BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

In re: Application for certificate to provide wastewater service in Charlotte County by Environmental Utilities, LLC

Docket No. 20240032-SU

DIRECT TESTIMONY

OF

JONATHAN H. COLE, P.E.

on behalf of

Environmental Utilities, LLC

**Q. Please state your name profession and address.**

A. My name is Jonathan H. Cole, P.E. I am a professional engineer and the President of Giffels-Webster Engineers, Inc. My business address is 900 Pine Street, Suite 225, Englewood, Florida 34223.

**Q. State briefly your educational background and experience.**

A. University of Connecticut B.S. Civil Engineering, 1979. I have been practicing Civil Engineering since 1979, utilities, site design, structural, civil engineering primarily in Florida for public and private clients.

**Q. Have you previously appeared and presented testimony before any regulatory bodies?**

A. Yes. Charlotte County Development Review Committee, Englewood Water District Board, and the Florida Public Service Commission. Also provided Expert Witness Testimony for some legal cases.

**Q. What is the purpose of your direct testimony?**

A. The purpose of my direct testimony is to present the Technical Memorandum dated April 2, 2021, addressing the proposed wastewater collection system in the service area and interconnection with Charlotte County Utilities from Knight Island, Don Pedro Island and Little Gasparilla Island prepared on behalf of EU, and to address other technical issues.

**Q. Can you identify any septic-to-sewer projects that you and your firm have been involved in?**

A. Yes, I have been the engineer for 9 septic to sewer projects for the Englewood Water District, septic to sewer projects in Martin County, Charlotte County, Sarasota County and currently in Hillsborough County. I have been working on large scale septic to sewer projects serving thousands of homes for over 30 years.

**Q. Can you compare the Charlotte County Utilities step system to the proposed grinder pump system?**

A. Yes. The CCU system uses a Septic Tank Effluent Pump (STEP) that is inserted inside the septic tank generally installed on private property. The septic tank holds the solids and only the effluent is pumped off site into the collection system and eventually treated at the treatment plant. From time to time the septic tank needs to be pumped of the solids.

The Ginder system is also a pressurized pump system, however there is no need for a septic tank since the grinder pump sends both the effluent and the solids to the treatment plant eliminating the need to periodically pump the septic tank.

**Q. Are you sponsoring any exhibits?**

A. Yes, I am sponsoring four exhibits. Exhibit JHC-1 which is the aforementioned Technical Memorandum, Exhibit JHC-2 are the maps of the proposed service area and proposed collection system, the system maps of which are an update of Exhibit E-4 to the Application, Exhibit JHC-3 is the legal description of the proposed service area, which is Exhibit E-1 to the Application. Exhibit JHC-4 are the line capacities which was Exhibit E-5 to the Application.

**Q. Was this Exhibit prepared by you and your staff?**

A. The engineering reports (JHC -1 and JHC-4) were. The survey information (JHC-2 and JHC -3) was prepared by DMK associates at my request.

**Q. Does that conclude your direct testimony?**

A. Yes, it does.

## Jonathan H. Cole, P.E.

**POSITION:**
President/Principal-In-Charge

**EDUCATION:**
University of Connecticut
Storrs, CT
B.S., Civil Engineering (1979)

**YEARS OF EXPERIENCE:** 39

**LICENSURE/CERTIFICATIONS:**

- P.E. #36384, Florida
- P.E. #0013198, Connecticut
- P.E. #06872, New Hampshire
- P.E. #E-17024, Nebraska
- P.E. #27320, Kansas
- FL Advanced Traffic Control
- FDEP Stormwater Erosion and Sediment Inspector

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Mr. Cole is a Professional Engineer registered in the States of Florida, Connecticut, New Hampshire, Nebraska and Kansas. He is President of Giffels-Webster Engineers, Inc., a Florida corporation and was formerly the County Engineer of Charlotte County, FL.

He has 39 years of experience in various types of civil engineering and construction projects, 30 of which were conducted in the Charlotte/Sarasota County area. He offers specialized knowledge, experience and proven ability in:

- Contract administration & construction services
- Entire utility infrastructure design/FDOT utility JPA plans for utility replacement/relocation in conjunction with major road widening projects
- Engineering design/permitting of water distribution systems; sewer collection, transmission, treatment; reclaimed water distribution systems; and package plants for private and municipal projects
- Expert Witness testimony for private or municipal civil, utility system, and construction projects
- Sub-surface utility locates using ground penetrating radar

Mr. Cole has also been the Principal-in-Charge/Engineer for over two dozen large utility projects in highly developed areas for Charlotte County Utilities, the East/West Spring Lake Wastewater Expansion Project; Englewood Water District, Sewer Collection System; Sarasota County's Phillippi Creek Septic System Replacement Program and the Martin County Sewer Expansion Program.

Mr. Cole is also certified by AIRVAC/Aqseptence, Inc., to design vacuum sewer systems. A few of these projects are listed below:

**Englewood Water District:**

- Nine Large Sewer Collection System areas (V-1 through V-9) and water distribution projects

**City of Punta Gorda:**

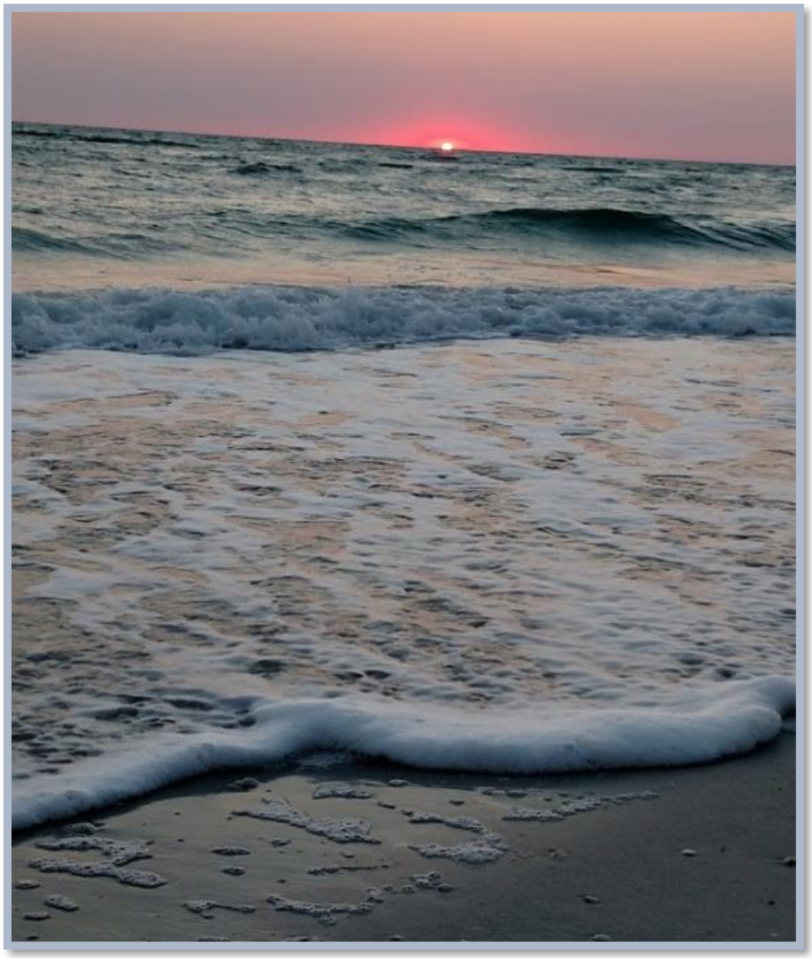
- Burnt Store Road Phase I Utility Relocation
- Piper Road Improvements – including 16" pressure mains

**Sarasota County:**

- Phillippi Creek Septic System Replacement Program, Area E; Area F; Area C; Area K, East & West; Area N, Phases I & II; Area M-West; Area I & J; Area O & P
- Phillippi Creek Septic System Replacement Program, Area N-3

**Martin County Utilities:**

- Seagate Harbor/Lighthouse Point Sewer Expansion area
- North River Shores, Phase 1 and 2 Sewer Expansion area



# EVALUATION OF WASTEWATER COLLECTION TECHNOLOGIES

**TECHNICAL MEMORANDUM**

**PREPARED BY:**

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**PREPARED FOR:**

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April 2, 2021

GWE Project #6374.20

GWE
Giffels-Webster
Engineers, Inc.

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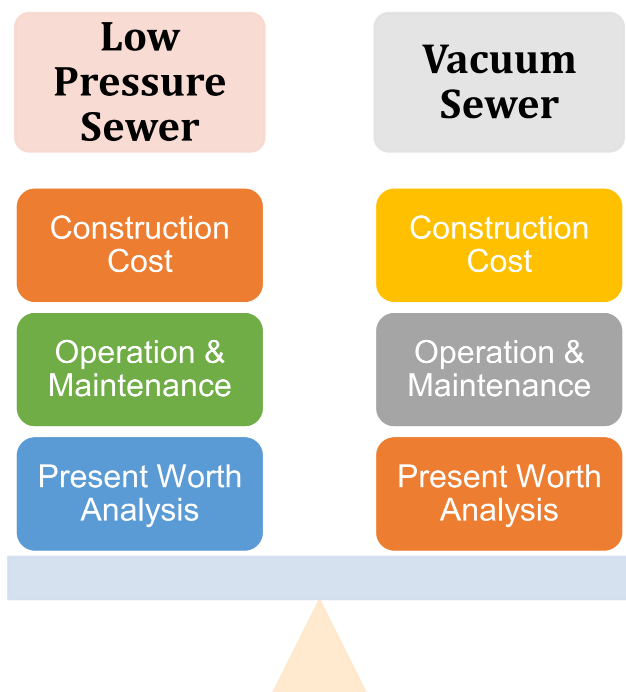
# 1. INTRODUCTION

Environmental Utilities, LLC is in the process of analyzing the costs to provide sewer service to a portion of Don Pedro/Knight Island and Little Gasparilla Island in Charlotte County, Florida. The purpose of this report is to review two types of wastewater collection systems, low pressure sewer and vacuum sewer, specifically to examine their limitations, and advantages, as well as estimate the initial and long term costs to determine the best system for this area.

# 2. SCOPE OF STUDY

The scope of this technical memorandum is to:

- Evaluate two methods of wastewater collection systems, specifically a low pressure sewer (LPS) and a vacuum sewer system.
- Provide conceptual layouts for both LPS and vacuum to serve the area.
- Provide quantity take-offs of the key components for both systems.
- Provide cost estimates for each system. The evaluation cost analysis will include construction costs, land acquisition, restoration (included in construction estimates), long-term operation and maintenance (O&M) and a present worth analysis to determine which type of collection system would best serve the area in the long run.



# 3. TOPOGRAPHY AND DRAINAGE

## 3.1 Topography

The study area is low, virtually level, and flat. Differential elevations will vary but will not have any significant effect on a vacuum system or low pressure system.

## 3.2 Soils

The soil profiles are generally a mix of Canaveral fine sand and St. Augustine fine sand down to 80 inches based on the Soil Conservation Service publications. Hardpan and caprock in significant quantities are not anticipated.

### 3.2.1 Don Pedro/Knight Island

The predominant soils within the Don Pedro/Knight Island area are Canaveral fine sand and St. Augustine sand.

*Canaveral Fine Sand:*

This moderately well drained soil is found on nearly level (0-2%) lands. The seasonal high groundwater table (SHGWT) is high at approximately 18”-40” below the surface, which may require dewatering for both LPS and vacuum sewer if installed in the wet season. The depths to known cap rock, rock, ledge or restrictive features is in excess of 80”.

*St. Augustine Sand:*

This somewhat poorly drained soil is found on nearly level (0-2%) lands. The SHGWT is typically 24”-36” below the surface, requiring dewatering for LPS and vacuum sewer if installed in the wet season. The depths to known cap rock, rock, ledge or restrictive features is in excess of 80”.

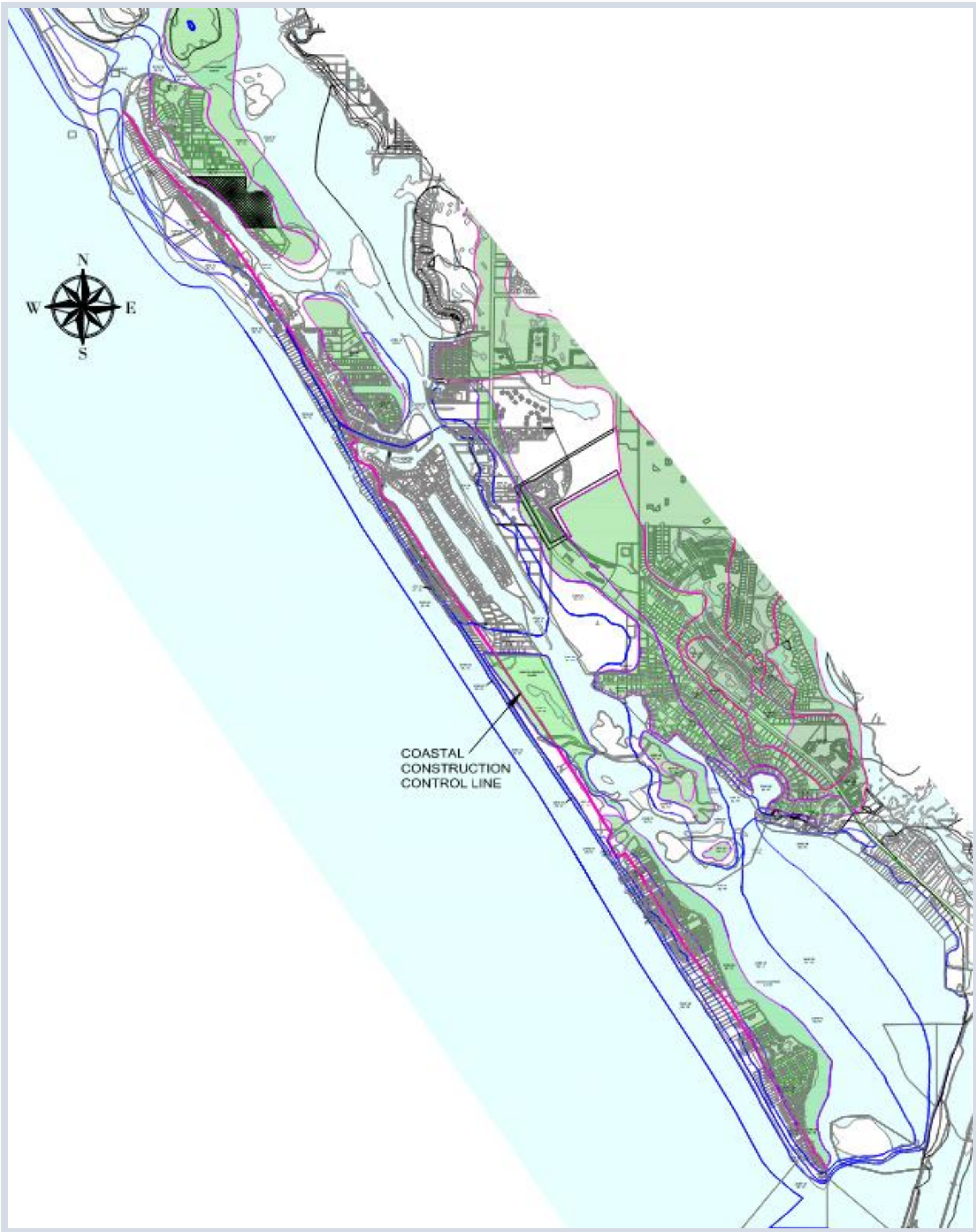
### 3.2.2 Little Gasparilla

The primary soil found in the Little Gasparilla area is Canaveral fine sand with the same characteristics as that found in the Don Pedro/Knight Island area.

## 3.3 FLOOD PLAIN

Much of the area is a barrier island with VE (velocity) FEMA flood zones. Moreover, some of the island is seaward of the Coastal Construction Control Line (CCCL).

Small portions of the island in the easterly areas are in AE FEMA flood areas.

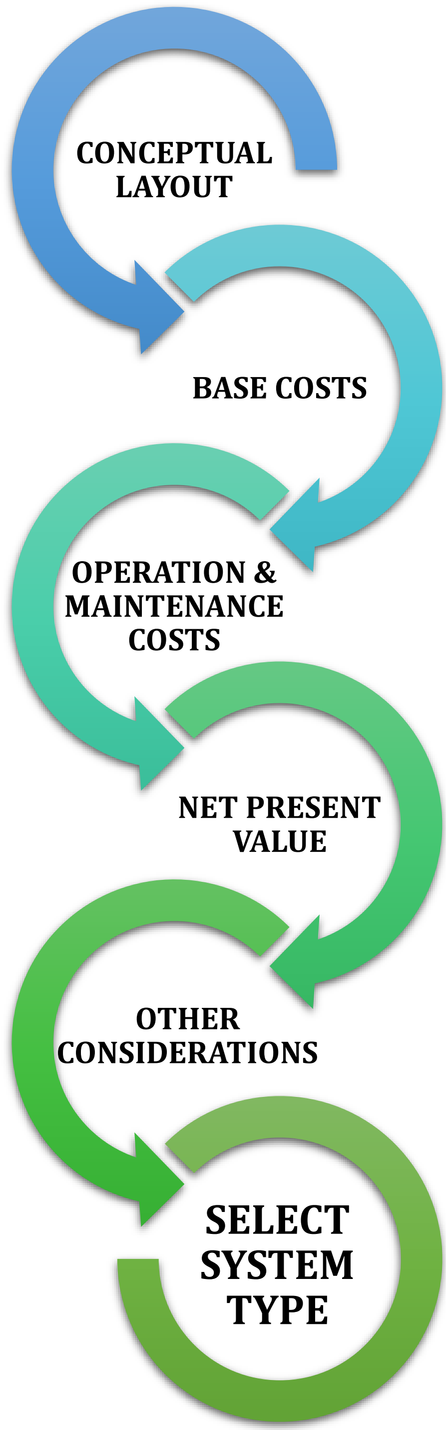


# 4. WASTEWATER COLLECTION SYSTEMS

## 4.1 DEVELOPMENT OF ALTERNATIVES

Two types of collection systems were analyzed to determine the most cost-effective option for the Don Pedro/Knight Island and Little Gasparilla Island areas.

1. Low Pressure Collection System
2. Vacuum Sewer Collection System




### 4.1.1 Methodology

To generate comparative costs, general layouts of each type of collection system were developed for the study area. Once the conceptual layouts were generated, construction costs, long term operation and maintenance and other costs for each layout were developed. These costs were then converted to a net present value to effectively compare the costs of each system for the different areas.

Once the comparative cost analysis is complete, other considerations are discussed to present additional factors that may not be reflected in the financial analysis.

After closely analyzing both wastewater collection systems and their respective costs and considerations, GWE will make a recommendation based on the engineer's opinion of the most suitable system type for the area.

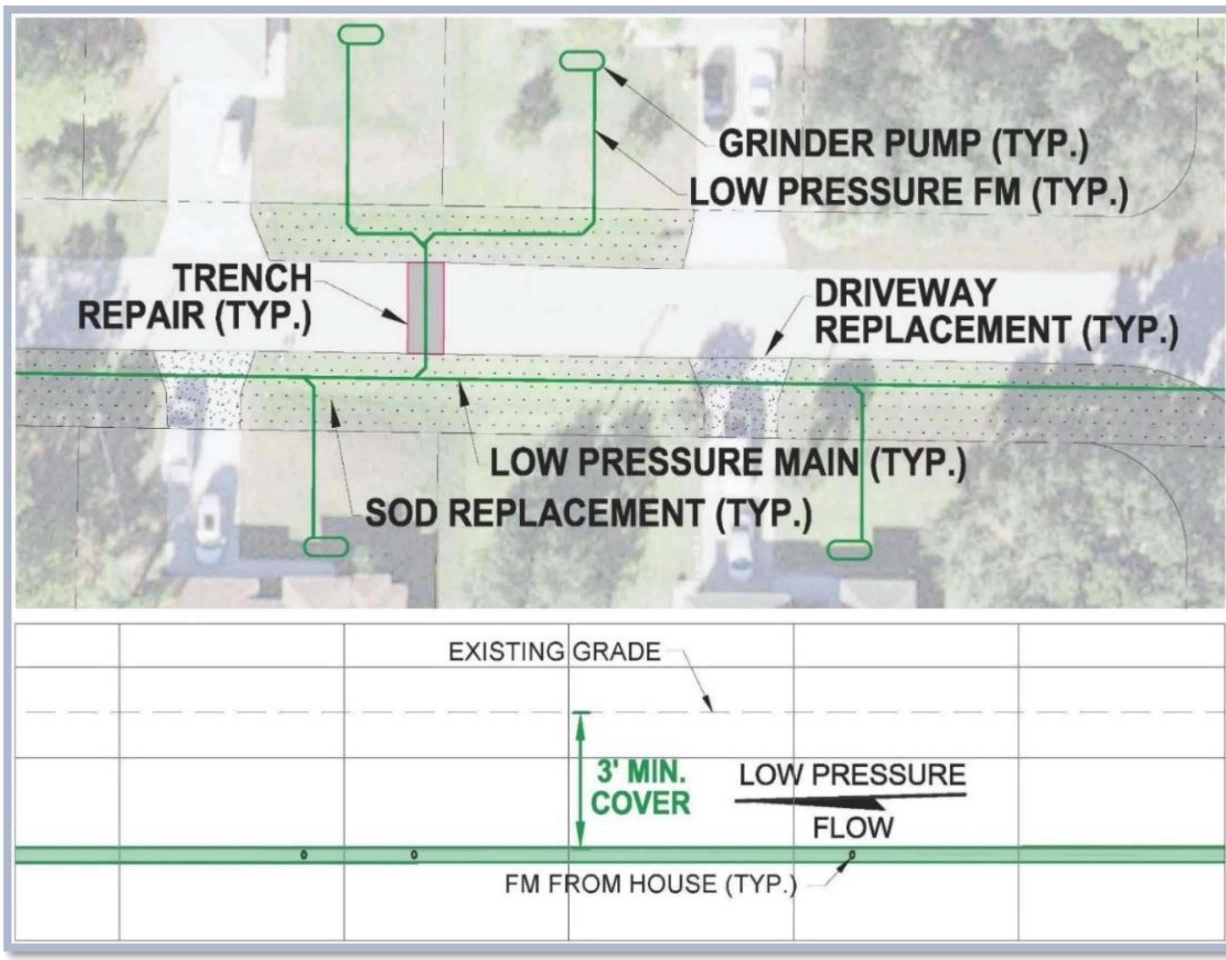
## 4.2 Low Pressure Sewer

### 4.2.1 General Description

Low pressure systems consist of relatively small diameter pipes normally installed in the road shoulder, with individual pumping units at each home or parcel to convey the sewage to a central station. Generally, the low pressure units cannot overcome the higher pressures in a transmission network and therefore an intermediate master pump station is necessary.

Since the LPS mains are under pressure, the velocities are higher than gravity mains, meaning that the pipe sizes can be considerably smaller to convey the equivalent amount of flow. Moreover, because the mains are under pressure, they can be installed in the shoulder areas at a minimal depth making installation relatively easy and inexpensive.

A schematic layout of a typical low-pressure system is shown below.



### 4.2.2 LPS Tank

A LPS tank is installed at every home or parcel to receive the flows from each connection, respectively. The tanks accept the flow from the house via a gravity line, within the tank the solids settle, and when the sewage level in the tank reaches the “pump on” elevation, the effluent pump turns on and pumps a portion of the liquid out of the tank and into the LPS mains towards the master pump station and eventually the wastewater treatment plant (WWTP).

### 4.2.3 High Head Effluent Pumps


Each tank requires a LPS submersible effluent pump to discharge the effluent from the tank to the collection system. Power supply is from each home and power consumption is quite low.

However, these LPS pumps need to be repaired or replaced every 5-10 years depending on the specific pump used.

### 4.2.4 Master Pump Station

The master pump station is like a conventional gravity lift station, with the exception that the station does not have to be as deep because the lines conveying the sewage are under pressure from the individual pump and therefore at a relatively shallow depth.

For our analysis, it was assumed that Charlotte County will be building a pump station that will be able to receive the flows from the project area in the Cape Haze area. Therefore, the cost of constructing and operating a pump station on the mainland was not included in the analysis.

