2 Existing Conditions

2.1 Geology and Soils

According to the Natural Resources Conservation Service (NRCS) Soils Report (1987),[5] a copy of which is included as Appendix E, Indian River County is in the coastal lowlands of the Atlantic Coastal Plain physiographic province, which are the remnants of ancient marine terraces. As shown in Figure 2-1, the county includes four distinct physiographic subdivisions, the Atlantic Coastal Ridge, the Eastern Valley, the Ten Mile Ridge, and the Osceola Plain.

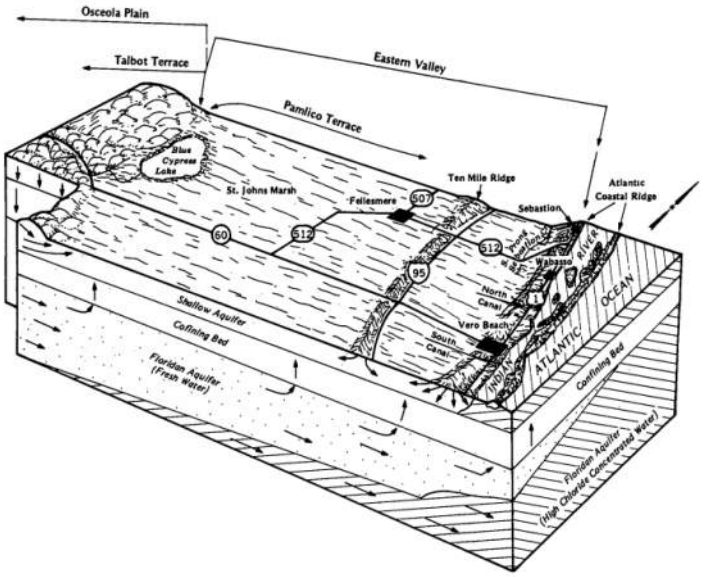

Figure 2-1. Geology and Physiographic Features of Indian River County (from NRCS)

The City of Sebastian is located in northeastern Indian River County, between the Indian River Lagoon and the South Prong of the St. Sebastian River. The easternmost portion of the City along the Indian River Lagoon lies within the Atlantic Coastal Ridge, where the soils are flat to gently sloping, sandy, and well drained. The majority of the City area lies west of the Atlantic Coastal Ridge, in the Eastern Valley, where the soils are predominately nearly level and wet. The topography of the City is very flat, with average grades of approximately 0.1 percent.

A shallow aquifer underlies all of the county and extends to a depth of approximately 150 feet below ground surface, where it is underlain by the Hawthorne Formation. The Hawthorne Formation acts as a confining layer and prevents the upward movement of water from the Floridan Aquifer, but also prevents the downward movement of water from the shallow aquifer, which results in high groundwater elevations and reduced percolation rates in the surficial soils. This is consistent with previous reports and observations from consultants and City staff, which indicated that the soils are virtually impermeable over most of the City and open channels have low infiltration rates and long recovery times.

Geologic and hydrogeologic information was obtained from the Soil Survey of Indian River County, published in 1987 by the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS). Geospatial soils data was obtained via the NRCS Web Soil Survey and the download noted that the data was Version 19 dated June 8, 2020. The Soil Survey classifies soils into four distinct Hydrologic Soil Groups (HSG), A-D, depending on their infiltration and runoff characteristics. HSG "A" soils, typically sands, have the lowest runoff potential while HSG "D" soils like clays and wetland soils have the highest. Soils with two HSG groups (i.e., A/D) indicate that a confining layer or high water table affects the infiltration rate that a given soil group would normally exhibit.

[5] Soil Survey of Indian River County, Florida. United States Department of Agricultural, Soil conservation Service. January 1987

The types, extents, drainage class and HSG of the soils within the City of Sebastian are shown below in Table 2-1. The soils within the City of Sebastian grouped based on drainage class are provided in Table 2-2. The majority of the City soils are poorly drained.

