



Stormwater Master Planning: Embracing Technology and Resilience

May 9, 2024
10:30 a.m. – 11:30 a.m. (Eastern)

www.florida-stormwater.org



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Civil Engineering
Watershed Planning
Urban Design
Resiliency Strategies



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Resilient Martin

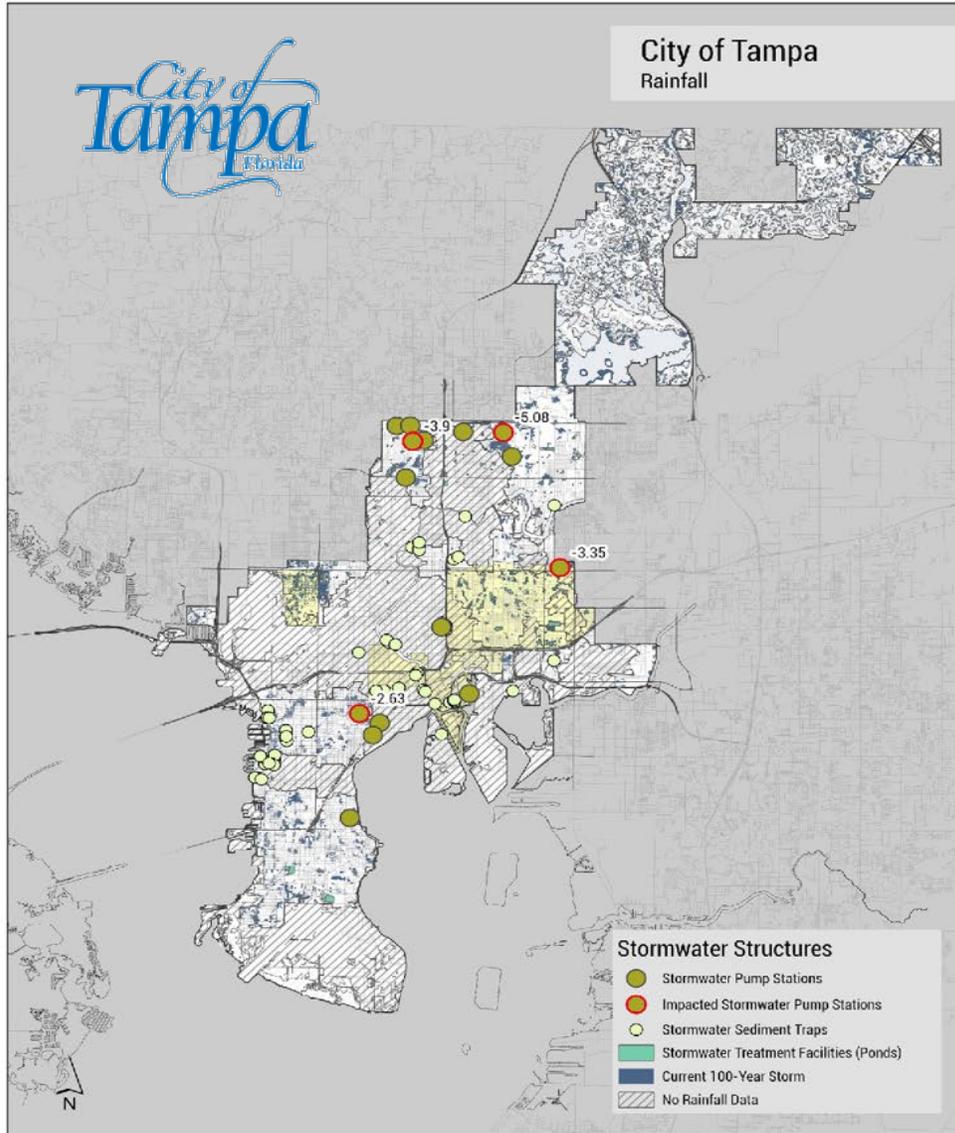


FIGURE 17: FIGURE 21: STORMWATER ASSETS WITH FUTURE STORM SURGE SCENARIOS.

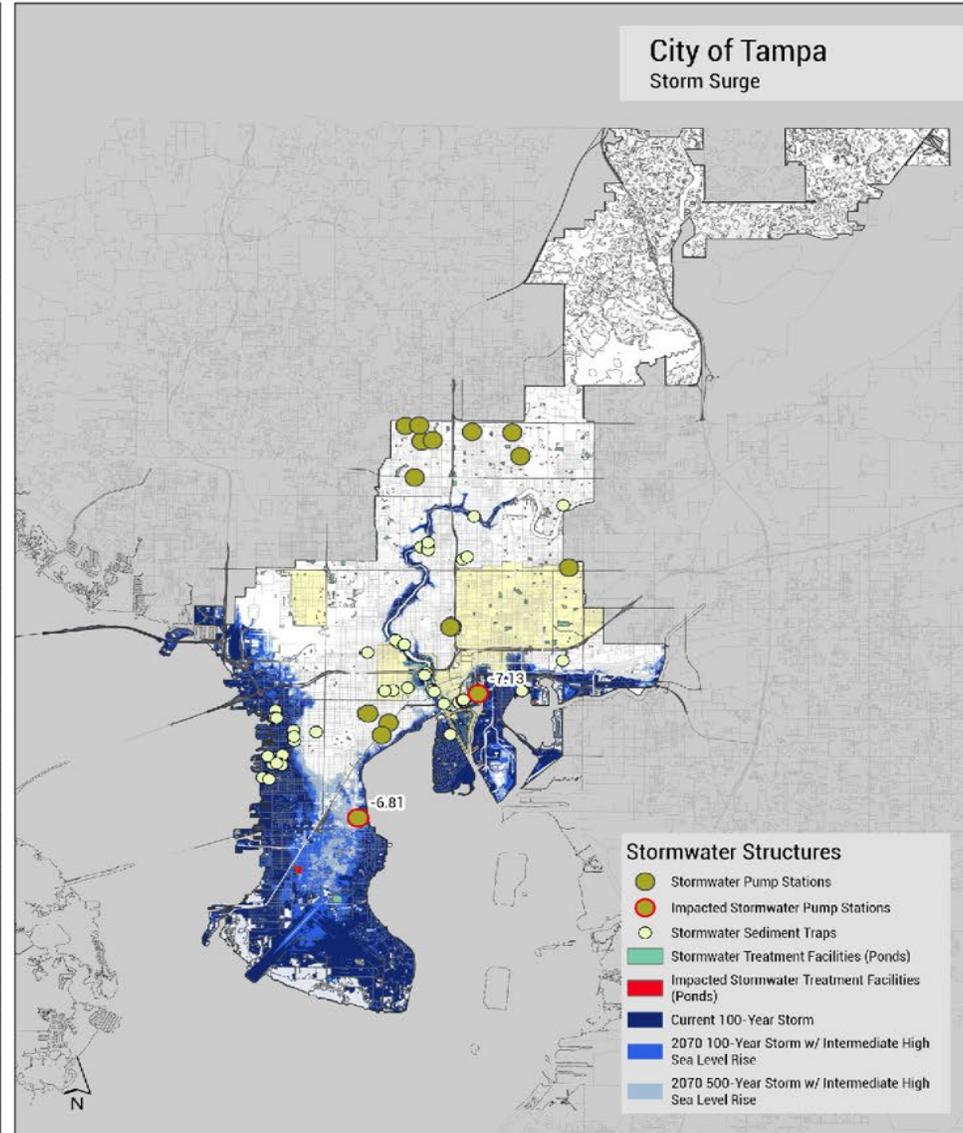


FIGURE 18: FIGURE 20: STORMWATER ASSETS WITH FUTURE RAINFALL SCENARIOS.



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Civil Engineering
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Resiliency Strategies



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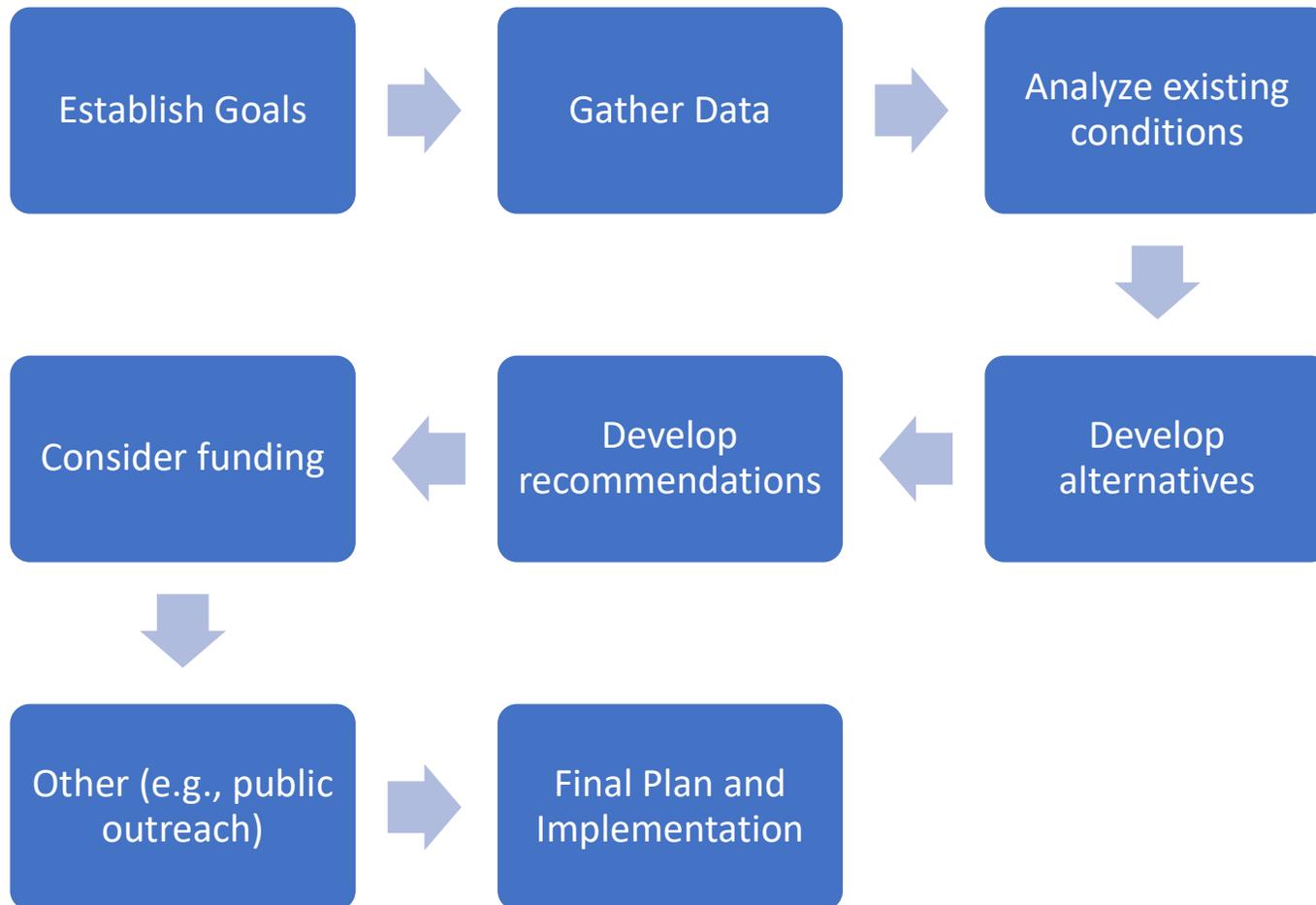


Stormwater Master Planning: Embracing Technology and Resilience

May 9, 2024

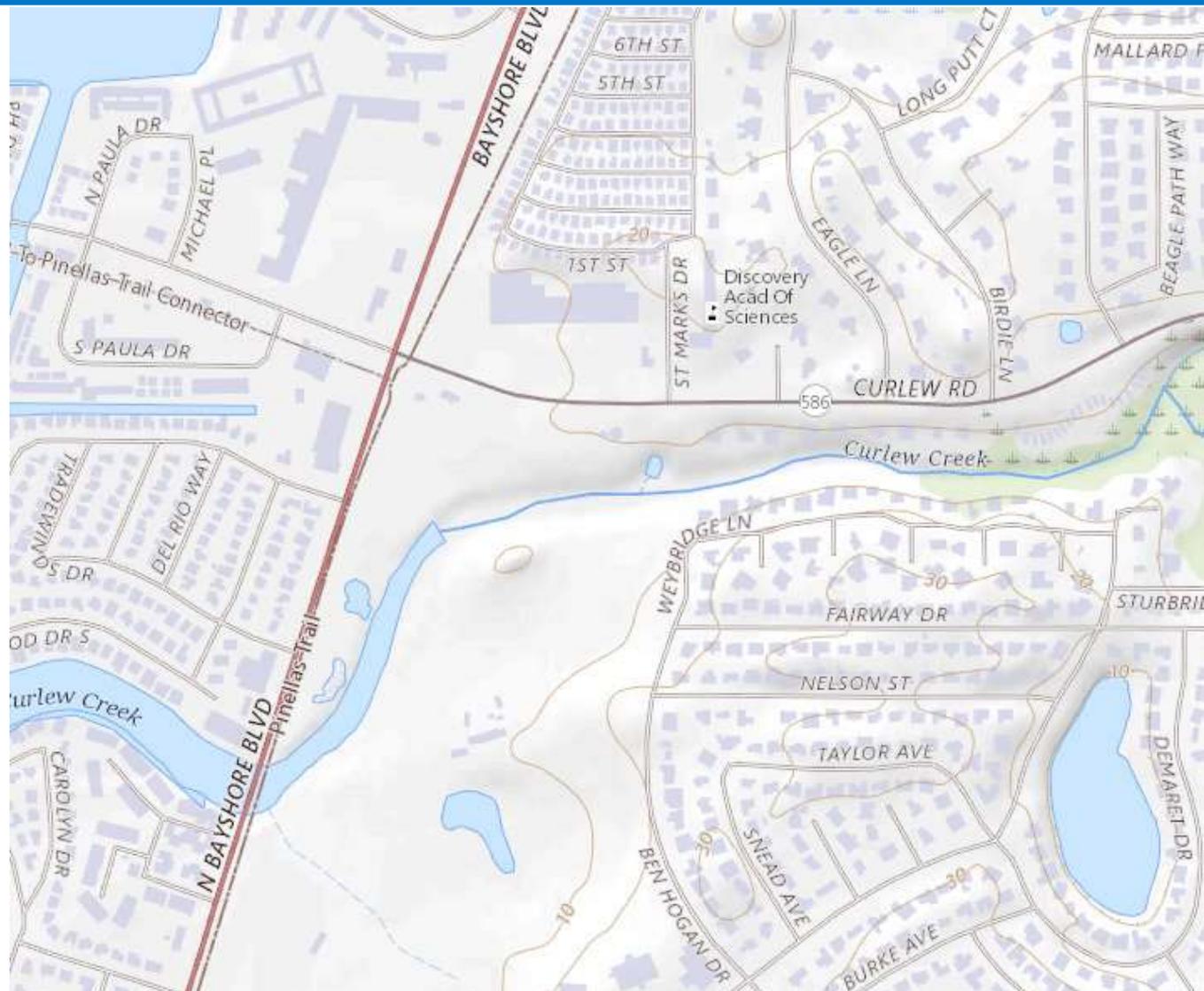
FSA Webinar

General Approach to Planning



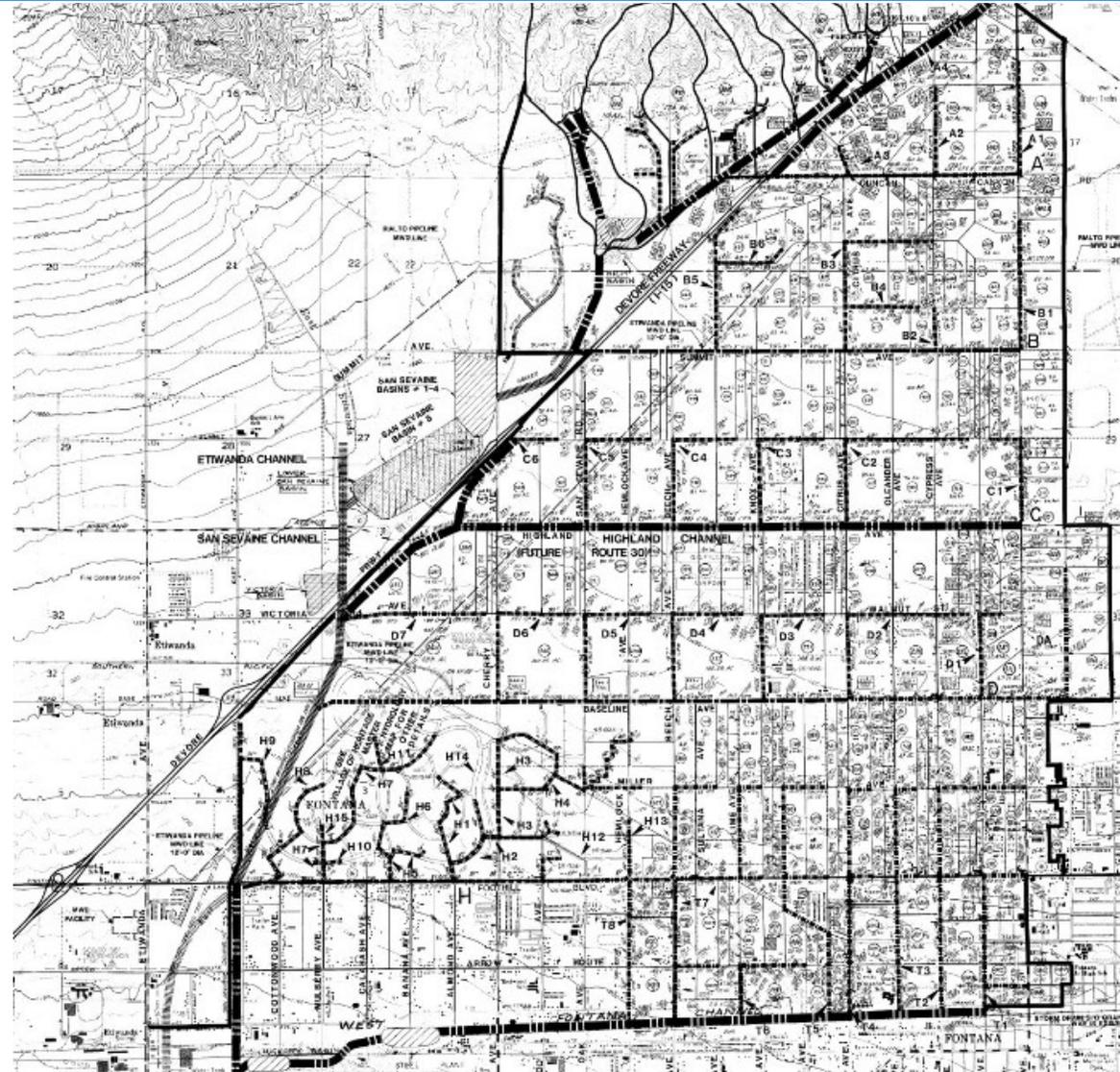
Historical Context of Stormwater Master Planning (Terrain Data)

