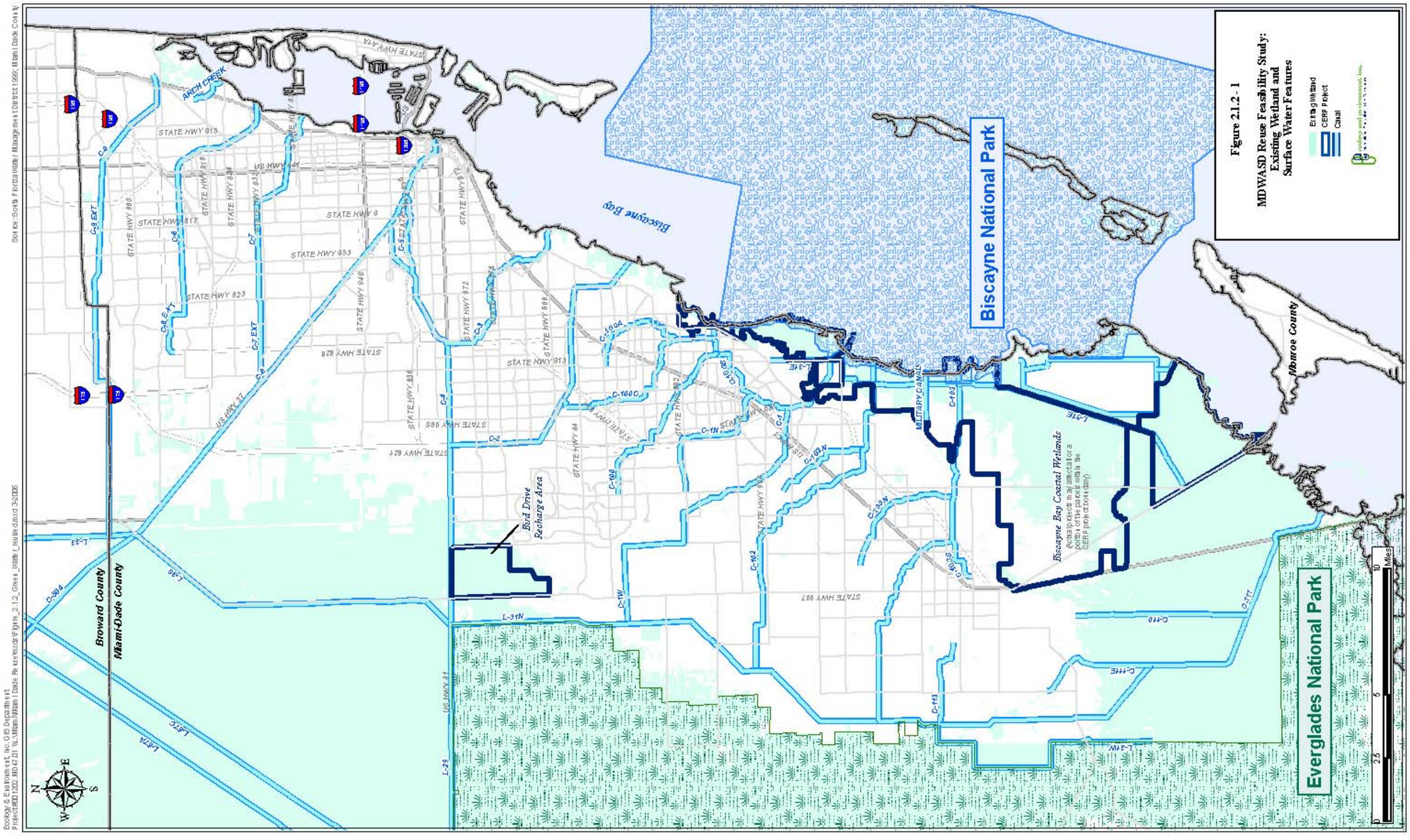
Figure 2.1.2 - 1
MDWASD Reuse Feasibility Study:
Existing Wetland and
Surface Water Features
Existing Wetland
CERP Project
Canal
Biscayne National Park
Everglades National Park
Biscayne Bay
Monroe County
Broward County
Miami-Dade County
Bird Drive
Recharge Area
Biscayne Bay Coastal Wetlands
ARCH CREEK
STATE HWY 915
STATE HWY 953
STATE HWY 823
STATE HWY 826
STATE HWY 838
STATE HWY 997
MILITARY CANALS
US HWY 1
C-9
C-9 EXT
C-8
C-8 EXT
C-7
C-7 EXT
C-6
C-5
C-4
C-3
C-2
C-1
C-100
C-100A
C-100C
C-100D
C-1W
C-102
C-103
C-111
C-111E
C-113
C-1N
C-100N
C-100S
L-31E
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L-31W
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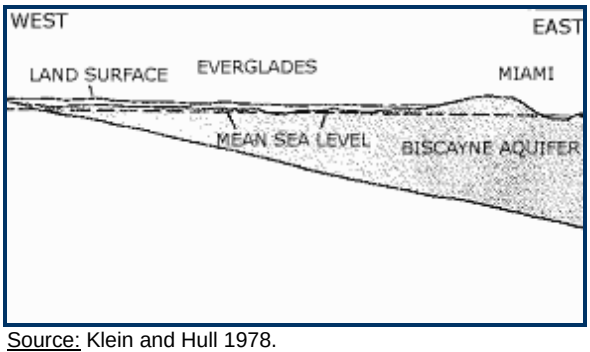
In Southeast Florida, the surficial system contains the Biscayne and the gray limestone aquifers. The Biscayne Aquifer, located just below the ground surface, is the sole source of potable water supply to Miami-Dade County. The base of the Biscayne Aquifer slopes upward in a westerly fashion forming a wedge from the Atlantic Coast Ridge, where depths are over 200 feet below sea level, toward the Everglades, where it wedges out. Figure 2.1.5-1 illustrates a section of the Biscayne Aquifer.



Source: Klein and Hull 1978.

Figure 2.1.5-1. Idealized Section of Biscayne Aquifer

The Biscayne Aquifer is recharged by rainfall and canal flow. Hydraulic conductivities of the Biscayne Aquifer can exceed 10,000 feet per day (ft/d; Fish and Stewart 1991). Its proximity to ground surface, coupled with the highly permeable nature of the sediments and rock, make the Biscayne Aquifer very productive, as well as highly susceptible to contamination, especially in the southern portion of Miami-Dade County where the over burden is not very deep. In the northern portions, a semi-confined layer, approximately 7 to 10 feet deep, overlays the Biscayne Aquifer.

The gray limestone aquifer is separated from the Biscayne Aquifer by a semi-confining bed made up of clayey sand. The gray limestone aquifer also slopes upward in a westerly fashion from 170 feet below sea level in Homestead to approximately 50 feet below sea level in northwest Miami-Dade County. Records of the gray limestone aquifer are fairly recent.

A confining layer, 300+ feet thick, separates the surficial system from the Upper Floridan Aquifer. The Upper Floridan is approximately 1,500 feet thick, with the lower 900 feet being the primary water bearing zone. According to MDWASD's 2003 Water Supply Master Plan, transmissivity of the Upper Floridan Aquifer has been documented at the West Wellfield site at approximately 100,000 gallons per day (GPD) per foot. While chlorides and total dissolved solids (TDS) are high in the Upper Floridan (1,500 mg/L and 4,000 mg/L, respectively) and advanced treatment would be needed, it is defined by the EPA as a USDW since the TDS levels are below 10,000 mg/L.