### 4.2.5 Advantages and Disadvantages

#### *Advantages:*

Low pressure systems are the least expensive to install in the right-of-way because pipes can be smaller in diameter than gravity and pipe slopes are not as critical as vacuum or gravity. Road disruption is minimized.

Low pressure is advantageous in areas with high ground water and level lands. It is also well suited to areas bisected with canals, as the sewage can be pumped up and over bridges and obstacles as well as under canals and water courses. There are several bridge crossings in the project area; therefore, the ability to directionally drill a LPS main is highly advantageous for this project.

Main lines can be installed shallow and pipe elevations or slope is not critical to its installation. Both vertical and horizontal alignment is more flexible than other collection systems.

Additionally, for this specific project, we are assuming that Charlotte County is to build and maintain the master pump station which will receive the flow. This greatly reduces the costs for LPS and is a significant advantage over vacuum which requires the construction of multiple vacuum stations.

#### *Disadvantages:*

Low-pressure sewer systems require the installation of a pump at each parcel or property. During power outages each pump should have a backup generator or special arrangements made to pump out systems, so they do not back up. The utility rather than the customer, will be responsible for having a FDEP approved plan for power outages and emergency operations.

Operation and maintenance costs for low pressure systems is normally considerably more than other collection systems that have only one central pump station with only a few larger pumps.

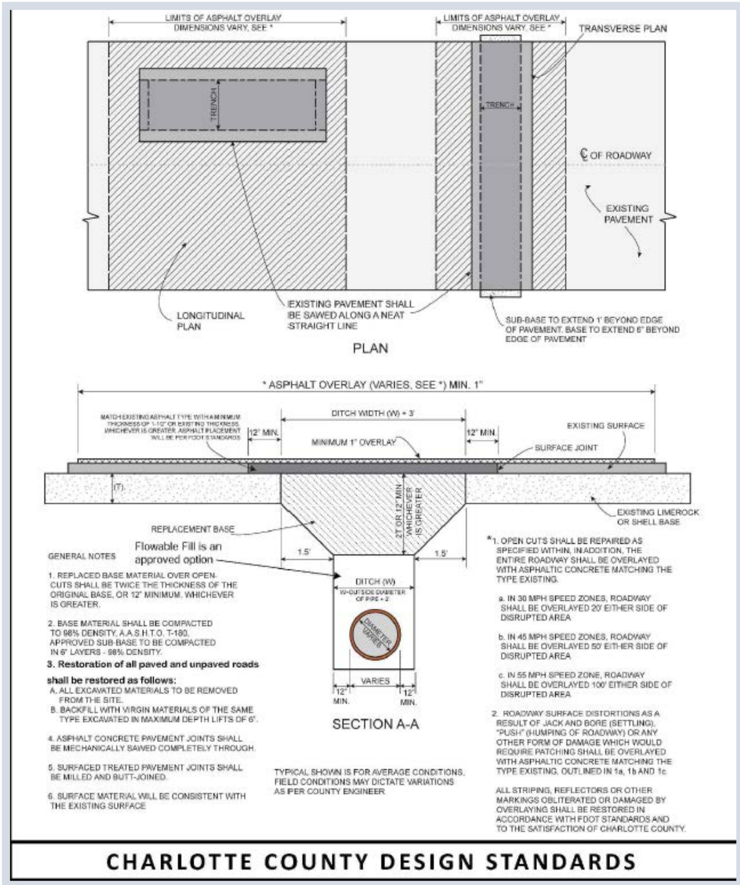
## 4.3 Vacuum Sewer

### 4.3.1 General Description

Vacuum collection systems rely on a central station providing energy (vacuum) in the collection pipe network pulling all flow to a central station and conveying the collected sewage to a wastewater treatment plant. Since the velocities are higher due to the vacuum propelling the flows, the main lines can be smaller as compared to a gravity system and typically range in size from 4” to 8” for an average system. In addition, because the vacuum assisted sewage can be physically lifted (to a limit), the main lines do not have to be installed at excessive depths.

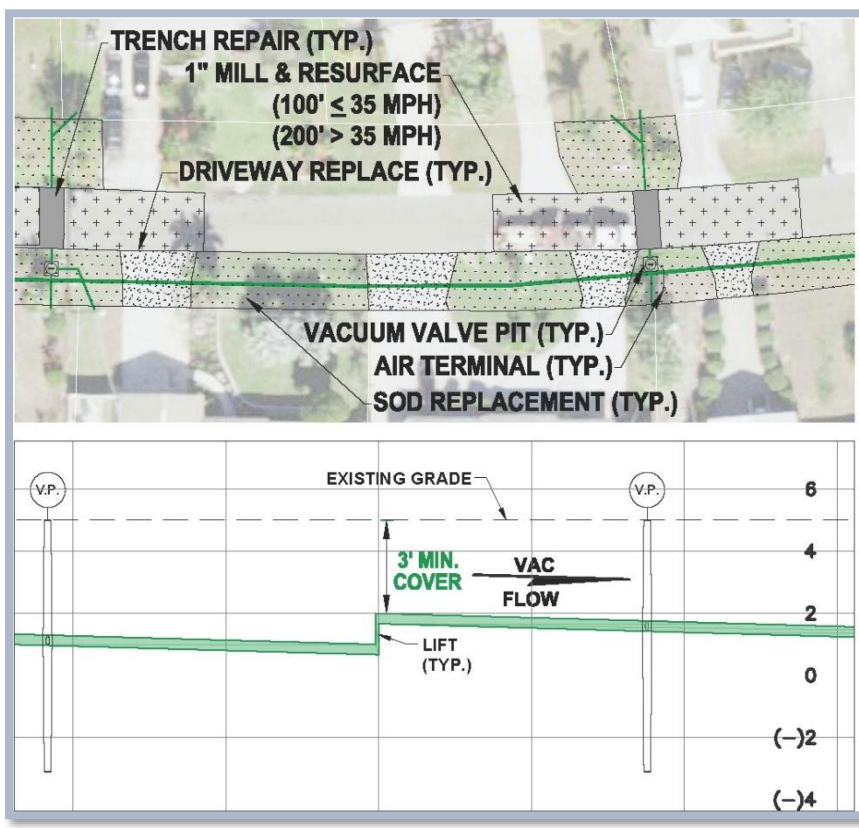
Vacuum main lines are normally installed at a depth of 3 to 6 feet, allowing it to be installed in the grass shoulder of the road network minimizing disruption of the pavement. Vacuum mains that cross side street intersections and gravity laterals from the valve pits cross the pavement using open cut methods.


Backfilling and restoration of the road at these trench crossings needs to be restored to current standards. After the trench is restored, a minimum 1” asphalt overlay of the entire road width and an additional distance depending on the posted speed limit will also be necessary.



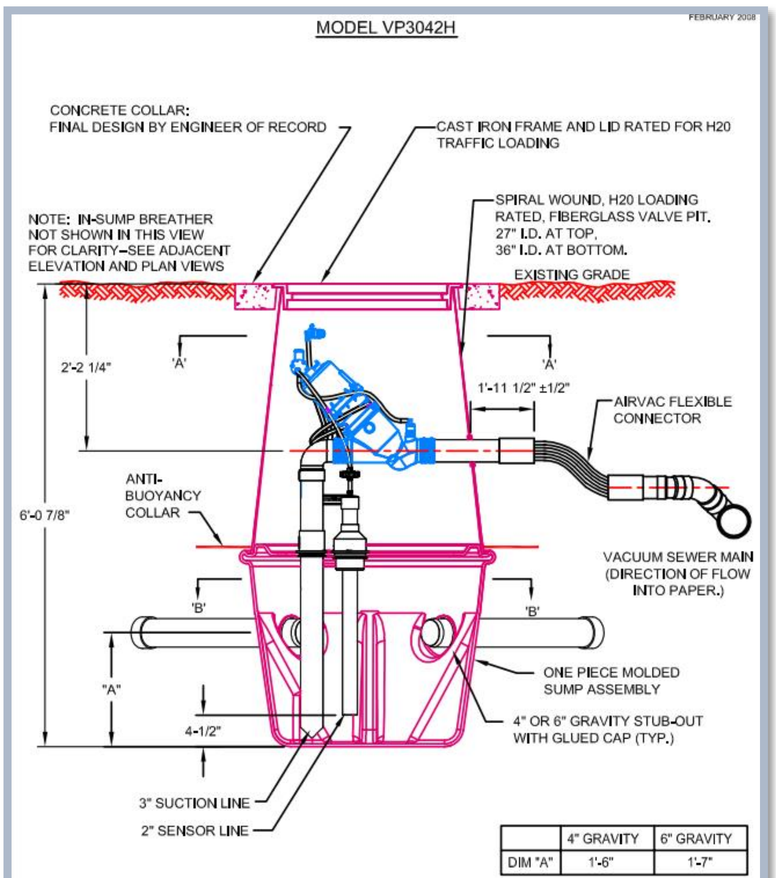

According to County standards, the roadway shall be overlayed 20’, 50’, or 100’ either side of the disrupted area depending on if the speed zone is 30, 45, or 55 mph, respectively on the island.

Since the vacuum main is normally installed on one side of the road, typically only half of the driveways are impacted by the construction. Usually, sod will need to be restored along the entire side of the main line, as well as portions of the opposite side of the roadway where the gravity lateral is installed. However, on the barrier islands with shell and sand roads there is virtually little or no sod. There may be some areas of sod along the paved road that may need to be replaced; however, the quantity should be minimal.



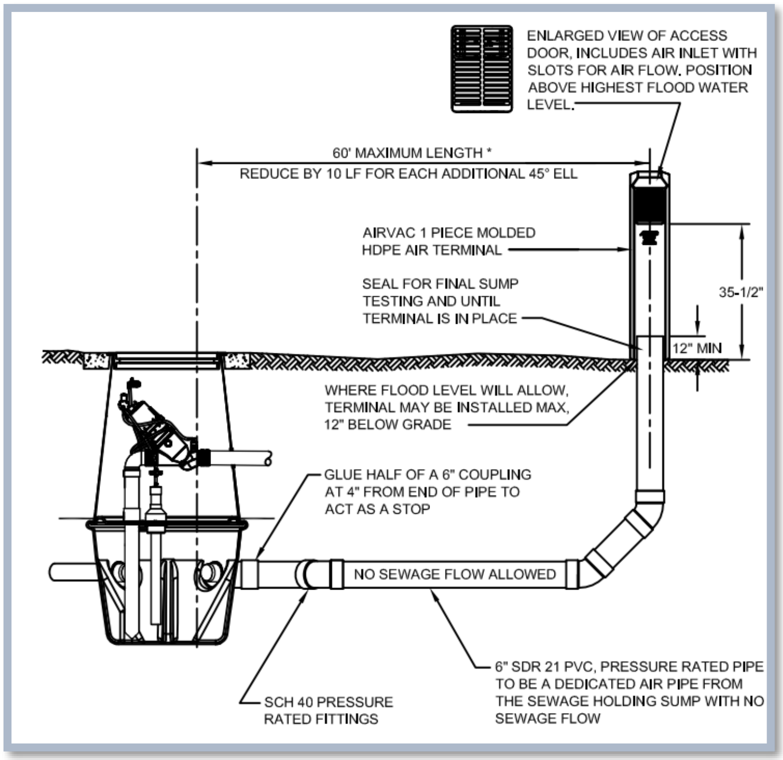
## 4.3.2 Valve Pits

To separate the negative pressure of the vacuum from the atmospheric pressure from the gravity service lateral, a vacuum interface valve is installed inside a “valve pit” normally located within the right of way. The valve pits are installed in the ground such that the top of the valve pit is at grade. A typical two-piece valve pit consists of a sump assembly which receives the sewage via gravity laterals and the valve located in the upper portion which conveys sewage from the sump to the vacuum sewer main.




Sewage enters the valve pit until there is approximately 10 gallons of sewage. A vertical tube senses the pressure differential and activates the vacuum valve to open, and sewage from the sump is pulled up and into the vacuum main toward the central vacuum station. There are four “knock outs” on the lower sump for receiving gravity laterals and one valve pit can accept flows from four or more locations. However, because of offsetting costs to extend gravity laterals and other constraints on average for the purposes of budgeting a single valve pit can serve approximately 2.5 ERC’s.

## 4.3.3 Air Terminals




Atmospheric air is necessary in the sump so as not to pull fluids from the traps inside the structures.

Earlier systems relied on "candy cane" or 4" air intakes on each gravity service lateral installed by the plumber at each home to "break the vacuum". In addition to general unsightliness, maintenance, and control of the "candy cane" was outside the utilities control.

Today's systems now use a single air terminal that is installed in the ROW as part of the system construction. One air terminal is needed for each valve pit to allow air into the valve pit.

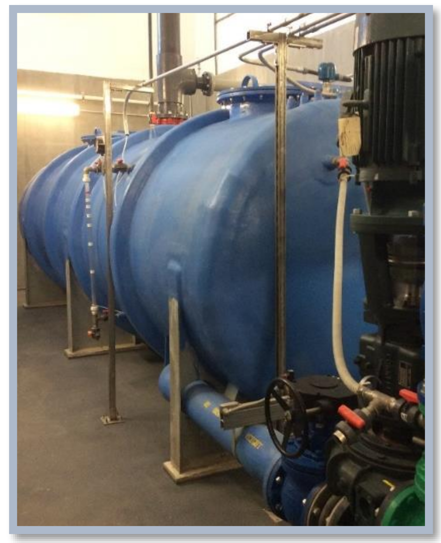
A 6" PVC lateral is extended from the sump of the valve pit over to the air terminal to allowing free flow of atmospheric air into the sump when the valve is activated.

An image of a typical air terminal is shown to the right.

## 4.3.4 Vacuum Station


Sewage from the homes is not under direct vacuum. Rather the “on-lot” connection from the structure is virtually the same as a gravity system using a gravity lateral except that the pipe material is slightly thicker for a vacuum connection.

Vacuum stations are typically installed on a vacant lot and can be designed to blend into the neighborhood. The larger stations are constructed with concrete foundations, masonry walls and wood truss system, like a conventional residential home.



Inside the station are a series of vacuum pumps which pull air from the top of a large collection tank. The sewage from the collection lines drops to the tank bottom and when the appropriate level is reached, adjacent sewage pumps draw down the tank sewage discharging into a force main that eventually goes to the treatment plant.

### 4.3.5 Package Vacuum (Pac-Vac) Station

Rather than design and build a large conventional building using poured in place concrete foundation, block walls and roof trusses; smaller "pre-engineered" package stations are now offered that are built offsite, preassembled under factory conditions, trucked to the site, and set up. The "Pac-Vac" provides factory quality control and testing, and in some cases, a faster, less disruptive assembly process.

The "Pac-Vac" station can also offer some cost savings. Normally, "Pac-Vacs" are considered for smaller areas serving up to 600 Equivalent Residential Connections (ERC's) due to limitations in tank and pump sizing of the smaller buildings.

### 4.3.6 Advantages and Disadvantages

#### *Advantages:*

Vacuum collection systems are advantageous in highly developed areas with high groundwater or hardpan/rock. Collection lines can be installed within the grass right-of-way (R-O-W) eliminating the need for total road reconstruction. Additionally, they can be installed at minimal depths, generally from 3 to 6 feet in depth, minimizing dewatering during construction. Since velocities within the pipes are high, the collection pipe diameter can be reduced.

A vacuum station can serve up to 2,500 ERC's provided the area is compact and not separated by waterways, long stretches of vacant land or bridges. With one central station, there is no need for electrical connections or individual pumps at each home. Moreover, only one large generator is needed to run the entire station during a power outage event.

The operation and maintenance of vacuum systems are relatively clean because it is a sealed airtight system and the operators do not need to enter manholes or wet wells to maintain the system operation. In the event of a leak, the negative pressure assures that sewage is pulled into the system rather than pushed out, making large scale environmental spills virtually nonexistent on the collection mains within the system.

## *Disadvantages:*

Vacuum systems are normally cost competitive when compared to LPS. However, this analysis has revealed many problems which make serving the area with vacuum sewer more difficult.

The design of a vacuum sewer collection system and station is very site specific. The design of the saw tooth profile to ensure the appropriate slopes are maintained while allowing for enough cover is necessary. The installation must be closely monitored to ensure that the appropriate slopes and tolerances are met, and that the system is constructed according to the plans.

Another major concern on Don Pedro/Knight Island is the feasibility of the bridge crossings. It is very difficult to cross bridges with vacuum mains, and assuming it is even possible to do so, it would be very expensive to build. The pipe cannot be directionally drilled, and slope must be maintained while crossing the bridge and several lifts will be needed to step the pipe up and over the bridge while maintaining boat clearances. These additional lifts may also affect the feasibility of the vacuum station to transport the sewage efficiently. For the purpose of this analysis, we are assuming that it will be feasible however there is a risk that, with actual elevations and hard design, vacuum across the bridges may not work meaning that regardless of cost, one vacuum station to serve all of Don Pedro/Knight Island may not be feasible, and more stations will be necessary.

There are also a few challenges with constructing a vacuum station on a barrier island. When looking for a suitable site for a vacuum station it is important to consider the VE (velocity) FEMA flood zones and the Coastal Construction Control Line (CCCL). Building in the VE zone or west of the CCCL would be extremely difficult. It would be preferable to build a vacuum station in the AE FEMA flood areas in the easterly areas of the islands. Still the vacuum station design will be challenging and costly and maintaining the station will likely be higher than that of a station that is not on a barrier island.

# 5. DESIGN PARAMETERS

For the conceptual system layouts, the following assumptions were made:

## 5.1 Low Pressure Collection System

The design assumptions for the LPS are consistent with Table 2.1 of the EPA Alternative Wastewater Collection System manual:

| Pipe Diameter | No. of Homes Served |
|---|---|
| 2” | 6 |
| 3” | 60 |
| 4” | 120 |
| 6” | 280 |
| 8” | 560 |

Additionally, a hydraulic analysis was performed using the Hazen-Williams approach to ensure that the system is appropriately sized for the Charlotte County approved LPS pumps. This hydraulic analysis was also used to do a comparative cost estimate for the additional cost required to assume the future flow from Knight Island. This pipe sizing analysis is located in Appendix G.

## 5.2 Vacuum Collection System

The following vacuum sewer design assumptions are based on GWE extensive experience with designing vacuum sewer systems:

- Valve Pit Ratio = 2.5:1 (homes/valve pit)
- Maximum Vacuum Line Length = 10,000 ft. from Vacuum Station
- Maximum ERC’s Served by One Station:
    - Conventional (concrete/truss) = 2,500 ERC’s

# 6. UNIT PRICES

Unit prices were developed for both collection systems based on averages from bids of similar systems. The averages of the bid tabulations and unit price assumptions are contained in Appendix A.

## 6.1 Low Pressure Sewer Collection Unit Prices

Unit prices for LPS were estimated using five bid tabulations from Charlotte County utility projects. Averages of the bids for the key elements were developed and unit prices were established as follows:

**Low Pressure Sewer Master Unit Price List**

| Description | Unit | Unit Price |
|---|---|---|
| 3" Low Pressure Sewer Main (PVC Pipe includes backfill) | LF | $ 20 |
| 4" Low Pressure Sewer Main (PVC Pipe includes backfill) | LF | $ 28 |
| 6" Low Pressure Sewer Main (PVC Pipe includes backfill) | LF | $ 30 |
| 8" Low Pressure Sewer Main (PVC Pipe includes backfill) | LF | $ 32 |
| 10" Low Pressure Sewer Main (PVC Pipe includes backfill) | LF | $ 50 |
| 12" Low Pressure Sewer Main (PVC Pipe includes backfill) | LF | $ 60 |
| 10" Dia. Directional Drill for Water Crossings (HDPE Pipe) | LF | $ 80 |
| 16" Dia. Directional Drill for Water Crossings (HDPE Pipe) | LF | $ 125 |
| Main Line Road Crossings Trench Repair and Overlay - Asphalt Roads (PVC Pipe) | LF | $ 210 |
| Open Cut Trench Repair and Overlay - Asphalt Roads (Service Laterals) | EA | $ 5,800 |
| Open Cut Trench Repair - Shell Roads (Service Laterals) | EA | $ - |
| Restoration - Concrete Driveways | EA | $ 1,100 |
| **On-Lot Costs** | | |
| LPS Tank Package | ERC | $ 8,000 |
| Pump, Crush and Fill Existing Septics | EA | $ 1,500 |
| On Site Lateral Connection | EA | $ 1,000 |
| **Other Costs** | | |
| Miscellaneous (Mobilization / MOT / Bonds / Permits) | | 18% |

The actual costs for the on-lot costs may vary from the proposed engineers estimate. The typical cost for Charlotte County Utilities to furnish and install the LPS tank package ranges from $4,800-$5,800. However, since most of this area is on a barrier island, the costs for transporting the materials and labor will likely be higher so an estimate of $10,500 was used for the LPS tank package, septic abandonment, and the on-site lateral connection.

## 6.2 Vacuum Sewer Collection Unit Prices

Unit prices for vacuum collection systems from similar septic to sewer projects in Sarasota, Charlotte and Martin County projects which were used as a basis. Average bid prices from the contractor's tabulation sheets were derived and unit prices based on the averages were developed as follows:

**Vacuum Sewer Master Unit Price List**

| Description | Unit | Unit Price |
|---|---|---|
| Vacuum Station Building 600-1000 ERC's | | |
| Building Site Work and Material - Install | | $1,500,000 |
| Pumps, Tank, and Controls - Material Only | | $ 450,000 |
| Total | EA | $1,950,000 |
| Vacuum Main (4" PVC Pipe includes backfill) | LF | $ 35 |
| Vacuum Main (6" PVC Pipe includes backfill) | LF | $ 45 |
| S Gulf Blvd Bridge - Vacuum Main Crossing | EA | $ 250,000 |
| S Gulf Blvd South Bridge - Vacuum Main Crossing | EA | $ 100,000 |
| 10" Dia. Directional Drill for Water Crossings (HDPE Pipe) | LF | $ 100 |
| Force Main (6" PVC Pipe) | LF | $ 40 |
| Force Main (8" PVC Pipe) | LF | $ 45 |
| Valve Pits (2.5 ERC/1 VP) | EA | $ 7,500 |
| 3" Valve Pit Connections (PVC Pipe, 15'/ERC) | EA | $ 450 |
| Gravity Laterals (PVC Pipe, 60' per VP @ $35/ft) | Valve Pit | $ 2,100 |
| Air Terminals and 6" line | Valve Pit | $ 2,000 |
| Main Line Road Crossings Trench Repair and Overlay - Asphalt Roads (PVC Pipe) | LF | $ 210 |
| Open Cut Trench Repair and Overlay - Asphalt Roads (Service Laterals) | Valve Pit | $ 5,800 |
| Open Cut Trench Repair - Shell Roads (Service Laterals) | EA | $ - |
| Restoration - Concrete Driveways | EA | $ 1,100 |
| Vacuum Station Land | EA | $ 200,000 |
| **On-Lot Costs** | | |
| Pump, Crush and Fill Existing Septics | EA | $ 1,500 |
| On Site Lateral Connection | EA | $ 1,000 |
| **Other Costs** | | |
| Additional Design Engineering - Vacuum Station | EA | $ 150,000 |
| Additional Design Engineering - Profiles | EA | $ 100,000 |
| Additional CEI - Vacuum Station | EA | $ 25,000 |
| Additional CEI - Profiles and As-Builts | EA | $ 50,000 |
| Miscellaneous (Mobilization / MOT / Bonds / Permits) | | 18% |

# 7. ENGINEERING ECONOMICS METHODOLOGY

## 7.1 ESTIMATE OF BASE COSTS

A general conceptual layout was developed for each type of collection system for the service areas. LPS and vacuum concepts were developed, and specific quantities of key construction components were estimated.

Key construction components include the entire pipe system network, pump stations, septic tank abandonment, valve pits and force mains necessary. Key elements (pumps and equipment) have an operation and maintenance cost associated with them.

Soft costs such as surveying, easements, funding and legal are generally equivalent regardless of which type of collection system is selected and therefore for the purpose of this *comparative* analysis those costs were neglected.

Construction related costs such as mobilization, bonds, force mains, valves, pre-construction video and other incidental costs were estimated at 18% of the primary component costs based on prior bid analysis.

Therefore, the costs presented *cannot and should not be taken as the total project cost*. Only differential costs (primarily construction of the collection system elements and long-term O&M costs) are included for comparative purposes only, to determine the most appropriate system for the areas. Engineering, connection fees and other fees needs to be added to the costs presented.

