



Low Impact Development and Green Stormwater Infrastructure (LID+GSI) Tool and Resource Development

February 10, 2022

FOR THE

#GATORGOOD

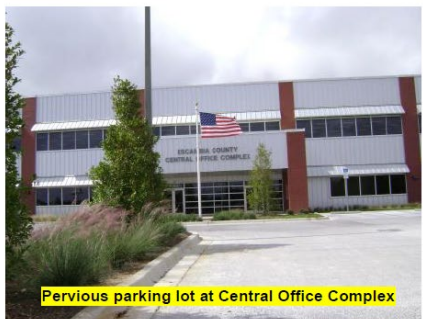
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Asst. Professor & Ext. Specialist

Urban Water Resources Engineering

Agricultural & Biological Engineering, UF|IFAS

Phase I – Needs Assessment



Pervious parking lot at Central Office Complex



Stormwater Management Manual for Western Washington



July 2019



Publication Number 19-10-021

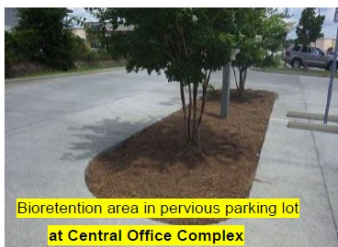
Inventory GSI/LID Manuals
in Florida

Current GSI Practices in
Florida

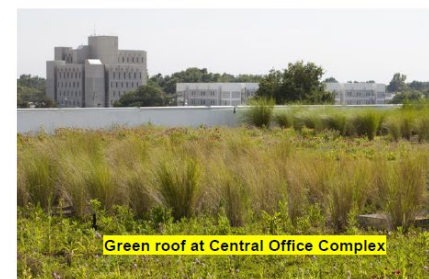
Implementation of GSI in
Florida

Needs Assessment Survey
of Technical Professionals

ESCAMBIA COUNTY LOW IMPACT DESIGN BMP MANUAL

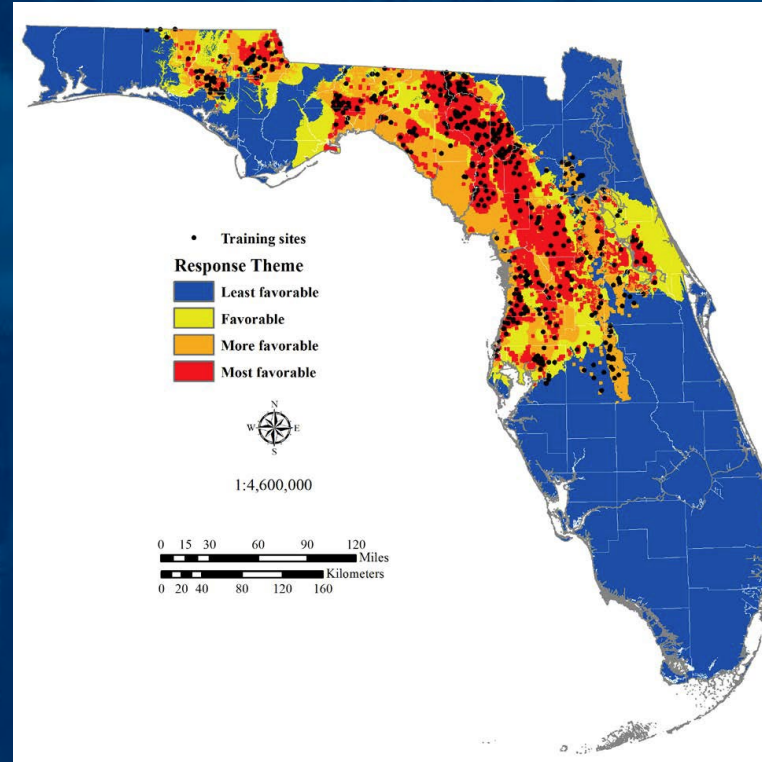
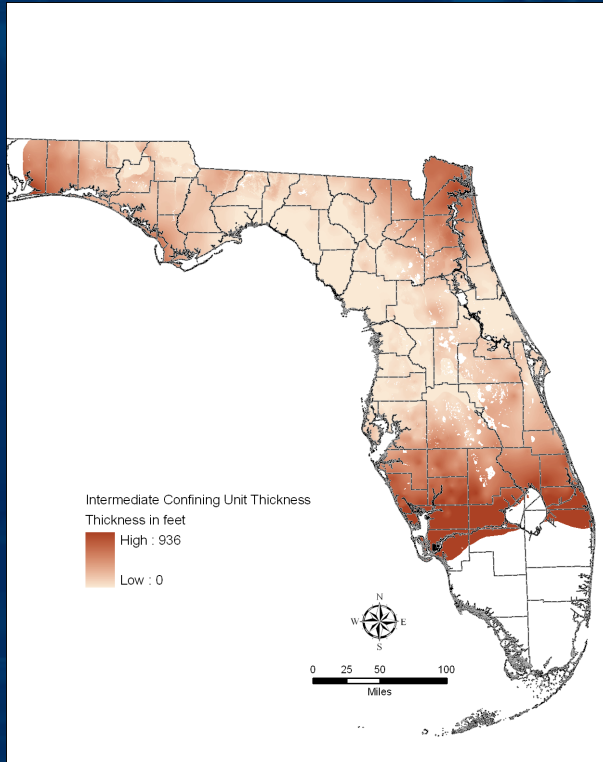