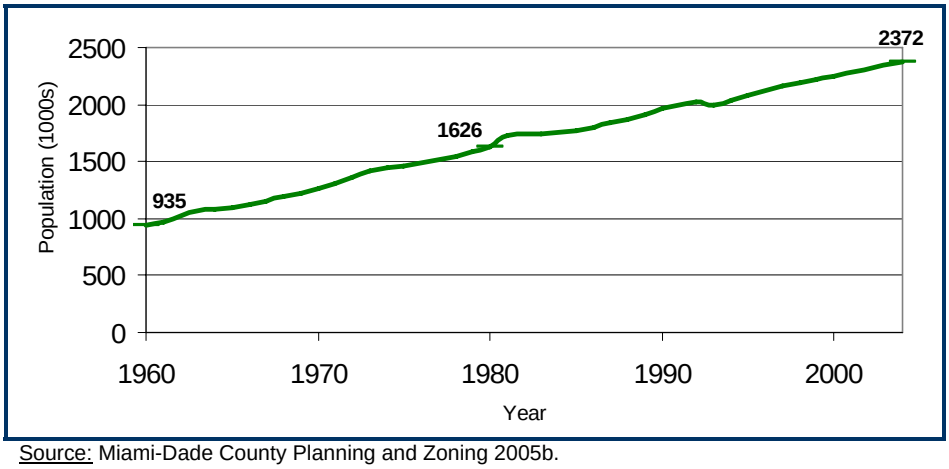
Underlying this Upper Region is a 1,000-foot thick confining layer which is underlain by a cavernous limestone system called the Boulder Zone. Treated effluent from the South District Wastewater Treatment Plant (SDWWTP) is disposed to the Boulder Zone of the Lower Floridan Aquifer and the effluent from the North District Wastewater Treatment

Plant (NDWWTP) will be disposed in the Boulder Zone of the Lower Floridan Aquifer in the future.

2.1.6 Population Trends

The population of Miami-Dade County has experienced a steady increase since the beginning of the century. Despite several pauses in growth, such as Hurricane Andrew in 1992 and the economic recession in early 1980's, the increasing population trend is evident. The Research Section of the Miami-Dade County Planning and Zoning Department reports that, from 1910 to 1960, the population "just about doubled in size every ten years."

Figure 2.1.6-1 presents the population trends from 1960 to 2004. During this period, the population increased by 2.5 times to over 2.37 million people, with an annual growth rate of over 32,600 persons.



Source: Miami-Dade County Planning and Zoning 2005b.

Figure 2.1.6-1. Population Trends in Miami-Dade County: 1960 – 2004

This rapid growth continues. The U.S. Census reports that, from April 2000 to July 2004, the population in Miami-Dade County increased by over 110,000 persons, or 4.9%.

2.2 WASTEWATER MANAGEMENT

The information provided in this section is based on information contained in the 1998 Reuse Feasibility Study and 2003 Wastewater Master Plan and updated through discussions with MDWASD personnel.

2.2.1 General Description

Collection and treatment of the 297 MGD of wastewater generated in Miami-Dade County is divided into three regional districts. The North District services the area from the north county boundary line to near NW 79th Street and includes unincorporated areas and the municipalities of Hialeah, Hialeah Gardens, North Miami, Miami Gardens, Miami Lakes, Miami Shores, Opa-Locka, and North Miami Beach. The Central District

extends from NW 79th Street to the Tamiami Canal and includes a portion of Coral Gables to SW 156th Street. This district services the unincorporated areas inside its boundary and the municipalities of Doral, Miami, Miami Beach, Miami Springs, Medley, Coral Gables, South Miami, Bal Harbor, and Key Biscayne. The South District includes the unincorporated areas located between the Tamiami Canal and SW 360th Street and the municipality of Pinecrest, Palmetto Bay, Homestead Air Force Base and Florida City. Figure 2.2.1-1 shows the MDWASD general service boundary lines.

The NDWWTP, the Central District Wastewater Treatment Plant (CDWWTP), and the SDWWTP are all located in the eastern portion of the county in the locations shown on Figure 2.2.1-1. The components of each of the regional treatment plants are described below.

2.2.2 Regional Collection and Transmission System

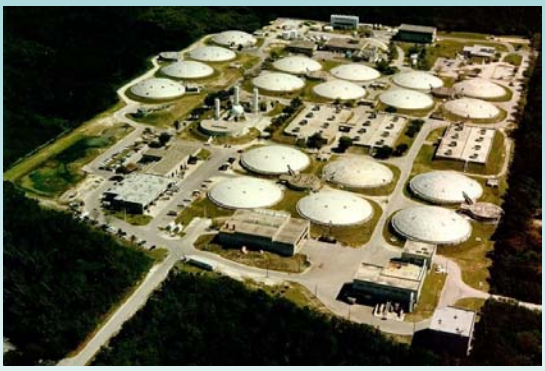
The MDWASD wastewater collection system consists of over approximately 2,900 miles of gravity sewers, 880 miles of force mains, and 987 pump stations. This is the largest system in Florida providing wastewater collection, treatment and disposal services to 13 wholesale customers and over 300,000 retail customers.

Over the last 10 years, MDWASD has implemented a major infiltration and inflow (I/I) program. The entire system has been televised, repairs have been made and they continue to be made. Pilot efforts are now ongoing to repair or replace laterals in 25 to 30 different pump station service areas most affected by rainfall. The purpose of the pilot effort is to assess the effectiveness lateral repairs in reducing peak flows. To date, the total flow reduction attributed to the I/I program accounts for over 160 MGD.

The majority of the pump stations are sized so that the nominal average pump operating time is less than or equal to 10 hours per day over a 12-month period, as required by the EPA. Also, efforts are ongoing to further assess peak flows and identify measures needed to ensure that pump stations convey all flows received in a design rainfall event.

2.2.3 North District Wastewater Treatment Plant

The NDWWTP, located at 2575 NE 151st Street, has a treatment capacity of 120 MGD, with an annual average daily flow of 92.75 MGD for 2006. Currently, NDWWTP is permitted for 112.5 MGD. The NDWWTP treats wastewater to secondary wastewater treatment standards with basic disinfection. A portion of the system effluent, up to 2.23 MGD, is processed further through effluent filters and disinfected with chlorine for reuse. The majority of the reuse stream is used onsite as process water or irrigation on the facility property. Approximately 0.1 MGD is supplied to the campus of Florida International University for public access irrigation. The remaining effluent is currently disposed of through ocean outfall or deep-well injection. Four Class I injection wells, currently undergoing operational permitting, have been constructed to a depth of approximately 2,400 feet.



NDWWTP – 2575 NE 151st Street

A schematic of the NDWWTP treatment system is presented as Figure 2.2.3-1. The wastewater enters the plant in one of three headers (one 54 inches in diameter, one 60 inches in diameter and one 72 inches in diameter). Wastewater from the North Miami and North Miami Beach areas that is higher in chlorides is kept separate from the rest of the influent through the treatment trains. The influent passes through the bar screens and into the primary clarifiers. The effluent of the clarifiers is transferred to the pure oxygen tanks. From the tanks, the mixed liquor overflow is pumped to the secondary clarifiers. The majority of the effluent from the secondary clarifiers is discharged to the ocean at a point approximately 11,000 feet from the shore through the outfall pipeline. Basic disinfection, by chlorine addition, is required for the effluent that is ocean-disposed. The chlorine is added to that stream just before the effluent pumping station. Effluent for reuse is further treated and is discussed in Section 2.4.

