FINAL REPORT

STORMWATER MASTER PLAN UPDATE
PHASE 1

City of St. Augustine

February 2013

CDM Smith

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List of Acronyms

BLS	Below Land Surface
CAFR	Comprehensive Annual Financial Report
DCIA	Directly connected impervious area
DEM	Digital elevation model
DTM	Digital terrain model
ERU	Equivalent Residential User
FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation
FEMA	Federal Emergency Management Agency
FIS	Flood Insurance Study
HU	Hydrologic Unit
HUC	Hydrologic Unit Code
IA	Initial abstraction
ICPR	Interconnected Pond Routing (Model)
JEA	Jones Edmunds
MA	Mean Annual
MHHW	Mean Higher High Water
MHW	Mean High Water
MLW	Mean Low Water
MLLW	Mean Lower Low Water
NAVD88	North American Vertical Datum 1988
NDCIA	Non-directly connected impervious area
NGVD29	National Geodetic Vertical Datum 1929
NOAA	National Oceanic and Atmospheric Administration
NWI	National Wetlands Inventory
O&M	Operations and Maintenance
PSWMP	Primary stormwater management system
SFMP	Stormwater Facilities Master Plan 1995
SFWMD	South Florida Water Management District
SFU	Single Family Unit
SJRWMD	St. Johns River Water Management District
SWMPU	Stormwater Master Plan Update

Section 1

Existing Data Collection, Evaluation, and Site Visits

1.1 Introduction and Background

The City of St. Augustine (City) is located in St. Johns County, Florida and based on the 2010 Census, the City has 12,975 inhabitants. Founded in 1565, St. Augustine is the oldest continuously occupied European established city and port in the United States. Tidal rivers divide the City into three main land masses: Anastasia Island, Old St. Augustine, and West St. Augustine. Receiving waters are all tidal and include Salt Run, the Matanzas River, and the San Sebastian River.

The current City stormwater infrastructure includes more than 158,000 feet of stormwater pipes and over 2,200 drainage structures. This infrastructure has existed for many years and several areas are in need of an upgrade to manage flooding and water quality. The collected stormwater runoff outfalls to 12 stream sub-basins that are grouped into 2 major watersheds: the San Sebastian River basin and the Matanzas River basin. The estimated stream length for the 9 stream outfalls located within the City combined is 20.8 stream miles.

CDM Smith developed this Stormwater Master Plan Update (SWMPU) to allow phasing for cost effective evaluations of higher priority problem areas while also establishing the framework for the entire program. The objective of this study, Phase 1, is to define the stormwater level of service (LOS) for flood control, create models for the City's primary stormwater management system (PSWMS) and outfalls, identify alternative solutions and capital improvement projects, and update the stormwater data management system. **Figure 1-1** is a citywide map printed on an ANSI E (34-in x 44-in.) sheet that provides a visual summary of the mappable data that have been collected for this project.

1.2 1995 Stormwater Master Plan

The City developed a "Stormwater Facilities Master Plan" (SFMP) in 1995. This study included the formulation and ordinance for a stormwater utility and stormwater facilities master planning. The 1995 SFMP was developed by CH2M HILL and was used as a baseline literature study for reviewing past conditions and previously assessed problem areas within the City.

1.3 GIS Datasets

1.3.1 Stormwater Related Data

CDM Smith received the following datasets related to stormwater: St. Johns County (County) hydrologic boundaries, streams, and retention-detention basins. This data assisted in hydrologic model development that is described in detail in Section 3.

1.3.2 Topographic Datasets

CDM Smith acquired the 2009 County 1-ft LiDAR contours prior to the Stormwater Master Plan Update. After meeting with the County, CDM Smith obtained the 2008 Digital Terrain Model (DTM) and Digital Elevation Model (DEM). The DEM was used to delineate tributary areas within the City Limits, which is explained further in Section 3. **Figure 1-2** shows a citywide map of the topographic data that were used for hydrologic delineation.

Legend

- CITY - DINLET
- CITY - DMANHOLE
- CITY - DOUTFALL
- CITY - DVALVE
- CITY - DCHANNEL
- CITY - DCONDUIT
- CITY - DPIPE
- CITY - DRETBASIN
- CITY - PREVIOUS STORMPTS
- CITY - PREVIOUS STORMLINES
- CITY - CITY LIMIT
- SJC - SURVEY_CONTROL_201202
- SJC - SEPTIC_FEB2012
- SJC - ICPR NODE
- SJC - ICPR LINK
- SJC - ICPR BASIN

Atlantic Ocean

Francis and Mary Usina Bridge

Bridge of Lions

Matanzas

San Sebastian

0 0.25 0.5 1 Miles

N W E S

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Figure 1-1
City of St. Augustine
Data Collection Summary

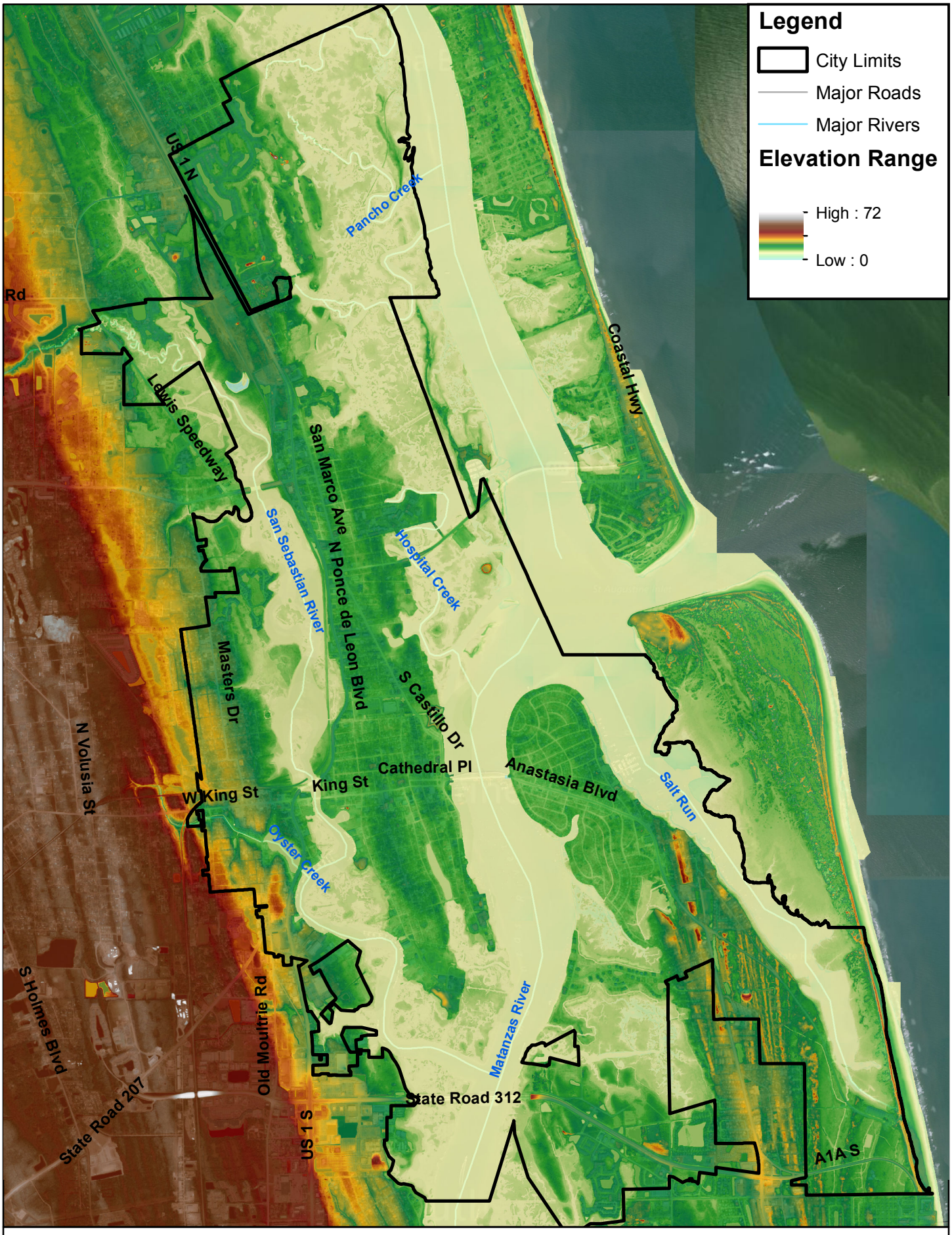

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Figure 1-2
Topographic Dataset
City of St. Augustine

1.3.3 Infrastructure Datasets

The City provided shapefiles of the existing infrastructure, which includes roads, stormwater pipes, channels, inlets, manholes, and outfalls. The stormwater pipes, inlets, and manholes contained invert values in National Geodetic Vertical Datum (NGVD), which was converted to North American Vertical Datum (NAVD) for this project. The Florida Department of Transportation (FDOT) stormwater piping was missing from the first shapefile received from the City; therefore, an older version of the City stormwater pipes that includes FDOT stormwater pipes was used.

1.4 External Agencies Data Collection

1.4.1 St. Johns County

CDM Smith obtained aerial data, a county SWMP, model, and survey benchmarks from the County. The County provided the draft model developed through Interconnected Pond Routing (ICPR) Stormwater Model. This model included results of the tributary area delineation (Phase 1) as well as preliminary hydraulic definition of West St. Johns County.

CDM Smith used information from the provided model to develop the delineation of the western city boundaries. The objective of this verification is to align the hydrologic flows between the County and the City within the Oyster Creek watershed. **Appendix B** includes detailed minutes of the coordination meeting and data provided by St. Johns County.

1.4.2 St. Johns River Water Management District

CDM Smith obtained data for this project from the St. Johns River Water Management District (SJRWMD). The data included rainfall distribution and depths, NRCS Soils, National Wetlands Inventory (NWI), ERP and association BMP data, and hydrogeologic data.

1.4.3 National Oceanic and Atmospheric Administration

CDM Smith obtained tidal stage data for this project from the National Oceanic and Atmospheric Administration (NOAA) at Gage 872-0582. Section 2.2.8 further describes the application of tidal information from this gage.

1.4.4 Florida Department of Environmental Protection

CDM Smith obtained water quality data for this project from the Florida Department of Environmental Protection (FDEP).

1.4.5 Federal Emergency Management Agency

CDM Smith obtained stillwater and floodplain data for this project from the Federal Emergency Management Agency (FEMA). FEMA FIS data were used for setting boundary conditions for the model. **Figure 1-3** is a map of the 100-year floodplain in the City.

The current FIS was issued by FEMA in September 2004 for St. Johns County and incorporated areas. The original analysis for the City of St. Augustine is based on a prior 1988 study, and will likely change based on the revision of the original coastal study for North East Florida.

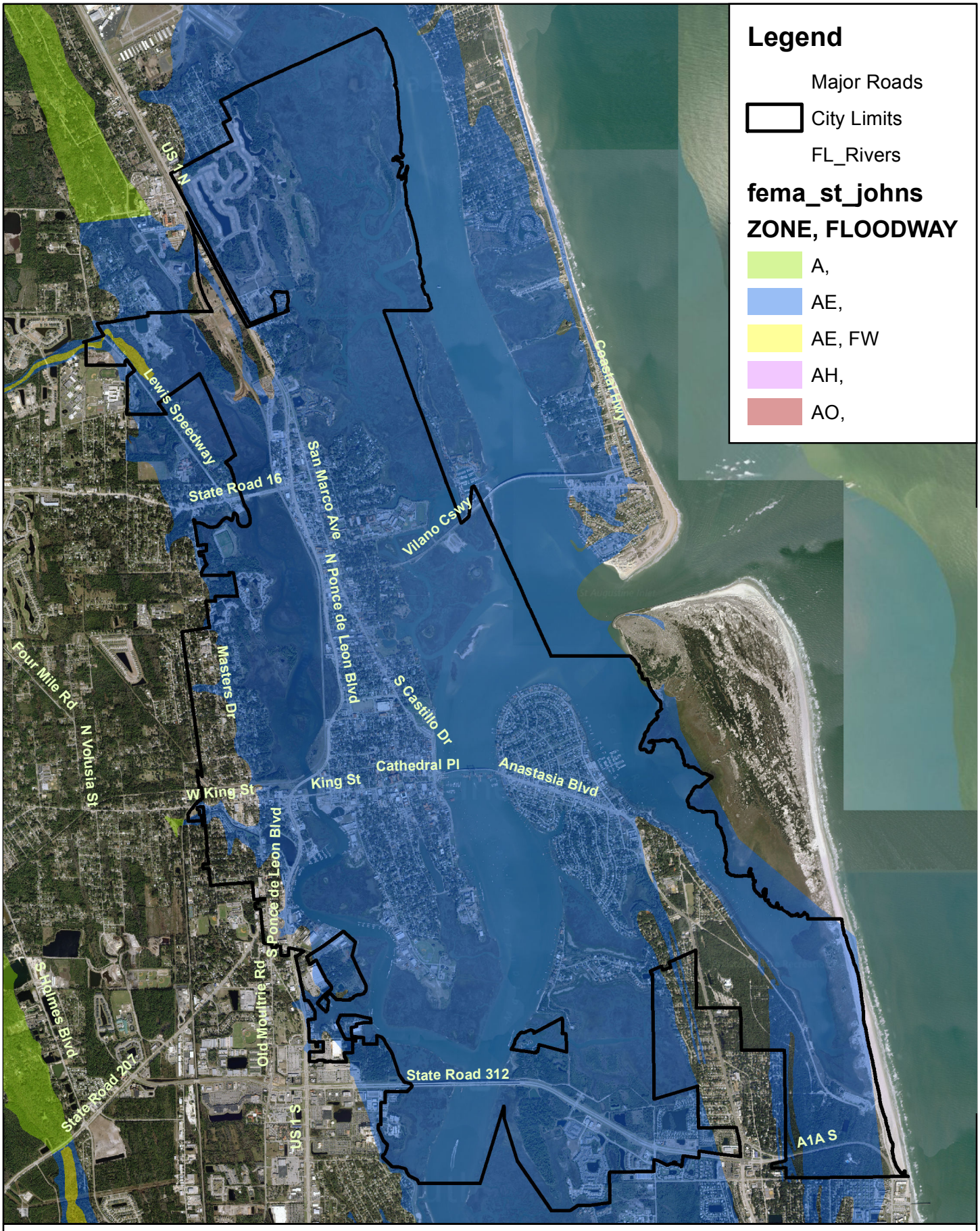

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Figure 1-3
Flood Zones
City of St. Augustine

1.4.6 Florida Department of Transportation

The City discussed the FDOT ongoing design of the May Street improvements. The purpose of the coordination is to consider potential cost shaving of construction schedule coordination between these two entities.

1.5 Flooding Complaints

As part of this stormwater master plan update, CDM Smith wanted to compile the information collected relative to stormwater complaints received from citizens. The City began recording complaints as of July 15, 2011 and a current file with flood complaints to the City was shared with CDM Smith. Each stormwater complaint was screened, categorized, and geocoded. The outcome is a GIS shapefile that provides a spatial distribution as well as date and comment attributes. This template will be used by the City for ongoing complaint logging. Contents in the complaint log should include: flooding address location, date and time, description of problem, person who handled complaint, response details, and additional comments. An aerial map showing the history and distribution of flood complaints is represented on **Figure 1-4.**

There are 19 recorded flood complaints since July 2011. CDM Smith noted that even after severe rainstorms, such as Tropical Storm Beryl (May 2012), there is a low volume of flooding complaints to the City. One of the potential causes for there not being a higher amount of complaints is that residents of St. Augustine are aware of the age and heritage of the City infrastructure and homes have always been built 2 to 3 feet above grade. Flooding is therefore only a traffic and roadway nuisance that results in City cleanup efforts after flooding events.

1.6 Vertical Datum Conversion

This project is based in the North American Vertical Datum of 1988 (NAVD88). In order to have all of the City's data accessible, some of the elevation data required a conversion from the National Geodetic Vertical datum of 1929 (NGVD29). The datums were converted using the US Army Corps of Engineers CORPSCON version 6.0. Using a Latitude of 29 degrees 53 minutes and 40 seconds and a Longitude of 81 degrees 18 minutes and 53 seconds for the entire City of St. Augustine, the conversion value from NGVD29 to NAVD88 is 1.06 feet (NAVD + 1.06 = NGVD).

1.7 Aerial Imagery

The County also provided 2011 aerial imagery of St. Johns County, which includes the City. This aerial imagery, along with topography, contributed to the creation of the tributary areas for the hydrologic delineation.

1.8 Site Visits

Site visits were conducted around the City's short listed priority areas with the City clients. Detailed site visit notes were taken of the stormwater issues, and locations for additional survey were marked. **Appendix C** includes some of the relevant pictures obtained during the site visits.

Complaint ID	Date
1	7/15/2011
2	9/23/2011
3	12/12/2011
4	12/12/2011
5	12/12/2011
6	2/18/2012
7	4/2/2012
8	4/9/2012
9	4/9/2012
10	4/19/2012
11	5/8/2012
12	5/29/2012
13	7/31/2012
14	8/1/2012
15	8/13/2012
16	8/21/2012
17	8/21/2012
18	8/21/2012
19	8/21/2012

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Figure 1-4
Flood Complaints
City of St. Augustine

Section 2
Hydrologic Model Development

The development of a detailed hydrologic model is essential in order for the City to effectively assess and manage flood risk, capital improvements, and water quality issues. CDM Smith used the existing data documented in the previous section to perform hydrologic unit delineations and generate hydrologic parameters for modeling.

CDM Smith used the public domain USEPA SWMM version 5 and ESRI ArcGIS 10.0 to identify, delineate, and refine 249 Hydrologic Units (HUs). CDM Smith also considered the City's major problem areas, photogrammatic mapping, and field-verification when required. SWMM will later be used to simulate the surface water hydrology and hydraulics.

SWMM is a dynamic hydrologic and hydraulic model capable of performing continuous or event simulations of surface runoff, and subsequent hydraulic conveyance in open channel and pipe systems. SWMM is also approved by FEMA for floodplain mapping and accepted as an industry standard modeling platform for urban areas with systems of combined open channels and piped networks.

The hydrologic system operates by applying precipitation across HUs and through hydrologic calculations, determining surface runoff to loading points on the user-defined PSWMS. Runoff hydrographs for these loading points provide input for hydraulic routing through the PSWMS to the outlet.

2.1 Basin Delineation

CDM Smith performed the basin delineation of the City considering the topography of the City and the hydraulic structures such as the culverts, pipes, and channels in the models from previous studies. CDM Smith identified areas where additional or updated information was needed and subsequently obtained as-builts, requested survey, and conducted field visits to close any data gaps. **Figure 2-1** contains the results of the basin delineation, identifying individual sub-basins and their ID, which is printed on an ANSI E (34 x 44 in.) size sheet attached separately to this report.

2.1.1 Methodology

First, topographic data was obtained from the County along with a current basin delineation of St. Johns County by Jones Edmunds.

The basins delineated by Jones Edmunds for the County were reviewed for areas that overlapped with the areas of interest and then checked for accuracy. The basins that overlap were extracted and used in CDM Smith's hydrologic evaluation. Some basins were divided further to allow for a more detailed hydrologic model.

The remaining areas in the county were delineated using the topographic data and existing data for the pipes, inlets, and outfall locations. The number of HUs was limited to 150 as determined in the scope.

Legend

Basins

- Fish Island - FI
- Hospital Creek - HC
- Indian Creek - IC
- Matanzas River - MZ
- Oyster Creek - OC
- Pancho Creek - PC
- Plantation Island - PI
- Quarry Creek - QC
- Red House Branch - RH
- Robinson Creek - RC
- Salt Run - SR
- San Sebastian River - SS
- City Limit

Atlantic Ocean

Matanzas River

San Sebastian River

0 0.25 0.5 1 Miles

N W E S

CDM Smith

Figure 2-1
City of St. Augustine
Citywide Hydrologic Map

The Hydrologic Unit Codes (HUCs) naming convention is based on an 8-character alphanumeric ID. The first two characters "HU" distinguish the Hydrologic Units from other model entities. The next two characters in the HUC ID are letters determined by the receiving water body to which each HUC discharges. The acronyms for the streams are as follows:

- FI: Fish Island
- HC: Hospital Creek
- IC: Indian Creek
- MZ: Matanzas River
- OC: Oyster Creek
- PI: Plantation Island
- PC: Pancho Creek
- QU: Quarry Creek
- RC: Robinson Creek
- RH: Red House Branch
- SR: Salt Run
- SS: San Sebastian River

The remaining 4 characters are a number code that starts with 1000 for the first HUC associated with the receiving water and increases by an increment of 10 for the other HUCs, leaving the flexibility for adding HUCs later if necessary.

ESRI GIS software was used to digitize the HUs, calculate properties (area, flow length, slope, etc.), and to extract land use and soil properties for use in calculation of HU hydrologic parameters.

2.1.2 As-Builts, Surveys, and Field Verification

Field visits were used to verify existing hydrologic delineation and hydraulic structures when as-built and survey data were not available or if there was a conflict in existing data. CDM Smith identified nine locations for field visits. The locations, observations, and pictures from the field visits can be found in Appendix B.

2.2 Hydrologic Analysis

The following sections describe the methods used to develop hydrologic parameters including: rainfall and design storm data; hydrologic unit divides, hydrologic unit width and area; percent directly connected impervious area (DCIA); average overland flow slope; Manning roughness coefficients for surface runoff flow; surface depression storage; infiltration rates; and soil storage capacities.

2.2.1 Topographic Data

Topographic data were used to define hydrologic boundaries, overland flow slopes, channel floodplain geometry, critical flood elevations, and stage-area relationships.

A DEM was provided by the County to use within the City area. Vertical accuracy is +/- 0.4-foot root-mean-square error RMSE for unobscured ground points. The vertical accuracy of the 2-foot contours, with supplemental 1-foot contours, is +/- 0.75 foot RMSE in unobscured areas.

2.2.2 Vertical Datum

The North American Vertical Datum of 1988 (NAVD88) was used in all model development tasks.

2.2.3 Hydrologic Units

Natural physical features or constructed stormwater management systems that control and direct stormwater runoff to a common outfall generally define HUs. The following criteria were used to determine HU boundaries:

- Topographic highs.
- Large-scale physical features such as railroad grades, airport runways, and roads.
- Structures or topographic features that could appreciably impound water for the 100-year event.
- Existing reports and studies and field verification, to define ambiguous boundaries.
- NPDES stormwater pipes and drainage coverage provided by the City were also utilized to determine the extent and boundaries of HUs.

GIS software was used to digitize the HUs, calculate properties, and to extract land use and soil properties for use in calculation of HU hydrologic parameters.

2.2.4 Soil Types and Characteristics

Each soil type was assigned a soil series and a Hydrologic Soil Group designated by Natural Resources Conservation Service (formerly the SCS). Hydrologic Soil Group A is comprised of soils having very high infiltration potential and low runoff potential. Hydrologic Soil Group D is characterized by soils with a very low infiltration potential and a high runoff potential. Hydrologic Soil Groups B and C are designated between these two categories. Soil group percentages for each hydrologic unit were estimated by overlaying a map of the hydrologic unit boundaries on the NRCS soil map. From the overlay map, the percentage of each soil group within a hydrologic unit was estimated using GIS software.

Citywide soil type distribution is presented in **Table 2-1**. The majority of the soils in the City are classified as D soils, or marine fill. This indicates limited infiltration capacity unless subsurface conditions are improved for drainage.

The Horton infiltration equation option in SWMM was used to calculate the rate and volume of water that infiltrates into the soil. According to the Horton equation, infiltration is computed as:

$$f_t = f_{min} + (f_{max} - f_{min})\, e^{-kt}$$

f_t = the infiltration capacity of the soil (in/hr) at time t,

f_{min} = the minimum (or final) infiltration capacity (in/hr),

f_{max} = the maximum (or initial) infiltration capacity (in/hr),

k = an exponential decay constant (hr^{-1}), and

t = time (hr)

The values in Table 2-1 are used to calculate the characteristics for each HU. The characteristics are weighted based on the distribution of soils in each HU. **Table 2-2** shows the existing soil distribution for the City based on acreage and percentages. The majority of the City has type D soil characteristics, with only 12.4 percent being type A soil classification.

Table 2-1 Global Soil Parameters

Soil Type	Initial Infiltration Rate (in/hr)	Final Infiltration Rate (in/hr)	Decay Rate (1/hr)	Dry Time (days)	Soil Storage (in)
A	12	1	2.0016	1	6.75
B	9	0.5	2.0016	1	5
C	6	0.25	2.0016	1	3.8
D	4	0.1	2.0016	1	1.4

Table 2-2 City of St. Augustine Soils Distribution*

Soils Class	Acres	Percent
A	1,010	12.4
C	1,999	24.5
D	3,437	42.2
Water	1,701	20.9
Total	**8,147**	**100.0**

*Note that the table is for the area within City Limits, not the HUCs for modeling

2.2.5 Land Use

Land use data are used to estimate imperviousness, surface friction factors, and initial abstractions for each hydrologic unit. Existing land use conditions were obtained using the St. Johns County Land Use plans (2004), available aerial imagery, and field investigations. For this project, the land uses were grouped into nine categories of relatively homogeneous geophysical parameters. Present land uses within the watershed include:

- Forest, Open, and Park
- Pasture
- Agricultural and Golf Course
- Low Density Residential
- Medium Density Residential

- High Density Residential
- Light Industrial, Commercial, and Institutional
- Heavy Industrial and Major Roadways
- Wetlands
- Watercourses and Waterbodies

The values in **Table 2-3 and Table 2-4** are used in developing weighted HUC characteristics based on existing land use data. The areas of the land use categories are matched with Table 2-3 and 2-4 to provide a unique set of characteristics including manning's n, DCIA, non-directly connected impervious area (NDCIA), and initial abstraction (I_A).

The breakdown of land use within the city limits is shown in **Table 2-5**. The total area of the City is 8,147, whereas SWMM only accounts for 4,825 acres. Note that over half of the City's acreage is wetlands and waterbodies.

Table 2-3 Land Use Based Manning's Roughness Coefficients used in SWMM

	Forest, Open & Park	Pasture	Agricultural & Golf Courses	Low Density Residential	Medium Density Residential	High Density Residential	Light Industrial, Commercial & Institutional	Heavy Industrial	Wetlands	Watercourses & Waterbodies
Impervious Manning's n	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.1	0.024
Pervious Manning's n	0.4	0.3	0.3	0.25	0.25	0.25	0.25	0.25	0.4	0.06

Table 2-4 Imperviousness by Land Use Category

Land Use Category	Percent Impervious	Percent DCIA	Percent NDCIA	Percent Pervious
Forest, Open & Park	5	1	4	95
Agricultural	5	1	4	95
Low Density Residential	15	8	7	85
Medium Density Residential	35	30	5	65
High Density Residential	83	50	33	18
Light Industrial, Commercial & Institutional	75	65	10	25
Heavy Industrial & Roadways	90	81	9	10
Wetlands	100	100	0	0
Watercourses & Waterbodies	100	100	0	0

Table 2-5 City of St. Augustine Land Use Distribution*

Land Use Class	Acres	Percent
Forest, Open & Park	1,441	17.7
Pasture	0	0.0
Agricultural & Golf Courses	167	2.0
Low Density Residential	12	0.1
Medium Density Residential	1,009	12.4
High Density Residential	423	5.2
Light Industrial, Commercial & Institutional	255	3.1
Heavy Industrial	639	7.8
Wetlands	2,182	26.8
Watercourses & Waterbodies	2,019	24.8
Total	**8,147**	**100**

*Note that the table is for the area within City limits, not the HUCs for modeling

2.2.6 Overland Flow Data

SWMM uses overland flow data in the form of HU width and surface slope to create an overland flow runoff plane that generates stormwater runoff. Topographic data were used to define up to three overland flow paths per HU. Each overland flow path is characterized by the flow length from the HU boundary to the PSWMS, by the path slope (change in elevation divided by the flow path length), and by the percent of the HU area associated with that flow path. Composite values of HU overland flow length and slope are calculated as the area-weighted length and slope values of the individual flow paths in the HU. The HU width is calculated as the area of the HU divided by the composite flow length value **Tables B-1 and B-2** in Appendix B show the values used in the calculation of the area-weighted HU overland flow parameters.

2.2.7 Rainfall Data

Rainfall data from the SJ 91-3 technical publication on the 24-Hour Rainfall Distribution for SJRWMD were used to generate stormwater runoff hydrographs for each hydrologic unit represented in the model. St. Augustine fell into Hydrologic Unit IX (HU IX), the upper coastal basin. The 24-hour distributions and rainfall maxims (inches) for varying return periods were obtained from the SJ 91-3 document. In the analysis for the City, design storm events were evaluated with the model. Design storm events are characterized by an event duration (e.g., 24 hours), rainfall amount (depth, measured in inches), and distribution (varying intensity of rainfall over the course of the event). Design storm events are usually characterized by a return period and event duration. For example, a 25-year, 72-hour design event describes a rainfall depth over a 3-day period that has a 4 percent (1/25) chance of occurring at a particular location in any given year.

CDM Smith used storm distributions for the following conditions: 2.33-year (Mean Annual, MA), 5-year, 10-year, 25-year, 50-year, 100-year, 24-hour duration rainfall events.

Figure 2-2 shows the power curve for the rainfall depths plotted for the upper coastal basin. The power curve was plotted in order to establish the rainfall depths for the 50-year and 5-year recurrence intervals, as they are not provided in the SJRWMD Applicants Handbook. **Table 2-6** shows the design storm depths in inches for all recurrence intervals.

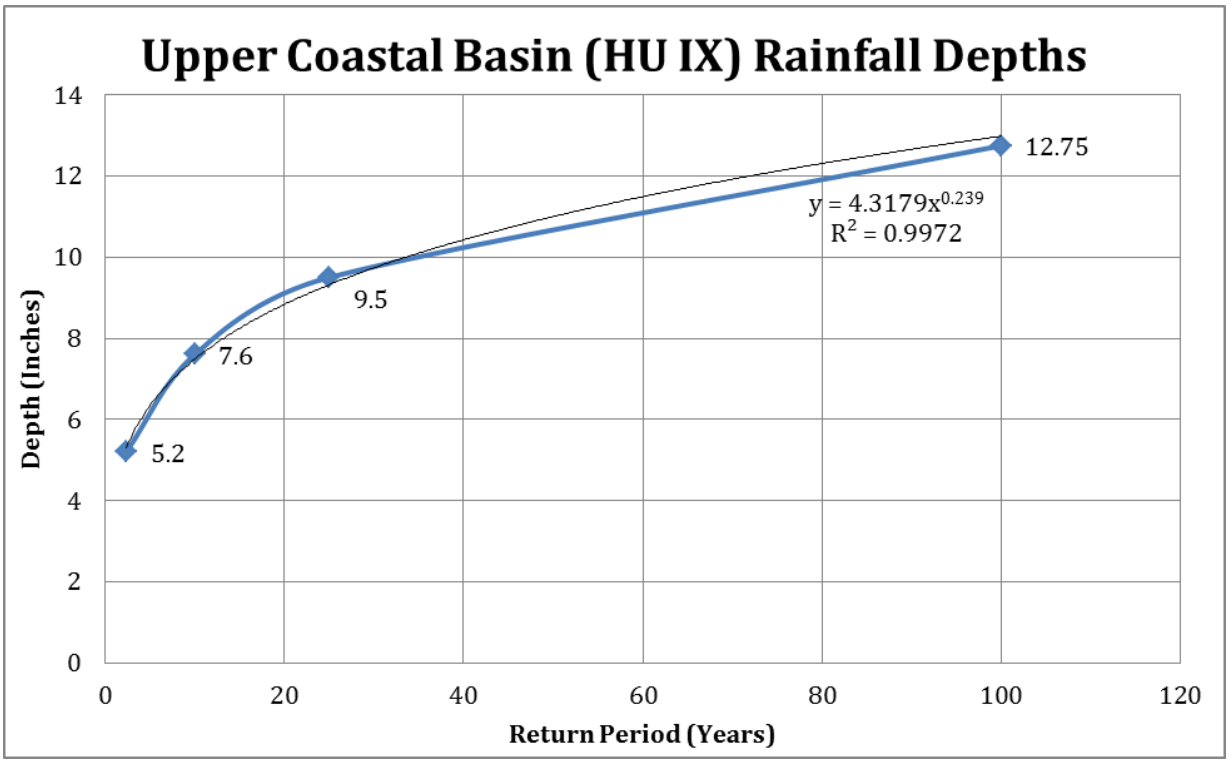


Figure 2-2 City of St. Augustine Rainfall Depths

Table 2-6 24-Hour Design Storm Depths in Inches

	Recurrence Interval					
	MA (2.3 year)	5 year	10 year	25 year	50 year	100 year
Peak Intensity (in/hr)	5.2	6.3	7.6	9.5	11	12.8

*MA is mean annual (2.33-year)

2.2.8 Boundary Conditions

Hydrologic boundary conditions are needed in order to simulate the tailwater effects on the streams and PSWMS. All streams and PSWMS in the City ultimately discharge into the San Sebastian River and the Matanzas River. The tidal influences on these systems can be estimated by using the NOAA ocean service. The elevation of tidal datums in NAVD 88 for the City are based on the following location:

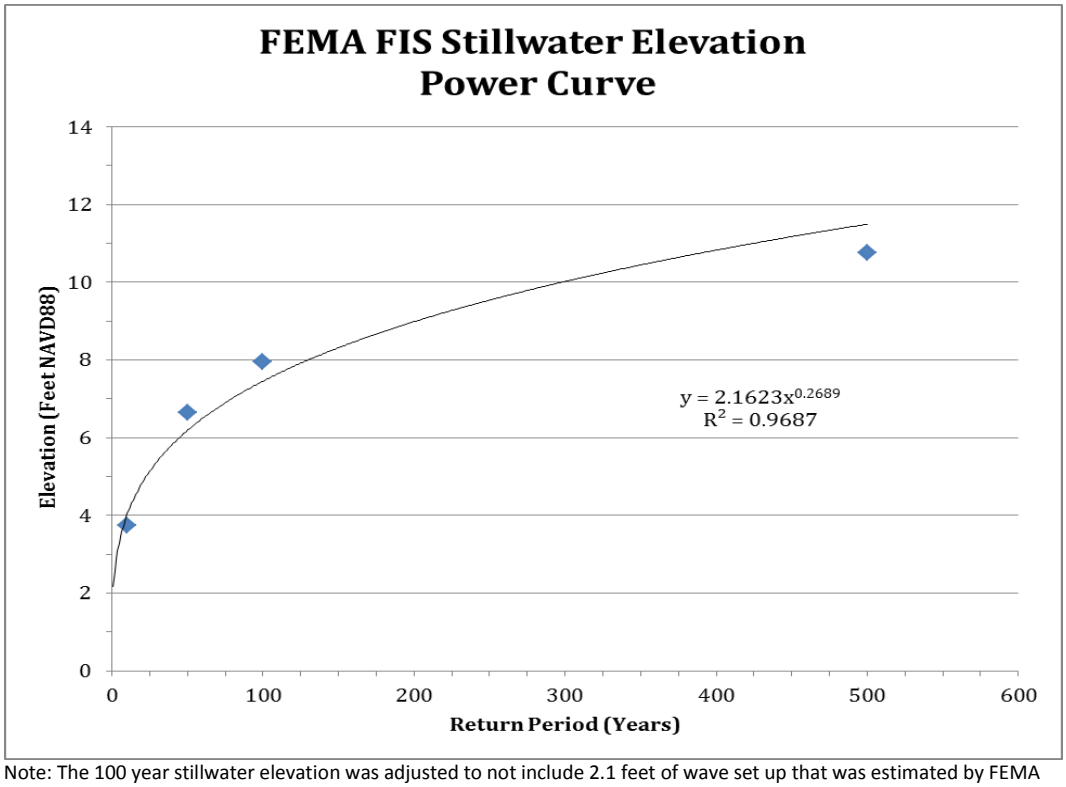
- Tide Station Number 872-0582, Tide station name: State Road 312, St. Augustine, Fl, Matanzas River, dated October 5, 2011

  - Mean Higher High Water (MHHW): +2.00 feet NAVD 88
  - Mean High Water (MHW): +1.67 feet NAVD 88
  - Mean Low Water (MLW): -2.61 feet NAVD 88
  - Mean Lower Low Water (MLLW): -2.80 feet NAVD 88

The above mean water levels can be used as a reference for the entire City when considering tidal influences; therefore, a value of +2.0 feet NAVD could be considered as a high tide condition for design

purposes. On the other hand, coastal evaluations consider stillwater conditions that account for surge conditions and represent cases with lower occurrence, such as the 10-, 50-, 100- and 500-year recurrence intervals. CDM Smith considered these values, as published by FEMA in the current Flood Insurance Study (FIS) and estimated the 1-year stillwater elevation to be 2.2 ft NAVD. The FEMA FIS report noted that the 100-year stillwater included 2.1 feet of wave setup by excluding this 2.1 feet CDM Smith obtained a better fit in the power curve on **Figure 2-3** and it did not change the 1-year stillwater elevation of 2.2 ft. This value is therefore more conservative than the higher high water, and is correlated to coastal storm events. **Table 2-7** has a number of stillwater elevations from various sources.

CDM Smith will therefore consider 2.2 ft NAVD as the design condition for future capital improvement projects to incorporate resilience against high tide and coastal storm conditions.



Note: The 100 year stillwater elevation was adjusted to not include 2.1 feet of wave set up that was estimated by FEMA

Figure 2-3 FEMA FIS Stillwater Elevation Power Curve

Table 2-7 Stillwater Elevation

Boundary Condition	Elevation (Feet NAVD 88)	Source
500-yr Stillwater	10.8	2004 FEMA FIS
100-yr Stillwater (minus wave setup)	8.0	2004 FEMA FIS
50-yr Stillwater	6.7	2004 FEMA FIS
10-yr Stillwater	3.8	2004 FEMA FIS
1-yr Stillwater	2.2	CDM Smith
Mean Higher High Water (MHHW)	2.0	NOAA 872-0582 Gage
Mean Tidal Water (MTL)	-0.5	NOAA 872-0582 Gage
Mean Lower Low Water (MLLW)	-2.8	NOAA 872-0582 Gage

Section 3
Hydraulic Model Schematic Development

CDM Smith reviewed the previous information from the previous tasks with the intent of creating a citywide hydraulic schematic.

3.1 Primary Stormwater Management System

The City PSWMS consists of streams, creeks, canals, culverts, bridges, control structures, underground pipe networks, and detention ponds. CDM Smith conducted field investigations to assist in updating the definition of the hydraulic network. The PSWMS for the City is shown on **Figure 3-1** on an ANSI E size sheet (34 x 44 in.) attached separately. The link naming convention is based on the upstream node ID. For the naming convention of the model nodes, refer to the section below.

3.2 Model Schematic Nodes

SWMM uses a node/link representation of the PSWMS. Nodes are located at:

- The ends of culverts
- Upstream and downstream of bridge structures
- Points along the streams where the geometry, direction, and/or slope of the channel varies significantly
- Stream intersections
- Structures along the streams (weirs, but in general may include pump stations, orifices, etc.)
- Points representing the HU low elevations

The naming convention for nodes in the City is based on a 9 digit-hyphenated system. A node ID has 4 digits, a hyphen, and then 5 five digits. The first 4 digits are the abbreviation of the street that the stormwater system is traveling along. For example, a node that is located in a PSWMS that is traveling along Sidney Street will have the first 4 digits as SIDN. If the node is at an intersection of two roads, then the last 5 digits are the abbreviation of the road that is perpendicular to the direction of the PSWMS. For example, if the system along Sidney Street is intersected by John Street, then the node ID will be SIDN-JOHNS. Though, if the node falls between two intersections, then the last 5 digits are the first two letters of the upstream intersection, then the number 2, then the first two letters of the downstream intersection. For example, if the node along Sidney Street falls between John Street and Christopher Street and John Street is the upstream intersection for the PSWMS, then the node ID will be SIDN-JO2CH.

Figure 2- 1
City of St. Augustine
Citywide Hydraulic Schematic Map

3.3 Stage-Area Relationships

Stage area relationships were computed for low lying areas in some HUs using the available topographic data. The plan area for storage at 2-ft intervals was calculated from the topographic surface as appropriate. In SWMM, the stage-area data can be assigned to a "storage node." SWMM uses the data to calculate the relationship between stage and storage volume.

To avoid "double counting" of storage in the model, storage associated with the floodplain of a stream reach must be kept separate from the stage-area storage nodes outside of the stream reach floodplain. Therefore, stage-area relationships were only provided to storage junctions at the furthest upstream node on a tributary, upstream of a structure, in roadway swales, to represent inline ponds, and to represent inline or offline storage where reaches do not include floodplains.

Stage-area relationships are necessary in relatively flat models where flood waters may overflow the channel banks and fill low-lying areas. An accounting of the volume of these areas is needed for both accurate flood elevation predictions as well as peak flow estimates.

3.4 Conduits

The following data were incorporated in SWMM to characterize conduits (channel, pipes, and bridges): local losses, Manning's n value, length, height, and width.

3.4.1 Culverts

For circular and elliptical pipes, as well as rectangular box culverts, model input data included surveyed depth, width (if non-circular), length and upstream and downstream inverts. Local loss coefficients are listed in **Tables 3-1 and 3-2**.

3.4.2 Natural Channels

Most of the natural channel (or irregular conduit) cross-sections in the model were developed from the survey data. To model 100-year events or other events that generate large flows, it was necessary to augment the surveyed cross-section with floodplain elevations from the topographic data.

For more intense storms, floodwater is simulated to the top of the bank for many of the cross-sections and flows over floodplains. These floodplains have been added to the canal/stream reaches in the model by augmenting the measured survey, while the significant storage that then was represented in each reach was removed from the stage-area relationship in the adjacent storage junctions, where applicable.

Table 3-1 Entrance Loss Coefficients (From SFWMD, 1989)

Type of Structure and Design of Entrance	Coefficient K_{ent}
Pipe, Concrete	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, sq. Cut end	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end)	0.2
Square-edge	0.5
Rounded (radius - 1/12 D)	0.2

Table 3-1 Entrance Loss Coefficients (From SFWMD, 1989)

Type of Structure and Design of Entrance	Coefficient K_{ent}
Mitered to conform to fill slope	0.7
End-Section conforming to fill slope	0.5
Beveled edges, 33.7 or 45 bevels	0.2
Side- or slope-tapered inlet	0.2
Pipe, or Pipe-Arch, Corrugated Metal	
Projecting from fill (no headwall)	0.9
Headwall or headwall and wingwalls square-edge	0.5
Mitered to conform to fill slope, paved or unpaved slope	0.7
End-Section conforming to fill slope	0.5
Beveled edges, 33.7 or 45 bevels	0.2
Side- or slope-tapered inlet	0.2
Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides	0.2
Wingwalls at 30 to 75 to barrel	
Square-edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Wingwall at 10E to 25E to barrel square edge at crown	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown	0.7
Side- or slope-tapered inlet	0.5

Table 3-2 Exit and In-Pipe Loss Coefficients (CDM Smith, 1988)

Description	K
Inlet to manhole	0.25
Manhole in straight section of closed conduit	0.10
Manhole at a 45 degree bend	0.25
Manhole at a 90 degree bend	0.50
Exit closed conduit to lake	1.00
Exit closed conduit to open channel	0.3-0.5

3.4.3 Bridges and Roadway Overflows

Bridges are irregular cross-sections that are unique in that if flood stages rise high enough, the cross-section is cut off by the bottom of the roadway (at the lower chord elevation) and the flow regime changes from an open channel with free water surface to a pressurized flow regime. In order to model bridges, the custom shape type conduit has been used in SWMM5. A custom shape may be any closed conduit shape that can be characterized by depth versus width at multiple depths in the section. From this data a shape curve is used to represent the bridge in SWMM.

Due to the high intensity of the design storms, some of the roads in the City are expected to be flooded, especially for the 25-, 50-, and 100-yr storms. For this SWMP update, the surveyed road crown elevations, where applicable, were merged with the topographic data to provide a wider, deeper cross-section for flow, in the same manner as channel cross-sections.

3.5 Boundary Conditions

Hydrologic boundary conditions are needed in order to simulate the tailwater effects on the streams system. The 1-year stillwater was applied for tidal boundaries. All the streams from the City of St. Augustine ultimately drain into the Matanzas River.

3.6 Model Calibration/Verification

Calibration and verification are desirable to validate predicted stages, flows, and velocities. For calibration or verification, data must be available in the form of rainfall, stage, flow, and/or high water marks for specific storm events, land use, and hydraulic conditions.

CDM Smith visited the pilot areas several times throughout the project duration to identify evidence of flooding associated with extreme rainfall events. On four separate occasions CDM Smith staff members deployed to the field, but were unable to record high water marks due to the flashy nature of the system. Two major tropical depressions occurred in 2012 (Beryl in May and Debby in June), and the associated flooding remained within the roadway right-of-way, and occurred at night. Site visits on the following day identified debris on the road, and evidence of shallow flooding at the following locations:

- Cordova Street
- Granada Street
- Sidney Street
- Christopher Street
- South Dixie

The field observations confirm the model results presented in Section 4 and stress the importance of maintenance and cleaning of City inlets and pipes.

3.7 Level of Service

In order to establish a stormwater program, and to fairly assess the benefits of proposed projects, it is necessary to identify concrete goals. These goals, or levels of service, are specific to each community and are related to the existing infrastructure capabilities. In an ideal scenario all communities would

strive to completely eliminate flooding of roads, buildings, and critical facilities but the reality is that there is a balance between cost and benefit that determines how much a community can really achieve.

In the case of St. Augustine, CDM Smith considered the results from the pilot areas evaluations described in Section 4 that included two different areas such as Oyster Creek, which was developed in recent years, and Maria Sanchez, which is part of the historical downtown. By considering the proposed improvements, and the current capacity of the stormwater infrastructure, CDM Smith proposes the following level of service goals:

- Local roads shall be passable for the 5-year/24-hour design storm (6.3 inches). This means that the proposed future projects should aim to have at most 0.5 ft of flooding for this scenario. This depth is considered a safe depth for travel by small size cars.
- Arterial and collector roads shall be passable for the 50-year/24-hour design storm (11 inches). This is particular relevant to ambulances, police vehicles and fire fighters that need to be able to reach residents in the event of a major flood, or evacuation scenario. The maximum depth of flooding for safe transit of vehicles is 0.5 ft also, as stated for local roads.
- Structures shall not flood up to the 100-year/24-hour design storm (12.8 inches). In order to assess this goal it is necessary to determine what the actual finished flood elevation of each structure in the project area is. Depending on the nature of the building foundation and structure the finished floor elevation can be at the ground level, or several feet above. Based on the site visits, and evaluation of the pilot problem areas CDM Smith determined that most residential structures are elevated with crawl space underneath. The actual elevation ranges from 2 to 3 feet, which confirms that residents of St. Augustine have lived with the threat of flooding for decades and have adjusted their structures to sustain minor floods.
- Future projects shall be assessed based on a design tidal condition of 2.2 ft-NAVD. This value corresponds to the 1-year stillwater elevation described in Section 2.2.8. By considering this condition, the City can implement projects that will be designed to operate under normal conditions, but also under storm surge conditions.

The level of service goals above were used to identify the proposed improvements for the pilot areas described in Section 4 and should be discussed and considered by the City to determine their applicability on a citywide scale. Since there is a clear difference between the stormwater infrastructure in the historical downtown and more recent neighborhoods, the City might also consider a different set of goals for historical areas. The goals described above are consistent with the ones set by other agencies such as the FDOT and FEMA. An aerial of the City's road classes is shown on **Figure 3-2**.

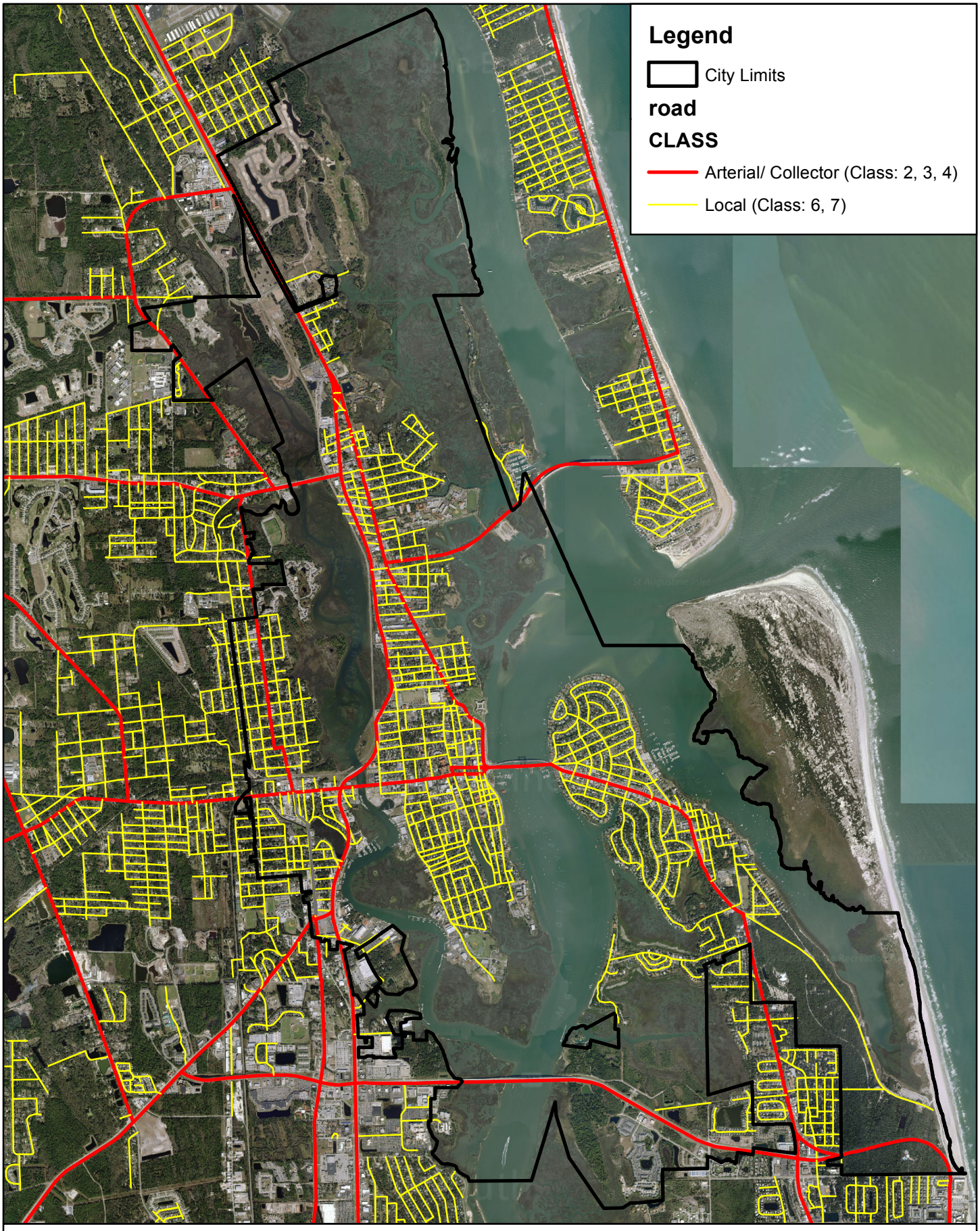


Figure 3-2
Functional Road Classifications
City of St. Augustine

Section 4
Pilot Area Stormwater Improvement Plan

In order to address flooding in high priority areas, demonstrate the alternative evaluation, and create a CIP process, a SWMM 5.0 hydraulic model has been developed for the pilot areas within the City.

4.1 Selected Pilot Areas

During the development of the hydrologic and hydraulic models, CDM Smith gathered information related to flooding complaints, logs of storm cleanups, and anecdotal information provided by City staff.

The review of this information allowed CDM Smith to identify three potential pilot areas on which the SWMPU can focus while a citywide project evaluation is completed.

A short list of potential pilot areas was created during the scoping process. In order to screen pilot areas for a hydraulic model and alternatives development as part of Phase 1 of the SWMPU, CDM Smith considered the following criteria:

- Frequency of flooding per discussions with City's staff
- Disruption to businesses
- Potential for joint projects with other public and private entities
- Ease of implementation

After evaluation of problem areas, the following three options were found to meet the criteria:

- Option 1: Oyster Creek (**Figure 4-1**)
- Option 2: Lake Maria Sanchez (**Figure 4-2**)
- Option 3: Valencia & Carrera Outfalls (Figure 4-2)

Each of the three options met the criteria. After presenting the three options to the City and discussing them, both Option 1 and Option 2 were selected. The first pilot area, Oyster Creek, offers great opportunity as an initial pilot area given the ease of implementation and limited cost. Oyster Creek was subsequently split into two separate projects and thus two separate models, analysis, and conceptual cost estimates were performed. The second pilot area, Lake Maria Sanchez, presents a challenge in implementation and cost, but will eventually provide significant benefits to the economic and historic center of the City. Valencia and Carrera outfall was not viewed as beneficial and was subsequently dismissed.

