State of the Practice for Stormwater Quality Master Planning

FSA 2021 Annual Conference

Friday, June 25, 2021

11:00 AM to 11:45 AM

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Water Resources Principal
ATM | DESIGN ENGINEERING CONSULTING
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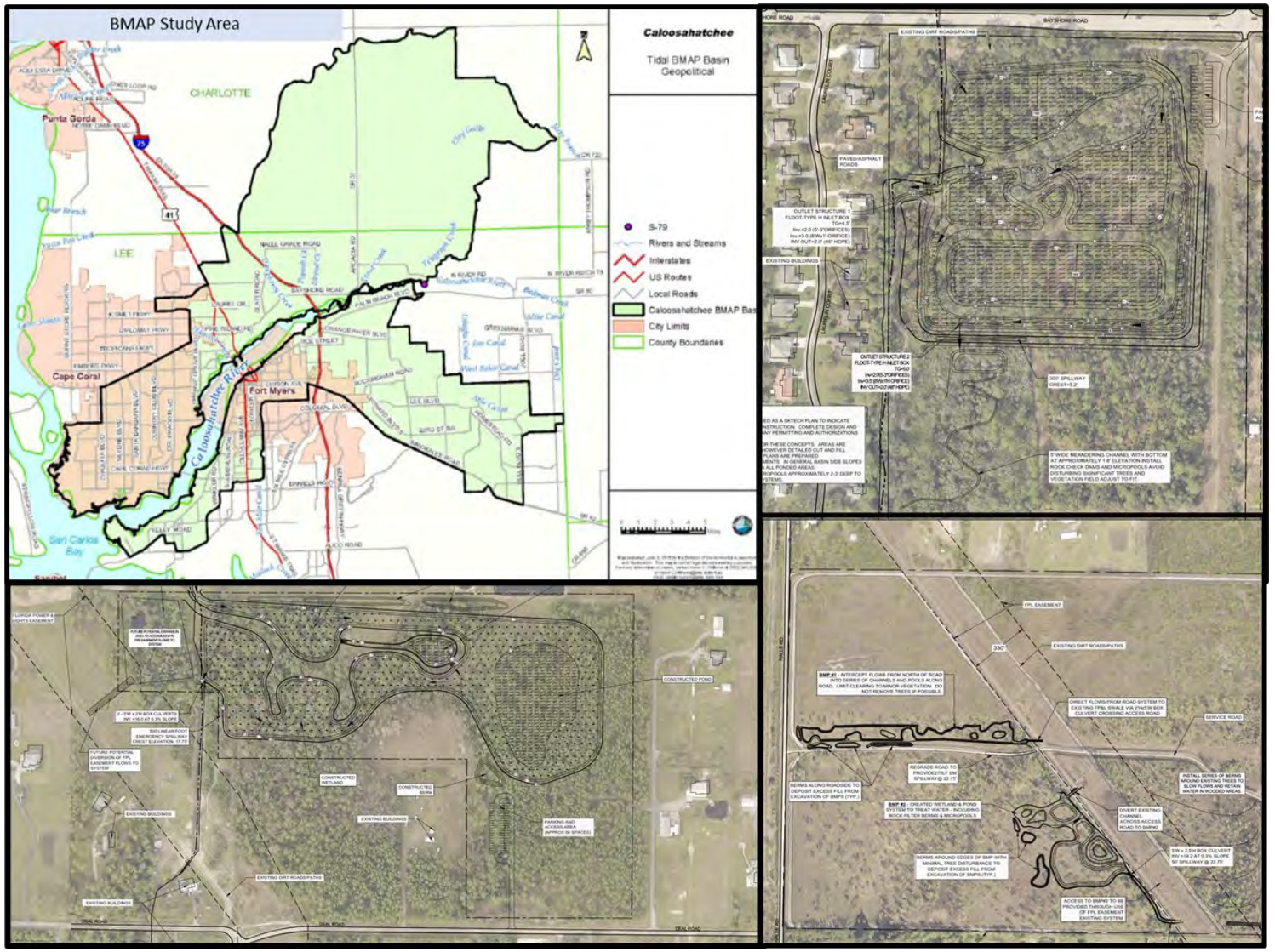
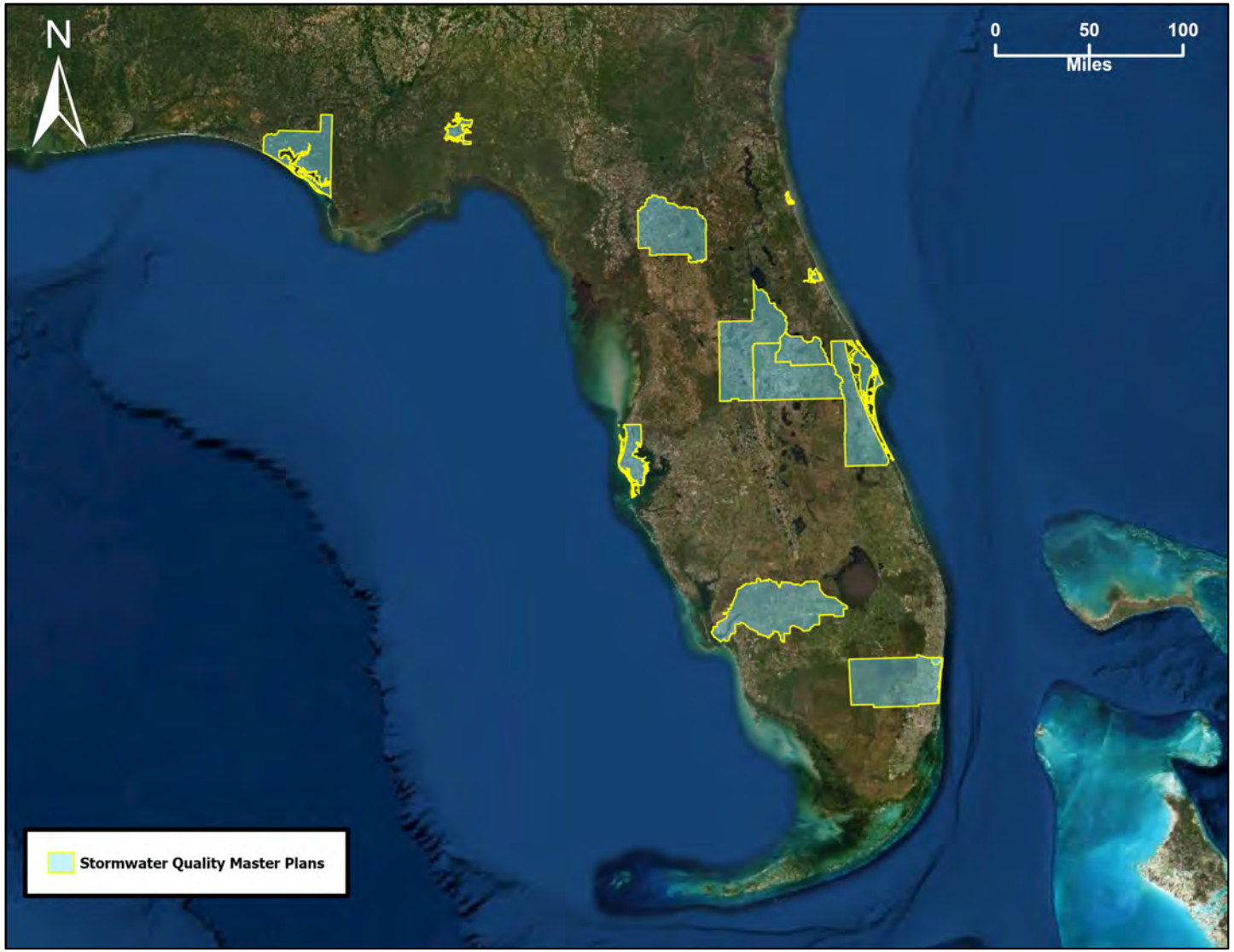
Presentation Outline

- Identifying Hot Spots
  - Approach
  - Impairment/TMDL/BMAP
  - Data Analyses
  - Pollutant Loading
  - Opportunity
- Restoration Strategies
  - Stormwater Inventory
  - BMP Planning / Siting
  - Structural BMPs
  - Non-Structural BMPs
  - BMP Controls
  - Future Climate Impacts



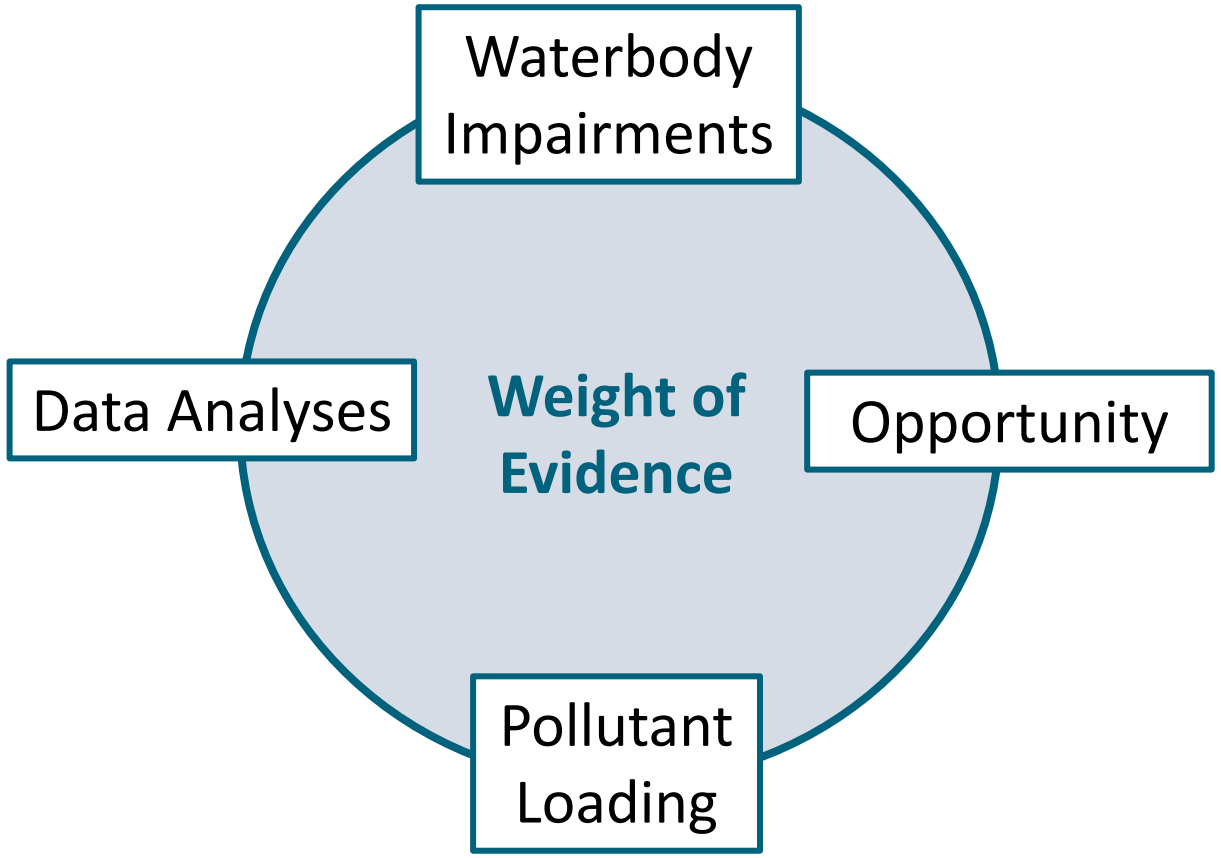
Projects Around Florida

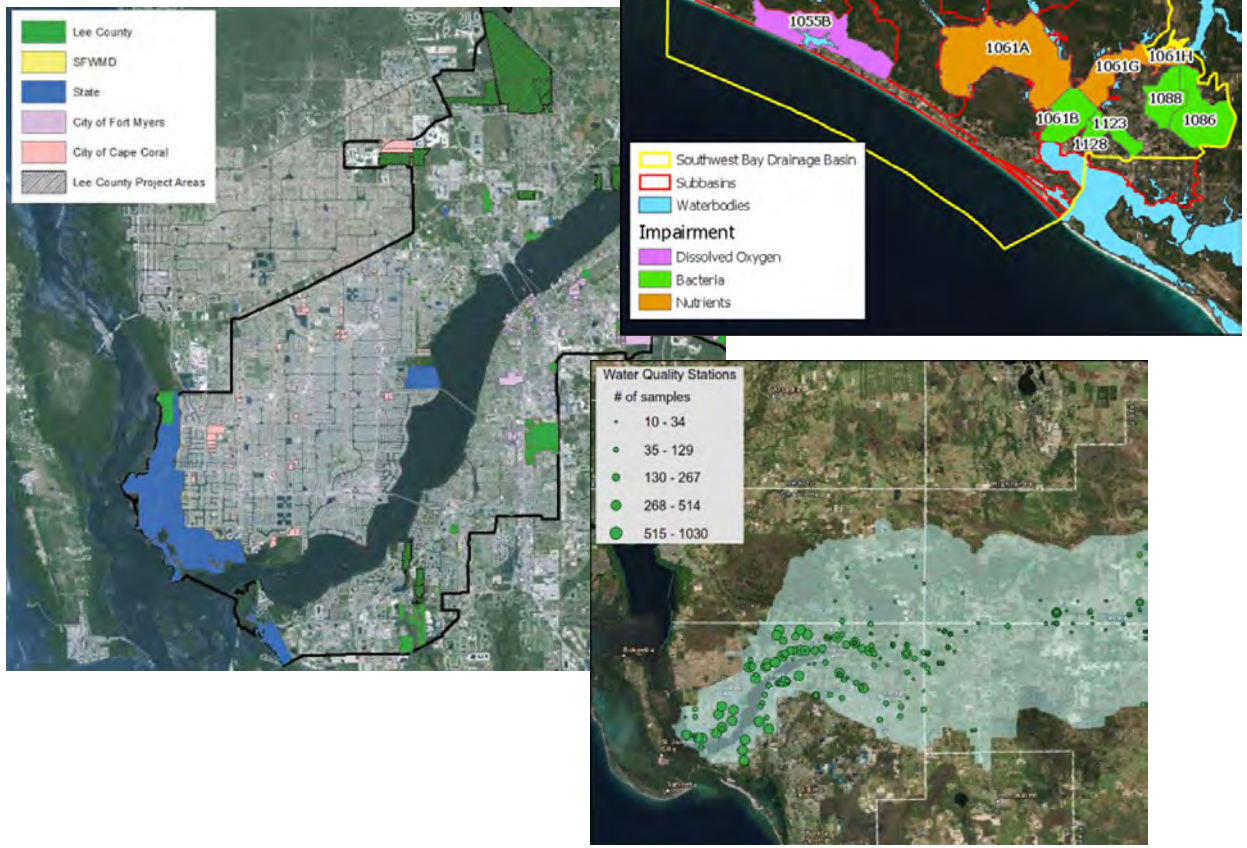


Identifying "Hot Spots"

- **Approach**
- Identifying Impairments/TMDLs/BMAPs
- Water Quality Data Analyses
- Pollutant Loading
- Opportunity