Scum and sludge from the primary clarifiers, waste activated sludge from the pure oxygen tanks, and scum from the secondary clarifiers is pumped to the sludge transfer station where it is pumped to the CDWWTP for treatment through two 16-inch lines that come together into one line at NW 36th Street and continue to the CDWWTP. The NDWWTP produces an effluent with relatively low levels of chlorides in Plant 1. Table 2.2.3-1 shows typical effluent concentrations for selected parameters.

Table 2.2.3-1. NDWWTP Effluent Quality Average Annual Effluent Concentrations

Year	$CBOD_5$ (mg/L)	TSS (mg/L)	Chlorides (mg/L)
1998	13.80	15.53	NA
1999	10.50	13.33	573
2000	8.39	11.71	580
2001	5.64	13.63	520
2002	6.30	12.37	593
2003	5.63	12.74	525
2004	3.75	11.02	NA
2005	8.39	10.45	NA
2006	9.83	10.78	NA

Source: Valdes 2006a.
Note: 2006 values represent average of monthly average concentrations from January through October.
Key:
$CBOD_5$ = five-day carbonaceous biochemical oxygen demand.
mg/L = milligrams per liter.
NA = not available.
NDWWTP = North District Wastewater Treatment Plant.
TSS = total suspended solids.

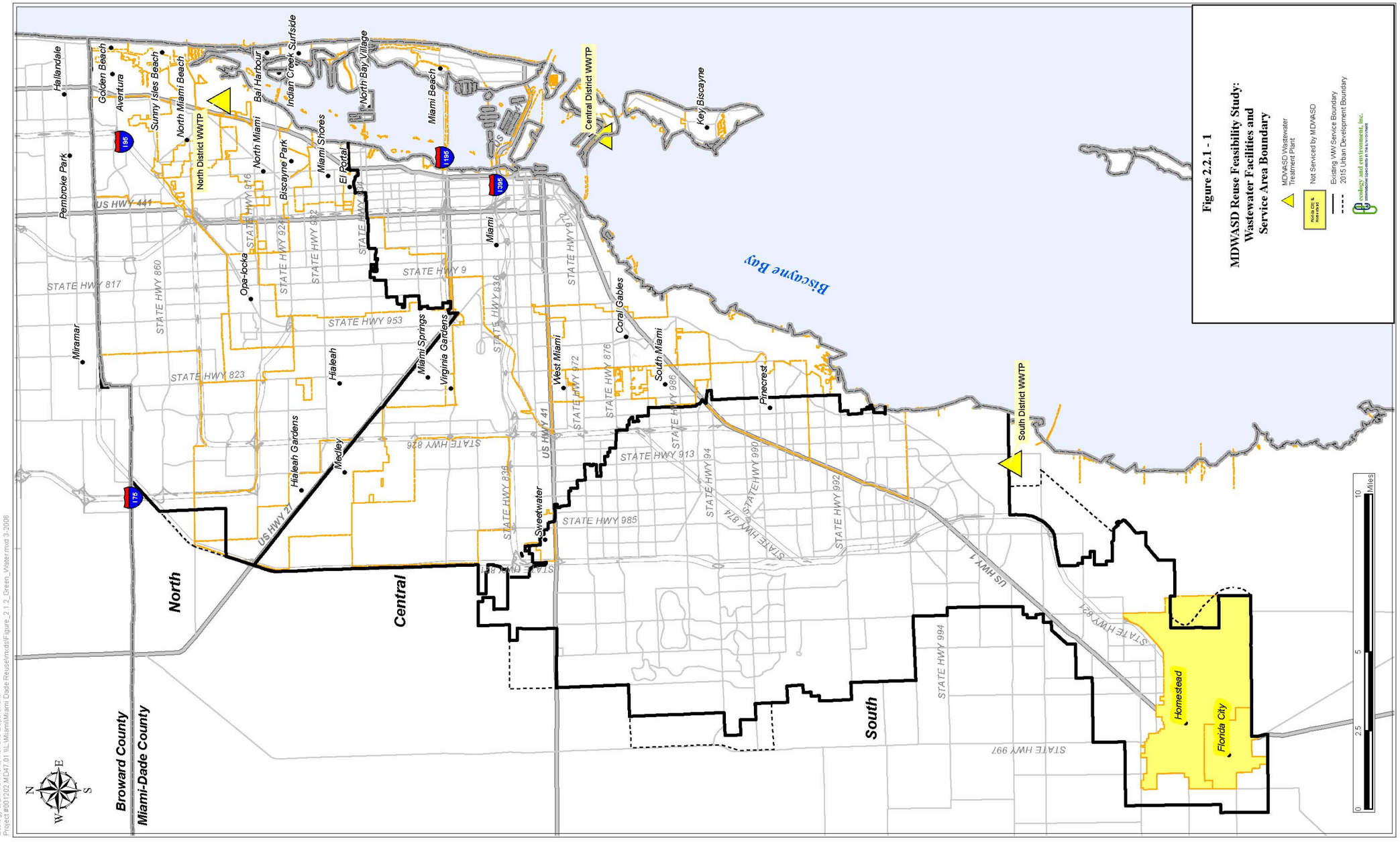


Figure 2.2.1 - 1
MDWASD Reuse Feasibility Study:
Wastewater Facilities and
Service Area Boundary
MDWASD Wastewater Treatment Plant
Not Serviced by MDWASD
Existing WW Service Boundary
2015 Urban Development Boundary
ecology and environment, inc.
International Specialists in the Environment
North District WWTP
Central District WWTP
South District WWTP
North
Central
South
Broward County
Miami-Dade County
Biscayne Bay
Hallandale
Golden Beach
Aventura
Sunny Isles Beach
North Miami Beach
Bal Harbour
Indian Creek
Surfside
North Bay Village
Miami Beach
Key Biscayne
Pembroke Park
North Miami
Biscayne Park
Miami Shores
El Portal
Miami
Opa-locka
Miramar
Hialeah
Miami Springs
Virginia Gardens
West Miami
Coral Gables
South Miami
Pinecrest
Hialeah Gardens
Medley
Sweetwater
Homestead
Florida City
US HWY 441
STATE HWY 817
STATE HWY 860
STATE HWY 916
STATE HWY 924
STATE HWY 932
STATE HWY 934
STATE HWY 9
STATE HWY 953
STATE HWY 823
STATE HWY 826
STATE HWY 836
STATE HWY 41
STATE HWY 972
STATE HWY 876
STATE HWY 986
STATE HWY 990
STATE HWY 913
STATE HWY 94
STATE HWY 874
STATE HWY 992
STATE HWY 985
US HWY 1
STATE HWY 821
STATE HWY 994
STATE HWY 997
US HWY 27
I-95
I-195
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Project #001202 MD47.01 \\IL-\Miami\Miami Dade Reuse\mxds\Figure_2.1.2_Green_Water.mxd 3-2006

