Downtown Cocoa Beach Community Redevelopment Plan

Volume III

Appendices (continued)

Prepared for:

Downtown Cocoa Beach Community Redevelopment Agency

City of Cocoa Beach, Florida

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Cocoa Beach, Florida 32931

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Vice Mayor:	Skip Williams
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Commissioner:	Dave Netterstrom
Commissioner:	Kevin Pruett

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Downtown Cocoa Beach Low Impact Development Stormwater Master Plan

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see Volume IV

MILLER LEGG

Stormwater Master Plan

Miller Legg Project No. 10-00119

March 2011

"Improving Communities ...

... Creating Environments"

Prepared for:

City of Cocoa Beach Downtown
Community Redevelopment Agency
2 South Orlando Avenue
Cocoa Beach, FL 32932-2430

Christopher D. Keller, RLA, AICP, Project Manager

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EXECUTIVE SUMMARY

PURPOSE

The City of Cocoa Beach Downtown Community Redevelopment Area (CRA) has been designated in accordance with State Statute Section 163 Part III. The finding of necessity for the CRA includes defining deficiencies in stormwater management systems which have been found to be a condition and symptom of blight. Correcting these deficiencies will serve to promote redevelopment and reverse blighted conditions within the redevelopment area. In addition, the City of Cocoa Beach (the City) is required by law to reduce the stormwater runoff pollution loads in accordance with the Clean Water Act's Total Maximum Daily Load (TMDL) program.

As such, Miller Legg has been commissioned to develop a Stormwater Master Plan which will outline stormwater best management practices (BMPs) aimed at mitigating the identified stormwater deficiencies within the boundaries of the CRA. Our approach includes developing a plan that is consistent with the stormwater TMDL pollutant reduction requirements of the Florida Department of Environmental Protection's (FDEP) *Banana River Lagoon Basin Management Action Plan*. This effort will show how to reduce the total nitrogen (TN) and total phosphorus (TP) entering the City's storm sewer systems and canals and ultimately the Banana River, a segment of the Indian River Lagoon.

Of equal importance, the Stormwater Master Plan effort shall seek to achieve these goals through the use of Low Impact Design (LID) stormwater techniques which are compatible with the goals and objectives of the Urban Design Plan for the redevelopment area. It is intended that the techniques identified herein may be utilized throughout the city on a case-by-case basis.

CURRENT STORMWATER MANAGEMENT

The majority of properties within the CRA provide little to no significant stormwater treatment facilities. Stormwater runoff is concentrated and conveyed over mostly impervious surfaces to the City's storm sewer collection system. The high percentage of impervious area within the CRA is further magnified by the high level of hydrological connectivity to the storm sewer system. This directly connected impervious area results in concentrated runoff flows at higher velocities that carry sediments and pollutant loads directly to the storm sewer collection system with little to no opportunity for infiltration and/or filtration prior to discharge into the Banana River.

TMDL REQUIREMENTS

FDEP's Banana River Lagoon Basin Management Action Plan (BMAP) sets forth the criteria for TMDL limits for non-point sources for the City. This plan provides an analysis of the baseline TP and TN loading based upon year 2000 land uses. The results are a TP loading of 10.10 lbs/acre (ac)/year (yr) and a TN loading of 2.036 lbs/ac/yr.

The Banana River Lagoon BMAP also establishes the target loads for the City. This loading is 2.32 lbs/ac/yr for TP and 0.344 lbs/ac/yr for TN.

The Banana River Lagoon BMAP requires that 33% of the target reduction must be achieved within 5 years of the plan's acceptance, which is anticipated to be the summer of 2011.

REDEVELOPMENT OBJECTIVES

The objective of a CRA is to implement government-based policies and physical improvements which stimulate private investment within the area. Public investment in infrastructure and private investment in real property enhancements will serve to increase land values, thus encouraging more private investment.

Improvements to the public stormwater infrastructure and redevelopment of private property provide an opportunity to eliminate flooding and enhance water quality within the CRA. More importantly, the policies and physical improvements undertaken by the government should also be recognized as a means to eliminate impediments to private investment in redevelopment. Redevelopment is a challenging enterprise with many potential pitfalls, including obsolete buildings and properties, potential contamination, antiquated water and sewer facilities, and lack of on-site stormwater treatment facilities, to name a few. Private lenders are hesitant to invest in development projects which have so much inherent risk. Therefore, the more barriers to redevelopment that can be removed from a private development parcel, the better the opportunity for investment in the CRA. Public investment in a master stormwater system is one step towards alleviating impediments to redevelopment.

METHODOLOGY

This plan seeks to correct existing stormwater deficiencies while meeting the TMDL criteria for nitrogen and phosphorus prior to discharge into the Banana River within the context of CRA redevelopment goals.

Improper water management techniques and uncoordinated investment in public improvements can have a deleterious effect on the ability to achieve the TMDL requirements. Given the limited area for stormwater management within the CRA, every opportunity to meet water quality standards must be taken advantage of. Additionally, infrastructure improvements must be made in accordance with the Downtown Plan so as not to prohibit the ability to make the improvements detailed in the Downtown Plan and Master Streetscape Plan. The LID techniques detailed in this study show how both objectives can be met.

Given the depth to groundwater in the CRA, it would take a combined 17 acres of surface water management area to meet the TMDL Reduction requirements. These lands would be dedicated stormwater treatment areas and, as such, would most probably be in public ownership and not contribute to the ad valorem tax base. The CRA has minimal undeveloped areas for surface treatment systems and needs to keep as much land on the tax rolls as possible.

The use of underground exfiltration provides higher pollutant removal efficiency and does not unnecessarily encumber surface property.

CONTRIBUTING PARTNERS FOR TMDL REDUCTION

The CRA stormwater constituency consists of three (3) primary land stakeholders: the City, private land owners within the CRA, and Florida Department of Transportation (FDOT). Each of these entities contributes to the pollutant loading concentrations. The City and FDOT are required by law to reduce the pollutant load within a required time frame. Private development would only be required to provide pollutant loading reduction if it chose to redevelop. Since private redevelopment

is an uncertainty, it is prudent that the City develop a pollution reduction plan that does not rely on private redevelopment.

