December 5, 2024

COMPREHENSIVE STORMWATER AND SEA LEVEL RISE MANAGEMENT

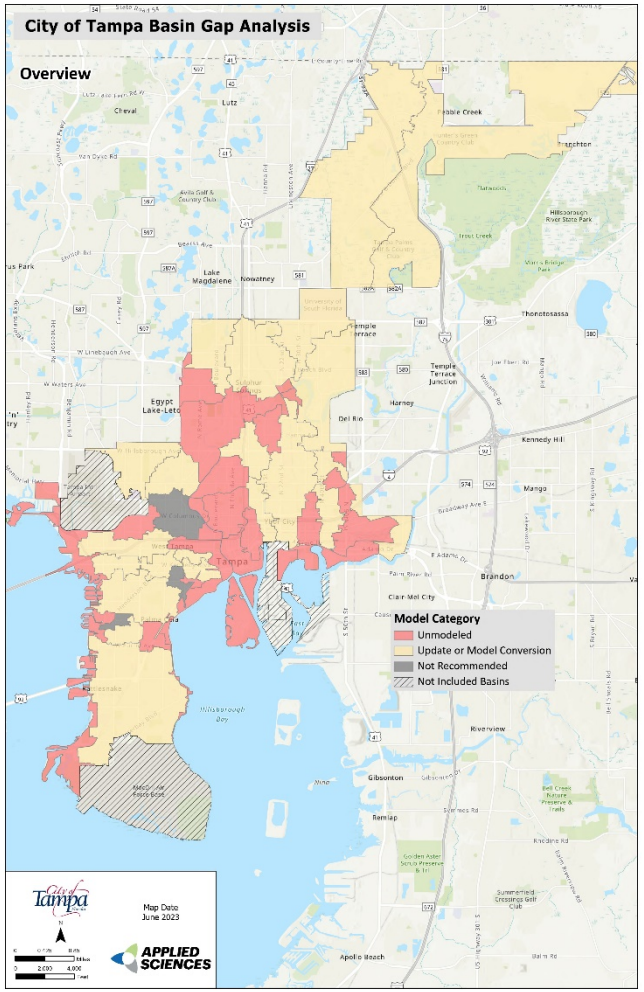
2024 FSA Winter Conference

APPLIED SCIENCES

City of Tampa Florida

Agenda

1. Basin Gap Analysis
   a) Introduction
   b) Data Collection
   c) Evaluation and Methodology
   d) Conclusions and Recommendations
   e) Summary
2. Pilot Project: Davis Islands Stormwater Analysis
   a) Resilient Florida Program
   b) Outfall Survey and Analysis
   c) Adaptation Strategies
   d) Application to Citywide Effort
   e) Guidelines and Recommendations



Introduction

- City of Tampa Stormwater staff have worked with the community and City administration to address and resolve flood complaints throughout the City for decades.
- Development of comprehensive studies and flood control implementation projects

  e.g., Upper Peninsula, Lower Peninsula, SE Seminole Heights, etc.
- The purpose of this study was to evaluate the level of completeness for previously studied basins, assess the effort necessary to update existing drainage models, identify unstudied drainage basins, and meet current/future CRS criteria.

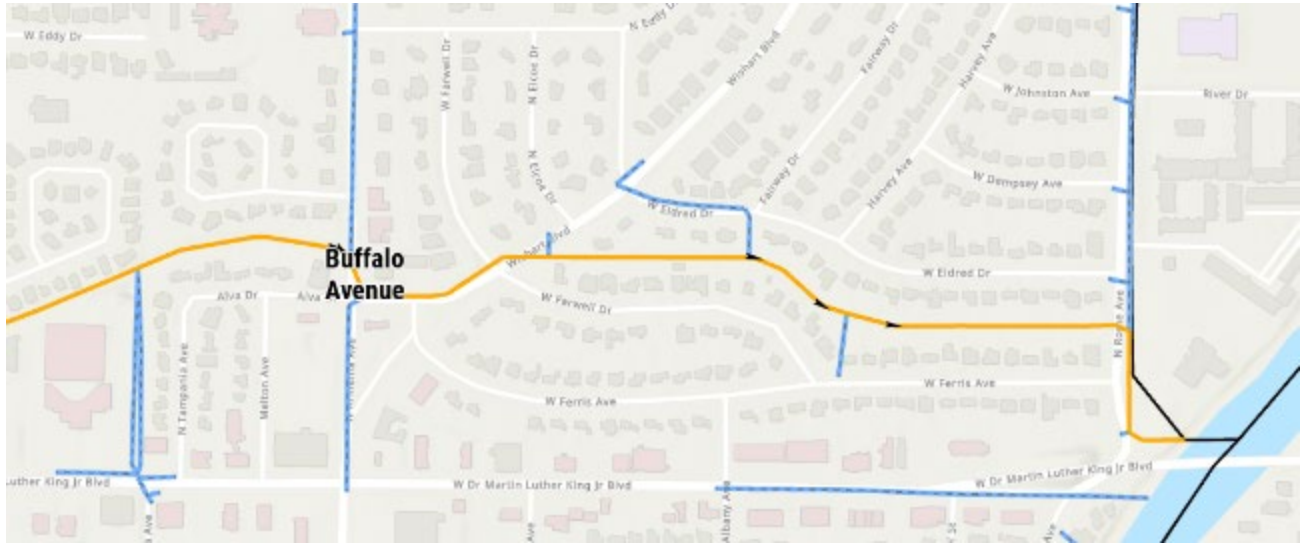
Data Collection

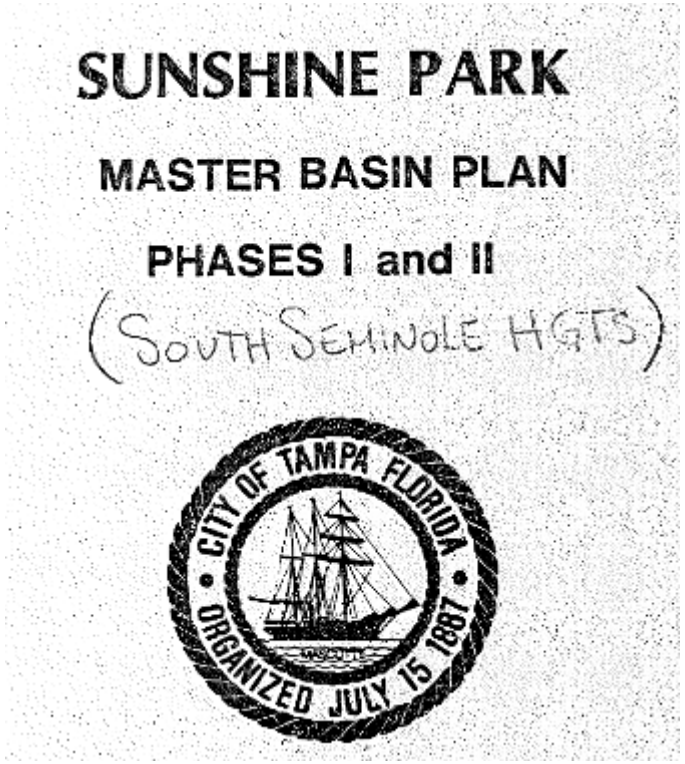
Through coordination with City staff, Applied Sciences collected a variety of GIS, PDF, and basin modeling datasets. Files were categorized as follows:

Model Files: XPSWMM, EPA SWMM, and ICPR4

GIS Files: Spatial GIS data which describes and delineates the modeled area and its components; stormwater inventory; flooding indicators (flood complaints, repetitive loss parcels, and Stormwater Advisory List (SAL) parcels)

Model Reports: Reports that describe the modeling methods and assumptions that the Engineer of Record made during the development of the model



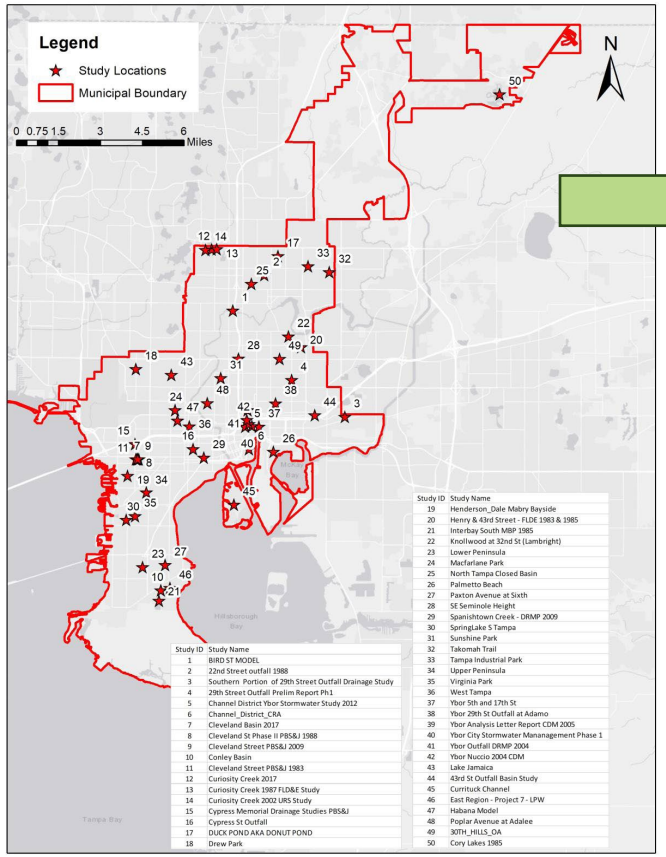


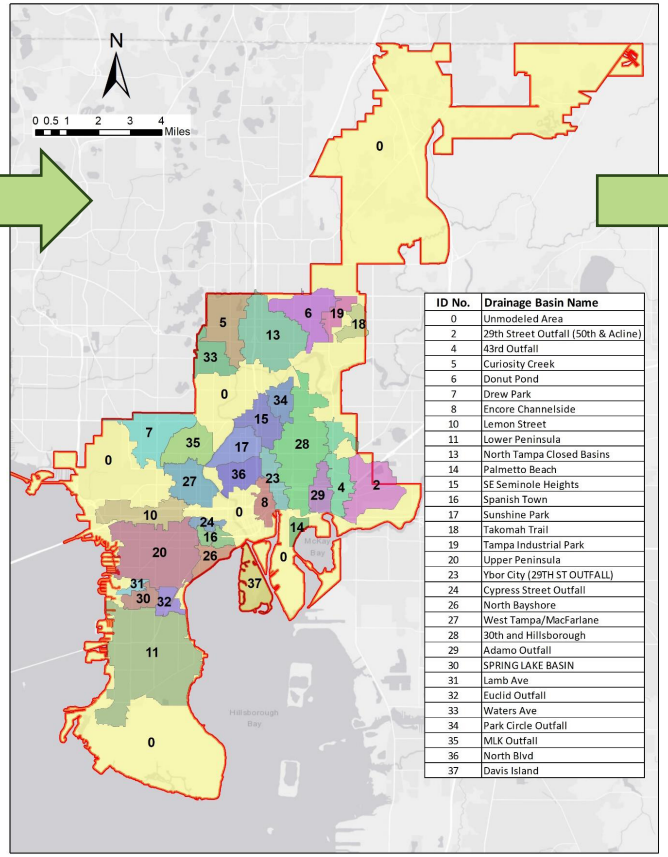
XPSWMM

icpr4

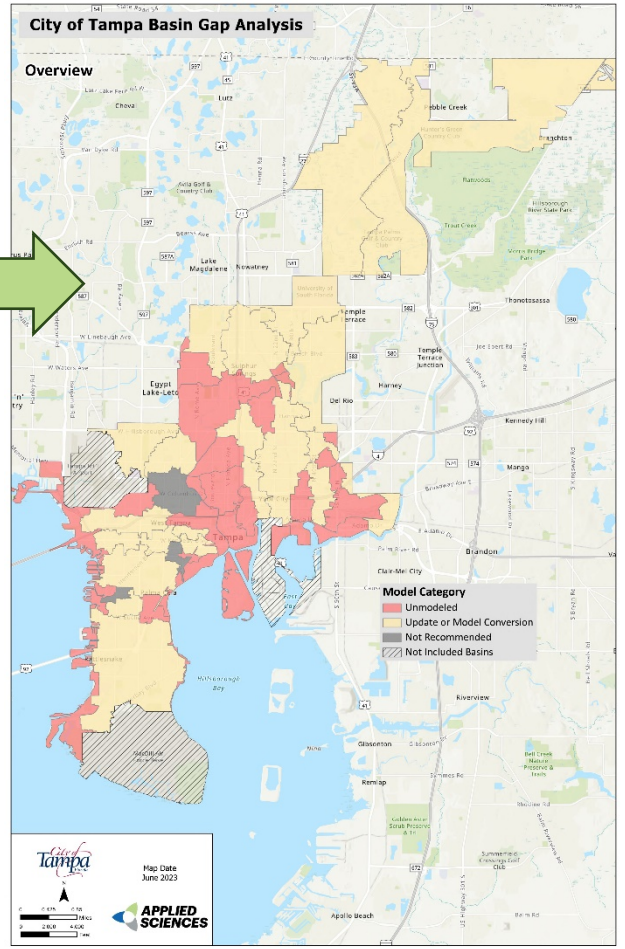
CITY OF TAMPA FLORIDA ORGANIZED JULY 15 1887