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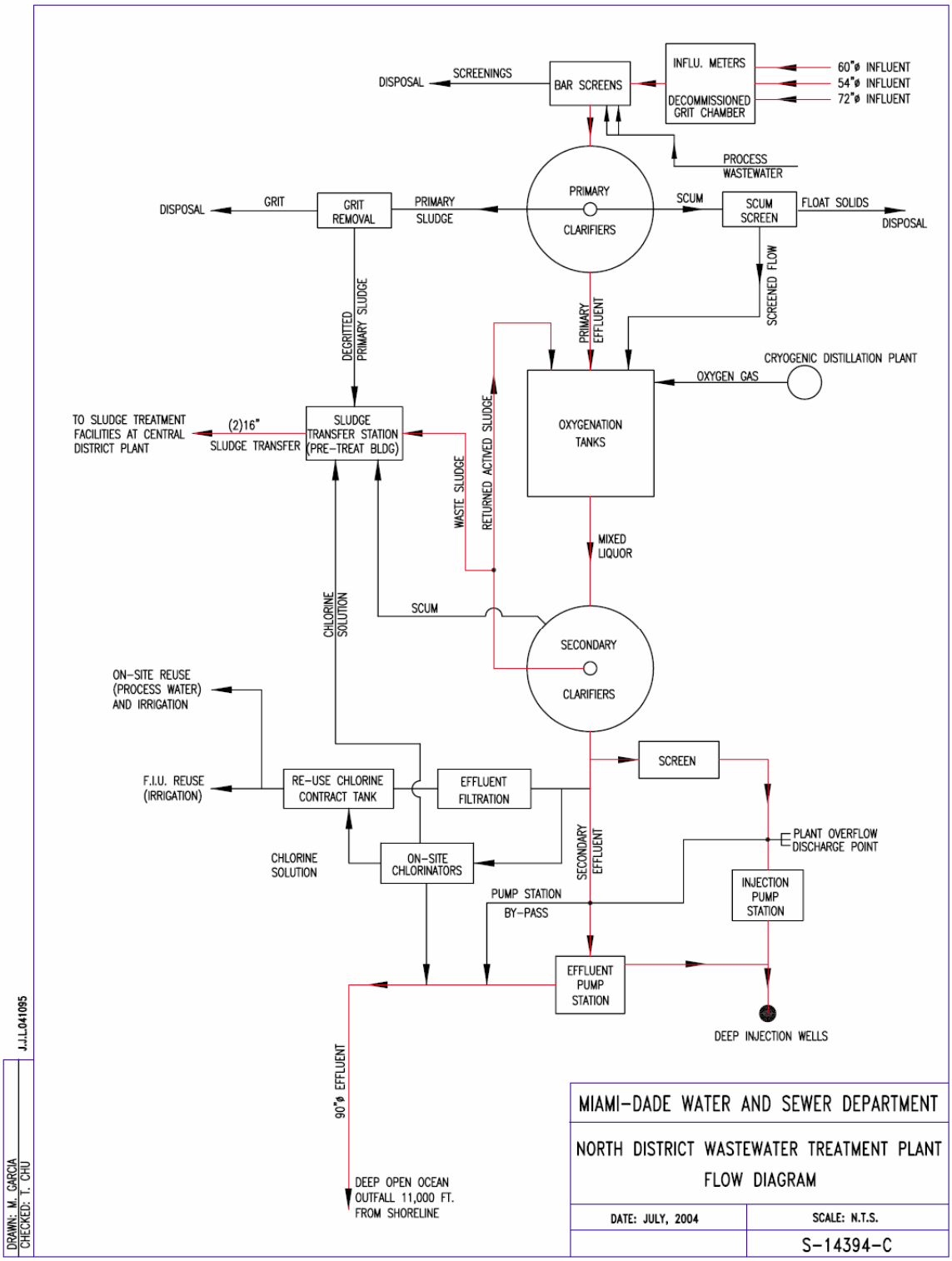


Source: Miami-Dade Water and Sewer Department.

Figure 2.2.3-1. NDWWTP Flow Diagram

2.2.4 Central District Waste Water Treatment Plant

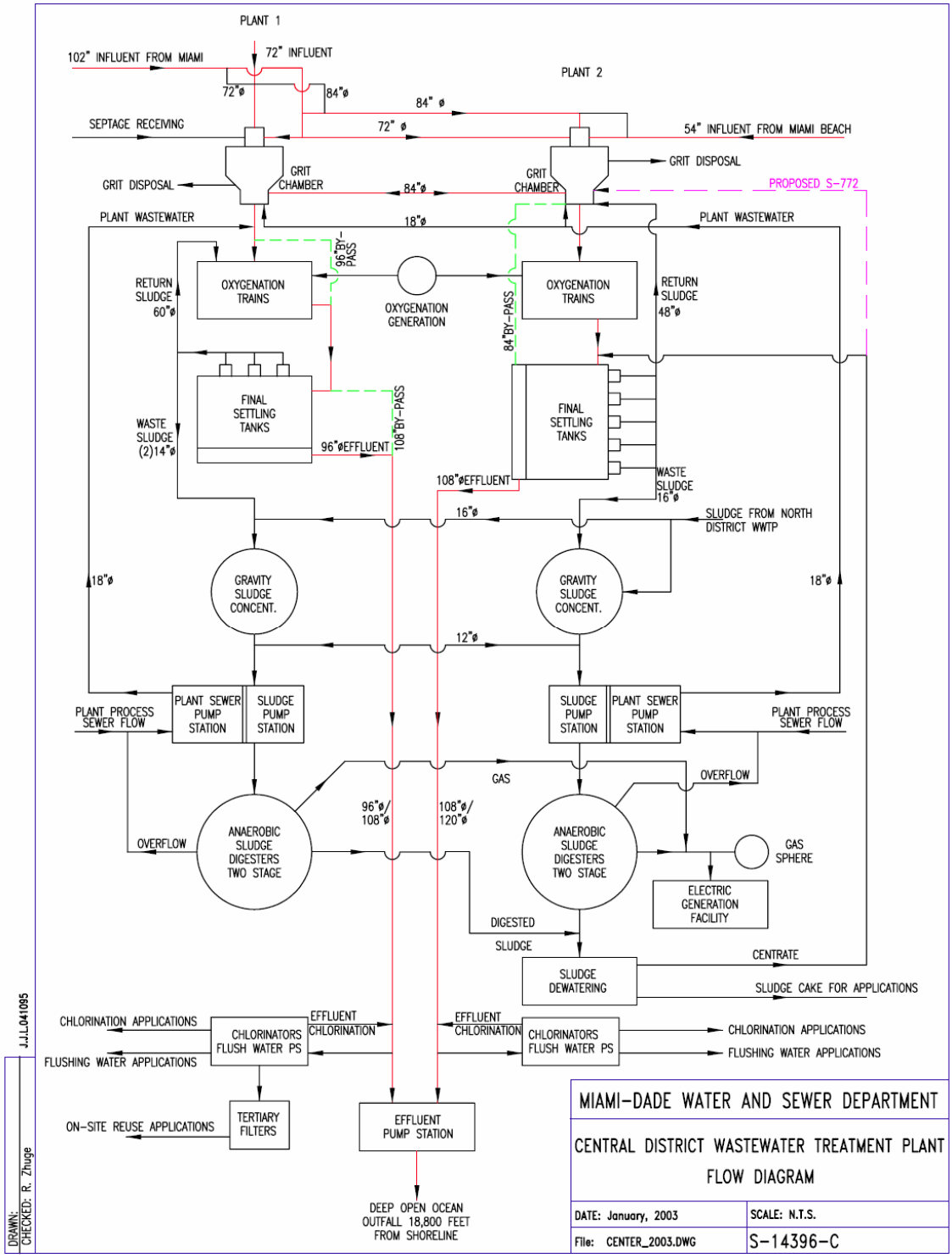
The CDWWTP, located on Virginia Key, has a permitted capacity of 143 MGD with an annual average daily flow of 110.56 MGD for 2006. The pure-oxygen activated treatment system effluent receives basic disinfection prior to disposal through the ocean outfall pipeline. The CDWWTP has the capacity to treat average flows through the year 2025. Figure 2.2.4-1 presents a schematic of the CDWWTP.

