



November 21, 2023

Re: City of Sebastian Stormwater Master Plan Update

Dear Members of Sebastian City Council,

In your review of the Stormwater Master Plan Update provided by Arcadis, you will find it is a comprehensive report totaling 1,712 pages of content. In order to help in your review I have created a summary focusing on the main content and findings. This should not be considered a subjective or opinionated review of the report, but rather an objective summary in order to ensure content is not missed during your review. If you would like my opinion of the report as well as what it means relative to the future of the City of Sebastian Stormwater system, department, and operations, I can provide that at a future date. Instead this can be considered a summary of the report in direct quote and paraphrased form. Please see the report for further details and clarification. In this summary I have also added pertinent background information to help with understanding our City's stormwater system or the master plan update itself. All my personal additions are highlighted in gray as shown [here](#). For an even quicker review of the most important aspects to understand the City's system as well as the SWMP analysis you can review the areas of interest highlighted in yellow as shown [here](#).

The Stormwater Master Plan has an extensive Table of Contents. Here is a summarized version in order to help pinpoint different sections of interest:

SECTION 1: Background, Level of Service, and Regulations and Regulatory Agencies

SECTION 2: Existing Conditions

SECTION 3: Data and Modeling

SECTION 4: Water Quality Assessment (Effects of Runoff, Best Management Practices, Stormwater Systems – definitions and applicability, State Regulations for Water Quality

SECTION 5: Sea Level Rise Assessment

SECTION 6: Operations and Maintenance (Evaluation of Existing personnel and organization as well as proposed changes, System assets and inspection and maintenance protocols, budget needs)

SECTION 7: Alternatives Development and CIP Prioritization

SECTION 8: Funding Plan and Grant Management (Review of Grant funding options)

SECTION 9: Conclusions and Recommendations

APPENDICES:

A-G are all existing reports related to stormwater regulations or local data

(for reference – all existing publications and no new material was created)

H-K were created for this Stormwater Master Plan Update

H – Inspection and Maintenance Standard Operating Procedures

I – Capital Improvement Plan Detailed Cost Estimates

J – Stormwater Asset GIS Database

K – Stormwater Network Summary Tables

SECTION 1 – Introduction

1.1 Background

- Goes into the statistics of our area regarding acreage and mileage
 - Note this study does not include the Graves Brothers Annexation Area as it was not completed at the time of the study
 - Introduces water quality issues within the St. Sebastian Watershed and Indian River Lagoon
 - Notes the City's system was designed for dealing with quantity of stormwater runoff rather than water quality control – this is since the system was designed by GDC in the 1950s when water quality control was not a factor in design or a public concern
 - City has previously and continues to reduce stormwater pollutant loads by making adjustments to the system (baffle boxes etc.)

1.2 Previous Studies

- Stormwater Master Planning began in 1996 with additional report updates in 2004, 2010, 2013, 2018
 - This is an update to the 2018 stormwater master plan
 - Note this update is more comprehensive than the 2018 SWMP as new regulations have come into play – specifically House Bill 53 which was enacted in 2021

1.3 Extent-of-Service and Level-of-Service

- Introduces our level of service per our 2040 Comprehensive Plan
 - Ensure adequate stormwater drainage to protect against flood conditions and prevent degradation of surface and groundwater quality (Objective 4-1.4)
 - Provide updates to the City's Stormwater Master Plan in order to address deficiencies and meet stormwater needs for future growth (Policy 4-1.4.2)
 - Ensure that drainage system components are monitored, inspected, and maintained pursuant to best management practices (Policy 4-1.4.9)

1.3.1 Flooding

- Outlines level of service requirements as seen in different references
 - City of Sebastian (CoS) Land and Development Code
 - CoS 2018 Stormwater Master Plan
 - CoS 2040 Comprehensive Plan

- Florida Department of Transportation Drainage Design Guide
- St. John’s River Water Management District (SJRWMD) Permit Manual

1.3.2 Water Quality

- Notes water quality improvements are important to the City and residents but the CoS Land and Development Code does not call for specific requirements
 - The City relies on Florida Department of Environmental Protection’s (FDEP) Total Maximum Daily Load requirements (TMDL)

1.3.3 LOS (Level of Service) Summary

- Level of service of conveyance without damage to habitable structures

Roadside Swales (and associated culverts)	Backyard Ditches and Side Yard Swales (and associated culverts)	Roadways	Canals	All Stormwater Discharges
Convey a 10-year, 24-hour storm event (7.24 inches of rainfall)	Convey a 25-year, 24-hour storm event (9.17 inches of rainfall)	Do not exceed 2 inches above the lowest elevation on the centerline profile of the roadway for a 25-year, 24-hour storm	Convey a 100-year, 72 –hour storm event (14.9 inches of rainfall)	Maintain compliance with Total Maximum Daily Loads (TMDL) of Florida Water Quality Standards

1.4 Regulatory and Intergovernmental Framework

Summarizes all of the different jurisdictional agencies and requirements that must be met by the City’s Stormwater management on a Federal, State, and local level

1.4.1 Agencies Having Jurisdiction

1.4.1.1 United States Environmental Protection Agency (USEPA)

- Review dredge and fill permit applications under US Army Corps of Engineers
- Created the NPDES Program and National Estuary Program (NEP)
 - Indian River Lagoon was identified as a threatened estuary

1.4.1.2 Federal Emergency Management Agency (FEMA)

- Regulates flood plain and Flood Insurance Rate Maps

1.4.1.3 State of Florida Department of Environmental Protection (FDEP)

- Regulates permits for discharge into State water
 - Later delegated to SJRWMD locally

- 1.4.1.4 St. John’s River Water Management District (SJRWMD)**
 - Regulates the management and storage surface waters with the St. John’s River Basin
- 1.4.1.5 Florida Department of Transportation (FDOT)**
 - Provides drainage for major arterial roads in IRC (US-1)
- 1.4.1.6 Local Government – Indian River County**
 - Manages stormwater of unincorporated areas and County road right-of-ways (CR512 – Sebastian Blvd/Fellsmere Road)
- 1.4.1.7 F.S. 298 Special Drainage Districts**
 - Five within IRC – Indian River Farms Water Control District (IRFWCD), Sebastian River Improvement District (SRID), Fellsmere Water Control District (FWCD), St. John’s Improvement District, Delta Farms Water Control District
 - The Graves Annexation Area falls within SRID
- 1.4.1.8 Incorporated Municipalities**
 - Have home rule powers in relation to stormwater management
 - Within IRC: City of Sebastian, City of Vero Beach, Town of Indian River Shores, City of Fellsmere, Town of Orchid
- 1.4.1.9 Private Systems**
 - The City of Sebastian has jurisdiction over private systems within its municipal boundaries (consider PUDs and commercial developments)

1.4.2 City of Sebastian Goals and Regulatory Requirements

- 1.4.2.1 City Goal**
 - Operate and maintain system in full compliance of Federal Clean Water Act and applicable jurisdictions
 - Provide highest level of service possible to the City’s residents and businesses, while effectively managing the quality and quantity of stormwater discharges to protect the sensitive nature environment and waterways in the area

1.4.2..2 **NPDES MS4 Permit Requirements**

- The City has a Municipal Separate Storm Sewer Systems (MS4) Permit through FDEP under the National Pollutant Discharge Elimination System (NPDES)
- The current permit expires March 1, 2025
 - The City works with FDEP every 5 years for a permit renewal and must adjust the plan every 5 years according to FDEP’s review process
 - This permit allows to City’s stormwater system to operate and the City must report on its activity in bi-annual reports as well as complete inspections and audits from FDEP every four years. This permit allows our stormwater system to exist as well as allows us to approve and inspect additional construction within our area (ex. construction of homes on individual lots)
- The current approved permit with FDEP requires public education and outreach related to stormwater discharges, public participation/involvement such as activities at the Earth Day event or local waterway cleanup events, Illicit discharge detection and elimination, construction site stormwater runoff control through building department and stormwater inspections, post construction stormwater management, and pollution prevention
- See Appendix A for the full NPDES MS4 permit requirements for the City of Sebastian

1.4.2..3 **Adopted Total Maximum Daily Load (TMDL) Requirements**

- FDEP regulates the TMDL-“a scientific determination of the maximum amount of a given pollutant that a surface water can absorb and still meet the water quality standards that protect human life and aquatic life”
- TMDL for Central and Southern South Indian River area are 278,273 lbs/year of Total Nitrogen (TN) and 53,599 lbs/year of TP (Total Phosphorous)

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1.4.2..5 Indian River Lagoon Comprehensive Conservation Management Plan

- Discusses the creation of the National Estuary Program (NEP) and its coordination with the Indian River Lagoon
- See Appendix C for 2030 Comprehensive Conservation Management Plan

1.4.2..6 Integrated Pest Management Plan

- Discusses the City's existing Integrate Pest Management Plan (IPM) that deals with aquatic vegetation management
- It's goals include
 - protection of environmental resources by reducing the amount of pollutants entering surface and ground water and minimizing effects on native plants, animals, and habitats
 - Ensure effective economic pest management within the City's stormwater conveyance system, while minimizing health risks to the public, City staff, and the environment
 - Promote transparency of the City's pest management activities
 - Increase public awareness of IPM methods and benefits
- The SWMP recommends we take the following actions with the IPM plan
 - Incorporate into the FDEP NPDES MS4 Permit reporting
 - Add as a new project in the BMAP program as a water quality program
 - Provide updates to the Indian River Lagoon Council for the Indian River Lagoon Comprehensive Conservation and Management Plan (CCMP) annual report for lagoon-related accomplishments
- See Appendix D for a full copy of the IPM plan adopted October 14, 2020

1.4.2..7 City Ordinances Related to the NPDES MS4Permit SWMP

- Illicit Discharge Ordinance
 - Prohibits non-stormwater discharges into the MS4 system, and implements inspection, reporting, and enforcement procedures

- Surface Water Management Ordinance
 - Requires all construction site operators control discarded materials and provide a sanitary waste facility. Waste management on each site is inspected as part of the “Erosion Control” inspections
- Erosion and Sediment Control on Construction Sites
 - Sites greater than an acre must submit a SWPP (Stormwater Pollution Prevention Plan) as part of their site plan to meet all City Land and Development Ordinances
- Site Plan Review
 - Article XVII of the Land and Development Code outline site plan review procedures

1.5 Project Goals - Specific Goals of the SWMP

- Develop a programmatic approach to address the current significant and costly backlog of stormwater capital improvement and system rehabilitation projects
- Provide a systematic process for developing 10-yr CIP program
- Establish 10-yr CIP with budget requirements
- Identify specific federal and state sources for funding
- GIS mapping of major stormwater assets
- Hydrologic and hydraulic (H&H) model of the City of Sebastian

SECTION 2 – EXISTING CONDITIONS

2.1 Geology and Soils

- Easternmost portion of the City along the IRL lies within the Atlantic Coastal Ridge, where the soils are flat to gently sloping, sandy, and well drained
- Most of the City is West of the Atlantic Coastal Ridge in the Eastern Valley where soils are predominantly nearly level and wet
- The topography of the City is very flat, with average grades of approximately 0.1 percent
- The categorize the different drainage soils in Table 2-1 on page 19
 - Soil Group A – typically sandy, lowest runoff potential
 - Soil Group D – clays, wetland soils, highest runoff potential
 - Soils with two groups (i.e. A/D) indicate a confining layer or high water table affecting the infiltration rate
- When summing up the soil types in Sebastian you will see 71.3% are poorly drained (Table 2-2 page 19)
- High groundwater table limits the infiltration capacity of the soils
- Poor draining soils and flat topography make drainage very challenging and limit the types of Best Management Practices that can be used in the Stormwater Management System

2.2 Environmental

- Stormwater runoff drains either directly to the Indian River Lagoon or to the South Prong of the St. Sebastian River (via multiple outfalls)
- Central Indian River Lagoon is classified as a Class III water, meaning it must be suitable for recreation
- 2009 FDEP revised the list of Verified List of Impaired Waters and identified several estuarine segments as impaired for dissolved oxygen (DO)
- 2011 Extensive algal blooms occurred in IRL and have returned periodically

2.3 Drainage System Characteristics

- Sebastian uses a combination of traditional stormwater infrastructure (pipes) and Green Infrastructure (GI) to collect and convey stormwater runoff
 - The City’s system is an older style system with majority open conveyance (swales, ditches, and canals)
 - The industry standard moved to piped systems, but the City’s system was not upgraded due to the cost limitations. In addition, piping the entire system would further reduce water quality, going against one of the City’s goals
 - At industry seminars and meetings it has been brought up that municipalities and developers need to incorporate more low impact development and green infrastructure such as swales and rain gardens, going back to previous systems for water quality improvement benefits

