Marco Island Water Treatment Facilities 2011 Capacity Analysis Report

1.0 Introduction

The City of Marco Island Utilities Department (MIU) operates two water treatment plants (WTP) on Marco Island that are permitted with the Florida Department of Environmental Protection (FDEP) under PWS ID Number 5110183. They are the North Water Treatment Plant (NWTP), which treats raw water from Marco Lakes surface water supply using lime softening and filtration, and the South Water Treatment Plant (SWTP), which desalts brackish groundwater using reverse osmosis (RO). The permitted operating capacity of the NWTP is 6.67 million gallons per day (mgd) and the permitted capacity of the SWTP is 6.0 mgd, for a total WTP production capacity of 12.67 mgd. The two WTPs supply water to the Marco Island service area.

Florida Administration Code (FAC) Section 62.555.348 "Planning for Expansion of Public Water System Source, Treatment, or Storage Facilities" requires initial CAR within six months after the month in which the total max-day quantity of finished water produced by all WTPs connected to a water system exceeds 75 percent of the total permitted maximum-day operating capacity of the system. An initial CAR was prepared and submitted to the FDEP in August 2007. Subsequent to that, annual updates to the initial CAR were submitted in 2008 and 2009 as per FAC section 62.555.348(3)(b)4 which requires an annual CAR when the max-day demand is projected to exceed the permitted capacity within the next five years. This CAR is an update to 2009 Marco Island Water Treatment Facilities CAR. The build out demand projections are revised in this CAR to account for the expanded reuse, lower water usage per ERC and anticipated slower growth of new ERCs. The updated projections indicate that the maximum-day water demand at build out will not exceed the total permitted max-day operating capacity of the WTP system and that finished water storage need at build out will not exceed the existing total useful finished water storage capacity, therefore additional CAR updates are not required.

This CAR evaluates the capacities of the source, treatment, and storage facilities connected to the Marco Island water system, and contains the following information:

- The maximum-day and annual average daily quantities of finished water produced by each WTP during each of the past ten years;
- Projected service area total water demands – total annual average daily demand and total maximum-day demand, including fire-flow demand, and projected total finished-water storage needed, including fire storage;
- The capacity of each WTP's source water facilities and treatment facilities, the permitted maximum-day operating capacity and, if applicable, permitted peak operating capacity of the WTP facilities, and the useful capacity of each finished water storage facility;

- An estimate of the time remaining before the maximum-day water demand, including fire-flow demand, exceeds the current total permitted maximum-day operating capacity of the WTPs, and an estimate of the time remaining before the finished-water storage needs, including fire storage, exceed the existing total useful finished-water storage capacity;
- Recommendations for new or expanded source, treatment, or storage facilities, if required; and
- A recommended schedule showing dates for design, permitting, and construction of recommended new or expanded source, treatment, or storage facilities, if required.

This updated 2011 Marco Island Water Treatment Facilities CAR evaluates the existing capacity of water system's source water, treatment, and storage facilities relative to projected future water demands, and discusses the potential improvements of existing facilities to reliably meet the projected service area water demands through 2035. WTP operating data through December 2010, previous capacity analysis reports, updated residential and commercial development unit data, population projections, and planned reuse system expansion plans have been utilized to write this report. Development planning information was obtained from MIU and the City Public Works Department. WTP facilities design and operating capacity information was obtained from the 2009 CAR, other available technical reports, and interviews with MIU WTP operating staff. This 2011 Marco Island Water Treatment System CAR meets the requirements of FDEP rule 62-555.348.

2.0 Potable Water Service Area

The Marco Island potable water service area includes all of the incorporated City of Marco Island except Key Marco, and is shown in Exhibit 1. The service area contains a mix of single family homes, multi-family developments including condominiums and timeshares, and commercial units including restaurants, hotels, municipal, recreational, and institutional facilities. Exhibit 2 shows the current and projected development units in the service area and effective population equivalent during the peak season.

The City of Marco Island (City) has an interconnection with Collier County (County) for bulk sale of potable water. Each year, the City sells the County bulk finished water and the County distributes the water through direct sales to customers in the Goodland and Key Marco developments. It is very likely that this arrangement will continue in the future, as these areas are too far away from the County's own water system distribution lines to be serviced by the County.

EXHIBIT 1
Marco Island Water Service Area
Marco Island Water Treatment Facilities 2011 Capacity Analysis Report

2.1 Water Service Area ERC Counts and Water Demands

In March 2005, a count was made of all residential development units on Marco Island, undeveloped but buildable lots, and planned but unoccupied or unbuilt condominiums. Exhibit 2 shows the number of development units in 2010 and at build out based on this count. The following changes have been made to the original unit counts:

1. Goodland and Key Marco units are combined and shown as "Collier County Bulk Sales".
2. Restaurants are shown separately than other commercial units because the conversion factor for restaurant units to Equivalent Resident Connections (ERCs) is significantly different than the other commercial units.
3. A developer purchased one of the hotels in 2007 and replaced the 280 hotel rooms with 219 timeshare units.

EXHIBIT 2
Marco Island Water Service Area - Land Use and Estimated Peak Season Population
Marco Island Water Treatment Facilities 2011 Capacity Analysis Report

Land Use	2010 Units	Estimated 2010 Population[1]	Build Out Units	Estimated Build Out Population[1]
Single Family	6,866	17,165[2]	8,704	21,760[2]
Collier County Bulk Sales	498	1,245[2]	596	1,490[2]
Multi-Family; Condominium; Timeshare	10,450	19,855[3]	10,932	20,771[3]
Hotel Rooms	1,079	2,050[3]	1,079	2,050[3]
Commercial	2,516	-	2,516	-
Restaurants	120	-	120	-
Government/Municipal	136	-	136	-
Total	21,665	40,315	24,083	46,071

[1]Estimate of effective population equivalent during peak season that results in maximum day demand, used for information only. [2]The average equivalent population factor for Single Family units is estimated to be 2.5 capita per dwelling unit. [3]The average equivalent population factor for multi- Family units is estimated to be 1.9 capita per dwelling unit.

