

**Agenda Packet**

**City Council Worksession Meeting**

**Monday, September 12, 2016**

**4:30 P.M.**

**City Council Worksession Meeting  
City of Belleair Beach, Florida**

**Monday, September 12, 2016  
Community Center, 4:30 P.M.**

**PUBLIC MEETING NOTICE  
AGENDA**

Call to Order  
Pledge of Allegiance  
Roll Call

1. Presentation by Larry Fluty, PhD, PE, President of Engineering Sciences Group, Inc., on the City of Belleair Beach Master Drainage Plan. (see backup)

Any person who decides to appeal any decision of the City Council with respect to any matter considered at this meeting will need a record of the proceedings and for such purposes may need to ensure that a verbatim record of the proceedings is made, which record includes the testimony and evidence upon which the appeal is based. The law does not require the City Clerk to transcribe verbatim minutes; therefore, the applicant must make the necessary arrangements with a private reporter or private reporting firm and bear the resulting expense. Any person with a disability requiring reasonable accommodation in order to participate in this meeting should call 727.595.4646 ext 124 or fax a written request to 727.593.1409.

Posted: September 7, 2016  
Patricia A. Gentry, CMC  
City Clerk

# **City of Belleair Beach Stormwater Master Drainage Plan Update**

**Prepared for**



**City of Belleair Beach  
444 Causeway Boulevard  
Belleair Beach, Florida 33786**

**Prepared by**



**Engineering Sciences Group, Inc.  
12331 Stringer Rd  
Brooksville, Florida 34601**

**September 1, 2016**



DRAFT

## Table of Contents

<b>Executive Summary</b> .....	ES-1
<b>Section 1 Introduction</b>	
1.1 Authorization .....	1-1
1.2 Purpose and Objective .....	1-1
<b>Section 2 Existing Reports and Studies</b>	
2.1 Existing Master Drainage Plan .....	2-1
2.2 FEMA Flood Insurance Study .....	2-1
2.3 Tampa Climate Advisory Panel .....	2-1
<b>Section 3 Inventory of Existing Facilities</b>	
3.1 Drainage Infrastructure Inventory .....	3-1
<b>Section 4 GIS Mapping and Database Development</b>	
4.1 Structures Data Collection .....	4-1
4.2 Stormwater Infrastructure Digitization .....	4-1
4.3 Watershed & Basin Delineation .....	4-2
4.4 Watershed Delineation Using ArcGIS .....	4-3
4.5 Watershed Attributes and Basin Creation .....	4-3
<b>Section 5 Model Selection, Construction and Calibration</b>	
5.1 ICPR Model Overview .....	5-1
5.2 ICPR Model Development .....	5-1
<b>Section 6 Hydrologic and Hydraulic Evaluation</b>	
6.1 Existing Conditions Modeling .....	6-1
<b>Section 7 Water Quality Evaluation</b>	
7.1 Pollutant Evaluation Model .....	7-1
7.2 Pollutant Types and Sources .....	7-4
7.3 Water Quality Analysis .....	7-5
<b>Section 8 Best Management Practices (BMP) Analysis</b>	
8.1 Project Selection and Prioritization .....	8-1
8.2 Best Management Practices (BMP) Descriptions .....	8-1
8.3 Evaluation of Funding Sources .....	8-7
<b>Section 9 Sea Level Rise (SLR) Considerations</b>	
9.1 Sea Level Rise Overview .....	9-1
9.2 Sea Level Rise Projections .....	9-2
9.3 ICPR Modeling with Increasing SLR .....	9-5



DRAFT

City of Belleair Beach  
Stormwater Master Drainage Plan Update  
September 1, 2016

Section 10 Recommendations  
10.1 Recommendations ..... 10-1

References

Appendices

Appendix A Figures and Maps  
Appendix B ICPR Existing Model Results  
Appendix C Water Quality Analysis Results  
Appendix D BMP Concept Plans and Costs  
Appendix E ICPR Model Results  
Appendix F Sea Level Rise ICPR Model Results  
Appendix G ICPR Model Input / Output Data

List of Figures

Figure 4-1 Existing Infrastructure Map  
Figure 4-2 DEM Map  
Figure 8-1 BMP Locations  
Figure 8-2 Proposed Infrastructure Map  
Figure 9-2 Sea Level Rise Floodplain

List of Tables

ES-1 BMP Projects, Priority and Budget  
4-1 Datasets  
4-2 City of Belleair Beach basin ID and Descriptions  
5-1 ICPR Model Identifiers  
5-2 Curve Number Look-up Table  
5-3 Summary of Selected Design Storm Events  
6-1 Node Peak Stages  
6-2 Reach Peak Flow Rates  
6-3 Existing Conditions Flood Area Table  
7-1 Event Mean Concentration (EMC)  
7-2 BMP Removal Factors  
7-3 Runoff Coefficients  
7-4 Water Quality Analysis Results  
8-1 Proposed Node Peak Stages  
8-2 Proposed Reach Peak Flow Rates  
8-3 Outfall Priority Matrix  
9-1 SLR Scenario Descriptions  
9-2 Adjusted Sea Level Rise Projection  
9-3 SLR Model Results  
ES-2  
4-1  
4-4  
5-2  
5-6  
5-5  
Appendix B  
Appendix B  
Appendix B  
7-2  
7-3  
7-4  
Appendix C  
Appendix E  
Appendix E  
8-9  
9-4  
9-4  
Appendix F



# DRAFT

## City of Belleair Beach Stormwater Master Drainage Plan Update September 1, 2016

---

### Executive Summary

In November of 2015, the City of Belleair Beach, Florida, (City) contracted with Engineering Sciences Group, Inc. (ESG) to update their Master Drainage Plan (MDP). The project goals established by the City for the Master Drainage Plan Update included:

- Inventory the City's stormwater drainage facilities
- Review and update the existing MDP computer model and GIS geodatabase
- Provide recommendations for stormwater Best Management Practices (BMP) for capital improvements

This report outlines the activities performed to complete the goals listed above, and includes documentation of the engineering procedures and information used in accomplishing the Master Drainage Plan update.

To accomplish these project goals, an ArcGIS geodatabase was created of stormwater infrastructure (data collected by the City and ESG), basins contributing runoff to the City stormwater system were delineated, and an Interconnected Pond and Routing (ICPR) hydrologic and hydraulic model of the stormwater system was developed. The ICPR model was then used to assess flooding resulting from the selected design storms. Potential stormwater infrastructure improvement projects were incorporated into the model, and were then evaluated based on the extent that each project reduced the model-calculated flooding extents. BMP modeling efforts focused on sixteen (16) flooding issue areas identified during the prioritization process.

This report documents all work performed to meet the goals of the stormwater management plan update. Detailed descriptions of the processes used in development of the stormwater infrastructure geodatabase, basin delineation, ICPR model development, and assessment of potential BMP projects are given. An assessment of potential funding sources was provided to be considered by the City when implementing recommended BMP projects. All work was performed under consultation with the City and all pertinent GIS data, ICPR model files and results, and relevant supporting documents are provided in electronic format on the accompanying data storage device in this report.

### Recommendation

Of the forty-eight (48) stormwater outfalls within the City, sixteen (16) flood issue areas were selected for further development of BMP concepts and cost estimate. The Belleair Beach Master Drainage Plan Update presents conceptual options to improve conveyance of stormwater runoff and opinions of probable construction cost for recommended BMP projects. The sixteen (16) selected flood prone areas and cost summary are listed in Table ES-1 below:

# City of Belleair Beach



## Master Drainage Plan

### BMP 1 1st Street

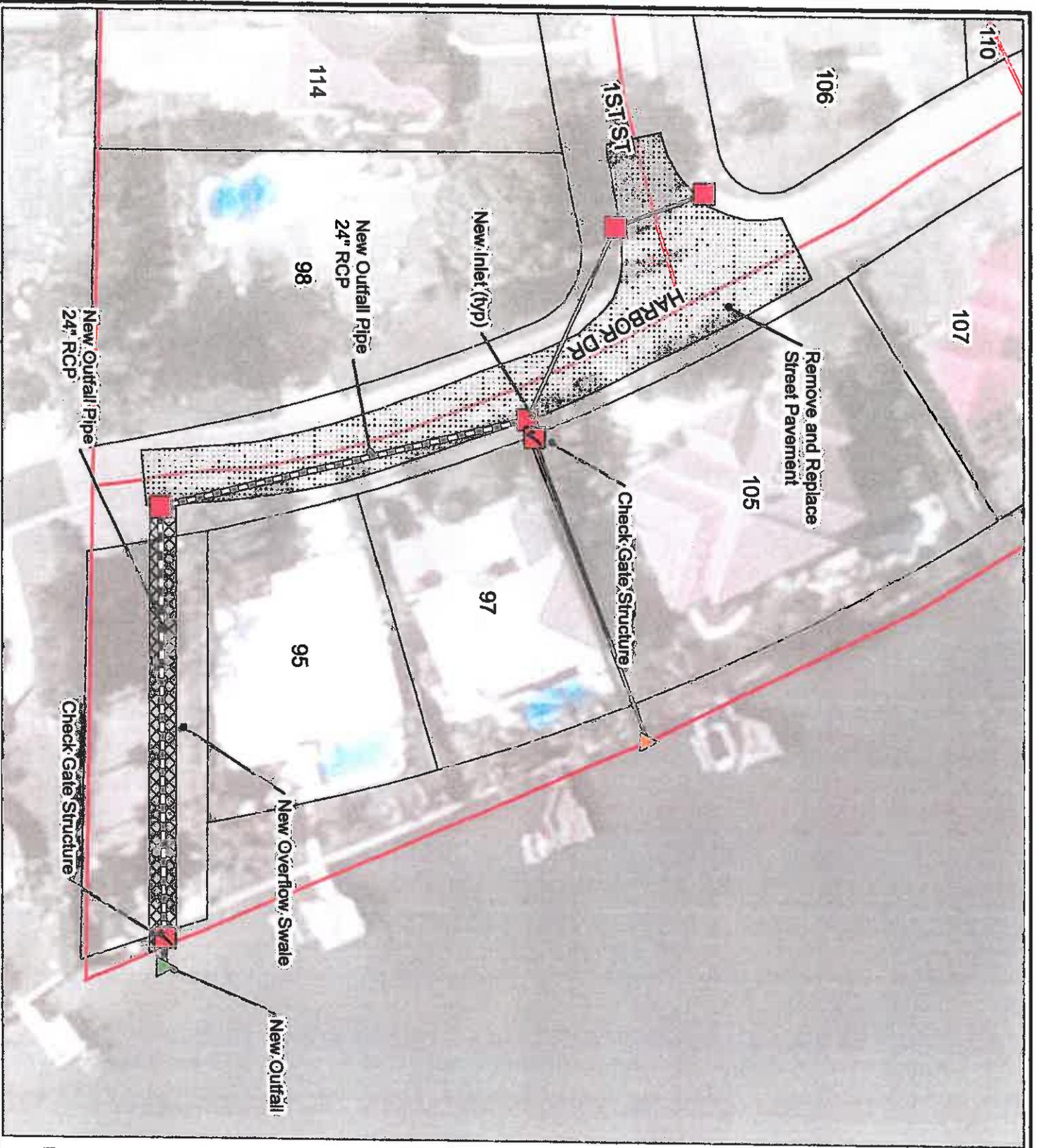


1 inch = 50 feet

Legend	
	Check Gate Structure
	Existing Inlet
	Existing Outfall
	New Outfall
	New Stormwater Inlet
	Existing Pipe
	New Pipe
	Overflow Swale
	Street Repair
	Stormwater_Basin
	Parcels



Engineering Sciences Group



**City of Belleair Beach**



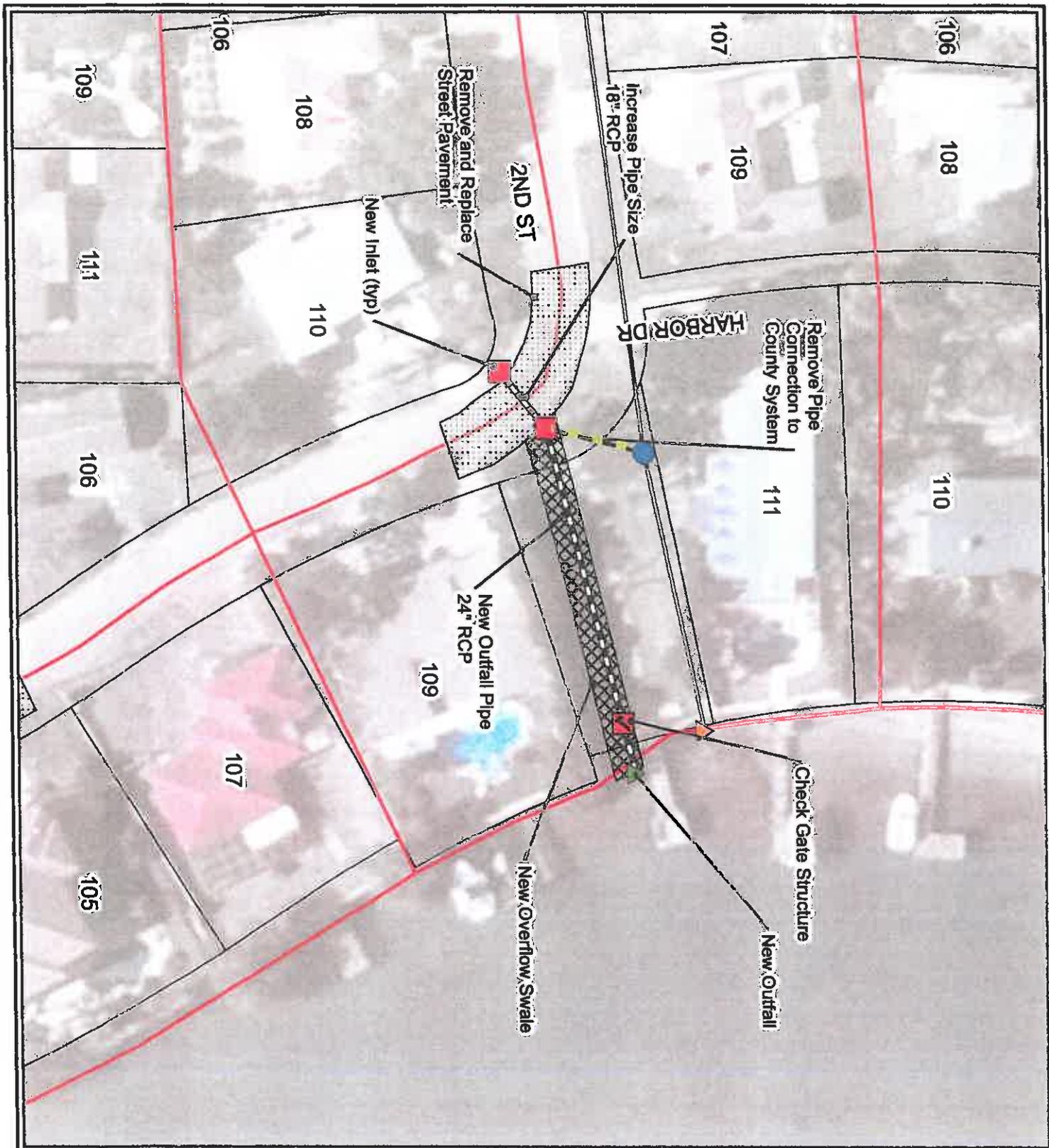
**Master Drainage Plan**

**BMP 2  
2nd Street**



Legend	
	Check Gate Structure
	Existing Inlet
	Existing Outfall
	New Outfall
	New Stormwater Inlet
	Existing Pipe
	New Pipe
	Overflow Swale
	Street Repair
	Stormwater Basin
	Parcels

