Historic Fellsmere Stormwater and Flood Control Master Plan

January 2014

Prepared by:
City of Fellsmere
22 S. Orange St.
Fellsmere, Florida 32948

with support from:

Carter & Associates, Inc.
Consulting Engineers & Land Surveyors
1708 21st Street
Vero Beach, Florida 32960

and

Hartley Surveying, Inc
283 Tiger Lily Court
Altamonte Springs, Florida 32714

with funding provided by:

St. Johns River Water Management District through the
Indian River Lagoon National Estuary Program

and generous contributions from:

The Fellsmere Water Control District
The City of Fellsmere
The Mirzam Group

EXECUTIVE SUMMARY

The City of Fellsmere was originally developed prior to modern flood control and stormwater treatment. Within the historic 2-square mile area of the City (the study area), a majority of the stormwater drains directly to public conveyances without treatment and is discharged into the Fellsmere Main Canal leading to the Sebastian River and Indian River Lagoon. As part of a 16,257-acre gravity drainage system, the historic area of Fellsmere continues to experience flood events during heavy rains and suffers from a lack of water quality treatment systems within its original system of swales, ditches, and canals.

The Historic Fellsmere Stormwater and Flood Control Master Plan (the Plan) addresses stormwater needs within the historic area of Fellsmere and identifies numerous strategies to improve stormwater management. The objective is to create a Stormwater and Flood Control Master Plan which defines a series of stormwater projects, public education, and regulatory controls that, once implemented, will result in the City's stormwater discharge meeting current federal, state, and local regulations while enhancing flood protection. This objective conforms to the action plans outlined in the Indian River Lagoon Comprehensive Conservation and Management Plan and the Surface Water Improvement and Management Plan to develop and implement strategies to address the impacts of freshwater and stormwater discharges on the resources of the Indian River Lagoon.

The analysis of stormwater and flood control needs within the study area utilized a regional stormwater model maintained by the Fellsmere Water Control District (FWCD). This regional model determines flood stages within the entire 16,257-acre gravity system at key points along the drainage ditches. The analytical model was recalibrated for this effort with LIDAR topography at six-inch contours. A total of five model runs were conducted. Model #1 entailed the recalibration of existing conditions. Model #2 assumed no additional capital projects but complete build-out of the historic area of Fellsmere. Model#3 included the main capital programs identified within this study including two regional lakes, roadway and alleyway drainage improvements, and a New York ditch diversion system. Model #4 included two additional regional lakes along FWCD ditches #14 and #18, and Model #5 identified additional regional lakes along FWCD ditches #15, #16, and #17 such that all ditches accepting stormwater within the study area were served by a stormwater and flood control regional lake. Although not modeled, a system of culvert replacement along New York Avenue was also considered as a final means to achieve the City stormwater and flood control goals.

The City goal for stormwater and flood control is to maintain the flood stage of the 100-year storm below the finished floor of homes and businesses and off the travel lanes of the main business corridor, North Broadway Street. In addition, the creation of a Stormwater Utility and Master Redevelopment Permit is envisioned to allow treatment, storage, and flood control within publicly owned regional systems for the benefit of small infill and redevelopment parcels. Based upon the results of the modeling efforts, the City has identified nearly $20Million in capital needs. An implementation schedule was developed to prioritize the recommended capital projects given the limitations of potential funding. Funding sources assumed receipt of grants to fund the construction of the two regional lakes, roadway paving and drainage improvements, and other improvements through economic development and recreation based grant programs. Local funds were derived from infrastructure taxes to support the grant required local matches and the recently implemented Stormwater Utility for ongoing operation and maintenance. Over a ten year period, assuming an aggressive grant program, approximately $10Million in revenues are anticipated. Over the initial ten year period of the plan, a deficit of over $9Million exists to fund the City's goals for stormwater and flood control within the study area.

As part of the development of this plan, the City reviewed ongoing regulatory and public education efforts to determine additional actions that could be taken to further enhance the water quality leaving the City and mitigate flood risks. After an extensive review of the existing regulatory controls for pet waste, fertilizer, irrigation, and stormwater management, the City concluded that current regulatory regimes are consistent with best management practices in these areas. The City will continue to work with federal, state and county programs to expand educational efforts for both flood prevention and stormwater quality.

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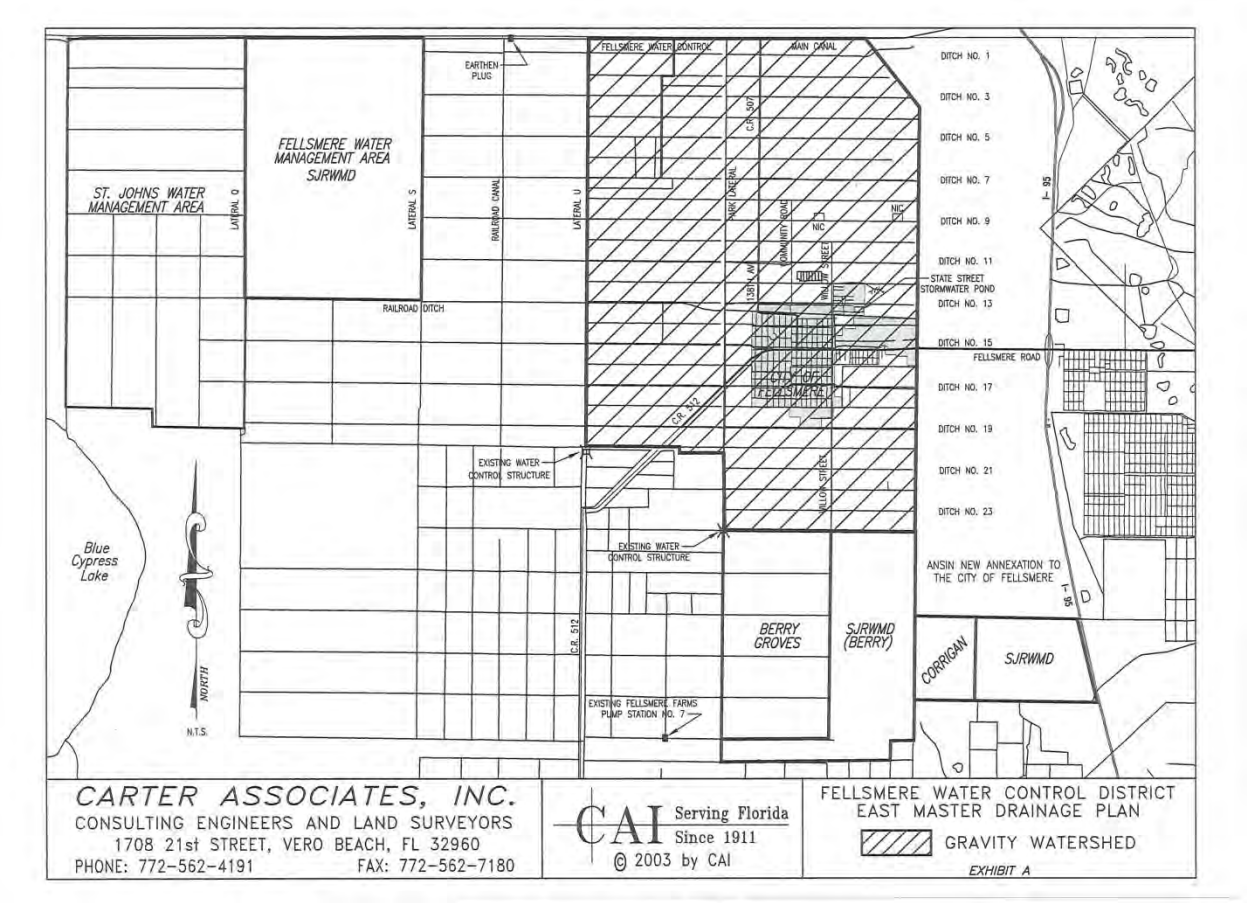
I. Introduction

The City of Fellsmere (City) is located in Indian River County and was platted and developed prior to modern flood control and stormwater treatment. Most development drains directly to roadside swales and/or pipe systems outfalling into one of the east-west sub-lateral ditches that then discharge into the north-south Park Lateral ditch. This system of public conveyances then discharges into the Fellsmere Main Canal leading to the Sebastian River and Indian River Lagoon (IRL). Development of a Stormwater and Flood Control Master Plan (the Plan) will identify action items for implementing non-point pollution prevention, flood control, and public education and outreach. The immediate area of influence will be the historic area of the City, approximately 2-square miles in area, as shown in Figure 1. The study area depicted in Figure 1 operates within a larger 16,257-acre gravity drainage system as shown in Figure 2. To effectively analyze the operation of the stormwater system within the study area, the analysis also considered the entire gravity drainage system in which the study area functions.

The objective of the study is to create a Stormwater and Flood Control Master Plan which defines a series of stormwater projects, public education, and regulatory controls that, once implemented, will result in the City's stormwater discharge meeting current federal, state, and local regulations while enhancing flood protection. This objective conforms to the action plans outlined in the Indian River Lagoon Comprehensive Conservation and Management Plan and the Surface Water Improvement and Management Plan to develop and implement strategies to address the impacts of freshwater and stormwater discharges on the resources of the Indian River Lagoon. The City's stated stormwater and flood control goal is to maintain flood waters out of homes and businesses and out of the travel lanes of the historic commercial district along North Broadway Street.

Figure 1: Study Area

Figure 2: FWCD Gravity Drainage System



II. Data gathering and analysis

The City utilized a combination of existing survey data, collection of limited original survey data, and comprehensive LIDAR topography over the entire 16,257-acre gravity drainage system to establish current conditions and to adequately reflect existing local area drainage basin parameters for hydrologic/hydraulic analysis. Conditions at build-out within the study area were also developed for historical lots of records that are not required to accommodate on-site stormwater needs and for infill parcels that are too small to economically accommodate such needs.

Topographic Survey

For development of the Plan, the City purchased LIDAR topography at 6-inch intervals reflecting a 3" margin of error. The LIDAR topography was flown between March 19, 2011 and March 24, 2011 by Eartheye, Inc. and processed by Hartley Surveying between April 2011 and June 2011. Quality control of the resulting data was performed over the course of March 2013 through July 2013 utilizing the 220 Fellsmere Water Control District (FWCD) drainage sub-basins as a means of data management and display. The LIDAR topography was enhanced through the use of existing survey data from completed City projects and through the collection of limited original survey data along the ditches fronting the two proposed regional lakes to estimate the size and water control elevations for the two regional stormwater lakes to prepare conceptual lake designs. The data was then analyzed to develop stage area data per sub-basin to be used as inputs to the stormwater model. A copy of the LIDAR topography and FWCD sub-basin stage area data for each FWCD drainage sub-basin is contained within the disc located in Appendix A. The stage area data for this study replaced stage area data utilized for the original 2002 FWCD Water Control Plan, which was derived from spot elevations taken on a 300' grid throughout the gravity

drainage system. The LIDAR data and resulting stage area data represent a significant improvement to the accuracy of the topographic information.

Roadway Improvement Design

To develop typical roadway and alleyway cross sections, the Consultant met with City staff and reviewed regulatory standards in relation to pavement width, shoulders, sidewalks, and swale slope requirements to minimize the stormwater needs of the roadway system. Recommended typical sections were presented to City Council and the general public at the first public workshop on May 11, 2013 and subsequently endorsed by Council. Figures 3 through 6 present the endorsed typical sections for the balance of the road paving projects in the City. The Consultant also prepared a roadway condition map (Figure 7) portraying the remaining unpaved roads within the City. Larger print versions of the cross-sections can be found in Appendix A.