Data Aggregation Process





ID No.	Drainage Basin Name
0	Unmodeled Area
2	29th Street Outfall (50th & Acline)
4	43rd Outfall
5	Curiosity Creek
6	Donut Pond
7	Drew Park
8	Encore Channelside
10	Lemon Street
11	Lower Peninsula
13	North Tampa Closed Basins
14	Palmetto Beach
15	SE Seminole Heights
16	Spanish Town
17	Sunshine Park
18	Takomah Trail
19	Tampa Industrial Park
20	Upper Peninsula
23	Ybor City (29TH ST OUTFALL)
24	Cypress Street Outfall
26	North Bayshore
27	West Tampa/MacFarlane
28	30th and Hillsborough
29	Adamo Outfall
30	SPRING LAKE BASIN
31	Lamb Ave
32	Euclid Outfall
33	Waters Ave
34	Park Circle Outfall
35	MLK Outfall
36	North Blvd
37	Davis Island



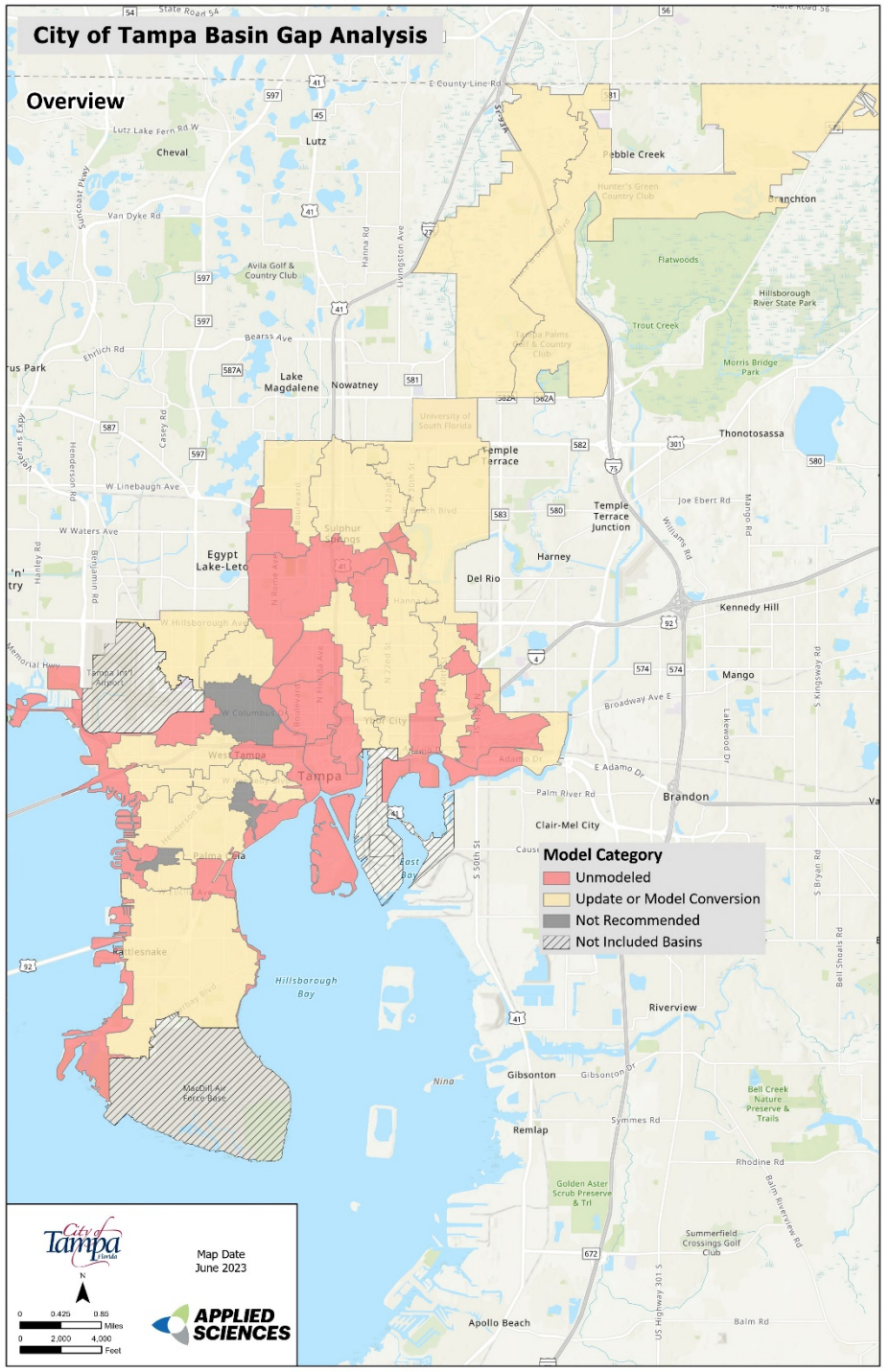
Study Locations **Past Basins** **Final Delineation**

Data Collection Summary

City of Tampa Basin Overview

- **Worked with City to…**
  - Delineate and name new/unmodeled basins
  - Determined previous studies/efforts related to each basin
  - Categorized basins as unmodeled, in need of update/conversion, or not recommended/not applicable

Category	Count
Unmodeled	20
Update/Model Conversion	19
Not Recommended	3
Not Included/Applicable	4
Total	**46 Basins**



Evaluation and Methodology

Basin Prioritization

Applied Sciences developed a priority ranking methodology that focused on understanding the **quantity of flooding indicators** in each model basin.

Repetitive Loss Parcels – 0 to 5 points
Stormwater Advisory List (SAL) Parcels – 0 to 5 points
Flood Complaints – 0 to 5 points

Higher Flood Indicator Score = Higher Priority

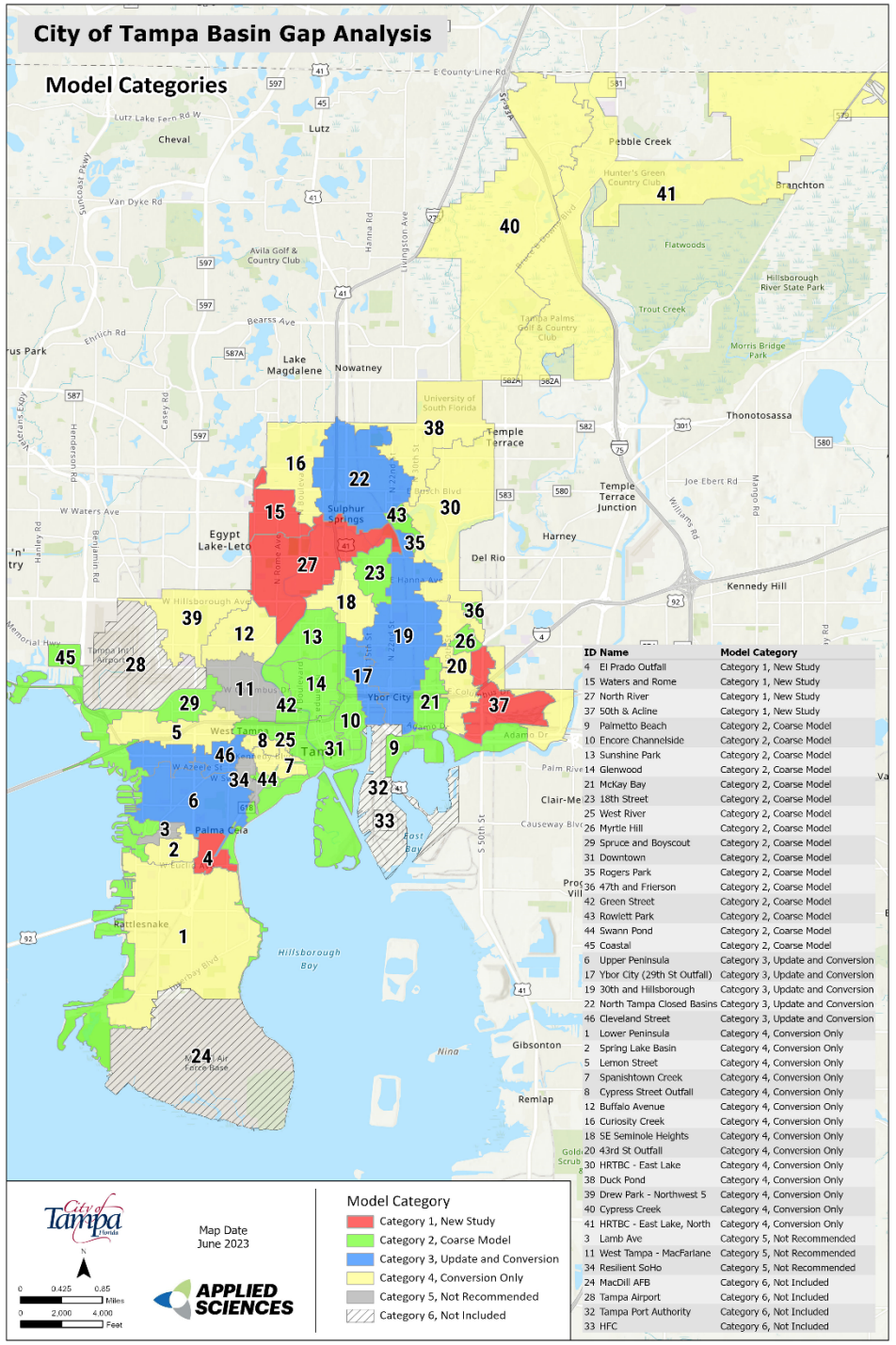
4

Evaluation and Methodology

Final Model Categorization

Applied Sciences developed overall model categories through coordination with City staff. These categories convey metrics related to level of effort, need, study age, and cost estimation.

