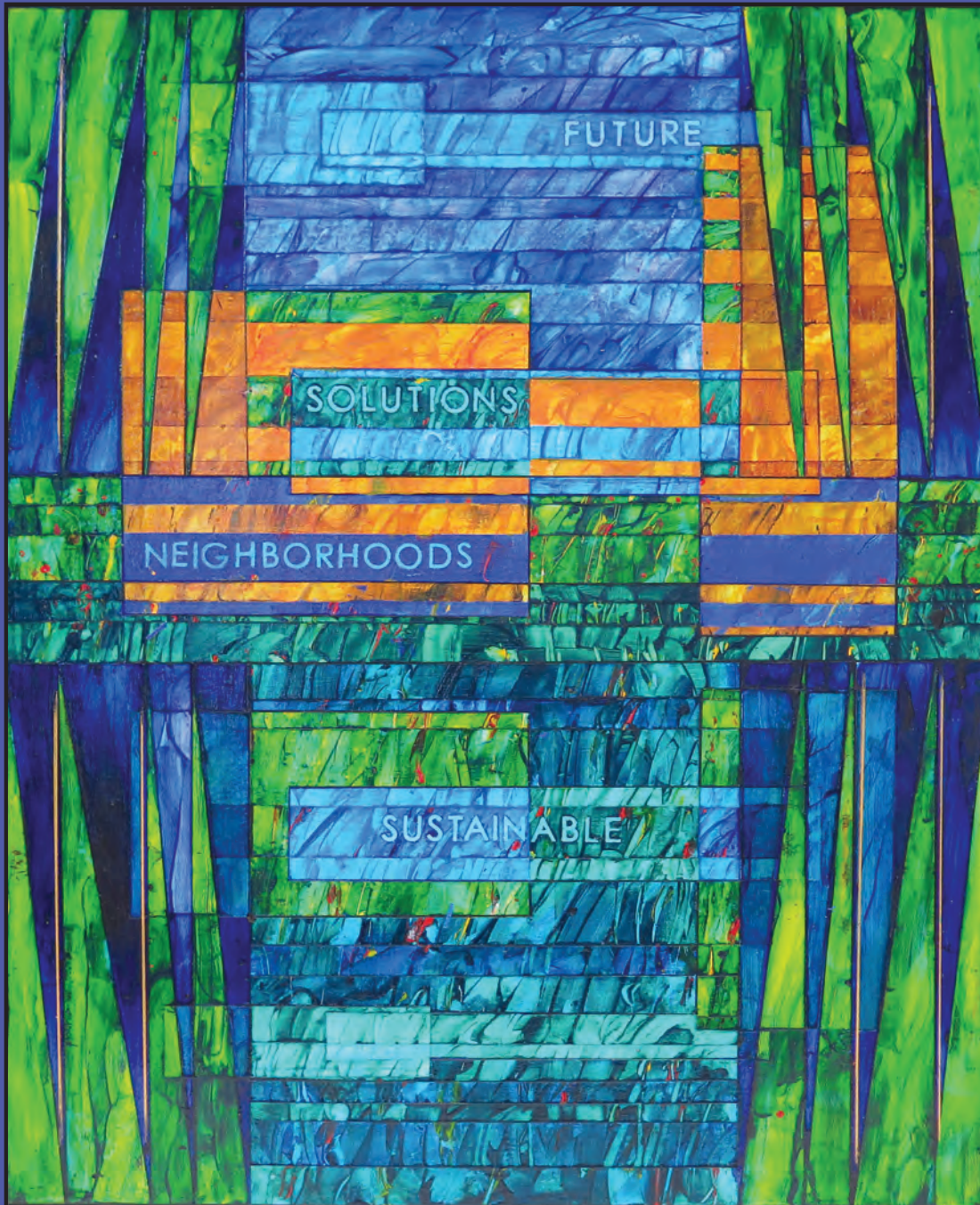


The Hazen Team



CITY OF
FORT LAUDERDALE

**Stormwater Master Plan Modeling
and Design Implementation
Update**

January 2018



Table of Contents

Section 1.0	Executive Summary	1-1
Section 2.0	Dorsey-Riverbend Neighborhood – Drainage Summary.....	2-1
2.1	Summary of Existing Conditions	2-1
2.1.1	Neighborhood Description	2-1
2.1.2	Existing Stormwater Management System.....	2-1
2.2	Flooding Evaluations	2-2
2.3	Proposed System Improvements	2-2
2.3.1	Goals and Objectives	2-2
2.3.2	Water Quality	2-3
2.3.3	Neighborhood Outreach	2-3
Section 3.0	Durrs Neighborhood – Drainage Summary	3-1
3.1	Summary of Existing Conditions	3-1
3.1.1	Neighborhood Description	3-1
3.1.2	Existing Stormwater Management System.....	3-1
3.2	Flooding Evaluations	3-2
3.3	Proposed System Improvements	3-2
3.3.1	Goals and Objectives	3-2
3.3.2	Water Quality	3-3
3.3.3	Neighborhood Outreach	3-3
Section 4.0	Progresso Village Neighborhood – Drainage Summary	4-1
4.1	Summary of Existing Conditions	4-1
4.1.1	Neighborhood Description	4-1
4.1.2	Existing Stormwater Management System.....	4-1
4.2	Flooding Evaluations	4-2
4.3	Proposed System Improvements	4-2
4.3.1	Goals and Objectives	4-2
4.3.2	Water Quality	4-3
4.3.3	Neighborhood Outreach	4-3
Section 5.0	Victoria Park Neighborhood – Drainage Summary	5-1
5.1	Summary of Existing Conditions	5-1
5.1.1	Neighborhood Description	5-1

- 5.1.2 Existing Stormwater Management System.....5-1
- 5.2 Stormwater Management System Evaluation5-2
- 5.3 Proposed System Improvements5-3
 - 5.3.1 Goals and Objectives5-3
 - 5.3.2 Water Quality5-3
 - 5.3.3 Neighborhood Outreach5-3
- Section 6.0 Edgewood Neighborhood – Drainage Summary 6-1**
 - 6.1 Summary of Existing Conditions6-1
 - 6.1.1 Neighborhood Description6-1
 - 6.1.2 Existing Stormwater Management System.....6-1
 - 6.2 Flooding Evaluations6-1
 - 6.3 Proposed System Improvements6-2
 - 6.3.1 Goals and Objectives6-2
 - 6.3.2 Water Quality6-3
 - 6.3.3 Neighborhood Outreach6-3
- Section 7.0 River Oaks Neighborhood – Drainage Summary..... 7-1**
 - 7.1 Summary of Existing Conditions7-1
 - 7.1.1 Neighborhood Description7-1
 - 7.1.2 Existing Stormwater Management System.....7-1
 - 7.2 Flooding Evaluations7-2
 - 7.3 Proposed System Improvements7-2
 - 7.3.1 Goals and Objectives7-2
 - 7.3.2 Water Quality7-3
 - 7.3.3 Neighborhood Outreach7-3
- Section 8.0 Southeast Isles Neighborhood – Drainage Summary..... 8-1**
 - 8.1 Summary of Existing Conditions8-1
 - 8.1.1 Neighborhood Description8-1
 - 8.1.2 Existing Stormwater Management System.....8-1
 - 8.2 Flooding Evaluations8-1
 - 8.3 Proposed System Improvements8-2
 - 8.3.1 Goals and Objectives8-2
 - 8.3.2 Water Quality8-4
 - 8.3.3 Neighborhood Outreach8-4
- Section 9.0 Conclusions and Recommendations..... 9-1**

List of Tables

Table 1-1	Priority Neighborhoods and Corresponding Watersheds	1-4
Table 1-2	Design Teams Leading the Seven Priority Neighborhood Projects.....	1-6
Table 1-3	Preliminary Design Neighborhood Meetings	1-7
Table 1-4	Neighborhood Final Design Meeting Schedule	1-7
Table 8-1	Summary of Seawalls to be Replaced.....	8-3

List of Figures

Figure 1-1	High Density LiDAR Tile Key Map.....	1-2
Figure 1-2	High Density LiDAR Examples	1-3
Figure 1-3	Fort Lauderdale Primary Watersheds.....	1-5

After Page

Figure 2-1	Dorsey Riverbend Neighborhood Limits.....	2-1
Figure 2-2	Dorsey Riverbend Drainage Map	2-2
Figure 2-3	Dorsey Riverbend Proposed Stormwater Improvements	2-3
Figure 3-1	Durrs Neighborhood Limits.....	3-1
Figure 3-2	Durrs Drainage Map	3-2
Figure 3-3	Durrs Proposed Stormwater Improvements	3-2
Figure 4-1	Progresso Neighborhood Limits	4-1
Figure 4-2	Progresso Drainage Map	4-3
Figure 4-3	Progresso Proposed Stormwater Improvements.....	4-3
Figure 5-1	Victoria Park Neighborhood Limits	5-1
Figure 5-2	Victoria Park Drainage Map	5-3
Figure 5-3	Victoria Park Proposed Stormwater Improvements.....	5-3
Figure 6-1	Edgewood Neighborhood Limits	6-1
Figure 6-2	Edgewood Drainage Map	6-2
Figure 6-3	Edgewood Proposed Stormwater Improvements	6-3
Figure 7-1	River Oaks Neighborhood Limits.....	7-1
Figure 7-2	River Oaks Drainage Map	7-3
Figure 7-3	River Oaks Proposed Stormwater Improvements	7-3
Figure 8-1	Southeast Isles Neighborhood Limits	8-1
Figure 8-2	Southeast Isles Drainage Map	8-3
Figure 8-3	Seawall Location Map	8-3
Figure 8-4	Southeast Isles Proposed Stormwater Improvements	8-3

Section 1.0 Executive Summary

Background

The City of Fort Lauderdale is implementing a stormwater management program to address chronic flooding and other stormwater management issues. Twenty-first century stormwater master planning and design for low-lying coastal areas requires new thinking. Solutions must be flexible, pragmatic, include a balance of conventional and innovative approaches, and utilize the natural environment as an asset. Development of those solutions is underway for the City. As part of this program a priority for the City is to address current flooding issues in seven specific neighborhoods.

The purpose of this document is to provide an update on the current status of the program (particularly relative to the seven initial neighborhoods) and to highlight the milestones that have been achieved to this point and identify upcoming next steps.

Project Status

On April 19, 2016, the City Commission awarded a contract for Stormwater Master Plan Modeling and Design Implementation to Hazen and Sawyer, P.C. The program scope of work includes citywide stormwater modeling and utility data collection; watershed planning; design, permitting and construction management services related to stormwater infrastructure; and community outreach services.

Work efforts associated with these objectives are being authorized through a variety of related task orders. To date, four such task orders have been issued by the City:

1. **Task Order 1** – Primarily addresses data collection, stormwater model development/use, and preparation of certain standard details and specifications to be used for future design efforts. Notice to Proceed for Task Order 1 was issued May 16, 2016, and the status of tasks being performed under this authorization is as follows:
 - Topographical mapping of the entire City using high density LiDAR (Light Detection and Ranging) technology is complete, and accuracy of the LiDAR data was confirmed through rigorous field checks using conventional survey techniques. The LiDAR data are arranged in “tiles” covering the entire City as shown in **Figure 1-1**. The City-wide high density LiDAR facilitated generation of accurate ground surface models which were critical for the hydrologic/hydraulic stormwater model development. The LiDAR data also have the potential to aid the City in various other manners, such as evaluating seawall cap elevations and tree canopies. Examples of LiDAR collected within the City are shown in **Figure 1-2**.

Figure 1-1: High Density LiDAR Tile Key Map

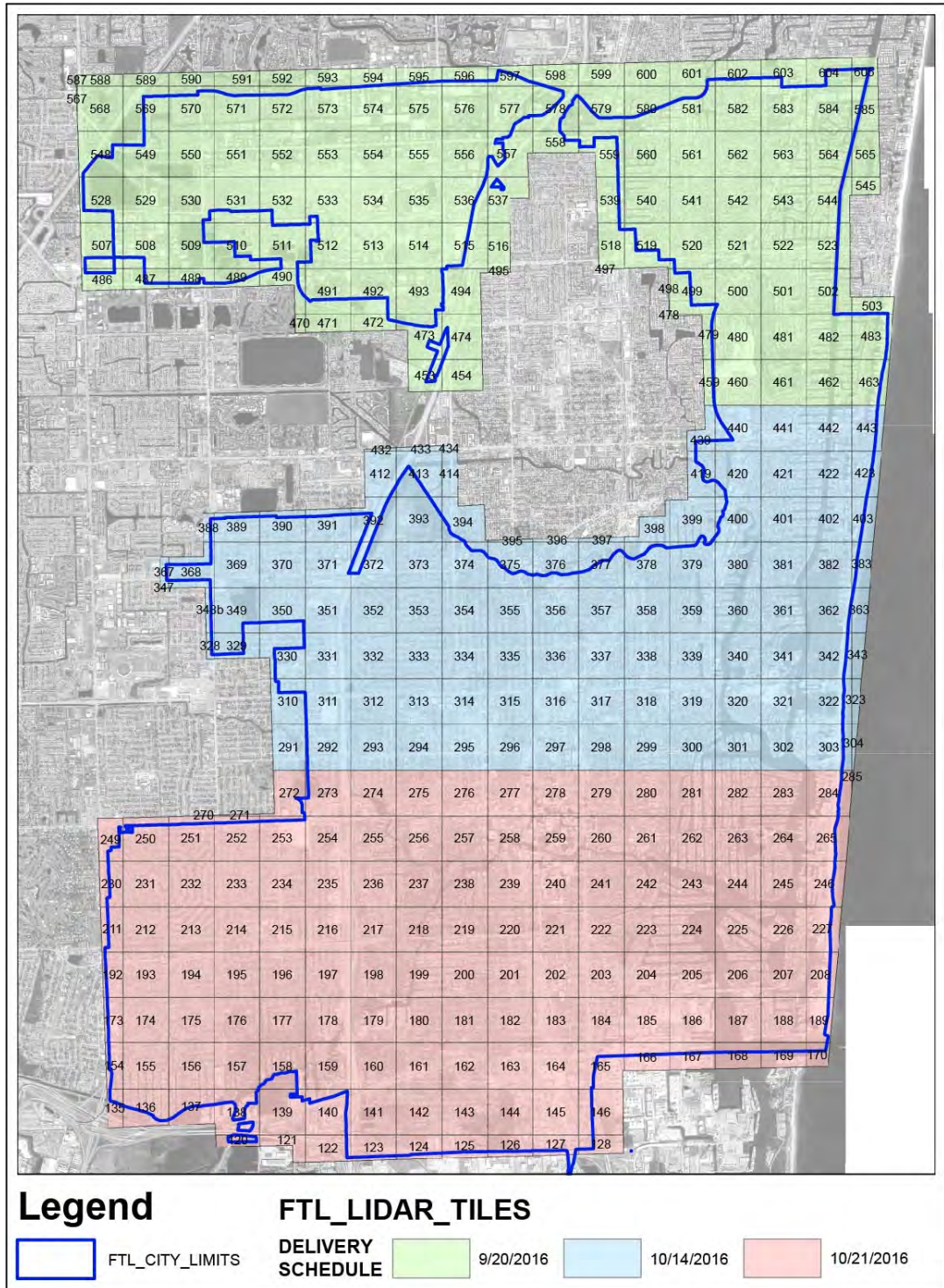
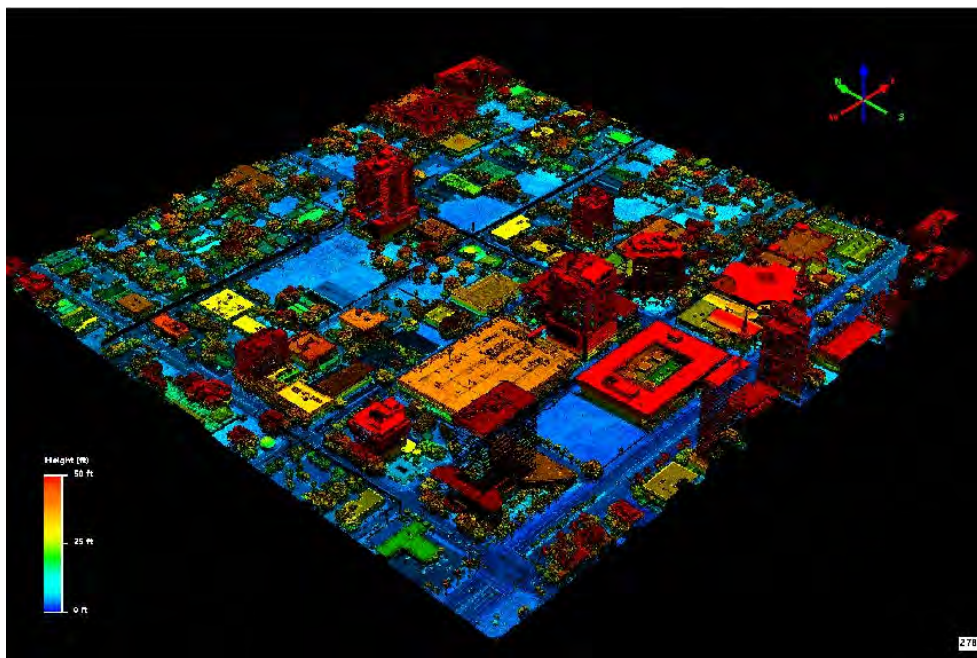
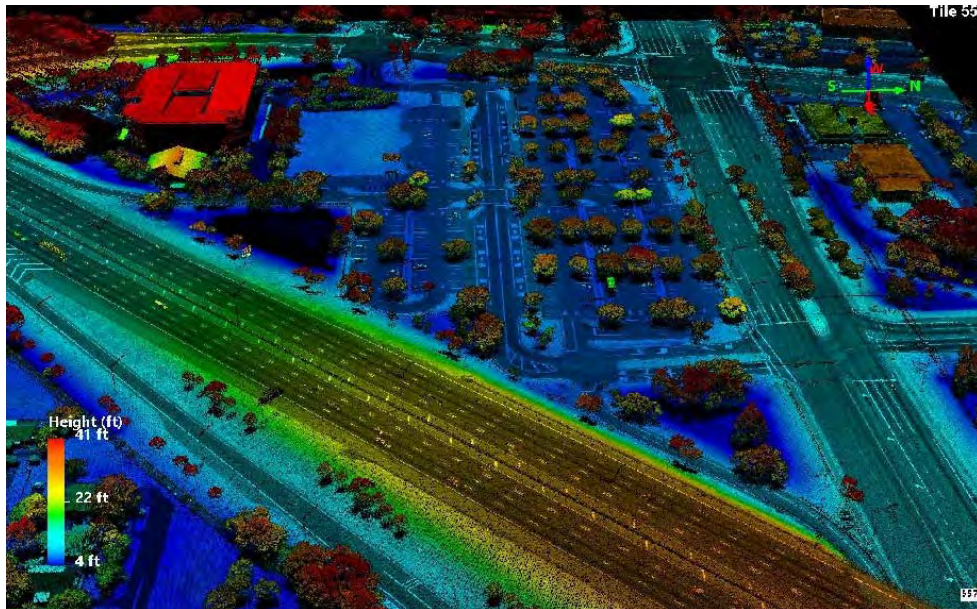


Figure 1-2: High Density LiDAR Examples



- Traditional field surveying and record drawing accumulation (from various sources) for collection of below-ground stormwater infrastructure data is also complete.
- Development of a stormwater geodatabase is largely complete, and data collected from the survey efforts noted above have been migrated to that system for the City’s future use. Additionally, stormwater asset information collected as part of the design surveys being conducted under Task Order 4 is being migrated to the new geodatabase.