- USGS contours
- 1- or 2-foot photogrammetry
- Field verification



Historical Context of Stormwater Master Planning (Asset Data)

- Hardcopy maps
- Limited attribute data



Historical Context of Stormwater Master Planning (Water Quantity Approach)

- Coarse level of detail
- Larger conveyances
- Difficult to keep current
- Future land use
- Future climate conditions not considered



Workers walk out of the excess stormwater at the entrance of the Robin Lane Neighborhood. It took more than two days to make the road accessible. (Grace King / WUFT News)

Historical Context of Stormwater Master Planning (Water Quality Data)

- National Urban Runoff Program (NURP) data
- Limited studies
- Sparse receiving water data



United States
Environmental Protection
Agency

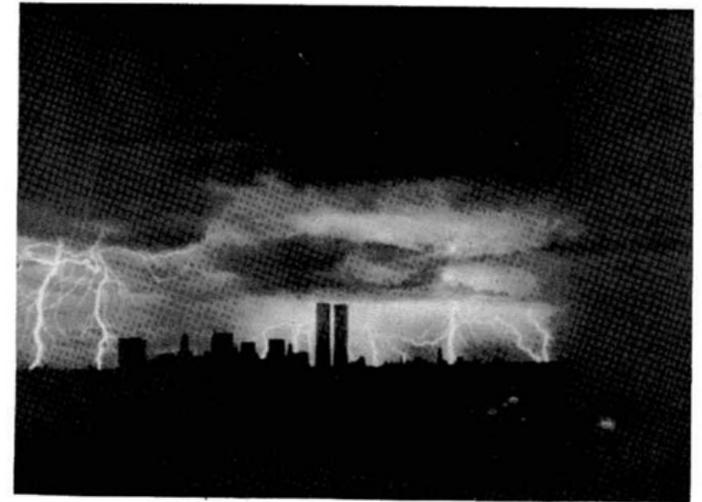
Water Planning Division
WH-554
Washington, DC 20460

December 1983

Water

Results of the Nationwide Urban Runoff Program

Volume I - Final Report



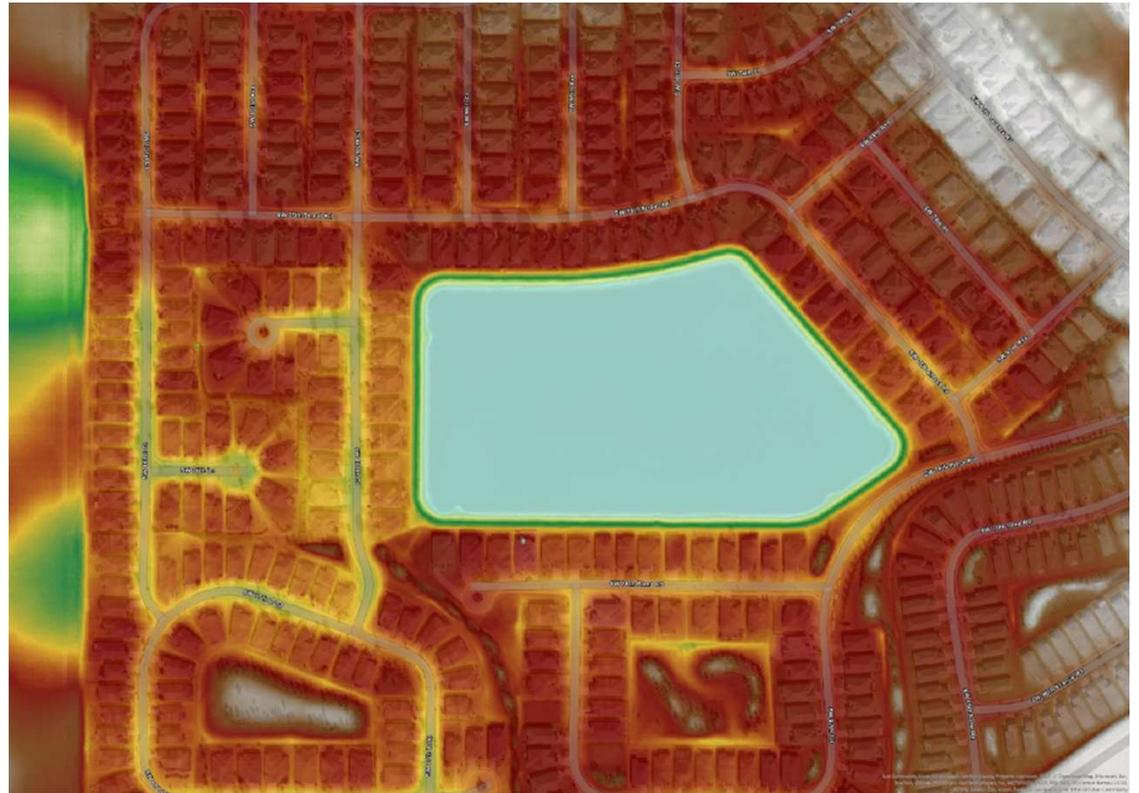
Historical Context of Stormwater Master Planning (Water Quality Approach)

- Coarse scale
- Difficult to verify



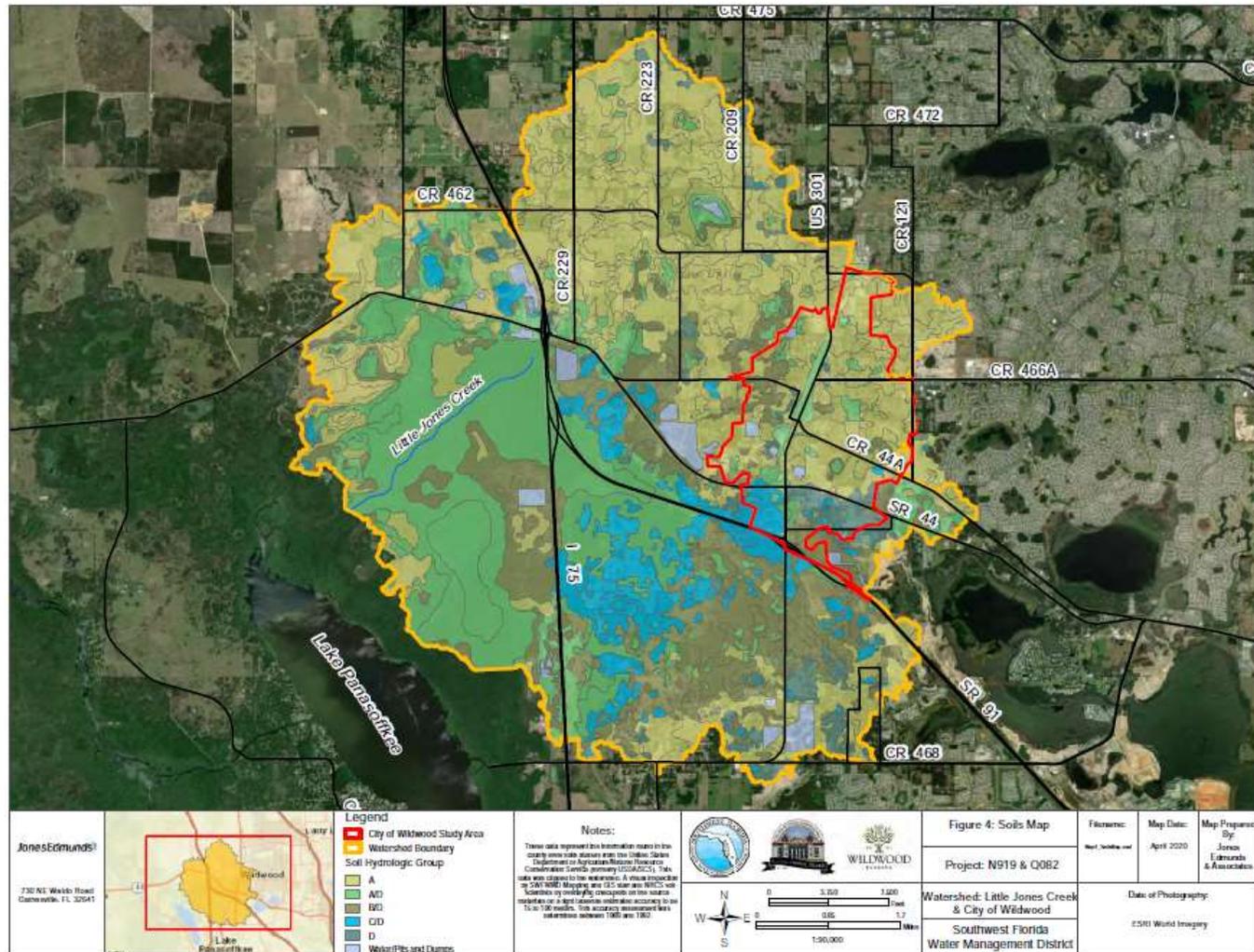
Present Innovations in Stormwater Management (Terrain Data)

- High point density
- Canopy penetration
- Supports detailed analysis
- Feature extractions



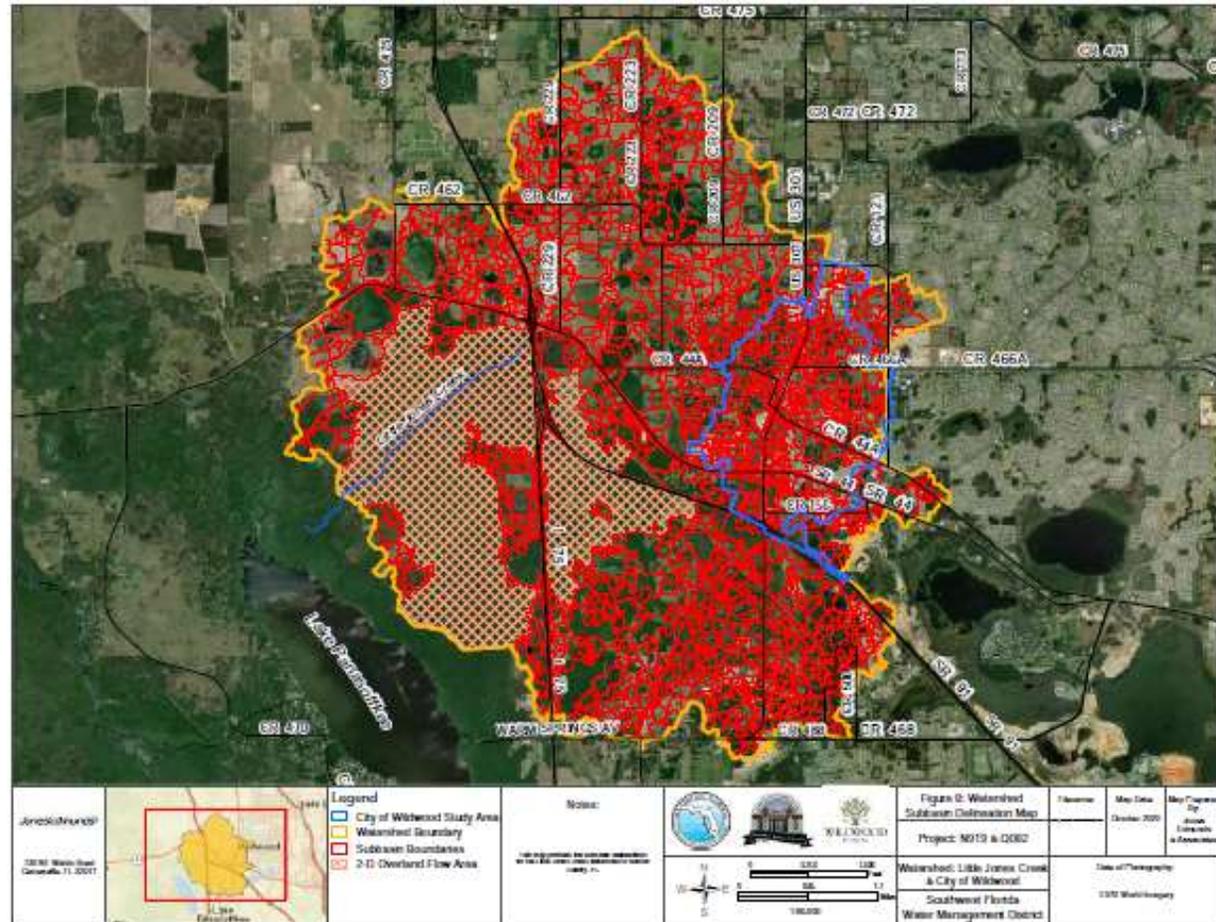
Present Innovations in Stormwater Management (Asset/GIS Data)

- More complete spatially
- More complete attributes
- More complete GIS data (e.g., SSURGO)



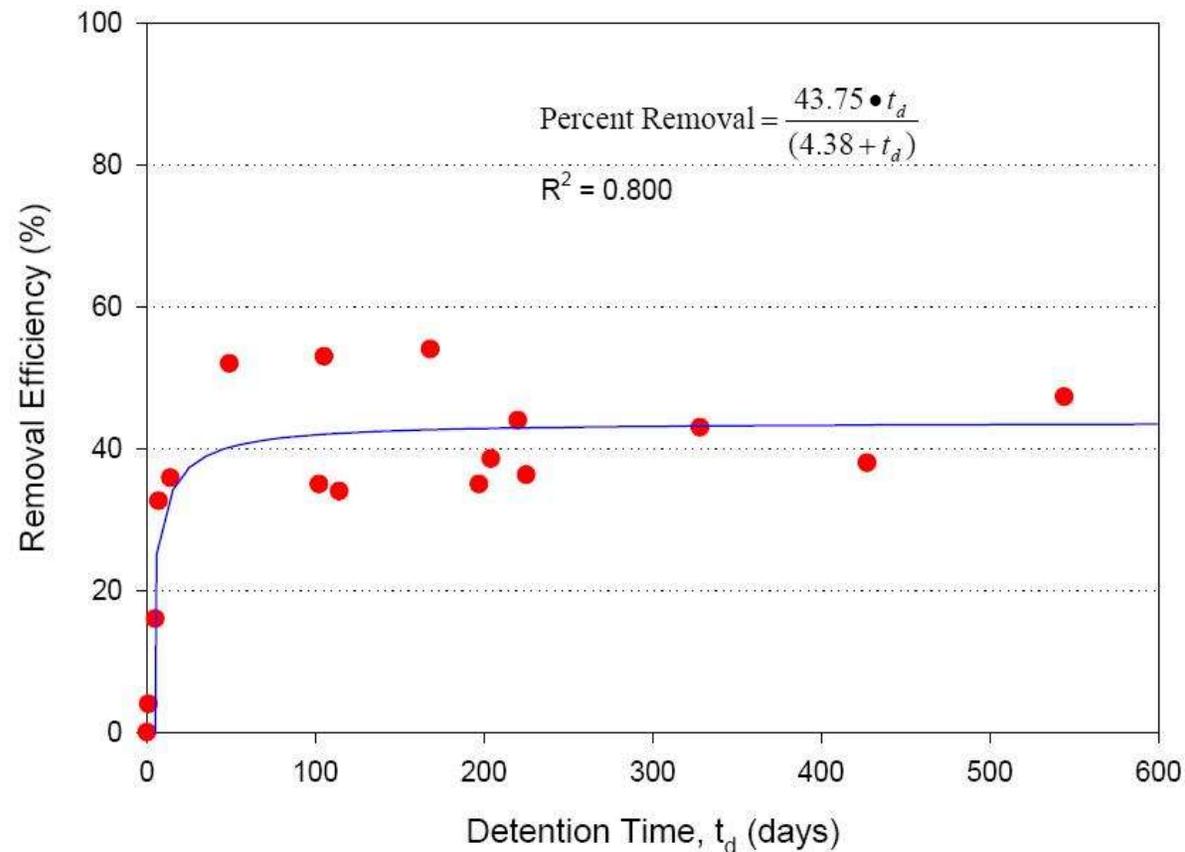
Present Innovations in Stormwater Management (Water Quantity Approach)

