

Legend

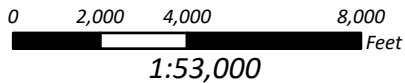
- Hollywood City Limits

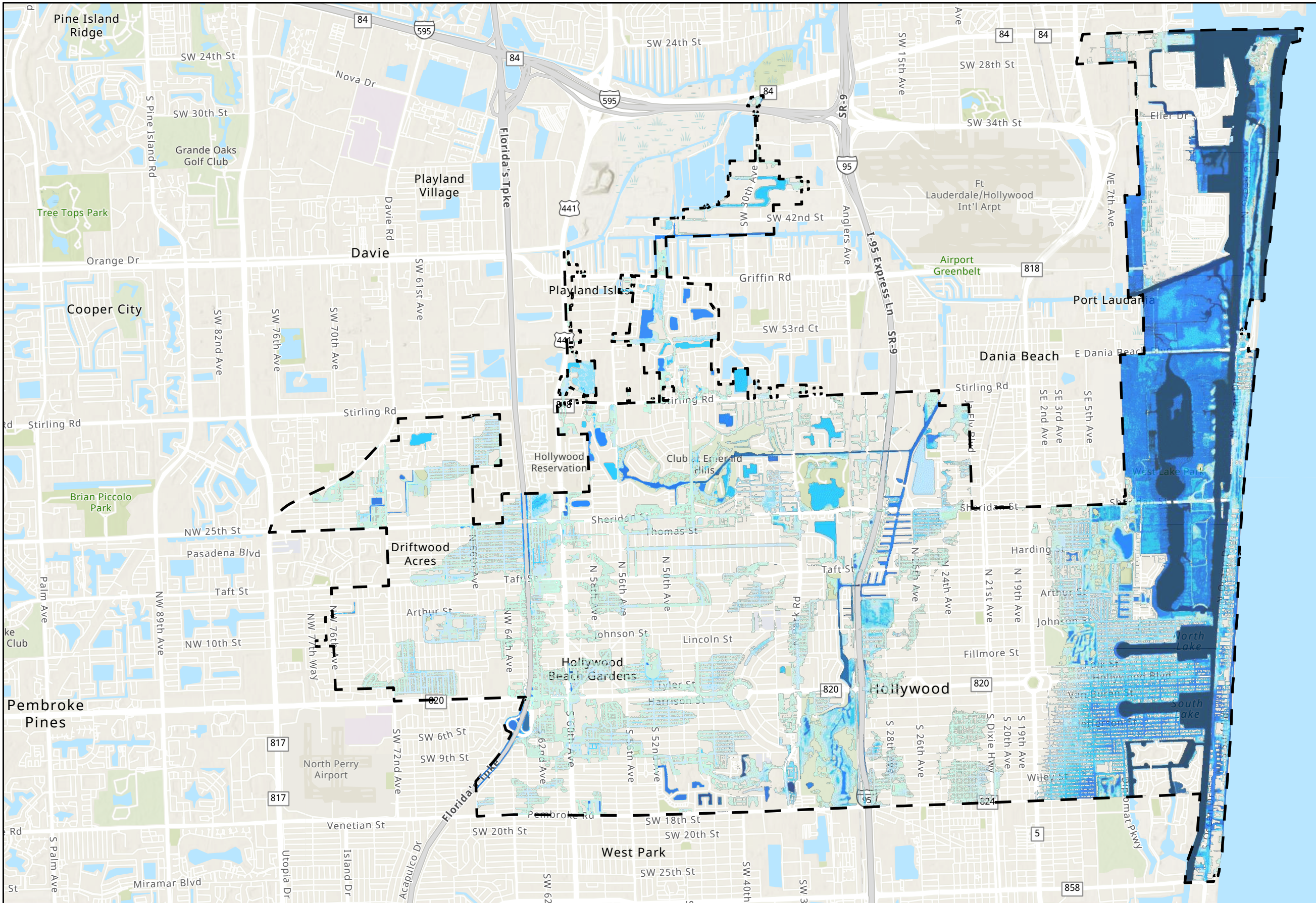
FEMA 100-Year Base Flood Feet

- <= 0 ft
- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- 5 - 6
- 6 - 7
- 7 - 8
- 8 - 9
- 9 - 10 ft



FEMA 100-Year Base Flood Extent
Existing Conditions





Legend

- Hollywood City Limits

FEMA 100-Year Surge Intermediate Low in 2040 Flooding

Feet

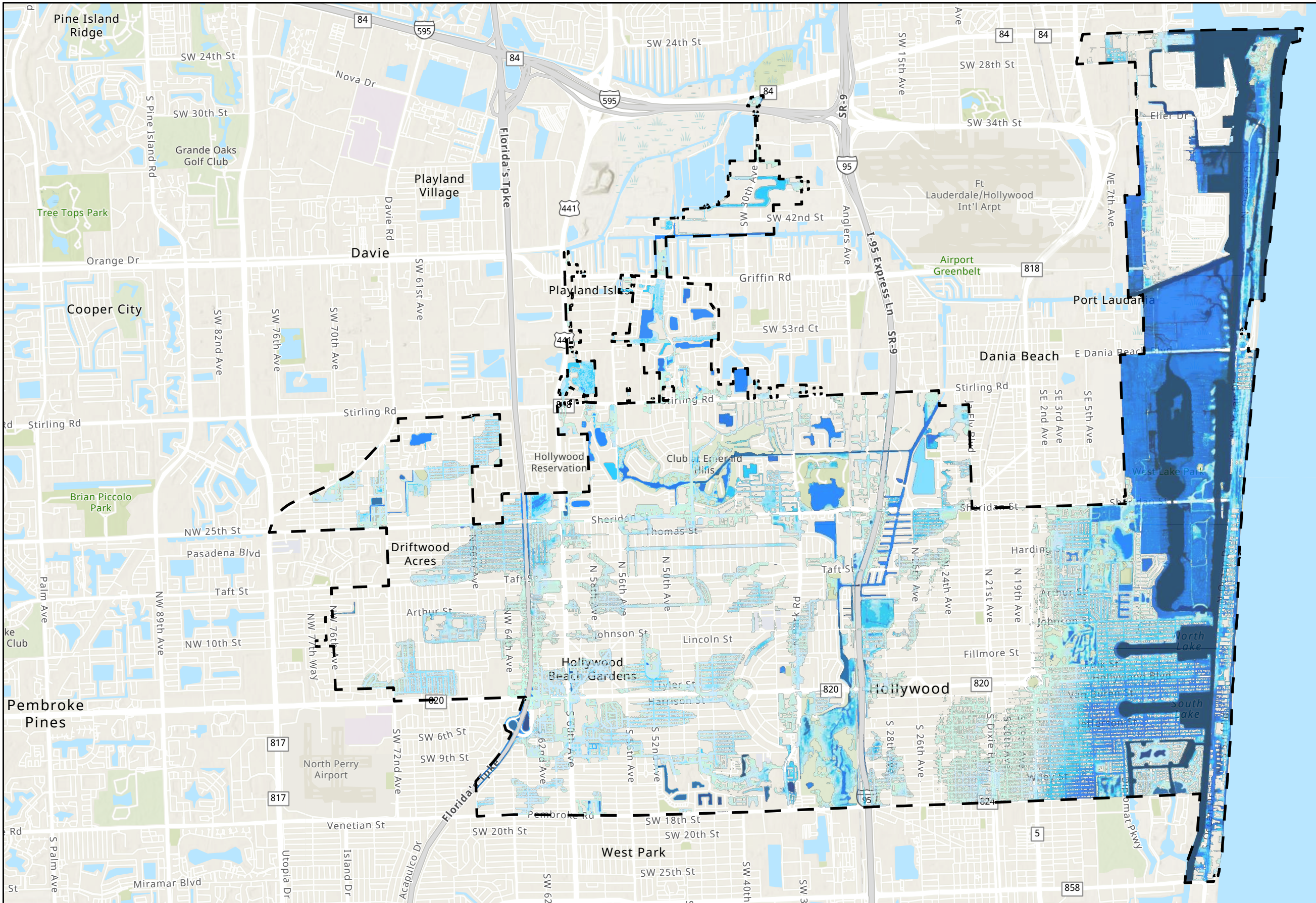
- <= 0 ft
- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- 5 - 6
- 6 - 7
- 7 - 8
- 8 - 9
- 9 - 10 ft



FEMA 100-Year Flooding with Storm Surge
NOAA Intermediate Low in 2040

0 2,000 4,000 8,000 Feet
1:53,000

City of Hollywood FS 380.093 Reporting
Figure 5-3
7/31/2023



Legend

- Hollywood City Limits

FEMA 100-Year Surge Intermediate Low in 2070 Flooding

Feet

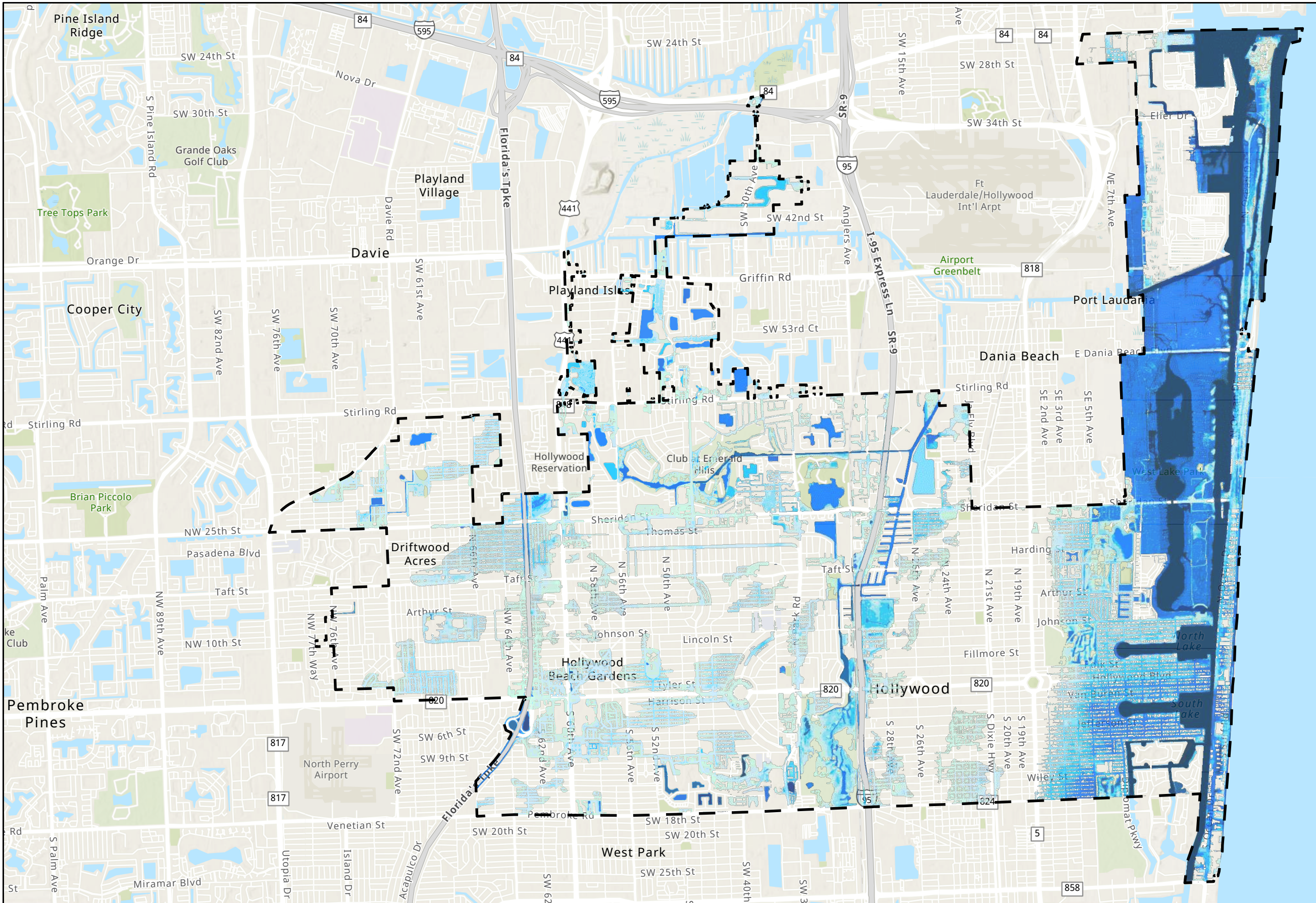
- <= 0 ft
- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- 5 - 6
- 6 - 7
- 7 - 8
- 8 - 9
- 9 - 10 ft



FEMA 100-Year Flooding with Storm Surge
NOAA Intermediate Low in 2070

0 2,000 4,000 8,000 Feet
1:53,000

City of Hollywood FS 380.093 Reporting
Figure 5-4
7/31/2023



Legend

- Hollywood City Limits

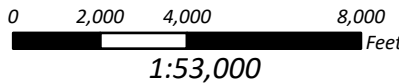
FEMA 100-Year Surge Intermediate High in 2040 Flooding

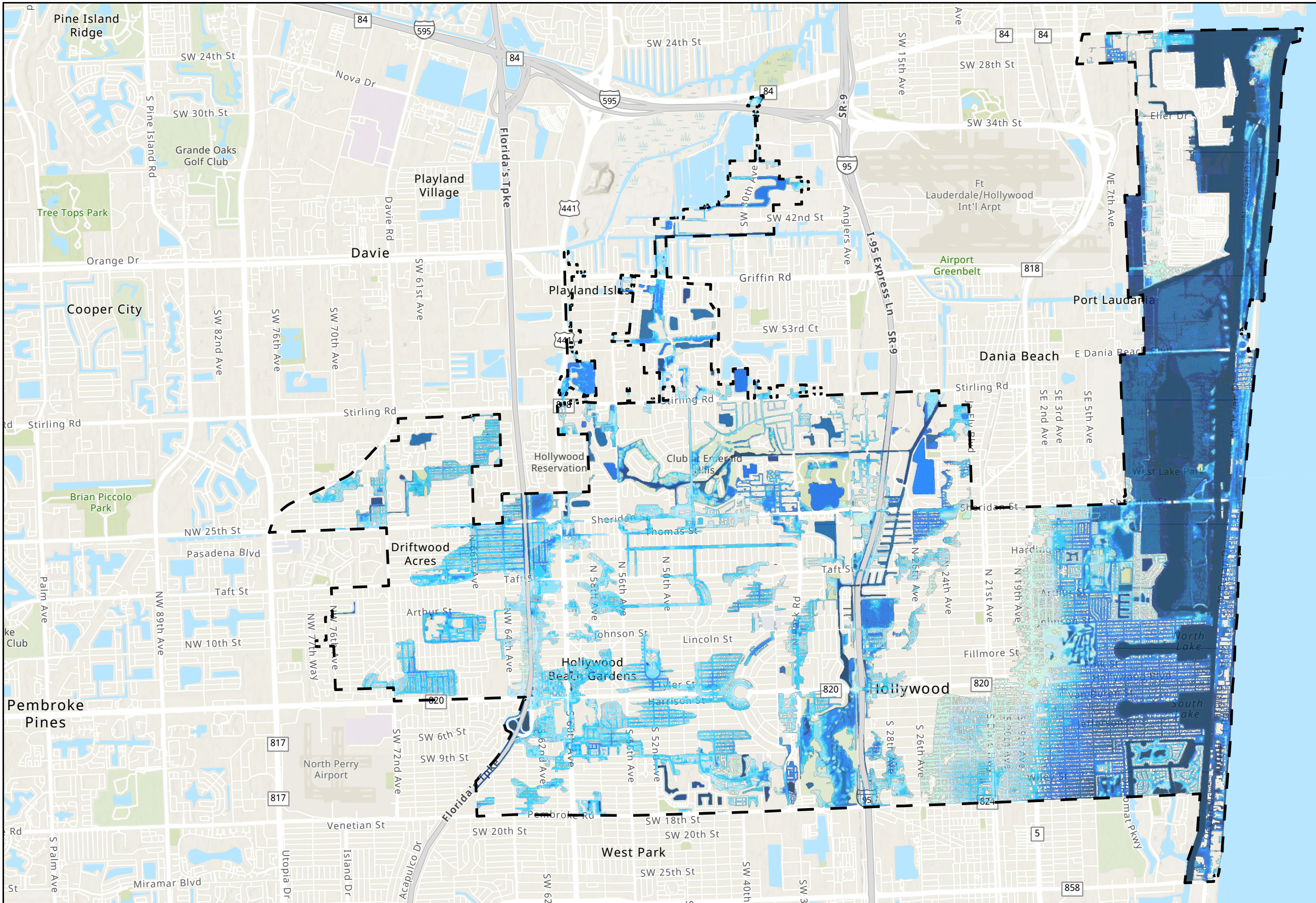
Feet

- <= 0 ft
- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- 5 - 6
- 6 - 7
- 7 - 8
- 8 - 9
- 9 - 10 ft



