Final

LONGBOAT KEY SUBAQUEOUS FORCE MAIN

Permit Support Document

Prepared for
Town of Longboat Key

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1.1 Introduction

Under current conditions, domestic wastewater from the barrier island Town of Longboat Key (Town) is collected and pumped, via Lift Station D, to the mainland for treatment at the Manatee County Southwest Regional Water Reclamation Facility (SWRWRF). The wastewater is transported via a 20-inch inner diameter (ID) ductile iron pipe (DIP) force main that was constructed in 1973 and placed into operation in 1975. This pipeline is the sole mode of wastewater transmission from the barrier island to the mainland and has been in continuous service for 45 years. The service life is considered to be 50 years. The existing force main was constructed using barge mounted equipment that excavated an open trench along the bottom of Sarasota Bay, laid the pipe in the trench, and then buried the pipe with the excavated material. Upon project completion, an as-built survey was completed.

The subaqueous force main provided decades of service without any known incidents of leakage or failure. However, due to concerns about the age of force main, the Town began conducting inspections of the subaqueous pipeline to determine the depth of the bury and the general external condition of the ductile iron pipe. Inspections were conducted in 1992, 1996, 2007, and 2011 (Suboceanic Consultants, Inc., 1992 and 1996; Dive Tech International, 2007 and 2011). In 2017 the Town conducted an internal Smart Ball® pipe wall assessment of the force main interior condition to determine the pipe wall thickness and degree of corrosion (Greeley & Hansen Engineers, 2017). The conclusions derived from the external inspections were that the force main was generally in good condition with sufficient bury depth (e.g., 2 foot minimum); while the 2017 internal inspection concluded that the pipe wall thickness was sufficient to provide another 15-20 years of service.

Given the age of the force main the Town contracted with CDM Smith in 2015 to evaluate five alternative alignments (routes), including the existing alignment, as well as various pipe materials and alternative construction approaches for replacing the existing force main (CDM Smith/Laney, 2015). A total of 90 scenarios (alignment + pipe material + construction approach) were identified. After an initial feasibility screening, the list of scenarios was reduced to 44. These various scenarios were ranked pursuant to a range of criteria.

The highest ranked scenario was the existing alignment (Alignment 1) using a single pull Horizontal Directional Drill (HDD). However, these conclusions were qualified, contingent upon the determination of suitable geotechnical conditions in the subaqueous portion of the alignment, as well as the technical feasibility of conducting a single pull HDD under the 2.3 mile crossing of

Sarasota Bay. At the time of this writing, the 2.3-mile crossing of Sarasota Bay would be longest HDD single pull subaqueous project in the U.S., testing the limits of this technology.

Due to concerns about the technical feasibility and cost of the HDD construction approach, the Town contracted with Carollo Engineers (Carollo) and Environmental Science Associates (ESA) in 2017 to initiate discussions with the Florida Department of Environmental Protection (FDEP) and the U.S. Army Corps of Engineers (USACE) to assess the permitability of an open cut construction approach to install a redundant force main adjacent to the existing force main. Based on the feedback received from the FDEP and USACE in these meetings, ESA conducted an environmental assessment of the marine resources at risk in the existing alignment - including seagrasses, mangroves, and oysters (ESA, 2019).

In 2019 Carollo and ESA conducted pre-application meetings with the FDEP and the USACE, during which the findings of the environmental assessment were presented, and the intent to pursue an open cut construction approach within the existing alignment was discussed. Feedback was received from both agencies with respect to the need to conduct an alternatives analysis, and to select an alignment and construction approach that best avoids and/or minimizes environmental impacts and risks.

On June 29, 2020, a sewage leak was discovered within the mangrove fringe along the east side of the existing force main alignment in Manatee County, approximately 400 feet from the open waters of Sarasota Bay. The cause of the leak appeared to be corrosion of the pipe where it was found to be in contact with a log or tree stump (see **Figure 1-1**).

Figure 1-1
Photograph of Existing Force Main Leak

The leak was quickly contained and repaired within a few days, and the volume of sewage that was discharged to the environment was determined to be approximately 11 million gallons. A pending Consent Order agreement is being negotiated with the FDEP. This incident has raised new concerns about the condition and remaining service life of the existing force main, thus creating an urgent need for the construction of a new redundant force main at this time.

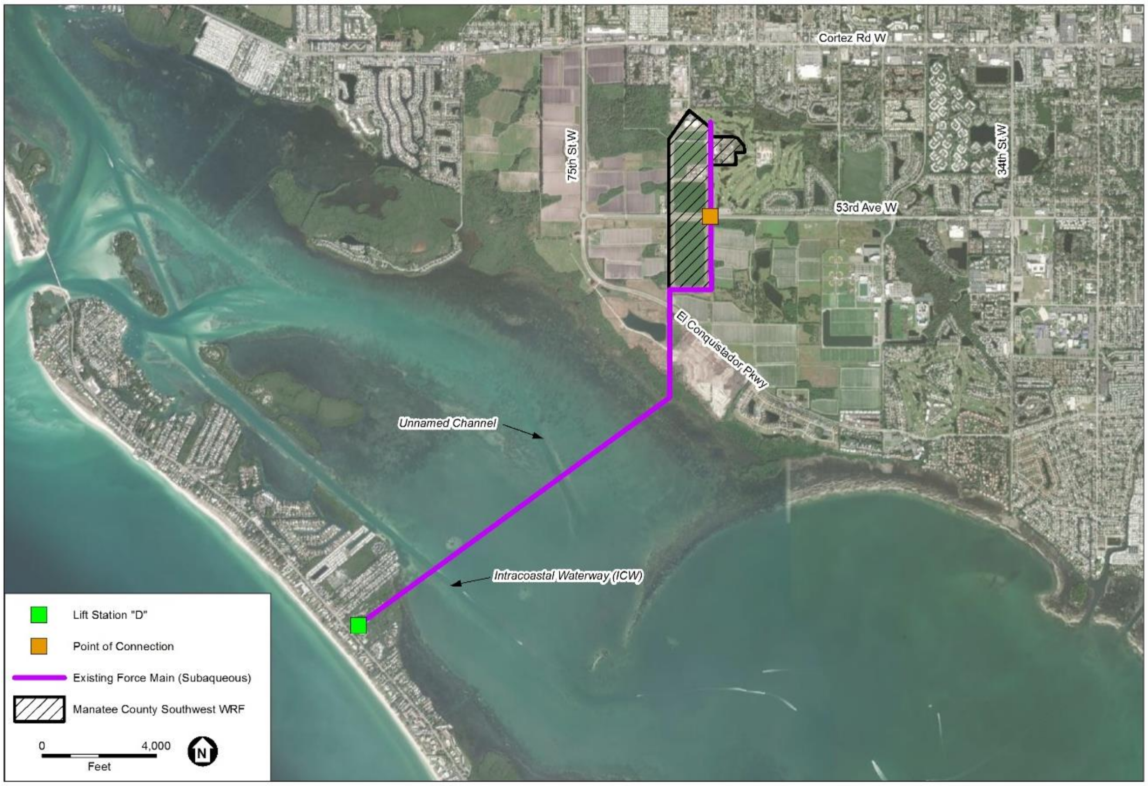
This document provides a summary of the alternatives analysis conducted by the Carollo/ESA consultant team, and describes the proposed open-cut construction approach for the preferred alignment. Existing environmental conditions are described, temporary impacts to marine resources are quantified, and proposed means to offset those impacts are presented.

1.2 Purpose and Need

The purpose of the proposed project is to construct a redundant domestic wastewater force main adjacent to, and north of, the existing force main. Given the approaching end of the projected service life of the existing force main, and the recently discovered and repaired sewage leak, there is a high degree of urgency to obtain permits and complete this critical infrastructure project expeditiously. Should the existing force main fail completely, the only alternative for conveying domestic sewage flows from Longboat Key is via tanker and pumper trucks.

In 2015, the Town prepared a Subaqueous Wastewater Forcemain Emergency Procedures Technical Memorandum (Carollo, 2015). The analysis completed as part of this document determined the number of trucks that could be utilized, the most efficient truck routes, and necessary loading and travel timing to transfer wastewater from the Town to the Manatee County and City of Sarasota collection systems in case of a force main failure. It was determined that the Town’s typical average daily flow (approximately 1.6 million gallons per day (mgd) could potentially be hauled under optimum handling. In order to transport this quantity of wastewater, the use of 24 trucks with varying volume and loading capacities under continuous 24/7 operation would be required, along with a sufficient number of properly licensed and insured truck drivers. While theoretically feasible, this scenario would cause substantial truck traffic on the island, would require a very well-coordinated and communicated effort between the various local governments, and would clearly be a challenge to execute. Higher flows during wet weather periods (up to 4 mgd) could not be fully hauled due to constraints with truck and driver availability, loading time requirements, truck traffic, and other complicating factors.

As proposed, the redundant force main will be constructed of 20-inch ID High Density Polyethylene (HDPE) pipe, which is impervious to corrosion and is highly resilient, thus making it ideal for applications in the marine environment. The proposed new force main will be constructed adjacent to, and north of the existing force main using an open cut trench construction approach. Upon completion of the new force main, the existing force main could be rehabilitated by lining it with a smaller diameter HDPE pipe, upon which it could be used as a redundant sewage line, or used for the return of the highly treated reclaimed water back to Longboat Key to offset the use of potable water for irrigation. The location and alignment of the existing and proposed new force main is shown in **Figure 1-2** below.



SOURCE: Carollo, 2020; ESA 2020

Longboat Key Force Main Replacement Project

Figure 1-2
Existing Force Main Alignment

During construction, impacts to the surface area of the bay bottom, as well as to the mangrove fringe on both ends of the project, will be minimized through tight confinement of the work areas using sheet piling, shoring, and turbidity screens. **It must be emphasized all impacts to wetlands and aquatic resources will be temporary impacts, as there will be no permanent loss of resources, or suitable elevations and bathymetric depths to support such resources, due to the proposed dredging and filling associated with the proposed project.**

Furthermore, the proposed project has the potential to result in a net environmental benefit to the Sarasota Bay marine ecosystem with respect to seagrass recovery. As discussed in Section 3 of this document, portions of the open cut trench previously excavated for the placement of the existing force main were never properly backfilled, resulting in persistent deep areas with bottom depths that have never supported seagrass, even when seagrass coverage was at its apex in early 2018. In addition, an unnamed dredged channel runs perpendicular to the existing force main along the eastern side of the project. This channel was dredged prior to Clean Water Act requirements, and it too has bottom depths that have never supported seagrass.

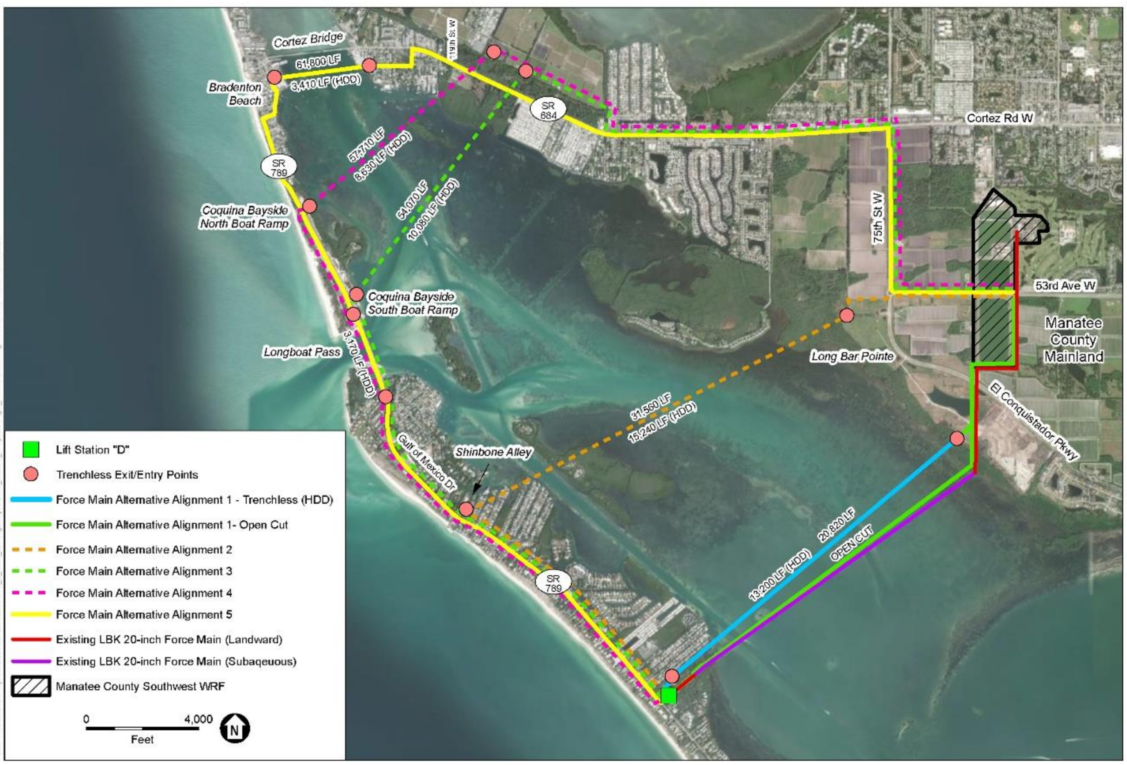
As part of the proposed project, the old trench cut, and a portion of the unmarked dredged channel will be backfilled to adjacent grade with suitable sediment material, and appropriately stabilized to support seagrass recovery. The proper backfilling of these deep areas to support seagrass recovery in the project vicinity is expected to fully offset all temporary disturbances to marine benthic communities associated with project construction, as well as result in a net increase in seagrass coverage.

SECTION 2
Alternatives Analysis

The primary focus of this Section is to document the various alternatives that were evaluated in the development of the proposed alignment and construction method for crossing the Sarasota Bay.

2.1 Alignment Alternatives Considered

The term "alignment" refers to the routing of pipeline. Six alternative alignments, as well as variations on those alignments, were developed and fully evaluated pursuant to a number or criteria in the document titled *Town of Longboat Key, Florida – Subaqueous Force Main Replacement Final Feasibility Study Technical Memorandum* (CDM Smith/Laney, 2015), provided as an appendix to this document. Those alignment alternatives are depicted on **Figure 2-1** below.



SOURCE: Carollo, 2020; ESA 2020

Longboat Key Force Main Replacement Project

Figure 2-1
Force Main Alignment Alternatives

These alternatives were developed based upon the project parameters identified by The Town along with Carollo Engineers, Inc., and were included in the Request for Qualifications for a project to be delivered by the Design-Build approach. The routing alternatives all included the following basic components:

- Landward pipeline on Longboat Key;
- Subaqueous pipeline under Sarasota Bay;
- Landward pipeline on the mainland.

A route following the alignment of the existing force main was used as a starting point to evaluate alternative routes for a new force main. When considering trenchless methods of crossing the Bay, the length of the crossing plays an important role in the feasibility. Each of the alternative alignments has varying lengths of subaqueous pipeline. Alignments that offer a shorter Bay crossing were considered. Those alignments trade off shorter subaqueous lengths for longer landward construction lengths.

Other potential alignments were explored but were ultimately removed from further consideration. Potential subaqueous alignment crossings farther south than the current force main alignment would increase the required length of the subaqueous crossings and would add overall length as the shorelines diverge moving south. Potential subaqueous alignment crossings farther north than Alignment 5 were not considered viable due to added overall length without additional advantages.

The CDM Smith/Laney (2015) analysis considered two methods of subaqueous installation: 1) an HDD trenchless installation; and 2) an open-cut trench installation. Within these two general methods they developed four construction scenarios for the subaqueous reaches of the all the viable alignments, including the following:

1. All Open-Cut - barge mounted equipment is used to excavate a trench in the bay and install the pipe;
2. The typical HDD approach - drill from one side of the crossing to the other in what is called a single pull;
3. Intermediate pull point (IPP) HDD - two HDD drills can be initiated from opposite shores and meet in the middle of the bay;
4. Hybrids of the IPP method combing a partial Bay crossing using HDD and the balance of the crossing using open-cut trenches.

CDM Smith/Laney (2015) generated scenarios by coupling alternative alignments with: 1) alternative construction methods; and 2) various viable pipeline materials. It should be noted that their primary directive was to evaluate trenchless construction approaches (e.g., HDD), as an open cut trench approach across the Bay was generally considered to be infeasible due to permitting concerns about the extent of seagrass in the project vicinity at the time. They then evaluated each of the scenarios pursuant the following criteria:

- Permitability;
- Land acquisition;

- Public impact;
- Safety;
- Construction risk;
- Environmental impact;
- Long-term integrity/O&M;
- Long Range Area Planning;
- Utility conflicts;
- Cost.

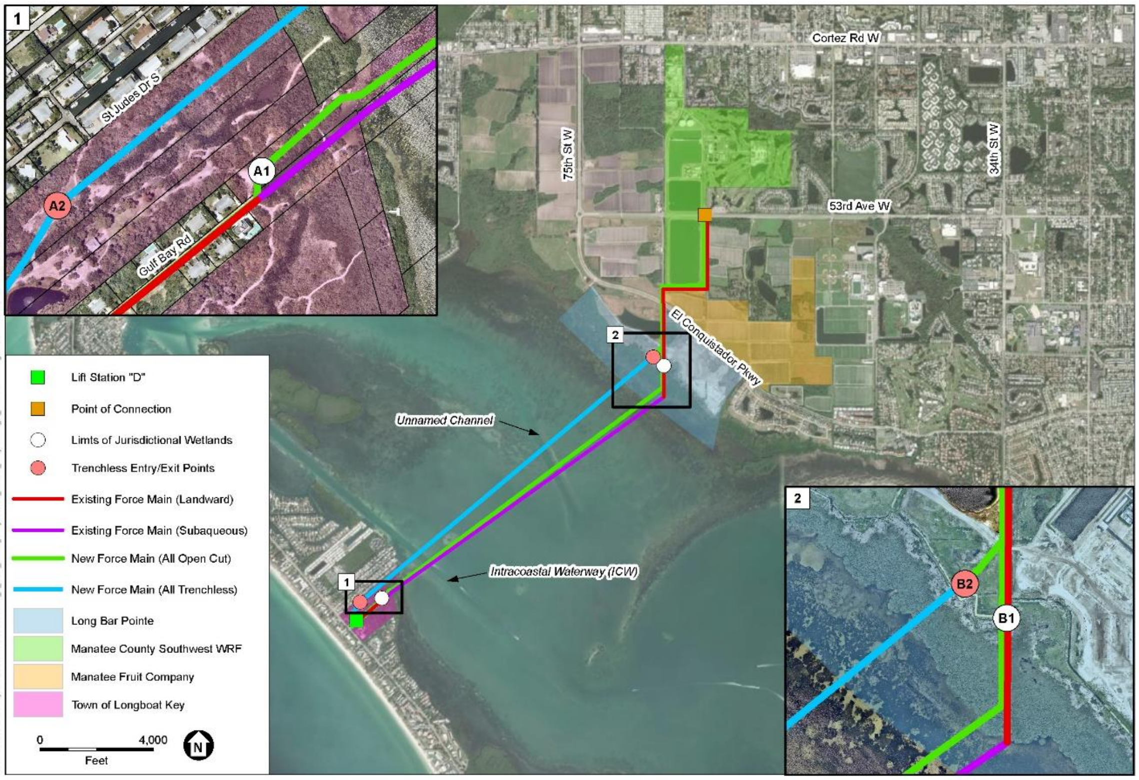
CDM Smith/Laney (2015) identified Alignment 1 as the highest ranked and preferred alignment, and recommended a single HDD pull with steel pipe as the preferred installation method and pipe material for the subaqueous pipeline, respectively. The primary reasons for their recommendation of Alignment 1 with a single HDD crossing of the Bay were because: 1) it provided the shortest route with the least environmental impacts (e.g., mangrove impacts); and 2) it could be completed in the shortest schedule because all necessary rights-of-way are already in place. All alignments other than Alignment 1 would involve substantial land and/or rights of way acquisition, public impacts (e.g., traffic disruption), and utility conflicts; as well as new environmental impacts to wetlands and aquatic resources associated with landfalls on both ends of the subaqueous HDD pipeline.