Identifying "Hot Spots" – Approach

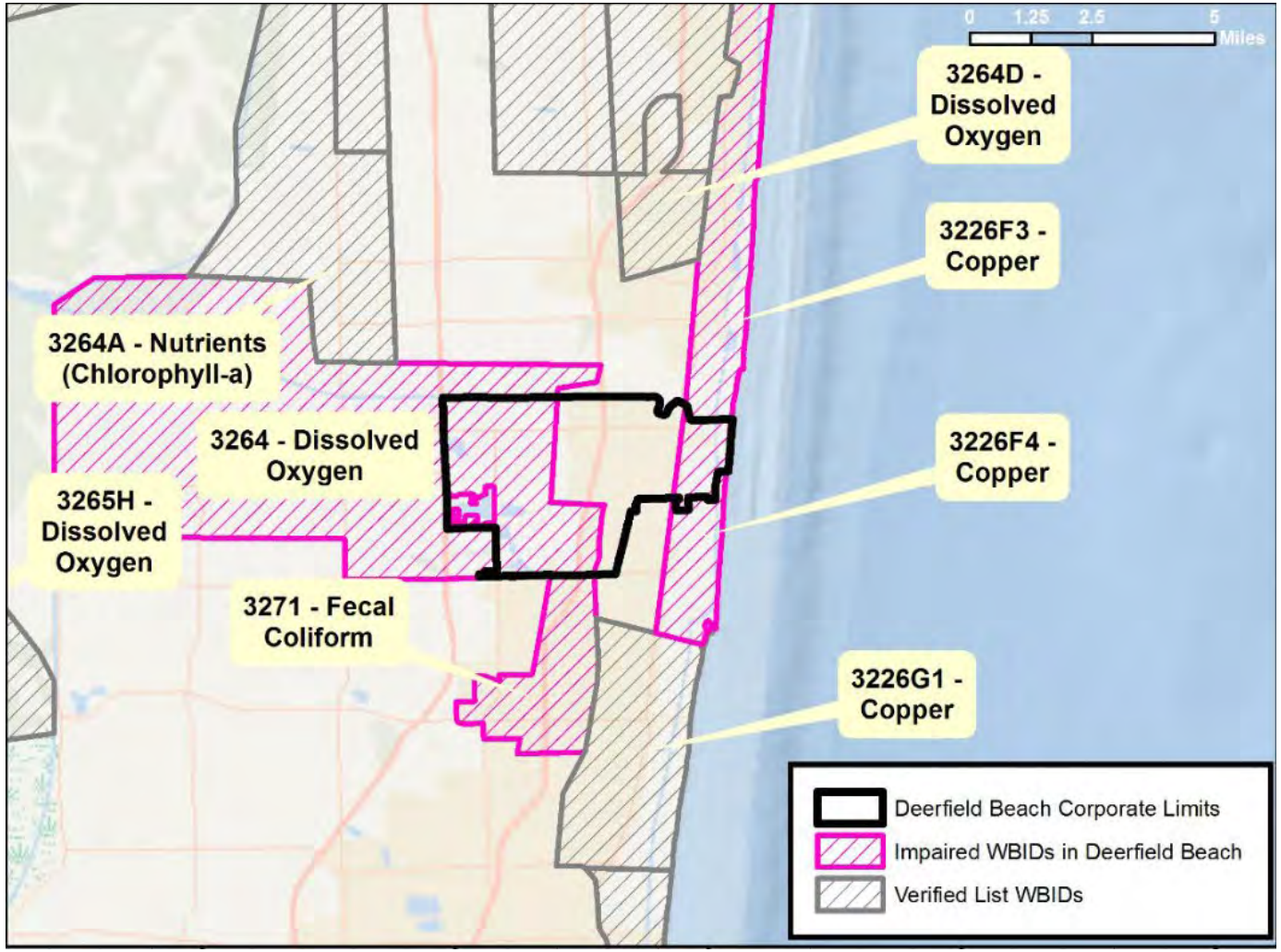


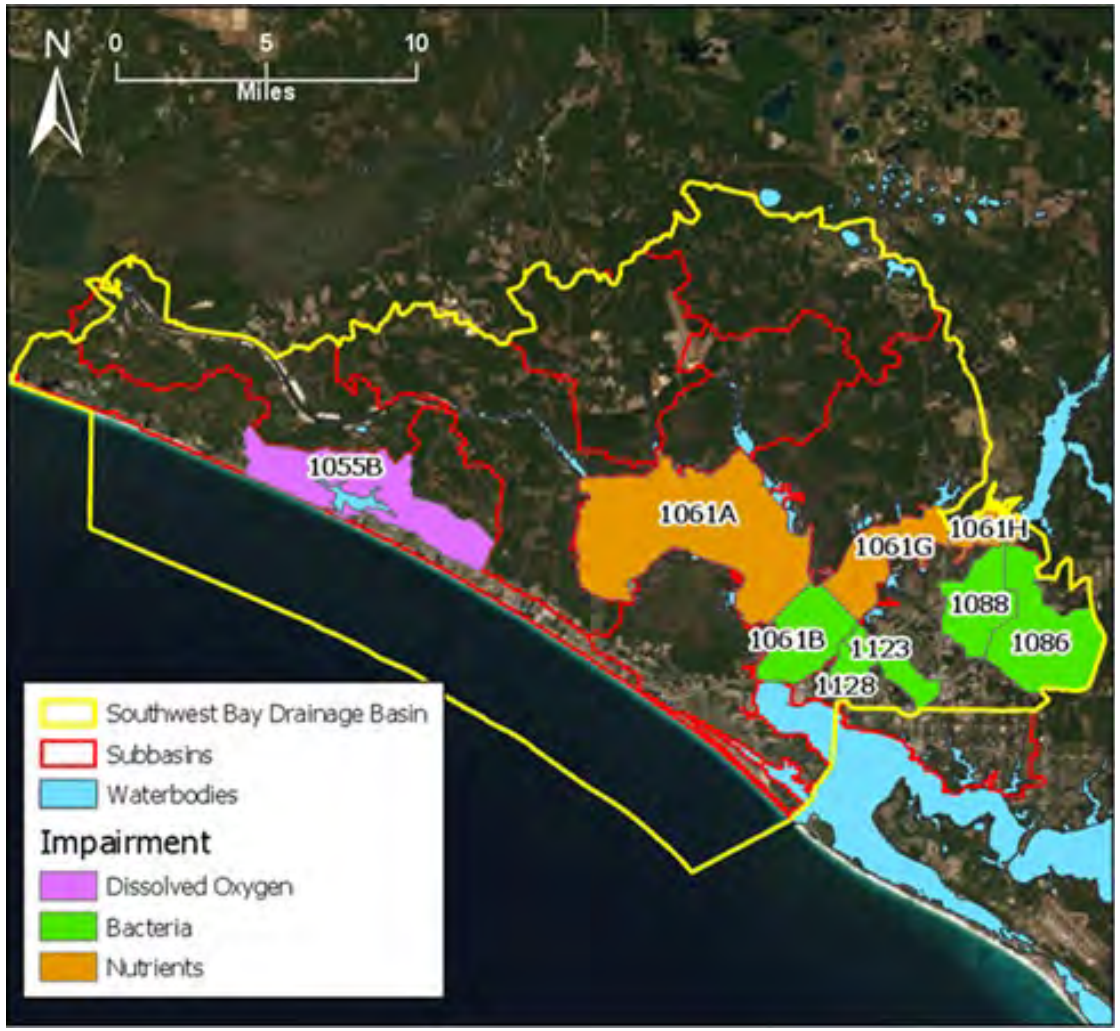


Identifying "Hot Spots"

- Approach
- **Identifying Impairments/TMDLs/BMAPs**
- Water Quality Data Analyses
- Pollutant Loading
- Opportunity

Identifying "Hot Spots" – Impairments/TMDLs/BMAPs

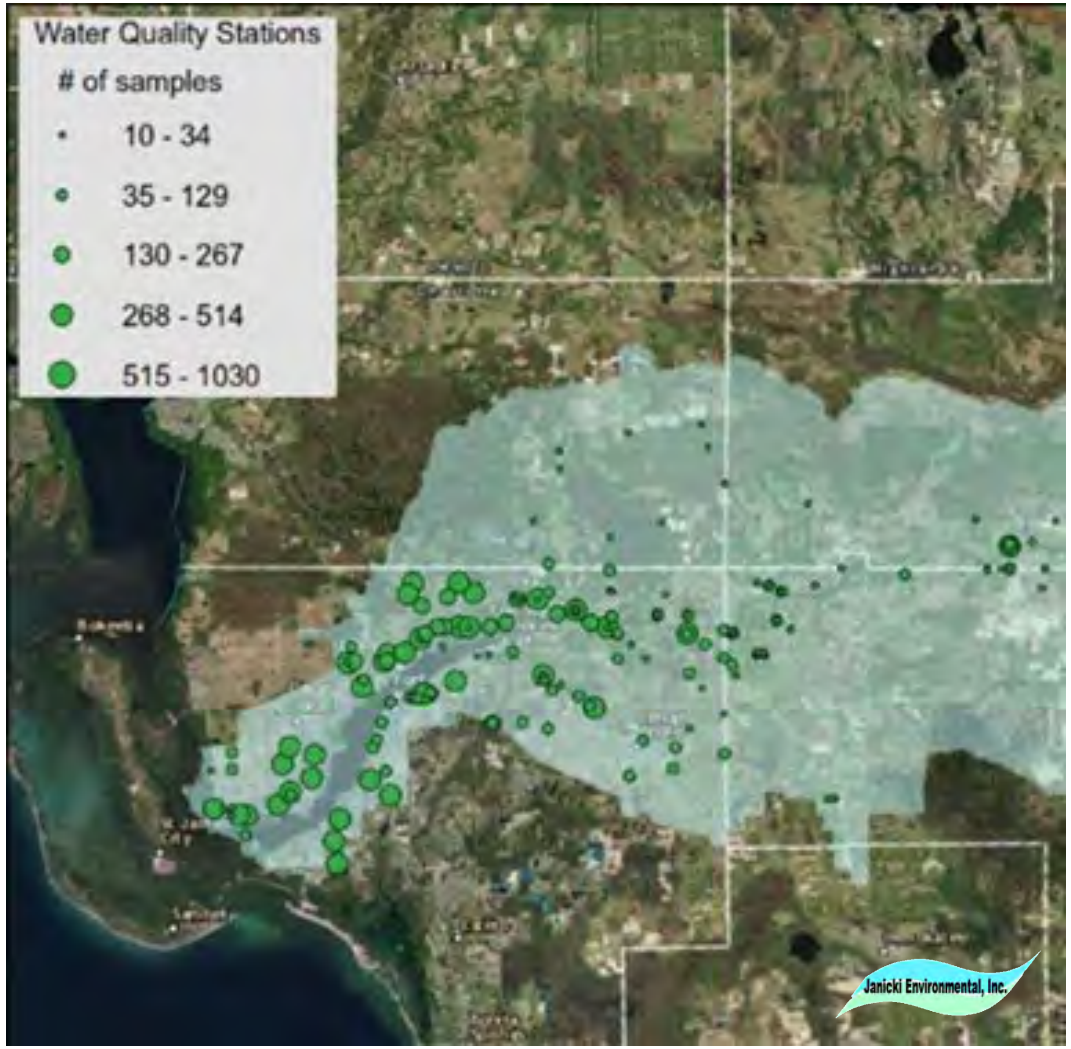


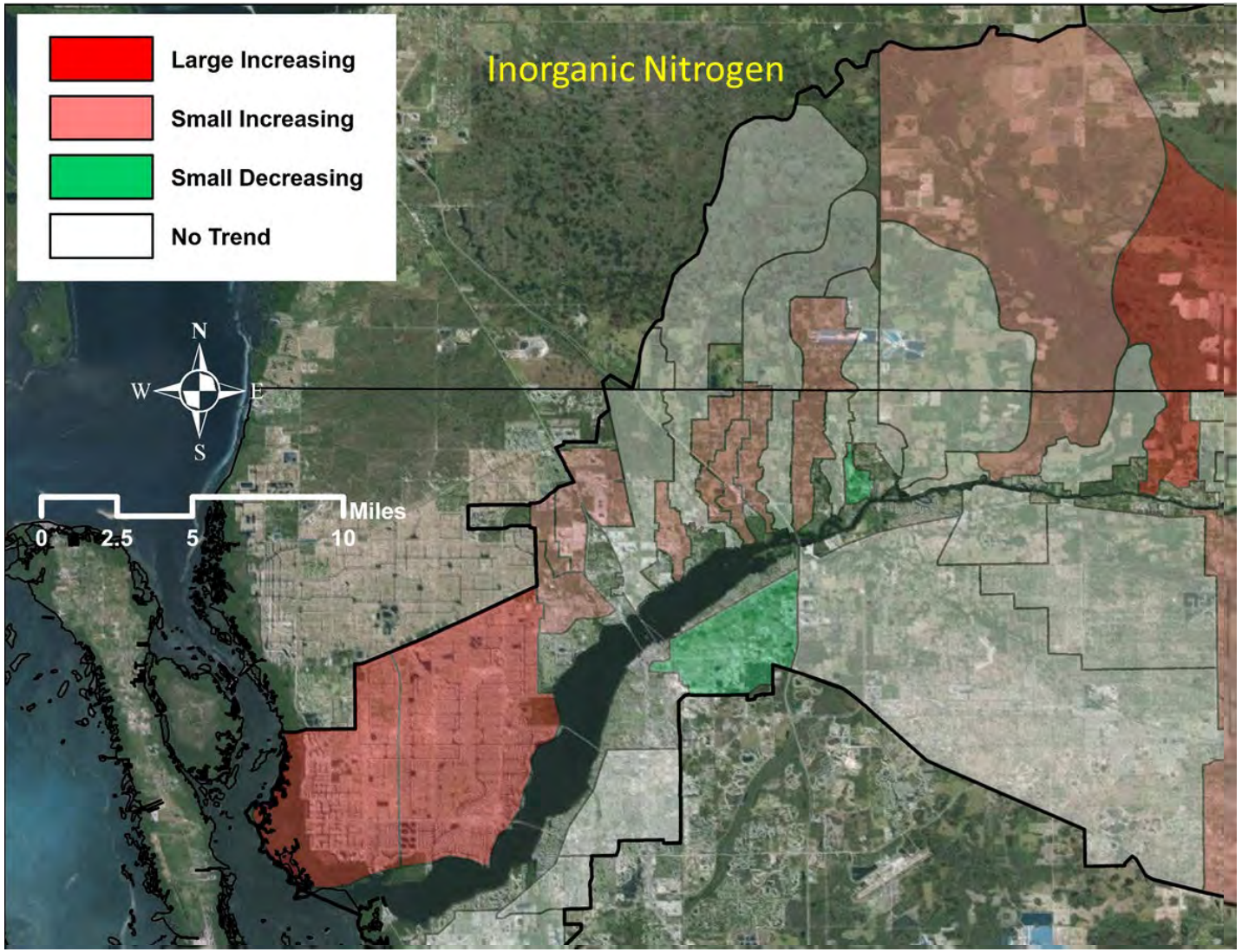


Identifying "Hot Spots"

- Approach
- Identifying Impairment TMDLs/BMAPs
- **Water Quality Data Analyses**
- Pollutant Loading
- Opportunity

Identifying "Hot Spots" – Water Quality Data Analyses

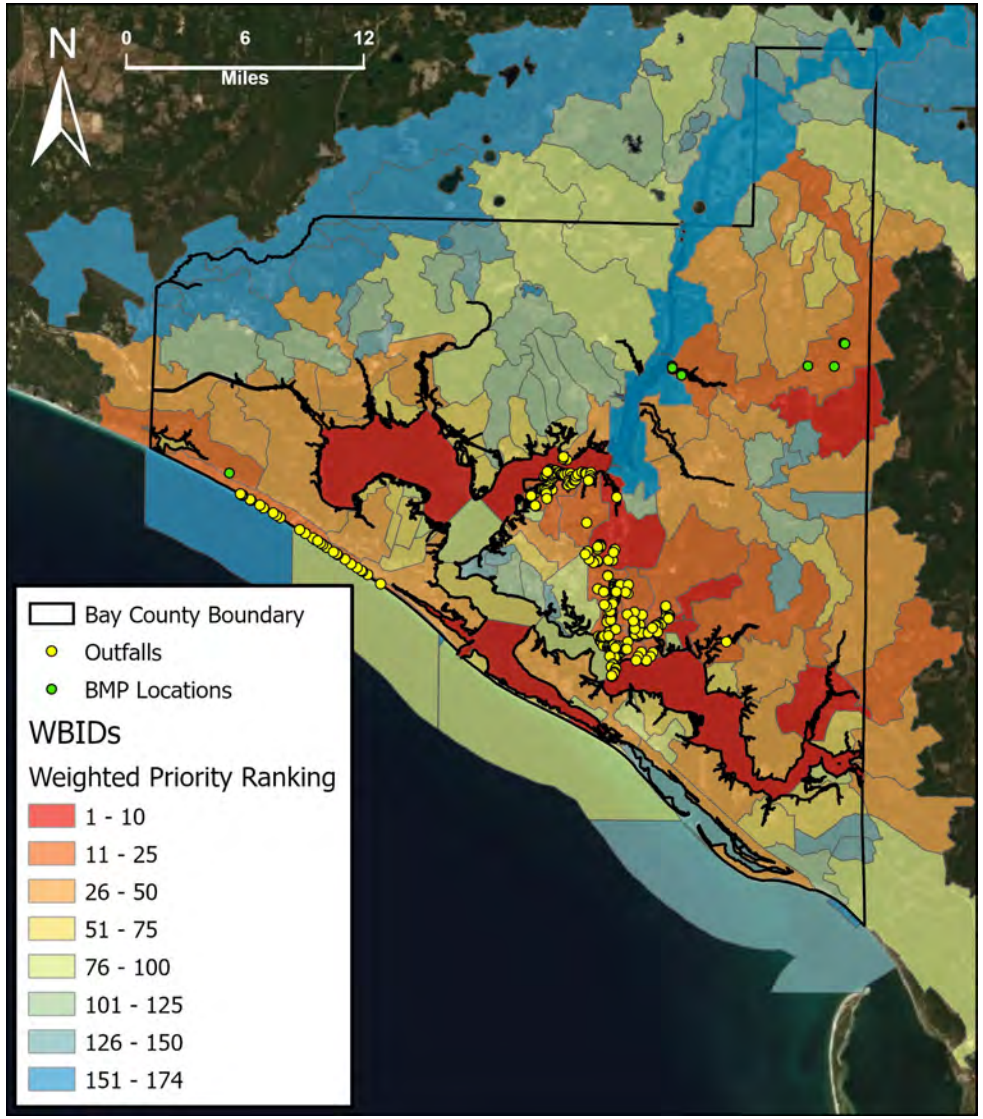


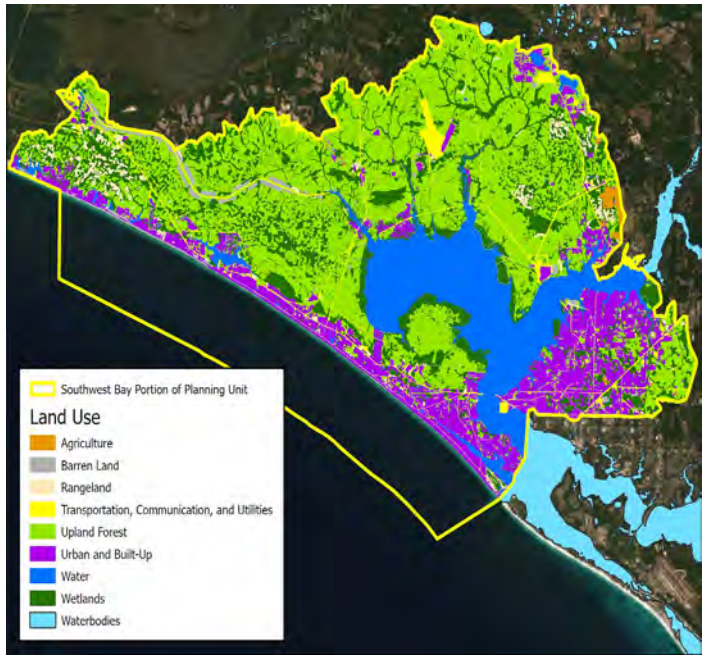


Identifying "Hot Spots"

- Approach
- Identifying Impairments/TMDLs/BMAPs
- Water Quality Data Analyses
- **Pollutant Loading**
- Opportunity