- A thorough literature review and inventory of existing models (which were deemed to be helpful in the development of the City’s stormwater model) was conducted and a Comprehensive Stormwater Modeling Approach and Standards document, which was used to guide the development and use of the stormwater model, was prepared.
 - A hydrologic/hydraulic stormwater model of the City was developed and utilized. The modeling effort consisted of a comprehensive basin by basin analysis of the existing and proposed stormwater systems and how they react to different conditions, including future projected climatological and land use conditions. The City was subdivided into 10 primary watersheds (see **Figure 1-3**). Model results were used to help develop conceptual plans to address seven priority neighborhoods’ stormwater issues, specifically in the areas found to be most susceptible to chronic flooding. This effort directly informed preliminary and final design in the seven neighborhoods (Task Orders 2 and 4), which are discussed below.
 - Updating and/or developing new standard details and specifications for use in both current and future community investment projects associated with the program is also complete.
2. **Task Order 2** – Primarily addresses preliminary design efforts in seven priority neighborhoods within the City. Those seven neighborhoods and the watersheds in which they are located are listed in **Table 1-1**.

Table 1-1: Priority Neighborhoods and Corresponding Watersheds

Neighborhood	Watershed(s)
Edgewood	South Fork New River
Victoria Park	New River, ICW South
Progresso Village	New River
Southeast Isles	ICW South, New River
Durrs	North Fork New River
Dorsey Riverbend	North Fork New River, New River
River Oaks	South Fork New River

Task Order 2 had a Notice to Proceed date of October 17, 2016, and the status of tasks being performed under this authorization is as follows:

- Geotechnical data collection throughout the seven neighborhoods to support the required preliminary design efforts is complete as is the preliminary geotechnical design report.
- Development of preliminary design plans addressing the engineering approaches for each of the seven neighborhoods is complete. In order to expedite this process, multiple design teams from the various firms comprising the overall team focused on specific neighborhoods (as shown in **Table 1-2**).

Figure 1-3: Fort Lauderdale Primary Watersheds

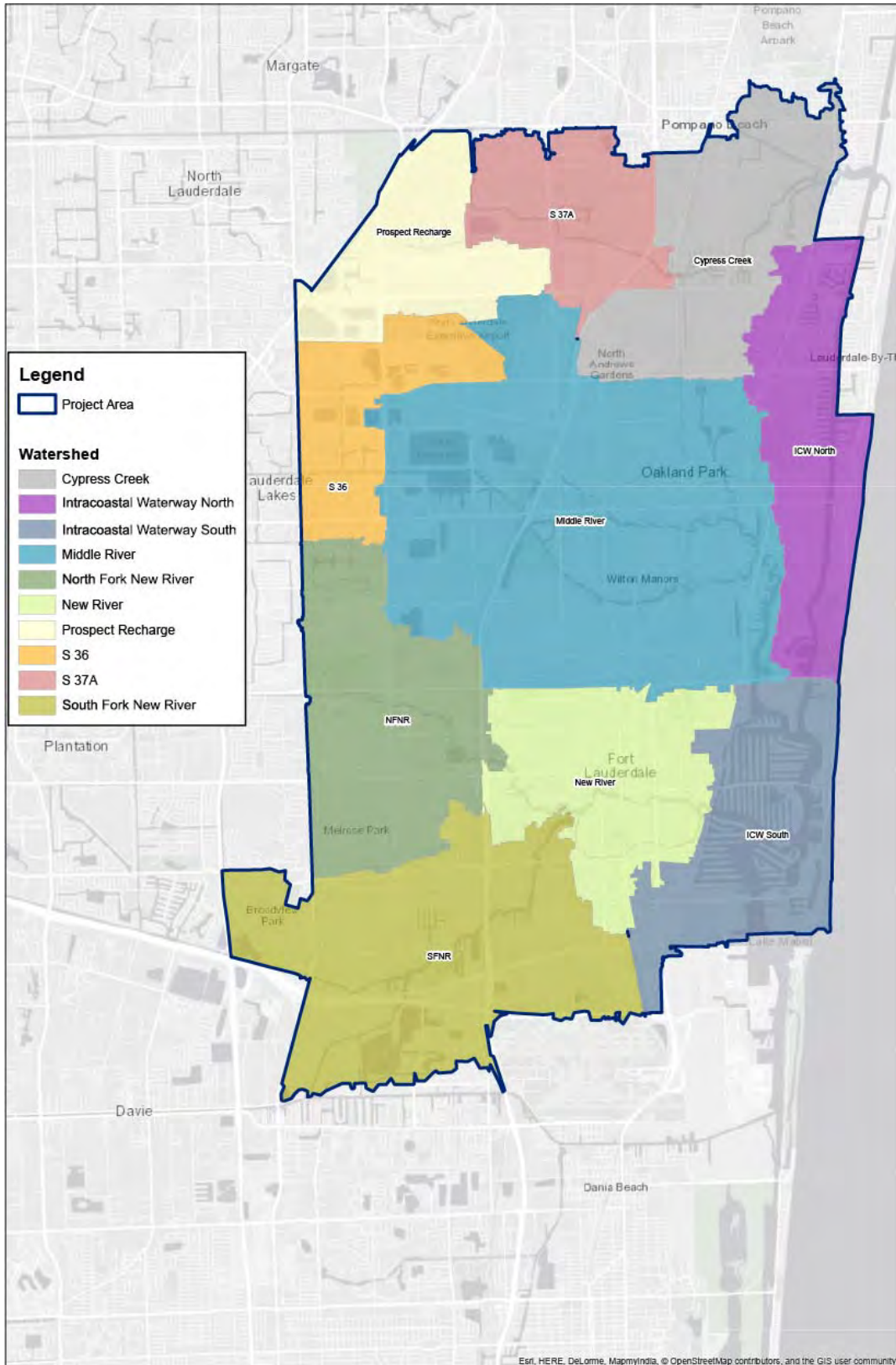


Table 1-2: Design Teams Leading the Seven Priority Neighborhood Projects

Neighborhood	Design Consultant
Dorsey Riverbend	HDR
Durrs	Craven Thompson & Associates
Edgewood	Hazen and Sawyer
Progresso Village	HDR
River Oaks	Craven Thompson & Associates
Southeast Isles	Hazen and Sawyer
Victoria Park	Chen-Moore & Associates

- As part of the preliminary design, a preliminary cost estimate was prepared for each neighborhood.
 - Also to support design, preliminary permitting coordination was conducted with regulatory agencies relative to the approach, methods and proposed neighborhood improvements.
3. **Task Order 3** – Primarily addresses community awareness and outreach to support investment implementation in the seven priority neighborhoods. Task Order 3 had a Notice to Proceed date of November 3, 2016, and the status of tasks being performed under this authorization is as follows:
- A community awareness and outreach plan was developed which identified a variety of approaches/tools that might be used throughout the course of the program, including social media, websites with active feedback capacity, and in-person meetings/presentations to neighborhood associations and other civic groups in the initial neighborhoods where improvements are proposed.
 - During the preliminary design phase, two meetings with each of the seven neighborhoods were conducted (as shown in **Table 1-3**).
 - During the months of February and March 2018, a third round of meetings will be held with the neighborhoods to review and discuss the final designs, permitting, and implementation timeline. These are intended to be the last of the neighborhood meetings during the design phase. The tentative meeting scheduled is shown in **Table 1-4**.

Table 1-3: Preliminary Design Neighborhood Meetings



Neighborhood	First Meeting	Second Meeting
Dorsey Riverbend	February 27, 2017	May 22, 2017
Durrs Area	April 3, 2017	May 22, 2017
Edgewood	March 8, 2017	June 15, 2017
Progresso Village	February 20, 2017	June 19, 2017
River Oaks	March 8, 2017	June 15, 2017
Southeast Isles	March 6, 2017	June 5, 2017
Victoria Park	March 1, 2017	June 7, 2017

Table 1-4: Neighborhood Final Design Meeting Schedule

Neighborhood	Date	Location
Victoria Park	Wednesday, February 7, 2018 7:00pm	St. Anthony 's Church Cafeteria 901 NE 2 nd Street Fort Lauderdale, FL 33301
Progresso Village	Monday, February 19, 2017 7:00pm	The Homeless Shelter Community Room 920 NW 7th Ave. Fort Lauderdale, FL 33311
Dorsey Riverbend/ Durrs Community Assoc.	Monday, February 26, 2018 7:00pm	Norfolk Elementary School 101 NW 15 th Ave. Fort Lauderdale, FL 33311
Southeast Isles	**Tentative** Monday, March 5, 2018	City Hall 8 th Floor 100 North Andrews Ave. Fort Lauderdale, FL 33301
River Oaks/ Edgewood	**Tentative** Thursday, March 15, 2018 6:30pm	Church of the Nazarene Room: TDB 2300 SW 15 th Ave. Fort Lauderdale, FL 33315

4. **Task Order 4** – Primarily focused on final design within the seven priority neighborhoods. These efforts will serve as the basis to substantiate funding requirements for construction of comprehensive stormwater infrastructure (in the seven neighborhoods) which will minimize flooding incidents/severity and promote an adaptable and resilient coastal community for the future. Task Order 4 authorized final design, and Notice to Proceed was issued on November 1, 2017. Primary tasks included and their status as of the issuance of this document are as follows:

- Final design geotechnical investigation field work, laboratory analyses, and draft report are complete.

- Final design survey, to support proposed improvements in the seven neighborhoods, is complete. This effort included right-of-way survey for over 40 miles of local roadways, and boundary and topographic surveys to support design of seven proposed stormwater pump stations. The effort utilized the services of multiple survey crews and mobile LiDAR to accelerate the project schedule.
- Final design for the seven neighborhoods is substantially complete. In total for the seven neighborhoods, over 1,000 drawings have been prepared, along with specifications and an Opinion of Probable Construction Cost (OPCC). Once funding is secured, final design plans and specifications will be utilized to obtain bids from prospective contractors for construction.
- Permitting coordination has been ongoing throughout the preliminary and final design phases, including a detailed workshop with Broward County to familiarize regulatory staff with both the City-wide model and the proposed improvements in the seven neighborhoods. Discussion with Broward County has centered on the approach of achieving conceptual approval for the model, so it can be used as the cornerstone for approving the initial seven neighborhood projects as well as future projects emanating from the overall program. Submittal of permit applications is anticipated to occur in February 2018.



Section 2.0 Dorsey-Riverbend Neighborhood – Drainage Summary

2.1 Summary of Existing Conditions

2.1.1 Neighborhood Description

The Dorsey-Riverbend neighborhood is located east of I-95 and is bound by NW 7th Avenue to the east, NW 6th Street (W. Sistrunk Boulevard) to the north, and State Road 842 (W. Broward Boulevard) to the south. The North Fork New River (NFNR) passes through the southwest portion of the neighborhood. The neighborhood occupies a total area of approximately 380 acres (0.6 mi²), and **Figure 2-1** shows the neighborhood limits. The elevations in the neighborhood range from approximately 3.6 feet NAVD 88 to approximately 10.6 feet NAVD 88, with lower elevations generally located within the central portion of the neighborhood.

The neighborhood is primarily residential, consisting of single family homes, multifamily homes, condominiums, apartment complexes, and some vacant lots. There are several commercial properties located along W. Sistrunk and W. Broward Boulevards. The neighborhood has four schools, including North Fork Elementary and Walker Elementary, and a number of public parks. The properties in this neighborhood generally range in age from about 10 years old to over 60 years old.

2.1.2 Existing Stormwater Management System

The neighborhood is primarily served by two City-owned stormwater systems (divided approximately along NW 11th Avenue), but is also served by private collection systems and the FDOT collection system on W. Broward Boulevard¹. Many segments of the storm sewer system, particularly in northern areas of the neighborhood, are undersized for their respective drainage areas.

The western stormwater system serves the majority of the neighborhood (approximately 0.3 mi²). The Durrs neighborhood, located directly north of Dorsey-Riverbend, discharges its stormwater into Dorsey-Riverbend's primary collector line at the intersection on NW 15th Avenue and W. Sistrunk Boulevard. Moving south, secondary lines feed into the main collector line, before reaching the outfall to the NFNR, near the intersection of NW 15th Way and NW 3rd Court, and adjacent to North Fork Elementary School.

The eastern stormwater system serves approximately 0.2 mi² in the northeast portion of the neighborhood. This system contributes stormwater flow eastward along NW 5th Street (Marjorie A. Davis Street) and discharges to the Progresso Village neighborhood stormwater system.

¹ An area of approximately 0.03 mi² in the southwest portion of the neighborhood (south of the NFNR) drains into the Florida Department of Transportation collection system on W. Broward Boulevard.

2.2 Flooding Evaluations

Past flooding reports were reviewed to better understand drainage concerns. Data from the City's QAlert service, FEMA Repetitive Loss records, neighborhood outreach meetings, and the 2009 Stormwater Master Plan was compiled to ascertain where to focus the improvement efforts.

In addition, field visits to Dorsey-Riverbend were conducted during dry and wet conditions. Drainage structures were inspected and generally appeared to be in proper working condition.

In areas of single family homes, the condition of most grass swales within the right-of-way appeared adequate; however, eroded swales were observed along some streets. The swales in front of most condominium and apartment complexes were paved and poorly graded in many areas, which appears to contribute to the localized ponding observed in these areas.

Lastly, in conjunction with the information gained from the flooding reports and field reconnaissance, the neighborhood stormwater management system's performance under a suite of storm events and present/future climatological conditions was simulated using the new, comprehensive City Stormwater Model.

The sum of this information was considered in development of proposed system improvements.