The alternative alignments shown in Figure 2-1 above were presented to FDEP and USACE by the Carollo/ESA consultant team during pre-application meetings conducted in September 2019, with respect to an open-cut trench construction approach. Exploration of the open-cut trench approach with the agencies was pursued by the Town primarily because two factors: 1) engineering constraints associated with various trenchless technologies; and 2) substantial losses of seagrass in the project vicinity following the 2018 red tide event, as well as general water quality degradation. The recent history of seagrass coverage and water quality conditions in this portion of Sarasota Bay are discussed in detail in Section 3 of this document.

The USACE representatives at that meeting agreed that alternative Alignments 2, 3, and 4 did not appear to be substantial improvements over Alignment 1; however, the agency representative advised the consultant team to evaluate Alignment 5 as it minimized the subaqueous segments. Therefore, the remainder of this Alternatives Analysis addresses only Alignment 1 - and various construction approaches within this alignment - and Alignment 5.

2.2 Alignment 1

Alignment 1 occurs within the general corridor of the existing force main. **Figure 2-2** shows a detailed plan view of Alignment 1. For the purposes of the requested environmental permits, the project limits of the subaqueous force main extend from the jurisdictional wetland limits on the western end of the project (Point 1) to the approximate jurisdictional wetland limits on the eastern end of the project (Point 2).



SOURCE: Carollo, 2020; ESA 2020

Longboat Key Force Main Replacement Project

Figure 2-2
Plan View of Alignment 1

2.2.1 Proposed Facilities

The proposed facilities for Alignment 1 include: 1) landward pipeline installation from Lift Station D to the end of Gulf Bay Road; 2) a subaqueous pipeline installation from the eastern shoreline of Joan Durante Park to the western shoreline of the Manatee County mainland; and 3) landward pipeline installation to the Manatee County SWRWRF.

Existing Lift Station D will convey the wastewater from Longboat Key to the SWRWRF along Alignment 1. An updated hydraulic analysis recently performed by Carollo for Alternative 1 identified that the current maximum flow capacity of Lift Station D is approximately 3,500 gallons per minute (GPM). The proposed pipeline in Alignment1 maintains similar hydraulic conditions and allows for the station to perform properly. Therefore, no station improvements are anticipated with respect to Alignment 1. To support this flow capacity, a 20-inch ID pipeline is the appropriate size pipeline for Alignment 1, which would be constructed parallel to the existing 20-inch force main using open-cut trenching, trenchless construction methods, or combinations of these two approaches.

2.2.2 Project Segmentation

With respect to wetlands and aquatic resources, the proposed project for Alignment 1 can be broken into five segments, moving from the western terminus to the eastern terminus, as described below.

- **Segment 1 – Intertidal Zone:** extends from western end of jurisdictional wetland limits in Joan Durante Park on the Longboat Key mainland eastward to the end of the intertidal zone (e.g., mangrove edge);
- **Segment 2 – Shallow Subtidal Zone:** extends from the edge of the intertidal zone to the eastern edge of the Intracoastal Waterway (ICW);
- **Segment 3 – Deep Subtidal Zone:** extends from the western edge of the ICW to the eastern edge of an unnamed dredged channel;
- **Segment 4 – Shallow Subtidal Zone:** extends from the eastern edge of the unnamed channel to the beginning of the intertidal zone on the mainland of Manatee County mainland (e.g., mangrove edge);
- **Segment 5 – Intertidal Zone:** extends from the beginning of the intertidal zone to the eastern end of jurisdictional wetland limits.

Figure 2-3 shows the extent and boundaries for each of the five project segments, while **Table 2-1** below summarizes the length, typical elevations/depths, wetlands and aquatic resources, and other pertinent features found in each segment.

TABLE 2-1
SUMMARY OF ALIGNMENT 1 PROJECT SEGMENT FEATURES

Segment	Approx. Length (linear feet LF)	Tidal Zone - Typical Elevations/Depths	Wetlands and Aquatic Resources	Other Pertinent Features
1	450 LF	Intertidal zone +2 feet to -2 feet, MSL	Mangroves and other tidal herbaceous vegetation	Public park trail and footbridge
2	1,360 LF	Shallow subtidal zone -2 feet to -5 feet, MSL	Sparse and continuous seagrass; bare sediment	Shallow subtidal benthic communities
3	4,850 LF	Deep subtidal zone -8 feet to -12 feet, MSL	Limited sparse seagrass; bare sediment	ICW channel; deep trench of existing pipeline; unnamed channel
4	4,290 LF	Shallow subtidal zone -5 feet to -2 feet, MSL	Sparse and continuous seagrass; limited oysters; bare sediment	Shallow subtidal benthic communities;
5	960 LF	Intertidal zone -2 to +2 feet, MSL	Mangroves and other tidal herbaceous vegetation	Fill road and dead mangroves from sewage leak remediation

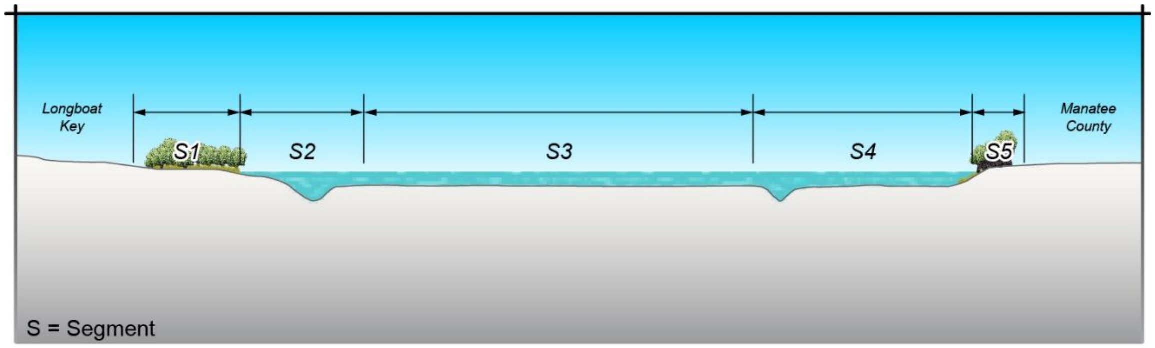


Figure 2-3
Alignment 1 Project Segmentation

With respect to conceptual design of the project, and the various construction methods considered, Alignment 1 can be more conveniently broken into three segments, moving from the western terminus to the east as follows: Segments 1-2, Segment 3, and Segments 4-5. These three segments are defined by ICW channel on the west of the alignment, and the unnamed channel on the east, which generally delineate breaks in depth zones and aquatic resource distributions.

2.2.3 Potential Construction Methods

As discussed above, the CDM Smith/Laney (2015) alternatives analysis focused primarily on Horizontal Directional Drill (HDD) construction alternatives. However, based on current conditions in Sarasota Bay, discussed in detail in Section 3 of this document, as well as recent advances in trenchless technology, three potential construction approaches are discussed and evaluated in the subsections below. These three construction approaches include: 1) open-cut trench; 2) Horizontal Directional Drill; 3) Direct Pipe®(DP). These three approaches are briefly discussed below.

Open-Cut Trench (OC)

This installation method is the same as that used for the original force main in 1973. Barge mounted equipment is used to excavate a trench in the bay bottom using a bucket dredge, and to lay the pipe. The trench is backfilled using the native material displaced from the excavation. This method has the greatest potential direct impact on the affected bay bottom, but results in only temporary disturbances environment as the cut is immediately backfilled with native sediments to pre-existing grades.

A subaqueous open-cut trench installation of a new Longboat Key force main assumes the installation of a new 20-inch ID HDPE pipeline at approximately 50 feet north of the existing 20-inch DIP force main to reduce the potential for disturbance of the existing force main and the sediments in which it is currently embedded. For open cut installations, any number of pipe materials could be installed. However, due to its flexibility and bending capacity, corrosion resistance, overall safety and longevity in the marine environment, and butt fusion joining allowing long lengths to be preassembled; HDPE is the Town's preference and is the pipe material selected for an open-cut installation.

Horizontal Directional Drill (HDD)

HDD is a trenchless pipeline installation method that can be used for crossing major roadway intersections and waterways, and was the primary focus of the CDM Smith/Laney (2015) analysis. Horizontal directional drilling can be divided into two main classes, Mini-HDD and HDD, based upon the size of the product being installed and the length of the bore. Mini-HDD is for drive lengths of less than 600 feet and pipe sizes up to 10 inches in diameter. Pipe diameters between 12 and 60 inches. and pipe lengths up to about 2,000 feet. can be installed by HDD where suitable geologic conditions exist. The distinction between Mini-HDD and HDD is made mainly due to the types of equipment involved. For this project, Mini-HDD is not applicable.

HDD crossings are installed between an entry and exit area, and involve the use of a drill rig tilted at the top at an angle, typically in the range of 10 to 15 degrees from horizontal. A small diameter (4- to 8-inch diameter) pilot hole is first drilled along a pre-determined horizontal and vertical alignment from the entry to exit area. This pilot hole can be guided using electromagnetic readings transmitted from the drill bit back to the drill rig. Excavation takes place by introducing pressurized slurry (a thin mixture of water and clay drilling fluids) through a drill string to the bit. The slurry pressure in combination with a rotating drill bit excavates the material, which is then transported back to the entry area along the outside of the drill string. In some cases, a larger diameter wash pipe may be rotated around the drill string to prevent sticking of the steerable string.

Entry and exit areas are required at each side of the crossing. These areas are approximately 50 to 100 feet square by approximately 5 feet deep minimum, and are used as the collection point for the fluid material removed during drilling, which is a mixture of the drilling slurry and spoil. This fluid is then pumped to a slurry separation plant to separate the spoil from the fluid so that the fluid can be reused. The pilot hole is then enlarged by pulling larger reamers from the pilot exit back towards the drilling rig. The pipeline is then pulled into place behind the last reamer.

The entry side requires a work area of approximately 1,500 to 3,000 square feet for the drill rig, slurry separation plant, material storage and other support equipment. The exit side requires a work area of about 1,000 to 1,500 square feet for the pullback. This area is exclusive of the area needed for the pipe assembly and laydown area. Typically, a corridor about 15 feet wide by the length of the pipe is needed for the buildup and laydown.

For this project HDD rigs would be set up on land on both sides of the subaqueous crossing. The location for terminating the drill and the location for pulling the pipe differs with the various alternatives but is either on land or at a location midway into the Bay. For longer crossings, two HDD rigs will be set up on opposite sides of the Bay and drill towards each other using the intersect method. Once the drills intersect, the borehole is completed using both machines in a push/pull fashion. As noted above, this approach is referred to as an Intermediate Pull Point (IPP).

The final bore diameter must be larger than the product diameter to reduce frictional pullback loads and to facilitate flow of the drilling fluids around the product. As a rule of thumb, the final bore diameter should be the lesser of the product diameter plus 12 inches or 1.5 times the diameter of the product. All pullback involves one continuous string of pipe. **Figure 2-4** below shows a conceptual diagram of a typical HDD project.

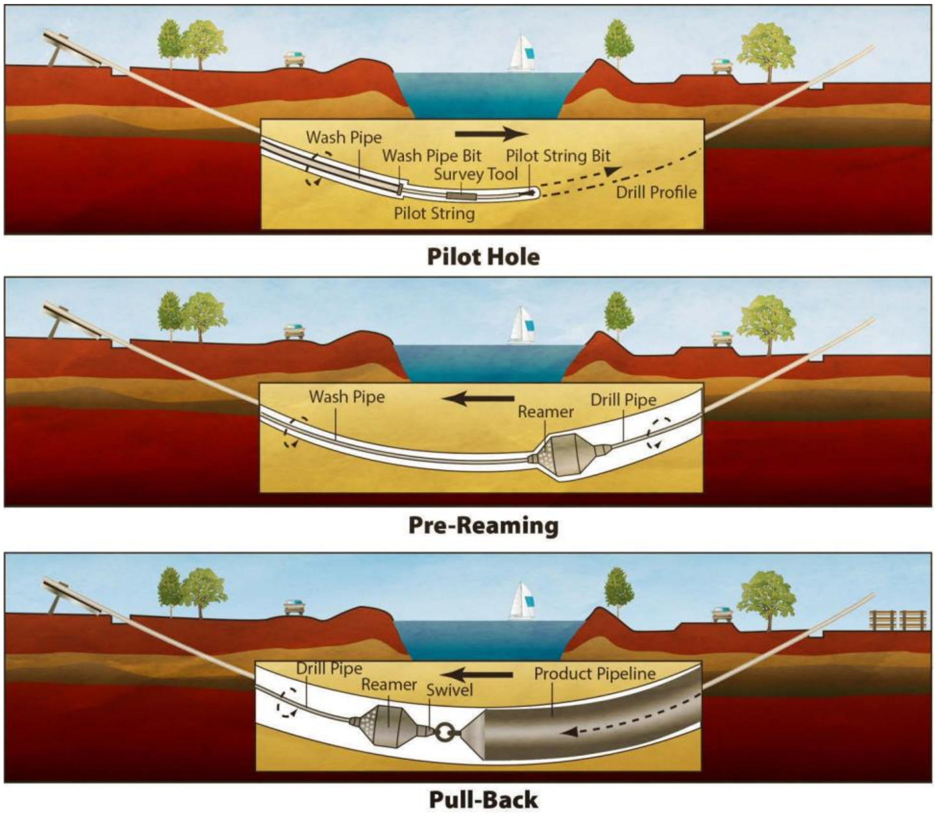


Figure 2-4
Schematic of a Horizontal Directional Drill Project

Direct Pipe® (DP)

Direct Pipe is a recently developed trenchless construction method, with a limited track record for subaqueous crossing in the marine environment. This alternative combines a pipe thruster and tunneling machine, allowing a borehole to be created and pre-welded pipeline to be inserted in one continuous step. A DP installation can be launched from the surface or a shallow shaft and can be accurately steered to navigate a precise route. However, the length of a DP installation is limited. Typically, the borehole diameter must be 48 inches or larger; therefore, for application on this project a 48-inch steel pipe would be installed as a casing for the proposed 20-inch HDPE force main, thus adding substantial material costs. DP on this project would be limited to less than half the length of the subaqueous crossing (e.g., <1-mile maximum), requiring at least some subaqueous open-cut excavation to retrieve the tunneling machine.

Table 2-2 below compares and contrasts the advantages and disadvantages of the OC, HDD, and DP construction methods with respect to this project.

TABLE 2-2
COMPARISON OF ALIGNMENT 1 CONSTRUCTION METHODS

Advantages	Disadvantages
Open-Cut Trench	
The most proven and has the lowest risks during construction – this approach was used for the existing force main.	Results in the temporary physical disturbance of bay bottom and associated benthic communities.
Allows for the greatest flexibility of pipe materials.	Results in temporary physical disturbances to intertidal wetlands
Allows for the greatest flexibility and control of the vertical alignment of the pipeline.	Soft bay sediments could result in differential settlement of the pipeline.
Can be installed at shallow depths with 4-5 feet of sediment cover – allowing for periodic inspection.	Construction across the ICW will result in temporary disruptions to vessel navigation, requiring coordination with the U.S. Coast Guard.
At shallow installation depths construction costs are substantially less than trenchless designs.	Construction across the subaqueous power line will require coordination with FPL.
No risk of frac-outs; turbidity can be effectively controlled in small contained work areas.	
The only approach that allows for simultaneous restoration of old dredge cuts in the project vicinity.	
Horizontal Directional Drill (HDD)	
Commonly used for land to land installations.	Longer installations (>1.5 mile) limit pipe materials to only steel.
Avoids or minimizes physical disturbances to the Bay bottom, benthic communities and intertidal wetlands.	Requires much deeper installation than open-cut trench.
Avoids temporary disruptions to vessel navigation through installation under the ICW.	Feasibility and risk are highly dependent on local geological conditions.
Avoids a subaqueous utility conflict during installation under the FPL power line.	Longer installations (>1.5 mile) increase the risk of borehole collapse and loss of installed pipe.
	An intermediate pull point (e.g., land to water) installation has the potential for frac-out of drilling fluids into the Bay.
Direct Pipe (DP)	
Typically used for shorter land to land installations.	The maximum length of a DP installation is <1-mile, thus requiring an open-cut trench is along some Segments.
Avoids or minimizes physical disturbances to the Bay bottom, benthic communities and intertidal wetlands.	Requires much deeper installation than open-cut trench; allows for only minimal control of vertical alignment.
Avoids temporary disruptions to vessel navigation during installation under the ICW.	Requires the installation of a 48-inch steel casing in which the 20-inch ID HDPE carrier pipe would be inserted.
Pipe is inserted as the borehole is created, thus reducing intermediate welds and the risk of borehole collapse.	DP is a newer technology than HDD and has not been extensively used in the U.S. for subaqueous marine crossings.
Laydown areas are more compact than those required for an HDD installation.	There are a limited number of contractors qualified to use this method of installation.
Uses significantly less drilling fluids than HDD, thus reducing the risk of borehore frac-out.	