**ESG**  
Engineering Sciences Group



# City of Belleair Beach



## Master Drainage Plan

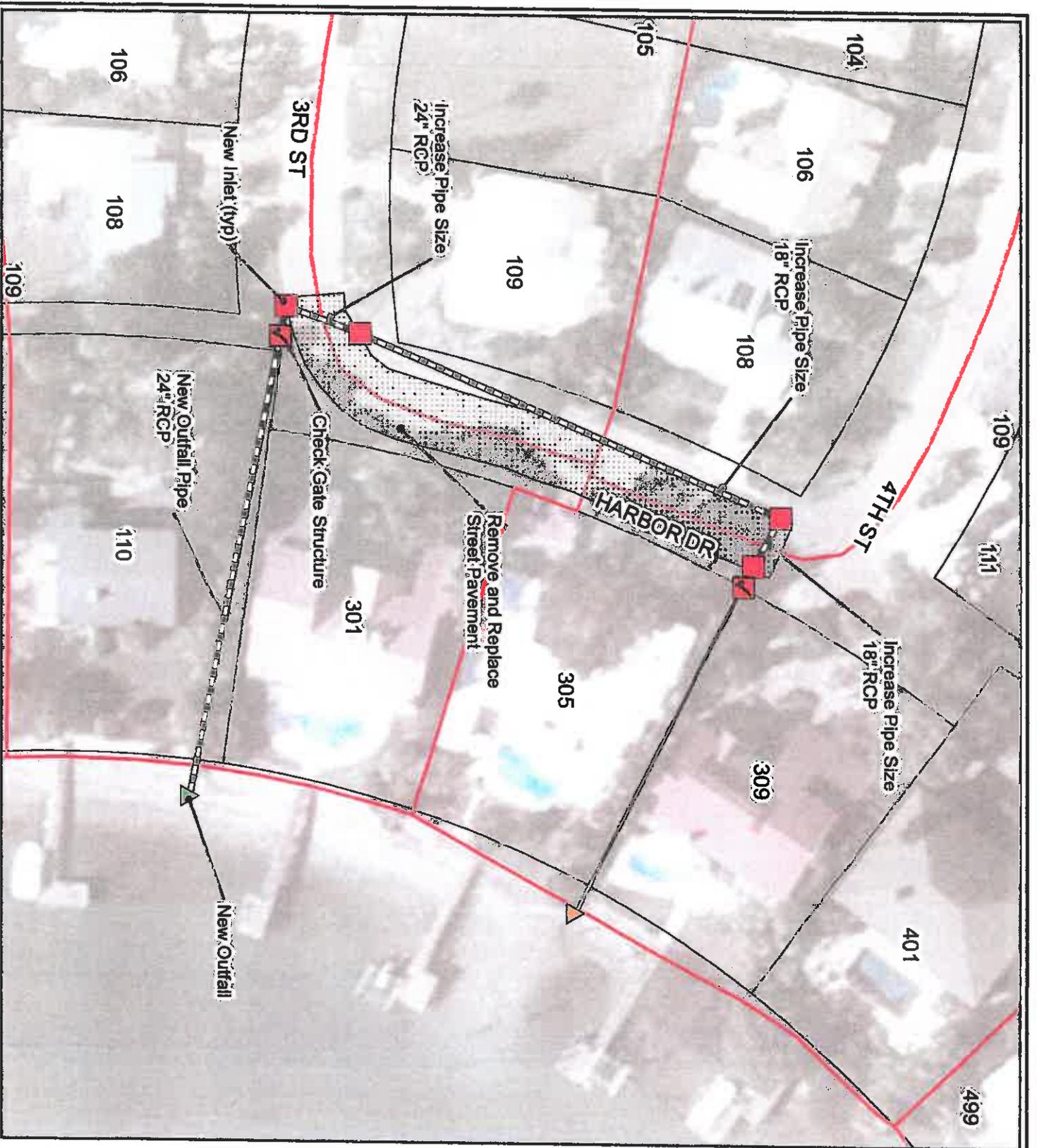
### BMP 3 3rd and 4th Street



Legend	
	Check Gate Structure
	Existing Inlet
	Existing Outfall
	New Outfall
	New Stormwater Inlet
	Existing Pipe
	New Pipe
	Overflow Swale
	Street Repair
	Stormwater Basin
	Parcels



Engineering Sciences Group



**City of  
Belleair Beach**



**Master  
Drainage Plan**

**BMP 4  
5th Street**

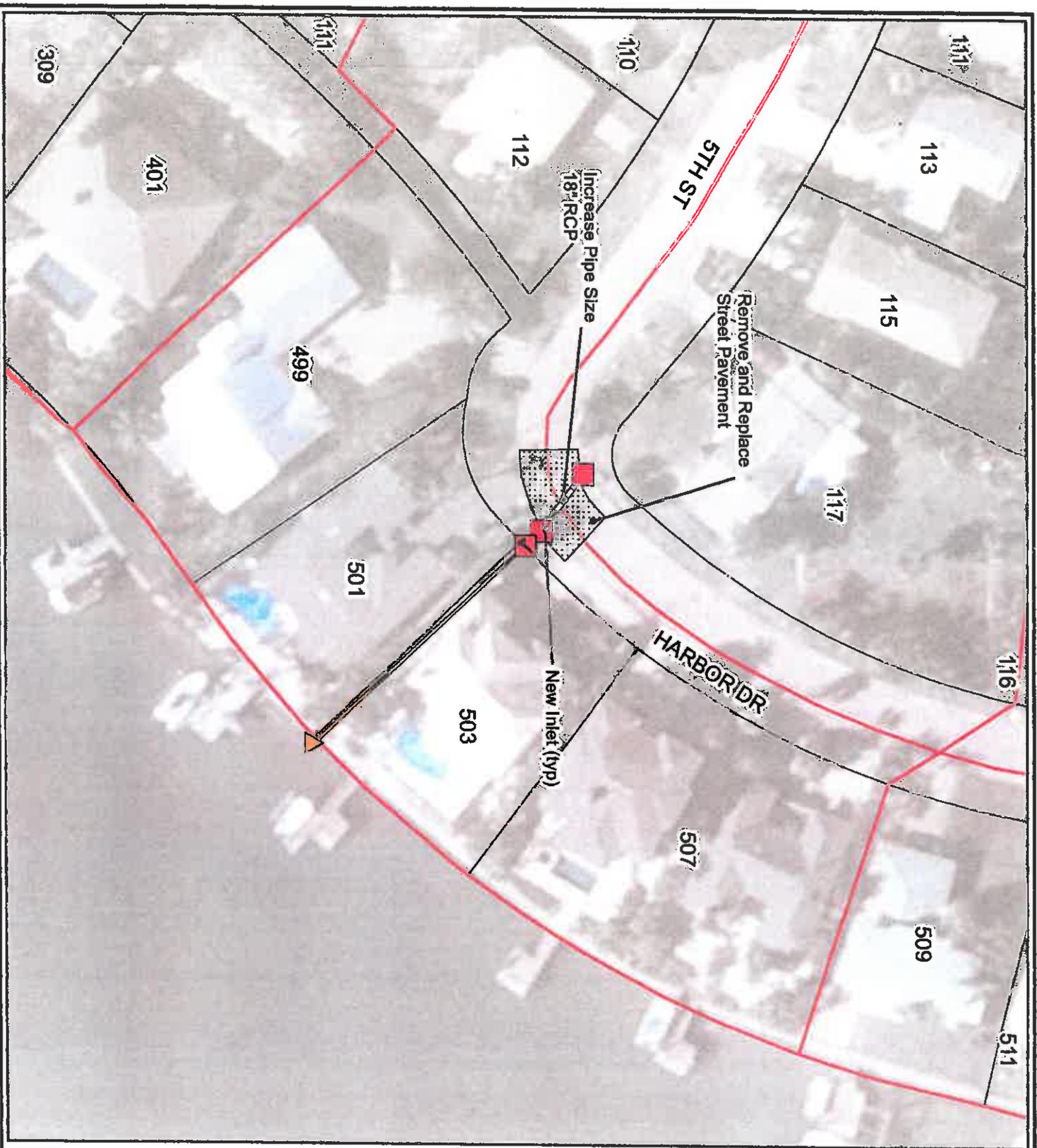


1 inch = 50 feet

Legend	
	Check Gate Structure
	Existing Inlet
	Existing Outfall
	New Outfall
	New Stormwater Inlet
	Existing Pipe
	New Pipe
	Overflow Swale
	Street Repair
	Stormwater_Basin
	Parcels



Engineering Sciences Group



**City of Belleair Beach**



**Master Drainage Plan**

**BMP 5  
7th Street**

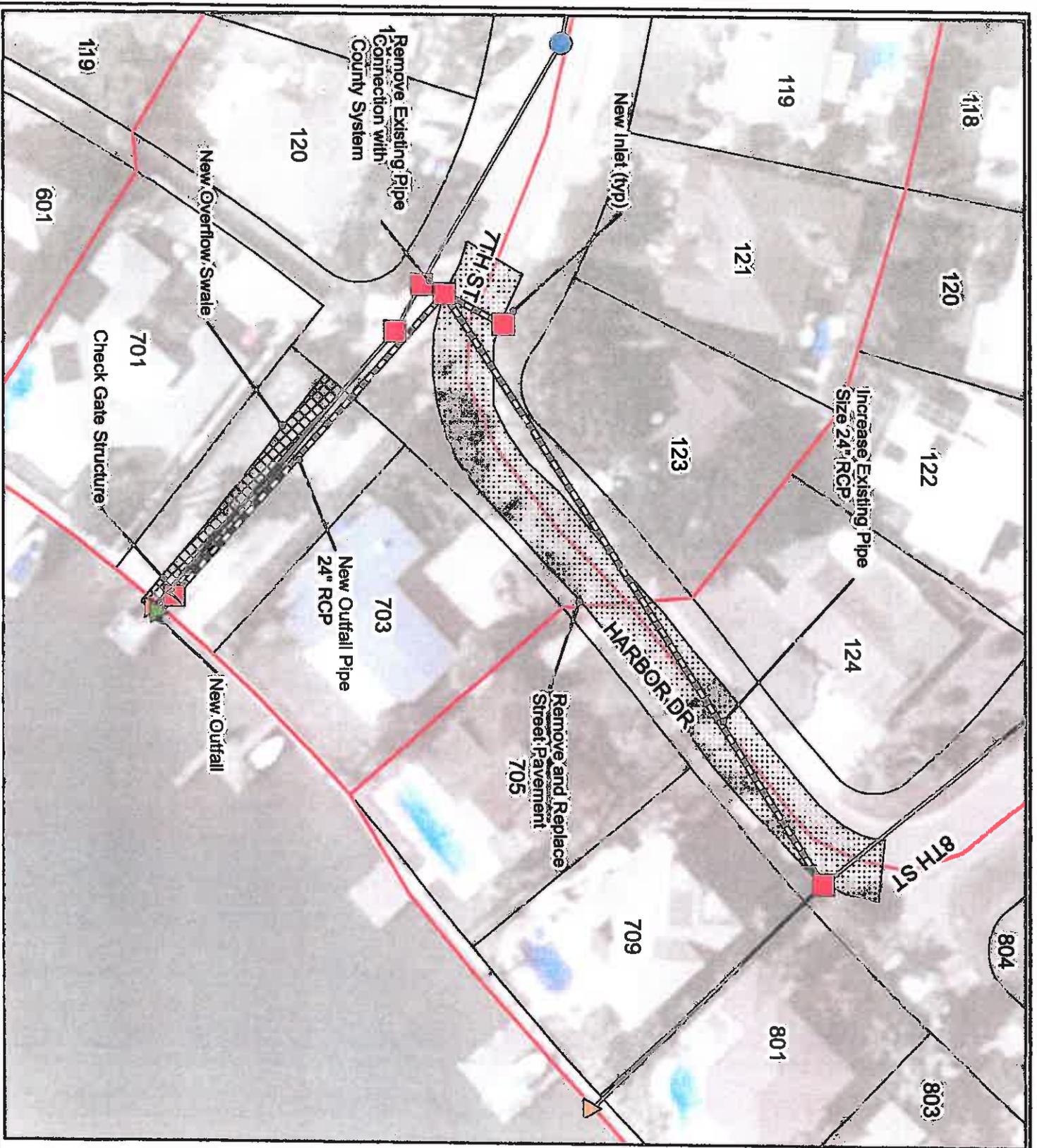


1 inch = 50 feet

Legend	
	Check Gate Structure
	Existing Inlet
	Existing Outfall
	New Outfall
	New Stormwater Inlet
	Existing Pipe
	New Pipe
	Overflow Swale
	Street Repair
	Stormwater Basin
	Parcels



Engineering Sciences Group



# City of Belleair Beach



## Master Drainage Plan

BMP 6  
City Hall/  
Cedar Dr/  
Spruce Dr

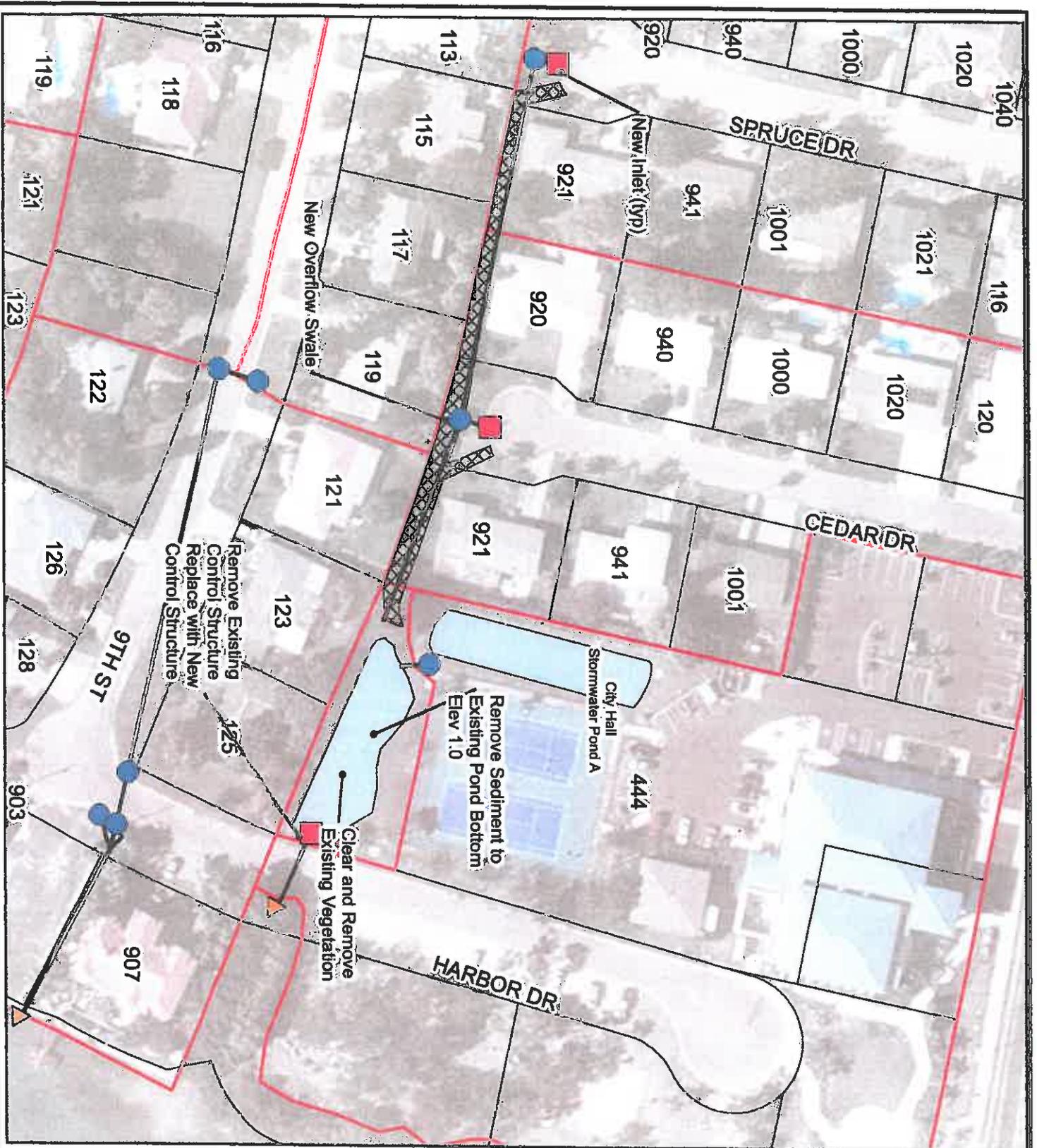


1 inch = 83 feet

Legend	
	Check Gate Structure
	Existing Inlet
	Existing Outfall
	New Outfall
	New Stormwater Inlet
	Existing Pipe
	New Pipe
	Overflow Swale
	Stormwater Pond
	Street Repair
	Stormwater_Basin
	Parcels



