CITY PLAN WATER LAB

VIRTUAL GATHERING CODE OF CONDUCT

The following reminders help to minimize disruption and ensure a more positive experience for all.

BE PATIENT WITH EACH OTHER AND THE TECHNOLOGY.

MICROPHONES WILL REMAIN MUTED FOR THE DURATION OF THE LAB.

PLEASE USE THE CHAT BOX TO ASK QUESTIONS.

TODAY'S AGENDA

15 min	WELCOME AND INTRODUCTIONS
10 min	WATER & LAND USE IN THE CITY PLAN
40 min	WATER & LAND USE PRELIMINARY ANALYSIS
20 min	Q&A
5 min	APPRECIATION & NEXT STEPS

WATER & LAND USE IN THE CITY PLAN

WHAT IS THE CITY PLAN?

It is required by the State of South Carolina.

Per the 1994 State Comprehensive Planning Act (SC Code Title 6, Chapter 29).

It is developed by the Planning Commission.

It is adopted by City Council.

It is revised every 10 years.

WHAT DOES THE PLAN DO?

Per state law, the City Plan has clearly defined limitations of what it can affect.

THE PLAN DOES

MAKE RECOMMENDATIONS
about the future

USE OBJECTIVE INFORMATION
and analysis

INCORPORATE INPUT
from everyone

INFORM DAILY DECISIONS
by staff, Planning Commission and Council

THE PLAN DOES NOT

CHANGE ZONING

CHANGE STORMWATER REGULATIONS

CHANGE TAXATION

MAKE DETAILED POLICY RECOMMENDATIONS
already covered in other adopted plans

THE PLAN IS ROOTED IN FOUR BASIC GUIDING PRINCIPLES.

WATER FIRST

anchored in where water is and where water is going to be

DATA SMART

using the best data available to understand the challenges facing the City

STRENGTH IN DIVERSITY

oriented toward actions that protect our City's historic diversity

COMMUNITY EMPOWERED

asking all members of the community to partner in the planning process

The City Plan is comprised of

TEN KEY ELEMENTS.

As listed in the State Comprehensive Planning Act (SC Code Title 6, Chapter 29).

01 POPULATION

Who are we planning for?

02 ECONOMIC DEVELOPMENT

How can we promote a healthy economy?

03 NATURAL RESOURCES

How can we best utilize, access and enjoy our living environment?

04 CULTURAL RESOURCES

How can we celebrate and preserve what makes us unique?

05 COMMUNITY FACILITIES

What public services are needed and where?

06 HOUSING

What kind of housing is needed, where and how much?

07 LAND USE

What kind of development should be supported where and what priorities should guide it?

08 TRANSPORTATION

How can we support improved mobility citywide?