- Increased automation
- More QC
- High level of detail
- Increased transparency
- Updates more focused on GIS data



Present Innovations in Stormwater Management (Water Quality Data)

- NPDES Phase I monitoring
- Decades of BMP research
- Increased confidence in predictions
- 1999 Consent Decree and TMDL Program

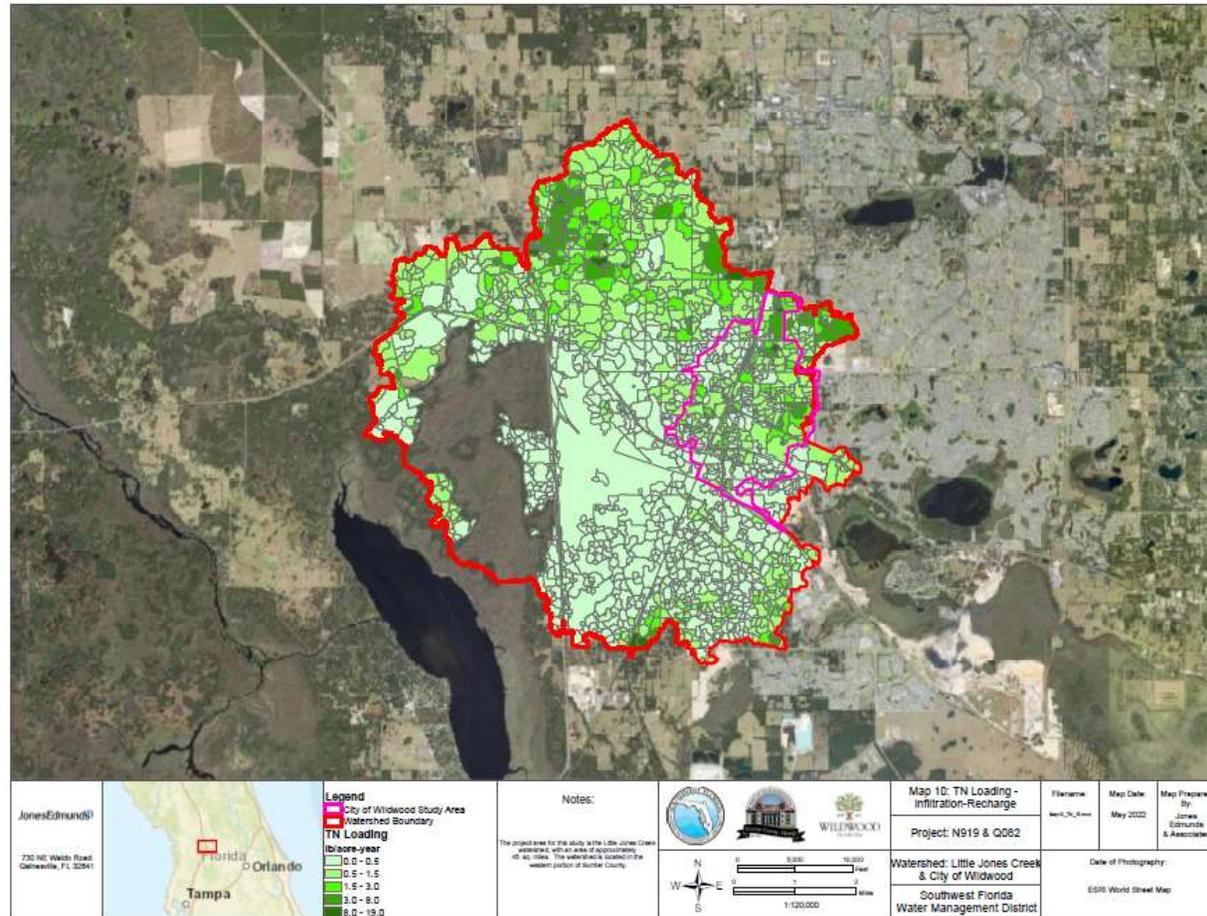


Source: Evaluation of Current Stormwater Design Criteria within the State of Florida (Harper and Baker, 2007)

Figure 5-10. Removal Efficiency of Total Nitrogen in Wet Detention Ponds as a Function of Residence Time.

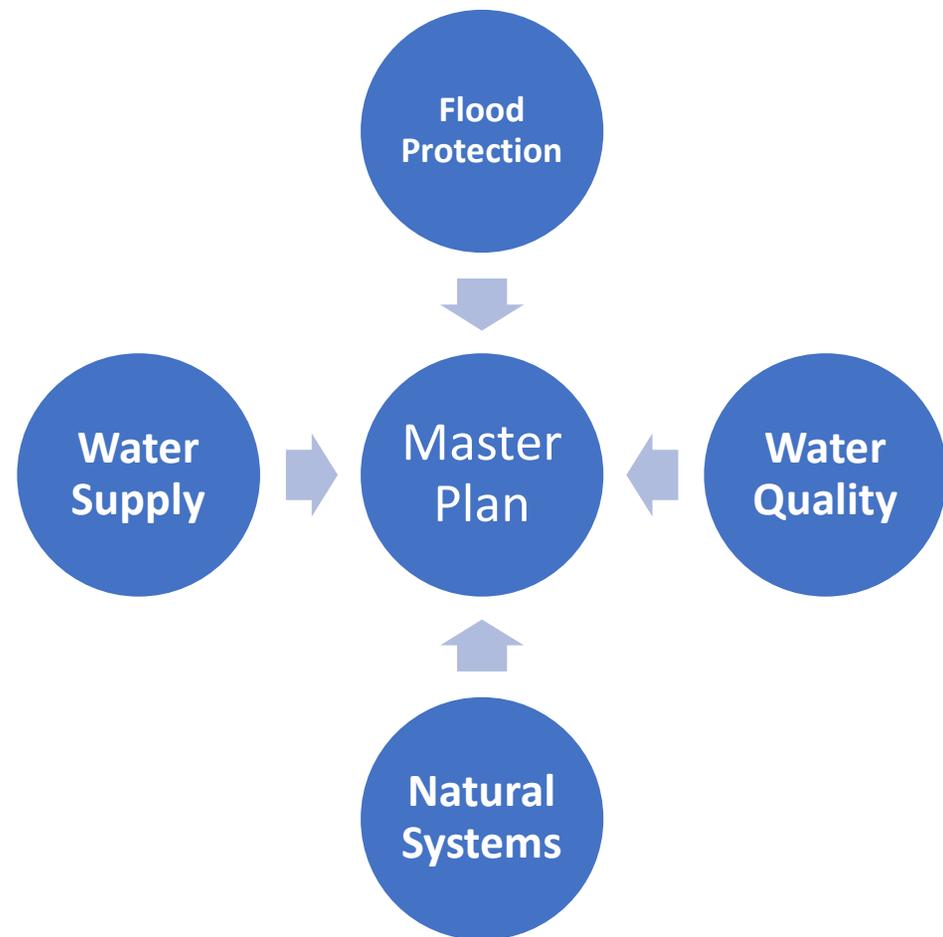
Present Innovations in Stormwater Management (Water Quality Approach)

- Affordable approach
 - SIMPLE, SWIL, etc.
- Focus improvements
- Focus on total loads
- Updates more focused on GIS data



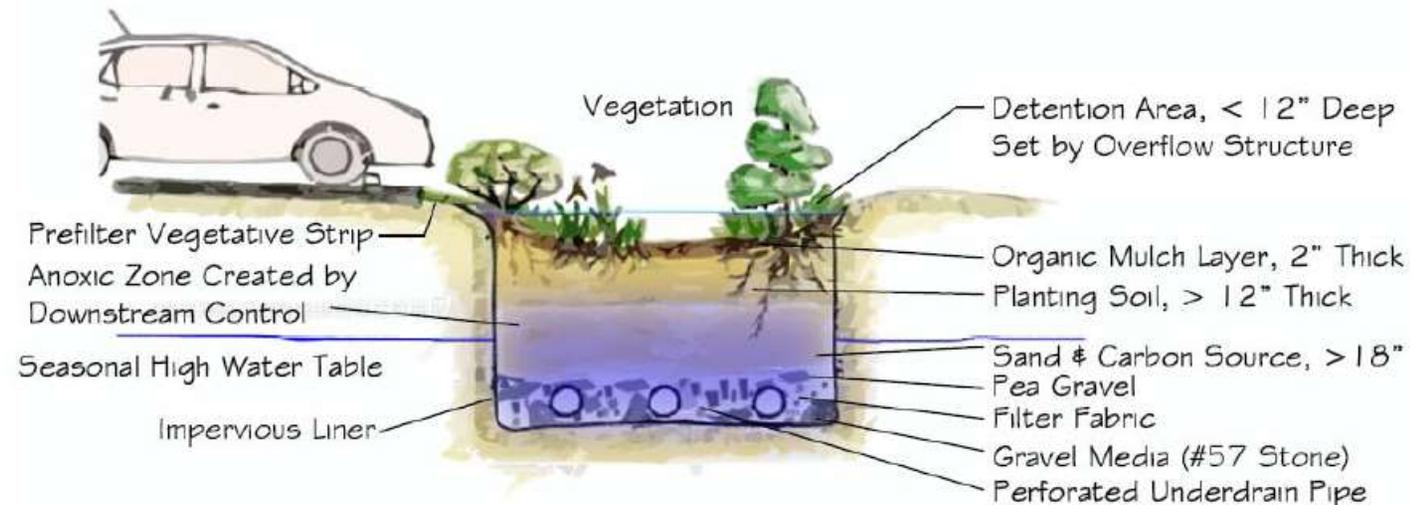
Present Innovations in Stormwater Management (One Water Approach)

- One Water Approach
- Prioritizing projects with different Areas of Interest



Present Innovations in Stormwater Management (BMPs)

- Limited number of conventional BMPs
- Green stormwater infrastructure, media, etc.



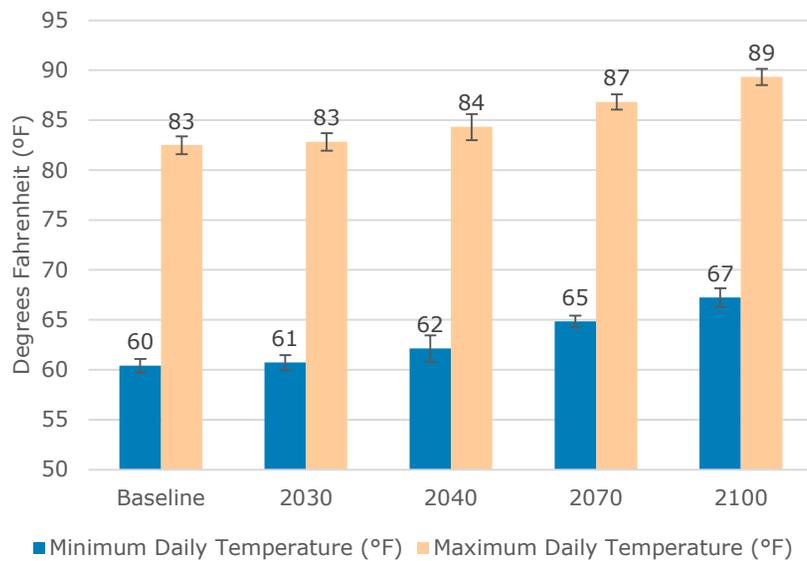
Future Innovations in Stormwater Management



- Changing rainfall patterns
- Sea level rise
- Improving water quality
- Managing water supply
- Resilience
- Urbanization
- Aging infrastructure
- Socioeconomic factors
- Technology

Future Innovations in Stormwater Management – Climate Change

- Increasing global temperatures
- Impacts on stormwater planning and management?



Future Innovations in Stormwater Management – Climate Change

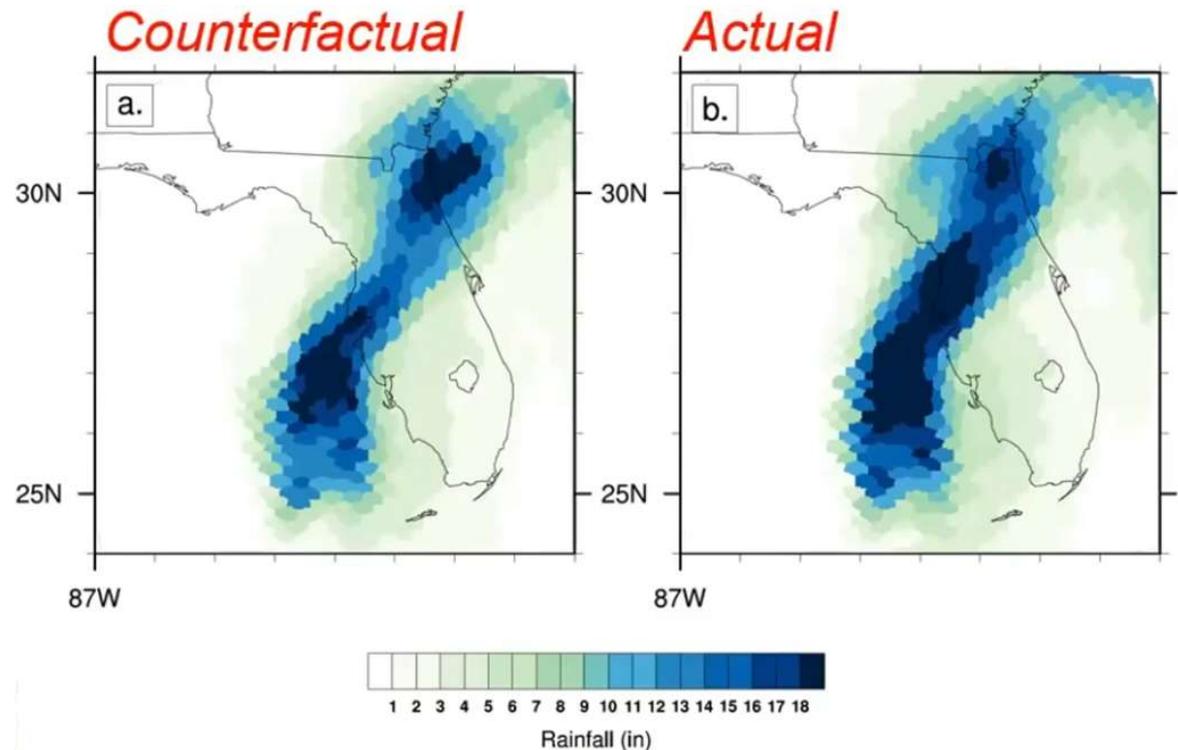
- Increasing global temperatures
- Impacts on stormwater planning and management?
 - Changing rainfall



Hurricane Ian
-10-20 inches rainfall
-\$112 Billion in damages

Future Innovations in Stormwater Management – Climate Change

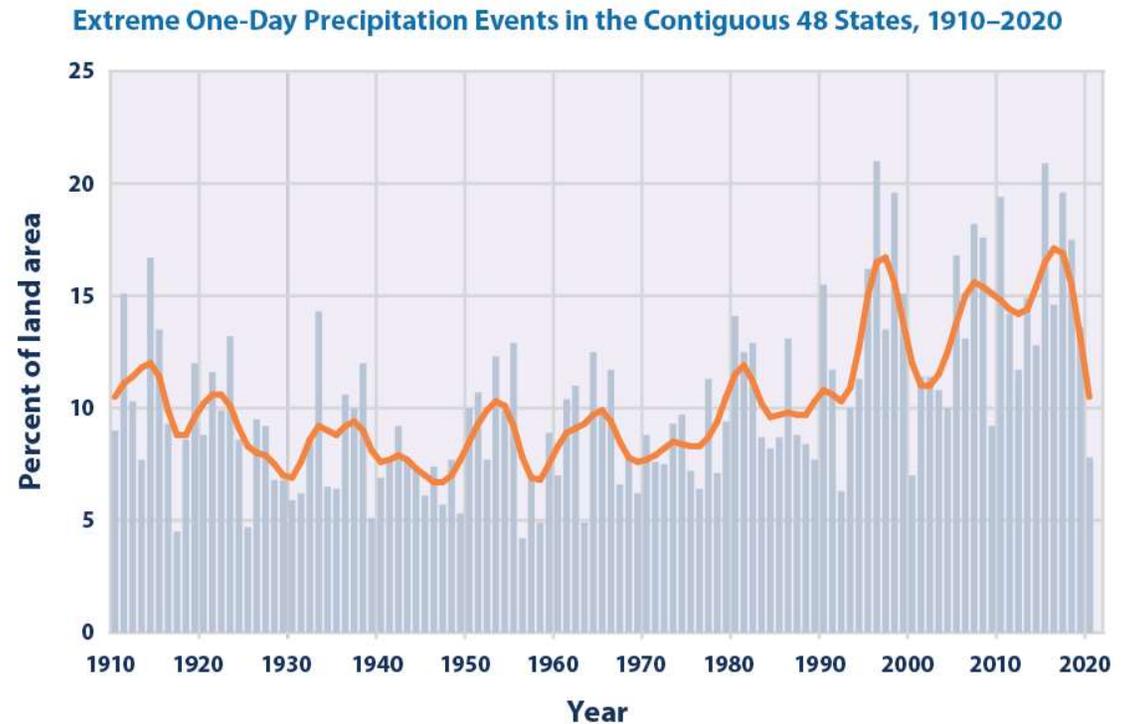
- Increasing global temperatures
- Impacts on stormwater planning and management?
 - Changing rainfall
 - Hurricane Ian 18% less rainfall without climate change



Dr Michael F. Wehner – Lawrence Berkley National Laboratory – Presentation 2023 Southwest Florida Climate Summit

Future Innovations in Stormwater Management – Climate Change

- Non-stationarity



Data source: NOAA (National Oceanic and Atmospheric Administration). 2021. U.S. Climate Extremes Index. Accessed January 2021. www.ncdc.noaa.gov/extremes/cei.