Engineering Sciences Group



# City of Belleair Beach



## Master Drainage Plan

### BMP 7 12th Street

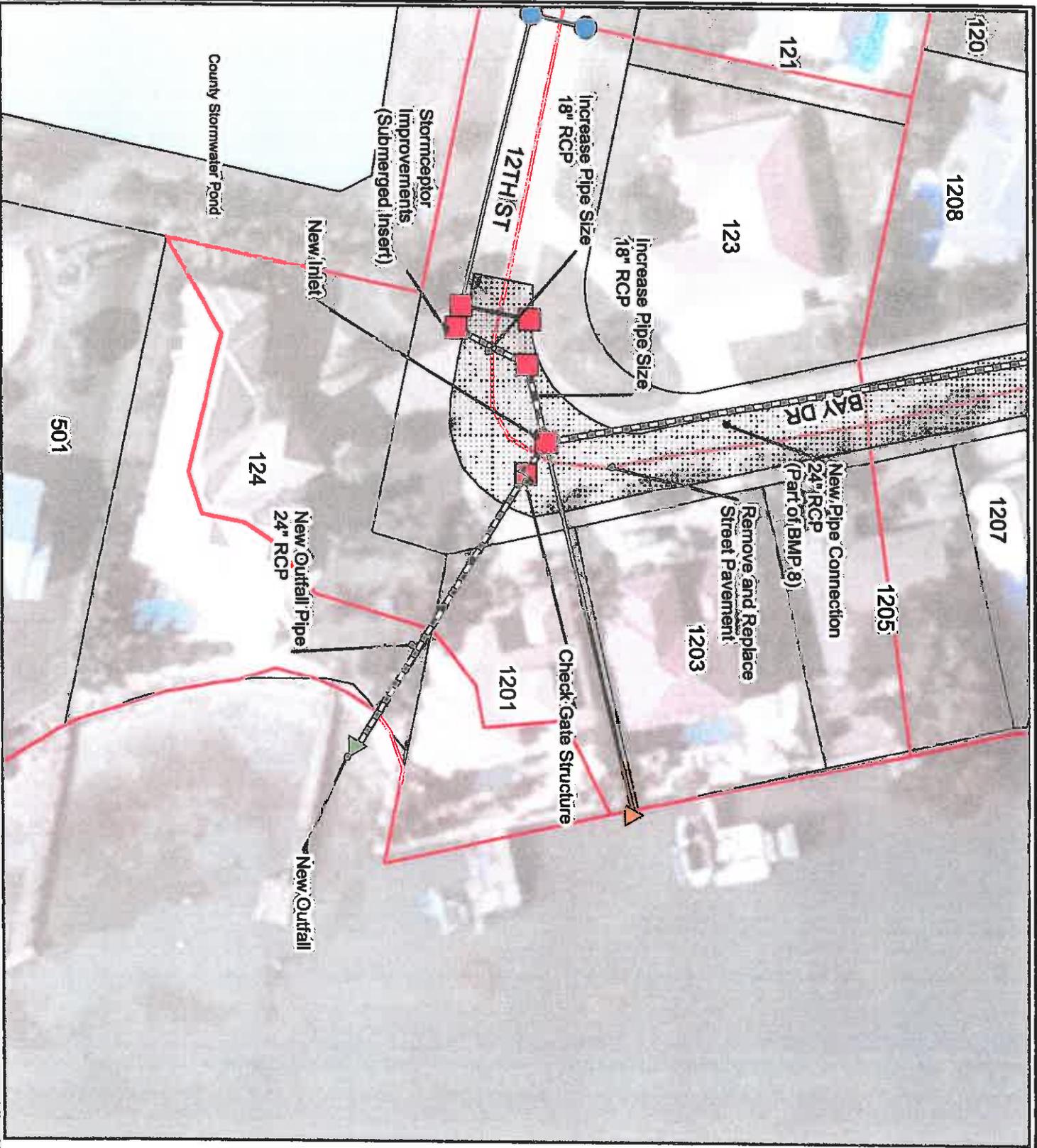


1 inch = 50 feet

Legend	
	Check Gate Structure
	Existing Inlet
	Existing Outfall
	New Outfall
	New Stormwater Inlet
	Existing Pipe
	New Pipe
	Overflow Swale
	Stormwater Pond
	Street Repair
	Stormwater_Basin
	Parcels



Engineering Sciences Group



**City of Belleair Beach**



**Master Drainage Plan**

**BMP 8  
13th Street**

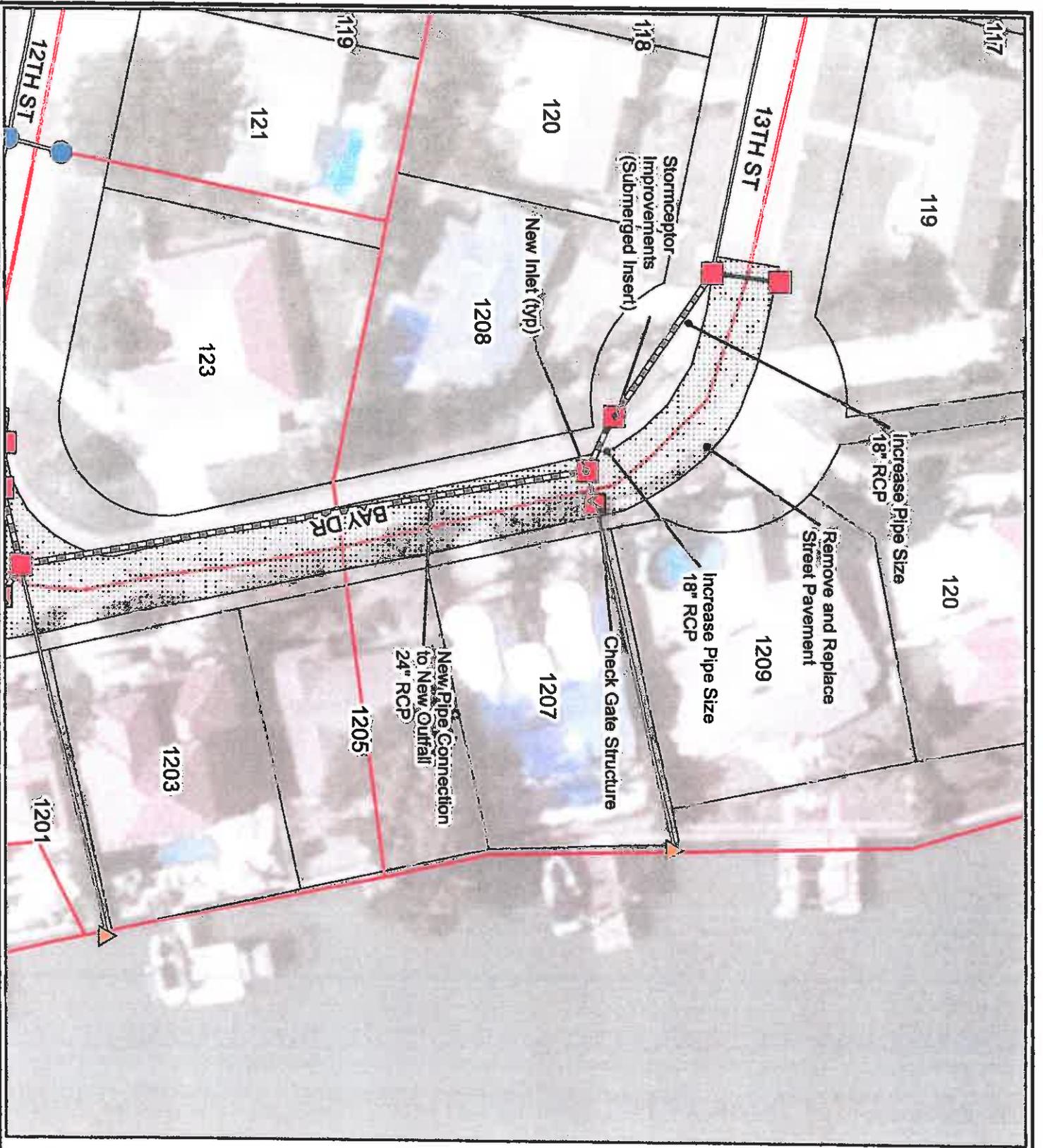


1 inch = 50 feet

Legend	
	Check Gate Structure
	Existing Inlet
	Existing Outfall
	New Outfall
	New Stormwater Inlet
	Existing Pipe
	New Pipe
	Overflow Swale
	Street Repair
	Stormwater Basin
	Parcels



Engineering Sciences Group



**City of  
Belleair Beach**



**Master  
Drainage Plan**

**BMP 9  
16th Street**

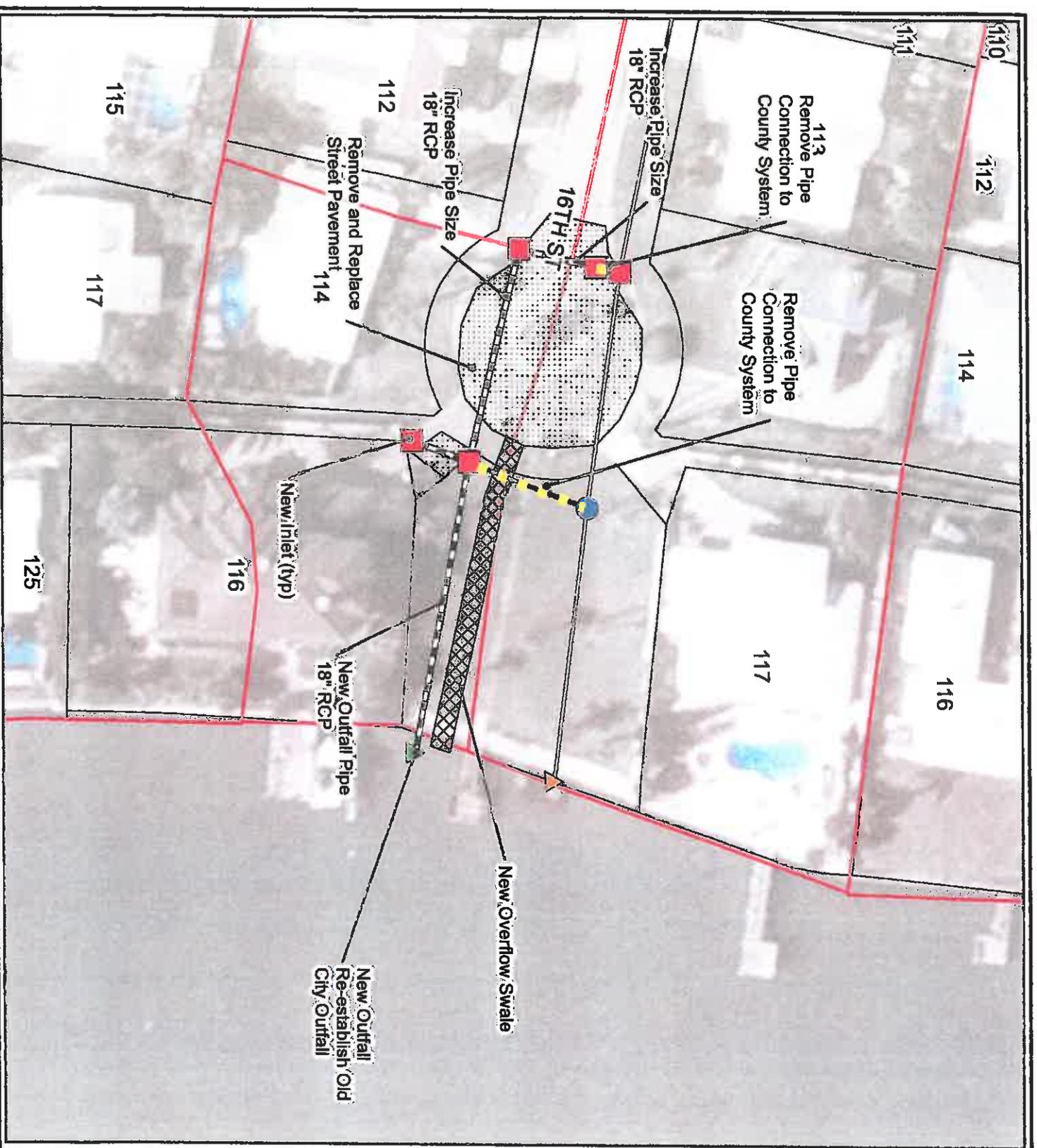


1 inch = 50 feet

Legend	
	Check Gate Structure
	Existing Inlet
	Existing Outfall
	New Outfall
	New Stormwater Inlet
	Existing Pipe
	New Pipe
	Overflow Swale
	Street Repair
	Stormwater_Basin
	Parcels