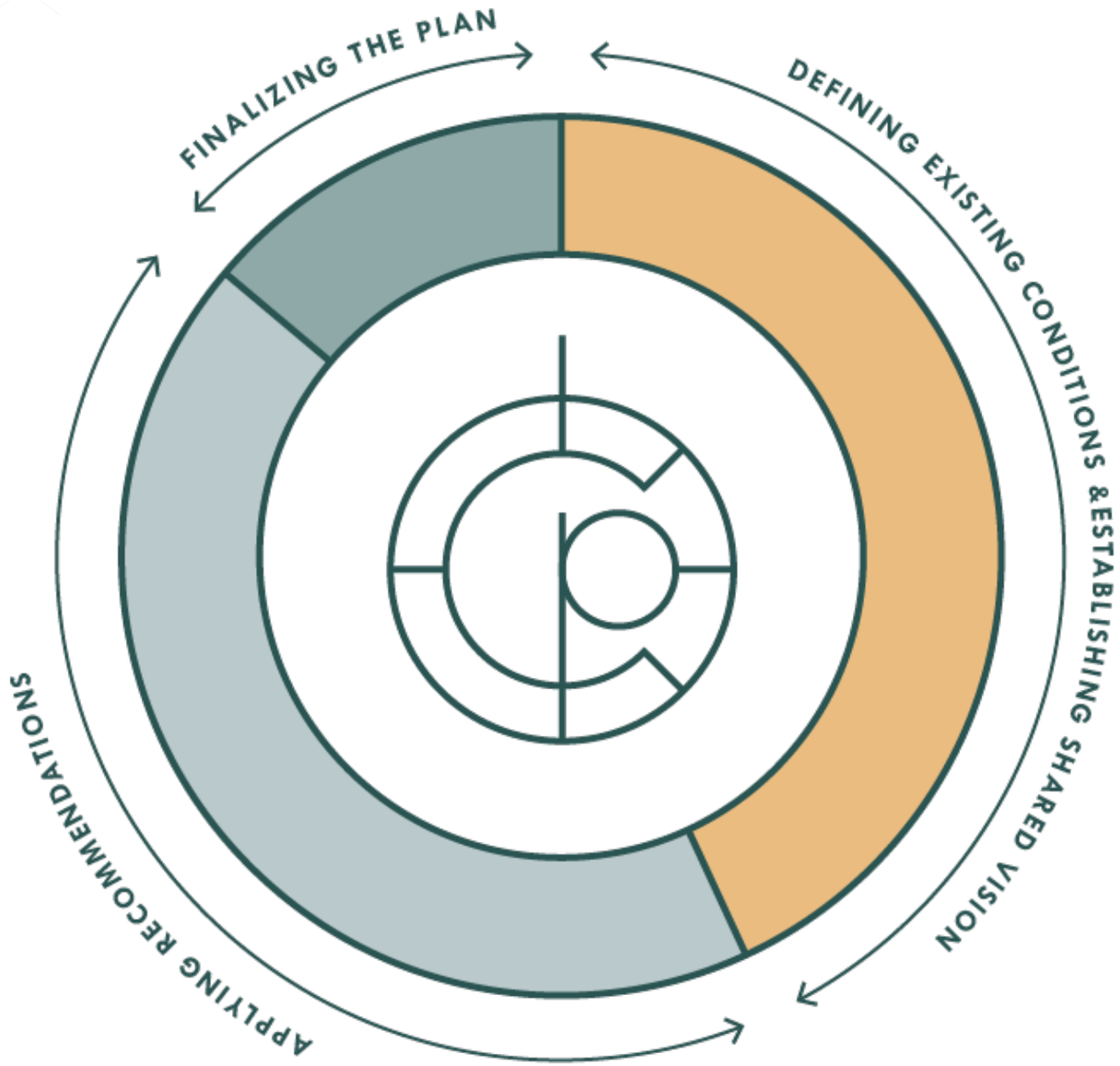
09 PRIORITY INVESTMENT

Where and on what should future investments be focused?

10 RESILIENCE

How can our City grow in a way that helps us better withstand disasters and climate change?

CITY PLAN SCHEDULE



WATER & LAND USE ANALYSIS:
Defining existing – and future – conditions

PLANNING FOR WATER

TODAY: deep dive into the preliminary analysis

1. WATER & LAND USE ANALYSIS

- Why does it flood, where, what kind, how much, and how will this change with the climate?
- How can land be used to increase resiliency in different scenarios?