Figure 3 represents the typical section that will be utilized north of CR512 and east of Broadway within the 60' road rights-of-way. The design utilizes a combination of swales and inlets to collect stormwater and diverts the flow via a system of underground pipes north to the Railroad ditch in lieu of the New York ditch (sub-lateral #14) since the capacity of the New York ditch is a limiting factor in flood control north of CR512. This ditch diversion is carried forward in Model #3 and all subsequent modelling efforts as will be detailed further in Section III Identification of Water Management and Flood Control Improvements. The swales, in addition to the alleyway swales presented in Figure 6, provide positive drainage for all residential historic lots of record in this portion of the study area and provide important stormwater storage during flood events.

Figure 3: 60' Right of Way Typical Road Section – North of CR512

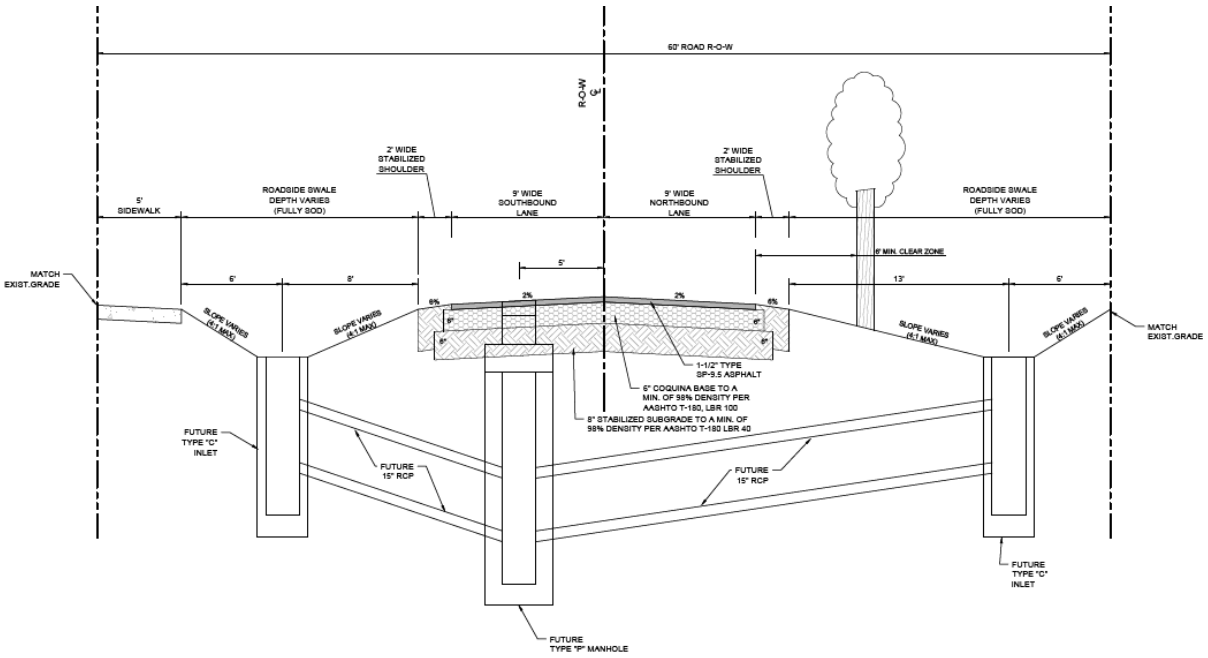


Figure 4 presents the typical section that will be utilized south of CR512 and east of Broadway within the 60' road rights-of-way. The design utilizes roadside swales as the means to direct such flows to the nearest sub-lateral ditch. The swales, in addition to the alleyway swales presented in Figure 6, provide positive drainage for all residential historic lots of record in this portion of the study area and provide important stormwater storage during flood events.

Figure 4: 60' Right of Way Typical Road Section – South of CR512

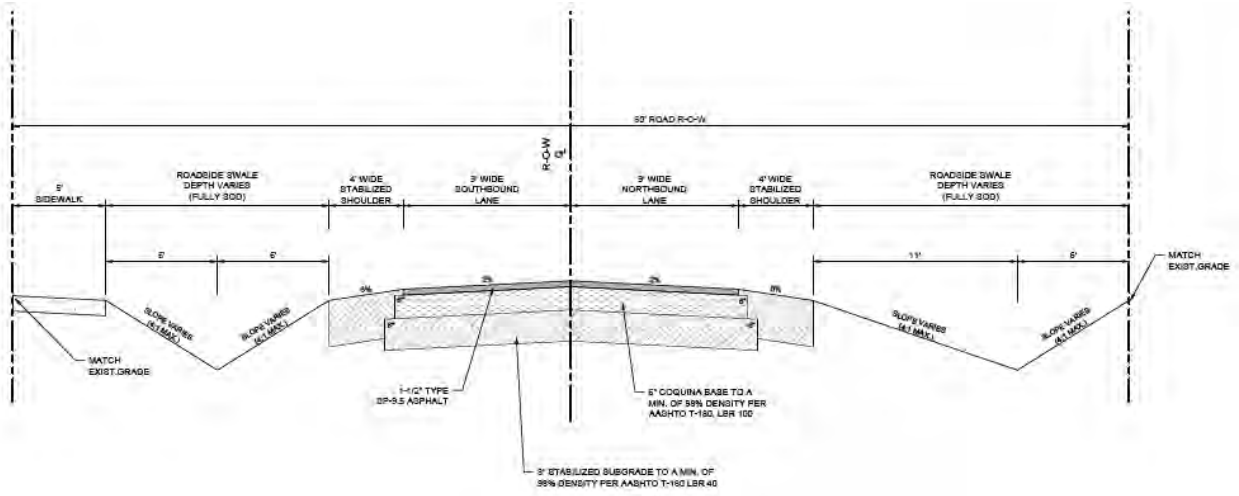


Figure 5 presents the typical section that will be utilized north and south of CR512 west of Broadway within the 80' road rights-of-way. The design utilizes roadside swales as the means to direct such flows to the nearest sub-lateral ditch. The swales, in addition to the alleyway swales presented in Figure 6, provide positive drainage for all residential historic lots of record in this portion of the study area and provide important stormwater storage during flood events.

Figure 5: 80' Right of Way Typical Road Section

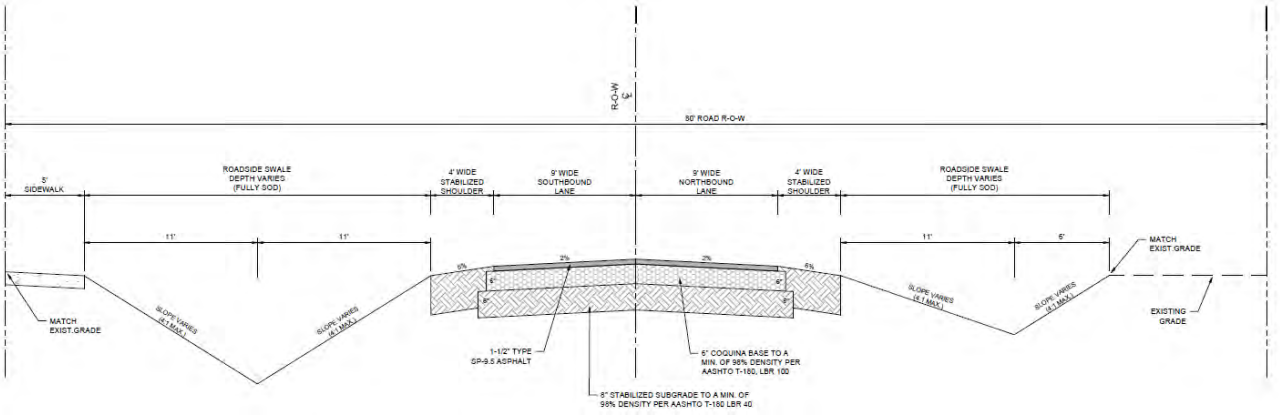
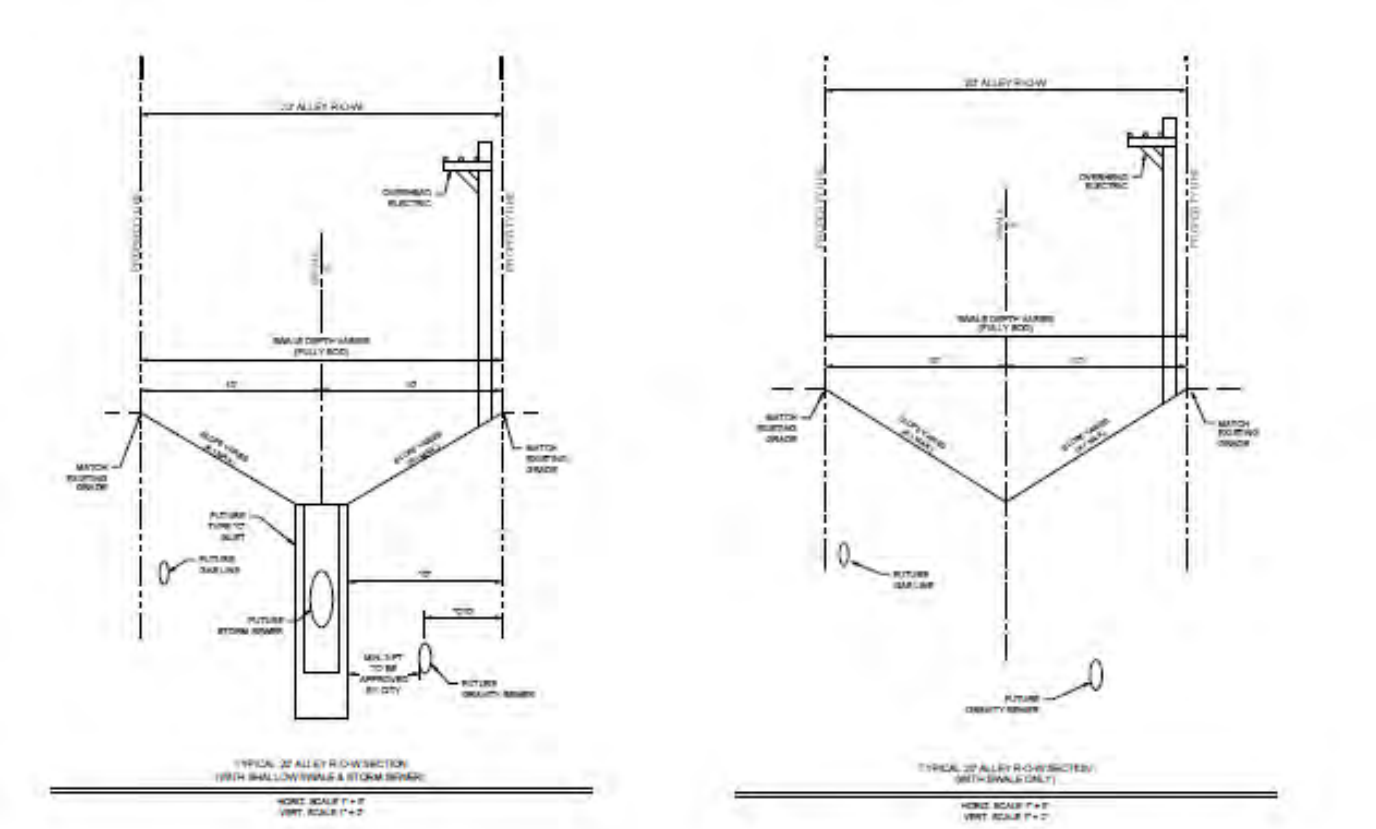


Figure 6 presents the typical section that will be utilized within alleyways that exist in a majority of the study area. Although only the 20' alleyway section is presented, a similar design is also utilized for the 15' wide alleyways. In the study area, alleys east of Broadway are 15' wide; whereas, alleys west of Broadway are 20' wide. This is similar to the varying roadway widths wherein roadway rights-of-way are 80' wide west of Broadway and only 60' wide east of Broadway. The design utilizes alleyway swales as the means to direct stormwater flows to the nearest sub-lateral ditch. An alternative piping concept is shown for alleyways in which the City determines vehicular access is desired. Alleyways accommodate approximately one-third to one-half of the stormwater discharge from residential lots of records.