Engineering Sciences Group



**City of  
Belleair Beach**



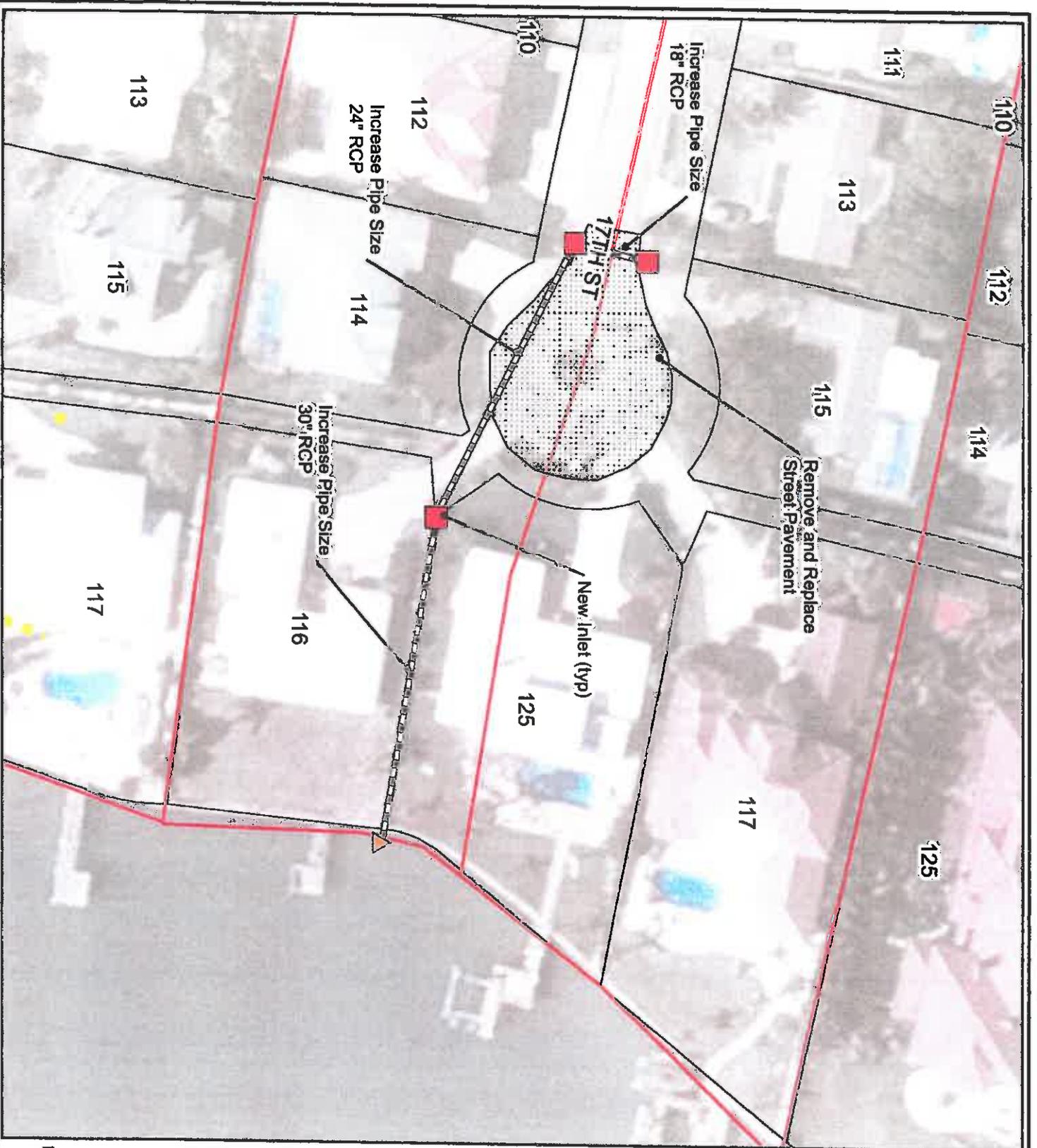
**Master  
Drainage Plan**

**BMP 10  
17th Street**



1 inch = 50 feet

Legend	
	Check Gate Structure
	Existing Inlet
	Existing Outfall
	New Outfall
	New Stormwater Inlet
	Existing Pipe
	New Pipe
	Overflow Swale
	Street Repair
	Stormwater Basin
	Parcels



Engineering Sciences Group

# City of Belleair Beach



## Master Drainage Plan

### BMP 11 18th Street

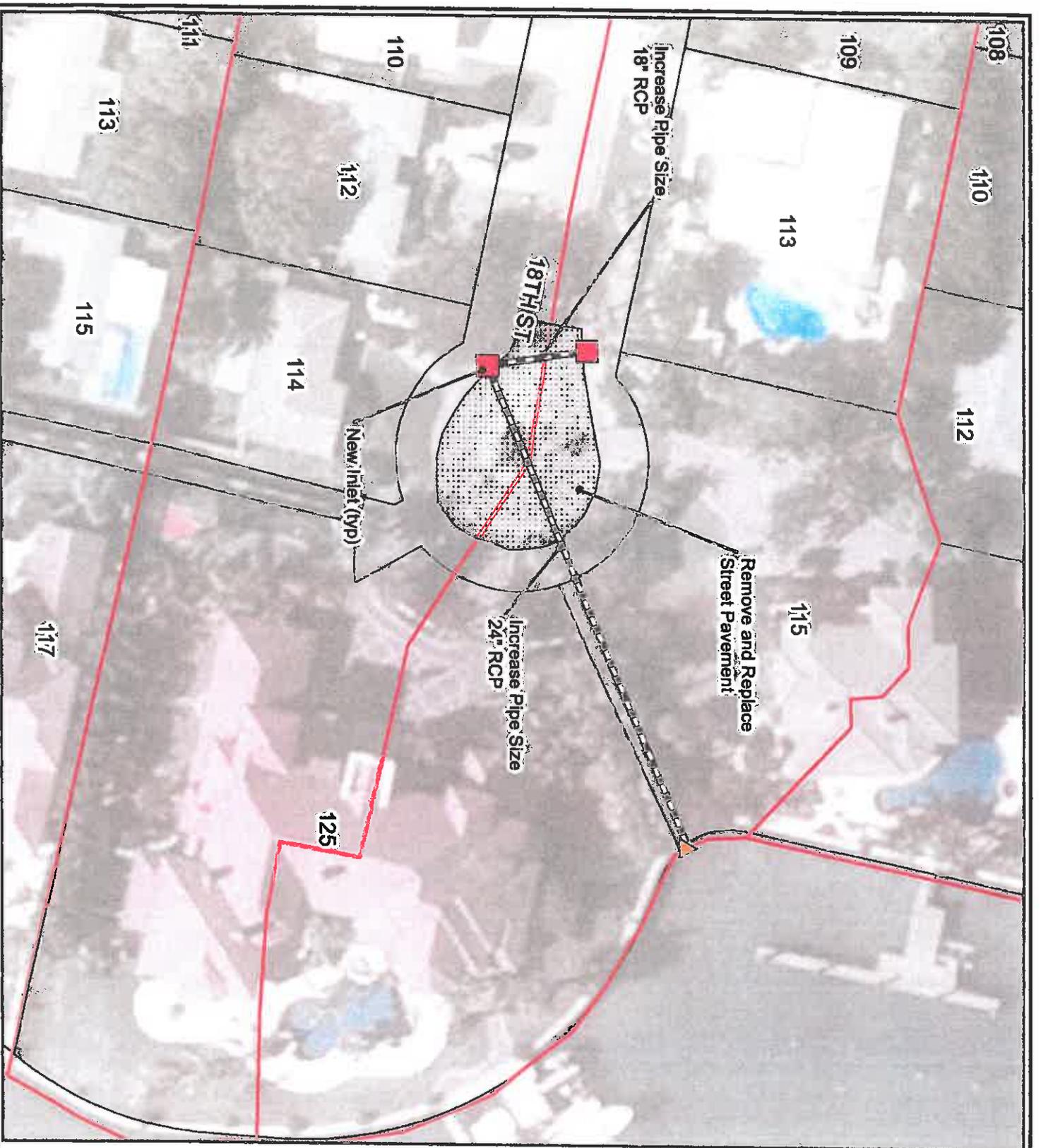


1 inch = 50 feet

Legend	
	Check Gate Structure
	Existing Inlet
	Existing Outfall
	New Outfall
	New Stormwater Inlet
	Existing Pipe
	New Pipe
	Overflow Swale
	Street Repair
	Stormwater_Basin
	Parcels



Engineering Sciences Group



**City of Belleair Beach**



**Master Drainage Plan**

**BMP 12  
19th Street**

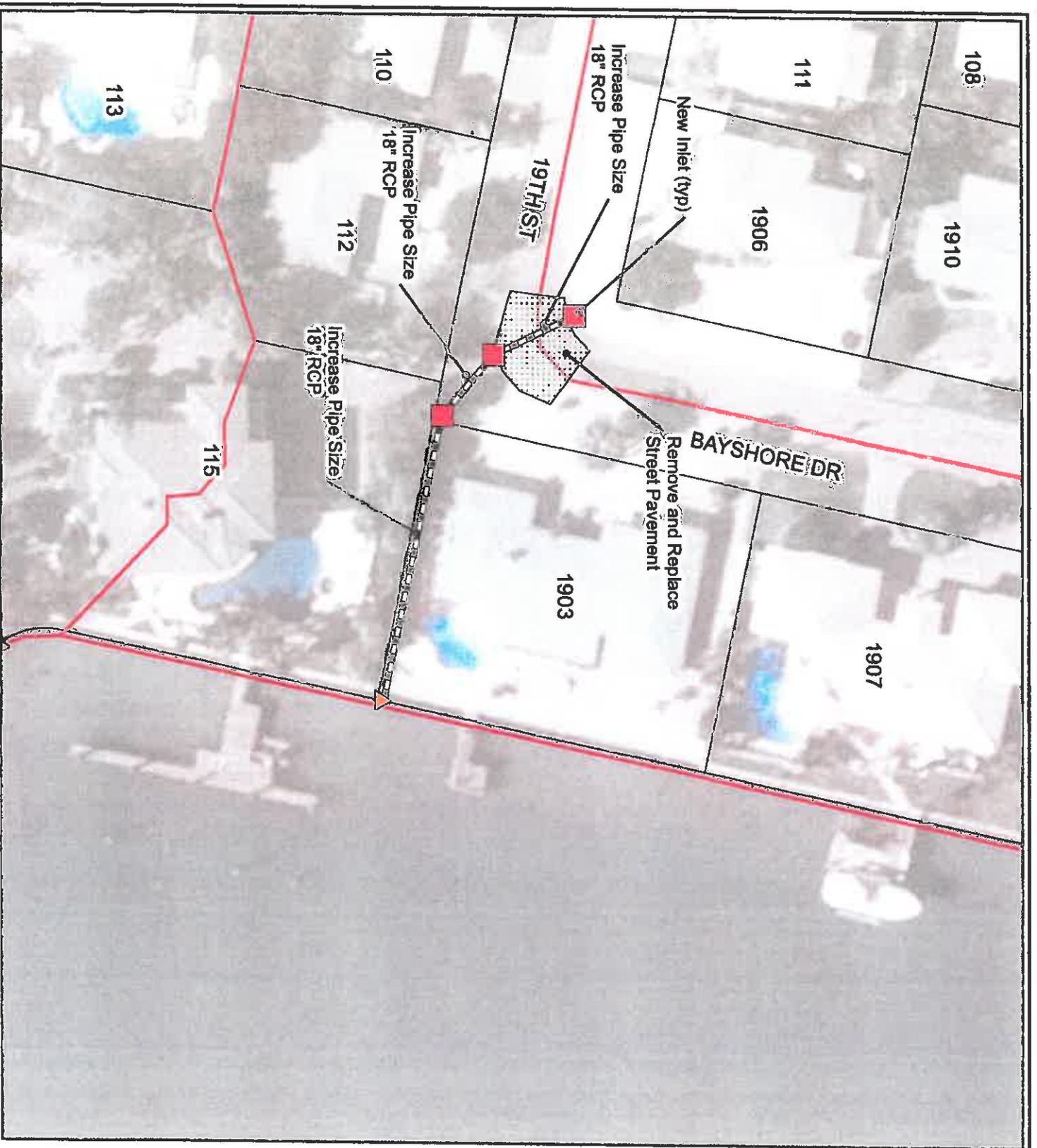


1 inch = 50 feet

Legend	
	Check Gate Structure
	Existing Inlet
	Existing Outfall
	New Outfall
	New Stormwater Inlet
	Existing Pipe
	New Pipe
	Overflow Swale
	Street Repair
	Stormwater_Basin
	Parcels



Engineering Sciences Group







# City of Belleair Beach



## Master Drainage Plan

### BMP 15 Belle Isle Ave

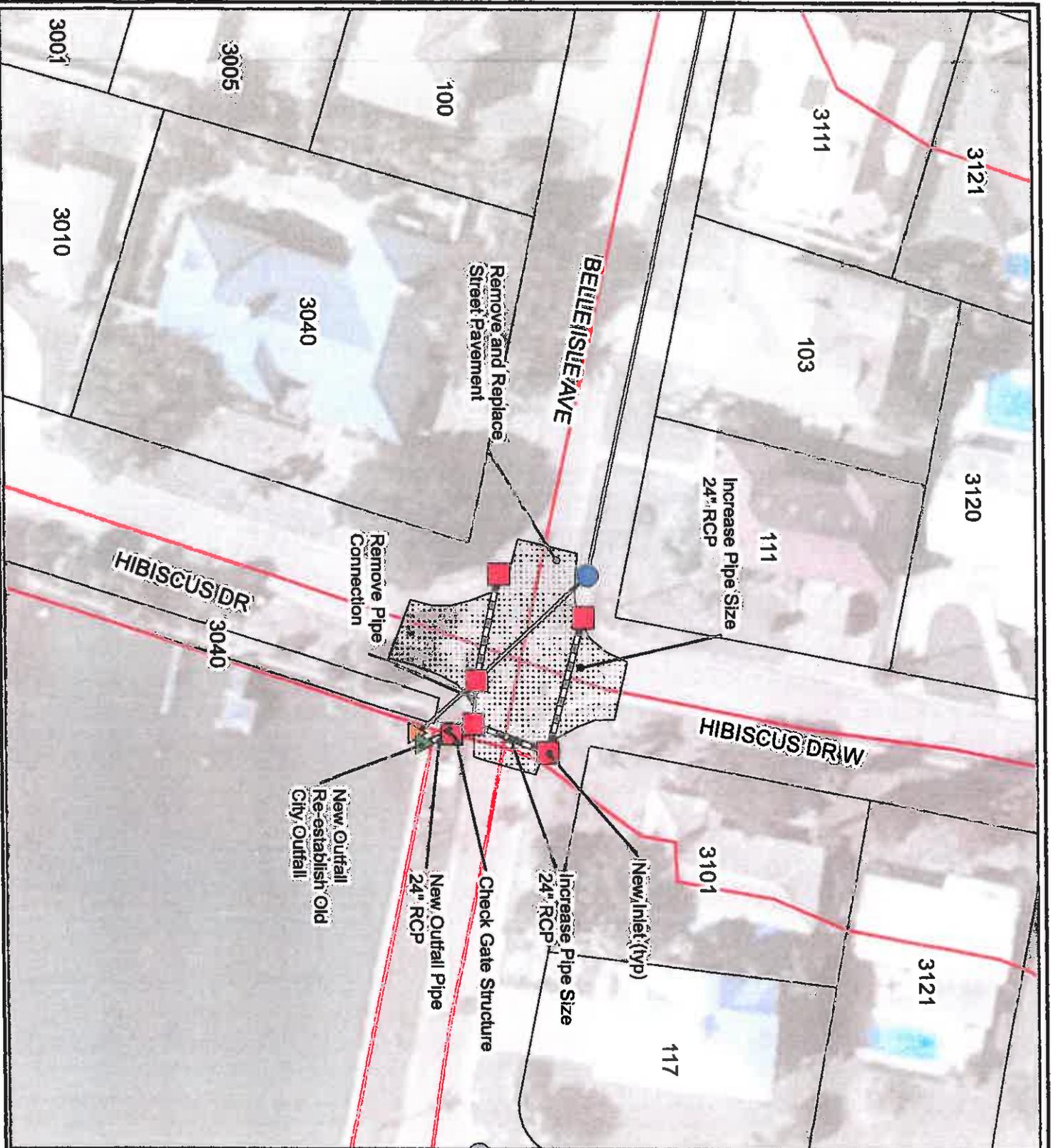
1 inch = 50 feet



Legend	
	Check Gate Structure
	Existing Inlet
	Existing Outfall
	New Outfall
	New Stormwater Inlet
	Existing Pipe
	New Pipe
	Overflow Swale
	Street Repair
	Stormwater Basin
	Parcels