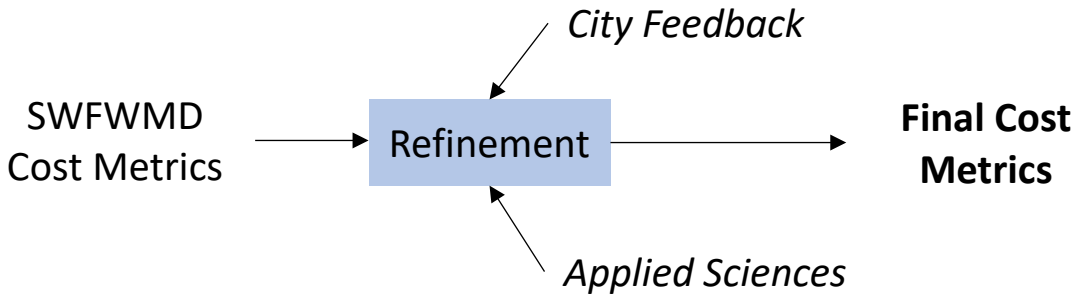
Category	Name
Category 1	New Study
Category 2	Coarse Model
Category 3	Update and Conversion
Category 4	Conversion Only
Category 5	Not Included



Evaluation and Methodology cont.

Cost Estimation

Applied Sciences utilized the SWFWMD Watershed Management Plan (WMP) cost metrics as the basis for the Gap Analysis cost estimation.



Final Cost Metrics

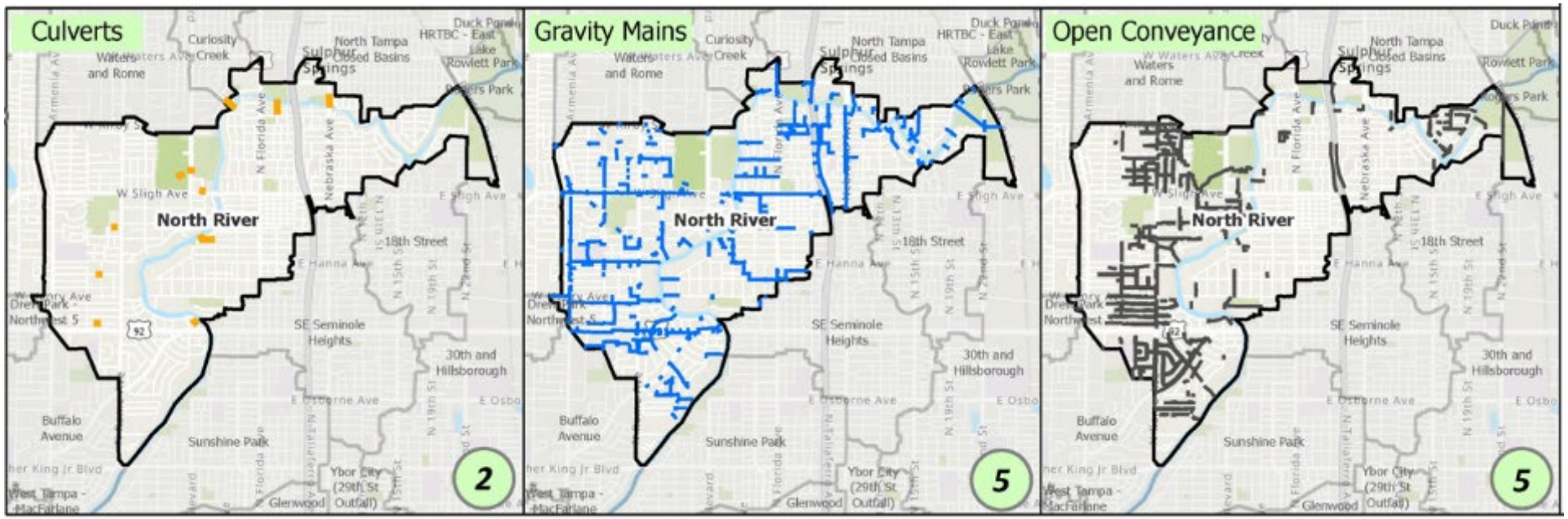
Through further internal discussions and correspondence with the City, the following final cost metrics were proposed:

Cost Category	Cost/Acre ($)
Category 1, New Study	150
Category 2, Coarse Model	100
Category 3, Update and Conversion	75
Category 4, Conversion Only	45
Category 5, Not Included	0

Evaluation and Methodology cont.

Basin Complexity Factors

More Stormwater Features = Higher Cost (up to 15%)



Evaluation and Methodology cont.

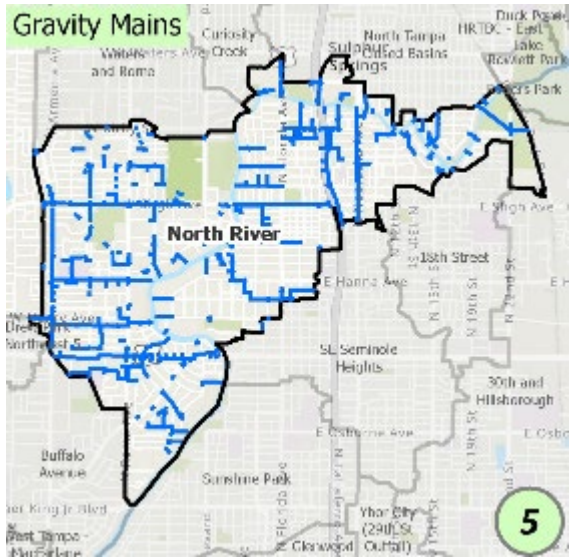
Complexity Increase Factor

Each stormwater category was also considered uniquely to impact the overall cost estimation through the following distribution, with a **total percent impact up to 15%.**

Category	Percent Impact
Box Culverts	4 %
Gravity Mains	3 %
Open Channels	8 %

North River Basin Example

The North River Basin contains a moderate amount of box culverts and a relatively large amount of gravity mains and open conveyance features.



Culverts	Gravity Mains	Open Conveyance	Complexity Increase Factor
2	5	5	12.6 %
1,394 ft	113,262 ft	126,128 ft	

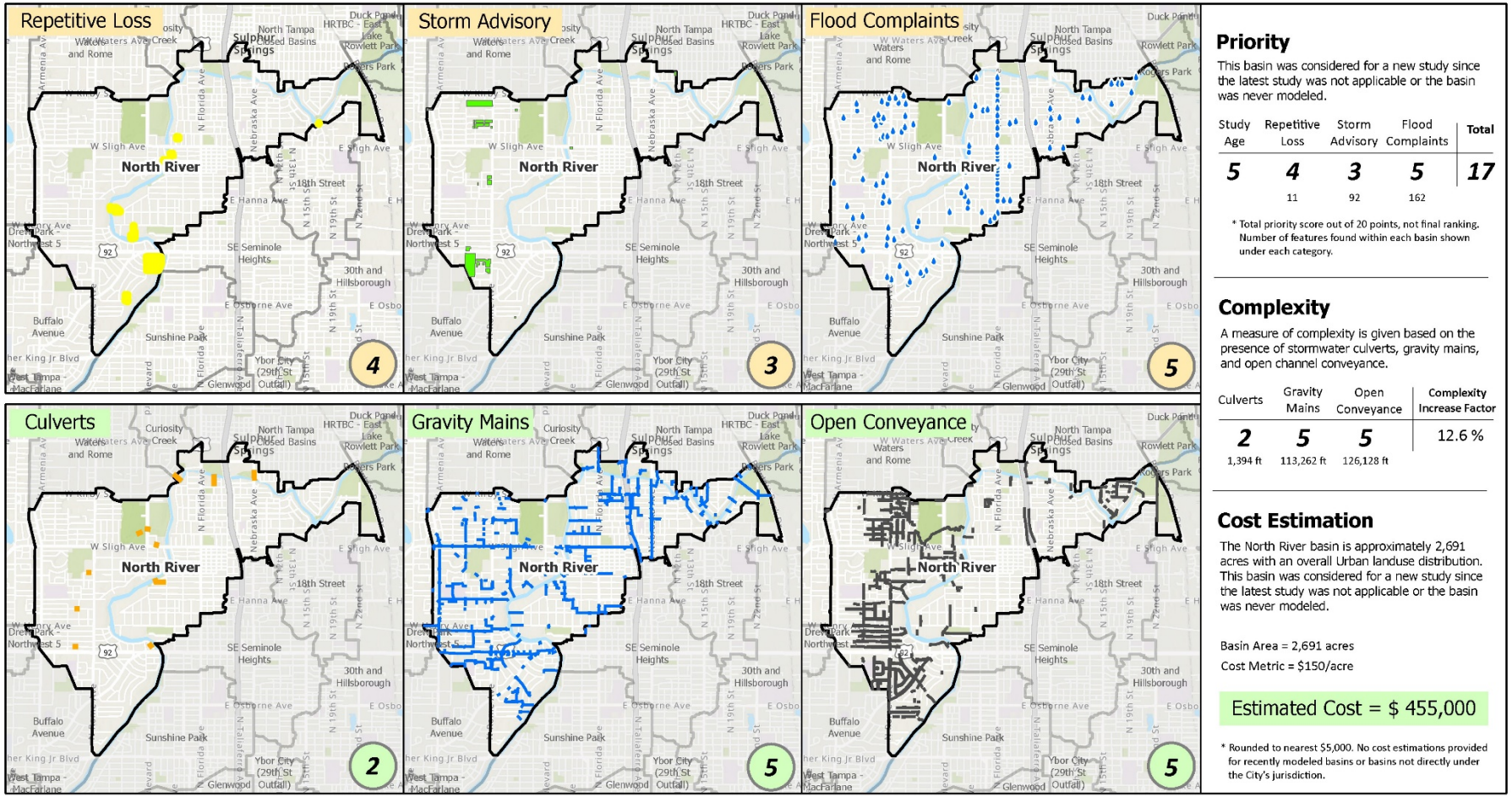
2 **x** (4%) + 5 **x** (3%) + 5 **x** (8%) = 12.6%

Base Cost = 2,691 Acres **x** $150/Acre = $403,650

Adjusted Cost = $403,650 **x** 12.6% = $452,088

Round to Nearest $5,000 → $455,000

Example Summary Map – North River



Priority

This basin was considered for a new study since the latest study was not applicable or the basin was never modeled.

Study Age	Repetitive Loss	Storm Advisory	Flood Complaints	Total
5	4	3	5	17
	11	92	162	

* Total priority score out of 20 points, not final ranking. Number of features found within each basin shown under each category.

Complexity

A measure of complexity is given based on the presence of stormwater culverts, gravity mains, and open channel conveyance.

Culverts	Gravity Mains	Open Conveyance	Complexity Increase Factor
2	5	5	12.6 %
1,394 ft	113,262 ft	126,128 ft	

Cost Estimation

The North River basin is approximately 2,691 acres with an overall Urban landuse distribution. This basin was considered for a new study since the latest study was not applicable or the basin was never modeled.

Basin Area = 2,691 acres

Cost Metric = $150/acre

Estimated Cost = $ 455,000

* Rounded to nearest $5,000. No cost estimations provided for recently modeled basins or basins not directly under the City's jurisdiction.

North River

2,691 acres

Category 1, New Study

Final Ranking

1

* Out of 46

Basin Notes

The North River basin was never previously studied. The basin contains a substantial length of the Hillsborough River starting at Rowlett Park Dr and ending around MLK JR Blvd. North River contains a high number of Repetitive Loss, Storm Advisory, and Flood Complaint features. The basin also contains a high number of stormwater features like gravity mains and open ditch systems. A new model using ICPR4 is recommended for North River.

