



Stormwater and Impervious Surfaces

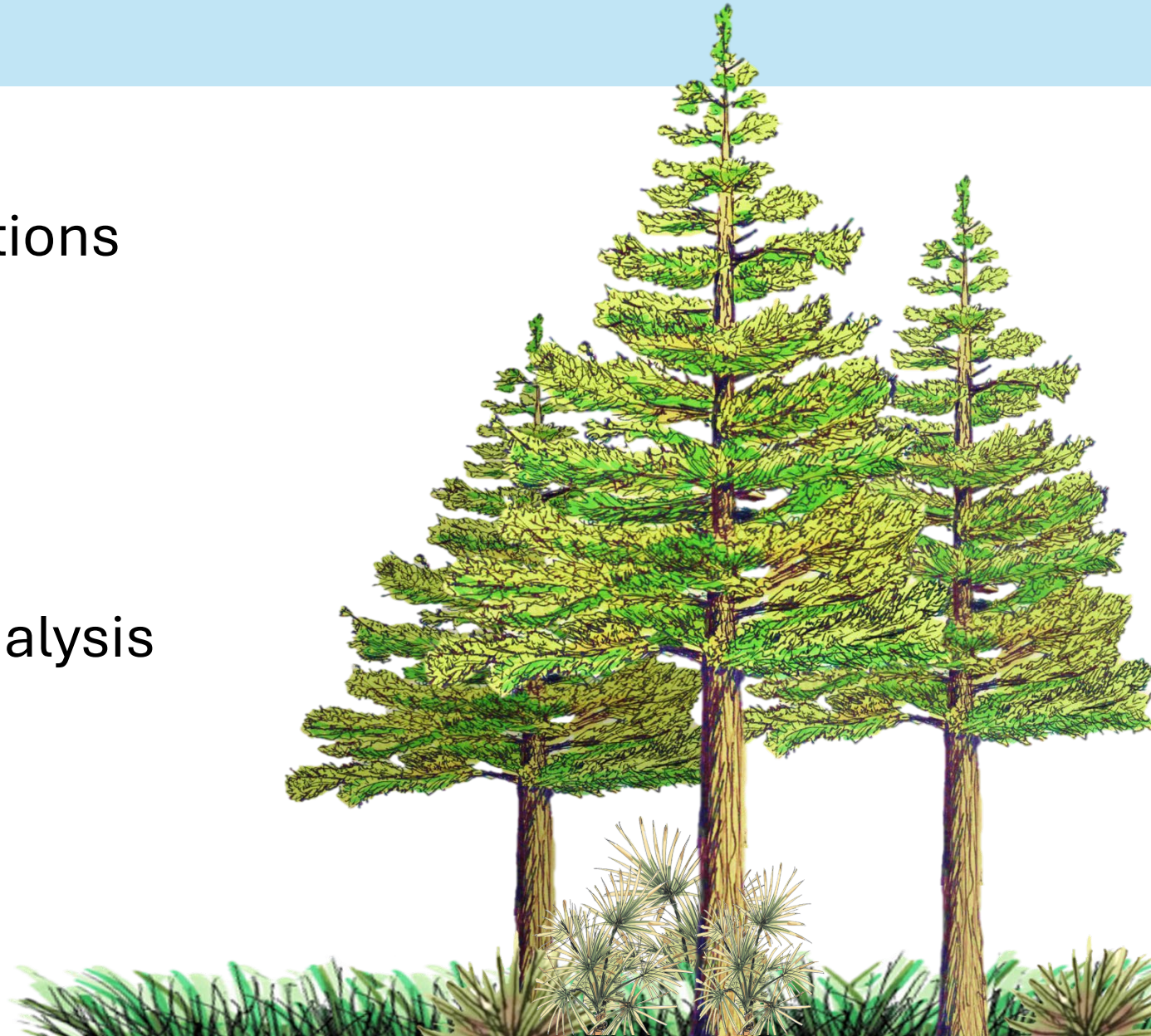
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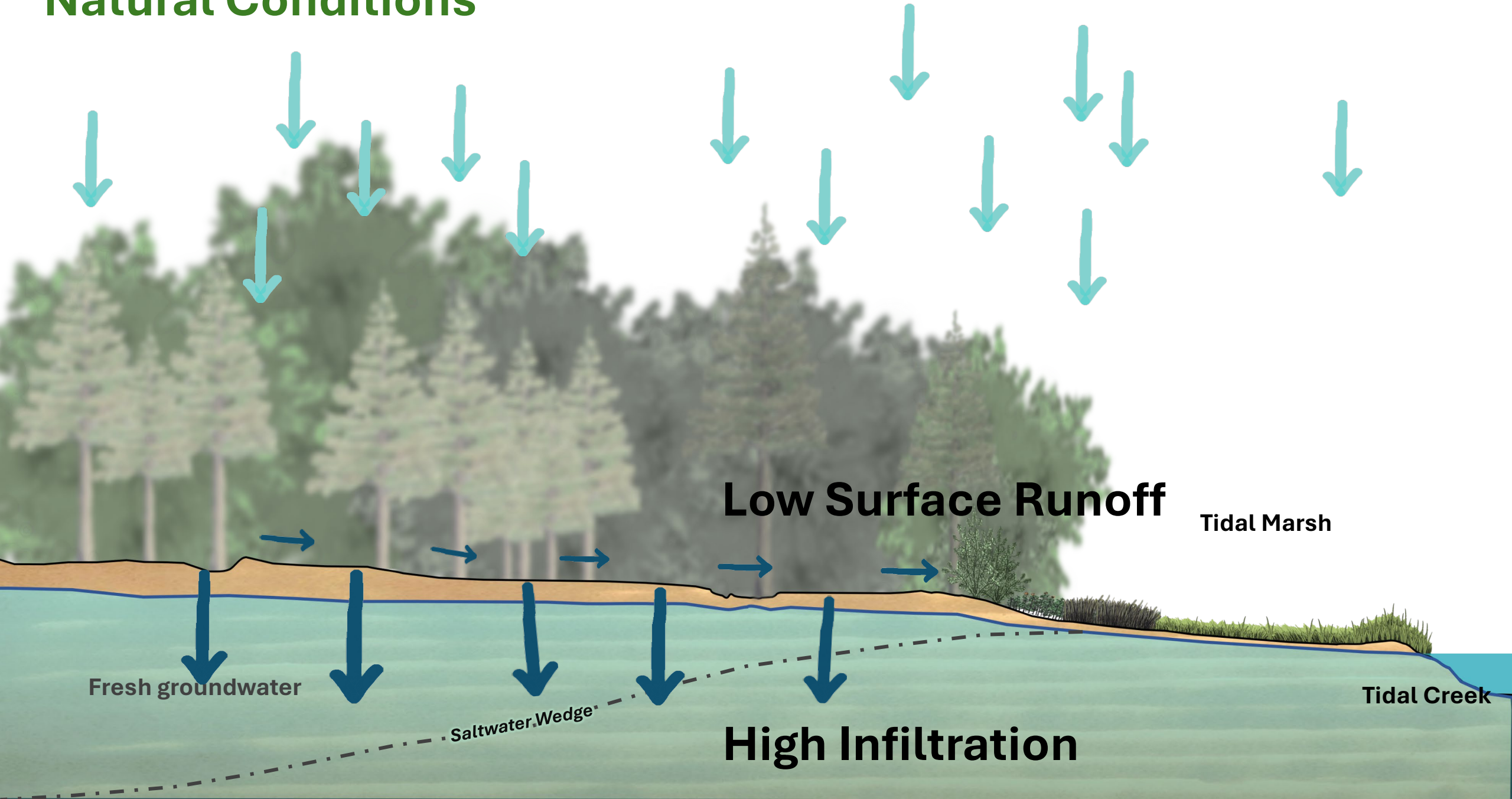


