TOWN OF EDISTO BEACH

WATER MASTER PLAN

Prepared for

Town of Edisto Beach, South Carolina

Earth Tech Project 103929
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1.0 INTRODUCTION

This Master Plan was prepared for the Town of Edisto Beach to develop a long term plan which prescribes facility improvements and additions to the Town's existing water distribution system in the areas of:

- Water Supply
- Water Storage
- Water Distribution
- Water Quality

Items of particular interest are:

- The Town's ability to meet seasonal peak demands while maintaining adequate reserves to meet minimum fire service demands
- The degree of uniformity of fire service and pressures throughout the Town
- To maintain acceptable water quality during the off season and times of low use
- To upgrade the level of fire service beyond the ISO minimum requirements
- To maintain a total dissolved solids (TDS) content of below 500 parts per million (PPM)

1.1 Methodology

A planning horizon of 15 years was selected for this Master Plan. It is likely that the island would be built out and any increase in water demand in the following years would be marginal. As with any Master Plan, the Town should revisit the Master Plan at a minimum of once every five years to review and modify the plan as necessary based on current events, trends, zoning changes, water regulations, and new technologies.

This document evaluates the four major areas of the water system. Each section describes the existing conditions, identifies potential problems, recommends solutions, and provides estimated costs for the recommended improvements. The end of the document will summarize the recommended improvements as well as prioritize projects.

As part of this document, Earth Tech:

- Evaluated water demand based on peak build out
- Evaluated the four major water system components
- Identified alternatives to meet the Town's objectives
- Made recommendations and provided cost estimates for short term and long term improvements based on the alternative analysis.

2.0 POPULATION PROJECTIONS

The initial step in creating a water supply Master Plan is determine what the water demand on the system will be at a future time, in this case, 15 years. Key components of this are evaluating current water usage data, peaking factors, population data and trends, building trends, amount of developable land remaining, and current ordinances with respect to development.

2.1 Water Service Area

Edisto Beach is located in Colleton County with a population of 641 permanent residents based on the last census conducted in the year 2000. The Town is comprised of approximately 7 square miles and the Town limits are essentially the island itself (see Figure 1). Most of the parcels on the island are developed with single family homes. The island also contains condominiums and commercial establishments that are present in an amount that is typical for an island community.

Along with the residents and businesses located on the island proper, the Town also provides water service to the Edisto Beach State Park and several businesses located along 174. The Town currently allows for businesses outside of the Town limits to connect and use the water system provided that there is existing water system infrastructure in place. These "outside users" are located along Highway 174 up to the intersection of Highway 174 and Palmetto Road, including the shopping complex housing the True Value Hardware store.

The majority of residents on the north side of Palmetto Road are located in Charleston County and therefore are not a part of the Town's water system. The existing water system is shown in Figure 2, in the pocket at the back of this report.

2.2 Water Demand Projections

Estimating future water demands for an area usually consists of evaluating population data and extrapolating growth trends. However, since Edisto Beach is an island community and relies heavily on tourism, evaluating population data for trends would give results that are not representative of the actual demand placed on the water system. Monthly water usages fluctuate greatly over the course of the calendar year, with peak usage occurring during the summer months, when tourists and vacationers visiting the island are at a peak volume.

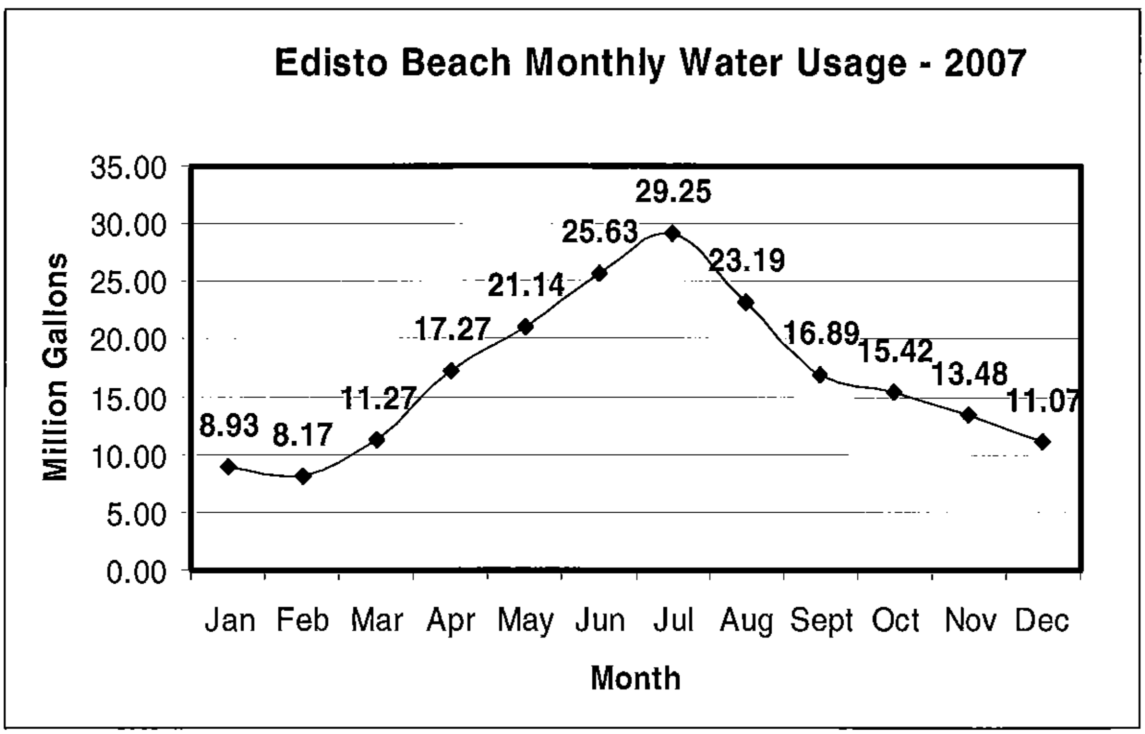
A more appropriate methodology is to evaluate the amount of existing customers and potential customers in the future. Evaluating past annual water usage for trends also facilitates predicting future water demand.

Edisto Beach currently has approximately 2,300 customer accounts in the following categories:

- House
- Business
- Water for Docks
- Water Exempt, Town usage
- Water for irrigation
- Water out of Town, residential / commercial
- Water for State Park

Edisto Beach used 201,702,000 gallons of water for 2007. The peak month for demand during the calendar year is the month of July, when water usage averages approximately 943,600 gallons per day (GPD). Graph 1 illustrates the Town's water usage on a per monthly basis for 2007.

Graph 1



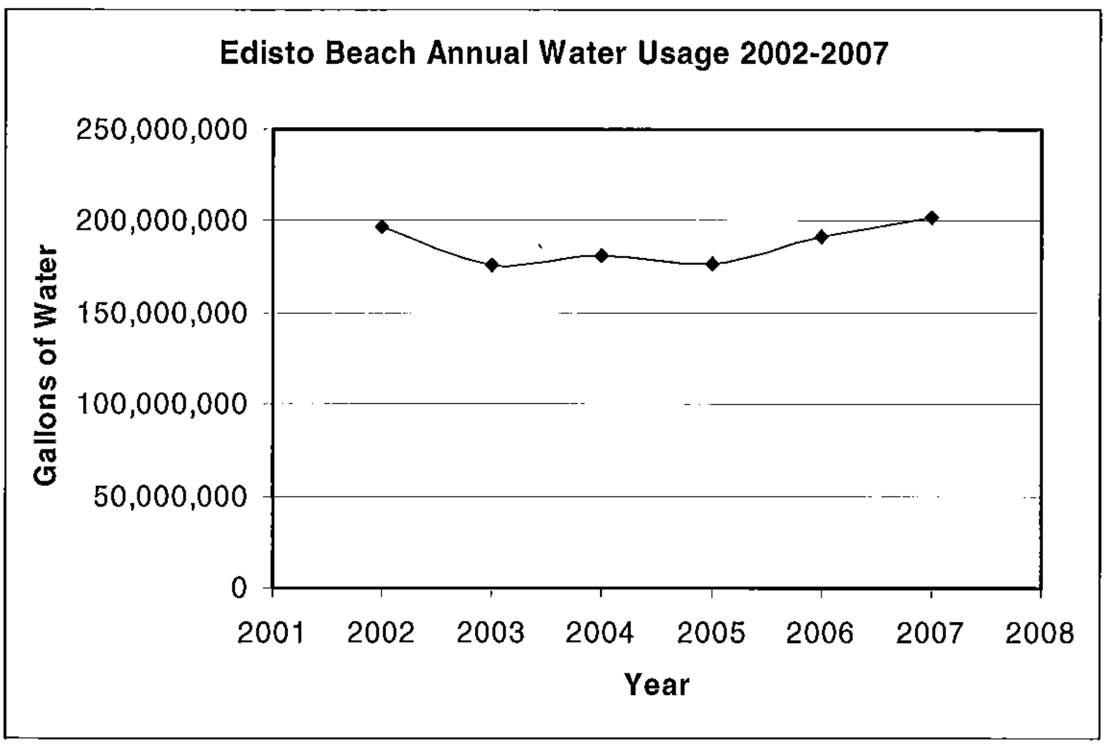
This demand curve is typical for most water systems with water demand peaking in the summer and dropping off as summer turns to fall and winter. The Town however has a more exaggerated curve due to the large number of homes that are occupied during the summer compared with the smaller number of occupied homes during the winter months.