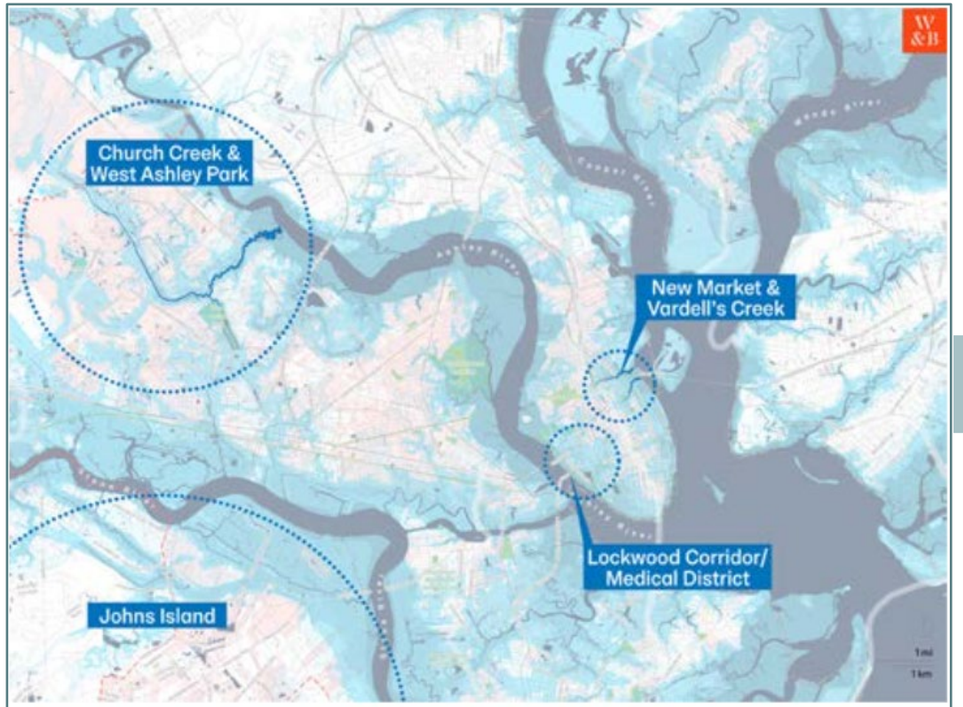
2. PLAN RECOMMENDATIONS

- Define and map new land use categories
- Identify other strategies related to land use policy and other plan elements (transportation, housing, priority investment, etc.)