Average construction unit prices used are based on previous experience and similar projects. Those average prices were then applied to the quantities for each type of system for the area size to develop an order of magnitude comparative cost.

## 7.2 OPERATION AND MAINTENANCE & PUMP REPAIR AND REPLACEMENT COSTS

Operation and maintenance (O&M) are dependent on the type of system. LPS generally has a higher O&M costs associated with the system because of the pump maintenance. The pumps need to be fixed or replaced every 5-10 years and since every ERC will have its own tank and pump package the costs are substantial.

For vacuum sewer, some vacuum energy is necessary to pull the sewage to the station. However, this added energy allows for smaller diameter pipes (since the velocity is much higher than LPS flow).

Operation and maintenance costs have been estimated for each system type that includes repair and replacement costs for pumps and components as well as electrical costs. The costs are averaged on an annual basis for the duration of the system life cycle. Operation and maintenance cost calculations for each area are found in Appendix C.

## 7.3 Life Cycle Present Worth Analysis

After the comparative construction costs and the O&M costs are developed for each system to serve the areas, a life cycle present worth analysis is conducted to provide an "apples to apples" analysis.

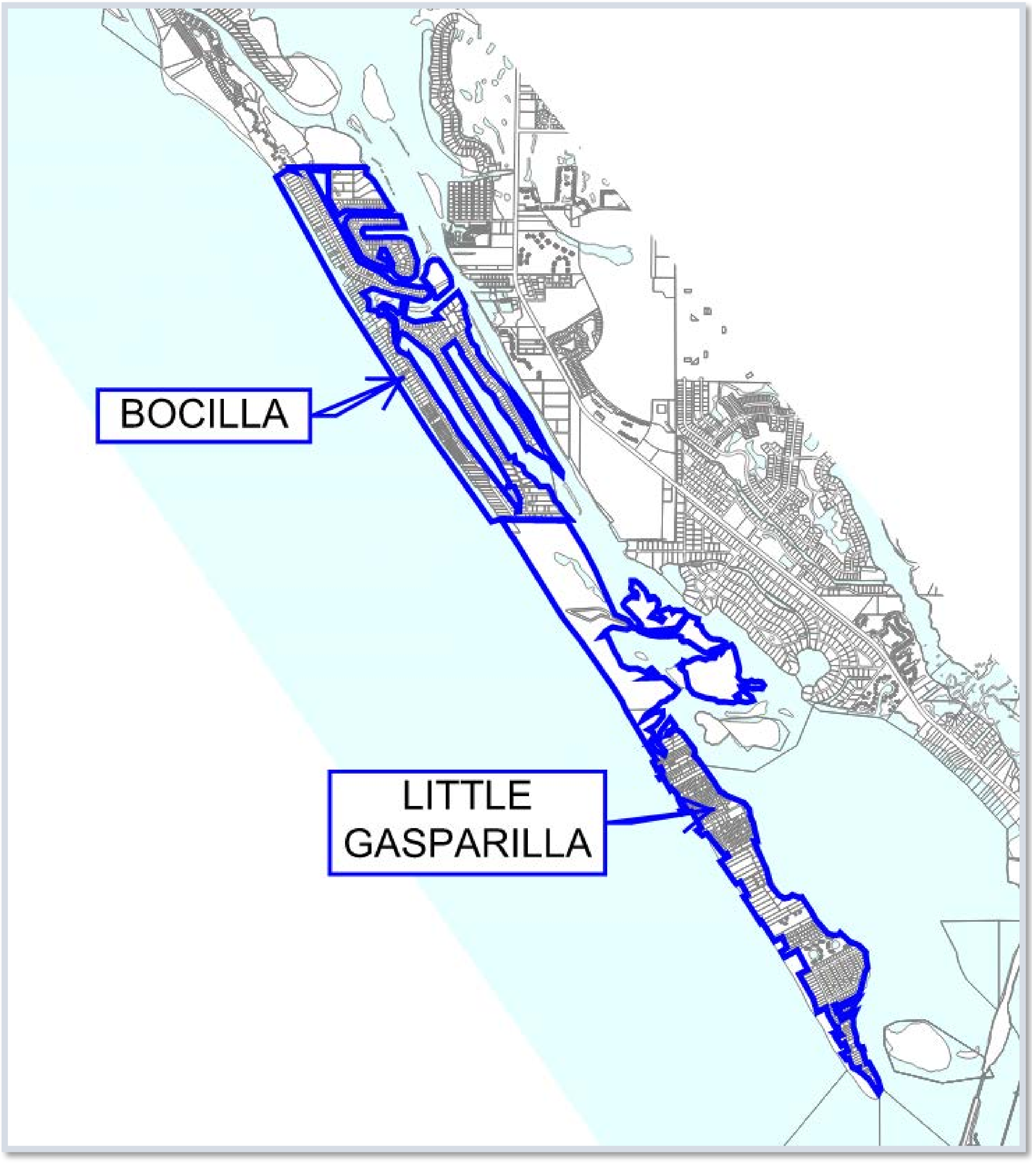
The annual uniform series of O&M costs are brought back to today's value using an appropriate discount rate for today and the foreseeable future. Although the current rates of interest are approaching the zero bound, the discount rate for the cost of funds is assumed as an average of 5% over the time analysis of 40 years.

Salvage value of the components at the end of the time period is subtracted from the total base cost, and present value of O&M costs, to get total value of the system, which is used as a basis for ranking. The present worth analysis for each area can be found in Appendix D.

# 8. ENGINEERING ECONOMICS ANALYSIS

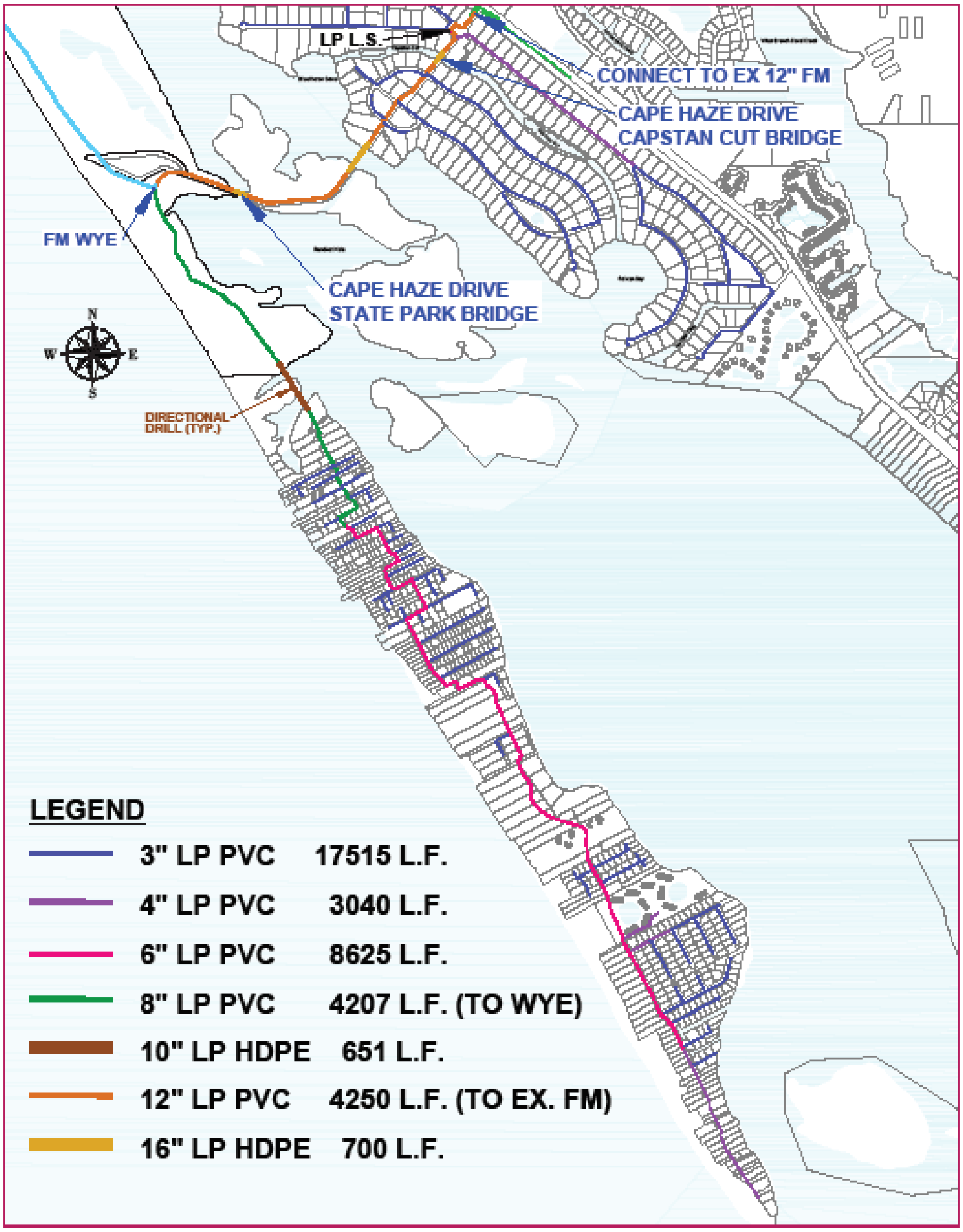
## 8.1 KEY MAP

The study area was partitioned into two areas, Don Pedro/Knight Island and Little Gasparilla Island, for the purpose of developing conceptual layouts and cost estimates.



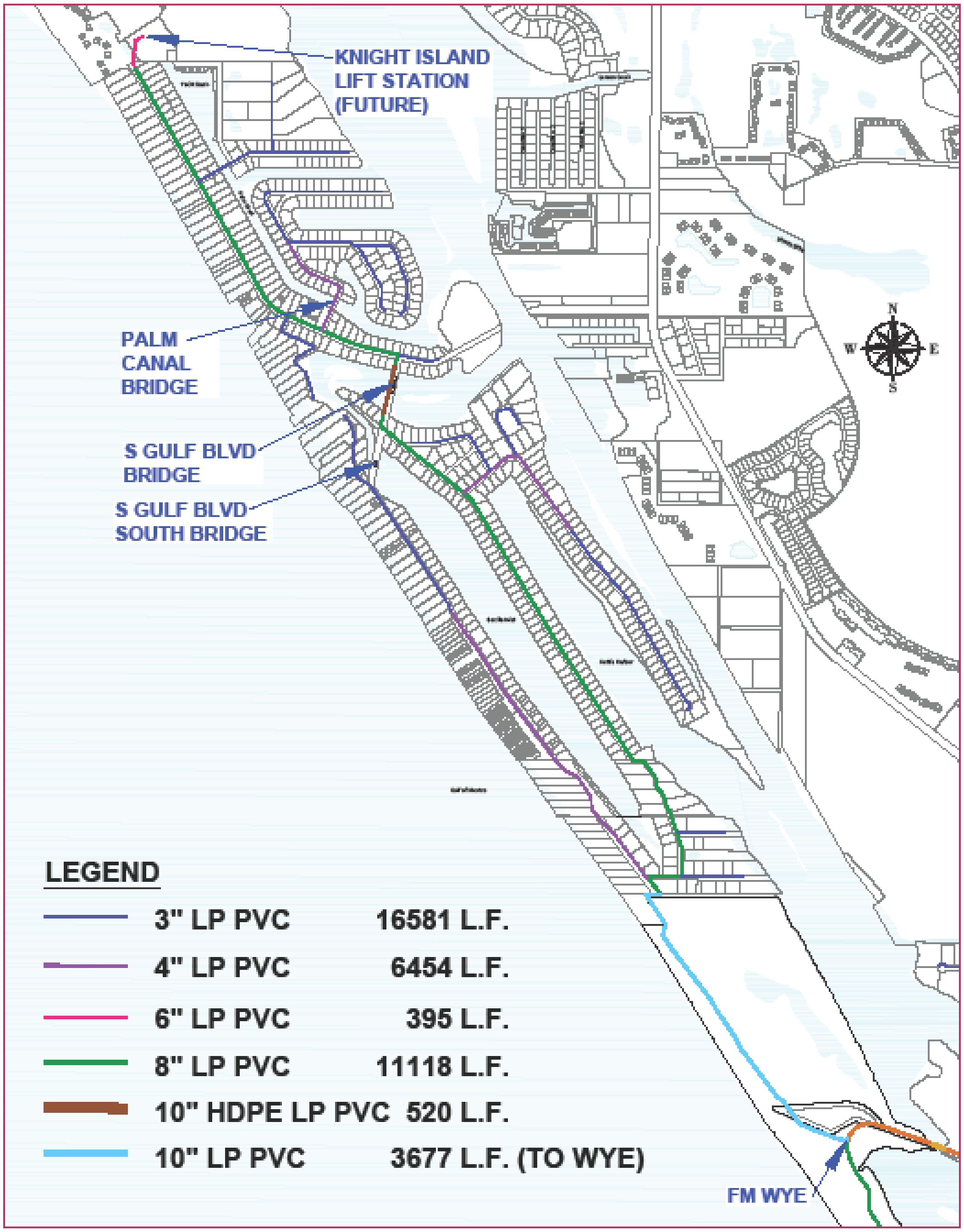
## 8.2 Conceptual LPS Layout

### *Little Gasparilla Island:*




(LGWU) AREA LOW PRESSURE CONCEPT

## *Don Pedro / Knight Island:*




DON PEDRO / KNIGHT ISLAND AREA LOW PRESSURE CONCEPT

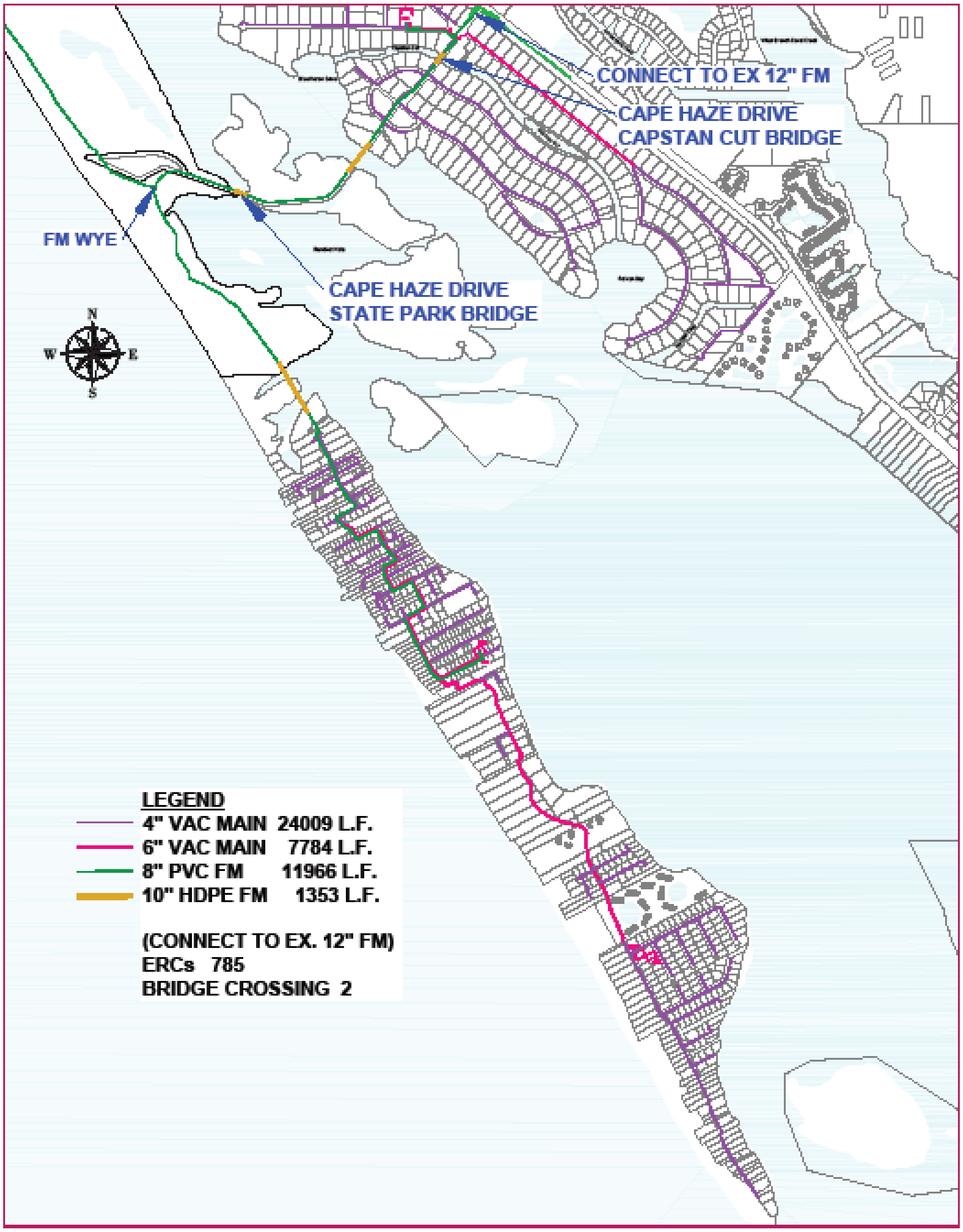
## 8.3 LPS Base Cost Estimate

| Low Pressure Sewer Master Unit Price List | | | | LGI / DON PEDRO / KNIGHT ISLAND |
|---|---|---|---|---|
| **Description** | **Unit** | **Unit Price** | **Est. Qty** | **Total** |
| 3" Low Pressure Sewer Main (PVC Pipe includes backfill) | LF | $ 20 | 34,096 | $ 681,920 |
| 4" Low Pressure Sewer Main (PVC Pipe includes backfill) | LF | $ 28 | 9,494 | $ 265,832 |
| 6" Low Pressure Sewer Main (PVC Pipe includes backfill) | LF | $ 30 | 9,020 | $ 270,600 |
| 8" Low Pressure Sewer Main (PVC Pipe includes backfill) | LF | $ 32 | 15,325 | $ 490,400 |
| 10" Low Pressure Sewer Main (PVC Pipe includes backfill) | LF | $ 50 | 3,677 | $ 183,850 |
| 12" Low Pressure Sewer Main (PVC Pipe includes backfill) | LF | $ 60 | 4,250 | $ 255,000 |
| 10" Dia. Directional Drill for Water Crossings (HDPE Pipe) | LF | $ 80 | 1,171 | $ 93,680 |
| 16" Dia. Directional Drill for Water Crossings (HDPE Pipe) | LF | $ 125 | 700 | $ 87,500 |
| Main Line Road Crossings Trench Repair and Overlay - Asphalt Roads (PVC Pipe) | LF | $ 210 | 45 | $ 9,450 |
| Open Cut Trench Repair and Overlay - Asphalt Roads (Service Laterals) | EA | $ 5,800 | 48 | $ 278,400 |
| Open Cut Trench Repair - Shell Roads (Service Laterals) | EA | $ - | 454 | $ - |
| Restoration - Concrete Driveways | EA | $ 1,100 | 59 | $ 64,900 |
| **On-Lot Costs** | | | | |
| LPS Tank Package | ERC | $ 8,000 | 1,251 | $ 10,008,000 |
| Pump, Crush and Fill Existing Septics | EA | $ 1,500 | 810 | $ 1,215,000 |
| On Site Lateral Connection | EA | $ 1,000 | 810 | $ 810,000 |
| **Other Costs** | | | | |
| Miscellaneous (Mobilization / MOT / Bonds / Permits) | | 18% | | $ 2,648,616 |
| **TOTAL** | | | | **$ 17,363,148** |

Additionally, there is an existing wastewater treatment plant which currently treats the flow from the Hideaway Bay Beach Club and Placida Beach Condominiums. The mains have been sized to accommodate for these future flows. Any additional costs to upgrade or modify the “on-site” pipes to connect to the main or lift station pump upgrades at the treatment plant has not been included in this estimate and will need to be considered in a bulk sewer agreement.

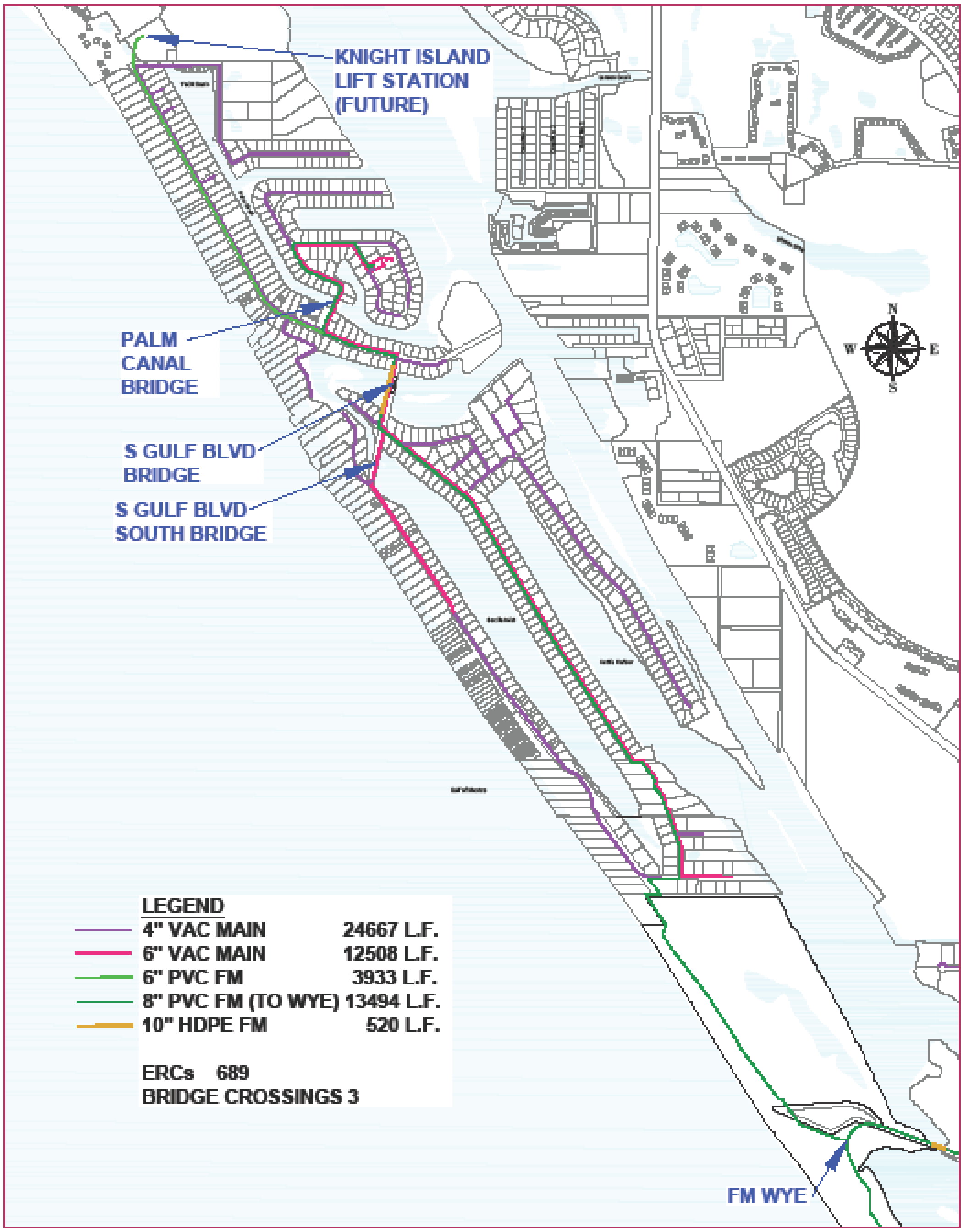
# 8.4 CONCEPTUAL VACUUM LAYOUT

*Little Gasparilla Island:*




(LGWU) AREA VACUUM CONCEPT

## *Don Pedro / Knight Island:*




DON PEDRO / KNIGHT ISLAND AREA VACUUM CONCEPT

# 8.5 VACUUM BASE COSTS ESTIMATE

| Vacuum Sewer Master Unit Price List | | | | LGI / DON PEDRO / KNIGHT ISLAND |
|---|---|---|---|---|
| **Description** | **Unit** | **Unit Price** | **Est. Qty** | **Total** |
| Vacuum Station Building 600-1000 ERC's | | | | |
| Building Site Work and Material - Install | | $1,500,000 | | |
| Pumps, Tank, and Controls - Material Only | | $ 450,000 | | |
| Total | EA | $1,950,000 | 2 | $ 3,900,000 |
| Vacuum Main (4" PVC Pipe includes backfill) | LF | $ 35 | 48,676 | $ 1,703,660 |
| Vacuum Main (6" PVC Pipe includes backfill) | LF | $ 45 | 20,292 | $ 913,140 |
| S Gulf Blvd Bridge - Vacuum Main Crossing | EA | $ 250,000 | 1 | $ 250,000 |
| S Gulf Blvd South Bridge - Vacuum Main Crossing | EA | $ 100,000 | 1 | $ 100,000 |
| 10" Dia. Directional Drill for Water Crossings (HDPE Pipe) | LF | $ 100 | 1,873 | $ 187,300 |
| Force Main (6" PVC Pipe) | LF | $ 40 | 3,933 | $ 157,320 |
| Force Main (8" PVC Pipe) | LF | $ 45 | 25,460 | $ 1,145,700 |
| Valve Pits (2.5 ERC/1 VP) | EA | $ 7,500 | 501 | $ 3,757,500 |
| 3" Valve Pit Connections (PVC Pipe, 15'/ERC) | EA | $ 450 | 501 | $ 225,450 |
| Gravity Laterals (PVC Pipe, 60' per VP @ $35/ft) | Valve Pit | $ 2,100 | 501 | $ 1,052,100 |
| Air Terminals and 6" line | Valve Pit | $ 2,000 | 501 | $ 1,002,000 |
| Main Line Road Crossings Trench Repair and Overlay - Asphalt Roads (PVC Pipe) | LF | $ 210 | 45 | $ 9,450 |
| Open Cut Trench Repair and Overlay - Asphalt Roads (Service Laterals) | Valve Pit | $ 5,800 | 48 | $ 278,400 |
| Open Cut Trench Repair - Shell Roads (Service Laterals) | EA | $ - | 454 | $ - |
| Restoration - Concrete Driveways | EA | $ 1,100 | 59 | $ 64,900 |
| Vacuum Station Land | EA | $ 200,000 | 2 | $ 400,000 |
| **On-Lot Costs** | | | | |
| Pump, Crush and Fill Existing Septics | EA | $ 1,500 | 810 | $ 1,215,000 |
| On Site Lateral Connection | EA | $ 1,000 | 810 | $ 810,000 |
| **Other Costs** | | | | |
| Additional Design Engineering - Vacuum Station | EA | $ 150,000 | 2 | $ 300,000 |
| Additional Design Engineering - Profiles | EA | $ 100,000 | 2 | $ 200,000 |
| Additional CEI - Vacuum Station | EA | $ 25,000 | 2 | $ 50,000 |
| Additional CEI - Profiles and As-Builts | EA | $ 50,000 | 2 | $ 100,000 |
| Miscellaneous (Mobilization / MOT / Bonds / Permits) | | 18% | | $ 3,207,946 |
| **TOTAL** | | | | **$ 21,029,866** |