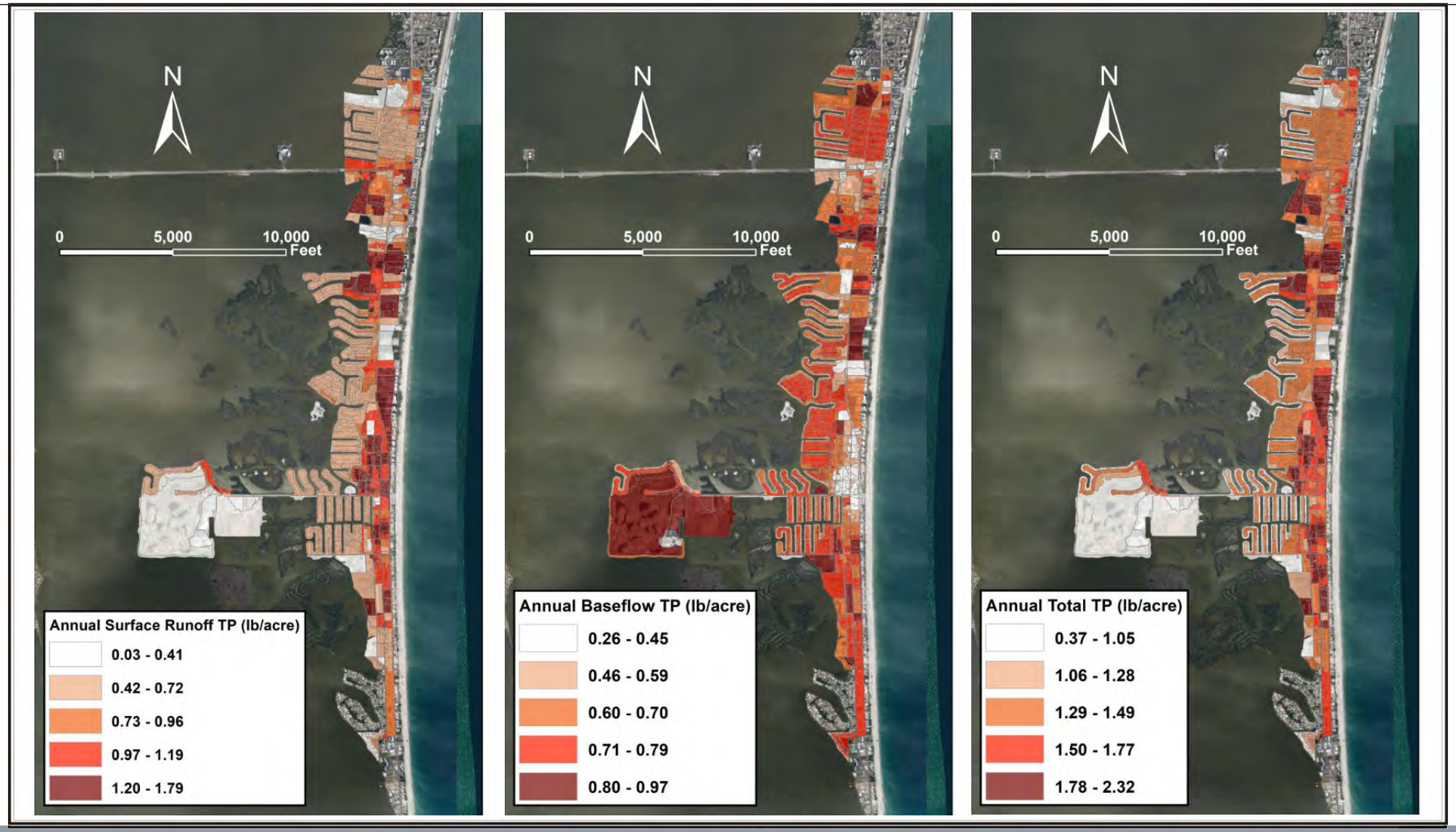
Identifying "Hot Spots" – Pollutant Loading





WBID	Name	Outfalls in WBID	BMPs in WBID	Impaired? (Y/N)	Impairment	Category	Adjacent to Impaired? (Y/N)	ATM Rank
1061F	EAST BAY (EAST SEGMENT)	2	0	Y	Nutrients (TN), Bacteria	5	Y	1
1061H	NORTH BAY (NORTH SEGMENT2)	4	0	Y	Nutrients (TN), Bacteria	5	Y	2
1061G	NORTH BAY (NORTH SEGMENT1)	4	0	Y	Nutrients (TN), Bacteria	5	Y	3
1061E	ST ANDREW BAY (MOUTH)	0	0	Y	Nutrients (TN)	5	Y	4
1061A	WEST BAY	0	0	Y	Nutrients (TN), Bacteria	5	Y	5
1142	BOGGY CREEK	0	0	Y	Bacteria, Dissolved Oxygen	5	Y	6
1142A	BOGGY CREEK (SHELLFISH PORTION)	0	0	Y	Bacteria, Dissolved Oxygen	5	Y	7
1086	MILL BAYOU	14	13	Y	Bacteria	5	Y	8
1041	LITTLE BEAR CREEK (SOUTH FORK)	0	0	Y	Bacteria	5	Y	9
1111A	SANDY CREEK (SHELLFISH PORTION)	0	0	Y	Bacteria	5	Y	10

Identifying “Hot Spots” – Pollutant Loading

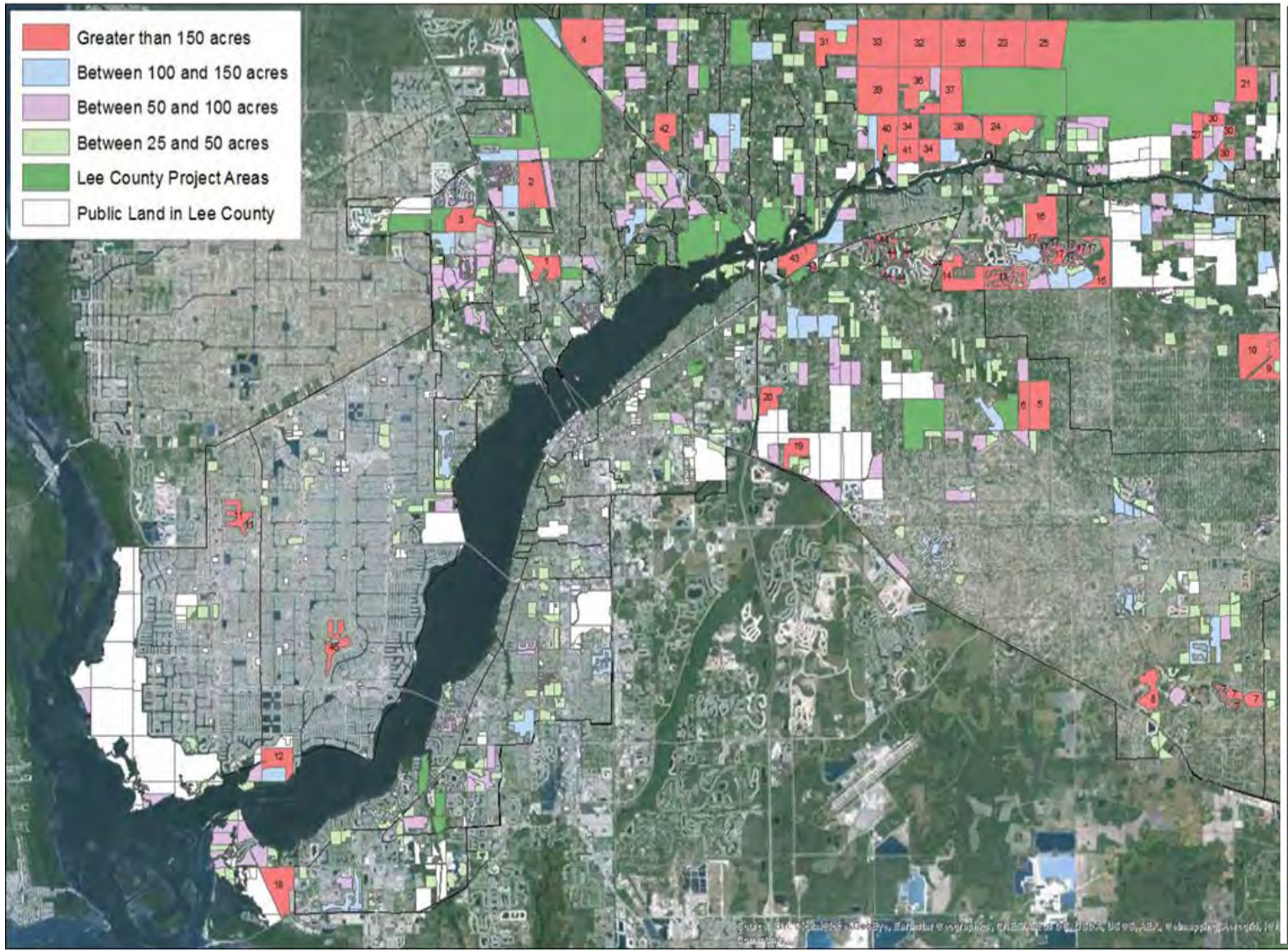


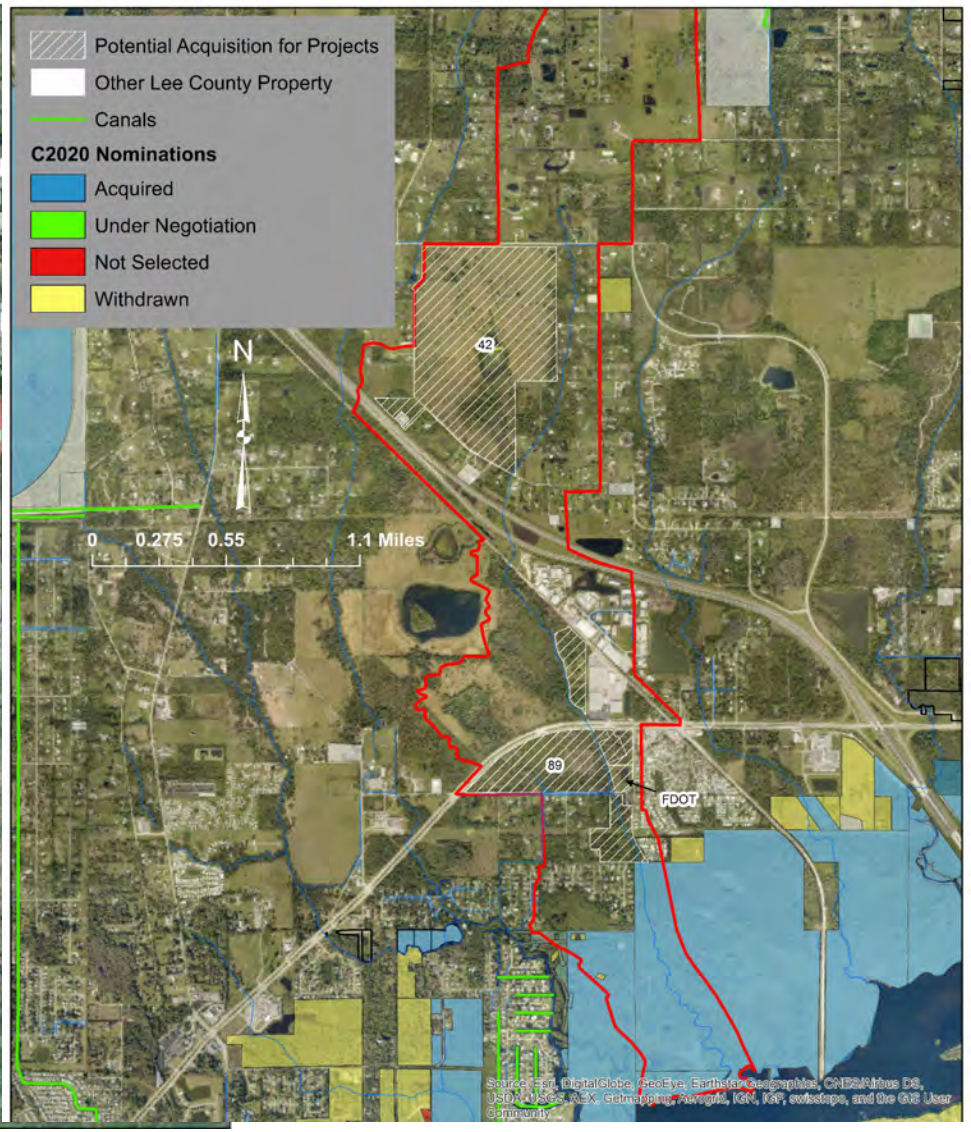
Identifying "Hot Spots" – Pollutant Loading

Identifying "Hot Spots"

- Approach
- Identifying Present Impairment Status
- Water Quality Data Analyses
- Pollutant Loading Analyses and Land Use
- **Opportunity**

Identifying "Hot Spots" – Opportunity





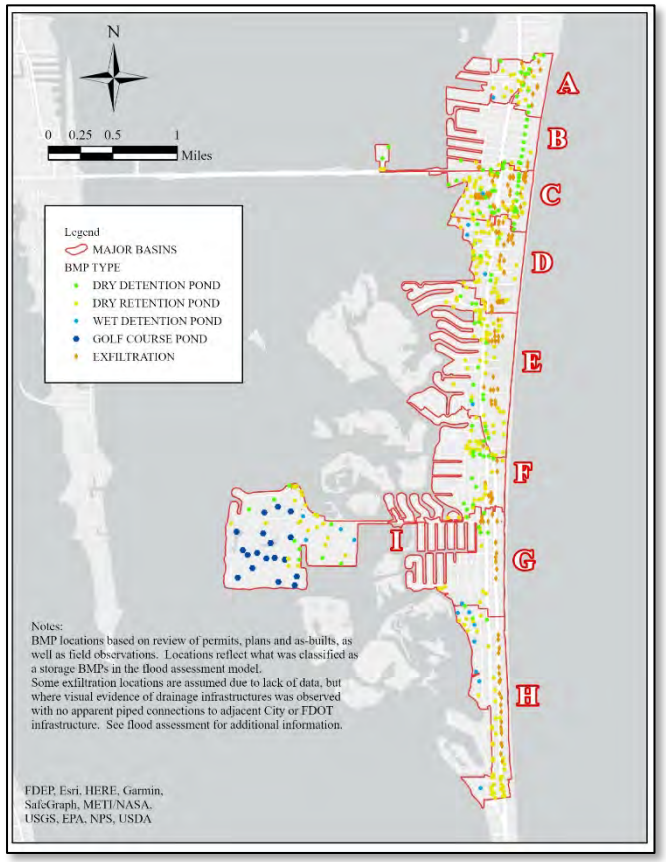
Restoration Strategies

- **Stormwater and BMP Inventory**
- Large Scale BMP Planning / Siting
- Structural BMP Types, Benefits, and Challenges
- Non-Structural BMP Types and Challenges
- Real Time / Active BMP Controls
- Future Climate Impacts

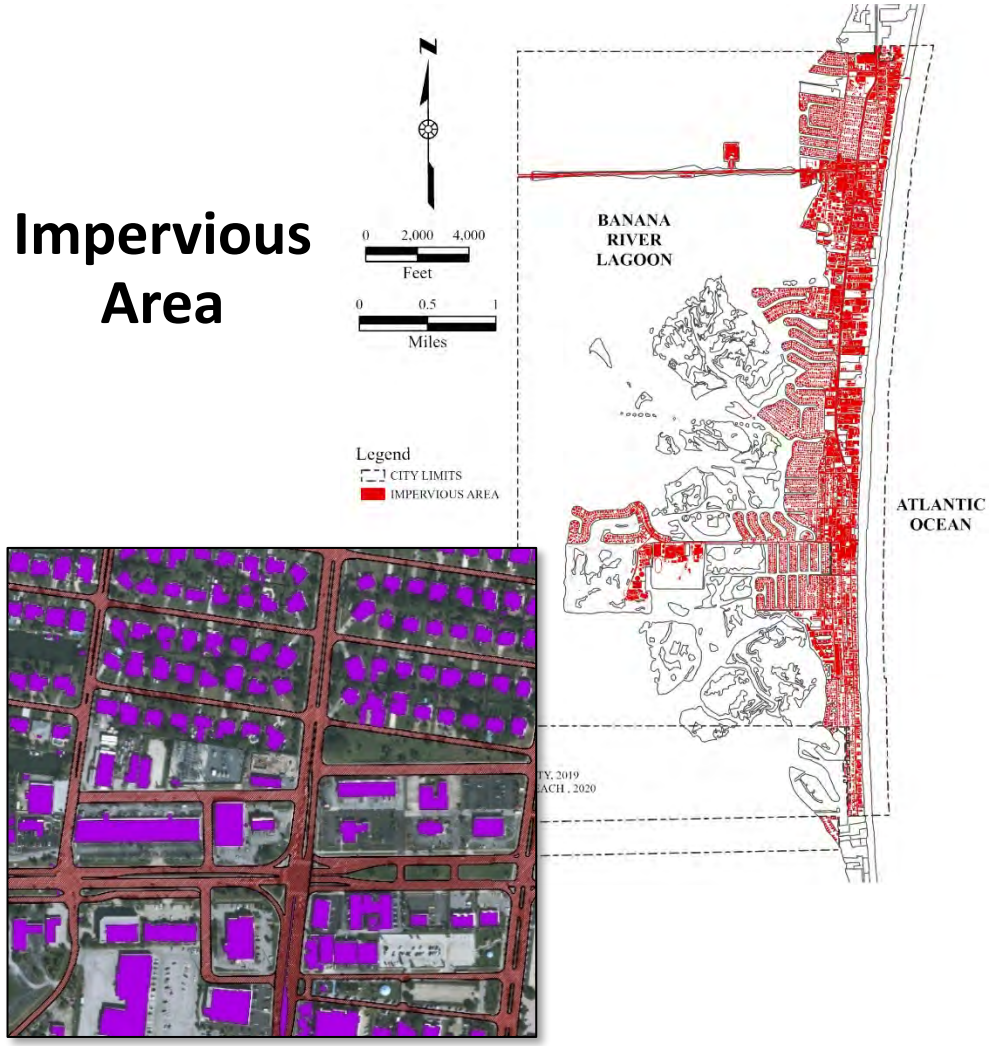
Restoration Strategies – Stormwater and BMP Inventory

Drainage Infrastructure

- Public and private



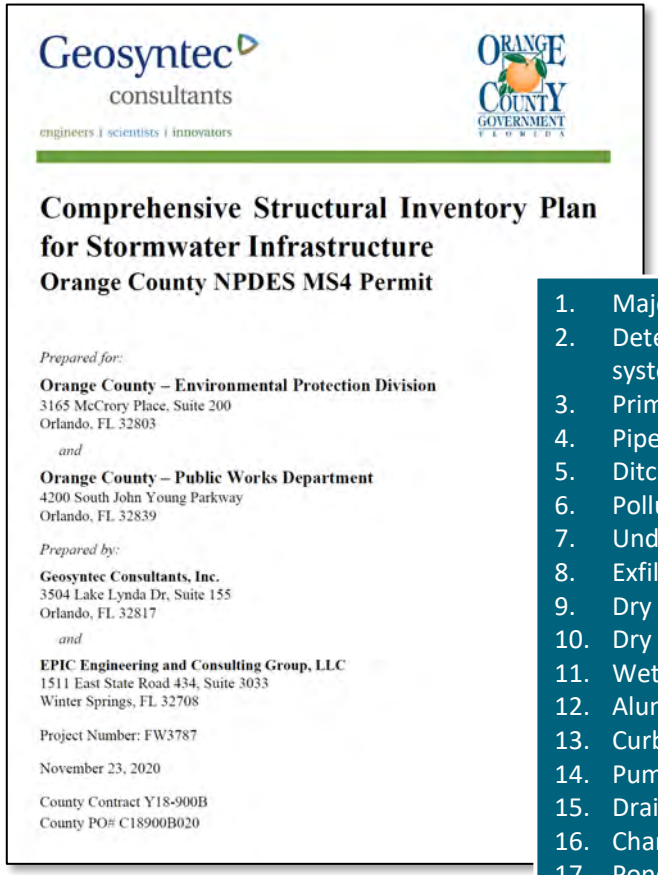
Impervious Area



Restoration Strategies – Stormwater and BMP Inventory

Orange County Stormwater Comprehensive Structural Inventory (CSI)