City of Tampa Florida

N

0 0.5 1 Miles

0 2,500 5,000 Feet

Map Date
June 2023

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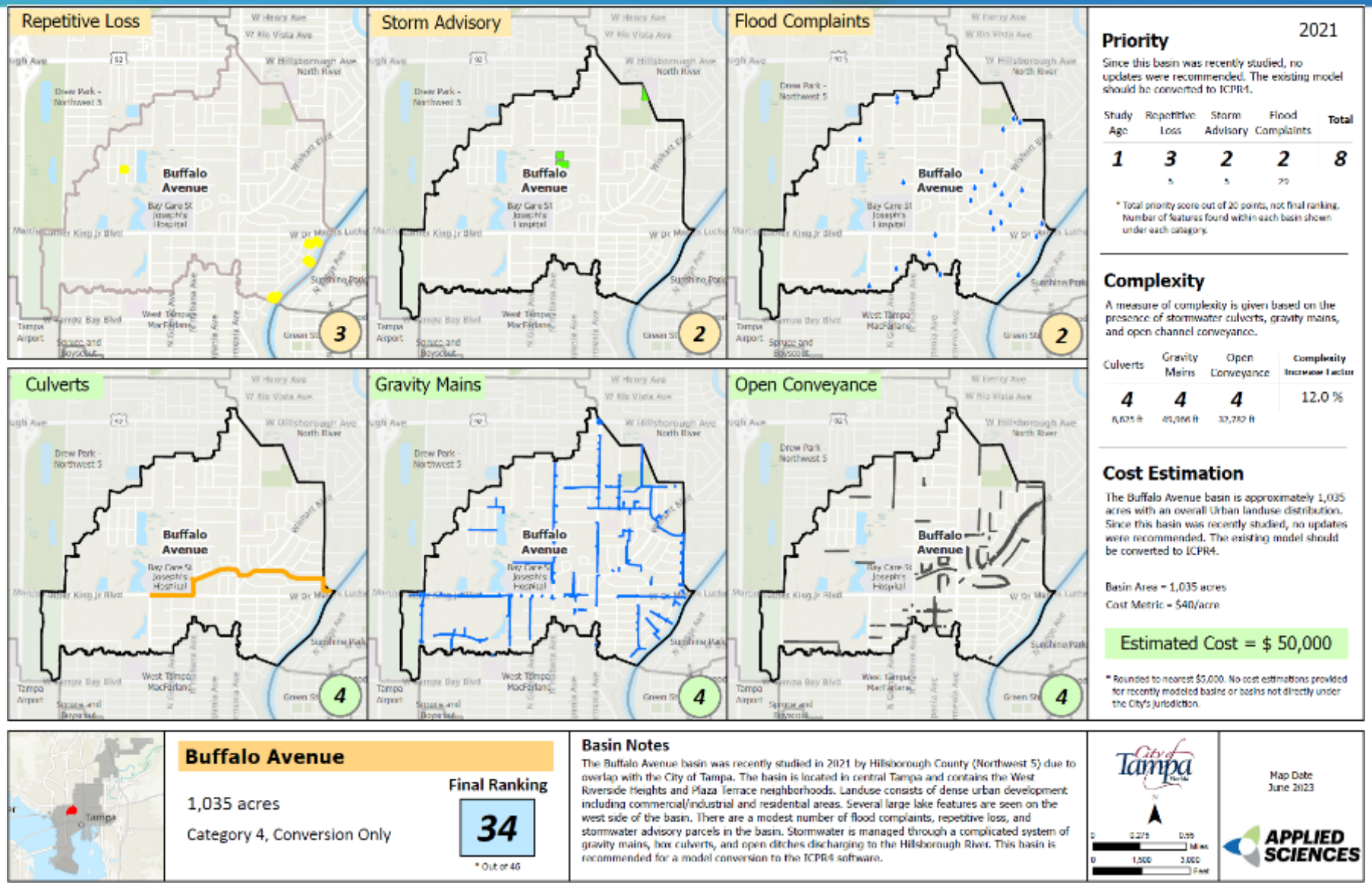
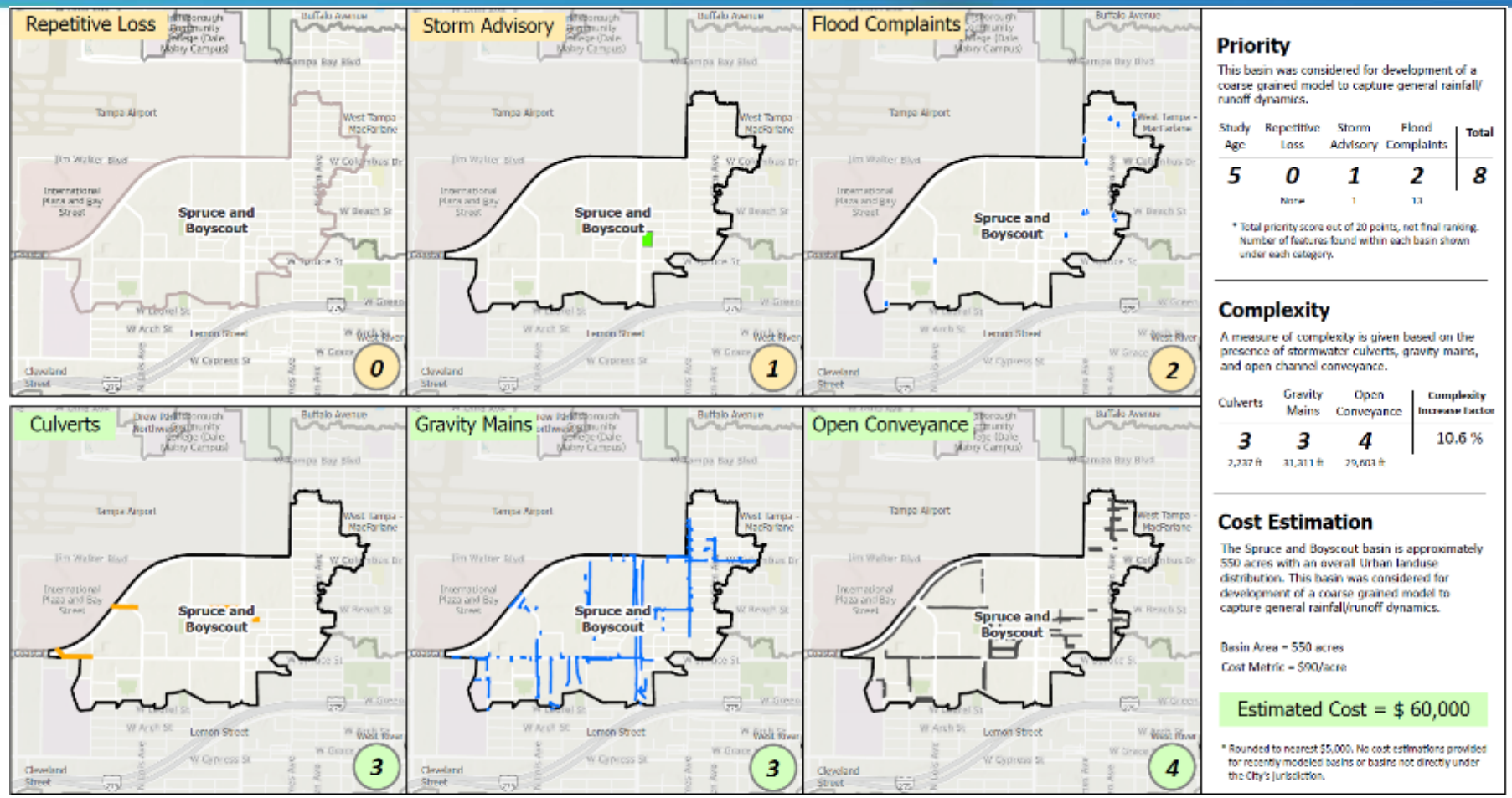
Example Summary Map – Buffalo Avenue



