Village of Pinecrest
Stormwater Master Plan Report

FINAL

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1.0 EXECUTIVE SUMMARY

The Village of Pinecrest (Village) is a suburban area in southeast Miami-Dade County (County), Florida. Incorporated in 1996, the Village has a population of over 18,000 (based on the 2010 Census) and has a total area of approximately 7.53 square miles. The Village falls within the boundaries of the South Florida Water Management District (SFWMD) C-2 and C-100 Basins – see **Figure 1-1**. These basins are drained by the C-2 Canal (Snapper Creek Canal) and the C-100 Canal, both primary SFWMD canals. The C-100 receives discharges from the Village via the C-100A, C-100A Extension Canals (Cutler Drain Canals maintained by SFWMD) and the SW 70th Avenue Canal that it is owned by Miami-Dade to the County, but it's maintained by the Village of Pinecrest.

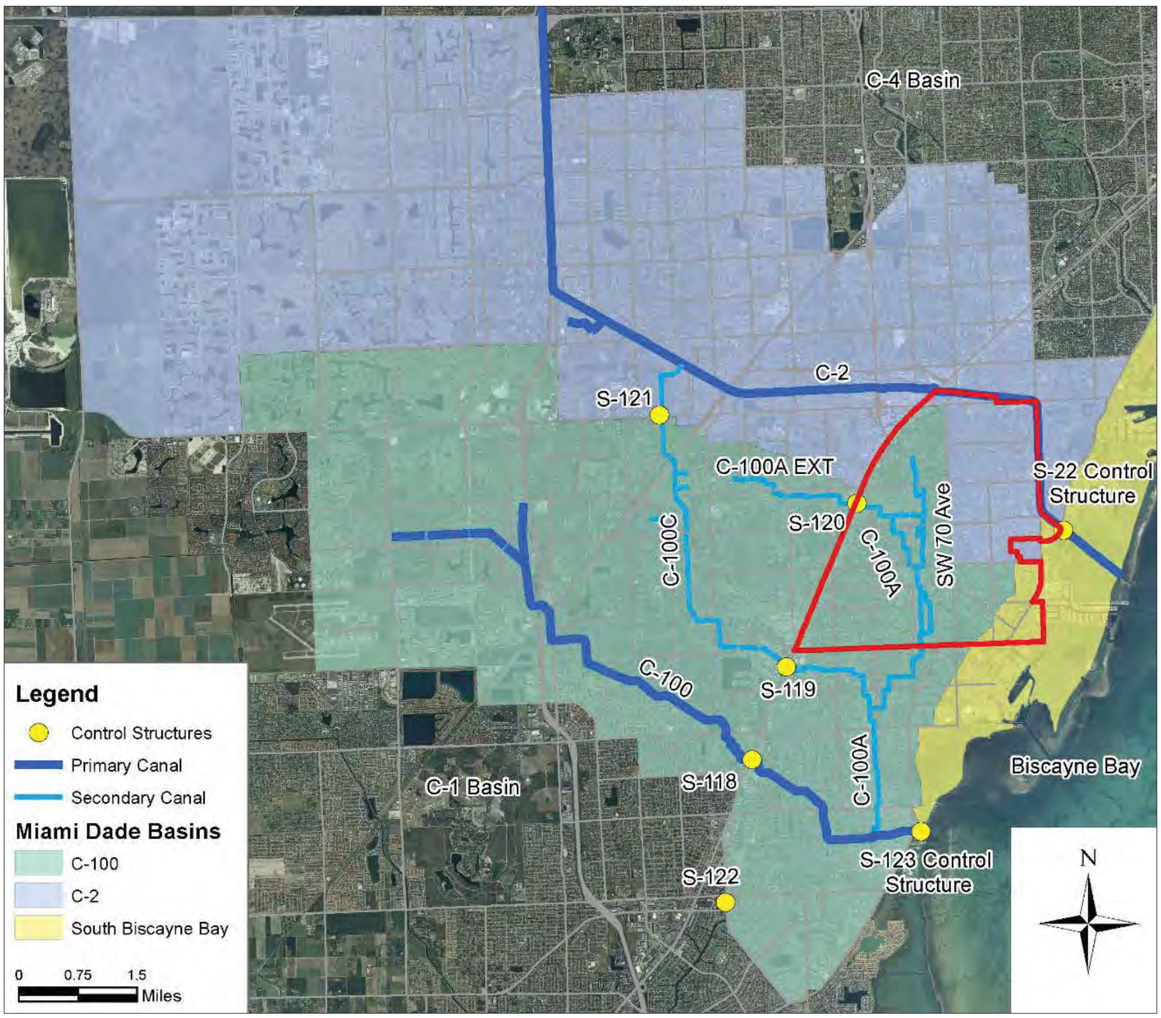


Figure 1-1 – SFWMD Canal Basin's & Village of Pinecrest Limits

The C-2 and C-100 Canals are controlled by the SFWMD Control Structures S-22 and S-123, respectively (see **Figure 1-1**). These structures are used to maintain optimum water control stages upstream in the C-2 and C-100 Canals, while discharging the flood waters for each basin. In addition to maintaining optimum upstream fresh water control under flood control regulation, the automatic controls on these structures have an overriding control which closes the gates, regardless of the upstream water level, in the rare event of a high flood tide where the differential between the head (upstream) and tailwater (downstream) pool elevations in the canal reaches 0.3 feet. This operating condition is implemented to prevent saltwater intrusion westward of the control structures.

The Village of Pinecrest does not have a previous stormwater master plan (SWMP); therefore, this document will serve as the first stormwater master plan for the Village. The Village retained the ADA Team, comprised of A.D.A. Engineering, Inc. (ADA) as prime consultant, EV Services, Inc. (EVSI) for public involvement and outreach services, and Cardno for surveying and mapping of the existing drainage systems within the Village, to develop a Stormwater Master Plan to serve as a planning-level engineering document that analyzes the current condition of the Village's existing stormwater management systems, identifies high priority flood prone areas, and establishes a planning-level, cost-effective conceptual designs of projects to address the flooding issues. Additional benefits of the SWMP for the Village include:

- Provide the Village with a roadmap to implement high priority projects in a systematic and objective manner,
- Help improve the Village FEMA Community Rating Score (CRS) that will help reduce resident flood insurance rates,
- Help the Village secure grants for flood protection projects, and
- Assist the Village in developing an Adaptive Management Plan for Climate Change and projected seal-level and groundwater rise.

The purpose of this project is to create a comprehensive SWMP incorporating the following activities:

- Collect and evaluate available data, including performing an inventory of existing stormwater drainage structures and features in a GIS Format.
- Implement a Public Involvement Plan to inform the residents and Land Developers of the SWMP approach, goals and objectives, and solicit input from the public to guide the development of the plan.
- Identify the current flood protection level of service within the Village and quality of stormwater discharges from the Village.
- Rank and prioritize sub-basins within the Village based on level of flooding severity.
- Assess the potential impact of sea level and groundwater rise on the Village's stormwater management infrastructure.
- Develop planning-level conceptual stormwater improvement projects and cost estimates to address flooding in the top 15 ranked sub-basins. The conceptual projects will be designed to address some level of projected sea level and groundwater rise, while providing adaptability for future increases in sea level and groundwater rise.
- Prioritize stormwater management improvement projects for the top 15 ranked sub-basins, based on cost effectiveness.

- Develop a 5-year Capital Improvement Plan (CIP) that takes into consideration the Village's capital budget for prioritized stormwater improvement projects.
- Meet requirements set forth in the National Pollutant Discharge Elimination System (NPDES) permit.

The scope of work to develop the Stormwater Master Plan was subdivided into the following key tasks:

- Task 1 – Data Collection and Evaluation
- Task 2 – Public Involvement and Outreach
- Task 3 – Existing Flood Protection and Water Quality Level of Service
- Task 4 – Sea Level Rise Impact Assessment
- Task 5 – Sub-basin Ranking and Prioritization
- Task 6 – Stormwater Management Improvement Project Conceptual Design and Ranking
- Task 7 – Projected Water Quality Load Reductions
- Task 8 – Capital Improvement Plan Development

The following sub-sections include a summary of the work completed under each of these tasks, and detailed descriptions are included in **Section 2.0** through **Section 10.0**of the draft Stormwater Master Plan Report.

1.1 Task 1 – Data Collection and Evaluation

Data was requested and acquired from the various sources maintaining data within Miami-Dade County as well as from the Village of Pinecrest. The collected data was cataloged, evaluated, and utilized as needed to support the analyses and preparation of the Stormwater Master Plan Report. Data was requested and/or collected from the following agencies:

- Village of Pinecrest
- Miami-Dade County Enterprise Technology Services Department (ETSD)
- Miami-Dade County Regulatory and Economic Resources (DRER)
- South Florida Water Management District (SFWMD)
- National Oceanic and Atmospheric Administration (NOAA)
- United States Army Corps of Engineers (USACE)
- United States Geological Survey(USGS)
- Natural Resources Conservation Service (NRCS)
- Federal Emergency Management Agency (FEMA) - National Flood Insurance Program
- Florida Department of Transportation (FDOT)

In addition to the data collected from these agencies, limited field visits were also performed during rainfall events occurring during the development of this SWMP to physically observe the response of some of the Village's stormwater management systems. Catalogs of the data collected from the Village and Miami-Dade County are included in **Appendix 3A** and **Appendix 3C**, respectively, and field site visit photographs are included in **Appendix 3B**.

Sufficient data was collected to proceed with the development of this Storm Water Master Plan. In addition, a number of sources were evaluated and examined to assess the potential impacts of the projected sea level rise on both surface and groundwater. A number of Federal, State, and local agencies were consulted, including SFWMD, USGS, USACE, the Miami-Dade Sea Level Rise Task Force, and sea level rise experts such as Dr. Wanless from the University of Miami and Chair of the science committee for the Miami-Dade Climate Change Advisory Task Force, and Dr. Obeysekera, a member of the US National Climate Assessment and Development and Advisory Committee and Climate Change expert for the SFWMD.

A stormwater infrastructure survey was completed and mapped in GIS to identify all the existing stormwater infrastructure within the Village. The infrastructure survey will be delivered to the Village in GIS format under a separate cover. Additional topographic, geotechnical, or other specific surveys were not included in the scope of work for this task.

1.2 Task 2 – Public Involvement and Outreach

The Village and the ADA Team implemented a pro-active Public Involvement and Outreach program to educate the public and local land developers in the activities that were being performed to complete this SWMP and to obtain feedback from the residents and land developers. The public involvement task included coordinating and conducting four (4) community workshops with the intent of providing a relaxed and comfortable venue where participants could focus on the Stormwater Master Plan process and goals, solicit feedback, discuss future improvements in general terms, and develop a positive rapport with community stakeholders.

Some of the objectives of the community workshops included:

- Foster an understanding of the Village's responsibility with its Stormwater Master Plan now and into the future;
- Minimize impact on businesses and stakeholder opposition to the proposed projects;
- Communicate to stakeholders the need for the SWMP, how it benefits the community, and explain the engineering process; and
- Engage the community in an open, healthy dialogue about the project, convey that the Village bases the final decision on several criteria, and that community input is an important part of those criteria.

The workshops were divided into two (2) phases: Phase I included one workshop with the residents and one workshop with land developers, and Phase II included a follow up workshops with the residents and land developers. **Appendix 4A** through **Appendix 4D** include a summary of each of the four workshops.

In addition to the resident and developer workshops, individual meetings were arranged with residents having heightened concerns with flooding of their homes and/or streets and with elected officials.

1.3 Task 3 – Existing Flood Protection and Water Quality Level of Service

To limit the cost and expedite development of the Village SWMP development, the scope of work included leveraging the hydrologic, hydraulic and water quality models developed by Miami-Dade County as part of the Stormwater Master Plans for the C-2 and C-100 Basins, rather than developing new models. With all pertinent data collected, including the 2004 XP-SWMM C-2 and C-100 Hydrologic and Hydraulic Basin Models from the Miami-Dade Department of Regulatory and Economic Resources (DRER), an update and conversion of the models was performed. The original 2004 models were converted to the 2014 version of XP-SWMM. The model conversion comparison results for the C-2 Basin, C-100 Basin and Village of Pinecrest are included in **Appendices 5A, 5B** and **5C**, respectively.

The models were updated to incorporate two areas of the Village that fall within the South Biscayne Basin and were not previously modeled by Miami-Dade County. In addition, to more accurately represent the Village, sub-basins falling within the Village limits were refined. The original Miami-Dade County model sub-basins and refined sub-basins within the Village are included in **Appendix 5D** and **Appendix 5E**, respectively. Finally, stormwater management infrastructure projects constructed since 2011 were incorporated into the models to establish a more representative existing condition models. Once the update and conversion were completed the results were compared against FEMA Flood Insurance Rate Map Flood Plains. Additionally, complaints from the village residents were identified and geocoded based on the recorded address and plotted over the 5-, and 100-year flood plains for comparison purposes. The recorded complaint data corresponded well with the 5-and 100-year flood plains with the majority of the points falling within the simulated flooded areas. The flood plain maps for the comparison between the documented resident complaints and simulated flood areas for the 5-, and 100-year storm events are provided in **Appendix 5F**, and maximum state comparison for the updated models is included in **Appendix 5G**. The models were then used to establish an existing baseline condition identifying peak stages, flows, and volumes for each Village sub-basin.

Once the performance of the models was validated within the Village limits, the models were simulated for the following design storm events:

- 5-year, 24-hour
- 10-year, 24-hour
- 25-year, 72-hour
- 50-year, 72-hour
- 100-year, 72-hour

Appendix 5H includes the flood maps for each of these design storm events.

The Baseline Scenario Model was also used to calculate pollutant loading from each of the Village sub-basins. Water Quality simulation production runs were conducted for 5 storm events (5-year, 10-year, 25-year, 50-year, and 100-year) and for 3 continuous yearlong simulations: dry (75%), average (50%), and wet (25%) continuous simulations. The loading for the following National Pollutant Discharge Elimination System (NPDES) permit pollutants were calculated:

1. 5-day Biochemical Oxygen Demand (BOD_5)
2. Chemical Oxygen Demand (COD)
3. Total Suspended Solids (TSS)
4. Total Dissolved Solids (TDS)
5. Total Kjeldahl Nitrogen (TKN) (total ammonia + organic nitrogen)
6. Total Nitrogen (TN)
7. Total Phosphorus (TP)
8. Dissolved Phosphorus (DP)
9. Total Cadmium (Cd)
10. Total Copper (Cu)
11. Total Lead (Pb)
12. Total Zinc (Zn)

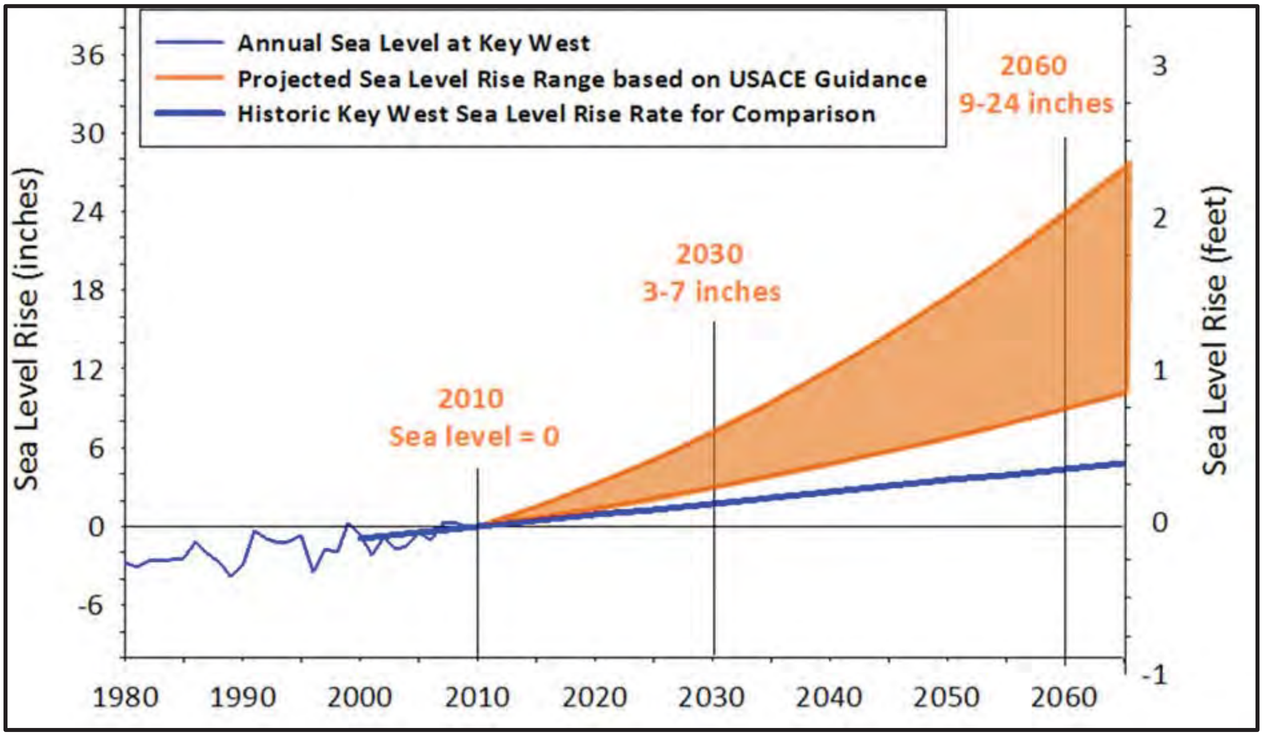
The results of the water quality modeling for the 5 storm events are included in **Appendix 5J**, and the water quality results for the continuous simulations are included in **Appendix 5K**. The digital disc provided in **Appendix 11** includes the model input and output files for the 2014 XP-SWMM models.

1.4 Task 4 – Sea Level Rise Impact Assessment

A thorough assessment of the potential impact of sea level rise on the Village's stormwater management infrastructure was also completed. The analysis performed for this SWMP takes into consideration the primary components of the existing stormwater infrastructure (manholes, inlets, and major conveyance pipes), canals and lakes, topography, land uses, as well as groundwater elevations, historical rainfalls, and current published predictions for 2030 and 2060 sea level rise. These elements are all combined and analyzed within a mathematical hydraulic and hydrologic model that simulates the performance of the Village's primary drainage systems during design rainfall events. The Village's secondary drainage stormwater management systems, such as individual inlets, manholes, and minor conveyance systems were not analyzed as a part of this SWMP. The secondary drainage systems are typically analyzed in the design phase and not in the Master Planning study phase.

The analysis of sea level rise for this SWMP was coordinated with a number of federal, state, and local agencies, including SFWMD, USACE, the Miami-Dade Sea-Level Rise Task Force, and sea level rise experts such as Dr. Wanless from the University of Miami and Chair of the science committee for the Miami-Dade Climate Change Advisory Task Force, and Dr. Obeysekera, a member of the US National Climate Assessment and Development and Advisory Committee and Climate Change expert for the SFWMD.

This cycle of the Stormwater Master Plan for the Village analyzed the maximum prediction for both the 2030 sea level rise projection of 7 inches and the 2060 maximum of 24 inches as determined by the latest data published in the 2014 *Miami-Dade Sea Level Rise Task Force Report* and Recommendations. The currently adopted projections are depicted on **Figure 1-2**. There is currently uncertainly regarding if actual seal-level rise will be higher or lower than currently predicted. Most experts do agree that the actual rate of sea level rise will be better known within the next 10 years. Stormwater Master Plans are typically updated every 5 years and should include an adaptive management approach to adjust based on the amount of seal-level rise that will occur over the next 15 to 45 years. At that time additional data available on sea level rise should be evaluated to modify the sea level rise scenarios and to update the Stormwater Master Plan as necessary.



Source: *A Region Responds to a Changing Climate, Southeast Florida Regional Climate Change Compact Counties*, October 2012. This projection uses historic tidal information form Key West and was calculated by Kristopher Esterson from the United States Army Corps of Engineers (USACE) using the USACE Guidance (USACE 2009) intermediate and high curves to represent the lower and upper bound for projected sea level rise in Southeast Florida. These curves were adopted in 2014 in the *Miami-Dade County Sea Level Rise Task Force Report*.

Figure 1-2 – Sea Level Rise Projection for the Southeast Florida Region

In addition to the impacts to surface flows associated with sea level rise, the impact on rising groundwater levels was also evaluated. At the time of this SWMP, the USGS documented projected groundwater level rise in the 2014 Hydrological Conditions and Effect of Pumpage and Sea Level on Canal Leakage and Regional Groundwater Flow.

This report documents a study completed to quantify the effects of sea level rise on surface water levels and groundwater levels, canal leakage, and the saltwater-freshwater interface in Southeast Florida. The study also examined the hydrological effects of different groundwater pumping rates. The modeling results from USGS indicate limited migration of the saltwater intrusion line due to the existence of salinity control structures along the coast. The results for the 2045 groundwater model showed that increased well pumping combined with a one foot rise in sea level (see **Figure 1-2**) would result in approximately 0.5 foot increase in groundwater along the coast and 0.1 foot increase in groundwater further west and in parts of the urbanized areas.

The 2014 Baseline XP-SWMM model described in the previous sections was used to evaluate the impacts of sea level rise within the Village of Pinecrest. The scenarios simulated and sea level rise parameters implemented are as follows:

1. Normal tidal fluctuations with no rainfall (3.3 feet high tide).
2. Maximum sea level rise prediction for the year 2030 and 2060 with no rainfall events (7 and 24 inches, respectively).
3. Maximum groundwater rise of 0.24 feet (3.36 inches) for 2030, 7 inches of sea level rise and 0.8 feet (9.6 inches) for 2060, 24 inches of sea level rise.
4. 5-year, 24-hour rainfall event combined with maximum sea level and groundwater rise predictions for the year 2030 and 2060.
5. 100-year, 72-hour rainfall event combined with maximum sea level and groundwater rise predictions for the year 2030 and 2060.

The digital disc provided in **Appendix 11** includes the model input and output files for the 2014 XP-SWMM models. The flood plain maps for the 2030 and 2060 Sea Level Rise projection without rainfall are presented in **Appendix 6A**. Maximum stage results and comparisons for the 5-, and 100-year storm events for the 2030 and 2060 Sea Level Rise projection are provided in **Appendix 6B**. The flood plain maps for the sea level rise projections with a 5- and 100-year storm event are presented in **Appendix 6C**. Additionally, flood plain maps which provide a comparison between the current extent of flooding with the 5-year and the 100-year storm events with the additional depth of flooding produced by the same storm events in addition to the projected sea level rise and the predicted effect on groundwater levels is provided in **Appendix 6D**.

The results of this SWMP analysis serve as an adaptive management tool for the Village in regards to sea level rise and it also serves to help identify and prioritize general areas where major drainage systems are deficient and to define the extent of the deficiencies. With problem areas identified, planning-level drainage projects can be developed and prioritized with the intent of alleviating flooding in flood prone areas. Additionally, planning-level construction costs for these projects can be determined in order to budget and define the implementation schedule for the proposed planning-level projects.

1.5 Task 5 – Sub-basin Ranking and Prioritization

After the hydraulic and hydrologic model was completed and the result data compiled per Task 3 (**Section 5.0**), the Village sub-basins were analyzed and ranked using the 2014 Baseline XP-SWMM mode and a refined version of the scoring methodology developed and used by the Miami-Dade County's Department of Regulatory and Economic Resources (DRER, formerly DERM/PERA) as part of their stormwater master planning activities. The refined scoring methodology includes ranking sub-basins by establishing a Flood Protection Severity Score (FPSS). The FPSS is derived by scoring the results of eight (8) Flooding Severity Indicators, weighting factor (WF) for applicable flooding severity indicators and an exceedance factor for each indicator. These scoring factors are summarized as follows:

Sub-basin Flooding Severity Indicators and WF

1. **NS:** Number of structures flooded by the 100-year flood, including commercial, residential, and public buildings. All structures and/or buildings are considered equivalent, regardless of their size or value. **(WF = 3)**
2. **DEM:** Total area experiencing flooding for the 100-year flood in 10 acre units. **(WF = 5)**
3. **MER:** Miles of principal arterial roads, including major evacuation routes, which are impassable during the 100-year flood. A principal arterial road is considered impassable if the depth of flooding exceeds 8 inches above the crown of the road during the 100-year design event. **(WF = 4)**
4. **MMAS:** Miles of minor arterial roads, which are impassable during the 10-year flood. **(WF = 4)**
5. **MCLRS:** Miles of collector and local residential streets impassable during the 5-year flood. Collector and local residential streets are considered impassable if the depth of flooding exceeds the crown of the road during the 5-year design storm event. **(WF = 2)**
6. **BM:** Miles of canal with out-of-bank flow, expressed in bank-miles. The length of canal flooding shall be determined for the design storm event originally used to design the canal. The C-100 and secondary canals are designed for a 10-year storm event and C-2 Designed for at least a 100-year storm event. **(WF = 3)**
7. **NFC**: Number of flooding complaints documented by residents and Village staff. **(WF = 2)**
8. **RPL:** Number of repetitive loss complaints reported to FEMA. **(WF = 8)**

The severity indicators are rated by an exceedance (E) value pursuant to the following DRER severity score listed in the table below for all values.

Depth of Flooding Above the FPLOS	E
Less than or equal to 6 inches	1
Greater than 6 inches and less than or equal to 12 inches	2
Greater than 12 inches	3

Given the definitions for the flooding severity indicators (NS, DEM, MER, MMAS, MCLRS, BM, NFC, and RPL), WF, and E, the FPSS for each sub-basin is calculated using the following formula, where $E_{(i)}$ through $E_{(v)}$ relates to the degree of exceedance for each of the applicable severity indicators.

$$\mathbf{FPSS} = [3 \times E_{(i)} \times NS] + [5 \times E_{(ii)} \times DEM] + [4 \times E_{(iii)} \times MER] + [4 \times E_{(iii)} \times MMAS] + [2 \times E_{(v)} \times MCLRS] + [3 \times E_{(vi)} \times BM] + [2 \times NFC] + [8 \times RPL]$$

Table 1-1 includes the top 15 ranked sub-basins and FPSS scores. **Appendix 7C** includes the sub-basin FPSS score and rank results, and **Appendix 7D** includes the sub-basin FPSS ranking and flood prioritization map.

Table 1-1 – Top 15 Ranked Sub-Basins FPSS Scores

Sub-Basin Name	Sub-Basin Area (Acres)	Composite Scores	
		FPSS	Rank
U29-S	60.15	377.50	1
C100DN-1W	136.07	267.00	2
C100A-W3N	172.75	260.00	3
U35-S	42.44	232.80	4
PNL&RGL	86.22	223.20	5
C100A-E-2	33.88	178.70	6
C100DN-1E	102.48	164.90	7
C100A-5	29.60	161.00	8
C100A-E-1	90.74	147.90	9
C2-S-9NE	204.78	146.60	10
U28-E	55.82	127.60	11
B-Bay-SE	99.92	123.80	12
U32-S	20.67	122.30	13
C100D-N-1	247.42	112.50	14
C100A-W3S	177.99	112.20	15

In addition to establishing an FPSS score for each basin, a flood protection level-of-service (FPLOS) score was also developed using a refined approach derived from the approach developed by DRER for the C-2 and C-100 Basins. The FPLOS for each sub-basin is dependent upon the number of FPLOS criteria that have been met. The refined approach establishes a FPLOS rating by assigning a letter value. Each sub-basin was analyzed and scored by the overall FPSS score. A statistical analysis of all the sub-basins was completed to reach the final FPLOS performance score for each sub-basin. The FPLOS criteria and statistical performance developed for the Village of Pinecrest, in corroboration with the Village Staff, is shown below:

FPLOS	Percent of FPSS Value
A	83% or higher of Sub-Basin FPSS
B	67 - 82% of Sub-Basin FPSS
C	51 - 67% of Sub-Basin FPSS
D	34- 50% of Sub-Basin FPSS
E	17 - 33% of Sub-Basin FPSS
F	0 - 16% of Sub-Basin FPSS

Appendix 7E includes a summary of the FPLOS score for the top 15 ranked sub-basins. **Appendix 7F** and **Figure 1-3** include a map of the FPSS ranking and FPLOS score within each sub-basin within the Village. These scoring methodologies were used to identify the most critical sub-basins within the Village and to establish the flood protection levels of service for each sub-basin. The resulting scores were then used to rank and prioritize the Village sub-basins in terms of the highest priority and the greatest risk of flooding.

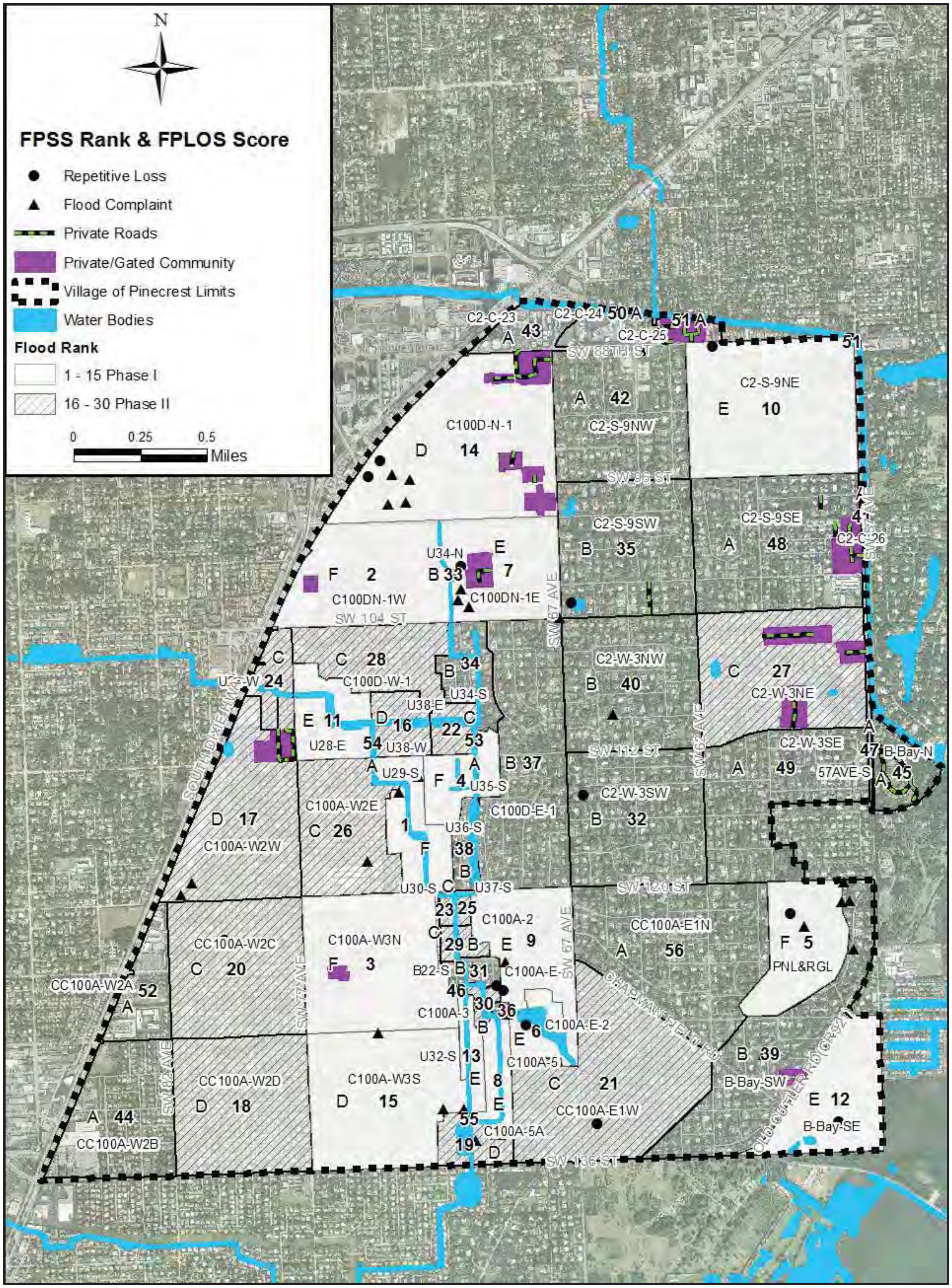


Figure 1-3 – Sub-basin FPSS Ranking and FPLOS Score

1.6 Task 6 – Stormwater Management Improvement Project Conceptual Design and Ranking

In accordance with the scope of work for the Village SWMP development, conceptual stormwater improvement projects were developed for the top 15 ranked sub-basins as outlined in Task 5 (**Section 7.0**). Working in coordination with Village staff, it was decided to conceptually design these projects to account for some level of sea level and groundwater rise, because there is compelling evidence that the climate is changing. According to the report by Dr. Leonard Berry at Florida Atlantic University, *Development of a Methodology for the Assessment of Sea Level Rise Impacts on Florida's Transportation Modes and Infrastructure,* sea levels are rising approximately 3 millimeters per year with the potential to accelerate.

The SWMP is a five-year planning document and there is currently a high uncertainty of the amount of seal level rise that will occur in the future. Therefore, it was decided to conceptually design these projects for a 2030 (15-year planning level) mid sea level and groundwater rise in accordance with the most current documented sea level rise projections as outlined in Task 4 (**Section 6.0**). The projects have been conceptually designed to be adaptable if sea level rise accelerates. Assessment of sea level and groundwater rise should be evaluated and projects adapted after every 5-year cycle of the SWMP update.

The 2014 Baseline XP-SWMM models developed and documented in Task 3 (**Section 5.0**) for the C-2 and C-100 Basins were used to assess the sea level and groundwater impact to the sub-basin peak elevations for the following design storm events:

- 5-year, 24-hour
- 10-year, 24-hour
- 10-year, 72-hour
- 100-year, 72-hour

To account for a mid-range 2030 sea level and groundwater rise, these models were modified as follows:

- The tidal boundary conditions for the Structure S-22, Structure S-123 and South Biscayne Bay basins were increased by 5 inches in accordance with the current 2030 mid-range sea level rise (**Figure 1-2**).
- The initial groundwater stage was increased by 0.17 feet (2.04 inches) to account for groundwater rise and/or reduced unsaturated zone storage within each basin for 2030 mid-rage seal-level rise (5 inches of sea level rise) in accordance with the USGS 2014 *Hydrological Conditions and Effect of Pumpage and Sea Level on Canal Leakage and Regional Groundwater Flow Report* modeling results.

The digital disc provided in **Appendix 11** includes the model input and output files for the 2014 XP-SWMM models. **Appendix 8A** includes the 5-, and 100-year design storm event flood maps for projected 2030 mid-range sea level and groundwater rise.

Exfiltration trenches were determined to be the most viable stormwater improvement systems for areas west of the saltwater intrusion line. For areas east of the saltwater intrusion line, pump stations and injection wells were the most viable option. When possible, infrastructure was proposed to provide additional connectivity within the existing system, rehabilitate the existing systems by replacing old and potentially inferior/damaged drainage systems presently in place, and to provide infrastructure in areas with limited or no stormwater management system.

To better assess the flood effectiveness of each project, local hydrologic/hydraulic models were developed for each of the top 15 ranked sub-basins using ICPR Version 3.10 SP11 modelling software. These models used the results from the mid-range 2030 sea level and groundwater rise, and the C-2 and C-100 Basin models described above were used to establish the local model boundary conditions. Each model was simulated and validated to ensure that the local models yielded similar stage and flow results as for the overall basin models. **Appendix 8B** includes the node-link schematic for each of the validated local ICPR models for the top 15 ranked sub-basins. The digital disc provided in **Appendix 11** includes the ICPR input, peak stages, and peak flow reports for the ICPR validated models for each of the top 15 ranked sub-basins.

Once the local models were validated, the stormwater management system features described above (exfiltration trenches, drainage wells, pump stations, outfalls, control structure, and conveyance pipes) were conceptually implemented in the local models to reduce flooding until the roadway and building design level of service were met or met to the maximum extent possible. The conceptual design was based on the elimination of flooding or to minimize the extent of flooding in each project area. The stormwater management features were simulated in ICPR using the procedures outlined in the FDOT District 6 ICPR Application Manual. A map showing the overall conceptual designs of the stormwater improvement projects within the top 15 ranked Village sub-basins is shown in **Figure 1-4**. **Appendix 8C** includes the detailed conceptual schematics for each of the stormwater improvement projects in the top 15 ranked sub-basins.

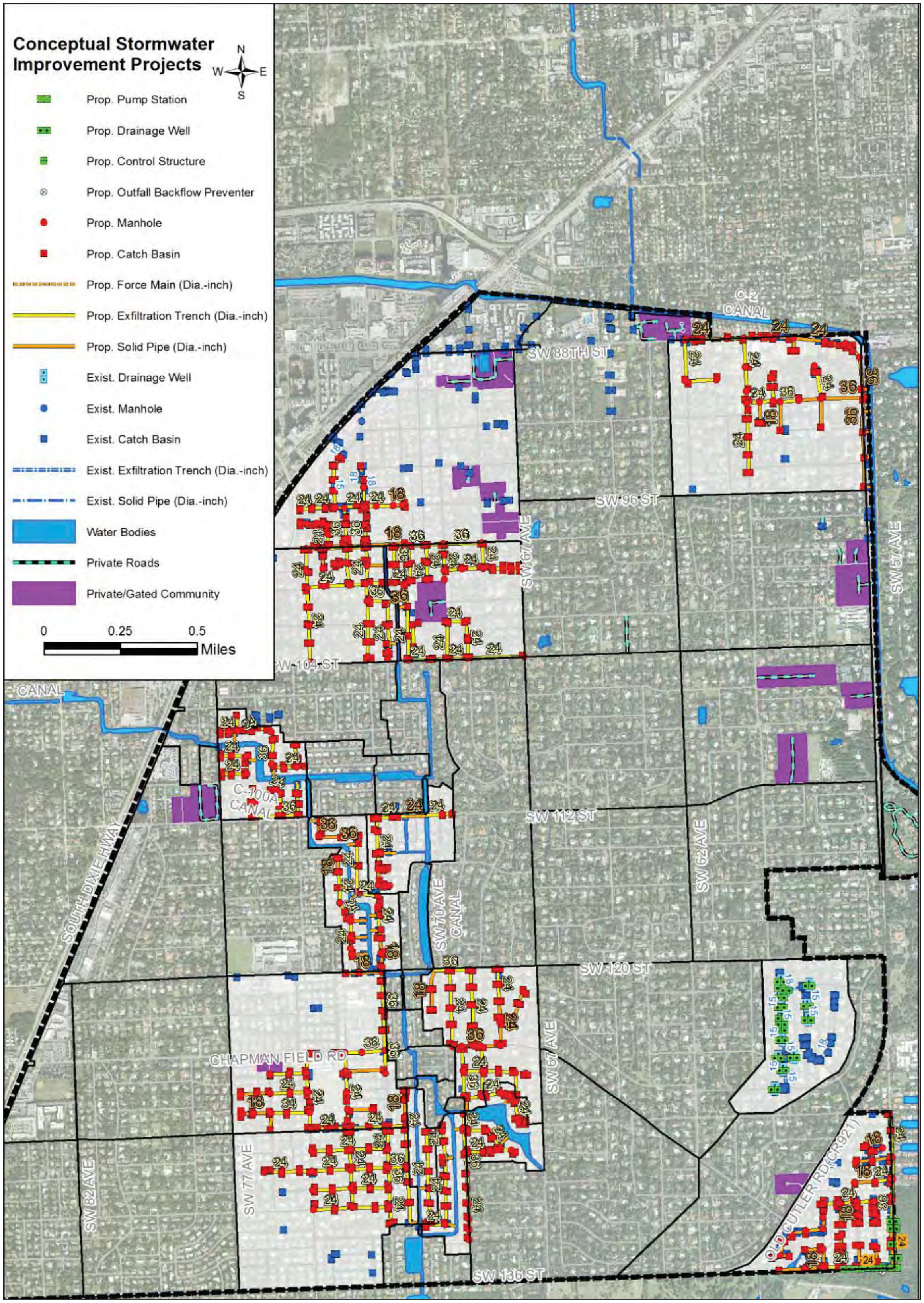


Figure 1-4- Conceptual Stormwater Improvement Projects for the Top 15 Ranked Sub-basins

Appendix 8D includes the node-link schematic for each of the local ICPR models with the conceptual stormwater improvement projects for the top 15 ranked sub-basins. The digital disc provided in **Appendix 11** includes the ICPR input, peak stages, and peak flow reports for the ICPR validated models for each of the top 15 ranked sub-basins.

Appendix 8E includes the 5-year, 24-hour flood maps for each of the top 15 ranked sub-basins showing flooding with and without the improvement projects, and **Appendix 8F** includes the 100-year, 72-hour flood maps for each of the top 15 ranked sub-basins showing flooding with and without the improvement projects. In addition to the node-link schematics with the proposed improvement projects, **Appendix 8D** in the electronic version of the final Stormwater Master Plan Report submitted to the Village of Pinecrest includes the ICPR input, model peak stages, and the flow results for the ICPR validated models for each of the top 15 ranked sub-basins.

Conceptual design of projects to address the top 15 ranked sub-basins during a 2030 mid-level sea level and groundwater rise indicate that due to the limited capacity of the C-100A canal and available underground storage, there is limited infrastructure improvements that can be implemented within the Village to mitigate larger sea level and groundwater rise. It is evident from this analysis that in order to accommodate larger sea level and groundwater rise, regional stormwater management projects must be implemented in cooperation with Miami-Dade County and the SFWMD. Some of these projects could include implementing forward pumping stations upstream of the S-22 and S-123 structures to be able to discharge excess runoff during excessive high tides. Other possible regional solutions could include increasing the capacity of the C-100 Canal, C-100A Canal, and S-123 Structure to a larger capacity than a 10-year design storm event.

Planning-level cost estimates were developed for each project for the top 15 ranked sub-basins. The costs used were based on recent bid data provided by the Village, FDOT cost databases and ADA's own construction cost databases. In addition to the average unit capital costs of the proposed projects, incidental expenditures such as maintenance of traffic, mobilization, permitting contingency, design, and a construction administration were also included in the planning-level cost. **Appendix 8I** includes detailed planning-level cost estimates for each of the proposed conceptual improvement projects.

A summary of the planning-level cost estimates for each of the top 15 ranked sub-basins is provided in **Table 1-2**.

Table 1-2 – Proposed Conceptual Project Planning Cost Estimate

Sub-Basin Name	Project Cost Estimate
U29-S	$2,361,083.47
C100DN-1W	$3,094,682.50
C100A-W3N	$3,535,767.67
U35-S	$981,252.22
PNL&RGL	$2,361,100.97
C100A-E-2	$1,228,832.50

Sub-Basin Name	Project Cost Estimate
C100DN-1E	$4,261,880.97
C100A-5	$1,714,848.33
C100A-E-1	$3,558,843.75
C2-S-9NE	$3,615,130.00
U28-E	$2,767,835.39
B-Bay-SE	$4,644,125.00
U32-S	$627,709.00
C100D-N-1	$2,208,589.25
C100A-W3S	$3,858,144.31
TOTAL	$40,819,825.33

These costs should be further refined during the final design and permitting phases of the CIP implementation process.

Several cost-effectiveness ranking approaches were evaluated and discussed with Village staff, and the approach that appears to be most representative for the top 15 ranked sub-basins is based on the project cost per flood volume reduction. A flood volume reduction analysis was completed for the 15 conceptual projects by using the local ICPR models for each project.

The proposed stormwater improvement projects are designed with systems to minimize the volume of stormwater runoff on the surface by providing conveyance to the groundwater table and discharges to adjacent canals. The stormwater removal capacity for each of the proposed stormwater management systems was determined using the 72-hour, 100-year storm event model results of each sub-basin. This total removal capacity was then related to a stage reduction within the sub-basin. The resulting stage and volume reduction was then used to rank each project. **Table 1-3** shows the flood volume reduction of each proposed project and the resulting rank for each sub-basin based on the cost per flood volume reduction.

Table 1-3 – Conceptual Design Project Ranking By Flood Volume Reduction

Volumetric Reduction Rank	Sub-Basin Name	Sub-Basin Area Acre)	Sub-Basin Flood Rank	Volume Removed (Cubic Feet)	Cost Per Cubic Foot of Runoff Removed
1	U35-S	42.4	4	9,005,988	$0.12
2	C100DN-1W	136.1	2	17,714,002	$0.17
3	C100DN-1E	102.5	7	23,912,244	$0.18
4	U29-S	60.1	1	11,683,434	$0.21
5	C100A-5	29.6	8	6,856,617	$0.25
6	U28-E	55.8	11	10,664,353	$0.26
7	U32-S	20.7	13	2,402,028	$0.26
8	C100A-E-2	33.9	6	3,760,808	$0.33
9	C100A-W3S	178	15	11,759,478	$0.33
10	C100D-N-1	247.4	14	6,602,810	$0.33
11	B-Bay-SE	99.9	12	13,657,580	$0.34
12	C100A-W3N	172.8	3	6,339,786	$0.56
Volumetric	Sub-Basin	Sub-Basin	Sub-Basin	Volume	Cost Per Cubic

Reduction Rank	Name	Area Acre)	Flood Rank	Removed (Cubic Feet)	Foot of Runoff Removed
13	C100A-E-1	90.7	9	5,585,777	$0.64
14	PNL&RGL	86.2	5	3,338,791	$0.71
15	C2-S-9NE	204.8	10	1,295,580	$2.79

Appendix 8J and **Figure 1-5** include a map of the ranking of the top 15 stormwater improvement projects based on cost-effectiveness.

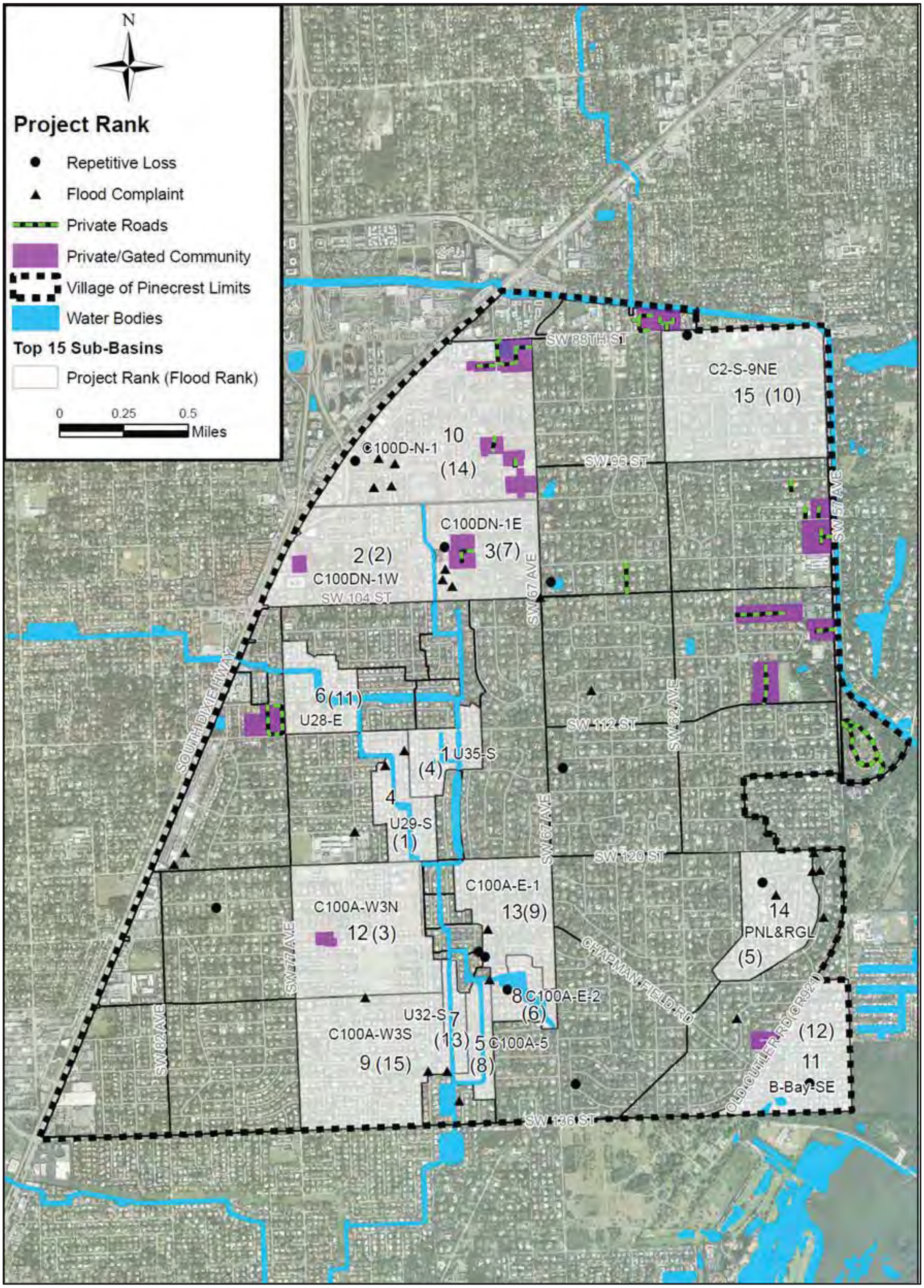


Figure 1-5 – Stormwater Improvement Projects Rank Based on Cost-Effectiveness

1.7 Task 7 – Projected Water Quality Load Reductions

Sub-basin pollutant load reductions based on the proposed conceptual stormwater management improvement projects for the top 15 ranked sub-basins were estimated by defining a contributing treatment area that contributes runoff to the exfiltration trenches or stormwater management systems and a Removal Percentage (R%) based on the best management practices applied. A Removal Percentage (R%) was established and applied to each of the sub-basin water quality loads to arrive at the final total load per sub-basin assuming the proposed stormwater improvement project has been implemented within the given sub-basin. The Removal Percentages (R%) for each of the top 15 ranked sub-basins are presented in **Table 1-4**.

Table 1-4 – Removal Percentages for Top 15 Sub-Basins

Sub-basin Rank*	Sub-Basin Name	Sub-Basin Total Area (A_{sb}, acres)	Length of Exf. Trench (L, ft)	Contributing Area (acres)	Removal Percentage ($R_{\%}$)
1	U29-S	60.1	3300	9.4697	15.76%
2	C100DN-1W	136.1	7000	20.0872	14.76%
3	C100A-W3N	172.8	8800	25.2525	14.61%
4	U35-S	42.4	2100	6.02617	14.21%
5	PNL&RGL	86.2	WELLs	WELLs	0.00%
6	C100A-E-2	33.9	2700	7.74793	22.86%
7	C100DN-1E	102.5	11000	31.5657	30.80%
8	C100A-5	29.6	4200	12.0523	40.72%
9	C100A-E-1	90.7	7200	20.6612	22.78%
10	C2-S-9NE	204.8	4600	13.2002	6.45%
11	U28-E	55.8	5100	14.635	26.23%
12	B-BAY-SE	99.9	4500	12.9132	12.93%
13	U32-S	20.7	1700	4.87833	23.57%
14	C100D-N-1	247.4	4600	13.2002	5.34%
15	C100A-W3S	178	10000	28.6961	16.12%

The removal percentage presented in **Table 1-4** was applied to the annual pollutant loading described in Task 3 (**Section 5.5)**. The resulting reduced annual pollutant loading for the top 15 ranked sub-basins for the dry, average, and wet yearlong continuous simulations are included in **Appendix 9A**.

The proposed improvement projects for the top 15 ranked sub-basins provide significant pollutant load reduction to the C-2, C-100 and South Biscayne Bay Basins. **Table 1-5** provides the total loads for each of the 12 pollutants for the dry, average, and wet simulations for the Village of Pinecrest sub-basins and the South Biscayne Bay Basin. **Table 1-6** shows the annual pollutant loads the Village of Pinecrest contributes to the C-100 Basin and the C-2 Basins.

Table 1-5 - Total Annual Pollutant Load for the Village of Pinecrest and South Biscayne Bay Basin

	Village of Pinecrest Total Annual Load (lbs/yr)		
Pollutant	**Dry**	**Average**	**Wet**
BOD5	3.37E+04	4.27E+04	5.25E+04
COD	1.73E+05	2.19E+05	2.68E+05
TSS	1.40E+05	1.78E+05	2.06E+05
TDS	3.87E+05	4.90E+05	5.87E+05
TN	5.67E+03	6.20E+03	8.05E+03
TKN	3.77E+03	4.77E+03	5.85E+03
TP	1.10E+03	1.39E+03	1.71E+03
DP	4.66E+02	5.90E+02	7.24E+02
Cd	7.91E+00	1.00E+01	1.22E+01
Cu	6.94E+01	8.53E+01	1.04E+02
Pb	2.82E+02	3.26E+02	4.08E+02
Zn	2.31E+02	2.92E+02	3.56E+02

	Biscayne Bay Basin Total Annual Load (lbs/yr)		
Pollutant	**Dry**	**Average**	**Wet**
BOD5	3.55E+03	5.02E+03	6.10E+03
COD	1.77E+04	2.50E+04	3.03E+04
TSS	1.41E+04	2.00E+04	2.38E+04
TDS	4.03E+04	5.70E+04	6.84E+04
TN	6.23E+02	5.63E+02	6.94E+02
TKN	3.97E+02	5.63E+02	6.82E+02
TP	1.19E+02	1.69E+02	2.05E+02
DP	4.91E+01	6.96E+01	8.44E+01
Cd	7.69E-01	1.10E+00	1.32E+00
Cu	6.63E+00	9.05E+00	1.12E+01
Pb	2.72E+01	3.19E+01	3.89E+01
Zn	2.26E+01	3.19E+01	3.87E+01

Table 1-6 - Total Annual Pollutant Load for the C-100 and C-2 Basins

	C-100 Basin Total Annual Load (lbs/yr)		
Pollutant	**Dry**	**Average**	**Wet**
BOD5	2.53E+04	3.61E+04	4.38E+04
COD	1.28E+05	1.83E+05	2.22E+05
TSS	1.04E+05	1.50E+05	1.82E+05
TDS	2.90E+05	4.14E+05	5.03E+05
TN	4.54E+03	5.34E+03	6.50E+03
TKN	2.81E+03	4.01E+03	4.87E+03
TP	8.26E+02	1.18E+03	1.43E+03
DP	3.49E+02	4.98E+02	6.04E+02
Cd	5.80E+00	8.34E+00	1.01E+01
Cu	4.88E+01	6.96E+01	8.45E+01
Pb	2.17E+02	2.75E+02	3.33E+02
Zn	1.70E+02	2.44E+02	2.96E+02

	C-2 Basin Total Annual Load (lbs/yr)		
Pollutant	**Dry**	**Average**	**Wet**
BOD5	5.76E+03	5.11E+03	4.51E+03
COD	3.13E+04	2.75E+04	2.53E+04
TSS	2.48E+04	2.18E+04	8.62E+03
TDS	6.69E+04	5.91E+04	3.78E+04
TN	6.58E+02	5.81E+02	8.18E+02
TKN	6.58E+02	5.81E+02	5.16E+02
TP	1.81E+02	1.61E+02	1.42E+02
DP	8.03E+01	7.12E+01	6.30E+01
Cd	1.52E+00	1.35E+00	1.20E+00
Cu	1.59E+01	1.30E+01	1.22E+01
Pb	4.39E+01	3.83E+01	4.30E+01
Zn	4.39E+01	3.83E+01	3.44E+01

1.8 Task 8 – Capital Improvement Plan Development

A fiscal analysis was performed and after discussions with Village staff, it was determined that based on the large funding requirement to address the top 15 ranked sub-basins and the limited funding the Village has available over the next five years, the prioritization and ranking criteria of the top 15 sub-basins would be further refined to determine the top five (5) high priority projects. These top (5) projects are addressed in the five-year Capital Improvement Plan. The refined prioritization and ranking criteria of the proposed projects were based on the number of repetitive loss claims, documented home flooding reported by citizens, FPSS score reduction, overall flood volume reduction, and input from Village staff. The results of resident survey questions conducted by Village staff and the number of repetitive losses within the top 15 ranked project areas are shown in **Table 10-1**.

Table 1-7 – Flooding Complaints for the Top 15 Ranked Project Areas

Basin Name	Survey Question 1*	Survey Question 3**	Repetitive Losses	Total	Complaint Rank	Cost
C100DN-1E	8	3	3	14	1	$4,261,881
U29-S	9	3	0	12	2	$2,361,083
C100D-N-1	4	3	5	12	3	$2,208,589
C2-S-9NE	5	2	4	11	4	$3,615,130
C100DN-1W	7	3	0	10	5	$3,094,683
PNL&RGL	2	3	2	7	6	$2,361,101
U35-S	4	2	0	6	7	$981,252
U28-E	2	3	0	5	8	$2,767,835
C100A-5	2	2	0	4	9	$1,714,848
C100A-E-1	0	1	2	3	10	$3,558,844
C100A-E-2	0	0	2	2	11	$1,228,833
C100A-W3N	1	1	0	2	11	$3,535,768
B-Bay-SE	0	0	2	2	11	$4,644,125
U32-S	1	0	0	1	12	$627,709
C100A-W3S	0	0	0	0	13	$3,858,144
					TOTAL COST	**$40,819,825**

* Question 1: Have you experienced chronic flooding or disruption as a result of heavy rain in your area?
** Question 3: Have you experienced flooding on your property?

Table 1-8 shows the top five (5) high priority projects the Village is recommended to implement over the next five years. This table also shows the project ranking, the original flood ranking, and volumetric reduction flood ranking for the recommended five projects.

Table 1-8 – Recommended Top Five (5) High Priority Project Ranking

Recommended Project Rank	Sub-Basin Name	Sub-Basin Area (Acre)	Sub-Basin Flood Rank	Volumetric Reduction Rank
1	C100DN-1E	102.5	7	3
2	U29-S	60.1	1	4
3	C100D-N-1	247.4	14	10
4	C2-S-9NE	204.8	10	15
5	U35-S	42.4	4	1

Figure 1-6 and **Appendix 10A** include a map of the recommended high priority project ranking shown in **Table 1-8**.

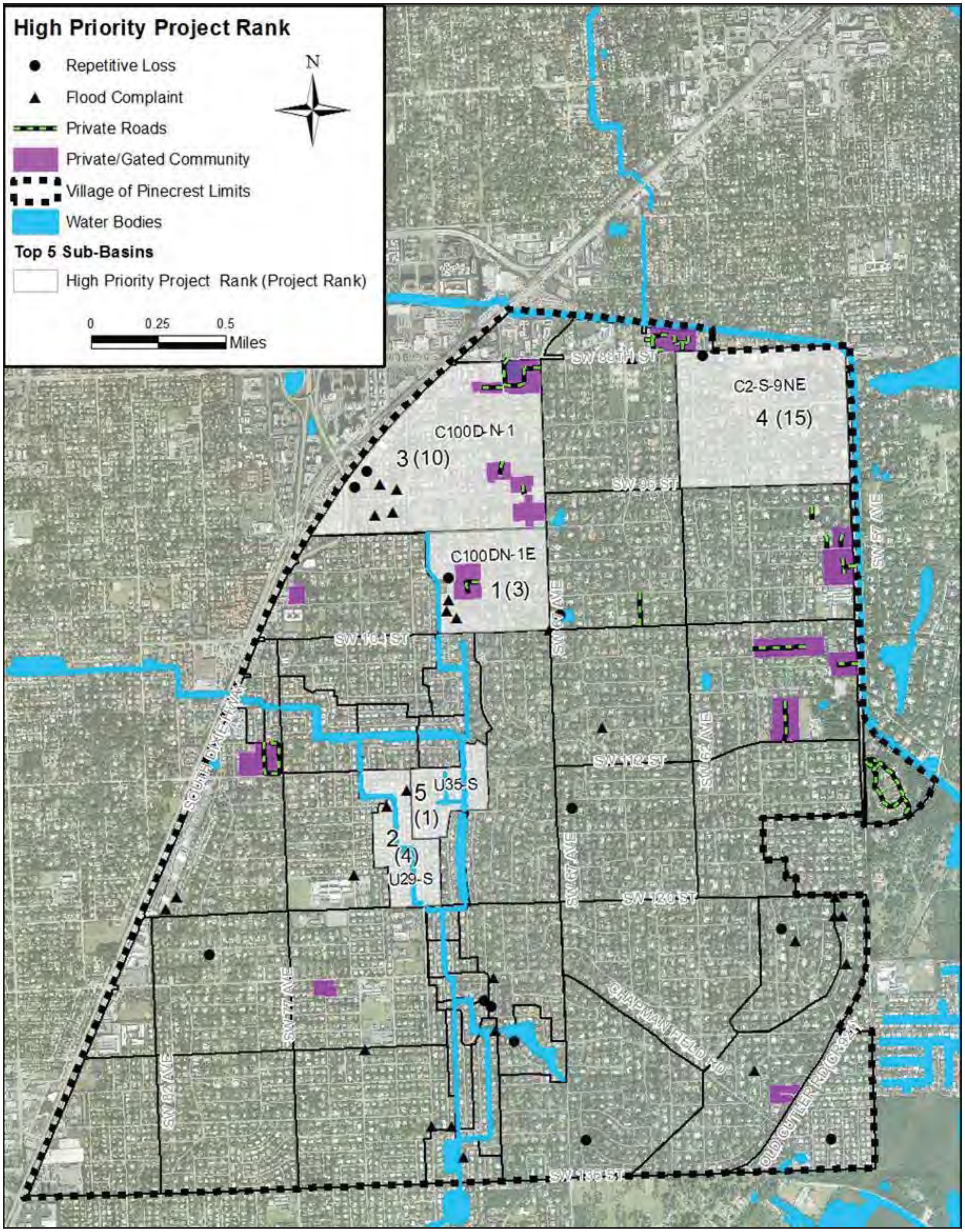


Figure 1-6 – Stormwater Improvement Projects Rank for Recommended Top 5 High Priority Projects

The total project planning level cost for the top five (5) projects is $13,427,935. The project planning level cost for each of the top five (5) high priority projects is included in **Table 1-9**.

Table 1-9– Project Planning Level Cost for the Top 5 Ranked Projects

Recommended Project Rank	Sub-Basin Name	Sub-Basin Area (Acre)	Sub-Basin Flood Rank	Volumetric Reduction Rank	Project Planning Level Cost
1	C100DN-1E	102.5	7	3	$ 4,261,881
2	U29-S	60.1	1	4	$ 2,361,083
3	C100D-N-1	247.4	14	10	$ 2,208,589
4	C2-S-9NE	204.8	10	15	$ 3,615,130
5	U35-S	42.4	4	1	$ 981,252
				Total Cost	**$ 13,427,935**

Taking into account the anticipated annual budget allocation for stormwater management projects and maintenance activities, and to expedite the implementation of these projects, it is recommended that the Village obtain a General Bond to expedite the implementation of the top five (5) high priority projects over the next five years. The Bond Debt Service can be potentially paid with the revenue generated from the current stormwater utility fees. The Village should also consider increasing the current stormwater utility fee based on extent of cost for required stormwater improvement projects and statewide average rates. It is recommended that the current fee should be increased from $5 to $8. This could generate an additional $400,000/year to allow more flexibility in implementing high priority projects.

The ranking and the Capital Improvement Plan developed for this SWMP are intended to help guide the Village in prioritizing the implementation of stormwater improvement projects based on cost-effectiveness and flood reduction. The ranking of projects does not require the Village to design and construct projects in this order. In addition, the recommendations of the CIP do not oblige the Village to obtain a Bond Debt Service, nor does it hold the Village responsible for allocating or expending the estimated project costs within the 5-year period. Further detailed analysis will be required to refine the information presented in this SWMP. Additional projects may be added to the 5-year CIP if more funding is allocated to these types of projects or if these projects can be combined with other Capital Improvement project in the Village.

1.9 Conclusions and Recommendations

The following conclusions can be derived based on the work completed in accordance with the Stormwater Master Plan development scope of work documented in **Section 2.0** through **10.0**:

1. Sufficient data was available and successfully collected to proceed with the development of the Stormwater Management Master Plan (SWMP) for the Village of Pinecrest to establish the current flood protection level of service and to analyze numerous sea level and groundwater rise scenarios. The collected

data provided adequate and sufficient information to perform the necessary tasks for the development of the SWMP.

2. The Public Involvement and Outreach program implemented was successful in to educating the public and local land developers in the activities that were being performed to complete the SWMP and to obtain feedback from the residents and land developers. Feedback received from residents and land developers were used, in coordination with Village staff, to refine the procedures used to develop the SWMP for the Village.
3. The C-2 Basin and C-100 Basin stormwater master plan models obtained from DRER offered well documented model development information as well as complete and functioning electronic versions of the XP-SWMM hydrologic and hydraulic models. The model conversions yielded functioning representative models that served as reliable models for use in developing the existing flood protection level of service within the Village, compute the quality of stormwater discharges from the Village and evaluate currently projected sea level and groundwater rise impacts to the Village.
4. The most recent available information provided by the US Army Corps of Engineers and adopted by the Miami-Dade Sea Level Rise Task Force in 2014 and the United States Geological Survey (USGS) groundwater analysis in 2014 to assess potential groundwater rise due to projected sea level rise in Miami-Dade County indicate the following:
    a. 2030 sea level rise projection can be in the range of 3 to 7 inches.
    b. 2060 sea level rise project can be in the range of 9 to 24 inches.
    c. 2045 groundwater modeling results with combined pumping and 1 foot of sea level rise yields 0.5 foot of groundwater rise along the coast and 0.1 foot in western parts of the urban area, and there is limited migration of saltwater intrusion line anticipated in the vicinity of the Village due to the existing control structures.
5. Hydrologic/hydraulic modeling of existing flooding conditions and projected seal-level and groundwater rise indicate that the 10-year design level of service of the C-100A Canal, C-100 Canal and S-123 Control Structure create a significant constraint within the Village for flood protection level of service for building finish floor elevations, since these facilities as designed for a 100-year design storm event.
6. A modified version of the DRER ranking procedure was applied to the Village of Pinecrest sub-basins to identify and rank the top 15 sub-basins with the lowest flood protection level of service. The ranking procedure utilized flood stage data derived from the models and topographic, property, and roadway data available in GIS to establish a Flood Protection Severity Score (FPSS) for each sub-basin. The FPSS provided representative ranking of the highest flood prone areas

within the Village based on observed flooding and resident complaints. A map of sub-basin flood ranking within the Village is included in **Appendix 7D**.

7. Conceptual stormwater improvement projects were developed for the top 15 ranked sub-basins in accordance with the scope of work to meet the required roadway and finish floor elevations flood protection level of service to the maximum extent possible. For the majority of the Village of Pinecrest, it was determined that the most viable stormwater improvement system would be exfiltration trench systems due to their relatively low construction cost, low maintenance requirements, effectiveness in satisfying stormwater quality and quantity requirements, and the potential to place the systems under the current roadways of the Village. In areas where it is feasible, outfalls were implemented and designed to adhere to the discharge limitations of the receiving water bodies. In addition, for areas located east of the saltwater intrusion line, injection wells and pump stations were implemented to increase the efficiency of existing systems and maximize the effectiveness of the proposed systems. All outfalls proposed include a control structure and implementation of a backflow preventer to control discharges and prevent high water levels in the canal systems to backflow on the roads and buildings. **Appendix 8C** includes conceptual design schematics for the top 15 ranked sub-basins.
8. Conceptual stormwater improvement projects analysis and design indicate that the required flood protection level of service cannot be achieved in most of the sub-basin, even with a 2030 mid-range sea level and groundwater rise projection of 5 and 2.04 inches, respectively, due to the constraints of the primary drainage systems within the Village.
9. The conceptual stormwater improvement projects were ranked based on the cost per flood volume reduction to rank the projects in order of cost-effectiveness. **Table 1-3** summarizes the conceptual design project ranking by flood volume reduction and total project cost.
10. The total cost to improve the flood protection level of service within the top 15 ranked sub-basins to the maximum extent possible for a 2030 mid-range sea level and groundwater rise is**$40,819,825**.
11. The proposed improvement projects for the top 15 ranked sub-basin provide significant pollutant load reduction to the C-2, C-100 and South Biscayne Bay Basins. The total load reduction for each of the 12 priority pollutants for the dry, average, and wet simulations is summarized in **Table 1-5** and **Table 1-6**.
12. Due to the limited funding available during this 5-year period, the ranking of the top 15 sub-basins was refined to provide the top five (5) high priority projects. The refined ranking was based on repetitive loss claims, documented home flooding reported by citizens, sub-basin FPSS score reduction, overall flood volume reduction, and input from Village staff. **Table 1-9** summarizes the conceptual design ranking priority for the top five (5) high priority projects based on the refined ranking.

13. The total cost to improve the flood protection level of service within these five (5) high priority ranked sub-basins to the maximum extent possible for a 2030 mid-range sea level and groundwater rise is **$13,427,935**.

The following recommendations are based on the work performed in accordance with the Stormwater Master Plan development scope of work documented in **Section 2.0** through **10.0** and the ADA Team's professional opinion:

1. Due to the constraints of the C-110A (10-year design storm capacity) and C-2 Canals and control structures, higher sea level rise than the 2030 mid-range projected rise cannot be accommodated within the Village and will require regional projects such as:
   - Implementing forward pump stations upstream of the S-22 and S-123 control structures to be able to discharge excess runoff when the gates cannot be opened due to high tidal conditions.
   - Increasing the capacity of the C-100 Canal, C-100A Canal and S-123 Structure to a larger capacity than a 10-year design storm event.
2. The Village should begin coordinating with municipalities within the C-2 and C-100 Basins, the SFWMD, and Miami-Dade County to begin to define required regional solutions and allocate funding to implement regional stormwater improvements to mitigate the future projected sea level rise.
3. The Village should implement a 5-year Capital Improvement Plan using a mid-range of 2030 projected sea level and groundwater rise (5 and 2.04 inches, respectively).
4. Implement an Adaptive Management Approach, track projected sea level/groundwater rise, and make corrective actions every five years. Conceptual design projects should be adaptive to accommodate sea level and groundwater rise, if predictions are accurate and/or higher than projected.
5. The proposed conceptual design projects for the recommended top five (5) high priority ranked sub-basins should be implemented in the order of priority outlined in **Table 1-9**Error! Reference source not found.**.** The refined ranking was based on repetitive loss claims, documented home flooding reported by citizens, sub-basin FPSS score reduction, overall flood volume reduction, and input from Village staff. However, it should be noted that this ranking does not require the Village to design and construct projects in this order. This list is also not a commitment by the Village to allocate or expend the estimated amounts within the 5-year Capital Improvement Plan (CIP) period. This SWMP serves to guide the Village in locating potential projects and correlating potential projects with simulated real world events. Further detailed analysis will be required to refine the information presented in this SWMP during the detailed design phase of the proposed stormwater management projects.

6. Implement a 1-foot clearance (freeboard) above the FEMA Based Flood Elevation (Elevation 10 feet-NGVD29) for residential areas in high-flood prone areas:
   - Higher elevations do not provide additional benefits in improving the Village's Community Rating Score (CRS).
   - Higher clearances (2' or higher) will significantly reduce flood plain storage within the Village.
   - Higher clearances will create excessive elevation disparity with many existing home elevations.
7. Conceptual project costs should be revised at the design and permitting phases of the projects to account for current material and labor costs and potential utility impacts not addressed as part of the planning phase.
8. The Village should consider obtaining a General Bond to expedite implementation of proposed projects to address the top five (5) high priority ranked sub-basin projects and use the available stormwater utility fee to pay for the bond's debt service cost.
9. The Village should consider increasing the current stormwater utility fee based on extent of cost for required stormwater improvement projects and statewide average rates. It is recommended that the current fee should be increased from $5 to $8. This could generate an additional $400,000/year to allow more flexibility in implementing high priority projects.
10. The Village should update the Stormwater Master Plan every 5-years to:
    - Maximize Community Rating Score (CRS)
    - Re-assess sea-level and groundwater rise trends
    - Re-prioritize projects based on projects previously implemented

2.0 INTRODUCTION

2.1 Background

The Village of Pinecrest (Village) is a suburban area in southeast Miami-Dade County (County), Florida. Incorporated in 1996, the Village of Pinecrest has a population of over 18,000 (based on the 2010 Census) and has a total area of 7.53 square miles. The Village is bounded by South Dixie Highway / US-1 to the west, S.W. 136th Street to the south, Old Cutler Road to the east, and just south of the SFWMD C-2 Canal to the north – see **Figure 2-1**.

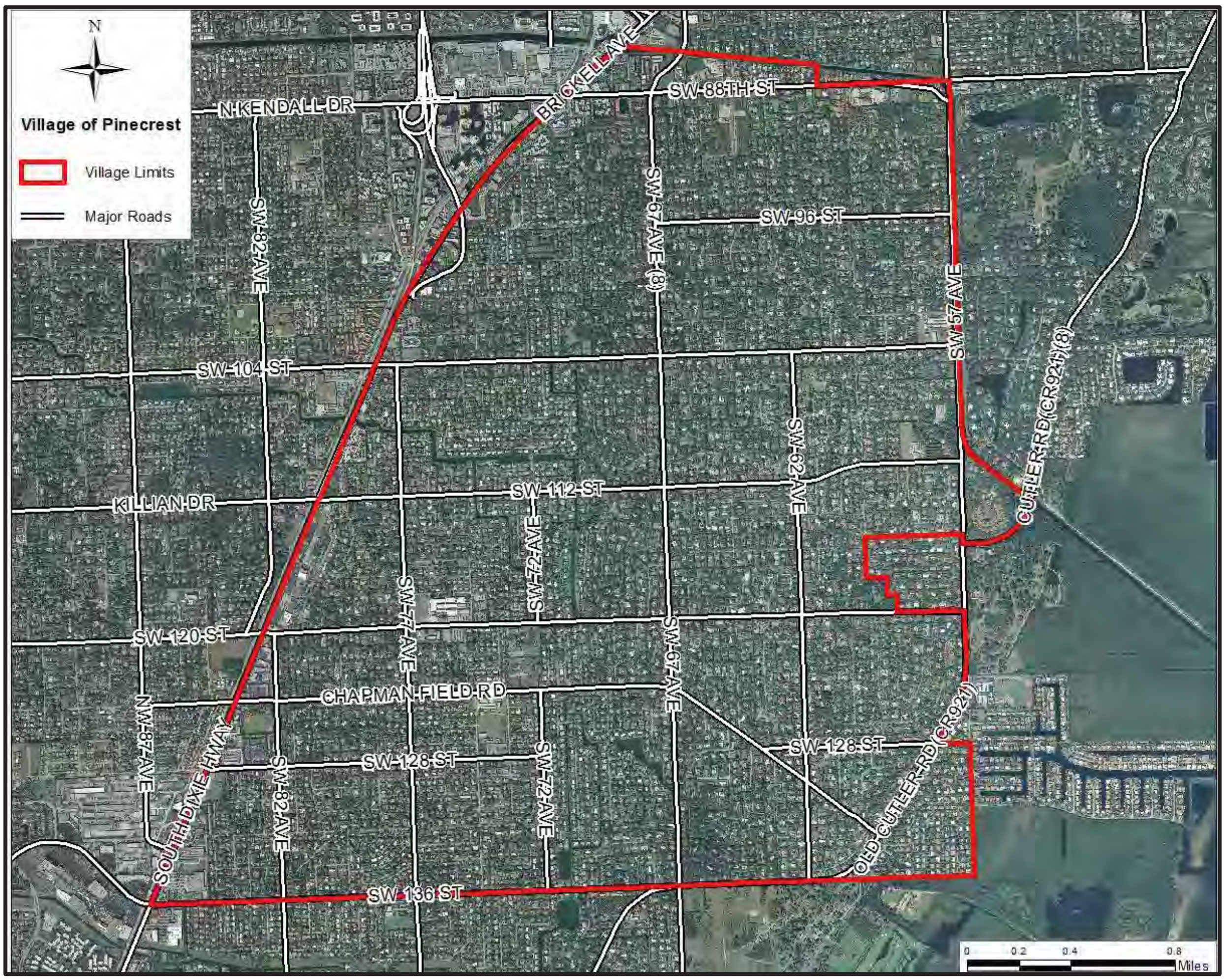


Figure 2-1 – Village of Pinecrest Limits

The Village's residential, commercial/industrial, and transportation land uses account for approximately 92% of the Village's total area – see **Figure 2-2**.

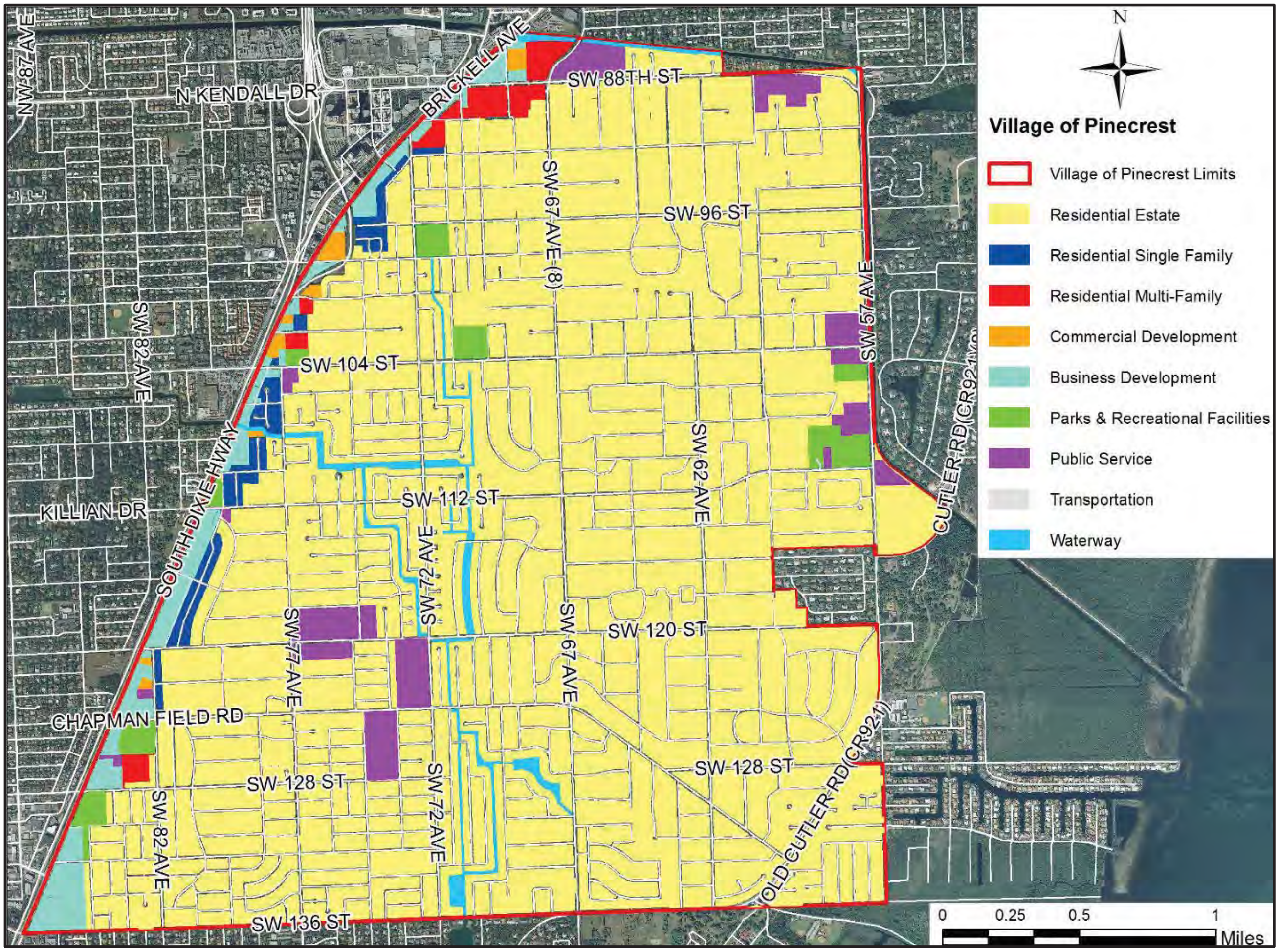


Figure 2-2 – Land Use Distribution within the Village of Pinecrest

The Village is predominantly built out to these existing land uses, with the exception of some small vacant areas scattered throughout the Village which can be mostly attributed to redevelopment – see **Table 2-1** for existing land use distribution.

Table 2-1 – Percent Land Use Distribution within the Village of Pinecrest

Land Use	Area (sq. mi)	% of Village
Residential	5.58	74.15
Commercial	0.05	0.71
Business	0.17	2.29
Public Service	0.21	2.81
Parks & Recreation	0.11	1.40
Transportation	1.30	17.29
Inland Water	0.10	1.36
Total	**7.52**	**100.00**

The Village falls within the boundaries of the South Florida Water Management District (SFWMD) C-2 and C-100 Basins and the South Biscayne Bay Basin – see **Figure 2-3**.

These basins are drained by the C-2 Canal (Snapper Creek Canal) and the C-100 Canal, both primary SFWMD canals. The C-100 receives discharges from the Village via the C-100A, C-100A Extension Canals (Cutler Drain Canals maintained by SFWMD) and the SW 70th Avenue Canal that it is owned by Miami-Dade County, but it is maintained by the Village of Pinecrest. The C-2 and C-100 Canals are controlled by the SFWMD Control Structures S-22 and S-123, respectively. **Figure 2-4** shows the location of the canals, which primarily flow through these control structures to Biscayne Bay.

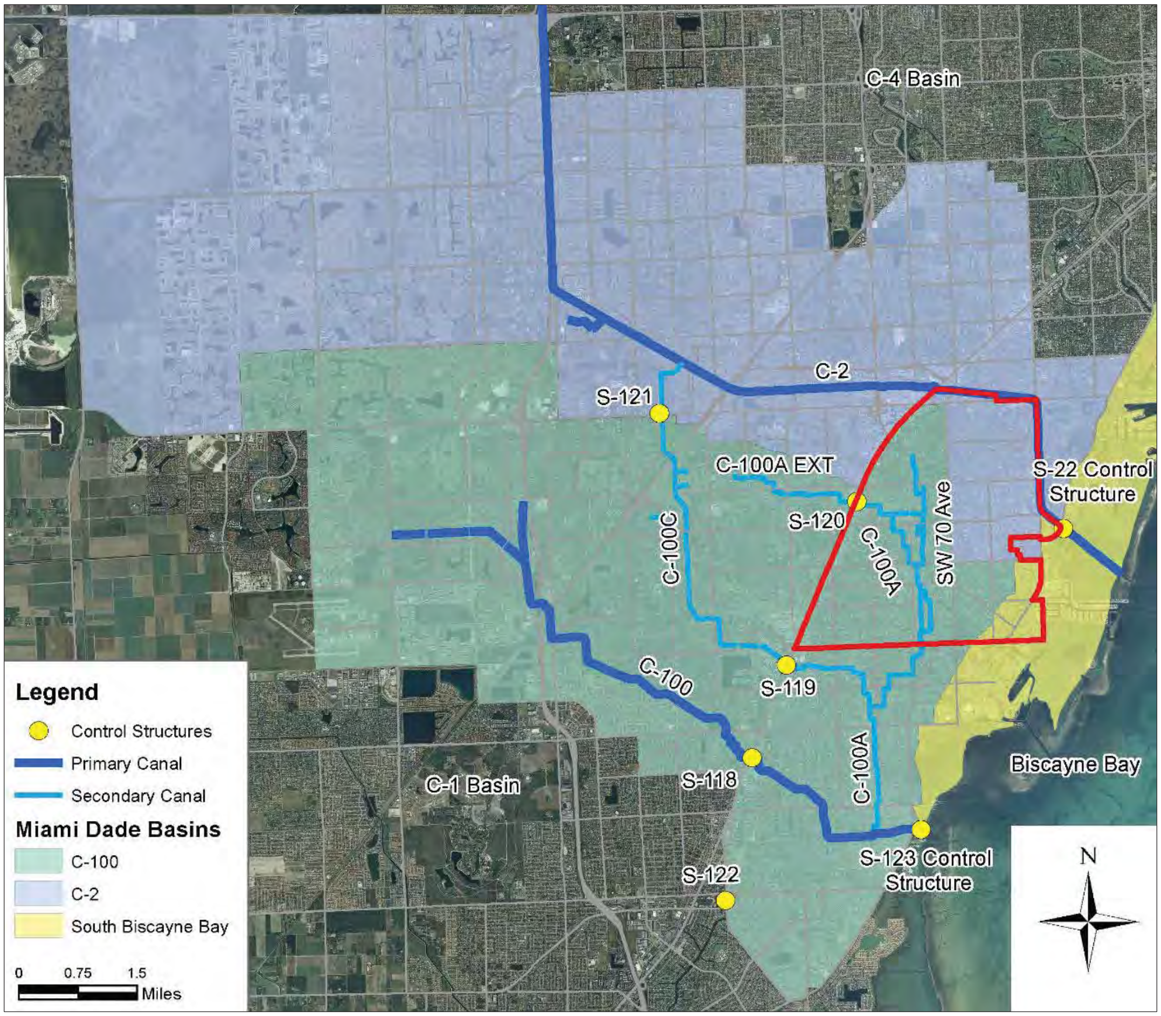


Figure 2-3 – SFWMD Canal Basin's & Village of Pinecrest Limits

The S-22 and S-123 Control Structures are operated and maintained by the SFWMD. These structures are used to maintain optimum water control stages upstream in the C-2 and C-100 Canals, respectively (see **Figure 2-3**), while discharging the flood waters for each basin. In addition to maintaining optimum upstream fresh water control, under flood control regulation, the automatic controls on these structures have an overriding control which closes the gates regardless of the upstream water level in the rare event of a high flood tide where the differential between the head (upstream) and tailwater (downstream) pool elevations in the canal reaches 0.3 feet. This operating condition is implemented to prevent saltwater intrusion westward of the control structures.

The issues related to both the C-2 and C-100 Canal basins, as well as the major conveyance systems associated with these canals and drainage basins, are well documented in the C-2 and C-100 Canal Basin Stormwater Master Plans prepared by Miami-Dade County. The documented issues include flooding of low lying areas, over development leading to an increase in stormwater runoff and undersized or non-existing drainage systems in need of improvement or construction. Similar issues affect the Village of Pinecrest.

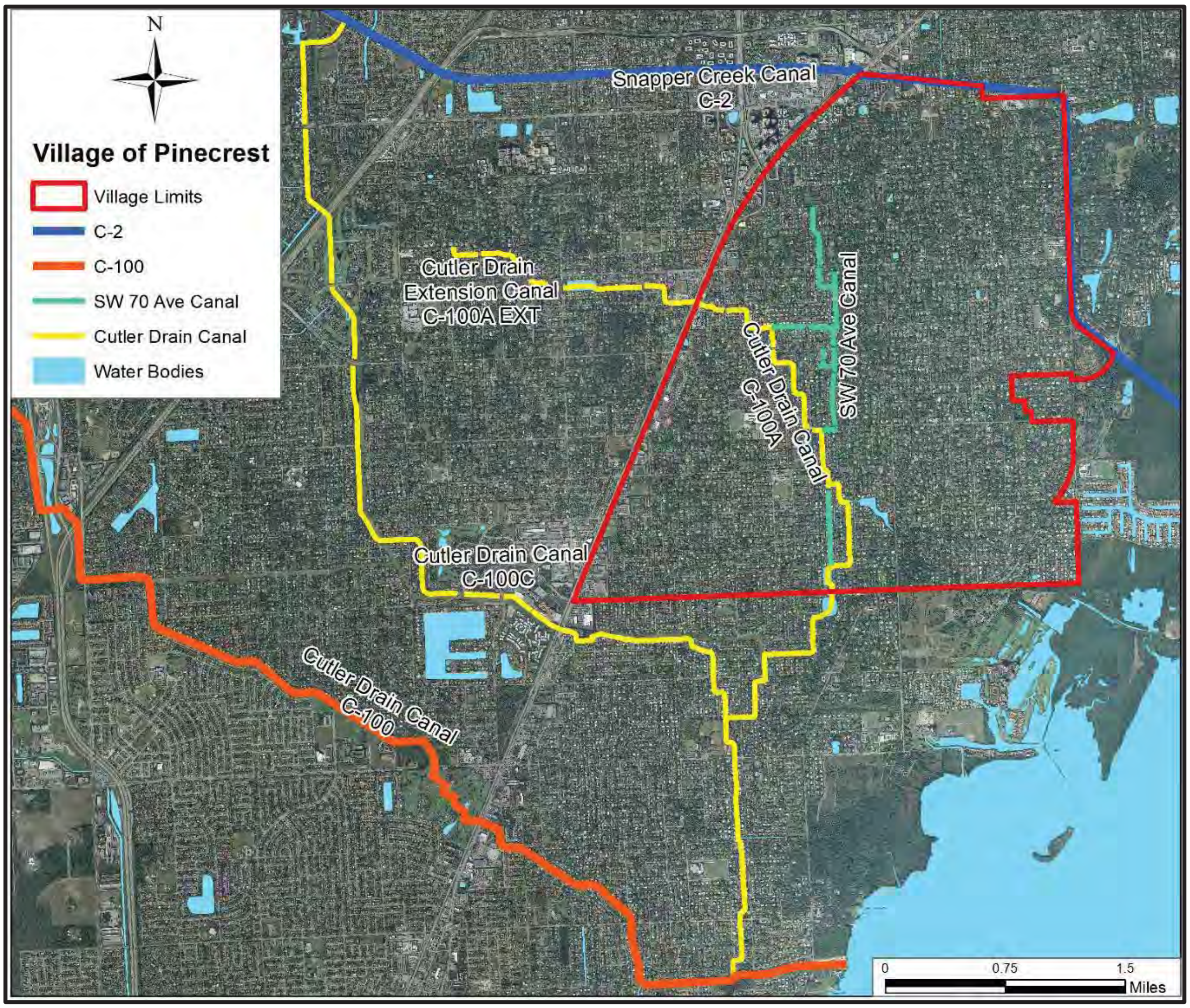


Figure 2-4 – Canals within the Village of Pinecrest

As depicted on **Figure 2-5**, elevations within the Village vary substantially from approximately elevation 4 to 20 ft-NGVD. There are several high elevation ridges within the Village, predominately located along the west side of the Village near US 1 and on the east near Old Cutler Road. Lower elevations tend to be near the canal systems located within the Village. Seasonal high groundwater elevations (average October groundwater elevation as determined by Miami-Dade County) vary from approximately 2 ft-NGVD on the east side of the Village to 3.5 ft-NGVD on the west side of the Village.

Also as shown on **Figure 2-5,** the salt water intrusion line as identified by Miami-Dade County is located just west of Old Cutler Road on the east side of the Village. Gravity drainage wells are generally constraint to the east of this salt water intrusion line.

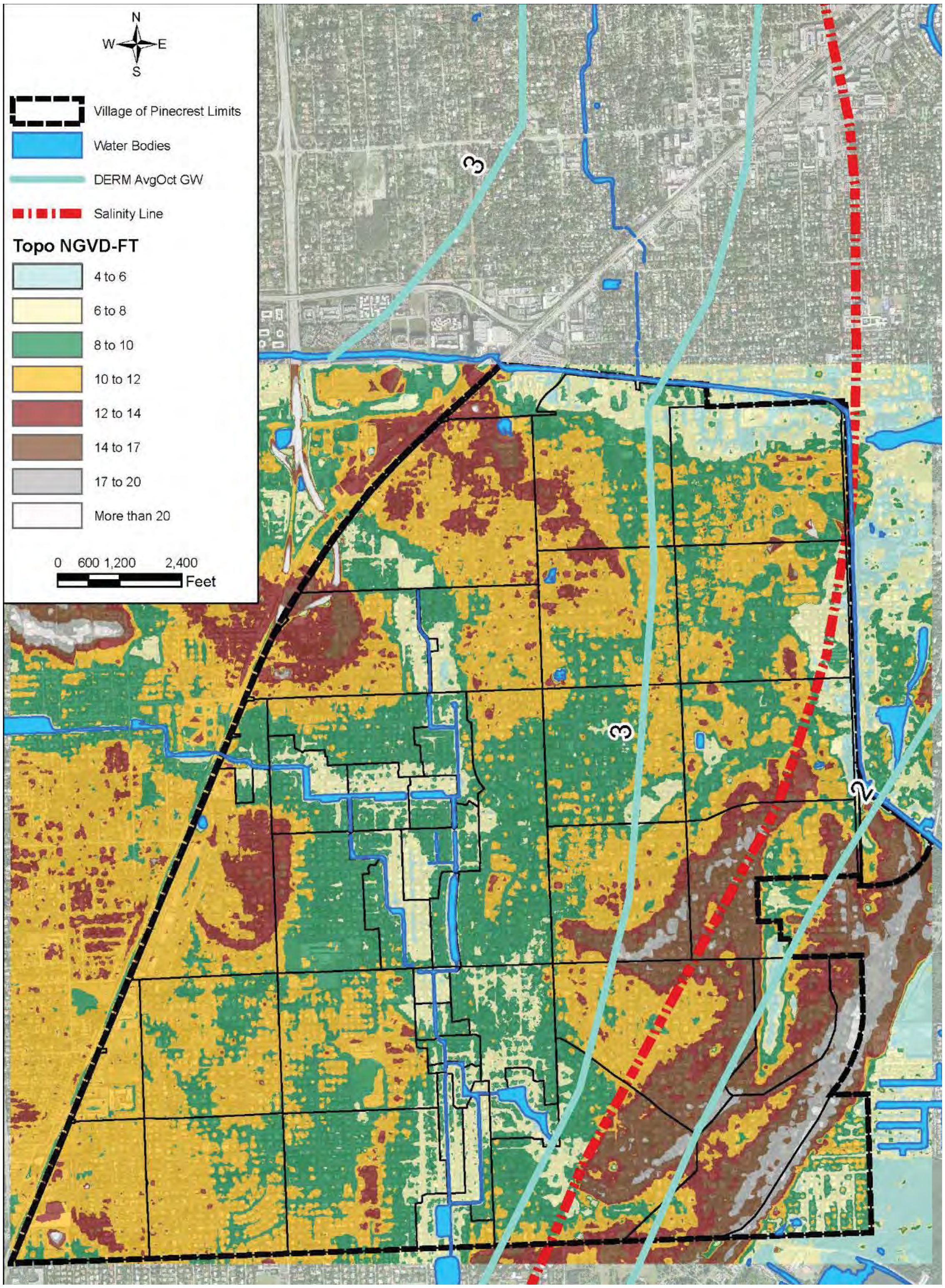


Figure 2-5 – Village of Pinecrest Topography, Seasonal High Groundwater Levels and Salinity Line

The Village, as with most of South Florida communities, experiences stormwater management challenges and can be susceptible to impacts of sea level rise and localized flooding. Although the Village is not a shore-based community, the rising of sea levels can affect canals and control structures which represent the primary drainage systems within the County and subsequently, the Village. These issues can in turn compromise existing secondary drainage systems and ultimately reduce the capacity of these systems, which often results in flooding when coupled with frequent storm events. Identification of areas with the most vulnerability to sea level rise within the Village of Pinecrest will provide the Village with an additional tool for evaluating future projects. This help the Village to partner with Miami Dade County and the SFWMD, which control the regional drainage systems, to implement regional solutions to address potential impacts due to sea level rise.

2.2 Stormwater Master Plan Purpose and Scope

The Village does not have a previous Stormwater Master Plan, a complete hydraulic and hydrologic stormwater model of its primary stormwater management systems, or an associated analysis to plan for sea level rise in terms of stormwater management related projects. Therefore, the Village retained the ADA Team, comprised of A.D.A. Engineering, Inc. (ADA) as prime consultant, EV Services, Inc. (EVSI) for public involvement and outreach services, and Cardno for surveying and mapping of the existing drainage systems within the Village, to develop the Stormwater Master Plan.

The purpose of this project is to create a comprehensive SWMP incorporating the following activities:

- Collect and evaluate available data, including performing an inventory of existing stormwater drainage structures and features in a GIS Format.
- Implement a Public Involvement Plan to inform the residents and Land Developers of the SWMP approach, goals and objectives, and solicit input from the public to guide the development of the plan.
- Identify the current flood protection level of service within the Village and quality of stormwater discharges from the Village.
- Rank and prioritize sub-basins within the Village based on level of flooding severity.
- Assess the potential impact of sea level and groundwater rise on the Village's stormwater management infrastructure.
- Develop planning-level conceptual stormwater improvement projects and cost estimates to address flooding in the top 15 highest ranking sub-basins. The conceptual projects will be designed to address some level of projected sea level and groundwater rise, while providing adaptability for future increases in sea level and groundwater rise.
- Prioritize stormwater management improvement projects for the top 15 ranked sub-basins, based on flood volume reduction cost effectiveness.
- Develop a 5-year Capital Improvement Plan (CIP) that takes into consideration the Village's capital budget for prioritized stormwater improvement projects.

- Meet requirements set forth in the National Pollutant Discharge Elimination System (NPDES) permit.

Stormwater Master Plans (SWMP) should be updated every five years as required by the Federal Emergency Management Agency (FEMA), as part of the National Flood Insurance Program (NFIP).

The ADA Team scope of work to develop the Village of Pinecrest Stormwater Master Plan was subdivided into the following key tasks:

- Task 1 – Data Collection and Evaluation
- Task 2 – Public Involvement and Outreach
- Task 3 – Existing Flood Protection and Water Quality Level of Service
- Task 4 – Sea Level Rise Impact Assessment
- Task 5 – Sub-basin Ranking and Prioritization
- Task 6 – Stormwater Improvement Project Conceptual Design and Ranking
- Task 7 – Projected Water Quality Load Reductions
- Task 8 – Capital Improvement Plan Development

A summary of the purpose and scope performed for Tasks 1 through 8 are discussed in the following subsections.

2.2.1 Task 1 – Data Collection and Evaluation

Data collection and evaluation involved requesting and collecting readily available data to support the development of and findings within the SWMP. Data was requested and acquired from the various sources maintaining data within the Village as well as from the Village. Limited field visits were also performed during rainfall events occurring during the development of this SWMP to physically observe the response of some of the Village's stormwater management systems.

The collected data was cataloged, evaluated, and utilized as necessary to support the analyses and preparation of this Stormwater Master Plan Report. Topographic, geotechnical, or other specific surveys were not included in the scope of work for this Task.

As part of the data collection task, the ADA Team surveyed catch basins/inlets, manholes and outfalls located within public right of ways throughout the Village to develop a thorough inventory of the current drainage systems. The surveyed information was used to populate and develop a GIS Geospatial Database, including the existing drainage infrastructure for the Village. The work performed as part of the surveying and mapping task will be delivered to the Village under a separate document.

2.2.2 Task 2 – Public Involvement and Outreach

The public involvement task included coordinating and conducting four (4) community workshops with the intent of providing a relaxed and comfortable venue where participants could focus on the Stormwater Master Plan process and goals, solicit feedback, discuss future improvements in general terms, and develop a positive rapport with community stakeholders. Two workshops were held with residents in the community and two workshops were held with Developers to address concerns with current Land Develop Stormwater Code regulations.

Some of the objectives of the community workshops included:

- Conducting an integrated Public Involvement and Community Outreach (public interaction) program;
- Engaging the community in an open, healthy dialogue about the project understanding that the Village bases the final decision on several criteria and community input is important to them;
- Fostering understanding of the Village's responsibility with its SWMP now and into the future;
- Discussing ways of minimizing impacts on stakeholders and preventing opposition to future stormwater management projects;
- Communicating to stakeholders the need for stormwater improvement projects and how they benefit the community; and
- Explaining the engineering and master planning process.

2.2.3 Task 3 – Existing Flood Protection and Water Quality Level of Service

The existing flood protection and water quality level of service determination established an existing baseline condition peak stages, flows, and volumes for each of the Village's sub-basins. This task used the data collected from the Village and Miami-Dade County as part of Data Collection and Evaluation task to establish the peak stages, flows, and volumes for the following storm events:

- 5-year, 24-hour
- 10-year, 24-hour
- 25-year, 72-hour
- 50-year, 72-hour
- 100-year, 72-hour

To limit the cost and expedite development of the Village SWMP development, the scope of work included leveraging the hydrologic, hydraulic and water quality models developed by Miami-Dade County as part of the Stormwater Master Plans for the C-2 and C-100 Basins, rather than developing new models. As part of this task, the previously developed 2004 C-2 Basin and C-100 Basin XP-SWMM hydrologic/hydraulic models were converted to the current version of XP-SWMM (Version 2014). The models developed by the County were used by FEMA to develop the current FEMA Flood Insurance Rate Maps (FIRM) for Miami-Dade County. ADA assessed the consistency between model versions and verified that the updated peak stages obtained with the newly converted XP-SWMM model version were representative of the results obtained with the prior model version.

The newly updated version of the XP-SWMM model incorporated changes associated with stormwater management projects recently completed by the Village. Changes in land use that resulted in an increase in impervious areas associated with development projects were also incorporated. In addition, the basins within the Village limits were refined to better represent the conditions of the stormwater management system. Upon completion of model validation, the updated XP-SWMM model was classified as the 2014 Baseline Scenario. ADA then simulated peak stages, flows, and volumes and summarized results obtained for all of the Village's sub-basins for the previously mentioned storm events. ADA also prepared flood plain maps for each of the design storm events.

The 2014 Baseline Scenario XP-SWMM model was then used by ADA to calculate pollutant loading using the same procedures and parameters included in the Miami-Dade County C-2 and C-100 Basin Stormwater Management Master Plans. Pollutants considered in this analysis included, and were limited to, the following pollutants set forth in the NPDES permit:

1. 5-day Biochemical Oxygen Demand (BOD_5)
2. Chemical Oxygen Demand (COD)
3. Total Suspended Solids (TSS)
4. Total Dissolved Solids (TDS)
5. Total Kjeldahl Nitrogen (TKN) (total ammonia + organic nitrogen)
6. Total Nitrogen (TN)
7. Total Phosphorus (TP)
8. Dissolved Phosphorus (DP)
9. Total Cadmium (Cd)
10. Total Copper (Cu)
11. Total Lead (Pb)
12. Total Zinc (Zn)

2.2.4 Task 4 – Sea Level Rise Impact Assessment

The sea level rise assessment used the latest available sea level and groundwater rise projections from available sources and studies published by the United States Army Corps of Engineers (USACE) and the US Geologic Survey (USGS) Agency. The 2014 Baseline Scenario XP-SWMM model was then used to incorporate maximum projected sea level and groundwater rise for Years 2030 and 2060 to predict the additional flooding increase that could be anticipated within the Village during the maximum projected elevations for these time periods. Flood maps were developed using the project maximum sea level and groundwater rise for Years 2030 and 2060 (7 and 24 inches, respectively), and these maps were compared to the flood plain maps for the 5- and 100-year design storm events without sea level rise.

2.2.5 Task 5 – Sub-basin Ranking and Prioritization

The sub-basin ranking and prioritization task identified and ranked the existing stormwater management problem areas in the Village and established current flood protection levels of service for all Village sub-basins. Miami-Dade County Regulatory and Economic Resources (DRER) established procedures and criteria, as part of their stormwater master planning activities, to identify problem areas, rank problem areas and establish flood protection levels of service using the hydrologic/hydraulic modeling results for the 5-, 10-, 25-, 50- and 100-year design storm events. These procedures and criteria are documented in Part I, Volume 3, "Stormwater Planning Procedures," March 1995. These planning documents were used by the County to develop the Stormwater Master Plans for all canal basins within the County.

The procedures developed by DRER were modified under this stormwater master plan to account for the needs of the Village and input from residents. The revised procedures were also used to establish the flood protection levels of service for each of the sub-basins within the Village.

2.2.6 Task 6 – Stormwater Improvement Project Conceptual Design and Ranking

The stormwater improvement project conceptual design and ranking task involved developing conceptual stormwater improvement projects to address flooding in the top 15 ranked sub-basins from Task 5. The proposed projects consisted of typically implemented stormwater infrastructure components constructed and maintained by the Village: inlets and catch basins, exfiltration trenches, control structures, drainage wells, and stormwater pump stations. The flood protection effectiveness for each project was assessed based on developing a localized hydrologic/hydraulic model using the ICPR Model Version 3.10. The results from the C-2 and C-100, 2014 Baseline Scenario XP-SWMM models were used to establish boundary conditions for the localized ICPR models. Planning-level sketches and cost estimates were developed for each project based on recent actual bid cost provided by the Village, Florida Department of Transportation cost database and ADA's own construction cost database. The projects were then ranked and prioritized based on aanking methodology, devised in combination with the Village, using total project cost, flood volume removal capacity, and input from the Village. This methodology ensured that flood prone areas are addressed by the proposed projects in a cost-effective manner.

2.2.7 Task 7 – Projected Water Quality Load Reductions

Once the conceptual stormwater improvement projects are developed for each of the 15 top ranked sub-basins, the pollutant load reductions were estimated by defining a contributing treatment area that contributes runoff to the exfiltration trenches or stormwater management systems and a Removal Percentage (R%) based on the best management practices applied. A Removal Percentage (R%) will be established and applied to each of the sub-basin water quality loads to arrive at the final total load per sub-basin, assuming the proposed stormwater improvement project has been implemented within the given sub-basin. Total net loading from the Village will be computed for the three basins receiving stormwater discharges from the Village: C-2, C-100 and South Biscayne Bay Basins.

2.2.8 Task 8 – Capital Improvement Plan Development

Once the stormwater improvement projects were conceptually designed, ranked, and cost estimates prepared, a five-year fiscal analysis was performed to identify the required capital expenditure schedule to fund the projects identified in Task 6.

To ensure that there will be adequate funding to implement the high priority projects, ADA discussed with Village staff the anticipated yearly budget allocation for stormwater management projects and maintenance activities. Based on the limited funding the Village has available over the next five years, the projects identified in Task 6 were further prioritized and ranked. The refined prioritization and ranking of the proposed projects were based on the number of repetitive loss claims, documented home flooding reported by citizens, sub-basin FPSS score reduction, overall flood volume reduction, and input from Village staff. The refined prioritization resulted in a final ranking and classification of the top five (5) high priority projects. Once a consensus had been reached, funding mechanisms were identified, and ADA prepared a five-year Capital Improvement Plan (CIP) that will serve as the framework that will allow the Village to accurately anticipate the future infrastructure expenditures and maintenance activities for the five (5) high priority projects. The totals provided in the cost estimates of the top five (5) high priority projects are provided as a guidance tool to be used by the Village as a basis for budget allocations and future planning. The cost estimates and project rankings are not commitments to expenditures by the Village over any time period.

The following sections document the detailed activities performed by the ADA Team.

3.0 DATA COLLECTION AND EVALUATION

The data collection task included collecting data from the various entities with jurisdiction or that maintain data within and around the Village's limits. Data was requested and/or collected from the flowing entities:

- Village of Pinecrest
- Miami-Dade County Enterprise Technology Services Department (ETSD)
- Miami-Dade County Regulatory and Economic Resources (DRER)
- South Florida Water Management District (SFWMD)
- National Oceanic and Atmospheric Administration (NOAA)
- United States Army Corps of Engineers (USACE)
- United States Geological Survey(USGS)
- Natural Resources Conservation Service (NRCS)
- Federal Emergency Management Agency (FEMA) - National Flood Insurance Program
- Florida Department of Transportation (FDOT)

The following information was requested from Miami-Dade County which, besides the Village, has the most pertinent and applicable data needed to complete the SWMP:

1. All master plan report volumes in PDF format for the C-2 and C-100 Basins
2. C-2 and C-100 Basin XP-SWMM models and binary results files for the following Calibrated/Verified model simulation scenarios:
    a. Existing conditions (5-, 10-, 25-, 50- and 100-year design storm events)
    b. Future conditions without control measures (5-, 10-, 25-, 50- and 100-year design storm events)
    c. Future conditions with control measures (5-, 10-, 25-, 50- and 100-year design storm events)
    d. Water quality simulations for wet, average and dry years (5-, 10-, 25-, 50- and 100-year design storm events)
3. C-2 and C-100 Basin delineation shapefiles
4. Latest bare-earth LIDAR data for all sections within the Village
5. Design plans for recently constructed stormwater management projects within the Village (within the last 3 years)
6. Pertinent GIS data/coverages
    a. Basin delineations
    b. Water bodies/canals
    c. Land use
    d. Soil types
    e. Contaminated sites
    f. Roadway Network by classification (local, arterial, and evacuation routes)
    g. Lot/Right-of-Way lines and parcels

In addition to this data request, the following information was requested from the Village:

1. All available digital and hard copy data of stormwater management related projects within the Village. This data may include reports, GIS shapefiles, CADD data, and digital PDF files
2. Pertinent GIS data/coverages that will support development of the stormwater master plan
3. Latest high resolution aerials
4. Current and future land use maps in GIS format
5. Current and future flood protection project design plans in hard copy and/or CADD format
6. Percolation test data
7. Latest stormwater Infrastructure GIS shapefiles
8. Stormwater improvement project construction unit cost data for recently constructed projects and roadway improvements
9. Current stormwater system operation and maintenance procedures and costs
10. Citizen flood/stormwater drainage complaints

Data collected from other entities was based on research of available web-data portals and ADA's own data catalogs. Data from these sources were assessed on a case by case basis for pertinence to the development of the Village's SWMP.

3.1 Village of Pinecrest

ADA collected data associated with stormwater infrastructure, construction projects, and studies from the Village of Pinecrest. The Village provided files which include the Village's current catch basins and outfalls, drainage structures, percolation studies, as well as project cost estimates for various completed projects.

The data catalog presented in **Appendix 3A** provides a listing of the Village project data collected for incorporation into the hydrologic/hydraulic models. The data catalog in **Appendix 3A** also includes a section of pertinent GIS data collected from the Village.

3.1.1 Stormwater Improvement Project Data

The Village of Pinecrest provided a list of completed stormwater improvement projects within the last 4 years in combination with reports and design files – see **Table 3–1**. Project data was primarily provided as PDF files in addition to some CADD files.

Table 3-1 - Project Data from Village of Pinecrest

Project Location	Year
SW 70th Ave (SW 100th Ave & 104th Ave)	2007
SW 72nd Ave (SW 112th ST to SW 120th St)	2009
SW 72nd Ave (SW 92th ST to SW 95th St)	2010
SW 73rd Ave, SW 72nd CT, SW 72 Ave, SW 96th Street	2012
Killian Park Road – 11100 Killian Park RD	2012
Pinecrest Gardens Stormwater Improv.	2013
South Mitchell Manor Circle & SW 64th Ave	2013
South Mitchell Manor Circle & SW 64th Ave	2013
Pine Needle Lane (near SW 121st St)	2013
Rock Garden Lane (near SW 121st St)	2013

3.1.2 Public Works Department

The Village of Pinecrest provided all readily available data, this data included digital and hard copy data of stormwater management related projects, reports, GIS shapefiles, CAD data, and digital PDF files. The data provided will support the development of the Stormwater Master Plan comprised of the following:

1. GIS shapefiles
    a. Village Limits
    b. Water and Sewer
    c. Existing and Future Land Use
    d. Canals, Water Bodies and Outfalls
    e. Pinecrest drainage and manholes
    f. FEMA Flood Zones
    g. Aerial images 2012
    h. Water Canal Ownership
2. Storm Drain Structures Description and Maintenance Cost
3. Drainage Improvement Projects
    a. Report and AutoCAD files
    b. Percolation Test Data
4. Capital Roadway Improvement Projects

3.1.3 GIS Data

The Village currently maintains stormwater infrastructure data in GIS shapefile format. The information is updated using field verified data collected during maintenance activities and all catch basins are identified with tags with unique numbers that correlate to the maintenance data sheets. The Shapefile pinpoints the relative location and date of last service. Currently the Village has an inventory of approximately 800 catch basins and under 50 outfalls. Connectivity, pipes sizes and inverts of drainage systems were not identified. Pipe connectivity will be developed as part of the stormwater infrastructure mapping task to be developed and documented under a separate report.

3.1.4 Site Visits

For this project, a total of three (3) one-day field reconnaissance site visits were performed within the Village to clarify, document, and supplement data that was collected and to assess the existing condition of major stormwater infrastructure components within the Village. These site visits took place in June 3rd 2014, September 3rd 2014, and September 12th, 2014. Dates were coordinated after recent heavy rainfall events to observe flooding severity. **Appendix 3B** includes photos taken during the site visits.

3.2 Miami-Dade County

Data from Miami-Dade County was acquired via two separate departments: DRER and the Miami-Dade Enterprise Technology Services Department (ETSD). **Appendix 3C** provides a catalog of the digital data provided by Miami-Dade County.

LiDAR topographic data for the Village of Pinecrest was acquired from Florida International University – International Hurricane Research Center (FIU-IHRC) LiDAR download portal (FIU-IHRC LiDAR - http://digir.fiu.edu/Lidar/lidarNew.php). LiDAR data is sourced by Miami-Dade County and corresponds to the latest available data from the County.

Additionally, ETSD provided GIS data which included shapefiles of County canals, roadways, soils, hurricane evacuation routes, as well as the 2012 SID aerial images of the County. The majority of Miami-Dade County's GIS data is also accessible via the web, at the following location:

- Miami-Dade County GIS data portal
    - http://gisweb.miamidade.gov/GISSelfServices/GeographicData/MDGeographicData.html

A screen capture of the Miami-Dade County GIS data portal is shown in **Figure 3-1**. A catalog of the GIS data collected is also included in **Appendix 3C**.

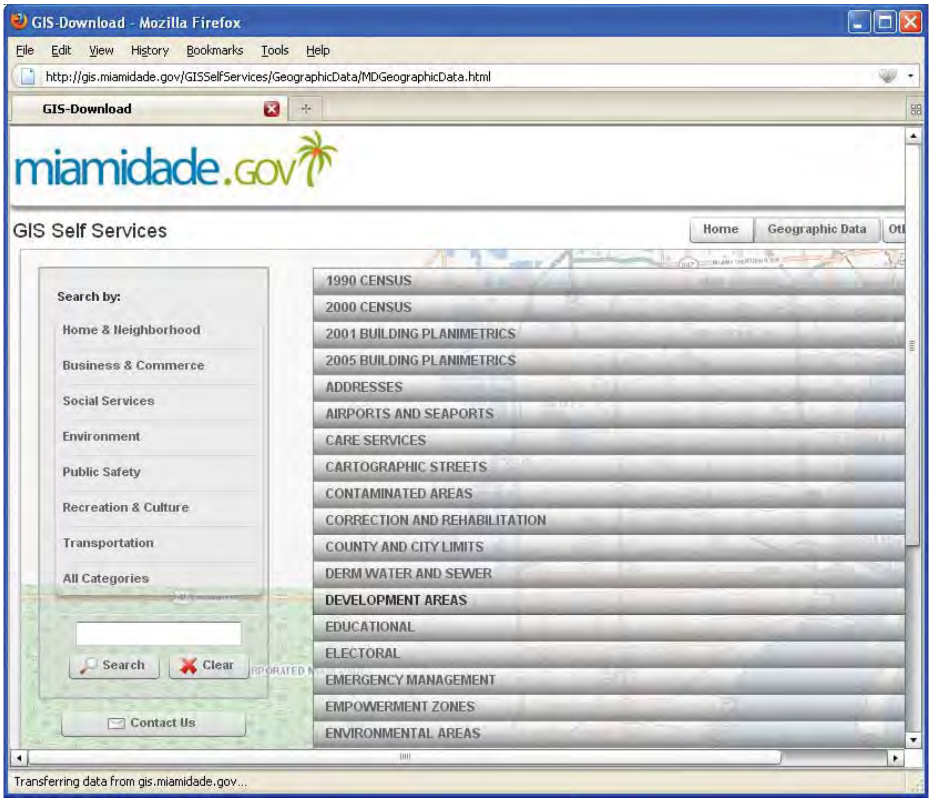


Figure 3-1 – Miami-Dade County GIS data portal

3.3 Data from Other Sources

In addition to the main data contributions from the Village of Pinecrest and Miami-Dade County, other sources of information were accessed to help support the development of the Stormwater Master Plan. The following subsections provide a description of the entity and applicable data collected to support development of the Village's SWMP.

3.3.1 South Florida Water Management District (SFWMD)

The SFWMD maintains an extensive water resources database, titled DBHYDRO, which includes hydrologic, meteorological, hydrogeologic and water quality data. The data contained within DBHYDRO includes historical and current data for the 16 counties governed by the SFWMD. In order to facilitate the access of this data, the SFWMD has developed a browser accessible via the web, at the following location:

- Main DBHYDRO portal:
  - http://www.sfwmd.gov/portal/page/portal/xweb%20environmental%20monitoring/dbhydro%20application
- DBHYDRO Browser Menu for accessing all SFWMD data:
  - http://my.sfwmd.gov/dbhydroplsql/show_dbkey_info.main_menu

A screen capture of both the main DBHYDRO portal and the DBHYDRO Browser Menu website are shown in **Figure 3–2** and **Figure 3-3**.

Figure 3-2 - Main DBHYDRO Portal

Figure 3-3 – DBHYDRO Browser Menu

A listing of the active stations within and near the Village is shown in **Table 3-2**. The location of the stations listed in **Table 3-2** is shown in **Figure 3-4**.

Table 3-2 – Active DBHYDRO Stations within the Village of Pinecrest

Station	Agency	Class	Status	Start Date	End Date
SP04	SFWMD/DERM	Water Quality	Active	07/11/1991	01/09/2014
S119_S	SFWMD	Flow	Active	12/18/2013	06/28/2014
S120_C	SFWMD	Flow	Active	02/11/1991	06/02/2014
S22_S	SFWMD	Flow	Active	05/31/1985	06/30/2014
C2SW2	SFWMD	Stage	Active	11/16/2002	06/23/2014
S119_H	SFWMD	Stage	Active	12/18/2013	07/08/2014
S119_T	SFWMD	Stage	Active	12/18/2013	07/08/2014
S120_H	SFWMD	Stage	Active	07/01/1988	06/02/2014
S120_T	SFWMD	Stage	Active	07/01/1988	06/02/2014
S22_H	SFWMD	Stage	Active	05/31/1985	07/08/2014
S22_T	SFWMD	Stage	Active	05/31/1985	07/08/2014
G-1009B_G	USGS	Well	Active	10/31/1994	05/08/2014
G-3313C	USGS	Well	Active	10/18/1996	05/08/2014
G-3313E	USGS	Well	Active	04/16/1998	04/09/2014
G-3608	USGS	Well	Active	10/17/1996	04/10/2014
G-3609	USGS	Well	Active	10/17/1996	04/10/2014
G-3610	USGS	Well	Active	10/18/1996	04/08/2014
G-3887A	USGS	Well	Active	01/07/2010	05/08/2014
G-3887B	USGS	Well	Active	11/23/2011	05/08/2014
G-553_G	USGS	Well	Active	01/01/1956	06/30/2014
G-580A	USGS	Well	Active	07/15/1949	07/01/2014
G-896	USGS	Well	Active	10/06/1975	05/08/2014

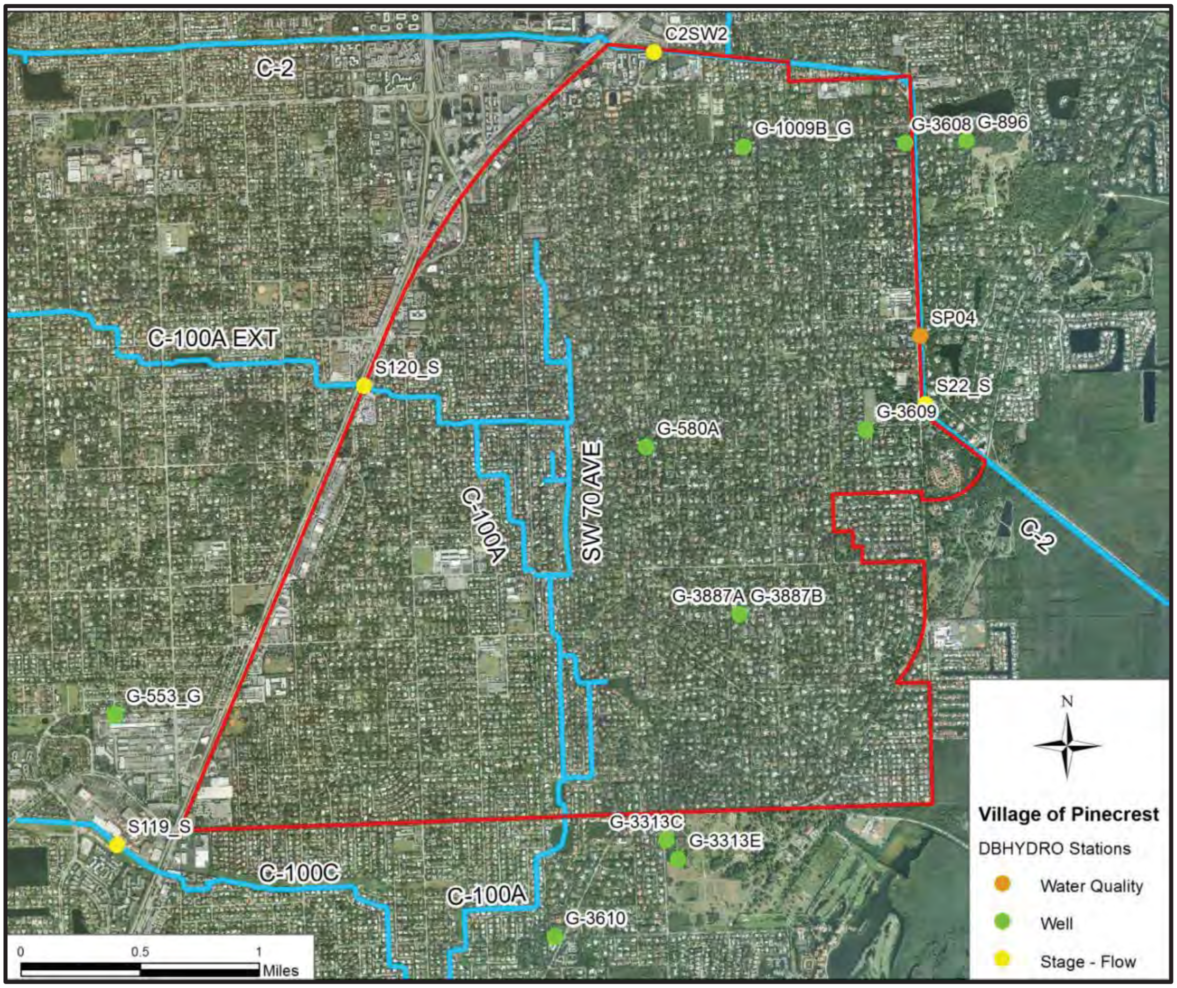


Figure 3-4 – Map of Active DBHYDRO Stations within & near the Village of Pinecrest

The SFWMD also maintains a GIS data repository for all GIS data for the SFWMD. This GIS data catalog contains a shapefile with the location of all the DBHYDRO stations where observations, samplings, or monitoring are collected. This shapefile is available via the web, at the following locations:

- GIS Data distribution site:
  - http://my.sfwmd.gov/gisapps/sfwmdxwebdc/
- DBHYDRO monitoring station shapefile:
  - http://my.sfwmd.gov/gisapps/sfwmdxwebdc/dataview.asp?query=unq_id=1588

Existing stormwater and environmental permitting information is also available via the SFWMD ePermitting website. This website contains supporting documentation for Environmental Resources Permits (ERP) and applications submitted to and approved by the SFWMD. These websites are as follows:

- Main SFWMD permitting portal:
  - http://www.sfwmd.gov/portal/page/portal/levelthree/permits

- SFWMD ePermitting portal:
    - http://my.sfwmd.gov/ePermitting/MainPage.do

In conjunction with the SFWMD permitting website, a GIS shapefile containing the location and extent of the SFWMD ERP permit can be found at the SFWMD GIS data repository mentioned previously.