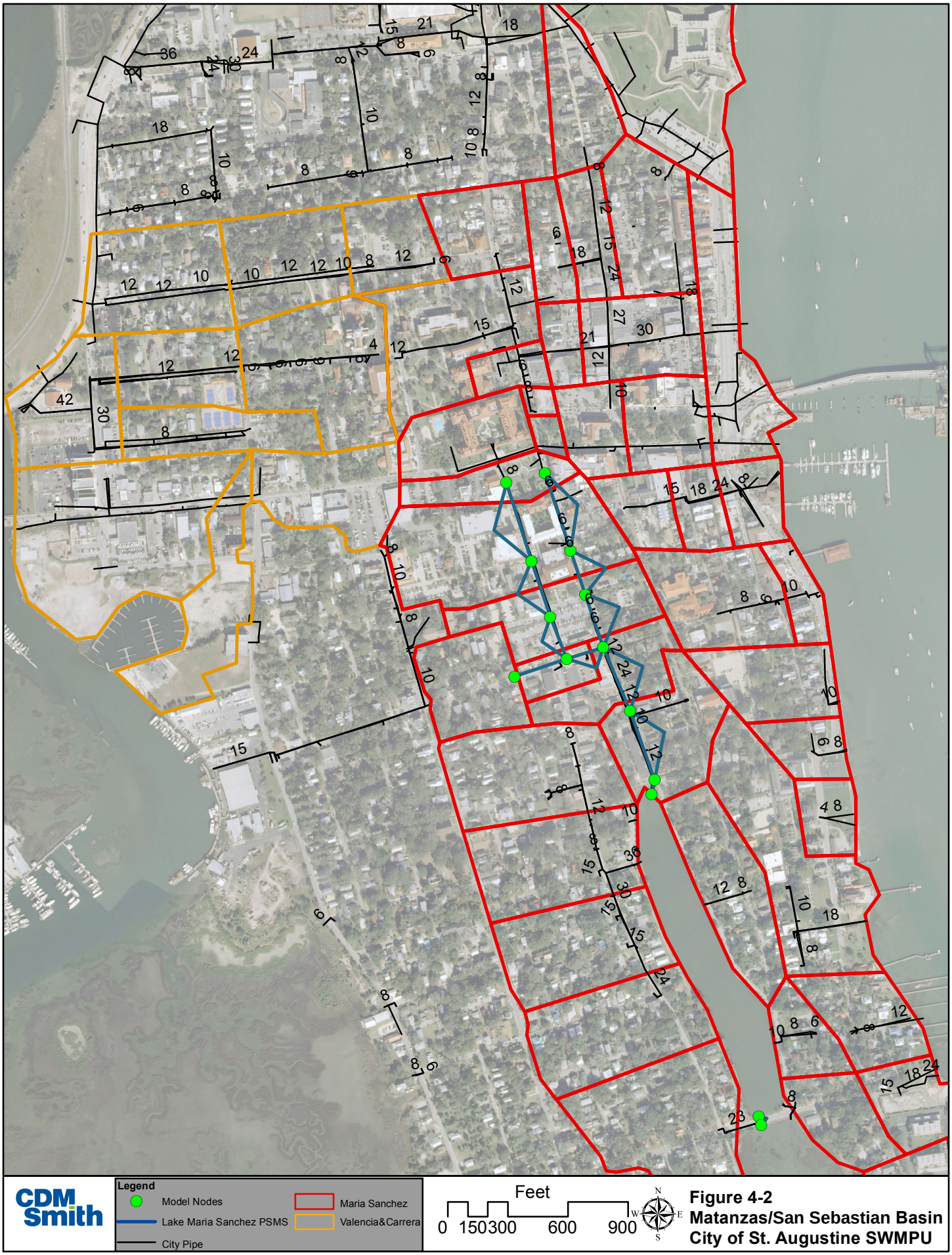


Figure 4-2
Matanzas/San Sebastian Basin
City of St. Augustine SWMPU

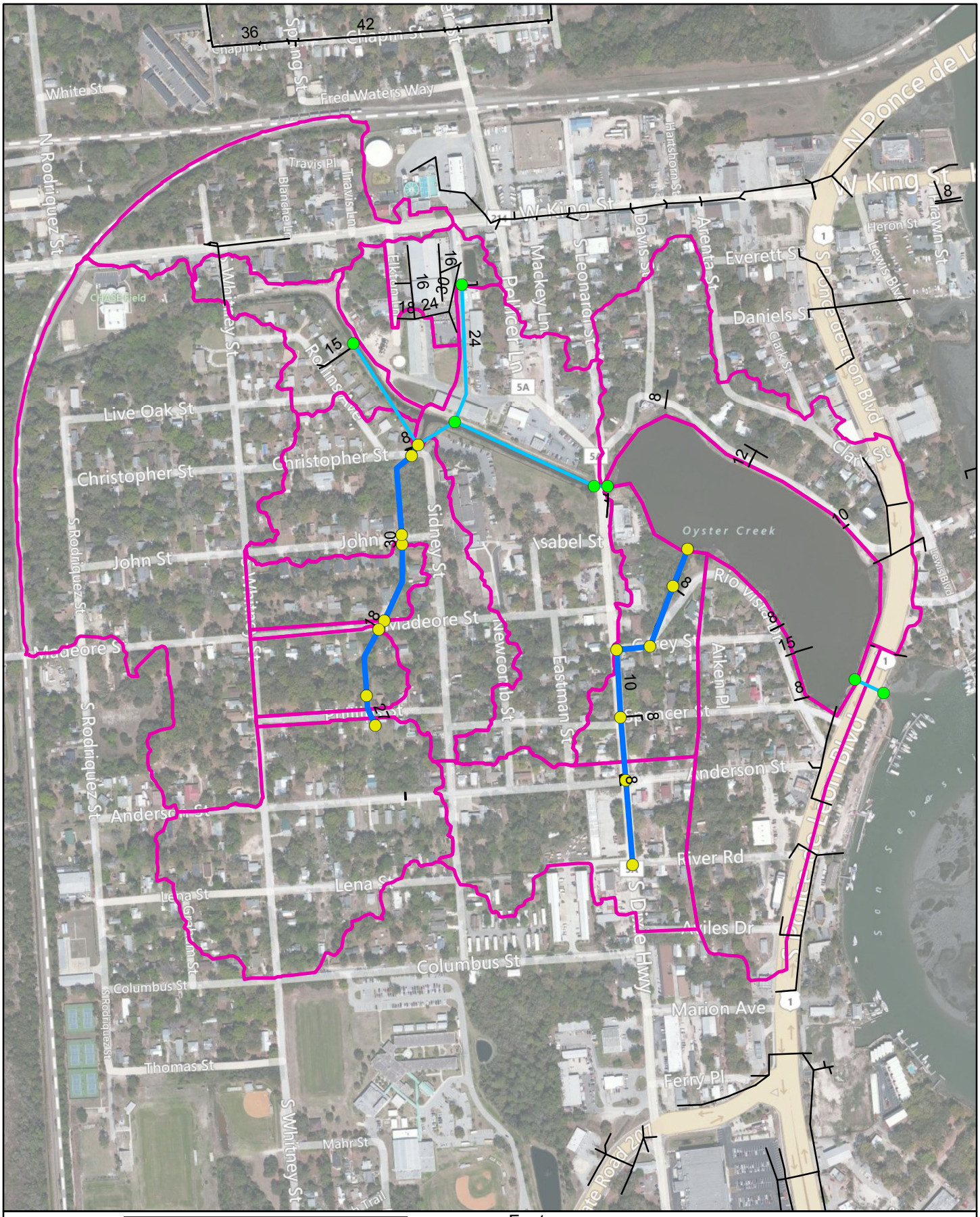


Figure 4-1
Oyster Creek Basin
City of St. Augustine SWMPU

4.2 Hydrologic & Hydraulic Model

4.2.1 Oyster Creek

The Oyster Creek sub-basin within the city limits contains 24 HUCs. The HUC IDs, loading nodes, and area for each HUC are provided in **Table 4-1**. The land use breakdown for the Oyster Creek sub-basin is presented in **Table 4-2**. The Soil type breakdown for the Oyster Creek Sub-basin is provided in **Table 4-3** as well as the hydrologic characteristics in **Table 4-4**. The pilot area model has been developed with 19 nodes and 23 links.

Table 4-1 Oyster Creek HUCs with Loading Node and Area

HUC ID	Loading Node	Area (Acres)
HUOC1000	MADI-OUTFA	3.0
HUOC1010	OYST-ROLLI	5.6
HUOC1020	DIXI-SPENC	22.3
HUOC1030	CARE-RIOVI	6.4
HUOC1040	OYST-ROLLI	12.4
HUOC1050	OYST-DIXDS	15.2
HUOC1060	OYST-PELLI	3.6
HUOC1070	PHIL-NORTH	39.3
HUOC1080	CHRI-SIDNE	2.6
HUOC1082	CHRI-SIDNE	4.4
HUOC1084	JOHN-NORTH	1.6
HUOC1086	SIDN-JO2OU	2.1
HUOC1088	MADE-NORTH	1.6
HUOC1090	JOHN-SOUTH	3.8
HUOC1092	MADE-NORTH	1.0
HUOC1094	SIDN-PH2MA	2.9
HUOC1096	PHIL-NORTH	1.8
HUOC1098	PHIL-NORTH	1.1
HUOC1100	OYST-PONCE	16.3
HUOC1110	MADE-SOUTH	3.0
HUOC1120	PHIL-SOUTH	18.1
HUOC1130	DIXI-ANDER	14.7
HUOC1140	SIDN-ANDER	15.5
HUOC1160	OYST-PONCE	12.8
Total		**211.2**

Table 4-2 Land Use Based Percentages in Oyster Creek

Land Use Category	Area (Acres)	Area (Percent)
Forest, Open & Park	2.5	1.2
Pasture	0.00	0.0
Agricultural	0.00	0.0
Low Density Residential	0.00	0.0
Medium Density Residential	155.8	73.8
High Density Residential	0.00	0.00
Light Industrial, Commercial & Institutional	19.8	9.4
Heavy Industrial & Roadways	20.9	9.9
Wetlands	0.00	0.00
Watercourses & Water bodies	12.2	5.8
Total	**211.2**	**100**

Table 4-3 Soil Group Breakdown for Oyster Creek

Hydrologic Soil Group (HSG)	Area (Acres)	Area (Percent)
A	182.6	86.5
B	0	0.0
C	0	0.0
D	28.6	13.5
Total	**211.2**	**100**

Table 4-4 HUC Hydrologic Characteristics for Oyster Creek

Land Use Category	Pervious, %	NDCIA, %	DCIA, %	DCIA, n	Pervious, n	DCIA, Ia	Pervious, Ia
HUOC1000	11.5	9.1	79.4	0.0150	0.1465	0.10	0.1839
HUOC1010	52.5	11.3	36.2	0.0150	0.2083	0.10	0.2234
HUOC1020	24.8	9.8	65.4	0.0150	0.1834	0.10	0.2075
HUOC1030	37.7	10.5	51.8	0.0150	0.1989	0.10	0.2174
HUOC1040	57.4	11.6	31.0	0.0150	0.2106	0.10	0.2248
HUOC1050	52.7	11.2	36.1	0.0153	0.2087	0.10	0.2236
HUOC1060	10.0	9.0	81.0	0.0150	0.1387	0.10	0.1789
HUOC1070	66.9	11.5	21.6	0.0150	0.2268	0.10	0.2280
HUOC1080	58.2	11.6	30.2	0.0150	0.2109	0.10	0.2250
HUOC1090	65.0	12.0	23.0	0.0150	0.2134	0.10	0.2266
HUOC1100	57.2	11.5	31.4	0.0153	0.2107	0.10	0.2249
HUOC1110	65.0	12.0	23.0	0.0150	0.2134	0.10	0.2266
HUOC1120	64.9	12.0	23.1	0.0150	0.2133	0.10	0.2266
HUOC1130	57.3	11.6	31.1	0.0150	0.2105	0.10	0.2248
HUOC1140	59.3	11.7	29.0	0.0150	0.2113	0.10	0.2253

4.2.2 Maria Sanchez Lake

The Maria Sanchez model area sub-basin within the City limits contains 13 HUCs. The HUC IDs, loading nodes, and area for each HUC are provided in **Table 4-5**. The land use breakdown for the Oyster Creek sub-basin is in **Table 4-6**. The Soil type breakdown for the Oyster Creek Sub-basin is provided in **Table 4-7** as well as the hydrologic characteristics provided in **Table 4-8**. The pilot area model has been developed with 19 nodes and 23 links.

Table 4-5 Maria Sanchez HUCs with Loading Node and Area

HUC ID	Loading Node	Area (Acres)
HUMZ1110A	GRAN-KI2CE	2.4
HUMZ1110B	CORD-KINGS	1
HUMZ1120A	GRAN-CEDAR	8.8
HUMZ1120B	CORD-K2BR1	3.7
HUMZ1130A	GRAN-DESOT	3.4
HUMZ1130B	CORD-K2BR2	3
HUMZ1140	CORD-BRIDG	4.6
HUMZ1150	BRID-GRANA	1.7
HUMZ1160	BRID-ONEID	5.4
HUMZ1180	CORD-BR2PA	6.5
HUMZ1260	MARI-SANCH	7.2
HUMZ1280	MARI-SANCH	9
HUMZ1290	MARI-SANCH	8.4
HUMZ1300	MARI-SANCH	8.3
HUMZ1310	MARI-SANCH	8.9
HUMZ1350	MARI-SANCH	2.9
HUMZ2350	CORD-KINGS	0.7
Total		**85.9**

Table 4-6 Land Use Based Percentages in Maria Sanchez

Land Use Category	Area (Acres)	Area (Percent)
Forest, Open & Park	0.00	0.00
Pasture	0.00	0.00
Agricultural	0.00	0.00
Low Density Residential	0.00	0.00
Medium Density Residential	0.00	0.00
High Density Residential	61.9	72.0
Light Industrial, Commercial & Institutional	23.2	27.0
Heavy Industrial & Roadways	0.6	0.7
Wetlands	0.0	0.00
Watercourses & Water bodies	0.3	0.3
Total	**85.9**	**100**

Table 4-7 Soil Group Breakdown for Maria Sanchez

Hydrologic Soil Group (HSG)	Area (Acres)	Area (Percent)
A	0	0
B	0	0
C	84.9	98.8
D	1.0	1.2
Total	**85.9**	**100**

Table 4-8 HUC Hydrologic Characteristics for Maria Sanchez

Land Use Category	Pervious, %	NDCIA, %	DCIA, %	DCIA, n	Pervious, n	DCIA, Ia	Pervious, Ia
HUMZ1110A	10	9	81	0.015	0.139	0.100	0.179
HUMZ1110B	10	9	81	0.015	0.139	0.100	0.179
HUMZ1120A	10	9	81	0.015	0.138	0.100	0.179
HUMZ1120B	12	12	76	0.015	0.136	0.100	0.177
HUMZ1130A	12	11	77	0.015	0.136	0.100	0.177
HUMZ1130B	15	15	69	0.015	0.134	0.100	0.176
HUMZ1140	15	15	71	0.015	0.134	0.100	0.176
HUMZ1150	13	13	74	0.015	0.135	0.100	0.177
HUMZ1160	18	18	65	0.015	0.133	0.100	0.175
HUMZ1180	15	15	70	0.015	0.134	0.100	0.176
HUMZ1260	17	17	65	0.015	0.133	0.100	0.175
HUMZ1280	17	17	66	0.015	0.133	0.100	0.175
HUMZ1290	17	17	65	0.015	0.133	0.100	0.175
HUMZ1300	17	17	65	0.015	0.133	0.100	0.175
HUMZ1310	17	17	65	0.015	0.133	0.100	0.175
HUMZ1350	17	17	66	0.015	0.133	0.100	0.175
HUMZ2350	10	9	81	0.015	0.139	0.100	0.179

4.3 Stormwater Improvements

4.3.1 Oyster Creek: Sidney Street

4.3.1.1 Sidney Street Existing Conditions

Based on the LOS established in Section 3 and the model generated for the existing conditions, the following locations fail to meet LOS.

- Local Roadways missing 5-year LOS:
  - Intersection of Sidney Street and Christopher Street (SIDN-OUTF2)
- Arterial/Collector Roads missing 50-year LOS:
  - None

- Structures missing the 100-year LOS:
  - None

There are several other areas of nuisance that are not represented in detail in the model, but that are of concern to the City.

- Roadway flooding at the ditch crossing on Phillips Street
- Roadway flooding at the ditch crossing on John Street
- Roadway flooding at the ditch crossing on Madeore Street
- Roadway flooding along Sidney Street

4.3.1.2 Sidney Street Proposed Improvements

CDM Smith proposed stormwater improvements that reduce the flood level along the locations that do not meet the LOS. The improvements were conceived by observing current permitting criteria set by the SJRWMD, such as:

- No flow increase is allowed at system outfalls
- No flood stage increase is allowed unless contained within the public right-of-way
- Retrofit areas are required to meet treatment requirements for stormwater quality goals

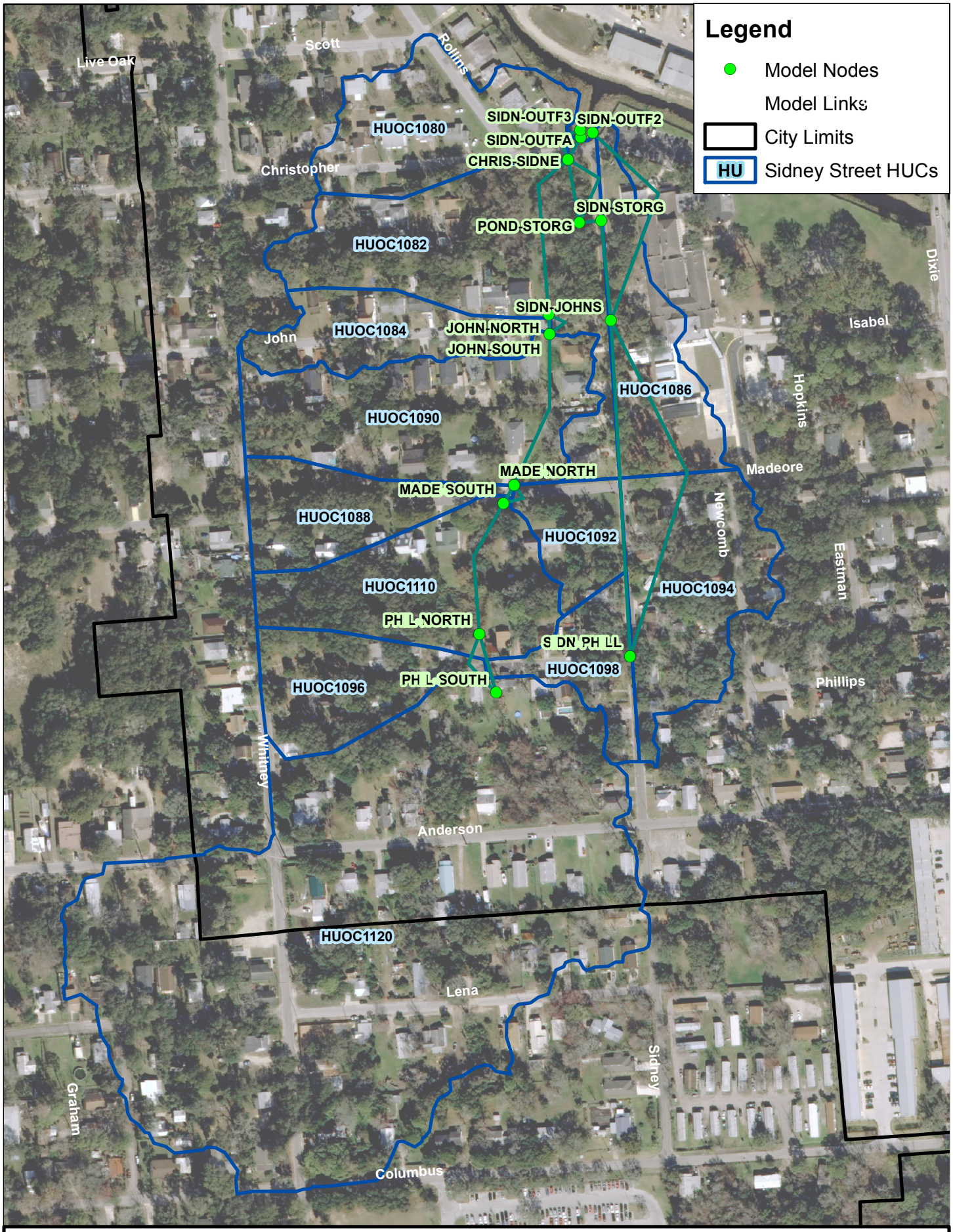
In order to develop the conceptual improvement, CDM Smith developed a SWMM 5.0 model for the Sidney outfall. The pilot area model schematic is shown on **Figure 4-3** and the location of the proposed improvements is shown on **Figure 4-4**.

- New 15-in collector along Sidney Street from Phillips to John St (Installed by minimal open trench cut)
- New 18-in collector along Sidney Street from John St to Pond Outfall (Installed by minimal open trench cut)
- Four Type 3 FDOT inlets (FDOT StormDrain Handbook, App. A) with a capacity of 4 CFS each
- Inlets flumes at ditch crossings at Phillips, Madeore, and John Streets
- Wet Detention Pond South of Christopher St (0.43 Acre)
- Control Structure with outfall to Ditch system just South of Christopher St

4.3.1.3 Sidney Street Improvement Benefits

As a result of the implementation of the proposed improvements, the following locations would meet the LOS.

- Local Roadways meeting 5-year LOS:
  - Intersection of Sidney Street and Christopher St (SIDN-OUTF2)



CDM Smith

Figure 4-3
Sidney St. Model Schematic
City of St. Augustine

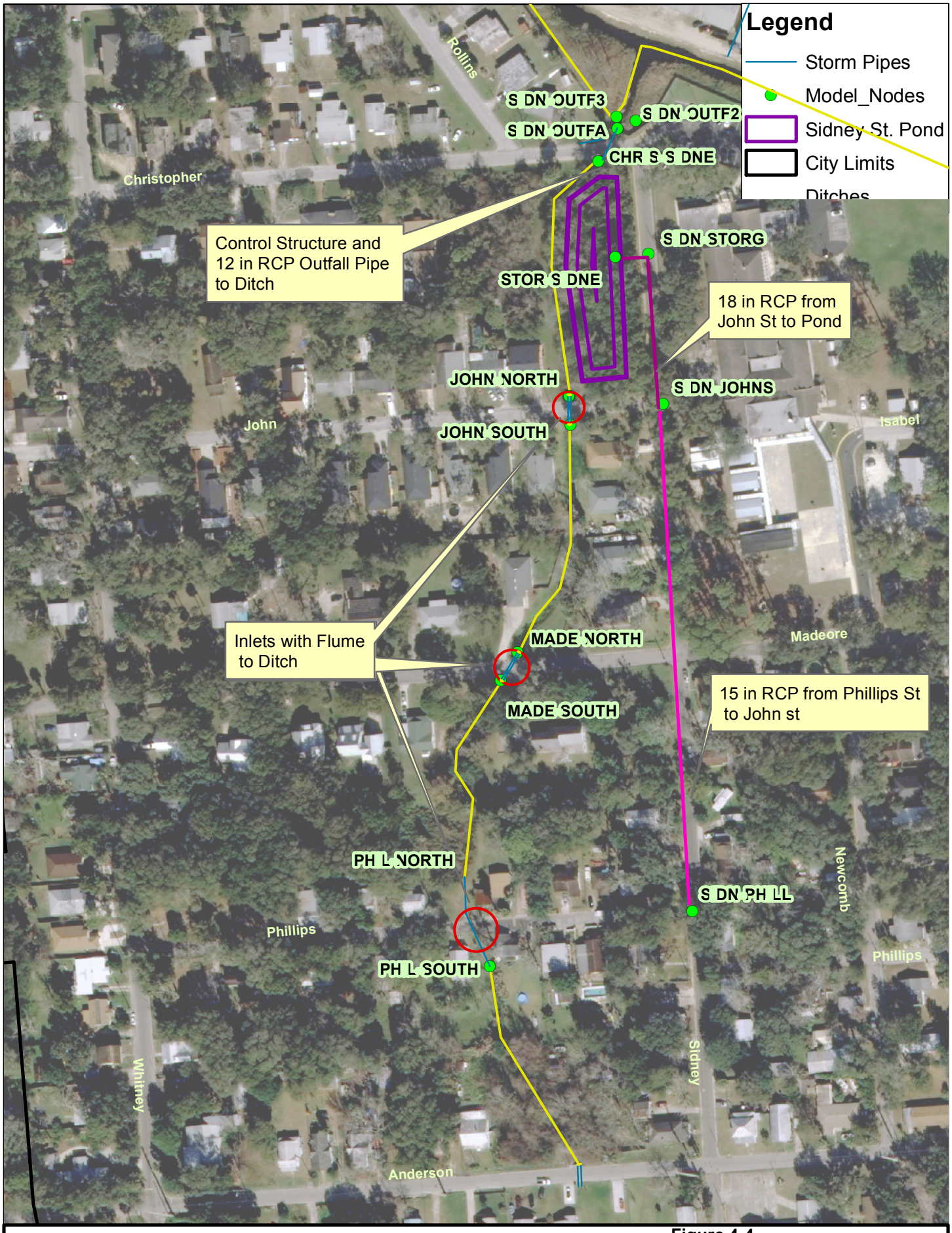


Figure 4-4
Sidney St, Priority Area
Proposed Improvements
City of St. Augustine

Table 4-9 has the comparison of peak flows between the pre- and post- conditions for this pilot area to show no increase in flows. The results confirm that the proposed configuration does not increase flows for any of the design storms. In **Table 4-10**, the comparison of the stages between pre- and post- shows no increase in stages at any location. **Table 4-11** shows that the required LOS is met for the proposed improvements.

4.3.1.4 Sidney Street Conceptual Cost Estimate

Cost for implementation of Sidney Street Improvements is estimated at $360,000, assuming the minimal cut construction method. A cost table of the proposed improvement plan is located in Appendix C as **Table C-1**. Alternative construction method costs can also be viewed in Appendix C.

4.3.1.5 Sidney Street Recommendations

- Pending completion of the St. Johns County Stormwater Management Plan, the City could consider off-site flows beyond the city limits to identify potential improvements along the Whitney St corridor.
- CDM Smith is including treatment and attenuation to meet current district regulations. It is possible to reduce or eliminate such permitting components of the project by establishing no adverse impact at the regional level for Oyster Creek. It is therefore necessary to wait for completion of the St. Johns County Stormwater Management Plan to complete such a regional evaluation.

4.3.2 Oyster Creek: South Dixie Highway

4.3.2.1 South Dixie Highway Existing Conditions

Based on the LOS established in Section 3 and the model generated for the existing conditions, the following locations fail to meet LOS.

- Local Roadways missing 5-year LOS:
  - Intersection of South Dixie and River Drive (DIXI-RIVER)
  - Intersection of South Dixie and Anderson Street (DIXI-ANDER)
  - Intersection of South Dixie and Carey Street (DIXI-CAREY)
  - Intersection of Carey Street and Rio Vista Drive (CARE-RIOVI)
- Arterial/Collector Roads missing 50-year LOS:
  - None
- Structures missing the 100-year LOS:
  - None

Table 4-11 Sidney Street Pilot Area Level of Service Flood Depths

			1 _ in/ 2 - hr				Mean Annual				5 Year				10 Year			
			Pre		Post		Pre		Post		Pre		Post		Pre		Post	
Junction	Location	Road Type	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?
PHIL-SOUTH	US of culvert crossing Phillips St	Local	-3.9	Yes	-3.9	Yes	-3.0	Yes	-3.0	Yes	-2.7	Yes	-2.7	Yes	-1.3	Yes	-1.3	Yes
PHIL-NORTH	DS of culvert crossing Phillips St	Local	-5.2	Yes	-5.2	Yes	-4.9	Yes	-4.9	Yes	-4.9	Yes	-4.9	Yes	-4.7	Yes	-4.7	Yes
MADE-SOUTH	US of culvert crossing Madeore St	Local	-2.6	Yes	-2.6	Yes	-2.1	Yes	-2.1	Yes	-1.3	Yes	-1.3	Yes	-0.2	Yes	-0.2	Yes
MADE-NORTH	DS of culvert crossing Madeore St	Local	-3.4	Yes	-3.4	Yes	-2.7	Yes	-2.7	Yes	-2.5	Yes	-2.5	Yes	-2.2	Yes	-2.2	Yes
JOHN-SOUTH	US of culvert crossing John St	Local	-4.3	Yes	-4.3	Yes	-2.5	Yes	-2.5	Yes	-2.0	Yes	-2.0	Yes	-1.4	Yes	-1.4	Yes
JOHN-NORTH	DS of culvert crossing John St	Local	-5.2	Yes	-5.2	Yes	-4.4	Yes	-4.4	Yes	-3.9	Yes	-3.9	Yes	-3.2	Yes	-3.2	Yes
CHRI-SIDNE	US of culvert crossing Christopher St	Local	-3.1	Yes	-3.1	Yes	-1.8	Yes	-1.8	Yes	-1.3	Yes	-1.3	Yes	-0.6	Yes	-0.6	Yes
SIDN-OUTF3	Outfall at Christopher St & Sidney St	Local	-3.6	Yes	-3.6	Yes	-3.4	Yes	-3.4	Yes	-3.4	Yes	-3.4	Yes	-3.4	Yes	-3.4	Yes
SIDN-OUTFA	Outfall at Christopher St & Sidney St	Local	-3.6	Yes	-3.6	Yes	-3.4	Yes	-3.4	Yes	-3.4	Yes	-3.4	Yes	-3.4	Yes	-3.4	Yes
SIDN-PHILL	Intersection of Sidney St & Phillips St	Local	0.2	Yes	-3.1	Yes	0.3	Yes	0.1	Yes	0.4	Yes	0.3	Yes	0.4	Yes	0.4	Yes
SIDN-JOHNS	Intersection of Sidney St & John St	Local	0.0	Yes	-2.0	Yes	0.3	Yes	0.0	Yes	0.3	Yes	0.2	Yes	0.4	Yes	0.3	Yes
SIDN-STORG	Between John St & Christopher St.	Local	-	NA	-2.2	Yes	-	NA	-0.9	Yes	-	NA	-0.9	Yes	-	NA	-0.4	Yes
POND-STORG	Sidney Street Pond	Local	-	NA	-3.6	Yes	-	NA	-0.9	Yes	-	NA	-0.9	Yes	-	NA	-0.7	Yes
SIDN-OUTF2	Outfall at Christopher St & Sidney St	Local	0.3	Yes	-0.3	Yes	0.5	Yes	-0.1	Yes	0.6	No	0.1	Yes	0.7	No	0.3	Yes

			25 Year				50 Year				100 Year			
			Pre		Post		Pre		Post		Pre		Post	
Junction	Location	Road Type	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?
PHIL-SOUTH	US of culvert crossing Phillips St	Local	-0.1	Yes	-0.1	Yes	0.1	Yes	0.1	Yes	0.2	Yes	0.2	Yes
PHIL-NORTH	DS of culvert crossing Phillips St	Local	-4.6	Yes	-4.6	Yes	-4.5	Yes	-4.5	Yes	-4.4	Yes	-4.4	Yes
MADE-SOUTH	US of culvert crossing Madeore St	Local	0.6	No	0.6	No	0.8	No	0.8	No	0.9	No	0.9	No
MADE-NORTH	DS of culvert crossing Madeore St	Local	-1.9	Yes	-1.9	Yes	-1.0	Yes	-1.0	Yes	-0.4	Yes	-0.4	Yes
JOHN-SOUTH	US of culvert crossing John St	Local	-0.9	Yes	-0.9	Yes	0.4	Yes	0.4	Yes	1.0	No	1.0	No
JOHN-NORTH	DS of culvert crossing John St	Local	-2.3	Yes	-2.3	Yes	-1.8	Yes	-1.8	Yes	-1.7	Yes	-1.7	Yes
CHRI-SIDNE	US of culvert crossing Christopher St	Local	0.3	Yes	0.3	Yes	0.8	No	0.8	No	0.9	No	0.9	No
SIDN-OUTF3	Outfall at Christopher St & Sidney St	Local	-3.4	Yes	-3.4	Yes	-3.4	Yes	-3.4	Yes	-3.4	Yes	-3.4	Yes
SIDN-OUTFA	Outfall at Christopher St & Sidney St	Local	-3.4	Yes	-3.4	Yes	-3.4	Yes	-3.4	Yes	-3.4	Yes	-3.4	Yes
SIDN-PHILL	Intersection of Sidney St & Phillips St	Local	0.5	Yes	0.4	Yes	0.5	Yes	0.4	Yes	0.5	Yes	0.5	Yes
SIDN-JOHNS	Intersection of Sidney St & John St	Local	0.5	Yes	0.4	Yes	0.5	No	0.4	Yes	0.5	No	0.4	Yes
SIDN-STORG	Between John St & Christopher St.	Local	-	NA	-2.2	Yes	-	NA	-0.9	Yes	-	NA	-0.9	Yes
POND-STORG	Sidney Street Pond	Local	-	NA	-3.6	Yes	-	NA	-0.9	Yes	-	NA	-0.9	Yes
SIDN-OUTF2	Outfall at Christopher St & Sidney St	Local	0.7	No	0.3	Yes	0.7	No	0.4	Yes	0.7	No	0.4	Yes

1. Passable roads- A depth of 6 inches is considered safe for vehicle traffic

Table 4-10 Sidney Street Pilot Area Peak Stage Table

				1 _ in/ 2 - hr			Mean Annual			5 - year			10 - year		
Junction	Location	Road Type	Road Elevation	Pre	Post	Δ (ft)	Pre	Post	Δ (ft)	Pre	Post	Δ (ft)	Pre	Post	Δ (ft)
PHIL-SOUTH	US of culvert crossing Phillips St	Local	15.2	11.3	11.3	0.0	12.2	12.2	0.0	12.5	12.5	0.0	13.9	13.9	0.0
PHIL-NORTH	DS of culvert crossing Phillips St	Local	15.2	10.0	10.0	0.0	10.3	10.3	0.0	10.4	10.4	0.0	10.5	10.5	0.0
MADE-SOUTH	US of culvert crossing Madeore St	Local	9.5	6.9	6.9	0.0	7.4	7.4	0.0	8.2	8.2	0.0	9.3	9.3	0.0
MADE-NORTH	DS of culvert crossing Madeore St	Local	9.5	6.1	6.1	0.0	6.9	6.9	0.0	7.0	7.0	0.0	7.3	7.3	0.0
JOHN-SOUTH	US of culvert crossing John St	Local	8.0	3.7	3.7	0.0	5.5	5.5	0.0	6.1	6.1	0.0	6.6	6.6	0.0
JOHN-NORTH	DS of culvert crossing John St	Local	8.0	2.8	2.8	0.0	3.7	3.7	0.0	4.1	4.1	0.0	4.8	4.8	0.0
CHRI-SIDNE	US of culvert crossing Christopher St	Local	5.4	2.3	2.3	0.0	3.6	3.6	0.0	4.1	4.1	0.0	4.8	4.8	0.0
SIDN-OUTF3	Outfall at Christopher St & Sidney St	Local	5.6	2.0	2.0	0.0	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0
SIDN-OUTFA	Outfall at Christopher St & Sidney St	Local	5.6	2.0	2.0	0.0	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0
SIDN-PHILL	Intersection of Sidney St & Phillips St	Local	12.0	12.2	8.9	-3.2	12.3	12.1	-0.1	12.4	12.3	-0.1	12.4	12.4	0.0
SIDN-JOHNS	Intersection of Sidney St & John St	Local	7.3	7.4	5.3	-2.1	7.6	7.3	-0.3	7.6	7.5	-0.1	7.7	7.6	-0.1
SIDN-STORG	Between John St & Christopher St.	Local	6.5	-	4.3	0.0	-	5.6	0.0	-	5.6	0.0	-	6.1	0.0
POND-STORG	Sidney Street Pond	Local	6.5	-	2.9	0.0	-	5.6	0.0	-	5.6	0.0	-	5.8	0.0
SIDN-OUTF2	Outfall at Christopher St & Sidney St	Local	5.8	6.1	5.5	-0.6	6.3	5.7	-0.5	6.4	5.9	-0.4	6.5	6.1	-0.4

				25 - year			50 - year			100 - year		
Junction	Location	Road Type	Road Elevation	Pre	Post	Δ (ft)	Pre	Post	Δ (ft)	Pre	Post	Δ (ft)
PHIL-SOUTH	US of culvert crossing Phillips St	Local	15.2	15.1	15.1	0.0	15.3	15.3	0.0	15.4	15.4	0.0
PHIL-NORTH	DS of culvert crossing Phillips St	Local	15.2	10.6	10.6	0.0	10.7	10.7	0.0	10.8	10.8	0.0
MADE-SOUTH	US of culvert crossing Madeore St	Local	9.5	10.1	10.1	0.0	10.3	10.3	0.0	10.4	10.4	0.0
MADE-NORTH	DS of culvert crossing Madeore St	Local	9.5	7.6	7.6	0.0	8.5	8.5	0.0	9.1	9.1	0.0
JOHN-SOUTH	US of culvert crossing John St	Local	8.0	7.1	7.1	0.0	8.5	8.5	0.0	9.0	9.0	0.0
JOHN-NORTH	DS of culvert crossing John St	Local	8.0	5.7	5.7	0.0	6.2	6.2	0.0	6.3	6.3	0.0
CHRI-SIDNE	US of culvert crossing Christopher St	Local	5.4	5.7	5.7	0.0	6.2	6.2	0.0	6.3	6.3	0.0
SIDN-OUTF3	Outfall at Christopher St & Sidney St	Local	5.6	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0
SIDN-OUTFA	Outfall at Christopher St & Sidney St	Local	5.6	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0
SIDN-PHILL	Intersection of Sidney St & Phillips St	Local	12.0	12.5	12.4	0.0	12.5	12.5	0.0	12.5	12.5	0.0
SIDN-JOHNS	Intersection of Sidney St & John St	Local	7.3	7.8	7.7	-0.1	7.8	7.7	-0.1	7.8	7.7	-0.1
SIDN-STORG	Between John St & Christopher St.	Local	6.5	-	4.3	0.0	-	5.6	0.0	-	5.6	0.0
POND-STORG	Sidney Street Pond	Local	6.5	-	2.9	0.0	-	5.6	0.0	-	5.6	0.0
SIDN-OUTF2	Outfall at Christopher St & Sidney St	Local	5.8	6.5	6.1	-0.4	6.5	6.2	-0.4	6.5	6.2	-0.3

Note: Green indicates the greatest benefit in each individual design storm

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Table 4-9 Sidney Street Pilot Area Outfall Peak Flow Table (Flows in CFS)

		1 _ in/ 2 - hr			Mean Annual			5 - year			10 - year		
Links	**Location**	**Pre**	**Post**	**Δ (cfs)**	**Pre**	**Post**	**Δ (cfs)**	**Pre**	**Post**	**Δ (cfs)**	**Pre**	**Post**	**Δ (cfs)**
CHRI-SIDNE-S	DS Christopher St.; Outfall into Oyster Creek	20	20	0	47	47	0	53	53	0	63	63	0
CHRI-SIDNE-O	Christopher St. Overflow into Oyster Creek	0	0	0	0	0	0	0	0	0	0	0	0
SIDN-JOHNS (-O)	Sidney St. overflow into Oyster Creek	3	0	-3	14	3	-11	21	10	-11	32	22	-9
Total		23	20	**-3**	61	50	**-11**	74	63	**-11**	95	86	**-9**

		25 - year			50 - year			100 - year		
Links	**Location**	**Pre**	**Post**	**Δ (cfs)**	**Pre**	**Post**	**Δ (cfs)**	**Pre**	**Post**	**Δ (cfs)**
CHRI-SIDNE-S	Outfall into Oyster Creek	73	73	0	78	78	0	79	79	0
CHRI-SIDNE-O	Christopher St. Overflow into Oyster Creek	0	0	0	63	62	-2	114	114	0
SIDN-JOHNS (-O)	Sidney St. overflow into Oyster Creek	38	29	-8	45	36	-8	46	39	-7
Total		111	103	**-8**	186	176	**-10**	239	231	**-8**

Note: US - Upstream location

DS - Downstream location

4.3.2.2 South Dixie Highway Proposed Improvements

In order to meet the LOS permitting requirements (i.e., no increased flows, no increased stage, and treatment requirements), the following improvements have been proposed. The pilot area model schematic is shown on **Figure 4-5** and the location of the proposed improvements is on **Figure 4-6**.

- New 18-in collector along South Dixie Highway from River Drive to Anderson Street
- Upsized 10-in collector to 30-in collector along South Dixie Highway from Anderson Street to Spencer
- Upsized 10-in collector to 30-in collector along South Dixie Highway from Spencer Street to Carey St
- Upsized 10-in collector to 30-in collector along Carey Street from South Dixie Highway to Rio Vista Drive
- Upsize 10-in collector to 36-in collector along Rio Vista Drive to the pond outfall
- Upsize 8 inlets to Type 3 FDOT inlets and install 4 additional inlets (FDOT StormDrain Handbook, App. A) with a capacity of 4 CFS each
- Wet Detention Pond South of Oyster Creek Pond (0.35 Acre)
- Control Structure with outfall to Ditch system just South of Oyster Creek Pond
- First flush collectors around inlets to collect sediment from coquina driveways along South Dixie Highway

4.3.2.3 South Dixie Highway Benefits

As a result of the implementation of the proposed improvements, the following locations would meet the LOS.

- Local Roadways Meeting 5-year LOS:
  - Intersection of South Dixie and River Drive (DIXI-RIVER)
  - Intersection of South Dixie and Anderson Street (DIXI-ANDER)
  - Intersection of South Dixie and Carey Street (DIXI-CAREY)
  - Intersection of Carey and Rio Vista Dr (CARE-RIOVI)

Table 4-12 shows the comparison of flows between the pre- and post- conditions for this pilot area. The results confirm that the proposed configuration does not increase flows for any of the design storms. In **Table 4-13**, the comparison of the stages between pre- and post- shows no increase in stages at any location. **Table 4-14** shows that the required LOS is met for the proposed improvements.

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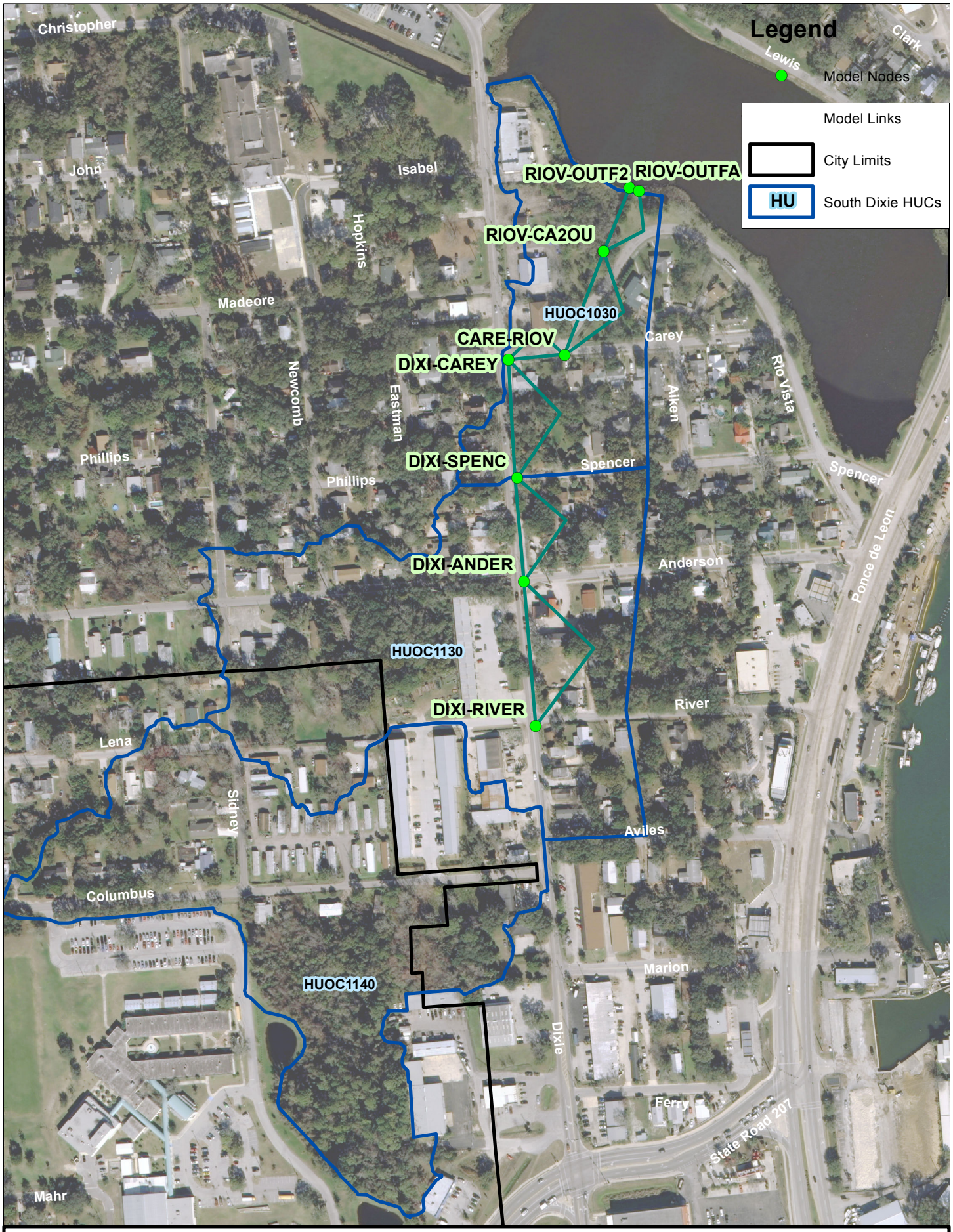
Figure 4-6
South Dixie Hwy Pilot Area
Proposed Improvements
City of St. Augustine



CDM Smith

0 80 160 320 Feet

Figure 4-5
South Dixie Model Schematic
City of St. Augustine

Table 4-14 South Dixie Highway Pilot Area Level of Service Flood Depths

			1 - in/ 2 - hr				Mean Annual				5 Year				10 Year			
			Pre		Post		Pre		Post		Pre		Post		Pre		Post	
Junction	Location	Road Type	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?
DIXI-RIVER	Intersection of S Dixie & River	Local	0.4	Yes	-5.9	Yes	0.5	Yes	0.3	Yes	0.5	No	0.4	Yes	0.6	No	0.5	No
DIXI-ANDER	Intersection of S Dixie & Anderson	Local	0.5	Yes	-5.7	Yes	0.7	No	-1.8	Yes	0.8	No	0.0	Yes	0.9	No	0.7	No
DIXI-SPENC	Intersection of S Dixie & Spencer	Local	0.3	Yes	-6.8	Yes	0.4	Yes	-3.3	Yes	0.4	Yes	-2.3	Yes	0.5	Yes	-1.2	Yes
DIXI-CAREY	Intersection of S Dixie & Carey	Local	0.4	Yes	-2.6	Yes	0.6	No	0.3	Yes	0.7	No	0.4	Yes	0.9	No	0.6	No
CARE-RIOVI	Intersection of Carey & Rio Vista	Local	0.3	Yes	-2.2	Yes	0.5	No	0.2	Yes	0.6	No	0.3	Yes	0.7	No	0.4	Yes
RIOV-CA2OU	Inlet along Rio Vista	Local	-0.8	Yes	-1.4	Yes	-0.6	Yes	-0.2	Yes	-0.6	Yes	-0.1	Yes	-0.5	Yes	0.0	Yes
RIOV-OUTFA	Outfall at Rio Vista	Local	-2.8	Yes	-2.8	Yes	-2.8	Yes	-2.8	Yes	-2.8	Yes	-2.8	Yes	-2.8	Yes	-2.8	Yes
RIOV-OUTF2	Outfall at Rio Vista	Local	-2.8	Yes	-2.8	Yes	-2.6	Yes	-2.8	Yes	-2.6	Yes	-2.8	Yes	-2.5	Yes	-2.8	Yes

			25 Year				50 Year				100 Year			
			Pre		Post		Pre		Post		Pre		Post	
Junction	Location	Road Type	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?
DIXI-RIVER	Intersection of S Dixie & River	Local	0.6	No	0.6	No	0.7	No	0.6	No	0.7	No	0.6	No
DIXI-ANDER	Intersection of S Dixie & Anderson	Local	1.0	No	1.0	No	1.2	No	1.2	No	1.3	No	1.3	No
DIXI-SPENC	Intersection of S Dixie & Spencer	Local	0.5	No	-0.1	Yes	0.6	No	0.4	Yes	0.7	No	0.4	Yes
DIXI-CAREY	Intersection of S Dixie & Carey	Local	0.9	No	0.6	No	1.0	No	0.8	No	1.1	No	0.8	No
CARE-RIOVI	Intersection of Carey & Rio Vista	Local	0.7	No	0.4	Yes	0.8	No	0.5	Yes	0.9	No	0.6	No
RIOV-CA2OU	Inlet along Rio Vista	Local	-0.4	Yes	0.0	Yes	-0.3	Yes	0.2	Yes	-0.3	Yes	0.4	Yes
RIOV-OUTFA	Outfall at Rio Vista	Local	-2.8	Yes	-2.8	Yes	-2.8	Yes	-2.8	Yes	-2.8	Yes	-2.8	Yes
RIOV-OUTF2	Outfall at Rio Vista	Local	-2.4	Yes	-2.8	Yes	-2.3	Yes	-2.8	Yes	-2.3	Yes	-2.8	Yes

1. Passable roads- A depth of 6 inches is considered safe for vehicle traffic

Table 4-13 South Dixie Highway Pilot Area Peak Stage Table

				1 - in/ 2 - hr			Mean Annual			5 - year			10 - year		
Junction	Location	Road Type	Road Elevation	Pre	Post	Δ (ft)	Pre	Post	Δ (ft)	Pre	Post	Δ (ft)	Pre	Post	Δ (ft)
DIXI-RIVER	Intersection of S Dixie & River	Local	15.0	15.3	9.1	-6.2	15.4	15.3	-0.1	15.5	15.4	-0.1	15.5	15.5	0.0
DIXI-ANDER	Intersection of S Dixie & Anderson	Local	12.6	13.1	7.0	-6.1	13.3	10.8	-2.5	13.4	12.6	-0.8	13.5	13.3	-0.2
DIXI-SPENC	Intersection of S Dixie & Spencer	Local	12.5	12.8	5.7	-7.1	12.9	9.2	-3.7	12.9	10.2	-2.8	13.0	11.3	-1.7
DIXI-CAREY	Intersection of S Dixie & Carey	Local	7.2	7.6	4.7	-3.0	7.9	7.5	-0.4	7.9	7.6	-0.3	8.1	7.8	-0.3
CARE-RIOVI	Intersection of Carey & Rio Vista	Local	6.8	7.1	4.7	-2.5	7.3	7.0	-0.4	7.4	7.1	-0.3	7.5	7.2	-0.3
RIOV-CA2OU	Inlet along Rio Vista	Local	6.0	5.2	4.7	-0.6	5.4	5.8	0.4	5.5	5.9	0.4	5.5	6.0	0.4
RIOV-OUTFA	Outfall at Rio Vista	Local	5.0	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0
RIOV-OUTF2	Outfall at Rio Vista	Local	5.0	2.2	2.2	0.0	2.4	2.2	-0.2	2.4	2.2	-0.2	2.5	2.2	-0.3

				25 - year			50 - year			100 - year		
Junction	Location	Road Type	Road Elevation	Pre	Post	Δ (ft)	Pre	Post	Δ (ft)	Pre	Post	Δ (ft)
DIXI-RIVER	Intersection of S Dixie & River	Local	15.0	15.6	15.5	-0.1	15.6	15.6	0.0	15.6	15.6	0.0
DIXI-ANDER	Intersection of S Dixie & Anderson	Local	12.6	13.6	13.6	0.0	13.8	13.8	0.0	13.9	13.9	0.0
DIXI-SPENC	Intersection of S Dixie & Spencer	Local	12.5	13.0	12.4	-0.6	13.1	12.9	-0.3	13.2	12.9	-0.2
DIXI-CAREY	Intersection of S Dixie & Carey	Local	7.2	8.1	7.9	-0.3	8.2	8.0	-0.3	8.3	8.0	-0.2
CARE-RIOVI	Intersection of Carey & Rio Vista	Local	6.8	7.5	7.2	-0.3	7.6	7.3	-0.3	7.7	7.4	-0.3
RIOV-CA2OU	Inlet along Rio Vista	Local	6.0	5.6	6.0	0.4	5.7	6.2	0.5	5.7	6.4	0.6
RIOV-OUTFA	Outfall at Rio Vista	Local	5.0	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0
RIOV-OUTF2	Outfall at Rio Vista	Local	5.0	2.6	2.2	-0.4	2.7	2.2	-0.5	2.7	2.2	-0.5

Note: Green indicates the greatest benefit in each individual design storm

Increase in stage at RIOV-CA2OU due to construction of pond

Table 4-12 South Dixie Highway Pilot Area Peak Flow Table (Flows in CFS)

		1 - in/ 2 - hr			Mean Annual			5 - year			10 - year		
Links	**Location**	**Pre**	**Post**	**Δ (cfs)**	**Pre**	**Post**	**Δ (cfs)**	**Pre**	**Post**	**Δ (cfs)**	**Pre**	**Post**	**Δ (cfs)**
RIOV-CA2OU-S	Pipeflow (Post: Pond Orifice)	4	0	-4	5	10	6	5	11	7	5	13	8
RIOV-CA2OU-O	Overland Flow (Post: Overflow Weir)	8	0	-8	37	31	-6	47	40	-7	69	53	-16
Total		13	0	**-13**	42	41	**-1**	51	51	**0**	74	66	**-8**

		25 - year			50 - year			100 - year		
Links	**Location**	**Pre**	**Post**	**Δ (cfs)**	**Pre**	**Post**	**Δ (cfs)**	**Pre**	**Post**	**Δ (cfs)**
RIOV-CA2OU-S	Pipeflow (Post: Pond Orifice)	5	14	9	5	15	10	5	16	11
RIOV-CA2OU-O	Overland Flow (Post: Overflow Weir)	91	64	-27	121	79	-42	140	93	-48
Total		96	78	**-18**	126	94	**-32**	145	108	**-37**

Note: US - Upstream location

DS - Downstream location

4.3.2.4 South Dixie Highway Conceptual Cost Estimate

- The City has released a public bid for the resurfacing of the South Dixie Highway Corridor between King Street and S.R. 207. This bid includes the stormwater recommendations proposed in this document. CDM Smith developed a cost estimate for the stormwater improvements and received feedback from the City staff to have the estimate include the ongoing design, which totals $2,891,000. A cost table of the proposed improvement plan is located in Appendix C as **Table C-2**. Appendix C also includes a cost estimate of the directional drilling option that only addresses the stormwater component.

4.3.2.5 South Dixie Highway Recommendations

- CDM Smith is including treatment and attenuation to meet current SJRWMD regulations. It is possible to reduce or eliminate such permitting components by establishing no adverse impact at the regional level for Oyster Creek. It is therefore necessary to wait for completion of the St. Johns County Stormwater Management Plan to finish such a regional evaluation.

4.3.3 Maria Sanchez Lake

4.3.3.1 Maria Sanchez Lake Previous Environmental Permits

As part of the pilot area evaluation, CDM Smith reviewed the current environment resource permits for the areas shown below:

Permit ID	Project Name
400-109-71134-1:	Maria Sanchez Lake Bank Stabilization
400-109-82626-1:	Maria Sanchez Stormwater Basin Improvements
400-109-82626-2:	Maria Sanchez Lake Shoreline Stabilization

4.3.3.2 Maria Sanchez Lake Existing Conditions

Due to the severity of the existing conditions of the Maria Sanchez Lake pilot area, it has been decided that the LOS in this pilot area should be lowered to the 2-year recurrence interval. The 2-year storm was not modeled; therefore, the mean annual (MA) storm, which was found to have a 2.3-year recurrence interval, was used. Based on this adjusted LOS, the model generated for the existing conditions reported that the following fail to meet LOS.

- Local Roadways missing MA LOS:
  - Granada Street South of King Street intersection (GRAN-KI2CE)
  - Intersection of Granada Street and Cedar Street (GRAN-CEDAR)
  - Cordova Street north of Bridge Street intersection (CORD-K2BR2)
  - Intersection of Granada Street and Desoto Place (GRAN-DESOT)
  - Intersection of Cordova Street and Bridge Street (CORD-BRIDG)
  - Intersection of Granada Street and Bridge Street (BRID-GRANA)
  - Cordova Street south of Bridge Street intersection (CORD-BR2PA)

- Arterial/Collector Roads missing 50-year LOS
  - None
- Structures missing the 100-year LOS:
  - None

4.3.3.3 Maria Sanchez Lake Deep Injection Well Feasibility Study

CDM Smith investigated the option to construct a stormwater deep injection well within the City limits of St. Augustine to address the flooding issues around Maria Sanchez Lake, Treasury Street, King Street, and St. George Street.