However, it is recommended that the land development regulations for the CRA be amended to include some level of TMDL treatment on private properties so as to ensure some level of partnering with these requirements when properties redevelop.

Based upon these constraints, this plan proposes that the City implement a stormwater program that will provide pollution reduction for public, private and FDOT-owned lands within the CRA.

RECOMMENDATIONS

- Every capital improvement project within the City should seek to maximize stormwater treatment consistent with the design guidelines of this report.
- Land Development Regulations should be updated to include minimum requirements for stormwater treatment for private development.
- The City already has a stormwater utility established which could serve as the vehicle for cost-sharing with private development for stormwater capital projects.
- It is recommended that the City pursue cost sharing agreements with FDOT for the construction of facilities that treat FDOT-owned lands.
- It is further recommended that the City develop a system for tracking pollution reduction achieved through the redevelopment of private lands. These improvements can be quantified and used to reduce the City's burden to construct the needed treatment facilities

This summary does not contain all the information that is found in the full report. The report should be read in its entirety to obtain a more complete understanding of the information provided, and to aid in any decisions made or actions taken based on the information.

A. PURPOSE

The City of Cocoa Beach Downtown Community Redevelopment Area (CRA) has been designated in accordance with State Statute Section 163 Part III. The finding of necessity for the CRA includes defining deficiencies in stormwater management systems which have been found to be a condition and symptom of blight. Correcting these deficiencies will serve to promote redevelopment and reverse blighted conditions within the redevelopment area. In addition, the City is required by law to reduce the stormwater runoff pollution loads in accordance with the Clean Water Act's Total Maximum Daily Load (TMDL) program.

As such, the purpose of this report is to develop a Stormwater Master Plan which shall outline stormwater best management practices (BMPs) aimed at mitigating identified stormwater deficiencies within the boundaries of the CRA. Included in this effort is the goal of developing a plan that is consistent with the stormwater TMDL pollutant reduction requirements of the Florida Department of Environmental Protection's (FDEP) *Banana River Lagoon Basin Management Action Plan*, (see **Appendix A**). This effort will seek to reduce the total nitrogen (TN) and total phosphorus (TP) loadings to city storm sewer systems and canals and ultimately the Banana River, a segment of the Indian River Lagoon.

Additionally, the Stormwater Master Plan effort shall seek to achieve these goals through the use of Low Impact Design (LID) stormwater techniques which are compatible with the goals and objectives of the Urban Design Plan for the redevelopment area. It is intended that the techniques identified herein may be utilized throughout the City on a case-by-case basis.

B. EXISTING CONDITIONS INVENTORY AND ANALYSIS

1. Project Area and History

Cocoa Beach is an urban barrier island community located between the Atlantic Ocean and the Banana River. The Downtown, which comprises most of the CRA, is the oldest portion of the City. The Downtown developed through the 1920s and 1930s spurred on by the Banana River Naval Air Station. A significant population expansion occurred between 1956 and 1968 in association with the space boom in nearby Cape Canaveral. To accommodate the increase in population and dense urbanization, the Downtown storm sewer system and surrounding canals were built. As such, today's storm sewer system within the Downtown reflects stormwater philosophies of almost 50 years ago. Likewise, the urban development patterns in the Downtown also reflect the design philosophies of the 1950s and 1960s. These factors contribute to the difficulties confronted by the City when considering the redevelopment and beautification of the Downtown CRA.

Generally within the CRA, all storm runoff drains from east to west towards the Banana River. The Banana River is an Outstanding Florida Water and Aquatic Preserve and an Estuary of National Significance. The downtown area has historically been developed as an urban landscape and, accordingly, possesses a high degree of impervious surfaces. A large percentage of the properties were developed prior to present day water quality regulations. Stormwater runoff from these impervious areas generally flows into a public storm sewer conveyance system located within rights-of-way and is discharged directly into the Banana River untreated.

The project area associated with this Stormwater Master Plan is comprised of the CRA which consists of approximately 220 acres. This area includes approximately 200-acres of mixed use development and 20-acres of Florida Department of Transportation (FDOT) rights-of-way (see **Figure 1**).

2. Permit Jurisdictions

Stormwater management improvements proposed within this master plan are subject to the jurisdictional review of the City, the St. John's Water Management District (SJRWMD), the FDOT, and the Florida Department of Environmental Protection (FDEP).

3. Land Use

Existing land uses within the CRA include civic and institutional uses, general commercial uses, multi-family residential uses and single family residential uses, and City and FDOT rights-of-way, see **Figure 2**.

Currently, land development within the study area is controlled by the Comprehensive Plan (Comp Plan) and Land Development Regulations. Land use, building massing and lot coverage are regulated by the Zoning Code and Downtown Overlay District criteria.

4. Topography

Topography throughout the City generally decreases from east to west ranging from mean sea level along the eastern shoreline to a height of 10-15 feet at the crest of the beach dunes, and then gradually decreasing back to mean sea level at the shore of the Banana River. A USGS quadrangle map of the CRA is provided as **Figure 3** which shows the general topography within the area. Detailed 1-foot contour topographic information was obtained from the City's survey as prepared by Pine Design, Inc. as well as from Brevard County's GIS database for use in the project analysis (see **Appendix B)**.

5. Soil Characteristics

Due to its location, the predominant soil formation within the CRA consists of a mixture of marine sands and shell fragments formed in marine sediments. Based upon the Natural Resources Conservation Service (NRCS) Custom Soil Resource Report for Brevard County, there are five (5) different types of soils that occur within the CRA as depicted on the soils map contained in **Appendix C**. These soils are as follows:

- Canaveral-Urban Land Complex (Soil Symbol 10)
- Beaches (Soil Symbol 14)
- Canaveral-Palm Beach-Urban Land Complex (Soil Symbol 25)
- Palm Beach Sand (Soil Symbol 42)
- Urban Land (Soil Symbol 69)

A standard method of soil classification used for hydrologic modeling is the hydrologic soil group. Soils are grouped into four hydrologic soil groups identified as A through D. A general description of these soil groups are as follows:

- Hydrologic Soil Group A: Soils that have high infiltration rates even when thoroughly wetted and a high rate of water transmission.
- Hydrologic Soil Group B: Soils that have moderate infiltration rates when thoroughly wetted and a moderate rate of water transmission.
- Hydrologic Soil Group C: Soils that have a slow infiltration rates when thoroughly wetted and a slow rate of water transmission.
- Hydrologic Soil Group D: Soils having very slow infiltration rates when thoroughly wetted and a very slow rate of water transmission.