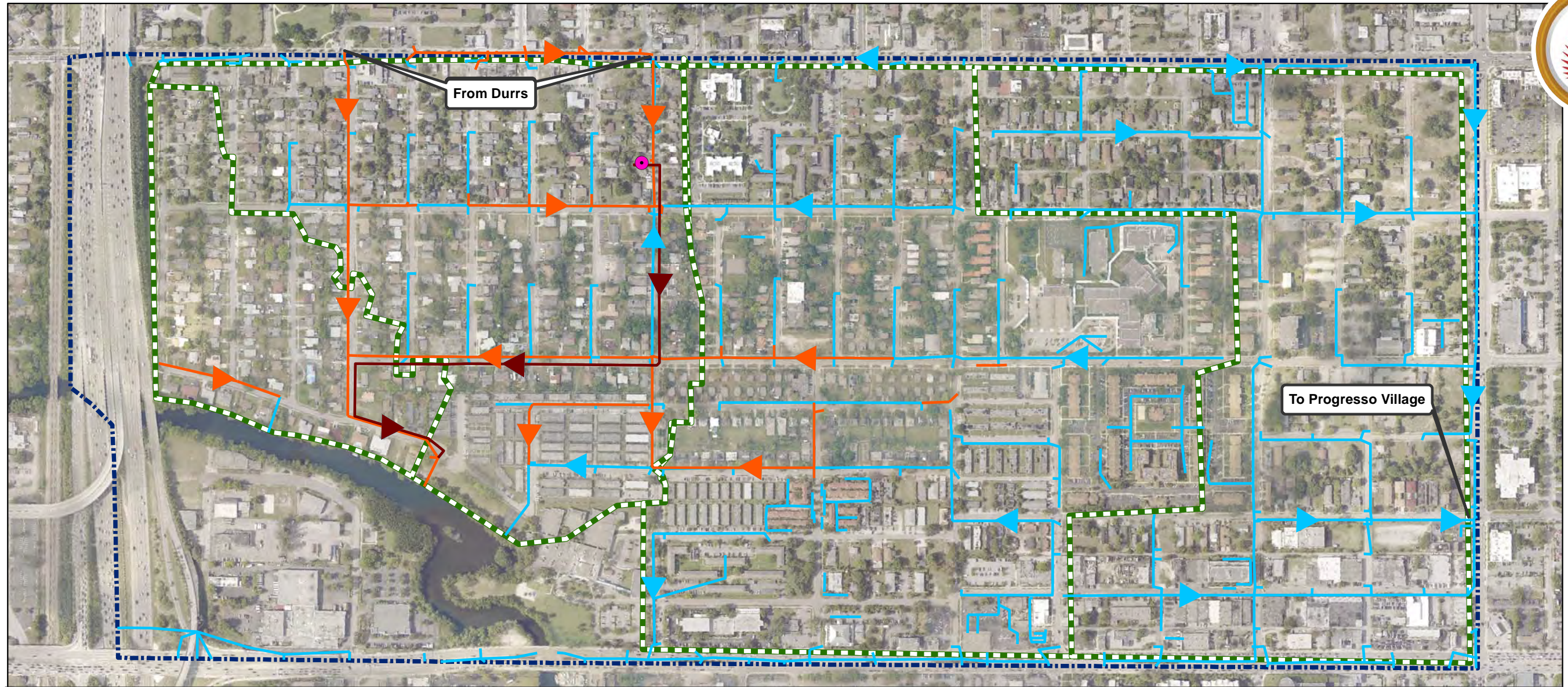
NW 15th Way between NW 5th Street and NW 6th Street on February 22, 2017. Example of poorly graded/paved swales.







2.3 Proposed System Improvements



2.3.1 Goals and Objectives

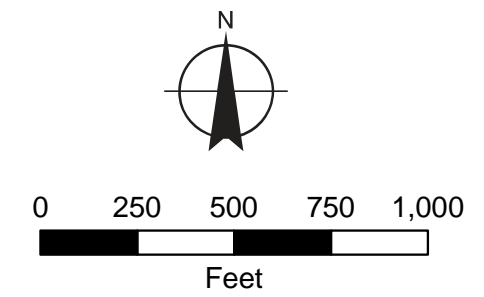
The primary goal is to provide Dorsey-Riverbend, whose existing storm sewer infrastructure is undersized and has insufficient conveyance capacity (particularly in upstream portions along the NW 15th Avenue trunk line), with a comprehensive system which will be adaptable to changing climate conditions in the future.

Multiple sub-basins exist within the Dorsey-Riverbend neighborhood, as shown in **Figure 2-2**. Within the eastern portion of the Dorsey Riverbend neighborhood, surface improvements, including grassed swale restoration, replacing standard pavements with permeable pavement, and minor roadway re-grading, are proposed without pipe network improvements. Within the western portion of the Dorsey Riverbend neighborhood, both surface improvements and improvements to existing collection/conveyance system are proposed to help mitigate more severe flooding occurring in this area. See **Figure 2-3** for proposed improvements.



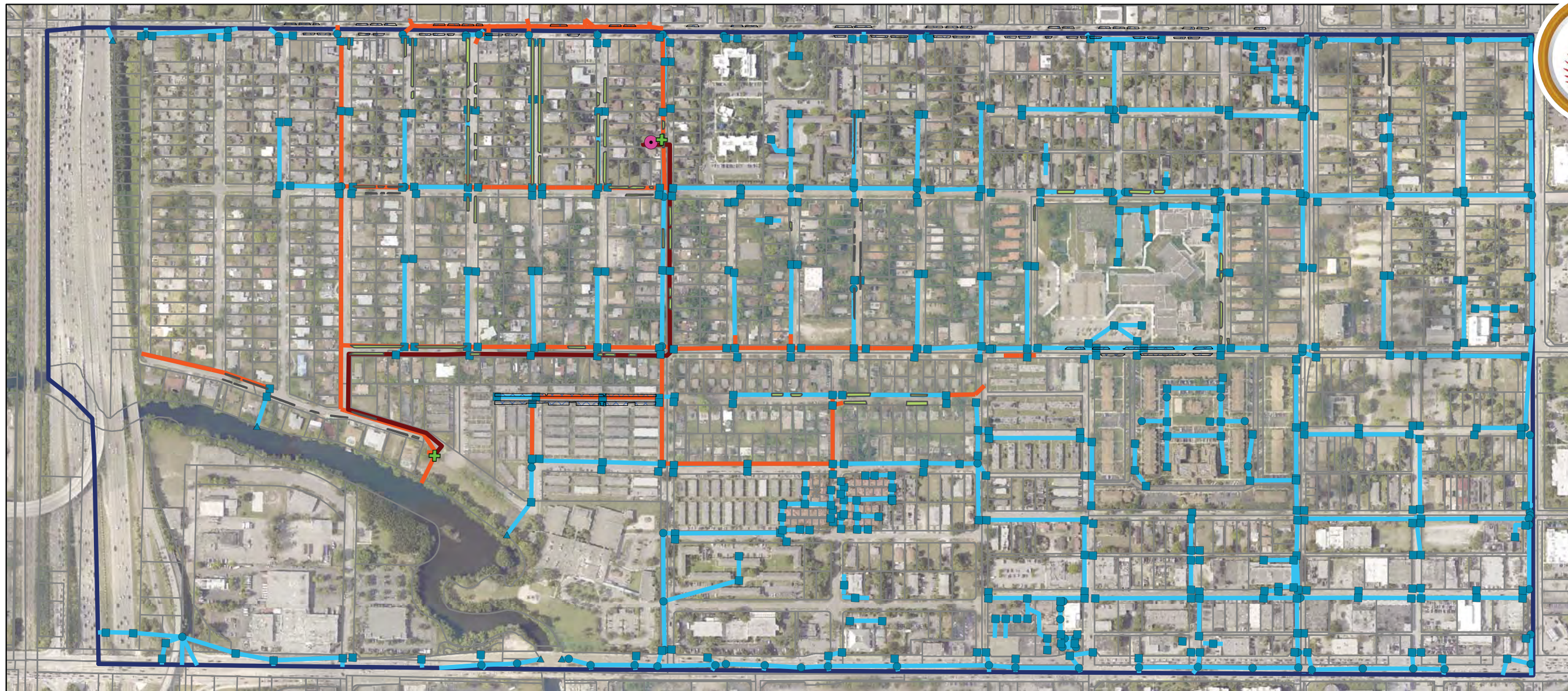
-  Existing Storm Sewer
-  Proposed Storm Sewer
-  Proposed Storm Force Main
-  Proposed Pump Station
-  Existing Flow Direction
-  Proposed Flow Direction

-  Sub-Basin Boundary
-  Dorsey Riverbend Neighborhood Boundary



43193-004.ai

Figure 2-2
Dorsey Drainage Map



Existing Infrastructure

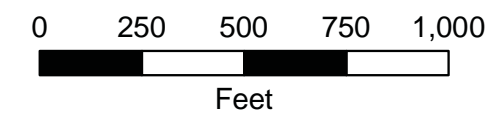
- Existing Catch Basin
- Existing Manhole
- ▲ Existing Outfall
- Existing Storm Line

Proposed Infrastructure

- ⊕ Proposed Water Quality Structure
- Proposed Pump Station
- ▨ Proposed Permeable Pavement
- Proposed Swale Area
- Proposed Storm Force Main
- Proposed Storm Line

Boundaries

- ▭ Dorsey Riverbend Neighborhood Boundary
- ▭ Parcel



Note: Proposed improvements also include 24 drainage wells throughout neighborhood.

43193-004.ai

The proposed surface improvements will provide additional surface storage, reduce stormwater runoff volumes, and minimize local low points along the roadways. Existing storm sewer pipe upsizing and new storm sewer installation will provide the existing collection system with increased conveyance capacity. Installation of new gravity drainage wells will allow stormwater to be discharged to the aquifer at localized points throughout the neighborhood, reducing the overall stormwater runoff which must be conveyed via the storm sewer system and discharged to the NFNR. A new stormwater pump station with force main discharge is proposed to convey stormwater where improvements to the gravity collection system alone were found to be ineffective, mostly due to the relative low elevation of that portion of the neighborhood.

These proposed improvements are intended to reduce flood stage and time of inundation above road crowns for a 10 year-24 hour design storm event and to protect against structural flooding in a 100 year-72 hour storm event wherever feasible.

2.3.2 Water Quality

Water quality treatment for stormwater runoff from the Dorsey-Riverbend neighborhood will be provided via various best management practices (BMPs), also shown in **Figure 2-3**. These consist of exfiltration trenches, restored swales, permeable pavement (largely along NW 6th Street, NW 5th Street, and NW 4th Street), and specifically designed water quality structures located upstream of the new pump stations and new outfall.

2.3.3 Neighborhood Outreach

Community involvement is a key factor in the long term success of the stormwater improvement initiatives. Public outreach was conducted throughout the planning and design process. An individual meeting with the Dorsey-Riverbend Neighborhood Association was held on February 27, 2017, and a joint meeting with the Dorsey-Riverbend and Durrs Neighborhood Associations was held on May 22, 2017. Public input was actively sought and neighbors provided information regarding flooding conditions and previous experiences. A meeting with those associations is also scheduled for February 26, 2018 to review the final design.



Section 3.0 Durrs Neighborhood – Drainage Summary

3.1 Summary of Existing Conditions

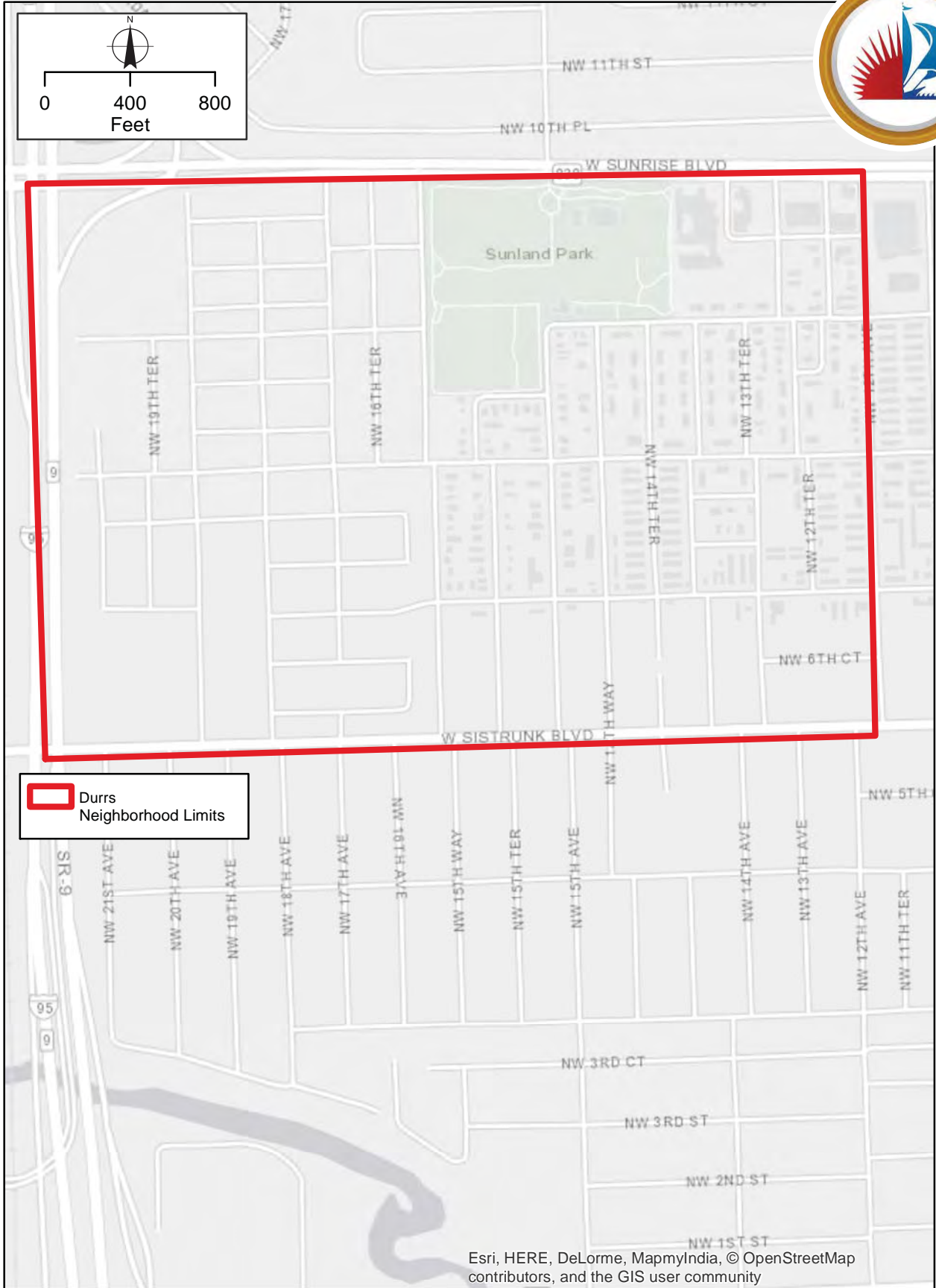
3.1.1 Neighborhood Description

The Durrs Neighborhood is located on the western side of central Fort Lauderdale, bounded by Interstate 95 (I-95) on the west, Sunrise Boulevard (State Road 845) on the north, NW 12th Avenue on the east, and Sistrunk Boulevard/NW 6th Street on the south. The neighborhood is comprised of approximately 237 acres (0.37 mi²), and **Figure 3-1** shows the neighborhood limits. The elevations in the neighborhood range from approximately 1.0 feet NAVD 88 to approximately 12.54 feet NAVD 88; low areas are dispersed throughout the neighborhood.

Broward County parcel data joined with 2016 tax data were analyzed to determine the composition of land use in Durrs. Sixty-three percent of properties in this area are residential, nine percent are industrial or commercial, and twenty-eight percent are institutional, governmental or of other miscellaneous use. Approximately 60% of the structures in the Durrs neighborhood were constructed between the 1940's and 70's.

3.1.2 Existing Stormwater Management System

The existing storm water system for the Durrs Neighborhood generally consists of drainage inlets, small diameter storm drainage pipes and roadside swales. The majority of the storm sewer systems are located within the City of Fort Lauderdale's right-of-way and the majority of the storm drainage pipes within Durrs are less than eighteen (18") inches in diameter. The neighborhood has a fairly extensive storm drainage system located on the majority of the neighborhood roadways. Undersized portions of the system will be replaced with a properly sized pipe network. Primarily, stormwater runoff is collected by inlets and passed through the pipe system ultimately discharging to one (1) of three (3) major stormwater trunk lines, depending upon the origination of the flow. The three (3) trunk line pipe systems are located along NW 18th Avenue, NW 15th Avenue and NW 13th Terrace. These pipe systems progressively increase in diameter until they reach thirty-six (36") inches. The three (3) trunk line pipes then connect to a thirty-six (36") inch pipe in Sistrunk Boulevard that eventually discharges to a sixty (60") inch pipe at the intersection of Sistrunk Boulevard and NW 15th Avenue. The sixty (60") inch pipe conveys runoff south through the Dorsey-Riverbend Neighborhood. The sixty (60") inch pipe increases in diameter to a sixty-six (66") inch pipe at NW 5th Street and then to a seventy-two (72") inch pipe at NW 3rd Street. The storm drainage pipe remains seventy-two (72") inches in diameter until the outfall into the North Fork New River.



43193-004.ai

Figure 3-1

Durrs Neighborhood Limits

3.2 Flooding Evaluations

Information on past flooding events was gathered from various sources for analysis. These sources include City of Fort Lauderdale Q-Alert, 2009 Stormwater Master Plan (SWMP), FEMA Repetitive Loss records, neighborhood outreach meetings, and resident reports. Based upon review of this data, it appears there are various locations of flooding concerns throughout the neighborhood and not just isolated areas.

In addition, a field visit to Durrs was conducted during wet conditions on June 6, 2017. Drainage structures were observed to be in proper working condition, but some structures were not located at the low point along the roadways. In areas of single family homes, the condition of most grass swales within the right-of-way ranged from fair to good; however, eroded swales were observed along some streets. Various areas of isolated ponding were observed as a result of localized low points without inlets for stormwater collection.



NW 8th Court/NW 17th Avenue – June 6, 2017. Example of isolated low area without inlet(s) for collection.

Lastly, in conjunction with the information gained from the flooding reports and field reconnaissance, the neighborhood stormwater management system's performance under a suite of storm events and present/future climatological conditions was simulated using the new, comprehensive City Stormwater Model. The sum of this information was considered in development of proposed system improvements.