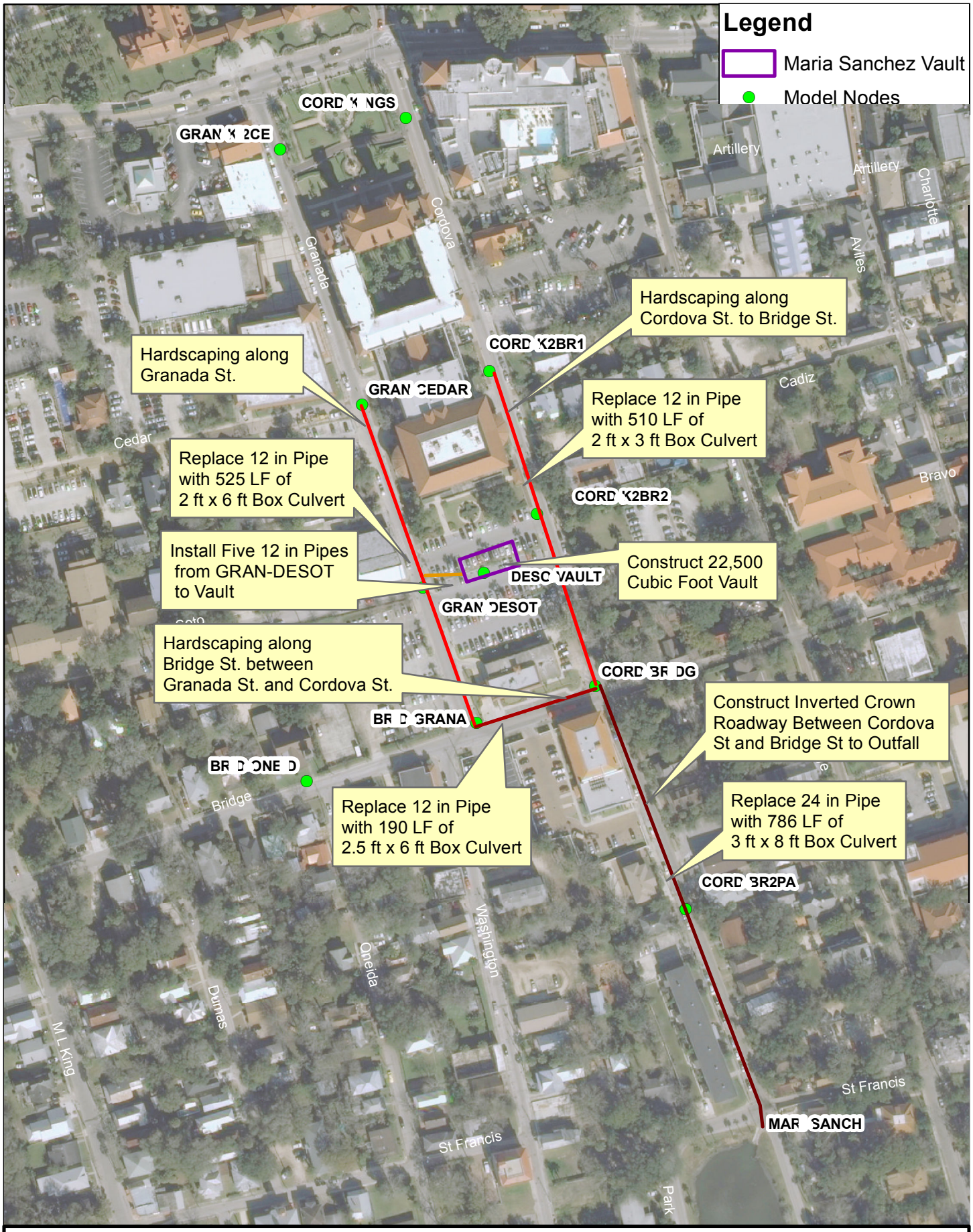
The project would first require that a pilot well be drilled for testing and water analysis. Some requirements for a pilot well are as follows:

- Well construction permit
- 8-in cased through Hawthorn Group 180- 250 ft below land surface (bls)
- Nominal 8-in borehole to 2,000 ft bls
- Up to 3 dual packer and up to 2 single packer tests with water quality sampling
- Static and dynamic geophysical logging
- Manage mud and drill cuttings
- Chanel drilling fluids to sanitary sewer or use close loop drilling system

Two wells may also be required for monitoring purposes. The conceptual cost for this project was estimated by a driller and geotechnical expert. For just the wells, the project is estimated to be between $1.0 and $2.0 million. FDEP permitting could require additional processes and costs.

4.3.3.4 Maria Sanchez Lake Proposed Improvements

CDM Smith considered several alternatives to alleviate flooding conditions, beginning with the evaluation of the proposed improvements developed in 2002 by the City. The original project included upsizing of the existing pipes along Cordova Street, Bridge Street, and Granada Street. CDM Smith estimated the benefits of this project and identified it as Alternative 1. Even though Alternative 1 increased conveyance capacity, the roads did not meet the desired level of service. The next effort was Alternative 2, which considered additional pipe upgrades in the collection system to provide additional storage and was concluded to be a nonviable alternative. Alternative 3 introduces underground storage to provide attenuation for the 5 year storm. Through a combination of conveyance, storage, and a drawdown pump, Alternative 3 meets the level of service. Finally Alternative 4 was the result of a reduction of the Alternative 3 to reduce cost and allow the City to meet the mean annual level of service. CDM Smith recommends the implementation of Alternative 4 outlined below. Appendix G includes additional details and results from Alternatives 1-3. The pilot area model schematic for Alternative 4 is shown on **Figure 4-7** and the location of the proposed improvements is shown on **Figure 4-8**.



CDM Smith

0 55 110 220 Feet

Figure 4-8
Maria Sanchez Lake
Alt 4 Improvements
City of St. Augustine

CDM Smith

Figure 4-7
Maria Sanchez Model Schematic
City of St. Augustine

- Upsized 12-in collector to a 2-ft x 6-ft box culvert along Granada Street from Cedar Street to Bridge Street
- Upsized 12-in collector to a 2.5-ft x 6-ft box culvert along Bridge Street from Granada Street to Cordova Street
- Upsized 12-in collector to a 2-ft x 3-ft box culvert along Cordova Street from CORD-K2BR1 to Bridge Street
- Upsized 24-in collector to a 3-ft x 8-ft box culvert along Cordova Street from Bridge Street to Maria Sanchez Lake
- Construct 22,500-cu-ft foot storage vault in parking lot south of City Hall

The vault shall be dry prior to the storm, and therefore shall include a drawdown pump of limited capacity to pump down its volume in a time frame of 48-96 hours after the storm. The structural calculations shall also consider buoyancy effect by providing necessary ballast, and anchoring.

- Add five 12-in pipes from intersection of Granada Street and Desoto Place to storage Vault
- Reconstruct roadway with inverted crown along Cordova Street south of Bridge Street
    - Such grading provides additional storage and promotes shallow flooding to the center line of the road, instead of the curb. The design speed for this road is 35 miles per hour, and has limited traffic for local residents only and therefore is a better candidate for such grading.

Other pilot area alternative considerations can be reviewed in **Appendix G.**

4.3.3.5 Maria Sanchez Lake Benefits

As a result of the implementation of the proposed improvements, the following locations would meet the LOS.

- Local Roadways Meeting MA LOS:
    - Granada Street South of King Street intersection (GRAN-KI2CE)
    - Cordova Street north of Bridge Street intersection (CORD-K2BR2)
    - Intersection of Granada Street and Desoto Place (GRAN-DESOT)
    - Intersection of Cordova Street and Bridge Street (CORD-BRIDG)
    - Intersection of Granada Street and Bridge Street (BRID-GRANA)
    - Cordova Street south of Bridge Street intersection (CORD-BR2PA)

Table 4-15 shows the comparison of flows between the pre- and post- conditions for this pilot area. The results confirm that the proposed configuration does not increase flows for any of the design storms. In **Table 4-16**, the comparison of the stages between pre- and post- shows no increase in stages at any location. **Table 4-17** shows that the required LOS is met for the proposed improvements.

Table 4-17 Maria Sanchez Lake Alternative 4 Level of Service Flood Depths

			1 - in/ 2 - hr				Mean Annual				5 Year				10 Year			
			Pre		Post		Pre		Post		Pre		Post		Pre		Post	
Junction	Location	Road Type	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?
GRAN-KI2CE	Granada St South of King St	Local	0.2	Yes	-0.1	Yes	0.6	No	0.5	Yes	0.6	No	0.5	Yes	0.8	No	0.6	No
CORD-KINGS	Cordova St South of King St	Local	0.3	Yes	-1.1	Yes	0.5	No	0.5	Yes	0.6	No	0.6	No	0.7	No	0.6	No
GRAN-CEDAR	Granada St at Cedar St intersection	Local	0.6	No	-1.3	Yes	1.0	No	0.5	Yes	1.1	No	0.8	No	1.3	No	1.0	No
CORD-K2BR1	Cordova St between King and Bridge	Local	0.4	Yes	-1.8	Yes	0.7	No	0.1	Yes	0.7	No	0.4	Yes	0.8	No	0.6	No
GRAN-DESOT	Granada St at Desoto Pl intersection	Local	0.6	No	-1.2	Yes	1.1	No	0.5	Yes	1.2	No	0.7	No	1.4	No	1.0	No
CORD-K2BR2	Cordova St between King and Bridge	Local	0.4	Yes	-1.5	Yes	0.7	No	0.1	Yes	0.8	No	0.4	Yes	0.9	No	0.7	No
CORD-BRIDG	Cordova St at Bridge St Intersection	Local	0.8	No	-1.0	Yes	1.3	No	0.4	Yes	1.4	No	0.7	No	1.5	No	1.1	No
BRID-GRANA	Bridge St at Granada St Intersection	Local	0.7	No	-1.1	Yes	1.2	No	0.5	Yes	1.3	No	0.8	No	1.5	No	1.1	No
BRID-ONEID	Bridge St at Oneida St Intersection	Local	0.2	Yes	0.1	Yes	0.5	Yes	0.5	Yes	0.5	No	0.5	No	0.6	No	0.6	No
CORD-BR2PA	Cordova St btwn Bridge St and Park Pl	Local	0.3	Yes	-1.2	Yes	0.8	No	0.0	Yes	0.9	No	0.3	Yes	1.0	No	0.5	No
MARI-SANCH	Maria Sanchez Lake	Local	-2.3	Yes	-2.2	Yes	-1.6	Yes	-1.5	Yes	-1.4	Yes	-1.3	Yes	-1.0	Yes	-0.8	Yes
SOUT-MARIA	Culvert	Local	-2.7	Yes	-2.7	Yes	-2.3	Yes	-2.3	Yes	-2.0	Yes	-2.0	Yes	-1.6	Yes	-1.6	Yes
SOUT-OUTFA	Maria Sanchez Outfall (South St)	Local	-1.8	Yes	-1.8	Yes	-1.8	Yes	-1.8	Yes	-1.8	Yes	-1.8	Yes	-1.8	Yes	-1.8	Yes
SOUT-OUTF2	Maria Sanchez Outfall (South St) 2	Local	-1.8	Yes	-1.8	Yes	-1.8	Yes	-1.8	Yes	-1.8	Yes	-1.8	Yes	-1.8	Yes	-1.8	Yes

			25 Year				50 Year				100 Year			
			Pre		Post		Pre		Post		Pre		Post	
Junction	Location	Road Type	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?	Flood Depth (ft)	Passable?
GRAN-KI2CE	Granada St South of King St	Local	1.0	No	0.6	No	1.0	No	0.7	No	1.0	No	0.7	No
CORD-KINGS	Cordova St South of King St	Local	0.7	No	0.7	No	0.7	No	0.7	No	0.8	No	0.7	No
GRAN-CEDAR	Granada St at Cedar St intersection	Local	1.4	No	1.1	No	1.5	No	1.2	No	1.5	No	1.2	No
CORD-K2BR1	Cordova St between King and Bridge	Local	0.8	No	0.7	No	0.8	No	0.8	No	0.9	No	0.8	No
GRAN-DESOT	Granada St at Desoto Pl intersection	Local	1.5	No	1.1	No	1.6	No	1.2	No	1.6	No	1.3	No
CORD-K2BR2	Cordova St between King and Bridge	Local	1.0	No	0.7	No	1.1	No	0.8	No	1.1	No	0.8	No
CORD-BRIDG	Cordova St at Bridge St Intersection	Local	1.6	No	1.2	No	1.7	No	1.3	No	1.7	No	1.4	No
BRID-GRANA	Bridge St at Granada St Intersection	Local	1.6	No	1.2	No	1.7	No	1.4	No	1.7	No	1.4	No
BRID-ONEID	Bridge St at Oneida St Intersection	Local	0.6	No	0.6	No	0.6	No	0.6	No	0.6	No	0.6	No
CORD-BR2PA	Cordova St btwn Bridge St and Park Pl	Local	1.1	No	0.7	No	1.2	No	0.8	No	1.2	No	0.9	No
MARI-SANCH	Maria Sanchez Lake	Local	-0.6	Yes	-0.5	Yes	-0.3	Yes	-0.2	Yes	-0.1	Yes	-0.1	Yes
SOUT-MARIA	Culvert	Local	-1.2	Yes	-1.2	Yes	-0.9	Yes	-0.9	Yes	-0.7	Yes	-0.8	Yes
SOUT-OUTFA	Maria Sanchez Outfall (South St)	Local	-1.8	Yes	-1.8	Yes	-1.8	Yes	-1.8	Yes	-1.8	Yes	-1.8	Yes
SOUT-OUTF2	Maria Sanchez Outfall (South St) 2	Local	-1.8	Yes	-1.8	Yes	-1.8	Yes	-1.8	Yes	-1.8	Yes	-1.8	Yes

1. Passable Roads - A depth of 6 inches that is considered safe for vehicle traffic

Table 4-16 Maria Sanchez Lake Alternative 4 Peak Stage Table

				1 - in/ 2 - hr			Mean Annual			5 - year			10 - year		
Junction	Location	Type	Road El.	Pre	Post	Δ (ft)	Pre	Post	Δ (ft)	Pre	Post	Δ (ft)	Pre	Post	Δ (ft)
GRAN-KI2CE	Granada St South of King St	Local	4.3	4.5	4.3	-0.3	4.9	4.8	-0.1	5.0	4.8	-0.1	5.1	4.9	-0.2
CORD-KINGS	Cordova St South of King St	Local	4.6	4.9	3.5	-1.4	5.1	5.1	0.0	5.2	5.2	0.0	5.3	5.2	0.0
GRAN-CEDAR	Granada St at Cedar St intersection	Local	3.9	4.5	2.6	-1.9	4.9	4.3	-0.5	5.0	4.6	-0.4	5.1	4.8	-0.3
CORD-K2BR1	Cordova St between King and Bridge	Local	4.4	4.8	2.6	-2.2	5.1	4.5	-0.6	5.1	4.8	-0.3	5.2	5.0	-0.2
GRAN-DESOT	Granada St at Desoto Pl intersection	Local	3.8	4.4	2.5	-1.9	4.8	4.2	-0.6	5.0	4.5	-0.5	5.1	4.7	-0.4
CORD-K2BR2	Cordova St between King and Bridge	Local	4.1	4.5	2.6	-1.9	4.8	4.2	-0.6	4.9	4.5	-0.4	5.0	4.8	-0.3
CORD-BRIDG	Cordova St at Bridge St Intersection	Local	3.5	4.3	2.5	-1.8	4.8	3.9	-0.9	4.9	4.2	-0.7	5.0	4.6	-0.5
BRID-GRANA	Bridge St at Granada St Intersection	Local	3.6	4.3	2.5	-1.8	4.8	4.1	-0.7	5.0	4.4	-0.6	5.1	4.7	-0.4
BRID-ONEID	Bridge St at Oneida St Intersection	Local	5.2	5.4	5.3	-0.1	5.7	5.7	0.0	5.7	5.7	0.0	5.8	5.8	0.0
CORD-BR2PA	Cordova St btwn Bridge St and Park Pl	Local	3.6	3.9	2.5	-1.4	4.5	3.6	-0.9	4.5	3.9	-0.7	4.7	4.1	-0.5
MARI-SANCH	Maria Sanchez Lake	Local	4.6	2.4	2.4	0.0	3.0	3.1	0.1	3.3	3.4	0.1	3.7	3.8	0.1
SOUT-MARIA	Culvert	Local	5.0	2.3	2.3	0.0	2.7	2.7	0.0	3.0	3.0	0.0	3.4	3.4	0.0
SOUT-OUTFA	Maria Sanchez Outfall (South St)	Local	4.0	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0
SOUT-OUTF2	Maria Sanchez Outfall (South St) 2	Local	4.0	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0

				25 - year			50 - year			100 - year		
Junction	Location	Type	Road El.	Pre	Post	Δ (ft)	Pre	Post	Δ (ft)	Pre	Post	Δ (ft)
GRAN-KI2CE	Granada St South of King St	Local	4.3	5.2	5.0	-0.3	5.3	5.0	-0.3	5.3	5.1	-0.3
CORD-KINGS	Cordova St South of King St	Local	4.6	5.3	5.3	0.0	5.3	5.3	0.0	5.4	5.3	0.0
GRAN-CEDAR	Granada St at Cedar St intersection	Local	3.8	5.2	4.9	-0.3	5.3	5.0	-0.3	5.3	5.1	-0.3
CORD-K2BR1	Cordova St between King and Bridge	Local	4.4	5.2	5.1	-0.1	5.2	5.2	-0.1	5.3	5.2	-0.1
GRAN-DESOT	Granada St at Desoto Pl intersection	Local	3.7	5.2	4.9	-0.4	5.3	5.0	-0.3	5.3	5.0	-0.3
CORD-K2BR2	Cordova St between King and Bridge	Local	4.1	5.1	4.8	-0.3	5.2	4.9	-0.3	5.2	4.9	-0.3
CORD-BRIDG	Cordova St at Bridge St Intersection	Local	3.5	5.1	4.7	-0.4	5.2	4.9	-0.3	5.2	4.9	-0.3
BRID-GRANA	Bridge St at Granada St Intersection	Local	3.6	5.2	4.8	-0.4	5.3	5.0	-0.3	5.3	5.0	-0.3
BRID-ONEID	Bridge St at Oneida St Intersection	Local	5.2	5.8	5.8	0.0	5.8	5.8	0.0	5.9	5.8	0.0
CORD-BR2PA	Cordova St btwn Bridge St and Park Pl	Local	3.6	4.7	4.3	-0.4	4.8	4.5	-0.3	4.8	4.6	-0.3
MARI-SANCH	Maria Sanchez Lake	Local	4.6	4.0	4.1	0.1	4.4	4.4	0.1	4.5	4.6	0.0
SOUT-MARIA	Culvert	Local	5.0	3.8	3.8	0.0	4.1	4.1	0.0	4.3	4.2	-0.1
SOUT-OUTFA	Maria Sanchez Outfall (South St)	Local	4.0	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0
SOUT-OUTF2	Maria Sanchez Outfall (South St) 2	Local	4.0	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0

Note: Green indicates the greatest benefit in each individual design storm
Increase in stage at MARI-SANCH is required to prevent increased flow downstream, More attenuation results from increased conveyance

Table 4-15 Maria Sanchez Lake Alternative 4 Peak Flow Table

		1 - in/ 2 - hr			Mean Annual			5 - year			10 - year		
Junction	**Location**	**Pre**	**Post**	**Δ (cfs)**	**Pre**	**Post**	**Δ (cfs)**	**Pre**	**Post**	**Δ (cfs)**	**Pre**	**Post**	**Δ (cfs)**
SOUT-MARIA-S	DS Culvert Under South Street	27	27	0	76	73	-2	91	89	-2	114	112	-3
SOUT-MARIA-O	South Street Overflow	0	0	0	0	0	0	0	0	0	0	0	0
Total		27	27	**0**	76	73	**-2**	91	89	**-2**	114	112	**-3**

		25 - year			50 - year			100 - year		
Junction	**Location**	**Pre**	**Post**	**Δ (cfs)**	**Pre**	**Post**	**Δ (cfs)**	**Pre**	**Post**	**Δ (cfs)**
SOUT-MARIA-S	DS Culvert Under South Street	134	130	-4	148	143	-6	155	148	-7
SOUT-MARIA-O	South Street Overflow	0	0	0	0	0	0	0	0	0
Total		134	130	**-4**	148	143	**-6**	155	148	**-7**

Note: US - Upstream location

DS - Downstream location

4.3.3.6 Maria Sanchez Lake Conceptual Cost Estimate

The cost for the implementation of Maria Sanchez Lake Improvement is estimated at $3.1 million. A cost table of the proposed improvement plan is located in Appendix C as **Table C-3**.

4.3.3.7 Potential Benefits to the Treasury Street Outfall

One of the potential aspects of the Maria Sanchez outfall improvement is to accommodate additional runoff volume from the Treasury Street outfall, which is located in the historic area north of Cathedral Plaza. The Treasury Street outfall drains 30.6 acres through an existing 48-inch outfall that connects to the FDOT collection system of Avenida Menendez. The constraints in terms of constructability and disturbance to the city businesses, makes it very unlikely to implement common solutions that will require excavations, closure of streets, relocation of utilities, and potential archaeological findings.

CDM Smith therefore considered the possibility of accommodating a fraction of the excess runoff from the Treasury outfall within the Maria Sanchez improvements. The evaluation consisted in estimating the volume of runoff that generates street ponding for different storm events, by using the citywide hydrologic model, and using the available pipe attributes from the data provided by the City. The results of the evaluation are listed below:

- Mean annual storm (5.2 in/24 hours)
  - Volume of flood: 35,000 cu-ft
  - Duration of flooding: 1.5 hrs
- 5 Year storm (6.3 in/24 hours)
  - Volume of flood: 65,000 cu-ft
  - Duration of flooding: 2.5 hrs

The magnitudes of the volumes confirm that the potential connection between the two outfalls would require significant upgrades to the proposed improvements for the Maria Sanchez Lake. In fact the proposed underground storage at the City parking between Cordova and Granada Streets is 22,500 cu-ft, which is smaller than the volume required for the mean annual storm shown above.

In the future when the City evaluates in greater detail the Treasury outfall, it may be possible to develop a solution that combines underground storage and conveyance upgrades to accommodate the volumes outlined above while also adding percent volume reduction by upsizing the outfall.

4.3.3.8 Maria Sanchez Lake Recommendations

The CDM Smith evaluation considered a tidal condition set at 2.2 ft NAVD, equivalent to the 1-year stillwater condition. This allows the system to better perform, and meet the level of service under high tide, but it can provide greater benefit during low tide conditions. Lowering the Maria Sanchez lake stage prior to anticipated storm events can increase the storage and attenuation and reduce upstream ponding.

CDM Smith explored other options such as the groundwater well, which has proven to be effective in other locations, but given the range of costs in the City of St. Augustine, CDM Smith does not recommend pursuing such an option at this time.

Section 5
Stormwater Utility Evaluation

The City established a stormwater fund and utility in 1994, based on guidance provided by a consultant in the same year. The utility has been a steady funding mechanism for both capital improvements and operational expenses, and it is structured as follows:

- Residential Equivalent Residential User (ERU) rate: $5.00/month
- Non-Residential ERU rate: $7.50/month
- 10 ERU non-residential cap (20,000 square feet)
- ERU base: 2,000 square feet
- Average yearly revenue: $750,000

The following sections evaluate the current utility rate structure as well as the potential adjustments to match the projected expenses.

5.1 Geocoding of Stormwater Utility Customers

Geocoding is the process of transforming a description of a location—such as a pair of coordinates, an address, or a name of a place—to a spatial point. Geocoding can be done manually by entering one location description at a time or by providing many of them at once in a table format. For the evaluation of the stormwater utility, CDM Smith geocoded the current database of customers by utilizing geocoding tools that allow multiple accounts to be processed in batches at the time. The resulting locations are output as geographic features with attributes, which can be used for mapping or spatial analysis.

The final result is a geodatabase in State Plane horizontal projection, in agreement with the other existing datasets provided for this project. There are a total of 7,119 customers included in the geodatabase distributed as follows:

- 5,742 customers were geocoded based on the data contained in the original database address attribute. The location of these customers was either an automatic placement, based on the existing attribute data, or the results of manual fixes for common typos, misspelling, or format issues.
- 1,848 customers had to be rectified manually based on information included in the original database, and the evaluation of aerials, parcel attributes, and professional judgment.
- 188 customers that cannot be identified based on the parcel shapefile. In all cases CDM Smith was able to locate them in the middle of the street, probably in front of the actual location. But the address itself cannot be found in the parcel coverage, or it is a duplicate and therefore needs to be verified.

- 1,070 condominium accounts. These customers were properly located within the potential parcel limits, but their location will have to be refined within the property.
- 115 non-residential customers that share similar addresses. They were placed properly within the parcel boundaries, but their location within the parcel should be verified in the field.

CDM Smith recommends that the City address the following issues to improve future geocoding, data management and appropriate location of utility customers:

1. The City has many addresses with fractional address numbers (for example 138½ Oneida Street South).
2. The address field includes information that should be kept in other fields such as "car wash" or "bakery." The address field should not include the description of the property.
3. In the case of apartments, condominiums, or businesses the address field should isolate the unit number in a separate field. For example "73 Orange Street Unit D." "Unit D" should not be included in the address field.
4. The current parcel database lacks addresses for some multifamily parcels. In this case all the customers associated with that polygon cannot be properly geocoded because the address field is empty in the parcel database.
5. Parcels IDs should be unique, and in many instances there are different sites with different polygons, but the same parcel ID.
6. In some instances the parcel was originally part of a greater parent parcel and kept the original address of the parent parcel. The new parcel might not even be located on the same street anymore, but carries over the previous street name.

5.1.1 Geocoding Results

The final geodatabase contains a total of 7,119 customers with a location. In addition to the breakdown shown above in terms of match type, CDM Smith identified one customer that seems to be located outside of the City limits (CACCOUNT_N 36493 - Point located on Gilbert Street).

For the purposes of evaluating revenue scenarios, the results of the current geocoding task are adequate for the potential consideration of districts with different level of service, as well as considerations for specific city neighborhoods. All customers were placed within the parcel limits, and in special cases in the vicinity of the closest address match type. The results of this evaluation will be the basis for potential consideration of differential rates based depending on location. Tables summarizing findings are included in **Appendix F**.

5.2 Stormwater Utility Rate Review

With utility account data received from the City in September 2011, CDM Smith identified those accounts that were considered to be commercial as indicated by a base rate of $7.50. A total of 2,570 billing units are associated with this category, which generates annual revenue of about $347,000 per year. From this data set, CDM Smith focused our review on those commercial accounts with a multiplier of 10 or greater. CDM Smith identified 146 accounts meeting these criteria to be reviewed.

Using the utility account's location address, CDM Smith cross referenced this address with addresses associated with the St Johns County Property Assessor's CAMA data obtained through the County's public FTP site. This allowed for the identification of the parcel(s) associated with the account address and the account itself. The locations can be found on **Figure 5-1**. The parcel identifying feature used is called the "strap."

Once the strap(s) was identified, CDM Smith performed a detailed analysis of the impervious area associated with the parcel(s). This was accomplished using ArcMap software consisting of parcel layer and aerial photography. In some cases, the density of the tree growth prevented a complete review of the impervious area footprint. The best estimate based upon existing information was used. Six accounts could not be linked to the associated parcel(s) based upon utility account addressing, and therefore were submitted to the City for further clarification. The City provided information for each of these parcels to further locate them.

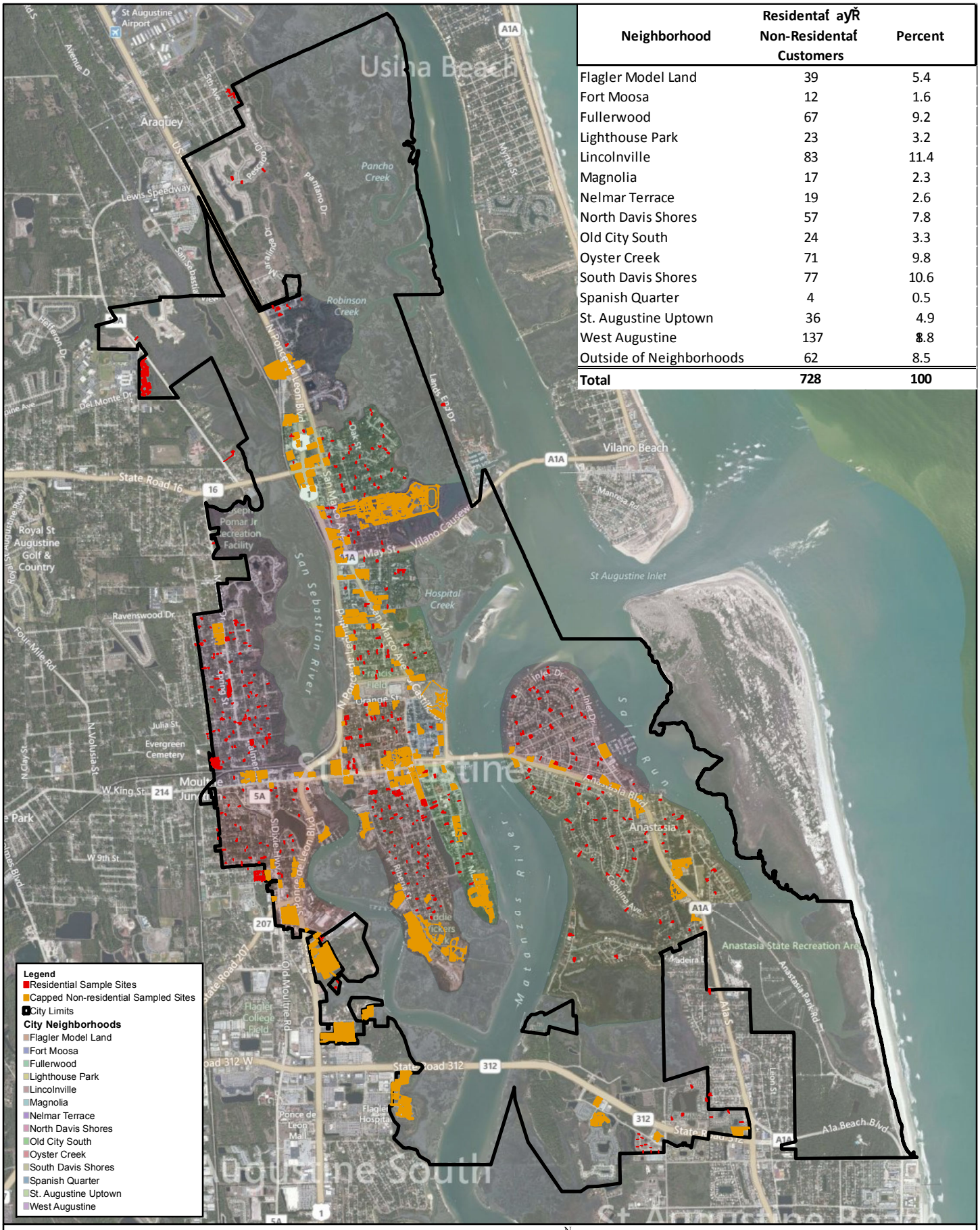
After the impervious areas were developed, the estimated ERU was calculated using the City's ERU base of 2,000 square feet. The monthly fee was then calculated using the City's $7.50/ERU rate.

CDM Smith combined all of the utility accounts that are associated with the same customer, which condensed the list from 146 accounts to 120 customers. **Table 5-1** shows the resulting summary of the 120 customers that include utility accounts with 10 ERU capped accounts along with associated accounts based upon customer name and address. For each customer, CDM Smith estimated the potential monthly charge without the 10 ERU cap, and compared it with the current monthly charge. The table shows the top non-residential customers ranked by the difference between the current and the potential charge if the 10 ERU cap is not considered.

As an example, the School of the Deaf and Blind currently has 2 accounts at 10 ERUs, 3 accounts at 9.93 ERUs, 1 account at 7.01 ERUs, 1 account at 1.01 ERUs, and 2 accounts at 1.00 ERU. This translates into a monthly fee of $448.60. For the same customer CDM Smith measured the actual impervious area, and considered the same basis for a stormwater utility fee: $7.5/month per ERU (2,000 sq. ft.). The estimated impervious area is about 1.265 million square feet, resulting in a potential fee of $4,745.92 per month. A similar evaluation was completed for each of the 146 accounts that make up the 120 customers shown in Table 5-1.

5.3 Residential Land Use Analysis

The following list is a summary of the approach used to conduct the residential land use analysis for the City. Using February 2012 CAMA Parcel Data from the St. Johns County's Property Appraiser's Office, CDM Smith produced a data set of parcels within the City. Once the parcel data set had been established, CDM Smith focused upon the Department of Revenue Land Use Codes, and parcel Strap Number.



Neighborhood	Residential / Non-Residential Customers	Percent
Flagler Model Land	39	5.4
Fort Moosa	12	1.6
Fullerwood	67	9.2
Lighthouse Park	23	3.2
Lincolnville	83	11.4
Magnolia	17	2.3
Nelmar Terrace	19	2.6
North Davis Shores	57	7.8
Old City South	24	3.3
Oyster Creek	71	9.8
South Davis Shores	77	10.6
Spanish Quarter	4	0.5
St. Augustine Uptown	36	4.9
West Augustine	137	18.8
Outside of Neighborhoods	62	8.5
Total	**728**	**100**

CDM Smith

0 0.25 0.5 1 Miles

N W E S

Figure 5-1
Stormwater Utility Sites Sampled
City of St. Augustine SWMPU

Table 5-1. List of Non Residential Customers with current charge of 10 ERUs

			Monthly Stormwater Utility Charge		
No	Customer Name	Reference Address	Current	Potential	Difference
1	D & B SCHOOL	207 SAN MARCO AVE	$ 448.60	$ 4,745.92	$ 4,297.32
2	W.J. DEVELOPMENT	400 RIBERIA ST	$ 75.00	$ 2,086.32	$ 2,011.32
3	TARGET	1440 US 1 SOUTH DOMESTIC METER	$ 75.00	$ 1,721.21	$ 1,646.21
4	THE HOME DEPOTC/O ACIS MS222	1750 US 1 SOUTH	$ 75.00	$ 1,486.79	$ 1,411.79
5	UNIVERSITY OF ST AUGUSTINE	1 UNIVERSITY BLVD	$ 75.00	$ 1,352.48	$ 1,277.48
6	FLAGER COLLEGE	65 VALENCIA ST	$ 835.66	$ 1,833.23	$ 997.57
7	WINN DIXIE #77	1010 PONCE DE LEON BLVD S	$ 75.00	$ 940.90	$ 865.90
8	WINN DIXIE #182	3551 PONCE DE LEON BLVD N	$ 75.00	$ 728.48	$ 653.48
9	ST JOHNS CO SCHOOL BOARD	125 MAGNOLIA DR	$ 75.00	$ 690.58	$ 615.58
10	SJC COUNCIL ON AGING INC	180 MARINE ST	$ 82.50	$ 623.33	$ 540.83
11	HOLIDAY INN	1300 PONCE DE LEON BLVD N	$ 75.00	$ 563.57	$ 488.57
12	CASTILLO DE SAN MARCOS NAT MON	1 CASTILLO DR S	$ 75.00	$ 546.11	$ 471.11
13	CITY OF ST AUGUSTINE	254 KING ST W WATER PLANT #1	$ 595.52	$ 1,044.17	$ 448.65
14	FISHERMEN'S HARBOR MARINA INC	150 RIBERIA ST	$ 75.00	$ 509.04	$ 434.04
15	OASIS BOAT YARD	256 RIBERIA ST	$ 82.50	$ 480.93	$ 398.43
16	WERNINCK, L	32 LOUISE ST	$ 75.00	$ 437.35	$ 362.35
17	THE ALLEGRO AT ST AUG LLC	1101 PLANTATION ISLAND DR S	$ 75.00	$ 421.31	$ 346.31
18	ST JOHNS CO SCHOOL BOARD	67 ORANGE ST	$ 75.00	$ 381.41	$ 306.41
19	ATLANTIC SELF STORAGE	1865 SR A1A	$ 75.00	$ 375.68	$ 300.68
20	ST AUGUSTINE HISTORICAL TOURS	167 SAN MARCO AVE	$ 75.00	$ 373.56	$ 298.56
21	TASTY WORLD RES	2800 PONCE DE LEON BLVD N	$ 75.00	$ 358.31	$ 283.31
22	ST JOHNS WELFARE FEDERATION	161 MARINE ST	$ 75.00	$ 356.97	$ 281.97
23	FAMILY DOLLAR INC STORE #03345	3501 PONCE DE LEON BLVD N UNIT M	$ 75.00	$ 356.75	$ 281.75
24	VACANT~36445	220 NIX BOATYARD RD	$ 75.00	$ 356.24	$ 281.24
25	MOHINI HOSPITALITY LLC	137 SAN MARCO AVE	$ 75.00	$ 353.83	$ 278.83
26	ALLIGATOR FARM	999 ANASTASIA BLVD	$ 75.00	$ 350.12	$ 275.12
27	THE VIEWS AT BAY POINTE CONDO	159 MARINE ST	$ 75.00	$ 332.79	$ 257.79
28	NATIONAL GUARD ARMORY	190 SAN MARCO AVE	$ 75.00	$ 326.26	$ 251.26
29	CONCH HOUSE BUILDERS II LLC	57 COMARES AVE	$ 91.35	$ 326.18	$ 234.83
30	TERRA FIRMA ASSETS	11 PALMER ST	$ 75.00	$ 294.52	$ 219.52
31	PONCE HOSPITALITY INC	1302 PONCE DE LEON BLVD N	$ 75.00	$ 290.65	$ 215.65
32	ALHAMBRA INN	2706 PONCE DE LEON BLVD N	$ 75.00	$ 285.03	$ 210.03
33	CVS CARE MARK #03591-02	2703 PONCE DE LEON BLVD N DOMESTIC	$ 75.00	$ 273.40	$ 198.40
34	CHARISMATIC ORTHODOZ CHURCH INTERN	110 MASTERS DR	$ 75.00	$ 260.56	$ 185.56
35	QUALITY INN	1111 PONCE DE LEON BLVD N	$ 75.00	$ 255.12	$ 180.12
36	JALARAM MOTELSINC	2050 PONCE DE LEON BLVD N	$ 75.00	$ 253.27	$ 178.27
37	RIPLEYS MUSEUM	19 SAN MARCO AVE	$ 75.00	$ 250.57	$ 175.57
38	US POST OFFICE	105 KING ST	$ 75.00	$ 216.62	$ 141.62
39	ORTHOPAEDIC ASSOC. OF ST AUGUSTINE P.	1 ORTHOPEDIC PL	$ 75.00	$ 206.89	$ 131.89
40	ST AUGUSTINE HISTORICAL TOURS INC	31 MCMILLAN ST	$ 75.00	$ 201.40	$ 126.40
41	STATE OF FLORIDA	189 MARINE ST	$ 75.00	$ 198.43	$ 123.43
42	PROSPERITY BANK	790 PONCE DE LEON BLVD N	$ 104.78	$ 227.23	$ 122.45
43	WALGREENS CO #11485	2801 PONCE DE LEON BLVD N	$ 75.00	$ 190.30	$ 115.30
44	SCHOONERS SEAFOOD HOUSE	3560 PONCE DE LEON BLVD N	$ 75.00	$ 189.42	$ 114.42
45	JALARAM MOTELS	420 ANASTASIA BLVD	$ 75.00	$ 186.77	$ 111.77
46	BHK PROPERTIES LLC	1200 PLANTATION ISLAND DR DOMESTIC	$ 75.00	$ 177.37	$ 102.37
47	FLAGLER RESORTLTD-DOMESTIC	95 CORDOVA ST DOMESTIC	$ 75.00	$ 174.63	$ 99.63
48	SEAWALL MOTOR LODGE INC.	32 AVENIDA MENENDEZ	$ 75.00	$ 168.47	$ 93.47
49	B & B FAMILY LLC	56 DIXIE HWY S	$ 75.00	$ 167.35	$ 92.35
50	DOUGLAS, DONALD C	65 LEWIS BLVD	$ 75.00	$ 166.41	$ 91.41
51	GATE PETROLEUM CO	1900 MIZELL RD	$ 75.00	$ 161.13	$ 86.13
52	ST JOHNS CO	1960 PONCE DE LEON BLVD N LIBRARY	$ 75.00	$ 156.48	$ 81.48
53	ECKERD DRUG CO#2268	150 SAN MARCO AVE	$ 75.00	$ 155.80	$ 80.80
54	COLUMBIA RESTAURANT	98 ST GEORGE ST	$ 75.00	$ 146.17	$ 71.17
55	W W GAY	132 A MASTERS DR	$ 92.85	$ 161.86	$ 69.01
56	VIRTU CATHEDRAL PLACE ASSOC	24 CATHEDRAL PL	$ 75.00	$ 137.91	$ 62.91
57	BROOKS SKILLED NURSING FACILITY	189 SAN MARCO AVE	$ 75.00	$ 135.87	$ 60.87
58	EYE CENTER OF ST AUGUSTINE	1400 US 1 S	$ 75.00	$ 135.55	$ 60.55
59	OLD FLORIDA MUSEUM	259 SAN MARCO AVE	$ 75.00	$ 129.64	$ 54.64
60	AUTO ELECTRIC PARTS	300 SAN MARCO AVE	$ 75.00	$ 128.54	$ 53.54
61	CITY OF ST AUGUSTINE	151 KING ST POLICE DEPT	$ 75.00	$ 128.32	$ 53.32
62	JAI MATAJI INC	601 ANASTASIA BLVD	$ 75.00	$ 125.62	$ 50.62
63	GURU KRUPA INCDBA RED CARPET	3101 PONCE DE LEON BLVD N	$ 75.00	$ 125.30	$ 50.30

No	Customer Name	Reference Address	Current	Potential	Difference
64	AMSOUTH BANK	1420 US 1 S DOMESTIC	$ 75.00	$ 125.20	$ 50.20
65	ANCHORAGE INN INC	1 DOLPHIN DR	$ 75.00	$ 124.59	$ 49.59
66	VICORP REST	904 PONCE DE LEON BLVD N	$ 75.00	$ 122.56	$ 47.56
67	BENNETT SR, THOMAS	50 DIXIE HWY S	$ 75.00	$ 121.02	$ 46.02
68	AUTOZONE FLORIDA LP #1223	510 PONCE DE LEON BLVD S	$ 75.00	$ 120.67	$ 45.67
69	A B DISTRIBUTORS	2200 PONCE DE LEON BLVD N	$ 75.00	$ 119.43	$ 44.43
70	LINCOLN PROPERTY COMPANY	60 CATHEDRAL PL	$ 75.00	$ 117.91	$ 42.91
71	MCDONALD'S #2535	1106 PONCE DE LEON BLVD N	$ 75.00	$ 117.06	$ 42.06
72	TITAN PROPANE LLC	254 RIBERIA ST	$ 75.00	$ 114.67	$ 39.67
73	JM & MM CONSULTANTS	1045 ANASTASIA BLVD	$ 75.00	$ 113.98	$ 38.98
74	FLORIDA PEST CONTROL	128 MASTERS DR	$ 75.00	$ 111.22	$ 36.22
75	WHETSTONE MOTEL	138 AVENIDA MENENDEZ	$ 75.00	$ 110.18	$ 35.18
76	ST JOHNS CO SCHOOL BOARD	47 ORANGE ST	$ 75.00	$ 109.86	$ 34.86
77	ST AUGUSTINE TROLLEY TOURS	27 SAN MARCO AVE	$ 75.00	$ 109.37	$ 34.37
78	ABC LIQUORS INC	160 KING ST DOMESTIC METER	$ 75.00	$ 109.32	$ 34.32
79	COMFORT SUITES	42 SAN MARCO AVE	$ 75.00	$ 109.14	$ 34.14
80	VISTA HOTEL III, INC.	16 AVENDIA MENENDEZ	$ 82.50	$ 115.94	$ 33.44
81	DRAKE, TAMMY R	69 LEWIS BLVD	$ 75.00	$ 107.55	$ 32.55
82	H FINANCIAL OF FLORIDA, INC	709 PONCE DE LEON BLVD S	$ 75.00	$ 106.29	$ 31.29
83	NETTLES, NICOLE C	500 ANASTASIA BLVD	$ 75.00	$ 105.78	$ 30.78
84	PIS-A-WAY LLC	154 CORDOVA ST	$ 75.00	$ 103.41	$ 28.41
85	ST JOHNS WELFARE FEDERATION	169 M L KING AVE	$ 75.00	$ 103.21	$ 28.21
86	ADVENTURE GOLF	701 ANASTASIA BLVD	$ 75.00	$ 102.48	$ 27.48
87	LEONARD'S STUDIO	143 SAN MARCO AVE UNIT A	$ 75.00	$ 101.23	$ 26.23
88	BUDGET INN	12 ANASTASIA BLVD	$ 75.00	$ 96.21	$ 21.21
89	SAFETY SHELTER OF ST JOHNS CO INC	1375 ARAPAHO AVE	$ 75.00	$ 90.66	$ 15.66
90	ST VINCENT DE PAUL SOCIETY	19 MCMILLAN ST	$ 75.00	$ 90.18	$ 15.18
91	SHRINE RELIGIOUS CHURCH SUPPLY	27 OCEAN AVE	$ 75.00	$ 88.42	$ 13.42
92	SHOWBOAT CARWASH	520 PONCE DE LEON BLVD S	$ 82.50	$ 95.78	$ 13.28
93	JOE TRINGALI SHELL	146 KING ST	$ 75.00	$ 86.58	$ 11.58
94	EDGEWATER INN	2 ST AUGUSTINE BLVD	$ 75.00	$ 85.80	$ 10.80
95	SHIVA HOSPITALITY LLC	2500 PONCE DE LEON BLVD N	$ 75.00	$ 84.31	$ 9.31
96	S & Y INVESTMENTS INC	282 SAN MARCO AVE	$ 82.50	$ 91.13	$ 8.63
97	SCOTTISH INN	110 SAN MARCO AVE	$ 75.00	$ 83.42	$ 8.42
98	FIRST COAST HONDA	2000 PONCE DE LEON BLVD N	$ 75.00	$ 80.36	$ 5.36
99	THOMPSON BROS REALTY INC	220 ST GEORGE ST	$ 75.00	$ 80.23	$ 5.23
100	CASA VERDE 501 LLC	69 DIXIE HWY S	$ 75.00	$ 79.43	$ 4.43
101	CHICK-FIL-A	1752 US 1 SOUTH DOMESTIC	$ 122.78	$ 125.57	$ 2.79
102	WEN SOUTH LLC	3531 PONCE DE LEON BLVD N	$ 75.00	$ 77.35	$ 2.35
103	BERGERON, DENNIS	3654 PONCE DE LEON BLVD N	$ 75.00	$ 76.65	$ 1.65
104	S & Y INVESTMANTS INC	281 SAN MARCO AVE	$ 75.00	$ 75.61	$ 0.61
105	FUSION POINT INC	3009 PONCE DE LEON BLVD N	$ 75.00	$ 75.40	$ 0.40
106	WHETSTONE CHOCOLATE FACTORY INC	149 KING ST	$ 84.30	$ 84.62	$ 0.32
107	A1A ALE WORKS	1 KING ST A1A ALE WORKS	$ 75.00	$ 74.79	$ (0.21)
108	ALPHA OMEGA MIRACLE HOME INC	283 SAN MARCO AVE	$ 75.00	$ 74.73	$ (0.27)
109	AMERICAN BAKERY	84 DIXIE HWY S	$ 75.00	$ 73.04	$ (1.96)
110	BUNGALOW EIGHT LLC	200 ANASTASIA BLVD	$ 75.00	$ 72.78	$ (2.22)
111	LIMELIGHT THEATRE	11 OLD MISSION AVE	$ 75.00	$ 71.67	$ (3.33)
112	PUTNAM STATE BANK	2300 PONCE DE LEON BLVD N	$ 75.00	$ 66.42	$ (8.58)
113	AMMAR BEAUTY SUPPLY	223 KING ST W	$ 75.00	$ 64.99	$ (10.01)
114	SEABREEZE MOTEL LLC	208 ANASTASIA BLVD	$ 75.00	$ 62.33	$ (12.67)
115	KRISHNA RNS2005 INC	218 ANASTASIA BLVD	$ 75.00	$ 60.69	$ (14.31)
116	YANNI VENTURES INC	2800 PONCE DE LEON BLVD N	$ 75.00	$ 55.26	$ (19.74)
117	TAVARY DDS, BERT A	700 ANASTASIA BLVD HOUSE METER	$ 75.00	$ 42.49	$ (32.51)
118	HERBIE WILES INSURANCE	400 PONCE DE LEON BLVD N	$ 75.00	$ 36.53	$ (38.47)
119	MARTIN OIL CO	1099 PONCE DE LEON BLVD S	$ 75.00	$ 35.15	$ (39.85)
120	ZORAYDA CASTLE	83 KING ST	$ 75.00	$ 30.13	$ (44.87)
	Total		**$ 10,813.34**	**$ 36,093.19**	**$ 25,279.85**

Using the Department of Revenue Land Use Codes as the primary sort, parcels were then classified into the following Land Use Categories:

- Residential Vacant
- Residential Single Family Home
- Residential Single Family Townhouse
- Residential Mobile Home
- Residential Multifamily 10+ units
- Residential Multifamily 9 or less units
- Residential Mobile Home Park
- Nonresidential Vacant
- Nonresidential
- Nonresidential Mixed Use
- Nonresidential Tax Exempt
- Miscellaneous

For the purpose of this analysis, nonresidential parcels were combined into one land use. Once the residential parcels had been grouped into their proper land use, a sampling of each land use category was conducted using GIS software, aerial photography, and GIS parcel data. This impervious area sampling consisted of digitizing structures that create a "footprint" within the boundaries of the parcel being evaluated. The sum of all the impervious area footprints was captured within the selected parcel, as shown on **Figure 5-2**.

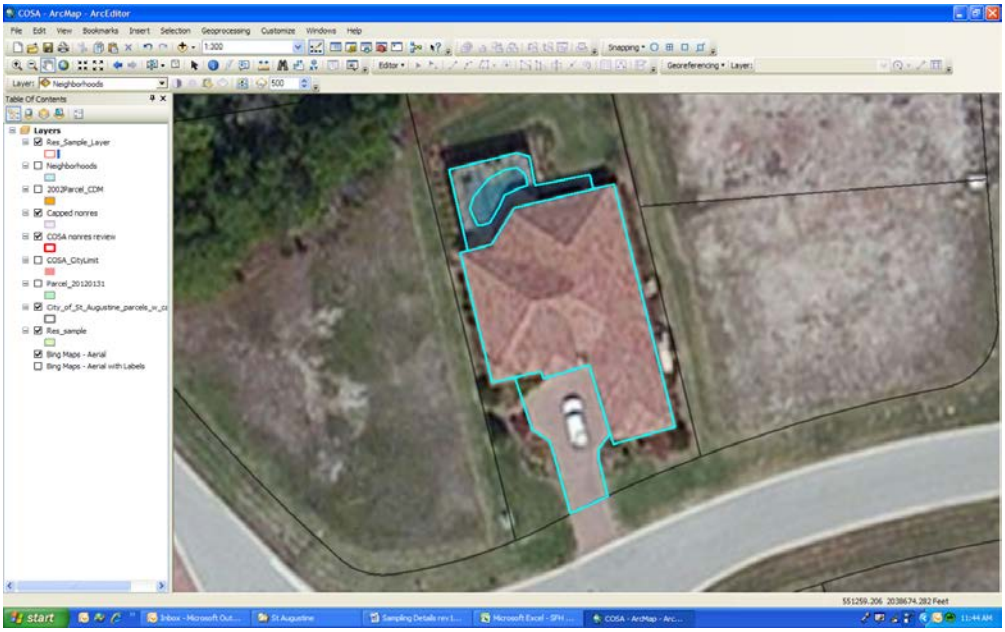


Figure 5-2
Example of Residential Impervious Area Delineation

For the selection of parcels to be sampled in the single family home land use category, factors noting physical location within the City (City Neighborhood GIS Layer), Assessed Value (range from $0 to $922,931), and Year Built (range from 1700 to 2010) were used to ensure a sample with a high degree of diversity. Three hundred parcels representing 300 dwelling units were determined to be the number of sampled parcels to ensure a statistically fair and equitable sampling of the single family home parcels.

For multifamily parcels, along with impervious area, dwelling units were determined for the sampled parcels in order to determine a square footage of impervious area per dwelling unit, similar to the single family home sample. The source of the dwelling unit estimate was the City's Utility Billing data, which carry a multiplier for certain accounts associated with multifamily parcels. 128 parcels representing a range of dwelling units from 1 thru 10+ were determined to be the number of sampled parcels to ensure a statistically fair and equitable sampling of the multifamily parcels.

For multifamily parcels, along with impervious area, dwelling units were determined for the sampled parcels in order to determine a square footage of impervious area per dwelling unit, similar to the single family home sample. A typical delineation of a multi-family unit is shown on **Figure 5-3**. The source of the dwelling unit estimate was the City's Utility Billing data, which carry a multiplier for certain accounts associated with multifamily parcels.

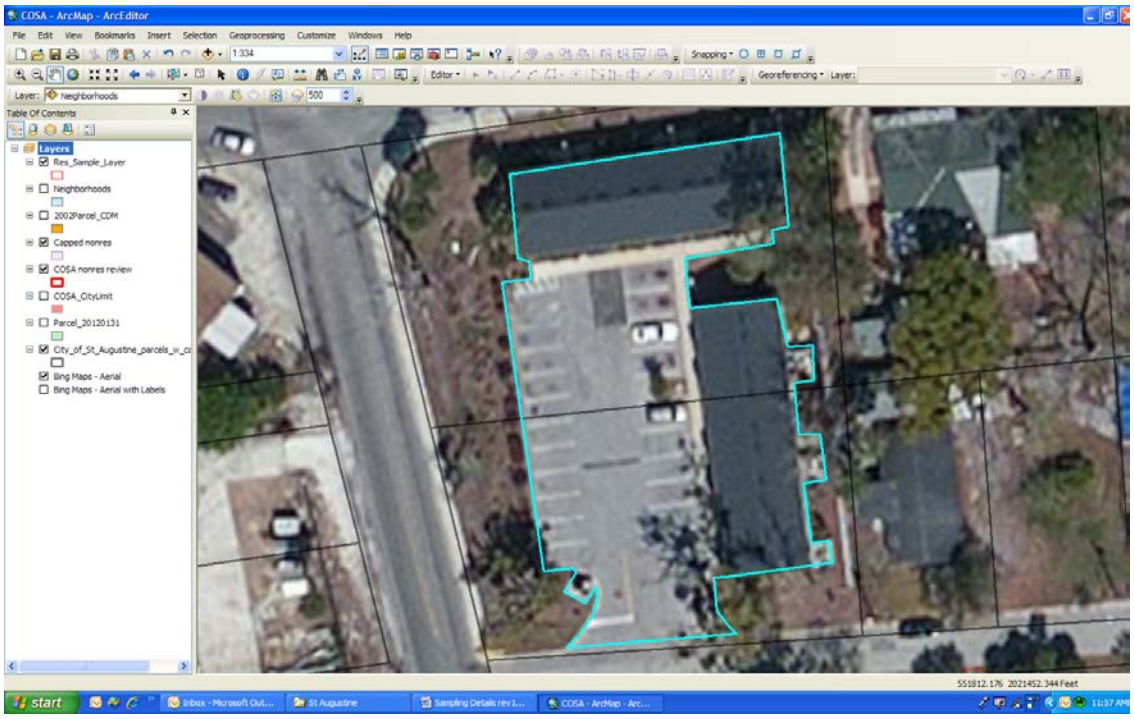


Figure 5-3
Example of a Multi-Family Impervious Area Delineation

Early on in the sampling process, CDM Smith discovered a "duplication" of parcel strap numbers throughout the parcel data set. Although the straps are duplicates, the parcels they represent are not. For this reason the results presented make a distinction between parcels and sites, since in many cases one site include several parcels, and in some cases the building straddles two adjacent parcels.

