9th UF Water Symposium

A JUSTICE-BASED DECISION SUPPORT TOOL FOR INTEGRATING STORMWATER BMPS IN NUTRIENT REMOVAL IN FLORIDA

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Content

INTRODUCTION

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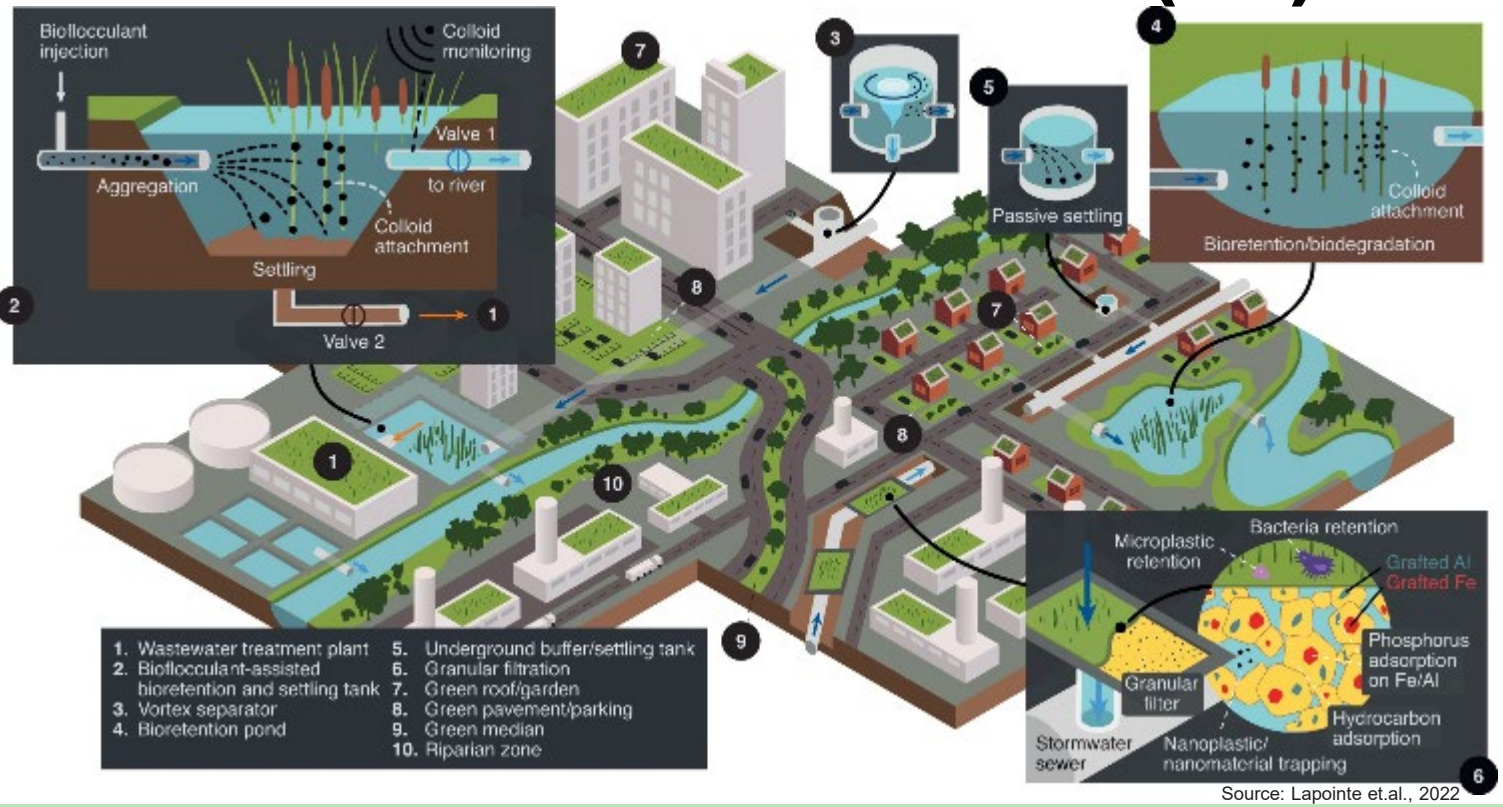
Background

Stormwater Runoff Problem

- Underserved communities, including low-income populations and minorities, frequently experience heightened environmental vulnerabilities, such as flooding due to insufficient infrastructure, stemming from historical zoning practices, housing dynamics, climate change, lack of representation, language barriers, and economic factors.
- Studies reveal that in Miami, communities with higher proportions of non-Hispanic African Americans and Hispanics experience disproportionate exposure to inland flood risks, while Pinellas County, Florida, exhibits increased urban heat in areas with more racial/ethnic minorities and higher poverty rates.

Environmental Justice Issues

Green Infrastructures (GI)



Source: Lapointe et.al., 2022

- A study by Raei et al., (2019) demonstrated a runoff volume reduction of up to 95% after the optimal implementation of bioretention.
- A study by Liu et al. (2015b) showed a reduction of up to 72% in total nitrogen and 80% in total phosphorus through the implementation of a retention pond lined with a grassed swale, resulting in improved runoff quality entering nearby watersheds.