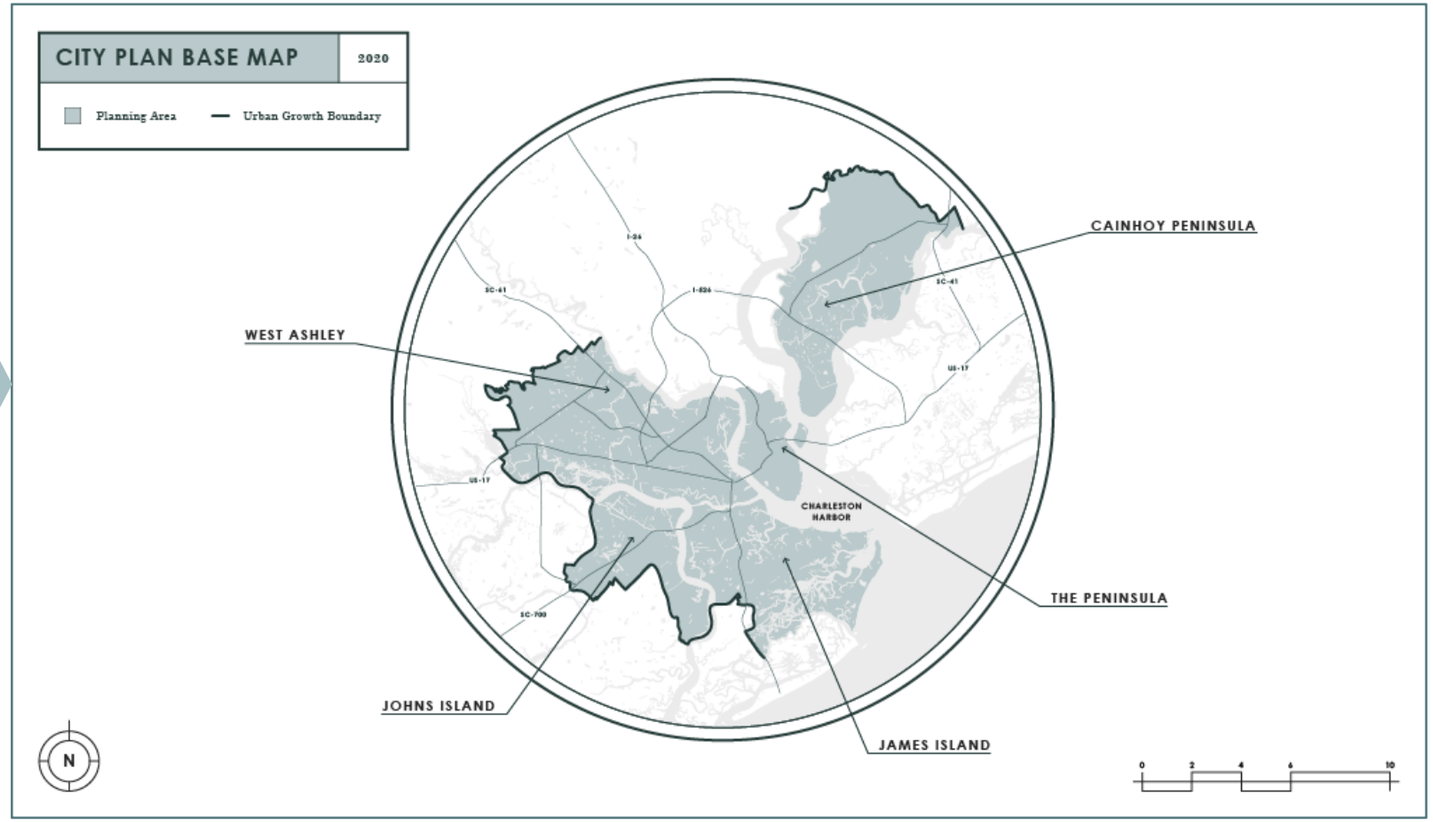
3. PLAN IMPLEMENTATION

- Adopt policies and invest in programs that implement plan recommendations in partnership with multiple departments, stakeholders, and the community

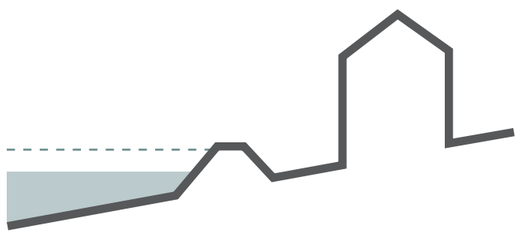
CITYWIDE ANALYSIS



Map of Dutch Dialogues Charleston Focus Areas



PLANNING STRATEGIES



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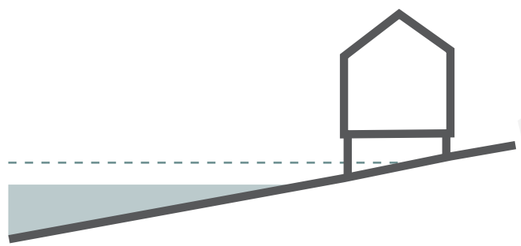

ADAPT

RESERVE

GROW

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WATER & LAND USE
PRELIMINARY ANALYSIS