The Marco Island service area is nearing build out unit and population levels. Approximately 78 percent of the estimated 9,300 buildable lots for single family homes in the Marco Island service area, Goodland, and Key Marco have been developed. The number of existing single family homes in 2010 was essentially unchanged from 2008. Including multi-family units, condos, and timeshares, water is now provided to 89 percent of the planned build out residential units. Including commercial development (near 100 percent in zoned areas), current land use is about 94 percent of build out.

An equivalent residential connection, or ERC, has a water demand equivalent to one residential single family home. Single Family and Collier County units are weighted at 1.0 ERC/unit in this study. Multi-family, condo, and timeshare units are weighted at 0.8 ERC/unit. Hotel and Government/Municipal ERC equivalents were estimated by dividing known water use by a gpd/ERC ratio equivalent to that of one residential ERC. Commercial units were given an ERC weighting from the City's ERC factor tables. The ERC equivalents of the units shown in Exhibit 2 are presented in Exhibit 3. A record of the new water connections added in each year from 2004 through 2010 was available, and used to estimate ERC counts in 2005, 2006, 2007, 2008, 2009 and 2010 from the base year 2004. Total ERC counts prior to 2003 were estimated and are unchanged from the previous year's CARs.

EXHIBIT 3
Marco Island Water Service Area 2005-2010 Year-end ERC and Projected Build Out ERC
Marco Island Water Treatment Facilities 2011 Capacity Analysis Report

Land Use	ERC per Unit	2005 ERC	2006 ERC	2007 ERC	2008 ERC	2009 ERC	2010 ERC	Build Out ERC
Single Family	1.0	6,765	6,866	6,866	6,866	6,866	6,866	8,704
Collier County Bulk	1.0	491	498	498	498	498	498	596
Multi-Family; Residential Condo; Timeshare	0.8	8,238	8,360	8,360	8,360	8,360	8,360	8,746
Hotel Rooms	0.57	775	775	615	615	615	615	615
Commercial	0.227	571	571	571	571	571	571	571
Restaurants[1]	9.1	1,092	1,092	1,092	1,092	1,092	1,092	1,092
Government/ Municipal	2.03	276	276	276	276	276	276	276
Total		18,207	18,438	18,278	18,278	18,278	18,278	20,600

[1] Average 100 seats/restaurant; 0.091 ERC/seat

Exhibit 4 shows the recorded water demands and ERC for the past 12 years. The water average daily water demands decreased by 0.23 mgd in 2009 and 0.62 mgd in 2010 compared to previous years despite no change in ERC counts. The average usage per ERC dropped from 413 gpd/ERC in 2008 to 400 gpd/ERC in 2009 and 366 gpd/ERC in 2010. This drop seems to be a result of expanded reuse and ongoing water conservation efforts. The lower water usage per ERC as a result of reuse expansion and irrigation restrictions is expected to continue. Future demand projections are updated to account for anticipated lower water usage per ERC and slower growth of new ERCs.

EXHIBIT 4
Marco Island Service Area 1999-2010 Water ERC and Water Demand Data
Marco Island Water Treatment Facilities 2011 Capacity Analysis Report

Year	Water ERC at Year End[1]	Average ERC During Year	ADD (mgd)	Average Usage (gpd/ERC)[1]	MDD (mgd)	Ratio MDD/ADD
1999	15,115	14,931	6.59	442	10.49	1.59
2000	15,484	15,299	7.58	495	12.03	1.59
2001	15,852	15,668	7.26	463	11.96	1.65
2002	16,221	16,037	7.38	460	12.19	1.65
2003	17,323	16,772	8.05	480	11.27	1.40
2004	17,899	17,611	8.26	469	10.96	1.33
2005	18,207	18,053	7.85	435	11.49	1.46
2006	18,438	18,323	8.26	451	11.28	1.37
2007	18,278	18,358	7.94	433	11.27	1.57
2008	18,278	18,278	7.54	413	12.88	1.71
2009	18,278	18,278	7.31	400	10.87	1.49
2010	18,278	18,278	6.69	366	9.89	1.48
2008-2010 Average				393		1.52[2]

ADD = annual average daily demand; MDD = maximum day demand; gpd = gallons per day
[1]2003-2006 ERC Counts and gpd/ERC usage have been revised to include ERC equivalents for Collier County bulk sales and to correct past timeshare and commercial unit counts and ERCs.
[2]MDD/ADD ratio of 1.52 is an average over the past 12 years.

2.2 Future ERC Projections and Future Water Demands

2.2.1 Future ERC Projections

The slower growth in southwest Florida is expected to continue over next several years. Year-end and average ERC estimates were made for years 2011 through 2035 based on the ERC count in the water service area on December 30, 2010, and the development of the remaining buildable lots and planned multi-family units at a rate of 93 ERC per year starting in 2011. This is somewhat lower than the average rate of growth during the 10 years prior to 2010. The number of ERC at build out is estimated to be 20,600, as shown in Exhibit 3.

2.2.2 Future Water Demands

Future annual average daily water demands (ADD) were calculated based on the projected future ERC counts and a water usage of 393 gpd/ERC, which is the average usage from 2008 to 2010 The City's reuse expansion was completed in 2008 and therefore 2008-2010 flow data can be used to represent the average water usage per ERC for the upcoming years. The projected maximum day water demands were calculated using an MDD/ADD ratio of 1.52, which is the average ratio from 1999 to 2010. Projected ERC counts and ADD and MDD flows are shown in Exhibit 5 and Exhibit 6. The projections indicate that with current water

usage per ERC, Marco Island WTP system capacity is adequate to provide build out flow demands. Build out is anticipated to occur around 2035, and the MDD is projected to level out at about 12.33 mgd.