FEMA 100-Year Flooding with Storm Surge
NOAA Intermediate High in 2040





Legend

- Hollywood City Limits

FEMA 100-Year Surge Intermediate High in 2070 Flooding

Feet

- <= 0 ft
- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- 5 - 6
- 6 - 7
- 7 - 8
- 8 - 9
- 9 - 10 ft



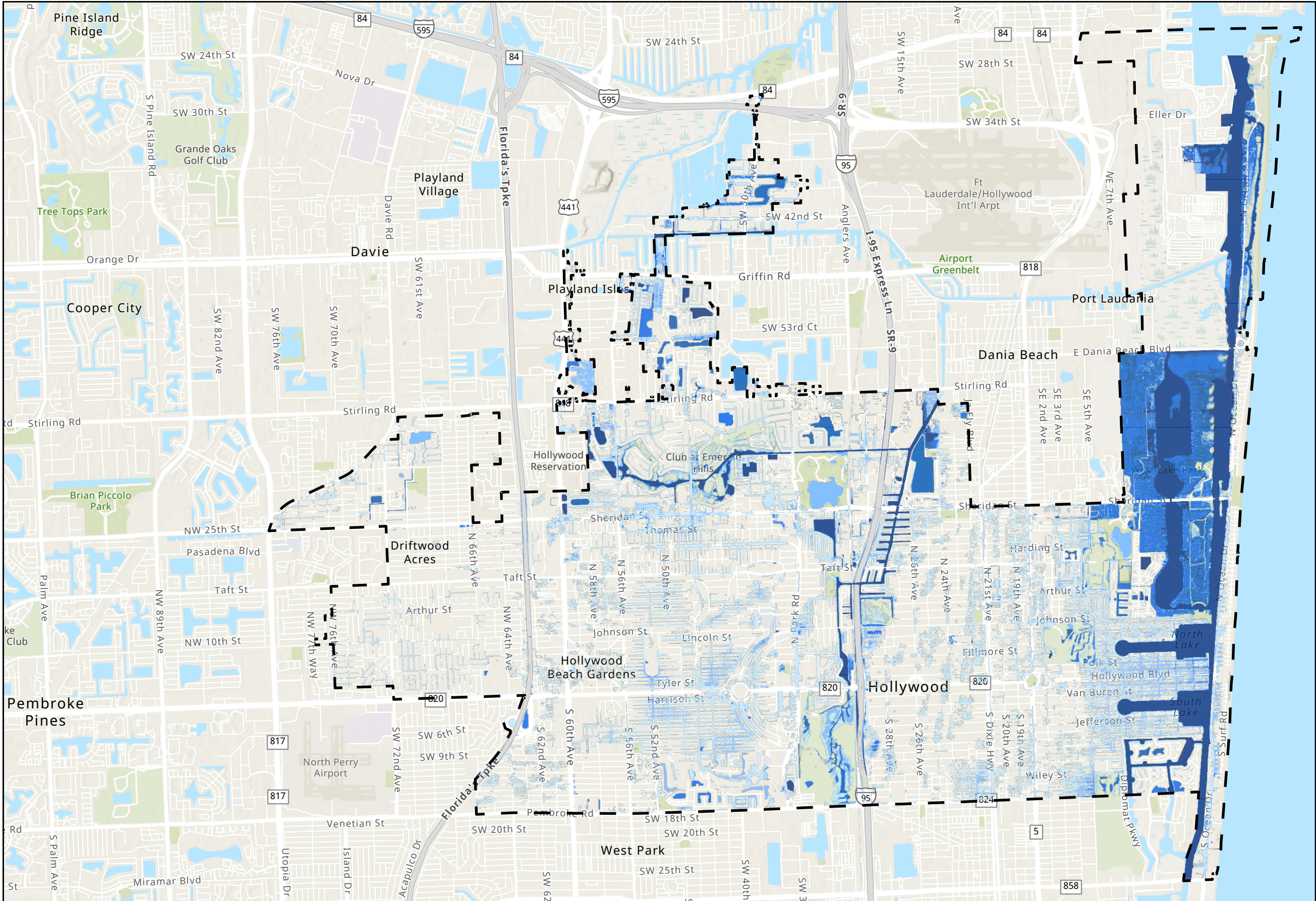
FEMA 100-Year Flooding with Storm Surge
NOAA Intermediate High in 2070

0 2,000 4,000 8,000 Feet
1:53,000

APPENDIX C

RAINFALL INDUCED FLOODING ANALYSIS RESULTS

SECTION 6 (ITEM 3) FIGURES



Legend

▬ ▬ Hollywood City

▬ ▬ Limits

10-Year, 72-Hour Design Storm

Feet

<= 0 ft

0 - 1

1 - 2

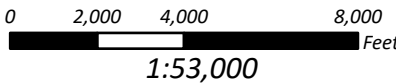
2 - 3

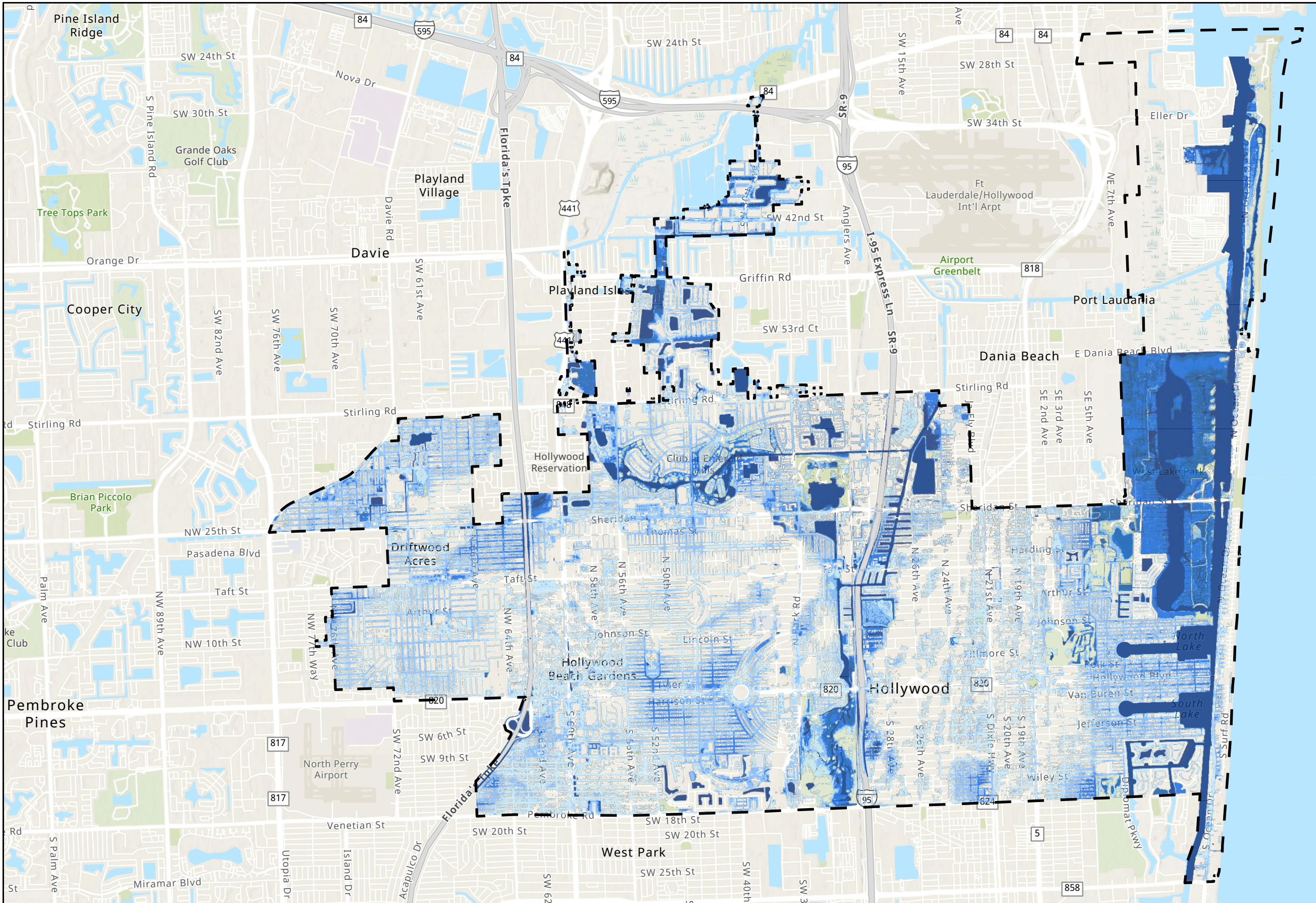
3 - 4

4 - 5 ft

Flood Depth Under Existing Conditions
10-Year, 72-Hour Design Storm

City of Hollywood FS 380.093 Reporting
Figure 6-1
7/31/2023





Legend

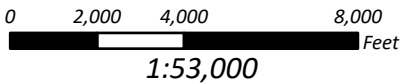
- Hollywood City Limits

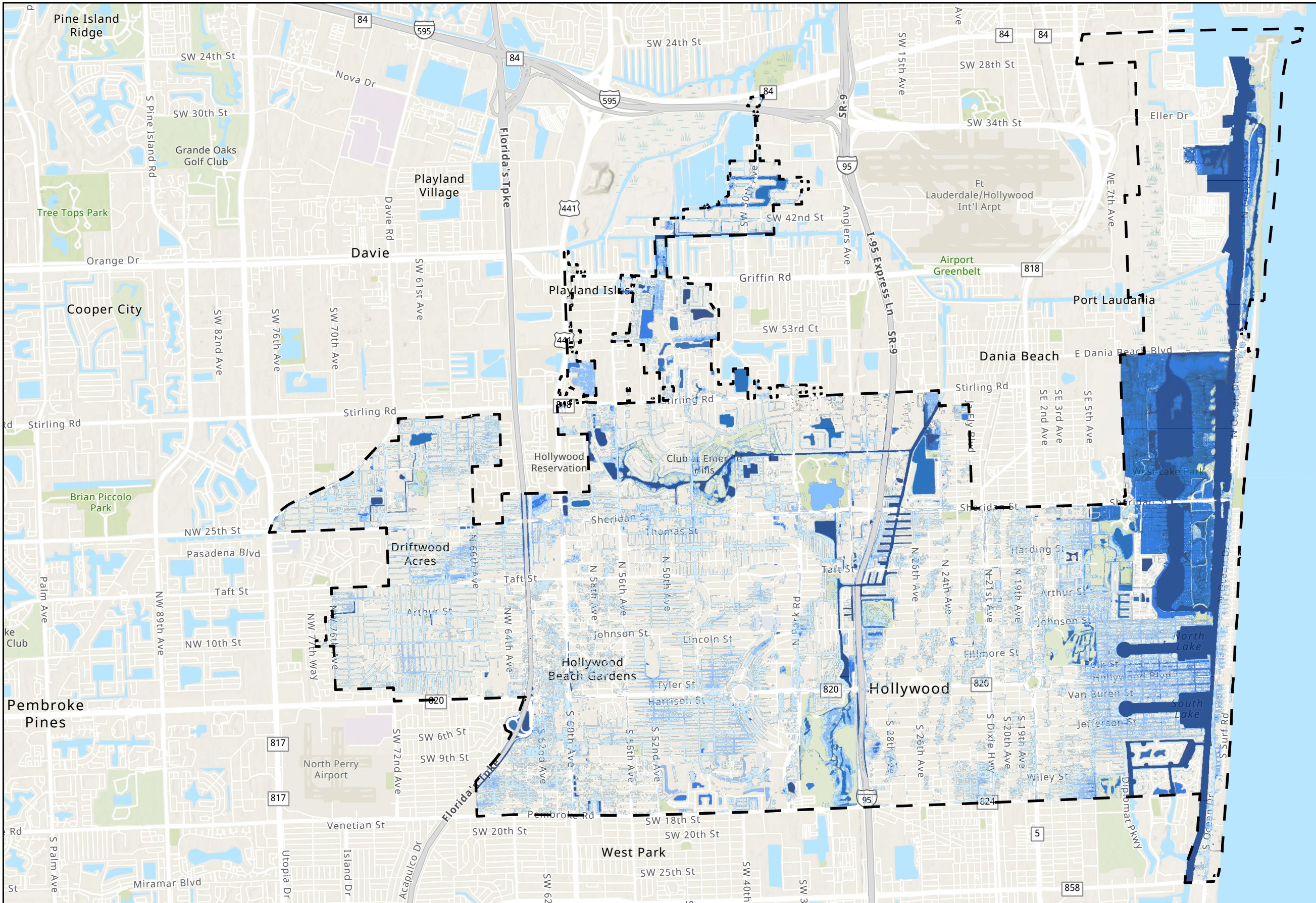
100-Year, 72-Hour Design Storm Feet

- <= 0 ft
- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5 ft



Flood Depth Under Existing Conditions
100-Year, 72-Hour Design Storm





Legend

- Hollywood City Limits

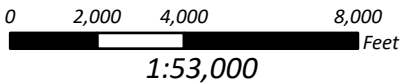
Sea-Level Rise with 10-Year NOAA Intermediate Low Flooding in 2040

Feet

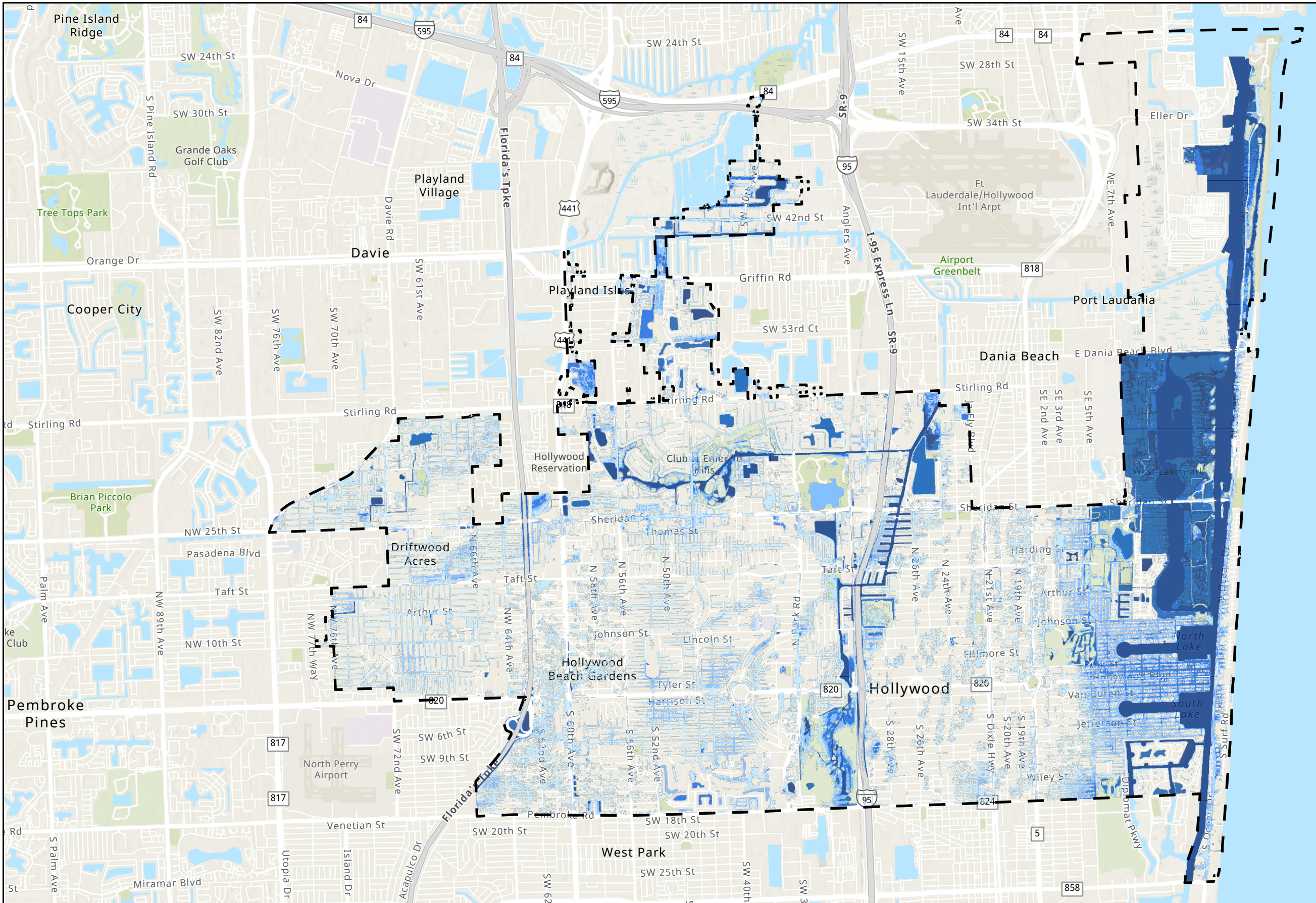
- <= 0 ft
- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5 ft