A copy of the NCRS Custom Soil Resource Report for Brevard County detailing the location, hydrologic group, water table and general soil characteristics for the soils located within the CRA is contained with Appendix C.

6. Water Table Conditions

The depth to the water table varies throughout the CRA becoming progressively more shallow from east to west through the Downtown area. In addition to the NCRS Soils Report, various geotechnical explorations as submitted to the City of Cocoa Beach in association with the permit review process of past projects were utilized to estimate seasonal high water table elevations within the CRA limits for use in the design of the proposed stormwater management best management practices.

In general, the estimated wet season water table ranges from 7 feet below grade along A1A, to 5 feet below grade along Orlando Avenue, to 4 feet below grade along Brevard Avenue to 2 feet below grade along Woodland Avenue. Due to the higher seasonal high water table elevations in the western portion of the CRA, it is anticipated that some relief from the FDEP/Water Management District criteria associated with separation of treatment systems from the seasonal high water table will be required due to the lack of other available treatment options with the CRA.

7. Current Stormwater Management

The majority of properties within the Downtown CRA provide little to no significant stormwater treatment facilities. Stormwater runoff is concentrated and conveyed over mostly impervious surfaces to the City's storm sewer collection system. The high percentage of impervious area within the CRA is further magnified by the high level of hydrological connectivity to the storm sewer system. This directly connected impervious area results in concentrated runoff flows at higher velocities that carry sediments and pollutant loads directly to the storm sewer collection system with little to no opportunity for infiltration and/or filtration prior to discharge into the Banana River.

While the stormwater treatment aspect of the CRA's drainage system is very poor, its collection and conveyance systems appear to be functioning adequately. In addition to the City's regularly schedule maintenance program, the City has implemented a storm sewer replacement program which replaces the older corrugated metal storm culverts with new reinforced concrete piping. To date, the majority of the storm sewer piping within the CRA has been replaced with reinforced concrete piping. Further discussion on the City's storm sewer collection and conveyance system is provided in later sections of this report.

8. Data Evaluation

The basis of this analysis is predicated on various sources of existing data which has been supplied by the City. Given the scope of this assignment, no new data has been created.

a. Land Development Criteria

The nature and extent of urban stormwater run-off is dependent on the land use, percent of lot coverage (impervious areas) and stormwater best management practices. Stormwater management requirements are also considered an impediment to redevelopment. Accordingly, the nature and extent of the stormwater treatment techniques proposed herein are dependent on the nature and type of land use (both existing and proposed).

The City recently prepared a Preliminary Assessment for a Design Based Code (Zyscovich 2010) which will form the basis of a Design-Based Code for the CRA area. When complete, this code will establish standards and criteria for building massing and a mix of uses which will ensure redevelopment is consistent with the current scale and character of the CRA. At the time of issuance of this report, the development standards have not been completed. However, Miller Legg has been advised that the lot geometry, building massing and impervious area ratios will not be changed significantly from the current standards. The methodology of this report has been developed accordingly.

This study suggests that there is a surplus of undeveloped/vacant land within the boundaries of the CRA which should be prioritized for redevelopment. Many of these undeveloped properties are currently being utilized for surface parking and may or may not be paved.

b. The 2005 Downtown Plan

In 2005, the City Commission recognized the need to develop a blueprint to guide the Downtown's future redevelopment. The first step in this process was completed in 2005, involving a visioning initiative that identified Downtown's assets and set priorities for future projects. To continue this process, the City Commission created the Downtown Area Sector Plan Committee on April 21, 2005. The Downtown Plan was unanimously endorsed by the Committee and the City's Planning Board and unanimously adopted by the City Commission.

c. The 2009 Master Streetscape Plan

In 2009 the City commissioned Miller Legg to create a master streetscape development plan which would guide the implementation of the Downtown Plan relative to the physical conditions within the rights of way within the Downtown area. This streetscape plan has been utilized as the basis for determining physical improvements that can be utilized to implement the TMDL compliance.

d. 2001 Stormwater Master Plan by Parsons Engineering Science, Inc.

In 2001, the City commissioned Parsons Engineering Sciences, Inc. to prepare a Stormwater Master Plan for the entire City. While this report did not specifically breakout and analyze the CRA area, its analysis did encompass the CRA area. A very limited amount of development/re-development has occurred within the CRA since the completion of the Parsons study. As such, the existing conditions analysis from this report was assumed to provide valid results for use in this CRA Stormwater Master Plan preparation. The following is a brief summary of the existing conditions analysis of the CRA area from the Parsons report.

(1) Flooding Assessment – A hydraulic flooding assessment model of the existing stormwater infrastructure was performed to identify flood prone areas within the City limits. The CRA area was encompassed within Stormwater Basins F and G of the model. Within the boundaries of the CRA twelve (12) flood prone areas were identified. These areas are identified in Table 1. Excerpts of the Parsons Stormwater Master Plan which identify the flood prone areas are contained within Appendix D.