5.3.1. Equivalent Residential Units (ERU)

The results of the residential sampling can be found in the Parcel Land Use Analysis table provided by CDM Smith. CDM Smith has developed two different results based upon the analysis of the residential parcel sampling.

The first result is defined as an ERU value. It considers the total impervious area of all residential land uses divided by the total number of dwelling units. This approach assigns 1 ERU for every residential

dwelling unit. The ERU base of 1,885 square feet is used to calculate the number of billing units for nonresidential parcels by dividing the total impervious area of a nonresidential parcel by this ERU base number.

$$\boldsymbol{ERU\ Unit = Dwelling\ Unit(s)\ \ or\ \ \frac{Non\ Residential\ Impervious\ Area}{ERU\ base\ square\ feet}}$$

Table 5-2 shows the detailed breakdown of different residential land use categories with their sampled impervious area, as well as number of billing units.

Table 5-2 Current Residential Billing Structure (ERU)

Land Use	Total Number of Parcels	Number of Sites	Total Impervious Area (Sq. Feet)	Number of Dwelling Units	Impervious Area per Unit (Sq. feet)	ERU Values	ERU Totals
Residential SFH	6,264	3,800	10,458,360	3,800	2,752.2	1.00	3,800
Residential 2-9 units*	896	494	1,755,760	1,700	1,032.8	1.00	2,900
Residential Townhouse	82	82	112,824	82	1,375.9	1.00	82
Residential Multifamily 10+ units*	75	18	1,051,100	1,000	1,051.1	1.00	985
Res Mobile Homes Park*	15	6	183,206	81	2,261.8	1.00	80
Res Mobile Homes	21	12	31,265	12	2,605.4	1.00	12
Res Vacant	1,531	1,090	0	0	0.0	0.00	0
Residential Totals	8,884	5,502	13,592,514	6,675			6,675
Non Residential	6,554	1,757	14,412,623			1.00	7,078
Totals	**15,438**	**7,259**	**28,005,137**	**6,675**			**13,753**

* Number of Dwelling Units estimated **Average Impervious Area: 2,036 Square Feet**

5.3.2 Single Family Unit (SFU)

The second methodology is defined as a Single Family Unit (SFU) value. It considers the total impervious area of the single family home divided by the number of associated dwelling units. This approach also looks into the possibility of a tiered single family structure based upon the results of the sampled single family results. It also compares the results of the other residential land use categories to the average single family home. The results are in the form of an SFU factor. The SFU factors are multiplied by the total dwelling units to calculate the total SFU units. The SFU base is used to calculate the number of billing units for nonresidential parcels by dividing the total impervious area of a nonresidential parcel by this SFU base number. **Figure 5-4** has examples of residential and non-residential SFU equivalencies. Detailed sampling information was provided in digital format as a shapefile database showing the delineation of individual parcels.

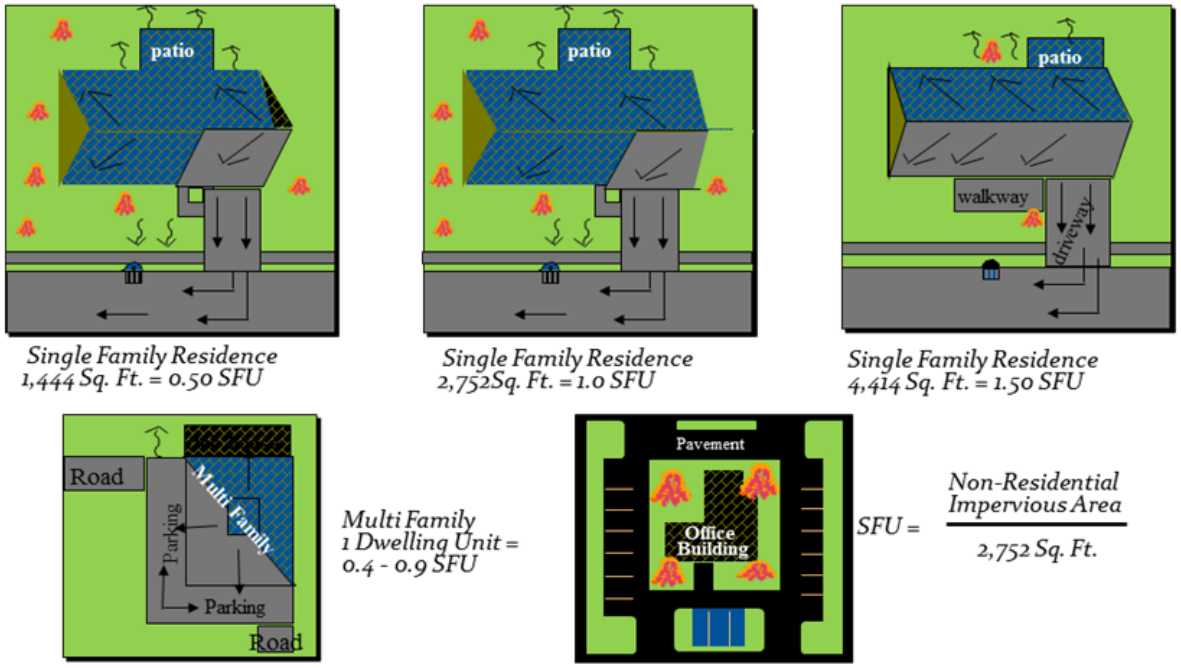


Figure 5-4
Examples of Residential and Non-Residential SFU Equivalencies

CDM Smith performed a measurement of a sample of residential properties in the City of St. Augustine with the intent of determining the spread and range of impervious areas associated with different land use categories. Based on the statistical sampling of the single family home land use, CDM Smith identified a disparity between the sampled sites. Table 5-8 shows that the ratio between the 10 percentile (smallest) and 90 percentile (largest) is 3.0. Therefore, the runoff generation of the largest 10 percent of the homes is 3 times larger than the runoff generation of the smallest 10 percent of the homes. The table also shows the ratios for broader breaks of the residential sample such as the 15 percentile and 20 percentile with ratios of 2.5 and 2.1 respectively. **Table 5-3** shows the results of the impervious area statistical analysis for SFU square footage ratios. A graphical tiered rate analysis is shown on **Figure 5-5**, where the 10th and 90th percentile are highlighted and impervious square footage displayed.

Table 5-3 Single Family Unit Square Footage of Impervious Area Statistical Analysis

SFU Tier Evaluation	Sampled Square Footage of Imperviousness	Ratio
10 Percentile	1,444	3.0
90 Percentile	4,400	
15 Percentile	1,588	2.5
85 Percentile	3,893	
20 Percentile	1,669	2.1
80 Percentile	3,520	

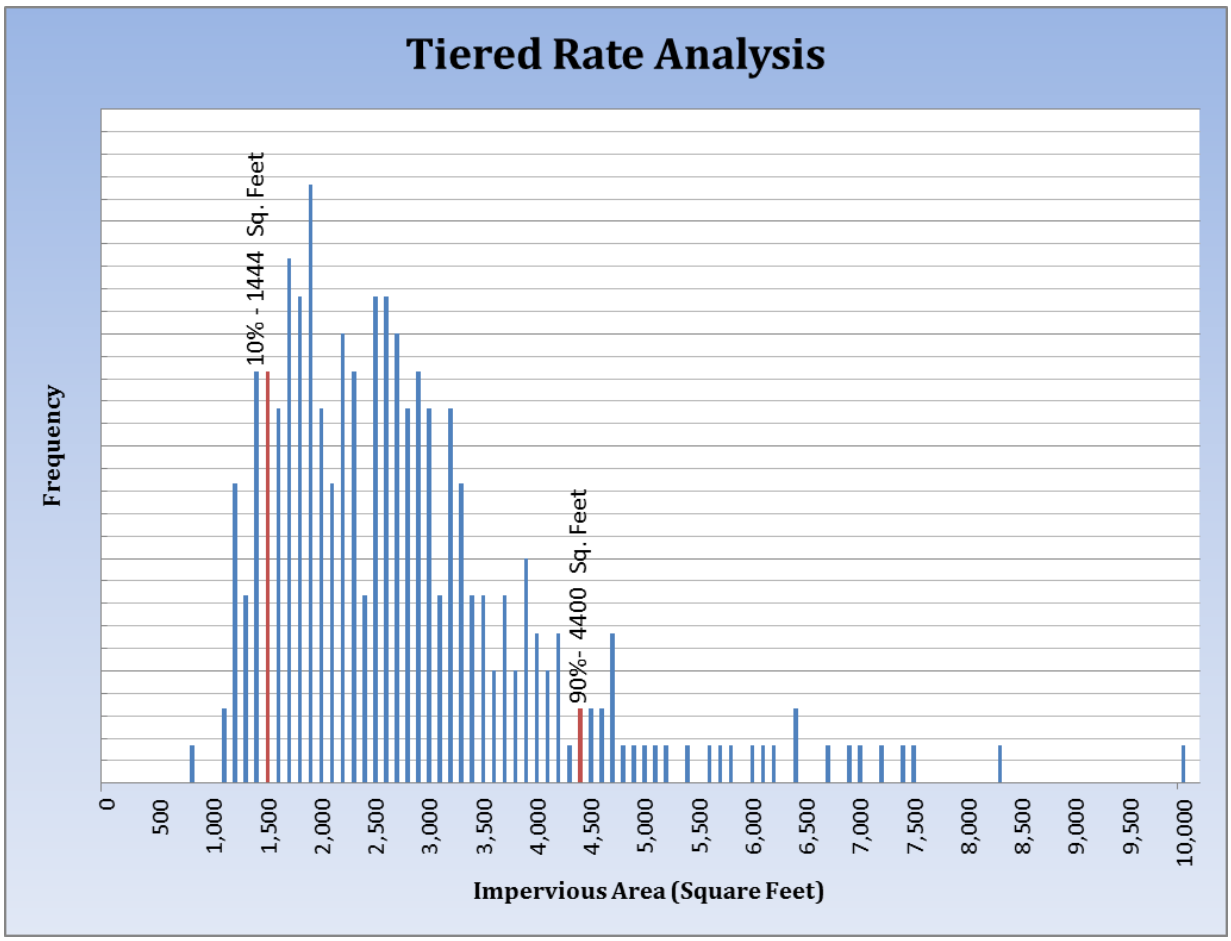


Figure 5-5
Tiered Rate Analysis for Single Family Unit Impervious Area

A common practice in service fees is that a single flat rate to all customers is acceptable only if their use is in the same range. If there are users utilizing the system in ratios greater of 2.5 compared to the smaller or average customer, then there is justification for a tiered fee structure. In the case of St. Augustine the 20/80 percentiles have a ratio of 2.1, while the 15/85 percentiles have a ratio of 2.5. The only ratio greater than 2.5 is the one for the 10/90 percentiles with a value of 3.0 that supports a residential tier. CDM Smith therefore recommends considering the tier as part of an overall re-structure of the utility, to provide a fairer and equitable fee structure. Without a systematic re-structure of the utility, the ratios are neutral enough that it might not require the development of residential tiers in the current stormwater utility fee.

Considering a potential tiered residential billing structure, CDM Smith prepared **Table 5-4**, which shows a suggested ratio of 0.52, 1.00 and 1.60 between small, average and large single family units. In practical terms this means that if the City adopts a SFU of $7.00/month, a small residential customer will pay $3.64/month (0.52 SFU factor), and a large single family home will pay $11.20/month (1.60 SFU factor). Similarly multifamily units will pay a range of fees between $2.66 (0.38 SFU factor) and $6.65/month (0.95 SFU factor).

Table 5-4 Tiered Residential Billing Structure (SFU)

Land Use	Total Number of Parcels	Number of Sites	Total Impervious Area (Sq. Feet)	Number of Dwelling Units	Impervious Area per Unit (Sq. feet)	SFU Factor	SFU Totals
Residential SFH Small	626	380	548,720	380	1,444.0	0.52	199.4
Residential SFH	5012	3,040	8,366,688	3,040	2,752.2	1.00	3,040.0
Residential SFH Large	626	380	1,677,662	380	4,414.9	1.60	609.6
Residential 2-9 units*	896	494	1,755,760	1,700	1,032.8	0.38	1,088.3
Residential Townhouse	82	82	112,824	82	1,375.9	0.50	41.0
Residential Multifamily 10+ units*	75	18	1,051,100	1,000	1,051.1	0.38	376.2
Res Mobile Homes Park*	15	6	183,206	81	2,261.8	0.82	65.7
Res Mobile Homes	21	12	31,265	12	2,605.4	0.95	11.4
Res Vacant	1,531	1,090					
Residential Totals	8,884	5,502	13,727,224	6,675			4,988
Nonres	6,554	1,757	14,412,623				5,237
Totals	15,438	7,259	**28,139,847**	**6,675**			**10,224**

** Number of Dwelling Units estimated* **Average Impervious Area: 2,752 Square Feet**

5.4 Stormwater Revenues and Expenses

CDM Smith was tasked with reviewing the City's Budget Summaries and Comprehensive Annual Financial Reports (CAFRs) for stormwater related finances over the last 3 fiscal years. The fiscal years ends on September 30, therefore the most recent CAFR available is for FY 2010/2011. When studying these documents CDM Smith looked for patterns or any major projects or expenses that would affect the stormwater expenses or revenues. The balance sheets for stormwater drainage were extracted from the three CAFRs and compared in an Excel document. **Table 5-5** shows stormwater statement of revenues and expenses since fiscal year 2009.

Table 5-5 Stormwater Statement of Revenues, Expenses

Year	Operating Revenues	Non Operating Revenues	Net Revenue	Operating Expenses	Net Operating Income
FY 2008/2009	$735,131	$25,947	$761,078	$539,034	$222,044
FY 2009/2010	$747,339	$7,748	$755,087	$466,522	$288,565
FY 2010/2011	$746,691	$374,122	$1,120,813	$355,674	$765,139

The review shows that the operating revenues from the stormwater utility are fairly constant between $735,000 and $747,000 in recent years. In addition to the steady revenue from the stormwater utility, there are other non-operating revenues coming from transfers, or other sources of funding ranging from $7,748 to $374,122. The amount of $374,122 in FY2011 is significant compared to previous years, and is mainly due to a grant obtained by the City from the SJRWMD for the construction of the Riberia Street baffle boxes and associated stormwater improvements.

Such funds are becoming harder to secure due to the fact that most agencies are reducing their funding; therefore, the City was correct in seeking such a grant in FY2011, but this will likely remain an exception more than a common source of revenue. Therefore, the addition of the operating revenue and other revenues, determines the net revenue which ranges from $761,078 to $1,120,813.

The CAFRs shows that the expenses have declined consistently from $539,034 to $355,674. This trend is justified by the following adjustments that occurred in the past years:

1. Staff covered under stormwater has changed throughout the years, but specifically in both 2010 and 2011 there are one engineer and two full-time municipal employees funded. As a result, salaries, wages and benefits have increased from $ 70,108 in FY2009 to $ 148,341 in FY2011.
2. Contractual services decreased significantly from $204,593 in FY2009 to $ 22,178 in FY2011, compensating for the increase in City staffing costs.
3. Overhead costs have been declining consistently from $151,302 in FY2009 to $113,350 in FY2011, and are included in the operating expenses.

In addition to these observations from the CAFRs, CDM Smith discussed with the City Engineer the fact that clean-up activities that take place after flooding and intense storm events are not recorded consistently under stormwater expenses, and therefore are funded by other revenue funds such as utilities and solid waste. This is another potential explanation for the reduction in operating expenses.

By comparing the net revenue with the operating expenses, we obtain the Net Operating Income which has constantly increased since the year 2009, from $222,044 to $765,139. Such a yearly surplus might be justified by current outstanding liabilities, and anticipation of upcoming expenses: in other words, the City has been increasing the stormwater reserve with the yearly surplus.

Table 5-6 shows the net change in the stormwater fund assets, which can be summarized in two major components: the stormwater reserve, and other fixed assets. The reserves were provided by the Finance Department, in order to consider adjustments that are ongoing since the last CAFR. The table shows that the stormwater reserves have been decreasing from $3.5M to $3.4M in the past 3 years, and that the fixed assets are increasing due to purchase of equipment and ongoing construction. The net result is therefore that the total assets have increased from $5.041M in FY2009 to $6.799M in FY2011.

Table 5-6 Stormwater Fund Reserve and Assets

Year	Reserves	Fixed Assets	Total Assets
FY 2008/2009	$3,555,713	$1,486,157	$5,041,870
FY 2009/2010	$3,514,191	$1,772,339	$5,286,530
FY 2010/2011	$3,410,165	$3,389,301	$6,799,466

The seawall project is currently being funded by a $2.0 million loan from the water/sewer utility fund that will have to be paid back by the stormwater reserves. The total estimated cost of the seawall improvements is $4.7 million. The historical trend of the liabilities confirms that the City saved most of its stormwater reserves for the seawall project, since in prior years it had only $44,000 (2010) and $375,000 (2009). Concurrently with the increase in liabilities, the City increased the level of

construction in the past year, which is confirmed by the 2011 CAFR that reported $2.0 million of construction in progress, compared to $267,000 in 2009 and $317,000 in 2010.

Riberia Street improvement is another major ongoing project, and is funded by a dedicated bond that will be extinct in 2012. The total bond was for $3.86 million and included both Phase I and Phase II. There is a common allocation of about $50,000 per year for minor infrastructure improvements.

Finally, an increase in machinery and equipment assets of $60,000 between 2011 and 2010 was noted. Based on the review of additional backup information provided by the finance department, it appears that these funds correspond to the transfer of a line-cleaning truck from the utility fund to the stormwater utility, related to the retirement of an old line-cleaning truck.

Summarizing the evaluation of the financial records, it appears that the revenues from the stormwater utility can properly sustain the current stormwater operation, since the operating income has been increasing constantly in the past 3 years. On the other hand, the capital investments are based on a stormwater reserve that is currently dedicated to the seawall project, and there is limited availability of funds for future projects.

The City refinanced a bond in 2011 to supply the general fund, and currently there are no plans to establish new bonds.

5.5 Project Implementation since the 1995 Master Plan

The City implemented the majority of the capital improvement projects identified in the 1995 stormwater master plan. See the list below in **Table 5-7** for a summary of the projects completed and their respective cost.

Table 5-7 Stormwater Projects Completed since 1995

Project	Status
Josiah Street Basin	Built
Bay Front Area	Built
Comares Avenue and Herada Street Area	Built
Oyster Creek watershed improvements	Planning
Maria Sanchez Lake Basin	Partially complete
Treasury Street area	Not complete
San Carlos Avenue area	Built
Riberia Street and Lincolnville Area	Built
Oviedo Street	Partially complete
Riberia/Castillo Area	Built

5.6 Projection of Future Expenditures

If the City intends to fund a long-term stormwater plan with a steady implementation of projects for the upcoming 10 years, it will be necessary to update the funding mechanisms to increase the stormwater reserve. As part of the results of this master plan, CDM Smith presented the proposed

projects for three pilot areas, with their respective conceptual cost estimate described in detail in Section 4:

- South Dixie Outfall Improvement $2,891,000 (2012 dollars)
- Sidney Street Outfall Improvement $360,000 (2012 dollars)
- Maria Sanchez Lake Outfall Improvements $3,073,000 (2012 dollars)

While the City continues to define a citywide capital improvements program, these three pilot areas were prioritized by CDM Smith and City staff because of the severity of flooding impact to residents, traffic, and operations and maintenance. Construction costs were estimated in 2012 dollars, therefore depending on the year of implementation a 2.5 percent inflation rate was applied. The South Dixie project is currently being designed with a conceptual cost estimate of $2,891,000, including an additional lane and land acquisition. CDM Smith estimated that $1,300,000 will be financed by the stormwater utility, by considering strictly the costs associated with the stormwater infrastructure, and roadway reconstruction.

The operating expenses are estimated at $450,000 per year, which is an average of the past 3 years shown in Table 5-5. Most communities are anticipating an increase in operation and maintenance (O&M) costs for stormwater activities, due to the renewal of NPDES permits, the upcoming water quality criteria being considered by the EPA, and the FEMA Community Rating System scoring system. In addition to this, the City installed new infrastructure that requires future maintenance, such as the seawall, the baffle boxes, and the additional pilot area projects. CDM Smith therefore estimates a 5 percent yearly increase in the upcoming 10 years for O&M costs, which also includes inflation costs. The following sections present a total of 6 funding scenarios for in 10 years from the year 2013 to 2022.

5.6.1 Funding Scenario 1 – $5.00 ERU/Pay as You Go

This scenario considers that the City will update the stormwater utility structure to set an even rate for both residential and non-residential customers, and will lift the current cap on the non-residential customers. CDM Smith estimated that by setting an ERU of $5.00/month based on a base of 2,036 sq-feet the revenue will increase from the current $750,000 to $780,000 per year.

CDM Smith staggered the implementation of the projects starting with the South Dixie outfall improvements in 2014, Sidney Street outfall in 2017 and finishing with the Maria Sanchez Lake outfall improvements 2022. Construction costs were escalated using a 2.5 percent inflation rate.

The results show that this scenario will result in an erosion of the stormwater reserves from $3,410,165 in year 2013 to a deficit of $77,905 in year 2022. **Table 5-8** shows the details by year with an increase in the net revenue after year 2013 from $750,000 to $780,000.

5.6.2 Funding Scenario 2 – ERU Rate Adjustment/Pay as You Go

The difference between this scenario and scenario 1 is that in addition to setting a unique ERU rate for both residential and non-residential customers, as well as eliminating the non-residential cap, the City will adjust the rate to increase the stormwater revenues. The proposed rate increase starts with $5.00/month per ERU in the year 2013 and increases up to $6.00/month per ERU in the year 2017 at a rate of 25 cents per year. CDM Smith estimated that the revenue will increase from the current $750,000 to $940,000 in the year 2017.

Table 5-8 Funding Scenario 1 - $5.00 Equivalent Residential Unit / Pay as you go

Yearly Increase in Operating Expenses	5.0%
South Dixie Outfall Improvements :	2014
Sydney Street Outfall Improvements:	2017
Maria Sanchez Lake outfall improvements:	2022
Starting ERU rate:	$5.00/ERU
Final ERU rate:	$5.00/ERU

Year	Billing Rate	Beginning Reserve	Net Revenue	Operating Expenses	Capital Investments	Yearly Revenue/Loss	Ending Reserve
FY 2012/2013	$5.00/$7.50 (1)	$ 3,410,165	$ 750,000	$ (455,000)	$ -	$ 295,000	$ 3,705,165
FY 2013/2014	$5.00	$ 3,705,165	$ 780,000	$ (477,750)	$ (1,300,000)	$ (997,750)	$ 2,707,415
FY 2014/2015	$5.00	$ 2,707,415	$ 780,000	$ (501,638)	$ -	$ 278,363	$ 2,985,778
FY 2015/2016	$5.00	$ 2,985,778	$ 780,000	$ (526,719)	$ -	$ 253,281	$ 3,239,058
FY 2016/2017	$5.00	$ 3,239,058	$ 780,000	$ (553,055)	$ (397,373)	$ (170,428)	$ 3,068,630
FY 2017/2018	$5.00	$ 3,068,630	$ 780,000	$ (580,708)	$ -	$ 199,292	$ 3,267,922
FY 2018/2019	$5.00	$ 3,267,922	$ 780,000	$ (609,744)	$ -	$ 170,256	$ 3,438,179
FY2019/2020	$5.00	$ 3,438,179	$ 780,000	$ (640,231)	$ -	$ 139,769	$ 3,577,948
FY 2020/2021	$5.00	$ 3,577,948	$ 780,000	$ (672,242)	$ -	$ 107,758	$ 3,685,706
FY 2021/2022	$5.00	$ 3,685,706	$ 780,000	$ (705,854)	$ (3,837,756)	$ (3,763,610)	$ (77,905)

2013 Stormwater Reserve:	$ 3,410,165
2022 Stormwater Reserve:	$ (77,905)

Notes:

1. The current utility structure has rate of $5.00 for residential ERU and $7.50 for non-residential ERU.
2. A revenue collection rate of 95% is considered.

The effect of the rate increase is that at the end of 2022, the stormwater reserve will still have an estimated $962,095 balance after the implementation of the three pilot capital improvement projects**.** **Table 5-9** shows the details of this scenario as well as the estimated billing rate per year starting at $5.00/month and reaching a high of $6.00/month in 2017.

5.6.3 Funding Scenario 3 – $5.00 ERU with Dedicated Bond

A third scenario based on EUR consists of a variation of scenario 1, with a fixed rate of $5.00/month and a yearly debt service to create a new dedicated bond. Under this scenario CDM Smith considered that the City could establish a bond dedicated to fund the 3 pilot projects identified above ($6,324,000), assuming a 3 percent interest rate, 20-year bond, and 10 percent closing costs.

The results in **Table 5-10** show that balance of the stormwater reserve in 2022 ($2,059,698) is less than the estimate for scenario 1 (-$77,905) due to the fact that the debt service will extend for an additional 10 years beyond the current evaluation.

5.6.4 Funding Scenario 4 – $7.00 SFU/Pay as You Go

This is the first scenario that considers that the City will implement the residential tier described in Section 5.3.2, with a rate of $7.00/month based on 2,752 square feet. The current cap on non-residential customers will also be eliminated, with resulting projected annual revenue of $820,000 instead of the current $750,000.

CDM Smith staggered the implementation of the projects starting with the South Dixie outfall improvements in 2014, Sidney Street outfall in 2017 and finishing with the Maria Sanchez Lake outfall improvements 2022. An adjustment of 2.5 percent of estimated inflation was applied to the 2012 construction costs.

The resulting projection shows that the final reserve in year 2022 would be $282,095 after the implementation of the three pilot capital improvement projects, as shown in **Table 5-11**.

5.6.5 Funding Scenario 5 –SFU Rate Adjustment/Pay as You Go

Scenario 5 expands on the concept of a tiered structure (SFU) based on 2,752 square feet of impervious area, starting at $7.00/month and increasing at a rate of 25 cents per year until it reaches a maximum of $8.00/month in the year 2017. The resulting projected annual revenue of $930,000 compared to the current $750,000 which allows implementation of the three pilot projects and still having a balance of $992,095 in 2022, as shown in **Table 5-12**.

5.6.6 Funding Scenario 6 – $7.00 SFU with Dedicated Bond

A third scenario based on a residential tiered structure (SFU) is a variation of equivalent residential unit consists of a variation of scenario 1, with a fixed rate of $7.00/month and a yearly debt service to create a new dedicated bond. Under this scenario CDM Smith considered that the City could establish a bond dedicated to fund the three pilot projects identified above ($6,324,000), assuming a 3 percent interest rate, 20-year bond, and 10 percent closing costs.

The results in **Table 5-13** show that the balance of the stormwater reserve in 2022 ($2,419,698) is greater than the estimate for scenario 4 ($282,095) due to the fact that the debt service will extend for an additional 10 years beyond the current evaluation.

Table 5-9 Funding Scenario 2 - Equivalent Residential Unit Rate Adjustment / Pay as you go

Yearly Increase in Operating Expenses	5.0%
South Dixie Outfall Improvements :	2014
Sydney Street Outfall Improvements:	2017
Maria Sanchez Lake outfall improvements:	2022
Starting ERU rate:	$5.00/ERU
Final ERU rate:	$6.00/ERU

Year	Billing Rate	Beginning Reserve	Net Revenue	Operating Expenses	Capital Costs	Yearly Revenue/Loss	Ending Reserve
FY 2012/2013	$5.00/$7.50 (1)	$ 3,410,165	$ 750,000	$ (455,000)	$ -	$ 295,000	$ 3,705,165
FY 2013/2014	$5.00	$ 3,705,165	$ 780,000	$ (477,750)	$ (1,300,000)	$ (997,750)	$ 2,707,415
FY 2014/2015	$5.25	$ 2,707,415	$ 820,000	$ (501,638)	$ -	$ 318,363	$ 3,025,778
FY 2015/2016	$5.50	$ 3,025,778	$ 860,000	$ (526,719)	$ -	$ 333,281	$ 3,359,058
FY 2016/2017	$5.75	$ 3,359,058	$ 900,000	$ (553,055)	$ (397,373)	$ (50,428)	$ 3,308,630
FY 2017/2018	$6.00	$ 3,308,630	$ 940,000	$ (580,708)	$ -	$ 359,292	$ 3,667,922
FY 2018/2019	$6.00	$ 3,667,922	$ 940,000	$ (609,744)	$ -	$ 330,256	$ 3,998,179
FY2019/2020	$6.00	$ 3,998,179	$ 940,000	$ (640,231)	$ -	$ 299,769	$ 4,297,948
FY 2020/2021	$6.00	$ 4,297,948	$ 940,000	$ (672,242)	$ -	$ 267,758	$ 4,565,706
FY 2021/2022	$6.00	$ 4,565,706	$ 940,000	$ (705,854)	$ (3,837,756)	$ (3,603,610)	$ 962,095

2013 Stormwater Reserve:	$ 3,410,165
2022 Stormwater Reserve:	$ 962,095

Notes:

1. The current utility structure has rate of $5.00 for residential ERU and $7.50 for non-residential ERU.
2. The proposed rate adjustment starts with a rate of $5.00/month per ERU and increases by $0.25 a year until reaching a final rate of $6.00/month per ERU.
3. A revenue collection rate of 95% is considered.

5.6.3 Funding Scenario 3 – $5.00 ERU with Dedicated Bond

A third scenario based on EUR consists of a variation of scenario 1, with a fixed rate of $5.00/month and a yearly debt service to create a new dedicated bond. Under this scenario CDM Smith considered that the City could establish a bond dedicated to fund the 3 pilot projects identified above ($6,324,000), assuming a 3 percent interest rate, 20-year bond, and 10 percent closing costs.

The results in **Table 5-10** show that balance of the stormwater reserve in 2022 ($2,059,698) is less than the estimate for scenario 1 (-$77,905) due to the fact that the debt service will extend for an additional 10 years beyond the current evaluation.

5.6.4 Funding Scenario 4 – $7.00 SFU/Pay as You Go

This is the first scenario that considers that the City will implement the residential tier described in Section 5.3.2, with a rate of $7.00/month based on 2,752 square feet. The current cap on non-residential customers will also be eliminated, with resulting projected annual revenue of $820,000 instead of the current $750,000.

CDM Smith staggered the implementation of the projects starting with the South Dixie outfall improvements in 2014, Sidney Street outfall in 2017 and finishing with the Maria Sanchez Lake outfall improvements 2022. An adjustment of 2.5 percent of estimated inflation was applied to the 2012 construction costs.

The resulting projection shows that the final reserve in year 2022 would be $282,095 after the implementation of the three pilot capital improvement projects, as shown in **Table 5-11**.

5.6.5 Funding Scenario 5 –SFU Rate Adjustment/Pay as You Go

Scenario 5 expands on the concept of a tiered structure (SFU) based on 2,752 square feet of impervious area, starting at $7.00/month and increasing at a rate of 25 cents per year until it reaches a maximum of $8.00/month in the year 2017. The resulting projected annual revenue of $930,000 compared to the current $750,000 which allows implementation of the three pilot projects and still having a balance of $992,095 in 2022, as shown in **Table 5-12**.

5.6.6 Funding Scenario 6 – $7.00 SFU with Dedicated Bond

A third scenario based on a residential tiered structure (SFU) is a variation of equivalent residential unit consists of a variation of scenario 1, with a fixed rate of $7.00/month and a yearly debt service to create a new dedicated bond. Under this scenario CDM Smith considered that the City could establish a bond dedicated to fund the three pilot projects identified above ($6,324,000), assuming a 3 percent interest rate, 20-year bond, and 10 percent closing costs.

The results in **Table 5-13** show that the balance of the stormwater reserve in 2022 ($2,419,698) is greater than the estimate for scenario 4 ($282,095) due to the fact that the debt service will extend for an additional 10 years beyond the current evaluation.

Table 5-10 Funding Scenario 3 - $5.00 Equivalent Residential Unit with Dedicated Bond

Yearly Increase in Operating Expenses:	5.0%
Bond Present Worth:	$ 4,733,000
Number of Years:	20
Bond rate:	3%
Bond yearly Payment:	$ (339,753)
Starting ERU rate:	$5.00/ERU
Final ERU rate:	$5.00/ERU

Year	Billing Rate	Beginning Reserve	Net Revenue	Operating Expenses	Debt Service	Yearly Revenue/Loss	Ending Reserve
FY 2012/2013	$5.00/$7.50 (1)	$ 3,410,165	$ 750,000	$ (455,000)	$ (339,753)	$ (44,753)	$ 3,365,412
FY 2013/2014	$5.00	$ 3,365,412	$ 780,000	$ (477,750)	$ (339,753)	$ (37,503)	$ 3,327,910
FY 2014/2015	$5.00	$ 3,327,910	$ 780,000	$ (501,638)	$ (339,753)	$ (61,390)	$ 3,266,520
FY 2015/2016	$5.00	$ 3,266,520	$ 780,000	$ (526,719)	$ (339,753)	$ (86,472)	$ 3,180,048
FY 2016/2017	$5.00	$ 3,180,048	$ 780,000	$ (553,055)	$ (339,753)	$ (112,808)	$ 3,067,240
FY 2017/2018	$5.00	$ 3,067,240	$ 780,000	$ (580,708)	$ (339,753)	$ (140,461)	$ 2,926,779
FY 2018/2019	$5.00	$ 2,926,779	$ 780,000	$ (609,744)	$ (339,753)	$ (169,496)	$ 2,757,283
FY2019/2020	$5.00	$ 2,757,283	$ 780,000	$ (640,231)	$ (339,753)	$ (199,983)	$ 2,557,300
FY 2020/2021	$5.00	$ 2,557,300	$ 780,000	$ (672,242)	$ (339,753)	$ (231,995)	$ 2,325,305
FY 2021/2022	$5.00	$ 2,325,305	$ 780,000	$ (705,854)	$ (339,753)	$ (265,607)	$ 2,059,698

2013 Stormwater Reserve:	$ 3,410,165
2022 Stormwater Reserve:	$ 2,059,698

Notes:

1. The current utility structure has rate of $5.00 for residential ERU and $7.50 for non-residential ERU.
2. A revenue collection rate of 95% is considered.

Table 5-11 Funding Scenario 4 - $7.00 Single Family Unit Pay as you go.

Yearly Increase in Operating Expenses	5.0%
South Dixie Outfall Improvements :	2014
Sydney Street Outfall Improvements:	2017
Maria Sanchez Lake outfall improvements:	2022
Starting SFU rate:	$7.00/SFU
Final SFU rate:	$7.00/SFU

Year	Billing Rate	Beginning Reserve	Net Revenue	Operating Expenses	Capital Investments	Yearly Revenue/Loss	Ending Reserve
FY 2012/2013	$5.00/$7.50 (1)	$ 3,410,165	$ 750,000	$ (455,000)	$ -	$ 295,000	$ 3,705,165
FY 2013/2014	$7.00	$ 3,705,165	$ 820,000	$ (477,750)	$ (1,300,000)	$ (957,750)	$ 2,747,415
FY 2014/2015	$7.00	$ 2,747,415	$ 820,000	$ (501,638)	$ -	$ 318,363	$ 3,065,778
FY 2015/2016	$7.00	$ 3,065,778	$ 820,000	$ (526,719)	$ -	$ 293,281	$ 3,359,058
FY 2016/2017	$7.00	$ 3,359,058	$ 820,000	$ (553,055)	$ (397,373)	$ (130,428)	$ 3,228,630
FY 2017/2018	$7.00	$ 3,228,630	$ 820,000	$ (580,708)	$ -	$ 239,292	$ 3,467,922
FY 2018/2019	$7.00	$ 3,467,922	$ 820,000	$ (609,744)	$ -	$ 210,256	$ 3,678,179
FY2019/2020	$7.00	$ 3,678,179	$ 820,000	$ (640,231)	$ -	$ 179,769	$ 3,857,948
FY 2020/2021	$7.00	$ 3,857,948	$ 820,000	$ (672,242)	$ -	$ 147,758	$ 4,005,706
FY 2021/2022	$7.00	$ 4,005,706	$ 820,000	$ (705,854)	$ (3,837,756)	$ (3,723,610)	$ 282,095

2013 Stormwater Reserve:	$ 3,410,165
2022 Stormwater Reserve:	$ 282,095

Notes:

1. The current utility structure has rate of $5.00 for residential ERU and $7.50 for non-residential ERU.
2. This scenario is based on a tiered residential structure (Single Family Unit SFU).
3. A revenue collection rate of 95% is considered.

Table 5-12 Funding Scenario 5 - Single Family Unit Rate Adjustment Pay as you go

Yearly Increase in Operating Expenses	5.0%
South Dixie Outfall Improvements :	2014
Sydney Street Outfall Improvements:	2017
Maria Sanchez Lake outfall improvements:	2022
Starting SFU rate:	$7.00/SFU
Final SFU rate:	$8.00/SFU

Year	Billing Rate	Beginning Reserve	Net Revenue	Operating Expenses	Capital Costs	Yearly Revenue/Loss	Ending Reserve
FY 2012/2013	$5.00/$7.50 (1)	$ 3,410,165	$ 750,000	$ (455,000)	$ -	$ 295,000	$ 3,705,165
FY 2013/2014	$7.00	$ 3,705,165	$ 820,000	$ (477,750)	$ (1,300,000)	$ (957,750)	$ 2,747,415
FY 2014/2015	$7.25	$ 2,747,415	$ 850,000	$ (501,638)	$ -	$ 348,363	$ 3,095,778
FY 2015/2016	$7.50	$ 3,095,778	$ 870,000	$ (526,719)	$ -	$ 343,281	$ 3,439,058
FY 2016/2017	$7.75	$ 3,439,058	$ 900,000	$ (553,055)	$ (397,373)	$ (50,428)	$ 3,388,630
FY 2017/2018	$8.00	$ 3,388,630	$ 930,000	$ (580,708)	$ -	$ 349,292	$ 3,737,922
FY 2018/2019	$8.00	$ 3,737,922	$ 930,000	$ (609,744)	$ -	$ 320,256	$ 4,058,179
FY2019/2020	$8.00	$ 4,058,179	$ 930,000	$ (640,231)	$ -	$ 289,769	$ 4,347,948
FY 2020/2021	$8.00	$ 4,347,948	$ 930,000	$ (672,242)	$ -	$ 257,758	$ 4,605,706
FY 2021/2022	$8.00	$ 4,605,706	$ 930,000	$ (705,854)	$ (3,837,756)	$ (3,613,610)	$ 992,095

2013 Stormwater Reserve:	$ 3,410,165
2022 Stormwater Reserve:	$ 992,095

Notes:

1. The current utility structure has rate of $5.00 for residential ERU and $7.50 for non-residential ERU.
2. This scenario is based on a tiered residential structure (Single Family Unit SFU).
3. A revenue collection rate of 95% is considered.
4. A rate adjustment of $0.25 per year is considered, starting with $7.00 per SFU up to $8.00 per SFU.

Table 5-13 Funding Scenario 6 - $7.00 Single Family Unit with Dedicated Bond

Yearly Increase in Operating Expenses:		5.0%
Bond Present Worth:	$	4,733,000
Number of Years:		20
Bond rate:		3%
Bond yearly Payment:	$	(339,753)
Starting SFU rate:		$7.00/SFU
Final SFU rate:		$7.00/SFU

Year	Billing Rate	Beginning Reserve	Net Revenue	Operating Expenses	Debt Service	Yearly Revenue/Loss	Ending Reserve
FY 2012/2013	$5.00/$7.50 (1)	$ 3,410,165	$ 750,000	$ (455,000)	$ (339,753)	$ (44,753)	$ 3,365,412
FY 2013/2014	$7.00	$ 3,365,412	$ 820,000	$ (477,750)	$ (339,753)	$ 2,497	$ 3,367,910
FY 2014/2015	$7.00	$ 3,367,910	$ 820,000	$ (501,638)	$ (339,753)	$ (21,390)	$ 3,346,520
FY 2015/2016	$7.00	$ 3,346,520	$ 820,000	$ (526,719)	$ (339,753)	$ (46,472)	$ 3,300,048
FY 2016/2017	$7.00	$ 3,300,048	$ 820,000	$ (553,055)	$ (339,753)	$ (72,808)	$ 3,227,240
FY 2017/2018	$7.00	$ 3,227,240	$ 820,000	$ (580,708)	$ (339,753)	$ (100,461)	$ 3,126,779
FY 2018/2019	$7.00	$ 3,126,779	$ 820,000	$ (609,744)	$ (339,753)	$ (129,496)	$ 2,997,283
FY2019/2020	$7.00	$ 2,997,283	$ 820,000	$ (640,231)	$ (339,753)	$ (159,983)	$ 2,837,300
FY 2020/2021	$7.00	$ 2,837,300	$ 820,000	$ (672,242)	$ (339,753)	$ (191,995)	$ 2,645,305
FY 2021/2022	$7.00	$ 2,645,305	$ 820,000	$ (705,854)	$ (339,753)	$ (225,607)	$ 2,419,698

2013 Stormwater Reserve:	$	3,410,165
2022 Stormwater Reserve:	$	2,419,698

Notes:

1. The current utility structure has rate of $5.00 for residential ERU and $7.50 for non-residential ERU.
2. This scenario is based on a tiered residential structure (Single Family Unit SFU).
3. A revenue collection rate of 95% is considered.

5.7 Funding Recommendations

CDM Smith reviewed the available financial information of the three most recent consolidated financial reports. The review showed steady net revenue from the current stormwater utility of $750,000 per year, compared to an average yearly operation and maintenance expense of $455,000. The most recent estimate of the stormwater reserve in June 2011 was $3,410,165, which provides a base for the funding the construction of capital improvement projects.

CDM Smith recommends that the City start recording staff allocations under stormwater to properly track costs and revenues. In fact, the current expenses do not capture significant efforts such as storm clean-up and street sweeping. It is CDM Smith opinion that the current estimate of $455,000 of stormwater operation and maintenance is substantially low, and that proper allocation of street sweeping, and storm clean-up activities, will provide a better estimate. In this evaluation CDM Smith considered that the average O&M cost of $455,000 per year is expected to increase at a rate of 5 percent in the upcoming years. If the City makes additional adjustments or projects a different O&M budget for upcoming years, the projections shown in this report shall be updated.

The information provided in this report section also includes a review of the current stormwater utility rate structure, which was established in 1994, and could be revised to consider recent trends in other Florida coastal communities. CDM Smith identified several updates to the stormwater utility that could increase its yearly revenue, improve its fairness, and update the methodology based on more recent information than that used in 1995 to set up the original stormwater fee. Among the options available to the City are the following:

- Set the same billing rate for both residential and non-residential customers
- Eliminate the current 10-ERU limit for non-residential customers
- Potentially adjust the ERU base from the current 2,000 sq-ft
- Implement a tiered residential rate structure (SFU)

CDM Smith considered six revenue scenarios that would allow the implementation of the capital improvement projects identified in this Phase 1 of the stormwater master plan update. The six scenarios include different options ranging from establishing additional bond capacity, differing projects as funds become available, or adjusting the stormwater utility rate. The current rates of $5 and $7.5 per ERU per month are about the average charged by most cities in the State of Florida. CDM Smith provides as a reference the rates charged by other cities and counties in the State, dated July 2011, in **Table 5-14**. Nevertheless CDM Smith recommends eliminating the dual fee for residential and non-residential customers since the basis of a stormwater utility is the runoff generated by an impervious area, regardless of its use.

The impact to the utility yearly revenue associated with each one of these adjustments was estimated by CDM Smith and summarized in **Table 5-15.**

The first three scenarios are considered high risk, because there are residential customers with impervious areas that are as much as four times larger than others that pay the same fee. Therefore, CDM Smith recommends addressing the issue before it becomes a necessity based on complaints from residents, particularly if other adjustments are going to be made.

The tiered scenarios provide a more equitable and fair methodology that will set a fee structure based on the most recent utilities, and has low risk of being contested for many years to come. Among scenarios 4, 5 and 6, CDM Smith recommends scenario 5 because it provides a yearly revenue that will allow the City to continue to fund stormwater projects, after the implementation of this phase 1 of the stormwater master plan. Scenario 5 can also reduce the initial impact to customers since many customer classes will see an initial reduction in their fee.

CDM Smith also recommends involving the public before introducing a significant change to the stormwater utility. Experience shows that the chances of receiving approval for a new utility, or a significant change to the fee structure, are much higher when the public is involved through a stormwater committee.

Table 5-14 List of Stormwater Utility Fees for Cities and Counties in Florida

Stormwater Utility	Monthly Rate per ERU	Stormwater Utility	Monthly Rate per ERU	Stormwater Utility	Monthly Rate per ERU	Stormwater Utility	Monthly Rate per ERU
Cities							
Altamonte Springs	$6.75	Fort Lauderdale	$3.58	Margate	$3.57	Pompano Beach	$3.00
Apopka	$2.08	Fort Meade	$4.25	Medley	$3.00	Port Orange	$8.25
Atlantic Beach	$5.00	Fort Myers	$4.80	Melbourne	$1.80	Port St. Lucie	$10.25
Auburndale	$0.75	Fort Pierce	$4.50	Melbourne Beach	$3.00	Riviera Beach	$4.50
Aventura	$2.50	Fort Walton Beach	$3.00	Miami	$3.50	Rockledge	$3.75
Bartow	$3.75	Frostproof	$3.00	Miami Beach	$9.06	Safety Harbor	$3.75
Bay Harbor Islands	$5.00	Fruitland Park	$2.00	Miami Gardens	$4.00	Sanford	$6.79
Belle Isle	$4.00	Gainesville	$8.15	Miami Shores	$3.75	Satellite Beach	$4.50
Boca Raton	$2.90	Golden Beach	$2.92	Miami Springs	$3.67	South Daytona	$5.00
Boynton Beach	$5.00	Gulfport	$2.87	Minneola	$4.00	South Miami	$3.00
Bradenton	$2.50	Haines City	$2.00	Miramar	$2.50	St. Augustine	$5.00
Bradenton Beach	$8.33	Hallandale Beach	$2.50	Mount Dora	$5.00	St. Cloud	$6.35
Cape Canaveral	$3.00	Hialeah	$2.50	Mulberry	$4.00	St. Petersburg	$6.85
Cape Coral	$6.25	Hialeah Gardens	$2.00	Naples	$12.00	Stuart	$3.76
Casselberry	$7.00	Holly Hill	$6.00	Neptune Beach	$3.00	Sunny Isles Beach	$2.50
Clearwater	$12.51	Hollywood	$3.22	New Port Richey	$3.36	Sunrise	$4.50
Clermont	$3.00	Holmes Beach	$4.50	New Smyrna Beach	$2.50	Surfside	$2.50
Cocoa	$5.00	Homestead	$3.18	Niceville	$4.25	Sweetwater	$2.50
Cocoa Beach	$6.00	Indian Creek	$4.39	North Bay Village	$2.25	Tallahassee	$7.95
Coconut Creek	$3.22	Indian Harbour Beach	$3.00	North Lauderdale	$3.00	Tamarac	$9.58
Cooper City	$20.80	0 Jacksonville	$5.00	North Miami	$5.64	Tampa	$3.00
Coral Gables	$3.50	Jacksonville Beach	$5.00	North Miami Beach	$4.50	Tarpon Springs	$5.65
Cutler Bay	$4.00	Jupiter	$4.37	Oakland Park	$6.00	Tavares	$4.50
Daytona Beach	$7.48	Key Biscayne	$7.50	Ocala	$4.00	Tequesta	$7.13
Debary	$7.00	Key West	$7.05	Ocoee	$7.00	Titusville	$6.15
Deland	$5.81	Kissimmee	$7.38	Oldsmar	$3.00	Treasure Island	$3.36
Delray Beach	$5.33	Lake Alfred	$2.00	Opa-Locka	$1.90	Venice	$5.00
Deltona	$6.26	Lake Mary	$3.00	Orlando	$9.99	West Melbourne	$3.00
Doral	$4.00	Lake Worth	$5.80	Ormond Beach	$5.00	West Miami	$2.50
Dundee	$1.00	Lakeland	$6.00	Oviedo	$4.00	West Palm Beach	$8.48
Dunedin	$7.40	Largo	$4.45	Palm Coast	$8.00	Wilton Manors	$3.50
Eagle Lake	$4.00	Lauderdale Lakes	$4.57	Palmetto	$3.68	Winter Garden	$4.00
Eatonville	$4.95	Lauderhill	$12.19	Pembroke Park	$6.25	Winter Haven	$2.68
Edgewater	$8.00	Leesburg	$6.00	Pensacola	$4.40	Winter Park	$11.56
El Portal	$3.00	Longwood	$6.00	Pinecrest	$4.00	Winter Springs	$5.50
Eustis	$3.00	Madeira Beach	$5.00	Plant City	$5.50		
Florida City	$2.50	Malabar	$3.00	Polk City	$1.50		
Counties							
Bay County	$3.33	Hillsborough County	$1.00	Miami-Dade County	$4.00	Volusia County	$6.00
Brevard County	$3.00	Leon County	$1.67	Pasco County	$3.92		
Charlotte County*	$10.71	Marion County	$1.25	Sarasota County	$7.55		
Summary: Cities		**Summary: Counties**					
Number	146	Number	10				
Average	$4.89	Average	$4.24				
Minimum	$0.75	Minimum	$1.00				
Maximum	$20.80	Maximum	$10.71				

Note: * per acre

Table provided by the Florida Stormwater Association (FSA)

Table 5-15
Summary of revenue scenarios for 10-year implementation of proposed capital improvements.

Scenario	Basis [1]	Risk	Monthly Rate [2]	Debt Service	2022 Stormwater Reserve [3]
1	ERU	High	$5.00	Pay as you go	$ (77,905)
2	ERU	High	$5.00(2013) $6.00(2017)	Pay as you go	$ 962,095
3	ERU	High	$5.00	Dedicated Bond	$ 2,059,698
4	SFU (Tier)	Low	$7.00	Pay as you go	$ 282,095
5	SFU (Tier)	Low	$7.00(2013) $8.00(2017)	Pay as you go	$ 992,095
6	SFU (Tier)	Low	$7.00	Dedicated Bond	$ 2,419,698

Notes:

1. The current stormwater utility is based on an Equivalent Residential Unit (ERU) of 2,000 square feet.
2. The current utility structure has a monthly rate of $5.00 for residential ERU and $7.50 for non-residential ERU.
3. The stormwater reserve as of 2012 is $3,410,265. The value shown in this column is the projected stormwater reserve in 2022 after the implementation of the proposed projects.
4. A positive change in the stormwater reserve means that the utility revenue exceeds the projected expenses over a 10 year period.
5. All scenarios are based on a revenue collection rate of 95%.

Section 6
Conclusions and Recommendations

The City has worked since the 1995 SFMP to reduce the severity of flooding and increase the LOS citywide. The current SWMPU developed a citywide hydrologic model, then developed a detailed hydrologic and hydraulic (H&H) model for three specific priority areas and used the model to propose potential improvements for each area. Also included in the City SWMPU is an evaluation of the current utility rate structure and potential adjustments that could be made to match projected expenses.

6.1 Data and Hydrologic-Hydraulic Model

The first three sections of the master plan presented data collection and evaluation, development of a citywide hydrologic model, and the requirements to develop a hydraulic model.

Section 1 focused on data collection and evaluation. This task involved reviewing the 1995 SWMP, obtaining GIS datasets from various entities, compiling flood complaints, converting vertical datums (NGVD29 to NAVD88), and conducting site visits.

In Section 2, the development of the citywide hydrologic model was discussed. The basin delineation methodology was thoroughly explained and the HU naming convention was established. The discussion of hydrologic analysis included topographic data, soil classes, and land use across the City and how these characteristics were used to establish unique hydrologic parameters for each HU. Rainfall data from SJRWMD was presented and boundary conditions and stillwater elevations were determined from the FEMA FIS. The result of the hydrologic evaluation was in the form of defined HUs for the entire city with unique IDs, as shown on Figure 2-1. The parameters for each individual hydrologic unit are summarized in Appendix A, and will provide the basis for future project planning and design.

For the hydraulic model schematic development in Section 3, PSWMS was defined for the entire city. The purpose of links and nodes in the SWMM was explained, along with the naming convention of each component. The stage-area relationships were explained in SWMM. Entrance and exit losses from the model, bridge and roadway overflow modeling, and model calibration were explained. The objective of the hydraulic schematic is to determine the connectivity of the system, and the first step toward the development of a citywide stormwater model to identify flood control LOS and identify solutions for the problem areas. The model can also be used for new and redevelopment reviews in the future.

6.2 Level of Service

Based on the results from the evaluation of the pilot areas described in Section 4, CDM Smith proposes a defined flood control LOS for stormwater. The LOS is the basis for determining problem areas, stormwater facility needs, comparing projects against each other, as well as providing guidance to future proposed projects. Section 3.7 describes in greater detail the LOS, which can be summarized as follows:

- Local roads shall be passable for the 5-year/24-hour design storm (6.3 inches)

- Arterial and collector roads shall be passable for the 50-year/24-hour design storm (11 inches). This is particularly relevant to ambulances, police vehicles, and fire fighters that need to be able to reach residents in the event of a major flood or evacuation scenario.
- Structures shall not flood up to the 100-year/24-hour design storm (12.8 inches).
- Design tidal condition set at 2.2 ft NAVD, which is equivalent to the 1-year stillwater condition.

A separate set of goals for the historical downtown area might have to be further relaxed due to the constraints associated with the construction and high implementation costs. In the case of the Lake Maria Sanchez outfall described in Section 4.3.3 the proposed improvements were sized to meet the mean annual storm (Alternative 4) instead of the 5-year/2- hour design storm (Alternative 3), because there is an increase of $1.3 million cost difference between the two. In similar fashion other projects in the historical downtown area would have to be balanced to have an acceptable cost/benefit ratio.