Projected Sea-Level Rise Scenario for 10-Year Storm
NOAA Intermediate Low Flooding in 2040



City of Hollywood FS 380.093 Reporting
Figure 6-3
7/31/2023



Legend

Hollywood City Limits

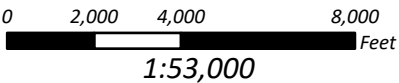
Sea-Level Rise with 10-Year NOAA Intermediate Low Flooding in 2070

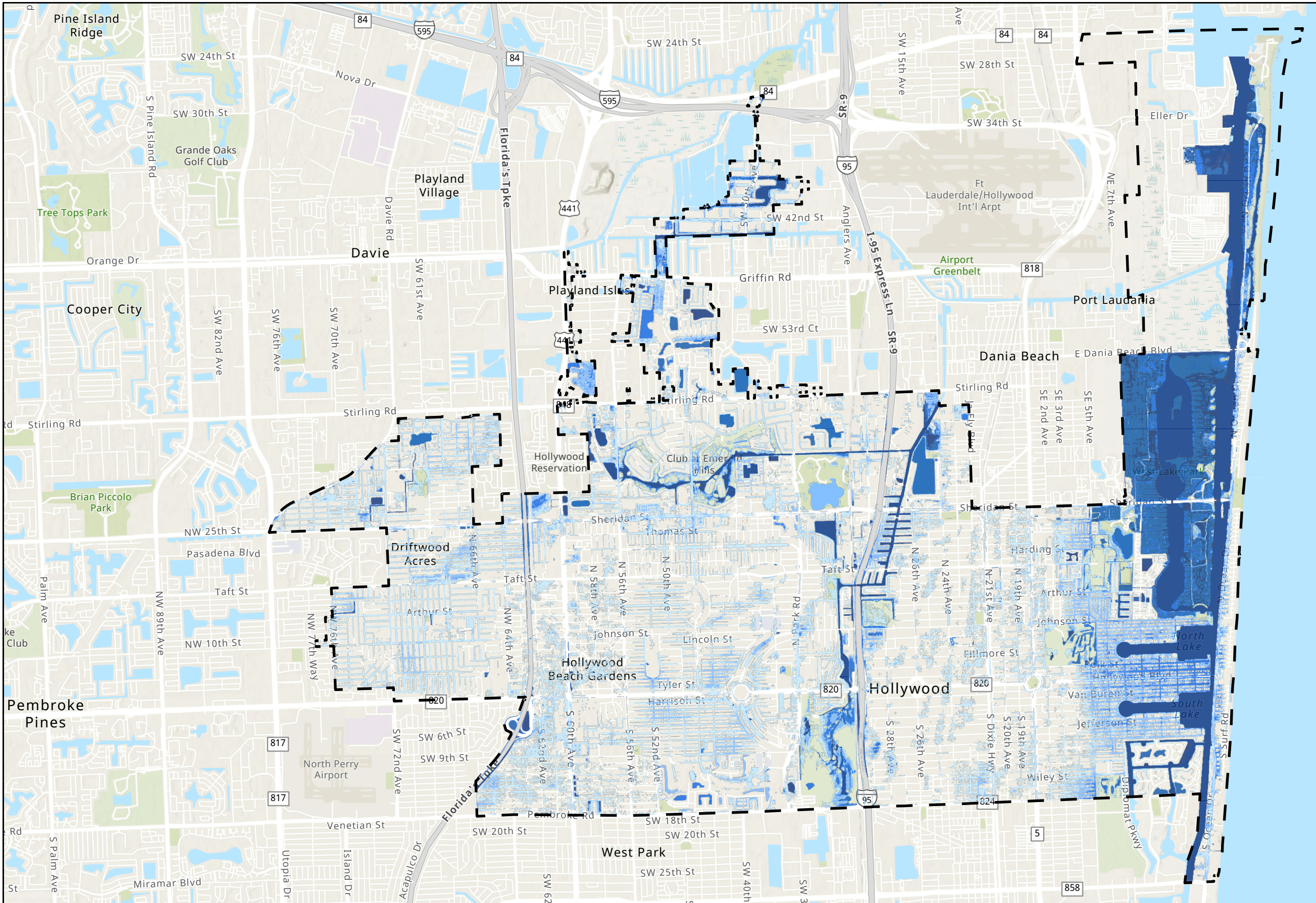
Feet

| | |
|--|----------|
| | <= 0 ft |
| | 0 - 1 |
| | 1 - 2 |
| | 2 - 3 |
| | 3 - 4 |
| | 4 - 5 ft |



Projected Sea-Level Rise Scenario for 10-Year Storm
NOAA Intermediate Low Flooding in 2070





Legend

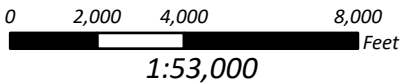
- Hollywood City Limits

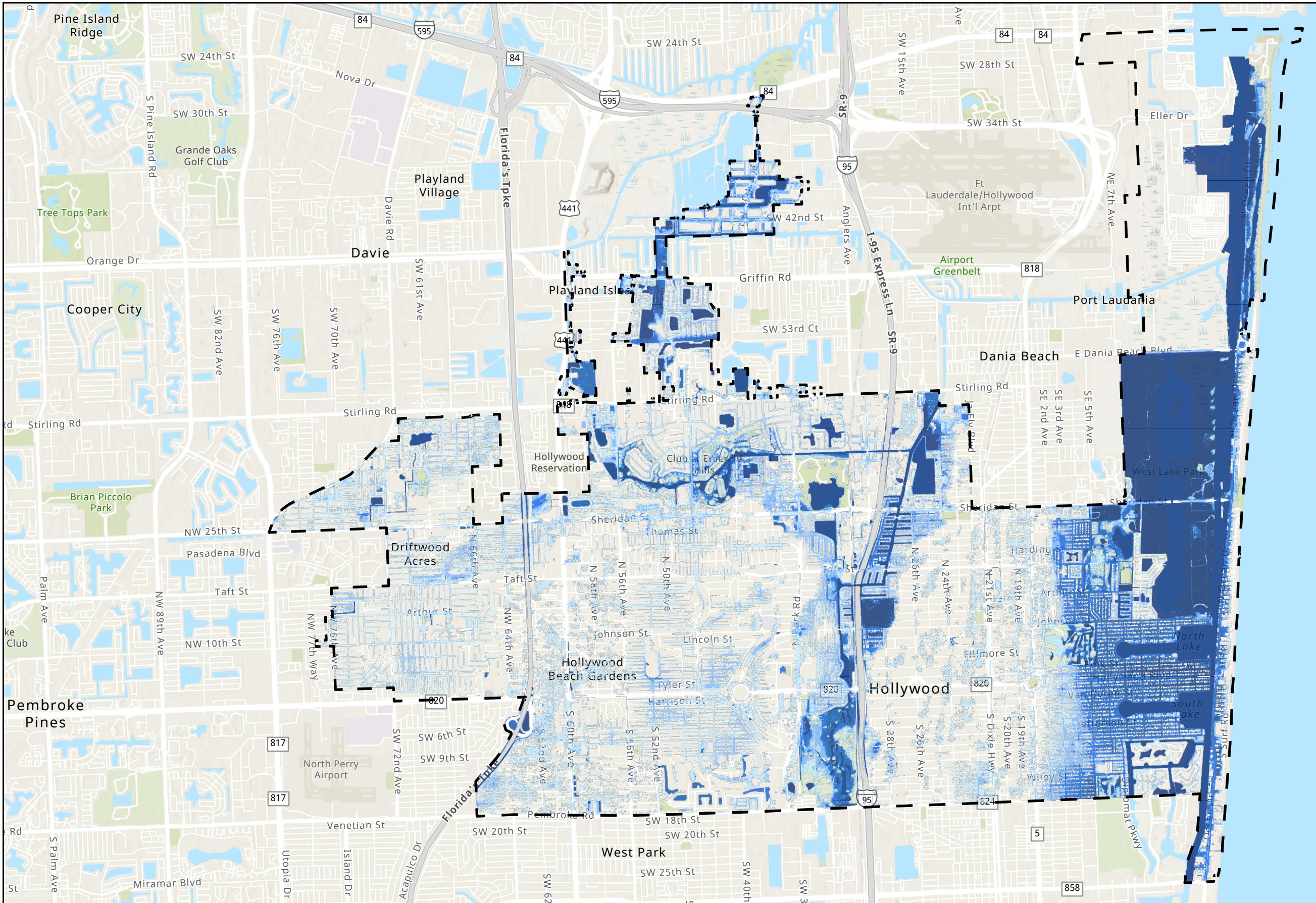
Sea-Level Rise with 10-Year NOAA Intermediate High Flooding in 2040
Feet

- <= 0 ft
- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5 ft

Projected Sea-Level Rise Scenario for 10-Year Storm
NOAA Intermediate High Flooding in 2040

City of Hollywood FS 380.093 Reporting
Figure 6-5
7/31/2023





Legend

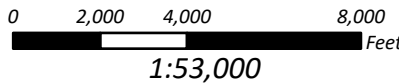
- Hollywood City Limits

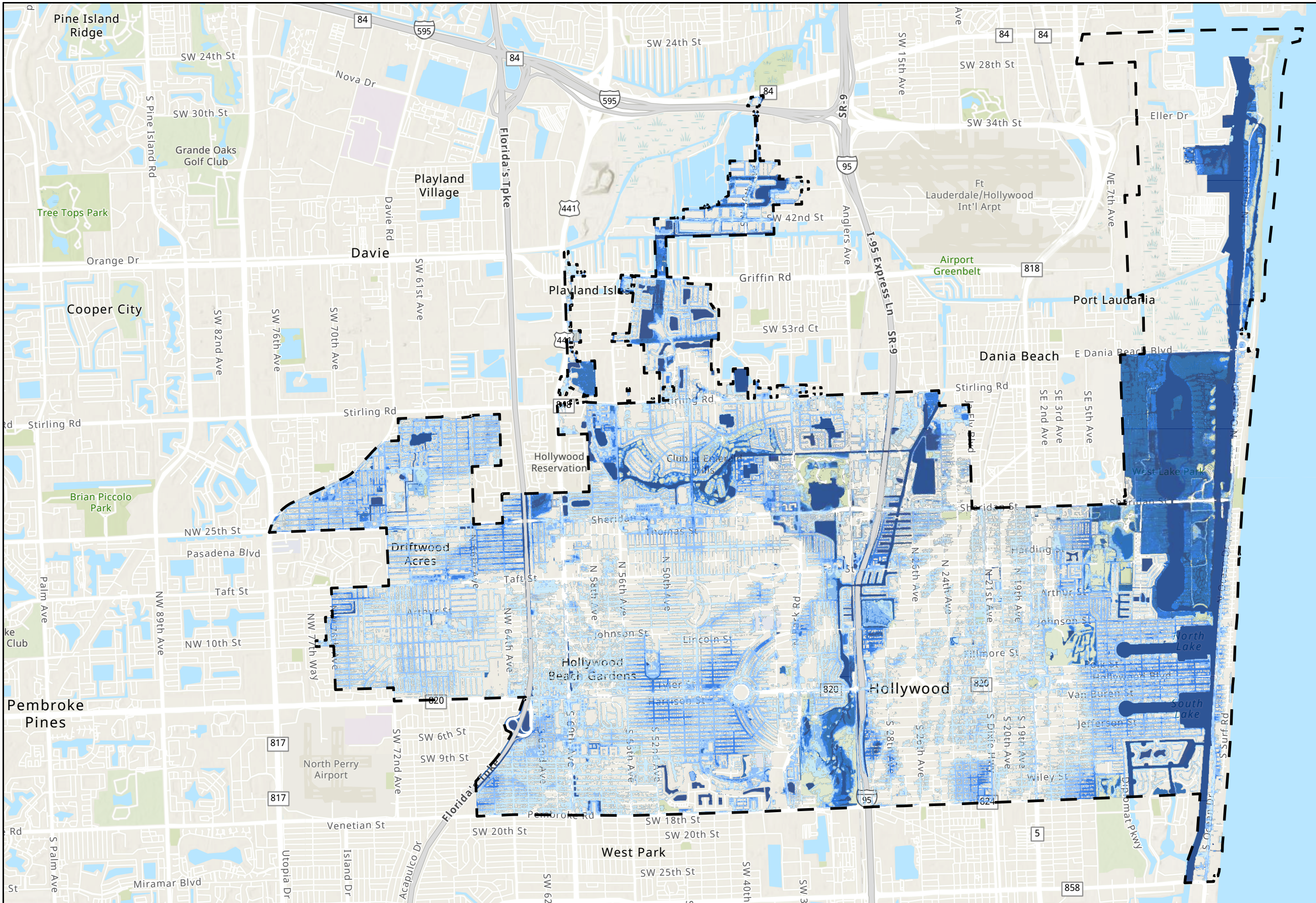
Sea-Level Rise with 10-Year NOAA Intermediate High Flooding in 2070
Feet

- ≤ 0 ft
- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5 ft



Projected Sea-Level Rise Scenario for 10-Year Storm
NOAA Intermediate High Flooding in 2070