Example Summary Map – Spruce and Boyscout

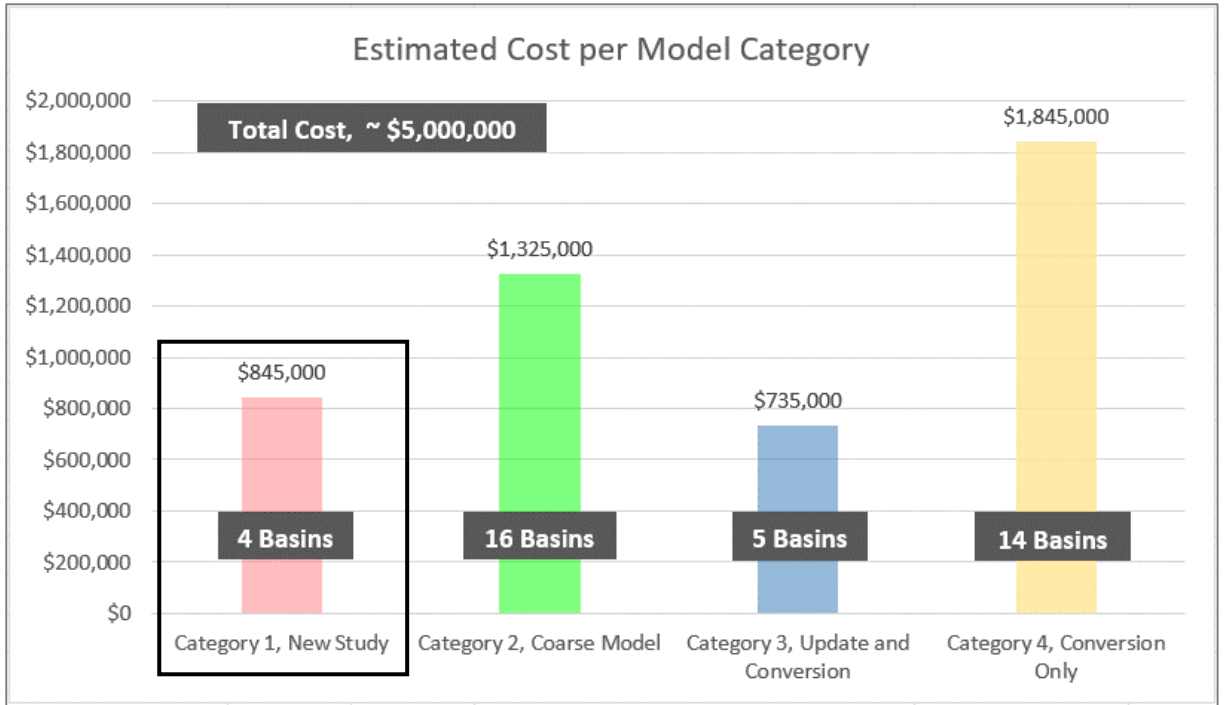


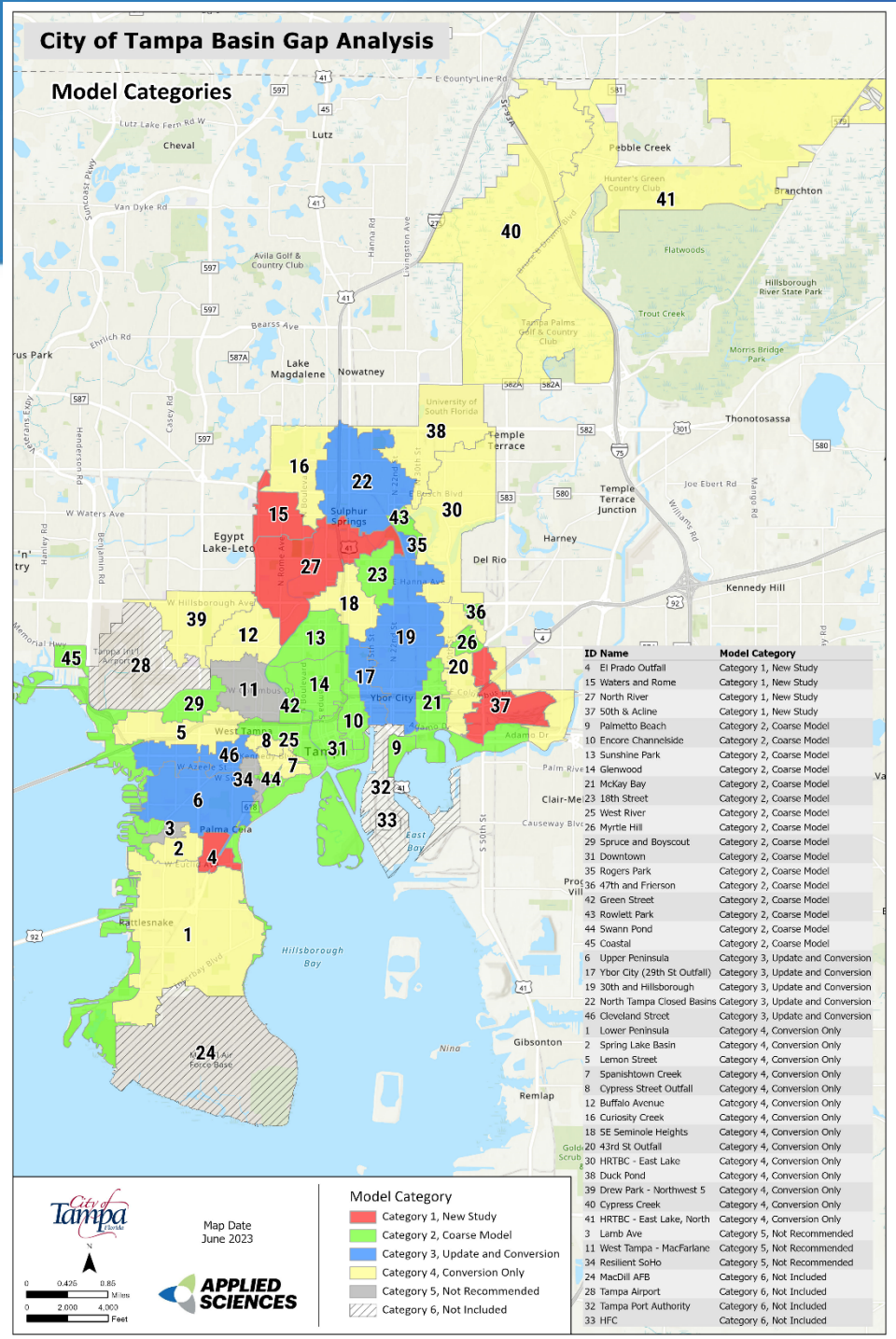
Conclusions and Recommendations

- Total Study Cost, **~ $5.0 Million**

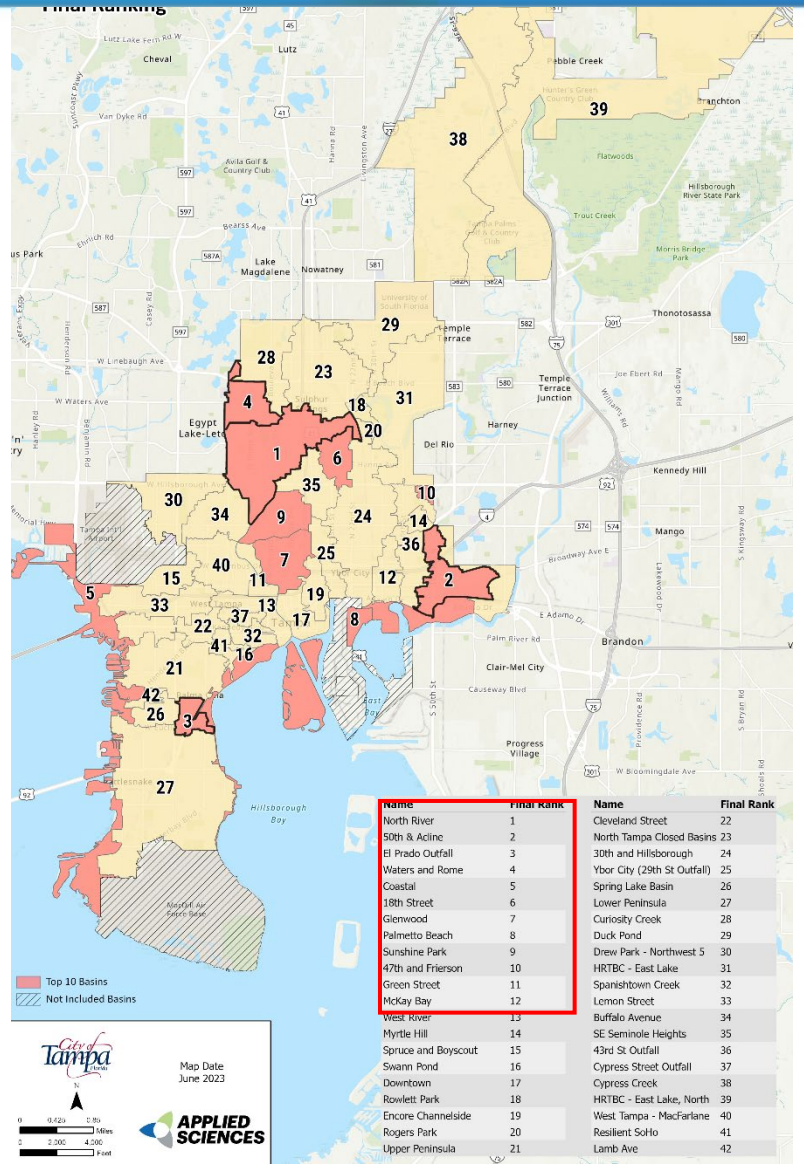
Benefits

- Improvements to CRS score, stormwater management/maintenance, decision making related to stormwater issues, CIP Project Identification
- Aid with future development for the **Technical Standards Manual**, i.e., make development more restrictive in certain areas based on the new/updated studies – peak sensitive/volume sensitive/etc.





Top 10 Basins – Final Ranking



Name	Final Rank
North River	1
50th & Acline	2
El Prado Outfall	3
Waters and Rome	4
Coastal	5
18th Street	6
Glenwood	7
Palmetto Beach	8
Sunshine Park	9
47th and Frierson	10
Green Street	11
McKay Bay	12
West River	13
Myrtle Hill	14
Spruce and Boyscout	15
Swann Pond	16
Downtown	17
Rowlett Park	18
Encore Channelside	19
Rogers Park	20
Upper Peninsula	21

Name	Final Rank
Cleveland Street	22
North Tampa Closed Basins	23
30th and Hillsborough	24
Ybor City (29th St Outfall)	25
Spring Lake Basin	26
Lower Peninsula	27
Curiosity Creek	28
Duck Pond	29
Drew Park - Northwest 5	30
HRTBC - East Lake	31
Spanishtown Creek	32
Lemon Street	33
Buffalo Avenue	34
SE Seminole Heights	35
43rd St Outfall	36
Cypress Street Outfall	37
Cypress Creek	38
HRTBC - East Lake, North	39
West Tampa - MacFarlane	40
Resilient SoHo	41
Lamb Ave	42

Conclusions and Recommendations

Current CRS Class

- Currently a 5 out of 10
- 2,905 Points
- 25% Flood Insurance Discount

Class 5 Savings:

$5.9 Million or $232/policy

Class 4 Savings:

$7.1 Million or $278/policy

Class 4 Prerequisites

- 3,000 Points
- 30% Flood Insurance Discount
- WMP or Basin studies

Net Benefits*:

$1.2 Million or $46/policy

Basin Study Recommendations – Adherence to CRS

- Sea Level Rise (SLR) analysis
- Impacts of future conditions related to landuse changes or projected development areas.
- Conceptual BMP projects should focus on preserving natural wetlands/open space, along with any channel improvements considering “soft” approaches rather than hardening with gabions, for example.

Summary

- Total WMP Cost, **~ $5.0 Million**

- 6 Consulting Firms, distribution of basins/study type
- ~ 30-month schedule or about 2.5 years
- StormWise Modeling Software

City of Tampa is starting the Citywide WMP right now!

- Improvements to CRS score – Flood Insurance Savings
- Stormwater management/maintenance, decision making related to stormwater issues
- Technical Standards Manual
- Identification of future CIP projects

Pilot Project: Davis Islands Stormwater Analysis & Adaptation Strategy Actions

Resilient Florida Grant Program
(Sec. 380.093 F.S.)

- Effective July 1, 2021

- The Florida Legislature recognizes the state's vulnerability to flooding from rainfall, storm surge, and sea level rise. It stresses the need for prioritized funding to address significant risks, highlighting a coordinated approach across coastal and inland communities to enhance resilience.

- **Regional Resilience Entities**
  - **Funding**: The Department may provide funds to regional entities established by local governments to assist with resilience planning, technical assistance, and project proposals.

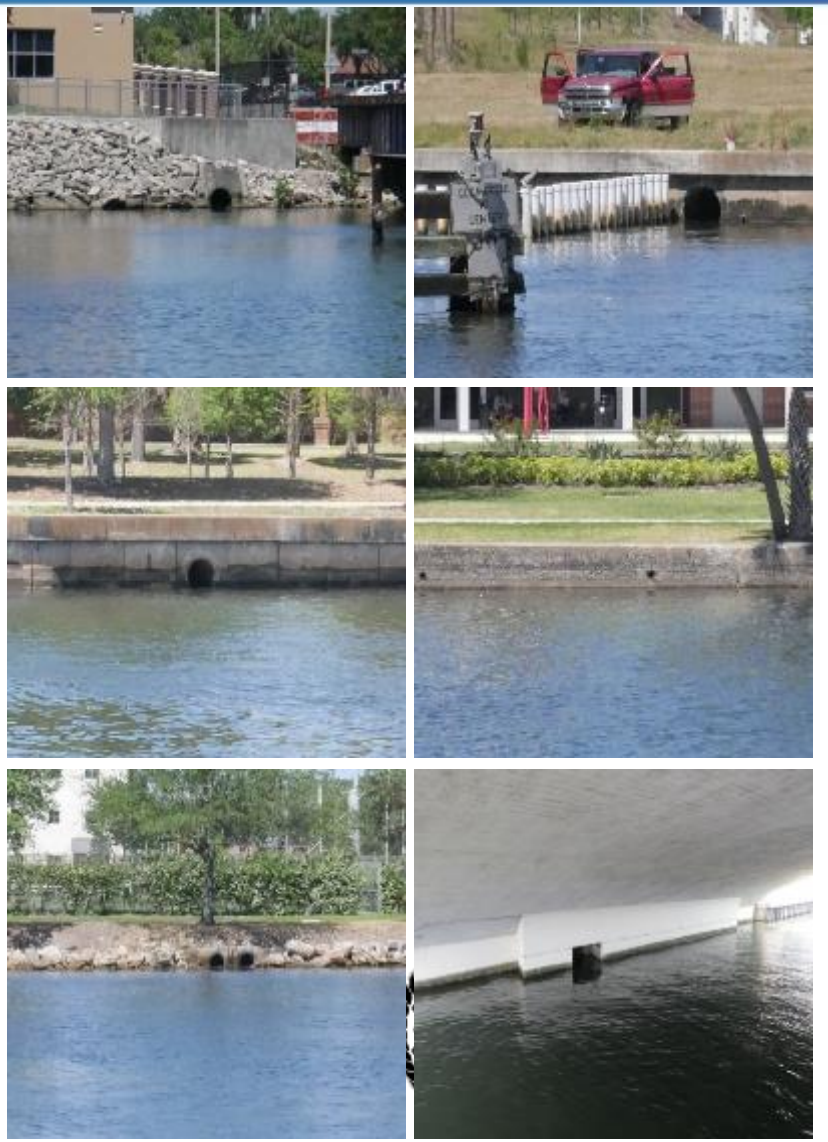
City of Tampa Grant Background

- October 2023 City of Tampa, Applied Sciences, and local surveyor (SurvTech) began work on data collection efforts related to the Davis Islands Stormwater Analysis.

