4.11 Utility Infrastructure Analysis and Master Plan

Potable Water System

Existing Conditions

The domestic water used on site is supplied from local deep wells and treated at an on-site Reverse Osmosis (RO) plant for potable use. The water treatment plant was built approximately 11 years ago and was upgraded to an RO plant approximately 4 years ago. There were some issues with contaminants in the previous water source that have been addressed with the new deep wells and RO plant. Currently the RO plant is not operating at full capacity, with only 6 of the 8 membrane cylinders functioning. The designed output of the system at full capacity was 160k gallons/day; however, the actual output is closer to 68k gallons per day. It is expected that when all cylinders are operational, the output will be around 80k gallons per day. The brine discharge from the RO process is currently pumped to a rapid infiltration bed.

Reverse Osmosis plant with chlorination and other chemical treatment

The domestic, potable and fire suppression water systems are all combined in a single distribution system. Many of the facilities on site are metered, and numerous valves appear to allow much of the system to be segregated. Some portions of the water system have been shut down due to leaks. The repair of these leaks is currently underway. In addition, many of the existing water fixtures at the comfort stations and visitor center are in the process of being replaced with low or no water use fixtures.

Recommendations for Future Use

The existing RO water treatment plant supply at full capacity is expected to be adequate to serve the proposed development as identified within the Master Plan. As the system ages and requires additional maintenance or replacement, it is recommended that the feasibility of alternative treatment systems be evaluated. An example of one such system is the Electo-Dialysis Reversal (EDR) system, which is substantially more efficient than RO and is growing in popularity. This system produces much less wastewater (brine) than the standard RO system. Other alternatives that may improve the efficiency of the water treatment system include the use of work exchangers, larger diameter filter elements, and additional pre-treatment. These measures can increase the efficiency, lower the operating cost, and increase the life span of the system, while reducing the overall carbon footprint.

The existing water supply system will be used whenever possible with minimal modifications and impacts to accommodate the proposed development. Some existing water lines will need to be relocated to accommodate new facilities, especially in the lodge and cottage area. There will also be a need for additional valves, backflow preventers, and meters to provide optimal management and control of the system in addition to serving the proposed uses. It is also important, considering the frequency of flooding, to maintain pressure in the system and have back flow preventers for all service taps (including irrigation) to prevent contamination in the event of a line break. The water lines within the area of the former lodge and the camping Loops B & C will need to be removed, including any services, in order for those areas to be restored to a natural state.

Some options for considerations for water reuse and sustainability are rooftop rainwater capture and grey water capture for reuse as toilet flushing and irrigation. The use of underground holding tanks or cisterns can collect the water from rooftops to be used on demand. Greywater (water from sinks, showers and clothes washing) can be collected separately in each facility as appropriate, pre-treated, and used for toilet flushing or irrigation, reducing the demand for potable water as much as 25 percent.

Fire Suppression System

Existing Conditions

The fire suppression system contains a large storage tank (approximately 500,000 gallons) and booster pumps located at the water treatment plant. Fire hydrants are located around the site, including the housing area, maintenance area, marina area and around the visitor center. Some of the water mains feeding these hydrants have been shut down due to leaks. The repair of these leaks is currently underway.

In addition to the proposed water demand estimate included in this report, the actual system sizing will require capacity to provide fire flow for all facilities in addition to any additional contingency and safety factors the NPS may require. If these additional flows and factors require an upgrade to the water treatment plant capacity, this upgrade should include sustainability and efficiency improvements as mentioned in the water treatment section above.

Recommendations for Future Use

All new permanent buildings will have internal sprinklers per the National Building Code. Some portions of the existing water system will require relocation within the area of the proposed lodge and cottages to serve the new facilities. Improvements to the system (as indicated in the water system recommendations above) will be required and will affect the combined water and fire system. Additional cross connection of the water loop may be required to maintain a high volume of flow to the new facilities and reduce sedimentation and maintenance of the system. A new maintenance program will also be required for the overall water system.