Legend

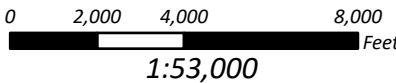
- Hollywood City Limits

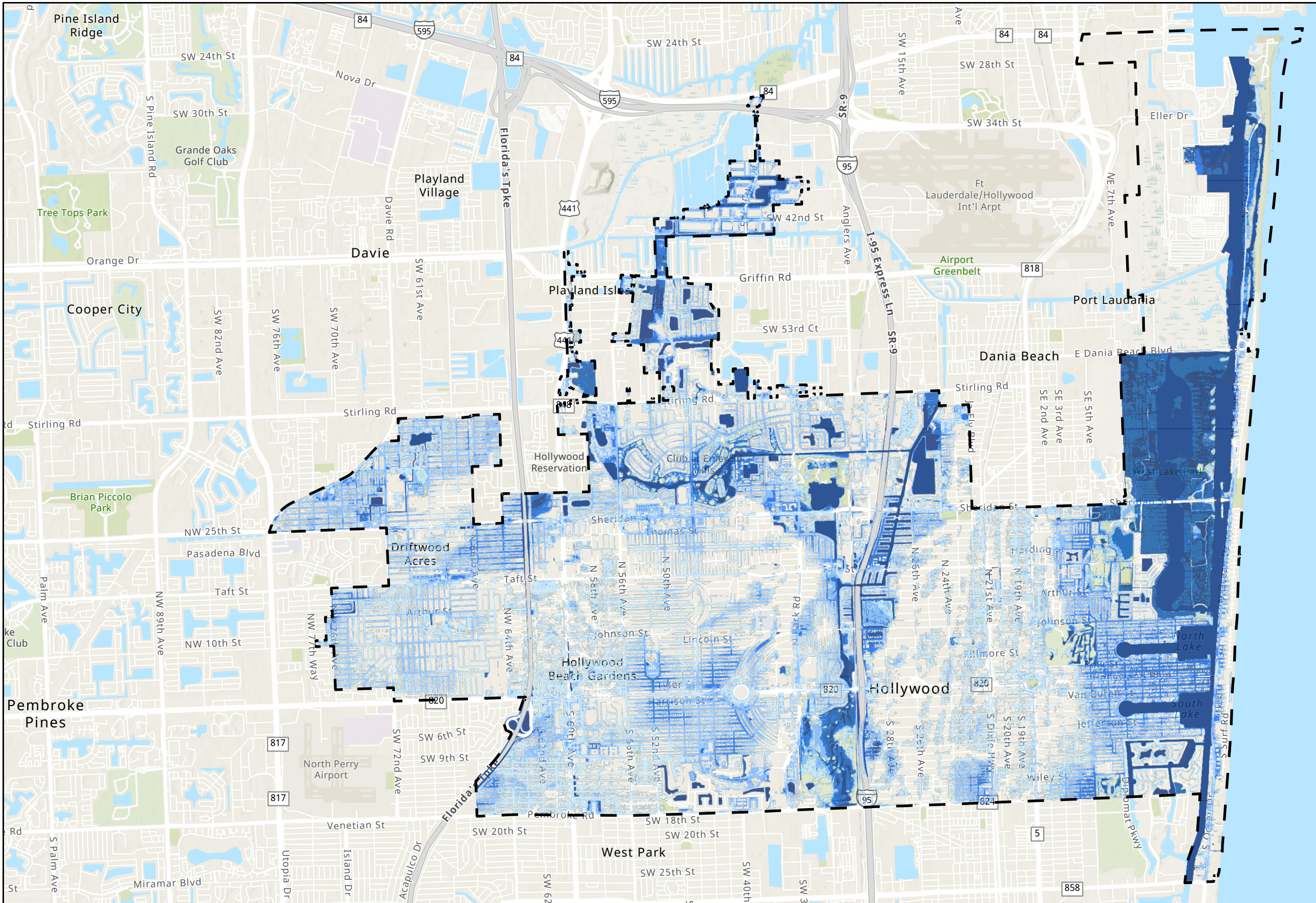
Sea-Level Rise with 100-Year NOAA Intermediate Low Flooding in 2040
Feet

- <= 0 ft
- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5 ft



Projected Sea-Level Rise Scenario for 100-Year Storm
NOAA Intermediate Low Flooding in 2040





Legend

- Hollywood City Limits

Sea-Level Rise with 10-Year NOAA Intermediate Low Flooding in 2070

Feet

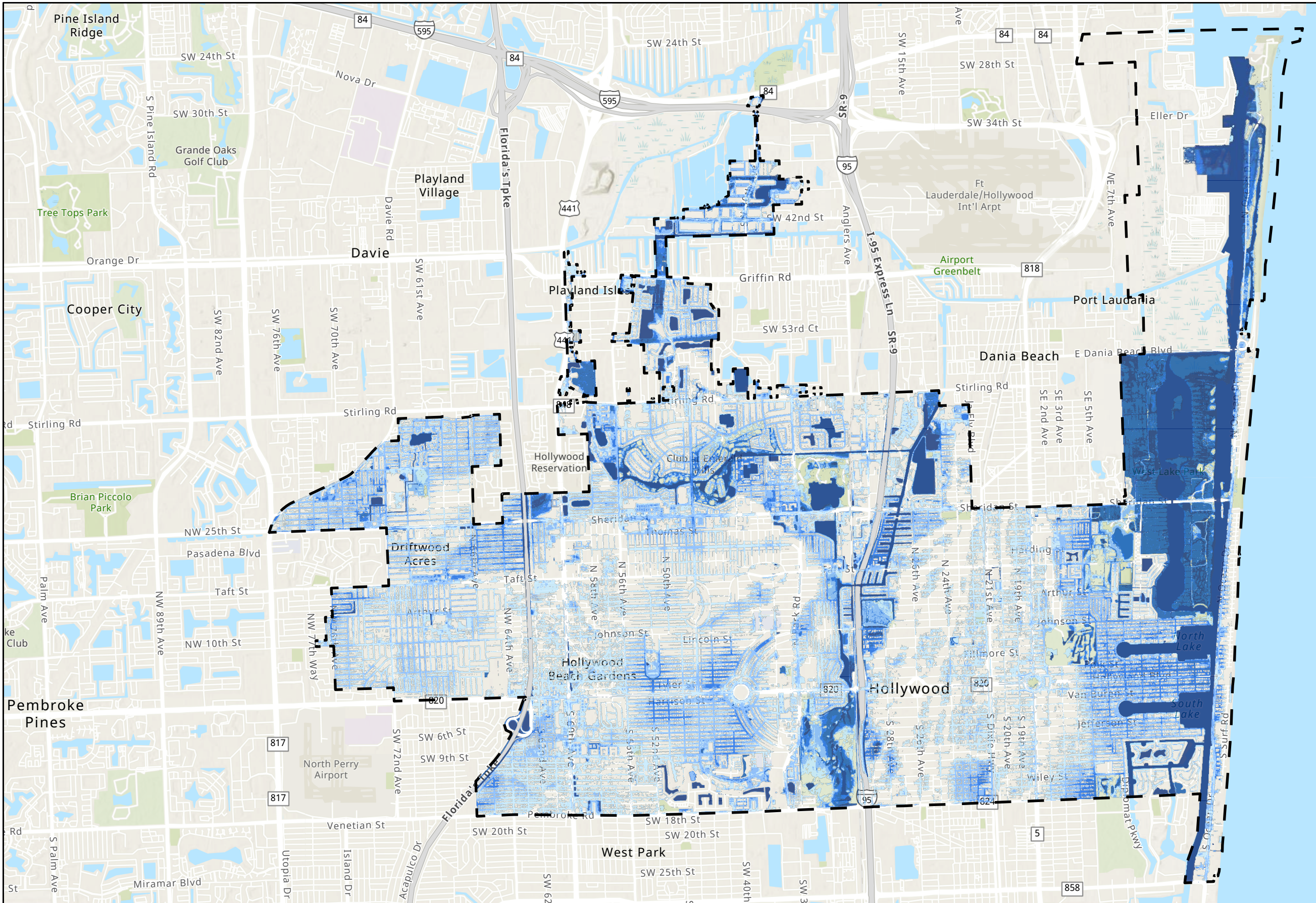
- <= 0 ft
- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5 ft

Projected Sea-Level Rise Scenario for 100-Year Storm
NOAA Intermediate Low Flooding in 2070

City of Hollywood FS 380.093 Reporting
Figure 6-8
7/31/2023



0 2,000 4,000 8,000 Feet
1:53,000



Legend

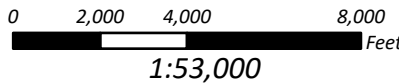
- Hollywood City Limits

Sea-Level Rise with 100-Year NOAA Intermediate High Flooding in 2040
Feet

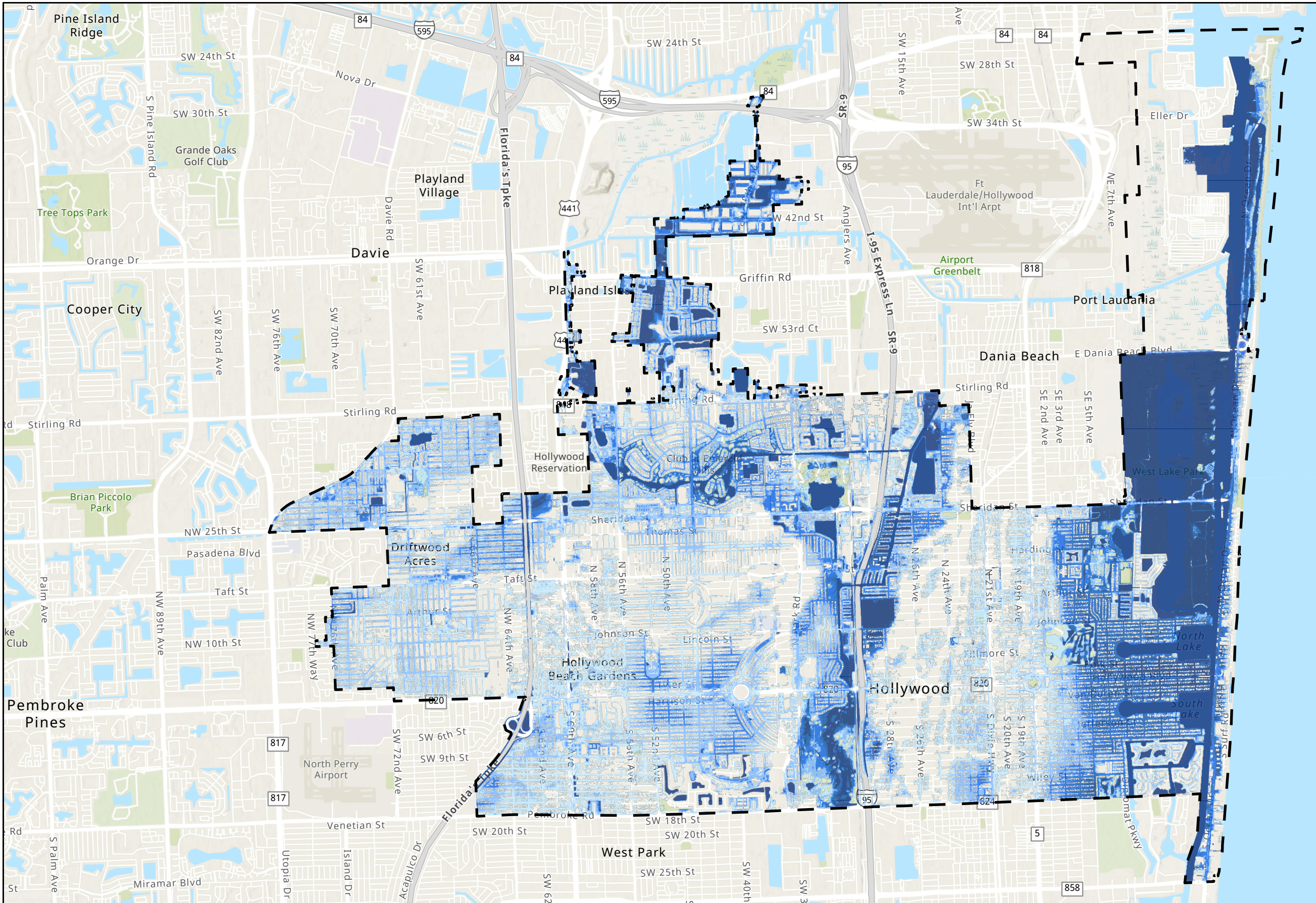
- <= 0 ft
- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5 ft



Projected Sea-Level Rise Scenario for 10-Year Storm NOAA Intermediate High Flooding in 2040



City of Hollywood FS 380.093 Reporting
Figure 6-9
7/31/2023



Legend

Hollywood City Limits

Sea-Level Rise with 100-Year NOAA Intermediate High Flooding in 2070

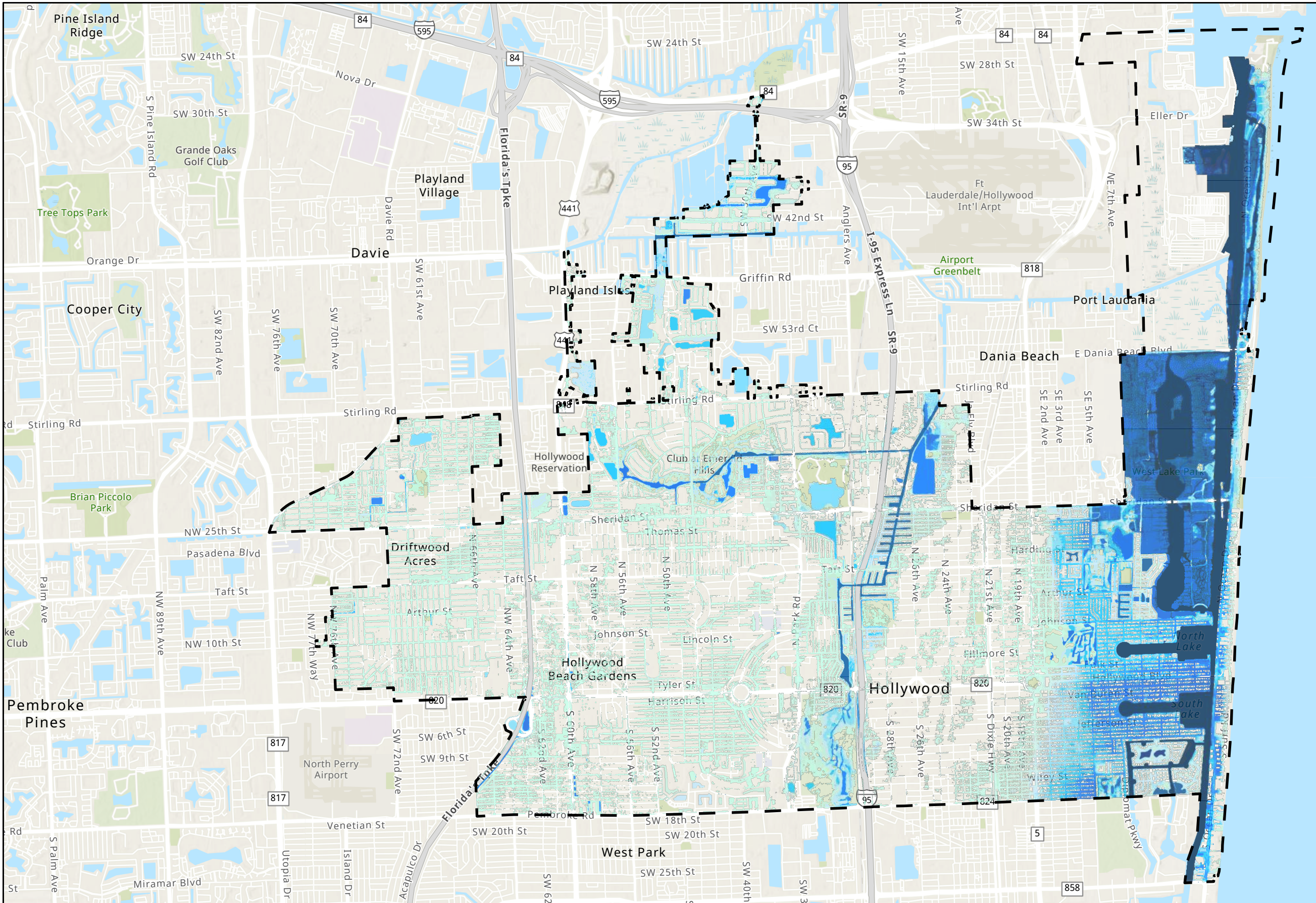
Feet

- <= 0 ft
- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5 ft

APPENDIX D

COMPOUND FLOODING ANALYSIS RESULTS

SECTION 7 (ITEM 4) FIGURES



Legend

- Hollywood City Limits

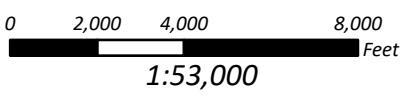
Compound Flooding
with Surge Event NOAA
Intermediate Low in
2040