CDWWTP - Virginia Key

There are two independent process trains: one to treat lower-chlorides wastewater from the mainland and one to treat higher-chlorides wastewater from Miami Beach, Virginia Key, and Key Biscayne. There are four force mains feeding the two independent process trains (102-inch and 72-inch diameter force mains bring wastewater from the mainland, a 54-inch diameter force main brings wastewater from Miami Beach through Fisher Island, and a 24-inch diameter force main brings wastewater from Key Biscayne). The Plant 1 process train influent passes through aerated grit chambers to the pure oxygenated tanks. The mixed liquor from these tanks passes to the final settling tank where the activated sludge settles out and the overflow goes to the effluent pumping station. Chlorine is added to the Plant 1 effluent as it flows to the effluent pumping station. The Plant 2 treatment train is identical to and separate from the Plant 1 train. The two plant effluents are combined in the pumping station. From the pumping station, the majority of the effluent flows by gravity through the outfall pipe that ultimately discharges 18,800 feet from the shore through 48-inch-diameter diffusers located at an approximate depth of 100 feet. If the effluent volume exceeds 116 MGD, the excess must be pumped through the outfall because of the high tide limitation on the gravity flow amount. A small volume of effluent is further treated for reuse and will be discussed in Section 2.4.

Sludge from the oxygenation tanks is either returned to the tanks or wasted to the gravity sludge thickeners. The sludge from the NDWWTP is also fed through the thickeners. Concentrated sludge is pumped to the sludge digesters and is dewatered prior to disposal or land application.

The CDWWTP produces an effluent with high levels of chlorides. Currently, the influent streams from the coast (higher chloride content) and the areas further inland (lower chloride content) are mixed as they enter the plant. Table 2.2.4-1 shows typical effluent concentrations for selected parameters.



Source: Miami-Dade Water and Sewer Department.

Figure 2.2.4-1. CDWWTP Flow Diagram

Table 2.2.4-1. CDWWTP Effluent Quality Average Annual Effluent Concentrations

Year	$CBOD_5$ (mg/L)	TSS (mg/L)	Chlorides		
			Combined effluent (mg/L)	High chlorides stream (mg/L)	Low chlorides stream (mg/L)
1998	20.58	21.00	NA	NA	NA
1999	8.92	11.50	1240	1340	1030
2000	5.92	9.17	1140	1250	960
2001	6.25	9.00	1200	1200	1150
2002	4.25	7.25	1270	1290	1210
2003	5.42	8.08	1170	1220	1130
2004	7.46	10.90	1010	1060	980
2005	8.2	10.96	1000	1090	910
2006	7.79	9.05	1130	1200	1090

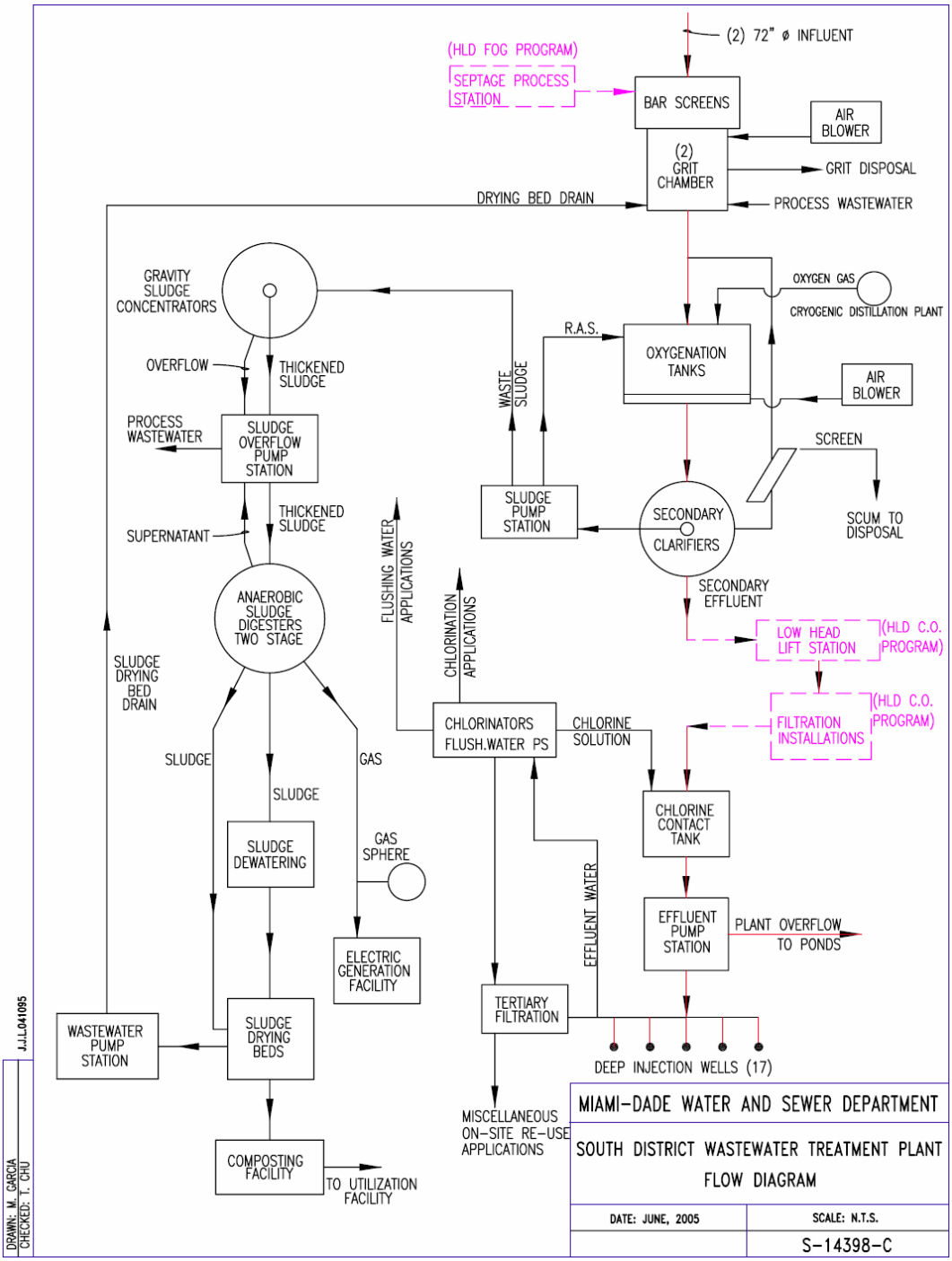
Source: Valdes 2006a.
Note: 2006 values represent average of monthly average concentrations from January through October.
Key:
$CBOD_5$ =five-day carbonaceous biochemical oxygen demand.
CDWWTP = Central District Wastewater Treatment Plant.
mg/L = milligrams per liter.
NA = not available.
TSS = total suspended solids.