2.2.4 Construction Alternatives Considered

In consideration of the advantages, disadvantages, constraints and risks associated with each of the construction methods discussed above, eight construction alternatives were developed for Alignment 1, and evaluated and ranked as part of this alternatives analysis. The eight construction alternatives are described and depicted in the subsections below. Segmentation of the hybrid alternatives are represented by designations of the construction method, moving from the western terminus of the project to the eastern terminus (e.g., HDD-OC-HDD).

Construction Alternative 1 – All Open-Cut Trench (OC)

Alternative 1 is comprised of approximately 12,200 linear fee of 20-inch ID diameter HDPE pipe installed using an open-cut trench construction method across all five project segments. **Figure 2-5** graphically depicts Alternative 1.

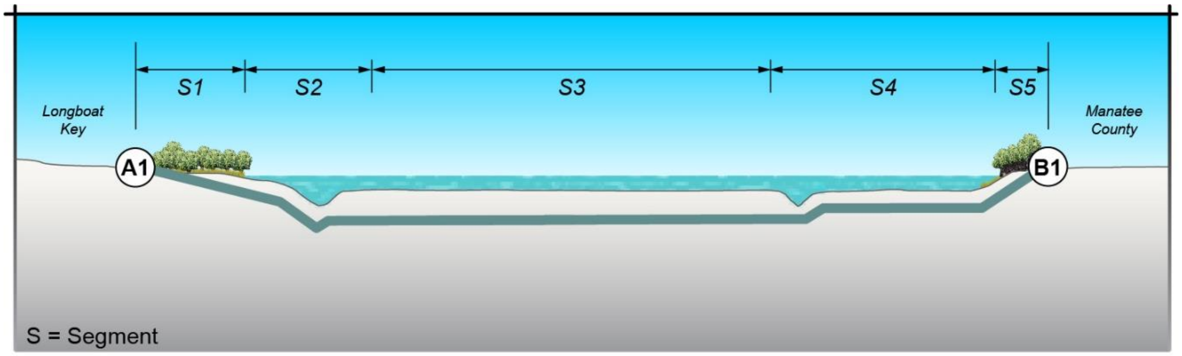


Figure 2-5
Schematic of Alternative 1

Construction Alternative 2 – All Horizontal Directional Drill (HDD)

Alternative 2 is comprised of approximately 12,200 linear fee of 20-inch ID Ductile Iron Pipe (DIP) pipe installed using a single pull Horizontal Directional Drill (HDD) construction method under all five project segments. This alternative would avoid virtually all impacts to wetlands and aquatic resources in Alignment 1. However, the length of this project would be the longest subaqueous HDD single pull project in the U.S., and would test the limits of the HDD technology. HDD requires consistent and hard geological substrates to drill through. The soft sediments and porous limestone underneath Sarasota Bay make HDD risky for a "frac-out" where pressurized drilling fluids break through their confinement in the borehole and discharge into the environment.

Furthermore, because of the length of the single pull, only metallic pipe could be used, as HDPE would not withstand the physical stress of installation. **Figure 2-6** graphically depicts Alternative 2.

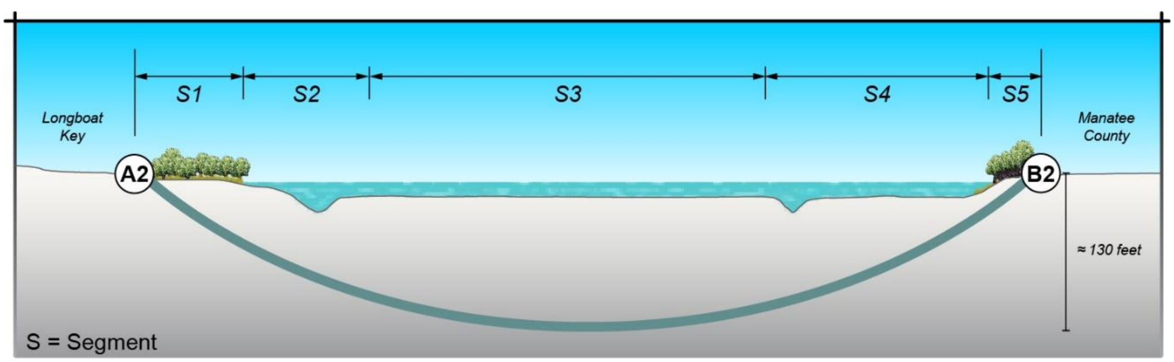


Figure 2-6
Schematic of Alternative 2

Construction Alternative 3 – Hybrid 1 (HDD-OC-HDD)

Alternative 3 combines the HDD and OC construction approaches. This alterative would avoid impacts to wetlands and aquatic resources in Segments 1-2 and 4-5. In this alternative, the HDD construction method would be used from both the western and eastern project termini and would extend under Segment 3 where the remainder of the pipe installation would be via open-cut trench. The western portion of HDD would be drilled from Longboat Key landside and extend under the ICW to some point under Segment 3. Similarly, the eastern portion of the HDD would be drilled from the Manatee County landside and extend under the unnamed channel also to Segment 3. Under this scenario, the HDD drilling would be conducted from the landsides; whereas the HDPE pipe insertion, stringing and fusion would all occur in the Bay within Segment 3. Because the depth of the HDD pipe installation, the open-cut trench portion would be at a higher elevation resulting in a high point along the force main transmission.

High points anywhere along the force main transmission have the potential to trap gases. These gases lead to significant loss in hydraulic performance, increasing risk of blockage, and entrapment of gases which potentially explosive (e.g., methane). In order to maintain safe and effective operation in this alternative, the installation of air release valve (ARV) would be required in Segment 3. This would require an air release structure within the middle of the Bay, posing both maintenance challenges and the risk for a spill in the unit is damaged or fails. Given the shorter lengths of the HDD segments, it may be possible in this alternative to construct the entire subaqueous force main using 20-inch ID HDPE pipe. **Figure 2-7** graphically depicts Alternative 3.

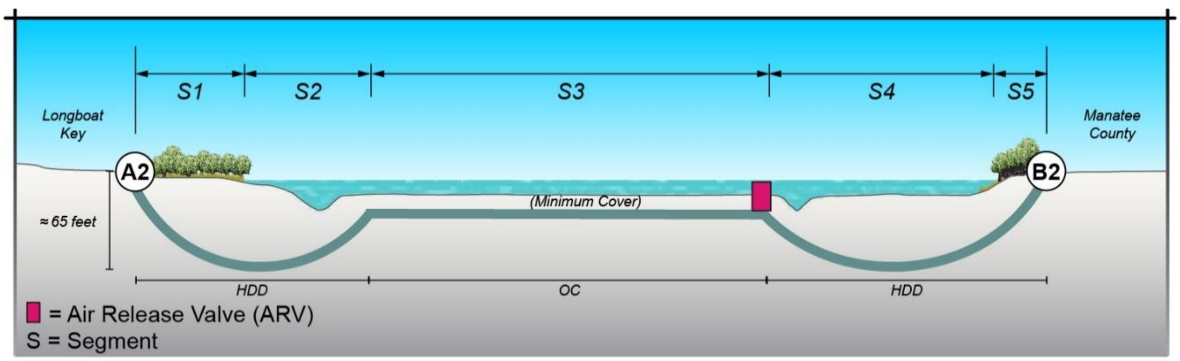


Figure 2-7
Schematic of Alternative 3

Construction Alternative 4 – Hybrid 2 (DP-OC-DP)

Alternative 4 combines the DP and OC construction approaches. Like Alternative 3, this alterative would avoid impacts to wetlands and aquatic resources in Segments 1-2 and 4-5. The current pipeline length limits using current DP technology are estimated to be less than one mile, so it is not possible to cover the entire subaqueous crossing using DP. In this alternative, the DP construction method would be used from both the western and eastern project termini and would extend under Segment 3 where the remainder of the pipe installation would be via open-cut trench. The western portion of DP would be drilled from Longboat Key landside and extend under the ICW to some point under Segment 3. Similarly, the eastern portion of the DP would be drilled from the Manatee County landside and extend under the unnamed channel also to Segment 3. The depth of the DP borehole is estimated to be approximately 40 feet below the sediment surface; therefore, two deep excavation pits in Segment 3 would be required to fuse the DP with the open-cut trench portions of the pipeline. In addition, because pipeline elevation along the open-trench portion would be higher than that in the eastern DP portion, a high point would exist along the force main transmission, thus requiring the installation of an ARV within Sarasota Bay. Furthermore, the DP portions would require that a 48-inch steel pipe be installed in the borehole, which would serve as a casing for the 20-inch ID HDPE force main pipe. **Figure 2-8** graphically depicts Alternative 4.

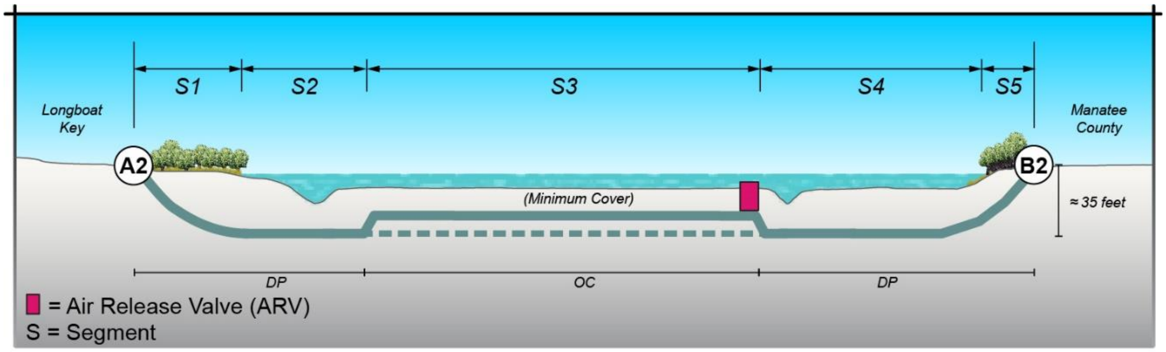


Figure 2-8
Schematic of Alternative 4

Construction Alternative 5 – Hybrid 3 (HDD-OC-OC)

Alternative 5 combines the HDD and OC construction approaches. In this alternative, the HDD construction method would be used from the western terminus only, and would extend under Segments 1-2; therefore, this alternative would avoid impacts to wetlands and aquatic resources in those segments. The HDD would be drilled from Longboat Key landside and extend under the ICW to some point in Segment 3 where the HDPE pipe insertion, stringing and fusion would all occur in the Bay. From there, the remainder of the pipeline would be installed using an open-cut trench approach. Unlike Alternatives 3 and 4, the elevation of the remaining open-cut trench portion of the pipe installation could be controlled such that there would be no high point requiring the installation of an ARV within Sarasota Bay. Given the shorter lengths of the HDD segment, it would be possible in this alternative to construct the entire subaqueous force main using 20-inch ID HDPE pipe. **Figure 2-9** graphically depicts Alternative 5.

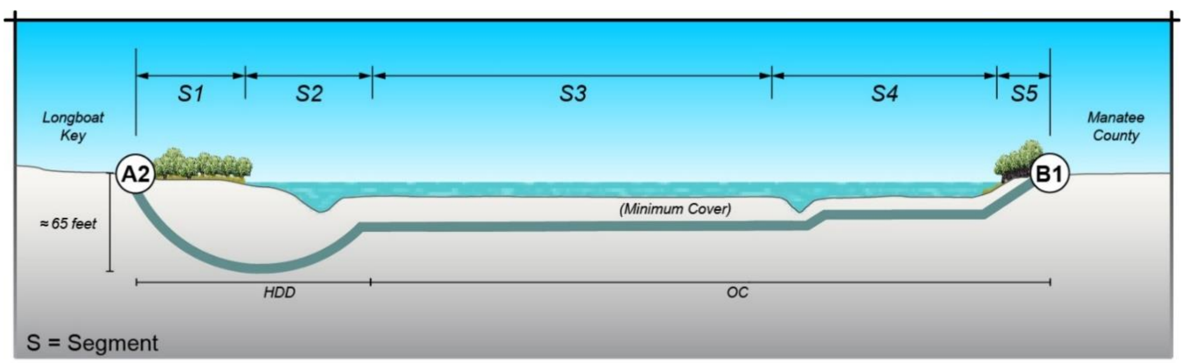


Figure 2-9
Schematic of Alternative 5

Construction Alternative 6 – Hybrid 4 (DP-OC-OC)

Alternative 6 combines the DP and OC construction approaches. In this alternative, the DP construction method would be used from the western terminus only, and would extend under Segments 1-2; therefore, this alterative would avoid impacts to wetlands and aquatic resources in those segments. The DP would be drilled from Longboat Key landside and extend under the ICW to some point in Segment 3 where the HDPE pipe insertion, stringing and fusion would all occur in the Bay. From there, the remainder of the pipeline would be installed using an open-cut trench approach. As with Alternative 4, the depth of the DP borehole is estimated to be approximately 40 feet below the sediment surface; therefore, a deep excavation pit in Segment 3 would be required to fuse the DP with the open-cut trench portions of the pipeline. Furthermore, the DP portion would require that a 48-inch steel pipe be installed in the borehole, which would serve as a casing for the 20-inch IDHDPE force main pipe. The elevation of the remaining open-cut trench portion of the pipe installation could be controlled such that there would be no high point requiring the installation of an ARV within Sarasota Bay. In this alternative the entire subaqueous force main would be constructed of 20-inch ID HDPE pipe, with a 48-inch steel casing in the DP segment only. **Figure 2-10** graphically depicts Alternative 6.

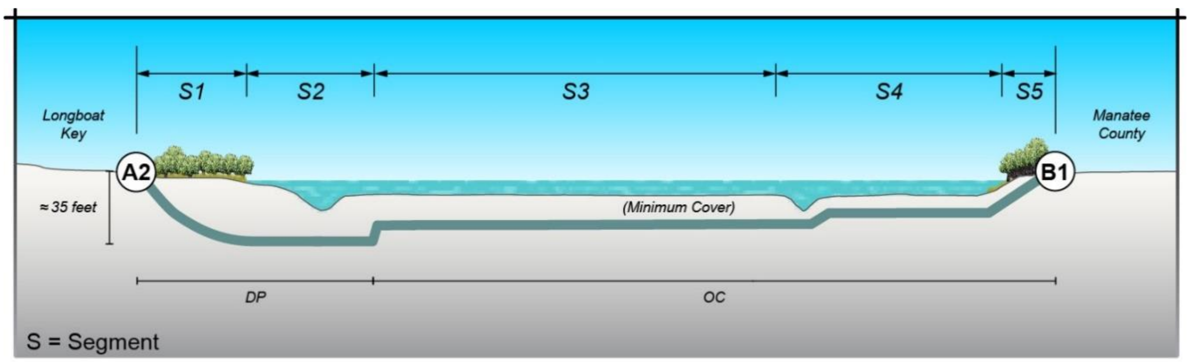


Figure 2-10
Schematic of Alternative 6

Construction Alternative 7 – Hybrid 5 (OC-OC-HDD)

Alternative 7 combines the HDD and OC construction approaches. In this alternative, the HDD construction method would be used from the eastern terminus only, and would extend under Segments 4-5; therefore, this alterative would avoid impacts to wetlands and aquatic resources in those segments. The HDD would be drilled from the Manatee County landside and extend under the unnamed channel to some point in Segment 3 where the HDPE pipe insertion, stringing and fusion would all occur in the Bay. From there, the remainder of the pipeline would be installed using an open-cut trench approach. It should be noted that because the elevation along the open-trench portion would be higher than that in the eastern HDD portion, a high point would exist along the force main transmission, thus requiring the installation of an ARV within Sarasota Bay. Given the shorter lengths of the HDD segment, it would be possible in this alternative to construct the entire subaqueous force main using 20-inch ID HDPE pipe. **Figure 2-11** graphically depicts Alternative 5.

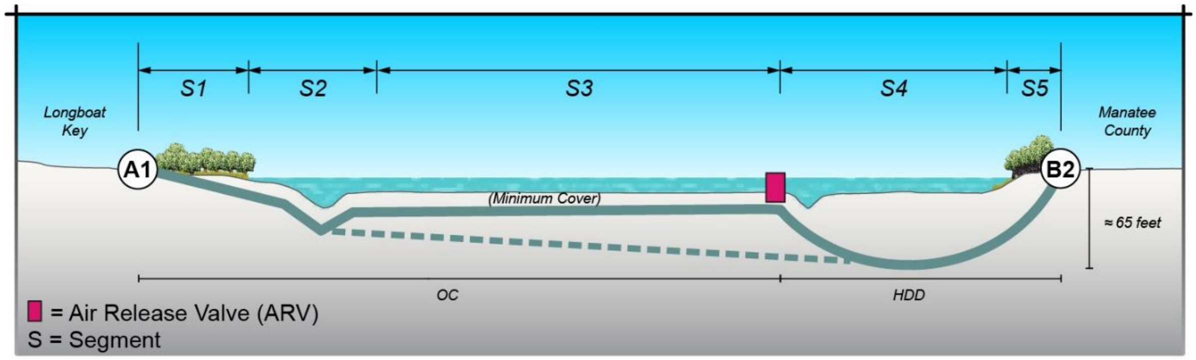


Figure 2-11
Schematic of Alternative 7

Construction Alternative 8 – Hybrid 6 (OC-OC-DP)

Alternative 8 combines the DP and OC construction approaches. In this alternative, the DP construction method would be used from the eastern terminus only, and would extend under Segments 4-5; therefore, this alterative would avoid impacts to wetlands and aquatic resources in those segments. The DP would be drilled from the Manatee County landside. From there, the remainder of the pipeline would be installed using an open-cut trench approach. As with other alternatives involving DP, the depth of the DP borehole is estimated to be approximately 40 feet below the sediment surface; therefore, a deep excavation pit in Segment 3 would be required to fuse the DP with the open-cut trench portions of the pipeline. Furthermore, the DP portion would require that a 48-inch steel pipe be installed in the borehole, which would serve as a casing for the 20-inch ID HDPE force main pipe. It should be noted that because the elevation along the open-trench portion would be higher than that in the eastern HDD portion, a high point would exist along the force main transmission, thus requiring the installation of an ARV within Sarasota Bay. **Figure 2-12** graphically depicts Alternative 8.