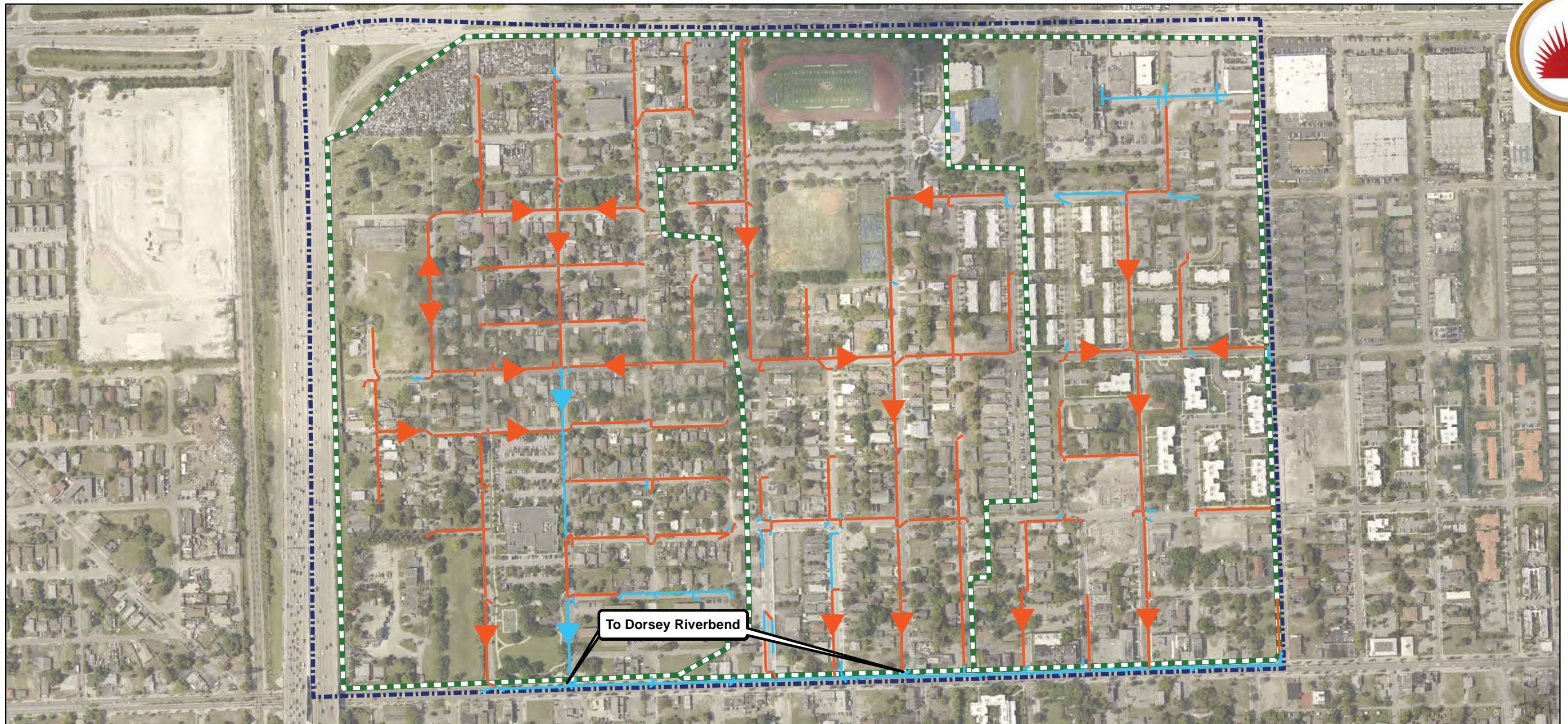
3.3 Proposed System Improvements

3.3.1 Goals and Objectives

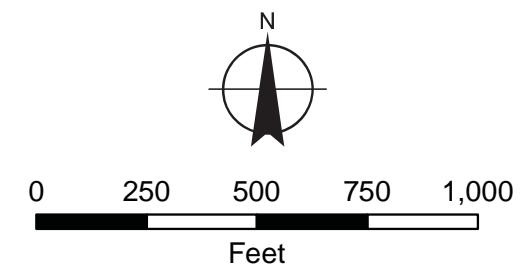
The primary goal is to provide Durrs, which currently has significant areas with undersized infrastructure, with a comprehensive system which will be adaptable to changing climate conditions in the future.

Multiple sub-basins exist within the Durrs neighborhood, as shown in **Figure 3-2**. A major objective is to collect the runoff from the low areas. Selective pipe upsizing, pipe interconnections, the installation of permeable pavement and exfiltration trench will be used to reduce road flooding in the residential areas. An additional interceptor installed within the Dorsey Riverbend neighborhood will collect runoff from the Durrs storm sewer and ultimately direct it to the North Fork of the New River. Tertiary storm sewers will collect and direct flow toward major pipelines. Swales and permeable pavement will be utilized where possible to increase storage, promote infiltration and reduce nuisance flooding.

Proposed improvements are intended to reduce flood stage and time of inundation above road crowns for a 10 year-24 hour design storm event and to protect against structural flooding in a 100 year-72 hour storm event. Flood stage and duration reductions will be achieved through a combination of added storage and discharge capacity via the community investments shown in **Figure 3-3**.

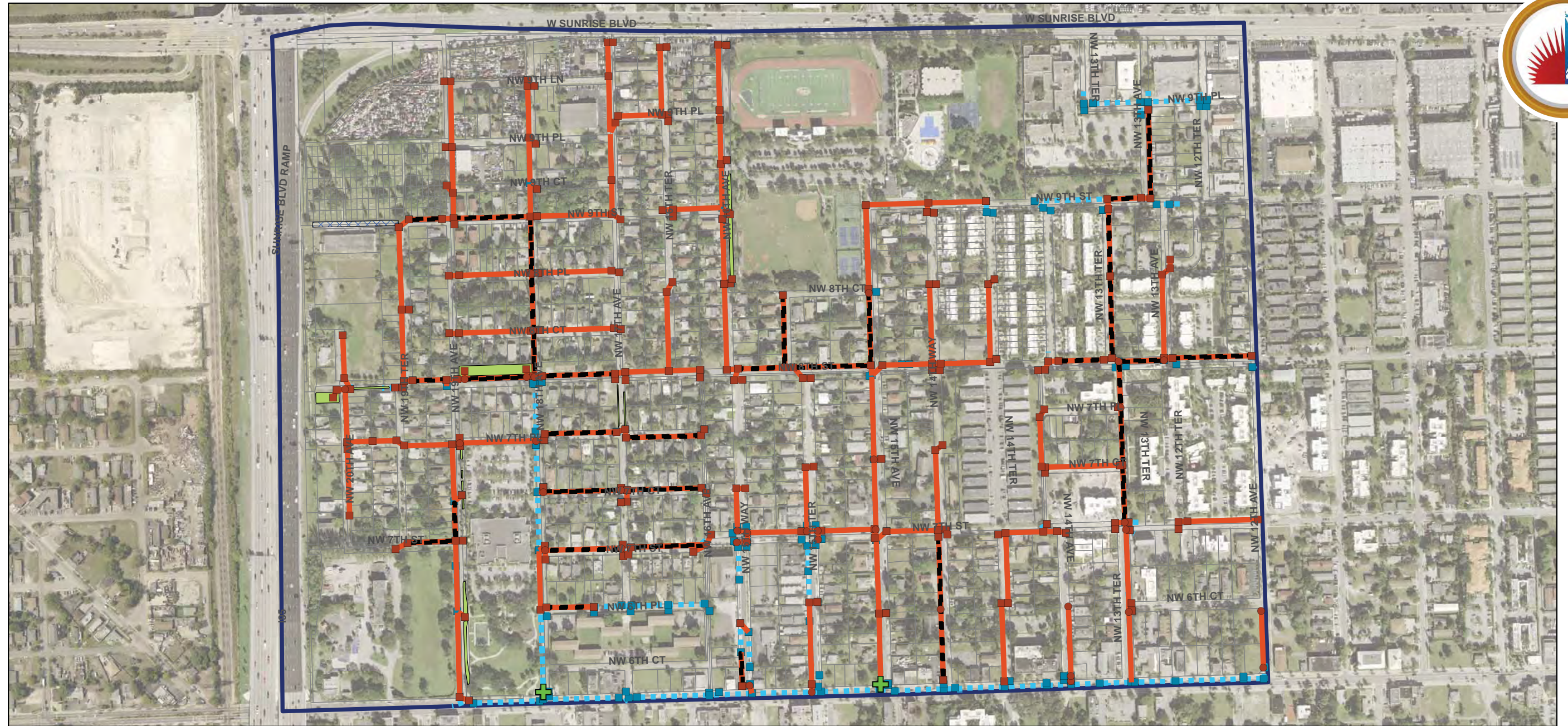


- Existing Storm Sewer
- Proposed Storm Sewer
- Existing Flow Direction
- Proposed Flow Direction
- Sub-Basin Boundary
- Durrs Neighborhood Boundary



43193-004.ai

Figure 3-2
Durrs Drainage Map



Existing Infrastructure

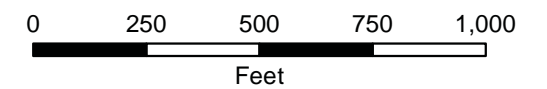
- Existing Catch Basin
- Existing Manhole
- - - Existing Storm Line

Proposed Infrastructure

- + Proposed Water Quality Structures
- Proposed Manhole
- Proposed Catch Basin
- - - Proposed Exfiltration Trench
- Proposed Storm Line
- Proposed Swale Area
- Proposed Permeable Pavement

Boundaries

- Durrs Neighborhood Boundary
- Parcels



43193-004.ai

Figure 3-3
Durrs Proposed Stormwater Improvement
Stormwater Management Improvements

3.3.2 Water Quality

Water quality treatment for stormwater runoff from the Durrs neighborhood will be provided via various best management practices (BMPs), also shown in **Figure 3-3**. These consist of exfiltration trenches, restored swales, permeable pavement and specifically designed water quality structures.

3.3.3 Neighborhood Outreach

Community involvement is a key factor in the long term success of the stormwater improvement initiatives. Public outreach was conducted throughout the planning and design process. A meeting was held with the Durrs Neighborhood Association on April 3, 2017, and a joint meeting with the Durrs and Dorsey Riverbend Neighborhood Associations was held on May 22, 2017. Public input was actively sought and neighbors provided information regarding flooding conditions and previous experiences. A meeting with those associations is also scheduled for February 26, 2018 to review the final design.



Section 4.0 Progresso Village Neighborhood – Drainage Summary

4.1 Summary of Existing Conditions

4.1.1 Neighborhood Description

The Progresso Village neighborhood is bound by State Road 838 (W. Sunrise Boulevard) to the north, the FEC Railway to the east, NW 9th Avenue (Powerline Road) north of NW 6th Street (W. Sistrunk Boulevard) and NW 7th Avenue (Avenue of the Arts) south of NW 6th Street (W. Sistrunk Boulevard) to the west, and State Road 842 (W. Broward Boulevard) to the south. The neighborhood occupies a total area of approximately 315 acres (0.5 mi²), and **Figure 4-1** shows the Progresso Village neighborhood limits. The elevations in the neighborhood range from approximately 1.1 feet NAVD 88 to approximately 12.7 feet NAVD 88.

Land use in the neighborhood is mixed use with industrial, commercial and residential. The industrial properties are located primarily in the east and west portions of the neighborhood, and are generally adjacent to W. Sunrise and W. Broward Boulevards; typical businesses include automotive mechanics/body shops, metals recycling, auto scrap yards, car dealerships, warehouses, etc. Residential properties occupy the eastern portion of the neighborhood and consist of single family homes, multifamily units and condominiums/apartment communities. The neighborhood is home to Sistrunk Park and four private schools. The properties in this neighborhood generally range in age from about 10 years old to over 60 years old.

4.1.2 Existing Stormwater Management System

The neighborhood is primarily served by a City-owned stormwater system, but is also served by private collection systems (mainly exfiltration trenches), the FDOT collection systems on W. Broward Boulevard and W. Sunrise Boulevard, and the Broward County collection systems along NW 9th Avenue (Powerline Road) and NW 7th Avenue (Avenue of the Arts).

Stormwater in Progresso Village is collected and conveyed on the ground surface through combination of swales, roadway shoulders and curb and gutter systems to catch basin and curb inlets. Once collected, stormwater runoff is conveyed through underground piping which is comprised of tertiary, secondary and primary collection lines, which exit the neighborhood and outfall to the North Fork New River (NFNR).

The tertiary lines collect stormwater runoff from street blocks. This runoff is typically conveyed via overland flow by roadway shoulders and grassed/paved swales to inlet structures located in middle of the street blocks. Once stormwater enters the piping system, it is conveyed south to the secondary lines. The tertiary lines generally do not have any stormwater infrastructure north of the mid-block inlet structures.

The secondary lines collect and convey stormwater in east and west directions along NW 9th Street, NW 8th Street, NW 7th Street, NW 6th Street (W. Sistrunk Boulevard), NW 5th Street (Marjorie A. Davis Street), NW 4th Street, NW 2nd Street and NW 1st Street. In addition to the flows from the tertiary lines, the secondary lines collect stormwater runoff from these streets through a combination of roadway shoulders, paved/grassed swales and curb and gutter systems, which flow to inlets generally located near street intersections. The stormwater collected in the secondary lines is then conveyed to three parallel primary lines on NW 9th Avenue (Powerline Road), NW 7th Avenue (Avenue) and NW 4th Avenue (north of NW 4th Street)/5th Avenue (south of NW 4th Street).

The County-owned primary line on Powerline Road collects stormwater runoff along its route and from secondary lines (including from the Dorsey-Riverbend neighborhood), and conveys the stormwater southward through a pipe network. The FDOT line collects stormwater runoff along its route and from secondary lines, and conveys the stormwater southward through a pipe network. This line then combines with the City collection system at the intersection of NW 5th Avenue and NW 2nd Street. This primary line collects stormwater runoff along its route and from secondary lines, and conveys the water southward along SW 5th Avenue through a pipe, which leads to an outfall at the NFNR located behind the Broward Center for the Performing Arts.

4.2 Flooding Evaluations

Past flooding reports were reviewed to better understand drainage concerns. Data from the City's QAlert service, FEMA Repetitive Loss records, neighborhood outreach meetings, and the 2009 Stormwater Master Plan was compiled to ascertain where to focus the improvement efforts.

In addition, field visits to Progresso Village were conducted during dry and wet conditions. Drainage structures were inspected and generally appeared to be in proper working condition.

During the rain event, ponding was observed on paved swales and on roadways, especially in industrial and multi-family residential areas where swales were paved for driveway access and parking.

Lastly, in conjunction with the information gained from the flooding reports and field reconnaissance, the neighborhood stormwater management system's performance under a suite of storm events and present/future climatological conditions was simulated using the new, comprehensive City Stormwater Model. The sum of this information was considered in development of proposed system improvements.

4.3 Proposed System Improvements

4.3.1 Goals and Objectives

The primary goal is to provide Progresso Village, whose existing storm sewer infrastructure is undersized and has insufficient conveyance capacity (particularly in upstream portions along the NW 4th Avenue trunk line), with a comprehensive system which will be adaptable to changing climate conditions in the future.

Multiple sub-basins exist within the Progresso Village neighborhood, as shown in **Figure 4-2**. Within the Progresso Village neighborhood, surface improvements (including grassed swale restoration, replacing standard pavements with permeable pavement, and minor roadway re-grading) are proposed, in addition to improvements to the existing collection/conveyance system. These improvements (see **Figure 4-3**) are expected alleviate the depth and duration of flooding occurring in the neighborhood.

The proposed surface improvements will provide additional surface storage, reduce stormwater runoff volumes, and minimize local low points along the roadways. Existing storm sewer pipe upsizing and new storm sewer installation will provide the existing collection system with increased conveyance capacity. Installation of new gravity drainage wells will allow stormwater to be discharged to the aquifer at localized points throughout the neighborhood, reducing the overall stormwater runoff which must be conveyed via the storm sewer system and discharged to the NFNR. A new stormwater pump station with force main discharge is proposed to convey stormwater where improvement to the gravity collection system was found to be ineffective, mostly due to the relative low elevation of this portion of the neighborhood.