Table 2-1. City of Sebastian USDA/NRCS Soil Types

Soil Type	% of Drainage Area	Drainage Class	Hydrologic Soil Group
Chobee loamy fine sand, frequently ponded, 0 to 1% slopes	0.30	Very poorly drained	C/D
EauGallie fine sand	23.81	Poorly drained	A/D
Immokalee fine sand	18.04	Poorly drained	B/D
Myakka-Myakka, wet, fine sands, 0 to 2% slopes	12.22	Poorly drained	A/D
Oldsmar fine sand	9.33	Poorly drained	A/D
Pepper sand	0.90	Poorly drained	D
Riviera fine sand, 0 to 2% slopes	1.91	Poorly drained	A/D
St. Lucie sand, 0 to 8% slopes	1.34	Excessively drained	A
Archbold sand, 0 to 5% slopes	3.34	Moderately well drained	A
Wabasso-Wabasso, wet, fine sand, 0 to 2% slopes	0.28	Poorly drained	B/D
Pineda-Pineda, wet, fine sand, 0 to 2% slopes	1.33	Poorly drained	A/D
Quartzipsamments, 0 to 5% slopes	0.43	Somewhat poorly drained	A
Pomello sand, 0 to 5% slopes	5.98	Somewhat poorly drained	A
Arents, 0 to 5% slopes	2.77	Somewhat poorly drained	A
Floridana sand, frequently ponded, 0 to 2% slopes	0.06	Very poorly drained	C/D
Immokalee-Urban land complex	0.20	Poorly drained	A/D
Astatula sand, 0 to 5% slopes	6.96	Excessively drained	A
Satellite fine sand, 0 to 2% slopes	0.46	Somewhat poorly drained	A
Malabar fine sand	1.25	Poorly drained	A/D
Myakka fine sand, frequently ponded, 0 to 1% slopes	2.60	Very poorly drained	A/D
Holopaw fine sand, 0 to 2% slopes	1.57	Poorly drained	A/D
Electra sand, 0 to 5% slopes	0.08	Somewhat poorly drained	A
Pompano fine sand, 0 to 2% slopes	0.07	Poorly drained	A/D
Riviera fine sand, frequently ponded, 0 to 1% slopes	0.35	Very poorly drained	A/D
Lokosee fine sand	0.41	Poorly drained	A/D

Notes: Four percent of the City of Sebastian drainage area is covered in water and not included in the soil type table.

Table 2-2. City of Sebastian Soil Drainage Classes

	Sum of % of Drainage Area
Excessively drained	8.3
Moderately well drained	3.3
Poorly drained	71.3
Somewhat poorly drained	9.7
Very poorly drained	3.3

As shown in the data above, the high groundwater table effectively limits the infiltration capacity of the soils, which is consistent with the local geological conditions described previously. These conditions, combined with the

relatively flat topography, make drainage very challenging and restrict the types of BMPs that can be employed in the SWMS, especially those that improve water quality.

2.2 Environmental

Stormwater runoff from the City of Sebastian drains either directly to the Indian River Lagoon (for areas east of the Atlantic Coastal Ridge) or to the South Prong of the St. Sebastian River (via multiple outfalls) which ultimately discharges to the Indian River Lagoon. The Indian River Lagoon is a 156-mile-long estuary along Florida's east coast with impaired portions directly adjacent to lands in Volusia, Brevard, Indian River, and St. Lucie counties.

The Clean Water Act requires that the surface waters of each state be classified according to designated uses, such as drinking water, aquatic life, recreation, and agriculture. Florida has six classes, based on the degree of protection required. Currently, most surface waters in Florida, including many of those in the Central Indian River Lagoon (CIRL), are categorized as Class III waters, meaning they must be suitable for recreation and must support fish consumption and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife.

In 2009, the FDEP adopted revisions to the Verified List of Impaired Waters for the CIRL that identified several estuarine segments as impaired for dissolved oxygen (DO) due to low DO concentrations and nutrients due to an imbalance in flora and fauna because of decreases in seagrass distribution.

The FDEP reported that intense and extensive algal blooms in the IRL began in 2011 and have returned periodically. Harmful algal blooms (HABs) cause shading that stresses seagrass in the IRL, adverse effects on wildlife, and in some cases, detrimental effects on human health.[6]

2.3 Drainage System Characteristics

The City of Sebastian uses a combination of traditional stormwater infrastructure and Green Infrastructure (GI) to collect and convey stormwater runoff. The City's stormwater management system (SWMS) consists of the following:

- More than 360 miles of grassed swales and ditches (i.e., Roadside swales, Front Yard swales, Side Yard ditches, Back Yard ditches, etc.
- 1,293 culverts, totaling more than 126,000 linear feet of pipe, and other drainage structures
- 30 retention and detention ponds
- 9 nutrient separating baffle boxes
- 8.4 miles of canals that discharge at seven locations to the South Prong of the St. Sebastian River.