Bioretention area in pervious parking lot
at Central Office Complex



Green roof at Central Office Complex

Phase II – Karst Manual



Develop Draft Outline &
Executive Summary

Focus Groups

Design Guidance for
Common Practices

Draft Manual

Phase III – Statewide Stormwater Guidance

Template

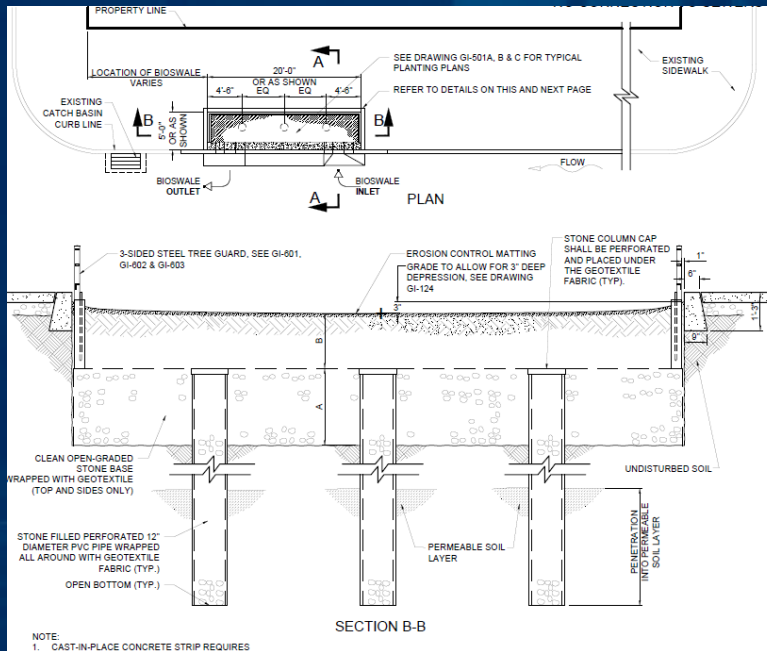
Ordinance Audit Checklist

SCM Selection Tool

SCM Examples and Case
Studies

Designs for Five Common
SCMs

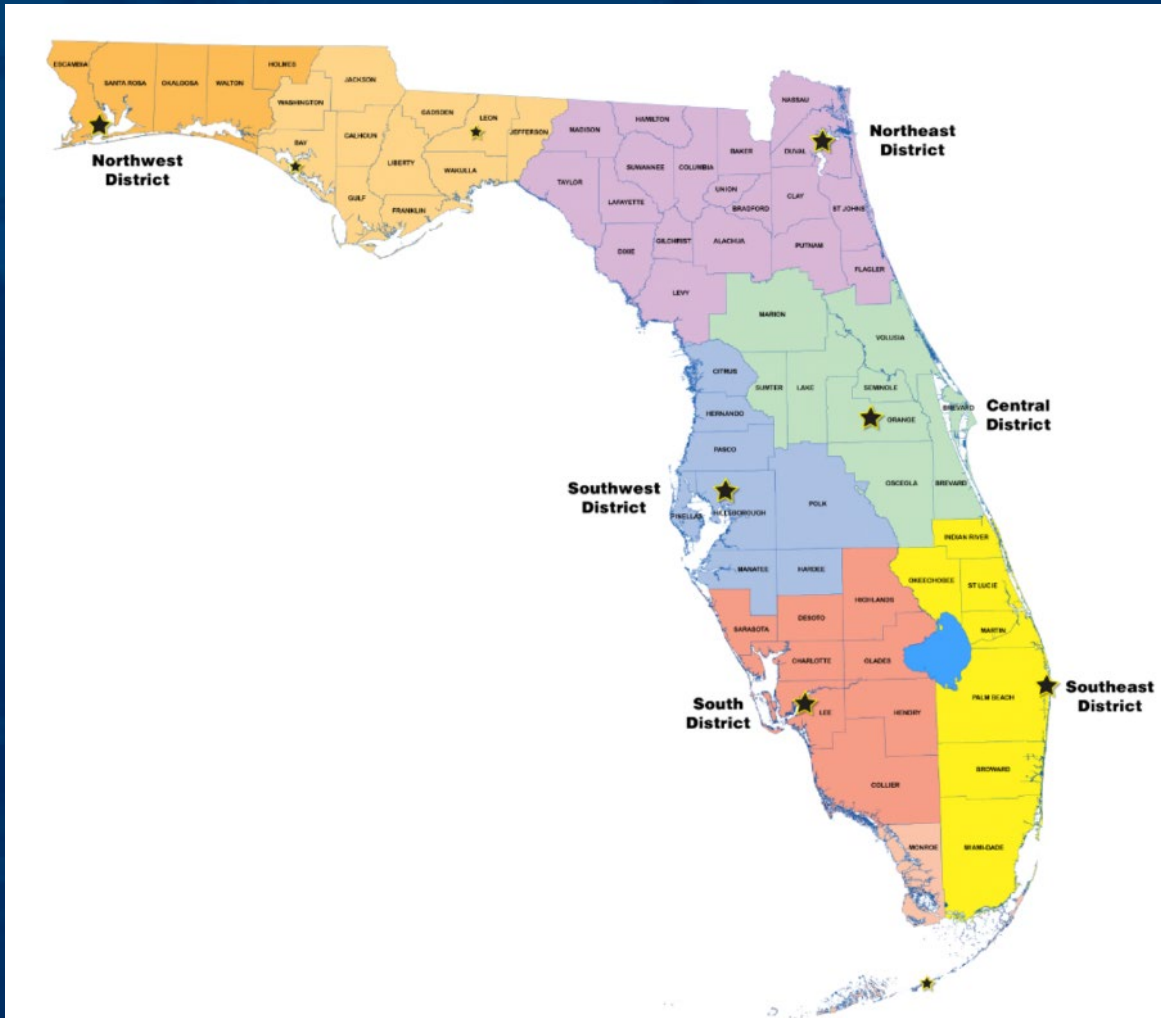
Maintenance Instructions
Draft and Final



SWP Description	Water Budget	Future Demand (100 Yr)	Flow Rate Regulation (100 Yr)	Stormwater Retention	Stormwater Treatment	Stormwater Storage	Stormwater Infiltration	Stormwater Evaporation	Stormwater Transpiration	Stormwater Sedimentation	Stormwater Nutrient Removal	Stormwater Pesticide Removal	Stormwater Heavy Metal Removal	Stormwater Organic Matter Removal	Stormwater Pathogen Removal	Stormwater Temperature Reduction	Stormwater Odor Reduction	Stormwater Noise Reduction	Stormwater Visual Quality	Stormwater Social Benefits	Stormwater Economic Benefits	Stormwater Environmental Benefits
Variable Treatment	1.1	High	High	●	○	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Variable Treatment	1.2	High	High	●	○	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Variable Treatment	1.3	High	High	●	○	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Variable Treatment	1.4	High	High	●	○	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Variable Treatment	1.5	High	High	●	○	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Variable Treatment	1.6	High	High	●	○	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Variable Treatment	1.7	High	High	●	○	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Variable Treatment	1.8	High	High	●	○	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Variable Treatment	1.9	High	High	●	○	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Variable Treatment	2.0	High	High	●	○	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Variable Treatment	2.1	High	High	●	○	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Variable Treatment	2.2	High	High	●	○	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Variable Treatment	2.3	High	High	●	○	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Variable Treatment	2.4	High	High	●	○	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Variable Treatment	2.5	High	High	●	○	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Variable Treatment	2.6	High	High	●	○	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Variable Treatment	2.7	High	High	●	○	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Variable Treatment	2.8	High	High	●	○	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Variable Treatment	2.9	High	High	●	○	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Variable Treatment	3.0	High	High	●	○	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●



Phase IV – GSI Education



Develop Public Education
Materials for Workshops

Hold 14 Workshops
Across Florida

Setup Project Website

Record Workshop(s)

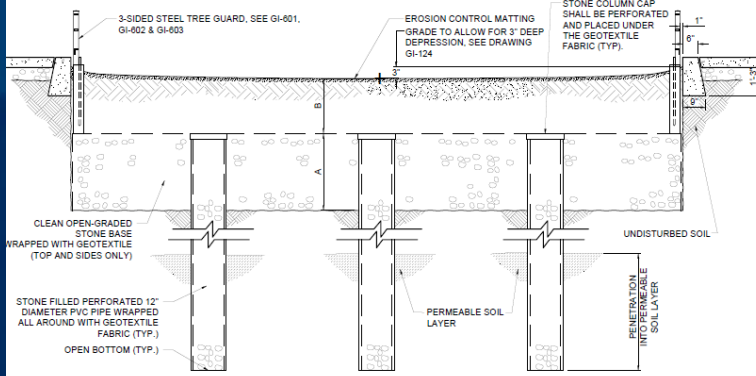
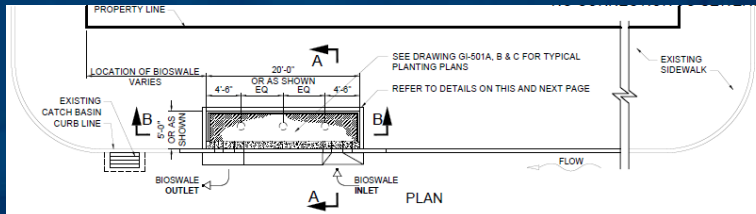
Post Workshop to
Website