- **NPDES Permit Requirement**



Geosyntec consultants
engineers | scientists | innovators

ORANGE COUNTY GOVERNMENT FLORIDA

Comprehensive Structural Inventory Plan for Stormwater Infrastructure
Orange County NPDES MS4 Permit

Prepared for:

Orange County – Environmental Protection Division
3165 McCrory Place, Suite 200
Orlando, FL 32803

and

Orange County – Public Works Department
4200 South John Young Parkway
Orlando, FL 32839

Prepared by:

Geosyntec Consultants, Inc.
3504 Lake Lynda Dr, Suite 155
Orlando, FL 32817

and

EPIC Engineering and Consulting Group, LLC
1511 East State Road 434, Suite 3033
Winter Springs, FL 32708

Project Number: FW3787

November 23, 2020

County Contract Y18-900B
County PO# C18900B020

1. Major outfalls
2. Detention with underdrain filter systems
3. Primary canals / secondary canals
4. Pipes / culverts
5. Ditches / conveyance swales
6. Pollution control structures
7. Underdrain filter systems
8. Exfiltration / French drains
9. Dry retention systems
10. Dry detention systems
11. Wet detention systems
12. Alum injection systems
13. Curb inlet baskets
14. Pump stations
15. Drain wells
16. Channel control structures
17. Pond control structures
18. Inlets / catch basin

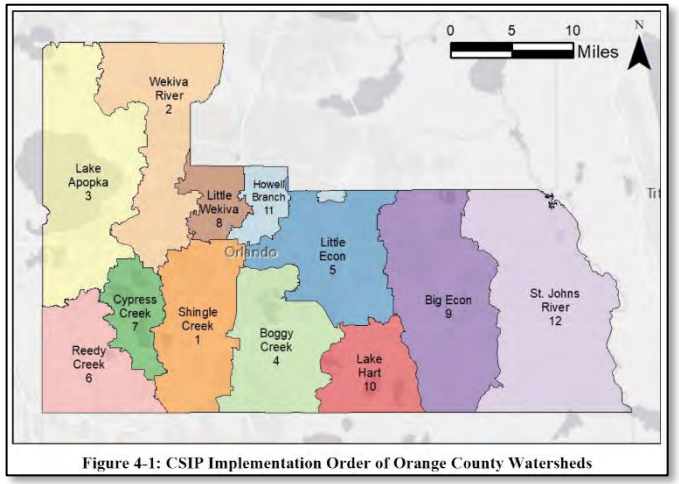


Figure 4-1: CSIP Implementation Order of Orange County Watersheds

Datasets that will be evaluated include the following:

- Existing County stormwater infrastructure GIS features (in format used by each of the County divisions)
- PW-SW Watershed Consultant GIS data from PW-SW's ongoing efforts to update the Shingle Creek Watershed Stormwater Management Master Plan.
- Survey / As Built Plans
- Construction plans
- Non-spatial data attributes and inspection forms/documents and pictures
- Factsheets from County's Data Management system (DM) which are hyperlinked with County's GIS layers.
- Aerial imagery and Google Street View / Bing StreetSide
- Topographic Data (digital elevation models from the most recent watershed project)

Table 2-5: Estimated Stormwater Infrastructure Gaps by Watershed

Type	Count Category[1,2]	Watershed												TOTAL
		Big Econ	Boggy Creek	Cypress Creek	Howell Branch	Lake Apopka	Lake Hart	Little Econ	Little Wekiva	Reedy Creek	Shingle Creek	St. Johns River	Wekiva River	
Structures[3]	Estimated	23,860	27,613	10,892	1,814	12,998	5,220	36,636	11,105	12,015	39,690	1,616	24,902	208,361
	Inventoried	14,871	12,975	6,574	339	2,657	3,115	17,447	3,645	9,056	19,447	506	9,264	99,896
	Remaining[4]	8,989	14,638	4,318	1,475	10,341	2,105	19,189	7,460	2,959	20,243	1,110	15,638	108,465
	% Complete	62%	47%	60%	19%	20%	60%	48%	33%	75%	49%	31%	37%	48%
Pipes[3]	Estimated	19,748	23,940	8,953	1,564	10,685	4,358	31,375	9,536	10,462	34,566	1,294	20,696	177,177
	Inventoried	11,147	10,826	5,619	259	2,203	2,648	14,312	3,017	7,916	16,715	268	7,940	82,870
	Remaining[4]	8,601	13,114	3,334	1,305	8,482	1,710	17,063	6,519	2,546	17,851	1,026	12,756	94,307
	% Complete	56%	45%	63%	17%	21%	61%	46%	32%	76%	48%	21%	38%	47%
Secondary Canals, Ditches, Swales (miles)	Estimated	149	33	35	3	77	28	60	14	30	48	126	96	699
	Inventoried	111	17	7	0	12	4	24	6	3	24	13	8	230
	Remaining[4]	38	16	28	3	65	24	36	8	27	24	113	88	469
	% Complete	75%	52%	20%	16%	16%	13%	40%	42%	9%	50%	11%	9%	33%
Outfalls[5]	Estimated	1,091	300	411	30	196	339	571	91	463	462	147	676	4,777
	Inventoried[6]	365	226	150	22	87	44	380	78	261	213	41	201	2,068
	Remaining[7]	726	74	261	8	109	295	191	13	202	249	106	475	2,709
	% Complete	33%	75%	36%	73%	44%	13%	67%	86%	56%	46%	28%	30%	43%

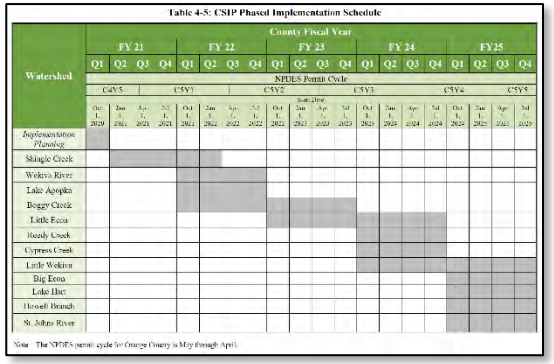


Table 4-5: CSIP Phased Implementation Schedule

Watershed	County Fiscal Year: FY 21				FY 22				FY 23				FY 24				FY25			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	NPDES Permit Cycle																			
	C4Y5				C5Y1				C5Y2				C5Y3				C5Y4			C5Y5
	Oct 1, 2020	Jan 1, 2021	Apr 1, 2021	Jul 1, 2021	Oct 1, 2021	Jan 1, 2022	Apr 1, 2022	Jul 1, 2022	Oct 1, 2022	Jan 1, 2023	Apr 1, 2023	Jul 1, 2023	Oct 1, 2023	Jan 1, 2024	Apr 1, 2024	Jul 1, 2024	Oct 1, 2024	Jan 1, 2025	Apr 1, 2025	Jul 1, 2025
Implementation Planning																				
Shingle Creek																				
Wekiva River																				
Lake Apopka																				
Boggy Creek																				
Little Econ																				
Reedy Creek																				
Cypress Creek																				
Little Wekiva																				
Big Econ																				
Lake Hart																				
Howell Branch																				
St. Johns River																				

Note: The NPDES permit cycle for Orange County is May through April.

Restoration Strategies – Stormwater and BMP Inventory

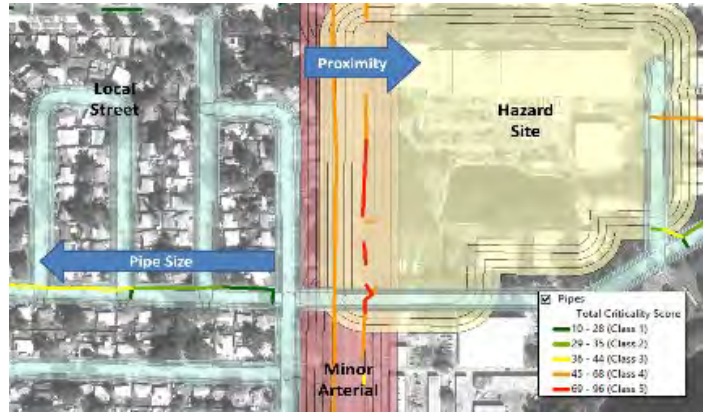
Pinellas County Stormwater Infrastructure Criticality Assessment

- Criticality Promotes Sustainability and Resilience
  - Guide strategies for proactive operation and maintenance
  - Prioritize long term rehabilitation of assets
  - Informs asset management plan and saves money over the long term
- Key Questions:
  - What are the factors that determine infrastructure criticality?
  - How to quantify criticality of a stormwater asset?
  - How to quantify criticality of stormwater assets relative to each other?
- Criticality = Likelihood of Failure x Consequences of Failure
  - Consequences (Impacts) – Multiple Factors Considered
    - Financial
    - Social
    - Environmental
    - Injury, Illness, Death
  - Likelihood (Vulnerability, Probability) – Multiple Factors Considered
    - Material / Condition
    - Age
    - Local Conditions
- Results provide ranking of assets for sustainable management
- Criticality can be applicable to any type of public infrastructure
  - Roads, water/wastewater, utilities, real estate

Analysis of Nearly 100,000 stormwater assets

Source: ASCE 2017 Infrastructure Report Card

GIS spatial weighting of assets



Criticality considered proximity to other sensitive assets and physical characteristics of asset

Restoration Strategies

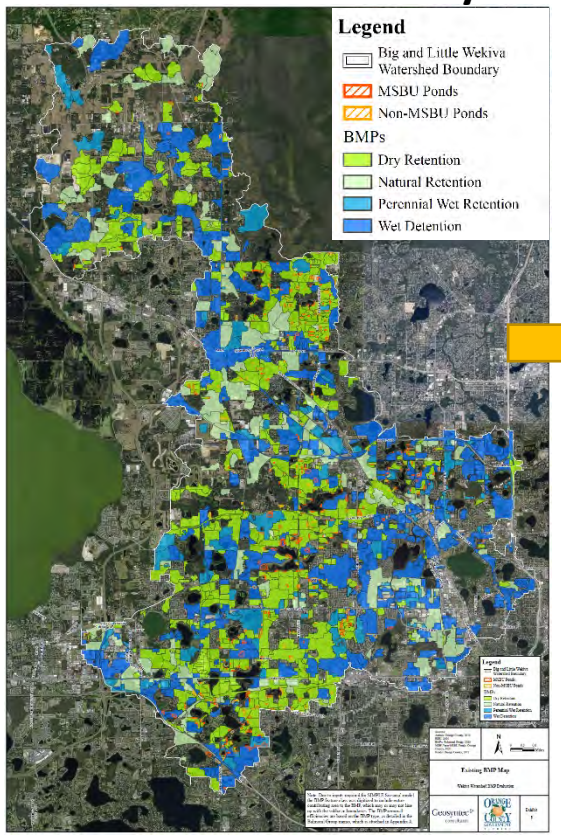
- Stormwater and BMP Inventory
- **Large Scale BMP Planning / Siting**
- Structural BMP Types, Benefits, and Challenges
- Non-Structural BMP Types and Challenges
- Real Time / Active BMP Controls
- Future Climate Impacts

Restoration Strategies – Large Scale BMP Planning / Siting

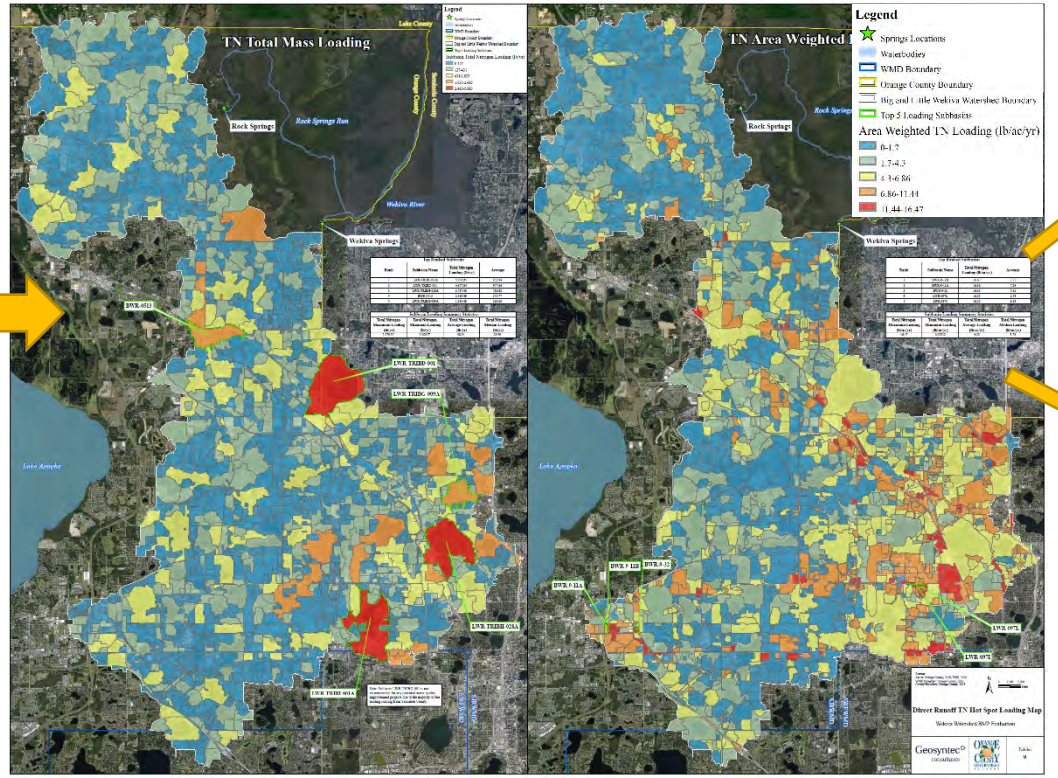
Orange County Wekiva Watershed BMP Study