Sebastian Stormwater Management System Summary				
Grassed swales and ditches	Culverts and Pipes	Retention and Detention Ponds	Nutrient Separating Baffle Boxes	Canals
360+ miles	1,293 culverts 126,000 linear feet of pipes	30	9	8.4 miles

***NOTE: The focus on this Stormwater Master Plan was on City owned infrastructure. Therefore culverts and pipes are considered road crossing pipes and other piping installed by the City. This does not include private piping such as homeowner’s driveway culvert pipes**

2.3.1 Previously Completed Improvements

- Shows a list of Capital Improvement Projects completed since 2006 (see page 21)

2.3.2 Previously Identified Drainage Issues

2.3.2.1 Topography

- City topography is very flat and the slopes of the conveyance structures are in many cases too shallow for proper flow velocities
- If stormwater runoff enters the conveyance structure at a greater rate than the flow capacity allows, the structure will rapidly fill up and flood over its banks into adjacent areas
- 2006 City started quarter round program to help with shallower slopes

- Plastic pipe has a lower friction coefficient than grass improving velocity
- Note with higher velocity more water is getting into the canal and ditch system quicker, this does limit percolation time within the swales and limits water quality happening on a small scale at individual lots
- After installation the City found homeowners were not adequately maintaining the quarter round, so the City hired contractors at approximately \$250,000 per year to clean swales
- Maintenance costs continued to increase and it was determined not cost effective and cancelled by Council in 2017

2.3.2.3 Surface Water Elevations (Tailwater Controls)

- Tailwater controlled system
 - Amount of water that can leave the City's system is dependent on the elevations of their eventual outfall, if their elevations increases, causes decreased drainage flow and upstream elevations to increase
 - When a canal or the St. Sebastian River is at maximum capacity water collects further upstream (ex. sits in residential swales) until the system has time to compensate and drain

2.3.2.3 Groundwater Elevations

- Groundwater elevation throughout most of the City are between 0-1 foot below the ground surface, which significantly reduces or prevents the infiltration of stormwater from the swales, ditches, ponds, and canals, etc.

2.3.2.4 Geology and Soils

- Limited infiltration due to high groundwater table and soils – causes water sitting in swales
- Investigated a concrete liner in swales (more permanent than quarter round) and found too cost inefficient and would increase impervious areas

2.3.2.5 Inadequate Stormwater Infrastructure

- Localized flooding due to system deficiencies, areas studied and included in CIP Plan (See section 7)

2.3.2.6 Operations and Maintenance Difficulties

- Maintenance of Open Channels – made difficult with heavy vegetation reducing the flow of velocity
 - Front Yard Swale – Per Code 54-2-7.15 (d) it is the continuous responsibility of any owner of a lot to maintain such swales,

- ditches, and pipes o the site to maintain proper flow of surface water
- City does not currently conduct regular front yard swale inspections (instead it is initiated by a Citizen Request)
- City mows the front yard swales of vacant lots
- Vacant lots with quarter round – City hand cleans once a year
- Side Yard and Back Yard ditches – overgrowth issues
 - City contractor mows
 - With increased height of home builds lots due to enhanced septic system requirements, side slopes have increased rendering many of them unstable and subject to rapid erosion
- Aquatic Weed Control – Contracts for spraying aquatic weeds and with herbicides to control them in the canals and minimize the discharge of live aquatic weeds downstream
- Canal dredging – Sediment buildup and shoaling was observed in the City’s canals
 - Indicating need for dredging
 - Last dredging completed in 2009 bulkhead reconstruction project
- Canal bulkheads – 756 bulkheads along the banks of the City’s canals. The City owns and maintains approximately 20 seawalls. Remainder of bulkheads are privately owned (see Section 3.3.3.1)
- Maintenance of Retention/Detention Ponds
 - City has 19 retention ponds and 11 detention ponds. Sediment buildup may have reduced the capacity of the ponds

2.3.2.7 Environmental Concerns

- Excessive freshwater drainage into the Indian River Lagoon may result in species shifts that could have significant effects on a fragile ecosystem
- Increased suspended matter and loading of pollutants and nutrients associated with stormwater runoff may further degrade water quality

SECTION 3 – DATA AND METHODOLOGY

3.1 Meetings with the City and Available Data

- A GIS network of the City owned structures was necessary and Arcadis staff went out in the field to collect data points of road crossings, catch basins, baffle boxes, weirs etc.
- Collected more than 4,400 stormwater components

3.2 Stormwater System GIS Map Development

- Data collection began with existing GIS and pdf maps from the City of Sebastian

- In Arcadis’s data collection, all items were located with GPS coordinates including the x, and y plane as well as the vertical z plane for elevations
- Spot elevations were checked in areas of documented historic flooding
- Arcadis created a point layer for stormwater structures and a polyline layer for closed and open pipe channels (all to help create a model of the entire conveyance system)
- Note private driveway culvert pipes were not included in the model, only City owned assets were included in the model
- Due to survey time limitations a priority ranking system was developed to ensure most critical cross-sections, elevations and vegetation conditions were determined
- The City considers this the creation of our GIS network and included funds in the FY23 and FY24 budgets to acquire surveying tools in order to expand the data network
- Of the 2,381 nodes and 1,875 conduits identified for the field survey activities 2,710 nodes and 1,539 conduits were inspected

3.3 Infrastructure Asset Survey and Assessment

3.3.1 Asset Assessment Goals, Criteria and Methodology

- Infrastructure assessment included over 4,500 stormwater assets including:
 - 756 bulkhead
 - 2,170 nodes (culvert inlets/outlets, outfalls, baffle boxes, curb inlets, yard inlets, and manholes)
 - 1,539 conduits (pipes, canals, ditches)

3.3.2 Inspection Methodology

- Inspections and data information was collected using Trimble R2 GNSS receiver (elevations, dimensions, measurements, notes of material & size, pictures of condition)

3.3.3 SWMS Components

3.3.3.1 Canals

- City’s Stormwater Management System (SWMS) contains approximately eight miles of canals with bulkheads of seawalls on both sides
- Varying amounts of vegetation and shoaling (where water becomes shallower typically due to movement of sediment or sand)
- The canals themselves are within the City’s drainage easement and are maintained by the City, but the majority of the bulkheads are privately owned and maintained
- 756 bulkheads inspected and 85% found to be structurally sound but many showed signs of deterioration (cracks along the bulkhead face or concrete cap)
- 108 of bulkheads had structurally failed and need to be replaced immediately, especially in the Schumann Lake area

- Many inspections were blocked by vegetation, and if left unchecked could cause failure
- No trees, shrubs, or other vegetation with substantial root systems should be present within 20 feet of a bulkhead structure

3.3.3.2 Green Infrastructure

- City's Stormwater Management System primarily relies on green infrastructure (interconnected roadside swales, side yard swales, and backyard ditches)
- Inspections were limited to the major flow paths for use in the H&H model
- Thousands of roadside swale sections were viewed during field work and generally appeared in good condition
- A detailed inspection and hydraulic analysis of the roadside swale systems throughout the City should be performed in the future
- See figure on page 27 for observed conditions in the field
 - Note this is a snapshot of time and with our ditch mowing maintenance on a rotating basis some areas that are observed in the report as highly vegetated may not have been a few weeks or months later. However it gives a great insight into the system and varying conditions that could occur month to month

3.3.3.3 Conveyance Structures

- Physical condition of pipes as well as measurements were taken in field survey
- Thousands of driveway culverts in the SWMS were not included in inspections
- The large number of roadside swale sections and their connecting driveway culverts in series create a collection system with a high probability of operational difficulties
- Again recommends an additional study be completed of the roadside swales

3.4 Hydrologic and Hydraulic Modeling

3.4.1 H&H Model Goals and Limitations

- A dynamic 1D Hydrologic and Hydraulic (H&H) computer model of the City of Sebastian stormwater network was developed to evaluate the system performance

3.4.2 Software Selection

- PCSWMM hydrologic and hydraulic software was chosen due to the relatively low cost, high accessibility, flexibility across projects, support, usage nationwide, and suitability

3.4.3 Model Extents and Level of Detail

- Model extents focused on including the pipes, culverts, and channels owned by CoS

- See Figure 3-3 on page showing the nodes included in the model as well as outlines of PUDs
- Planned Unit Developments (PUDs), or private developments/HOA, are shown as 57 storage nodes separate from the City's system as PUDs are designed to contain their own stormwater
 - However per code they are allowed to overflow into the CoS system and this is not accounted for in this model as each private development would have to be modeled in the process and this was outside of the scope of the project
 - The City would like to include overflow quantities in future model updates
 - It is critical for PUDs to keep their systems maintained so vegetation and growth does not inhibit storage, and cause overflow into the City system at an earlier point than their originally intended and approved design
- There are 27 outfalls within the City of Sebastian (see Table 3-1 on page 31)
 - 14 to the IRL, with 5 owned and maintained by FDOT, and 9 owned by CoS
 - 9 outfalls to the St. Sebastian River, 1 IRC owned, 1 private, 6 owned by CoS and one shared by IRC and CoS

3.4.4. Hydraulic Parameters – How water behaves in motion

- GPS unit used in field collection found invert elevations of pipes (determined a list of pipes that had negative slope)
- Missing invert elevations were determined using 2007 LiDAR topography data of the area
- Flow directions in open channels determined by the invert elevations of adjacent pipes and assuming smaller pipes flow to larger pipes
- Cross section geometry was calculated for the open channels (ditches)
- Manning's roughness coefficients for pipes, culverts, and channels were assigned to each section (see Table 3-2 on page 33 for values)
 - In the model this helps determine the flow velocity as friction/resistance varies for different materials (ex. water will flow faster through a clean concrete pipe than it will through a vegetated grass area)
- The H&H model assumes that pipe blockages have been addressed through regular O&M (Operation and Maintenance)
 - This was in order to evaluate the system as designed by GDC, to determine miscalculations in the system, rather than model the system for varying operating conditions
 - Allows identification of undersized infrastructure and determines CIP projects
 - Note it is impossible to attain a system that is 100% clear without blockages with the current staffing and equipment
 - For a 100% clear system a crew would need to inspect and correct issues at every single location within the City of Sebastian on a daily basis as conditions are constantly changing

- It is much more reasonable to consider the entire system is approximately 75%-80% clear at any point in time
- The system was modeled with the Stormwater Treatment Facility, or Stormwater Park, pump turned off in wet weather conditions as the City currently functions

3.4.4.1 Outfall Boundary Conditions

- Reiterates outfall data as in section 3.4.3 (14 outfalls to IRL, 9 outfalls to St. Sebastian)
- Table 3-3 shows invert elevation at each outfall and water surface level for 10-year, 25-year, and 100-year storm
- Surface water elevations were determined using fixed stage elevations based on FEMA Flood Insurance Study (FIS) for IRC
 - FIS provides still water elevations for 10, 50, 100, and 500-yr recurrence intervals

3.4.5 Hydrologic Parameters – Water cycle or rain

- Hydrologic parameters for the area tributary to the stormwater collection system were developed to define the PCSWMM calculations which convert rainfall into stormwater runoff and infiltration

3.4.5.1 Subcatchment Delineation

- Site topography, inlet locations, site survey, and visual inspections were used to delineate drainage areas throughout the system
- Drainage areas is 7,243 acres split into 1,898 subcatchments
- PUDs were individual subcatchments that are “disconnected areas” from the City system
 - Totaling 1,087 acres
 - See PUD information in section 3.4.3
- There were also 29 disconnected areas subcatchments (ex. FDOT, FEC, IRC jurisdiction)
 - Totaling 734 acres
- Subcatchments Parameters – Area, Average Flow Path Length, Average Subcatchment Slope, Impervious Area, Infiltration Parameters
 - Parameters affect stormwater runoff volume and peak flow
- Site topography based off of FDEM Coastal Program 2007 Light Detection and Ranging (LiDAR) elevation data
- Impervious area in the City was determined by GIS shapefiles and aerial imagery
 - IRC provided building footprint file and it was compared to aeriels, areas of buildings were increased by 25% to account for driveways
 - Impervious roadways were determined from the CoS GIS shapefile
 - Total impervious area of the system was calculated at approximately 20%
- Infiltration parameters are based on physical soil attributes and include the initial moisture deficit of the soil, soil hydraulic conductivity (infiltration rate), and suction head at the wetting front
- Green-Ampt infiltration method was selected for modeling infiltration of rainfall into the pervious surfaces