- Objective to perform a Stormwater Analysis for Davis Islands and to provide information regarding existing and future conditions for directing stormwater through drainage systems due to Sea Level Rise (SLR).

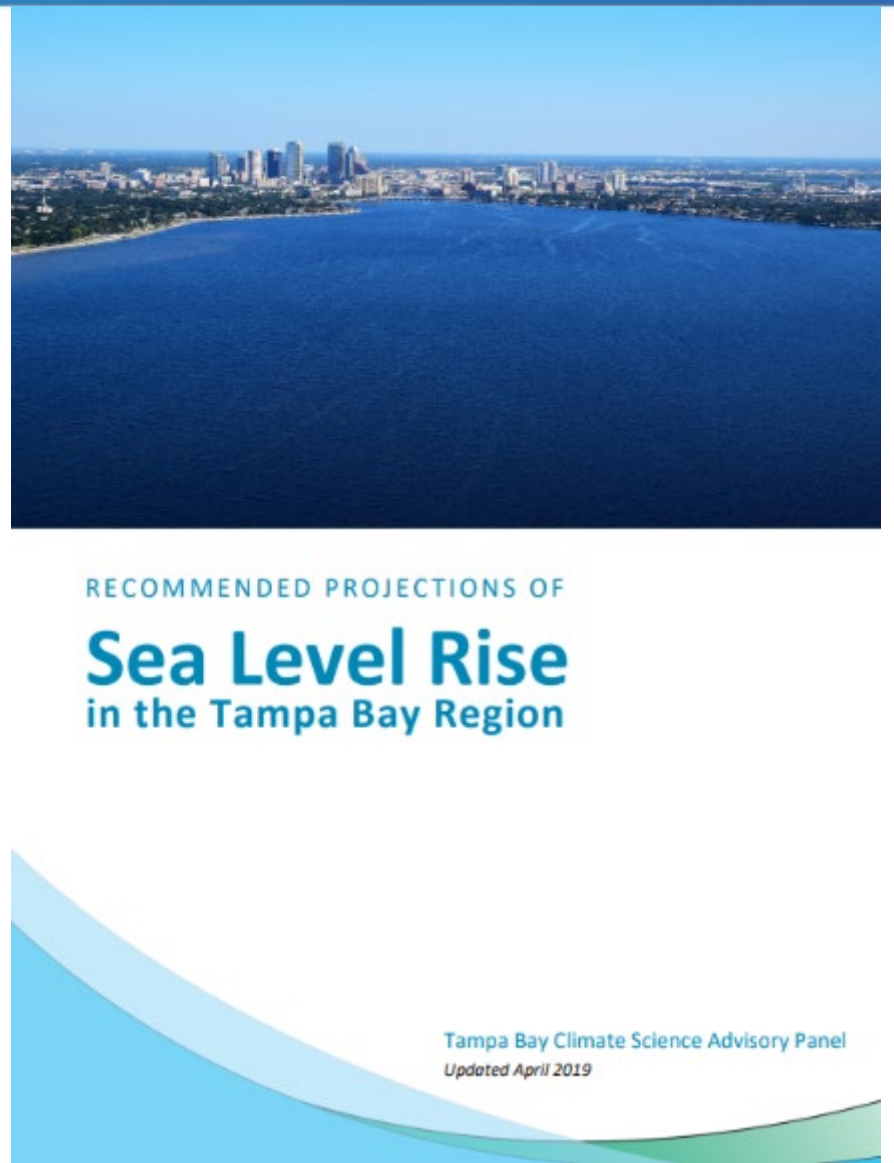
- Analysis focuses on stormwater outfalls on Davis Islands, while providing projections for applying survey/analysis techniques, **citywide**.

- Includes re-addressing adaptation strategies for long-term solutions related to Sea Level Rise and future conditions.

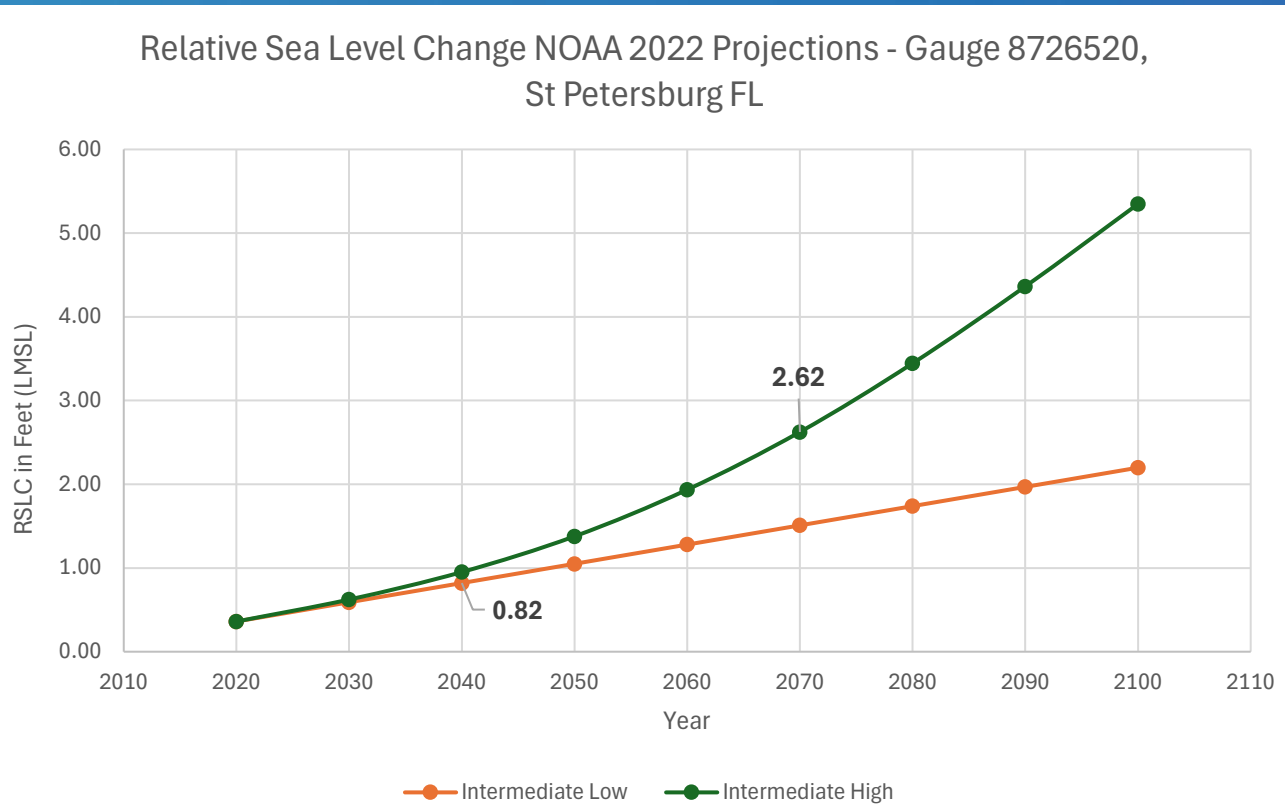


Tampa Bay Climate Science Advisory Panel

- Tampa Bay region can expect to see approximately 0.4 to 0.7 feet SLR by 2040 and between 1.0 to 3.0 feet by 2070
- NOAA “Low” scenario projections should not be used for planning purposes
- Adaptation planning should employ a scenario-based approach that, at minimum, considers location, time horizon, and risk tolerance.



- Updated SLR values based on NOAA 2022 Technical Report
- Vulnerability Assessments consider 2040 and 2070 Sea Level Rise projections associated with the Intermediate Low and Intermediate High scenarios.
- Approximately 0.86 to 2.62 feet of Sea Level Rise by 2040 and 2070, respectively.



Year	Low	Intermediate Low	Intermediate	Intermediate High	High
2020	0.33	0.36	0.36	0.36	0.36
2030	0.52	0.59	0.59	0.62	0.66
2040	0.72	**0.82**	0.89	0.95	1.05
2050	0.92	1.05	1.18	1.38	1.61
2060	1.08	1.28	1.51	1.94	2.36
2070	1.21	1.51	1.90	**2.62**	3.31
2080	1.35	1.74	2.43	3.44	4.49
2090	1.44	1.97	3.05	4.36	5.74
2100	1.57	2.20	3.77	5.35	7.02

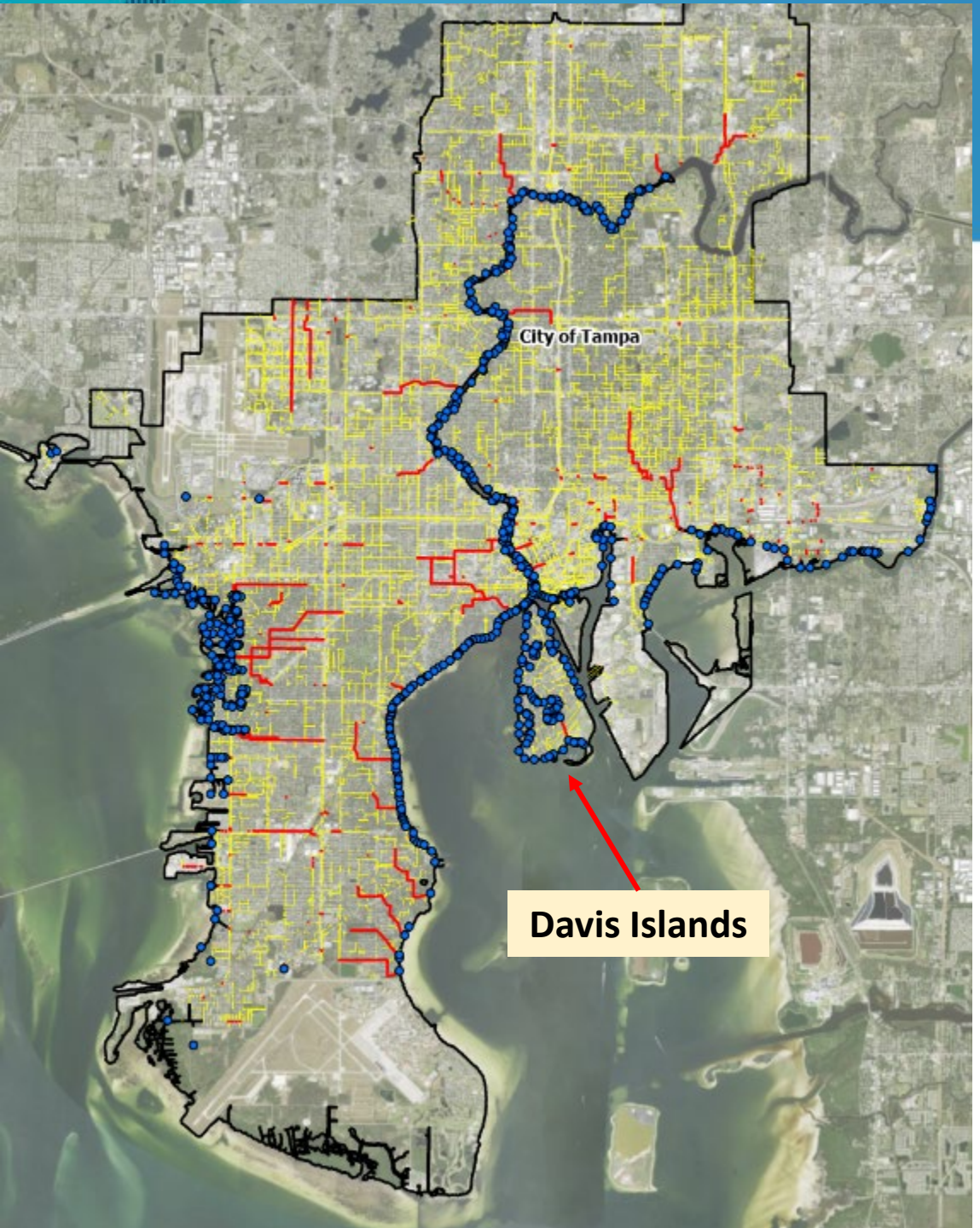
Relative changes compared to baseline conditions for St Petersburg Epoch from 1983 – 2001.