Research Gaps

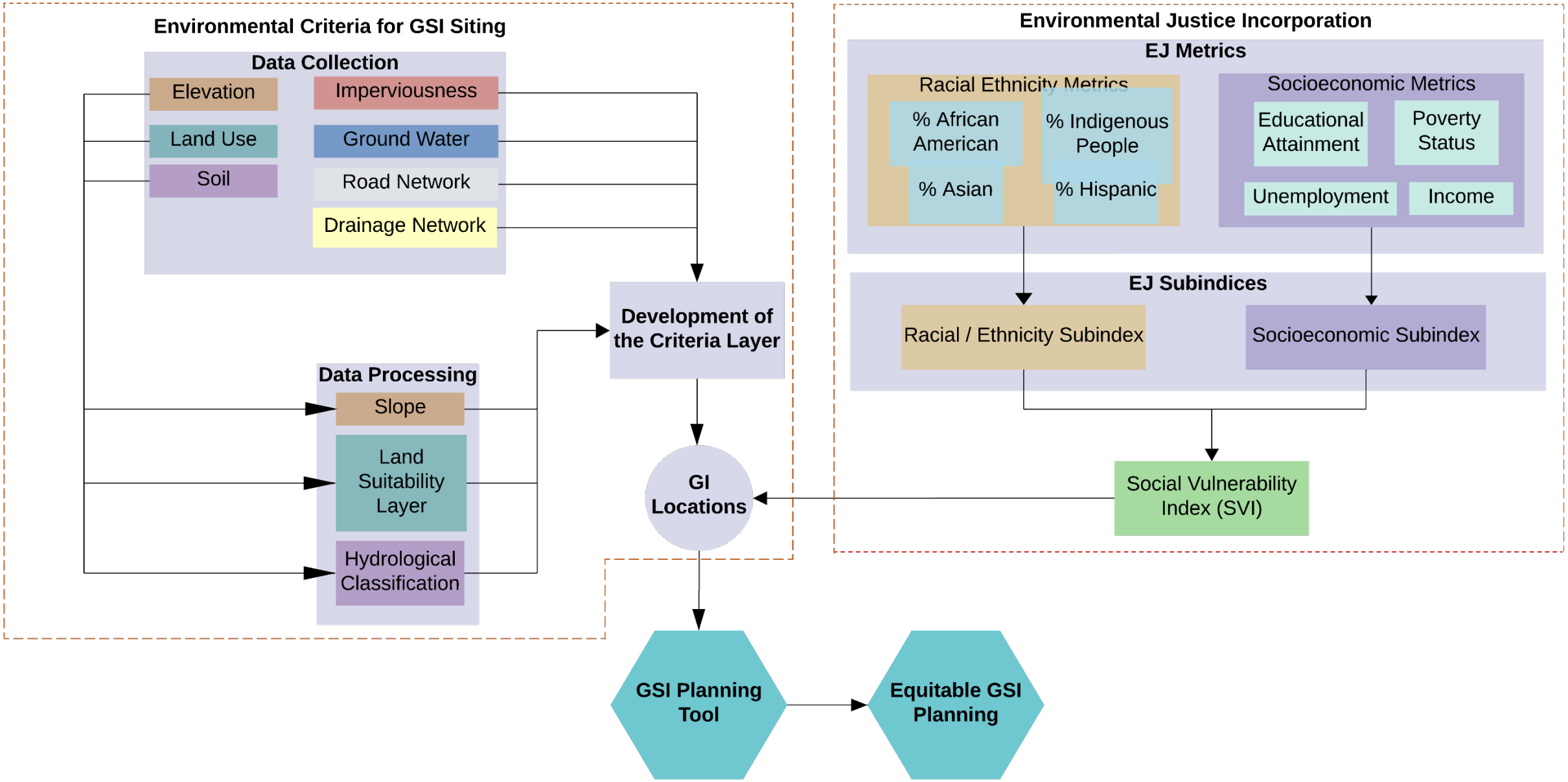
Absence of spatial allocation for GIs, omission of O&M costs and end-of-life considerations in total cost, and the need for open-source tools suitable for large-scale applications.

Despite socio-environmental benefits, traditional Green Stormwater Infrastructure (GSI) planning often neglects Environmental Justice considerations.

Goals and Objectives

To develop a statewide decision support tool for the siting and selection of green infrastructure (GI) with consideration of the environmental justice metrics to help urban communities control nutrients in their watersheds.