Additionally, the SFWMD data repository is a viable source for additional data that is often directly available from other sources such as land use, soils, aerial imagery, etc. Although this data may not be maintained regularly, this data may be used if alternate sources are not accessible.

3.3.2 Florida Department of Transportation (FDOT)

Data from FDOT was requested through the FDOT District 6 Drainage Department. The FDOT provided available GIS shapefiles of FDOT maintained drainage structures located within State roads right of ways within the Village. As shown in **Figure 3-5** all FDOT drainage structures are located along US-1 (South Dixie Highway), which is the only FDOT major road found within the limits of the Village. The data provided by the FDOT was evaluated for possible inclusion into the XP-SWMM hydrologic, hydraulic, and water quality analyses.

3.3.3 National Oceanic and Atmospheric Administration (NOAA)

Tide data is available from the NOAA. NOAA monitors, assess, and distributes tide, current water level, and other coastal oceanographic data via their Center for Operational Oceanographic Products and Services (CO-OPS). NOAA's data is accessible via the web, at the following location:

- Main NOAA CO-OPS portal:
    - http://tidesandcurrents.noaa.gov/
- NOAA's Observational Data Interactive Navigation (ODIN) site for station data:
    - http://tidesandcurrents.noaa.gov/gmap3/

GIS data is also available from NOAA. GIS data for the NOAA stations can be obtained from the following location:

- NOAA GIS portal:
    - http://www.nws.noaa.gov/gis/

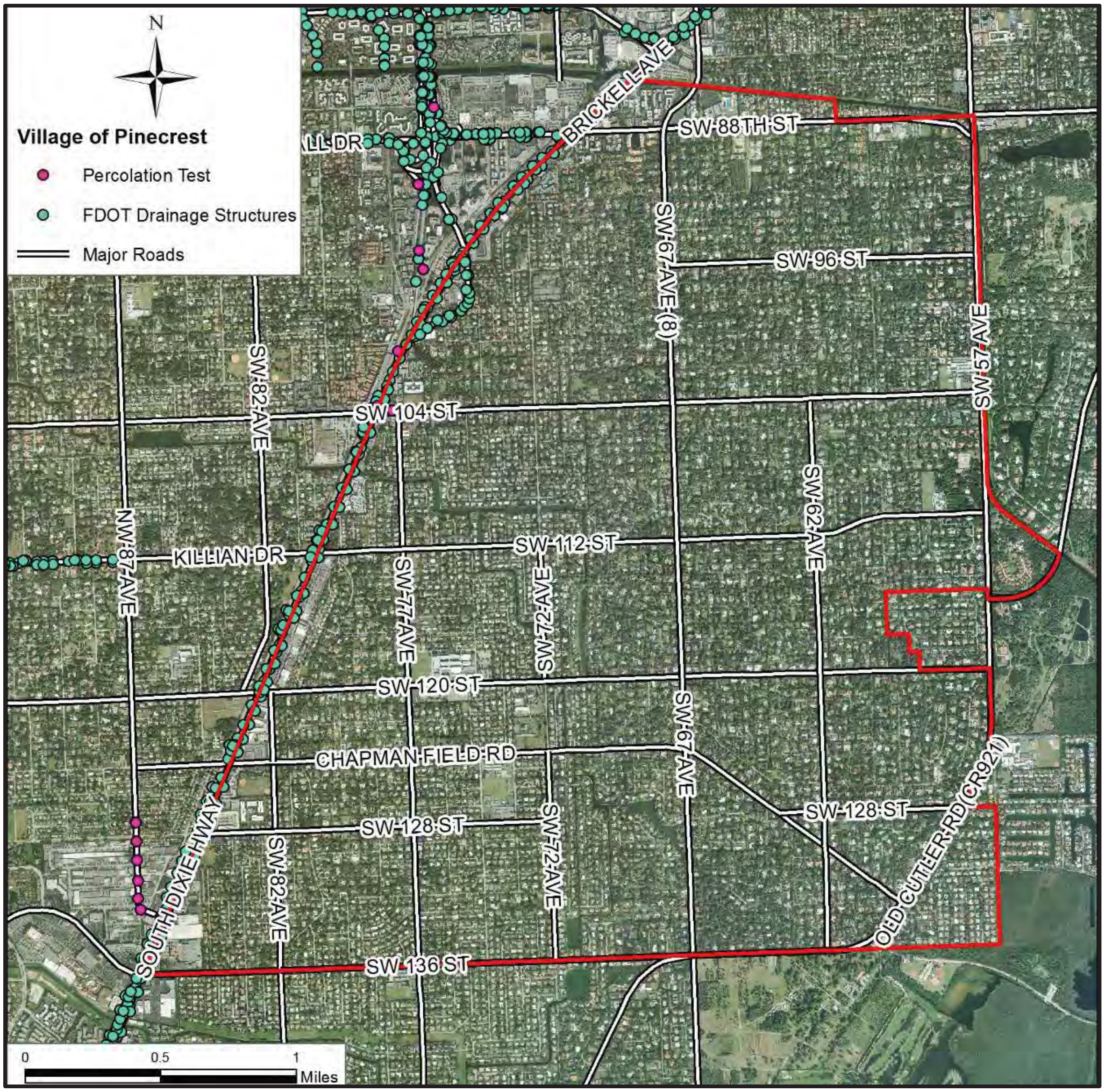


Figure 3-5 – FDOT Drainage Structures & Major Roads

A screen capture of the NOAA's station data access site as well as the main GIS data access site are shown in **Figure 3-6** and **Figure 3-7**, respectively.

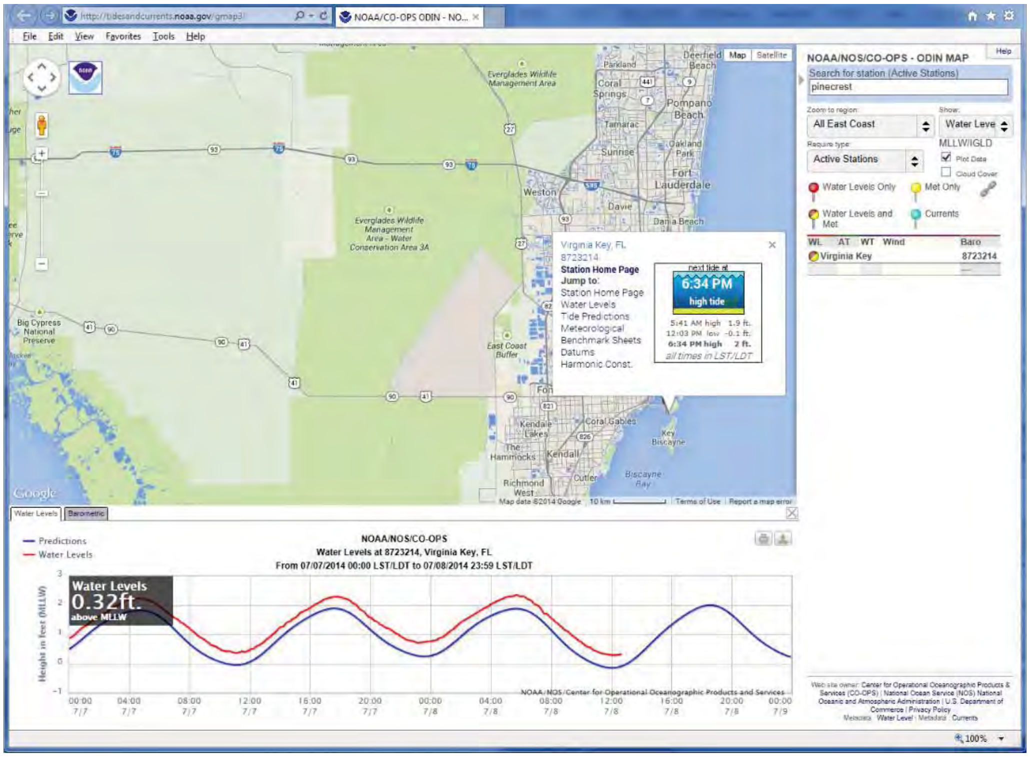


Figure 3-6 – NOAA CO-OPS ODIN data access site

Figure 3-7 – NOAA GIS data site

3.3.4 United States Army Corps of Engineers (USACE)

In July, 2009, the USACE prepared an Engineer Circular which discussed future potential sea level changes and their effects on managing, planning, engineering, designing, constructing, operating, and maintaining USACE projects and systems of projects in coastal regions. This document references various locations in South Florida. This document is available via the web at the following location:

- USACE Sea Level Change Engineer Circular (EC 1165-2-212)
  - http://www.publications.usace.army.mil/Portals/76/Publications/EngineerCirculars/EC_1165-2-212.pdf

3.3.5 United States Geological Survey (USGS)

The USGS maintains a network of groundwater wells that are monitored continuously in cooperation with the SFWMD. Several active groundwater wells are located within and near the Village of Pinecrest - **Table 3-2**. In general, groundwater stage data can be obtained from the following website:

- Main USGS data portal:
  - http://www.sflorida.er.usgs.gov/
- Data access site:
  - http://www.sflorida.er.usgs.gov/ddn_data/index.html

The data is provided in trended and de-trended or without trend removal. This accounts for the historical drop in the groundwater levels within the region. The data access site is shown in **Figure 3-8**.

In addition, in 2014, USGS, in cooperation with the Miami-Dade Water and Sewer Department, published *Hydrological Conditions and Effect of Pumpage and Sea Level on Canal Leakage and Regional Groundwater Flow*. This report documents a study completed to quantify the effects of sea level rise on surface water levels and groundwater levels, canal leakage, and the saltwater-freshwater interface in Southeast Florida. The study also examined the hydrological effects of different groundwater pumping rates. The report is available on the USGS website at:

- http://pubs.usgs.gov/sir/2014/5162/

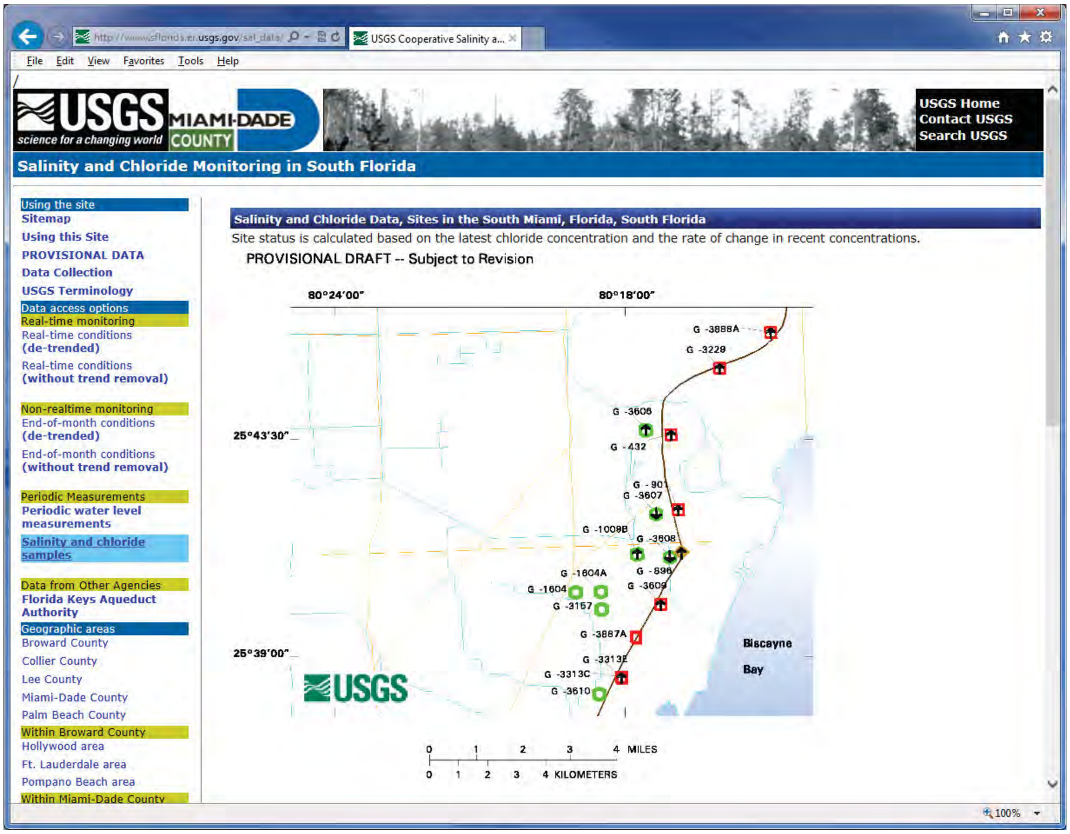


Figure 3-8 – USGS groundwater well data site

3.3.6 Natural Resources Conservation Service (NRCS)

The NRCS is a federal agency under the United States Department of Agriculture (USDA) which performs and maintains soil survey information for the United States. Through the USDA's Geospatial Data Gateway site, soil maps and data is available online for more than 95 percent of the nation's counties – see **Figure 3-9**. The site is updated and maintained online as the single authoritative source of soil survey information and can be accessed via the web at:

- Main Geospatial Data Gateway Portal:
    - http://datagateway.nrcs.usda.gov/

Additional data is available through this system including digital ortho imagery, digital elevation models, and other cultural and demographic data.

Figure 3-9 – USDA's Geospatial Data Gateway site

3.3.7 Federal Emergency Management Agency (FEMA)

As stated by FEMA in the National Flood Insurance Program (NFIP) Description document:

> "The U.S. Congress established the National Flood Insurance Program (NFIP) with the passage of the National Flood Insurance Act of 1968. The NFIP is a Federal program enabling property owners in participating communities to purchase insurance as a protection against flood losses in exchange for State and community floodplain management regulations that reduce future flood damages. Participation in the NFIP is based on an agreement between communities and the Federal Government. If a community adopts and enforces a floodplain management ordinance to reduce future flood risk to new construction in floodplains, the Federal Government will make flood insurance available within the community as a financial protection against flood losses. This insurance is designed to provide an insurance alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods."

Additionally, the Community Rating System (CRS) is described as follows in the same document:

> "The NFIP's Community Rating System (CRS) provides discounts on flood insurance premiums in those communities that establish floodplain management programs that go beyond NFIP minimum requirements. Under the CRS, communities receive credit for more restrictive regulations, acquisition, relocation, or flood-proofing of flood-prone buildings, preservation of open space, and other measures that reduce flood damages or protect the natural resources and functions of floodplains."

The NFIP Flood Insurance Manuals were collected from the following FEMA website:

- FEMA Flood Insurance Manual portal:
  - http://www.fema.gov/business/nfip/manual.shtm

These manuals provide direction with regards to improving the Village's CRS rating and thus increasing the discount available to Village residents through NFIP. These manuals also provide guidelines and requirement for Stormwater Master Plans to improve CRS ratings.

A comparison will also be performed using the 100-year flood plains resulting from this SWMP's XP-SWMM model runs in order to verify agreement with the FEMA Flood Zone shapefiles collected from FEMA. These flood zones are used in FEMA Flood Insurance Rate Maps, otherwise more commonly known as FIRMs. Congruence between the two data sets will be assessed based on the approximate boundaries of the FEMA Flood Zones for zones A, AE, and AH and the flood plains to be developed.

The Village provided a spreadsheet containing the Repetitive Loss and Severe Repetitive Loss list for the Village of Pinecrest, compiled by the Federal Emergency Management Agency (FEMA). The repetitive losses were geocoded in GIS and assigned to a sub-basin based on the address listed within the spreadsheet.

3.3.8 Sea Level Rise Studies

A number of sources were evaluated and examined for the potential impacts of projected sea level rise on both surface and groundwater. In addition, a number of Federal, State, and local agencies were consulted, including SFWMD, USGS, USACE, the Miami-Dade Sea Level Rise Task Force, and sea level rise experts such as Dr. Wanless from the University of Miami and Chair of the science committee for the Miami-Dade Climate Change Advisory Task Force, and Dr. Obeysekera, a member of US National Climate Assessment and Development and Advisory Committee and Climate Change expert for the SFWMD.

A number of sea level rise studies are available through the internet with often diverging opinions as to the existence, cause, and extent of the expected rise in average sea level in addition to impacts associated with storm surges from hurricanes combined with sea level rise. In July 2014, Miami-Dade County published the findings of a Sea Level Task Force initiated by the County to review available sea level studies and to provide recommendations with regards to addressing sea level rise at the County Level. This document titled *Miami-Dade Sea Level Rise Task Force Report and Recommendations* is available through the County's Sea Level Rise Task Force webpage:

- http://www.miamidade.gov/planning/boards-sea level-rise.asp

Additionally, Florida Atlantic University, with funding from FDOT, has also done research on sea level rise and climate change as it relates to South Florida. Their research is available through their Climate Change in South Florida webpage:

- http://www.ces.fau.edu/climate_change/

In addition, in 2014, USGS, in cooperation with the Miami-Dade Water and Sewer Department, published *Hydrological Conditions and Effect of Pumpage and Sea Level on Canal Leakage and Regional Groundwater Flow* as documented in **Section 3.3.5**.

http://pubs.usgs.gov/sir/2014/5162/

3.3.9 Stormwater Infrastructure Field Survey and GIS Stormwater Infrastructure Shapefile Development

The ADA Team surveyed catch basins/inlets, manholes and outfalls located within public right of ways throughout the Village to develop a thorough inventory of the current drainage systems. All survey measurements were obtained by GPS methods. Included in the survey were pipe sizes, pipe inverts, pipe material, bottom of structures, and basic structure dimensions. Along with the drainage information, digital pictures were taken for informational purposes. The horizontal control was based on the North American Datum (NAD) 83/latest adjustment, and the vertical datum was based on the National Geodetic Vertical Datum of 1929 (NGVD)

ADA linked the collected photographs to each applicable GIS structure object so the condition of the structure top can be viewed through the GIS application. ADA also developed metadata for all shapefiles developed as part of this project. The metadata provides descriptive documentation of the spatial data, describing content, and other characteristics of the data sets. GIS shapefiles were also developed to be incorporated into the Village's overall GIS data repository. The work performed as part of the stormwater infrastructure surveying and mapping task will be delivered to the Village under a separate document.

3.4 Data Evaluation

The data collected was evaluated to define the completeness and viability of the data as well as to identify the pertinent items that would be applicable to the Stormwater Master Plan development process. The following subsections detail the pertinent components of the data collected and their potential role in the development of this Stormwater Master Plan.

3.4.1 Village of Pinecrest Data

With regards to the Village of Pinecrest Data, the Village provided project data for recent stormwater management improvement projects as well as the Year-1 and Year-2 Capital Roadway Improvement Projects.

The data for those projects is evaluated under **Section 5.4.1.1** and their inclusion in the SWMP is dependent on the type of system implemented and the overall function of the system. It should be noted that typically, planning-level models such as the ones used for this SWMP, do not represent minor components within a given stormwater management system and as such, smaller localized projects will not be fully included in the XP-SWMM models. For example, minor improvements that would only provide a localized benefit within an intersection or interior road and is primarily associated with conveyance within a sub-basin rather than exfiltration or conveyance out of the basin would not be included because the benefit would not be realized in any portion of the primary system hydraulic analysis.

The XP-SWMM models include existing infrastructure data and current boundary conditions based on data from Miami-Dade County. Additionally, the Village provided stormwater infrastructure data, which along with surveying activities, were used to help verify the connectivity of the existing system. Percolation test data as well as project cost estimates were used to evaluate future projects and their costs.

The XP-SWMM models developed as part of **Section 5.0** were used to assess the current flood protection level of service for the Village and to evaluate future improvement projects and their associated benefits.

3.4.2 Data from other Sources

The data collection effort associated with this task was primarily focused on collecting the necessary data to ensure the SWMP can be completed. The most important data collected from other sources included the Miami-Dade DRER hydrologic/hydraulic and water quality models prepared to support the development of the Stormwater Master Plans for the C-2 and C-100 Canal Basins and the LiDAR showing the topographic elevations throughout the Village. These Stormwater Master Plan Reports and supporting data will provide additional data that can be used to establish boundary conditions for the Village of Pinecrest models.

4.0 PUBLIC INVOLVEMENT AND OUTREACH

The Village and the Project Team implemented a pro-active Public Involvement and outreach program to educate the public and local developers in the activities that were being performed to complete this SWMP and to obtain feedback from the residents. The public involvement task included coordinating and conducting four (4) community workshops with the intent of providing a relaxed and comfortable venue where participants could focus on the Stormwater Master Plan process and goals, solicit feedback, discuss future improvements in general terms, and develop a positive rapport with community stakeholders.

The workshops were divided into two (2) phases: Phase I included one workshop with the residents and one workshop with land developers, and Phase II included a follow up workshops with the residents and developers. In addition, to the resident and developer workshops, individual meetings were arranged with residents having heightened concerns with flooding of their homes and/or streets and with elected officials. To further involve the public and gather feedback and data on the current flooding within the top ranked sub-basins, flood surveys were sent by mail to each home located within the top 15 ranked sub-basins.

Beginning in July 2014, the ADA Team met with the Village staff in order to discuss what public involvement efforts would best serve the Village residents. At that time, it was concluded that there is an active (and historically dissatisfied) community of local developers and that their needs and concerns would likely need to be heard and addressed in a separate, more specific forum. It was decided that the ADA Team would work with the Village staff in order to plan and execute two distinct meetings for the Village residents and developers in the Fall and two subsequent meetings in the Spring. Content was created and included on the Village of Pinecrest website throughout the development of this SWMP. A Village email account was also created so that the public could report drainage problems and report areas they have observed flooding.

For each phase of the workshops the Village, with the assistance of the Project Team, notified landowners and businesses in advance of the workshop events. Email blasts, direct mailings, and advertisements were used to inform the public of all Open House events to maximize the exposure and attendance from the Village residents and developers. All items that were presented at the open house events were uploaded to the Village's website at the completion of the Open House events.

For the workshop events the project team prepared the following items:

- Meeting notice message(s)
- Public announcements
- Frequently Asked Question (FAQ) Sheet
- Informational graphic boards
- Secured site selection
- Prepared sign in sheet
- Assisted with Media Inquiries

- Prepared comment cards
- Press-release summarizing the workshop activities and presentations

4.1 Phase I Public Workshops

The first round of meetings was intended to serve as an introduction to the SWMP for the general population and developers. The ADA team informed the developers on the possible impacts that the SWMP should have on their projects within the Village. Prior to the meetings, the Village and the ADA Team worked together extensively in constructing the targeted message for all public involvement efforts and developing collateral materials to be disseminated. They also worked to plan the meetings themselves, making decisions as to the most efficient format for relating the message to the appropriate audience.

The first Developer Meeting took place on Tuesday, September 23, 2014 at 9:00 AM at Council Chambers in the Village Municipal Center. The ADA Team received developers' contact information from the village, and sent an email with information on the meeting. The ADA Team followed up with the developers the week prior to the meeting, and prepared the relevant collateral materials (SWMP fact sheet, Frequently Asked Questions, Comment Card) to be distributed to them. The Village had requested that the ADA Team make a small introductory presentation to the developers, especially since it was more technical and specific than that of the residents.

As developers arrived, they were given their collateral materials and asked to sign in. Alex Vazquez, PE, ADA Project Manager for development of the SWMP and assessment of the current stormwater requirements of the Land Development Code, gave a presentation encompassing the Village's current level of service requirement and the impact the SWMP could have on this requirement. Following the presentation, it became clear that many developers were frustrated with the current level of service requirements and were dissatisfied with the proposed changes being considered as these could have a negative impact on their business and residential lots. Though there were some disagreements as to which areas in the Village actually flood and what constitutes "chronic" flooding, the ADA Team took the developers' feedback at the meeting by way of comment cards. The engineers from ADA also returned to the Village later that week, meeting with developers to tour flooded areas and view flooding impact in certain areas, considering the repercussions of changing the current level of service requirements or adding alternatives. **Appendix 4A** includes a summary of the Land Developer Workshop No. 1.

The first Resident Meeting occurred a week later, on Tuesday, September 30, 2014 at 7:00 PM at Evelyn Greer Park. Because the Village and the ADA Team anticipated an audience who was not necessarily versed in SWMP matters and would have flooding complaints, the format of this meeting was adjusted as were the collateral materials. The SWMP Fact Sheet and FAQ's were edited to be less technical and broader in scope than the developers'.

As residents arrived to the meeting, they were given their collateral materials and asked to sign in. They were then directed to the boards that applied to them—the ADA Team had effectively split the Village into two zones, North and South, in order to better hone in on specific areas within the Village. The ADA Team staff were present and available at each board to answer residents' questions and address their concerns. Though there was no formal presentation at this meeting, resident attendees were able to receive personalized attention from SWMP experts and were able to designate where flooding occurs specifically and what the gravity and extent of that flooding is. All residents were also asked to fill out a comment card describing their flooding issues and any other comments or concerns they may have had. **Appendix 4B** includes a summary of Resident Workshop No. 1.

After these two initial meetings, the ADA Team took feedback from the residents and developers and met with the Village in order to debrief them on the results of the meetings and discuss how to proceed. In the following months ADA worked diligently to study and rank the flood basins in the Village according to their gravity and cost effectiveness. The ADA team compiled the feedback garnered from the meetings and began putting an action plan into place for the subsequent update meetings in early 2015. The ADA Team also sent the Village all relevant collateral materials (FAQs, fact sheets, presentations, and boards) to be posted to the Village website for public access and use.

4.2 Phase II Public Workshops

In January, the ADA Team and the Village reconvened to discuss the upcoming meetings with the purpose of informing both the resident's and the developer's concerns, questions and comments regarding what had been accomplished in the preceding months, describe the methodology implemented, and explain the next steps moving forward. Both the ADA Team and the Village staff agreed that the resident and developer meetings should be comprised of a formal presentation in which ADA would describe the progress made in identifying the top fifteen (15) ranked flood areas in the Village followed by a Question and Answer session. The presentations would be supported by visual aids—boards depicting the SWMP timeline, the top fifteen (15) affected flood areas, level of service standards, and specific projects within Village sub-basins.

The second resident meeting took place Tuesday, March 3, 2015 at 7:00 PM, again at Evelyn Greer Park in the Village. As they arrived, residents were asked to sign in and were invited to look at the boards displayed around the room with the ADA Team staff available for their questions. During the presentation, residents were informed of the top fifteen (15) ranked flood areas and drainage projects as well as the methodology by which the rankings were determined. Mr. Vazquez also described the current flooding conditions of the Village, detailing the extent of flooding and the basis for the necessity of the SWMP. He also addressed projected sea level rise for 2030 and 2060, a point that will become increasingly relevant as climate change issues affect the Village and State of Florida as a whole.

During the Question and Answer period the audience was able to ask general questions about the SWMP and express their concerns. A number of the attendees were unhappy with the ranking number of their property or area but they were reassured that this methodology was based on science and mathematical fact. Others were concerned with the high price of enacting a SWMP in the Village— approximately $40 million – but the ADA Team reminded the audience that this was a suggestion to be presented to the Village and regardless of whether it is enacted or not, a Master Plan is essential in order to apply for State funding. Other questions and concerns were written on comment cards which residents were encouraged to fill out and return prior to leaving. **Appendix 4C** includes a summary of the Resident Workshop No. 2.

The second developer meeting was held on Tuesday, March 10, 2015 at 9:00 AM at Council Chambers in the Village Municipal Center. In this meeting, the ADA Team wanted to engage with their audience and address the stormwater requirements in the Village's Land Development Code, discussing concerns raised about the impact the current requirements have within the property of new developments and gauging their interest in having an alternative stormwater treatment method incorporated into the Land Development Code.

As developers arrived, they were asked to sign in. At the start of the meeting, they were informed that the meeting's purpose was to provide an update on the progress made since the September 2014 meeting and to demonstrate the ways in which their feedback had been taken into consideration. The presentation reviewed the current progress of the project and emphasized the existing condition of flooding within the Village, including the potential future impact of sea level rise. It went on to present the ADA Team's assessment of the current stormwater drainage requirements and the proposed alternative to the current Land Development Code, which would minimize the impact on residential lot open space while maintaining the current flood protection from the development and how such an alternative could be enacted. The Village's consulting engineer from CAP Engineering also spoke at this meeting to clarify current permitting requirements. He has been working closely with local developers.

The presentation closed with the next steps moving forward and a Question and Answer Period. This part of the meeting showed marked progress from the first meeting, with the developers being far less vocal with the current level of service requirements and seeming more at ease with the proposed changes. The majority of their questions were about the projected cost of the alternative presented to them, but the fact that it was an option made it more palatable. Overall, this meeting provided a hospitable forum in which the developers and the ADA Team staff could engage in a dialogue for new projects and developments. **Appendix 4D** includes a summary of the Land Developer Workshop No. 2.

On Wednesday, March 11, 2015, the ADA Team met with the Village staff once again to discuss the outcomes of these meetings and best practices moving forward. As a result of the presence of several councilmembers at the meetings, the Village Manager and others wanted to be sure and follow up with residents and developers in the best, most efficient way. The ADA Team expressed their belief that throughout the process of developing a SWMP, those public involvement tactics employed had been successful in both informing the community and addressing their concerns. The SWMP, however, is still a dynamic process in development, so changes or updates should continue to be communicated to the Village. It also came up that Vice Mayor Bob Ross wanted to survey residents in order to garner their feedback specific to the gravity of flooding on their property. The ADA Team assisted the Village in drafting a series of questions (based on the Vice Mayor's proposed questions) to be reviewed by the Village and sent to the residents within the confines of the designated flood basins. The Village staff took the lead in finalizing and submitting the survey to the residents.

4.3 Meeting with Residents

On March 31, 2015, two of ADA SWMP team members, Mr. Alex Vazquez and Ms. Viviana Villamizar met with Mr. Tom David of the Royal Palm Tennis Club at the site. The purpose of the meeting was to obtain input from Mr. David on the current flooding conditions at the tennis club due to the low elevations of the tennis courts relative to the adjacent roads. Mr. Vazquez described to Mr. David the current Master Plan process that the Village is undertaking and the proposed conceptual project that is currently being proposed in the vicinity of the Royal Palm Tennis Club that should alleviate substantially the flooding problems of the club, by redirecting runoff from higher areas adjacent to the club to the canal just south of the tennis club.

On April 15, 2015, ADA staff, Village staff and Vice Mayor Ross met with several residents that live in a neighborhood just north of Coral Pine Park. The residents have expressed concerns with the repetitive high levels of flooding within their neighborhood and provided examples during the meeting. During the March 3, 2015 Public Workshop, the residents had expressed concerns with the ranking approach implemented by the ADA Team. Mr. Alex Vazquez from ADA stated that the ranking approach was re-evaluated and refined slightly to incorporate some of the comments received at the March 3rd Workshop. Mr. Vazquez also stated that the project ranking recommendation will be based on a scientific approach, but the Village staff and Council will have flexibility in modifying the priority based on several factors such as available funding, coordination with other programmed projects within the Village and resident concerns. Vice Mayor Ross also stated that the Village was performing two sets of surveys to obtain resident feedback, and these surveys may be used by the Council to refine the proposed ranking by the ADA Team. Mr. Vazquez also provided an overview of the proposed project that was conceptually designed to address the flooding in their neighborhood.

4.4 Council Workshops

On May 7, 2015 the draft Stormwater Master Plan was presented to the Village Council. Comments were received from both Council members and from residents. Comments received are addressed and incorporated in this Final Stormwater Master Plan.

5.0 EXISTING FLOOD PROTECTION AND WATER QUALITY LEVEL OF SERVICE

5.1 Summary of Original C-2 and C-100 Stormwater Master Plan Models

To support the development of the Stormwater Management Master Plans for the C-2 and C-100 Basins, Miami-Dade County DRER (formerly DERM/PERA) implemented previously established procedures for developing, calibrating and verifying hydrologic, hydraulic and water quality models using the XP-SWMM computer model. These procedures were documented in Part I, Volumes 2 and 3, of the "Stormwater Planning Procedures" document, dated March 1995 which was obtained from DRER for this project. These documents and procedures were used by DRER to develop existing conditions XP-SWMM models for each basin, using the 2002 Miami-Dade County land use data.

The XP-SWMM models developed were calibrated and verified using available measured rainfall, stage and flow data recorded for extreme storm events. Once the models were calibrated and verified, the models were adjusted to perform design event simulations (production runs) for the following design storm events:

- 5-year, 1-day
- 10-year, 1-day
- 25-year, 3-day
- 50-year, 3-day
- 100-year, 3-day

For some basins, the existing conditions models were further revised to incorporate 2025 land use data. Once revised, the future land use condition models were also simulated for these five design storm events. The County compared the modeling results between existing and future land uses and for the C-2 and C-100 Basins found little to no difference between the existing and future land use models. Therefore, based on these results, both the existing and future land use models will be evaluated for the areas within the Village of Pinecrest. Based on the evaluation, the 2025 land use models were selected for the development of the Stormwater Master Plan for the Village.

The Stormwater Management Master Plan Reports for the C-2 and C-100 Basins provide the background, assumptions, and approach on how these models were developed. These reports and their respective existing and future XP-SWMM hydrologic/hydraulic models will provide the basis for the hydrologic/hydraulic modeling activities required as part of the Village of Pinecrest Stormwater Master Plan (SWMP) development.

5.1.1 General Hydrologic/Hydraulic Model Setup Approach and Methodologies

The XP-SWMM modeling software is a one-dimensional, node-link, hydrodynamic model that was originally derived from the United States Environmental Protection Agency (EPA) surface water management model (SWMM). XP-SWMM offers substantial enhancements over the EPA SWMM model, including a more refined and robust mathematical engine and graphical user interface that has extensive inter-phase capabilities with GIS and AutoCAD. The new version of XP-SWMM also has the capability of performing two-dimensional analysis. However, DRER did not perform two-dimensional analyses as part of any of the County's Stormwater Master Plans. Two-dimensional analyses will not be performed as part of the Village of Pinecrest SWMP development.

XP-SWMM software uses three different modules, or Blocks, to calculate stormwater flows and water quality loads: the Runoff Block (Hydrology), Extran (Hydraulic) Block, and Sanitary Block (Water Quality) and are described as follows:

- **Runoff Block:** is used to generate hydrographs for each sub-basin and simulates rainfall, infiltration, evaporation, and depressional storage for each sub-catchment and calculates the runoff to a collection node. The hydrologic methods used to generate the runoff hydrographs include SCS Hydrology, Laurenson, EPA Runoff, Nash, Snyder, Clark, Rational Formula, and Santa Barbara Unit Hydrograph. Similarly, pollutant hydrographs (pollutographs) are generated based on land use and land use distribution for each sub-basin.
- **Extran or Hydraulic Block:** is used to generate stage levels at basin nodes and flows within links using the Saint-Venant dynamic wave equations. This Block simulates the storage and transport of water through a drainage or sanitary sewer network. The pollutant loads calculated in the Runoff Block are routed and conveyed through the sub-basins which in turn generate mass loadings for the system.
- **Sanitary Block (Water Quality):** is used to compute removal of pollutants based upon the pollutant removal efficiencies stipulated for each Best Management Practice (BMP) implemented within the sub-basins.

The XP-SWMM model representation of the C-2 and C-100 Basins, including the Village of Pinecrest, is constructed of storage nodes representing major hydrologic sub-basins, hydraulic junctions (where applicable) where changes in the stormwater management systems occur, and links representing major hydraulic components such as major stormwater management systems and overland weirs.

5.1.1.1 Hydrology Model Setup (Runoff Block)

In the development of the XP-SWMM models for the C-2 and C-100 Basins, DRER implemented the EPA Runoff Method which is a non-linear reservoir runoff routing method for generating runoff hydrographs. The first step in developing the Runoff Block parameters is to delineate sub-basins within the watershed. The sub-basin delineation was performed following the procedure from Volume 1 Stormwater Master Plan C-2 Basin, Phase II Hydrologic and Hydraulic Modeling for Existing and Future Conditions without Control Measures, June 2004, and Volume 1 Stormwater Master Plan C-100 Basin, Phase II Hydrologic and Hydraulic Modeling for Existing and Future Conditions without Control Measures, May 2003.

DRER predominantly used light detection and ranging (LiDAR) elevation data developed and confirmed by USACE to develop digital terrain (DTM) models for each basin. LiDAR based data provided the most extensive coverage of topographic data available and was the only elevation data used in most areas. Various sets of topographic point elevations were also incorporated in the development of the DRER DTMs and included WASD, Woolpert, and SRM survey elevations. All topographic data was provided by the County.

In order to minimize the projection of the bare-earth surface to “false elevation” points attributed to buildings, points that resided within the County’s building coverage were removed from the topographic data point sets. Additionally, points with elevations that did not reasonably coincide with the elevation range of neighboring points, were also omitted. The resulting surfaces within these point gaps were the result of an interpolation process that is carried out by the software used and thus a “bare earth” equivalent surface was achieved.

Similarly, the point data was filtered using GIS to remove all points falling within the County’s water body coverage to account for the available storage below the water elevation present at the time of the LIDAR data collection. Sub-basin delineations were developed along the high ridge lines within the major basin areas using the newly developed DTMs. Additional delineation lines were developed from canals, major roads, railroads and other natural or man-made high elevation breaks.

With regards to the sub-basin nomenclature, DRER used a uniform naming system which was implemented in all the Stormwater Management Plans for the County. The naming convention applicable to all basins can be summarized as follows, using the C-100 Basin as an example:

- Each sub-basin is given a name based on the location within the basin, proximity to one of the major canals or tributaries, or proximity to a major road. Sub-basins are assigned a direction from the adjacent canal and numbered upstream to downstream in that area, thus, the first upstream sub-basin east of the C-100C Canal is labeled C100C-E-1, the next is C100C-E-2 and so forth.
- Sub-basins that contain portions of the canals are assigned the canal name, a ‘C’ label, and are numbered upstream to downstream such as C100-C-14.
- Sub-basins along major roads are assigned names based on the roadway such as SR874-3.
- Closed sub-basins are assigned a leading ‘C’ label in the name such as CC100-W-1.

For open and closed sub-basins, the node name is the same as the name of the sub-basin that contains it, and surface runoff from the sub-basin is directed to the node. For open sub-basins, and those containing canals surface runoff is directed to the downstream canal node. Not every node in the model has surface runoff and/or groundwater base flow directed to it.

Some nodes collect more than one sub-basin's runoff and/or groundwater base flow. For the case of runoff, the model uses different sub-catchment numbers to account for multiple sub-basins directed to one node. A second sub-catchment may also be used to account for the BMP land use area. XP-SWMM allows up to five (5) sub-catchments for each sub-basin, each sub-catchment must have the following input parameters:

- The Area in acres for each sub-basin (and corresponding node/sub-catchment) was calculated using AutoCAD. Areas are not adjusted during the calibration process.
- The Directly Connected Impervious Area (DCIA) is a percentage and was calculated based on the procedure developed by DRER to correlate DCIAs to land use. The Miami Dade County Land Use map was used as the base map. The DCIA for each sub-basin (and corresponding node/sub-catchment) was adjusted to account for BMPs. The calculated values were not further adjusted during the calibration process.
- The Slopes (ft/ft) for most of the sub-basins (and corresponding node sub-catchments) were calculated using the USGS Digital Elevation Model (DEM) for the C-2 Basin. The DEM was available in a 10-meter grid. The average slope of every DEM grid was computed and then the average slope of the grids within each sub-basin was estimated and used as the input parameter. Within the C-100 Basin, the average slopes of three flowpath elevations were assigned for the sub-basins. However, for most sub-basins along canals and roads, a default slope of 0.001 was assigned.
- The width of the sub-basin is an estimate of the overland flowpath width across the sub-basin, the flow path direction being from higher elevations to lower elevations. In cases where the sub-basin was large and squared with a poorly defined pathway, the square root of the sub-basin area was used as the width parameter. The width of the basin, like the slope, affects the shape of the runoff hydrograph. Large widths relative to the area produce high peak flows, whereas small widths attenuate the overland flow.

A global groundwater interflow database using groundwater inflow hydrographs was developed and assigned to each node/ sub-catchment. The following parameters are included in the database:

- Depth of Upper Zone (DWT1) – The depth of the upper zone represents the vertical distance from ground surface to the top of the water table in the Biscayne aquifer. USGS groundwater contours are interpolated at every groundwater node to calculate the top of the water surface elevation at that node. This elevation is subtracted from the ground surface elevation estimated for the node. The USGS contours are compilations of 5 and 10 year records in the 1990s for high and low groundwater conditions, as well as average May and October conditions.

- Depth of the Lower Zone (D1) – The depth of the lower zone is estimated from SFWMD contours of the base of the Biscayne aquifer. The contours are interpolated at every groundwater node to calculate the depth of the lower zone at the node.
- Channel Depth (BC) – The channel bottom elevation is found for each node from the nearest channel surveyed cross section. The channel depth is the vertical distance from the groundwater elevation to the channel bottom elevation.
- Depth from Channel Bottom to Aquifer Base (BO) – This distance is depth of the lower zone minus the channel depth.

In XP-SWMM there are two options available for modeling infiltration from pervious areas of watersheds: Green-Ampt infiltration and Horton infiltration. The Horton parameters are empirical values that area best estimated from calibration to monitored data. Conversely, the Green-Ampt parameters are physical parameters that can be measured in the field and estimated using information in the soil triangle.

As part of the DRER's Stormwater Planning Procedures, each sub-basin was sub-divided by land use to account for areas were BMPs have been implemented. Areas with exfiltration trenches or Hybrid system land uses, which have relatively large capacities, were separated to a second sub-catchment. Therefore, each sub-basin was assigned to two sub-catchments at each node, if it contained exfiltration trenches or Hybrid systems. The second sub-catchment was given a DCIA value of 0.0 which represents a 100 percent pervious area. Areas with BMPs were simulated using the Horton infiltration solution.

The Horton infiltration parameters are only used to mimic the operation of the exfiltration trenches and Hybrid System BMP land use areas. Note that the infiltration parameters are designed to provide total infiltration up to the 5-year 24-hour storm volume (6.5 inches) and allow total runoff beyond this volume. This maximum infiltration volume was decreased during calibration to 5.0 inches. It is assumed that due to the age of the BMPs, as well as lack of maintenance, that they are no longer able to control the 5-year, 24-hour storm volumes. The Horton infiltration parameters are:

- Maximum Infiltration Rate – 4.0 in/hr
- Minimum Infiltration Rate – 0.25 in/hr
- Decay Rate of Infiltration – 0.00115 sec^{-1}
- Maximum Infiltration Volume – 5.0 inches
- Impervious Area Depression Storage (IDS) - 0.02 inches
- Pervious Area Depression Storage (PDS) – 0.05 inches
- Impervious Area Manning's Roughness Coefficient (IMPN) – 0.04

- Pervious Area Manning's Roughness Coefficient (PERVN) – 0.02
- Percent of DCIA without Detention Storage (PCTZER) – 25
- Horton Regeneration Factor – 0.003

The non-BMP areas contain swales, and the depression storage of these areas was adjusted to account for the percentage area of swale. Impervious and Pervious Area Depression Storage are augmented by the initial abstraction from the Swale land use area up to 0.5 inches based on percent area of Swale up to 0.5 inches. Areas without BMPs were simulated using the Green-Ampt infiltration solution. The Green-Ampt infiltration parameters are:

- Saturated Hydraulic Conductivity (HYDCON) – 0.4 in/hr
- Initial Moisture Deficit (SMDMAX) – 0.30
- Average Capillary Suction (SUCT) – 4 inches
- Impervious Area Depression Storage (IDS) - 0.02 inches
- Pervious Area Depression Storage (PDS) - 0.2 inches
- Impervious Area Manning's Roughness Coefficient (IMPN) – 0.04
- Pervious Area Manning's Roughness Coefficient (PERVN) – 0.3
- Percent of DCIA without Detention Storage (PCTZER) – 25

Monthly evaporation data for the C-2 Basin was derived from the University of Florida Institute of Food and Agricultural Sciences reports. These data were adjusted to South Florida turf grass values by applying a crop coefficient of 0.8. The values used for the C-100 Basin were obtained from daily pan evaporation data collected from 1948 to 2001, from a station located 23 miles west of the north-western edge of the basin. The greatest evaporation rate occurs during the months of March and May (spring) and the least evaporation rates occurs during the months of December to February (winter). All values for the C-2 and C-100 Basins were input into the XP-SWMM model for both the continuous and design storm event models.

Rainfall in Miami-Dade County has differing volumes between coastal and inlands areas. The model nodes for the C-2 Basin were assigned either inland or coastal rainfall stations by dividing the basin along a line that roughly follows the Palmetto Expressway in the basin. Daily data within the C-2 Basin shows that there is a significant spatial variation of rainfall volumes throughout the basin, however, the 15-minute data necessary for proper model simulation were only available at locations outside the C-2 Basin limits which made the calibration process challenging. In a similar approach, the model nodes for the C-100 Basin were assigned either inland or coastal rainfall stations by dividing the basin along a northeast-southwest line that intersects SW 88th Street (Kendall Drive) at US-1. The 15-minute data necessary for model simulations were only available at two locations. This data was not changed for the event calibration.

The global database contains three storm events for calibration of the model and five design storms with specific recurrence intervals, volumes and durations. These are shown in **Table 5-1** for the C-2 and C-100 Basin.

Table 5-1 – XP-SWMM C-2 and C-100 Design Storm Events

Design Storm Event	C-2 Basin (inches)		C-100 Basin (inches)	
	Coastal	Inland	Coastal	Inland
5-year, 24-hour	6.2	7.0	6.3	6.7
10-year, 24-hour	8.0	8.5	7.4	8.2
25-year, 72-hour	12.4	13.8	12.0	13.7
50-year, 72-hour	13.5	15.6	13.4	14.9
100-year, 72-hour	15.1	17.5	14.9	16.3

Additionally, the database contains two year-long continuous rainfall data sets for calibration of the model as well as three year-long synthetic rainfall data sets representing dry, average, and wet conditions.

5.1.1.2 Hydraulics Model Setup (Extran Block)

The Extran Block uses nodes and links to define the hydraulic network - in XP-SWMM nodes are referred to as junctions and links as conduits. For each basin, DRER coded the Extran Block hydraulic parameters for the primary drainage systems responsible for inter-basin transfers using available as-built plans, permit data, and collected field survey data. Secondary and local drainage systems were not included in the model. More emphasis was placed on unincorporated areas of the County, because the purposes of those models were to implement projects with funding from the County.

In general, there were several types of conduits used in the DRER C-2 and C-100 Basin Hydraulics models:

- Circular conduits for the cross drains and stormwater pipes
- Rectangular conduits for cross drains, stormwater pipes and bridges
- Bendable weirs for some of the control structures
- Irregular shaped conduits for some of the bridges and culverts
- Time varying orifices to simulate control structure gate opening and closing
- Pumps for control structures
- Natural channels for the open channel reaches and overland flow connection between adjacent basins
- Seepage channels to allow for the transfer of water from the canals to the groundwater

No secondary stormwater management systems were defined or simulated in the models unless a system served the purpose of conveying runoff from one sub-basin to another. Self-contained systems were mostly ignored for this reason. The following items were generally noted regarding DRER's models:

- Sub-basin stage-storage relationships were developed using GIS and the DTMs created for each sub-basin.
- Overland connectivity between adjacent sub-basins was simulated using natural channel conduits.

- Channel cross sections were obtained using GIS and the developed DTMs.
- The initial groundwater depth of each junction was established based on the average October groundwater elevations or the historical stage.

With regards to the nomenclature for conduits, the first three letters define the canal represented by the conduit, and the remaining characters refer to the location of the conduit. For conduits representing cross drain conduits, the names begin with either U, E, or B to indicate whether the structure is a culvert, an equalizer or a bridge, respectively. Control structures use the SFWMD labels such as S-22 for the C-2 Basin outfall and S-123 for the C-100 Basin outfall.

The endpoint junctions of each model network were simulated as outfall junctions and defined the boundary conditions of the models. The outfall junctions used by DRER included Free Outfall, Fixed Backwater, Tidal Series, Stage-Discharge relationships, or Time-Stage relationships. One set of boundary conditions were used for calibration based on measured data and another set was used to simulate design storm event conditions.

5.1.1.3 Water Quality Model Setup (Sanitary Block)

The XP-SWMM model Sanitary Block calculates the net annual pollutant loads for each sub-basin (pounds per year) using planning-level hydrologic techniques approved by the Environmental Protection Agency (EPA) in the National Pollutant Discharge Elimination System (NPDES) Part 2 Application Guidance Manual (EPA, 1992). Calculations were performed by summing the product of each land use area times the corresponding runoff coefficient and pollutant concentration. Pollutant removal fractions assigned for BMP drainage, associated with each land use per sub-basin, are outlined in the DRER Part I Planning Criteria and Procedures, Volume 2, Model Evaluation and Selection (CH2MHILL, 1996a).

The annual pollutant loads were estimated for the following 14 constituents (indicator pollutants), as specified in Paragraph 122.26(d)(2)(iii)(B) of the NPDES regulation and in Part I Planning Criteria and Procedures, Volume 3, Stormwater Planning Procedures (CH2MHILL, January 1996):

1. 5-day Biochemical Oxygen Demand (BOD5)
2. Chemical Oxygen Demand (COD)
3. Total Suspended Solids (TSS)
4. Total Dissolved Solids (TDS)
5. Total Kjeldahl Nitrogen (TKN) (total ammonia + organic nitrogen)
6. Nitrogen Oxides (NO_x-N)
7. Ammonium Nitrogen (NH_3-N)
8. Total Nitrogen (TN)
9. Total Phosphorus (TP)
10. Dissolved Phosphorus / Orthophosphate (DP)
11. Total Cadmium (Cd)

12. Total Copper (Cu)
13. Total Lead (Pb)
14. Total Zinc (Zn)

The total load per model node per pollutant was determined using the Runoff and Sanitary Blocks of the XP-SWMM model. Model sub-basins/nodes are generally comprised of more than one sub-catchment. The groundwater inflow and surface runoff for the multiple sub-catchments, developed from the Runoff Block, are combined at model nodes in the Sanitary Block. Therefore, pollutant removal fractions were determined by area weighting rates by sub-basin at nodes with multiple sub-catchments. Pollutant loading was routed through the Basin using the Extran Block, and pollutographs of discharge concentrations (unit loads) were displayed for the 14 pollutants at the outfall structure and at selected points upstream for all 5 production events and the synthetic average year continuous simulation.

5.1.2 Model Calibration and Verification

Both the C-2 Basin model and the C-100 Basin model were calibrated based on historic peak flow and canal stages. Observed data from Structure S-118 at the upper reach of C-100 Canal, Structure S-119 at the upper reach of the C-100C Canal, and Structure S-123 located at the C-100 Canal outfall were used to calibrate the C-100 Basin model. Structure S-22 located at the outfall for C-2 was the only location with observed data available for calibration of the C-2 Basin model. With the limit of observed data within the C-2 Basin, DRER based the C-2 Basin model calibration on the setup used during calibration of the C-100 Basin model.

Groundwater calibration parameters included evapotranspiration (ET), infiltration/percolation, hydraulic conductivity of the saturated zone, and groundwater outflow coefficients which determine groundwater base flow and the rate of rise and decline of the groundwater table. The initial depth of hydraulic nodes was varied during model calibration and verification.

The C-2 and C-100 Basin XP-SWMM models were calibrated to three storm events. For consistency between basins, two major events (high intensity) were used for both Basins: October 2, 2000 storm (No name Storm) and October 13, 1999 storm (Hurricane Irene). For the low to medium intensity two different events were used: August, 25 2000 and September 15, 1998 respectively. Tidal stage history from the tailwater recording gauge at S-123 (C-100 Basin) and S-22 (C-2 basin) at 15-minute intervals was used as the outfall boundary condition. For the continuous year simulations data was used for calibration at 1-hour intervals.

Once the models were calibrated and verified, the peak stages simulated at each model node/sub-basin represents the maximum water elevation experienced within that sub-basin. These results were used to develop flood maps and identify sub-basins with flooding concerns. The ranking and prioritization of the problem areas identified served as a guide for the implementation of the Projects proposed, which addresses the high-priority stormwater problem areas for both the C-2 and C-100 Basins. These results were used by FEMA in the 2009 update to the Miami-Dade County Flood Insurance Rate Maps (FIRM).

5.2 XP-SWMM Model Conversion

The XP-SWMM models and binary files for the C-2 and C-100 Basins for the following model simulation scenarios were collected from Miami-Dade County DRER:

a. Existing conditions for C-2 Basin model and C-100 Basin model (5-, 10-, 25-, 50-, and 100-year design storm events)
b. Future conditions without control measures for C-2 Basin model and C-100 Basin model (5-, 10-, 25-, 50-, and 100-year design storm events)
c. Future conditions with control measures for the C-100 Basin model (5-, 10-, 25-, 50-, and 100-year design storm events)
d. Water quality simulations for C-2 Basin model and C-100 Basin model (design storm events and wet, average, and dry years)

Table 5-2 and **Table 5-3** provide a listing of the original data file names and the XP-SWMM model versions for the files obtained from DRER. The models provided were developed in an older version of XP-SWMM and required a conversion to a more recent version of the XP-SWMM model to ensure that the most resent algorithms and refined computational engine of the model is used to accurately estimate flows and stages.

Table 5-2 – Original XP-SWMM C-2 Basin Model Data Provided by DRER

Design Storm Event	Existing Conditions Model Name	Existing Conditions XP-SWMM Version	Future Conditions Model Name	Future Conditions XP-SWMM Version
5-year, 24-hour	Ex-5.xp	9.00	Fut-5.xp	9.00
10-year, 24-hour	Ex-10.xp	9.00	Fut-10.xp	9.00
25-year, 72-hour	Ex-25.xp	9.00	Fut-25.xp	9.00
50-year, 72-hour	Ex-50.xp	9.00	Fut-50.xp	9.00
100-year, 72-hour	Ex-100.xp	12.00	Fut-100.xp	12.00

Table 5-3 – Original XP-SWMM C-100 Basin Model Data Provided by DRER

Design Storm Event	Existing Conditions Model Name	Existing Conditions XP-SWMM Version	Future Conditions Model Name	Future Conditions XP-SWMM Version
5-year, 24-hour	5.xp	8.53	5Fut.xp	8.53
10-year, 24-hour	10.xp	8.53	10Fut.xp	8.53
25-year, 72-hour	25.xp	8.53	25Fut.xp	8.53
50-year, 72-hour	50.xp	8.53	50Fut.xp	8.53
100-year, 72-hour	100.xp	8.53	100Future.xp	8.53

The most recent, stable version of the XP-SWMM at the time of this SWMP was model Version 2014. The original models were converted to this version of XP-SWMM. The following subsections provide a brief background of the original models and describe the conversion and comparison of the converted models to the original result files of the models listed in **Table 5-2** and **Table 5-3**.

5.2.1 C-2 Basin Model

The C-2 Basin models cover approximately 53 square miles of eastern Miami-Dade County and contain 435 nodes, 552 links, and 235 sub-basins. Sub-basins have a maximum of 4 sub-catchments. The major canal in the Basin is the C-2 Canal, also known as the Snapper Creek Canal, which begins just northeast of the intersection between SW 57th Avenue and Old Cutler Road. The major functions of the canal are to provide drainage and flood protection for the Basin, to supply water to the C-2 and C-100 Basins for irrigation, and to maintain an adequate groundwater table elevation near the lower reach of C-100 to prevent saltwater intrusion. The canal flows southeast with discharge via the SFWMD Outfall Structure S-22 to Biscayne Bay, east of Old Cutler Road, near the Village of Pinecrest limits.

Sub-basin division was based on land use BMPs and was conceptual, not physical. Sub-basins containing canals are classified into two types: areas along the canal with drainage systems and areas without drainage. Sub-basins for areas with drainage systems are wide and contain the drained area. For these sub-basins, the downstream node within each sub-basin acts as a storage node for the area of the sub-basin that does not include the canal. For sub-basins that do not contain a drainage system the downstream node is not a storage node.

The original C-2 Basin model files were developed in XP-SWMM Version 9.00 (5-, 10-, 25-, and 50-year events) and Version 12.00 (100-year event). XP-SWMM performs an automatic model conversion when opening an input file from an older version of XP-SWMM. The model files provided were converted to the current version of XP-SWMM (Version 2014) successfully and no errors were noted during the conversion process.

The converted models were run with the current version of XP-SWMM. No errors were encountered or reported by XP-SWMM during the simulation process. However, high continuity errors were encountered for both the existing condition simulations and the future condition simulations. Continuity errors ranged from -33.68% to -20.35% for both model configurations. Negative continuity errors indicate model fluctuations that results in an overall gain of water in the routing calculations between the original and converted models.

To improve the model continuity, numerous adjustments were made to configuration parameters and to multiple job control parameters based on the recommendations of the XP Solutions Technical Support Team. Configuration parameters were enabled to decrease the time step for the computational engine iterations, and parameters were enabled to alter the spatial weighting in the links. Adjustments to these configuration parameters did not show improvement in the continuity error. Within the job control settings the following adjustments were made to improve the continuity error: the use of interface files was disabled, the hydraulic time step was varied, simulation tolerances were disabled, the routing control option was disabled, and the simulation time step was decreased. The continuity error remained high and in some cases became worse. In instances that the continuity error showed minor improvement, it was not consistent for all storm events. In addition, comparison of the peak stages showed larger differences than when no modifications to the original model files were made. It should be noted that the continuity error was in the excellent to good range for all but 2-6 model junctions for all the simulations with an excellent mean node error. The nodes with the greater errors are outside the limits of the Village of Pinecrest.

Based on sound engineering judgment it was determined that the converted model files with no modifications to parameters were to be used for development of the SWMP within the Village of Pinecrest. This decision took into account the stage differences, continuity error calculations, and calibration of the original models. Without going through the exhausting procedure of recalibrating the converted models the number and type of modifications that could be made was limited. It is assumed that the continuity error is accounted for by the numerous enhancements that have been made to improve the computational power and accuracy of the XP-SWMM software engine since the 2004, Version 9.00 release that was used for the original models. A statistical summary and comparison of the original C-2 Basin model and the converted C-2 model are discussed in detail in **Subsection 5.2.3**.

5.2.2 C-100 Basin Model

The C-100 Basin has an area of approximately 40.6 square miles and is located in eastern Miami-Dade County, also known as the Cutler Basin. There are four major canals in the C-100 Basin: C-100, C-100A, C-100B, and C-100C. These canals provide drainage and flood protection to the C-100 Basin, supply water to the Basin for irrigation, and maintain an adequate groundwater table elevation near the lower reach of the C-100 to prevent saltwater intrusion.

There are a total of six control structures in the C-100 Basin that control water movement in and out of the Basin. The XP-SWMM model contains 286 nodes and 366 links connecting 201 sub-basins, 86 of which are along canals. The sub-basin division is based on land use BMPs and is conceptual, not physical. Sub-basins containing canals, are classified into two types: areas along the canal with drainage systems and areas without drainage. Sub-basins for areas with drainage systems are wide and contain the drained area. For these, the downstream node within the sub-basin acts as a storage node for the area of the sub-basin that does not include the canal. Sub-basins without drainage systems are as narrow as the canal width and the downstream node is not a storage node.

The original model files provided were developed in XP-SWMM version 8.53. As for the C-2 Basin model, XP-SWMM automatically performs a model conversion when opening an input file from an older version of XP-SWMM. The models were all successfully converted to the current available version of XP-SWMM (Version 2014) and no errors were noted during the input process. The continuity errors of both versions of the C-100 Basin models ranged from approximately -0.10% to -0.75% which is considered extremely good.

With the models converted, the newly converted models were run under the current version of XP-SWMM. As with the automatic conversion process no errors were reported by XP-SWMM or encountered during the simulation process. A statistical summary and comparison of the original C-100 Basin model and the converted C-100 Basin model are shown in **Subsection 5.2.3**.

5.2.3 Model Results Comparison

After completion of the model conversion process, a comparison of stages, flows, and volumes was performed for the models listed in **Table 5-2** and **Table 5-3**. Model comparisons were completed by extracting data from the original output files that were provided with the models from DRER (XP-SWMM-2004 for C-2 Basin models, and XP-SWMM-2003 for C-100 Basin models), and the output files created by running the converted model files in XP-SWMM 2014. The overall difference was calculated for all sub-basins in the C-2 and C-100 Basins. A statistical summary of the results is shown **Section 5.2.3.4** for the C-2 Basin model and **Section 5.2.3.5** for the C-100 Basin model. Detailed results are presented in **Appendix 5A** for the C-2 Basin and **Appendix 5** for the C-100 Basin with the sub-basins in the Village of Pinecrest displayed in bold. The highlighted nodes in the appendices have a difference greater than ±0.50 feet for each model junction/node. Overall, the converted model results compared favorably for both the C-2 Basin and the C-100 Basin.

Within the Village of Pinecrest limits and the immediately adjacent areas the results of the converted models for the both C-2 and C-100 Basin existing condition models and the C-2 and C-100 future condition models for all storm events were comparable. A comparison of the minimum, maximum and average stage, continuity error, and difference in stage were similar and showed the same trends for both the existing and future model configurations. However, based on the results of the calculated differences between the models obtained from DRER and the converted models (for both existing conditions and future conditions) the future condition model configuration for the C-2 Basin and C-100 Basin had a slightly more favorable correlation overall within the limits of the Village of Pinecrest this is important for the development of the SWMP.

In addition, the land use within original model files used predictions for 2025 to represent the future condition model configurations. While very little difference exists between the land use within the existing and future configurations of the original files, the future condition configuration is more representative of the current land use in the Village at the time of this SWMP development. **Appendix 5C** provides the details of the maximum stage comparison for all storm events at each model node/sub-basin within and immediately adjacent to the Village for both the existing configuration and the future condition configuration.

5.2.3.4 C-2 Basin Model Comparison

The maximum, minimum, and average stage of the original models was compared to the stage results of the converted models. Maximum stage results are presented in feet relative to the National Geodetic Vertical Datum of 1929 (ft-NGVD) for each of the design storm events, with the maximum, minimum, and average values calculated using absolute values. **Table 5-4** shows the statistical comparison for all storm events for the Village of Pinecrest sub-basins within the C-2 Basin existing condition models, and **Table 5-5** shows the comparison for the Village of Pinecrest sub-basins in the C-2 Basin future condition models. Both of the converted model configurations compared favorably, with no significant differences between the maximum, minimum, and average stages between the original and converted models.

Table 5-4 – Village of Pinecrest Maximum Stage Comparison C-2 Basin Model Existing Conditions

XP-SWMM Model	Maximum Stage Comparison (ft)					
	Max		Min		Average	
	Original	Converted	Original	Converted	Original	Converted
5-year, 24-hour	10.48	10.48	3.30	3.30	4.79	4.74
10-year, 24-hour	10.59	10.59	3.30	3.30	5.15	5.07
25-year, 72-hour	10.67	10.66	3.30	3.30	6.01	5.76
50-year, 72-hour	10.72	10.72	3.30	3.30	6.34	6.03
100-year, 72-hour	10.80	10.79	3.30	3.30	6.67	6.31

Table 5-5 – Village of Pinecrest Maximum Stage Comparison C-2 Basin Model Future Conditions

XP-SWMM Model	Maximum Stage Comparison (ft)					
	Max		Min		Average	
	Original	Converted	Original	Converted	Original	Converted
5-year, 24-hour	10.48	10.48	3.30	3.30	4.78	4.76
10-year, 24-hour	10.59	10.59	3.30	3.30	5.15	5.08
25-year, 72-hour	10.67	10.66	3.30	3.30	6.02	5.78
50-year, 72-hour	10.72	10.72	3.30	3.30	6.32	6.07
100-year, 72-hour	10.80	10.79	3.30	3.30	6.65	6.32

For the sub-basins within the limits of the Village of Pinecrest, the difference in the stage values between the original and converted models are shown in **Table 5-6** in for the C-2 existing condition configuration and **Table 5–7** for the C-2 future condition configuration. The minimum, maximum and average stage comparisons were calculated using the absolute values for the difference between the original and the converted model stage values.

Table 5-6 – Stage Comparison in the Village of Pinecrest, C-2 Basin Model Existing Condition – Original to Converted

XP-SWMM Model	Maximum Stage Comparison (ft)		
	Max Difference	Min Difference	Average Difference
5-year, 24-hour	1.00	0.00	0.15
10-year, 24-hour	1.05	0.00	0.18
25-year, 72-hour	1.03	0.00	0.32
50-year, 72-hour	1.11	0.00	0.39
100-year, 72-hour	1.21	0.00	0.44

Table 5-7 – Stage Comparison in the Village of Pinecrest, C-2 Basin Model Future Condition – Original to Converted

XP-SWMM Model	Maximum Stage Comparison (ft)		
	Max Difference	Min Difference	Average Difference
5-year, 24-hour	0.89	0.00	0.13
10-year, 24-hour	0.99	0.00	0.16
25-year, 72-hour	1.09	0.00	0.32
50-year, 72-hour	1.47	0.00	0.37
100-year, 72-hour	1.30	0.00	0.42

Appendix 5A provides the details of the maximum stage comparison for all storm events at each model node/sub-basin for the C-2 Basin existing and future condition configurations. The maximum difference of the stage in the C-2 Basin was 2.32 feet; however, these sub-basins are not within the limits of the Village of Pinecrest or in the immediately adjacent areas.

The average difference between model stages showed differences of less than ± 0.5 feet within the Village. Some differences in the sub-basins are attributed to numerous refinements of the XP-SWMM computational engine between 2004 and the most current version. Overall the conversions of the models are satisfactory and the differences in stage values are within a reasonable range. In general, the differences between the original results and the converted model files are acceptable for the development of the Village SWMP.

The overall model continuity errors for all storm events for the C-2 Basin are presented for the existing condition models in **Table 5-8** and future condition models in **Table 5–9**. The continuity error usually indicates numerical instabilities generated from small pipes or conduits that cause a volumetric increase (negative error) or decrease (positive error) in water. This is particularly the case with the use of storage nodes and simulations run for short periods of time. The continuity error was poor for all storm events for both the future and existing condition configurations for the C-2 Basin model.

Table 5-8 – Continuity Error Comparison, C-2 Basin Model Existing Condition

XP-SWMM Model	Overall Model Continuity Error			
	ft^3		%	
	Original	Converted	Original	Converted
5-year, 24-hour	4329494.52	-137488202.043	0.82	-25.18
10-year, 24-hour	7444524.72	-192008753.49	1.16	-28.98
25-year, 72-hour	6023500.83	-425100157.86	0.48	-33.68
50-year, 72-hour	6070021.78	-416973345.84	0.43	-28.96
100-year, 72-hour	9863370.53	-333762448.74	0.61	-20.35
+ Error means a continuity loss, - a gain				

Table 5-9 – Continuity Error Comparison, C-2 Basin Model Future Condition

XP-SWMM Model	Overall Model Continuity Error			
	ft^3		%	
	Original	Converted	Original	Converted
5-year, 24-hour	2976295.85	-137961410.32	0.57	-25.59
10-year, 24-hour	6949000.35	-201651239.27	1.1	-30.99
25-year, 72-hour	5572237.60	-407939888.81	0.46	-33.01
50-year, 72-hour	2084100.12	-390791378.40	0.15	-27.75
100-year, 72-hour	8815853.23	-355321185.01	0.56	-22.16
+ Error means a continuity loss, - a gain				

Numerous attempts to lower the continuity error without requiring a recalibration of the models were unsuccessful. Although these errors are significantly larger than desired, a review of **Table 5-4** and **Table 5-5** shows these errors do not represent a significant change in overall stages when comparing the original models to the converted models.

5.2.3.5 C-100 Model Comparison

With the model conversion of the C-100 Basin complete, a comparison of stages, flows, and volumes was performed for the models listed in **Table 5-3**. The maximum stage results are presented in ft-NGVD for each of the design storm events for the Village sub-basins within the C-100 Basin for both the original and converted models, with the maximum, minimum, and average values calculated using absolute values. **Table 5-10** shows the maximum stage comparison for all storm events for the existing condition configuration and **Table 5-11** shows the comparison for the future condition configuration. The converted models compared favorably as shown in tables presented in this section.

Table 5-10 – Village of Pinecrest Maximum Stage Comparison C-100 Basin Model Existing Condition

XP-SWMM Model	Maximum Stage Comparison (ft)					
	Max		Min		Average	
	Original	Converted	Original	Converted	Original	Converted
5-year, 24-hour	8.78	8.82	5.53	5.94	6.20	6.54
10-year, 24-hour	8.86	8.90	6.30	6.73	6.89	7.27
25-year, 72-hour	9.05	9.08	7.29	7.58	7.73	7.96
50-year, 72-hour	9.10	9.12	7.63	7.79	8.02	8.16
100-year, 72-hour	9.35	9.20	7.88	7.99	8.25	8.33

Table 5-11 – Village of Pinecrest Maximum Stage Comparison C-100 Basin Model Future Conditions

XP-SWMM Model	Maximum Stage Comparison (ft)					
	Max		Min		Average	
	Original	Converted	Original	Converted	Original	Converted
5-year, 24-hour	8.78	8.82	5.57	8.82	6.24	6.56
10-year, 24-hour	8.87	8.91	6.35	8.91	6.94	7.30
25-year, 72-hour	9.06	9.08	7.29	9.08	7.73	7.99
50-year, 72-hour	9.23	9.13	7.69	9.13	8.09	8.18
100-year, 72-hour	9.45	9.27	7.88	9.27	8.29	8.34

The difference in the maximum stage values between the original and converted models for the sub-basins within the Village are listed in **Table 5-12** for the existing configuration and in for the future conditions configuration. The minimum, maximum and average stage comparisons were calculated using the absolute values for the difference between the original and the converted model stage values.

Table 5-12 – Village of Pinecrest Stage Comparison, C-100 Basin Model Existing Condition – Original to Converted

XP-SWMM Model	Model Stage Comparison (ft)		
	Max Difference	Min Difference	Average Difference
5-year, 24-hour	0.49	0.00	0.34
10-year, 24-hour	0.49	0.01	0.38
25-year, 72-hour	0.31	0.00	0.23
50-year, 72-hour	0.21	0.01	0.14
100-year, 72-hour	0.25	0.00	0.09

Table 5-13 – Village of Pinecrest Stage Comparison, C-100 Basin Model Future Condition – Original to Converted

XP-SWMM Model	Model Stage Comparison (ft)		
	Max Difference	Min Difference	Average Difference
5-year, 24-hour	0.48	0.00	0.32
10-year, 24-hour	0.47	0.01	0.36
25-year, 72-hour	0.35	0.00	0.26
50-year, 72-hour	0.25	0.01	0.11
100-year, 72-hour	0.29	0.01	0.08

The maximum difference between the converted and the original models for the C-100 Basin model ranges from 0.69 to as much as 2.56 feet. However, within the Village of Pinecrest the maximum difference is less than 0.5 feet. Some differences can be attributed to the numerous refinements in the computational engine between the XP-SWMM 2004 and the current version. Overall the conversion of the model was successful and the differences in results are within a reasonable range. In general, the differences between the original results and the converted model files are acceptable for the development of the Pinecrest SWMP. **Appendix 5B** provides the details of the maximum stage comparison for all storm events at each model node/sub-basin for the C-100 Basin existing and future condition configurations. The sub-basins within the Village of Pinecrest are in bold.

The overall model continuity errors are presented for all storm events for the existing condition models in **Table 5-14** and future condition models in **Table 5-15**.The model continuity errors compared favorably for all storm events in both the existing condition and future conditions models. The continuity errors from the original model were not available for comparison in the C-100 Basin.

Table 5-14 – Continuity Error Comparison, C-100 Basin Model Existing Condition

XP-SWMM Model	Overall Model Continuity Error	
	ft^3	%
5-year, 24-hour	-2455379.29	-0.75
10-year, 24-hour	-2318080.96	-0.50
25-year, 72-hour	-1259587.82	-0.11
50-year, 72-hour	-5179802.37	-0.39
100-year, 72-hour	-4758442.02	-0.32
+ Error means a continuity loss, - a gain		

Table 5-15 – Continuity Error Comparison, C-100 Basin Model Future Condition

XP-SWMM Model	Overall Model Continuity Error	
	ft^3	%
5-year, 24-hour	-2474282.85	-0.75
10-year, 24-hour	-2148324.26	-0.46
25-year, 72-hour	-1189433.11	-0.10
50-year, 72-hour	-5044851.52	-0.37
100-year, 72-hour	-4797667.41	-0.32
+ Error means a continuity loss, - a gain		

The continuity errors for both the existing and future configurations are within the preferred range of 0-5%, are consistent for all design storm events, and show similar trends for both configurations. There is a minor improvement in the convergence of the future configuration models for the 10-, 25-, and 50- year storm events.

5.3 Sub-Basin Delineation

During the analysis of the existing DRER C-2 and C-100 Basin XP-SWMM models it was determined that sub-basin delineations needed to be revised and refined to accurately represent conditions within the Village and provide a better resolution of sub-basin delineations. Additionally, no sub-basin delineations were developed by DRER for the coastal areas (South Biscayne Basin) within the Village of Pinecrest limits, because the limits of the C-2 and C-100 Basins only extend to approximately a quarter mile west of Old Cutler Road . As such, sub-basin delineations were developed for these coastal areas. The details of this delineation are described in the following sections.

5.3.1 Village of Pinecrest Existing Delineation

The original sub-basin delineation for the Village of Pinecrest was obtained from DRER C-2 and C-100 Basin XP-SWMM models. The County defined the drainage sub-basins for the C-2 and C-100 Basins based on the existing stormwater management systems and the best available topographic data present at that time. These sub-basin delineations were provided as shapefiles compatible with ESRI's ArcMap GIS platform. The sub-basins are generally divided based on quadrants bound by major roads, with additional sub-basins being divided based on contributing areas to major roadway systems. A list of all C-2 and C-100 sub-basin names and areas within the Village of Pinecrest is provided in **Table 5-16**. Of the 436 sub-basins in C-2 and C-100 Basins, 46 sub-basins are within the Village of Pinecrest limits. Highlighted sub-basins were better refined to more accurately represent conditions in the Village of Pinecrest.

Table 5-16 – Original C-2 & C-100 Sub-Basin Names and Areas within the Village of Pinecrest

C-2 Basin		C-100 Basin		C-100 Basin (continued)	
Sub-Basin	Area (acres)	Sub-Basin	Area (acres)	Sub-Basin	Area (acres)
57AVE-S	6.89	C100A-C-10	60.15	C100AD-C-1	32.81
C2-W-3	736.44	C100A-C-11	5.80	C100AD-C-2	20.07
C2-E-5	532.92	C100A-C-12	13.68	C100C-E-7	37.08
C2-S-9	784.25	C100A-C-13	13.43	C100D-C-1	3.13
LG-C-14	0.80	C100A-C-14	1.88	C100D-C-2	39.98
US1-S	42.76	C100A-C-15	8.98	C100D-C-3	1.16
C2-C-26	41.27	C100A-C-16	1.37	C100D-C-4	42.44
C2-C-25	10.22	C100A-C-17	20.67	C100D-C-5	19.44
C2-C-24	3.18	C100A-C-18	0.18	C100D-C-6	5.26
C2-C-23	66.67	C100A-C-19	29.60	C100D-E-1	186.07
		C100A-C-20	29.98	C100D-N-1	485.96
		C100A-C-7	25.93	C100D-W-1	83.66
		C100A-C-8	55.81	CC100A-E-1	461.63
		C100A-C-9	1.08	CC100A-W-2	507.72
		C100A-E-1	90.74	US1-N-1	13.16
		C100A-E-2	33.88	US1-N-2	24.98
		C100A-W-2	280.75	US1-S-1	26.81
		C100A-W-3	350.74		

Figure 5-1 shows the map of original C-2 and C-100 sub-basin delineation within the Village of Pinecrest. Only sub-basins to be delineated are labeled. It is important to note that there are no sub-basins for the coastal areas within the Village since the Basin models were not developed by the County for those areas. **Appendix 5D** shows the map of original sub-basin delineation.

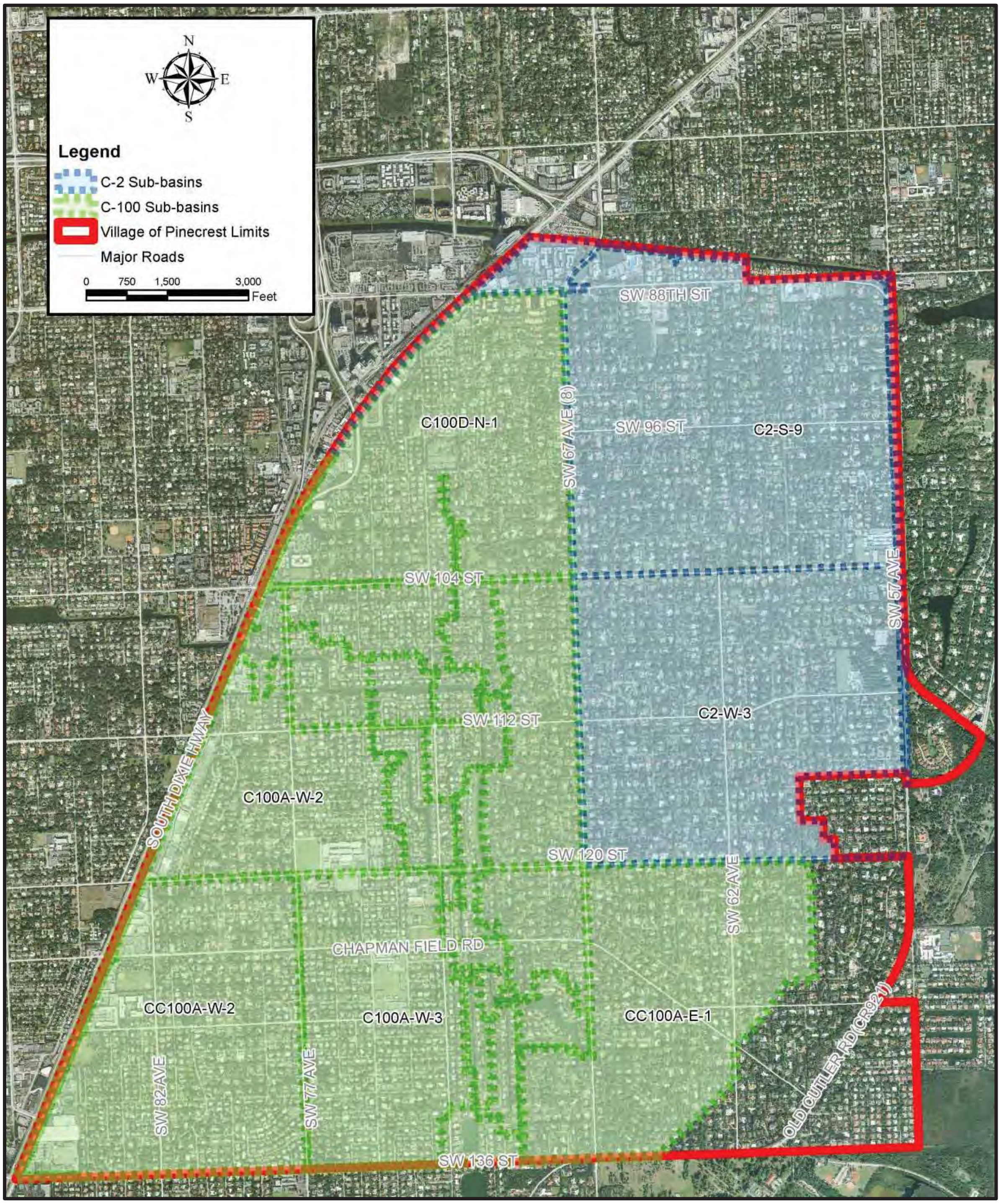


Figure 5-1 – Original Sub-Basin Delineation for the Village of Pinecrest

Comparing the Miami-Dade County original sub-basin delineation for the Village with the available raster DEM, there are divides that can be determined using topographic ridges or high elevations of major road as shown in **Figure 5-2**. The original sub-basin delineation from the DRER's C-2 and C-100 SWMP models appeared to be more directly influenced by the available infrastructure data rather than topographic data.

The topographic data set shown in **Figure 5-2** illustrates locations where high and low topographic elevations are shown within the Village. The lowest areas within the Village are, for the most part, the areas adjacent to the C-2, C-100A and SW 70th Avenue Canals. Low topographic elevations are also present along coastal areas near Biscayne Bay. Coastal ridges can also be interpreted from the raster where elevations are noticeably higher than elevations found further inland. For clarity, the elevations shown in **Figure 5-2** are truncated to only display elevations between 0 and 14 ft-NGVD.

The raster based DTM allows for high and low topographic areas to be visually identified as areas where natural basin breaks exist or where runoff is collected. Topographic ridges represent high areas where a break in the flow of runoff will most likely occur. Runoff will flow perpendicular to a ridge and continue down to lower lying areas. Runoff flowing from high elevations will congregate in low lying areas and remain there until removed from the sub-basin via conveyance systems, infiltration, evaporation, or a combination thereof. These low lying areas will represent the areas where the majority of flood waters will congregate during a storm event and are also the most susceptible to inadequate stormwater management systems and thus, flooding.

Floodwaters within a delineated sub-basin cannot cross along ridges to an adjacent sub-basin unless the depth of flooding in a sub-basin exceeds the lowest elevation along that boundary. These ridges will be defined as cross sections in XP-SWMM model, when necessary. In most cases, ridges represent the outer limits of a sub-basin and will be the location of sub-basin divides. They can be naturally elevated areas or areas where man made divides such as highways exist.

The Village of Pinecrest provided stormwater infrastructure data for most catch basins/inlets located within the public right-of-way. Although the data provided was complete for the most part, several structures and data fields were missing. However, it was possible to establish connectivity for the majority of the systems to determine inter-basin connections.

These systems can primarily be classified into four types; 1) systems which convey runoff out of a sub-basin to a discharge point; 2) systems which facilitate the infiltration of runoff into the groundwater table with designed overflows to a discharge point; 3) systems which facilitate the infiltration of runoff into the groundwater table with no designed overflows; and 4) areas where no systems are in place and which rely on infiltration through the surface.

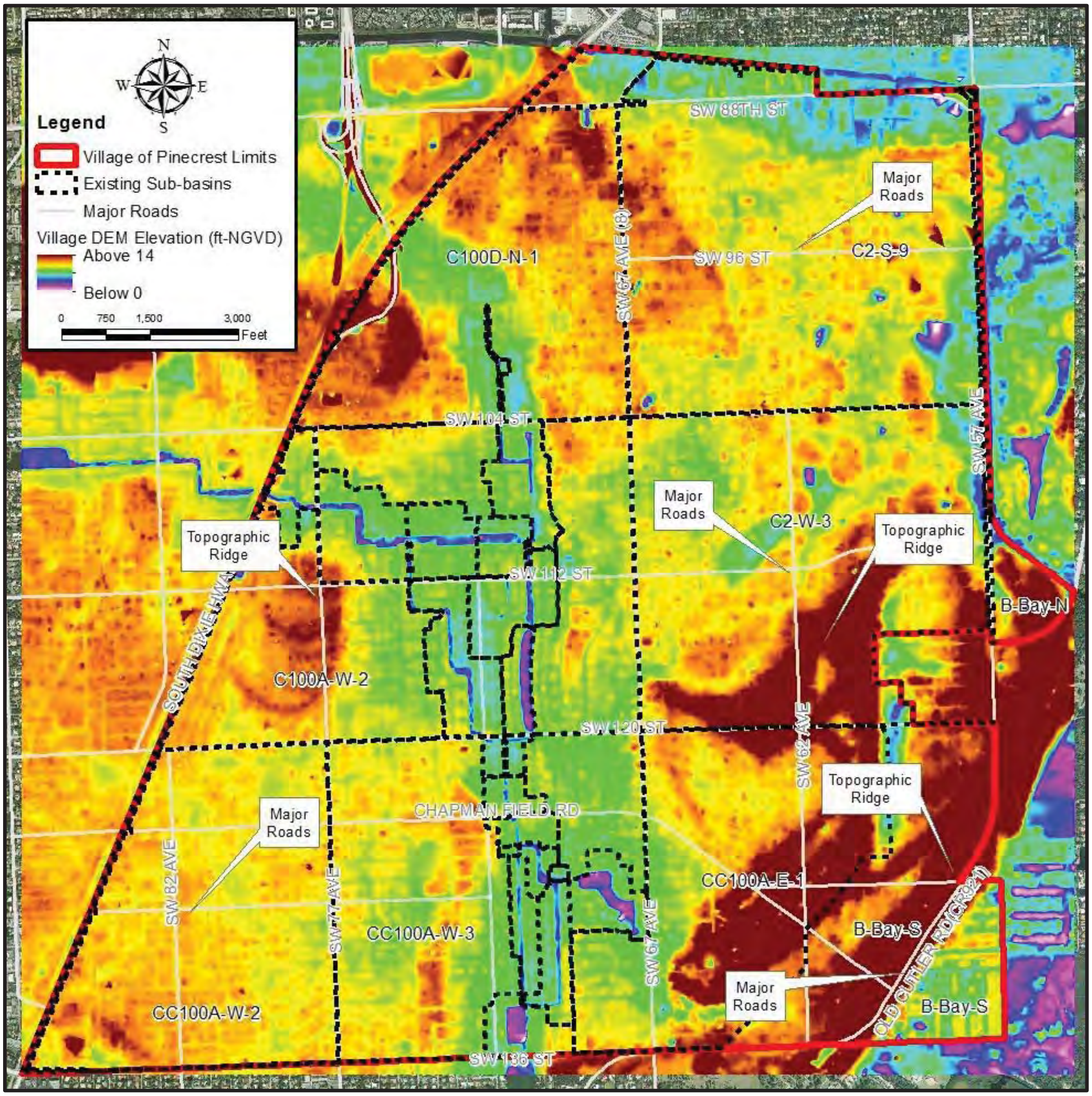


Figure 5-2 – Village of Pinecrest DEM (Elevation Ft-NGVD)

5.3.2 Village of Pinecrest Sub-basin Delineation Refinement

The original DRER C-2 and C-100 Basin model sub-basin delineations were closely analyzed and refined based on a close inspection of the available data previously described in order to accurately represent the most up-to-date conditions. Sub-basin delineations were developed for the coastal areas within the Village near Biscayne Bay.

A list of all C-2 and C-100 sub-basin names and areas delineated within the Village of Pinecrest is provided in **Table 5-17**. After refinement of the Basin models, a total of 57 sub-basins were used to represent the Village of Pinecrest. The sub-basin refinements are highlighted.

Table 5-17 – C-2 and C-100 Sub-Basin Names & Areas within the Village of Pinecrest

C-2 Basin		C-100 Basin		C-100 Basin	
Sub-Basin	Area (acres)	Sub-Basin	Area (acres)	Sub-Basin	Area (acres)
57AVE-S	6.89	C100A-C-10	60.15	C100AD-C-2	20.07
C2-E-5	532.92	C100A-C-11	5.8	C100C-E-7	37.08
LG-C-14	0.8	C100A-C-12	13.68	C100D-C-1	3.13
US1-S	42.76	C100A-C-13	13.43	C100D-C-2	39.98
C2-C-26	41.27	C100A-C-14	1.88	C100D-C-3	1.16
C2-C-25	10.22	C100A-C-15	8.98	C100D-C-4	42.44
C2-C-24	3.18	C100A-C-16	1.37	C100D-C-5	19.44
C2-C-23	66.67	C100A-C-17	20.67	C100D-C-6	5.26
C2-W-3SW	165.23	C100A-C-18	0.18	C100D-E-1	186.07
C2-W-3SE	222.5	C100A-C-19	29.6	C100D-N-1N	247.42
C2-W-3NW	164.95	C100A-C-20	29.98	C100D-N-1E	102.48
C2-W-3NE	183.76	C100A-C-7	25.93	C100D-N-1W	136.07
C2-S-9SW	164.6	C100A-C-8	55.81	C100D-W-1	83.66
C2-S-9SE	202.7	C100A-C-9	1.08	CC100A-E1N	217.08
C2-S-9NW	201.9	C100A-E-1	90.74	CC100A-E1W	224.22
C2-S-9NE	215.05	C100A-E-2	33.88	CC100A-W-2A	48.43
		C100A-W-2E	110.43	CC100A-W-2B	124.62
		C100A-W-2W	170.32	CC100A-W-2C	167.38
		C100A-W-3N	172.76	CC100A-W-2D	167.29
		C100A-W-3S	177.99	US1-N-1	13.16
		US1-N-2	24.98		
		US1-S-1	26.81		

Originally, no existing sub-basin delineations were developed by DRER for the coastal areas (South Biscayne Bay sub-basins) within the Village of Pinecrest limits because no models were developed for those basins. The developed sub-basin names and areas are summarized in **Table 5-18** for the coastal area of South Biscayne Bay within the Village. The C-2, C-100, and South Biscayne Bay refined sub-basin delineations within the Village of Pinecrest are shown in **Figure 5-3** and in **Appendix 5E**.

Table 5-18 – South Biscayne Bay Sub-Basin Names & Areas within the Village of Pinecrest

Biscayne Bay Basin	
Sub-Basin	Area (acres)
B-Bay-N	39.18
B-Bay-SW	166.72
B-Bay-SE	99.92

In general, the sub-basins limits were refined based on topography and infrastructure data but were not significantly changed to maintain concurrency with the original calibrated and validated delineation from DRER. For the most part, large sub-basins were divided into smaller sub-basins to better represent stages within the Village of Pinecrest area.

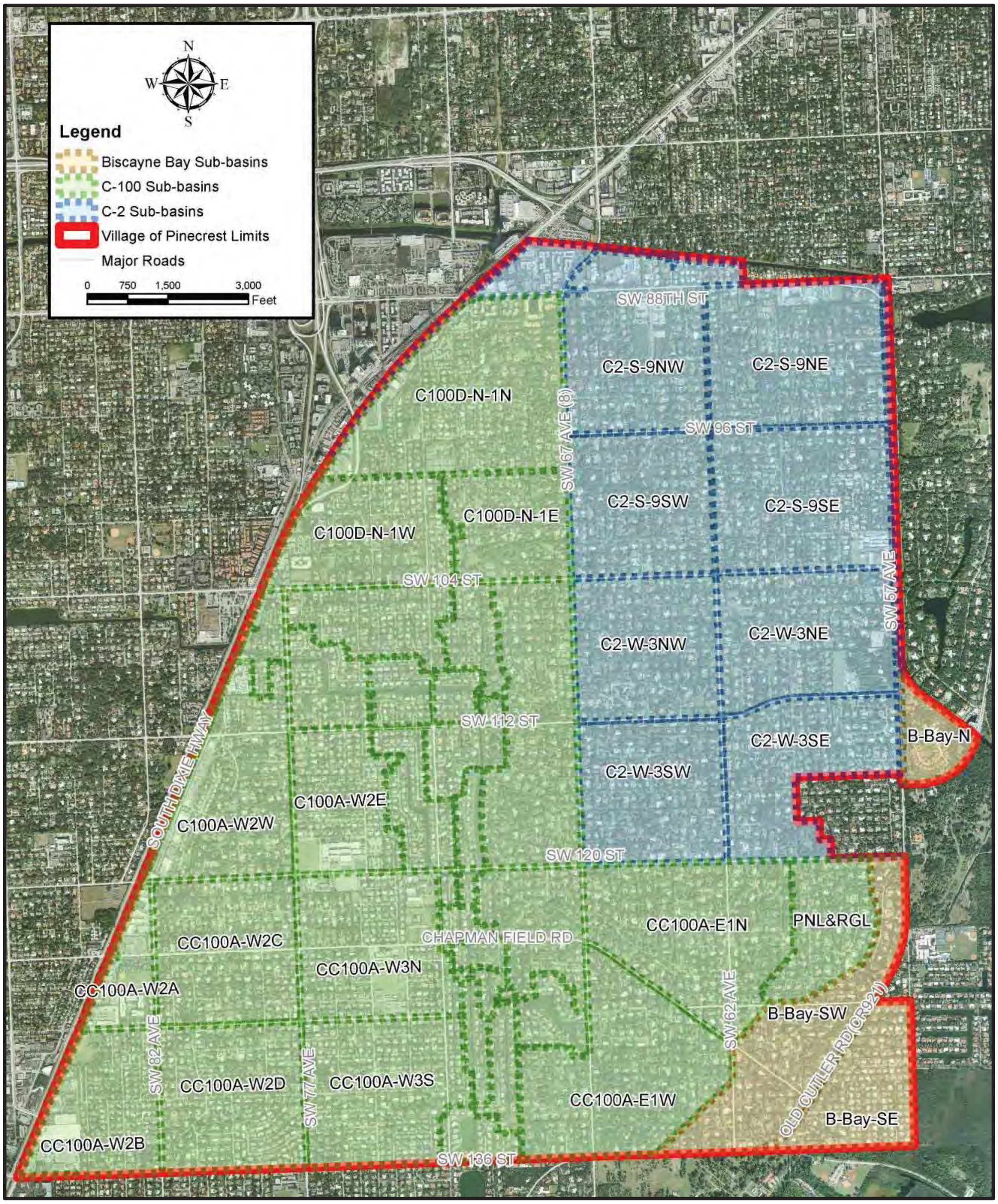


Figure 5-3 – Sub-Basin Delineation for the Village of Pinecrest

The delineation of the sub-basins resulted in eight (8) additional sub-basins within the C-2 Basin, 14 additional sub-basins within the C-100 Basin, and three (3) new sub-basins for the South Biscayne Bay area. The naming convention for the refined sub-basins was dependent on location and original sub-basin name. For example, the existing C2-S-9 sub-basin (C-2 Basin) was divided into 4 smaller sub-basins C2-S-NE, C2-S-NW, C2-S-SE, and C2-S-SW respectively.

5.4 2014 XP-SWMM Baseline Model Scenario

The data collected from the Village of Pinecrest and Miami-Dade County was evaluated to define the completeness and viability of the data as well as to identify the pertinent items that would be implemented into the development of this Stormwater Master Plan. The following subsections detail the updated XP-SWMM model input parameters that were implemented in the development of this Stormwater Master Plan for the Village of Pinecrest.

5.4.1 Village of Pinecrest XP-SWMM Baseline Model

Following the same methodology implemented by DRER in the development of the C-2 and C-100 Basin XP-SWMM models the sub-basins that contain BMPs, such as exfiltration trench systems, were simulated using the Horton infiltration solution assuming 0% directly connected impervious areas (DCIA) and a Maximum Infiltration Volume parameter set to 5 inches. **Table 5-19** provides a summary of the infiltration methodology and parameters used to modify each additional sub-basin.

Table 5-19 – Infiltration Methodology and Sub-Catchment Classification

Infiltration Methodology		
Sub-catchment	**1 - Green.Ampt**	**2 - Horton**
Infiltration	Green.Ampt	Horton
Drainage Structure	Non-BMPs	BMPs
% Impervious	%Adjusted DCIA	0%
Groundwater	Node / Sub-basin	Node / Sub-basin
Max. Infiltration Volume	N/A	5

5.4.1.1 Representation of Stormwater Projects

The Village of Pinecrest provided information for a total of seven (7) drainage improvement projects that have been completed within the last three years. The project data was primarily provided in electronic format and PDF files in addition to some CAD files. **Table 5-20** provides a listing of the project location and year completed with a listing of the length of exfiltration trench (Exf. Trench) implemented for each project in linear feet (LF). Additionally, the table shows the sub-basin location of the projects and the main stormwater management components constructed.

Table 5-20 – Completed Stormwater Improvement Projects for the Village of Pinecrest

Project Location	Year	Sub-Basin	Stormwater Management Structure
SW 70th Ave (SW 100th Ave & 104th Ave)	2007	C100DN-1E	2 New Catch Basins Connected to Existing Outfall
SW 72nd Ave (SW 112 ST to SW 120th St)	2010	U29-S	450 LF Exf Trench
SW 72nd Ave (SW 112 ST to SW 120th St)	2010	U35-S	325 LF Exf Trench
SW 73rd Ave, SW 72nd CT, SW 72 Ave, SW 96th Street	2012	C100D-N-1	200 LF Exf. Trench
Killian Park Road – 11100 Killian Park RD	2012	C2-W-3NW	696 LF of Exf. Trench
Pinecrest Gardens Stormwater Improv.	2012	C2-W-3NE	Replacement 170 LF Exf. Trench
South Mitchell Manor Circle & SW 64 Ave	2013	C2-W-3SW	204 LF of Exf. Trench
South Mitchell Manor Circle & SW 64 Ave	2013	C2-W-3SW	236 LF of Exf. Trench

Project Location	Year	Sub-Basin	Stormwater Management Structure
Pine Needle Lane (near SW 121st St)	2013	PNL&RGL	250 LF of Exf. Trench/4 Gravity Wells
Rock Garden Lane (near SW 121st St)	2013	PNL&RGL	693 LF of Exf. Trench / 12 Gravity Wells

5.4.1.2 Exfiltration Trenches

The stormwater projects completed by the Village of Pinecrest were primarily intended to address localized flooding and consisted predominately of exfiltration trenches and some gravity drainage wells. There were no other major components that transfer or facilitated the transfer of stormwater flows between sub-basins or to the groundwater table. Therefore, for the purpose of this SWMP update, the changes implemented in the XP-SWMM model resulted in representing additional length of exfiltration trench that serviced each area within a sub-basin.

An extraction methodology utilizing prorated reductions in rainfall depths unique to each sub-basin was used to simulate extraction volumes due to BMPs such as exfiltration trenches. This extraction methodology assumed that the exfiltration trenches in a given system have the ability to extract or exfiltrate up to 3.28 inches of the total rainfall depth produced by a rainfall event over the area contributing to the exfiltration trench - this is an accepted practice by DRER and the SFWMD and equates to a typical 5-year, 1-hour rainfall event. The resulting extraction volume was then prorated over the entire sub-basin area and then extracted from the total rainfall depth associated with a given rainfall condition.

For this methodology, the total area contributing to an exfiltration trench was based on the length of exfiltration trench constructed within a given sub-basin. This length was associated to a width of 320 feet along the length of the exfiltration trench which identified the typical contributing area adjacent to both sides of the exfiltration trench. The width was based on a random sampling of the areas within the Village which showed that 160 feet on either side of a trench typically extends to the rear of a property in a typical residential area within the Village - see **Figure 5-4**.

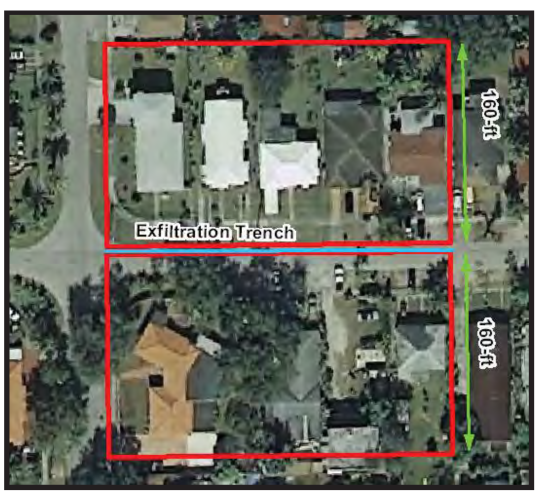


Figure 5-4 – Area Attributed to an Exfiltration Trench Length

The rainfall extractions calculated resulted in negligible decreases in peak stages in most of the modified sub-basins due to the small amount of exfiltration trench constructed within each sub-basin. This is typical of most municipal projects which mostly address localized roadway ponding. The total extraction depth is calculated in **Table 5-21** for each sub-basin.

Table 5-21 – Rainfall Depth Extraction Implemented in Modified Sub-Basins for Exfiltration Trenches

Sub-Basin	Exfiltration Trench Length from New Projects (ft)	Basin Area (ac)	Total Contributing Area to the Exfiltration Trench (ac)	Sub-Basin Rainfall Extraction Depth (in)
C2-W-3SW	236	165.23	1.73	0.03
C2-W-3NW	696	164.95	5.11	0.10
C2-W-3-NE	170	183.76	1.25	0.02
57AVE-S	170	6.89	1.25	0.59

Table 5-22 shows a comparison of Original (O) versus Revised (R) models for the resulting rainfall depth per design event based on the extraction methodology for the coastal rainfall reference for the C-2 Basin.

Table 5-22 – Rainfall Depth Extraction Implemented in Modified C-2 Sub-Basins per Design Event

C-2 Rainfall Depth (inches) COASTAL											
Sub-Basin	Extraction (in)	5-year		10-year		25-year		50-year		100-year	
		O	R	O	R	O	R	O	R	O	R
C2-W-3SW	0.03	6.20	6.17	8.00	7.97	9.10	9.06	9.90	9.87	11.08	11.04
C2-W-3NW	0.10	6.20	6.10	8.00	7.90	9.10	8.99	9.90	9.80	11.08	10.97
C2-W-3-NE	0.02	6.20	6.18	8.00	7.98	9.10	9.08	9.90	9.88	11.08	11.06
57AVE-S	0.59	6.20	5.61	8.00	7.41	9.10	8.51	9.90	9.31	11.08	10.49

5.4.1.3 Gravity Drainage Wells

For the purpose of this SWMP, the data utilized to calculate the extraction values for the gravity drainage wells was provided by the Village under the stormwater management system design report "Pine Needle Lane & Rock Garden Lane" DRER item No.: DW13-01, FDEP permit No.: 0317175-001-UC. The extraction methodology implemented for handling gravity drainage well capacity within the models followed a similar procedure to the extraction methodology for exfiltration trenches.

The total volumetric capacity of a well or wells was based on the results provided in the "Pine Needle Lane & Rock Garden Lane" design report. This project included the addition of 4 gravity drainage wells with the purpose of lowering the stages on Pine Needle Lane and to compensate for the underperformance of the 12 gravity drainage wells previously installed. **Table 5-23** shows a comparison of Original (O) versus Revised (R) models for the resulting rainfall depth per design event based on data provided by the Village for the coastal rainfall reference for the PNL&RGL sub-basin in the C-100 Basin. The values were adjusted for each design storm event.

Table 5-23 – Rainfall Depth Extraction Implemented in Modified C-100 Sub-Basins per Design Event

C-100 Rainfall Depth (inches) COASTAL											
Sub-Basin	Extraction (in)	5-year		10-year		25-year		50-year		100-year	
		O	R	O	R	O	R	O	R	O	R
PNL&RGL	7.0	6.30	0.0	7.40	1.60	9.30	2.64	10.00	2.95	10.90	3.28

5.4.1.4 Land Use Changes

The Village and the County provided GIS shapefiles for land use. Both land use files were evaluated for use within the development of this SWMP. It was determined that both land use files were accurate and matched for the most part for all the areas within the Village limits. There were a few areas with small percentage of changes in land use, these types of changes most commonly resulted in insignificant changes in impervious areas since they already were mostly developed. Land use definition and code are shown in **Table 5-26**.

Originally, no existing sub-basin delineations were developed by DRER for the coastal areas (South Biscayne Bay sub-basins) within the Village of Pinecrest limits because no models were developed for those basins. The developed sub-basin name and area are summarized in **Table 5-18** and shown in **Figure 5-3**.

The additional sub-basins were analyzed following the same methodology implemented for the development of the C-2 and C-100 Basin models. The new sub-basins were classified by land use to account for areas were BMPs have been implemented. Areas with exfiltration trenches or Hybrid system land uses, which have relatively large capacities, were separated to a second sub-catchment. Therefore, each sub-basin was assigned to two sub-catchments at each node if it contained exfiltration trenches or Hybrid systems. The second sub-catchment was given a DCIA value of 0.0 which represents a 100 percent pervious area. Areas with BMPs were simulated using the Horton infiltration solution.

The Horton infiltration parameters are only used to mimic the operation of the contained exfiltration trenches and Hybrid System BMP land use areas. Note that the infiltration parameters are designed to provide total infiltration up to the 5-year 24-hour storm volume (6.5 inches) and allow total runoff beyond this volume. The non-BMP areas contain swales, and the depression storage of these areas was adjusted to account for the percentage area of swale. Impervious and Pervious Area Depression Storage are augmented by the initial abstraction from the Swale land use area up to 0.5 inches based on percent area of Swale. Areas without BMPs were simulated using the Green-Ampt infiltration solution.

5.4.1.5 Boundary Conditions

The C-2 Basin is bounded by the C-100 Basin to the south, the C-4 Basin to the north, and Biscayne Bay to the east. Connection to the C-100 Basin is regulated by SFWMD Control Structure S-121 which remains closed during flood conditions and during low water conditions minimum releases are occasionally made. Since the SFWMD operates the structure infrequently, a no-flow boundary condition was implemented in the C-2 SWMP at this node. Connection to the C-4 Basin is not regulated and it occurs at two locations, with the flow normally moving from C-4 into C-2. Due to lack of available data and based on preliminary studies, it was determined that boundary conditions between C-4 and C-2 were limited to a relatively small base flow (20cfs) for the event storms and none during the continuous simulations. **Figure 5-5** shows the C-2 and C-100 Basins Control Structures Location and Limits.

The SFWMD Control Structure S-22 controls the flows between the C-2 Canal and the Biscayne Bay. The purpose is to maintain optimum water control stages upstream and to prevent saline intrusion. This is the only structure that falls within the limits of the Village of Pinecrest. During flood conditions, the gates open when the headwater elevation rises to 3.5 feet NGVD and closes when the elevation falls to 2.9 feet NGVD. For salinity control, if the differential between headwater and tailwater elevation reaches 0.3 feet, the gate closes regardless of headwater stage. The boundary condition used downstream of the structure is a sinusoidal tidal hydrograph to simulate the tidal fluctuations of Biscayne Bay. The maximum tidal elevation used is 3.3 ft-NGVD with a low elevation of 0.3 ft-NGVD.

The C-100 Basin is bounded by the C-2 Basin to the north, the C-1 Basin to the west and south, and Biscayne Bay to the east. As stated above, connection between the C-2 and C-100 Basin is regulated by the SFWMD Control Structure S-121. Connection to the C-1 Basin is regulated by SFWMD Control Structure S-122 which remains closed during flood conditions and during low water conditions minimum releases are occasionally made. Since the SFWMD operates the structure infrequently, a no-flow boundary condition was implemented in the C-2 SWMP at this node. **Figure 5-5** shows the C-2 and C-100 Basins Control Structures Location and Basins Limits.

The SFWMD Control Structure S-123 controls the flows between the C-100 Canal and the Biscayne Bay. The purpose of this structure is to maintain optimum water control stages upstream in Canals C-100, C-100A, C-100B, and C-100C and to prevent saline intrusion. During flood conditions, the gates open when the headwater elevation rises to 2.4 ft-NGVD and closes when the elevation falls to 1.6 ft-NGVD. For salinity control, if the differential between headwater and tailwater elevation reaches 0.3 feet, the gate closes regardless of headwater stage to prevent saltwater intrusion westward. The boundary condition used downstream of the structure is a sinusoidal tidal hydrograph to simulate the tidal fluctuations of Biscayne Bay. The maximum tidal elevation used is 3.3 ft-NGVD with a low elevation of 0.3 ft-NGVD.

In addition to the structures included in the C-2 Basin and C-100 Basin models as boundary conditions, one additional boundary condition was implemented along the Biscayne Bay Basin of the C-100 model. Structure “Outfall_B” was implemented following the same methodology used for the development of the C-2 and C-100 Basin model outflows. Therefore, the boundary condition is a sinusoidal tidal hydrograph to simulate the tidal fluctuations of Biscayne Bay. The maximum tidal elevation used is 3.3 ft-NGVD with a low elevation of 0.3 ft-NGVD. It is important to note that this is not a structure and it does not discharge into the C-100 Basin or the C-2 Basin. Discharge is ultimate to Biscayne Bay via overland flow.

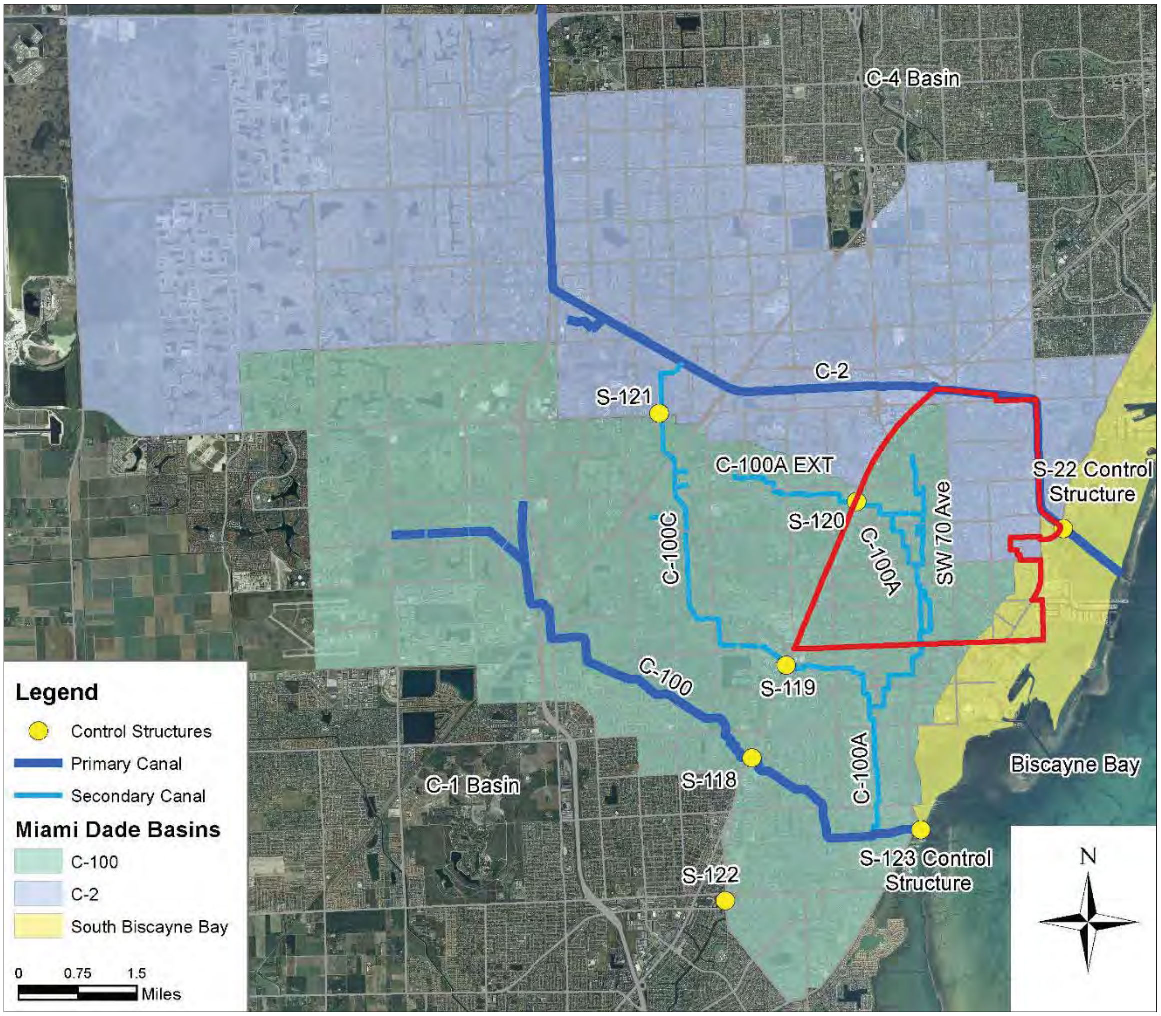


Figure 5-5 – C-2 and C-100 Basins Control Structure Location and Basin Limits

5.4.1.6 Model Validation

The completed XP-SWMM models were run and the results were extracted from the output files for each simulation. **Table 5-24** provides the model efficiency and overall error for all the storm events simulated for the C-2 and C-100 Basin. Overall, the models ran efficiently.

Validation of the XP-SWMM models for the design storm event was performed using anecdotal data due to the absence of measured stage, flow, or runoff volume data for canals, streams, rivers, or lakes within the Village's areas that fall between the C-2, C-100 and Biscayne Bay Basins. These are generally the locations where stage and flow data are gathered and where comparisons for calibration can best be performed. With no data to compare model results with observed conditions, verification of model results was achieved by comparing input from the Village residents and staff in the form of known flooding areas and resident complaints.

Table 5-24 – Model Efficiency and Errors

Basin	Event	Continuity Error	Efficiency of the Simulation	Overall Error	
				%	Rating
C-2	5-yr 24-hr	-21.0%	3.50	15.6%	Poor
	10-yr 24-hr	-21.3%	3.47	21.3%	Poor
	25-yr 72-hr	-15.3%	3.48	12.2%	Poor
	50-yr 72-hr	-10.2%	3.46	8.0%	Fair
	100yr 72-hr	-7.1%	3.43	5.1%	Fair
C-100	5-yr 24-hr	0.02%	2.23	0.02%	Excellent
	10-yr 24-hr	-0.21%	2.83	-0.21%	Excellent
	25-yr 72-hr	-0.19%	2.38	-0.19%	Excellent
	50-yr 72-hr	-0.16%	2.34	-0.16%	Excellent
	100yr 72-hr	-0.01%	2.41	-0.01%	Excellent

Additionally, results obtained were compared against FEMA Flood Insurance Rate Map Flood Plains. FEMA maps the 100-year flood plains which should correlate with the flood plains developed for the 100-year design storm event. The FEMA zones associated with the 100-year flood plain are Zones A, AE, and AH. Model results were also checked for instabilities by selecting individual links and evaluating the static and dynamic graphs for pipe flow and stages. **Figure 5-6** provides a comparison between the FEMA flood plains and the derived flood plains from the 100-year storm event simulation for the Village of Pinecrest.

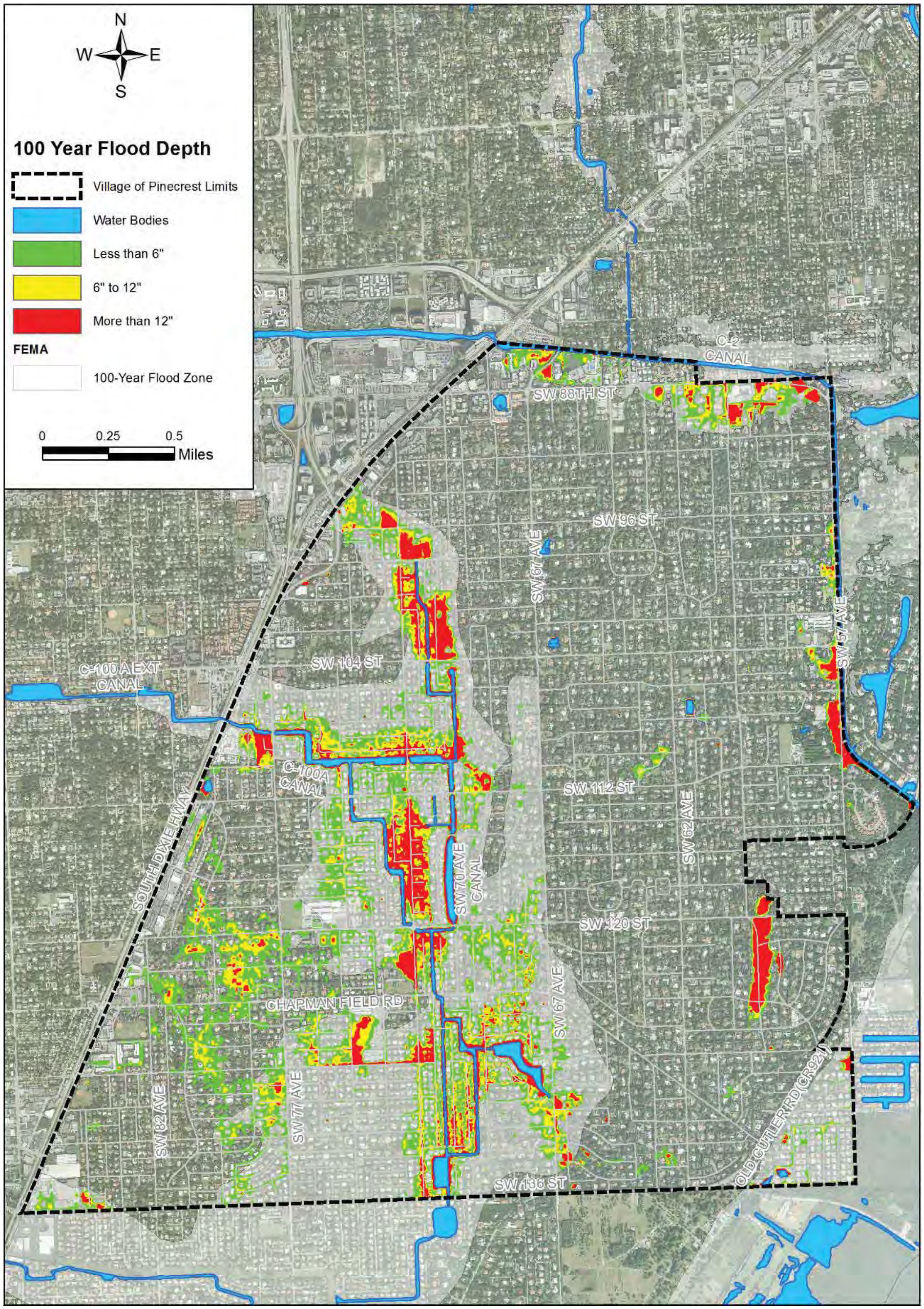


Figure 5-6 – FEMA Flood Plains and 100-year Storm Simulated Flood Plains

Additionally, complaints from the village residents were identified and geocoded based on the recorded address and plotted over the 5-, and 100-year flood plains for comparison purposes. The recorded complaint data corresponded well with the 5-and 100-year flood plains with the majority of the points falling within the simulated flooded areas. The flood plain maps for the comparison between the documented resident complaints and simulated flood areas for the 5-, and 100-year storm events are provided in **Appendix 5F.** In general, the areas showing concentrated flood complaint data tended to fall within the resulting flood plains from the models. Additionally, as with the FEMA data, additional areas of complaints were also observed where the complaint data fell outside of the flood plains possibly due to localized deficiencies within the Village systems generally not captured within planning-level models such as these. In general, more often than not, the flood complaint data agreed with the resulting flood plains with the exception for the coastal areas (South Biscayne Bay) mentioned previously.

5.4.2 Model Production Runs/Design Storm Event Runs

Once the model was updated, the event simulation production runs were simulated for the 5-, 10-, 25-, 50, and 100-year storm events. Each of the models incorporated the changes to land use and completed drainage projects as described in **Section 5.4.1**. The peak stages, flows and volumes were reported for the Village of Pinecrest sub-basins for the following design storm events:

- 5-year, 24-hour
- 10-year, 24-hour
- 25-year, 72-hour
- 50-year, 72-hour
- 100-year, 72-hour

Maximum stage results and comparisons for all events for each model node/sub-basin are provided in **Appendix 5G**. The flood plain maps for the 5-, 10-, 25-, 50, and 100-year storm events are presented in **Appendix 5H**. The flood plain maps display the extent of flooding and depth of flooding at each sub-basin for all design storm events. A summary of model results peak stages for the Village of Pinecrest sub-basins is shown in **Table 5-25**. The 2014 Baseline XP-SWMM model input and output files for the production runs are included on the Digital Disc provided in **Appendix 11**.

Table 5-25 – XP-SWMM Peak Stage Baseline Scenario Results

XP-SWMM Model	Maximum Stage Comparison (ft)		
	Max	Min	Average
5-year, 24-hour	10.13	3.81	6.44
10-year, 24-hour	10.19	4.29	7.03
25-year, 72-hour	10.34	5.27	7.69
50-year, 72-hour	10.39	5.64	7.84
100-year, 72-hour	10.42	6.06	8.00

Although validation of the XP-SWMM models was performed using anecdotal data, the results appeared to generally correspond with expected results within the sub-basins. Comparisons to the FEMA flood plains and with collected complaints from Village residents showed a positive correlation to the previously developed flood plains.

The methodology implemented in the revision and updates of the XP-SWMM Basin models were consistent with the methodology previously established by DRER. Methods for calculating stage-areas and defining hydrologic parameters typical to South Florida, as well as typical assumptions regarding urban stormwater management systems, were all well documented in the various Miami Dade County Basin SWMMP reports. These methods and concepts were carried forward to the Village of Pinecrest SWMP model update process, whenever possible and/or viable.

The resulting updated models developed for this project were both stable with regards to the internal calculations performed by XP-SWMM as well as justifiable based on the anecdotal validation process undertaken. The results obtained from these models provided a relatively representative and detailed synopsis of the flooding conditions present within the Village. These models will provide the Village with useful planning-level tools that will aid the Village in defining future projects and potential future expenditures.