Table 1: Flood Problem Areas

Problem ID	Problem Location	Problem Description
F1	Intersection of N. Orlando Avenue and 2nd Street North	Nuisance Flooding, standing water
F2	A1A and 2nd Street North and 1st Street North	Nuisance Flooding, standing water
F4	Lookout Point Apts. – 1st Street N. and Cedar Ave.	Stormwater from apartments. causing flooding at residence to west
F6	Model Node SF024I – North Orlando Ave.	Model Indicates possible deficiency
F7	Model Node SF057I – Woodland, Yard/Open Space	Model Indicates possible deficiency
F8	Model Node SF050M – N. Brevard, North 2nd St, Yard/Open Space	Model Indicates possible deficiency
G1	N. Brevard Ave. and the alley north of Minuteman Causeway	Nuisance Flooding, standing water
G2	A1A at Minuteman Causeway and 1st Street South	Nuisance Flooding, standing water
G3	A1A near 3rd Street South	Nuisance Flooding, standing water
G5	4th Street S.- Greenswood Land to Yawl Drive	Nuisance Flooding, standing water
G9	Model Node SG077I – N. Brevard, South 2nd Street, Yard/Open Space	Model Indicates possible deficiency
G10	Model Node SG076M - N. Brevard, South 2nd Street, Yard/Open Space	Model Indicates possible deficiency

(2) Water Quality Assessment – At the time of the development of the Parsons Stormwater Master Plan, TMDL regulations had not been developed. As such, the Parsons Stormwater Master Plan made certain assumptions with respect to pollutant load reduction goals which are not applicable in light of the recently approved Banana River Lagoon Basin Management Action Plan (BMAP), which specifies the pollutant reduction requirements for the City of Cocoa Beach. For this reason, the results of the Parsons Stormwater Master Plan with respect to the Water Quality analysis have been disregarded.

C. STORMWATER MASTER PLAN ANALYSIS

1. Methodology

This plan seeks to correct existing stormwater deficiencies while meeting the TMDL criteria for nitrogen and phosphorus prior to discharge into the Banana River within the context of redevelopment goals of the CRA. The FDEP has tabulated all land uses and best management practices within the City and quantified the pollutant loads on a parcel by parcel basis. Ultimately, FDEP issued the Banana River Lagoon BMAP in June 2006 (see **Appendix A**) which calculated a citywide pollutant loading rate to be applied on a per-acre basis. The BMAP also defined the pollutant load reduction required for Cocoa Beach. This study utilizes this Citywide pollutant loading rate to calculate the approximate pollutant loading for the treatment areas within the CRA as a basis for determining the required treatment facilities. FDEP also quantifies the pollutant load reduction efficiencies for the various forms of treatment facilities. This study will utilize these pollutant load reduction efficiencies for calculating the total pollution load reduction for each treatment area within the study area.

2. Opportunities and Challenges

a. Redevelopment opportunities

The objective of CRA is to implement government-based policies and physical improvements which stimulate private investment within the area. Public investment in infrastructure and private investment in real property enhancements will serve to increase land values, thus encouraging more private investment.

Improvements to the public stormwater infrastructure and redevelopment of private property provide an opportunity to eliminate flooding and enhance water quality within the CRA. More importantly, the policies and physical improvements undertaken by the government should also be recognized as a means to eliminate impediments to private investment in redevelopment. Redevelopment is a challenging enterprise, with many potential pitfalls including obsolete buildings and properties, potential contamination, antiquated water and sewer facilities, and lack of on-site stormwater treatment facilities to name a few. Private lenders are hesitant to invest in development projects which have so much inherent risk. Therefore, the more barriers to redevelopment that can be removed from a private development parcel the better the opportunity for investment in the Downtown

CRA. Public investment in a master stormwater system is one step towards alleviating impediments to redevelopment.

b. Maximizing Treatment Opportunities

Improper water management techniques and uncoordinated investment in public improvements can have a deleterious effect on the ability to achieve the TMDL requirements. Given the limited area for stormwater management within the CRA, every opportunity to meet water quality standards must be taken advantage of. Additionally, infrastructure improvements must be made in accordance with the Downtown Plan so as to not prohibit the ability to make the improvements detailed in the Downtown Plan and Master Streetscape Plan. The LID techniques detailed in this study show how these two objectives can be met.

c. BMP Selection

The existing soil characteristics and water table elevations through the CRA play a significant role in the selection and design of the Best Management Practices (BMPs) necessary to achieve the TMDL reduction. Soil permeability is relatively high in the eastern portion of the CRA and moderate in the western portions of the CRA. Likewise, water table elevations are low in the eastern portion of the CRA and get higher within the western portions of the CRA. As such, the selection of BMPs should focus on those systems that incorporate retention and infiltration as a means of treatment. The use of underground exfiltration provides higher pollutant removal efficiency and does not unnecessarily encumber surface property. The CRA has minimal undeveloped areas for surface treatment systems and needs to keep as much land as possible on the tax rolls.

d. Flood Protection

Proper functioning of the storm sewer system is important for providing flood protection for homes and businesses. The quick removal of rain water from roadways helps to prevent hydroplaning and provides safe passage for bicyclists and pedestrians. A clogged or poorly maintained storm sewer system will reduce its effectiveness in providing the intended protection to homes and roadways.

e. Contributing Partners for TMDL Reduction

The CRA consist of three (3) primary land stakeholders: the City, private land owners within the CRA, and FDOT rights-of-way. Each of these entities contributes to the pollutant loading concentrations. The City and FDOT are required by law to reduce the pollutant load within a required time frame. Private development would only be required to provide pollutant loading reduction if it chose to redevelop. Since private redevelopment is an uncertainty, it is prudent for the City to develop a pollution reduction plan that does not rely on private redevelopment.

However, it is recommended that the land development regulations for the CRA be amended to include some level of TMDL treatment on private properties.

In addition, the City's greatest opportunity for the development of treatment facilities is within existing rights-of-way; both City and FDOT owned. As such, treatment facilities within the Atlantic Avenue and Orlando Avenue rights-of-way present a viable opportunity to provide treatment for City lands, both private and public.

Based upon these constraints, this plan proposes that the City implement a stormwater program that will provide pollution reduction for public, private and FDOT-owned lands within the CRA. It is further recommended that the City pursue cost sharing agreements with FDOT for the construction of facilities that treat FDOT-owned lands. Lastly, this plan should be viewed as a living document such that private redevelopment should be tracked so pollution reduction achieved through the redevelopment of private lands can be quantified to reduce the City's burden to construct the needed treatment facilities.