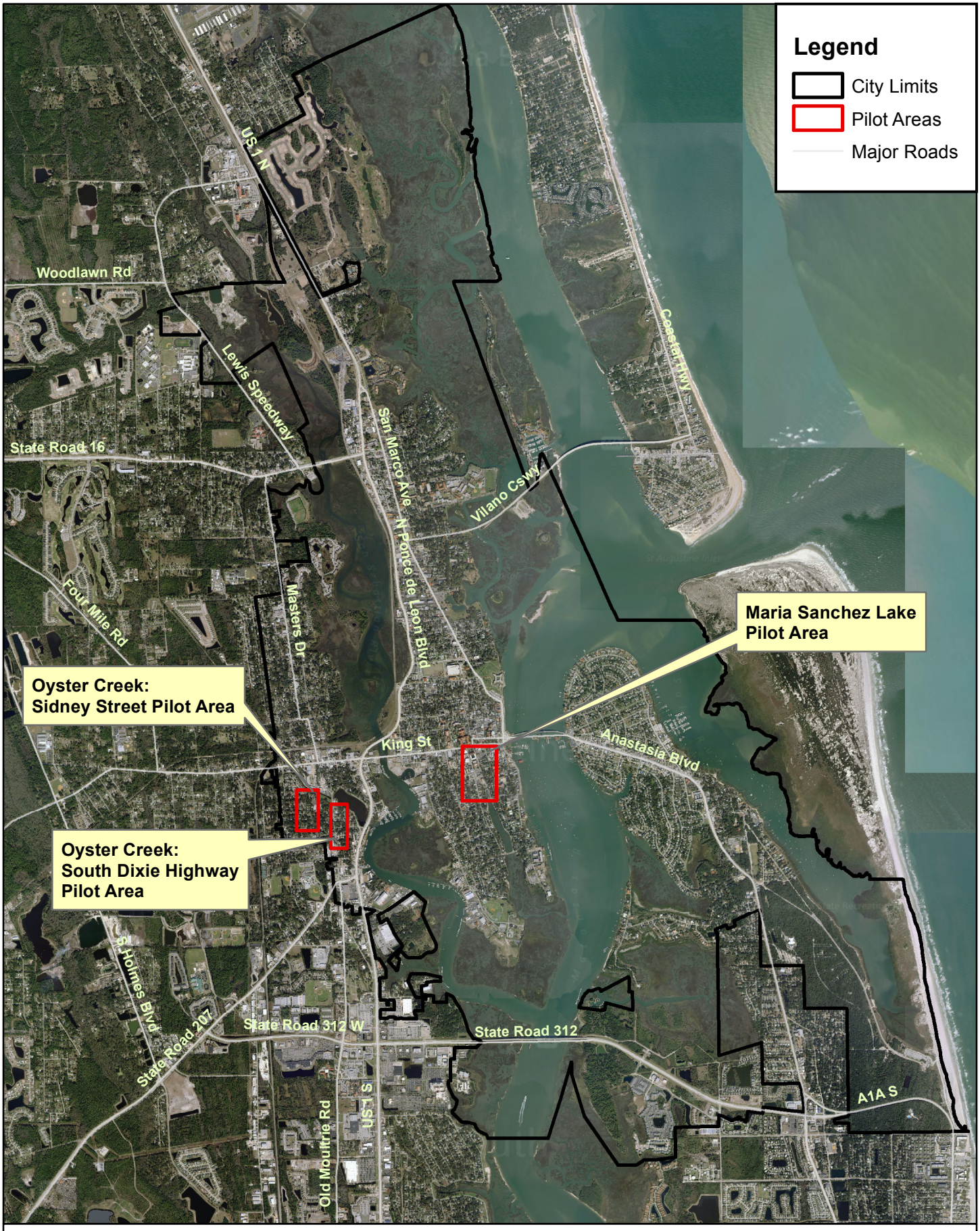
6.3 Pilot Area Stormwater Improvements

The stormwater pilot areas that were selected are described in detail in Section 4. The selection process considered a short list of criteria that are provided in the section. After evaluation of problem areas, three watersheds were found to meet the criteria and two were selected: Oyster Creek and Maria Sanchez Lake. CDM Smith identified three separate projects in the two areas as shown on **Figure 6-1** and in **Table 6-1**.

Table 6-1 Stormwater Projects Identified in Pilot Areas

Project	Watershed	Conceptual Cost Estimate
Sidney Street outfall improvements	Oyster Creek	$360,000
South Dixie Highway outfall improvements	Oyster Creek	$2,891,000
Cordova/Granada/Bridge Street Improvements	Maria Sanchez	$3,073,000

Oyster Creek: Sidney Street Pilot Area failed to meet LOS at one location at Sidney Street and Christopher Street. However, there were several locations that regularly experienced nuisance flooding due to the absence of a stormwater system and lack of curb inlets at ditch crossings. The proposed improvements will address the 5 year LOS and also fix the nuisance flooding. The improvements include a 15 inch collector along Sidney, which then is increased to an 18 inch collector and discharges into a newly constructed wet detention pond at the corner of Sidney Street and Christopher Street. The wet detention pond was sized to meet permitting criteria, but might be reduced if St. Johns River Water Management District allows consideration for potential treatment in the Oyster Creek impoundment upstream of the FDOT weir. The conceptual capital cost estimate for this improvement is $360,000.



CDM Smith

0 0.25 0.5 1 Miles

Figure 6-1
Pilot Area Stormwater Improvements
City of St. Augustine

Oyster Creek: South Dixie Highway Pilot Area failed to meet LOS at several locations along South Dixie Highway. The intersection of South Dixie and River Drive, Anderson Street, and Carey Street; with flooding at Carey Street and Rio Vista Drive also failed to meet LOS. The proposed improvements include extending the stormwater system up to River Drive and upsizing piping down South Dixie Highway to Carey Street and Rio Vista Drive. A wet detention pond south of Oyster Creek Pond is to be installed for treatment and attenuation. Similar to the Sidney Street pilot area project, it might be possible to consider water quality credits in the Oyster Creek impoundment upstream of the existing FDOT weir that would reduce the size of the proposed wet detention pond. The conceptual cost estimate of $2,891,000 for this improvement includes rehabilitation and widening of the road currently being designed by others.

The Maria Sanchez Lake Pilot Area experiences chronic flooding conditions, in addition to cost and constructability limitations since the area is completely built-out. There are no records of home or structural flooding at this time; therefore, the flooding impact is potentially limited to traffic disruption and nuisance to residents and visitors.

CDM Smith evaluated the improvements designed in 2002 by the City (Alternative 1) with the intent of evaluating the 5-year LOS within the project area. After reviewing the model results it was determined that conventional circular pipe conveyance would not solve the flooding issues. The next iteration (Alternative 2) introduced culverts to better perform in high tide conditions, but still could not meet the 5-year LOS. The subsequent iteration (Alternative 3) added additional storage in the form of an underground vault located that collected runoff from the Granada Street system, which met the 5-year LOS, with a conceptual cost estimate of $3.5 million. Given the magnitude of the underground storage, pipe improvements and roadway reconstruction required, CDM Smith proposed a smaller project that could meet the mean annual storm, which has a 2.3-year recurrence interval. The final proposed improvement (Alternative 4) includes replacing the existing piping system with box culverts, a stormwater vault system for additional storage and to create a wet well, and a drawdown pump to drain the vault after storm events. The improvements will allow the project area to meet the mean annual storm LOS, and reduce the number of locations that do not meet the 5-year LOS. Alternative 4 requires fewer pipe improvements, smaller culvert sizes, and does not disturb roads in the vicinity of King Street; which ultimately results in significant cost savings. The project also includes regrading Cordova Street south of Bridge Street to promote flooding to the centerline of the road (inverted crown), and effectively use the road as part of the conveyance system for intense storms. The cost for the implementation of Alternative 4 for the Maria Sanchez Lake Improvement is estimated at $3.1 million. The project includes first flush inlets and the vault itself that will apply towards water quality treatment requirements, in conjunction with potential treatment credits from Maria Sanchez Lake.

In the evaluation of the Maria Sanchez Lake area, CDM Smith also considered the future benefits to the Treasury Street outfall. Section 4.3.3.7 of this report estimated the flooding volumes in the Treasury Street area, and show that it might be possible to consider a combination of the following methods to reduce flooding in the historical district:

- Increase the diameter of existing pipes up to 6 inches through pipe bursting. CDM Smith estimated ponding volume reduction of 50% for the 5 year storm by upsizing existing pipes by 6 inches in diameter in the Treasury outfall (from Cordova Street_ to Charlotte Street), without upsizing the FDOT pipes associated with Avenida Menendez.

- Consider land acquisition, or treatment right of way to construct a stormwater pump station under one of the existing parking lots along Treasury Street. The outflow from this pump station should be combined with either the Maria Sanchez Lake, or with other outfall improvements such as those along King Street.

6.4 City Ordinance Recommendations

Based on the field observations and the results of the evaluations of this report, CDM Smith recommends considering updates to the current stormwater ordinance.

Control of Erosion From Coquina Parking Lots and Driveways

The current *use of coquina* material for driveways is generating a significant amount of sand and sediment load to the City stormwater infrastructure. The current load originated from coquina and unpaved driveways is clogging inlets, and pipes exacerbating the flood conditions in areas such as South Dixie, Comares Avenue, and Riberia Street. The City ordinance could be updated to allow the use of Coquina only if the site grading allows to pre-treat runoff and remove the sand prior to discharging into the City inlets and pipes. A common method to achieve this consists in requiring a recess of the proposed driveway, to allow temporary ponding and retention of sediments prior to runoff discharge to the City stormwater system. An alternative solution consists in grading the site to promote runoff to a swale, or permeable cover prior to discharge to the City infrastructure.

Finished Floor Elevations

Most structures in the City have a *finished floor elevation* that is elevated from the existing grade, which protects them from chronic flooding. The current ordinance states that new structures and substantial improvements need to have a finished flood elevation at or above the FEMA base flood elevation, which is based on a tidal surge. The latest FEMA study estimates base flood elevations of 9 ft NAVD in the downtown area for tidal surge conditions.

Floodplain Storage and Conveyance

The current floodplain ordinance requires an engineering analysis that "demonstrates that the flood carrying capacity of the altered or relocated portion of the water course will not be decreased". This is common accepted practice in agreement with FEMA guidance, but is does not account for the protection of *floodplain storage*. In fact, in tidal influenced areas, with mild slopes, the actual conveyance is limited by the tailwater condition and floodplain storage plays a critical role. CDM Smith recommends modifying the ordinance to require that the engineering analysis includes the conveyance capacity as well as the floodplain storage. This will prevent cumulative adverse impacts from loss of storage and conveyance for development and redevelopment.

Runoff Collection and Landscaping

It is recommended that the City encourage the use of landscape areas for the collection, storage, and harvesting (reuse) of stormwater runoff. This can be done in conjunction with rain barrels or cisterns as noted in the next section.

6.5 Low Impact Development

The City is built out and has limited land available to implement traditional Low Impact Development (LID) technology (also called green infrastructure). The process for determining what systems to select for evaluation is based on regulatory acceptance, applicability, and established design information. Since the City has implemented a stormwater utility, there are opportunities to promote

the use of stormwater best management practices (BMPs) and LID through a credit policy. In cases of *redevelopment*, or even new construction the City can promote the use of low impact development practices that can further reduce the runoff volume and can pre-treat stormwater.

Rain barrels or cisterns can be an effective way to collect, store, and reuse water particularly when combined with nearby garden and lawn irrigation. The volume of treatment provided by these BMPs is not significant, but does reduce the size and cost of downstream facilities. Several communities are implementing rain barrels as another effective tool to educate the public about stormwater and to promote water reuse. Some citywide programs distribute free or discounted rain barrels to residents, such as the City of New York, Philadelphia and Portland. The ideal setup of a rain barrel is close to gardens and lawns to re-use its water for irrigation. A citywide program with educational materials can promote the use in individual homes, and can keep track of their location for water quality credits NPDES permits.

Rain Barrel Pilot Program

The City could start a pilot program on City-owned buildings to educate its residents and evaluate the appropriate size, setup and aesthetics of the rain barrel that would be most appropriate for the City. CDM Smith estimated that the City Hall building could have up to 40 rain barrels with volumes ranging from 50 to 100 gallons per barrel. This is equivalent to 0.1 inch retention volume based on a roof area of 53,000 sq-ft, or potentially up to 4,000 gallons per storm. Rain barrels can be customized to meet the architectural criteria of the historical area. The rain barrels can discharge directly to landscape and garden areas, to a swale or the street, and/or as appropriate, be connected to drip irrigation systems for landscape areas or gardens.

Figure 6-2
Potential locations for the installation of rain barrels at the City Hall building. Ideal locations are adjacent to pervious and vegetated areas for irrigation. Other areas should be considered as an educational tool to promote water reuse.

Bioretention (also called landscape swales or rain gardens) are recessed vegetative areas on a property that detains stormwater runoff. The runoff is filtered and treated by the vegetation and soil. This BMP can be implemented in private gardens and individual landscaping plans.

Exfiltration trenches (also can be called infiltration trenches) are sub-surface retention areas with perforated pipes and significant pore space for runoff storage. The trench is filled with a perforated pipe and gravel, or crushed stone, in order to manage the volume of on-site runoff. Stormwater is filtered through the stone and exfiltrates into the native soil.

6.6 Stormwater Utility Evaluation

Since 1993 the City of St. Augustine has a utility as a dedicated funding source for stormwater functions, including both capital and operation/maintenance. CDM Smith reviewed the financial reports of 2010, 2011 and 2012 to identify the magnitude of revenues and expenses. The yearly revenue has been steady, with an average of $743,000 per year, while expenses are much lower due to the way they are classified. The city should consider paying for storm clean-up activities, and street sweeping as part of the stormwater activities listed in the NPDES program, as well as transferring associated staff under the stormwater activity.

CDM Smith reviewed the current utility rate structure and provided several recommendations to improve its accuracy and fairness. Six different scenarios were presented, among which CDM Smith recommends Scenario No. 5, to implement a tiered residential structure with an escalating monthly fee up to $8.00/month. The proposed new rate structure will also eliminate the dual rate between residential and non-residential structures, as well as eliminating the current 10 ERU cap on non-residential customers.

Given the nature of the changes recommended, CDM Smith advises the City to engage the public through public education and a stormwater committee to ensure that there is public is a participant from the beginning.

6.7 Future Phases

This first phase of the SWMPU developed the foundational tools to support the preparation of a citywide stormwater capital improvement program, including:

- hydrologic and tidal condition boundaries
- primary stormwater management system GIS database
- pilot study area H/H models
- recommended pilot area improvement
- recommendations for ordinance refinements and LID, coordination with FDOT and St Johns County, and stormwater utility rates and credits

The City can use the hydrologic-hydraulic models for development and redevelopment reviews and to support design and permitting of other public works projects to identify joint project opportunities and cost savings. In Phase II, the models can also be extended as needed for the remainder of the City's tributary areas to evaluate additional areas for stormwater runoff, flows, flood stages, and velocities.

Currently St. Johns County is developing a countywide stormwater master plan that includes watersheds such as Oyster Creek that flow into the city limits of St. Augustine. The City should coordinate with the County to identify joint project opportunities in this basin, and ensure that there are no increases in peak stages, flows or velocities from upstream projects.

In general, continued coordination with FDOT will provide opportunities for joint projects and cost savings since many City systems discharge through FDOT outfalls. FDOT has an ongoing design for roadway improvements along May Street. CDM Smith recommends that the City coordinate with FDOT to consider offsite runoff that is currently being routed by the roadway collection system, and select the stormwater components considering operation and maintenance issues. Such coordination will be even more relevant for the King Street outfall, where the City and FDOT face constructability challenges due to the historical and urban nature of the area.

APPENDIX A

Appendix A

Citywide Hydrologic Parameters

Name	Area	Width	%Imperv	%Slope	Outlet
HUFI1000	610.9	17527	57.8	0.55	MZ2490
HUHC1000	18.1	937	24.2	0.57	HC1000
HUHC1010	15	864	23.2	0.5	HC1010
HUHC1020	7.9	689	23	0.61	HC1020
HUHC1030	18.7	1076	76.1	0.59	HC1030
HUHC1040	10.1	930	28.3	0.56	HC1040
HUHC1050	6.9	559	34.9	0.5	HC1050
HUHC1060	8.3	691	37.1	0.56	HC1060
HUHC1070	6	464	48.9	0.61	HC1070
HUHC1080	2.5	337	49.7	1.48	HC1080
HUHC1090	3	418	81	1.3	HC1090
HUHC1100	6.3	1155	81	1.14	HC1100
HUHC1110	3.7	724	81	1.62	HC1110
HUHC1120	3.7	551	81	1.3	HC1120
HUHC1130	3.6	529	81	1.22	HC1130
HUHC1140	22.7	1080	81.1	0.41	HC1140
HUHC1150	18.8	1410	41.4	0.27	HC1150
HUHC1160	10.8	849	79.4	0.72	HC1160
HUHC1170	7.4	598	62.5	0.99	HC1170
HUHC1180	17.7	1645	43.4	0.71	HC1180
HUHC1190	10.7	353	30.4	0.31	HC1190
HUHC1195	17.4	1235	8.7	0.74	HC1195
HUHC1200	10.9	1697	51.2	1.11	HC1200
HUHC1210	9.2	1235	17.6	0.32	HC1210
HUHC1220	4.7	582	68	0.74	HC1220
HUHC1230	5.4	695	60.3	0.56	HC1230
HUHC1250	7.2	900	18.8	1.84	HC1250
HUHC1270	33.1	2933	49.7	1.18	HC1270
HUHC1280	11.9	730	57.5	0.48	HC1280
HUHC1290	3.8	659	65.4	0.53	HC1290
HUHC1300	3.8	322	69.6	0.36	HC1300
HUHC1320	2.1	708	66.1	1.94	HC1320
HUHC1330	2.1	278	73.6	0.77	HC1330
HUHC1340	5.1	855	69.6	1.09	HC1340
HUHC1350	2	641	60.3	2.12	HC1350
HUIC1000	42.7	4626	10.2	1.45	IC1000
HUMZ1000	19.3	3113	6	0.76	MZ1000
HUMZ1010	5.1	480	67.3	0.25	MZ1010
HUMZ1020	6.7	648	78.3	0.58	MZ1020

Name	Area	Width	%Imperv	%Slope	Outlet
HUMZ1030	3.3	1074	81	1.11	MZ1030
HUMZ1040	2.8	277	81	0.33	MZ1040
HUMZ1045	4.6	578	76.1	0.64	MZ1045
HUMZ1050	5.7	703	81	0.42	MZ1050
HUMZ1055	3.3	572	81	0.68	MZ1055
HUMZ1060	1.9	462	81	0.6	MZ1060
HUMZ1065	4.5	631	81	1.01	MZ1065
HUMZ1070	7.9	491	78.8	0.38	MZ1070
HUMZ1080	2.9	780	48.8	2.65	MZ1080
HUMZ1090	2.4	337	81	0.79	MZ1090
HUMZ1100	2.9	629	79.7	0.62	MZ1100
HUMZ1110A	2.4	297	81	1.05	MZ1110A
HUMZ1110B	1	459	81	1.93	MZ1110B
HUMZ1120A	8.8	1032	80.5	1.31	MZ1120A
HUMZ1120B	3.7	816	76.2	2.01	MZ1120B
HUMZ1130A	3.4	504	77	1.09	MZ1130A
HUMZ1130B	3	765	69.4	1.44	MZ1130B
HUMZ1140	4.6	731	70.6	1.52	MZ1140
HUMZ1150	1.7	278	74.2	0.87	MZ1150
HUMZ1160	5.4	968	65	2.17	MZ1160
HUMZ1180	6.5	1333	70.1	2.08	MZ1180
HUMZ1190	2.1	682	71.3	3.12	MZ1190
HUMZ1200	7.2	1056	74.3	1.29	MZ1200
HUMZ1220	5.3	361	69.5	0.56	MZ1220
HUMZ1230	2.6	775	76.1	2.82	MZ1230
HUMZ1240	2.4	461	77.2	1.25	MZ1240
HUMZ1250	11.7	581	72.9	0.32	MZ1250
HUMZ1260	7.2	613	65.3	0.35	MZ1260
HUMZ1280	9	940	66	0.67	MZ1280
HUMZ1290	8.4	740	65.1	0.54	MZ1290
HUMZ1300	8.3	584	65.1	0.79	MZ1300
HUMZ1310	8.9	586	65.3	0.59	MZ1310
HUMZ1320	15.1	766	65.5	0.42	MZ1320
HUMZ1330	26.1	1903	32.3	0.74	MZ1330
HUMZ1350	2.9	356	65.6	0.62	MZ1350
HUMZ1360	4.8	823	66	0.62	MZ1360
HUMZ1370	4.5	614	78.2	1.52	MZ1370
HUMZ1380	4.1	577	66.3	1.13	MZ1380
HUMZ1390	5.9	1199	79.6	2.39	MZ1390
HUMZ1400	9.5	1300	81.1	1.15	MZ1400
HUMZ2000	4.6	779	23	0.52	MZ2000
HUMZ2010	6.9	1154	23	1.03	MZ2010

Name	Area	Width	%Imperv	%Slope	Outlet
HUMZ2020	7.5	1105	23	0.99	MZ2020
HUMZ2030	4	627	23	0.84	MZ2030
HUMZ2040	5.3	452	23	0.38	MZ2040
HUMZ2050	6.3	1049	23	1.26	MZ2050
HUMZ2060	15.7	2201	23	1.06	MZ2060
HUMZ2080	4.7	1028	23	1.17	MZ2080
HUMZ2090	4.6	686	23	0.56	MZ2090
HUMZ2100	5.6	374	23	0.62	MZ2100
HUMZ2110	13.3	1162	23	0.48	MZ2110
HUMZ2130	4.9	1309	23	1.56	MZ2130
HUMZ2140	13.1	1493	30.9	0.53	MZ2140
HUMZ2150	2.8	765	23	1.95	MZ2150
HUMZ2160	3.6	491	23	0.61	MZ2160
HUMZ2170	14.5	996	41.5	0.33	MZ2170
HUMZ2180	4.9	504	25.9	0.67	MZ2180
HUMZ2190	15.3	3874	80.1	2.18	MZ2190
HUMZ2200	4.7	537	47.1	0.49	MZ2200
HUMZ2210	12.3	1357	31.1	0.77	MZ2210
HUMZ2230	12.4	1108	23.7	0.54	MZ2230
HUMZ2240	4.9	506	49.8	0.31	MZ2240
HUMZ2250	18.9	1737	45.1	0.27	MZ2250
HUMZ2270	4.8	671	55	0.69	MZ2270
HUMZ2280	10.8	1147	23.5	0.46	MZ2280
HUMZ2290	7.6	643	23	0.3	MZ2290
HUMZ2300	10.4	580	23	0.39	MZ2300
HUMZ2310	11.1	579	30.8	0.3	MZ2310
HUMZ2320	25.8	956	36.7	0.08	MZ2320
HUMZ2340	12.9	999	23.6	0.5	MZ2340
HUMZ2350	0.7	224	81	1.26	MZ2350
HUMZ2360	0.5	161	81	1.37	MZ2360
HUMZ2370	5	1076	81	2.6	MZ2370
HUMZ2380	9.5	1615	81	0.99	MZ2380
HUMZ2400	1.8	419	81	1.68	MZ2400
HUMZ2480	10.7	2794	9.4	3.55	MZ2480
HUOC1000	3	1167	79.4	2.48	OC1000
HUOC1010	5.6	938	36.2	0.98	OC1010
HUOC1020	22.3	1174	65.4	1.23	OC1020
HUOC1030	8.4	1071	45.2	3.15	OC1030
HUOC1040	12.4	1422	31	3.19	OC1040
HUOC1050	15.2	1824	36.1	2.18	OC1050
HUOC1060	3.6	559	81	1.31	OC1060

Name	Area	Width	%Imperv	%Slope	Outlet
HUOC1070	39.3	2280	21.6	2.09	OC1070
HUOC1080	16.5	1399	31.3	1.68	OC1080
HUOC1090	4.3	338	23	1.95	OC1090
HUOC1100	16.3	588	31.4	1.42	OC1100
HUOC1110	4.4	445	23	2.15	OC1110
HUOC1120	18.9	819	23.1	1.32	OC1120
HUOC1130	12.8	850	32.3	0.8	OC1130
HUOC1140	15.5	507	29	0.74	OC1140
HUOC1160	12.8	640	95.9	0.05	OC1160
HUPC1000	57.4	5634	20.8	0.98	PC1000
HUPC1010	21.8	1269	10.3	0.64	PC1010
HUPC1020	23.9	2779	8.9	0.94	PC1020
HUPI1000	223.8	11749	42.8	0.59	PI1000
HUQU2330	8.3	912	23	0.49	QU2330
HUQU2350	13.3	1022	21.6	0.48	QU2350
HUQU2360	9	436	23	0.21	QU2360
HUQU2370	5.3	658	23	0.58	QU2370
HUQU2380	20.9	535	49.5	0.18	QU2380
HUQU2390	27.3	1168	60.6	0.95	QU2390
HUQU2400	20.4	1188	20.9	1.29	QU2400
HUQU2420	7.7	1255	17.8	5.12	QU2420
HUQU2430	21.7	1487	23.4	2.67	QU2430
HUQU2440	14.8	1198	23.4	1.85	QU2440
HUQU2450	10.6	1986	28.6	0.79	QU2450
HUQU2470	13.7	2641	10.2	2.21	QU2470
HURC1000	183.9	8475	15.4	0.66	RC1000
HURC1010	37.1	3298	8.7	1.4	RC1010
HURC1020	39.7	8652	10.6	4.76	RC1020
HURC1030	52.2	2711	10.1	0.68	RC1030
HURC1040	83.3	3150	43.6	0.58	RC1040
HURC1050	9.4	982	76.2	0.95	RC1050
HURC1060	10.5	626	58.5	0.39	RC1060
HURC1070	4.7	465	81	0.78	RC1070
HURC1090	12.9	1170	45.2	0.91	RC1090
HURC1100	4.6	730	24.8	0.75	RC1100
HURC1110	14.3	1507	26.7	0.8	RC1110
HURH1000	90.2	4121	64.8	0.69	RH1000
HURH1010	30.4	1535	31.1	0.99	RH1010
HURH1020	12.6	1273	1.5	1.46	RH1020
HUSR1000	3.7	680	23	0.46	SR1000
HUSR1010	3.7	601	23	0.47	SR1010
HUSR1020	4.7	1248	23	2.17	SR1020
HUSR1030	3.6	497	23	0.67	SR1030

Name	Area	Width	%Imperv	%Slope	Outlet
HUSR1040	6.2	539	23	0.56	SR1040
HUSR1050	6.6	929	46.3	2.2	SR1050
HUSR1060	13.2	2009	50.9	0.16	SR1060
HUSR1070	14.7	777	48.4	0.33	SR1070
HUSR1080	10.2	731	45.2	0.17	SR1080
HUSR1090	111.2	8748	35.2	2.64	SR1090
HUSR1100	342.3	7718	21.6	0.81	SR1100
HUSR1110	163.8	1786	1.9	0.13	SR1110
HUSS1000	27.7	1673	25.4	0.69	SS1000
HUSS1010	59.4	2404	21.3	0.7	SS1010
HUSS1020	10.6	979	11	0.98	SS1020
HUSS1030	9	659	1	0.3	SS1030
HUSS1035	8.1	1949	65.9	3.85	SS1035
HUSS1040	28.7	1626	29.1	1.01	SS1040
HUSS1045	14.1	654	56.1	0.58	SS1045
HUSS1060	26	2572	75.7	1.53	SS1060
HUSS1080	4.3	327	43.9	1.18	SS1080
HUSS1090	25.9	1326	27.1	0.5	SS1090
HUSS1120	10.3	965	74.3	0.93	SS1120
HUSS1140	8.6	985	62	1.43	SS1140
HUSS1150	8.3	933	24.9	0.35	SS1150
HUSS1160	16.5	736	30.8	0.5	SS1160
HUSS1170	30	1053	23	0.65	SS1170
HUSS1180	17	597	23.6	0.41	SS1180
HUSS1190	7.3	1312	23	1.57	SS1190
HUSS1200	2.2	491	23	3	SS1200
HUSS1210	15.4	963	22.8	0.91	SS1210
HUSS1220	18.4	814	26	0.49	SS1220
HUSS1230	3.9	320	27.6	1.16	SS1230
HUSS1240	13	286	14.7	0.31	SS1240
HUSS1250	29.2	1216	73.4	0.91	SS1250
HUSS1260	8.7	1113	57.3	0.5	SS1260
HUSS1270	13.6	2281	58.6	1.63	SS1270
HUSS1280	8.5	1560	71.7	3.03	SS1280
HUSS1290	28.2	1489	74.1	1.13	SS1290
HUSS1300	48.7	1519	69.8	0.68	SS1300
HUSS1310	27	770	44.9	0.58	SS1310
HUSS1320	19.2	1937	15.5	1.35	SS1320
HUSS1330	137.8	3535	62.7	1.15	SS1330
HUSS2000	33.6	1154	6.8	0.4	SS2000
HUSS2010	32.7	1025	34	0.28	SS2010
HUSS2020	138.9	4386	30.8	0.36	SS2020

Name	Area	Width	%Imperv	%Slope	Outlet
HUSS2030	7	488	81	0.41	SS2030
HUSS2035	4.6	1087	81	1.03	SS2035
HUSS2040	10	2422	81	1.24	SS2040
HUSS2045	6.7	996	81	0.31	SS2045
HUSS2050	13	2817	81	0.87	SS2050
HUSS2055	9.9	1659	81	1.47	SS2055
HUSS2060	6.6	731	81	0.5	SS2060
HUSS2070	8.9	1011	81	1.04	SS2070
HUSS2080	4.5	708	81	1.26	SS2080
HUSS2090	11.1	1578	74.1	0.66	SS2090
HUSS2100	13.1	1427	79.9	0.7	SS2100
HUSS2110	7.9	861	81	0.38	SS2110
HUSS2120	13	1191	73.1	0.49	SS2120
HUSS2130	6.1	1745	66.9	1.77	SS2130
HUSS2140	3.3	572	66.4	0.43	SS2140
HUSS2150	1.6	410	81	0.87	SS2150
HUSS2160	6.1	748	69.9	1.46	SS2160
HUSS2170	5.6	423	71.1	0.74	SS2170
HUSS2180	17.6	1962	48.9	1.19	SS2180
HUSS2210	16	2294	19.3	0.72	SS2210
HUSS2250	11.1	1009	56.3	0.38	SS2250
HUSS2260	0.9	138	1	1.01	SS2260
HUSS2280	6.7	847	70.4	0.52	SS2280
HUSS2300	10.8	1769	68.2	0.72	SS2300
HUSS2330	4.9	1374	65	1.07	SS2330
HUSS2340	1.1	339	65	0.74	SS2340
HUSS2350	2.5	463	77.3	0.82	SS2350
HUSS2360	8.6	875	68.6	0.61	SS2360
HUSS2370	6.9	822	66.8	0.7	SS2370
HUSS2390	4.5	1289	74.5	1.43	SS2390
HUSS2400	6.8	2670	81.5	2.48	SS2400
HUSS2410	5.5	738	56.5	0.77	SS2410
HUSS2430	10.3	968	71	1.32	SS2430
HUSS2440	5.2	903	58	0.87	SS2440
HUSS2480	17.1	1475	74.5	0.78	SS2480
HUSS2490	7	550	58.1	0.27	SS2490
HUSS2500	10.7	1748	3.5	1.51	SS2500
HUSS2510	25.4	1195	65.2	0.47	SS2510
HUSS2520	5	233	74.2	0.57	SS2520
HUSS2530	6.7	408	80.9	0.54	SS2530
HUSS2540	10.4	662	64.7	0.73	SS2540
HUSS2550	5.4	443	65.2	0.85	SS2550
HUSS2560	7.1	679	65.4	1.29	SS2560

Name	Area	Width	%Imperv	%Slope	Outlet
HUSS2570	2.5	197	12	0.79	SS2570
HUSS2580	8.9	463	64.8	0.54	SS2580
HUSS2590	23.2	1361	63.2	0.47	SS2590
HUSS2610	29	2121	1.4	1.51	SS2610

APPENDIX B

City of St. Augustine

Stormwater Utility Evaluation Kickoff Meeting

Friday January 6 2012 – 9AM – 4th Floor Conference Room - Public Works

Attendees:

City of St. Augustine: Martha Graham, Mark Litzinger, Meredith Braidenstein, Bill Mendez, Reuben Franklin.

CDM Smith: Patrick Victor, Steve Sedgwick, Michael Schmidt, José Maria Guzmán

Action Items:

1. CDMSmith will request utility and assessors data to Mark Litzinger before requesting it from St. Johns County.
2. The project schedule will be re-assessed after completion of Task D in April 2012. The project team discussed and accepted the attached scheduled for now as the basis until then.
3. Martha will provide to the group the information regarding past ordinances discussing the implementation of the stormwater utility.
4. Reuben will provide the database with the matching results of the stormwater utility customers performed by ATM.

Discussion Topics:

Project overview: CDMSmith introduced the project team, and described the objectives of both components of the project. The financial evaluation of the stormwater utility was the first item of discussion, involving the attendees listed above. In particular the group discussed potential limitations, or requirements to present results in coordination with next year budgets, or other ongoing financial activities within the City. Mark confirmed that since the fiscal year starts on October 1st, there is enough time to complete the evaluation and decide the next steps based on the attached schedule.

Task A: Stormwater utility review: CDMSmith will provide a report section outlining the results of the evaluation with the main objective of quantifying the impact of the updates of the current utility fee structure. For this task CDMSmith will need the updated databases of utility customers, county assessor, and parcels shapefile. The information shall include at least the following information for all customers and parcels: address, customer name, year built, legal description, heated square footage, and land use code.

Task B: Operation and maintenance needs and costs: CDMSmith will provide a summary of the current expenditures for operation and maintenance of stormwater infrastructure. Martha and Bill explained that currently the City adjusts the amount of O/M based on the funds available. Steve pointed out that

this analysis will allow to identify future expenditures associated with increased maintenance of new infrastructure.

Task C: Land use analysis: The objective of this task is to measure a significant sample of residential parcels within the City limits to confirm or update the current ERU value of 2,000 square feet. The current value was determined based on average values of other communities in Florida, without a specific evaluation of City parcels.

Task D: Rate methodology: Once the actual value of the equivalent residential unit (ERU) is determined in Task C, CDMSmith will develop a series of scenarios to allow the City to discuss potential updates to the fee structure. Some of the potential upgrades include residential tiers, and geographic districts. Once the City will have reviewed the results of Task D, the project team will meet to discuss the results and assess the schedule of the subsequent tasks.

Task E: Stormwater committee/meeting facilitation: This is a reimbursable task that allows the City to use CDMSmith staff to moderate and coordinate meetings with City staff, or a specific committee on the updates to the stormwater utility.

Task F: Credit policy and adjustment options: This task includes the preparation of a manual to provide credits. This task is usually the result of discussions with a stormwater committee or with a larger group than the project team. This task will be re-assessed depending on the results of tasks D and E.

City of St. Augustine, Florida
Stormwater Funding Evaluation

Scope of Services

September 27, 2011

Background

Camp Dresser & McKee Inc. (CDM) was selected for the update of the current stormwater master plan for the City of St. Augustine, Florida (City). CDM proposes to structure the work in phases to allow the project team to better define project goals, cost and funding. The following tasks provide details on work included in Phase 1.

Task A. Stormwater Utility Rate Review

The City will provide CDM with the database that contains the existing billing file by utility account number for all customers within the City limits. CDM will also utilize the latest parcel database as provided by St. Johns County with address information, owner, and parcel limits. Based on our preliminary review of the information, CDM will develop a common key between the parcel coverage and the utility database by geocoding addresses for the utility customers for up to 80% of the customers. Once the geocoding is complete a manual verification of location will be completed for all customers that exceed 1 ERU. CDM will utilize this information to develop a shape file that identifies the billing units by utility account that exceed one ERU per account and are less than 10 ERUs per account. This will be displayed graphically and will allow a comparison between the existing charges by utility account and the parcels that exceed 10 ERUs per account.

In addition to this data file, the City will provide CDM with the latest aerial photography, the parcel boundary shape files, the planimetric shape files, and the attribute data file for every parcel within the City. Within these data files, CDM will digitize those parcels/accounts that have a present multiplier of 10.0, approximately 150 accounts.

With these comparisons, CDM will identify the estimated billing units for those utility non residential accounts/parcels that are 10 ERUs. For example, if a utility account is charged 10.0 ERUs and has an approximate impervious area that represents 30 ERUs, this utility account will show an underbilling of 20 ERUs. With these values preliminary identified, CDM will generate the approximate increased revenue utilizing the present rate structure for the increased ERUs.

CDM will evaluate the alternatives to create a unique rate structure for both residential and non residential customers. A potential solution would create a user fee of $7.5/ERU for both residential and commercial. CDM will also provide a range of ERU user fees with the relative projected revenue, to allow City staff to consider options.

Following these analyses, CDM will present these results to the project team at a meeting scheduled by City staff. This meeting will be held at the convenience of the City representatives.

Deliverable:

- *Draft report section outlining the results of the stormwater utility review*

Task B. Operation and Maintenance Needs and Costs

The City will provide CDM with the existing expenditures for fiscal year 2009, 2010, and 2011 which represent all costs for stormwater services within the City. If there are any projected costs that have been approved by the City Council for future fiscal years (i.e., FY 2012 and beyond), these values will be provided to CDM for all expenditures, including capital improvement projects. Dependent upon the available data, CDM will utilize these three fiscal years as the basis for projecting costs for FY 2012 through FY 2014. If any data are generated for future stormwater projects that provide preliminary O&M cost information, these data will also be incorporated in this analysis.

CDM has performed many evaluations of cost components from other stormwater utilities in Florida, the Southeast, and 20 states east of the Rocky Mountains. With this database, CDM can assist the City in quantifying the approximate range of expenditures that could be anticipated during 2012 – 2032. That data will then be utilized to support Task C evaluations.

Deliverable:

- *Draft report section outlining the existing expenditures (FY2009-2011)*
- *Draft report section outlining the projected 20 year expenditure (FY 2012-2032)*

Task C. Land Use Analysis

Based upon the data provided to CDM in Task A, CDM will develop the following information: Utilizing statistically significant sampling, a completed land use analysis will be generated to identify impervious area estimates by residential and nonresidential categories. The preliminary evaluation of the existing utility database shows that there are 6,277 customers: 5,220 are residential and 1,057 are non residential. A total of 400 single family detached residential customers will be digitized along with a maximum of 400 multi family dwelling units; within the non residential customer file, CDM will delineate polygons that estimate the impervious are for all non residential customers below 10 ERUs.

Deliverable:

- *Shapefile identifying all the sampled parcels*

Task D. Rate Methodology

In stormwater utilities there are two widely accepted methodologies that group group certain types of residential parcels depending on the variation in runoff contribution between parcels and the specific billing needs of a community. CDM will group residential parcels according to single-family units (SFU) and equivalent residential units (ERUs). These user classes have been proven legally defensible and greatly simplify the administrative burden of developing the necessary billing system plan and future billing updates because they reduce the need to measure runoff potential for each of the parcels within the class. However, nonresidential parcels will still require parcel-by-parcel determinations of runoff contribution because of non-uniformity in parcel-to-parcel characteristics.

SFU Alternative

Under this alternative, the SFU used for determining the customer charge is defined as the average area covered by all impervious improvements on a typical single-family detached residence. With this alternative, all single family detached residences would be treated as a single class with each customer assessed one SFU. A nonsingle family parcel (duplexes and multifamily) would be assessed according to the ratio of its impervious area to that established for a SFU.

ERU Alternative

The ERU alternative is based on the premise that program administration is simplified through user class groups; in this case by combining all residential parcels into one user class. Under this alternative, all residential parcels would be treated as a single class and be assessed one ERU. This value utilizes the total number of dwelling units as the basis for establishing residential ERUs. This definition simplifies billing administration, while also expanding the customer base available for allocating costs.

CDM will evaluate the ERU and SFU rate structures based upon the data developed in Task C. These results will quantify the range of billing units for each rate methodology. Rate methodologies will be identified to correlate the significance between different base billing units and geographically-based Level of Service charges. CDM will also consider impacts from adjustment/credit programs typically used in Florida.

Deliverable: Draft report section outlining the following:

- *Statistical metrics for potential residential billing units, including tiers (SFU).*
- *Potential charges for alternative billing units to generate projected revenues identified in Task B.*
- *These results will quantify the charges by different land use categories for each rate methodology; single family detached, multifamily, and non residential land uses.*
- *Potential revenue increase by eliminating the 10 ERU cap for non residential customers.*

Task E. Stormwater Committee/Meeting Facilitation (Reimbursable)

CDM has successfully facilitated meetings and committees to educate city staff, elected officials, citizens, and key stake holders in the development and update to stormwater utilities. CDM Team member Steve Sedgwick has led these tasks in multiple communities throughout the USA and Canada and will be available to assist the City as needed in the role of facilitator, consensus builder, and senior professional in the field of stormwater utilities. The CDM team will also provide presentation documents, backup information from other communities, and educational materials as needed.

Upon request by the City, CDM can assist the City with the following activities to conduct a successful Stormwater Advisory Committee process:

- Identify appropriate members for committee (16-20).
- Identify meeting content and schedule one meeting per month for four months.
- Develop meeting materials, conduct meetings, develop minutes, and provide summary recommendations to the administration.
- Assist City with conducting a field visit to existing problem areas between SWAC meetings #2 and #3.
- Assist SWAC membership in presenting recommendations to City Council.
- Prepare presentation for City Council, present to City Administration, and develop draft report summarizing the SWAC process.

Upon the City's recommendation to CDM regarding specific rate methodology, CDM will update the utility billing file under a separate authorization.

Potential Services included under this task:

- *Presentation materials such as graphics, statistics, and tables quantifying different rate methodologies in terms of billing units.*
- *Assistance to develop, facilitate, and coordinate a Stormwater Advisory Committee (SWAC)*
- *Presentations to City Council.*

Task F. Credit Policy and Adjustment Options

CDM will assess a maximum of 5 potential credit options for utility customers (along with exemptions). CDM will also consider methods to ensure proper construction and periodic maintenance of BMPs that may be offered a credit. CDM will suggest the amount of such

credit as well as the procedure whereby a credit is obtained. CDM will meet with the City to discuss the credit policy options. The policies will review if a credit should be granted to a private property owner who provides an existing stormwater management facility that benefits the service area in ways similar, in whole or in part, to the City's stormwater programs and activities. The review will consider the length of time that a credit is granted, and the frequency that the credit should be evaluated and conditions that should be attached to the credited facilities (e.g. maintenance, inspection reports, etc.). Based on the discussion with the City CDM will summarize the proposed credit policy.

CDM will work with the City to include an appeals process within the stormwater utility ordinance and to provide a standard organizational protocol for handling such appeals. The appeal process will consider imperviousness measurements or calculations documentation for non-residential customers and the clarity and simplicity of the appeals protocol for handling by the staff for the public.

Deliverables:

- *Draft presentation summarizing the credit policy.*
- *Credit policy manual*

Schedule and Budget

CDM will perform the work outlined in Tasks A, B, C, D and F within 8 months of notice to proceed, and are budgeted as a lump sum amount shown in Table 1. Task E is budgeted as a reimbursable cost subject to request from the City Engineer, and will be billed according to the hourly rates shown in Table 1.

City of St. Augustine

Stormwater Master Plan Update – Kickoff Meeting

Friday January 6 2012 – 9:45 AM – 4th Floor Conference Room - Public Works

Attendees:

City of St. Augustine: Bill Mendez, Reuben Franklin.

CDM Smith: Patrick Victor, Steve Sedgwick, Michael Schmidt, José Maria Guzmán. Project staff attending site visits: Katie Lytle, Heather Singletary, and Matt Goolsby.

Action Items:

1. CDMSmith will coordinate with Bill/Reuben setting up meeting with St. Johns County regarding their ongoing master plan and data collection.
2. CDMSmith will complete the hydrologic evaluation and hydraulic schematic first (Tasks 3 and 4) to make recommendations regarding the two pilot areas. The project team will discuss the issue, and will select the two pilot areas for Task 6.
3. The project team discussed the attached schedule, and agreed on the current implementation.
4. Reuben will coordinate the submittal of data files identified in red in this document. Other datasets requested have been already submitted by the City and are listed in black.

Discussion Topics:

Task 1: Data collection, evaluation and site visits. The group reviewed the list of datasets needed for the evaluation and the status of those already submitted summarized in the table below:

Data to be provided by the City:

- 1992 Stormwater Master Plan (received)
- 1992 Stormwater Utility Evaluation (received)
- GIS data (dinlet, dmanhole, dvalve, mapped outfall, channel, pipe, retention basin) (Received)
- Riberia Street Design drawings (received)
- Lake Maria Sanchez design drawings (received)
- W. Augustine Community Redevelopment Area (2010) - Received
- Cordova & St. George Drainage Assessment (2009)- Received

- ATM geocoding of utility database – Received
- Assessor database - received
- History of the ordinances that have changed and the clerk minutes
- 2009, 2010, 2011 Fiscal Year Expenditures
- FEMA repetitive loss database
- Shapefile of historical districts
- Shapefile of City-owned parcels
- Shapefile of parcels
- May Street FDOT design drawings

Task 2: Coordination meetings with county and FDOT: CDMSmith will first request the data outlined above from the City, and then coordinate a meeting with St. Johns County with the intent to discuss the items outlined below:

- Planimetric data, which potentially delineated impervious surfaces throughout the county?
- Parcel shapefile (only if not available from the City)
- Update on the County stormwater master plan to coordinate watershed boundaries and future CIPs in the west boundary of the City.
- Updated aerial imagery (we currently have 2008 aerials)
- Updated roadway coverage (we currently have 2008 roads)

A future meeting will be scheduled with the Florida Department of Transportation (FDOT) to coordinate the projects currently being planned and designed by the agency. The group discussed in particular the case of May Street which is being designed, and could convey additional runoff to an existing City outfall. CDMSmith and the City will prepare for the meeting by reviewing the most recent set of plans for May Street, and other potential projects. Currently the meeting is planned to be scheduled in the month of February 2012.

Task 3: Citywide hydrologic model development (Areas A through J): CDMSmith will develop a citywide hydrologic model using the most recent topographical information. Reuben pointed out that the current LiDAR is known for low accuracy in downtown areas. CDMSmith will request survey services to confirm spot elevations as necessary.

Task 4: Citywide hydraulic schematic development: CDMSmith will use the information provided by the City to develop a map showing the proposed citywide hydraulic schematic. This will be the basis for the discussion regarding the selection of two pilot areas to be evaluated in detail as part of this Phase 1. Bill pointed out that there is the potential that other areas will require additional evaluation besides these two. Patrick confirmed that CDMSmith will be available to do additional work at request of the City as a separate scope.

Task 5: Definition of levels of service: CDMSmith will propose to the City a revision of the objectives (levels of service) for stormwater. The objectives will clearly state the depth of flooding acceptable for roadways and buildings.

Task 6: Pilot area stormwater improvement plan: CDMSmith will develop a detailed evaluation of two pilot areas. The proposed areas will be limited by the number of conduits and nodes that will be included in the model. This will allow the City to select the most significant areas based on the results of Tasks 4 and 5.

Task 7: Phase 1 summary report: CDMSmith will summarize the findings of each one of the tasks above in a report submitted to the City for review.

Field Visits

- West St. Augustine: priority areas "A", "B" and "C".
- Downtown/Old St. Augustine: priority areas "D", "E", "J"
- Anastasia Island: priority areas "F" and "H".

City of St. Augustine, Florida
Stormwater Master Plan Update
Phase 1

Scope of Services

September 27, 2011

Background

Camp Dresser & McKee Inc. (CDM) was selected for the update of the 1995 stormwater master plan for the City of St. Augustine, Florida (City). CDM proposes to structure the work in phases to allow the project team to better define project goals, costs and funding. This Stormwater Master Plan (SWMP) will be phased to allow cost effective evaluation of higher priority problem areas and solutions while establishing the framework for the entire program. The following tasks provide details on work included in Phase 1.

Task 1.0 City Data Collection, Evaluation, and Site Visits

In order to update the current stormwater master plan, CDM will collect and evaluate available information with the objective of creating a summary document and map that comprise the City's past and current efforts in addressing stormwater quantity and quality issues. The collected data will be the central element of the sub-sequent tasks and will provide guidance in the update of the stormwater master plan. The data collected will include:

- 1995 CH2MHill Stormwater Master Plan (SWMP) Report; (Received)
- SWMM models from the 1995 SWMP (do not appear to be available);
- GIS datasets related to stormwater (hydrologic boundaries, streams, rainfall gages, stream gages, etc.); (Received)
- Topographic GIS information (contours, TINs, DTMs); Currently CDM has the 2009 St. Johns County 1 ft LiDAR contours;
- Current priority of capital improvement projects;
- Latest FEMA flood zone delineations in GIS format;
- Flooding complaint records;
- Latest aerial imagery available to the City;
- Roadway coverage including evacuation routes or functional classification;
- Most recent table of FEMA repetitive loss properties; and
- Most recent parcel database.

CDM will dedicate two business days to visit the problem areas identified by the City to inspect field conditions, and gather field information that will allow quantifying the severity of the problem.

Based on the review of the available data, site visits, and project meetings, CDM will develop a preliminary list of problem areas. CDM will prepare an "E" size wall map that will summarize the information and will be the basis for future discussions, planning meetings, and project updates. The map will be submitted to the City in hard copy and PDF format.

Deliverable:

- *Draft Report Section summarizing City data and potential data needs to support the SWMP.*
- *"E" Size Map in PDF format and hard copy*

Task 2.0 External Agencies Data Collection and Evaluation

CDM will collect and evaluate available data from Federal and State agencies as noted below. CDM will assist the City to obtain the latest version of the stormwater models being developed by St Johns County as part of their ongoing stormwater master plan. One meeting is budgeted at this time, for meeting the County's consultant, and the receipt of the information.

CDM will request the latest FDOT pipe information generated as part of their NPDES permitting requirements. The intent of this data request is to obtain the layout and size of the existing stormwater outfalls that fall under the maintenance of the FDOT, particularly for King Street and other major arterial roads.

Other datasets collected and reviewed will include:

- St Johns River Water Management District: rainfall depths and distributions, NRCS soils, National Wetlands Inventory (NWI), ERP and associated BMP data, and hydrogeologic data.
- NOAA: tidal stage data.
- FDEP: water quality data, septic tank surveys, hydrogeologic and groundwater well data
- FEMA: most current Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs).

Deliverables:

- *One coordination meeting with the County.*
- *One coordination meeting with the FDOT.*

- *Citywide map showing the received information from the County and FDOT*
- *Draft report section summarizing data collected and potential data needs*

Task 3.0 Citywide Hydrologic Model Development

The City currently has 107 outfalls mapped in GIS. According to the 1995 SWMP, there are 133 outfalls located within the City. Based on initial review of the City's mapped outfalls in GIS, there are outfalls within the City that are currently not mapped, and several mapped locations that are labeled improperly. CDM will review and refine the City's mapped outfalls under this task.

CDM proposes to use US EPA SWMM5 for the citywide hydrologic evaluation. The hydrologic features of SWMM5 apply precipitation across Hydrologic Units (HUs) and through overland flow and infiltration, conveying surface runoff to loading points on the user-defined stormwater management system. Runoff hydrographs for these loading points provide input for hydraulic routing in downstream reaches.

CDM will setup the SWMM5 hydrologic models for the Study Area (**Figure 1**). CDM will use available digital terrain data from St. Johns County to identify, delineate, and refine up to 150 hydrologic units. CDM will also include consideration of city's-identified serious problem areas (flooding homes, buildings, and evacuation routes), photogrammetric mapping, and field-verification as required. The City of St. Augustine's GIS will be used wherever possible.

Table 1. Stormwater Hydrologic Units

Unit	Area
A (Smith Street)	141.2 Ac
B (Oyster Creek)	156.5 Ac
C (Historical Downtown)	367.6 Ac
D (Macaris Street)	97.3 Ac
E	65.9 Ac

Unit	Area
F (Anastasia Island)	231.5 Ac
G (Quarry Creek)	12.5 Ac
H	21.6 Ac
J	85.8 Ac
Total	1,180 Acres

Soils: CDM will use the St John's County/National Resource Conservation Service (NRCS) hydrologic soil groups GIS data for soils data estimates, including percentages of Soil Groups A, B, C, and D per hydrologic unit. Based on this, CDM will estimate soil infiltration rates (maximum and minimum) and total soil storage values.

Land Use: CDM will catalog the present land use data into ten classifications based on hydrologic similarity. These 10 classes of Land Use will then be applied to each hydrologic

unit to determine the acreage of each land used class within the hydrologic unit and larger sub-basins. Future built-out land use will be provided by the City's GIS and will be applied only in basins with expected urbanization. CDM will estimate the percentage of directly connected impervious area (DCIA) by hydrologic unit based on representative example areas.

Overland Flow Data: CDM will generate overland flow data for each hydrologic unit (overland flow length, slope, manning n roughness, and initial abstractions).

Stage-Area-Storage Data: CDM will develop stage-area-storage characteristics for significant floodplain areas, as determined by CDM, for the purposes of developing routing curves based on available topographic data. The latest 1 ft LiDAR coverage for St. Johns County will be used as the basis for these delineations.

Rainfall Data: CDM will use storm distributions included in the SJRWMD Applicants Handbook for the following conditions: 1.0 inch, 2.33 year, 5-year, 10-year, 25-year, 50-year and 100-year, 24-hour duration rainfall events.

The information developed under this task will allow CDM to estimate hydrologic parameters for each one of the hydrologic units developed, according to the SCS methodology (Curve Number and Tc). The outcome of this task will become the basis for estimating flows in different areas within the City limits. During the development of the citywide detailed hydraulic network (future task 7) this coverage will be further discretized in areas that required increased level of detail.

Deliverables:

- *GIS shapefile including the citywide tributary area delineations.*
- *SWMM 5.0 input files with hydrologic parameters.*
- *Summary table with estimated runoff rate for each of the 150 tributary areas.*
- *Draft report section describing the methodology and results.*

Task 4.0 Citywide Hydraulic Schematic Development

CDM will review the information submitted as part of Tasks 1 and 2 with the intent of creating a citywide hydraulic schematic. CDM will also consider the results of the hydraulic delineation performed in Task 3, to determine the loading points where the hydrologic delineation can estimate flows for the hydraulic network. The outcome of this task will provide a quantification of the pipes needed to develop a hydraulic model that will become the basis for estimating the existing conditions, establishing the level of service, and ultimately screening and ranking capital improvement projects. CDM will define the City primary stormwater management system (PSMS) outfalls, culverts, and channels based on priority and criticality. The draft PSMS is shown in **Figure 1**.

The development of the hydraulic network will include a nomenclature methodology to link survey, field visits, model development, and the GIS database. A draft report section will be submitted to the City for review to document the nomenclature methodology, and allow for coordination of other data collection efforts as they relate to the stormwater hydraulic model.

Deliverables:

- *Draft report section outlining nomenclature;*
- *GIS shapefile of the proposed PSMS hydraulic network;*
- *PDF map displaying the citywide hydraulic network and hydrologic units.*

Task 5.0 Definition of Stormwater Levels of Service

CDM will propose a flood level of service to the City. Common metrics for flood levels of service are local road, major road, and structures. CDM will review the City's Comprehensive plan and Ordinances that relate to LOS and will recommend potential refinements as necessary for application in the SWMP tasks.

Deliverables:

- *Proposed Level of Service criteria*

Task 6.0 Pilot Area Stormwater Improvement Plan

In order to address flooding high priority areas, demonstrate the alternative evaluation, and CIP process, CDM will develop the SWMM5 hydraulic model for up to 40 model junctions, and 35 links. Potentially this model will include PSMS outfalls located within the historical downtown area, or other areas identified with City's staff. CDM will evaluate existing land use and PSMS hydraulics conditions and will identify stormwater improvements to meet the City desired level of service and SJRWMD permit requirements. CDM will simulate the design rainfall storms outlined in Task 3.0, and will develop capital cost estimates for the recommended stormwater facilities.