5.5 Water Quality Analysis

The converted 2014 Baseline Scenario XP-SWMM Models were used to calculate pollutant loading to the Village of Pinecrest sub-basins using the same procedures and parameters included in the Miami-Dade County C-2 and C-100 Basin Stormwater Master Plans. Event mean concentrations, pollutant removal fractions, and the land use descriptions used in the C-2 and C-100 Basin models were implemented in the 2014 Baseline Scenario XP SWMM Models. Using the Runoff Block of XP-SWMM, pollutographs for each sub-basin are calculated in the model based on surface runoff and groundwater flows at each node. These pollutographs were then attenuated in the Sanitary Block of XP-SWMM for sub-basins containing BMPs to obtain total pollutant loads at each sub-basin within the Village of Pinecrest.

5.5.1 Water Quality Analysis

The pollutants considered in this analysis include, and were limited to, the following 12 constituents:

1. 5-day Biochemical Oxygen Demand (BOD)
2. Chemical Oxygen Demand (COD)
3. Total Suspended Solids (TSS)
4. Total Dissolved Solids (TDS)
5. Total Kjeldahl Nitrogen (TKN) (total ammonia + organic nitrogen)
6. Total Nitrogen (TN)
7. Total Phosphorus (TP)
8. Dissolved Phosphorus (DP)

9. Total Cadmium (Cd)
10. Total Copper (Cu)
11. Total Lead (Pb)
12. Total Zinc (Zn)

The total pollutant load per sub-basin is calculated using the Runoff Block of the XP-SWMM model. The water quality procedures in the Runoff Block require assigning a separate pollutant factor or Event Mean Concentration (EMC) for each land use classification, for each pollutant. The land use classifications used to define the EMC for each pollutant are shown in **Table 5-27.**

The total net annual pollutant loads for each Village of Pinecrest sub-basin, in pounds per year, were estimated using planning-level hydrologic techniques approved by the Environmental Protection Agency (EPA) in the National Pollution Discharge Elimination System (NPDES) Part 2 Application Guidance Manual (EPA, 1992). The equation used is presented below:

$$L = P * CF * \left(\frac{2.72}{12}\right) * \sum_{i}^{n} Rv_i * C_i * A_i$$

Where:

- L = Estimated Base Annual Pollutant Load (lb/yr)
- P = Annual Rainfall Depth (in/yr)
- CF = Correction Factor for Storms that Produce no Runoff
- A_i = Drainage Area for Land Use
- Rv_i = Runoff Coefficient for Land Use
- C_i = Pollutant Event Mean Concentration for Land Use (mg/L)
- 12 = Conversion Factor (12 inches = 1 foot)
- 2.72 = Conversion Factor Converts (ft./yr)(mg/L)(acres) to (lb/yr)
- $\sum_i^n$ = Sum over *n* Land Use Types.

The total pollutant loads per sub-basin were calculated using the Runoff Block of the XP-SWMM model. Pollutant generation in the Runoff Block is land-use dependent and for each land-use a separate pollutant factor or Event Mean Concentration (EMC) can be applied. After the pollutant loadings are generated per sub-basin the pollutant removal is implemented and final pollutant loadings are calculated.

Table 5-26 – Land Use Description and Code

No.	Code	Land Use Description	No.	Code	Land Use Description
1	TRNS	Transportation	13	URSL	Single Family (low density)
2	UTAP	Airports	14	URSM	Single-Family Residential
3	UCCE	Cultural/Entertainment	15	USGF	Government
4	UCHM	Hotels/Motels	16	ACCL	Row and Field Cropland
5	UCPL	Parking Lots	17	ACCF	Fallow and Pasture

No.	Code	Land Use Description	No.	Code	Land Use Description
6	UCSC	Retail Commercial	18	AMNU	Plant Nurseries
7	UIJK	Junk Yard/Service Equipment	19	ACCLS	Farm Storage Area
8	UILT	Light Industrial	20	USMD	Hospital/Medical
9	UOGC	Golf Courses	21	USRL	Religious Facilities
10	UOUN	Vacant Land	22	UTEP	Utilities
11	URMF	Multi-Family Residential	23	W	Water
12	URMH	Mobile Homes			

A matrix, in which each land use classification is linked with each one of the 12 pollutants, a total of 276 elements, is generated and imported into the global hydrologic parameters input into the Runoff Block. A detailed list of each land use-pollutant pair and their respective EMC value is shown in **Table 5-27** for the C-2 Basin and **Table 5-28**for the C-100 Basin. EMC values that differ between the Basin models are highlighted in yellow. The distinctive percent land use at each node/sub-basin is specified in the water quality data input of XP-SWMM so that the model can calculate a pollutograph at each model node in the Runoff Block.

Table 5-27 – C-2 Basin Event Mean Concentration (EMC) Values

Land Use Classification		Indicator Pollutant (mg/l)											
		BOD5	COD	TSS	TDS	TN	TKN	TP	DP	Cd	Cu	Pb	Zn
1	TRNS	7.90	69.40	38.80	99.80	1.33	0.98	0.19	0.13	0.01	0.01	0.21	0.12
2	UTAP	6.00	42.50	36.10	90.00	1.51	0.94	0.16	0.10	0.00	0.09	0.03	0.07
3	UCCE	10.30	67.50	69.80	137.00	1.73	0.93	0.16	0.13	0.01	0.02	0.27	0.13
4	UCHM	10.30	67.50	69.80	137.00	1.73	0.93	0.16	0.13	0.01	0.02	0.27	0.13
5	UCPL	7.90	69.40	38.80	99.80	1.33	0.98	0.19	0.13	0.01	0.03	0.21	0.12
6	UCSC	10.30	67.50	69.80	137.00	1.73	0.93	0.16	0.13	0.01	0.02	0.27	0.13
7	UIJK	29.20	120.30	159.10	120.30	1.97	1.80	0.28	0.12	0.00	0.05	0.12	0.23
8	UILT	29.20	120.30	159.10	120.30	1.97	1.80	0.28	0.12	0.00	0.05	0.12	0.23
9	UOGC	6.00	42.50	36.10	90.00	1.51	0.94	0.16	0.10	0.00	0.09	0.03	0.07
10	UOUN	6.00	42.50	36.10	90.00	1.51	0.94	0.16	0.10	0.00	0.09	0.03	0.07
11	URMF	10.10	50.20	40.10	114.40	1.81	1.13	0.34	0.14	0.00	0.02	0.08	0.06
12	URMH	10.10	50.20	40.10	114.40	1.81	1.13	0.34	0.14	0.00	0.02	0.08	0.06
13	URSL	10.10	50.20	40.10	114.40	1.81	1.13	0.34	0.14	0.00	0.02	0.08	0.06
14	URSM	10.10	50.20	40.10	114.40	1.81	1.13	0.34	0.14	0.00	0.02	0.08	0.06
15	USGF	10.30	67.50	69.80	137.00	1.73	0.93	0.16	0.13	0.01	0.02	0.27	0.13
16	ACCL	0.00	0.00	12.70	463.00	2.83	0.00	1.46	0.81	0.00	0.04	0.00	0.00
17	ACCF	0.00	0.00	94.30	463.00	2.48	0.00	0.48	0.35	0.00	0.04	0.00	0.00
18	AMNU	0.00	0.00	16.30	463.00	2.05	0.00	0.14	0.09	0.00	0.04	0.00	0.00
19	ACCLS	0.00	0.00	16.30	463.00	2.05	0.00	0.14	0.09	0.00	0.04	0.00	0.00
20	USMD	10.30	67.50	69.80	137.00	1.73	0.93	0.16	0.13	0.01	0.02	0.27	0.13
21	USRL	10.30	67.50	69.80	137.00	1.73	0.93	0.16	0.13	0.01	0.02	0.27	0.13
22	UTEP	29.20	120.30	159.10	120.30	1.97	1.80	0.28	0.12	0.00	0.05	0.12	0.23
23	W	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 5-28 – C-100 Basin Event Mean Concentration (EMC) Values

Land Use Classification		Indicator Pollutant (mg/l)											
		BOD5	COD	TSS	TDS	TN	TKN	TP	DP	Cd	Cu	Pb	Zn
1	TRNS	7.9	69.4	38.8	100	1.33	0.98	0.19	0.13	0.01	0.01	0.21	0.12
2	UTAP	6	42.5	36.1	90	1.51	0.94	0.16	0.1	0	0.09	0.03	0.07
3	UCCE	10.3	67.5	69.8	137	1.73	0.93	0.16	0.13	0.01	0.02	0.27	0.13
4	UCHM	10.3	67.5	69.8	137	1.73	0.93	0.16	0.13	0.01	0.02	0.27	0.13
5	UCPL	7.9	69.4	38.8	100	1.33	0.98	0.19	0.13	0.01	0.03	0.21	0.12
6	UCSC	10.3	67.5	69.8	137	1.73	0.93	0.16	0.13	0.01	0.02	0.27	0.13
7	UIJK	29.2	120	159	120	1.97	1.8	0.28	0.12	0	0.05	0.12	0.23
8	UILT	29.2	120	159	120	1.97	1.8	0.28	0.12	0	0.05	0.12	0.23
9	UOGC	6	42.5	36.1	90	1.51	0.94	0.16	0.1	0	0.09	0.03	0.07
10	UOUN	6	42.5	36.1	90	1.51	0.94	0.16	0.1	0	0.09	0.03	0.07
11	URMF	10.1	50.2	40.1	114	1.81	1.13	0.34	0.14	0	0.02	0.08	0.06
12	URMH	10.1	50.2	40.1	114	1.81	1.13	0.34	0.14	0	0.02	0.08	0.06
13	URSL	10.1	50.2	40.1	114	1.81	1.13	0.34	0.14	0	0.02	0.08	0.06
14	URSM	10.1	50.2	40.1	114	1.81	1.13	0.34	0.14	0	0.02	0.08	0.06
15	USGF	10.3	67.5	69.8	137	1.73	0.93	0.16	0.13	0.01	0.02	0.27	0.13
16	ACCL	0	0	12.7	463	2.83	0	1.46	0.81	0	0.04	0	0
17	ACCF	0	0	94.3	463	2.48	0	0.48	0.35	0	0.04	0	0
18	AMNU	0	0	16.3	463	2.05	0	0.14	0.09	0	0.04	0	0
19	ACCLS	0	0	16.3	463	2.05	0	0.14	0.09	0	0.04	0	0
20	USMD	10.3	67.5	69.8	137	1.73	0.93	0.16	0.13	0.01	0.02	0.27	0.13
21	USRL	10.3	67.5	69.8	137	1.73	0.93	0.16	0.13	0.01	0.02	0.27	0.13
22	UTEP	29.2	120	159	120	1.97	1.8	0.28	0.12	0	0.05	0.12	0.23
23	W	0	0	0	0	0	0	0	0	0	0	0	0

Within the Sanitary Block, pollutant load reductions due to BMPs are used to attenuate the pollutographs generated in the Runoff Block. The removal equation option in the screen treatment unit option with the removal equation was used in XP-SWMM to model BMPs. Removal factors (RMAX) were assigned for each sub-basin in the Village of Pinecrest based on the estimates used in the C-2 and C-100 Basin models received from the County. These values were applied to the total loads per pollutant for the 2014 Baseline Models. For each sub-basin, the type of treatment and area treated is prorated to develop the overall sub-basin RMAX value for the Village of Pinecrest. **Appendix 5I** shows the removal fraction or RMAX value implemented at each sub-basin and for each pollutant.

5.5.1.1 Water Quality Production Run

Water Quality simulation production runs were conducted for 5 storm events (5-year, 10-year, 25-year, 50-year, and 100-year) and for 3 continuous yearlong simulations: dry (75%), average (50%), and wet (25%) continuous simulations. The XP-SWMM models were executed following the same methodology and rainfall distributions used by DRER for the C-2 and C-100 Basin models. The rainfall input frequency was 15-minute intervals for all water quality simulations. The 2014 Baseline XP-SWMM model input and output files for the water quality analysis are included on the Digital Disc provided in **Appendix 11**.

5.5.1.2 Water Quality Results

The pollutant loads for the 12 pollutants were obtained using the Runoff Block and Sanitary Block of the XP-SWMM model as previously described. The pollutant loads for each sub-basin within the Village of Pinecrest are provided in **Appendix 5J** for each of the 5 storm event simulations. The XP-SWMM model results shown in **Appendix 5K** present the pollutant loads for each of the 12 pollutants at each sub-basin for the average, dry, and wet continuous one year simulations. **Table 5-29** provides the total loads for each of the 12 pollutants for the dry, average, and wet simulations for the Village of Pinecrest sub-basins and the South Biscayne Bay Basin. **Table 5-30** shows the annual pollutant loads the Village of Pinecrest contributes to the C-100 Basin and the C-2 Basins. The pollutant modeling production runs and annual simulations are included on the digital disc provided to the Village of Pinecrest as part of the SWMP.

Table 5-29 – Total Annual Pollutant Loads for the Village of Pinecrest and South Biscayne Bay Basin

	Village of Pinecrest Total Annual Load (lbs/yr)		
Pollutant	**Dry**	**Average**	**Wet**
BOD5	3.37E+04	4.27E+04	5.25E+04
COD	1.73E+05	2.19E+05	2.68E+05
TSS	1.40E+05	1.78E+05	2.06E+05
TDS	3.87E+05	4.90E+05	5.87E+05
TN	5.67E+03	6.20E+03	8.05E+03
TKN	3.77E+03	4.77E+03	5.85E+03
TP	1.10E+03	1.39E+03	1.71E+03
DP	4.66E+02	5.90E+02	7.24E+02
Cd	7.91E+00	1.00E+01	1.22E+01
Cu	6.94E+01	8.53E+01	1.04E+02
Pb	2.82E+02	3.26E+02	4.08E+02
Zn	2.31E+02	2.92E+02	3.56E+02

	Biscayne Bay Basin Total Annual Load (lbs/yr)		
Pollutant	**Dry**	**Average**	**Wet**
BOD5	3.55E+03	5.02E+03	6.10E+03
COD	1.77E+04	2.50E+04	3.03E+04
TSS	1.41E+04	2.00E+04	2.38E+04
TDS	4.03E+04	5.70E+04	6.84E+04
TN	6.23E+02	5.63E+02	6.94E+02
TKN	3.97E+02	5.63E+02	6.82E+02
TP	1.19E+02	1.69E+02	2.05E+02
DP	4.91E+01	6.96E+01	8.44E+01
Cd	7.69E-01	1.10E+00	1.32E+00
Cu	6.63E+00	9.05E+00	1.12E+01
Pb	2.72E+01	3.19E+01	3.89E+01
Zn	2.26E+01	3.19E+01	3.87E+01

Table 5-30 – Total Annual Pollutant Loads for the C-100 and C-2 Basins

	C-100 Basin Total Annual Load (lbs/yr)		
Pollutant	**Dry**	**Average**	**Wet**
BOD5	2.53E+04	3.61E+04	4.38E+04
COD	1.28E+05	1.83E+05	2.22E+05
TSS	1.04E+05	1.50E+05	1.82E+05
TDS	2.90E+05	4.14E+05	5.03E+05
TN	4.54E+03	5.34E+03	6.50E+03
TKN	2.81E+03	4.01E+03	4.87E+03
TP	8.26E+02	1.18E+03	1.43E+03
DP	3.49E+02	4.98E+02	6.04E+02
Cd	5.80E+00	8.34E+00	1.01E+01
Cu	4.88E+01	6.96E+01	8.45E+01
Pb	2.17E+02	2.75E+02	3.33E+02
Zn	1.70E+02	2.44E+02	2.96E+02

	C-2 Basin Total Annual Load (lbs/yr)		
Pollutant	**Dry**	**Average**	**Wet**
BOD5	5.76E+03	5.11E+03	4.51E+03
COD	3.13E+04	2.75E+04	2.53E+04
TSS	2.48E+04	2.18E+04	8.62E+03
TDS	6.69E+04	5.91E+04	3.78E+04
TN	6.58E+02	5.81E+02	8.18E+02
TKN	6.58E+02	5.81E+02	5.16E+02
TP	1.81E+02	1.61E+02	1.42E+02
DP	8.03E+01	7.12E+01	6.30E+01
Cd	1.52E+00	1.35E+00	1.20E+00
Cu	1.59E+01	1.30E+01	1.22E+01
Pb	4.39E+01	3.83E+01	4.30E+01
Zn	4.39E+01	3.83E+01	3.44E+01

The pollutant loading within each sub-basin in the Village of Pinecrest was implemented using the same methodology and parameters used for the C-2 and C-100 Basin Models. The EMC and RMAX values were preserved across the updated model sub-basins within the Village of Pinecrest. The results were within a reasonable range.

6.0 SEA LEVEL RISE IMPACT ASSESSMENT

The analysis of sea level rise for this SWMP was coordinated with a number of federal, state, and local agencies, including SFWMD, USACE, the Miami-Dade Sea-Level Rise Task Force, and sea level rise experts such as Dr. Wanless from the University of Miami and Chair of the science committee for the Miami-Dade Climate Change Advisory Task Force, and Dr. Obeysekera, a member of US National Climate Assessment and Development and Advisory Committee and Climate Change expert for the SFWMD.

In July 2014, Miami-Dade County published the findings of a Sea Level Task Force initiated by the County to review available sea level studies and to provide recommendations with regards to addressing sea level rise at the County Level. This document, titled *Miami-Dade Sea Level Rise Task Force Report and Recommendations* is available through the County's Sea Level Rise Task Force webpage: http://www.miamidade.gov/planning/boards-sea level-rise.asp. Additionally, Florida Atlantic University, with funding from FDOT, has also done research on sea level rise and climate change as it relates to South Florida. Their research is available through their Climate Change in South Florida webpage: http://www.ces.fau.edu/climate_change/. Sea level Rise projections developed by the Army Corps of Engineers, which was accepted and implemented as part of the Miami-Dade County Sea Level Rise Task Force Report in 2014 were utilized to evaluate the conceptual projects proposed in this SWMP.

The threat of "Sea Level Rise" in south Florida, especially in Miami Dade County, is a significant concern. The areas that are more susceptible to impact of changes in sea level rise are the areas already subject to flooding by major rain events and storm surges or that lay within Flood Zones. **Figure 6-1** shows the areas that are considered Flood Zones established by FEMA in 2009 as part of the National Flood Insurance Program (NFIP) within the limits of the Village.

The drainage of the Village of Pinecrest primarily relies on two canal systems (C-2 Canal and C-100 Canal) which discharge to Biscayne Bay via downstream control structures. The sea level rise projections for 2030 and 2060 are based on historical data collected in Monroe County with minimum and maximum projections for 2030 and 2060 being 3-7 and 9-24 inches, respectively.

This cycle of the Stormwater Master Plan analyzed the maximum prediction for both the 2030 sea level rise projection of 7 inches and the 2060 maximum of 24 inches for the design of the proposed projects. There is currently uncertainty regarding if actual seal-level rise will be higher or lower than currently predicted. Most experts do agree that the actual rate of sea level rise will be better known within the next 10 years. Stormwater Master Plans are typically updated every 5 years and should include an adaptive management approach to adjust based on the amount of seal-level rise that will occur over the next 15 to 45 years. At that time additional data available on sea level rise should be evaluated to modify the sea level rise scenario and to update the Stormwater Master Plan as necessary.

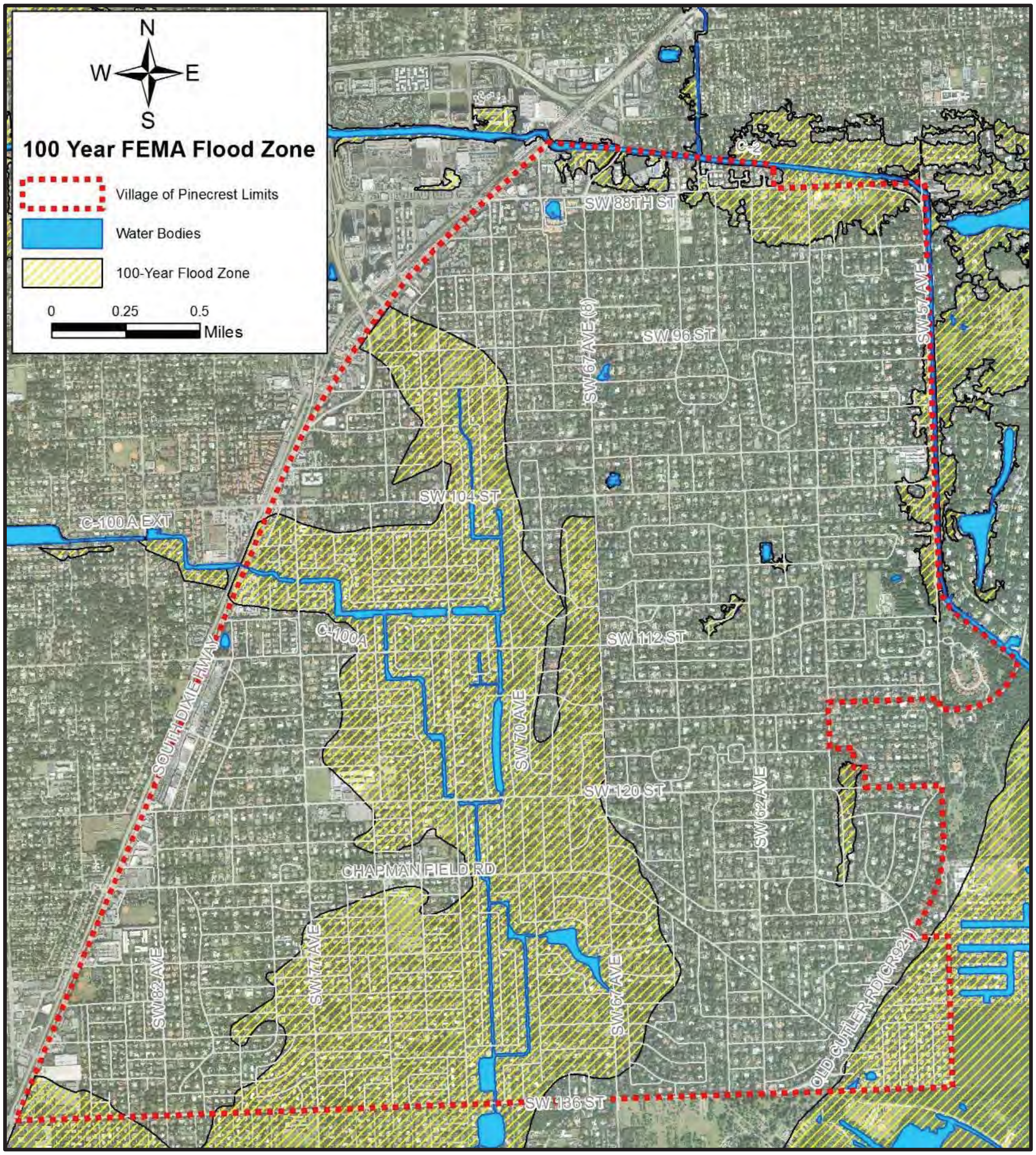
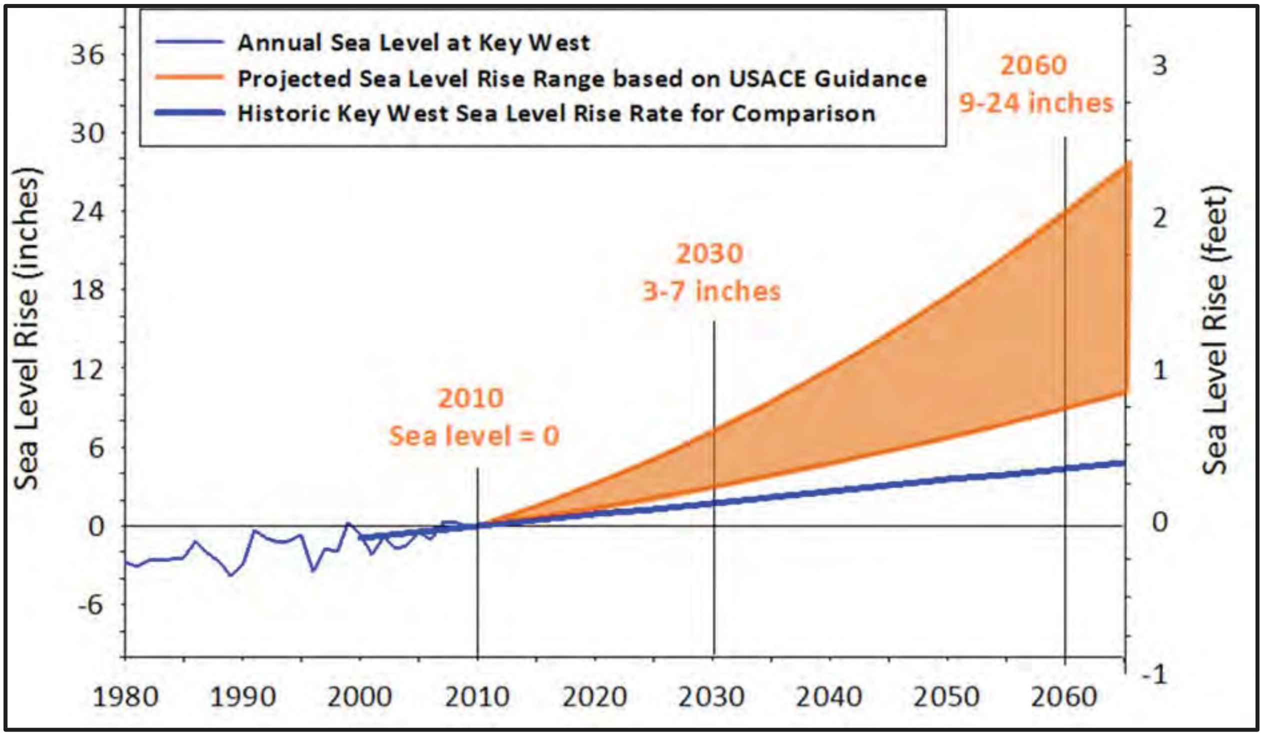


Figure 6-1 – FEMA Flood Zones within the Village of Pinecrest

The parameters used for analysis of sea level rise in the Village are based on the findings in the Miami-Dade County Sea Level Task Force Report and Recommendations, July 1, 2014. This report contains the most relevant data for South Florida and is the most recent document available at the time of this SWMP regarding sea level rise and the potential effects to South Florida ecology and infrastructure. The Task Force Report focused on sea level rise predictions up to the year 2060. The planning guidelines adopted by the County's Task Force were based mostly on the projections developed by the Southeast Florida Regional Climate Change Compact partners. The Southeast Florida Regional Climate Change Compact convened a group of experts in 2010 which reviewed the most current science and data and developed a sea level rise projection over time for the Southeast Florida region. The sea level rise projection they developed for South Florida from their review of numerous sources is shown in **Figure 6-2**.



Source: *A Region Responds to a Changing Climate, Southeast Florida Regional Climate Change Compact Counties*, October 2012. This projection uses historic tidal information form Key West and was calculated by Kristopher Esterson from the United States Army Corps of Engineers (USACE) using the USACE Guidance (USACE 2009) intermediate and high curves to represent the lower and upper bound for projected sea level rise in Southeast Florida. These curves were adopted in 2014 in the *Miami-Dade County Sea Level Rise Task Force Report*.

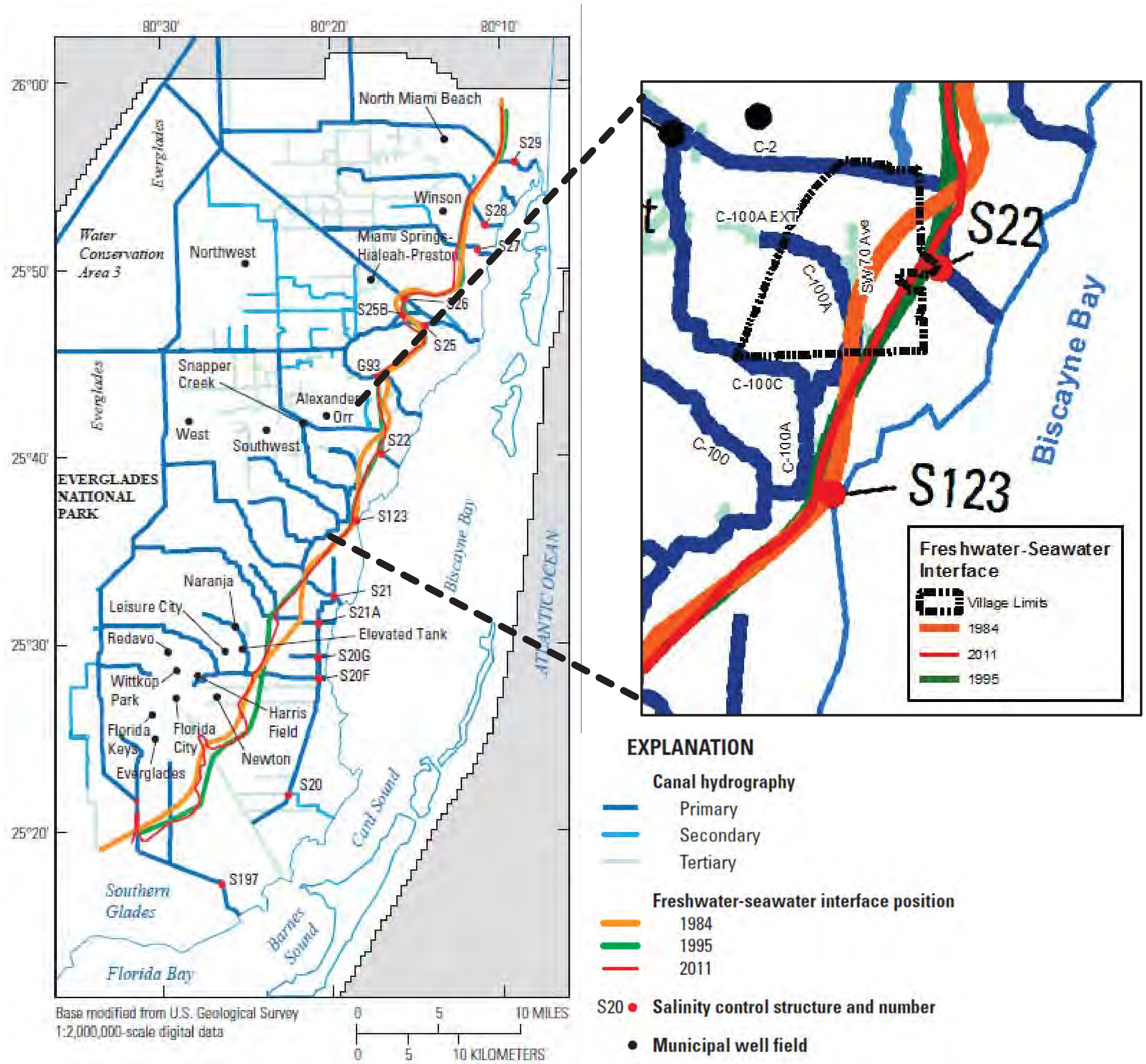
Figure 6-2 – Sea Level Rise Projection for the Southeast Florida Region

6.1 Sea Level Rise Effects on Groundwater

In addition to the surface flows associated with sea level rise, the impact on increasing groundwater levels was also evaluated. During the time this SWMP was being prepared, DRER and USGS published the groundwater table maps for the period of 2000-2009. Historically there have been no significant changes in groundwater levels for the previous published period of 1990 to 1999. At this point, results do not show a global trend in changing groundwater levels due to sea level rise. Based on the study performed by USGS, small changes in water levels can be observed due to modifications in the operations of primary canal systems by SFWMD. Only the salinity control structures show a rising trend in groundwater levels since the main function of these structures is to maintain groundwater levels to prevent salinity intrusion.

The USGS document that compares trends in groundwater levels for the previous periods can be found at http://fl.water.usgs.gov/PDF_files/ofr02_91_lietz.pdf "Average Altitude of the Water Table (1990-99) and Frequency Analysis of Water Levels (1974-99) in the Biscayne Aquifer, Miami-Dade County, Florida". In addition, in 2014, USGS, in cooperation with the Miami-Dade Water and Sewer Department, published *Hydrological Conditions and Effect of Pumpage and Sea Level on Canal Leakage and Regional Groundwater Flow*. This report documents a study completed to quantify the effects of sea level rise on surface water levels and groundwater levels, canal leakage, and the saltwater-freshwater interface in Southeast Florida. The study also examined the hydrological effects of different groundwater pumping rates. The report is available on the USGS website at http://pubs.usgs.gov/sir/2014/5162/.

According to the *Hydrological Conditions and Effect of Pumpage and Sea Level on Canal Leakage and Regional Groundwater Flow*, the saltwater-freshwater interface has shown little to no movement inland since 1995. Studies conducted in 2011, which indicated small inland and seaward movements throughout the study area, are believed to be a result of more accurate measurement techniques and better availability of data rather than a substantial shift in the actual saltwater-freshwater interface. Subtle changes are attributed to changes in the rate of pumpage at well fields and the water levels maintained within the conveyance system. As shown in **Figure 6-3**, the freshwater-seawater interface has shown negligible migration between 1984 and 2011 within the Village of Pinecrest and adjacent areas.



*Adapted from *Hydrological Conditions and Effect of Pumpage and Sea Level on Canal Leakage and Regional Groundwater Flow* by Joseph D. Hughes and Jeremy T. White http://pubs.usgs.gov/sir/2014/5162/

Figure 6-3 – Freshwater-Seawater Interface in 1984, 1995, and 2011

The model used for the study was calibrated for the time period of 1997 through 2014 and verified for 2005-2010. The study evaluated the impacts on groundwater levels using a base-case 30-year period, simulating through 2045, with 12 inches (1 foot) of sea level rise. The findings of the simulated effect on groundwater elevations are shown in **Figure 6-4**. The left figure shows the effects of increased well pumping, the center figure displays the effects of 12 inches (1 foot) in sea level rise, and figure on the right displays the combined effect of increased well pumping and sea level rise. The Village is outlined with a red square and orange corresponds to a groundwater elevation decrease of one foot and dark blue corresponds to a one-foot increase.

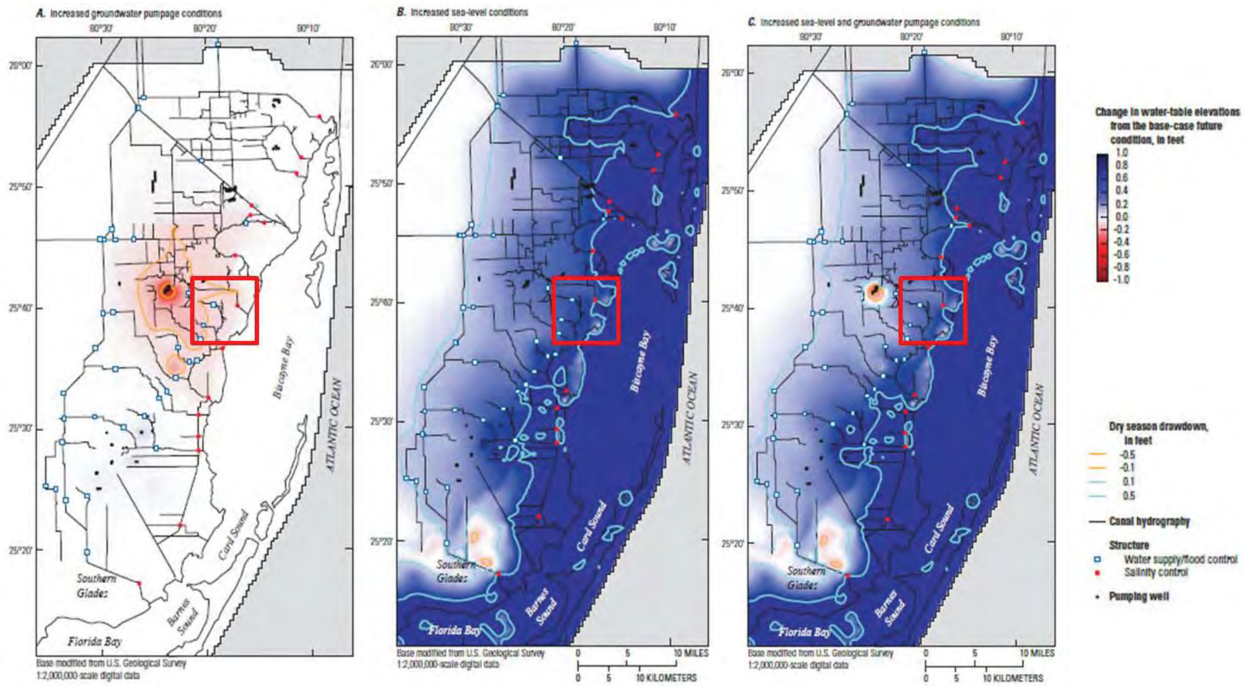


Figure 6-4 – Simulated Changes in Water Table Elevations from the base-case scenario in the 30th year of the scenario simulation period

The modeling results from USGS indicate limited migration of the saltwater intrusion line due to the existence of salinity control structures along the coast. The results for the 2045 groundwater model showed that increased well pumping combined with a one foot rise in sea level would result in approximately 0.5 foot increase in groundwater along the coast and 0.1 foot increase in groundwater further west and in parts of the urbanized areas.

6.2 Sea Level Rise Results

Although the Village is not a shore-based community, the rising of sea levels can affect canals which represent the primary drainage systems within the County, and subsequently, the Village. These issues can compromise existing secondary drainage systems and ultimately reduce the capacity of these systems which often results in flooding when coupled with frequent storm events. Identification of areas with the most vulnerability to sea level rise within the Village of Pinecrest will provide the Village with an additional tool for evaluating future projects and partner with Miami Dade County and the SFWMD which control the regional drainage system to implement regional solutions to address potential impacts due to sea level rise.

As described previously, the Village falls within the boundaries of the South Florida Water Management District (SFWMD) C-2 and C-100 Basins. These basins are drained by the C-2 Canal (Snapper Creek Canal) and the C-100 Canal. The C-100 receives discharges from the Village via the C-100A and C-100A Extension Canals (Cutler Drainage Canals) and the SW 70th Avenue Canal. These canals primarily flow to Biscayne Bay discharging runoff from the western most areas of the C-2 and C-100

Basin. This runoff, along with runoff from the major portions of the Village, is controlled by two SFWMD structures that are outside the Village limits, gate structure S-22 and gate structure S-123.

Structure S-22 is located near the mouth of the C-2 Canal approximately 7,000 feet from Biscayne Bay shoreline. This reinforced concrete gated spillway controls discharge with two cable operated vertical lift gates. The purpose of this structure is to maintain optimum upstream water stages and to prevent salt water intrusion during the periods of high tide. The structure passes the design flood (100% of the Standard project Flood) without exceeding upstream flood design stage and restricts downstream flood stages and discharge velocities to non-damaging levels. In general, this structure is operated to maintain an optimum headwater elevation of 2.9 ft-NGVD when sufficient water is available to maintain this level. However, in the rare event of a high flood tide, whenever the differential between the head and tailwater pool elevations reaches 0.3 feet the system will override the normal gate operations and the gates will close to regulate saline intrusion. Additionally, in response to heavy rainfall, the gate may lower headwater elevations until the storm has passed.

Structure S-123 is located near the mouth of Canal C-100 below the junction of C-100, C-100A, and C-100B, approximately 600 feet from the shore of Biscayne Bay. This is also a reinforced concrete gated spillway with discharge controlled by two cable operated vertical lift gates. The purpose of this structure is to maintain optimum water control upstream stages in Canals C-100, C-100A, and C-100B. The structure passes the design flood (40% of the Standard Project Flood) without exceeding upstream flood design stage and restricts downstream flood stages and discharge velocities to non-damaging levels. It also prevents salt water intrusion during periods of high flood tides. In general, this structure is operated to maintain an optimum headwater elevation which varies seasonally from a low of 2.0 ft-NGVD during the flood condition to a maximum of 3.5 ft-NGVD during the dry condition, if sufficient water is available to maintain this level. However, in the rare event of a high flood tide, when the differential between the head and tailwater pool elevations reach 0.3 feet the system will override the normal gate operations and the gates will close to regulate salt water intrusion.

The sea level predictions for the years 2030 and 2060 were selected for analysis in the Village of Pinecrest. The 2030 projection indicates the sea level will be at an additional 3 to 7 inches above the current levels, with a rise of 9 to 24 inches above current levels by the year 2060. Simulations using the 2014 XP-SWMM Baseline Model were completed by implementing maximum predictions, 7 and 24 inches for the year 2030 and 2060, respectively. The modeling results from USGS indicate that for the 2045 groundwater model showed that increased well pumping combined with a one foot rise in sea level would result in approximately 0.5 foot increase in groundwater along the coast and 0.1 foot increase in groundwater further west and in parts of the urbanized areas. A 0.5 foot of sea level rise was assumed for the Village for year 2045, which correlates to 0.24 feet (3.36 inches) of groundwater rise for 2030, 7 inches of sea level rise, and 0.8 feet (9.6 inches) of groundwater rise for 2060, 24 inches of sea level rise.

According to the report by Dr. Leonard Berry at Florida Atlantic University, *Development of a Methodology for the Assessment of Sea Level Rise Impacts on Florida's*

Transportation Modes and Infrastructure, the current global rate of Sea Level Rise is approximately 3 mm per year. However, projections of Sea Level Rise indicate a non-linear increase in future years as can be seen in **Figure 6-2** for the Southeast Florida region for the next 50-years. A rise of at least one meter (about 3.28 feet) before the end of the century is an increasingly likely possibility. Here in South Florida sea level rise is already a problem. Significant impacts can be seen along the coast that are affecting canal functionality. Higher sea levels prevent the canal systems from discharging water from low-lying areas during periods of high rainfall and high tide which is what they are designed for. It is important to note that the impacts of sea level rise on groundwater levels, flooding, drainage, and salt water intrusion may occur in inland areas before direct shoreline impacts are more apparent. Therefore, it is prudent and essential to prepare for and adjust activities and infrastructure to sea level rise.

The 2014 Baseline XP-SWMM model described in the previous sections was used to evaluate the impacts of sea level rise within the Village of Pinecrest. The scenarios simulated and sea level rise parameters implemented are as follows:

1. Normal tidal fluctuations with no rainfall (3.3 feet high tide).
2. Maximum sea level rise prediction for the year 2030 and 2060 with no rainfall events (7 and 24 inches, respectively).
3. Maximum groundwater rise of 0.24 feet (3.36 inches) for 2030, 7 inches of sea level rise and 0.8 feet (9.6 inches) for 2060, 24 inches of sea level rise.
4. 5-year, 24-hour rainfall event combined with maximum sea level and groundwater rise predictions for the year 2030 and 2060.
5. 100-year, 72-hour rainfall event combined with maximum sea level and groundwater rise predictions for the year 2030 and 2060.

The 2014 Baseline XP-SWMM model input and output files for evaluating the impact of sea level rise are included on the Digital Disc provided in **Appendix 11**.

The results obtained for the maximum sea level rise predictions without rainfall for the year 2030 and 2060, 7-inches and 24-inches respectively, generally indicate stages throughout the Village will not be affected with little impact on most areas. This is primarily due to the fact that both structures, S-22 and S-123, which regulate water exchanges with Biscayne Bay will remain closed. The only impacts that can be seen from the analysis are in those areas that are not controlled by the two SFWMD structures. The flood plain maps for the 2030 and 2060 Sea Level Rise projection without rainfall are presented in **Appendix 6A** along with the model results using the current normal tidal conditions for comparison.

For the remaining analysis, a 5-year, 24-hour storm event and a 100-year, 72-hour storm event was simulated in addition to the sea level rise projections for 2030 and 2060. The resulting stage increase across the Village was low to moderate for the inland areas. This is most likely due to the SFWMD gate operation for structures S-22 and S-123, which are designed to be closed when there is more than 0.3 feet difference between headwater and tailwater elevation, thus excess rainfall runoff cannot be released into Biscayne Bay. Maximum stage results and comparisons for the 5-, and 100-year storm events for the 2030 and 2060 Sea Level Rise projection are provided in **Appendix 6B**. The flood plain maps for the sea level rise projections with a 5- and 100-year storm event are presented in **Appendix 6C**. A statistical summary of model peak stages for the Village of Pinecrest sub-basins is shown in **Table 6-1**.

Table 6-1 – XP-SWMM Peak Stage Results for Sea Level Rise 2030 and 2060 Projection

Sea Level and Groundwater Rise	Maximum Stage Comparison (ft)		
	Max	Min	Average
2030, 5-Year Storm	10.13	4.00	6.60
2030, 100 Year Storm	10.42	6.29	8.04
2060, 5-Year Storm	10.13	4.00	7.00
2060, 100-Year Storm	10.42	6.76	8.18

In general, the projections for sea level rise in 2030 (maximum of 7 inches) and 2060 (maximum of 24 inches) show limited areas of flooding, mainly concentrated near water bodies, including the C-100 Canal and C-2 Canal and in limited areas with low elevations.

Flood plain maps which provide a comparison between the current extent of flooding with the 5-year and the 100-year storm events with the additional depth of flooding produced by the same storm events in addition to the projected sea level rise and the predicted effect on groundwater levels is provided in **Appendix 6D**. These comparisons demonstrate that the extent and depth of flooding with sea level rise in the Village of Pinecrest would be greater than the present extent of flooding with the current tidal fluctuations. This is particularly the case near the C-2 and SW 70th Street Canals and areas of low elevation.

7.0 SUB-BASIN RANKING AND PRIORITIZATION

7.1 DRER Sub-basin Ranking & Level of Service Procedure

Miami-Dade County Department of Regulatory and Economic Resources (DRER) established procedures and criteria, as part of their stormwater master planning activities, to identify problem areas, rank problem areas (sub-basins) and establish flood protection level of service using the hydrologic/hydraulic modeling results for the 5-, 10-, 25-, 50- and 100-year design storm events. These procedures and criteria are documented in Part I, Volume 3, "Stormwater Planning Procedures," March 1995 and was applied by DRER to the C-2 and C-100 Basins. In this methodology, the ranking of flooding problem areas is related to the defined floodplain level of service (FPLOS) as follows:

1. All structures (commercial, residential, and public) should be flood-free during the 100-year storm event.
2. Principal arterial roads, including major evacuation routes, should be passable during the 100-year storm event.
3. All canals should operate within their banks during their respective design floods. (Primary canal design criteria vary from 10-year to 100-year events and are described for the major drainage basins in the Miami-Dade County Comprehensive Plan). The C-100 and secondary canals are designed for a 10-year storm event and C-2 Canal is designed for a 100-year storm event
4. Minor arterial roads (up to 4-lanes) should be passable during the 10-year storm event.
5. Collector and local residential streets should be passable during the 5-year storm event, as per current Miami-Dade County Drainage Policy.

The severity of flooding within each sub-basin is determined through the calculation of a flooding problem severity score (FPSS), which is a function of five "severity indicators" that are directly related to the FPLOS criteria described previously. These severity indicators are defined and summarized below. Each of these indicators also have an assigned "weighing factor" (WF), which is related to the relative importance of the flooding severity indicator.

<u>DRER set the following sub-basin Flooding Severity Indicators and WF:</u>

1. **NS:** Number of structures flooded by the 100-year flood, which can include commercial, residential, and public buildings. All structures and/or buildings are considered equivalent, regardless of their size or value. **(WF = 4)**
2. **MER:** Miles of principal arterial roads, including major evacuation routes, which are impassable during the 100-year flood. DRER has defined that a principal arterial road is considered impassable if the depth of flooding exceeds 8 inches above the crown of the road during the 100-year design event. **(WF = 4)**
3. **BM:** Miles of canal with out-of-bank flow, expressed in bank-miles. The length of canal flooding shall be determined for the design storm event originally used to design the canal. **(WF = 3)**

4. **MMAS:** Miles of minor arterial roads impassable during the 10-year flood. DRER has defined that a minor arterial road is considered impassable if the depth of flooding exceeds the crown of the road during the 10-year design event. **(WF = 2)**
5. **MCLRS:** Miles of collector and local residential streets impassable during 5-year flood. DRER has defined that collector and local residential streets are considered impassable if the depth of flooding exceeds the crown of the road during the 5-year design storm event. **(WF = 1)**

The severity indicators are rated by an exceedance (E) value pursuant to the following DRER severity score listed in the table below.

Depth of Flooding Above the FPLOS	E
Less than or equal to 6 inches	1
Greater than 6 inches and less than or equal to 12 inches	2
Greater than 12 inches	3

Given the definitions for the flooding severity indicators (NS, MER, BM, MMAS, and MCLRS), WF, and E, the FPSS for each sub-basin is calculated using the following formula, where $E_{(i)}$ through $E_{(v)}$ relates to the degree of exceedance for each of the five severity indicators.

$$\textbf{FPSS} = [4 \times E_{(i)} \times NS] + [4 \times E_{(ii)} \times MER] + [3 \times E_{(iii)} \times BM] + [2 \times E_{(iv)} \times MMAS] + [1 \times E_{(v)} \times MCLRS]$$

Once the severity score is calculated per basin, the sub-basin with the highest FPSS is given a ranking value of 1. Subsequent FPSS scores are then given ranking values of 1 through X. Sub-basins with equivalent FPSS are given the same ranking value. This approach will yield the basins with the highest flooding problems based on a quantifiable and mathematical basis.

Flood Protection Level of Service (FPLOS)

The actual flood protection level-of-service (FPLOS) provided within a particular sub-basin is dependent upon the number of FPLOS criteria that have been met, as defined previously. DRER established a FPLOS rating by assigning a letter values based on the following schedule.

FPLOS	Number of Indicators/ FPLOS Criteria Met
A	all five met
B	four of the five met
C	three of the five met
D	two of the five met
E	one or none of the five met

7.2 Village of Pinecrest Sub-basin Ranking & Level of Service Procedure

As described in **Section 7.1**, DRER's procedure utilized parameters that were dependent on the peak flood elevations for the 5-, 10-, 25-, 50- and 100-year design storm events. For the Village of Pinecrest Stormwater Management Master Plan, it is recommended to use DRER's procedure with some refinements to provide additional quantifiable flooding factors for the sub-basin ranking. The proposed refinements should account for only the results associated with the 5-, 10- and 100-year design storm events because these are the only design storm events that define the level of service of the existing infrastructure within the Village.

The following parameters are recommended to be added to the DRER parameters to provide a more representative indication of the flood severity within a given sub-basin:

1. **DEM**: Total area experiencing flooding during the 100-year storm event in 10 acre units.
2. **NFC**: Number of flooding complaints received from residents and Village staff.
3. **RPL**: Total number of repetitive loss complaints reported to FEMA.

Similar to DRER's ranking procedure, the ranking of flooding problem areas will be related to the defined floodplain level of service (FPLOS) as follows:

1. All structures (commercial, residential, and public) should be flood-free during the 100-year storm event.
2. Principal arterial roads, including major evacuation routes, should be passable during the 100-year storm event.
3. All canals should operate within their banks during their respective design floods. The C-100 and secondary canals are designed for a 10-year storm event and C-2 Canal is designed for a 100-year storm event.
4. Minor arterial roads (up to 4-lanes) should be passable during the 10-year storm event.
5. Collector and local residential streets should be passable during the 5-year storm event, as per current Miami-Dade County Drainage Policy.
6. Total area flooded within a sub-basin will be minimized during the 100-year storm event.
7. Number of documented flooding complaints should be kept to a minimum.
8. Total number of repetitive loss complaints should be reduced or eliminated.

In keeping with the DRER procedure, the severity of flooding within each sub-basin is determined through the calculation of a flooding problem severity score (FPSS). For the Village of Pinecrest SWMP the FPSS will be a function of the eight (8) "severity indicators" described below that are directly related to the FPLOS criteria described previously. These severity indicators are defined and summarized below. Each of these indicators also have an assigned recommended "weighing factor" (WF) which is related to the relative importance of the flooding severity indicator. Input was obtained from the Village staff and residents in establishing WF for some of the Flood Severity Indicators.

<u>Sub-basin Flooding Severity Indicators and WF</u>

1. **NS:** Number of structures flooded by the 100-year flood, including commercial, residential, and public buildings. All structures and/or buildings are considered equivalent, regardless of their size or value. **(WF = 3)**
2. **DEM:** Total area experiencing flooding for the 100-year flood in 10 acre units. **(WF = 5)**
3. **MER:** Miles of principal arterial roads, including major evacuation routes, which are impassable during the 100-year flood. A principal arterial road is considered impassable if the depth of flooding exceeds 8 inches above the crown of the road during the 100-year design event. **(WF = 4)**
4. **MMAS:** Miles of minor arterial roads, which are impassable during the 10-year flood. **(WF = 4)**
5. **MCLRS:** Miles of collector and local residential streets impassable during 5-year flood. Collector and local residential streets are considered impassable if the depth of flooding exceeds the crown of the road during the 5-year design storm event. **(WF = 2)**
6. **BM:** Miles of canal with out-of-bank flow, expressed in bank-miles. The length of canal flooding shall be determined for the design storm event originally used to design the canal. The C-100 and secondary canals are designed for a 10-year storm event and C-2 Designed for at least a 100-year storm event. **(WF = 3)**
7. **NFC**: Number of flooding complaints documented by residents and Village staff. **(WF = 2)**
8. **RPL:** Number of repetitive loss complaints reported to FEMA. **(WF = 8)**

Also in keeping with the DRER procedures, the severity indicators are rated by an exceedance (E) value pursuant to the following DRER severity score listed in the table below for all values.

Depth of Flooding Above the FPLOS	E
Less than or equal to 6 inches	1
Greater than 6 inches and less than or equal to 12 inches	2
Greater than 12 inches	3

No severity factor will be assigned for the number of flooding complaint (NFC) and repetitive losses (RPL) because there is no consistent, verifiable data to determine the extent of flooding for these severity factors.

Given the definitions for the flooding severity indicators (NS, DEM, MER, MMAS, MCLRS, BM, NFC, and RPL), WF, and E, the FPSS for each sub-basin is calculated using the following formula where $E_{(i)}$ through $E_{(v)}$ relates to the degree of exceedance for each of the applicable severity indicators.

$$\mathbf{FPSS} = [3 \times E_{(i)} \times NS] + [5 \times E_{(ii)} \times DEM] + [4 \times E_{(iii)} \times MER] + [4 \times E_{(iii)} \times MMAS] + [2 \times E_{(v)} \times MCLRS] + [3 \times E_{(vi)} \times BM] + [2 \times NFC] + [8 \times RPL]$$

Once the severity score is calculated per sub-basin, the sub-basin with the highest FPSS is given a ranking value of 1. Subsequent FPSS scores are then given ranking values of 2 through X. Sub-basins with equivalent FPSS are given the same ranking value. This approach will yield the basins with the highest flooding problems based on a quantifiable and mathematical basis.

7.2.1 Village of Pinecrest Flood Protection Level of Service Procedure

The actual flood protection level-of-service (FPLOS) provided within a particular sub-basin is dependent upon the number of FPLOS criteria that have been met, as defined previously. DRER established a FPLOS rating by assigning a letter value. A similar but refined approach was developed to establish a FPLOS rating by assigning a letter value. Each sub-basin was analyzed and scored by the overall FPSS score. A statistical analysis of all the sub-basins was completed to reach the final FPLOS performance score for each sub-basin. The FPLOS criteria and statistical performance developed for the Village of Pinecrest, in corroboration with Village Staff, is shown below:

FPLOS	Percent of FPSS Value
A	83% or higher of Sub-Basin FPSS
B	67 - 82% of Sub-Basin FPSS
C	51 - 67% of Sub-Basin FPSS
D	34- 50% of Sub-Basin FPSS
E	17 - 33% of Sub-Basin FPSS
F	0 - 16% of Sub-Basin FPSS

7.2.2 Excluded Areas

The Village of Pinecrest contains some areas within a sub-basin which are considered private and do not fall within the Village’s responsibility when it comes to maintenance of the drainage systems or implementing flood protection improvements. These mostly include areas such as private developments, where not only are the structures, lakes, and open/common areas privately owned, but the roadways and underlying stormwater management infrastructure are also privately owned and managed. The Village is not responsible for maintaining or constructing improvements to address flooding issues within these areas. The property parcels highlighted in green and the roadways shown in yellow in **Figure 7–1** have been identified by the Village as being completely private and are outside of the responsibility of the Village. As such, for the purposes of this study, these areas were excluded in the final FPSS ranking and FPLOS scoring and future projects will not be proposed for these areas.

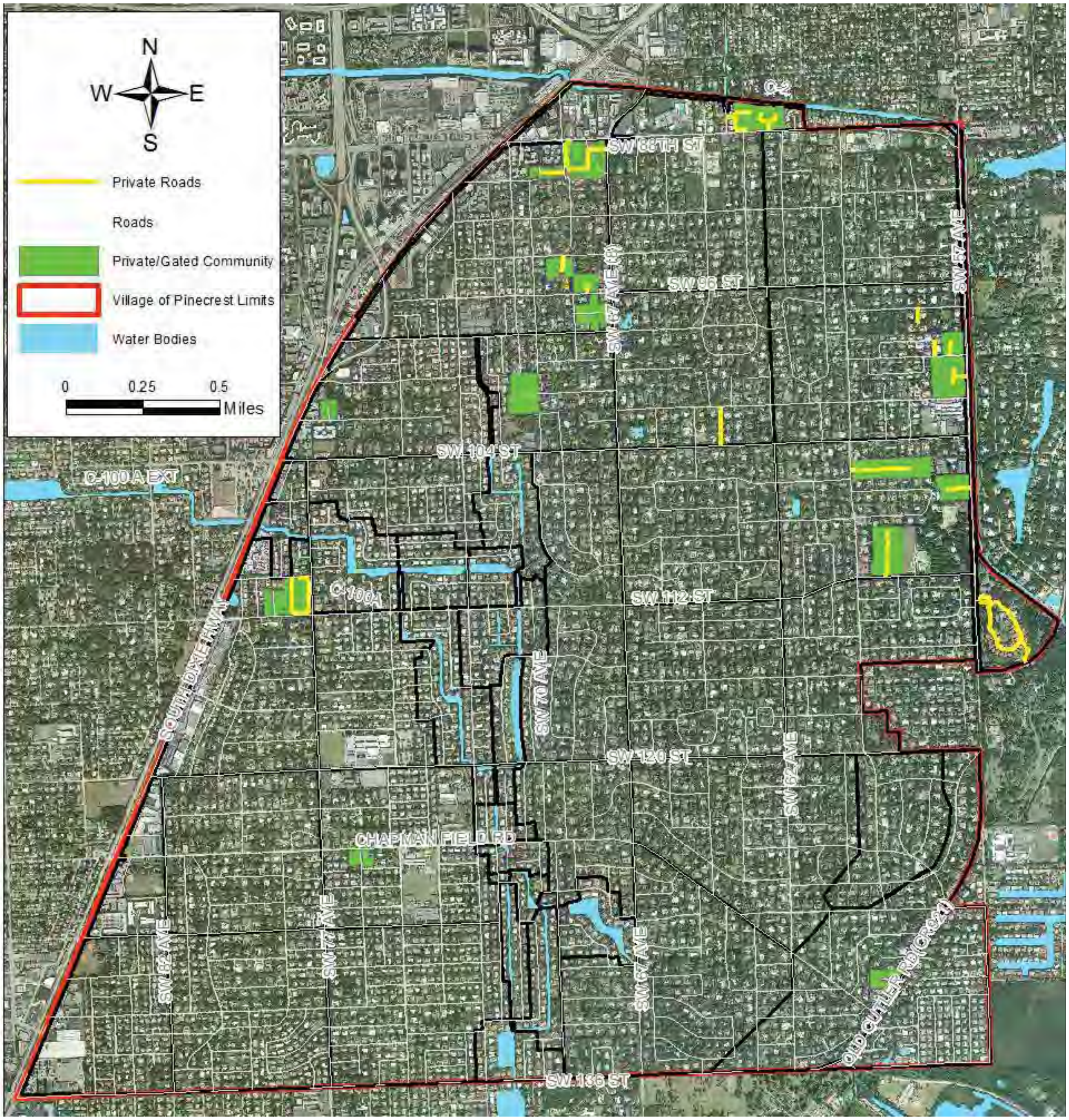


Figure 7-1 – Private/Gated Communities and Streets in the Village of Pinecrest

7.3 Sub-Basin & Level of Service Summary of Results

The existing conditions modeling results documented in **Section 5.0** were used to derive the required values to establish the FPSS for each sub-basin. In addition, numerous GIS files were collected from Miami-Dade County and the Village which represent the roads, properties, buildings, and topography within the Village limits. These files were modified and used to rank areas susceptible to flooding within the Village. Roadways and properties were updated to better represent current conditions in the Village and to exclude areas that are not the responsibility of the Village. These updated files were then further defined using a topography file to include the elevation of their location. The defined roadway and property files were combined with model results to quantify the values for each of each of the sub-basin flooding severity Indicators and perform the level of service analysis.

7.3.1 Quantifying Methodology for Sub-basin Flooding Severity Indicators

The various flood severity indicators of the FPSS equation outlined in **Section 7.2** were quantified using standard GIS tools to facilitate the analysis of the resulting model data versus the digital elevation model (DEM). The DEM created for this SWMP is a raster based bare earth topographic elevation model in the National Geodetic Vertical Datum of 1929 (NGVD) derived from the TIN provided by Miami-Dade County which was developed using Light Detection And Ranging (LiDAR) topographic data points provided by DRER.

This TIN was converted into a raster based DEM with cell dimensions of 10-ft by 10-ft in GIS using ESRI's Spatial Analyst. This cell size provided sufficient resolution to represent the overall topographic characteristics of the Village, while still remaining manageable in the GIS environment. Individual roadways and canals are visible and general topographic trends can be seen for all areas within the Village. **Figure 7-2** shows an example of the LiDAR coverage with visible streets and canal features. The full extent of LiDAR data across the Village of Pinecrest, along with the delineation of sub-basins, is shown in **Appendix 7A.**

7.3.1.1 Quantification of MER, MMAS, and MCLRS

The polyline roadway network from the Village GIS database was utilized to determine the severity indicator values associated with the roadway network - the MER, MMAS, and MCLRS indicators. The GIS roadway coverage represented the approximated centerline of each roadway throughout the Village. Each road had a number classification for the type of road with values of zero through three (0-3) being minor arterials or highways and values four through nine (4-9) being collectors or local roads. This number classification allowed each segment of roadway to be classified under either the MER, MMAS or MCLRS severity indicator.

The roadway network was broken into individual segments at intervals of approximately 10-ft. To ensure that each line segment was only counted once a point was created at the centroid of each street segment – see **Figure 7-3**. The representative point for each line segment was assigned the length of the street segment it represents and the elevation of nearest raster cell. A number of private roads that the Village is not responsible for were removed from the roadway network file and excluded from this study.

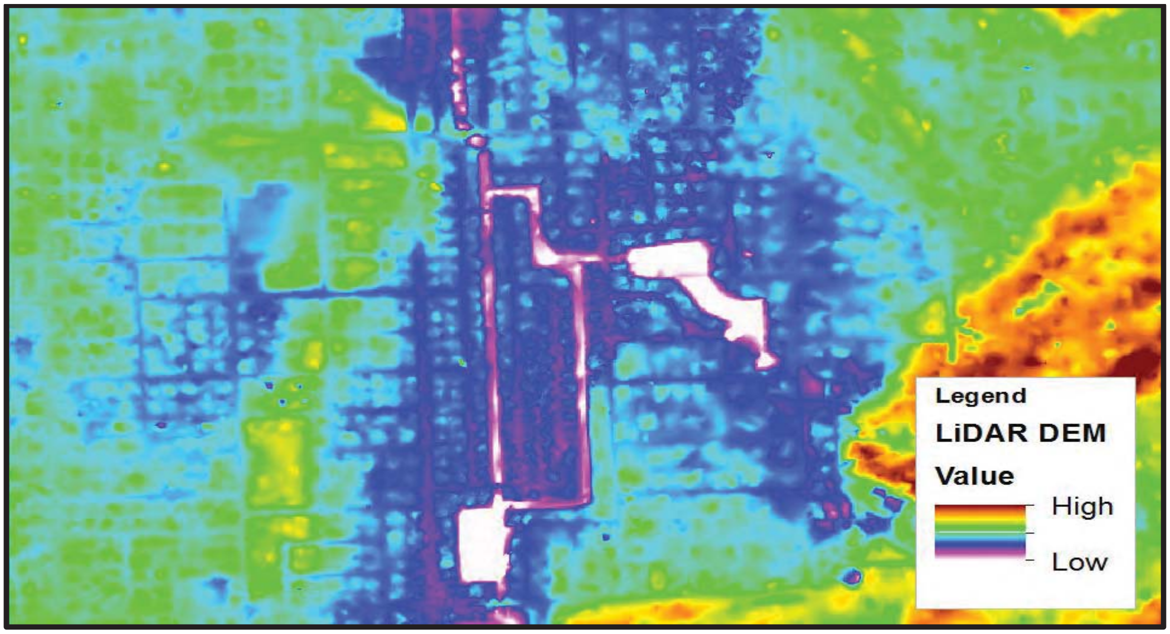


Figure 7-2 – LiDAR Based Raster DEM

Figure 7-3 – Roadways Lines to Points

7.3.1.2 Quantification of NS

The number of structures flooded, or NS, was calculated using the existing property appraisers coverage acquired from Miami-Dade County. A file that indicated the vacant lots having no structures was provided by the Village. It was observed during a cursory review of the vacant lot file and current satellite imagery that many vacant lots had been developed and some lots with a building square footage value were in fact vacant at the time of this SWMP. To correct for the inconsistencies the property coverage was manually updated to omit properties that do not currently have a structure. The property coverage was also modified to exclude a list of private properties that are not the responsibility of the Village.

The resulting coverage was converted to a point file from the polygons representing the property limits. The points created were located at the centroid of each polygon. In the vast majority of the cases the point lied within the building footprint and was an excellent representation of the structure location as shown in **Figure 7-4**. In certain cases, due to irregular lot shapes, the point resided just outside the building footprint but remained inside the property limit. These exceptions were negligible considering the number of properties accounted for in this analysis.

Figure 7-4 – Property Polygons to Points

Neither the County nor the Village maintains a complete GIS database of finished floor elevations for properties located within their respective limits. Because of this, finished floor elevations had to be estimated utilizing a methodology similar to that which was used by the County. The Z value, or the finished floor elevation, for these properties was estimated using the same approach used by DRER in numerous stormwater management master plans. This approach estimates the finished floor elevation of a lot based on the closest adjacent crown of road elevation. The road crown plus an additional eight (8) inches added is used to obtain the floor elevation. For this SWMP, this was done in GIS by performing a spatial join of the property points and the roadway points. This resulted in the property points being assigned the elevation based on the closest roadway point, plus eight (8) inches. **Figure 7-3** shows an example of location of the roadway points relative to property points.

The Village provided actual elevation data, where available, using available information from property Elevation Certificates. The summary of elevation data provided by the Village is included in **Appendix 7B**. These certificates were applicable at properties located throughout the Village. Of the 442 Elevation Certificates, approximately 16 did not provide the floor elevation. The property point in the GIS file was modified to implement the actual finished floor elevation for the 426 properties with actual floor elevations available.

7.3.1.3 Quantification of DEM

The DEM file was also converted to point coverage to help quantify the area which was inundated under the modeled storm events. Each raster cell was assigned a point at the center of the cell, with this point containing the cell's topographic elevation - see **Figure 7-5**. Each point represented 100 square feet (sq-ft) of topographic area within a basin. These points were then joined spatially in GIS with the sub-basin coverage which contained the peak elevations from the storm event scenarios analyzed.

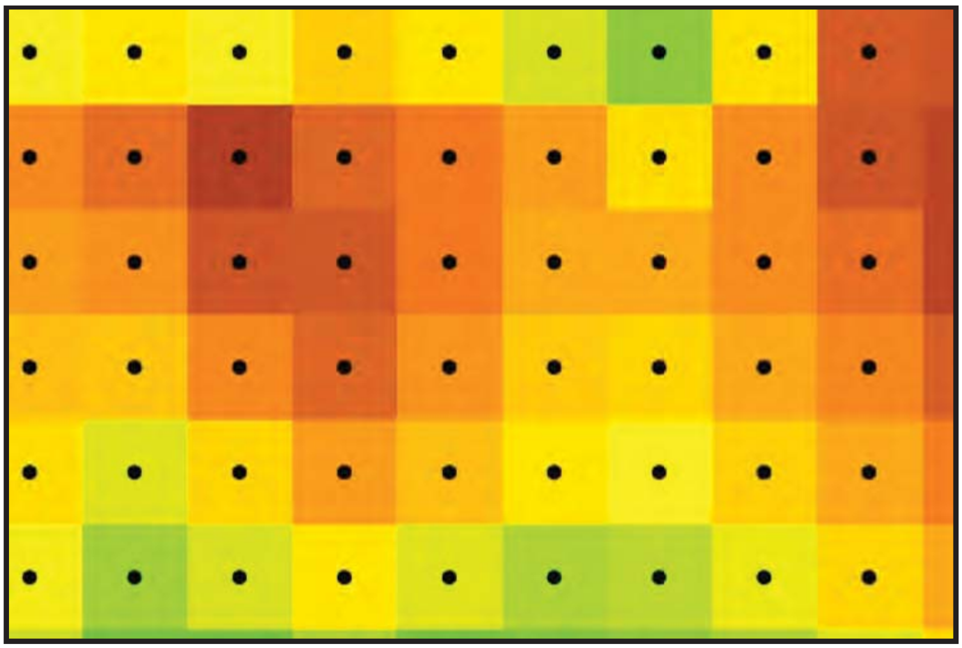


Figure 7-5 – Raster DEM to Points

7.3.1.4 Quantification of BM

The BM flooding severity indicator quantifies the amount of land adjacent to canals that experiences flooding due to canal overflow. The amount of land is measured in Bank Miles (BM) based on the storm event used for the original canal design. The C-100 canal network was originally designed for a 10-year storm event and the C-2 canal network was designed for a 100-year event. A GIS polygon shape file was provided by the Village which contained all water bodies, including canals and ponds, located within the Village of Pinecrest. The polygons representing any bodies of water, other than the canal networks, were removed from the polygon coverage. The remaining polygon shapes of the canals where converted to a point file along the border of the polygon shapes. The points were equally distributed every 10 feet with each point representing 10 feet of canal bank. The elevation of the point was the elevation of the DEM raster cell which it overlapped.

7.3.1.5 Quantification of NFC and RPL

To quantify the flooding severity indicators for NFC (number of flooding complaints) and RPL (repetitive loss reports) data was collected from Village residents, developers, and FEMA. Two workshops were held in the Village where residents and developers familiar with the study area documented areas that flooded during storm events. The documented complaints received from residents and developers were assigned to a sub-basin based on the reported address. The Village provided a spreadsheet containing the Repetitive Loss and Severe Repetitive Loss list for the Village of Pinecrest compiled by the Federal Emergency Management Agency (FEMA). The repetitive losses were geocoded and assigned to a sub-basin based on the address listed within the spreadsheet. **Table 7-1** includes the sub-basin name where the property is located within the Village of Pinecrest and dates of the losses reported.

Table 7-1 – FEMA Repetitive Loss and Severe Repetitive Loss List for the Village of Pinecrest

Sub-Basin	Loss Date 1	Loss Date 2	Loss Date 3	Loss Date 4
B22-S	8/25/2005	10/15/1999		
B-Bay-SE	8/25/2005	10/15/1999		
C100A-E-1	8/25/2005	6/20/2005		
C100A-E-2	8/26/2005	10/15/1999		
C100D-N-1	10/15/1991	6/10/1997	4/26/1997	
C100D-N-1	8/26/2005	6/9/1997		
C100DN-1E	10/2/2013	8/25/2005	10/15/1999	
C2-S-9NE	10/2/2013	8/26/2005	12/10/2000	10/15/1999
C2-S-9SW	8/25/2005	6/9/1997		
C2-W-3SW	10/4/2008	10/3/2000	10/15/1999	
CC100A-E1W	10/2/2000	10/15/1999	6/11/1997	
CC100A-W2C	4/24/1982	8/18/1981		
PNL&RGL	10/30/2011	8/25/2005		

Each of the point coverages representing the various parameters were joined with the model sub-basin delineations in order to provide each point with a corresponding sub-basin. This enabled the grouping of various parameters within their respective sub-basins.

The attribute tables from these various coverages (DEM, Properties, and Roadways) were then imported into Microsoft Access databases to process the subsets of data and arrive at a proper count of the criteria for the FPSS. Each attribute table contained data such as sub-basin name, point elevation, and other pertinent data necessary for the proper grouping and summarizing of the entities they represented.

As stated previously, it is important to note that these separate items were only quantified for areas within the limits of the Village. This approach will ensure that the resultant sub-basin ranking scores were not skewed by areas that were outside of the Village.

7.3.2 Flood Problem Area Ranking Results and Flood Protection Level of Service Results

The flood severity result data was collected under three storm event results developed as part of **Section 5.0**: 5-year, 24-hour; 10-year, 24-hour; and the 100-year, 72-hour storm events. The flood plain data for each of the storm events was prepared in raster format to show the location and severity of the flood conditions developed under this analysis. Flooding was represented in three colors corresponding to the exceedance of flooding above the FPLOS conditions. The exceedance levels of the depth of flooding and corresponding color codes are:

- Exceedance value 1: Green - flooding is less than or equal to 6-inches
- Exceedance value 2: Yellow - flooding is greater than 6-inches and less than or equal to 12-inches
- Exceedance value 3: Red - flooding is greater than 12-inches

An example of a raster file of the flood plain developed for this SWMP is shown below. The green is representative of less than 6 inches of flooding and an FPLOS exceedance value of 1, with red indicating a flood depth of greater than 12 inches with a FPLOS exceedance of 3.

Figure 7-6 – FPLOS Exceedance Values Derived from Floodplain Map

The values quantified by the eight (8) “severity indicators” determined the severity of flooding within each sub-basin and were used to establish the FPSS values. These severity indicators are defined and summarized in **Section 7.2**. Each of these indicators also has an assigned recommended "weighing factor" (WF) which is related to the relative importance of the flooding severity indicator. Once the severity score is calculated for each sub-basin, the sub-basins are ranked from highest FPSS to lowest. The 1 ranking represents the highest flooding problem and a 57 ranking the lowest. This approach will yield the basins with the highest flooding problems based on a quantifiable and mathematical basis.

Similarly, each sub-basin was analyzed and scored by the number of criteria met or failed. Each criterion was assigned a specific weight depending on the severity of the criterion failed. Once the criteria met were added for each sub-basin, a FPLOS rating was established by assigning a letter score as described in **Section 7.2.1**. The FPSS ranking and FPLOS score for the top 30 sub-basins in the Village of Pinecrest are provided in **Table 7-2.**

Table 7-2 **-** Top 30 Sub-Basins, FPSS and FPLOS Score and Ranking

Sub-Basin Name	Sub-Basin Area (Acres)	Composite Scores		
		FPSS	**Rank**	**FPLOS**
U29-S	60.15	377.5	1	F
C100DN-1W	136.07	267.0	2	F
C100A-W3N	172.75	260.0	3	F
U35-S	42.44	232.8	4	F
PNL&RGL	86.22	223.2	5	F
C100A-E-2	33.88	178.7	6	E
C100DN-1E	102.48	164.9	7	E
C100A-5	29.60	161.0	8	E
C100A-E-1	90.74	147.9	9	E
C2-S-9NE	204.78	146.6	10	E
U28-E	55.82	127.6	11	E
B-Bay-SE	99.92	123.8	12	E
U32-S	20.67	122.3	13	E
C100D-N-1	247.42	112.5	14	D
C100A-W3S	177.99	112.2	15	D
U38-W	32.81	105.7	16	D
C100A-W2W	170.32	93.8	17	D
CC100A-W2D	167.29	92.4	18	D
C100A-5A	28.08	86.9	19	D
CC100A-W2C	167.39	75.8	20	C
CC100A-E1W	224.40	71.0	21	C
U38-E	20.07	68.6	22	C
U30-S	5.80	65.8	23	C
U28-W	25.93	64.4	24	C
U37-S	5.26	54.0	25	C
C100A-W2E	110.43	40.0	26	C
C2-W-3NE	183.76	32.4	27	C
C100D-W-1	83.66	30.2	28	C
C100A-2	13.68	26.8	29	B
C100A-3	8.98	25.9	30	B

The detailed results for the eight (8) severity indicator criteria for the FPSS ranking for all 56 sub-basins is provided in **Appendix 7C**. The top 15 sub-basins are considered high priority basins in terms of stormwater improvements. These sub-basins are considered Phase I and conceptual designs of stormwater improvement projects were completed as part of this SWMP. While still high priority areas, the sub-basins ranked 16-30 are considered Phase II and will most likely be addressed in the future or as funds become available. A map of the FPSS ranking result of each sub-basin is shown in **Appendix 7D** with Phase I sub-basins (rank 1-15) in red and Phase II sub-basins (rank 16-30) in yellow.

A summary of the results for the FPLOS score is provided in **Appendix 7E.** The results of the FPLOS described in **Section 7.2.1** are presented as a map included in **Appendix 7F**, along with the FPSS ranking. **Appendix 7G** includes a map of the 100-year, 72-hour design storm event with the FPSS ranking results.

8.0 STORMWATER IMPROVEMENT PROJECT CONCEPTUAL DESIGN AND RANKING

8.1 Stormwater Improvement Project Design Criteria and Constraints

Stormwater management systems must adhere to strict water quality and quantity criteria set forth by various local, state, and federal agencies with jurisdiction within the state of Florida. All new or improved stormwater management systems must be shown to adhere to these criteria prior to permitting and be constructed as permitted. As such, all projects which are developed for the Village will require full coordination with regulatory agencies and adherence to all local, state, and federal laws. As with any regulatory requirements, changes do occur over time and all criteria must be verified with the applicable agency prior to the commencement of the design phase of a project.

The typical stormwater management systems used within the Village of Pinecrest includes positive drainage systems connected to surface water bodies and exfiltration trenches. A small portion of the Village is approved to use drainage wells due to the location of the salt water intrusion zone. These management systems and their performance within the parameters of the analyses performed for this SWMP are detailed further in this section.

8.1.1 Water Quality Regulatory Requirements

In the Village of Pinecrest, and dependent upon project/site specific circumstances, the South Florida Water Management District (SFWMD) and Miami Dade County department of Permitting, Environment and Regulatory Affairs (DRER) may have jurisdiction over stormwater quality criteria. The following subsections outline the current requirements set forth by these entities. All systems to be permitted must be designed to meet the most stringent of these requirements and are specific to each project.

8.1.1.1 Village of Pinecrest

The Village of Pinecrest requires that all new projects adhere to applicable regulatory design and permitting criteria as outlined in the Land Development Code, Division 6.15 – Storm Water Management. The current criteria for water quality is as follows:

1. Water quality standard: Storm water facilities shall be designed to meet the design and performance standards established in Ch. 62-25, Paragraph 25.025, Florida Administrative Code, with treatment of the storm water runoff, from the first inch of rainfall on-site to meet the water quality standards required by Ch. 62-302, Paragraph 62-302.500 of the Florida Administrative Code.

The Village is currently in the process of revising the Land Development Code water quality criteria, but it will require Council approval.

8.1.1.2 Miami-Dade County DRER

Miami-Dade County DRER requires that all projects meet the State of Florida water quality standards as set forth in Florida Administrative Code (F.A.C.) Chapter 17-302. To assure that this criterion is met, 100 percent of the first one inch of runoff from the furthest hydrologic point must be retained on site. The methodology for calculating this volume is outlined in DRER's Policy for Design of Drainage Structures dated December 1980 using the following equations, **Equations 8-1** through **8-4**.

$$V = 60CiAT_t \qquad \textbf{Equation 8-1}$$

Where,
- V = Required stormwater quality volume, cubic feet
- C = Runoff Coefficient; 0.3 for pervious areas, 0.9 for impervious areas, or weighted average for areas with mixed type.
- A = Total tributary area, acre
- T_t = Time to generate one inch of runoff plus the time of concentration, minutes, from **Equation 8-2**
- i = Rainfall intensity, inches per hour, from **Equation 8-4**

$$\mathbf{T_t = T_{1"} + T_c} \qquad \textbf{Equation 8-2}$$

Where,
- T_c = Time of concentration, minutes
- $T_{1"}$ = Time to generate one inch of runoff, minutes, from **Equation 8-3**

$$\mathbf{T_{1"} = \frac{2940\ F^{-0.11}}{308.5\ C - 60.5(0.5895 + F^{-0.67})}} \qquad \textbf{Equation 8-3}$$

Where, F = Storm frequency, years

$$\mathbf{i = \frac{308.5}{48.6F^{-0.11} + T_t(0.5895 + F^{-0.67})}} \qquad \textbf{Equation 8-4}$$

Additionally, DRER requires that the required stormwater quality volume, V, from **Equation 8-1** is infiltrated into the groundwater table in a period of less than 24-hours.

8.1.1.3 South Florida Water Management District

The SFWMD requires that all projects meet State of Florida water quality standards, as set forth in Florida Administrative Code (F.A.C.) Chapter 62-302. To assure that these criteria are met, projects must meet the following volumetric retention/detention requirements as described in the SFWMD Environmental Resource Permit Applicant's Handbook Volume II:

2. For wet detention systems:
   a. A wet detention system is a system where the control elevation is less than one foot above the seasonal high groundwater elevation and does not bleed-down more than one-half inch of detention volume in 24 hours.
   b. The greater of the following volumes must be detained on site:

   i. the first one inch of runoff times the total project area
   ii. 2.5 inches of total runoff from the impervious area
3. Dry detention systems must provide 75 percent of the required wet detention volume. Dry detention systems maintain the control elevation at least one foot above the seasonal high groundwater elevation.
4. Retention systems must provide at least 50 percent of the wet detention volume.
5. For projects with impervious areas accounting for more than 50 percent of the total project area, discharge to receiving water bodies must be made through baffles, skimmers, and/or other mechanisms suitable of preventing oil and grease from discharging to or from the retention/detention areas.

8.1.2 Water Quantity Regulatory and Permitting Requirements

The following subsections outline the most stringent stormwater quantity requirements applicable to any Village of Pinecrest projects. Also, dependent on project specific circumstances, the SFWMD and FDOT may have jurisdiction over specific stormwater quantity criteria.

8.1.2.1 Village of Pinecrest

As for water quantity, the Village of Pinecrest requires that all new projects adhere to applicable regulatory design and permitting criteria as outlined in the Land Development Code, Division 6.15 – Storm Water Management. The current criteria for water quantity is as follows:

1. Water quantity standard: Post development runoff shall not exceed the predevelopment runoff rate for a 25-year, 24-hour storm event.

The Village is currently in the process of revising the Land Development Code water quantity criteria, but it will require Council approval.

8.1.2.2 Miami-Dade County DRER

Miami-Dade County DRER applies the same criteria for allowable discharge as set forth by the SFWMD as outlined in Section 8.1.2.3 below. In addition, the County requires that residential roads be designed with a minimum elevation at or above the peak 5-year, 24-hour design storm event elevation. For major and minor arterials, the minimum roadway elevation must be at or above the peak 10-year, 24-hour design storm event elevation.

8.1.2.3 South Florida Water Management District

The SFWMD requires that off-site discharge rates be limited to rates not causing adverse impacts to existing off-site properties, and:

1. historic discharge rates,
2. rates determined in previous SFWMD permit action, or
3. basin allowable discharge rates.

For projects discharging to a SFWMD canal basin, the SFWMD Environmental Resource Permit Applicant's Handbook Volume II outlines basin allowable discharge rates. Portions of the Village of Pinecrest receiving water bodies are within the C-2 Canal Basin and C-100 Canal Basin. The C-2 Canal was designed for the 100-year, 3-day storm event and has an allowable discharge based on pre- and post-development peak discharge rates for a 25-year, 3-day design storm event. The C-100 Canal and C-100A Canal are designed for the 10-year, 3-day storm event and have a specified allowable discharge. **Table 8-1** includes the allowable discharge criteria as per SFWMD Environmental Resource Permit Applicant's Handbook Volume II.

Table 8-1 – SFWMD Allowable Discharge Rate Formulas for Basins with Restricted Discharge

Canal	Allowable Discharge Rate Formula	Design Storm
C-2	Post-development peak discharge does not exceed pre-development peak discharge rates	25-year, 72-hour
C-100	No greater than 56.6 CSM (8.8 cfs per 100 acre)	10 year, 72-hour
South Biscayne Basin	Post-development peak discharge does not exceed pre-development peak discharge rates	25-year, 72-hour

*cfs = cubic feet per second
*CSM = cfs per square mile

For project areas within the C-100 Canal Basin, the allowable discharge applies to the 10-year, 3-day storm event. Beyond the design storm event the discharge rate becomes unlimited. For the C-2 Canal Basin, SFWMD requires that pre-development flows during a 25-year, 3 day rainfall event are not increased during post-development conditions.

8.1.2.4 Florida Department of Transportation

FDOT requires that proposed drainage systems meet the offsite discharge requirements outlined in F.A.C. Chapter 14-86. The following items are applicable regarding the FDOT criteria for the transfer of stormwater to the FDOT right of way as a result of manmade changes to adjacent properties:

- The offsite discharge criteria is based on a critical storm frequency analysis including storm events with 2- to 100-year frequencies and 1-hour to 10-day durations for closed sub-basins and 3-day durations for sub-basins with positive outlets.
- Any discharging pipe establishing or constituting a drainage connection to the FDOT's right of way is limited in size based on the pre-improvement discharge rate, downstream conveyance limitations, downstream tailwater influences, and design capacity restrictions imposed by other governmental entities.
- The peak discharge rates and total volumes allowed by applicable local regulations are not exceeded.
- The improvements shall not increase stormwater discharge rates above the pre-development conditions.
- The quality of water conveyed by the connection meets all applicable water quality standards.

8.1.3 Stormwater Management Systems

Using the methodology and procedure for flood problem area ranking previously described, the top 15 sub-basins were ranked based on their calculated Flood Protection Severity Score for project formulation and conceptual design. Project formulation took into consideration existing infrastructure and flooding within the Village, the potential for sea level rise, design constraints within the Village, and flood protection best management practices. The Village currently relies on swales in the right-of-way, self-contained exfiltration trenches, a limited number of gravity wells, and natural drainage for stormwater management. The Village of Pinecrest provided project plans for a total of eight (8) drainage improvement projects constructed within last three (3) years. The location of these drainage projects, year of implementation, and structure components are listed in **Table 8-2**.

Table 8-2 – Existing Drainage System Components

Project Location	Year	Sub-Basin	Stormwater Management Structure
SW 70th Ave (SW 100th Ave & 104th Ave)	2007	C100DN-1E	2 New Catch Basins Connected to Existing Outfall
SW 72nd Ave (SW 112 ST to SW 120th St)	2010	U29-S	450 LF Exf Trench
SW 72nd Ave (SW 112 ST to SW 120th St)	2010	U35-S	325 LF Exf Trench
SW 73rd Ave, SW 72nd CT, SW 72nd Ave, SW 96th Street	2012	C100D-N-1	200 LF Exf. Trench
Killian Park Road – 11100 Killian Park RD	2012	C2-W-3NW	696 LF of Exf. Trench
Pinecrest Gardens Stormwater Improv.	2012	C2-W-3NE	Replacement 170 LF Exf. Trench
South Mitchell Manor Circle & SW 64th Ave	2013	C2-W-3SW	204 LF of Exf. Trench
South Mitchell Manor Circle & SW 64th Ave	2013	C2-W-3SW	236 LF of Exf. Trench
Pine Needle Lane (near SW 121st St)	2013	PNL&RGL	250 LF of Exf. Trench/4 Gravity Wells
Rock Garden Lane (near SW 121st St)	2013	PNL&RGL	693 LF of Exf. Trench / 12 Gravity Wells

The project plans provided were reviewed and the drainage components were identified. The projects consisted of gravity drainage systems, exfiltration trenches and gravity drainage wells designed to resolve localized flooding issues. The flooding issues were primarily resolved by implementing short lengths of exfiltration trench connected to catch basins to help collect runoff. This approach is standard for most municipal projects and are typically designed for the 5-year, 24 hour storm event. The drainage components were represented in the XP-SWMM Baseline Scenario Model by calculating the total volume accounted for by the exfiltration trenches and introducing this volume at the lowest stage-storage elevation within the respective sub-catchment – this methodology is further described in detail in **Section 8.1.3.1**. Representation of the gravity wells and pump stations are described in **Section 8.1.3.2** and **Section 8.1.3.3**, respectively.

This SWMP proposes infrastructure that is conceptually designed using a holistic approach which takes into consideration historical changes in groundwater levels, the current topography, projected seal-level rise and existing infrastructure. The proposed infrastructure is designed to maximize the discharge into the canal system, to address areas with known flooding, and to prepare for sea level rise. Each of the proposed projects incorporates recently constructed infrastructure, improves smaller, outdated infrastructure, and greatly expands the storage capacity for stormwater runoff during storm events. Each project is designed as a fully connected, comprehensive drainage system that minimizes the amount of surface water and runoff during storm events.

The proposed infrastructure includes drainage wells, exfiltration systems, inlets, and pump stations connected with solid pipe. In areas where feasible, berms are proposed to maximize the use of available open space and minimize overland flow into buildings and homes. With the holistic approach used during the conceptual design, each infrastructure component will function cohesively to more effectively address flooding within the streets and homes of the Village than the existing drainage systems.

8.1.3.1 Exfiltration Trenches

A drainage system utilizing exfiltration trenches is the most common system used in South Florida to meet stormwater quantity and quality retention requirements. Exfiltration trenches have a relatively low construction cost and are one of the least land intensive stormwater drainage systems available. Their effectiveness is heavily dependent on acceptable soil hydraulic conductivity, groundwater table elevations, and available topographic elevations. The pipes associated with exfiltration trench systems can also provide additional interconnectivity within an area, as does a solid pipe system.

An exfiltration trench system consists of at least one catch basin or inlet that leads to a perforated or slotted pipe laid in a bed of aggregate filter media, such as ballast rock. They can be placed below paved surfaces or at the bottom of retention areas and offer a method of conveying stormwater runoff to the groundwater table in areas where impervious areas have been greatly increased. **Figure 8-1** shows a typical longitudinal profile and cross section of an exfiltration trench.

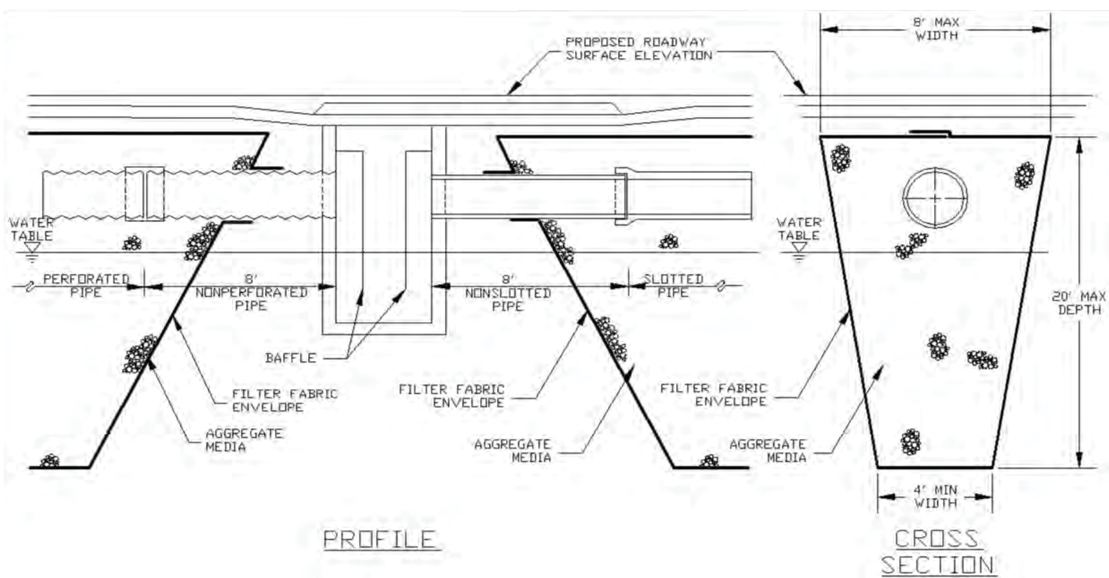


Figure 8-1 – Typical Exfiltration Trench Sections

These types of systems typically include a weir or control structure which retain a certain amount of stormwater runoff and surcharges the perforated pipe and trench to induce exfiltration into the surrounding native soil. Self-contained systems do not require a weir or control structure since the lowest inlet elevation acts as the target surge elevation, or control elevation of the system.

8.1.3.2 Drainage Wells

Drainage wells consist of a drilled hole into the aquifer to discharge stormwater runoff into the portion of the aquifer that meets certain salinity and total dissolved solids (TDS) requirements. Drainage wells are typically used only when it is not practical to use exfiltration trenches because of low soil hydraulic conductivity. **Figure 8-2** shows a typical section of a drainage well.

Drainage wells can be categorized as gravity drainage wells under gravity or injection wells under pressure. Gravity drainage wells act under the hydraulic gradient induced by gravity of the drainage system discharging to the well, whereas, injection wells under pressure use an artificially applied hydraulic head induced via a stormwater pump station. Well discharge capacity is determined in the field through testing by a certified well drilling contractor.

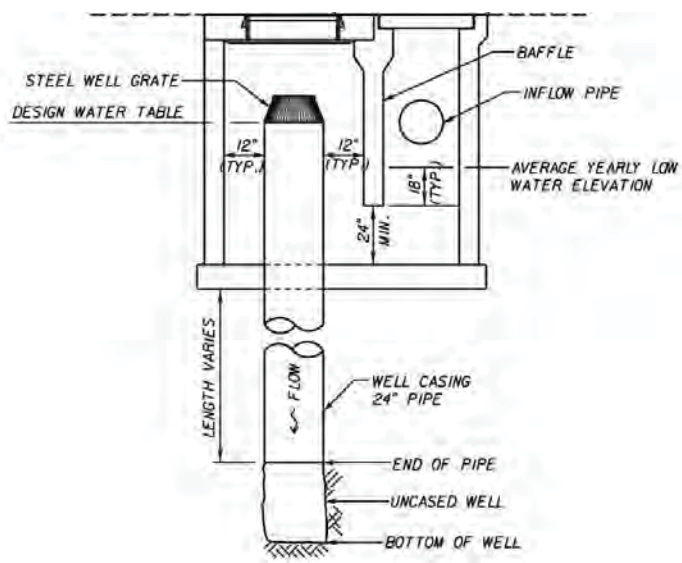


Figure 8-2 – Typical Injection Drainage Well

If drainage wells are present in a drainage system, DEP requires the use of a passive control device, such as a weir, in order to provide a method of controlling the total head at the drainage well or wells.

For the purpose of this SWMP, the data utilized to calculate the extraction values for the gravity drainage wells was provided by the Village under the stormwater management system design report “Pine Needle Lane & Rock Garden Lane” DRER item No.: DW13-01, FDEP permit No.: 0317175-001-UC.

8.1.3.3 Pump Stations

Pump stations are used for expediting flows to a receiving water body or retention area. Although stormwater pump stations are expensive to install, operate, and maintain, their use is often required in areas where space is limited and no other practical gravity alternative is available. **Figure 8-3** shows a typical detail of a stormwater pump station.

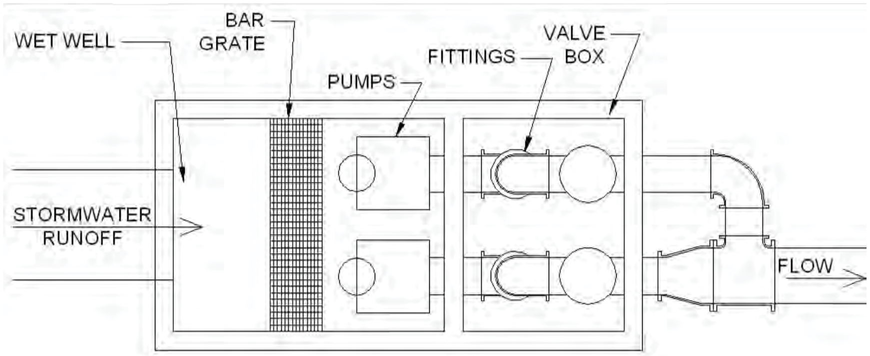


Figure 8-3 – Typical Stormwater Pump Station Plan

Numerous factors play a role in determining the potential rate/volume for which a pump station can account for. They include limits on rate/volume of receiving water body, conveyance capacity of contributing systems, and size constraints for the pump station wet well. Pump stations are a viable option for the Village to maximize the capacity and effectiveness of existing and proposed drainage wells.

8.2 Conceptual Project Development and Cost

In accordance with the scope of work for the Village SWMP development, conceptual stormwater improvement projects were developed for the top 15 ranked sub-basins as outlined in **Section 7.0**. Working in coordination with Village staff, it was decided to conceptually design these projects to account for some level of sea level and groundwater rise because there is compelling evidence that the climate is changing and sea levels are rising approximately 3 millimeters per year with the potential to accelerate.

The SWMP is a five-year planning document and there is currently a high uncertainty of the amount of seal level that will occur in the future. Therefore, it was decided to conceptually design these projects for a 2030 mid-range sea level and groundwater rise in accordance with the most current documented projected rise as outlined in **Section 6.0**. The projects must be designed to be adaptable if sea level rise increases or accelerates. Assessment of sea level and groundwater rise should be evaluated and projects adapted after every 5-year cycle of the SWMP update.

The 2014 Baseline XP-SWMM models developed and documented in **Section 5.0** for the C-2 and C-100 Basins were used to assess the sea level and groundwater impact to the sub-basin peak elevations for the following design storm events:

- 5-year, 24-hour

- 10-year, 24-hour
- 10-year, 72-hour
- 100-year, 72-hour

To account for a mid-range 2030 sea level and groundwater rise, these models were modified as follows:

- The tidal boundary conditions for the Structure S-22, Structure S-123 and South Biscayne Bay basins were increased by 5 inches in accordance with the current 2030 mid-range sea level rise (**Figure 6.2**).
- The initial groundwater stage was increased by 0.17 feet (2.04 inches) to account for groundwater rise and/or reduced of unsaturated zone storage within each basin for 2030 mid-rage seal level rise (5 inches of sea level rise) in accordance with the USGS 2014 *Hydrological Conditions and Effect of Pumpage and Sea Level on Canal Leakage and Regional Groundwater Flow Report* modeling results.

The 2014 Baseline XP-SWMM model input and output files evaluating the impacts of sea level and groundwater rise are included on the Digital Disc provided in **Appendix 11**.

Table 8-3 summarizes the peak elevations for baseline conditions and 2030 mid-range sea level and groundwater rise for the 5- and 100-year design storm event for the top 15 ranked sub-basins. **Appendix 8A** includes the 5- and 100-year design storm event flood maps for projected 2030 mid-range sea level and groundwater rise.

Table 8-3 – Top 15 Ranked Sub-basin Peak Elevations for Existing Conditions and 2030 Mid-Range Sea Level and Groundwater Rise

Sub-Basin Name	Maximum Stage (feet)				
	2014 Baseline Model			SLR 2030 Mid-Range	
	5-Year, 24-Hour	100-Year, 72-Hour		5-Year, 24-Hour	100-Year, 72-Hour
U29-S	5.69	8.13		5.96	8.16
C100DN-1W	7.64	8.48		7.64	8.48
C100A-W3N	9.04	9.72		9.04	9.72
U35-S	5.75	8.13		6.02	8.16
PNL&RGL	4.00	9.40		4.00	9.40
C100A-E-2	5.83	8.13		6.12	8.15
C100DN-1E	7.37	8.36		7.37	8.37
C100A-5	5.52	7.91		5.79	7.95
C100A-E-1	7.82	8.13		7.82	8.15
C2-S-9NE	5.80	6.29		5.80	6.29
U28-E	5.77	8.24		6.04	8.26
B-Bay-SE	6.84	6.98		6.84	6.98
U32-S	5.56	8.02		5.84	8.05
C100D-N-1	5.92	8.36		6.20	8.37
C100A-W3S	7.56	8.03		7.56	8.06

8.2.1 Conceptual Stormwater Improvement Project Development

For the Village of Pinecrest, exfiltration trenches were determined to be most viable stormwater improvement project best management practice for areas west of the saltwater intrusion line. For areas east of the saltwater intrusion line, pump stations and injection wells were the most viable option. The following items were considered when evaluating the effectiveness of the proposed stormwater drainage systems:

- The hydraulic conductivity for exfiltration trenches was extracted from various permits issued throughout the Village. A total of 12 permits included percolation tests and these points were interpolated across the study area.
- Ground elevations of the lowest lying areas were used as the average rim elevations of the drainage inlets proposed and averaged approximately elevation of 7.0 ft-NGVD.
- Groundwater elevations were obtained from the average October water level prepared by DRER and USGS. For the Village of Pinecrest, 3.5 ft NGVD was used with the exception of the South Biscayne area that used 2.5 ft NGVD.
- Design parameters for the exfiltration trench were as follows:
    - Exfiltration trench will be installed below the roadway
    - Top of exfiltration trench should be located at 2-ft from top of grade (minimum 1-ft)
    - Top of pipe should be located 1’ below the top of the exfiltration trench
    - Exfiltration trenches were designed to provide additional storage to specific areas within the top 15 ranking sub-basins
- In areas permitted, injection wells and pump stations were utilized to improve efficiency of existing and proposed infrastructure.
- Outfalls into adjacent canals were maximized where possible. Control structures and outfalls with backflow preventers were implemented based on the allowable discharge rate for 10-year, 72-hour storm event along the C-100 Canal and 25-year, 72-hour pre- versus post- discharge rate for the C-2 Canal.

When possible, infrastructure was proposed to provide additional connectivity within the existing system, rehabilitate the existing systems by replacing old and potentially inferior/damaged drainage systems presently in place, and to provide infrastructure in areas with limited or no stormwater management system.

To better assess the flood effectiveness of each project, local hydrologic/hydraulic models were developed for each of the top 15 ranking sub-basin using the ICPR Version 3 model. Input files, peak stage, and peak flow results for each sub-basin are included on the Digital Disc provided in **Appendix 11.** These models used the results from the mid-range 2030 sea level and groundwater rise C-2 and C-100 Basin models described above to establish the local model boundary conditions. Each model was simulated and validated to ensure that the local models yielded similar stage and flow results as for the overall basin models. **Appendix 8B** includes the node-link schematic for each of the local models. A digital copy of the input files, peak stage results, and peak flow results of the validated ICPR models for the top 15 ranking sub-basins was provided as part of **Appendix 8B** on a digital disc to the Village of Pinecrest as part of the SWMP.

Once the local models were validated, the stormwater management system features described above (exfiltration trenches, drainage wells, pump stations, outfalls, control structure, and conveyance pipes) were conceptually implemented in the local models to reduce flooding until the roadway and building design level of service were met or met to the maximum extent possible. For the Village of Pinecrest, the conceptual design was based on the complete elimination of flooding in each project area. In areas where elimination of all flooding was not physically feasible, projects were designed to minimize the extent of flooding. The stormwater management features were simulated in ICPR using the procedures outlined in the FDOT District 6 ICPR Application Manual.

A map showing the overall projects designed within the Village is shown on **Figure 8-4**. **Appendix 8C** includes the detailed conceptual schematics for each of the top 15 ranked sub-basins. The schematic maps include the location of existing stormwater management systems, proposed catch basin/inlet locations, manholes, exfiltration trench labeled with the diameter, solid pipes, force mains, pump stations, and injection wells. Utility conflicts were not assessed although this should be addressed in the design phase as with all subsurface work that is performed.

Appendix 8D includes the node-link schematic for each of the proposed project areas. Input files, peak stage, and peak flow results for each sub-basin are included on the Digital Disc provided in **Appendix 11. Appendix 8E** includes the 5-year, 24-hour flood maps for each of the top 15 ranked sub-basins showing flooding with and without project, and **Appendix 8F** includes the 100-year, 72-hour flood maps for each of the top 15 ranked sub-basins showing flooding with and without project.

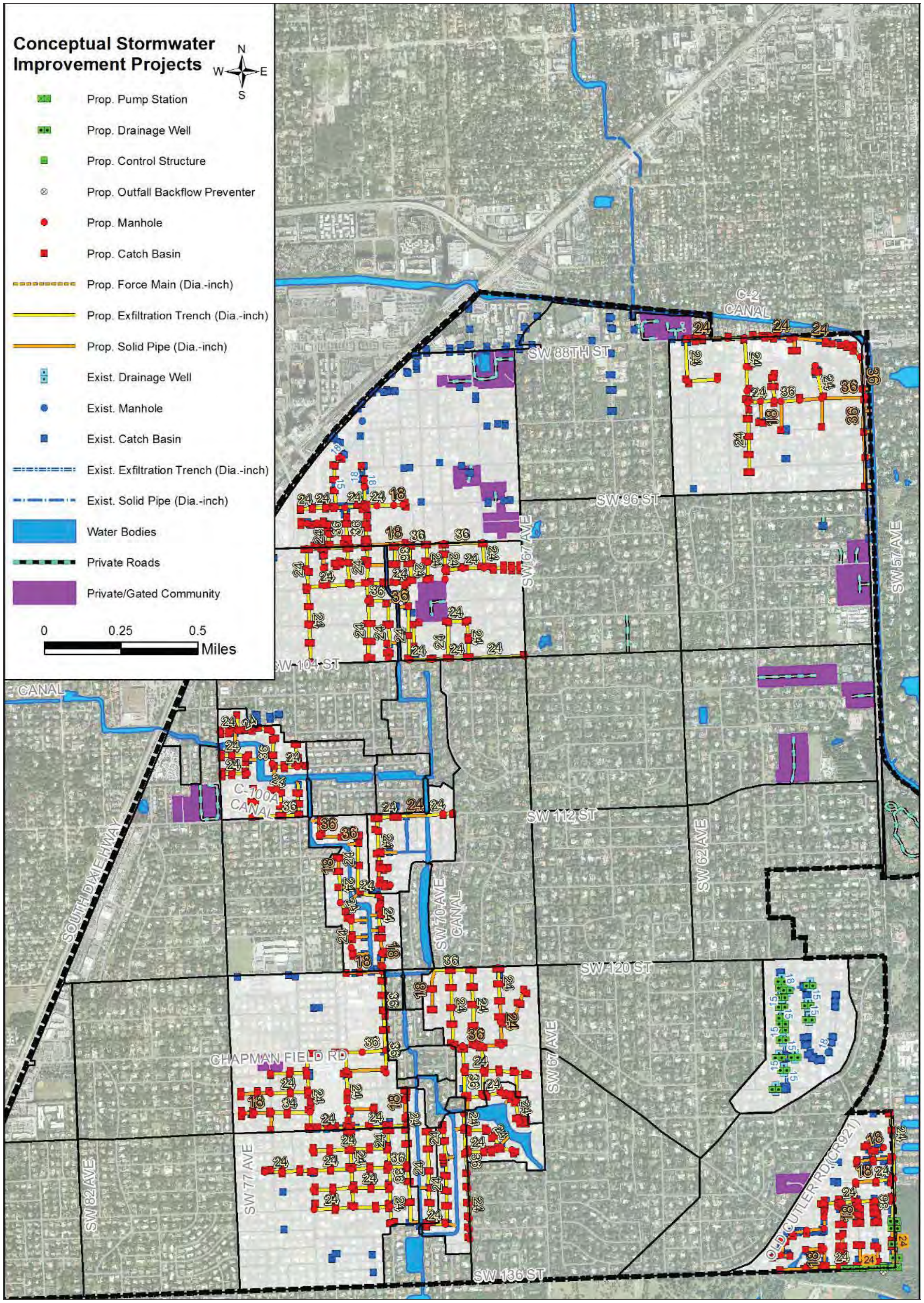


Figure 8-4 – Conceptual Stormwater Improvement Projects for the Top 15 Ranking Sub-basins

Table 8-4 includes the results of the improved FPSS scores with project compared to FPSS score without project. **Appendix 8G** includes the revised sub-basin FPSS results for the top 15 ranked sub-basins. **Appendix 8H** includes a summary of the FPSS reduced score for the top 15 ranked sub-basins and the flood volume reduction associated with each of the conceptual stormwater improvement projects.

Conceptual design of projects to address the top 15 ranked sub-basins during a 2030 mid-level sea level and groundwater rise indicate that due to the limited capacity of the C-100A canal and available underground storage, there is limited infrastructure improvements that can be accomplished within the Village to mitigate larger sea level and groundwater rise. It appears that in order to accommodate larger sea level and groundwater rise, regional stormwater management projects must be implemented in cooperation with Miami-Dade County and the SFWMD. Some of these projects could include implementing forward pump station upstream of the S-22 and S-123 structures to be able to discharge excess runoff when the gates cannot be opened due to high tidal conditions. Other possible regional solutions could include increasing the capacity of the C-100 Canal, C-100A Canal and S-123 structure to a larger capacity than a 10-year design storm event.

8.2.2 Stormwater Improvement Project Planning-Level Cost

As outlined in **Section 8.2.1**, the proposed projects consisted of typically implemented stormwater infrastructure components constructed and maintained by the Village. Each project was assessed based on its volumetric stormwater removal capacity over a 24-hour period for the 5-year design storm event and the 72-hour period for the 25-year and 100-year storm events. Planning-level cost estimates were developed for each project based on recent bid tabulation provided by the Village, FDOT cost databases and ADA's own construction cost databases.

In addition to the average unit cost of the proposed projects, provided in **Table 8-4**, the incidental expenditures including maintenance of traffic, mobilization, permitting contingency, design, and a construction administration were also calculated. The cost factors for the incidental expenditures used to calculate the final cost estimates are provided in **Table 8-5**.

Table 8-4 – Average Unit Cost for Proposed Projects

Description	Units	Average Unit Cost
ROADWAY PAY ITEMS		
CLEARING AND GRUBBING	AC	$10,000.00
MILLING EXISTING ASPHALT (1" AVG. DEPTH)	SY	$3.00
SUPERPAVE ASPHALTIC CONC, TRAFFIC C	TN	$97.00
PERFORMANCE TURF (SOD)	SY	$3.00
DRAINAGE ITEMS		
INLETS, DT BOT TYPE D, <10'	EA	$2,640.00
MANHOLE , P-7, <10'	EA	$3,600.00
MANHOLE SPECIAL, >10' (CONTROL STRUCT. 6'X4', WEIR)	EA	$12,000.00
PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 18" SD	LF	$50.00
PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 24" S	LF	$53.00

Description	Units	Average Unit Cost
PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 36" SD	LF	$90.00
FLAP GATES, BACKFLOW PREVENTOR 36"	EA	$20,000.00
EXFILTRATION TRENCH, 24"	LF	$139.00
EXFILTRATION TRENCH, 36"	LF	$168.00
PUMP STATION WITH CONTROL PANEL	EA	$205,000.00
DRAINAGE WELL	EA	$65,000.00

*AC=Acre, SY= Square Yards, TN=Tons , EA=Each, LF=Linear Feet

Table 8-5 – Capital Cost Factors

Capital Cost Factors As Percentage of Total Material Cost					
Maintenance Of Traffic	Mobilization	Permitting	Contingency	Design	Construction Administration
10%	10%	5%	30%	10%	10%

It should be noted that the planning-level cost estimates developed for this SWMP are intended as an adaptive planning tool for sea level rise and to help guide the Village in prioritizing the location where stormwater improvement projects would immediately address current and observed areas of known flooding in a cost-effective manner. Costs were identified for placing stormwater management systems within the Village right-of-way for the top 15 sub-basins. **Appendix 8I** includes detailed planning-level cost estimate for each of the top 15 ranked sub-basins. A summary of the planning-level cost estimates for each of the top 15 ranked sub-basins is provided in **Table 8-6**.

Table 8-6 – Proposed Conceptual Project Planning-Level Cost Estimate

Sub-Basin Name	Sub-Basin Flood Rank	Project Cost Estimate
U29-S	1	$2,361,083.47
C100DN-1W	2	$3,094,682.50
C100A-W3N	3	$3,535,767.67
U35-S	4	$981,252.22
PNL&RGL	5	$2,361,100.97
C100A-E-2	6	$1,228,832.50
C100DN-1E	7	$4,261,880.97
C100A-5	8	$1,714,848.33
C100A-E-1	9	$3,558,843.75
C2-S-9NE	10	$3,615,130.00
U28-E	11	$2,767,835.39
B-Bay-SE	12	$4,644,125.00
U32-S	13	$627,709.00
C100D-N-1	14	$2,208,589.25
C100A-W3S	15	$3,858,144.31
TOTAL		**$40,819,825.33**

These costs should be further refined during the final design and permitting phases of the CIP implementation process.

8.3 Stormwater Improvement Project Ranking

Several cost-effectiveness project ranking approaches were evaluated and discussed with Village staff, and the approach that appears to be most representative for the top 15 ranked sub-basin is based on the project cost per flood volume reduction. A flood volume reduction analysis was completed for the 15 conceptual projects by using the local ICPR models for each project.

The proposed stormwater improvement projects are designed with systems to minimize the volume of stormwater runoff on the surface by providing conveyance to the groundwater table and discharges to adjacent canals. The stormwater removal capacity for each of the proposed stormwater management systems was determined using the 72-hour, 100-year storm event model results of each sub-basin. This total removal capacity was then related to a stage reduction within the sub-basin. The resulting stage and volume reduction was then used to rank each project. **Table 8-7** shows the flood volume reduction of each proposed project and the resulting rank for each sub-basin based on the cost per volume reduction.

Table 8-7 – Conceptual Design Project Ranking By Flood Volume Reduction

Volumetric Reduction Rank	Sub-Basin Name	Sub-Basin Area Acre)	Sub-Basin Flood Rank	Runoff Volume Removed (Cubic Feet)	Cost Per Cubic Foot of Runoff Removed
1	U35-S	42.4	4	9,005,988	$0.12
2	C100DN-1W	136.1	2	17,714,002	$0.17
3	C100DN-1E	102.5	7	23,912,244	$0.18
4	U29-S	60.1	1	11,683,434	$0.21
5	C100A-5	29.6	8	6,856,617	$0.25
6	U28-E	55.8	11	10,664,353	$0.26
7	U32-S	20.7	13	2,402,028	$0.26
8	C100A-E-2	33.9	6	3,760,808	$0.33
9	C100A-W3S	178	15	11,759,478	$0.33
10	C100D-N-1	247.4	14	6,602,810	$0.33
11	B-Bay-SE	99.9	12	13,657,580	$0.34
12	C100A-W3N	172.8	3	6,339,786	$0.56
13	C100A-E-1	90.7	9	5,585,777	$0.64
14	PNL&RGL	86.2	5	3,338,791	$0.71
15	C2-S-9NE	204.8	10	1,295,580	$2.79

Appendix 8J includes a map of the conceptual stormwater improvement projects ranked based on flood reduction cost effectiveness.

9.0 PROJECTED WATER QUALITY LOAD REDUCTIONS

Sub-basin load reductions based on the proposed conceptual stormwater management improvement projects for the top 15 ranked sub-basins were estimated by defining a contributing treatment area that contributes runoff to the exfiltration trenches or stormwater management systems. For the proposed systems consisting of longitudinal lengths of exfiltration trench primarily running the length of a roadway, the anticipated load reduction can be estimated by defining a contributing width per linear foot of exfiltration trench and then finally calculating the total contributing area. This contributing area can then be compared to the total sub-basin area thus giving a percentage of the sub-basin contributing to the system.

This method is a reliable measure of estimating the total load reductions in a sub-basin due to the known effectiveness of exfiltration trench systems in treating stormwater runoff. Additionally, the systems being proposed in this SWMP that will be self-contained systems with no discharge to a receiving water body will treat the entire contributing volume.

For the purposes of this estimation, various locations within the Village were evaluated and contributing areas were estimated by evaluating the width of the typical roadway/right-of-way where systems were proposed and also assuming a certain amount of contributing area beyond the right-of-way. The estimated width of contributing area was estimate to be approximately 125-ft which typically equated to the roadway right-of-way, the swale areas, and the front of properties which typically includes the carport/driveway of most homes as shown in **Figure 9-1**.

Figure 9-1 – Average Contributing Area to Roadway

The calculation for determining the load reduction from a proposed stormwater project would be as follows:

$$R_{\%} = (W \times L / 43{,}560 \text{ ft}^2) / A_{sb}$$ **Equation 9-1**

Where:
$R_{\%}$ = Removal Percentage
A_{sb} = Total Sub-basin Area, acres
L = Length of exfiltration trench, ft
W = Contributing Width, ft (predefined as 125-ft)

The resulting Removal Percentage ($R_{\%}$) can then be applied to the each of the sub-basin water quality loads to arrive at the final total load per sub-basin assuming the proposed stormwater improvement project has been implemented within the given sub-basin. The Removal Percentages ($R_{\%}$) for each of the top 15 ranked sub-basins are presented in **Table 9-1**.

Table 9-1 – Removal Percentages for Top 15 Sub-Basins

Sub-Basin Flood Rank	Sub-Basin Name	Sub-Basin Total Area (A_{sb}, acres)	Length of Exf. Trench (L, ft)	Contributing Area (acres)	Removal Percentage ($R_{\%}$)
1	U29-S	60.1	3300	9.4697	15.76%
2	C100DN-1W	136.1	7000	20.0872	14.76%
3	C100A-W3N	172.8	8800	25.2525	14.61%
4	U35-S	42.4	2100	6.02617	14.21%
5	PNL&RGL	86.2	WELLs	WELLs	0.00%
6	C100A-E-2	33.9	2700	7.74793	22.86%
7	C100DN-1E	102.5	11000	31.5657	30.80%
8	C100A-5	29.6	4200	12.0523	40.72%
9	C100A-E-1	90.7	7200	20.6612	22.78%
10	C2-S-9NE	204.8	4600	13.2002	6.45%
11	U28-E	55.8	5100	14.635	26.23%
12	B-BAY-SE	99.9	4500	12.9132	12.93%
13	U32-S	20.7	1700	4.87833	23.57%
14	C100D-N-1	247.4	4600	13.2002	5.34%
15	C100A-W3S	178	10000	28.6961	16.12%

The Removal Percentage ($R_{\%}$) were applied to the annual pollutant loads that were previously estimated in this SWMP and included the following 12 priority pollutants:

1. 5-day Biochemical Oxygen Demand (BOD)
2. Chemical Oxygen Demand (COD)
3. Total Suspended Solids (TSS)
4. Total Dissolved Solids (TDS)
5. Total Kjeldahl Nitrogen (TKN) (total ammonia + organic nitrogen)
6. Total Nitrogen (TN)
7. Total Phosphorus (TP)
8. Dissolved Phosphorus (DP)
9. Total Cadmium (Cd)

10. Total Copper (Cu)
11. Total Lead (Pb)
12. Total Zinc (Zn)

The removal percentage presented in **Table 9-1** was applied to the annual pollutant loading described in **Section 5.5**. The resulting reduced annual pollutant loading for the top 15 ranked sub-basins for the dry, average, and wet yearlong continuous simulations are included in **Appendix 9A**.

Table 9-2 provides the total loads for each of the 12 pollutants for the dry, average, and wet simulations for the Village of Pinecrest sub-basins and the South Biscayne Bay Basin. **Table 9-3** shows the annual pollutant loads the Village of Pinecrest contributes to the C-100 Basin and the C-2 Basins.

Table 9-2– Total Annual Pollutant Load for the Village of Pinecrest and South Biscayne Bay Basin

	Village of Pinecrest Total Annual Load (lbs/yr)		
Pollutant	**Dry**	**Average**	**Wet**
BOD5	3.37E+04	4.27E+04	5.25E+04
COD	1.73E+05	2.19E+05	2.68E+05
TSS	1.40E+05	1.78E+05	2.06E+05
TDS	3.87E+05	4.90E+05	5.87E+05
TN	5.67E+03	6.20E+03	8.05E+03
TKN	3.77E+03	4.77E+03	5.85E+03
TP	1.10E+03	1.39E+03	1.71E+03
DP	4.66E+02	5.90E+02	7.24E+02
Cd	7.91E+00	1.00E+01	1.22E+01
Cu	6.94E+01	8.53E+01	1.04E+02
Pb	2.82E+02	3.26E+02	4.08E+02
Zn	2.31E+02	2.92E+02	3.56E+02

	Biscayne Bay Basin Total Annual Load (lbs/yr)		
Pollutant	**Dry**	**Average**	**Wet**
BOD5	3.55E+03	5.02E+03	6.10E+03
COD	1.77E+04	2.50E+04	3.03E+04
TSS	1.41E+04	2.00E+04	2.38E+04
TDS	4.03E+04	5.70E+04	6.84E+04
TN	6.23E+02	5.63E+02	6.94E+02
TKN	3.97E+02	5.63E+02	6.82E+02
TP	1.19E+02	1.69E+02	2.05E+02
DP	4.91E+01	6.96E+01	8.44E+01
Cd	7.69E-01	1.10E+00	1.32E+00
Cu	6.63E+00	9.05E+00	1.12E+01
Pb	2.72E+01	3.19E+01	3.89E+01
Zn	2.26E+01	3.19E+01	3.87E+01

Table 9-3– Total Annual Pollutant Load for the C-100 and C-2 Basins

	C-100 Basin Total Annual Load (lbs/yr)		
Pollutant	**Dry**	**Average**	**Wet**
BOD5	2.53E+04	3.61E+04	4.38E+04
COD	1.28E+05	1.83E+05	2.22E+05
TSS	1.04E+05	1.50E+05	1.82E+05
TDS	2.90E+05	4.14E+05	5.03E+05
TN	4.54E+03	5.34E+03	6.50E+03
TKN	2.81E+03	4.01E+03	4.87E+03
TP	8.26E+02	1.18E+03	1.43E+03
DP	3.49E+02	4.98E+02	6.04E+02
Cd	5.80E+00	8.34E+00	1.01E+01
Cu	4.88E+01	6.96E+01	8.45E+01
Pb	2.17E+02	2.75E+02	3.33E+02
Zn	1.70E+02	2.44E+02	2.96E+02

	C-2 Basin Total Annual Load (lbs/yr)		
Pollutant	**Dry**	**Average**	**Wet**
BOD5	5.76E+03	5.11E+03	4.51E+03
COD	3.13E+04	2.75E+04	2.53E+04
TSS	2.48E+04	2.18E+04	8.62E+03
TDS	6.69E+04	5.91E+04	3.78E+04
TN	6.58E+02	5.81E+02	8.18E+02
TKN	6.58E+02	5.81E+02	5.16E+02
TP	1.81E+02	1.61E+02	1.42E+02
DP	8.03E+01	7.12E+01	6.30E+01
Cd	1.52E+00	1.35E+00	1.20E+00
Cu	1.59E+01	1.30E+01	1.22E+01
Pb	4.39E+01	3.83E+01	4.30E+01
Zn	4.39E+01	3.83E+01	3.44E+01

10.0 PRIORITIZATION OF PROPOSED PROJECTS & CAPITAL IMPROVEMENT PLAN

The top 15 priority projects and the cost estimate for the implementation of the projects were presented to Village staff and Council. The estimated cost for implementation of the top 15 projects totaled $40,819,825.33. Based on the limited funding the Village has available over the next five years, the top 15 projects were further prioritized and ranked. The refined prioritization and ranking of the proposed projects were based on the number of repetitive loss claims, documented home flooding reported by citizens, sub-basin FPSS score reduction, overall flood volume reduction, and input from Village staff. The refined prioritization resulted in a final ranking and classification of the top five (5) high priority projects. These top five projects are recommended for implementation over the next five years based on funding available and the refined ranking criteria.