## 8.6 Operation & Maintenance

Based on the operation and maintenance cost analysis (Appendix C), the O&M costs (including repair and replacement of pumps and controls) on a per year per ERC basis is significantly higher for a low pressure sewer system as compared to a vacuum sewer system. This price differential is attributed to the fact that LPS systems require a power input at every ERC, whereas a singular vacuum station supplies the power input needed for transporting the sewage from the ERCs.

| Annual O&M Comparison | | |
|---|---|---|
| LPS | $201 | $/year/ERC |
| Vacuum | $95 | $/year/ERC |

## 8.7 Present Worth Analysis

The present worth analysis summarizes the base cost, the O&M cost, and the salvage value into a net present value which helps to determine which system will be the most affordable over the 40-year analysis period. This is reviewed below:

**Present Worth Analysis**

| Area | System Type | Base Cost | Uniform Series Present Worth (O&M) | Present Worth of Salvage Value | Net Present Value |
|---|---|---|---|---|---|
| LGI / Don Pedro / Knight Island | LPS | $17,363,148 | $ 4,314,549 | $ 222,925 | $21,454,772 |
| | Vacuum | $21,029,866 | $ 2,030,520 | $ 575,176 | $22,485,210 |

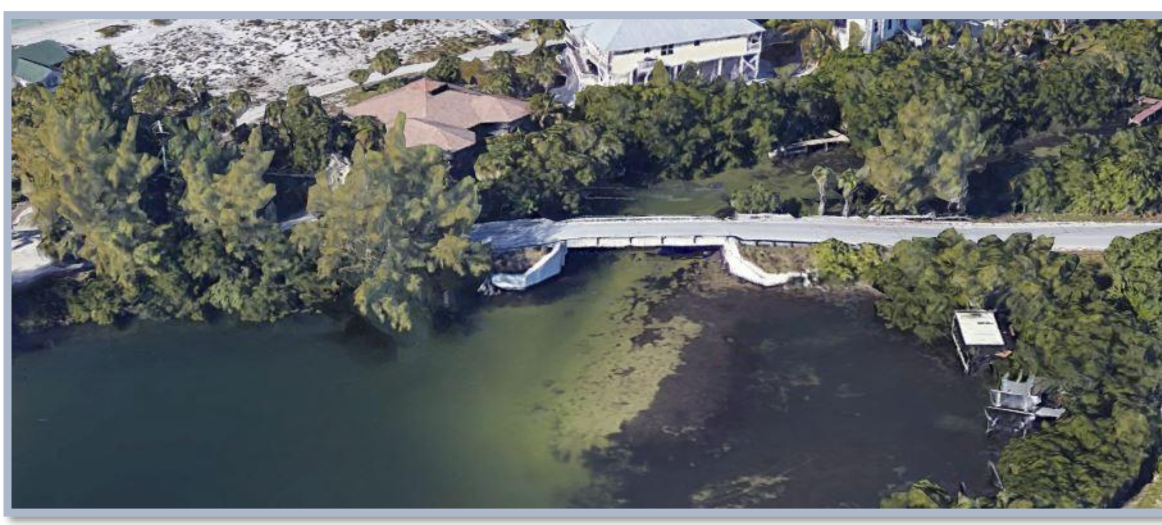
The present worth analysis for the barrier islands, Little Gasparilla Island and Don Pedro/Knight Island areas, shows that LPS is the most cost effective wastewater collection system. The initial base costs for LPS are lower than vacuum, and although LPS has a high O&M cost, when the analysis was extended over a 40-year period at a 5% interest rate, LPS proved to still be the best choice.

# 9. OTHER CONSIDERATIONS

Financial impacts are certainly the significant part of determining which collection system would best serve the area. Still, in addition to the cost of installing, operating, and maintaining the selected system, there are other considerations which should be factored into the final selection. Some considerations have more merit than others and can be subjective depending on who is deciding. This is where engineering judgement comes in to weigh the following considerations before final selection is made.

## 9.1 BRIDGE CROSSINGS

There are a total of four bridges that must be crossed with vacuum mains to transport the sewage off the barrier islands. Bridge crossings with an LPS system is relatively simple, as the LPS main can be directionally drilled under the water. However, vacuum sewer mains cannot be directionally drilled and instead must use a series of lifts on piles to cross the bridge. This type of bridge crossing, if possible, would be extremely expensive and difficult to construct. At this stage, *we are not even certain that it is possible* to build these vacuum main bridge crossings to the required standards.



## 9.2 Corrosive Environment

Due to the corrosive nature of salt spray especially on the barrier islands, the costs for vacuum station maintenance would be significantly higher than typical vacuum stations inland. To help prevent corrosion, more costly stainless-steel materials of construction should be considered.

## 9.3 Shell Road Erosion

On the barrier islands, most roads are shell or sand, rather of asphalt. This could be a problem for vacuum sewer maintenance as the valve pits can become exposed over time as the sand roads erode. Valve pits could be subject to impacts from be vehicles or grading operations. Similarly, in the event of a hurricane or strong storm, there is the possibility of washing out valve pits which can be costly to repair or replace.

Conversely, the shell roads are not a serious concern for LPS as the mains and the tanks are completely buried so there is less risk of damage.

## 9.4 Design Costs

It is important to note that for these specific project areas, specifically Don Pedro/Knight Island and Little Gasparilla, the cost to design a vacuum system will exceed that of an LPS system. There are critical design components for vacuum sewer such as maintaining the required minimum 0.2% slope, ensuring that the system does not exceed the maximum allowable head, and designing the vacuum station to withstand extreme conditions, for example. This drives up the cost for designing vacuum sewer significantly as opposed to LPS in which the design is not as critical.

## 9.5 Land Acquisition for Vacuum Station Sites

The acquisition of property to place new lift stations in developed areas can be problematic. Concerns about odor, landscaping, buffering, and noise are always an issue for the neighbors, and those concerns must be addressed for each site. Moreover, some properties may not allow the installation of a pump station without going through a special exception or rezone process that can take months. In addition, the time it takes to locate and purchase private lands can be significant.

For the vacuum station option, land for three vacuum stations is needed. However, if LPS is chosen, there is no need to purchase land assuming CCU will be constructing the master lift station in Cape Haze to receive all LPS flows. The time it takes to locate, purchase, and address all the issues with the neighbors can be substantial. Therefore, for these areas, the LPS option which requires no land purchase is preferable over multiple land purchases necessary to serve with vacuum.

## 9.6 Knight Island Flow

A hydraulic analysis was performed to assess the difference in pipe sizes needed in order to account for the future flow from Knight Island. This was then converted to a cost estimate for the purpose of determining the approximate cost differential for the increased pipe sizes.

Assuming that the existing wastewater treatment facility is converted into a pump station, two scenarios were assessed:

1. Construct an LPS or Vacuum System – with Knight Island flow
2. Construct an LPS or Vacuum System – without Knight Island flow

There are additional costs for scenario 1 to upsize some mains from the island to the mainland. The hydraulic analysis for the pipe sizing is found in Appendix G. The estimated cost differential is assumed to be the same for either system and was determined as follows:

| LPS/VACUUM MAIN SIZING | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Section | SCENARIO 1 - Assumes Knight Island Flow | | | | SCENARIO 2 - Does Not Assume Knight Island Flow | | | | Cost Differential |
| | Nominal Pipe Size (in) | Unit Price | Length of Main (ft) | TOTAL | Nominal Pipe Size (in) | Unit Price | Length of Main (ft) | TOTAL | |
| Knight Island Section 1 | 6 | $ 30 | 400 | $ 12,000 | N/A | N/A | N/A | $ - | $ 12,000 |
| Don Pedro / Knight Island Section 2 | 8 | $ 32 | 2000 | $ 64,000 | 4 | $ 28 | 1400 | $ 39,200 | $ 24,800 |
| Don Pedro / Knight Island Section 3 | 8 | $ 32 | 2035 | $ 65,120 | 6 | $ 30 | 2035 | $ 61,050 | $ 4,070 |
| Don Pedro / Knight Island Section 4 | 8 | $ 32 | 2750 | $ 88,000 | 6 | $ 30 | 2750 | $ 82,500 | $ 5,500 |
| Don Pedro / Knight Island Section 5 | 8 | $ 32 | 5120 | $ 163,840 | 8 | $ 32 | 5120 | $ 163,840 | $ - |
| Don Pedro / Knight Island Section 6 | 10 | $ 50 | 4060 | $ 203,000 | 8 | $ 32 | 4060 | $ 129,920 | $ 73,080 |
| Little Gasparilla Section 1 | 4 | $ 28 | 2080 | $ 58,240 | 4 | $ 28 | 2080 | $ 58,240 | $ - |
| Little Gasparilla Section 2 | 6 | $ 30 | 2340 | $ 70,200 | 6 | $ 30 | 2340 | $ 70,200 | $ - |
| Little Gasparilla Section 3 | 8 | $ 32 | 6050 | $ 193,600 | 8 | $ 32 | 6050 | $ 193,600 | $ - |
| Little Gasparilla Section 4 | 8 | $ 32 | 5200 | $ 166,400 | 8 | $ 32 | 5200 | $ 166,400 | $ - |
| Section 11 - Wye to Future LS | 12 | $ 60 | 4930 | $ 295,800 | 10 | $ 50 | 4930 | $ 246,500 | $ 49,300 |
| | | | | | | | | | **$ 168,750** |

Force mains are sized to keep the velocities and friction low, so no additional master pump stations are necessary on the island. Force mains from the Don Pedro/Knight Island area are sized to also accept flow from the Knight Island WWTP. If the Knight Island flow is included, the mains must be upsized. The primary crossing from the island to the mainland should be a 12" PVC (open cut) and because HDPE is measured on the outside diameter (rather than the inside diameter) and 14" HDPE is difficult to find, the directional drilled pipe under the intercoastal is preliminary sized and priced as a 16". Final hydraulic analysis may reduce this main size.

If flows from Knight Island Utilities is not included, then the crossing can be reduced to 10" PVC (open cut) and a 12" HDPE.

# 10. CONCLUSIONS

Based on the conceptual layout, financial analysis and additional considerations, the following conclusions are summarized.

## 10.1 Collection System Recommendation

Based on the study, vacuum sewer *in this instance on a barrier island* is not cost effective for several reasons:

1. The area is bisected with canals and bridges, so crossing is difficult and expensive. Because of the bridge crossings we are not even certain that the vacuum mains can cross them efficiently. Although we are assuming that it can be crossed, there is a risk on final design with accurate topo that it may not be feasible.

2. Much of the area is in a velocity zone so the vacuum station needs to be in an AE Flood zone.
3. Most of the streets are sand or shell subject to erosion from the elements and the traffic. Valve pits located in the shell roads will be subject to erosion around the pit or concrete collar and be subject to impacts from golf carts, and road regrading operations.

4. Another added benefit of selecting LPS is that for vacant lots, LPS tank packages can be installed as needed. In contrast, valve pits, even ones serving vacant lots, should be installed all at once which results in a higher initial cost and the potential for valve pits to remain unused for considerable time.

Therefore, LPS is the recommended wastewater collection technology to serve the barrier island areas, Don Pedro/Knight Island and Little Gasparilla. The analysis for this specific project has shown that the greatest advantages of LPS over vacuum sewer are that LPS is more cost effective, feasible to construct, and is more suitable for the conditions encountered on the barrier islands.

# APPENDIX A: BID TABULATIONS AVERAGE PRICING

**MASTER LOW PRESSURE BID AVERAGE PRICING**

| Item Description | Unit | UNDERGROUND UTILITY CONSTRUCTION & MAINTENANCE | RECLAIMED WATER, LOW PRESSURE SEWER, AND FORCE MAIN INSTALLATIONS | UTILITY IMPROVEMENTS - PARKSIDE C.R.A. | EAST/WEST SPRING LAKE WASTEWATER EXPANSION CONTRACT D | Average of Average Unit Prices | Price Used for Cost Estimate |
|---|---|---|---|---|---|---|---|
| 4" Low Pressure Sewer Main (PVC Pipe) | LF | $ 12.18 | $ 26.37 | $ 29.06 | $ 33.14 | $ 25.19 | **$ 28.00** |
| 6" Low Pressure Sewer Main (PVC Pipe) | LF | $ 16.71 | | $ 41.82 | $ 25.24 | $ 27.93 | **$ 30.00** |
| 8" Low Pressure Sewer Main (PVC Pipe) | LF | $ 22.15 | $ 32.09 | $ 35.32 | $ 29.60 | $ 29.79 | **$ 32.00** |
| 4" Dia. Directional Drill for Water Crossings (HDPE Pipe) | LF | $ 34.70 | | | | $ 34.70 | **$ 40.00** |
| 6" Dia. Directional Drill for Water Crossings (HDPE Pipe) | LF | $ 48.76 | | | | $ 48.76 | **$ 50.00** |
| 8" Dia. Directional Drill for Water Crossings (HDPE Pipe) | LF | $ 63.79 | | | | $ 63.79 | **$ 70.00** |

## MASTER VACUUM BID AVERAGE PRICING

| Item Description | Unit | Golden Gate | Ackerman | El Jobean | O and P | N-2 | Bell Shoals | Average of Average Unit Prices | Equivalent Unit Price | Price Used for Cost Estimate |
|---|---|---|---|---|---|---|---|---|---|---|
| 3" PVC SDR-21 Vacuum Main | LF | $ 30.32 | $ 28.01 | $ 34.96 | $ 20.67 | $ 21.48 | | $ 27.09 | | |
| **3" Valve Pit Connections (15')** | EA | | | | | | | | $ 406.29 | **$ 450.00** |
| 4" PVC SDR-21 Vacuum Main | LF | $ 30.58 | $ 29.50 | $ 39.96 | $ 24.33 | $ 26.00 | | $ 30.07 | | |
| 6" PVC SDR-21 Vacuum Main | LF | $ 35.08 | $ 33.75 | $ 45.76 | $ 32.67 | $ 34.50 | | $ 36.35 | | |
| 8" PVC SDR-21 Vacuum Main | LF | $ 41.53 | $ 42.85 | $ 53.51 | $ 46.67 | $ 43.50 | | $ 45.61 | | |
| **Vaccum Main (4"-8")** | LF | | | | | | | | $ 37.35 | **$ 40.00** |
| 4" PVC SDR-21 Gravity Sewer Service Lateral | LF | | $ 28.41 | $ 30.67 | $ 23.33 | $ 22.98 | | $ 26.35 | | |
| 6" PVC SDR-21 Gravity Sewer Service Lateral | LF | | $ 34.18 | $ 35.97 | $ 28.00 | $ 26.50 | | $ 31.16 | $ 35.00 | |
| **6" Gravity Laterals (60'/valve pit)** | Valve Pit | | | | | | | | $ 2,100.00 | **$ 2,100.00** |
| Dedicated Air Intake Terminal & 6" Grommet Purchase Material | EA | $ 291.63 | | | | | | $ 291.63 | $ 291.63 | |
| 6" PVC SDR-21 Air Terminal Feeds (40') | EA | | | $ 32.19 | | | | $ 32.19 | $ 1,287.50 | |
| Dedicated Air Terminal Installation | EA | $ 230.36 | $ 317.50 | $ 475.50 | | | | $ 341.12 | $ 341.12 | |
| **Air Terminals (Including 6" Line)** | EA | | | | | | | | $ 1,920.24 | **$ 2,000.00** |
| Valve Pit 3042 H Purchase Material | EA | $ 4,348.81 | | | | | | $ 4,348.81 | | |
| Valve Pit 5442 H Purchase Material | EA | $ 4,690.75 | | | | | | $ 4,690.75 | | |
| Vacuum Valve Pit Assembly 3042 H Installation | EA | $ 1,788.39 | $ 1,910.50 | $ 1,889.25 | | | | $ 1,862.71 | | |
| Vacuum Valve Pit Assembly 5442 H Installation | EA | $ 2,067.14 | $ 2,726.25 | $ 2,649.13 | $ 2,850.00 | | | $ 2,573.13 | | |
| Vacuum Valve Pit Assembly 4830 Installation | EA | | | | $ 1,416.67 | $ 1,105.00 | | $ 1,260.83 | | |
| Vacuum Valve Pit Assembly 4842 Installation | EA | | | | $ 1,566.67 | $ 1,595.00 | | $ 1,580.83 | | |
| **Valve Pits** | EA | | | | | | | | $ 6,211.53 | **$ 6,250.00** |
| 6" PVC C900/C905 DR18 Forcemain | LF | $ 32.59 | | | $ 31.67 | $ 25.00 | $ 37.53 | $ 31.70 | | |
| 8" PVC C900/C905 DR18 Forcemain | LF | $ 57.71 | $ 28.44 | | $ 40.67 | $ 30.50 | $ 51.85 | $ 41.83 | | |
| **Force Main 8"** | LF | | | | | | | | | **$ 45.00** |
| Driveway Replacement - Concrete | SY | $ 63.45 | $ 59.05 | $ 61.53 | $ 44.33 | $ 40.75 | $ 51.35 | $ 53.41 | $ 55.00 | |
| Driveway Replacement - Asphalt | SY | $ 76.45 | $ 80.45 | $ 63.38 | $ 46.00 | $ 47.55 | | $ 62.77 | | |
| **Concrete Driveway Replacement (20 SY/driveway)** | EA | | | | | | | | $ 1,100.00 | **$ 1,100.00** |
| Open Cut Trench Repair | SY | $ 73.93 | $ 61.20 | $ 148.58 | | | | $ 94.57 | $ 95.00 | |
| Open Cut Trench Repair | LF | | | | $ 46.33 | $ 38.75 | | $ 42.54 | | |
| **Open Cut Trench Repair Main Line (9 ft wide=1 SY/LF)** | LF | | | | | | | | $ 95.00 | **$ 95.00** |
| Open Cut Trench Repair - Laterals (9ft/9*22 = 22 SY/crossing) | EA | | | | | | | | $ 2,090.00 | **$ 2,100.00** |
| **Open Cut Trench Repair - Vacuum Sewer Laterals (9ft/9*10 = 10 SY/crossing)** | Valve Pit | | | | | | | | $ 950.00 | **$ 950.00** |
| **Open Cut Trench Repair - LPS Laterals (9ft/9*15 = 15 SY/crossing)** | 50% of ERCs | | | | | | | | $ 1,425.00 | **$ 1,425.00** |
| Mill and Resurface Trench (1") | SY | | | | | | | | $ 10.00 | **$ 10.00** |
| Mill and Resurface Trench (1", 150ft*22 ft wide/9*$10/SY) | EA | | | | | | | | $ 3,666.67 | |
| Mill and Resurface Trench (1", 100ft/9*$10/SY) | LF | | | | | | | | $ 111.11 | |
| **Road Overlay (1", 20ft/9*$15/SY)** | LF | | | | | | | | $ 33.33 | **$ 35.00** |
| **5' Open Cut Trench Repair (LPS Main Line)** | LF | | | | | | | | $ 52.78 | **$ 55.00** |
| **10' Open Cut Trench Repair (Vacuum Main Line)** | LF | | | | | | | | $ 105.56 | **$ 110.00** |
| **Open Cut Trench Repair + Overlay (Service Lateral)** | EA | | | | | | | | $ 5,766.67 | **$ 5,800.00** |
| **Open Cut Trench Repair + Overlay (Main Line)** | LF | | | | | | | | $ 206.11 | **$ 210.00** |
| Type S-1 Asphaltic Concrete, 1.50" Thickness | SY | | | | $ 10.23 | $ 11.50 | | $ 10.87 | $ 15.00 | $ 15.00 |
| Limerock Base, 7" Thickness, LBR 100 Minimum | SY | | | | $ 14.53 | $ 15.00 | | $ 14.77 | | |
| Type 'B' Stabilization (12") | SY | | | | $ 6.83 | $ 5.50 | | $ 6.17 | | |
| | SY | | | | | | | $ 31.80 | $ 35.00 | |
| **Shell Road Reconstruction (2SY/LF)** | | | | | | | | | $ 40.00 | **$ 40.00** |
| **Total Road Reconstruction (2.44 SY/LF)+ stripe + signage + MOT** | LF | | | | | | | | $ 85.40 | **$ 100.00** |
| Sod - Bahia | SY | | $ 2.35 | $ 3.49 | $ 2.87 | $ 2.25 | | $ 2.74 | | |
| Sod - Floratam | SY | | $ 4.04 | | | | | $ 4.04 | | |
| Sod - St. Augustine | SY | | | | $ 4.00 | $ 3.50 | | $ 3.75 | | |
| Sod - Various Types | SY | $ 5.71 | | | | | | $ 5.71 | $ 6.00 | |
| **Restoration - Sod (150 SY/ERC)** | ERC | | | | | | | | $ 900.00 | **$ 900.00** |

# APPENDIX B: LIFE EXPECTANCY OF COMPONENTS

| LPS Components Life Expectancy | |
|---|---|
| **Description** | **Life Span** |
| LPS Main (PVC Pipe) | 80 |
| LPS Main (HDPE Directionally Drilled Water Crossing) | 80 |
| LPS Tank | 40 |
| Grinder Pump | 7 |
| On Site Lateral Connection | 80 |

| Vacuum Components Life Expectancy | |
|---|---|
| **Description** | **Life Span** |
| Vacuum Station Building | 40 |
| Vacuum Pumps | 15 |
| Sewage Pumps | 15 |
| Collection Tank | 30 |
| Control Panel | 20 |
| Vacuum Main (PVC Pipe) | 80 |
| Bridge Crossings - Vacuum Main | 40 |
| Force Main (PVC Pipe) | 80 |
| Force Main (HDPE Directionally Drilled Water Crossing) | 80 |
| Valve Pits | 50 |
| 3" Valve Pit Connections (PVC Pipe) | 80 |
| Gravity Laterals (PVC Pipe) | 80 |
| Air Terminals and 6" line | 50 |
| On Site Lateral Connection | 80 |