Engineering Sciences Group





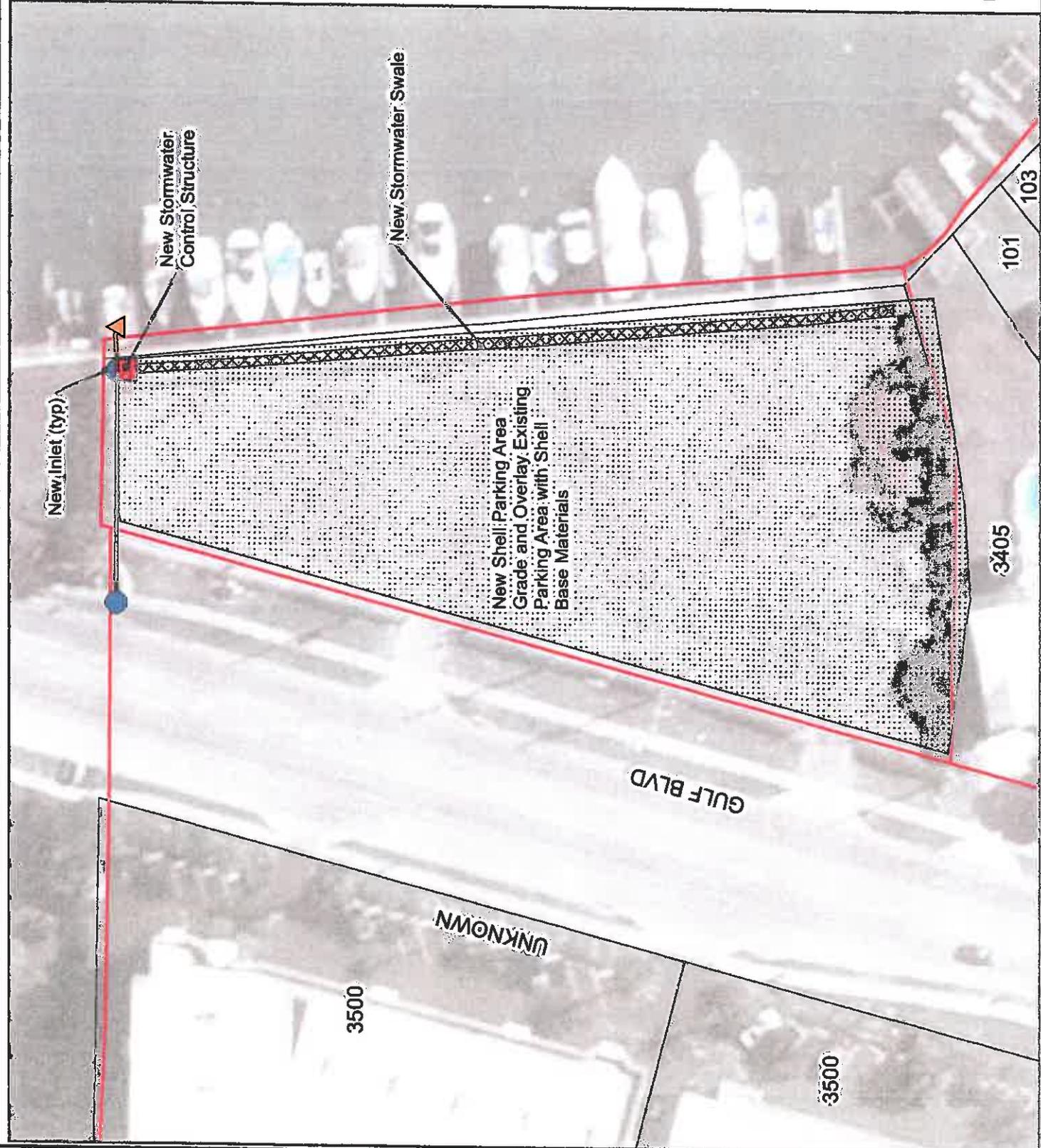
Master Drainage Plan

BMP 16 Marina



1 inch = 50 feet

Legend	
	Check Gate Structure
	Existing Inlet
	Existing Outfall
	New Outfall
	New Stormwater Inlet
	Existing Pipe
	New Pipe
	Overflow Swale
	Street Repair
	Stormwater_Basin
	Parcels





# DRAFT

## City of Belleair Beach Stormwater Master Drainage Plan Update September 1, 2016

Table ES-1, BMP Projects, Priority and Budget

BMP	Description	Priority	Budget
1	1st Street	1	\$279,000
2	2nd Street	2	\$136,000
3	3rd and 4th Street	3	\$268,000
4	5th Street	4	\$88,000
5	7th Street	5	\$297,000
6	City Hall	6	\$123,000
7	12th Street	10	\$204,000
8	13th Street	12	\$203,000
9	16th Street	11	\$167,000
10	17th Street	14	\$187,000
11	18th Street	15	\$131,000
12	19th Street	16	\$108,000
13	22nd Street	13	\$125,000
14	Morgan Drive	8	\$178,000
15	Belle Isle Ave	7	\$170,000
16	Marina	9	\$326,000
	<b>Totals</b>		<b>\$2,990,000</b>

The BMP projects listed above were simulated in the ICPR model. Each flood prone area was analyzed and compared with respect to effectiveness in alleviating the flooding problems and implementation cost.

Regular updates of the stormwater infrastructure geodatabase and stormwater master plan are recommended. Changes to the system are inevitable including continued development within the City as the City implements BMP projects. This stormwater master plan update will be an invaluable tool as the City evaluates both current and future infrastructure projects. The infrastructure database could also be updated as BMP projects are completed.



# DRAFT

## City of Belleair Beach Stormwater Master Drainage Plan Update September 1, 2016

---

### Section 1 Introduction

#### 1.1 Authorization

In November of 2015, the City of Belleair Beach, Florida, (City) contracted with Engineering Sciences Group, Inc. (ESG) to update their Master Drainage Plan (MDP). The project goals established by the City for the Master Drainage Plan Update included:

- Inventory the City's stormwater drainage facilities
- Review and update the existing MDP computer model and GIS geodatabase
- Provide recommendations for stormwater Best Management Practices (BMP) for capital improvements

This report outlines the activities performed to complete the goals listed above, and includes documentation of the engineering procedures and information used in accomplishing the Master Drainage Plan update.

#### 1.2 Purpose and Objective

The purpose of this project was to update the Master Drainage Plan for the City of Belleair Beach, and to study the contributing basins that affect stormwater conveyance inside the City limits. The master drainage plan currently in place for the City of Belleair Beach was conducted and completed in 2004. Since that time, capital improvements have been made in an effort to protect flood prone areas. Because of long period of time since the initial completion it became necessary to update the existing Master Drainage Plan. The new MDP will make it possible to more accurately assess the impact of localized flooding, analyze effects of sea level rise, and support the development of Best Management Practices (BMPs).

To achieve the project goals, the newly developed MDP will effectively address and identify the following:

- Existing stormwater problems,
- The condition of the stormwater drainage system,
- Adequacy of the drainage system, and
- Necessary capital improvements to mitigate flooding hazards.

Two project phases were undertaken to achieve the above objectives: 1) digitization and mapping of known drainage system features in ArcGIS, and 2) numerical modeling of the performance of the drainage system. During Phase 1, available existing plans of the drainage system were provided by the City and were utilized to create a geodatabase of known drainage system features. This database was used in determining the land areas (basins) contributing runoff to each drainage feature during storm events. The drainage feature geodatabase and delineated basins formed the physical parameters for this project. During Phase 2, the basins and drainage features were used in the development of a hydraulic model to simulate storm events in the City and its contributing drainage areas. The model selected for use was the Interconnected Channel and Pond Routing (ICPR) stormwater model, Version



**DRAFT**

**City of Belleair Beach  
Stormwater Master Drainage Plan Update  
September 1, 2016**

---

**4.02. The model domain includes the drainage areas within the City of Belleair Beach. The model was used to test and prioritize several stormwater management strategies designed to mitigate flooding concerns within the City of Belleair Beach.**

**Along with fully documenting all work performed in updating the Master Drainage Plan, this report is designed to serve as a resource for the City of Belleair Beach for matters related to stormwater management.**



**DRAFT**

## **Section 2 Existing Reports and Studies**

The following reports, studies, and documents were collected as part of the background study conducted prior to commencing the MDP update. Copies of these documents are included in portable document format (.pdf) on the enclosed data storage device. This compilation of files is included as a source of information only and is included on an "as is" basis with no expressed warranty implied.

### **2.1 Existing Master Drainage Plan**

*"Watershed Management Plan Existing Conditions Analysis Task I"*  
TBE Group, June 2004

*"Watershed Management Plan Existing Conditions Analysis Task II"*  
TBE Group, June 2004

*"Watershed Management Plan Existing Conditions Analysis Task III"*  
TBE Group, July 2004

*"Watershed Management Plan Existing Conditions Analysis Task IV"*  
TBE Group, January 2005

### **2.2 FEMA Flood Insurance Study**

*"Flood Insurance Study: Pinellas County, Florida and Incorporated Areas"*  
Federal Emergency Management Agency, Revised August 18, 2009

### **2.3 Tampa Bay Climate Advisory Panel (CSAP)**

*"Recommended Projection of Sea Level Rise in the Tampa Bay Region"*  
Tampa Bay Climate Science Advisory Panel, August 2015



# DRAFT

## Section 6 Hydrologic and Hydraulic Evaluation

### 6.1 Existing Conditions Modeling

The drainage infrastructure in the City of Belleair Beach consists primarily of curb and gutter, inlets, manholes and closed pipes. Street grades have shallow slopes and thus time for runoff to completely drain itself occurs at longer times of concentration. Tidal influences can be observed at most of the storm system outfalls and especially during periods of high tide where at some lower elevation locations the intercoastal waters backs up into the storm drainage system outfalls and onto streets. Several of the existing drainage system inlets, manholes and pipes are greater than 30 years old and will be approaching or have exceeded their design life expectancy.

The existing conditions ICPR model is a representation of the City's existing stormwater drainage system (Appendix A, Figure 4-1) that allows the ability to evaluate how the system responds to each of the design storm events and collaborate reported flooding issues/locations.

The existing conditions ICPR model simulation results of peak stages and flow rates are summarized in Table 6-1 and Table 6-2 located in Appendix B.

Model results reveal that street flooding is a significant issue throughout the City's watershed. Analysis of model results identified several locations throughout the City's watershed that showed various levels for flooding issues.

Flooding issues throughout the city is generally a result of one of four categories below or a combination thereof. They are:

1. Stormwater Infrastructure Tailwater

The tail water or receiving water system backs up into the upstream areas, thereby causing flooding. In these areas, stormwater infrastructure may have adequate flow capacity; however the design and construction of the system may have assumed tailwater (receiving waters) conditions significantly lower than actual flood condition levels.

2. Undersized Infrastructure

In this category, high tailwater is not backing up of floodwaters into the stormwater management system. However, the existing stormwater infrastructure may be outdated and undersized.

3. Unmaintained Stormwater Infrastructure

Sometimes the only remedy action required to address localized flooding is maintenance of stormwater infrastructure. The infrastructure may have adequate size; however, the buildup of sediment in a ditch, pipe or catch basin will reduce the flow capacity.

4. No Stormwater Infrastructure

There are many areas in the city that have no stormwater infrastructure. The lack of stormwater structures will contribute to flooding.



**DRAFT**

**City of Belleair Beach  
Stormwater Master Drainage Plan Update  
September 1, 2016**

---

Model results of the existing conditions found sixteen (16) significant flooding area locations for further consideration and evaluation. Table 6-3, Appendix B, provides the data utilized to evaluate the flooding areas for possible BMP development. Sixteen (16) flooding areas were identified to be candidates for development of Best Management Projects (BMP) and prioritized for implementation.



**DRAFT**

## **Section 8 Best Management Practices (BMP) Analysis**

### **8.1 Project Selection and Prioritization**

There are numerous methodologies that could be implemented to manage stormwater in the watershed. In general these can be classified as structural or non-structural in nature. This MDP update is an evaluation of structural alternatives which divert, contain, or transport flow, such as pipes, control structures or inlets.

BMP projects to resolve stormwater flooding issues are generally ranked in an order that indicates their relative importance to one another. Based on the assessment of collected data and the existing conditions model results, it is possible to evaluate the priority ranking of possible BMP projects. The stormwater infrastructure inventory also assisted in the evaluation.

Selecting and prioritizing flooding issues areas for further evaluation consisted of reviewing several factors applicable to the study, review each outfall model results and apply a score value to the prioritization chart. Factors considered important to review included if the existing stormwater drainage system had easements, close to a park site, available space between building if no easement is present, depth of flooding, can water quality be accomplished at the location and if the area is experiencing tidal backup.

The proposed conditions model focused on the top 16 flooding issues areas to further develop recommended BMP projects. BMPs locations are illustrated in Figure 8-1, Appendix A. The BMPs were then evaluated with respect to alleviating flooding issues, project costs for implementation, maintenance requirements, feasibility, water quality benefits, and public acceptance. Model results for node peak stage elevations and Reach peak flow rates are shown on Tables 8-1 and 8-2 in Appendix E.

The Outfall Priority Matrix, Table 8-3, located at the end of this section, summarizes the prioritization scoring for each of the outfalls. There are 48 stormwater outfalls within the City of Belleair Beach watershed which two of these outfalls, NPC20-0 and NPC25-50, are dedicated outfalls for the Gulf Boulevard drainage system. These outfalls are owned by Pinellas County and not included in this evaluation.

### **8.2 Selected Best Management Practices (BMP) Descriptions**

Forty-eight outfalls were evaluated and prioritized for the top 16 BMP project locations. The conceptual analysis of each BMP considered available opportunities mitigate street flooding and provide improvements to water quality. The proposed conditions stormwater model considered various layout alternatives to reduce street flooding. Alternatives considered upgrading pipes, improved inlets, additional outfall and pips and improvements to stormwater pond storage capacity.









**DRAFT**

City of Belleair Beach

Stormwater Master Drainage Plan Update

September 1, 2016

shown this connection contributes to flooding issues at this location. Street pavement and curb conditions are poor and in need of replacement.

The proposed BMP project will consists of replacing the existing curb inlets with larger more efficient curb inlets; disconnect from the County system; remove and replace street pavement and curb; increase pipe size under the streets; install a new overflow outfall pipe from the existing inlets, through the park and out to a new outfall at the seawall; and construct an overflow swale through the south park.

**BMP 10: 17<sup>th</sup> Street Cost: \$187,000**

The stormwater drainage system at 17<sup>th</sup> Street is over 30 years old and under current conditions is not capable of completely conveying stormwater runoff through the systems inlets and pipes. The area is experiencing flooding during heavy rainfall conditions as well as experiencing increased water levels during the high tide. The ability of the system to function as intended is diminished during high tidal phases.

The proposed BMP project will consists of replacing the existing curb inlets with larger more efficient curb inlets; remove and replace street pavement and curb; increase pipe size under the streets; and increase the outfall pipe size between existing buildings to the outfall.

**BMP 11: 18<sup>th</sup> Street Costs: \$131,000**

The stormwater drainage system at 18<sup>th</sup> Street is over 30 years old and under current conditions is not capable of completely conveying stormwater runoff through the systems inlets and pipes. The area is experiencing flooding during heavy rainfall conditions as well as experiencing increased water levels during the high tide. The ability of the system to function as intended is diminished during high tidal phases.

The proposed BMP project will consists of replacing the existing curb inlets with larger more efficient curb inlets; remove and replace street pavement and curb; increase pipe size under the streets; and increase the outfall pipe size between existing buildings to the outfall.