Table 1 and Graph 2 illustrate the Town of Edisto Beach's annual water usage from 2002 to 2007.

Table 1

Year	Annual Usage (gallons)
2002	196,736,000
2003	176,121,000
2004	181,264,000
2005	176,398,000
2006	191,380,000
2007	201,702,000

Graph 2



The above graph indicates a relatively uniform annual water demand for the system, with demand the same in 2007 as it was in 2002. Various factors can directly or indirectly affect water demand on an annual basis including:

- Rainfall amount
- Economy
- Number of tourists

The flat curve for the annual water demand is reflected below by the number of building permits issued annually for the past 4 years as shown in Table 2 below.

Table 2

Year	Building Permits Issued
2004	33
2005	42
2006	37
2007	24

With building permits averaging approximately 34 per year and with existing customers at 2,300, this equates to a small annual growth of 1.47%. It was necessary to project that growth for 15 years until 2023.

The Town currently has 86% of the available developable lots built upon with 14% of the lots vacant and undeveloped. Town ordinances limit the new dwelling square footage to 3,800 square feet.

The two areas for potential water demand increase are:

- Build out of remaining 14% of lots
- Demolition of older cottages to be replaced with larger dwellings
- Installation of irrigation systems

There will be some increase in water demand as the Town's older cottages with small footprints are replaced with newer, larger dwellings, thus increasing the water demand.

The two factors responsible for the increased usage on the reconstructed lots include a likely increase in dwelling size and number of bathrooms along with the installation of irrigation systems.

However, based on the current configuration of the island, the building permits being issued by the Town averaging 34 per year along with available building lots reducing in numbers, the potential for significant growth is still relatively small.

Edisto Beach State Park comprises of approximately 1255 acres of woodlands. Discussions with the South Carolina Department of Parks, Recreation & Tourism Engineering Department revealed no major development plans in the next 15 years for the state park.

2.3 Water Demand at Build Out Calculations

Assume final 14% build out:

(1/.86) * 201,702,000 gallons per year = 234,537,209 gallons per year

It is estimated by the year 2023, the water demand for the Town of Edisto Beach will be approximately 235,000,000 gallons per year.

Increases in water demand and usage will be somewhat offset as water conservation becomes more prevalent and the trend for reducing water consumption comes to the forefront in the coming years. This trend can be facilitated through building code requirements for water saving fixtures for new construction, including reconstruction or remodeling on existing occupied parcels.

3.0 WATER SUPPLY

3.1 Existing Water Wells

The Town of Edisto Beach has a total of six supply wells located at various locations throughout the service area that feed the system. Pumping capacities range from 90 gallons per minute (GPM) up to 495 GPM. See Figure 2 for locations of the wells. Table 3 describes the existing wells.

Table 3

Well #	**1**	**2**	**3**	**4**	**5**	**6**
Location	Dockside	Bay Point	Lions Club	Well Field	Well Field	Bay Creek
Depth (ft)	500	500	500	530	593	580
Casing Size (in)	6	6	4	6 to 8	8	8
Pump Manufacturer	unknown	unknown	unknown	Goulds	unknown	Grunfos
Pump HP	20	7.5	7.5	15	20	40
Pumping Rate @ 60 psi (GPM)	250	135	90	186	276	495
Airline length (ft)	63	NA	none	106	84	84

At the time of the first submittal of this report, June 2008, the existing submersible pump in Well No. 1 was a 130 gpm pump with a 10 HP motor. Based on interim study recommendations, this was replaced in August 2008 with a larger pump and a 20 HP motor as shown above, increasing its pumping capacity to 250 GPM. This upgrade has been implemented and the new well is in service. The remaining projections will include this increased capacity.

The wells are controlled by the water level in the 100,000 gallon elevated storage tank. The Town also has two booster pumps, Goulds Texas Turbine 9 CLC-1 with 40 hp motors, located at the ground storage tank with an individual capacity of approximately 650 GPM and a combined capacity of 700 GPM. Also located adjacent to the ground storage tank is an emergency generator with a manual switch over to operate both Wells 4 & 5 as well as the booster pumps. The tank telemetry is described in Table 4 on the following page.

Table 4

Group	Resource Size	Well Control Tank Levels On (ft)	Well Control Tank Levels Off (ft)
Group A Lead	Small Resource	21	24
Group B Lead	Large Resource	21	24
Group A Lag 1	Small Resource	20	24
Group B Lag 1	Large Resource	20	24
Group A Lag 2	Small Resource	18	23
Group B Lag 2	Large Resource	18	23

In February of 2008 US Filter modified the existing telemetry on the system to allow for all wells and pumps to run simultaneously as well as adjusting the tank levels at which resources turn on and off. Large resources are Well 6 and Booster Pumps 1 & 2. Small resources are Wells 1, 2, and 3. The telemetry can be explained briefly in the following manner. If the water level in the tank drops to 21 ft, a large and a small resource are turned on. If the level in the tank continues to drop to 20 ft, an additional large and small resource are turned on, and if the level in the tank continues to drop to 18 ft, the final large and small resource will be turned on. The lead large and small resources are rotated at each consecutive start.

3.2 Recommended Water Supply Improvements

The Town should consider moving towards the consolidation of wells in the future. Numerous small capacity wells can be maintenance intensive, and individually do not contribute significantly to the water system's capacity.

The Town should continue to closely monitor well performance on an annual basis to ensure that the wells are operating as intended. With Well # 6 being a relatively new well and Well # 1 scheduled for pump replacement, Well #'s 2 & 3 are potential candidates for future abandonment.

4.0 WATER STORAGE

Water storage is a critical component of a water system for several reasons. Most importantly, it provides additional resources to fight fires beyond the existing wells along with providing sufficient quantities of water throughout the distribution system should pumping facilities be out of service. Other advantages include equalizing the use of pumping resources as well as maintaining stable water pressure throughout the distribution system.

4.1 Existing Water Storage

The Town currently has one 100,000 gallon elevated storage tank located at the end of Holmes Street. The existing elevated storage tank is the shape of a pedesphere and has a head range of 25 ft and an overflow elevation of 163.18 feet. It was constructed in 1998.

The Town also has one 200,000 gallon ground storage tank located off of Palmetto Road. The ground storage tank was installed in February 1990 and has a height of 33 ft according to its identification plate. Water from the ground storage tank enters the distribution system via two booster pumps.

4.2 Existing Water Demand and Storage

South Carolina Department of Health and Environmental Control's (DHEC) minimum standard for storage capacity in community water systems is as follows:

- Water Storage – Tanks shall be sized to provide 2 hours of supply for a combined peak hour domestic plus fire flow OR the capacity shall be equal to ½ the maximum daily consumption, whichever is greater. However, either requirement can be reduced if the source and treatment facilities have sufficient capacity to supplement peak demands of the system.

Before the required storage could be calculated to determine whether or not the DHEC minimum storage standards were met, it was necessary to determine the maximum daily demand (MDD), and the peak hour demand (PHD) for the water system. The Town of Edisto Beach pumped a total of 29.25 million gallons (MG) from the wells for the month of July 2007. July represents the peak pumping month for the Town.

MDD = the maximum total amount of water used during any 24 hour period (July 4th)
MDD = 1,100,000 gallons

PHD = (MDD / 24)* 2.1 peaking factor

PHD = (1,100,000 gallons/ 24 hours) *2.1 = 96,250 gallons per hour or approx. 1600 GPM

The 2.1 peaking factor for the PHD is a standard peaking factor recommended by the AWWA.

4.3 Minimum Storage Based on DHEC Calculations

Storage = (1/2) MDD OR PHD * 2 hours + Fire Flow during same 2 hour period, whichever is greater

Storage = 0.5 * 1,100,000 gallons = **550,000 gallons**

OR

96,250 gallons * 2 hours + 500 GPM * 120 minutes = **252,500 gallons**

Based on the DHEC regulations, that require the greater of the two storage volumes, the Town of Edisto Beach requires 550,000 gallons of storage. The current infrastructure has only 300,000 gallons of storage capacity, a deficiency of 250,000 gallons. However, as mentioned above, DHEC allows the storage requirement to be reduced if the water system has the capacity to supplement peak demands.