- See Table 3-4 on page 37 for parameters for each soil type present East of the coastal divide (alongside the IRL)
- West of the coastal divide the high water table and hardpan layer limit potential infiltration
 - East Central Florida Transient Model (ECFTX) groundwater recharge rates are less than 0.005 in/hr
 - The most restrictive soil type documented in the City's Western section was used for infiltration parameters (see Table 3-5 on page 38 for value)
- See Table 3-6 for all Subcatchment parameters

3.4.5.2 Rainfall

- The City's system was evaluated for a 10 year 24 hour storm, 25yr-24hr, and 100yr-24hr storm – standard design events
- NOAA Atlas 14 Precipitation Frequency Data was used to develop design rainfall depths
- Design rainfall depths distributed over the 24-hour duration using the NRCS Type II FL Modified Distribution with a 30 minute interval
 - One of the recommended design storm distributions by SJRWMD
- Table 3-7 on page 39 shows the Design Storm Rainfall Depths and Distributions

3.4.6 H&H Model Validation

- H&H model was validated to historical flooding locations documented by the CoS
 - Focused on roadway areas and their relative flooding depth
- Compared to peak flows from 2004 Master Management Plan by CDM
 - PCSWMM model simulated higher flows than 2004 model
 - Likely due to additional information in PCSWMM model
 - 2004 model of main conveyance had 80 culvert crossings and 204 subcatchments
- Current PCSWMM is a planning level tool that provides a dynamic representation of the stormwater network
- Potential future improvement to the H&H model is the addition of stormwater overflow from the PUD areas into the CoS stormwater network

3.4.7 H&H Model Limitations

- Model is a planning level representation of the CoS stormwater networks and is based on the information available at the time of development
- Focuses on main conveyance network and does not include all pipes and open channels within the model extents
 - For example does not include driveway culverts that are within the stormwater system
- The H&H is a living model and as improvements are made to the system and additional information is collected the model will require updates

3.5 Existing Conditions Design Storm Analysis

- According to the simulated existing conditions H&H model 1073, 1424, and 1738 locations experience flooding for more than two hours for the 10yr-24hr, 25yr-24hr, and 100yr-24hr storm
- Identified pipes and open channels that were at limited capacity during a storm event (see in Tables in Appendix K, or **Figures 3-4 to 3-6 on pages 42-44**)
- The H&H model is a 1D model, showing the location and quantity of flooding, rather than a 2D model which uses contours of elevation to show the overall extent where the water migrates
- Surface flooding is modeled with an assumed surface flooding area of 500sf at each node
- 2D modeling of the system including surface topography will affect the simulated flooding locations and flooding extents compared to the 1D results
- Assumes the drainage through Collier Creek is consistent with the 2012 FEMA Flood Insurance Study and the Hardee Dam is able to discharge into the Collier Creek (waterway in the Collier Club PUD)
 - The stormwater drainage through the Hardee Dam is a critical outfall
 - The loss of drainage and flood control capabilities through Collier Creek (waterway in the Collier Club PUD) would have serious impacts on the flooding frequency and extent within CoS

SECTION 4 - Water Quality Assessment

4.1 Effects of Urban Stormwater Runoff

- Stormwater runoff from urbanized areas often has negative effects on downstream waterways and receiving waters
 - Short term water quality effects – during and after storm events
 - Increases in the concentration of one or more pollutants, toxins, or bacteria levels
 - Long-term water quality effects – cumulative effects associated with repeated stormwater discharges from many sources
 - Physical effects – erosion, scour, deposition, plant and aquatic species changes, other affects associated with increased frequency and volume of runoff that alters aquatic habitat
 - Increases in the concentration of one or more pollutants, toxins, or bacteria

4.1.1 Water Quality Effects

- Water quality effects pertain to changes in water chemistry and can significantly reduce the capacity of a waterbody to support life or maintain its ecosystem
 - Extent of degradation depends on the type(s) and concentrations of pollutants

- Pollutants – solids, oxygen demanding substance, nitrogen and phosphorous, pathogens, petroleum hydrocarbons (oils and greases), metals, and synthetic organics (pesticides, herbicides, etc.) See Table 4-1 on page 46 for contributing sources for each type
- See Table 4-2 page 46 for Typical Pollutant Loadings From Urban Runoff by Land Use

4.1.1.1 Short Term Water Quality Effects

- Short-term effects vary widely, ranging from minor changes in temperature or salinity to complete loss of species or habitat, in the case of a major spill or serious contamination event
- These effects usually only last for few days or weeks following a storm event
- Repeated introduction of pollutants can lead to long-term effects

4.1.1.2 Long-Term Water Quality Effects

- Long-term effects resulting from either large-scale contamination events or repeated introductions of smaller pollutant loads over time
- Depending on the type of pollutant, they may bioaccumulate in aquatic plant and animal species
- Effects can last many years, can seriously impair the health and use of a waterbody, and are difficult to correct

4.1.2 Physical Effects

- Water quality effects are not usually observed by the general public, the physical effects are more visible
- Stream channel and channel bank erosion provide direct evidence of water velocity impacts
- As development continues, urban streams are often forced to accommodate larger volumes of stormwater runoff that recur on a more frequent basis
 - Resulting in overloading, channel instability, channel widening and scour, and larger amounts of sediment and pollutants
 - This section is discussing impacts on natural waterbodies however this has been seen in our ditches after storm events as the system was designed in the 1950s considering 1,200 sf homes, and home sizes and impervious driveway areas have increased
- Visible impacts include eroded and exposed stream banks, channel slope failures, fallen trees, sedimentation, and recognizably turbid or murky conditions
- Public health effects are for the most part related to bacteria and disease-causing organisms carried by urban stormwater runoff into waters used for water supplies, fishing, and recreation
- Debris and litter floating are aesthetic impacts particularly noticeable to the public
 - Stormwater is a major source of floatables
- Nuisance algal conditions including surface scum and odor problems can also be attributed to urban stormwater runoff

4.2 Best Management Practices (BMPs)

- Techniques, approaches, or designs that promote sound use and protection of natural resources to meet program goals and levels of service
- The BMPs discussed in this section are most applicable for the CoS
- Multiple BMPs can be used in sequence to develop a “treatment train”
 - Intended to maximize the use of available site conditions from the point of runoff to discharge to maximize flood control, pollutant load reduction, and wetland benefit

4.2.1 Best Management Practices (BMPs) Considerations

- In this section are Best Management Practices that are currently in use or should be considered for use in the City of Sebastian since the City can receive significant pollutant credit reduction under the CIRL BMAP if implemented

4.2.1.1 Non-structural Source Controls (Regulation or Ordinances)

Non-Structural Source Controls
Land Use Planning
Public Information Programs
Stormwater Management Ordinance Requirements
Fertilizer Application Controls
Pesticide and Herbicide Use Controls
Solid Waste Management
Directly Connected Impervious Area (DCIA) Minimization
Erosion and Sediment Control on Construction Sites

*for more information for each item see sections 4.2.1.1.1 - 4.2.1.1.7 below or pages 48-50

4.2.1.1.1 Land Use Planning

- Use comprehensive planning goals into the development and redevelopment process
- Land development codes to include larger storage volumes or stormwater harvesting
- Greater restrictions may be warranted where development can affect impaired, threatened, or significant water bodies such as IRL

4.2.1.1.2 Public Information Programs

- Informing employees, public, and businesses about the importance of protecting stormwater from improperly used, stored, and disposed pollutants
- Many people do not realize that yard debris or trash thrown into ditches today will worsen tomorrow’s flooding and pollute surface waters
- Municipal employees must be trained, especially in those that work in departments not directly related to stormwater but whose actions affect stormwater
- Residents must be aware of hazardous materials in their home and proper disposal
- A key element is public awareness of the benefits of roadside swales
- Small businesses must be informed of ways to reduce their potential to pollute stormwater (particularly those that may not be regulated by Federal, State, or local regulations)

- The perception by many citizens is that shallow ponding (four to six inches) for one or two days after a storms during the wet season is a problem
 - In reality, this shallow ponding and infiltration is the onsite storage that saves money by reducing pipe sizes and cost-effectively providing water quality treatment

4.2.1.1.3 Fertilizer Application Controls

- Overuse of fertilizers will cause excessive runoff of nutrients to surface waters thereby wasting money for the homeowner and potentially degrading the receiving waterbody
- The City has implanted fertilizer application controls through its Integrated Pest Management (IPM) program as well as fertilizer ordinance
- Further education and enforcement of these items are necessary

4.2.1.1.4 Pesticide and Herbicide use controls

- Part of housekeeping and lawn maintenance
- Overuse of these chemicals can cause excessive runoff to surface waters and entry into the food chain
- The City has implemented pesticide use controls through its Integrated Pest Management (IPM) program

4.2.1.1.5 Solid Waste Management

- Problems can arise from trash and other debris flowing into and obstructing open channels
- It is recommended that the public be informed of the adverse impacts of littering and poor solid waste management
 - Including pet droppings and illegal dumping into storm drains, wooded areas, and ditches

4.2.1.1.6 Directly Connected Impervious Area (DCIA) Minimization

- Minimize directly connected impervious area on a site and promote the use of green buffer zones around paved areas for infiltration
- Roof runoff from structures can be directed to green buffer zones or shallow swales around houses
- Requiring retrofitting of roof drainage systems for all existing and new construction would likely be difficult
 - Changing City building codes to require roof discharge to green areas for all new construction or significant repairs/alterations could be easier to accomplish
- Parking lots and driveways can be graded to landscaped/grassed areas or swale

4.2.1.1.7 Erosion and Sediment Control on Construction Sites

- Erosion and sediment control on construction sites provides protection of receiving waters from sediment loads

- City Ordinance No 54-3-11.2 requires erosion and sediment control on construction sites

4.2.1.2 Structural Stormwater Controls (constructed facilities)

Structural Stormwater Controls
Retention Systems
Dry Detention Systems
Underdrain Systems
Wet Detention Systems
Wetland Systems
Exfiltration Systems
Grassed Swales and Channels
Water Quality Inlets and Baffle Boxes
Skimmer
Dams
Aeration Systems

*for more information about each type sections 4.2.1.2.1 – 4.2.1.2.10 below or pages 50-59

*A section detail of each type of system is shown in the report

4.2.1.2.1 Retention Systems

- Storage area designed to store a defined quantity of runoff allowing it to percolate through permeable soils into the shallow ground water aquifer
- Works best where soils are highly permeable and seasonal high water table is situated well below the soil surface (at least 2 to 3 feet below pond bottom)
- City currently uses several retention systems

Potential Benefits of Retention System	Potential Limitations of a Retention Basin
<ul style="list-style-type: none"> ○ Promotes groundwater recharge close to the point of runoff ○ Can provide offline or on-line treatment for environmentally sensitive waters ○ Reduces peak rate and volume of flood discharge by retaining water onsite ○ Can be used as sediment traps during the construction phase of a project ○ Are reasonably cost effective for construction and maintenance (where soils are favorable) 	<ul style="list-style-type: none"> ○ Require well-drained soils to function properly ○ Unsuitable soils limit drawdown capacity, thereby reducing pollutant load reduction and flood control capacity ○ Soluble pollutants can be conveyed into groundwater ○ Possible nuisances such as odors, mosquitoes, and nuisance vegetation can occur

4.2.1.2.2 Dry Detention Systems

- Designed to store water and slowly release the collected runoff through an outlet structure (to an adjacent surface water)
- Sedimentation is primary pollutant removal process
 - Pollutant removal is not as great as a retention system as only particulate form pollutants are removed
- Due to limited pollutant removal this BMP must only be utilized where no other BMP is technically feasible such as when:
 - High ground water table
 - Small drainage basins (less than 5 acres)
- SJRWMD currently only permits off-line dry detention basins
 - High ground water table
 - Small drainage basins (less than 5 acres)

Potential Benefits of a Dry Detention Pond	Potential Limitations of a Dry Detention Pond
<ul style="list-style-type: none"> ○ Reduction of downstream flooding problems by attenuating the peak flow rate ○ Some removal of pollutant loadings to receiving bodies of water for suspended pollutants ○ Reduction in cost for downstream conveyance facilities ○ Creation of fill that may be used on site or sold (pond sediment removal) ○ Low frequency of failure as compared with filtration systems 	<ul style="list-style-type: none"> ○ Does not remove dissolved pollutants ○ Potential safety hazards if not designed and constructed properly ○ No permanent pool to store sediment flow ○ Occasional nuisance problems such as debris and mosquitoes ○ Regular maintenance is required to prevent nuisance plant species ○ Must be off-line