Overview

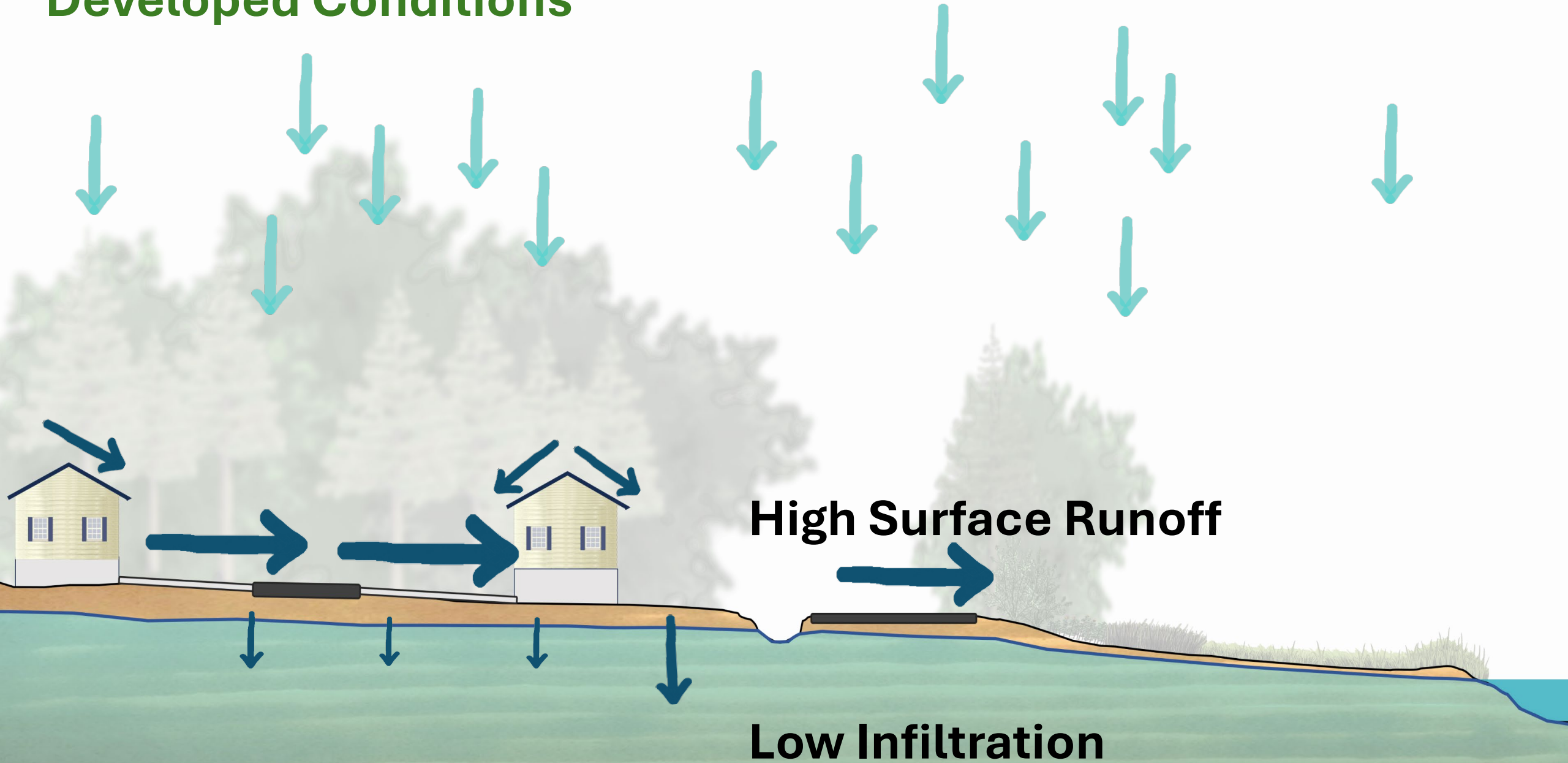
- Natural vs. Developed Conditions
- Impervious surface data
- Water Quality
- Pervious surfaces primer / analysis



Natural Conditions



Developed Conditions



High Surface Runoff

Low Infiltration



Impervious surfaces prevent stormwater from infiltrating into underlying soils

- Buildings
- Roads
- Driveways
- Multi-use Pathways
- Parking lots
- Tennis courts
- Pool decks...



Stormwater runoff volume (flooding)