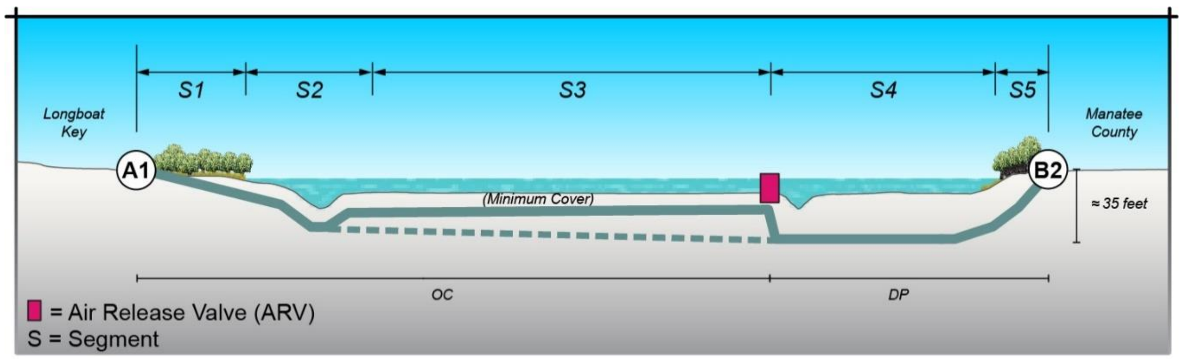


Figure 2-12
Schematic of Alternative 8

Construction Alternatives Summary

Table 2-3 below provides a summary of the eight alternatives with respect to the various construction methods across the project segments of Alignment 1.

TABLE 2-3
SUMMARY OF ALIGNMENT 1 CONSTRUCTION ALTERNATIVES

		Construction Method		
Alternative	**Description**	**Segments 1-2**	**Segment 3**	**Segments 4-5**
1	All OC	OC	OC	OC
2	All HDD	HDD	HDD	HDD
3	Hybrid 1	HDD	OC	HDD
4	Hybrid 2	DP	OC	DP
5	Hybrid 3	HDD	OC	OC
6	Hybrid 4	DP	OC	OC
7	Hybrid 5	OC	OC	HDD
8	Hybrid 6	OC	OC	DP

2.2.5 Evaluation Criteria

The eight construction alternatives presented above for Alignment 1 were evaluated and ranked pursuant to three criteria: 1) constructability; 2) environmental impacts; and 3) operation and maintenance. These three criteria are described and discussed below.

Constructability

Constructability is a critical criterion. All eight of the alternatives presented above are considered constructible or buildable; however, several of the trenchless approaches have more significant unknowns and risks. Significant construction challenges and risks may significantly increase the project cost and schedule, and overall ability to complete the project. Important constructability considerations include those discussed below.

Geotechnical Constraints

Geotechnical constraints will affect the feasibility of alternative construction methods. The type of soils and sediments can affect the recommended pipe material, construction methods, the need for import material, and the need for shoring (e.g., sheet pile barriers). In lieu of a full geotechnical evaluation for the proposed project at this stage, the geotechnical boring information provided by Driggers Engineering Services, Inc. (2014) was used to evaluate the potential soil conditions. The surface sediments are generally characterized as fine sands down to a depth of about 25 feet below sea level. Below the loose sands, the boring logs identify a layer of clay between -30 and -35 feet and a layer of dolomitic limestone below elevation -40 feet. Provided the identified soil conditions in the subsequent reports, geotechnical information may reveal conditions that are unsuitable for HDD. Such conditions could result in the collapse of the borehole, resulting in the loss of the inserted pipe; or a drilling fluid frac-out, which would release highly turbid fluids into to the surface waters of Sarasota Bay. The feasibility of HDD will have to be verified by completion of additional geotechnical investigations and preparation of a geotechnical baseline report.

Limits of Excavation

Where open-cut excavation is used, it is essential to minimize impacts to environmentally sensitive resources. Based upon our understanding of the loose sandy soils in the Bay bottom, the width of the subaqueous trench could be 5 times that of the trench depth, without the use of shoring. Installing shoring along the trench walls is a method by which to limit the trench width and the area of surface impacts from trenching. Shoring is an added expense, the cost of which increases with the depth of the trench. A general rule for shoring design is 1/3 retainment and 2/3 below grade. With all things considered, shallower trenches are less expensive and less difficult to construct than deeper trenches, and result in less impact to the environment. Therefore, scenarios requiring deep open-cut excavation are less desirable than those that require shallower excavation, i.e. minimum cover conditions.

Easement Acquisition

The easements and work areas can limit a contractor's ability to proficiently and efficiently perform the necessary work. Also, restoration of the property features such as trees, landscaping, fencing, and landscape features can increase project costs and construction duration. Staging areas are needed to store project material during construction, the size and magnitude of which would be dependent upon the method of installation. Working within existing easements or public areas is less difficult than securing permanent or temporary construction easements in private properties. Therefore, scenarios that minimize acquisition of new permanent easement or temporary construction easements are more desirable.

Environmental Impacts

State and federal environmental permitting requirements address and regulate impacts to wetlands, aquatic resources, and potentially affected species. Avoiding, minimizing and mitigating impacts to identified ecological resources is a critically important criterion when evaluating project alternatives. Project alternatives that do not adequately avoid, minimize or mitigate project impacts will be more difficult to permit, thus potentially delaying the project schedule and significantly increasing project costs, especially if the required environmental mitigation is too burdensome or infeasible.

With respect to the proposed project, impacts to wetlands and aquatic resources – primarily mangroves, seagrasses, and oysters – are a primary concern. However, it must be emphasized that any and all impacts to these resources caused by the proposed project are associated with project construction only – not long term operation. No components of the proposed project will result in a permanent loss of any ecological resources within Alignment 1; therefore, all impacts are considered to be temporary.

In addition to avoiding and minimizing temporary impacts, construction alternatives that create opportunities to restore previous environmental damage in the project vicinity, such as old dredge cuts, were ranked higher than alternatives that do not directly support such opportunities. Section 3 of this document provides a detailed discussion of measures to avoid, minimize and mitigate project impacts, as well as measures to restore previous dredge impacts.

Operation and Maintenance

As stated in Section 1 of this document, the purpose and need of the proposed project to provide a redundant or replacement domestic wastewater force main that performs well and will not require maintenance or replacement for at least 100 years. Therefore, an important aspect of the proposed project design is to minimize maintenance requirements to the greatest extent possible. Nonetheless, there are significant engineering design constraints and limitations that could directly affect the performance and long-term reliability and service life of the proposed force main. Important operation and maintenance considerations include those discussed below.

Performance

Under normal operating conditions, sewer force mains collect air at high points. If the air is not expelled, the presence of air and potentially explosive gases in the pipeline can reduce the effective cross-sectional flow area, resulting in increased pressure loss and deceased flow. This ultimately leads to the inability to pump from the lift station, and to transfer sufficient wastewater from the Town. Accumulated air or gas may also cause water hammer and metering inaccuracies, and accelerates the rate of corrosion. This issue is typically mitigated by installing sewage air release valves at high points. An ARV installed in Sarasota Bay would require a permanent structure and regular maintenance, which is highly undesirable for this particular marine environment. Alternatives with pipeline profiles that have a single low point with positive slopes toward the Manatee County SWRWRF are clearly preferable for the proposed project.

Long-Term Reliability and Service Life

The existing force main installed in 1973 is ductile iron pipe. The cause of the recent sewage leak that was discovered on June 29, 2020 was a hole in the existing pipe, which was the result of corrosion, and is consistent with the fact that in a subaqueous environment all metallic pipe will corrode over time. The location of the force main in the Bay, makes regular maintenance and the ability to perform condition assessments challenging. As a result, non-metallic pipe, either HDPE or fusible PVC, is far more desirable. HDPE is twice the pipe wall thickness as fusible PVC, and the polyethylene pipe industry estimates a service life for HDPE pipe to conservatively be 50-100 years. This relates to savings in replacement costs for generations to come. Due to the corrosion potential of metallic pipe, alternatives that require metallic pipe were ranked lower than those that would allow non-metallic pipe.

2.2.6 Alignment 1 Evaluation

Each of the eight construction alternatives were evaluated with respect to the three criteria discussed above. A simple non-weighted approach was used to score each alternative on a scale of 1 to 10 - with a score of 1 being most problematic and/or undesirable, and a score of 10 being most feasible and/or desirable. If an alternative had a fatal flaw with respect to one of the criteria it was scored with an X, and failed the evaluation. Members of the Carollo/ESA consultant team independently scored each of the eight alternatives, and the scores represent the average of the reivewers. Alternatives with the highest total scores represent the preferred alternatives. **Table 2-4** below shows the results of the ranking.

TABLE 2-4
SUMMARY OF ALIGNMENT 1 CONSTRUCTION ALTERNATIVES EVALUATION

Alt. No.	Alternative Segmentation	Constructability	Environmental Impacts	Operation & Maintenance	Total Score
1	OC-OC-OC	10	4	10	24
2	HDD-HDD-HDD	3	10	4	17
3	HDD-OC-HDD	6	7	X	**Fail**
4	DP-OC-DP	3	6	X	**Fail**
5	HDD-OC-OC	4	5	10	19
6	DP-OC-OC	6	5	9	20
7	OC-OC-HDD	7	6	X	**Fail**
8	OC-OC-DP	3	5	X	**Fail**

Hybrid alternatives that involve combinations of open-cut trench and trenchless construction approaches were developed to minimize surface impacts to wetlands and aquatic resources, as well as other surface issues (e.g., navigational disruptions in the ICW). Some of these hybrid alternatives have variable pipeline elevations and slopes that result in high points along the force main transmission line. These high points form air pockets that require a subaqueous air valve to release the accumulated gases. As stated above, an ARV in Sarasota Bay would require a permanent structure and regular maintenance. This is highly undesirable in the marine environment, and was considered to be a fatal flaw by the engineering professionals scoring the alternatives. Therefore, the only acceptable alternatives are those with profiles that have a single low point with positive slopes from there toward the Manatee County SWRWRF. For this analysis, alternatives that have more than one low point and require an ARV were considered infeasible, and thus failed the evaluation.

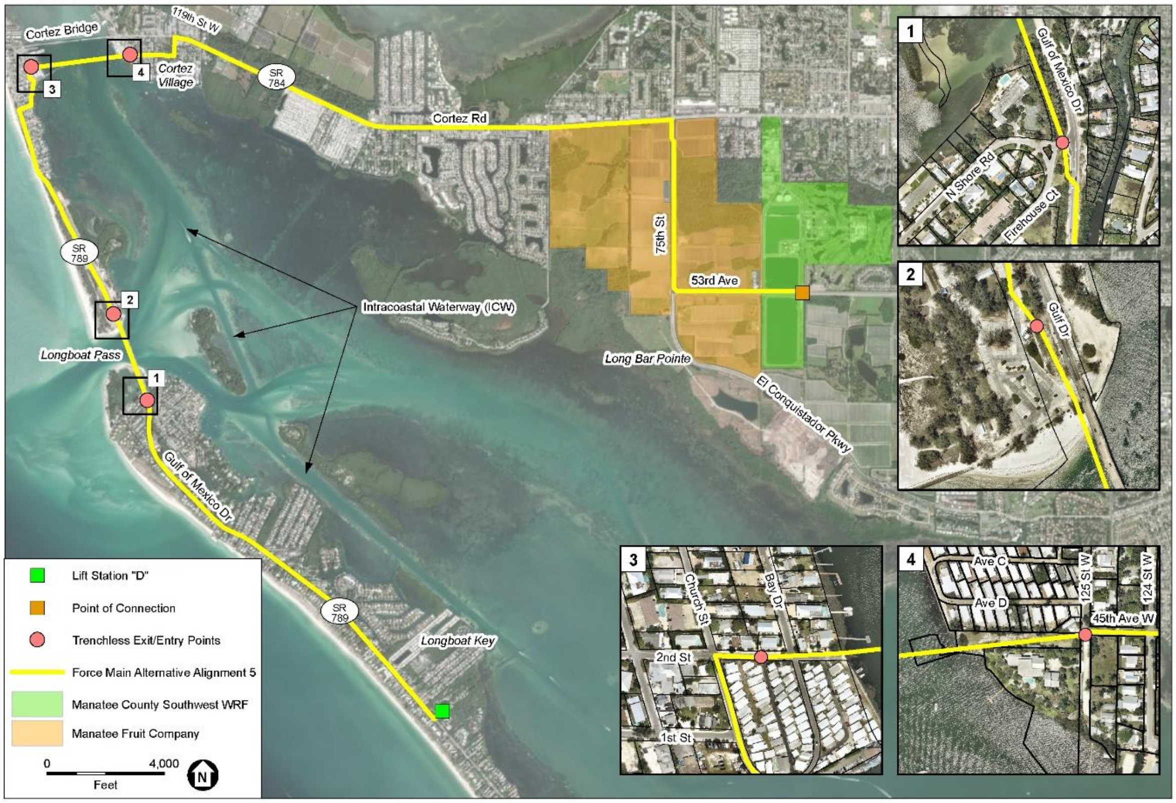
As shown in Table 2-4, four of the eight alternatives failed the evaluation due to the requirement for an ARV, while the other four passed. The highest ranked construction alternative was Alternative 1 (All Open-Cut Trench), followed by Alternatives 5 (Hybrid 3) and Alternative 6 (Hybrid 4). Alternatives 5 and 6 both involve trenchless construction approaches on the western end of the project which avoid surface impacts in Segments 1 and 2. **Table 2-5** below summarizes the advantages and disadvantages of each of the eight alternatives.

TABLE 2-5
SUMMARY OF ADVANTAGES/DISADVANTAGES OF THE ALIGNMENT 1 CONSTRUCTION ALTERNATIVES

Alt. No.	Alternative Segmentation	Advantages	Disadvantages
1	OC-OC-OC	Most proven construction method; no ARV required; allows for HDPE pipe; minimal long-term maintenance; allows for concurrent mitigation via backfill of old dredge cuts.	Greatest amount of temporary impacts to wetlands and aquatic resources; temporary vessel navigational disruption in ICW; crosses FPL subaqueous power line.
2	HDD-HDD-HDD	Avoids all impacts to wetlands and aquatic resources; avoids vessel navigational disruptions in the ICW; avoids FPL subaqueous power line crossing	Highly questionable constructability due to length of single pull; potential for frac-out and/or borehole collapse; requires metallic pipe; greater long-term maintenance; likely the highest construction cost.
3	HDD-OC-HDD	Avoids impacts to wetlands and aquatic resources in Segments 1-2 and 4-5; avoids vessel navigational disruptions in the ICW; avoids FPL subaqueous power line crossing.	**Fatal flaw of ARV requirement**; potential for frac-out; requires metallic pipe for HDD segments; greater long-term maintenance.
4	DP-OC-DP	Avoids impacts to wetlands and aquatic resources in Segments 1-2 and 4-5; avoids vessel navigational disruptions in the ICW; avoids FPL subaqueous power line crossing; allows for HDPE pipe.	**Fatal flaw of ARV requirement**; requires 48-inch borehole and steel casing for HDPE pipe.
5	HDD-OC-OC	Avoids impacts to wetlands and aquatic resources in Segments 1-2; avoids vessel navigational disruptions in the ICW; allows for concurrent mitigation via backfill of old dredge cuts.	Impacts wetlands and aquatic resources in Segments 3, 4 and 5; potential for frac-out; requires metallic pipe for HDD segment; greater long-term maintenance; crosses FPL subaqueous power line.
6	DP-OC-OC	Avoids impacts to wetlands and aquatic resources in Segments 1-2; avoids vessel navigational disruptions in the ICW; allow for HDPE pipe; allows for concurrent mitigation via backfill of old dredge cuts.	Impacts wetlands and aquatic resources in Segments 3, 4 and 5; potential for frac-out; requires metallic pipe for HDD segment; greater long-term maintenance; crosses FPL subaqueous power line.
7	OC-OC-HDD	Avoids impacts to wetlands and aquatic resources Segments 4-5; avoids FPL subaqueous power line crossing; allows for concurrent mitigation via backfill of old dredge cuts.	**Fatal flaw of ARV requirement**; impacts wetlands and aquatic resources in Segments 1, 2 and 3; potential for frac-out; requires metallic pipe for HDD segment; greater long-term maintenance.
8	OC-OC-DP	Avoids impacts to wetlands and aquatic resources in Segments 4-5; avoids FPL subaqueous power line crossing; allows for HDPE pipe; allows for concurrent mitigation via backfill of old dredge cuts.	**Fatal flaw of ARV requirement**; impacts wetlands and aquatic resources in Segments 1, 2 and 3; requires 48-inch borehole and steel casing for HDPE pipe.

2.3 Alignment 5

As discussed in Section 2.1 above, CDM Smith/Laney (2015) developed and evaluated a mostly upland route, which they term Alignment 5. The Carollo/ESA consultant team further evaluated this alignment and modified the exact routing somewhat based on current conditions on the ground. **Figure 2-13** shows a detailed plan view of the modified Alignment 5.



SOURCE: Carollo, 2020; ESA 2020

Longboat Key Force Main Replacement Project

Figure 2-13
Plan View of Alignment 5

2.3.1 Proposed Facilities

The proposed facilities for Alignment 5 include the construction of a new 20-inch ID force main extend from Lift Station D northward along the east side of Gulf Drive (SR-789), under Longboat Pass to Anna Maria Island; then northward along Gulf Drive and through residential neighborhoods to the vicinity of Cortez Road (SR-684); then under Sarasota Bay to the mainland; and then finally southeasterly along a landward route to the Manatee County SWRWRF. This alternative would require two subaqueous crossings: under Longboat Pass adjacent to the Longboat Pass bridge; and under Sarasota Bay somewhere near the Cortez Road bridge.

Alignment 5 is by far the longest alternative alignment evaluated, but it has the shortest length of subaqueous pipe of any of the alignments previously considered by CDM Smith/Laney (2015). The southern crossing is approximately 2,065 LF and adjacent to the Longboat Pass bascule bridge. The northern crossing is approximately 2,970 LF and approximately 660 feet south of the Cortez Road bridge. It is important to note that both of the bridges are drawbridges, which eliminates the potential to hang the new force main on either bridge. Therefore, two subaqueous crossings would be required in this alternative. In addition, the FDOT is considering future replacement of the SR-789 bridge, which could result in challenges to locate the subaqueous mains to avoid any future pilings or structures.

2.3.2 Alternative 5 Evaluation

As noted by CDM Smith/Laney (2015), Alternative 5 has severe engineering and public impact constraints that make it infeasible. These constraints are discussed below.

Right-of-Way (ROW) Constraints

Historic development in both Bradenton Beach and Cortez Village results in very narrow public ROW available for the open-cut landward construction. Additionally, there is insufficient public ROW available for setting up and executing an HDD or DP drill at both subaqueous crossings. Setting up and executing HDD or DP crossings at both locations would require acquisition of easements through developed private properties, which is very difficult and highly unlikely, and would significantly delay the construction of a new force main. Given the severe ROW constraints, one or both of these crossings may require an open-cut trench construction approach. In addition to temporary environmental impacts to wetlands and aquatic resources, these crossings would also have substantial navigational disruptions of vessel traffic in the ICW, as there is limited space to divert ICW boat traffic in both locations.