4.2.1.2.3 Underdrain System

- Dry basin underlain with perforated drainage pipe which collects and conveys stormwater following percolation from the basin through suitable soil
- Generally used where high water table conditions dictate that recovery of the stormwater treatment volume cannot be achieved by natural percolation
- Intended to control both the water table elevation over the entire area of the treatment
- On-site soils overlay the pipes (must have adequate soil permeability)
- SJRWMD Permitting requirements
 - Designed for drawdown within 72 hours following a storm event
 - Should only contain standing water within 72 hours following a storm event
 - Designed with safety factor of at least two unless a demonstrated through documentation a lower safety factor is appropriate

4.2.1.2.4 Wet Detention Systems

- Permanently wet pond designed to slowly release collected stormwater runoff through an outlet structure
- Includes a shallow littoral zone with aquatic plants

- Pollutant removal occurs primarily within the permanent pool during the period of time between storm events
- Sized for two-week hydraulic residence time during the wet season
- Removes pollutants via sedimentation and uptake from rooted aquatic plants
- When designed properly considered a property value amenity
- City has several wet detention systems, but due to land area needed they may not be suitable for future systems as undeveloped land is very limited
 - Report was not taking Graves annexation area into account

Potential Benefits of a Wet Detention System	Potential Limitations of a Wet Detention System
<ul style="list-style-type: none"> ○ Reduction of downstream flooding by attenuating the peak flow rate ○ Reduction in pollutant loadings to receiving waters for dissolved and suspended pollutants ○ Reduction in cost for downstream conveyance facilities ○ Creation of local wildlife habitat ○ More aesthetically pleasing than dry detention/retention systems ○ Low frequency of failure ○ Can be used in areas with high water tables and less permeable soils ○ Pollutant removal can be optimized and pretreatment such as retention swales 	<ul style="list-style-type: none"> ○ Land area needed to meet dimensional requirements ○ Potential safety hazards if not designed and constructed properly (gradual slopes are desired) ○ Occasional nuisance problems such as odors, algae, debris, and mosquitoes ○ Regular maintenance for the littoral zone is required to control nuisance plant species ○ Recurring need for sediment removal from the permanent pool

4.2.1.2.5 Wetland Systems

- Wetlands incorporate either a natural or man-made wetlands areas
 - Used in combination with other best management practices
- Must be an isolated wetland and be connected to other wetlands or surface waters in order to provide stormwater treatment
- Should maximize residence time of the stormwater within the wetland
- The City uses a series of wetlands at the Stormwater Treatment Facility or Stormwater Park

Potential Benefits of a Wetland System	Potential Limitations of a Wetland System
<ul style="list-style-type: none"> ○ Reduction in pollutant loadings to receiving waters for dissolved and suspended pollutants ○ High-quality wildlife habitat ○ Aesthetically pleasing 	<ul style="list-style-type: none"> ○ Higher maintenance effort and cost – control of invasive species, periodic sediment removal, pump systems and control structure maintenance

4.2.1.2.8 Inlet Filters

- Designed to fit under the grate in a storm inlet structure and capture and separate solids (i.e. soil, road grit, grass clippings, etc.) and hydrocarbons

- Helps reduce deposition of solids in conveyance pipes and improve water quality
- One example is Flogard™ for grated catch basins
 - Collected debris is suspended and stored in a dry state above static water level until removed during service
 - Service time takes a few minutes and no vactor truck is required
 - Purchase price for a standard FDOT Type C inlet is approximately \$1,500

Benefits of Inlet Filters	Potential Limitations of Inlet Filters
<ul style="list-style-type: none"> ○ Will not impede inlet water flow ○ Captures debris and sediment ○ Bypass openings prevent cloggings ○ Minimal space requirements ○ Quick service times at an average of 15 minutes or less ○ Can obtain BMAP credits dependent on the amount of debris collected 	<ul style="list-style-type: none"> ○ High initial cost due to number of inlets (approximately 320 in City's SWMS) but can be acquired a few at a time to reduce the capital costs ○ Requires consistent, regular maintenance cleaning. Units should be cleaned approximately every four weeks but maintenance scheduled should be adjusted depending on storm frequency and observed loading rates

4.2.1.2.9 Baffle Boxes

- Typically installed near or at the storm sewer outfall
- Typically consist of a rectangular concrete box divided into three chambers where floatables, sediment, grit, and oil are separated from stormwater runoff as it passes through the chambers before exiting through the outlet
- City currently has eight baffle boxes in its SWMS (located along the IRL)
- Good choice where other options upstream are not possible
- Require a minimum of cleaning the chambers at least twice a year to remove pollutants
 - The City cleans theirs quarterly (four times a year)
- These maintenance operations can be costly

4.2.1.2.10 Aeration Systems

- The canals and ponds within the SWMS are shallow and warm, with very little water movement
- The City has a few surface aerators
- Diffused aeration systems are much more effective at introducing oxygen to water, which increases oxidation reactions and can significantly reduce the concentrations of phosphorous, ammonia, biochemical oxygen demand, chemical oxygen demand, and promotes beneficial bacteria
- Aeration systems are not currently eligible for BMAP nutrient reduction
 - A pilot study using an aeration system in a canal segment might be a potential segway to regulatory acceptance

4.3 State Water Quality Standards

- Established by FDEP

4.3.1 Surface Water Quality Standards

- Class I, II, and III share water quality criteria established to protect fish consumption, recreation and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife
- Indian River Lagoon and St. Sebastian River are classified as Class II surface waters
 - Classified for Shellfish Propagation or Harvesting
 - See Table 4-3 page 60 for all Florida Surface Water Classifications

4.3.2 Nutrient Loadings (Nitrogen and Phosphorous)

- Nitrogen and Phosphorous support the growth of algae and aquatic plants, which provide food and habitat for fish, shellfish and smaller organisms that live in water
- However, when too much nitrogen and phosphorous enter the environment, the air and water can become polluted
- Primary source of nitrogen and phosphorous from human activity include urban and agricultural runoff, wastewater treatment facilities, and septic systems
- More than 90% of residents in the City of Sebastian are equipped with septic systems
 - 10-20% of septic systems fail at some point in time in their operational lifetimes
 - City does not have sufficient wastewater treatment facility capacity or the sewer collection infrastructure necessary for a centralized sanitary sewer system (currently all are through the Indian River County Utilities system)
- Excessive nitrogen and phosphorous in the water causes algae to grow faster than ecosystems can handle
 - Decreases oxygen that fish and other aquatic life need to survive
- Federal regulations related to nutrient pollution are expected to get more stringent
 - Most recently HB 1379 was passed with requirements for enhanced nutrient-reducing systems

4.3.3 Dissolved Oxygen (DO)

- Biochemical Oxygen Demand (BOD) is the amount of dissolved oxygen needed by aerobic biological organisms to break down organic material
- Chemical Oxygen Demand (COD) is the amount of oxygen that can be consumed by reactions in a measured solution
- Nitrogenous Oxygen Demand (NOD) is the amount of dissolved oxygen required for the biological oxidation of nitrogenous material (nitrogen in ammonia, organic nitrogen in wastewater)
- DO concentration in a given waterbody can be influenced by temperature, salinity, flow, water depth, photosynthesis, respiration, sediment oxygen demand (SOD), the oxidation of organic carbon or inorganic reductants, and low DO ground water input
- Low DO concentrations were found in the IRL in the summer months (May to Sept)
- Occasional DO concentrations lower than 5.0mg/L were also observed in other months, but with a much lower frequency

- Florida Surface Water Quality Standards require that DO concentrations for Class II and III marine waters shall not average less than 5.0mg/L in a 24-hr period and shall never be less than 4.0mg/L
 - Normal daily and seasonal fluctuations above these levels shall be maintained

4.4 Total Maximum Daily Load (TMDL) Requirements

- Reiterates information from section 1.4.2.3 and 1.4.2.4
 - FDEP regulates the TMDL-“a scientific determination of the maximum amount of a given pollutant that a surface water can absorb and still meet the water quality standards that protect human life and aquatic life”
 - 5, 10, and 15 year milestones have been created for 35% reduction of TN and TP by 2025, 70% reduction by 2030, 100% reduction by 2035
- Reduction for ENTIRE CIRL section (which goes beyond Sebastian)
 - 5 year – 320,614 lbs/yr of TN, 77,290 lb/yr of TP
 - 10 year – 641,228 lbs/yr of TN, 154,580 lbs/yr of TP
 - 15 year – 916,040 lbs/yr of TN, 220,828 lbs/yr of TP

4.5 Water Quality Model Evaluation

4.5.1 Water Quality Model –SWIL

- Original BMAP nutrient loads were estimated with Pollutant Load Screening Model (PLSM) and represented year 2000 loading in most of the IRL Watershed
- Several MS4 permittees within IRL Watershed expressed interest in creating a new watershed model to improve upon PLSM
 - Spatial Watershed Iterative Loading (SWIL) Model was created
- SWIL model used to determine total TN and TP by project zone
 - Percentage of each stakeholder’s anthropogenic load was determined relative to the total project zone

4.5.2 Water Quality Conclusions/Recommendations

- To date, the overall progress for TN and TP reductions over all four CIRL BMAP project zones relative to the established milestones appears to be on track
- For projects complete through July 31, 2020 in project zone SEB, which includes CoS
 - 23% reduction of TN, 51% reduction of TP
- To date, 16 projects have been completed by the City of Sebastian
 - 5,223 lbs/yr of TN reduction (15.7% of required reduction)
 - 620 lbs/yr of TP reduction (10.3% of required reduction)

- While the City’s performance appears to be lower than the overall progress reported for the zone, it should be noted that the City has not yet received reduction credits for seven completed projects, including the Stormwater Park (that single project may account for a significant part of the City’s required reduction goals)
- FDEP conducts an annual review of BMAP implementation efforts, and during that review project-specific information may be revised and updated
- The City is currently updating their information for BMAP projects in order to align the credit reduction with all projects that have been completed
 - Municipalities may only update BMAP information between November and January each year
 - This includes compiling all as-built drawings and documents of previous projects
- The City of Sebastian appears to be meeting the allowable loads for TN and TP, however, as additional development occurs, additional projects will be needed to ensure ongoing compliance
- Some possible projects that could be considered for the BMAP include the following:
 - Additional dry detention areas
 - Dredging of sediment from existing retention/detention ponds
 - Reduction of canal water surface elevation to reduce peak discharge
 - Blossom Ditch Drainage Improvements (CIP Project 24) – addition of a Baffle Box to the existing outfall to improve water quality

SECTION 5 – SEAL LEVEL RISE ASSESSMENT

- Global mean sea level (GMSL) rise results from a combination of warming ocean waters and the addition of water mass (i.e. glacial melt) into the ocean
- At local and regional level measured by tide gauges

5.1 State Climate Change Efforts

- State of Florida adopted the Renewable Energy Technologies and Energy Efficiency Act in 2006
 - Created Florida Energy Commission – create recommended steps and a schedule for development of a state climate action plan
- Florida focused on disaster planning and recovery
- Florida Fish and Wildlife Conservation Commission – data collection and monitoring
- Department of Economic Opportunity – provide technical assistance for local governments for compliance with 2015 “Peril of Flood” legislation
- FDEP – focused on coral reefs and climate change impacts
- 2011 Legislation changes – HB 7207 – allowed for a more discretionary function rather than prescriptive one for local governments
- 2020 Senate Bill 178 – acknowledged seal level rise – requires sea-level impact project (SLIP) study to be done for all governmental structures built in the coastal building zone using state funds

- Must undergo an assessment of potential damage over the next 50 years from higher seas, flooding, storm surges and wave action

5.2 Available Reports and Sea Level Rise (SLR) Projections

- Report published February 2022 by National Ocean Service of the NOAA
 - Update from 2017 report
- Primary report findings:
 - Increased confidence, includes narrower range for sea level rise at 2050 than previously reported
 - Expects U.S. coastline to rise on average 0.25-0.3 meters between 2020 and 2050 as it has over the last 100 years (1920-2000)
 - By 2050 expected relative sea level (RSL) will cause tide and storm surge heights to increase

Type of High Tide Flooding Event	Average Frequency 2020	Predicted Frequency 2050
Minor/disruptive	3 events per year	Less than 10 events per year
Moderate/typically damaging	0.3 events/year	~ 4 events/year
Major/Often destruction	0.04 events/year	0.2 events/year