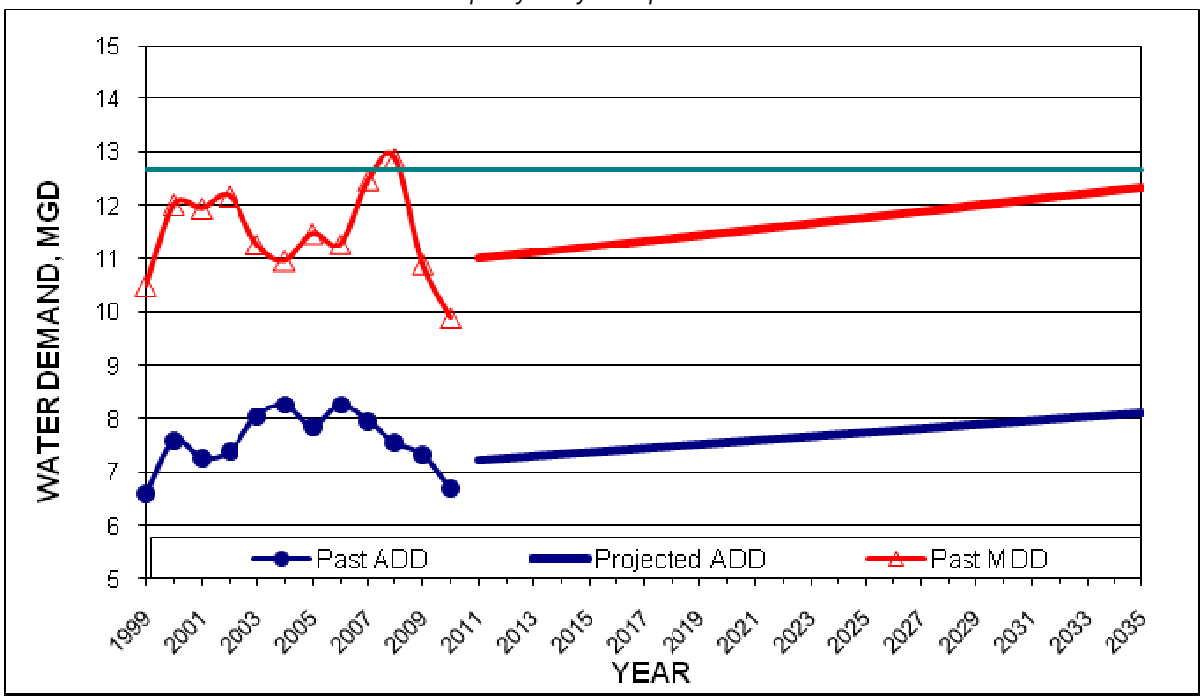
2.2.3 Impact of Expanded Reuse

Prior to 2008, an average annual flow of 0.48 mgd of potable water, and about 0.56 mgd on a maximum flow day, was used for irrigation by condominiums near the existing Marco Island reuse (reclaimed) water main. MIU has connected these condominiums to the reuse system and added 500,000 gallons of reuse water storage to reduce potable water demand. The expanded reuse project was completed in 2008 and the reclaimed water is used by these condominiums since then. The 2009 and 2010 demand data have shown further reduction in the average and maximum month water usage. The lower demand per ERC is expected to continue due to the permanent nature of reuse expansion.

EXHIBIT 5
Marco Island Service Area 2011-2035 Projected Water Demands
Marco Island Water Treatment Facilities 2011 Capacity Analysis Report

Year	Projected Water ERC at Year End	Projected Avg. ERC during year	Projected ADD (mgd)	Projected MDD (mgd)
2011	18,371	18,371	7.22	11.00
2013	18,557	18,557	7.29	11.11
2015	18,742	18,742	7.36	11.22
2017	18,928	18,928	7.44	11.33
2019	19,114	19,114	7.51	11.44
2021	19,300	19,300	7.58	11.55
2023	19,485	19,485	7.66	11.67
2025	19,671	19,671	7.73	11.78
2027	19,857	19,857	7.80	11.89
2029	20,043	20,043	7.87	12.00
2031	20,228	20,228	7.95	12.11
2033	20,414	20,414	8.02	12.22
2035	20,600	20,600	8.09	12.33

EXHIBIT 6
Marco Island Service Area Past and Projected Water Demands
Marco Island Water Treatment Facilities 2011 Capacity Analysis Report



3.0 Raw Water Supply

The water use permit (WUP) for Marco Island lists three raw water sources: fresh surface water from Marco Lakes; recovered water from aquifer storage and recovery (ASR) wells located next to Marco Lakes; brackish groundwater from the Mid-Hawthorn aquifer wellfield on Marco Island. Marco Lakes receives water from Henderson Creek.

The WUP annual allocation from all three sources (Marco Lakes, ASR wellfield, Mid-Hawthorn wellfield) is 4,535 MG, or an average of 12.42 mgd. The maximum month withdrawal limit for direct use from Marco Lakes and the brackish wellfield is 381 MG, or an average of 12.7 mgd (30-day month). ASR well recovered water can be used to supplement these maximum month withdrawals as needed. The amount of raw water injected into the ASR wellfield is limited to 1,600 MG on an annual basis. It is possible that withdrawal from the ASR wellfield could exceed 1,600 MG if there is a sufficient volume of stored water.

The NWTP uses the Marco Lakes fresh water and water recovered from the ASR wells, while the SWTP uses the water from the Mid-Hawthorn wellfield.

3.1 NWTP Raw Water Supply

The Marco Lakes raw water facility is located 8miles north of the NWTP and includes the following major components:

- Marco Lakes (A & B)
- A connection to Henderson Creek that is controlled by a sluice gate that can be opened to allow additional creek water into the lakes from June 1 to November 30 if Henderson Creek is above +3.5 ft NGVD. This additional water is typically only needed when water is injected into the ASR wellfield. The ASR well storage water is not separately limited by annual or monthly allocations.
- One 250,000-gallon ground storage tank (GST) for on-site storage of raw or recovered ASR water
- An ASR system, including seven (7) ASR wells, each with an injection capacity of 1.5 mgd per well (10.5 mgd total), and each with a dedicated pump capable of recovering and sending 1.5 mgd per well (10.5 mgd total) to the GST.
- Two 5,000 gpm (14.4 mgd total) vertical turbine raw water transfer pumps that can transfer raw water from the lake to the GST.
- Two 3,100 gpm (8.93 mgd total) vertical turbine raw water transfer pumps that can transfer raw water from the lakes to the GST or to the ASR system. MIU intends to replace these pumps with larger pumps to meet the full injection capacity of the ASR system. Pump replacement is planned for 2015.
- Five high pressure centrifugal raw water pumps with a total capacity of 23,900 gpm that can transfer raw water from the GST to the NWTP. The total firm capacity of the pumps is 19,375 gpm (27.9 mgd). However, the maximum velocity and pressure drop in the transmission main limits the maximum raw water flow to the NWTP to about 10.5 mgd.