3. Land Use

The pollutant loadings as determined within the Banana River Lagoon BMAP incorporated land use type as a component of the pollutant loading calculations. However, the BMAP specifies an average annual pollutant loading and pollutant loading target on a lbs/acre basis for Cocoa Beach as a whole. Therefore, the specific land use of a parcel did not factor into the pollutant loading calculations for this master plan.

However, certain available BMPs solutions are more readily applicable to certain land use types, development patterns and the corresponding densities. In addition, the pollutant load reduction efficiency achieved by a particular BMP is in many cases dependent upon the Curve Number and the Directly Connected Impervious Area percentage which is directly related to land use. As such, this plan utilized the proposed land uses as identified within the Design Based Code being prepared by Zyscovich for purposes of identifying land use attributes for each particular segment of the CRA. The land uses identified within this plan and their corresponding attributes are as identified in **Table 2.**

Table 2: Land Use Attributes

Land Use	Max. % Impervious	Curve Number (A Soils)	Curve Number (C Soils)	DCIA* %
Artisan	60	64	84	30
Civic/Semi Public	85	76	89	60
Cottage Row Commercial	60	64	84	30
Cottage Row Residential	40	54	80	20
Downtown Core	90	73	88	77
Oceanside District	70	63	884	49
Park Lands	5	41	75	2
Right-of-way	85	78	90	55

* Directly Connected Impervious Area

4. Low Impact Stormwater Design Techniques

BMPs are structural controls, non-structural controls, and operation and maintenance procedures that are used in stormwater management to reduce or attenuate runoff volume and reduce pollutant loadings into receiving water bodies.

The Downtown CRA currently employs traditional stormwater collection and conveyance techniques to deal with runoff. Minimal stormwater treatment facilities exist within the CRA. The implementation of traditional stormwater treatment facilities, such as wet detention ponds, is not readily feasible due to the highly developed nature of the CRA which affords very few opportunities to construct these systems without condemnation and taking properties off the tax rolls. In addition, the soil and water table characteristics within the CRA are more conducive to treatment systems that take advantage of the ability to infiltrate stormwater into the ground.

LID stormwater management techniques are BMPs with an ecologically friendly approach to stormwater management that aims to mitigate development impacts to land, water, and air. The approach emphasizes the integration of planning techniques and site design that conserve the natural systems and hydrologic functions of a site. LID techniques seek to accomplish the following:

- Reduce impervious area
- Decrease hydraulic connectivity
- Control stormwater at the source
- Treat stormwater at the source
- Promote offline treatment
- Promote retention and infiltration opportunities
- Preserve or create natural habitat

Not all low impact stormwater design solutions are suitable for each land use type. Highly urbanized land uses allow for less pervious green space on a given parcel and as such, are more suited for underground or off-site treatment facilities. Undeveloped properties may be good candidates for the development of localized stormwater facilities or "stormwater parks". Low and moderate density residential uses and Cottage Row properties allow for more pervious green space and could accommodate on-site facilities such as pervious pavement systems, rain gardens, bio-retention facilities, swales, etc. That said, LID stormwater techniques are ideally suited to address the CRA stormwater deficiencies and the TMDL requirements for a number of reasons.

- Large undeveloped lands for use as centralized stormwater facilities are not available in the CRA. Therefore, small scale "treat at the source" LID solutions are required.

- Portions of the CRA area contain soils with low water table elevations and high permeability rates, thus lending themselves to retention and infiltration opportunities.

- Implementation of upstream retention facilities will reduce runoff volumes in downstream areas, reducing flooding potential; will reduce downstream hydraulic velocities and the potential scour / turbidity problems in the canals / lagoons; and will reduce the hydraulic loading on the storm sewer system potentially reducing the hydraulic grade line.

The following LID BMPs have been identified for possible implementation with the CRA:

Table 3: Stormwater Infrastructure BMP's	
Dry Retention Ponds	Sediment Traps
Pervious Pavement System	Tree Filters
Exfiltration Trenches	Baffle Boxes/Outfall Filters
Underground Storage/Retention Systems	Debris Baskets/Inlet Screens
Bio-swales and Swales with Swale Blocks	Vegetative Natural Buffers

Table 4: City BMP Policies/Programs	
Public Education	Florida Friendly Landscaping
Street Sweeping	Impervious Area Reduction
Street Tree Program	Dune Revegetation

Table 5: LID BMP Characteristics and Opportunities/Constraints Evaluation

BMP Type	Site Location					Pollutant Removal Efficiencies			
	Land Requirement	Drainage Area Accommodated	Soil Permeability Requirement	Water Table Depth Requirement	Upstream / Downstream Preference	Factors	TSS	TN	TP
Dry Retention Ponds	Mid - Large	High	Mid - High	Low - Mid	Downstream	Volume, depth to WT, soil permeability	Good	Good	Good
Bio-Swales	Low - Mid	Small - Mid	Mid - High	Low - Mid	Both	Volume, slope/length, soil infiltration, detention time, depth to WT	Good	Good	Good
Exfiltration Trenches	Low	Small - Mid	High	Low	Both	Soil percolation, trench surface area, storage volume, depth to WT	Good	Good	Good
Underground Storage/Retention Systems	Low	Small - Mid	Mid - High	Low	Downstream	Depth to WT, storage Volume, soil percolation	Good	Good	Good
Swales/Swales with Swale blocks	Low - Mid	Small	Mid - High	Low - Mid	Both	Volume, slope/length, soil infiltration, detention time, depth to WT	Mid	Mid	Mid
Sediment Traps	Low	Small - Mid	N/A	N/A	Downstream	Maintenance, sediment storage volume, runoff volume	Good	Low	Low
Tree Filters	Low - Mid	Small	Mid - High	Low - Mid	Upstream	Soil percolation, storage volume, maintenance	Good	Mid	Mid
Baffle Boxes/Outfall Filters	Low	Small	N/A	N/A	Downstream	Maintenance, runoff volume	Low*	Low*	Low*
Debris Baskets/Inlet Screens	N/A	Small	N/A	N/A	Downstream	Maintenance, runoff volume	Low*	Low*	Low*
Vegetative Natural Buffers	Low – Mid	Small – Mid	N/A	N/A	Both	Runoff volume, slope/length, soil infiltration, vegetative cover	Good	Good	Good
Public Education	N/A	Large	N/A	N/A	N/A	Extent of program	Low	Low	Low
Street Sweeping	N/A	Large	N/A	N/A	N/A	Frequency	Mid	Low	Low