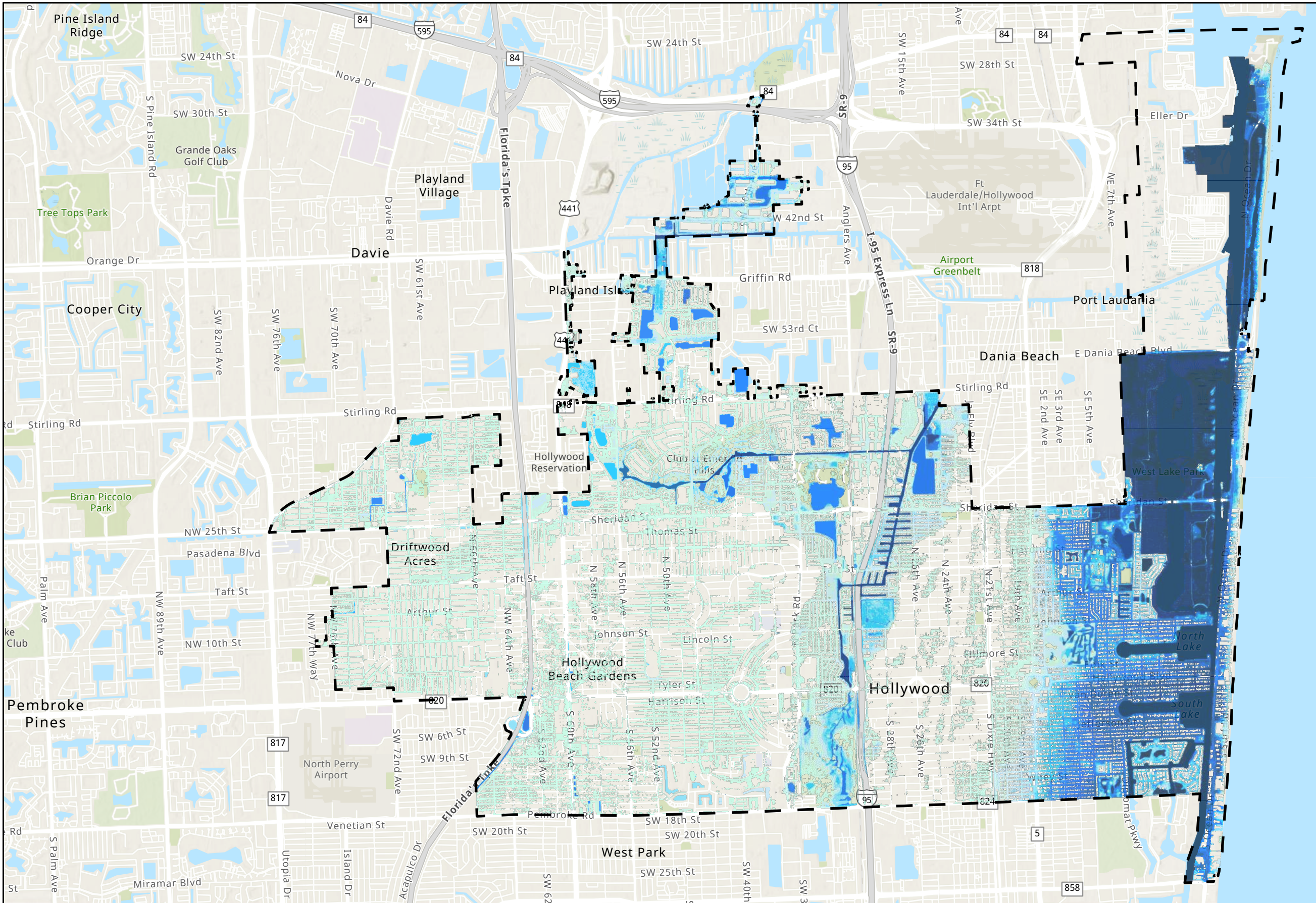
Feet

- <= 0 ft
- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- 5 - 6
- 6 - 7
- 7 - 8
- 8 - 9
- 9 - 10 ft

Combination Precipitation and Surge Event Scenario
10-Year, 24-Hour Compound Flood
NOAA Intermediate Low in 2040

City of Hollywood FS 380.093 Reporting
Figure 7-3
7/31/2023





Legend

- Hollywood City Limits

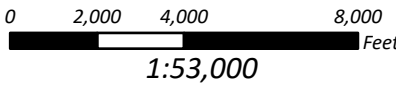
Compound Flooding
with Surge Event NOAA
Intermediate High in
2070

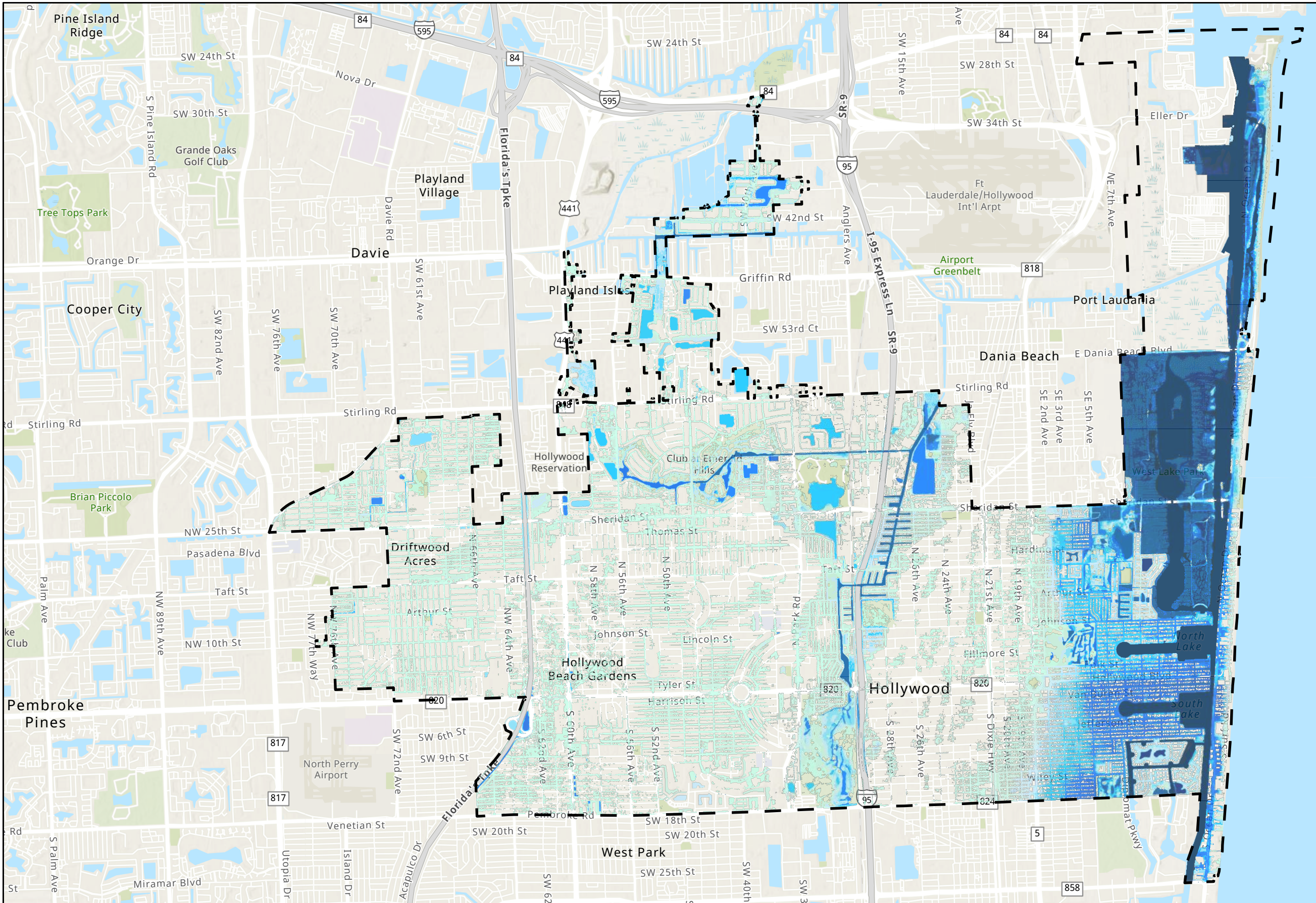
Feet

- <= 0 ft
- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- 5 - 6
- 6 - 7
- 7 - 8
- 8 - 9
- 9 - 10 ft

Combination Precipitation and Surge Event Scenario
10-Year, 24-Hour Compound Flood
NOAA Intermediate High in 2070

City of Hollywood FS 380.093 Reporting
Figure 7-6
7/31/2023





Legend

- Hollywood City Limits

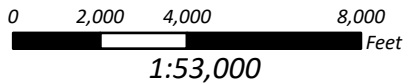
Compound Flooding
with Surge Event NOAA
Intermediate Low in
2070

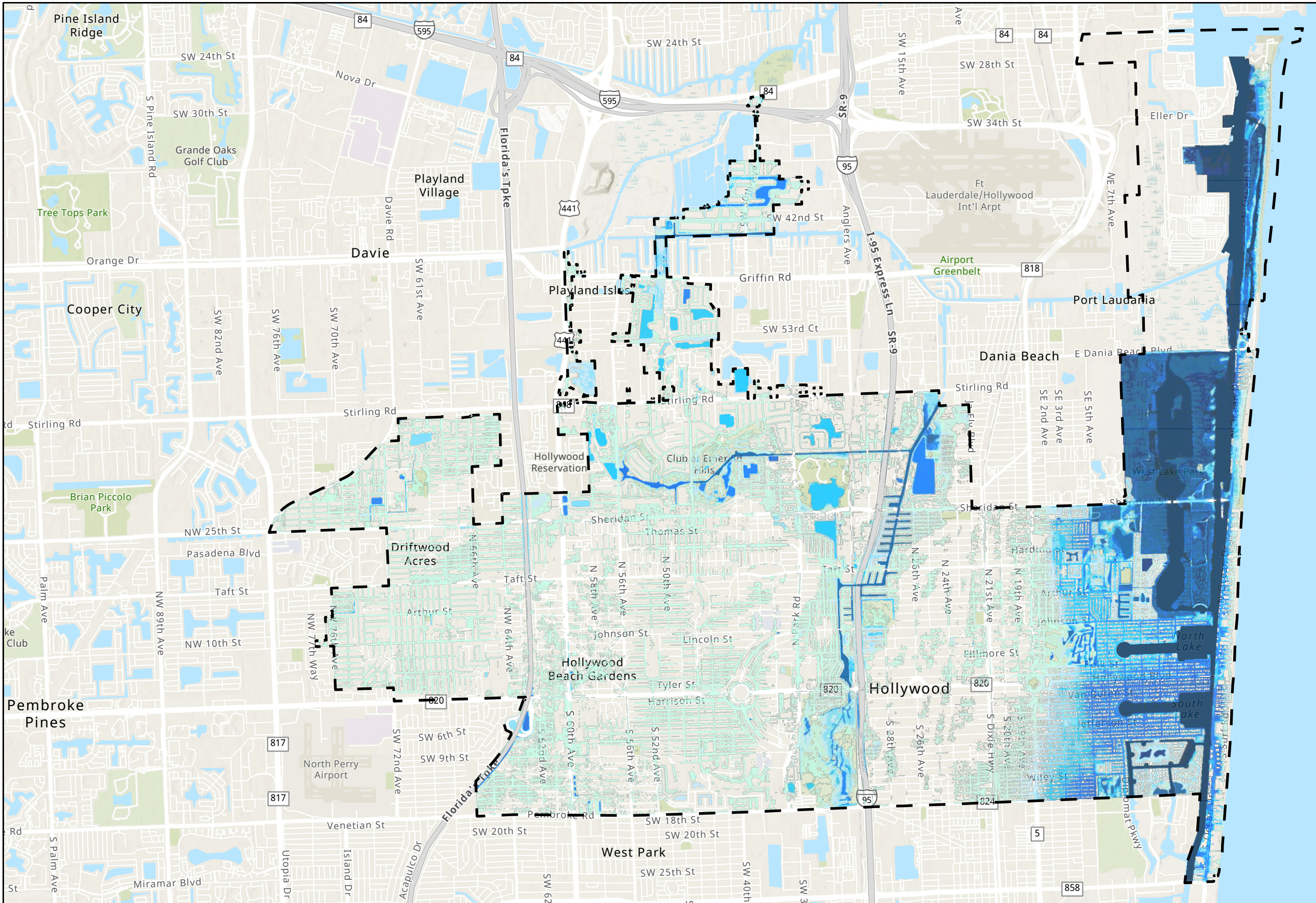
Feet

- <= 0 ft
- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- 5 - 6
- 6 - 7
- 7 - 8
- 8 - 9
- 9 - 10 ft



Combination Precipitation and Surge Event Scenario
10-Year, 24-Hour Compound Flood
NOAA Intermediate Low in 2070





Legend

- Hollywood City Limits

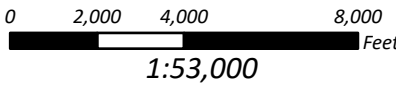
Compound Flooding with Surge Event NOAA Intermediate High in 2040

Feet

- <= 0 ft
- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- 5 - 6
- 6 - 7
- 7 - 8
- 8 - 9
- 9 - 10 ft

Combination Precipitation and Surge Event Scenario
10-Year, 24-Hour Compound Flood
NOAA Intermediate High in 2040

City of Hollywood FS 380.093 Reporting
Figure 7-5
7/31/2023



APPENDIX E

REPRODUCTION OF FS 380.093 (2021)

Source: <https://www.flsenate.gov/laws/statutes/2021/380.093>

2021 Florida Statutes

Title XXVIII - NATURAL RESOURCES; CONSERVATION, RECLAMATION, AND USE

Chapter 380 LAND AND WATER MANAGEMENT

SECTION 093

Resilient Florida Grant Program; comprehensive statewide flood vulnerability and sea level rise data set and assessment; Statewide Flooding and Sea Level Rise Resilience Plan; regional resilience entities.

380.093 Resilient Florida Grant Program; comprehensive statewide flood vulnerability and sea level rise data set and assessment; Statewide Flooding and Sea Level Rise Resilience Plan; regional resilience entities.—

(1) LEGISLATIVE INTENT.—

(a) The Legislature recognizes that the state is particularly vulnerable to adverse impacts from flooding resulting from increases in frequency and duration of rainfall events, storm surge from more frequent and severe weather systems, and sea level rise. Such adverse impacts pose economic, social, environmental, and public health and safety challenges to the state. To most effectively address these challenges, funding should be allocated in a manner that prioritizes addressing the most significant risks.

(b) The Legislature further recognizes that the adverse impacts of flooding and sea level rise affect coastal and inland communities all across the state. Consequently, a coordinated approach is necessary to maximize the benefit of efforts to address such impacts and to improve the state's resilience to flooding and sea level rise.

(c) The Legislature further recognizes that to effectively and efficiently address and prepare for the adverse impacts of flooding and sea level rise in the state, it is necessary to conduct a comprehensive statewide assessment of the specific risks posed to the state by flooding and sea level rise and develop a statewide coordinated approach to addressing such risks.

(2) DEFINITIONS.—As used in this section, the term:

(a) "Critical asset" includes:

1. Transportation assets and evacuation routes, including airports, bridges, bus terminals, ports, major roadways, marinas, rail facilities, and railroad bridges.

2. Critical infrastructure, including wastewater treatment facilities and lift stations, stormwater treatment facilities and pump stations, drinking water facilities, water utility conveyance systems, electric production and supply facilities, solid and hazardous waste facilities, military installations, communications facilities, and disaster debris management sites.

3. Critical community and emergency facilities, including schools, colleges, universities, community centers, correctional facilities, disaster recovery centers, emergency medical service facilities, emergency operation centers, fire stations, health care facilities, hospitals, law enforcement facilities, local government facilities, logistical staging areas, affordable public housing, risk shelter inventory, and state government facilities.

4. Natural, cultural, and historical resources, including conservation lands, parks, shorelines, surface waters, wetlands, and historical and cultural assets.

(b) “Department” means the Department of Environmental Protection.

(3) RESILIENT FLORIDA GRANT PROGRAM.—

(a) The Resilient Florida Grant Program is established within the department.

(b) Subject to appropriation, the department may provide grants to a county or municipality to fund the costs of community resilience planning and necessary data collection for such planning, including comprehensive plan amendments and necessary corresponding analyses that address the requirements of s. [163.3178\(2\)\(f\)](#); vulnerability assessments that identify or address risks of flooding and sea level rise; the development of projects, plans, and policies that allow communities to prepare for threats from flooding and sea level rise; and projects to adapt critical assets to the effects of flooding and sea level rise.