**BMP 12: 19<sup>th</sup> Street Costs: \$108,000**

The stormwater drainage system at 19<sup>th</sup> Street is over 30 years old and under current conditions is not capable of completely conveying stormwater runoff through the systems inlets and pipes. The area is experiencing flooding during heavy rainfall conditions as well as experiencing increased water levels during the high tide. The ability of the system to function as intended is diminished during high tidal phases.

The proposed BMP project will consists of replacing the existing curb inlets with larger more efficient curb inlets; remove and replace street pavement and curb; increase pipe size under the streets; and increase the outfall pipe size between existing buildings to the outfall.



# DRAFT

City of Belleair Beach  
Stormwater Master Drainage Plan Update  
September 1, 2016

---

**BMP 13: 22<sup>nd</sup> Street Costs: \$125,000**

The stormwater drainage system at 12<sup>th</sup> Street and Bayshore Drive is over 30 years old and under current conditions is not capable of completely conveying stormwater runoff through the systems inlets and pipes. The area is experiencing flooding during heavy rainfall conditions as well as experiencing increased water levels during the high tide. The ability of the system to function as intended is diminished during high tidal phases.

The proposed BMP project will consists of replacing the existing curb inlets with larger more efficient curb inlets; install a new curb inlet at 22<sup>nd</sup> Street, remove and replace street pavement and curb; and increase pipe size under the streets.

**BMP 14: Morgan Drive Costs: \$178,000**

The drainage system at Morgan Drive and Hibiscus Drive is experiencing high flooding conditions during heavy rainfall events. The stormwater drainage system converges from each curb inlet at the intersection to a manhole junction and continues along Morgan Drive to the outfall location. Modeling shows this is causing backup into the curb inlets and out onto the street.

The proposed BMP project will consist of consists of replacing the existing curb inlets with larger more efficient curb inlets; increase pipe size under the streets; and remove and replace street pavement and curb.

**BMP 15: Belle Isle Ave Costs: \$170,000**

The drainage system at Belle Isle Ave and Hibiscus Drive is experiencing high flooding conditions during heavy rainfall events. The stormwater drainage system converges from each curb inlet at the intersection to a manhole junction and continues to the seawall outfall location. Additionally, the stormwater drainage system at is connected to the Pinellas County drainage system for Gulf Blvd. Modeling has shown this connection contributes to flooding issues at this location. Street pavement and curb conditions are poor and in need of replacement. The area is also experiencing flooding during normal tide conditions as well as experiencing increased water levels during the high tide. The ability of the system to function as intended is diminished due to tidal effects.

The proposed BMP project will consists of replacing the existing curb inlets with larger more efficient curb inlets; disconnect from the County system; remove and replace street pavement and curb; increase pipe size under the streets; install a new overflow outfall pipe from the existing inlets to a new outfall at the seawall; construct an overflow swale to the seawall; and install check gate structures equipped with backflow devices to prevent high tide backup onto the City street.



# DRAFT

City of Belleair Beach  
Stormwater Master Drainage Plan Update  
September 1, 2016

---

**BMP 16: Marina Costs: \$326,000**

The Marina area is an undeveloped parking area for marina customers and users. The project areas does not experience flooding issues, however, the parking lot during heavy rainfalls causes sheet flow towards the marina dock causing sediment pollutant into the intercoastal waterway.

The proposed BMP project will consists of installation of a stormwater treatment swale, construct a new stormwater overflow outfall pipe to a new outfall at the seawall; install a new stormwater control structure, and construct a new shell parking area by regrading and overlay with shell base materials. The primary goal for this BMP is to provide water quality treatment to meet NPDES and water quality discharge requirements.

### 8.3 Evaluation of Funding Sources

With the increased focus at the State and Federal levels, supplemental funding sources are being made available to local governments to share the costs of new projects. Since these programs are continuously changing, it is entirely possible that a single project may have more than one source as a funding option. All funding sources may not necessarily be suitable for specific projects. Careful evaluation should be conducted before choosing a funding source. Operating costs, direct capital costs, and cost benefits may be factors in choosing or declining funding options. Projects can also meet criteria for funding sources through demonstrations of secondary impacts. For example, if a project is addressing flooding concerns, the flooding could generate risk to water quality to adjacent lands or ecosystems making flooding projects eligible for water quality funding.

#### State Revolving Fund (SRF)

A State Revolving Fund (SRF) is a fund administered by a U.S. state for the purpose of providing low-interest loans for investments in water and sanitation infrastructure (e.g., sewage treatment, stormwater management facilities, drinking water treatment), as well as for the implementation of nonpoint source pollution control and estuary protection projects. The SRF program is by far DEP's largest funding program and makes \$200-300 million or more available, primarily to local governments, each year.

#### SWFWMD - Cooperative Funding Initiative

A key program for building partnerships is the District's Cooperative Funding Initiative (CFI) program. The CFI covers up to 50 percent of the cost of projects that help create sustainable water resources, enhance conservation efforts, restore natural systems and provide flood protection. All CFI funding decisions are made by volunteer Governing Board members who are well informed on the specific resources and challenges within their areas.



# DRAFT

City of Belleair Beach  
Stormwater Master Drainage Plan Update  
September 1, 2016

---

## **FDEP – Coastal Partnership Initiative Grant Program**

Eligible entities may apply for grants for community projects that include habitat restoration, park planning and improvements, waterfront revitalization, and improving communities' resiliency to coastal hazards. CPI grant financial awards are limited to a maximum \$30,000 and a minimum \$10,000 for construction projects, habitat restoration, invasive, exotic plant removal or land acquisition, and a maximum \$15,000 and a minimum \$10,000 for planning, design and coordination activities. Grant recipients are required to provide 100 percent (1 to 1) matching funds, which may be cash or in-kind.

## **FDEP - Clean Water Act Section 319 (h)**

The Clean Water Act (CWA) was established in 1987 to address non-point source efforts. The CWA Section 319 is an opportunity for federal funding provided to the State and administered through the office of Florida Department of Environmental Protection (FDEP). Projects that are eligible for Section 319 funding must meet the criteria for mitigating nonpoint source pollution. Applications must be submitted to the Environmental Protection Agency for review and approval of funding.

## **FDEP - Clean Water Act Section 319 (h)**

The Clean Water Act (CWA) was established in 1987 to address non-point source efforts. The CWA Section 319 is an opportunity for federal funding provided to the State and administered through the office of Florida Department of Environmental Protection (FDEP). Projects that are eligible for Section 319 funding must meet the criteria for mitigating nonpoint source pollution. Applications must be submitted to the Environmental Protection Agency for review and approval of funding.



## Appendix D – BMP Concept Plans and Costs

**Opinion of Probable Cost  
City of Belleair Beach Master Drainage Plan Update**

**BMP Cost Summary**

July 1, 2016

<b>BMP</b>	<b>Description</b>	<b>Priority</b>	<b>Budget</b>
1	1st Street	1	\$279,000
2	2nd Street	2	\$136,000
3	3rd and 4th Street	4	\$268,000
4	5th Street	5	\$88,000
5	7th Street	6	\$297,000
6	City Hall	16	\$123,000
7	12th Street	7	\$204,000
8	13th Street	8	\$203,000
9	16th Street	14	\$167,000
10	17th Street	13	\$187,000
11	18th Street	3	\$131,000
12	19th Street	12	\$108,000
13	22nd Street	11	\$125,000
14	Morgan Drive	15	\$178,000
15	Belle Isle Ave	10	\$170,000
16	Marina	9	\$326,000
	<b>Totals</b>		<b>\$2,990,000</b>

**Opinion of Probable Cost  
City of Belleair Beach Master Drainage Plan Update  
BMP No. 1: 1st Street**

July 1, 2016

Description	Unit	Estimated Quantity	Unit Price	Amount
Mobilization	LS	1.0	\$10,000	\$10,000
Maintenance of Traffic	LS	1.0	\$5,000	\$5,000
Floating Turbidity Barrier	LF	70.0	\$50	\$3,500
Silt Fence, Staked (FDOT Type III)	LF	350.0	\$3	\$1,050
Clearing and Grubbing	AC	0.1	\$5,200	\$520
Sodding	SY	759.0	\$5	\$3,795
Pipe Culvert, 18" RCP	LF	118.0	\$80	\$9,440
Pipe Culvert, 24" RCP	LF	323.0	\$100	\$32,300
Ditch Bottom Inlet	EA	1.0	\$4,500	\$4,500
Curb Inlet	EA	3.0	\$5,000	\$15,000
Water Quality Inserts (Inlets)	EA	4.0	\$2,000	\$8,000
Check Gate Structure	EA	2.0	\$10,000	\$20,000
Overflow Swale	SY	195.0	\$15	\$2,925
Pipe Removal (Pipe < 30")	LF	118.0	\$40	\$4,720
Tideflex TF-1 Check Gate	EA	2.0	\$5,000	\$10,000
Rip Rap Rubble with Fabric	SY	10.0	\$80	\$800
Remove and Replace Exist. Curb	LF	290.0	\$30	\$8,700
Remove and Replace Asphalt Pavement	SY	912.0	\$50	\$45,600
<b>Subtotal</b>				<b>\$185,850</b>
Unspecified Work (Allowance)	EA	1.00	\$37,150	\$37,150
Engineering and Permitting	EA	1.00	\$56,000	\$56,000
<b>Totals</b>				<b>\$279,000</b>

**Opinion of Probable Cost  
City of Belleair Beach Master Drainage Plan Update  
BMP No. 2: 2nd Street**

July 1, 2016

Description	Unit	Estimated Quantity	Unit Price	Amount
Mobilization	LS	1.0	\$10,000	\$10,000
Maintenance of Traffic	LS	1.0	\$5,000	\$5,000
Floating Turbidity Barrier	LF	35.0	\$50	\$1,750
Silt Fence, Staked (FDOT Type III)	LF	260.0	\$3	\$780
Clearing and Grubbing	AC	0.1	\$5,200	\$520
Sodding	SY	455.0	\$5	\$2,275
Pipe Culvert, 18" RCP	LF	30.0	\$80	\$2,400
Pipe Culvert, 24" RCP	LF	140.0	\$100	\$14,000
Curb Inlet	EA	2.0	\$5,000	\$10,000
Water Quality Inserts (Inlets)	EA	2.0	\$2,000	\$4,000
Check Gate Structure	EA	1.0	\$10,000	\$10,000
Plug Existing Storm Manhole	EA	1.0	\$2,000	\$2,000
Overflow Swale	SY	190.0	\$15	\$2,850
Pipe Removal (Pipe < 30")	LF	40.0	\$40	\$1,600
Tideflex TF-1 Check Gate	EA	1.0	\$5,000	\$5,000
Rip Rap Rubble with Fabric	SY	5.0	\$80	\$400
Remove and Replace Exist. Curb	LF	210.0	\$30	\$6,300
Remove and Replace Asphalt Pavement	SY	228.0	\$50	\$11,400
<b>Subtotal</b>				<b>\$90,275</b>
Unspecified Work (Allowance)	EA	1.00	\$18,725	\$18,725
Engineering and Permitting	EA	1.00	\$27,000	\$27,000
<b>Totals</b>				<b>\$136,000</b>

**Opinion of Probable Cost  
City of Belleair Beach Master Drainage Plan Update  
BMP No. 3: 3rd and 4th Street**

July 1, 2016

Description	Unit	Estimated Quantity	Unit Price	Amount
Mobilization	LS	1.0	\$10,000	\$10,000
Maintenance of Traffic	LS	1.0	\$5,000	\$5,000
Floating Turbidity Barrier	LF	35.0	\$50	\$1,750
Silt Fence, Staked (FDOT Type III)	LF	350.0	\$3	\$1,050
Clearing and Grubbing	AC	0.1	\$5,200	\$520
Sodding	SY	382.0	\$5	\$1,910
Pipe Culvert, 18" RCP	LF	200.0	\$80	\$16,000
Pipe Culvert, 24" RCP	LF	223.0	\$100	\$22,300
Curb Inlet	EA	4.0	\$5,000	\$20,000
Water Quality Inserts (Inlets)	EA	4.0	\$2,000	\$8,000
Check Gate Structure	EA	2.0	\$10,000	\$20,000
Pipe Removal (Pipe < 30")	LF	423.0	\$40	\$16,920
Tideflex TF-1 Check Gate	EA	2.0	\$5,000	\$10,000
Rip Rap Rubble with Fabric	SY	10.0	\$80	\$800
Remove and Replace Exist. Curb	LF	545.0	\$30	\$16,350
Remove and Replace Asphalt Pavement	SY	564.0	\$50	\$28,200
<b>Subtotal</b>				<b>\$178,800</b>
Unspecified Work (Allowance)	EA	1.00	\$35,600	\$35,600
Engineering and Permitting	EA	1.00	\$53,600	\$53,600
<b>Totals</b>				<b>\$268,000</b>

**Opinion of Probable Cost  
City of Belleair Beach Master Drainage Plan Update  
BMP No. 4: 5th Street**

July 1, 2016

Description	Unit	Estimated Quantity	Unit Price	Amount
Mobilization	LS	1.0	\$10,000	\$10,000
Maintenance of Traffic	LS	1.0	\$5,000	\$5,000
Floating Turbidity Barrier	LF	35.0	\$50	\$1,750
Silt Fence, Staked (FDOT Type III)	LF	100.0	\$3	\$300
Clearing and Grubbing	AC	0.1	\$5,200	\$520
Sodding	SY	96.0	\$5	\$480
Pipe Culvert, 18" RCP	LF	30.0	\$80	\$2,400
Curb Inlet	EA	2.0	\$5,000	\$10,000
Water Quality Inserts (Inlets)	EA	2.0	\$2,000	\$4,000
Check Gate Structure	EA	1.0	\$10,000	\$10,000
Pipe Removal (Pipe < 30")	LF	30.0	\$40	\$1,200
Tideflex TF-1 Check Gate	EA	1.0	\$5,000	\$5,000
Rip Rap Rubble with Fabric	SY	5.0	\$80	\$400
Remove and Replace Exist. Curb	LF	90.0	\$30	\$2,700
Remove and Replace Asphalt Pavement	SY	95.0	\$50	\$4,750
<b>Subtotal</b>				<b>\$58,500</b>
Unspecified Work (Allowance)	EA	1.00	\$12,000	\$12,000
Engineering and Permitting	EA	1.00	\$17,500	\$17,500
<b>Totals</b>				<b>\$88,000</b>

**Opinion of Probable Cost**  
**City of Belleair Beach Master Drainage Plan Update**  
**BMP No. 5: 7th Street**

July 1, 2016

Description	Unit	Estimated Quantity	Unit Price	Amount
Mobilization	LS	1.0	\$10,000	\$10,000
Maintenance of Traffic	LS	1.0	\$5,000	\$5,000
Floating Turbidity Barrier	LF	35.0	\$50	\$1,750
Silt Fence, Staked (FDOT Type III)	LF	260.0	\$3	\$780
Clearing and Grubbing	AC	0.1	\$5,200	\$520
Sodding	SY	190.0	\$5	\$950
Pipe Culvert, 18" RCP	LF	25.0	\$80	\$2,000
Pipe Culvert, 24" RCP	LF	435.0	\$100	\$43,500
Curb Inlet	EA	3.0	\$5,000	\$15,000
Ditch Bottom Inlet	EA	2.0	\$4,500	\$9,000
Water Quality Inserts (Inlets)	EA	3.0	\$2,000	\$6,000
Check Gate Structure	EA	2.0	\$10,000	\$20,000
Plug Existing Storm Manhole	EA	1.0	\$2,000	\$2,000
Overflow Swale	SY	120.0	\$15	\$1,800
Pipe Removal (Pipe < 30")	LF	295.0	\$40	\$11,800
Tideflex TF-1 Check Gate	EA	2.0	\$5,000	\$10,000
Rip Rap Rubble with Fabric	SY	10.0	\$80	\$800
Remove and Replace Exist. Curb	LF	650.0	\$30	\$19,500
Remove and Replace Asphalt Pavement	SY	750.0	\$50	\$37,500
<b>Subtotal</b>				<b>\$197,900</b>
Unspecified Work (Allowance)	EA	1.00	\$39,600	\$39,600
Engineering and Permitting	EA	1.00	\$59,500	\$59,500
<b>Totals</b>				<b>\$297,000</b>