Exhibit 7 shows an aerial view of the Marco Lakes raw water facility, including Marco Lakes, the ASR wells, and the GST and pumping facility location.

The WUP has a specific annual withdrawal limit of 1,935 MG (5.3 mgd annual average) from Marco Lakes for direct transfer to the NWTP. ASR withdrawals are typically made in the dry season between December 1 and May 31 to meet additional demand. This is equivalent to an average withdrawal of 8.79 mgd during that 182 day period.

The ASR wells are used to provide a year-round water supply by storing large quantities of Marco Lakes water during the wet season, when water is plentiful, for later recovery during the dry season when water is limited. The two-3,100 gpm raw water pumps discharge into a header that runs through the ASR wellfield. The wells are designed to take in up to 1.5 mgd each (up to 10.5 mgd total). Due to the size of the pumps, the maximum injection rate is currently about 8.9 mgd. MIU is permitted to inject water into the ASR wells from June 1 to November 30 (183 days) if and when the elevation of Henderson Creek is above +3.5 ft NGVD. At 10.5 mgd, the theoretical maximum storage capacity of the ASR wells during each wet season (183 days from June 1 to November 30) is about 1,920 MG. Historically, actual injection of water typically started sometime between July 10 and August 10.

The raw lake water is stored in a deep and otherwise unused aquifer, which minimizes the flow of the fresh water away from the well. The ambient water in the storage aquifer is higher-density brackish water. There is a significant degree of stratification of the fresh and brackish waters, which limits mixing and changes in the fresh water quality. The intent is that the injected raw water creates a "bubble" of fresh water within the brackish aquifer that can be recovered later by pumping the wells. However, even with the selection of an aquifer that has minimal flow and mixing characteristics, typically only about 70-80 percent of the bubble of water is recovered before the drinking water standards for TDS and chloride are exceeded. The amount of ASR well water recovered annually has been between 250 to 480 MG. In 2010, the large rainfall resulted in no water needing to be recovered from the ASR wells.

The total amount of water available to the NWTP is limited by the 10-mgd maximum hydraulic capacity of the raw water main between Marco Lakes and the NWTP. Therefore the maximum water that can be transferred to the NWTP is 3,650 MG annually if the pipeline is operated at maximum capacity year round. This hydraulic maximum is less than the maximum amount of water that can be withdrawn from a combination of Marco Lakes and the ASR wells.

Three golf courses use approximately 75 MG of the raw Marco Lakes water annually for irrigation (1.0 mgd maximum flow during dry season). Therefore, up to 3,550 MG annually is available for treatment at the NWTP, but is limited to the 9.0 mgd remaining hydraulic capacity in the water main during the dry season when sending 1.0 mgd to the golf courses. The WUP appears to be sufficient for the needs of the NWTP now and at build out. The existing raw water transfer pumps, raw water high pressure transmission main pumps, and ASR well pumps are more than adequate to supply the 6.67 mgd of feedwater needed for the existing NWTP, as well as the 9 mgd of water that will be needed for the future expanded facility.

EXHIBIT 7
Marco Lakes Raw Water Source Facilities and ASR Wells
Marco Island Water Treatment Facilities 2011 Capacity Analysis Report

3.2 SWTP Raw Water Supply

The RO system at the SWTP is supplied by a Mid-Hawthorn aquifer brackish wellfield including 15 operating wells that are located on the SWTP site, north of the SWTP along Bald Eagle Dr, and northeast from the SWTP along US 92, as shown in Exhibit 8. MIU has abandoned and plugged four brackish wells (#2, #3, #6, and #9) due to increasing salinity from those wells, and two wells (#5 and #8) with very high salt concentrations are disconnected from the system and should be plugged in one or two years.. Exhibit 9 shows the rated capacity of each of the operating brackish wells. The total capacity of the operating wells with the largest well out of service is 8.596 mgd, which is more than the 8.0 mgd needed to feed the SWTP and produce 6.0 mgd, its permitted capacity, at 75% recovery of raw water as RO permeate.

The existing water use permit allows MIU to withdraw up to 1,460 MG annually (4.0 mgd annual average) from the mid-Hawthorn aquifer system. This results in 1,095 MG (3.0 mgd annual average) of finished water at an RO recovery of 75%. The highest monthly withdrawals occur during the dry winter season when the SWTP operates around 80% of its permitted capacity. The water use permit allows a total of up to 381 MG of surface and brackish water to be withdrawn in the maximum demand month, or 12.3 mgd average during a 31-day month. In 2010, the maximum demand month was October, when an average of 6.72 mgd was used in the Marco Island service area. The projected maximum monthly average demand at build out is 11.13 mgd. Assuming 8.0 mgd of brackish water is withdrawn during this month, yielding 6 mgd of finished water at the SWTP, then 4.3 mgd of Marco Lakes water and 0.83 mgd of ASR withdrawals would be needed to completely meet this demand, which is within the design capabilities of those source water facilities.

The Marco Island maximum day production in 2010 was reported as 9.89 mgd in the MOR for the month of October. The 4.0 MG finished water storage tank at the NWTP had been out of service in October until it was put back into service on October 19. Approximately 5.145 MG of finished water was produced on October 19 to fill out the tank. However, only 2.69 MG was pumped out in the distribution system. The maximum day demand in 2010 was reported as 9.65 mgd for the month of June. The maximum day demand at build out is projected to be 12.33 mgd. There is no limit on maximum day well withdrawals. The 12.33 mgd can be met by producing 6.0 mgd at the SWTP and 6.33 mgd at the NWTP. The withdrawal of 8.0 mgd from the RO wells is needed to produce the 6.0 mgd of potable water at the SWTP and 6.5 mgd of raw water direct from Marco Lakes (or supplemented with raw water from the ASR wells, if needed) is needed to produce 6.33 mgd at the NWTP (only 2% loss of raw water to produce potable water). A total withdrawal of 14.5 mgd of raw water is needed to produce the 12.33 mgd of potable water.