(c) A vulnerability assessment conducted pursuant to paragraph (b) must encompass the entire county or municipality; include all critical assets owned or maintained by the grant applicant; and use the most recent publicly available Digital Elevation Model and generally accepted analysis and modeling techniques. An assessment may encompass a smaller geographic area or include only a portion of the critical assets owned or maintained by the grant applicant with appropriate rationale and upon approval by the department. Locally collected elevation data may also be included as part of the assessment as long as it is submitted to the department pursuant to this paragraph.

1. The assessment must include an analysis of the vulnerability of and risks to critical assets, including regionally significant assets, owned or managed by the county or municipality.

2. Upon completion of a vulnerability assessment, the county or municipality shall submit to the department the following:

a. A report detailing the findings of the assessment.

b. All electronic mapping data used to illustrate flooding and sea level rise impacts identified in the assessment. When submitting such data, the county or municipality shall include:

- (I) Geospatial data in an electronic file format suitable for input to the department's mapping tool.
- (II) Geographic information system data that has been projected into the appropriate Florida State Plane Coordinate System and that is suitable for the department's mapping tool. The county or municipality must also submit metadata using standards prescribed by the department.
- c. A list of critical assets, including regionally significant assets, that are impacted by flooding and sea level rise.
- (d) A vulnerability assessment conducted pursuant to paragraph (b) must include all of the following, if applicable:
 - 1. Peril of flood comprehensive plan amendments that address the requirements of s. [163.3178](#)(2)(f), if the county or municipality is subject to such requirements and has not complied with such requirements as determined by the Department of Economic Opportunity.
 - 2. The depth of:
 - a. Tidal flooding, including future high tide flooding, which must use thresholds published and provided by the department. To the extent practicable, the analysis should also geographically display the number of tidal flood days expected for each scenario and planning horizon.
 - b. Current and future storm surge flooding using publicly available National Oceanic and Atmospheric Administration or Federal Emergency Management Agency storm surge data. The initial storm surge event used must equal or exceed the current 100-year flood event. Higher frequency storm events may be analyzed to understand the exposure of a critical asset.
 - c. To the extent practicable, rainfall-induced flooding using spatiotemporal analysis or existing hydrologic and hydraulic modeling results. Future boundary conditions should be modified to consider sea level rise and high tide conditions.
 - d. To the extent practicable, compound flooding or the combination of tidal, storm surge, and rainfall-induced flooding.
 - 3. The following scenarios and standards:
 - a. All analyses in the North American Vertical Datum of 1988.
 - b. At least two local sea level rise scenarios, which must include the 2017 National Oceanic and Atmospheric Administration intermediate-low and intermediate-high sea level rise projections.
 - c. At least two planning horizons that include planning horizons for the years 2040 and 2070.
 - d. Local sea level data that has been interpolated between the two closest National Oceanic and Atmospheric Administration tide gauges. Local sea level data may be taken from one such gauge if the gauge has a higher mean sea level. Data taken from an alternate tide gauge may be used with appropriate rationale and department approval, as long as it is publicly available or submitted to the department pursuant to paragraph (b).

(4) COMPREHENSIVE STATEWIDE FLOOD VULNERABILITY AND SEA LEVEL RISE DATA SET AND ASSESSMENT.—

(a) By July 1, 2022, the department shall complete the development of a comprehensive statewide flood vulnerability and sea level rise data set sufficient to conduct a comprehensive statewide flood vulnerability and sea level rise assessment. In developing the data set, the department shall compile, analyze, and incorporate, as appropriate, information related to vulnerability assessments submitted to the department pursuant to subsection (3) or any previously completed assessments that meet the requirements of subsection (3).

1. The Chief Science Officer shall, in coordination with necessary experts and resources, develop statewide sea level rise projections that incorporate temporal and spatial variability, to the extent practicable, for inclusion in the data set. This subparagraph does not supersede regionally adopted projections.

2. The data set must include information necessary to determine the risks to inland and coastal communities, including, but not limited to, elevation, tidal levels, and precipitation.

(b) By July 1, 2023, the department shall complete a comprehensive statewide flood vulnerability and sea level rise assessment that identifies inland and coastal infrastructure, geographic areas, and communities in the state that are vulnerable to flooding and sea level rise and the associated risks.

1. The department shall use the comprehensive statewide flood vulnerability and sea level rise data set to conduct the assessment.

2. The assessment must incorporate local and regional analyses of vulnerabilities and risks, including, as appropriate, local mitigation strategies and post-disaster redevelopment plans.

3. The assessment must include an inventory of critical assets, including regionally significant assets, that are essential for critical government and business functions, national security, public health and safety, the economy, flood and storm protection, water quality management, and wildlife habitat management, and must identify and analyze the vulnerability of and risks to such critical assets. When identifying critical assets for inclusion in the assessment, the department shall also take into consideration the critical assets identified by local governments and submitted to the department pursuant to subsection (3).

(c) The department shall update the comprehensive statewide flood vulnerability and sea level rise data set and assessment every 5 years. The department may update the data set and assessment more frequently if it determines that updates are necessary to maintain the validity of the data set and assessment.

(5) STATEWIDE FLOODING AND SEA LEVEL RISE RESILIENCE PLAN.—

(a) By December 1, 2021, and each December 1 thereafter, the department shall develop a Statewide Flooding and Sea Level Rise Resilience Plan on a 3-year planning horizon and submit it to the

Governor, the President of the Senate, and the Speaker of the House of Representatives. The plan must consist of ranked projects that address risks of flooding and sea level rise to coastal and inland communities in the state.

(b) The plan submitted by December 1, 2021, before the comprehensive statewide flood vulnerability and sea level rise assessment is completed, will be a preliminary plan that addresses risks of flooding and sea level rise identified in available local government vulnerability assessments. The plan submitted by December 1, 2022, will be an update to the preliminary plan. The plan submitted by December 1, 2023, and each plan submitted by December 1 thereafter, shall address risks of flooding and sea level rise identified in the comprehensive statewide flood vulnerability and sea level rise assessment.

(c) Each plan submitted by the department pursuant to this subsection must include the following information for each recommended project:

1. A description of the project.
2. The location of the project.
3. An estimate of how long the project will take to complete.
4. An estimate of the cost of the project.
5. The cost-share percentage available for the project.
6. A summary of the priority score assigned to the project.
7. The project sponsor.

(d)1. By September 1, 2021, and each September 1 thereafter, counties and municipalities may submit to the department a list of proposed projects that address risks of flooding or sea level rise identified in vulnerability assessments that meet the requirements of subsection (3). A regional resilience entity may also submit such proposed projects to the department on behalf of one or more member counties or municipalities.

2. By September 1, 2021, and each September 1 thereafter, each water management district and flood control district may submit to the department a list of any proposed projects that mitigate the risks of flooding or sea level rise on water supplies or water resources of the state and a corresponding evaluation of each project.

3. Each project submitted to the department by a county, municipality, regional resilience entity, water management district, or flood control district for consideration by the department for inclusion in the plan must include:

- a. A description of the project.
- b. The location of the project.
- c. An estimate of how long the project will take to complete.
- d. An estimate of the cost of the project.

e. The cost-share percentage available for the project.

f. The project sponsor.

(e) Each project included in the plan must have a minimum 50 percent cost share unless the project assists or is within a financially disadvantaged small community. For purposes of this section, the term “financially disadvantaged small community” means:

1. A municipality that has a population of 10,000 or fewer, according to the most recent April 1 population estimates posted on the Office of Economic and Demographic Research’s website, and a per capita annual income that is less than the state’s per capita annual income as shown in the most recent release from the Bureau of the Census of the United States Department of Commerce that includes both measurements; or

2. A county that has a population of 50,000 or fewer, according to the most recent April 1 population estimates posted on the Office of Economic and Demographic Research’s website, and a per capita annual income that is less than the state’s per capita annual income as shown in the most recent release from the Bureau of the Census of the United States Department of Commerce that includes both measurements.

(f) To be eligible for inclusion in the plan, a project must have been submitted by a county, municipality, regional resilience entity, water management district, or flood control district pursuant to paragraph (d) or must have been identified in the comprehensive statewide flood vulnerability and sea level rise assessment, as applicable.

(g) Expenses ineligible for inclusion in the plan include, but are not limited to, expenses associated with:

1. Aesthetic vegetation.
2. Recreational structures such as piers, docks, and boardwalks.
3. Water quality components of stormwater and wastewater management systems, except for expenses to mitigate water quality impacts caused by the project or expenses related to water quality which are necessary to obtain a permit for the project.
4. Maintenance and repair of over-walks.
5. Park activities and facilities, except expenses to control flooding or erosion.
6. Navigation construction, operation, and maintenance activities.
7. Projects that provide only recreational benefits.

(h) The department shall implement a scoring system for assessing each project eligible for inclusion in the plan pursuant to this subsection. The scoring system must include the following tiers and associated criteria:

1. Tier 1 must account for 40 percent of the total score and consist of all of the following criteria:

- a. The degree to which the project addresses the risks posed by flooding and sea level rise identified in the local government vulnerability assessments or the comprehensive statewide flood vulnerability and sea level rise assessment, as applicable.
 - b. The degree to which the project addresses risks to regionally significant assets.
 - c. The degree to which the project reduces risks to areas with an overall higher percentage of vulnerable critical assets.
 - d. The degree to which the project contributes to existing flooding mitigation projects that reduce upland damage costs by incorporating new or enhanced structures or restoration and revegetation projects.
2. Tier 2 must account for 30 percent of the total score and consist of all of the following criteria:
 - a. The degree to which flooding and erosion currently affect the condition of the project area.
 - b. The overall readiness of the project to proceed in a timely manner, considering the project's readiness for the construction phase of development, the status of required permits, the status of any needed easement acquisition, and the availability of local funding sources.
 - c. The environmental habitat enhancement or inclusion of nature-based options for resilience, with priority given to state or federal critical habitat areas for threatened or endangered species.
 - d. The cost-effectiveness of the project.
 3. Tier 3 must account for 20 percent of the total score and consist of all of the following criteria:
 - a. The availability of local, state, and federal matching funds, considering the status of the funding award, and federal authorization, if applicable.
 - b. Previous state commitment and involvement in the project, considering previously funded phases, the total amount of previous state funding, and previous partial appropriations for the proposed project.
 - c. The exceedance of the flood-resistant construction requirements of the Florida Building Code and applicable flood plain management regulations.
 4. Tier 4 must account for 10 percent of the total score and consist of all of the following criteria:
 - a. The proposed innovative technologies designed to reduce project costs and provide regional collaboration.
 - b. The extent to which the project assists financially disadvantaged communities.
- (i) The total amount of funding proposed for each year of the plan may not exceed \$100 million. Upon review and subject to appropriation, the Legislature shall approve funding for the projects as specified in the plan. Multiyear projects that receive funding for the first year of the project must be included in subsequent plans and funded until the project is complete, provided that the project sponsor has complied with all contractual obligations and funds are available.
 - (j) The department shall initiate rulemaking by August 1, 2021, to implement this section.

(6) REGIONAL RESILIENCE ENTITIES.—Subject to specific legislative appropriation, the department may provide funding for the following purposes to regional entities that are established by general purpose local governments and whose responsibilities include planning for the resilience needs of communities and coordinating intergovernmental solutions to mitigate adverse impacts of flooding and sea level rise:

- (a) Providing technical assistance to counties and municipalities.
- (b) Coordinating multijurisdictional vulnerability assessments.
- (c) Developing project proposals to be submitted for inclusion in the Statewide Flooding and Sea Level Rise Resilience Plan.

History.—s. 1, ch. 2021-28.

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Technical Memorandum

Citywide Seawall Assessment

City Of Hollywood City Project 20-11053

Comprehensive Citywide Stormwater Master Plan (SWMP)

November 2022

1.0 Introduction

This Technical Memorandum (TM) and associated GIS file is provided as a deliverable for City Project 20-11053, *Stormwater Master Plan Modeling and CIP Development Phase* and presents a summary of the methodology and results of the special-purpose seawall assessment survey performed for the SWMP.

1.1 Background Information

As part of the comprehensive SWMP, the City desired to perform an assessment of its existing shoreline armoring as a first step to addressing resiliency and sea-level rise, and to create a baseline condition of the approximate extent of existing shoreline armoring. Shoreline armoring is defined as physical measures to protect and stabilize the land abutting water bodies to keep out the water side and prevent the loss of sediment from the land side.

In the City of Hollywood, sand dune berm shorelines exist along the coastal beaches abutting the Atlantic Ocean on the east coast, along the banks of the Intracoastal Waterway (ICW) on both the east and west sides, along the SFWMD drainage canals which extend into the City, and around the perimeters of the many lakes. Shorelines can exist in several forms, both armored and natural, sometimes referred to as "grey" and "green". Hard armoring has been the traditional approach to shoreline protection and includes the construction of bulkheads, seawalls, revetments, dikes, berms, and rip rap. Natural alternatives to shoreline armoring include maintaining or planting native coastal shrubs, trees, and other plants that have an established root system to help prevent erosion and dissipate wave energy.

With current sea level rise predictions, the increasing tide elevations, while stopped by the tidal valves from entering the stormwater system pipes at the outfalls, will also overtop any existing low shoreline areas along the connected coastal waterways and result in tidal flooding of seawater into the City's streets. This includes non-sea walled areas, low sea walled areas, failed existing sea walls, gaps in seawalls, and any non-bermed low-lying areas or areas of rip-rap where the interstitial spaces were not completely sealed watertight. Additionally, any low, non-armored shoreline

sections of adjacent municipalities will need to be addressed and coordinated with their owners, as flood waters can flow into the City from these other areas.

As Hollywood is a coastal city rising only approximately 10-15 feet above sea level or lower (and several neighborhoods are at, below, or barely above, sea level at high tide), there are many areas that are particularly susceptible to tidal flooding if not protected. To effectively plan for future shoreline armoring CIP, an assessment survey of the existing conditions along the City's shorelines must first be conducted as a baseline for comparison.

1.2 Shoreline Armoring Regional Standards

Adopted by the Broward County Board of Commissioners on January 7th, 2020, as a part of the Land Use Plan, *Policy 2.21.7* applies to all tidally influenced properties within Broward County and sets the ground rules for minimum seawall and top-of-bank elevation standards in areas that are susceptible to flooding from high tides and storm surge for all properties in the County and states:

In order to ensure coordination, consistency and maximum effectiveness of improvements necessary to mitigate high tide flooding associated with realized and additional sea level rise through the year 2070, tidally-influenced municipalities shall adopt within 24-months of the effective date of this Policy (February 13, 2020), regionally consistent top elevations for seawalls, banks and berms, and other appurtenant infrastructure (e.g., boat ramps) consistent with the findings and recommendations of the United States Army Corps of Engineers/Broward County Flood Risk Management Study for Tidally Influenced Coastal Areas. These standards shall be consistent with Chapter 39, Article XXV – Resiliency Standards for Flood Protection - of the Broward County Code of Ordinances, which shall serve as the model ordinance, and shall not be applicable to oceanfront beaches or shorelines seaward of the Coastal Construction Control Line.

Broward County Article XXV. – Resiliency Standards for Tidal Flood Protection is provided in **Appendix A**. Local governments are required to adopt a local ordinance implementing the regional standard by February 13, 2022. In summary:

- All tidally influenced barriers will need to be at a minimum elevation of 5 ft-NAVD by Yr 2050, and;
- If constructed prior to January 1, 2035, barriers can be at a minimum EL 4 ft-NAVD with a provision for expansion to 5 ft-NAVD by the 2050 deadline.
- The trigger for mandatory barrier construction to the required height (other than the deadlines cited above) is”
 1. “Substantial improvements” to the property (as determined by the Building Official),
or,

2. Issuance of a citation for causing or allowing the trespass of tidally influenced waters onto another property or into the public right of way.

The standards were developed to mitigate flooding from tidewater coming over seawalls or similar structures and resulting in flooding neighboring private and/or public properties and have been adopted by the City in 2021 by the City in its Code of Ordinances *150.30 Resiliency Standards for Tidal Flood Barriers*.