Hydraulic Constraints

Alignment 5 is approximately 55,700 linear feet (10.6 miles), which is more than 4.5 times the length of the existing force main (Alignment 1).

Assuming the same pipe material and size, the hydraulic head-loss over Alignment 5 would be approximately 3-4 times that of Alignment 1. This would require significantly higher pumping pressures, likely requiring upgrades of Lift Station D, and the need for at one or more additional pump stations along the route. Both requirements pose significant challenges. There is insufficient space available at Lift Station D for the necessary upgrades, and very limited ROW available along the alignment to add new pump stations. In addition, the construction a pump station(s) outside of the limits of the Town of Longboat Key (e.g., in Manatee County) will likely be required, further complicating ROW and easement issues which will substantially delay project construction and increase project costs.

Utility Conflicts

Based on the CDM Smith/Laney (2015) analysis and Manatee County GIS data, Alignment 5 has extensive utility conflicts, significantly more than any other alternative alignment. Utility conflicts reduce the contractor's production rates, and increase the overall duration of construction and related public impacts, resulting in schedule delays and increased costs.

Operation and Maintenance Requirements

The long length of the landward portion of the force main with numerous utility conflicts necessitates the use of ARV's and odor control appurtenances (carbon canister type) along the force main alignment. ARV's require routine maintenance service and increase both the capital and long-term maintenance costs of the new force main. The project would include facilities to mitigate odors emanating from the ARV's. The potential for odors in close proximity to homes, resorts, and businesses is likely to face public opposition should these facilities fail. The addition of ARV's also increase the potential for failure. This may include blockage resulting in a loss in system capacity, or a break/leak which would cause environmental damage.

Traffic Disruptions

Gulf Drive (SR-789) is the main thoroughfare and the only route connecting Longboat Key and Bradenton Beach. This segment of SR-789 traverses mostly residential and resort areas and includes bike lanes. As a result, the impacts to vehicle and bike traffic and the potential damage and repairs to the existing pavement resulting from months of open cut pipeline construction in SR-789 would be significant, highly undesirable, and require a high level of coordination with Florida Department of Transportation (FDOT).

Public Opposition

This alternative route impacts a majority of the entire island corridor, and would be a direct impact to the public for extended period of time. The primary public impacts include traffic disruptions and odor, as described above. In addition, construction noise in and around residential neighborhoods is likely to be significant. These public impacts are likely to result in a high degree of public opposition to the project, further delaying the completion of a critically important infrastructure project. Finally, given that the length of this alignment is over 3 times that of Alignment 1, and all of the necessary coordination and potential conflict, it is anticipate that construction of the project in Alignment 5 would taking many years to complete. Comparatively, construction of the project in Alignment 1 would take months to complete.

2.4 Alternatives Analysis Summary and Conclusions

2.4.1 Alignment Alternatives

Based on the CDM Smith/Laney (2015) alignment analysis, and the evaluations presented above, Alignment 1 is clearly the preferred alignment. The Town's wastewater infrastructure has been designed and constructed over the years to collect and pump domestic sewage to existing Lift Station D, and to pump all collected sewage from this lift station to the Manatee County SWRWRF through the existing subaqueous force main. Alignment 1 is a long-established utility corridor which parallels the existing force main.

As discussed in Section 1, given the estimated remaining service life, and recent leak, of the existing force main the construction of a redundant force main is a critical infrastructure project. Constructing a new force main along Alignment 5 would require substantial modifications to the Town's existing wastewater infrastructure. In addition, Alignment 5 poses numerous and extensive engineering and public impact constraints, including: ROW limitations; hydraulic constraints; utility conflicts; increased operation and maintenance requirements; traffic disruptions; odor; and overall public opposition. All of these issues cumulatively make Alignment 5 infeasible with respect to both schedule and budget.

2.4.2 Alignment 1 Construction Alternatives

As detailed in Section 2.2 above, the highest ranked construction alternative for Alignment 1 was Alternative 1 (All Open-Cut Trench), followed by Alternatives 5 (Hybrid 3) and Alternative 6

(Hybrid 4). Alternatives 5 and 6 both involve trenchless construction approaches on the western end of the project which avoid surface impacts in Segments 1 and 2. Four of the eight hybrid alternatives evaluated were eliminated due to the fatal engineering flaw of having high points in the force main transmission line that would require an ARV be installed in Sarasota Bay. Given that open-cut trench construction approach is the most proven construction method that meets all other engineering specifications (e.g., HDPE pipe), Alternative 1 is the preferred construction alternative for the proposed project.

While Alternative 1 (All Open-Cut Trench) does have the greatest impacts to wetlands and aquatic resources, it must be emphasized here that any and all impacts to these resources caused by the proposed project are associated with project construction only. No components of the proposed project will result in a permanent loss of any ecological resources within Alignment 1; therefore, all impacts are considered to be temporary. Furthermore, the proposed construction approach has been developed to avoid and minimize impacts to wetlands and aquatic resources to the greatest extent possible.

Finally, as discussed in Section 3 of this document, construction of the existing force main in the early 1970’s left a deep trench along the alignment in Segment 3 that never recovered seagrass coverage like surrounding areas, as documented by seagrass mapping program implemented by the Southwest Florida Water Management District (SWFWMD). Investigations conducted by ESA (2019) determined that the cause of the lack of seagrass recovery in this area was simply due to depth, as this area is below the long-term average photic zone necessary to support seagrass growth and reproduction.

In addition to the old trench cut associated with the installation of the existing force main, an old unnamed channel exists perpendicular to eastern side of Alignment 1. The dredging of this channel pre-dates Clean Water Act regulatory requirements, and it is not marked or maintained. The bottom of this channel is also too deep to support seagrass growth and reproduction, as documented by the SWFWMD seagrass mapping program. With the construction of the proposed project, opportunities exist to restore these old dredge cuts by backfilling them to adjacent grade with appropriate sediments, derived both from the construction of the new force main, as well as from offsite borrow sources.

SECTION 3

Environmental Analysis

As discussed in Section 2, the proposed project is to construct a redundant 20-inch HDPE domestic sewage force main along Alignment 1 using an all open-cut trench approach. This section presents the analysis of environmental impacts associated with the proposed project, including measures to avoid, minimize, and mitigate those impacts. In addition, opportunities to restore previous dredge cuts in the project vicinity are discussed.

3.1 Regulatory Status

Alignment 1 is located in the northern reach of Sarasota Bay, typically referred to as Upper Sarasota Bay, approximately 2.3 miles south of Longboat Pass. Sarasota Bay is a designated Outstanding Florida Water (OFW) pursuant to section 62-302-700 of the Florida Administrative Code (FAC). An Outstanding Florida Water (OFW) is a water designated worthy of special protection because of its natural attributes. This special designation is applied to certain waters and is intended to protect existing good water quality. Generally, the waters within these managed areas are OFWs because the managing agency has requested this special protection. Sarasota Bay falls under the management purview of the Sarasota Bay Estuary Program (SBEP). The SBEP began in June 1989 when Sarasota Bay was designated an “estuary of national significance” by the U.S. Congress as part of the Water Quality Act of 1987. SBEP is one of 28 National Estuary Programs in the United States.

In addition, pursuant to section 62-302-400 FAC, all waters of Sarasota Bay south of the Cortez Road bridge (SR-684) are designated as Class II Waters, which are defined as waters suitable for the propagation and harvesting of shellfish. In Florida, shellfishing is regulated by the Florida Department of Agriculture and Consumer Services (FDACS) and, depending on pollution sources and recent water quality conditions, Class II waters can be further designated as: 1) approved; 2) conditionally approved; or 3) prohibited. The waters in the vicinity of Alignment 1 are currently designated as “prohibited” for shellfishing of oysters and clams, and there are no commercial shellfishing areas in Sarasota Bay.

3.2 Existing Conditions

This subsection provides a general summary of protected ecological resources in Alignment 1, as well as a detailed discussion of the status and trends of seagrasses in this portion of Sarasota Bay.

3.2.1 Ecological Resources of Concern

With respect to the proposed project, ecological resources of concern include jurisdictional wetlands, deepwater habitats, and federally listed and protected species that occur within the project limits of Alignment 1.

Wetlands and Deepwater Habitats

Within the limits of the proposed project, the primary types of jurisdictional wetlands include mangroves in the intertidal zones on both ends of the project, and seagrasses in the shallow subtidal zones in Sarasota Bay. In addition, small clumps of oysters are distributed around the project vicinity, primarily along the eastern shoreline. **Table 3-1** lists the prominent wetland and deepwater species organized pursuant to the federal *Classification of Wetlands and Deepwater Habitats of the United States* (Federal Geographic Data Committee, 2013).

TABLE 3-1
WETLAND AND DEEPWATER HABITAT SPECIES IN THE PROJECT VICINITY

Common Name	Scientific Name	System	Subsystem	Class
Red mangrove	*Rhizophora mangle*	Estuarine	Intertidal	Emergent wetland
Black mangrove	*Avicennia germinans*	Estuarine	Intertidal	Emergent wetland
White mangrove	*Laguncularia racemosa*	Estuarine	Intertidal	Emergent wetland
Shoal grass	*Halodule wrightii*	Estuarine	Subtidal	Aquatic bed
Turtle grass	*Thalassia testudinum*	Estuarine	Subtidal	Aquatic bed
Manatee grass	*Syringodium filiforme*	Estuarine	Subtidal	Aquatic bed
American oyster	*Crassostrea virginica*	Estuarine	Subtidal	Reef

Listed Species

The proposed project will be conducted primarily within the subtidal zone, so the primary species of concern include: West Indian manatee; green sea turtle; and loggerhead sea turtle. **Table 3-2** below summarizes the status of these three species in the project vicinity

TABLE 3-2
FEDERALLY LISTED SPECIES IN THE PROJECT VICINITY

Common Name	Scientific Name	Federal Status	Notes
West Indian manatee	*Trichechus manatus latirostris*	Threatened	Sarasota Bay is located within the USFWS consultation area; no critical manatee habitat.
Green sea turtle	*Chelonia mydas*	Endangered	Some recorded strandings in Sarasota Bay; no recorded nestings.
Loggerhead sea turtle	*Caretta caretta*	Threatened	Some recorded strandings in Sarasota Bay; no recorded nestings.

National Marine Fisheries Service (NMFS) guidance documentation also indicates that Sarasota Bay is designated Essential Fish Habitat (EFH) for the following species:

- Spiny lobster;
- Coastal migratory pelagics;
- Shrimp;
- Reef fish;
- Red drum;
- Stone crab.

3.2.2 Seagrass Status and Trends

Based on input received from the FDEP and the USACE in the 2019 pre-application meetings conducted with both agencies, impacts to seagrasses are the most significant concern with respect to the proposed project. This subsection presents a detailed discussion of the status and trends in seagrass distributions in Sarasota Bay in general, and in the vicinity of the proposed project specifically.

Seagrass Trends

In southwest Florida, focused management actions over the past several decades have reduced watershed nutrient loads, resulting in an additional 18 square miles of seagrass meadows that arose between 1999 and 2016, an increase of 32%. These increases were distributed throughout each of the six systems of St. Joseph Sound, Clearwater Harbor, Tampa Bay, Sarasota Bay, Lemon Bay, and Charlotte Harbor. In Sarasota Bay, seagrass coverage increased by 46% bay-wide, between 1999 and 2016, followed by a 5% decrease between 2016 and 2018. The decrease in coverage between 2016 and 2018 was attributed to the impacts of Hurricane Irma, which passed through Florida in September of 2017 (Tomasko et al., 2020).

The portion of Sarasota Bay south and east of Longboat Pass has been the epicenter of most of the seagrass increases that have occurred bay-wide (Tomasko et al., 2018). In that part of Sarasota Bay between Siesta Key Drive and Manatee Avenue, seagrass coverage in 2018 was estimated to be 61% higher than in 1988, and even 37% higher than estimated coverage in 1948. **Figure 3-1** shows a time series plot of seagrass coverage in Upper Sarasota Bay (e.g., between Siesta Key Drive and Manatee Avenue).

Thus, up to 2018, the increased coverage of seagrass meadows in that portion of Sarasota Bay north and west of Long Bar Point was evidence of the benefits of the widespread improvements in water quality that had been previously quantified for those same waters (e.g. Tomasko et al., 2005, 2018).

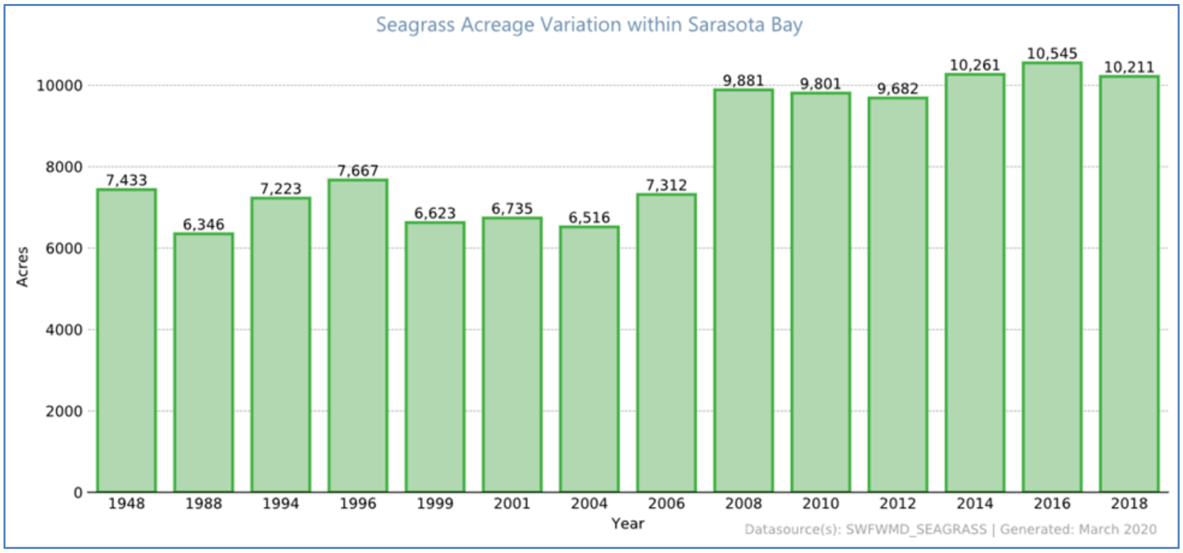


Figure 3-1
Time Series of Seagrass Acres in Sarasota Bay

Figure 3-2 shows an aerial photograph of seagrass in that portion of Sarasota Bay north and west of Long Bar Point in 2006, prior to the 35% regional increase that occurred between 2006 and 2008 (Figure 3-1).

Figure 3-2
Seagrass Coverage in Project Vicinity - January 2006

In 2006, seagrass coverage is clearly evident along the shoreline north of Long Bar Point, and also east of the ICW. The footprint of the bay bottom along the existing force main route shows up as a linear feature angled on a southwest to northeast alignment, roughly in the center of the photo. Along most of the western half of the force main route, very little seagrass coverage is found. The increase in seagrass coverage after 2006 is clearly evident when comparing aerial photographs from 2006 to aerial photography from 2010, as shown in **Figure 3-3**.

Figure 3-3
Seagrass Coverage in Project Vicinity – December 2010

The impressive increases in seagrass coverage between 2006 and 2010 were maintained up to March 2018, as shown in **Figure 3-4**. This figure shows that the footprint of the force main cut can be discerned as an area of reduced seagrass coverage, likely due to the footprint representing a portion of the bay that is slightly deeper than the surrounding bay bottom. However, by January 2019, much of the seagrass increase documented between 2006 and 2008, which had been maintained for over 10 years, appears to have been lost.

Figure 3-5 shows seagrass coverage in January 2019. The footprint of the force main cut is less clear in 2019 than it was in 2010 to 2017, because the surrounding bay bottom also appears to be un-vegetated. The extensive seagrass meadows that show up in Sarasota Bay north and west of Long Bar Point during the period of 2010 to 2017 appear to have decreased substantially by late 2018 to early 2019.

Figure 3-4
Seagrass Coverage in Project Vicinity – March 2018

Figure 3-5
Seagrass Coverage in Project Vicinity – January 2019

As part of the environmental assessment process for initial project planning, ESA bathymetric, seagrass, and sediment surveys of the existing force main corridor. The surveys were completed and the summer of 2018 and summarized in an environmental assessment report (ESA, 2019). The 2018 seagrass survey was conducted using a stratified random subsampling design to estimate the acreage of seagrass within a 14-meter corridor over the existing force main centerline. Based on the results of that work, ESA concluded that the lack of seagrass recovery in the existing force main alignment is due solely to bathymetric elevation (e.g., water depth). No evidence was derived from the sediment survey and associated laboratory analyses that seagrass recovery was precluded by hostile substrate conditions or poor sediment quality.

Table 3-3 below, excerpted from the ESA environmental assessment (ESA, 2019), shows a comparison of bathymetric elevation and seagrass cover. The "counts" represent the number of quadrats that were sampled within each of 12 elevation ranges. The total number of counts includes the 516 quadrats sampled within the seagrass assessment area plus an additional 21 quadrats that were assessed outside the seagrass assessment area as controls. The maximum, mean, and median values represent the percent seagrass cover in the quadrats sampled within each elevation range.

TABLE 3-3
COMPARISON OF BOTTOM ELEVATION AND SEAGRASS OCCURRENCE

	Elevations in feet (NAVD 88)											
	-12 to -11	-11 to -10	-10 to -9	-9 to -8	-8 to -7	-7 to -6	-6 to -5	-5 to -4	-4 to -3	-3 to -2	-2 to -1	-1 to 0
count	1	27	113	107	85	63	36	30	46	21	6	2
min	0	0	0	0	0	0	0	0	0	0	35	0
max	0	0	100	100	100	100	100	100	100	100	100	0
mean	0.0	0.0	12.8	17.2	21.6	33.8	43.1	59.8	54.7	45.9	74.8	0.0
median	0.0	0.0	0.0	0.0	0.0	0.0	6.0	81.0	71.5	22.0	82.0	0.0
% sites	0.2	5.0	21.0	19.9	15.8	11.7	6.7	5.6	8.6	3.9	1.1	0.4

From Table 3-3 it is clearly evident that seagrass occurrence is inversely related to water depth. The greatest seagrass densities occur in the elevation range of -2 to -1 feet NAVD 88. Furthermore, no seagrass occurs below -10 feet NAVD 88.