The 8.896 firm capacity of the existing brackish wellfield is more than sufficient to meet the feedwater needs of the SWTP running at the current maximum 8.0 mgd raw water capacity and planned future reduced brackish water capacity of 6.4 mgd. The wellfield will not require capacity expansion in the near future. MIU will only need to drill new wells to replace existing wells that experience salinity increases that make them unsuitable to feed the RO WTP.

EXHIBIT 8
Location Map: Lime Softening WTP (NWTP) - RO WTP (SWTP) - SWTP Brackish Wellfield (Wells 1-21)
Marco Island Water Treatment Facilities 2011 Capacity Analysis Report

EXHIBIT 9
SWTP Mid-Hawthorn Wellfield Summary
Marco Island Water Treatment Facilities 2011 Capacity Analysis Report

Name of Well	Aquifer	Design Capacity of Well Pump (mgd)
RO well 1	Mid-Hawthorn	0.691
RO well 2	Mid-Hawthorn	Not in use – filled in
RO well 3	Mid-Hawthorn	Not in use - filled in
RO well 4	Mid-Hawthorn	0.216
RO well 5	Mid-Hawthorn	Out of Service
RO well 6	Mid-Hawthorn	Not in use - filled in
RO well 7	Mid-Hawthorn	0.698
RO well 8	Mid-Hawthorn	Out of Service
RO well 9	Mid-Hawthorn	Not in use - filled in
RO well 10	Mid-Hawthorn	0.605
RO well 11	Mid-Hawthorn	0.792
RO well 12	Mid-Hawthorn	0.756
RO well 13	Mid-Hawthorn	0.792
RO well 14	Mid-Hawthorn	0.612
RO well 15	Mid-Hawthorn	0.432
RO well 16	Mid-Hawthorn	0.691
RO well 17	Mid-Hawthorn	0.634
RO well 18	Mid-Hawthorn	0.510
RO well 19	Mid-Hawthorn	0.634
RO well 20	Mid-Hawthorn	0.634
RO well 21	Mid-Hawthorn	0.691
Wellfield Firm Capacity (largest well out of service)	Mid-Hawthorn	8.596

4.0 Water Treatment, Storage and Pumping Facilities

MIU owns and operates two water treatment plants located on Marco Island that are permitted with the Florida Department of Environmental Protection (FDEP) under PWS ID Number 5110183. The two plants are the NWTP that lime softens and filters raw water from Marco Lakes surface water supply and ASR wellfield, and the SWTP that desalts brackish groundwater using RO. The permitted capacity of the NWTP is 6.67 mgd and the permitted

capacity of the SWTP is 6.0 mgd, for a total system production capacity of 12.67 mgd. The two WTPs supply finished water to a single service area.

4.1 NWTP

The NWTP is a lime softening WTP located at Elkcam Circle and Windward Drive in the northern part of Marco Island, as shown in Exhibit 8. Marco Lakes and the Marco Lakes ASR wellfield, located 8 miles north of Marco Island, provide raw water to the NWTP. The NWTP is typically operated at least at 80% of its permitted capacity year round; with the SWTP used for peaking in the high demand winter months.

The City is currently in the process of installing a microfiltration membrane system in place of the existing sand filter.

4.1.1 NWTP Treatment Process

The NWTP uses a lime softening reactor/clarifier followed by a rapid sand filter. Lime and alum are added to the reactor/clarifier to remove TOC, color, hardness and alkalinity from the raw water. Primary and residual disinfection are accomplished by adding sodium hypochlorite and ammonia to the reactor/clarifier effluent to form chloramines. The sand filters remove residual turbidity from the lime softening process, as well as provide a critical removal barrier for pathogens. The finished water is transferred to storage tanks for additional disinfection contact time, storage and eventual distribution. All treatment components are sized to operate at 6.67 mgd or greater in accordance with FDEP rules.

Approximately 3.8 mgd of the NWTP finished water is distributed by NWTP high service pumps to the north side of Marco Island. Up to 2.9 mgd of finished water is transferred to the SWTP for blending with RO permeate and distribution to the south end of the island.

4.1.2 NWTP Disinfection Requirements

The NWTP treats a surface water source and is therefore required by the surface water treatment rule and FDEP rules to meet disinfection requirements that include 0.5-log inactivation of Giardia after filtration and 2-log inactivation of virus after exposure to open air. The Giardia inactivation is required after filtration and can occur in the finished water transfer lines and storage tanks. Virus inactivation may occur before filtration, but according to new FDEP rules, must happen after exposure to air.

The normal temperature range of the Marco Lakes raw water between winter and summer seasons is 20 to 25-degrees. The required chlorine contact concentration-time (CT) for 0.5-log of Giardia inactivation by chloramines at 20 and 25 degrees Celsius is 185 and 125 mg/L-minute, respectively. The required CT for 2-log virus inactivation by chloramines at 20 and 25 degrees Celsius is 321 and 214 mg/L-minute, respectively. For conservatism, assuming the raw water temperature of 15 degrees Celsius, the required CTs for 0.5-log Giardia and 2.0-log virus inactivation by chloramines are 250 mg/L-minute and 428 mg/L-minute respectively. Given the typical minimum chloramine residual in the finished water of 3.5 mg/L, the accepted 0.3 baffling factor in the storage tanks, and the peak hourly flow out of the tanks, approximately 469 mg/L-minute of CT is available as shown in Exhibit 10.

EXHIBIT 10
NWTP Disinfection Contract Time available in Transfer lines and Storage Tanks
Marco Island Water Treatment Facilities 2011 Capacity Analysis Report

Component	Baffling Factor	Contract Time Available (mg/L-minute)
Transfer line from clearwell to 0.5 MG storage tank	1	80
0.5 MG storage tank	0.3	231.8
Transfer line from 0.5 MG storage tank to 4.0 MG storage tank	1	16.6
4.0 MG storage tank	0.3	141
Total	-	469.5

The City was planning the installation of a new UV disinfection system to eliminate the finished water storage volume needed for contact time and to ensure compliance with future EPA regulations that may require more advanced inactivation of Giardia and cryptosporidium. However, recent changes in source water (Marco Lakes) quality have rendered UV disinfection option less efficient and uneconomical. Once the conversion to the microfiltration is completed, the total 3-log Giardia removal and 4-log virus inactivation process credits can be achieved. The membrane filtration system will receive 3-log Giardia removal credit without the need for additional primary disinfection. The 4.0-log virus inactivation will be achieved via free chlorine disinfection by addition of sodium hypochlorite upstream of the new membrane feed tank. The worst-case required CT of 2 mg/L-minute at low temperature conditions will be satisfied by the 4 mg/L chlorine residual in contact with the operating volume in the feed tank and process piping before ammonia addition downstream of the membrane process.