Pollutant & suspended solids transport



Downstream geomorphic changes



Saltwater Intrusion



Surficial groundwater recharge



Water quality conditions



Biodiversity & Ecosystem Integrity

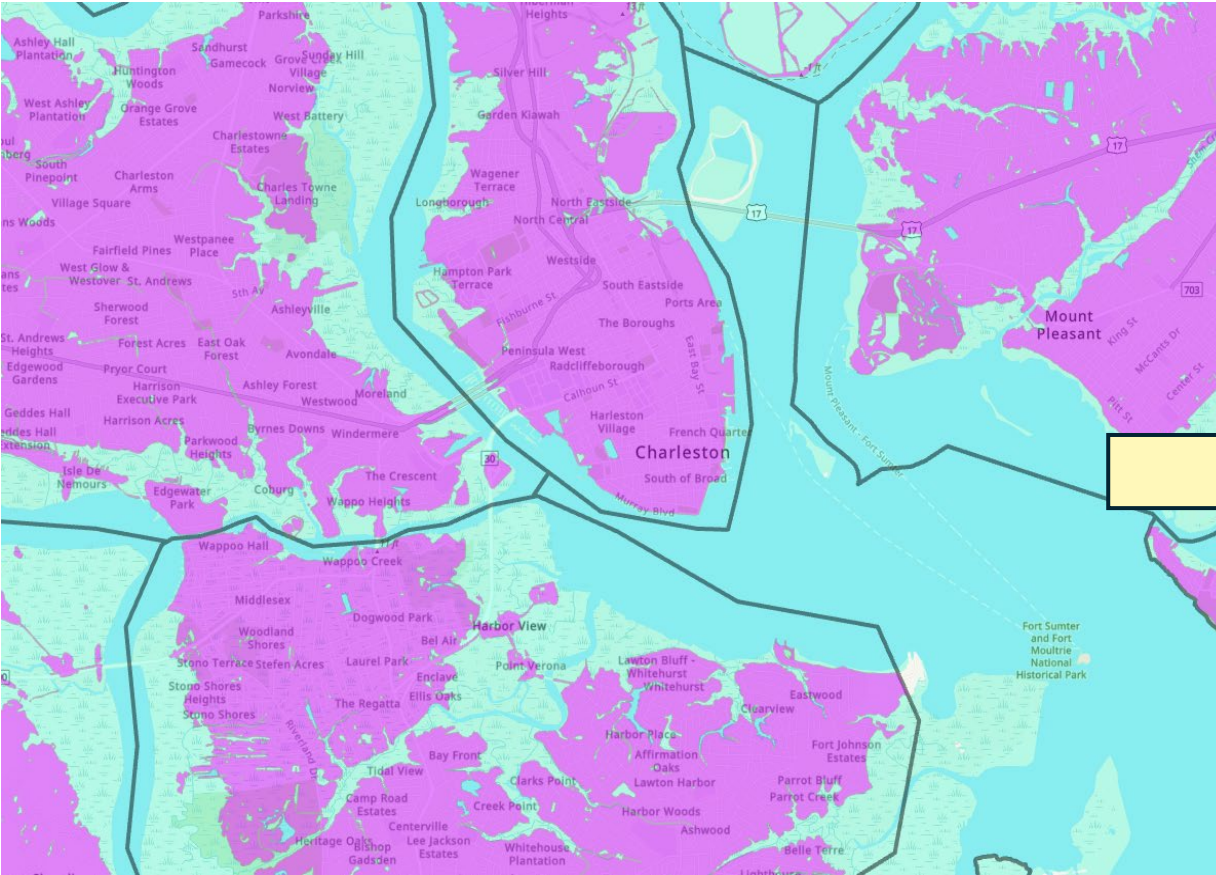
Upland Impervious Land Cover

Regional Upland Areas

Charleston (18) + Hilton Head + Pawleys Island
Excluded areas within the National Wetlands Inventory

NOAA CCAP Landcover (2021)

1-meter impervious layer
Coastal South Carolina



See Table 1

Upland Impervious Land Cover

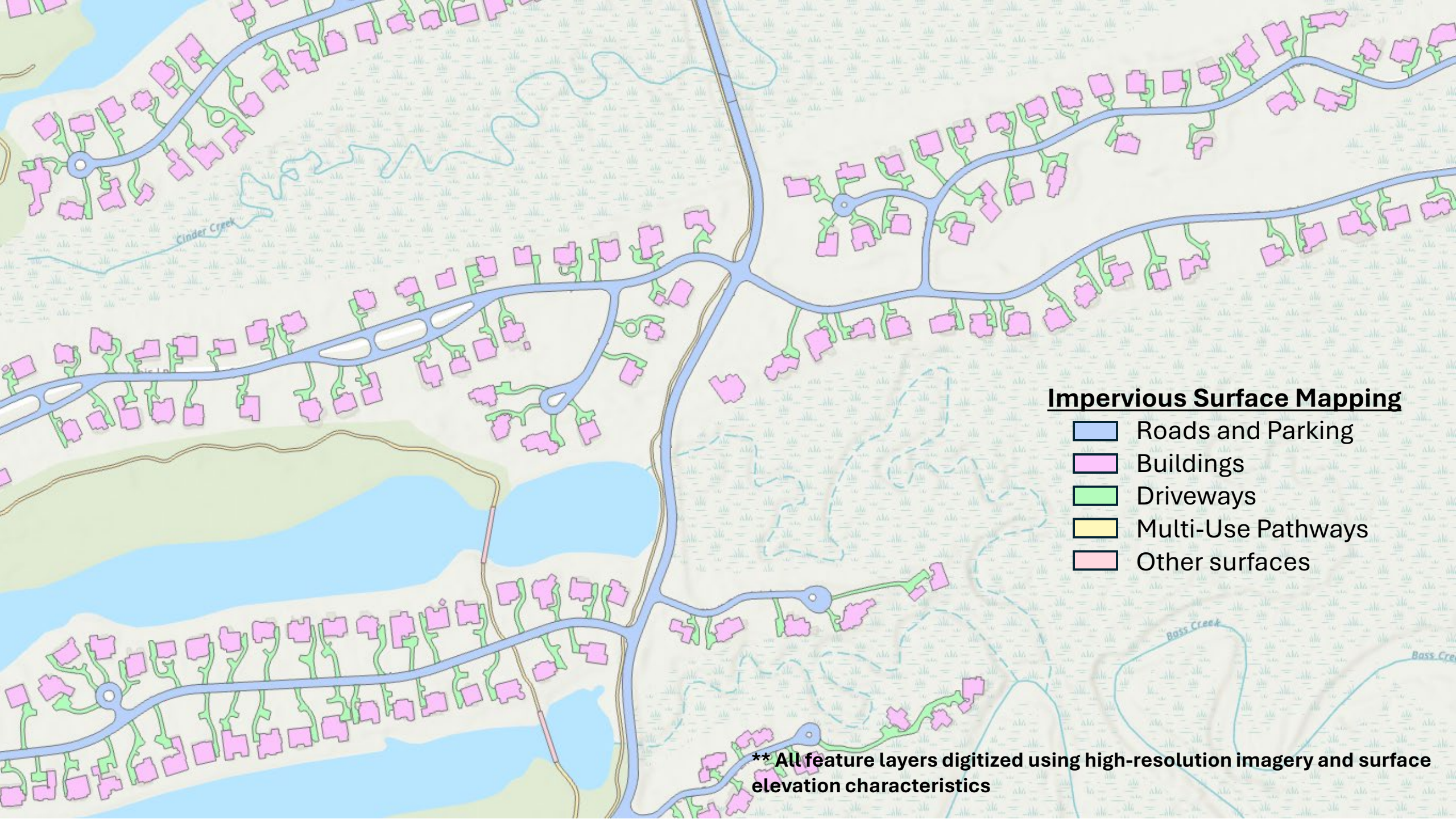
Region	Impervious Coverage (NOAA CCAP)
Wadmalaw Island	1.91%
Deweese Island	2.64%
Johns Island (South)	3.30%
Johns Island (North)	5.46%
Johns Island (Central)	11.52%
Daniel Island	13.96%
Kiawah Island (unadjusted)	15.31%
Seabrook Island	15.83%
Mount Pleasant East	18.87%
Pawleys Island	19.66%

Region	Impervious Coverage (NOAA CCAP)
Folly Beach	19.86%
Hilton Head Island	20.92%
James Island	23.30%
Sullivan's Island	28.40%
West Ashley	28.84%
Edisto Beach	30.63%
Isle of Palms	32.04%
Mount Pleasant West	33.91%
North Charleston	36.73%
Downtown Charleston	56.45%