Figure 6: Alleyway Typical Cross Section

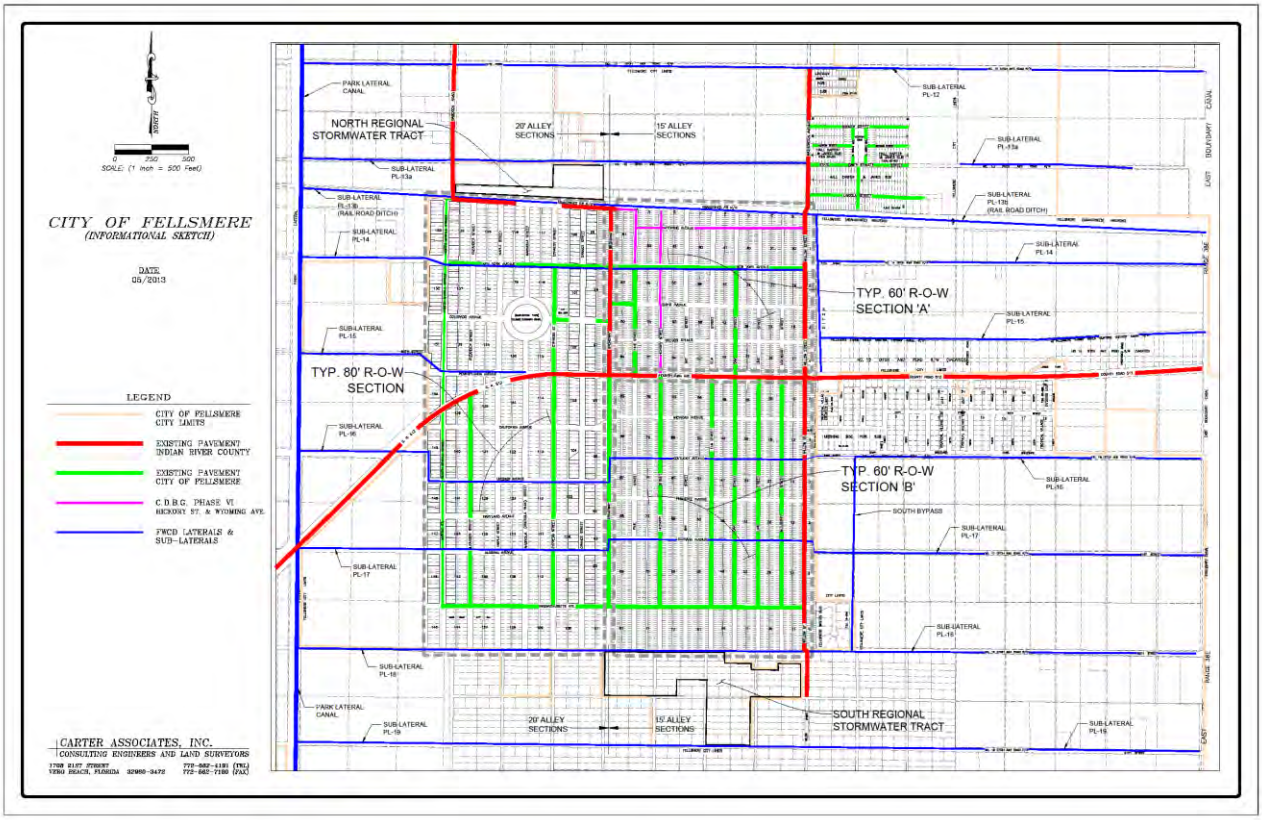


As mentioned earlier, the Consultant also prepared a roadway condition map (Figure 7) portraying the remaining unpaved roads within the original town plat of the City. This area represents the east-west and north-south roads that lie between Willow and Myrtle and South Carolina and Massachusetts, respectively. Additional paved and unpaved roads lie within the study area such as 89th Street at the south end of town and 97th Street, which is the eastern extension of New York Avenue. All told, within the study area, approximately 30.5 miles of roadways are maintained by either the City of Fellsmere or Indian River County. A breakdown of this mileage by ownership/maintenance responsibility and pavement status is provided in Table 2. The historic area of Fellsmere contains approximately 16.5 miles of unpaved streets. Although these streets are graded regularly and contain roadside swales, they often have substandard or aging, dilapidated culverts and outfalls resulting in poor drainage conditions. The City has made steady progress over the years paving the remaining unpaved streets and improving the drainage system at that time. As part of each paving project, all culverts are replaced, each sub-lateral ditch crossing is replaced, and all outfalls are replaced. In addition, the entire swale system is expanded in depth and width and re-graded to provide a greater positive flow and storage. On streets that have been paved, drainage has been markedly improved.

Table 1: Status of Street Paving

Entity	Miles
City Paved	9.6
City Unpaved	16.0
County Paved	4.4
County Unpaved	0.5

Figure 7: Roadway Conditions Map



Coordination Meetings

To address overlapping jurisdictional issues, the Consultant met with the FWCD to discuss the plan development. A similar meeting was held with City staff, the Consultant and staff from the St. Johns River Water Management District (SJRWMD) to discuss the City's ideas in relation to public/private partnerships as a means to address stormwater and flood protection. The meeting with the SJRWMD was followed up with email communications to ensure clarity and commence the process of informal review to implement agreements for specific public/private partnerships sought by the City. A summary of the meeting discussions is provided below.

> Subject to technical justification, the District will consider a permit to the City that allocates a portion of the treatment capacity of a public regional stormwater lake to meet the drainage needs of private property. Two ways were discussed. One involved designating a specific area of the City that would be allocated to a lake, and the other involved simply tallying the stormwater treatment credits of a regional lake and allowing them to be used on a first come, first serve basis by private parties. The first method was deemed to be the easiest of the two to quantify as the lake would act like any stormwater treatment system designed to serve a specific development program. The City was charged with drafting some language for the District's attorneys to review that would address issues such as maintenance responsibilities of all parties, authorizations to join such systems and make permit applications, etc. On the second of these options, from a technical perspective, the treatment benefits of a regional lake must be demonstrated, particularly if the lake is prior to the discharge point of the private party. In this case, since all stormwater emanating from the City ends up at the same point via a system of ditches and canals prior to discharging into the Sebastian River, water coming into a regional lake from uses prior to the lake could be treated, and then, the load from the new private development could be added after the lake as long as a net benefit to water quality is achieved. Water

quantity issues must still be addressed as well. Finally, the City was informed that two methods are available to address water quality: the standard method and the nutrient method. Most thought the nutrient method would be more beneficial in this case.

Approvals needed for an individual parcel from the District would still be required. The level of water quality and quantity provisions in the City's permit would determine the level of facilities to be provided by the private developer. Although water quality and flooding may be addressed by the City's permit for a private parcel, any wetland issues on the parcel will still need to be addressed. This could be done through a permit for the parcel development (leaving to the developer to handle), but may also be addressed through the City's master permit.

Finally, the City introduced the District to their plans of obtaining easements over all private stormwater systems so that in the future, if there is ever a benefit to combine such systems to utilize the upland space between adjoining systems as additional storage capacity, such permissions would already be in place. Such systems would be ideal to reserve capacity for future road widening along CR512 as separate drainage systems will be lining CR512 as development continues to fill in lots. Issues were discussed about the need to address issues such as maintenance responsibilities of all parties, authorizations to join such systems and make permit applications, etc. Draft language of the easements was requested to run by the District attorneys to see if such language would be sufficient to allow the City to unilaterally amend the permits in the future without the need for property owner sign-off.

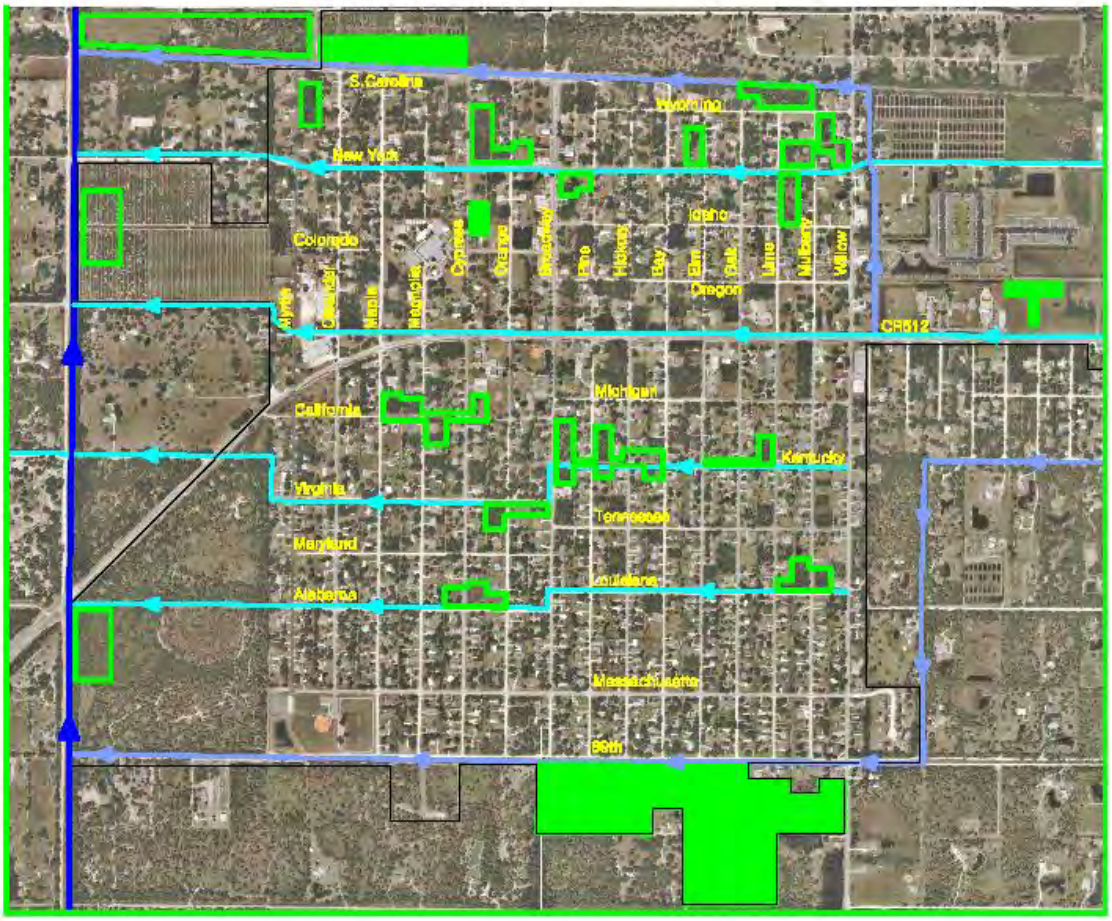
Upon completion of the Plan and as funds are programmed to commence construction of the regional stormwater lakes, the City will begin earnestly coordinating with the SJRWMD to implement a permit structure.

Regional Stormwater Lake Access and Data

The City's primary means of stormwater control and flood protection is in the creation of regional stormwater lakes to detain stormwater for flood protection and water quality treatment prior to release into main canals and eventual outfall into the Sebastian River and Indian River Lagoon. As shown in Figure 8, a series of sub-lateral ditches (east-west ditches) run through the City. Stormwater is conveyed via roadside swales and piping systems to these ditches that in turn drain west to a larger north-south lateral ditch called Park Lateral (dark blue line on Figure 8). Due to the increased impervious areas within the City as compared the rural agricultural areas that comprise the balance of the gravity system, all flows within sub-lateral ditches #14 through #17 are diverted around the historic area of the City through ditch #18 to the south and the Railroad ditch to the north. The only flow within ditches #14 through #17 are flows emanating from development within study area.