Irrigation Water System

Existing Conditions

Some irrigation heads were observed around the Mission 66 visitor center; however, no irrigation is currently in use nor currently planned within the Flamingo area. Water for the previous irrigation system was supplied from the potable water system. The efficiency and management of the system when it was operational is unknown.

Recommendations for Future Use

Even though an irrigation system is not currently planned as part of the master planning process, the use of an irrigation system for new plantings is highly recommended, even if on a temporary basis. These plantings could be irrigated via drip line and other high efficiency irrigation components. Should permanent irrigation be installed, a site-wide central control system or other weather-based control system would also be recommended, along with a strict management plan to ensure the highest efficiency for all irrigation water use. These control systems along with efficient irrigation management methods are likely to save more than 30 percent of irrigation water.

Irrigation water can be provided by sources other than potable water. The capture of storm water from roofs and grey water reuse may also be a viable for some common buildings where enough storm and grey water is captured or generated and the reuse of this water is justified. Some examples are the lodge building and visitor center.

Water storage tank

Water supply booster pumps

Sanitary Sewer System

Existing Conditions

Wastewater is currently collected and treated on site and discharged to effluent percolation/evaporation ponds located immediately adjacent to and northwest of the wastewater treatment plant. The old effluent pond, or eco-pond, located approximately 500 feet northeast of the existing campgrounds, just north of the west end of the Flamingo Lodge Highway, is no longer used for this purpose and is being naturally restored to a wetland state. There is a possibility that the eco-pond may be used again for treated effluent discharge.

As part of the collection system, and because of the flat site with a high groundwater table, there are a series of 17 lift stations across the site pumping water to the wastewater treatment plant.

The existing wastewater treatment facility was designed for approximately 90,000 gallons/day; however, this demand is not currently seen, even during peak season. As a result, the plant is not operating efficiently, requiring additional maintenance. Plans are currently underway to modify the plant, which will allow the system to fluctuate between 20,000 gal/day and 70,000 gal/day as the seasonal use varies, in order to keep the system operations as efficient as possible.

Since the Everglades area has been designated as an Outstanding Florida Water, the quality of the discharge water from the plant is even higher than state requirements. This additional level of treatment removes nutrients contained within the effluent discharge that do not naturally occur in the Everglades environment.

Recommendations for Future Use

The existing sanitary collection system and lift stations will be used whenever possible with minimal modifications and impacts to accommodate the proposed master plan development. The existing sanitary facilities within the lodge and cottage area will need to be relocated to accommodate new buildings, and any sanitary facilities within the areas to be restored will need to be removed prior to restoration.

Any new full service restaurant facilities will require grease traps with access to cleanouts for maintenance. The dumpsters serving full service restaurants should also be located adjacent to storm water inlets to capture and treat any grease and food residue runoff from the dumpster pad rather than allowing this water to flow directly into the basins and Florida Bay.

Wastewater Treatment Plant

Electric Power System

Existing Conditions

Florida Power & Light provides the power to Flamingo facilities. The power is brought to the site via underground lines from the Miami Dade area, where the closest sub-station is located. Provided plans show (8) buried 25kv cables serving the site. Electricity is extremely important for the water treatment plant. Since power outages are common, a 50kW backup diesel generator was installed at the water plant to power some miscellaneous equipment and lighting at the plant in addition to pumps that maintain system pressure; however, the generator is not used to run all of the water treatment plant systems.

Recommendations for Future Use

No major power improvements are planned; all major systems, such as water, wastewater, and other public facilities, should have backup generators to ensure minimal loss of services when power is out. Alternative sources of energy are recommended for electrical generation and for water heating, where applicable. Roof mounted photovoltaic panels can be used to supplement the electric power provided to lower the overall electric cost for the Park Service. The use of solar water heating is also a viable option for use on comfort stations, marina, lodge, cottages and many other buildings on site that will use hot water. This system provides another solution to lower overall energy demand for the Flamingo area. Another source of renewable energy is available in the way of ground source heating and cooling. This is the use of a heat exchange system and the constant groundwater temperature to provide both water heating and area space conditioning. This source is consistent and has a short simple payback period.