- Address TMDL BMAP goals
- Address surface, groundwater, baseflow impacts

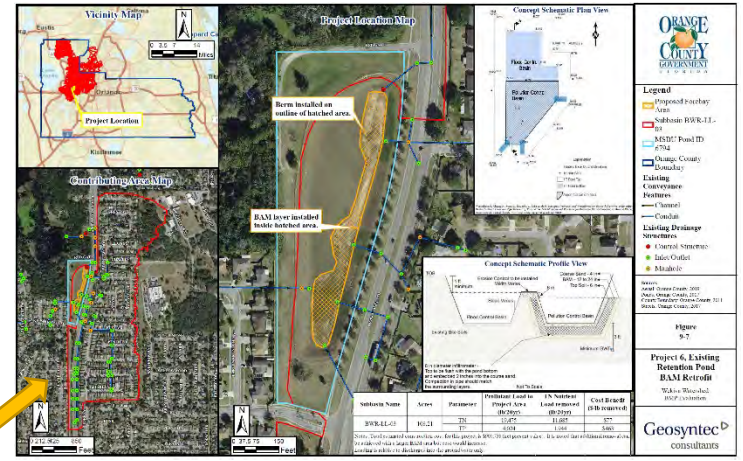
Basin BMP Inventory

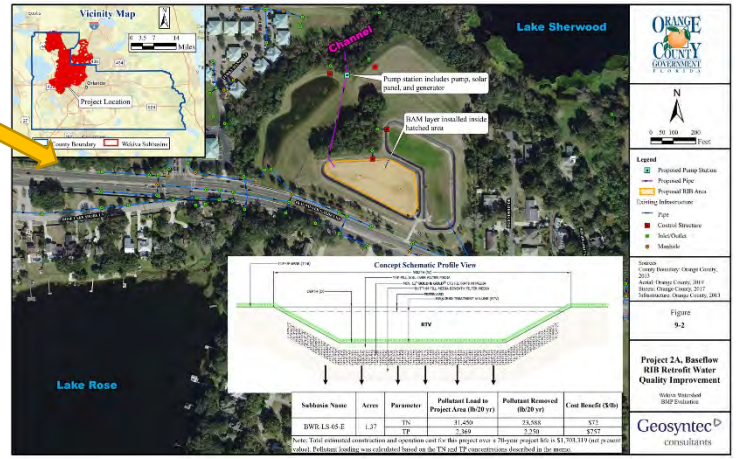


Pollutant Load Hot Spot Analysis



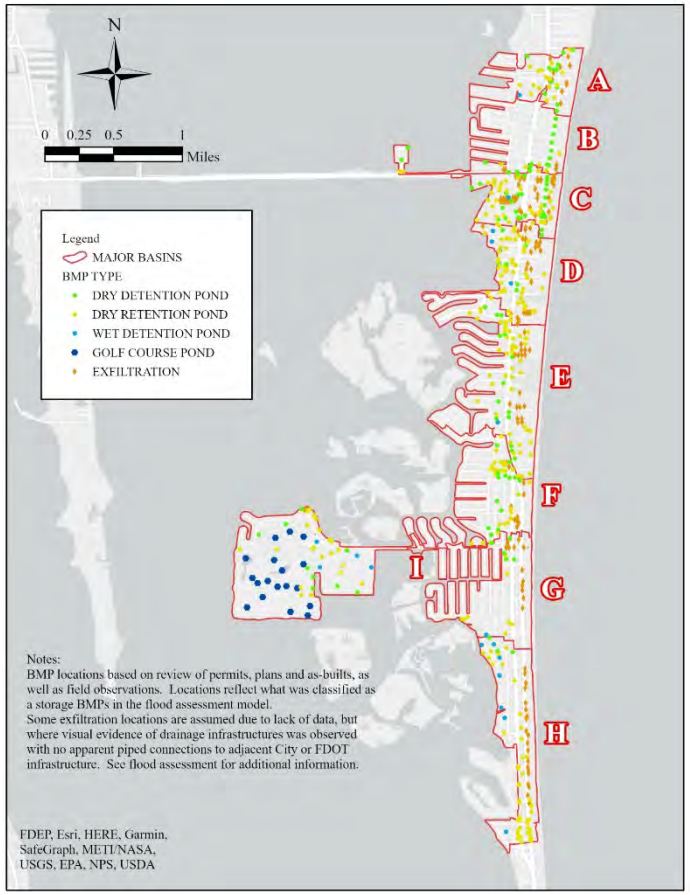
Project Concepts



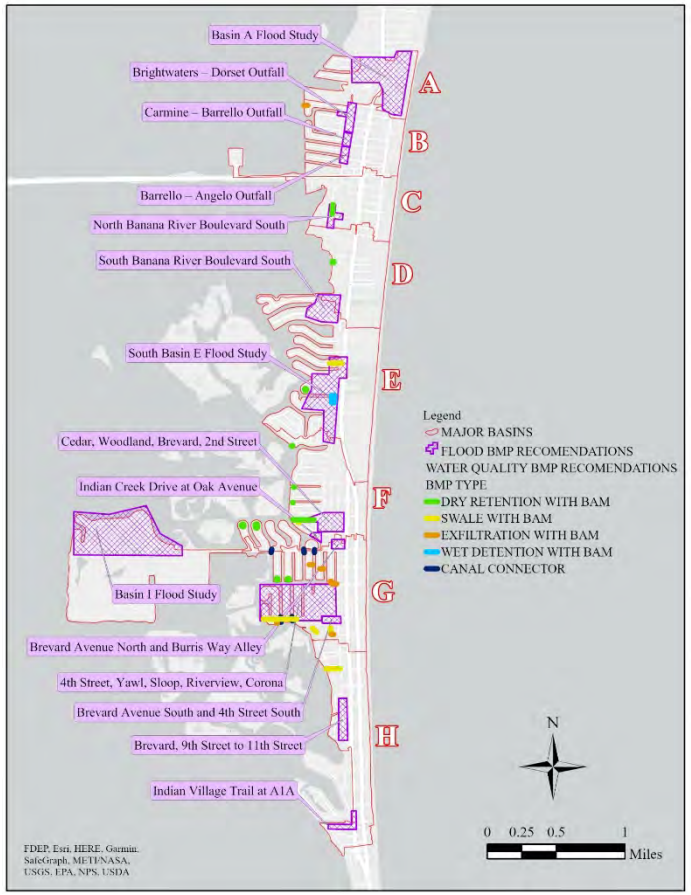


Restoration Strategies – Large Scale BMP Planning / Siting

Existing BMP Inventory



CIP Recommendations



CIP Project Details

CIP Project WETDT-01
HOLIDAY LANE WET DETENTION POND


Proposed pond location at Holiday Lane


Proposed pond location at Holiday Lane

Project Description:	Holiday Lane Wet Detention Pond: there are small area opportunities to install small wet detention areas to treat and infiltrate runoff. Treatment can be enhanced by including BAM into the outfall structure design (upflow filter) to provide additional pollutant load reduction. This project will require the City to acquire and utilize this currently vacant parcel to provide treatment for the outfall system. The pond should include an upflow filter on the outfall structure with incorporate BAM for additional treatment.		
Project Development Needs:	Survey, geotechnical investigation, modeling, design, permitting.		
Project Constraints:	Possible utility conflicts, possible R/W acquisition (either easement or purchase), private property coordination.		
Estimated Pollutant Load Reduction:	Runoff (lbs/yr): TN = 22.64, TP = 4.73, TSS = 1260.71		
Planning Level CIP Cost Projection:	$525,000	**Ranking:**	11

CIP Project DRYDT-06
LA RIVIERE ROAD BAM DRY POND


View of cul-de-sac on La Riviere Rd.

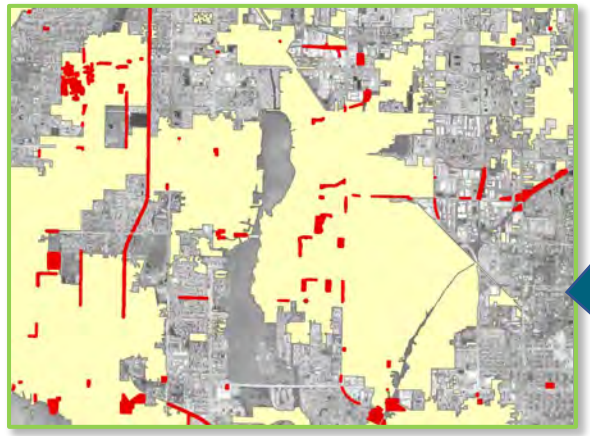

View of cul-de-sac on La Riviere Rd.

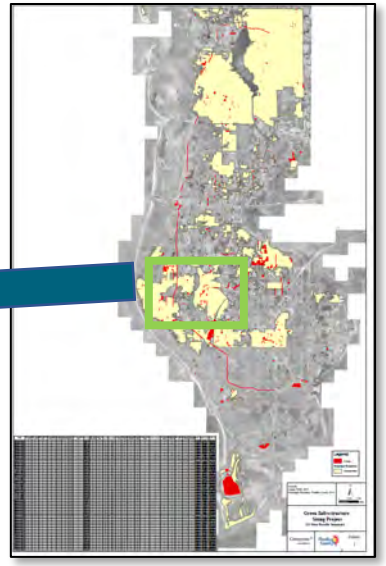
Project Description:	La Riviere Road BAM Dry Pond: There are small area opportunities at the ends of streets and cul-de-sacs near outfalls to install retention areas to treat and infiltrate runoff. Treatment can be enhanced by including BAM into the retention bottom design to provide additional pollutant load reduction. For this location, it is proposed that the City utilize the cul-de-sac to provide retention.		
Project Development Needs:	Survey, geotechnical investigation, modeling, design, permitting.		
Project Constraints:	Possible utility conflicts.		
Estimated Pollutant Load Reduction:	Runoff (lbs/yr): TN = 13.68, TP = 2.16, TSS = 247.88		
Planning Level CIP Cost Projection:	$105,000	**Ranking:**	23

Restoration Strategies – Large Scale BMP Planning / Siting

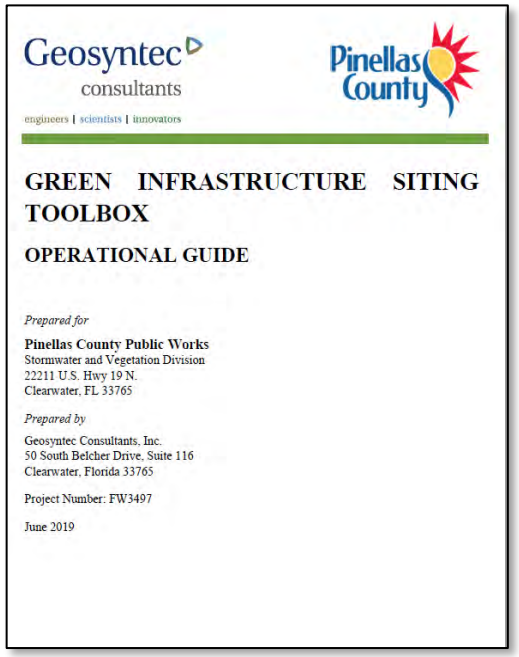
Green Infrastructure (GI) Siting Tools

- Develop a rating and suitability framework for siting GI as part of the new GI program
  - Take into account where the COUNTY owns property or has right-of-way
  - TMDL /impaired water priority areas
  - Considering site suitability (land use, soils, water table, etc.)
- Leverage depth of GIS data resources to develop spatial analysis tool
- End result to provide framework and toolset to evaluate water quality benefits and suitability to conceptualize and prioritize future GI projects
- Produce initial list of ranked GI projects
- Top ranked projects are conceptualized as proof of concept
- Establish standardized water quality benefit evaluation procedures
- SOPs developed so COUNTY may easily replicate the results

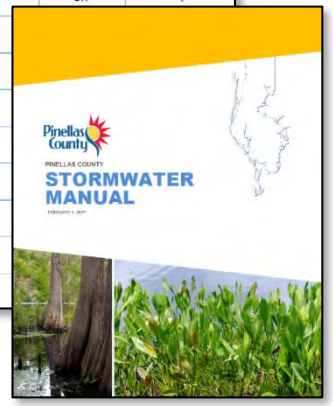


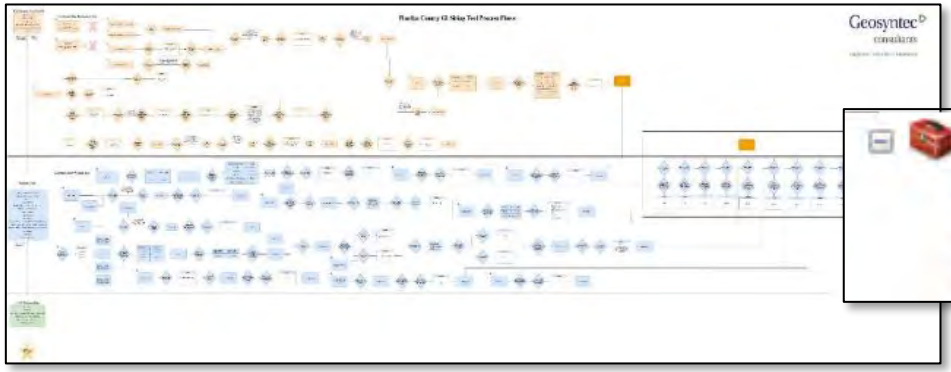


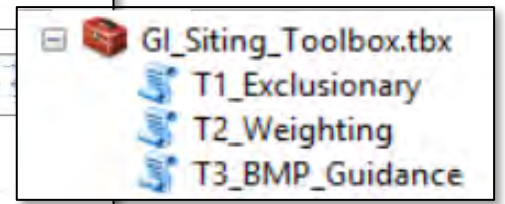
Over 430,000 parcels plus R/W areas evaluated – Nearly 900 GI candidate sites identified



Structural BMPs	Structural Stormwater BMPs	Manual Section	Explicit Load Reduction Credit
SW1	Retention Basin	6.1	√
SW2	Exfiltration Trench	6.2	√
SW3	Underground Storage and Retention	6.3	√
SW4	Treatment Swales	6.4	√
SW5	Vegetate Natural Buffers	6.5	√
SW6	Pervious Pavements	6.6	√
SW7	Green Roofs with Cisterns	6.7	√
SW8	Wet Detention Systems		
SW9	Stormwater Harvesting/ Horizontal Wells		
SW10	Up-Flow Filter Systems		
SW11	Managed Aquatic Plant Systems		
SW12	Biofiltration Systems/Tree Box Filters		
SW13	Rain gardens		
SW14	Rainwater Harvesting/Cisterns		
SC15	Rainfall Interceptor Trees		







Restoration Strategies

- Stormwater and BMP Inventory
- Large Scale BMP Planning / Siting
- **Structural BMP Types, Benefits, and Challenges**
- Non-Structural BMP Types and Challenges
- Real Time / Active BMP Controls
- Future Climate Impacts

Restoration Strategies – Structural BMP Types, Benefits, and Challenges

Traditional Stormwater Strategy

Sensitive to Groundwater Table and Tailwater Elevation

Centralized One Big Stormwater Facility for Attenuation and Treatment

Receiving Water

Restoration Strategies – Structural BMP Types, Benefits, and Challenges

Distributed Hydrology Stormwater Strategy

GSI / LID ➔ Treatment Train

Bioretention / Rain Gardens

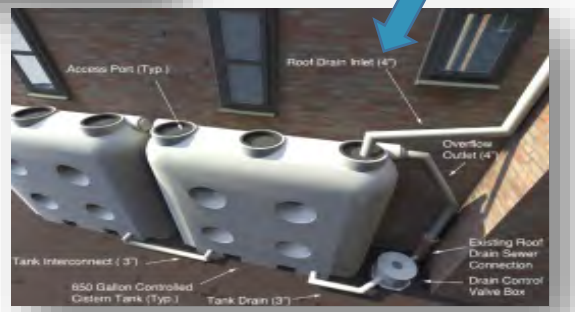
Smaller Footprint Pond

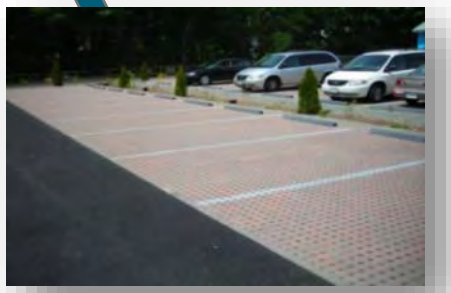
Inlet Filters / Modular Wetlands

Planter Boxes / Tree Boxes

Mitigate Constraints of Shallowing Groundwater Table and Increasing Tailwater

Stormwater Harvesting

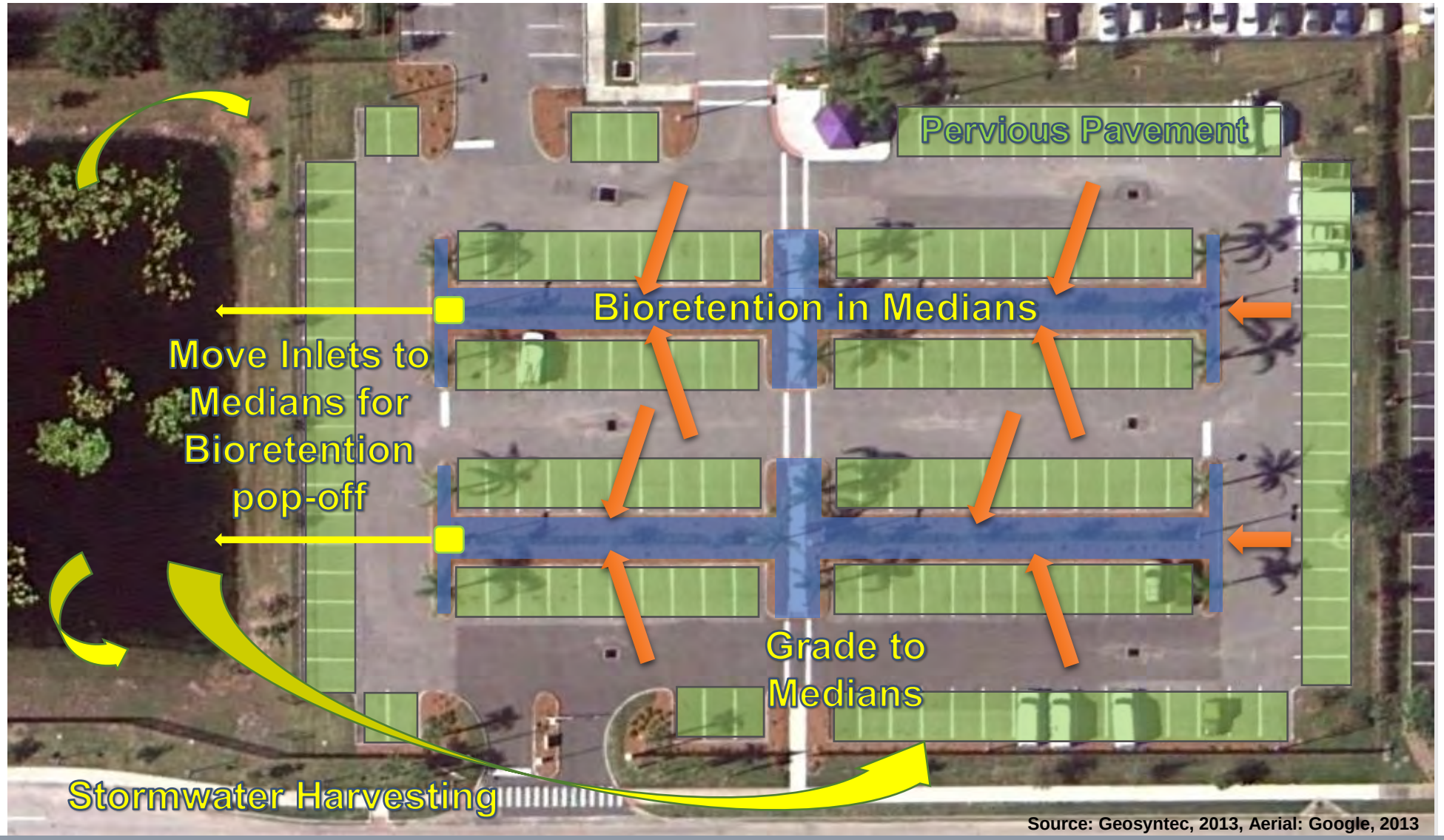




Pervious Pavement

Receiving Water

Restoration Strategies – Structural BMP Types, Benefits, and Challenges



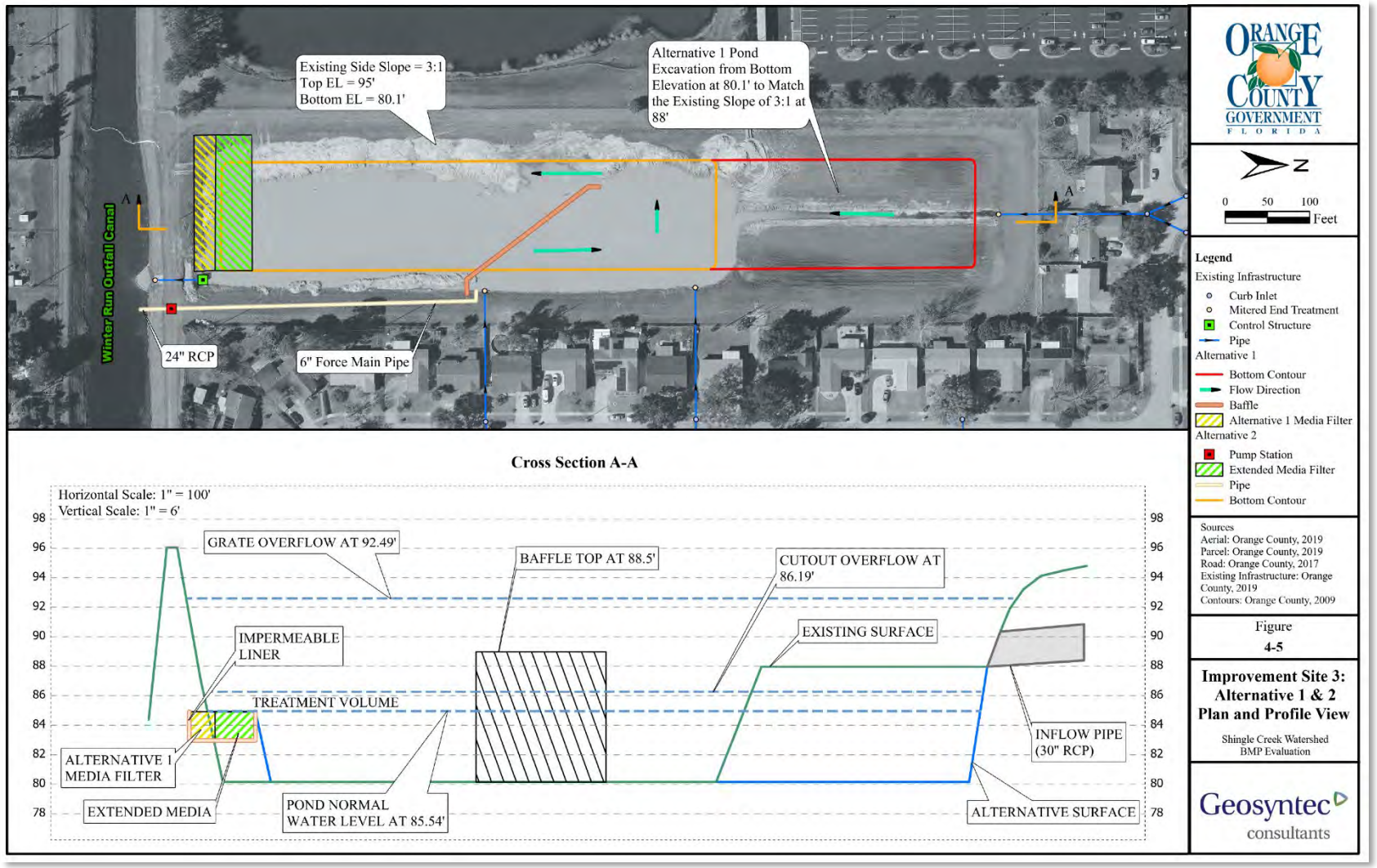
Source: Geosyntec, 2013, Aerial: Google, 2013