A series of sites were investigated as potential candidates for regional lakes with consideration given to sites currently under governmental control or sites within the City on large tracts of land where the City may seek public/private partnerships for their creation. Figure 8 presents the multitude of sites considered for this initial iteration of the plan. Eventually, after discussions with various land owners and consideration of location and potential efficiency of the sites, two parcels were selected for the specific analysis to be conducted as part of the plan development. These parcels are shown in solid green color on Figure 8. A second tier of sites was then considered for additional storage and treatment as part of the final model runs as discussed later in the Plan. As will be discussed in Section III Identification of Water Management and Flood Control Improvements, the study also considers the benefit of additional lake locations along the west end of each sub-lateral ditch within the study area as a means to meet the ultimate goals of the City for achieving stormwater and flood control. Existing site conditions for the two selected regional lake sites are contained in Appendix A.

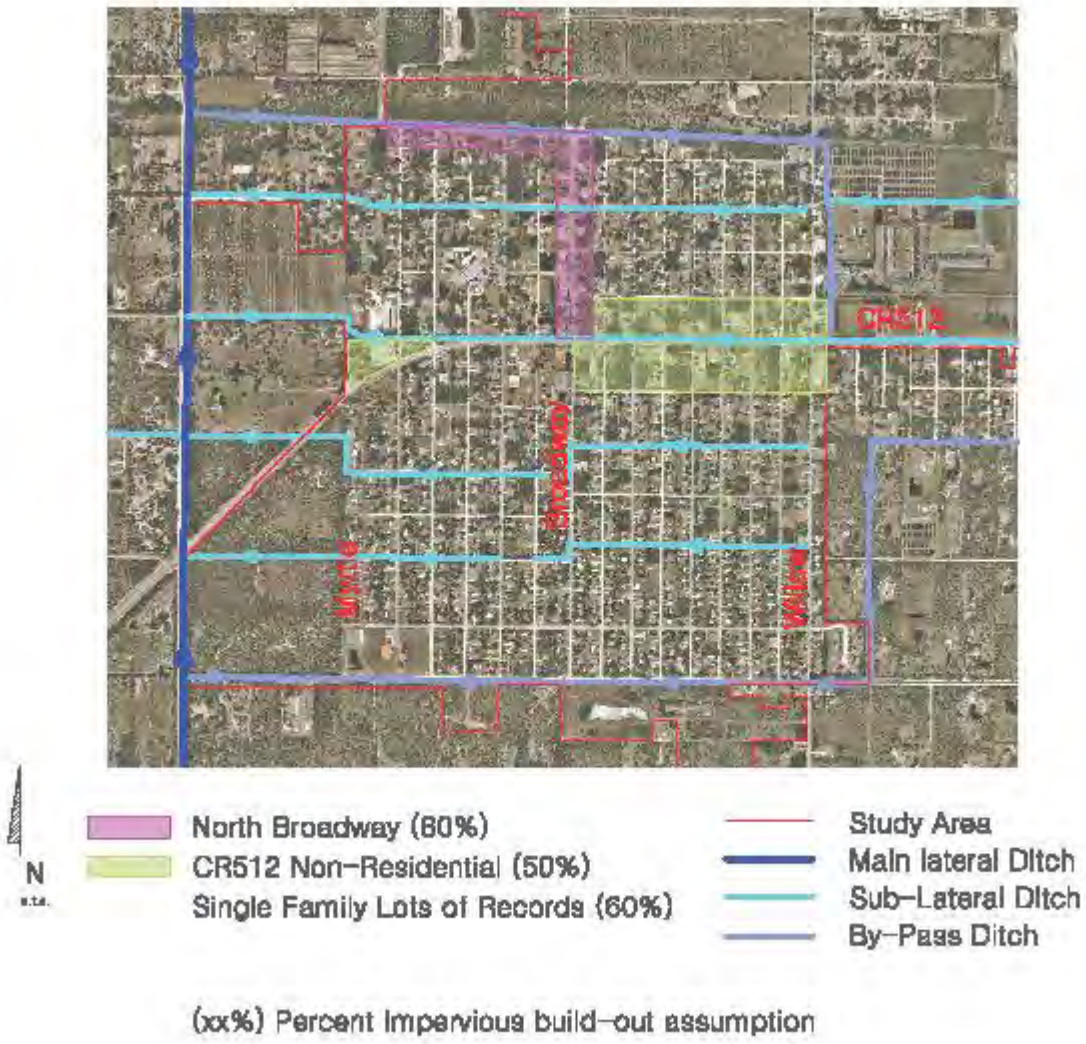
Figure 8: Potential Regional Lake Candidate Sites



Post Development Conditions

As presented earlier, the historic area of Fellsmere developed prior to modern-day stormwater regulations. Even today, residential historic lots of record are not required to provide stormwater treatment and are not part of a larger comprehensively designed stormwater treatment system. In addition, a majority of the historic nonresidential lots along North Broadway and CR512 are too small to accommodate stormwater systems given the high water table that exists in Fellsmere and limited lot sizes. To address the stormwater and flood control needs of these parcels, a build-out of both the residential and nonresidential areas was identified for the modeling efforts performed in this study. Figure 9 presents a graphic depiction of the build-out scenario utilized in this study. Historic residential lots of record are assumed to build-out with a 60% lot coverage. Historic nonresidential lots of record along North Broadway Street are assumed to build-out with a 80% lot coverage. Finally, nonresidential parcels along CR512 from Myrtle Street to Willow Street were assumed to build-out at 50% lot coverage. These guiding assumptions were converted to the model inputs in the form of runoff curve numbers for each sub-basin of analysis. The land areas depicted in Figure 9 are not assumed to provide any on-site drainage facilities within the modelling analyses.

Figure 9: Post Development Conditions



III. Identification of Water Management and Flood Control Improvements

Based on analyses and examination of existing conditions for selected design events (25-year and 100-year), including an examination of existing conveyance and retention/detention facilities, modifications were developed to correct identified deficiencies and provide enhancements to water quality treatment and flood control. Hydrologic/hydraulic analysis of the proposed modifications within each basin was performed to confirm adequacy and appropriateness of such modifications. This section provides a summary of the modeling efforts, including model assumptions, along with a summary of the modeling results given the proposed modifications reflected in each model run.

Hydrologic Modeling

The plan includes the important task of computer modeling the proposed regional stormwater lake improvements to evaluate the peak stage reductions that each lake will produce. The computer model is based on the "Fellsmere Water Control District (FWCD) East Hydrologic Analysis of the Gravity Drainage System" originally completed in 2002. Given the various changes in the FWCD system since 2002 and the opportunity to incorporate the recently flown and more accurate LIDAR topography, the decision was made to update the FWCD model as part of this Plan. The FWCD and the City of Fellsmere jointly funded the update to the FWCD model.

The FWCD drainage model utilizes the Interconnected Channel and Pond Routing, Version 3.1 (ICPR) software. The updated FWCD model was then used as a baseline to evaluate the improvements from the proposed lakes. The following steps were followed to complete the ICPR model update and the evaluation of the proposed stormwater and flood control improvements.

Step 1 – Develop Model #1

The 2002 model was updated to include refinements to the input data noted below. The model was then recalibrated to closely match the peak stage elevations observed during the Hurricane Frances event. This model is named Model #1 and includes the impervious areas and drainage improvements observed in 2004 at the time of Hurricane Frances. A summary of the results from this calibration model run are contained in Appendix B.

1. The topographic survey of existing ground elevations throughout the watershed were updated based on the LIDAR topography (see the survey certification in Appendix 1).
2. The elevations are now based on the NAVD 88 datum rather than the NGVD 29 datum used in the 2002 model. The datum update was needed to match the datum used in the recently updated FEMA Flood Insurance Rate Maps. Also, most governmental agencies require new projects to be designed and permitted using the 1988 datum.
3. Miscellaneous basin area adjustments and added two additional gravity connections.

Step 2 – Develop Model #2

Bring Model #1 up to 2013 conditions and insert an assumed build out condition for the historic Fellsmere area. The results of this model are the baseline for comparing the peak stage reduction benefits obtained from the proposed improvements. Model #2 was created using Model #1 as the basis and includes the following adjustments to the input data.

1. Impervious areas within the Historic Fellsmere area were increased to reflect the full development of houses, roads, and commercial uses on the remaining land. A 60% lot coverage was assumed for historic residential lots of record, an 80% lot coverage for lots along North Broadway Street, and a 50% lot coverage for lots along CR-512 between Myrtle St. and Willow St.
2. LIDAR topography for existing grades were adjusted based on an assumption that fill would be placed to bring future building sites up to 18" above adjacent roads.
3. Impervious areas within the unincorporated County were not changed based on the assumption that any development in these areas would provide standalone stormwater systems that would offset any negative impacts that site related impervious areas and fill would create.
4. Pipes replaced between 2002 and 2013 in the FWCD sub-laterals were updated to reflect the new size, length, and material type in the model. For the most part these pipes were replaced in conjunction with the City of Fellsmere program of street paving and drainage improvement projects.
5. Some of the large site plans submitted, approved, and constructed between 2002 and 2013 were included in the input data.

Step 3 – Develop Model #3

Modify Model #2 to include the proposed North and South Regional Lakes.

1. The preliminary lake designs were used to develop the input data for the stage storage and outfall structures.
2. An existing 48" diameter pipe along the South Bypass ditch just west of the proposed south lake outfall was increased to a 60" diameter pipe.
3. 18" diameter diversion pipes between New York Ditch (FWCD Ditch #14) and the North Bypass Ditch (Railroad Ditch) were included on six (6) north-south roads between Broadway and Willow.

Step 4 – Develop Model #4

Modify Model #3 to include two additional regional stormwater lakes along FWCD Sub-lateral Ditches #14 and #18. The City of Fellsmere has some interest on parcels along these two sub-laterals. The parcels were annexed into the City over the last 10 years, and the plans are to build regional stormwater lakes on them. Both parcels are located near the west end of the sub-laterals where they connect to Park Lateral. These locations are ideal to construct a lake since they are near the downstream end of the respective sub-lateral watershed. In each case the sub-lateral(s) will be connected to a stormwater lake. The lake will provide off-line storage for the rainfall runoff before it discharges into the FWCD Park Lateral Canal.

1. Each lake is assumed to be constructed on a five (5) acre tract.
2. A 15 foot perimeter maintenance road located at the top of bank is provided
3. The lake slopes are 4(H): 1(V) and the control elevation is ±9 feet below the average natural ground.
4. A low diversion weir was added to each drainage sub-lateral to divert lower flows into the lakes while allowing for an overflow during major events.

Step 5 – Develop Model #5

Modify Model #4 to include three additional regional stormwater lakes along FWCD sub-lateral ditches #15, #16, and #17. The concept is to provide some treatment and flood plain storage on all sub-laterals which drain the historic Fellsmere watershed while continuing to bring the peak stage elevations down to meet the City's stormwater and flood control goals. The City of Fellsmere does not have an interest in the parcels needed to build the improvements at this time; therefore these lakes are not included in the Model #4. These remaining lake improvements will follow the construction of all lakes noted in Model #4; however, their size was adjusted to ensure the resulting stormwater and flood control are sufficient to meet the City's flood protection goals of maintaining water out of homes and businesses and maintaining water off of North Broadway. Fellsmere may decide to acquire parcels to build larger or smaller lakes as opportunities arise. As an unfunded component of the Plan, as will be discussed in Section VI Implementation Schedule, time exists to evaluate the level of service obtained from prior projects. This model includes all the proposed lake input data assumptions as Model #4 and the additional assumption that the City of Fellsmere can obtain land along each sub-lateral.