- Increase in the sea level rise will not result in noticeable changes to the normal standing water elevations adjacent to existing roads and buildings
- Changes during large and peak storm frequency will be more noticeable
 - As sea level rise increases at the outlet end of a drainage system, stormwater flow rates through the drainage system will be reduced, which will result in elevated flooding over longer durations
- FEMA Flood Insurance Study (FIS) water surface elevations were used for the 10, 25, and 100-year storm analysis of the City of Sebastian model
 - 10-year stormwater surface elevation is higher than the projected 2050 sea level
 - Therefore the CoS stormwater model is a conservative analysis
- King Tide elevation – two highest sea level elevations recorded each year

5.3 Expected Effects

- Based on the data available, the estimated increase in mean sea levels alone through 2050 are not expected to have a significant effect on the performance of the City’s SWMS
- However in the unlikely event that a storm event were to occur during the peak of a maximum estimated king tide similar to Hurricane Nicole in November 2022, the resulting tailwater elevation may temporarily reduce or stop flow from some City outfalls resulting in localized flooding conditions upstream
- Other effects of sea level rise to the City may include the following:
 - Increases shoreline erosion
 - Habitat damage/destruction
 - Habitat loss/migration
 - Changes to plant and animal communities
- The following mitigation policies should be considered:

- Shoreline protection
- Outfall modifications – Stonecrop weir and other outfalls may need to be modified to maintain maximum allowable discharge flows with increased tailwater conditions (while balancing reducing quantity and improving its quality)
- Publications that can currently give the City and residents information:
 - City of Sebastian 2022 Stormwater Master Plan
 - City of Sebastian 2040 Comprehensive Plan
 - City of Sebastian Coastal Resiliency Plan
 - The City is currently completing an update to this plan with FDEP grant funding
- It is recommended that the City begins planning and having open discussions with residents and businesses so policies and ordinances can be thoroughly considered by all stakeholders

SECTION 6 – OPERATIONS AND MAINTENANCE

6.1 O&M Program Requirements

- Any operation and maintenance (O&M) program for any purpose needs to be well defined, given proper management authority, and be properly funded to provide sufficient staffing and equipment
- The City’s system relies heavily on open channels which require significant O&M to ensure proper functionality
 - Open channels are affected by sedimentation, erosion, and vegetation
- Currently, the City requires residents to mow and maintain the grades of roadside swales, swales in drainage easements, and stabilize the banks of waterways (i.e. bulkheads) on their property
- The O&M plan needs to include the following activities make the system function properly and operate at peak performance and efficiency:
 - Mowing of detention/retention ponds, swales, and ditches
 - Regular visual inspection of ponds, swales, and ditches
 - Coordination of the mowing and maintenance of right-of-way swales (front yard swales) and associated driveway culverts
 - Removal of sediment and debris from inlets, conveyance pipes, culverts, outfall structures, Nutrient Separating Baffle Boxes, and other drainage structures
 - Removal of sediment and aquatic weed control in retention/detention ponds
 - Removal of sediment and regrading side yard and back yard ditches
 - Effecting minor repairs
 - Coordination of canal side slope maintenance, aquatic weed control and periodic removal of sediment
 - Coordination with SJRWMD for maintenance of drainage paths outside City boundaries

- Stormwater management facilities including conveyance and attenuation provide the means of removing stormwater from streets, parking areas, public parks, public and private areas
- Address environmental water quality controls, erosion abatement, and drainage
- Integral to public safety
- When developing a budget for O&M the costs associated with renewal and replacement (R&R) of failing infrastructure should also be considered

6.2 Relevant City Ordinances and Codes

Code of Ordinances – Article V- Ordinance No. O-0-16

- Established the Stormwater Utility (SU) which has the powers necessary for the exercise of its responsibility for the drainage of all properties within the City
 - Includes preparation for improvements
 - Construction of improvements
 - Regulations for the stormwater system
 - Review and approval of all new development and related stormwater management
 - Performance of routine maintenance
 - Establishment of charges for connection and use of the SWMS
 - Evaluation of water quality concerns
 - Performance of all normal functions to include construction, operation, and maintenance (hiring of staff, consultants, entering contracts, handling purchases, lease, sale or other rights to property)
 - Issuance of revenue bonds and other debt instruments
 - Imposition of a stormwater fee – for one Equivalent Residential Unit (ERU) is \$10 per month
 - Establishing procedures for the collection of SU fees
 - Establishing a Sebastian Stormwater Utility Fund for the deposit of all fees collected (shall be used exclusively for funding the stormwater management)
 - The City Manager may promote reasonable regulations concerning operation of the SU (subject to modification or nullification by resolution by City Council)

Code of Ordinances – Section 54-2-7.15(d)

- Establish that the property owner is responsible for the maintenance of all drainage features on a property, including front yard swales, driveway culverts, side yard swales, and back yard ditches to maintain the proper flow of surface water (from paragraph 2 and 3 of the code)

Code of Ordinances – Article VI- Urban Stormwater Quality Management and Discharge Control

- Ordinance No. O-13-11 established Article VI, which is intended to ensure the health, safety, and general welfare of citizens, and protect and enhance the water quality pursuant to Federal Clean Water Act by reducing pollutants in stormwater discharges to the maximum extent practical and by prohibiting non-stormwater discharges to a storm drain system
- Section 102-145 – Watercourse protection, which makes owners of properties along the banks of watercourses responsible for maintaining existing privately owned structures within or adjacent to a watercourse and maintaining and stabilizing that portion of watercourse that is within their property lines in order to protect against erosion and degradation

Code of Ordinances – Article XII- Surface Water Management

- Article XII (Code Section 54-3-12) – gives the Stormwater Department review and approval authority over development permits (standards for surface water management and flood protection)

6.3 Existing Operations and Maintenance Program

6.3.1 Stormwater Management Organization

- The City has placed the responsibility for the management of the SU with the Stormwater Department
- Funding for the Stormwater Department administration, O&M and capital projects is generated primarily from the Stormwater Utility fee revenues, with additional revenues from the Discretionary Sales Tax and other sources

6.3.2 Current Resources

- Staff of ten (see Table 6-1 on page 74)
 - There is currently a staff of twelve
- Maintains a fleet of 24 vehicles and heavy equipment (see Table 6-2, page 74, for summary of vehicles including age and expected life in years)
 - Many times multiple types of equipment are required at each work site

6.3.3. Operational Responsibilities and Maintenance Activities

- Stormwater Department operates through a combination of direct maintenance by staff, coordination with other City Departments, and City contractors, and coordination with SJRWMD
- The stormwater system is divided into six management zones (see Figure 6-1, page 75)
- Due to limitations of funding and resources, the management of the SWMS is generally reactive, with inspections and maintenance performed on an as-needed basis or when responding to Citizen Requests (CR)
- Current Operational Responsibilities and Maintenance Activities are outlined in Table 6-3, page 78. This includes maintenance frequency

6.3.4 Problem Areas

- Physical Challenges – Topography, Geology, and Groundwater as discussed in previous sections
- Environmental Challenges – Climate change, St. Sebastian River Watershed drainage patterns and offsite pollutant loading, Water Quality issues (low DO, High BOD/COD concentrations, aquatic weed growth, septic system dependence
- Regulatory Challenges – TMDL load reductions, NPDES MS4 permit documentation, Development standards/permit reviews, No legal over offsite discharge areas – dependent on SJRWMD, Issues related to codes and operations
- Engineering and Construction Deficiencies –
 - Design Deficiencies – roadside swales in residential area apparently designed for 1-year, 3-hour storm event
 - Current Drainage Issues – localized flooding as discussed in Section 3.7, Undersized culverts in drainage paths, Negatively sloped pipes, Apparent incorrect culvert and control structure installations
- Funding Issues
 - SW Department revenue – staffing and equipment needs
 - Capital Projects – several capital projects identified during previous master planning efforts have not been completed by the City, apparently due to funding limitations
- Maintenance Issues
 - Front Yard Swales and Driveway Culverts – The City does not currently conduct routine inspections of the front yard swales and driveway culverts, only performing them after a Citizen Request (CR) is filed. If found deficient, the City goes through Code Enforcement procedures to address the deficiency with the property owner. If not corrected the City can impose punitive fines until the deficiency is corrected. The current method of management consumes personnel time from several City departments and has not resulted in consistent or timely restoration of the drainage components. The City
 - Side Yard Swales and Back Yard Ditches – regrading needs, raised foundation pad, septic fields, etc.
 - Inlet and Pipe Systems – cleaning frequencies, efforts, etc.
 - Culverts – inspection and cleaning frequencies
 - Canals
 - Capacity – water elevations, dredging needs
 - Maintenance of canal banks – ownership/responsibility for existing bulkheads

6.3.5 O& M Plan Development

- An operations model was developed to estimate the labor, equipment, and materials needed to operate and maintain the City’s SWMS based on the proposed maintenance activities

6.4 Proposed Operation and Maintenance Plan

6.4.1 Purpose and Goals

- Many important goals of the stormwater system including the following:
 - Maintain compliance with all applicable Federal, State, and local permits and regulations
 - Meet all applicable policy goals in the City’s Comprehensive Plan
 - Make the stormwater system more resilient and improve performance during larger storm events
 - Improve drainage and reduce recovery times
 - Improve the quality of discharged water
 - Maintain stormwater fees as low as possible and reduce economic burdens on the City’s residents
 - Adjust City codes to complement and support stormwater management goals
 - Improve public education and outreach programs related to stormwater management
- Note the system receives approximately 58 inches of rain per year and occasional intense storm events
- The Stormwater system is further complicated by the fact that a significant portion of the City’s roadside swales, critical components of the SWMS conveyance system, are maintained by individual residents
- Operations and Maintenance Plan defines tasks, processes, equipment, staffing, budgets, and Standard Operating Procedures (SOPs) that can be used by staff
- As the City is looking to move into an asset management program for work order management and record keeping, this plan established forms to be used in the field as well as in the office
- This O&M Plan is not part of the City’s NPDES MS4 permit requirements and is only a recommendation. Deviations will not constitute a violation of the City’s permit

6.4.2 Stormwater Management Organization

6.4.2.1 Organizational Structure

- The management and funding structure for the SWMS appears very well planned, efficiently organized and with the necessary authority to meet the operational and maintenance challenges
- This plan does not propose any changes to the SU or Stormwater Department organizational structure
- Funding is a significant issue (see Section 8)

6.4.2.2 Operational Responsibilities

- No proposed changes to the operational responsibilities of the City with respect to SWMS
- Note Section 8 funding analysis assumes that activities currently completed by other City Departments will continue to do so

- If SW Department were to assume all stormwater maintenance activities, the funding analysis would need to be revised accordingly

6.4.3 Asset Management

6.4.3.1 Scope of Maintenance Asset Management

- During the development of the GIS map, more than 8,500 SWMS assets were identified, located, and applicable data (i.e. asset type, material, dimensions, invert elevations) were compiled
- Database will play a role in determining life-cycle performance of each asset
- Due to funding and staffing limitations many inspection and maintenance tasks are scheduled and performed on an as-needed basis, and documentation retrieval processes need improvement
- Due to the sheer number of assets a Computerized Maintenance Management System (CMMS) is needed to establish a system of regularly scheduled inspections and maintenance
- At the time of the report the City was looking into software options
 - As an interim measure, an MS-Excel based CMMS system was developed

6.4.3.1 Computerized Maintenance Management System (CMMS) Protocols

- All inspection and maintenance tasks performed will be recorded within the CMMS
- At beginning of each workday staff will generate reports from CMMS for inspection and maintenance crews
- Report will show scheduled activities, and cross reference Standard Operating Procedure forms
- Completion of SOP forms should happen onsite during or immediately following inspection or maintenance work
- At end of the day forms will be turned in, and data will be placed in CMMS system
- Non-completed work will be carried out to the next day
- Discrepancies between work completed and work scheduled should be communicated with the City Engineer so that scheduling delays do not compound
- Currently the City assigns work daily and requires completed work order forms, but this new system will keep all historical information for each asset together to show the full life-cycle. Previously work orders were sorted according to work type, now they will be sorted by the asset (and can still be sorted via other details as well)

6.4.4 Standard Inspection and Maintenance Protocols

6.4.4.1 Overview of Inspection and Maintenance Protocols

- Protocols were created for the most common occurring tasks (see SOPs in Appendix H)
 - This took existing verbal and/or written direction and compiled them into one location to help in the case of training consistency and personnel turnover

6.4.4.2 List of BMP Asset Categories and Technologies

- See Table 6-4, page 85, describing asset categories and a brief description of their maintenance
 - Includes Non-Structural BMPS, Structural BMPs, Canals, Ponds, Ditches and Swales, and Dry Retention