Alternative Stormwater Management

Green Infrastructure

Low Impact Design

Restoration Strategies – Structural BMP Types, Benefits, and Challenges



Retrofitting Existing BMPs

- Shingle Creek Pond
  - Expand pond
  - Add BAM
  - Treat baseflow with pump system

Restoration Strategies

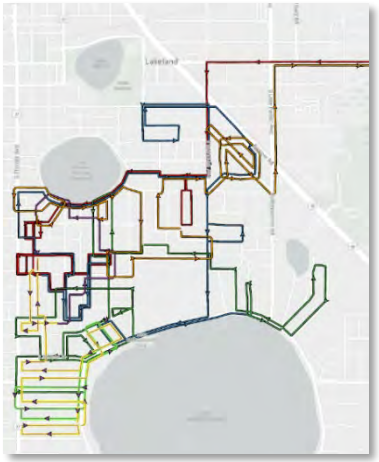
- Stormwater and BMP Inventory
- Large Scale BMP Planning / Siting
- Structural BMP Types, Benefits, and Challenges
- **Non-Structural BMP Types and Challenges**
- Real Time / Active BMP Controls
- Future Climate Impacts

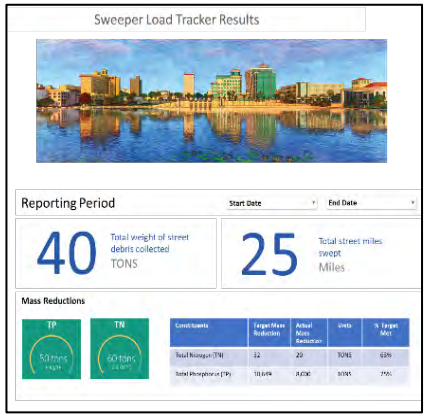
Restoration Strategies – Non-Structural BMP Types and Challenges

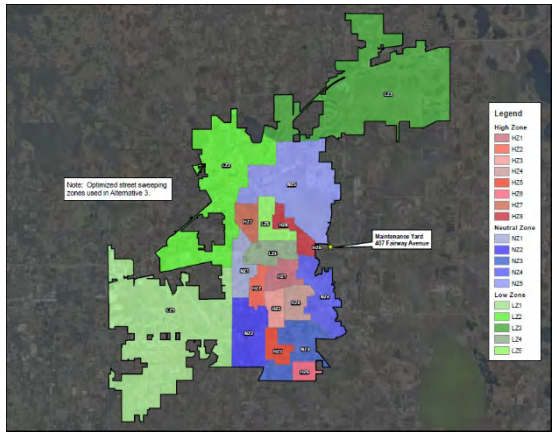
Lakeland Street Sweeping Study

- Characterize the street debris collected for street segments with different land use and tree canopy characteristics
  - Organic vs Inorganic
  - Nutrient content
- Evaluate and optimize the street sweeping practices in the City of Lakeland
  - Streets currently being swept (all public curbed streets)
  - Divided into several zones
- Optimize routes by zones and trips to minimize travel time and save fuel costs
- Optimization shows that the City can decrease the cost per pound of TN or TP removed utilizing new zones and frequencies
- Lakeland received approval from FDEP to use site specific nutrient concentration data in future NPDES reporting

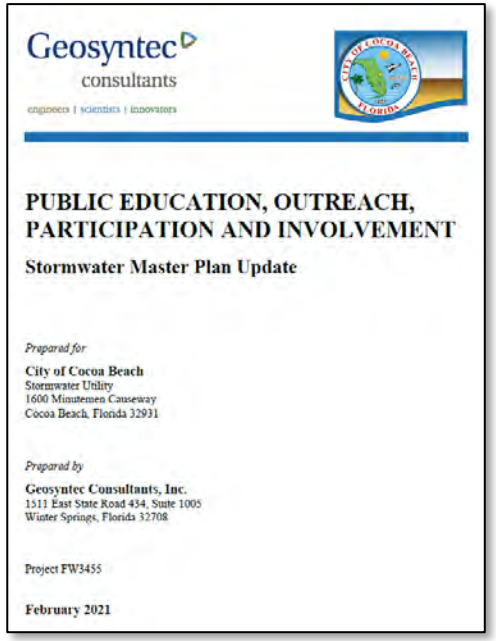
Scenario	Cost ($)	Curb Miles Swept (mi)	Mass of Street Debris Collected (lb)	TN (lb)	TP (lb)	TN ($/lb)	TP ($/lb)	TN (lb/$1000)	TP (lb/$1000)
NPDES	689,779	16,584	3,544,577	2578	1335	267.58	516.81	3.74	1.93
Existing	689,779	16,584	3,274,021	2501	1231	275.81	560.37	3.63	1.78
Alternative 1	689,779	16,584	3,271,511	6908	2508	99.85	275.04	10.02	3.64
Alternative 2	693,027	16,662	3,264,861	7110	2541	97.47	272.79	10.26	3.67
Alternative 3	681,164	16,377	3,252,778	7211	2553	94.47	266.79	10.59	3.75







Restoration Strategies – Non-Structural BMP Types and Challenges


Geosyntec consultants
engineers | scientists | innovators

PUBLIC EDUCATION, OUTREACH, PARTICIPATION AND INVOLVEMENT

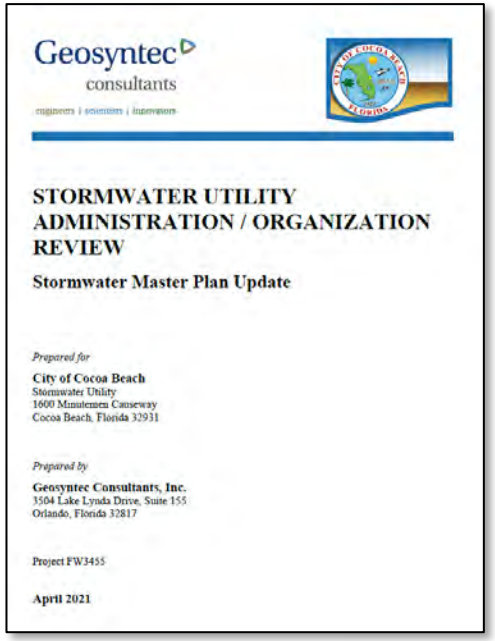
Stormwater Master Plan Update

Prepared for
City of Cocoa Beach
Stormwater Utility
1600 Minutemen Causeway
Cocoa Beach, Florida 32931

Prepared by
Geosyntec Consultants, Inc.
1511 East State Road 434, Suite 1005
Winter Springs, Florida 32708

Project FW3455

February 2021


Geosyntec consultants
engineers | scientists | innovators

STORMWATER UTILITY ADMINISTRATION / ORGANIZATION REVIEW

Stormwater Master Plan Update

Prepared for
City of Cocoa Beach
Stormwater Utility
1600 Minutemen Causeway
Cocoa Beach, Florida 32931

Prepared by
Geosyntec Consultants, Inc.
3504 Lake Lynda Drive, Suite 155
Orlando, Florida 32817

Project FW3455

April 2021


Geosyntec consultants
engineers | scientists | innovators

MAINTENANCE PROGRAM REVIEW

Stormwater Master Plan Update

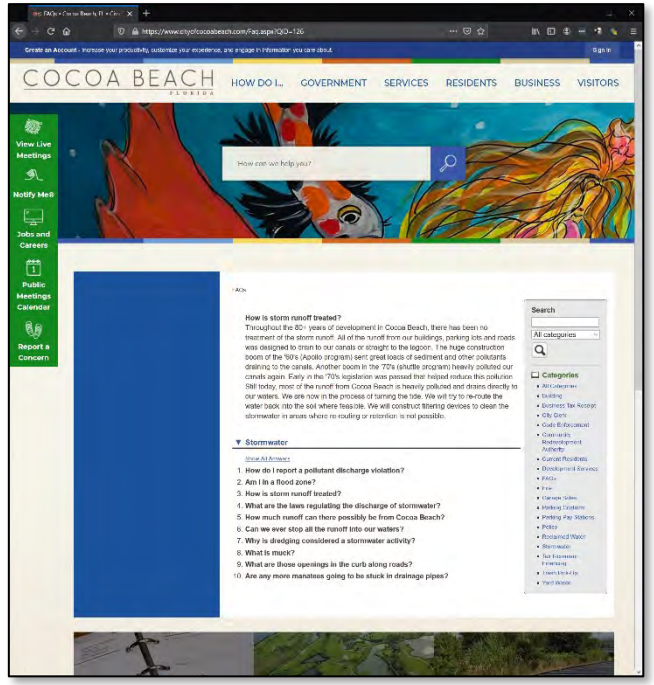
Prepared for
City of Cocoa Beach
Stormwater Utility
1600 Minutemen Causeway
Cocoa Beach, Florida 32931

Prepared by
Watershed Management Services, LLC
410 White Oak Drive
Crawfordville, FL 32327

In collaboration with
Geosyntec Consultants, Inc.
1511 East State Road 434, Suite 1005
Winter Springs, Florida 32708

Project FW3455

March 2020



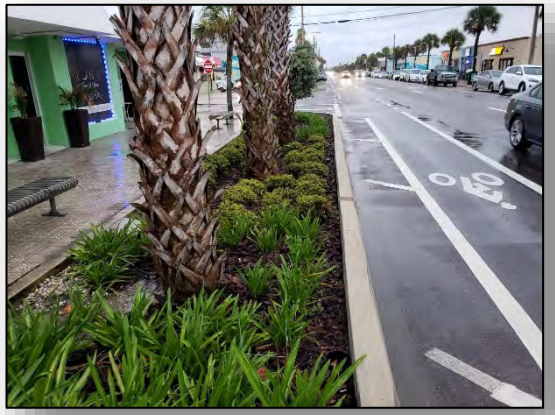
NPDES ANNUAL REPORT
Phase II MS4 Permit ID # FLR04E0 6 2

SECTION II: SUMMARY OF STORMWATER MANAGEMENT PROGRAM ACTIVITIES

Indicate the Phase II MS4 status of compliance in terms of progress toward each of the measurable goals described in the generic permit. Refer to the NOI for a list of the specific BMPs and Measurable Goals the Phase II MS4 committed to perform and track. Changes which will result in deviation from the NOI should be listed in Section III of this form. Include activities for all reporting periods (permit years) in this section. A summary of results is expected for the current reporting period but may be added to results from previous annual report periods. A summary of results is not expected for future reporting periods, but the anticipated BMPs, measurable goals and schedules for future reporting periods should be provided in this section.

Element ID/BMP #		A BMP Description	B Measurable Goal	C Summary of Results
2a	01	Public School Involvement	Engage CB primary school students (K-5) with classroom presentations (Change to Blue – 5th, Stormwater Storytime – GK-2). Approx 200-220 students. **Document & Report number of school classroom presentations, number of students and teacher critiques.**	Roosevelt Elementary - 3 programs (62 students) IRLNR LIPR provides Roosevelt Elementary Lagoon based hands on eco-education through a County Cooperative program in which the City is a partner. Children Events - 3 City Festivals/375 kids/parents CB Friday Posts: 01/12/2018 (68), 02/07/2018 (75), 03/16/2018 (332) Number of teacher critiques - 3 Total Number Parents/Children/Students: 337
2a	03	Citizens Academy (All City Departments)	Introduce stormwater management to residents annually via Citizens Academy. **Document & Report number of citizens in each annual Citizens Academy.**	Citizens Academy – Stormwater Section March 24, 2018 Number Citizens in Attendance - 25
2a	04	Trash Bash Coordination	Coordinate with KBB (Keep Brevard Beautiful) & IRLNEP (Indian River Lagoon National Estuary Program) in biannual Trashbash. **Document & Report number of events and number of people taking part in events.**	KBB/FL Coastal Cleanup – Oct 14, 2017, 38 KBB/ Trashbash – April 7, 2018, 31 City of Cocoa Beach Sea Oat Planting – April 25,2017, 27 Surfrider Sea Oat Planting – Feb 6, 2018, 60 No. Volunteers TrashBash/Planting Events - 156
2a	06	Be Floridian Now - BFN www.befloridiannow.org	Be Floridian Now is calling on all Floridians to help protect what makes Florida so fun, our waters! **Document & Report number of BFN Events in Cocoa Beach. Document & Report the number of CBNNs and CB Facebook promotions/likes.**	No. of BFN Events in Cocoa Beach - 0 No. of CBNNs and CB Facebook - 0 No. of BFN CB web visits – 42 (2.1% of 2059 total) BFN program/website was under development most of permit period, the City was not able to customize features specific for Cocoa Beach. Numbers given above are from web analysis tools that isolate PC/mobile device visits from within Cocoa Beach.

Page 3 of 13 of Phase II MS4 Annual Report 4



Stormwater Master Plan Themes

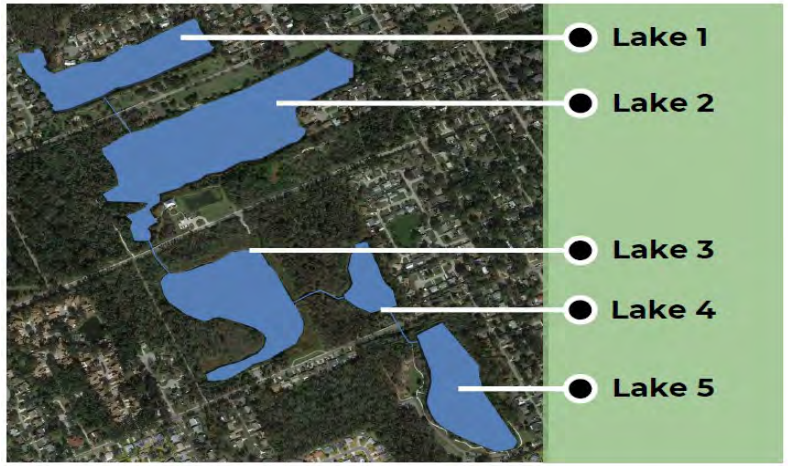
Restoration Strategies

- Stormwater and BMP Inventory
- Large Scale BMP Planning / Siting
- Structural BMPs types, Benefits, and Challenges
- Non-Structural BMPs Types and Challenges
- **Real Time / Active BMP Controls**
- Future Climate Impacts

Restoration Strategies – Real Time / Active BMP controls

Ormond Beach
Laurel Creek Basin Project

Historic flooding after the 2009 storm



HURRICANE IRMA

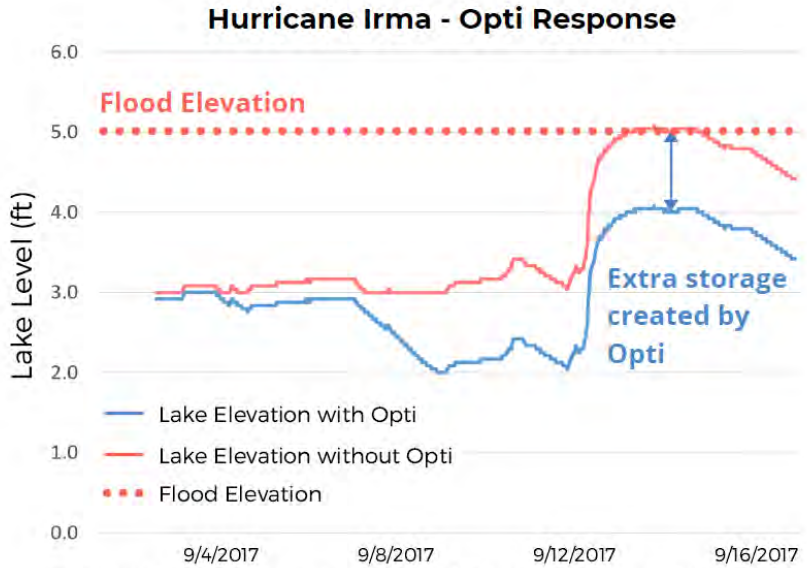
Over the course of 3 days in September 2017, Hurricane Irma dropped nearly 9 inches of rain over central and eastern Florida. During this period, the Central Park Lakes received 190 ac-ft of inflow.

With Opti's real-time monitoring and forecast based control solution, the lakes were lowered in anticipation of the Hurricane, protecting residents from flooding.