Hydrologic Model Assumptions

The hydrologic model input data was based on the above noted information to the extent possible. However, due to budget and time restraints some assumptions were adopted to complete the input data requirements. The assumptions are based on engineering judgment and site observations and are the same for typical reach and basin inputs within the model. Some of the assumptions are noted below:

1) A limited seepage from the ground water into the drainage system is provided.
2) The boundary node (NF-10) is located in the Fellsmere Main Canal immediately downstream of the weir structure (RF-10). The boundary condition water level is assumed to start at a 1.5 and rise to a 3.0 NAVD 88 for the 25-year event based on a review of the FEMA Maps for the Sebastian River**,** (ref. Map 12009C0710 E). The boundary condition for the 100-year event starts at elevation 3.0 and raises to elevation 4.5 NAVD 88.
3) The storm events modeled include a 25-year/ 24-hour (9.2 inch) storm with a SCS Type 2 distribution and a 100-year/96-hour (15 inch) storm with a SJRWMD 96 hour distribution.
4) Typical grove areas are modeled with a Cn of 72, utilizing a Santa Barbara Hydrograph, Tc= 30 minute and an initial water level in the grove ditches of 4 feet below natural ground. The groves are modeled with stage/area curves based on a grove bed/furrow system.

5) Typical pasture areas are modeled with a Cn of 74, a peaking factor of 256, Tc = 60 minutes, and a typical stage/area curve adjusted to average natural ground.
6) Residential areas are modeled with a Cn of 86.8 at build out south of C.R. 512 where the lots are smaller and 86.3 north of C.R. 512, a peaking factor of 323, and a stage/area curve adjusted to average natural ground.
7) Ranchette areas are modeled with a Cn of 78, a peaking factor of 323, Tc=34 minutes, and a 0.5-acre pond in each 5 acre sub-basin.
8) Wooded areas have a Cn of 70, peaking factor of 256, stage/area curve adjusted to natural ground.
9) Basins with more than one ground type previously mentioned vary from the typical as the numbers were combined using a percentage basis and engineering judgement.
10) Model #1 utilizes lower curve numbers in the residential and ranchette areas by closer approximating the current impervious areas present at this time.
11) Pipes have been modeled with a bottom clip to represent the typical sediment deposit in the invert of pipes. Entrance and exit losses are assumed to be 0.5 and 0.95 respectively.
12) The basin pipe connections to the sub-laterals are modeled as typical 12" CMP. One pipe is provided for each 5 acres of residential area, one pipe per 10 acres of grove and ranchette developments, and one pipe per 20 acres of woods and pastures areas.

Stormwater Management & Roadway Drainage Improvements

Table 2 provides a list of modifications to existing conditions and facilities that are contained within the Plan to correct identified deficiencies.

Table 2: List of Modifications to Existing Conditions and Facilities to Correct Identified Deficiencies

Item	Notes
North 5-ac Regional Lake	Open water lake with littoral/upland plantings and recreation amenities
South 42-ac Lake	Wetland system flowing through existing open waters with littoral/upland plantings and recreation amenities
Roadway Paving	Pave remaining unpaved streets within the study area
Alleyway Grading	Regrade all alleyways within the study area to provide greater positive drainage and additional stormwater storage capacity
New York Ditch Diversion	Divert historical flows from New York ditch (Sub-lateral #14) to the Railroad Ditch through piping system
Two Additional 5-ac. Lakes	Open water and/or wetland system with littoral/upland plantings and recreation amenities
Three Additional 10-ac. Lakes and increase prior Lakes to 10 ac.	Open water and/or wetland system with littoral/upland plantings and recreation amenities
Micro Systems	Conversion of upland areas between private systems for additional capacity and creation of stormwater greenways along underused east-west dirt roads in south half of historic area
Culvert Replacement	Replace all existing culverts along New York Avenue (Ditch 14) with 66" RCP to reduce head loss to Park Lateral.
Operation & Maintenance	Over a ten year period.

Modeling Results

As presented earlier, the modeling efforts included a series of five model runs for each storm event. The storm events included a 25-year/24-hour storm and a 100-year/96-hour storm. The former is the standard storm event required for development projects; whereas the latter is the standard storm event in determining areas subject to Federal Emergency Management Agency mandatory flood insurance

requirements (i.e., areas located within the special flood hazard area or floodplain). The five model runs or scenarios are summarized again as follows.

Model #1
The initial model was simply a calibration effort to ensure that the updated data from LIDAR topography, conversion to NAVD 88 datum, and miscellaneous improvements through 2004, the base year for calibration, closely match the peak stage elevations observed during the Hurricane Frances event.

Model #2
Bring Model #1 up to 2013 conditions and insert an assumed build out condition for the historic Fellsmere area. Updates included impervious area assumptions of the study area as noted earlier, adjustments to LIDAR survey data for future building fill pads, piping adjustments for changes from 2004 through 2013, and incorporation of large site plans submitted, approved, and constructed between 2002 and 2013. The results of this model are the baseline for comparing the peak stage reduction benefits obtained from the proposed lake projects.

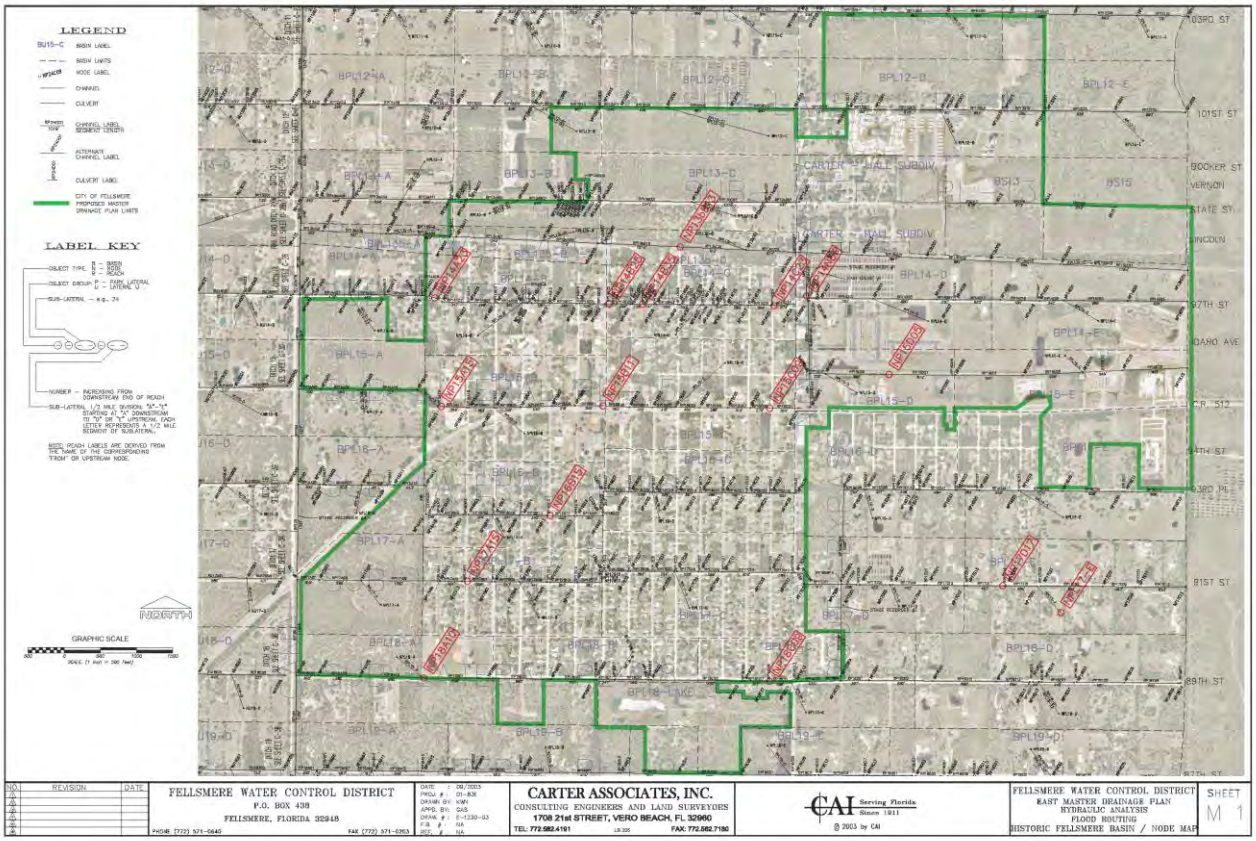
Model #3
Modify Model #2 to include the proposed North and South Regional Lakes. The preliminary lake designs were used to develop the input data for the stage storage and outfall structures including replacement of an existing 48" diameter pipe along the South Bypass ditch just west of the proposed south lake outfall to a 60" diameter pipe and inclusion of 18" diameter diversion pipes between New York Ditch (FWCD Ditch #14) and the North Bypass Ditch (Railroad Ditch) on six (6) north-south roads between Broadway and Willow.

Model #4
Modify Model #3 to include two additional regional stormwater lakes (±5 acres per lake) along FWCD Sub-lateral Ditches #14 and #18 including a low diversion weir added to each drainage sub-lateral to divert lower flows into the lakes while allowing for an overflow during major events.

Model #5
Modify Model #4 to include three additional regional stormwater lakes along FWCD Sub-lateral Ditches #15, #16, and #17 including a low diversion weir added to each drainage sub-lateral to divert lower flows into the lakes while allowing for an overflow during major events. The concept is to provide some treatment and flood plain storage on all sub-laterals which drain the Historic Fellsmere watershed.

In presenting the results, model output nodes throughout the study area where tracked to compare adjacent site grades to the peak stage elevation of stormwater within the conveyance sub-lateral ditches. Figure 10 presents the location of the various nodes used to portray the modeling results. These nodes vary both north to south and east to west throughout the study area and represent a broad range of real-life features found throughout the study area. For example, node NP14B25 represents the inlet grate elevation at the southwest corner of New York Avenue and North Broadway Street. This node was selected to gauge the success of the stormwater and flood control projects in keeping flood waters below the finished grade of North Broadway Street, the core of the City's redevelopment efforts. Please note, this grate is set within a specially designed catchment system that is at least 0.5 feet lower than the edge of pavement of the roadway in this area. In comparing peak stage elevations to this point, 0.5 feet are added to the grate elevation for logical comparison. Nodes NP15B11 and NP13bB13 are other nodes along North Broadway and general vicinity that can also be used to measure the success of the stormwater projects. As another example, Node NP18A10 and NP17A15 are elevations of natural ground at a City Park south of Massachusetts between Myrtle Street and Maple Street and centerline of the Oleander/Alabama intersection, respectively. These nodes can be used to measure the success of the stormwater and flood control projects in keeping flood waters below the finished floor elevations within residential areas. Other nodes such as NP16B15 and NP15A15 can also be used for this same measure. Each of these nodes use elevations that are comparable to lowest finished floor of homes in the respective areas of the City.

Figure 10: Model Output Nodes



This study did not survey the finish floor of any homes within the Study Area. Neither did this study review building permit records for the average elevation of permitted homes. All new construction is required to be elevated a minimum of 18" above the adjacent road grade, and due to the high water table and use of septic systems, the final grade is often much higher. In fact, homes are commonly raised as high as 3' above natural grade. Only historic homes developed prior to modern septic regulations may be lower than the noted standards. Through a drive-by survey of the study area, the lowest elevated home is approximately 12" above natural grade, which in some cases can be up to 6" to 12" below the centerline of the adjacent road. Consequently, keeping the peak stage elevation in residential areas at or below the adjacent road grade should meet the City's goal of keeping floodwaters out of residential homes. As funds allow, the City can enhance the measure of success of future stormwater projects by obtaining minimum control elevations (finished floor) per FWCD sub-basin – the smallest unit of measure within the modeling program.