In addition to the flooding observations reported, Village staff surveyed residents in the areas of the top 15 ranked projects to evaluate the severity of flooding experienced on individual properties. The survey assessed the severity and frequency of water affecting overall quality of life, entering homes, and/or obstructing roadways. The results of survey questions and the number of repetitive losses within the top 15 ranked project areas are shown in **Table 10-1**.

Table 10-1 – Flooding Complaints for the Top 15 Ranked Project Areas

Basin Name	Survey Question 1*	Survey Question 3**	Repetitive Losses	Total	Complaint Rank	Cost
C100DN-1E	8	3	3	14	1	$4,261,881
U29-S	9	3	0	12	2	$2,361,083
C100D-N-1	4	3	5	12	3	$2,208,589
C2-S-9NE	5	2	4	11	4	$3,615,130
C100DN-1W	7	3	0	10	5	$3,094,683
PNL&RGL	2	3	2	7	6	$2,361,101
U35-S	4	2	0	6	7	$981,252
U28-E	2	3	0	5	8	$2,767,835
C100A-5	2	2	0	4	9	$1,714,848
C100A-E-1	0	1	2	3	10	$3,558,844
C100A-E-2	0	0	2	2	11	$1,228,833
C100A-W3N	1	1	0	2	11	$3,535,768
B-Bay-SE	0	0	2	2	11	$4,644,125
U32-S	1	0	0	1	12	$627,709
C100A-W3S	0	0	0	0	13	$3,858,144
					TOTAL COST	**$40,819,825**

* Question 1: Have you experienced chronic flooding or disruption as a result of heavy rain in your area?
** Question 3: Have you experienced flooding on your property?

In corroboration with Village staff, the top five (5) high priority projects were identified and ranked. The total number of flooding complaints (from **Table 10-1**), the sub-basin flood ranking, the rank of each project based on the cost effectiveness, and total cost for the top (5) high priority projects are shown in **Table 10-2**.

Table 10-2 – Recommended High Priority Project Ranking

Recommended Project Rank	Sub-Basin Name	Total Complaints	Sub-Basin Flood Rank	Cost Effectiveness Rank	Project Planning Level Cost
1	C100DN-1E	18	7	3	$4,261,881
2	U29-S	14	1	4	$2,361,083
3	C100D-N-1	16	14	10	$2,208,589
4	C2-S-9NE	11	10	15	$3,615,130
5	U35-S	6	4	1	$981,252
				Total Cost	**$13,427,935**

The Village of Pinecrest Council adopted the SWMP and approved the recommended top 5 high priority project ranking in RESOLUTION NO. 2015- A RESOLUTION OF THE VILLAGE OF PINECREST, FLORIDA, ADOPTING THE STORMWATER MASTER PLAN (2015) PREPARED BY A.D.A. ENGINEERING, INC. AND APPROVING THE PROJECT PRIORITY LIST; PROVIDING FOR AN EFFECTIVE DATE.

Table 10-3 presents the project ranking for the top five (5) high priority projects the Village should implement over the next five years based on the refined assessment. This table also shows the final recommended project ranking, the original flood ranking, and volumetric reduction flood ranking for the five (5) high priority projects. The total cost for the top five (5) high priority projects is $13,427,935.

Table 10-3 – Final Capital Improvement Plan - Proposed Project Order

Recommended Project Rank	Sub-Basin Name	Sub-Basin Area (Acre)	Sub-Basin Flood Rank	Volumetric Reduction Rank	Project Planning Level Cost
1	C100DN-1E	102.5	7	3	**$ 4,261,881**
2	U29-S	60.1	1	4	**$ 2,361,083**
3	C100D-N-1	247.4	14	10	**$ 2,208,589**
4	C2-S-9NE	204.8	10	15	**$ 3,615,130**
5	U35-S	42.4	4	1	**$ 981,252**
				Total Cost	**$ 13,427,935**

Taking into account the anticipated annual budget allocation for stormwater management projects and maintenance activities, and to expedite the implementation of these projects, it is recommended that the Village obtain a General Bond for the implementation of the top five (5) high priority projects over the next five years. The Bond Debt Service can be potentially paid with the revenue generated from the current stormwater utility fees. The Village should also consider increasing the current stormwater utility fee based on extent of cost for required stormwater improvement projects and statewide average rates. It is recommended that the current fee should be increased from $5 to $8. This could generate an additional $400,000/year to allow more flexibility in implementing high priority projects.

The ranking and the Capital Improvement Plan developed for this SWMP are intended to help guide the Village in prioritizing the implementation of stormwater improvement projects based on cost-effectiveness and flood reduction. The ranking of projects does not require the Village to design and construct projects in this order. In addition, the recommendations of the CIP do not oblige the Village to obtain a Bond Debt Service, nor does it hold the Village responsible for allocating or expending the estimated project costs within the 5-year period. Further detailed analysis will be required to refine the information presented in this SWMP. Additional projects may be added to the 5-year CIP if more funding is allocated to these types of projects or if these projects can be combined with other Capital Improvement project in the Village.

11.0 CONCLUSIONS AND RECOMMENDATIONS

11.1 Conclusions

The following conclusions can be derived based on the work completed in accordance with the Stormwater Master Plan development scope of work documented in **Section 2.0** through **10.0**:

1. Sufficient data was available and successfully collected to proceed with the development of the Stormwater Management Master Plan (SWMP) for the Village of Pinecrest to establish the current flood protection level of service and to analyze numerous sea level and groundwater rise scenarios. The collected data provided adequate and sufficient information to perform the necessary tasks for the development of the SWMP.
2. The Public Involvement and Outreach program implemented was successful in to educating the public and local land developers in the activities that were being performed to complete the SWMP and to obtain feedback from the residents and land developers. Feedback received from residents and land developers were used, in coordination with Village staff, to refine the procedures used to develop the SWMP for the Village.
3. The C-2 Basin and C-100 Basin stormwater master plan models obtained from DRER offered well documented model development information as well as complete and functioning electronic versions of the XP-SWMM hydrologic and hydraulic models. The model conversions yielded functioning representative models that served as reliable models for use in developing the existing flood protection level of service within the Village, compute the quality of stormwater discharges from the Village and evaluate currently projected sea level and groundwater rise impacts to the Village.
4. The most recent available information provided by the US Army Corps of Engineers and adopted by the Miami-Dade Sea Level Rise Task Force in 2014 and the United States Geological Survey (USGS) groundwater analysis in 2014 to assess potential groundwater rise due to projected sea level rise in Miami-Dade County indicate the following:
    a. 2030 sea level rise projection can be in the range of 3 to 7 inches.
    b. 2060 sea level rise project can be in the range of 9 to 24 inches.
    c. 2045 groundwater modeling results with combined pumping and 1 foot of sea level rise yields 0.5 foot of groundwater rise along the coast and 0.1 foot in western parts of the urban area, and there is limited migration of saltwater intrusion line anticipated in the vicinity of the Village due to the existing control structures.

5. Hydrologic/hydraulic modeling of existing flooding conditions and projected seal-level and groundwater rise indicate that the 10-year design level of service of the C-100A Canal, C-100 Canal and S-123 Control Structure create a significant constraint within the Village for flood protection level of service for building finish floor elevations, since these facilities as designed for a 100-year design storm event.
6. A modified version of the DRER ranking procedure was applied to the Village of Pinecrest sub-basins to identify and rank the top 15 sub-basins with the lowest flood protection level of service. The ranking procedure utilized flood stage data derived from the models and topographic, property, and roadway data available in GIS to establish a Flood Protection Severity Score (FPSS) for each sub-basin. The FPSS provided representative ranking of the highest flood prone areas within the Village based on observed flooding and resident complaints. A map of sub-basin flood ranking within the Village is included in **Appendix 7D**.
7. Conceptual stormwater improvement projects were developed for the top 15 ranked sub-basins in accordance with the scope of work to meet the required roadway and finish floor elevations flood protection level of service to the maximum extent possible. For the majority of the Village of Pinecrest, it was determined that the most viable stormwater improvement system would be exfiltration trench systems due to their relatively low construction cost, low maintenance requirements, effectiveness in satisfying stormwater quality and quantity requirements, and the potential to place the systems under the current roadways of the Village. In areas where it is feasible, outfalls were implemented and designed to adhere to the discharge limitations of the receiving water bodies. In addition, for areas located east of the saltwater intrusion line, injection wells and pump stations were implemented to increase the efficiency of existing systems and maximize the effectiveness of the proposed systems. All outfalls proposed include a control structure and implementation of a backflow preventer to control discharges and prevent high water levels in the canal systems to backflow on the roads and buildings. **Appendix 8C** includes conceptual design schematics for the top 15 ranked sub-basins.
8. Conceptual stormwater improvement projects analysis and design indicate that the required flood protection level of service cannot be achieved in most of the sub-basin, even with a 2030 mid-range sea level and groundwater rise projection of 5 and 2.04 inches, respectively, due to the constraints of the primary drainage systems within the Village.
9. The conceptual stormwater improvement projects were ranked based on the cost per flood volume reduction to rank the projects in order of cost-effectiveness. **Table 8-7** summarizes the conceptual design project ranking by flood volume reduction and total project cost.
10. The total cost to improve the flood protection level of service within the top 15 ranked sub-basins to the maximum extent possible for a 2030 mid-range sea level and groundwater rise is **$40,819,825**.

11. The proposed improvement projects for the top 15 ranked sub-basin provide significant pollutant load reduction to the C-2, C-100 and South Biscayne Bay Basins. The total annual pollutant load for each of the 12 priority pollutants for the dry, average, and wet simulations is summarized in **Table 9-2** and **Table 9-3**.
12. Due to the limited funding available during this 5-year period, the ranking of the top 15 sub-basins was refined to provide the top five (5) high priority projects. The refined ranking was based on repetitive loss claims, documented home flooding reported by citizens, sub-basin FPSS score reduction, overall flood volume reduction, and input from Village staff. **Table 10-3** summarizes the conceptual design ranking priority for the top five (5) high priority projects based on the refined ranking.
13. The total cost to improve the flood protection level of service within these five (5) high priority ranked sub-basins to the maximum extent possible for a 2030 mid-range sea level and groundwater rise is **$13,427,935**.

11.2 Recommendations

The following recommendations are based on the work performed in accordance with the Stormwater Master Plan development scope of work documented in **Section 2.0** through **10.0** and the ADA Team's professional opinion:

1. Due to the constraints of the C-110A (10-year design storm capacity) and C-2 Canals and control structures, higher sea level rise than the 2030 mid-range projected rise cannot be accommodated within the Village and will require regional projects such as:
    - Implementing forward pump stations upstream of the S-22 and S-123 control structures to be able to discharge excess runoff when the gates cannot be opened due to high tidal conditions.
    - Increasing the capacity of the C-100 Canal, C-100A Canal and S-123 Structure to a larger capacity than a 10-year design storm event.
2. The Village should begin coordinating with municipalities within the C-2 and C-100 Basins, the SFWMD, and Miami-Dade County to begin to define required regional solutions and allocate funding to implement regional stormwater improvements to mitigate the future projected sea level rise.
3. The Village should implement a 5-year Capital Improvement Plan using a mid-range of 2030 projected sea level and groundwater rise (5 and 2.04 inches, respectively).
4. Implement an Adaptive Management Approach, track projected sea level/groundwater rise, and make corrective actions every five years. Conceptual design projects should be adaptive to accommodate sea level and groundwater rise, if predictions are accurate and/or higher than projected.

5. The proposed conceptual design projects for the recommended top five (5) high priority ranked sub-basins should be implemented in the order of priority outlined in **Table 10-3.** The refined ranking was based on repetitive loss claims, documented home flooding reported by citizens, sub-basin FPSS score reduction, overall flood volume reduction, and input from Village staff. However, it should be noted that this ranking does not require the Village to design and construct projects in this order. This list is also not a commitment by the Village to allocate or expend the estimated amounts within the 5-year Capital Improvement Plan (CIP) period. This SWMP serves to guide the Village in locating potential projects and correlating potential projects with simulated real world events. Further detailed analysis will be required to refine the information presented in this SWMP during the detailed design phase of the proposed stormwater management projects.
6. Implement a 1-foot clearance (freeboard) above the FEMA Based Flood Elevation (Elevation 10 feet-NGVD29) for residential areas in high-flood prone areas:
    - Higher elevations do not provide additional benefits in improving the Village's Community Rating Score (CRS).
    - Higher clearances (2' or higher) will significantly reduce flood plain storage within the Village.
    - Higher clearances will create excessive elevation disparity with many existing home elevations.
7. Conceptual project costs should be revised at the design and permitting phases of the projects to account for current material and labor costs and potential utility impacts not addressed as part of the planning phase.
8. The Village should consider obtaining a General Bond to expedite implementation of proposed projects to address the top five (5) high priority ranked sub-basin projects and use the available stormwater utility fee to pay for the bond's debt service cost.
9. The Village should consider increasing the current stormwater utility fee based on extent of cost for required stormwater improvement projects and statewide average rates. It is recommended that the current fee should be increased from $5 to $8. This could generate an additional $400,000/year to allow more flexibility in implementing high priority projects.
10. The Village should update the Stormwater Master Plan every 5-years to:
    - Maximize Community Rating Score (CRS)
    - Re-assess sea-level and groundwater rise trends
    - Re-prioritize projects based on projects previously implemented

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village of
PINECREST
FLORIDA

VILLAGE OF PINECREST STORMWATER MASTER PLAN

Final Report

VOLUME 2

Prepared by:

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July 2015

Appendix 3A

Village of Pinecrest Project Data Catalog

Project Location	Year	File Type	Description
S. Mitchell Manor Circle & SW 64th Ave Phase I	2013	PDF, CAD	Project Plans & Report
S. Mitchell Manor Circle & SW 64th Ave Phase II	2013	PDF, CAD	Project Plans & Report
Pine Needle Lane (near SW 121st St)	2013	PDF, CAD	Project Plans & Report
Rock Garden Lane (near SW 121st St)	2013	PDF, CAD	Project Plans & Report
Killian Park Road – 11100 Killian Park RD	2012	PDF, CAD	Project Plans & Geotechnical Report
Pinecrest Gardens Stormwater Improv.	2012	PDF, CAD	Project Plans & Report
Pinecrest Gardens Parking Stormwater Improv.	2012	PDF, CAD	Project Plans & Report
SW 70th Ave (SW 100th Ave & 104th Ave)	2007	PDF, CAD	Project Plans & Report
SW 72th Ave (SW 112th St to SW 120th St)	2010	PDF, CAD	Project Plans & Report

Village of Pinecrest Data Catalog

Title of Document or File	File Type	Description
Drainage Improvements	PDF/ACAD	Plans and Reports 2013
Capital Improvement Projects	PDF	Paving Projects Year-1 and Year-2
Storm Drain Structures	XLS	Location and Description for 63 structures
Storm Drainage System Maintenance	PDF	Cleaning services - Pricing
Percolation Test Data	PDF	Performed for drainage improvements projects
Ortho - MD2012	GIS	Aerial images 2012
Existing Land use 2013	GIS	Requested Layers - March 2014 Updates
Future Land use	GIS	Requested Layers - March 2014 Updates
Canals, Water Bodies and Outfalls	GIS	Requested Layers - March 2014 Updates
Village Limits	GIS	Requested Layers - March 2014 Updates
FEMA Flood Zones	GIS	Requested Layers - March 2014 Updates
Soil Condition	GIS	Requested Layers - March 2014 Updates
Properties	GIS	Requested Layers - March 2014 Updates
Zoning Districts	GIS	Requested Layers - March 2014 Update
Customers Pinecrest	GIS	Water and Sewer - November 2013 Update
Sewer Lines, Nodes & Main Lines	GIS	Water and Sewer - November 2013 Update
Water Lines, Nodes	GIS	Water and Sewer - November 2013 Update
Pump Stations	GIS	Water and Sewer - November 2013 Update
Flood Zone 2013 Book	PDF	Flood Zones 2013
Pinecrest Drainage, Manholes, Outfalls	GIS	Base Layer - Village of Pinecrest
Right-of-Way, Parcels	GIS	Base Layer - Village of Pinecrest
Water Canal Ownership	GIS	Base Layer - Village of Pinecrest
Subdivisions	GIS	Base Layer - Village of Pinecrest

Appendix 3B

Photos on File in the Office of the Village Clerk

Appendix 3C

Miami Dade County Data Catalog

Title of Document or File	Author	File Type
Canals & Water Bodies	Miami Dade County	Digital
Transportation Highways- Streets	Miami Dade County	Digital
Landuse_2013	Miami Dade County	Digital / Hardcopy
Lot	Miami Dade County	Digital
MD_pribasins	Miami Dade County	Digital
Properties	Miami Dade County	Digital
Soils	Miami Dade County	Digital
Soils_sfwmd	Miami Dade County	Digital
2012_Miami-Dade Aerials	Miami Dade County	Digital
LiDAR - Topo	Miami Dade County	Digital
C-2 / C-100 Basin XPSWMM Models	Miami Dade County	XP-SWMM / Hardcopy
C-2 / C-100 Basin Master Plan Reports	Miami-Dade County	PDF
Miami Dade Sea Level Rise Task Force Report and Recommendations	Miami-Dade County	PDF

Appendix 4A

VILLAGE OF PINECREST STORMWATER MASTER PLAN

DEVELOPER MEETING | TUESDAY, SEPTEMBER 23, 2014

As part of the outreach efforts for the Village of Pinecrest's Stormwater Master Plan (SWMP), ADA Engineering, in conjunction with EV Services, Inc. and the Village manager's office, held a special workshop on the morning of Tuesday, September 23, 2014. Having received a number of complaints and concerns regarding existing level of service requirements, The Village invited ADA to host a special meeting in which they would clarify what is required of developers working in Pinecrest according to the existing village ordinance, and also to introduce them to the SWMP and describe the benefits it will bring.

The meeting was held in the Village Municipal Center in Council Chambers and was attended by twelve developers, as well as four representatives from ADA (Alberto Argudin, president; Alex Vazquez, the project manager; Viviana Villamizar, Engineer and GIS Modeler; and Amy Cook, Engineer) three representatives from EV Services Inc. (Esther Monzon-Aguirre, president; Teresa Herran, public information; Bernardo Favole, public information), and three Village staff members (Maria Menedez, Assistant Village Manager; Stephen Olmsted, director of planning and zoning; and Leo Llanos, Building Official) . As developers arrived, they were asked to sign in and were given a Frequently Asked Question (FAQ) Booklet as well as a Comment Card.

Esther Monzon-Aguirre opened with a short description of the meeting's format and purpose. Alex Vazquez then began the workshop with a brief introduction to the SWMP and the positive impact it would have on the Village, as well as an anticipated timeline for the project. He illustrated his discourse with various informational boards.

The floor was then opened up to the developers for their questions. There were a number of recurring themes: whether or not flooding complaints in the village are legitimate and warrant such a stringent level of service requirement, regulations and safety concerns for basins on private property, budget concerns for such an extensive project, whether an expedited study could be carried out and presented to the Village before adding and codifying more regulations, and inconsistency in Miami-Dade County reviews relating to stormwater issues. Throughout this question and answer process, developers were reminded that while their feedback in the workshop was important, it was imperative for them to write their thoughts on the comment cards provided to them for ADA and The Village's records.

After the workshop, EV Services and ADA Engineering asked developers to take their time filling out their comment cards, providing extras as necessary. Once this was complete and the meeting ended, ADA's engineers accompanied a developer to visit a property that currently experiences significant flooding in Pinecrest. This was not only an exercise in engaging with the developer community, but also in seeing one of the problems described at the workshop.

Moving forward, ADA has taken the feedback given to them by the developers and will consider it moving forward. Though different in its focus, this upcoming workshop will serve the same purpose of engaging with the community—this time catering to the residents of Pinecrest on a more personal level and informing them of how it can benefit them and their community.

Appendix 4B

VILLAGE OF PINECREST STORMWATER MASTER PLAN

RESIDENT OPEN HOUSE | TUESDAY, SEPTEMBER 30, 2015

On the evening of Tuesday, September 30, The Village of Pinecrest (The Village) and ADA Engineering hosted a special workshop for residents of The Village regarding the upcoming Stormwater Master Plan (SWMP). This workshop was held at Evelyn Greer Park as an informal open-house where residents were invited to attend and speak directly with the engineers carrying out the development of the SWMP, while also identifying any areas of their property that experiences flooding issues.

Upon arriving, residents were asked to sign in and were given a packet containing general information about the SWMP, as well as a list of Frequently Asked Questions. They were then referred to a map of The Village which had SW 112th Street serving as the mid-way line bisecting the area. Those residents living to the north of SW 112th Street were directed to one side of the room, and those living to the south of it were directed to the other. The purpose of dividing The Village in this manner was to better address individual residents' needs, as ADA's engineers were able to take the time to listen to residents' questions, complaints, and comments on a more personal and individual level.

Roughly twenty residents attended the meeting, and each was able to speak directly with the Village officials who were present, as well as the engineers that are working on the SWMP. They were also able to consult various boards prepared by ADA Engineering, which included a projected timeline for the SWMP and an illustration of the flooding determination and responsibility in the public right of way, and a more specific map of their corresponding area (North or South). Many of those in attendance identified areas that flood on their property (or in the Village in general) by placing a marker on the maps of North and South Pinecrest, and all residents were encouraged to fill out a comment card with their thoughts, concerns, or suggestions.

This workshop was a productive event in that it informed village residents of the SWMP on the most basic level, breaking down the process of developing the plan and the benefits it will bring to The Village into very simple and accessible terms. Those residents in attendance who already had a working knowledge of the SWMP also profited from the experience, as they were encouraged to use their familiarity with the process and the plan to make suggestions.

Moving forward, ADA will take the feedback garnered from this resident workshop and the previous developer workshop into consideration while developing the SWMP. They will also meet with The Village to discuss pressing concerns from the community, and together the two entities will work together to find the best course of action for The Village's SWMP.

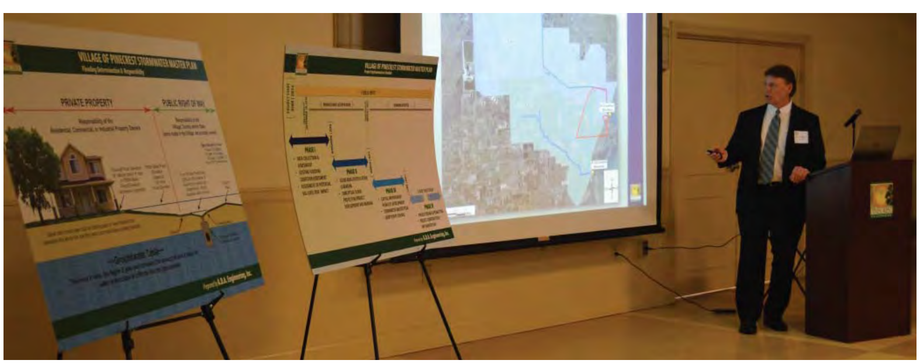
Appendix 4C

VILLAGE OF PINECREST STORMWATER MASTER PLAN
UPDATE OPEN HOUSE MEETING | TUESDAY, MARCH 3, 2015

On Tuesday, March 3, 2015, the Village of Pinecrest (Village), in conjunction with ADA Engineering (ADA), and EV Services, Inc. (EVSI) hosted a Stormwater Master Plan Update Open House Meeting at 7:00 PM at Evelyn Greer Park. The purpose of this meeting was to inform residents of ADA's progress on the development of the Stormwater Master Plan (SWMP), to share the top fifteen (15) ranked areas of flooding in the Village, and to explain the ranking methodology and formulation of drainage projects.

ADA and EVSI began setting up at Evelyn Greer at 5:00 PM. The Village provided chairs and set them up to face the projection screen, which ADA used for their PowerPoint presentation. ADA also placed boards around the room for reference, each depicting a breadth information from the flood rankings to level of service standards and specific projects proposed within Village sub-basins.

Residents began to arrive around 6:30 PM and were asked to sign in. They were invited to look at the boards displayed throughout the room, and questions were answered by ADA staff. At 7:00 PM, Esther Monzon-Aguirre, President of EVSI, began the meeting with a brief introduction. She stated that the purpose of the meeting was to provide an update on progress made since last September's initial open house meeting, and to inform residents of the top fifteen ranked flood and drainage project rankings, as well as the methodology by which the rankings were determined. She encouraged residents to hold their questions until the end, and asked that questions during the Question-Answer period remain general, adding that there would be ample time afterward for residents to ask engineers about their specific properties or concerns on a more personal level. She also encouraged residents to fill out the comment cards provided to them, citing these as vital in the feedback process for the Village.



With that, Mr. Alex Vazquez, PE, ADA Project Manager for the Stormwater Master Plan development, took over the presentation. He began with a timeline of the overall SWMP, giving a brief overview of what has been accomplished thus far. He then delved into current flooding conditions of the Village including the extent of flooding, the rules and regulations on drainage infrastructure available for use in the Village, and the existing drainage infrastructure to provide a basis for the necessity of the SWMP. After explaining sea level rise and showing a graph of projected sea level rise for 2030 and 2060, he moved on to the national standard for calculating flood area rankings, a Miami-Dade County and FEMA-approved approach. He explained that this approach, based on science and math, is what ADA used in order to calculate the Village's flood rankings. The presentation went on to show the project rankings, in order of cost-effectiveness, alongside their projected costs.

Mr. Vazquez finished the presentation by going back to the original timeline and describing what the next steps would be. At this point, residents began asking their questions. Overall, it seemed that the biggest concerns were the high cost of enacting a SWMP and the efficacy of the ranking matrix.

A number of residents from SW 70th Avenue were present at the meeting, and they were especially frustrated that their area was ranked 12th out of 15th. According to their accounts, their road becomes impassable during heavy rain, with even emergency vehicles being unable to enter. Although ADA assured them that the formula used to arrive at the ranking was based on objective facts, the residents clamored for subjectivity, saying that their complaints and feedback should be weighted more heavily. This led to a productive conversation and suggestion (supported by Councilmember Ball) that rather than rely on voluntary feedback and the presence of residents who attend these types of meetings, the Village and SWMP could benefit from sending residents in affected areas surveys and take that survey into account as part of the ranking process.

The other major concern, of course, was the high cost of the projects currently proposed to address flooding within the top 15 highest flooding areas. The "sticker shock" of almost $38 million made many residents visibly and vocally uncomfortable, and they began questioning where this money would come from, fearing it would affect their taxes. After Mr. Vazquez replied that the SWMP at this point was merely a suggestion to be presented to the Village, Councilmember Kraft elaborated and shared the information that the best—and indeed only—way to get State funding is to have a Master Plan. This put many worries at ease.

Although the issue of Climate Change remains universally controversial and uncertain, Mayor Lerner disagreed with those people in the room who dismissed it and cited several scientific studies that predict the gravity of flooding and damage the Village will face in the coming years. This proved to be a valuable counterpoint to those questioning the necessity of going through the expense of having a SWMP.

At this point, the presentation and Question and Answer period ended, but residents were again invited to stay and have another look at the boards, ask ADA specific questions, and most importantly, fill out their comment cards. Residents were informed that the evening's presentation and all the boards would be posted on the Village website. As they left, EVSI collected their comment cards and thanked them for attending.

Overall, it was a productive meeting in which the Village and ADA informed Village residents of the progress made on the SWMP and the methodology being used to rank and select future drainage projects. The meeting also allowed residents to express their concerns and weigh-in on the process in a responsive forum.

Appendix 4D

On Tuesday, March 10, 2015, the Village of Pinecrest (Village), in conjunction with ADA Engineering (ADA), and EV Services, Inc. (EVSI) hosted an update meeting for local developers regarding the Stormwater Master Plan at 9:00 AM at Council Chambers in the Village Municipal Center. The purpose of this meeting was to inform developers who work in Pinecrest of ADA's progress on the development of the Stormwater Master Plan (SWMP) and to address comments from the first public meeting regarding the stormwater requirements in the Village of Pinecrest Land Development Code. The primary objective of the meeting was to address concerns raised about the impact the current requirements have within the property of new developments. A secondary goal of the meeting was to gauge the developers' interest in having an alternative stormwater treatment method incorporated into the Land Development Code.

ADA and EVSI began setting up at Council Chambers at 8:00 AM. Michelle Hammontree of the Village had provided chairs and a podium, which were set up by facilities staff the night before. EVSI brought a screen on which to project ADA's PowerPoint presentation, as well as the projector that was used. ADA also placed two boards at the front of the room depicting the proposed alternative to the current level of service standard and the Stormwater Master Plan Timeline.

Developers began to arrive around 8:50 AM and were asked to sign in. They were invited to have a seat, and the presentation began promptly at 9:00 AM. Esther Monzon-Aguirre, President of EVSI, began the meeting with a brief introduction. She stated that the purpose of the meeting was to provide an update on progress made since last September's initial developer meeting, and emphasized that the feedback at that time had been taken into consideration throughout the progress made during the last six months. She encouraged developers to hold their questions until the end, and requested developers to fill out the comment cards provided to them, citing these as vital in the feedback process.

Monzon-Aguirre then turned the presentation over to Mr. Alex Vazquez, PE, ADA Project Manager for development of the Stormwater Master Plan and assessment of the current stormwater requirements of the Land Development Code. He briefly covered the current progress and findings of the Stormwater Master Plan emphasizing the existing condition of flooding within the Village and future impact sea level rise could have. Mr. Vazquez then went on to present ADA's assessment of the current stormwater drainage requirements and the proposed alternative to the current land development code to minimize the impact on residential lot open space, while maintaining the current flood protection for the development. The presentation went on to show how the alternative could be enacted. Mr. Vazquez also presented proposed updates to the current land development code stormwater management requirements. The revisions and recommendations are aimed to clarify the requirements and provide a more consistent permitting process. The Village's consulting engineer from CAP Engineering, who has been working closely with the developers, took some time to clarify current permitting requirements.

Mr. Vazquez finished the presentation by going back to the original timeline and describing what the next steps will be. At this point, developers began asking their questions. Overall, it seemed that their biggest concerns were the high cost of enacting the proposed alternative. Aside from Mr. Vazquez, Steve Olmsted and Maria Menendez from the Village also took the time to address some of the questions and concerns posed by the developers.

Developers who were present for the presentation seemed to be less frustrated with the current level of service requirements. However, a number of them did raise questions about the projected cost of the alternative; the fact that it was an option they could choose to take on seemed to assuage many of their doubts or apprehensions. Also, according to the Village, tensions have been minimized and disagreements are being sorted out with the review of past and current permit applications and design by CAP Engineering. The engineering consultant has been able to open a more direct and effective line of communication with most of the developers. He was even congratulated by one of the developers who were present, and the rest of the audience agreed with the accolade.

Overall, it was a productive meeting in which the Village and ADA informed developers of a possible alternative method of meeting the stormwater requirements for new developments. The meeting provided the Village and engineers the opportunity to engage with the developers on a more hospitable level than the previous meeting. Moving forward, ADA will continue to work with the Village on the Stormwater Master Plan, and will work with them to decide whether the alternative should be presented to Council for incorporation into the Land Development Code.

Appendix 5A

XP-SWMM Model Junction	5-Year			10-Year			25-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
107AVE-N-1	9.39	9.39	0.00	9.45	9.45	0.00	9.53	9.52	0.00
107AVE-N-2	8.06	8.06	0.00	8.08	8.08	0.00	8.10	8.10	0.00
107AVE-N-3	8.32	8.32	0.00	8.37	8.37	0.00	8.44	8.44	0.00
107AVE-S-1	8.64	8.64	0.00	8.75	8.75	0.00	8.91	8.90	-0.01
137AVE-2	8.04	8.04	0.00	8.06	8.06	0.00	8.17	8.21	0.04
137AVE-N-1	6.86	6.85	-0.01	7.16	7.20	0.04	8.37	8.38	0.00
139AVE-E-1	6.70	6.74	0.04	7.15	7.19	0.04	8.38	8.38	0.00
139AVE-N-1	6.70	6.74	0.04	7.15	7.19	0.04	8.38	8.38	0.00
144AVE-C-1	6.56	6.60	0.04	7.15	7.19	0.04	8.38	8.38	0.00
144AVE-C-2	6.53	6.57	0.04	7.14	7.18	0.04	8.37	8.37	0.00
144AVE-E-1	6.70	6.74	0.04	7.15	7.19	0.04	8.38	8.38	0.00
144AVE-W-1	6.56	6.60	0.04	7.15	7.19	0.04	8.38	8.38	0.00
147AVE-1	6.55	6.59	0.04	7.15	7.19	0.04	8.37	8.38	0.00
26ST-1	7.78	7.79	0.01	7.81	7.82	0.01	8.32	8.33	0.00
26ST-2	7.97	7.98	0.02	8.01	8.02	0.01	8.13	8.13	0.00
57AVE-S	**7.06**	**7.06**	**0.00**	**7.08**	**7.08**	**0.00**	**7.10**	**7.09**	**0.00**
64ST-C-1	6.78	6.81	0.03	7.21	7.24	0.03	8.38	8.38	0.00
64ST-C-10N	5.33	5.24	-0.09	6.01	5.92	-0.09	8.30	8.24	-0.06
64ST-C-10S	5.33	5.24	-0.09	6.01	5.91	-0.10	8.04	7.89	-0.14
64ST-C-11	5.33	5.23	-0.09	6.01	5.91	-0.10	8.03	7.89	-0.14
64ST-C-12	5.05	4.96	-0.09	5.69	5.61	-0.09	7.68	7.52	-0.16
64ST-C-13	4.99	4.91	-0.08	5.63	5.56	-0.07	7.60	7.44	-0.16
64ST-C-14	4.75	4.73	-0.03	5.39	5.36	-0.03	7.29	7.08	-0.21
64ST-C-15	4.72	4.69	-0.03	5.35	5.31	-0.03	7.22	6.99	-0.23
64ST-C-16	4.67	4.64	-0.03	5.30	5.27	-0.03	7.16	6.92	-0.25
64ST-C-17	4.55	4.51	-0.03	5.17	5.13	-0.05	6.91	6.62	-0.30
64ST-C-18	4.54	4.51	-0.03	5.17	5.12	-0.05	6.91	6.61	-0.30
64ST-C-19	4.53	4.50	-0.03	5.16	5.12	-0.05	6.90	6.60	-0.29
64ST-C-2	6.88	6.90	0.02	7.32	7.35	0.03	8.40	8.40	0.00
64ST-C-20	4.53	4.49	-0.03	5.16	5.11	-0.05	6.88	6.59	-0.29
64ST-C2122	4.53	4.49	-0.03	5.15	5.10	-0.05	6.87	6.58	-0.30
64ST-C-3	6.90	6.93	0.02	7.34	7.38	0.03	8.41	8.41	0.00
64ST-C-4	6.78	6.78	0.01	7.20	7.22	0.02	8.38	8.38	0.00
64ST-C-5	6.40	6.38	-0.02	6.81	6.78	-0.03	8.33	8.31	-0.02
64ST-C-6	5.73	5.65	-0.08	6.41	6.32	-0.08	8.26	8.20	-0.06
64ST-C-7	5.72	5.64	-0.08	6.40	6.31	-0.09	8.26	8.19	-0.06

XP-SWMM Model Junction	50-Year			100-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
107AVE-N-1	9.58	9.58	0.00	9.64	9.64	0.00
107AVE-N-2	8.12	8.12	0.00	8.23	8.14	-0.09
107AVE-N-3	8.49	8.49	0.00	8.55	8.55	0.00
107AVE-S-1	9.01	8.99	-0.01	9.10	9.09	-0.01
137AVE-2	8.49	8.48	-0.02	8.76	8.74	-0.03
137AVE-N-1	8.60	8.59	-0.01	8.85	8.84	-0.01
139AVE-E-1	8.60	8.59	0.00	8.85	8.84	-0.01
139AVE-N-1	8.60	8.59	0.00	8.85	8.84	-0.01
144AVE-C-1	8.60	8.60	0.00	8.85	8.84	-0.01
144AVE-C-2	8.59	8.59	-0.01	8.85	8.84	-0.01
144AVE-E-1	8.60	8.59	0.00	8.85	8.84	-0.01
144AVE-W-1	8.60	8.60	0.00	8.85	8.84	-0.01
147AVE-1	8.60	8.59	-0.01	8.85	8.84	-0.01
26ST-1	8.56	8.55	-0.02	8.84	8.83	-0.01
26ST-2	8.49	8.43	-0.06	8.83	8.81	-0.02
57AVE-S	**7.11**	**7.10**	**0.00**	**7.12**	**7.12**	**0.00**
64ST-C-1	8.60	8.60	0.00	8.85	8.84	-0.01
64ST-C-10N	8.64	8.65	0.00	8.84	8.83	-0.01
64ST-C-10S	8.50	8.48	-0.02	8.80	8.75	-0.05
64ST-C-11	8.50	8.48	-0.02	8.80	8.75	-0.05
64ST-C-12	8.19	8.13	-0.06	8.63	8.50	-0.12
64ST-C-13	8.14	8.06	-0.07	8.59	8.45	-0.14
64ST-C-14	7.88	7.75	-0.13	8.42	8.18	-0.24
64ST-C-15	7.84	7.68	-0.16	8.42	8.18	-0.25
64ST-C-16	7.81	7.62	-0.18	8.42	8.18	-0.25
64ST-C-17	7.59	7.30	-0.29	8.42	8.12	-0.30
64ST-C-18	7.58	7.29	-0.29	8.42	8.12	-0.30
64ST-C-19	7.57	7.28	-0.29	8.42	8.12	-0.30
64ST-C-2	8.62	8.61	0.00	8.86	8.85	-0.01
64ST-C-20	7.55	7.25	-0.29	8.39	8.08	-0.31
64ST-C2122	7.53	7.24	-0.29	8.37	8.06	-0.31
64ST-C-3	8.62	8.62	0.00	8.86	8.85	-0.01
64ST-C-4	8.60	8.60	0.00	8.85	8.84	-0.01
64ST-C-5	8.63	8.63	0.00	8.86	8.85	-0.01
64ST-C-6	8.66	8.67	0.00	8.87	8.85	-0.01
64ST-C-7	8.66	8.67	0.00	8.87	8.85	-0.01

XP-SWMM Model Junction	5-Year			10-Year			25-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
64ST-C-8	5.65	5.56	-0.09	6.34	6.25	-0.09	8.23	8.16	-0.07
64ST-C-9	5.60	5.51	-0.09	6.29	6.20	-0.09	8.20	8.11	-0.09
64ST-N-1	6.77	6.80	0.03	7.21	7.24	0.03	8.38	8.38	0.00
64ST-N10-1	5.33	5.24	-0.09	6.01	5.91	-0.10	8.04	7.89	-0.14
64ST-N10-2	5.33	5.24	-0.09	6.01	5.91	-0.10	8.04	7.89	-0.14
64ST-N10-3	5.33	5.24	-0.09	6.01	5.91	-0.10	8.04	7.89	-0.14
64ST-N10-4	5.33	5.24	-0.09	6.01	5.91	-0.10	8.04	7.89	-0.14
64ST-N10-5	5.33	5.23	-0.09	6.01	5.91	-0.10	8.03	7.89	-0.14
64ST-N10-6	5.33	5.23	-0.09	6.01	5.91	-0.10	8.03	7.89	-0.14
64ST-N-2	6.77	6.80	0.03	7.21	7.24	0.03	8.38	8.38	0.00
64ST-N-3	6.77	6.80	0.03	7.21	7.24	0.03	8.38	8.38	0.00
64ST-N-4	7.87	8.12	0.24	8.26	8.28	0.01	8.52	8.53	0.01
64ST-N-5	5.92	5.97	0.04	6.06	6.13	0.07	6.90	6.61	-0.28
64ST-S-1	6.78	6.81	0.03	7.21	7.24	0.03	8.38	8.38	0.00
64ST-S-2	6.78	6.81	0.03	7.21	7.24	0.03	8.38	8.38	0.00
64ST-S-3	6.19	6.36	0.17	6.84	7.07	0.23	8.75	8.78	0.02
64ST-S-4	6.82	7.05	0.23	7.52	7.81	0.29	8.75	8.77	0.02
64ST-S-5	4.76	4.73	-0.03	5.39	5.36	-0.03	7.29	7.08	-0.21
64ST-S-6	5.46	5.50	0.04	5.57	5.61	0.04	6.89	6.60	-0.28
72AVE-S	9.07	9.07	0.00	9.10	9.10	0.00	9.13	9.13	0.00
72ST-1	8.41	8.41	0.00	8.47	8.47	0.00	8.55	8.54	-0.01
72ST-2	8.23	8.23	0.00	8.28	8.28	0.00	8.36	8.36	0.00
72ST-3	9.12	9.12	0.00	9.15	9.15	0.00	9.17	9.17	0.00
72ST-4	9.17	9.17	0.00	9.20	9.20	0.00	9.23	9.23	0.00
87AVE-N-1	10.00	9.96	-0.03	10.17	10.13	-0.04	10.39	10.36	-0.03
88ST-1-2	4.40	4.36	-0.04	5.02	4.94	-0.08	6.63	6.34	-0.29
88ST-3	7.65	7.70	0.06	7.82	7.85	0.04	8.09	8.13	0.03
B10-E	4.54	4.51	-0.03	5.17	5.13	-0.05	6.91	6.61	-0.30
B10-W	4.55	4.51	-0.03	5.17	5.13	-0.05	6.91	6.62	-0.30
B11-E	4.54	4.51	-0.03	5.17	5.12	-0.05	6.90	6.61	-0.30
B11-W	4.54	4.51	-0.03	5.17	5.12	-0.05	6.90	6.61	-0.30
B12-E	4.53	4.50	-0.03	5.16	5.11	-0.05	6.89	6.59	-0.29
B12-W	4.53	4.50	-0.03	5.16	5.11	-0.05	6.89	6.59	-0.29
B13-E	4.53	4.49	-0.04	5.16	5.10	-0.05	6.88	6.58	-0.30
B13-W	4.53	4.49	-0.03	5.16	5.11	-0.05	6.88	6.58	-0.30
B14-E	4.52	4.49	-0.03	5.15	5.10	-0.05	6.87	6.57	-0.30

XP-SWMM Model Junction	50-Year			100-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
64ST-C-8	8.65	8.65	0.00	8.86	8.84	-0.02
64ST-C-9	8.62	8.62	0.00	8.85	8.83	-0.02
64ST-N-1	8.60	8.60	0.00	8.85	8.84	-0.01
64ST-N10-1	8.50	8.48	-0.02	8.80	8.75	-0.05
64ST-N10-2	8.50	8.48	-0.02	8.80	8.75	-0.05
64ST-N10-3	8.50	8.48	-0.02	8.80	8.75	-0.05
64ST-N10-4	8.50	8.48	-0.02	8.80	8.75	-0.05
64ST-N10-5	8.50	8.48	-0.02	8.80	8.75	-0.05
64ST-N10-6	8.50	8.48	-0.02	8.80	8.75	-0.05
64ST-N-2	8.60	8.60	0.00	8.85	8.84	-0.01
64ST-N-3	8.60	8.60	0.00	8.85	8.84	-0.01
64ST-N-4	8.66	8.67	0.00	8.86	8.84	-0.01
64ST-N-5	7.57	7.28	-0.29	8.42	8.12	-0.30
64ST-S-1	8.60	8.60	0.00	8.85	8.84	-0.01
64ST-S-2	8.60	8.60	0.00	8.85	8.84	-0.01
64ST-S-3	8.80	8.83	0.02	8.88	8.89	0.01
64ST-S-4	8.80	8.82	0.02	8.88	8.88	0.01
64ST-S-5	7.88	7.75	-0.13	8.42	8.18	-0.24
64ST-S-6	7.55	7.26	-0.29	8.40	8.09	-0.31
72AVE-S	9.15	9.15	0.00	9.17	9.17	0.00
72ST-1	8.61	8.60	-0.01	8.66	8.66	-0.01
72ST-2	8.42	8.41	-0.01	8.48	8.47	0.00
72ST-3	9.18	9.18	0.00	9.20	9.20	0.00
72ST-4	9.25	9.25	0.00	9.27	9.27	0.00
87AVE-N-1	10.53	10.50	-0.03	10.66	10.64	-0.03
88ST-1-2	7.22	6.88	-0.34	7.81	7.51	-0.30
88ST-3	8.19	8.22	0.02	8.27	8.29	0.02
B10-E	7.58	7.30	-0.29	8.42	8.12	-0.30
B10-W	7.58	7.30	-0.29	8.42	8.12	-0.30
B11-E	7.58	7.29	-0.29	8.42	8.12	-0.30
B11-W	7.58	7.29	-0.29	8.42	8.12	-0.30
B12-E	7.55	7.26	-0.29	8.40	8.09	-0.31
B12-W	7.55	7.26	-0.29	8.40	8.09	-0.31
B13-E	7.54	7.25	-0.29	8.38	8.06	-0.31
B13-W	7.54	7.25	-0.29	8.38	8.06	-0.31
B14-E	7.53	7.24	-0.29	8.35	8.05	-0.31

XP-SWMM Model Junction	5-Year			10-Year			25-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
B14-W	4.52	4.49	-0.03	5.15	5.10	-0.05	6.87	6.57	-0.30
B1-N	4.86	4.85	-0.01	5.54	5.51	-0.02	7.43	7.18	-0.25
B1-S	4.86	4.85	-0.01	5.53	5.51	-0.02	7.43	7.18	-0.25
B27-E	4.48	4.43	-0.04	5.10	5.04	-0.06	6.82	6.50	-0.32
B27-W	4.48	4.43	-0.04	5.10	5.04	-0.06	6.82	6.50	-0.32
B28-N	4.58	4.55	-0.02	5.19	5.16	-0.03	6.89	6.60	-0.29
B28-S	4.53	4.50	-0.03	5.16	5.11	-0.05	6.88	6.58	-0.30
B29-N	4.50	4.46	-0.04	5.13	5.07	-0.06	6.83	6.53	-0.30
B29-S	4.50	4.46	-0.04	5.13	5.07	-0.06	6.83	6.53	-0.30
B2-N	4.86	4.85	-0.01	5.53	5.51	-0.02	7.43	7.18	-0.25
B2-S	4.86	4.85	-0.01	5.53	5.51	-0.02	7.42	7.18	-0.25
B30-N	4.46	4.40	-0.06	5.08	4.99	-0.09	6.72	6.41	-0.32
B30-S	4.44	4.40	-0.04	5.06	4.98	-0.07	6.71	6.41	-0.30
B31-N	4.43	4.39	-0.05	5.05	4.98	-0.07	6.70	6.41	-0.30
B31-S	4.43	4.38	-0.05	5.05	4.97	-0.08	6.70	6.41	-0.30
B32-E	4.43	4.38	-0.05	5.05	4.97	-0.08	6.70	6.40	-0.30
B32-W	4.43	4.38	-0.05	5.05	4.97	-0.08	6.70	6.40	-0.30
B33-E	4.43	4.38	-0.05	5.04	4.97	-0.08	6.69	6.40	-0.30
B33-W	4.43	4.38	-0.05	5.04	4.97	-0.08	6.70	6.40	-0.30
B34-E	4.40	4.35	-0.05	5.01	4.93	-0.08	6.63	6.34	-0.29
B34-W	4.40	4.35	-0.05	5.02	4.93	-0.09	6.63	6.34	-0.28
B35-E	4.39	4.33	-0.06	5.00	4.91	-0.09	6.61	6.32	-0.29
B35-W	4.39	4.34	-0.06	5.00	4.91	-0.09	6.60	6.32	-0.29
B36-N	4.39	4.33	-0.05	5.00	4.92	-0.07	6.60	6.31	-0.29
B37N	4.39	4.33	-0.05	5.00	4.91	-0.09	6.60	6.31	-0.29
B37S	4.39	4.34	-0.05	5.00	4.91	-0.08	6.60	6.31	-0.29
B38-E	4.35	4.29	-0.06	4.95	4.86	-0.09	6.51	6.22	-0.29
B38-W	4.36	4.30	-0.06	4.96	4.87	-0.09	6.52	6.23	-0.29
B40-E	4.31	4.25	-0.06	4.90	4.82	-0.08	6.44	6.15	-0.29
B40-W	4.31	4.25	-0.06	4.91	4.82	-0.08	6.44	6.15	-0.29
B41-E	4.27	6.01	1.73	4.86	6.01	1.14	6.39	6.08	-0.31
B41-W	4.27	5.30	1.03	4.86	5.30	0.44	6.39	6.08	-0.31
B43-E	4.26	4.18	-0.08	4.85	4.77	-0.07	6.37	6.05	-0.31
B43-W	4.26	4.19	-0.08	4.85	4.77	-0.08	6.37	6.06	-0.31
B45-E	4.26	4.17	-0.08	4.84	4.72	-0.12	6.35	6.04	-0.32
B45-W	4.26	4.19	-0.07	4.84	4.79	-0.05	6.35	6.04	-0.32

XP-SWMM Model Junction	50-Year			100-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
B14-W	7.53	7.24	-0.29	8.36	8.05	-0.31
B1-N	8.17	8.01	-0.16	8.62	8.49	-0.13
B1-S	8.17	8.01	-0.16	8.62	8.49	-0.13
B27-E	7.52	7.22	-0.30	8.23	7.95	-0.28
B27-W	7.52	7.22	-0.30	8.23	7.95	-0.28
B28-N	7.55	7.28	-0.28	8.39	8.09	-0.30
B28-S	7.54	7.25	-0.28	8.37	8.07	-0.30
B29-N	7.48	7.18	-0.30	8.26	7.94	-0.32
B29-S	7.48	7.18	-0.30	8.25	7.94	-0.32
B2-N	8.17	8.01	-0.16	8.62	8.49	-0.13
B2-S	8.16	8.00	-0.16	8.60	8.47	-0.13
B30-N	7.36	6.98	-0.38	8.08	7.64	-0.45
B30-S	7.33	6.98	-0.35	8.01	7.63	-0.38
B31-N	7.32	6.98	-0.34	7.97	7.63	-0.34
B31-S	7.32	6.97	-0.34	7.97	7.63	-0.34
B32-E	7.31	6.96	-0.34	7.95	7.61	-0.34
B32-W	7.31	6.96	-0.34	7.95	7.61	-0.34
B33-E	7.30	6.96	-0.34	7.94	7.60	-0.33
B33-W	7.30	6.96	-0.34	7.94	7.60	-0.33
B34-E	7.22	6.88	-0.34	7.81	7.51	-0.30
B34-W	7.22	6.89	-0.32	7.81	7.52	-0.29
B35-E	7.19	6.86	-0.33	7.76	7.48	-0.28
B35-W	7.19	6.86	-0.33	7.76	7.48	-0.28
B36-N	7.18	6.85	-0.33	7.75	7.47	-0.28
B37N	7.18	6.85	-0.33	7.75	7.47	-0.28
B37S	7.18	6.85	-0.33	7.75	7.47	-0.28
B38-E	7.07	6.75	-0.33	7.62	7.33	-0.29
B38-W	7.08	6.76	-0.33	7.63	7.34	-0.29
B40-E	6.98	6.66	-0.32	7.49	7.17	-0.32
B40-W	6.99	6.66	-0.32	7.50	7.18	-0.32
B41-E	6.91	6.59	-0.32	7.41	7.08	-0.34
B41-W	6.91	6.59	-0.32	7.41	7.08	-0.34
B43-E	6.88	6.56	-0.33	7.38	7.04	-0.34
B43-W	6.89	6.56	-0.32	7.39	7.04	-0.34
B45-E	6.87	6.54	-0.33	7.36	7.02	-0.35
B45-W	6.87	6.54	-0.33	7.36	7.02	-0.35

XP-SWMM Model Junction	5-Year			10-Year			25-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
B46-E	4.25	4.15	-0.09	4.83	4.69	-0.14	6.33	6.01	-0.32
B46-W	4.25	4.15	-0.09	4.83	4.70	-0.13	6.33	6.01	-0.32
B47-E	4.24	4.15	-0.09	4.82	4.68	-0.14	6.32	5.99	-0.33
B47-W	4.24	4.15	-0.09	4.82	4.68	-0.14	6.32	5.99	-0.33
B49-E	**4.22**	**4.13**	**-0.09**	**4.79**	**4.66**	**-0.14**	**6.27**	**5.93**	**-0.34**
B49-W	**4.22**	**4.13**	**-0.09**	**4.80**	**4.66**	**-0.14**	**6.28**	**5.94**	**-0.34**
B50-E	**4.21**	**4.11**	**-0.10**	**4.78**	**4.65**	**-0.13**	**6.25**	**5.89**	**-0.35**
B50-W	**4.21**	**4.11**	**-0.10**	**4.78**	**4.65**	**-0.14**	**6.25**	**5.90**	**-0.35**
B51-E	4.72	4.65	-0.07	5.53	5.46	-0.07	7.72	7.55	-0.18
B51-W	4.72	4.65	-0.07	5.53	5.46	-0.07	7.72	7.55	-0.18
B53-N	**4.13**	**4.02**	**-0.11**	**4.67**	**4.53**	**-0.14**	**5.98**	**5.57**	**-0.41**
B53-S	**4.13**	**4.02**	**-0.11**	**4.67**	**4.53**	**-0.14**	**5.98**	**5.57**	**-0.41**
B54-N	**4.02**	**3.89**	**-0.14**	**4.50**	**4.27**	**-0.23**	**5.64**	**5.11**	**-0.53**
B54-S	**4.02**	**3.89**	**-0.13**	**4.50**	**4.25**	**-0.25**	**5.63**	**5.10**	**-0.53**
B55-N	**3.93**	**3.72**	**-0.21**	**4.34**	**4.10**	**-0.24**	**5.28**	**4.60**	**-0.69**
B55-S	**3.93**	**3.71**	**-0.22**	**4.33**	**4.07**	**-0.27**	**5.28**	**4.59**	**-0.69**
BD-C-1	6.77	6.80	0.03	7.21	7.24	0.03	8.38	8.38	0.00
BD-C-10	4.85	4.84	-0.01	5.53	5.51	-0.02	7.42	7.17	-0.25
BD-C-11	4.84	4.83	-0.01	5.52	5.49	-0.02	7.39	7.13	-0.26
BD-C-12	4.79	4.78	-0.01	5.45	5.43	-0.02	7.25	6.96	-0.29
BD-C-13	4.77	4.76	-0.01	5.43	5.41	-0.02	7.22	6.93	-0.29
BD-C-14	4.69	4.67	-0.02	5.33	5.31	-0.03	7.05	6.80	-0.25
BD-C-15	4.62	4.60	-0.02	5.25	5.22	-0.03	6.95	6.67	-0.28
BD-C-2	6.77	6.80	0.03	7.21	7.24	0.03	8.38	8.38	0.00
BD-C-3	6.76	6.79	0.03	7.21	7.24	0.03	8.38	8.38	0.00
BD-C-4	6.56	6.59	0.03	7.15	7.18	0.04	8.38	8.38	0.00
BD-C-5	6.51	6.53	0.02	7.11	7.14	0.03	8.38	8.38	0.00
BD-C-6	6.11	6.09	-0.02	6.65	6.63	-0.02	8.25	8.20	-0.05
BD-C-7	6.08	6.06	-0.02	6.62	6.59	-0.02	8.24	8.19	-0.05
BD-C-8	5.24	5.14	-0.11	5.79	5.77	-0.02	7.87	7.70	-0.17
BD-C-9	5.01	4.97	-0.04	5.65	5.63	-0.02	7.63	7.42	-0.21
BDC-N-1	6.56	6.60	0.04	7.15	7.19	0.04	8.38	8.38	0.00
BDC-N-2	6.56	6.60	0.04	7.15	7.19	0.04	8.38	8.38	0.00
BDC-N-3	6.56	6.60	0.04	7.15	7.19	0.04	8.38	8.38	0.00
BDC-S-1	6.77	6.80	0.03	7.21	7.24	0.03	8.38	8.38	0.00
BDC-S-2	6.77	6.80	0.03	7.21	7.24	0.03	8.38	8.38	0.00

XP-SWMM Model Junction	50-Year			100-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
B46-E	6.84	6.51	-0.33	7.33	6.98	-0.35
B46-W	6.84	6.51	-0.33	7.33	6.98	-0.35
B47-E	6.82	6.48	-0.34	7.31	6.95	-0.36
B47-W	6.82	6.48	-0.34	7.31	6.95	-0.36
B49-E	**6.77**	**6.42**	**-0.35**	**7.25**	**6.88**	**-0.37**
B49-W	**6.77**	**6.42**	**-0.35**	**7.25**	**6.88**	**-0.37**
B50-E	**6.73**	**6.38**	**-0.35**	**7.19**	**6.82**	**-0.37**
B50-W	**6.73**	**6.38**	**-0.35**	**7.19**	**6.82**	**-0.37**
B51-E	8.42	8.26	-0.15	9.04	9.01	-0.03
B51-W	8.42	8.26	-0.15	9.04	9.01	-0.03
B53-N	**6.37**	**5.97**	**-0.40**	**6.81**	**6.37**	**-0.44**
B53-S	**6.36**	**5.96**	**-0.40**	**6.81**	**6.36**	**-0.44**
B54-N	**5.98**	**5.42**	**-0.57**	**6.39**	**5.75**	**-0.64**
B54-S	**5.98**	**5.41**	**-0.57**	**6.39**	**5.74**	**-0.64**
B55-N	**5.59**	**4.84**	**-0.75**	**5.97**	**5.07**	**-0.91**
B55-S	5.59	4.82	-0.76	5.97	5.06	-0.91
BD-C-1	8.60	8.60	0.00	8.85	8.84	-0.01
BD-C-10	8.16	8.00	-0.16	8.61	8.48	-0.14
BD-C-11	8.14	7.97	-0.17	8.60	8.46	-0.14
BD-C-12	8.01	7.80	-0.21	8.47	8.27	-0.20
BD-C-13	7.99	7.76	-0.22	8.46	8.25	-0.21
BD-C-14	7.84	7.52	-0.32	8.44	8.17	-0.26
BD-C-15	7.96	7.36	-0.60	8.44	8.17	-0.27
BD-C-2	8.60	8.60	0.00	8.85	8.84	-0.01
BD-C-3	8.60	8.60	0.00	8.85	8.84	-0.01
BD-C-4	8.60	8.60	0.00	8.85	8.84	-0.01
BD-C-5	8.60	8.60	0.00	8.85	8.84	-0.01
BD-C-6	8.59	8.58	-0.01	8.85	8.84	-0.01
BD-C-7	8.59	8.58	-0.01	8.85	8.83	-0.01
BD-C-8	8.51	8.47	-0.04	8.81	8.79	-0.03
BD-C-9	8.34	8.24	-0.10	8.72	8.64	-0.08
BDC-N-1	8.60	8.60	0.00	8.85	8.84	-0.01
BDC-N-2	8.60	8.60	0.00	8.85	8.84	-0.01
BDC-N-3	8.60	8.60	0.00	8.85	8.84	-0.01
BDC-S-1	8.60	8.60	0.00	8.85	8.84	-0.01
BDC-S-2	8.60	8.60	0.00	8.85	8.84	-0.01

XP-SWMM Model Junction	5-Year			10-Year			25-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
BDC-S-3	6.77	6.80	0.03	7.21	7.24	0.03	8.38	8.38	0.00
BD-N-1	6.56	6.60	0.04	7.15	7.19	0.04	8.38	8.38	0.00
BD-N-2	6.56	6.60	0.04	7.15	7.19	0.04	8.38	8.38	0.00
BD-N-3	6.56	6.60	0.04	7.15	7.19	0.04	8.38	8.38	0.00
BD-N-4	6.54	6.58	0.04	7.14	7.18	0.04	8.37	8.37	0.00
BD-N-5	6.87	6.93	0.06	7.14	7.18	0.04	8.36	8.37	0.00
BD-N-6	6.87	6.93	0.06	7.14	7.18	0.04	8.36	8.37	0.00
BD-N-7	7.80	7.82	0.01	7.84	7.85	0.01	8.25	8.25	0.00
BD-N-8	7.77	7.78	0.02	7.84	7.85	0.01	7.98	7.96	-0.03
BD-S-1	6.77	6.80	0.03	7.21	7.24	0.03	8.38	8.38	0.00
BD-S-2	6.77	6.80	0.03	7.21	7.24	0.03	8.38	8.38	0.00
BD-S-3	6.77	6.80	0.03	7.21	7.24	0.03	8.38	8.38	0.00
BD-S-4	6.10	6.25	0.15	6.55	6.75	0.20	8.20	8.25	0.04
BD-S-5	6.84	6.99	0.15	7.45	7.64	0.19	8.01	8.03	0.02
C2-C-1	4.62	4.60	-0.03	5.25	5.21	-0.04	6.95	6.67	-0.27
C2-C-10	4.44	4.39	-0.05	5.06	4.98	-0.08	6.72	6.42	-0.30
C2-C-11	4.43	4.38	-0.05	5.05	4.97	-0.08	6.70	6.40	-0.30
C2-C-12	4.43	4.38	-0.05	5.05	4.97	-0.08	6.70	6.40	-0.30
C2-C-1-2	4.62	4.60	-0.02	5.25	5.21	-0.03	6.94	6.67	-0.27
C2-C-13	4.41	4.36	-0.05	5.03	4.95	-0.08	6.67	6.37	-0.30
C2-C-1415	4.40	4.34	-0.05	5.01	4.92	-0.08	6.63	6.34	-0.29
C2-C-16	4.37	4.32	-0.06	4.98	4.89	-0.09	6.56	6.27	-0.29
C2-C-17	4.33	4.26	-0.06	4.93	4.84	-0.08	6.47	6.18	-0.29
C2-C-18	4.29	4.48	0.19	4.88	4.80	-0.08	6.41	6.11	-0.30
C2-C-19	4.27	4.20	-0.07	4.85	4.77	-0.08	6.38	6.07	-0.31
C2-C-2	4.62	4.60	-0.02	5.25	5.21	-0.03	6.94	6.67	-0.28
C2-C-21	4.24	4.15	-0.09	4.82	4.68	-0.14	6.32	6.00	-0.32
C2-C-22	**4.23**	**4.14**	**-0.09**	**4.81**	**4.67**	**-0.14**	**6.30**	**5.96**	**-0.33**
C2-C-23	**4.21**	**4.12**	**-0.09**	**4.79**	**4.65**	**-0.13**	**6.26**	**5.91**	**-0.35**
C2-C-24	**4.20**	**4.11**	**-0.10**	**4.77**	**4.64**	**-0.13**	**6.23**	**5.88**	**-0.36**
C2-C-25	**4.16**	**4.07**	**-0.09**	**4.72**	**4.59**	**-0.13**	**6.10**	**5.73**	**-0.38**
C2-C-26	**4.08**	**3.96**	**-0.12**	**4.60**	**4.45**	**-0.14**	**5.85**	**5.40**	**-0.46**
C2-C-3	4.62	4.60	-0.02	5.24	5.21	-0.03	6.94	6.67	-0.28
C2-C-4	4.62	4.59	-0.02	5.24	5.21	-0.03	6.94	6.66	-0.28
C2-C-45	4.62	4.59	-0.02	5.24	5.21	-0.03	6.94	6.66	-0.28
C2-C-5	4.61	4.58	-0.02	5.23	5.20	-0.03	6.93	6.65	-0.28

XP-SWMM Model Junction	50-Year			100-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
BDC-S-3	8.60	8.60	0.00	8.85	8.84	-0.01
BD-N-1	8.60	8.60	0.00	8.85	8.84	-0.01
BD-N-2	8.60	8.60	0.00	8.85	8.84	-0.01
BD-N-3	8.60	8.60	0.00	8.85	8.84	-0.01
BD-N-4	8.59	8.59	-0.01	8.85	8.84	-0.01
BD-N-5	8.59	8.58	-0.01	8.85	8.83	-0.01
BD-N-6	8.59	8.58	-0.01	8.84	8.83	-0.01
BD-N-7	8.53	8.50	-0.04	8.84	8.82	-0.01
BD-N-8	8.49	8.42	-0.07	8.83	8.81	-0.02
BD-S-1	8.60	8.60	0.00	8.85	8.84	-0.01
BD-S-2	8.60	8.60	0.00	8.85	8.84	-0.01
BD-S-3	8.60	8.60	0.00	8.85	8.84	-0.01
BD-S-4	8.55	8.53	-0.02	8.82	8.80	-0.02
BD-S-5	8.19	8.14	-0.06	8.63	8.50	-0.12
C2-C-1	7.64	7.37	-0.27	8.51	8.24	-0.27
C2-C-10	7.34	7.01	-0.34	8.01	7.66	-0.34
C2-C-11	7.31	6.97	-0.34	7.96	7.62	-0.34
C2-C-12	7.31	6.96	-0.35	7.94	7.61	-0.34
C2-C-1-2	7.63	7.37	-0.27	8.49	8.22	-0.27
C2-C-13	7.27	6.92	-0.35	7.89	7.56	-0.34
C2-C-1415	7.22	6.88	-0.34	7.81	7.51	-0.30
C2-C-16	7.13	6.80	-0.33	7.69	7.41	-0.28
C2-C-17	7.03	6.70	-0.32	7.55	7.25	-0.31
C2-C-18	6.94	6.62	-0.32	7.45	7.11	-0.34
C2-C-19	6.90	6.58	-0.32	7.40	7.06	-0.34
C2-C-2	7.63	7.36	-0.26	8.48	8.21	-0.27
C2-C-21	6.83	6.50	-0.33	7.32	6.97	-0.35
C2-C-22	**6.79**	**6.45**	**-0.34**	**7.28**	**6.91**	**-0.36**
C2-C-23	**6.75**	**6.40**	**-0.35**	**7.22**	**6.85**	**-0.37**
C2-C-24	**6.71**	**6.36**	**-0.35**	**7.17**	**6.79**	**-0.38**
C2-C-25	**6.52**	**6.17**	**-0.36**	**6.95**	**6.58**	**-0.38**
C2-C-26	**6.23**	**5.77**	**-0.46**	**6.68**	**6.16**	**-0.53**
C2-C-3	7.62	7.36	-0.26	8.46	8.19	-0.27
C2-C-4	7.62	7.36	-0.26	8.45	8.18	-0.27
C2-C-45	7.63	7.35	-0.28	8.44	8.17	-0.27
C2-C-5	7.59	7.33	-0.26	8.43	8.15	-0.28

XP-SWMM Model Junction	5-Year			10-Year			25-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
C2-C-6	4.58	4.56	-0.02	5.20	5.17	-0.03	6.90	6.61	-0.29
C2-C-7	4.51	4.48	-0.04	5.14	5.09	-0.05	6.85	6.55	-0.30
C2-C-8	4.49	4.45	-0.04	5.11	5.05	-0.06	6.81	6.51	-0.30
C2-C-9	4.46	4.42	-0.05	5.08	5.01	-0.07	6.76	6.46	-0.30
C2C-E-1	8.61	7.96	-0.64	8.61	8.28	-0.33	8.64	8.61	-0.03
C2C-E-2	7.46	7.68	0.22	7.91	7.93	0.02	8.18	8.20	0.02
C2C-E-3	10.05	10.29	0.24	10.12	10.37	0.25	10.49	10.76	0.27
C2C-N-1	7.70	7.73	0.03	7.82	7.84	0.02	8.06	8.05	-0.01
C2-CN-1	4.39	4.33	-0.05	5.00	4.93	-0.06	6.60	6.31	-0.29
C2C-N-2	9.46	9.47	0.01	9.53	9.53	0.00	9.69	9.72	0.04
C2C-N-3	9.46	9.46	0.01	9.53	9.53	0.00	9.69	9.72	0.04
C2C-N-4	10.05	10.29	0.24	10.12	10.37	0.25	10.49	10.76	0.27
C2C-N-5	9.54	9.58	0.05	9.64	9.68	0.04	9.89	9.93	0.03
C2C-S-1	8.04	8.05	0.01	8.09	8.10	0.01	8.21	8.22	0.00
C2C-S-2	4.40	4.35	-0.05	5.02	4.94	-0.08	6.63	6.34	-0.29
C2C-S-3	8.31	8.31	0.00	8.37	8.38	0.01	8.48	8.47	0.00
C2C-S-4	7.65	7.70	0.06	7.82	7.85	0.04	8.10	8.13	0.03
C2-E-1	8.36	8.14	-0.22	8.43	8.25	-0.18	8.59	8.56	-0.04
C2-E-2	7.30	7.42	0.13	7.72	7.87	0.16	8.45	8.45	0.01
C2-E-3	7.86	7.89	0.03	7.88	7.91	0.03	7.92	7.96	0.04
C2-E-4	4.48	4.43	-0.05	5.10	5.03	-0.07	6.79	6.49	-0.30
C2-E-5	**6.41**	**6.42**	**0.01**	**6.52**	**6.53**	**0.01**	**6.59**	**6.59**	**0.00**
C2-N-10	**6.53**	**6.54**	**0.01**	**6.64**	**6.64**	**0.00**	**6.71**	**6.71**	**0.00**
C2-N-2	7.65	7.67	0.03	7.76	7.78	0.02	7.95	7.95	0.00
C2-N-3	7.26	7.27	0.01	7.33	7.33	0.00	7.40	7.41	0.00
C2-N-4	7.70	7.72	0.01	7.74	7.75	0.01	7.82	7.82	0.00
C2-N-5	7.03	7.04	0.01	7.08	7.08	0.00	7.12	7.12	0.00
C2-N-7	8.32	8.35	0.03	8.45	8.47	0.03	8.58	8.59	0.01
C2-N-8	6.37	6.61	0.24	7.00	7.07	0.07	7.24	7.28	0.03
C2-N-9	**5.97**	**5.98**	**0.01**	**6.04**	**6.05**	**0.01**	**6.11**	**6.10**	**-0.01**
C2-S-1	4.47	4.42	-0.05	5.11	5.03	-0.07	6.86	6.62	-0.23
C2-S-2	8.04	8.05	0.01	8.09	8.10	0.01	8.21	8.21	0.00
C2-S-4	4.39	4.34	-0.04	5.00	4.92	-0.07	6.60	6.31	-0.29
C2-S-5	6.07	6.07	0.00	6.08	6.08	0.00	6.47	6.18	-0.29
C2-S-6	7.78	7.81	0.03	7.86	7.88	0.03	8.03	8.04	0.01
C2-S-7	6.43	6.48	0.05	6.60	6.62	0.02	6.85	6.88	0.03

XP-SWMM Model Junction	50-Year			100-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
C2-C-6	7.56	7.28	-0.27	8.40	8.10	-0.30
C2-C-7	7.50	7.21	-0.29	8.30	7.99	-0.31
C2-C-8	7.45	7.15	-0.31	8.20	7.87	-0.32
C2-C-9	7.40	7.07	-0.32	8.09	7.75	-0.34
C2C-E-1	8.69	8.66	-0.03	8.74	8.72	-0.02
C2C-E-2	8.23	8.25	0.01	8.29	8.31	0.02
C2C-E-3	10.61	10.89	0.28	10.74	11.03	0.29
C2C-N-1	8.11	8.10	-0.02	8.17	8.15	-0.02
C2-CN-1	7.18	6.85	-0.33	7.75	7.47	-0.28
C2C-N-2	9.79	9.83	0.03	9.90	9.93	0.03
C2C-N-3	9.79	9.83	0.03	9.90	9.93	0.03
C2C-N-4	10.61	10.89	0.28	10.74	11.03	0.29
C2C-N-5	9.98	10.01	0.03	10.07	10.09	0.02
C2C-S-1	8.25	8.25	0.00	8.28	8.28	0.00
C2C-S-2	7.22	6.88	-0.34	7.81	7.51	-0.30
C2C-S-3	8.55	8.54	0.00	8.61	8.61	0.00
C2C-S-4	8.20	8.23	0.03	8.29	8.31	0.02
C2-E-1	8.64	8.61	-0.03	8.69	8.67	-0.03
C2-E-2	8.47	8.48	0.01	8.49	8.50	0.01
C2-E-3	7.91	7.95	0.04	8.40	8.10	-0.29
C2-E-4	7.44	7.13	-0.31	8.16	7.84	-0.32
C2-E-5	**6.64**	**6.64**	**0.00**	**6.70**	**6.69**	**0.00**
C2-N-10	**6.76**	**6.75**	**0.00**	**6.81**	**6.81**	**0.00**
C2-N-2	8.01	8.01	0.00	8.07	8.07	0.00
C2-N-3	7.46	7.46	0.00	7.81	7.51	-0.30
C2-N-4	7.85	7.85	0.00	7.89	7.88	-0.01
C2-N-5	7.15	7.15	0.00	7.45	7.18	-0.27
C2-N-7	8.62	8.62	0.00	8.66	8.67	0.00
C2-N-8	7.30	7.33	0.04	7.39	7.41	0.02
C2-N-9	**6.52**	**6.17**	**-0.35**	**6.95**	**6.58**	**-0.37**
C2-S-1	7.51	7.28	-0.23	8.14	7.96	-0.19
C2-S-2	8.25	8.24	0.00	8.27	8.27	0.00
C2-S-4	7.18	6.85	-0.33	7.75	7.47	-0.28
C2-S-5	7.03	6.70	-0.32	7.55	7.25	-0.31
C2-S-6	8.08	8.08	0.00	8.12	8.12	0.00
C2-S-7	6.94	6.97	0.03	7.41	7.09	-0.32

XP-SWMM Model Junction	5-Year			10-Year			25-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
C2-S-8	9.02	9.05	0.03	9.10	9.11	0.01	9.18	9.18	0.00
C2-S-9	**6.27**	**6.28**	**0.01**	**6.38**	**6.39**	**0.01**	**6.46**	**6.46**	**0.00**
C2-SC-1	4.47	4.42	-0.05	5.11	5.03	-0.07	6.85	6.61	-0.23
C2-SC-2	4.46	4.41	-0.05	5.09	5.02	-0.07	6.78	6.53	-0.25
C2-SC-3	4.46	4.41	-0.05	5.09	5.02	-0.07	6.78	6.52	-0.25
C2-SC-4	4.46	4.41	-0.05	5.08	5.01	-0.07	6.76	6.50	-0.27
C2-SC-5	4.40	4.36	-0.04	5.02	4.93	-0.08	6.63	6.34	-0.29
C2-SC-6	4.40	4.35	-0.05	5.01	4.93	-0.08	6.63	6.34	-0.29
C2-SC-7	4.39	4.34	-0.04	5.00	4.92	-0.08	6.60	6.31	-0.29
C2-W-1	4.64	4.62	-0.02	5.27	5.24	-0.02	7.09	6.92	-0.17
C2-W-2	5.59	5.68	0.09	5.93	6.01	0.09	6.91	6.63	-0.27
C2-W-3	**6.57**	**6.59**	**0.02**	**6.68**	**6.70**	**0.02**	**6.84**	**6.84**	**0.00**
HC-C-1	4.97	5.20	0.23	5.85	6.03	0.18	7.59	7.60	0.01
HC-C-3	4.96	5.18	0.22	5.83	6.01	0.17	7.57	7.58	0.01
HC-C-4	4.96	5.33	0.38	5.83	6.01	0.17	7.57	7.58	0.01
HC-C-5	4.96	5.18	0.22	5.83	6.00	0.17	7.57	7.57	0.01
HC-C-6	4.96	5.18	0.23	5.83	6.00	0.18	7.58	7.59	0.01
HC-C-7	4.96	5.18	0.22	5.83	6.00	0.17	7.57	7.57	0.01
HC-C-8	4.96	5.18	0.22	5.83	6.00	0.17	7.57	7.57	0.01
HC-C-9	4.96	5.18	0.22	5.83	6.00	0.17	7.57	7.57	0.01
HC-W-1	6.03	6.03	0.01	6.05	6.06	0.01	7.57	7.58	0.01
LG-C-1	5.01	4.94	-0.07	5.85	5.79	-0.06	7.84	7.68	-0.15
LG-C-10	4.52	4.45	-0.07	5.25	5.18	-0.07	7.22	6.99	-0.23
LG-C-11	4.36	4.28	-0.08	5.04	4.92	-0.12	6.73	6.43	-0.29
LG-C-12	4.29	4.20	-0.09	4.91	4.78	-0.13	6.48	6.16	-0.32
LG-C-13	4.23	4.14	-0.10	4.83	4.69	-0.14	6.32	5.98	-0.35
LG-C-14	**4.20**	**4.10**	**-0.10**	**4.76**	**4.63**	**-0.14**	**6.22**	**5.86**	**-0.36**
LG-C-2	4.75	4.68	-0.07	5.57	5.50	-0.06	7.75	7.58	-0.17
LG-C-3	4.75	4.68	-0.07	5.57	5.50	-0.06	7.75	7.58	-0.17
LG-C-4	4.72	4.65	-0.07	5.53	5.46	-0.07	7.72	7.55	-0.18
LG-C-5	7.07	5.23	-1.84	7.38	5.46	-1.92	7.72	7.61	-0.11
LG-C-6	4.72	4.65	-0.07	5.53	5.46	-0.07	7.72	7.55	-0.18
LG-C-7	4.72	4.65	-0.07	5.53	5.46	-0.07	7.72	7.55	-0.18
LG-C-8	4.64	4.57	-0.07	5.43	5.37	-0.06	7.57	7.37	-0.20
LG-C-9	4.57	4.50	-0.07	5.32	5.26	-0.07	7.37	7.15	-0.22
LG-E-1	7.92	7.92	0.00	8.02	8.03	0.00	8.08	8.08	0.00

XP-SWMM Model Junction	50-Year			100-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
C2-S-8	9.19	9.19	0.00	9.21	9.22	0.00
C2-S-9	**6.52**	**6.49**	**-0.03**	**6.94**	**6.58**	**-0.36**
C2-SC-1	7.50	7.26	-0.24	8.13	7.94	-0.19
C2-SC-2	7.42	7.11	-0.31	8.07	7.78	-0.28
C2-SC-3	7.42	7.11	-0.31	8.07	7.78	-0.29
C2-SC-4	7.40	7.08	-0.32	8.06	7.76	-0.30
C2-SC-5	7.22	6.88	-0.34	7.81	7.51	-0.30
C2-SC-6	7.22	6.88	-0.34	7.81	7.51	-0.30
C2-SC-7	7.18	6.85	-0.33	7.75	7.47	-0.28
C2-W-1	8.49	8.42	-0.07	8.83	8.81	-0.02
C2-W-2	7.58	7.31	-0.27	8.42	8.13	-0.29
C2-W-3	**6.87**	**6.87**	**0.00**	**6.92**	**6.92**	**0.00**
HC-C-1	8.04	8.04	-0.01	8.25	8.27	0.01
HC-C-3	8.03	8.02	-0.02	8.25	8.24	-0.01
HC-C-4	8.03	8.02	-0.02	8.25	8.24	-0.01
HC-C-5	8.03	8.01	-0.02	8.24	8.23	-0.02
HC-C-6	8.04	8.03	-0.02	8.24	8.22	-0.02
HC-C-7	8.03	8.01	-0.02	8.24	8.23	-0.02
HC-C-8	8.03	8.01	-0.02	8.24	8.23	-0.02
HC-C-9	8.03	8.01	-0.02	8.24	8.23	-0.02
HC-W-1	8.03	8.02	-0.02	8.25	8.24	-0.01
LG-C-1	8.47	8.33	-0.14	9.04	9.01	-0.03
LG-C-10	7.81	7.58	-0.23	8.35	8.21	-0.14
LG-C-11	7.27	6.98	-0.29	7.72	7.47	-0.24
LG-C-12	6.99	6.67	-0.32	7.39	7.13	-0.26
LG-C-13	6.81	6.46	-0.34	7.24	6.91	-0.33
LG-C-14	**6.70**	**6.34**	**-0.36**	**7.15**	**6.77**	**-0.38**
LG-C-2	8.44	8.28	-0.16	9.04	9.01	-0.03
LG-C-3	8.44	8.28	-0.16	9.04	9.01	-0.03
LG-C-4	8.42	8.26	-0.15	9.04	9.01	-0.03
LG-C-5	8.44	8.28	-0.16	9.04	9.01	-0.03
LG-C-6	8.42	8.27	-0.15	9.04	9.01	-0.03
LG-C-7	8.42	8.26	-0.15	9.04	9.01	-0.03
LG-C-8	8.28	8.10	-0.17	8.90	8.87	-0.03
LG-C-9	7.98	7.77	-0.21	8.54	8.44	-0.10
LG-E-1	8.44	8.28	-0.16	9.04	9.01	-0.03

XP-SWMM Model Junction	5-Year			10-Year			25-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
LG-E-2	4.72	4.65	-0.07	5.53	5.46	-0.07	7.72	7.55	-0.18
LG-E-3	7.44	7.74	0.29	8.12	8.21	0.09	8.38	8.43	0.05
LG-N-1	6.67	6.86	0.19	8.13	8.38	0.25	8.72	8.74	0.02
LG-W-1	8.05	8.11	0.06	8.48	8.50	0.02	8.72	8.74	0.02
LG-W-2	8.62	8.64	0.02	8.72	8.74	0.01	8.82	8.83	0.01
MC-C-N1	4.92	4.92	0.00	5.62	5.61	-0.01	8.37	8.37	0.00
MC-C-N2	5.81	5.83	0.01	5.96	5.97	0.01	8.24	8.23	-0.01
MC-C-N2-W	4.92	4.92	0.00	5.62	5.61	-0.01	8.24	8.23	-0.01
MC-C-N3	4.90	4.90	0.00	5.60	5.59	-0.01	8.12	8.10	-0.02
MC-C-S1	4.86	4.85	-0.01	5.53	5.51	-0.02	7.42	7.18	-0.25
MC-C-S2	4.86	4.85	-0.01	5.53	5.51	-0.02	7.42	7.18	-0.25
MC-C-S3	4.86	4.85	-0.01	5.53	5.51	-0.02	7.43	7.18	-0.25
MC-C-S4	4.86	4.85	-0.01	5.54	5.51	-0.02	7.43	7.18	-0.25
MC-E-1	7.01	7.28	0.27	7.50	7.74	0.24	8.14	8.20	0.06
MC-E-2	8.00	8.02	0.02	8.05	8.07	0.02	8.19	8.20	0.00
MC-E-3	4.86	4.85	-0.01	5.53	5.51	-0.02	7.42	7.18	-0.25
MC-E-4	4.86	4.85	-0.01	5.53	5.51	-0.02	7.42	7.18	-0.25
MC-S-1	4.99	4.91	-0.08	5.63	5.56	-0.07	7.60	7.44	-0.16
MC-W-1	6.86	6.85	-0.01	7.16	7.20	0.04	8.37	8.38	0.00
N-SC-LG	**4.19**	**4.10**	**-0.10**	**4.76**	**4.62**	**-0.14**	**6.22**	**5.86**	**-0.36**
N-SS-C-1-2	4.78	4.77	-0.01	5.46	5.44	-0.02	7.73	7.61	-0.13
PTTO-EX-N	12.48	12.48	0.00	12.77	12.77	0.00	13.03	12.99	-0.04
PTTO-EX-S	8.25	8.42	0.17	8.70	8.88	0.18	9.53	9.75	0.22
S-121	3.40	3.40	0.00	3.40	3.40	0.00	3.40	3.40	0.00
S-22	**3.84**	**3.60**	**-0.24**	**4.17**	**3.84**	**-0.34**	**4.93**	**4.25**	**-0.68**
S22-outW	**3.30**	**3.30**	**0.00**	**3.30**	**3.30**	**0.00**	**3.30**	**3.30**	**0.00**
S22-Wet1	**3.78**	**4.39**	**0.61**	**4.03**	**4.25**	**0.22**	**4.59**	**4.54**	**-0.05**
S22-wet2	**3.42**	**4.30**	**0.89**	**3.34**	**4.33**	**0.99**	**3.32**	**4.41**	**1.09**
SC-EXPWY-1	9.41	11.30	1.89	9.48	11.30	1.82	9.61	11.30	1.69
SC-EXPWY-2	12.31	12.31	0.00	12.57	12.57	0.00	12.79	12.75	-0.03
SC-EXPWY-3	9.24	9.24	0.00	9.30	9.30	0.00	9.36	9.35	-0.01
SD-EXPWY-1	9.80	9.72	-0.08	9.95	9.87	-0.08	10.17	10.12	-0.05
SD-EXPWY-2	12.09	12.98	0.89	12.30	12.98	0.68	12.53	12.98	0.45
SD-EXPWY-3	7.20	7.32	0.12	7.36	7.49	0.13	7.80	7.93	0.13
SS-C-1	4.78	4.77	-0.01	5.46	5.44	-0.02	7.73	7.61	-0.13
SS-C-2	4.78	4.77	-0.01	5.46	5.44	-0.02	7.73	7.61	-0.13

XP-SWMM Model Junction	50-Year			100-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
LG-E-2	8.42	8.26	-0.15	9.04	9.01	-0.03
LG-E-3	8.44	8.49	0.05	8.54	8.57	0.03
LG-N-1	8.81	8.83	0.02	8.99	8.99	-0.01
LG-W-1	8.81	8.83	0.02	8.99	8.99	-0.01
LG-W-2	8.86	8.87	0.01	8.93	8.91	-0.02
MC-C-N1	8.59	8.58	-0.01	8.85	8.83	-0.01
MC-C-N2	8.51	8.46	-0.05	8.83	8.82	-0.02
MC-C-N2-W	8.51	8.46	-0.05	8.83	8.82	-0.02
MC-C-N3	8.50	8.45	-0.06	8.83	8.82	-0.02
MC-C-S1	8.16	8.00	-0.16	8.60	8.47	-0.13
MC-C-S2	8.16	8.00	-0.16	8.60	8.47	-0.13
MC-C-S3	8.17	8.01	-0.16	8.62	8.49	-0.13
MC-C-S4	8.17	8.01	-0.16	8.62	8.49	-0.13
MC-E-1	8.50	8.44	-0.06	8.83	8.82	-0.02
MC-E-2	8.50	8.44	-0.06	8.83	8.82	-0.02
MC-E-3	8.16	8.00	-0.16	8.60	8.47	-0.13
MC-E-4	8.16	8.00	-0.16	8.60	8.47	-0.13
MC-S-1	8.13	8.06	-0.07	8.59	8.45	-0.14
MC-W-1	8.60	8.59	-0.01	8.85	8.84	-0.01
N-SC-LG	**6.69**	**6.34**	**-0.35**	**7.15**	**6.77**	**-0.38**
N-SS-C-1-2	8.49	8.42	-0.07	8.83	8.81	-0.02
PTTO-EX-N	12.63	12.62	-0.01	13.37	13.31	-0.05
PTTO-EX-S	9.72	9.94	0.22	9.98	10.22	0.24
S-121	3.40	3.40	0.00	3.40	3.40	0.00
S-22	**5.20**	**4.36**	**-0.84**	**5.52**	**4.42**	**-1.11**
S22-outW	**3.30**	**3.30**	**0.00**	**3.30**	**3.30**	**0.00**
S22-Wet1	**4.81**	**4.99**	**0.18**	**5.07**	**4.67**	**-0.40**
S22-wet2	**3.32**	**4.79**	**1.47**	**3.32**	**4.62**	**1.30**
SC-EXPWY-1	9.70	11.30	1.60	9.80	11.30	1.50
SC-EXPWY-2	12.46	12.44	-0.01	13.08	13.03	-0.04
SC-EXPWY-3	9.39	9.39	-0.01	9.44	9.43	-0.01
SD-EXPWY-1	10.27	10.23	-0.04	10.37	10.33	-0.04
SD-EXPWY-2	12.69	12.98	0.29	12.85	12.98	0.12
SD-EXPWY-3	7.96	8.09	0.13	8.11	8.21	0.10
SS-C-1	8.49	8.42	-0.07	8.83	8.81	-0.02
SS-C-2	8.49	8.42	-0.07	8.83	8.81	-0.02

XP-SWMM Model Junction	5-Year			10-Year			25-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
SS-C-3	4.72	4.71	-0.01	5.39	5.37	-0.02	7.29	7.03	-0.26
SS-C-4	4.68	4.67	-0.02	5.33	5.31	-0.02	7.04	6.88	-0.16
SS-C-5	4.78	4.77	-0.01	5.46	5.44	-0.02	7.73	7.61	-0.13
SS-C-6	4.78	4.77	-0.01	5.46	5.44	-0.02	7.72	7.59	-0.12
SS-C-7	4.63	4.60	-0.02	5.25	5.22	-0.03	6.95	6.70	-0.25
TRNP-S-1	5.25	5.26	0.01	5.41	5.42	0.01	6.89	6.60	-0.29
U10-N	4.92	4.92	0.00	5.62	5.61	-0.01	8.24	8.23	-0.01
U10-S	4.90	4.90	0.00	5.60	5.59	-0.01	8.12	8.10	-0.02
U11-N	4.90	4.90	0.00	5.60	5.59	-0.01	8.11	8.08	-0.02
U12-E	4.86	4.85	-0.01	5.54	5.51	-0.02	7.43	7.18	-0.25
U12-W	4.98	4.95	-0.03	5.64	5.61	-0.02	7.61	7.40	-0.22
U13-N	4.84	4.84	-0.01	5.52	5.50	-0.02	7.40	7.15	-0.25
U14-E	4.79	4.78	-0.01	5.46	5.44	-0.02	7.26	6.97	-0.29
U14-W	4.83	4.82	-0.01	5.51	5.49	-0.02	7.38	7.12	-0.26
U17-E	6.88	6.90	0.02	7.32	7.35	0.03	8.40	8.40	0.00
U18-E	6.90	6.93	0.02	7.34	7.38	0.03	8.41	8.41	0.00
U18-W	6.88	6.90	0.02	7.32	7.35	0.03	8.40	8.40	0.00
U19-E	6.78	6.79	0.01	7.20	7.22	0.02	8.38	8.38	0.00
U19-W	6.90	6.92	0.02	7.34	7.38	0.03	8.41	8.41	0.00
U1-E	6.76	6.80	0.03	7.21	7.24	0.03	8.38	8.38	0.00
U1-W	6.77	6.80	0.03	7.21	7.24	0.03	8.38	8.38	0.00
U20-E	6.40	6.38	-0.02	6.81	6.78	-0.03	8.33	8.31	-0.02
U20-W	6.78	6.78	0.01	7.20	7.22	0.02	8.38	8.38	0.00
U21-E	5.73	5.65	-0.08	6.41	6.32	-0.08	8.26	8.20	-0.06
U21-W	6.40	6.38	-0.02	6.81	6.78	-0.03	8.33	8.31	-0.02
U22-E	5.72	5.64	-0.08	6.40	6.31	-0.09	8.26	8.20	-0.06
U22-W	5.73	5.65	-0.08	6.41	6.32	-0.09	8.26	8.20	-0.06
U23-E	5.65	5.56	-0.09	6.34	6.25	-0.09	8.23	8.16	-0.08
U23-W	5.72	5.63	-0.08	6.40	6.31	-0.09	8.26	8.19	-0.06
U24-E	5.60	5.51	-0.09	6.29	6.20	-0.09	8.20	8.11	-0.09
U24-W	5.65	5.56	-0.09	6.34	6.25	-0.09	8.23	8.16	-0.08
U25-E	5.33	5.24	-0.09	6.01	5.91	-0.10	8.04	7.89	-0.14
U25-W	5.60	5.51	-0.09	6.28	6.19	-0.09	8.20	8.11	-0.09
U2-E	6.57	6.60	0.03	7.15	7.19	0.04	8.38	8.38	0.00
U2-W	6.75	6.78	0.03	7.21	7.24	0.03	8.38	8.38	0.00
U35-E	5.05	4.96	-0.09	5.69	5.61	-0.09	7.68	7.53	-0.16

XP-SWMM Model Junction	50-Year			100-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
SS-C-3	8.49	8.42	-0.07	8.83	8.81	-0.02
SS-C-4	8.47	8.39	-0.08	8.83	8.81	-0.02
SS-C-5	8.49	8.42	-0.07	8.83	8.81	-0.02
SS-C-6	8.47	8.39	-0.08	8.83	8.81	-0.02
SS-C-7	8.47	8.39	-0.08	8.83	8.81	-0.02
TRNP-S-1	7.55	7.26	-0.29	8.40	8.09	-0.31
U10-N	8.51	8.46	-0.05	8.83	8.82	-0.02
U10-S	8.50	8.45	-0.06	8.83	8.82	-0.02
U11-N	8.50	8.44	-0.06	8.83	8.81	-0.02
U12-E	8.17	8.01	-0.16	8.62	8.49	-0.13
U12-W	8.33	8.22	-0.11	8.71	8.63	-0.08
U13-N	8.15	7.98	-0.17	8.60	8.47	-0.14
U14-E	8.02	7.81	-0.21	8.49	8.29	-0.20
U14-W	8.14	7.96	-0.18	8.59	8.45	-0.15
U17-E	8.62	8.61	0.00	8.86	8.85	-0.01
U18-E	8.62	8.62	0.00	8.86	8.85	-0.01
U18-W	8.62	8.61	0.00	8.86	8.85	-0.01
U19-E	8.60	8.60	0.00	8.85	8.84	-0.01
U19-W	8.62	8.62	0.00	8.86	8.85	-0.01
U1-E	8.60	8.60	0.00	8.85	8.84	-0.01
U1-W	8.60	8.60	0.00	8.85	8.84	-0.01
U20-E	8.63	8.63	0.00	8.86	8.85	-0.01
U20-W	8.60	8.60	0.00	8.85	8.84	-0.01
U21-E	8.66	8.67	0.00	8.87	8.85	-0.01
U21-W	8.63	8.63	0.00	8.86	8.85	-0.01
U22-E	8.66	8.67	0.00	8.87	8.85	-0.01
U22-W	8.66	8.67	0.00	8.87	8.85	-0.01
U23-E	8.65	8.65	0.00	8.86	8.84	-0.02
U23-W	8.66	8.67	0.00	8.87	8.85	-0.01
U24-E	8.62	8.62	0.00	8.85	8.83	-0.02
U24-W	8.65	8.65	0.00	8.86	8.84	-0.02
U25-E	8.50	8.48	-0.02	8.80	8.75	-0.05
U25-W	8.62	8.62	0.00	8.85	8.83	-0.02
U2-E	8.60	8.60	0.00	8.85	8.84	-0.01
U2-W	8.60	8.60	0.00	8.85	8.84	-0.01
U35-E	8.20	8.14	-0.06	8.63	8.50	-0.12

XP-SWMM Model Junction	5-Year			10-Year			25-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
U35-W	5.33	5.23	-0.09	6.01	5.91	-0.10	8.03	7.89	-0.14
U36-N	5.05	4.96	-0.09	5.69	5.60	-0.09	7.68	7.52	-0.16
U37-E	4.76	4.73	-0.03	5.40	5.36	-0.04	7.30	7.08	-0.21
U37-W	4.99	4.91	-0.08	5.62	5.55	-0.07	7.60	7.44	-0.16
U38-NE	4.72	4.69	-0.03	5.35	5.32	-0.03	7.22	6.99	-0.23
U38-SW	4.75	4.72	-0.03	5.39	5.35	-0.03	7.29	7.07	-0.21
U39-N	4.67	4.64	-0.03	5.31	5.27	-0.03	7.17	6.92	-0.25
U39-S	4.71	4.69	-0.03	5.35	5.31	-0.03	7.22	6.99	-0.23
U3-E	6.52	6.54	0.02	7.12	7.15	0.04	8.38	8.38	0.00
U3-W	6.55	6.58	0.03	7.15	7.18	0.04	8.38	8.38	0.00
U40-N	4.86	4.85	-0.01	5.53	5.51	-0.02	7.42	7.18	-0.25
U40-S	4.67	4.64	-0.03	5.31	5.27	-0.03	7.16	6.92	-0.25
U41-E	4.55	4.52	-0.03	5.18	5.13	-0.05	6.92	6.62	-0.30
U41-W	4.66	4.63	-0.03	5.30	5.27	-0.03	7.16	6.91	-0.25
U42-E	4.72	4.71	-0.01	5.39	5.37	-0.02	7.29	7.03	-0.26
U42-W	4.78	4.77	-0.01	5.46	5.44	-0.02	7.73	7.61	-0.13
U43-E	4.68	4.67	-0.02	5.33	5.31	-0.03	7.04	6.88	-0.16
U43-W	4.72	4.71	-0.01	5.39	5.37	-0.02	7.29	7.03	-0.26
U44-N	4.78	4.77	-0.01	5.46	5.44	-0.02	7.73	7.61	-0.13
U44-S	4.78	4.77	-0.01	5.46	5.44	-0.02	7.72	7.59	-0.13
U45-N	4.78	4.77	-0.01	5.46	5.44	-0.02	7.72	7.59	-0.12
U45-S	4.78	4.77	-0.01	5.44	5.42	-0.02	7.24	6.94	-0.29
U46-E	4.71	4.69	-0.02	5.35	5.33	-0.03	7.07	6.82	-0.25
U46-W	4.76	4.75	-0.01	5.43	5.40	-0.02	7.21	6.92	-0.28
U47-W	4.67	4.65	-0.02	5.32	5.29	-0.03	7.03	6.78	-0.26
U4-E	6.12	6.10	-0.02	6.65	6.64	-0.02	8.25	8.20	-0.04
U4-W	6.50	6.52	0.02	7.10	7.13	0.03	8.37	8.37	0.00
U56E	4.62	4.60	-0.02	5.24	5.21	-0.03	6.94	6.67	-0.28
U56-W	4.68	4.67	-0.02	5.33	5.31	-0.03	7.04	6.88	-0.16
U57-E	4.62	4.60	-0.02	5.24	5.21	-0.03	6.94	6.66	-0.28
U58-N	4.96	6.50	1.54	5.83	6.50	0.67	7.57	7.58	0.01
U58-S	4.96	5.18	0.22	5.83	6.01	0.17	7.57	7.58	0.01
U59-N	4.96	5.18	0.22	5.83	6.00	0.17	7.57	7.57	0.01
U59-S	4.96	5.63	0.67	5.83	6.01	0.17	7.57	7.58	0.01
U5-N	6.55	6.59	0.04	7.15	7.19	0.04	8.38	8.38	0.00
U5-S	6.54	6.57	0.04	7.15	7.18	0.04	8.37	8.37	0.00

XP-SWMM Model Junction	50-Year			100-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
U35-W	8.50	8.48	-0.02	8.80	8.75	-0.05
U36-N	8.19	8.13	-0.06	8.62	8.50	-0.12
U37-E	7.88	7.76	-0.13	8.42	8.18	-0.24
U37-W	8.13	8.06	-0.07	8.59	8.45	-0.14
U38-NE	7.84	7.68	-0.16	8.42	8.18	-0.25
U38-SW	7.88	7.75	-0.13	8.42	8.18	-0.24
U39-N	7.81	7.63	-0.18	8.42	8.18	-0.25
U39-S	7.84	7.68	-0.16	8.42	8.18	-0.25
U3-E	8.60	8.60	0.00	8.85	8.84	-0.01
U3-W	8.60	8.60	0.00	8.85	8.84	-0.01
U40-N	8.16	8.00	-0.16	8.60	8.47	-0.13
U40-S	7.81	7.63	-0.18	8.42	8.18	-0.25
U41-E	7.59	7.30	-0.29	8.42	8.12	-0.30
U41-W	7.80	7.62	-0.18	8.42	8.17	-0.25
U42-E	8.49	8.42	-0.07	8.83	8.81	-0.02
U42-W	8.49	8.42	-0.07	8.83	8.81	-0.02
U43-E	8.47	8.39	-0.08	8.83	8.81	-0.02
U43-W	8.49	8.42	-0.07	8.83	8.81	-0.02
U44-N	8.49	8.42	-0.07	8.83	8.81	-0.02
U44-S	8.47	8.39	-0.08	8.83	8.81	-0.02
U45-N	8.47	8.39	-0.08	8.83	8.81	-0.02
U45-S	8.00	7.78	-0.21	8.46	8.25	-0.21
U46-E	7.88	7.57	-0.31	8.44	8.19	-0.25
U46-W	7.98	7.75	-0.23	8.46	8.24	-0.22
U47-W	7.89	7.49	-0.40	8.44	8.17	-0.27
U4-E	8.59	8.58	-0.01	8.85	8.84	-0.01
U4-W	8.60	8.60	0.00	8.85	8.84	-0.01
U56E	7.63	7.36	-0.27	8.47	8.20	-0.27
U56-W	8.47	8.39	-0.08	8.83	8.81	-0.02
U57-E	7.62	7.36	-0.26	8.45	8.18	-0.27
U58-N	8.03	8.02	-0.02	8.25	8.24	-0.01
U58-S	8.03	8.02	-0.02	8.25	8.24	-0.01
U59-N	8.03	8.01	-0.02	8.24	8.23	-0.02
U59-S	8.03	8.02	-0.02	8.25	8.24	-0.01
U5-N	8.60	8.59	0.00	8.85	8.84	-0.01
U5-S	8.59	8.59	-0.01	8.85	8.84	-0.01

XP-SWMM Model Junction	5-Year			10-Year			25-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
U60-E	4.96	5.18	0.23	5.83	6.00	0.18	7.58	7.59	0.01
U61-N	4.97	5.20	0.23	5.85	6.03	0.18	7.59	7.60	0.01
U62-E	4.96	5.18	0.22	5.83	6.00	0.17	7.57	7.57	0.01
U62-W	4.74	4.77	0.03	5.43	5.46	0.02	6.92	6.81	-0.11
U63-E	4.73	4.76	0.03	5.43	5.45	0.02	6.92	6.81	-0.11
U63-W	4.62	4.60	-0.02	5.24	5.22	-0.02	6.91	6.64	-0.27
U64-E	4.61	4.59	-0.02	5.23	5.21	-0.03	6.91	6.64	-0.27
U64-W	4.59	4.57	-0.02	5.21	5.18	-0.03	6.91	6.63	-0.28
U65-N	4.48	4.43	-0.05	5.10	5.03	-0.06	6.82	6.50	-0.32
U65-S	4.48	4.43	-0.05	5.10	5.03	-0.07	6.81	6.50	-0.31
U66-E	4.48	4.43	-0.05	5.10	5.03	-0.07	6.81	6.50	-0.31
U66-W	4.48	4.43	-0.05	5.10	5.03	-0.07	6.79	6.49	-0.30
U67-N	4.48	4.43	-0.05	5.10	5.03	-0.07	6.79	6.49	-0.31
U67-S	4.48	4.43	-0.05	5.10	5.03	-0.07	6.79	6.48	-0.30
U68-E	4.47	4.42	-0.05	5.11	5.03	-0.07	6.86	6.62	-0.23
U68W	4.47	4.42	-0.05	5.11	5.03	-0.07	6.88	6.63	-0.25
U69-E	4.47	4.42	-0.05	5.11	5.03	-0.07	6.85	6.61	-0.23
U69-W	4.47	4.42	-0.05	5.11	5.03	-0.07	6.86	6.62	-0.23
U6-N	6.50	6.53	0.03	7.11	7.14	0.03	8.36	8.36	0.00
U6-S	6.10	6.09	-0.02	6.64	6.62	-0.02	8.24	8.20	-0.05
U70-NE	4.46	4.41	-0.05	5.09	5.02	-0.07	6.78	6.53	-0.25
U70-SW	4.47	4.42	-0.05	5.11	5.03	-0.07	6.85	6.61	-0.23
U71-E	4.46	4.41	-0.05	5.09	5.02	-0.07	6.78	6.52	-0.25
U71-W	4.46	4.41	-0.05	5.09	5.02	-0.07	6.78	6.53	-0.25
U72-E	4.46	4.41	-0.05	5.08	5.01	-0.07	6.76	6.50	-0.27
U72-W	4.46	4.41	-0.05	5.09	5.02	-0.07	6.78	6.52	-0.25
U73-N	4.45	4.40	-0.05	5.07	5.00	-0.07	6.74	6.44	-0.30
U73-S	4.46	4.41	-0.05	5.08	5.01	-0.07	6.76	6.50	-0.27
U74-N	8.05	8.11	0.07	8.48	8.50	0.02	8.72	8.74	0.02
U74-S	5.01	4.94	-0.07	5.85	5.79	-0.06	7.84	7.68	-0.15
U75-E	4.75	4.68	-0.07	5.57	5.50	-0.06	7.75	7.58	-0.17
U75-W	5.01	4.94	-0.07	5.85	5.79	-0.06	7.84	7.68	-0.15
U76-N	4.75	4.68	-0.07	5.57	5.50	-0.06	7.75	7.58	-0.17
U76-S	4.72	4.65	-0.07	5.53	5.46	-0.07	7.72	7.55	-0.18
U77-W	4.72	4.65	-0.07	5.53	5.46	-0.07	7.72	7.55	-0.18
U78-N	4.72	4.65	-0.07	5.53	5.46	-0.07	7.72	7.55	-0.18

XP-SWMM Model Junction	50-Year			100-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
U60-E	8.04	8.03	-0.02	8.24	8.22	-0.02
U61-N	8.04	8.04	-0.01	8.25	8.27	0.01
U62-E	8.03	8.01	-0.02	8.24	8.23	-0.02
U62-W	7.54	7.28	-0.26	8.24	7.97	-0.27
U63-E	7.54	7.28	-0.26	8.24	7.97	-0.27
U63-W	7.57	7.30	-0.27	8.41	8.12	-0.29
U64-E	7.57	7.30	-0.27	8.42	8.13	-0.29
U64-W	7.58	7.31	-0.27	8.42	8.13	-0.29
U65-N	7.52	7.22	-0.30	8.23	7.95	-0.28
U65-S	7.48	7.18	-0.30	8.19	7.89	-0.30
U66-E	7.48	7.18	-0.30	8.19	7.89	-0.30
U66-W	7.44	7.13	-0.31	8.16	7.84	-0.32
U67-N	7.44	7.13	-0.31	8.16	7.84	-0.32
U67-S	7.42	7.11	-0.32	8.14	7.81	-0.33
U68-E	7.51	7.28	-0.23	8.14	7.96	-0.19
U68W	7.57	7.30	-0.27	8.15	7.96	-0.18
U69-E	7.50	7.26	-0.24	8.13	7.94	-0.19
U69-W	7.51	7.28	-0.23	8.14	7.96	-0.19
U6-N	8.59	8.59	-0.01	8.85	8.84	-0.01
U6-S	8.59	8.58	-0.01	8.85	8.83	-0.01
U70-NE	7.42	7.11	-0.31	8.07	7.78	-0.28
U70-SW	7.50	7.26	-0.24	8.13	7.94	-0.19
U71-E	7.42	7.11	-0.31	8.07	7.78	-0.29
U71-W	7.42	7.11	-0.31	8.07	7.78	-0.28
U72-E	7.40	7.08	-0.32	8.06	7.76	-0.30
U72-W	7.42	7.11	-0.31	8.07	7.78	-0.29
U73-N	7.37	7.04	-0.33	8.05	7.70	-0.35
U73-S	7.40	7.08	-0.32	8.06	7.76	-0.30
U74-N	8.81	8.83	0.02	8.99	8.99	-0.01
U74-S	8.47	8.33	-0.14	9.04	9.01	-0.03
U75-E	8.44	8.28	-0.16	9.04	9.01	-0.03
U75-W	8.47	8.33	-0.14	9.04	9.01	-0.03
U76-N	8.44	8.28	-0.16	9.04	9.01	-0.03
U76-S	8.42	8.26	-0.15	9.04	9.01	-0.03
U77-W	8.42	8.27	-0.15	9.04	9.01	-0.03
U78-N	8.42	8.27	-0.15	9.04	9.01	-0.03

XP-SWMM Model Junction	5-Year			10-Year			25-Year		
	Max Stage Original	**Max Stage Converted**	**Stage Difference**	**Max Stage Original**	**Max Stage Converted**	**Stage Difference**	**Max Stage Original**	**Max Stage Converted**	**Stage Difference**
U78-S	4.72	4.65	-0.07	5.53	5.46	-0.07	7.72	7.55	-0.18
U79-N	4.72	4.64	-0.07	5.52	5.46	-0.07	7.72	7.54	-0.18
U79-S	4.64	4.58	-0.07	5.43	5.37	-0.06	7.57	7.37	-0.20
U7-E	5.38	5.27	-0.11	5.87	5.83	-0.04	7.93	7.78	-0.15
U7-W	6.06	6.03	-0.02	6.59	6.57	-0.03	8.23	8.18	-0.05
U80-N	4.64	4.57	-0.07	5.43	5.37	-0.06	7.57	7.37	-0.20
U80-S	4.57	4.50	-0.07	5.32	5.26	-0.07	7.37	7.15	-0.22
U81-E	4.52	4.45	-0.07	5.26	5.18	-0.07	7.22	6.99	-0.23
U81-W	4.56	4.49	-0.07	5.32	5.25	-0.07	7.36	7.14	-0.22
U82-N	4.52	4.45	-0.07	5.25	5.18	-0.07	7.22	6.98	-0.23
U82-S	4.37	4.29	-0.08	5.05	4.93	-0.12	6.74	6.45	-0.29
U83-N	4.35	4.27	-0.09	5.03	4.91	-0.12	6.71	6.42	-0.30
U83-S	4.29	4.20	-0.09	4.92	4.79	-0.13	6.49	6.17	-0.32
U84-N	4.28	4.19	-0.09	4.90	4.77	-0.13	6.47	6.15	-0.32
U84-S	4.24	4.14	-0.10	4.83	4.69	-0.13	6.33	5.98	-0.35
U85-N	4.23	4.14	-0.10	4.82	4.69	-0.14	6.32	5.97	-0.35
U85-S	4.20	4.10	-0.10	4.77	4.63	-0.14	6.23	5.87	-0.36
U8-E	5.04	4.99	-0.05	5.67	5.64	-0.02	7.65	7.44	-0.21
U8-W	5.22	5.12	-0.10	5.78	5.75	-0.02	7.85	7.68	-0.17
U9-N	4.92	4.92	0.00	5.62	5.61	-0.01	8.37	8.37	0.00
U9-S	4.92	4.92	0.00	5.62	5.61	-0.01	8.24	8.23	-0.01
US1-N	10.20	10.20	0.00	10.25	10.25	0.00	10.29	10.29	0.00
US1-S	**10.48**	**10.48**	**0.00**	**10.59**	**10.59**	**0.00**	**10.67**	**10.66**	**0.00**
WW-C-1	4.74	4.77	0.03	5.43	5.46	0.02	6.92	6.81	-0.11
WW-C-10	4.45	4.40	-0.05	5.07	4.99	-0.08	6.72	6.41	-0.31
WW-C-11	4.43	4.39	-0.05	5.05	4.99	-0.07	6.70	6.41	-0.30
WW-C-2	4.74	4.77	0.03	5.43	5.46	0.02	6.92	6.81	-0.11
WW-C-3	4.74	4.77	0.03	5.43	5.45	0.02	6.92	6.81	-0.11
WW-C-4	4.73	4.76	0.03	5.43	5.45	0.02	6.92	6.81	-0.11
WW-C-5	4.61	4.60	-0.02	5.24	5.21	-0.02	6.91	6.64	-0.27
WW-C-6	4.74	4.77	0.03	5.43	5.46	0.02	6.92	6.81	-0.11
WW-C-7	4.48	4.43	-0.04	5.10	5.04	-0.06	6.82	6.50	-0.32
WW-C-8	4.48	4.43	-0.05	5.10	5.03	-0.07	6.81	6.50	-0.31
WW-C-8A	4.48	4.43	-0.05	5.10	5.03	-0.07	6.81	6.50	-0.31
WW-C-8B	4.48	4.43	-0.05	5.10	5.03	-0.07	6.81	6.50	-0.31
WW-C-9	4.48	4.43	-0.05	5.10	5.03	-0.07	6.79	6.49	-0.30

XP-SWMM Model Junction	50-Year			100-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
U78-S	8.42	8.26	-0.15	9.04	9.01	-0.03
U79-N	8.41	8.26	-0.15	9.03	9.01	-0.03
U79-S	8.28	8.11	-0.17	8.91	8.88	-0.03
U7-E	8.55	8.52	-0.03	8.83	8.81	-0.02
U7-W	8.59	8.57	-0.01	8.84	8.83	-0.01
U80-N	8.28	8.10	-0.17	8.90	8.87	-0.03
U80-S	7.98	7.77	-0.21	8.55	8.44	-0.10
U81-E	7.81	7.58	-0.23	8.35	8.22	-0.14
U81-W	7.96	7.76	-0.21	8.53	8.42	-0.11
U82-N	7.81	7.58	-0.23	8.35	8.21	-0.14
U82-S	7.28	6.99	-0.29	7.73	7.49	-0.24
U83-N	7.25	6.96	-0.29	7.70	7.46	-0.24
U83-S	7.00	6.68	-0.32	7.40	7.14	-0.26
U84-N	6.98	6.66	-0.32	7.38	7.12	-0.27
U84-S	6.81	6.47	-0.34	7.24	6.91	-0.33
U85-N	6.80	6.46	-0.34	7.24	6.90	-0.34
U85-S	6.70	6.35	-0.36	7.16	6.78	-0.38
U8-E	8.35	8.25	-0.10	8.73	8.65	-0.07
U8-W	8.50	8.46	-0.04	8.81	8.78	-0.03
U9-N	8.59	8.58	-0.01	8.85	8.83	-0.01
U9-S	8.51	8.46	-0.05	8.83	8.82	-0.02
US1-N	10.30	10.29	0.00	10.34	10.34	0.00
US1-S	**10.72**	**10.72**	**-0.01**	**10.80**	**10.79**	**-0.01**
WW-C-1	7.54	7.28	-0.26	8.24	7.97	-0.27
WW-C-10	7.35	6.98	-0.36	8.05	7.64	-0.41
WW-C-11	7.32	6.98	-0.34	7.98	7.63	-0.35
WW-C-2	7.54	7.28	-0.26	8.24	7.97	-0.27
WW-C-3	7.54	7.28	-0.26	8.24	7.97	-0.27
WW-C-4	7.54	7.28	-0.26	8.24	7.97	-0.27
WW-C-5	7.57	7.30	-0.27	8.42	8.13	-0.29
WW-C-6	7.53	7.27	-0.27	8.23	7.96	-0.27
WW-C-7	7.52	7.22	-0.30	8.23	7.95	-0.28
WW-C-8	7.48	7.18	-0.30	8.19	7.89	-0.30
WW-C-8A	7.48	7.18	-0.30	8.19	7.89	-0.30
WW-C-8B	7.48	7.18	-0.30	8.19	7.89	-0.30
WW-C-9	7.44	7.13	-0.31	8.16	7.84	-0.32

C-2 Basin - All Storm Events
Maximum Stage Comparison

XP-SWMM Model Junction	5-Year			10-Year			25-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
WW-E-1	8.23	8.23	0.00	8.29	8.30	0.00	8.39	8.39	0.00
WW-W-1	4.45	4.40	-0.05	5.07	4.99	-0.08	6.72	6.41	-0.31
WW-W-2	7.19	7.21	0.01	7.22	7.23	0.01	7.25	7.27	0.01

XP-SWMM Model Junction	50-Year			100-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
WW-E-1	8.44	8.44	0.00	8.48	8.48	0.00
WW-W-1	7.34	6.98	-0.36	8.05	7.64	-0.41
WW-W-2	7.35	7.29	-0.05	8.05	7.64	-0.41

Appendix 5B

XP-SWMM Model Junction	5-Year			10-Year			25-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
104ST-CS	8.03	8.12	0.09	8.20	8.29	0.09	8.57	8.66	0.09
B10-N	4.87	5.12	0.25	5.55	6.00	0.45	7.58	7.98	0.40
B10-S	4.86	5.11	0.25	5.54	5.99	0.45	7.57	7.97	0.40
B11-NW	4.84	5.08	0.24	5.51	5.95	0.44	7.52	7.93	0.41
B12-N	4.59	4.72	0.13	4.98	5.21	0.23	6.24	6.65	0.41
B12-S	4.59	4.72	0.13	4.97	5.20	0.23	6.22	6.63	0.41
B13-E	4.09	4.16	0.07	4.30	4.42	0.12	5.09	5.40	0.31
B13-W	4.09	4.18	0.09	4.33	4.45	0.12	5.12	5.44	0.32
B14-NW	6.52	6.90	0.38	7.39	7.58	0.19	8.27	8.35	0.08
B14-SE	6.52	6.90	0.38	7.39	7.58	0.19	8.26	8.34	0.08
B15-E	6.07	6.52	0.45	7.11	7.42	0.31	8.02	8.15	0.13
B15-W	6.32	6.52	0.20	7.14	7.42	0.28	8.06	8.15	0.09
B16-NW	5.65	5.97	0.32	6.28	6.68	0.40	7.00	7.46	0.46
B16-SE	5.51	5.97	0.46	6.27	6.68	0.41	7.00	7.46	0.46
B17-E	5.47	5.89	0.42	6.23	6.63	0.40	7.00	7.37	0.37
B17-W	5.47	5.90	0.43	6.23	6.64	0.41	7.00	7.38	0.38
B18-N	5.37	5.77	0.40	6.12	6.52	0.40	6.98	7.24	0.26
B18-S	5.36	5.77	0.41	6.11	6.51	0.40	6.98	7.23	0.25
B19-N	5.04	5.36	0.32	5.69	6.05	0.36	6.68	6.99	0.31
B19-S	5.01	5.32	0.31	5.65	6.01	0.36	6.64	6.96	0.32
B20-N	4.38	4.54	0.16	4.76	4.96	0.20	5.68	6.02	0.34
B20-S	4.37	4.52	0.15	4.74	4.93	0.19	5.66	5.99	0.33
B21-W	**7.34**	**7.41**	**0.07**	**7.78**	**8.04**	**0.26**	**8.84**	**8.84**	**0.00**
B22-N	**5.73**	**6.13**	**0.40**	**6.55**	**6.97**	**0.42**	**7.48**	**7.81**	**0.33**
B22-S	**5.73**	**6.12**	**0.39**	**6.54**	**6.97**	**0.43**	**7.48**	**7.80**	**0.32**
B23-N	**5.60**	**5.98**	**0.38**	**6.38**	**6.79**	**0.41**	**7.31**	**7.62**	**0.31**
B23-S	**5.57**	**5.96**	**0.39**	**6.35**	**6.77**	**0.42**	**7.29**	**7.60**	**0.31**
B24-N	5.45	5.83	0.38	6.20	6.60	0.40	7.12	7.41	0.29
B24-S	5.43	5.82	0.39	6.19	6.59	0.40	7.10	7.39	0.29
B25-E	5.36	5.75	0.39	6.10	6.50	0.40	7.01	7.28	0.27
B25-W	5.35	5.72	0.37	6.08	6.47	0.39	6.99	7.26	0.27
B4-E	5.73	5.87	0.14	6.22	6.58	0.36	7.56	7.79	0.23
B5-N	5.73	5.87	0.14	6.22	6.58	0.36	7.56	7.79	0.23
B5-S	5.72	5.86	0.14	6.22	6.58	0.36	7.55	7.78	0.23
B6-N	5.29	5.47	0.18	5.95	6.43	0.48	7.89	8.10	0.21
B6-S	5.26	5.47	0.21	5.94	6.43	0.49	7.89	8.10	0.21

XP-SWMM Model Junction	50-Year			100-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
104ST-CS	8.87	8.95	0.08	9.13	9.18	0.05
B10-N	8.10	8.23	0.13	8.30	8.42	0.12
B10-S	8.09	8.22	0.13	8.29	8.41	0.12
B11-NW	8.05	8.19	0.14	8.26	8.38	0.12
B12-N	6.81	7.00	0.19	7.12	7.26	0.14
B12-S	6.79	6.98	0.19	7.10	7.24	0.14
B13-E	5.54	5.67	0.13	5.79	5.89	0.10
B13-W	5.56	5.71	0.15	5.82	5.93	0.11
B14-NW	8.44	8.49	0.05	8.57	8.63	0.06
B14-SE	8.44	8.48	0.04	8.57	8.62	0.05
B15-E	8.28	8.33	0.05	8.48	8.50	0.02
B15-W	8.32	8.33	0.01	8.55	8.50	-0.05
B16-NW	7.42	7.71	0.29	7.70	7.95	0.25
B16-SE	7.39	7.71	0.32	7.68	7.94	0.26
B17-E	7.35	7.64	0.29	7.64	7.88	0.24
B17-W	7.35	7.64	0.29	7.64	7.88	0.24
B18-N	7.32	7.51	0.19	7.54	7.77	0.23
B18-S	7.32	7.51	0.19	7.54	7.76	0.22
B19-N	7.10	7.21	0.11	7.33	7.43	0.10
B19-S	7.07	7.19	0.12	7.31	7.41	0.10
B20-N	6.17	6.33	0.16	6.47	6.59	0.12
B20-S	6.15	6.30	0.15	6.45	6.57	0.12
B21-W	**9.23**	**9.10**	**-0.13**	**9.45**	**9.27**	**-0.18**
B22-N	**7.88**	**8.01**	**0.13**	**8.16**	**8.18**	**0.02**
B22-S	**7.88**	**8.01**	**0.13**	**8.14**	**8.18**	**0.04**
B23-N	**7.70**	**7.82**	**0.12**	**7.90**	**8.02**	**0.12**
B23-S	**7.69**	**7.80**	**0.11**	**7.88**	**8.01**	**0.13**
B24-N	7.50	7.62	0.12	7.70	7.86	0.16
B24-S	7.48	7.61	0.13	7.68	7.85	0.17
B25-E	7.37	7.51	0.14	7.57	7.76	0.19
B25-W	7.36	7.49	0.13	7.55	7.75	0.20
B4-E	7.83	8.08	0.25	8.11	8.34	0.23
B5-N	7.83	8.08	0.25	8.11	8.34	0.23
B5-S	7.82	8.07	0.25	8.10	8.33	0.23
B6-N	8.17	8.33	0.16	8.41	8.52	0.11
B6-S	8.17	8.33	0.16	8.41	8.52	0.11