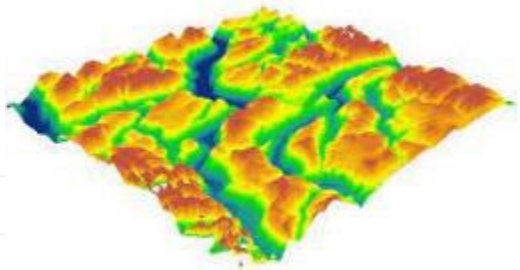
Overall Workflow

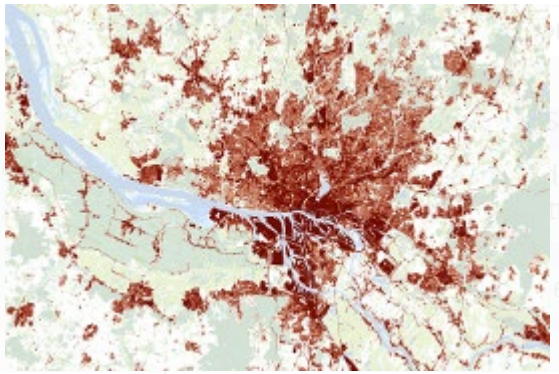


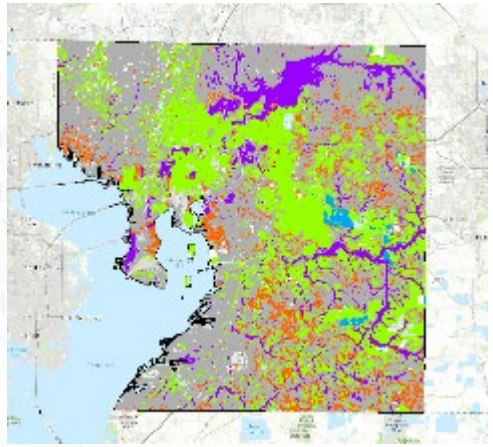
Data Collection

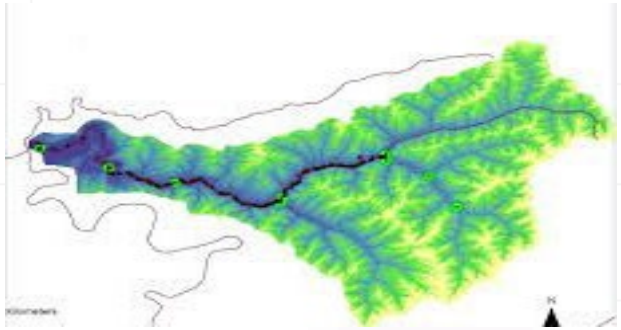
Data Collection

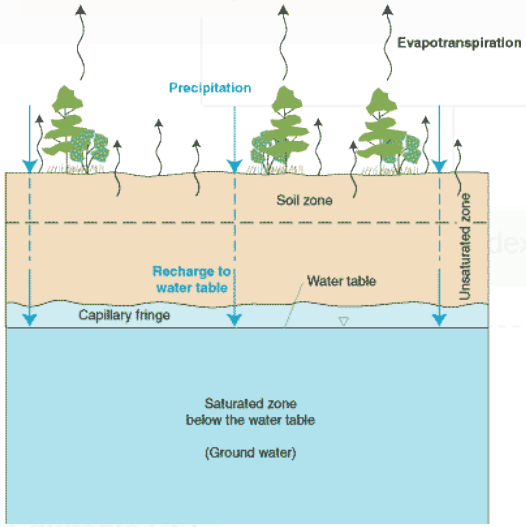
- Elevation
- Imperviousness
- Land Use
- Ground Water
- Soil
- Road Network
- Drainage Network











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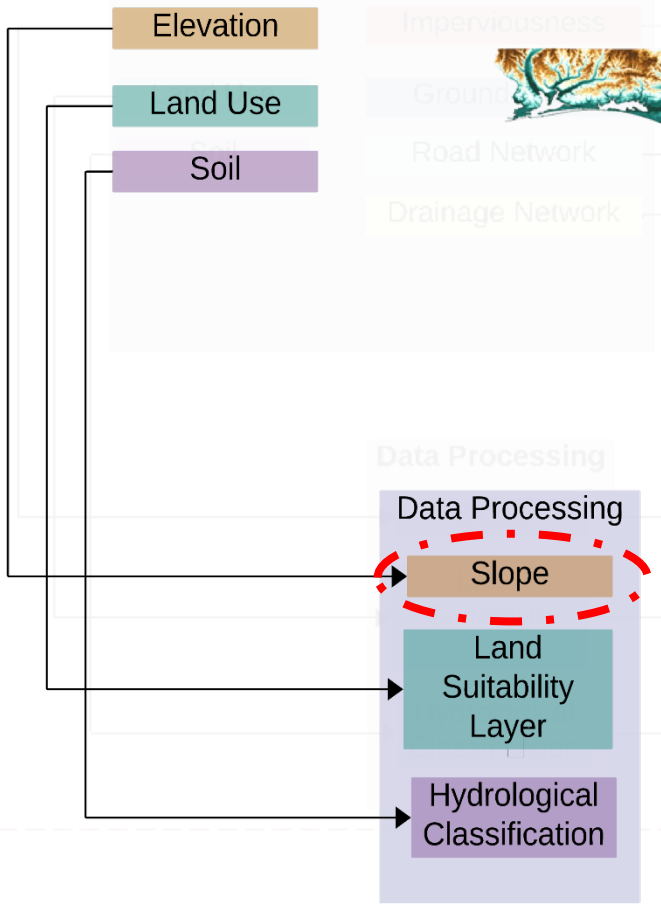
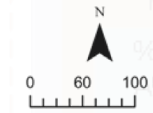
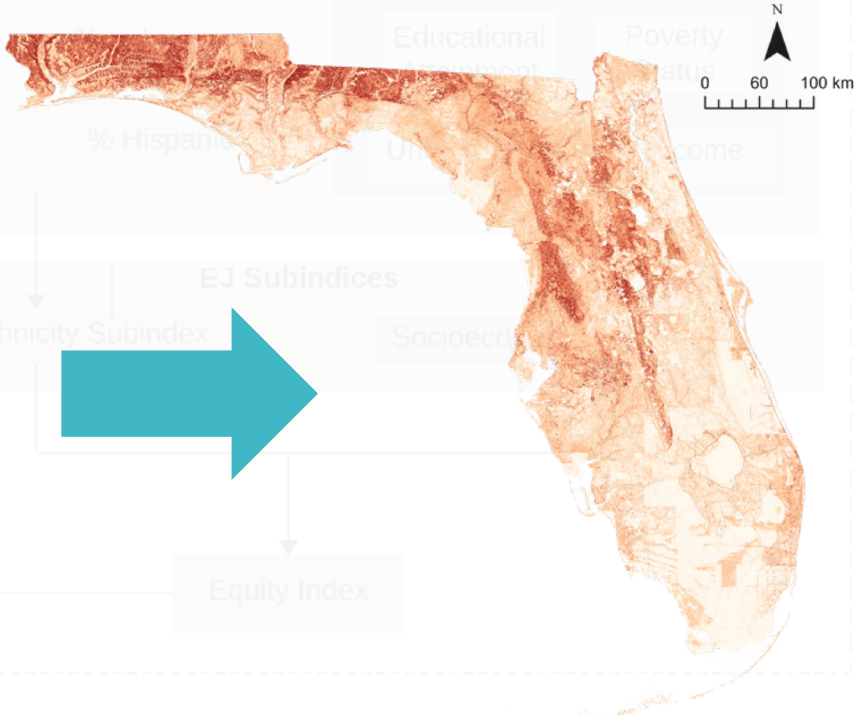