Therefore, it is necessary to determine if the existing water system has supplemental pumping capacity to provide supply during peak demands. The objective is to determine how long the Town could fight a fire at 500 GPM fire flows during the peak hour for domestic demand. In other words, how long can the water system produce 2,100 GPM.

The following is the yield from each of wells and the booster pumps if they were all operating at the same time, at a system pressure of 60 psi (a full elevated storage tank):

- Well 1 (upgraded capacity) 250 GPM
- Well 2 135 GPM
- Well 3 90 GPM
- Booster Pump 1 350 GPM
- Booster Pump 2 350 GPM
- Well 6 495 GPM

Total Water System Production @ 60 psi 1,670 GPM

Based on a fire flow demand of 500 GPM plus a peak hour demand of 1,600 GPM, the total peak demand is 2100 GPM. With a total water production of 1,670 GPM, the well pumps alone are deficient by 430 GPM that must be made supplied by drawdown from the elevated storage tank. Subsequently, based on the existing elevated storage capacity of 100,000 gallons, the Town could fight a fire for approximately 232 minutes during July 4th at 7:00 pm in the evening, the peak demand hour during the year. This meets the minimum DHEC requirement.

As previously noted, 500 GPM of fire flow is only the minimum requirement. 1,000 GPM is the recommended fire flow based on the AWWA recommendations for the majority of the building density on the island. This would increase the total usage under the worst case scenario (a fire on peak hour of peak day) to 2,600 GPM. Under this scenario, the system production would be deficient by 930 GPM, and the Town could fight the fire for 107 minutes utilizing the additional storage in the elevated tower, while still supplying the peak domestic demand of 1600 GPM.

4.4 Storage for Future Demand

As explained in Section 2, the projected annual water demand in 15 years or the year 2023 for the Town is 235,000,000 gallons. This equates to a 16% increase of the current water demand. This, along with the slight increase of the Well # 1 capacity requires the recalculation of water storage.

Using the methodology in the previous section:

MDD = the maximum total amount of water used during any 24 hour period (July 4th)
MDD = 1,100,000 gallons x (235,000,000 gal. / 201,702,000 gal) = 1,281,600 gallons

PHD = (MDD / 24)* 2.1 peaking factor
PHD = (1,281,600 gallons/ 24 hours) *2.1 = 112,140 gallons per hour or approx. 1869 GPM

4.5 Minimum Future Storage based on DHEC calculations:

Storage = (1/2) MDD OR PHD for 2 hours + Fire Flow during same 2 hour period, whichever is greater

Storage = 0.5 * 1,281,600 gallons = **640,800 gallons**

OR

112,140 gallons * 2 hours + 500 GPM * 120 minutes = **284,280 gallons**

As previously mentioned, either storage requirement can be reduced if the Town has sufficient pumping facilities to augment storage.

Total Well & Booster Pump Capacity (note this capacity includes upgraded Well No. 1):

- Well 1 (upgraded capacity) 250 GPM
- Well 2 135 GPM
- Well 3 90 GPM
- Booster Pump 1 350 GPM
- Booster Pump 2 350 GPM
- Well 6 495 GPM

Total Water System Production @ 60 psi 1,670 GPM

Table 5 below summarizes the fire fighting duration of the water system currently, as well as in 15 years. **Note that the fire fighting projections for second year 2023 column includes a new 200,000 gallon elevated storage tank.**

Table 5

	500 GPM Fire Flow			1000 GPM Fire Flow		
Year	**2008**	**2023**	**2023**	**2008**	**2023**	**2023**
Average Annual Water Demand (gal)	201,702,000	235,000,000	235,000,000	201,702,000	235,000,000	235,000,000
Maximum Day Water Demand (gal)	1,100,000	1,281,594	1,281,594	1,100,000	1,281,594	1,281,594
Peaking Factor	2.1	2.1	2.1	2.1	2.1	2.1
Peak Hour Demand (GPH)	96,250	112,139	112,139	96,250	112,139	112,139
Peak Hour Demand (GPM)	1,604	1,869	1,869	1,604	1,869	1,869
Pumping Capacity @ 60 psi	1,670	1,670	1,670	1,670	1,670	1,670
Required Fire Flow (GPM)	500	500	500	1,000	1,000	1,000
Total Combined System Demand (GPM)	2,104	2,369	2,369	2,604	2,869	2,869
Pumping Deficit (GPM)	434	699	699	934	1199	1199
Usable Water Storage (gal)	100,000	100,000	300,000	100,000	100,000	300,000
Time to fight fire (min)	230	143	429	107	83	250
Time to fight fire (hr)	3.84	2.38	7.15	1.78	1.39	4.17

4.6 Water Storage Recommendations

The Town should strive to increase their fire fighting capability during the peak hour on a maximum day during the summer. Currently, with the upgraded capacity of Well No. 1, the Town could only fight the fire for 107 minutes at the recommended 1000 GPM rate.

Water storage can be broken into two broad categories: elevated and ground. The main operational difference between elevated and ground storage is ground storage requires additional pumps to inject the stored water into the distribution system. With elevated storage, no pumps are needed since the energy comes from the height of the water within the tank. Each type of storage has advantages and disadvantages.

Ground storage systems can be more economical and have shorter constructions times compared to elevated storage tanks. Ground storage tank foundations are also much less sensitive to site soil conditions since they are placed on spread footings. Elevated storage tanks usually require pile foundations that are more costly. Seismic and wind loads are less of a concern on ground storage tanks.

Disadvantages for ground storage systems include the purchasing, operation and maintenance of booster pumps necessary to transfer water from the ground storage tank into the distribution system. SCDHEC requires pumping equipment to be above the 100 year flood elevation so site conditions are a consideration for ground storage tanks as well.

The major benefit of an elevated storage tank compared to ground storage systems is the simplicity of the design. No pumps are needed and no maintenance of pumps. Should the power be disrupted in the service area, the elevated storage tank can remain fully operational, providing water to the community. The energy costs associated with an elevated storage tank are small compared to ground storage systems. The limiting factor for the ability of an elevated storage tank to provide water to the distribution system is based on the configuration of the distribution system itself (line sizes, pipe material, condition of lines, etc,). Ground storage can only provide as much water as the booster pumps can pump. Disadvantages of elevated storage tanks include higher construction costs and, potentially aesthetics.

Even though the Town has 300,000 gallons of storage, only 100,000 gallons are in elevated storage. Water stored at the ground storage tank is only accessible through operation of the booster pumps, and therefore contributes only indirectly to a fire fighting scenario.

Based on the previous mentioned advantages and disadvantages of both elevated and ground storage tanks, it is recommended that the town pursue the addition on an elevated storage tank.

The long term reliability and minimal oversight required for an elevated storage tank is better suited for the Town.

To raise the Town's fire fighting capability above the minimum, it is recommended that the Town construct a 200,000 gallon elevated storage tank on the east end of the beach. This additional elevated storage tank would essentially balance the water system hydraulically. The location of the new elevated storage tank would of course be dependent on site availability. The new tank should be placed as close as possible to the area of the service station and grocery store, near the start of Palmetto Boulevard.

An additional elevated storage tank would be beneficial for several reasons. The most obvious benefit would be to increase the fire fighting duration from approximately 107 minutes currently or 83 minutes projected in 2023, to 250 minutes in2023 as demonstrated in Section 4.5.

As explained in Section 4.4, the peak hour demand in 2023 is projected to be 1,869 GPM and during a fire scenario and additional 1,000 GPM will be required from the distribution system. That equates to a total system demand of 2,869 GPM. The pumping capacity of the system is equal 1,670 GPM.

2,869 GPM – 1,670 GPM = 1,199 GPM = deficit

300,000 gallons / 1,199 GPM = 250 minutes

The elevated storage tank also alleviates the problem of low fire flows on east of Portia Street which can occur when the booster pumps are not running. This will be discussed in greater detail in Section 5 of this report.

Pressures throughout the system would be better equalized and the tank would increase water quality due to increased flushing of the system on the east end of the Town.

Reliability is also improved since the new tank will serve as additional water source in an area of the island lacking supply wells.

4.6.1 Tank Selection and Estimated Cost

Cost estimates were obtained from Caldwell Tanks on various sizes and shapes for the elevated storage tank. Due to the size of the proposed tank, two tanks types were evaluated and estimated, the multicolumn and the pedesphere. See Figures 6 and 7 respectively for an elevation view of the tanks. The multicolumn style tank is the most economical elevated storage tank. However, what its make up for in cost, it is lacking in aesthetics and security. The pedesphere style is slightly more expensive than the multicolumn style tank and is more aesthetically pleasing. Pedespheres can be painted to resemble baseballs, volleyballs or other "beachy" symbols. Instead of the elevated storage tank being aesthetically detrimental, it can be a topic of proud discussion and a symbol of the Town. The current 100,000 gallon elevated storage tank is a pedesphere style. Security and safety is also improved with a pedesphere. The only access to the stored water on the pedesphere is through a secured bottom door located in the pedestal. In contrast, an intruder could possibly scale the outside of a multicolumn tank.