XP-SWMM Model Junction	5-Year			10-Year			25-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
B-7A-E	5.18	5.45	0.27	5.93	6.41	0.48	7.88	8.10	0.22
B-7A-W	5.18	5.45	0.27	5.93	6.41	0.48	7.88	8.10	0.22
B7-NW	5.17	5.46	0.29	5.93	6.42	0.49	7.87	8.10	0.23
B7-SE	5.17	5.45	0.28	5.93	6.42	0.49	7.87	8.10	0.23
B8-NW	5.15	5.44	0.29	5.93	6.40	0.47	7.87	8.09	0.22
B8-SE	5.15	5.44	0.29	5.91	6.40	0.49	7.87	8.09	0.22
B9-E	5.11	5.41	0.30	5.89	6.38	0.49	7.86	8.09	0.23
B9-W	5.11	5.42	0.31	5.89	6.38	0.49	7.86	8.09	0.23
C100-1	5.55	5.67	0.12	6.10	6.51	0.41	7.91	8.11	0.20
C100-2	4.99	5.27	0.28	5.73	6.20	0.47	7.76	8.05	0.29
C100-2B	4.93	5.20	0.27	5.65	6.11	0.46	7.68	8.02	0.34
C100-3	4.50	4.63	0.13	4.86	5.07	0.21	5.98	6.36	0.38
C100-4	4.24	4.36	0.12	4.55	4.70	0.15	5.44	5.76	0.32
C100A-1	**5.88**	**6.29**	**0.41**	**6.75**	**7.18**	**0.43**	**7.67**	**7.99**	**0.32**
C100A-1A	7.37	7.50	0.13	7.91	8.21	0.30	9.05	9.13	0.08
C100A-1B	7.32	7.41	0.09	7.78	8.04	0.26	8.81	8.84	0.03
C100A-2	**5.74**	**6.14**	**0.40**	**6.57**	**6.99**	**0.42**	**7.50**	**7.82**	**0.32**
C100A-3	**5.72**	**6.12**	**0.40**	**6.54**	**6.96**	**0.42**	**7.47**	**7.80**	**0.33**
C100A-4	**5.69**	**6.08**	**0.39**	**6.49**	**6.91**	**0.42**	**7.43**	**7.75**	**0.32**
C100A-5	**5.60**	**5.99**	**0.39**	**6.39**	**6.80**	**0.41**	**7.32**	**7.63**	**0.31**
C100A-5A	**5.60**	**5.99**	**0.39**	**6.39**	**6.80**	**0.41**	**7.32**	**7.64**	**0.32**
C100A-5B	5.54	5.93	0.39	6.31	6.73	0.42	7.25	7.56	0.31
C100A-5C	5.57	5.96	0.39	6.35	6.77	0.42	7.29	7.60	0.31
C100A-C-1	7.38	7.52	0.14	7.91	8.23	0.32	9.04	9.18	0.14
C100A-E-1	**7.67**	**7.69**	**0.02**	**7.71**	**7.73**	**0.02**	**7.78**	**7.97**	**0.19**
C100A-E-2	**6.13**	**6.61**	**0.48**	**7.21**	**7.62**	**0.41**	**7.82**	**7.99**	**0.17**
C100A-E-3	6.71	6.71	0.00	6.78	6.78	0.00	7.12	7.41	0.29
C100A-E-4	6.85	6.88	0.03	6.92	6.95	0.03	7.02	7.28	0.26
C100A-N-1	9.22	9.28	0.06	9.36	9.42	0.06	9.64	9.66	0.02
C100A-N-2	9.49	9.51	0.02	9.55	9.57	0.02	9.64	9.65	0.01
C100A-W-1	8.46	8.46	0.00	8.57	8.58	0.01	9.06	9.14	0.08
C100A-W-2	**8.67**	**8.67**	**0.00**	**8.72**	**8.73**	**0.01**	**8.81**	**8.85**	**0.04**
C100A-W-3	**7.68**	**7.69**	**0.01**	**7.74**	**7.75**	**0.01**	**7.84**	**7.89**	**0.05**
C100A-W-4	7.47	7.50	0.03	7.52	7.55	0.03	7.62	7.67	0.05
C100B-N-1	6.30	6.33	0.03	6.36	6.39	0.03	6.60	6.81	0.21
C100B-S-1	6.46	6.54	0.08	6.60	6.67	0.07	6.97	7.22	0.25

XP-SWMM Model Junction	50-Year			100-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
B-7A-E	8.17	8.31	0.14	8.38	8.49	0.11
B-7A-W	8.17	8.31	0.14	8.38	8.50	0.12
B7-NW	8.17	8.31	0.14	8.38	8.50	0.12
B7-SE	8.17	8.31	0.14	8.39	8.50	0.11
B8-NW	8.17	8.30	0.13	8.37	8.49	0.12
B8-SE	8.17	8.30	0.13	8.37	8.49	0.12
B9-E	8.16	8.30	0.14	8.36	8.48	0.12
B9-W	8.16	8.30	0.14	8.36	8.48	0.12
C100-1	8.21	8.36	0.15	8.44	8.55	0.11
C100-2	8.13	8.27	0.14	8.34	8.46	0.12
C100-2B	8.11	8.26	0.15	8.32	8.45	0.13
C100-3	6.50	6.68	0.18	6.80	6.95	0.15
C100-4	5.91	6.05	0.14	6.19	6.30	0.11
C100A-1	**8.08**	**8.20**	**0.12**	**8.31**	**8.37**	**0.06**
C100A-1A	9.37	9.41	0.04	9.57	9.59	0.02
C100A-1B	9.15	9.10	-0.05	9.36	9.27	-0.09
C100A-2	**7.90**	**8.02**	**0.12**	**8.16**	**8.20**	**0.04**
C100A-3	**7.87**	**8.00**	**0.13**	**8.06**	**8.18**	**0.12**
C100A-4	**7.83**	**7.95**	**0.12**	**8.02**	**8.13**	**0.11**
C100A-5	**7.72**	**7.84**	**0.12**	**7.91**	**8.03**	**0.12**
C100A-5A	**7.72**	**7.84**	**0.12**	**7.92**	**8.03**	**0.11**
C100A-5B	7.64	7.76	0.12	7.84	7.98	0.14
C100A-5C	7.68	7.80	0.12	7.88	8.00	0.12
C100A-C-1	9.41	9.50	0.09	9.62	9.67	0.05
C100A-E-1	**8.02**	**8.10**	**0.08**	**8.16**	**8.22**	**0.06**
C100A-E-2	**8.03**	**8.10**	**0.07**	**8.16**	**8.23**	**0.07**
C100A-E-3	7.50	7.62	0.12	7.70	7.86	0.16
C100A-E-4	7.37	7.51	0.14	7.57	7.76	0.19
C100A-N-1	9.71	9.73	0.02	9.77	9.79	0.02
C100A-N-2	9.67	9.68	0.01	9.69	9.70	0.01
C100A-W-1	9.37	9.42	0.05	9.57	9.59	0.02
C100A-W-2	**8.87**	**8.88**	**0.01**	**8.91**	**8.92**	**0.01**
C100A-W-3	**7.97**	**8.07**	**0.10**	**8.16**	**8.24**	**0.08**
C100A-W-4	7.68	7.77	0.09	7.85	7.98	0.13
C100B-N-1	6.83	6.94	0.11	7.00	7.12	0.12
C100B-S-1	7.25	7.37	0.12	7.43	7.54	0.11

XP-SWMM Model Junction	5-Year			10-Year			25-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
C100B-S-2	7.49	7.50	0.01	7.63	7.64	0.01	7.86	7.92	0.06
C100C-1	6.52	6.90	0.38	7.39	7.57	0.18	8.27	8.35	0.08
C100C-13A	6.41	6.78	0.37	7.32	7.59	0.27	8.13	8.25	0.12
C100C-13B	6.28	6.62	0.34	7.19	7.49	0.30	8.08	8.19	0.11
C100C-2	6.52	6.90	0.38	7.39	7.58	0.19	8.27	8.35	0.08
C100C-3	5.32	5.70	0.38	6.05	6.44	0.39	6.96	7.23	0.27
C100C-4	4.51	4.70	0.19	4.94	5.18	0.24	5.88	6.22	0.34
C100C-C-8	7.64	6.91	-0.73	7.41	7.64	0.23	8.21	8.29	0.08
C100C-E-1	6.15	6.27	0.12	6.75	7.53	0.78	8.27	8.35	0.08
C100C-E-10	6.51	6.53	0.02	6.59	6.61	0.02	6.72	6.79	0.07
C100C-E-11	6.78	6.80	0.02	6.84	6.87	0.03	6.95	7.00	0.05
C100C-E-2	6.32	6.60	0.28	6.98	7.25	0.27	8.09	8.33	0.24
C100C-E-3	6.50	6.89	0.39	7.39	7.59	0.20	8.25	8.33	0.08
C100C-E-4	8.26	8.30	0.04	8.40	8.44	0.04	8.67	8.72	0.05
C100C-E-5	8.71	8.60	-0.11	9.07	8.73	-0.34	9.57	9.23	-0.34
C100C-E-6	7.91	7.94	0.03	8.00	8.03	0.03	8.16	8.24	0.08
C100C-E-7	7.28	7.29	0.01	7.33	7.35	0.02	7.41	7.45	0.04
C100C-E-8	7.00	7.01	0.01	7.05	7.06	0.01	7.13	7.24	0.11
C100C-E-9	7.08	7.11	0.03	7.14	7.16	0.02	7.22	7.27	0.05
C100C-EX2	8.14	7.67	-0.47	7.39	8.09	0.70	8.25	8.33	0.08
C100C-EX3	6.50	6.89	0.39	7.39	7.59	0.20	8.25	8.33	0.08
C100CS-1	6.89	7.55	0.66	7.96	8.10	0.14	8.57	8.66	0.09
C100CS-2	6.55	6.90	0.35	7.39	7.58	0.19	8.27	8.35	0.08
C100CS-C-3	6.67	7.20	0.53	7.66	7.82	0.16	8.41	8.50	0.09
C100CS-N-1	7.90	7.94	0.04	7.98	8.11	0.13	8.57	8.66	0.09
C100CS-N-2	8.43	8.46	0.03	8.49	8.52	0.03	8.61	8.66	0.05
C100CSN3	8.30	8.35	0.05	8.37	8.41	0.04	8.57	8.66	0.09
C100CS-X-4	7.54	7.66	0.12	7.70	7.84	0.14	8.07	8.23	0.16
C100CS-X-5	6.84	6.95	0.11	6.96	7.09	0.13	8.27	8.35	0.08
C100C-W-1	7.26	7.39	0.13	7.48	7.60	0.12	8.27	8.35	0.08
C100C-W-1A	7.33	6.91	-0.42	7.39	7.57	0.18	8.27	8.35	0.08
C100CW1AX	6.73	6.85	0.12	6.91	7.12	0.21	8.27	8.35	0.08
C100C-W-1B	7.34	6.91	-0.43	7.40	7.57	0.17	8.27	8.35	0.08
C100CW1BX	7.30	7.36	0.06	7.42	7.57	0.15	8.27	8.35	0.08
C100C-W-2	7.78	7.81	0.03	7.89	7.93	0.04	8.18	8.29	0.11
C100C-W-3	8.84	8.87	0.03	8.93	8.96	0.03	9.13	9.14	0.01

XP-SWMM Model Junction	50-Year			100-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
C100B-S-2	8.00	7.97	-0.03	8.09	8.03	-0.06
C100C-1	8.44	8.49	0.05	8.57	8.63	0.06
C100C-13A	8.35	8.44	0.09	8.57	8.62	0.05
C100C-13B	8.33	8.38	0.05	8.55	8.55	0.00
C100C-2	8.44	8.49	0.05	8.57	8.63	0.06
C100C-3	7.32	7.46	0.14	7.51	7.72	0.21
C100C-4	6.38	6.54	0.16	6.69	6.81	0.12
C100C-C-8	8.38	8.43	0.05	8.51	8.56	0.05
C100C-E-1	8.44	8.49	0.05	8.57	8.63	0.06
C100C-E-10	6.81	6.83	0.02	6.86	6.88	0.02
C100C-E-11	7.01	7.03	0.02	7.05	7.06	0.01
C100C-E-2	8.43	8.48	0.05	8.57	8.62	0.05
C100C-E-3	8.43	8.47	0.04	8.56	8.61	0.05
C100C-E-4	8.76	8.82	0.06	8.84	8.90	0.06
C100C-E-5	9.65	9.41	-0.24	9.72	9.62	-0.10
C100C-E-6	8.26	8.29	0.03	8.31	8.34	0.03
C100C-E-7	7.46	7.64	0.18	7.64	7.88	0.24
C100C-E-8	7.32	7.51	0.19	7.54	7.77	0.23
C100C-E-9	7.28	7.31	0.03	7.33	7.34	0.01
C100C-EX2	8.58	8.48	-0.10	8.57	8.62	0.05
C100C-EX3	8.43	8.47	0.04	8.56	8.61	0.05
C100CS-1	8.87	8.95	0.08	9.13	9.18	0.05
C100CS-2	8.44	8.49	0.05	8.57	8.63	0.06
C100CS-C-3	8.61	8.67	0.06	8.79	8.85	0.06
C100CS-N-1	8.87	8.95	0.08	9.13	9.18	0.05
C100CS-N-2	8.87	8.95	0.08	9.13	9.18	0.05
C100CSN3	8.87	8.95	0.08	9.13	9.18	0.05
C100CS-X-4	8.17	8.34	0.17	8.29	8.46	0.17
C100CS-X-5	8.44	8.49	0.05	8.57	8.63	0.06
C100C-W-1	8.44	8.49	0.05	8.57	8.63	0.06
C100C-W-1A	8.44	8.49	0.05	8.57	8.63	0.06
C100CW1AX	8.44	8.49	0.05	8.57	8.63	0.06
C100C-W-1B	8.44	8.49	0.05	8.57	8.63	0.06
C100CW1BX	8.44	8.49	0.05	8.57	8.63	0.06
C100C-W-2	8.37	8.46	0.09	8.57	8.63	0.06
C100C-W-3	9.18	9.18	0.00	9.22	9.23	0.00

XP-SWMM Model Junction	5-Year			10-Year			25-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
C100C-W-4	5.02	5.17	0.15	5.24	5.79	0.55	6.83	7.46	0.63
C100C-W-5	7.25	7.25	0.00	7.32	7.32	0.00	7.43	7.47	0.04
C100C-W-6	6.74	6.74	0.00	6.82	6.82	0.00	6.95	7.03	0.08
C100C-W-7	6.55	6.58	0.03	6.63	6.66	0.03	6.78	6.84	0.06
C100C-X-1	7.54	7.61	0.07	7.62	7.68	0.06	8.27	8.35	0.08
C100C-X-10	7.73	7.78	0.05	7.78	7.82	0.04	8.21	8.29	0.08
C100C-X-12	7.29	7.32	0.03	7.38	7.60	0.22	8.21	8.28	0.07
C100C-X-13	7.94	7.82	-0.12	8.12	8.21	0.09	8.53	9.22	0.69
C100C-X-14	7.70	7.75	0.05	7.77	7.83	0.06	7.99	8.11	0.12
C100C-X-2	7.28	7.30	0.02	7.39	7.58	0.19	8.27	8.35	0.08
C100C-X-6	7.56	7.58	0.02	7.60	7.63	0.03	8.25	8.33	0.08
C100C-X-7	7.68	7.70	0.02	7.72	7.74	0.02	8.23	8.30	0.07
C100C-X-8	6.31	6.76	0.45	7.25	7.65	0.40	8.21	8.29	0.08
C100C-X-9	7.90	7.96	0.06	7.97	8.03	0.06	8.21	8.29	0.08
C100D-1	**5.97**	**6.40**	**0.43**	**6.86**	**7.31**	**0.45**	**7.72**	**8.00**	**0.28**
C100D-E-1	**7.89**	**7.90**	**0.01**	**7.93**	**7.95**	**0.02**	**7.98**	**8.01**	**0.03**
C100D-N-1	**6.17**	**6.63**	**0.46**	**7.16**	**7.62**	**0.46**	**7.93**	**8.21**	**0.28**
C100D-W-1	**7.50**	**7.50**	**0.00**	**7.54**	**7.55**	**0.01**	**7.67**	**7.99**	**0.32**
C100-E-1	6.44	6.58	0.14	6.71	6.85	0.14	7.48	7.73	0.25
C100-N-1	5.73	5.87	0.14	6.23	6.58	0.35	7.56	7.79	0.23
C100-N-10	4.96	5.18	0.22	6.15	6.21	0.06	7.52	7.93	0.41
C100-N-11	7.08	7.09	0.01	7.16	7.17	0.01	7.28	7.32	0.04
C100-N-12	6.53	6.54	0.01	6.58	6.59	0.01	6.65	6.68	0.03
C100-N-2	5.96	6.04	0.08	6.17	6.33	0.16	7.56	7.79	0.23
C100-N-3	7.92	7.95	0.03	7.98	8.01	0.03	8.10	8.13	0.03
C100-N-4	7.60	7.64	0.04	7.66	7.70	0.04	7.91	8.11	0.20
C100-N-5	7.58	7.61	0.03	7.63	7.66	0.03	7.91	8.11	0.20
C100-N-6	7.59	7.65	0.06	7.74	7.80	0.06	8.01	8.10	0.09
C100-N-7	7.73	7.78	0.05	7.83	7.87	0.04	8.02	8.07	0.05
C100-N-8	7.98	8.03	0.05	8.08	8.12	0.04	8.26	8.33	0.07
C100-N-9	8.90	8.91	0.01	8.96	8.97	0.01	9.05	9.09	0.04
C100S-1	5.55	5.67	0.12	6.10	6.51	0.41	7.91	8.11	0.20
C100-S-1	8.16	8.20	0.04	8.24	8.27	0.03	8.40	8.43	0.03
C100-S-2	7.57	7.67	0.10	7.74	7.80	0.06	7.97	8.12	0.15
C100-S-3	7.53	7.63	0.10	7.69	7.77	0.08	7.95	8.12	0.17
C100-S-4	7.91	7.96	0.05	8.02	8.07	0.05	8.26	8.31	0.05

XP-SWMM Model Junction	50-Year			100-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
C100C-W-4	7.42	7.71	0.29	7.70	7.95	0.25
C100C-W-5	7.49	7.51	0.02	7.54	7.77	0.23
C100C-W-6	7.13	7.24	0.11	7.35	7.44	0.09
C100C-W-7	6.86	6.89	0.03	6.91	6.94	0.03
C100C-X-1	8.44	8.49	0.05	8.57	8.63	0.06
C100C-X-10	8.38	8.43	0.05	8.51	8.57	0.05
C100C-X-12	8.40	8.43	0.03	8.54	8.58	0.04
C100C-X-13	8.64	9.41	0.77	8.75	9.62	0.87
C100C-X-14	8.24	8.30	0.06	8.41	8.46	0.05
C100C-X-2	8.44	8.49	0.05	8.57	8.63	0.06
C100C-X-6	8.43	8.47	0.04	8.56	8.62	0.06
C100C-X-7	8.41	8.45	0.04	8.55	8.60	0.05
C100C-X-8	8.38	8.43	0.05	8.51	8.56	0.05
C100C-X-9	8.38	8.43	0.05	8.51	8.56	0.05
C100D-1	**8.05**	**8.19**	**0.14**	**8.28**	**8.35**	**0.07**
C100D-E-1	**8.02**	**8.03**	**0.01**	**8.15**	**8.20**	**0.05**
C100D-N-1	**8.26**	**8.34**	**0.08**	**8.39**	**8.46**	**0.07**
C100D-W-1	**8.06**	**8.20**	**0.14**	**8.29**	**8.37**	**0.08**
C100-E-1	7.68	8.01	0.33	8.01	8.29	0.28
C100-N-1	7.83	8.08	0.25	8.11	8.34	0.23
C100-N-10	8.05	8.19	0.14	8.26	8.38	0.12
C100-N-11	7.36	7.37	0.01	7.42	7.42	0.00
C100-N-12	6.69	6.71	0.02	6.80	6.95	0.15
C100-N-2	7.83	8.08	0.25	8.11	8.34	0.23
C100-N-3	8.21	8.35	0.14	8.44	8.55	0.11
C100-N-4	8.20	8.35	0.15	8.44	8.55	0.11
C100-N-5	8.20	8.35	0.15	8.44	8.55	0.11
C100-N-6	8.17	8.31	0.14	8.37	8.48	0.11
C100-N-7	8.15	8.28	0.13	8.35	8.46	0.11
C100-N-8	8.36	8.38	0.02	8.42	8.46	0.04
C100-N-9	9.11	9.12	0.01	9.15	9.15	0.00
C100S-1	8.22	8.37	0.15	8.45	8.57	0.12
C100-S-1	8.45	8.48	0.03	8.50	8.55	0.05
C100-S-2	8.20	8.35	0.15	8.43	8.55	0.12
C100-S-3	8.19	8.34	0.15	8.42	8.54	0.12
C100-S-4	8.33	8.37	0.04	8.40	8.46	0.06

XP-SWMM Model Junction	5-Year			10-Year			25-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
C100-S-5	7.90	7.95	0.05	8.00	8.05	0.05	8.23	8.28	0.05
C100-S-6	7.80	7.87	0.07	7.95	8.02	0.07	8.23	8.33	0.10
C100-S-7	6.66	6.67	0.01	6.74	6.76	0.02	6.91	6.98	0.07
C100-S-8	6.39	6.42	0.03	6.47	6.51	0.04	6.63	6.70	0.07
C100TRPKE1	8.04	8.16	0.12	8.23	8.30	0.07	8.46	8.51	0.05
C100TRPKE2	8.23	8.38	0.15	8.35	8.46	0.11	8.51	8.61	0.10
C100TRPKW1	6.89	7.01	0.12	7.14	7.27	0.13	7.95	8.10	0.15
C100-W-1	8.31	8.42	0.11	8.47	8.59	0.12	8.81	8.89	0.08
C100-W-2	8.45	8.52	0.07	8.56	8.63	0.07	8.84	8.91	0.07
C100-W-3	8.48	8.55	0.07	8.58	8.65	0.07	8.85	8.92	0.07
C100-W-4	8.48	8.55	0.07	8.58	8.65	0.07	8.85	8.92	0.07
C100-W-5	8.04	8.09	0.05	8.11	8.15	0.04	8.26	8.31	0.05
C100-W-6	8.07	8.14	0.07	8.23	8.28	0.05	8.42	8.43	0.01
C100-X-14	6.77	6.78	0.01	6.81	6.81	0.00	7.58	7.98	0.40
C100-X-2	8.27	8.32	0.05	8.31	8.35	0.04	8.35	8.37	0.02
C100-X-4	7.41	7.50	0.09	7.50	7.60	0.10	7.71	7.82	0.11
C100-X-7	7.52	7.59	0.07	7.59	7.67	0.08	7.90	8.11	0.21
CC100A-E-1	**7.89**	**7.90**	**0.01**	**7.95**	**7.96**	**0.01**	**8.02**	**8.05**	**0.03**
CC100A-W-1	11.08	11.11	0.03	11.15	11.18	0.03	11.24	11.30	0.06
CC100A-W-2	**9.94**	**9.96**	**0.02**	**9.99**	**10.01**	**0.02**	**10.07**	**10.10**	**0.03**
CC100B-N-1	7.06	7.07	0.01	7.12	7.14	0.02	7.23	7.28	0.05
CC100C-E-1	8.37	8.38	0.01	8.47	8.49	0.02	8.64	8.71	0.07
CC100-N-5	5.91	6.04	0.13	6.17	6.33	0.16	7.56	7.79	0.23
CC100-N-6	6.40	6.52	0.12	6.60	6.72	0.12	7.19	7.34	0.15
CC100-N-CL	7.14	7.28	0.14	7.40	7.55	0.15	8.23	8.41	0.18
CC100-S-1	6.42	6.50	0.08	6.79	6.84	0.05	7.91	8.11	0.20
CC100-S-2	6.78	7.17	0.39	7.60	7.94	0.34	8.30	8.36	0.06
CC100-S-3	8.12	8.15	0.03	8.19	8.22	0.03	8.33	8.36	0.03
CC100-S-4	7.66	7.77	0.11	7.86	7.98	0.12	8.31	8.38	0.07
CC100-W-1	8.31	8.42	0.11	8.47	8.60	0.13	8.82	8.90	0.08
CC100-W-2	8.78	8.82	0.04	8.87	8.91	0.04	9.06	9.08	0.02
HOWARDDR1	6.51	6.64	0.13	6.72	6.81	0.09	7.61	7.74	0.13
HOWARDDRX	5.83	6.21	0.38	6.79	7.01	0.22	7.61	7.74	0.13
S118-NW	4.80	4.98	0.18	5.37	5.78	0.41	7.29	7.71	0.42
S118-SE	4.68	4.83	0.15	5.14	5.45	0.31	6.75	7.22	0.47
S119-NW	5.81	6.13	0.32	6.71	6.91	0.20	7.51	7.65	0.14

XP-SWMM Model Junction	50-Year			100-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
C100-S-5	8.30	8.33	0.03	8.35	8.45	0.10
C100-S-6	8.37	8.42	0.05	8.48	8.55	0.07
C100-S-7	7.03	7.05	0.02	7.14	7.27	0.13
C100-S-8	6.72	6.75	0.03	6.78	6.80	0.02
C100TRPKE1	8.52	8.56	0.04	8.57	8.62	0.05
C100TRPKE2	8.56	8.66	0.10	8.60	8.70	0.10
C100TRPKW1	8.09	8.26	0.17	8.30	8.45	0.15
C100-W-1	8.89	8.97	0.08	8.97	9.04	0.07
C100-W-2	8.92	8.99	0.07	8.99	9.06	0.07
C100-W-3	8.93	9.00	0.07	9.00	9.07	0.07
C100-W-4	8.93	9.00	0.07	9.00	9.07	0.07
C100-W-5	8.35	8.41	0.06	8.45	8.54	0.09
C100-W-6	8.47	8.49	0.02	8.54	8.60	0.06
C100-X-14	8.10	8.23	0.13	8.30	8.42	0.12
C100-X-2	8.36	8.39	0.03	8.38	8.40	0.02
C100-X-4	7.77	7.87	0.10	7.83	7.96	0.13
C100-X-7	8.20	8.35	0.15	8.44	8.55	0.11
CC100A-E-1	**8.07**	**8.11**	**0.04**	**8.17**	**8.23**	**0.06**
CC100A-W-1	11.31	11.34	0.03	11.36	11.38	0.02
CC100A-W-2	**10.11**	**10.12**	**0.01**	**10.15**	**10.15**	**0.00**
CC100B-N-1	7.30	7.36	0.06	7.42	7.52	0.10
CC100C-E-1	8.75	8.77	0.02	8.81	8.82	0.01
CC100-N-5	7.83	8.08	0.25	8.11	8.34	0.23
CC100-N-6	7.30	7.47	0.17	7.43	7.60	0.17
CC100-N-CL	8.37	8.52	0.15	8.50	8.63	0.13
CC100-S-1	8.22	8.37	0.15	8.45	8.57	0.12
CC100-S-2	8.39	8.45	0.06	8.48	8.55	0.07
CC100-S-3	8.39	8.45	0.06	8.48	8.55	0.07
CC100-S-4	8.41	8.49	0.08	8.52	8.60	0.08
CC100-W-1	8.90	8.98	0.08	8.98	9.05	0.07
CC100-W-2	9.11	9.13	0.02	9.15	9.17	0.02
HOWARDDR1	7.96	7.95	-0.01	8.17	8.16	-0.01
HOWARDDRX	7.96	7.95	-0.01	8.17	8.16	-0.01
S118-NW	7.84	7.99	0.15	8.07	8.19	0.12
S118-SE	7.37	7.54	0.17	7.64	7.78	0.14
S119-NW	7.90	7.88	-0.02	8.11	8.09	-0.02

XP-SWMM Model Junction	5-Year			10-Year			25-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
S119-SE	5.65	5.98	0.33	6.29	6.70	0.41	7.01	7.48	0.47
S120-E	**6.03**	**6.36**	**0.33**	**6.84**	**7.29**	**0.45**	**7.79**	**8.14**	**0.35**
S120-M	**6.13**	**6.38**	**0.25**	**6.86**	**7.31**	**0.45**	**8.05**	**8.19**	**0.14**
S120-W	**7.34**	**7.41**	**0.07**	**7.76**	**8.04**	**0.28**	**8.79**	**8.85**	**0.06**
S-121	6.53	6.90	0.37	7.39	7.57	0.18	8.27	8.35	0.08
S122-E	5.41	5.65	0.24	6.08	6.53	0.45	6.98	7.23	0.25
S-123-H	4.09	4.15	0.06	4.29	4.40	0.11	5.06	5.38	0.32
SEAB-NW	5.15	4.14	-1.01	5.92	6.40	0.48	7.87	8.09	0.22
SR874-3	7.77	7.77	0.00	7.94	8.08	0.14	8.57	8.66	0.09
SR874-4	7.92	7.93	0.01	7.96	8.08	0.12	8.57	8.66	0.09
TRPK-N-1	5.20	5.49	0.29	5.96	6.43	0.47	7.89	8.12	0.23
TRPK-N-3	5.36	5.48	0.12	5.96	6.45	0.49	7.92	8.12	0.20
TRPK-N4OUT	3.28	3.41	0.13	3.33	3.45	0.12	3.43	3.55	0.12
TRPK-N-C-2	5.65	5.91	0.26	6.25	6.59	0.34	8.05	8.30	0.25
TRPK-S-1	5.35	5.72	0.37	6.23	6.76	0.53	8.23	8.30	0.07
TRPK-S-2	5.12	5.42	0.30	5.90	6.39	0.49	8.03	8.27	0.24
U10A-E	6.64	6.90	0.26	7.39	7.57	0.18	8.27	8.35	0.08
U10-W	6.51	6.89	0.38	7.39	7.58	0.19	8.26	8.34	0.08
U11-W	6.51	6.89	0.38	7.39	7.58	0.19	8.25	8.33	0.08
U12-N	6.51	6.89	0.38	7.38	7.58	0.20	8.25	8.33	0.08
U12-S	6.49	6.88	0.39	7.38	7.59	0.21	8.23	8.30	0.07
U13-E	6.53	6.89	0.36	7.41	7.64	0.23	8.21	8.29	0.08
U14-NE	6.51	6.89	0.38	7.40	7.64	0.24	8.21	8.29	0.08
U14-SW	6.51	6.89	0.38	7.41	7.64	0.23	8.21	8.29	0.08
U15-NE	6.50	6.89	0.39	7.40	7.63	0.23	8.21	8.29	0.08
U15-SW	6.50	6.89	0.39	7.40	7.64	0.23	8.21	8.29	0.08
U16-NE	6.50	6.88	0.38	7.38	7.59	0.21	8.23	8.30	0.07
U16-SW	6.50	6.89	0.39	7.40	7.63	0.23	8.21	8.29	0.08
U17-N	6.48	6.87	0.39	7.38	7.60	0.22	8.21	8.28	0.07
U17-S	6.42	6.79	0.37	7.33	7.59	0.26	8.14	8.25	0.11
U18-W	5.97	6.49	0.52	7.08	7.39	0.31	7.99	8.11	0.12
U19-E	5.79	6.14	0.35	6.72	6.91	0.19	7.52	7.66	0.14
U19-W	5.83	6.20	0.37	6.78	6.99	0.21	7.60	7.73	0.13
U1-N	5.71	5.85	0.14	6.21	6.57	0.36	7.57	7.78	0.21
U1-S	5.57	5.69	0.12	6.11	6.51	0.40	7.87	8.06	0.19
U20-E	6.87	7.53	0.66	7.94	8.08	0.14	8.57	8.66	0.09

XP-SWMM Model Junction	50-Year			100-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
S119-SE	7.43	7.73	0.30	7.71	7.96	0.25
S120-E	**8.33**	**8.38**	**0.05**	**8.59**	**8.56**	**-0.03**
S120-M	**8.68**	**8.43**	**-0.25**	**8.91**	**8.62**	**-0.29**
S120-W	**9.22**	**9.10**	**-0.12**	**9.41**	**9.27**	**-0.14**
S-121	8.44	8.49	0.05	8.57	8.63	0.06
S122-E	7.26	7.39	0.13	7.45	7.55	0.10
S-123-H	5.51	5.64	0.13	5.76	5.87	0.11
SEAB-NW	8.17	8.30	0.13	8.37	8.49	0.12
SR874-3	8.87	8.95	0.08	9.13	9.18	0.05
SR874-4	8.87	8.95	0.08	9.13	9.18	0.05
TRPK-N-1	8.19	8.34	0.15	8.39	8.52	0.13
TRPK-N-3	8.20	8.34	0.14	8.43	8.54	0.11
TRPK-N4OUT	3.46	3.57	0.11	3.50	3.60	0.10
TRPK-N-C-2	8.35	8.52	0.17	8.53	8.65	0.12
TRPK-S-1	8.34	8.41	0.07	8.45	8.54	0.09
TRPK-S-2	8.35	8.47	0.12	8.51	8.59	0.08
U10A-E	8.44	8.49	0.05	8.57	8.63	0.06
U10-W	8.43	8.48	0.05	8.56	8.62	0.06
U11-W	8.43	8.47	0.04	8.56	8.62	0.06
U12-N	8.43	8.47	0.04	8.56	8.62	0.06
U12-S	8.41	8.45	0.04	8.55	8.60	0.05
U13-E	8.38	8.43	0.05	8.51	8.56	0.05
U14-NE	8.38	8.43	0.05	8.51	8.57	0.05
U14-SW	8.38	8.43	0.05	8.51	8.56	0.05
U15-NE	8.39	8.43	0.04	8.51	8.57	0.06
U15-SW	8.38	8.43	0.05	8.51	8.57	0.05
U16-NE	8.41	8.45	0.04	8.55	8.60	0.05
U16-SW	8.39	8.43	0.04	8.51	8.57	0.06
U17-N	8.40	8.43	0.03	8.54	8.58	0.04
U17-S	8.35	8.44	0.09	8.56	8.61	0.05
U18-W	8.23	8.30	0.07	8.41	8.46	0.05
U19-E	7.90	7.89	-0.01	8.12	8.10	-0.02
U19-W	7.96	7.94	-0.02	8.16	8.15	-0.01
U1-N	7.81	8.06	0.25	8.09	8.32	0.23
U1-S	8.17	8.31	0.14	8.39	8.52	0.13
U20-E	8.87	8.95	0.08	9.13	9.18	0.05

XP-SWMM Model Junction	5-Year			10-Year			25-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
U20-W	6.89	7.55	0.66	7.96	8.10	0.14	8.57	8.66	0.09
U21SW	6.88	7.53	0.65	7.94	8.08	0.14	8.57	8.66	0.09
U22A-SE	6.66	6.90	0.24	7.39	7.58	0.19	8.27	8.35	0.08
U22-NE	6.54	6.90	0.36	7.39	7.58	0.19	8.27	8.35	0.08
U23-E	7.38	7.52	0.14	7.89	8.18	0.29	8.86	8.98	0.12
U24-N	7.38	7.51	0.13	7.89	8.18	0.29	8.86	8.98	0.12
U24-S	7.38	7.51	0.13	7.87	8.14	0.27	8.77	8.88	0.11
U25-E	7.38	7.50	0.12	7.85	8.12	0.27	8.74	8.84	0.10
U25-W	7.38	7.51	0.13	7.87	8.14	0.27	8.77	8.88	0.11
U26-E	7.37	7.50	0.13	7.91	8.21	0.30	9.05	9.13	0.08
U26-W	7.38	7.50	0.12	7.85	8.12	0.27	8.74	8.84	0.10
U27-E	7.32	7.42	0.10	7.78	8.05	0.27	8.82	8.86	0.04
U27-W	7.37	7.50	0.13	7.91	8.21	0.30	9.05	9.12	0.07
U28-E	**5.96**	**6.29**	**0.33**	**6.75**	**7.18**	**0.43**	**7.67**	**7.99**	**0.32**
U28-W	**6.00**	**6.36**	**0.36**	**6.84**	**7.28**	**0.44**	**7.78**	**8.13**	**0.35**
U29-N	5.88	6.28	0.40	6.74	7.18	0.44	7.67	7.99	0.32
U29-S	5.80	6.21	0.41	6.65	7.08	0.43	7.58	7.91	0.33
U2-N	5.57	5.69	0.12	6.10	6.51	0.41	7.87	8.07	0.20
U2-S	5.55	5.67	0.12	6.10	6.51	0.41	7.90	8.10	0.20
U30-N	**5.79**	**6.20**	**0.41**	**6.63**	**7.06**	**0.43**	**7.56**	**7.89**	**0.33**
U30-S	**5.75**	**6.15**	**0.40**	**6.57**	**7.00**	**0.43**	**7.50**	**7.82**	**0.32**
U31-W	**5.69**	**6.08**	**0.39**	**6.49**	**6.91**	**0.42**	**7.43**	**7.75**	**0.32**
U32-N	**5.72**	**6.12**	**0.40**	**6.54**	**6.96**	**0.42**	**7.47**	**7.80**	**0.33**
U32-S	**5.70**	**6.10**	**0.40**	**6.52**	**6.95**	**0.43**	**7.52**	**7.86**	**0.34**
U33-N	**5.70**	**6.10**	**0.40**	**6.52**	**6.95**	**0.43**	**7.52**	**7.86**	**0.34**
U33-S	**5.60**	**5.99**	**0.39**	**6.39**	**6.80**	**0.41**	**7.32**	**7.64**	**0.32**
U34-N	**6.15**	**6.61**	**0.46**	**7.13**	**7.60**	**0.47**	**7.90**	**8.11**	**0.21**
U34-S	**5.97**	**6.40**	**0.43**	**6.86**	**7.32**	**0.46**	**7.72**	**8.00**	**0.28**
U35-N	**5.97**	**6.40**	**0.43**	**6.86**	**7.31**	**0.45**	**7.72**	**8.00**	**0.28**
U35-S	**5.87**	**6.28**	**0.41**	**6.71**	**7.13**	**0.42**	**7.56**	**7.86**	**0.30**
U36-N	**5.87**	**6.28**	**0.41**	**6.71**	**7.13**	**0.42**	**7.56**	**7.86**	**0.30**
U36-S	**5.79**	**6.19**	**0.40**	**6.62**	**7.04**	**0.42**	**7.50**	**7.82**	**0.32**
U37-N	**5.78**	**6.19**	**0.41**	**6.62**	**7.04**	**0.42**	**7.50**	**7.82**	**0.32**
U37-S	**5.74**	**6.14**	**0.40**	**6.57**	**6.99**	**0.42**	**7.50**	**7.82**	**0.32**
U38-E	**5.97**	**6.40**	**0.43**	**6.86**	**7.31**	**0.45**	**7.72**	**8.00**	**0.28**
U38-W	**5.93**	**6.29**	**0.36**	**6.75**	**7.18**	**0.43**	**7.67**	**7.99**	**0.32**

XP-SWMM Model Junction	50-Year			100-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
U20-W	8.87	8.95	0.08	9.13	9.18	0.05
U21SW	8.87	8.95	0.08	9.13	9.18	0.05
U22A-SE	8.44	8.49	0.05	8.57	8.63	0.06
U22-NE	8.44	8.49	0.05	8.57	8.63	0.06
U23-E	9.19	9.24	0.05	9.41	9.42	0.01
U24-N	9.19	9.24	0.05	9.41	9.42	0.01
U24-S	9.10	9.14	0.04	9.33	9.34	0.01
U25-E	9.06	9.09	0.03	9.29	9.30	0.01
U25-W	9.10	9.14	0.04	9.33	9.34	0.01
U26-E	9.37	9.41	0.04	9.57	9.59	0.02
U26-W	9.05	9.09	0.04	9.29	9.30	0.01
U27-E	9.16	9.12	-0.04	9.37	9.29	-0.08
U27-W	9.36	9.41	0.05	9.57	9.59	0.02
U28-E	**8.18**	**8.20**	**0.02**	**8.42**	**8.37**	**-0.05**
U28-W	**8.30**	**8.37**	**0.07**	**8.53**	**8.55**	**0.02**
U29-N	8.08	8.20	0.12	8.31	8.37	0.06
U29-S	7.99	8.12	0.13	8.23	8.29	0.06
U2-N	8.17	8.32	0.15	8.40	8.52	0.12
U2-S	8.21	8.35	0.14	8.44	8.55	0.11
U30-N	**7.96**	**8.10**	**0.14**	**8.22**	**8.27**	**0.05**
U30-S	**7.90**	**8.03**	**0.13**	**8.16**	**8.20**	**0.04**
U31-W	**7.83**	**7.95**	**0.12**	**8.02**	**8.13**	**0.11**
U32-N	**7.88**	**8.00**	**0.12**	**8.07**	**8.18**	**0.11**
U32-S	**7.95**	**8.07**	**0.12**	**8.15**	**8.24**	**0.09**
U33-N	**7.95**	**8.07**	**0.12**	**8.15**	**8.24**	**0.09**
U33-S	**7.72**	**7.84**	**0.12**	**7.92**	**8.03**	**0.11**
U34-N	**8.17**	**8.30**	**0.13**	**8.37**	**8.44**	**0.07**
U34-S	**8.05**	**8.19**	**0.14**	**8.28**	**8.35**	**0.07**
U35-N	**8.05**	**8.19**	**0.14**	**8.28**	**8.35**	**0.07**
U35-S	**7.92**	**8.07**	**0.15**	**8.18**	**8.25**	**0.07**
U36-N	**7.92**	**8.07**	**0.15**	**8.18**	**8.25**	**0.07**
U36-S	**7.90**	**8.02**	**0.12**	**8.15**	**8.20**	**0.05**
U37-N	**7.89**	**8.02**	**0.13**	**8.15**	**8.20**	**0.05**
U37-S	**7.90**	**8.02**	**0.12**	**8.16**	**8.20**	**0.04**
U38-E	**8.05**	**8.19**	**0.14**	**8.28**	**8.35**	**0.07**
U38-W	**8.06**	**8.20**	**0.14**	**8.29**	**8.37**	**0.08**

XP-SWMM Model Junction	5-Year			10-Year			25-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
U39-NE	5.38	5.61	0.23	6.06	6.52	0.46	6.96	7.21	0.25
U39-SW	5.41	5.65	0.23	6.08	6.53	0.45	6.97	7.21	0.24
U3-N	5.55	5.67	0.12	6.10	6.51	0.41	7.91	8.11	0.20
U3-S	5.55	5.67	0.12	6.10	6.51	0.41	7.91	8.11	0.20
U40-N	5.32	5.55	0.23	5.98	6.42	0.44	6.85	7.12	0.27
U40-S	5.34	5.57	0.23	6.05	6.49	0.44	6.95	7.20	0.25
U41-E	5.11	5.32	0.21	5.64	5.95	0.31	6.43	6.71	0.28
U41-W	5.27	5.50	0.23	5.85	6.23	0.38	6.62	6.86	0.24
U4-E	5.52	5.64	0.12	6.08	6.50	0.42	7.91	8.11	0.20
U4-W	5.54	5.65	0.11	6.09	6.50	0.41	7.91	8.11	0.20
U5-E	5.49	5.61	0.12	6.06	6.50	0.44	7.91	8.11	0.20
U5-W	5.51	5.62	0.11	6.07	6.50	0.43	7.91	8.11	0.20
U6-E	5.38	5.49	0.11	5.96	6.44	0.48	7.93	8.10	0.17
U6-W	5.48	5.59	0.11	6.05	6.49	0.44	7.91	8.11	0.20
U-8S	5.36	5.48	0.12	5.96	6.45	0.49	7.91	8.11	0.20
U9-N	5.36	5.48	0.12	5.96	6.45	0.49	7.91	8.11	0.20
U9-S	5.41	5.48	0.07	5.95	6.44	0.49	7.93	8.10	0.17

XP-SWMM Model Junction	50-Year			100-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
U39-NE	7.24	7.37	0.13	7.43	7.53	0.10
U39-SW	7.24	7.37	0.13	7.43	7.53	0.10
U3-N	8.21	8.36	0.15	8.44	8.55	0.11
U3-S	8.22	8.36	0.14	8.45	8.56	0.11
U40-N	7.14	7.28	0.14	7.33	7.45	0.12
U40-S	7.24	7.36	0.12	7.43	7.53	0.10
U41-E	6.77	6.92	0.15	6.99	7.12	0.13
U41-W	6.89	7.02	0.13	7.08	7.19	0.11
U4-E	8.21	8.35	0.14	8.44	8.55	0.11
U4-W	8.21	8.35	0.14	8.44	8.55	0.11
U5-E	8.20	8.35	0.15	8.44	8.55	0.11
U5-W	8.21	8.35	0.14	8.44	8.55	0.11
U6-E	8.18	8.34	0.16	8.42	8.53	0.11
U6-W	8.20	8.35	0.15	8.44	8.55	0.11
U-8S	8.19	8.34	0.15	8.43	8.54	0.11
U9-N	8.19	8.34	0.15	8.43	8.54	0.11
U9-S	8.18	8.33	0.15	8.42	8.53	0.11

Appendix 5C

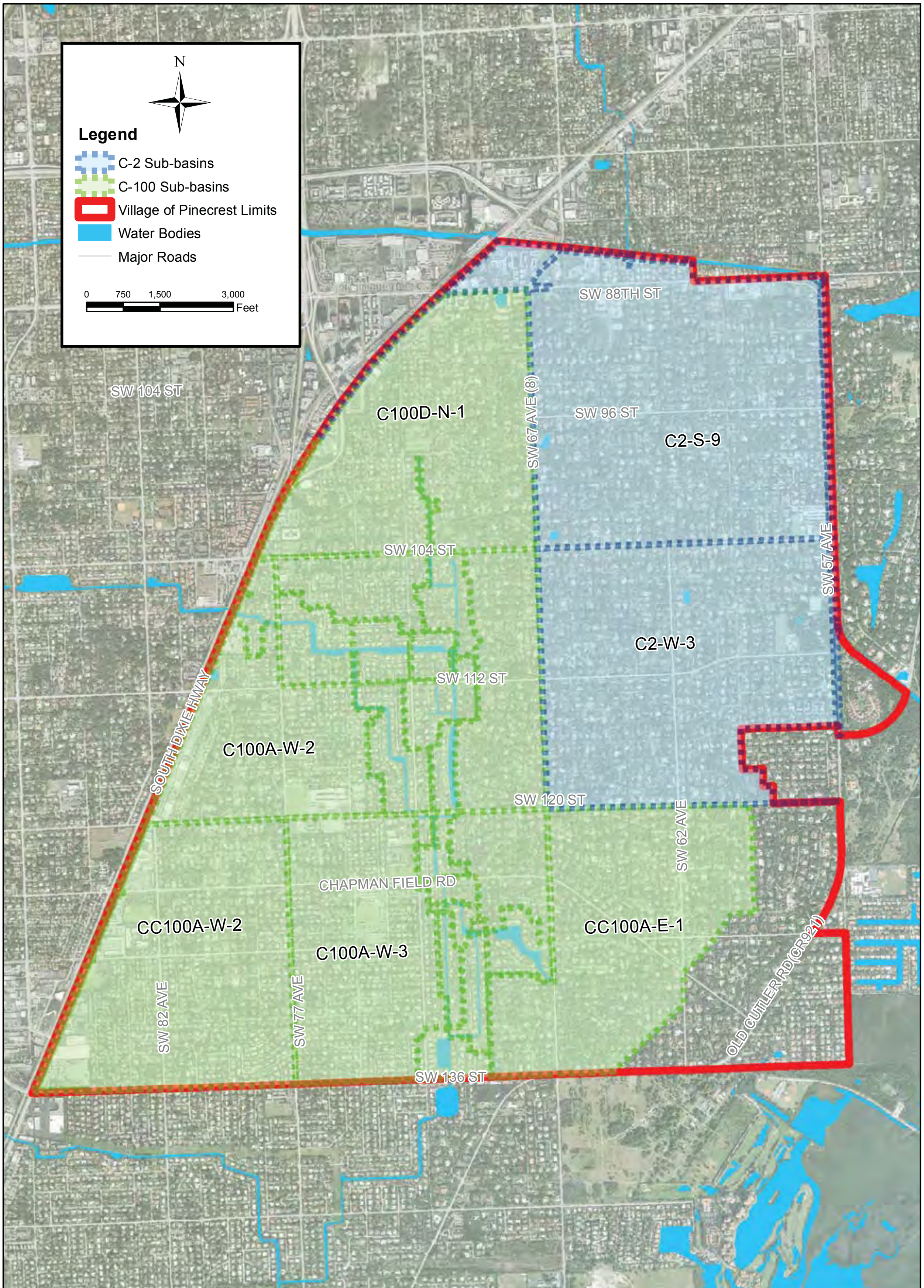
XP-SWMM Model Junction	5-Year			10-Year			25-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
57AVE-S	7.06	7.06	0.00	7.08	7.08	0.00	7.10	7.09	0.00
B49-E	4.22	4.13	-0.09	4.79	4.66	-0.14	6.27	5.93	-0.34
B49-W	4.22	4.13	-0.09	4.80	4.66	-0.14	6.28	5.94	-0.34
B50-E	4.21	4.11	-0.10	4.78	4.65	-0.13	6.25	5.89	-0.35
B50-W	4.21	4.11	-0.10	4.78	4.65	-0.14	6.25	5.90	-0.35
B53-N	4.13	4.02	-0.11	4.67	4.53	-0.14	5.98	5.57	-0.41
B53-S	4.13	4.02	-0.11	4.67	4.53	-0.14	5.98	5.57	-0.41
B54-N	4.02	3.89	-0.14	4.50	4.27	-0.23	5.64	5.11	-0.53
B54-S	4.02	3.89	-0.13	4.50	4.25	-0.25	5.63	5.10	-0.53
B55-N	3.93	3.72	-0.21	4.34	4.10	-0.24	5.28	4.60	-0.69
B55-S	3.93	3.71	-0.22	4.33	4.07	-0.27	5.28	4.59	-0.69
C2-C-22	4.23	4.14	-0.09	4.81	4.67	-0.14	6.30	5.96	-0.33
C2-C-23	4.21	4.12	-0.09	4.79	4.65	-0.13	6.26	5.91	-0.35
C2-C-24	4.20	4.11	-0.10	4.77	4.64	-0.13	6.23	5.88	-0.36
C2-C-25	4.16	4.07	-0.09	4.72	4.59	-0.13	6.10	5.73	-0.38
C2-C-26	4.08	3.96	-0.12	4.60	4.45	-0.14	5.85	5.40	-0.46
C2-E-5	6.41	6.42	0.01	6.52	6.53	0.01	6.59	6.59	0.00
C2-N-10	6.53	6.54	0.01	6.64	6.64	0.00	6.71	6.71	0.00
C2-N-9	5.97	5.98	0.01	6.04	6.05	0.01	6.11	6.10	-0.01
C2-S-9	6.27	6.28	0.01	6.38	6.39	0.01	6.46	6.46	0.00
C2-W-3	6.57	6.59	0.02	6.68	6.70	0.02	6.84	6.84	0.00
LG-C-13	4.23	4.14	-0.10	4.83	4.69	-0.14	6.32	5.98	-0.35
LG-C-14	4.20	4.10	-0.10	4.76	4.63	-0.14	6.22	5.86	-0.36
N-SC-LG	4.19	4.10	-0.10	4.76	4.62	-0.14	6.22	5.86	-0.36
S-22	3.84	3.60	-0.24	4.17	3.84	-0.34	4.93	4.25	-0.68
S22-outW	3.30	3.30	0.00	3.30	3.30	0.00	3.30	3.30	0.00
S22-Wet1	3.78	4.39	0.61	4.03	4.25	0.22	4.59	4.54	-0.05
S22-wet2	3.42	4.30	0.89	3.34	4.33	0.99	3.32	4.41	1.09
US1-N	10.20	10.20	0.00	10.25	10.25	0.00	10.29	10.29	0.00
US1-S	10.48	10.48	0.00	10.59	10.59	0.00	10.67	10.66	0.00
B21-W	7.34	7.41	0.07	7.78	8.04	0.26	8.84	8.84	0.00
B22-N	5.73	6.13	0.40	6.55	6.97	0.42	7.48	7.81	0.33
B22-S	5.73	6.12	0.39	6.54	6.97	0.43	7.48	7.80	0.32
B23-N	5.60	5.98	0.38	6.38	6.79	0.41	7.31	7.62	0.31
B23-S	5.57	5.96	0.39	6.35	6.77	0.42	7.29	7.60	0.31
C100A-1	5.88	6.29	0.41	6.75	7.18	0.43	7.67	7.99	0.32
C100A-2	5.74	6.14	0.40	6.57	6.99	0.42	7.50	7.82	0.32
C100A-3	5.72	6.12	0.40	6.54	6.96	0.42	7.47	7.80	0.33

XP-SWMM Model Junction	50-Year			100-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
57AVE-S	7.11	7.10	0.00	7.12	7.12	0.00
B49-E	6.77	6.42	-0.35	7.25	6.88	-0.37
B49-W	6.77	6.42	-0.35	7.25	6.88	-0.37
B50-E	6.73	6.38	-0.35	7.19	6.82	-0.37
B50-W	6.73	6.38	-0.35	7.19	6.82	-0.37
B53-N	6.37	5.97	-0.40	6.81	6.37	-0.44
B53-S	6.36	5.96	-0.40	6.81	6.36	-0.44
B54-N	5.98	5.42	-0.57	6.39	5.75	-0.64
B54-S	5.98	5.41	-0.57	6.39	5.74	-0.64
B55-N	5.59	4.84	-0.75	5.97	5.07	-0.91
B55-S	5.59	4.82	-0.76	5.97	5.06	-0.91
C2-C-22	6.79	6.45	-0.34	7.28	6.91	-0.36
C2-C-23	6.75	6.40	-0.35	7.22	6.85	-0.37
C2-C-24	6.71	6.36	-0.35	7.17	6.79	-0.38
C2-C-25	6.52	6.17	-0.36	6.95	6.58	-0.38
C2-C-26	6.23	5.77	-0.46	6.68	6.16	-0.53
C2-E-5	6.64	6.64	0.00	6.70	6.69	0.00
C2-N-10	6.76	6.75	0.00	6.81	6.81	0.00
C2-N-9	6.52	6.17	-0.35	6.95	6.58	-0.37
C2-S-9	6.52	6.49	-0.03	6.94	6.58	-0.36
C2-W-3	6.87	6.87	0.00	6.92	6.92	0.00
LG-C-13	6.81	6.46	-0.34	7.24	6.91	-0.33
LG-C-14	6.70	6.34	-0.36	7.15	6.77	-0.38
N-SC-LG	6.69	6.34	-0.35	7.15	6.77	-0.38
S-22	5.20	4.36	-0.84	5.52	4.42	-1.11
S22-outW	3.30	3.30	0.00	3.30	3.30	0.00
S22-Wet1	4.81	4.99	0.18	5.07	4.67	-0.40
S22-wet2	3.32	4.79	1.47	3.32	4.62	1.30
US1-N	10.30	10.29	0.00	10.34	10.34	0.00
US1-S	10.72	10.72	-0.01	10.80	10.79	-0.01
B21-W	9.23	9.10	-0.13	9.45	9.27	-0.18
B22-N	7.88	8.01	0.13	8.16	8.18	0.02
B22-S	7.88	8.01	0.13	8.14	8.18	0.04
B23-N	7.70	7.82	0.12	7.90	8.02	0.12
B23-S	7.69	7.80	0.11	7.88	8.01	0.13
C100A-1	8.08	8.20	0.12	8.31	8.37	0.06
C100A-2	7.90	8.02	0.12	8.16	8.20	0.04
C100A-3	7.87	8.00	0.13	8.06	8.18	0.12

XP-SWMM Model Junction	5-Year			10-Year			25-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
C100A-4	5.69	6.08	0.39	6.49	6.91	0.42	7.43	7.75	0.32
C100A-5	5.60	5.99	0.39	6.39	6.80	0.41	7.32	7.63	0.31
C100A-5A	5.60	5.99	0.39	6.39	6.80	0.41	7.32	7.64	0.32
C100A-E-1	7.67	7.69	0.02	7.71	7.73	0.02	7.78	7.97	0.19
C100A-E-2	6.13	6.61	0.48	7.21	7.62	0.41	7.82	7.99	0.17
C100A-W-2	8.67	8.67	0.00	8.72	8.73	0.01	8.81	8.85	0.04
C100A-W-3	7.68	7.69	0.01	7.74	7.75	0.01	7.84	7.89	0.05
C100D-1	5.97	6.40	0.43	6.86	7.31	0.45	7.72	8.00	0.28
C100D-E-1	7.89	7.90	0.01	7.93	7.95	0.02	7.98	8.01	0.03
C100D-N-1	6.17	6.63	0.46	7.16	7.62	0.46	7.93	8.21	0.28
C100D-W-1	7.50	7.50	0.00	7.54	7.55	0.01	7.67	7.99	0.32
CC100A-E-1	7.89	7.90	0.01	7.95	7.96	0.01	8.02	8.05	0.03
CC100A-W-2	9.94	9.96	0.02	9.99	10.01	0.02	10.07	10.10	0.03
U28-E	5.96	6.29	0.33	6.75	7.18	0.43	7.67	7.99	0.32
U28-W	6.00	6.36	0.36	6.84	7.28	0.44	7.78	8.13	0.35
U29-N	5.88	6.28	0.40	6.74	7.18	0.44	7.67	7.99	0.32
U29-S	5.80	6.21	0.41	6.65	7.08	0.43	7.58	7.91	0.33
U30-N	5.79	6.20	0.41	6.63	7.06	0.43	7.56	7.89	0.33
U30-S	5.75	6.15	0.40	6.57	7.00	0.43	7.50	7.82	0.32
U31-W	5.69	6.08	0.39	6.49	6.91	0.42	7.43	7.75	0.32
U32-N	5.72	6.12	0.40	6.54	6.96	0.42	7.47	7.80	0.33
U32-S	5.70	6.10	0.40	6.52	6.95	0.43	7.52	7.86	0.34
U33-N	5.70	6.10	0.40	6.52	6.95	0.43	7.52	7.86	0.34
U33-S	5.60	5.99	0.39	6.39	6.80	0.41	7.32	7.64	0.32
U34-N	6.15	6.61	0.46	7.13	7.60	0.47	7.90	8.11	0.21
U34-S	5.97	6.40	0.43	6.86	7.32	0.46	7.72	8.00	0.28
U35-N	5.97	6.40	0.43	6.86	7.31	0.45	7.72	8.00	0.28
U35-S	5.87	6.28	0.41	6.71	7.13	0.42	7.56	7.86	0.30
U36-N	5.87	6.28	0.41	6.71	7.13	0.42	7.56	7.86	0.30
U36-S	5.79	6.19	0.40	6.62	7.04	0.42	7.50	7.82	0.32
U37-N	5.78	6.19	0.41	6.62	7.04	0.42	7.50	7.82	0.32
U37-S	5.74	6.14	0.40	6.57	6.99	0.42	7.50	7.82	0.32
U38-W	5.93	6.29	0.36	6.75	7.18	0.43	7.67	7.99	0.32
U38-E	5.97	6.40	0.43	6.86	7.31	0.45	7.72	8.00	0.28

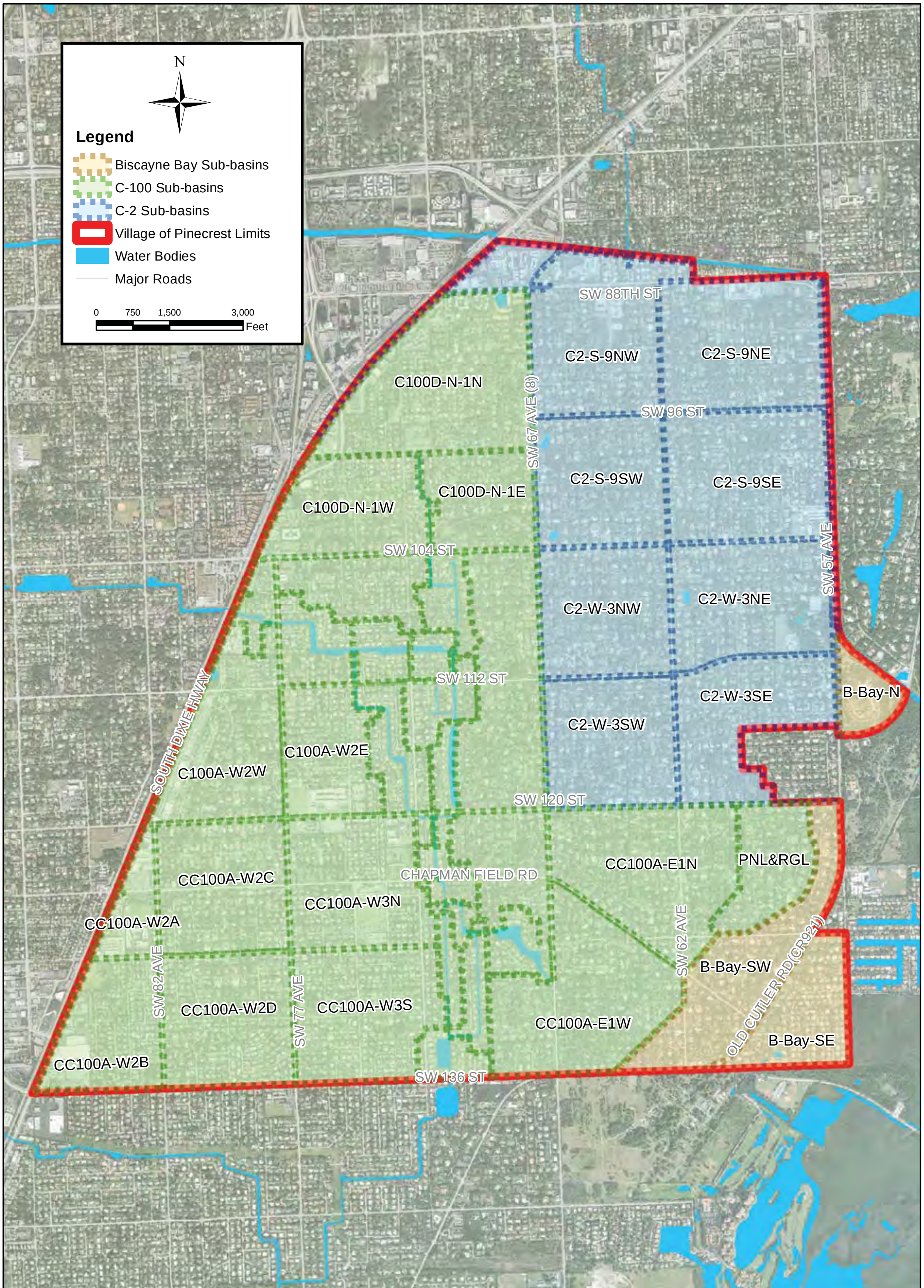
XP-SWMM Model Junction	50-Year			100-Year		
	Max Stage Original	Max Stage Converted	Stage Difference	Max Stage Original	Max Stage Converted	Stage Difference
C100A-4	7.83	7.95	0.12	8.02	8.13	0.11
C100A-5	7.72	7.84	0.12	7.91	8.03	0.12
C100A-5A	7.72	7.84	0.12	7.92	8.03	0.11
C100A-E-1	8.02	8.10	0.08	8.16	8.22	0.06
C100A-E-2	8.03	8.10	0.07	8.16	8.23	0.07
C100A-W-2	8.87	8.88	0.01	8.91	8.92	0.01
C100A-W-3	7.97	8.07	0.10	8.16	8.24	0.08
C100D-1	8.05	8.19	0.14	8.28	8.35	0.07
C100D-E-1	8.02	8.03	0.01	8.15	8.20	0.05
C100D-N-1	8.26	8.34	0.08	8.39	8.46	0.07
C100D-W-1	8.06	8.20	0.14	8.29	8.37	0.08
CC100A-E-1	8.07	8.11	0.04	8.17	8.23	0.06
CC100A-W-2	10.11	10.12	0.01	10.15	10.15	0.00
U28-E	8.18	8.20	0.02	8.42	8.37	-0.05
U28-W	8.30	8.37	0.07	8.53	8.55	0.02
U29-N	8.08	8.20	0.12	8.31	8.37	0.06
U29-S	7.99	8.12	0.13	8.23	8.29	0.06
U30-N	7.96	8.10	0.14	8.22	8.27	0.05
U30-S	7.90	8.03	0.13	8.16	8.20	0.04
U31-W	7.83	7.95	0.12	8.02	8.13	0.11
U32-N	7.88	8.00	0.12	8.07	8.18	0.11
U32-S	7.95	8.07	0.12	8.15	8.24	0.09
U33-N	7.95	8.07	0.12	8.15	8.24	0.09
U33-S	7.72	7.84	0.12	7.92	8.03	0.11
U34-N	8.17	8.30	0.13	8.37	8.44	0.07
U34-S	8.05	8.19	0.14	8.28	8.35	0.07
U35-N	8.05	8.19	0.14	8.28	8.35	0.07
U35-S	7.92	8.07	0.15	8.18	8.25	0.07
U36-N	7.92	8.07	0.15	8.18	8.25	0.07
U36-S	7.90	8.02	0.12	8.15	8.20	0.05
U37-N	7.89	8.02	0.13	8.15	8.20	0.05
U37-S	7.90	8.02	0.12	8.16	8.20	0.04
U38-E	8.05	8.19	0.14	8.28	8.35	0.07
U38-W	8.06	8.20	0.14	8.29	8.37	0.08

Appendix 5D



Appendix 5D
Original Sub-Basin Delineation
Village of Pinecrest

Appendix 5E



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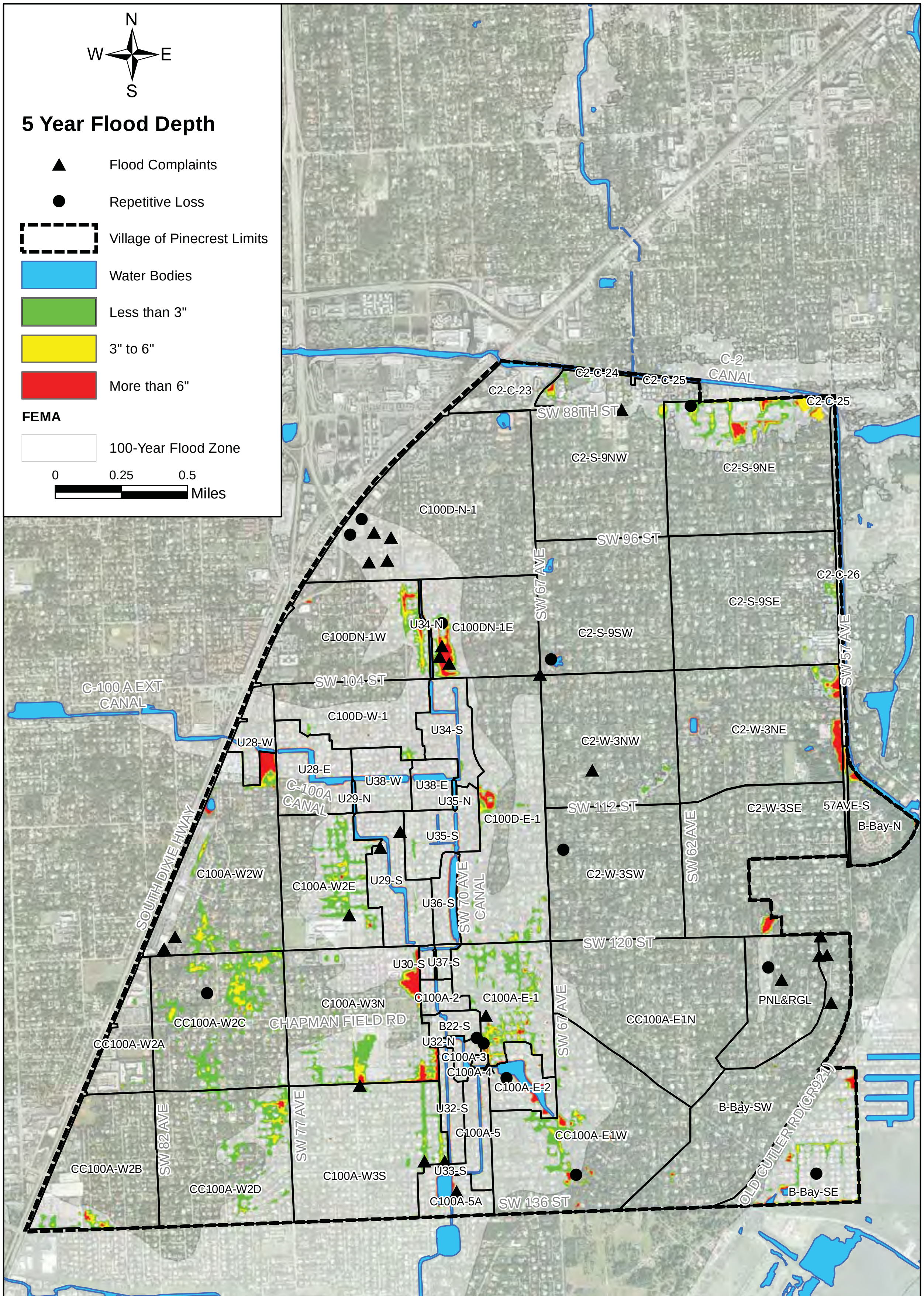
Appendix 5E
Refined Sub-Basin Delineation
Village of Pinecrest

Village of PINECREST FLORIDA

Appendix 5F



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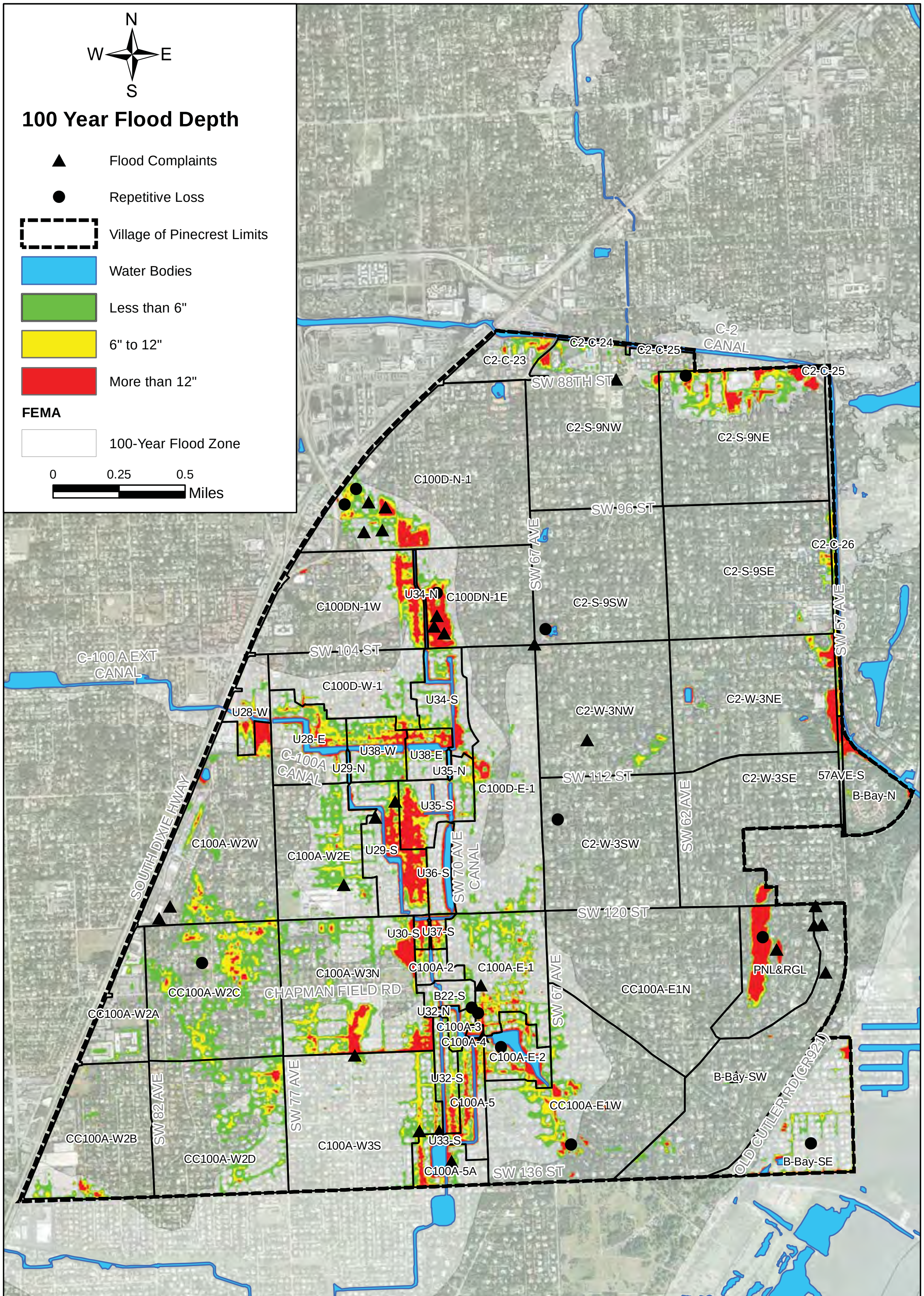
Appendix 5F
Model Validation 5-Year, 24-Hour & Flood Complaints
Village of Pinecrest Stormwater Master Plan

Village of PINECREST FLORIDA



Appendix 5F

Model Validation 100-Year, 72-Hour & Flood Complaints

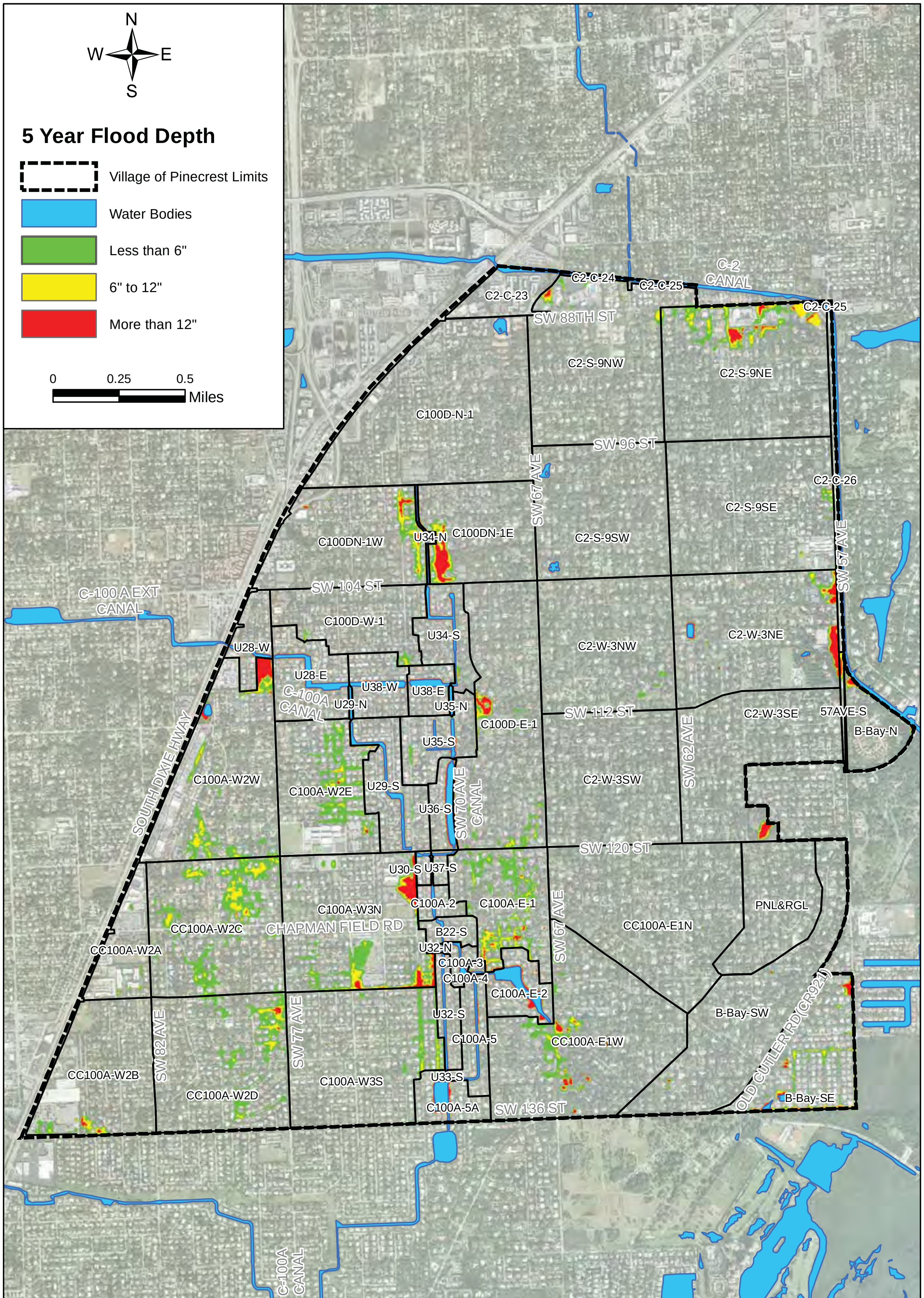
Village of Pinecrest Stormwater Master Plan

Appendix 5G

Sub-Basin Name	Maximum Stage (feet)				
	5-Year, 24-Hour	10-Year, 24-Hour	25-Year, 72-Hour	50-Year, 72-Hour	100-Year, 72-Hour
B22-S	5.62	6.53	7.65	7.85	8.04
57AVE-S	6.36	6.43	7.03	7.08	7.11
B-Bay-N	5.28	5.93	7.03	7.08	7.11
B-Bay-SE	6.84	6.87	6.94	6.96	6.98
B-Bay-SW	9.41	9.55	9.82	9.89	9.97
C100A-2	5.63	6.56	7.67	7.86	8.05
C100A-3	5.61	6.53	7.64	7.84	8.03
C100A-4	5.59	6.49	7.60	7.80	7.99
C100A-5	5.52	6.40	7.50	7.70	7.91
C100A-5A	5.52	6.39	7.50	7.70	7.90
C100A-E-1	7.82	7.87	7.94	8.00	8.13
C100A-E-2	5.83	6.98	7.90	8.01	8.13
C100A-W2E	8.55	8.59	8.68	8.70	8.73
C100A-W2W	10.13	10.19	10.34	10.39	10.42
C100A-W3N	9.04	9.19	9.61	9.66	9.72
C100A-W3S	7.56	7.61	7.72	7.85	8.03
C100D-E-1	7.90	7.95	8.01	8.03	8.07
C100D-N-1	5.92	7.10	8.07	8.24	8.36
C100DN-1E	7.37	7.90	8.08	8.24	8.36
C100DN-1W	7.64	8.14	8.38	8.44	8.48
C100D-W-1	7.50	7.55	7.87	8.06	8.24
C2-C-23	3.98	4.49	5.79	6.30	6.81
C2-C-24	3.96	4.47	5.75	6.25	6.75
C2-C-25	3.92	4.39	5.59	6.04	6.51
C2-C-26	3.81	4.29	5.27	5.64	6.06
C2-S-9NE	5.80	5.99	6.13	6.20	6.29
C2-S-9NW	5.82	6.01	6.17	6.24	6.34
C2-S-9SE	5.69	5.85	6.07	6.15	6.25
C2-S-9SW	6.01	6.14	6.25	6.30	6.38
C2-W-3NE	6.20	6.38	6.50	6.56	6.64
C2-W-3NW	6.44	6.61	6.83	6.91	7.01
C2-W-3SE	6.21	6.39	6.59	6.68	6.81
C2-W-3SW	6.31	6.47	6.69	6.78	6.90
CC100A-E1N	8.29	8.37	8.47	8.51	8.54
CC100A-E1W	7.67	7.75	7.91	8.01	8.13
CC100A-W2A	9.78	9.86	10.02	10.06	10.11
CC100A-W2B	9.66	9.73	9.86	9.89	9.93
CC100A-W2C	9.78	9.86	10.02	10.06	10.11
CC100A-W2D	9.66	9.73	9.85	9.89	9.93
LG-C-14	3.95	4.46	5.73	6.24	6.73
PNL&RGL	4.20	8.71	9.08	9.21	9.40
U28-E	5.77	6.75	7.87	8.06	8.24
U28-W	5.85	6.87	8.03	8.25	8.45
U29-N	5.76	6.75	7.87	8.05	8.23
U29-S	5.69	6.64	7.75	7.95	8.13
U30-S	5.64	6.56	7.67	7.87	8.05
U32-N	5.61	6.53	7.64	7.84	8.03
U32-S	5.56	6.46	7.63	7.83	8.02
U33-S	7.07	7.07	7.50	7.70	7.91
U34-N	5.91	7.09	8.03	8.16	8.33
U34-S	5.82	6.85	7.90	8.06	8.24
U35-N	5.82	6.85	7.90	8.06	8.23

Sub-Basin Name	Maximum Stage (feet)				
	5-Year, 24-Hour	10-Year, 24-Hour	25-Year, 72-Hour	50-Year, 72-Hour	100-Year, 72-Hour
U35-S	5.75	6.72	7.75	7.93	8.13
U36-S	5.68	6.62	7.68	7.87	8.07
U37-S	5.63	6.56	7.67	7.86	8.05
U38-E	5.82	6.85	7.90	8.06	8.23
U38-W	5.77	6.75	7.87	8.06	8.24

Appendix 5H



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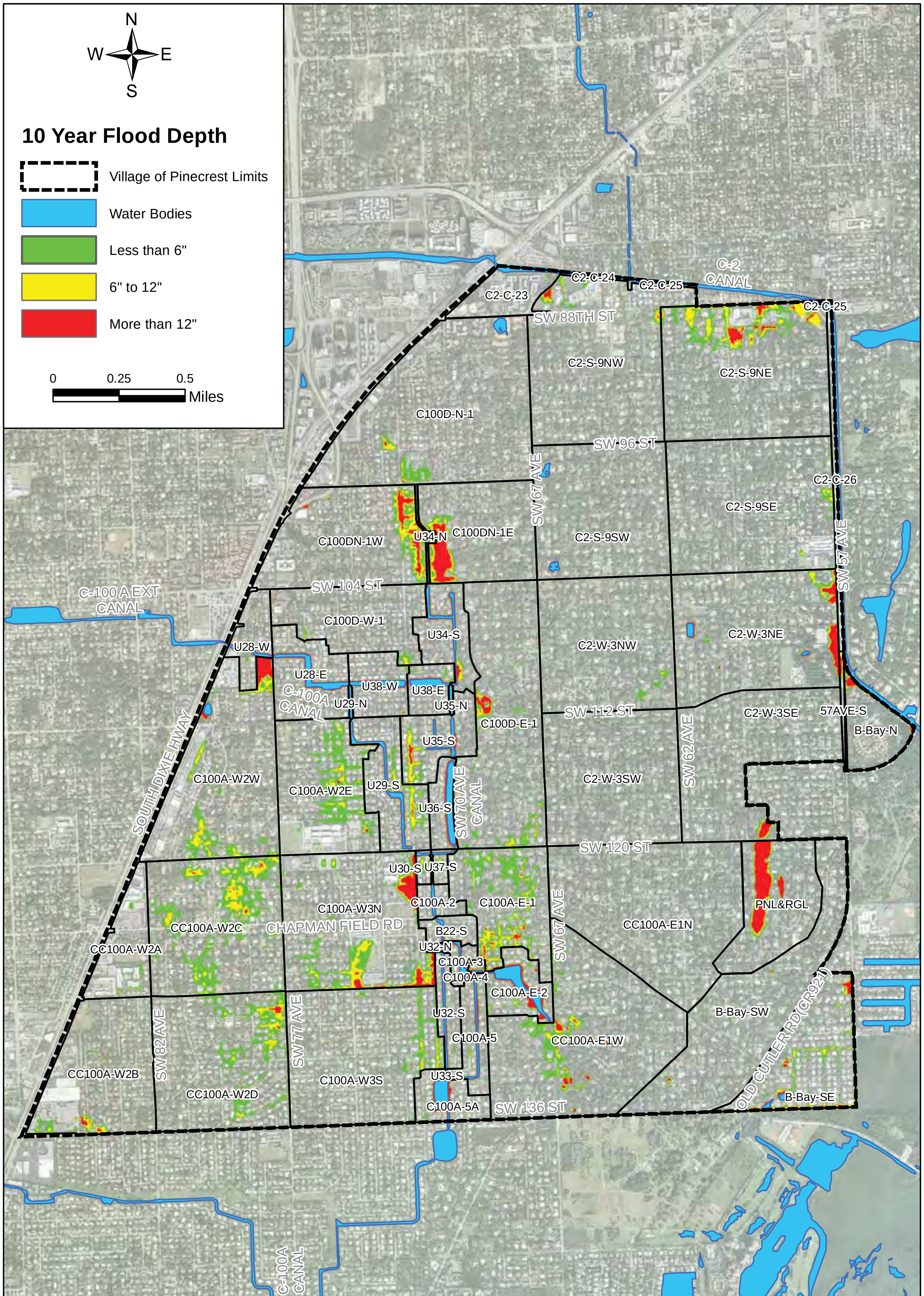
Appendix 5H
5-Year, 24-Hour Flood Plain Map
Village of Pinecrest Stormwater Master Plan

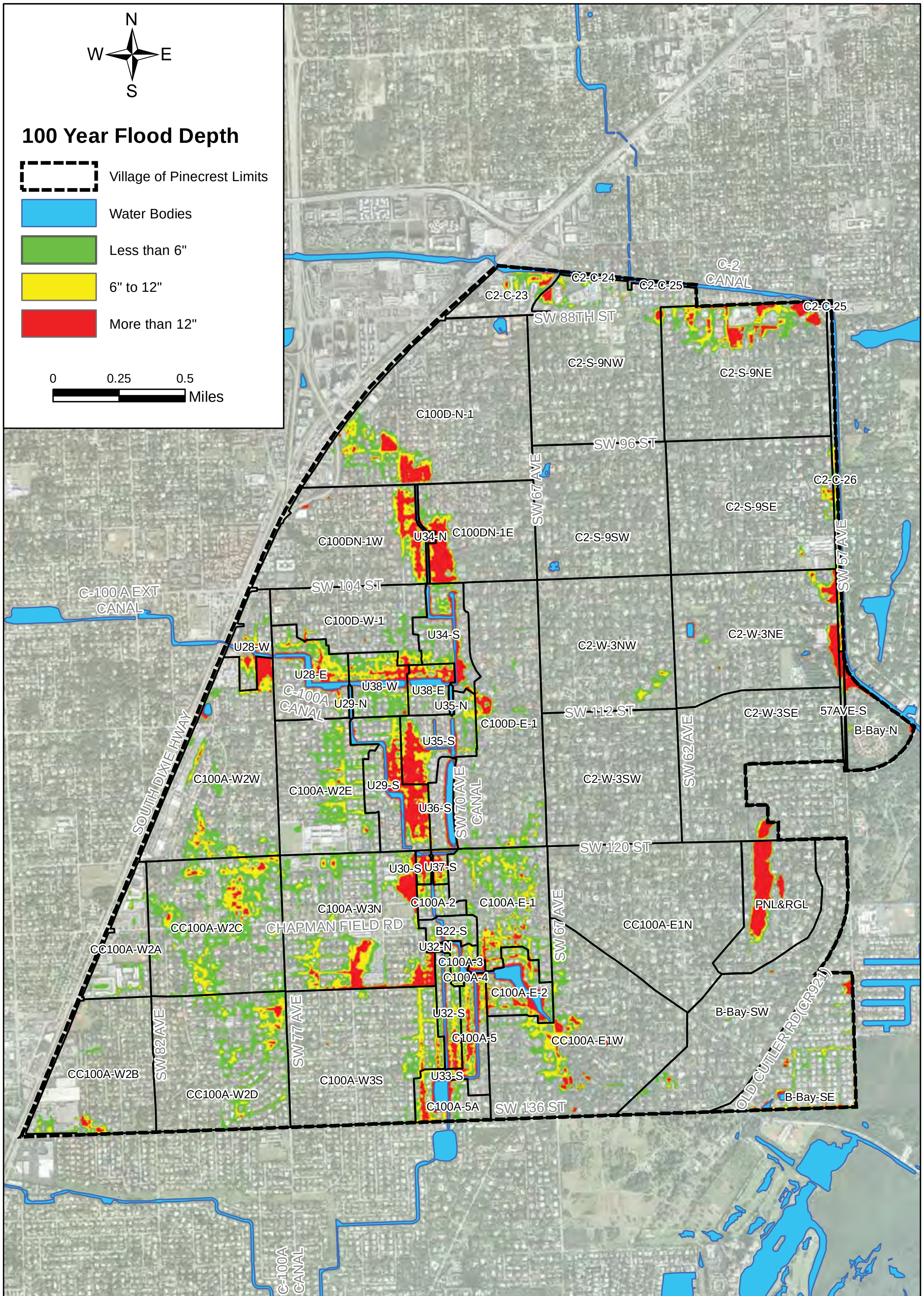
village of PINECREST FLORIDA



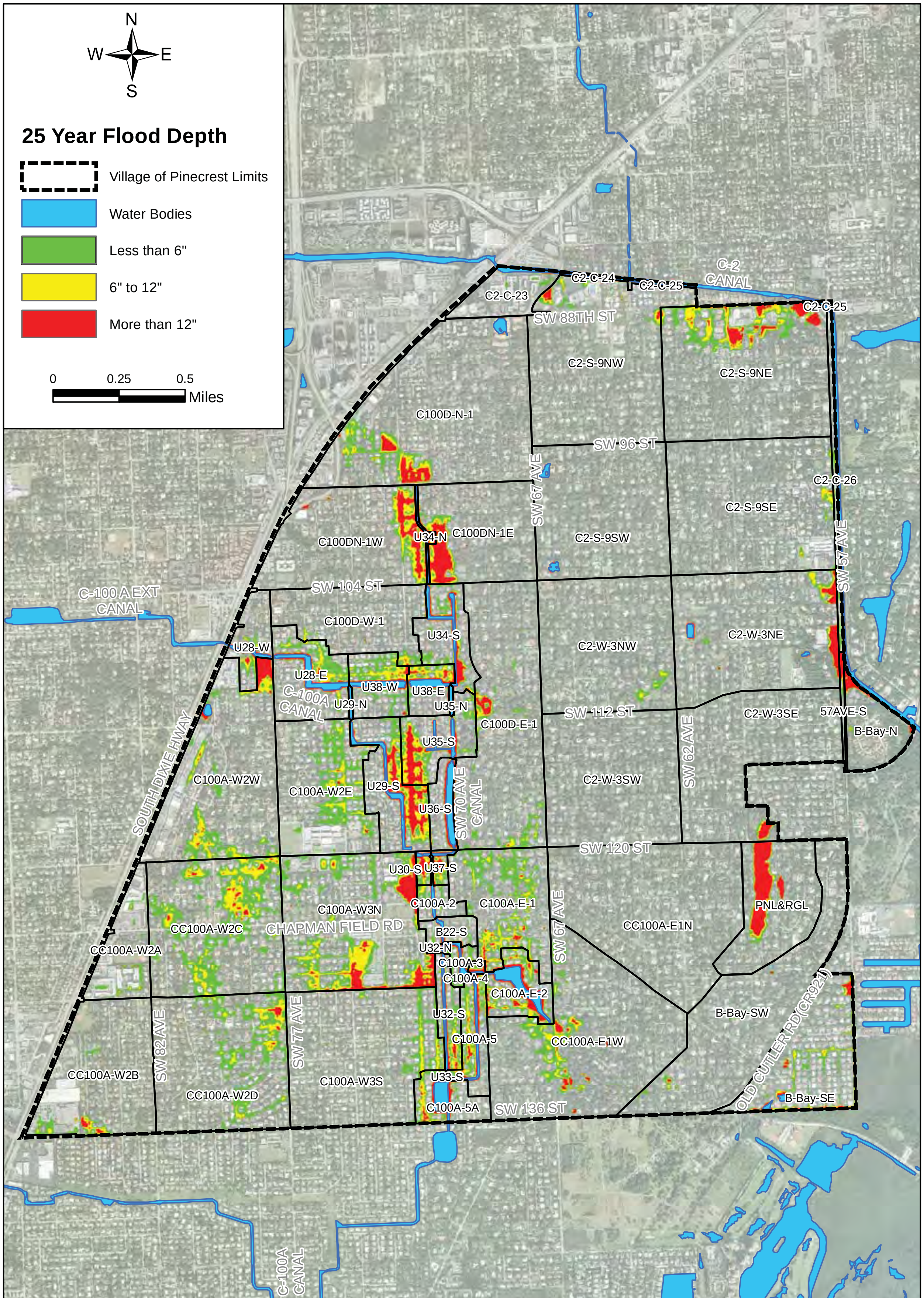
A·D·A ENGINEERING

Appendix 5H
10-Year, 24-Hour Flood Plain Map
Village of Pinecrest Stormwater Master Plan

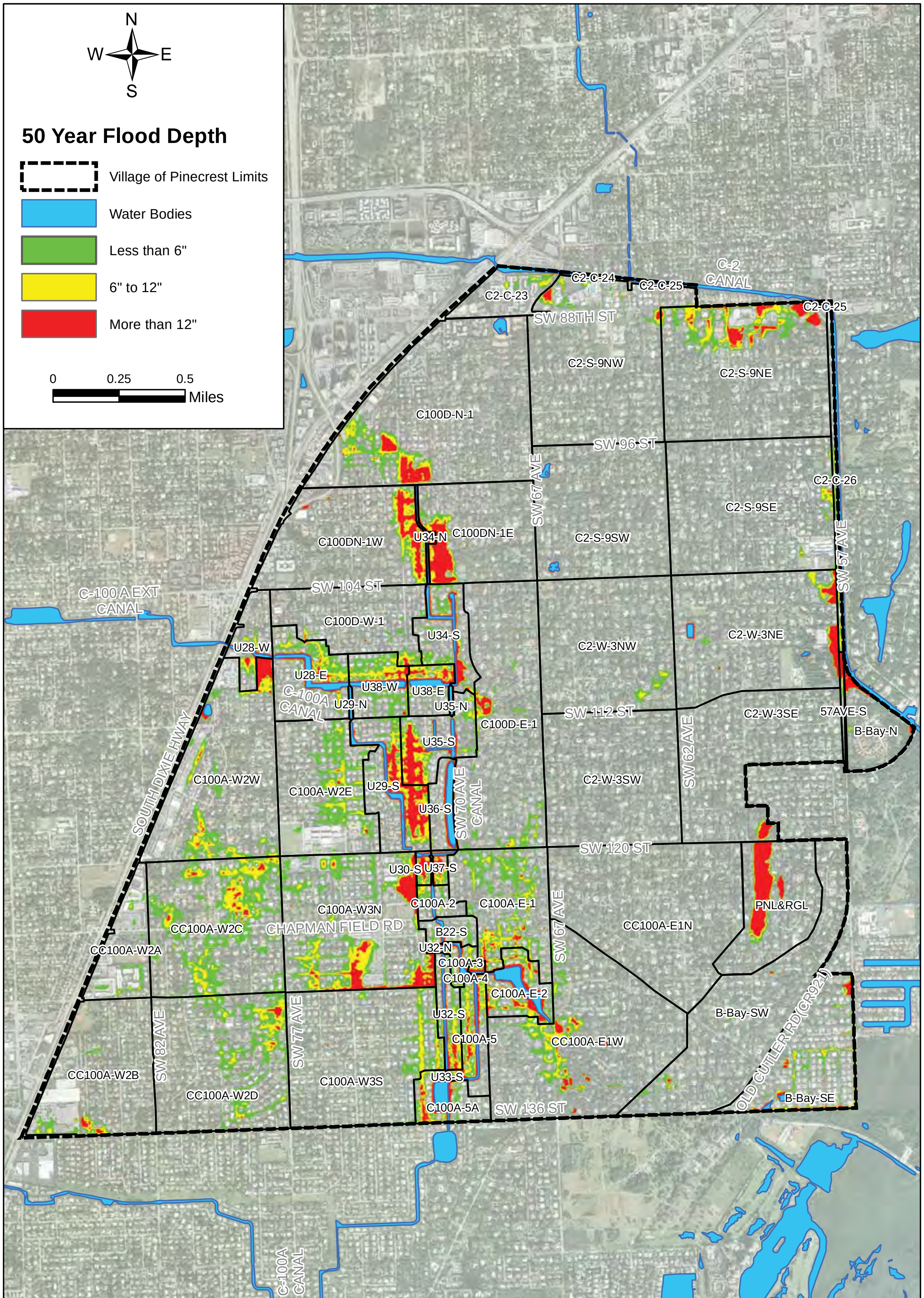
village of PINECREST FLORIDA



Appendix 5H
100-Year, 72-Hour Flood Plain Map
Village of Pinecrest Stormwater Master Plan



Appendix 5H
25-Year, 72-Hour Flood Plain Map
Village of Pinecrest Stormwater Master Plan



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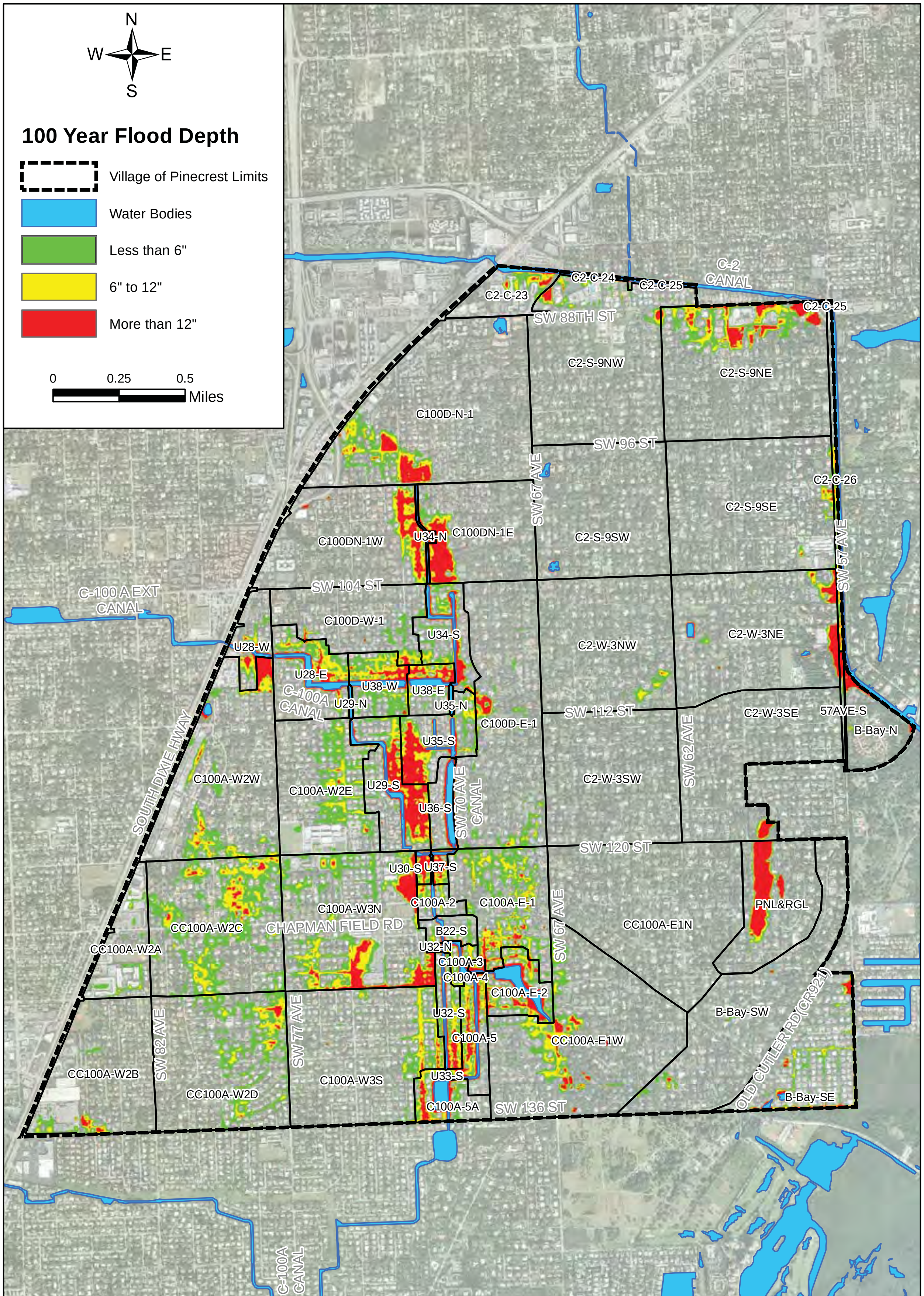
Appendix 5H
50-Year, 72-Hour Flood Plain Map
Village of Pinecrest Stormwater Master Plan

village of PINECREST FLORIDA



Appendix 5H
100-Year, 72-Hour Flood Plain Map
Village of Pinecrest Stormwater Master Plan

Appendix 5I

SUB-BASIN	REMOVAL FRACTION - RMAX VALUE PER POLLUTANT AT EACH SUB-BASIN											
	BOD5	COD	TSS	TDS	TN	TKN	TP	DP	Cd	Cu	Pb	Zn
57AVE-S	48%	48%	48%	0%	41%	40%	39%	33%	56%	49%	71%	55%
B21-W	5%	5%	5%	0%	5%	5%	4%	4%	4%	12%	4%	5%
B22-N	1%	1%	1%	0%	1%	1%	1%	1%	0%	4%	0%	1%
B23-N	28%	24%	24%	0%	24%	24%	24%	22%	27%	27%	27%	27%
B-Bay-N	48%	48%	48%	0%	41%	40%	39%	33%	56%	49%	71%	55%
B-Bay-SE	80%	69%	69%	0%	67%	68%	68%	61%	76%	76%	76%	76%
B-Bay-SW	80%	69%	69%	0%	67%	68%	68%	61%	76%	76%	76%	76%
C100A-1	9%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
C100A-2	1%	1%	1%	0%	1%	1%	1%	1%	1%	1%	1%	1%
C100A-3	5%	4%	4%	0%	4%	4%	4%	4%	5%	5%	5%	5%
C100A-4	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
C100A-5	5%	5%	5%	0%	5%	5%	5%	4%	5%	5%	5%	5%
C100A-E-1	70%	60%	60%	0%	59%	60%	60%	54%	67%	67%	67%	67%
C100A-E-2	27%	23%	23%	0%	23%	23%	23%	21%	26%	26%	26%	26%
C100A-W2E	61%	54%	54%	0%	51%	51%	52%	46%	58%	59%	58%	58%
C100A-W2W	61%	54%	54%	0%	51%	51%	52%	46%	58%	59%	58%	58%
C100A-W3N	61%	54%	54%	0%	51%	51%	52%	46%	58%	59%	58%	58%
C100A-W3S	61%	54%	54%	0%	51%	51%	52%	46%	58%	59%	58%	58%
C100D-1	36%	21%	21%	0%	20%	20%	21%	18%	23%	23%	23%	23%
C100D-E-1	81%	69%	69%	0%	68%	69%	69%	63%	77%	77%	77%	77%
C100D-N-1	81%	74%	75%	0%	70%	70%	71%	62%	78%	78%	78%	78%
C100DN-1E	81%	74%	75%	0%	70%	70%	71%	62%	78%	78%	78%	78%
C100DN-1W	81%	74%	75%	0%	70%	70%	71%	62%	78%	78%	78%	78%
C100D-W-1	79%	72%	74%	0%	66%	67%	69%	58%	77%	77%	77%	77%
C2-C-23	82%	82%	82%	0%	70%	70%	74%	57%	78%	82%	79%	80%
C2-C-24	96%	96%	96%	0%	93%	93%	94%	81%	89%	89%	96%	89%
C2-C-25	87%	87%	87%	0%	86%	87%	84%	76%	68%	88%	73%	81%
C2-C-26	41%	41%	41%	0%	41%	41%	35%	34%	35%	66%	38%	46%
C2-E-5	74%	74%	74%	0%	69%	69%	70%	60%	70%	76%	59%	71%
C2-S-9NE	63%	63%	63%	0%	61%	61%	63%	56%	59%	59%	24%	59%
C2-S-9NW	63%	63%	63%	0%	61%	61%	63%	56%	59%	59%	24%	59%
C2-S-9SE	63%	63%	63%	0%	61%	61%	63%	56%	59%	59%	24%	59%
C2-S-9SW	63%	63%	63%	0%	61%	61%	63%	56%	59%	59%	24%	59%
C2-W-3NE	78%	78%	78%	0%	71%	72%	74%	62%	75%	75%	62%	75%
C2-W-3NW	78%	78%	78%	0%	71%	72%	74%	62%	75%	75%	62%	75%
C2-W-3SE	78%	78%	78%	0%	71%	72%	74%	62%	75%	75%	62%	75%
C2-W-3SW	78%	78%	78%	0%	71%	72%	74%	62%	75%	75%	62%	75%
CC100A-E1N	80%	69%	69%	0%	67%	68%	68%	61%	76%	76%	76%	76%
CC100A-E1W	80%	69%	69%	0%	67%	68%	68%	61%	76%	76%	76%	76%
CC100A-W2A	80%	71%	72%	0%	68%	68%	69%	61%	77%	77%	77%	77%
CC100A-W2B	80%	71%	72%	0%	68%	68%	69%	61%	77%	77%	77%	77%
CC100A-W2C	80%	71%	72%	0%	68%	68%	69%	61%	77%	77%	77%	77%
CC100A-W2D	80%	71%	72%	0%	68%	68%	69%	61%	77%	77%	77%	77%

SUB-BASIN	REMOVAL FRACTION - RMAX VALUE PER POLLUTANT AT EACH SUB-BASIN											
	BOD5	COD	TSS	TDS	TN	TKN	TP	DP	Cd	Cu	Pb	Zn
LG-C-14	76%	76%	76%	0%	78%	78%	75%	70%	65%	82%	62%	73%
U36-N	30%	25%	25%	0%	25%	25%	25%	23%	28%	28%	28%	28%
US1-S	25%	25%	25%	0%	25%	26%	32%	23%	29%	30%	15%	26%

Appendix 5J

SUB-BASIN NAME	WATER QUALITY 5-YEAR STORM EVENT SIMULATION (lb)												TOTAL / SUB-BASIN
	BOD5	COD	TSS	TDS	TN	TKN	TP	DP	Cd	Cu	Pb	Zn	
57AVE-S	14.7	77.8	66.1	172.8	1.6	1.6	0.4	0.2	0.0	0.0	0.1	0.1	**335.6**
B-Bay-N	71.0	361.6	284.4	809.1	8.0	8.0	2.4	1.0	0.0	0.1	0.5	0.5	**1546.4**
C2-C-23	123.2	903.9	668.0	1598.3	14.6	14.6	2.9	1.8	0.1	0.5	1.6	1.6	**3331.1**
C2-C-24	6.3	44.5	37.5	93.3	1.0	1.0	0.2	0.1	0.0	0.1	0.1	0.1	**184.0**
C2-C-26	113.3	672.4	575.4	1461.6	14.4	14.4	3.2	1.6	0.0	0.8	1.0	1.0	**2859.4**
C2-S-9NE	238.1	1212.5	978.8	2733.7	26.5	26.5	7.8	3.3	0.1	0.4	1.6	1.6	**5230.9**
C2-S-9NW	224.9	1144.2	921.5	2579.4	24.9	24.9	7.4	3.1	0.1	0.4	1.5	1.5	**4933.8**
C2-S-9SE	224.9	1148.6	925.9	2579.4	25.1	25.1	7.4	3.1	0.1	0.4	1.5	1.5	**4943.1**
C2-S-9SW	186.1	945.8	762.8	2125.2	20.7	20.7	6.1	2.6	0.0	0.3	1.3	1.3	**4072.8**
C2-W-3NE	217.4	1091.3	892.9	2447.1	24.0	24.0	7.1	3.0	0.0	0.4	1.4	1.4	**4710.1**
C2-W-3NW	186.5	945.8	756.2	2096.6	20.7	20.7	6.1	2.6	0.0	0.3	1.2	1.2	**4038.0**
C2-W-3SE	251.3	1274.3	1018.5	2821.9	28.0	28.0	8.2	3.4	0.1	0.5	1.7	1.7	**5437.5**
C2-W-3SW	196.7	992.1	806.9	2226.6	21.7	21.7	6.4	2.7	0.0	0.4	1.3	1.3	**4277.8**
US1-S	60.6	522.5	304.2	780.4	7.7	7.7	1.5	1.0	0.1	0.3	0.9	0.9	**1687.8**
B21-W	346.1	1810.0	1481.5	4056.5	39.5	39.5	11.1	4.8	0.1	0.9	2.5	2.5	**7794.9**
B22-N	87.1	436.5	348.3	992.1	9.8	9.8	2.9	1.2	0.0	0.2	0.6	0.6	**1889.1**
B23-N	170.6	848.8	676.8	1933.4	19.1	19.1	5.8	2.4	0.0	0.3	1.1	1.1	**3678.5**
B-BAY-SE	357.1	1821.0	1428.6	4056.5	40.1	40.1	11.9	5.0	0.1	0.6	2.4	2.4	**7765.8**
B-BAY-SW	754.0	3769.9	2998.3	8553.8	84.7	84.7	25.4	10.5	0.2	1.4	4.8	4.8	**16292.2**
C100A-1	308.6	1541.0	1230.2	3505.3	34.6	34.6	10.4	4.3	0.1	0.6	2.0	2.0	**6673.6**
C100A-2	69.7	346.1	275.6	789.2	7.8	7.8	2.3	1.0	0.0	0.1	0.4	0.4	**1500.5**
C100A-3	74.7	370.4	295.4	846.6	8.4	8.4	2.5	1.0	0.0	0.1	0.5	0.5	**1608.4**
C100A-4	12.3	61.1	48.7	138.9	1.4	1.4	0.4	0.2	0.0	0.0	0.1	0.1	**264.5**
C100A-5	192.9	959.0	765.0	2184.8	21.6	21.6	6.5	2.7	0.0	0.3	1.2	1.2	**4156.8**
C100A-E-1	390.2	1942.3	1552.0	4431.2	43.7	43.7	13.1	5.4	0.1	0.7	2.5	2.5	**8427.3**
C100A-E-2	182.8	908.3	725.3	2070.1	20.4	20.4	6.2	2.5	0.0	0.3	1.2	1.2	**3938.7**
C100A-W2E	394.6	2162.7	1915.8	4717.8	41.7	41.7	11.1	5.3	0.1	0.7	3.3	3.3	**9298.2**
C100A-W2W	582.0	3174.6	2821.9	6944.5	61.3	61.3	16.3	7.8	0.2	1.1	4.9	4.9	**13680.7**
C100A-W3N	668.0	3373.0	2755.8	7650.0	74.1	74.1	21.9	9.2	0.2	1.2	4.5	4.5	**14636.3**
C100A-W3S	687.8	3461.2	2821.9	7848.4	76.1	76.1	22.5	9.5	0.2	1.2	4.6	4.6	**15013.9**

SUB-BASIN NAME	WATER QUALITY 5-YEAR STORM EVENT SIMULATION (lb)												TOTAL / SUB-BASIN
	BOD5	COD	TSS	TDS	TN	TKN	TP	DP	Cd	Cu	Pb	Zn	
C100D-1	379.19	1915.80	1556.45	4343.06	67.90	42.11	12.43	5.22	0.09	0.72	3.22	2.54	**8328.7**
C100D-E-1	769.41	3813.96	3042.35	8708.17	137.79	85.98	25.79	10.67	0.17	1.37	5.93	4.87	**16606.5**
C100D-N-1	610.67	3262.81	2799.84	7187.00	109.13	66.58	18.21	8.29	0.16	1.37	6.72	4.76	**14075.5**
C100DN-1E	260.14	1386.69	1188.28	3064.39	46.52	28.44	7.78	3.53	0.07	0.59	2.82	2.02	**5991.3**
C100DN-1W	335.10	1781.32	1523.38	3924.19	59.74	36.60	9.99	4.52	0.09	0.76	3.62	2.58	**7681.9**
C100D-W-1	403.44	2037.05	1649.04	4607.61	72.31	44.97	13.32	5.58	0.09	0.72	3.42	2.67	**8840.2**
CC100A-E1N	551.15	2733.70	2193.58	6261.06	98.99	61.73	18.56	7.65	0.12	0.99	4.25	3.51	**11935.3**
CC100A-E1W	522.49	2601.43	2078.94	5930.37	93.92	58.64	17.61	7.25	0.11	0.94	4.03	3.33	**11319.1**
CC100A-W2A	116.84	645.95	582.01	1404.33	20.46	12.17	3.17	1.55	0.04	0.22	1.64	1.01	**2789.4**
CC100A-W2B	235.89	1287.49	1139.78	2821.89	41.45	24.91	6.66	3.15	0.07	0.45	3.09	1.97	**5566.8**
CC100A-W2C	321.87	1783.52	1602.74	3880.10	56.44	33.51	8.75	4.28	0.10	0.61	4.54	2.80	**7699.3**
CC100A-W2D	381.40	2098.78	1880.52	4563.52	66.80	39.68	10.43	5.05	0.12	0.72	5.27	3.28	**9055.6**
U36-N	227.07	1126.55	899.48	2557.34	40.56	25.35	7.63	3.15	0.05	0.40	1.75	1.44	**4890.8**
	12508.2	**64798.0**	**53276.6**	**144497.6**	**1735.0**	**1383.7**	**397.7**	**172.0**	**3.1**	**24.8**	**102.4**	**88.8**	**278988.1**

SUB-BASIN NAME	WATER QUALITY 10-YEAR STORM EVENT SIMULATION (lb)												TOTAL / SUB-BASIN
	BOD5	COD	TSS	TDS	TN	TKN	TP	DP	Cd	Cu	Pb	Zn	
57AVE-S	37.7	200.0	171.1	443.1	4.1	4.1	1.1	0.5	0.0	0.1	0.3	0.3	**862.3**
B-Bay-N	101.6	518.1	407.9	1157.4	11.4	11.4	3.4	1.4	0.0	0.2	0.7	0.7	**2214.2**
C2-C-23	306.4	2129.6	1675.5	3924.2	34.2	34.2	7.2	4.3	0.2	0.9	3.7	3.7	**8124.0**
C2-C-24	8.4	60.0	49.8	124.3	1.3	1.3	0.2	0.1	0.0	0.1	0.1	0.1	**245.7**
C2-C-26	159.8	939.2	804.7	2096.6	20.2	20.2	4.6	2.3	0.0	1.1	1.5	1.5	**4051.5**
C2-S-9NE	388.0	1968.7	1585.1	4431.2	43.2	43.2	12.8	5.4	0.1	0.7	2.6	2.6	**8483.6**
C2-S-9NW	366.0	1858.5	1496.9	4188.7	40.8	40.8	12.1	5.1	0.1	0.7	2.4	2.4	**8014.4**
C2-S-9SE	368.2	1865.1	1501.3	4210.8	41.0	41.0	12.1	5.1	0.1	0.7	2.4	2.4	**8050.2**
C2-S-9SW	304.2	1547.6	1245.6	3483.3	34.0	34.0	10.0	4.2	0.1	0.5	2.0	2.0	**6667.6**
C2-W-3NE	542.3	2733.7	2226.6	6150.8	60.0	60.0	17.7	7.4	0.1	1.0	3.6	3.6	**11806.8**
C2-W-3NW	474.0	2425.1	1918.0	5357.2	53.1	53.1	15.6	6.5	0.1	0.9	3.2	3.2	**10310.0**
C2-W-3SE	628.3	3196.7	2535.3	7098.8	70.1	70.1	20.7	8.7	0.1	1.2	4.2	4.2	**13638.3**
C2-W-3SW	491.6	2491.2	2019.4	5577.6	54.5	54.5	16.0	6.7	0.1	0.9	3.3	3.3	**10719.1**
US1-S	80.2	690.0	403.4	1034.0	10.2	10.2	2.0	1.3	0.1	0.3	1.2	1.2	**2234.2**
B21-W	436.5	2292.8	1869.5	5114.7	49.6	49.6	14.0	6.1	0.1	1.2	3.1	3.1	**9840.2**
B22-N	110.7	555.6	445.3	1263.2	12.5	12.5	3.7	1.5	0.0	0.2	0.7	0.7	**2406.7**
B23-N	216.5	1075.8	859.8	2447.1	24.3	24.3	7.3	3.0	0.0	0.4	1.4	1.4	**4661.2**
B-BAY-SE	445.3	2270.7	1779.1	5048.5	50.0	50.0	14.8	6.2	0.1	0.8	3.0	3.0	**9671.6**
B-BAY-SW	1036.2	5158.8	4122.6	11750.5	116.2	116.2	34.8	14.4	0.2	1.9	6.6	6.6	**22364.9**
C100A-1	396.8	1973.1	1578.5	4497.4	44.5	44.5	13.3	5.5	0.1	0.7	2.5	2.5	**8559.6**
C100A-2	88.6	440.9	352.7	1005.3	9.9	9.9	3.0	1.2	0.0	0.2	0.6	0.6	**1912.9**
C100A-3	96.6	480.6	383.6	1093.5	10.8	10.8	3.3	1.3	0.0	0.2	0.6	0.6	**2081.9**
C100A-4	15.5	77.2	61.5	175.7	1.7	1.7	0.5	0.2	0.0	0.0	0.1	0.1	**334.3**
C100A-5	246.9	1221.3	976.6	2777.8	27.6	27.6	8.3	3.4	0.1	0.4	1.6	1.6	**5293.1**
C100A-E-1	498.2	2469.2	1979.7	5643.8	55.8	55.8	16.7	6.9	0.1	0.9	3.2	3.2	**10733.4**
C100A-E-2	233.7	1159.6	925.9	2645.5	26.0	26.0	7.8	3.2	0.1	0.4	1.5	1.5	**5031.3**
C100A-W2E	518.1	2821.9	2491.2	6172.9	54.7	54.7	14.5	6.9	0.2	1.0	4.3	4.3	**12144.6**
C100A-W2W	758.4	4144.6	3681.7	9060.9	80.0	80.0	21.3	10.1	0.2	1.4	6.3	6.3	**17851.5**
C100A-W3N	866.4	4387.2	3571.5	9898.7	96.1	96.1	28.4	11.9	0.2	1.6	5.8	5.8	**18969.6**
C100A-W3S	890.7	4497.4	3659.6	10185.3	98.8	98.8	29.1	12.3	0.2	1.6	5.9	5.9	**19485.5**

SUB-BASIN NAME	WATER QUALITY 10-YEAR STORM EVENT SIMULATION (lb)												TOTAL / SUB-BASIN
	BOD5	COD	TSS	TDS	TN	TKN	TP	DP	Cd	Cu	Pb	Zn	
C100D-1	478.40	2425.06	1970.91	5489.45	85.98	53.35	15.72	6.61	0.11	0.91	4.08	3.20	**10533.8**
C100D-E-1	961.21	4783.98	3813.96	10890.72	172.18	107.58	32.41	13.32	0.21	1.71	7.43	6.08	**20790.8**
C100D-N-1	813.50	4343.06	3725.77	9545.92	145.06	88.40	24.25	11.00	0.21	1.82	8.95	6.33	**18714.3**
C100DN-1E	346.12	1847.45	1578.49	4078.51	61.95	37.92	10.41	4.72	0.09	0.79	3.75	2.69	**7972.9**
C100DN-1W	443.12	2358.92	2019.41	5202.86	79.37	48.50	13.29	6.02	0.12	1.01	4.78	3.44	**10180.8**
C100D-W-1	511.47	2579.38	2085.55	5842.19	91.49	56.88	16.87	7.05	0.12	0.91	4.32	3.37	**11199.6**
CC100A-E1N	720.90	3593.50	2865.98	8179.07	129.41	80.69	24.25	10.01	0.16	1.30	5.58	4.59	**15615.4**
CC100A-E1W	696.65	3461.22	2777.80	7892.47	125.00	78.04	23.37	9.68	0.15	1.25	5.38	4.43	**15075.4**
CC100A-W2A	156.09	866.41	780.43	1878.32	27.34	16.23	4.21	2.07	0.05	0.29	2.23	1.37	**3735.0**
CC100A-W2B	313.05	1704.16	1510.15	3725.77	54.89	32.85	8.77	4.17	0.09	0.59	4.10	2.60	**7361.2**
CC100A-W2C	462.97	2579.38	2336.88	5577.64	80.91	48.06	12.35	6.13	0.15	0.87	6.72	4.10	**11116.2**
CC100A-W2D	513.67	2843.93	2557.34	6172.88	89.95	53.57	13.98	6.81	0.16	0.97	7.21	4.45	**12264.9**
U36-N	286.60	1428.58	1141.98	3262.81	51.59	32.19	9.68	3.99	0.06	0.51	2.23	1.82	**6222.0**
	17815.7	**92465.1**	**75944.3**	**205797.4**	**2431.6**	**1970.7**	**565.9**	**245.0**	**4.4**	**35.1**	**145.0**	**126.7**	**397547.0**