Seagrasses are flowering vascular plants that require adequate light to conduct photosynthesis to support growth and reproduction. Therefore, the distributions of seagrass occurrence and densities in the seagrass assessment area can be explained solely on the basis of elevation. As water depth increases so does light attenuation, and the point at which light becomes limiting to plant survival is referred to as the photic zone. In this portion of Sarasota Bay, the depth range most suitable for seagrass is -2 to -5 feet NAVD 88; whereas, the photic zone apparently extends to approximately -10 feet NAVD 88 under excellent water quality conditions. Shallow water depths are clearly more conducive to seagrass growth; however, if it is too shallow (e.g., <-2 feet) seagrass cannot flourish due to periodic desiccation during extreme low tides.

It is not clear why large sections of the existing force main cut are deeper than the surrounding area. It is possible that during construction of the existing force main some of the overburden was removed and not totally replaced once the pipe was buried. Alternatively, the overburden replaced over the buried force main could have eroded away due to physical disturbance and "loosening" of the sediment matrix within the alignment.

The improvements in seagrass coverage between 2006 and 2010 (Figure 3-3) mostly occurred in deeper waters, in response to improvements in water quality that accompanied careful management of nutrient loads (i.e., Tomasko et al., 2018). However, the depth distribution of seagrass meadows appears to have been substantially impacted between 2018 and 2019, as seen when comparing Figures 3-4 and 3-5. While the basis for the recent seagrass loss is not fully understood, there is an emerging consensus that the losses may be related to changes in water quality caused by a major and prolonged red tide event that initiated in late 2018.

The red tide organism, *Karenia brevis*, is an alga that produces large amounts of the pigment chlorophyll-a during blooms. Accordingly, the highest chlorophyll-a values seen over the past 10 years in Sarasota Bay occurred in the summer to fall of 2018, as shown in **Figure 3-6**.

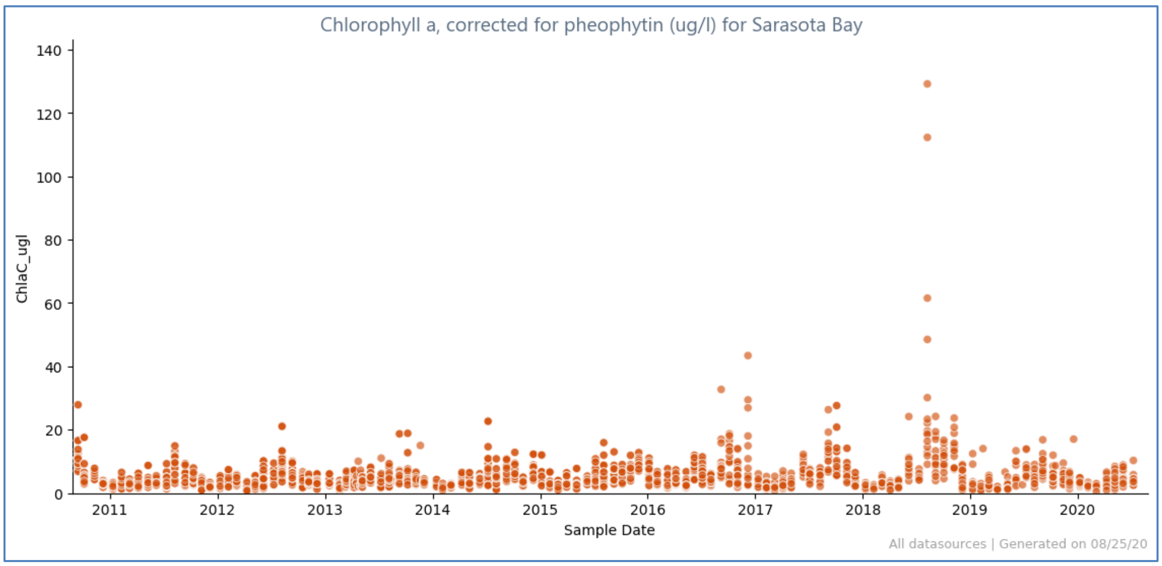


Figure 3-6
Chlorophyll-a values (µg/L) in Upper Sarasota Bay (2011-2020)

Chlorophyll-a and other algal pigments, as well as turbidity associated with suspended solids, absorb and diffract light transmission through the water column, thus reducing shallowing the viable photic zone (e.g., light intensity zone) for seagrass recruitment, growth and reproduction. That is, as water clarity declines, the depth at which seagrasses can be sustained becomes shallower.

When the chlorophyll-a data are displayed as a one-month average, it is evident that Upper Sarasota Bay had elevated values of chlorophyll-a for a period of several months, from the late spring of 2018 until early 2019, as shown in **Figure 3-7**. Dashed grey line equals annual average. Dashed and solid red lines refer to different regulatory guidance thresholds.

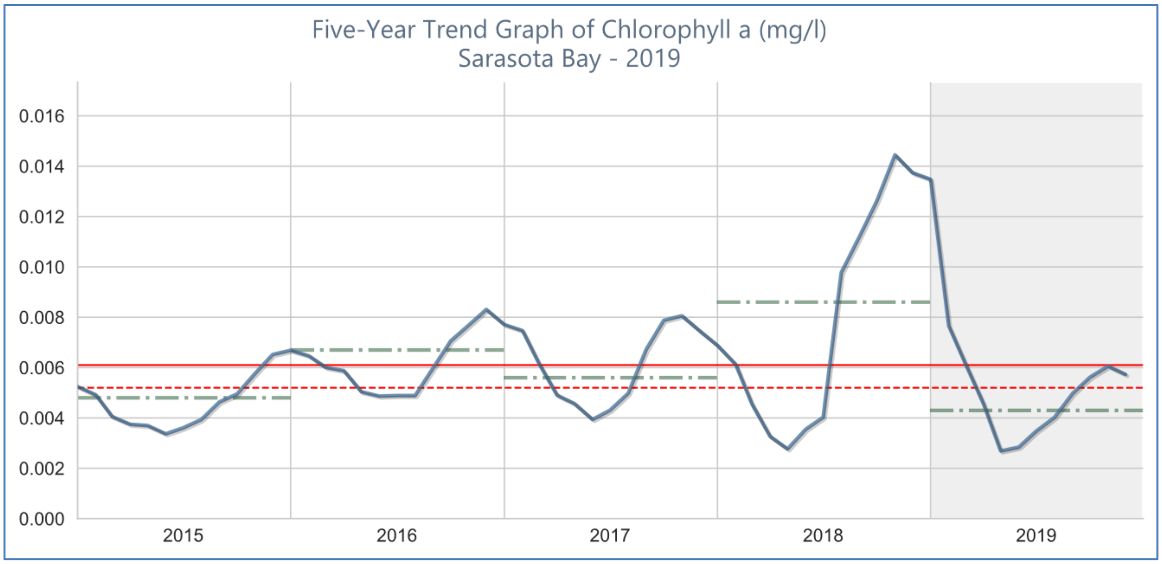


Figure 3-7
Monthly Average Chlorophyll-a Values (µg/L) in
Upper Sarasota Bay (2015-2019)

Results shown in Figure 3-7 show that across Upper Sarasota Bay, chlorophyll-a values exceeded 10 µg/L for several months, and averaged more than 12 µg/L for at least three months – a value twice as high as the highest relevant water quality target. The very high levels of chlorophyll-a in the latter part of 2018 appears to correspond to a period of time when the *Karenia brevis* was abundant in Upper Sarasota Bay, as shown in **Figure 3-8**.

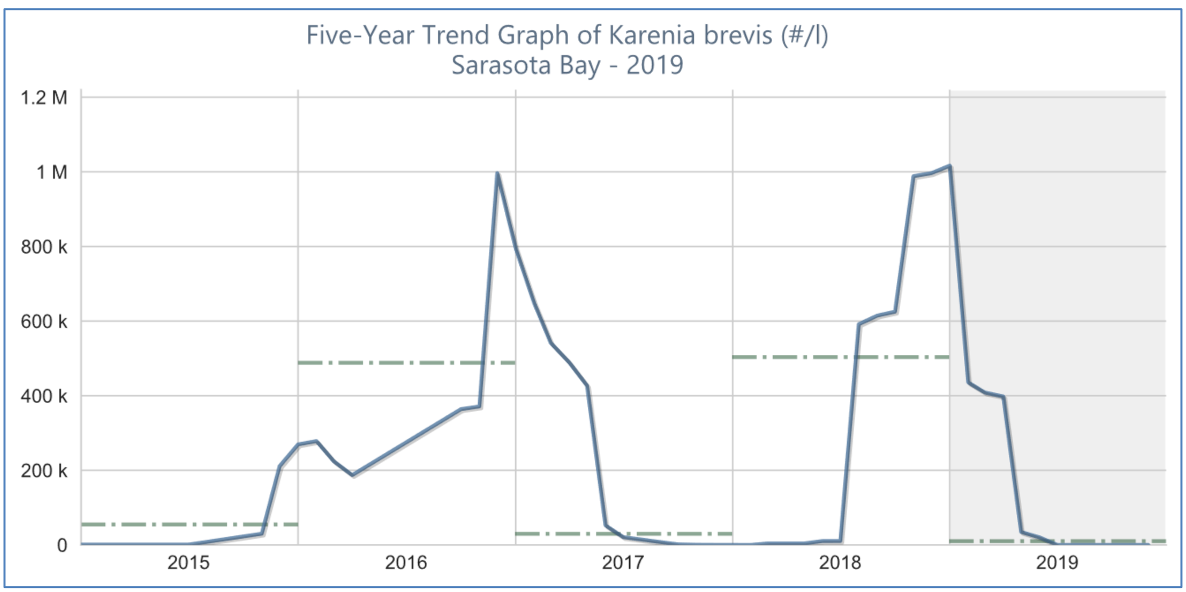


Figure 3-8
Monthly abundance of *Karenia brevis* (cells/L) in
Upper Sarasota Bay (2015-2019)

While the data displayed in Figure 3-8 shows that there was a sustained red tide that co-occurred with the sustained chlorophyll-a values seen over the same months, there was also a 2016 to 2017 red tide event that didn't appear to have the same effect on chlorophyll-a. The combination of data displayed in Figures 3-6 to 3-8 suggest that Upper Sarasota Bay was impacted by both a red tide and a more traditional phytoplankton bloom during the period of late 2018 to early 2019. That time period seems to co-occur with the period during which seagrass meadows have been lost or substantially diminished in the waters north and west of Long Bar Point.

Thus, the combination of algal blooms from both red tide and non-red tide organisms appears to have resulted in a substantial reduction in water clarity, which caused a rapid and massive decline in seagrass coverage in the project vicinity. While red tide blooms are considered to be "natural" events along the southwest coast of Florida, there is emerging evidence that development and coastal eutrophication can exacerbate the severity and longevity of red time blooms (Outman, 2015). Furthermore, trend analyses of water quality conditions in Sarasota Bay indicated that chlorophyll-a concentrations in Upper Sarasota Bay have been increasing since 2006, and that both total nitrogen and chlorophyll-a concentrations have been increasing in the southern reaches of Sarasota Bay over the past decade (Tomasko and Keenan, 2019). Therefore, while seagrass coverage did significantly increase in Upper Sarasota Bay from 2006 to 2018, declining water quality conditions in this portion of the Bay could retard or delay the recovery of seagrass coverage following the catastrophic losses associated with the 2018 red tide event.

Seagrass Current Status

The Southwest Florida Water Management District (SWFWMD) surveys and maps seagrass, oyster, and tidal flat distributions within the coastal waters in its jurisdiction every two years, with data extending back to 1988. Geospatial datasets and maps are produced and provided to the public for resource management purposes. The methodology used to develop these data include the collection of high resolution aerial imagery under ideal conditions for subtidal observations, when water clarity is optimal (e.g. winter months during low tides). The aerial imagery is then ground-truthed in the field and digital polygons of these marine resources are produced through both geospatial machine-learning algorithms and visual digitization. Seagrass is mapped as two categories: 1) sparse; and 2) continuous. ESA is one of the contractors responsible for ground-truthing seagrass imagery for SWFWMD.

Pursuant to the discussion on seagrass trends above, seagrass coverage in Upper Sarasota Bay reached its apex in 2018 mapping period. The 2018 SWFWMD seagrass maps are published public records; however, the 2020 SWFWMD seagrass maps have not yet been produced. To support the project alternatives and analysis and conceptual design presented in this document, ESA conducted an extensive seagrass survey of the Alignment 1 corridor in June-July of 2020 to assess current seagrass coverages that represent seagrass declines caused by the 2018 red tide event. High resolution, multi-spectral aerial imagery of the project area (Source: NAIP, 2019) was used as the base imagery. Polygons are various subtidal signatures were drawn using GIS machine learning algorithms, and then thoroughly ground-truthed by ESA divers to develop a highly accurate 2020 seagrass coverage geospatial dataset and map.

Figure 3-9 shows seagrass coverage in 2018 (SWFWMD) and 2020 (ESA) within the project limits of Alignment 1, which is represented by a 300-foot wide corridor with the existing force main serving as the centerline. Consistent with observed seagrass trends discussed above, the 2020 seagrass coverage shows a very substantial decline over the 2018 coverage. Of particular note are the deep trenched areas in Segment 3 that did not support seagrass during the 2018 apex of seagrass coverage in this area. Similarly, the unnamed channel on the east side of Alignment 1 is also devoid of seagrass in 2018, and likely has never supported seagrass. As discussed above, the cause for the lack of seagrass coverage in these areas is the deeper bottom depths, which fall below the viable photic zone for seagrass recruitment and growth.

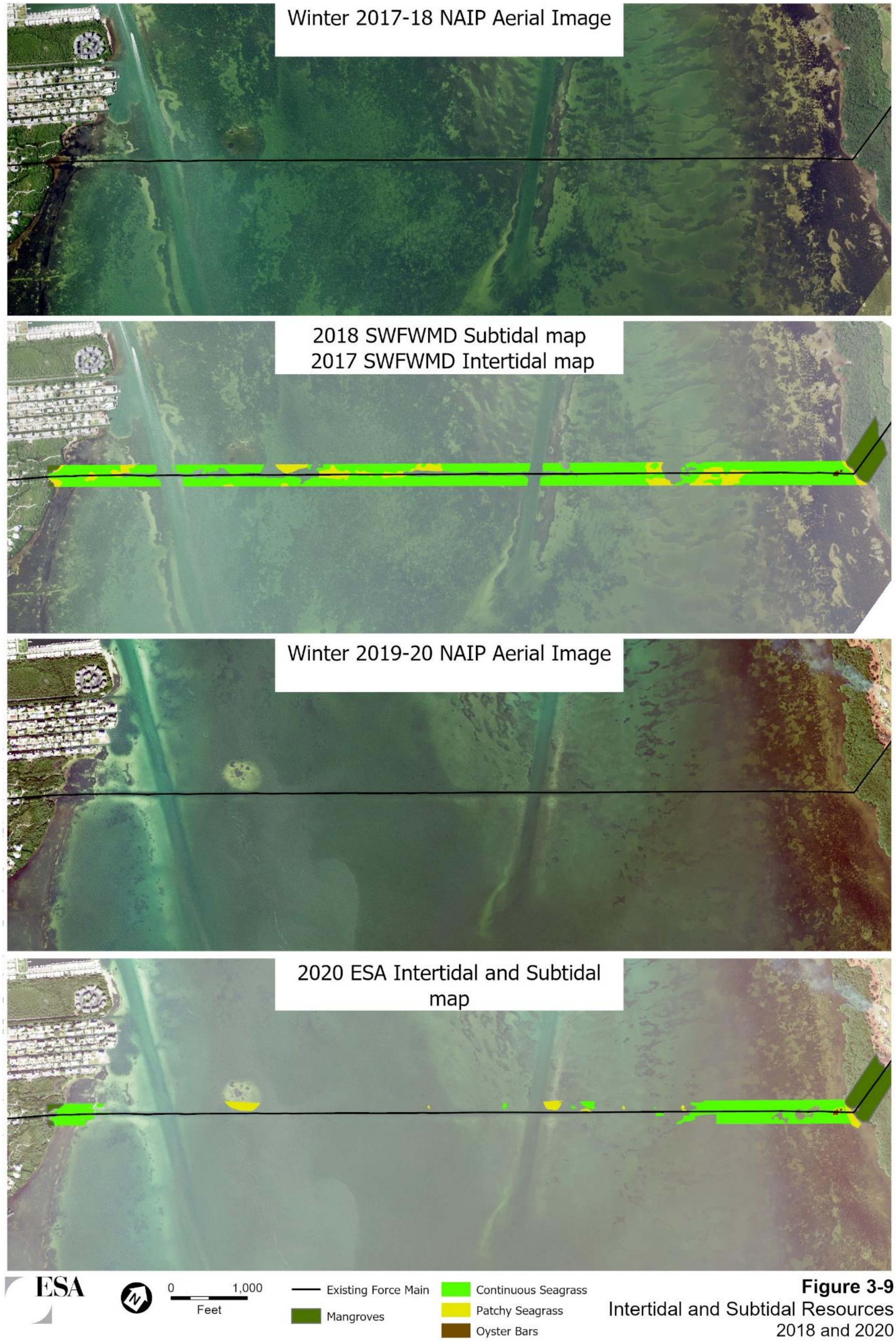


Figure 3-9
Intertidal and Subtidal Resources
2018 and 2020

3.3 Avoidance and Minimization

The proposed project is to construct a redundant 20-inch ID HDPE domestic sewage force main along Alignment 1 using an all open-cut trench approach (also referred to as open trench with shoring or cut-and-cover). While the open-cut trench approach will incur temporary surface impacts to wetlands and deepwater habitats, such impacts can be avoided and minimized through various construction measures designed to keep the project footprint and direct project impacts to a minimum, and to control potential secondary impacts caused by turbidity. The subsections that follow describe the proposed construction approach.

3.3.1 Proposed Construction Approach

Based upon the current understanding of the field conditions and discussions with a local marine contractor, work is anticipated to follow the methods described below. However, based on actual field conditions encountered at the time of project construction, the contractor(s) may propose alternative means and methods.

Construction Considerations

All pipeline construction will occur within permanent and temporary construction easements on private or public property. Soil excavated during construction will be reused on-site for backfilling, and excess spoils will be used to restore the depressed areas along the original pipeline trench.