Task 7.0 Phase 1 Summary Report

CDM will summarize the results of Tasks 1 through 6 in a final report that will include the assessment of the available data, field visits. The report will also outline the following tasks that will allow the City to implement a City wide master plan and address other City objectives not included in Phase 1.

Budget and Scope

CDM will complete the work outlined in tasks 1 through 7 for a lump sum amount outlined in Table 2, and will be billed monthly according to the progress achieved. The work will be completed within 6 months of notice to proceed, and the collection of data outlined in tasks 1 and 2.

City of St. Augustine, Florida
Stormwater Master Plan Update
Phase 2

September 27, 2011

Background

Phase 2 will build upon the data and model foundation established in Phase 1 for the completion of the hydraulics network and alternatives evaluations to provide a CIP for the City to meet desired LOS and for permittable projects.

Task 8.0 Citywide Hydraulic Model Development

CDM will set up the hydraulic module of SWMM 5.0 for the remaining of the PSMS shown in Figure 1. This will include up to 165 conduits and up to 290 junctions. The process will be based on the hydrologic boundaries determined as part of Task 3, and will refine them during the development of the detailed hydraulic network. For each one of the conduits, CDM will use available information to establish horizontal coordinates and vertical elevation. In cases where survey data will not be available, CDM will use professional judgment to estimate the elevations or request detailed survey from our survey team.

Table 3. Preliminary Estimate of Hydraulic Model elements proposed.

Hydrologic Unit	Outfalls	Links	Nodes
A (Smith Street)	2	8	14
B (Oyster Creek)	1	6	11
C (Historical Downtown)	12	64	115
D	2	17	32
E	4	8	14
F (Anastasia Island)	9	46	83
G (Quarry Creek)	2	4	6
H	1	2	3
J	4	12	20

Total	37	167	298

Deliverables:

- *Draft report section on PSMS hydraulics model development*
- *SWMM 5.0 input files of the PSMS*
- *GIS shapefile of the model links, nodes and flowpaths.*

Task 9. Stormwater Model Evaluation and Results

CDM will consolidate the hydrologic parameters developed in Task 3, with the hydraulic parameters developed in Task 8 to develop a citywide model. The model will be used to estimate the peak flood elevations, flows, and velocities throughout the City for the following design storms:

- 1.0 inch/24 hour,
- 2.33 year/24 hour, (mean annual)
- 5-year/24 hour,
- 10-year/24 hour,
- 25-year/24 hour
- 50-year/24 hour and
- 100-year/ 24-hour.

CDM will compile the model results in tabular form for each design storm. Based on the model estimates and the flooding records, CDM will look at the number of roads and structures that do not appear to meet the level of service to propose criteria that are acceptable and support the completion of a 20 year capital improvement plan.

Deliverables:

- *Draft report section summarizing results for design storms*
- *Tables summarizing peak flood levels throughout the City.*

Task 10. Geocoding of flooding complaints

CDM will work with the City GIS staff and the Engineering department to obtain available information for flooding complaints that may exist. CDM will develop the necessary GIS data

layers needed to support the project, by evaluating the available complaint reports provided by the CITY and spatially locating them in a GIS data layer. This type of information is usually a decision based tool to confirm commonly known flooded areas, and is a first step towards the future inclusion of this information in the current CITY asset management tool (Cityworks).

The creation of a database that registers flooding complaints will be made following FEMA data guidelines and specifications, to allow the use of such information for FEMA related activities such as the documentation of the Community Rating System, and supporting documentation for repetitive flooding properties.

Deliverables:

- *GIS shape file of flooding complaints with associated attribute table.*
- *Draft report section*

Task 11. Model Verification

The models shall be validated for one system as determined by the CDM and the CITY to simulate one actual storm event which occurred in the project area if data are available as determined by CDM. CDM will use available stage data from up to 5 locations within the project area for calibration/validation. CDM will identify rainfall, stage/discharge, and/or high water mark data as provided by the CITY to validate the models. CDM will develop a comparative table of simulated and measured-estimated flood stages.

Deliverables:

- *Up to two site visits to obtain high water marks*
- *Draft report section outlining the model results compared with field data.*

Task 12. Evaluation of Alternative Capital Improvement Projects

CDM will use the SWMM hydrologic and hydraulic models to evaluate two improvement alternatives at up to 20 locations to address flooding in the areas identified in the previous tasks. CDM will simulate the seven design storms and estimate the flood stage and peak discharge reduction along with the resultant LOS associated with the project implementation. CDM will summarize the results in tabular format and update the GIS layers as appropriate. In the formulation of these projects, CDM will take into account other public and private projects such as CITY utility CIPs, private developments, and FDOT projects (e.g., May Street improvements) with the goal of coordinating CITY improvements with those by the FDOT and private redevelopment in order to promote synergies and cost savings. CDM will also evaluate potential institutional arrangements with FDOT that would benefit all parties.

Planned areas of private redevelopment will be evaluated in conjunction with the CITY to identify desired right-of-way improvements that could include stormwater management components. The stormwater management requirements identified through the master planning process will be available to the CITY for incorporation in agreements to be negotiated with private developers. Based on CITY comments, CDM will prepare the list of projects that should be included in the final recommendation, and will summarize the flood stage and peak discharge reduction benefits in tabular form.

For up to 20 problem areas, CDM will develop up to two alternatives that will follow the BMP treatment train approach. The main objective of the treatment train is the combination of several BMPs that address stormwater quantity and quality issues, starting from cost effective solutions until the implementation of complex engineering projects. CDM will estimate the equivalent treatment in Ac-ft and inches for Environmental Resource Permitting needs.

Deliverables:

- *Draft report section presenting alternative capital improvement projects*

Task 13. Conceptual Cost Estimates

CDM will develop preliminary probable capital cost estimates for the final project recommendations based on recent bidding costs provided by the CITY, combined with the extensive CDM cost database from projects in Florida. CDM will also develop cost estimates for the average yearly operation and maintenance of each project.

Deliverables:

- *Draft report section with up to 20 preliminary probable cost estimates*

Task 14. Prioritization of 20 year Capital Improvement Projects

CDM will develop a methodology to rank the alternatives identified in Task 12. The process will quantify the benefits that the City will obtain in terms of flood reduction, traffic disturbance, number of residents impacted, and long term operation and maintenance costs. Each alternative will have a relative score, and will allow CDM to rank projects by considering the lowest cost benefit ratio and allowing the City to budget fiscal years accordingly. Each project will consider the combination of different tiers of the BMP treatment train and could be implemented in Phases as funding and land acquisition allows. In many instances the scoring can also consider shared funding opportunities, as well as aesthetic, recreational, architectural, and historical elements to ensure that the scoring criteria reflects the values of the community.

Deliverables:

- *Draft report section outlining the prioritization of capital improvement projects.*

Task 15. Community Rating System Certification Assistance

The City of St Augustine currently holds a class 8 CRS, and is interested in updating some of the supporting documentation to obtain an additional 5 percent discount from the National Flood Insurance Program (NFIP). The City will review the following documentation in compliance with CRS credited activities based on the AW214 Recertification Form:

- Verification of the City's geodetic benchmark network
- A log of Floodplain Determination Requests and Responses
- Floodplain Management Annual Outreach Materials
- Flood Protection Assistance Outreach Materials
- Repetitive Loss Property Owner Outreach Materials
- Floodplain Management Plan Annual Progress Report
- Typical Inspection Reports
- Report on Flood Warning Program
- Flood Warning Program Outreach Materials
- Amendments to Floodplain Regulations
- Amendments to the allowable density of development in zoning districts within the floodplain
- Amendments to the City Building Code
- Amendments to the City Stormwater Management Regulations

City staff shall provide information regarding the most recent annual recertification report, status of changes to floodplain regulations, City building code, development zoning within the floodplain, and stormwater management regulations.

Deliverable:

- *A draft report section outlining the findings of the data review and recommendations to improve documentation and scoring in order to maximize the CRS certification.*

Task 16. BMP Inventory Data

CDM will tabulate data for major existing stormwater BMPs (such as retention ponds, recharge wells, baffle boxes, oil separators, swales, and others), as available from the CITY. *Deliverable: BMP inventory summary and GIS database.*

Task 17.0 Groundwater Recharge and Reuse Evaluation

CDM will evaluate the available hydrogeologic information, as well as well digital logs for up to five wells to estimate the well head and discharge for potential stormwater recharge wells. The main objective of the analysis is to determine the stormwater quantity and quality benefits of recharge wells, while replenishing the aquifer for potential reuse.

Based on the evaluation CDM will propose potential applications and locations for recharge wells, and identify reuse opportunities. By applying these criteria, it might be possible to reduce stormwater outfall sizes while creating an opportunity for groundwater recharge, irrigation reuse, and recreation facilities.

Deliverable: Report section outlining opportunities for recharge wells and reuse in surface water systems.

Task 18. GIS Upgrades and Integration with Asset Management Tool

Currently the City uses CITYWORKS to manage assets for water, sewer and stormwater operations. This tool is currently not completely integrated with work order generation and tracking when it comes to stormwater operation and management. Under this task CDM will consider the experience of other communities that have integrated their GIS tools with commercial asset management software to allow the City to consider some of the alternatives and combine field data, with the tracking of asset parameters such as age, useful life, and preventive maintenance..

CDM will organize up to three meetings with City staff to discuss the current data organization, including versioning, data distribution, existing software licenses, backup and data redundancy, among several aspects. The data obtained during the meetings will be then discussed with CDM staff that have developed similar applications for other communities, to formulate a series of recommendations for potential implementation at the City of St. Augustine.

Deliverables:

- *Three meetings with City staff including purchasing, IT, and GIS functions*
- *Memorandum of recommendations tailored to the City of St. Augustine*

Task 19.0 Phase 2 Report

CDM will summarize the results of Tasks 8 through 19 in a final report that will summarize the work outlined in Phase 2. CDM will deliver two hard copies for review, and will incorporate comments received from the City. Upon incorporation of comments, CDM will deliver two hard copies and a PDF digital file.

Deliverables:

- *Two hard copies of the Phase 2 Report*
- *Digital version in PDF format of the final Phase 2 Report*

Budget and Schedule

CDM will perform the work outlined in Tasks 8-19 within 14 months of notice to proceed. The work will be performed as a lump sum amount shown in Table 4, and will be billed monthly according to the progress achieved.

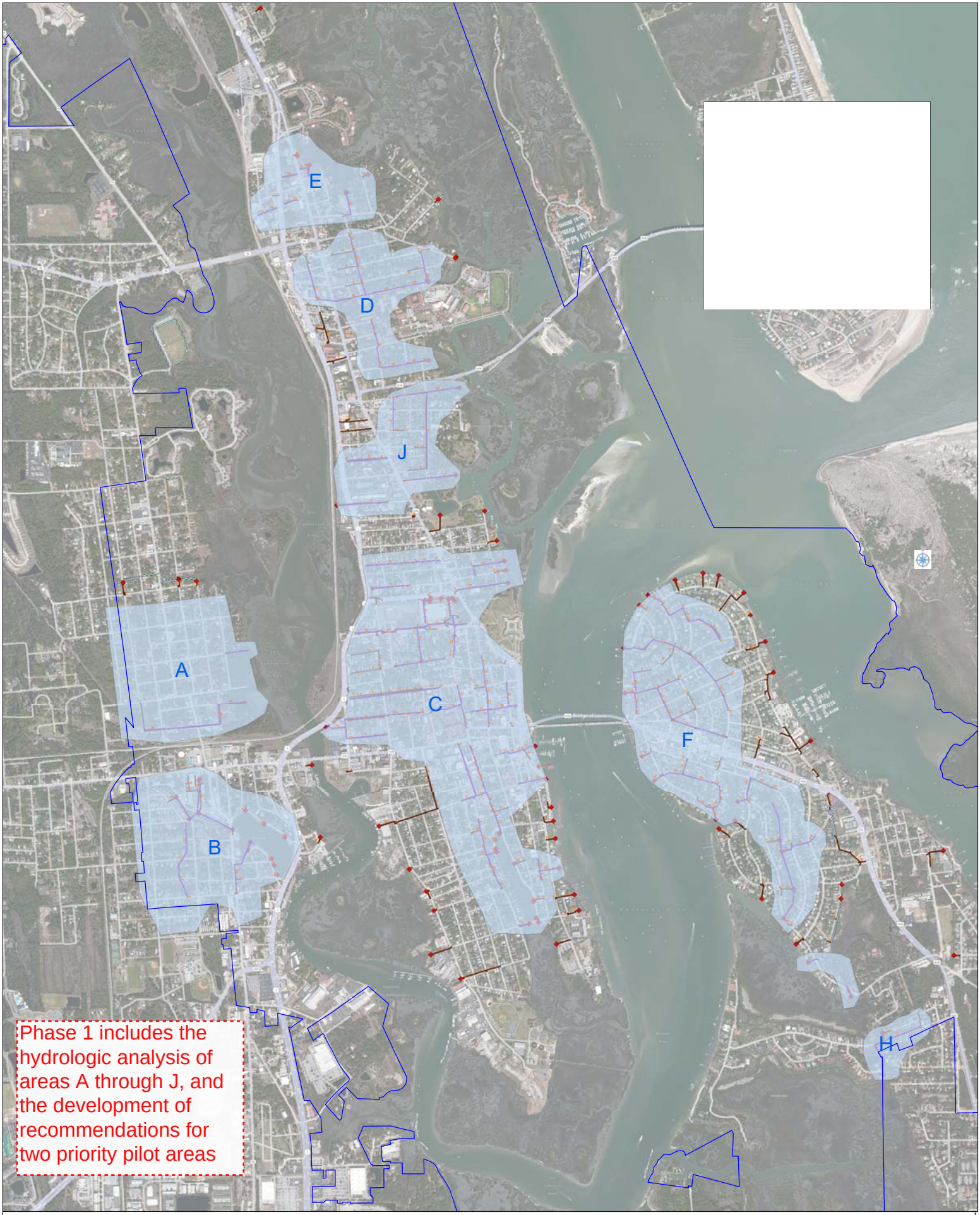


Figure 1.
City of St. Augustine
Primary Stormwater Management System

City of St. Augustine

Stormwater Coordination Meeting

Location: SJC Engineering - 2740 Industry Center Road - St. Augustine, FL 32084

Date/Time: January 30 2012 – 9:30 AM

Attendees: St. Johns County (COUNTY) : Press Tompkins, Douglas Tarbox, Andrew James;
Jones Edmunds and Associates (JEA) : Alan Foley, Jason Icerman, Mark Nelson;
City of St. Augustine (CITY) : Bill Mendez, Reuben Franklin;
CDM Smith (CDMS): Patrick Victor, José Maria Guzmán.

Action Items:

1. JEA will provide the following datasets to CITY to coordinate boundaries and avoid duplication of data collection:
    a. Countywide shapefile with watershed delineations
    b. West-St Augustine - Shapefile with model links and nodes
    c. West-St Augustine – Survey collected in the area, or data received from FDOT.
    d. Countywide septic tank shapefile
    e. Pollutant loading estimates for the San Sebastian watershed.
    f. Sampling records in the San Sebastian area.
2. The City will inform the COUNTY of progress achieved in the project in upcoming months. The results from models developed by the City could be submitted to FEMA to be included in the map updates anticipated for 2013.
3. Potential coordination for joint projects might have higher access to grants if headed by the CITY, due to the fact that they have a stormwater utility.
4. CDMS will coordinate with Gale Oliver (County surveyor) the location of survey benchmarks.

Discussion Topics:

1. <u>CITY master plan update</u>: the current project outlined by CDMS includes the following:
    a. Hydrologic evaluation of problem areas A-J identified in the attached figure.
    b. Development of a citywide hydraulic model schematic
    c. Selection of two pilot areas for hydraulic evaluation

    The project team kicked off the project in January, and expects to have results in 6 months. The main goal of the project is quantity, but all projects will include water quality component as possible.
2. <u>COUNTY master plan overview</u>: the project was structured in phases as follows. Phase 1 includes the use of the digital terrain model (DTM) to delineate sub-basins, the evaluation of ponds and water bodies to determine their regional relevance, and determine the survey needs. Phase 2 includes the development of a hydraulic model to estimate flood elevations. Phase 1 has been completed for the entire county, while Phase 2 is focused in the south west quadrant for now. Recently Ponte Vedra was added to the master plan, and is now being evaluated. The modeling has been completed using ICPR, with hydrologic estimates based on the curve number method. The project datum is 1988 NAVD. The project team has collected field observations confirming that the model has 5-6% accuracy.

3. West-St. Augustine sub-basin update: The Phase 1 for this portion of the COUNTY master plan has been completed, and JEA will start the survey collection and Phase 2 modeling. As part of Phase 1, JEA developed a schematic that the group browsed on the JEA computer. JEA will provide in digital format the files outlined in Action Item 1 to the CITY for coordination purposes. The intent is to ensure that both master plans agree in the limits of the watersheds, and that the evaluation of joint projects in the same watershed are coordinated.
4. COUNTY improvements occurred in the West St. Augustine include:
    a. Ravenwood new outfall: The COUNTY mentioned that they recently completed the construction of a new outfall in the Ravenwood area, which includes a stormceptor for water quality reduction.
    b. Recently completed stormwater improvements in Josiah Street.
5. Joint projects and funding assistance. The City and the County will continue to combine their efforts to obtain State and Federal grants to pursue projects together. The City has a stormwater utility which allows to obtain a higher score in most stormwater applications.
6. FEMA Coordination. The COUNTY is a Cooperative Technical Partner to FEMA and will provide the model results to update the current flood maps. The recent map update did not include new modeling, but rather a re-delineation of the previous models on the 2008 LiDAR topographic data. Depending on the project schedule the CITY will submit the results of the models developed in the master plan for potential use by FEMA for mapping purposes.
7. TMDL Evaluation: As part of the master plan the COUNTY developed a countywide loading model, based on EMC calculations in GIS. The land use FLUCCS were compiled into 10 major land use categories, and updated the land use to the year 2009. The model estimates seasonal and annual flows and pollutant loads. The general goal is to achieve 30% nitrogen reduction. The program include a monthly sampling program in selected watersheds.
8. Mill Creek: The County was able to identify a significant redundancy in the number of septic tanks in this area, which might result in a reconsideration by FDEP of the current water body impairment classification.
9. The City discussed with FDEP the re-classification of the San Sebastian river to classify it as Class 3, since no sampling data is available.

Guzman, Jose Maria

From: Guzman, Jose Maria
Sent: Thursday, 05 April, 2012 4:58 PM
To: 'Bill Mendez'; Reuben Franklin (rfranklin@citystaug.com)
Cc: Victor, Patrick; Schmidt, Michael F; Goolsby, Matthew A.; Lytle, Kathleen
Subject: Stormwater Master Plan - Meeting Minutes
Attachments: Selection_of_Pilot_Areas.pdf

Good afternoon Bill/Reuben,

Please find attached the minutes of our meeting held yesterday, as well as the revised attachment summarizing the selection of the pilot areas. Based on our discussion we suggest to model two outfalls of Oyster Creek, and use the remaining balance of pipes for Lake Maria Sanchez. As you can see in the attachment we can consider the Cordova and Granada street outfalls, considering the entire tributary area, as a first step towards including the Treasury and King Street outfalls in the future.

We will let you discuss our recommendation with Martha and John in the upcoming days, and will check with next week to proceed with the hydraulic model development.

Thank you,

José Maria Guzman, PE, D.WRE
CDM Smith | 8381 Dix Ellis Trail, Suite 400| Jacksonville, FL 32256| Tel: 904-527-6702| Fax: 904-519-7090| www.cdmsmith.com

Stormwater Master Plan – Projet Update
Meeting Minutes

Date: 4 April 2012 – 11 AM – Public Works Conference Room

Attendees: Bill Mendez, Reuben Franklin (City of St. Augustine)
Patrick Victor, Jose Maria Guzman (CDM Smith)

Objective: Discuss the CDM Smith recommendation for pilot areas and overview the project status

Action Items:

1. CDM Smith will send an updated map/write up documenting the pilot area selection. The plan is to develop models for two Oyster Creek outfalls, and for the Lake Maria Sanchez Outfall.
2. The 2011 financial report is now published and will be used for Task B.
3. Reuben will send the 12 month utility database to CDM Smith to consider yearly trends.
4. The meeting of April 18 has been accepted by City staff.

Topics of Discussion:

1. Pilot area selection: CDM Smith identified 5 outfalls, grouped in three separate areas: Oyster Creek, Lake Maria Sanchez and Carrera/Valencia streets. One of the critical items in selecting a pilot area is the ease of implementation, considering the disuption to businesses and tourism in the historical district. For this reason Oyster Creek seems to be an ideal candidate given its ease of implementation, while Lake Maria Sanchez.
2. Stormwater Utility Residential sample: CDM Smith concluded the residential sample which included 300 single family homes as well as 300 multifamily units. The results show that the average single family home in St. Augustine has 1,885 square feet, and that the spread between the small and large homes could justify a tiered billing structure. CDM Smith will send to the City a summary in writing for review prior to the meeting of April 18.

3. General overview of the project:
    a. Task 1. Data Collection (90%)
    b. Task 2. External Agencies Data Collection and Evaluations (60%)
    c. Task 3. Citywide Hydrologic Model Development (100%)
    d. Task 4. Citywide Hydraulic Schematic Development (100%)
    e. Task 5. Definition of Stormwater Level of Service (0%)
    f. Task 6. Pilot Area Implementation Plan (0%)
    g. Task 7. Phase I Summary Report (0%)
    h. Task A. Stormwater Utility Rate Review (100%)
    i. Task B. Operation and Maintenance Needs and Costs (20%)
    j. Task C. Land Use Analysis (80%)
    k. Task D. Rate Methodology (10%)
    l. Task E. Stormwater Committee/Meeting Facilitation (Reimbursable) (0%)
    m. Task F. Credit Policy and Adjustment Options (0%)

City of St. Augustine

Stormwater Master Plan Updates

Wednesday April 4 2012 – 11AM – 4th Floor Conference Room - Public Works

Attendees:

Engineering department: Bill Mendez, Reuben Franklin

CDM Smith: Patrick Victor, Jose Maria Guzman

Action Items:

1. CDM Smith will send an updated map/write up documenting the pilot area selection. The plan is to develop models for two Oyster Creek outfalls, and for the Lake Maria Sanchez Outfall.
2. The 2011 financial report is now published and will be used for Task B.
3. Reuben will send the 12 month utility database to CDM Smith to consider yearly trends.
4. The meeting of April 18 has been accepted by City staff.

Discussion Topics (see attached PDF file for detailed discussion)

1. Pilot area selection: CDM Smith identified 5 outfalls, grouped in three separate areas: Oyster Creek, Lake Maria Sanchez and Carrera/Valencia streets. One of the critical items in selecting a pilot area is the ease of implementation, considering the disuption to businesses and tourism in the historical district. For this reason Oyster Creek seems to be an ideal candidate given its ease of implementation, while Lake Maria Sanchez.

2. Stormwater Utility Residential sample: CDM Smith concluded the residential sample which included 300 single family homes as well as 300 multifamily units. The results show that the average single family home in St. Augustine has 1,885 square feet, and that the spread between the small and large homes could justify a tiered billing structure. CDM Smith will send to the City a summary in writing for review prior to the meeting of April 18.

3. General overview of the project:

    a. Task 1. Data Collection (90%)

    b. Task 2. External Agencies Data Collection and Evaluations (60%)

    c. Task 3. Citywide Hydrologic Model Development (100%)

    d. Task 4. Citywide Hydraulic Schematic Development (100%)

    e. Task 5. Definition of Stormwater Level of Service (0%)

f. Task 6. Pilot Area Implementation Plan (0%)

g. Task 7. Phase I Summary Report (0%)

h. Task A. Stormwater Utility Rate Review (100%)

i. Task B. Operation and Maintenance Needs and Costs (20%)

j. Task C. Land Use Analysis (80%)

k. Task D. Rate Methodology (10%)

l. Task E. Stormwater Committee/Meeting Facilitation (Reimbursable) (0%)

m. Task F. Credit Policy and Adjustment Options (0%)

Guzman, Jose Maria

From: Guzman, Jose Maria
Sent: Wednesday, 25 April, 2012 9:22 AM
To: 'Bill Mendez'; Reuben Franklin (rfranklin@citystaug.com); 'Martha Graham'; 'Meredith Breidenstein'; 'Mark Litzinger'; 'tburchfield@citystaug.com'
Cc: Sedgwick, Steven; Victor, Patrick
Subject: Stormwater Utility Meeting Minutes
Attachments: Draft_Billing_Alternative_Table.pdf; Stormwater_Utility_Evaluation.pdf; Residential_Utility_Sample.pdf

Please find below the draft meeting minutes for your review and comment. We are including a map with the location of the sampled residential and non residential customers for your convenience.

Thank you,

José Maria Guzman, PE, D.WRE
CDM Smith | 8381 Dix Ellis Trail, Suite 400| Jacksonville, FL 32256| Tel: 904-527-6702| Fax: 904-519-7090| www.cdmsmith.com

City of St. Augustine
Stormwater Utility Evaluation Update Meeting

Wednesday April 18 2012 – 9AM – 4th Floor Conference Room - Public Works

Attendees:

Finance Department: Mark Litzinger, Meredith Breidenstein
Public Works: Martha Graham
Engineering department: Bill Mendez, Reuben Franklin
City Manager: Timothy Burchfield
CDM Smith: Steve Sedgwick, Patrick Victor, Jose Maria Guzman

Action Items:

1) *City staff shall review Table A.1 to determine the impacted customers..*
2) *CDM Smith will finalize the draft O/M yearly expenditures in coordination with the Finance and Engineering Department.*
3) *CDM Smith will provide additional detail regarding the residential sample. CDM Smith shall provide a figure showing the location of the parcels sample (attached)*
4) *City staff will discuss the potential revenue scenarios to determine a potential update to the billing structure based on the discussion held.*

Discussion Topics (see attached PDF file for detailed discussion)

1) The current stormwater utility was developed based on a study that has been updated since, and the current utility is structured as follows:

    A. *Residential ERU rate: $5.00/month*

B. *Non-Residential ERU rate: $7.50/month*
C. *10 ERU non residential cap (20,000 sq-ft)*
D. *ERU base: 2,000 square feet*
E. *Average yearly revenue: $750,000*

2) CDM Smith evaluated the following aspects of the current utility.

A. *10 ERU non residential cap. Table A-1 lists the customers that would be impacted by lifting the current cap.*
B. *Actual ERU base: 1,885 sq-ft. Table A-3 shows the actual parameters for different land use categories, with an ultimate result of 1,885 square feet for an equivalent residential unit (ERU), in comparison with the current 2,000 square feet.*
C. *Table A-4 shows the data specific to St. Augustine, with a ratio between the small and large residential customers. The results provide justification for a residential tiered structure (SFU) if the City were to consider it.*

3) CDM Smith estimated the potential revenue change with respect to the current utility and summarized in Table A-6. Among the many options available, CDM Smith proposes there are two main options available to the City.

Option 1: Correcting billing issues

- *Eliminating the 10 ERU non-residential cap*
- *Standarizing to a single ERU base*
- *ERU base of 1,885 sq-ft*
- *Obtaining city council approval of updated ordinance*
- *Restructuring of the billing database*
- *Considering the use of utility credits*

Option 2: Overall update of the stormwater billing structure

- *Establish the projected 15 year stormwater CIP*
- *Use most updated information for estimating impervious areas*
- *Consider the option of a tiered billing structure (SFU)*
- *Potentially consider an advisory committee*
- *Potentially include a credit system to reduce City O/M and promote low impact development*

José Maria Guzman, PE, D.WRE
CDM Smith | 8381 Dix Ellis Trail, Suite 400| Jacksonville, FL 32256| Tel: 904-527-6702| Fax: 904-519-7090| www.cdmsmith.com

City of St. Augustine

Stormwater Utility Evaluation Update Meeting

Wednesday April 18 2012 – 9AM – 4th Floor Conference Room - Public Works

Attendees:

Finance Department: Mark Litzinger, Meredith Breidenstein

Public Works: Martha Graham

Engineering department: Bill Mendez, Reuben Franklin

City Manager: Timothy Burchfield

CDM Smith: Steve Sedgwick, Patrick Victor, Jose Maria Guzman

Action Items:

1) City staff shall review Table A.1 to determine the impacted customers..

2) CDM Smith will finalize the draft O/M yearly expenditures in coordination with the Finance and Engineering Department.

3) CDM Smith will provide additional detail regarding the residential sample. CDM Smith shall provide a figure showing the location of the parcels sample (attached)

4) City staff will discuss the potential revenue scenarios to determine a potential update to the billing structure based on the discussion held.

Discussion Topics (see attached PDF file for detailed discussion)

1) The current stormwater utility was developed based on a study that has been updated since, and the current utility is structured as follows:

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   B. Non-Residential ERU rate: $7.50/month

   C. 10 ERU non residential cap (20,000 sq-ft)

   D. ERU base: 2,000 square feet

   E. Average yearly revenue: $750,000

2) CDM Smith evaluated the following aspects of the current utility.

   A. 10 ERU non residential cap. Table A-1 lists the customers that would be impacted by lifting the current cap.

B. Actual ERU base: 1,885 sq-ft. Table A-3 shows the actual parameters for different land use categories, with an ultimate result of 1,885 square feet for an equivalent residential unit (ERU), in comparison with the current 2,000 square feet.

C. Table A-4 shows the data specific to St. Augustine, with a ratio between the small and large residential customers. The results provide justification for a residential tiered structure (SFU) if the City were to consider it.

3) CDM Smith estimated the potential revenue change with respect to the current utility and summarized in Table A-6. Among the many options available, CDM Smith proposes there are two main options available to the City.

Option 1: Correcting billing issues

- Eliminating the 10 ERU non-residential cap
- Standarizing to a single ERU base
- ERU base of 1,885 sq-ft
- Obtaining city council approval of updated ordinance
- Restructuring of the billing database
- Considering the use of utility credits

Option 2: Overall update of the stormwater billing structure

- Establish the projected 15 year stormwater CIP
- Use most updated information for estimating impervious areas
- Consider the option of a tiered billing structure (SFU)
- Potentially consider an advisory committee
- Potentially include a credit system to reduce City O/M and promote low impact development

City of St. Augustine

Stormwater Master Plan Update Meeting

Friday July 13 2012 – 10:30 AM – 4th Floor Conference Room - Public Works

1) ***Level of Service (LOS):***
   a) *Local roads shall be passable for the 5 year/24 hour design storm (6.3 inches/24 hours)*
   b) *Arterial and collector roads shall be passable for the 50 year/24 hour design storm (11 inches). This is particularly relevant to ambulances, police vehicles, and fire fighters that need to be able to reach residents in the event of a major flood, or evacuation scenario.*
   c) *Structures shall not flood up to the 100 year/24 hour design storm (12.8 inches).*
   d) *Design tidal condition set at 2.2 ft NAVD*

2) ***Pilot Area 1 - Oyster Creek – Sidney outfall***
   a) *Only one location does not meet LOS (Sidney & Christopher)*
   b) *Proposed project is based on minimal roadway reconstruction*

3) ***Pilot Area 2 - Oyster Creek– South Dixie Outfall***
   a) *Four locations currently do not meet the LOS*
   b) *Proposed project is based on complete roadway reconstruction*

4) ***Pilot Area 3 - Maria Sanchez Lake***
   a) *Existing condition does not meet LOS at multiple locations*
   b) *Alternative 1 – 2002 City Design*
   c) *Alternative 2 – Conveyance improvements*
   d) *Alternative 3 – Conveyance improvement with underground storage*

5) ***Stormwater Utility***
   a) *Geocoding of customers submitted in June 2012*
   b) *Revenues and expenses finalized*

6) ***Other***
   a) *Treasury outfall - Groundwater injection well*
   b) *Treasury outfall - Ground penetrating radar at King Street & Cathedral Street*

7) ***Upcoming milestones***
   a) *Draft report*
   b) *Additional survey?*

APPENDIX C

Table C-1

City of St. Augustine SWMP

Sidney St. Road and Ditch - Minimal Cut

Opinion of Probable Construction Costs for Concept Design

No.	ITEM DESCRIPTION	UNITS	PROBABLY QUANTITY	UNIT PRICE	ESTIMATED COST
1	Mobilization	LS	1	$8,000.00	$8,000
2	Maintenance of Traffic (MOT)	LS	1	$5,000.00	$5,000
3	Sediment Barrier	LF	3,000	$2.00	$6,000
4	Clearing & Grubbing	AC	0.5	$12,000.00	$6,000
5	Mitered End Section 18"	UN	1	$800.00	$800
6	Guard rail	LF	460	$30.00	$13,800
7	Control Strucutre	UN	1	$20,000.00	$20,000
8	Land Acquisition (123650)	AC	0.39	$25,000.00	$9,800
9	Land Acquisition (123626)	AC	0.45	$55,200.00	$24,900
10	*Inlets, Curb (Type 3) (9')*	EA	4	$3,900.00	$15,600
11	Excavation	CY	3,200	$8.00	$25,600
12	15" Reinforced Concrete Pipe	LF	700	$50.00	$35,000
13	18" Reinforced Concrete Pipe	LF	400	$60.00	$24,000
14	2" S-1 Asphalt Paving	SY	600	$12.00	$7,200
15	10" Aggregate Base Course	SY	600	$15.00	$9,000
16	12" Compacted Subgrade	SY	600	$1.35	$800
17	Ditch inlet system (Flume)	UN	4	$5,000.00	$20,000
18	Milling Existing Pavement	SY	600	$8.00	$4,800
19	Sod	SY	1,000	$4.00	$4,000
				Sub-Total	$240,300
				30% Contingency	$72,090
				Sub-Total 2	$312,390
				Engineering, Survey, & Permitting (15% of Subtotal 2)	$46,859
				Total Cost	**$360,000**

Notes:

1. This cost estimate does not include permitting, easement acquisition, utility adjustments, wetland mitigation, contamination remediation or other unforeseen conditions.
2. Total cost rounded to two significant figures.
3. Stormwater vault bid price should include all excavation, dewatering, structures, piping, backfill, access covers, etc.
4. If the project is more than 6 months from being bid/awarded, it is recommended to carry an escalation percentage (+/- 3% per year).
5. The cost estimates are shown in 2012 dollars.

CDM Smith

Table C-2
City of St. Augustine SWMPU
South Dixie Hwy - Open Cut
Opinion of Probable Construction Costs for Concept Design

No.	ITEM DESCRIPTION	UNITS	PROBABLE QUANTITY	UNIT PRICE	ESTIMATED COST
1	Mobilization	ls	1	$ 50,000.00	$ 50,000.00
2	Maintenance of Traffic	ls	1	$ 50,000.00	$ 50,000.00
3	Sediment Barrier	lf	3000	$ 2.00	$ 6,000.00
4	Clearing & Grubbing	ac	0.5	$ 11,400.00	$ 5,700.00
5	Excavation	cy	3000	$ 9.00	$ 27,000.00
6	New 36" CI 3 RCP (By Open Cut)	lf	400	$ 150.00	$ 60,000.00
7	New 30" CI 3 RCP (BY Open Cut)	lf	550	$ 140.00	$ 77,000.00
8	New 18" CI 3 RCP (BY Open Cut)	lf	520	$ 110.00	$ 57,200.00
9	*Inlets, Curb (Type 3) (9')*	EA	12	$ 3,900.00	$ 46,800.00
10	Type F Curb & Gutter	lf	2000	$ 30.00	$ 60,000.00
11	Control Structure	ea	1	$ 20,000.00	$ 20,000.00
12	Type S-1 Asphalt Paving	sy	4000	$ 14.00	$ 56,000.00
13	10" Aggregate Base Course	sy	4000	$ 20.00	$ 80,000.00
14	12" Compacted Subgrade	SY	4000	$ 2.00	$ 8,000.00
15	Milling Existing Pavement	sy	4000	$ 6.00	$ 24,000.00
16	Sod	sy	1000	$ 6.00	$ 6,000.00
17	Additional - Type S-1 Asphalt Paving	sy	13000	$ 14.00	$ 182,000.00
18	Additional - 10" Aggregate Base Course	sy	13000	$ 20.00	$ 260,000.00
19	Additional - 12" Compacted Subgrade	SY	14400	$ 2.00	$ 28,800.00
20	Additional - Milling Existing Pavement	sy	10000	$ 6.00	$ 60,000.00
21	Additional - Type F Curb and Gutter	lf	5600	$ 30.00	$ 168,000.00
22	Additional - Concrete Box Culvert Replacement	ls	1	$ 30,000.00	$ 30,000.00
23	Additional Land Acquisition	ls	1	$ 200,000.00	$ 200,000.00
24	Water and sewer replacement	ls	1	$ 350,000.00	$ 350,000.00
25	Additional - Sediment Barrier	lf	4600	$ 2.00	$ 9,200.00
26	Additional - Sod	sy	2000	$ 6.00	$ 12,000.00

Sub-Total	$1,933,700
30% Contingency	$580,110
Sub-Total 2	$2,513,810
Engineering, Survey, & Permitting (15% of Subtotal 2)	$377,072
Total Cost	**$2,891,000**

Notes:

1. This cost estimate does not include permitting, land or easement acquisition, utility adjustments, wetland mitigation, contamination remediation or other unforeseen conditions.
2. Total cost rounded to two significant figures.
3. Stormwater vault bid price should include all excavation, dewatering, structures, piping, backfill, access covers, etc.
4. If the project is more than 6 months from being bid/awarded, it is recommended to carry an escalation percentage (+/- 3% per year).
5. The cost estimates are shown in 2012 dollars.
6. This cost estimate includes additional roadway improvements already planned by the City within the same street corridor.

CDM Smith

Table C-3

City of St. Augustine SWMPU

Maria Sanchez - Open Cut Alternative 4

Opinion of Probable Construction Costs for Concept Design

No.	ITEM DESCRIPTION	UNITS	PROBABLE QUANTITY	UNIT PRICE	ESTIMATED COST
1	Mobilization	LS	1	$ 70,000.00	$ 70,000.00
2	Maintenance of Traffic	LS	1	$ 80,000.00	$ 80,000.00
3	Sediment Barrier	LF	6200	$ 2.00	$ 12,400.00
4	Stormwater Vault	CF	22,500	$ 20.00	$ 450,000.00
5	Vault - Type S-1 Asphalt Paving	SY	700	$ 14.00	$ 9,800.00
6	Vault - 10" Aggregate Base Course	SY	700	$ 20.00	$ 14,000.00
7	Vault - 12" Compacted Subgrade	SY	700	$ 2.00	$ 1,400.00
8	Vault - Milling Existing Pavement	SY	700	$ 6.00	$ 4,200.00
9	2' x 3' Box Culvert	LF	510	$ 375.00	$ 191,250.00
10	2' x 6' Box Culvert	LF	525	$ 550.00	$ 288,750.00
11	2.5' x 6' Box Culvert	LF	190	$ 600.00	$ 114,000.00
12	3' x 8' Box Culvert	LF	780	$ 745.00	$ 581,100.00
13	*Inlets, Curb (Type 3) (9')*	EA	12	$ 3,900.00	$ 46,800.00
14	Type F Curb & Gutter	LF	1220	$ 30.00	$ 36,600.00
15	Type S-1 Asphalt Paving	SY	1650	$ 14.00	$ 23,100.00
16	10" Aggregate Base Course	SY	1650	$ 20.00	$ 33,000.00
17	12" Compacted Subgrade	SY	1650	$ 2.00	$ 3,300.00
18	Hardscaping	SY	1000	$ 50.00	$ 50,000.00
19	Milling Existing Pavement	SY	1650	$ 6.00	$ 9,900.00
20	*Inverted Crown - Inlets, Curb (Type V) (>10')*	EA	6	$ 3,900.00	$ 23,400.00
21	Inverted Crown Type F Curb & Gutter	LF	1220	$ 30.00	$ 36,600.00
22	Inverted Crown - Type S-1 Asphalt Paving	SY	1650	$ 14.00	$ 23,100.00
23	Inverted Crown -10" Aggregate Base Course	SY	1650	$ 20.00	$ 33,000.00
24	Inverted Crown - 12" Compacted Subgrade	SY	1650	$ 2.00	$ 3,300.00
25	Inverted Crown - Milling Existing Pavement	SY	1650	$ 6.00	$ 9,900.00

Sub-Total	$	2,148,900.00
30% Contingency	$	644,670.00
Sub-Total 2	$	2,793,570.00
Engineering, Survey, & Permitting (10% of Subtotal 2)	$	279,357.00
Total Cost	**$**	**3,073,000.00**

Notes:

1. This cost estimate does not include permitting, land or easement acquisition, utility adjustments, wetland mitigation, contamination remediation or other unforeseen conditions.
2. Total cost rounded to two significant figures.
3. Stormwater vault bid price should include all excavation, dewatering, structures, piping, backfill, access covers, etc.
4. If the project is more than 6 months from being bid/awarded, it is recommended to carry an escalation percentage (+/- 3% per year).
5. The cost estimates are shown in 2012 dollars.

CDM Smith

Table C-4
City of St. Augustine SWMP
Sidney St. Road and Ditch - Horizontal Direction Drilling
Opinion of Probable Construction Costs for Concept Design

No.	ITEM DESCRIPTION	UNITS	PROBABLY QUANTITY	UNIT PRICE	ESTIMATED COST
1	Mobilization	LS	1	$8,000.00	$8,000
2	Maintenance of Traffic (MOT)	LS	1	$50,000.00	$50,000
3	Sediment Barrier	LF	2,500	$2.00	$5,000
4	Clearing & Grubbing	AC	0.5	$12,000.00	$6,000
5	Control Structure	UN	1	$20,000.00	$20,000
6	Guard rail	LF	460	$30.00	$13,800
7	Land Acquisition	AC	0.4	$15,000.00	$6,000
8	*Inlets, Curb (Type 3) (9')*	EA	4	$3,900.00	$15,600
9	Excavation	CY	3,200	$9.00	$28,800
10	15" Reinforced Concrete Pipe (HDD)	LF	700	$188.00	$131,600
11	18" Reinforced Concrete Pipe (HDD)	LF	300	$224.00	$67,200
12	18" Reinforced Concrete Pipe (Open Cut)	LF	100	$60.00	$6,000
13	2" S-1 Asphalt Paving	SY	0	$12.00	$0
14	10" Aggregate Base Course	SY	0	$15.00	$0
15	12" Compacted Subgrade	SY	0	$1.35	$0
16	*Ditch inlet system (Flume)*	UN	4	$5,000.00	$20,000
17	Milling Existing Pavement	SY	0	$8.00	$0
18	Sod	SY	1,000	$4.00	$4,000
				Sub-Total	$382,000
				30% Contingency	$114,600
				Sub-Total 2	$496,600
				Engineering, Survey, & Permitting (15% of Subtotal 2)	$74,490
				Total Cost	**$580,000**

Notes:

1. This cost estimate does not include permitting, land or easement acquisition, utility adjustments, wetland mitigation, contamination remediation or other unforeseen conditions.
2. Total cost rounded to two significant figures.
3. Stormwater vault bid price should include all excavation, dewatering, structures, piping, backfill, access covers, etc.
4. If the project is more than 6 months from being bid/awarded, it is recommended to carry an escalation percentage (+/- 3% per year).
5. The cost estimates are shown in 2012 dollars.

CDM Smith

Table C-5
City of St. Augustine SWMP
Sidney St. Road and Ditch - Open Cut
Opinion of Probable Construction Costs for Concept Design

No.	ITEM DESCRIPTION	UNITS	PROBABLY QUANTITY	UNIT PRICE	ESTIMATED COST
1	Mobilization	LS	1	$8,000.00	$8,000
2	Maintenance of Traffic (MOT)	LS	1	$5,000.00	$5,000
3	Sediment Barrier	LF	3,000	$2.00	$6,000
4	Clearing & Grubbing	AC	0.5	$12,000.00	$6,000
5	Control Structure	UN	1	$20,000.00	$20,000
6	Guard rail	LF	460	$30.00	$13,800
7	Land Acquisition	AC	0.4	$15,000.00	$6,000
8	*Inlets, Curb (Type 3) (9')*	EA	4	$3,900.00	$15,600
9	Excavation	CY	3,200	$9.00	$28,800
10	Curb Type F	LF	2,000	$26.80	$53,600
11	15" Reinforced Concrete Pipe	LF	700	$50.00	$35,000
12	18" Reinforced Concrete Pipe	LF	1,100	$60.00	$66,000
13	2" S-1 Asphalt Paving	SY	2,800	$12.00	$33,600
14	10" Aggregate Base Course	SY	2,800	$15.00	$42,000
15	12" Compacted Subgrade	SY	2,800	$1.35	$3,800
16	*Ditch inlet system (Flume)*	UN	4	$5,000.00	$20,000
17	Milling Existing Pavement	SY	2,800	$8.00	$22,400
18	Sod	SY	1,000	$4.00	$4,000
				Sub-Total	$389,600
				30% Contingency	$116,880
				Sub-Total 2	$506,480
				Engineering, Survey, & Permitting (15% of Subtotal 2)	$75,972
				Total Cost	**$590,000**

Notes:

1. This cost estimate does not include permitting, land or easement acquisition, utility adjustments, wetland mitigation, contamination remediation or other unforeseen conditions.
2. Total cost rounded to two significant figures.
3. Stormwater vault bid price should include all excavation, dewatering, structures, piping, backfill, access covers, etc.
4. If the project is more than 6 months from being bid/awarded, it is recommended to carry an escalation percentage (+/- 3% per year).
5. The cost estimates are shown in 2012 dollars.

CDM Smith

Table C-6
City of St. Augustine SWMPU
South Dixie Hwy - Open Cut
Opinion of Probable Construction Costs for Concept Design

No.	ITEM DESCRIPTION	UNITS	PROBABLE QUANTITY	UNIT PRICE	ESTIMATED COST
1	Mobilization	ls	1	$ 17,500.00	$ 17,500.00
2	Maintenance of Traffic	ls	0	$ 7,000.00	$ -
3	Sediment Barrier	lf	3000	$ 1.90	$ 5,700.00
4	Clearing & Grubbing	ac	0.5	$ 11,400.00	$ 5,700.00
5	Excavation	cy	3000	$ 9.00	$ 27,000.00
7	New 36" Cl 3 RCP (By Open Cut)	lf	400	$ 150.00	$ 60,000.00
8	New 30" Cl 3 RCP (BY Open Cut)	lf	550	$ 125.00	$ 68,750.00
9	New 18" Cl 3 RCP (BY Open Cut)	lf	520	$ 70.00	$ 36,400.00
12	*Inlets, Curb (Type 3) (9')*	EA	12	$ 3,900.00	$ 46,800.00
14	Type F Curb & Gutter	lf	2000	$ 26.80	$ 53,600.00
15	Control Structure	ea	1	$ 20,000.00	$ 20,000.00
16	Type S-1 Asphalt Paving	sy	0	$ 13.80	$ -
17	10" Aggregate Base Course	sy	0	$ 19.60	$ -
18	12" Compacted Subgrade	SY	0	$ 1.55	$ -
19	Milling Existing Pavement	sy	0	$ 5.80	$ -
20	Sod	sy	1000	$ 5.75	$ 5,750.00

Sub-Total	$347,200
30% Contingency	$104,160
Sub-Total 2	$451,360
Engineering, Survey, & Permitting (15% of Subtotal 2)	$67,704
Total Cost	**$520,000**

Notes:

1. This cost estimate does not include permitting, land or easement acquisition, utility adjustments, wetland mitigation, contamination remediation or other unforeseen conditions.
2. Total cost rounded to two significant figures.
3. Stormwater vault bid price should include all excavation, dewatering, structures, piping, backfill, access covers, etc.
4. If the project is more than 6 months from being bid/awarded, it is recommended to carry an escalation percentage (+/- 3% per year).
5. The cost estimates are shown in 2012 dollars.

CDM Smith

Table C-7

City of St. Augustine SWMPU

South Dixie Hwy - Directional Drill

Opinion of Probable Construction Costs for Concept Design

No.	ITEM DESCRIPTION	UNITS	PROBABLE QUANTITY	UNIT PRICE	ESTIMATED COST
1	Mobilization	ls	1	$ 10,000.00	$ 10,000.00
2	Maintenance of Traffic	ls	1	$ 7,000.00	$ 7,000.00
3	Sediment Barrier	lf	3000	$ 1.90	$ 5,700.00
4	Clearing & Grubbing	ac	0.5	$ 11,400.00	$ 5,700.00
5	Excavation	cy	3000	$ 9.00	$ 27,000.00
7	New 36" Cl 3 RCP (By Open Cut)	lf	400	$ 150.00	$ 60,000.00
8	New 24"HDPE DR 17 Storm Drain (BY Horizontal Directional Drilling)	lf	140	$ 318.00	$ 44,520.00
9	New 18"HDPE DR 17 Storm Drain (BY Horizontal Directional Drilling)	lf	550	$ 224.00	$ 123,200.00
11	New 15"HDPE DR 17 Storm Drain (BY Horizontal Directional Drilling)	lf	350	$ 188.00	$ 65,800.00
12	Inlets (Gutter) (Type V) (<10')	ea	8	$ 3,950.00	$ 31,600.00
13	Concrete Headwall	ea	1	$ 5,750.00	$ 5,750.00
14	Type F Curb & Gutter	lf	0	$ 26.80	$ -
15	Baffle Box	ea	1	$ 35,000.00	$ 35,000.00
16	Type S-1 Asphalt Paving	sy	0	$ 13.80	$ -
17	10" Aggregate Base Course	sy	0	$ 19.60	$ -
18	12" Compacted Subgrade	sy	0	$ 1.55	$ -
19	Milling Existing Pavement	sy	0	$ 5.80	$ -
20	Sod	sy	0	$ 5.75	$ -

Sub-Total	$421,270
30% Contingency	$126,381
Sub-Total 2	$547,651
Engineering, Survey, & Permitting (15% of Subtotal 2)	$82,148
Total Cost	**$630,000**

Notes:

1. This cost estimate does not include permitting, land or easement acquisition, utility adjustments, wetland mitigation, contamination remediation or other unforeseen conditions.
2. Total cost rounded to two significant figures.
3. Stormwater vault bid price should include all excavation, dewatering, structures, piping, backfill, access covers, etc.
4. If the project is more than 6 months from being bid/awarded, it is recommended to carry an escalation percentage (+/- 3% per year).
5. The cost estimates are shown in 2012 dollars.

CDM Smith

Table C-8
City of St. Augustine SWMPU
Maria Sanchez - Open Cut Alternative 3
Opinion of Probable Construction Costs for Concept Design

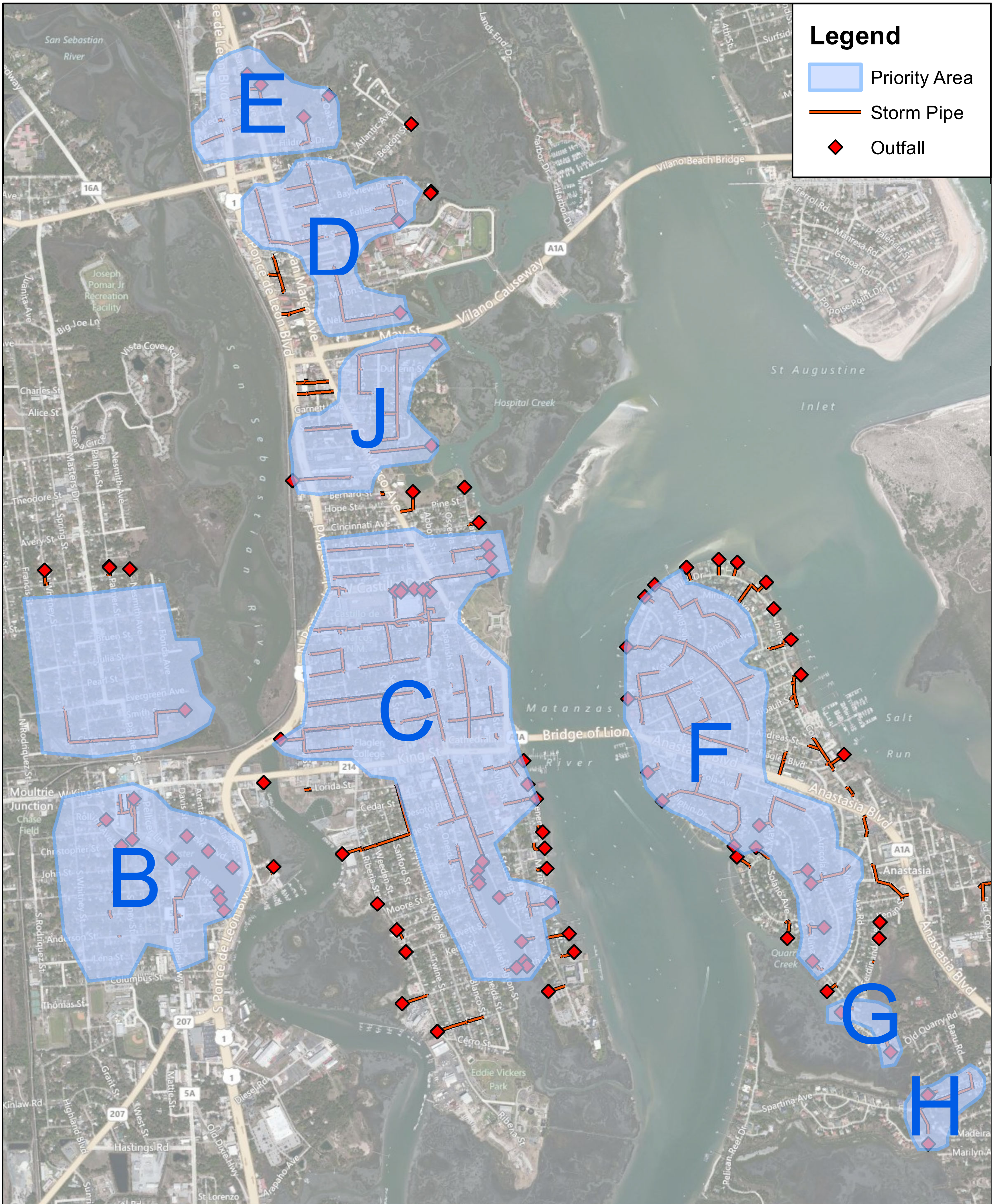
No.	ITEM DESCRIPTION	UNITS	PROBABLE QUANTITY	UNIT PRICE	ESTIMATED COST
1	Mobilization	ls	1	$ 70,000.00	$ 70,000.00
2	Maintenance of Traffic	ls	1	$ 80,000.00	$ 80,000.00
3	Sediment Barrier	lf	6200	$ 2.00	$ 12,400.00
4	Stormwater Vault	cf	22,500	$ 18.00	$ 405,000.00
5	Vault - Type S-1 Asphalt Paving	sy	700	$ 14.00	$ 9,800.00
6	Vault - 10" Aggregate Base Course	sy	700	$ 20.00	$ 14,000.00
7	Vault - 12" Compacted Subgrade	SY	700	$ 2.00	$ 1,400.00
8	Vault - Milling Existing Pavement	sy	700	$ 6.00	$ 4,200.00
9	2' x 3' Box Culvert	lf	510	$ 375.00	$ 191,250.00
10	2' x 3' Box Culvert	lf	410	$ 375.00	$ 153,750.00
11	2' x 6' Box Culvert	lf	410	$ 550.00	$ 225,500.00
12	2' x 6' Box Culvert	lf	275	$ 550.00	$ 151,250.00
13	2.5' x 6' Box Culvert	lf	190	$ 600.00	$ 114,000.00
14	2' x 8' Box Culvert	lf	520	$ 690.00	$ 358,800.00
15	4' x 8' Box Culvert	lf	780	$ 800.00	$ 624,000.00
16	*Inlets, Curb (Type 3) (9')*	EA	24	$ 3,900.00	$ 93,600.00
17	Type F Curb & Gutter	lf	6200	$ 30.00	$ 186,000.00
18	Type S-1 Asphalt Paving	sy	8250	$ 14.00	$ 115,500.00
19	10" Aggregate Base Course	sy	8250	$ 20.00	$ 165,000.00
20	12" Compacted Subgrade	SY	8250	$ 2.00	$ 16,500.00
21	Milling Existing Pavement	sy	8250	$ 6.00	$ 49,500.00

Sub-Total	$	3,041,450.00
30% Contingency	$	912,435.00
Sub-Total 2	$	3,953,885.00
Engineering, Survey, & Permitting (10% of Subtotal 2)	$	395,388.50
Total Cost	**$**	**4,350,000.00**

Notes:

1. This cost estimate does not include permitting, land or easement acquisition, utility adjustments, wetland mitigation, contamination remediation or other unforeseen conditions.
2. Total cost rounded to two significant figures.
3. Stormwater vault bid price should include all excavation, dewatering, structures, piping, backfill, access covers, etc.
4. If the project is more than 6 months from being bid/awarded, it is recommended to carry an escalation percentage (+/- 3% per year).
5. The cost estimates are shown in 2012 dollars.