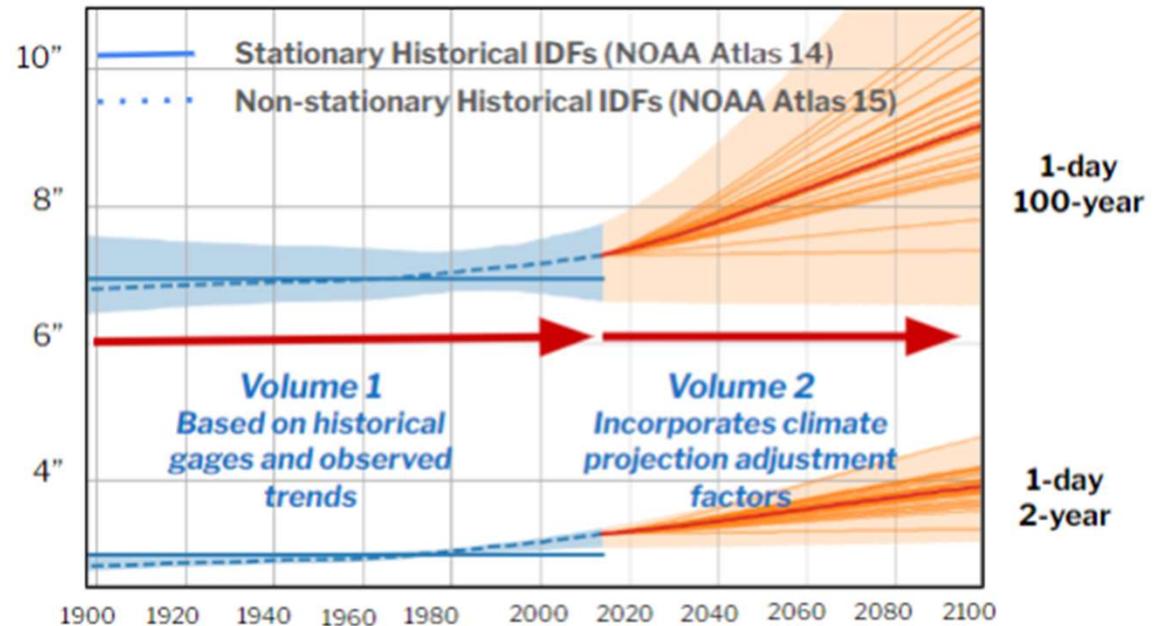
For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at www.epa.gov/climate-indicators.

Future Innovations in Stormwater Management – Climate Change

- Non-stationarity
- NOAA Atlas 15
- Change factors
- Preliminary Report 2025
- Final Report 2026
- 2022 FLOODS Act
 - NOAA Precip. Freq. Atlas of the US
 - Update every 10 years

NOAA Atlas 15

New National Precipitation Frequency Standard

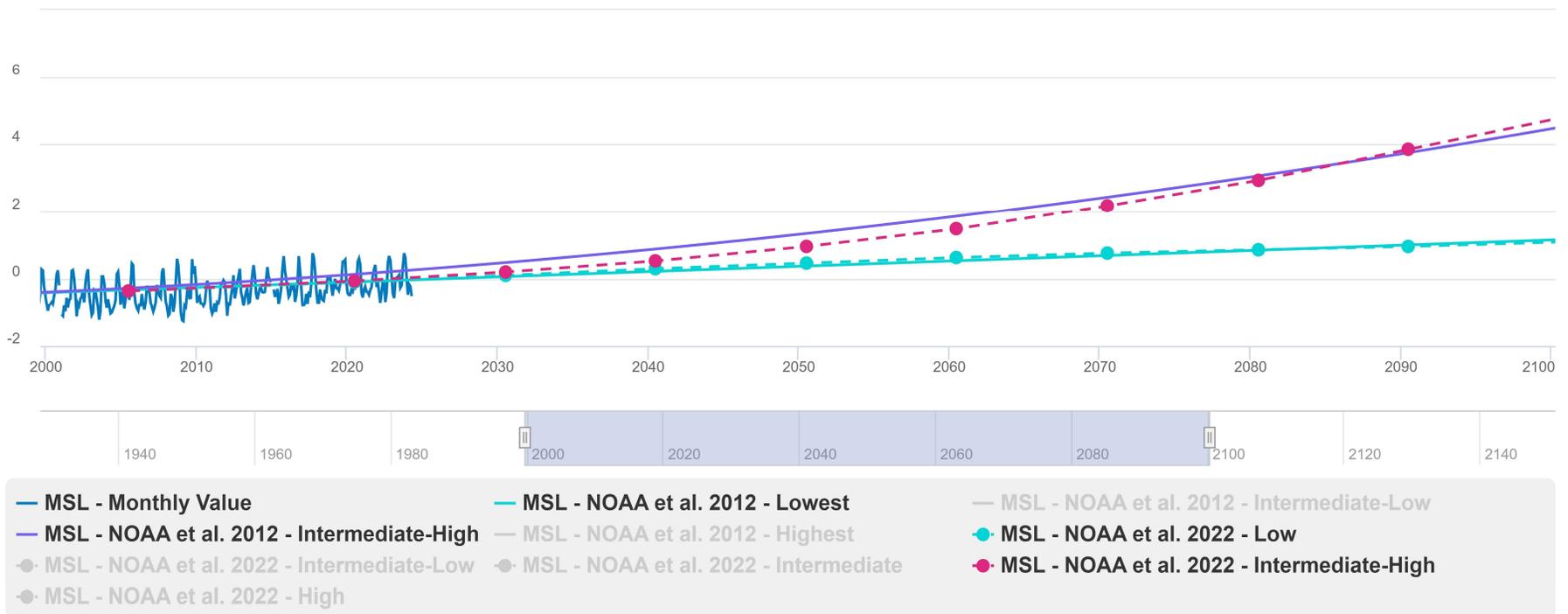


Future Innovations in Stormwater Management – Climate Change

Sea Level Data and Projections: Mayport (Bar Pilots Dock), FL (8720218)

NOAA Tide Gauge

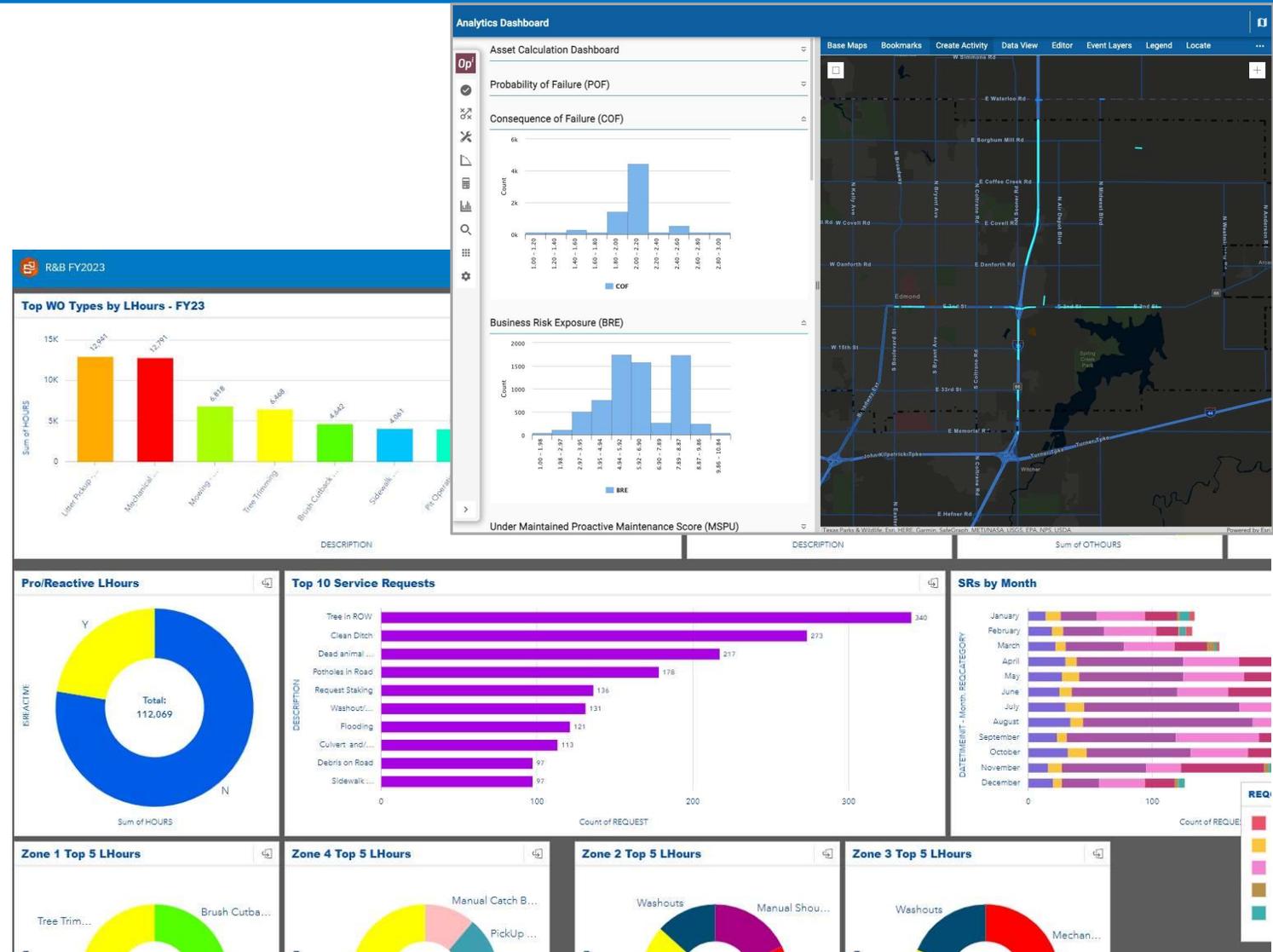
Feet above North American Vertical Datum of 1988
(1983-2001 epoch)



- Changing sea-levels
- Improved confidence in forecasts

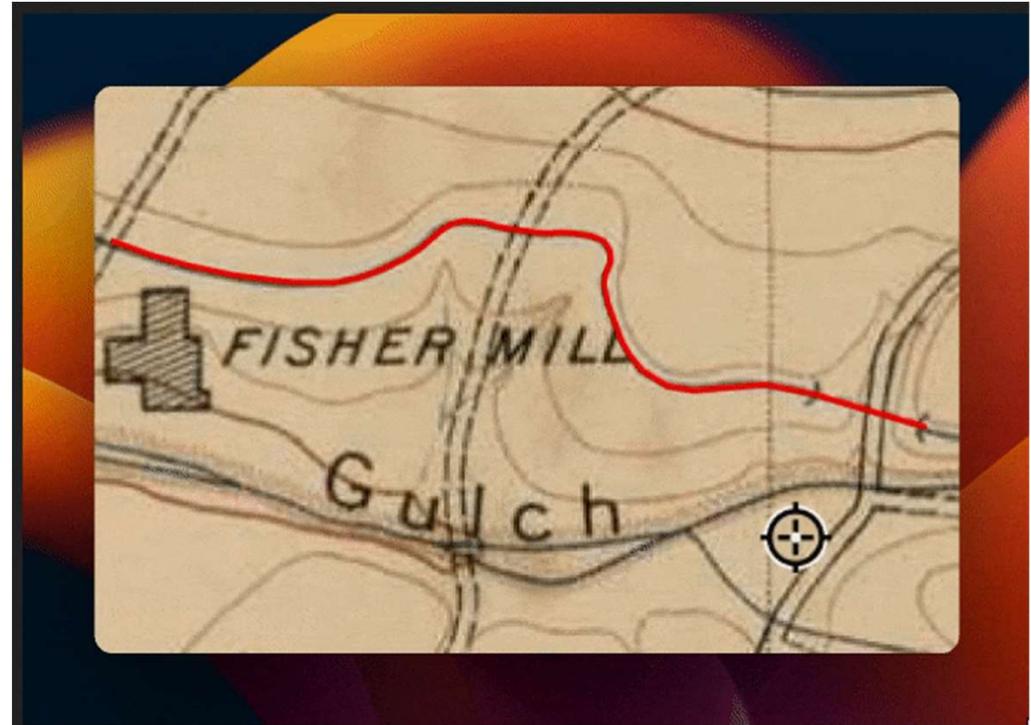
Future Innovations in Stormwater Management – Aging Infrastructure

- Expansion of AMS
- Leverage AMS records
- Proactive maintenance
- Track LID/GSI



Future Innovations in Stormwater Management – Use of AI

- Digitizing Plans
 - AI-based raster tracing tools
 - AI-based map vectorization tools
 - Automated georeferencing



Source:
Bunting Labs

Future Innovations in Stormwater Management – Use of AI

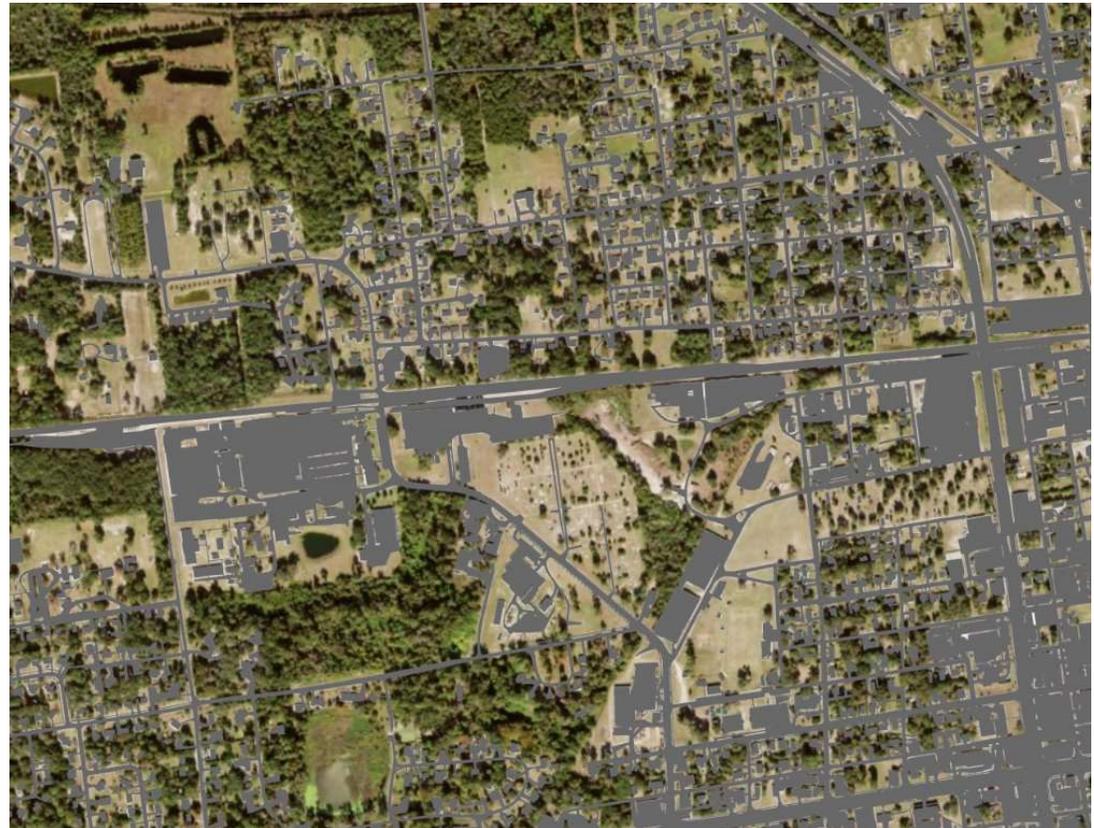
- Digitizing Plans
 - AI-based raster tracing tools
 - AI-based map vectorization tools
 - Automated georeferencing
 - AI based object detection



Source: Meta – Segment
Anything Model

Future Innovations in Stormwater Management – Use of AI

- Stormwater Model Parameterization
 - High-resolution land cover mapping
 - Feature identification
- NOAA C-CAP
- NearMap
- Mapillary



Future Innovations in Stormwater Management – Use of AI

summarise the key aspects of future stormwater master planning in Florida

Pro Search

4 steps completed

Sources

[PDF] Stormwater Management: A Guide f...

chnep.wateratlas · 1

Miami's Roadmap to Stormwater and Coastal...

cdmsmith · 2

Stormwater Master Plan - City of Miami

miami · 3

View 15 more

Answer

Based on the provided search results, here are the key aspects of future stormwater master planning in Florida:

Regulations:

- Florida's stormwater regulatory program has helped minimize adverse effects but there are challenges with ensuring proper maintenance of stormwater management facilities ¹
- Future regulations will begin impacting stormwater management, such as the EPA's Section 303(d) of the Clean Water Act which establishes a list of impaired waters and is used to develop Total Maximum Daily Loads (TMDLs) for listed impaired waterbodies ⁵
- Local governments have varying requirements for flood protection level of service (LOS) for roads ⁴

Technologies:

- Stormwater master plans utilize technologies like LiDAR to delineate drainage basins