Communications

Existing Conditions

Phone service is provided via antenna. Buried telephone lines currently serve the maintenance facility, the concessioner and employee housing, the marina facilities, the visitor center and restaurant. Phone service will be provided to the new cottages and lodge, with wireless phone coverage provided. Cable television is provided by satellite. A large antenna is located adjacent to the water treatment facility and serves multiple users including the Coast Guard, the Park Service, and many other federal agencies. This antenna is scheduled to be upgraded or replaced in the near future.

Recommendations for Future Use

Communication services to the following facilities will need to be maintained, improved or added including landline phone, cell phone, cable TV, and high-speed internet. Wireless internet should be evaluated for feasibility in providing service to the entire site in addition to the lodge and other public gathering areas.

Natural Gas / Liquid Petroleum Gas

Existing Conditions

There is no use of natural gas, historically or currently. There was an aboveground propane tank located at the Mission 66 gas station near the Flamingo area entrance to fill RV and camper propane tanks; however, the tank and appurtenances were removed and mitigated many years ago.

Petroleum fuel storage tanks at marina

There is currently a series of (4) 2,000 gallon above ground liquid petroleum fuel storage tanks located in the marina area adjacent to the marina retail store; three of which hold gasoline, and the fourth holds diesel fuel. There are (3) pumping stations, one located on a fueling slab for automobiles and the other two located on the sea-wall of the marina for boat fueling.

Recommendations for Future Use

Two of the fuel tanks will remain at the marina area to continue to serve the existing pumps for boat fueling. The relocation of the other two fuel tanks and fuel pumps to the old gas station area for a new vehicle fueling station is recommended. The two relocated tanks and the remaining two tanks will be screened from public view.

Storm Water Management

Existing Conditions

The Flamingo area receives an average of 48.5 inches of rainfall per year. This relatively high volume of precipitation frequently causes flooding during the larger storm events.

The entire Flamingo area is located within the 100-year floodplain as indicated on the FEMA FIRM map for Monroe County as revised on Feb. 18, 2005 (map # 12087C0675K). The topography of the site is very flat with the majority of the site being between 3 and 5 feet above sea level, and the highest point at approximately 7 to 8 feet. Since all new development will be within this floodplain, an elevation of 15 feet will be required for FF elevation for all new permanent structures. The existing comfort stations and common buildings are primarily CMU walls on slab on grade and do not contain the type of finishes or furniture that would be damaged by flood waters.

There are no stormwater retention or detention facilities on site. All rainwater from impervious surfaces including roads and parking lots sheet flow into non-developed natural marsh areas or directly into the basins and to Florida Bay with a minimal level of treatment. There is minimal structured conveyance of stormwater on site with approximately four to six grated inlet structures with culverts in grassed areas adjacent to the visitor center and marina parking lots. Some of these culverts, which drain directly into the marina basins and Florida Bay, will be plugged as part of the seawall improvements currently under construction.

The coastline of Florida Bay along the campground area and near the amphitheater has experienced severe erosion during past hurricanes and other large storm events. Some attempts to curb this erosion have been implemented with little noticeable improvement.

Recommendations for Future Use

As with any developed site, the two main issues regarding stormwater management is quality and quantity. The quality should be addressed with appropriate designs, including Low Impact Development (LID) strategies for the smaller storm events or the "first flush" of the larger storm events. This water should be captured and treated wherever possible to prevent pollutants from entering the natural environment and surface waters. The quantity is generally addressed on a larger scale with larger conveyance and treatment swales and ponds for the 100-year design storm event. A detailed evaluation of the required stormwater quality and flood storage and routing should be completed during the design phase of the development.