6.4.4.3 Inspection Protocols for SMWS Assets

- See Table 6-5, page 86, describing the different types of inspections including:
 - Routine Inspection, Post Storm (Supplemental) Inspection, Compliance Evaluation Inspection, State Regulatory Agency Inspection

6.4.4.4 Inspection Frequencies and Protocols

BMPs within Public ROW or Drainage Easements

- Subjected to significant stormwater loading, resulting in the need of continual inspection and maintenance
- City considers the front yard swales and driveway culverts privately owned and do not currently conduct regular inspections
- It is recommended that the City implement a minimum visual inspection program for them
 - Recommended twice per year, May before rainy season and in November after it ends
 - Additional inspections would also be made upon a resident complaint

Private BMPs

- Those not in public right-of-way generally experience less disturbance
- City only inspects privately-owned BMPs if there is a permit enforcement issue
- It is recommended that the City establish a program for certification of all privately owned systems and the program would include:
 - A certification fee – additional revenue for SW Dept
 - An annual inspection report by a Florida-licensed professional engineer and accompanying digital time-stamped photographs
 - A certification form, signed and sealed by Florida-licensed professional engineer documenting that the system is properly maintained and operated as designed and permitted
 - The City has a certification program in its existing Stormwater Fee Credit program for private systems exceeding SJRWMD standards, which could easily be incorporated

Post-Storm Inspections – recommended to be done after a storm greater or equal to one inch of precipitation

Other Inspections – Site compliance and State Regulatory Agency inspections are performed as needed

Routine Maintenance Activities for SWMS Assets

- See Table 6-3, pgs 76-79, for SWMS maintenance activities currently carried out
 - Current frequency of activities was compared with industry standards
- The City's Stormwater Department is conducting most of the maintenance activities needed for the SWMS and appears to be doing a good job with the resources they have available
- Unfortunately, the City's SWMS is very challenging to operate and maintain, and the funding, staffing, and equipment resources will have to increase from current levels in order to properly maintain the system, document maintenance activities, and shift from a reactive to proactive style of management
- Table 6-6 pages 89-94 represents the minimum recommended maintenance activities that should be performed
 - Comparing with Table 6-3, pages 76-79, showing Existing Maintenance activities, staff found the following differences
 - Activity 1 – Increased clerical support recommended
 - Activity 2 – Routine drive by visual inspection of roadside swales 2x per year
 - Activity 4 – Recommend removing the Quarter Round systems during future activities to reduce maintenance costs
 - Activity 6 and 7 – Tracking the work orders of the last year more than these estimates can be cleaned (this number was taken from existing work order documentation available at the time)
 - Activity 6 - Recommend increasing the frequency of service from as needed to annually
 - Activity 7 – Add annual visual inspection of road crossings (previously in response to Citizen Request)
 - Activity 8 – Ensure all road crossings are cleaned every 5 years
 - Activity 12 – Recommends changing side yard ditch regrading to a 10-yr basis (Currently every 2 years for ROWs and 5 years for easement ditches – See notes below)
 - Activity 14 – Move back yard ditch regrading to a 10-yr basis
 - Currently Right-of-Way ditches are completed every 2 years
 - Easement ditches (which are technically to be homeowner maintained) are completed every 5 years currently
 - Staff does not agree with reducing the frequency to 10-years, but has been told it is the standard timeframe
 - When considering funding and time resources Staff wants to remind homeowners that the mowing of easement ditches and regrading of easement ditches is not their responsibility per the current City of Sebastian Code
 - Activity 19 – Alter the manual pumps turned on as needed at Stormwater park to automatic pumps. Currently within this year's

capital improvements budget. Also mentions adding a smaller continuous pump to allow small amounts of constant water movement

- Activity 23 – Changed inspection and maintenance of Dams and weirs from as needed to Semiannual
- Activity 26 – Offsite drainage areas inspections – currently not undertaken by the City unless requested or necessary, changed to semiannual in coordination with SJRWMD
- Activity 32 – Added Annual inspection of private stormwater systems with the placement of a new certification program (currently they City reminds private subdivisions to inspect and clean their systems prior to hurricane season every July)

6.4.4.5 Non-Routine and Corrective Maintenance Protocols for SWMS Assets

- Inspectors and maintenance crews should remain vigilant in diagnosing maintenance deficiencies and must make a judgement call to determine the proper course of action
- If unsure, contact the City Engineer

6.4.4.5.1 Non-Routine Tasks

- Tasks that are not outlined in Table 6-6's Routine Activities
- Sufficient lead time should be provided to allow for proper preparation and procurement of materials

6.4.4.5.2 Corrective Maintenance Actions

- Once issues identified, they will be elevated to the City Engineer who will decide how to address the issue
- Less intensive corrective issues may require coordination between crews
- More involved corrective maintenance may need to be added to the Capital Improvement Program
 - Project scope, schedule, and estimate to be determined by City Engineer
 - An example would be major regrading work

Prioritizing Corrective Maintenance

- Project priority should be discussed and decided upon by the City Engineer
- In certain more complex emergency situations, temporary resolutions should be presented as a stop gap measure
- A weighted priority ranking system was proposed to weigh the importance of a proposed corrective maintenance action
 - Criteria includes: Public Safety, Area Affected, Correction Scope, Correction Cost, and Correction Schedule
 - According to the ranking score the time when the corrective measure should take place can be determined

- Immediate repair, As soon as possible before next rain event, Before the next rainfall event, or during routine inspection are the different timelines

6.4.4.6 Recommended Maintenance Frequency Based on Service Level

- Recommended maintenance to encourage proper functioning of SWMS system and available funding
- The plan provides an adaptive approach to maintenance frequency, focusing expenditures on components that have the largest performance effects on the system
- The inspection and maintenance frequencies presented should be regularly reviewed and changed to fit the current system priorities and funding levels (see Table 6-6 for tasks)

6.4.4.7 Preventative Functional Maintenance

- Employees are expected to not only determine what issues are currently affecting a SWMS component, but also to look for and report signs of future issues
- Identifying issues early, the City Engineer can plan and execute preventative maintenance

6.4.4.8 Aesthetic Maintenance

- City of Sebastian is a tourist destination, and as such proper aesthetic maintenance of SWMS components is one of the primary goals of the O&M Plan
- Proper maintenance assists in positive perception of SWMS and City as a whole
- Priority for addressing aesthetic issues must be carefully considered due to Stormwater Department staff availability and funding limitations

6.4.5 O&M Forms, Logs, and Reporting

6.4.5.1 Requirements for Tracking and Reporting Inspections and Maintenance

- The City is required to provide a semiannual report for the preceding six-month period to FDEP on January 30th and July 30th of each year
 - Report is required to include the status of any construction or compliance measures, status of permit applications, O&M information
 - The status of corrective maintenance projects will be provided in each report (need for corrective action, corrective maintenance proposed, and corrective action taken)

6.4.5.2 Overview of Inspection and Maintenance Reporting, Data Management, and Forms

Maintenance Reporting and Data Management

- Reiterates information about the new interim CMMS system for daily work orders and tracking of activities

Inspection and Maintenance SOP Forms

- Reiterates about Standard Operating Procedures forms that were created

6.4.5.3 Notifications

- City Engineer or staff will provide the Stormwater Superintendent with the Work Order Report and SOPs, which is then provided to the crew it is assigned to
- Completed forms to be turned in daily to City Engineer for input into CMMS system

6.4.5.4 Coordination with Other Agencies

- Coordination with agencies such as FDEP, SJRWMD, and others is critical to the success of the O&M plan
- The City can champion this stewardship by remaining responsive to requests set by other agencies and community members and through the implementation of a proactive O&M program

6.4.5.5 Reporting Safety Hazards

- If a safety issue related to the SWMS asset is observed by an inspector or crew, it should be reported immediately to the City Engineer
- Reporting person should remain on site while the issue is resolved so long as there is no immediate danger
- City Engineer should create emergency inspection or maintenance work order or take other measures as appropriate

6.4.5.6 Completion of Standard Inspection and Maintenance Form

- SOP forms should be turned in, updated in the CMMS system, and should be kept on file for a minimum of three year in accordance with USEPA recordkeeping

6.4.6 O&M Schedules

6.4.6.1 Scheduling Routine Inspection and Maintenance

- Keeping a well-organized schedule will allow the City to assure their SWMS assets are frequently and crew members maintain a consistent workload

6.4.6.2 Recurring Schedule

- All routine inspection and maintenance tasks
- Assets will be visited in the same order over a set time interval
- CMMS system allows for up to four recurring maintenance activities to be scheduled for each asset

6.4.6.3 Adjustments to Recurring Schedule and Adaptive Management

- Frequency of routine visits can be changed based on operational experience, staff or funding limitations, or other reasons
- Adjustments cannot result in a recurrence interval that is below required minimum interval for the asset type

6.4.6.4 Scheduling Inspection-Driven Maintenance

- Inspection-driven maintenance can occasionally be incorporated into a previously scheduled routine event without disrupting the remaining schedule

- If additional work is required after inspection the City Engineer can schedule it

6.4.6.5 Weather and Other Conflicts

- If weather conditions do not allow for work, the recurring schedule will need to be shifted

6.4.6.6 Unscheduled Maintenance

- **Emergency maintenance**
 - Typically due to safety issues
 - Causes need for recurring schedule to adjust
- **Corrective maintenance**
 - Often not as high priority as emergencies and can occur at the end of the month between schedules
 - City can accrue a backlog of open work orders which can be performed during the dry season, or when workload permits

6.4.6.7 Inspection Follow-up Protocols

- Any additional maintenance for an asset not on its typical schedule can be added as a note on the asset record
- It is crucial that CMMS administration and inspection/maintenance personnel are in communication with each other consistently

6.4.6.8 Documenting and Reporting Problems

- Reiterates importance of safety issues and noting problems of seen in the field
- Keeps a consistent log for each asset that carries with it to the next time of service

6.4.6.9 Initiating Corrective Maintenance

- Maintenance initiated by work orders
- City Engineer and Stormwater Superintendent should discuss the request and plan

6.4.6.10 Adding New Assets to the Schedule

- The City will need to add new assets into the CMMS database as it grows
 - Will prompt maintenance and work order reports according to asset type

6.4.6.11 Scheduling Capital Replacements

- Capital Improvement Program projects will be designed by the City Engineer based on the end of an assets design life
 - A long-term asset replacement plan will minimize system downtime

6.4.7 Personnel, Equipment and Budget Needs

6.4.7.1 O&M Cost Model

- An MS Excel spreadsheet model was developed to estimate the total annual cost of each activity required to maintain the City's SWMS
 - Considers labor, equipment, fuel, materials, and staffing necessary for each activity

6.4.7.2 Personnel and Equipment Requirements

- Based on the calculations 36,778 work hours are needed to adequately maintain the SWMS in its current condition (considering task in Table 6-6)
- Table 6-7, page 102 shows a breakdown of staff required
 - Calls for an additional 3 Maintenance Worker (MW) IIIs, 4 MWIIs, 3 MWIs for a **total of 10 new staff members**
 - Note this calculation is considering the reduced frequency of side yard and back yard ditch regrading to every 10 years, considering more frequent maintenance would increase additional staff members required even further
 - Note this table showed the hired staffing at the time of the creation of the report
 - Inspector was considered 0.25 as much of their time is also related to Building Department items
 - At that point in time the City had budgeted for 14 employees but had only 10.5 full time employees
 - Applications increased after the hiring bonus program
- Table 6-8, page 103 shows Equipment usage summary

6.4.7.3 Budget Requirements

- Estimated cost for the first full year of maintenance activities following the schedule in Table 6-6 is estimated to cost \$2.2 million with total Department budget at \$2.97 million
 - See Table 6-9, page 104-105 for breakdown of cost of each maintenance task including labor hours in the year, cost, and number of new employees it would require

SECTION 7 – ALTERNATIVES DEVELOPMENT AND CIP PRIORITIZATION

7.1 Previously Identified CIP Projects

- Table 7-1, pages 106-108, shows the Previously identified Capital Improvement Projects
 - Notes include information about status

7.2 Current and Proposed CIP Projects

- The current CIP projects were identified through the modeling work, included prior SWMP projects, and tasks carried over by staff
 - The H&H model was used to find projects that would reduce flooding from the 25yr-24hr design storm event