Water Level During Irma

Flood Elevation: 5 ft

Peak Storm Level: 4 ft



Comparison of forecast based management (blue) vs. traditional pump controls (red)

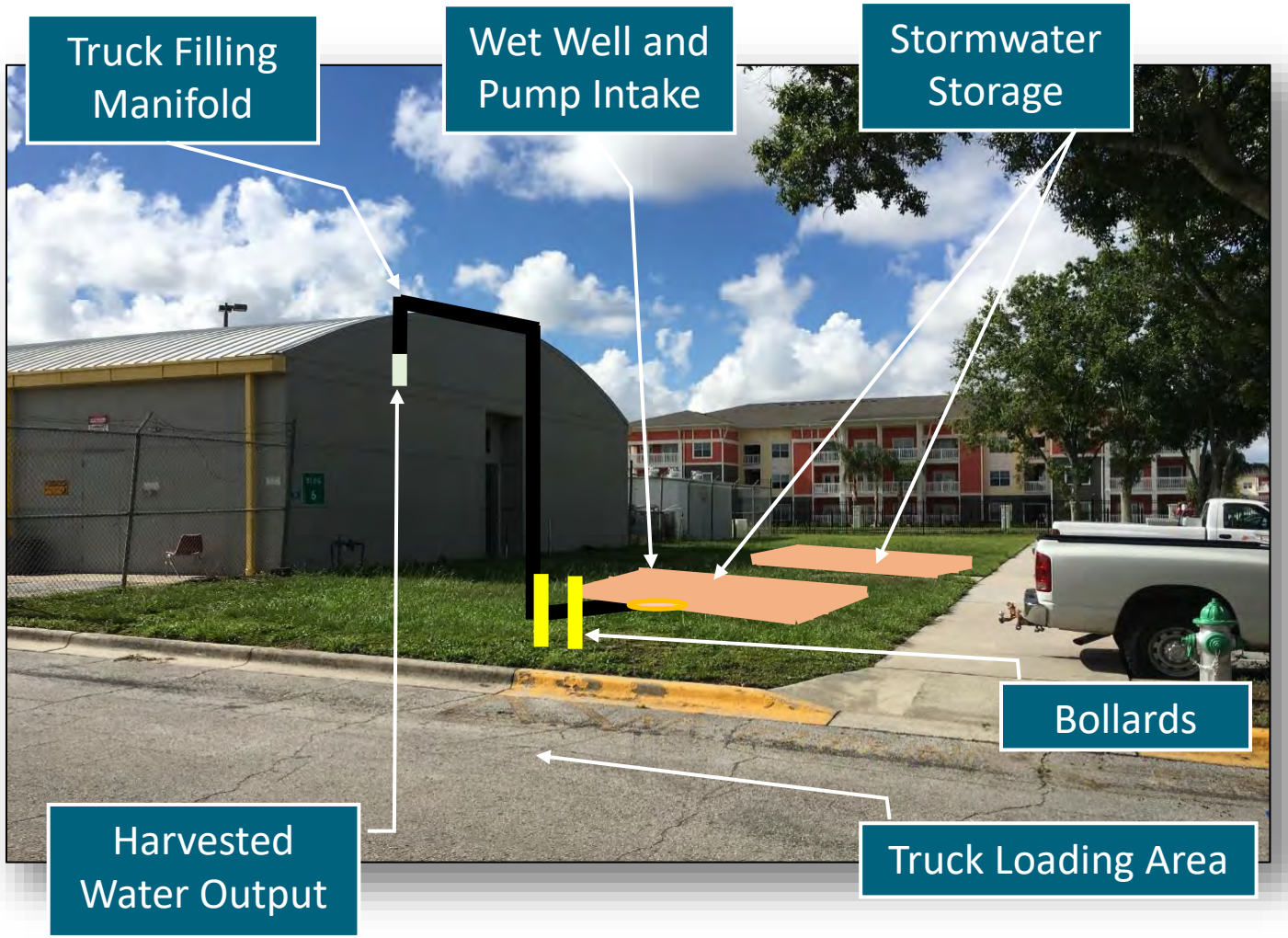
Source: https://optirtc.com/assets/images/case-studies/CaseStudy-OrmondBeach.pdf?_cchid=04fa6d00dba4b155e4cba1dca6503120

Opti
Optimizing Stormwater Management

Restoration Strategies – Real Time / Active BMP controls

Stormwater Harvesting Site Layout

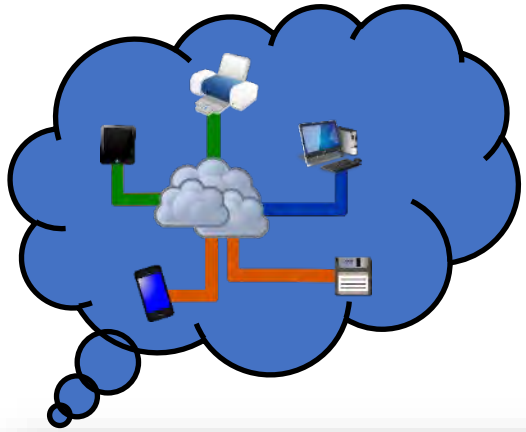
- Designed, installed, and monitored stormwater harvesting demonstration project at Orange County Public Works Maintenance Yard
- System to collect stormwater from maintenance building roof
- 10,300 gallons underground reservoir (PIPE-R)
- Provide water for spray trucks and jetter trucks
- Real-time control management of storage (OPTI)
- Monitor system for water quantity and water quality for 1 year
- Based on modeling results of this system the following benefits can be expected
  - Reduce potable water use by estimated 70,000 gallons per year
    - Makes the County more sustainable
    - Cost savings
  - Reduce stormwater leaving site by estimated 83% on an average annual basis
    - Reduce pressure on downstream drainage infrastructure
    - Improve water quality by reducing mass of pollutants discharged to surface water bodies
  - Increase groundwater recharge by estimated 46,000 gallons per year

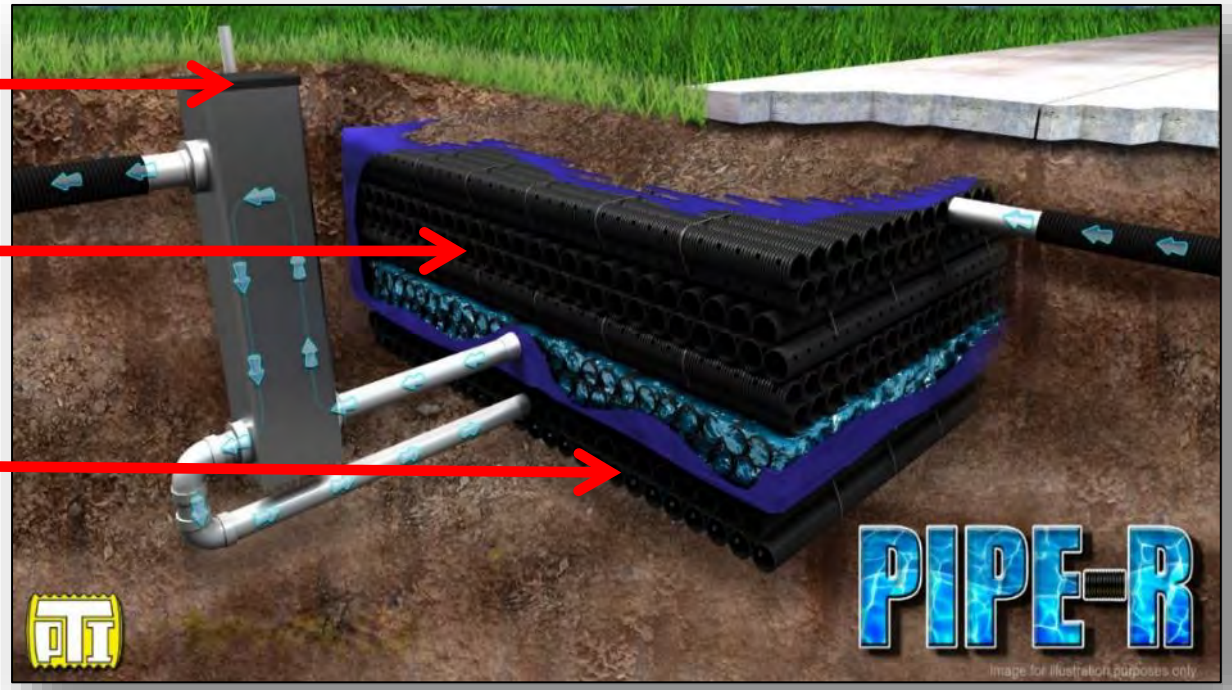


Restoration Strategies – Real Time / Active BMP controls

Stormwater Harvesting System Description

- Main Components
  - Reservoir storage layer
    - Storage of harvested water
    - 10,300 gallons
  - Control box
    - Controls the water level in the reservoir layer
    - Will use real-time control technology (smart controls)
      - Hold on to water when it is needed
      - Release water when it is not needed (before rain event)
    - Location of pump
  - Drainfield overflow
    - Allows water to infiltrate prior to discharge to drainage infrastructure
    - Recharge the groundwater





Restoration Strategies

- Stormwater and BMP Inventory
- Large Scale BMP Planning / Siting
- Structural BMPs types, Benefits, and Challenges
- Non-Structural BMPs Types and Challenges
- Real Time / Active BMP controls
- **Future Climate Impacts**

Restoration Strategies – Future Climate Impacts

Existing and Forecasted Nuisance Flooding Conditions at **St. Augustine's** Maria Sanchez Lake based on FDEO's 2016 *Coastal Vulnerability Assessment*

Existing | 12" SLR (2030s) | 24" SLR (2040s)

Restoration Strategies – Future Climate Impacts

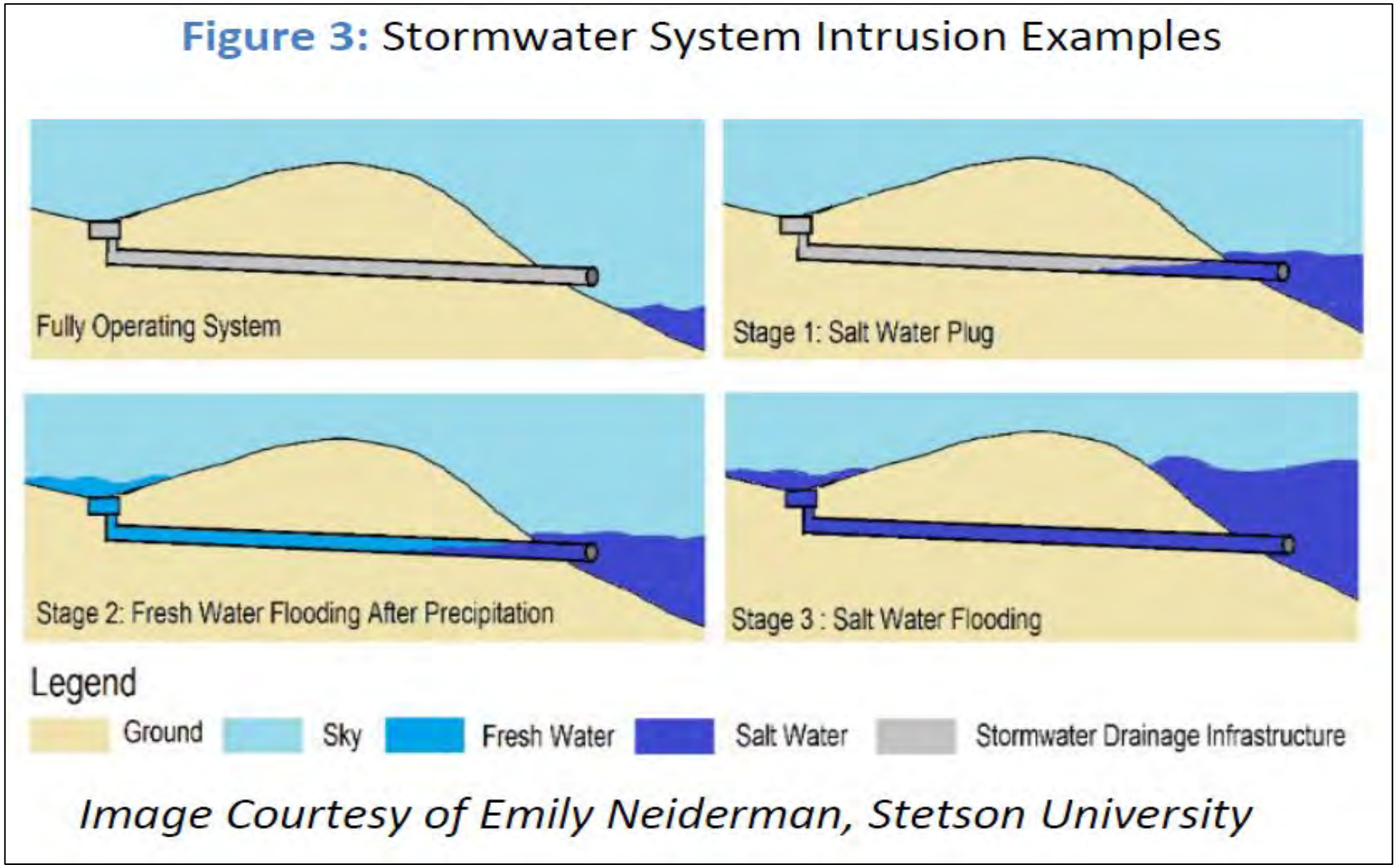
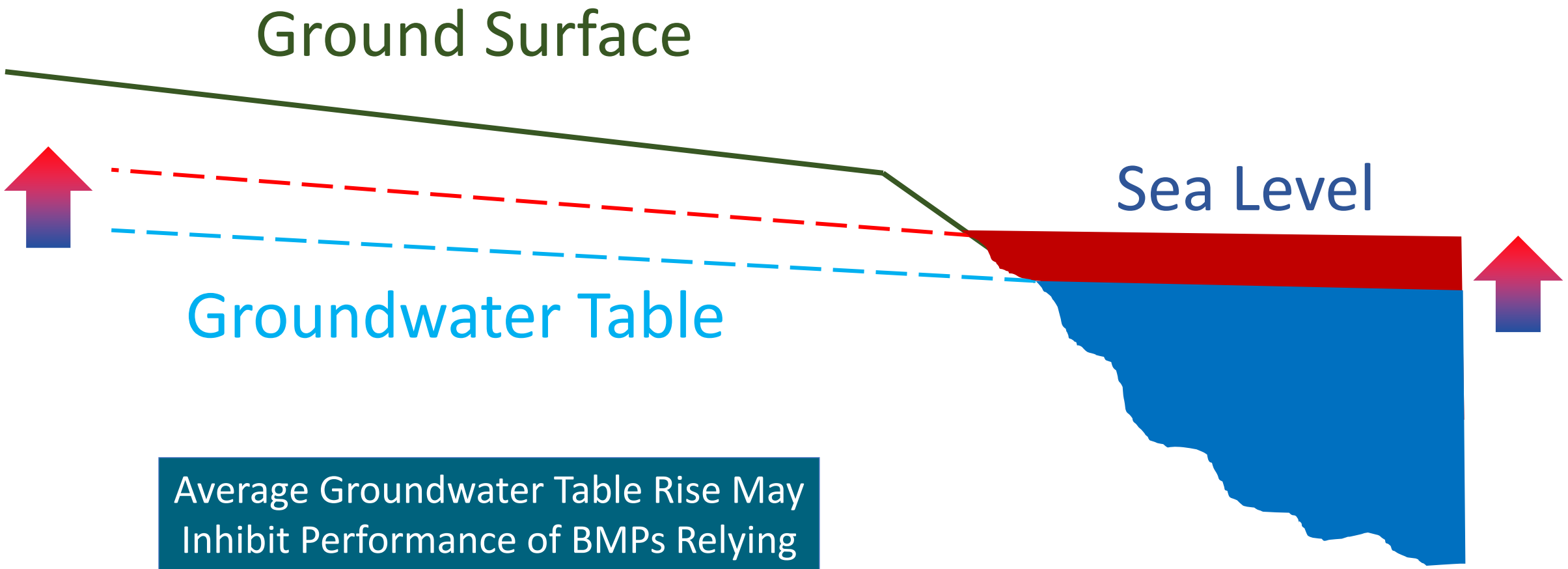


Image Courtesy of Emily Neiderman, Stetson University

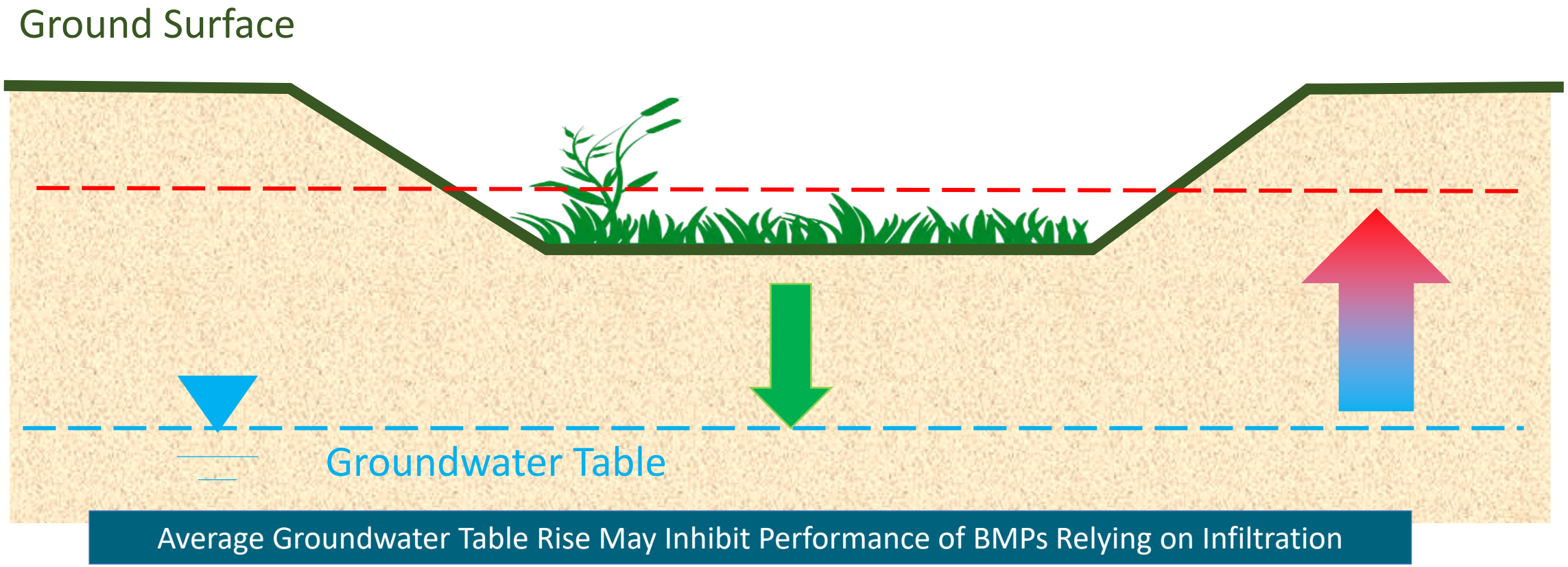
Restoration Strategies – Future Climate Impacts