* The addition of sorbtive media can increase nutrient removal characteristics

5. Storm Sewer Collection System

As described in Section B.8.d, various areas within the CRA were identified as an area of flooding concern within the Parsons study. However, of the twelve areas noted, five of the areas (F6, F7, F8, and G9 and G10) were areas of flooding concern only as identified by the modeling. These five areas were not "observed" flooding issues and therefore did not require action.

Flooding area G5 was determined not to be an area of flooding concern when City staff determined that the flooding was caused by blockage of the roadway inlets.

Of the six remaining flooding areas, five (F1, F2, G1, and G2 and G3) were noted as areas of nuisance flooding/standing water which indicated a stormwater collection issue not a conveyance issue. It was determined that these areas of nuisance flooding/standing water would be readily addressed through the implementation of streetscape redevelopment projects. As such, individual drainage projects specifically aimed at addressing these standing water issues was not considered cost effective. It was determined that addressing these issues as part of an overall streetscape project, which would also address the TMDL reduction requirement, would be more cost effective.

The final remaining flooding area, F3, will require a detailed engineering analysis and design in order to recommend an improvement project that would adequately address the flooding issue. It should be noted that the implementation of upstream BMP's, which would significantly reduce the rate and quantity of stormwater directed to this area would potentially address some if not all of the flooding observed in this area.

6. Total Maximum Daily Load (TMDL) Analysis

a. City of Cocoa Beach TMDL Requirements

FDEP's Banana River Lagoon BMAP sets forth the criteria for TMDL limits for non-point sources for the City. This plan provides an analysis of the baseline TP and TN loading as based upon year 2000 land uses. The results are a TP loading of 10.10 lbs/acre/yr and a TN loading of 2.036 lbs/ac/yr.

The Banana River Lagoon BMAP also establishes the target loads for the City. This loading is 2.32 lbs/ac/yr for TP and 0.344 lbs/ac/yr for TN.

The Banana River Lagoon BMAP requires that 33% of the target reduction must be achieved within 5 years of the plan's acceptance, which is anticipated to be the summer of 2011.

b. FDOT TMDL Requirements

The Cocoa Beach CRA contains both City property and FDOT property/right-of-way as associated with Orlando Avenue and A1A. The Banana River Lagoon BMAP addresses FDOT property as a separate entity and assigns a specific loading to FDOT land uses. As such, FDOT baseline loading and reduction calculations

were broken out separately from the Cocoa Beach CRA property. The baseline TP and TN loading as based upon year 2000 land uses are 9.69 lbs/ac/yr and 2.788 lbs/ac/yr respectively.

The Banana River Lagoon BMAP target loads for the FDOT property/right-of-way are also 2.32 lbs/ac/yr for TP and 0.344 lbs/ac/yr for TN.

The Banana River Lagoon BMAP requires that 33% of the target reduction must be achieved within 5 years of the plan's acceptance which is anticipated to be the summer of 2011.

c. Pollutant Reduction Calculation

The pollutant reduction efficiency of a BMP measure is dependent upon a number of factors. For the purpose of this analysis, the *Department of Environmental Protection and the Water Management Districts Environmental Resource Permit Stormwater Quality Applicant's Handbook, March 2010 Draft Version* was utilized as the basis for calculating the pollutant load reduction achieved by a particular BMP measure. While this resource is a draft version and not yet accepted, it is the most current guide with respect to pollutant load reduction and is based upon the latest reports and studies to date. In addition, since the methodology was developed by DEP and the SJRWMD, it was assumed to be the best guide in terms of achieving future permit approval through these agencies.

d. Pollutant Load Reduction Credits

The FDEP pollutant load analysis was based upon the City's year 2000 land use. This analysis allocated a pollutant load reduction credit for development that provided on-site stormwater management facilities. As such, development activity which occurred subsequent to the year 2000 which provided stormwater management facilities where previously there were none, should be provided some pollutant load reduction credit. As such, the existing treatment volumes provided within stormwater management systems constructed after 2000 were included in the analysis.

The following table details the development activities within the CRA since year 2000 which provided stormwater management facilities, the treatment area in which these developments are located, and the subsequent pollutant loading reduction credit due.

Table 6: Pollutant Load Reduction Credits

Project Name and Treatment Area	Retention Storage Vol. (cf)	Project Name and Treatment Area	Retention Storage Vol. (cf)
Cottage Row Parking Lot 5, TA 9	7,448	Enclave at 300, TA 21	32,754
Cottage Row Parking Lot 14, TA 8	3,172	Cottage Row Parking Lots Alleyways, TA 9	3,724

7. Treatment Area Analysis/Calculations

The Cocoa Beach CRA was divided into 28 treatment areas for analysis; see *Cocoa Beach CRA Stormwater master Plan – Overall Treatment Area* plan. The basis of the analysis assumed full redevelopment under the proposed land use categories currently being defined under the Design Based Code being prepared by Zyscovich. The treatment areas were defined based upon existing and anticipated grading patterns, land use, and by the BMP system proposed to be implemented.

Parcel acreages were obtained through the use of the GIS parcel data as provided by the City.

Land use characteristics were based upon the proposed land uses within the CRA as defined within the Design Based Code currently being prepared for the City of Cocoa Beach by Zyscovich. Table 2 of Section C.3 of this report identifies the individual attributes for each land use for use in determining the pollutant load efficiency.