The following are the estimated costs for the various tank sizes and styles base on an overflow elevation of 163.18 feet and an operating range of approximately 25 feet:

Table 6

Style	Capacity (gal)	Estimated Cost
Multi Column	200,000	$650,000
	250,000	$750,000
	300,000	$815,000
	400,000	$1,000,000
Pedesphere	200,000	$800,000
	250,000	$875,000
	300,000	$950,000
	400,000	$1,200,000

Please note that the costs above include the tank and basic installation but assume site soil characteristics sufficient for a spread footing. If the soils aren't capable of supporting the tank via a spread footing, an additional $250,000 should be included in the estimate for the installation of a pile supported foundation and an additional $20,000 should be estimated for tank controls. The price above also does not include permitting, site acquisition costs, or miscellaneous piping costs up to the tank.

One other item of note is that the cost of the tank is heavily dependent on the height of the tank and not so much the capacity of the tank.

The Town also has to be cognizant not to get too much water storage. This becomes especially critical when the demand is low during the winter. Water age increases as demand decreases.

Water quality will degrade the longer the water is stored. Common problems with increased water age include:

- Disinfectant decay / loss of chlorine residual
- Microbial growth
- Taste and odor issues

Water age can vary widely depending on multiple factors but typically an ideal water age is less than 7 days. Since the demand in the winter months can get as low as 288,065 GPD or approximately 30% of the July demand, it is recommended that the new 200,000 gallon tank be placed on standby in the months of December, January, February, and March. The pumping capacity of the system exceeds the withdrawal during peak demand with fire flow so a storage deficit is never encountered. As the summer approaches, the tank can be brought online. Other options include adding a single acting altitude valve at the larger tank to reduce its water level, therefore reducing the stored water and reduce water age.

5.0 WATER DISTRIBUTION AND FIRE PROTECTION

This portion of the Master Plan evaluates the adequacy of the existing water distribution system and its ability to provide adequate fire protection to the Town. See Section 4 – Water Storage, for a detailed discussion of fire protection in terms of storage.

5.1 Existing Water Distribution

Edisto Beach water distribution consists of pipe sizes ranging from 2" to 10" in diameter. Refer to Figure 2 for a layout of the water system. Most of the pipes are ductile iron or polyvinyl chloride (PVC). Static system pressures range from 60 to 70 psi depending on current demand and the water level in the elevated storage tank.

The system is looped in most areas. Looping water systems is beneficial for several reasons. First, looped systems provide greater flows throughout the system due to the reduced headloss through the pipes. Secondly, it eliminates dead ends, preventing the deterioration of water at the end of a system and reducing water age. Lastly, looped systems provide alternate avenues of water flow should a water line be closed for repairs.

The Town also has approximately 133 fire hydrants dispersed throughout the Town and as well as outside the Town limits along Palmetto Road and at the state park. Hydrant flows ranged from 750 gallons per minute (GPM) to 1400 GPM. Most hydrants are dated 1976 or newer.

Earth Tech obtained and reviewed the hydrant test results from Bishop Hydrant Service. These hydrant tests appear to be conducted on an annual basis over the span of several days in the months of August 2006 and September 2007. Unfortunately, other water systems parameters during the period of hydrant testing, including the elevated storage tank water level and which well pumps and/or booster pumps were operating, were unavailable. These previously mentioned parameters are important because it is difficult to tell how the resources (wells and booster pumps) impact the various hydrants. Approximately 133 fire hydrants were tested and inspected. The hydrant test results indicated that at the time of testing, the Town of Edisto Beach has adequate system pressure to produce satisfactory fire flows. All the hydrants tested within the water system met the minimum DHEC requirement of 500 GPM with a 20 psi residual pressure, most showing significantly higher flows at much higher residual pressures.

5.2 Water Distribution System Design Standards and Criteria

Before beginning the evaluation of water system, it was first necessary to establish the minimum water distribution standards criteria set forth by the regulating authority, in this case, the South

Carolina Department of Health and Environmental Control (DHEC). DHEC has the following requirement for the distribution system:

- Hydrant Performance - Every fire hydrant shall be able to produce a minimum of 500 GPM while maintaining a 20 psi residual in the water system. All hydrant leads shall be no smaller than 6" diameter pipe.

The regulations enforced by DHEC are minimum standards only. 500 GPM of fire flow is only adequate where the distance between dwellings is great or in rural areas.

American Water Works Association (AWWA) Manual M31 - Distribution Requirements for Fire Protection, recommends the fire flows based on dwelling spacing as shown in Table 7 below.

Table 7

Distance Between Buildings (ft)	Needed Fire Flow (GPM)
More than 100	500
31-100	750
11-30	1,000
Less than 11	1,500

The majority of dwellings in the Town fall into the 750 to 1000 GPM category. Out of 133 fire hydrants, there were no hydrants that tested below 750 GPM of fire flow. Fire flows centered mostly around 900 to 1200 GPM, which meet AWWA recommendations for needed fire flow.

5.3 Hydrants below 900 GPM

Out of 133 fire hydrants located in the Edisto Beach water system, only 4 hydrants produced less than 900 GPM during the fire flow testing. Most these hydrants are located near the state park and Palmetto Road (see Figure 2 for location of hydrants). The four hydrants below 900 GPM are listed below with their associated flows:

- Hydrant No. 20 750 GPM
- Hydrant No. 124 820 GPM
- Hydrant No. 125 790 GPM
- Hydrant No. 129 860 GPM

It must be noted that the four hydrants producing the lowest flow are in areas where the space between buildings are the greatest, typically over 31 feet and not densely populated. Based on Table 7, these hydrants meet the recommended fire flow.

5.4 Modeling Results Based on Existing Conditions

As previously mentioned, the results from the hydrant tests did not indicate which resources (wells and / or booster pumps) were in operation during the time of testing. It was necessary to run the WaterCAD model provided by American Engineering Consultants in order to evaluate hydraulically how the water system operates.

The model was configured to reflect a fire scenario occurring at 7:00 pm on July 4th. This would be the peak demand for a year. The peak hour demand (PHD) was 1,600 GPM for domestic flow plus 1,000 GPM for fire flow for a total of 2,600 GPM. See Section 4.2 for the derivation of the peak hour demand.

With the baseline demand of 2,600 GPM established, it was then necessary to evaluate hydrants in this fire scenario at various locations throughout the Town while using different resources. The following four scenarios for source water were evaluated:

- Fighting a fire utilizing the elevated storage tank only
- Fighting a fire utilizing the elevated storage tank, well #6, and well #1
- Fighting a fire utilizing the elevated storage tank, booster pump, well #1 and well #3
- Fighting a fire utilizing the elevated storage tank, booster pump, well #1, well #3, and well # 6

Table 8 below illustrates the modeling results. The "Min System Pressure" column is a key component of the table. This column represents the minimum system pressure if 1,000 GPM were to be produced from the hydrant in question. This is a key pressure since DHEC prohibits system pressures below 20 psi due to backflow concerns, thus hydrants that have a 20 psi or lower of minimum system pressure are not in compliance during the modeling scenario. See Figure 2 for the location of the hydrants modeled.

Table 8

Resources on	Fire Hydrant	Junction #	Max System Pressure (psi)	Min System Pressure (psi)	Max Fire Flow (gpm)
EST	66	J-5	66.3	39.1	1008.29
EST	90	J-71	66.3	51.7	1013.38
EST	35	J-58	66.3	36.4	1007.64
EST	19	J-119	66.3	-5.6	1028.05
EST	107	J-161	66.3	-24.9	1000.00
EST	128	J-47	66.3	-106.3	1000.57
EST, Well 6, Well 1	66	J-5	66.5	50.9	1008.29
EST, Well 6, Well 1	90	J-71	66.5	54.2	1013.38
EST, Well 6, Well 1	35	J-58	66.5	40.2	1007.64
EST, Well 6, Well 1	19	J-119	66.5	-1.7	1028.05
EST, Well 6, Well 1	107	J-161	66.5	-21.1	1000.00
EST, Well 6, Well 1	128	J-47	66.5	-102.5	1000.57
EST, Booster Pump 1, Well 3	66	J-5	86.0	43.7	1008.29
EST, Booster Pump 1, Well 3	90	J-71	86.3	53.9	1013.38
EST, Booster Pump 1, Well 3	35	J-58	84.2	51.8	1007.64
EST, Booster Pump 1, Well 3	19	J-119	81.7	26.8	1028.05
EST, Booster Pump 1, Well 3	107	J-161	78.5	38.0	1000.00
EST, Booster Pump 1, Well 3	128	J-47	66.6	38.2	1000.57
EST, Booster Pump 1, Well 3, Well 6	66	J-5	86.6	53.0	1008.29
EST, Booster Pump 1, Well 3, Well 6	90	J-71	86.8	55.3	1013.38
EST, Booster Pump 1, Well 3, Well 6	35	J-58	84.7	54.0	1007.64
EST, Booster Pump 1, Well 3, Well 6	19	J-119	82.2	28.6	1028.05
EST, Booster Pump 1, Well 3, Well 6	107	J-161	78.9	39.5	1000.00
EST, Booster Pump 1, Well 3, Well 6	128	J-47	67.5	39.2	1000.57

Note:
A peaking factor of 2.1 was applied to demands at all the junctions.
The results are based on a steady state analysis

With only using the energy in the elevated storage tank, with no wells or booster pumps operating, the following hydrants didn't meet 1,000 GPM during a fire event:

- Fire Hydrant # 19 – intersection of Portia Street and Jungle Road
- Fire Hydrant # 107 – intersection of 174 and Jungle Road
- Fire Hydrant # 128 – near the end of Palmetto Road

Turning on Well # 1 and Well # 6 raised the pressures somewhat but not enough to bring the system into compliance. It wasn't until the booster pump was turned on that the residual systems pressures exceeded the 20 psi minimum when pumping 1,000 GPM.