SUB-BASIN NAME	WATER QUALITY 25-YEAR STORM EVENT SIMULATION (lb)												TOTAL / SUB-BASIN
	BOD5	COD	TSS	TDS	TN	TKN	TP	DP	Cd	Cu	Pb	Zn	
57AVE-S	97.4	518.1	443.1	1144.2	10.5	10.5	2.9	1.3	0.0	0.2	0.8	0.8	**2229.8**
B-Bay-N	182.8	930.3	731.9	2076.7	20.5	20.5	6.1	2.5	0.0	0.3	1.2	1.2	**3974.2**
C2-C-23	771.6	5246.9	4232.8	9788.4	84.0	84.0	17.9	10.8	0.4	2.0	9.1	9.1	**20257.0**
C2-C-24	13.6	98.3	80.7	201.5	2.1	2.1	0.4	0.2	0.0	0.2	0.2	0.2	**399.4**
C2-C-26	273.4	1589.5	1358.0	3659.6	34.2	34.2	8.0	3.9	0.0	1.8	2.4	2.4	**6967.4**
C2-S-9NE	758.4	3836.0	3086.4	8642.0	84.4	84.4	24.9	10.5	0.2	1.4	5.0	5.0	**16538.7**
C2-S-9NW	716.5	3637.6	2910.1	8179.1	79.8	79.8	23.6	9.9	0.2	1.3	4.8	4.8	**15647.3**
C2-S-9SE	718.7	3637.6	2932.1	8201.1	80.0	80.0	23.8	10.0	0.2	1.3	4.8	4.8	**15694.3**
C2-S-9SW	599.7	3020.3	2425.1	6834.3	66.8	66.8	19.8	8.3	0.1	1.1	4.0	4.0	**13050.1**
C2-W-3NE	1360.2	6856.3	5599.7	15476.3	150.8	150.8	44.3	18.7	0.3	2.6	9.1	9.1	**29678.1**
C2-W-3NW	1203.7	6150.8	4872.2	13668.5	134.9	134.9	39.7	16.7	0.3	2.2	8.1	8.1	**26240.1**
C2-W-3SE	1580.7	8068.8	6371.3	17923.4	176.8	176.8	52.2	21.9	0.4	2.9	10.6	10.6	**34396.4**
C2-W-3SW	1234.6	6239.0	5092.6	14043.3	136.9	136.9	40.3	17.0	0.3	2.3	8.2	8.2	**26959.7**
US1-S	127.2	1093.5	639.3	1638.0	16.2	16.2	3.1	2.1	0.1	0.5	1.9	1.9	**3540.0**
B21-W	751.8	3968.3	3262.8	8840.4	85.5	85.5	23.8	10.5	0.2	2.1	5.5	5.5	**17041.9**
B22-N	185.6	930.3	745.2	2116.4	20.9	20.9	6.2	2.6	0.0	0.4	1.2	1.2	**4031.0**
B23-N	374.8	1858.5	1483.7	4232.8	41.9	41.9	12.6	5.2	0.1	0.7	2.4	2.4	**8056.8**
B-BAY-SE	862.0	4387.2	3439.2	9788.4	96.8	96.8	28.7	12.0	0.2	1.5	5.7	5.7	**18724.1**
B-BAY-SW	2039.3	10163.2	8112.9	23148.3	229.3	229.3	68.6	28.2	0.4	3.7	13.0	13.0	**44049.2**
C100A-1	718.7	3571.5	2866.0	8135.0	80.5	80.5	24.3	10.0	0.2	1.3	4.6	4.6	**15496.9**
C100A-2	150.6	747.4	597.4	1704.2	16.8	16.8	5.1	2.1	0.0	0.3	1.0	1.0	**3242.6**
C100A-3	165.3	822.3	657.0	1871.7	18.5	18.5	5.6	2.3	0.0	0.3	1.0	1.0	**3563.6**
C100A-4	26.0	129.9	103.6	295.4	2.9	2.9	0.9	0.4	0.0	0.0	0.2	0.2	**562.3**
C100A-5	412.3	2054.7	1640.2	4673.8	46.3	46.3	13.9	5.7	0.1	0.7	2.6	2.6	**8899.2**
C100A-E-1	930.3	4629.7	3703.7	10560.0	104.3	104.3	31.3	12.9	0.2	1.7	5.9	5.9	**20090.3**
C100A-E-2	401.2	1990.8	1591.7	4541.5	44.8	44.8	13.5	5.6	0.1	0.7	2.5	2.5	**8639.6**
C100A-W2E	1119.9	6172.9	5489.5	13448.1	117.7	117.7	31.1	14.9	0.3	2.1	9.6	9.6	**26533.4**
C100A-W2W	1690.9	9325.5	8311.3	20304.4	177.2	177.2	46.5	22.5	0.5	3.2	14.5	14.5	**40088.3**
C100A-W3N	1946.7	9810.5	7958.6	22266.5	216.1	216.1	63.9	26.9	0.4	3.5	12.9	12.9	**42534.9**
C100A-W3S	2004.0	10097.1	8201.1	22927.8	222.7	222.7	65.9	27.6	0.5	3.6	13.3	13.3	**43799.4**

SUB-BASIN NAME	WATER QUALITY 25-YEAR STORM EVENT SIMULATION (lb)												TOTAL / SUB-BASIN
	BOD5	COD	TSS	TDS	TN	TKN	TP	DP	Cd	Cu	Pb	Zn	
C100D-1	892.9	4497.4	3659.6	10207.3	160.1	99.4	29.3	12.3	0.2	1.7	7.5	5.9	**19573.7**
C100D-E-1	1726.2	8575.9	6856.3	19532.8	308.6	192.9	58.0	23.8	0.4	3.1	13.3	10.9	**37302.2**
C100D-N-1	1913.6	10251.4	8840.4	22486.9	339.5	207.0	56.2	25.8	0.5	4.2	21.7	15.1	**44162.4**
C100DN-1E	767.2	4100.6	3505.3	8994.8	136.7	83.3	22.7	10.4	0.2	1.7	8.4	6.0	**17637.3**
C100DN-1W	996.5	5335.1	4585.6	11728.5	177.7	108.5	29.5	13.5	0.3	2.2	11.1	7.8	**22996.2**
C100D-W-1	1058.2	5313.1	4299.0	12059.2	189.2	117.5	35.1	14.6	0.2	1.9	8.8	6.9	**23103.7**
CC100A-E1N	1408.7	7010.6	5599.7	15961.3	253.5	157.6	47.4	19.5	0.3	2.5	10.9	8.9	**30481.1**
CC100A-E1W	1358.0	6746.1	5401.3	15388.1	242.5	151.9	45.6	18.8	0.3	2.4	10.5	8.6	**29374.2**
CC100A-W2A	399.0	2248.7	2054.7	4850.1	69.7	41.0	10.4	5.2	0.1	0.8	6.1	3.6	**9689.4**
CC100A-W2B	712.1	3946.2	3527.4	8553.8	125.0	74.5	19.5	9.5	0.2	1.3	9.9	6.2	**16985.6**
CC100A-W2C	1331.6	7561.8	6966.5	16247.9	231.5	136.5	34.2	17.5	0.4	2.5	20.9	12.3	**32563.6**
CC100A-W2D	1349.2	7583.8	6922.4	16358.1	235.9	138.9	35.3	17.8	0.4	2.5	20.3	12.2	**32677.0**
U36-N	502.6	2491.2	1995.2	5687.9	90.2	56.2	16.9	7.0	0.1	0.9	3.9	3.2	**10855.2**
	37833.7	**197244.5**	**163152.7**	**438387.8**	**5160.2**	**4165.4**	**1188.8**	**518.6**	**9.6**	**73.6**	**319.1**	**273.5**	**848327.6**

SUB-BASIN NAME	WATER QUALITY 50-YEAR STORM EVENT SIMULATION (lb)												TOTAL / SUB-BASIN
	BOD5	COD	TSS	TDS	TN	TKN	TP	DP	Cd	Cu	Pb	Zn	
57AVE-S	113.3	601.9	515.9	1331.6	12.2	12.2	3.4	1.5	0.0	0.2	0.9	0.9	**2594.0**
B-Bay-N	210.1	1071.4	842.2	2381.0	23.6	23.6	7.0	2.9	0.1	0.4	1.4	1.4	**4565.0**
C2-C-23	899.5	6106.7	4938.3	11419.8	97.7	97.7	20.8	12.5	0.5	2.2	10.6	10.6	**23616.9**
C2-C-24	15.4	111.3	91.5	229.3	2.4	2.4	0.4	0.2	0.0	0.2	0.2	0.2	**453.5**
C2-C-26	304.2	1776.9	1519.0	4100.6	38.1	38.1	8.9	4.4	0.1	2.0	2.7	2.7	**7797.7**
C2-S-9NE	875.2	4431.2	3549.4	9986.8	97.4	97.4	28.9	12.1	0.2	1.6	5.8	5.8	**19092.0**
C2-S-9NW	828.9	4188.7	3373.0	9457.7	92.4	92.4	27.3	11.5	0.2	1.5	5.5	5.5	**18084.7**
C2-S-9SE	831.1	4210.8	3373.0	9479.8	92.6	92.6	27.6	11.5	0.2	1.5	5.5	5.5	**18131.7**
C2-S-9SW	694.4	3527.4	2821.9	7936.6	77.4	77.4	22.9	9.6	0.2	1.3	4.6	4.6	**15178.2**
C2-W-3NE	1600.5	8068.8	6591.8	18210.0	177.5	177.5	52.2	22.0	0.4	3.0	10.7	10.7	**34925.0**
C2-W-3NW	1422.0	7253.1	5732.0	16115.6	159.2	159.2	47.0	19.7	0.3	2.6	9.5	9.5	**30929.6**
C2-W-3SE	1860.7	9501.8	7517.7	21098.0	208.3	208.3	61.5	25.8	0.4	3.4	12.5	12.5	**40511.0**
C2-W-3SW	1455.0	7341.3	5974.5	16556.5	161.2	161.2	47.4	20.0	0.3	2.7	9.7	9.7	**31739.5**
US1-S	140.2	1205.9	705.5	1807.8	17.9	17.9	3.4	2.3	0.1	0.6	2.1	2.1	**3905.7**
B21-W	824.5	4343.1	3571.5	9678.2	93.7	93.7	26.2	11.5	0.2	2.2	6.0	6.0	**18656.8**
B22-N	202.6	1016.3	813.5	2314.8	22.9	22.9	6.8	2.8	0.0	0.4	1.3	1.3	**4405.8**
B23-N	410.1	2034.8	1627.0	4629.7	45.9	45.9	13.8	5.7	0.1	0.7	2.6	2.6	**8818.8**
B-BAY-SE	954.6	4872.2	3814.0	10846.6	107.1	107.1	31.7	13.3	0.2	1.7	6.3	6.3	**20761.3**
B-BAY-SW	2314.8	11486.0	9171.1	26234.7	257.9	257.9	77.6	32.0	0.5	4.3	14.7	14.7	**49866.2**
C100A-1	791.5	3946.2	3152.6	8994.8	88.8	88.8	26.7	11.0	0.2	1.5	5.0	5.0	**17112.1**
C100A-2	164.7	817.9	652.6	1865.1	18.4	18.4	5.5	2.3	0.0	0.3	1.0	1.0	**3547.3**
C100A-3	181.7	903.9	720.9	2056.9	20.3	20.3	6.1	2.5	0.0	0.3	1.2	1.2	**3915.3**
C100A-4	28.4	141.5	113.1	321.9	3.2	3.2	1.0	0.4	0.0	0.1	0.2	0.2	**613.1**
C100A-5	451.9	2248.7	1792.3	5114.7	50.5	50.5	15.2	6.3	0.1	0.8	2.9	2.9	**9736.7**
C100A-E-1	1034.0	5158.8	4122.6	11728.5	116.0	116.0	34.8	14.4	0.2	1.9	6.6	6.6	**22340.2**
C100A-E-2	438.7	2180.3	1741.6	4960.4	49.2	49.2	14.8	6.1	0.1	0.8	2.8	2.8	**9446.7**
C100A-W2E	1267.6	6966.5	6217.0	15189.7	132.9	132.9	35.1	16.9	0.4	2.4	10.8	10.8	**29983.0**
C100A-W2W	1907.0	10515.9	9391.6	22927.8	200.0	200.0	52.5	25.4	0.6	3.6	16.4	16.4	**45257.0**
C100A-W3N	2195.8	11067.1	8994.8	25132.4	244.7	244.7	72.3	30.2	0.5	3.9	14.5	14.5	**48015.5**
C100A-W3S	2270.7	11397.8	9237.3	25793.8	251.3	251.3	74.3	31.1	0.5	4.0	15.0	15.0	**49342.1**

SUB-BASIN NAME	WATER QUALITY 50-YEAR STORM EVENT SIMULATION (lb)												TOTAL / SUB-BASIN
	BOD5	COD	TSS	TDS	TN	TKN	TP	DP	Cd	Cu	Pb	Zn	
C100D-1	987.7	4982.4	4034.4	11287.6	177.0	109.8	32.4	13.6	0.2	1.9	8.3	6.6	**21641.8**
C100D-E-1	1902.6	9457.7	7561.8	21561.0	341.7	213.0	64.2	26.5	0.4	3.4	14.7	12.1	**41158.9**
C100D-N-1	2167.1	11596.2	10008.9	25573.4	385.8	233.7	63.7	29.3	0.6	4.7	24.5	17.1	**50105.0**
C100DN-1E	870.8	4651.7	3990.3	10251.4	155.6	95.0	26.0	11.8	0.2	2.0	9.6	6.8	**20071.3**
C100DN-1W	1133.2	6040.6	5202.9	13315.8	201.9	123.2	33.7	15.3	0.3	2.5	12.5	8.8	**26090.9**
C100D-W-1	1177.3	5930.4	4784.0	13426.0	210.8	131.0	39.0	16.3	0.3	2.1	9.8	7.7	**25734.6**
CC100A-E1N	1596.1	7936.6	6349.2	18077.7	286.6	178.6	53.8	22.0	0.3	2.9	12.3	10.1	**34526.3**
CC100A-E1W	1536.6	7650.0	6106.7	17416.3	275.6	172.2	51.8	21.3	0.3	2.8	11.9	9.7	**33255.2**
CC100A-W2A	449.7	2535.3	2314.8	5467.4	78.5	46.3	11.7	5.9	0.1	0.9	6.9	4.1	**10921.6**
CC100A-W2B	806.9	4453.3	3990.3	9678.2	141.5	84.4	22.0	10.7	0.2	1.5	11.2	7.0	**19207.4**
CC100A-W2C	1503.5	8531.8	7870.4	18364.3	262.3	153.9	38.4	19.8	0.5	2.8	23.6	14.0	**36785.3**
CC100A-W2D	1525.6	8575.9	7826.3	18496.6	266.8	157.2	39.9	20.1	0.5	2.9	22.9	13.8	**36948.4**
U36-N	553.4	2755.8	2193.6	6261.1	99.0	61.7	18.6	7.7	0.1	1.0	4.3	3.5	**11959.6**
	42899.8	**223592.1**	**184912.6**	**497077.8**	**5843.9**	**4720.6**	**1348.4**	**588.0**	**10.9**	**83.4**	**361.3**	**310.1**	**961748.7**

SUB-BASIN NAME	WATER QUALITY 100-YEAR STORM EVENT SIMULATION (lb)												TOTAL / SUB-BASIN
	BOD5	COD	TSS	TDS	TN	TKN	TP	DP	Cd	Cu	Pb	Zn	
57AVE-S	136.7	725.3	621.7	1607.2	14.7	14.7	4.1	1.9	0.0	0.3	1.1	1.1	**3128.7**
B-Bay-N	253.5	1291.9	1016.3	2888.0	28.4	28.4	8.5	3.5	0.1	0.5	1.7	1.7	**5522.5**
C2-C-23	1086.9	7363.4	5974.5	13778.8	117.7	117.7	25.1	15.1	0.6	2.7	12.7	12.7	**28507.9**
C2-C-24	18.3	131.8	108.2	271.2	2.8	2.8	0.5	0.3	0.0	0.2	0.2	0.2	**536.6**
C2-C-26	352.7	2056.9	1757.1	4761.9	44.3	44.3	10.4	5.1	0.1	2.3	3.2	3.2	**9041.3**
C2-S-9NE	1060.4	5357.2	4321.0	12103.3	118.2	118.2	35.1	14.7	0.2	1.9	7.0	7.0	**23144.1**
C2-S-9NW	1005.3	5092.6	4100.6	11463.9	112.0	112.0	33.3	13.9	0.2	1.8	6.7	6.7	**21949.0**
C2-S-9SE	1009.7	5114.7	4100.6	11508.0	112.4	112.4	33.3	14.0	0.2	1.8	6.7	6.7	**22020.5**
C2-S-9SW	846.6	4276.9	3439.2	9656.1	94.4	94.4	28.0	11.7	0.2	1.5	5.6	5.6	**18460.2**
C2-W-3NE	1959.9	9898.7	8068.8	22266.5	217.4	217.4	63.9	26.9	0.4	3.7	13.1	13.1	**42749.7**
C2-W-3NW	1743.8	8906.6	7054.7	19775.3	195.3	195.3	57.5	24.3	0.4	3.2	11.7	11.7	**37979.8**
C2-W-3SE	2292.8	11662.3	9215.2	25793.8	255.7	255.7	75.4	31.7	0.5	4.2	15.3	15.3	**49618.1**
C2-W-3SW	1781.3	8994.8	7341.3	20282.3	197.5	197.5	58.2	24.5	0.4	3.3	11.9	11.9	**38905.0**
US1-S	159.8	1375.7	804.7	2061.3	20.4	20.4	3.9	2.6	0.1	0.7	2.4	2.4	**4454.2**
B21-W	917.1	4828.1	3990.3	10780.5	104.3	104.3	29.1	12.8	0.2	2.5	6.7	6.7	**20782.5**
B22-N	224.9	1128.8	901.7	2557.3	25.4	25.4	7.5	3.1	0.0	0.5	1.5	1.5	**4877.4**
B23-N	456.4	2270.7	1812.2	5158.8	51.1	51.1	15.4	6.3	0.1	0.8	2.9	2.9	**9828.7**
B-BAY-SE	1080.3	5489.5	4321.0	12279.6	121.3	121.3	35.9	15.1	0.3	1.9	7.1	7.1	**23480.3**
B-BAY-SW	2667.6	13249.6	10582.1	30203.0	297.6	297.6	89.5	36.8	0.6	4.9	16.9	16.9	**57463.2**
C100A-1	890.7	4431.2	3549.4	10097.1	99.6	99.6	30.0	12.3	0.2	1.6	5.7	5.7	**19223.2**
C100A-2	183.2	910.5	727.5	2074.5	20.5	20.5	6.2	2.5	0.0	0.3	1.2	1.2	**3948.1**
C100A-3	203.3	1009.7	806.9	2292.8	22.7	22.7	6.8	2.8	0.0	0.4	1.3	1.3	**4370.7**
C100A-4	31.5	157.0	125.2	357.1	3.5	3.5	1.1	0.4	0.0	0.1	0.2	0.2	**679.9**
C100A-5	500.4	2491.2	1988.5	5665.8	56.0	56.0	16.9	6.9	0.1	0.9	3.2	3.2	**10789.2**
C100A-E-1	1172.8	5842.2	4673.8	13315.8	131.6	131.6	39.5	16.3	0.3	2.2	7.5	7.5	**25340.9**
C100A-E-2	489.4	2425.1	1940.0	5533.5	54.7	54.7	16.4	6.8	0.1	0.9	3.1	3.1	**10527.8**
C100A-W2E	1461.6	8046.8	7165.0	17526.6	153.4	153.4	40.6	19.5	0.4	2.8	12.5	12.5	**34595.0**
C100A-W2W	2198.0	12125.3	10824.6	26455.2	231.5	231.5	60.6	29.3	0.7	4.1	18.8	18.8	**52198.5**
C100A-W3N	2535.3	12742.6	10339.6	28880.3	280.0	280.0	83.1	34.8	0.6	4.5	16.7	16.7	**55214.2**
C100A-W3S	2601.4	13095.3	10648.2	29762.1	288.8	288.8	85.5	35.9	0.6	4.7	17.2	17.2	**56845.8**

SUB-BASIN NAME	WATER QUALITY 100-YEAR STORM EVENT SIMULATION (lb)												TOTAL / SUB-BASIN
	BOD5	COD	TSS	TDS	TN	TKN	TP	DP	Cd	Cu	Pb	Zn	
C100D-1	1111.1	5599.7	4541.5	12698.5	199.1	123.7	36.6	15.3	0.3	2.1	9.3	7.4	**24344.5**
C100D-E-1	2145.1	10670.3	8509.8	24250.6	383.6	240.3	72.3	29.8	0.5	3.8	16.6	13.6	**46336.1**
C100D-N-1	2513.2	13426.0	11596.2	29541.6	445.3	271.2	73.9	34.0	0.7	5.5	28.4	19.8	**57955.8**
C100DN-1E	1014.1	5423.3	4651.7	11926.9	181.2	110.7	30.2	13.8	0.3	2.3	11.1	7.9	**23373.5**
C100DN-1W	1316.1	7032.7	6040.6	15454.2	233.7	143.3	39.0	17.8	0.3	3.0	14.5	10.3	**30305.6**
C100D-W-1	1338.2	6724.0	5423.3	15233.8	240.3	148.8	44.3	18.5	0.3	2.4	11.2	8.8	**29193.9**
CC100A-E1N	1856.3	9237.3	7385.4	21031.9	332.9	207.9	62.4	25.8	0.4	3.4	14.3	11.8	**40169.7**
CC100A-E1W	1787.9	8884.5	7098.8	20260.3	319.7	200.2	60.2	24.7	0.4	3.2	13.8	11.4	**38665.0**
CC100A-W2A	518.1	2932.1	2667.6	6305.2	90.6	53.4	13.5	6.8	0.2	1.0	7.9	4.7	**12601.0**
CC100A-W2B	937.0	5158.8	4629.7	11243.5	164.2	97.9	25.6	12.4	0.3	1.8	13.0	8.1	**22292.1**
CC100A-W2C	1730.6	9832.5	9060.9	21142.1	302.0	177.2	44.1	22.7	0.6	3.3	27.3	16.1	**42359.5**
CC100A-W2D	1761.5	9898.7	9038.9	21362.6	308.6	181.7	46.1	23.1	0.6	3.3	26.7	15.9	**42667.6**
U36-N	619.5	3086.4	2469.2	7010.6	110.9	69.2	20.8	8.6	0.1	1.1	4.8	3.9	**13405.2**
	49970.3	**260398.5**	**215433.3**	**578619.3**	**6785.5**	**5498.7**	**1570.2**	**685.3**	**12.7**	**97.1**	**420.5**	**361.1**	**1119852.4**

Appendix 5K

SUB-BASIN NAME	WATER QUALITY CONTINUOUS SIMULATION WET-YEAR (lbs/yr)												TOTAL / SUB-BASIN
	BOD5	COD	TSS	TDS	TN	TKN	TP	DP	Cd	Cu	Pb	Zn	
57AVE-S	11.8	61.0	23.4	96.3	2.2	1.4	0.4	0.2	0.0	0.0	0.1	0.1	**196.8**
B-Bay-N	169.3	876.0	320.0	1410.0	31.4	19.6	5.6	2.4	0.0	0.5	1.3	1.2	**2837.2**
C2-C-23	198.5	886.0	468.0	1948.0	38.9	26.7	4.9	3.2	0.1	1.2	3.9	2.8	**3582.3**
C2-C-24	23.3	1626.0	61.6	257.6	5.9	3.6	0.6	0.4	0.0	0.3	0.1	0.3	**1979.7**
C2-C-26	402.0	2410.0	908.0	3758.0	82.3	51.5	11.3	5.7	0.1	3.0	3.1	3.8	**7638.7**
C2-S-9NE	630.0	3220.0	1150.0	5180.0	112.7	70.0	20.6	8.7	0.2	1.1	5.6	4.3	**10403.1**
C2-S-9NW	593.0	3020.0	1080.0	4870.0	106.0	65.9	19.4	8.2	0.1	1.1	5.2	4.0	**9772.9**
C2-S-9SE	596.0	3040.0	1080.0	4890.0	106.4	66.2	19.5	8.2	0.1	1.1	5.2	4.0	**9816.8**
C2-S-9SW	487.0	2470.0	885.0	3995.0	86.9	54.1	15.9	6.7	0.1	0.9	4.3	3.3	**8009.2**
C2-W-3NE	345.0	1720.0	633.0	2753.0	60.6	38.1	11.2	4.7	0.1	0.7	2.7	2.3	**5571.2**
C2-W-3NW	312.0	1553.0	572.0	2482.0	54.7	34.3	10.1	4.2	0.1	0.6	2.4	2.0	**5027.4**
C2-W-3SE	414.0	2063.0	757.0	3307.0	72.7	45.6	13.4	5.6	0.1	0.8	3.2	2.7	**6685.2**
C2-W-3SW	312.0	1556.0	573.0	2483.0	54.8	34.3	10.1	4.2	0.1	0.6	2.4	2.0	**5032.6**
US1-S	190.2	1631.0	425.0	1795.0	33.7	24.2	4.6	3.1	0.2	0.8	4.7	2.8	**4115.2**
B21-W	2645.5	15145.6	13844.9	32628.1	277.8	277.8	67.7	35.1	0.8	6.6	24.7	24.7	**64979.2**
B22-N	709.9	3571.5	2843.9	8112.9	80.2	80.2	23.8	9.9	0.2	1.5	4.6	4.6	**15443.2**
B23-N	1283.1	6371.3	5092.6	14528.3	143.5	143.5	43.2	17.8	0.3	2.3	8.1	8.1	**27642.2**
B-BAY-SE	1957.7	9744.3	7782.2	22266.5	219.4	219.4	65.9	27.1	0.4	3.5	12.4	12.4	**42311.3**
B-BAY-SW	3968.3	19687.1	15718.8	44753.4	443.1	443.1	133.2	54.9	0.9	7.1	25.1	25.1	**85260.1**
C100A-1	1973.1	9832.5	7848.4	22266.5	220.5	220.5	66.4	27.3	0.4	3.6	12.5	12.5	**42484.2**
C100A-2	575.4	2866.0	2292.8	6525.6	64.4	64.4	19.4	8.0	0.1	1.0	3.6	3.6	**12424.3**
C100A-3	590.8	2932.1	2336.9	6679.9	66.1	66.1	19.9	8.2	0.1	1.1	3.7	3.7	**12708.8**
C100A-4	101.6	504.9	403.4	1150.8	11.4	11.4	3.4	1.4	0.0	0.2	0.6	0.6	**2189.8**
C100A-5	1521.2	7561.8	6040.6	17217.9	170.2	170.2	51.1	21.1	0.3	2.7	9.6	9.6	**32776.4**
C100A-E-1	2381.0	11860.7	9479.8	27116.6	266.8	266.8	80.0	33.1	0.5	4.4	15.2	15.2	**51520.0**
C100A-E-2	1364.6	6790.2	5423.3	15454.2	152.8	152.8	45.9	18.9	0.3	2.4	8.6	8.6	**29422.7**
C100A-W2E	1263.2	6525.6	5445.4	14638.5	138.7	138.7	39.9	17.3	0.3	2.4	9.0	9.0	**28228.1**
C100A-W2W	1821.0	9369.6	7760.2	21053.9	201.1	201.1	58.2	24.9	0.4	3.5	12.8	12.8	**40519.4**
C100A-W3N	1792.3	9171.1	7583.8	20635.1	196.9	196.9	57.3	24.5	0.4	3.2	12.5	12.5	**39686.5**
C100A-W3S	1836.4	9391.6	7782.2	21142.1	201.7	201.7	58.6	25.1	0.4	3.3	12.8	12.8	**40668.9**

SUB-BASIN NAME	WATER QUALITY CONTINUOUS SIMULATION WET-YEAR (lbs/yr)												TOTAL / SUB-BASIN
	BOD5	**COD**	**TSS**	**TDS**	**TN**	**TKN**	**TP**	**DP**	**Cd**	**Cu**	**Pb**	**Zn**	
C100D-1	2164.92	10758.45	8597.94	24471.06	388.01	242.51	72.75	29.98	0.47	3.86	16.71	13.71	**46760.4**
C100D-E-1	5246.95	26014.28	20855.52	59524.20	941.36	588.63	176.81	72.75	1.14	9.37	40.56	33.29	**113504.9**
C100D-N-1	1717.38	8950.68	7319.27	20017.77	315.26	195.11	55.12	23.81	0.39	4.52	14.77	12.21	**38626.3**
C100DN-1E	804.68	4188.74	3439.18	9391.60	147.05	91.05	25.57	11.16	0.18	2.09	7.05	5.75	**18114.1**
C100DN-1W	1025.14	5335.13	4387.15	11948.93	187.61	116.40	32.85	14.24	0.23	2.69	8.86	7.30	**23066.5**
C100D-W-1	1792.34	9105.00	7429.50	20524.83	319.67	198.41	58.42	24.69	0.43	3.22	15.87	12.13	**39484.5**
CC100A-E1N	3240.76	16071.53	12830.77	36596.36	579.81	361.55	108.69	44.75	0.70	5.82	24.91	20.50	**69886.2**
CC100A-E1W	3064.39	15211.74	12147.35	34612.22	548.95	341.71	102.95	42.33	0.67	5.51	23.59	19.42	**66120.8**
CC100A-W2A	337.30	1724.00	1428.58	3858.05	59.97	37.04	10.74	4.61	0.08	0.63	3.11	2.34	**7466.4**
CC100A-W2B	868.61	4431.25	3659.64	9942.75	154.54	95.68	27.78	11.88	0.21	1.63	7.91	6.00	**19207.9**
CC100A-W2C	895.07	4563.52	3747.82	10251.39	159.61	98.77	28.88	12.26	0.21	1.68	8.02	6.13	**19773.4**
CC100A-W2D	1146.39	5842.19	4828.07	13139.42	204.15	126.32	36.82	15.70	0.27	2.15	10.41	7.91	**25359.8**
U36-N	1684.31	8377.48	6679.94	19091.84	302.03	188.49	56.66	23.37	0.37	3.00	13.01	10.67	**36431.2**
	54457.6	**278031.8**	**213966.0**	**608765.7**	**8011.5**	**6071.6**	**1775.5**	**751.4**	**12.6**	**107.8**	**415.1**	**368.9**	**1172735.6**

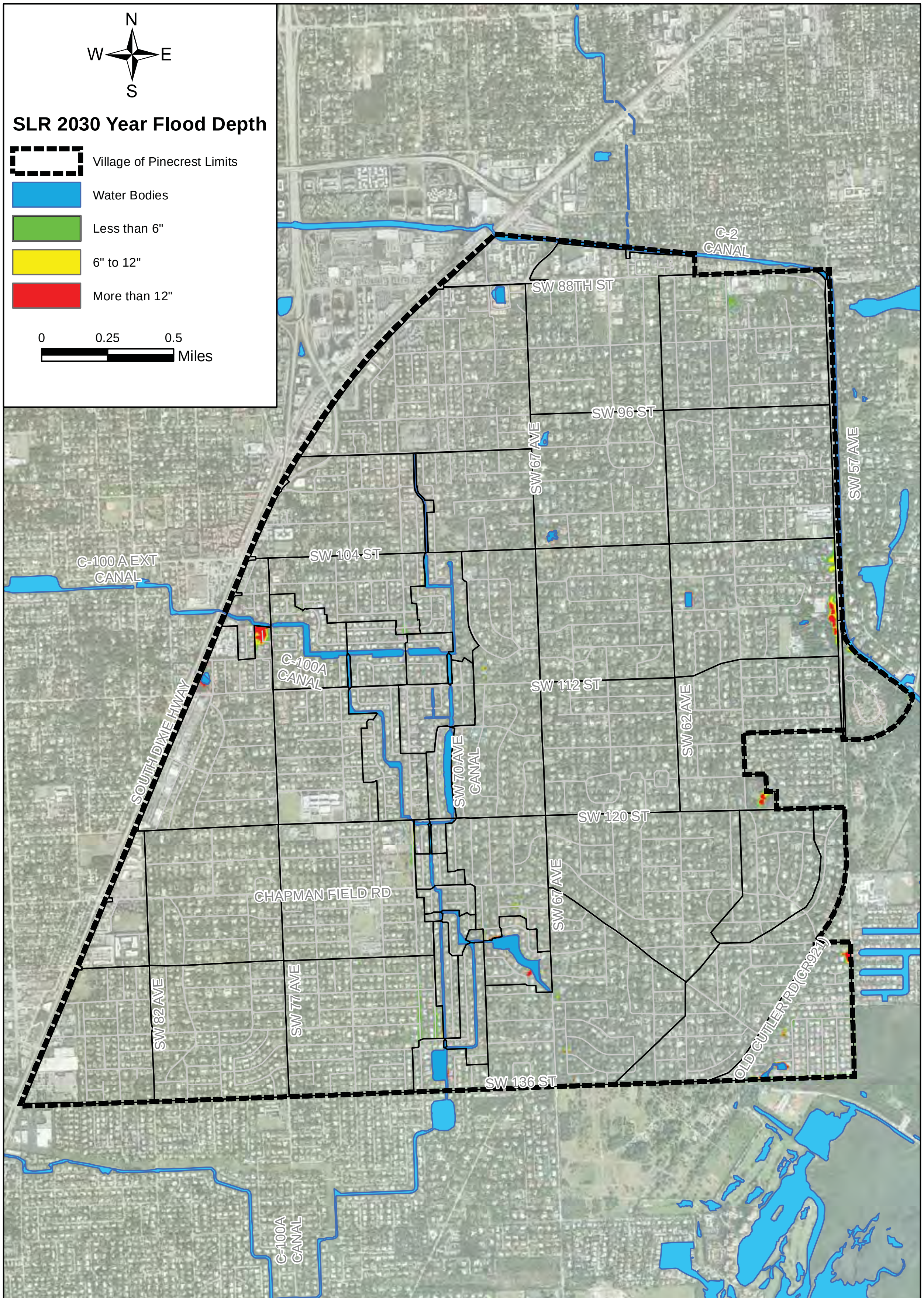
SUB-BASIN NAME	WATER QUALITY CONTINUOUS SIMULATION DRY-YEAR (lbs/yr)												TOTAL / SUB-BASIN
	BOD5	COD	TSS	TDS	TN	TKN	TP	DP	Cd	Cu	Pb	Zn	
57AVE-S	14.2	73.6	59.3	166.0	1.6	1.6	0.5	0.2	0.0	0.0	0.1	0.1	**317.4**
B-Bay-N	213.0	1100.1	886.2	2482.4	24.6	24.6	7.0	3.0	0.0	0.6	1.5	1.5	**4744.6**
C2-C-23	257.5	2112.0	1358.0	3454.6	34.7	34.7	6.4	4.1	0.2	1.6	3.6	3.6	**7271.0**
C2-C-24	32.7	231.3	196.4	489.4	5.1	5.1	0.9	0.5	0.0	0.5	0.4	0.4	**962.7**
C2-C-26	566.6	3388.5	2899.0	7165.0	72.5	72.5	15.9	8.0	0.1	4.2	5.3	5.3	**14202.9**
C2-S-9NE	798.1	4060.9	3282.6	9105.0	88.6	88.6	26.0	11.0	0.2	1.4	5.4	5.4	**17473.3**
C2-S-9NW	749.6	3822.8	3088.6	8575.9	83.1	83.1	24.5	10.4	0.2	1.4	5.1	5.1	**16449.6**
C2-S-9SE	754.0	3836.0	3099.7	8620.0	83.6	83.6	24.6	10.4	0.2	1.4	5.1	5.1	**16523.5**
C2-S-9SW	615.1	3137.1	2535.3	7032.7	68.3	68.3	20.1	8.5	0.1	1.1	4.2	4.2	**13495.1**
C2-W-3NE	433.2	2156.1	1768.1	4806.0	47.6	47.6	14.0	5.8	0.1	0.8	2.8	2.8	**9285.1**
C2-W-3NW	390.0	1942.3	1593.9	4336.4	43.0	43.0	12.6	5.2	0.1	0.8	2.6	2.6	**8372.4**
C2-W-3SE	520.3	2590.4	2125.2	5776.1	57.3	57.3	16.9	7.0	0.1	1.0	3.4	3.4	**11158.4**
C2-W-3SW	390.4	1946.7	1596.1	4340.9	43.0	43.0	12.7	5.3	0.1	0.8	2.6	2.6	**8384.0**
US1-S	234.3	2012.8	1179.5	3015.9	29.9	29.9	5.7	3.8	0.2	1.0	3.5	3.5	**6519.7**
B21-W	1717.4	9854.6	9016.8	21208.3	306.4	180.8	44.3	22.9	0.6	4.3	26.0	16.1	**19231.8**
B22-N	469.6	2358.9	1884.9	5357.2	84.9	52.9	15.7	6.5	0.1	1.0	3.6	3.0	**4644.1**
B23-N	804.7	4012.4	3196.7	9127.0	144.4	90.2	27.1	11.2	0.2	1.4	6.2	5.1	**7904.6**
B-BAY-SE	1084.7	5401.3	4299.0	12279.6	194.4	121.3	36.4	15.0	0.2	2.0	8.4	6.9	**10636.4**
B-BAY-SW	2248.7	11177.3	8928.6	25573.4	403.4	251.3	75.6	31.1	0.5	4.1	17.4	14.3	**22101.8**
C100A-1	1179.5	5886.3	4695.8	13404.0	212.1	132.3	39.7	16.4	0.3	2.2	9.1	7.5	**11605.3**
C100A-2	379.2	1880.5	1501.3	4276.9	67.7	42.3	12.7	5.2	0.1	0.7	2.9	2.4	**3706.8**
C100A-3	381.4	1900.4	1519.0	4321.0	68.6	42.8	12.9	5.3	0.1	0.7	3.0	2.4	**3745.5**
C100A-4	67.0	332.9	266.8	758.4	12.0	7.5	2.2	0.9	0.0	0.1	0.5	0.4	**657.2**
C100A-5	989.9	4916.3	3924.2	11199.4	177.2	110.7	33.3	13.7	0.2	1.8	7.6	6.3	**9698.1**
C100A-E-1	1358.0	6768.1	5401.3	15410.2	244.7	152.3	45.6	18.8	0.3	2.5	10.5	8.7	**13345.3**
C100A-E-2	862.0	4276.9	3417.1	9766.4	154.3	96.3	29.1	11.9	0.2	1.5	6.7	5.5	**8449.6**
C100A-W2E	663.6	3395.1	2777.8	7627.9	118.8	73.4	21.4	9.1	0.2	1.3	6.0	4.6	**6667.5**
C100A-W2W	965.6	4916.3	4012.4	11111.2	173.5	107.4	31.5	13.3	0.2	1.9	8.5	6.6	**9683.5**
C100A-W3N	912.7	4673.8	3880.1	10515.9	162.5	100.1	29.1	12.5	0.2	1.6	8.8	6.4	**9209.7**
C100A-W3S	934.8	4806.0	3990.3	10780.5	166.7	102.5	29.8	12.8	0.2	1.7	9.0	6.6	**9453.3**

SUB-BASIN NAME	WATER QUALITY CONTINUOUS SIMULATION DRY-YEAR (lbs/yr)												TOTAL / SUB-BASIN
	BOD5	**COD**	**TSS**	**TDS**	**TN**	**TKN**	**TP**	**DP**	**Cd**	**Cu**	**Pb**	**Zn**	
C100D-1	1300.71	6459.48	5158.76	14726.73	233.69	145.50	43.65	18.01	0.28	2.31	10.03	8.25	**12749.4**
C100D-E-1	2998.26	14903.10	11904.84	33950.84	537.92	335.10	100.97	41.67	0.65	5.34	23.15	19.00	**29402.5**
C100D-N-1	914.91	4761.94	3858.05	10670.26	168.43	104.72	29.76	12.79	0.20	2.47	7.54	6.42	**9315.7**
C100DN-1E	427.69	2226.65	1807.77	4982.40	78.26	48.72	13.80	5.95	0.10	1.14	3.57	3.00	**4354.1**
C100DN-1W	546.74	2843.93	2314.83	6393.34	100.75	62.61	17.77	7.65	0.12	1.47	4.54	3.84	**5578.2**
C100D-W-1	985.46	5004.44	4078.51	11265.51	175.71	108.91	31.97	13.56	0.23	1.76	8.77	6.68	**9834.7**
CC100A-E1N	1845.25	9171.14	7341.32	20921.65	330.69	206.57	62.17	25.57	0.40	3.33	14.24	11.71	**18114.0**
CC100A-E1W	1748.25	8686.12	6944.49	19819.35	313.05	195.77	58.86	24.25	0.38	3.15	13.49	11.09	**17154.3**
CC100A-W2A	181.66	921.52	756.18	2072.32	32.41	20.08	5.89	2.49	0.04	0.34	1.59	1.23	**1812.5**
CC100A-W2B	476.19	2403.01	1977.53	5423.32	84.88	52.69	15.45	6.53	0.11	0.89	4.12	3.22	**4739.2**
CC100A-W2C	485.01	2447.11	2006.19	5533.55	86.64	53.79	15.81	6.66	0.11	0.91	4.14	3.26	**4827.7**
CC100A-W2D	626.11	3174.62	2601.43	7142.90	111.55	69.22	20.35	8.60	0.14	1.17	5.40	4.21	**6244.1**
U36-N	1044.98	5202.86	4144.65	11838.70	187.39	117.06	35.27	14.51	0.23	1.86	8.07	6.64	**10252.3**
	34568.7	**177173.3**	**143274.7**	**396824.3**	**5816.1**	**3867.8**	**1126.0**	**478.4**	**8.1**	**71.3**	**288.0**	**236.5**	**420278.8**

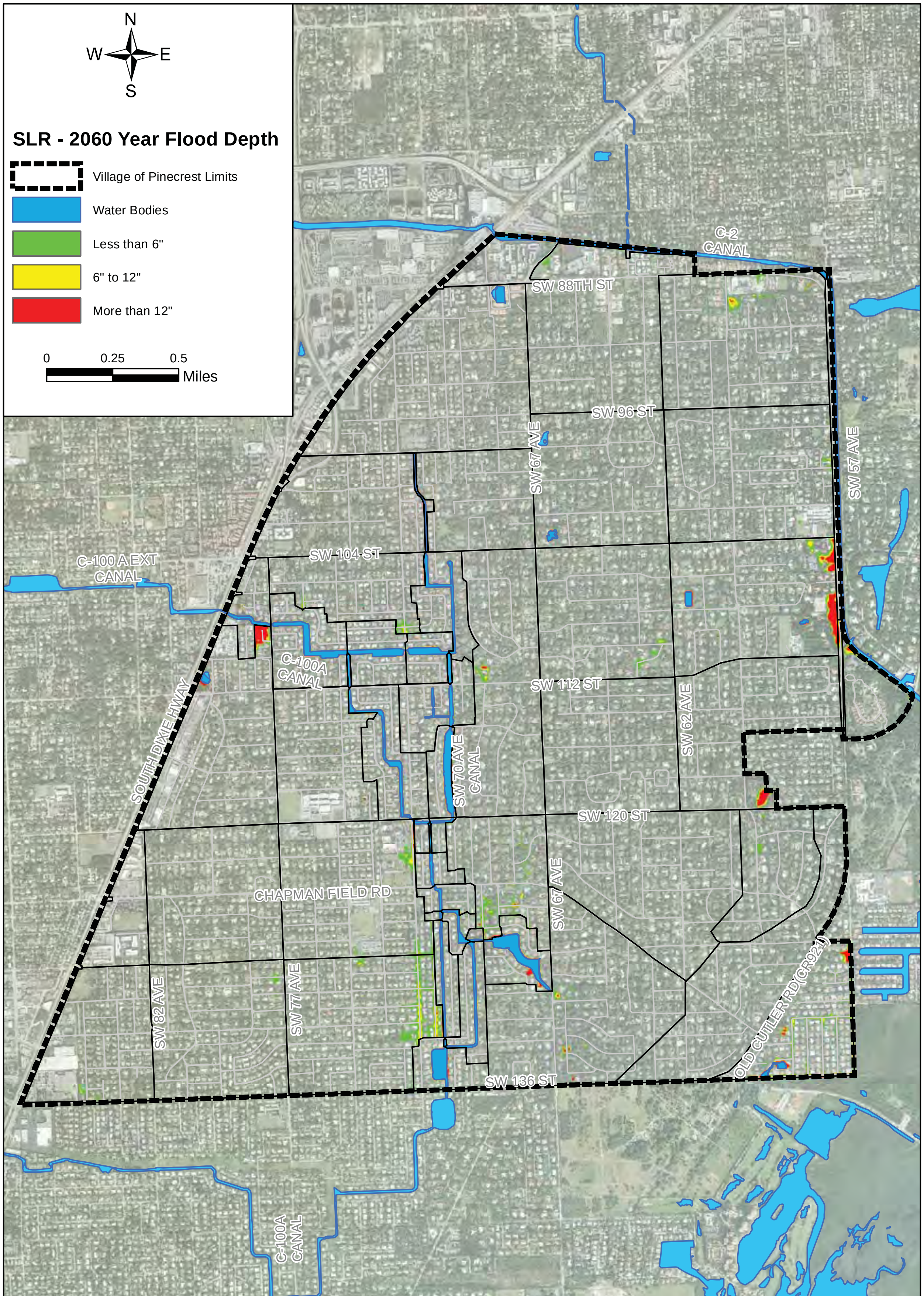
SUB-BASIN NAME	WATER QUALITY CONTINUOUS SIMULATION AVERAGE-YEAR (lbs/yr)												TOTAL / SUB-BASIN
	BOD5	COD	TSS	TDS	TN	TKN	TP	DP	Cd	Cu	Pb	Zn	
57AVE-S	13.1	68.0	55.7	152.8	1.5	1.5	0.4	0.2	0.0	0.0	0.1	0.1	**293.4**
B-Bay-N	190.9	978.8	767.2	2175.9	21.5	21.5	6.3	2.7	0.0	0.3	1.3	1.3	**4167.8**
C2-C-23	202.2	1646.8	1069.2	2707.2	27.0	27.0	5.0	3.2	0.1	1.2	2.8	2.8	**5694.7**
C2-C-24	20.2	143.3	121.5	303.1	3.2	3.2	0.5	0.3	0.0	0.3	0.2	0.2	**596.1**
C2-C-26	388.9	2328.1	1990.8	4936.1	49.8	49.8	11.0	5.5	0.1	2.9	3.6	3.6	**9770.0**
C2-S-9NE	734.1	3723.6	3015.9	8377.5	81.3	81.3	23.9	10.1	0.2	1.3	5.0	5.0	**16059.3**
C2-S-9NW	687.8	3516.3	2837.3	7892.5	76.7	76.7	22.5	9.5	0.2	1.2	4.7	4.7	**15130.2**
C2-S-9SE	692.2	3523.0	2848.3	7914.5	76.9	76.9	22.6	9.6	0.2	1.3	4.7	4.7	**15174.9**
C2-S-9SW	565.3	2879.2	2328.1	6472.7	62.8	62.8	18.5	7.8	0.1	1.0	3.8	3.8	**12405.9**
C2-W-3NE	402.8	2001.8	1642.4	4479.7	44.2	44.2	13.0	5.4	0.1	0.8	2.6	2.6	**8639.8**
C2-W-3NW	364.0	1829.8	1488.1	4054.3	40.0	40.0	11.8	4.9	0.1	0.7	2.4	2.4	**7838.4**
C2-W-3SE	482.8	2427.3	1973.1	5374.8	53.2	53.2	15.7	6.5	0.1	0.9	3.2	3.2	**10393.9**
C2-W-3SW	364.2	1832.0	1490.3	4056.5	40.2	40.2	11.8	4.9	0.1	0.7	2.4	2.4	**7845.8**
US1-S	187.6	1613.8	943.6	2416.2	23.9	23.9	4.6	3.0	0.2	0.8	2.8	2.8	**5223.1**
B21-W	2180.3	12522.1	11463.9	26896.1	229.3	229.3	56.0	28.9	0.7	5.5	20.5	20.5	**53653.1**
B22-N	588.6	2954.2	2358.9	6724.0	66.4	66.4	19.7	8.2	0.1	1.2	3.8	3.8	**12795.3**
B23-N	1056.0	5246.9	4188.7	11948.9	118.2	118.2	35.5	14.6	0.2	1.9	6.7	6.7	**22742.6**
B-BAY-SE	1587.3	7892.5	6305.2	17989.5	177.7	177.7	53.4	22.0	0.3	2.9	10.1	10.1	**34228.6**
B-BAY-SW	3240.8	16137.7	12896.9	36816.8	363.8	363.8	109.1	45.0	0.7	5.8	20.6	20.6	**70021.5**
C100A-1	1618.2	8046.8	6437.4	18342.3	181.2	181.2	54.5	22.5	0.4	3.0	10.3	10.3	**34908.0**
C100A-2	476.2	2358.9	1889.3	5379.2	53.1	53.1	16.0	6.6	0.1	0.8	3.0	3.0	**10239.6**
C100A-3	487.2	2425.1	1933.4	5511.5	54.5	54.5	16.4	6.7	0.1	0.9	3.1	3.1	**10496.4**
C100A-4	84.0	418.9	332.9	952.4	9.4	9.4	2.8	1.2	0.0	0.1	0.5	0.5	**1812.2**
C100A-5	1258.8	6261.1	5004.4	14241.7	140.9	140.9	42.3	17.4	0.3	2.2	8.0	8.0	**27126.0**
C100A-E-1	1937.8	9656.1	7716.1	22001.9	217.6	217.6	65.3	26.9	0.4	3.6	12.4	12.4	**41868.1**
C100A-E-2	1124.3	5599.7	4475.3	12742.6	125.9	125.9	37.9	15.6	0.2	2.0	7.1	7.1	**24263.7**
C100A-W2E	1056.0	5467.4	4585.6	12257.6	115.7	115.7	33.1	14.4	0.3	2.0	7.6	7.6	**23663.1**
C100A-W2W	1516.8	7826.3	6481.5	17548.6	166.9	166.9	48.1	20.8	0.4	2.9	10.7	10.7	**33800.6**
C100A-W3N	1505.7	7694.1	6349.2	17306.1	165.3	165.3	48.1	20.6	0.4	2.7	10.4	10.4	**33278.5**
C100A-W3S	1541.0	7892.5	6525.6	17747.0	169.3	169.3	49.4	21.1	0.4	2.8	10.7	10.7	**34139.8**

SUB-BASIN NAME	WATER QUALITY CONTINUOUS SIMULATION AVERAGE-YEAR (lbs/yr)												TOTAL / SUB-BASIN
	BOD5	**COD**	**TSS**	**TDS**	**TN**	**TKN**	**TP**	**DP**	**Cd**	**Cu**	**Pb**	**Zn**	
C100D-1	1794.54	8928.63	7120.86	20326.41	321.87	200.84	60.41	24.91	0.39	3.20	13.87	11.38	**38807.3**
C100D-E-1	4254.88	21120.07	16865.19	48060.28	762.79	476.19	143.08	58.86	0.93	7.58	32.85	26.90	**91809.6**
C100D-N-1	1430.79	7473.59	6128.79	16688.82	262.35	162.26	45.86	19.86	0.33	3.75	12.43	10.21	**32239.0**
C100DN-1E	672.40	3527.36	2888.03	7848.38	123.02	76.06	21.43	9.33	0.15	1.74	5.97	4.85	**15178.7**
C100DN-1W	855.38	4453.29	3659.64	9986.84	156.31	97.00	27.34	11.88	0.20	2.23	7.47	6.11	**19263.7**
C100D-W-1	1468.26	7451.55	6062.65	16799.05	262.35	162.48	47.84	20.22	0.35	2.62	12.99	9.92	**32300.3**
CC100A-E1N	2623.47	13095.32	10471.85	29762.10	471.78	295.42	88.62	36.60	0.57	4.74	20.33	16.71	**56887.5**
CC100A-E1W	2491.20	12411.90	9920.70	28218.88	447.53	279.98	84.00	34.61	0.54	4.50	19.27	15.83	**53928.9**
CC100A-W2A	277.78	1424.17	1183.87	3196.67	49.38	30.42	8.82	3.79	0.07	0.52	2.60	1.95	**6180.0**
CC100A-W2B	716.50	3659.64	3042.35	8201.11	127.21	78.70	22.71	9.77	0.17	1.34	6.61	4.98	**15871.1**
CC100A-W2C	734.13	3747.82	3086.44	8399.53	130.51	80.69	23.59	10.03	0.17	1.37	6.66	5.05	**16226.0**
CC100A-W2D	943.57	4828.07	3990.33	10824.59	167.99	103.84	30.20	12.90	0.22	1.77	8.66	6.55	**20918.7**
U36-N	1382.28	6878.35	5489.45	15674.71	246.92	154.76	46.52	19.18	0.30	2.47	10.69	8.77	**29914.4**
	46200.5	**235911.7**	**191426.2**	**529707.6**	**6487.4**	**5156.0**	**1505.6**	**638.4**	**10.8**	**91.6**	**345.5**	**314.3**	**1017795.6**

Appendix 6A



Appendix 6A - No Storm Event
Sea Level Rise Projection 2030 - Max 7"
Village of Pinecrest - Flood Plain Map



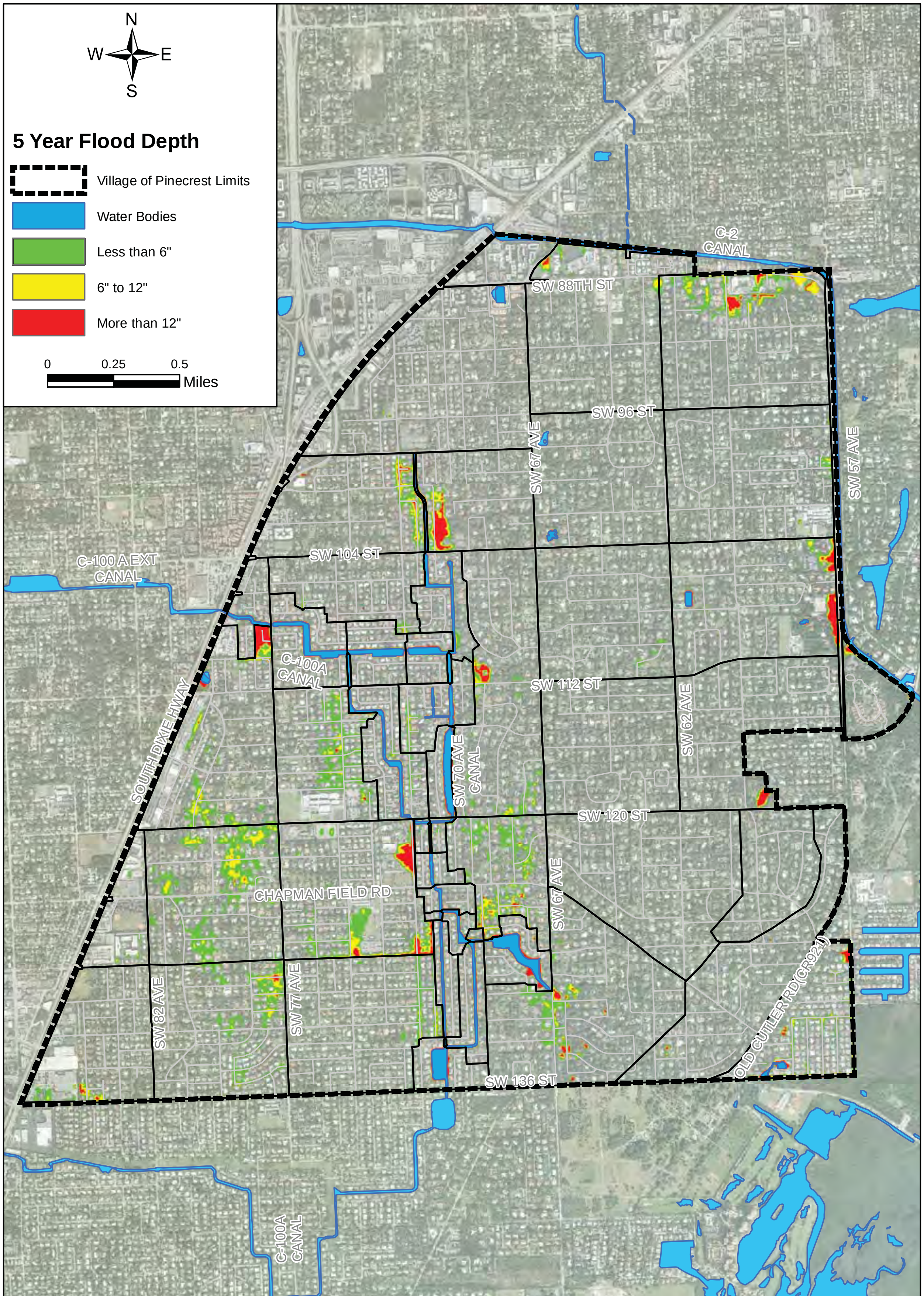
Appendix 6A - No Storm Event
Sea Level Rise Projection 2060 - Max 24"
Village of Pinecrest - Flood Plain Map

Appendix 6B

Sub-Basin Name	2030 Year - 7" Sea Level Rise			Sub-Basin Name	2060 Year - 24" Sea Level Rise	
	5-Year Max Stage	100-Year Max Stage			5-Year Max Stage	100-Year Max Stage
57AVE-S	6.36	7.11		57AVE-S	6.36	7.11
B22-S	5.99	8.08		B22-S	6.71	8.19
B-Bay-N	5.28	7.11		B-Bay-N	5.28	7.11
B-Bay-SE	6.84	6.97		B-Bay-SE	7.23	7.36
B-Bay-SW	9.41	9.97		B-Bay-SW	9.41	9.97
C100A-2	6.01	8.10		C100A-2	6.72	8.20
C100A-3	5.99	8.08		C100A-3	6.71	8.19
C100A-4	5.96	8.04		C100A-4	6.68	8.16
C100A-5	5.89	7.97		C100A-5	6.63	8.10
C100A-5A	5.89	7.97		C100A-5A	6.63	8.10
C100A-E-1	7.82	8.15		C100A-E-1	7.82	8.22
C100A-E-2	6.22	8.16		C100A-E-2	6.98	8.22
C100A-W2E	8.55	8.73		C100A-W2E	8.55	8.73
C100A-W2W	10.13	10.42		C100A-W2W	10.13	10.42
C100A-W3N	9.04	9.72		C100A-W3N	9.04	9.72
C100A-W3S	7.56	8.07		C100A-W3S	7.56	8.17
C100D-E-1	7.90	8.12		C100D-E-1	7.90	8.22
C100D-N-1	6.29	8.38		C100D-N-1	7.00	8.44
C100DN-1E	7.37	8.38		C100DN-1E	7.37	8.44
C100DN-1W	7.64	8.48		C100DN-1W	7.65	8.49
C100D-W-1	7.50	8.27		C100D-W-1	7.50	8.36
C2-C-23	4.42	6.96		C2-C-23	5.43	7.41
C2-C-24	4.41	6.90		C2-C-24	5.43	7.37
C2-C-25	4.36	6.70		C2-C-25	5.41	7.21
C2-C-26	4.28	6.29		C2-C-26	5.37	6.90
C2-S-9NE	5.80	6.31		C2-S-9NE	5.80	6.90
C2-S-9NW	5.82	6.34		C2-S-9NW	5.82	6.91
C2-S-9SE	5.69	6.31		C2-S-9SE	5.69	6.89
C2-S-9SW	6.01	6.38		C2-S-9SW	6.01	6.90
C2-W-3NE	6.20	6.64		C2-W-3NE	6.20	6.76
C2-W-3NW	6.44	7.01		C2-W-3NW	6.44	7.01
C2-W-3SE	6.21	6.81		C2-W-3SE	6.21	6.81
C2-W-3SW	6.31	6.90		C2-W-3SW	6.31	6.90
CC100A-E1N	8.29	8.54		CC100A-E1N	8.29	8.54
CC100A-E1W	7.67	8.16		CC100A-E1W	7.67	8.22
CC100A-W2A	9.78	10.11		CC100A-W2A	9.78	10.11

Sub-Basin Name	2030 Year - 7" Sea Level Rise			Sub-Basin Name	2060 Year - 24" Sea Level Rise	
	5-Year Max Stage	100-Year Max Stage			5-Year Max Stage	100-Year Max Stage
CC100A-W2B	9.66	9.93		CC100A-W2B	9.66	9.93
CC100A-W2C	9.78	10.11		CC100A-W2C	9.78	10.11
CC100A-W2D	9.66	9.93		CC100A-W2D	9.66	9.93
LG-C-14	4.40	6.89		LG-C-14	5.43	7.35
PNL&RGL	4.00	9.40		PNL&RGL	4.00	9.40
U28-E	6.13	8.28		U28-E	6.82	8.36
U28-W	6.21	8.48		U28-W	6.88	8.56
U29-N	6.13	8.27		U29-N	6.82	8.36
U29-S	6.06	8.17		U29-S	6.77	8.26
U30-S	6.01	8.10		U30-S	6.72	8.21
U32-N	5.99	8.08		U32-N	6.71	8.19
U32-S	5.94	8.07		U32-S	6.67	8.17
U33-S	5.89	7.97		U33-S	6.63	8.11
U34-N	6.28	8.36		U34-N	6.99	8.43
U34-S	6.18	8.27		U34-S	6.88	8.36
U35-N	6.19	8.27		U35-N	6.88	8.36
U35-S	6.12	8.18		U35-S	6.81	8.28
U36-S	6.05	8.12		U36-S	6.76	8.22
U37-S	6.01	8.10		U37-S	6.72	8.20
U38-E	6.19	8.27		U38-E	6.88	8.36
U38-W	6.13	8.27		U38-W	6.82	8.36

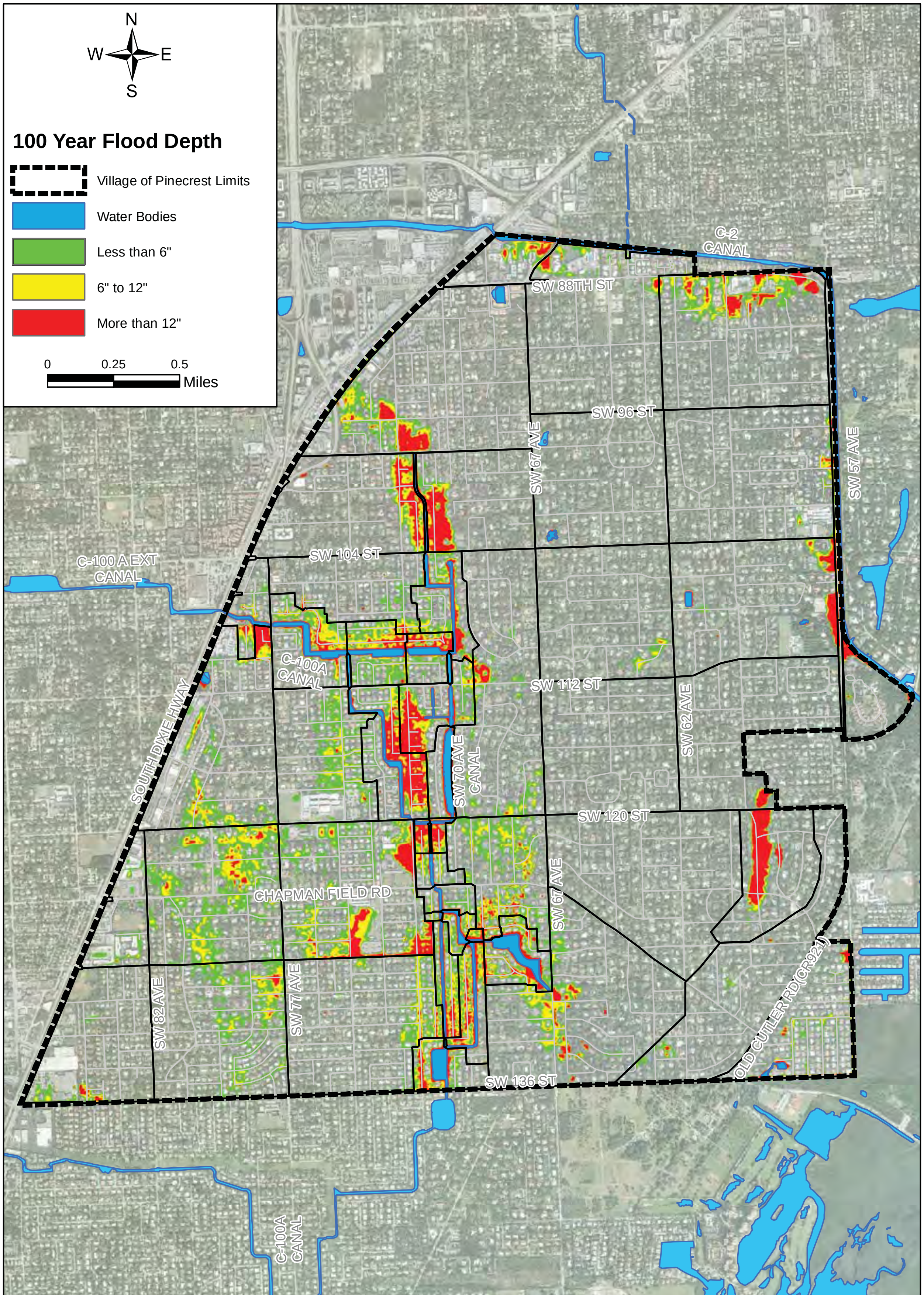
Appendix 6C



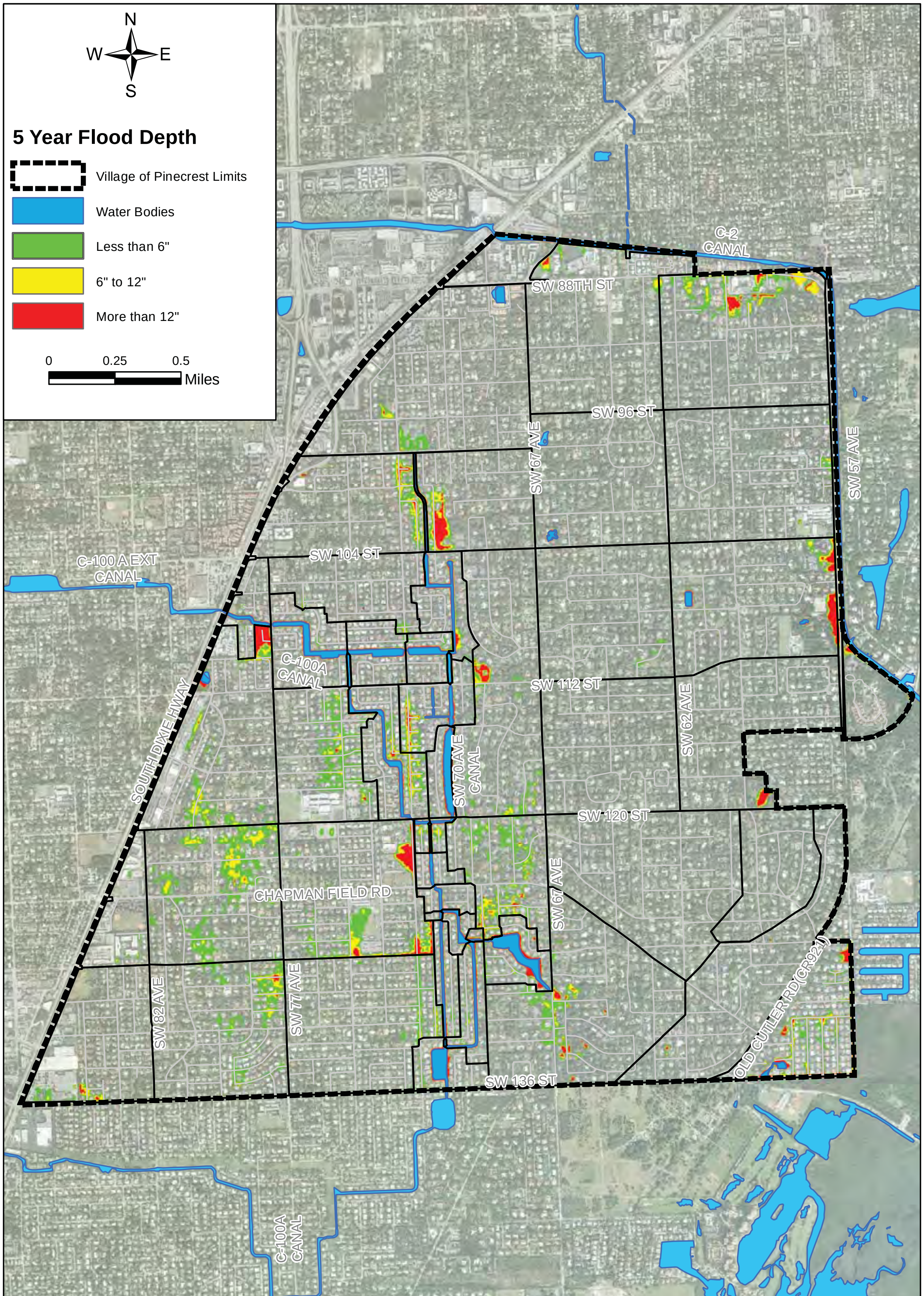
Appendix 6C

Sea Level Rise Projection 2030 - Max 7"

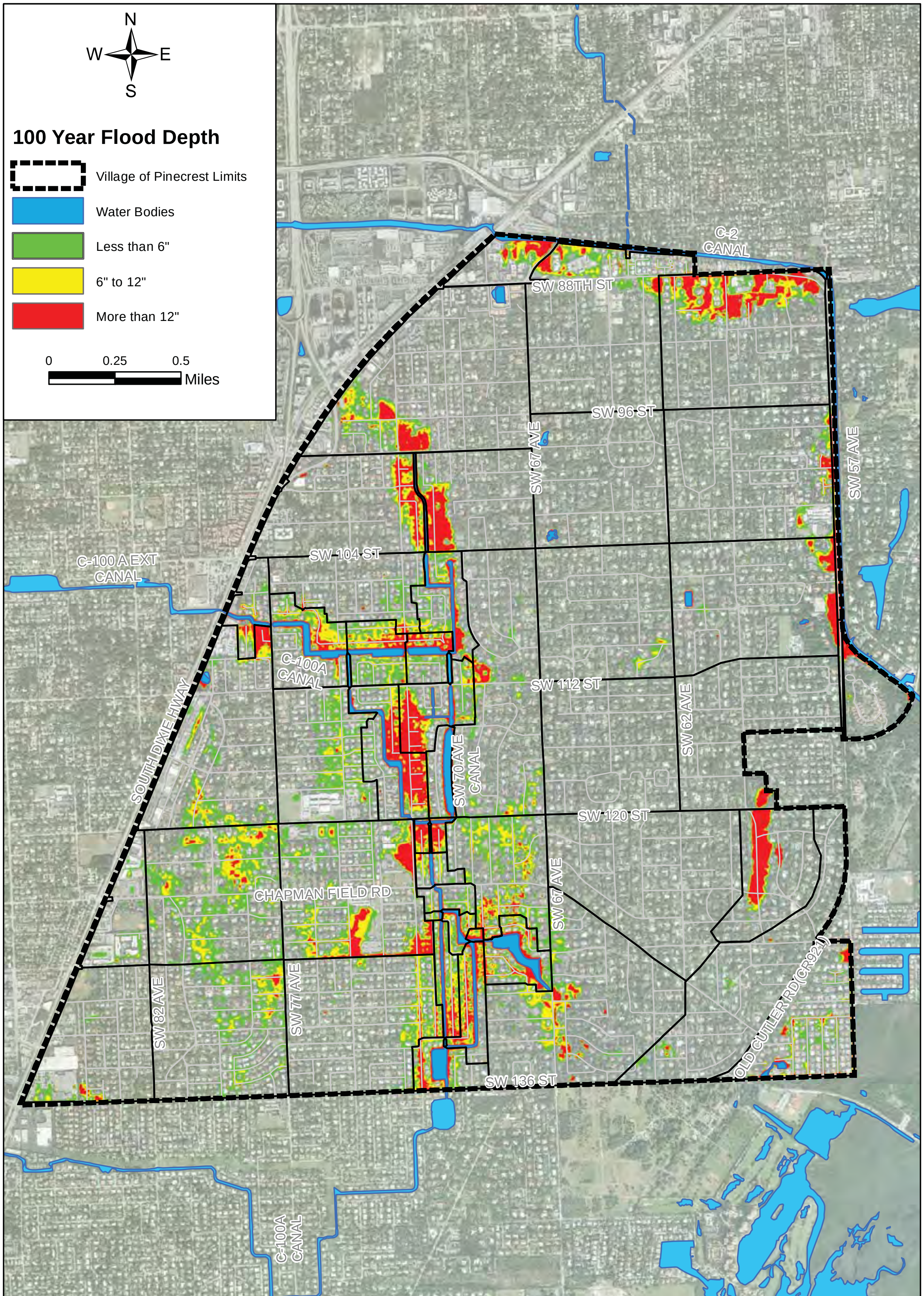
5 Year Flood Plain Map Village of Pinecrest



Appendix 6C
Sea Level Rise Projection 2030 - Max 7"
100 Year Flood Plain Map Village of Pinecrest



Appendix 6C
Sea Level Rise Projection 2060 - Max 24"
5 Year Flood Plain Map Village of Pinecrest

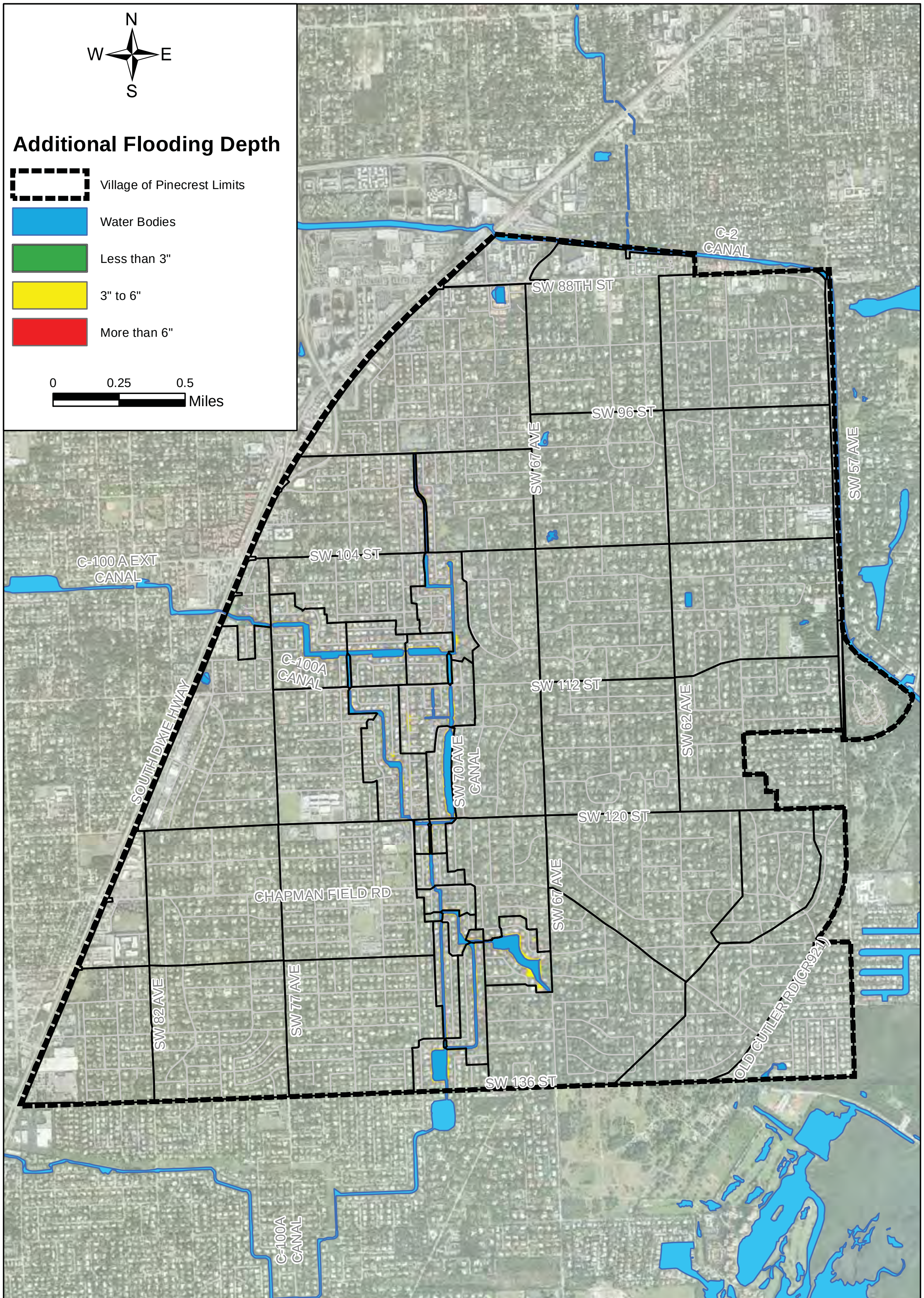


Appendix 6C

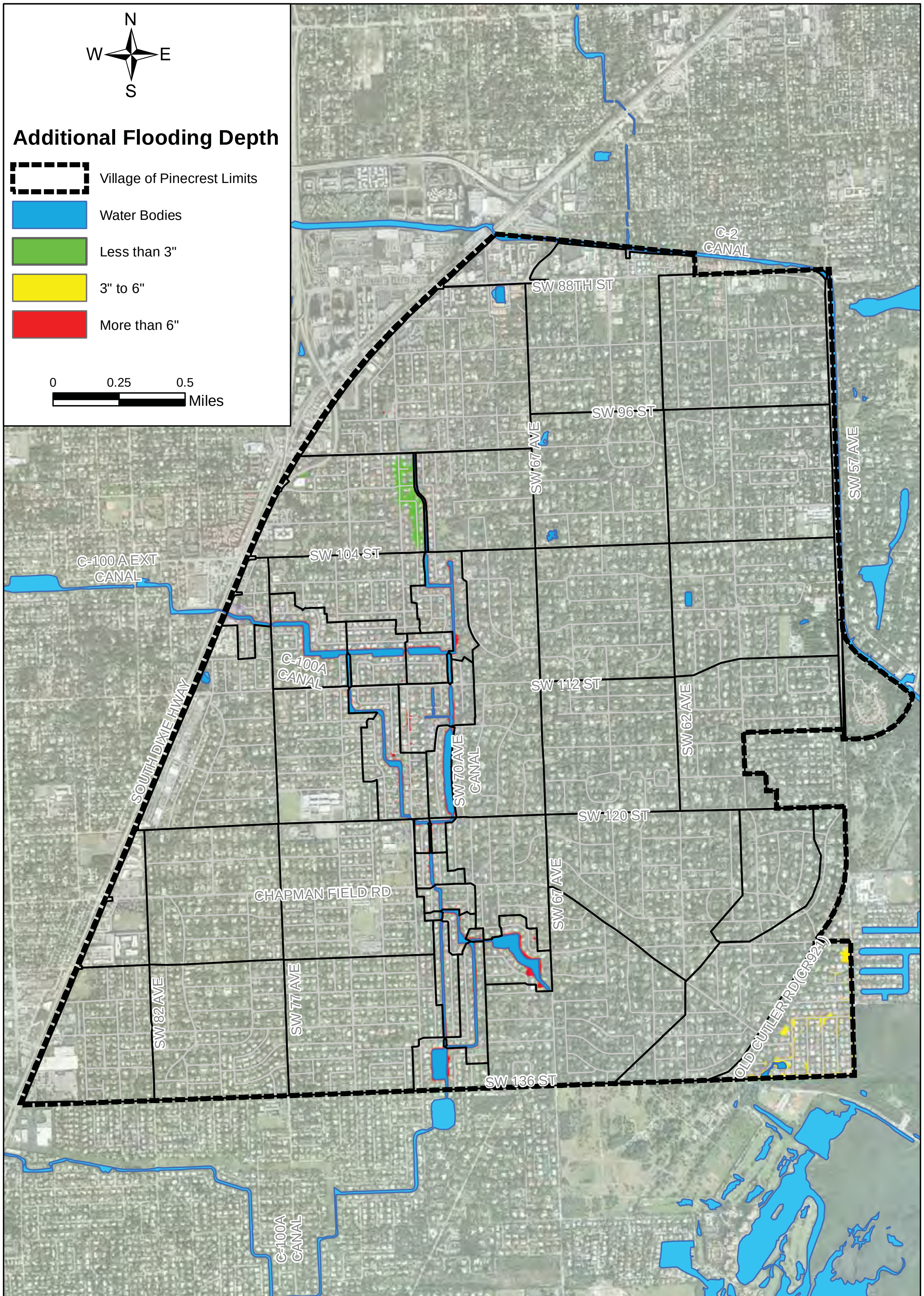
Sea Level Rise Projection 2060 - Max 24"

100 Year Flood Plain Map Village of Pinecrest

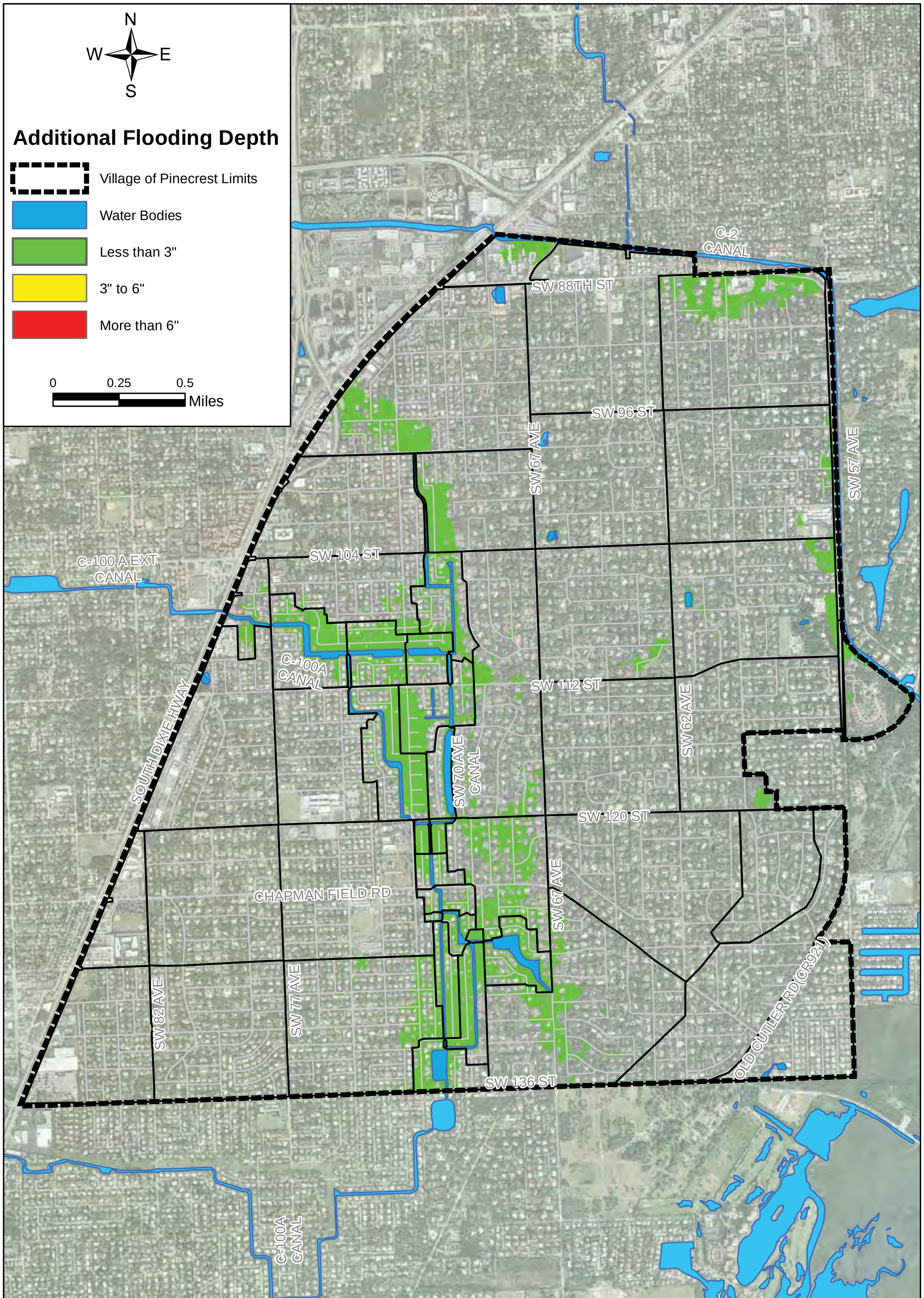
Appendix 6D



Appendix 6D -Additional Flooding Depth
5-Year, 24-Hour - SLR 2030 - Max 7"
Village of Pinecrest Stormwater Master Plan



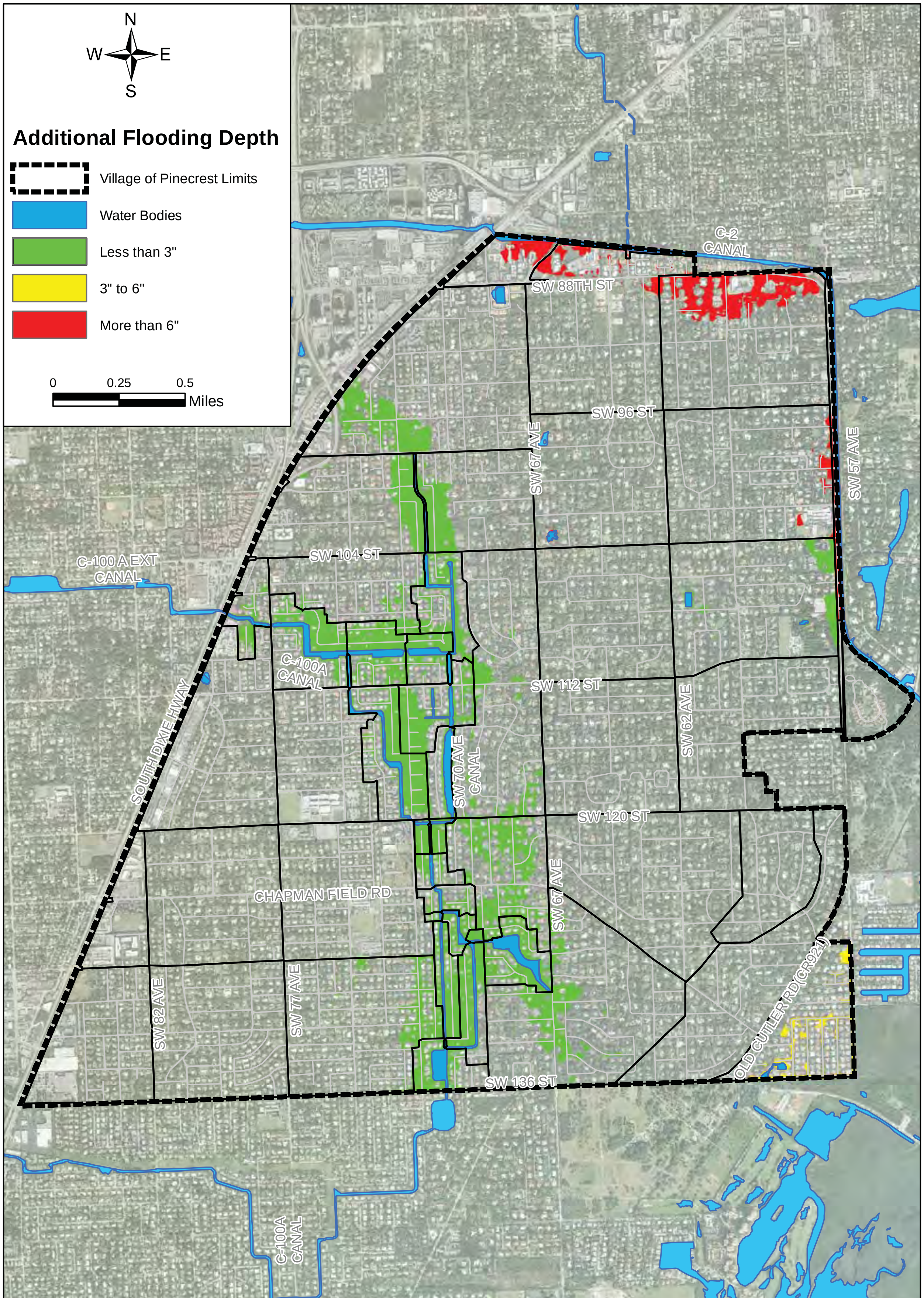
Appendix 6D -Additional Flooding Depth
5-Year, 24-Hour - SLR 2060 - Max 24"
Village of Pinecrest Stormwater Master Plan



Appendix 6D -Additional Flooding Depth
100-Year, 72-Hour - SLR 2030 - Max 7"
Village of Pinecrest Stormwater Master Plan

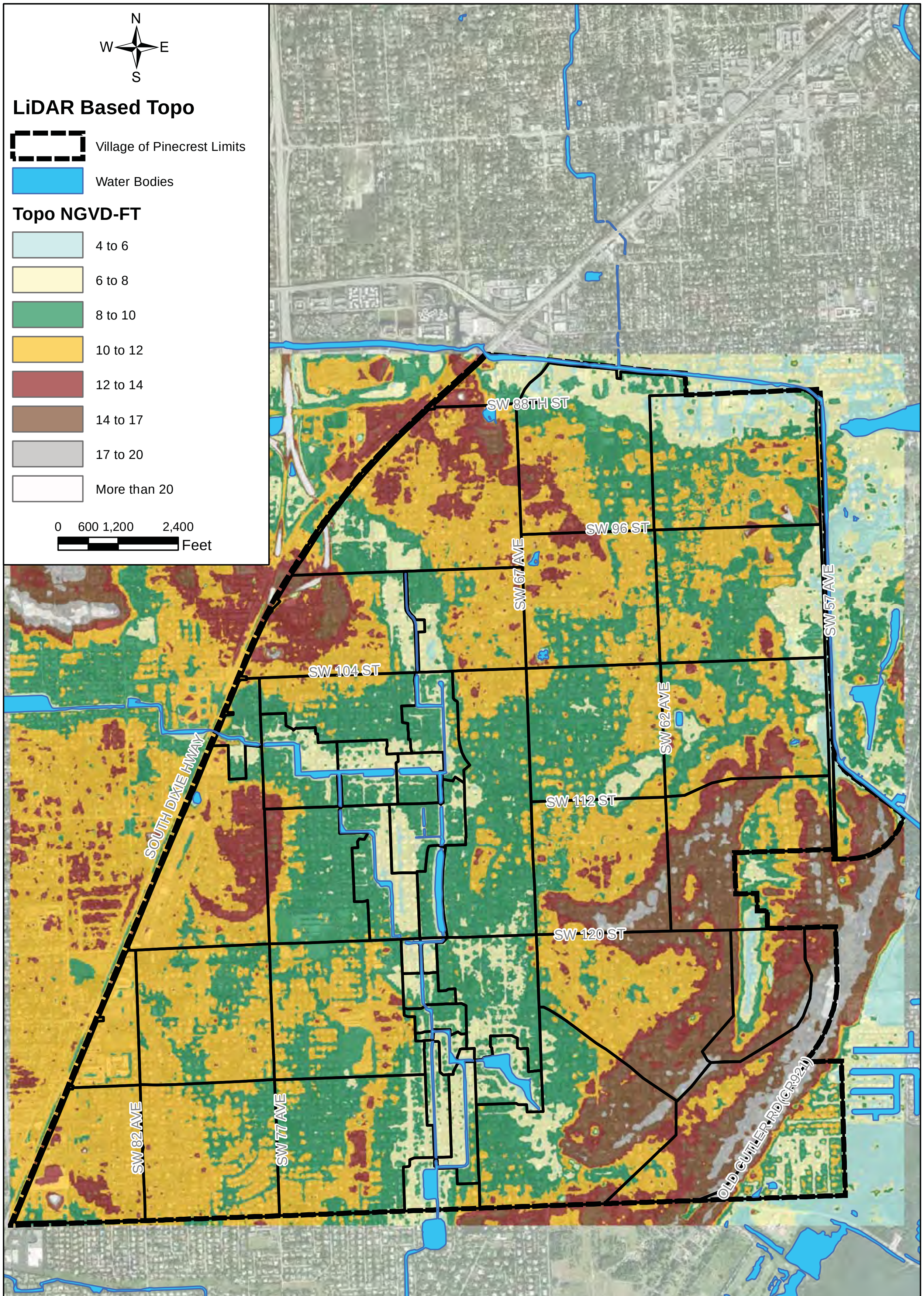
A·D·A ENGINEERING

village of PINECREST FLORIDA



Appendix 6D -Additional Flooding Depth
100-Year, 72-Hour - SLR 2060 - Max 24"
Village of Pinecrest Stormwater Master Plan

Appendix 7A



Appendix 7A
LiDAR Based Topographic Map
Village of Pinecrest Stormwater Master Plan

Appendix 7B

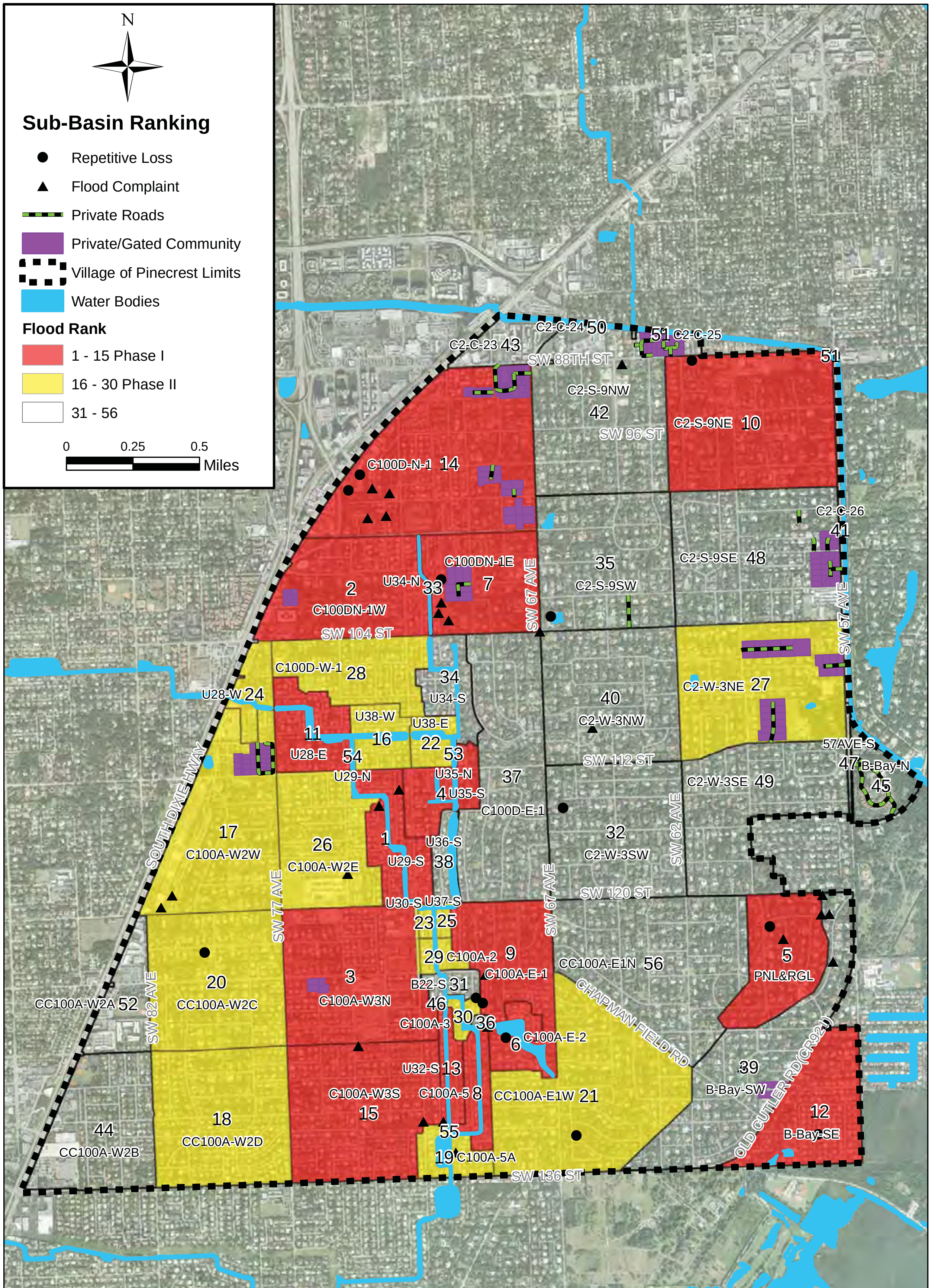
On File in the Office of the Village Clerk

Appendix 7C

Sub-Basin Name	Sub-Basin Area (Acres)	NS 3 Weighing Factor		DEM 5 Weighing Factor		MER 4 Weighing Factor		MMAS 4 Weighing Factor		MCLRS 2 Weighing Factor		RPL 8 Weighing Factor		NFC 2 Weighing Factor		BM 3 Weighing Factor		Composite Scores	
		Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	FPSS	Rank
U29-S	60.15	333	1	39.8	3	0	7	0	7	0.2	16	0	13	4	5	0.5	17	377.50	1
C100DN-1W	136.07	240	2	22	12	0	7	0	7	2.2	6	0	13	0	14	2.8	2	267.00	2
C100A-W3N	172.75	204	3	51.9	1	0	7	0	7	4.1	2	0	13	0	14	0	33	260.00	3
U35-S	42.44	204	3	27.7	5	0.1	5	0	7	0.2	16	0	13	0	14	0.8	11	232.80	4
PNL&RGL	86.22	180	5	25.2	9	0	7	0	7	0	22	16	6	2	7	0	33	223.20	5
C100A-E-2	33.88	132	7	26.9	7	0	7	0	7	0	22	16	6	0	14	3.8	1	178.70	6
C100DN-1E	102.48	111	8	19.3	18	0	7	0	7	0.9	9	24	3	8	2	1.7	4	164.90	7
C100A-5	29.60	138	6	22.1	11	0	7	0	7	0	22	0	13	0	14	0.9	8	161.00	8
C100A-E-1	90.74	99	11	27.1	6	0	7	0	7	3.2	3	16	6	2	7	0.6	14	147.90	9
C2-S-9NE	204.78	78	15	29.7	4	2.2	1	3.9	1	0.8	11	32	2	0	14	0	33	146.60	10
U28-E	55.82	102	10	24.7	10	0	7	0	7	0	22	0	13	0	14	0.9	8	127.60	11
B-Bay-SE	99.92	90	12	11.8	26	0	7	0	7	6	1	16	6	0	14	0	33	123.80	12
U32-S	20.67	105	9	17	20	0	7	0	7	0	22	0	13	0	14	0.3	21	122.30	13
C100D-N-1	247.42	39	23	25.5	8	0	7	0	7	0	22	40	1	8	2	0	33	112.50	14
C100A-W3S	177.99	90	12	13.5	24	0	7	0	7	2	7	0	13	6	4	0.7	13	112.20	15
U38-W	32.81	84	14	21.5	14	0	7	0	7	0	22	0	13	0	14	0.2	24	105.70	16
C100A-W2W	170.32	66	17	21.7	13	0	7	0.1	6	1.5	8	0	13	4	5	0.5	17	93.80	17
CC100A-W2D	167.29	69	16	21	15	0	7	0	7	2.4	5	0	13	0	14	0	33	92.40	18
C100A-5A	28.08	66	17	17.6	19	0	7	0	7	0	22	0	13	2	7	1.3	5	86.90	19
CC100A-W2C	167.39	18	27	40.9	2	0	7	0	7	0.9	9	16	6	0	14	0	33	75.80	20
CC100A-E1W	224.40	24	24	21	15	0.3	4	0.9	2	0.8	11	24	3	0	14	0	33	71.00	21
U38-E	20.07	54	21	13.8	23	0	7	0	7	0	22	0	13	0	14	0.8	11	68.60	22
U30-S	5.80	60	19	5.5	36	0	7	0	7	0	22	0	13	0	14	0.3	21	65.80	23
U28-W	25.93	57	20	7.2	31	0	7	0	7	0	22	0	13	0	14	0.2	24	64.40	24
U37-S	5.26	48	22	5.8	33	0	7	0	7	0	22	0	13	0	14	0.2	24	54.00	25
C100A-W2E	110.43	18	27	16.5	21	0	7	0	7	2.9	4	0	13	2	7	0.6	14	40.00	26
C2-W-3NE	183.76	18	27	14.3	22	0	7	0	7	0.1	18	0	13	0	14	0	33	32.40	27
C100D-W-1	83.66	24	24	5.8	33	0	7	0	7	0.4	13	0	13	0	14	0	33	30.20	28
C100A-2	13.68	21	26	5.7	35	0	7	0	7	0	22	0	13	0	14	0.1	29	26.80	29
C100A-3	8.98	18	27	7.4	30	0	7	0	7	0	22	0	13	0	14	0.5	17	25.90	30
B22-S	13.43	6	33	3.5	40	0	7	0	7	0	22	16	6	0	14	0.1	29	25.60	31
C2-W-3SW	165.23	0	39	0.1	55	0	7	0	7	0	22	24	3	0	14	0	33	24.10	32
U34-N	3.13	18	27	4.6	38	0	7	0	7	0	22	0	13	0	14	0.2	24	22.80	33
U34-S	39.98	0	39	19.4	17	0	7	0	7	0	22	0	13	0	14	1.2	6	20.60	34
C2-S-9SW	164.60	0	39	1.2	52	0	7	0	7	0	22	16	6	0	14	0	33	17.20	35
C100A-4	1.88	12	32	2.1	46	0	7	0	7	0	22	0	13	2	7	0.3	21	16.40	36
C100D-E-1	186.07	3	36	10.3	27	0.1	5	0.3	5	0.3	15	0	13	0	14	2.3	3	16.30	37
U36-S	19.44	0	39	12.8	25	0	7	0	7	0	22	0	13	0	14	0.6	14	13.40	38
B-Bay-SW	166.72	0	39	1.6	50	0	7	0	7	0	22	0	13	10	1	0	33	11.60	39
C2-W-3NW	164.95	6	33	2.3	45	0	7	0	7	0.1	18	0	13	2	7	0	33	10.40	40
C2-C-26	14.49	0	39	8.3	28	1.1	2	0	7	0	22	0	13	0	14	0.2	24	9.60	41
C2-S-9NW	201.90	0	39	6.4	32	0	7	0	7	0	22	0	13	2	7	1	7	9.40	42
C2-C-23	33.34	0	39	8.3	28	0	7	0	7	0	22	0	13	0	14	0.9	8	9.20	43
CC100A-W2B	124.62	3	36	5.4	37	0	7	0.4	4	0.4	13	0	13	0	14	0	33	9.20	44
B-Bay-N	39.18	3	36	4.3	39	0	7	0	7	0	22	0	13	0	14	0.5	17	7.80	45
U32-N	1.37	6	33	0.8	53	0	7	0	7	0	22	0	13	0	14	0	33	6.80	46
57AVE-S	4.56	0	39	2	48	0.8	3	0.8	3	0	22	0	13	0	14	0	33	3.60	47
C2-S-9SE	202.70	0	39	3.2	41	0	7	0	7	0.1	18	0	13	0	14	0	33	3.30	48

Sub-Basin Name	Sub-Basin Area (Acres)	NS 3 Weighing Factor		DEM 5 Weighing Factor		MER 4 Weighing Factor		MMAS 4 Weighing Factor		MCLRS 2 Weighing Factor		RPL 8 Weighing Factor		NFC 2 Weighing Factor		BM 3 Weighing Factor		Composite Scores	
		Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	FPSS	Rank
C2-W-3SE	161.34	0	39	3.1	42	0	7	0	7	0	22	0	13	0	14	0	33	3.10	49
C2-C-24	2.00	0	39	2.8	43	0	7	0	7	0	22	0	13	0	14	0.1	29	2.90	50
C2-C-25	3.03	0	39	2.7	44	0	7	0	7	0	22	0	13	0	14	0.1	29	2.80	51
CC100A-W2A	48.43	0	39	2.1	46	0	7	0	7	0.1	18	0	13	0	14	0	33	2.20	52
U35-N	1.16	0	39	1.7	49	0	7	0	7	0	22	0	13	0	14	0	33	1.70	53
U29-N	1.08	0	39	1.6	50	0	7	0	7	0	22	0	13	0	14	0	33	1.60	54
U33-S	0.18	0	39	0.3	54	0	7	0	7	0	22	0	13	0	14	0	33	0.30	55
CC100A-E1N	217.08	0	39	0.1	55	0	7	0	7	0	22	0	13	0	14	0	33	0.10	56

Appendix 7D



A-D-A ENGINEERING

Appendix 7D
Sub-Basin FPSS Ranking & Flood Prioritization
Village of Pinecrest Stormwater Master Plan

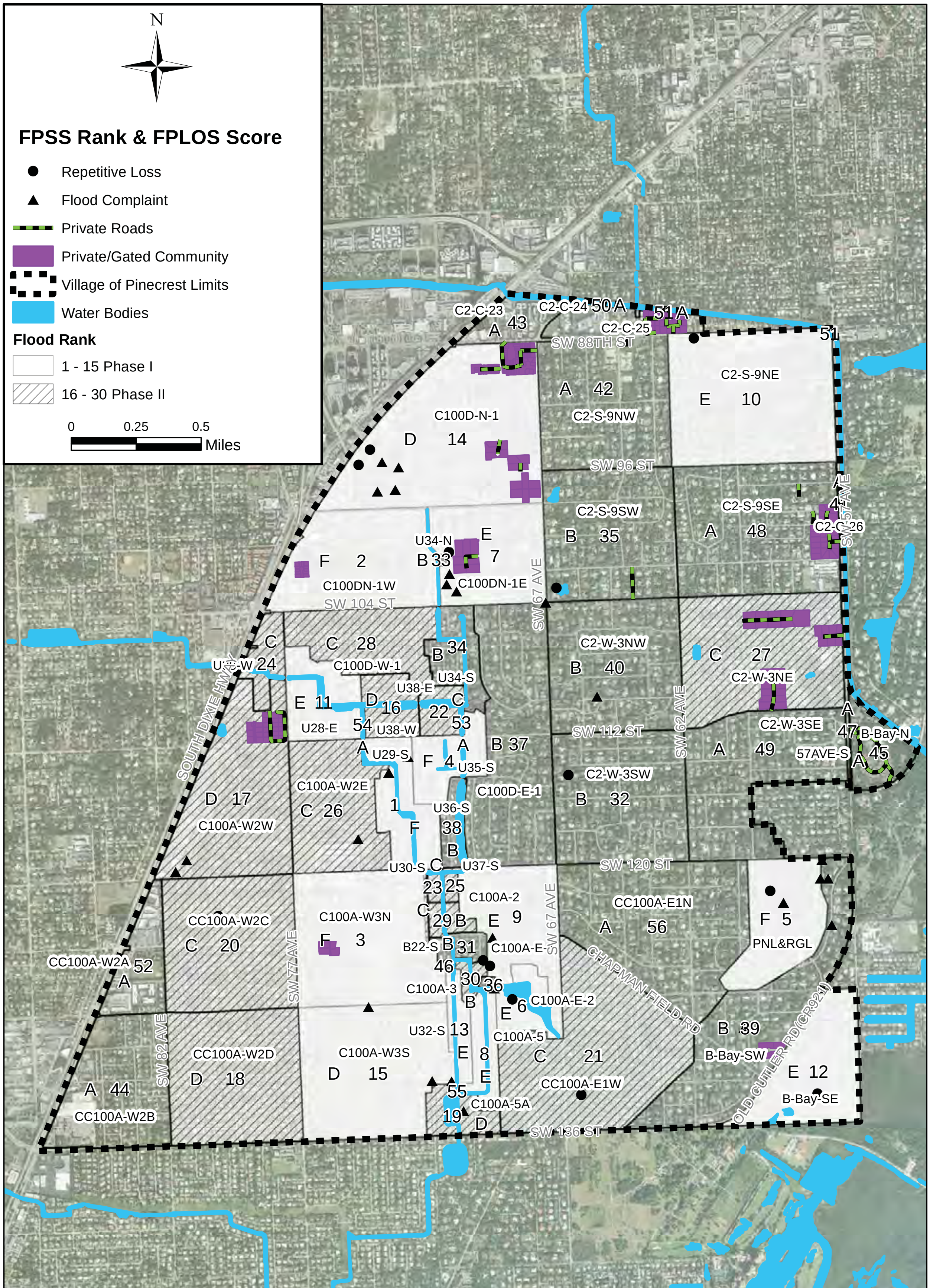
village of PINECREST FLORIDA INCORPORATED 1996

Appendix 7E

Sub-Basin Name	Sub-Basin Area (Acres)	NS 3 Weighing Factor		DEM 5 Weighing Factor		MER 4 Weighing Factor		MMAS 4 Weighing Factor		MCLRS 2 Weighing Factor		RPL 8 Weighing Factor		NFC 2 Weighing Factor		BM 3 Weighing Factor		Composite Scores		
		Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	FPSS	Rank	FPLOS
U29-S	60.15	333	1	39.8	3	0	7	0	7	0.2	16	0	13	4	5	0.5	17	377.50	1	F
C100DN-1W	136.07	240	2	22	12	0	7	0	7	2.2	6	0	13	0	14	2.8	2	267.00	2	F
C100A-W3N	172.75	204	3	51.9	1	0	7	0	7	4.1	2	0	13	0	14	0	33	260.00	3	F
U35-S	42.44	204	3	27.7	5	0.1	5	0	7	0.2	16	0	13	0	14	0.8	11	232.80	4	F
PNL&RGL	86.22	180	5	25.2	9	0	7	0	7	0	22	16	6	2	7	0	33	223.20	5	F
C100A-E-2	33.88	132	7	26.9	7	0	7	0	7	0	22	16	6	0	14	3.8	1	178.70	6	E
C100DN-1E	102.48	111	8	19.3	18	0	7	0	7	0.9	9	24	3	8	2	1.7	4	164.90	7	E
C100A-5	29.60	138	6	22.1	11	0	7	0	7	0	22	0	13	0	14	0.9	8	161.00	8	E
C100A-E-1	90.74	99	11	27.1	6	0	7	0	7	3.2	3	16	6	2	7	0.6	14	147.90	9	E
C2-S-9NE	204.78	78	15	29.7	4	2.2	1	3.9	1	0.8	11	32	2	0	14	0	33	146.60	10	E
U28-E	55.82	102	10	24.7	10	0	7	0	7	0	22	0	13	0	14	0.9	8	127.60	11	E
B-Bay-SE	99.92	90	12	11.8	26	0	7	0	7	6	1	16	6	0	14	0	33	123.80	12	E
U32-S	20.67	105	9	17	20	0	7	0	7	0	22	0	13	0	14	0.3	21	122.30	13	E
C100D-N-1	247.42	39	23	25.5	8	0	7	0	7	0	22	40	1	8	2	0	33	112.50	14	D
C100A-W3S	177.99	90	12	13.5	24	0	7	0	7	2	7	0	13	6	4	0.7	13	112.20	15	D
U38-W	32.81	84	14	21.5	14	0	7	0	7	0	22	0	13	0	14	0.2	24	105.70	16	D
C100A-W2W	170.32	66	17	21.7	13	0	7	0.1	6	1.5	8	0	13	4	5	0.5	17	93.80	17	D
CC100A-W2D	167.29	69	16	21	15	0	7	0	7	2.4	5	0	13	0	14	0	33	92.40	18	D
C100A-5A	28.08	66	17	17.6	19	0	7	0	7	0	22	0	13	2	7	1.3	5	86.90	19	D
CC100A-W2C	167.39	18	27	40.9	2	0	7	0	7	0.9	9	16	6	0	14	0	33	75.80	20	C
CC100A-E1W	224.40	24	24	21	15	0.3	4	0.9	2	0.8	11	24	3	0	14	0	33	71.00	21	C
U38-E	20.07	54	21	13.8	23	0	7	0	7	0	22	0	13	0	14	0.8	11	68.60	22	C
U30-S	5.80	60	19	5.5	36	0	7	0	7	0	22	0	13	0	14	0.3	21	65.80	23	C
U28-W	25.93	57	20	7.2	31	0	7	0	7	0	22	0	13	0	14	0.2	24	64.40	24	C
U37-S	5.26	48	22	5.8	33	0	7	0	7	0	22	0	13	0	14	0.2	24	54.00	25	C
C100A-W2E	110.43	18	27	16.5	21	0	7	0	7	2.9	4	0	13	2	7	0.6	14	40.00	26	C
C2-W-3NE	183.76	18	27	14.3	22	0	7	0	7	0.1	18	0	13	0	14	0	33	32.40	27	C
C100D-W-1	83.66	24	24	5.8	33	0	7	0	7	0.4	13	0	13	0	14	0	33	30.20	28	C
C100A-2	13.68	21	26	5.7	35	0	7	0	7	0	22	0	13	0	14	0.1	29	26.80	29	B
C100A-3	8.98	18	27	7.4	30	0	7	0	7	0	22	0	13	0	14	0.5	17	25.90	30	B
B22-S	13.43	6	33	3.5	40	0	7	0	7	0	22	16	6	0	14	0.1	29	25.60	31	B
C2-W-3SW	165.23	0	39	0.1	55	0	7	0	7	0	22	24	3	0	14	0	33	24.10	32	B
U34-N	3.13	18	27	4.6	38	0	7	0	7	0	22	0	13	0	14	0.2	24	22.80	33	B
U34-S	39.98	0	39	19.4	17	0	7	0	7	0	22	0	13	0	14	1.2	6	20.60	34	B
C2-S-9SW	164.60	0	39	1.2	52	0	7	0	7	0	22	16	6	0	14	0	33	17.20	35	B
C100A-4	1.88	12	32	2.1	46	0	7	0	7	0	22	0	13	2	7	0.3	21	16.40	36	B
C100D-E-1	186.07	3	36	10.3	27	0.1	5	0.3	5	0.3	15	0	13	0	14	2.3	3	16.30	37	B
U36-S	19.44	0	39	12.8	25	0	7	0	7	0	22	0	13	0	14	0.6	14	13.40	38	B
B-Bay-SW	166.72	0	39	1.6	50	0	7	0	7	0	22	0	13	10	1	0	33	11.60	39	B
C2-W-3NW	164.95	6	33	2.3	45	0	7	0	7	0.1	18	0	13	2	7	0	33	10.40	40	B
C2-C-26	14.49	0	39	8.3	28	1.1	2	0	7	0	22	0	13	0	14	0.2	24	9.60	41	A
C2-S-9NW	201.90	0	39	6.4	32	0	7	0	7	0	22	0	13	2	7	1	7	9.40	42	A
C2-C-23	33.34	0	39	8.3	28	0	7	0	7	0	22	0	13	0	14	0.9	8	9.20	43	A
CC100A-W2B	124.62	3	36	5.4	37	0	7	0.4	4	0.4	13	0	13	0	14	0	33	9.20	44	A
B-Bay-N	39.18	3	36	4.3	39	0	7	0	7	0	22	0	13	0	14	0.5	17	7.80	45	A
U32-N	1.37	6	33	0.8	53	0	7	0	7	0	22	0	13	0	14	0	33	6.80	46	A
57AVE-S	4.56	0	39	2	48	0.8	3	0.8	3	0	22	0	13	0	14	0	33	3.60	47	A
C2-S-9SE	202.70	0	39	3.2	41	0	7	0	7	0.1	18	0	13	0	14	0	33	3.30	48	A
C2-W-3SE	161.34	0	39	3.1	42	0	7	0	7	0	22	0	13	0	14	0	33	3.10	49	A
C2-C-24	2.00	0	39	2.8	43	0	7	0	7	0	22	0	13	0	14	0.1	29	2.90	50	A

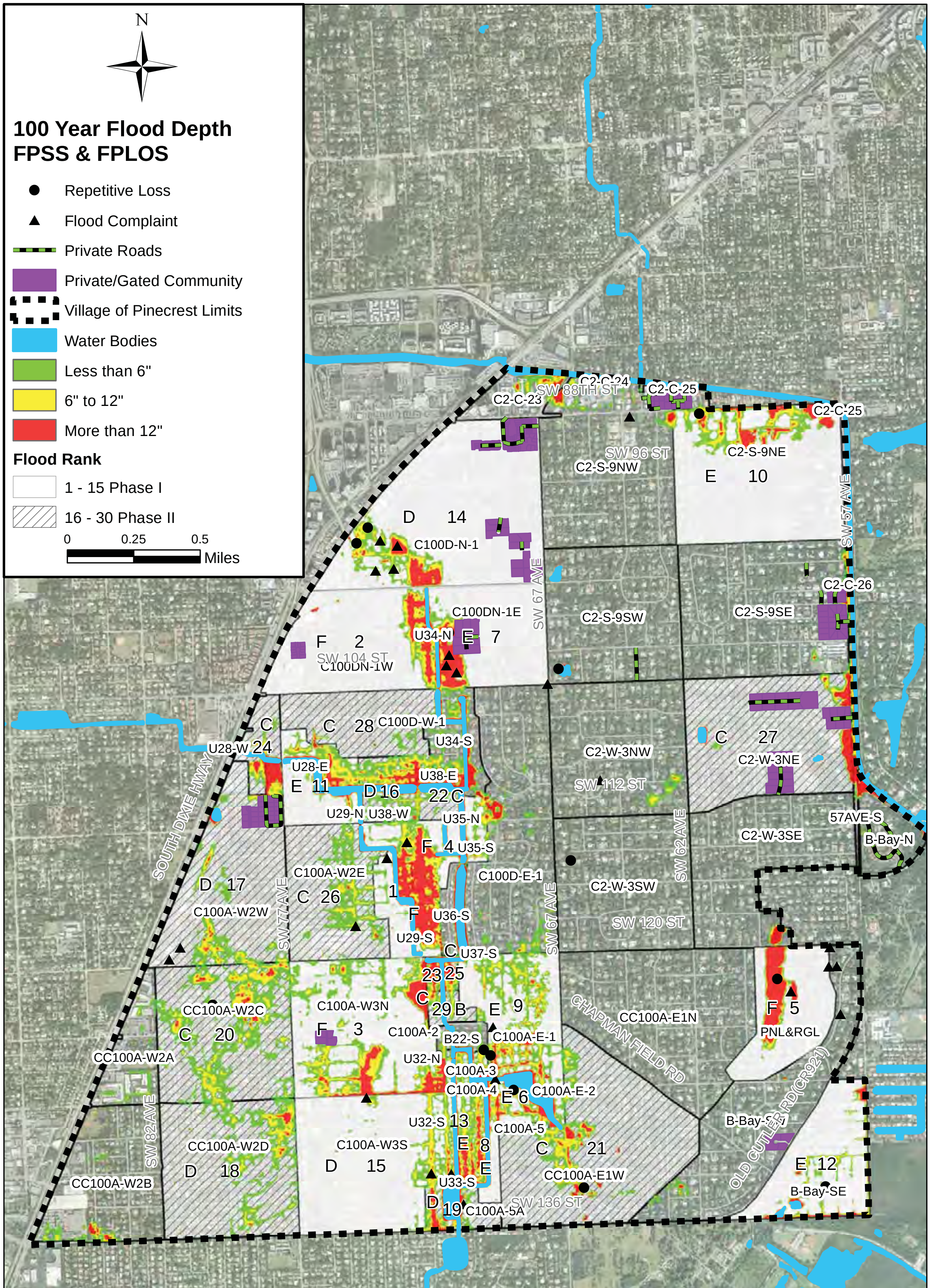
Sub-Basin Name	Sub-Basin Area (Acres)	NS 3 Weighing Factor		DEM 5 Weighing Factor		MER 4 Weighing Factor		MMAS 4 Weighing Factor		MCLRS 2 Weighing Factor		RPL 8 Weighing Factor		NFC 2 Weighing Factor		BM 3 Weighing Factor		Composite Scores		
		Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	FPSS	Rank	FPLOS
C2-C-25	3.03	0	39	2.7	44	0	7	0	7	0	22	0	13	0	14	0.1	29	2.80	51	A
CC100A-W2A	48.43	0	39	2.1	46	0	7	0	7	0.1	18	0	13	0	14	0	33	2.20	52	A
U35-N	1.16	0	39	1.7	49	0	7	0	7	0	22	0	13	0	14	0	33	1.70	53	A
U29-N	1.08	0	39	1.6	50	0	7	0	7	0	22	0	13	0	14	0	33	1.60	54	A
U33-S	0.18	0	39	0.3	54	0	7	0	7	0	22	0	13	0	14	0	33	0.30	55	A
CC100A-E1N	217.08	0	39	0.1	55	0	7	0	7	0	22	0	13	0	14	0	33	0.10	56	A

Appendix 7F



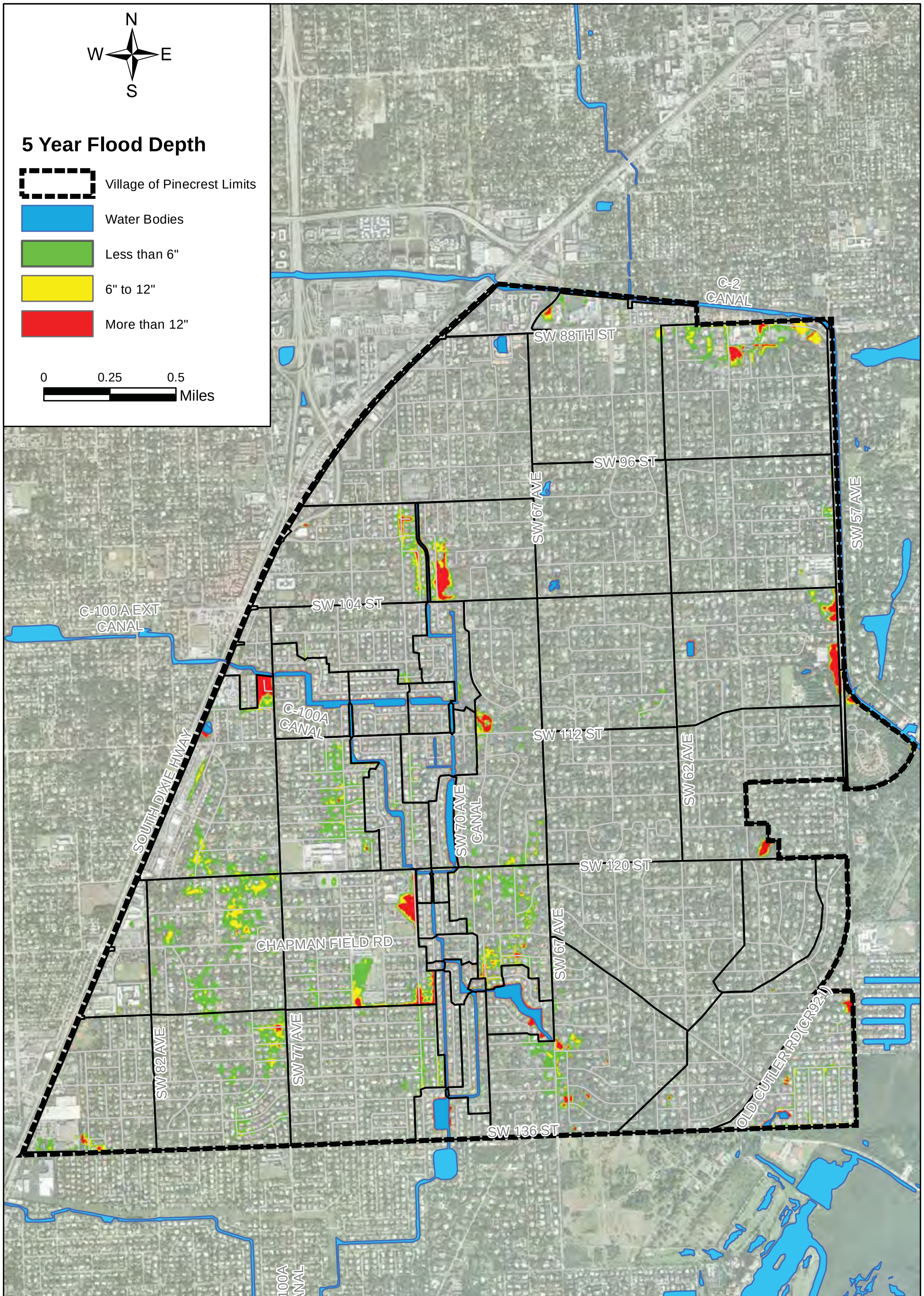
Appendix 7F
FPSS Rank & FPLOS Score
Village of Pinecrest Stormwater Master Plan