Note: Does not include all impervious surfaces due to canopy interference and data availability. Surfaces such as driveways, pathways, and portions of roads/parking lots are typically not included

NOAA CCAP Impervious Cover (2021)

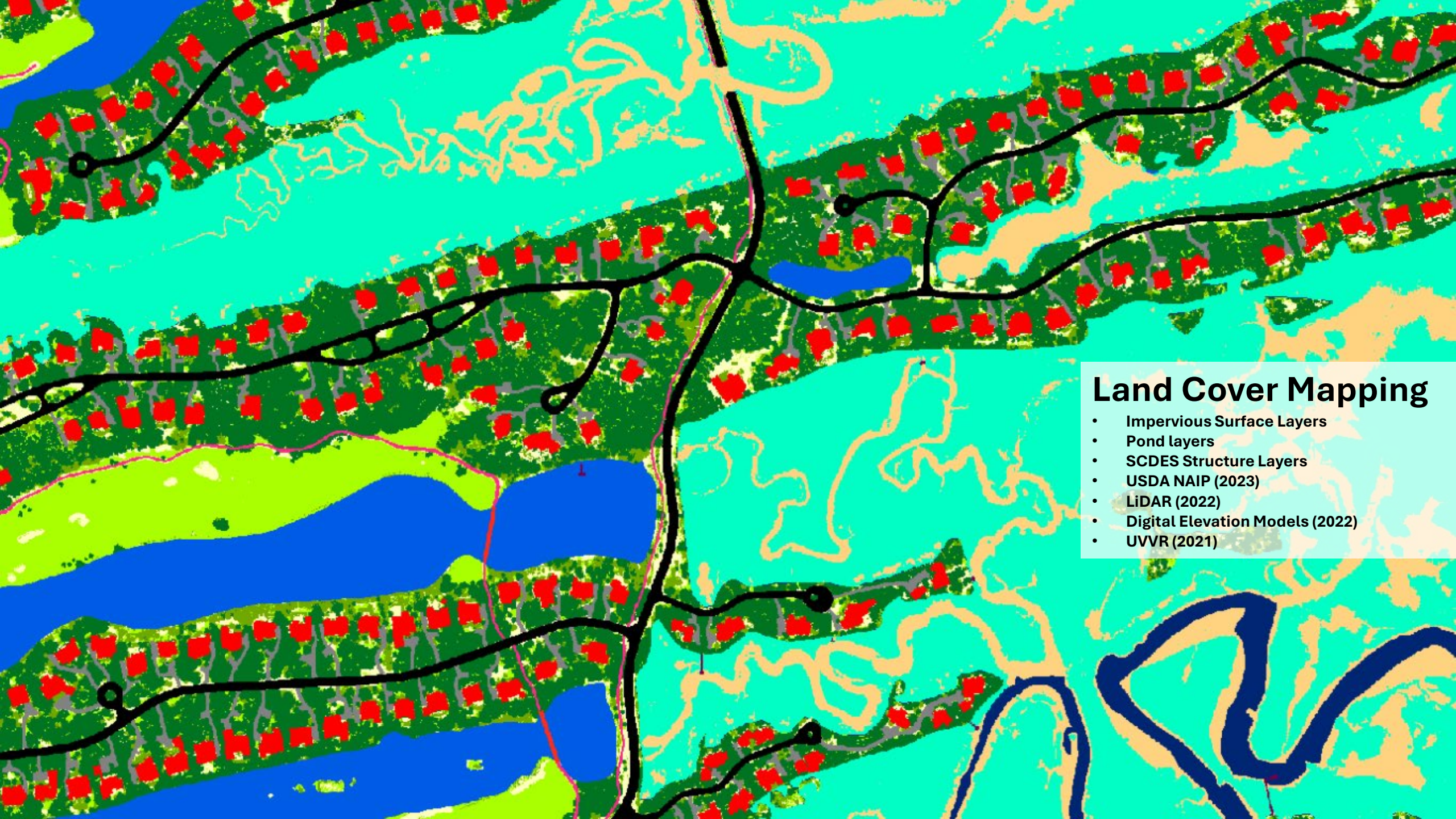




Impervious Surface Mapping

- Blue box: Roads and Parking
- Pink box: Buildings
- Green box: Driveways
- Yellow box: Multi-Use Pathways
- Light pink box: Other surfaces

**** All feature layers digitized using high-resolution imagery and surface elevation characteristics**



Land Cover Mapping

- Impervious Surface Layers
- Pond layers
- SCDES Structure Layers
- USDA NAIP (2023)
- LiDAR (2022)
- Digital Elevation Models (2022)
- UVVR (2021)

See Table 2

Impervious Surface Summary

Kiawah Island

3725

Total upland acres

669

Acres of impervious cover

18%

Impervious Cover

354.07

Acres transportation related

Surface Type	Number	Acreage (% upland total)
Buildings	3545	262.32 (39.2%)
Driveways	2696	112.13 (16.8%)
Roads & Parking	-	241.94 (36.2%)
Multi-use pathways	-	43.08 (6.4%)
Other	58	9.77 (1.4%)
Total		669.24

Water Quality

Litter & Debris
Petroleum Products (Oil, grease, PAHs)
Heavy metals (Pb, Cu, Cd, Zn...)
Polybrominated diphenyl ethers (PBDEs)
Polychlorinated biphenyls (PCBs)
Suspended Solids (Turbidity)
Fecal Coliforms
Reduced dissolved oxygen levels
Fertilizers – nitrogen and phosphorus
Pesticides
Contaminants of emerging concern (CECs)
Microplastics
Among others...

Impervious Surface



Stormwater runoff



Pollutant & suspended solid transport

Downstream water quality impairments

Microbial contamination
Reduction in ecosystem function
Negative impacts to biodiversity

Ecosystem Impact Thresholds

SCDNR/NOAA (*Holland et al., 2005; Sanger et al., 2015; Parker et al., 2023*)

- Adverse physical and chemical changes exceeding **10-20%** impervious cover
- Significant changes exceeding **20-30%** impervious cover
- Measurable increases in PAHs, trace metals, PBDEs.