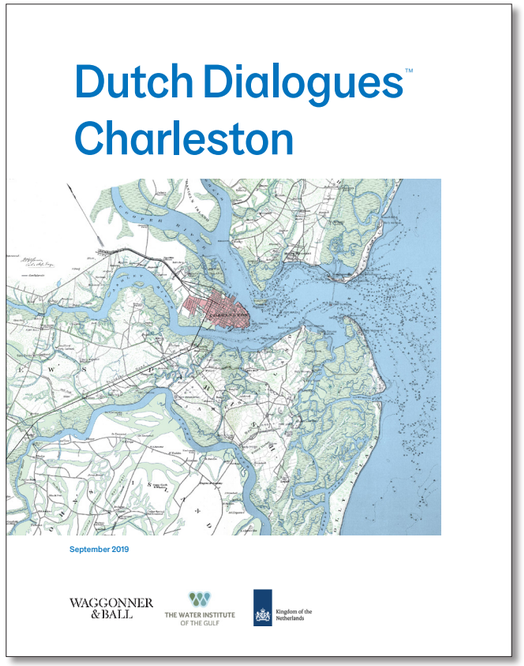
WAGGONNER & BALL

THE WATER INSTITUTE OF THE GULF®

Robinson Design Engineers

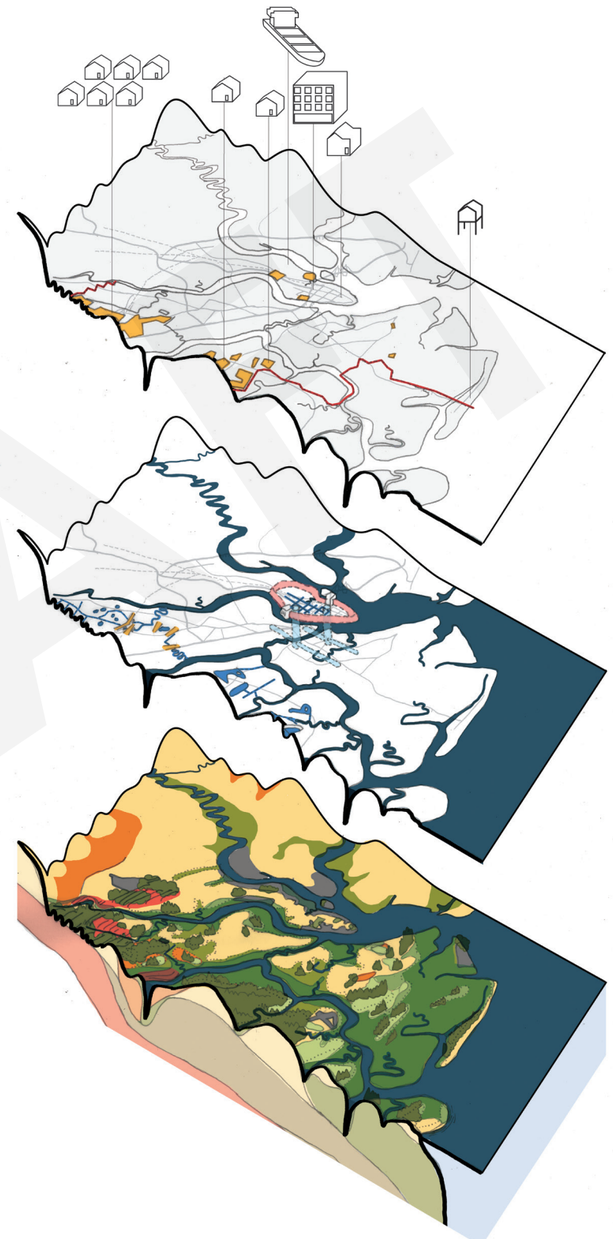
SURCULUS

BUILDING ON DUTCH DIALOGUES™



dutchdialoguescharleston.org

LAND & WATER ANALYSIS →



INHABITATION
DEVELOPMENT & LAND USE

INFRASTRUCTURE
DRAINAGE & TRANSPORTATION NETWORKS

GROUND
SOIL, WATER & ECOLOGY

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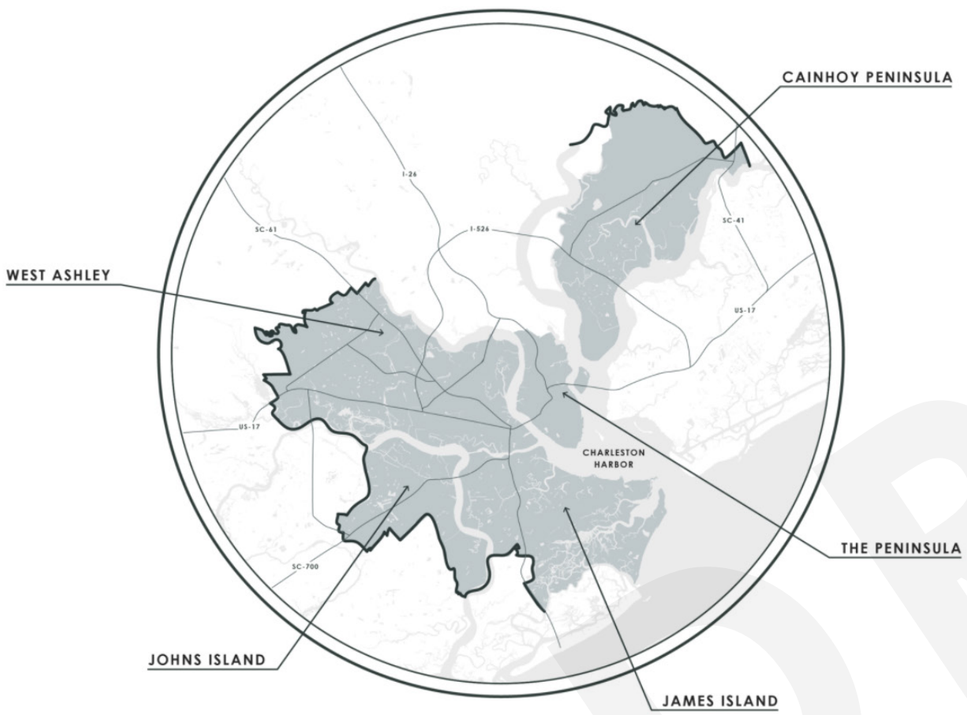
WHO WE TALKED TO



BUSINESS & REGIONAL STAKEHOLDERS

Josh Dix (Metro Realtors)
Chuck Jarman (Clemson Extension)
Lauren Gellatly (LLF)
Alison Simmons (Berkeley County Planning)
Kathryn Basha (BCD COG)
Jane Baker (DI Company)
Scott Barhight (MetroChamber)
Jason Crowley (CCL)
Laura Cantrall (CCL)
Betsy LaForce (CCL)
David Ray (LCLT)
Chris Magaldi (Thomas & Hutton)
Chris Mack (FEMA consultant)
Tim Callahan, PhD (College of Charleston)
Jeff Lamberson (Citadel)
Elizabeth Fly (TNC)
Winslow Hastie (Historic Charleston Foundation)
Norm Levine (College of Charleston)
Bruce Binney (LLT)
Carl Taylor (LLT)