4.1.3 NWTP Finished Water Storage

An analysis of the diurnal flows from the existing NWTP high service pumps has shown that on the current maximum daily finished water demand results in a 700,000-gallon drop in finished water storage tank level during the peak demand time between midnight and noon, when many customers use finished water for residential and commercial irrigation. To meet this diurnal peak demand, the NWTP requires a useful storage volume that is approximately 0.7 MG greater than the total of the required disinfection contact volume and the required fire flow storage volume. It is projected that this diurnal deficit may increase to approximately 1.0 MG now that the high service flow capabilities have been increased since the NWTP finished water tank and pumping expansion.

In summary, the NWTP currently needs finished water storage for the following purposes:

- Disinfection contact time (at operating water temperature of 20-25 degrees Celsius and peak hourly flow of 2200 gpm out of the tank)for Giardia (60,000 to 185,000 gallons) and viruses (additional 190,000 to 285,000 gallons): total 0.47 MG
- Diurnal peak attenuation (~700,000 - 1,000,000 gallons)
- Contribute to the WTP system fire flow storage (3,500 gpm for 4 hours, or 0.84 MG; see Section 4.3)

The NWTP has one 0.5 MG finished water storage tank currently being used for disinfection contact time. MIU recently added a 4 MG storage tank at the NWTP which allows MIU to meet diurnal and fire flow storage while using the existing 0.5 MG storage tank (along with transfer lines) to meet the disinfection requirements.

4.1.4 NWTP Finished Water Pumping

FDEP rule 62-555 requires the firm high service pumping capacity of the WTP system to meet the greater of the fire flow plus the maximum day demand or the peak hourly demand. As recorded, the current peak hourly finished water demand at the NWTP is approximately 12.2 mgd (8,500 gpm), which is higher than the maximum day production of 6.67 mgd (4,632 gpm) plus fire flow (3,500 gpm), or 11.7 mgd (8,132 gpm). The high service pumps must therefore meet the current and projected peak hour demand at the NWTP, which is anticipated to remain greater than the maximum day demand plus fire flow at build out. The future peak hourly demand will likely increase after the NWTP is expanded and finished water production and high service pumping capabilities increase. A maximum high service pumping capacity of 9,900 gpm is projected to be needed to meet build out peak hourly demands at the NWTP.

The NWTP has six existing high service pumps with a total pumping capacity of 9,600 gpm and a firm pumping capacity of 7,600 gpm. These pumps are currently being used to transfer water from the two 500,000 gallon storage tanks to the 4.0 MG storage tank. The high service pumps at the NWTP and the high service pumps at the SWTP can together be used to meet the current peak hourly flow requirement of the WTP system as a whole. See Section 4.3 for a discussion of the firm high service pump capacity of the WTP system.

The NWTP has a new high service pumping system at the NWTP consisting of three 3,300 gpm pumps, with room for a fourth 3,300-gpm pump when needed. The new pumping system pumps water from the 4.0 MG storage tank to distribution and the existing high service pumps (currently being used as transfer pumps) also pumps water from the 500,000 gallon tanks to the SWTP for blending. MIU is currently adding two new SWTP transfer pumps that will pump water from the 4.0 MG storage tank to the SWTP after the membrane filtration system is completed. Also, the old high service pumps will be demolished once the membrane filtration system is operational.

Exhibit 111 summarizes the capacities of the components of the NWTP water supply and treatment facilities in 2011.

EXHIBIT 111
NWTP Capacity Summary – 2011
Marco Island Water Treatment Facilities 2011 Capacity Analysis Report

Component	Number and Capacity	Firm Capacity
Raw Water Transfer Pumps	2 @ 5,000 gpm ea. 2 @ 3,100 gpm ea.	16.13 mgd
ASR well pumps	7 @ 1.5 mgd ea.	9.0 mgd
NWTP Feed Pumps	5 @ 23,900 gpm total (34.4 mgd)	27.9 mgd
Lime Softening Reactor/Clarifier	6.67 mgd	6.67 mgd
Sand Filters	6.67 mgd	6.67 mgd
Transfer Pumps (former high service pumps)	6 @ 9,600 gpm total (13.82 mgd)	10.9 mgd
New SWTP Transfer Pumps	2 @ 3,500 gpm ea.	5.0 mgd
New High Service Pumps	3 @ 3,300 gpm ea. (14.26 mgd)	14.3 mgd[1]

[1]Former high service pumps may be used to pump to distribution allowing use of all three new high service pumps for firm capacity

4.2 SWTP

The SWTP is an RO WTP located in the southern part of Marco Island off Lily Court (see Exhibit 8). Raw water is provided to the facility by 16 brackish wells located in the central and eastern portion of the island, shown in Exhibit 8 and described in Exhibit 9. The SWTP has a permitted production capacity of 6.0 mgd and receives up to 2.9 mgd of additional finished water from the NWTP for blending with RO permeate before being distributed from the SWTP.

4.2.1 SWTP Treatment Process

The SWTP utilizes sand separation, cartridge filtration, and scale inhibitor chemical addition as pretreatment to a two-stage RO desalination process. Hydrogen sulfide is removed from the RO permeate by forced air degasification. The RO concentrate is discharged to a deep injection disposal well located at the NWTP. FDEP does not require primary disinfection because the SWTP uses protected deep mid-Hawthorn brackish well source water, the water is not exposed to open air through treatment and distribution, and the water is treated using RO membranes. Chloramines are used for residual disinfection before the permeate is transferred to finished water storage tanks for blending with NWTP finished water, storage, and eventual distribution. The RO system has been operational since 1991, and each year selected system components are upgraded, based on condition, to maintain the overall good operating condition of the entire SWTP.