APPENDIX D



Priority Areas (Site Visit Locations)
City of St. Augustine
Primary Stormwater Management System

CDM Smith

Project Kickoff 01-06-2012

Florida&Evergreen

EvergreenDitch

EvergreenDitch2

EvergreenDitchDS

EvergreenDitchWidth

EvergreenDitchDepth

EvergreenDitch3

EvergreenDitch4

EvergreenDitchOutfall

EvergreenDitchOutfall2

FloridaAveWetlands

FloridaAveWetlands2

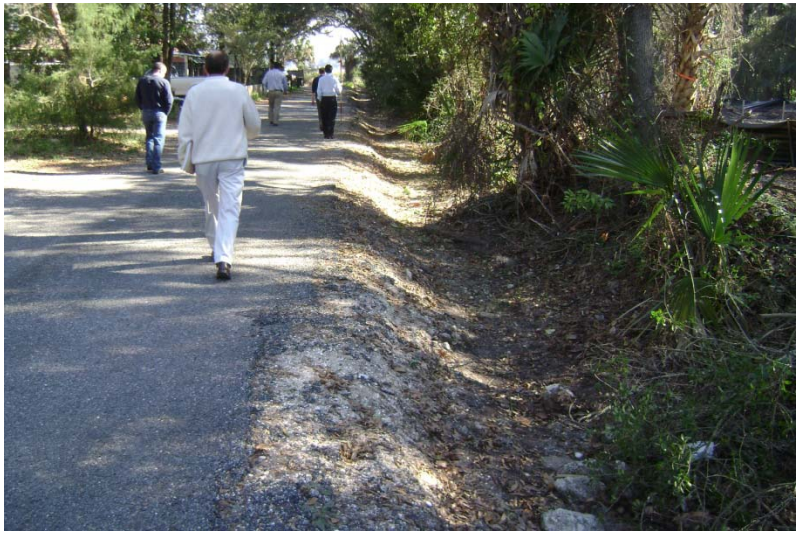
FloridaAveWetlands3

FloridaAveWetlands4

FloridaAveDevelopment

Florida&Julia

JuliaStDitch



JuliaStDitch2

JuliaStDitch3

JuliaStDitch4

JuliaStDitch_RemovedCulvert

JuliaStDitch_Depth

SanSebastianRiver

JuliaStDitch_Outfall

SanSebastianRiver2

SanSebastianRiver3

JuliaStDitch_FacingDS

JuliaStDitch_Width

JuliaStDitch_DS2

JuliaSt

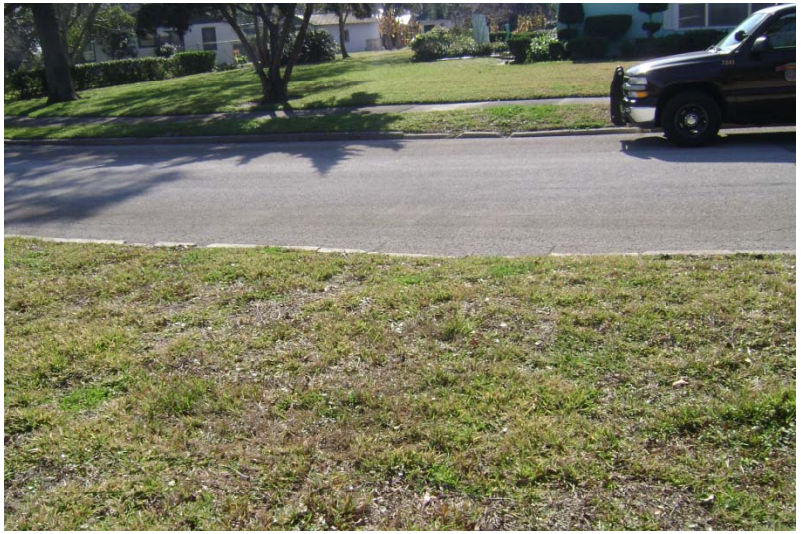
Florida&Julia_NECorner

OysterCreek_RioVista

OysterCreek

Riovista2

RioVista3



RioVista4

OysterCreek_RioVista_Outfall

OysterCreek_RioVista_Outfall2

OysterCreek_RioVista_Outfall3

RioVista_CurbInlet

RioVista_CurbInlet2

RioVista_CurbInlet3

RioVista_CurbInlet_Debris

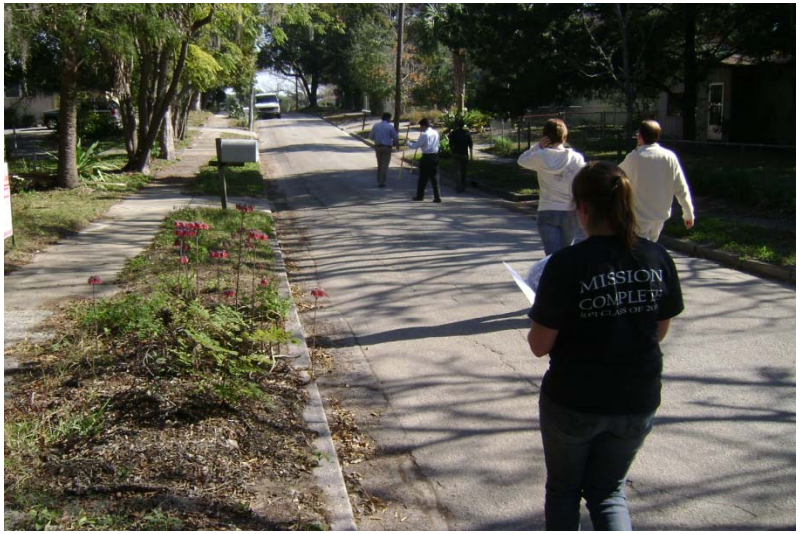
RioVista_Curb_Sediment

Bioretention_CareySt

Carey&RioVista

SouthDixie&Carey

SouthDixie&Spencer



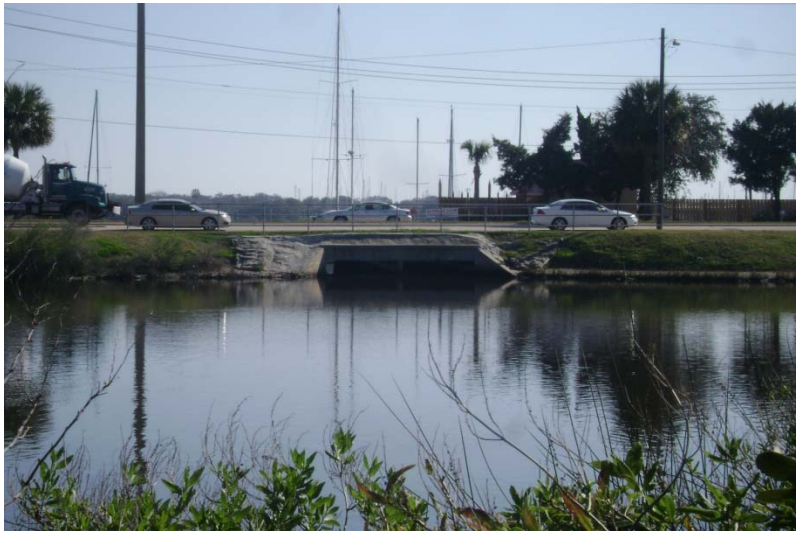
SpencerRd_Depression

Blocked_Curb_Aiken

Blocked_Curb_Aiken2

Aiken&Carey

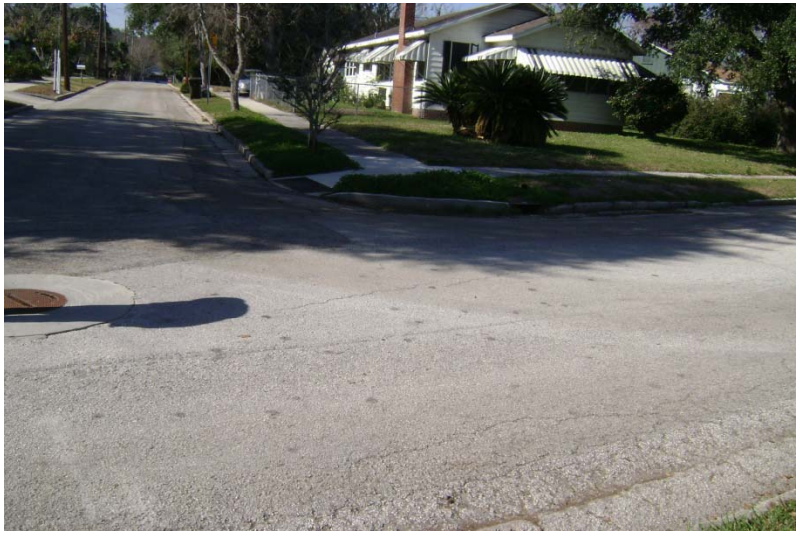
OysterCreek_Weir



OysterCreek_Weir2

Carey&RioVista2

Carey&Rio_CurbInlet



Carey&Rio_Curbinlet2

CordovaSt_Inlet

Cordova&BridgeSt

CordovaSt_Inlet2

CordovaSt_Outfall

CordovaSt_Outfall2

MariaSanchez_CordovaOutfall3

MariaSanchez

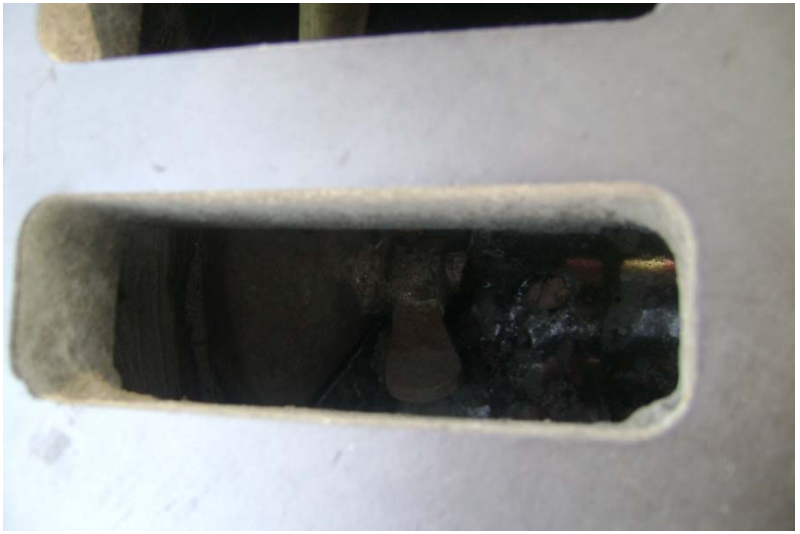
MariaSanchez2

MariaSanchez_Depth

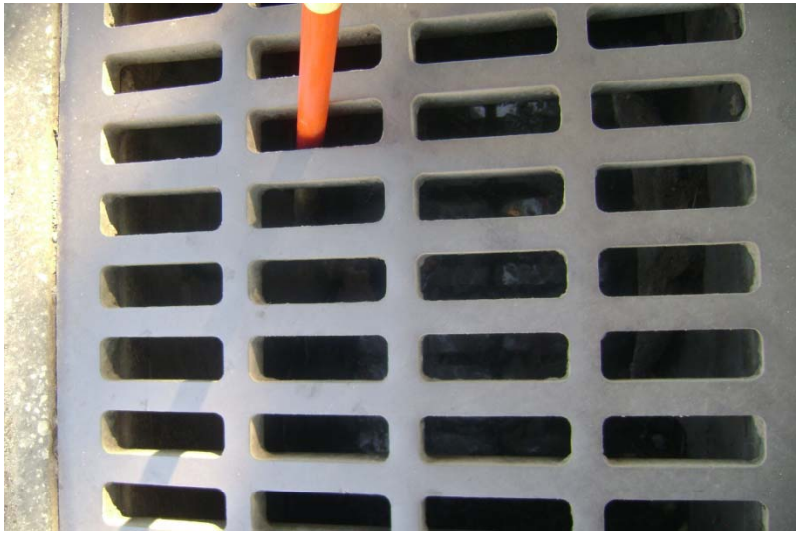
MariaSanchez3

StFrancis&Cordova

Cordova&Valencia



InletPipePlug



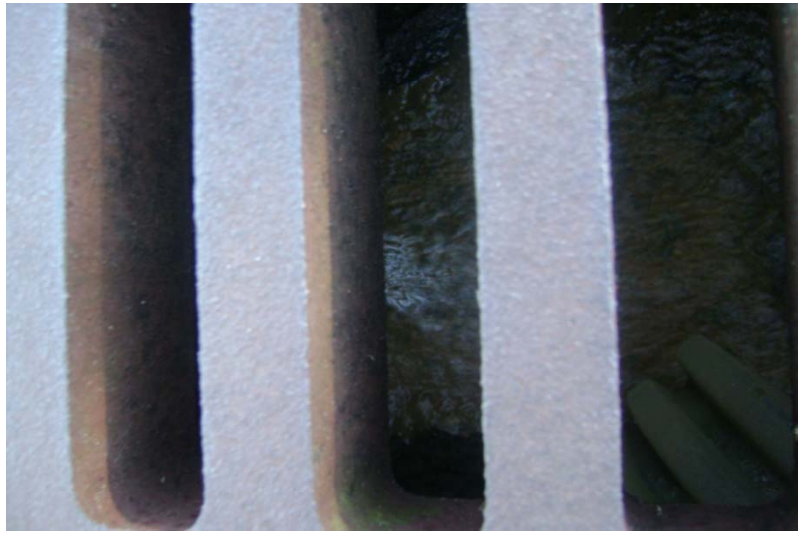
DSC00374

StFrancis_InletPipePlug2

DSC00376

Uncapped

AvenidaMenendez_Inlet_Flowing



AvenidaMenendez_Inlet_Flowing2

Hypolita_Inlet

Hypolita&Spanish

HypolitaInlet

Statue

CourtEdna&Banan

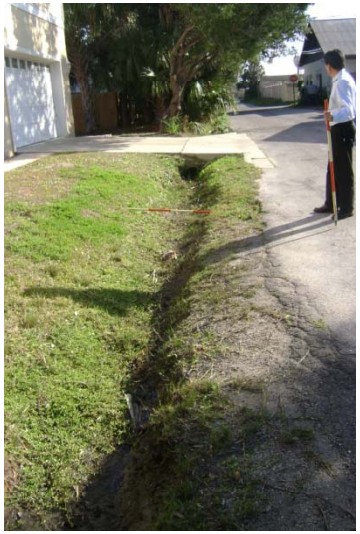
Banan_Inlet

Banan_Inlet2

CourtEdna_Marsh

Banan_Outfall

Banan_Outfall2



Banan_Ditch_Width

CurbInlet_AreaH

DSC00393

Magnolia&SanCarlos

Magnolia&SanCarlos2

SanCarlos_Outfall

SanCarlos_Outfall2

Fancher&Eugene_Inlet

Fancher&Eugene_Inlet2

AreaH

Fancher_Inlet

Fancher_Inlet2

Outfall_Casanova

Outfall_Casanova2

Outfall_Casanova3

Outfall_Casanova4

Outfall_Casanova5

Coquina_InletChannel

Coquina_AreaG

Coquina_InletChannel2

Coquina_InletChannel3

Coquina_CurbInletl

Coquina_BlockedCurbl

Coquina_Curbinlet

Coquina_outlet

Coquina_outet2

Site Visit 4-23-2012

Sidney-Christopher

ChrisSt_Inlet

ChrisST_Inlets

Upstreamfrom_Christopher

ChrisSt_DS_Headwall

ChrisSt_DS_Headwall2

DSofChrisSt_Facing_DS

DSofChrisSt_Facing_US

JohnST_US_Culvert

JohnST_US_Culvert3

JohnST_US_Culvert2

Sidney_John

MadeoreSt

MadeoreSt2

MadeoreST_US_Culvert1

MadeoreST_US_Culvert

MadeoreST_Sediment

MadeoreSt_Sediment (2)

MadeoreSt_DS

MadeoreST_DS_Culvert

PhillipsST_US_Culvert

PhillipsST_US_facingUS

PhillipsST_US_facingDS

PhillipsST_US_Culvert2

Sidney_Anderson

Anderson_Culvert1

Anderson_US_Culvert2

Anderson_US_Culvert3

AndersonST_US_facingUS

Anderson_US_StreetOpening

Anderson_US_StreetOpening2

AndersonSt_DropInlet

AndersonSt_DropInlet2

AndersonSt_DropInlet3

Andersonst_DS_DitchConnection

SDixie&Colums_Sediment

SDixie&Columb_facingSouth

Porous_Asphalt

Porous_Asphalt2

Aviles_SDixie

SDixie

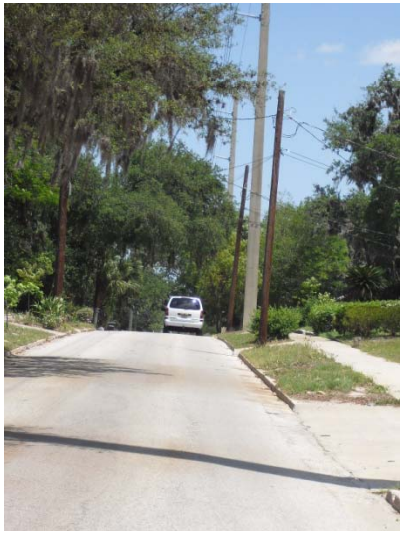
AvilesSt_SDixie

RiverRd_SDixie

RiverRD

Anderson_SDixie

Anderson_Inlet



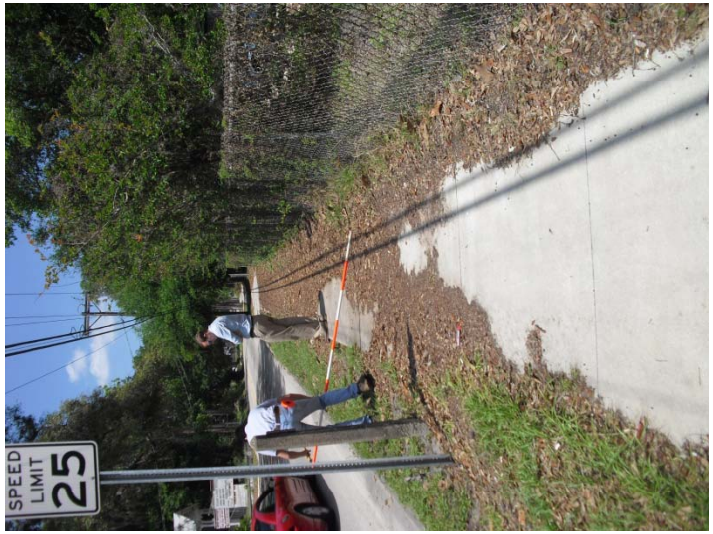
Facing_Anderson_SDixie

Anderson_Curbinlet

Anderson_Curbinlet2

Anderson_Curbinlet3

Anderson_Curbinlet4

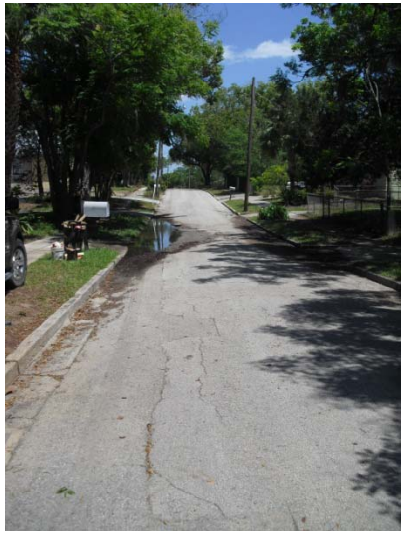


SDixie_NofAnderson_Debris

SDixie_NofAnderson_Debris2

SDixie_NofAnderson_Debris3

Spencer_SDixie



Spencer_Ponding

Spencer_Inlet

Spencer_PluggedInlet

Spencer_Ponding2

Spencer_CloggedInlet2

Spencer_Ponding3

Carey_SDIxie

Carey_Sediment

Carey_Sediment2

Carey_CloggedInlet

Carey_CloggedInlet2

Carey_CloggedInlet3

CurbInlet_RioV

RioVista_Outfall

SDixie_Inlet_NofCarey

SDixie_Outfall

SDixie_Outfall2

SDixie_Culvert

Madeore_Sediment

Madeore_Sediment2

Madeore_Sediment3

Madeore_Sediment4

SidneyOutfall_FacingDS

SidneyOutfall_FacingDS2

OysterDitch

Site Visit 05-08-2012

MariaSanchezLake_Weir1

MariaSanchezLake_Weir2

MariaSanchezLake_Weir3

MariaSanchezLake_Weir4

MariaSanchezLake_Weir 5

MariaSanchezLake_Weir 6

MariaSanchezLake_Weir7

SouthSt_SewageSpill

SouthSt_SewageSpill2

SouthSt_SewageSpill3

IMAG1203

TreasurySt_RainTanks

TreasurySt_RainTanks2

KingST_Inlet

KingST_Inlet2

TS Beryl 05-28-2012

Street_Sweeper611

Street_Sweeper

Wind_took_down_scooters

Sindey_Looking_North

Christopher Ditch

Anderson_0637

AndersonMG_0638

Madeore_0639

Madeore

Madeore_Sidney

Sidney

Sidney_North

Sidney_Facing_Outfall

Sidney_Outfall_US

Whitney_Crossing

APPENDIX E

Survey Sketches and Photos

Received 6/18/2012

TYPICAL CIRCULAR CULVERT

Basin:
Stream: OYSTER CREEK
XSection: R10V-OUTFA

Survey file: 392-054 (S) .txt
Photo file(s): R10V-OUTFA _USC.jpg photo # 001
R10V-OUTFA _DSC.jpg photo # 002
R10V-OUTFA _USC.jpg photo # 003
R10V-OUTFA _DSC.jpg photo # 004

Location (Street, County, State): SOUTH DIXIE HIGHWAY
DOT Number:

Crew: JODY CONLEY / LEE WILLINGHAM
Initials: JC / LW
Benchmark ID: CP-002
Benchmark Elevation: 5.83
Benchmark Description: 1/2" IRON PIPE "LB6824"

Date: 5/30/2012
Time: 10:00 AM
Rainfall: Y (N)

Number of Identical Culverts 1

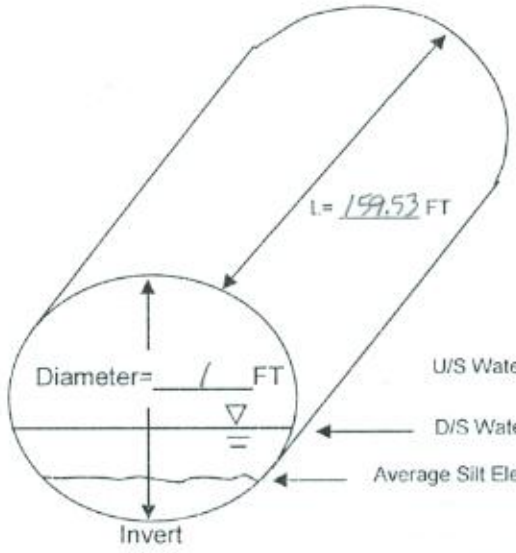
Invert Elevations:

(Compass Direction = SW) = 0.62 FT-NAV

(Compass Direction = _____) = _____ FT-NAV

(Compass Direction = _____) = _____ FT-NAV

Add lines if identically shaped culverts have different inverts



U/S Water Surface Elevation = _____ FT-NAV

D/S Water Surface Elevation = 1.55 FT-NAV

Average Silt Elevation 0.64 FT-NAV

Culvert Material: Reinforced Concrete (Corragated Metal) Other _____ (circle one)

Estimated Age 15+ Condition: FAIR

Bed Material Type: Gravel Silt Clay (Earthen) Concrete Other_____ Unknown
(circle one)

Fill Material Type: Gravel Silt Clay (Earthen) Concrete Other_____ Unknown
(circle one)

Head Wall: Material_____

Condition:_____

Type:_____

General Notes:

Attach roadway elevation sheet to culvert survey sheet.

NOTE: Additional detail regarding FEMA Data Capture Standards for Surveys can be found in FEMA Specifications and Guidelines Appendix N

RIOV-OUTFA 001

RIOV-OUTFA 002

RIOV-OUTFA 003

RIOV-OUTFA 004

TYPICAL BOX CULVERT

Basin:
Stream: OYSTER CREEK
XSection: CHRI-SIDNE

Survey file: _____ .txt
Photo file(s): CHRI-SIDNE_USC.jpg photo # 031
CHRI-SIDNE_DSC.jpg photo # 029
CHRI-SIDNE_USC.jpg photo # 30
CHRI-SIDNE_DSC.jpg photo # 024

Location (Street, County, State): CHRISTOPHER ST., ST. JOHNS COUNTY, FLORIDA
DOT Number:

Crew: LEE WILLINGHAM / JODY CONLEY
Initials: LW/JC
Benchmark ID: CP-019
Benchmark Elevation: 5.35' NAVD88
Benchmark Description:

Date: 6/04/2012
Time: 3:40PM
Rainfall: Y (N)

Number of Identical Culverts 1

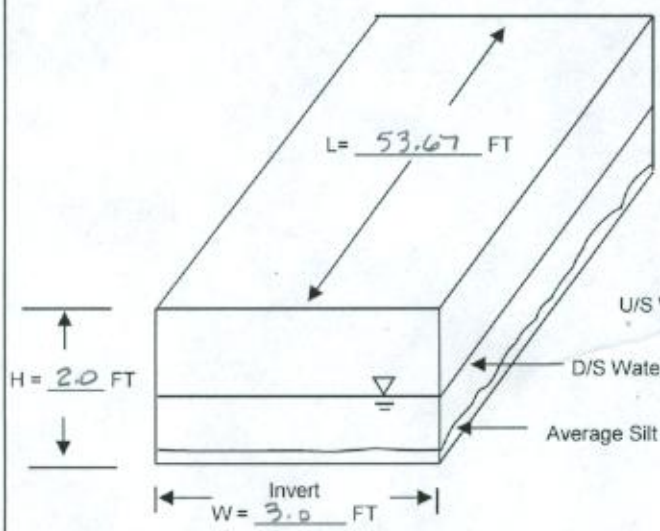
Invert Elevations:

(Compass Direction = NE) = -0.83 FT-NAV

(Compass Direction = SW) = -0.99 FT-NAV

(Compass Direction = _____) = _____ FT-NAV

Add lines if identically shaped culverts have different inverts



Culvert Material: (Reinforced Concrete) Corragated Metal Other _____ (circle one)

Estimated Age 30+ Condition: UNDER WATER

Bed Material Type: Gravel Silt Clay (Earthen) Concrete Other_____ Unknown
(circle one)

Fill Material Type: Gravel Silt Clay Earthen (Concrete) Other_____ Unknown
(circle one)

Head Wall: Material CONCRETE
Condition: GOOD
Type: WING WALL

General Notes:

Attach roadway elevation sheet to culvert survey sheet.

NOTE: Additional detail regarding FEMA Data Capture Standards for Surveys can be found in FEMA Specifications and Guidelines Appendix N

CHRI-SIDNE DS facing DS

CHRI-SIDNE DS facing US

CHRI-SIDNE facing DS

CHRI-SIDNE US facing US

TYPICAL CIRCULAR CULVERT

Basin:
Stream: OYSTER CREEK
XSection: JOHN - SOUTH

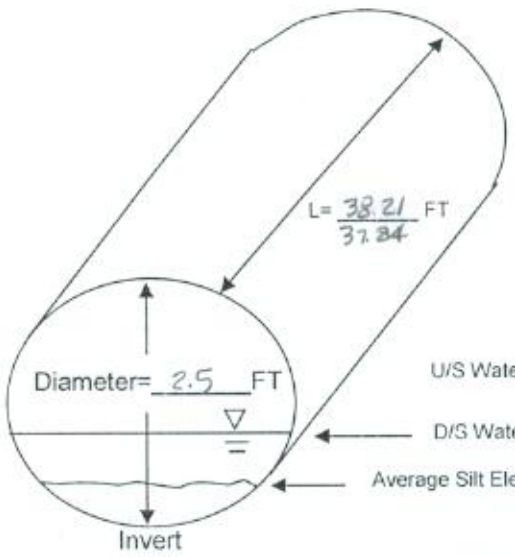
Survey file: 392-054 (3) .txt
Photo file(s): JOHN-SOUTH_USC.jpg photo # 20
JOHN-SOUTH_DSC.jpg photo # 22
JOHN-SOUTH_USC.jpg photo # 21
JOHN-SOUTH_DSC.jpg photo # 23

Location (Street, County, State): JOHN STREET, ST. JOHNS COUNTY, FLORIDA
DOT Number:

Crew: LEE WILLINGHAM/JODY CONLEY
Initials: LW/JC
Benchmark ID: CP-014
Benchmark Elevation: 9.36 NAVD 88
Benchmark Description: MAG NAIL/DISK "BM LBG824"

Date: 6/7/2012
Time: 2:00 PM
Rainfall: Y (N)

Number of Identical Culverts 2



U/S Water Surface Elevation = 2.74 FT-NAV
D/S Water Surface Elevation = 2.38 FT-NAV
Average Silt Elevation _____ FT-NAV

Invert Elevations:

(Compass Direction = NW) = 2.23 FT-NAV
(Compass Direction = SW) = 2.35 FT-NAV
(Compass Direction = NE) = 2.27 FT-NAV
(Compass Direction = SE) = 2.20
Add lines if identically shaped culverts have different inverts

Culvert Material: Reinforced Concrete (Corragated Metal) Other _____ (circle one)

Estimated Age 25+ Condition: POOR

Bed Material Type: Gravel Silt Clay (Earthen) Concrete Other _____ Unknown
(circle one)

Fill Material Type: Gravel Silt Clay Earthen Concrete Other ASPHALT Unknown
(circle one)

Head Wall: Material _____
Condition: _____
Type: _____

General Notes:

Attach roadway elevation sheet to culvert survey sheet.

NOTE: Additional detail regarding FEMA Data Capture Standards for Surveys can be found in FEMA Specifications and Guidelines Appendix N

JOHN-SOUTH DSC 1

JOHN-SOUTH DSC 2

JOHN-SOUTH USC 2

JOHN-SOUTH USC 3

TYPICAL CIRCULAR CULVERT

Basin:
Stream: OYSTER CREEK
XSection: MADE - SOUTH

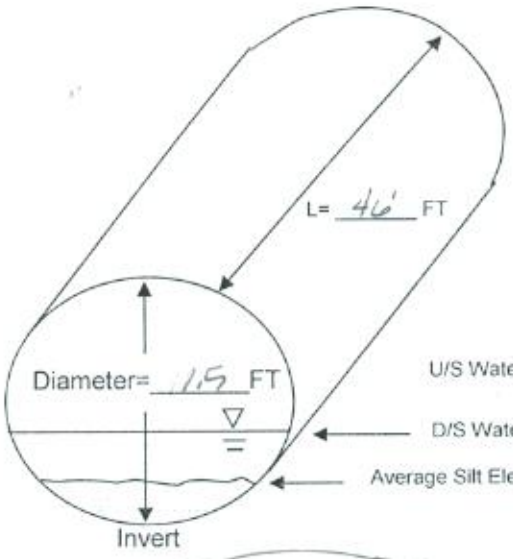
Survey file: 392-054 (4) .txt
Photo file(s): MADE-SOUTH USC.jpg photo # 016
MADE-SOUTH DSC.jpg photo # 017
MADE-SOUTH USC.jpg photo # 018
MADE-SOUTH DSC.jpg photo # 019

Location (Street, County, State): MADEORE ST., ST. JOHNS COUNTY, FLORIDA
DOT Number:

Crew: LEE WILLINGHAM
Initials: LW
Benchmark ID: CP-011
Benchmark Elevation: 9.91' NAVD88
Benchmark Description: 1/2" IRON PIPE "TRAN. LB4824"

Date: 6/4/2012
Time: 1:35PM
Rainfall: Y (N)

Number of Identical Culverts 2



U/S Water Surface Elevation = 6.60 FT-NAV
D/S Water Surface Elevation = 5.19 FT-NAV
Average Silt Elevation N/A FT-NAV

Invert Elevations:

(Compass Direction = NE) = 5.14 FT-NAV
(Compass Direction = NW) = 5.15 FT-NAV
(Compass Direction = SW) = 6.42 FT-NAV
(Compass Direction = SE) = 6.44

Add lines if identically shaped culverts have different inverts

Culvert Material: (Reinforced Concrete) Corragated Metal Other _____ (circle one)

Estimated Age 15+ Condition: GOOD

Bed Material Type: Gravel Silt Clay Earthen (Concrete) Other _____ Unknown
(circle one)

Fill Material Type: Gravel Silt Clay Earthen (Concrete) Other _____ Unknown
(circle one)

Head Wall: Material CONCRETE
Condition: GOOD
Type: REGULAR

General Notes:

Attach roadway elevation sheet to culvert survey sheet.

NOTE: Additional detail regarding FEMA Data Capture Standards for Surveys can be found in FEMA Specifications and Guidelines Appendix N

Sheet ____ of ____

MADE-SOUTH DSC 019

MADE-SOUTH USC 016

MADE-SOUTH USC 017

MADES-SOUTH DSC 018

CL-SDIXIE CAREY ST 006

CL-SDIXIE END 008

CL-SDIXIE N-S 005

C--SDIXIE AVILES ST 007

APPENDIX F

Geocoding of Stormwater Utility Customers

Geocoding is the process of transforming a description of a location—such as a pair of coordinates, an address, or a name of a place—to a spatial point. Geocoding can be done manually by entering one location description at a time or by providing many of them at once in a table format. For the evaluation of the stormwater utility, CDM Smith geocoded the current database of customers by utilizing geocoding tools that allow to process in batches multiple accounts at the time. The resulting locations are output as geographic features with attributes, which can be used for mapping or spatial analysis.

The final result is a geodatabase in State Plane horizontal projection, in agreement with the other existing datasets provided for this project. There are a total of 7,119 customers included in the geodatabase distributed as follows:

- 5,742 customers were geocoded based on the data contained in the original database address attribute. The location of these customers was either an automatic placement, based on the existing attribute data, or the results of manual fixes for common typos, misspelling, or format issues.
- 1,848 customers had to be rectified manually based on information included in the original database, and the evaluation of aerials, parcel attributes, and professional judgment.
- 188 customers that cannot be identified based on the parcel shapefile. In all cases we were able to locate them in the middle of the street, probably in front of the actual location. But the address itself cannot be found in the parcel coverage, or it is a duplicate and therefore needs to be verified.
- 1,070 condominium accounts. These customers were properly located within the potential parcel limits. But their location will have to be refined within the property.
- 115 non residential customers that share similar addresses. They were placed properly within the parcel boundaries, but their location within the parcel should be verified in the field.

CDM Smith recommends to address the following issues to improve future geocoding, data management and appropriate location of utility customers:

1. The City has many addresses with fractional address numbers. For example 138 ½ Oneida Street South.
2. The address field includes information that should be kept in other fields such as " car wash" or " bakery". The address field should not include the description of the property.
3. In the case of apartments, condominiums, or businesses the address field should isolate the unit number in a separate field. For example "73 Orange Street Unit D". "Unit D" should not be included in the address field.

4. The current parcel database lacks addresses for some multifamily parcels. In this case all the customers associated with that polygon cannot be properly geocoded because the address field is empty in the parcel database.

5. Parcels IDs should be unique, and in many instances there are different sites with different polygons, but the same parcel ID.

6. In some instances the parcel was originally part of a greater parent parcel and kept the original address of the parent parcel. The new parcel might not even be located on the same street anymore, but carries over the previous street name.

Results:

The final geodatase contains a total of 7,119 customers with a location. In addition to the breakdown shown above in terms of match type, CDM Smith identified a limited number of customers that seem to be located outside of the City limits, shown below:

CACCOUNT_N 3396, 3397, 3398 – Points located along Chapin Street which is outside of the City limits. Points need to be verified by City staff.

CACCOUNT_N 36493 - Point located on Gilbert Street is outside of City limits. I think it is true that it is outside, therefore I left it there.

For the purposes of evaluating revenue scenarios the results of the current geocoding task are satisfactory. All customers were placed within the parcel limits, and in special cases in the vicinity of the closest address match type. The results of this evaluation will be the basis for potential consideration of differential rates based depending on location.

Table F.1 - Customers with address outside of the City Limits

	Address	caccount_n	Customer Name
1	85 CHAPIN ST	3396	BERGER, PAUL
2	95 CHAPIN ST	3397	THOMAS, LILLIAN
3	97 CHAPIN ST	3398	STANISH, JAMIE L
4	150 GILBERT ST	36493	VACANT~36493

Table F.2 - Customers with approximated location that require field verification

	Address	Utility caccount_n	Customer Name
1	81 COLON AVE	1467	OWENS, R
2	14 RIO VISTA AVE	1491	TESSIER, THEODORE L
3	11 CLARK ST	1955	MARTINEZ, PASTOR
4	13 CLARK ST	1959	DIAZ, JUAN M
5	1 PARK AVE N	2614	FITZGERALD, E
6	3 PARK AVE N	2615	FITZGERALD, ERNEST & GAIL
7	3 B PARK AVE N	2616	FITZGERALD, ERNEST L
8	20 OAK ST	2665	RAYMOND, PAUL S
9	40 COLONY ST	2709	PORTER, BETTY A
10	34 COLONY ST	2715	MCWHORTER, ALICIA A
11	62 WHITNEY ST S	3425	KIRBY, W J
12	57 WHITNEY ST N	3426	DAILEY, MYRTIES
13	55 SMITH ST	3475	
14	70 SPRING ST	3523	LAGRANGE, LISA MAY GWAY
15	58 SPRING ST	3529	VAN, EDWIN H
16	110 JULIA ST	3549	HENDERSON, MARGARET E
17	107 JULIA ST	3550	BAEZ, RAMON
18	109 JULIA ST	3551	CODA MANAGMENT INC
19	177 PALMER ST	4119	DIMSDALE, JAMES ETAL
20	177 PALMER ST	4120	JOHNSTON, JOHN P
21	177 PALMER ST	4121	WILLIAMS, LESLIE R
22	903 S PONCE DE LEON BLVD	4552	DIPAULO, CHRISTINE K
23	905 PONCE DE LEON BLVD S	4553	OPSAHL, CHRISTINA J
24	907 PONCE DE LEON BLVD S	4554	FAUST, THOMAS E
25	909 PONCE DE LEON BLVD S	4555	BARBOUR, CASSANDRA ~
26	911 PONCE DE LEON BLVD S	4556	CAMM, PENNY
27	913 PONCE DE LEON BLVD S	4557	BELL, JAMES
28	915 PONCE DE LEON BLVD S	4558	SEVERT, MICHAEL L
29	917 PONCE DE LEON BLVD S	4560	HOZA, GWEN M
30	919 PONCE DE LEON BLVD S	4561	PACETTI, CRYSTAL M
31	921 PONCE DE LEON BLVD S	4562	SATHER, STACEY G
32	923 PONCE DE LEON BLVD S	4563	STEIGERWALD, PETER M
33	925 PONCE DE LEON BLVD S	4564	PALMER, KAREN S
34	927 PONCE DE LEON BLVD S	4565	MATUSHESKI, PATRICIA J
35	929 PONCE DE LEON BLVD S	4566	STILLS, LANE
36	931 PONCE DE LEON BLVD S	4567	STRANGE,LARRY
37	933 PONCE DE LEON BLVD S	4568	RUCCI, NICHOLAS J
38	935 PONCE DE LEON BLVD S	4569	CAIL, SHARON
39	937 PONCE DE LEON BLVD S	4570	LAGASSE, DONALYN
40	939 PONCE DE LEON BLVD S	4571	TIFT, OLIVIA B
41	943 PONCE DE LEON BLVD S	4572	HOCKENBERRY, EDWARD J
42	945 PONCE DE LEON BLVD S	4573	MILLER, GARY
43	941 PONCE DE LEON BLVD S	4574	CHAMPAGNE, KRISTIAN M
44	947 PONCE DE LEON BLVD S	4575	
45	949 PONCE DE LEON BLVD S	4576	JOHNSON, KURT E
46	57 CARRERA ST	5809	DELCASTILLO, ARMANDO E
47	53 CARRERA ST	5816	PFISTER, JOHN A
48	41 VALENCIA ST	5829	HULL, HENRY H
49	22 SEVILLA ST	5870	MASTERS, ELIZABETH C
50	41 CARRERA ST	5878	MELTON, H
51	24 RIBERIA ST	5892	PALEVSKY, ELLIOTT
52	61 SARAGOSSA ST	5896	LAMOUREUX, AUDREY A
53	26 SARAGOSSA ST	5951	BURCHENAL, AMY B
54	23 SARAGOSSA ST	5952	GREENBERG, REBECCA H
55	16 MIRUELA AVE	6201	SHIMER, L
56	196 INLET DR	6221	STARK, KEVIN J
57	242 RIBERIA ST	6306	TERRY, A B
58	200 GERADO ST	6412	FRASER, J S
59	206 GERADO ST	6413	AVERY, JERRY
60	204 GERADO ST	6414	BUTLER, LISA
61	202 GERADO ST	6415	YOUNG JR., JAMES E

62	321 ANASTASIA BLVD	6527	GOODWIN, KYLE H
63	413 1/2 ANASTASIA BLVD	6541	REIMER, F A
64	6 MOULTRIE PL	6555	FINK, RICHARD A
65	215 COQUINA AVE	6812	VACANT
66	215 COQUINA AVE	6813	SOLANA, STEVEN A
67	231 COQUINA AVE	6824	HENLEY, PATRICK J
68	72 COQUINA AVE	6853	CONNOR, MARGARET M
69	71 COMARES AVE	6989	ATWELL, JEFFREY J
70	69 COMARES AVE	6993	BIRD, H H
71	435 FLAGLER BLVD	7040	SCHREIBER, TERRY R
72	301 FLAGLER BLVD	7070	MATZKE JR., FRANK J
73	513 ANASTASIA BLVD	7243	LIL' CHAMP FOODSTORES INC
74	515 ANASTASIA BLVD	7244	LIL' CHAMP FOODSTORES INC
75	19 CASANOVA RD	7394	WALLACE, DAVID B
76	5 ST GEORGE ST	7649	FRASER JOHN R REVOCABLE TRUST
77	5 ST GEORGE ST UNIT F	7796	FRASER JOHN R REVOCABLE TRUST
78	5 ST GEORGE ST UNIT E	7798	OFF THE DIME, INC
79	277 ST GEORGE ST	7894	RENIGAR, FRANK A
80	344 CHARLOTTE ST	7943	MUSSELWHITE, ANGELA M
81	300 CHARLOTTE ST	7972	
82	206 CHARLOTTE ST	8004	REGAN JR, JOHN P
83	154 AVENIDA MENENDEZ	8055	BEATIE, M K
84	170 AVENIDA MENENDEZ	8125	CHARLSON, FRANCES
85	123 CORDOVA ST	8135	ALLEN, DENNIS W
86	176 CORDOVA ST DOMESTIC	8163	LAKEVIEW OF ST AUGUSTINE CONDOMINIUMS ASSOC. INC.
87	181 CORDOVA ST	8166	STEPHAN, TAMMY L
88	65 ONEIDA ST	8223	HAYWARD, ADDIE A
89	52 WEEDEN ST	8699	FALISE, BRANDY
90	137 RIBERIA ST	8763	BOSHART, DUSTIN N
91	137 1/2 RIBERIA ST	8764	KELLAR, REGINA K
92	136 ANASTASIA LAKES DR	9732	ZALAUF, THOMAS J
93	33103 HARBOUR VISTA CIR	10030	ORLANDO, KRISTEN J
94	12 HOPE ST	10147	DENNIS, JOHNNIE & JULIE
95	5 SAN CARLOS AVE	10262	VISTA HOTEL IV INC ~
96	5 MAY ST	10279	SINCLAIR, LESLIE V
97	43 VALENCIA ST	34102	HORAN, JOHN W
98	100 ISLANDER DR	36603	SHIELDS, TARA
99	224 KING ST W	1891	SAILOR'S EXCHANGE INC
100	197 KING ST W	1913	MORRISON, K F
101	203 KING ST W	1914	SCHMIDT, DENNIS R
102	69 LEWIS BLVD	1980	DRAKE, TAMMY R
103	278 KING ST W UNIT B	2392	SHILOH MISSIONARY BAPTIST CHURCH
104	278 KING ST W UNIT A	2393	UNLIMITED POSSIBILITIES
105	286 KING ST W	2401	SPENCER, LILLIAN
106	285 KING ST W	2407	RESTORATION CENTER HOLY TEMPLE OF GOD INC.
107	233 KING ST W UNIT A,B,C.	3736	LAQUIDARA, JAMES M
108	141 MASTERS DR	4155	STEVES BONDING AGENCY INC
109	811 PONCE DE LEON BLVD S	4398	BONNER, ROBERT L
110	84 DIXIE HWY S	4420	AMERICAN BAKERY
111	81 DIXIE HWY S	4427	GREEN III, H F
112	1040 PONCE DE LEON BLVD S	4514	ADVANCE AMERICACASH ADVANCE
113	1050 PONCE DE LEON BLVD S	4515	CHEN, TONY JIN JIE
114	1060 PONCE DE LEON BLVD S	4516	FIRST COAST FITNESS EQUIPMENT
115	1070 PONCE DE LEON BLVD S	4517	THE HAIR LOFT
116	1080 PONCE DE LEON BLVD S	4518	GATES OF ST JOHNS LLC
117	1090 PONCE DE LEON BLVD S	4519	BALLY NAILS
118	1092 PONCE DE LEON BLVD S UNIT A	4528	VILLAGE WASH HOUSE INC
119	1092 PONCE DE LEON BLVD S UNIT B	4529	MIKATO JAPANESE STEAK HOUSE
120	1092 PONCE DE LEON BLVD S UNIT J	4530	B&M LEASING & MANAGEMENT LLC
121	601 RIBERIA ST	6491	CITY OF ST AUGUSTINE
122	400 RIBERIA ST	6495	W.J. DEVELOPMENT

123	213 ANASTASIA BLVD	6512	THE BRITISH PUB INC
124	303 ANASTASIA BLVD UNIT D	6517	ECLECTIONS
125	303 ANASTASIA BLVD UNIT B	6518	SHIPPING PLUS
126	308 ANASTASIA BLVD	6521	ZORIC CAR WASH
127	321 ANASTASIA BLVD	6527	GOODWIN, KYLE H
128	413 ANASTASIA BLVD	6540	DESIGNERS ETC
129	419 ANASTASIA BLVD UNIT A	6545	MONAHAN D.C., C
130	517 ANASTASIA BLVD	7245	BLUE SKY SURF SHOP
131	900 ANASTASIA BLVD UNIT H I J	7467	FLORIDIAN INN KEEPERS
132	900 ANASTASIA BLVD UNIT G	7470	RIVER REGION HUMAN SERVICES INC
133	900 ANASTASIA BLVD UNIT F	7471	CITY YOGA INC
134	900 ANASTASIA BLVD UNIT E-2	7472	TIMBER & TEXTILES INC
135	900 ANASTASIA BLVD UNIT E-1	7473	TRIPP HARRISON INC
136	900 ANASTASIA BLVD UNIT D	7474	YANNI VENTURES INC
137	900 ANASTASIA BLVD UNIT C	7475	YANNI VENTURES
138	900 ANASTASIA BLVD UNIT B	7476	RIDEMAN, DEBRA J
139	900 ANASTASIA BLVD UNIT A	7477	YANNI VENTURES INC
140	854 ANASTASIA BLVD	7586	YANNI VENTURES INC
141	852 ANASTASIA BLVD	7587	PUDDY MUD LLC
142	846 ANASTASIA BLVD	7588	YANNI VENTURES INC
143	848 ANASTASIA BLVD	7589	SHEAR DELIGHT STYLING SALON
144	850 ANASTASIA BLVD	7590	PERRELLA, DEBORAH
145	19 ST GEORGE ST	7652	MILLTOP TAVERN INC
146	37 ST GEORGE ST	7662	CITY OF ST AUGUSTINE
147	46 1/2 CUNA ST	7672	CITY OF ST AUGUSTINE
148	60 ST GEORGE ST	7673	SPANISH DUTCH CONVOY
149	45 CUNA ST	7675	ST AUG FOUNDATION INC
150	69 ST GEORGE ST	7677	WHAT A PEACH, INC
151	72 ST GEORGE ST	7678	THE PIRATE & HIS LADY
152	76 ST GEORGE ST	7683	ART BOUTIQUE GALLERY, INC
153	91 ST GEORGE ST	7686	SEA GEMS
154	97 ST GEORGE ST	7687	THE PINK PETUNIA
155	5 ST GEORGE ST UNIT B	7799	SWEDISH CLOGS INC.
156	68 CUNA ST	7821	FLAGLER COLLEGE
157	267 ST GEORGE ST	7889	CATHEDRAL LYCEUM
158	273 CHARLOTTE ST	7979	OLDEST HOUSE
159	271 CHARLOTTE ST	7980	ST AUG HISTORICAL SOCIETY
160	4 AVILES ST	8014	LA HERENCIA INC
161	8 AVILES ST	8015	NORTON, JEFFREY J
162	25 KING ST	8016	BRILLIANCE IN COLOR FINE ART GALLERY
163	6 AVILES ST	8017	CELLAR 6 LLC
164	10 AVILES ST	8019	LOVE'S
165	243 ST GEORGE ON AVILES	8031	ST JOSEPH CONVENT
166	99 MARINE ST ARSENAL	8078	STATE OF FLORIDA
167	179 MARINE ST	8110	ST JOHNS COUNTY
168	159 MARINE ST	8113	THE VIEWS AT BAY POINTE CONDO
169	160 NIX BOAT YARD RD	8451	CREEKSIDE DINER
170	87 RIBERIA ST	8539	ATLANTIQUE PRESS
171	95 RIBERIA ST	8546	AVALON CARRIAGE SERVICE
172	152 RIBERIA ST	8749	ICE EXPRESS INC
173	152 1/2 RIBERIA ST	8758	SEAFOOD SHOPPE WHOLESALE
174	2205 PONCE DE LEON BLVD N	11246	AMUN, GHALIB
175	6 ST GEORGE ST UNIT 101	11526	VACANT~11526
176	6 ST GEORGE ST	11527	CITY PERKS COFFEE COMPANY
177	6 ST GEORGE ST UNIT 201	11528	CONATHAN, BARBARA A
178	4 ST GEORGE ST UNIT 201	11546	CONATHAN, BARBARA A
179	4 ST GEORGE ST UNIT 101	11548	ST GEORGE ST INVESTMENTS
180	4 ST GEORGE ST UNIT 102	11659	GIBSON, JOAN L
181	4 ST GEORGE ST UNIT 105	11661	PELICAN BAY CLOTHING CO
182	4 ST GEORGE ST UNIT 108	11662	PAPER WHITES
183	6 ST GEORGE ST UNIT 105	11663	STOGIES SMOKE SHOP
184	6 ST GEORGE ST UNIT 110	11664	TRADING POST JEWERLY AND GIFTS
185	97 ST GEORGE ST UPSTAIRS	35090	ST. AUGUSTINE FOUNDATION
186	1092 PONCE DE LEON BLVD S UNIT H	36296	AVIS
187	1092 PONCE DE LEON BLVD S UNIT M	36297	ALIA DANCE CENTER INC
188	1092 PONCE DE LEON BLVD S UNIT L	36298	GATES OF ST JOHNS LLC

Table F.3 - Non Residential customers with multiple accounts per parcel.