The construction approach and limits of impacts to jurisdictional wetlands differs depending upon the location along the alignment. The construction corridor has been narrowed in the intertidal areas and along the shallow subtidal area with continuous seagrass (e.g., Segments 1-2 and 4-5). Construction limits are wider in Segment 3 where existing seagrass is sparse and water depths are greater, and where the proposed mitigation and trench restoration will occur, as trench shoring (e.g., sheet piling) would provide minimal benefits beyond those provide by turbidity screen is these areas. Four site-specific construction approaches were developed for pipeline installation within jurisdictional wetland limits, as discussed in the following sections and shown on the plans. The specific areas are:

- Subtidal areas of sparse seagrass (subaqueous);
- Subtidal areas of continuous seagrass (subaqueous);
- Intertidal west (landward);
- Intertidal east (landward).

The proposed subaqueous pipeline alignment generally follows in parallel to the existing force main, approximately 50 feet north of it, and installed with a minimum cover of 3 feet. The corridor to the north of the existing pipeline was selected to both allow tie-in with the Lift Station D on the western terminus, and to minimize impacts to wetlands and deepwater habitats.

A 50 foot offset will be maintained and needed to protect the existing force from any damage during construction. The maximum angle of repose of the existing soils is presumed to be 5 to 1. In the soils and sediments of the project area, without shoring, the cut-and-cover trench for a 20-inch ID HDPE pipeline with 3 feet of cover is 5 feet deep, approximately 2 feet wide at the bottom, and approximately 52 feet wide at the top. The total trench width is estimated to increase by 10 feet with every foot of additional trench depth, unless shoring is provided. For the landward portions of the alignment shoring is required, and for areas of continuous seagrass sheet piling is required to limit direct construction impacts.

Open-cut construction will generally involve trenching of the existing material, removing the material, fusing and installing the new 20-inch ID HDPE pipeline, and then backfilling the new force main and the open trench with the excavated material. To minimize direct impacts on environmental resources, site-specific construction approaches have been developed for each of the areas above. These site-specific approaches are detailed in the following sections.

Subaqueous Pipeline Installation

Figure 3-10 below shows a photo of typical construction of a subaqueous pipeline using an open-cut trench approach. Although there are differences, the materials and equipment shown in this photo are similar to what is anticipated for the proposed project, including turbidity curtains, barges, crane(s), excavator(s), sheet piling, pipe fusing equipment, and pipe. Barges and equipment can be placed at the contractor's discretion anywhere within the construction limits identified on the plans.

Figure 3-10
Typical Subaqueous Pipeline Installation
Using an Open-Cut Trench Approach

Construction Equipment

Additional details regarding subaqueous construction equipment to be used for this project are provided below.

- Barges: Barges provide a solid work platform for offshore and other maritime projects. The specific barge type used on this project will be selected by the contractor. Traditional barges are typically 40 x 80 feet in dimension. Smaller sectional barges approximately 40 x 10 feet in dimension can be connected to each other to provide greater maneuverability. **Figure 3-11** shows a photo pf a typically sectional barge. Sectional barges provide flexibility to modify and configure the platform's size and shape best to fit the site-specific corridor conditions and the necessary equipment. The proposed limits of construction provide an area at least 40 feet wide to accommodate either barge type.
- Spuds: Through-deck pilings or steel shafts are commonly referred to as spuds. The spuds are used to temporarily moor the barge on the bottom.
- Excavators: Excavators, similar to what is shown in **Figure 3-11** below are used to remove the existing soil material from the trench and return the same material to the trench. The excavators are equipped with GPS for horizontal and vertical accuracy for trenching and backfilling along the proposed alignment.
- Cranes: Similar to what is shown in **Figure 3-12** below, barge mounted cranes will be used to lift equipment, pipe, and other materials, and to move sectional barges, if those are used.

Figure 3-11
Sectional Barge with Excavator

Figure 3-12
Barge Mounted Crane

Pipe Laying

When placing the HDPE pipe into the trench, additional ballast weights may be required. The attachment of the required ballast weights can be conducted in two stages: preliminary weighting is conducted so as to still allow the pipe to be floated into position, and then the additional required weights are added where required after the completion of the submerging of the pipe; or the required ballast weights can be attached onto the pipe from a barge from which the pipe is slid to the bottom by means of a sled.

Construction Sequencing

The general sequence of construction for installation of the proposed subaqueous force main in accordance with the design plans will be as follows:

1. Provide construction survey and staking of both the existing pipeline and the new pipeline alignment, which is typically offset from the existing pipeline by 50 feet.
2. Install turbidity curtains to delineate and isolate the area of turbidity impacts.
3. Create a construction platform with barges to carry and store all construction equipment and materials.
4. Install sheet piling, where required.
5. Excavate the native material from the trench in accordance with and to the limits shown on the plans.
6. Fuse and install 20-inch ID HDPE pipe.
7. Backfill the trench by placing the excavated material into the trench with the previously excavated native backfill material.

8. Remove sheet piling.
9. Move the construction barge train along the alignment.

Construction Approach in Deep Subtidal Areas (Segment 3)

Based on the 2020 seagrass survey presented above (Figure 3-9) most of the central Bay in Segment 3 has sparse or no seagrass along the project alignment. As a result, the proposed project will not require sheet piling for excavation in this area. The depth of excavation in this area varies from 3 to 8 feet of cover. The deepest trench is that which crosses the ICW. In an effort to minimize the amount of time the contractor is working within the ICW and disrupting vessel traffic, sheet piling will not be installed here. The ICW is adequately wide to divert vessel traffic to one side, while the pipe is being laid on the other side. Interference with boat traffic along the ICW can also be mitigated with night work, if necessary.

Because water depths in this area are greater than 4 feet, the barges will float on the water surface. As a result, the only direct impacts from the barges will be from placement of spuds on the bottom. Other direct impacts include both the trenching and placing of the spoils. In this area, it is anticipated that spoils will be placed adjacent to and south of the open trench. As portions of the pipe are laid, backfilling can commence. **Figure 3-13** shows a typical construction section in the deep portions of the project, primarily in Segment 3.

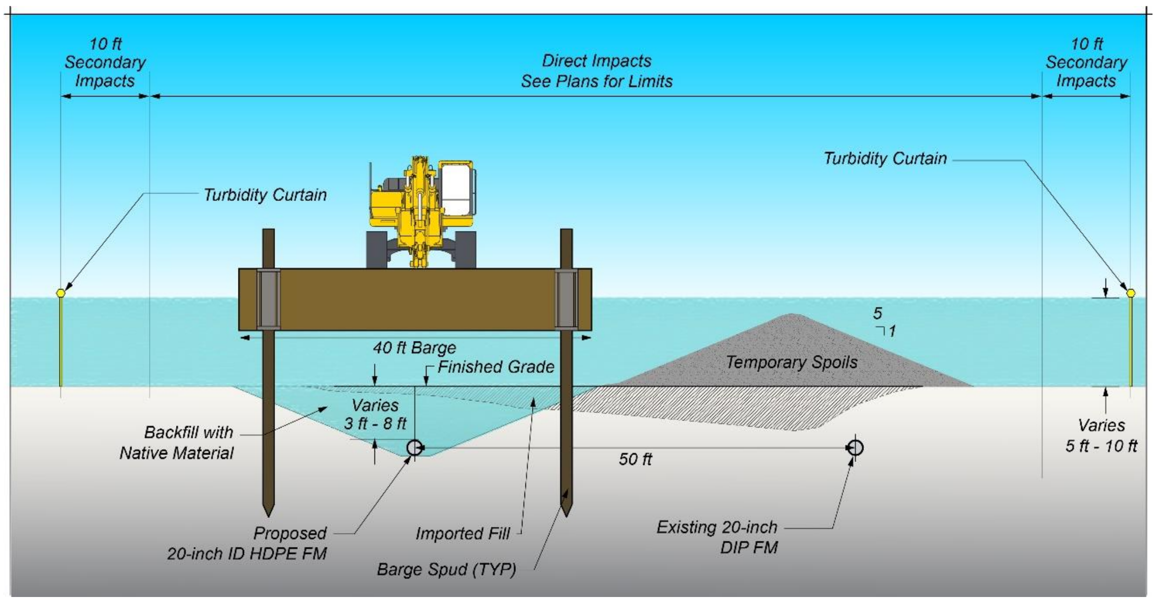


Figure 3-13
Typical Construction Section in Deep Subtidal Areas (Segment 3)

Construction Approach in Shallow Subtidal Areas (Segments 2 and 4)

Barges are structurally and buoyantly sufficient to support excavation operations and prevent settling of the equipment into the sand; therefore, it is anticipated that the contractor will use sectional barges in the shallow subtidal areas. Sectional barges can extend as much as 7-feet tall which will keep heavy equipment out of the saltwater, which can be detrimental to the condition of the equipment.

To minimize seagrass impacts in this area, sheet piles will be required to maintain a trench width of no more than 10 feet. Sheet piles will be picked up and moved by a crane and installed with a pile driver, if needed. Approximately 20 to 40 2-foot wide sheet piles can be installed per day. A total of 20 feet in length of open trench (50 sheet piles on each side) is practical for pipeline installation. Length of open trench will be limited to the reach of the crane. Sheet piles at the one end of the trench can be picked up and moved to the other end, where new sheet piles are needed ahead of the excavation. Sheet piles will extend above the water surface to visually locate the trench and avoid potential damage to the sheet piles or barges.

Barges will be located adjacent to the sheet piles. From the barge the excavators will reach over the sheet piles and remove material during trenching operations. Spoils from sheet piled excavation operations will be stored in containers on the barge during pipeline installation. This avoids direct impacts that would otherwise result from temporary spoils stored on or removed from the sea floor. HDPE pipe will be fused on the barge, then lifted over the sheet piles and lowered into the trench. As portions of the pipe are laid, backfilling can then commence. The spoils from the excavation placed back in the trench to backfill the new pipe and any excess spoils will be used to restore the original force main trench in the areas designated on the plans. **Figure 3-14** shows a typical construction section in the shallow subtidal portions of the project, primarily in Segment 2 and 4.

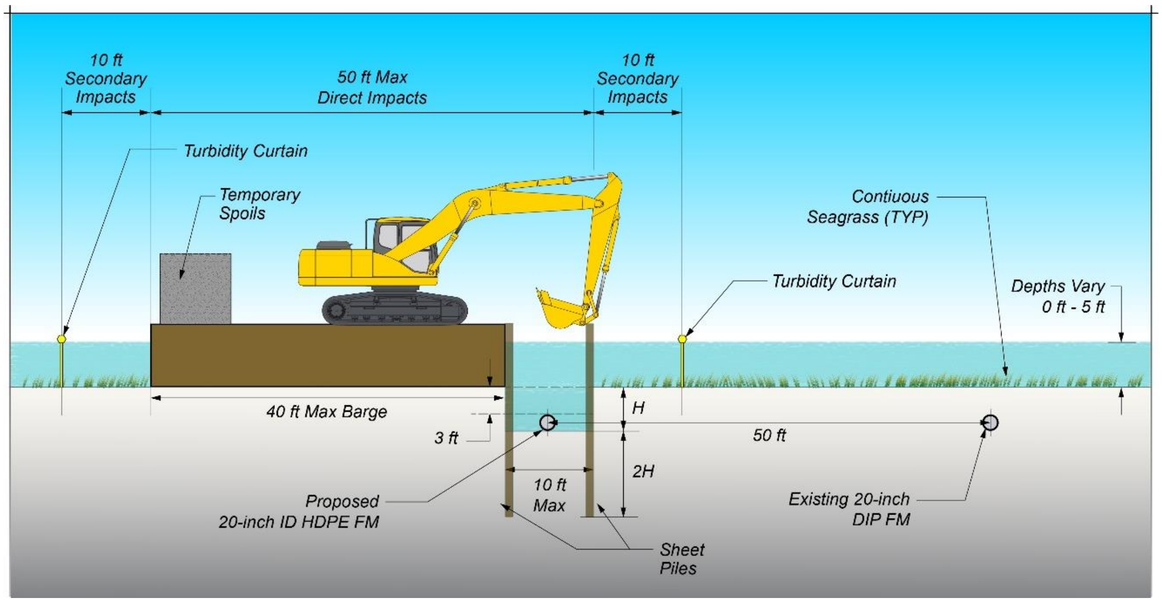


Figure 3-14
Typical Construction Section in Deep Subtidal Areas
(Segment 2 and 4)

Landward Pipeline Installation

Landward open cut construction is proposed for installing the new force main in the intertidal areas on the west and east ends of the jurisdictional wetlands - Segments 1 and 5, respectively. To minimize direct impacts to mangroves in these areas, the open-cut construction in these upland areas will require a vertical trench wall with shoring. Clearing and grubbing of mangroves and other vegetation will be required. Laying temporary timber matting will likely be required to stabilize the soil on both of these segments prior to excavation. To accommodate construction and equipment in the work area, the entire construction corridor (active work area including the trench) will be up to 55 feet wide.

Construction Equipment

Equipment used for this work is typical for landward construction and includes:

- Heavy equipment for excavation typically an excavator;
- Dump trucks to transport soils;
- HDPE pipe and pipe fusing equipment.

Construction Sequencing

The sequence of landward construction in accordance with the design plans will be as follows:

1. Provide construction survey and staking of both the existing pipeline and the new pipeline alignment;
2. Mobilize construction equipment.
3. Clear and grub the area of direct impact shown on the drawings.
4. Stabilize the soils along the cleared area, which will likely include timber matting.
5. Excavate the native material from the trench with a trench box in accordance with and to the limits shown on the plans.
6. Fuse and install 20-inch ID HDPE pipe.
7. Move trench box and continue excavating.
8. Backfill the trench by placing the excavated material back into the trench.
9. Move the construction equipment along the alignment.

After clearing and grubbing, the contractor will install timber matting for the excavation equipment to rest upon. The trench will then be excavated side casting spoils adjacent to the trench. The cleared area of direct impacts includes a 5-foot wide trench, an area for the fusing and stringing the HDPE pipe, excavation equipment, and a stockpile of the trench spoils prior to backfilling the trench.

Construction Approach in the West Intertidal Areas (Segment 1)

From Gulf Bay Road, the proposed alignment jogs slightly north into Joan M. Durante Park (Park) and away from the existing force main to avoid impacts to the wetlands area at the end of Gulf Bay Road and the associated risk of installing the new subaqueous pipe in close proximity to the existing force main. Through the Park, the new force main alignment generally follows the walking trail and is located more than 65 feet north of the existing force main to minimize wetland impacts. In this area, it is presumed that the contractor will place the side cast spoils on the north side of the proposed trench. **Figure 3-15** shows a typical construction section in the west intertidal areas of the project (Segment 1).

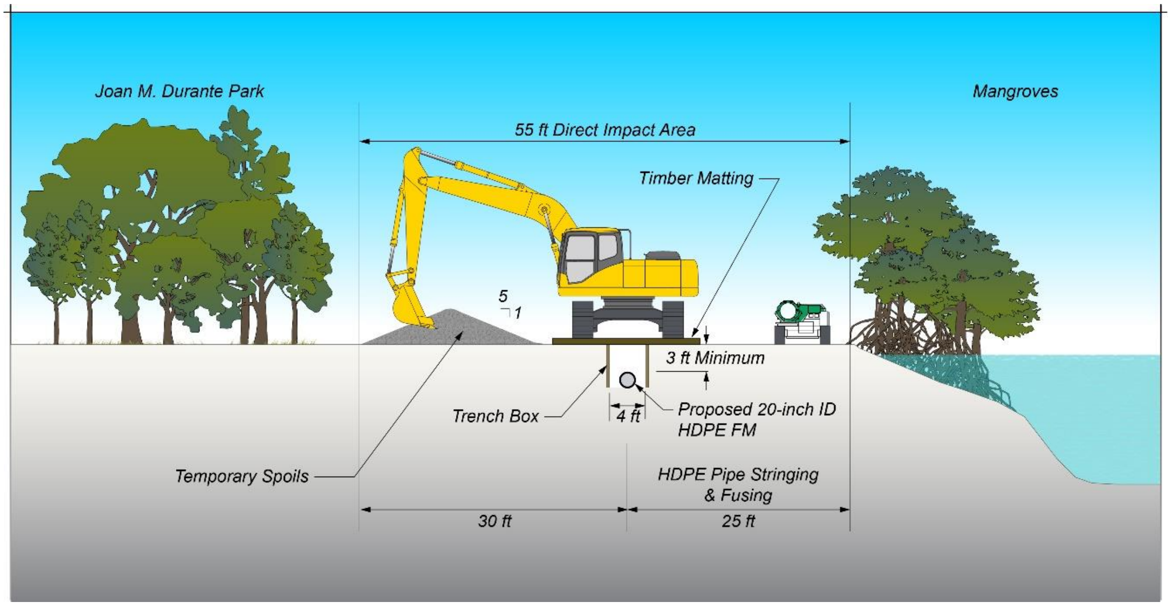


Figure 3-15
Typical Construction Section West Intertidal Zone (Segment 1)

Construction Approach in the East Intertidal Areas (Segment 5)

On the Manatee County mainland side of the project, the new force main will be installed parallel to and 25 feet north of the existing force main. In this area, it is presumed that the contractor will place the side cast spoils on the south side of the proposed trench, a portion of which has been impacted by an emergency fill road to repair the leak in the existing force main. **Figure 3-16** shows a typical construction section in the east intertidal areas of the project (Segment 5), while **Figure 3-17** shows a photo of the repair of the existing force main leak on the Manatee County mainland.