Ask follow-up

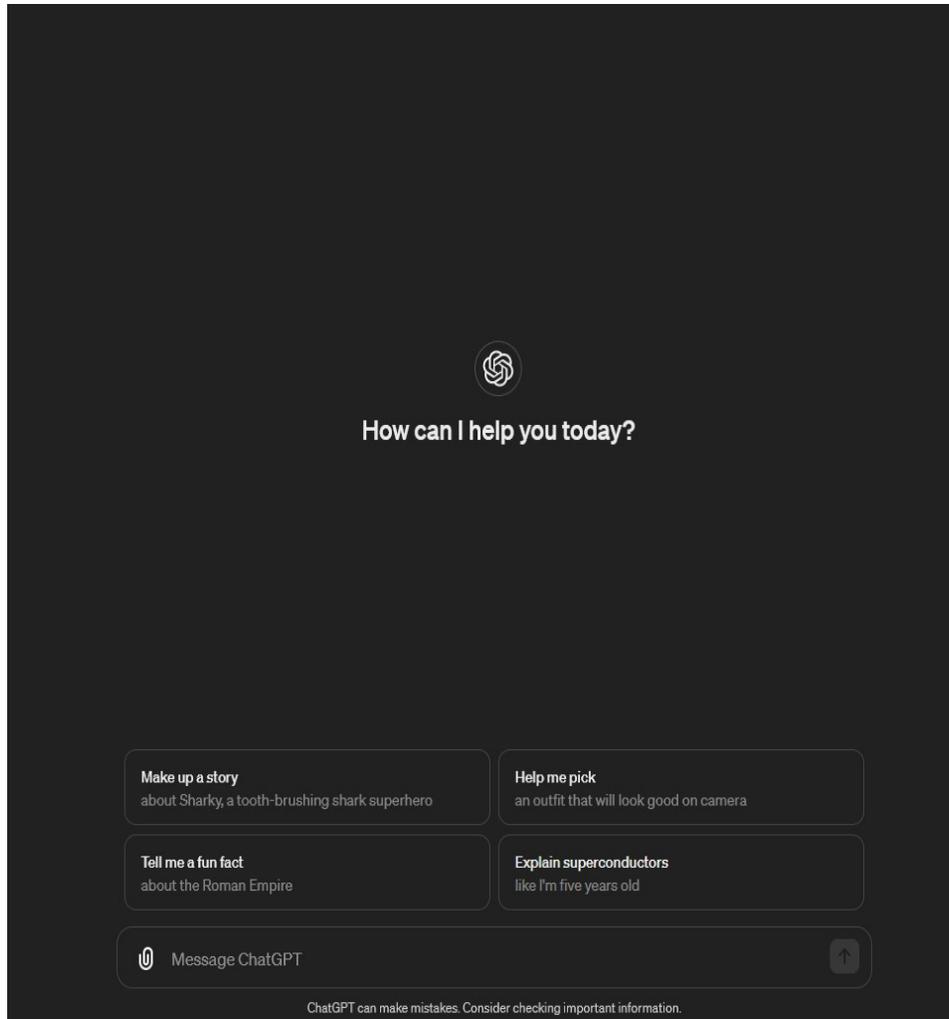
Pro

solutions

- Low-impact development and green infrastructure BMPs are being used more to

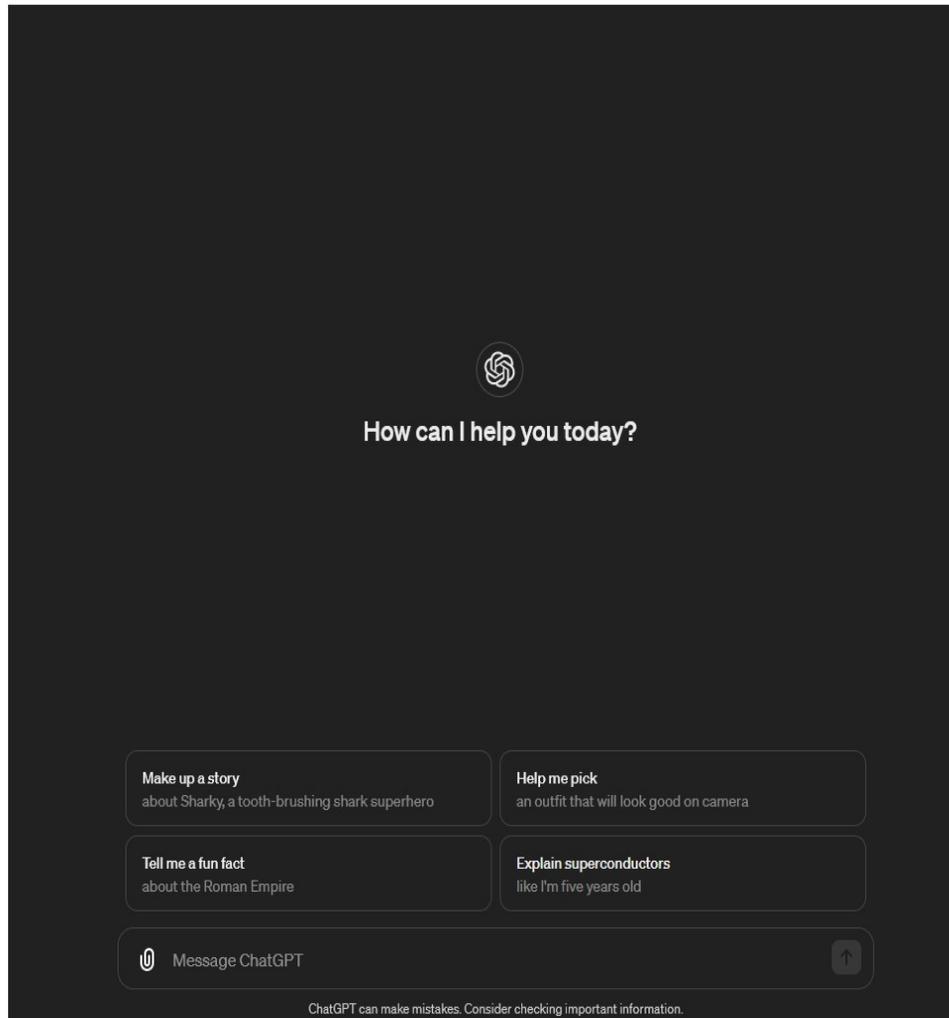
- Use of LLM AI
 - Improved search
 - Generating code/scripts
 - Presentations

Future Innovations in Stormwater Management – Use of AI



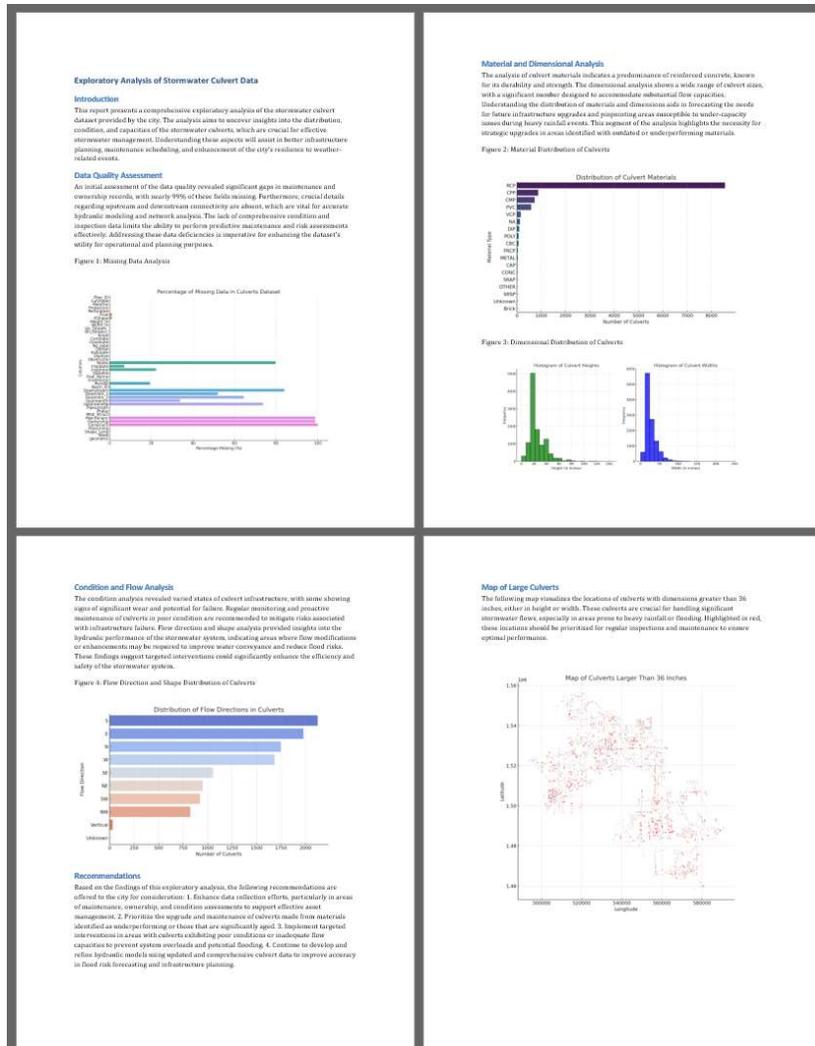
- Use of LLM AI
 - Data analysis
 - GIS analysis

Future Innovations in Stormwater Management – Use of AI



- Use of LLM AI
 - Data analysis
 - GIS analysis

Future Innovations in Stormwater Management – Use of AI



- Use of LLM AI
 - Data analysis
 - GIS analysis
 - Report writing

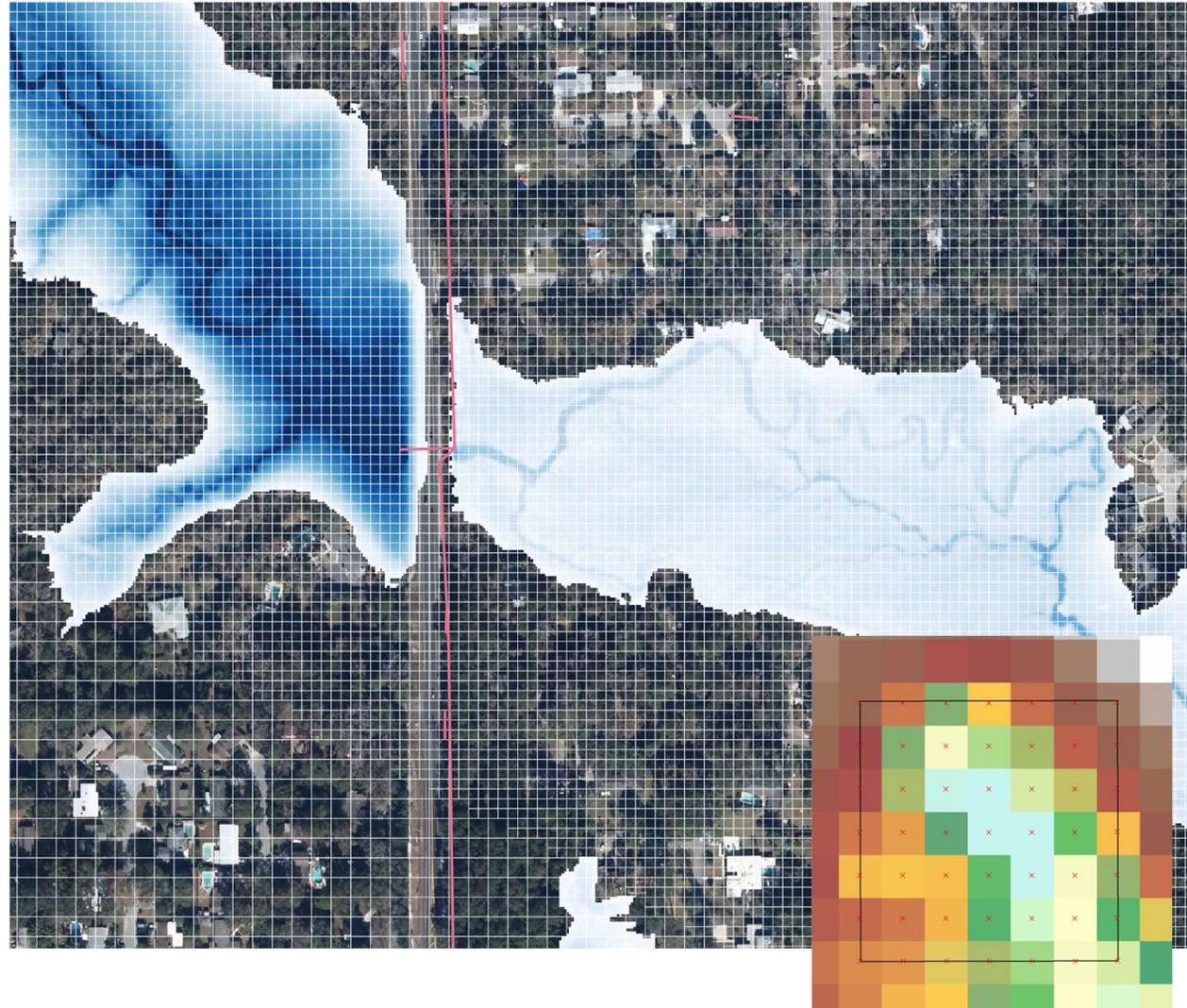
Future Innovations in Stormwater Management – Computing Technology

- CPUs
 - General computing
 - Sequential processing
- GPUs
 - Massively Parallelized Tasks
 - Machine learning, modeling
- NPUs
 - Efficiently execute AI algorithms



Future Innovations in Stormwater Management – High Resolution Stormwater Modeling

- New high-resolution 2D models
 - Leverage new computing technology
 - Improving LiDAR data
 - Full SWE



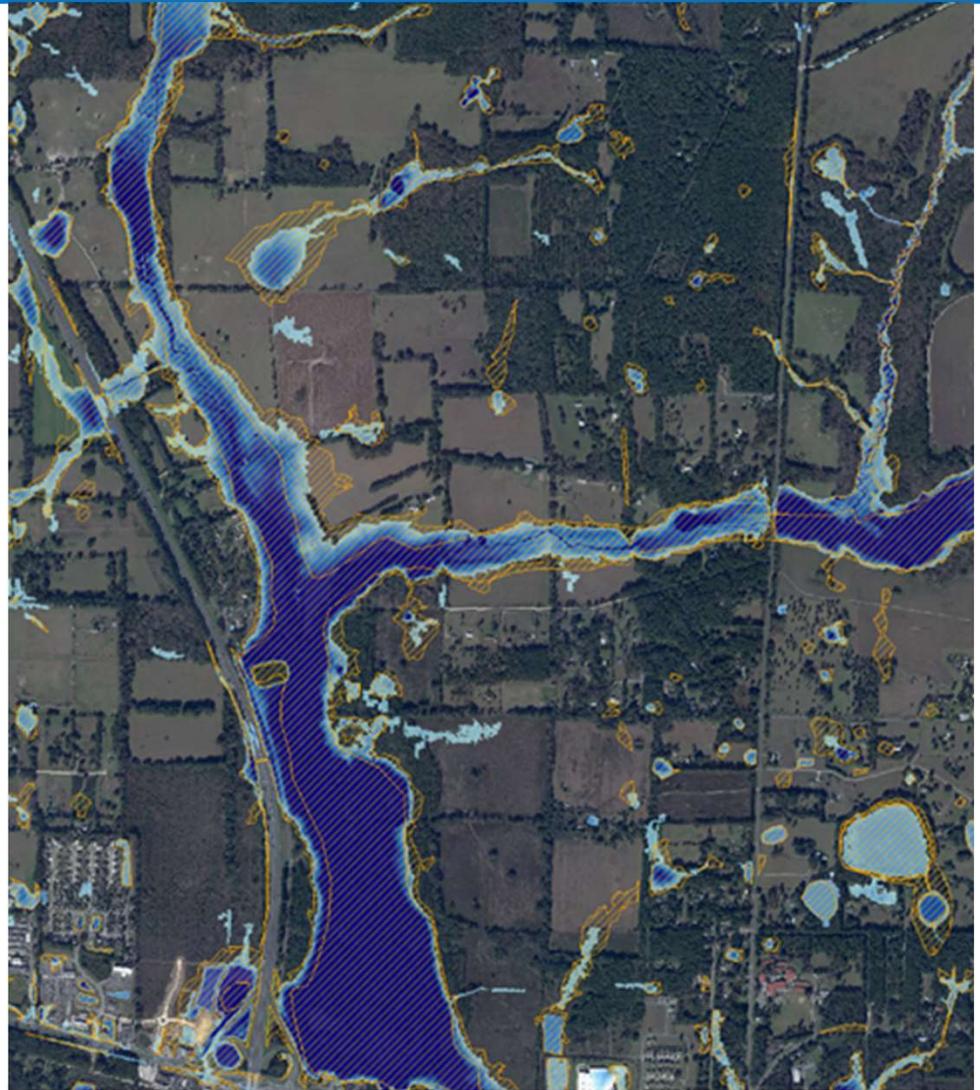
Future Innovations in Stormwater Management – High Resolution Stormwater Modeling

- New high-resolution 2D models
 - Integrate with GIS
 - Include all stormwater structures
 - Scalable
 - Setup time



Countywide Inundation Model

- Over 14,000 stormwater pipes and structures.
- Calibrated against observed flooding
 - Irma 2017
 - Elsa 2021
- Run of current, 2040 and 2070 rainfall conditions