# APPENDIX C: OPERATION AND MAINTENANCE COSTS

# LGI / Don Pedro / Knight Island

# connections 1251
# EDU's 1251

## ANNUAL O&M ESTIMATE
Future Sewer
**LOW PRESSURE SYSTEM**

### LABOR

| Item | Labor effort | | Quantity | | | Annual Labor |
|---|---|---|---|---|---|---|
| Lift Station - (if req'd) | 180 hrs/yr/station | x | 0 station | | = | 0 hrs/yr |
| Piping | 60 hrs/yr/system | x | 0 system | | = | 0 hrs/yr |
| Grinder pumps | 1.50 hrs/yr/GP | x | 1,251 GP's | | = | 1877 hrs/yr |
| | | | | | | 1877 hrs/yr |
| | | | | | x | $20 /hr |
| | | | | | x | 1.25 Overhead |
| | | | | | | $46,925 /yr |
| | | | | ROUND TO: | | $46,900 /yr |

### POWER

| Item | Unit cost | | EDU | | Duration | | Annual Power |
|---|---|---|---|---|---|---|---|
| Lift Station - (if req'd) | | | | | | | |
| Flat rate | $125.00 /mo | x | 0 | | 12 mo | | $0 /yr |
| Consumption | $1.00 /mo/EDU | x | 1251 EDU | x | 12 mo | = | $0 /yr |
| | | | | | | | $0 |
| Grinder Pumps | $1.00 /mo/EDU | x | 1251 EDU | x | 12 mo | | $15,012 /yr |
| | | | | | | | $15,012 |
| | | | | | ROUND TO: | | $15,000 /yr |

### EQUIPMENT REPLACEMENT

| Item | Replacement cost | | Useful life | | Quantity | | Annual R&R |
|---|---|---|---|---|---|---|---|
| LIFT STATION (if req'd) | | | | | | | |
| Sewage Pumps | $12,000 /ea | / | 15 years | x | 0 pumps | = | $0 /yr |
| Wetwell | $10,000 /ea | / | 20 years | x | 0 ea | = | $0 /yr |
| Control Panel | $25,000 /ea | / | 20 years | x | 0 ea | = | $0 /yr |
| Misc. Equip | $1,000 /ea | / | 15 years | x | 0 ea | = | $0 /yr |
| | | | | | | | $0 /yr |
| | | | | | ROUND TO: | | $0 /yr |
| GRINDER PUMPS | | | | | | | |
| Rebuild pump core | $750 /ea | / | 7 years | x | 1,251 GP's | = | $134,036 /yr |
| Replace controls | $300 /ea | / | 7 years | x | 1,251 GP's | = | $53,614 /yr |
| Misc. Parts | $15 /yr | / | 10 years | x | 1,251 GP's | = | $1,877 /yr |
| | | | | | | | $189,527 /yr |
| | | | | | ROUND TO: | | $189,500 /yr |

### SUMMARY

| | |
|---|---|
| LABOR | $46,900 /yr |
| POWER | $15,000 /yr |
| EQUIPMENT REPLACEMENT (LIFT STATION) | $0 /yr |
| EQUIPMENT REPLACEMENT (GP'S) | $189,500 /yr |
| | $251,400 /yr |
| ANNUAL O&M | $201 /yr/EDU |

# LGI / Don Pedro / Knight Island

# ANNUAL O&M ESTIMATE

## Future Sewer

## VACUUM SYSTEM

| | |
|---|---|
| # connections | 1251 |
| # EDU's | 1251 |

**LABOR**

| Item | Labor effort | | Quantity | | Annual Labor |
|---|---|---|---|---|---|
| Vacuum Station | 450 hrs/yr/station | x | 2 station | = | 900 hrs/yr |
| Piping | 60 hrs/yr/system | x | 2 system | = | 120 hrs/yr |
| Valves | 1.75 hrs/yr/valve | x | 500 valves | = | 876 hrs/yr |
| | | | | | 1896 hrs/yr |
| | | | | x | $20 /hr |
| | | | | x | 1.25 Overhead |
| | | | | | $47,400 /yr |
| | | | | ROUND TO: | $47,400 /yr |

**POWER**

| Item | Unit cost | | EDU | | Duration | | Annual Power |
|---|---|---|---|---|---|---|---|
| Vacuum Station | | | | | | | |
| Flat rate | $125.00 /mo | x | 2 Vac Sta | | 12 mo | | $3,000 /yr |
| Consumption | $2.50 /mo/EDU | x | 1251 EDU | x | 12 mo | = | $37,530 /yr |
| | | | | | | | $40,530 |
| | | | | | | ROUND TO: | $40,500 /yr |

**EQUIPMENT REPLACEMENT**

| Item | Replacement cost | | Useful life | | Quantity | | Annual R&R |
|---|---|---|---|---|---|---|---|
| VACUUM STATION | | | | | | | |
| Vacuum Pumps | $26,000 /ea | / | 15 years | x | 8 pumps | = | $13,867 /yr |
| Sewage Pumps | $15,000 /ea | / | 15 years | x | 4 pumps | = | $4,000 /yr |
| Collection Tank | $50,000 /ea | / | 30 years | x | 2 ea | = | $3,333 /yr |
| Control Panel | $40,000 /ea | / | 20 years | x | 2 ea | = | $4,000 /yr |
| Misc. Equip | $3,000 /ea | / | 15 years | x | 2 ea | = | $400 /yr |
| | | | | | | | $25,600 /yr |
| | | | | | | ROUND TO: | $25,600 /yr |
| VACUUM VALVES | | | | | | | |
| Vacuum Valves | $45 /ea | / | 15 years | x | 500 valves | = | $1,501 /yr |
| Controller | $45 /ea | / | 10 years | x | 500 valves | = | $2,252 /yr |
| Misc. Parts | $20 /ea | / | 10 years | x | 500 valves | = | $1,001 /yr |
| | | | | | | | $4,754 /yr |
| | | | | | | ROUND TO: | $4,800 /yr |

**SUMMARY**

| | |
|---|---|
| LABOR | $47,400 /yr |
| POWER | $40,500 /yr |
| EQUIPMENT REPLACEMENT (STATION) | $25,600 /yr |
| EQUIPMENT REPLACEMENT (VALVES) | $4,800 /yr |
| | $118,300 /yr |
| ANNUAL O&M | $95 /yr/EDU |

## LGI / Don Pedro / Knight Island

| ANNUAL O&M COMPARISON | | |
|---|---|---|
| | VACUUM | LOW PRESSURE |
| # CONNECTIONS | 1251 ea | 1251 ea |
| # OF EDU'S | 1251 ea | 1251 ea |
| # UNITS | 500 valves | 1,251 GP's |
| # VACUUM OR LIFT STATIONS | 2 ea | 0 ea |
| LABOR | $47,400 /yr | $46,900 /yr |
| POWER | $40,500 /yr | $15,000 /yr |
| EQUIPMENT REPLACEMENT (Vac Sta/Lift Sta) | $25,600 /yr | $0 /yr |
| REBUILD/REPAIR FREQUENCY | | |
| Rebuild/repair frequency (vacuum valve/wetwell pumps/GP core) | 15 yrs | 7 yrs |
| Rebuild/repair frequency (controllers/pump controls) | 10 yrs | 7 yrs |
| Rebuild/repair frequency (gravity wetwell) | n/a | 20 yrs |
| Misc Spare parts frequency | 10 yrs | 10 yrs |
| EQUIPMENT REPLACEMENT (Valves/Grinder Pumps) | $4,800 /yr | $189,500 /yr |
| ANNUAL O&M | $118,335 /yr | $251,444 /yr |
| ANNUAL O&M per EDU | $95 /yr/EDU | $201 /yr/EDU |

# APPENDIX D: PRESENT WORTH ANALYSIS

# Present Worth Analysis

| | | | |
|---|---|---|---|
| **Project** | **LGI / Don Pedro / Knight Island** | | |
| **Planning Time Frame** | 40 | years | |
| **Interest Rate** | 5.00 | % | |
| **ERC's (Build-Out)** | 1251 | ERC's | |
| **ERC's (Existing)** | 810 | ERC's | |

**For Comparitive Analysis Only**
*(Does not include all costs)*

| | | |
|---|---|---|
| LPS | $ 13,879 | $/build-out ERC |
| Vac | $ 16,810 | $/build-out ERC |

**ASSUMES CCU LIFT STATION**

| System Type | Base Cost | Other Costs | Legal, Engr, Survey | Const Services/ Contingency | Total Initial Cost "C" | Annual O&M | O&M Uniform Series Present Worth Factor | USPW (O+M) | Salvage Value | SPPW(S) | Present Worth of Salvage Value | NET PRESENT VALUE | RANK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LPS | $ 17,363,148 | $ - | $ - | $ - | $ 17,363,148 | $ 251,444 | 17.16 | $ 4,314,549 | $ 1,569,391 | 0.14 | $ 222,925 | $ 21,454,772 | 1 |
| Vacuum | $ 21,029,866 | $ - | $ - | $ - | $ 21,029,866 | $ 118,335 | 17.16 | $ 2,030,520 | $ 4,049,235 | 0.14 | $ 575,176 | $ 22,485,210 | 2 |

NPV = C+ USPW (O&M)-SPPW(S)
NPV Net Present Value
C Capital Cost

| | | n (years) | i % | (1+i)nth | i(1+i)nth | Present W factor |
|---|---|---|---|---|---|---|
| USPW (O&M) | Uniform Series Present Worth | 40 | 0.05 | 7.040 | 0.352 | 17.159 |
| equals | A(1+i)nth -1 / i(1+i)nth | | | | | |

SPPW (S) Single Payment Present Worth Salvage Value FV*1/(1+i)nth — **SPPW** 0.142

## Salvage Value

| | Element | Life Span | Value New | 40 Year Dep | Remaining Value |
|---|---|---|---|---|---|
| **LPS** | 3" Low Pressure Sewer Main (PVC Pipe includes backfill) | 80 | $ 681,920 | $ 340,960 | $ 340,960 |
| | 4" Low Pressure Sewer Main (PVC Pipe includes backfill) | 80 | $ 265,832 | $ 132,916 | $ 132,916 |
| | 6" Low Pressure Sewer Main (PVC Pipe includes backfill) | 80 | $ 270,600 | $ 135,300 | $ 135,300 |
| | 8" Low Pressure Sewer Main (PVC Pipe includes backfill) | 80 | $ 490,400 | $ 245,200 | $ 245,200 |
| | 10" Low Pressure Sewer Main (PVC Pipe includes backfill) | 80 | $ 183,850 | $ 91,925 | $ 91,925 |
| | 12" Low Pressure Sewer Main (PVC Pipe includes backfill) | 80 | $ 255,000 | $ 127,500 | $ 127,500 |
| | 10" Dia. Directional Drill for Water Crossings (HDPE Pipe) | 80 | $ 93,680 | $ 46,840 | $ 46,840 |
| | 16" Dia. Directional Drill for Water Crossings (HDPE Pipe) | 80 | $ 87,500 | $ 43,750 | $ 43,750 |
| | LPS Tank Package | 40 | $ 10,008,000 | $ 10,008,000 | $ - |
| | On Site Lateral Connection | 80 | $ 810,000 | $ 405,000 | $ 405,000 |
| | | | | | $ 1,569,391.00 |

## Cost Estimates

| Description | Qty | Unit Price | Total |
|---|---|---|---|
| 3" Low Pressure Sewer Main (PVC Pipe includes backfill) | 34,096 | $ 20 | $ 681,920 |
| 4" Low Pressure Sewer Main (PVC Pipe includes backfill) | 9,494 | $ 28 | $ 265,832 |
| 6" Low Pressure Sewer Main (PVC Pipe includes backfill) | 9,020 | $ 30 | $ 270,600 |
| 8" Low Pressure Sewer Main (PVC Pipe includes backfill) | 15,325 | $ 32 | $ 490,400 |
| 10" Low Pressure Sewer Main (PVC Pipe includes backfill) | 3,677 | $ 50 | $ 183,850 |
| 12" Low Pressure Sewer Main (PVC Pipe includes backfill) | 4,250 | $ 60 | $ 255,000 |
| 10" Dia. Directional Drill for Water Crossings (HDPE Pipe) | 1,171 | $ 80 | $ 93,680 |
| 16" Dia. Directional Drill for Water Crossings (HDPE Pipe) | 700 | $ 125 | $ 87,500 |
| Main Line Road Crossings Trench Repair and Overlay - Asphalt Roads (PVC Pipe) | 45 | $ 210 | $ 9,450 |
| Open Cut Trench Repair and Overlay - Asphalt Roads (Service Laterals) | 48 | $ 5,800 | $ 278,400 |
| Open Cut Trench Repair - Shell Roads (Service Laterals) | 454 | $ - | $ - |
| Restoration - Concrete Driveways | 59 | $ 1,100 | $ 64,900 |
| LPS Tank Package | 1,251 | $ 8,000 | $ 10,008,000 |
| Pump, Crush and Fill Existing Septics | 810 | $ 1,500 | $ 1,215,000 |
| On Site Lateral Connection | 810 | $ 1,000 | $ 810,000 |
| Miscellaneous (Mobilization / MOT / Bonds / Permits) | | 18% | $ 2,648,616 |
| | | Total | **$ 17,363,148** |

**Project** **LGI / Don Pedro / Knight Island**

**Salvage Value**

| | | | | | |
|---|---|---|---|---|---|
| **Vacuum** | Building Site Work and Material - Install | 40 | $ 3,000,000 | $ 3,000,000 | $ - |
| | Vacuum Main (4" PVC Pipe includes backfill) | 80 | $ 1,703,660 | $ 851,830 | $ 851,830 |
| | Vacuum Main (6" PVC Pipe includes backfill) | 80 | $ 913,140 | $ 456,570 | $ 456,570 |
| | S Gulf Blvd Bridge - Vacuum Main Crossing | 40 | $ 250,000 | $ 250,000 | $ - |
| | S Gulf Blvd South Bridge - Vacuum Main Crossing | 40 | $ 100,000 | $ 100,000 | $ - |
| | 10" Dia. Directional Drill for Water Crossings (HDPE Pipe) | 80 | $ 187,300 | $ 93,650 | $ 93,650 |
| | Force Main (6" PVC Pipe) | 80 | $ 157,320 | $ 78,660 | $ 78,660 |
| | Force Main (8" PVC Pipe) | 80 | $ 1,145,700 | $ 572,850 | $ 572,850 |
| | Valve Pits (2.5 ERC/1 VP) | 50 | $ 3,757,500 | $ 3,006,000 | $ 751,500 |
| | 3" Valve Pit Connections (PVC Pipe, 15'/ERC) | 80 | $ 225,450 | $ 112,725 | $ 112,725 |
| | Gravity Laterals (PVC Pipe, 60' per VP @ $35/ft) | 80 | $ 1,052,100 | $ 526,050 | $ 526,050 |
| | Air Terminals and 6" line | 50 | $ 1,002,000 | $ 801,600 | $ 200,400 |
| | On Site Lateral Connection | 80 | $ 810,000 | $ 405,000 | $ 405,000 |
| | | | | | $4,049,235.00 |

**Cost Estimates**

| | | | |
|---|---|---|---|
| Vacuum Station Building 600-1000 ERC's | 2 | $1,950,000 | $ 3,900,000 |
| Vacuum Main (4" PVC Pipe includes backfill) | 48,676 | $ 35 | $ 1,703,660 |
| Vacuum Main (6" PVC Pipe includes backfill) | 20,292 | $ 45 | $ 913,140 |
| S Gulf Blvd Bridge - Vacuum Main Crossing | 1 | $ 250,000 | $ 250,000 |
| S Gulf Blvd South Bridge - Vacuum Main Crossing | 1 | $ 100,000 | $ 100,000 |
| 10" Dia. Directional Drill for Water Crossings (HDPE Pipe) | 1,873 | $ 100 | $ 187,300 |
| Force Main (6" PVC Pipe) | 3,933 | $ 40 | $ 157,320 |
| Force Main (8" PVC Pipe) | 25,460 | $ 45 | $ 1,145,700 |
| Valve Pits (2.5 ERC/1 VP) | 501 | $ 7,500 | $ 3,757,500 |
| 3" Valve Pit Connections (PVC Pipe, 15'/ERC) | 501 | $ 450 | $ 225,450 |
| Gravity Laterals (PVC Pipe, 60' per VP @ $35/ft) | 501 | $ 2,100 | $ 1,052,100 |
| Air Terminals and 6" line | 501 | $ 2,000 | $ 1,002,000 |
| Main Line Road Crossings Trench Repair and Overlay - Asphalt Roads (PVC Pipe) | 45 | $ 210 | $ 9,450 |
| Open Cut Trench Repair and Overlay - Asphalt Roads (Service Laterals) | 48 | $ 5,800 | $ 278,400 |
| Open Cut Trench Repair - Shell Roads (Service Laterals) | 454 | $ - | $ - |
| Restoration - Concrete Driveways | 59 | $ 1,100 | $ 64,900 |
| Vacuum Station Land | 2 | $ 200,000 | $ 400,000 |
| Pump, Crush and Fill Existing Septics | 810 | $ 1,500 | $ 1,215,000 |
| On Site Lateral Connection | 810 | $ 1,000 | $ 810,000 |
| Additional Design Engineering - Vacuum Station | 2 | $ 150,000 | $ 300,000 |
| Additional Design Engineering - Profiles | 2 | $ 100,000 | $ 200,000 |
| Additional CEI - Vacuum Station | 2 | $ 25,000 | $ 50,000 |
| Additional CEI - Profiles and As-Builts | 2 | $ 50,000 | $ 100,000 |
| Miscellaneous (Mobilization / MOT / Bonds / Permits) | | 18% | $ 3,207,946 |
| | | Total | **$ 21,029,866** |

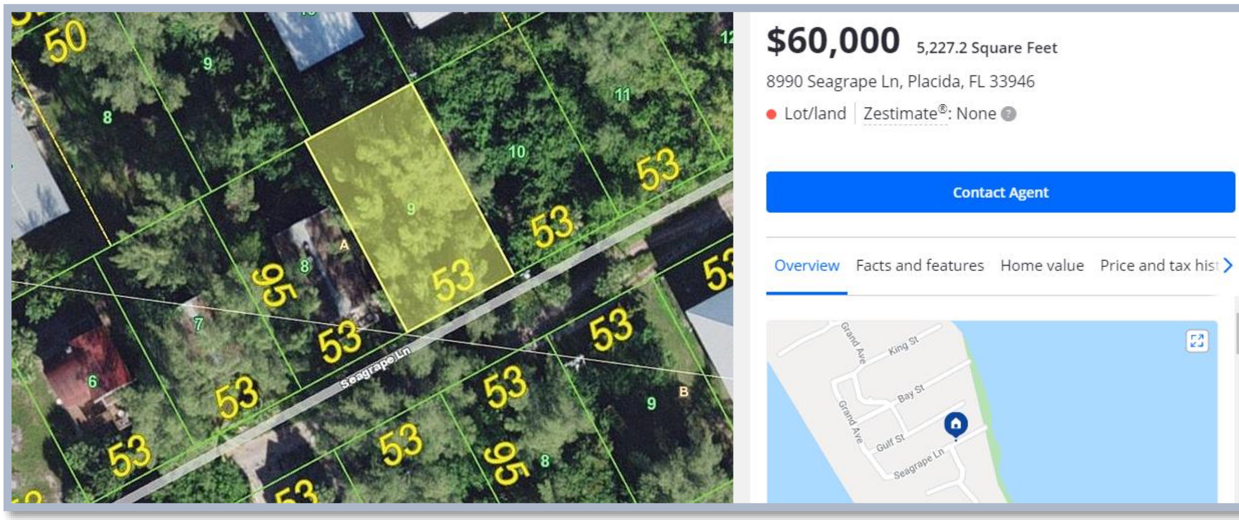
**O & M Costs per Year**

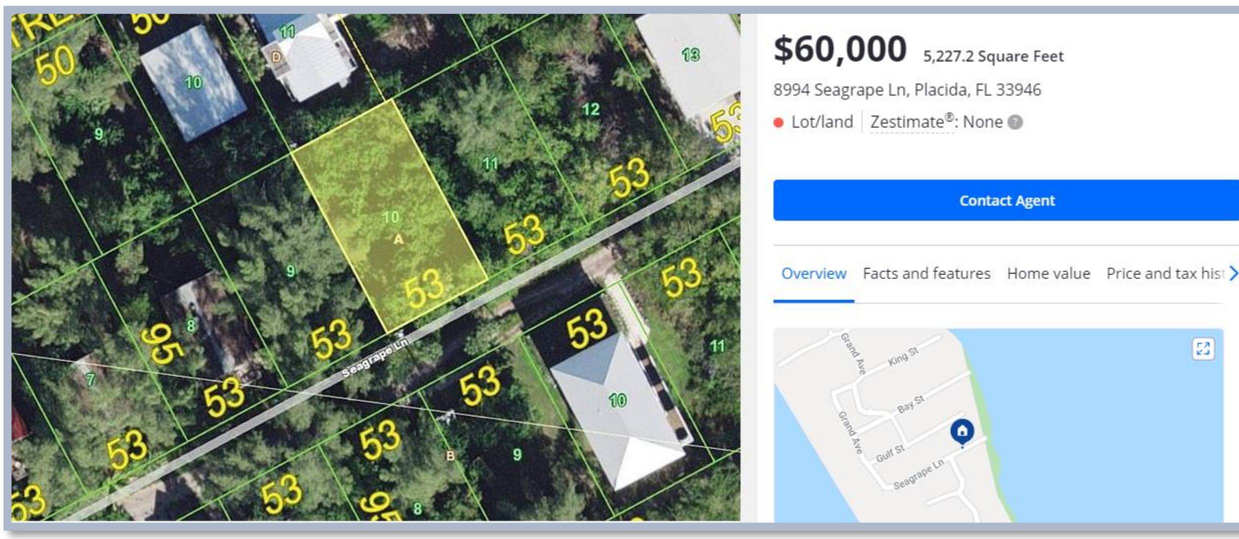
| | Cost per EDU | EDU's | Cost/Year |
|---|---|---|---|
| **LPS** | $ 201 | 1251 | $ 251,444 |
| **Vacuum** | $ 95 | 1251 | $ 118,335 |