Workshop Evaluations

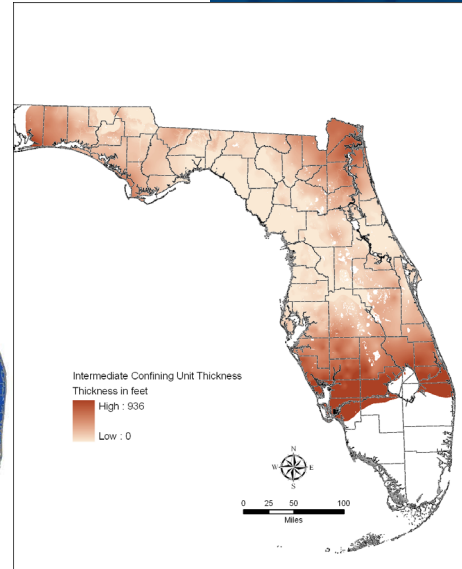
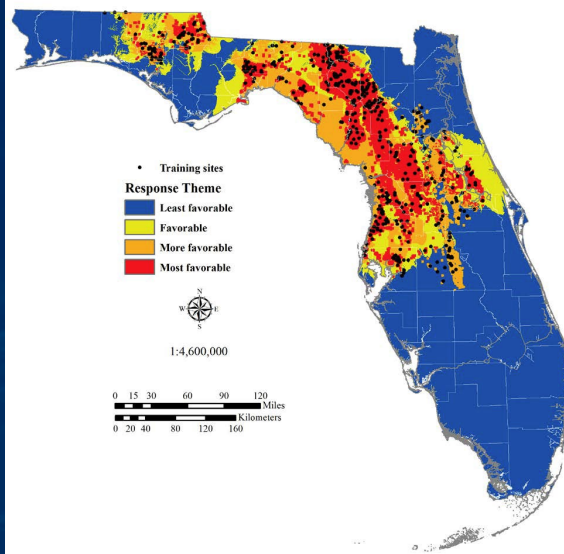
GSI Education Program Tasks & Timeline

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Phase II.I (II+III)– Statewide LID+GSI Manual

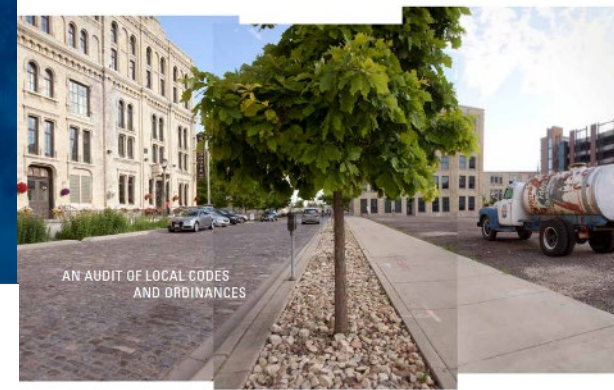


NOTE:
1. CAST-IN-PLACE CONCRETE STRIP REQUIRES



BMP Description	Manual Section	Benefits Provided ^{1,2,3,4}												Other
		Volume Reduction (Retention)	Flow Rate Reduction (Detention)	Source Control	Flow Control & Conveyance	Flow-through Treatment	Grass Solids	Sedimentation	Nitrogen	Phosphorus	Metals	Pathogens	Credit Available	
Preserve Site Resources	3.2.1	High	High	●	○	○	●	●	●	●	—	—	●	Community wildlife
Limit Site Disturbance & Soil Compaction	3.2.4	High	High	●	○	○	●	●	●	●	—	—	●	Agroforestry
Limit Impervious Areas	3.2.1	High	High	●	○	○	●	●	●	●	—	—	●	
Disconnected Impervious Areas	3.2.2	Medium	Medium	○	●	○	○	○	●	●	—	—	●	
Curb Elimination and Curb Cuts	3.2.3	Medium	High	○	●	○	○	○	○	○	—	—	●	
Florida Friendly Landscaping	3.2.4	Medium	Low	●	○	○	○	○	●	●	—	—	●	May save water
Fertilizer Reduction Strategies	3.2.4	—	—	—	—	—	—	—	—	—	—	—	—	