The SWMS has two primary purposes – (1) to drain surface water to prevent flooding within habitable structures and on roadways, and (2) to reduce pollutant loading to the City's canals, the South Prong of the St. Sebastian River, and ultimately the Indian River Lagoon (IRL). In order to satisfy both of these seemingly conflicting purposes, the SWMS must carefully balance the quantity of flows needed for proper drainage and the quality of the drained water to prevent excessive pollutant loading to receiving waters. GI components such as canals, wet detention and retention ponds are used to add capacity to the existing storm sewer system and increase removal of pollutants while creating additional green space benefits for the community.

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6 *Central Indian River Lagoon Basin Management Action Plan, February 2021.*

2.3.1 Previous Completed Improvements

The City has completed several important capital improvement projects in the SWMS since 2006, which are shown in Table 2-3, and have had positive effects on the quantity and quality of the stormwater discharged. Some of the listed projects were not previously identified on a SWMP update but were added separately by the City.

Table 2-3. CIP Projects Completed Since 2006

Project Name	Year Completed	SJRWMD Permit No.
Davis Street Drainage/Baffle Box	2006	98724-1
Periwinkle Detention Pond	2008	103638-1 & FDEP Permit
George Street Drainage	2009	18714-4
Collier Canal Dredging/Seawall	2009	104663-2 & FDEP Permit (Section 319 Grant Funds)
Potomac Street Baffle Box	2009	119623-1 & FDEP Permit
Schumann Park Imp./Drainage	2009	40952-2
Barber Sport Complex Drainage	2010	40775-4
City Stormwater Park Update	2012	No Permit
Quarter Round Review	2013	No Permit
Stormwater Master Plan Update	2013	No Permit
Coolidge Street Baffle Box	2014	135385-1
Presidential Street Drainage	2014	130339-1 (FDEP TMDL Grant Funds)
Water Monitoring/Testing	2014-2017	No Permit
Seawall Investigations	2014-2016	No Permit
Northern Area Ditch Cleaning	2015	No Permit
FDEP MS4 NPDES Update	2016	MS4 Permit
Tulip Detention Pond	2016	134274-1 & ACOE Permit FDEP TMDL/Section 319 Funds)
Working Waterfront Baffle Box	2016	145977-1 & FDEP Permit SJRWMD Grant and TMDL Grant)
Oyster Bag Pilot Project	2016	142124-1 & ACOE Permit
CavCorp Parking Drainage	2016	142058-2
Jefferson Street Drainage Repair	2017	FDOT US-1 R/W Permit

2.3.2 Previously Identified Drainage issues

After reviewing the previous studies and discussions with City staff, the following issues related to the City's stormwater management system have been identified.

2.3.2.1 Topography

The topography of the City is very flat, and the slopes of the conveyance structures (i.e., swales, ditches, culverts etc.) are in many cases too shallow for proper flow velocities, which limits their capacity. 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 onto adjacent areas.

In an experimental effort to improve the water conveyance in swales with shallow slopes, the City initiated the Quarter Rounds program in 2006, which used plastic pipes cut into quarters and installed along the bottom of the

swale. The plastic pipe is a lower friction coefficient than grass, and field testing showed it did improve the velocity. After installations were completed, the City found that homeowners were not adequately maintaining the swale bottoms, so the City hired contractors at a cost of approximately $250,000 per year to clean swales equipped with quarter round pipe. Maintenance costs continued to increase and the City ultimately determined the program was not cost effective, so it was cancelled by the City Council in 2017.

2.3.2.2 Surface Water Elevations (Tailwater Controls)

The overall system is, for the most part, a tailwater controlled system. The conveyance paths end at a waterbody (i.e., canal, St. Sebastian River, etc.), and if the water elevation within that downstream waterbody increases then a tailwater control occurs, decreasing the drainage flow and causing upstream water elevations to increase. It may not be possible or practical to solve all drainage problems within the City's system without reductions in tailwater elevations.

Drainage issues related to tailwater controls will be further exacerbated by the future effects of climate change and projected increases in sea level elevations in certain parts of the City. This issue is explained in more detail in Section 5 – Sea Level Rise Assessment.

2.3.2.3 Groundwater Elevations

Groundwater elevations 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 and makes water quality treatment efforts extremely challenging.