- CIP projects were evaluated based on surface flooding reduction, open channel flooding reduction, and cost effectiveness
- See Table 7-2, pages 108-113, for the Current and Proposed CIP Projects (for more detailed breakdown of costs see Appendix I)
 - The first section of Appendix I shows a breakdown for each Fiscal Year from 2023 to 2032. See top right of page for Fiscal Year. All 28 projects are always shown, but on the right hand side it shows the items for that Fiscal Year with the breakdown of what comes from DST funding and what would require grant funding. The breakdown was based on approximately \$1 million dollars in Discretionary Sales Tax funding each year.
 - The second part of Appendix I shows breakdowns of costs for each additional project. The location map is helpful for understanding where the project falls within the City's system
- The total estimated cost of all proposed CIP projects is \$197,686,732
 - Note in Appendix I the CIP list is slightly updated with cost of \$198,236,732
 - Changes were project 3 – Roadway Swale Work dollar value decreased
 - Dollar value has since updated with FY24 budget
 - Project 28 added – for Canal dredging of sediment removal only
 - This was requested by staff since Projects 4-10 were not scheduled between 2023 and 2032

7.2.1 Cost Estimate Criteria

- A detailed project cost estimate was prepared for all CIP projects and is included in Appendix I

7.3 CIP Prioritization Process/Tool

- Upon identifying a CIP need, the project priority should be determined by the City Engineer
- For the purpose of this report, and as a tool for the CoS to use, a CIP priority scoring calculation was outlined
 - Weighted importance for: Economic, Social, and Environmental criteria
- See an example project scorecard in Figure 7-2, page 115
- See Figure 7-3, page 116, for how all of the CIP project scores compared
- See Figure 7-4, page 117 for Criticality vs. Effectiveness of CIP Prioritization Scoring

7.4 Recommended and Prioritized Improvements

- Projects with high costs and low priority scores were shown in the 10-year CIP plan as “Future”
- CIP planning emphasis was directed towards lower cost, higher priority projects
- See Appendix I for project detail sheets
 - Canal work project 4-10 was not scheduled in CIP and considered “Future” since grant funding is not possible to use to replace privately owned seawalls. In order to take on those projects as described, the City would have to take on ownership

and maintenance of the seawalls in perpetuity. This additional ownership and maintenance was not considered in the creation of this Stormwater Master Plan. At the end of this Master Plan creation staff discussed with Arcadis the possibility of using grant funding to remove and/or bury in some cases existing seawalls and regrade the canals for a gradually sloped earthen embankment. This would allow the option of grant funding opportunities. A feasibility study and conceptual design would be necessary to determine if this is an option the City can move forward with

SECTION 8 – FUNDING PLAN AND GRANT MANAGEMENT PLAN

8.1 City Stormwater Department Revenue Sufficiency Analysis

8.1.1 Overview

- Arcadis prepared a Revenue Sufficiency Analysis and forecast for the City of Sebastian’s Stormwater Department from FY2022-2031
- Fiscal year October 1st-September 30th

8.1.2 General Methodology

- The Revenue Sufficiency Analysis provides a forecast of the total system rate revenue needs
 - It does not include a determination of the actual rates and charges
- Identifies revenue requirements of the system (operating expenses, capital expenses) and compares them with the total source of funds during each year
- Overall goal of the Revenue Sufficiency Analysis is to determine the revenue necessary over the forecast period to:
 - Meet the operating and capital revenue requirements, including CIP
 - Build up a working capital reserve level of 4-months of operating expenses

8.1.3 Data Used in the Analysis

8.1.3.1 Data Items

- The following documents were reviewed, discussed with the Department, and incorporated into the Revenue Sufficiency Analysis
 - Financial management goals of SW Utility
 - FY2022 Budget book including fund balance, sources of funds, and use of funds
 - Capital Improvement Plan
 - Arcadis’ O&M modeling tool
 - General assumptions relates to customer growth and cost escalation factors

8.1.3.2 Working Capital Reserves and Balances

- Reviewed funds available at the end of FY2021

8.1.3.3 Sources of Funds from FY2022-2023 Draft Stormwater Budget

- The City provided the FY2022-2023 Draft Stormwater Budget
- Projected revenues for FY2023-2031 were developed based of 2022 revenues

8.1.3.4 Use of Funds from FY2022-2023 Proposes Stormwater Budget

- Reviewed line-item expense detail in the FY2023 Proposed Budget
- Line-item projected expenses for FY2024 through FY2031 were developed using cost escalation factors

8.1.3.5 Capital Improvement Plan (CIP)

- The Stormwater Department provided the annual funding for the FY2022-FY2031 CIP Plan
- The financial forecast considers the amount of actual costs projected to be expended in each year (whether paid for with cash or debt)

8.1.3.6 Arcadis O&M Model

- Arcadis developed an MS-Excel O&M model that calculates the full labor and equipment cost per hour and applies those cost to each activity based on labor crew size and equipment used
- Cost for activities performed by City contractors was also included in the total cost

New Full Time Employee (FTE) Positions and Associated Benefits

- The O&M model estimates the need for twenty FTEs versus the fourteen that were budgeted at the time
- To incorporate the six new FTEs, Arcadis assumed an additional two FTEs per year for three years starting in FY2024
 - Expected to add \$179,988 in salaries by FY2026
 - Expected cost of benefits \$110,310 by FY2026

Other Contractual Services

- Mentions and increase in the ~~Contract Mowing Services~~, which should be an increase in the Lake and Pond Weed Services contract
 - Need for additional pond cleaning and SW pump maintenance
 - Assumes \$87,000 increase in FY2024 with total increase of \$111,681 by FY2031
 - Note contract was extended an additional year without price increases, however, this service is on an as-needed basis and total yearly cost is very dependent on weather conditions
 - Future contracts may have different rates
- Mentions a 10% increase in costs at the start of a City contract

- This is considering the increase in prices the City has seen when re-bidding items that were previously contracted with the City
- Considers an additional 3% increase in the final year of the contract
 - Clause allowing inflation/CPI adjustments to a contract with justification and Council approval

Contracted Mowing Services

- Assumes the Contract Mowing Services will cost \$853,000 in FY2024
 - This is a result of optional mowing services that the City may request
 - An increase of \$231,158 from what was budgeted FY2023
 - Cost was \$548,500 in FY2023 and contract expires January 2023 with an option for extension
 - The City has been following the contract with typically four ditch cuts per year, but we have been seeing vegetation grow back at a much quicker rate. We have discussed options to increase cutting frequency to optimize ditch capacity, but have only begun this consideration. An increase would not be warranted for aesthetic reasons alone
- Reiterates 10% increase at start of contract
 - This is considering the increase in prices the City has seen when re-bidding items that were previously contracted with the City
 - Since typical mowing contract are 3 years in length it equates to a 3.33% increase per year from the initial time of bid
- Reiterates about possible 3% increase in the final year of the contract
 - Clause allowing inflation/CPI adjustments to a contract with justification and Council approval

Operating Equipment

- O&M model assumes and increase in need of operating equipment due to increased maintenance frequencies for some activities
 - Expected total increase of \$224,502 by FY2026

Sod/Cement/Culvert Pipes

- Cost reduction of \$52,267 per year starting in FY2024 due to reductions in material usage projected – based on discussion with City staff
 - This discussion with staff occurred when 2020 and 2021 culvert repairs were estimated off of numbers from the 2019 paving program section
 - With each area an individual inspection is completed. Staff no longer stands by this call for a reduction as we have already found

the counts in the 2020 zone to be higher than estimates based off of the 2019 zone

8.1.3.7 General Assumptions

Growth – Considered 1.5% growth per City’s Comprehensive Plan and currently used growth factors

- This does not consider Graves annexation area. At the time of SWMP development, growth was projected many years in the future

Cost Escalation Factors

- General Inflation 3.11% using a 5-year average of CPI-U Index
- Labor and Benefits – 3.00% (all personnel related costs)
- Utilities – 5.00% (water/sewer, electric, trash pickup/hauling)

CIP

- All capital projects and capital outlay (vehicles, equipment) consider full funding from DST Fund
- No capital is funded from operating revenues or fund balance/cash reserves

8.1.4 Financial Management and Goals of the Stormwater Utility

8.1.4.1 Minimum Working Capital Reserves in the Operating Fund

- Working capital target – 3 to 12 months of operating expense
 - Liquidity is one of several important factors
- Utilities that keep too much cash on hand, while borrowing at the same time, can be viewed as building excessive cash reserves and paying interest expense in lieu of spending existing cash
- Buildup of cash reserves beyond 3 to 12-month level does not necessarily indicate excessive reserves so long as there is a plan to spend those funds in the near future in lieu of additional borrowing

8.1.5 Results of Baseline Stormwater Revenue Sufficiency Analysis

- Developed a plan which provides for the continued financial strength of the stormwater utility
- Should there be any change to the data or assumption used, this plan would need to be updated accordingly

8.1.5.1 Summary Pro Forma and Revenue Increases Required

- Annual adjustments required during the forecast period are as follows:
 - October 1, 2023 – 41% revenue increase
 - If applied to the Stormwater Fee, the monthly fee would increase approximately \$4.10 per customer, from \$10.00 to \$14.10

- October 1, 2024 (and annually thereafter): 3.00% revenue increase
- See Table 8-1, page 123 and Figure 8-2, page 124 for the revenue and cost comparisons between FY2022 and FY2031

8.2 Grant Funding Overview

- Provides a summary of grant programs and how they align with the goals of CIP projects for the City of Sebastian
- Most State and Federal funding opportunities are published on an annual basis, as well as after a major disaster declaration
 - Refer to most current publication (NOFO, or NOFA)
- City of Sebastian is encouraged to monitor new programs and opportunities and sign up for agency newsletters and/or Listservs to receive notifications directly
- Sections 8.2 – 8.3 outline different grant programs and give general summaries to help the City with their future grant planning. To see specific recommendations for grant programs that are applicable to the latest CIP plan move to section 8.4.
- The stormwater master plan contract continues with one grant application to be created by Arcadis

8.2.1 Federal Funding Opportunities

8.2.1.1 Florida Department of Environmental Protection State Revolving Fund

- Provide low-interest loans to local governments to plan, design, and build or upgrade
 - 1. Clean Water Act State Revolving Fund:** wastewater, stormwater, or nonpoint source pollution prevention projects
 - 2. Drinking Water State Revolving Fund:** drinking water systems
 - 3. State Revolving Fund Management:** Supports with agreements and procurement
- **Eligibility** – Local governments
- **Submission Requirements-** Request for Inclusion form can be submitted any time during the year
- **Eligible Activities**
 - Publicly owned wastewater collection and treatment facilities
 - Publicly owned stormwater Best Management Practice
 - Living shorelines
 - Upgrades, Repair, Replacement or Installation and Construction

8.2.1.2 Water Infrastructure Finance and Innovation Act (WFIA)

Program Summary – Loans with low fixed interest rates for up to 35 years

- Maximum up to 49% of eligible project costs
- Minimum project amount is \$20 million (considering Sebastian falls into the large community category with population over 25,000)

Submission Requirements – Letter of Intent

Eligible Activities –

- Brackish or seawater desalinization, aquifer recharge, alternative water supply
- Acquisition of property (if integral to environmental impact)
- A combination of projects under one SRF program application

Eligible development and implementation activities include:

- Development/design phase through construction phases

8.2.1.3 Florida Department of Environmental Protection Nonpoint Source Funds

Program Summary

- Through EPA for programs reducing pollution from nonpoint sources, with a focus on impaired water bodies and Total Maximum Daily Loads and restoration plans

Federal Clean Water Act 319(h)- \$6 Million awarded annually

- 50% must go to implementing BMAP plans
- Remaining 50% of funding is more limited

State Water-Quality Assistance Grants (SWAG)

- \$5 Million annually
- Projects must be shovel ready (already designed)

Eligibility –Require 40% non-federal or local match

Submission Requirements – May apply anytime, reviewed in the fall and spring

Eligible Activities – Reduction of nonpoint sources, stormwater treatment, stormwater infrastructure, groundwater protection, hydrologic restoration

8.2.1.4 Florida Department of Environmental Protection Coastal Management

Program – Administered by NOAA

Coastal Partnership Initiation (CIP) Grant: Provides from \$10,000-\$60,000 for innovative local coastal management projects

- Resilient Community projects – respond to climate change
- Coastal Resource Stewardship – promote stewardship of fragile coastal resources
- Access to Coastal Resources – to revitalize, renew, and promote local interest in their waterfront districts

Submission Requirements – Notice posted each year in August or September

Eligible Activities – habitat restoration, parks, waterfronts, public access facilities, environmental education and coastal planning

State Agency and Water Management District Grant Program

Must contribute to protection, management and enhancement of Florida's coast

Eligibility – Must be complete in 12-month period, between \$15,000-\$74,000

Submission Requirements – Previous cycles closed November

Eligible Activities – Construction, land acquisition, planning, design, habitat restoration, invasive exotic plant removal