TACKLING BARRIERS TO Green Infrastructure



Second Draft of Manual

Part I: Intro & Overview

Part II: LID

Part III: GSI Design & Maintenance

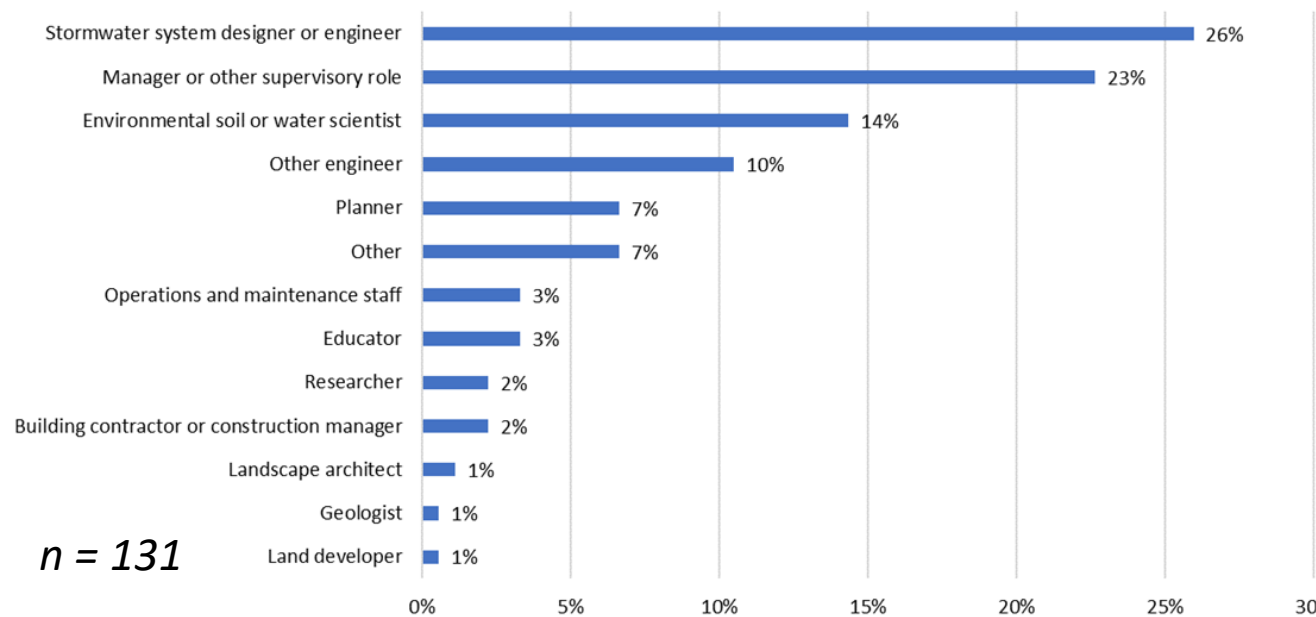
Code Audit Tool

LID+GSI Selection Tool

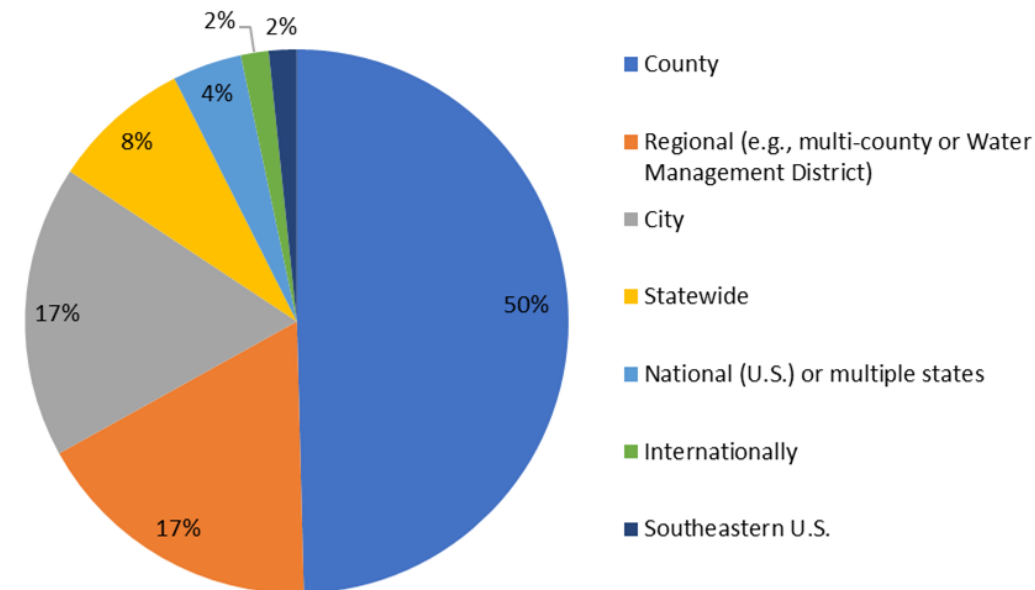
GSI Education Program Tasks & Timeline

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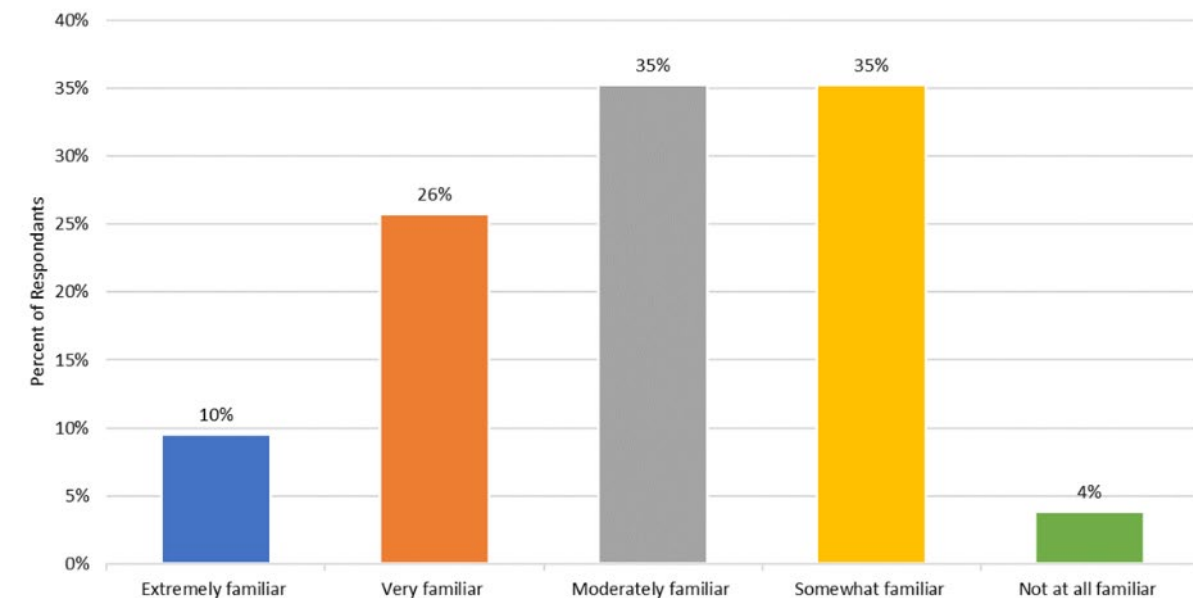
Which of the following describes your profession role or title?



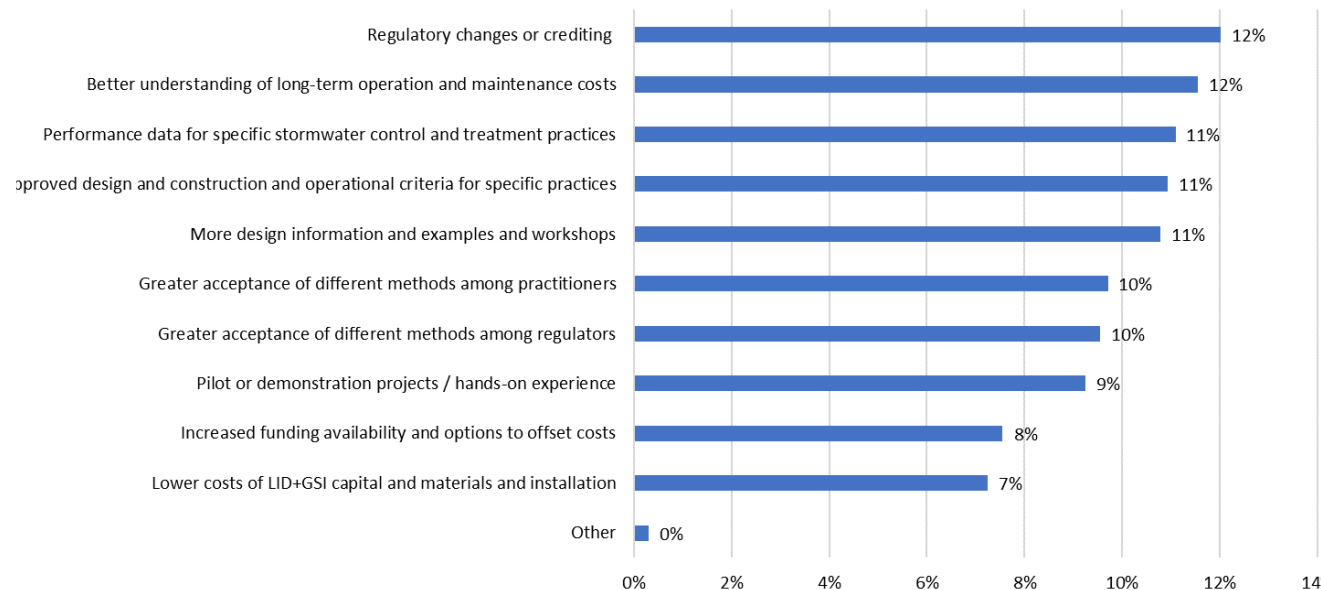
At what geographic scale do you currently work?



How familiar are you with general LID+GSI concepts?