Phosphorous and nitrogen loading calculations for the existing baseline condition, allowable loading condition, and loading reduction requirements were based upon the data provided in Section C.5. These loadings were calculated for the overall CRA area. This calculation was then subdivided by the lands controlled by FDOT and the City; see *Cocoa Beach Stormwater Master Plan – Treatment Area Summary* table.

Figure 4 provides data sheets identifying the limits of each treatment area, the calculations of the baseline loading and required loading reduction, and details of the BMP measures proposed to provide stormwater management and TMDL reduction for each treatment area.

D. SPECIFIC RECOMMENDATIONS

The following recommendations are based upon the specific conditions, analysis and potential solutions for each defined geographic boundary (i.e. Treatment Area) as identified in the preceding section. While there are many techniques (BMPs) that may be employed to mitigate the existing

stormwater deficiencies and to meet the TMDL-loading reduction requirements within each Treatment Area, the recommended solutions represent Miller Legg's preferred approach to achieving these goals. The solutions are accompanied by an opinion of probable construction cost which can be utilized for capital project planning.

1. Treatment Area Analysis Results Summary

The analysis indicates that 1,723 lbs of TP and 394 lbs of TN are required to be removed from the stormwater runoff from the CRA. Approximately 845,000 cubic-feet of stormwater retention treatment facilities are required to provide the required pollutant load reduction. Due to a lack of public open space, the majority of this treatment volume is proposed to be achieved through the use of pervious paver systems and underground infiltration systems. In addition, the Master Plan assumes that the City will continue its Street Sweeping Operations and its Public Education Programs which also achieve a pollution reduction credit which varies dependent upon the specific elements of the programs.

While not considered within the treatment calculation, bio-swales installed within the islands and tree wells along the roadways should be included within every streetscape redevelopment project. These treatment systems provide a negligible amount of treatment volume when compared to the overall treatment volume required. However, they are a valuable component in the treatment train system and provide a secondary benefit to the City in terms of beautification, which in turn will promote the redevelopment within the CRA.

In addition, the pervious paver and underground infiltration systems proposed to achieve the necessary treatment volumes were specified, for the most part, within the north-south road rights-of-way. Due to the east-west drainage patterns of the lands within the CRA, the north-south rights-of-way receive the vast majority of the runoff and as such were the chosen location for the treatment systems. However, it should be noted that the east-west side streets have the ability to accommodate the proposed treatment systems as well and may be incorporated into overall treatment concept. Any treatment volumes achieved within the east-west side streets would in turn reduce the treatment volume required within the north-south streets.

2. Prioritization of Improvements

a. Prioritization Methodology

In order to determine a prioritized schedule of improvements, it was necessary to evaluate the impact of stormwater BMP improvements on the redevelopment efforts of the CRA while considering the Federal requirements of the Banana River Lagoon BMAP pollutant load reduction requirements. The prioritization method is based on pollutant reduction effectiveness, the cost of the proposed BMP measures and the potential impact to the redevelopment efforts of the CRA. Flooding was not considered in the evaluation because the borderline flooding issues would be expected to address through the implementation of the BMP measures.

b. Project Ranking Methodology

Three methods of ranking were used to compare and prioritize projects:

- Pollutant Reduction Ranking – BMP projects were ranked solely upon the quantity of pollutant load reduction provided regardless of cost. Nitrogen was the pollutant that governed.

- Unit Cost Ranking – BMP projects were ranked based upon the unit cost per mass of pollutant load reduced.

- Redevelopment Priority – BMP projects were cross-referenced with the redevelopment projects identified in the Downtown Master Plan.

- BMP Location – Projects were provided a ranking based on their location with the most upstream projects receiving the highest ranking and the most downstream projects receiving the lowest ranking. Rankings ranged from 1 for the most upstream projects to 4 for the most downstream projects.

c. Project Costs Methodology

Calculation of the Unit Cost Effectiveness (UCE) is based upon the total cost for a project. Total project cost is determined by the sum of construction costs, capital costs, land acquisition, and operation and maintenance costs (O&M).

- Construction Costs – total cost that a contractor would bear for delivery of a completed project. Based on average estimated costs.

- Capital Costs – total cost to the City for implementation of a project. Includes consultant Design fees, City fees (Administration, Labor & Legal), Permitting fees, and Contingency fees. Based on percentage of construction cost.

- Land Acquisition – total cost for City to purchase any real property or easement rights to lands for implementation of project. Based upon average cost of acre of land within CRA.

- Operation and Maintenance Costs – total annual costs to City to ensure projects continued performance in accordance with original design after completion of construction. Based upon percentage of construction cost or estimate annual cost.

See Appendix E for the Project Cost Analysis and supporting documentation.

d. Equivalent Annual Cost

Upon determination of the total construction cost for each project, the equivalent annual cost (EAC) of each project is required in order to compare projects. The

EAC approach annualizes the construction, capital, and land acquisition costs (if any) of a project so it can be added to the annual O&M costs to obtain a total cost per year.

For this analysis, a 10-year analysis period and an interest rate of 7.5% was utilized. Unit costs were calculated by dividing the EAC by the total mass of Phosphorous and Nitrogen removed on an annual basis.

e. Project Ranking Results

The results of the project rankings are contained within Table 7 below. This table presents the results of the four ranking methods as identified above. The final ranking results were based upon the overall ranking score of each project.

However, given the requirement to achieve 33% of the pollutant load reduction within 5-years, cost/funding may become the overriding factor in terms of which projects can be funded. As a result, an adjusted ranking may be required upon development of the 5-year Capital Improvement Program.

Table 7: Project Rankings

Treatment Area	Load Reduction Ranking (1)	Unit Cost Ranking	Redevelopment Priority Ranking	Overall Score
1	25	25	21	71
2	25	25	20	70
3	14	9	11	34
4	25	25	12	62
5	13	4	5	22
6	8	10	16	34
7	9	11	10	30
8	3	14	4	21
9	2	18	3	23
10	25	25	28	78
11	10	19	1	30
12	20	17	18	55
13	17	3	23	43
14	21	1	22	44
15	25	25	17	67
16	6	6	15	27
17	15	7	9	31
18	7	15	8	30
19	4	13	2	19
20	5	12	13	30
21	1	8	7	16
22	12	16	6	34
23	19	5	24	48
24	25	25	27	77
25	16	2	25	43
26	18	20	19	57
27	25	25	26	76
28	11	21	14	46

(1) Seven treatment areas provided zero load reduction. These areas were assigned average ranking of 25.