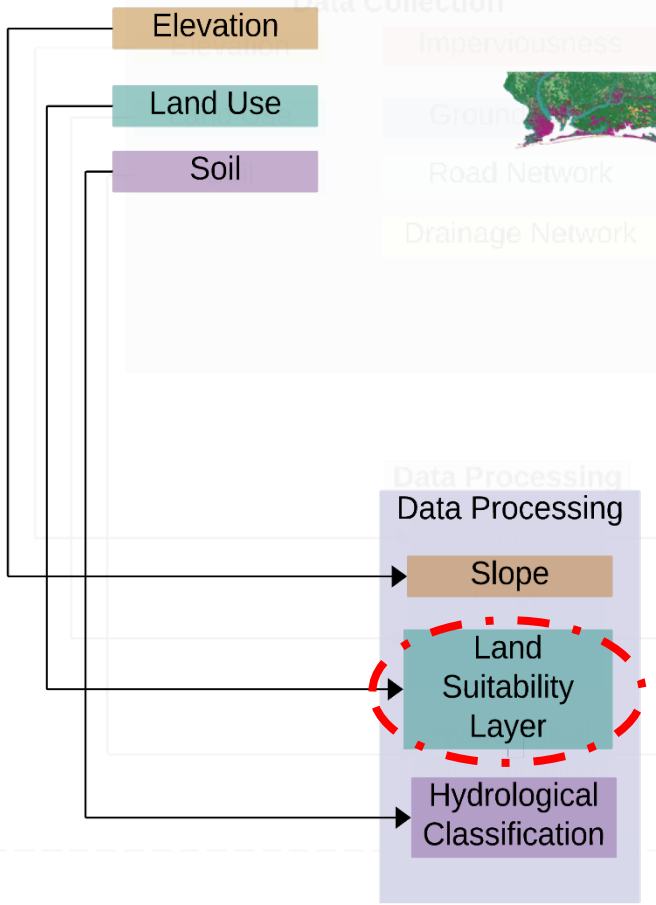


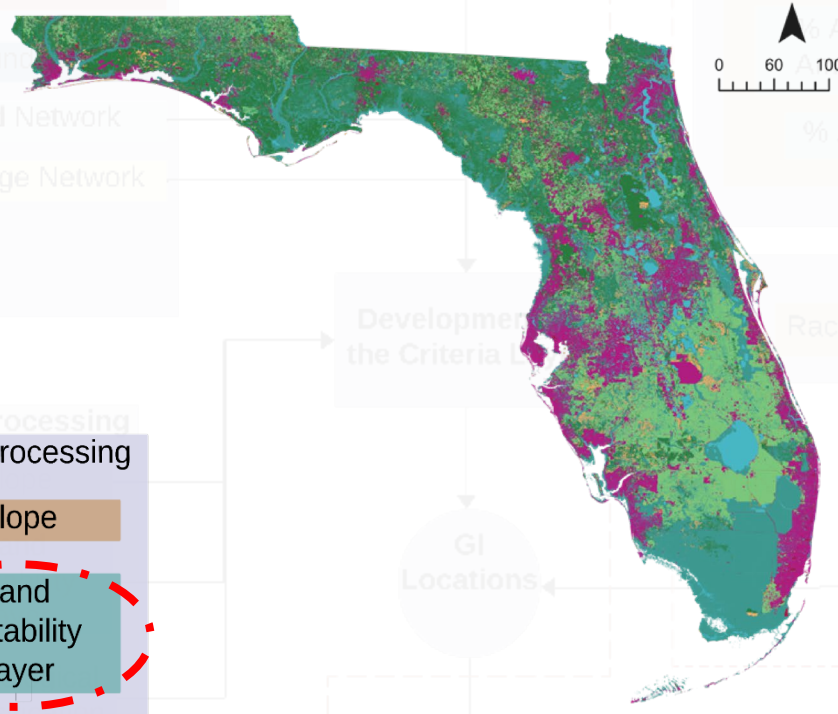
Elevation



Slope

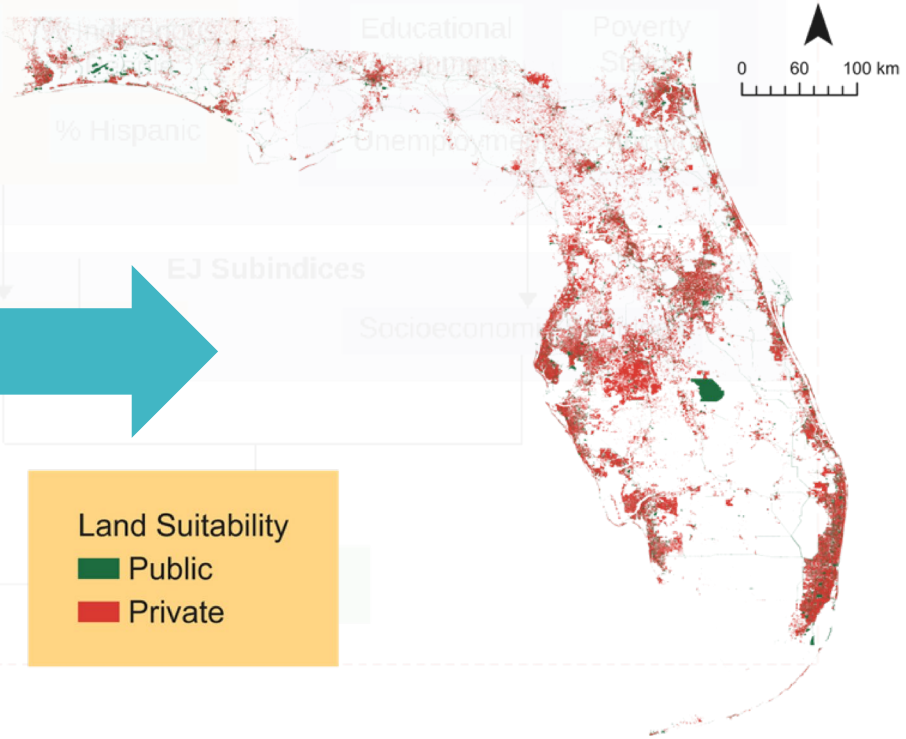
Overall Workflow





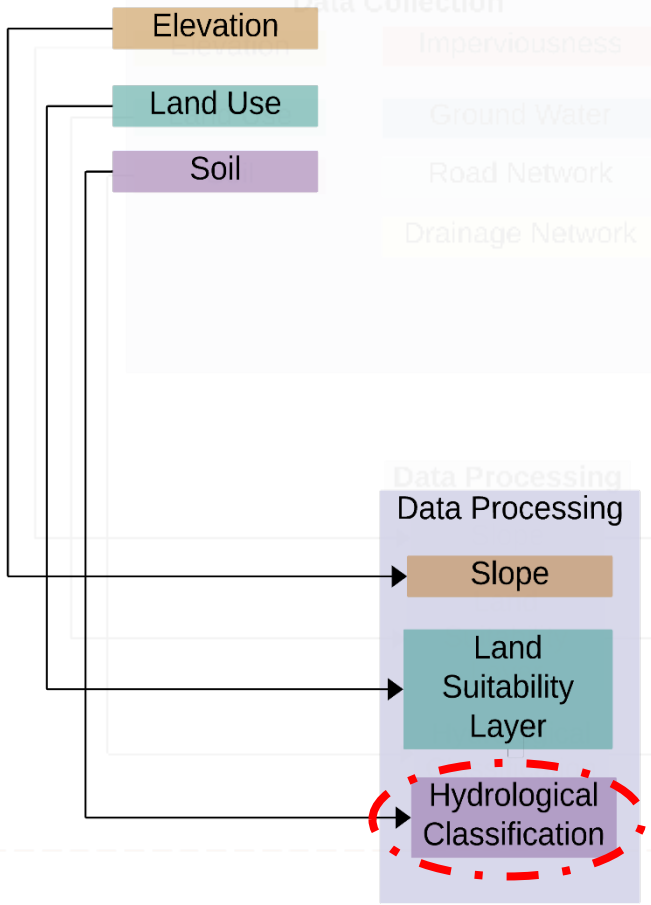
Land Use

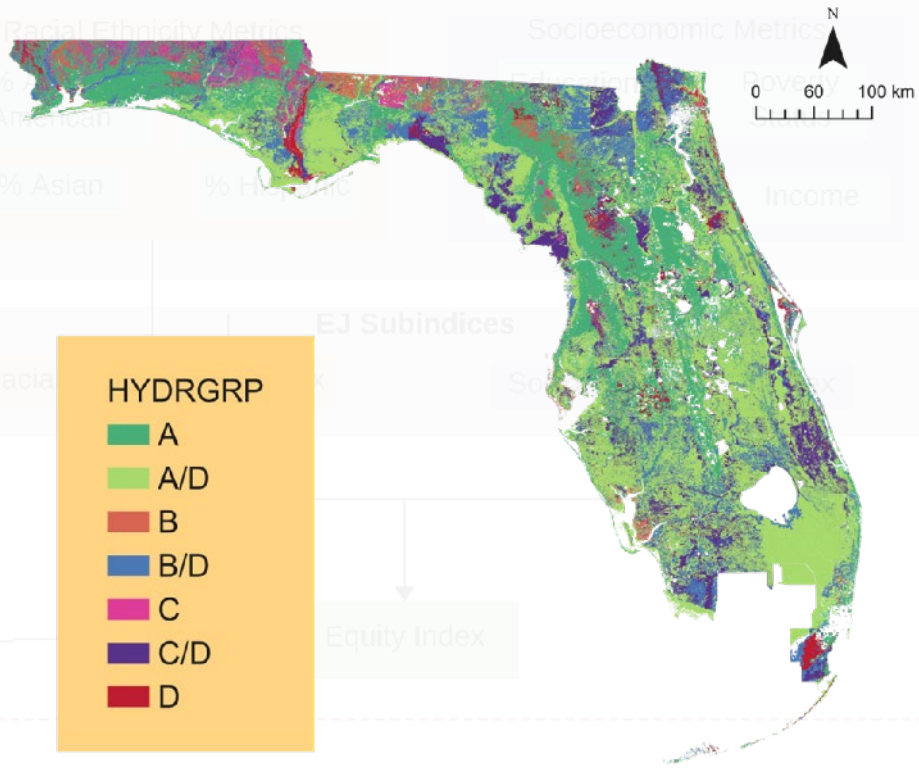
Land Suitability
Public
Private



Land Suitability

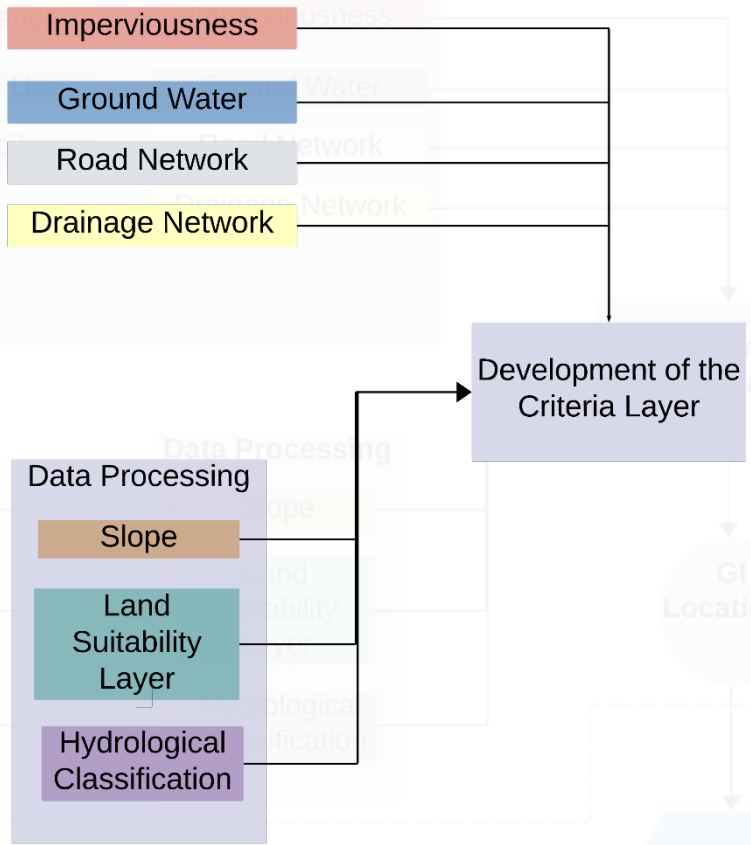
Overall Workflow





Hydrological Soil Classification