Stormwater Analysis – Davis Islands

- Stormwater analysis approach includes:
  - Stormwater Outfall Locations,
  - Type of Outfall,
  - Digital Elevation Models (DEMs),
  - Sea Level Rise Projections
- Typical stormwater project useful life of 30-50 years.
- NOAA 2070 Intermediate-High Value of 2.62 ft.
- The relative change of 2.62 feet was added to the 1-year Stillwater elevation of 2.0 ft, resulting in a SLR elevation scenario of 4.62 ft.

Year	Low	Intermediate Low	Intermediate	Intermediate High	High
2020	0.33	0.36	0.36	0.36	0.36
2030	0.52	0.59	0.59	0.62	0.66
2040	0.72	**0.82**	0.89	0.95	1.05
2050	0.92	1.05	1.18	1.38	1.61
2060	1.08	1.28	1.51	1.94	2.36
2070	1.21	1.51	1.90	**2.62**	3.31
2080	1.35	1.74	2.43	3.44	4.49
2090	1.44	1.97	3.05	4.36	5.74
2100	1.57	2.20	3.77	5.35	7.02

Stormwater Analysis – Davis Islands



- **How will Sea Level Rise impact the various stormwater outfalls located throughout the City?**

- Pilot Study designated for Davis Islands to better understand existing stormwater outfalls and how they are potentially vulnerable due to sea level rise and future conditions.

Davis Islands Overview

- Approximately 80 stormwater outfall pipes

Davis Islands Outfall Survey

Hydro_Code	Pipe_Length	Span	Rise	Material	Geo_Type
231204011	191	15	15	Changes	Circular

Notes

None

- Survey of stormwater outfall pipes
- Collection of important parameters including:
  - Pipe Length
  - Pipe Span (inches)
  - Pipe Rise (inches)
  - Material Type (Concrete, Corrugated Metal, PVC, etc.)
  - Geometry (Circular, Elliptical)
  - Upstream and Downstream Inverts
  - Photos of Outfall Pipe

Davis Islands Outfall Survey

Davis Islands Outfall Survey

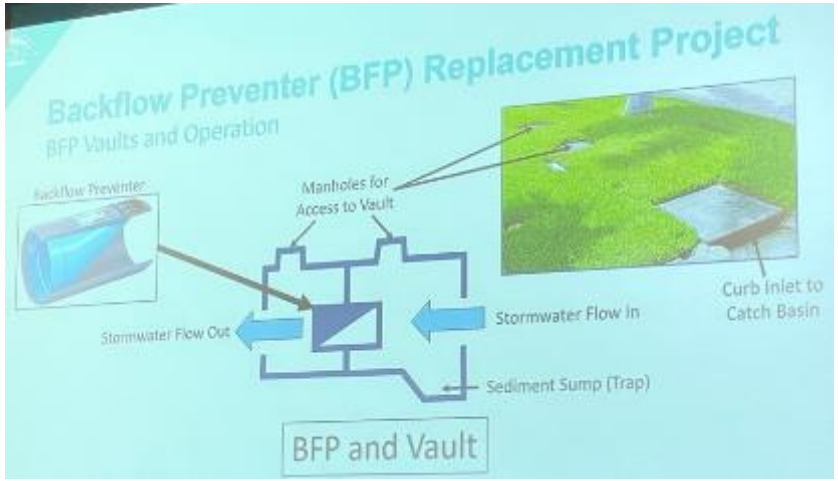
Tidal Gates and Backflow Preventors

- Low lying areas around 4 to 4.5 feet (elevation); similar to projected 2070 tidal conditions
- Possibility for tidal waters to backflow through the stormwater system into streets without additional rainfall

Tidal Gates and Backflow Preventors

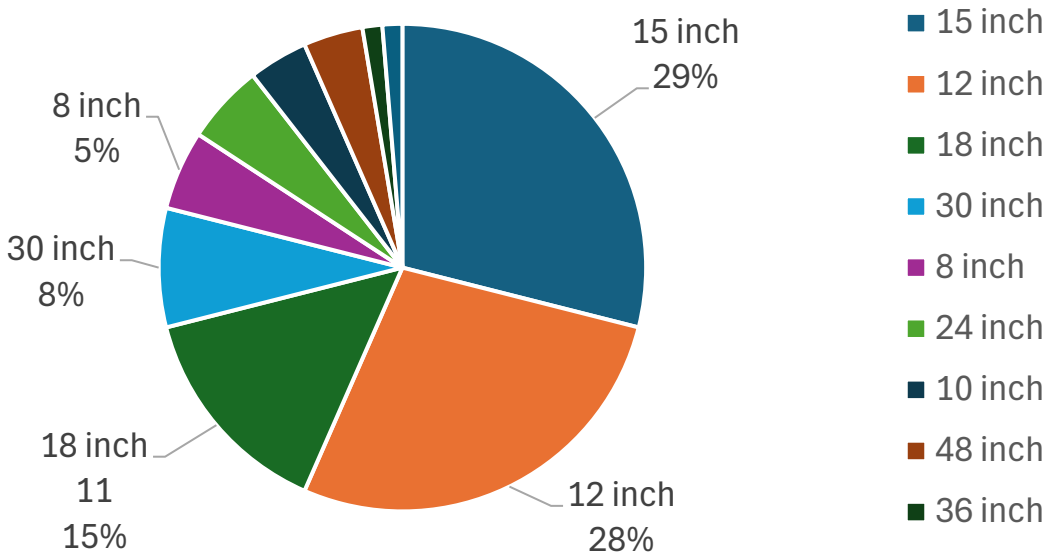
- **Duckbill (low pressure)** vs Flap Gate (high pressure, structurally more robust, handles debris better)
- Coordination for lacking easements associated with existing outfall pipes that connect to City infrastructure
- Recent efforts in St Pete to install/replace backflow preventors to address sunny day flooding

Shore Acres, St Petersburg, April 2024



Tidal Gates and Backflow Preventors

- For high tides around 3.2 NAVD88-ft, Davis Islands is relatively unaffected
- Combination of heavy rainfall and high tides can cause temporary street flooding
- Backflow preventors/duckbills could be placed on the lowest lying stormwater outfall pipes
- Potential for upstream flooding from lack of head pressure → Continued monitoring and proactive maintenance

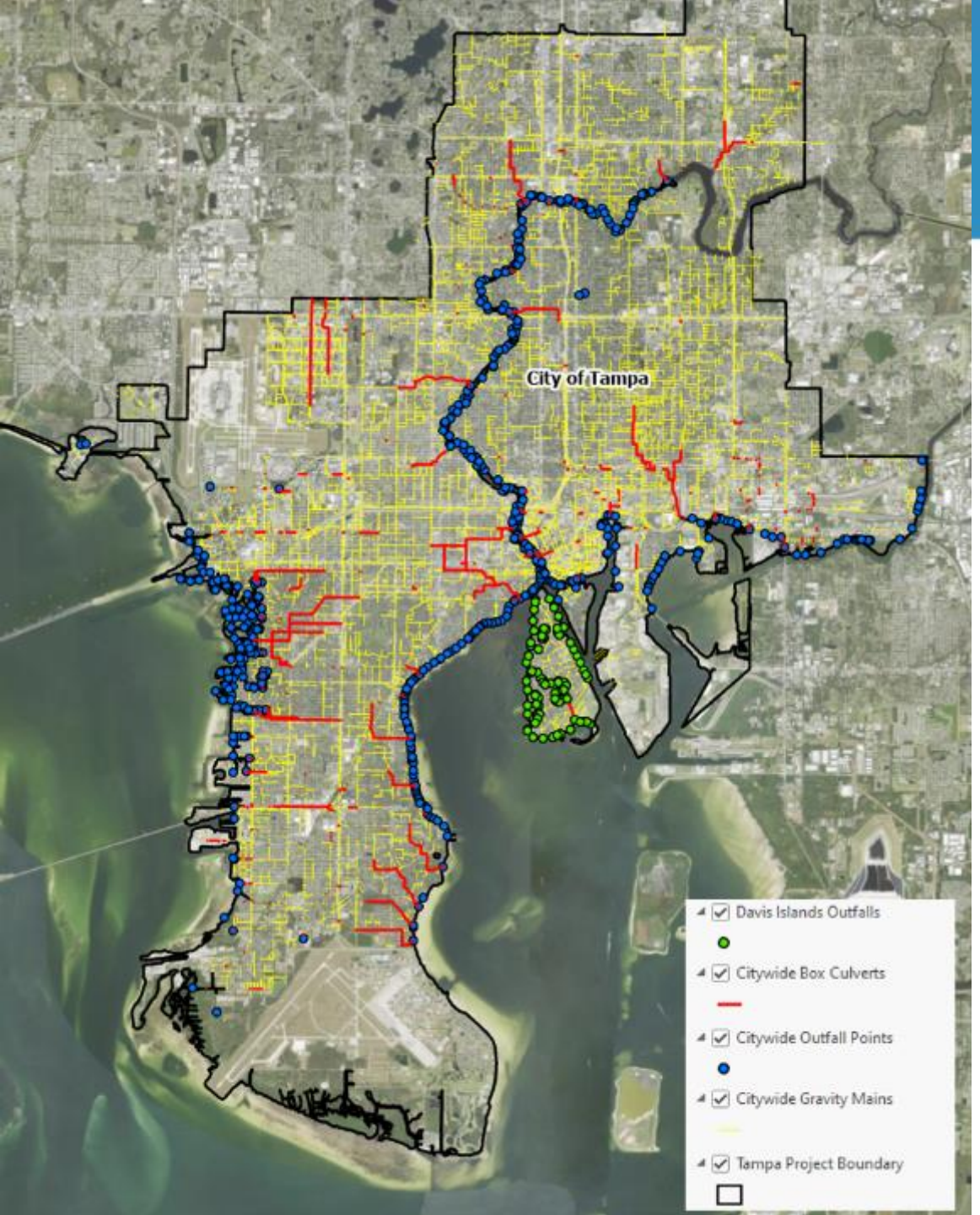


- Pipe Diameter Distribution
- Majority of pipes on Davis Islands are between 12 to 18 inches (~70 percent)
  - Ideal sizes for duckbill applications
  - ~ 10-year service life

Overland Low Points of Entry

- Approximate analysis of terrain elevations surrounding Davis Islands
- Overland flow from tidal waters impacting streets/structures, independent of stormwater management system
- Better understanding of seawall elevations and which tidal elevations will cause inland flooding through overtopping existing shorelines