	Address	caccount_n	Customer Name
1	111 CEDAR ST	8561	SHIELDS, LYNN
2	114 CEDAR ST	34175	FUNARI, ZACHARY M
3	114 CEDAR ST	34176	CARRIAGE HOUSE OF ST AUGUSTINE
4	114 CEDAR ST	34177	MCCANN, MEHGAN R
5	114 CEDAR ST	34178	DEVANE, STEVEN C
6	114 CEDAR ST	34179	HAMMOCK, JARED
7	114 CEDAR ST	34180	JACOBS, CAMERON
8	114 CEDAR ST	34181	ARMOLD, MELANIE S
9	114 CEDAR ST	34182	OLAOYE, OLAWALE G
10	114 CEDAR ST	34183	JACOBS, CAMERON
11	12 FLAGLER BLVD BLDG A201	7118	VAN OLPHEN, JOHN H
12	12 FLAGLER BLVD BLDG A202	7120	DONNELLY, JAMES E
13	12 FLAGLER BLVD BLDG A203	7122	LIVERMORE, DONNA M
14	12 FLAGLER BLVD BLDG A204	7124	RYAN, DIANE E
15	12 FLAGLER BLVD BLDG A301	7119	FORBRICH, CAROL S
16	12 FLAGLER BLVD BLDG A302	7121	HALL, STEPHEN B
17	12 FLAGLER BLVD BLDG A303	7123	TUCKER, MITCHELL A
18	12 FLAGLER BLVD BLDG A304	7125	HAWLEY, ROBERT E
19	12 FLAGLER BLVD BLDG B101	7115	WINTER, DAVID E
20	12 FLAGLER BLVD BLDG B102	7114	VIJGEN, ALPHONS
21	12 FLAGLER BLVD BLDG B201	7116	WALLACE, CLAIRE L.
22	12 FLAGLER BLVD BLDG B202	7117	IRISH, CLAIR
23	162 SAN MARCO AVE	11133	TENNYSON FOOD INC
24	162 SAN MARCO AVE	11175	DIXON AND ASSOCIATES~
25	162 SAN MARCO AVE SUITE 1	11174	GREEN, SHIRLEY T
26	164 SAN MARCO AVE	11132	FIRST COAST SUZUKI
27	30 IROQUOIS ST #1	4542	SPECIALIZED TECHNOLOGY RESOURCES
28	3149 PONCE DE LEON BLVD N SUITE 1	1292	COMMUNITY FIRST CREDIT UNION OF FLORIDA
29	3149 PONCE DE LEON BLVD N SUITE 2	1293	AARIANA INC
30	3149 PONCE DE LEON BLVD N SUITE 3	1294	DALMATIAN GROUP LLC
31	3149 PONCE DE LEON BLVD N SUITE 4	1295	SOMETHING BORROWED BRIDAL GOWNS LLC
32	3149 PONCE DE LEON BLVD N SUITE 5	1296	LASHOMB, VICKIE A
33	3149 PONCE DE LEON BLVD N SUITE 6	1297	PUTNAM BICYCLES
34	3149 PONCE DE LEON BLVD N SUITE 7	1298	INTERNOSIA, DAVID J
35	3149 PONCE DE LEON BLVD N SUITE 9	1300	DALMATIAN GROUP LLC
36	33 COMARES AVE #101	7029	ALLGOOD, HOWARD
37	33 COMARES AVE #102	7031	BARRETT, MATTHEW
38	33 COMARES AVE #103	7037	DIPIAZZA, MICHAEL
39	33 COMARES AVE #104	7026	ANGYALFY, JUDITH
40	33 COMARES AVE #105	7036	THORNE, RICHARD A
41	33 COMARES AVE #201	7025	KING, NEIL C
42	33 COMARES AVE #202	7035	ABERCROMBIE, DENNIS
43	33 COMARES AVE #203	7038	GREEN, PHYLLIS T
44	33 COMARES AVE #204	7028	MARTIZEZ, FREDRICK J
45	33 COMARES AVE #205	7034	GADDIS, JILL
46	33 COMARES AVE #301	7027	TUMLIN, RONALD G
47	33 COMARES AVE #302	7033	ROCK, LORI A
48	33 COMARES AVE #303	7024	PARKS, CASSIE
49	33 COMARES AVE #304	7030	BARTLETT, KIMBERLY A
50	33 COMARES AVE #305	7032	CLARK, DOUGLAS J
51	4 ARTILLERY LN	36249	PRICE, STANTON P
52	4 ARTILLERY LN	36250	SUTTON JR, JOHN
53	4 ARTILLERY LN	36251	DUNN, JESSICA J
54	4 ARTILLERY LN	36253	SANCHEZ, CARLOS M
55	4 ARTILLERY LN	36254	JERTSON, DIANA R~

56	4 ARTILLERY LN	36255	NAUYALIS, JASON M
57	4 ARTILLERY LN	36256	WALL III, SAMUEL H
58	4 ARTILLERY LN	36257	WARD, JOHN
59	4 ARTILLERY LN	36258	SUTTON JR, JOHN
60	4 ARTILLERY LN A	36259	HARVEY, DONALD H
61	48 MASTERS DR	3612	YOUNG, SHELLY A
62	48 MASTERS DR	3613	COSHOW III, CHARLES
63	48 MASTERS DR	3614	ARDENTE, BLANCHE
64	48 MASTERS DR	3615	ANDERSON, JONNI
65	50 MASTERS DR	3616	
66	50 MASTERS DR	3617	CAMPER, CHRISTOPHER D
67	50 MASTERS DR	3619	
68	52 MASTERS DR	3621	TAYLOR, CORY R
69	52 MASTERS DR	3622	MEADOWS, CLAYTON L
70	52 MASTERS DR	3623	HANNSSON TRUST
71	52 MASTERS DR	3624	LOVELL, ANNA
72	54 MASTERS DR	3625	HANNER, JOHN W
73	54 MASTERS DR	3627	FRY, ROY T
74	54 MASTERS DR	3628	HANSSON TRUST
75	56 MASTERS DR	3630	KNOWLES, SAMANTHA J
76	56 MASTERS DR	3631	GRIFFIN, MELISSA A
77	56 MASTERS DR	3632	MAGAT, ERIC T M
78	56 MASTERS DR	3633	MATHIS, JACQUELINE
79	60 MASTERS DR	3640	WALL, ROBERT S
80	60 MASTERS DR	3641	CHILDERS, JENNIFER R
81	60 MASTERS DR	3642	NUNEZ, EDITH D
82	60 MASTERS DR	3643	TEATER, MICHAEL C
83	64 MASTERS DR	3654	TNT INVESTMENTS LLP
84	66 MASTERS DR	3656	HANSSON TRUST
85	66 MASTERS DR	3657	RATLIFF, CHRISTINA J
86	66 MASTERS DR	3658	HANSSON TRUST
87	66 MASTERS DR	3659	ANDERSON, SARAH J
88	71 DIXIE HWY S UNIT 1&2	4415	PARKER POOL, INC
89	71 DIXIE HWY S UNIT 3	4411	MY TIME DESIGN & ASSOCIATES INC
90	71 DIXIE HWY S UNIT 4	4410	LINCARE INC
91	71 DIXIE HWY S UNIT 5	4409	GREEN III, HENRY
92	71 DIXIE HWY S UNIT 7	4425	SCRAPPY CHIC CAFE INC
93	71 DIXIE HWY S UNIT 8	4422	GREEN, H F
94	71 DIXIE HWY S UNIT 9/10	4424	JANICE W LAKE & ASSOCIATES INC
95	825 ANASTASIA BLVD UNIT A1	34295	HENRY, MARK
96	825 ANASTASIA BLVD UNIT A2	34296	THOMPSON, RICHARD S
97	825 ANASTASIA BLVD UNIT A3	34297	SCHIECK, WILLIAM J
98	825 ANASTASIA BLVD UNIT A4	34298	LOUGHAN, CATHERINE A
99	825 ANASTASIA BLVD UNIT A5	34299	BUBECK, M DAVID~
100	825 ANASTASIA BLVD UNIT A6	34300	GOMULINSKI, PAUL J
101	825 ANASTASIA BLVD UNIT A7	34301	LEE, ALLISON D
102	825 ANASTASIA BLVD UNIT A8	34302	DELGADO, GAIL W
103	825 ANASTASIA BLVD UNIT A9	34303	NADZIEJA, ELISA B
104	825 ANASTASIA BLVD UNIT B10	34304	SORRENTINO, FRANCES A
105	825 ANASTASIA BLVD UNIT B11	34305	CURIO, THOMAS R~
106	825 ANASTASIA BLVD UNIT B12	34306	RODGERS, JUDY K
107	825 ANASTASIA BLVD UNIT B13	34307	SUTTON, CHERI L
108	825 ANASTASIA BLVD UNIT C14	34308	VACANT~34308
109	825 ANASTASIA BLVD UNIT C15	34309	VARGA, BERNICE C
110	825 ANASTASIA BLVD UNIT C16	34310	LEISTNER, DEBORAH L
111	825 ANASTASIA BLVD UNIT C17	34311	MASSARO , JOSEPH J
112	825 ANASTASIA BLVD UNIT C18	34312	DEAN, BROOK M
113	825 ANASTASIA BLVD UNIT C19	34313	VACANT~34313
114	825 ANASTASIA BLVD UNIT C20	34314	LEIBSON, RICHARD & SANDRA
115	825 ANASTASIA BLVD UNIT C21	34315	HUSS-FLATH, DARLENE S

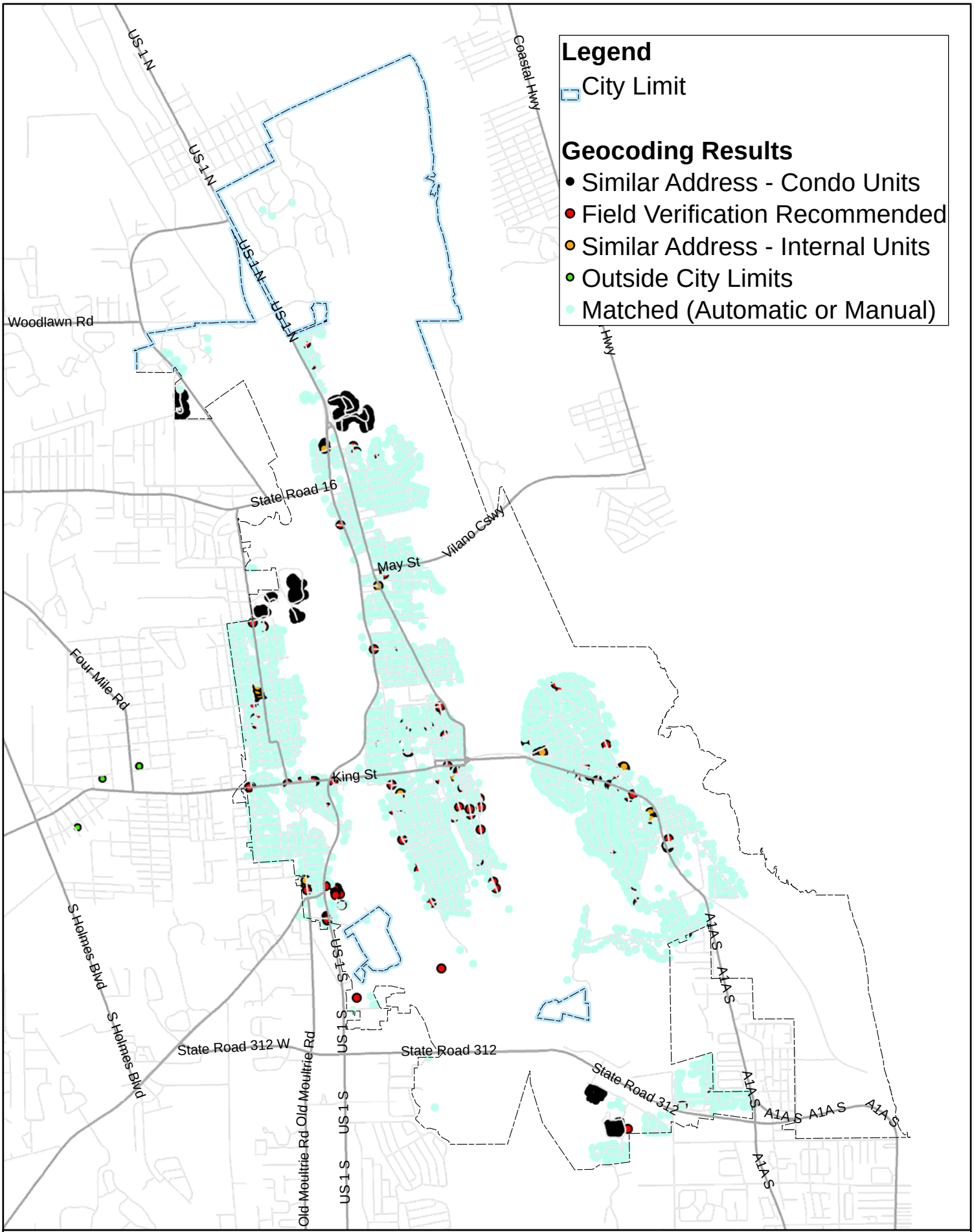


Figure D.
City of St. Augustine
Geocoding of Stormwater Utility Customers

APPENDIX G

Pilot Area Alternative Improvements

Sidney Street Improvements

There were no alternative designs for the Sidney Street pilot area. There were though, three construction methods to consider (with conceptual cost estimate table locations included) are:

1. Minimal Open Cut Roadway (Table C-1)
2. Open Cut Roadway (Table C-5)
3. Horizontal Directional Drilling (Table C-6)

South Dixie Improvements

Again, Alternative designs were not selected for South Dixie Highway pilot area, but alternative construction methods were reviewed. Conceptual cost estimates for two construction methods, horizontal directional drilling and open cut (with and without roadway reconstruction costs), were generated. The reason for having two open cut cost estimates is because the City is already planning to repave South Dixie Highway, and it is uncertain what department will incur the cost to repave the road.

1. Open Cut Roadway – With Paving (Table C-2)
2. Open Cut Roadway – Without Paving (Table C-6)
3. Horizontal Directional Drilling (Table C-7)

Maria Sanchez Improvements

Alternative 1

Alternative 1 is a model of the design that was proposed by the City in 2002. It involves a gradual upsize of pipes in the pilot area, with no proposed storage or pumping system. No roadway improvements.

Proposed Improvements

- Upsized 12 inch collector to a 18 inch pipe along Granada Street south of King St to Cedar Street
- Upsized 12 inch collector to a 24 inch pipe Granada Street from Cedar Street to Bridge Street
- Upsized 12 inch collector to a 30 inch along Bridge Street from Granada Street to Cordova Street
- Upsized 12 inch collector to a 18 inch pipe along from south of King Street 410 feet (CORD-K2BR1)
- Upsized 12 inch collector to a 24 inch pipe along Cordova Street from CORD-K2BR1 to Bridge Street
- Upsized 24 inch collector to a 36 inch pipe along Cordova Street from Bridge Street to Maria Sanchez Lake

Results

Table G-1 Maria Sanchez Lake Alternative 1 (2002 City Design) Peak Stage Table

				Mean Annual			5 - year			10 - year		
Junction	Location	Type	Road El.	Pre	Post	Δ (ft)	Pre	Post	Δ (ft)	Pre	Post	Δ (ft)
GRAN-KI2CE	Granada St South of King St	Local	4.3	5.0	4.7	-0.3	5.1	4.9	-0.3	5.3	5.0	-0.2
CORD-KINGS	Cordova St South of King St	Local	4.6	5.0	4.9	-0.1	5.1	5.0	-0.1	5.2	5.1	-0.1
GRAN-CEDAR	Granada St at Cedar St intersection	Local	3.8	4.9	4.7	-0.2	5.0	4.8	-0.2	5.2	5.0	-0.2
CORD-K2BR1	Cordova St between King and Bridge	Local	4.4	5.0	4.8	-0.1	5.0	4.9	-0.1	5.2	5.1	-0.1
GRAN-DESOT	Granada St at Desoto Pl intersection	Local	3.7	4.9	4.7	-0.2	5.0	4.8	-0.2	5.2	5.0	-0.2
CORD-K2BR2	Cordova St between King and Bridge	Local	4.1	4.9	4.7	-0.2	5.0	4.8	-0.2	5.2	5.0	-0.2
CORD-BRIDG	Cordova St at Bridge St Intersection	Local	3.5	4.9	4.6	-0.2	5.0	4.8	-0.2	5.2	5.0	-0.2
BRID-GRANA	Bridge St at Granada St Intersection	Local	3.6	4.9	4.7	-0.2	5.0	4.8	-0.2	5.2	5.0	-0.2
BRID-ONEID	Bridge St at Oneida St Intersection	Local	5.2	4.9	5.6	0.7	5.1	5.7	0.6	5.3	5.7	0.4
CORD-BR2PA	Cordova St btwn Bridge St and Park Pl	Local	3.6	4.6	4.3	-0.2	4.7	4.5	-0.2	4.8	4.6	-0.2
MARI-SANCH	Maria Sanchez Lake	Local	4.6	3.0	3.3	0.3	3.3	3.6	0.3	3.7	4.0	0.2
SOUT-MARIA	Culvert	Local	5.0	2.8	2.6	-0.1	3.0	2.9	-0.2	3.5	3.3	-0.2
SOUT-OUTFA	Maria Sanchez Outfall (South St)	Local	4.0	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0
SOUT-OUTF2	Maria Sanchez Outfall (South St) 2	Local	4.0	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0

				25 - year			50 - year			100 - year		
Junction	Location	Type	Road El.	Pre	Post	Δ (ft)	Pre	Post	Δ (ft)	Pre	Post	Δ (ft)
GRAN-KI2CE	Granada St South of King St	Local	4.3	5.4	5.1	-0.2	5.4	5.2	-0.2	5.5	5.3	-0.2
CORD-KINGS	Cordova St South of King St	Local	4.6	5.3	5.2	-0.1	5.4	5.2	-0.1	5.4	5.3	-0.1
GRAN-CEDAR	Granada St at Cedar St intersection	Local	3.8	5.3	5.1	-0.2	5.4	5.2	-0.2	5.5	5.3	-0.2
CORD-K2BR1	Cordova St between King and Bridge	Local	4.4	5.3	5.1	-0.1	5.4	5.2	-0.2	5.4	5.2	-0.2
GRAN-DESOT	Granada St at Desoto Pl intersection	Local	3.7	5.3	5.1	-0.2	5.4	5.2	-0.2	5.5	5.3	-0.2
CORD-K2BR2	Cordova St between King and Bridge	Local	4.1	5.3	5.1	-0.2	5.3	5.2	-0.2	5.4	5.2	-0.2
CORD-BRIDG	Cordova St at Bridge St Intersection	Local	3.5	5.3	5.1	-0.2	5.3	5.2	-0.2	5.4	5.2	-0.2
BRID-GRANA	Bridge St at Granada St Intersection	Local	3.6	5.3	5.1	-0.2	5.4	5.2	-0.2	5.5	5.3	-0.2
BRID-ONEID	Bridge St at Oneida St Intersection	Local	5.2	5.4	5.7	0.3	5.5	5.8	0.2	5.6	5.8	0.2
CORD-BR2PA	Cordova St btwn Bridge St and Park Pl	Local	3.6	4.9	4.7	-0.2	5.0	4.8	-0.2	5.0	4.9	-0.1
MARI-SANCH	Maria Sanchez Lake	Local	4.6	4.1	4.3	0.2	4.5	4.7	0.2	4.7	4.8	0.1
SOUT-MARIA	Culvert	Local	5.0	3.9	3.7	-0.2	4.2	4.0	-0.2	4.4	4.2	-0.2
SOUT-OUTFA	Maria Sanchez Outfall (South St)	Local	4.0	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0
SOUT-OUTF2	Maria Sanchez Outfall (South St) 2	Local	4.0	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0

Table G-2 Maria Sanchez Lake Alternative 1 (2002 City Design) Level of Service Flood Depths

		Mean Annual				5 Year				10 Year			
		Pre		Post		Pre		Post		Pre		Post	
Junction	Location	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?
GRAN-KI2CE	Granada St South of King St	0.8	Yes	0.5	No	0.8	Yes	0.6	Yes	1.0	Yes	0.8	Yes
CORD-KINGS	Cordova St South of King St	0.4	No	0.3	No	0.5	No	0.4	No	0.6	Yes	0.5	Yes
GRAN-CEDAR	Granada St at Cedar St intersection	1.1	Yes	0.9	Yes	1.2	Yes	1.0	Yes	1.4	Yes	1.2	Yes
CORD-K2BR1	Cordova St between King and Bridge	0.6	Yes	0.4	No	0.6	Yes	0.5	Yes	0.8	Yes	0.7	Yes
GRAN-DESOT	Granada St at Desoto Pl intersection	1.2	Yes	1.0	Yes	1.3	Yes	1.1	Yes	1.5	Yes	1.3	Yes
CORD-K2BR2	Cordova St between King and Bridge	0.8	Yes	0.6	Yes	0.9	Yes	0.7	Yes	1.1	Yes	0.9	Yes
CORD-BRIDG	Cordova St at Bridge St Intersection	1.4	Yes	1.1	Yes	1.5	Yes	1.3	Yes	1.6	Yes	1.5	Yes
BRID-GRANA	Bridge St at Granada St Intersection	1.3	Yes	1.1	Yes	1.4	Yes	1.2	Yes	1.6	Yes	1.4	Yes
BRID-ONEID	Bridge St at Oneida St Intersection	-0.3	No	0.4	No	-0.1	No	0.5	No	0.1	No	0.5	Yes
CORD-BR2PA	Cordova St btwn Bridge St and Park Pl	0.9	Yes	0.7	Yes	1.1	Yes	0.8	Yes	1.2	Yes	1.0	Yes
MARI-SANCH	Maria Sanchez Lake	-1.6	No	-1.3	No	-1.3	No	-1.0	No	-0.9	No	-0.7	No
SOUT-MARIA	Culvert	-2.2	No	-2.4	No	-2.0	No	-2.2	No	-1.6	No	-1.7	No
SOUT-OUTFA	Maria Sanchez Outfall (South St)	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No
SOUT-OUTF2	Maria Sanchez Outfall (South St) 2	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No

		25 Year				50 Year				100 Year			
		Pre		Post		Pre		Post		Pre		Post	
Junction	Location	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?
GRAN-KI2CE	Granada St South of King St	1.1	Yes	0.9	Yes	1.2	Yes	1.0	Yes	1.2	Yes	1.0	Yes
CORD-KINGS	Cordova St South of King St	0.7	Yes	0.6	Yes	0.8	Yes	0.6	Yes	0.8	Yes	0.7	Yes
GRAN-CEDAR	Granada St at Cedar St intersection	1.5	Yes	1.3	Yes	1.6	Yes	1.4	Yes	1.7	Yes	1.5	Yes
CORD-K2BR1	Cordova St between King and Bridge	0.9	Yes	0.7	Yes	0.9	Yes	0.8	Yes	1.0	Yes	0.8	Yes
GRAN-DESOT	Granada St at Desoto Pl intersection	1.6	Yes	1.4	Yes	1.7	Yes	1.5	Yes	1.7	Yes	1.5	Yes
CORD-K2BR2	Cordova St between King and Bridge	1.2	Yes	1.0	Yes	1.2	Yes	1.1	Yes	1.3	Yes	1.1	Yes
CORD-BRIDG	Cordova St at Bridge St Intersection	1.7	Yes	1.6	Yes	1.8	Yes	1.7	Yes	1.9	Yes	1.7	Yes
BRID-GRANA	Bridge St at Granada St Intersection	1.7	Yes	1.5	Yes	1.8	Yes	1.6	Yes	1.9	Yes	1.7	Yes
BRID-ONEID	Bridge St at Oneida St Intersection	0.2	No	0.5	Yes	0.3	No	0.6	Yes	0.4	No	0.6	Yes
CORD-BR2PA	Cordova St btwn Bridge St and Park Pl	1.3	Yes	1.1	Yes	1.4	Yes	1.2	Yes	1.4	Yes	1.2	Yes
MARI-SANCH	Maria Sanchez Lake	-0.5	No	-0.3	No	-0.1	No	0.0	No	0.0	No	0.2	No
SOUT-MARIA	Culvert	-1.1	No	-1.3	No	-0.8	No	-1.0	No	-0.6	No	-0.8	No
SOUT-OUTFA	Maria Sanchez Outfall (South St)	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No
SOUT-OUTF2	Maria Sanchez Outfall (South St) 2	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No

CDM Smith

Alternative 2

Alternative 2 is a design performed by CDM Smith to meet the 5 year LOS without using any underground storage or pumping systems. Due to high groundwater conditions during 1 year stillwater conditions, the proposed conveyance system are box culverts due to the primarily horizontal surface area. No roadway improvements.

Proposed Improvements

- Upsized 12 inch collector to a 2' x 6' box culvert along Granada Street south of King St to Cedar Street
- Upsized 12 inch collector to a 2' x 8' box culvert along Granada Street from Cedar Street to Bridge Street
- Upsized 12 inch collector to a 2' x 6' box culvert along Bridge Street from Oneida St to Granada Street
- Upsized 12 inch collector to a 2.5' x 6' box culvert along Bridge Street from Granada Street to Cordova Street
- Upsized 12 inch collector to a 2' x 3' box culvert along from south of King Street 410 feet (CORD-K2BR1)
- Upsized 12 inch collector to a 2' x 6' box culvert along Cordova Street from CORD-K2BR1 to Bridge Street
- Upsized 24 inch collector to a 4' x 8' box culvert along Cordova Street from Bridge Street to Maria Sanchez Lake

Results

Table G-3 Maria Sanchez Lake Alternative 2 (Conveyance) Peak Stage Table

				Mean Annual			5 - year			10 - year		
Junction	Location	Type	Road El.	Pre	Post	Δ (ft)	Pre	Post	Δ (ft)	Pre	Post	Δ (ft)
GRAN-KI2CE	Granada St South of King St	Local	4.3	5.0	4.2	-0.8	5.1	4.4	-0.7	5.3	4.7	-0.6
CORD-KINGS	Cordova St South of King St	Local	4.6	5.0	4.6	-0.4	5.1	4.8	-0.3	5.2	4.9	-0.3
GRAN-CEDAR	Granada St at Cedar St intersection	Local	3.8	4.9	4.2	-0.8	5.0	4.4	-0.6	5.2	4.7	-0.6
CORD-K2BR1	Cordova St between King and Bridge	Local	4.4	5.0	4.6	-0.4	5.0	4.7	-0.3	5.2	4.9	-0.3
GRAN-DESOT	Granada St at Desoto Pl intersection	Local	3.7	4.9	4.1	-0.9	5.0	4.3	-0.7	5.2	4.6	-0.6
CORD-K2BR2	Cordova St between King and Bridge	Local	4.1	4.9	4.3	-0.6	5.0	4.5	-0.5	5.2	4.7	-0.5
CORD-BRIDG	Cordova St at Bridge St Intersection	Local	3.5	4.9	3.6	-1.2	5.0	4.0	-1.0	5.2	4.4	-0.7
BRID-GRANA	Bridge St at Granada St Intersection	Local	3.6	4.9	3.9	-1.0	5.0	4.2	-0.8	5.2	4.6	-0.7
BRID-ONEID	Bridge St at Oneida St Intersection	Local	5.2	4.9	4.0	-1.0	5.1	4.3	-0.8	5.3	4.7	-0.6
CORD-BR2PA	Cordova St btwn Bridge St and Park Pl	Local	3.6	4.6	3.4	-1.1	4.7	3.8	-0.9	4.8	4.2	-0.6
MARI-SANCH	Maria Sanchez Lake	Local	4.6	3.0	3.1	0.1	3.3	3.4	0.1	3.7	3.8	0.1
SOUT-MARIA	Culvert	Local	5.0	2.8	2.8	0.0	3.0	3.0	0.0	3.5	3.4	0.0
SOUT-OUTFA	Maria Sanchez Outfall (South St)	Local	4.0	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0
SOUT-OUTF2	Maria Sanchez Outfall (South St) 2	Local	4.0	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0

				25 - year			50 - year			100 - year		
Junction	Location	Type	Road El.	Pre	Post	Δ (ft)	Pre	Post	Δ (ft)	Pre	Post	Δ (ft)
GRAN-KI2CE	Granada St South of King St	Local	4.3	5.4	4.8	-0.6	5.4	4.9	-0.5	5.5	5.0	-0.5
CORD-KINGS	Cordova St South of King St	Local	4.6	5.3	5.0	-0.3	5.4	5.1	-0.3	5.4	5.1	-0.3
GRAN-CEDAR	Granada St at Cedar St intersection	Local	3.8	5.3	4.8	-0.5	5.4	4.9	-0.5	5.5	5.0	-0.5
CORD-K2BR1	Cordova St between King and Bridge	Local	4.4	5.3	5.0	-0.3	5.4	5.0	-0.3	5.4	5.1	-0.3
GRAN-DESOT	Granada St at Desoto Pl intersection	Local	3.7	5.3	4.7	-0.6	5.4	4.9	-0.5	5.5	4.9	-0.5
CORD-K2BR2	Cordova St between King and Bridge	Local	4.1	5.3	4.8	-0.5	5.3	4.8	-0.5	5.4	4.9	-0.5
CORD-BRIDG	Cordova St at Bridge St Intersection	Local	3.5	5.3	4.6	-0.6	5.3	4.8	-0.6	5.4	4.8	-0.5
BRID-GRANA	Bridge St at Granada St Intersection	Local	3.6	5.3	4.7	-0.6	5.4	4.9	-0.5	5.5	4.9	-0.5
BRID-ONEID	Bridge St at Oneida St Intersection	Local	5.2	5.4	5.0	-0.5	5.5	5.2	-0.3	5.6	5.2	-0.3
CORD-BR2PA	Cordova St btwn Bridge St and Park Pl	Local	3.6	4.9	4.4	-0.5	5.0	4.6	-0.4	5.0	4.6	-0.4
MARI-SANCH	Maria Sanchez Lake	Local	4.6	4.1	4.2	0.0	4.5	4.4	0.0	4.7	4.6	-0.1
SOUT-MARIA	Culvert	Local	5.0	3.9	3.8	-0.1	4.2	4.1	-0.1	4.4	4.3	-0.2
SOUT-OUTFA	Maria Sanchez Outfall (South St)	Local	4.0	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0
SOUT-OUTF2	Maria Sanchez Outfall (South St) 2	Local	4.0	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0

CDM Smith

Table G-4 Maria Sanchez Lake Alternative 2 (Conveyance) Level of Service Flood Depths

		Mean Annual				5 Year				10 Year			
		Pre		Post		Pre		Post		Pre		Post	
Junction	Location	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?
GRAN-KI2CE	Granada St South of King St	0.8	Yes	-0.1	No	0.8	Yes	0.2	No	1.0	Yes	0.4	No
CORD-KINGS	Cordova St South of King St	0.4	No	0.0	No	0.5	No	0.2	No	0.6	Yes	0.3	No
GRAN-CEDAR	Granada St at Cedar St intersection	1.1	Yes	0.4	No	1.2	Yes	0.6	Yes	1.4	Yes	0.9	Yes
CORD-K2BR1	Cordova St between King and Bridge	0.6	Yes	0.1	No	0.6	Yes	0.3	No	0.8	Yes	0.5	No
GRAN-DESOT	Granada St at Desoto Pl intersection	1.2	Yes	0.3	No	1.3	Yes	0.6	Yes	1.5	Yes	0.9	Yes
CORD-K2BR2	Cordova St between King and Bridge	0.8	Yes	0.2	No	0.9	Yes	0.4	No	1.1	Yes	0.6	Yes
CORD-BRIDG	Cordova St at Bridge St Intersection	1.4	Yes	0.1	No	1.5	Yes	0.5	No	1.6	Yes	0.9	Yes
BRID-GRANA	Bridge St at Granada St Intersection	1.3	Yes	0.3	No	1.4	Yes	0.6	Yes	1.6	Yes	0.9	Yes
BRID-ONEID	Bridge St at Oneida St Intersection	-0.3	No	-1.3	No	-0.1	No	-0.9	No	0.1	No	-0.5	No
CORD-BR2PA	Cordova St btwn Bridge St and Park Pl	0.9	Yes	-0.2	No	1.1	Yes	0.2	No	1.2	Yes	0.6	Yes
MARI-SANCH	Maria Sanchez Lake	-1.6	No	-1.5	No	-1.3	No	-1.2	No	-0.9	No	-0.8	No
SOUT-MARIA	Culvert	-2.2	No	-2.3	No	-2.0	No	-2.0	No	-1.6	No	-1.6	No
SOUT-OUTFA	Maria Sanchez Outfall (South St)	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No
SOUT-OUTF2	Maria Sanchez Outfall (South St) 2	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No

		25 Year				50 Year				100 Year			
		Pre		Post		Pre		Post		Pre		Post	
Junction	Location	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?
GRAN-KI2CE	Granada St South of King St	1.1	Yes	0.5	Yes	1.2	Yes	0.7	Yes	1.2	Yes	0.7	Yes
CORD-KINGS	Cordova St South of King St	0.7	Yes	0.4	No	0.8	Yes	0.5	No	0.8	Yes	0.5	Yes
GRAN-CEDAR	Granada St at Cedar St intersection	1.5	Yes	1.0	Yes	1.6	Yes	1.1	Yes	1.7	Yes	1.2	Yes
CORD-K2BR1	Cordova St between King and Bridge	0.9	Yes	0.6	Yes	0.9	Yes	0.6	Yes	1.0	Yes	0.7	Yes
GRAN-DESOT	Granada St at Desoto Pl intersection	1.6	Yes	1.0	Yes	1.7	Yes	1.2	Yes	1.7	Yes	1.2	Yes
CORD-K2BR2	Cordova St between King and Bridge	1.2	Yes	0.7	Yes	1.2	Yes	0.7	Yes	1.3	Yes	0.8	Yes
CORD-BRIDG	Cordova St at Bridge St Intersection	1.7	Yes	1.1	Yes	1.8	Yes	1.3	Yes	1.9	Yes	1.3	Yes
BRID-GRANA	Bridge St at Granada St Intersection	1.7	Yes	1.1	Yes	1.8	Yes	1.3	Yes	1.9	Yes	1.3	Yes
BRID-ONEID	Bridge St at Oneida St Intersection	0.2	No	-0.2	No	0.3	No	0.0	No	0.4	No	0.0	No
CORD-BR2PA	Cordova St btwn Bridge St and Park Pl	1.3	Yes	0.8	Yes	1.4	Yes	0.9	Yes	1.4	Yes	1.0	Yes
MARI-SANCH	Maria Sanchez Lake	-0.5	No	-0.5	No	-0.1	No	-0.2	No	0.0	No	0.0	No
SOUT-MARIA	Culvert	-1.1	No	-1.2	No	-0.8	No	-0.9	No	-0.6	No	-0.8	No
SOUT-OUTFA	Maria Sanchez Outfall (South St)	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No
SOUT-OUTF2	Maria Sanchez Outfall (South St) 2	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No

CDM Smith

Alternative 3

Alternative 3 is a design performed by CDM Smith to meet the 5 year LOS while using underground storage or pumping systems. Due to high groundwater conditions during 1 year stillwater conditions, the proposed conveyance system are box culverts due to the primarily horizontal surface area. No roadway improvements.

Proposed Improvements

- Upsized 12 inch collector to a 2' x 6' box culvert along Granada Street south of King St to Cedar Street
- Upsized 12 inch collector to a 2' x 8' box culvert along Granada Street from Cedar Street to Bridge Street
- Upsized 12 inch collector to a 2' x 6' box culvert along Bridge Street from Oneida St to Granada Street
- Upsized 12 inch collector to a 2.5' x 6' box culvert along Bridge Street from Granada Street to Cordova Street
- Upsized 12 inch collector to a 2' x 3' box culvert along from south of King Street 410 feet (CORD-K2BR1)
- Upsized 12 inch collector to a 2' x 6' box culvert along Cordova Street from CORD-K2BR1 to Bridge Street
- Upsized 24 inch collector to a 4' x 8' box culvert along Cordova Street from Bridge Street to Maria Sanchez Lake
- Construct storage vault in parking lot south of City Hall
- Add five 12" pipes from intersection of Granada Street and Desoto Place to storage Vault

Results

Table G-5 Maria Sanchez Lake Alternative 3 (Conveyance with Storage) Peak Stage Table

				Mean Annual			5 - year			10 - year		
Junction	**Location**	**Type**	**Road El.**	**Pre**	**Post**	**Δ (ft)**	**Pre**	**Post**	**Δ (ft)**	**Pre**	**Post**	**Δ (ft)**
GRAN-KI2CE	Granada St South of King St	Local	**4.3**	5.0	4.0	-1.1	5.1	4.3	-0.9	5.3	4.6	-0.6
CORD-KINGS	Cordova St South of King St	Local	**4.6**	5.0	4.6	-0.4	5.1	4.8	-0.3	5.2	4.9	-0.3
GRAN-CEDAR	Granada St at Cedar St intersection	Local	**3.8**	4.9	3.9	-1.0	5.0	4.2	-0.8	5.2	4.6	-0.6
CORD-K2BR1	Cordova St between King and Bridge	Local	**4.4**	5.0	4.5	-0.4	5.0	4.7	-0.3	5.2	4.9	-0.3
GRAN-DESOT	Granada St at Desoto Pl intersection	Local	**3.7**	4.9	3.8	-1.2	5.0	4.2	-0.9	5.2	4.5	-0.7
CORD-K2BR2	Cordova St between King and Bridge	Local	**4.1**	4.9	4.3	-0.6	5.0	4.5	-0.5	5.2	4.7	-0.5
CORD-BRIDG	Cordova St at Bridge St Intersection	Local	**3.5**	4.9	3.5	-1.4	5.0	3.8	-1.2	5.2	4.4	-0.8
BRID-GRANA	Bridge St at Granada St Intersection	Local	**3.6**	4.9	3.7	-1.2	5.0	4.0	-1.0	5.2	4.5	-0.7
BRID-ONEID	Bridge St at Oneida St Intersection	Local	**5.2**	4.9	3.8	-1.2	5.1	4.1	-1.0	5.3	4.6	-0.7
CORD-BR2PA	Cordova St btwn Bridge St and Park Pl	Local	**3.6**	4.6	3.3	-1.2	4.7	3.6	-1.0	4.8	4.1	-0.7
MARI-SANCH	Maria Sanchez Lake	Local	**4.6**	3.0	3.1	0.0	3.3	3.4	0.1	3.7	3.8	0.0
SOUT-MARIA	Culvert	Local	**5.0**	2.8	2.7	0.0	3.0	3.0	0.0	3.5	3.4	-0.1
SOUT-OUTFA	Maria Sanchez Outfall (South St)	Local	**4.0**	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0
SOUT-OUTF2	Maria Sanchez Outfall (South St) 2	Local	**4.0**	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0

				25 - year			50 - year			100 - year		
Junction	**Location**	**Type**	**Road El.**	**Pre**	**Post**	**Δ (ft)**	**Pre**	**Post**	**Δ (ft)**	**Pre**	**Post**	**Δ (ft)**
GRAN-KI2CE	Granada St South of King St	Local	**4.3**	5.4	4.8	-0.6	5.4	4.9	-0.5	5.5	4.9	-0.5
CORD-KINGS	Cordova St South of King St	Local	**4.6**	5.3	5.0	-0.3	5.4	5.1	-0.3	5.4	5.1	-0.3
GRAN-CEDAR	Granada St at Cedar St intersection	Local	**3.8**	5.3	4.8	-0.6	5.4	4.9	-0.5	5.5	4.9	-0.5
CORD-K2BR1	Cordova St between King and Bridge	Local	**4.4**	5.3	5.0	-0.3	5.4	5.0	-0.3	5.4	5.1	-0.3
GRAN-DESOT	Granada St at Desoto Pl intersection	Local	**3.7**	5.3	4.7	-0.6	5.4	4.9	-0.6	5.5	4.9	-0.5
CORD-K2BR2	Cordova St between King and Bridge	Local	**4.1**	5.3	4.8	-0.5	5.3	4.8	-0.5	5.4	4.9	-0.5
CORD-BRIDG	Cordova St at Bridge St Intersection	Local	**3.5**	5.3	4.6	-0.7	5.3	4.8	-0.6	5.4	4.8	-0.5
BRID-GRANA	Bridge St at Granada St Intersection	Local	**3.6**	5.3	4.7	-0.6	5.4	4.9	-0.6	5.5	4.9	-0.6
BRID-ONEID	Bridge St at Oneida St Intersection	Local	**5.2**	5.4	4.9	-0.5	5.5	5.2	-0.4	5.6	5.2	-0.3
CORD-BR2PA	Cordova St btwn Bridge St and Park Pl	Local	**3.6**	4.9	4.4	-0.6	5.0	4.5	-0.5	5.0	4.6	-0.4
MARI-SANCH	Maria Sanchez Lake	Local	**4.6**	4.1	4.1	0.0	4.5	4.4	-0.1	4.7	4.6	-0.1
SOUT-MARIA	Culvert	Local	**5.0**	3.9	3.8	-0.1	4.2	4.1	-0.2	4.4	4.2	-0.2
SOUT-OUTFA	Maria Sanchez Outfall (South St)	Local	**4.0**	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0
SOUT-OUTF2	Maria Sanchez Outfall (South St) 2	Local	**4.0**	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0

Table G-6 Maria Sanchez Lake Alternative 3 (Conveyance with Storage) Level of Service Flood Depths

		Mean Annual				5 Year				10 Year			
		Pre		Post		Pre		Post		Pre		Post	
Junction	Location	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?
GRAN-KI2CE	Granada St South of King St	0.8	Yes	-0.3	No	0.8	Yes	0.0	No	1.0	Yes	0.4	No
CORD-KINGS	Cordova St South of King St	0.4	No	0.0	No	0.5	No	0.2	No	0.6	Yes	0.3	No
GRAN-CEDAR	Granada St at Cedar St intersection	1.1	Yes	0.1	No	1.2	Yes	0.4	No	1.4	Yes	0.8	Yes
CORD-K2BR1	Cordova St between King and Bridge	0.6	Yes	0.1	No	0.6	Yes	0.3	No	0.8	Yes	0.5	No
GRAN-DESOT	Granada St at Desoto Pl intersection	1.2	Yes	0.0	No	1.3	Yes	0.5	No	1.5	Yes	0.8	Yes
CORD-K2BR2	Cordova St between King and Bridge	0.8	Yes	0.2	No	0.9	Yes	0.4	No	1.1	Yes	0.6	Yes
CORD-BRIDG	Cordova St at Bridge St Intersection	1.4	Yes	0.0	No	1.5	Yes	0.3	No	1.6	Yes	0.9	Yes
BRID-GRANA	Bridge St at Granada St Intersection	1.3	Yes	0.1	No	1.4	Yes	0.4	No	1.6	Yes	0.9	Yes
BRID-ONEID	Bridge St at Oneida St Intersection	-0.3	No	-1.5	No	-0.1	No	-1.1	No	0.1	No	-0.6	No
CORD-BR2PA	Cordova St btwn Bridge St and Park Pl	0.9	Yes	-0.3	No	1.1	Yes	0.0	No	1.2	Yes	0.5	Yes
MARI-SANCH	Maria Sanchez Lake	-1.6	No	-1.5	No	-1.3	No	-1.3	No	-0.9	No	-0.8	No
SOUT-MARIA	Culvert	-2.2	No	-2.3	No	-2.0	No	-2.0	No	-1.6	No	-1.6	No
SOUT-OUTFA	Maria Sanchez Outfall (South St)	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No
SOUT-OUTF2	Maria Sanchez Outfall (South St) 2	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No

		25 Year				50 Year				100 Year			
		Pre		Post		Pre		Post		Pre		Post	
Junction	Location	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?
GRAN-KI2CE	Granada St South of King St	1.1	Yes	0.5	No	1.2	Yes	0.6	Yes	1.2	Yes	0.7	Yes
CORD-KINGS	Cordova St South of King St	0.7	Yes	0.4	No	0.8	Yes	0.5	No	0.8	Yes	0.5	Yes
GRAN-CEDAR	Granada St at Cedar St intersection	1.5	Yes	1.0	Yes	1.6	Yes	1.1	Yes	1.7	Yes	1.1	Yes
CORD-K2BR1	Cordova St between King and Bridge	0.9	Yes	0.6	Yes	0.9	Yes	0.6	Yes	1.0	Yes	0.7	Yes
GRAN-DESOT	Granada St at Desoto Pl intersection	1.6	Yes	1.0	Yes	1.7	Yes	1.1	Yes	1.7	Yes	1.2	Yes
CORD-K2BR2	Cordova St between King and Bridge	1.2	Yes	0.7	Yes	1.2	Yes	0.7	Yes	1.3	Yes	0.8	Yes
CORD-BRIDG	Cordova St at Bridge St Intersection	1.7	Yes	1.1	Yes	1.8	Yes	1.3	Yes	1.9	Yes	1.3	Yes
BRID-GRANA	Bridge St at Granada St Intersection	1.7	Yes	1.1	Yes	1.8	Yes	1.3	Yes	1.9	Yes	1.3	Yes
BRID-ONEID	Bridge St at Oneida St Intersection	0.2	No	-0.3	No	0.3	No	0.0	No	0.4	No	0.0	No
CORD-BR2PA	Cordova St btwn Bridge St and Park Pl	1.3	Yes	0.7	Yes	1.4	Yes	0.9	Yes	1.4	Yes	1.0	Yes
MARI-SANCH	Maria Sanchez Lake	-0.5	No	-0.5	No	-0.1	No	-0.2	No	0.0	No	-0.1	No
SOUT-MARIA	Culvert	-1.1	No	-1.2	No	-0.8	No	-0.9	No	-0.6	No	-0.8	No
SOUT-OUTFA	Maria Sanchez Outfall (South St)	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No
SOUT-OUTF2	Maria Sanchez Outfall (South St) 2	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No

CDM Smith

Alternative 4

Alternative 4 is a design performed by CDM Smith to meet the mean annual (2.3 year) LOS while using underground storage and pumping system. Due to high groundwater conditions during 1 year stillwater conditions, the proposed conveyance system are box culverts due to the primarily horizontal surface area. Alternative 4 does not include improvements along Granada between King Street and Cedar Street, and Cordova from King Street to Palm Row. The design also contains an inverted crown roadway along Cordova Street between Bridge Street and Maria Sanchez Lake.

Proposed Improvements

- Upsized 12 inch collector to a 2' x 6' box culvert along Granada Street from Cedar Street to Bridge Street
- Upsized 12 inch collector to a 2.5' x 6' box culvert along Bridge Street from Granada Street to Cordova Street
- Upsized 12 inch collector to a 2' x 3' box culvert along Cordova Street from CORD-K2BR1 to CORD-K2BR2
- Upsized 12 inch collector to a 2' x 4' box culvert along Cordova Street from CORD-K2BR2 to Bridge Street
- Upsized 24 inch collector to a 3' x 8' box culvert along Cordova Street from Bridge Street to Maria Sanchez Lake
- Construct storage vault in parking lot south of City Hall
- Add five 12" pipes from intersection of Granada Street and Desoto Place to storage Vault

Results

Table G-7 Maria Sanchez Lake Alternative 3 (Conveyance with Storage) Peak Stage Table

				Mean Annual			5 - year			10 - year		
Junction	**Location**	**Type**	**Road El.**	**Pre**	**Post**	**Δ (ft)**	**Pre**	**Post**	**Δ (ft)**	**Pre**	**Post**	**Δ (ft)**
GRAN-KI2CE	Granada St South of King St	Local	**4.3**	5.0	4.0	-1.1	5.1	4.3	-0.9	5.3	4.6	-0.6
CORD-KINGS	Cordova St South of King St	Local	**4.6**	5.0	4.6	-0.4	5.1	4.8	-0.3	5.2	4.9	-0.3
GRAN-CEDAR	Granada St at Cedar St intersection	Local	**3.8**	4.9	3.9	-1.0	5.0	4.2	-0.8	5.2	4.6	-0.6
CORD-K2BR1	Cordova St between King and Bridge	Local	**4.4**	5.0	4.5	-0.4	5.0	4.7	-0.3	5.2	4.9	-0.3
GRAN-DESOT	Granada St at Desoto Pl intersection	Local	**3.7**	4.9	3.8	-1.2	5.0	4.2	-0.9	5.2	4.5	-0.7
CORD-K2BR2	Cordova St between King and Bridge	Local	**4.1**	4.9	4.3	-0.6	5.0	4.5	-0.5	5.2	4.7	-0.5
CORD-BRIDG	Cordova St at Bridge St Intersection	Local	**3.5**	4.9	3.5	-1.4	5.0	3.8	-1.2	5.2	4.4	-0.8
BRID-GRANA	Bridge St at Granada St Intersection	Local	**3.6**	4.9	3.7	-1.2	5.0	4.0	-1.0	5.2	4.5	-0.7
BRID-ONEID	Bridge St at Oneida St Intersection	Local	**5.2**	4.9	3.8	-1.2	5.1	4.1	-1.0	5.3	4.6	-0.7
CORD-BR2PA	Cordova St btwn Bridge St and Park Pl	Local	**3.6**	4.6	3.3	-1.2	4.7	3.6	-1.0	4.8	4.1	-0.7
MARI-SANCH	Maria Sanchez Lake	Local	**4.6**	3.0	3.1	0.0	3.3	3.4	0.1	3.7	3.8	0.0
SOUT-MARIA	Culvert	Local	**5.0**	2.8	2.7	0.0	3.0	3.0	0.0	3.5	3.4	-0.1
SOUT-OUTFA	Maria Sanchez Outfall (South St)	Local	**4.0**	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0
SOUT-OUTF2	Maria Sanchez Outfall (South St) 2	Local	**4.0**	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0

				25 - year			50 - year			100 - year		
Junction	**Location**	**Type**	**Road El.**	**Pre**	**Post**	**Δ (ft)**	**Pre**	**Post**	**Δ (ft)**	**Pre**	**Post**	**Δ (ft)**
GRAN-KI2CE	Granada St South of King St	Local	**4.3**	5.4	4.8	-0.6	5.4	4.9	-0.5	5.5	4.9	-0.5
CORD-KINGS	Cordova St South of King St	Local	**4.6**	5.3	5.0	-0.3	5.4	5.1	-0.3	5.4	5.1	-0.3
GRAN-CEDAR	Granada St at Cedar St intersection	Local	**3.8**	5.3	4.8	-0.6	5.4	4.9	-0.5	5.5	4.9	-0.5
CORD-K2BR1	Cordova St between King and Bridge	Local	**4.4**	5.3	5.0	-0.3	5.4	5.0	-0.3	5.4	5.1	-0.3
GRAN-DESOT	Granada St at Desoto Pl intersection	Local	**3.7**	5.3	4.7	-0.6	5.4	4.9	-0.6	5.5	4.9	-0.5
CORD-K2BR2	Cordova St between King and Bridge	Local	**4.1**	5.3	4.8	-0.5	5.3	4.8	-0.5	5.4	4.9	-0.5
CORD-BRIDG	Cordova St at Bridge St Intersection	Local	**3.5**	5.3	4.6	-0.7	5.3	4.8	-0.6	5.4	4.8	-0.5
BRID-GRANA	Bridge St at Granada St Intersection	Local	**3.6**	5.3	4.7	-0.6	5.4	4.9	-0.6	5.5	4.9	-0.6
BRID-ONEID	Bridge St at Oneida St Intersection	Local	**5.2**	5.4	4.9	-0.5	5.5	5.2	-0.4	5.6	5.2	-0.3
CORD-BR2PA	Cordova St btwn Bridge St and Park Pl	Local	**3.6**	4.9	4.4	-0.6	5.0	4.5	-0.5	5.0	4.6	-0.4
MARI-SANCH	Maria Sanchez Lake	Local	**4.6**	4.1	4.1	0.0	4.5	4.4	-0.1	4.7	4.6	-0.1
SOUT-MARIA	Culvert	Local	**5.0**	3.9	3.8	-0.1	4.2	4.1	-0.2	4.4	4.2	-0.2
SOUT-OUTFA	Maria Sanchez Outfall (South St)	Local	**4.0**	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0
SOUT-OUTF2	Maria Sanchez Outfall (South St) 2	Local	**4.0**	2.2	2.2	0.0	2.2	2.2	0.0	2.2	2.2	0.0

Table G-8 Maria Sanchez Lake Alternative 3 (Conveyance with Storage) Levelof Service Flood Depths

		Mean Annual				5 Year				10 Year			
		Pre		Post		Pre		Post		Pre		Post	
Junction	Location	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?
GRAN-KI2CE	Granada St South of King St	0.8	Yes	-0.3	No	0.8	Yes	0.0	No	1.0	Yes	0.4	No
CORD-KINGS	Cordova St South of King St	0.4	No	0.0	No	0.5	No	0.2	No	0.6	Yes	0.3	No
GRAN-CEDAR	Granada St at Cedar St intersection	1.1	Yes	0.1	No	1.2	Yes	0.4	No	1.4	Yes	0.8	Yes
CORD-K2BR1	Cordova St between King and Bridge	0.6	Yes	0.1	No	0.6	Yes	0.3	No	0.8	Yes	0.5	No
GRAN-DESOT	Granada St at Desoto Pl intersection	1.2	Yes	0.0	No	1.3	Yes	0.5	No	1.5	Yes	0.8	Yes
CORD-K2BR2	Cordova St between King and Bridge	0.8	Yes	0.2	No	0.9	Yes	0.4	No	1.1	Yes	0.6	Yes
CORD-BRIDG	Cordova St at Bridge St Intersection	1.4	Yes	0.0	No	1.5	Yes	0.3	No	1.6	Yes	0.9	Yes
BRID-GRANA	Bridge St at Granada St Intersection	1.3	Yes	0.1	No	1.4	Yes	0.4	No	1.6	Yes	0.9	Yes
BRID-ONEID	Bridge St at Oneida St Intersection	-0.3	No	-1.5	No	-0.1	No	-1.1	No	0.1	No	-0.6	No
CORD-BR2PA	Cordova St btwn Bridge St and Park Pl	0.9	Yes	-0.3	No	1.1	Yes	0.0	No	1.2	Yes	0.5	Yes
MARI-SANCH	Maria Sanchez Lake	-1.6	No	-1.5	No	-1.3	No	-1.3	No	-0.9	No	-0.8	No
SOUT-MARIA	Culvert	-2.2	No	-2.3	No	-2.0	No	-2.0	No	-1.6	No	-1.6	No
SOUT-OUTFA	Maria Sanchez Outfall (South St)	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No
SOUT-OUTF2	Maria Sanchez Outfall (South St) 2	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No

		25 Year				50 Year				100 Year			
		Pre		Post		Pre		Post		Pre		Post	
Junction	Location	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?	Flood Depth (ft)	Exceed Standard?
GRAN-KI2CE	Granada St South of King St	1.1	Yes	0.5	No	1.2	Yes	0.6	Yes	1.2	Yes	0.7	Yes
CORD-KINGS	Cordova St South of King St	0.7	Yes	0.4	No	0.8	Yes	0.5	No	0.8	Yes	0.5	Yes
GRAN-CEDAR	Granada St at Cedar St intersection	1.5	Yes	1.0	Yes	1.6	Yes	1.1	Yes	1.7	Yes	1.1	Yes
CORD-K2BR1	Cordova St between King and Bridge	0.9	Yes	0.6	Yes	0.9	Yes	0.6	Yes	1.0	Yes	0.7	Yes
GRAN-DESOT	Granada St at Desoto Pl intersection	1.6	Yes	1.0	Yes	1.7	Yes	1.1	Yes	1.7	Yes	1.2	Yes
CORD-K2BR2	Cordova St between King and Bridge	1.2	Yes	0.7	Yes	1.2	Yes	0.7	Yes	1.3	Yes	0.8	Yes
CORD-BRIDG	Cordova St at Bridge St Intersection	1.7	Yes	1.1	Yes	1.8	Yes	1.3	Yes	1.9	Yes	1.3	Yes
BRID-GRANA	Bridge St at Granada St Intersection	1.7	Yes	1.1	Yes	1.8	Yes	1.3	Yes	1.9	Yes	1.3	Yes
BRID-ONEID	Bridge St at Oneida St Intersection	0.2	No	-0.3	No	0.3	No	0.0	No	0.4	No	0.0	No
CORD-BR2PA	Cordova St btwn Bridge St and Park Pl	1.3	Yes	0.7	Yes	1.4	Yes	0.9	Yes	1.4	Yes	1.0	Yes
MARI-SANCH	Maria Sanchez Lake	-0.5	No	-0.5	No	-0.1	No	-0.2	No	0.0	No	-0.1	No
SOUT-MARIA	Culvert	-1.1	No	-1.2	No	-0.8	No	-0.9	No	-0.6	No	-0.8	No
SOUT-OUTFA	Maria Sanchez Outfall (South St)	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No
SOUT-OUTF2	Maria Sanchez Outfall (South St) 2	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No	-1.8	No

CDM Smith