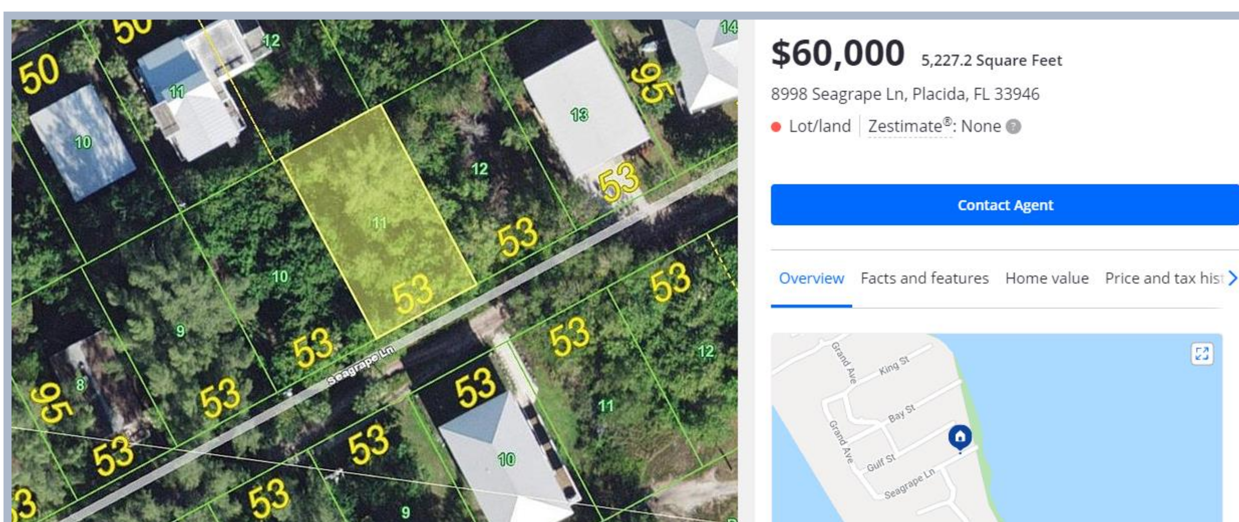
GWE # 6374.20

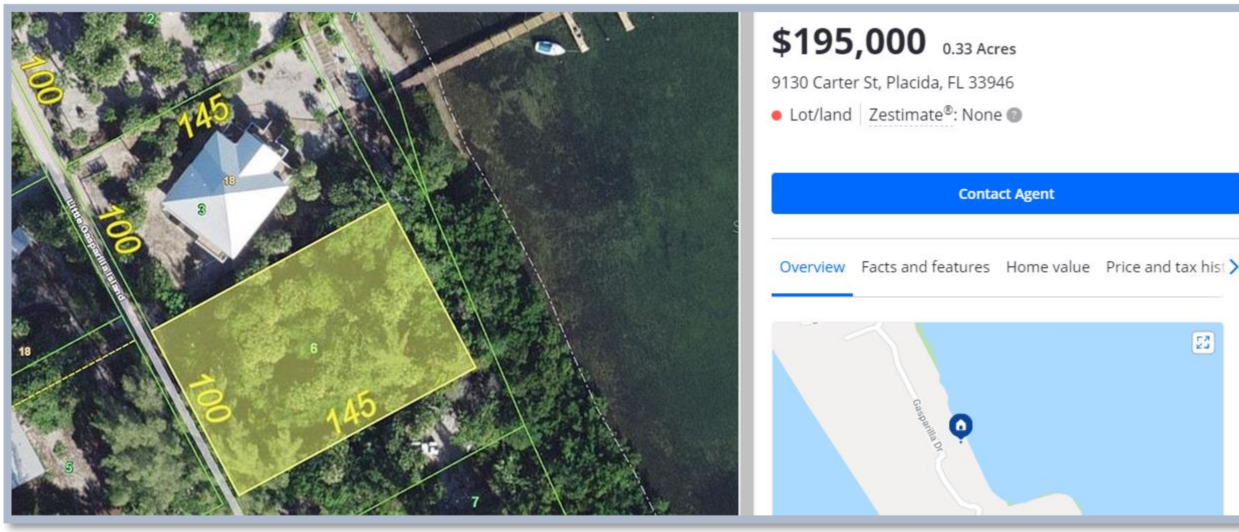
# APPENDIX E: PROPERTY COST ESTIMATES

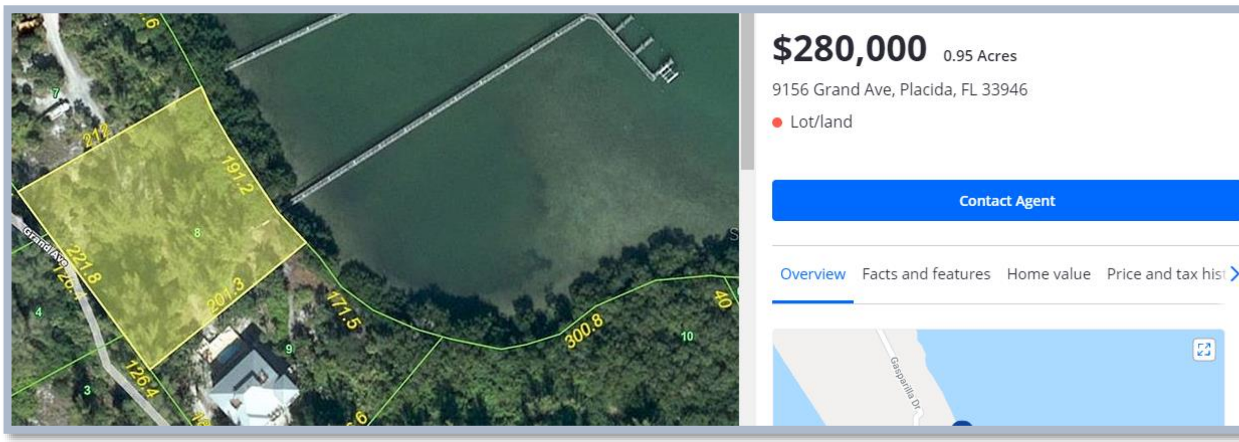
## Little Gasparilla Island



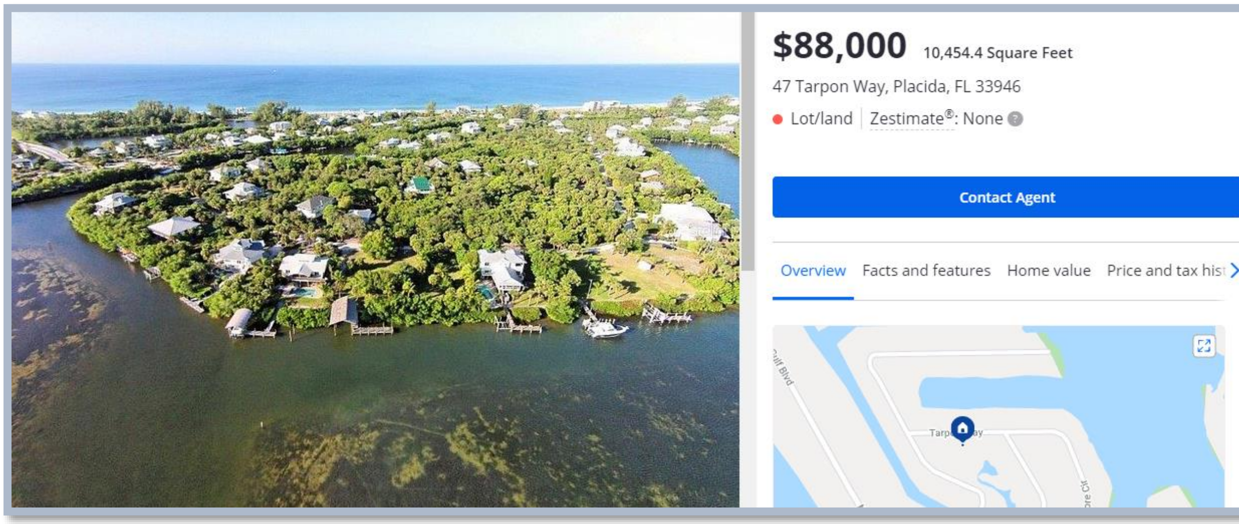



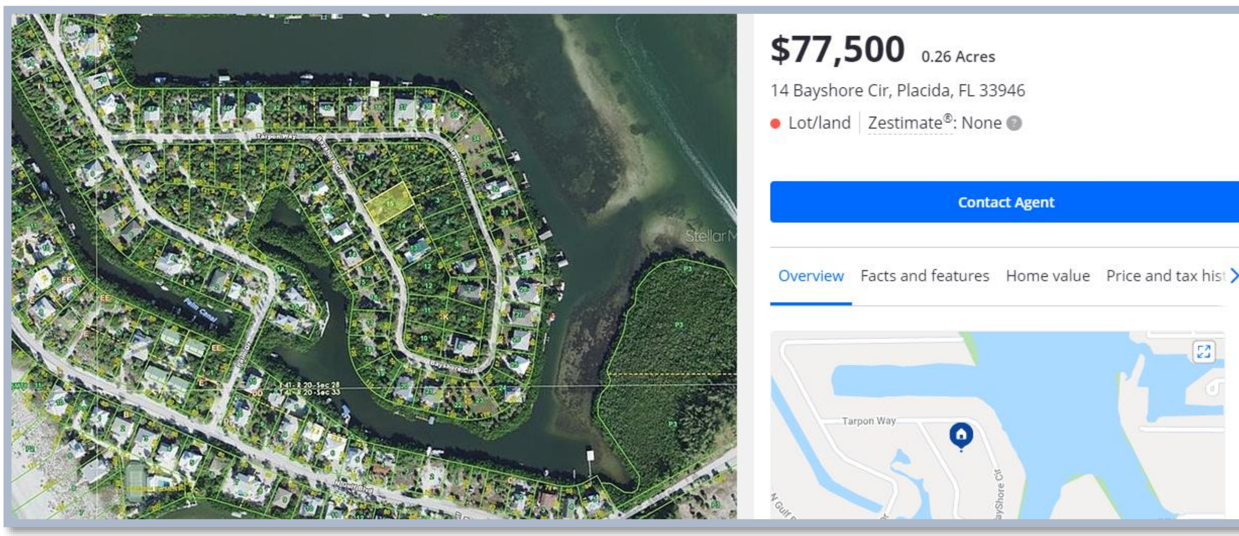



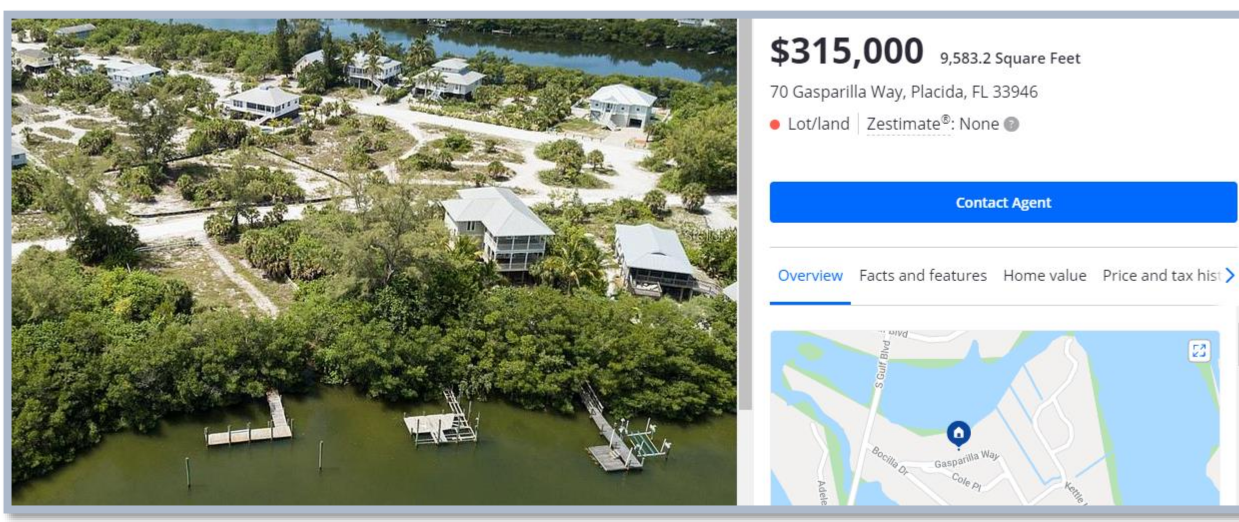

100
145
100
100
145
$195,000 0.33 Acres
9130 Carter St, Placida, FL 33946
Lot/land
Zestimate®: None
Contact Agent
Overview
Facts and features
Home value
Price and tax hist
Gasparilla Dr


212
191.2
221.8
201.3
171.5
300.8
126.4
Grand Ave
$280,000 0.95 Acres
9156 Grand Ave, Placida, FL 33946
Lot/land
Contact Agent
Overview
Facts and features
Home value
Price and tax hist
Gasparilla Dr