8.2.1.5 Florida Division of Emergency Management Building Resilient Infrastructure and Communities Grant Program (FEMA BRIC)

Program Summary – Annual, mitigate risk and future losses by storm events

State/Territory Competition - \$2 million allocated to each State/Territory

National Competition – Can also apply to the national pool with more stringent community requirements

Submission Requirements – Notice of Interest – previously due September, full application previously due November

- 25% non-federal local match

Eligible Activities – Building code activities, hazard mitigation, non-critical structure evaluation, dry flood proofing, mitigation reconstruction

8.2.1.6 Florida Division of Emergency Management Flood Mitigation Assistance Program (FDEM FMA)

Program Summary- Annual, Reduce or eliminate the risk of repetitive flood damage to buildings

Individual Flood Mitigation Projects – Buildings must meet repetitive loss requirements or severe repetitive loss requirements

Localized Flood Risk Reduction Project – Demonstrate the proposed project benefits National Flood Insurance Program insured properties

- Up to \$50 Million project cost

Eligibility – 25% non-federal local match required

Eligible Activities – localized flood control, floodwater storage and diversion, floodplain and stream restoration, stormwater management, wetland restoration/creation

8.2.1.7 Florida Division of Emergency Management Hazard Mitigation Grant Program (FDEM HMGP)

Program Summary – Supports rebuilding efforts that reduce or mitigate future disaster-related losses, only available after a federally declared disaster

Eligibility – Must be approved by Local Mitigation Strategy working group

- 25% non-federal local match

Submission Requirements – follows a declared disaster only

Eligible Activities – retrofitting existing buildings, development and adoption of a hazard mitigation plan, aquifer storage and recovery, flood diversion and storage, green infrastructure to reduce flood impacts, utility infrastructure retrofits, acquisition of hazard prone areas, slope stabilization

- The City currently has an HMGP grant for the Stonecrop project

8.2.1.8 Florida Department of Economic Opportunity CDBG-DR

Program Summary – Community Development Block Grant Disaster Recovery

- Presidentially declared disasters only
- Infrastructure – replacement, repair, or relocation
- Planning – Studies and analysis for capacity building
- Preparedness and Mitigation – rebuilding activities and mitigation

Eligibility – benefit low and moderate income persons, address severe community welfare or health needs, or eliminate slum and blighting

Submission Requirements – following a declared disaster

Eligible Activities – construction, acquisition, preconstruction, rehab/reconstruction, road and bridge repair, job training, loans and grants to businesses, and improvements to commercial/retail districts

8.2.1.9 Florida Department of Economic Opportunity CDBG-MIT

Program Summary – Helps those recently impacted by a disaster to plan and mitigate

- General planning support, Critical facility hardening, general infrastructure program

Eligibility –Similar to CDBG-DR

Submission Requirements – Following a disaster

Eligible Activities – dry and wet proofing, energy resiliency, construction, rehabilitation or construction of stormwater management system, improve drainage facilities, modernization and resilience planning, floodplain and wetland management, upgrading mapping or data for risk assessment, planning and public service activities to reduce flood insurance premiums

8.2.1.10 Florida Department of Economic Opportunity Small Cities CDBG Program

Program Summary- For small urban and rural communities for water and sewer improvements, and drainage and stormwater improvements

Eligibility –Similar to CDBG-DR

Submission Requirements – Application cycle typically closes in June/July

Eligible Activities – Construction, rehabilitation or construction of stormwater management systems, improvements to drainage facilities, modernization and resiliency planning, capital improvements

8.2.1.11 EDA Public Works and Economic Adjustment Assistance Program

Program Summary – Build, design, or engineer critical infrastructure and facilities, to advance economic development

Eligibility – 50% local match

Submission Requirements – No submission deadlines, accepted on an ongoing basis

Eligible Activities – Construction, non-construction, planning, technical assistance, revolving loan fund

8.2.1.12 US Treasury State and Local Fiscal Recovery Funds

Program Summary – To facilitate recovery from COVID-19 pandemic, also known as the American Rescue Plan

- For investments in water, sewer, broadband infrastructure, and resiliency

Eligibility – Projects must be completed by Dec. 31, 2026

Eligible Activities – Planning, pre-construction, projects addressing flooding/sea level rise

- The City is currently using ARPA funds for many different projects

8.3 State Funding Opportunities

8.3.1 St. John’s River Water Management District Districtwide Cost Share Funding Program (FY2023-24)

Program Summary –cost share to reduce flooding

- Project types include: improved nutrient treatment processes of existing wastewater facilities, pumping stations or storage facilities, transmission and distribution systems, improved landscape irrigation efficiencies, low impact development projects, regional flood control, natural systems restoration

Eligibility – Up to \$3 million per project, must be completed within two years

Submission Requirements - Applications due Jan. 31, 2023

Eligible Activities – construction, inspection services, water quality BMPs, retrofitting stormwater outfalls, reconstruction of weirs, stormwater management expansion, plumbing retrofits, piping and other construction related materials

8.3.2 Florida Department of Environmental Protection Resilient Florida Program

Program Summary – To address impacts of flooding and sea level rise

Statewide Flooding and Sea Level Rise Resilience Plan – Funding to analyze and plan for vulnerabilities, as well as implementation projects

- The City currently has a fully funded grant to update the Coastal Resiliency Plan
- Note that updates to this Coastal Resiliency Plan are required in order to be eligible for other Resilient Florida Grants in the future

Supplemental Resilient Florida Grants - \$20 million for planning and pre-construction

Eligibility – 50% match, must have a vulnerability assessment that aligns with Florida Resilient requirements

Eligible Activities – Planning, pre-construction, implementation projects

8.4 Grant Funding Recommendations

- To strengthen the competitiveness of any application, it may be useful to link the primary need to repair aging City infrastructure with other beneficial outcomes
- The City can apply for grant funding offered by FEMA through any of the mitigation and resilience programs if the project can demonstrate the following:
 - Projects is located in a floodplain
 - Project will reduce or eliminate risk to residents and/or buildings under National Flood Insurance Program
 - Project will reduce or eliminate risk to a natural hazard
 - Project will be cost beneficial and minimize expected future losses
 - The project include studies/plans yet to be conducted but necessary for pending upgrades or replacement of the facility of equipment
- See Table 8-2, page 139, for an overview of funding options according to project type that could potentially support CIP projects
- Note grant funding is typically only applicable to City owned infrastructures
 - Typically the City must provide documentation regarding ownership as well as maintenance records and future maintenance plans/costs
- Table 8-3, page 141 shows a summary of the different grant programs with a link to their website as well as their program criteria

SECTION 9 – CONCLUSIONS AND RECOMMENDATIONS

9.1 Operational Recommendations

1. Increase SWMS Maintenance Activities

- The number and types of maintenance activities indicated in the proposed O&M plan represent the minimum level of maintenance effort needed to properly maintain the City's SWMS
- See Table 6-6 pages 89-94 for O&M plan referenced
- Current O&M activities is shown in Table

2. Implement the CMMS and Improve SWMS Documentation

- Utilize the CMMS excel spreadsheet created until asset management and work order software is purchased

3. Increase Stormwater Department Staffing

- To meet the proposed O&M plan and minimum service for the SWMS, ten additional full time employees will be needed (see Table 6-7, page 102, and section 6.4.7.2)
 - At the time of this summary the SW Department has 12 full time employees on staff with one vacancy looking to be filled

4. Modernize and Increase the Capital Equipment Fleet

- Currently the City has 24 light vehicles and equipment and 5 (21%) appear to be beyond their useful life

- It is recommended a detailed fleet analysis be conducted to determine the appropriate operational life for each fleet item based on maintenance data and usage, to plan for future replacement needs and costs
- Five fleet items need to be replaced
- One additional vector truck is recommended
- The addition of more energy efficient light vehicles (i.e. EVs) should be considered for visual inspection purposes

5. Increase Available Canal Storage Volume

- Include an adjustable weir in the Concha Dam replacement design to allow the City to decrease canal water elevations by approximately 1.5 ft
 - Increases storage capacity
 - Reduces peak discharges to the South Prong of the St. Sebastian River
- Should be designed for storage volume to recover in 14 days following a storm event
- Replace wood stoplogs on the Hardee Dam with new ones, and lower the control elevation in the Collier Canal by 1.5 feet (see 2006 permit drawings in Appendix I)

6. Coordinate Maintenance of the Hardee Dam Spillway with SJRWMD

- SJRWMD was granted a conservation easement within the Collier Club property
- The Hardee Dam has historically discharged into the Collier Canal North that is within this conservation easement
- The area is left natural and over time the flow path will fill in with sediment and vegetation, which will reduce or completely stop the discharge flow from the Hardee Dam during storm events
- Arcadis recommended bringing this to the attention of SJRWMD and reminding them this is conservation easement is not natural as it was likely constructed in the 1950s or 1960s when the Collier Canal North was constructed during the development of the Sebastian Highlands
 - In inherent conflict exists between the competing uses of drainage and conservation of existing condition

7. Obtain TMDL Load Reduction Credits for BMAP Activities

- While the City's performance appears to be lower than the overall progress reported for CIRL Project Zone SEB, it should be noted that the City has not yet received reduction credits for seven completed projects
- It is recommended the City continues to obtain TMDL load reduction credits for BMAP activities

8. Establish a Certification Program for Private Systems

- It is recommended the City establish a program for annual certifications for all privately-owned stormwater systems including:
 - Certification fee
 - Require an annual inspection by a Florida-license professional engineer and time-stamped photographs

- Require a certification form, signed and sealed by a Florida licensed professional engineer documenting that the system is properly maintained and operating as designed and permitted
- The City currently has a Stormwater Fee Credit program, which could be used to incorporate this certification for private systems

9. Reduce Costs Where Possible

- Eliminate quarter round on vacant lots where it is hand cleaned by Stormwater crews
- It is recommended that the City considers the need to identify other funding sources for activities unrelated to the SWMS such as sidewalk replacements

10. SWMS Survey Information Needs

- Continue the development of City-wide survey monument network that is needed to allow for rapid elevation checks of SWMS components
- Perform a full bathymetric survey of all canals, waterways, and retention/detention ponds in the SWMS to verify whether dredging is needed to restore the original design grades and storage and conveyance capacity

9.2 Policy and Local Ordinance Recommendations

Policy 1-2.3.2 – Incorporate Innovate Techniques in the Land Development Code

- In accordance with this policy, it is recommended the City considers allowing use of stormwater harvesting tanks as a method of residential and commercial properties to meet their required stormwater detention volumes
 - Should be designed to recover no more than half their available volume within 24 hrs following a storm event and recover full volume within 72 hours

Code of Ordinances – Section 54-2-7.15(d)

- Paragraph (2) and (3) establish the property owner responsible for maintenance of all drainage features on a property, including front yard swales, driveway culverts, side yard swales, and back yard ditches to maintain the proper flow of surface water
- For several years the City has contracted outside contractor for mowing the side yards and back yards
- Consider revising the Code to reflect this change
- Specifically this refers to easement ditches (majority of the ditches) in the Sebastian Highlands North of CR-512, where the City has taken over mowing maintenance, but the Code calls for homeowner maintenance

Code of Ordinances – Section 54-3-12.5 Exemptions

- The City's stormwater system does not have sufficient storage and conveyance capacity to prevent localized flooding in a 10-year storm event, as evidenced by modeling results
- The system is operating beyond its design capacity
- Current code states that impervious site additions 10% of the site, or less than 5,000 SF, whichever is less, is exempt from surface water management permitting
- It is recommended this section be deleted or modified as it currently allows up to a 5,000 SF addition without storage
- The rainfall depth for the 25yr-24hr storm event is 9.17 inches and in that storm a 5,000 SF concrete slab would result in approximately 3,821 cubic feet (28,580 gallons) of runoff, with no storage requirement
- Detention storage of at least the 25yr-24hr runoff volume could be required by any additional impervious area

Code of Ordinances – Section 54-3-12.10 – Type “A” Permit, Stormwater Management (drainage)

- The requirements for the Type “A” stormwater permit should be modified to include detention storage of at least the 25-year, 24-hour runoff volume as explained above
 - This would be applicable to all new construction, development or redevelopment requiring updated code compliance

Again for more information please see the full document of the Stormwater Master Plan supplied by Arcadis. If you have any questions or need additional clarification please contact me at kmiller@cityofsebastian.org or (772)-228-7056.

Sincerely,



Karen Miller,
Public Works Director / City Engineer