Kiawah Island = 17.97% Impervious*

USEPA Specific Impact Thresholds

- High algal biomass (> 5%)
- Benthic invertebrates (8-15%)
- Macroinvertebrate diversity & richness (8-12%)
- Fish Biological Integrity (6-11%)
- Geomorphic response patterns (13-24%)
- Channel instability (> 10%)

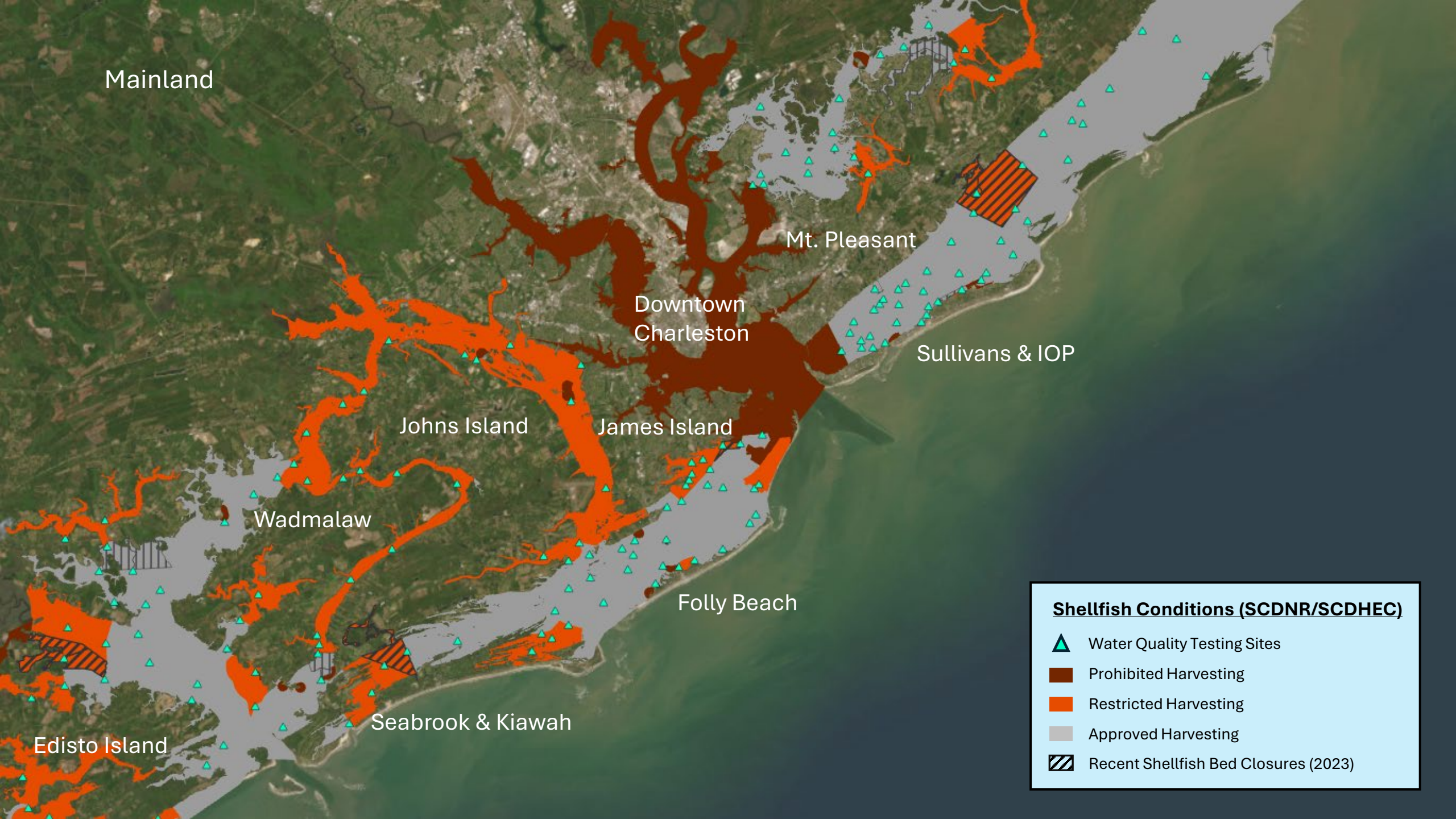
Water Quality Monitoring - Regulatory

SCDES Shellfish Management Area 11 (2023)

- Each station with >30 samples over 36 months (SRS strategy)
- Annual water quality oscillations are primarily rainfall-induced

Existing Water Quality Impairments

- Fecal Coliforms (primary) & turbidity
- Restrictions – several stations exceeding Fcoli geometric mean MPN = 14
- Bacteriological water quality directly affected by non-point source pollution associated with development



Mainland

Mt. Pleasant

Downtown
Charleston

Sullivan's & IOP

Johns Island

James Island






Wadmalaw

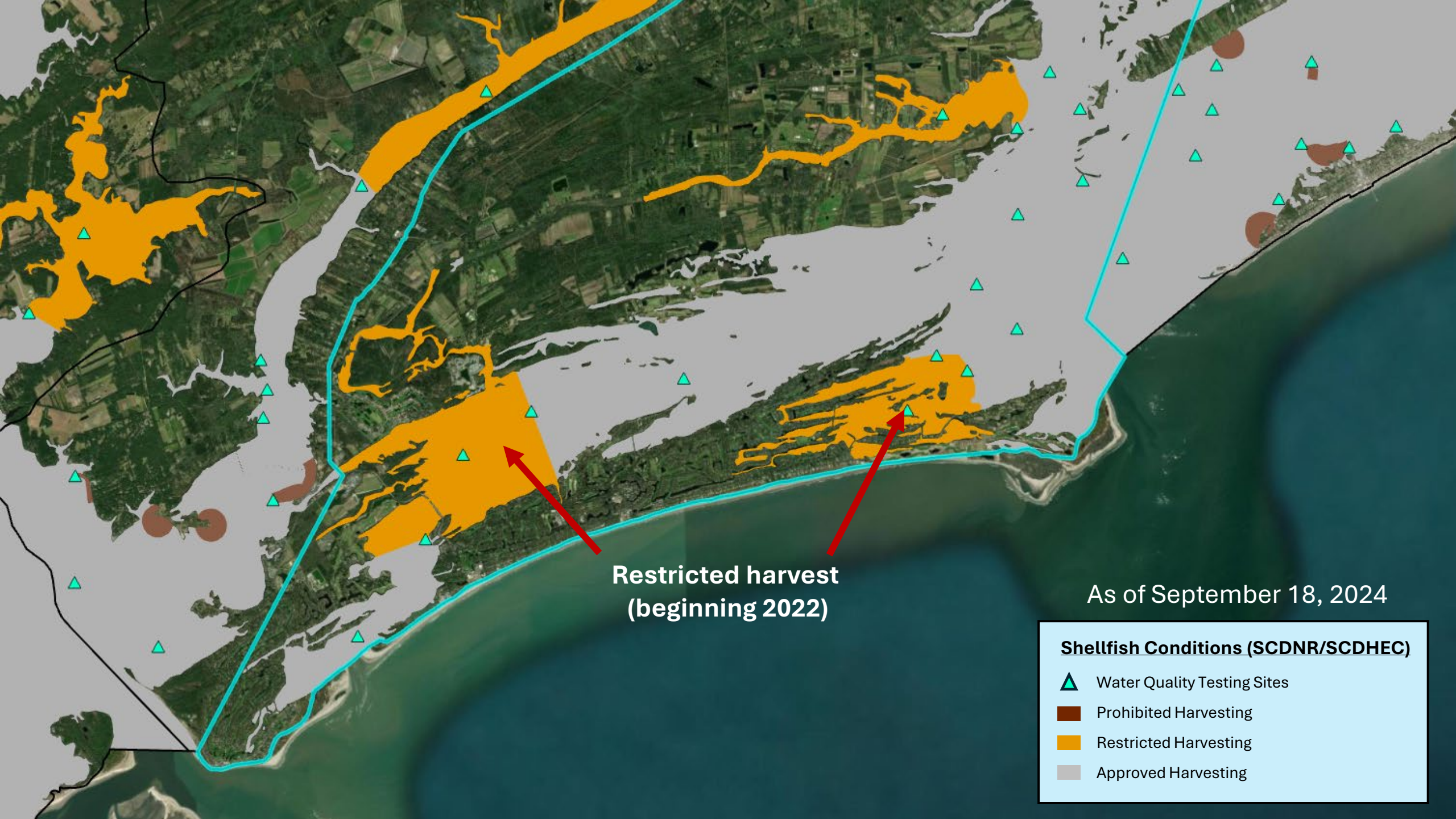
Folly Beach

Seabrook & Kiawah

Edisto Island

Shellfish Conditions (SCDNR/SCDHEC)