1.3 Statement of Project Need

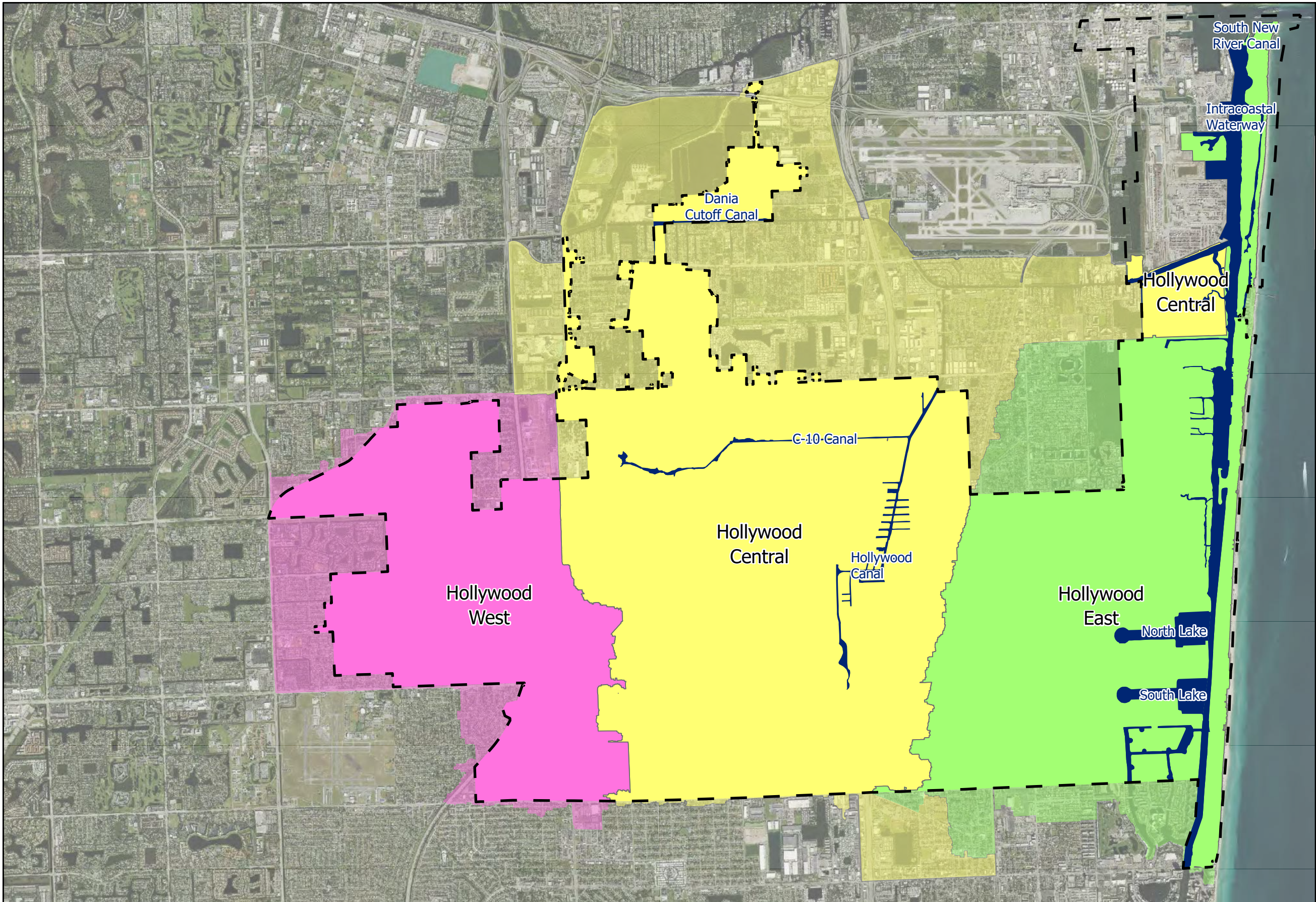
The existing shoreline types and seawall heights and condition are currently only sporadically known in available records for the City's water-front properties, both Public (City-owned), privately-owned, and owned by other entities (FDOT, Broward County, State, Federal, etc.). As the City is now adapting the Broward County Ordinance requiring all seawalls to comply with the minimum heights by the dates and compliance conditions set in the ordinance above, an initial assessment of the approximate heights of the existing seawalls and shoreline is being undertaken so that the improvement efforts and financial implications for compliance to the ordinance can be better understood, and planning costs for shoreline armoring improvements can be estimated for both the public and private sectors with the City limits.

The purpose of this project is to obtain initial shoreline elevation data to enter into the stormwater models being developed under the SWMP (which include affects from tidal boundary conditions in their flooding predictions) to further refine the flooding extent and depth from high tides, storm surge, and sea level rise, so that capital improvements for those resiliency measures can be formulated, and the City can predict the impact of flooding inundation and economic risk if the City's seawalls are not improved.

It is important to note that individual property owners (both City and Private/Other) will eventually be responsible for a final, legal elevation survey of their extent of seawall or shoreline by a licensed professional land surveyor (PLS), performed to construction accuracy, for seawall height ordinance compliance which will be on file with the City's building department. As these physical surveys are completed, the surveys should be imported into the GIS seawall layer created under this project by the City's GIS team, replacing the initially estimate from the approximated bulk LiDAR data being provided in this project at the current (+/-) 3-inch vertical accuracy.

1.3 City Area Description

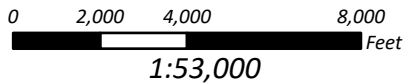
The City is divided by natural and man-made riverine/canal floodplains, topography, and major conveyance infrastructure into five major "Basins" as shown on **Figure 1-1** which contain the shoreline surveyed in this analysis. Major exposed waterfront is along the Intracoastal Waterway including Hollywood Lakes and Harbor Islands Areas, and the C-10 Canal/Spur including Liberia, North Central, Park East finger Islands, and westward through Emerald Hills.



- Legend
- Hollywood City Limits
 - Major Drainage Canals
- Model Basin
- Hollywood Central
 - Hollywood East
 - Hollywood West



City Limits, Major Drainage Canals,
and Major Basins



2.0 Methodology

The following methodology was formulated to perform the seawall survey in a format that can be incorporated into the stormwater models for the SWMP and easily used by the City for planning purposes.

2.1 Data Review

A review of available previous reports, studies, plans and other available applicable data sources that were provided by the City regarding the existing extent of the seawalls was first performed. Some previous analyses were performed generally addressing small portions of seawalls in the City or rip rap armoring of the Lakes area; however, none could be found that provided an inventory of the existing seawall heights throughout the City.

Several previous studies and reports specifically stated the case and need for seawalls throughout the City:

1. Hollywood Waterways Master Plan, EDSA 2014 stated in the recommendations “to perform a comprehensive seawall survey/assessment to assess and develop mechanisms to improve/repair all City owned seawalls as needed. Where seawalls are found to be failing, improvements made should take into account sea level rise and be constructed to a suitable elevation, with the justification of preventing tidal flooding, and to concurrently upgrade related upland public access, waterfront park, and landscaping. The study further states the majority of Hollywood’s waterways have seawall edge condition as opposed to a natural boundary. Ownership of seawalls is both private and public, and the age range spans several decades. City-wide there are many examples of decaying seawalls which make coastal areas vulnerable to flooding and can become hazards. Extensive seawall reconstruction may be required throughout the City on both public and private property; the team recommends a City-wide survey to assess conditions and formulate a priority replacement program. Funding and financing are a key aspect of any such program and would be a critical part of the study. In the mid and long term, seawall replacement or augmentation is one important means along with installation of backflow preventers, to mitigate climate change and defend against predicted sea level rise in the decades to come. Eastern Hollywood lies in FEMA zones AE and VE, which are especially vulnerable to storm-related water rise events. Seawall design going forward should be designed in coordination with FEMA standards and increased property protection as essential criteria.”
2. Unified SLR Projection Southeast Florida, SE FL Regional Climate Change Compact, 2019 stated shoreline armoring measures are required for all south Florida communities in conjunction with back flow prevention in open pipes to all tidally influenced waterways.
3. The County-wide Resiliency Analysis, BC-EPGMD, 2018 performed by Broward County’s Community Resilience Division stated the need for seawalls throughout the City’s shorelines and classified them as “vulnerable” and presents model results for future sea level rise

overtopping at high tides. Their model and economic risk calculations was the basis for setting the Seawall Ordinance heights and adaptation timeline to construct.

4. The FDOT A1A Flood Improvements Preliminary Design and Alternatives Report, FDOT/Scalar, 2020 states that “FDOT has experienced tidal flooding along and adjacent to SR-A1A in Hollywood, Florida. The limits of this study are SR-A1A from the southbound flyover from Hallandale Beach Boulevard to just north of Dania Beach Boulevard. This Study includes review of various as built plans, studies, SFWMD permits, and Broward County surface water licenses along with field reviews to document existing conditions. The latest FDOT lidar survey data was used with the above data to create into a hydrodynamic model of the area. Field reviews were performed to document existing conditions, to note changes in seawalls along the ICWW and to identify any anomalies such as cave ins behind seawalls. Modelling included wet and dry weather tidal cycles, King tidal cycles and Sea Level Rise (SLR), using both FDOT and Broward County rainfall curves. The initial model results were field verified to determine the extent of tidal flooding along SR-A1A in Hollywood. Estimates of the causes of the flooding will be reviewed with FDOT staff to determine recommended alternative solutions, which include seawall improvements, storm water pumps, backflow valves, flap gates, etc., and/or roadway profile reconstruction.” These values were used to supplement the project data.

2.2 Seawall/Shoreline Assessment Survey Process and Workflow

Several steps were required to obtain the seawall/shoreline survey. It was determined that the most efficient and cost-effective methodology within the City’s available budget and timeline for this project was to undertake a special purpose LiDAR flight to capture the bulk of the data in one pass followed by ground survey to fill in the missing or obscured data returns from the LiDAR-produced pointcloud.

LiDAR (Light Detection and Ranging) is a remote sensing method used to examine the surface of the earth from an airborne vehicle that uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth. The light pulses, combined with other spatial geolocation data recorded by the airborne system generate precise, three-dimensional topographic information about the shape of the Earth and its surface characteristics which can be extracted and used for survey purposes **(Figure 2-1, Courtesy Quantum Spatial)**.

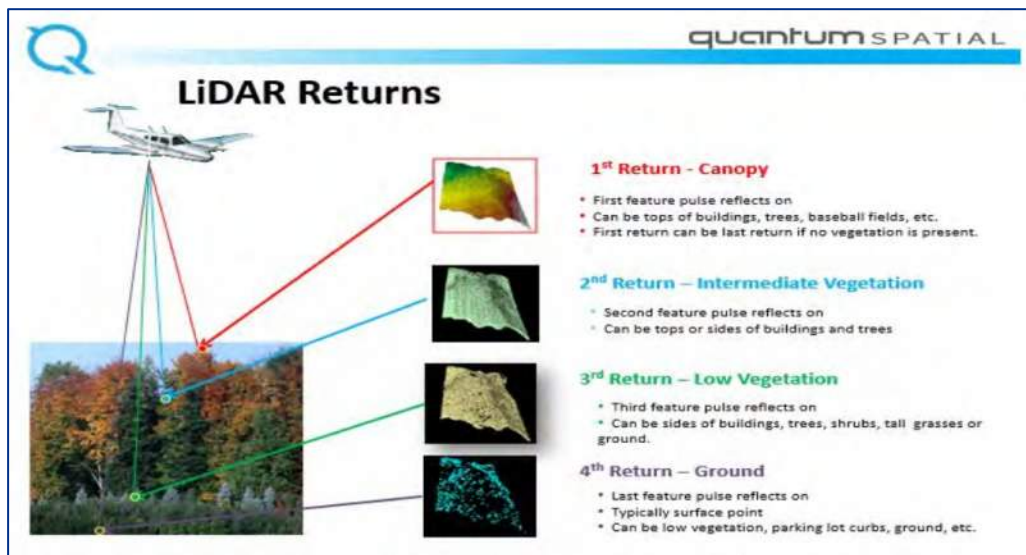
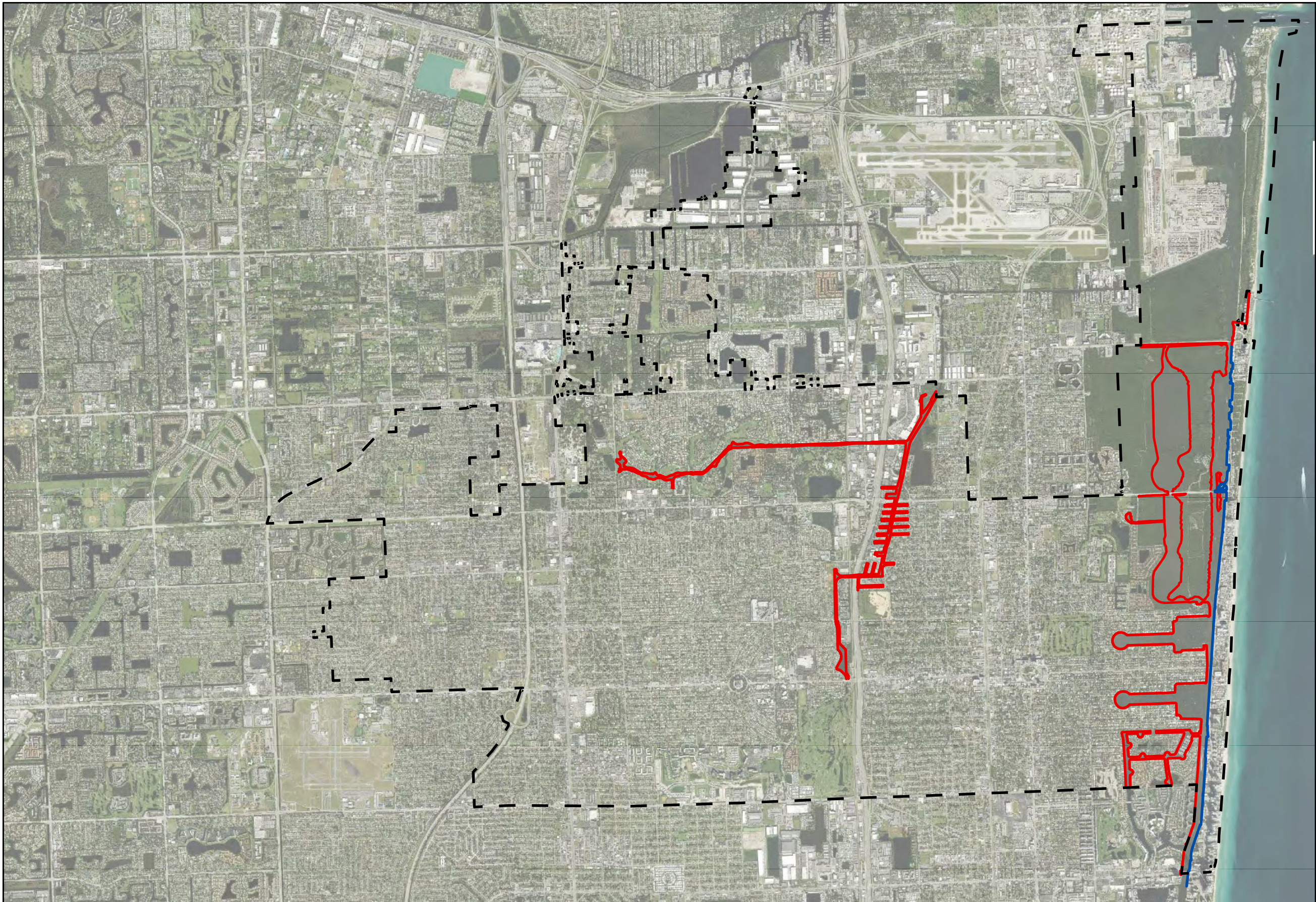


Figure 2-1. LiDAR Technology for Topographic Survey

For the SWMP, a continuous segmented GIS polyline with the associated x, y, and z coordinates and other associated data such as shoreline type is required for the boundary condition elevations analysis. The goal for the SWMP was to create the seawall polyline with elevations at the end vertices of each property (either seawall or shoreline section) to the accuracy necessary for the SWMP analysis consisting of a set of points connected by straight line segments and end points with the data stored in the GIS database. The seawall 3D polyline is then used in the stormwater model to help define the topographical conditions at the interface between the model basins and the model's hydraulic boundaries (i.e., the land and water interface).