## Don Pedro / Knight Island

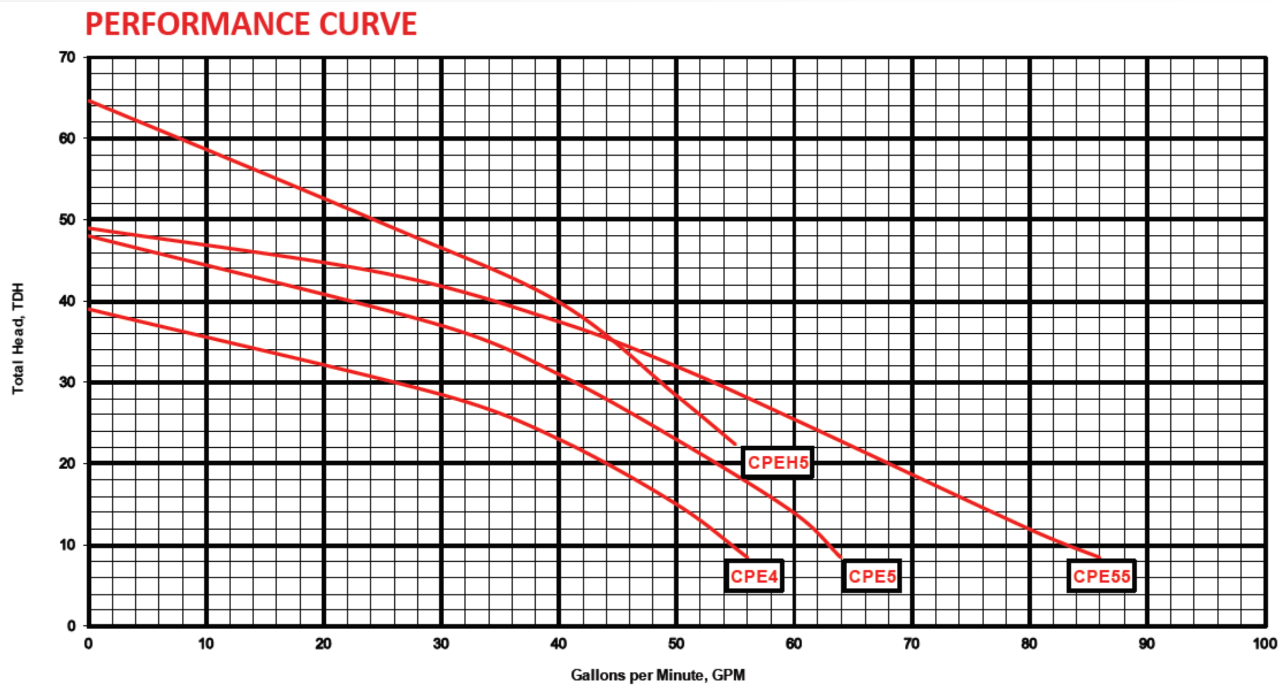


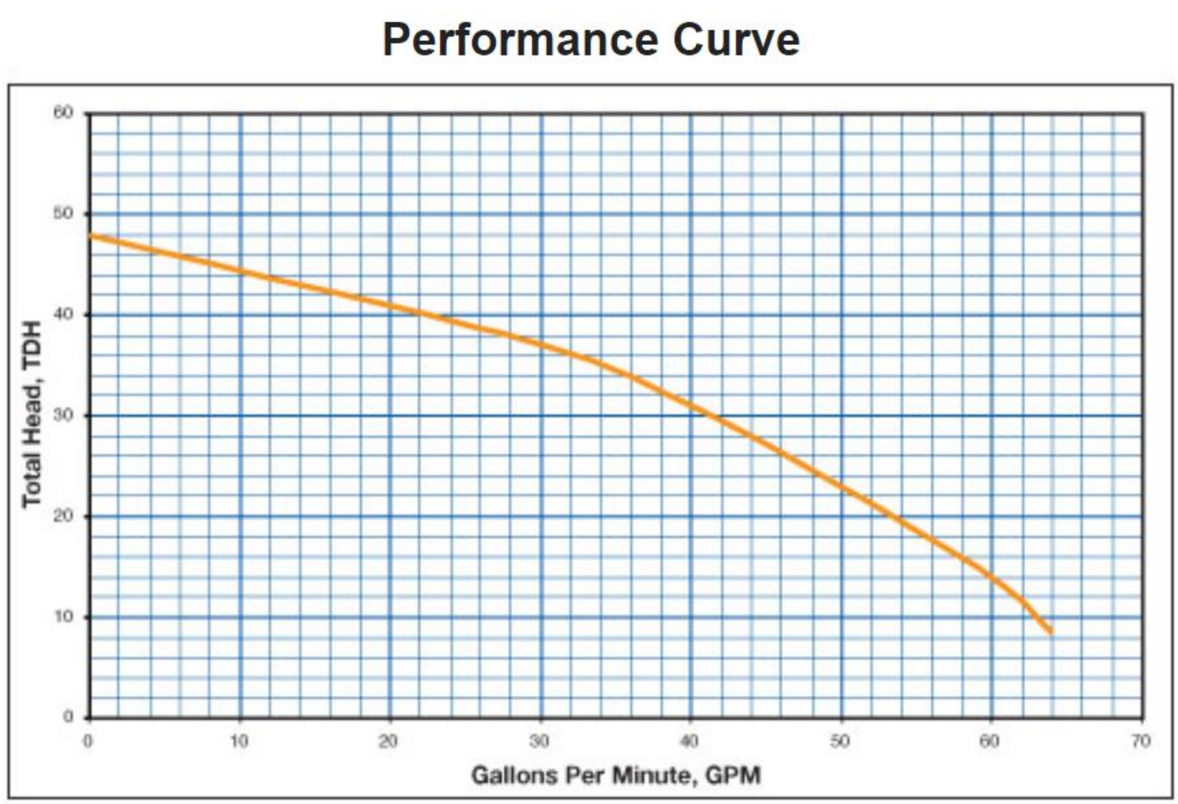



# APPENDIX F: PUMP PERFORMANCE CURVES

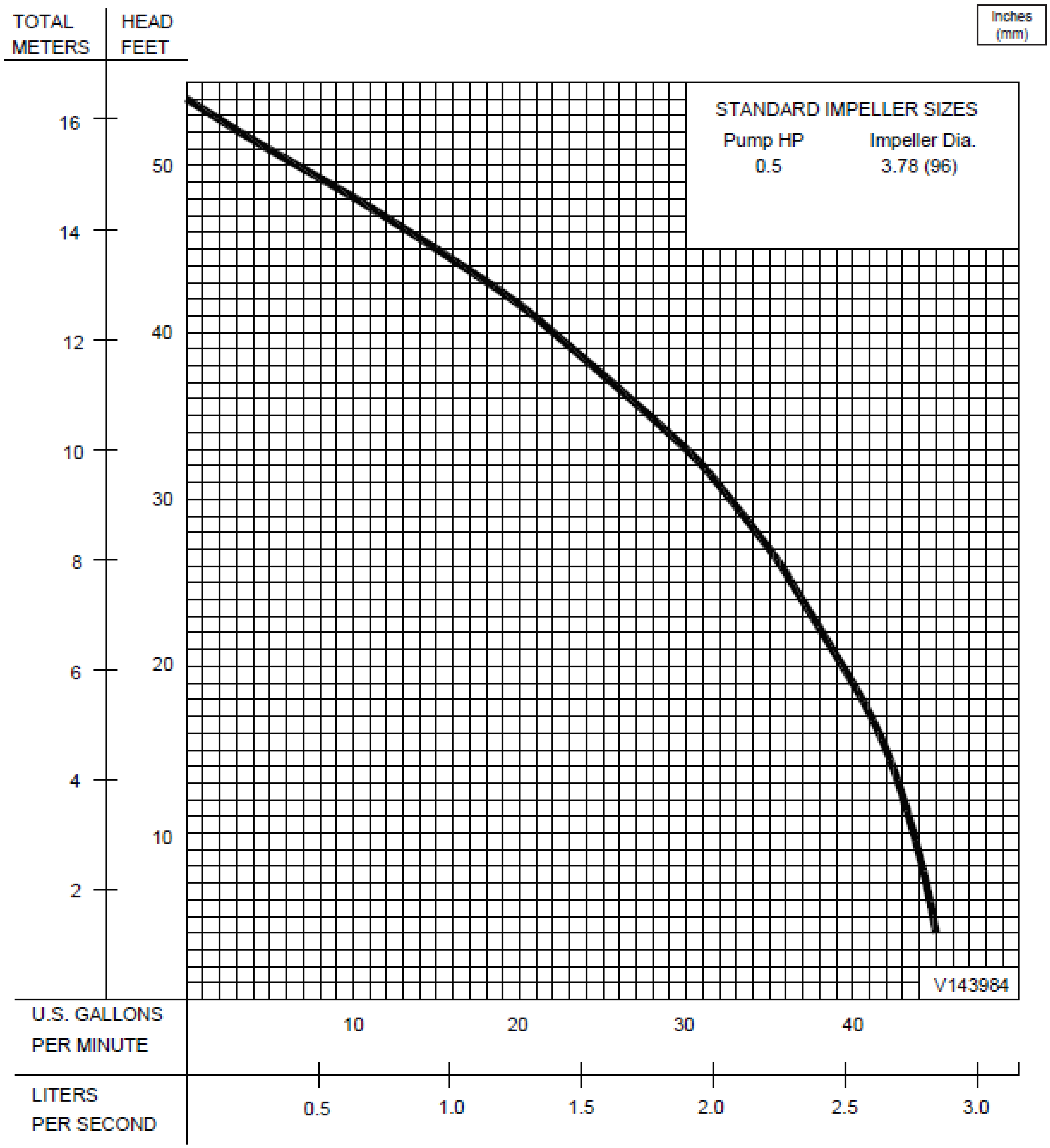
### Champion Pump Company, Inc. – CPE5




### Milwaukee Pump Company – MP-E5



## Barnes – EHV512



# APPENDIX G: HYDRAULIC ANALYSIS RESULTS

**PRELIMINARY LOW-PRESSURE SEWER SYSTEM PIPE SCHEDULE AND ZONE ANALYSIS OF BOCILLA / LITTLE GASPARILLA FUTURE SEWER**

***SCENARIO 1: Pipe Sizing Analysis With Flow from Knight Island***

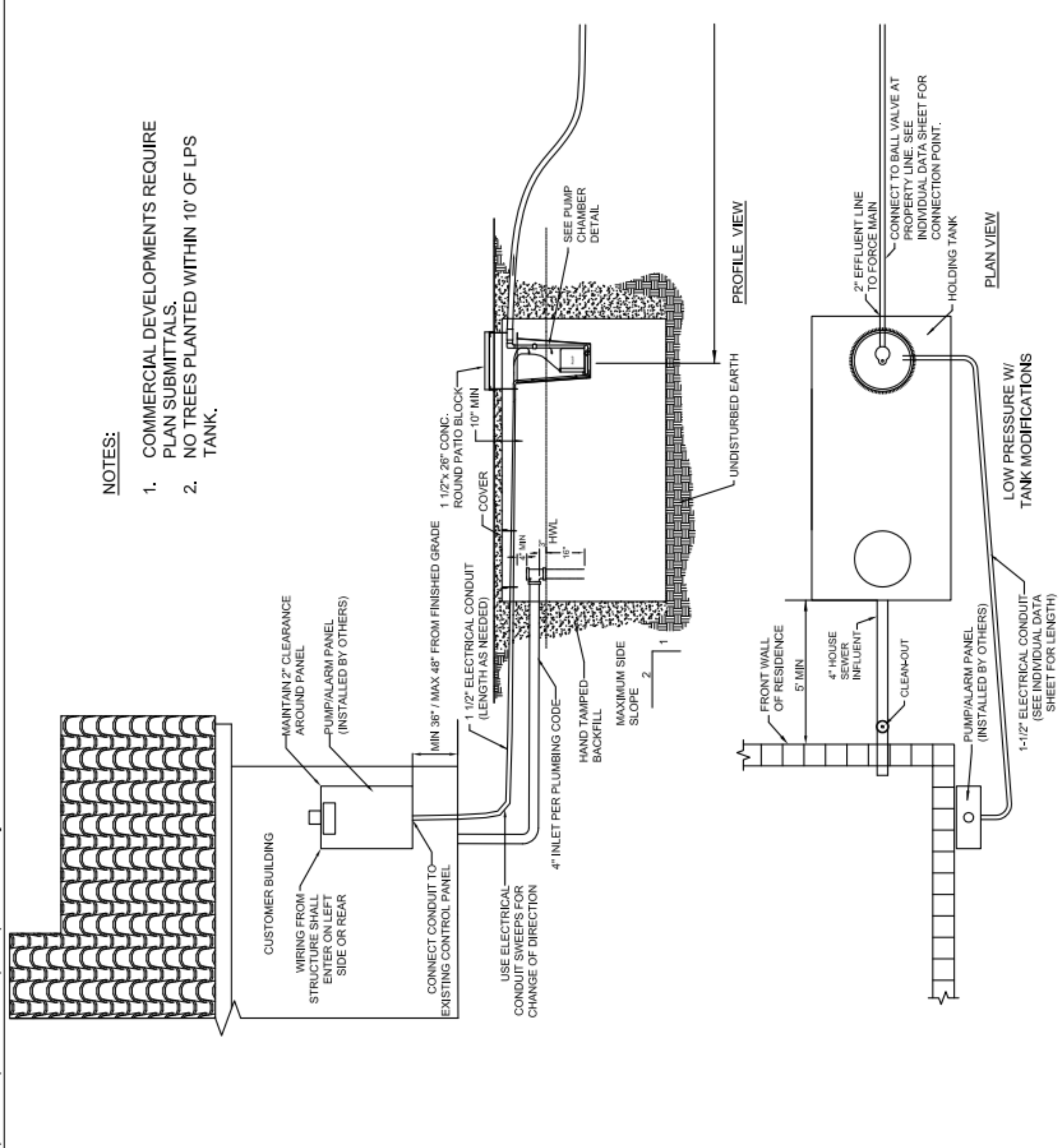
| SECTION | CUMU. ERCs (BUILD OUT) | ACCUM. PUMPS IN SECTION | GAL/DAY PER CORE | MAX FLOW PER CORE | ASSUMED MAX SIMULTANEOUS PUMPS OPERATING | CUMU. MAX FLOW (gpm) | NOMINAL PIPE SIZE (in) | INNER PIPE DIAMETER (in) | MAX VELOCITY (FPS) | LENGTH OF MAIN THIS ZONE (ft) | FRICTION LOSS FACTOR (FT/100 FT) | FRICTION LOSS THIS SECTION | ACCUM. FRICTION LOSS (ft) | STATIC HEAD (ft) | MISC. LOSSES (ft) * Assumes 5% of friction loss | TOTAL DYNAMIC HEAD (ft) | PRESSURE (psi) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Knight Island Section 1 | | | | | | 250 | 6 | 6.07 | 2.78 | 2000 | 0.42 | 8.4 | 41.6 | 2 | 2.1 | 45.6 | 19.8 |
| Bocilla Section 1 | 540 | 540 | 200 | 12.5 | 21 | 262.5 | 8 | 7.98 | 1.68 | 2000 | 0.12 | 2.4 | 38.3 | 3 | 1.9 | 43.2 | 18.7 |
| Bocilla Section 2 | 759 | 759 | 200 | 12.5 | 28 | 350 | 8 | 7.98 | 2.24 | 2035 | 0.21 | 4.2 | 33.1 | 2 | 1.7 | 36.8 | 15.9 |
| Bocilla Section 3 | 816 | 816 | 200 | 12.5 | 30 | 375 | 8 | 7.98 | 2.40 | 2750 | 0.23 | 6.5 | 28.9 | 2 | 1.4 | 32.4 | 14.0 |
| Bocilla Section 4 | 1032 | 1032 | 200 | 12.5 | 36 | 450 | 8 | 7.98 | 2.89 | 5120 | 0.33 | 16.9 | 22.5 | 2 | 1.1 | 25.6 | 11.1 |
| Bocilla Section 5 | 1189 | 1189 | 200 | 12.5 | 41 | 512.5 | 10 | 10.02 | 2.09 | 4060 | 0.14 | 5.6 | 5.6 | 2 | 0.3 | 7.9 | 3.4 |
| Little Gasparilla Section 1 | 40 | 40 | 200 | 12.5 | 6 | 75 | 4 | 4.03 | 1.89 | 2080 | 0.33 | 6.9 | 37.8 | 2 | 1.9 | 41.7 | 18.0 |
| Little Gasparilla Section 2 | 295 | 295 | 200 | 12.5 | 14 | 175 | 6 | 6.07 | 1.94 | 2340 | 0.22 | 5.1 | 30.9 | 2 | 1.5 | 34.4 | 14.9 |
| Little Gasparilla Section 3 | 660 | 660 | 200 | 12.5 | 25 | 312.5 | 8 | 7.98 | 2.00 | 6050 | 0.17 | 10.1 | 25.8 | 2 | 1.3 | 29.1 | 12.6 |
| Little Gasparilla Section 4 | 700 | 700 | 200 | 12.5 | 26 | 325 | 8 | 7.98 | 2.08 | 5200 | 0.18 | 9.4 | 15.6 | 2 | 0.8 | 18.4 | 8.0 |
| Section 11 - Wye to Future LS | 1889 | 1889 | 200 | 12.5 | 62 | 775 | 12 | 11.94 | 2.22 | 4930 | 0.13 | 6.3 | 6.3 | 2 | 0.3 | 8.6 | 3.7 |

**PRELIMINARY LOW-PRESSURE SEWER SYSTEM PIPE SCHEDULE AND ZONE ANALYSIS OF BOCILLA / LITTLE GASPARILLA FUTURE SEWER**

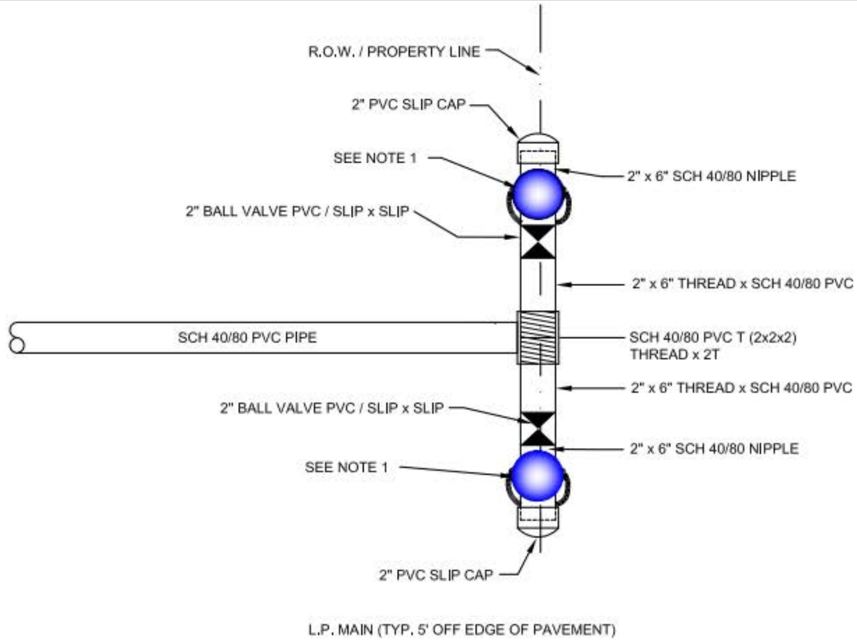
***SCENARIO 2: Pipe Sizing Analysis Without Flow from Knight Island***

| SECTION | CUMU. ERCs (BUILD OUT) | ACCUM. PUMPS IN SECTION | GAL/DAY PER CORE | MAX FLOW PER CORE | ASSUMED MAX SIMULTANEOUS PUMPS OPERATING | CUMU. MAX FLOW (gpm) | NOMINAL PIPE SIZE (in) | INNER PIPE DIAMETER (in) | MAX VELOCITY (FPS) | LENGTH OF MAIN THIS ZONE (ft) | FRICTION LOSS FACTOR (FT/100 FT) | FRICTION LOSS THIS SECTION | ACCUM. FRICTION LOSS (ft) | STATIC HEAD (ft) | MISC. LOSSES (ft) * Assumes 5% of friction loss | TOTAL DYNAMIC HEAD (ft) | PRESSURE (psi) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bocilla Section 1 | 40 | 40 | 200 | 12.5 | 6 | 75 | 4 | 4.03 | 1.89 | 1400 | 0.33 | 4.7 | 28.8 | 2 | 1.4 | 32.3 | 14.0 |
| Bocilla Section 2 | 259 | 259 | 200 | 12.5 | 13 | 162.5 | 6 | 6.07 | 1.80 | 2035 | 0.19 | 3.9 | 24.2 | 2 | 1.2 | 27.4 | 11.9 |
| Bocilla Section 3 | 316 | 316 | 200 | 12.5 | 15 | 187.5 | 6 | 6.07 | 2.08 | 2750 | 0.25 | 6.8 | 20.3 | 2 | 1.0 | 23.3 | 10.1 |
| Bocilla Section 4 | 532 | 532 | 200 | 12.5 | 21 | 262.5 | 8 | 7.98 | 1.68 | 5120 | 0.12 | 6.2 | 13.5 | 2 | 0.7 | 16.2 | 7.0 |
| Bocilla Section 5 | 689 | 689 | 200 | 12.5 | 26 | 325 | 8 | 7.98 | 2.08 | 4060 | 0.18 | 7.3 | 7.3 | 2 | 0.4 | 9.7 | 4.2 |
| Little Gasparilla Section 1 | 40 | 40 | 200 | 12.5 | 6 | 75 | 4 | 4.03 | 1.89 | 2080 | 0.33 | 6.9 | 40.3 | 2 | 2.0 | 44.3 | 19.2 |
| Little Gasparilla Section 2 | 295 | 295 | 200 | 12.5 | 14 | 175 | 6 | 6.07 | 1.94 | 2340 | 0.22 | 5.1 | 33.4 | 2 | 1.7 | 37.1 | 16.0 |
| Little Gasparilla Section 3 | 660 | 660 | 200 | 12.5 | 25 | 312.5 | 8 | 7.98 | 2.00 | 6050 | 0.17 | 10.1 | 28.3 | 2 | 1.4 | 31.7 | 13.7 |
| Little Gasparilla Section 4 | 700 | 700 | 200 | 12.5 | 26 | 325 | 8 | 7.98 | 2.08 | 5200 | 0.18 | 9.4 | 18.2 | 2 | 0.9 | 21.1 | 9.1 |
| Section 10 - Wye to Future LS | 1389 | 1389 | 200 | 12.5 | 47 | 587.5 | 10 | 10.02 | 2.39 | 4930 | 0.18 | 8.8 | 8.8 | 2 | 0.4 | 11.2 | 4.9 |

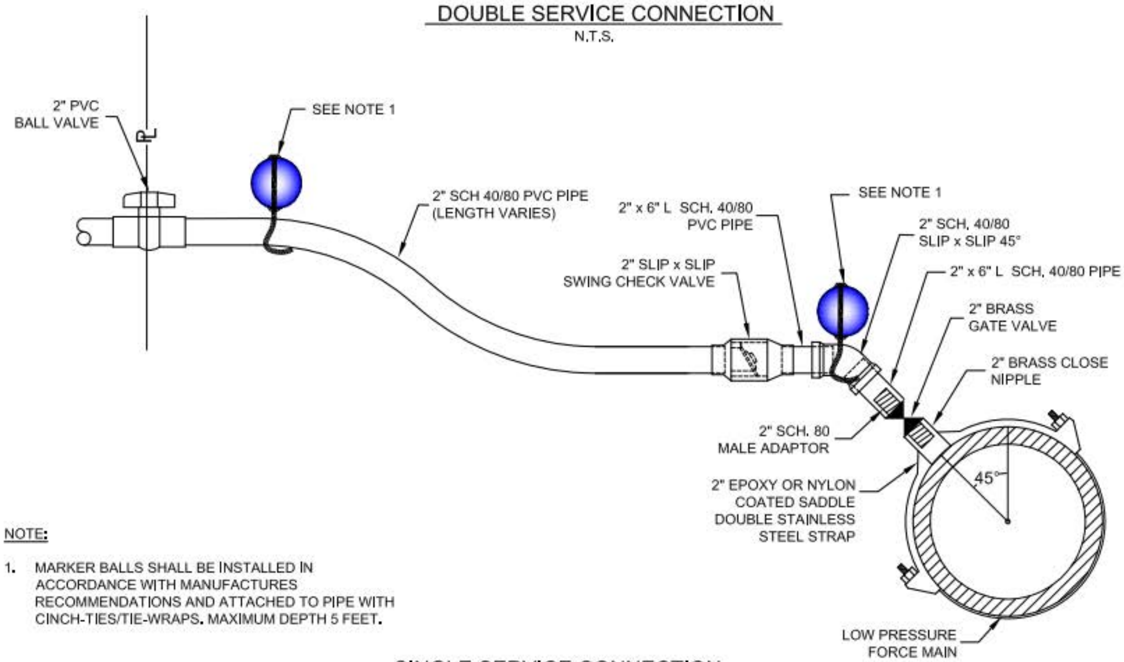
# APPENDIX H: CHARLOTTE COUNTY LPS STANDARD DETAILS




| | | |
|---|---|---|
| DATE: 11/01/2011 | TYPICAL LPS TANK W/ MODIFICATIONS | PROVIDED FOR INFORMATIONAL PURPOSES ONLY. NO MODIFICATIONS WITHOUT WRITTEN CCU APPROVAL. |
| DRAWN BY: DEC | | LP-01 |
| APPROVED BY: BRB | CHARLOTTE COUNTY UTILITIES | ID: LPS-01-TMODS.dwg |




DOUBLE SERVICE CONNECTION
N.T.S.

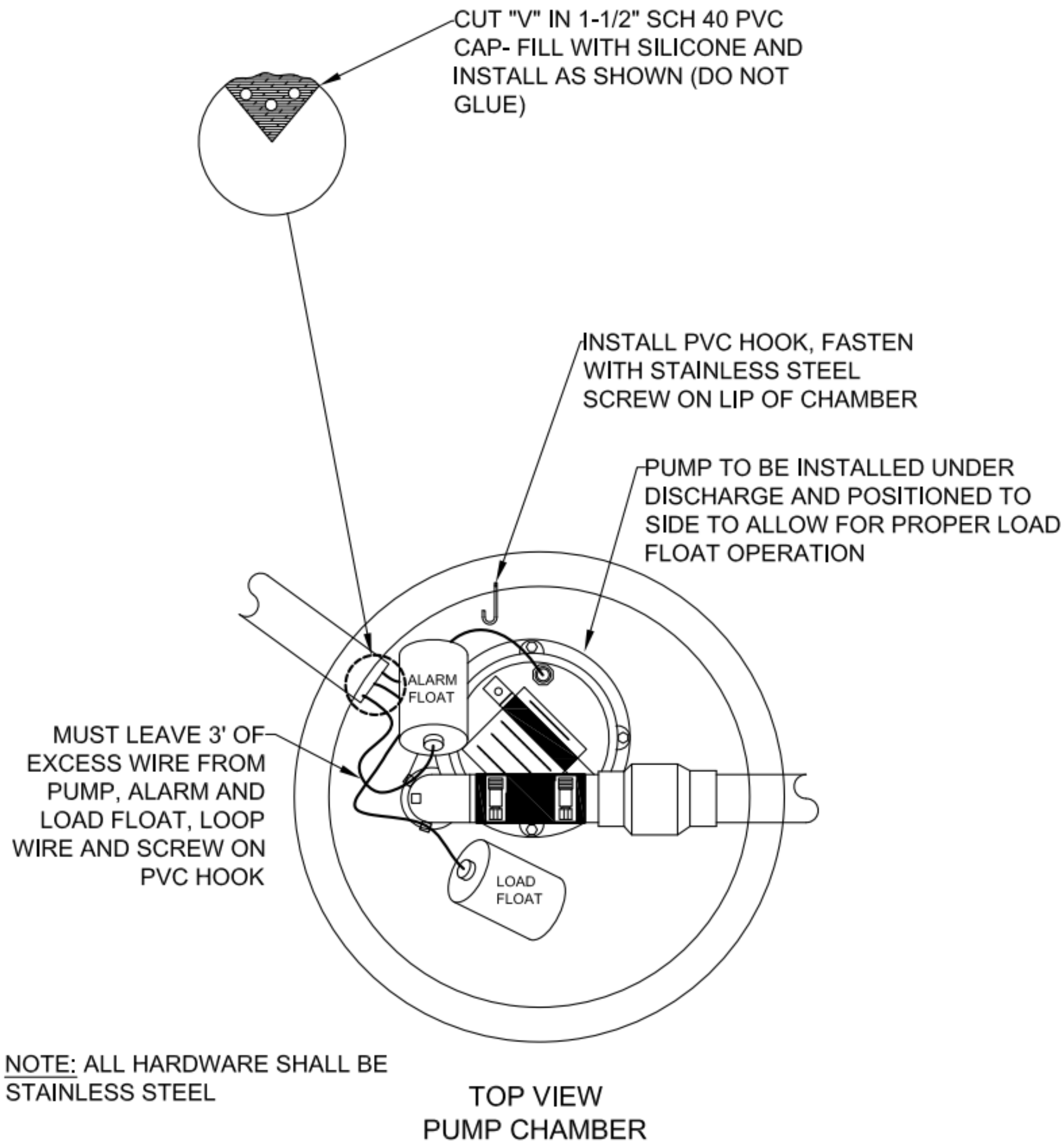



NOTE:

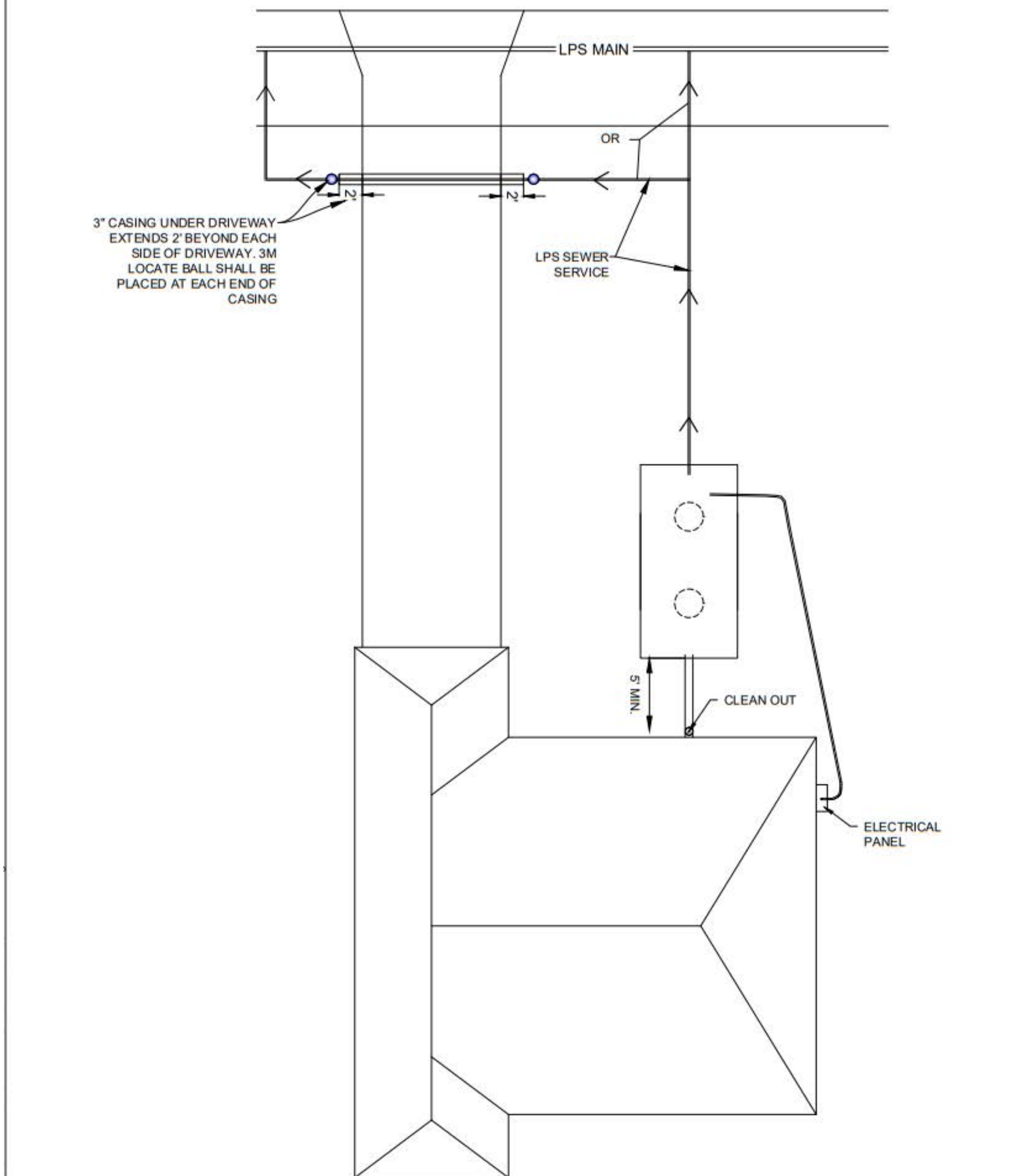
1. MARKER BALLS SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURES RECOMMENDATIONS AND ATTACHED TO PIPE WITH CINCH-TIES/TIE-WRAPS. MAXIMUM DEPTH 5 FEET.

SINGLE SERVICE CONNECTION
N.T.S.

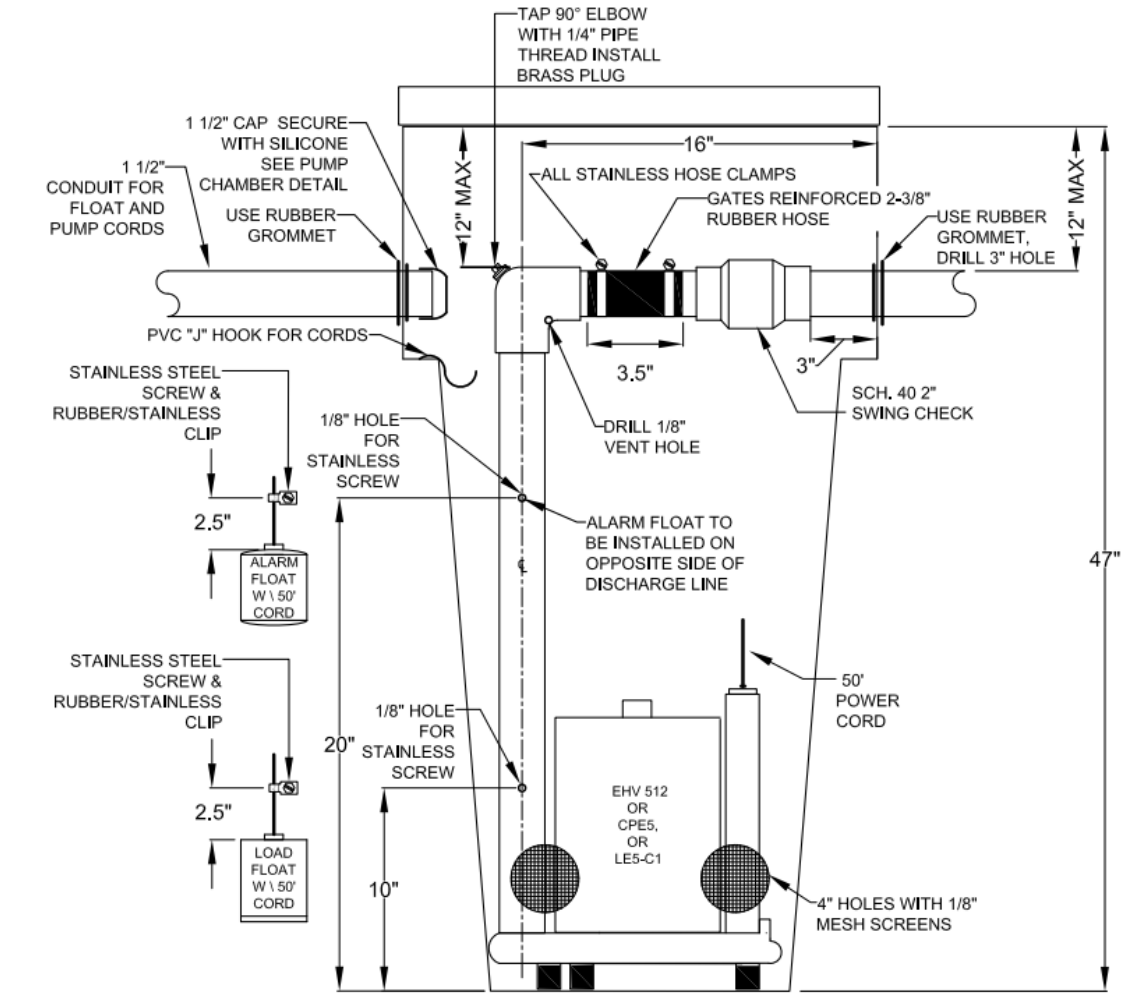
| | | |
|---|---|---|
| DATE: 11/01/2011 | LOW PRESSURE SERVICE CONNECTIONS DETAIL | PROVIDED FOR INFORMATIONAL PURPOSES ONLY. NO MODIFICATIONS WITHOUT WRITTEN CCU APPROVAL. |
| DRAWN BY: DEC | | LP-02 |
| APPROVED BY: BRB | CHARLOTTE COUNTY UTILITIES | ID: LPS-02-SRVCO.dwg |




| | | |
|---|---|---|
| DATE: 11/01/2011 | TYPICAL PUMP CHAMBER | PROVIDED FOR INFORMATIONAL PURPOSES ONLY. NO MODIFICATIONS WITHOUT WRITTEN CCU APPROVAL. |
| DRAWN BY: DEC | TOP VIEW DETAIL | LP-04 |
| APPROVED BY: BRB | CHARLOTTE COUNTY UTILITIES | ID: LPS-04-PCH.dwg |




| | | |
|---|---|---|
| DATE: 11/01/2011 | TYPICAL TANK INSTALLATION | PROVIDED FOR INFORMATIONAL PURPOSES ONLY. NO MODIFICATIONS WITHOUT WRITTEN CCU APPROVAL. |
| DRAWN BY: DEC | | LP-05 |
| APPROVED BY: BRB | CHARLOTTE COUNTY UTILITIES | ID: LPS-05-TYPINST.dwg |