-  Water Quality Testing Sites
-  Prohibited Harvesting
-  Restricted Harvesting
-  Approved Harvesting
-  Recent Shellfish Bed Closures (2023)



As of September 18, 2024

Restricted harvest
(beginning 2022)

Shellfish Conditions (SCDNR/SCDHEC)

- ▲ Water Quality Testing Sites
- Prohibited Harvesting
- Restricted Harvesting
- Approved Harvesting

Nature Based Solutions Manual for Kiawah Island

Marsh protection and stormwater mitigation

Detailed information on ~13 practices

- *Site Selection*
- *Installation*
- *Preparation*
- *Maintenance*
- *Materials*
- *Monitoring*

Accessible with enough technical detail

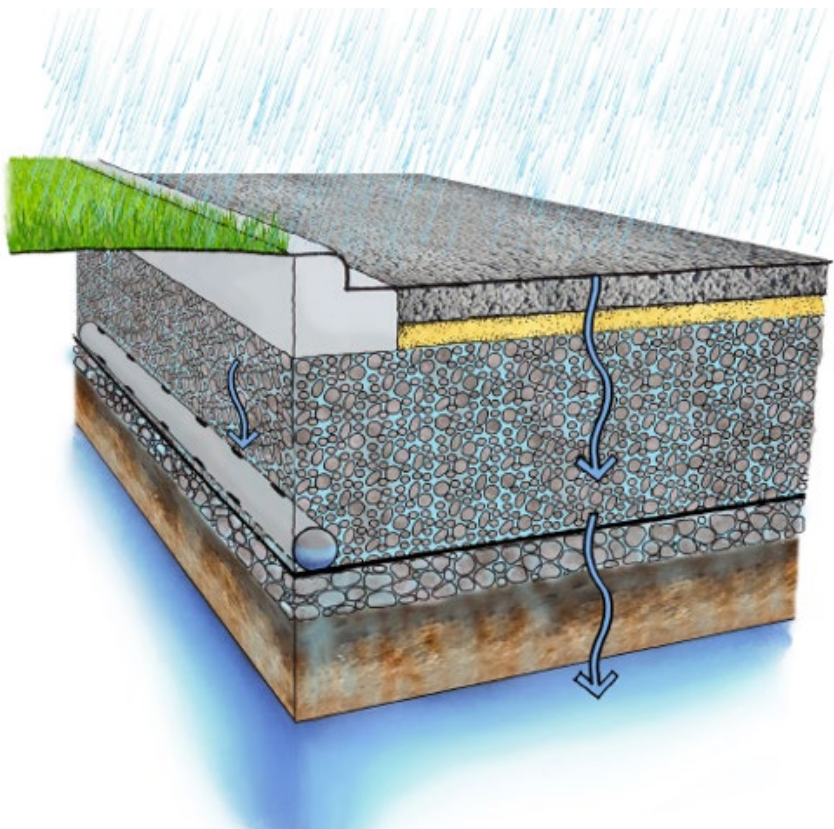
Provides “blueprints” for ideas



Pervious Surfaces

Allows for the penetration of stormwater runoff through the surface and into the underlying soils

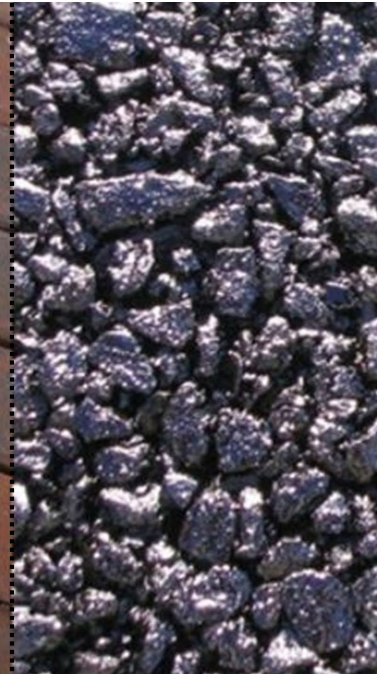
Reduces runoff volume and downstream water quality impairments



**Pervious Concrete
Interlocking Pavers**



**Pervious
Asphalt**



**Pervious
Concrete**



Grass Geogrid



Pervious Surface Testing

Kiawah Island and Surrounds

ASTM C1701 Infiltrometer Testing

- Three (3) tests at each site
- Each test with an initial pour (1 gal) and second pour (2-3 gal)
- Inches per hour calculated based on time to fully drain