2.2.5 South District Wastewater Treatment Plant

The SDWWTP is located at 8950 SW 232nd Street. It is currently permitted to process 112.5 MGD. The plant treated an annual average daily flow of 92.48 MGD in 2006. The plant currently treats its influent to secondary treatment standards prior to deep-well injection. A small portion of the effluent is treated to HLD standards and is reused as non-potable water for the plant. Figure 2.2.5-1 presents a schematic of the SDWWTP.

SDWWTP – 8950 SW 232nd Street

Influent to the plant enters in one of two 72-inch diameter force mains and is treated in one of two identical process treatment trains. The influent is screened for grit removal prior to entering the pure oxygen activated sludge process tanks. Mixed liquor overflows to the secondary clarifiers, and the clarifier overflow is pumped to the deep injection wells. The effluent does pass through a chlorine chamber that can be utilized to disinfect the effluent in emergency situations when onsite disposal to ponds is necessary.



Source: Miami-Dade Water and Sewer Department.

Figure 2.2.5-1. SDWWTP Flow Diagram

Sludge from the oxygenation tanks is either returned to the tanks or wasted to the gravity sludge thickeners. Scum skimmed from the surface of the clarifiers is also pumped to the thickeners. Concentrated sludge is pumped to the sludge digesters and is dewatered and dried prior to disposal or composting.

The effluent from the SDWWTP is good quality. Table 2.2.5-1 shows typical SDWWTP effluent concentrations for selected parameters.

Digesters at the SDWWTP

Table 2.2.5-1. SDWWTP Effluent Quality Average Annual Effluent Concentrations

Year	$CBOD_5$ (mg/L)	TSS (mg/L)	Chlorides (mg/L)
1998	4.25	7.92	65.1
1999	4.08	7.58	66.8
2000	4.67	10.25	64.2
2001	4.80	12.53	93.4
2002	5.00	10.15	71.9
2003	4.70	9.69	70.6
2004	4.80	8.51	69.2
2005	5.04	9.52	68.1
2006	5.56	8.64	96.1

Source: Valdes 2006a.
Note: 2006 values represent average of monthly average concentrations from January through August.
Key:
$CBOD_5$ = five-day carbonaceous biochemical oxygen demand.
mg/L = milligrams per liter.
SDWWTP = South District Wastewater Treatment Plant.
TSS = total suspended solids.

2.2.6 Existing Rate Structure

Table 2.2.6-1 presents the existing MDWASD wastewater disposal rate structure.

Table 2.2.6-1. MDWASD Wastewater Disposal Rate Structure

Monthly Water Use (gallons)	Charge per 1,000 gallons
0 – 3,750	$1.85
3,751 – 12,750	$3.48
12,751 and over	$4.50

Key:
MDWASD = Miami-Dade Water and Sewer Department

2.3 WATER SUPPLY

The latest update to Miami-Dade County's Water Facilities Master Plan was prepared in September 2002 (CH2M Hill 2002). The information provided in this section is based on this document, current efforts on updating the Water Facilities Master Plan and additional feedback from MDWASD personnel.

2.3.1 General Description

MDWASD's water treatment, supply, and distribution system is the largest in Miami-Dade County providing more than 340 MGD to over 2 million customers including residential areas, commercial and industrial operations, educational facilities, and parks and recreational facilities, among others. In addition, MDWASD supplies treated water on a volume basis to most publicly-owned utilities in Miami-Dade County that own and operate their own transmission and distribution systems, with the exception of the City of Homestead, Florida City, and portions of the Cities of North Miami and North Miami Beach. Many areas including residences, farms and other agricultural areas, and golf courses, among others, are supplied by private wells. Figure 2.3.1-1 presents the MDWASD Water Supply System and its service boundaries.

MDWASD's water supply system-wide operation includes wellfields for groundwater withdrawals, aquifer storage and secondary Aquifer Storage and Recovery (ASR) wells for raw water storage, three water treatment plants (WTPs), and transmission and distribution systems. The MDWASD water supply system consists of three main service areas: Hialeah-Preston, Alexander Orr, and South Dade. The Hialeah-Preston service area includes the Hialeah and Preston WTPs and four associated wellfields; the Alexander Orr service area includes the Alexander Orr, Jr. WTP as well as four other wellfields; and the South Dade service area consists of five small WTPs (Everglades Labor Camp, Leisure City, Newton, Elevated Tank, and Naranja WTPs,) and associated wellfields, containing a total of 12 water supply wells.

The finished water system-wide per capita demand for 2005 was 154.87 gallons per capita per day (gpcd). Future per capita demand is expected to be 155 gpcd. Table 2.3.1-1 summarizes the average per capita demand for MDWASD from 2003 to 2005. Reductions in per capita usage can be attributed to water conservation and reuse practices.

Table 2.3.1-1. MDWASD System-Wide Demand for 2003 to 2005

Year	Total Population Served	System-Wide Average Daily Demand (MGD)	System-Wide Per Capita Usage (gpcd)
2003	2,135,669	344.80	158.40
2004	2,165,881	340.34	156.80
2005	2,196,093	346.50	154.87

Source: Valdes 2006a.
Key:
MDWASD = Miami-Dade Water and Sewer Department.
MGD = million gallons per day.
gpcd = gallons per capita per day.

In the last ten years, MDWASD has implemented a water conservation plan. Since then, the per capita demand has been reduced from 200 gpcd as observed in the 1990s to less than 160 gpcd in 2005. MDWASD continues to implement water conservation measures and has developed the *Water Use Efficiency Five Year Plan* which evaluates MDWASD's operations, current water conservation activities, and provides a list of proposed water conservation Best Management Practices (BMPs).

MDWASD also implements a leak detection program to detect and repair leakages throughout the system. Between 2003 and 2004, water savings resulting from the underground leak detection program accounted for over 23 MGD. Replacement and repair programs of meters and above ground leak repairs accounted for nearly another 12.3 MGD of water savings.

2.3.2 Wellfields

Table 2.3.2-1 summarizes existing wells and wellfield capacities for withdrawal from the Biscayne Aquifer for MDWASD service areas for a total of 35.3 MGD.