All of these hydrants are located either on the east end of the island, or out Palmetto Road, closer to the booster pump system and further from the elevated storage tank. Simply put, the further away a hydrant is located heading east from the elevated storage tank, the less influence the elevated storage tank has on that hydrant's discharge and the more the influence the booster pumps have on that hydrant's discharge.

Modeling Results for Replacing 2" Water Lines with 6" Water Lines

Earth Tech also evaluated the benefits of replacing existing 2" water lines in certain areas with 6" water lines. Edisto Beach has a significant amount of 2" water line. Typically 2" water lines are not recommended for water distribution since head loss is great during a fire event.
Larger diameter water pipes would reduce the headloss through the system at that point, thus increasing the fire flows. Ten 6" cross connections between Lybrand and Portia street, one for each road from Palmetto Boulevard to Jungle Road including Marianne, Dorothy, Chancellor, Thistle, Nancy, Byrd, Osceola, Cheehaw, half of Dawhoo, and Portia streets were modeled during a fire scenario.

The modeling revealed that replacing the 2" cross connections with 6" water lines will not increase the fire flows at the hydrants in that area significantly. The existing system is looped enough that water is drawn from multiple pipes, effectively reducing the velocity of the water and subsequent headloss. This is the reason that the Towns' hydrants flows are adequate despite the small line sizes in certain areas.

5.5 Insurance Services Office (ISO) Rating

The ISO method is used by insurance companies as a way to rate water systems on the basis of three categories: Fire Department, Water Supply and Communication. In addition, there is a final factor called a Diversion. There are a total of 100 points available and the points available for each category are:

Fire Department:	50 points
Water Supply:	40 points
Communication:	10 points

The ISO ratings go from 1 to 10, with 1 being the best, and 10 the worst. The ratings and the corresponding point range are:

Rating 1:	90 to 100 points

Rating 2:	80 to 89.99 points
Rating 3:	70 to 79.99 points
Rating 4:	60 to 69.99 points
Rating 5:	50 to 59.99 points
Rating 6:	40 to 49.99 points
Rating 7:	30 to 39.99 points
Rating 8:	20 to 29.99 points
Rating 9:	10 to 19.99 points
Rating 10:	1 to 9.99 points

The better the rating, the better the system is judged to protect the property and safety of the town's citizens, and the lower the insurance premium. However, the rating structure should be used as only one tool among many for achieving the ultimate goal, which is to improve the protection of property and safety of the citizens of the town.

The Town of Edisto Beach currently has a rating of 4 with a point total of 62.96.

The category breakdown for the points is a follows:

Table 9

ISO Category	Available Points	Edisto Beach Points	Percentage Available
Fire Department	50	27.26	54.52
Water Supply	40	33.31	83.28
Communication	10	8.14	81.4
Diversion	0 (this only deducts)	-5.75	NA
	Total	62.96	

The Diversion category is an expression of the balance in the system. Any significant imbalance between the scores of the three categories results in deducted points for diversion. In the case of Edisto Beach, such an imbalance exists between the fire department, which has earned 54.5 percent of the available points, and the water supply and communication, each with over 80 percent of the available points.

Based on the ISO rating system, it is clear that making improvements to the Fire Department score will have more beneficial impact than improvements to the water supply. In fact, making improvements to the water supply without making improvements to the fire department, while raising the score, will have diminished impact.

Increasing the Water Supply score by 3 or 4 points without increasing the Fire Department's score may result in an increase in the Diversion deduction of a point or more, resulting in a net improvement of only a point or two.

Simply put, there is no way to improve the ISO ratings through Water Supply improvements alone, and indeed, of the three categories, the Water Supply has the strongest score.

The last ISO rating evaluation was done in 2000. If significant water system or fire department improvements have been made over the past 8 years, the Town may wish to consider having a more current evaluation done. The Town could increase the Fire Department's score to 40 or more, making it on par with the 80% of available points that both the communication and the water supply categories currently have, resulting in the ISO rating potentially being raised to at least a 3 rating (depending upon what the Diversion deduction was) and possibly a 2. Without a higher score from the Fire Department, there are no improvements that can be made to the water supply and the communication that will raise the Town's ISO rating to the next level of a 3. Getting the maximum number of points from these two categories would not move the rating to the next level due to the corresponding increase in the Diversion deduction.

Whether moving to a rating of 3 will have an impact on insurance rates is determined by how Edisto Beach's fire insurance rate is structured. Some insurance companies combine ISO ratings of 3 and 4 within the same rate structure, in which case no rate savings would be realized unless the ISO rating became a 2. Other insurance companies give the lowest rates to communities with ISO ratings of 1, 2, or 3, in which case improvement to a 3 would result in insurance savings.

5.6 Water Distribution Recommended Improvements

Fire hydrants need to be located in areas easily assessable to the fire department. Common locations for fire hydrants include intersections and at dead end lines. SCDHEC requires that the line feeding the fire hydrant be a minimum diameter of 6". AWWA recommends hydrants spaced a maximum of one every 600 ft. However, this distance should be used as a guide only. Numerous other factors affect hydrant spacing and location.

The majority of the Town's fire hydrants are properly located. There are however areas that could be difficult to fight a fire should one occur due to the locations of hydrants or lack of hydrants.

The "Point" is the most significant area in need of fire hydrant additions. The housing spacing in this area is relatively close compared to the rest of the island and the square footage of the houses are larger than average. The existing 2" line that services Point Street is too small to provide fire service. It is recommended that 7 new hydrants be installed along Point Street. See Figure 3 for the location of the new hydrants.

Jungle Shores Drive is another area that needs additional fire hydrants installed. There are currently fire hydrants located on Jungle Road, which runs parallel to Jungle Shores Drive. The hydrants located on Jungle Road are spaced approximately one every 700 ft. Though the distance from the hydrants located on Jungle Road to the houses on Jungle Shores Drive is adequate (less than 600 feet), the type of terrain, in particular woods and heavy brush that separate the two areas could make it difficult to effectively fight a fire. It is recommended that areas along Jungle Shores Drive with 2" lines be replaced with 6" lines and an additional 6 fire hydrants be added. See Figure 4 for a layout the proposed modifications.

The final area that should be considered for additional hydrants is between Dorothy Street and Cheehaw Street. Currently there are hydrants located along Jungle Road and Palmetto Boulevard. However, there are no hydrants located on the side streets connecting Jungle Road and Palmetto Boulevard. It would be beneficial to add fire hydrants at the midpoints of Dorothy, Thistle, Byrd, and Cheehaw Street. Since the only water lines along those streets are 2" in diameter, it would be necessary to replace a portion of those lines with 6" lines. See Figure 5 for a layout of the proposed hydrants. Dry hydrants were briefly evaluated in this area due to a nearby water source that could be used for water. However the cost to install the dry hydrants compared to the cost to install hydrants connected to the distribution system was similar and the benefits of hydrants connected to the distribution system outweigh the dry hydrant benefits. The three main benefits of hydrants connected to the distribution system in this area include:

- Allows fire department to fight fire without the need for a pumper truck.
- Less environmental impact. Dry hydrants would require a suction line be placed in wetlands.
- When using dry hydrants, less than desirable water would be pumped through the pumper truck, potentially damaging pump components and seals.

As previously discussed, the modeling results revealed that fire hydrants located east of Portia Street will be unable to adequately fight a fire if the booster pumps are off. The head loss between the elevated storage tank to the eastern portions of the system would be so large that hydrants located east of Portia Street would not be able to produce a sufficient discharge to adequately fight a fire without the energy added to the system from the booster pumps.