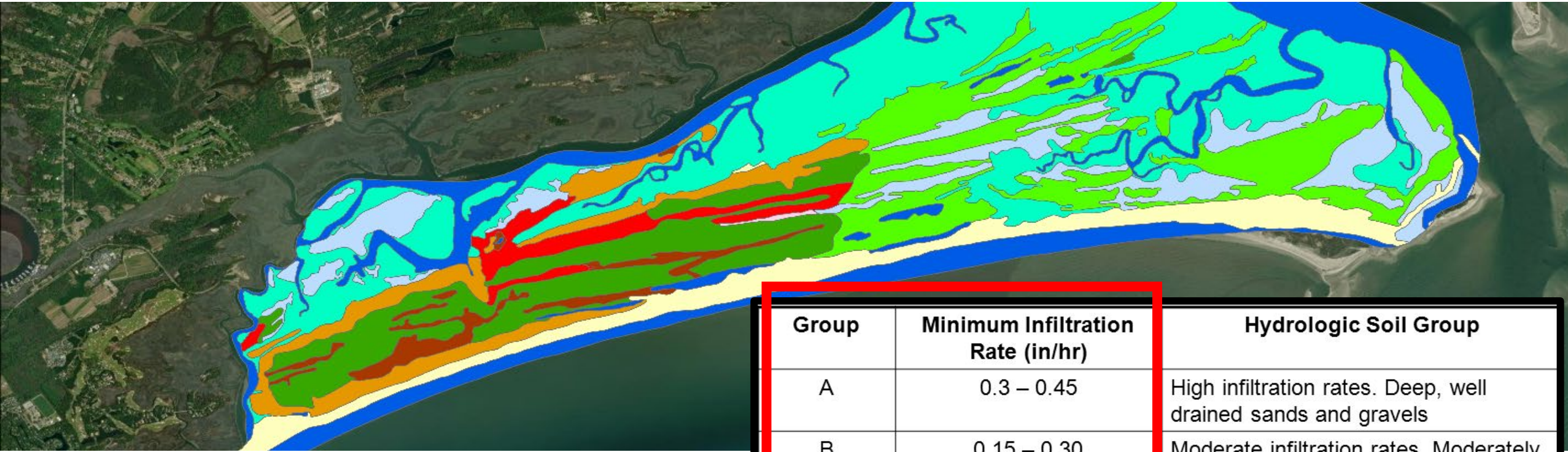


Site	Type	First Pour (in/hr)	Second Pour (in/hr)	Average (in/hr)
Sandcastle	Paver	127.0	149.3	138.8
Oceanwoods	Paver	6.6	-	6.6
Cassique	Pervious Concrete	59.0	75.5	70.4
Saltmeadow	Pea Gravel	1189.7	1092.1	1106.5
Indigo Park	Pervious Concrete	47.6	39.9	41.3

See Table 3

Infiltration at surface exceeds typical rainfall event

Soil Infiltration Rate



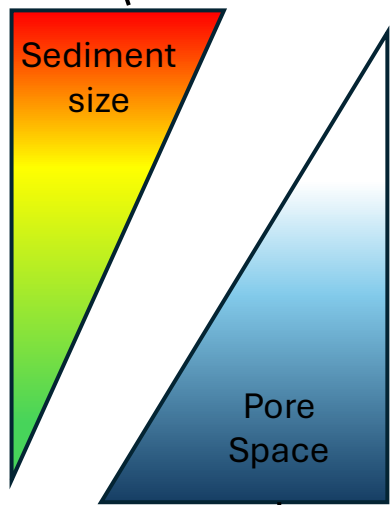
Soil Types on Kiawah Island

- Wando (A)
- Kiawah (A/D)
- Dawhoo/Rutlege (A/D)
- Seabrook Series (B)
- Crevasse-Dawhoo (A or A/D)

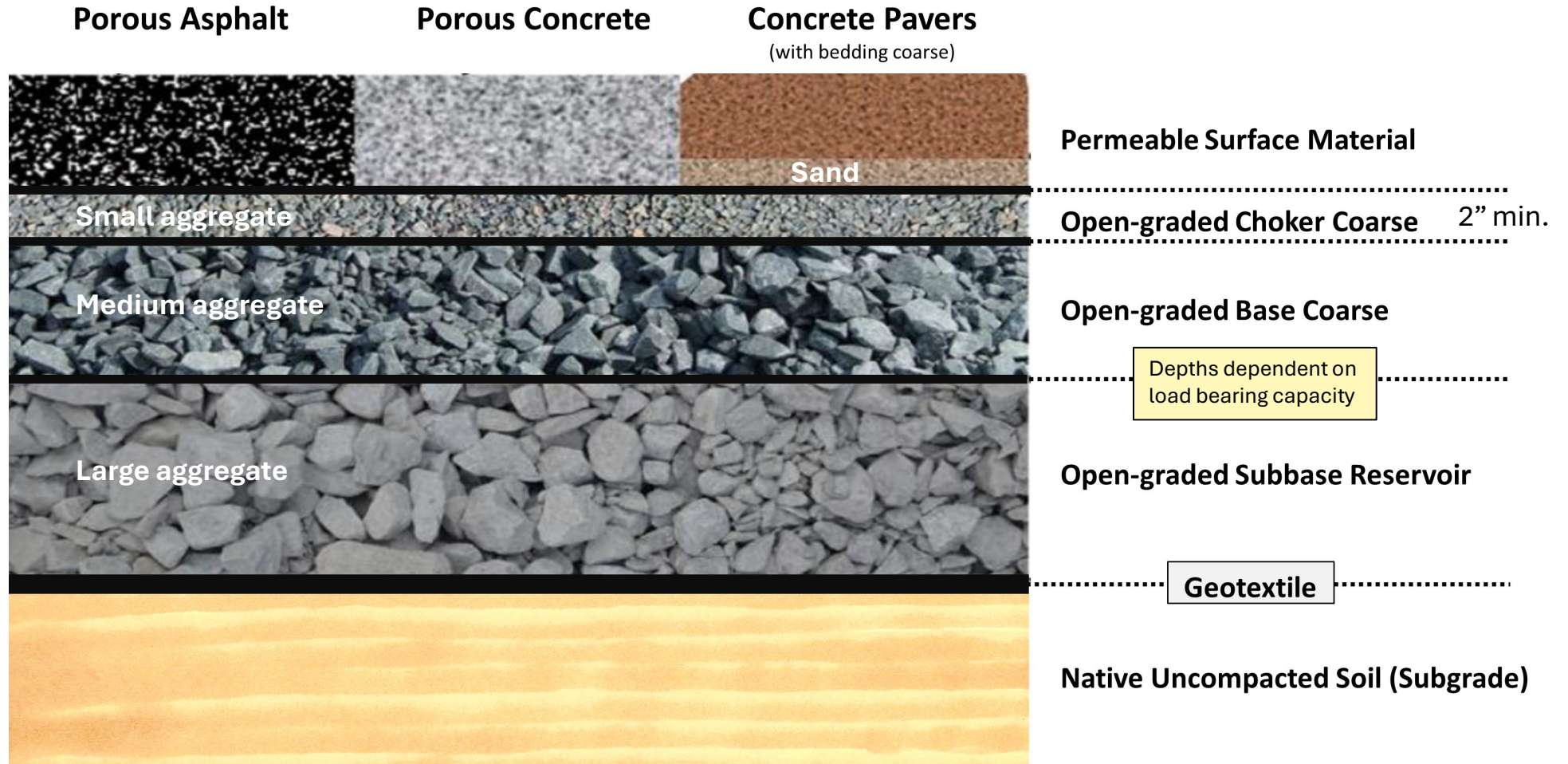
Group	Minimum Infiltration Rate (in/hr)	Hydrologic Soil Group
A	0.3 – 0.45	High infiltration rates. Deep, well drained sands and gravels
B	0.15 – 0.30	Moderate infiltration rates. Moderately deep, moderately well drained soils with moderately coarse textures (silt, silt loam)
C	0.05 – 0.15	Slow infiltration rates. Soils with layers, or soils with moderately fine textures (clay loams)
D	0.00 – 0.05	Very slow infiltration rates. Clayey soils, high water table, or shallow impervious layer