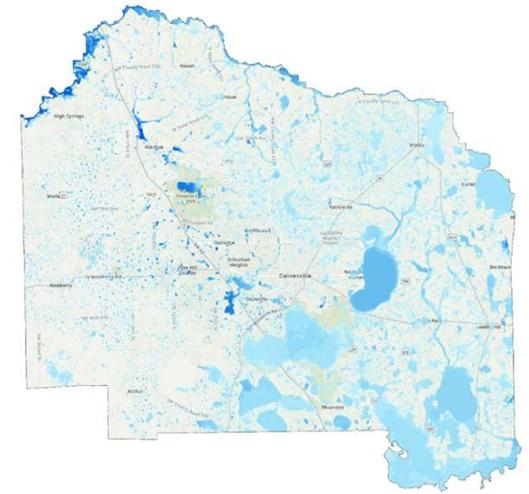
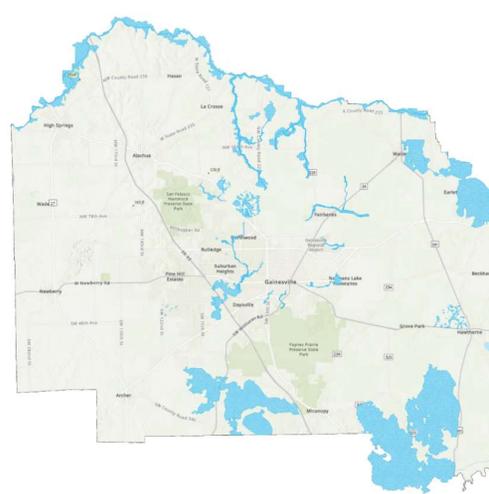
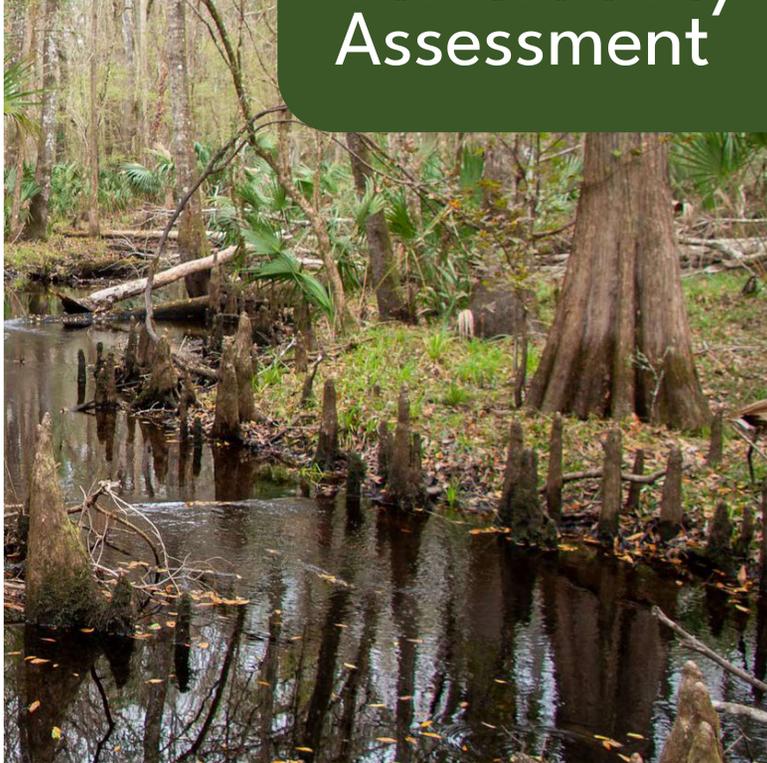


Alachua County Climate Vulnerability Assessment



Executive Summary

Climate Vulnerability Assessment



JonesEdmunds

BRIZAGA
ASSESS COMMUNICATE ADAPT



NEMAC+FernLeaf

BE BR BUREAU OF ECONOMIC AND BUSINESS RESEARCH

eda
consultants - inc.

CRC
Climate Resilience Consulting

Vulnerability Analyses are Now Critical to Stormwater Master Planning

Critical Infrastructure Flooding



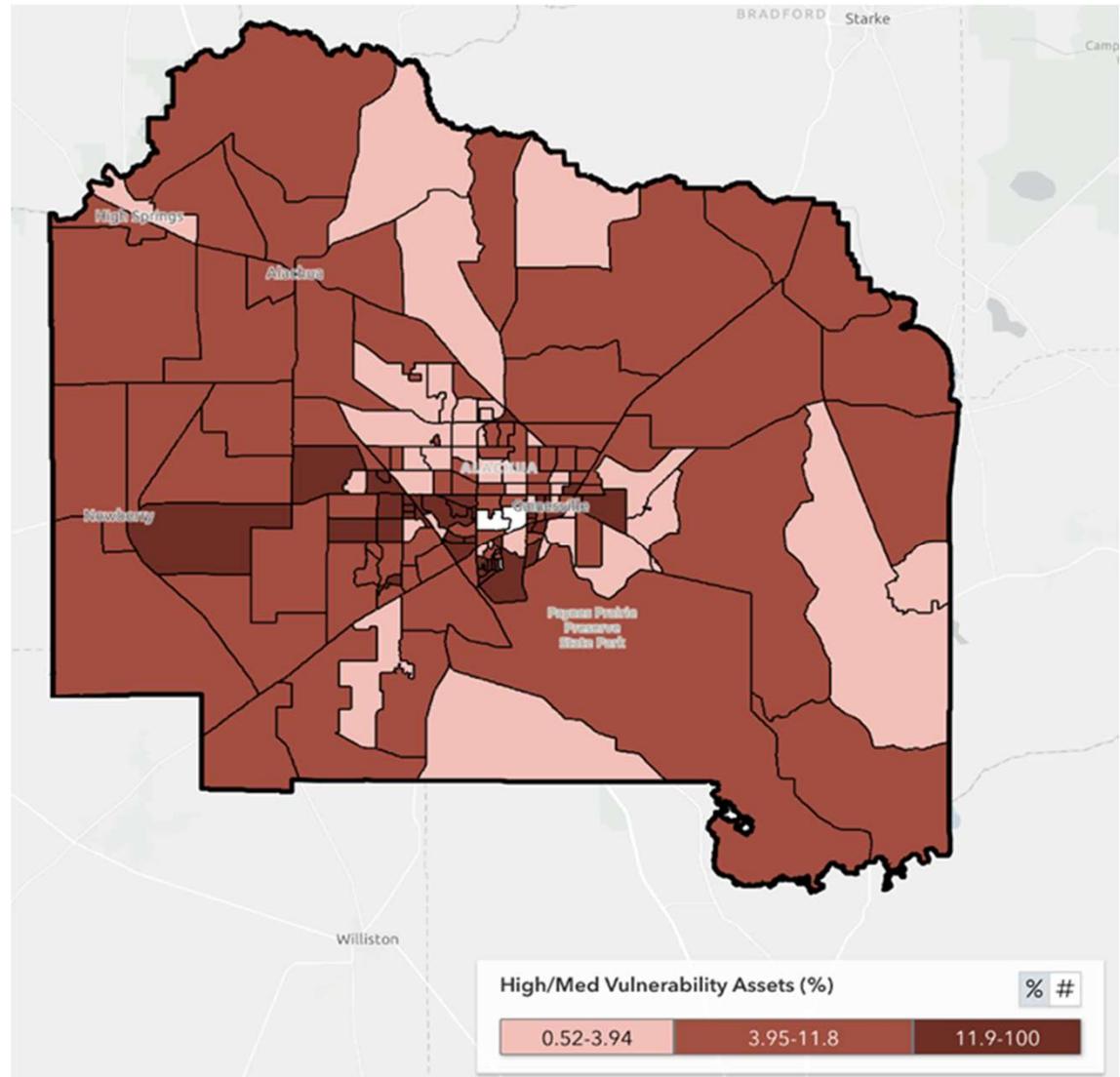
Photos by Alachua County Public Works



Property Flooding

Aggregated Residential Vulnerability

- Percent of Residential Properties High or Medium Vulnerability to Current 100-Year Rainfall-Induced Flooding by Census Block Group.



Parcel Scale Vulnerability

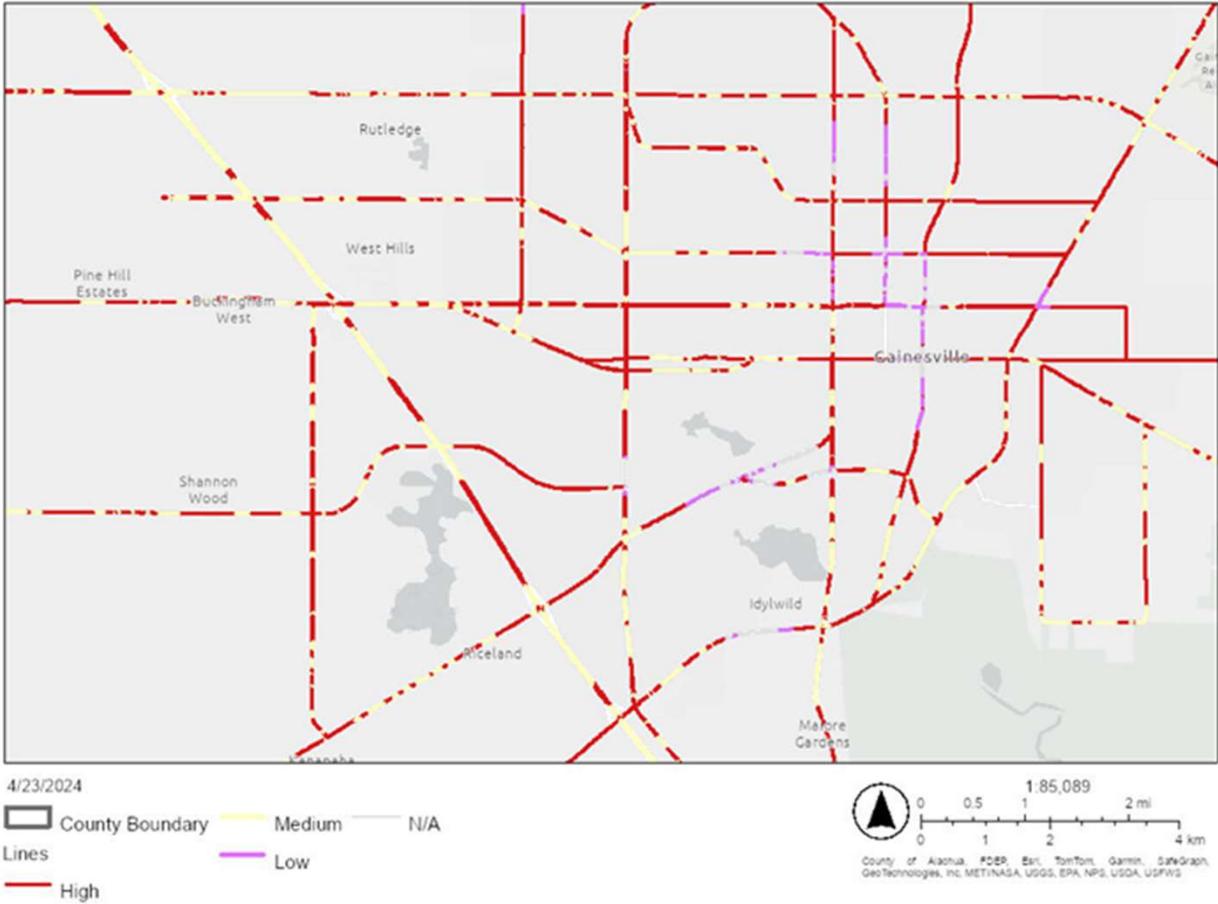
- Advances in modeling:
We can now quickly assess future conditions.
- Identify potential problem areas before they are problems!
- 8% of Alachua County residential properties vulnerable in 2020.
 - 12% in 2040
 - 15% in 2070



Critical Infrastructure Prioritization

- Assessing critical infrastructure for future rainfall conditions allow for better prioritization.

Major Road Prioritization



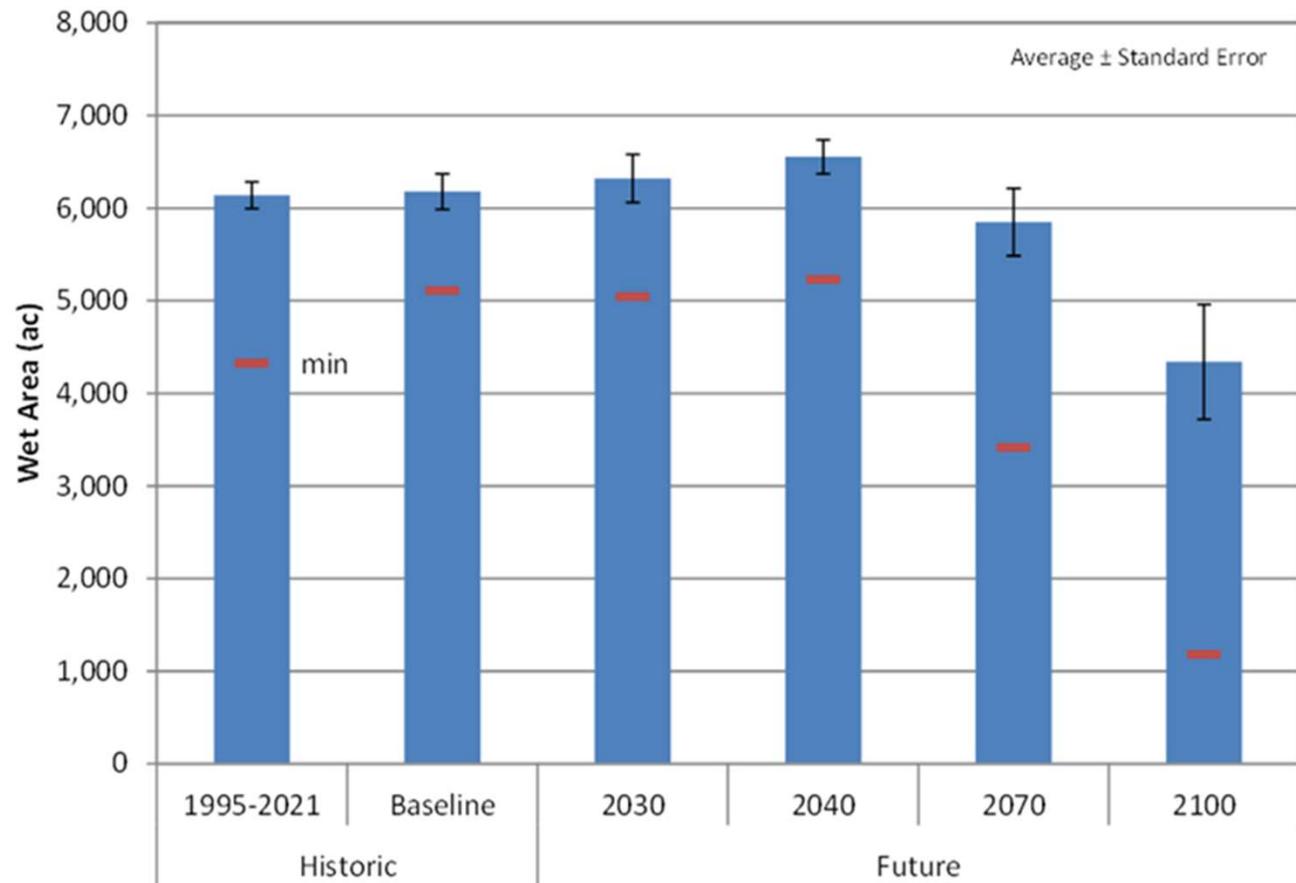
Beyond Flooding: Other Things for a Master Plan

- Impacts to waterways from altered hydrology
- Impact to agriculture
- Water quality
- Population growth
- Water supply



Predicted Lake Area for Newnans Lake

- Lake is impaired. Load reduction allocations in effect.
- Lake is impaired. Load reduction allocations in effect.
- Monthly stage and discharge modeled. Stage correlated with net monthly rainfall.