Appendix 7G



Appendix 7G
100-Year, 72-Hour Flood Plain Map with FPSS Rank & FPLOS Score for Top 30 Ranked Sub-Basins

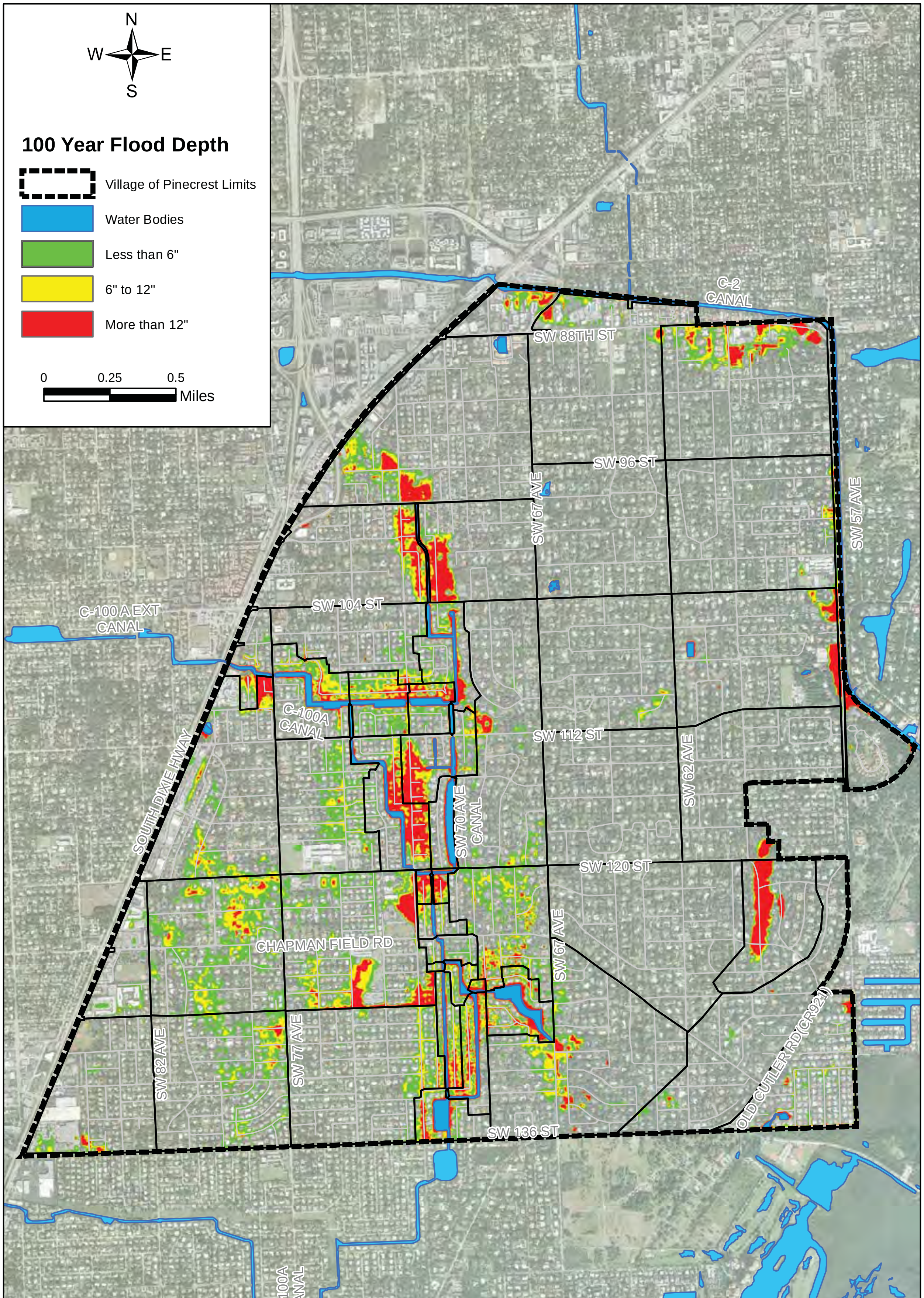
Appendix 8A



A·D·A ENGINEERING

Appendix 8A
Sea Level Rise Projection 2030 - Mid-Range 5"
5-Year, 24-Hour Flood Plain Map Village of Pinecrest

village of PINECREST FLORIDA



Appendix 8A
Sea Level Rise Projection 2030 - Mid-Range 5"
100-Year, 72-Hour Flood Plain Map Village of Pinecrest

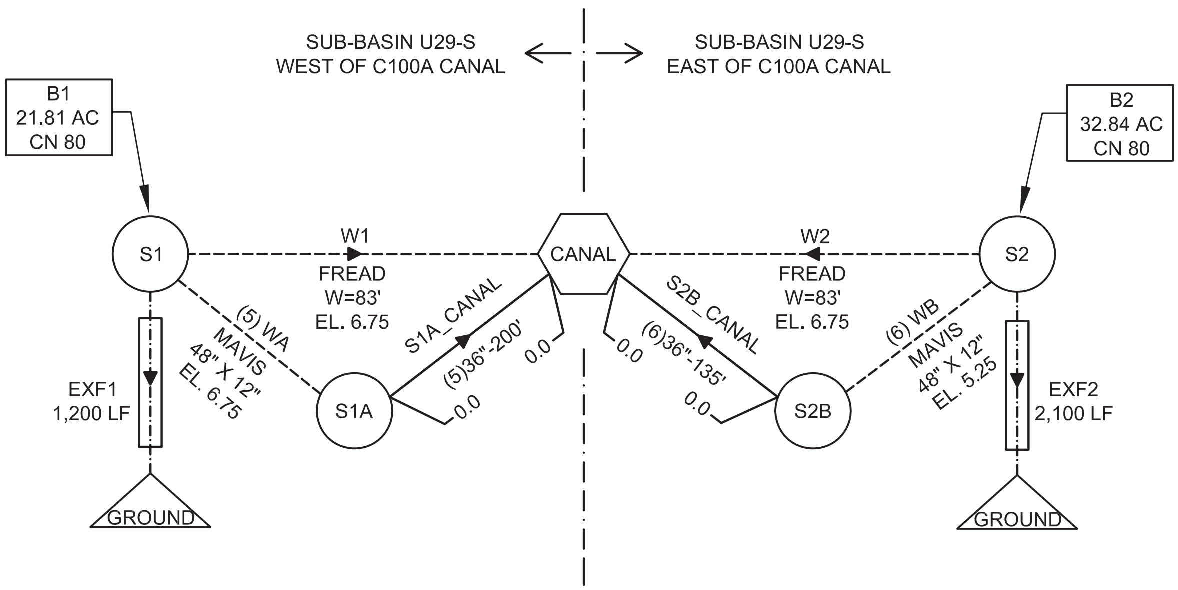
Appendix 8B

On File in the Office of the Village Clerk

Appendix 8C

On File in the Office of the Village Clerk

Appendix 8D



NODE-LINK SCHEMATIC

LEGEND	
B1 / 21.81 AC / CN 80	CONTRIBUTING BASIN BASIN NAME AC=BASIN AREA ACRES CN=CURVE NUMBER
B2 / 32.84 AC / CN 80	CONTRIBUTING BASIN BASIN NAME AC=BASIN AREA ACRES CN=CURVE NUMBER
S1	SUB-BASIN U29-S WEST OF C100A CANAL
S2	SUB-BASIN U29-S EAST OF C100A CANAL
GROUND	BOUNDARY NODE WITH VARIABLE TAILWATER

LEGEND	
CANAL	BOUNDARY NODE WITH TIME STAGE CANAL NAME C100A
S1A_CANAL / (5)36"-200' / 0.0 0.0	PIPE LINK WITH (QUANTITY)SIZE-LENGTH INVERT ELEVATIONS
(5) WA / MAVIS / 48" X 12" / EL. 6.5	(QUANTITY) WEIR LINK WEIR TYPE SIZE (WIDTH X DEPTH) EL=CREST ELEVATION
EXF1 / 1,000 LF	EXFILTRATION TRENCH WITH FLOW DIRECTION LENGTH LINEAR FOOT (LF)

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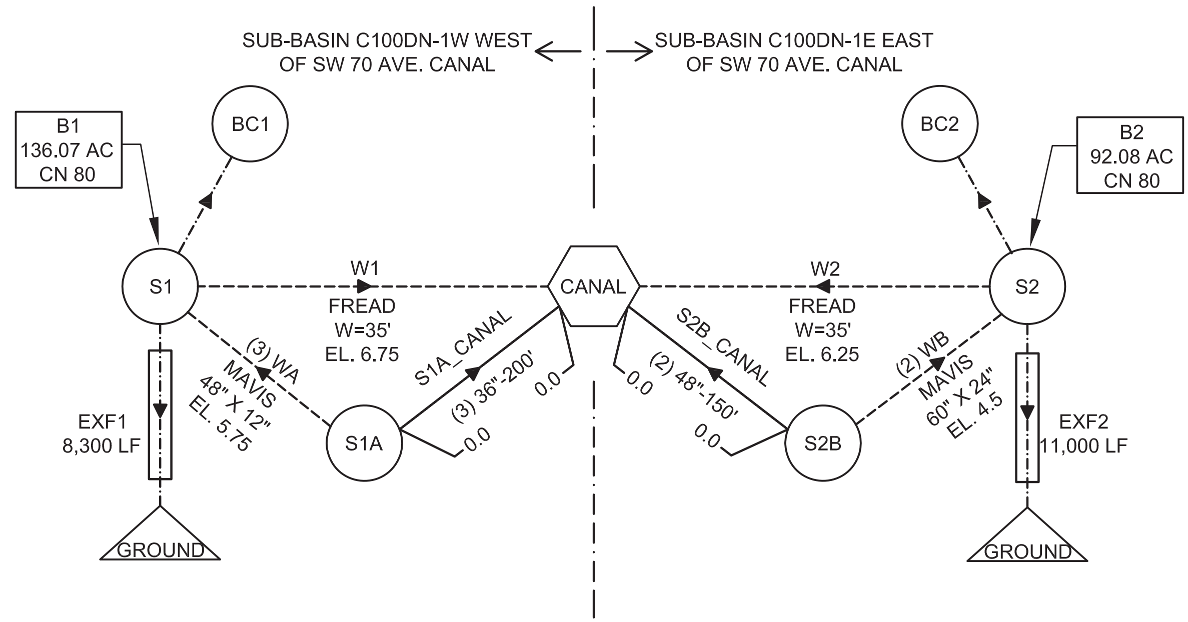
PROPOSED CONDITION
NODE–LINK SCHEMATIC
SUB–BASIN U29–S

APPENDIX
8D



NODE-LINK SCHEMATIC

LEGEND

B1 136.07 AC CN 80	CONTRIBUTING BASIN BASIN NAME AC=BASIN AREA ACRES CN=CURVE NUMBER
B2 92.08 AC CN 80	CONTRIBUTING BASIN BASIN NAME AC=BASIN AREA ACRES CN=CURVE NUMBER
S1	SUB-BASIN C100DN-1W OF SW 70 AVE.
S2	SUB-BASIN C100DN-1E OF SW 70 AVE.
BC1	BOUNDARY CONDITION FOR C100DN-1W
BC2	BOUNDARY CONDITION FOR C100DN-1E

LEGEND

GROUND	BOUNDARY NODE WITH VARIABLE TAILWATER
CANAL	BOUNDARY NODE WITH TIME STAGE CANAL SW 70 AVE.
S1A_CANAL (3) 36"-200' 0.0 0.0	PIPE LINK WITH (QUANTITY)SIZE-LENGTH INVERT ELEVATIONS
(3) WA MAVIS 48" X 12" EL. 5.75	(QUANTITY) WEIR LINK WEIR TYPE SIZE (WIDTH X DEPTH) EL=CREST ELEVATION
EXF1 7,000 LF	EXFILTRATION TRENCH WITH FLOW DIRECTION LENGTH LINEAR FOOT (LF)
	RATING CURVE LINK

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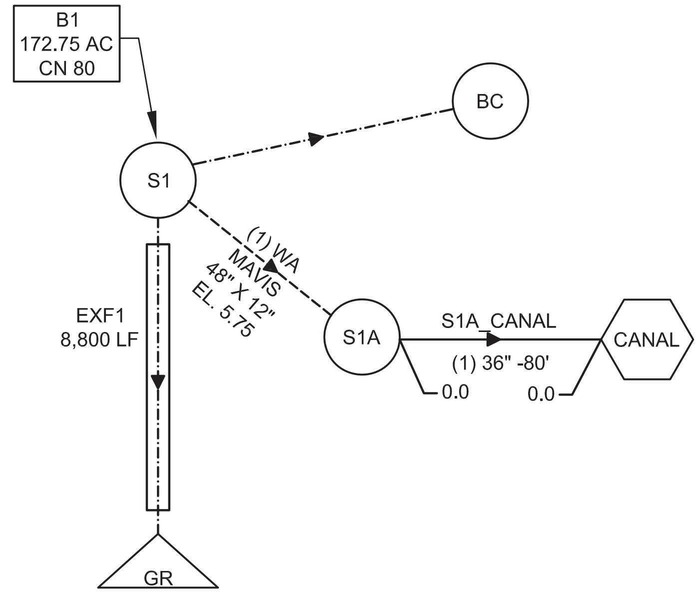
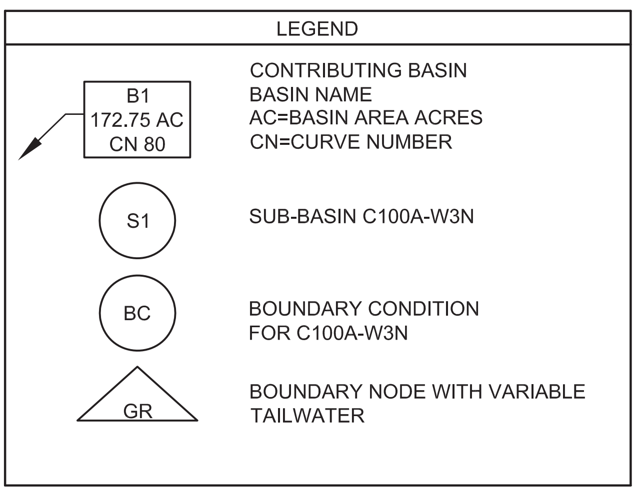
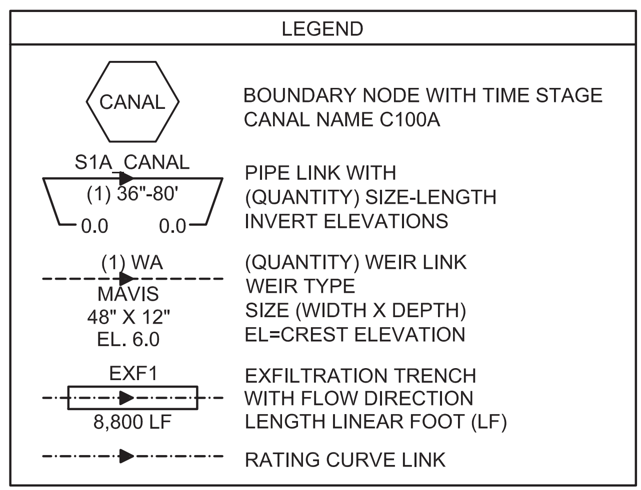
PROPOSED CONDITION
NODE-LINK SCHEMATIC
SUB-BASIN C100DN-1W&C100DN-1E

APPENDIX
8D



NODE-LINK SCHEMATIC





PROPOSED CONDITION
NODE–LINK SCHEMATIC
SUB–BASIN C100A–W3N

APPENDIX
8D

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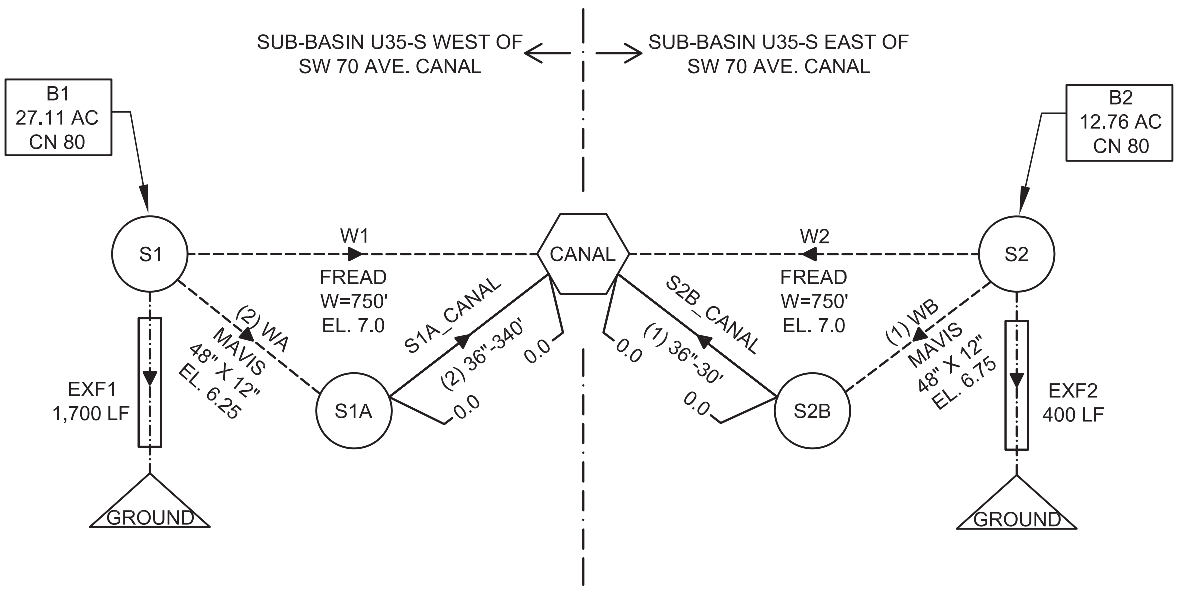

NODE-LINK SCHEMATIC

LEGEND	
B1 / 27.11 AC / CN 80	CONTRIBUTING BASIN BASIN NAME AC=BASIN AREA ACRES CN=CURVE NUMBER
B2 / 12.76 AC / CN 80	CONTRIBUTING BASIN BASIN NAME AC=BASIN AREA ACRES CN=CURVE NUMBER
S1	SUB-BASIN U35-S WEST OF SW 70 AVE CANAL
S2	SUB-BASIN U35-S EAST OF SW 70 AVE CANAL
GROUND	BOUNDARY NODE WITH VARIABLE TAILWATER

LEGEND	
CANAL	BOUNDARY NODE WITH TIME STAGE CANAL NAME C100A
S1A_CANAL (2) 36"-340' 0.0 0.0	PIPE LINK WITH (QUANTITY) SIZE-LENGTH INVERT ELEVATIONS
(2) WA MAVIS 48" X 12" EL. 6.0	(QUANTITY) WEIR LINK WEIR TYPE SIZE (WIDTH X DEPTH) EL=CREST ELEVATION
EXF1 1,700 LF	EXFILTRATION TRENCH WITH FLOW DIRECTION LENGTH LINEAR FOOT (LF)

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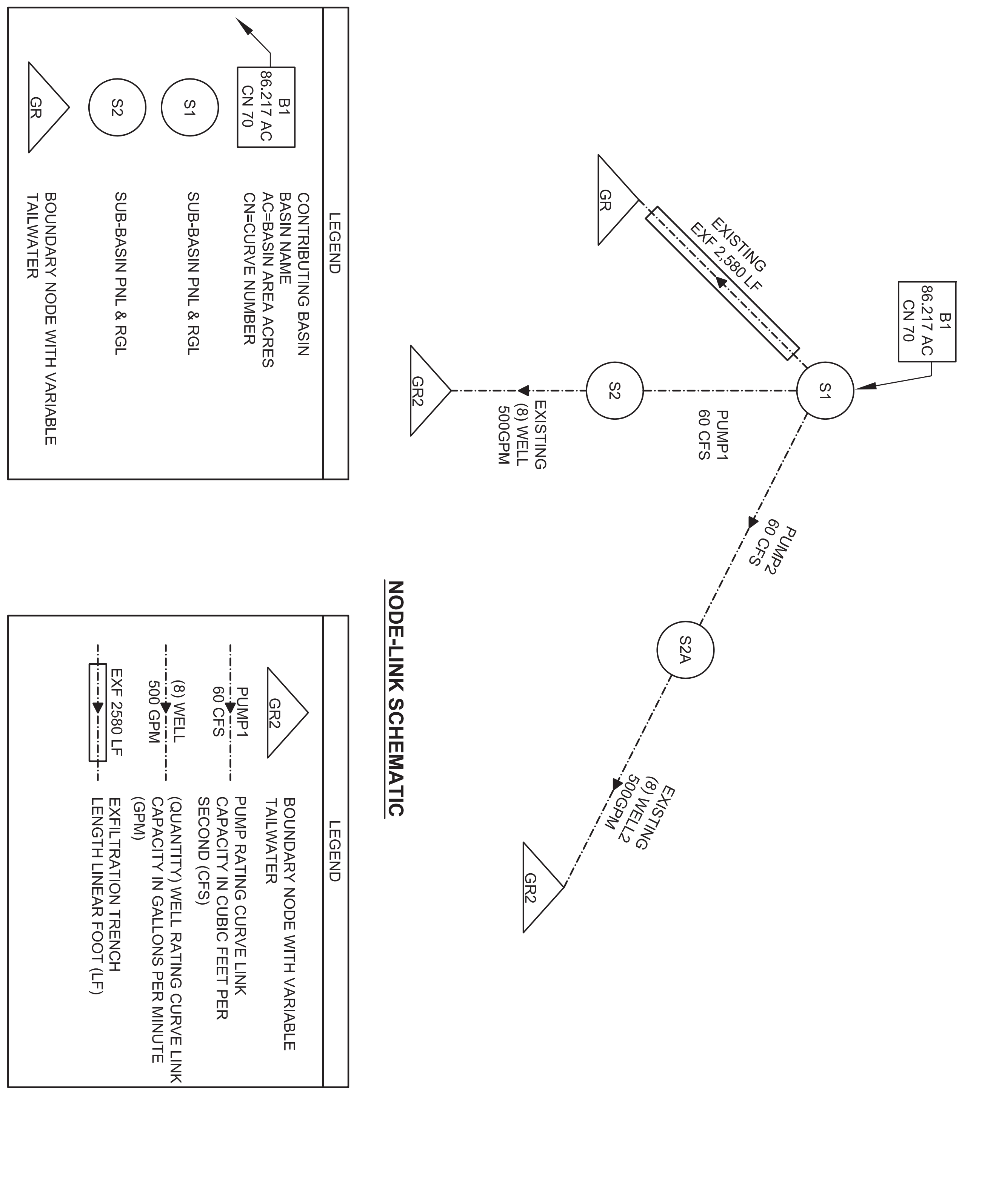
PROPOSED CONDITION NODE–LINK SCHEMATIC SUB–BASIN U35–S

APPENDIX 8D



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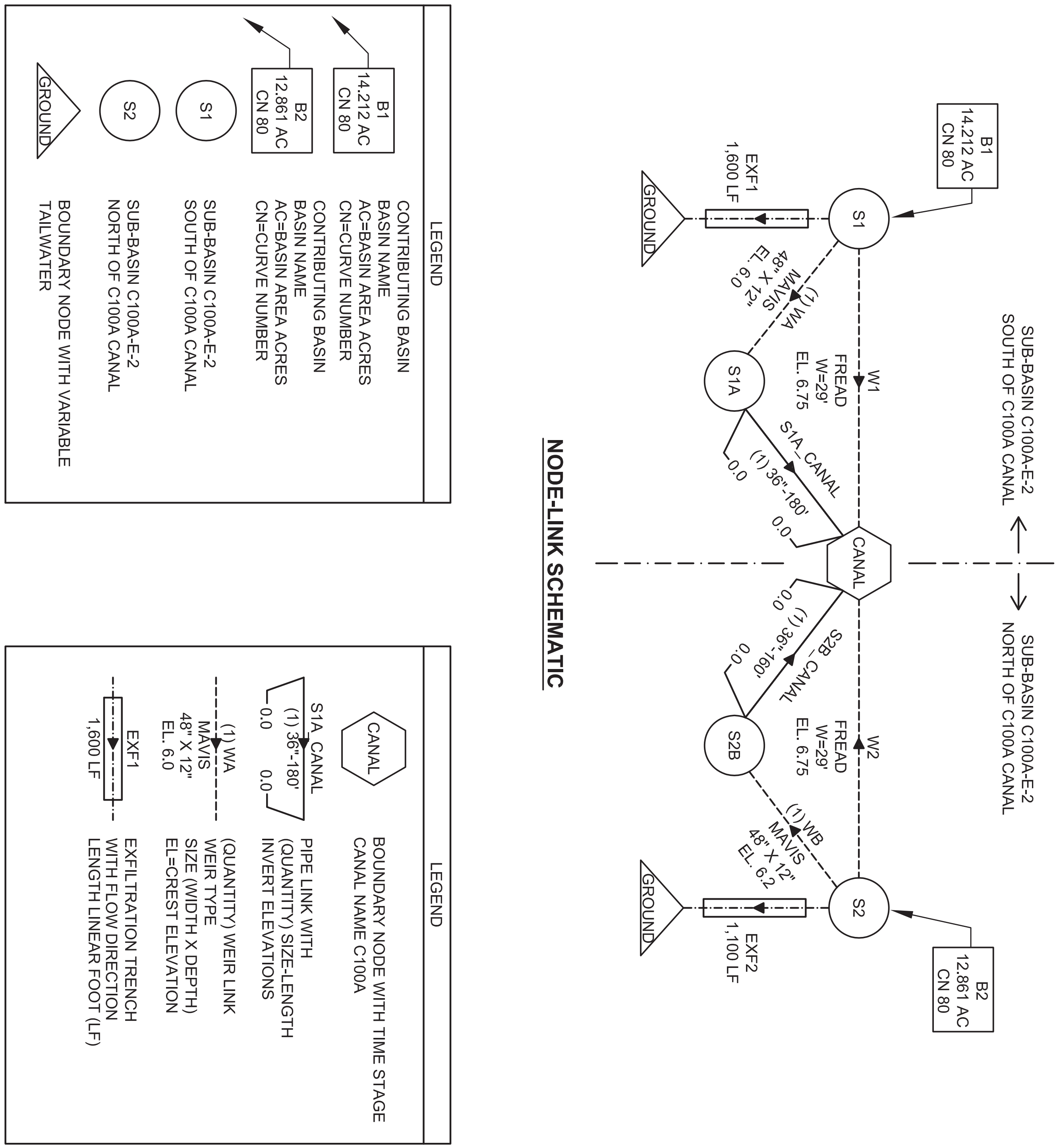
PROPOSED CONDITION
NODE-LINK SCHEMATIC
SUB-BASIN PNL & RGL

APPENDIX
8D



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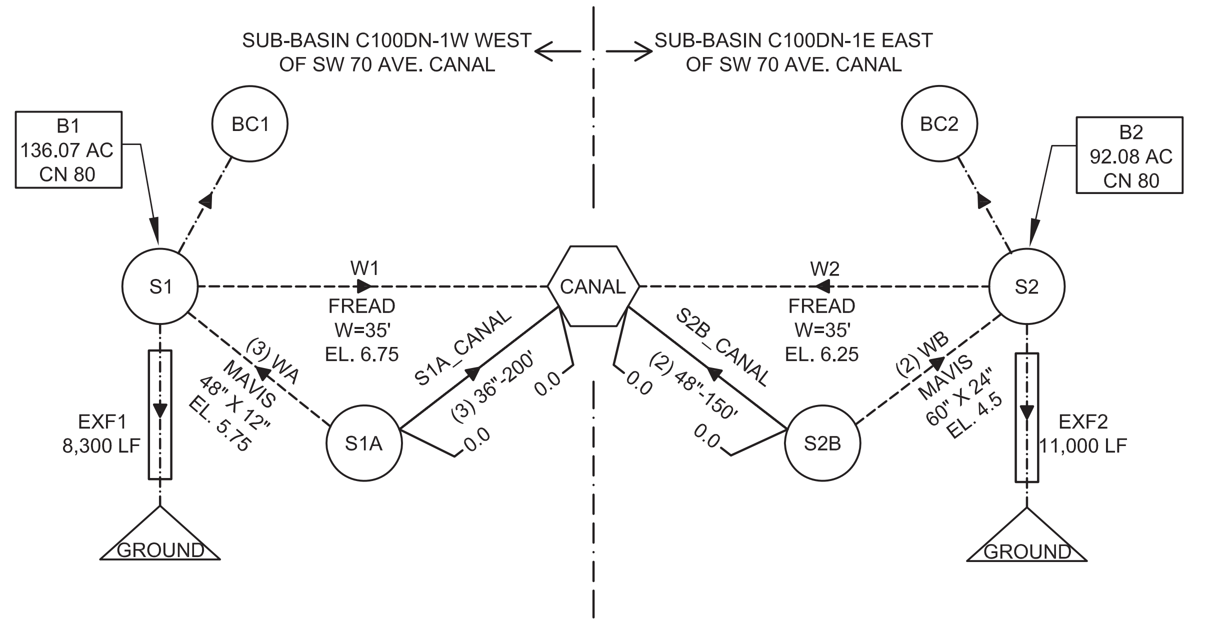
PROPOSED CONDITION
NODE-LINK SCHEMATIC
SUB-BASIN C100A-E-2

APPENDIX
8D



NODE-LINK SCHEMATIC

LEGEND	
B1 136.07 AC CN 80	CONTRIBUTING BASIN BASIN NAME AC=BASIN AREA ACRES CN=CURVE NUMBER
B2 92.08 AC CN 80	CONTRIBUTING BASIN BASIN NAME AC=BASIN AREA ACRES CN=CURVE NUMBER
S1	SUB-BASIN C100DN-1W OF SW 70 AVE.
S2	SUB-BASIN C100DN-1E OF SW 70 AVE.
BC1	BOUNDARY CONDITION FOR C100DN-1W
BC2	BOUNDARY CONDITION FOR C100DN-1E

LEGEND	
GROUND	BOUNDARY NODE WITH VARIABLE TAILWATER
CANAL	BOUNDARY NODE WITH TIME STAGE CANAL SW 70 AVE.
S1A_CANAL (3) 36"-200' 0.0 0.0	PIPE LINK WITH (QUANTITY)SIZE-LENGTH INVERT ELEVATIONS
(3) WA MAVIS 48" X 12" EL. 5.75	(QUANTITY) WEIR LINK WEIR TYPE SIZE (WIDTH X DEPTH) EL=CREST ELEVATION
EXF1 7,000 LF	EXFILTRATION TRENCH WITH FLOW DIRECTION LENGTH LINEAR FOOT (LF)
	RATING CURVE LINK

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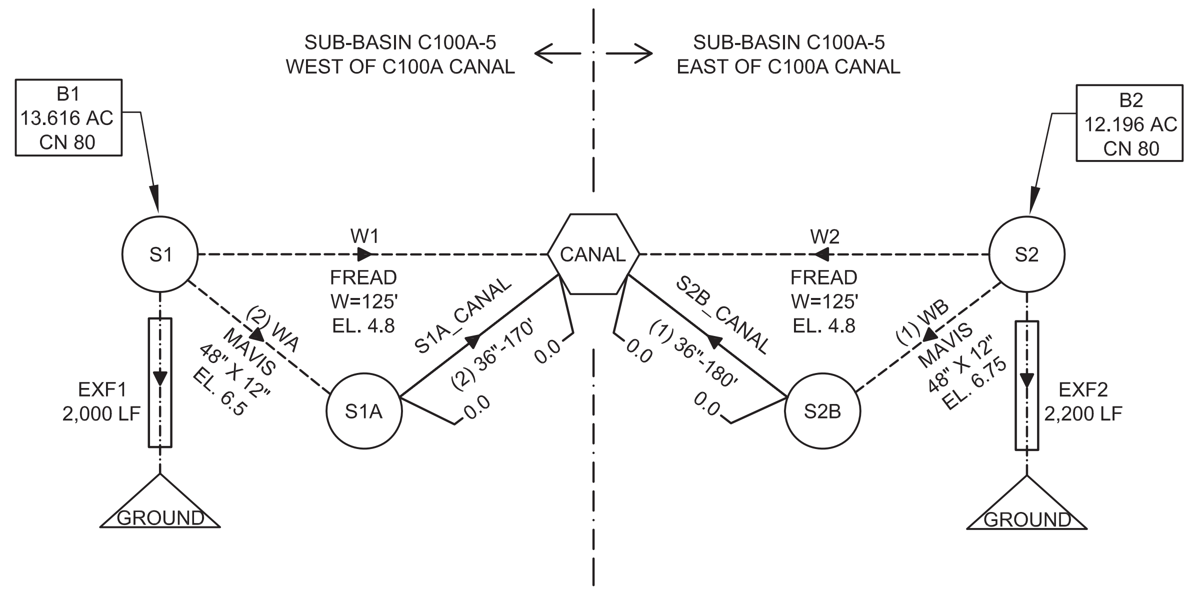
PROPOSED CONDITION
NODE–LINK SCHEMATIC
SUB–BASIN C100DN–1W&C100DN–1E

APPENDIX
8D



NODE-LINK SCHEMATIC

LEGEND	
B1 13.616 AC CN 80	CONTRIBUTING BASIN BASIN NAME AC=BASIN AREA ACRES CN=CURVE NUMBER
B2 12.196 AC CN 80	CONTRIBUTING BASIN BASIN NAME AC=BASIN AREA ACRES CN=CURVE NUMBER
S1	SUB-BASIN C100A-5 WEST OF C100A CANAL
S2	SUB-BASIN C100A-5 EAST OF C100A CANAL
GROUND	BOUNDARY NODE WITH VARIABLE TAILWATER

LEGEND	
CANAL	BOUNDARY NODE WITH TIME STAGE CANAL NAME C100A
S1A_CANAL (2) 36"-170' 0.0 0.0	PIPE LINK WITH (QUANTITY) SIZE-LENGTH INVERT ELEVATIONS
(2) WA MAVIS 48" X 12" EL. 5.75	(QUANTITY) WEIR LINK WEIR TYPE SIZE (WIDTH X DEPTH) EL=CREST ELEVATION
EXF1 2,000 LF	EXFILTRATION TRENCH WITH FLOW DIRECTION LENGTH LINEAR FOOT (LF)

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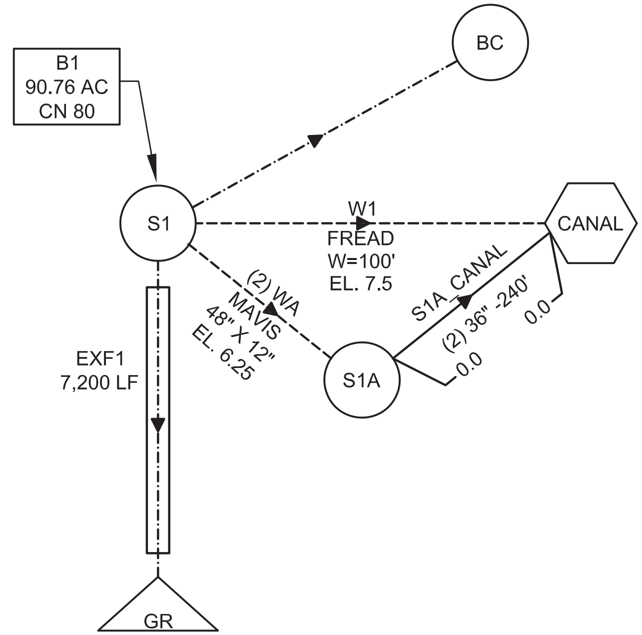
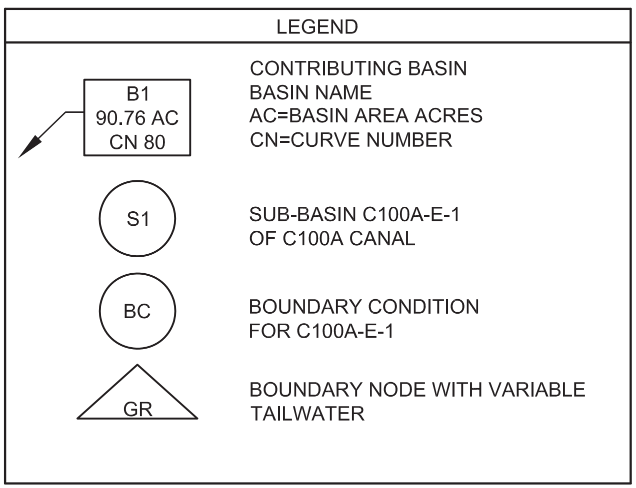
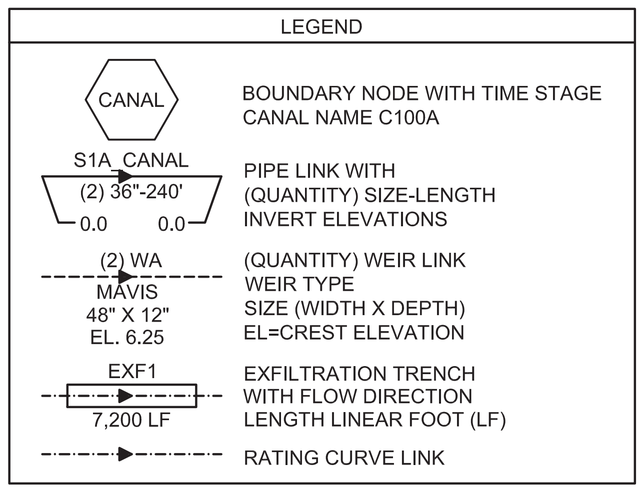
PROPOSED CONDITION NODE-LINK SCHEMATIC SUB-BASIN C100A-5

APPENDIX 8D



NODE-LINK SCHEMATIC





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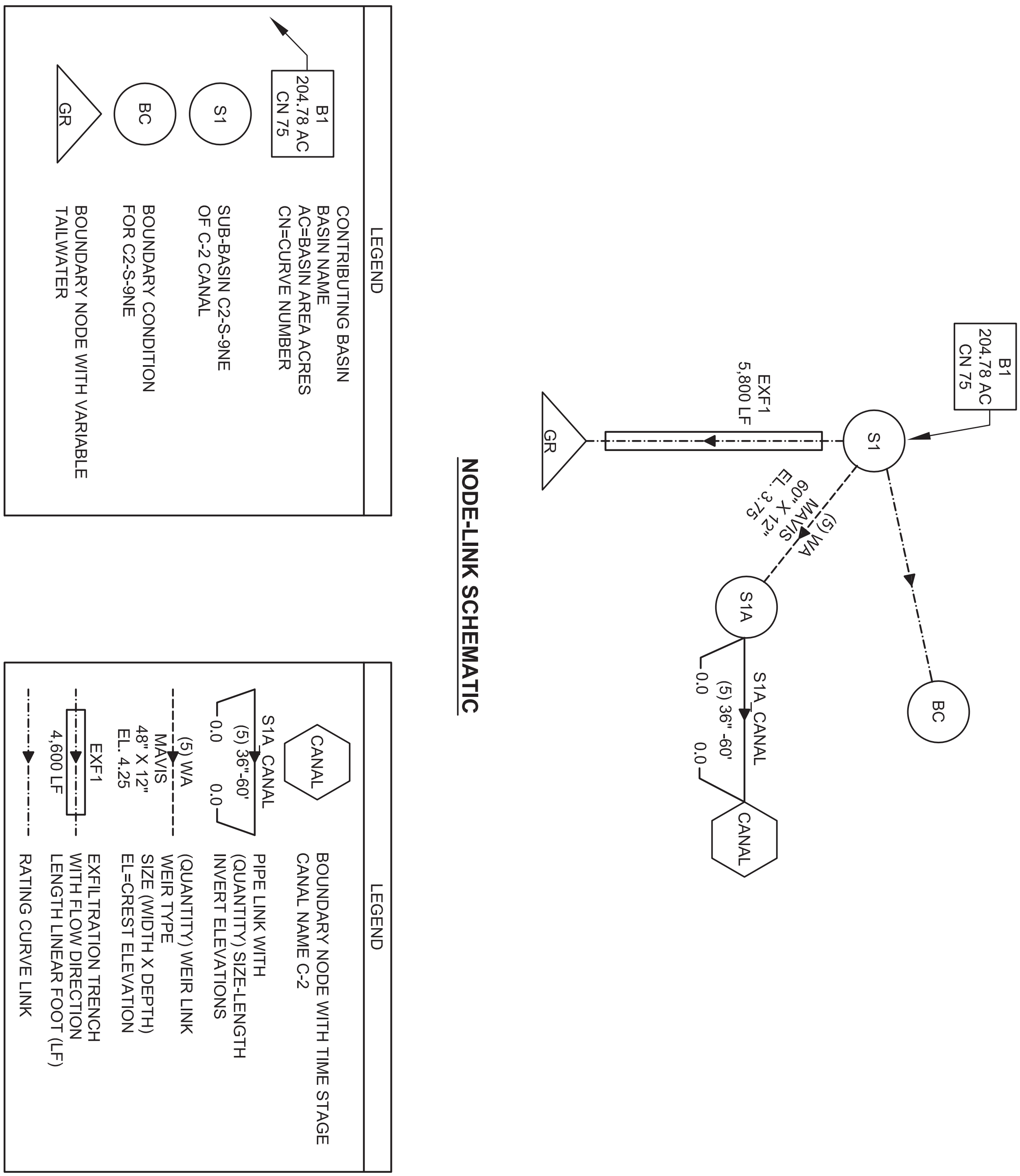
PROPOSED CONDITION
NODE—LINK SCHEMATIC
SUB—BASIN C100A—E—1

APPENDIX
8D



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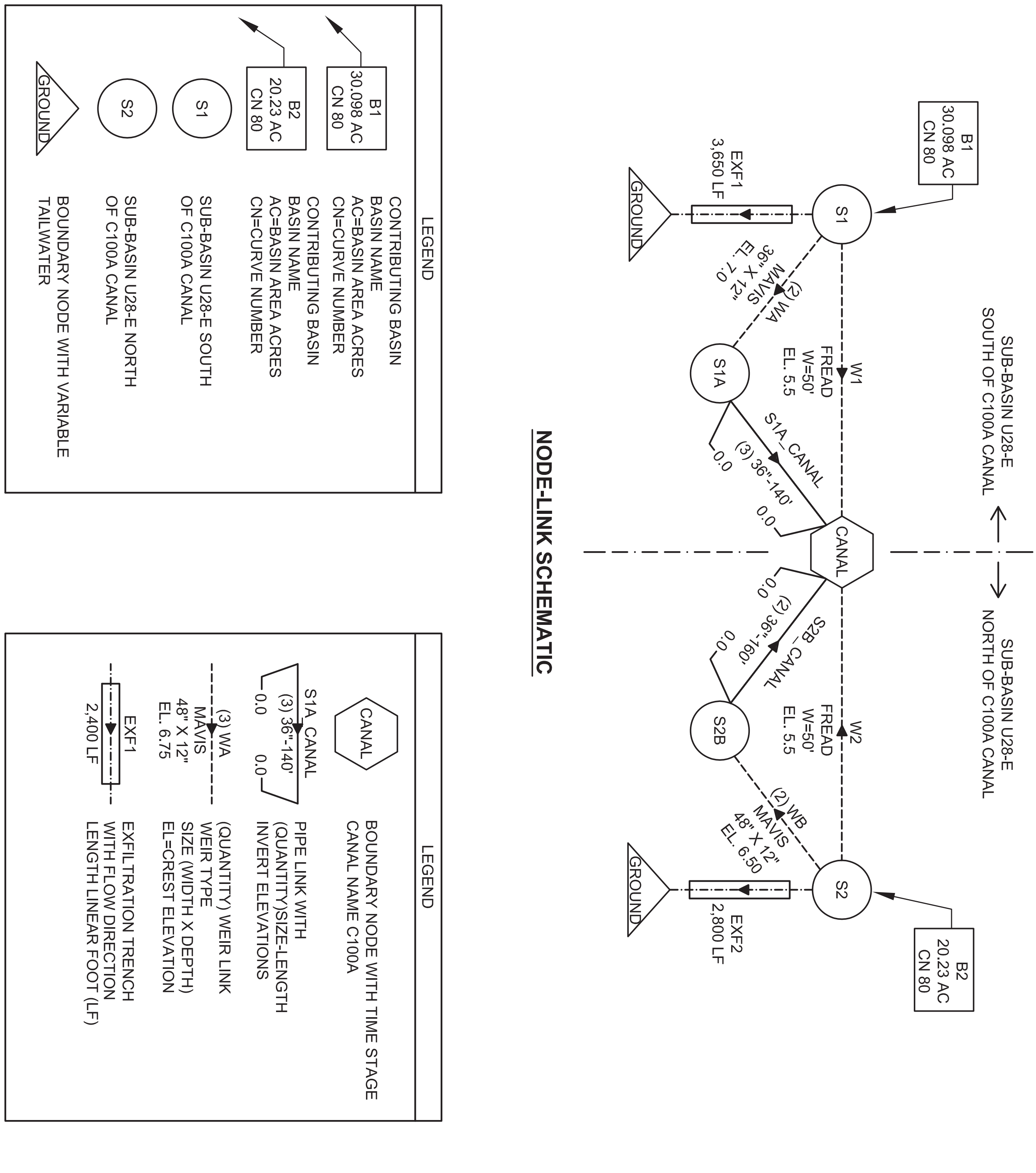
PROPOSED CONDITION
NODE-LINK SCHEMATIC
SUB-BASIN C2-S-9NE

APPENDIX
8D



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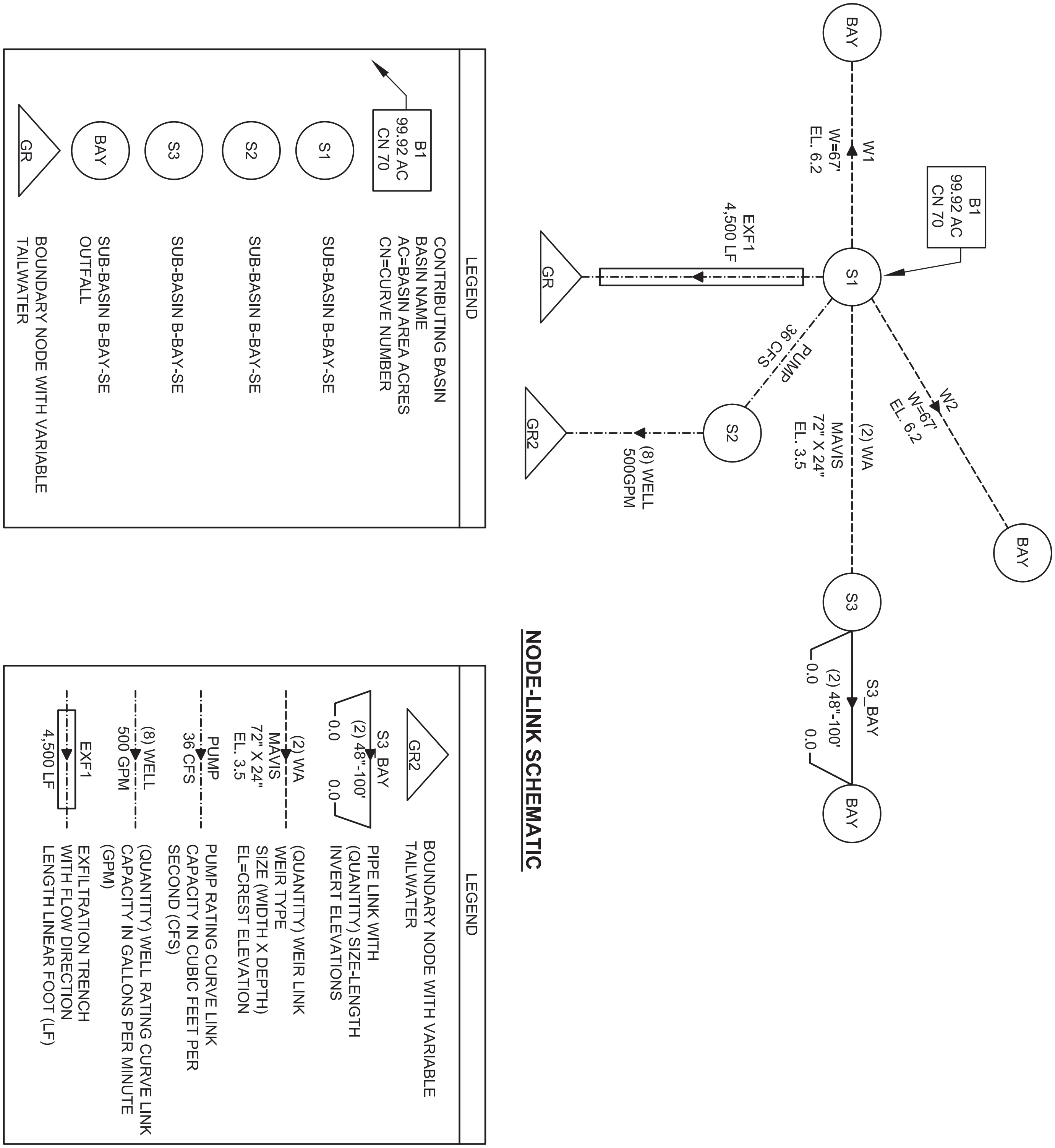
PROPOSED CONDITION
NODE-LINK SCHEMATIC
SUB-BASIN U28-E

APPENDIX
8D



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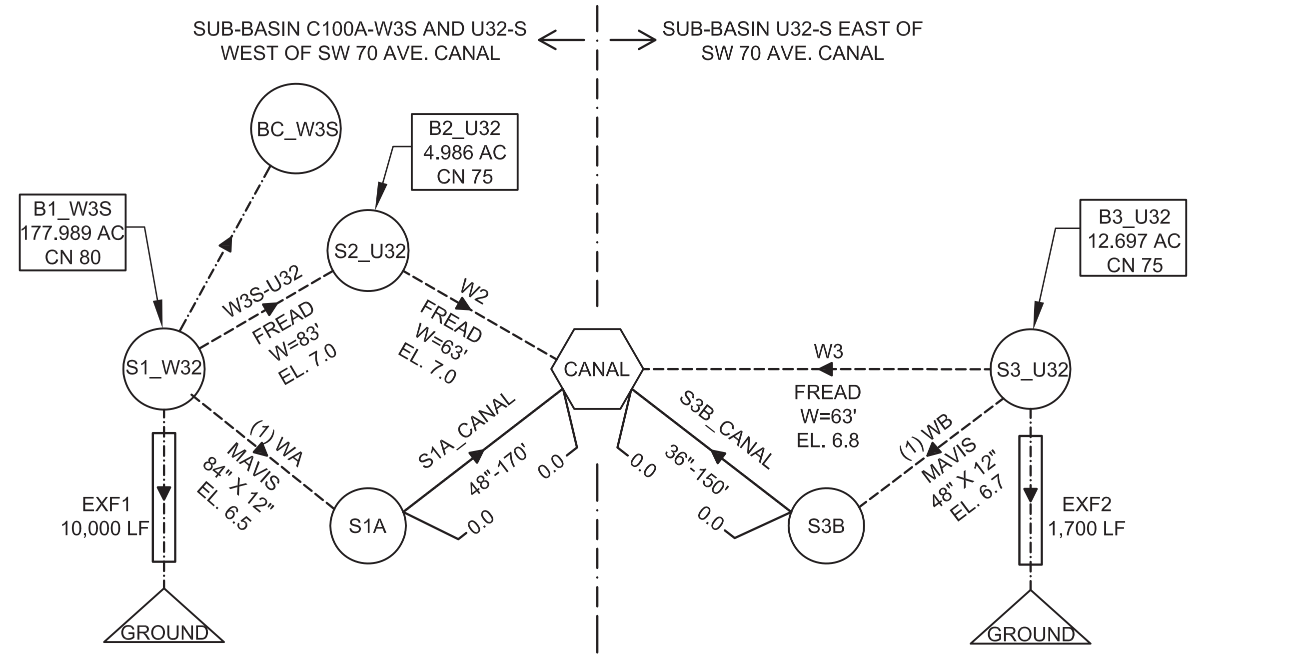
PROPOSED CONDITION
NODE–LINK SCHEMATIC
SUB–BASIN B–BAY–SE

APPENDIX
8D



NODE-LINK SCHEMATIC

LEGEND

B1_W3S 177.989 AC CN 80	CONTRIBUTING BASIN BASIN NAME AC=BASIN AREA ACRES CN=CURVE NUMBER
B2_U32 4.986 AC CN 75	CONTRIBUTING BASIN BASIN NAME AC=BASIN AREA ACRES CN=CURVE NUMBER
B3_U32 12.697 AC CN 75	CONTRIBUTING BASIN BASIN NAME AC=BASIN AREA ACRES CN=CURVE NUMBER
S1_W32	SUB-BASIN C100A-W3S WEST OF SW 70 AVE CANAL
S2_U32	SUB-BASIN U32-S WEST OF SW 70 AVE CANAL
S3_U32	SUB-BASIN U32-S EAST OF SW 70 AVE CANAL

LEGEND

BC_W3S	BOUNDARY CONDITION FOR C100A-W3S
GROUND	BOUNDARY NODE WITH VARIABLE TAILWATER
CANAL	BOUNDARY NODE WITH TIME STAGE CANAL NAME SW 70 AVE.
S1A_CANAL 48"-170' 0.0 0.0	PIPE LINK WITH SIZE-LENGTH INVERT ELEVATIONS
(1) WA MAVIS 84" X 12" EL. 6.5	(QUANTITY) WEIR LINK WEIR TYPE SIZE (WIDTH X DEPTH) EL=CREST ELEVATION
EXF1 1,700 LF	EXFILTRATION TRENCH WITH FLOW DIRECTION LENGTH LINEAR FOOT (LF)
(dash-dot line with arrow)	RATING CURVE LINK

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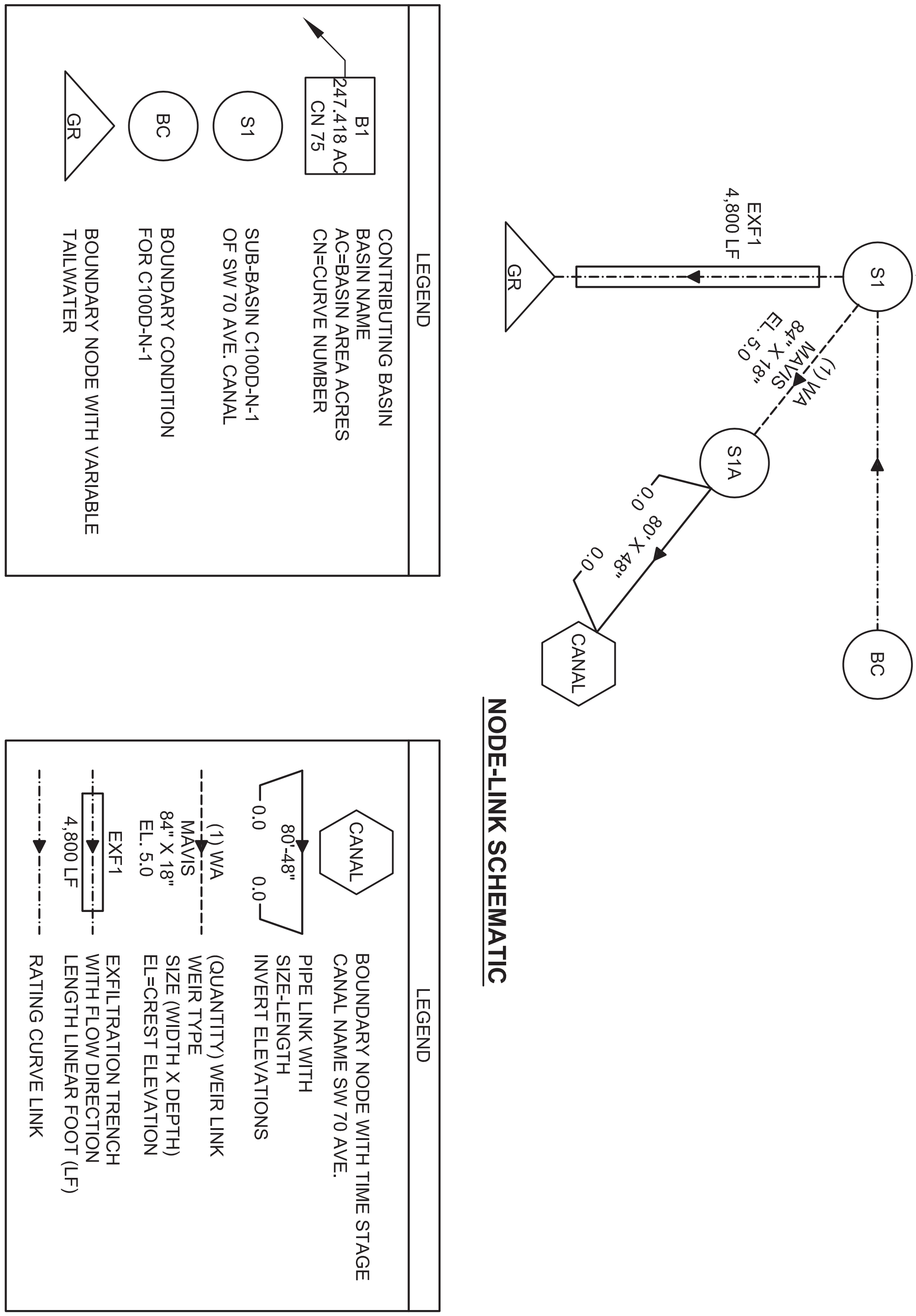
PROPOSED CONDITION
NODE–LINK SCHEMATIC
SUB–BASIN C100A–W3S&U32–S

APPENDIX 8D



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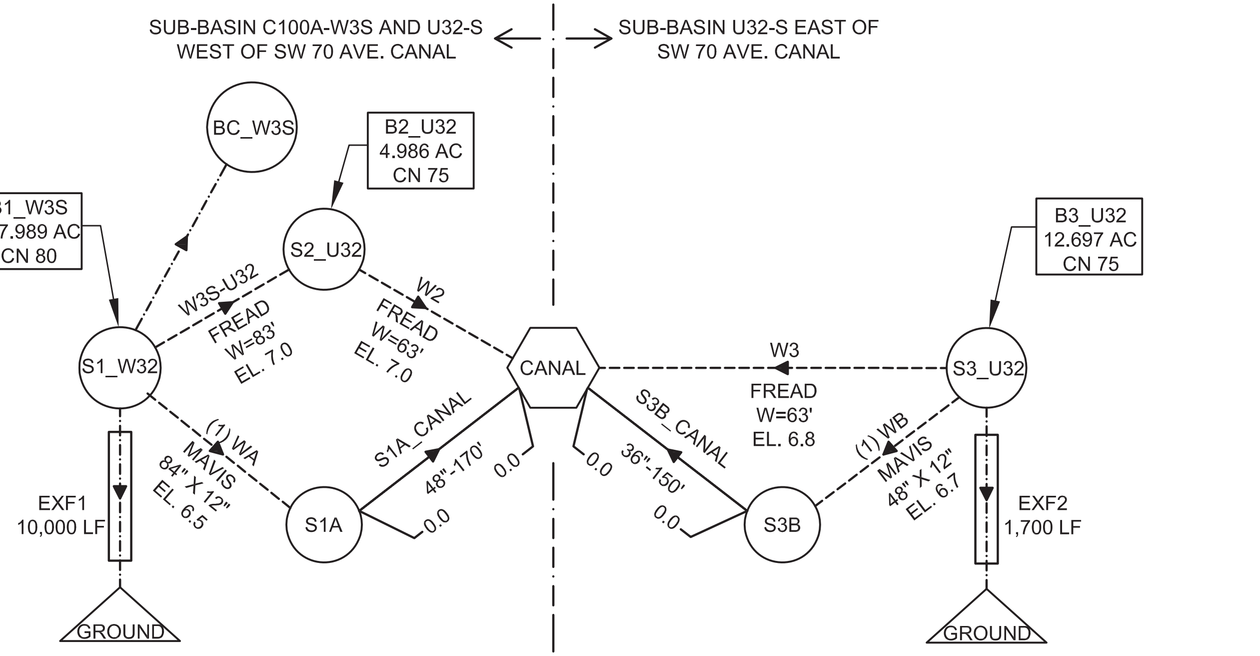
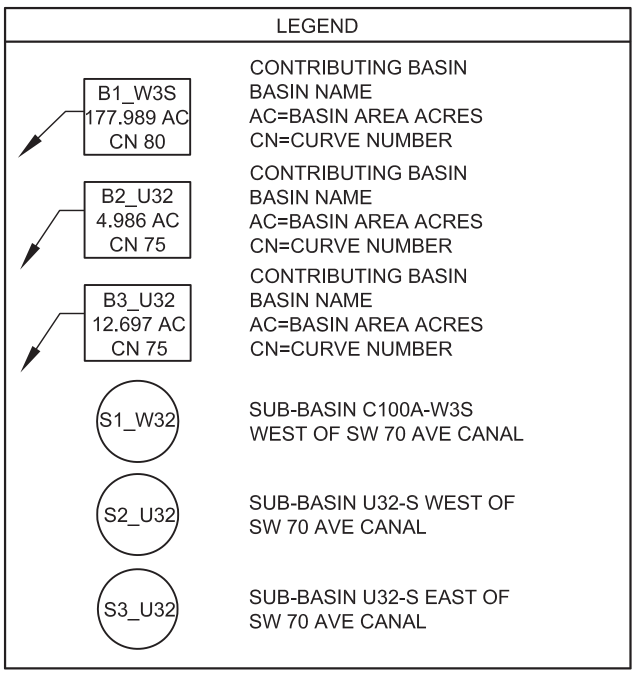
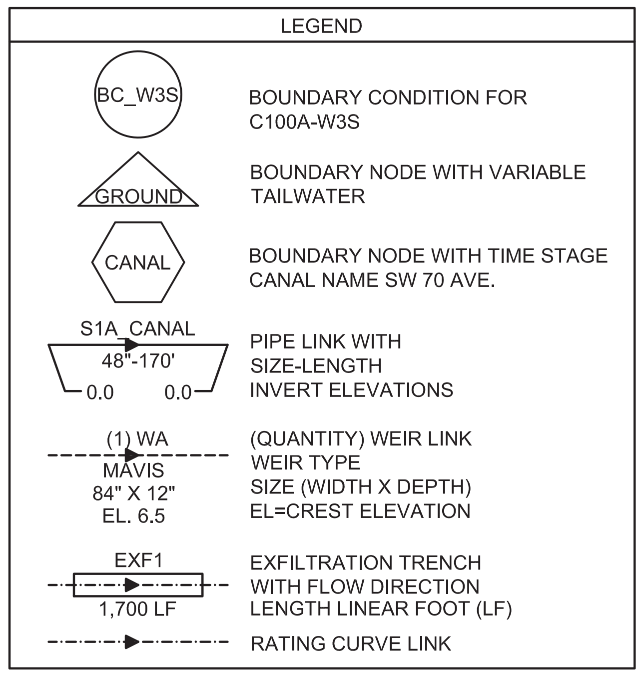
PROPOSED CONDITION
NODE-LINK SCHEMATIC
SUB-BASIN C100D-N-1

APPENDIX
8D



NODE-LINK SCHEMATIC





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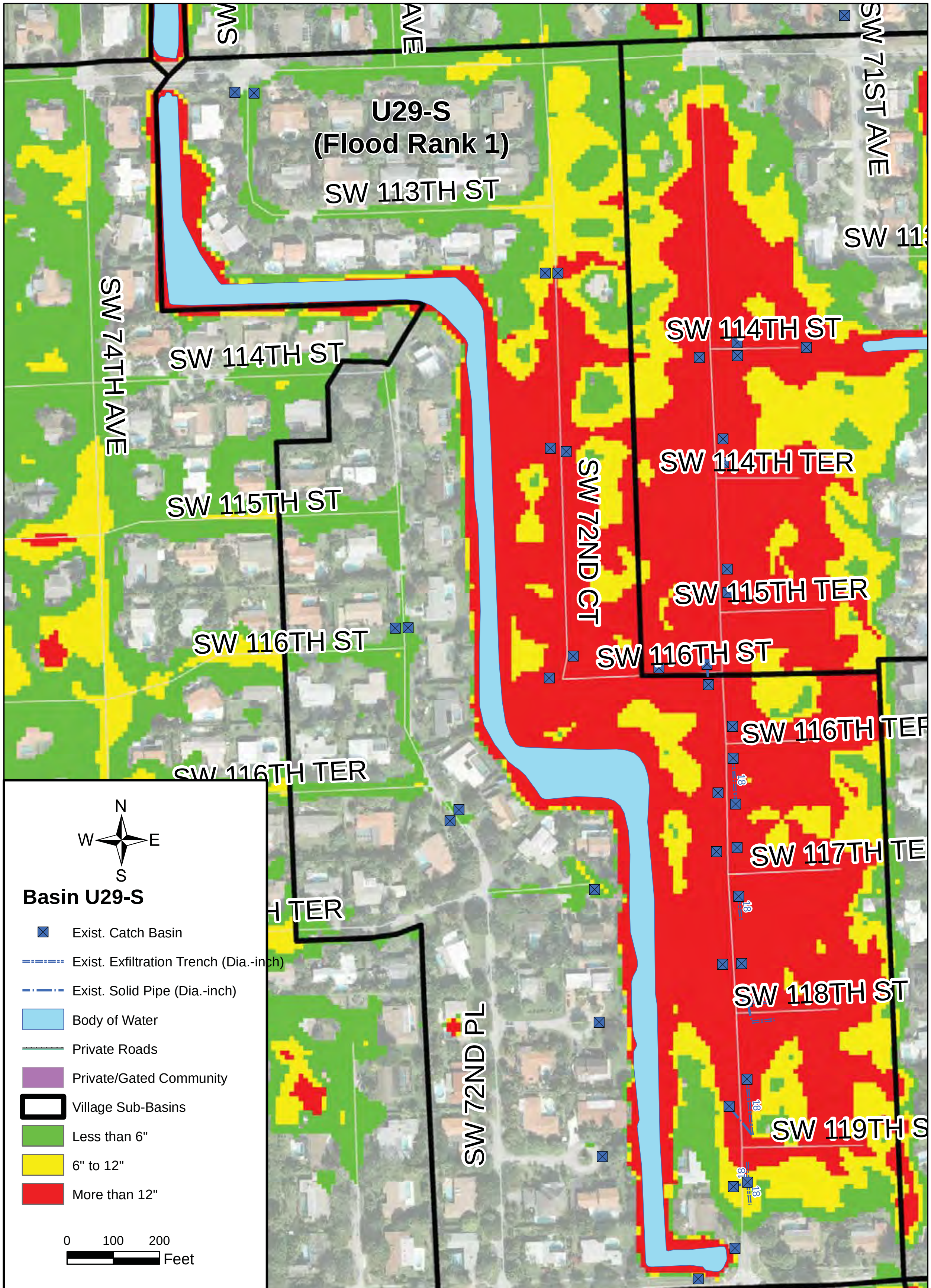
PROPOSED CONDITION
NODE-LINK SCHEMATIC
SUB-BASIN C100A-W3S&U32-S

APPENDIX
8D

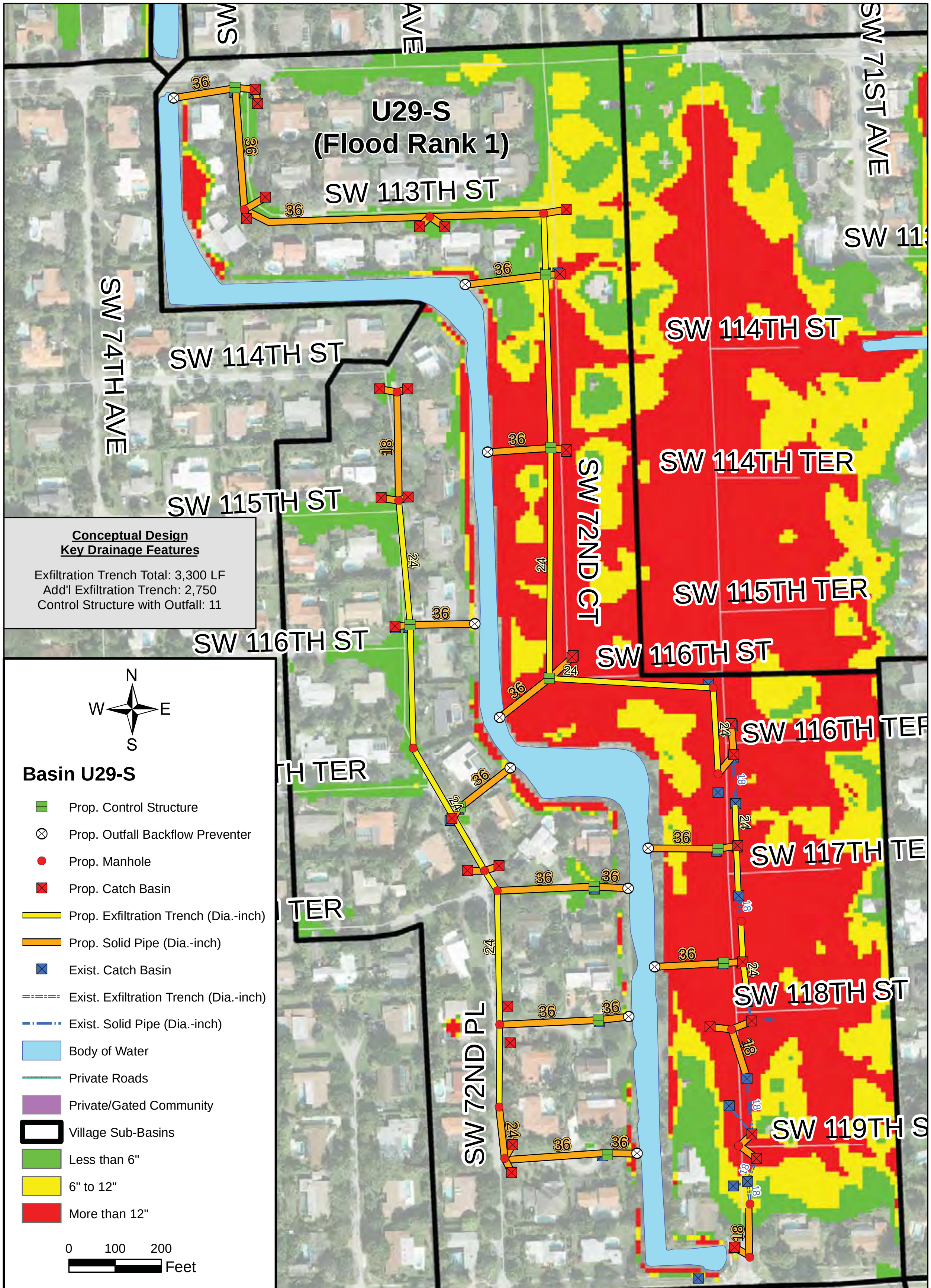
Appendix 8E

On File in the Office of the Village Clerk

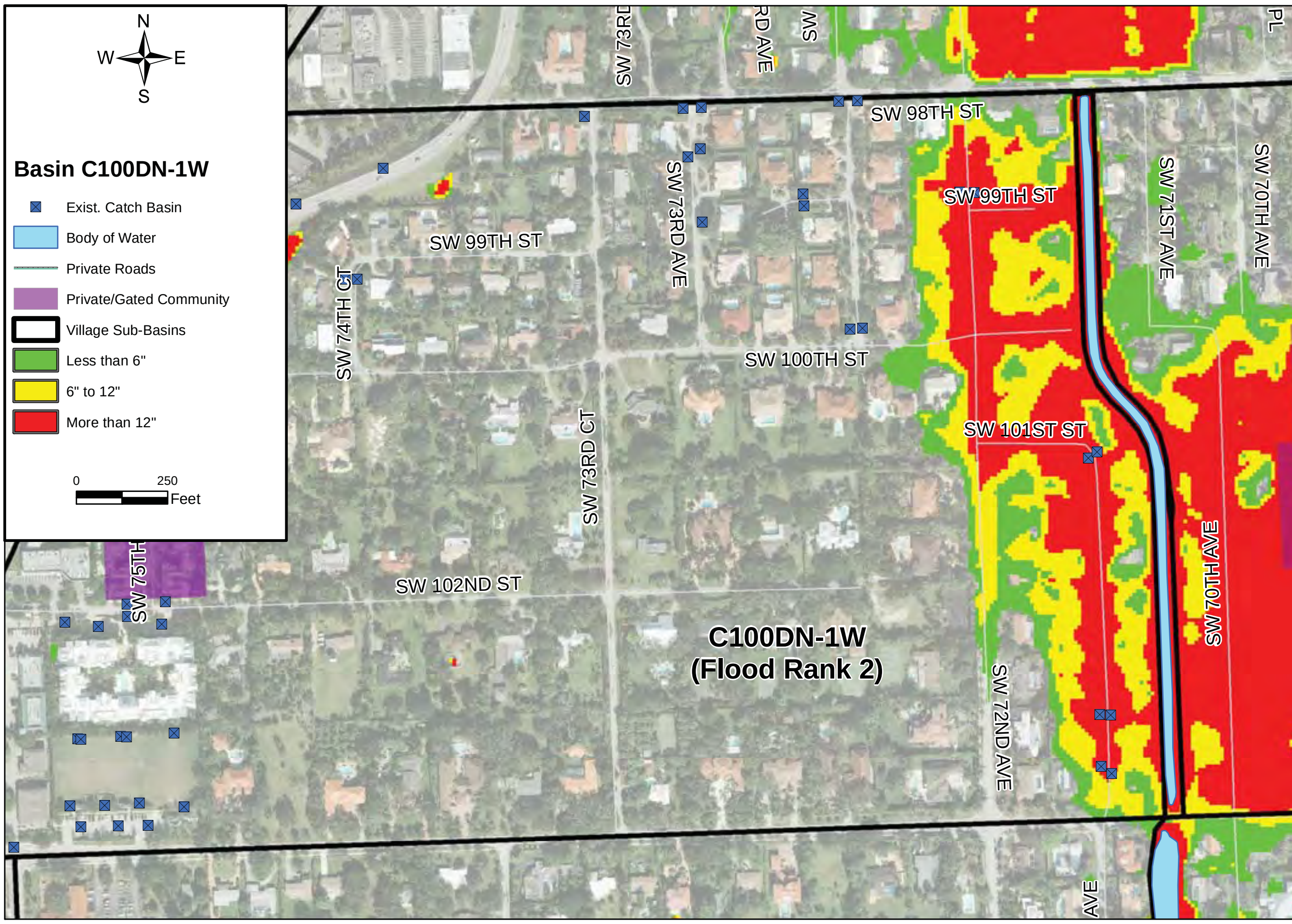
Appendix 8F



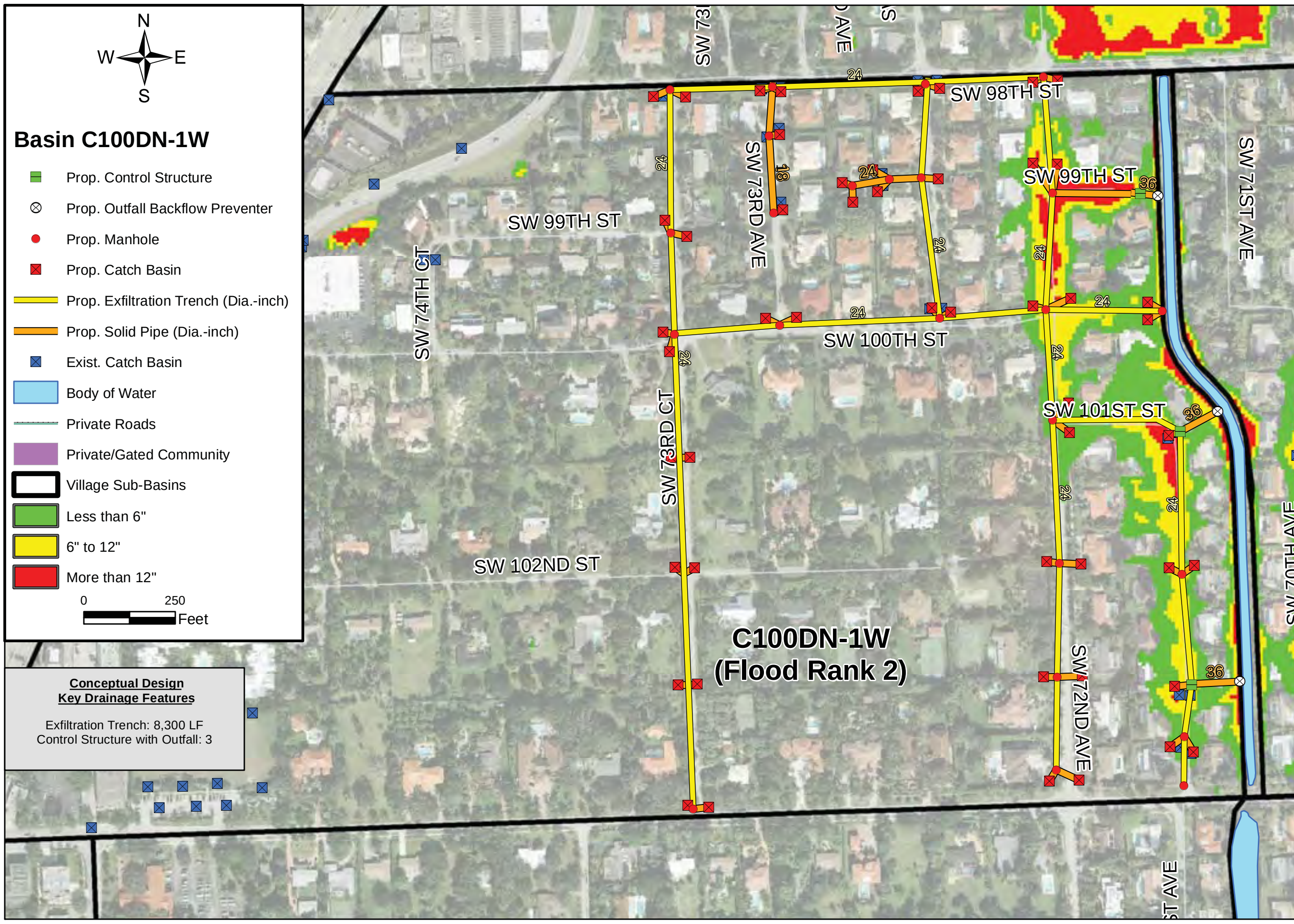
Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin U29-S
(Flood Rank 1) w/o Proposed Improvement Projects



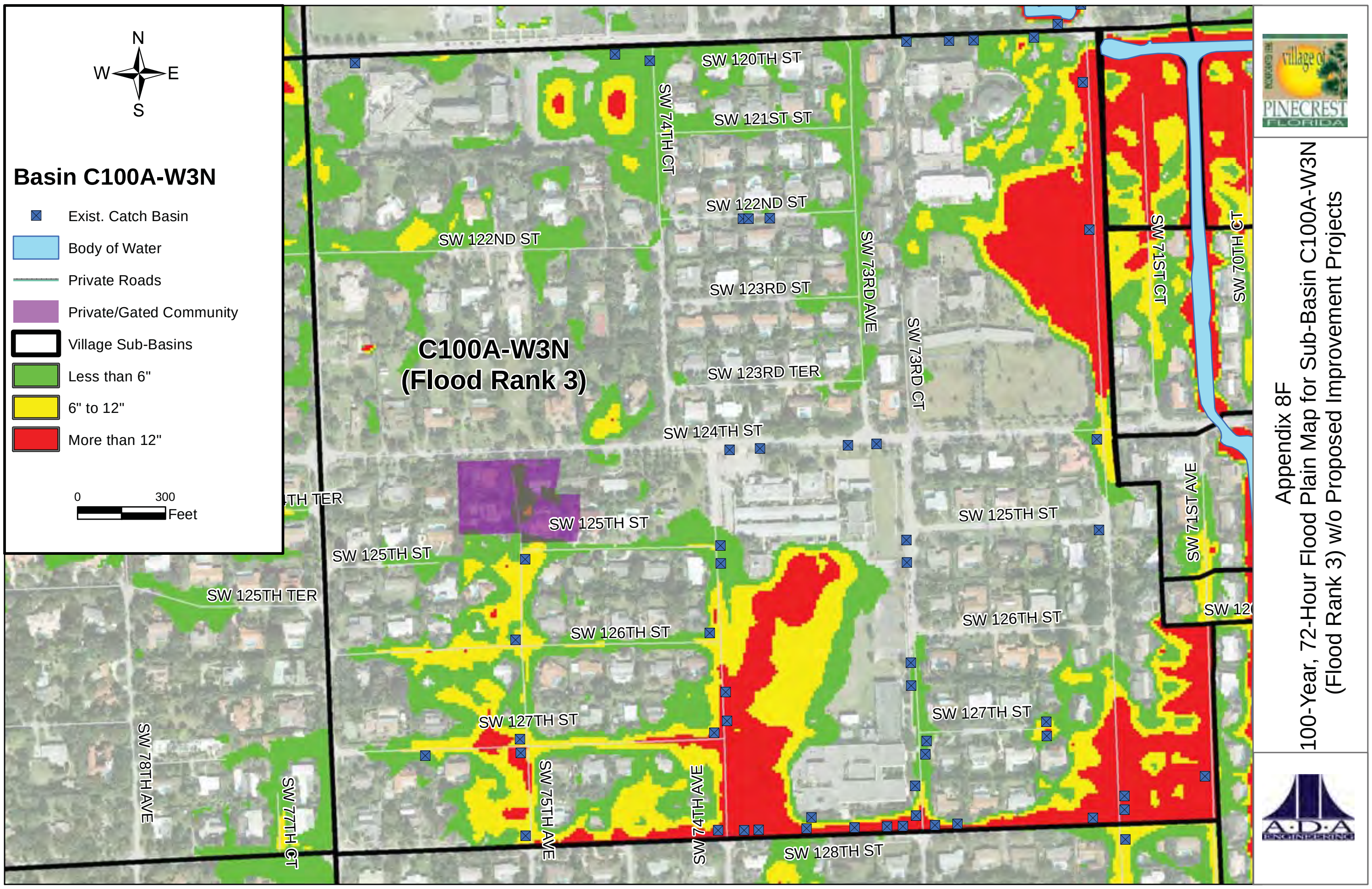
Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin U29-S
(Flood Rank 1) with Proposed Improvement Projects



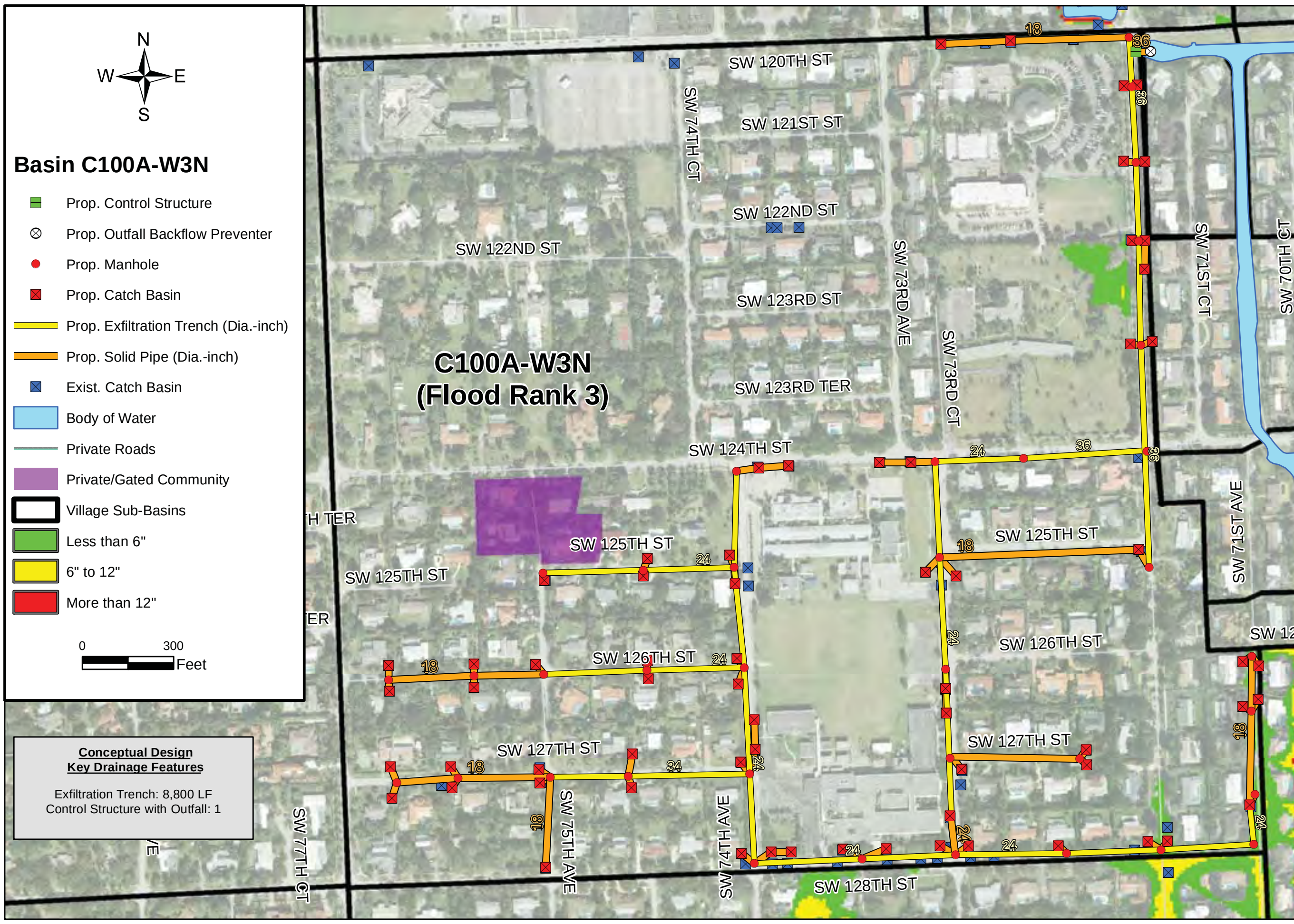
Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin C100DN-1W
(Flood Rank 2) w/o Proposed Improvement Projects



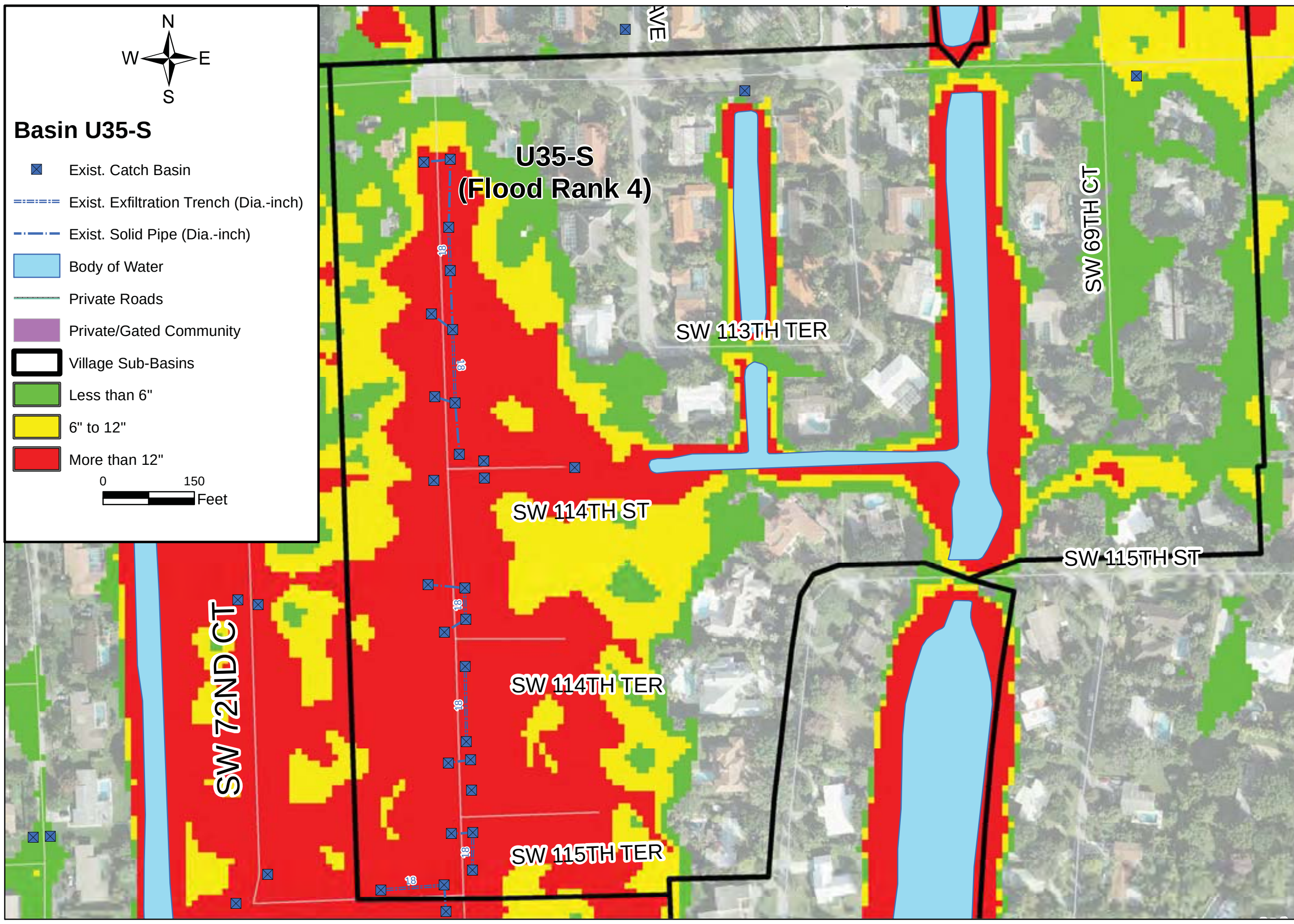
Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin C100DN-1W
(Flood Rank 2) with Proposed Improvement Projects



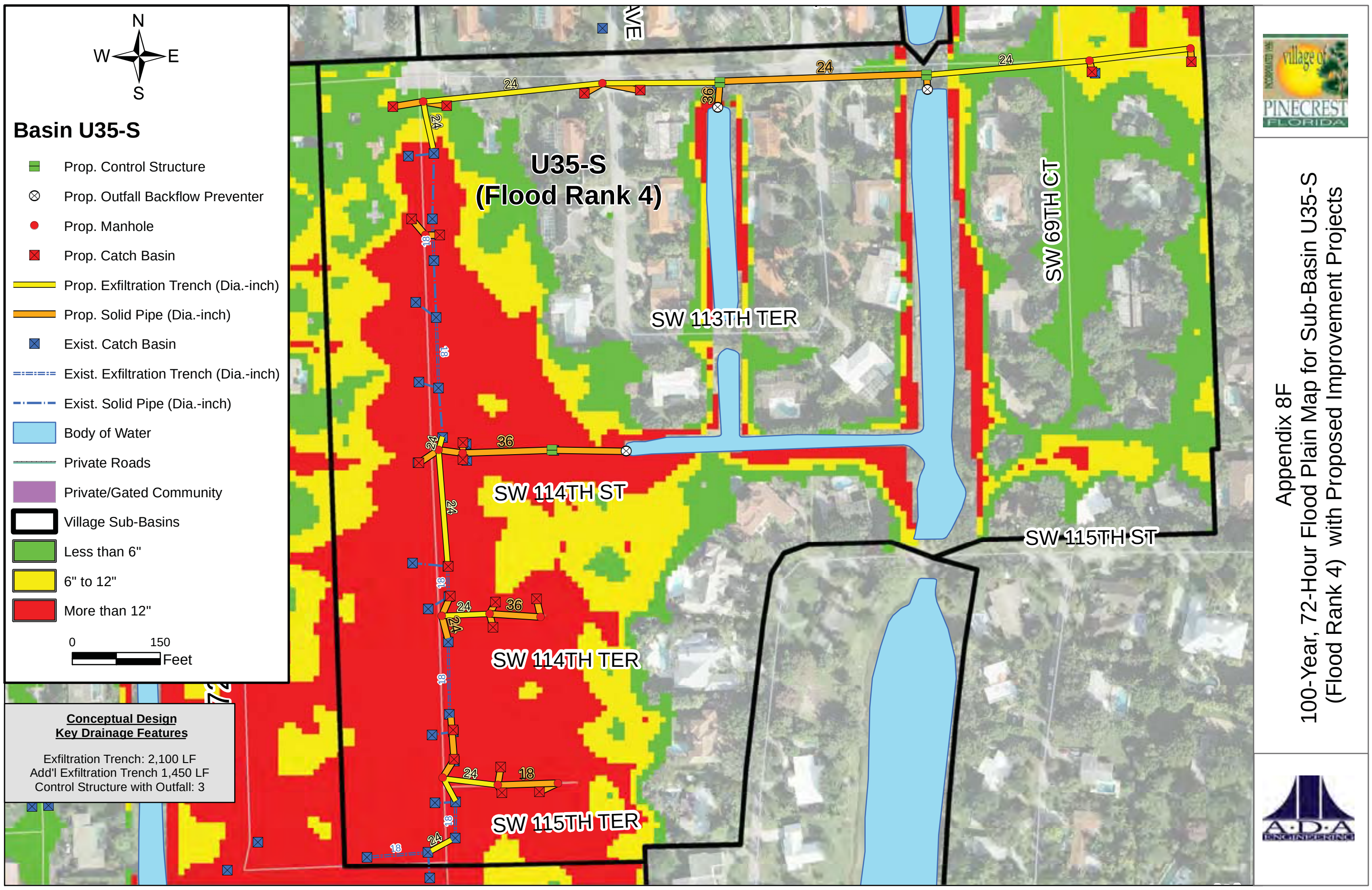
N
W
E
S
Basin C100A-W3N
Exist. Catch Basin
Body of Water
Private Roads
Private/Gated Community
Village Sub-Basins
Less than 6"
6" to 12"
More than 12"
0
300
Feet
C100A-W3N
(Flood Rank 3)
SW 120TH ST
SW 121ST ST
SW 122ND ST
SW 122ND ST
SW 123RD ST
SW 123RD TER
SW 124TH ST
SW 125TH ST
SW 125TH ST
SW 125TH ST
SW 125TH TER
SW 126TH ST
SW 126TH ST
SW 127TH ST
SW 127TH ST
SW 128TH ST
SW 74TH CT
SW 73RD AVE
SW 73RD CT
SW 71ST CT
SW 70TH CT
SW 71ST AVE
SW 78TH AVE
SW 77TH CT
SW 75TH AVE
SW 74TH AVE
village of PINECREST FLORIDA
Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin C100A-W3N
(Flood Rank 3) w/o Proposed Improvement Projects
A·D·A



Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin C100A-W3N
(Flood Rank 3) with Proposed Improvement Projects



Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin U35-S
(Flood Rank 4) w/o Proposed Improvement Projects



N
W
E
S
Basin U35-S
Prop. Control Structure
Prop. Outfall Backflow Preventer
Prop. Manhole
Prop. Catch Basin
Prop. Exfiltration Trench (Dia.-inch)
Prop. Solid Pipe (Dia.-inch)
Exist. Catch Basin
Exist. Exfiltration Trench (Dia.-inch)
Exist. Solid Pipe (Dia.-inch)
Body of Water
Private Roads
Private/Gated Community
Village Sub-Basins
Less than 6"
6" to 12"
More than 12"
0
150
Feet
Conceptual Design
Key Drainage Features
Exfiltration Trench: 2,100 LF
Add'l Exfiltration Trench 1,450 LF
Control Structure with Outfall: 3
U35-S
(Flood Rank 4)
SW 113TH TER
SW 114TH ST
SW 114TH TER
SW 115TH TER
SW 115TH ST
SW 69TH CT
24
36
18
Village of
PINECREST
FLORIDA
Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin U35-S
(Flood Rank 4) with Proposed Improvement Projects
A·D·A
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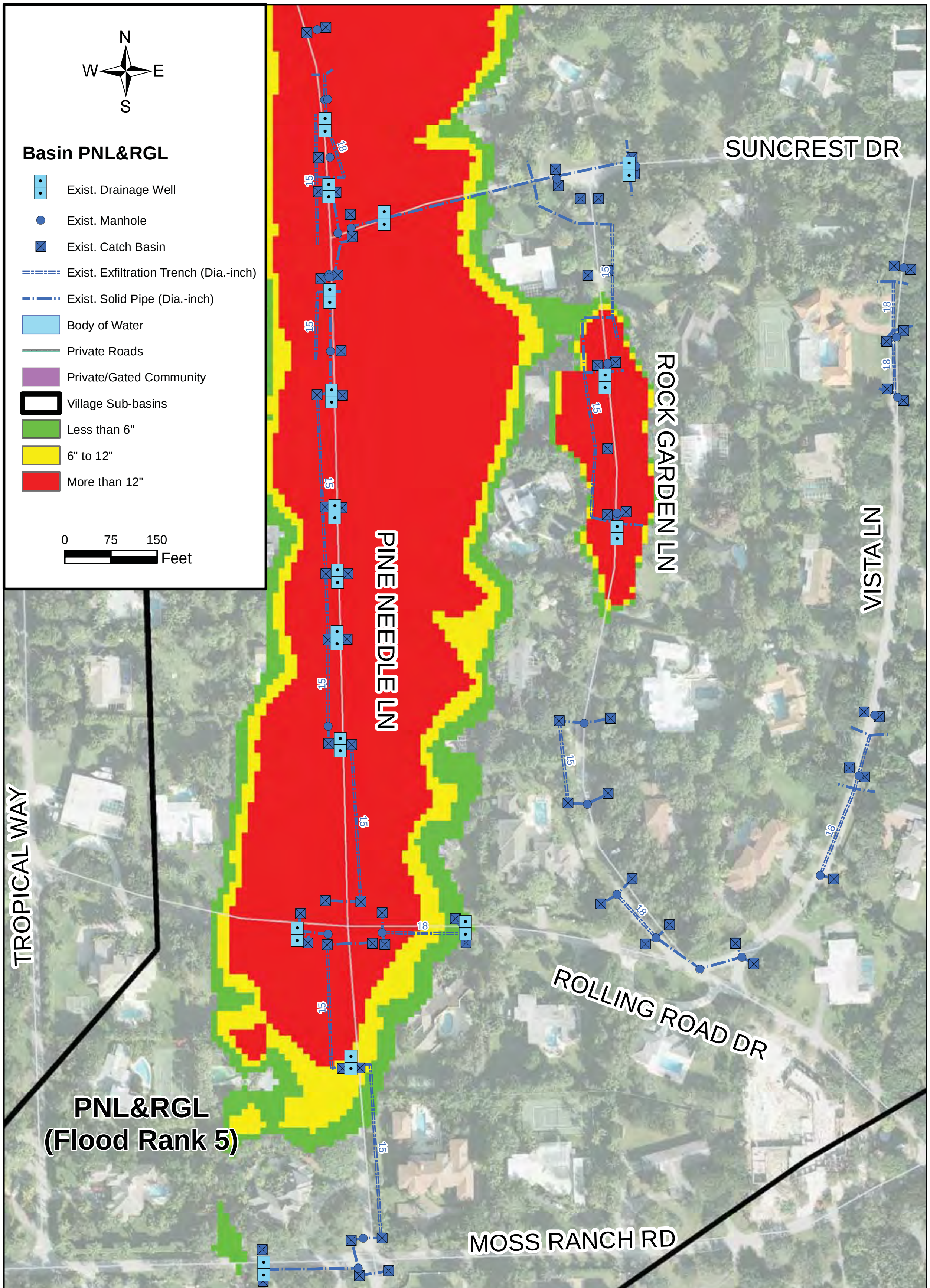
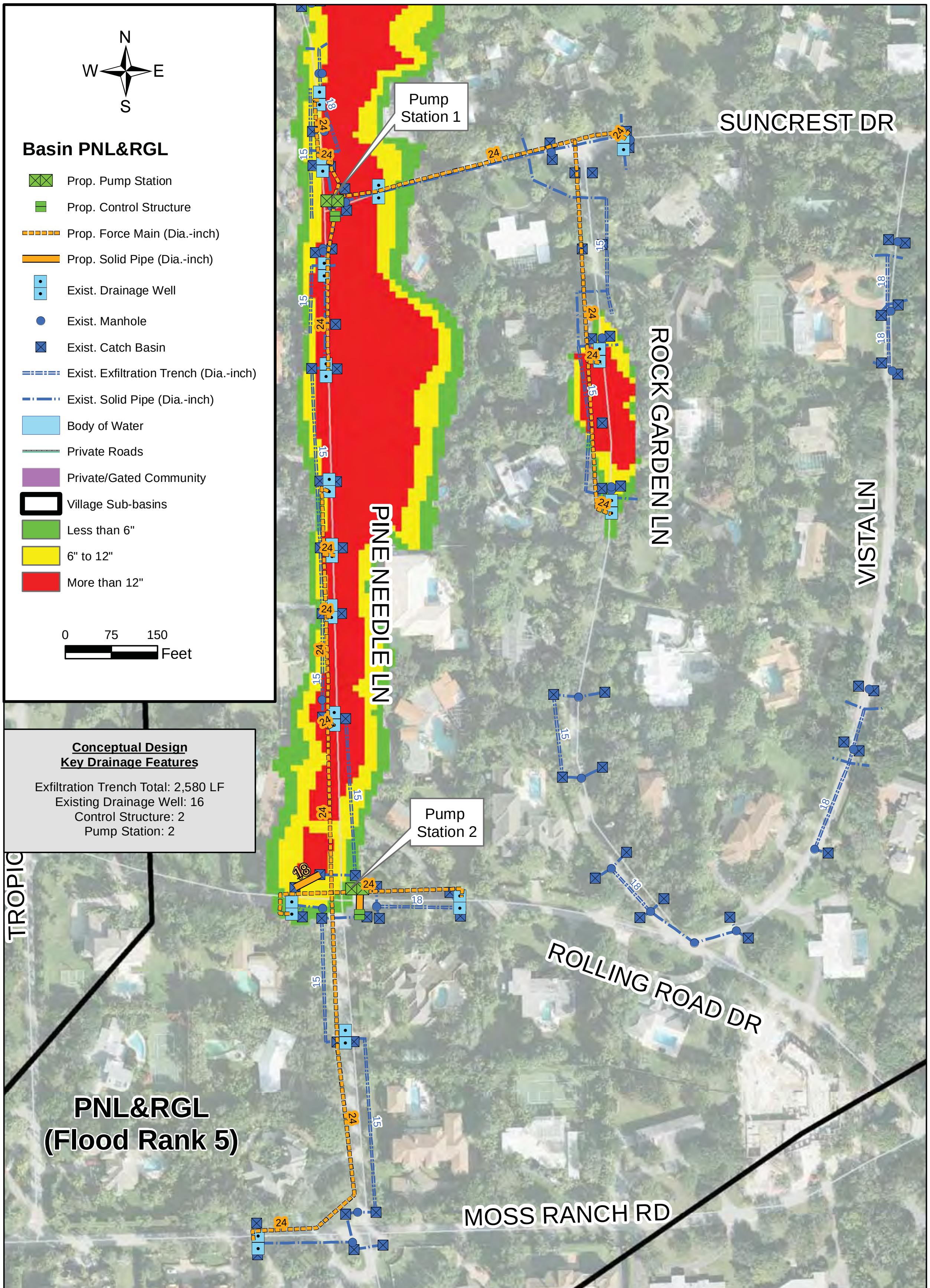
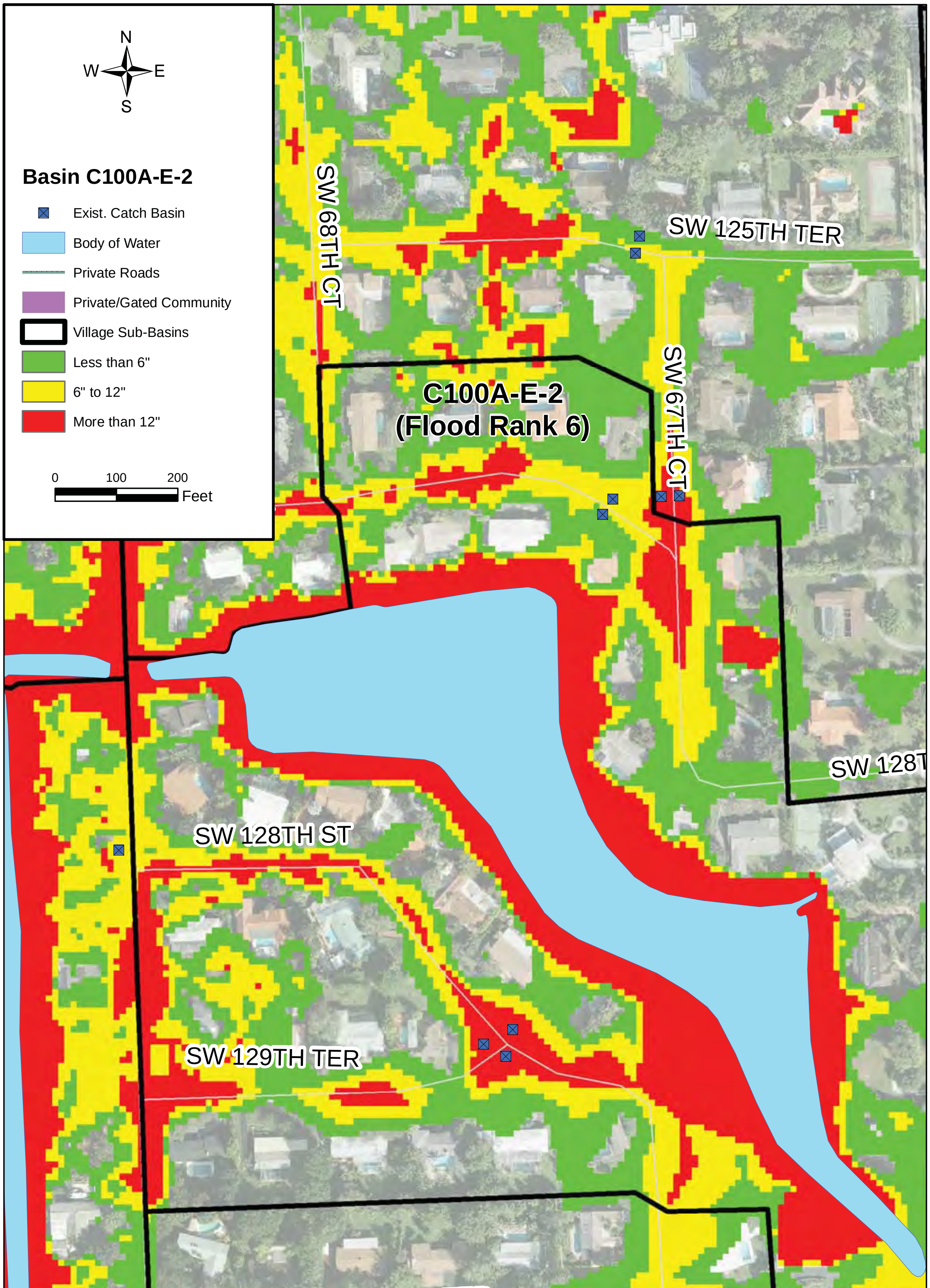


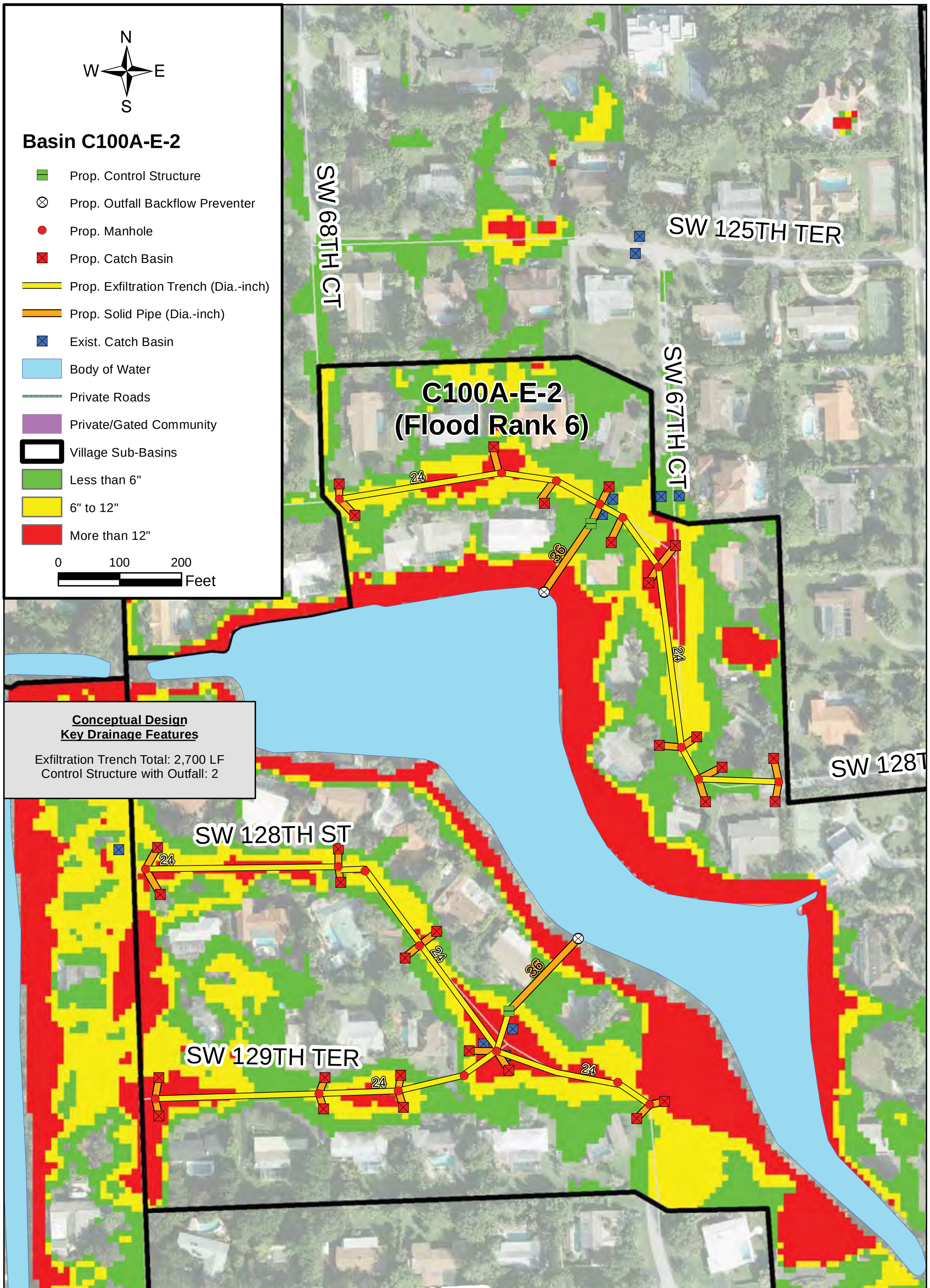
Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin PNL&RGL
(Flood Rank 5) w/o Proposed Improvement Projects



Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin PNL&RGL
(Flood Rank 5) with Proposed Improvement Projects

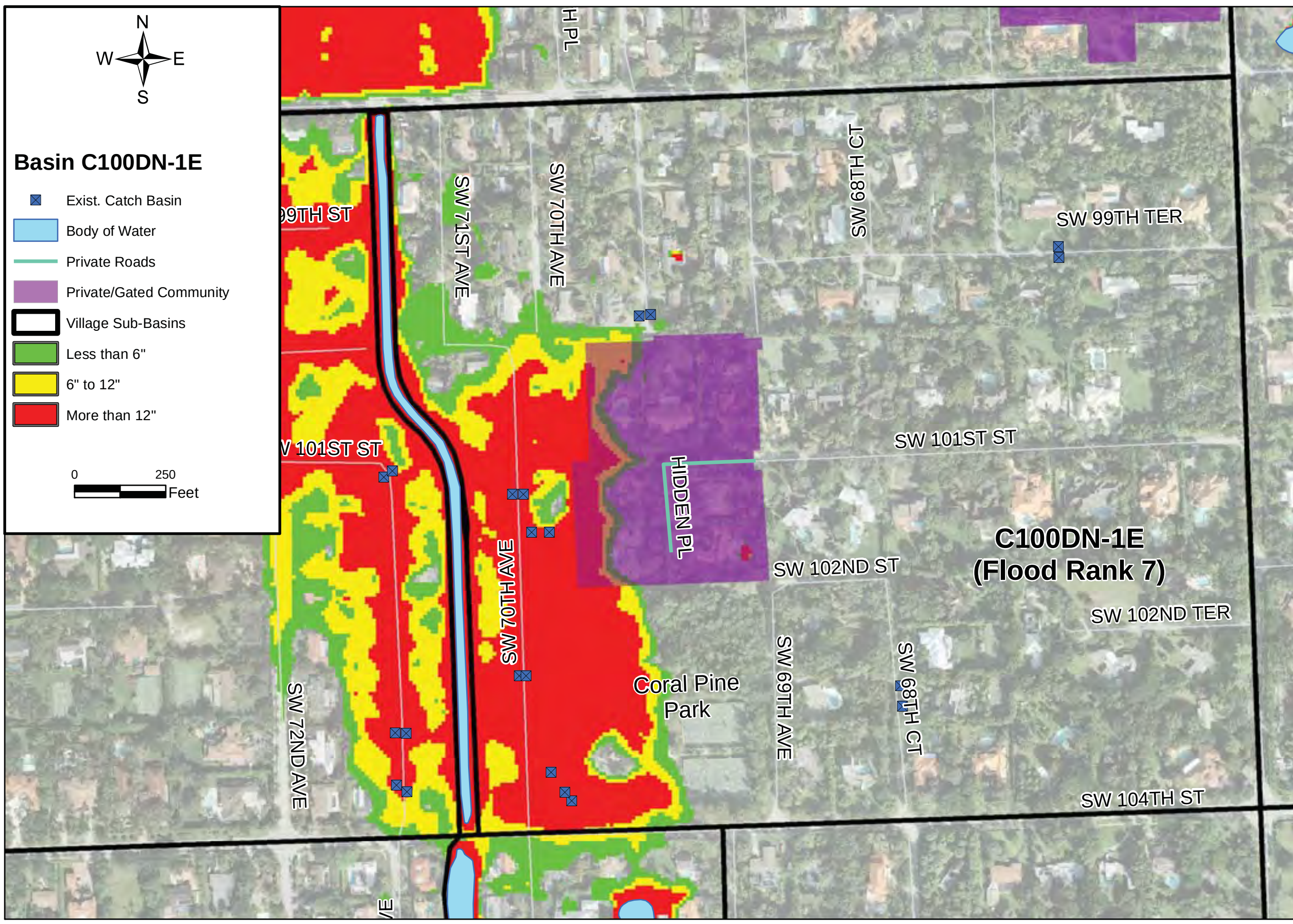


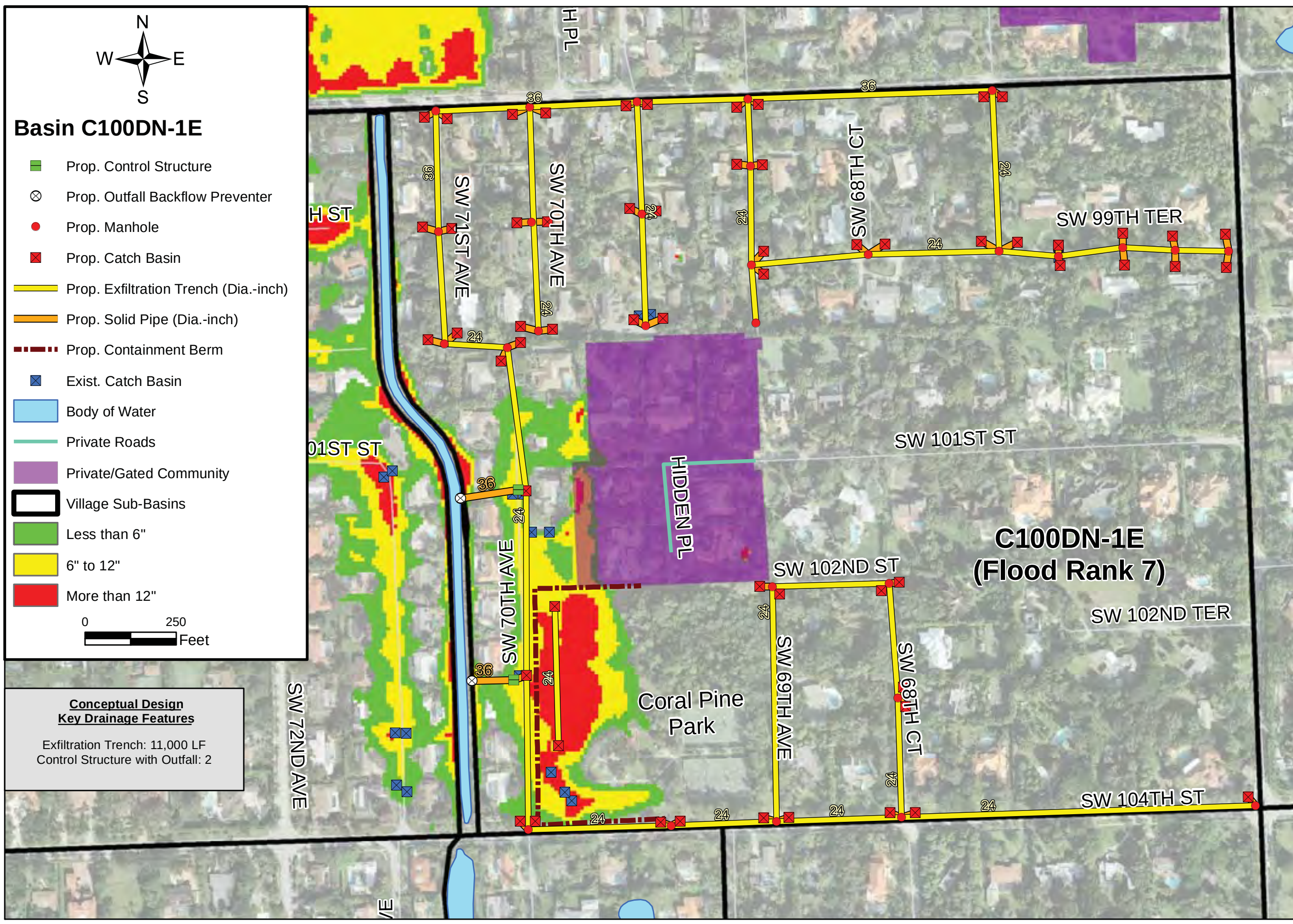
Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin C100A-E-2
(Flood Rank 6) w/o Proposed Improvement Projects