The proposed development, as shown in the Master Plan, will generate stormwater runoff from the additional impervious services. This runoff increases the potential for transportation of pollutants and nutrients into the marina basins and into Florida Bay. To address this, all paved surfaces which may contain grease, oil and fuel from vehicles, and other sediment and pollutants will be either directed into a stormwater collection system and treatment pond or allowed to sheet flow into a created wetland, grass swale or other means of providing conveyance and treatment prior to entering the natural waterways or Florida Bay. Parking areas, in particular, will need to be regraded in a manner to encourage stormwater runoff to enter a swale or created wetland for pre-treatment prior to entering the natural waterways. This can also be accomplished by installing shallow trench drains to intercept this water, which directs it via a short pipe, to a pond or swale for treatment to minimize regrading. The use of porous pedestrian pavement is also recommended at some locations to provide additional infiltration and limit the runoff and transportation of pollutants into the adjacent surface waters.

In addition to capturing and/or treating the stormwater from all paved impervious surfaces, the rainwater may be captured from rooftops for reuse as irrigation, toilet flushing and or other domestic non-potable uses. This water will be relatively clean and, depending on the anticipated use, will require only limited, if any, pre-treatment. By collecting and reusing this water, the stormwater treatment volume will be reduced by the volume captured and reused.

Shoreline protection should be considered to address on-going shoreline erosion and protection of the proposed facility improvements at Flamingo. Shoreline protection is not part of this master plan effort, however, and would require analysis of alternatives (e.g., use of geotextiles) as well as consideration of any associated ecological impacts.

A Stormwater Best Management Practices (BMPs) program is also recommended. BMPs incorporate a wide range of stormwater programs, technologies, and processes that can control or prevent damage from runoff as well as reduce potential pollution from site runoff.

Summary

The overall utility infrastructure is in good shape and will only require minimal improvements to serve the new and renovated facilities in the Flamingo area. With new federal mandates, executive orders, and other requirements to reduce overall water and energy use, many sustainable concepts and systems are being evaluated and recommended for use as part of the Master Plan upgrades to the site. As with many types of solar dependant and sustainable systems, a backup or primary system may also be required to ensure a high level of service to meet hot water needs, electricity demand, etc. For this reason, these systems are recommended as a supplemental system to lower the demand and cost of energy in Flamingo.

As the mechanical systems age and require major repair and replacement, an evaluation of new technology and more efficient or green systems is recommended, such as the use of an EDR water treatment system which has a similar water cost to that of an RO system, but is far more efficient and may reduce energy consumption.

Flamingo Proposed Utility Demand Summary

Land Use	# of Units	Total Building s.f.	Potable Water Demand (gal/day)	Wastewater Demand (gal/day)	Potential Rainwater Capture Available (gal/day)	Potential Greywater Reuse Available (gal/day)	Electric Power Demand (kW)
Housing	201	85,970	25,680	20,544	125	7,190	1,662.0
Restaurant	4	17,120	7,200	5,760	25	2,016	85.6
Day Use / Public Buildings	25	22,065	14,600	11,680	32	4,088	127.825
Retail	2	18,030	2,400	1,920	26	672	90.2
Camping	202	7,600	3,318	2,654	11	929	482.0
Storage & Back of House	8	22,440	4,958	3,966	32	1,388	112.2
Sub-total	442	173,225	58,156	46,525	251	16,284	2,559.8
10% Contingency			5,816	4,652			256.0
TOTAL	442	173,225	63,972	51,177	251	16,284	2,815.8

Notes and Assumptions

1. Approximately 80% of potable water is returned as wastewater.
2. Approximately 35% of interior wastewater may be captured as greywater (Amy Vickers 2001.)
3. Existing NPS housing s.f. is estimated.
4. Rainwater capture is based on a daily average from a 48.5" per year average.
5. The energy demand est. does not include the water or wastewater treatment plants.
6. The energy demand does not include site lighting.
7. The energy demand does not include energy for any communication systems.
8. Water demand does not include fire suppression water (or safety factors), only potable water use.

Legend-Proposed Utilities

- Water Line
- Sanitary Sewer
- Sanitary Force Main
- Electric
- Communications
- Electric Transformer
- Fuel Line
- Fuel Tank

Legend-Existing Utilities

- Water Line
- Sanitary Sewer
- Sanitary Force Main
- Electric
- Communications
- Abandoned Lines
- Sanitary Lift Station