The results of the five modeling scenarios for each storm event are reflected in Appendix III. In reviewing these results, two levels of consistency with the goals of the City were considered. Recall, the goals of the City are to 1) maintain flood water below the edge of pavement along North Broadway Street and 2) below the finished floors of residential and nonresidential structures within the study area. The first level of consideration was a direct comparison of the peak stage data resulting from the model output to the adjacent reference elevation. Since all drainage conveyance sub-laterals are hydraulically connected through outfall pipes to all areas within each FWCD sub-basin, the peak stage elevation within the sub-lateral ditches as reported in the model output can be used as a measure of the flood elevation within the sub-basin. The second level of consideration compared the peak stage data resulting from the model output with a 10% elevation surcharge to the adjacent reference elevation. The 10% surcharge was added to provide a factor of safety or freeboard to the analysis given the tailwater constraints floodwaters experience as they find their way to the sub-lateral ditches and to accommodate a factor of safety for general modeling assumptions.

Modeling Results - Residential

Within the residential areas of the City, the modeling results showed only two areas of potential concern. These areas are excerpted from the results contained in Appendix III and are presented in Table 3 below.

Table 3: Model Result - Residential Areas of Concern

100-year Storm Event

Node Name	Ref. Elev.	Location	Model #1	Model #2	Model #3	Model #4	Model #5
NP14B35	22.70	NY EOP b/w Pine/Hickory	23.131	23.414	23.230	23.218	23.170
NP16B15	23.25	CL Cypress/Virginia	23.224	23.280	23.230	23.221	23.102

25-year Storm Event

Node Name	Ref. Elev.	Location	Model #1	Model #2	Model #3	Model #4	Model #5
NP14B35	22.70	NY EOP b/w Pine/Hickory	22.998	23.154	22.886	22.864	22.755
NP16B15	23.25	CL Cypress/Virginia	22.920	22.944	22.837	22.816	22.622

Table 3 reflects considerable success in maintaining floodwaters below finished floor elevations of residential homes within the study area. Of the sixteen reference nodes, only one, the New York edge of pavement between Pine and Hickory, contains potential floodwaters above the centerline of an adjacent roadway. For the 25-year event, this excess is only 0.055 feet or two-thirds of one inch, certainly within the margin of error of the modeling efforts. For the 100-year event, this excess is 0.47 feet or approximately six inches of water above the centerline of the roadway. Older homes within this general area may experience some intrusion of water if their finished floors are less than six inches above the centerline of the roadway. A review of aerial photography and drive by surveys in this area reflects a number of older homes. Finished floors range generally from six to twelve inches above the road. However, without surveyed finished floor elevations of at risk structures, this study cannot determine with certainty whether such homes would be free from flood waters during a 100-year storm event. The study has determined that in a 100-year storm event, with the full build-out of the study area, there will likely be standing water in the roadways within the area of the reference node, generally around New York Avenue between Pine Street and Hickory Street. This flood stage, however, is comparable to that which would be experienced today, so the proposed projects modelled in this study provide for adequate flood control for a 100-year storm to maintain conditions as they are today after full build-out of all historic lots of records and small nonresidential infill parcels.

If the 10% elevation surcharge is considered, only one additional node, the centerline of Cypress and Virginia, is added to the areas of concern. However, with full implementation of the projects identified and modelled within this Plan, the 25-year and 100-year base flood elevations at this node would continue to be below the reference elevation, even with the 10% surcharge.

The potential flooding concern at New York Avenue between Pine Street and Hickory Street is, to some degree, a larger system deficiency of the shear magnitude of the 16,257-acre gravity drainage area. A review of the model results indicates that the peak stage of Park Lateral itself, the receiving water body of the New York ditch is at elevation 22.10; while, the peak stage between Pine/Hickory Streets along Ditch #14 is at elevation 23.170 reflects a one-foot head loss over the 4,800 feet.

Modeling Results – Non-Residential

Within the non-residential areas of the City, the City sought a heightened goal of maintaining flood waters out of the travel lanes of North Broadway. The reasoning for this heightened standard is

twofold. First, it provides an added factor of safety against flood waters intruding into nonresidential structures, and second, given the arrangement of nonresidential buildings close to the road with finished floors at back of sidewalk, it will keep wave action caused by passing vehicles from pushing flood waters into nonresidential buildings.

Table 4: Non-Residential Areas of Concern

100-year Storm Event

Node Name	Ref. Elev.	Location	Model #1	Model #2	Model #3	Model #4	Model #5
NP13bB13	23.00	Cl S.C. Ave b/w Pine/Broadway	22.698	22.916	23.075	23.068	23.031
NP14B23	22.50+0.5	Grate SW NY/Broadway	23.023	23.292	23.117	23.109	23.066
NP14B25	22.70	Grate SE NY/Broadway	23.094	23.376	23.207	23.195	23.146
NP15B11	22.50	W EOP @ Broadway and Gas Station	22.769	23.086	23.053	23.039	22.980

25-year Storm Event

Node Name	Ref. Elev.	Location	Model #1	Model #2	Model #3	Model #4	Model #5
NP14B23	22.50+0.5	Grate SW NY/Broadway	22.898	23.063	22.801	22.781	22.675
NP14B25	22.70	Grate SE NY/Broadway	22.915	23.065	22.859	22.836	22.723
NP15B11	22.50	W EOP @ Broadway and Gas Station	22.478	22.773	22.678	22.649	22.486

Even with the heightened standard, for the 25-year storm, all but one of the sixteen reference nodes reflect potential floodwaters below the elevation of the roadway. The one reported excess, the inlet grate at the southeast corner of New York and Broadway, is only 0.023 feet or one-quarter of one inch, certainly within the margin of error of the modeling efforts. For the 100-year event, all four nodes along North Broadway reflect flood waters above the edge of travel lanes along North Broadway. Two of these nodes, though, are, at most, only 0.66 feet above the reference elevation or about three-quarters of one inch – within the tolerance of the model. The two other nodes have estimated flood waters close to six inches above the reference elevation. Specifically, floodwaters adjacent to the inlet grate at the southeast corner of New York and Broadway is 0.446 feet or slightly more than five inches above the edge of the roadway, and floodwaters at the west edge of pavement at the corner of Broadway and CR512 (gas station) are 0.48 feet or about six inches above the edge of pavement. A review of aerial photography and drive by surveys in this area reflect finished floors at least twelve inches above the edge of the road. However, without surveyed finished floor elevations of at risk structures, this study cannot determine with certainty whether all nonresidential structures would be free from flood waters during a 100-year storm event. The study has determined that in a 100-year storm event, with the full build-out of the study area, there will likely be standing water along the roadway edge of North Broadway from CR512 to north of the intersection with New York Avenue and reflects a degredation of flood control over existing conditions (Model #1).

If the 10% elevation surcharge is considered, two additional nodes reflecting conditions farther north along Broadway are added to the areas of concern during the 100-year storm. This measure demonstrates that the entire North Broadway corridor is likely to experience some standing water in the travel lanes following a 100-year storm event even with full implementation of the projects contained within this study. The modeling results provide a reason for this inability to meet the goal of keeping flood waters out of the North Broadway travel lanes. First, as presented earlier, the outfall for each of the sub-laterals running east-west through the City is the north-south Park Lateral that discharges approximately four miles to the north into the main canal that then discharges into the Sebastian River approximately five miles to the east. In other words, a drop of stormwater travels considerable distance before leaving the influence of the 16,257-acre gravity drainage system. Stormwater that attempts to enter Park Lateral from any of the sub-laterals serving the study area is hampered by inflows from other sub-laterals that discharge into Park Lateral downstream. For example, the peak stage at the confluence of Park Later and Ditch #14, the ditch that runs parallel to New York Avenue and drains a substantial

portion of North Broadway, is approximately elevation 22.10. Given standard head loss along the east-west sub-laterals from natural bank conditions and intersection driveway and roadway culverts, the Park Lateral peak stage constraint reduces the effectiveness of increasing regional lake sizes. This can be seen by the increasingly smaller gains obtained by ever increasing lake sizes expressed across the model runs.

To achieve the City's goal of maintaining flood waters out of the North Broadway travel lanes, the City and other affected stakeholders must address the peak stage constraints along Park Lateral or reduce the head loss that is experienced from North Broadway to Park Lateral. Of these choices, reducing head losses by increasing driveway and roadway culverts along the east-west sub-laterals is the most cost effective solution. This study did not model the revised pipe sizes or otherwise attempt to address this larger system constraint since its cause is largely outside the City. However, preliminary analysis of the head loss gains by replacing pipes with larger diameters and smoother walls, indicates that at least six inches of reduce head loss can be obtained under a pipe replacement program. Consequently, a cost estimate for a pipe replacement program is included in Section V Cost Estimating and reflected further in Section VI Implementation Schedule.

IV. Preliminary Engineering

As part of the Plan development, preliminary designs for two regional stormwater sites were prepared: 1) a City owned ±40 acre parcel along the south side of Ditch 18 and 2) a privately owned ±5 acre parcel between Ditch #13 and #14 just east of Park Lateral located along the Railroad ditch. The ±40 acre parcel provides stormwater water quality and flood attenuation benefits for the south and south east portion of the historic Fellsmere area, including areas outside of the corporate city limits in unincorporated Indian River County. The ±5 acre parcel provides stormwater water quality and flood attenuation benefits for the central and west area of the historic Fellsmere area. Although the latter site is privately owned, initial discussions with the developer indicate their willingness to dedicate this portion of their larger land holding to the City for the purpose City-wide stormwater benefits.

As presented earlier in Section II Data Gathering and Analysis, specific route surveys of the drainage ditches along the property frontages were obtained to support the preliminary design of each facility. In addition, as presented in Section III Identification of Water Management and Flood Control Improvements, the regional lakes and route conveyance improvements were incorporated into the analytic model to determine their resulting benefits as compared to the existing conditions in the reductions to the peak stages for the 25-year and 100-year storm events. The design of these regional lakes can be found in Appendix C.

The potential water quality attributes from the two proposed regional lakes was also estimated. The estimates were based on the Florida Department of Environmental Protection approved removal *Efficiencies for Stormwater Best Management Practices* developed in August 2010. The South Regional Lake is an off-line system that can provide for water quality enhancements for an approximate 373-acre drainage basin. As an off-line system and given its design providing both open water and wetland filtration systems, the South Regional Lake provides extensive water quality enhancements. The North Regional Lake is an in-line system providing water quality enhancements through an open water design for an approximate 154-acre drainage basin. The primary means of providing water quality enhancements is through sedimentation and separation resulting from the reduced flow velocities. The residence time in the permanent pool of the lake may not provide all the required water quality enhancements required for new development and will likely have to be supplemented. The estimates of water quality enhancement for each lake are contained in Appendix C.

Road Paving Route Survey Cost Estimates of remaining "original" town streets for the design and permitting of typical paved roads with drainage swales are assumed to be comparable to those incurred for the previous paving projects. The most recent design and surveying costs are approximately $70,000.

V. Cost Estimating

Preliminary cost estimates for all suggested modifications were prepared. Please refer to Appendix V for detailed supporting estimates. A summary of the cost estimates is provided below in Table 5. The primary elements to address stormwater and flood control are the regional lakes. Two specific lakes were modeled and detailed preliminary cost estimates prepared. Costs for the additional regional lakes required to achieve the full control sought by the City were estimated on an acreage basis

using the per acre cost of the North regional lake. Due to the water quality enhancements that are created by paving existing unpaved roads within the study area, the costs of the road paving and swale drainage improvements to the remaining unpaved roads were also estimated. Finally, micro-systems identified within the study as a means to treat water within the historic area of the City were also estimated. A series of micro-systems could be used in lieu of a regional lake where the stormwater and flood control benefits are comparable. Two examples of micro-systems presented at the public workshops and endorsed by the City Council include converting underused east-west roads south of CR512 into stormwater greenways with trails and recreational amenities and converting unused space between adjacent private systems along CR512 into additional capacity by converting such individual systems into larger coordinated systems.