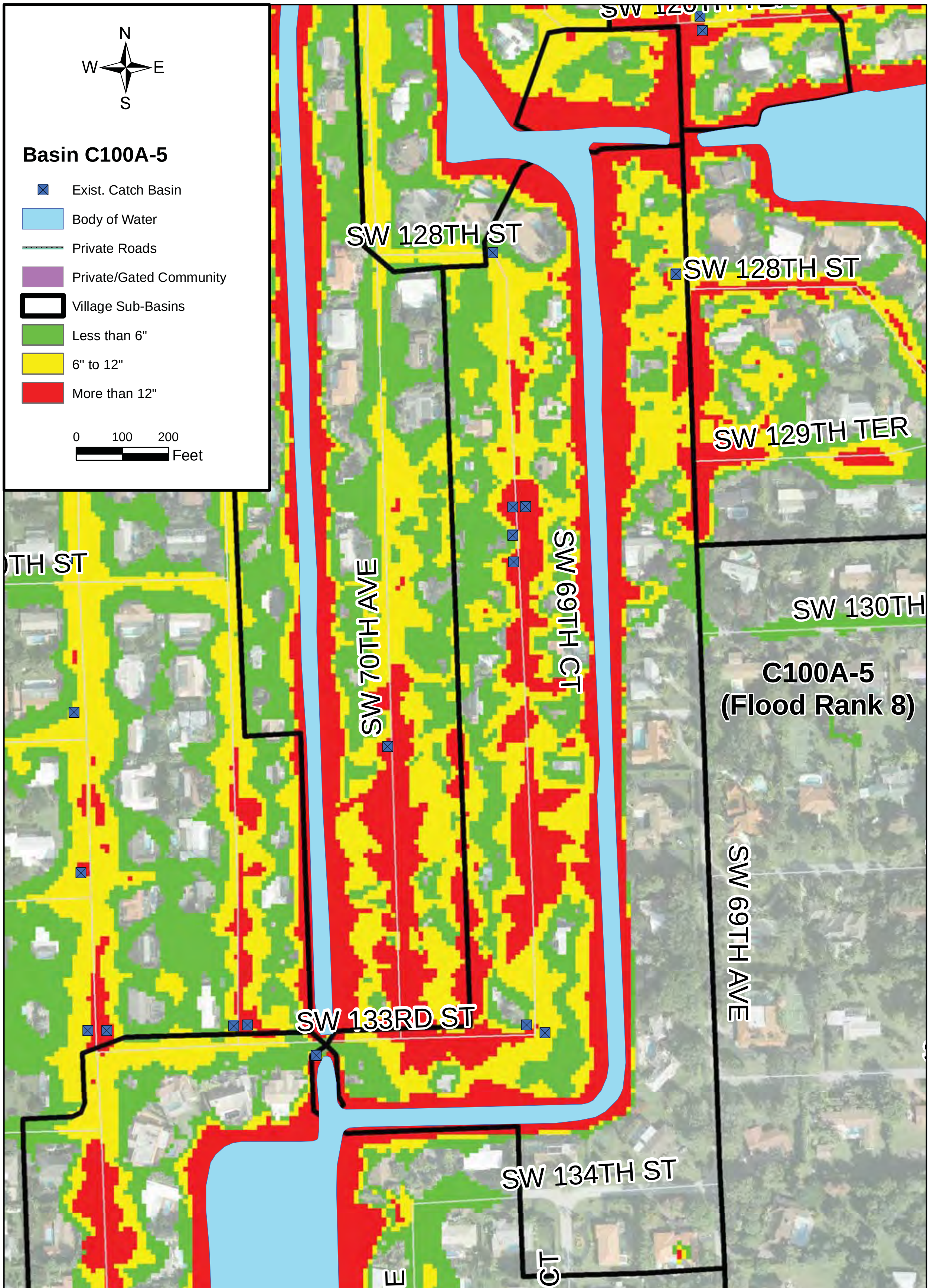
Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin C100A-E-2
(Flood Rank 6) with Proposed Improvement Projects

Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin
C100DN-1E (Flood Rank 7) w/o Proposed Improvement Projects

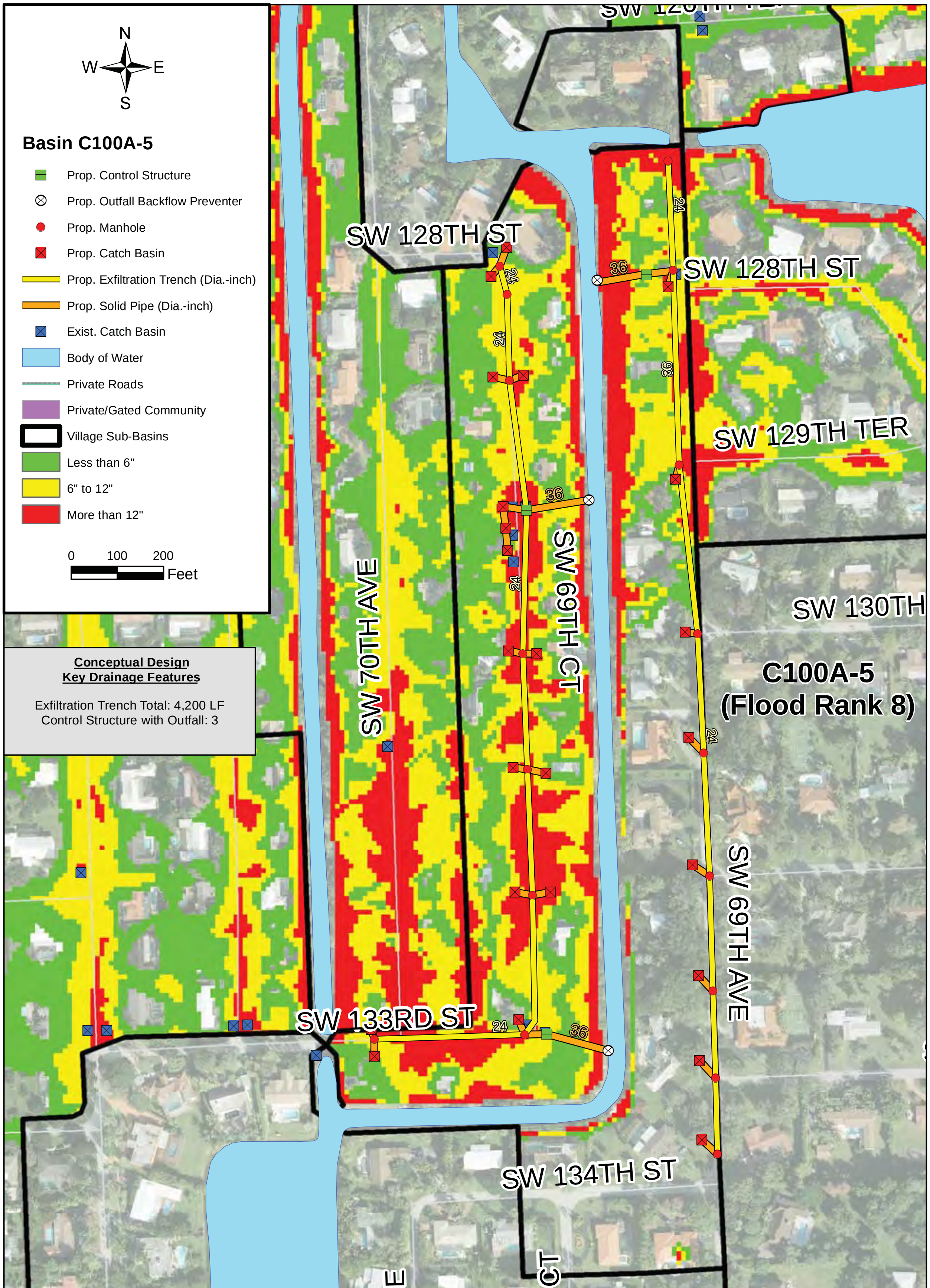




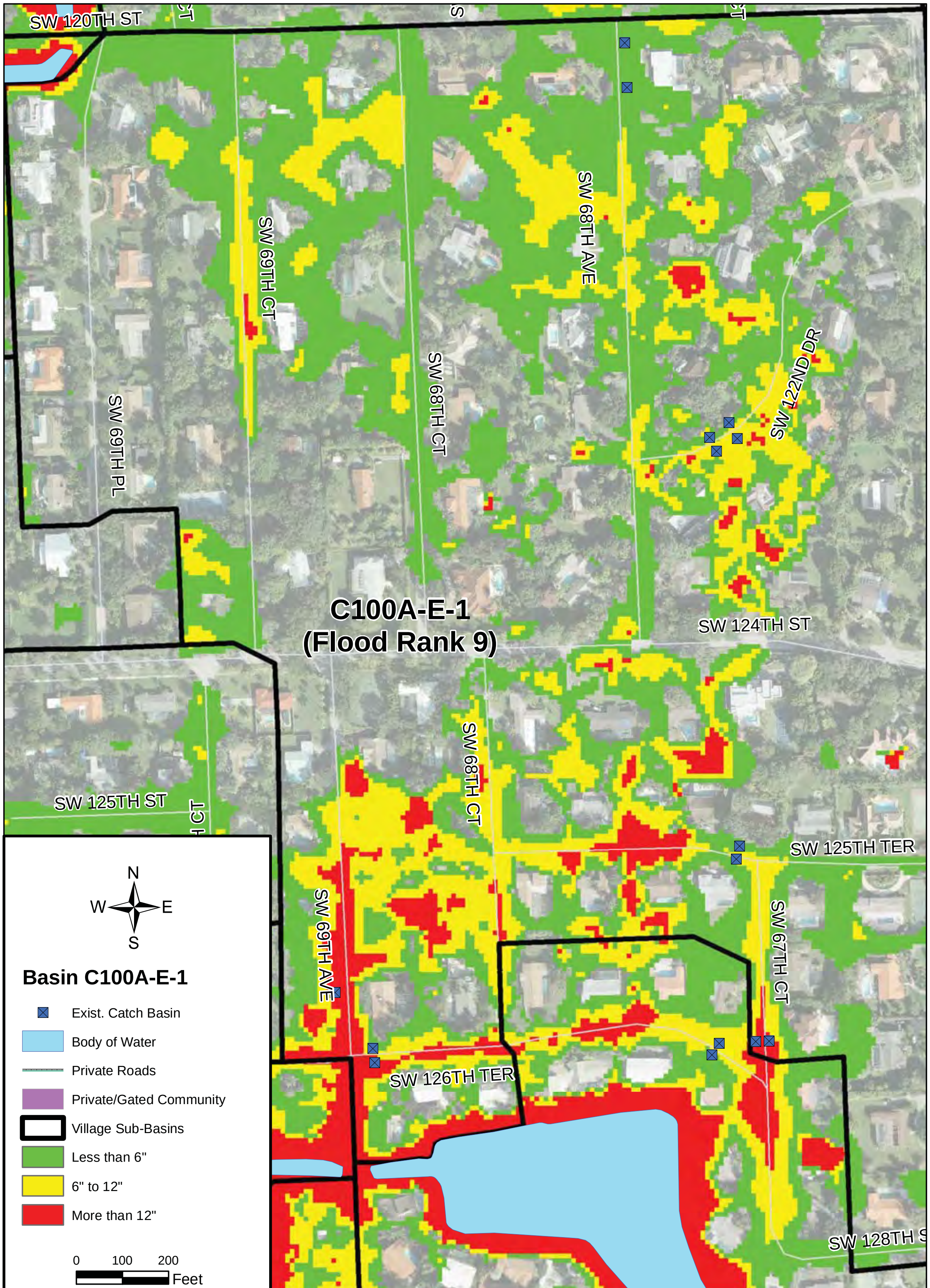
Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin
C100DN-1E (Flood Rank 7) with Proposed Improvement Projects



Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin C100A-5
(Flood Rank 8) w/o Proposed Improvement Projects



Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin C100A-5
(Flood Rank 8) with Proposed Improvement Projects



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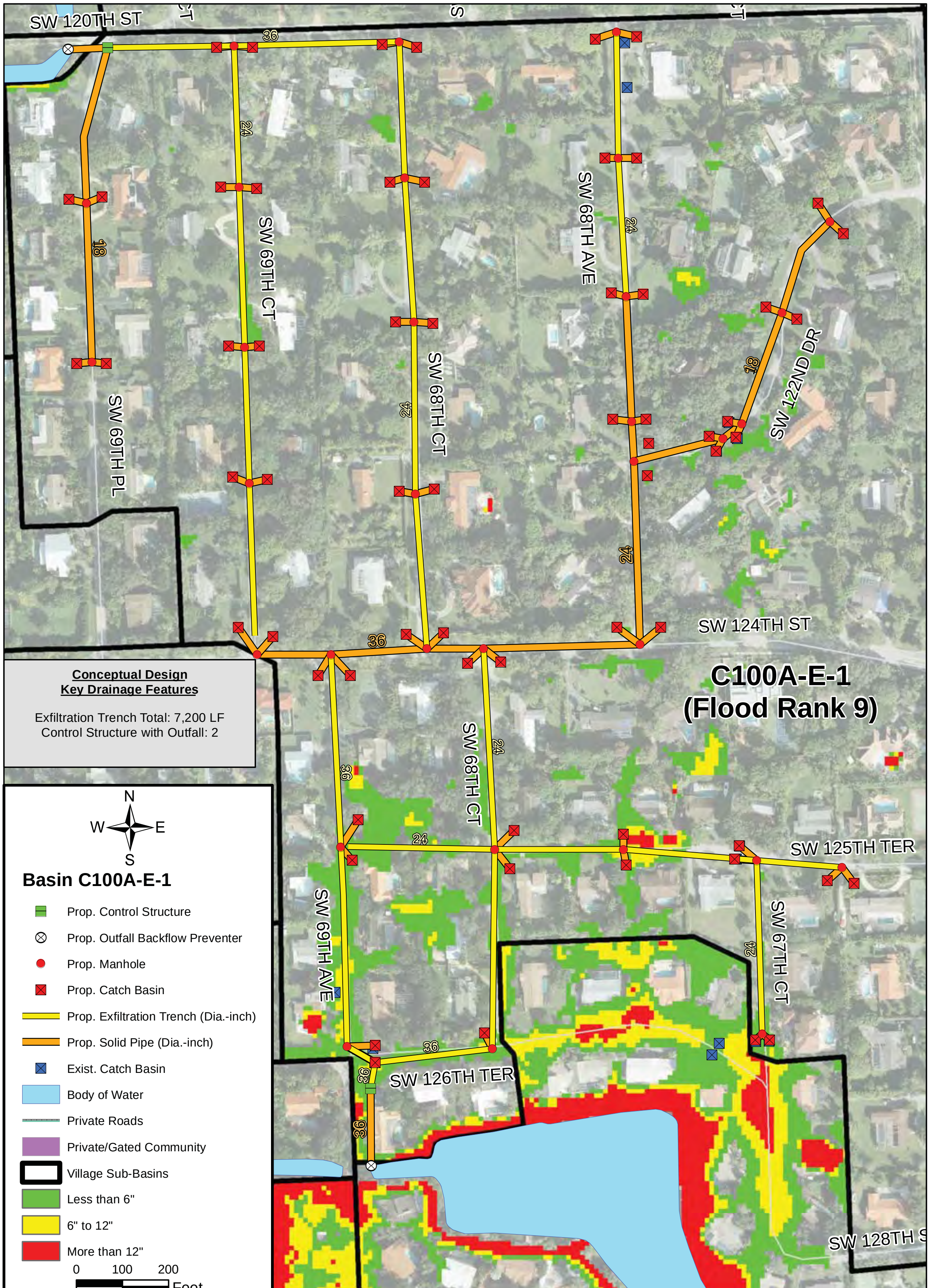
Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin C100A-E-1
(Flood Rank 9) w/o Proposed Improvement Projects

village of PINECREST FLORIDA



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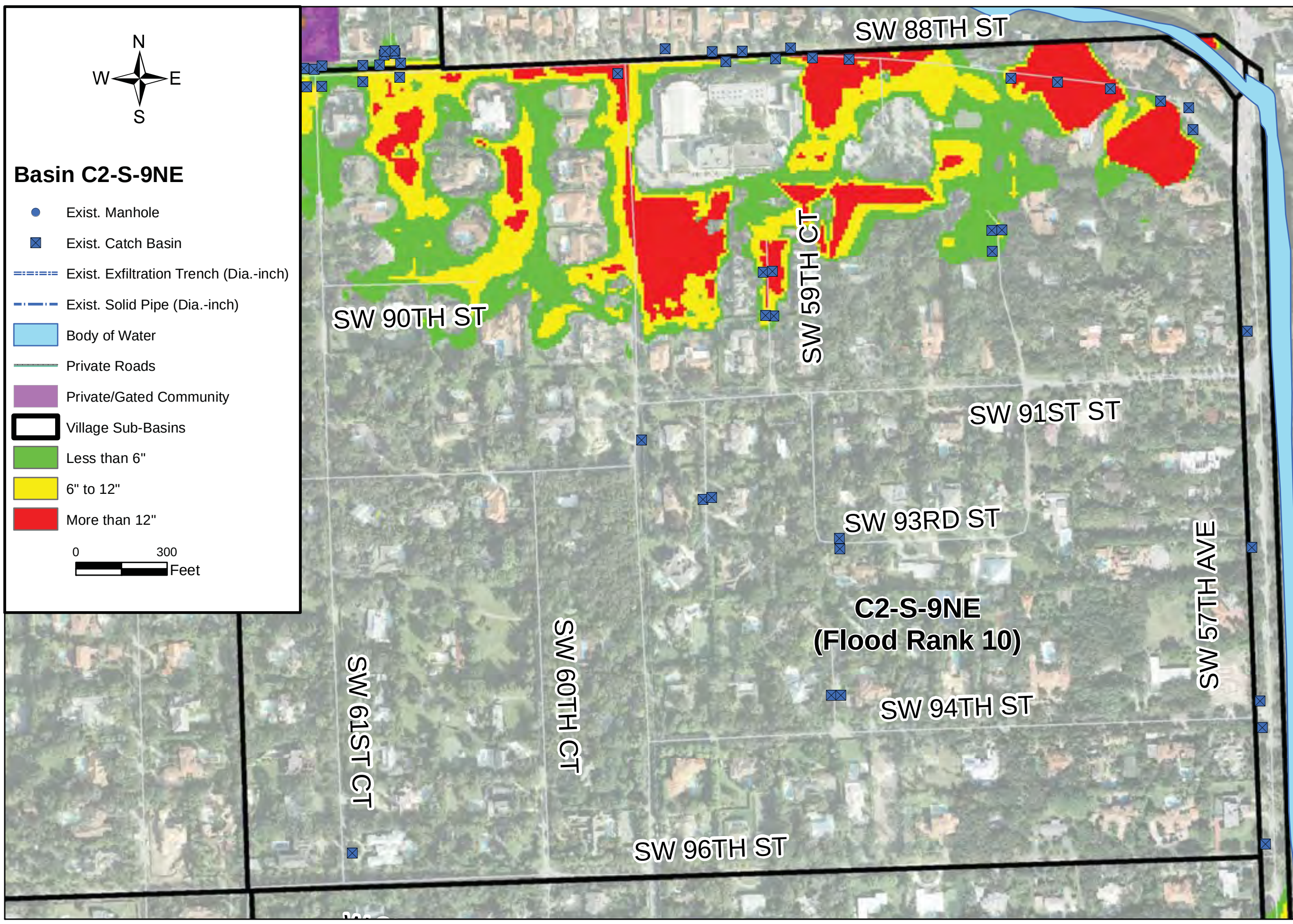
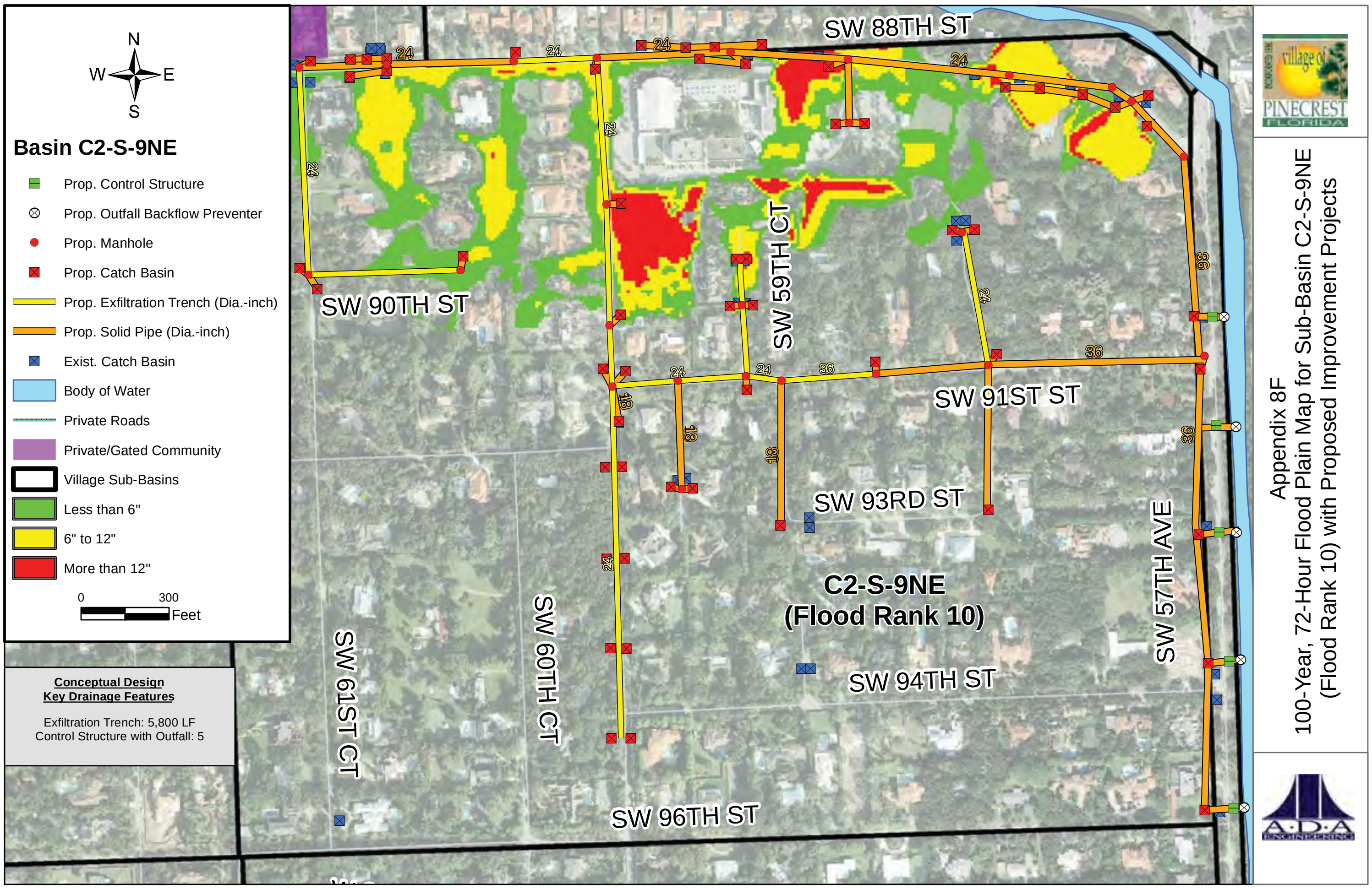
Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin C100A-E-1
(Flood Rank 9) with Proposed Improvement Projects

village of PINECREST FLORIDA



Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin C2-S-9NE
(Flood Rank 10) w/o Proposed Improvement Projects


Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin C2-S-9NE
(Flood Rank 10) with Proposed Improvement Projects
Basin C2-S-9NE
N
W
E
S
Prop. Control Structure
Prop. Outfall Backflow Preventer
Prop. Manhole
Prop. Catch Basin
Prop. Exfiltration Trench (Dia.-inch)
Prop. Solid Pipe (Dia.-inch)
Exist. Catch Basin
Body of Water
Private Roads
Private/Gated Community
Village Sub-Basins
Less than 6"
6" to 12"
More than 12"
0
300
Feet
Conceptual Design
Key Drainage Features
Exfiltration Trench: 5,800 LF
Control Structure with Outfall: 5
SW 88TH ST
SW 90TH ST
SW 59TH CT
SW 91ST ST
SW 93RD ST
SW 94TH ST
SW 96TH ST
SW 60TH CT
SW 61ST CT
SW 57TH AVE
C2-S-9NE
(Flood Rank 10)
Village of PINECREST FLORIDA
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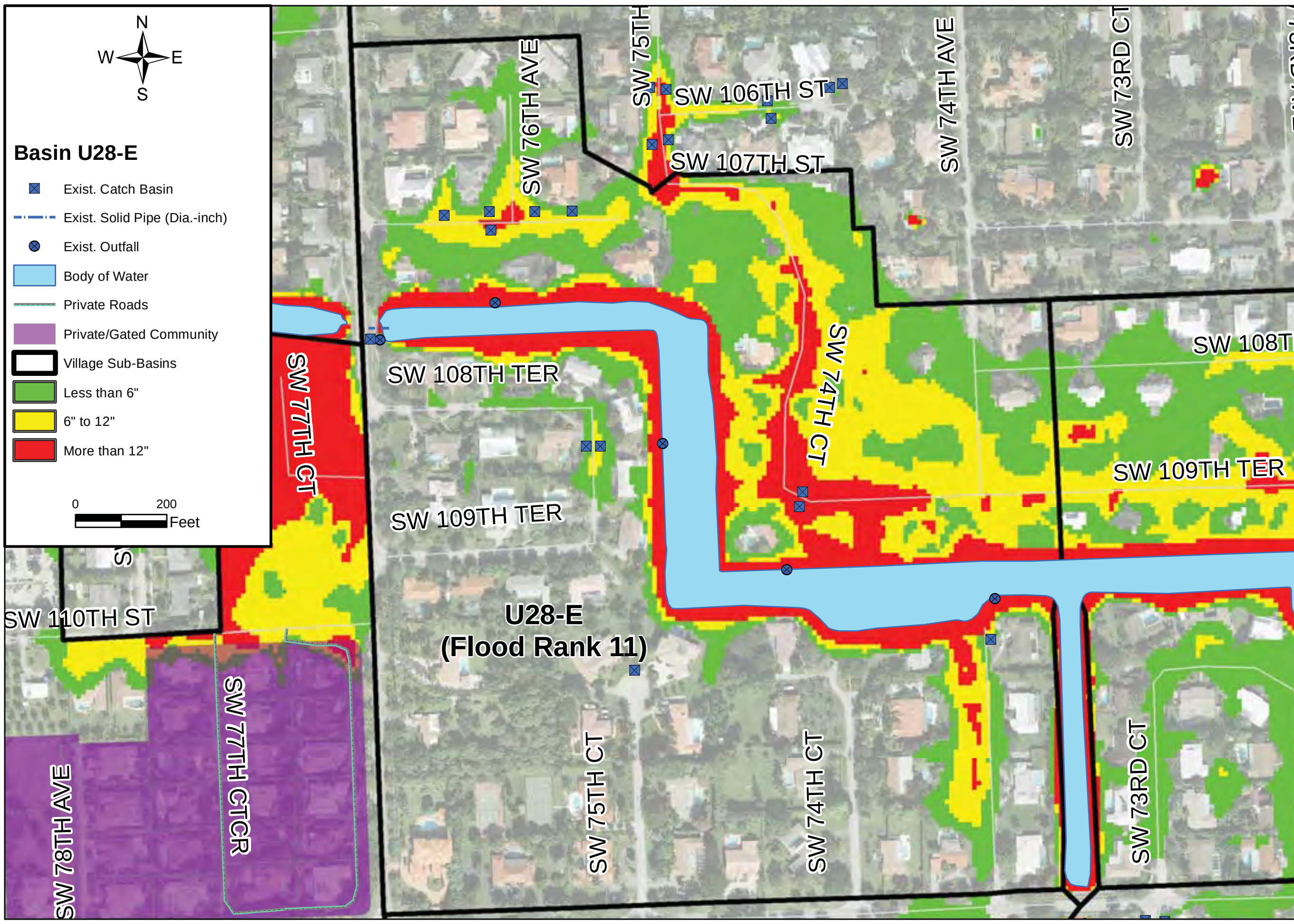

Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin U28-E
(Flood Rank 11) w/o Proposed Improvement Projects

village of PINECREST FLORIDA

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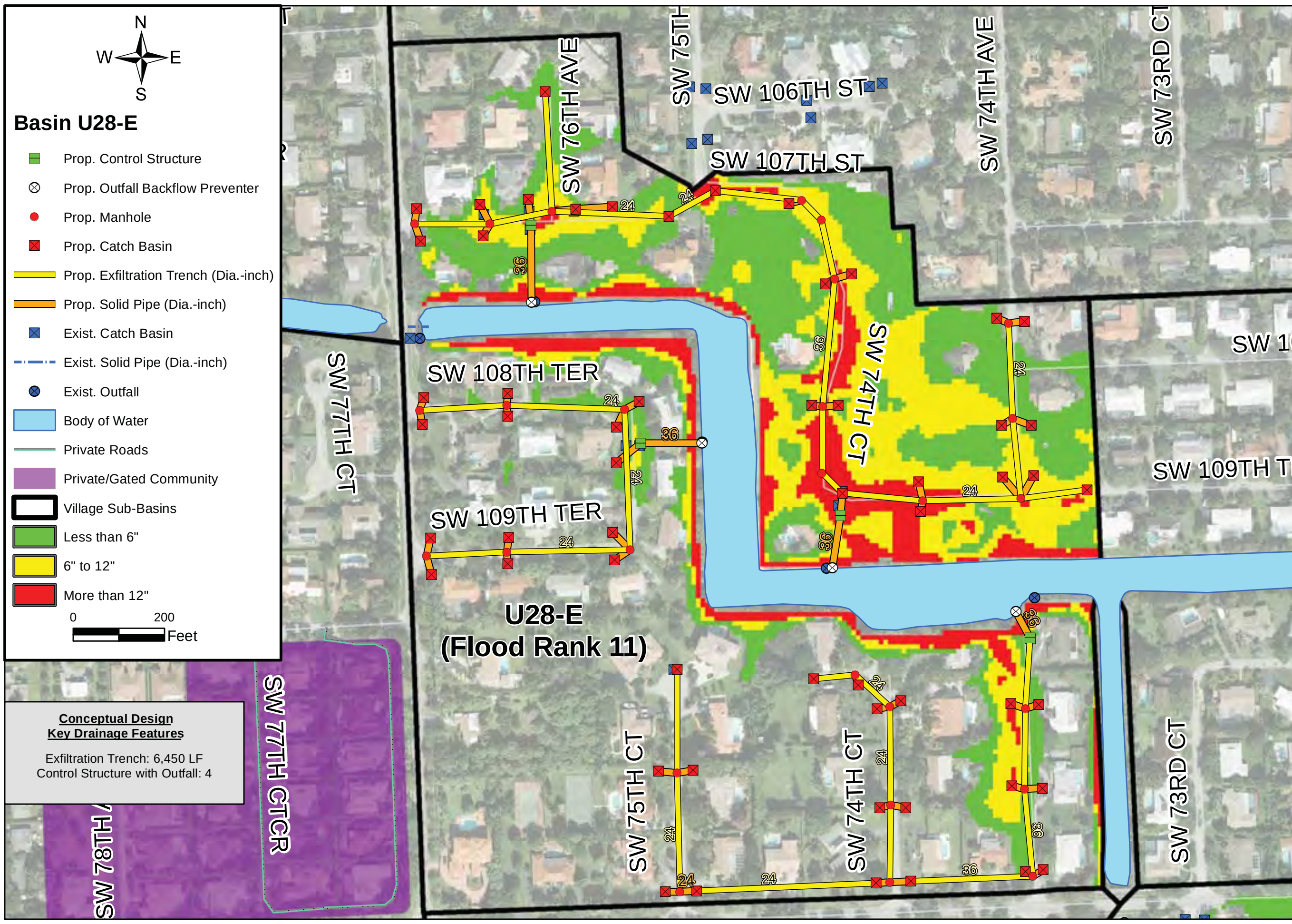
Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin U28-E
(Flood Rank 11) with Proposed Improvement Projects



Village of Pinecrest Florida

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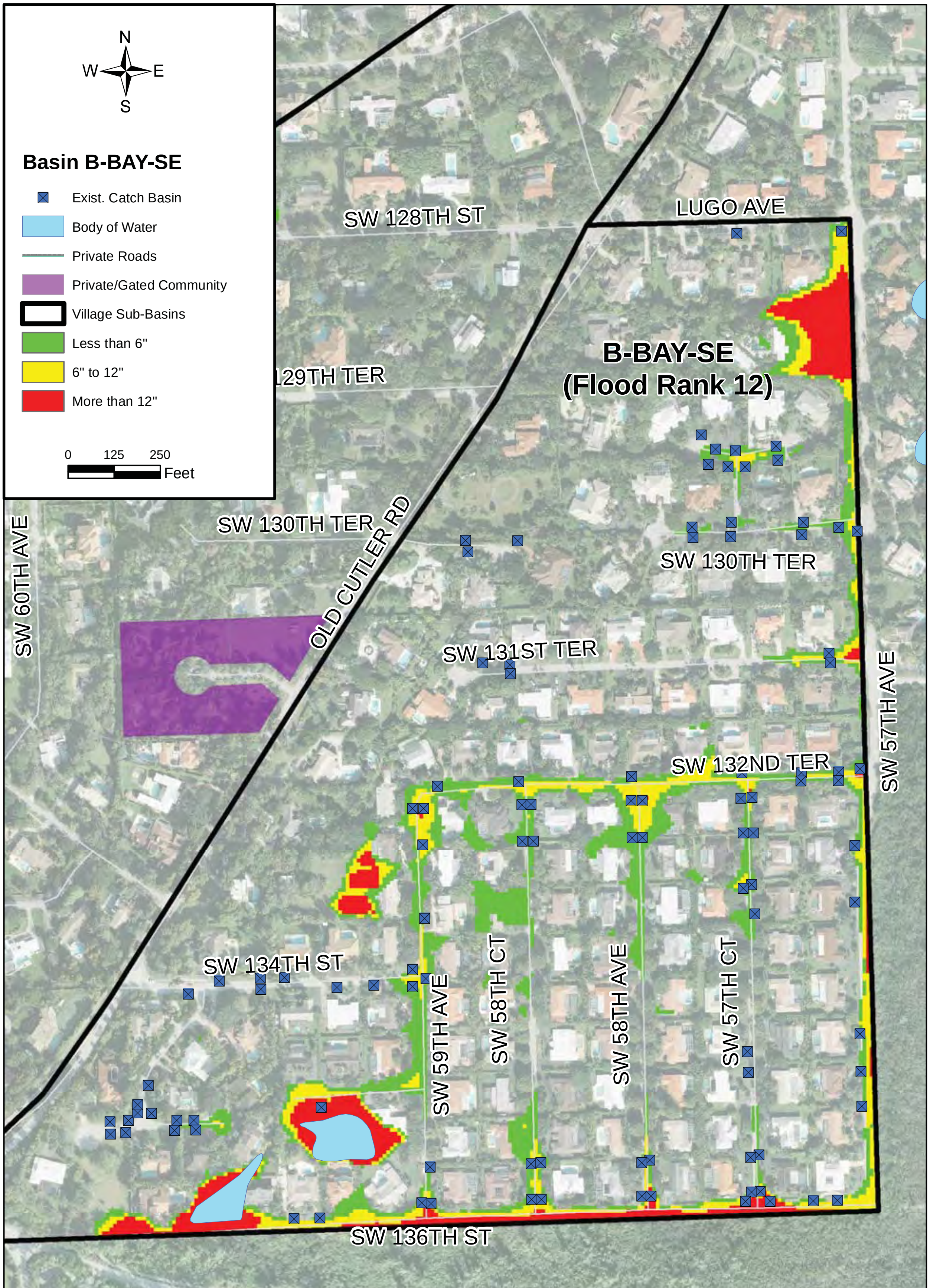
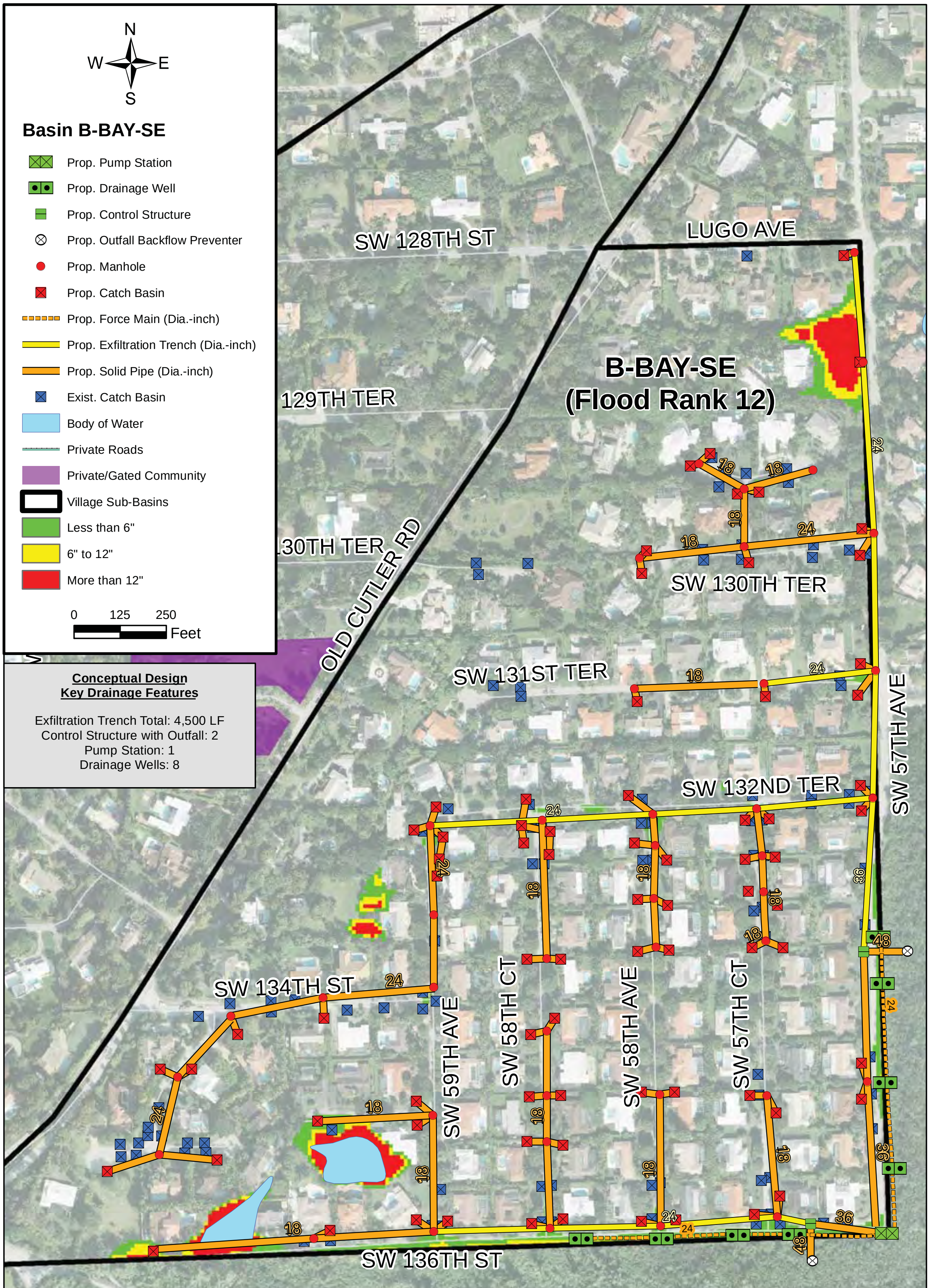
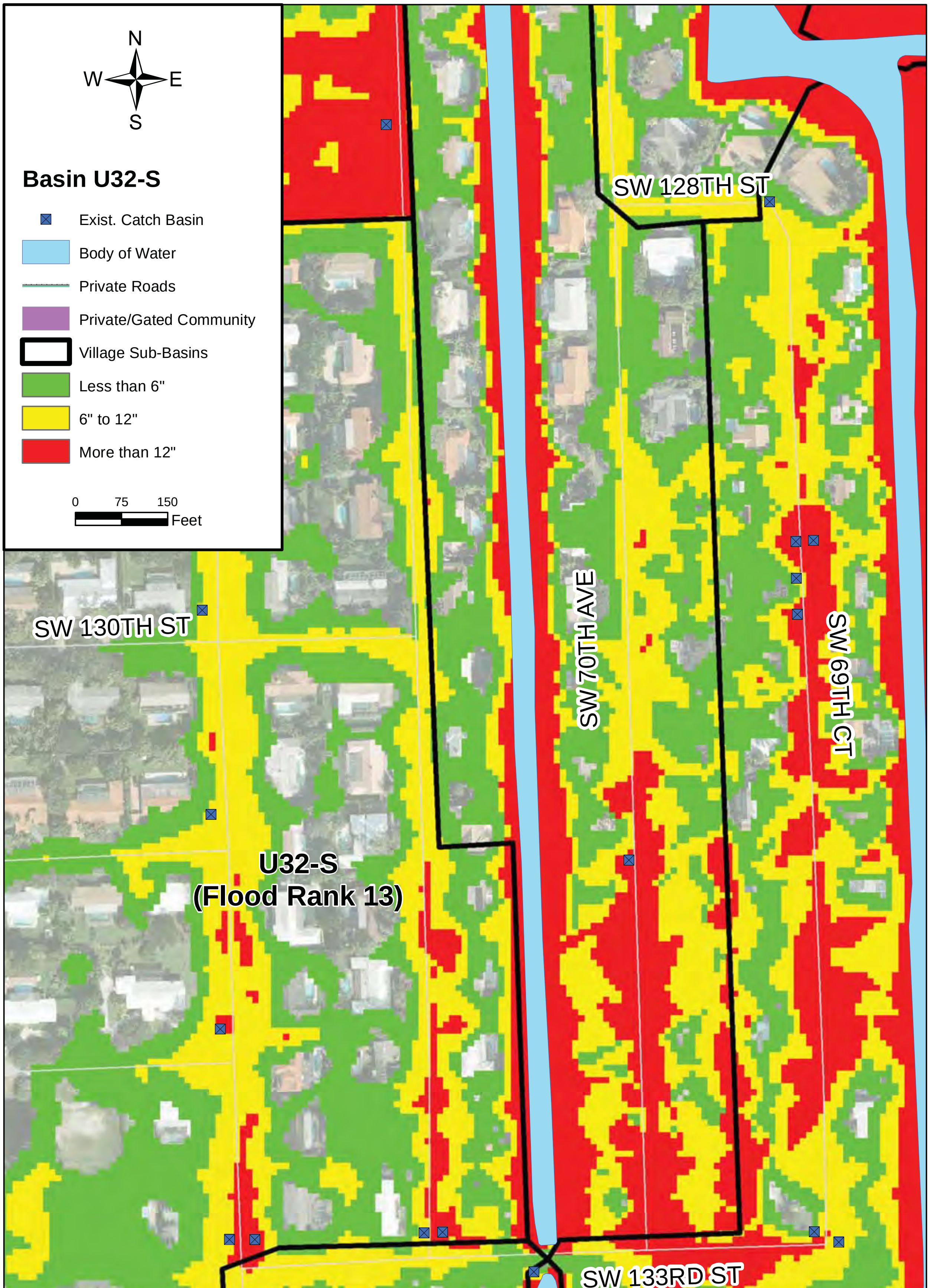


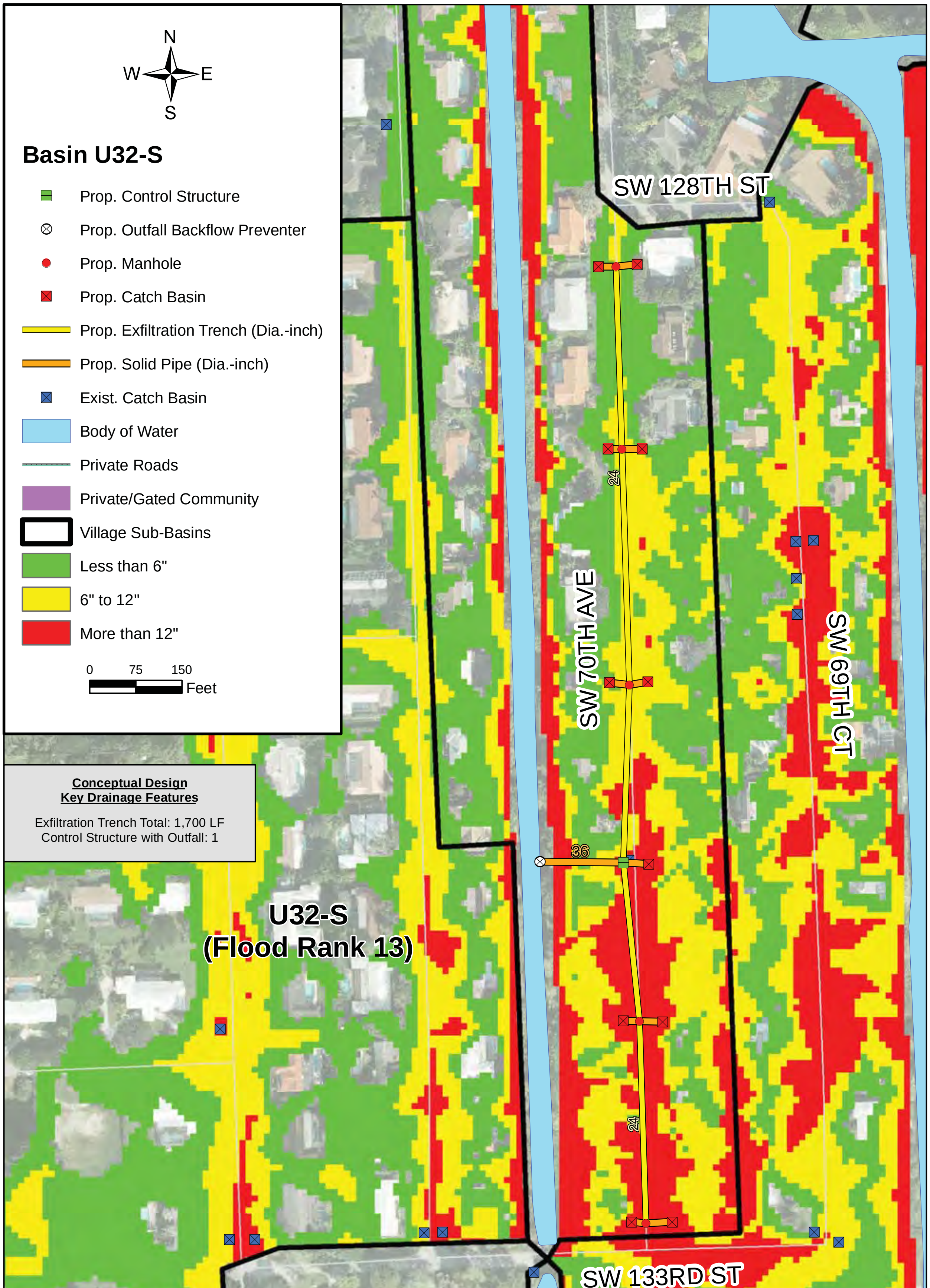
Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin
B-BAY-SE (Flood Rank 12)
without Proposed Improvement Projects



Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin B-BAY-SE (Flood Rank 12) with Proposed Improvement Projects



Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin U32-S
(Flood Rank 13) w/o Proposed Improvement Projects



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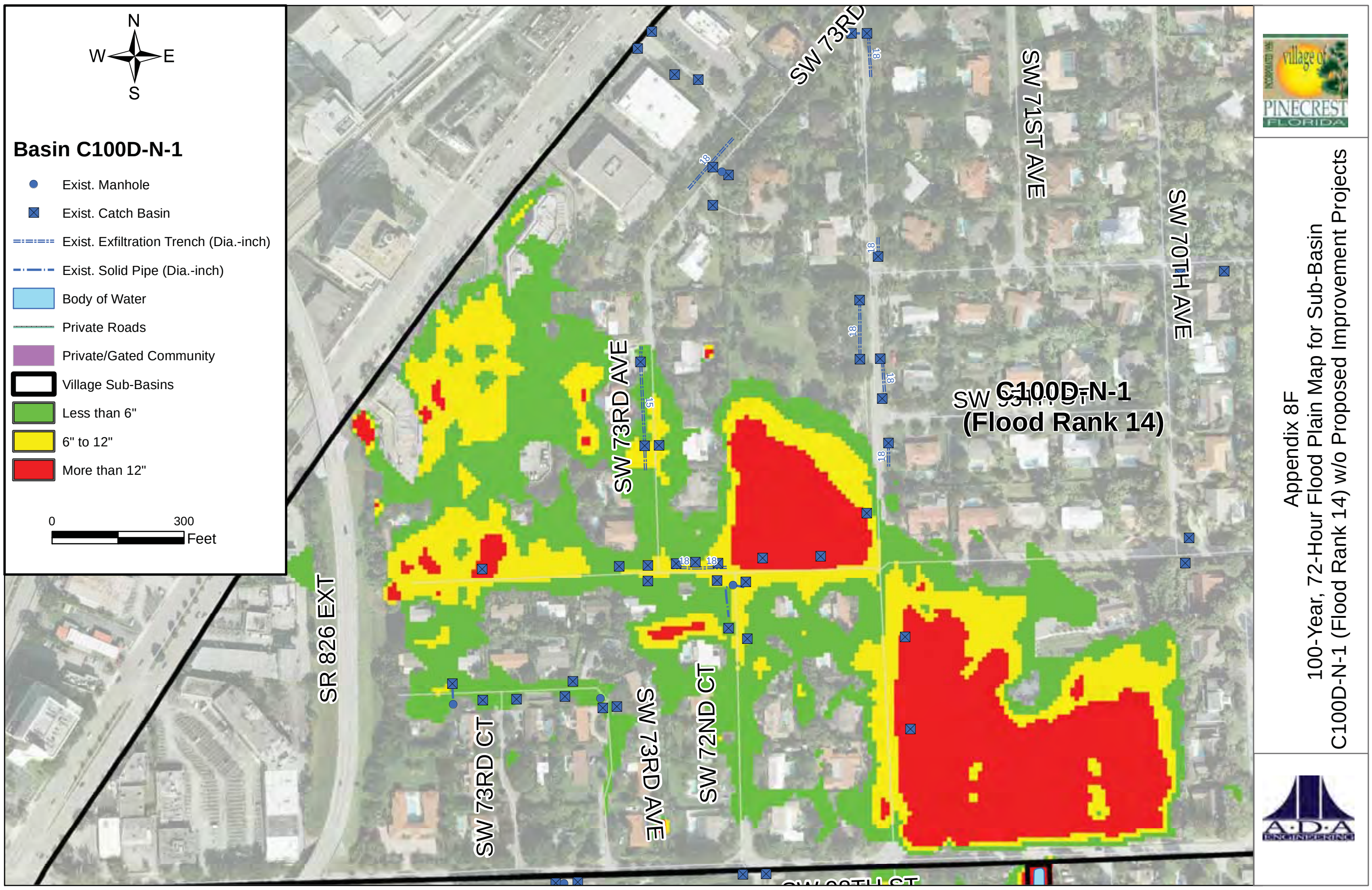
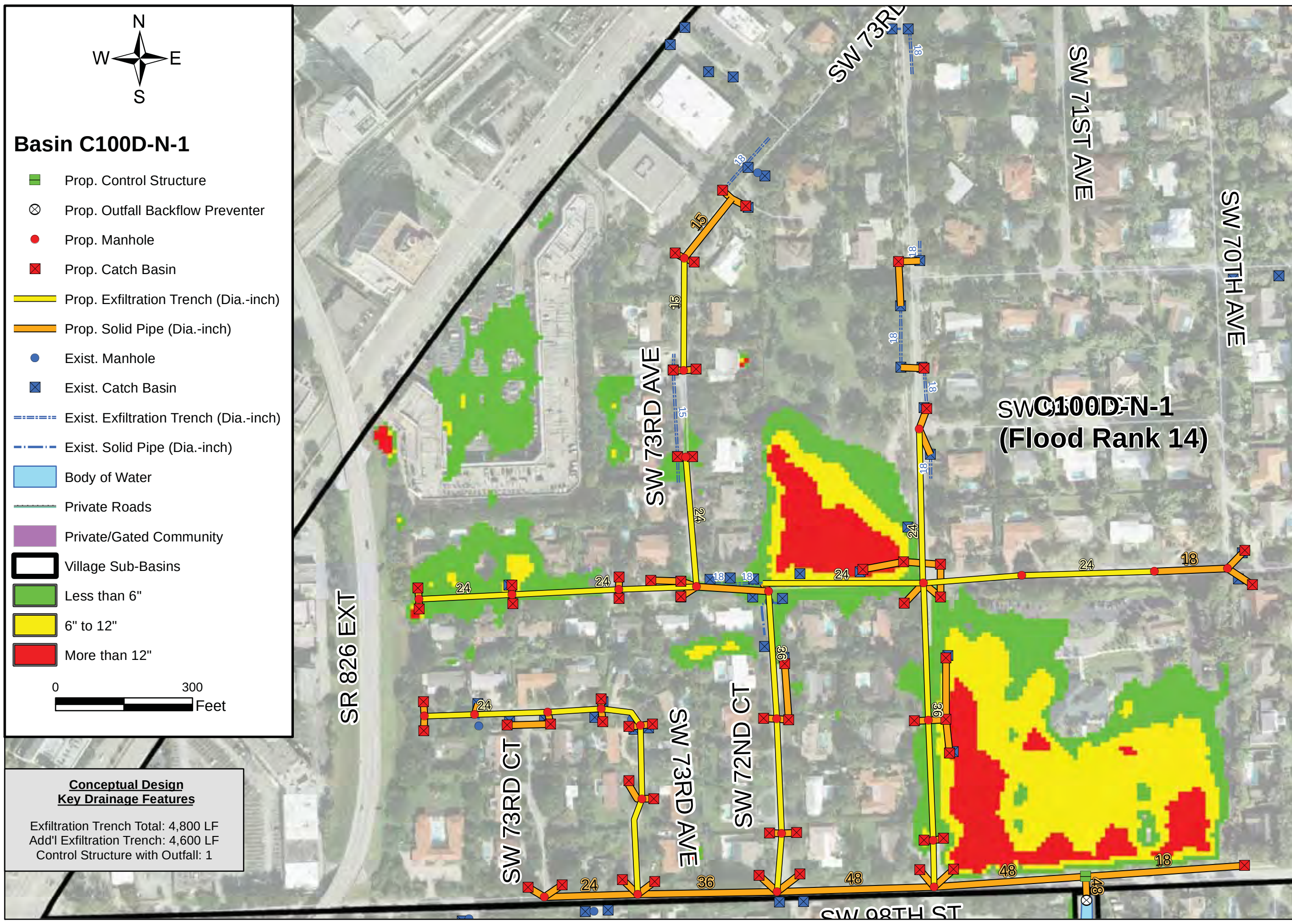
Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin U32-S (Flood Rank 13) with Proposed Improvement Projects

village of PINECREST FLORIDA



N
W
E
S
Basin C100D-N-1
Exist. Manhole
Exist. Catch Basin
Exist. Exfiltration Trench (Dia.-inch)
Exist. Solid Pipe (Dia.-inch)
Body of Water
Private Roads
Private/Gated Community
Village Sub-Basins
Less than 6"
6" to 12"
More than 12"
0
300
Feet
SW 73RD
SW 71ST AVE
SW 70TH AVE
SW 73RD AVE
SR 826 EXT
C100D-N-1
(Flood Rank 14)
SW 73RD CT
SW 73RD AVE
SW 72ND CT
Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin
C100D-N-1 (Flood Rank 14) w/o Proposed Improvement Projects
village of PINECREST FLORIDA
A·D·A ENGINEERING



Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin
C100D-N-1 (Flood Rank 14) with Proposed Improvement Projects

Village of Pinecrest Florida

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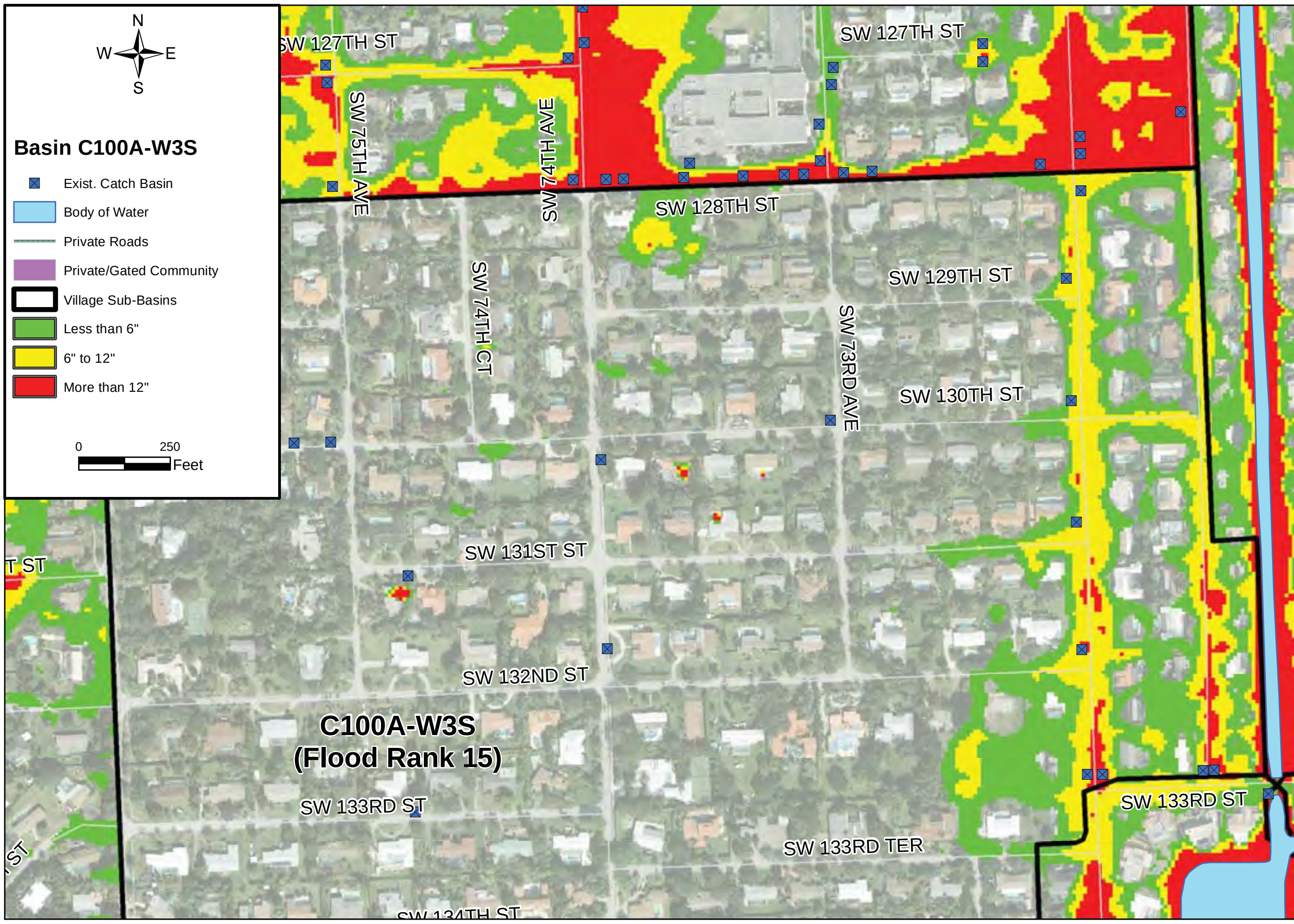
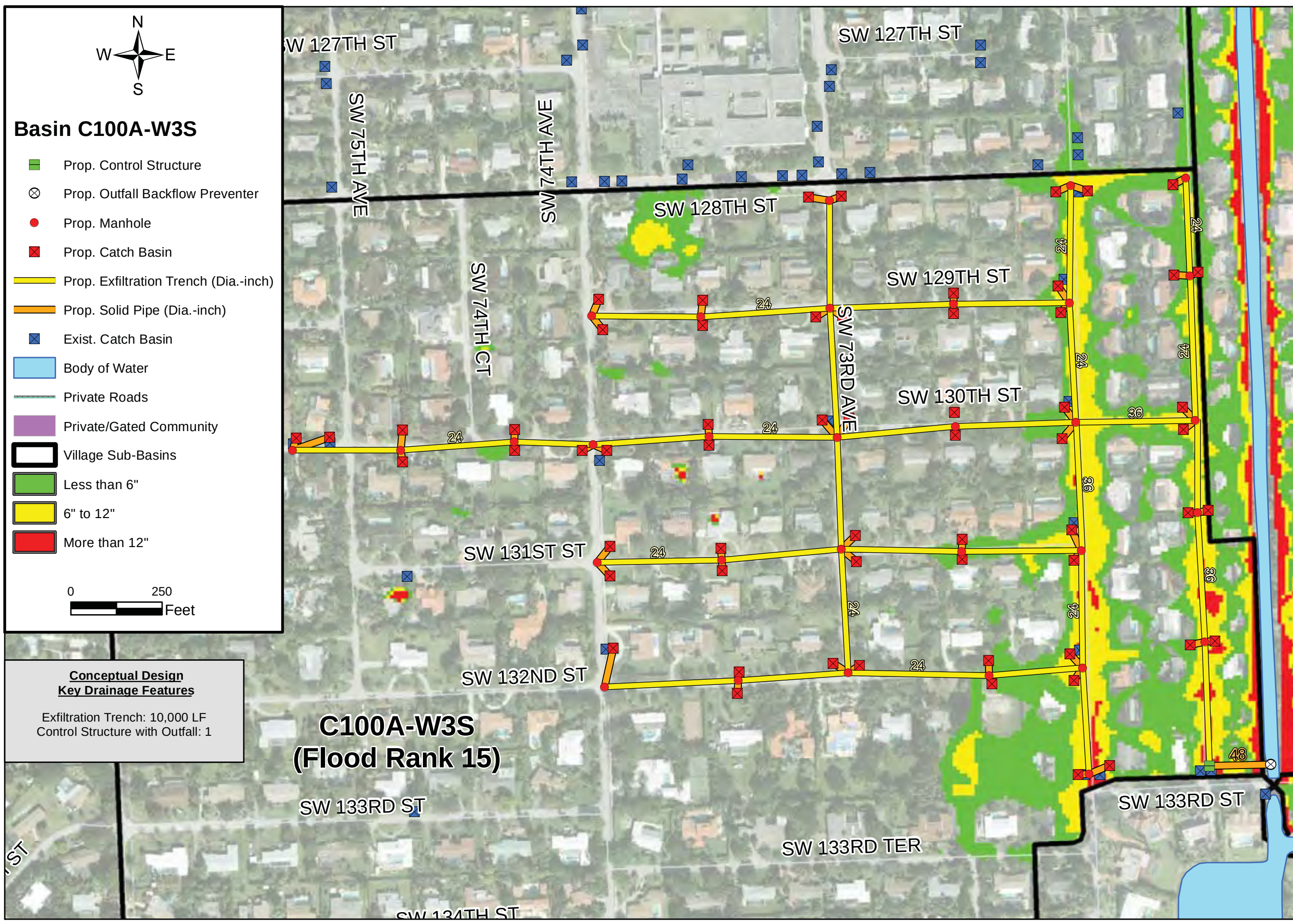


Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin C100A-W3S
(Flood Rank 15) w/o Proposed Improvement Projects



Appendix 8F
100-Year, 72-Hour Flood Plain Map for Sub-Basin C100A-W3S
(Flood Rank 15) with Proposed Improvement Projects

village of PINECREST FLORIDA

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Appendix 8G

Revised FPSS Scores
Top 15 Ranked Sub-Basins

Sub-Basin Name	Sub-Basin Area (Acres)	NS		DEM		MER		MMAS		MCLRS		RPL		NFC		BM		Revised Scores
		3 Weighing Factor		5 Weighing Factor		4 Weighing Factor		4 Weighing Factor		2 Weighing Factor		8 Weighing Factor		2 Weighing Factor		3 Weighing Factor		
		Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	FPSS
U29-S	60.15	258	1	39.8	1	0	3	0	1	0.1	4	0	1	0	1	0.5	4	298.4
U35-S	42.44	138	2	24.1	2	0.1	2	0	1	0	5	0	1	0	1	0.6	3	162.8
C100A-E-2	33.88	99	3	14.6	4	0	3	0	1	0	4	0	1	0	1	2.1	1	115.7
U32-S	20.67	90	4	12.2	7	0	3	0	1	0	4	0	1	0	1	0.4	5	102.6
C100A-W3S	177.99	87	5	12.7	5	0	3	0	1	0.2	3	0	1	0	1	0.5	4	100.4
PNL&RGL	86.22	72	6	9.1	8	0	3	0	1	0.4	2	0	1	0	1	0	9	81.5
C100DN-1W	136.07	69	7	8	9	0	3	0	1	0	4	0	1	0	1	0	9	77.0
C2-S-9NE	204.78	51	8	20.1	3	1.3	1	0	1	0	4	0	1	0	1	0	9	72.4
C100DN-1E	102.48	21	9	6.9	10	0	3	0	1	0	4	0	1	0	1	0	9	27.9
C100D-N-1	247.42	0	12	12.5	6	0	3	0	1	0	4	0	1	0	1	0	9	12.5
B-Bay-SE	99.92	3	10	4.4	11	0	3	0	1	0.9	1	0	1	0	1	0	9	8.3
C100A-E-1	90.74	3	10	3.2	12	0	3	0	1	0	4	0	1	0	1	0.1	7	6.3
U28-E	55.82	0	12	2.1	13	0	3	0	1	0	4	0	1	0	1	1.2	2	3.3
C100A-5	29.60	0	12	1	14	0	3	0	1	0	4	0	1	0	1	0.2	6	1.2
C100A-W3N	172.75	0	12	0.7	15	0	3	0	1	0	4	0	1	0	1	0	9	0.7

Appendix 8H

Project Rank	Sub-Basin	Flood Rank	Basin Area (acre)	FPSS Score w/o Improvements	FPSS Score with Improvements	FPSS Sore Reduction	Volume Removed (cubic feet)	Cost per Sub-Basin	Cost per Volume Reduction
1	U35-S	4	42.44	232.8	162.8	70.0	9,005,988	$ 981,252	$ 0.12
2	C100DN-1W	2	136.07	267	77.0	190.0	17,714,002	$ 3,094,683	$ 0.17
3	C100DN-1E	7	102.48	164.9	27.9	137.0	23,912,244	$ 4,261,881	$ 0.18
4	U29-S	1	60.15	377.5	298.4	79.1	11,683,434	$ 2,361,083	$ 0.21
5	C100A-5	8	29.60	161	1.2	159.8	6,856,617	$ 1,714,848	$ 0.25
6	U28-E	11	55.82	127.6	3.3	124.3	10,664,353	$ 2,767,835	$ 0.26
7	U32-S	13	20.67	122.3	102.6	19.7	2,402,028	$ 627,709	$ 0.26
8	C100A-E-2	6	33.88	178.7	115.7	63.0	3,760,808	$ 1,228,833	$ 0.33
9	C100A-W3S	15	177.99	112.2	100.4	11.8	11,759,478	$ 3,858,144	$ 0.33
10	C100D-N-1	14	247.42	112.5	12.5	100.0	6,602,810	$ 2,208,589	$ 0.33
11	B-Bay-SE	12	99.92	123.8	8.3	115.5	13,657,580	$ 4,644,125	$ 0.34
12	C100A-W3N	3	172.75	260	0.7	259.3	6,339,786	$ 3,535,768	$ 0.56
13	C100A-E-1	9	90.74	147.9	6.3	141.6	5,585,777	$ 3,558,844	$ 0.64
14	PNL&RGL	5	86.22	223.2	81.5	141.7	3,338,791	$ 2,361,101	$ 0.71
15	C2-S-9NE	10	204.78	146.6	72.4	74.2	1,295,580	$ 3,615,130	$ 2.79

Appendix 8I

VILLAGE OF PINECREST STORMWATER MANAGEMENT MAST PLAN UPDATE
ENGINEER'S OPINION OF CONSTRUCTION COST ESTIMATE
Rank 1 (U29-S)

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		ROADWAY PAY ITEMS				
1	110-1-1	CLEARING AND GRUBBING	AC	$ 10,000.00	0.254	$ 2,540.00
2	327-70-1	MILLING EXISTING ASPHALT (1" AVG. DEPTH)	SY	$ 3.00	12556	$ 37,666.67
3	334-1-13	SUPERPAVE ASPHALTIC CONC, TRAFFIC C	TN	$ 97.00	691	$ 66,983.89
4	570-1-2	PERFORMANCE TURF (SOD)	SY	$ 3.00	5750	$ 17,250.00
		TOTAL ROADWAY ITEMS=				**$ 124,440.56**

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		DRAINAGE ITEMS				
5	425-1-541	INLETS, DT BOT TYPE D, <10'	EA	$ 2,640.00	30	$ 79,200.00
6	425-2-41	MANHOLE , P-7, <10'	EA	$ 3,600.00	16	$ 57,600.00
7	425-2-102	MANHOLE SPECIAL, >10' (CONTROL STRUCT. 6'X4', WEIR)	EA	$ 12,000.00	11	$ 132,000.00
8	430-175-118	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 18" SD	LF	$ 50.00	1290	$ 64,500.00
9	430-175-124	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 24" SD	LF	$ 53.00	150	$ 7,950.00
10	430-175-136	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 36" SD	LF	$ 90.00	3125	$ 281,250.00
11	430-880-02	FLAP GATES, BACKFLOW PREVENTOR 36"	EA	$ 20,000.00	11	$ 220,000.00
12	443-70-4	FRENCH DRAIN, 24"	LF	$ 139.00	2750	$ 382,250.00
		TOTAL DRAINAGE ITEMS=				**$ 1,224,750.00**
		SUBTOTAL ALL AREAS				**$ 1,349,190.56**
13	102-1	MAINTENANCE OF TRAFFIC (10%)	LS	$ 134,919.06	1	$ 134,919.06
14	101-1	MOBILIZATION (10%)	LS	$ 134,919.06	1	$ 134,919.06
15		PERMIT (5%)	LS	$ 67,459.53	1	$ 67,459.53
16		CONTINGENCY (30%)	LS	$ 404,757.17	1	$ 404,757.17
17		DESIGN (10%)	LS	$ 134,919.06	1	$ 134,919.06
18		CONSTRUCTION ADMINISTRATION (10%)	LS	$ 134,919.06	1	$ 134,919.06
		SWMMP PLAN UPDATE COST ESTIMATE				**$ 2,361,083.47**

VILLAGE OF PINECREST STORMWATER MANAGEMENT MAST PLAN UPDATE
ENGINEER'S OPINION OF CONSTRUCTION COST ESTIMATE
Rank 2 (C100DN-1W)

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		ROADWAY PAY ITEMS				
1	110-1-1	CLEARING AND GRUBBING	AC	$ 10,000.00	0.353	$ 3,530.00
2	327-70-1	MILLING EXISTING ASPHALT (1" AVG. DEPTH)	SY	$ 3.00	20000	$ 60,000.00
3	334-1-13	SUPERPAVE ASPHALTIC CONC, TRAFFIC C	TN	$ 97.00	1100	$ 106,700.00
4	570-1-2	PERFORMANCE TURF (SOD)	SY	$ 3.00	5667	$ 17,000.00
		TOTAL ROADWAY ITEMS=				**$ 187,230.00**

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		DRAINAGE ITEMS				
5	425-1-541	INLETS, DT BOT TYPE D, <10'	EA	$ 2,640.00	49	$ 129,360.00
6	425-2-41	MANHOLE , P-7, <10'	EA	$ 3,600.00	26	$ 93,600.00
7	425-2-102	MANHOLE SPECIAL, >10' (CONTROL STRUCT. 6'X4', WEIR)	EA	$ 12,000.00	3	$ 36,000.00
8	430-175-118	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 18" SD	LF	$ 50.00	1220	$ 61,000.00
9	430-175-136	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 36" SD	LF	$ 90.00	520	$ 46,800.00
10	430-880-02	FLAP GATES, BACKFLOW PREVENTOR 18"	EA	$ 12,000.00	1	$ 12,000.00
11	430-880-06	FLAP GATES, BACKFLOW PREVENTOR 36"	EA	$ 20,000.00	2	$ 40,000.00
12	443-70-4	FRENCH DRAIN, 24"	LF	$ 139.00	8000	$ 1,112,000.00
13	443-70-6	FRENCH DRAIN, 36"	LF	$ 168.00	300	$ 50,400.00
14						
		TOTAL DRAINAGE ITEMS=				**$ 1,581,160.00**

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		SUBTOTAL ALL AREAS				**$ 1,768,390.00**
15	102-1	MAINTENANCE OF TRAFFIC (10%)	LS	$ 176,839.00	1	$ 176,839.00
16	101-1	MOBILIZATION (10%)	LS	$ 176,839.00	1	$ 176,839.00
17		PERMIT (5%)	LS	$ 88,419.50	1	$ 88,419.50
18		CONTINGENCY (30%)	LS	$ 530,517.00	1	$ 530,517.00
19		DESIGN (10%)	LS	$ 176,839.00	1	$ 176,839.00
20		CONSTRUCTION ADMINISTRATION (10%)	LS	$ 176,839.00	1	$ 176,839.00
		SWMMP PLAN UPDATE COST ESTIMATE				**$ 3,094,682.50**

VILLAGE OF PINECREST STORMWATER MANAGEMENT MAST PLAN UPDATE
ENGINEER'S OPINION OF CONSTRUCTION COST ESTIMATE
Rank 3 (C100A-W3N)

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		ROADWAY PAY ITEMS				
1	110-1-1	CLEARING AND GRUBBING	AC	$ 10,000.00	0.254	$ 2,540.00
2	327-70-1	MILLING EXISTING ASPHALT (1" AVG. DEPTH)	SY	$ 3.00	25867	$ 77,600.00
3	334-1-13	SUPERPAVE ASPHALTIC CONC, TRAFFIC C	TN	$ 97.00	1423	$ 137,998.67
4	570-1-2	PERFORMANCE TURF (SOD)	SY	$ 3.00	6467	$ 19,400.00
		TOTAL ROADWAY ITEMS=				**$ 237,538.67**

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		DRAINAGE ITEMS				
5	425-1-541	INLETS, DT BOT TYPE D, <10'	EA	$ 2,640.00	65	$ 171,600.00
6	425-2-41	MANHOLE , P-7, <10'	EA	$ 3,600.00	35	$ 126,000.00
7	425-2-102	MANHOLE SPECIAL, >10' (CONTROL STRUCT. 6'X4', WEIR)	EA	$ 12,000.00	1	$ 12,000.00
8	430-175-118	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 18" SD	LF	$ 50.00	3770	$ 188,500.00
	430-175-124	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 24" SD	LF	$ 53.00	125	$ 6,625.00
9	430-175-136	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 36" SD	LF	$ 90.00	50	$ 4,500.00
10	430-880-02	FLAP GATES, BACKFLOW PREVENTOR 36"	EA	$ 20,000.00	1	$ 20,000.00
11	443-70-4	FRENCH DRAIN, 24"	LF	$ 139.00	7025	$ 976,475.00
12	443-70-6	FRENCH DRAIN, 36"	LF	$ 168.00	1650	$ 277,200.00
		TOTAL DRAINAGE ITEMS=				**$ 1,782,900.00**

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		SUBTOTAL ALL AREAS				**$ 2,020,438.67**
13	102-1	MAINTENANCE OF TRAFFIC (10%)	LS	$ 202,043.87	1	$ 202,043.87
14	101-1	MOBILIZATION (10%)	LS	$ 202,043.87	1	$ 202,043.87
15		PERMIT (5%)	LS	$ 101,021.93	1	$ 101,021.93
16		CONTINGENCY (30%)	LS	$ 606,131.60	1	$ 606,131.60
17		DESIGN (10%)	LS	$ 202,043.87	1	$ 202,043.87
18		CONSTRUCTION ADMINISTRATION (10%)	LS	$ 202,043.87	1	$ 202,043.87
		SWMMP PLAN UPDATE COST ESTIMATE				**$ 3,535,767.67**

VILLAGE OF PINECREST STORMWATER MANAGEMENT MAST PLAN UPDATE
ENGINEER'S OPINION OF CONSTRUCTION COST ESTIMATE
Rank 4 (U35-S)

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		ROADWAY PAY ITEMS				
1	110-1-1	CLEARING AND GRUBBING	AC	$ 10,000.00	0.116	$ 1,160.00
2	285-704	OPTIONAL BASE GROUP 04	SY	$ 9.00	1333	$ 12,000.00
3	327-70-1	MILLING EXISTING ASPHALT (1" AVG. DEPTH)	SY	$ 3.00	5889	$ 17,666.67
4	334-1-13	SUPERPAVE ASPHALTIC CONC, TRAFFIC C	TN	$ 97.00	324	$ 31,417.22
5	570-1-2	PERFORMANCE TURF (SOD)	SY	$ 3.00	1672	$ 5,016.67
6						
		TOTAL ROADWAY ITEMS=				**$ 67,260.56**

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		DRAINAGE ITEMS				
7	425-1-541	INLETS, DT BOT TYPE D, <10'	EA	$ 2,640.00	18	$ 47,520.00
8	425-2-41	MANHOLE , P-7, <10'	EA	$ 3,600.00	12	$ 43,200.00
9	425-2-102	MANHOLE SPECIAL, >10' (CONTROL STRUCT. 6'X4', WEIR)	EA	$ 12,000.00	3	$ 36,000.00
10	430-175-118	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 18" SD	LF	$ 50.00	700	$ 35,000.00
11	430-175-124	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 24" SD	LF	$ 53.00	645	$ 34,185.00
12	430-175-136	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 36" SD	LF	$ 90.00	400	$ 36,000.00
13	430-880-02	FLAP GATES, BACKFLOW PREVENTOR 36"	EA	$ 20,000.00	3	$ 60,000.00
14	443-70-4	FRENCH DRAIN, 24"	LF	$ 139.00	1450	$ 201,550.00
		TOTAL DRAINAGE ITEMS=				**$ 493,455.00**

		SUBTOTAL ALL AREAS				**$ 560,715.56**
15	102-1	MAINTENANCE OF TRAFFIC (10%)	LS	$ 56,071.56	1	$ 56,071.56
16	101-1	MOBILIZATION (10%)	LS	$ 56,071.56	1	$ 56,071.56
17		PERMIT (5%)	LS	$ 28,035.78	1	$ 28,035.78
18		CONTINGENCY (30%)	LS	$ 168,214.67	1	$ 168,214.67
19		DESIGN (10%)	LS	$ 56,071.56	1	$ 56,071.56
20		CONSTRUCTION ADMINISTRATION (10%)	LS	$ 56,071.56	1	$ 56,071.56
		SWMMP PLAN UPDATE COST ESTIMATE				**$ 981,252.22**

VILLAGE OF PINECREST STORMWATER MANAGEMENT MAST PLAN UPDATE
ENGINEER'S OPINION OF CONSTRUCTION COST ESTIMATE
Rank 5 (PNL & RGL)

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		ROADWAY PAY ITEMS				
1	110-1-1	CLEARING AND GRUBBING	AC	$ 10,000.00	0.521	$ 5,210.00
2	327-70-1	MILLING EXISTING ASPHALT (1" AVG. DEPTH)	SY	$ 3.00	26889	$ 80,666.67
3	334-1-13	SUPERPAVE ASPHALTIC CONC, TRAFFIC C	TN	$ 97.00	1479	$ 143,452.22
4	570-1-2	PERFORMANCE TURF (SOD)	SY	$ 3.00	6889	$ 20,666.67
		TOTAL ROADWAY ITEMS=				**$ 249,995.56**

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		DRAINAGE ITEMS				
5	425-2-102	MANHOLE SPECIAL, >10' (CONTROL STRUCT. 8'X6)	EA	$ 20,000.00	2	$ 40,000.00
6	430-175-118	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 18" SD	LF	$ 50.00	1000	$ 50,000.00
7	430-175-124	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 24" SD	LF	$ 53.00	3485	$ 184,705.00
8	430-175-136	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 36" SD	LF	$ 90.00	50	$ 4,500.00
9	448-73	PUMP STATION WITH CONTROL PANEL	EA	$ 410,000.00	2	$ 820,000.00
		TOTAL DRAINAGE ITEMS=				**$ 1,099,205.00**

		SUBTOTAL ALL AREAS				**$ 1,349,200.56**
10	102-1	MAINTENANCE OF TRAFFIC (10%)	LS	$ 134,920.06	1	$ 134,920.06
11	101-1	MOBILIZATION (10%)	LS	$ 134,920.06	1	$ 134,920.06
12		PERMIT (5%)	LS	$ 67,460.03	1	$ 67,460.03
13		CONTINGENCY (30%)	LS	$ 404,760.17	1	$ 404,760.17
14		DESIGN (10%)	LS	$ 134,920.06	1	$ 134,920.06
15		CONSTRUCTION ADMINISTRATION (10%)	LS	$ 134,920.06	1	$ 134,920.06
		SWMMP PLAN UPDATE COST ESTIMATE				**$ 2,361,100.97**

VILLAGE OF PINECREST STORMWATER MANAGEMENT MAST PLAN UPDATE
ENGINEER'S OPINION OF CONSTRUCTION COST ESTIMATE
Rank 6 (C100A-E-2)

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		ROADWAY PAY ITEMS				
1	110-1-1	CLEARING AND GRUBBING	AC	$ 10,000.00	0.123	$ 1,230.00
2	327-70-1	MILLING EXISTING ASPHALT (1" AVG. DEPTH)	SY	$ 3.00	6000	$ 18,000.00
3	334-1-13	SUPERPAVE ASPHALTIC CONC, TRAFFIC C	TN	$ 97.00	330	$ 32,010.00
4	570-1-2	PERFORMANCE TURF (SOD)	SY	$ 3.00	2083	$ 6,250.00
		TOTAL ROADWAY ITEMS=				**$ 57,490.00**

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		DRAINAGE ITEMS				
5	425-1-541	INLETS, DT BOT TYPE D, <10'	EA	$ 2,640.00	30	$ 79,200.00
6	425-2-41	MANHOLE , P-7, <10'	EA	$ 3,600.00	22	$ 79,200.00
7	425-2-102	MANHOLE SPECIAL, >10' (CONTROL STRUCT. 6'X4', WEIR)	EA	$ 12,000.00	2	$ 24,000.00
8	430-175-118	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 18" SD	LF	$ 50.00	310	$ 15,500.00
9	430-175-136	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 36" SD	LF	$ 90.00	350	$ 31,500.00
10	430-880-02	FLAP GATES, BACKFLOW PREVENTOR 36"	EA	$ 20,000.00	2	$ 40,000.00
11	443-70-4	FRENCH DRAIN, 24"	LF	$ 139.00	2700	$ 375,300.00
12						
		TOTAL DRAINAGE ITEMS=				**$ 644,700.00**

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		SUBTOTAL ALL AREAS				**$ 702,190.00**
13	102-1	MAINTENANCE OF TRAFFIC (10%)	LS	$ 70,219.00	1	$ 70,219.00
14	101-1	MOBILIZATION (10%)	LS	$ 70,219.00	1	$ 70,219.00
15		PERMIT (5%)	LS	$ 35,109.50	1	$ 35,109.50
16		CONTINGENCY (30%)	LS	$ 210,657.00	1	$ 210,657.00
17		DESIGN (10%)	LS	$ 70,219.00	1	$ 70,219.00
18		CONSTRUCTION ADMINISTRATION (10%)	LS	$ 70,219.00	1	$ 70,219.00
		SWMMP PLAN UPDATE COST ESTIMATE				**$ 1,228,832.50**

VILLAGE OF PINECREST STORMWATER MANAGEMENT MAST PLAN UPDATE
ENGINEER'S OPINION OF CONSTRUCTION COST ESTIMATE
Rank 7 (C100DN-1E)

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		ROADWAY PAY ITEMS				
1	110-1-1	CLEARING AND GRUBBING	AC	$ 10,000.00	0.486	$ 4,860.00
2	120-6	EMBANKMENT	LF	$ 17.36	1125	$ 19,530.00
3	327-70-1	MILLING EXISTING ASPHALT (1" AVG. DEPTH)	SY	$ 3.00	23556	$ 70,666.67
4	334-1-13	SUPERPAVE ASPHALTIC CONC, TRAFFIC C	TN	$ 97.00	1296	$ 125,668.89
5	570-1-2	PERFORMANCE TURF (SOD)	SY	$ 3.00	7842	$ 23,525.00
		TOTAL ROADWAY ITEMS=				**$ 244,250.56**

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		DRAINAGE ITEMS				
6	425-1-541	INLETS, DT BOT TYPE D, <10'	EA	$ 2,640.00	54	$ 142,560.00
7	425-2-41	MANHOLE , P-7, <10'	EA	$ 3,600.00	27	$ 97,200.00
8	425-2-102	MANHOLE SPECIAL, >10' (CONTROL STRUCT. 6'X4', WEIR)	EA	$ 12,000.00	2	$ 24,000.00
9	430-175-118	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 18" SD	LF	$ 50.00	520	$ 26,000.00
10	430-175-136	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 36" SD	LF	$ 90.00	3000	$ 270,000.00
11	430-880-02	FLAP GATES, BACKFLOW PREVENTOR 36"	EA	$ 20,000.00	2	$ 40,000.00
12	443-70-4	FRENCH DRAIN, 24"	LF	$ 139.00	8850	$ 1,230,150.00
13	443-70-6	FRENCH DRAIN, 36"	LF	$ 168.00	2150	$ 361,200.00
		TOTAL DRAINAGE ITEMS=				**$ 2,191,110.00**

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		SUBTOTAL ALL AREAS				**$ 2,435,360.56**
14	102-1	MAINTENANCE OF TRAFFIC (10%)	LS	$ 243,536.06	1	$ 243,536.06
15	101-1	MOBILIZATION (10%)	LS	$ 243,536.06	1	$ 243,536.06
16		PERMIT (5%)	LS	$ 121,768.03	1	$ 121,768.03
17		CONTINGENCY (30%)	LS	$ 730,608.17	1	$ 730,608.17
18		DESIGN (10%)	LS	$ 243,536.06	1	$ 243,536.06
19		CONSTRUCTION ADMINISTRATION (10%)	LS	$ 243,536.06	1	$ 243,536.06
		SWMMP PLAN UPDATE COST ESTIMATE				**$ 4,261,880.97**

VILLAGE OF PINECREST STORMWATER MANAGEMENT MAST PLAN UPDATE
ENGINEER'S OPINION OF CONSTRUCTION COST ESTIMATE
Rank 8 (C100A-5)

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		ROADWAY PAY ITEMS				
1	110-1-1	CLEARING AND GRUBBING	AC	$ 10,000.00	0.192	$ 1,920.00
2	327-70-1	MILLING EXISTING ASPHALT (1" AVG. DEPTH)	SY	$ 3.00	9333	$ 28,000.00
3	334-1-13	SUPERPAVE ASPHALTIC CONC, TRAFFIC C	TN	$ 97.00	513	$ 49,793.33
4	570-1-2	PERFORMANCE TURF (SOD)	SY	$ 3.00	3167	$ 9,500.00
					TOTAL ROADWAY ITEMS=	**$ 89,213.33**

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		DRAINAGE ITEMS				
5	425-1-541	INLETS, DT BOT TYPE D, <10'	EA	$ 2,640.00	25	$ 66,000.00
6	425-2-41	MANHOLE , P-7, <10'	EA	$ 3,600.00	17	$ 61,200.00
7	425-2-102	MANHOLE SPECIAL, >10' (CONTROL STRUCT. 6'X4', WEIR)	EA	$ 12,000.00	3	$ 36,000.00
8	430-175-118	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 18" SD	LF	$ 50.00	505	$ 25,250.00
9	430-175-136	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 36" SD	LF	$ 90.00	440	$ 39,600.00
10	430-880-02	FLAP GATES, BACKFLOW PREVENTOR 36"	EA	$ 20,000.00	3	$ 60,000.00
11	443-70-4	FRENCH DRAIN, 24"	LF	$ 139.00	3550	$ 493,450.00
12	443-70-6	FRENCH DRAIN, 36"	LF	$ 168.00	650	$ 109,200.00
					TOTAL DRAINAGE ITEMS=	**$ 890,700.00**

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		SUBTOTAL ALL AREAS				**$ 979,913.33**
13	102-1	MAINTENANCE OF TRAFFIC (10%)	LS	$ 97,991.33	1	$ 97,991.33
14	101-1	MOBILIZATION (10%)	LS	$ 97,991.33	1	$ 97,991.33
15		PERMIT (5%)	LS	$ 48,995.67	1	$ 48,995.67
16		CONTINGENCY (30%)	LS	$ 293,974.00	1	$ 293,974.00
17		DESIGN (10%)	LS	$ 97,991.33	1	$ 97,991.33
18		CONSTRUCTION ADMINISTRATION (10%)	LS	$ 97,991.33	1	$ 97,991.33
		SWMMP PLAN UPDATE COST ESTIMATE				**$ 1,714,848.33**

VILLAGE OF PINECREST STORMWATER MANAGEMENT MAST PLAN UPDATE
ENGINEER'S OPINION OF CONSTRUCTION COST ESTIMATE
Rank 9 (C100A-E-1)

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		ROADWAY PAY ITEMS				
1	110-1-1	CLEARING AND GRUBBING	AC	$ 10,000.00	0.537	$ 5,370.00
2	327-70-1	MILLING EXISTING ASPHALT (1" AVG. DEPTH)	SY	$ 3.00	26000	$ 78,000.00
3	334-1-13	SUPERPAVE ASPHALTIC CONC, TRAFFIC C	TN	$ 97.00	1430	$ 138,710.00
4	570-1-2	PERFORMANCE TURF (SOD)	SY	$ 3.00	6958	$ 20,875.00
					TOTAL ROADWAY ITEMS=	**$ 242,955.00**

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		DRAINAGE ITEMS				
5	425-1-541	INLETS, DT BOT TYPE D, <10'	EA	$ 2,640.00	63	$ 166,320.00
6	425-2-41	MANHOLE , P-7, <10'	EA	$ 3,600.00	34	$ 122,400.00
7	425-2-102	MANHOLE SPECIAL, >10' (CONTROL STRUCT. 6'X4', WEIR)	EA	$ 12,000.00	2	$ 24,000.00
8	430-175-118	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 18" SD	LF	$ 50.00	640	$ 32,000.00
9	430-175-124	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 24" SD	LF	$ 53.00	2200	$ 116,600.00
10	430-175-136	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 36" SD	LF	$ 90.00	1075	$ 96,750.00
11	430-880-02	FLAP GATES, BACKFLOW PREVENTOR 36"	EA	$ 20,000.00	2	$ 40,000.00
12	443-70-4	FRENCH DRAIN, 24"	LF	$ 139.00	5800	$ 806,200.00
13	443-70-6	FRENCH DRAIN, 36"	LF	$ 168.00	2300	$ 386,400.00
					TOTAL DRAINAGE ITEMS=	**$ 1,790,670.00**

		SUBTOTAL ALL AREAS				**$ 2,033,625.00**
14	102-1	MAINTENANCE OF TRAFFIC (10%)	LS	$ 203,362.50	1	$ 203,362.50
15	101-1	MOBILIZATION (10%)	LS	$ 203,362.50	1	$ 203,362.50
16		PERMIT (5%)	LS	$ 101,681.25	1	$ 101,681.25
17		CONTINGENCY (30%)	LS	$ 610,087.50	1	$ 610,087.50
18		DESIGN (10%)	LS	$ 203,362.50	1	$ 203,362.50
19		CONSTRUCTION ADMINISTRATION (10%)	LS	$ 203,362.50	1	$ 203,362.50
		SWMMP PLAN UPDATE COST ESTIMATE				**$ 3,558,843.75**

VILLAGE OF PINECREST STORMWATER MANAGEMENT MAST PLAN UPDATE
ENGINEER'S OPINION OF CONSTRUCTION COST ESTIMATE
Rank 10 (C2-S-9NE)

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		ROADWAY PAY ITEMS				
1	110-1-1	CLEARING AND GRUBBING	AC	$ 10,000.00	0.530	$ 5,300.00
2	327-70-1	MILLING EXISTING ASPHALT (1" AVG. DEPTH)	SY	$ 3.00	28333	$ 85,000.00
3	334-1-13	SUPERPAVE ASPHALTIC CONC, TRAFFIC C	TN	$ 97.00	1558	$ 151,158.33
4	570-1-2	PERFORMANCE TURF (SOD)	SY	$ 3.00	7917	$ 23,750.00
		TOTAL ROADWAY ITEMS=				**$ 265,208.33**

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		DRAINAGE ITEMS				
5	425-1-541	INLETS, DT BOT TYPE D, <10'	EA	$ 2,640.00	52	$ 137,280.00
6	425-2-41	MANHOLE , P-7, <10'	EA	$ 3,600.00	30	$ 108,000.00
7	425-2-102	MANHOLE SPECIAL, >10' (CONTROL STRUCT. 6'X4', WEIR)	EA	$ 12,000.00	5	$ 60,000.00
8	430-175-118	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 18" SD	LF	$ 50.00	2440	$ 122,000.00
9	430-175-124	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 24" SD	LF	$ 53.00	2700	$ 143,100.00
10	430-175-136	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 36" SD	LF	$ 90.00	3600	$ 324,000.00
11	430-880-02	FLAP GATES, BACKFLOW PREVENTOR 36"	EA	$ 20,000.00	5	$ 100,000.00
12	443-70-4	FRENCH DRAIN, 24"	LF	$ 139.00	5800	$ 806,200.00
		TOTAL DRAINAGE ITEMS=				**$ 1,800,580.00**

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		SUBTOTAL ALL AREAS				**$ 2,065,788.33**
13	102-1	MAINTENANCE OF TRAFFIC (10%)	LS	$ 206,578.83	1	$ 206,578.83
14	101-1	MOBILIZATION (10%)	LS	$ 206,578.83	1	$ 206,578.83
15		PERMIT (5%)	LS	$ 103,289.42	1	$ 103,289.42
16		CONTINGENCY (30%)	LS	$ 619,736.50	1	$ 619,736.50
17		DESIGN (10%)	LS	$ 206,578.83	1	$ 206,578.83
18		CONSTRUCTION ADMINISTRATION (10%)	LS	$ 206,578.83	1	$ 206,578.83
		SWMMP PLAN UPDATE COST ESTIMATE				**$ 3,615,129.58**

VILLAGE OF PINECREST STORMWATER MANAGEMENT MAST PLAN UPDATE
ENGINEER'S OPINION OF CONSTRUCTION COST ESTIMATE
Rank 11 (U28-E)

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		ROADWAY PAY ITEMS				
1	110-1-1	CLEARING AND GRUBBING	AC	$ 10,000.00	0.296	$ 2,960.00
2	327-70-1	MILLING EXISTING ASPHALT (1" AVG. DEPTH)	SY	$ 3.00	14356	$ 43,066.67
3	334-1-13	SUPERPAVE ASPHALTIC CONC, TRAFFIC C	TN	$ 97.00	790	$ 76,586.89
4	570-1-2	PERFORMANCE TURF (SOD)	SY	$ 3.00	4672	$ 14,016.67
					TOTAL ROADWAY ITEMS=	**$ 136,630.22**

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		DRAINAGE ITEMS				
5	425-1-541	INLETS, DT BOT TYPE D, <10'	EA	$ 2,640.00	56	$ 147,840.00
6	425-2-41	MANHOLE , P-7, <10'	EA	$ 3,600.00	28	$ 100,800.00
7	425-2-102	MANHOLE SPECIAL, >10' (CONTROL STRUCT. 6'X4', WEIR)	EA	$ 12,000.00	4	$ 48,000.00
8	430-175-118	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 18" SD	LF	$ 50.00	770	$ 38,500.00
9	430-175-124	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 24" SD	LF	$ 53.00	800	$ 42,400.00
10	430-175-136	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 36" SD	LF	$ 90.00	1010	$ 90,900.00
11	430-880-02	FLAP GATES, BACKFLOW PREVENTOR 36"	EA	$ 20,000.00	4	$ 80,000.00
12	443-70-4	FRENCH DRAIN, 24"	LF	$ 139.00	6450	$ 896,550.00
					TOTAL DRAINAGE ITEMS=	**$ 1,444,990.00**

		SUBTOTAL ALL AREAS				**$ 1,581,620.22**
13	102-1	MAINTENANCE OF TRAFFIC (10%)	LS	$ 158,162.02	1	$ 158,162.02
14	101-1	MOBILIZATION (10%)	LS	$ 158,162.02	1	$ 158,162.02
15		PERMIT (5%)	LS	$ 79,081.01	1	$ 79,081.01
16		CONTINGENCY (30%)	LS	$ 474,486.07	1	$ 474,486.07
17		DESIGN (10%)	LS	$ 158,162.02	1	$ 158,162.02
18		CONSTRUCTION ADMINISTRATION (10%)	LS	$ 158,162.02	1	$ 158,162.02
		SWMMP PLAN UPDATE COST ESTIMATE				**$ 2,767,835.39**

VILLAGE OF PINECREST STORMWATER MANAGEMENT MAST PLAN UPDATE
ENGINEER'S OPINION OF CONSTRUCTION COST ESTIMATE
Rank 12 (B-BAY-SE)

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		ROADWAY PAY ITEMS				
1	110-1-1	CLEARING AND GRUBBING	AC	$ 10,000.00	0.521	$ 5,210.00
2	327-70-1	MILLING EXISTING ASPHALT (1" AVG. DEPTH)	SY	$ 3.00	26889	$ 80,666.67
3	334-1-13	SUPERPAVE ASPHALTIC CONC, TRAFFIC C	TN	$ 97.00	1479	$ 143,452.22
4	570-1-2	PERFORMANCE TURF (SOD)	SY	$ 3.00	6889	$ 20,666.67
		TOTAL ROADWAY ITEMS=				**$ 249,995.56**

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		DRAINAGE ITEMS				
5	425-1-541	INLETS, DT BOT TYPE D, <10'	EA	$ 2,640.00	76	$ 200,640.00
6	425-2-41	MANHOLE , P-7, <10'	EA	$ 3,600.00	41	$ 147,600.00
7	425-2-102	MANHOLE SPECIAL, >10' (CONTROL STRUCT. 10'X6', WEIR)	EA	$ 20,000.00	2	$ 40,000.00
8	430-175-118	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 18" SD	LF	$ 50.00	6470	$ 323,500.00
9	430-175-124	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 24" SD	LF	$ 53.00	3350	$ 177,550.00
10	430-175-136	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 36" SD	LF	$ 90.00	800	$ 72,000.00
11	430-175-148	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 48" SD	LF	$ 117.00	100	$ 11,700.00
12	430-880-02	FLAP GATES, BACKFLOW PREVENTOR 48"	EA	$ 30,000.00	2	$ 60,000.00
13	443-70-4	FRENCH DRAIN, 24"	LF	$ 139.00	3800	$ 528,200.00
14	443-70-6	FRENCH DRAIN, 36"	LF	$ 168.00	700	$ 117,600.00
15	448-73	PUMP STATION WITH CONTROL PANEL	EA	$ 205,000.00	1	$ 205,000.00
16	449-1	DRAINAGE WELL	EA	$ 65,000.00	8	$ 520,000.00
		TOTAL DRAINAGE ITEMS=				**$ 2,403,790.00**

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		SUBTOTAL ALL AREAS				**$ 2,653,785.56**
17	102-1	MAINTENANCE OF TRAFFIC (10%)	LS	$ 265,378.56	1	$ 265,378.56
18	101-1	MOBILIZATION (10%)	LS	$ 265,378.56	1	$ 265,378.56
19		PERMIT (5%)	LS	$ 132,689.28	1	$ 132,689.28
20		CONTINGENCY (30%)	LS	$ 796,135.67	1	$ 796,135.67
21		DESIGN (10%)	LS	$ 265,378.56	1	$ 265,378.56
22		CONSTRUCTION ADMINISTRATION (10%)	LS	$ 265,378.56	1	$ 265,378.56
		SWMMP PLAN UPDATE COST ESTIMATE				**$ 4,644,124.72**

VILLAGE OF PINECREST STORMWATER MANAGEMENT MAST PLAN UPDATE
ENGINEER'S OPINION OF CONSTRUCTION COST ESTIMATE
Rank 13 (U32-S)

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		ROADWAY PAY ITEMS				
1	110-1-1	CLEARING AND GRUBBING	AC	$ 10,000.00	0.078	$ 780.00
2	327-70-1	MILLING EXISTING ASPHALT (1" AVG. DEPTH)	SY	$ 3.00	3778	$ 11,333.33
3	334-1-13	SUPERPAVE ASPHALTIC CONC, TRAFFIC C	TN	$ 97.00	208	$ 20,154.44
4	570-1-2	PERFORMANCE TURF (SOD)	SY	$ 3.00	1194	$ 3,583.33
		TOTAL ROADWAY ITEMS=				**$ 35,851.11**

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		DRAINAGE ITEMS				
5	425-1-541	INLETS, DT BOT TYPE D, <10'	EA	$ 2,640.00	11	$ 29,040.00
6	425-2-41	MANHOLE , P-7, <10'	EA	$ 3,600.00	5	$ 18,000.00
7	430-175-118	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 18" SD	LF	$ 50.00	120	$ 6,000.00
8	430-175-136	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 36" SD	LF	$ 90.00	150	$ 13,500.00
9	430-880-02	FLAP GATES, BACKFLOW PREVENTOR 36"	EA	$ 20,000.00	1	$ 20,000.00
10	443-70-4	FRENCH DRAIN, 24"	LF	$ 139.00	1700	$ 236,300.00
		TOTAL DRAINAGE ITEMS=				**$ 322,840.00**

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		SUBTOTAL ALL AREAS				**$ 358,691.11**
11	102-1	MAINTENANCE OF TRAFFIC (10%)	LS	$ 35,869.11	1	$ 35,869.11
12	101-1	MOBILIZATION (10%)	LS	$ 35,869.11	1	$ 35,869.11
13		PERMIT (5%)	LS	$ 17,934.56	1	$ 17,934.56
14		CONTINGENCY (30%)	LS	$ 107,607.33	1	$ 107,607.33
15		DESIGN (10%)	LS	$ 35,869.11	1	$ 35,869.11
16		CONSTRUCTION ADMINISTRATION (10%)	LS	$ 35,869.11	1	$ 35,869.11
		SWMMP PLAN UPDATE COST ESTIMATE				**$ 627,709.44**

VILLAGE OF PINECREST STORMWATER MANAGEMENT MAST PLAN UPDATE
ENGINEER'S OPINION OF CONSTRUCTION COST ESTIMATE
Rank 14 (C100D-N-1)

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		ROADWAY PAY ITEMS				
1	110-1-1	CLEARING AND GRUBBING	AC	$ 10,000.00	0.330	$ 3,300.00
2	327-70-1	MILLING EXISTING ASPHALT (1" AVG. DEPTH)	SY	$ 3.00	16000	$ 48,000.00
3	334-1-13	SUPERPAVE ASPHALTIC CONC, TRAFFIC C	TN	$ 97.00	880	$ 85,360.00
4	570-1-2	PERFORMANCE TURF (SOD)	SY	$ 3.00	4000	$ 12,000.00
5						
		TOTAL ROADWAY ITEMS=				**$ 148,660.00**

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		DRAINAGE ITEMS				
6	425-1-541	INLETS, DT BOT TYPE D, <10'	EA	$ 2,640.00	54	$ 142,560.00
7	425-2-41	MANHOLE , P-7, <10'	EA	$ 3,600.00	28	$ 100,800.00
8	425-2-102	MANHOLE SPECIAL, >10' (CONTROL STRUCT. 10'X6', WEIR)	EA	$ 20,000.00	1	$ 20,000.00
9	430-175-118	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 18" SD	LF	$ 50.00	2150	$ 107,500.00
10	430-175-124	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 24" SD	LF	$ 53.00	500	$ 26,500.00
11	430-175-136	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 36" SD	LF	$ 90.00	300	$ 27,000.00
12	430-175-148	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 48" SD	LF	$ 117.00	620	$ 72,540.00
13	430-880-02	FLAP GATES, BACKFLOW PREVENTOR 48"	EA	$ 30,000.00	1	$ 30,000.00
14	443-70-2	FRENCH DRAIN, 15"	LF	$ 110.00	100	$ 11,000.00
15	443-70-4	FRENCH DRAIN, 24"	LF	$ 139.00	2569	$ 357,091.00
16	443-70-6	FRENCH DRAIN, 36"	LF	$ 168.00	1300	$ 218,400.00
		TOTAL DRAINAGE ITEMS=				**$ 1,113,391.00**

		SUBTOTAL ALL AREAS				**$ 1,262,051.00**
17	102-1	MAINTENANCE OF TRAFFIC (10%)	LS	$ 126,205.10	1	$ 126,205.10
18	101-1	MOBILIZATION (10%)	LS	$ 126,205.10	1	$ 126,205.10
19		PERMIT (5%)	LS	$ 63,102.55	1	$ 63,102.55
20		CONTINGENCY (30%)	LS	$ 378,615.30	1	$ 378,615.30
21		DESIGN (10%)	LS	$ 126,205.10	1	$ 126,205.10
22		CONSTRUCTION ADMINISTRATION (10%)	LS	$ 126,205.10	1	$ 126,205.10
		SWMMP PLAN UPDATE COST ESTIMATE				**$ 2,208,589.25**

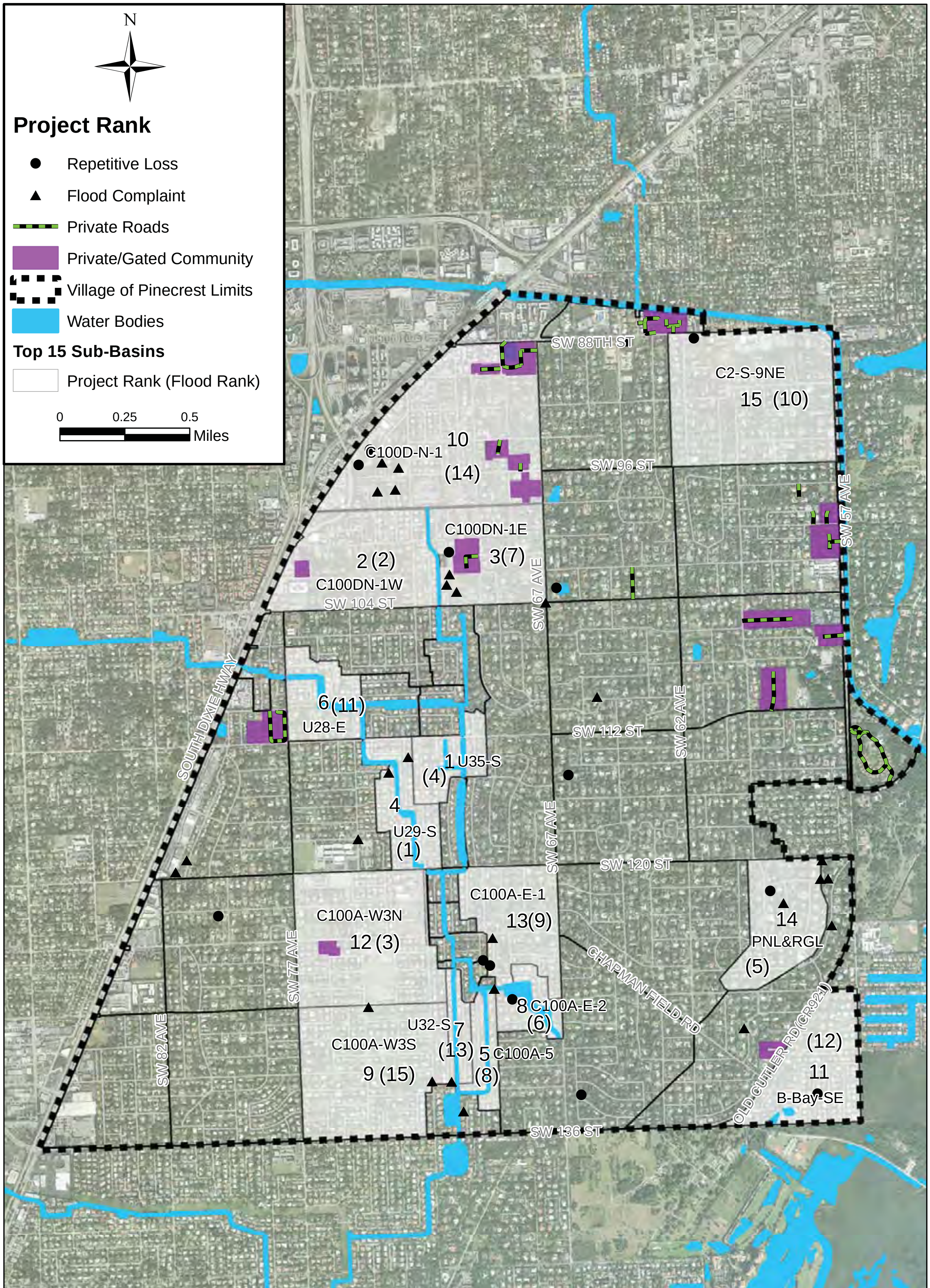
VILLAGE OF PINECREST STORMWATER MANAGEMENT MAST PLAN UPDATE
ENGINEER'S OPINION OF CONSTRUCTION COST ESTIMATE
Rank 15 (C100A-W3S)

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		ROADWAY PAY ITEMS				
1	110-1-1	CLEARING AND GRUBBING	AC	$ 10,000.00	0.521	$ 5,210.00
2	327-70-1	MILLING EXISTING ASPHALT (1" AVG. DEPTH)	SY	$ 3.00	25222	$ 75,666.67
3	334-1-13	SUPERPAVE ASPHALTIC CONC, TRAFFIC C	TN	$ 97.00	1387	$ 134,560.56
4	570-1-2	PERFORMANCE TURF (SOD)	SY	$ 3.00	6306	$ 18,916.67
		TOTAL ROADWAY ITEMS=				**$ 234,353.89**

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		DRAINAGE ITEMS				
5	425-1-541	INLETS, DT BOT TYPE D, <10'	EA	$ 2,640.00	60	$ 158,400.00
6	425-2-41	MANHOLE , P-7, <10'	EA	$ 3,600.00	31	$ 111,600.00
7	425-2-102	MANHOLE SPECIAL, >10' (CONTROL STRUCT. 10'X6', WEIR)	EA	$ 20,000.00	1	$ 20,000.00
8	430-175-118	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 18" SD	LF	$ 50.00	840	$ 42,000.00
9	430-175-148	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 48" SD	LF	$ 117.00	150	$ 17,550.00
10	430-880-02	FLAP GATES, BACKFLOW PREVENTOR 48"	EA	$ 30,000.00	1	$ 30,000.00
11	443-70-4	FRENCH DRAIN, 24"	LF	$ 139.00	9450	$ 1,313,550.00
12	443-70-6	FRENCH DRAIN, 36"	LF	$ 168.00	1650	$ 277,200.00
		TOTAL DRAINAGE ITEMS=				**$ 1,970,300.00**

Item	Pay Item	Description	Units	Average Unit Cost	Quantity	Total Amount
		SUBTOTAL ALL AREAS				**$ 2,204,653.89**
13	102-1	MAINTENANCE OF TRAFFIC (10%)	LS	$ 220,465.39	1	$ 220,465.39
14	101-1	MOBILIZATION (10%)	LS	$ 220,465.39	1	$ 220,465.39
15		PERMIT (5%)	LS	$ 110,232.69	1	$ 110,232.69
16		CONTINGENCY (30%)	LS	$ 661,396.17	1	$ 661,396.17
17		DESIGN (10%)	LS	$ 220,465.39	1	$ 220,465.39
18		CONSTRUCTION ADMINISTRATION (10%)	LS	$ 220,465.39	1	$ 220,465.39
		SWMMP PLAN UPDATE COST ESTIMATE				**$ 3,858,144.31**

Appendix 8J



Appendix 8J
Stormwater Improvement Project Rank
Based on Cost Effectiveness

A·D·A ENGINEERING

village of PINECREST FLORIDA

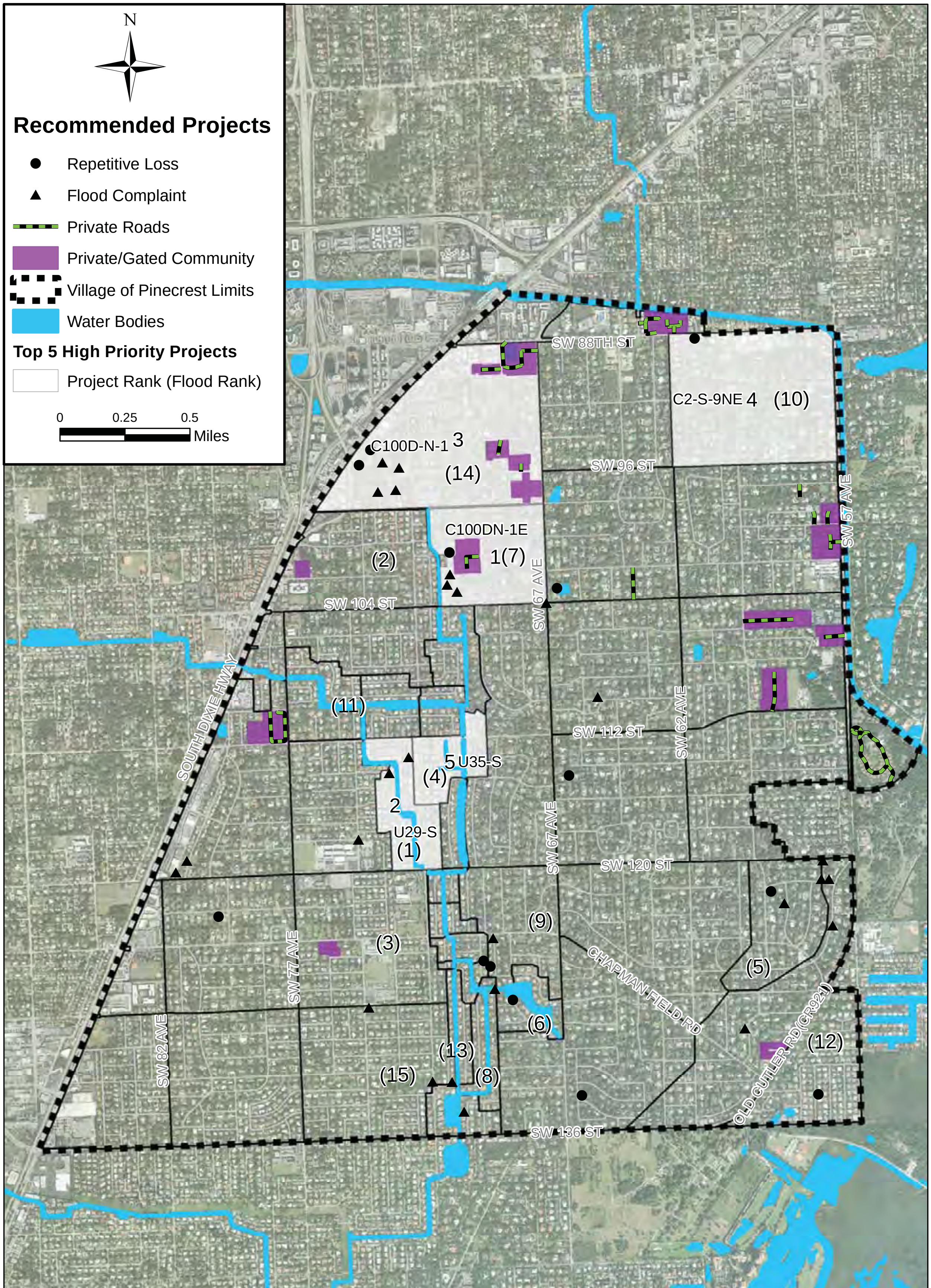
Appendix 9A

SUB-BASIN NAME	WATER QUALITY CONTINUOUS SIMULATION DRY-YEAR (lbs/yr) w/ REMOVAL PERCENTAGE APPLIED												TOTAL / SUB-BASIN
	BOD5	COD	TSS	TDS	TN	TKN	TP	DP	Cd	Cu	Pb	Zn	
B-BAY-SE	694.9	3536.0	2858.3	7928.1	77.2	77.2	22.7	9.6	0.2	1.3	4.7	4.7	**15,215**
C2-S-9NE	1014.8	5053.1	4021.9	11488.2	181.9	113.4	34.0	14.1	0.2	1.8	7.8	6.4	**21,938**
C100A-5	805.1	4012.3	3202.0	9135.5	145.1	90.3	27.1	11.2	0.2	1.5	6.2	5.1	**17,442**
C100A-E-1	764.4	3796.4	3030.3	8648.2	136.9	85.5	25.7	10.6	0.2	1.4	5.9	4.8	**16,510**
C100A-E-2	704.1	3605.6	2993.3	8112.5	125.3	77.2	22.4	9.6	0.2	1.3	6.8	4.9	**15,663**
C100A-W3N	736.0	3651.9	2917.8	8339.1	131.8	82.3	24.8	10.2	0.2	1.3	5.7	4.7	**15,906**
C100A-W3S	767.4	3994.2	3236.1	8950.1	141.3	87.8	25.0	10.7	0.2	2.1	6.3	5.4	**17,227**
C100D-N-1	884.9	4549.6	3777.4	10205.3	157.8	97.0	28.2	12.1	0.2	1.6	8.5	6.2	**19,729**
C100DN-1E	378.4	1968.1	1602.0	4424.5	69.7	43.3	12.3	5.3	0.1	1.0	3.1	2.7	**8,510**
C100DN-1W	364.6	1898.0	1541.0	4247.0	66.7	41.5	11.8	5.1	0.1	1.0	3.0	2.6	**8,182**
U28-E	1536.9	7644.0	6099.0	17402.3	274.9	172.4	51.7	21.3	0.3	2.7	11.9	9.7	**33,227**
U29-S	993.6	4958.8	3955.9	11292.0	178.7	111.4	33.4	13.8	0.2	1.8	7.7	6.3	**21,554**
U32-S	11.8	58.6	46.8	133.8	2.1	1.3	0.4	0.2	0.0	0.0	0.1	0.1	**255**
U35-S	497.4	2477.6	1985.8	5636.0	89.3	55.8	16.8	6.9	0.1	0.9	3.8	3.2	**10,773**

SUB-BASIN NAME	WATER QUALITY CONTINUOUS SIMULATION AVERAGE-YEAR (lbs/yr) w/ REMOVAL PERCENTAGE APPLIED												TOTAL / SUB-BASIN
	BOD5	**COD**	**TSS**	**TDS**	**TN**	**TKN**	**TP**	**DP**	**Cd**	**Cu**	**Pb**	**Zn**	
B-BAY-SE	1382.1	6872.3	5490.1	15664.2	154.7	154.7	46.5	19.2	0.3	2.5	8.8	8.8	**29,804**
C2-S-9NE	686.8	3483.6	2821.5	7837.5	76.1	76.1	22.4	9.5	0.2	1.2	4.6	4.6	**15,024**
C100A-5	746.3	3711.7	2966.8	8442.9	83.5	83.5	25.1	10.3	0.2	1.3	4.7	4.7	**16,081**
C100A-E-1	1496.4	7456.5	5958.4	16989.9	168.0	168.0	50.4	20.8	0.3	2.8	9.6	9.6	**32,331**
C100A-E-2	867.4	4319.9	3452.5	9830.2	97.1	97.1	29.3	12.0	0.2	1.5	5.5	5.5	**18,718**
C100A-W3N	1285.7	6569.7	5421.4	14777.0	141.2	141.2	41.0	17.6	0.3	2.3	8.9	8.9	**28,415**
C100A-W3S	1292.6	6620.1	5473.6	14886.0	142.0	142.0	41.4	17.7	0.3	2.3	9.0	9.0	**28,636**
C100D-N-1	1354.4	7074.8	5801.8	15798.4	248.3	153.6	43.4	18.8	0.3	3.5	11.8	9.7	**30,519**
C100DN-1E	465.3	2441.1	1998.6	5431.4	85.1	52.6	14.8	6.5	0.1	1.2	4.1	3.4	**10,504**
C100DN-1W	729.1	3796.0	3119.5	8512.9	133.2	82.7	23.3	10.1	0.2	1.9	6.4	5.2	**16,421**
U28-E	1193.8	5936.3	4749.0	13531.5	133.7	133.7	40.2	16.6	0.3	2.2	7.6	7.6	**25,752**
U29-S	1002.5	4970.4	3967.9	11288.6	179.4	112.0	33.7	13.9	0.2	1.8	7.7	6.3	**21,584**
U32-S	264.5	1314.7	1047.1	2996.2	47.4	29.6	8.9	3.7	0.1	0.5	2.0	1.7	**5,716**
U35-S	7.9	39.4	31.5	90.1	1.4	0.9	0.3	0.1	0.0	0.0	0.1	0.1	**172**

SUB-BASIN NAME	WATER QUALITY CONTINUOUS SIMULATION WET-YEAR (lbs/yr) w/ REMOVAL PERCENTAGE APPLIED												TOTAL / SUB-BASIN
	BOD5	COD	TSS	TDS	TN	TKN	TP	DP	Cd	Cu	Pb	Zn	
B-BAY-SE	1704.6	8484.8	6776.3	19388.3	191.0	191.0	57.4	23.6	0.4	3.1	10.8	10.8	**36,842**
C2-S-9NE	589.4	3012.5	1075.9	4846.1	105.4	65.5	19.3	8.2	0.1	1.1	5.2	4.0	**9,733**
C100A-5	901.8	4482.8	3581.0	10207.2	100.9	100.9	30.3	12.5	0.2	1.6	5.7	5.7	**19,431**
C100A-E-1	1838.6	9158.9	7320.3	20939.5	206.0	206.0	61.8	25.5	0.4	3.4	11.7	11.7	**39,784**
C100A-E-2	1052.8	5238.3	4183.8	11922.1	117.9	117.9	35.4	14.6	0.2	1.9	6.7	6.7	**22,698**
C100A-W3N	1530.4	7830.9	6475.5	17619.5	168.1	168.1	48.9	20.9	0.4	2.7	10.6	10.6	**33,887**
C100A-W3S	1540.4	7877.5	6527.6	17733.7	169.2	169.2	49.2	21.1	0.4	2.8	10.7	10.7	**34,112**
C100D-N-1	1625.8	8473.1	6928.7	18949.7	298.4	184.7	52.2	22.5	0.4	4.3	14.0	11.6	**36,565**
C100DN-1E	556.9	2898.8	2380.1	6499.4	101.8	63.0	17.7	7.7	0.1	1.4	4.9	4.0	**12,536**
C100DN-1W	873.8	4547.7	3739.6	10185.4	159.9	99.2	28.0	12.1	0.2	2.3	7.6	6.2	**19,662**
U28-E	1455.6	7253.7	5789.9	16426.5	162.6	162.6	49.0	20.2	0.3	2.7	9.3	9.3	**31,342**
U29-S	2674.4	13260.6	10586.2	30272.9	477.3	299.0	89.7	37.0	0.6	4.8	20.6	16.9	**57,740**
U32-S	699.3	3471.2	2780.3	7919.7	125.4	78.4	23.6	9.7	0.2	1.2	5.4	4.4	**15,119**
U35-S	21.0	104.4	83.4	238.3	3.8	2.3	0.7	0.3	0.0	0.0	0.2	0.1	**455**

Appendix 10A



Appendix 10A
Recommended Stormwater Improvement Projects
Top 5 High Priority Projects

A·D·A ENGINEERING

Village of PINECREST FLORIDA

Appendix 11

Digital Disc