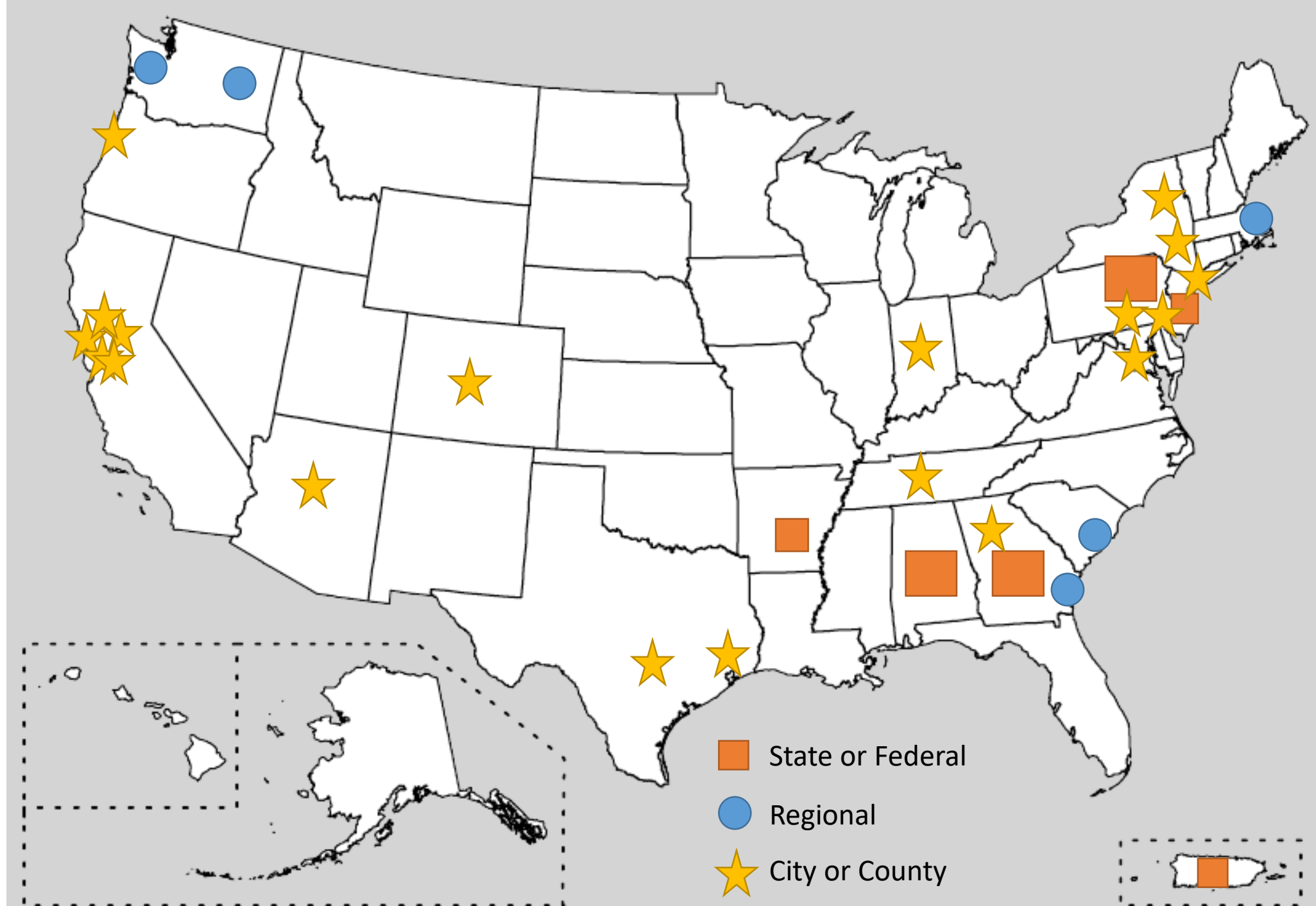
Which of the following do you think is needed to promote broader implementation of LID+GSI Florida?



An (incomplete) Review from FL....



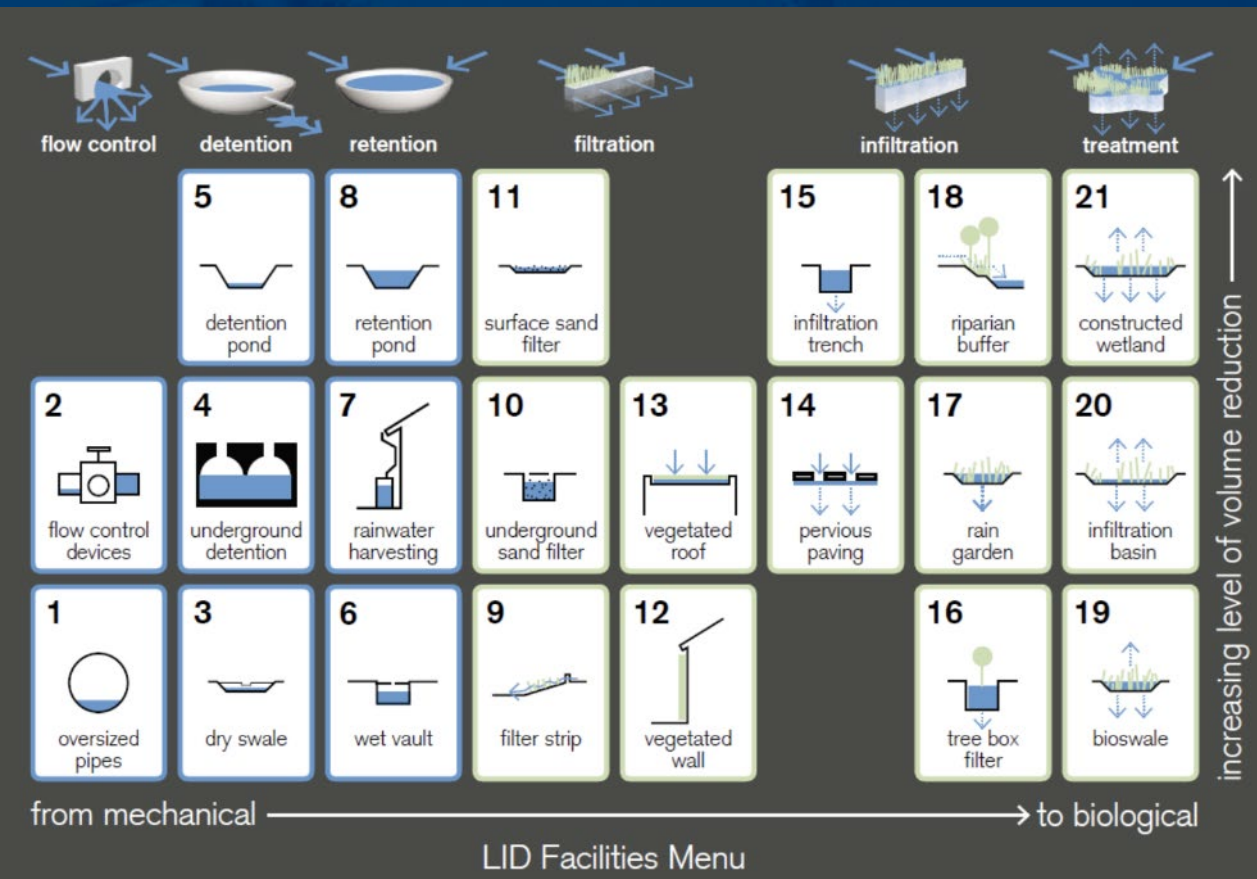
MUNICIPALITY	TYPE OF DOCUMENT	DOCUMENT NAME	DATE
ALACHUA COUNTY	Stormwater Manual	Alachua County Stormwater Treatment Manual	2018
BROWARD COUNTY	Stormwater Manual	South Broward Drainage District Stormwater Management - Regulations, Standards, Procedures and Design Criteria Manual	2015
DUVAL COUNTY	LID Manual	Duval County Low-Impact Design Manual	2013
ESCAMBIA COUNTY	LID Manual	Escambia County Low Impact Design BMP Manual	2016
HILLSBOROUGH COUNTY	Stormwater Manual	Hillsborough County Stormwater Management Technical Manual	2015
LAKE COUNTY	Stormwater Manual	Lake County Stormwater Management Design Standards, Appendix C	NA
MANATEE COUNTY	Stormwater Manual	Manatee County Public Works Standards, Part 2 - Stormwater Management Design Manual	2015
MONROE COUNTY	Stormwater Manual	Draft Stormwater Master Plan (Update from 2001)	2020
ORMOND BEACH	LID Manual	Low Impact Development Design Manual	2013
PALM BEACH COUNTY	Stormwater Manual	Boynton Inlet Contributing Area Watershed Management Plan	2018
PINELLAS COUNTY	Stormwater Manual	Pinellas County Stormwater Manual	2017
SARASOTA COUNTY	LID Manual	Sarasota County Low Impact Development Guidance Document	2015
WALTON COUNTY	LID Manual	Low Impact Development Technical Manual	2019