Due to existing soil and groundwater characteristics, it was determined that BMP measures at upstream points within the CRA's treatment areas would provide the greatest overall benefit. These measures would achieve this benefit for the following reasons:

- Upstream BMP measures would be expected to address downstream flooding problems through the implementation of TMDL reduction measures with runoff volume reduction attributes;

- Upstream BMP measures that were integrated into the streetscape efforts would effectively achieve both redevelopment and pollutant reduction goals.

Because of this point, the location of the BMP measure should be considered when evaluating the project priority ranking results.

In addition, FDEP will require a 33% City-wide TMDL reduction within 5 years of the acceptance of the Banana River Lagoon BMAP. Any prioritization schedule would therefore need to factor in this required reduction when determining which projects to implement within the first 5 years.

As such, the recommended 5-year project prioritization schedule is as defined with in Table 8.

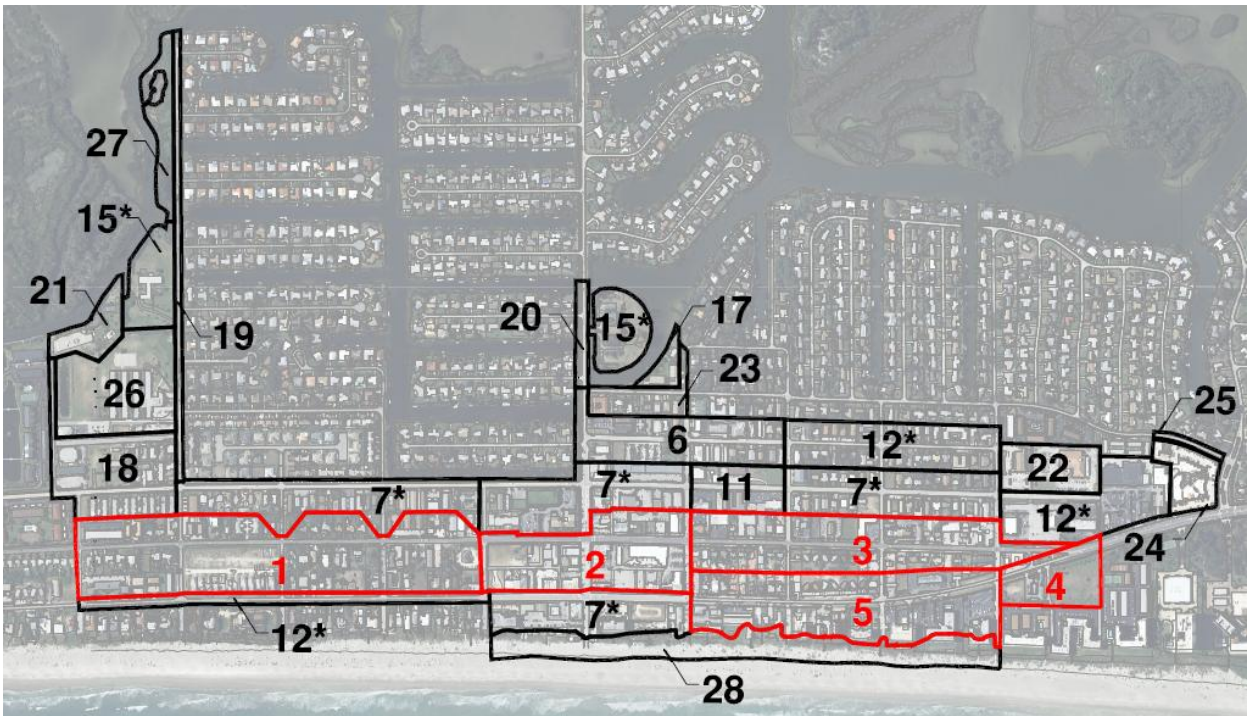
Table 8: Recommended 5-Year Project Prioritization Schedule

Priority	Treatment Area	Load Reduction Ranking	Unit Cost Ranking	Redevelopment Priority Ranking	Overall Score	Cumulative % TMDL Reduction*
1	21	1	8	7	16	15.33%
2	19	4	13	2	19	21.89%
3	8	3	14	4	21	30.47%
4	5	13	4	5	22	32.97%
5	9	2	18	3	23	42.61%
33% TMDL Reduction Met						
7*	11	10	19	1	30	46.85%
12*	22	12	16	6	34	52.18%

*Must meet 33% TMDL reduction within 5 years

The five (5) treatment areas with the best overall score are located along the Atlantic Avenue and Orlando Avenue corridors, and will satisfy the 33% TMDL reduction requirement. However, the improvements within treatment areas 11 and 22 have been recommended, despite their lower priority, as they would most likely be constructed as part of projects associated with Atlantic Avenue and Orlando Avenue. The map below summarizes the priority of each treatment area as determined by the rankings defined previously. The five (5) treatment areas that

are to be completed to satisfy the 33% TMDL reduction requirement have been highlighted in red.



*Tie in overall score (7th, 12th, & 15th)

E. RECOMMENDED MANUFACTURERS

Two (2) main BMP measures were proposed to achieve the pollutant load reduction within the CRA. These BMPs utilize specialized products to achieve the stormwater management and TMDL reduction requirements. The following identifies specific product manufacturers for these products. Product information for these products in contained within **Appendix F**.

a. Underground Storage Systems

- Rank Tank – ACF Environmental
- StormTech Chambers – StormTech, LLC
- Rainstore – Invisible Structures, Inc.

b. Pervious Pavers

- Turf Cell - ACF Environmental
- Geoweb Cellular Confinement System – Presto
- Geopave Porous Pavement – Presto
- Aquaflow Pervious Paver System – Hanson

END OF REPORT