Table 5: Cost Estimates of Identified Stormwater and Flood Control Improvements

Item	Total Cost	Notes
North 5-ac Regional Lake	$520,000	
South 42-ac Lake	$2,000,000	Implement in phases
Roadway Paving	$10,500,000	$850,310 per mile of roadway ("original" town streets)
Alleyway Grading	$1,260,000	$105,000 per mile of alleyway
New York Ditch Divergence	$570,000	$95,000 per roadway divergence
Additional Lake (5-ac increment)	$2,080,000	$520,000 per 5-ac. increment
Micro Systems	$1,750,000	$125,000 per block (±300lf)
Operation & Maintenance	$530,000	Over a ten year period.
TOTAL	**$19,900,000**	

Notes:

1. O&M Costs assumptions
    a. Annual maintenance costs $15,000 per year in base year of 2014.
    b. Annual maintenance costs increase by $5,000 per year following major addition to stormwater facility inventory.
    c. Annual maintenance costs increase by $2,500 per year following minor addition to stormwater facility inventory.
    d. $10,000 littoral/upland plant maintenance and exotic removal cost first year following major addition to stormwater facility inventory.
    e. $5,000 littoral/upland plant maintenance and exotic removal cost first year following minor addition to stormwater facility inventory.
    f. Two percent annual cost increase.

VI. Implementation Schedule

In creating an implementation schedule, revenue estimates were first completed including revenue from the stormwater utility, grants, and other funding sources that may be utilized for the stormwater and flood control projects identified in this study. Following these estimates, the identified stormwater and flood control improvements were then programmed in a priority fashion until funds were exhausted. The project priority gave higher consideration to projects that can be implemented on existing government owned lands or lands in which public/private partnerships can be formed within the City's limited financial resources. The revenue estimates were developed over a ten year period. Since master plans of this nature are generally updated every ten years to reflect completed projects, changing regulatory standards, etc. and given the difficulty of predicting revenue flows deep into the future, a ten-year timeframe was considered adequate. As demonstrated below, the magnitude of projects required to achieve the City's stormwater and flood control goals cannot be funded over a ten year period. Unfunded projects are simply listed as such.

Revenue Estimates

The proposed Stormwater Utility has been in operation for approximately six months as of the date of this study and collects approximately $5,000 per month. All levies are currently a flat rate of $4.00 per parcel. Upon completion of this study, a rate study will then be prepared to determine the level of benefits and attributable fee for each parcel. The fee is anticipated to be broken into three tiers. The

first tier will be levied to all parcels within the benefit area (study area) to cover administrative costs of the stormwater utility. The second tier will cover a water quality levy for those projects that rely upon the public system for achieving the water quality requirements of their development. The third tier will be for those projects that rely upon the public system for achieving the water quantity aspects of their development, including flood control.

Initially, the total revenue collected is not expected to appreciably increase until development that utilizes the public system come on line. Given the lax development climate over the past five years, a conservative annual growth of 0.5% over the course of the next ten year was assumed. Table 6 presents the stormwater utility revenue estimates.

Table 6: Stormwater Utility Revenue Estimates

	Annual Receipt
Year 1	$60,000
Year 2	$60,300
Year 3	$60,602
Year 4	$60,905
Year 5	$61,209
Five Year Total	$303,016

	Annual Receipt
Year 6	$61,515
Year 7	$61,823
Year 8	$62,132
Year 9	$62,442
Year 10	$62,755
Ten Year Total	$613,683

Grant Receipt Estimates

The City of Fellsmere relies heavily upon grants from state and federal partners in achieving a large portion of their capital needs regardless of capital facility type. The City also seeks partnerships with private landowners and developers to achieve shared capital needs. Stormwater and flood control improvements are not expected to be any different. Over the course of the next ten year timeframe, the City anticipates all land needs to implement the priority projects to be achieved through grants and/or private dedications. To be conservative, the revenue estimates do not assume cash contributions from developers. However, no land costs are assumed either reflecting the likely receipt of additional stormwater tracts through public/private partnerships. The City anticipates receiving grants from numerous sources. Table 7 presents the historical grant awards to the City for the past five years and an estimate of the future grant receipts over the next ten years.

Table 7: Historical and Future Grant Receipts

Grant	Year	Amount	Use	Stormwater Eligible
PAST				
USDA Rural Development	2009	$200,000	Extension of sewer to job producer	Yes
ARA Water Plant	2009	$1,050,000	Expansion of water plant	No
FRDAP – Grant Park	2009	$400,000	Rehabilitation and expansion of park facilities	Yes
CDBG Neighborhood – Myrtle Street	2010	$1,050,000	One mile of roadway paving and associated drainage improvements	Yes
LWCF – Preserve	2011	$400,000	Construct park amenities and associated drainage improvements	Yes
CDBD – Economic Development	2012	$1,090,000	Natural Gas extension to job producer	Yes
Historic Preservation	2012	$50,000	Rehabilitate historic Marian Fell Library	No
Economic Development (EDA and EDTF)	2012	$728,000	Construct access road pairs and associated drainage to support job development	Yes
Indian River Lagoon National Estuary Program	2013	$55,000	Stormwater Master Plan	No

Table 7: Historical and Future Grant Receipts - continued

FUTURE				
Economic Development (EDA, CDBG, USDA, etc.)	2014-2023	$520,000	North Regional Lake and additional 5-ac. lake increment every three years	Yes
Land Conserv./Recreation (LWCF, FRDAP, RTP, etc.)	2015-2023	$400,000	Every two years to construct South Regional Lake	Yes
IRLNEP/Stormwater	2016-2022	$125,000	Every two years to construct stormwater greenways (micro-systems)	Yes
CDBG Neighborhood	2014-2022	$970,000	Every two years to pave one mile of roadway and associated drainage improvements	Yes

The source of the local match required for each grant program is generally provided through the City infrastructure fund – a revenue source derived from the County's infrastructure surtax applied to the general countywide sale tax and apportioned to each municipality.

Implementation Schedule

The implementation schedule presented in Table 8 is derived from the cost and revenue estimates presented earlier. As noted, the dedicated revenue source from the Stormwater Utility is not sufficient to implement major stormwater and flood control projects. In fact, this revenue is essentially needed to provide proper operation and maintenance of existing stormwater systems and new systems that may come along during the next ten years. The primary means to implement major stormwater and flood control projects during this initial ten year period will be through receipt of state and federal grants with local matches provided through the City's infrastructure tax. Although developer contributions will be sought, most will come in the form of land. Table 8 presents an estimated implementation schedule based on the available funds and improvement priorities. The improvement priorities, again, grant higher consideration to projects that can be implemented on existing government owned lands or lands in which public/private partnerships can be formed within the City's limited financial resources. The two regional lakes that are presented within this Plan at the preliminary engineering level, see Appendix IV, are the primary candidates for initial implementation through grant programs.

Over time, as various projects are implemented and as new development occurs, the City will update the Plan to reflect these changed conditions, update revenue estimates, and extend the Plan's implementation schedule further into the future. At a minimum, the Plan should be updated every ten years.

Table 8: Implementation Schedule

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023		
Revenue											**Total Revenue**	
Economic Development Grant	**$ 520,000**	$ -	$ -	**$ 520,000**	$ -	$ -	**$ 520,000**	$ -	$ -	**$ 520,000**	$ 2,080,000	
CDBG Neighborhood Grant	**$ 970,000**	$ -	**$ 970,000**	$ -	**$ 970,000**	$ -	**$ 970,000**	$ -	**$ 970,000**	$ -	$ 4,850,000	
Land Conserv./Recreation Grant	$ -	**$ 400,000**	**$ -**	**$ 400,000**	**$ -**	**$ 400,000**	**$ -**	**$ 400,000**	**$ -**	**$ 400,000**	$ 2,000,000	
IRLNEP/Stormwater	$ -	$ -	**$ 125,000**	**$ -**	**$ 125,000**	**$ -**	**$ 125,000**	**$ -**	**$ 125,000**	$ -	$ 500,000	
Developer Contribution	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
CRA Funds	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Arbor Fund	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Stormwater Utility	$ 60,000	$ 60,300	$ 60,602	$ 60,905	$ 61,209	$ 61,515	$ 61,823	$ 62,132	$ 62,442	$ 62,755	$ 613,682	
TOTAL REVENUE	**$ 1,550,000**	**$ 460,300**	**$ 1,155,602**	**$ 980,905**	**$ 1,156,209**	**$ 461,515**	**$ 1,676,823**	**$ 462,132**	**$ 1,157,442**	**$ 982,755**	**$ 10,043,682**	
Costs												
Item	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**Total Cost**	**Unfunded**
North 5-ac Regional Lake	**$ 520,000**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 520,000	$ -
South 42-ac Lake (Phased)	$ -	**$ 400,000**	**$ -**	**$ 400,000**	**$ -**	**$ 400,000**	**$ -**	**$ 400,000**	**$ -**	**$ 400,000**	$ 2,000,000	$ -
Roadway Paving	**$ 875,000**	$ -	**$ 875,000**	$ -	**$ 875,000**	$ -	**$ 875,000**	$ -	**$ 875,000**	$ -	$ 10,500,000	$ (6,125,000)
New York Ditch Divergence	**$ 95,000**	$ -	**$ 95,000**	$ -	**$ 95,000**	$ -	**$ 95,000**	$ -	**$ 95,000**	$ -	$ 950,000	$ (475,000)
Alleyway Grading	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,050,000	$ (1,050,000)
Additional Lake (5-ac increment)	$ -	$ -	$ -	**$ 520,000**	$ -		**$ 520,000**	$ -	$ -	**$ 520,000**	$ 2,600,000	$ (1,040,000)
Micro Systems	$ -	$ -	**$ 125,000**	**$ -**	**$ 125,000**	**$ -**	**$ 125,000**	**$ -**	**$ 125,000**	$ -	$ 1,750,000	$ (1,250,000)
Operation and Maintenance	$ 20,000	$ 30,600	$ 36,414	$ 34,489	$ 62,240	$ 49,684	$ 61,939	$ 77,536	$ 79,087	$ 77,681	$ 529,670	$ -
Reserves	$ 40,000	$ 29,700	$ 24,188	$ 26,415	$ (1,031)	$ 11,831	$ (116)	$ (15,405)	$ (16,645)	$ (14,926)		
TOTAL COSTS	**$ 1,550,000**	**$ 460,300**	**$ 1,155,602**	**$ 980,905**	**$ 1,156,209**	**$ 461,515**	**$ 1,676,823**	**$ 462,132**	**$ 1,157,442**	**$ 982,755**	**$ 19,899,670**	**$ (9,940,000)**
Cummulative Reserves	$ 40,000	$ 69,700	$ 93,888	$ 120,303	$ 119,272	$ 131,103	$ 130,987	$ 115,583	$ 98,938	$ 84,012	NA	

VII. Public Outreach/Education

A component of the planning effort included public outreach and education. Over the course of the nine month study, three distinct opportunities were afforded the residents and business owners of Fellsmere to identify stormwater concerns and comment on proposed projects. An initial workshop was held early in the planning process on May 11, 2013. The SJRWMD participated in this initial workshop providing an extensive educational presentation on the health of the Indian River Lagoon, sources of pollution and how the City and its residents can assist in the effort of improving the water quality of this water body. A variety of handouts and educational material was made available in both English and Spanish for the general public. As part of this initial workshop, the City presented the purpose of the study and conducted an open forum seeking input on where the drainage problems are within the City. A copy of the meeting agenda, accompanying power point presentation (of both the City and SJRWMD) and the various handouts are contained in Appendix VII.

A second workshop was conducted on December 12, 2013 wherein the City presented to the general public proposed solutions to drainage problems along with corresponding cost estimates. Direction was sought and obtained on the level of flood protection desired within the City. The directive obtained from this workshop was to ensure that flood waters remain out of homes within residential areas and, along North Broadway Street, given the numerous historic structures and build-to sidewalk requirements of the main street corridor, to remain out of the street and within the drainage structures. This direction was then used by the study team to complete final investigations to determine specifically the extent of additional regional lake systems that would be required to achieve the desired level of flood control. A copy of the meeting agenda, accompanying power point presentation and the various handouts are contained in Appendix VII.