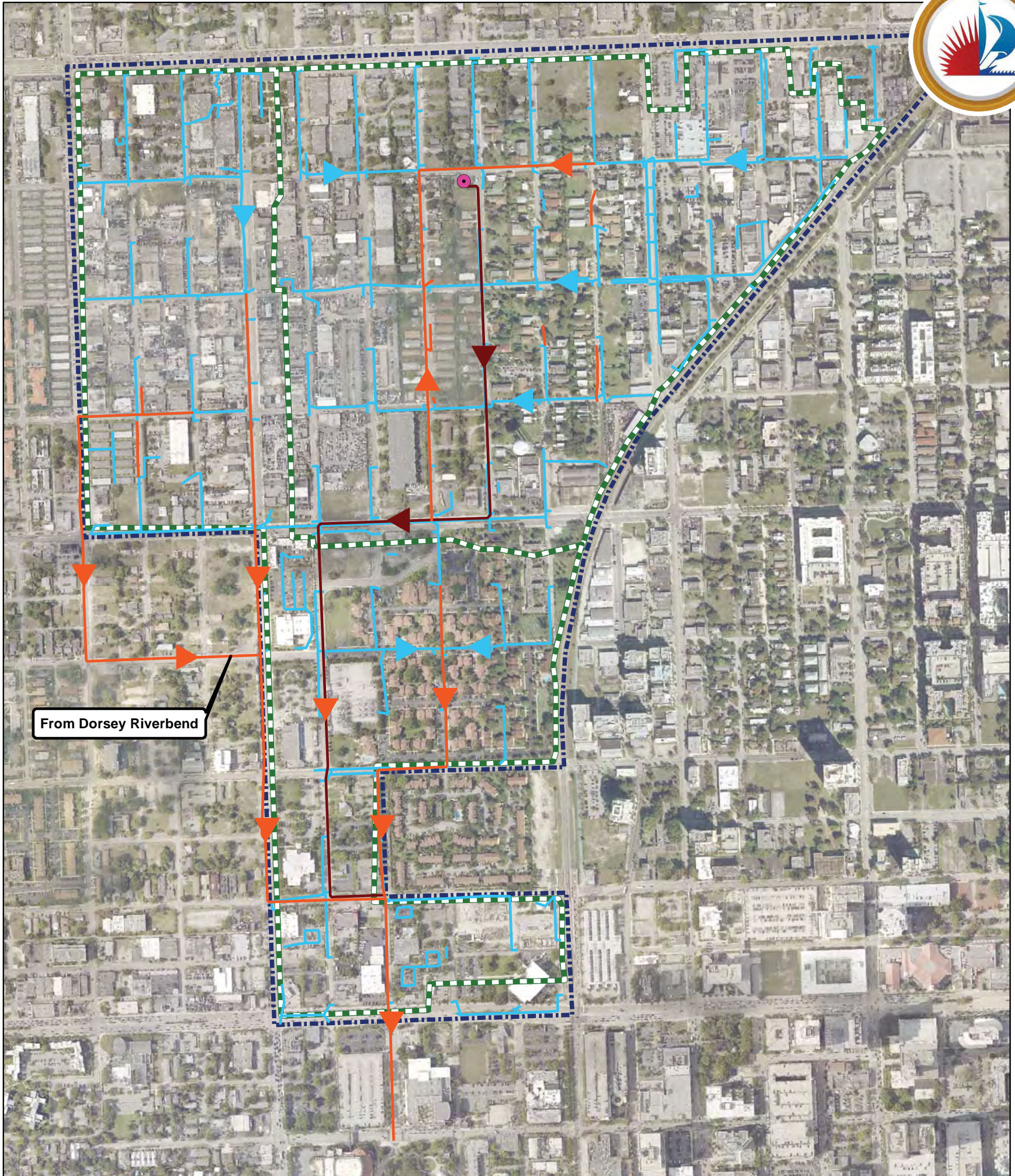
These proposed improvements are intended to reduce flood stage and time of inundation above road crowns for a 10 year-24 hour design storm event and to protect against structural flooding in a 100 year-72 hour storm event wherever feasible.

4.3.2 Water Quality









Water quality treatment for stormwater runoff from the Progresso Village neighborhood will be provided via various best management practices (BMPs), also shown in **Figure 4-3**. These consist of exfiltration trenches, restored swales, permeable pavement, and specifically designed water quality structures located upstream of the new pump station.

4.3.3 Neighborhood Outreach

Community involvement is a key factor in the long term success of the stormwater improvement initiatives. Public outreach was conducted throughout the planning and design process. Meetings with the Progresso Village Neighborhood Associations were held on February 20, 2017 and June 19, 2017. Public input was actively sought and neighbors provided information regarding flooding conditions and previous experiences. A meeting with that association is also scheduled for February 19, 2018 to review the final design.



From Dorsey Riverbend

-  Existing Storm Sewer
-  Proposed Storm Sewer
-  Proposed Storm Force Main
-  Proposed Pump Station
-  Existing Flow Direction
-  Proposed Flow Direction
-  Sub-Basin Boundary
-  Progresso Village Neighborhood Boundary

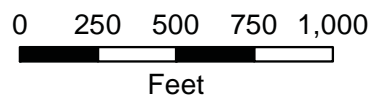
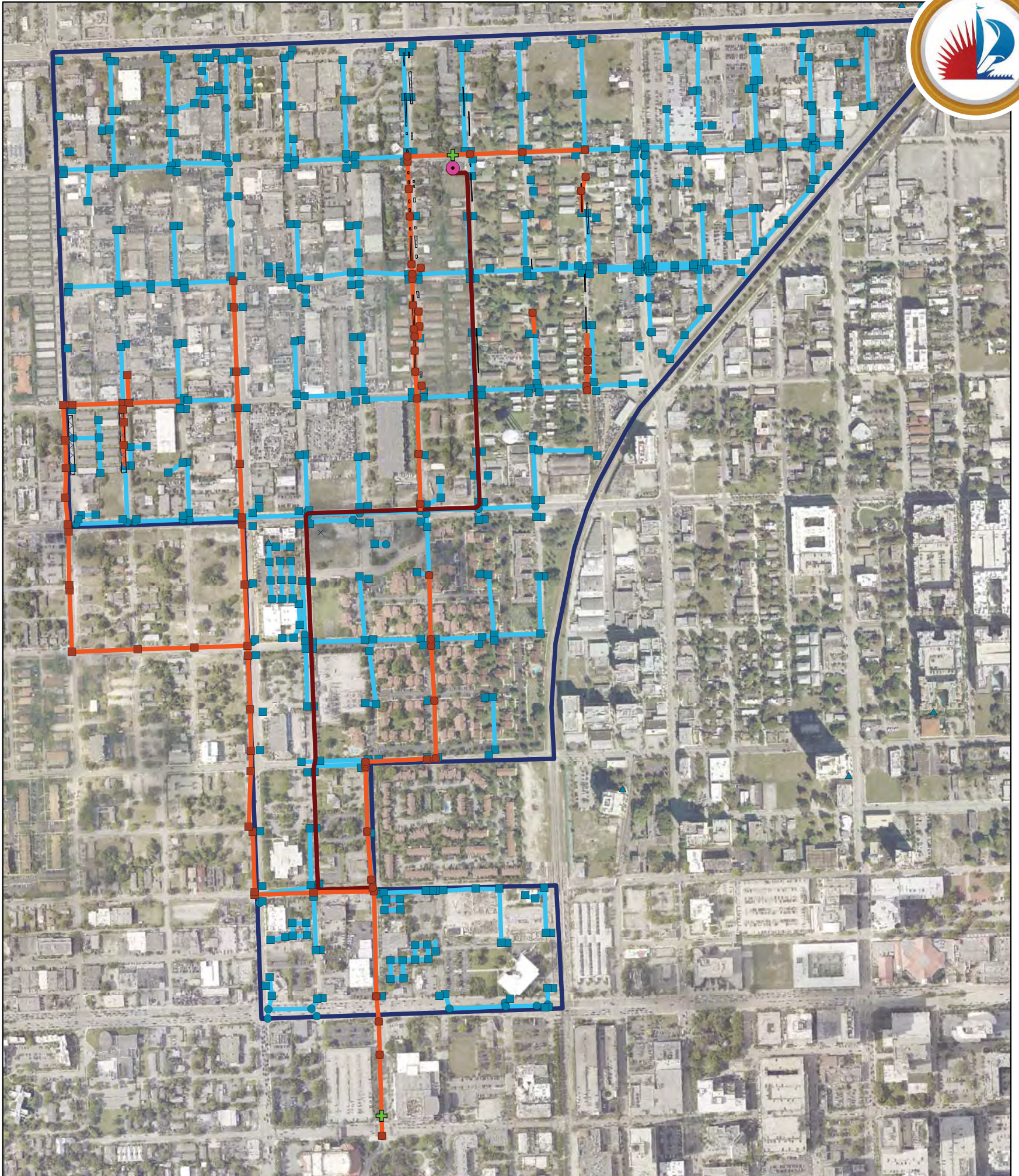


Figure 4-2
Progresso Drainage Map

43193-004.ai



Existing Infrastructure

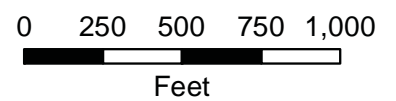
- Existing Catch Basin
- Existing Manhole
- ▲ Existing Outfall
- Existing Storm Line

Proposed Infrastructure

- ⊕ Proposed Water Quality Structure
- Proposed Pump Station
- Proposed Catch Basin
- Proposed Manhole
- Proposed Outfall
- ▨ Proposed Permeable Pavement
- Proposed Storm Line
- Proposed Storm Force Main
- Proposed Swale Area

Boundaries

- ▭ Progresso Village Neighborhood Boundary
- ▭ Parcel



43193-004.ai

Figure 4-3
Progresso Proposed Stormwater Improvements



Section 5.0 Victoria Park Neighborhood – Drainage Summary

5.1 Summary of Existing Conditions

5.1.1 Neighborhood Description

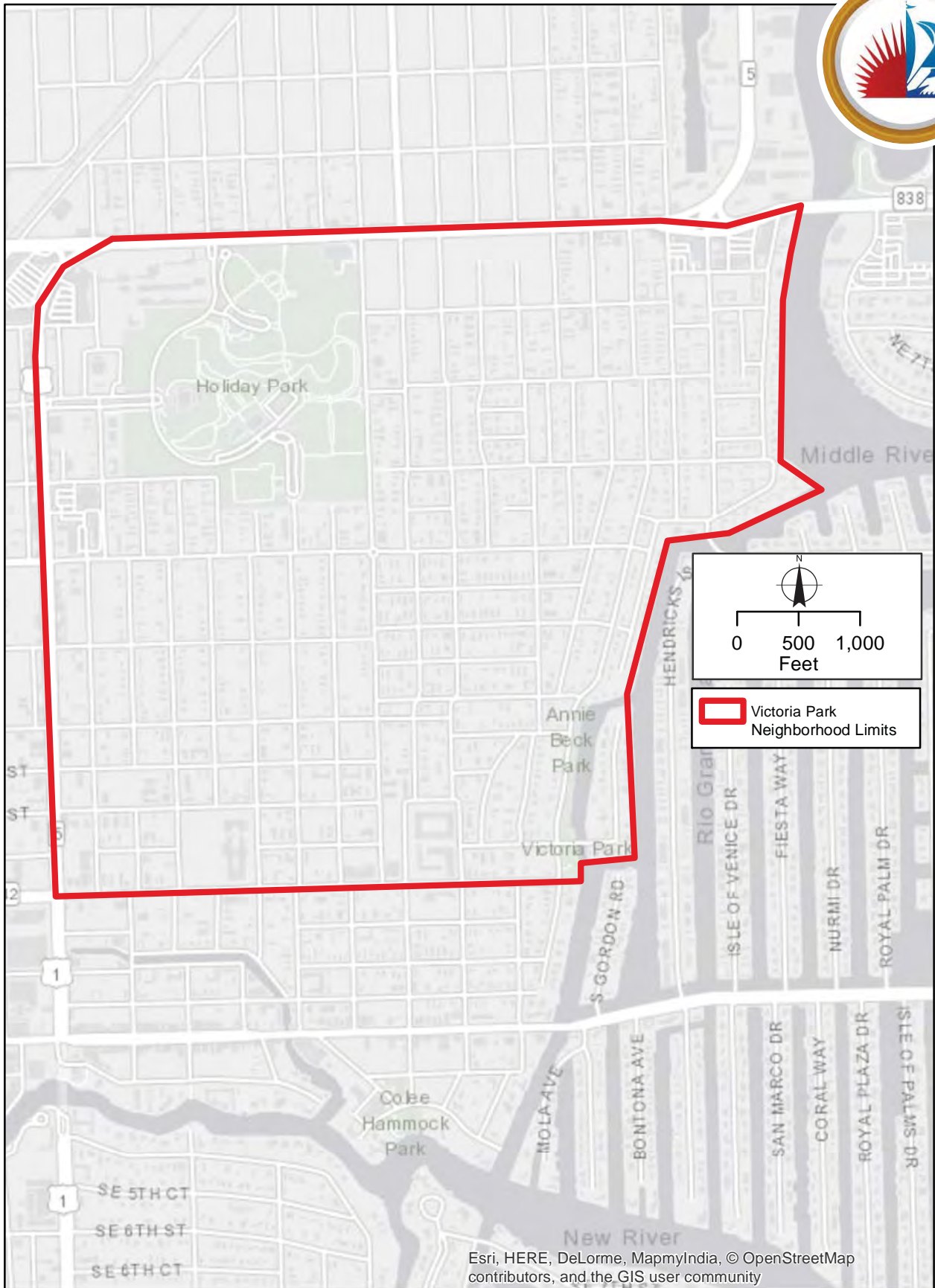
The Victoria Park neighborhood is bound by Federal Highway to the west, Sunrise Boulevard to the north, Broward Boulevard to the south, and the Middle River to the east as shown in **Figure 5-1**. The neighborhood encompasses approximately 668 acres of total land area and consists of approximately 3,600 individual parcels. The parcels within the neighborhood are primarily fully developed with only 2% of the parcels currently remaining vacant. The land use breakdown of these parcels within the neighborhood is 95% residential properties, 4% commercial properties, and 1% other classifications. The majority of the residential properties are single family with a mixture of multi-family. The commercial properties are primarily located along the major roadways along the perimeter of the neighborhood, such as Federal Highway and Sunrise Boulevard. The other classifications include municipalities, schools, and churches.

Per the Broward County Property Appraiser Database, a majority of the properties within Victoria Park were originally developed in the 1950s with some structures dating back to the 1930s. Since the Victoria Park neighborhood is currently built out, any future development activities within the neighborhood would be limited to the redevelopment of existing parcels.

5.1.2 Existing Stormwater Management System

The existing stormwater system within the Victoria Park neighborhood is generally comprised of two separate, independent drainage systems on each side of the coastal ridge. The existing stormwater system on the east side of the coastal ridge primarily consists of multiple independent outfalls which discharge into the Middle River. The existing stormwater system on the west side of the coastal ridge primarily consists of multiple independent pipe networks, which either do not have an outfall or are interconnected to other stormwater systems, such as the FDOT stormwater system along Federal Highway and Sunrise Boulevard. Significant roadway segments throughout the Victoria Park neighborhood do not have any existing stormwater infrastructure.

When this neighborhood was originally developed, graded grass swale areas along the roadways were used as the primary method for handling stormwater runoff from the public right of way areas. Over time, these graded grass swale areas within the public right of way have accumulated sediments from stormwater runoff, become overgrown with vegetation, and been eliminated by the installation of extensive landscaping, paved parking lanes, expanded driveway approaches, and other hardscape elements throughout the Victoria Park Neighborhood. The reduction and elimination of graded grass swale areas throughout the neighborhood has reduced the storage capacity and infiltration capacity for



43193-004.ai

Figure 5-1
Victoria Park Street Map

stormwater runoff generated within and/or draining to the public right of way and has led to ponding issues within roadway areas during and after rainfall events.

5.2 Stormwater Management System Evaluation

Historical data from the 2009 Fort Lauderdale Stormwater Report, the City's Q-Alert database, neighborhood outreach meetings, and from the FEMA Repetitive Loss records were evaluated to identify drainage concerns. The historical data was collected and used to identify priority locations for any proposed stormwater improvements.

In addition, an extensive site visit to the Victoria Park neighborhood was conducted during a storm event on February 22, 2017 for the purpose of identifying the approximate location, extent, and severity of any flooding problems within the public right of way areas. In general, the locations of this localized ponding typically corresponded to the locations of the historical flooding reports for Victoria Park. This site visit confirmed that ponding can be expected at the locations of the historical flooding reports within the Victoria Park neighborhood. Field reconnaissance and survey of existing trees and landscaping within the right of way was also performed to determine where preservation and incorporation into the design was appropriate.

Lastly, in conjunction with the information gained from the flooding reports and field reconnaissance, the neighborhood stormwater management system's performance under a suite of storm events and present/future climatological conditions was simulated using the new, comprehensive City Stormwater Model. The sum of this information was considered in development of proposed system improvements.



NE 15th Avenue – February 22, 2017



NE 9th Street and NE 14th Avenue – February 22, 2017

Examples of localized intersection and roadway flooding in Victoria Park

5.3 Proposed System Improvements

5.3.1 Goals and Objectives

The primary goals of this project are to implement new stormwater infrastructure within the right of way areas of the Victoria Park neighborhood that will meet level of service criteria for flood control and water quality treatment while alleviating any historical localized flooding issues within the neighborhood.