Range of Practices in Manuals

Category		LID/GI Description		FL LID Manuals		FL SW other		Outside FL Primary		OFL Secondary		Assessment
				7		12		15		12		
Mimize Site Functional Loss	Preserve Site Resources or Limit Disturbance (e.g. compaction)		7	100%	6	50%	13	87%	1	8%	Common in FL and Beyond	
	Limit Impervious Areas		6	86%	3	25%	10	67%	0	0%	Common in FL and Beyond	
Restore Landscape Function	Reforestation or Revegetation		1	14%	1	8%	6	40%	0	0%	Innovative to FL	
	Soil Amendments		5	71%	1	8%	8	53%	0	0%	Common in FL and Beyond	
	Sustainable FFL, Limited Irrigation and Fertilization		5	71%	3	25%	4	27%	0	0%	Common in FL and Beyond	
Disconnected Impervious	Disconnect impervious Areas		6	86%	4	33%	9	60%	4	33%	Common in FL and Beyond	
	Curb Elimination & Curb Cuts		3	43%	1	8%	6	40%	1	8%	Commonly Used	
Capture and Evaporate	Rainfall interceptor trees		3	43%	0	0%	4	27%	3	25%	New	
	Blue Roofs (shallow rooftop detention)		0	0%	0	0%	3	20%	1	8%	New	
Capture and ET Elimination	Green Roofs		4	57%	4	33%	12	80%	3	25%	Innovative to FL	
Capture, Treat, Eliminate or Discharge	Bioretention Cells (w/ or w/o underdrains) or Rain Gardens		7	100%	7	58%	14	93%	4	33%	Common in FL and Beyond	
	Infiltration Planters		4	57%	2	17%	10	67%	2	17%	Innovative to FL	
	Permeable Pavements or Pavers		7	100%	5	42%	15	100%	4	33%	Common in FL and Beyond	
Capture and Infiltrate	Infiltration Trenches or Dry Wells (Exfiltration trench)		5	71%	3	25%	10	67%	3	25%	Common in FL and Beyond	
	Infiltration Basins		0	0%	1	8%	4	27%	2	17%	Conventional Stormwater	
	Wet Retention Ponds		2	29%	6	50%	6	40%	0	0%	Conventional Stormwater	

Communicating Concepts



GUIDE TO READING THE TOOLKIT PAGES

Functions

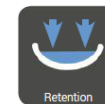
Many LID tools provide a specific function related to stormwater. Some LID tools can perform several functions. The function intended by the designer is often a determining factor in the selection of which tool/technique to use in the design.



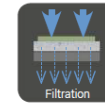
Flow Control
-the regulation of stormwater runoff flow rates.



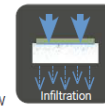
Detention
-the temporary storage of stormwater runoff in underground vaults, ponds, or depressed areas to allow for metered discharge that reduce peak flow rates.



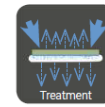
Retention
-the storage of stormwater runoff on-site to allow for sedimentation of suspended solids.



Filtration
-the sequestration of sediment from stormwater runoff through a porous medium such as sand, a fibrous root system, or a human-made filter.



Infiltration
-the vertical movement of stormwater runoff through soil, recharging groundwater.



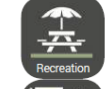
Treatment
-processes that use plant materials, natural phytoremediation and/or bacterial colonies to metabolize contaminants in stormwater runoff.

Benefits

LID tools can provide benefits that go beyond stormwater management. By managing stormwater close to its source, they can nourish a healthy stand of vegetation, which provides interest in the landscape, reduces water and energy use, and reduces the cost of stormwater infrastructure and contaminants downstream. The following icons identify the indirect benefits associated with each LID practice.



Shade
-promotes vegetated shade



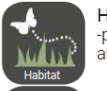
Recreation
-creates recreational areas



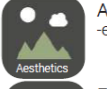
Design
-encourage creative solutions to stormwater manage



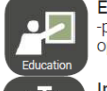
Heat Island
-mitigates heat island effects



Habitat
-provides wildlife habitat area



Aesthetics
-enhances aesthetics



Education
-provides learning opportunity



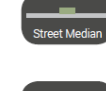
Infrastructure
-reduces impact on existing or future infrastructure

Location

Some LID tools are specific to certain locations and types of development. Other tools can be used in multiple locations and be adapted to different development types. It is important to assess which locations and applications each tool is appropriate for during the design process. The locations and development types identified by the following icons are intended to be scalable. For instance, the landscaped yard around a residence can be considered similar to the site area around a small business or school. Open space can describe a park, or a large landscaped area on the campus of an institution or corporate facility.



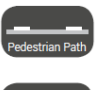
Street Buffer
-landscaped area between street and building



Street Median
-distinct island in middle of road designed to guide traffic



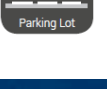
Parking Island
-distinct island in parking area designed to guide traffic



Pedestrian Path
-designed walkway for pedestrians



Driveway
-private vehicular accessway



Parking Lot
-designated area for parking

Typical Organization of Manuals

1. Introduction – Accessible Language

- Purpose/How to use the document
- Stormwater Background (Hydrology, WQ, Impacts)
- Local Context – Hydrogeology, Climate, Impairment
- Definitions (Appendix or Glossary – beginning or end)
 - Bioswale

2. Regulatory Requirements

- Site Planning and Design Criteria
- Stormwater Management Criteria
- Special Criteria (e.g. TMDLs)
- Permitting Process