The final opportunity as part of this specific study for the public to provide input occurred on February 6, 2014. The final draft of the report was presented to the City Council for formal adoption. The City adopted the plan with no substantive changes and directed staff to proceed with implementation. Additional opportunities for public input will arise as part of the implementation of the study recommendations as the City programs funds for the capital projects contained herein. In addition, the Plan is expected to be updated every five to ten years depending upon the level of development and changing conditions over time.

Public Education beyond that conducted as part of the workshops presented above will continue over the course of the plan and includes two primary sources. The first relates to the public education components conducted by the City on an annual basis through the Federal Emergency Management Agency (FEMA) Community Rating System (CRS). The City is a participant in the CRS and utilizes educational outreach as a key component of their qualifying activities. Three primary activities are conducted as part of this program. First, the City provides a mailer each year to all residents of the City containing information about flood risks, flood safety, flood insurance, and flood mitigation. Second, the City offers direct assistance to homeowners in reviewing their specific circumstances to identify methods to reduce flood risks. Third, the City provides information to all inquiries concerning flood maps and areas of special flood hazards.

The second component of the City's ongoing educational efforts is actually its partnership with Indian River County and other municipalities in the county on hazard mitigation planning. The County provides the lead on outreach activities associated with this program, but the reach of their efforts is countywide.

Future public outreach and education opportunities will also be sought as part of the implementation of the regional lakes and other stormwater and flood control projects. Public information displays will be installed as part of these projects educating the public on the benefits of proper stormwater practices and how the overall system operates and can impact the health of water bodies far removed, such as the Sebastian River and Indian River Lagoon. Signs at drains and along the ditches will be installed as further educational efforts when funds allow.

Long term, the City will also seek to implement a more aggressive education effort. An informed and knowledgeable community is crucial to the success of the City of Fellsmere Stormwater Management Program since it helps to ensure the following:

1. Greater support for the program as the public gains a greater understanding of the reasons why it is necessary and important. Public support is particularly beneficial when the City attempts to institute new funding initiatives for the program or seek volunteers to help implement the program; and
2. Greater compliance with the program as the public becomes aware of the personal responsibilities expected of them and others in the community, including the individual actions they can take to protect or improve the quality of State waters.

Due to personnel and budget considerations, the City of Fellsmere staff should ascertain which Education and Outreach programs are presently conducted by Indian River County and/or St. John's River Water Management District in the FWCD area and determine how the existing programs could possibly be tailored, if necessary, to maximize the benefit to the City. If adequate funding is obtained, the following BMP(s) could be implemented.

BMP 1: Encourage & Educate Stormwater Management Program Volunteers

Volunteers can prove to be an invaluable asset to the Stormwater Management Program's success, encouraging citizens to learn about the City of Fellsmere water resources. Some of the ways that encouraging volunteers may help include (but are not limited to):

- Building awareness of pollution problems
- Becoming trained in pollution prevention
- Help in cleaning up outfall ditches
- Providing data for waters that might otherwise be un-assessed
- Increasing the amount of water quality information available to decision makers at all levels of government.

The volunteers often become educators themselves, informing inquisitive passersby, family, colleagues, and friends about stormwater.

BMP 2: Prepare a Presentation of Stormwater Pollution Awareness at Public Events

Educational materials, displays, and presentations should be present at various public events to promote the District's Stormwater Management Program. Every effort should be made to show how much pollution is in the surrounding water bodies, how much stormwater contributes to this problem, and what must be done to improve the Indian River Lagoon's water quality. There are a variety of pamphlets and brochures relating to water pollution available at the FDEP which are tailored to the Indian River Lagoon, the ultimate point of discharge for the District.

BMP 3: Stormwater Education Program for School Children (K-12)

Early education and involvement in the Stormwater Program at elementary, junior-high, and high schools is integral for its future performance. Providing stormwater education through the schools not only exposes the message to students but to their parents, as well. Lessons may include an outdoor classroom, storm stencil draining, river/ditch cleanup, etc.

BMP 4: Availability of Stormwater Educational Materials to Business, Residential, and Agricultural Communities

Stormwater educational material should be available to business, residential, and agricultural communities with the intent to reduce stormwater pollutants in the City of Fellsmere/Fellsmere Water Control District from normal, everyday activities. Topics should include (but not be limited to):

- issues pertaining to litter control
- inorganic, fertilizers & pesticide runoff awareness
- septic system maintenance

- water conservation
- oil and grease containment practices for restaurants
- proper disposal of waste oils, paints and other hazardous materials
- proper pre-treatment of animal waste in the rainfall runoff before discharging off site

Methods of distributing the material include direct mail, hand-outs at events, public posters, targeted businesses, and presentations.

BMP 5: Promote Lawn & Garden and Agricultural Stormwater Pollution Prevention Practices

Lawn and garden and agricultural operations, including the small 5-acre ranchettes, contribute to the contamination of stormwater through pesticide, soil, fertilizer and animal waste runoff. Proper landscape management, however, can effectively reduce water use and contaminant runoff and enhance the aesthetics of a property. Environmentally friendly landscape management can protect the environment through careful planning and design, routine soil analysis, appropriate plant selection, use of practical turf areas, stormwater runoff management areas, water use efficiency, use of mulches, and appropriate maintenance. Recommended practices that the City should consider promoting to reduce the amount of fertilizer entering runoff include (but are not limited to):

- Slow-release organic fertilizers. These are less likely to enter stormwater.
- Application techniques, such as tilling fertilizers into moist soil to move the chemicals directly into the root zone, reduce the likelihood that the chemicals will be mobilized in stormwater.
- Timing. Warm season grasses should be fertilized in the summer, in frequent and small doses, while cool season grasses should be fertilized in the fall. Also, fertilizer should not be applied on a windy day or immediately before a heavy rain.
- Property owners apply fertilizer at rates at or below those recommended on the packaging or should apply fertilizer based on the needs of the soil (as determined by a soil test).
- Safe disposal of excess fertilizer and containers should be encouraged.

BMP 6: Determine Requirements to Maintain the City's Master Drainage Plan

The Master Drainage Plan (due to fluctuations in population, community expansion, etc.) should be considered a dynamic document, subject to periodic review and amendment to meet changing conditions. An evaluation of this plan should be frequent enough to assess response to changing development trends and incorporate new information regarding the District's development. The review and amendment process should include decision-making tools such as policy criteria guidelines, watershed master plans, and financial programs used to collect drainage service charges to fund the program. Implementation of services could include maintenance, public information and education, and capital improvement projects.

VIII. Regulatory Efforts

In additional to investigating infrastructure solutions to stormwater treatment and flood control, the City also evaluated the existing land development code and ordinances in relation to how they address various stormwater practices such as pet waste, fertilizer application, stormwater utility, best management practices, and stormwater and flood control mitigation. Since 2010, the City has been amending their codes to incorporate best management practices for many of these issues. As a result, based upon a review of the codes and ordinances conducted by the Planning and Zoning Commission on September 4, 2013 and City Council on November 14, 2013, the City did not find a need to recommend additional statutory language to address the variety of stormwater treatment practices. Below is a summary of the various stormwater treatment practices reviewed by the City as part of this study and how such practices had recently been updated. Appendix VIII contains an excerpt of the codes and ordinances for each of these areas.

Pet Waste: adopted on February 13, 1992 via Ordinance 92-1 as part of amendments to the Code of Ordinances, Chapter 14 – Animals. This ordinance implemented the countywide control of animals through Indian River County. The City amended the enforcement section of this ordinance on June 7,

2012 via Ordinance 2012-05 to allow City Code Enforcement and the Police Department to also enforce provisions of this code.

Irrigation: adopted on July 7, 2011 via Ordinance 2011-02 as part of amendments to the Chapter 11 – Landscaping. This ordinance sought to ensure irrigation systems were designed to meet the water demands of the specific vegetation being irrigated and that all installers be properly licensed.

Fertilizer: adopted on July 7, 2011 via Ordinance 2011-02 as part of amendments to the Chapter 11 – Landscaping. The ordinance followed the State of Florida's model language and restricted fertilizer application to rates and locations consistent with best management practices. The ordinance also required all applicators to obtain proper training prior to issuance of a Business Tax Receipt. The County adopted a fertilizer ordinance on July 18, 2013 that has county-wide application and is consistent with the City ordinance ensuring that County businesses are also duly regulated.

Stormwater: Regulations addressing stormwater are limited within the land development code because in most cases regulation of stormwater is addressed through review by other outside agencies. For example, the SJRWMD has authority for all systems that meet their regulatory thresholds, which can generally be defined as any project that hass more than 4,000sf of impervious or semi-pervious parking area and/or 9,000sf of total site development (impervious area). In addition, all projects except single family lots of records are required to meet the FWCD permitting requirements which are even more stringent than the SJRWMD standards; however, only those projects with direct connections to a FWCD facility are required to obtain a FWCD permit. One specific standard of the FWCD worth noting is their requirement that any fill or structural impact on a flood plain is required to be mitigated. This ensures that cumulative development impacts will not result in the increase of flood stage levels. For projects that do not have direct FWCD connections, the City ensures compliance with the FWCD standards. For single family lots of record, the City ensures such lots are properly drained through Section 7.12 of the Land Development Code as excerpted below.

> *Sec. 7.12. Drainage.*
> *All single-family and two-family new construction on platted lots of record created prior to December 17, 1956 shall direct all surface water to the street and adjacent drainage conveyance system. All other development shall only be approved in conjunction with an approved surface water runoff management system permitted by the St. John's River Water Management District or the city engineer as applicable.*

Currently, the City has not elected to regulate beyond that which is regulated by the St. Johns River Water Management District (SJRWMD) and the Fellsmere Water Control District (FWCD). Regardless of regulatory authority, the City reviews all development applications for drainage to ensure site design issues are supported by the drainage design instead of being dictated by drainage. Examples of this include ensuring proper slopes of drainage areas to eliminate the need for fencing, where feasible, and requiring shared easements for future City use and ensuring proper landscaping and aesthetic appeal.

An acknowledged fact within Fellsmere and addressed by this study is the historic development within Fellsmere that does not provide any stormwater treatment and discharges directly to FWCD facilities that ultimately discharge into the Sebastian River and end up in the Indian River Lagoon. As the City constructs the major facilities recommended within the Plan, treatment credits will be available to cover this deficit as well as future development of historic lots that are unable to provide their own stormwater treatment needs. These credits will be allocated by policy between rectifying treatment deficits of historic development and partnering with small historic infill lots. This policy will be guided by economic development goals of the City, ever increasing stormwater treatment standards, and allocations that may result from the Basin Management Action Plan due to the degradation of the Indian River Lagoon.

APPENDIX A

DATA GATHERING

A. The North Regional Stormwater Lake Topographic Survey

B. South Regional Stormwater Lake Topographic Survey

C. Topographic Survey of Historic Fellsmere

APPENDIX B

MODELLING SUPPORT

A. Model Input Data – See disk included

B. Hurricane Frances Model Calibration

C. 25-year Peak Stage Comparison

D. 100-year Peak Stage Comparison

APPENDIX C

PRELIMINARY ENGINEERING

A. North and South Regional Stormwater Lake Design (30%)

APPENDIX D

COST ESTIMATING

A. Road Paving and Drainage Opinion of Costs (Preliminary)

B. North and South Regional Lake Construction Cost

C. Alleyway Construction Cost

D. New York Divergence Cost

E. Culvert Replacement Cost

F. Stormwater Greenway Cost

Appendix E:

PUBLIC OUTREACH

APPENDIX F

REGULATORY EFFORTS