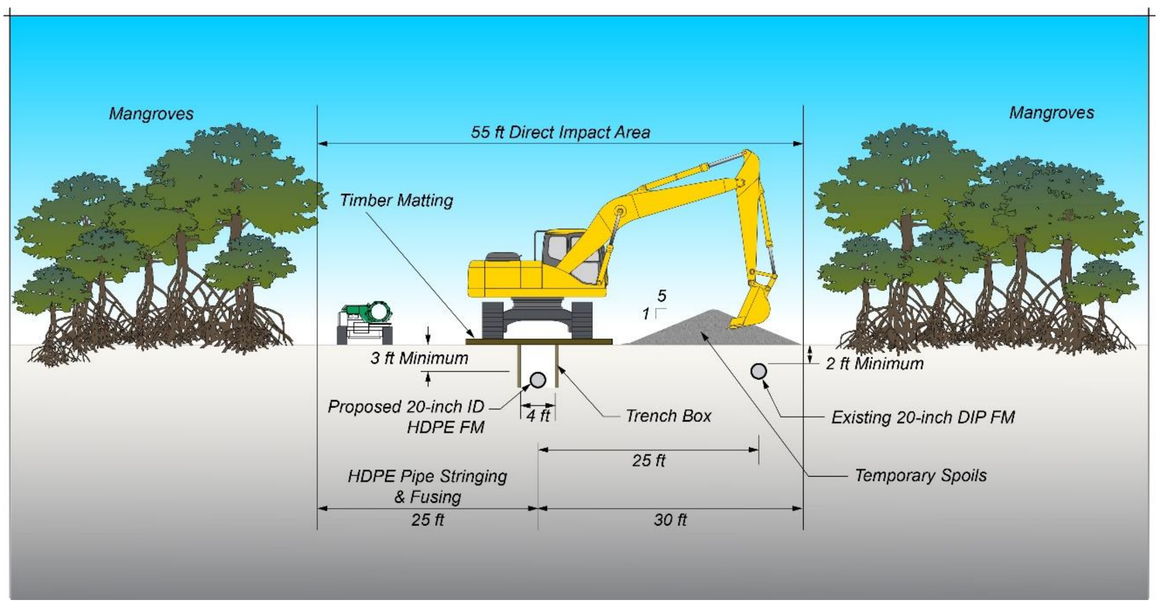


Figure 3-16
Typical Construction Section East Intertidal Zone (Segment 5)

Figure 3-17
Photograph of Existing Force Main Repair

Staging Areas

The staging areas for the project will be outside the limits of jurisdictional wetlands. On the Longboat Key (western) side of the Bay, the contractor will have access to a specified area of the Joan M. Duarte Park for temporary storage of equipment, pipe, and sheet piling and other supplies. On the Manatee County Mainland (eastern) side of the Bay, the contractor will be limited to using the area of direct impacts identified on the plans along the proposed force main alignment and any temporary staging areas identified outside of the jurisdictional wetlands.

3.3.2 Environmental Commitments

In order to reduce the width of the trench, and therefore minimize impacts, vertical trench walls will be required in upland areas and areas of continuous seagrass typically along the east and west shorelines of the Bay. Environmental impacts have been categorized as direct or secondary impacts, as defined in Section 3.4 below. Direct impacts include direct impacts to mangroves, seagrass, oyster bars, or other biological resources. Secondary impacts consist of indirect impacts to existing seagrass within the limits of work, such as the areas outside the trench, but inside the turbidity screens that will be exposed to increased turbidity from excavation.

For the subaqueous pipeline installed without sheet piling, assuming 3 feet of cover and side slopes no greater than 5:1, the trench width will be approximately 52 feet. Ten feet outside these offsets is the proposed placement of the turbidity curtains. Note that for areas without sheet piping, barge navigation is limited to the areas of direct impact identified on the plans. The total impact area for pipe installation without sheet piles varies between 150 and 175 feet in width. Trench width for sheet piling operations for subaqueous pipeline installation will be 10 feet. A total offset of 40 feet to the north from the sheet piles is required for barge clearance and one row of turbidity curtain. In areas with less than 4 feet of water depth the barges will sit on the seafloor until moved. Forty feet is allotted for the barge and 10 feet for the turbidity curtains. An offset of 10 feet from the sheet piles to the south is required for the turbidity curtain. The total width of impacted area for pipe installation with sheet piles is 70 feet.

With respect to potential impacts to the West Indian manatee and sea turtles, it should be noted that all work areas in the open water will be entirely contained within sheet piling and/or turbidity screens. These containments will prevent the entry of large motile wildlife into the work areas. In addition, standard marine construction conditions for continuous monitoring of manatees will be adhered to throughout the duration of project construction.

3.4 Project Impacts

As discussed in Section 3.3 above, avoidance and minimization of impacts to wetlands and aquatic resources in Alignment 1 is achieved through: 1) routing of the new force main north of the existing force main, which avoids some areas of continuous seagrass and minimizes impacts to mangroves on the west side of the project; and 2) specific construction approach measures, which minimize the open-cut trench footprint, as well as secondary impacts caused by temporary turbidity increases. Nonetheless, as proposed, the project will incur impacts to wetlands and aquatic resources.

Table 3-4 below provides a summary of direct and secondary impacts to wetlands and the deepwater habitats of concern in Alignment 1. Direct impacts represent the surface area that will be physically disturbed by excavation of soils and sediments to install the new force main, and then the re-burial of the force main with the same native materials. Secondary impacts represent the surface area that may be impacted by increased turbidity within the work areas. Secondary impacts areas are outside of the sheet piling that will contain the excavation and re-burial activities, but within turbidity screening that will encompass the entire construction area.

TABLE 3-4
SUMMARY OF PROJECT IMPACTS TO WETLANDS AND DEEPWATER HABITATS

Wetlands and Deepwater Habitats	Direct Impact Area (acres)	Secondary Impact Area (acres)
Mangroves and Intertidal Habitats	1.5	N/A
Seagrasses	3.5	2.2
Oysters	0.2	N/A

It is emphasized here again that all direct impacts associated with the proposed open-cut trench construction approach will be temporary impacts only. There will be no permanent hardening or placement of structures in the work areas, and there will be no permanent alteration of elevations or bathymetric contours (e.g., permanent dredge and fill areas). All directly impacted areas will be restored back to natural elevations and grades immediately upon installation and burial of the new force main.

It should also be noted that seagrass transplanting is not proposed as a means to minimize the proposed construction impacts. It is the experience of the ESA consultant team that transplanting of seagrass is very costly and rarely successful, especially bare root transplanting. The success of seagrass transplanting increases when it involves thick continuous seagrass material with dense root mats which can be extracted and placed in the recipient site similar to the sodding of lawn grass. However, it should be noted that the seagrass communities in the project vicinity are currently under extreme stress due to red tide events, and perhaps declining water clarity. Therefore, the cost/benefit of seagrass transplanting on this project is not supported by the data.

Finally, as discussed in Section 2.2.6 above, it may be possible to reduce surface impacts to wetlands and aquatic resources by implementing a trenchless construction approach under Segments 1 and 2 on the west side of the project (Alternative 5 or 6 in Table 2-4); however, both the HDD and DP trenchless construction approaches have uncertainties and other risks (e.g., borehole failure; drilling fluid frac-out) associated with them.

3.5 Mitigation and Restoration Opportunities

Section 3.2.2 above presents a detailed assessment of the status and trends of seagrass coverage in the project vicinity. From this analysis, it is clear that major portions of the old dredge cut associated with the installation of the existing force main never recovered seagrass, even when adjacent areas showed substantial recovery over the period 2006-2018. Figure 3-9 above clearly shows these areas in the 2018 seagrass coverage produced by SWFWMD; and these areas correspond with bathymetric data collected to support project conceptual design.

Analyses conducted by ESA (2019) clearly showed that depth is the primary variable controlling seagrass distributions in the project area. An investigation of sediment quality in the old dredge cut showed that other factors such as the accumulation of organic matter or hydrogen sulfide were not significant. Furthermore, the ESA analysis showed that the absolute depth limit for seagrass recruitment and sustained growth was about -10 feet NAVD under excellent water quality conditions.

3.5.1 Seagrass Mitigation and Restoration

To offset both direct and secondary impacts to seagrasses, backfilling of the deep dredge cuts in the project limits is proposed. The areas to be backfilled are shown in **Figure 3-18**. These areas include both the remnant trench cuts from the installation of the existing force main, as well as a portion of the unnamed channel through which the new force main will be installed. These backfill areas are indicated on the 30% design plans included as part of this submittal. Cut and fill analysis from the conceptual plans indicate the following specifications for proposed backfill areas:

- 6.5 acres of backfill to natural adjacent depths;
- 15,300 cubic yards of backfill material (1,300 from cut for new force main; 14,000 from offsite source);
- 1.9 to 1 mitigation ratio for direct seagrass impact.

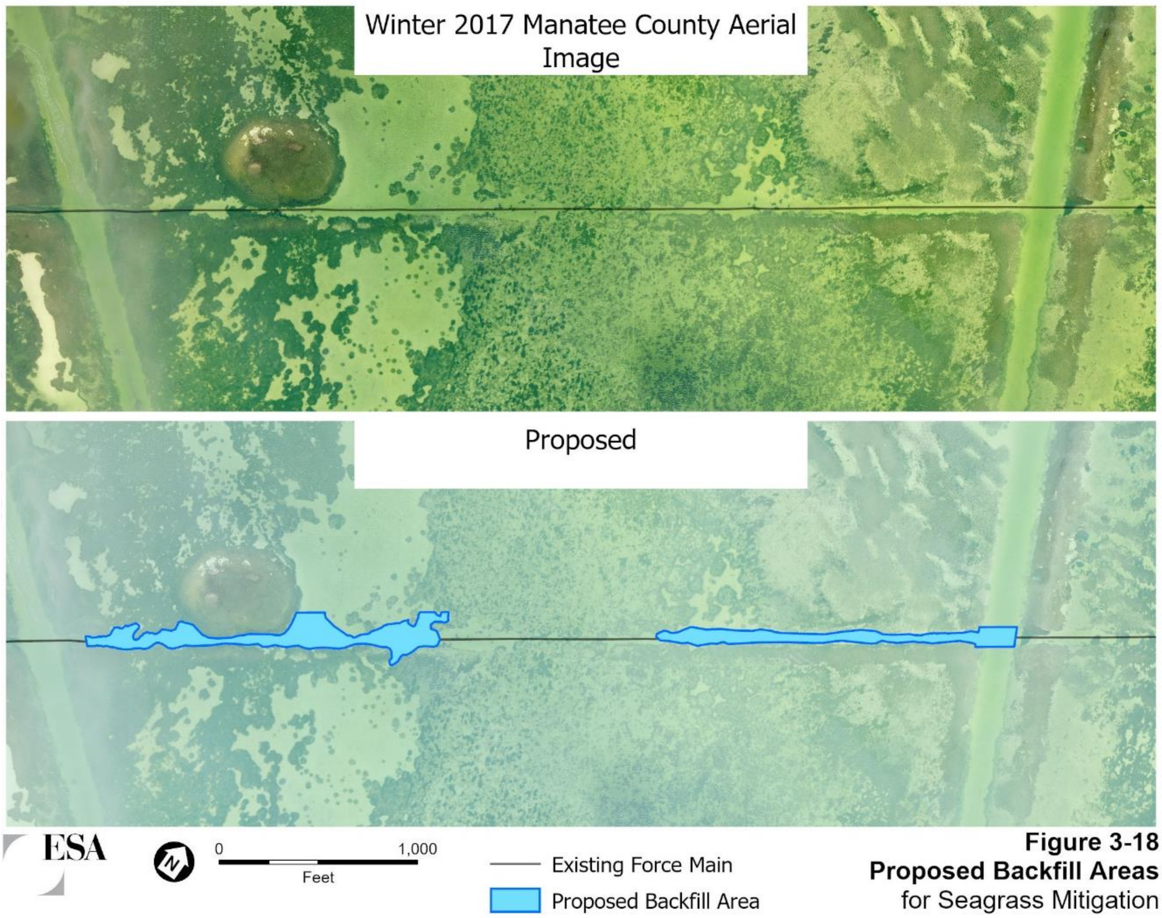


Figure 3-18
Proposed Backfill Areas
for Seagrass Mitigation

The average depths of the backfilled areas will be approximately -6 to -7 feet NAVD, well into the viable seagrass photic zone. Backfill material will be derived from surplus native material associated with the installation of the new force main, as well as the import of offsite material from nearby upland borrow pits. The characteristics of the offsite backfill material will clean fine sands consistent in grain size and percent organic matter as native material. It is estimated that about 14,000 cubic yards of offsite material will be required.

Surplus native material derived from the installation of the new force main in Segment 3 will be distributed into the old trench cuts concurrent with the installation. Very little seagrass currently exists in the proposed work areas in Segment 3, which will be completely contained within double-hung turbidity barriers to prevent secondary impacts to adjacent seagrass. The same measures will be applied to the backfill of the unnamed channel segment. The offsite material will be imported to the backfill areas on barges and placed into the dredge cuts using a mechanical bucket. Precision bathymetric surveys will be conducted during this process to ensure that target depths are attained in the backfill areas. All of the backfill activities will be conducted concurrent with the installation of the new force main, and will not require additional mobilization or disturbance to the work areas.

Upon completion of the new force main installation, bathymetric surveys will be conducted in the backfill areas to ensure that settlement or erosion has not occurred, and that target depths are being maintained. If necessary, the unstable backfill areas may be temporarily stabilized using large mesh geotextile fabric staked into the bottom. The target depths of the backfill areas, and the characteristics of the backfill material, are anticipated to create 6.5 acres of new surface area within the viable seagrass photic zone. The proposed 6.5 acres of backfill will offset the 3.5 acres of direct seagrass impacts on a 1.9 to 1 ratio. Lime rock rip-rap will be used to stabilize the slopes of the fill section in the unnamed channel.

Beyond the mitigation requirements of this project, there is the potential to conduct substantial ecosystem restoration in Upper Sarasota Bay through additional backfilling of the unnamed channel. This old dredged channel is 200 feet wide in most places, and extends southward of the existing force main by about 1,000 feet, and northward by about 3,500 feet. This feature has substantial restoration potential exceeding 20 acres, which could be accomplished through backfilling to shallower depths that can support future seagrass recovery. Such a project should be evaluated by the various natural resource management agencies (e.g., FDEP, SWFWMD, SBEP) for public funding (e.g. RESTORE Act funds) as a long-term habitat restoration project.

3.5.2 Mangrove Mitigation

All direct impacts to mangroves will be mitigated by restoring the grade of the impacted surface areas and planting these areas with mangrove propagules purchased at local nurseries. Propagules will be planted on 3-foot centers in all restoration areas. If additional mitigation is needed to offset the temporal loss of wetland functions during the recovery of impacted mangrove areas, there are substantial opportunities for Brazilian pepper removal and mangrove restoration in the pending Long Bar Pointe mitigation bank.

3.5.3 Oyster Mitigation

As proposed, the project will only impact approximately 0.2 acres of oyster, which are all located in the shallow depths of the eastern shoreline. The oysters present in the project construction area are “clumps” that reside on the sediment surface. It may be possible to simply relocate these oyster clumps out of the direct and secondary impact areas in the adjacent shallow subtidal zone. If this is not possible, then the appropriate and proven technique for establishing new oyster reef growth is the placement of cleaned oyster shell material and other hard substrate such a lime rock in locations with suitable salinity and a quiescent wave energy environment. If required by the regulatory agencies, these measures will be implemented to offset any oyster losses.

SECTION 4
Summary Conclusions

- The applicant for the proposed project is the Town of Longboat Key (Town), an incorporated local government unit in Manatee County, Florida.
- The purpose of the proposed project is to construct a redundant or replacement domestic wastewater force main adjacent to the Town's existing force main under Sarasota Bay.
- The existing force main is approaching end of its projected 50-year service life. On June 29,2020, a sewage leak was discovered on the Manatee County landside, within the mangrove fringe approximately 400 feet from the open waters of Sarasota Bay. The leak was quickly repaired, and a Consent Order agreement with the Florida Department of Environmental Protection is currently being negotiated.
- Should the existing force main fail completely, the only alternative for conveying domestic sewage flows from Longboat Key is via tanker and pumper trucks, which would require approximately 24 trucks running continuously. While theoretically feasible, this scenario would cause substantial truck traffic, would require a very well-coordinated and communicated effort between the various local governments, and would clearly be a challenge to execute. Higher wastewater flows during wet weather conditions could likely not be managed in this manner.
- There is a high degree of urgency to obtain permits and complete this critical infrastructure project expeditiously. Accordingly, the applicant is requesting an expedited review of this project.
- Given the age of the force main, in 2015 the Town conducted a study of various alignment (routes) and construction alternatives for replacing for existing force main. Five alternative alignments, including the existing alignment, as well as various pipe materials and alternative construction approaches were analyzed and ranked.
- The highest ranked scenario was the existing alignment (Alignment 1) using a single pull Horizontal Directional Drill (HDD). However, these conclusions were qualified, contingent upon the determination of suitable geotechnical conditions in the subaqueous portion of the alignment, as well as the technical feasibility of conducting a single pull HDD under the 2.3 mile crossing of Sarasota Bay, which would be the longest single pull subaqueous HDD project in the U.S., thus testing the limits of this technology.
- Based on input received from environmental regulatory agencies during pre-application meetings, an "upland" alignment was also evaluated (Alignment 5), which would route domestic sewage north to Bradenton Beach, west near the Cortez Road (SR-684) bridge, and then southeast to the Manatee County SWRWRF. This alternative would require major modifications to the Town's wastewater collection infrastructure, including new pump stations, as well as extensive Rights-of-Way coordination with other local governments and private property owners. Given the urgency of this project, this alternative alignment is considered to be infeasible.

- Seagrass coverage in Alignment 1 declined precipitously between 2018 and 2020, primarily due to a severe and long-lasting red tide event that occurred in the late summer and fall of 2018. The relatively depauperate condition of seagrass meadows that currently exists in the project vicinity has created an opportunity to construct the redundant force main within Alignment 1 without incurring significant seagrass impacts.
- As proposed, the redundant force main will be constructed of 20-inch ID High Density Polyethylene (HDPE) pipe, which is impervious to corrosion and is highly resilient, thus making it ideal for applications in the marine environment.
- The proposed new force main will be constructed adjacent to, and north of the existing force main using the same open-cut trench construction approach that was used for the installation of the existing force main.
- Impacts to the surface area of the bay bottom, as well as to the mangrove fringe on both ends of the project, will be minimized through tight confinement of the work areas using sheet piling, shoring, and turbidity screens.
- All impacts to wetlands and aquatic resources will be temporary impacts, as there will be no permanent loss of resources, or suitable elevations and bathymetric depths to support such resources, due to the proposed dredging and filling associated with the proposed project.
- The proposed project has the potential to result in a net environmental benefit to the Sarasota Bay marine ecosystem with respect to seagrass recovery. Portions of the open cut trench previously excavated for the placement of the existing force main were never properly backfilled, resulting in persistent deep areas with bottom depths that have never supported seagrass even when seagrass coverage was at its apex in early 2018. In addition, a deep unmarked dredged channel runs perpendicular to the existing force main along the eastern side of the project.
- As part of the proposed project, the old trench cut, and a portion of the unmarked dredged channel will be backfilled to adjacent grade with suitable sediment material, and appropriately stabilized to support seagrass recovery. The proper backfilling of these deep areas to support seagrass recovery in the project vicinity is expected to fully offset all temporary disturbances to marine benthic communities associated with project construction, as well as result in a net increase in seagrass coverage.
- Rehabilitation of the existing force main (e.g., lining it with a smaller diameter HDPE pipe) will allow it to continue to serve as a redundant sewage pipeline, and may also allow for the return of the highly treated reclaimed water back to Longboat Key to offset the use of potable water for irrigation.

SECTION 5
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