Michelle Sinkler (OSI)

CITIZEN LEADERS

Diane Hamilton (West Ashley)
Katherine Anderson (West Ashley)
Carolee Williams (West Ashley)
Frances Waite (West Ashley)
Mason Holland (Cainhoy/Daniel Is)
Fred Lincol (Cainhoy)
Eileen Dougherty (James Island)
Amy Luisi (James Island)
Greg Payton (James Island)
Harriet Reavis (James Island)
Troy Miller (James Island)
John Zoglar (Johns Island TF)
Wagener Terrace Neighborhood Assn.

ELECTED OFFICIALS

Sandy Senn
Marie DelCioppo
Harry Griffin
Karl Brady
Carol Jackson
Dudley Gregorie
Ross Appel
Mike Seekings
Kevin Shealy
Perry Waring
Peter Shahid
Jason Sakran

CITY STAFF

Matt Fountain
Jacob Lindsey
Christopher Morgan
Kinsey Holton
Steven Julka
Jason Kronsberg
Eric Pohlman
Eric Schultz
Su Griffin

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RAINFALL (NOAA ATLAS 14)

CHARLESTON, SOUTH CAROLINA

DURATION	FREQUENCY: 2 YR*	25 YR*	100 YR	500 YR	1,000 YR
1 HR	2.0”	3.5”	4.4”	5.5”	6.0”
12 HR	3.5”	6.6”	8.7”	11.5”	12.9”
24 HR	4.2”	7.8”	10.2”	13.3”	14.7”
48 HR	4.9”	8.9”	11.6”	15.0”	16.6”
1 WEEK	6.4”	11.1”	13.9”	17.5”	19.1”