The current controls for the wells and booster pumps are located both at the pump houses of the individual units along with a control panel at the elevated storage tank. In the event of a fire, the current scenario requires a person to manually monitor the tank water levels and to turn on wells and/or booster pumps as necessary. With the booster pumps in operation, the eastern portion of the Town has adequate fire flows. The major disadvantage of the current configuration of the controls is that there could be a delay from when a fire occurs and when the wells and / or booster pumps are turned on, since someone has to physically go to the control panel to initiate resources. It also requires one person to be located at the control panel for the entire duration of the fire. This will be explored in depth in Section 6 on the Supervisory Control and Data Acquisition (SCADA) system.

5.7 Estimated Costs for Water Distribution Improvements

The Point

Item	Quantity	Unit	Unit Cost	Total Cost
6" DIP	1680	LF	$25	$42,000
8x6 Tapping sleeve	7	Each	$5,000	$35,000
Fire Hydrant and valve	7	Each	$3,000	$21,000
			Total Cost	$98,000

Jungle Shores

Item	Quantity	Unit	Unit Cost	Total Cost
6" DIP	3100	LF	$25	$77,500
Fire Hydrant and valve	6	Each	$3,000	$18,000
			Total Cost	$95,500

Dorothy/Cheehaw

Item	Quantity	Unit	Unit Cost	Total Cost
6" DIP	1700	LF	$25	$42,500
8x6 Tapping sleeve	4	Each	$5,000	$20,000
Fire Hydrant and valve	4	Each	$3,000	$12,000
			Total Cost	$74,500

6.0 SCADA

As discussed in Section 5.6, one issue with fire response is that a water system operator must be notified, and must travel to the elevated storage tank to access the well pump controls. Installation of a Supervisory Control and Data Acquisition (SCADA) system would resolve this response problem. A comprehensive SCADA system would have the advantage of allowing any or all pumps to be turned on from a remote location – an operator would not be required to go to the elevated storage tower, and remain there for the duration of the fire fighting effort. This would greatly enhance the response time, effectiveness and utilization of the water supply for the fire fighting effort, while maintaining domestic flows to the rest of the system.

Additionally, the SCADA system can be configured to monitor the elevated tower and ground storage tank, and each well site, indicating flow rates, pumping duration, times of pumping, and any alarm conditions. All this information can be sent to a laptop computer, allowing instant access to the entire system conditions from a remote location. Currently, the operators must go out to each well to determine the pump run time and total flows, but no information is available on when the peaks occur or what the water demand is at that time. As indicated in the discussion on hydrant testing, knowing what pumps are operating during each test, and further, being able to initiate a certain pump operation and determine its effect on each hydrant flow, would be extremely valuable information. This could be easily done with a SCADA system.

The SCADA can also automate report preparation, by compiling the needed information and developing the report in the preconfigured format. This will free up staff from a very time consuming and tedious task, and allow for more time for system analysis rather than compiling data. Trends can be spotted, pump capacities and well yield monitored. In short, SCADA is a vital component of running a water utility and its addition is highly recommended.

There are two basic types of SCADA systems, proprietary systems that can be serviced by licensed technicians of that one manufacturer, and what is called "open architecture" systems that can be programmed and serviced by a number of technicians. The main difference is in the communication protocols and the software used for the human-machine interface. Proprietary systems typically use communication protocols, or data coding, that are developed by that particular company and that does not translate to other communication systems. In addition, they may have software packages for the human-machine interface that fulfill all the needs of the client, but the applications have been developed by the SCADA company – these may or may not interface easily with other standard software packages such as Microsoft Office applications of Excel or Access, or other business software such as Oracle, Datastream, Operator 10, etc. These systems work very well, but the client typically pays more for the system due to the fact that all components must be manufactured and programmed by that one company – there is no hardware that can be purchased "off the shelf" that will communicate within their system.

An "open architecture" will communicate in a more universal, non-proprietary computer language, typically an industry standard, as the communication protocol. In other words the coding system will be available to any company that wishes to use it and develop applications for it. Likewise the software package will also be open, typically Windows based, with the coding known. By using a more common computer language that shares standard coding with other computer programs, the data can be transferred and manipulated in other standard software programs such as Excel or Access. Thus, data can be transferred out to another program and reports and graphics developed, without special applications having to be developed by the SCADA provider. In addition, because the language or code is non-proprietary, more technicians are available from multiple companies to trouble shoot any programming problems.

A helpful analogy might be to compare the proprietary and open architecture to Apple computers and IBM computers several years back. At that time, if you bought an Apple computer, the communication protocols were totally proprietary. You needed to buy special software that had been developed specifically for Apple, and a document developed on an Apple could not be opened or manipulated on another type of computer. IBM developed a non-proprietary communication system, which was quickly cloned, with several companies manufacturing the computers which greatly reduced the price of a PC. In addition, because of the open architecture, software was developed that was also open to some extent, and programs could be used with one another. A document developed on an IBM machine could be opened and manipulated on any other PC which shared the same operating system, not just on an IBM machine. Of course now the language systems have been developed that allow Apple computers and PCs to work with one another, but this was not the case just a decade ago.

One major advantage to an "open architecture" is that the hardware components used are typically "off-the-shelf" items. Thus, if something were to happen to a piece of the SCADA equipment, such as a lightning strike that disables one of the control panels, the technician can purchase another control panel locally, perhaps even shopping competitively for it, and does not have to order it from a particular manufacturer. This reduces down time and also reduces the cost for repairs and maintenance. Again, to follow the Apple /PC analogy, if you want to put a new DVD drive in your PC, there are a number of stores that will be able to sell you a compatible drive; in fact you will have multiple manufacturers from which to choose. Or if your PC needs servicing, there are many different companies, locally available, that can trouble shoot your equipment. If you have a similar issue with your Apple, you will need to find an Apple trained technician or send your machine back to an authorized service center.

The controls that the Town of Edisto Beach currently has are manufactured by a proprietary vendor, US Filter. However, despite their proprietary source, these are simple control devises only, and discussions with open architecture vendors indicate that these can be configured to operate within an open architecture system. Therefore, no existing equipment will need to be replaced to move to an open architecture system, and the Town should not suffer any disadvantage from moving to a less expensive and less restrictive open architecture system.

In a SCADA system, the data gathered is done in one of two ways. A system that transmits data continuously on a set schedule is called a polling system. This system will in essence take reading from each remote station in sequence on a set schedule. The number of data points collected and the frequency of collection will vary from system to system according to the needs and budget. For instance, the system for Edisto Beach might assess the status of each well pump and booster pump, whether the pump is on or in standby, and if the flow meter is also being polled, the pumping rate if the pump is on. It would also determine the water level in each storage tank and whether there were any alarm conditions. This data can be collected on a predetermined schedule, but typically would be gathered every 15 seconds. This method allows for the gathering of data that can be analyzed and trended. The number of data points, called tags, and the frequency of collection are dependent upon the system needs. A very small system may have only 20 tags polled every 15 seconds, whereas a medium sized utility that operates water treatment and wastewater treatment plants, as well as lift stations and water wells may have as many as 15,000 tags collected every 15 seconds. The larger the number of data points collected the more expensive the system, but also the more information is available for analysis.

The second method of data gathering is called quiescent gathering. This system only sends a signal if there is an alarm condition. If there is no alarm, there is no data collection or communication. This system will typically poll each remote station once an hour to determine if the system is still operational, but a system can fail without producing an alarm (alarm failure) and this not be discovered until the next polling time. Though this system is inexpensive and can operate over inexpensive dial up or cellular phone lines, it does not allow for data collection for trending or analysis. This type of system is typically not recommended.

In addition to the two basic systems for SCADA and two different methods of data collection, there are different systems by which the data is communicated from the remote monitoring stations to the central computer system. There are two basic systems and then different types or frequencies within that system. These are:

- Telephone
    - Leased

    - Dial-up
    - Cellular
- Radio Transmission
    - VHF/UHF Radio System
    - 800 MHz Trunked Radio System
    - 900 MHz Radio System
    - Spread Spectrum Radio System
    - Hybrid 900 MHz & Spread Spectrum Radio System

Each of these methods has positive and negative aspects, typically involving the reliability of the system and the cost. Roughly, the faster the connection, the more information that can be transmitted, and the more reliable the system, the higher the cost. Conversely, there are inexpensive, cellular based systems that have reduced reliability but may be quite adequate for many less critical functions. These systems can also be blended, with the highly reliable PLC based and radio systems being utilized for critical stations and functions, and less reliable but less expensive cellular systems being used for less critical functions.

SCADA systems can provide instantaneous readings and reports for:

- Tank levels
- Well pump flows
- Disinfection amounts
- Booster pump flows
- Well and booster pump run times
- System pressures

SCADA systems can also generate maintenance orders for water system staff as well as trends from collected data include water usage, maximum day and peak hour factors, average system pressure, and average well run times.