2.3.2.4 Geology and Soils

The soils and underlying geology in the Sebastian area create many challenges for the management of stormwater as mentioned in Section 2.1. One of the most difficult challenges is the high groundwater conditions and corresponding low infiltration rates in swales, combined with very shallow grades. This results in standing water in many swales throughout the City after storm events. During system evaluations the addition of concrete linings in swales was considered to improve the drainage velocities and flows, but such modifications would be costly, would add substantial impervious area, and would increase runoff volumes that would likely overload downstream drainage areas and not be acceptable to regulators. For these reasons, they were not selected as a CIP project.

2.3.2.5 Inadequate Stormwater Infrastructure

Many of the localized flooding and other drainage issues identified in previous studies and observed in the City are the result of specific deficiencies in the stormwater management system. These deficiencies were further studied, and corrective measures were recommended to the City in the form of Capital Improvement Program (CIP) projects. Several of the identified CIP projects have been completed, but many others have not been addressed, presumably because of a lack of funding. The updated CIP project inventory, including project descriptions, current status, and estimated costs are included in Section 7 - Alternatives Development and CIP Prioritization.

2.3.2.6 Operations and Maintenance Difficulties

Maintenance of Open Channels - The presence of heavy vegetation reduces the flow velocity within an open channel (i.e., grassed swale, etc.), which in turn reduces its flow capacity.

- Front Yard Swale – Per City Code Section 54-2-7.15(d), it is the continuous responsibility of any owner of a lot to maintain such swales, ditches, and pipes on the site to maintain the proper flow of surface water. Maintenance issues with front yard swales and driveway culverts are widespread and have been a historical problem area in the management of the SWMS. The City has historically used code

enforcement to correct non-compliance issues, but only when reported by residents or noticed by City staff during other work activities. As noted above the inspection and maintenance of the swale is the responsibility of the homeowner therefore the City does not currently conduct regular inspections of the front yard swales.

In addition, the City mows the front yard swale of vacant lots to maintain adequate drainage, as the lot owners historically have been unresponsive. On vacant lot parcels that have "Quarter Round" installed, the City crews must hand clean the Front Yard swale to prevent damage to the PVC, which is labor-intensive and costly to the City.

- Side Yard and Back Yard Ditches – previous issues related to the side yard and back yard ditches included overgrown vegetation and unstable side slopes. The City began mowing these ditches through a contract vendor several years ago on a quarterly basis, which has improved the vegetation issue. However, the costs have increased rapidly and are a significant burden on the Stormwater Department's finances. Also, as the elevations required for building foundations and septic tank mounds have increased over the years, the slope of the side yard ditches also increased, rendering many of them unstable and subject to rapid erosion.
- Aquatic Weed Control – the City currently contracts for spraying aquatic weeds with herbicides to control them within the canals and minimize the discharge of live aquatic weeds downstream. This is costly to the City but must be regularly performed to effectively control aquatic weeds within the City's canals.
- Canal dredging – Sediment buildup and shoaling was observed in the City's canals, indicating the need for dredging to restore canal storage and conveyance capacity. City staff reported that the City has not performed maintenance dredging on the canals since they were constructed, except for the Collier Canal North, which was dredged during the 2009 bulkhead reconstruction project.
- Canal bulkheads – There are currently 756 bulkheads along the banks of the City's canals. The City of Sebastian owns and maintains approximately 20 seawalls within the City ROW along the banks of the City's canals. The remainder of the 756 bulkheads are privately owned and maintained. The bulkheads are constructed of several different materials, and more than 200 are structurally failing. For more information on the condition of the bulkheads, see Section 3.3.3.1.

Maintenance of Retention/Detention Ponds

- The City's SWMS includes 19 retention ponds and 11 detention ponds. The Stormwater Department maintains one (Schumann Dr.), all others are maintained by the Parks Department. Sediment buildup may have reduced the capacity of the ponds, they are not on a regular dredging schedule.

2.3.2.7 Environmental Concerns

As mentioned before, the St. Johns River Water Management District (SJRWMD) and South Florida Water Management District (SFWMD) previously identified several drainage concerns for the St. Sebastian River watershed. The principal concerns involve the seagrass coverage in the IRL and the volume of stormwater (fresh water) discharged to the river and its dilution effects on the salinity within the receiving waters. Excessive freshwater drainage into the Indian River Lagoon may result in species shifts that could have significant effects on its fragile ecosystem. In addition, increased suspended matter and excessive loading of pollutants and nutrients associated with stormwater runoff may further degrade water quality.