4.2.2 SWTP Finished Water Storage

Finished water made at the SWTP is stored in two, 2.0 MG tanks and one, 1.0 MG storage tank (5.0 MG total capacity). An additional 3.0 MG finished water storage tank was recently

constructed at the SWTP and is expected to be placed in service in October or November 2011. MIU needs finished water storage at the SWTP to attenuate diurnal peaks in this part of the island and to contribute to the City's fire flow storage (840,000 gallons). An analysis of the diurnal flows from the existing SWTP high service pumps shows that on the current maximum finished water demand day, there is an approximate 1,300,000-gallon drop in finished water storage tank level during the peak demand time between midnight and noon. It is projected that the diurnal deficit may increase to approximately 2,500,000 gallons as high service flow from the SWTP is increased to build out levels.

4.2.3 SWTP Finished Water Pumping

FDEP rule 62-555 requires firm high service pumping capacity to meet the greater of the fire flow plus the maximum day demand or the peak hourly demand. The measured current peak hourly finished water flow at the SWTP (10,500 gpm) is higher than the maximum day flow from the SWTP plus the required fire flow, which is the sum of 6.0 mgd (4,170 gpm) and 3,500 gpm, or a total of 7,670 gpm. The high service pumps must therefore meet current and projected peak hour flows, which are anticipated to remain greater than the maximum day demand plus fire flow at build out. However, the peak hourly flow at the SWTP is not expected to increase through build out. The SWTP has eight existing high service pumps with a total design capacity of 16,600 gpm. The largest pump has a capacity of 3,300 gpm, and therefore the firm capacity is 13,300 gpm. The existing high service pumps can meet the current peak and future anticipated hourly flows. Exhibit 12 summarizes the capacities of the components of the SWTP water supply and treatment facilities.

EXHIBIT 12
SWTP Capacity Summary
Marco Island Water Treatment Facilities 2011 Capacity Analysis Report

Component	Number and Capacity	Firm Capacity
Wellfield Wells/Pumps	16 @ 9.39 mgd total	8.596 mgd
Sand Separators	2 @ 5.38 mgd ea.	10.76 mgd
Cartridge Filters	6 @ 1.87 mgd ea.	9.35 mgd
RO feed pumps	6 @ 1.34 mgd ea.	8.04 mgd
RO skids	6 @ 1 mgd ea. (75% recovery)	6 mgd
High Service Pumps	8 @ 16,600 gpm total	19.2 mgd (13,300 gpm)

4.3 Fire Flow Storage - WTP System Storage - High Service Pumping

MIU provides fire protection water to Marco Island in compliance with the American Water Works Association (AWWA). MIU can provide fire flow for residential, multi-family, or commercial areas at the medium to higher levels of recommended flows. The assumed fire flow rates are conservatively based on typical AWWA rates. Fire flow storage requirement applies to the entire WTP system, and is based on maintaining the single highest fire flow rate of 3,500 gpm (commercial) for four (4) hours. The total storage volume required to meet the four-hour fire flow demand is 840,000 gallons, as shown in Exhibit 13.

EXHIBIT 13
Marco Island Fire Flow Storage Requirements (4 hours)
Marco Island Water Treatment Facilities 2011 Capacity Analysis Report

Land Use	Fire Flow Rate (gpm)	Fire Flow Storage for 4 hr (gallons)
Single-family residential	1,500	360,000
Multifamily residential	2,500	600,000
Commercial (hotel)	3,500	840,000
Maximum fire flow storage		840,000

This fire flow storage requirement can be met using the combined storage at the NWTP and SWTP. In addition, the FDEP finished water storage requirement for meeting diurnal peak demands is that the total system storage is 25% of the service area maximum day demand (MDD). (The separate storage volume required for disinfection contact time only applies to the NWTP, and will be met using the existing 0.5 MG storage tank at that site until the membrane filtration system is operational.)

The required FDEP finished water storage volume for the Marco Island service area is determined as follows:

1. A volume equal to a fire flow volume of 0.84 MG, plus;
2. 25% of the service area MDD. The required storage volume to meet current MDD flows is thus 3.22 mgd.

Based on the above criteria, the minimum usable storage volume required for the NWTP and the SWTP together is 4.06 MG. A total WTP system finished water storage capacity of 4.41 MG (including fire flow storage) will be needed to meet build out finished water demands at the anticipated future WTP system production capacity of 12.33 mgd (see Section 5.0). At the present time, the 8.0 MG storage capacity at the SWTP (that includes the new 3.0 MG tank) is more than adequate to meet the current and future finished water storage requirements.

Because the NWTP and SWTP supply water to the same service area, the high service pumping needs of the service area are allowed to be met with a combination of the pumps

at both the NWTP and the SWTP. The current and future capacities of the high service pumps and projected peak hourly flows in the service area are shown in Exhibit 14.

EXHIBIT 14
Marco Island Service Area High Service Pump Summary
Marco Island Water Treatment Facilities 2011 Capacity Analysis Report

Location	Pumps (Capacity)	Firm Capacity, gpm	Projected Peak Hourly Flow, gpm
SWTP	Pumps 1-8 (16,600 gpm)	13,300	
NWTP	Existing Pumps 1-6 (9,600 gpm)	7,600	
Total (2007)		20,900	19,000
SWTP	Pumps 1-8 (16,600 gpm)	13,300	
NWTP	New Pumps 1-3 (9,900 gpm)	9,900	
Total (2009)[1]		23,200	19,000
SWTP	Pumps 1-8 (16,600 gpm)	13,300	
NWTP	New Pumps 1-4 (13,200 gpm)	9,900	
Total (Build Out)		23,200	20,400

[1]Existing NWTP High Service Pumps (1-6) are used as transfer pumps and can be used as spare high service pumps.