Table 2.3.2-1. MDWASD Existing Biscayne Aquifer Wellfield Capacities

Service Area / Wellfields	# Active Wells	Wellfield Capacity (MGD)	Most Recent Consumptive Use Permit Allocation (MGD)
Hialeah-Preston Service Area:	45	382.64	199.19
Hialeah Wellfield	3		
Miami Springs Wellfield	20		Max Daily: 235.04
John E. Preston Wellfield	7		
Northwest Wellfield	15		
Alexander Orr Service Area:	39	290.17	203.11
Alexander Orr	10		
Snapper Creek	4		Max Daily: 241.6*
Southwest	17 (plus 2 ASR wells)		(*23.96 ASR)
West Wellfields	3 (plus 3 ASR wells)		
South Dade Service Area:	12	19.44	10.95
Leisure City Wellfield	4		
Everglades Labor Camp Wellfield	3		Max Daily: 13.4
Newton Wellfield	2		
Elevated Tank Wellfield	2		
Naranja Lakes Wellfield	1		
	Total: 96	**692.25**	**413.25**

Source: MDWASD 2005.
Note: The Alexander-Orr service area also has five ASR wells in the Upper Floridan Aquifer. Three wells are located in the West Wellfield, and two wells are located in the southwest wellfield.
Key:
ASR = aquifer storage and recovery.
MDWASD = Miami-Dade Water and Sewer Department

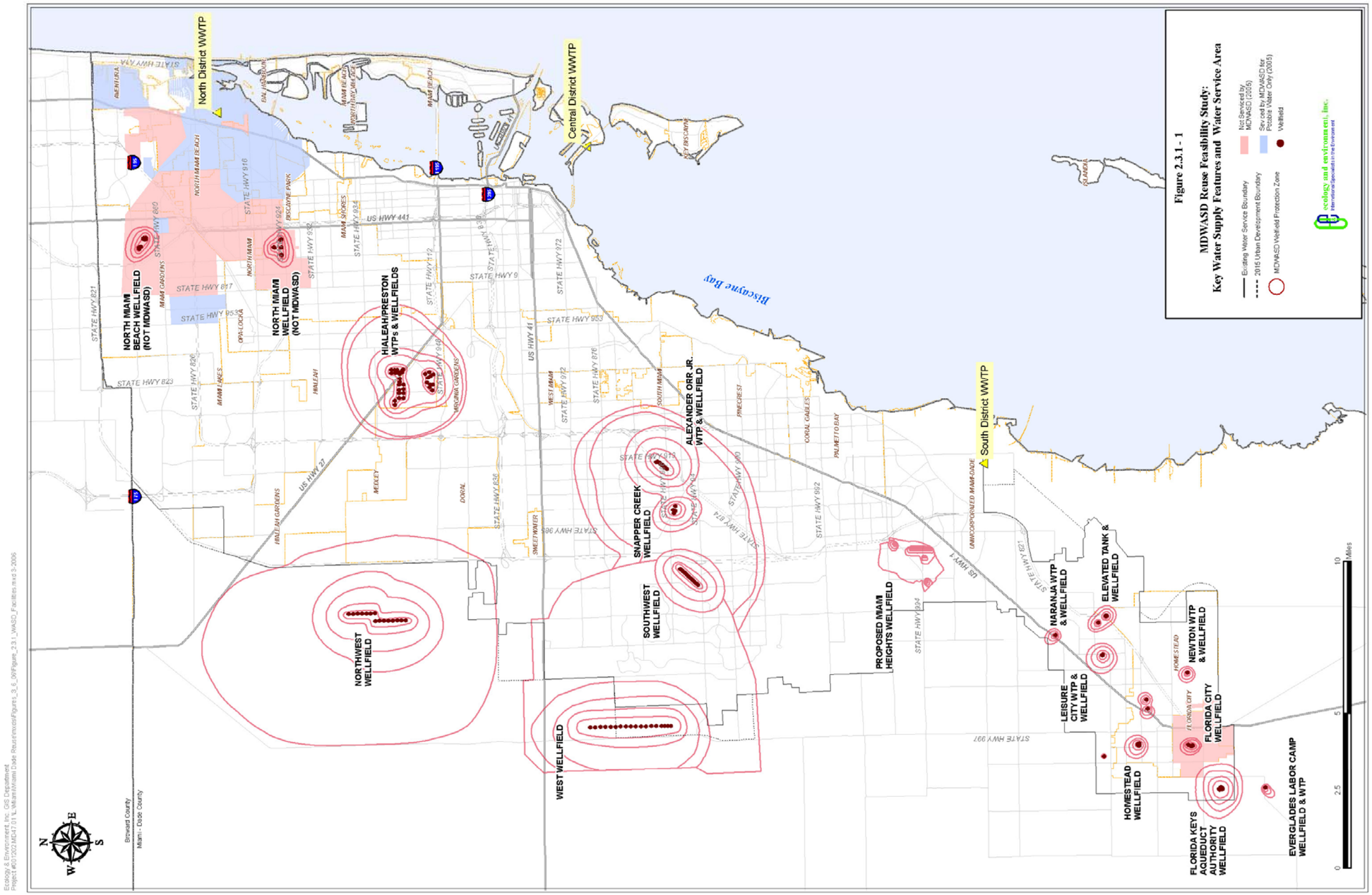


Figure 2.3.1 - 1
MDWASD Reuse Feasibility Study:
Key Water Supply Features and Water Service Area
Existing Water Service Boundary
2015 Urban Development Boundary
MDWASD Wellfield Protection Zone
Not Serviced by MDWASD (2005)
Served by MDWASD for Potable Water Only (2005)
Wellfield
ecology and environment, inc.
International Specialists in the Environment
North District WWTP
Central District WWTP
South District WWTP
Biscayne Bay
NORTH MIAMI BEACH WELLFIELD (NOT MDWASD)
NORTH MIAMI WELLFIELD (NOT MDWASD)
HIALEAH/PRESTON WTPs & WELLFIELDS
ALEXANDER ORR JR. WTP & WELLFIELD
SNAPPER CREEK WELLFIELD
SOUTHWEST WELLFIELD
NORTHWEST WELLFIELD
WEST WELLFIELD
PROPOSED MIAMI HEIGHTS WELLFIELD
NARANJA WTP & WELLFIELD
ELEVATED TANK & WELLFIELD
LEISURE CITY WTP & WELLFIELD
NEWTON WTP & WELLFIELD
FLORIDA CITY WELLFIELD
HOMESTEAD WELLFIELD
FLORIDA KEYS AQUEDUCT AUTHORITY WELLFIELD
EVERGLADES LABOR CAMP WELLFIELD & WTP
Broward County
Miami - Dade County
Miles

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In order to protect public water supply, the Miami-Dade County DERM has designated wellfield protection areas around existing water supply wellfields. The Wellfield Protection Ordinance, under Section 24-43 of the Miami-Dade County Code, restricts the types of land uses and activities within designated wellfield protection areas. In March 2006, following an internal technical assessment by their staff, DERM concluded that applying reclaimed water within designated wellfield protection areas, was not consistent with the ordinance and a variance would be required.

2.3.3 Treatment and Storage Facilities

The Hialeah and Preston WTPs have a combined rated capacity of 225 MGD. The Hialeah WTP has a rated capacity of 60 MGD, while the Preston WTP is rated at 165 MGD. In the near future, the Hialeah WTP will be increased to an FDEP rated capacity of 70 MGD, for a total combined capacity of 235 MGD. In 2005, the average finished water flow was 162.5 MGD. Both plants provide the following basic processes:

- lime softening;
- recarbonation;
- fluoridation;
- gravity filtration;
- air stripping (for treatment of volatile organic compounds);
- ammoniation (ammonia feed); and
- chlorination.