**Opinion of Probable Cost**  
**City of Belleair Beach Master Drainage Plan Update**  
**BMP No. 6: City Hall, Cedar Dr., Spruce Dr.**

July 1, 2016

Description	Unit	Estimated Quantity	Unit Price	Amount
Mobilization	LS	1.0	\$10,000	\$10,000
Maintenance of Traffic	LS	1.0	\$5,000	\$5,000
Floating Turbidity Barrier	LF	35.0	\$50	\$1,750
Silt Fence, Staked (FDOT Type III)	LF	260.0	\$3	\$780
Clearing and Grubbing	AC	0.1	\$5,200	\$520
Sodding	SY	600.0	\$5	\$3,000
Remove Sediment	CY	740.0	\$25	\$18,500
Curb Inlet	EA	2.0	\$5,000	\$10,000
Water Quality Inserts (Inlets)	EA	2.0	\$2,000	\$4,000
New Control Structure	EA	1.0	\$10,000	\$10,000
Remove Existing Control Structure	EA	1.0	\$4,000	\$4,000
Overflow Swale	SY	470.0	\$15	\$7,050
Rip Rap Rubble with Fabric	SY	5.0	\$80	\$400
Remove and Replace Exist. Curb	LF	40.0	\$30	\$1,200
Remove and Replace Asphalt Pavement	SY	100.0	\$50	\$5,000
<b>Subtotal</b>				<b>\$81,200</b>
Unspecified Work (Allowance)	EA	1.00	\$16,200	\$16,200
Engineering and Permitting	EA	1.00	\$25,600	\$25,600
<b>Totals</b>				<b>\$123,000</b>

**Opinion of Probable Cost**  
**City of Belleair Beach Master Drainage Plan Update**  
**BMP No. 7: 12th Street**

July 1, 2016

Description	Unit	Estimated Quantity	Unit Price	Amount
Mobilization	LS	1.0	\$10,000	\$10,000
Maintenance of Traffic	LS	1.0	\$5,000	\$5,000
Floating Turbidity Barrier	LF	35.0	\$50	\$1,750
Silt Fence, Staked (FDOT Type III)	LF	190.0	\$3	\$570
Clearing and Grubbing	AC	0.1	\$5,200	\$520
Sodding	SY	330.0	\$5	\$1,650
Pipe Culvert, 18" RCP	LF	60.0	\$80	\$4,800
Pipe Culvert, 24" RCP	LF	140.0	\$100	\$14,000
Curb Inlet	EA	5.0	\$5,000	\$25,000
Water Quality Inserts (Inlets)	EA	5.0	\$2,000	\$10,000
Stormceptor Modifications	EA	1.0	\$5,000	\$5,000
Check Gate Structure	EA	1.0	\$10,000	\$10,000
Tideflex TF-1 Check Gate	EA	1.0	\$5,000	\$5,000
Pipe Removal (Pipe < 30")	LF	60.0	\$40	\$2,400
Rip Rap Rubble with Fabric	SY	5.0	\$80	\$400
Remove and Replace Exist. Curb	LF	280.0	\$30	\$8,400
Remove and Replace Asphalt Pavement	SY	647.0	\$50	\$32,350
<b>Subtotal</b>				<b>\$136,840</b>
Unspecified Work (Allowance)	EA	1.00	\$27,000	\$27,000
Engineering and Permitting	EA	1.00	\$40,160	\$40,160
<b>Totals</b>				<b>\$204,000</b>

**Opinion of Probable Cost  
City of Belleair Beach Master Drainage Plan Update  
BMP No. 8: 13th Street**

July 1, 2018

Description	Unit	Estimated Quantity	Unit Price	Amount
Mobilization	LS	1.0	\$10,000	\$10,000
Maintenance of Traffic	LS	1.0	\$5,000	\$5,000
Floating Turbidity Barrier	LF	35.0	\$50	\$1,750
Silt Fence, Staked (FDOT Type III)	LF	260.0	\$3	\$780
Clearing and Grubbing	AC	0.1	\$5,200	\$520
Sodding	SY	390.0	\$5	\$1,950
Pipe Culvert, 18" RCP	LF	90.0	\$80	\$7,200
Pipe Culvert, 24" RCP	LF	225.0	\$100	\$22,500
Curb Inlet	EA	4.0	\$5,000	\$20,000
Water Quality Inserts (Inlets)	EA	4.0	\$2,000	\$8,000
Stormceptor Modifications	EA	1.0	\$5,000	\$5,000
Check Gate Structure	EA	1.0	\$10,000	\$10,000
Tideflex TF-1 Check Gate	EA	1.0	\$5,000	\$5,000
Pipe Removal (Pipe < 30")	LF	90.0	\$40	\$3,600
Rip Rap Rubble with Fabric	SY	5.0	\$80	\$400
Remove and Replace Exist. Curb	LF	330.0	\$30	\$9,900
Remove and Replace Asphalt Pavement	SY	450.0	\$50	\$22,500
<b>Subtotal</b>				<b>\$134,100</b>
Unspecified Work (Allowance)	EA	1.00	\$26,400	\$26,400
Engineering and Permitting	EA	1.00	\$42,500	\$42,500
<b>Totals</b>				<b>\$203,000</b>

**Opinion of Probable Cost**  
**City of Belleair Beach Master Drainage Plan Update**  
**BMP No. 9: 16th Street**

July 1, 2018

Description	Unit	Estimated Quantity	Unit Price	Amount
Mobilization	LS	1.0	\$10,000	\$10,000
Maintenance of Traffic	LS	1.0	\$5,000	\$5,000
Floating Turbidity Barrier	LF	70.0	\$50	\$3,500
Silt Fence, Staked (FDOT Type III)	LF	250.0	\$3	\$750
Clearing and Grubbing	AC	0.1	\$5,200	\$520
Sodding	SY	141.0	\$5	\$705
Pipe Culvert, 18" RCP	LF	255.0	\$80	\$20,400
Curb Inlet	EA	4.0	\$5,000	\$20,000
Water Quality Inserts (Inlets)	EA	4.0	\$2,000	\$8,000
Plug Existing Storm Manhole	EA	2.0	\$2,000	\$4,000
Overflow Swale	SY	110.0	\$15	\$1,650
Pipe Removal (Pipe < 30")	LF	200.0	\$40	\$8,000
Rip Rap Rubble with Fabric	SY	5.0	\$80	\$400
Remove and Replace Exist. Curb	LF	190.0	\$30	\$5,700
Remove and Replace Asphalt Pavement	SY	480.0	\$50	\$24,000
<b>Subtotal</b>				<b>\$112,625</b>
Unspecified Work (Allowance)	EA	1.00	\$22,175	\$22,175
Engineering and Permitting	EA	1.00	\$32,200	\$32,200
<b>Totals</b>				<b>\$167,000</b>

**Opinion of Probable Cost  
City of Belleair Beach Master Drainage Plan Update  
BMP No. 10: 17th Street**

July 1, 2016

Description	Unit	Estimated Quantity	Unit Price	Amount
Mobilization	LS	1.0	\$10,000	\$10,000
Maintenance of Traffic	LS	1.0	\$5,000	\$5,000
Floating Turbidity Barrier	LF	35.0	\$50	\$1,750
Silt Fence, Staked (FDOT Type III)	LF	350.0	\$3	\$1,050
Clearing and Grubbing	AC	0.1	\$5,200	\$520
Sodding	SY	246.0	\$5	\$1,230
Pipe Culvert, 18" RCP	LF	30.0	\$80	\$2,400
Pipe Culvert, 24" RCP	LF	120.0	\$100	\$12,000
Pipe Culvert, 30" RCP	LF	125.0	\$190	\$23,750
Curb Inlet	EA	3.0	\$5,000	\$15,000
Water Quality Inserts (Inlets)	EA	3.0	\$2,000	\$6,000
Pipe Removal (Pipe < 30")	LF	275.0	\$40	\$11,000
Rip Rap Rubble with Fabric	SY	5.0	\$80	\$400
Remove and Replace Exist. Curb	LF	250.0	\$30	\$7,500
Remove and Replace Asphalt Pavement	SY	540.0	\$50	\$27,000
<b>Subtotal</b>				<b>\$124,600</b>
Unspecified Work (Allowance)	EA	1.00	\$25,000	\$25,000
Engineering and Permitting	EA	1.00	\$37,400	\$37,400
<b>Totals</b>				<b>\$187,000</b>

**Opinion of Probable Cost**  
**City of Belleair Beach Master Drainage Plan Update**  
**BMP No. 11: 18th Street**

July 1, 2016

Description	Unit	Estimated Quantity	Unit Price	Amount
Mobilization	LS	1.0	\$10,000	\$10,000
Maintenance of Traffic	LS	1.0	\$5,000	\$5,000
Floating Turbidity Barrier	LF	35.0	\$50	\$1,750
Silt Fence, Staked (FDOT Type III)	LF	250.0	\$3	\$750
Clearing and Grubbing	AC	0.1	\$5,200	\$520
Sodding	SY	250.0	\$5	\$1,250
Pipe Culvert, 18" RCP	LF	40.0	\$80	\$3,200
Pipe Culvert, 24" RCP	LF	200.0	\$100	\$20,000
Curb Inlet	EA	2.0	\$5,000	\$10,000
Water Quality Inserts (Inlets)	EA	2.0	\$2,000	\$4,000
Pipe Removal (Pipe < 30")	LF	240.0	\$40	\$9,600
Rip Rap Rubble with Fabric	SY	5.0	\$80	\$400
Remove and Replace Exist. Curb	LF	225.0	\$30	\$6,750
Remove and Replace Asphalt Pavement	SY	280.0	\$50	\$14,000
<b>Subtotal</b>				<b>\$87,220</b>
Unspecified Work (Allowance)	EA	1.00	\$17,400	\$17,400
Engineering and Permitting	EA	1.00	\$26,380	\$26,380
<b>Totals</b>				<b>\$131,000</b>

**Opinion of Probable Cost  
City of Belleair Beach Master Drainage Plan Update  
BMP No. 12: 19th Street**

July 1, 2016

Description	Unit	Estimated Quantity	Unit Price	Amount
Mobilization	LS	1.0	\$10,000	\$10,000
Maintenance of Traffic	LS	1.0	\$5,000	\$5,000
Floating Turbidity Barrier	LF	35.0	\$50	\$1,750
Silt Fence, Staked (FDOT Type III)	LF	280.0	\$3	\$840
Clearing and Grubbing	AC	0.1	\$5,200	\$520
Sodding	SY	388.0	\$5	\$1,940
Pipe Culvert, 18" RCP	LF	180.0	\$80	\$14,400
Curb Inlet	EA	3.0	\$5,000	\$15,000
Water Quality Inserts (Inlets)	EA	3.0	\$2,000	\$6,000
Pipe Removal (Pipe < 30")	LF	180.0	\$40	\$7,200
Rip Rap Rubble with Fabric	SY	5.0	\$80	\$400
Remove and Replace Exist. Curb	LF	100.0	\$30	\$3,000
Remove and Replace Asphalt Pavement	SY	115.0	\$50	\$5,750
<b>Subtotal</b>				<b>\$71,800</b>
Unspecified Work (Allowance)	EA	1.00	\$14,200	\$14,200
Engineering and Permitting	EA	1.00	\$22,000	\$22,000
<b>Totals</b>				<b>\$108,000</b>



DRAFT

**City of Belleair Beach**  
**Stormwater Master Drainage Plan Update**  
 September 1, 2016

Table 8-3 Outfall Priority Matrix

Priority	BMP	Outfall	Street	Drainage Easement	Park Site	Space Available to Upgrade	Flood Depth Issues	Water Quality	Tide Issues	Score
1	BMP 1	N1-0	1st St	0	5	5	5	3	5	23
2	BMP 2	N2-0	2nd St	0	5	5	5	3	5	23
3	BMP 3	N3-0	3rd/4th St	3	1	5	5	3	5	22
4	BMP 4	N4-0	5th St/Harbor Dr	4	0	4	5	3	5	21
5	BMP 5	N6-0	7th St/Harbor Dr	3	5	3	3	3	3	20
5	BMP 5	N7-0	8th St/Harbor Dr	0	0	0	5	3	3	11
6	BMP 6	N9-0	City Hall	5	5	0	5	4	0	19
7	BMP 15	N25-0	Belle Isle Ave - Hibiscus Dr - West	3	0	3	3	3	5	17
8	BMP 14	N24-0	Morgan Dr	5	0	4	5	3	0	17
9	BMP 16	N10101	Marina	5	5	0	2	5	0	17
10	BMP 7	N10-0	12th St/Bay Dr	0	0	5	3	3	5	16
11	BMP 9	N14-0	16th St	0	5	5	3	3	0	16
12	BMP 8	N11-0	13th St/Bay Dr	0	0	3	3	3	5	14
13	BMP 13	N19-0	22nd/Bayshore Dr	3	0	3	5	3	0	14
14	BMP 10	N15-0	17th St	0	0	5	2	3	0	10
15	BMP 11	N16-0	18th St	0	0	3	4	3	0	10
16	BMP12	N17-0	19th St/Bayshore Dr	0	0	3	4	3	0	10
		N18-0	20th - 21st St/Bayshore Dr	0	0	0	5	0	0	5
		N20-0	22nd - 23rd St/Bayshore Dr	0	0	0	5	0	0	5
		N21-0	23rd - 24th St/Bayshore Dr	0	0	0	5	0	0	5
		N23-0	25th - Morgan/Bayshore Dr	0	0	0	5	0	0	5
		N26-0	Belle Isle Ave - Hibiscus Dr - East	0	0	0	5	0	0	5
		N42-0	Donato Dr - South End Entrance	0	0	0	5	0	0	5
		N43-0	Donato Dr - North End	0	0	0	5	0	0	5
		N44-0	Aleta Dr	0	0	0	5	0	0	5
		N45-0	22nd St - East End	0	0	0	5	0	0	5
		N46-0	Louisa Dr	0	0	0	5	0	0	5





DRAFT

**City of Belleair Beach**  
**Stormwater Master Drainage Plan Update**  
 September 1, 2016

**Table 8-3 Outfall Priority Matrix**

Priority	BMP	Outfall	Street	Drainage Easement	Park Site	Space Available to Upgrade	Flood Depth Issues	Water Quality	Tide Issues	Score
		N12-0	14th St	0	0	0	2	0	0	2
		N13-0	15th St	0	0	0	2	0	0	2
		N22-0	24th - 25th St/Bayshore Dr	0	0	0	2	0	0	2
		N5-0	6th St/Harbor Dr	0	0	0	2	0	0	2
		N27-0	Harrison Ave - West Bridge	0	0	0	1	0	0	1
		N28-0	Harrison Ave - East Bridge	0	0	0	1	0	0	1
		N29-0	Harrison Ave - East End	0	0	0	1	0	0	1
		N31-0	Wedgewood Dr	0	0	0	1	0	0	1
		N32-0	Belle Isle Ave - Wedgewood/Tiffany	0	0	0	1	0	0	1
		N33-0	Tiffany Dr - North End	0	0	0	1	0	0	1
		N34-0	Tiffany Dr - South Entrance	0	0	0	1	0	0	1
		N35-0	Belle Isle Dr - Tiffany/Crystal Cay	0	0	0	1	0	0	1
		N36-0	Crystal Cay	0	0	0	1	0	0	1
		N37-0	Belle Isle Ave - East of Crystal Cay	0	0	0	1	0	0	1
		N38-0	Belle Isle Ave - East End	0	0	0	1	0	0	1
		N39-0	Howard Dr - West End	0	0	0	1	0	0	1
		N40-0	Howard Dr - Central	0	0	0	1	0	0	1
		N41-0	Howard Dr - East End	0	0	0	1	0	0	1
		N8-0	9th St	0	0	0	1	0	0	1
		N30-0	Belle Isle Ave Park	0	0	0	0	0	0	0
		NPCC20-0	20th St	0	0	0	0	0	0	0
		NPCC25-50	25th St	0	0	0	0	0	0	0

Scoring Factors: 5 = Best 4 = Moderate High 3 = Moderate 2= Moderate Low 1 = Low





DRAFT

## Section 9 Sea Level Rise (SLR) Considerations

### 9.1 SLR Risk Assessments

Stormwater infrastructure in many cases stays in service many years beyond its intended service life. With continued maintenance, repair and replacement, stormwater infrastructure that has been in service for very long periods of time are now faced with impacts due to sea level rise.