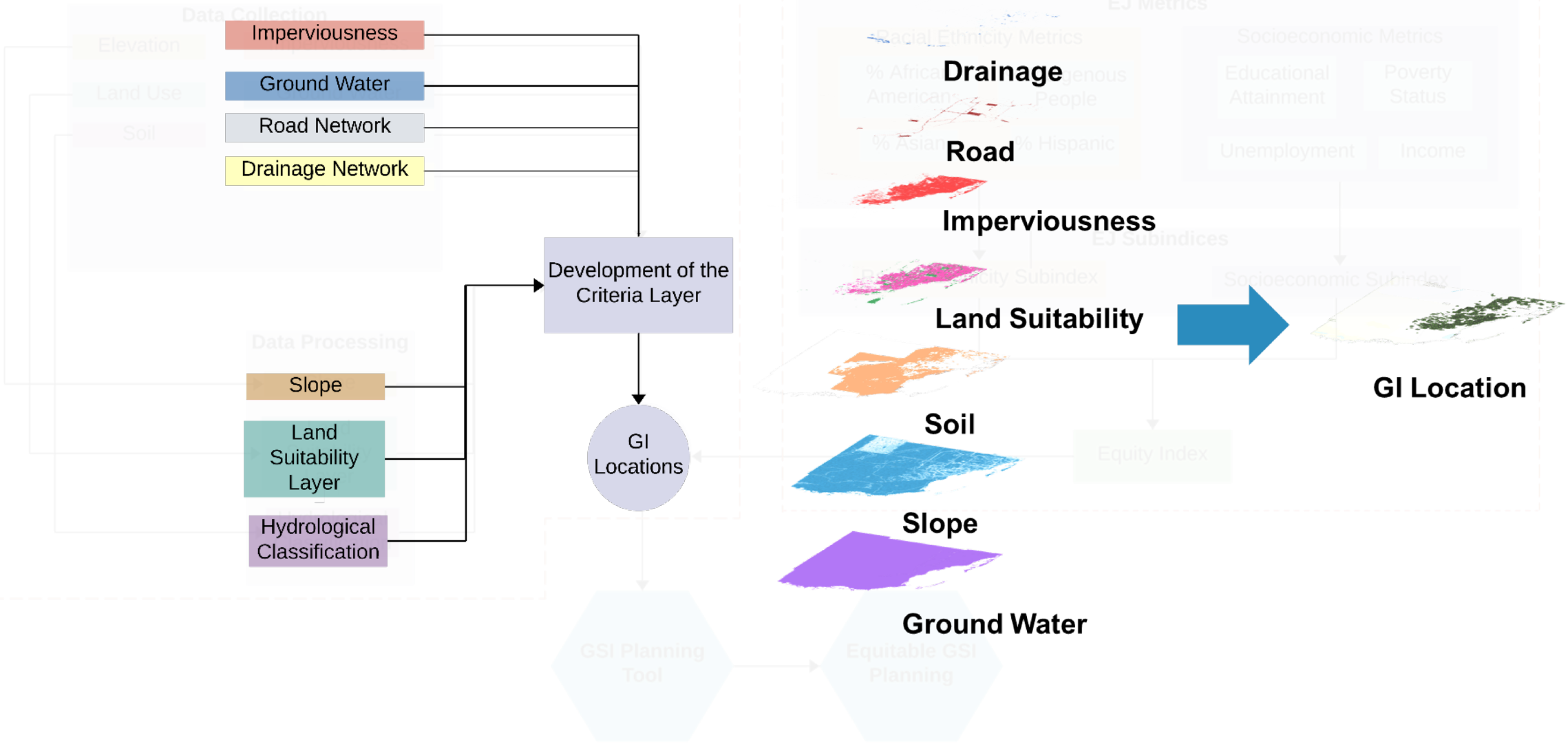
Overall Workflow



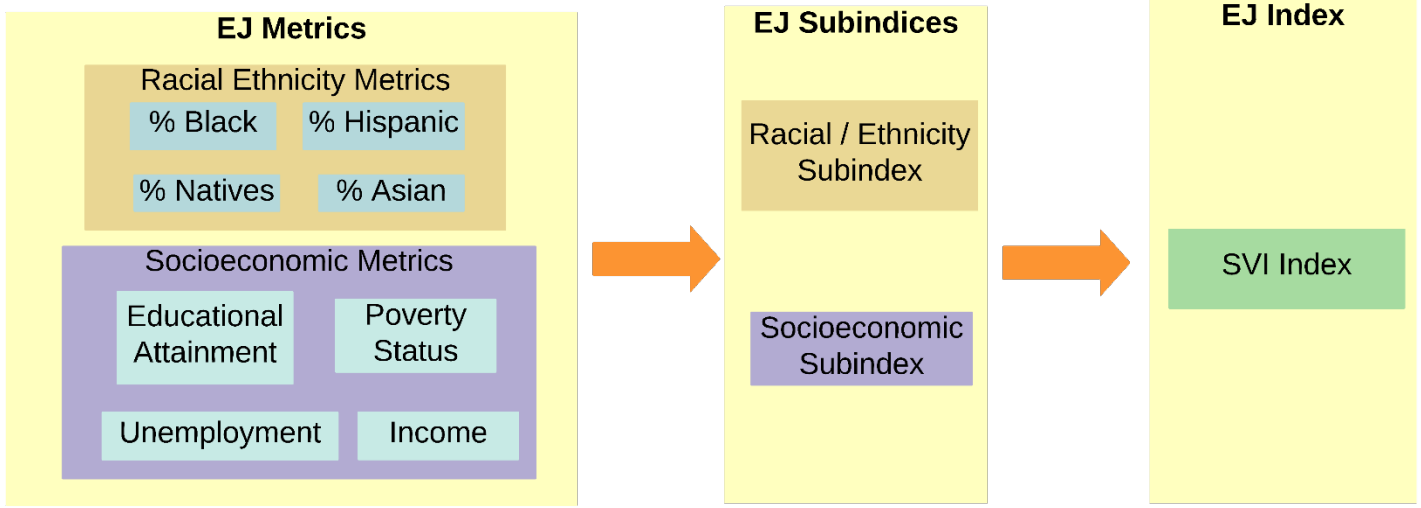
Criteria adopted in siting the GI

BMP Type	Drainage Area (acre)	Drainage Slope (%)	Impervious (%)	Hydrologic Soil Group	Water Table Depth (ft)	Road Buffer (ft)	Stream Buffer (ft)	Building Buffer (ft)
Bioretention	<2	<5	>0	A-D	>2	<100	>100	---
Cistern	---	---	---	---	---	---	---	<20