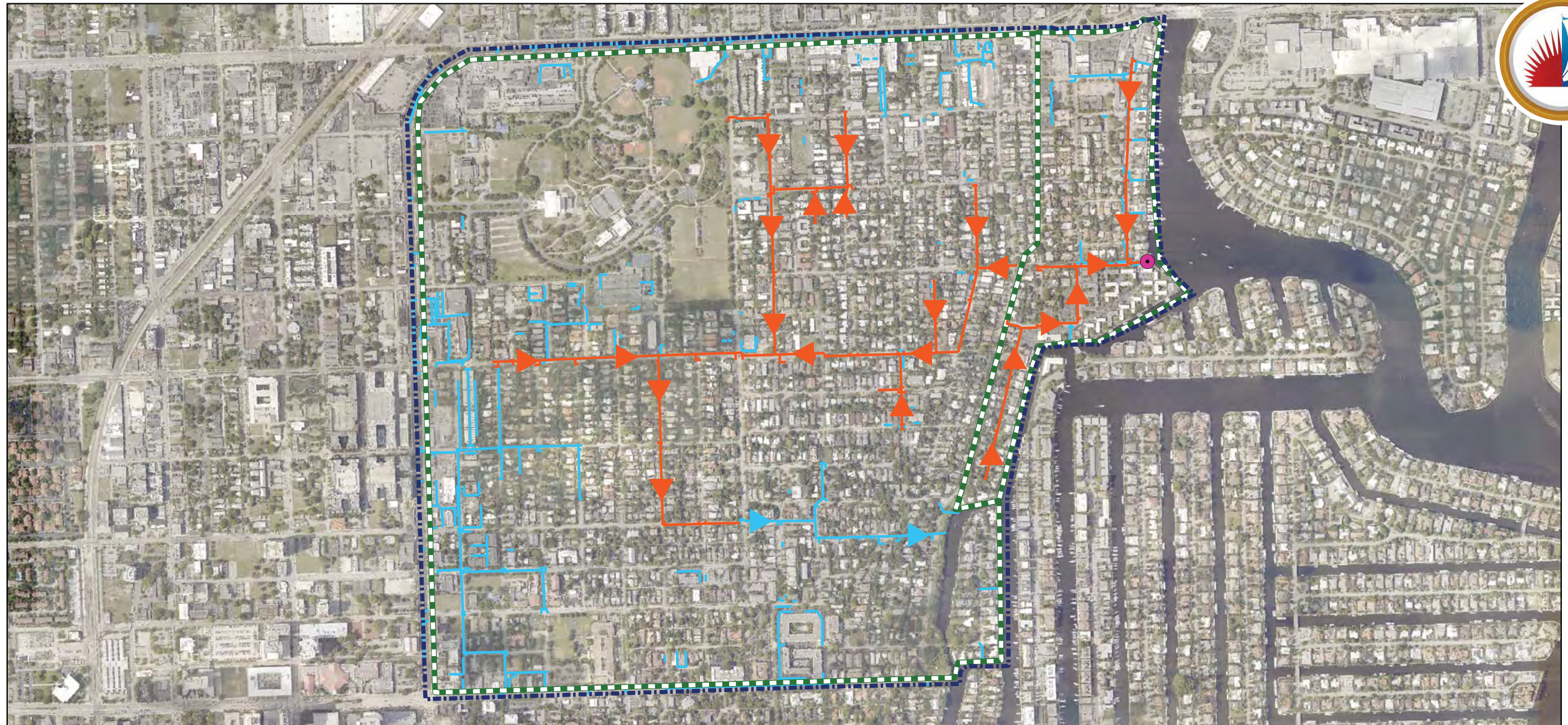
The Victoria Park neighborhood is generally comprised of two separate drainage areas on each side of the elevated coastal ridge, with each experiencing different types of flooding issues. The coastal ridge is generally located along North Victoria Park Road and NE 18th Avenue as shown in **Figure 5-2**. Within the eastern portion of the Victoria Park neighborhood, the proposed stormwater improvements include the interconnection of the seven independent positive outfalls with additional drainage piping and the incorporation of a proposed stormwater pump station at one of the existing outfalls to combat the tidal influence on flooding issues. The stormwater pump station will drawdown the flooding levels during storm events while ensuring consistent discharge capacity during elevated tide levels. Within the western portion of the Victoria Park neighborhood, the proposed stormwater improvements include the interconnection of various existing independent drainage networks located throughout the neighborhood with additional drainage piping and new exfiltration trench, along with limited roadway swale restoration where feasible. The general configuration of the proposed stormwater improvements within the Victoria Park neighborhood is displayed within **Figure 5-3**. A small section of City-owned seawall is also proposed to be improved. Its location is shown on **Figure 8-4** in Section 8.

5.3.2 Water Quality

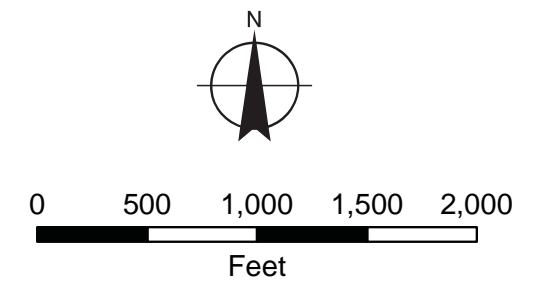
The proposed stormwater improvements within the Victoria Park neighborhood will consist of additional pipe interconnections, exfiltration trenches, restored swales, and water quality structures. The proposed exfiltration trench will be installed in the western portion of the Victoria Park neighborhood where the ground elevation is 6.0 feet or higher to allow for effective storage above the water table. Water quality structures will be installed before each of the seven outfalls in the eastern portion of the Victoria Park Neighborhood before discharging into the Middle River. The existing swale areas will be regraded where possible and at locations within the neighborhood in which the swales do not have extensive landscaping and have not been paved over.

5.3.3 Neighborhood Outreach

The City held public outreach meetings on March 1, 2017 and June 7, 2017 at the Victoria Park Civic Association Meeting. During these meetings, representatives from the City of Fort Lauderdale, Hazen and Sawyer, and Chen Moore and Associates conducted a presentation to the residents to provide information on the purposes of this project and request additional input on existing flooding concerns throughout the Victoria Park neighborhood. Neighbor Input Forms were provided to the residents and collected following the meeting. In an effort to document the location of observed past flooding, neighborhood maps were also on display at the meeting for residents to mark the location of their concerns according to categories of structural flooding, yard flooding, roadway flooding and tidal flooding. In general, the locations of flooding concerns are located near the Middle River where seasonal tidal flooding is prominent and in the low lying

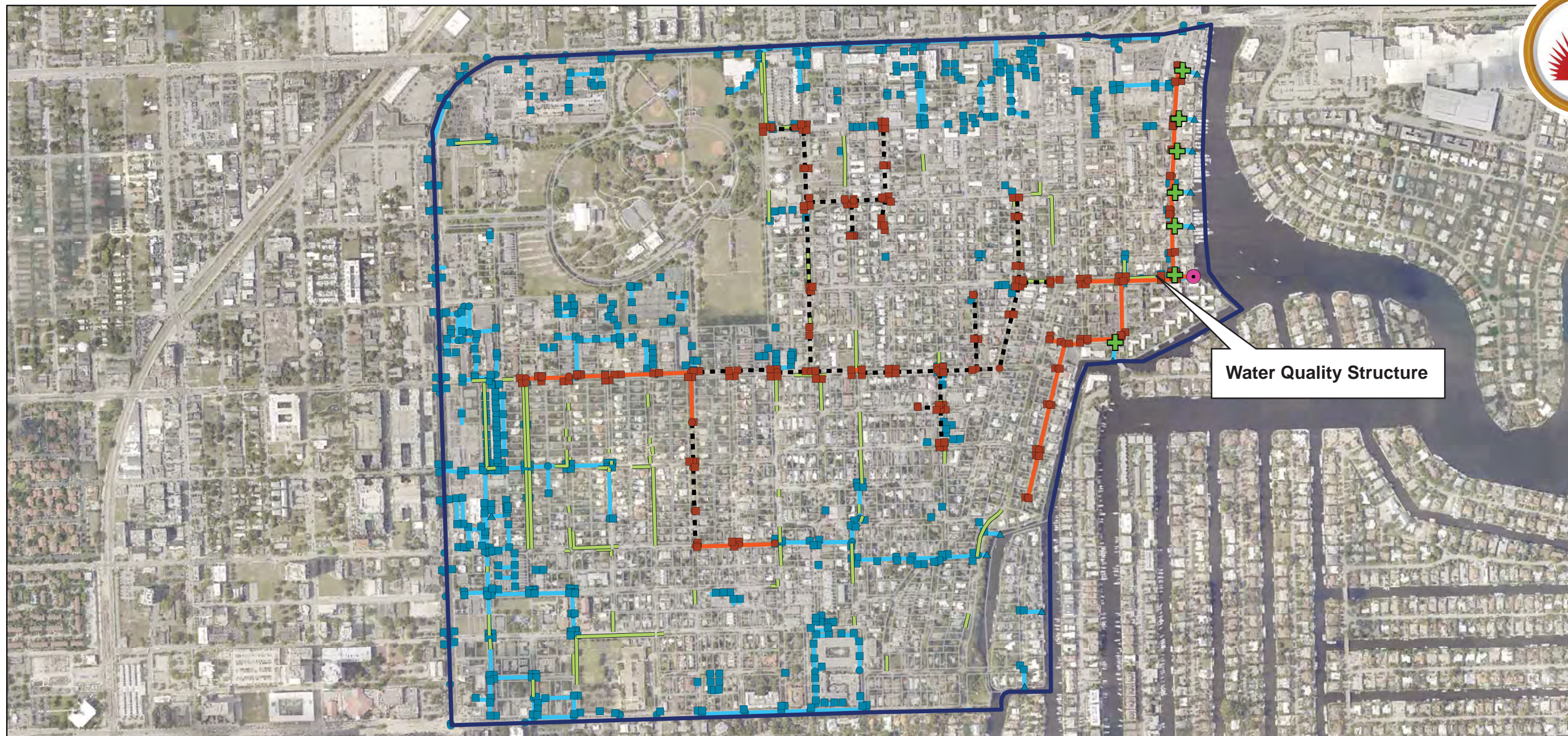


-  Existing Storm Sewer
-  Proposed Storm Sewer
-  Proposed Pump Station
-  Existing Flow Direction
-  Proposed Flow Direction
-  Sub-Basin Boundary
-  Victoria Park Neighborhood Boundary



43193-004.ai

Figure 5-2
Victoria Park Drainage Map



Existing Infrastructure

- Existing Catch Basin
- Existing Manhole
- ▲ Existing Outfall
- Existing Storm Line

Proposed Infrastructure

- ⊕ Proposed Water Quality Structure
- Proposed Pump Station
- Proposed Catch Basin
- Proposed Manhole
- Proposed Exfiltration Trench
- Proposed Storm Line
- Proposed Swale Area

Boundaries

- ▭ Victoria Park Neighborhood Boundary
- ▭ Parcels

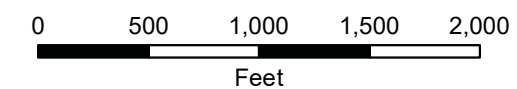


Figure 5-3
Victoria Park Proposed Stormwater Improvements

43193-004.ai

roadway areas to the west of the elevated coastal ridge. A third meeting is tentatively scheduled for March 5, 2018 to review the final design.



Section 6.0 Edgewood Neighborhood – Drainage Summary

6.1 Summary of Existing Conditions

6.1.1 Neighborhood Description

The Edgewood neighborhood is located east of I-95 and is bound by I-595 to the south, State Road (SR) 84 to the north and the FEC Railroad to the east. The neighborhood occupies a total area of approximately 750 acres (1.17 mi²). **Figure 6-1** shows the Edgewood neighborhood limits. The elevations in the neighborhood range from approximately 1.9 feet NAVD 88 to approximately 12.2 feet NAVD 88, with most of the lower elevation areas in the central section and adjacent to Osceola Creek. The eastern section is primarily industrial and commercial, while the remainder of the neighborhood is primarily residential (single and multifamily). Snyder Park and the Edgewood Passive Park provide large open spaces for recreation.

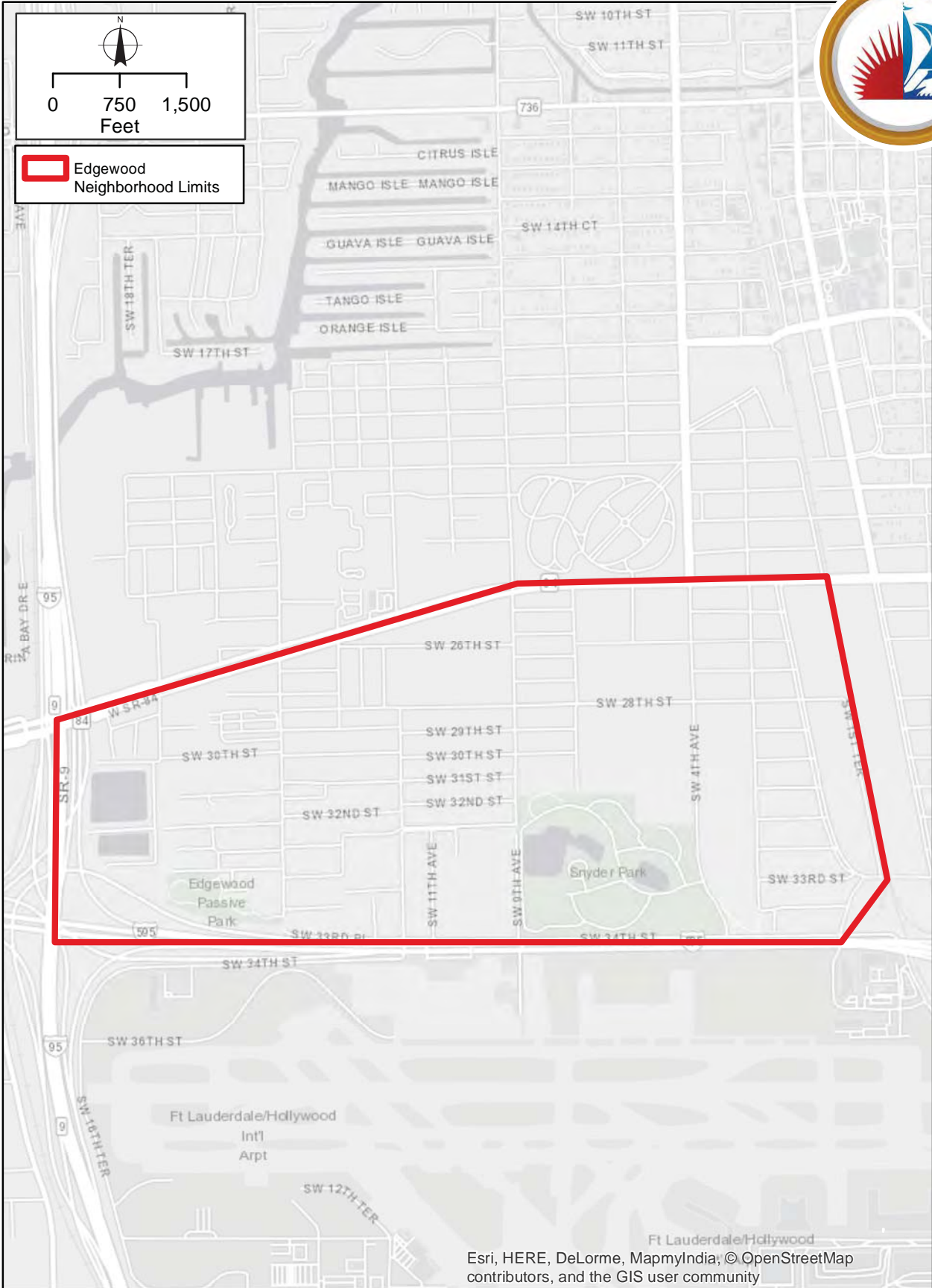
Broward County parcel data joined with 2016 tax data were analyzed to determine the composition of land use in Edgewood. Sixty five percent of properties in this area are residential and 17% are industrial. The balance are commercial, institutional or other. Approximately 75% of the structures in the Edgewood neighborhood were constructed in the 1950's, 60's and 70's.

6.1.2 Existing Stormwater Management System

Most of the existing stormwater management infrastructure exists in the eastern section of Edgewood, with relatively little infrastructure in the majority of the residential (central and western) areas. The eastern section has storm sewers that connect to the SR 84 system, as well as isolated sections of exfiltration trench. Segments of the storm sewer systems are undersized for their respective drainage areas. In the residential areas, there are some limited areas with exfiltration trenches and limited outfall capacity to the Osceola Creek in the southwest corner of the neighborhood. The neighborhood was designed primarily for swale drainage which is not functioning adequately in many areas, particularly those areas with limited means of positive outfall for runoff that exceeds the capacity of the swale system.

6.2 Flooding Evaluations

Past flooding reports were reviewed to better understand drainage concerns. Data from the City's QAlert service, FEMA Repetitive Loss records, neighborhood outreach meetings, and the 2009 Stormwater Master Plan was compiled to ascertain where to focus the improvement efforts.



43193-004.ai

Figure 6-1

Edgewood Neighborhood Limits

In addition, field visits to Edgewood were conducted during dry and wet conditions. Significant ponding was noted at intersections and observed to overtop the crown of roadways in multiple areas. Low points along local roads often had significant standing water as well. Much of the right of way that



SW 29th Street – June 7, 2017



SW 12th Terrace – June 7, 2017

Examples of localized roadway flooding in Edgewood

would typically facilitate swale drainage has not been properly graded to achieve that purpose and/or has been hardened for parking. Portions of Osceola Creek are in need of improvement and ongoing maintenance to provide better and more reliable flood control for the western portion of the neighborhood.