Prices for SCADA systems again are dependent upon the number of data points, or tags, that are monitored, the communication system chosen, and the type of data collection and data processing desired. Therefore, costs may range from $40,000 to $160,000 or more depending upon what the Town determines to be needed. Development of these needs is being pursued and will be submitted under a separate task.

A simplified schematic is provided in Figure 8 at the end of this report.

A preliminary list of needs includes:

SCADA Setpoints, Screens and Controls:

Elevated Storage Tank:
1. Instantaneous level as well (may require new transmitter)
2. Level history, downloadable level on an operator selected time interval basis of between 5 minutes to a day, with download into an Excel spreadsheet or other reporting program.

Ground Storage Tank and Booster Pump system:
1. Instantaneous level as well
2. Level history, downloadable level on an operator selected time interval basis of between 5 minutes to a day, with download into an Excel spreadsheet or other reporting program.
3. Booster Pumps status on/off/ready
4. Instantaneous Flow rate for Booster Pumps (will require new transmitting flow meter)
5. Generator status

Wells (for Wells 1 to 6):
1. Water Level (may require transmitter)
2. Pump on/off/ready status
3. Instantaneous flow rate (will require new transmitting flow meter)
4. Chlorine residual with tracking (will require new 4-20 mA controlled chlorination pumps)
5. Chlorine tank level (will require transmitting level sensor)
6. Pump run time – cumulative and since last maintenance

Pressure Sensors Perhaps close to hydrants 128/129, 107 and 19 or 20 (Island Cove)

Screens:
1. System Overview – Master Screen
    a. Elevation in Elevated Tank
    b. Elevation in Ground Storage Tank
    c. Well pumps status (on or off)
    d. Booster Pump status
    e. Pumping rate of pumps on
    f. Pressures at pressure sensors if monitoring
2. Ground Storage system status (larger screen)
    a. Elevation in Ground Storage Tank
    b. Well pumps status (on or off)
    c. Booster Pump status
    d. Pumping rate of pumps on
    e. Gallons pumped in last 24 hours
3. Wells for each well
    a. Water elevation in well
    b. Well pumps status (on or off)
    c. Pumping rate of pumps on
    d. Gallons pumped in last 24 hours
    e. Chlorine residual (will require new 4-20 mA controlled chlorination pumps)
4. Trending – for each parameter below, trend either in table or graph the parameter indicated on an operator set time interval from 15 minutes to 1 day, to perhaps weekly or monthly.

a. Time based flow pattern to show usage at individual times of day downloadable on operator set interval from 5 minutes to 1 day for each pump, well or booster
b. Total all groundwater wells in time based to determine trend of total flows or daily totals
c. Time based level in elevated tank
d. Time based level in ground storage tank
e. Time based Chlorine residuals for each pump
f. System pressures at monitoring locations

Controls:

1. Activate any well pump or booster pump remotely by clicking on well either in master screen or individual screens
2. Establish a program that cycles well pumps either by elevated tower elevation (as is currently done) or, if a well pump has run a certain amount of time (operator determined), the program cycles to the next resource of that size category.

Reports:

1. Daily flow totals for each well
2. Total of flows for the day
3. Weekly, monthly or some other operator determined interval (between two dates, or past 30 days, etc) totals for each well pumping, tabulated in the time interval specified. For instance if you want the daily totals for each pump, and the total for each pump for the week, and the total pumped from all pumps for the day or week.
4. Pump Run time for each well on operator specified interval – day, week, month, quarter or year, or between two dates.
5. Pumping time for each booster pump on operator specified interval – day, week, month, quarter or year, or between two dates.
6. Monthly average daily flow average for each pump and for the total from all pumps.
7. Peak day for total pumped flow
8. Chlorine residual for each pump, with minimum and maximum noted

At the time of this report, the Town is investigating installation of a comprehensive SCADA System to include one additional laptop computer, licenses for two laptops, Human Machine Interface (HMI) software and programming, interface with the existing Master Terminal Unit (MTU), and training for one day. The exact configuration and monitoring points will be designated to provide the Water System staff the necessary tools to operate, monitor, analyze and improve the water system operation. Fire response will be greatly improved, which in itself is an excellent reason to automate operations with a SCADA system.

7.0 WATER QUALITY

Secondary water standards are guidelines to assist public water systems in managing their drinking water for aesthetic considerations. Currently, Edisto Beach has no treatment at the wellheads to improve secondary water standard contaminants for taste, color, and odor. All six wells currently use sodium hypochlorite for disinfection.

Saltwater intrusion, the movement of saline water into freshwater aquifers, is most commonly caused by groundwater pumping near the coast. Freshwater aquifers along the Atlantic coastal zone are among the most productive in the United States, supplying drinking water to an estimated 30 million people from Maine to Florida. These freshwater aquifers are bounded at their seaward margins by saltwater. Because freshwater has a lower concentration of dissolved solids than does saltwater, it is less dense than saltwater and tends to flow on top of surrounding or underlying saltwater.

Under natural conditions, the seaward flow of freshwater prevents saltwater from encroaching coastal aquifers, and the boundary between freshwater and saltwater is maintained near the coast or far below land surface. Typically, this boundary is not sharp but rather is a diffuse zone where freshwater and saltwater mix. The zone can be as narrow as 1,500-foot or as wide as several miles.

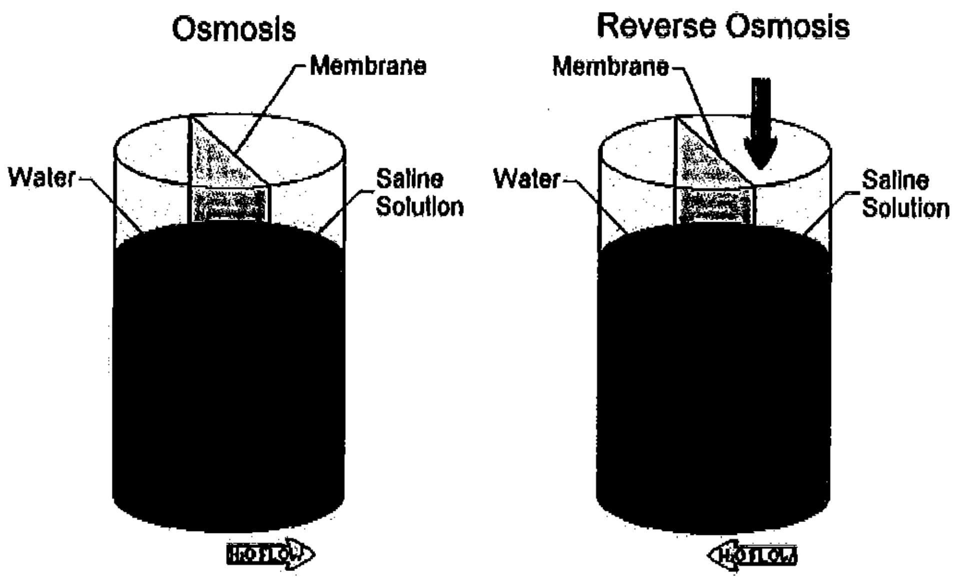
The pumping of groundwater lowers water levels and can cause saltwater to be drawn toward the areas of the well fields. Saltwater contamination can occur by lateral flow of saltwater from the sea or by vertical flow of saltwater from deeper, more saline zones of a groundwater system. Saltwater intrusion reduces fresh groundwater storage and can lead to the abandonment of supply wells when concentrations of dissolved ions exceed drinking-water standards. Saltwater intrusion has been documented throughout the Atlantic coastal zone, but the degree of saltwater intrusion varies widely among localities and hydro-geologic settings.

Previous water sampling in November of 2007 revealed elevated levels of chloride, above 250 mg/L at all wells. The secondary maximum contaminant level (SMCL) for chloride is 250 mg/L, which is considered to be the maximum amount the substance without encountering water taste problems. Excessive chloride levels can also contribute to pipe corrosion.

No data was available at the time of this report for the amount of TDS in the Town's water but it is likely to be above the SMCL of 500 mg/L which is typical for the Floridian Aquifer from which the water is drawn. Elevated levels of TDS can lead to water hardness, deposits, staining, scaling, corrosion, and a salty taste in the water.

The difficulty with the existing water system in terms of improving water quality is the lack of centralized groundwater withdrawal facilities. The ideal system configuration is one is with a centralized wells which then pump to a nearby water treatment plant. Though disinfection is provided at the various well heads, this does nothing to improve the taste, odor, and other aesthetic aspects of drinking water.