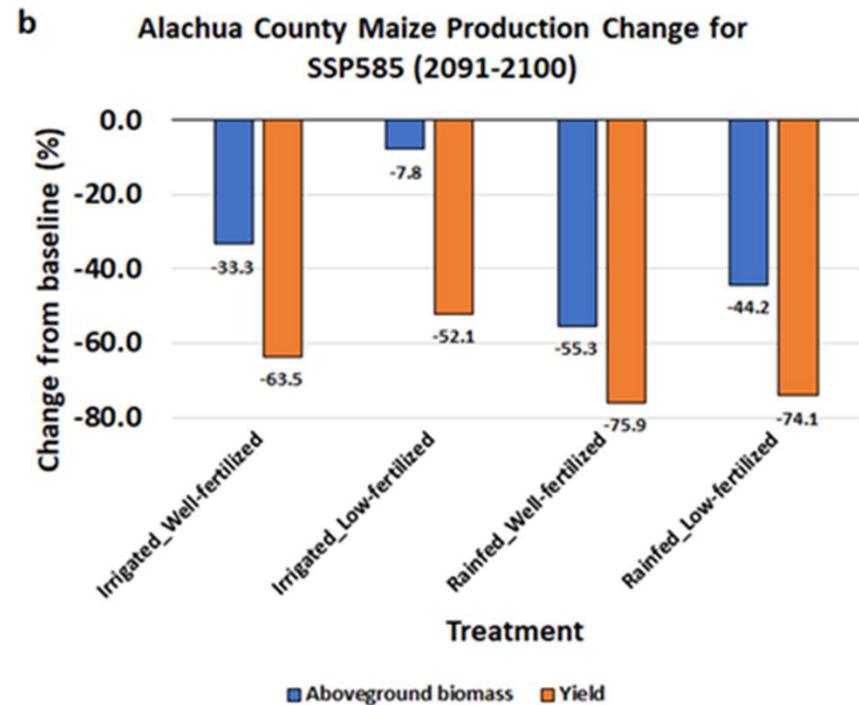
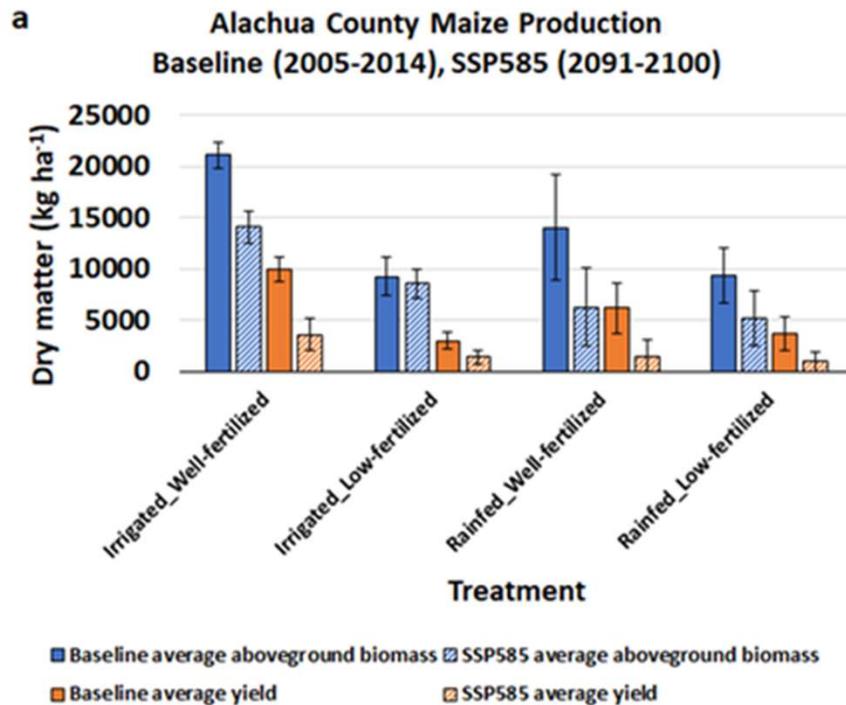


Impact of Climate Change on Agriculture

- Why? Agriculture contributes nutrients to aquifer and waterways.
- Three crop models:
 - Corn – Field crop
 - Bahia grass – Forage crop
 - Snap bean – Vegetable crop
- Irrigated and non-irrigated; fertilized and non-fertilized



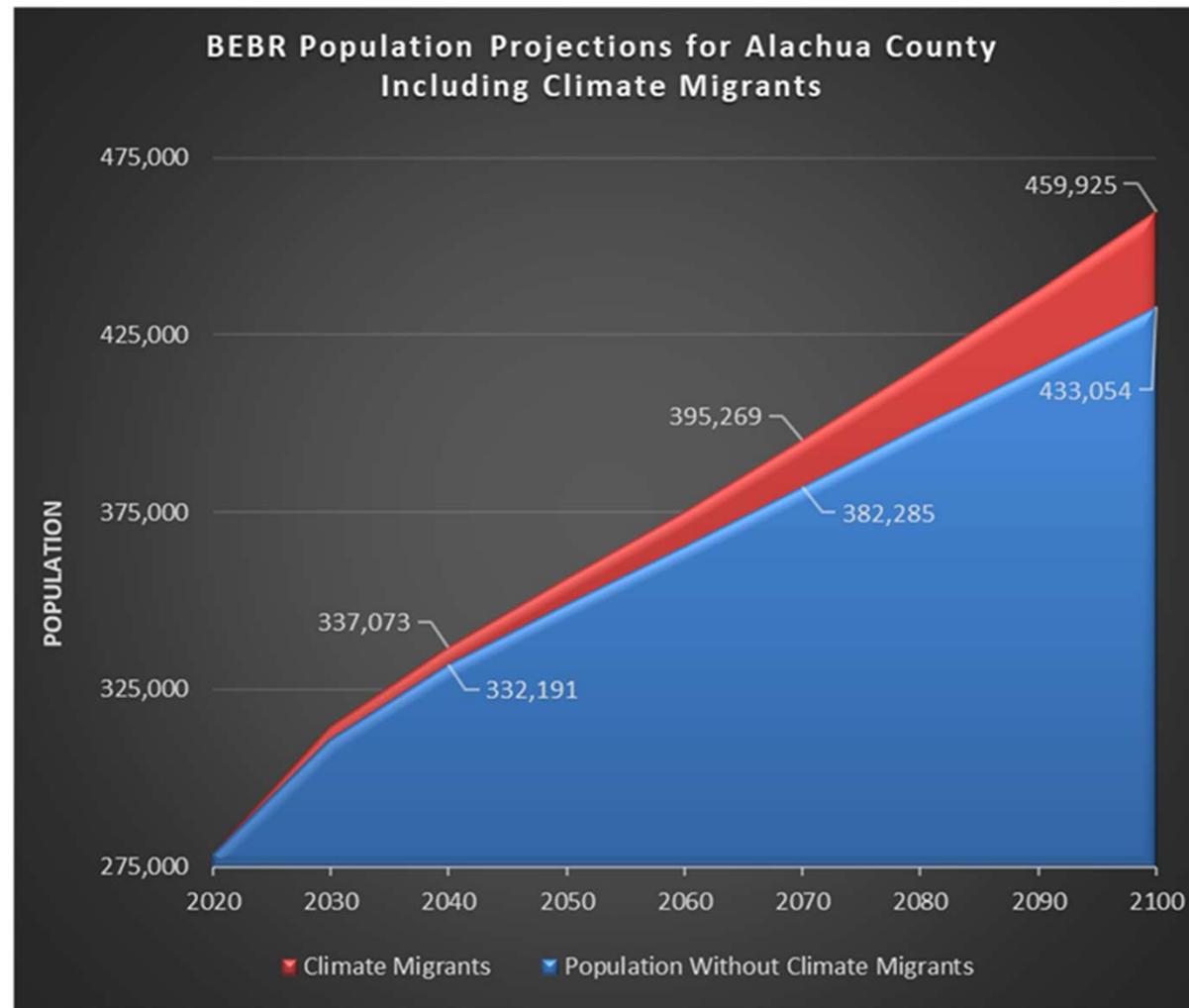
Example: Corn



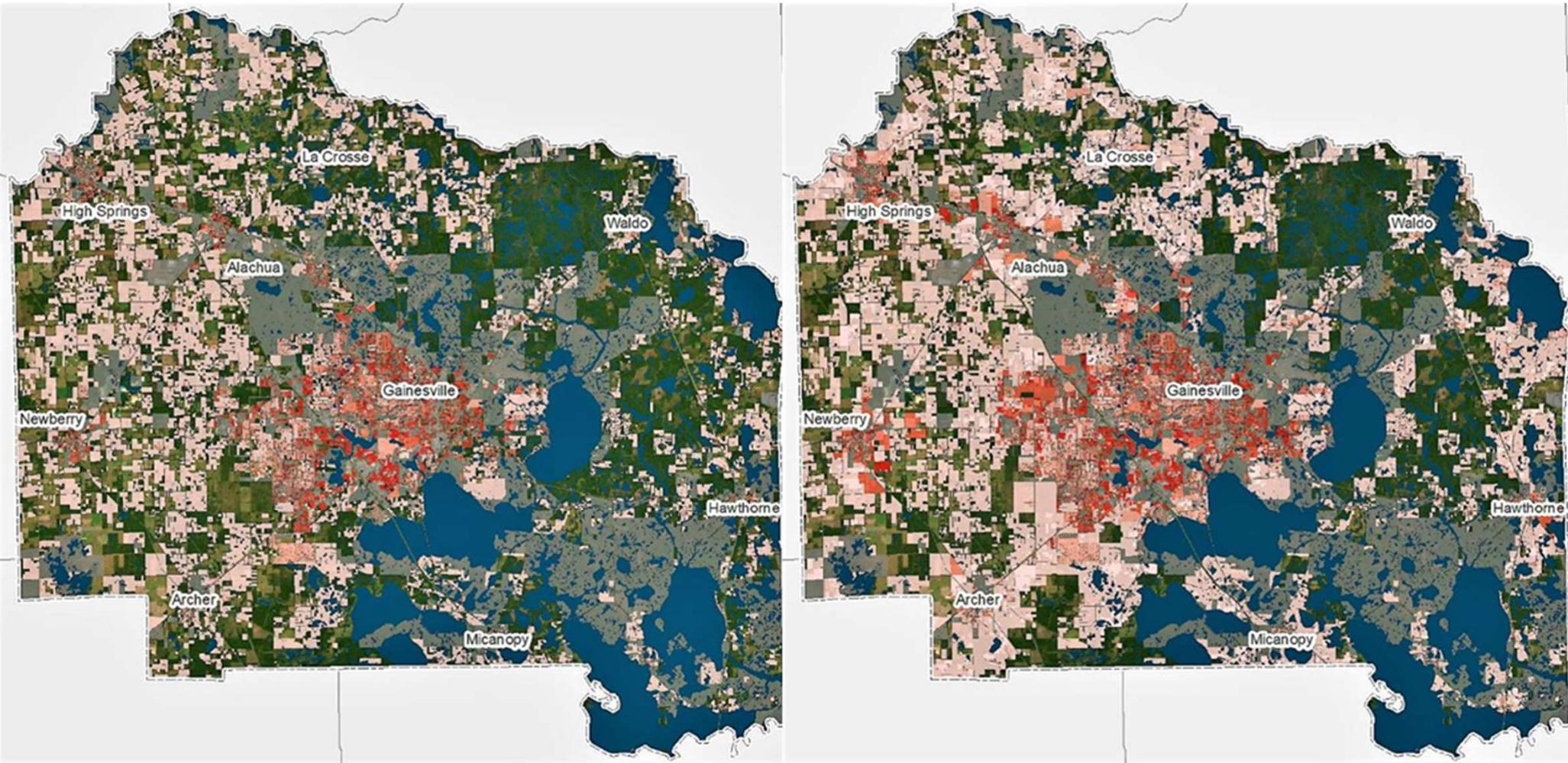
- Reduced yield due to heat and water deficit stress
- Potential for increased nutrient input from fertilization
- Also potential for increased irrigation and competition for water

What About Population Growth?

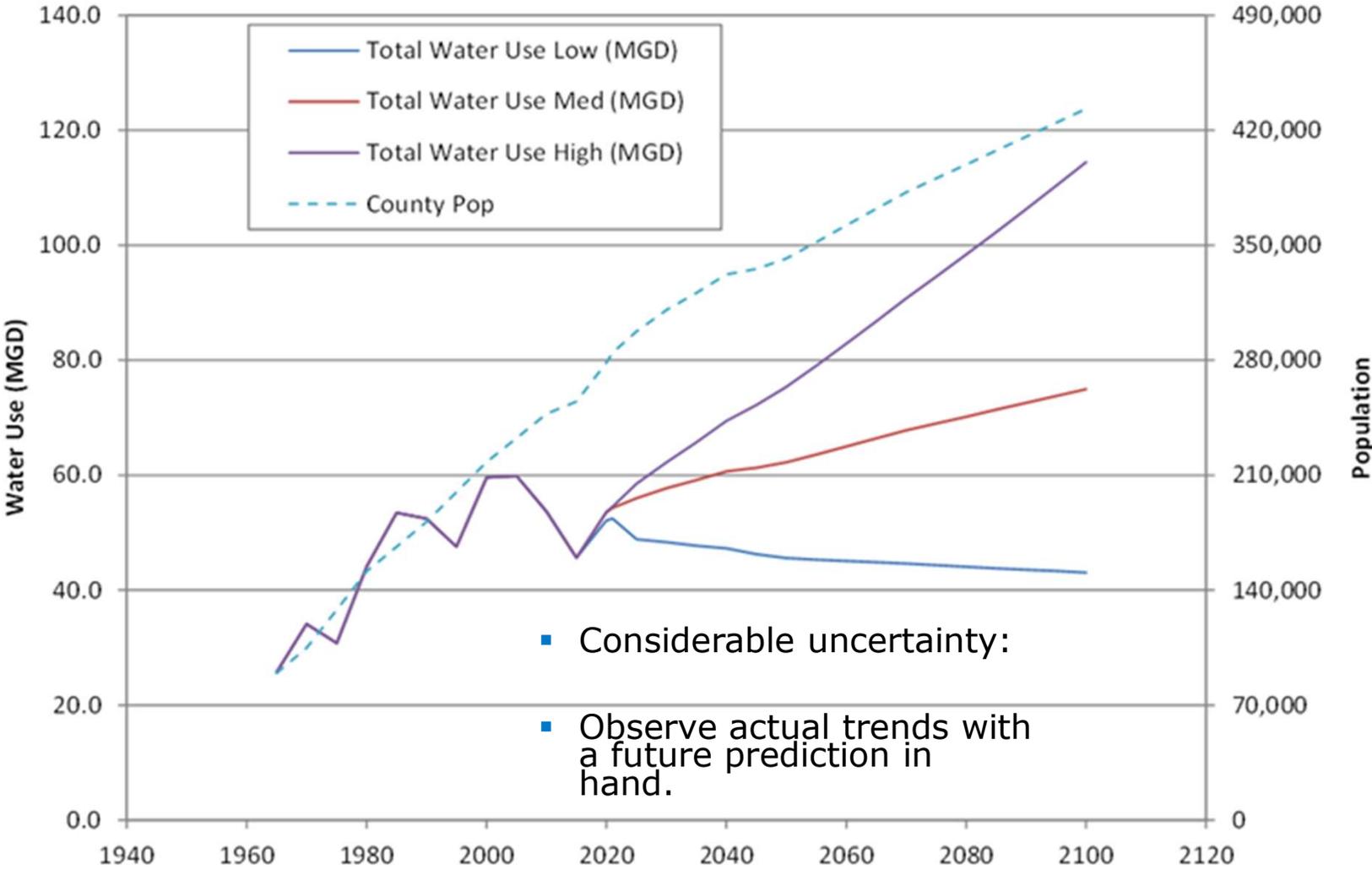
- "Climate Migration" not currently accounted for in population projections.
- What will future density look like?



Current and 2100 Population Density



Water Supply Planning



Tracking LID/GSI

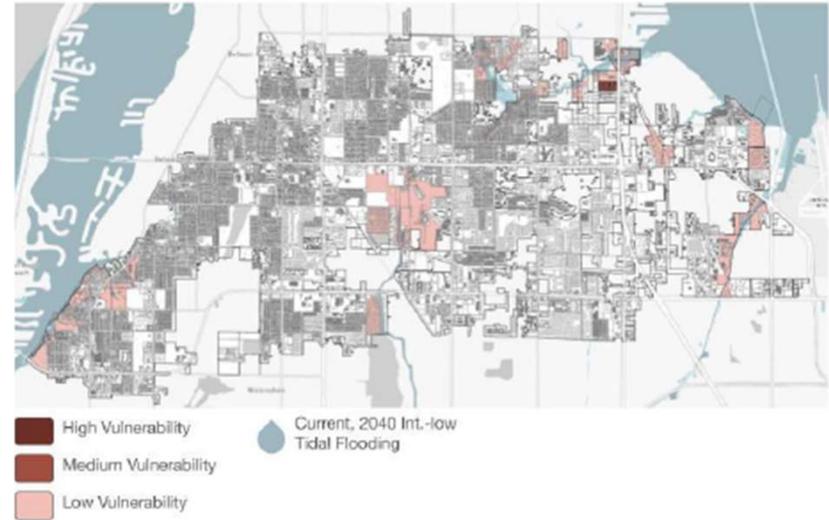
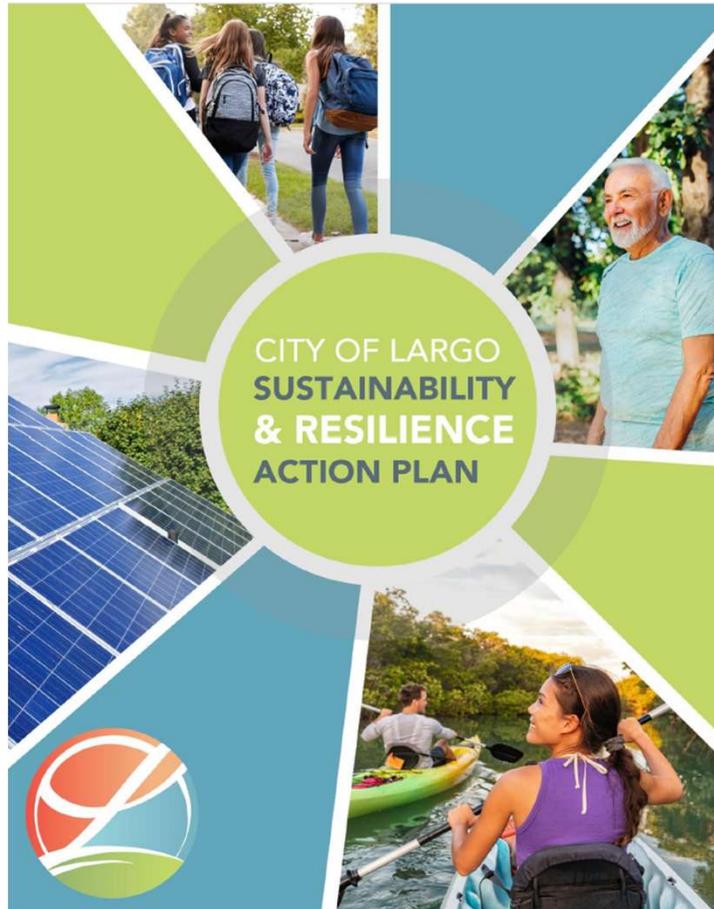