3. Site Design Planning/LID/Non-structural BMPs

1. Site Design Steps

Organization of Manuals

4. Structural BMP/GSI/SCM Design

1. General Design
2. Specific Design
3. Design Requirements (Descriptive) or Steps (Prescriptive)

5. Retrofits/Alternative Approaches

6. Operation & Maintenance/Inspection/Performance

7. Case Studies

Appendices

A. Vegetation Lists

B. Details, Specs, CAD Drawings

C. Design Calculators

4. Structural BMP/GSI/SCM Design: Specific Design

1. Non-technical Overview
2. Description
3. Planning Considerations
4. Design Criteria & Specifications
5. Construction Materials
6. Installation/Construction Considerations
7. Operation & Maintenance

Statewide Guidance Manual

- Not meant to be rule
- Site water and nutrient (nitrogen) balance
- Sensitive Groundwater Areas
 - Karst and Surface Water Adjacent
- Focus groups and workshops
- Part I: Public officials and non-technical
 - Draft: Spring 2022
- Part II: LID & Planning
 - Draft: Summer 2022
- Part III: GSI technical focus
 - Draft Late 2022

LOW-IMPACT DEVELOPMENT & GREEN INFRASTRUCTURE:

Pollution Reduction Guidance for
Water Quality in Southeast Florida

August 22, 2019

Prepared for:

Coral Reef Conservation Program (CRCP)
Florida Department of Environmental Protection (FDEP)
1277 NE 79th Street Causeway
Miami, FL 33138

Prepared by:

Eban Bean, Ph.D., P.E.
Lynn Jarrett
Jennison Kipp Searcy
Mary Szoka

Program for Resource Efficient Communities (PREC), Center for Land Use Efficiency (CLUE)
Department of Agricultural & Biological Engineering (ABE)
Institute of Food and Agricultural Sciences (IFAS)
University of Florida (UF)

This report was funded in part by the Florida Department of Environmental Protection, Office of Resilience and Coastal Protection. The views expressed herein are those of the author(s) and do not necessarily reflect the views of the State of Florida or any of its sub-agencies.

LID+GSI Selection Matrix

		Benefits Provided ^{1, 2, 3, 4}													Site Applicability					Implementation Considerations			
BMP Description	Manual Section	Volume Reduction (Retention)	Flow Rate Reduction (Detention)	Source Control	Flow Control & Conveyance	Flow-through Treatment	Gross Solids	Sedimentation	Nitrogen	Phosphorus	Metals	Pathogens	Credit Available	Other	Development Type	Soils Type	Water Table (Minimum SHGW)	Tributary Area	Private Property	Land Requirement	Capital Cost	Maintenance	Design Life
Preserve Site Resources	3.2.1	High	High	●	○	○	●	●	●	●	—	—	●	Community amenity, wildlife habitat	All	Any	Any	NA - Source Control	●	Varies	—	—	> 20 years
Limit Site Disturbance & Soil Compaction	3.2.4	High	High	●	○	○	●	●	●	●	—	—	●	Aquifer recharge	Suburban-Rural	Any	Any	NA - Source Control	●	—	—	—	> 20 years
Limit Impervious Areas	5.2.1	High	High	●	○	○	●	●	●	●	—	—	●	—	All	Any	Any	NA - Source Control	●	Varies	—	—	> 20 years
Disconnected Impervious Areas	5.2.2	Medium	Medium	○	●	○	○	○	●	●	—	—	●	—	All	Any	Any	NA - Source Control	●	—	—	—	> 20 years
Curb Elimination and Curb Cuts	5.2.3	Medium	High	○	●	○	○	○	○	○	—	—	●	—	Urban-Suburban	—	Any	Roads & Parking lots	⦿	—	—	—	> 20 years
Florida Friendly Landscaping	5.2.4	Medium	Low	●	○	○	○	○	●	●	—	—	⦿	May save potable water	All	Any	Any	NA - Source Control	●	—	Low	Low	> 20 years
Fertilizer Reduction Strategies	5.2.4	—	—	●	○	○	○	○	●	●	—	—	●	—	Suburban	Any	Any	NA - Source Control	●	—	—	—	> 20 years

Benefits Provided ^{1, 2, 3, 4}																
Volume Reduction (Retention)	Flow Rate Reduction (Detention)	Source Control	Flow Control & Conveyance	Flow-through Treatment	Gross Solids	Sedimentation	Nitrogen	Phosphorus	Metals	Pathogens	Credit Available	Other				

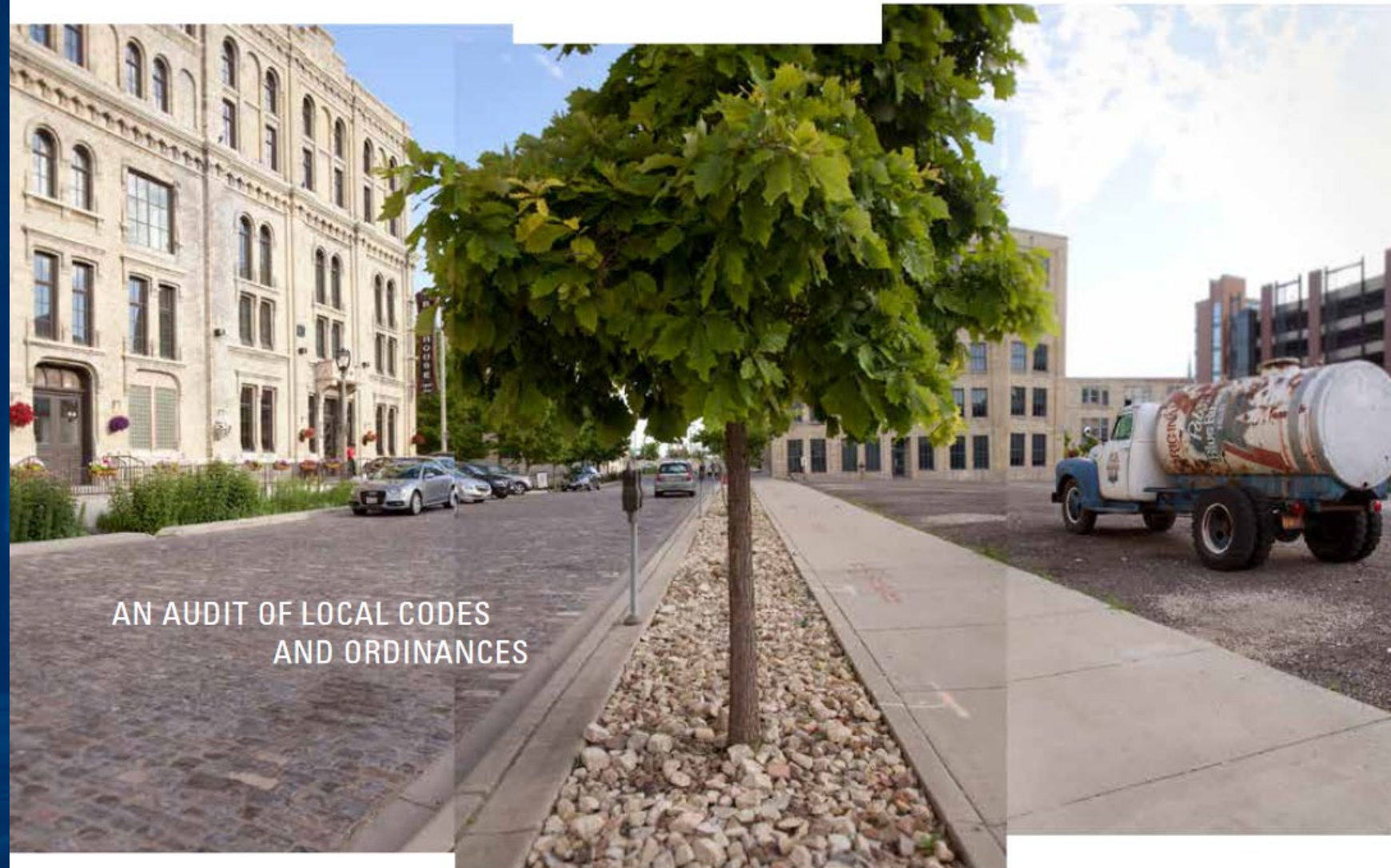
Site Applicability				
Development Type	Soils Type	Water Table (Minimum SHGW)	Tributary Area	Private Property