Based on the high levels of sodium and TDS, Reverse osmosis (RO) is the technology of choice to improve the aesthetics of the water. RO technology has come a long way in the past ten years. Energy consumption has been reduced along with more efficient RO units in terms of less reject water being produced. Reverse osmosis is the process by which water with high TDS, including chlorides, sodium, and sulfates, is forced under high pressure (a pressure in excess of the osmotic pressure) through a water-permeable membrane to remove the TDS. The dissolved solids do not pass through the membrane. As the concentration of TDS in the raw solution increases, the osmotic pressure increases. Once the osmotic pressure equals the pressure applied in the RO process, no more water is pushed through the membrane. The brine solution that remains is referred to as the concentrate, or reject, and needs to be disposed. The purified portion which passed through the membrane is referred to as permeate, and is the finished product of the RO process. Typically, some of the raw water is not sent through the RO, but is bypassed and then blended with the treated water to add some minerals back into the water and improve the overall efficiency. The ratio of the treated water to the bypass water is dependent upon the raw water quality and the desired final water quality. The ratio of finished water to the original volume of saline water treated is called recovery efficiency. Recovery efficiency varies with the quality of the feed water, but for groundwater along the east coast, with no water quality data available, a ballpark number is approximately 75%. That is, for every 100 gallons of water treated, 75 gallons will be ready for consumption and 25 gallons will be reject water to be discharged to a permitted location. Detailed water analyses and sometimes pilot studies are required to determine the estimated blend rate, and the estimated recovery efficiency for a specific raw water quality. The RO process is shown in the diagram on the next page.



Reverse Osmosis Process Diagram from Water & Power Technologies, Inc., a division of Earth Tech, Inc.

Generally speaking, reverse osmosis systems are comprised of:

- Influent feed
- Anti-scalant feed
- Cartridge filters
- Booster pumps
- RO treatment units
- Sodium Hypochlorite feed pumps
- Aqueous ammonia feed pumps
- Sulfuric acid feed pumps
- Corrosion inhibitor feed pumps

There are several configurations that are feasible in terms of improving water quality using RO systems.

Option A

The most cost effective method to improve water quality would be to install two 400,000 gallon per day RO units at the highest capacity wells, wells 1 & 6. One benefit of this option is that the supply wells are already in place and that wells 1 & 6 are in relatively close proximity to each other. Untreated groundwater would be pumped from both wells 1 & 6 into a RO unit where it would then be treated and discharged into the system. This would provide a combined capacity of 562 gpm, continuous flow, of treated water with approximately 188 gpm of reject water or concentrate. RO units are designed to run continuously and this is the preferred method of operation. This would provide up to 810,000 gallons of treated water per day. Under this scenario a deficit would remain of approximately 500,000 gallons during the maximum day of the year, which occurs during July when 1,300,000 gallons of water is required to meet the daily demand. When the supply of the RO water is exceeded by the demand, other existing supply wells 2, 3, 4, & 5 would operate to supply the deficit. This scenario would lead to blended water during times of high usage. The current aesthetics problems with the existing water would become more prevalent during this time. Residences not located near the wells housing RO units would see little or no increase in the aesthetic quality of the water since the majority of the "good" water would go to residences near the wells with RO units. In the event of a fire occurring, all water supply wells could be initiated to fight the fire. The affect of blending water under this scenario could be somewhat mitigated by adding additional water storage, which would allow more storage of the treated water and allows the system to better handle to the fluctuating water demands during peak usage. During periods of low water usage during the winter, one of the two units could be shut down since only one unit would be required to meet the winter demand.

Besides the drawback of blended water there are other drawbacks associated with this option. RO units can be up to 25 ft by 10 ft in size and the town would have to construct buildings to house the RO units. Additional considerations include acquiring the property to house the RO units. RO also produces a waste stream or concentrate that must be discharged or reused appropriately and finding locations for reject water discharge may be difficult.

Cost Estimate for Treating at Wells 1 and 6

Item	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
0.4 MGD RO Unit	2	Each	$400,000	$800,000
Building 60 ft x 40 ft	1	Each	$300,000	$300,000
RO Piping	1	Each	$200,000	$200,000
Piping from Wells 1 & 6	1	Each	$100,000	$100,000
Chemical Addition	1	Each	$200,000	$200,000

Item	Quantity	Unit	Unit Cost	Total Cost
Electrical and Controls	1	Each	$175,000	$175,000
Site Acquisition	1	Each	$200,000	$200,000
Engineering & Contingency (20%)				$395,000

Total Estimated Cost for Option A $2,370,000

Annual operation and maintenance costs for this option are estimated to be:

Energy:		$40,000
O&M:		$200,000
	Total:	$240,000

Option B

The other option in terms of improving water quality for the town includes constructing a centralized water treatment facility essentially constructing one large RO facility in order to treat 100% of the towns' drinking water. In terms of sizing, three 400,000 gallon RO units could be housed in a new building. Since the water withdrawn from the wells would need to be treated before distribution into the water system, new supply wells would have to be constructed near the new treatment facility or the piping from the existing wells would need to be piped directly to the RO system prior to connection to the distribution system. Assuming new supply wells are provided, these would be sized to handle the peak future flows during the maximum day, or approximately 1,300,000 gallons per day.

Difficulties with this option include site acquisition for the new RO facility and wells, as well as finding a location to discharge the reject water. Operation and maintenance costs will increase as well compared to Option A.

Cost Estimate for New Wells and Centralized RO System

Item	Quantity	Unit	Unit Cost	Total Cost
0.4 MGD RO Unit	3	Each	$400,000	$1,200,000

Item	Quantity	Unit	Unit Cost	Total Cost
Building 70 ft x 50 ft	1	Each	$438,000	$438,000
RO Piping	1	Each	$300,000	$300,000
New 500 GPM Production Wells	2	Each	$250,000	$500,000
Chemical Addition	1	Each	$300,000	$300,000
Electrical and Controls	1	Each	$250,000	$250,000
Site Acquisition	1	Each	$300,000	$300,000
Engineering & Contingency (20%)				$657,600

Total Estimated Cost for Option B $3,945,600

Annual operation and maintenance costs for this option are estimated to be:

Energy:		$60,000
O&M:		$300,000
	Total:	$360,000

8.0 CONCLUSIONS – SUMMARY OF FINDINGS AND RECOMMENDATIONS

The Town of Edisto Beach water demand is projected to slightly increase over the next 15 years with a peak average annual water demand of 235,000,000 gallons by 2023. The geography of the island is such that major increases in water demand are unlikely since most of the parcels are already built upon. Past annual water usage data revealed a flat or slightly increasing water demand. The Town should be very cautious if considering servicing any undeveloped areas outside of the Town limits. Expanding the current service area would require additional infrastructure to provide adequate water supply.

Hydraulically speaking, the location of the existing ground storage tank, two wells, and two booster pumps are in a poor location. Essentially five major water system components are in an area far (almost 2 miles) from where the major demand is occurring. This leads to two booster pumps, two wells, and one ground storage tank that provides little contribution to the overall water system. The headloss through the existing 8" line from the ground storage tank to the island is significant. Ground storage is also often an undesirable form of water storage since the water has to be repumped into the system, requiring additional infrastructure and O & M costs. The current location of the two booster pumps, two wells, and the ground storage tank are likely the product of a lack of property or sites for infrastructure or a belief that water demand along Palmetto Road near the state park would be high, which the findings don't support.

The main area that should be considered for immediate improvement is the area of system monitoring and control. Currently, the Town's utility staff has limited information on the operation of the system, typically only total gallons per day. All monitoring is done manually. Control is also either localized, at the individual wells, or centralized at the elevated tower control station. There is no capacity for remote monitoring or control. This could be particularly critical during a fire on the east end of the island, when it is crucial that the booster pumps located on Palmetto Road be activated for sustained fire flows.

The installation of a SCADA system would allow for remote control of all pumps, as well as monitoring of the entire system. Status and alarm conditions at each well and tower could also be monitored. Vital system information on pump run time, peak flows, and flow patterns could also be obtained easily and automatically with the data control system. Report development could be automated, freeing up staff time for other duties.

The water distribution system is configured properly for the most part. The system is adequately looped to reduce water age and improve chlorine residuals. Modeling results revealed that the costs for additional looping of the distribution system were not justified by the small increase in fire hydrant flows. There are some areas on the island lacking adequate fire hydrant coverage and these areas are described in Table 10. The "Point" distribution improvements should be a top priority for the Town.

Water storage could be improved in terms of capacity. A new 200,000 gallon elevated storage tank on the east end of the island is necessary to improve fire fighting durations during peak demand.

The existing wells should continue to be monitored annually for any signs of capacity reduction. The Town in the future should move towards the consolidation of the wells. Two of the existing wells, Well Nos. 2 and 3, are very small contributors to the overall system and may be more of a hindrance than a benefit.

Table 10 below lists the potential water projects that need consideration:

Table 10

Project	Priority	Area	Completed By	Estimated Cost
SCADA	High	System Control	2009	$40,000 – 160,000
200,000 gal Storage Tank	Medium	Storage	2011	$800,000
The "Point" Distribution Improvements	High	Distribution	ASAP	$98,000
Jungle Shore Distribution Improvements	Medium	Distribution	2010	$95,500
Dorothy/Cheehaw Distribution Improvements	Medium	Distribution	2010	$74,500