5.0 Planning for Expansion of Source, Treatment, and Storage Facilities

5.1 Source Water Expansion

Based on the capacity analysis of the source water systems for the NWTP and SWTP, an expansion of these systems is not needed prior to build out, which is expected to occur by the year 2035. A potential future addition of ASR wells for the NWTP or Mid-Hawthorn aquifer wells for the SWTP would be for the purposes of increased reliability. Additional ASR wells could also be used if the brackish water feeding the RO WTP degrades to a point where the permeate recovery and capacity of the SWTP is reduced. In that case more surface water would be needed to supplement this loss in capacity.

5.2 SWTP Reverse Osmosis Treatment Process Expansion

The City and CH2M HILL reviewed the existing water facilities and 20-year treatment needs during a planning study conducted in 2007. During this study, the City and CH2M HILL determined that increasing well salinity is reducing the reliable capacity and increasing the treatment cost of the south water treatment plant (SWTP). The study determined that the City must expand the treatment of surface water at the north water treatment plant (NWTP)

in order to offset this reduced SWTP capacity. Existing NWTP site has a very little room for capacity expansion. Alternatively, the surface water treatment capacity can be expanded by performing improvements at the SWTP. The following improvements are planned at the SWTP which will not only expand the surface water treatment capacity but also enhance the overall reliability of the system.

The existing RO trains when installed were rated for 1.0 mgd each for a total of 6.0 mgd. An initial analysis of the existing infrastructure concluded that the trains could be readily expanded to 1.2 mgd each (7.2 mgd total capacity) if new interstage booster pumps are installed. MIU is therefore planning a short-term expansion of the SWTP to 7.2 mgd using these skid modifications in 2016. The existing source water and finished water systems are more than adequate to handle this expanded flow as outlined in this CAR.

Two of the expanded 1.2-mgd trains will be reallocated for treatment of membrane filtered surface water pumped from the NWTP in 2016 as described in the following sections. This conversion will reduce the brackish water treatment capacity of this RO facility to 4.8 mgd (from original 6.0 mgd) but will provide additional 2.4 mgd surface water treatment capacity with a total treatment capacity of 7.2 mgd compared to original 6.0 mgd treatment capacity. The reduction in brackish water treatment capacity will be needed to ensure the long-term viability of the existing brackish water wells which are subject to salinity increases if over utilized.

5.3 NWTP Disinfection and Transfer Pumping Improvements

The existing sand filters are currently being replaced by a 6.67 mgd capacity microfiltration membrane system. Once this conversion is completed, 3-log Giardia removal and 2-log virus removal process credits can be achieved. Remaining 2.0 log virus inactivation will be achieved via free chlorine disinfection by addition of sodium hypochlorite upstream of membrane feed tanks as discussed previously.

A new transfer pumping system will be installed to replace aging infrastructure, simplify the pumping process, and reduce overall energy consumption. The new pump station will pump filtered water to the NWTP 4-MG storage tank and directly to the SWTP tanks for blending with RO permeate. The project will also include a new high service pump for the recently commissioned high service pump station to maintain 9,900 gpm of firm capacity without the need for the old high service pumps. These improvements are anticipated to be completed by 2012.

5.4 NWTP Surface Water Treatment Process Expansion

MIU is planning to increase the surface water filtration capacity by 3.0 mgd at the NWTP by addition of a coagulation tank and two membrane micro filters. The additional 3.0 mgd filtered water will be transferred to the SWTP for further treatment by the two converted RO trains and for blending with the RO permeate. Exhibit 16 shows the schedule of these expansion projects.

5.5 Future Demands and Production

The potential production at each WTP from 2011 through 2035 is shown in Exhibit 15, and is conservatively based on the operation of the NWTP near its permitted capacity, no additional use of reclaimed water, and the operation of the SWTP for peaking during the

high demand season. Under these conditions at build out, the projected MDD of 12.33 mgd will be 97.3 percent of the existing total WTP capacity of 12.67 mgd.

EXHIBIT 15
2011-2035 Marco Island Projected Water Service Area Demands and Anticipated WTP Production
Marco Island Water Treatment Facilities 2011 Capacity Analysis Report

Year	Avg. Day Water Demand	Max Day Water Demand	NWTP Avg. Day Production	NWTP Max Day Production NWTP	SWTP Avg. Day Production	NWTP Max Day Production
2011	7.22	11.00	6.50	6.67	0.72	4.33
2013	7.29	11.11	6.50	6.67	0.79	4.44
2015	7.36	11.22	6.50	6.67	0.86	4.55
2017	7.44	11.33	6.50	6.67	0.94	4.66
2019	7.51	11.44	6.50	6.67	1.01	4.77
2021	7.58	11.55	6.50	6.67	1.08	4.88
2023	7.66	11.67	6.50	6.67	1.16	5.00
2025	7.73	11.78	6.50	6.67	1.23	5.11
2027	7.80	11.89	6.50	6.67	1.30	5.22
2029	7.87	12.00	6.50	6.67	1.37	5.33
2031	7.95	12.11	6.50	6.67	1.45	5.44
2033	8.02	12.22	6.50	6.67	1.52	5.55
2035	8.09	12.33	6.50	6.67	1.59	5.66

5.6 Schedule for Expansion

Exhibit 16 shows a possible schedule for the construction of future expansion and improvements at the SWTP and NWTP.

EXHIBIT 16
Marco Island Utilities Expansion Planning Schedule Through 2025
Marco Island Water Treatment Facilities 2011 Capacity Analysis Report

Year	Description of Expansion Improvements
2012	Install a 6.67 mgd micro filtration system and new transfer pumps and install fourth high service pump at NWTP
2016	Install additional 3.0 mgd surface water micro filtrations capacity at NWTP
2016	Expand capacity of SWTP RO membrane system to 7.2 mgd

6.0 References

1. Marco Island Utilities, 2003-2008 Monthly Operating Reports, Marco Island, FL.
2. Marco Island Utilities, 2005 Analysis of Approved Development Plans to Build Out, Excel file "All-Residential WW-rev 4-li (2).xls", Marco Island, FL.
3. City of Marco Island, 2000 Service Area Boundary Map, Marco Island, FL.
4. Marco Island Utilities, Source Water and Water Treatment Master Plan, Marco Island, FL
5. City of Marco Island, "Preliminary Design Report - City of Marco Island NWTP 4 MG Water Tank and Pump Station", FDEP Construction Permit Application, August 3, 2007.