Implementation Considerations			
Land Requirement	Capital Cost	Maintenance	Design Life

Code Audit

- Identify barriers in local codes
- Walk through sections of Code
- 190 questions in 16 categories
- Add coastal & karst material
- Release 2022
- Looking to Pilot with a community
- 3-6 months

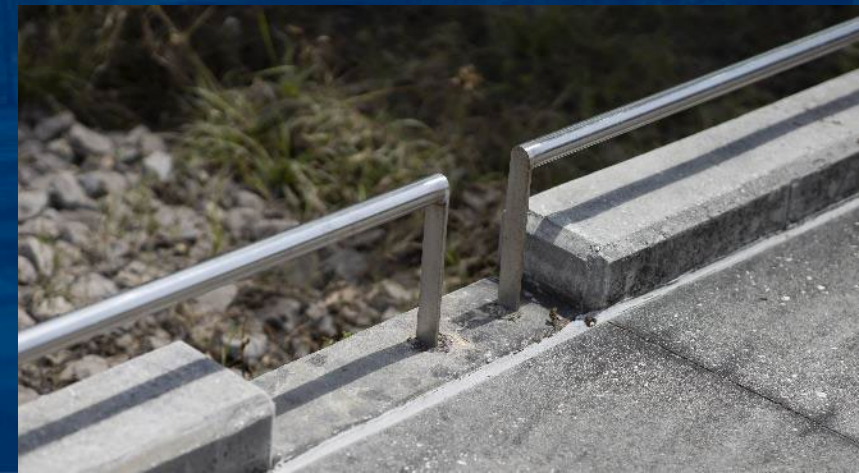
TACKLING BARRIERS TO Green Infrastructure



AN AUDIT OF LOCAL CODES
AND ORDINANCES

Photo Library

- Partnership with The Nature Conservancy
- Identified 40+ projects statewide (began spring 2021)
- GIS Map with project locations
- Photos (photo essay), links to plans (ERP), available cost information
- Regionally specific (plants)
 - Plant selection tool in development
- Intended to be a tool for ideation and client discussions



Operation and Maintenance is Key

“Another flaw in the human character is that everybody wants to build and nobody wants to do maintenance.”

- Kurt Vonnegut
- Filters clog
- Plants die
- Sediment builds up



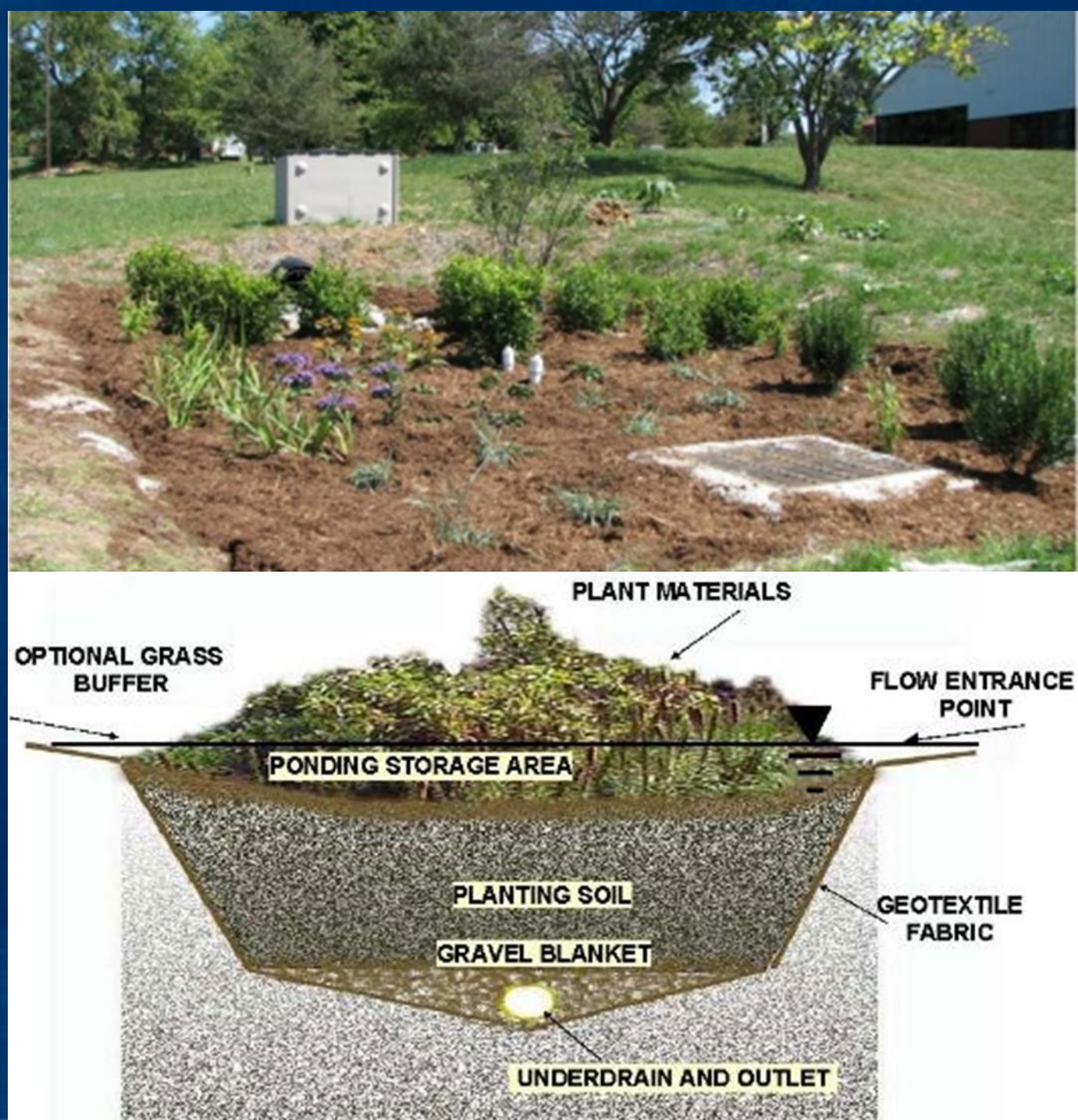
GSI Maintenance Trainings



- Projected to start development Spring 2022
- Modeled after GI-BMP program
- Led by County IFAS Extension
- Pilot trainings in Spring/Summer 2022

GSI Pilot Projects

- Bioretention, bioswales, and tree boxes
- Nutrient removal
- Inflow and outflow
- Efficiencies
- 4-5 locations around Florida
- Different configurations
- Communities currently in design stages



Questions?

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SUSTAINABLE HUMAN AND
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