The United States Army Corp of Engineers (USACE) Technical Letter ETL 1100-2-1, 30 June 2014, explains that as the service life of infrastructure increases, so does the severity of climate impacts. Figure 9-1

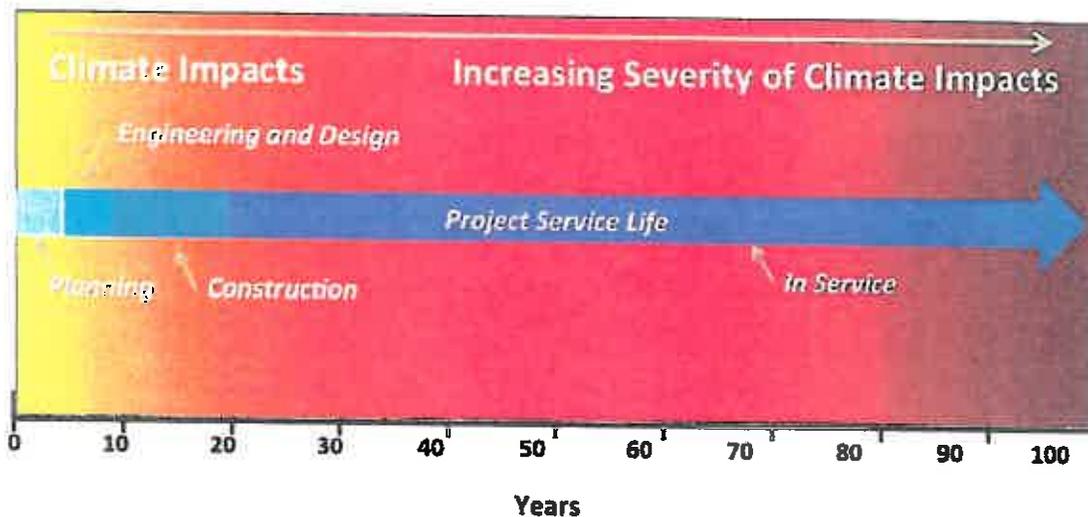


Figure 9-1 Infrastructure vs. Climate Change

(Source: Water resources infrastructure time frames vs. climate impacts, USACE ETL 1100-2-1, 2014 and Savonis, M.J. (2011) U.S. ports: Addressing the adaptation challenge. *Ad Hoc Expert Meeting on Climate Change Impacts and Adaptation: A Challenge for Global Ports*, 29–30 September 2011.)

USACE guidance advises that each infrastructure system has a tipping point where performance of the system is diminished resulting adverse impacts upon the infrastructure and surrounding area of influence. The impact can be a reduction or loss of the ability to function as initially designed, economic impacts due to the reduction or loss and possible environmental impacts.

Establishing a suitable level of risk is based on evaluation of the systems tolerance to risk. Long lived infrastructure lasting more than 50 years have less tolerance to risk than infrastructure with a design life of a couple decades. Moreover, communities experiencing



DRAFT

climate impacts resulting in the community experiencing flooding have a very low tolerance to risk.

Figure 9-2, illustrates variable levels of risk to sea level rises across the southeast United States. According to the National Climate Assessment, the vulnerability is a function of tide levels, wave action, terrain, and other coastal processes affecting sea level change.

### Vulnerability to Sea Level Rise

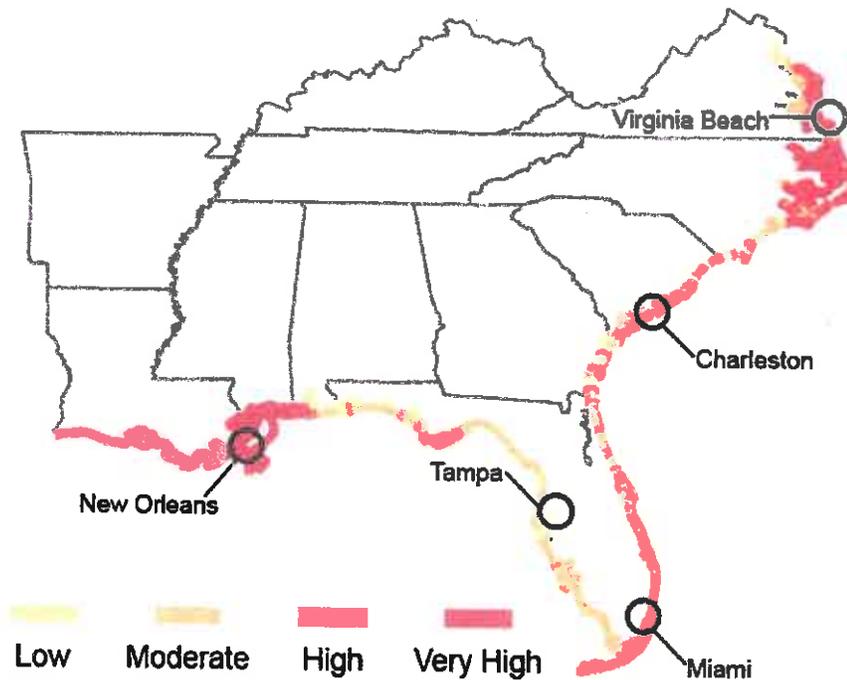


Figure 9-2 Vulnerability of Sea Level Rise

(Source: Third National Climate Assessment, U.S. Global Change Research Program)

The level of risk associated with the City of Belleair Beach is shown in an area considered as moderate vulnerability to sea level rise.

### 9.2 Sea Level Rise Projections

The Tampa Bay Climate Science Advisory Panel (CSAP) is an interagency and academic partnership working to assist communities plan for climate change. CSAP published "Recommended Projection of Sea Level Rise in the Tampa Bay Region, August 2015" as a means to provide information and data for estimating regional Sea Level Rise (SLR) in the



DRAFT

City of Belleair Beach  
Stormwater Master Drainage Plan Update  
September 1, 2016

Tampa Bay Region. CSAP utilized the USACE "Sea Level Change Curve Calculator (2015.46)" for development of SLR projections.

Previous discussion for possible levels of rise associated with regional factors provides the basis to recommend establishing an appropriate level of risk within the City of Belleair Beach as moderate. By using the moderate risk level, the projection estimate then coincide with SLR scenario "Intermediate-Low" with resulting SLR rate change primarily influenced by ocean warming factors.

Figure 9-3, describes SLR projections estimates ranging from lowest to highest scenarios. Descriptions for each SLR Scenario are also provided in Table 9-1.

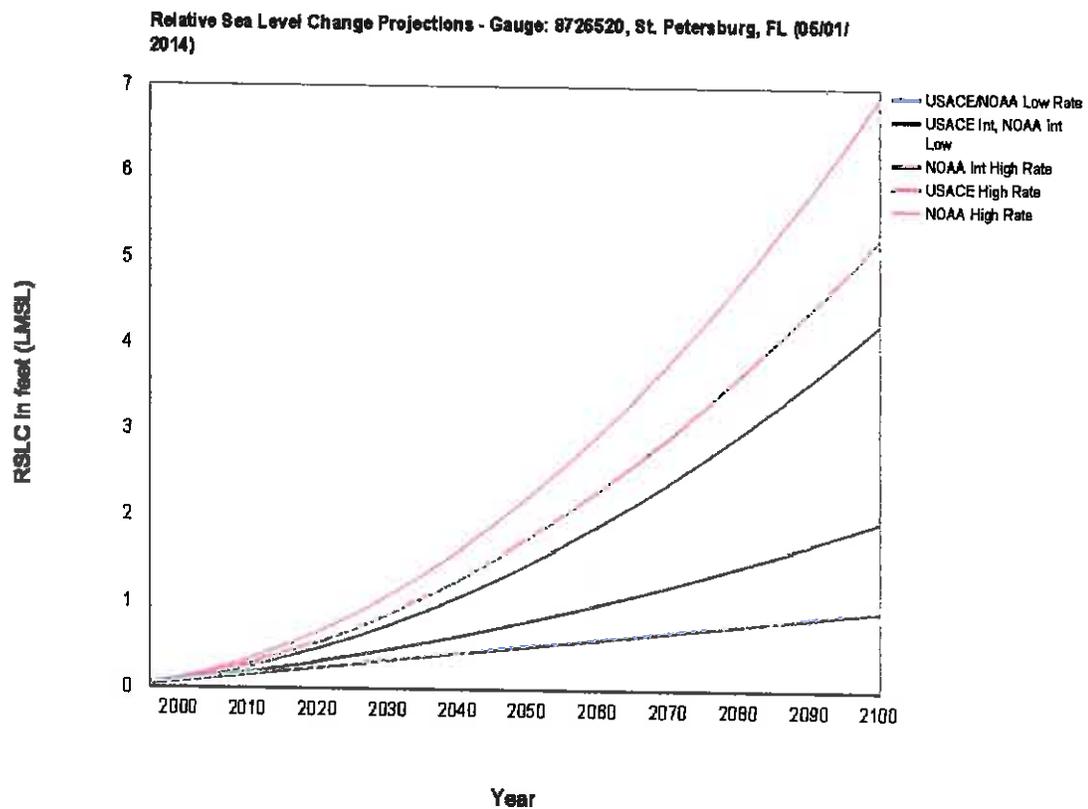


Figure 9-1, Projected Sea Level Rise for Variable Scenarios

(Source: Tampa Bay Climate Science Advisory Panel. 2015. *Recommended Projection of Sea Level Rise in the Tampa Bay Region.*)



DRAFT

City of Belleair Beach  
Stormwater Master Drainage Plan Update  
September 1, 2016

Table 9-1 SLR Scenario Descriptions

Scenario	Description
Highest	Increased rate caused by ocean warming combined with maximum potential glacier and ice-sheet melt
Intermediate-High	Increased rate caused by ocean warming and limited ice sheet loss
Intermediate-Low	Increased rate caused by ocean warming only
Lowest	Linear extrapolation of historical rate of change

Utilizing the USACE SLR Calculator and the St. Petersburg, Florida gage 8726520, the resulting SLR projections for the City of Belleair Beach is provided in Table 9-2.

Table 9-2 Adjusted Sea Level Rise Projection

Adjusted Sea Level Change From 2016 to 2100 (All values are expressed in feet)					
Year	USACE/ NOAA Low	USACE/ NOAA Intermediate Low	NOAA Intermediate High	USACE High	NOAA High
2016	0.00	0.00	0.00	0.00	0.00
2020	0.03	0.05	0.09	0.11	0.14
2025	0.08	0.12	0.22	0.27	0.34
2030	0.12	0.20	0.37	0.44	0.56
2035	0.16	0.27	0.52	0.63	0.81
2040	0.20	0.36	0.70	0.84	1.08
2045	0.24	0.44	0.88	1.07	1.38
2050	0.29	0.53	1.08	1.32	1.71
2055	0.33	0.63	1.30	1.59	2.06
2060	0.37	0.73	1.53	1.87	2.44
2065	0.41	0.83	1.77	2.17	2.84
2070	0.45	0.94	2.03	2.50	3.27
2075	0.50	1.06	2.30	2.84	3.72
2080	0.54	1.18	2.59	3.20	4.20
2085	0.58	1.30	2.89	3.57	4.70
2090	0.62	1.42	3.20	3.97	5.23
2095	0.66	1.56	3.53	4.38	5.79
2100	0.71	1.69	3.87	4.82	6.37



**DRAFT**

### **9.3 ICPR Model with Increasing SLR**

The next steps for addressing sea level rise are to evaluate the impact of SLR on the existing stormwater system. The evaluation will provide a means to estimate when the stormwater systems would become diminished in function.

Values for existing tide elevations for 2016 were derived from the NOAA gage station located at St. Petersburg and Clearwater Beach, Florida. These values were then utilized for SLR projections shown in the previous section.

SLR projections in the analysis are used as model boundary conditions for years starting at year 2016 for ten (10) year increments up to year 2065, resulting in a 50 year timeframe. Model results are located in Appendix F, Table 9-3.

For comparison of floodplain impacts due to the 10 year storm event, Figure 9-2, Appendix A. The 10 year storm event was chosen primarily this is the current typical design storm event for stormwater drainage systems.



# DRAFT

## City of Belleair Beach Stormwater Master Drainage Plan Update September 1, 2016

---

### Section 10 Recommendations

#### 10.1 Recommendations

ESG evaluated the issues and capacity of the existing stormwater drainage system within the City of Belleair Beach. The existing conditions evaluation confirmed known flooding issues occurring throughout the City and provided the framework to develop potential improvement alternatives. The ICPR model results indicate in many areas the stormwater management system is not capable of passing the mean annual storm (2.33 year) without street flooding. The Master Drainage Plan update also evaluated impacts to the stormwater drainage system due to Sea Level Rise over a 50 year period. Several of the existing inlets in system are less than the Mean High High Water Level (MHHW) causing water from the intercoastal to back up on City streets.

Best Management Plans (BMPs) were evaluated to measure improvements to the stormwater quantity and quality conditions across the City. These included inlet improvements, stormwater pipe upgrades, separation from the County's Gulf Boulevard drainage system, tide check valve structures and new outfalls. The BMP alternatives modeling indicated that there are limited opportunities to lessen the impact of street flooding, tidal backflow and improvements to water quality. This is due to the existing terrain consisting of highly urban, flat topography with high groundwater, and tidal conditions in the City.

Based on the analyses performed, the following recommendations are offered:

1. City Council acceptance of the updated MDP.
2. Continue with regular maintenance of the City's stormwater system. Inlets and pipes should be cleaned of trash and debris to allow full access to stormwater pipes.
3. Implementation of the recommended 16 BMP projects. It is recommended that a long term approach to include one to two BMP projects annually into the Capital Improvements Program.
4. Pursue grant and loan funding from local, state and federal sources to reduce the burden on the City's general fund. Grants and loans offer opportunities for stormwater improvements funding. Grants could include the State revolving funds and other cooperative grants with the SWFWMD or innovative BMP grants through FDEP and EPA. Loans can include the Florida State Revolving Loan program which offers funding to municipalities for storm water related infrastructure.