Average Groundwater Table Rise May Inhibit Performance of BMPs Relying on Infiltration

Restoration Strategies – Future Climate Impacts

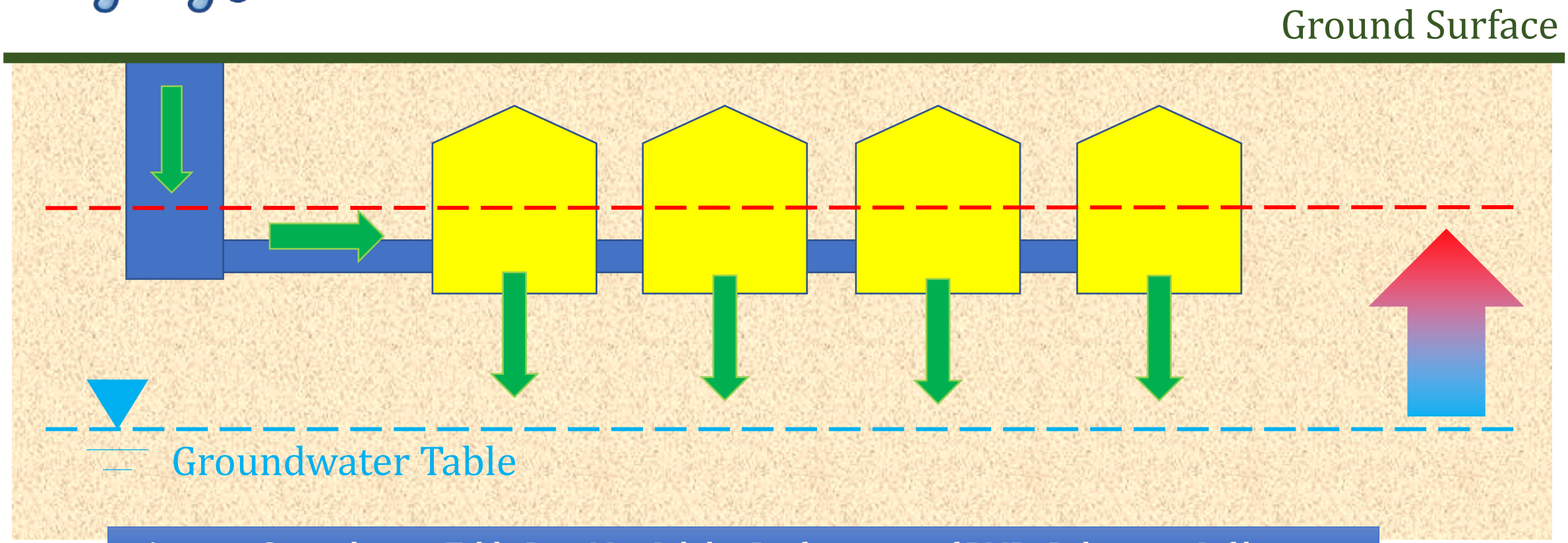
Retention Pond / Bioretention / Rain Garden / Swale



Average Groundwater Table Rise May Inhibit Performance of BMPs Relying on Infiltration

Restoration Strategies – Future Climate Impacts

Exfiltration System / French Drains

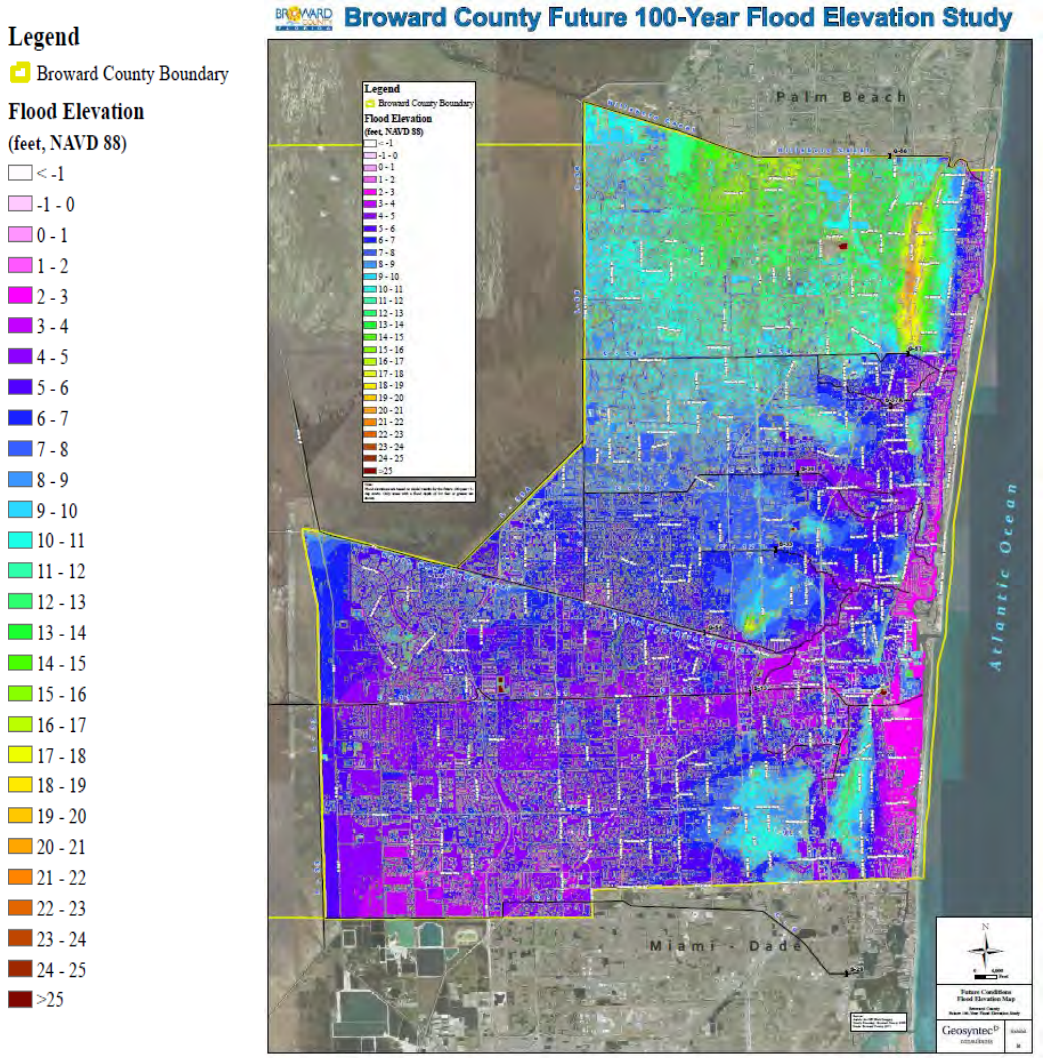


Average Groundwater Table Rise May Inhibit Performance of BMPs Relying on Infiltration

Restoration Strategies – Future Climate Impacts

Broward County Future Conditions
100-Year Flood Community Map Project

- Goals:
  - Future resiliency for buildings and infrastructure in face of projected sea level rise and climate change
  - Reducing flood risk for development and redevelopment
  - Increasing sustainability of structures over lifespan
  - Incorporate future map into County code
- Approach and Advantages:
  - Integrated surface water – groundwater hydrological model
  - **Reflects future sea level rise, groundwater table rise, rainfall, and land use changes**
  - Support updates for water management operations
  - Coordinate with 30 municipalities and 21 water control districts, SFWMD, and USGS
  - Develop Future Conditions Rainfall Intensity- Duration data
  - Consider ongoing FEMA coastal flood surge modeling efforts
- Develop regulatory future conditions 100-year flood elevation maps to establish finished floor elevations



Restoration Strategies – Future Climate Impacts

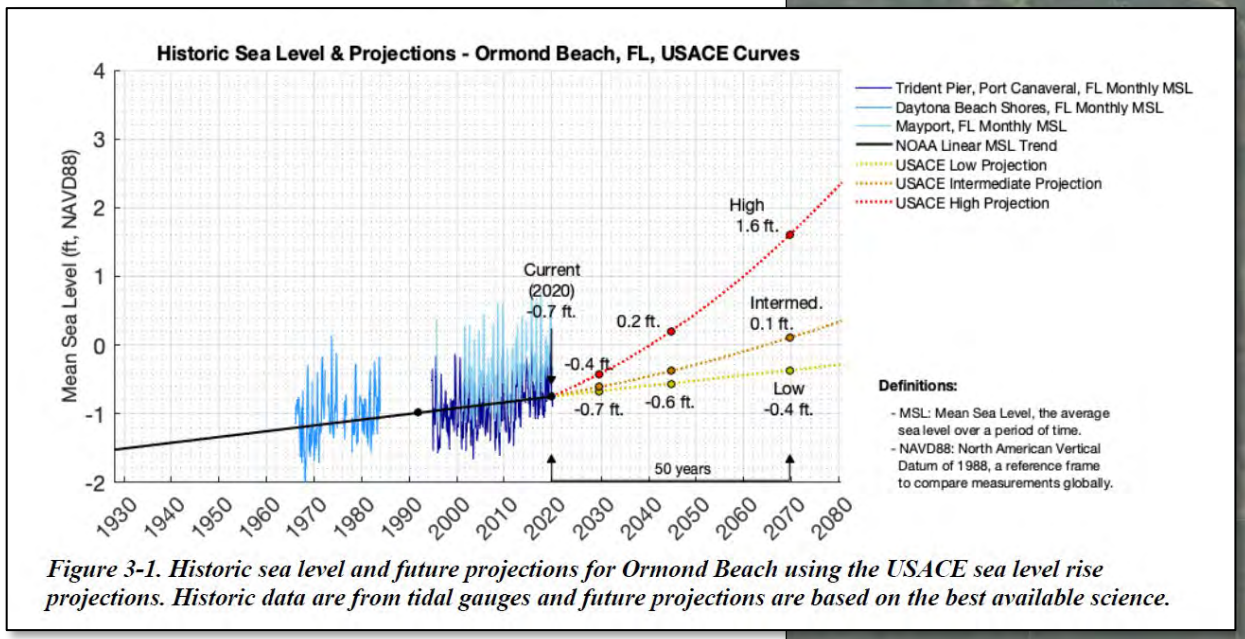
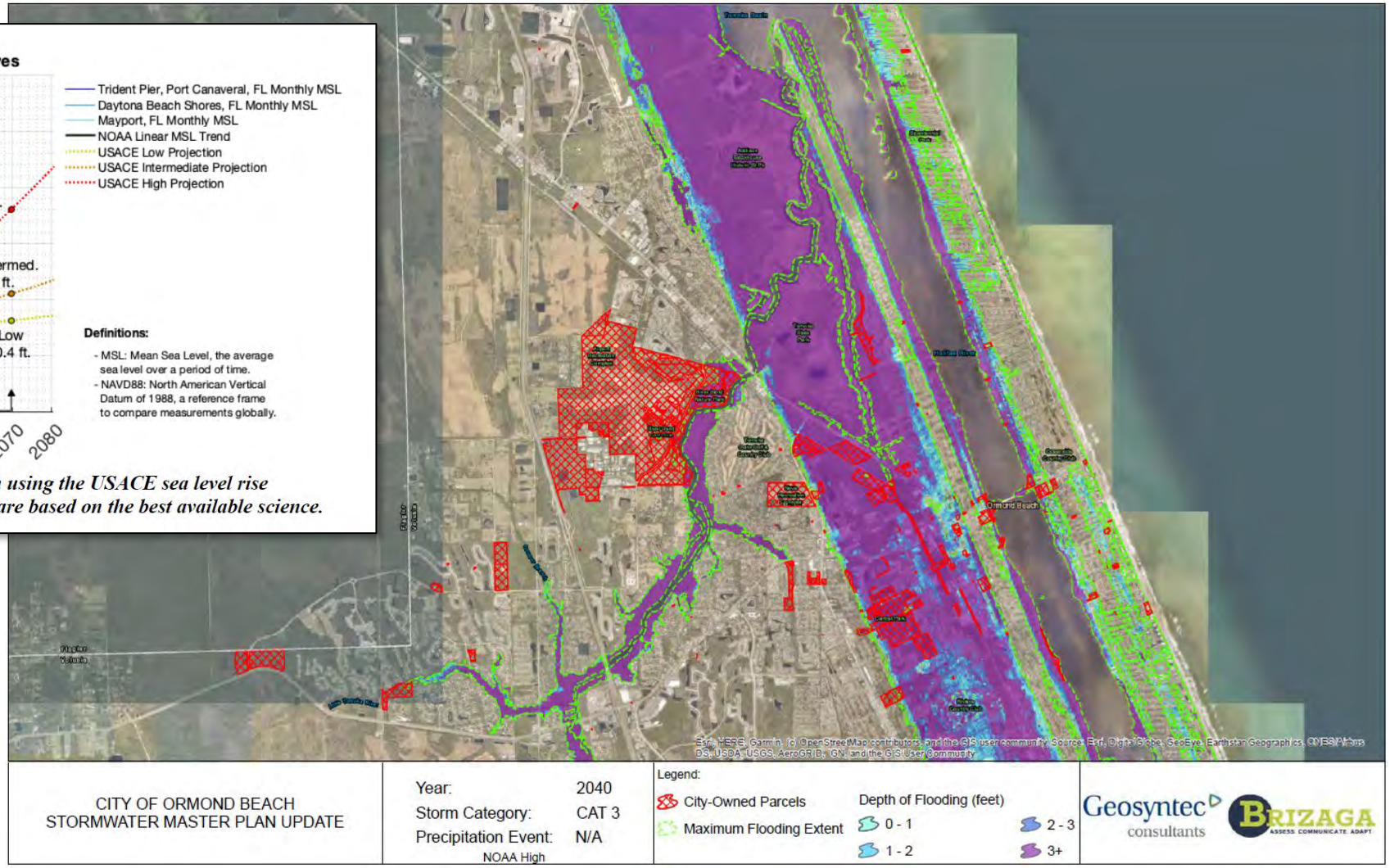


Figure 3-1. Historic sea level and future projections for Ormond Beach using the USACE sea level rise projections. Historic data are from tidal gauges and future projections are based on the best available science.

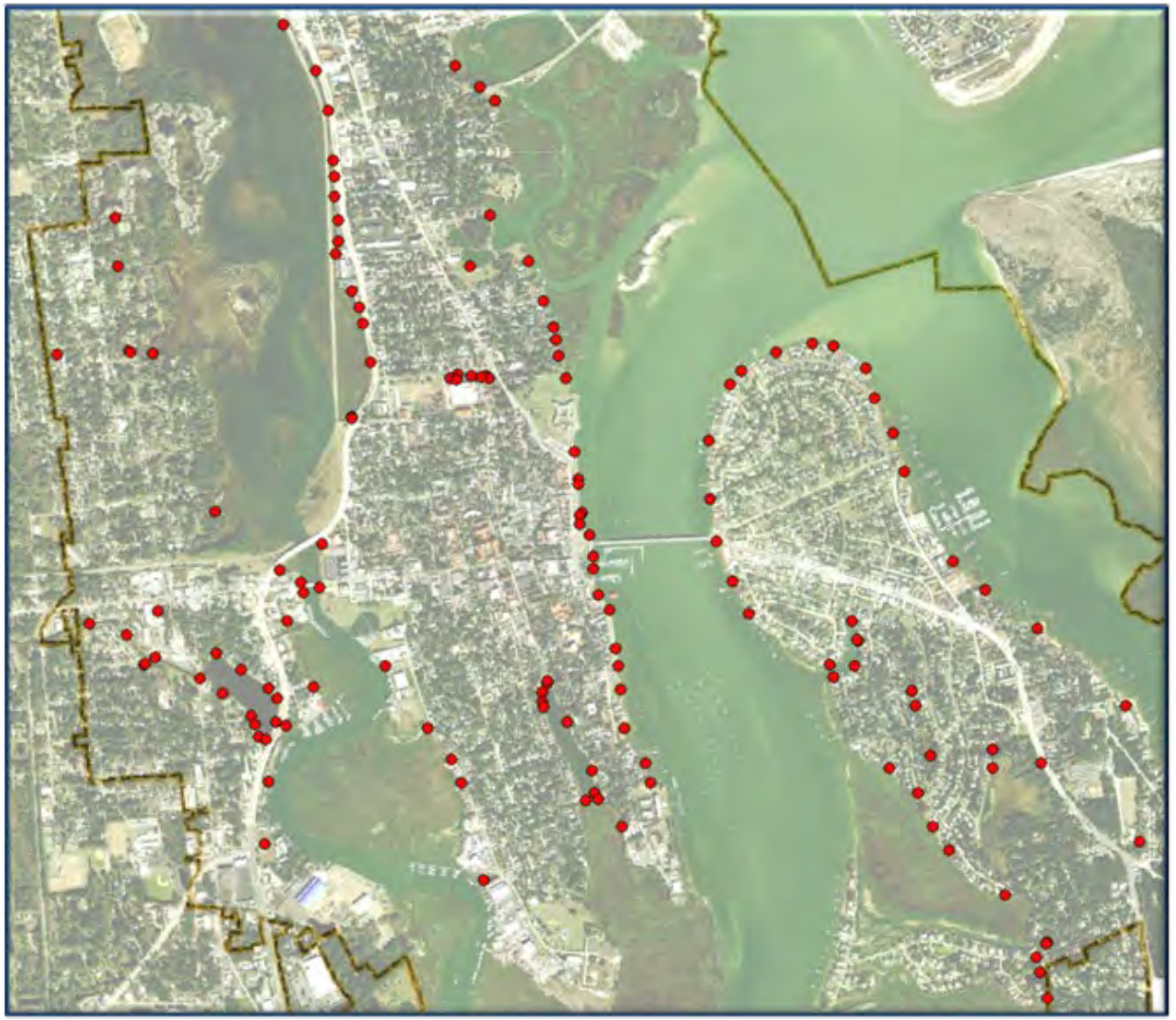
Ormond Beach Stormwater Master Plan
Critical Asset Vulnerability Assessment
Identifying Preliminary Risk Targets to Address Flood Resiliency



Restoration Strategies – Future Climate Impacts

St. Augustine Outfall Master Plan

1. Data collection
2. Comprehensive outfall atlas
3. Field confirmation of outfall data
4. Future resiliency and adaptation criteria evaluation
5. Outfall improvement assessment
6. Capital project prioritization
7. Master plan



Thank you!

Questions?