The following methodology was followed for establishing the shoreline/seawalls:

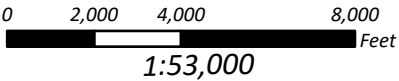
1. Ground control was established by the land surveyor for the LiDAR flight tracks for the project area using approximately 40 standard surveyed control point stations for the seawall corridor plan.
2. A contoured LiDAR flight was flown to capture elevations and location of the approximately 32 miles of shoreline barrier around the City (**Figure 2-2**). This involved flight planning and an FAA clearance for the flight over the City's controlled airspace, establishment of a favorable-weather window of opportunity for the flight, coordination for coincident low tides so the shoreline is exposed, and post-flight download and data processing where the multiple flight passes along the City's shorelines were stitched together and joined into a single data set. The deliverable from the specialty firm was a classified LAS File. A LAS file is



- Legend
- [-] Hollywood City Limits
 - FDOT Seawall Data
 - Missing Shoreline Data



Hollywood Seawall Survey Extent

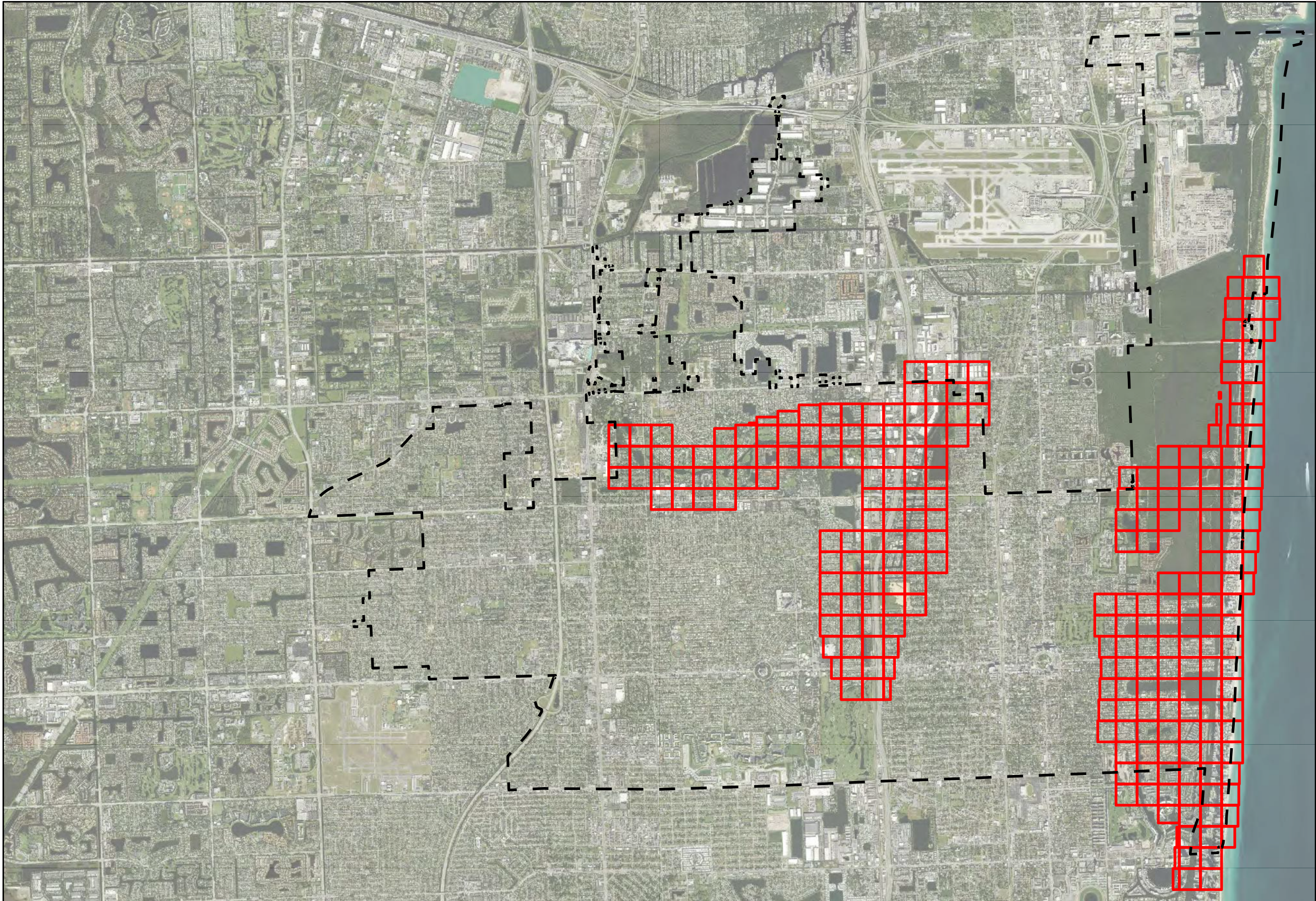


an industry-standard binary format for storing airborne LiDAR data. The file contained point classification for ground, water, vegetation, building, power lines and are standard codes defined by the American Society for Photogrammetry and Remote Sensing. The file contained Classes 1, 2, 7, 9, 10, Hydro BLs at USGS specifications, BE DEM, intensity imaging, seawall vectors, and Vegetation Classification (Classes 3, 4, 5) file. The Airborne LiDAR accuracy for this project was to USGS specifications, RMSEz of 5 cm for QLO (30 ppsm) providing a (+/-) 0.25ft (3-inch) vertical accuracy. The horizontal accuracy is what the sensor manufacturer outlines for each sensor, a Nominal Point Spacing (NPS) for 30 ppsm (18 cm).


3. The provided LiDAR raw data point cloud was rectified to discard foreign objects in the data return and isolate and create the seawall feature class (**Figure 2-3**).
4. The shoreline data was classified to seawall, shoreline, riprap, or other as a feature type and visually QC checked through Google Earth™ street view where available.
5. The shoreline data was then merged with the Broward County Property Appraiser's Office (BCPA) 2021property data file to isolate sections of seawall or other shoreline to each property within the City limits (**Figure 2-4**).
6. The LiDAR point cloud was analyzed property by property for the entire City shoreline for missing data due to vegetative cover or other data obstruction anomalies that obscured the LiDAR return (**Figure 2-5**).
7. Properties with three or more consistent points clearly determined to be on the "seawall" were flattened property line to property line and given the consistent average value for elevation.
8. Non-structural areas remained as un-improved shoreline at their topographical elevation in the pointcloud from the "backyards" DEM.
9. Twenty-eight areas were identified where the shoreline was too obstructed to process. Ground survey crews were deployed to the data gap locations to obtain the missing data (**Figure 2-6**). Door hanger and mail notifications were sent to the property owners alerting them to the pending assess to the seawall. Areas inaccessible to the surveyor or where access was refused were accessed from the waterside by floating vessel.
10. The ground survey data was merged into the rectified LiDAR data to create a continuous shoreline digital elevation model file.
11. A polyline for the feature class seawall was created and snapped to the point cloud data using GIS transformations and the associated database attributes for x,y coordinates, elevation z data, type, and owner was tabulated. The elevation values from the two ends of


each polyline segment representing the seawall for that property were mosaic'd with the model DEM at the shoreline for use in the SWMM model. **(Figure 2-7).**

12. Statistics were then extracted from the data set by analyzing the populated fields of the data within the GIS.



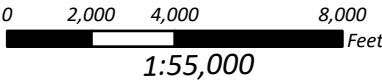
Legend

 Hollywood City Limits

 LAS Dataset



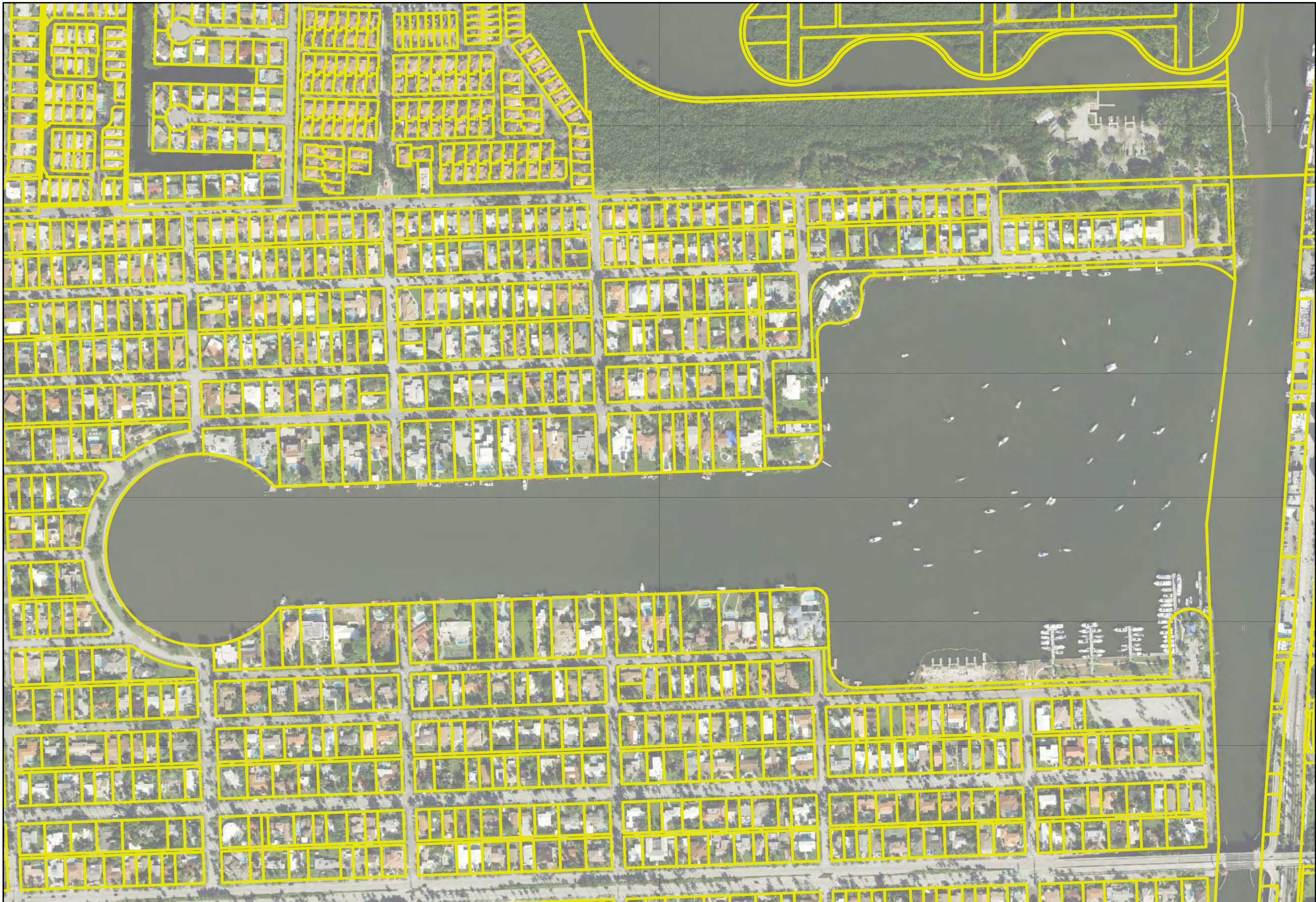
LiDAR Point Cloud Extent






City of Hollywood Stormwater Master Plan

Figure 2-3

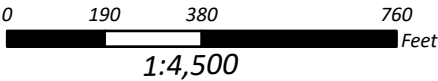
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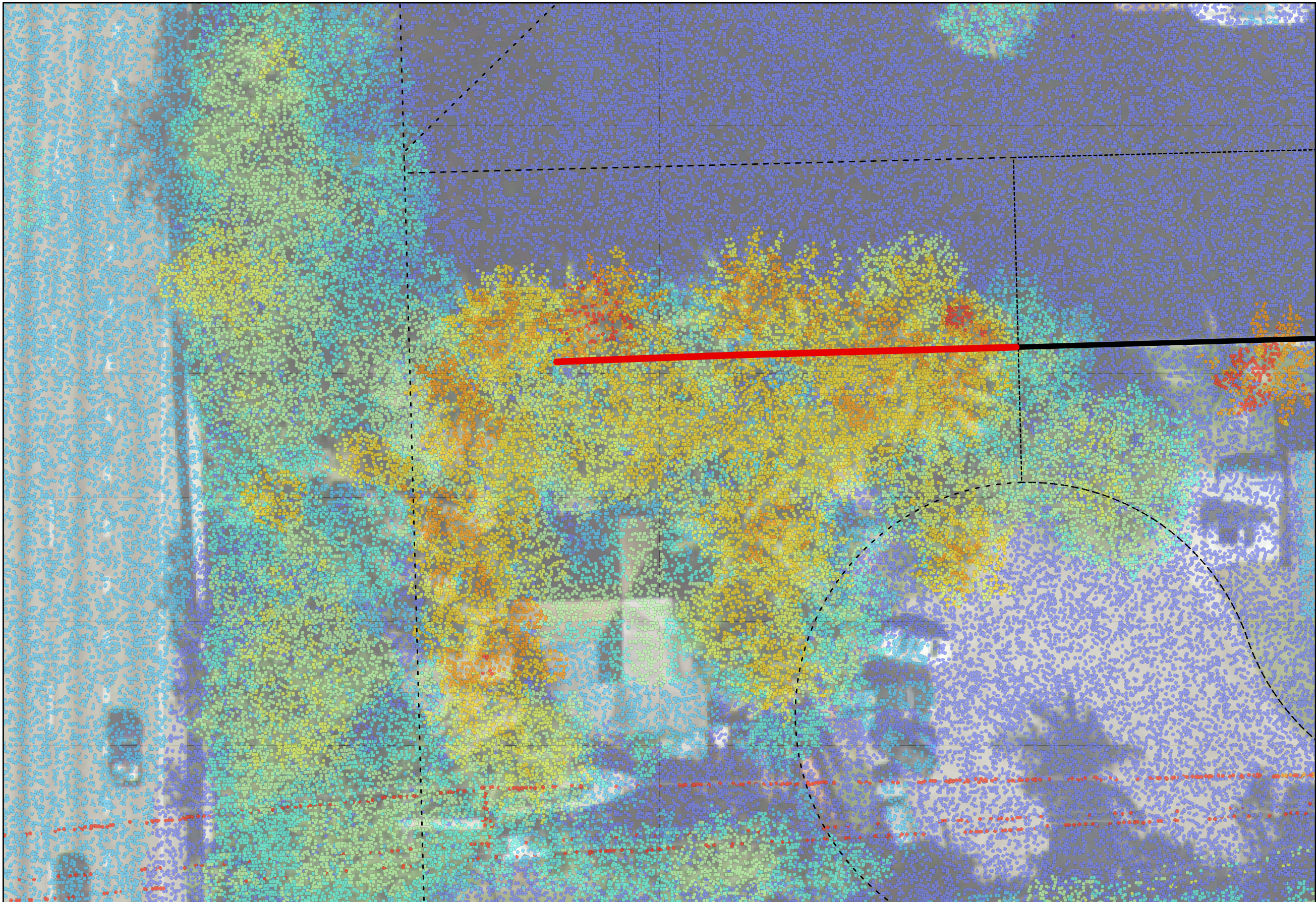


- Legend
-  Hollywood City Limits
 -  BC Property Appraiser
 -  Parcels (North Lake Example)



Broward County Property Data Layer

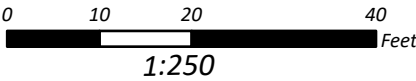




- Legend
- Hollywood City Limits
 - Parcel Boundary
 - Seawall
 - Seawall - Obstructed Return
 - LiDAR Point Cloud Elevation (FT NAVD88)**
 - <56
 - 48.37 - 56.73
 - 40.02 - 48.37
 - 31.66 - 40.02
 - 23.3 - 31.66
 - 14.94 - 23.3
 - 6.59 - 14.94
 - 1.77 - 6.59
 - >-1.77



Obstructed LiDAR Return



City of Hollywood Stormwater Master Plan
Figure 2-5
 10/27/2022