April 23, 2024

- dLowImpactDevelopment
 Baffle Box/Vault with Filter
 BAM Lined Retention
- BioRetention
 BioSwale
 Constructed Wetland
 Green Roofs
- Conveyance Swales
 Filter Strips
 Other
 Permeable Pavers
 Porous Pavement

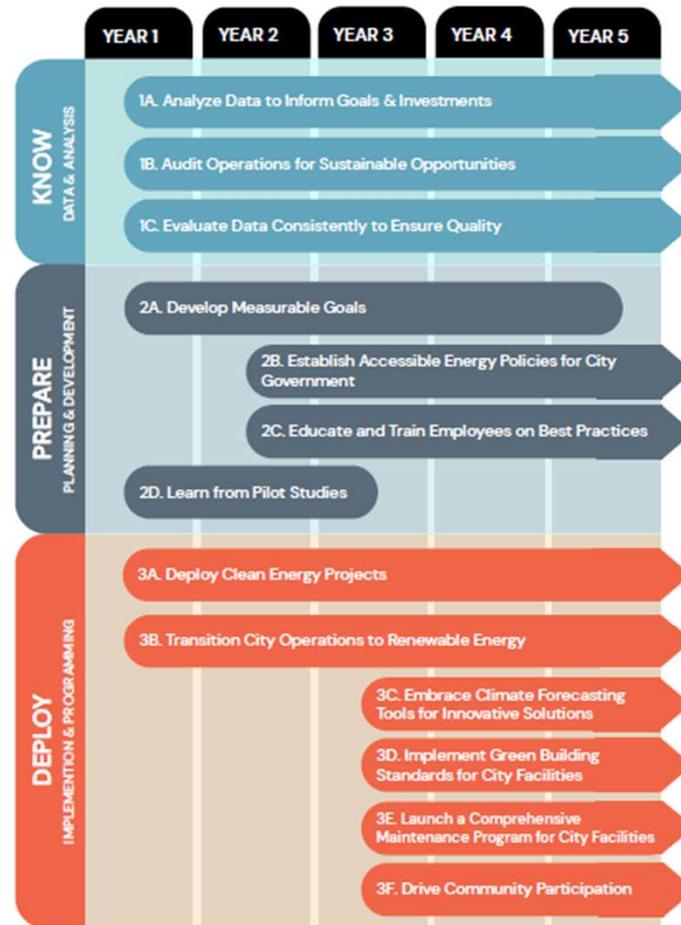
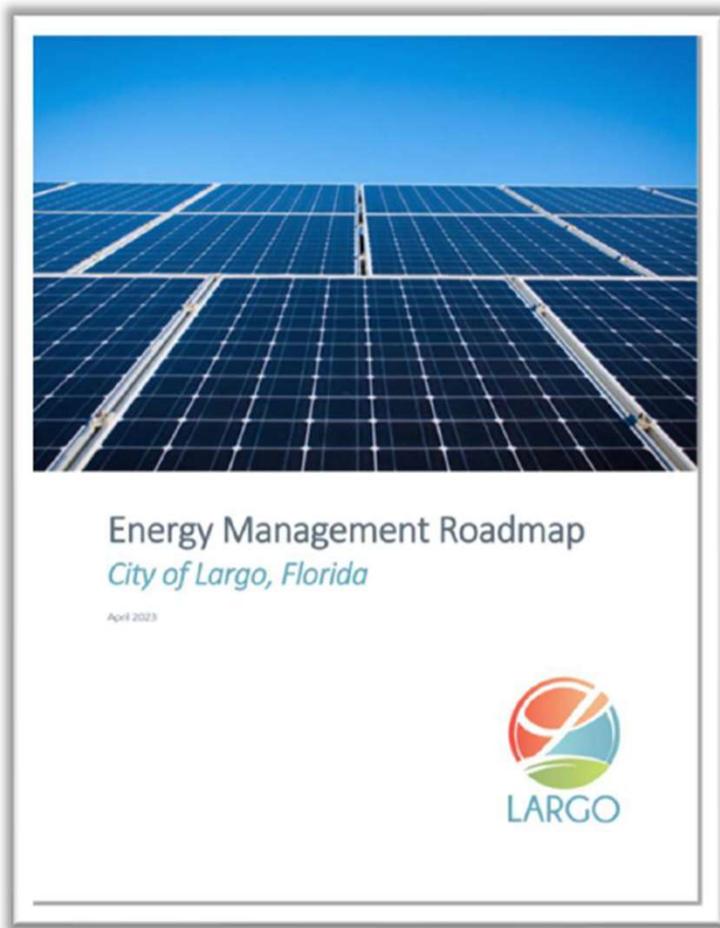
Facility ID	Subtype	Location	Admin Area	Surface Area	Geomembrane
DLI_000004	BioRetention	SE 16 th Ave at Sweetwater Trailhead	Alachua County	Parking Lot	Yes
DLI_000005	BioRetention	SE 16 th Ave at Sweetwater Trailhead	Alachua County	Parking Lot	No
DLI_000006	Permeable Pavers	SE 16 th Ave at Sweetwater Trailhead	Alachua County	Parking Lot	No
DLI_000007	Permeable Pavers	SE 16 th Ave at Sweetwater Trailhead	Alachua County	Parking Lot	No

Largo Sustainability and Resilience Action Plan (SRAP)



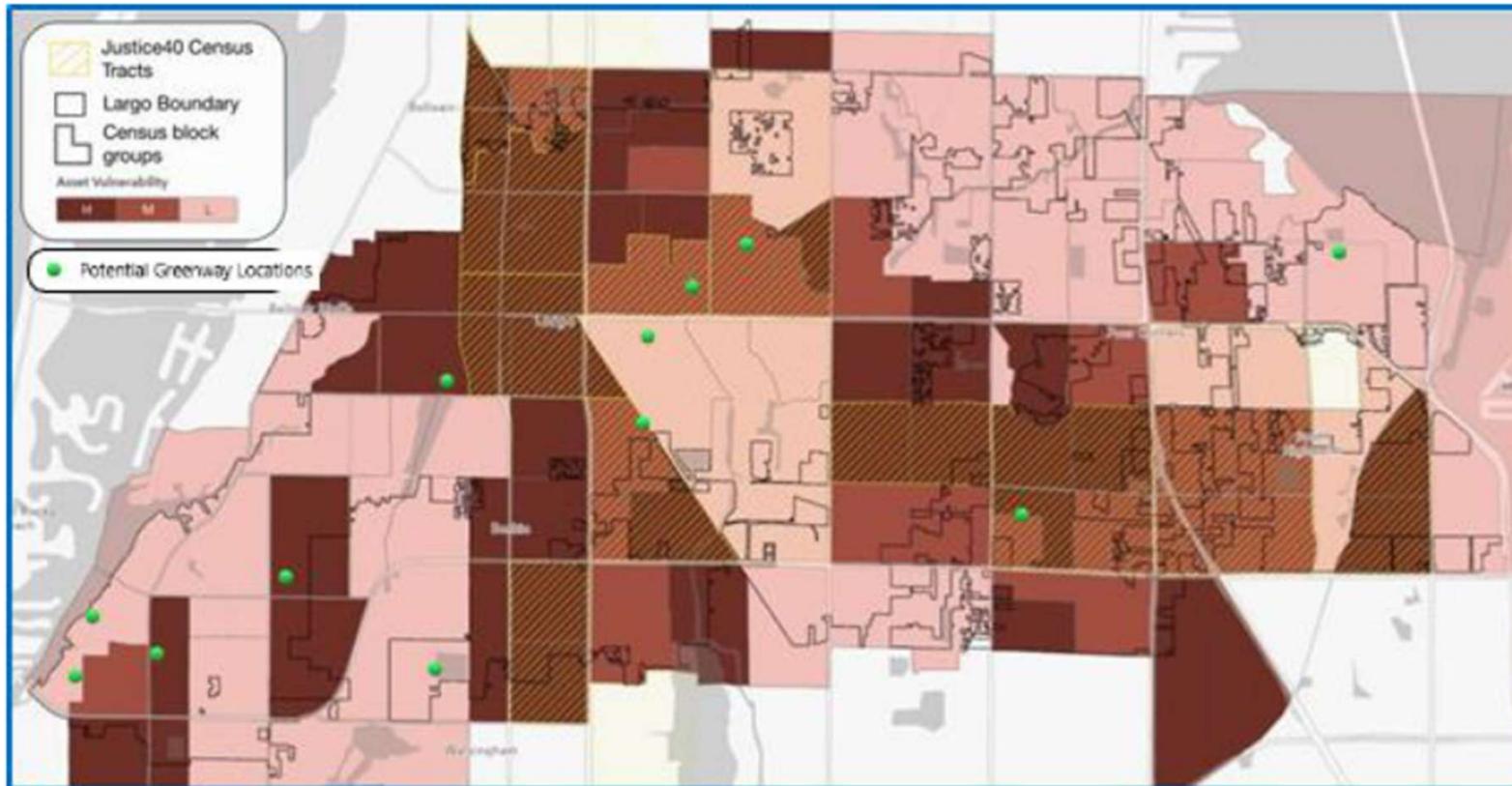
Energy and Sustainability

FIGURE 1 – LARGO ENERGY MANAGEMENT ROADMAP



Stormwater, Heat, & Equity

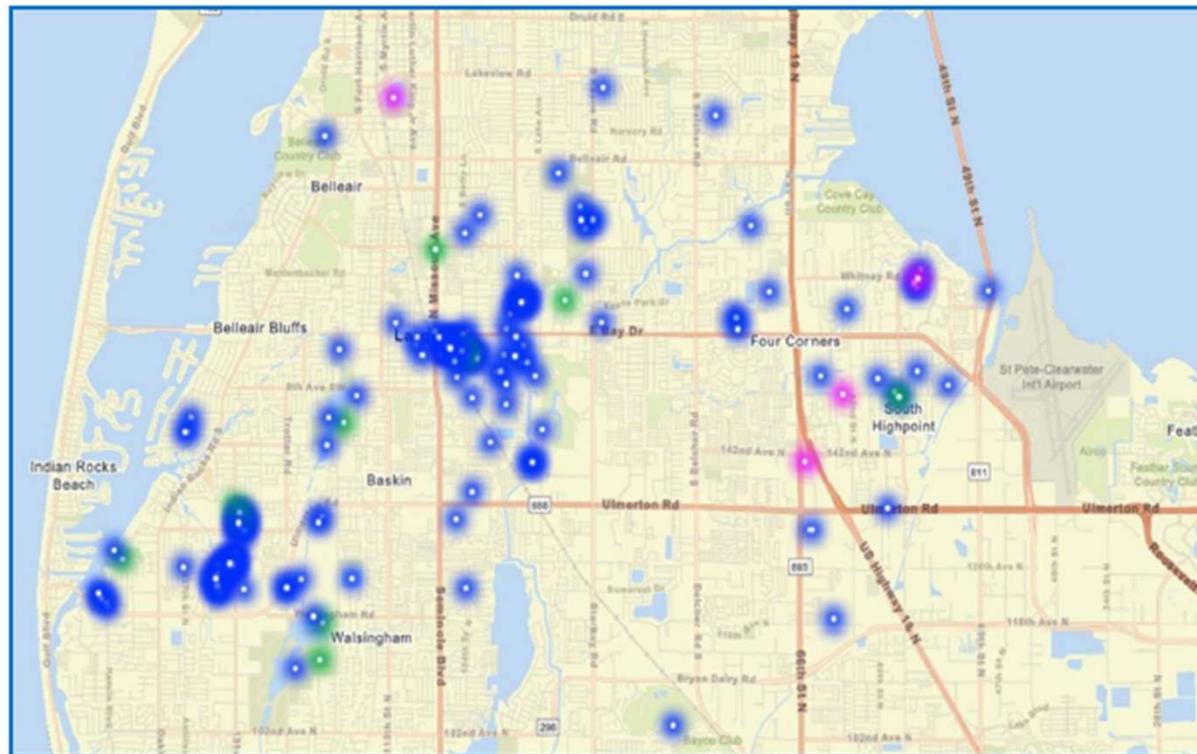
FIGURE 41- CENSUS BLOCK GROUPS, EXTREME HEAT VULNERABILITY, AND OPPORTUNITIES FOR GREENWAYS



Equity at the Forefront & Throughout

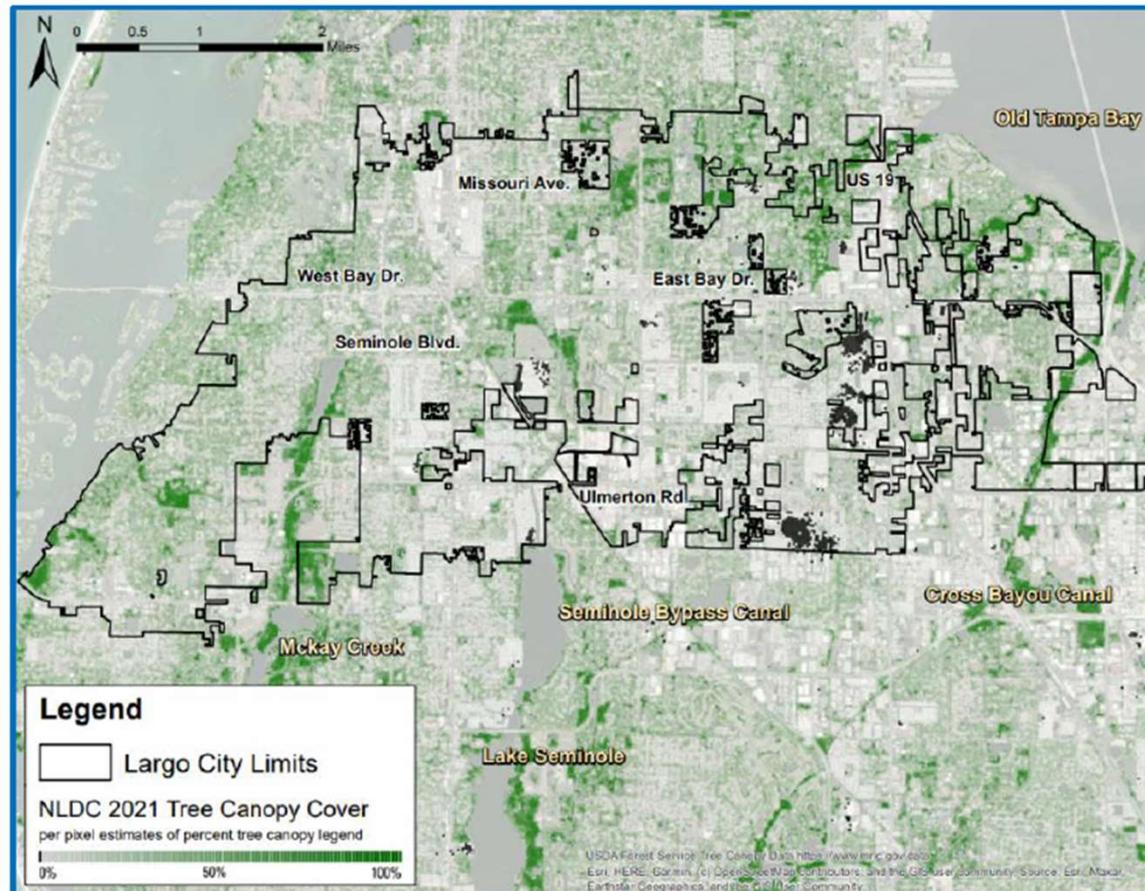
It is important to note that equity is a core component of the SRAP, as communities on the frontlines of climate change are already disproportionately affected and this impact will magnify in the future. For this assessment, we leveraged datasets that highlight various aspects of equity as part of every scientific task within the Vulnerability Assessment that are available via the Centers for Disease Control's Social Vulnerability Index and the federal government's recent [Climate and Economic Justice Screening Tool](#). Large census tracts that this tool identifies as overburdened and underserved are referred to as "disadvantaged communities" throughout this document.

FIGURE 5 - COMMUNITY RESOURCES RESULTS (DATA GENERATED BY LARGO COMMUNITY MEMBERS, 2022).



Bringing Stormwater Into Climate Conversations

FIGURE 36 - PERCENT TREE CANOPY FOR THE CITY OF LARGO



Community Support: Support for the themes in this strategy were evident in 3 out of 3 community outreach categories.

2023 Roadmap

SRAP ADAPTATION ROADMAP

Thirteen strategies designed to equitably mitigate the effects of climate hazards and increase the sustainability of our community.

0-5
YEARS

SHORT TERM COMPLETION (0-5 YEARS)

- Equitable Climate Preparedness
- Join the One Water Movement
- Lift Station Modernization and Hardening
- Eliminate Surface Wastewater Discharge
- Green Resilience
- Energy Management
- Annual CIP Planning for a Sustainable and Resilient Largo

6-10
YEARS

MEDIUM TERM COMPLETION (6-10 YEARS)

- Sustainable Business
- Coastal Resilience
- Flood Mitigation
- City Sustainability Continuous Improvement

11-15
YEARS

LONG-TERM COMPLETION (11-15 YEARS)

- Develop, Adopt, and Begin Implementing a Greenways Plan
- Inland Waterway Resilience



Conclusions

People and The
Environment
Remain at The
Center

Gone Are the
Days of Static,
Siloed Planning

Computing Is
Much Faster

Our Scientific
Baselines
Constantly
Change

Modern Plans
Are Living
Datasets and
Processes