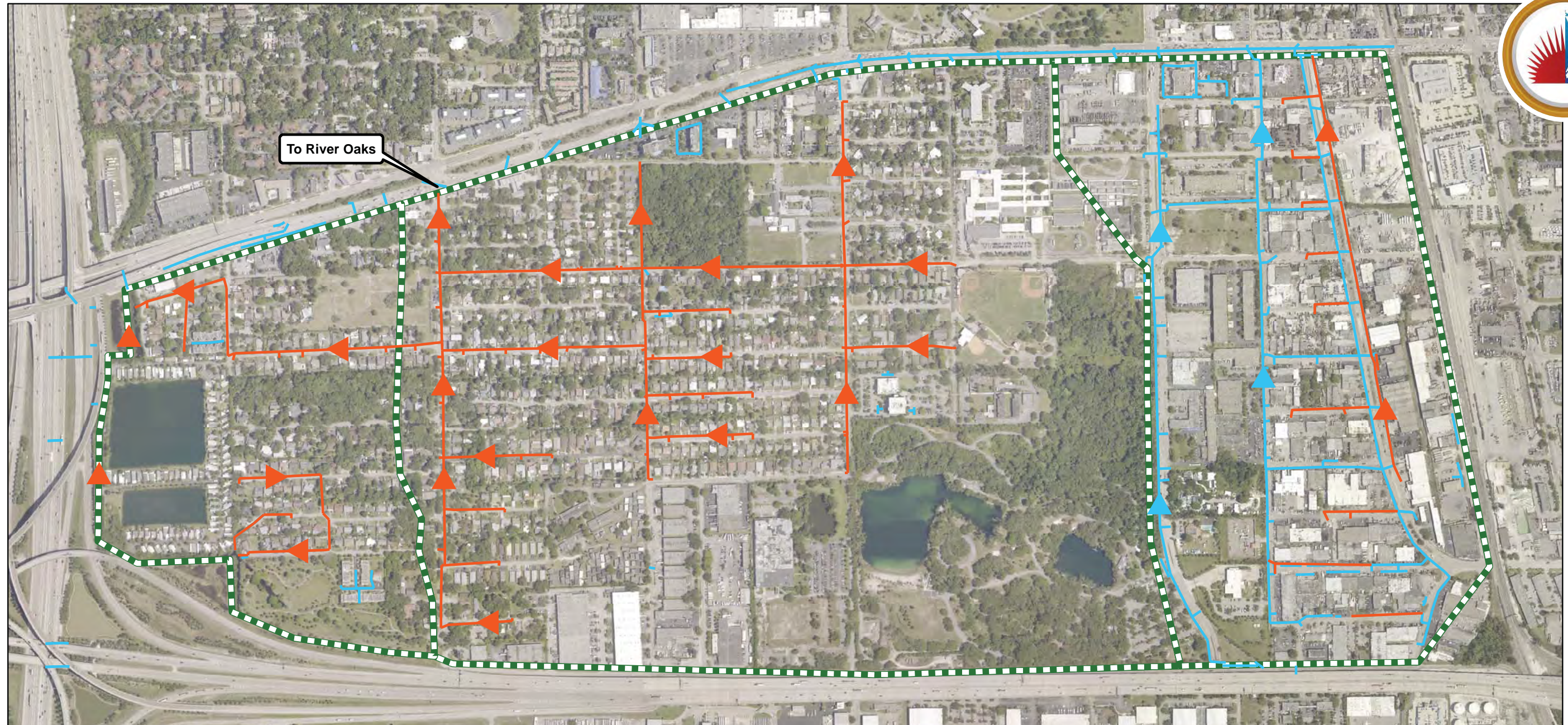
Lastly, in conjunction with the information gained from the flooding reports and field reconnaissance, the neighborhood stormwater management system's performance under a suite of storm events and present/future climatological conditions was simulated using the new, comprehensive City Stormwater Model. The sum of this information was considered in development of proposed system improvements.





6.3 Proposed System Improvements



6.3.1 Goals and Objectives

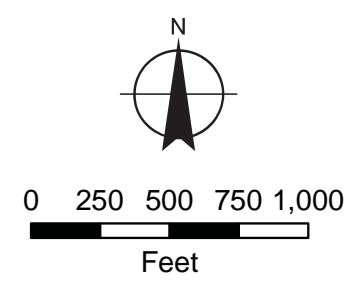
The primary goal is to provide Edgewood, which currently has very limited stormwater management infrastructure in its western and central portions, with a comprehensive system which will be adaptable to changing climate conditions in the future.

Multiple sub-basins exist within the Edgewood neighborhood, as shown in **Figure 6-2**. A major objective is to redirect runoff from the low areas in central Edgewood north, through River Oaks, and ultimately to the South Fork New River. The major storm sewer trunk lines to facilitate this run along SW 9th Avenue, SW 12th Avenue, SW 28th Street, and finally SW 15th Avenue (which will continue on through River Oaks). Tertiary storm sewers will collect and direct flow toward these major lines. Swales and permeable



-  Existing Storm Sewer
-  Proposed Storm Sewer
-  Existing Flow Direction
-  Proposed Flow Direction

-  Sub-Basin Boundary
-  Edgewood Neighborhood Boundary



43193-004.ai

Figure 6-2
Edgewood Drainage Map

pavement will be utilized where possible to increase storage, promote infiltration and reduce nuisance flooding. Improvements in the western section of Edgewood will help to direct flow toward Osceola Creek and move it more efficiently toward the South Fork New River. Maintenance improvements to the Osceola canal itself are also intended. In the eastern section of Edgewood, selective pipe upsizing and the installation of permeable pavement and exfiltration trench will be used to reduce road flooding in the industrial area.

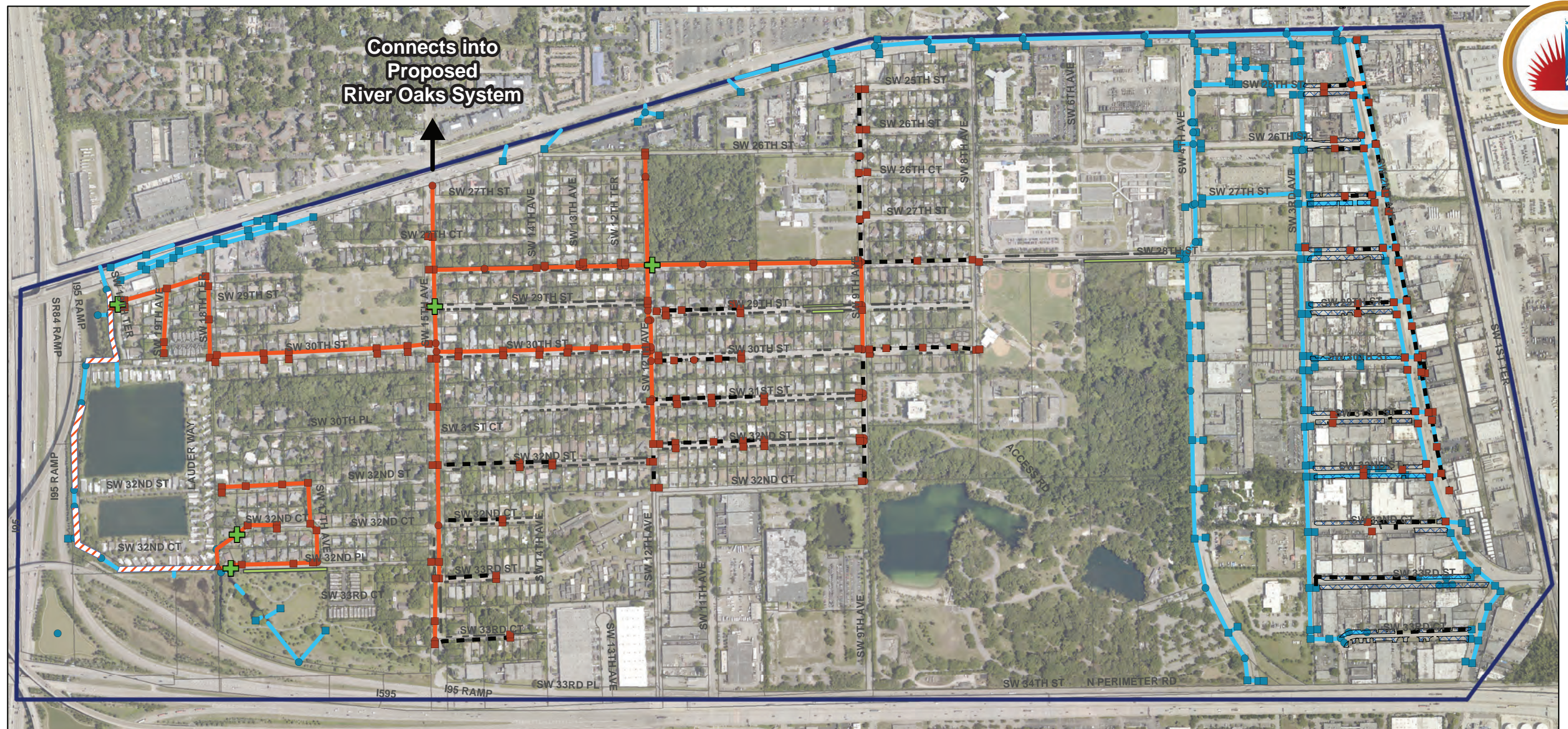
Proposed improvements are intended to reduce flood stage and time of inundation above road crowns for a 10 year-24 hour design storm event and to protect against structural flooding in a 100 year-72 hour storm event where feasible. Flood stage and duration reductions will be achieved through a combination of added storage and discharge capacity via the community investments shown in **Figure 6-3**.

6.3.2 Water Quality

Water quality treatment for stormwater runoff from the Edgewood neighborhood will be provided via various best management practices (BMPs), also shown in **Figure 6-3**. These consist of exfiltration trenches, restored swales, permeable pavement (largely in the eastern/industrial sub-basin), specifically designed water quality structures located upstream of new and upsized (existing) outfalls. Flexibility to connect into future surface storage facilities is also incorporated in the plan.

6.3.3 Neighborhood Outreach

Community involvement is a key factor in the long term success of the stormwater improvement initiatives. Public outreach was conducted throughout the planning and design process. Joint meetings with the Edgewood and River Oaks Neighborhood Associations were held on March 8, 2017 and June 15, 2017. Public input was actively sought and neighbors provided information regarding flooding conditions and previous experiences. A meeting with those associations is tentatively scheduled for March 15, 2018 to review and discuss the final design.



Connects into
Proposed
River Oaks System

Existing Infrastructure

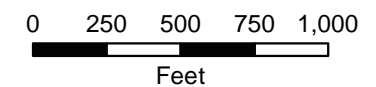
- Existing Storm Line
- Existing Catch Basin
- Existing Manhole
- Existing Outfall

Proposed Infrastructure

- Proposed Water Quality Structure
- Proposed Catch Basin
- Proposed Manhole
- Proposed Outfall
- Proposed Storm Line
- Proposed Exfiltration Trench
- Proposed Swale Area
- Proposed Canal Improvements
- Proposed Permeable Pavement

Boundaries

- Edgewood Neighborhood Boundary
- Parcel



43193-004.ai

Figure 6-3

Edgewood Proposed Stormwater Improvement Map



Section 7.0 River Oaks Neighborhood – Drainage Summary

7.1 Summary of Existing Conditions

7.1.1 Neighborhood Description

The River Oaks neighborhood is located east of I-95 and South Fork New River, and is bound by State Road 84 to the south, Davie Road to the north, and SW 9th Avenue to the east. The neighborhood occupies a total area of approximately 518 acres (0.81 mi²). **Figure 7-1** shows the River Oaks neighborhood limits. The elevations in the neighborhood range from approximately 1.5 feet NAVD 88 to approximately 13 feet NAVD 88, with most of the lower elevation areas occurring south of SW 20th Street and adjacent to the Preserve Park. Adjacent to South Fork New River and State Road 84 are primarily industrial and commercial land uses, while the rest of the neighborhood is primarily residential (single and multifamily).

Broward County parcel data joined with 2016 tax data were analyzed to determine the composition of land use in River Oaks. Approximately 90% of properties in this area are residential. Approximately 70% of the structures in the River Oaks neighborhood were constructed between the 1940's and 70's.

7.1.2 Existing Stormwater Management System

The overall existing storm drainage system is disconnected with many separate drainage systems located throughout the neighborhood. The northern portion of the neighborhood, north of SW 17th Street has several individual outfalls to the canals that function well in providing discharge of stormwater runoff. However, there are many areas that lack any type of conveyance system. A seventy-two (72") inch diameter storm sewer exists in SW 12th Avenue from State Road 84 to a residential canal. This trunk line is a Florida Department of Transportation (FDOT) storm drain that does not capture or convey runoff from within the River Oaks neighborhood. It is strictly used for FDOT roadways and does not appear to have additional capacity for the River Oaks neighborhood. There is an outfall to an existing canal along the west right-of-way of Coconut Drive that does serve the southeastern portion of the neighborhood. There are several independent systems located in the southwestern portion of the neighborhood that consist of exfiltration trenches and swales to disperse the collected runoff. The southwestern section was designed primarily for swale drainage and surface flow towards the Preserve Park. This does not function adequately in many areas, particularly those areas where the swale capacity is exceeded. The Osceola Creek is located on the western edge of the neighborhood and drains to the South Fork New River under Interstate 95 (I-95). Only the area in the extreme southwest portion of the neighborhood drains to the Osceola Creek before it is piped under I-95 to the northwest.

7.2 Flooding Evaluations

Past flooding reports were reviewed to better understand drainage concerns. Data from the City's QAlert service, FEMA Repetitive Loss records, neighborhood outreach meetings, and the 2009 Stormwater Master Plan was compiled to ascertain where to focus the improvement efforts.

In addition, field visits to River Oaks were conducted during dry and wet conditions. Significant ponding was seen at intersections and observed to overtop the crown of the road in multiple areas. Low points along local roads often had significant standing water as well. Much of the right of way that would



SW 25th Street – June 6, 2017



SW 15th Avenue/SW 20th Street - June 6, 2017

Examples of roadway ponding in River Oaks

typically facilitate swale drainage has not been properly graded to achieve that purpose and/or has been hardened for parking. The Coconut Drive ditch and the Preserve Park are in need of improvement and ongoing maintenance to provide better and more reliable flood control for the southwestern portion of the neighborhood.

Lastly, in conjunction with the information gained from the flooding reports and field reconnaissance, the neighborhood stormwater management system's performance under a suite of storm events and present/future climatological conditions was simulated using the new, comprehensive City Stormwater Model. The sum of this information was considered in development of proposed system improvements.

7.3 Proposed System Improvements

7.3.1 Goals and Objectives

The primary goal is to provide River Oaks, which currently has very limited stormwater management infrastructure in its southern portions, with a comprehensive system which will be adaptable to changing climate conditions in the future.

Multiple sub-basins exist within the River Oaks neighborhood, as shown in **Figure 7-2**. The major objective of the proposed improvements is to collect the runoff from the low areas in the south western portion of River Oaks and send it to the Preserve Park, and ultimately to the South Fork New River. Tertiary storm sewers will collect and direct flow toward major lines. Swales and permeable pavement will be utilized where possible to increase storage, promote infiltration and reduce nuisance flooding. Infrastructure and surface improvements in the section south of the finger canals within River Oaks will help to direct flow towards the Preserve Park and Coconut Drive ditch, and move it more efficiently toward the South Fork New River. In addition, within the section of River Oaks north and south of SW 20th Street, selective pipe upsizing, pipe interconnections, the installation of permeable pavement and exfiltration trench will be used to reduce road flooding.

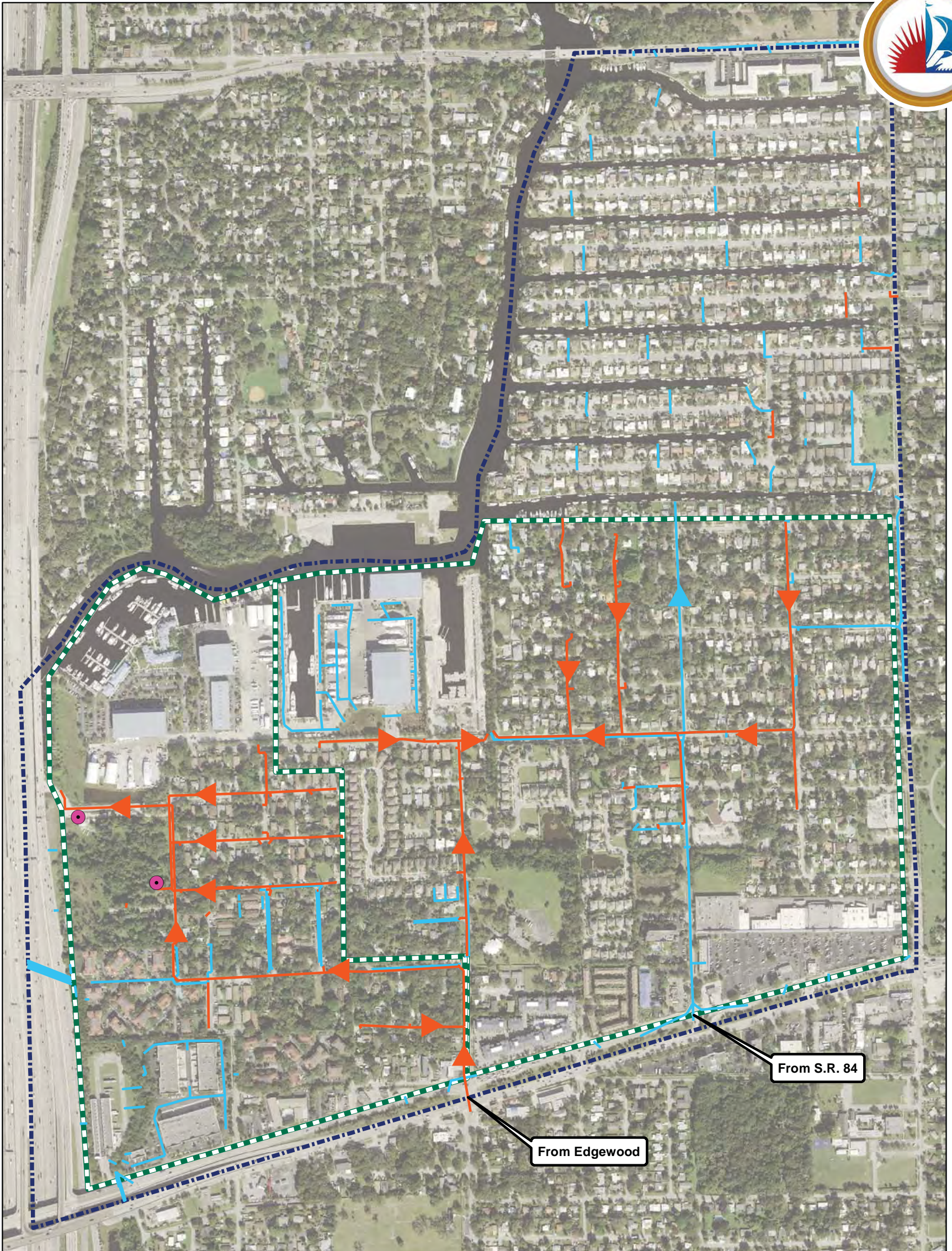
Proposed improvements are intended to reduce flood stage and time of inundation above road crowns for a 10 year-24 hour design storm event and to protect against structural flooding in a 100 year-72 hour storm event where feasible. Flood stage and duration reductions will be achieved through a combination of added storage and discharge capacity via the community investments shown in **Figure 7-3**.