Pervious Surface Anatomy

Particles trapped by geotextile layers



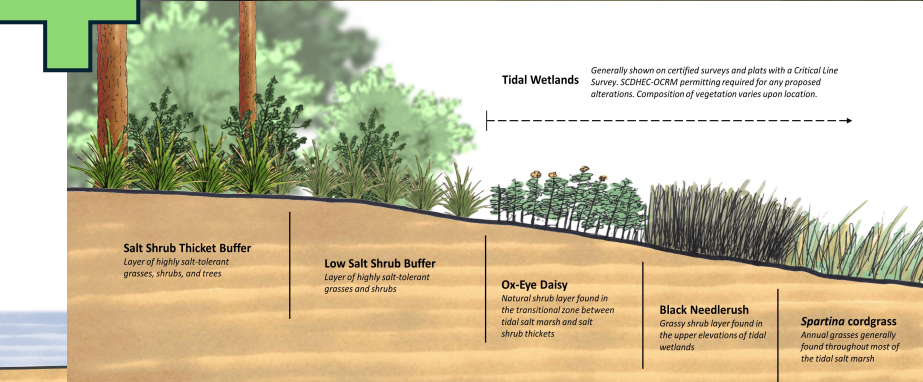
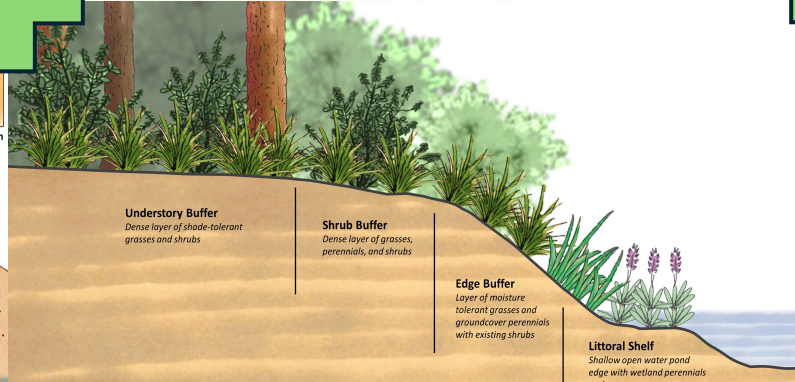
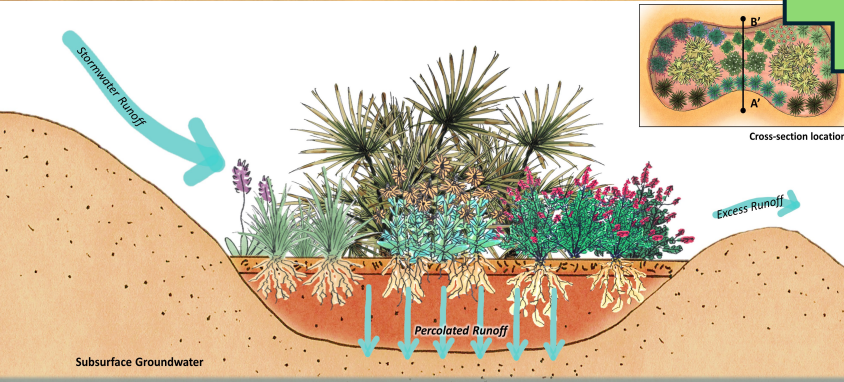
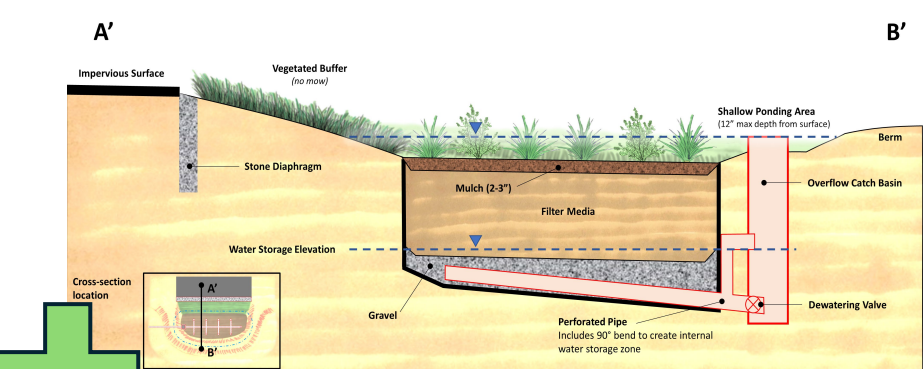
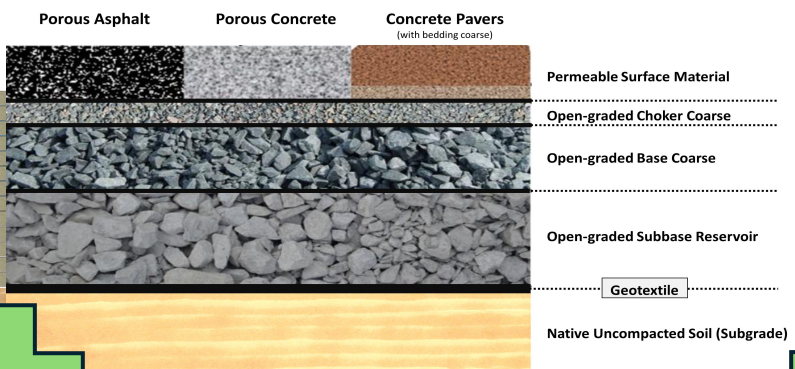
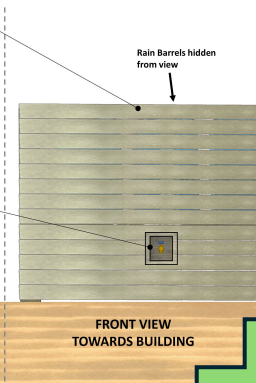
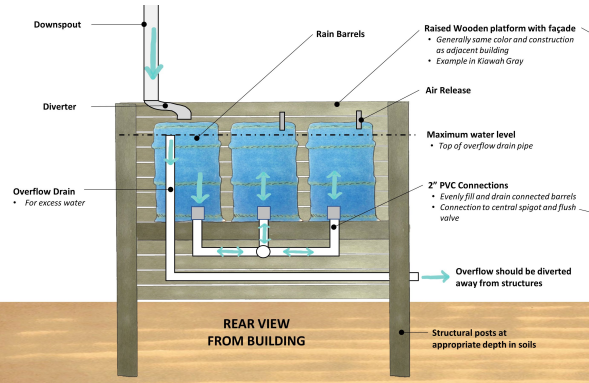
Bottom layers act as a reservoir for stormwater



Stormwater Treatment Trains

- Incorporate multiple practices to mitigate issues with stormwater runoff

Rain barrels >>> Pervious surfaces >>> Rain Gardens >>> Vegetated Buffers



Summary

Kiawah Island contains 18% impervious cover

- Below regional median
- Water quality impacts

Approaching next threshold for ecological impacts

- +70 acres to reach 20% impervious cover

Consideration for pervious surfaces

- Efficacy dependent on subsurface design
- Part of a stormwater “treatment train” that involves other practices