Extension to Citywide Outfall Survey

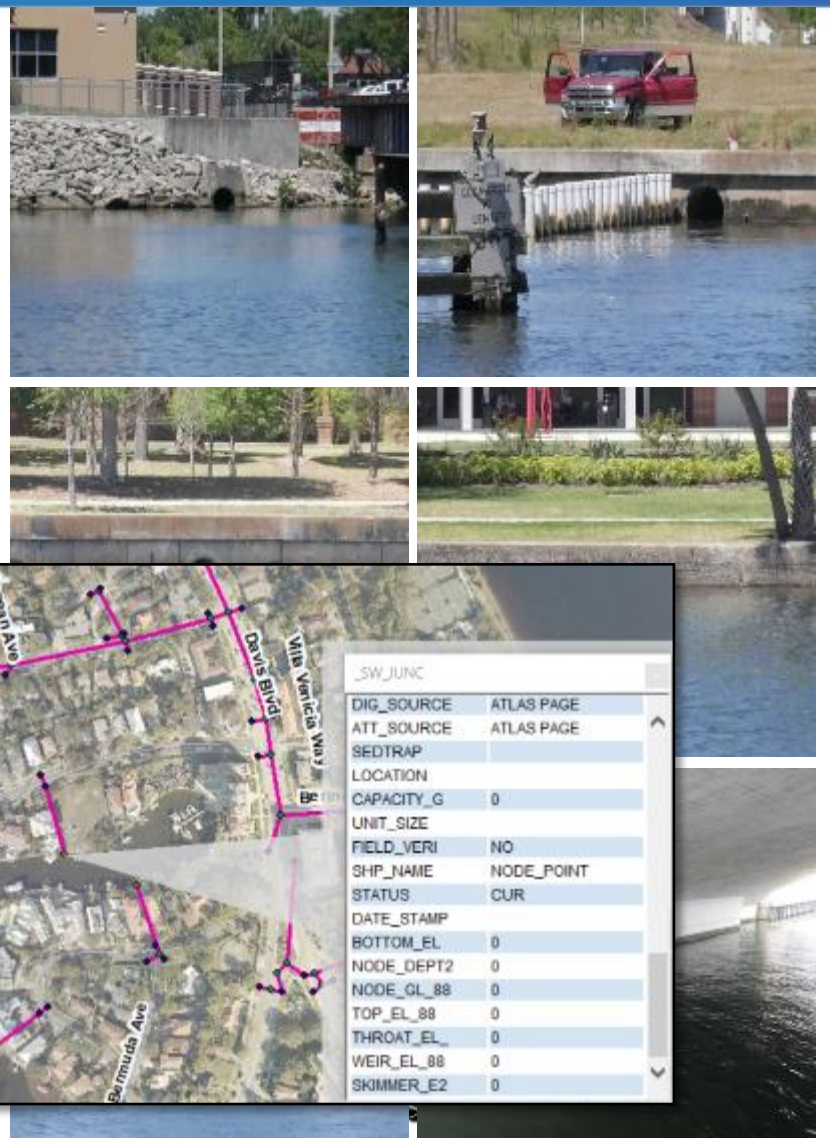


- Additional 540 outfalls exist along gravity mains and box culvert outfalls
- Approximately 12 months and budget of $400,000 to collect additional outfall pipes

Citywide Guidelines and Recommendations

Stormwater Outfall Inventory

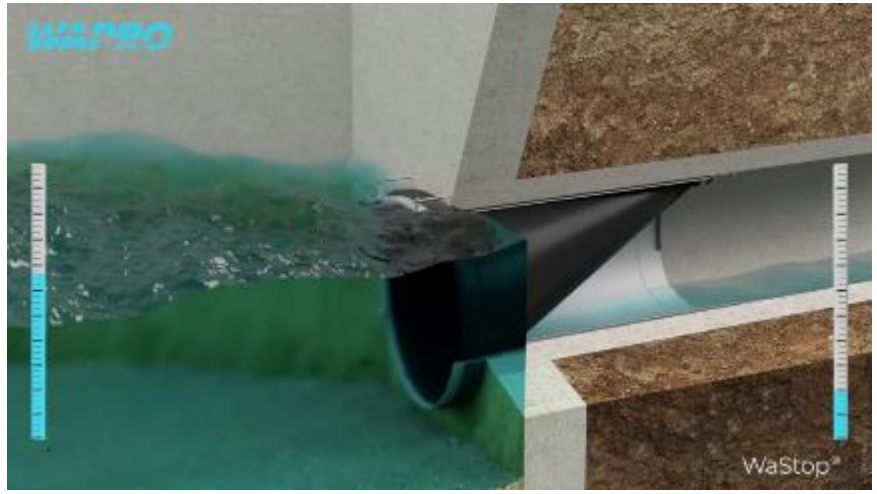
- A more robust inventory with verified outfall sizes, material, and condition – **Citywide Collection**
- Assists in confirming vulnerable locations where backflow preventors may assist with meeting stormwater and roadway level of service



Citywide Guidelines and Recommendations

Backflow Preventors for Lowest Lying Pipes

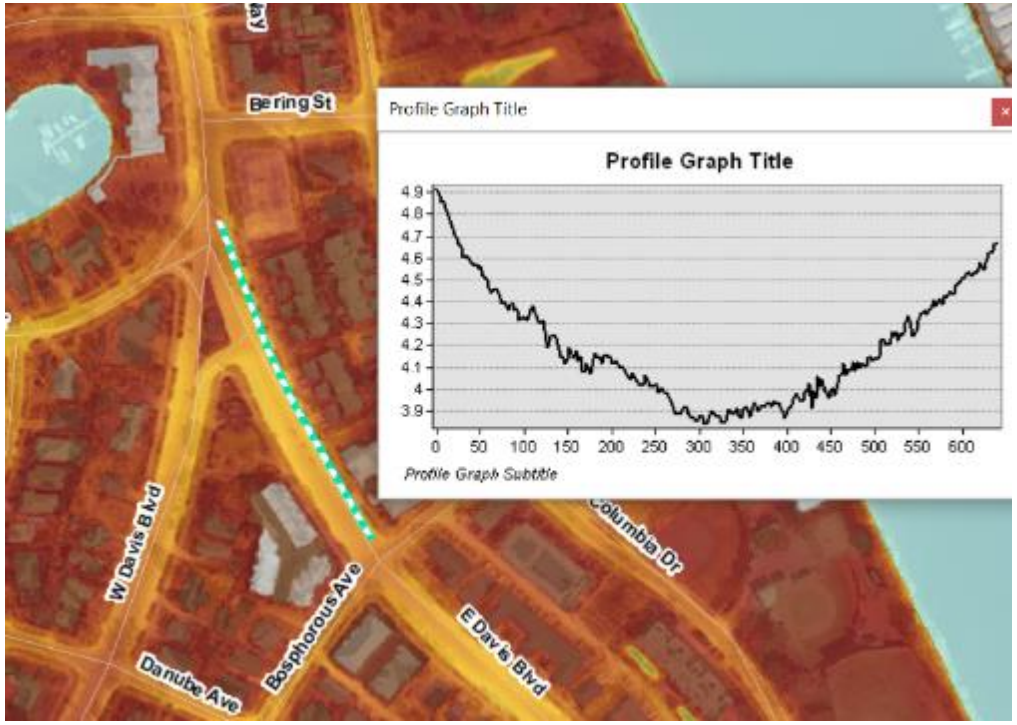
- Use of duckbill backflow devices for smaller diameter pipes
- Low pressure requirement, no moving parts, self sealing, and corrosion resistance
- ~10-year service life



Citywide Guidelines and Recommendations

Minimum Roadway/Sea Wall Elevation Criteria

- Minimum roadway elevation Design Criteria for future transportation capital projects
- Protect both road surfaces and subbase from damages due to elevated water table conditions
- Meet level of service by keeping roads fully operational and safe for traffic.
- Reduce flooding from overtopping sea wall elevations



Citywide Guidelines and Recommendations

Seawall Ordinance

- Review and evaluate benefits of a seawall ordinance that accounts for future SLR conditions and sets consistent city-wide standards.
- Assess current and proposed Seawall Ordinances from similar communities.

City of Miami	Broward County
6'NAVD and 8' NAVD SLR by 2070	Prior to 1/1/2035 = 4' but must accommodate 5' by 1/1/2050
Substantial Repairs can trigger compliance; 50% length, repairs > 50% cost of new seawall or BH or elev. change > than 50% length	Substantial Repairs can trigger compliance; > 50% length or appurt. structure > 50% value
Defines disrepair	Defines disrepair
Specifies materials; Promote living shorelines	Promote enhancing habitat
POs are prohibited from tidal water entering property to flow to adjacent properties or public ROW	POs are prohibited from tidal water entering property to flow to adjacent properties or public ROW (trespass of water = public nuisance)
Code enforcement + initiate abatement w/in 180 days and begin repairs w/in 265 days; complete in 18 months	Failure to maintain = violation; progress within 60 days and complete w/in 265
	Allows automatically elevated structure not dependent on human intervention
Source: Erin L. Deady, PA	Disclosure on tidally influence area and meeting min. barrier elevation stds.

Citywide Guidelines and Recommendations

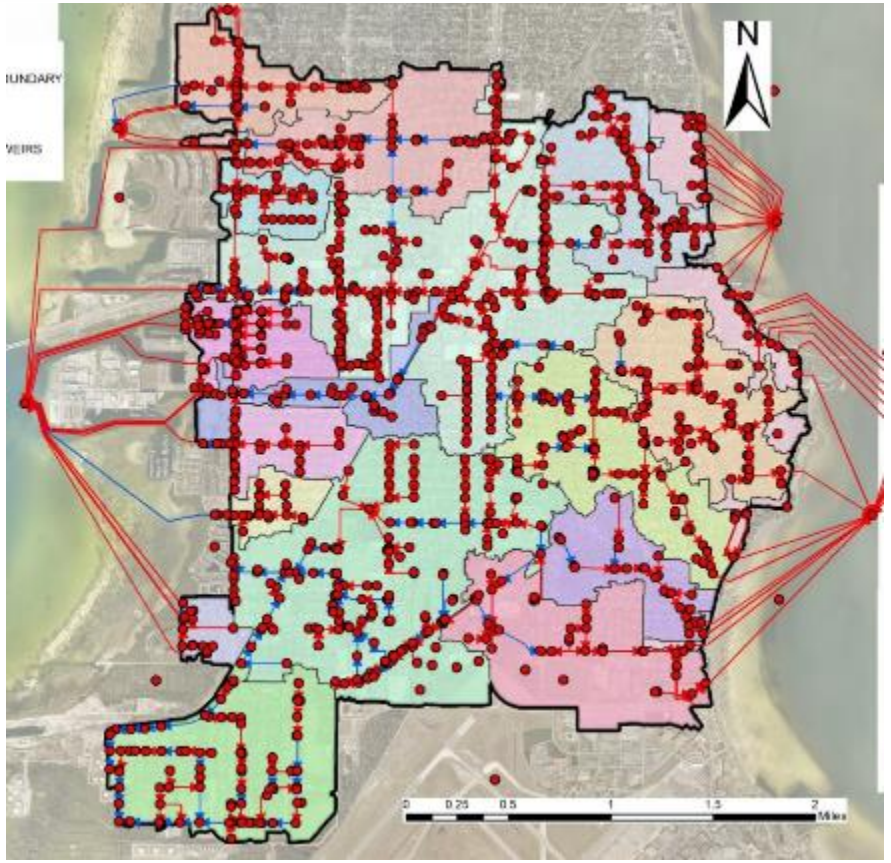
Outreach Efforts and Educational Workshops

To improve general public awareness and assist design professionals with adherence to flood resilient design and construction practices

Citywide Guidelines and Recommendations

Continue Development of Hydrologic and Hydraulic Models

Continue the development of Citywide comprehensive hydrologic and hydraulic models with a priority on areas with tidal outfalls subject to SLR.



Lower Peninsula Watershed Model, City of Tampa

December 5, 2024

COMPREHENSIVE STORMWATER AND SEA LEVEL RISE MANAGEMENT

2024 FSA Winter Conference

APPLIED SCIENCES

City of Tampa Florida