Constructed Wetland	>25	<15	>0	A-D	>4	---	>100	---
Dry Pond	>10	<15	>0	A-D	>4	---	>100	---
Grassed Swale	<5	<4	>0	A-D	>2	<100	---	---
Green Roof	---	---	---	---	---	---	---	---
Infiltration Trench	<5	<15	>0	A-B	>4	<100	>100	---
Porous Pavement	<3	<1	>0	A-B	>2	---	---	---
Rain Barrels	---	---	---	---	---	---	---	<20
Vegetative Filter Bed	---	<10	>0	A-D	>2	<100	---	----
Wet Pond	>25	<15	>0	A-D	>4	---	>100	---

Overall Workflow



Calculation of the Social Vulnerability Index



$$Standardized\ Metric = \frac{S_{max} - S_i}{S_{max} - S_{min}} \quad \text{(Eq 1)}$$

$$Standardized\ Metric = \frac{S_i - S_{min}}{S_{max} - S_{min}} \quad \text{(Eq 2)}$$

Where,

S_{max} = maximum metric value across all census tracts,

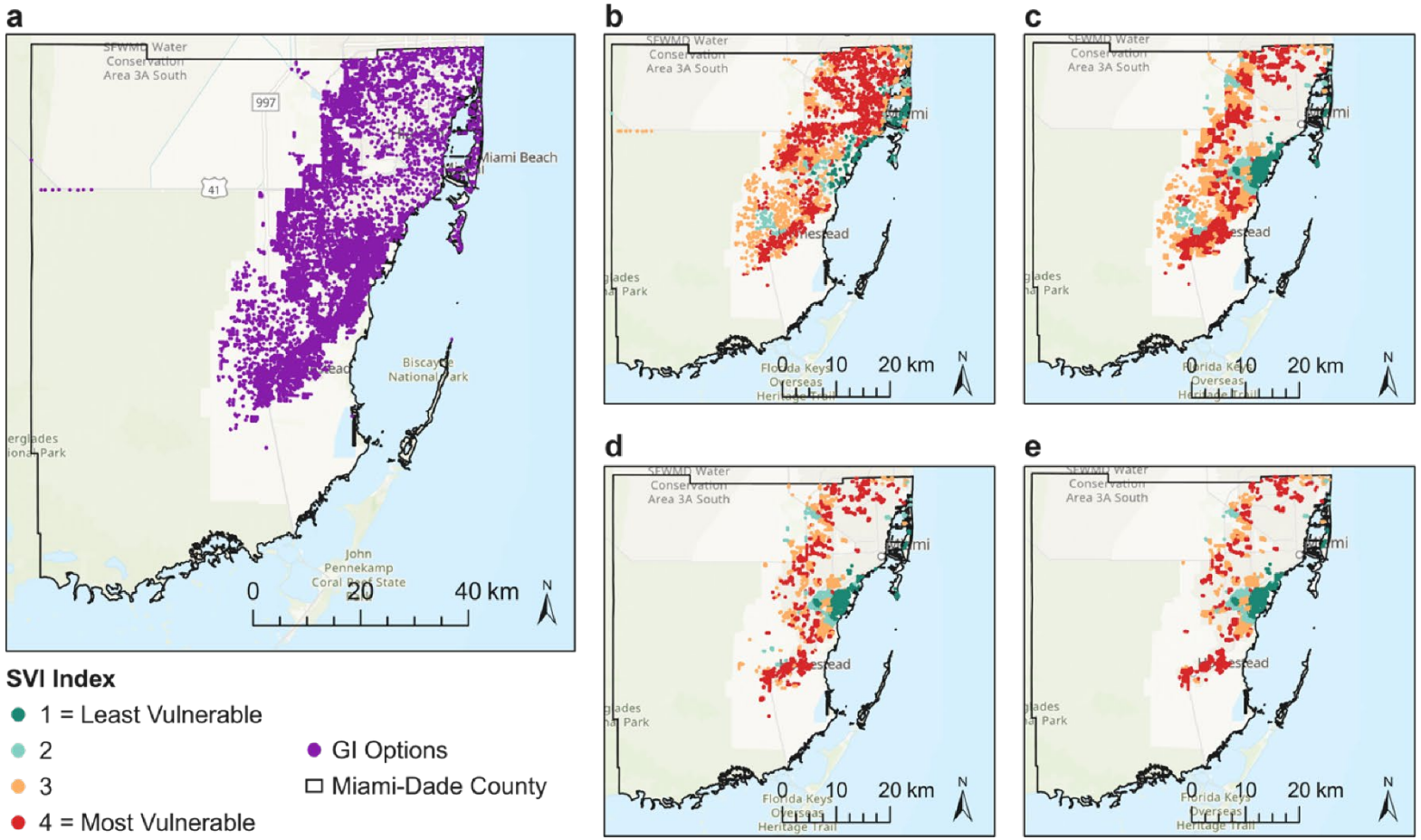
S_{min} = minimum metric value across all census tracts.