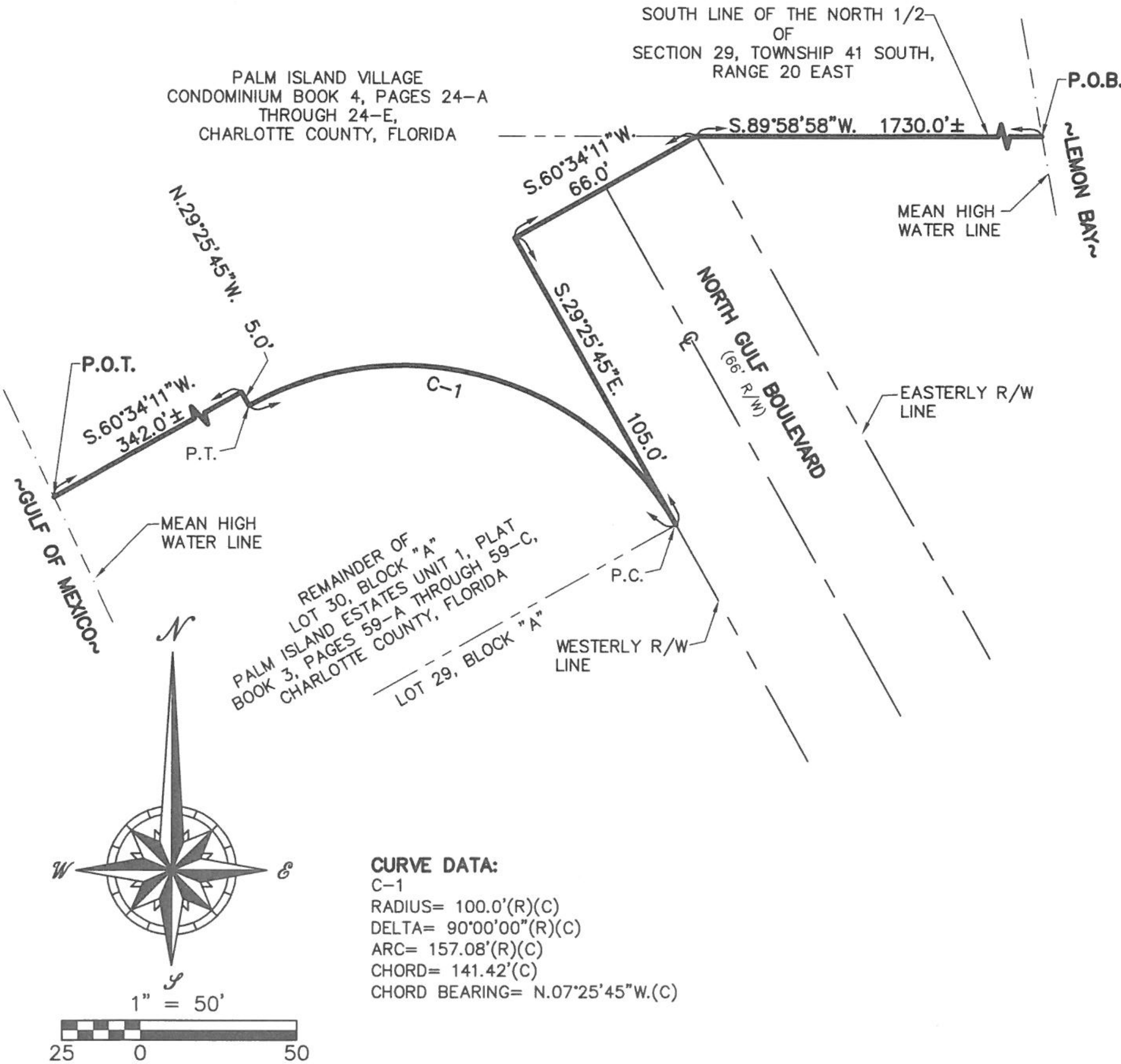

**NOTES:**

1. FIBERGLASS AND CONCRETE LPS TANK APPLICATIONS, IF RISER IS INSTALLED ALL PLUMBING SHALL BE MOVED TO WITHIN 12" OF BOTTOM OF LID.
2. ALL HARDWARE SHALL BE STAINLESS STEEL

SIDE VIEW
PUMP CHAMBER

| | | |
|---|---|---|
| DATE: 11/01/2011 | FIBERGLASS/CONCRETE LOW PRESSURE SEWER PUMP CHAMBER | PROVIDED FOR INFORMATIONAL PURPOSES ONLY. NO MODIFICATIONS WITHOUT WRITTEN CCU APPROVAL. |
| DRAWN BY: DEC | | LP-06 |
| APPROVED BY: BRB | CHARLOTTE COUNTY UTILITIES | ID:LPS-06-FLOAT.dwg |

# SKETCH AND DESCRIPTION:
# (EXHIBIT A)



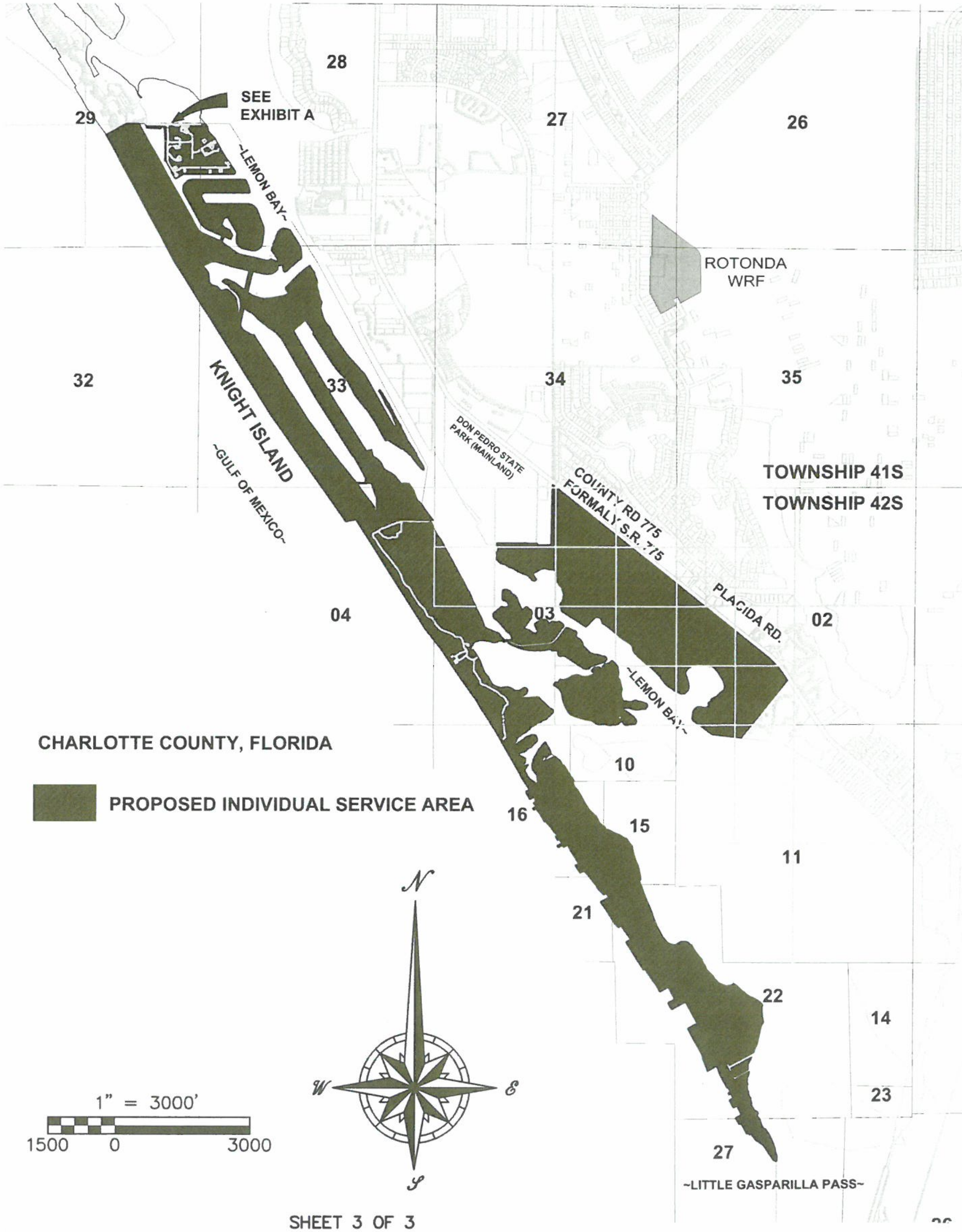

**CURVE DATA:**
C-1
RADIUS= 100.0'(R)(C)
DELTA= 90°00'00"(R)(C)
ARC= 157.08'(R)(C)
CHORD= 141.42'(C)
CHORD BEARING= N.07°25'45"W.(C)

SHEET 2 OF 3

NOTE:
1. This is not a boundary survey.
2. This sketch and description contains two (2) sheets and is intended to be used in its entirety.

| DMK ASSOCIATES ENGINEERS & SURVEYORS 4315 S. ACCESS ROAD ENGLEWOOD, FL. 34224 TEL: (941) 475-6596 FAX: (941) 475-1881 | DATE: 10/12/20 | JOB No. 20-0227A | |
|---|---|---|---|
| | SCALE: 1"=50' | DWN. JRM | CK'D WAM |
| | UPDATES & REV. | DATE | DWN. BY: |

# SKETCH AND DESCRIPTION: EXHIBIT D

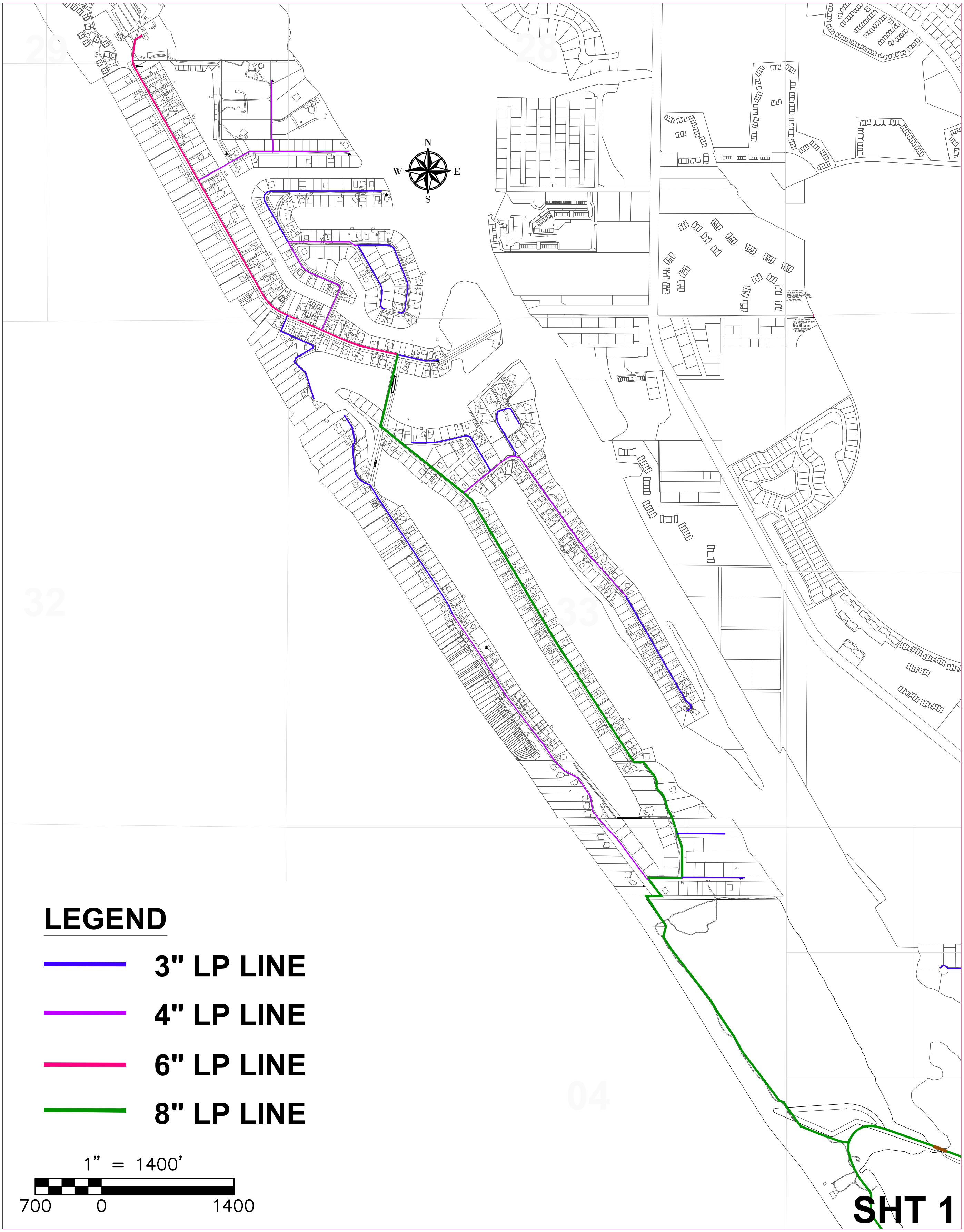



SHEET 3 OF 3

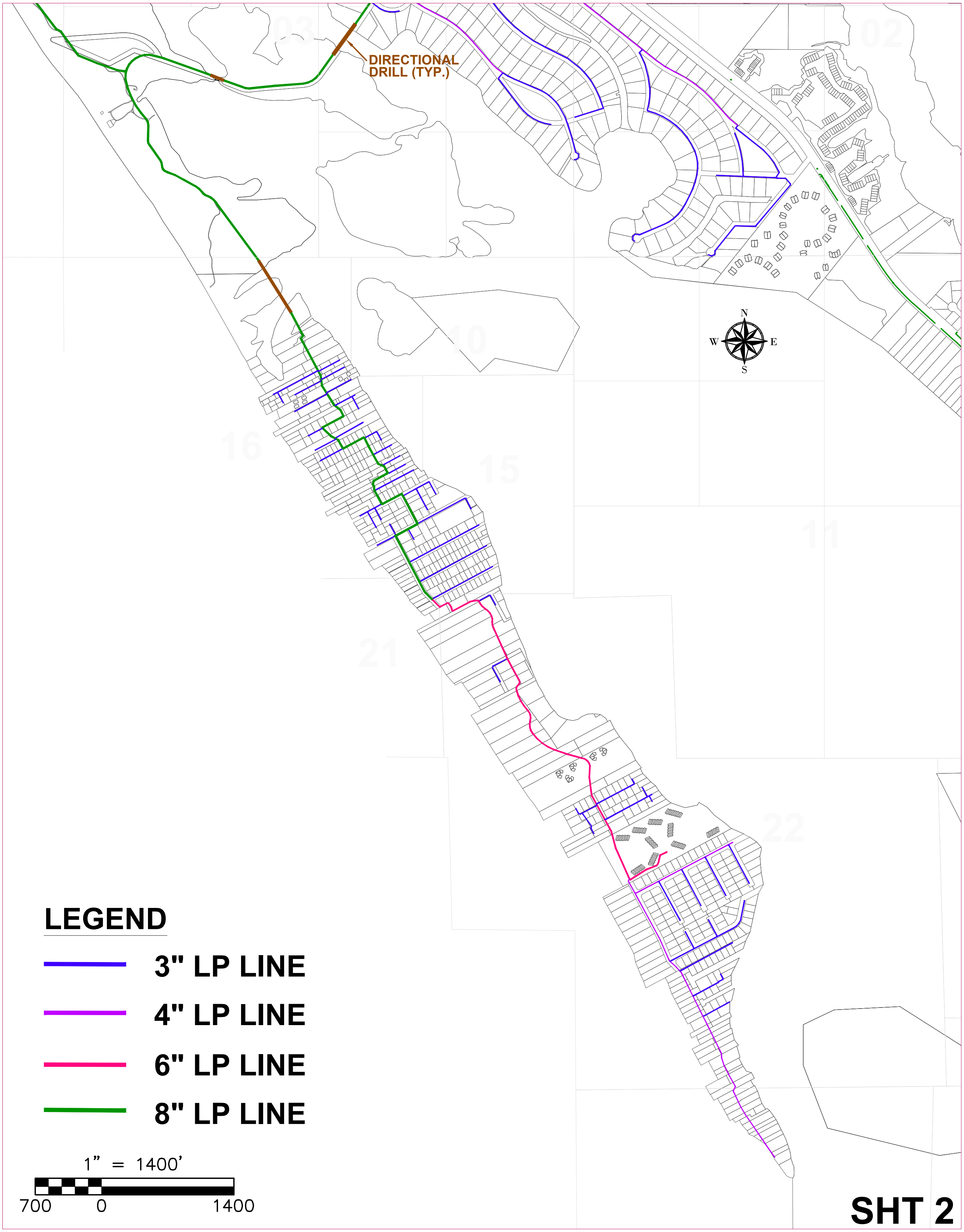
NOTE:
1. This is not a boundary survey.
2. This sketch and description contains two (2) sheets and is intended to be used in its entirety.

DMK ASSOCIATES ENGINEERS SURVEYORS
4315 S. ACCESS ROAD
ENGLEWOOD, FL. 34224
TEL: (941) 475-6596
FAX: (941) 475-1881

| | | | |
|---|---|---|---|
| DATE: 10/12/20 | JOB No. 20-0227A | | |
| SCALE:1"=3000' | DWN. TDM | CK'D WAM | |
| UPDATES & REV. | DATE | | DWN. BY: |




# BOCILLA AREA CONCEPTUAL PIPE NETWORK




# LGWU AREA CONCEPTUAL PIPE NETWORK

# ISLANDS

AN INDIVIDUAL SERVICE AREA OVER A PORTION OF THE FOLLOWING DESCRIBED LANDS, LYING IN THE FOLLOWING DESCRIBED FRACTIONAL SECTIONS OF LAND:

SECTION 28, TOWNSHIP 41 SOUTH, RANGE 20 EAST, SECTION 29, TOWNSHIP 41 SOUTH, RANGE 20 EAST, SECTION 32, TOWNSHIP 41 SOUTH, RANGE 20 EAST, SECTION 33, TOWNSHIP 41 SOUTH, RANGE 20 EAST, SECTION 3, TOWNSHIP 42 SOUTH, RANGE 20 EAST, SECTION 4, TOWNSHIP 42 SOUTH, RANGE 20 EAST, SECTION 10, TOWNSHIP 42 SOUTH, RANGE 20 EAST, SECTION 15, TOWNSHIP 42 SOUTH, RANGE 20 EAST, SECTION 16, TOWNSHIP 42 SOUTH, RANGE 20 EAST, SECTION 21, TOWNSHIP 42 SOUTH, RANGE 20 EAST, SECTION 22, TOWNSHIP 42 SOUTH, RANGE 20 EAST, SECTION 27, TOWNSHIP 42 SOUTH, RANGED 20 EAST, CHARLOTTE COUNTY, FLORIDA, SAID LANDS BEING BOUNDED ON THE WEST BY THE GULF OF MEXICO, BOUNDED ON THE EAST BY LEMON BAY AND GASPARILLA SOUND, BOUNDED OF THE SOUTH BY LITTLE GASPARILLA PASS AND BOUNDED ON THE NORTH BY THE FOLLOWING DESCRIBED LINE:

COMMENCE AT THE SOUTHEAST CORNER OF SAID SECTION 29 THENCE NORTH 00 DEGREES 00 MINUTES 00 SECONDS EAST A DISTANCE OF 2717.15 FEET TO THE INTERSECTION WITH THE SOUTH LINE OF THE NORTH HALF OF SAID SECTION 29; THENCE SOUTH 89 DEGREES 58 MINUTES 58 SECONDS WEST ALONG SAID SOUTH LINE OF THE NORTH HALF OF SAID SECTION 29 A DISTANCE OF 60 FEET MORE OR LESS TO THE INTERSECTION WITH WESTERLY MEAN HIGH WATER LINE OF LEMON BAY AND THE POINT OF BEGINNING; THENCE CONTINUE SOUTH 89 DEGREES 58 MINUTES 58 SECONDS WEST ALONG SAID SOUTH LINE OF THE NORTH HALF OF SAID SECTION 29, TOWNSHIP 41 SOUTH, RANGE 20 EAST, A DISTANCE OF 1730.0 FEET MORE OR LESS TO THE INTERSECTION WITH THE EASTERLY RIGHT-OF-WAY LINE OF NORTH GULF BOULEVARD (66 FOOT RIGHT-OF-WAY) AS SHOWN OF THE PLAT OF PALM ISLAND VILLAGE, A CONDOMINIUM, ACCORDING TO THE PLAT THEREOF, AS RECORDED IN CONDOMINIUM BOOK 4, PAGES 24-A THROUGH 24-E, OF THE PUBLIC RECORDS OF CHARLOTTE COUNTY, FLORIDA; THENCE SOUTH 60 DEGREES 34 MINUTES 11 SECONDS WEST, A DISTANCE OF 66.0 FEET TO THE WESTERLY RIGHT-OF-WAY LINE OF SAID NORTH GULF BOULEVARD; THEN SOUTH 29 DEGREES 25 MINUTES 45 SECONDS EAST, ALONG SAID WESTERLY RIGHT-OF-WAY LINE OF NORTH GULF BOULEVARD, A DISTANCE OF 105.0 FEET TO THE POINT OF CURVATURE OF A CIRCULAR CURVE TO THE LEFT; THENCE ALONG THE ARC OF SAID CURVE IN A NORTHWEST DIRECTION; HAVING A RADIUS DISTANCE OF 100.0 FEET, A CENTRAL ANGLE OF 90 DEGREES 00 MINUTES 00 SECONDS, WHOSE RADIUS POINT BEARS SOUTH 60 DEGREES, 34 MINUTES 15 SECONDS WEST, A ARC DISTANCE OF 157.08 FT TO THE POINT OF TANGENT OF SAID CURVE; THENCE NORTH 29 DEGREES, 25 MINUTES 45 SECONDS WEST, A DISTANCE OF 5.0 FT; THENCE SOUTH 60 DEGREES, 34 MINUTES 11 SECONDS WEST, A DISTANCE OF 342.0 FEET MORE OR LESS TO THE MEAN HIGH WATER LINE OF THE GULF OF MEXICO AND THE POINT OF TERMINUS OF SAID LINE.

# EXHIBIT E-5
# [Line Capacities]

## Proposed Low Pressure Pipe Capacity
(assuming max velocity of 8 ft./sec)

| Diameter | ERC's sewer |
|---|---|
| 3" | 60 |
| 4" | 480 |
| 6" | 960 |
| 8" | 2240 |

**CERTIFICATE OF SERVICE**

I HEREBY CERTIFY that a true and correct copy of the foregoing prefiled testimony has been furnished by E-mail to the following parties this 23rd day of August, 2024:

Palm Island Estates Association, Inc.
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Linda Cotherman
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Holtzman Vogel PLLC
Robert Volpe, Esquire
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Kkentnor@holtzmanvogel.com

*/s/ Martin S. Friedman*
Martin S. Friedman