7.3.2 Water Quality

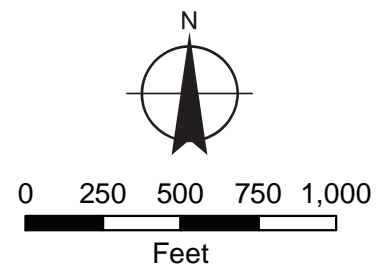
Water quality treatment for stormwater runoff from the River Oaks neighborhood will be provided via various best management practices (BMPs), also shown in **Figure 7-3**. These consist of exfiltration trenches, restored swales, permeable pavement), and specifically designed water quality structures.

7.3.3 Neighborhood Outreach

Community involvement is a key factor in the long term success of the stormwater improvement initiatives. Public outreach was conducted throughout the planning and design process. Joint meetings with the Edgewood and River Oaks Neighborhood Associations were held on March 8, 2017 and June 15, 2017. Public input was actively sought and neighbors provided information regarding flooding conditions and previous experiences. A meeting with those associations is also tentatively scheduled for March 15, 2018 to review and discuss the final design.



-  Existing Storm Sewer
-  Proposed Storm Sewer
-  Proposed Pump Station
-  Existing Flow Direction
-  Proposed Flow Direction
-  Sub-Basin Boundary
-  River Oaks Neighborhood Boundary



43193-004.ai

Figure 7-2
River Oaks Drainage Map



Section 8.0 Southeast Isles Neighborhood – Drainage Summary

8.1 Summary of Existing Conditions

8.1.1 Neighborhood Description

The Southeast Isles neighborhood is located in the southeast section of Fort Lauderdale. The area includes many coastal neighborhoods, situated on narrow islands, which typically contain one street. The islands are connected by small strips of land or bridges to facilitate pedestrian and automobile traffic. Private homes line the streets and are fronted by canals that provide dock access. The land surface in the Southeast Isles neighborhood is relatively flat with a range of elevations from below sea level (0.78 ft) to 9.86 ft NAVD. The total area of the neighborhood is approximately 1,240 acres (1.94 mi²), which includes both the land and the vast amount of water within the neighborhood. **Figure 8-1** shows the neighborhood limits.

Broward County parcel data joined with 2016 tax data was analyzed for the neighborhood to determine the composition of land use in the Southeast Isles neighborhood. The majority of properties (93%) in this area are residential. The Southeast Isles neighborhood is estimated to be 41% pervious area and 59% impervious area.

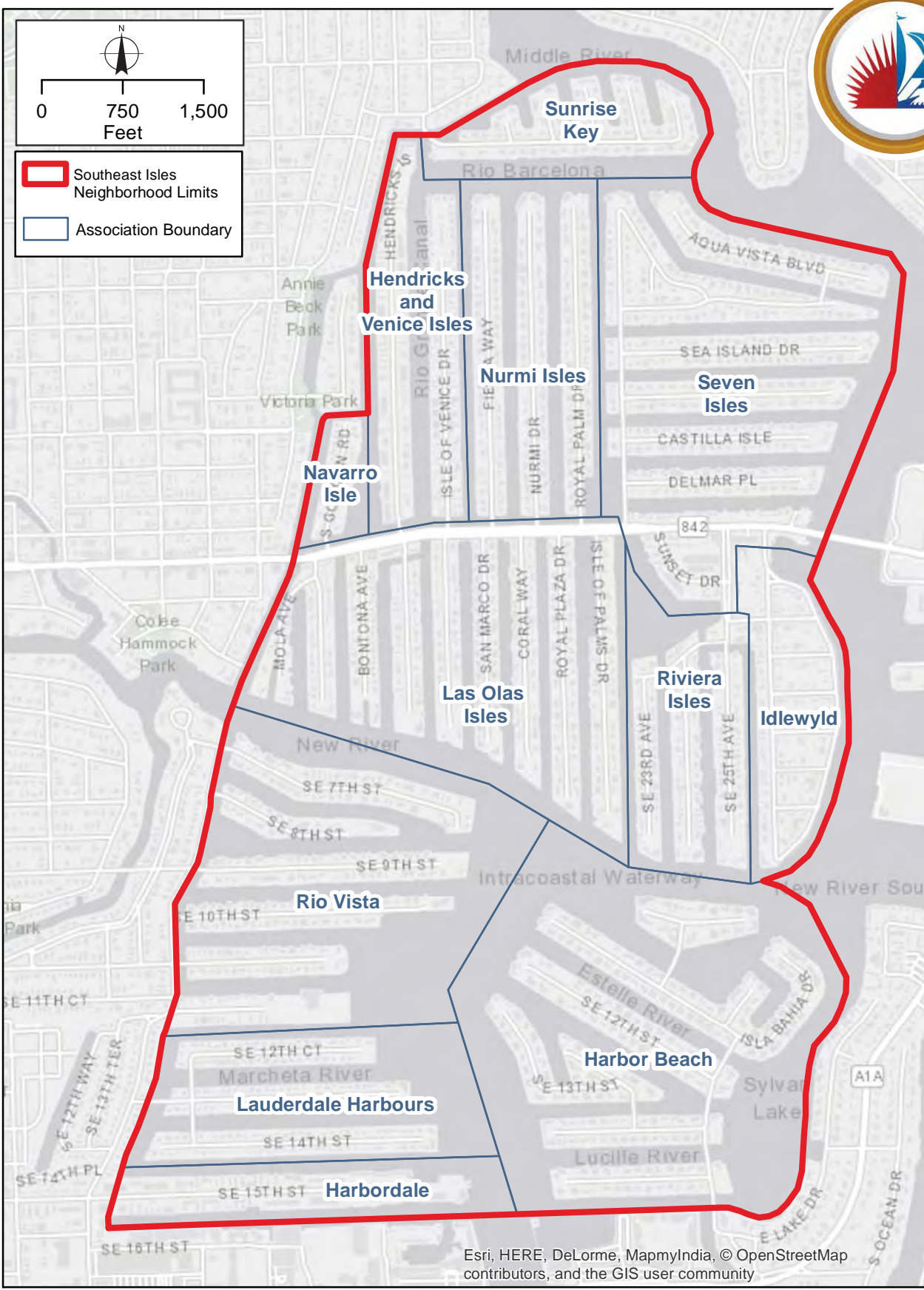
8.1.2 Existing Stormwater Management System

The Southeast Isles stormwater system consists of inlets and outfalls with the majority of the pipe diameters ranging from 6-inches to 18-inches. Most of the storm sewer connects the street level inlets to an outlet that drains directly into the canals. The inlets in the Southeast Isles area can be grouped into two categories: curb type and grate type. There are two stormwater pump stations within the Southeast Isles area; one is located off SE 25th Ave and the other is located off Coconut Isle Dr. In addition, the system includes about 88 tidal valves.

8.2 Flooding Evaluations

Historical flooding records were evaluated to obtain a comprehensive view of the areas prone to flooding within the Southeast Isles neighborhood. Data from the City's QAlert service, FEMA Repetitive Loss records, neighborhood outreach meetings, the 2009 Stormwater Master Plan, and City-owned and private-owned seawall breaching records were compiled to ascertain where to focus the improvement efforts.

In addition, field visits have been conducted during extreme tide and rain events to assess the neighborhood's storm and tidal flooding conditions. Furthermore, the team visited the site during dry conditions to inspect the drainage structures.



43193-004.ai

Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Figure 8-1
Southeast Isles Neighborhood Limits



Isles of Palms – April 23, 2017

Example of tidal overtopping of seawall



Gordon Road – June 7, 2017

Example of rainfall driven street flooding

During high tides, significant flooding was observed at Mola Avenue, SE 25th Avenue, Cordova Road, and Isles of Palms. In addition, it was noted that several of the roads flooded due to overtopped privately-owned seawalls. During rain events, flooding was observed at Gordon Road, Coconut Drive, and at the entrance of San Marco Drive.

Lastly, in conjunction with the information gained from the flooding reports and field reconnaissance, the neighborhood stormwater management system's performance under a suite of storm events and sea level rise conditions was simulated using the new, comprehensive City Stormwater Model. The sum of this information was considered in development of proposed system improvements.

8.3 Proposed System Improvements

8.3.1 Goals and Objectives

The proposed design focuses on reducing tidal flooding and improving system conveyance during storm and tidal flooding. Steps toward alleviating tidal flooding will be made by installing approximately 100 additional tidal valves to prevent backflow during high tide events and raising fourteen City-owned seawalls. Tidal valve locations were selected for outfalls without existing tidal valves and with inlet rim elevations below 2.5 ft NAVD 88. City-owned seawalls with average wall elevations below 2.5 ft NAVD88 will be raised to 5.0 ft NAVD vs NAVD88 (standardize) as per City Seawall Ordinance No. C-16-13.

In addition, stormwater conveyance will be facilitated by installing two pump stations. These will pump runoff from Las Olas Blvd and a portion of Las Olas Isles and Idlewyld areas. One proposed stormwater

pump station will be located at the existing City wastewater pump station at 301 Lido Dr., and the second pump station will be located at Merle Fogg Park. The proposed pump station configurations will be capable of handling a range of flows (including future projected flows) by adding and/or replacing pumps in the future. **Figure 8-2** shows existing outfalls and the pump station drainage basins for the current (proposed) phase of improvements. Additional piping will be added in future phases to connect additional areas to the Merle Fogg Park and Lido Drive pump stations. This will help to drain the remainder of Idlewyld and other Isles. Also, (future) small pump stations will be installed on remaining Isles to assist with flood protection during tidal and/or storm events.

Under this phase of work, the City proposes to replace 14 seawalls (or portions thereof). Twelve of these seawalls have average top elevations below 2.50 ft NAVD, and two seawalls have structural deficiencies and are adjacent to proposed stormwater pump stations. **Figure 8-3** shows the 14 seawalls locations and **Table 8-1** presents a summary of the seawalls to be improved. Approximately 5,400 linear feet of seawall will be replaced in total.







Table 8-1: Summary of Seawalls to be Improved



City-Owned Seawalls	Seawall Description
Seawall 9	Victoria Park Rd at East of Broward Blvd.
Seawall 10	Seven Isles Dr at Del Mar Pl.
Seawall 11	301 Lido Dr.
Seawall 12	E. Las Olas Blvd. East of Lido Dr..
Seawall 13	E. Las Olas Blvd East of Marco Dr.
Seawall 14	E. Las Olas Blvd. East Coral Way
Seawall 15	Isles of Palm Dr.
Seawall 17	Solar Plaza Dr.
Seawall 18	Merle Fogg Park
Seawall 29	Cordova Rd.
Seawall 30	SE 10th ST
Seawall 32	Mola Avenue
Seawall 34	Barcelona DR.
Seawall 35	SE 8th St.

As needed, to allow for adequate drainage, stormwater catch basins and outfalls with tidal valves will be installed at these areas. In addition, new landscaping will be provided as needed.

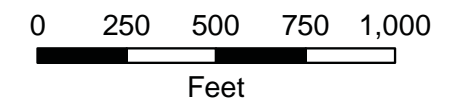
Proposed improvements are intended to reduce flood stage and time of inundation above road crowns for a 10 year-24 hour design storm event, and to protect against structural flooding in a 100 year-72 hour storm event. **Figure 8-4** shows the proposed improvements for Southeast Isles. Stemming tidal flooding will require a systematic, phased approach which will include the aforementioned improvements,



-  Existing Storm Sewer
-  Proposed Storm Sewer
-  Existing Outfall
-  Proposed Pump Station
-  Existing Flow Direction
-  Proposed Flow Direction

-  Sub-Basin Boundary Current Phase (Pump Station Drainage Basins Only)
-  Southeast Isles Neighborhood Boundary

Note: Sub-basin boundaries for future (phased) system extension not shown.



43193-004.ai



43193-004.ai

Legend

 City-Owned Seawalls to be Replaced

Figure 8-3
Seawall Location Map



Existing Infrastructure

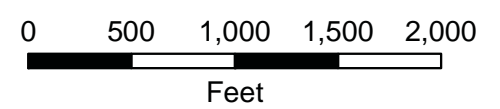
- Existing Catch Basin
- Existing Manhole
- Existing Storm Line

Proposed Infrastructure

- ⊗ Proposed Tidal Valve
- Proposed Pump Station
- ⊕ Proposed Water Quality Structure
- Proposed Catch Basin
- Proposed Storm Line
- Proposed Seawall (raised)

Boundaries

- ▭ Southeast Isles Neighborhood Boundary
- ▭ Parcel



43193-004.ai

Figure 8-4
Southeast Isles Proposed Stormwater Improvements

modifications by private property owners to their own infrastructure (such as seawalls), and future extensions of City storm sewers (including connections to pump stations). Additionally road grades may be modified in some areas.

8.3.2 Water Quality

Water quality treatment will be provided via two water quality structures located upstream of the two proposed stormwater pump stations. These structures will capture particulate material and will improve the water quality of the discharged water. In addition, permeable pavers will be installed at the driveway of Merle Fogg Pump Station. **Figure 8-4** shows the location of the of the water quality structures.

8.3.3 Neighborhood Outreach

Community involvement is a key factor in the long-term success of the stormwater improvement initiatives. Public outreach was conducted throughout the planning and design process. Neighborhood meetings were held on March 6, 2017 and June 5, 2017 at City Hall. Post card invitations were sent to the neighbors of the 12 associations included within the Southeast Isles project boundary. Neighbors' input regarding flooding conditions was collected via input forms provided at the meetings, at the City's website, and by using printed-maps where neighbors marked and categorized flooding areas. A third meeting is also tentatively scheduled for March 2018 to review the final design.



Section 9.0 Conclusions and Recommendations

As the data collection, modeling and design efforts associated with the seven initial neighborhood projects draws to a close, a number of conclusions can be drawn and recommendations made; the following outlines a number of the most compelling.

1. Validation of project prioritization – Based on the modeling completed for current and future conditions it appears the City was correct in its prioritization of the seven selected neighborhoods on the basis of existing flooding concerns.
2. Planning for current improvements must consider impacts of future conditions. Direct and indirect impacts of rising seas, extreme tides, and higher groundwater levels (as a result) will affect significant areas of the City. City sponsored and funded community investments alone will not be able to adequately address the situation in certain locations. Policies, new/revised codes, and redevelopment criteria, particularly in areas within current/future floodplains, should be used in conjunction with community investments and programmatic changes.
3. Resilience improvements in some areas should be strategically phased and coordinated, and may require modifications on both public and private property. Probably the best example is in Southeast Isles (and other similar areas which are directly tidally influenced). Initial improvements, such as installation of tidal valves and raising of seawalls should be purposely aimed at protecting the lowest areas which are most severely impacted by tidal flooding. This is especially true of primary travel routes affecting neighbors (such as Las Olas Boulevard and Cordova Road). The backbone of a more robust drainage system should also be initiated (this system can be appropriately expanded in the future). Other improvements, such as connection of certain areas into pumped drainage systems, should be sequenced to occur after necessary modifications occur on private properties to keep tidal waters from breaching seawalls or other land/sea interfaces and reaching public right of way. Premature construction of extended storm sewer systems would result in repumping tidal flood waters. Other improvements, like road construction (and potential raising) would be placed at risk if it precedes some of these other improvements.
4. Proceed with the proposed community investments in the Dorsey/Riverbend, Durrs, Progresso Village, River Oaks, Edgewood, Victoria Park, and Southeast Isles neighborhoods. Community investment projects for these neighborhoods are anticipated to be through the permitting, process and ready for bidding in 2018. Project sequencing and appropriateness of certain projects concurrent construction should be evaluated based on a number of factors, including disruptions to traffic and other services, impacts to local construction costs, etc.

5. Planning the next phase of projects should commence. With the proposed improvements in the seven initial neighborhoods seemingly headed to construction over the next several years, planning for the next phase of projects, especially in those areas which will be increasingly vulnerable to a changing climate, should begin. With the City-wide model in place to drive this effort, it is suggested that additional factors and scenarios be considered in this next wave of planning in order to achieve greater resiliency.
6. Coordination with other programs. Moving forward, it is recommended that the City be intentional about continuing coordination and communication with adjacent municipalities, Broward County, FDOT, SFWMD and others. Resilience will be best achieved through a collaborative effort of many stakeholders. Opportunities for joint funding and project execution will exist, as will the chance to share in the innovative efforts that will be needed to remain resilient in the face of a changing climate.