S_i = metric value at a given census tract.

Table 1:The average of environmental justice metrics in the quartile groups of the developed equity index.

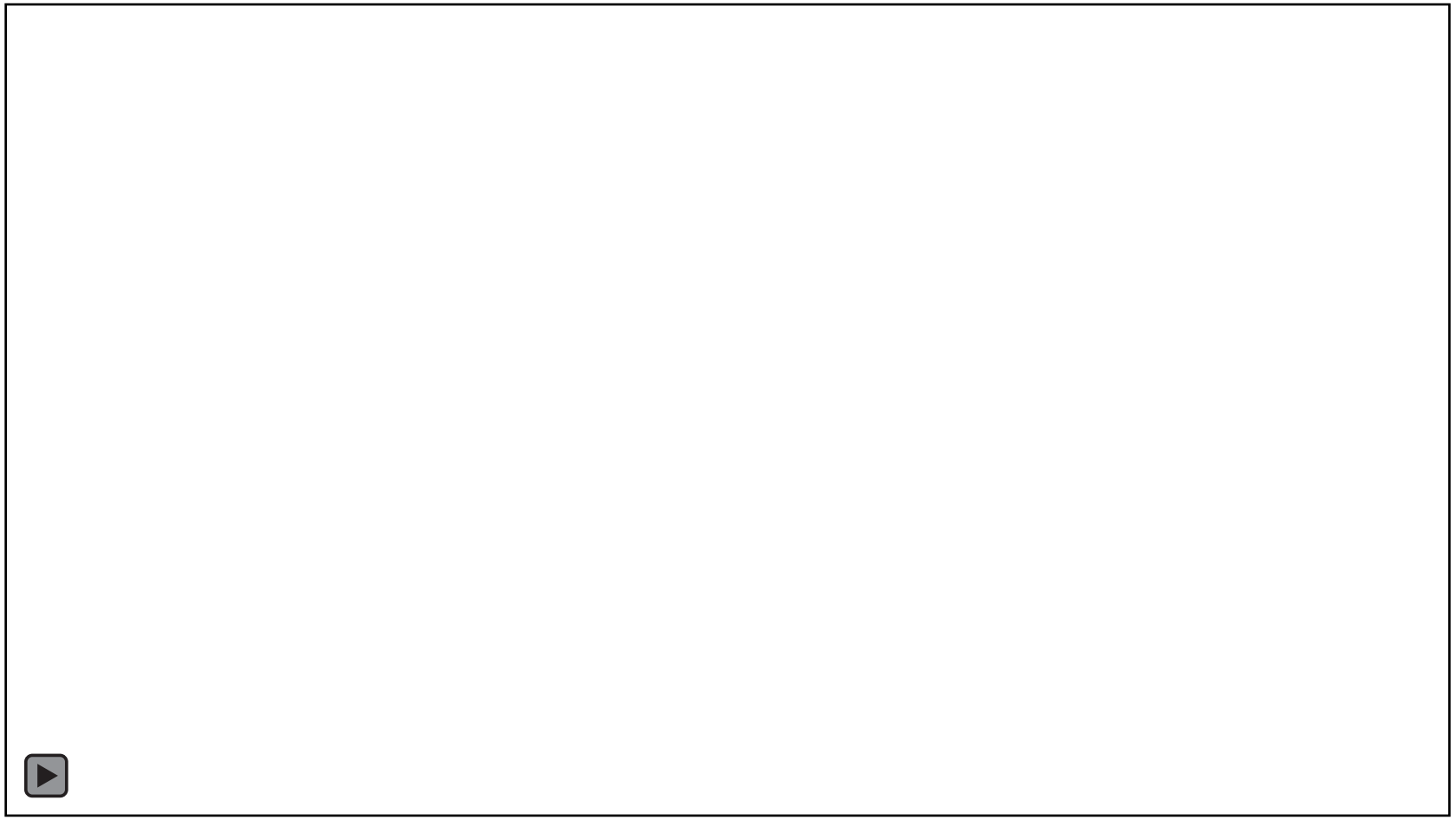
Census Tract Quartile	Racial/Ethnicity Metrics				Socioeconomic Metrics			
	% Black or African American alone	% American Indian and Alaska Native alone	% Asian alone	% Hispanic or Latino	% Without High School Diploma (Population 25 Years and Over)	% In Poverty	% Unemployed (Population 16 Years and Over)	Median Household Income
4 = Most vulnerable	30.68	0.19	2.12	45.10	14.63	22.95	7.76	$44,654
3	15.05	0.17	3.14	29.59	8.46	13.82	5.84	$59,277
2	8.17	0.18	2.57	16.52	6.02	10.13	4.80	$68,290
1 = Least vulnerable	3.15	0.12	2.11	9.61	3.18	5.99	3.23	$90,767

Location of the GI



a. All GI options
b. Only Green Roof
c. Only Bioretention
d. Only Porous Pavement
e. Only Infiltration Trench

iPlanGreenS2: Integrated Planning Toolkit for Green Infrastructure Selection and Siting



Conclusion

- The outcomes from the tool indicated the most cost-effective GI strategies for nutrient reduction across Florida.
- The methodology adopted in this study is applicable to large-scale watershed areas and is simply transferrable to any region of the United States.
- This tool will aid decision-makers and planners in developing a scientifically thorough plan to achieve the watershed's cost-effective GI goals.

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THANK
You!