The Alexander Orr, Jr. WTP currently has a rated capacity of 217 MGD, but, in the near future, will be re-rated to a firm capacity of 248 MGD. In 2005, the average daily flow was 176.96 MGD. The treatment processes provided are:

- lime softening with activated sodium silicate (added as a lime coagulant aid);
- recarbonation;
- chlorination;
- ammoniation; and
- filtration.

The South Dade area has a treatment facility that disinfects raw water by chlorination. The total design capacity for the five WTPs is 12.03 MGD, as is the combined rated

capacity. The annual average daily flow for 2005 was 7.00 MGD. Design capacities for the five treatment plants within the South Dade area are:

- Leisure City WTP: 6.48 MGD;
- Newton WTP: 2.01 MGD;
- Elevated Tank WTP: 1.44 MGD;
- Everglades Labor Camp WTP: 0.72 MGD;
- Naranja WTP: 1.38 MGD;

Existing tank/reservoir storage facilities are summarized in Table 2.3.3-1.

Table 2.3.3-1. MDWASD Existing Storage Facilities

Water Treatment Plant	Location	Type of Storage	Capacity (MG)
Hialeah WTP	Onsite	Ground Storage Reservoir	3.0
	Onsite	Clear Well	1.7
	NW 20th Street	3 Remote Tanks	7.5
	NW 36th Street	2 Remote Tanks	5.0
	NW 67th Street	3 Remote Tanks	8.2
	NW 30th Avenue	1 Remote Tank	2.5
John E. Preston WTP	Onsite	Ground Storage Reservoir	9.0
	Onsite	Ground Storage Reservoir	14.0
	Onsite	Clear Well	1.1
	Carol City Storage	Ground Storage Tank	2.0
Alexander Orr, Jr. WTP	Onsite	3 Ground Storage Tanks	59.0
	Onsite	Clear Well	1.6
		Total:	**114.6**

Source: MDWASD 2005.
Key:
MDWASD = Miami-Dade Water and Sewer Department.
MG = million gallons.
WTP = water treatment plant.

In addition to the above storage facilities, MDWASD also has five ASR wells that store water from the Biscayne Aquifer in the Upper Floridan Aquifer that service the Alexander-Orr area. Three wells are located in the West Wellfield and two wells are located in the Southwest Wellfield. In addition, two new ASR wells are being proposed for the Hialeah-Preston Service Area. These two new wells are not expected to be in service until late 2009. The storage provided by all the ASR wells will help balance dry season demands from the Biscayne Aquifer.

2.3.4 Major Users

MDWASD records from 2000 to 2004 were evaluated to identify the water customers with highest annual consumption for the period of record. Among the top users were: Miami-Dade County Parks and Recreation Department, Miami-Dade Aviation Department, and various hotels, hospitals, laundry facilities, schools and universities, bottling facilities, and concrete operations. Figure 2.3.4-1 presents the major users identified based on MDWASD records.

The commercial, manufacturing, and industrial users were contacted individually to better understand their water uses and needs. In general, the existing water consumption for many of the major users was less than 100,000 GPD. Users that consumed more than 100,000 GPD can be categorized into the following industries: food and beverage (excluding dairies); dairies; concrete production; and hospitals, hotels and laundry facilities. Communication with the various major users indicated the following:

- Food and beverage-related industries use most of the potable water for washing containers that are in contact with food products, and/or in the preparation of their products.
- Dairies use the majority of their potable water for triple rinsing tanker trucks that carry milk from surrounding farms.
- Concrete facilities use the majority of their potable water for concrete mixing, keeping aggregate piles wet, washing down mud trucks, and filling up the water tanks on the mud trucks for slumping and cleaning the shoots at the jobsite.
- Hospitals, hotels, and laundry facilities use much of their water for cleaning products that will be in direct contact with humans.

The Miami-Dade Parks and Recreation Department was identified as a large MDWASD water customer in various locations throughout Miami-Dade County. A meeting was held with the Parks and Recreation Department to discuss their water consumption needs and potential reuse opportunities. Most of their water consumption is due to irrigation. Additional details are provided in Section 4.

Other major users identified as large MDWASD water customers include the Miami-Dade Seaport and the Miami-Dade County Department of Solid Waste Management. Both users were contacted to discuss their water usage and consumption. At the Miami-Dade Seaport, 75 to 80% of their potable water is used for restocking water on cruise ships that is in direct contact with humans. The Department of Solid Waste Management's Resource Recovery Facility was identified in previous Reuse Feasibility Studies as a major user with a process demand of 1 to 3.5 MGD. In communications with Department of Solid Waste Management personnel, it was determined that their operations do not use as much water as was estimated in previous studies, and that their

existing water consumption is a combination of all their operations that occur throughout Miami-Dade County, rather than water use at a single facility.

2.3.5 Existing Rate Structure

To promote water conservation, MDWASD uses an inclining rate structure which has been in effect since 1994. The unit price is based on consumption, thereby promoting conservation measures year-round. Table 2.3.5-1 summarizes the existing (effective October 1, 2005) retail water rate structure:

Table 2.3.5-1. MDWASD Tiered Retail Water Rate Structure

Monthly Water Use (gallons)	Charge per 1,000 gallons
0 – 3,750	$0.50
3,751 – 7,500	$1.76
7,501 – 12,750	$2.48
12,751 and over	$3.66

Key:
MDWASD = Miami-Dade Water and Sewer Department.

2.4 REUSE FACILITIES

2.4.1 General Description

Currently, approximately 16.2 MGD of wastewater are reused in MDWASD's system. The majority of that reuse is process water and irrigation at the regional WWTPs. The reuse treatment systems at each of the WWTPs are described in more detail below.

2.4.2 North District Wastewater Treatment Plant

A portion of the system effluent, up to 2.23 MGD, is processed further through effluent filters and disinfected with chlorine for reuse. The majority of the reuse stream is used onsite as process water or irrigation on the facility property. Approximately 0.1 MGD is supplied to the campus of Florida International University for public access irrigation.

The reuse treatment system consists of pumps, a filtration system, chlorine contact tanks, and effluent storage tanks. The filtration system has a total rated capacity of 4.44 MGD. The chlorine contact chambers have a rated capacity of 6 MGD with a 15-minute contact time. Effluent storage is limited to a tank with a capacity of approximately 150,000 gallons.

Based on discussions with the plant operators, the overall system capacity, when all components are in good working condition, is actually about 5 MGD. However, a number of the filter units are old and are frequently in need of repair (Caracappa 2006). Therefore, the plant reuse system production averages closer to 3 MGD.

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2.4.3 Central District Wastewater Treatment Plant

As discussed in Section 2.2, the effluent from the CDWWTP is high in chloride content, making it unsuitable for reuse in irrigation systems. Therefore, reuse at the CDWWTP is limited to process reuse, such as supplying makeup water to the chlorination system and supplying wash water and line flushing water.

The onsite reuse system consists of water transfer pumps, chlorine contact tanks, chlorine injector pumps, and strainers. The system produces approximately 9.73 MGD for onsite reuse.

2.4.4 South District Wastewater Treatment Plant

Approximately 4.25 MGD of wastewater at the SDWWTP is disinfected by chlorine addition for onsite process reuse including chlorination system makeup water, washdown water, and spray water for foam and scum control.

The reuse system includes water transfer pumps, a chlorine contact tank, and an automatic backwash strainer to remove solids greater than 0.01 inches.

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