* Regulatory design storms

Recent upward revisions elsewhere in US

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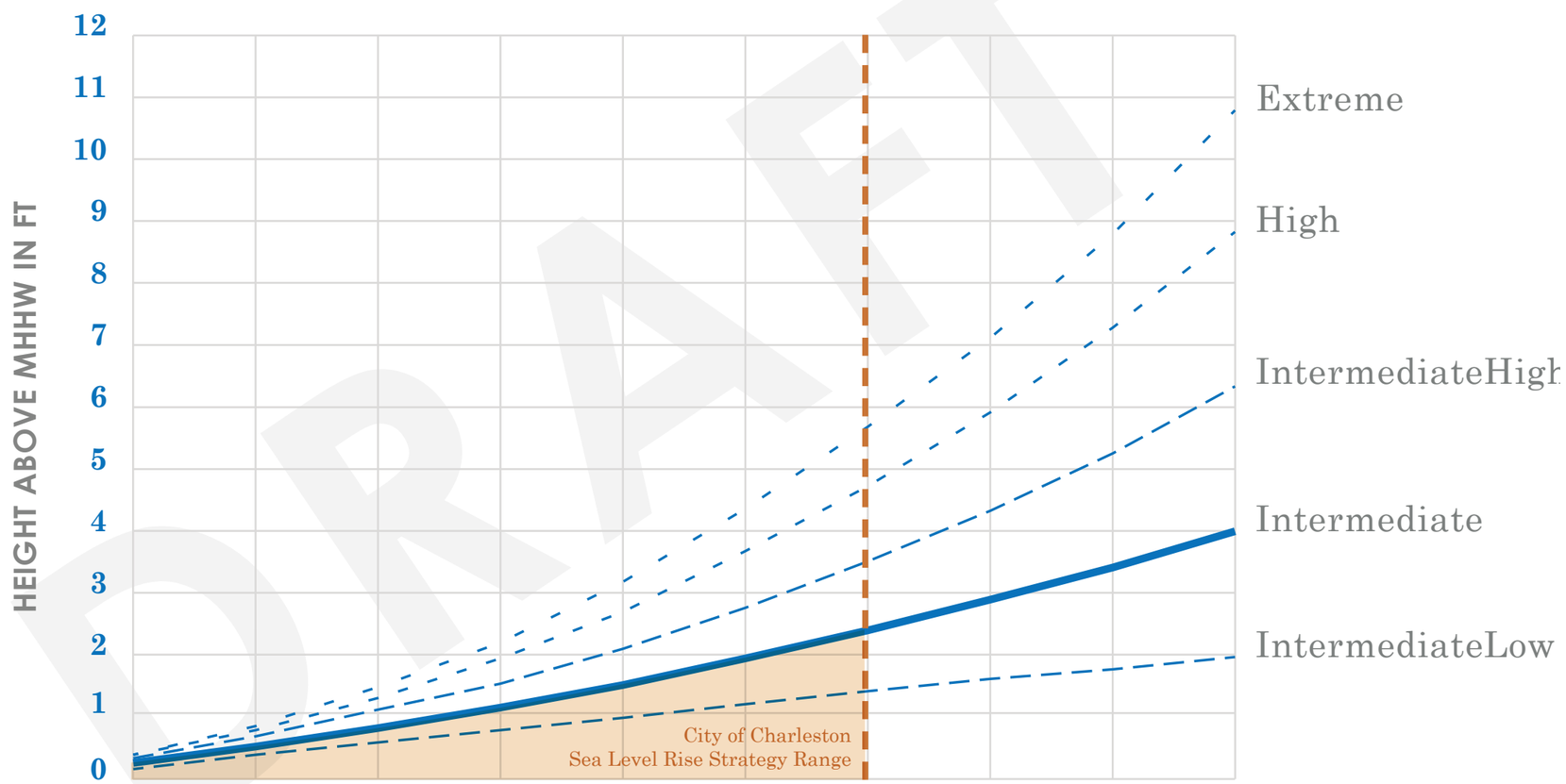
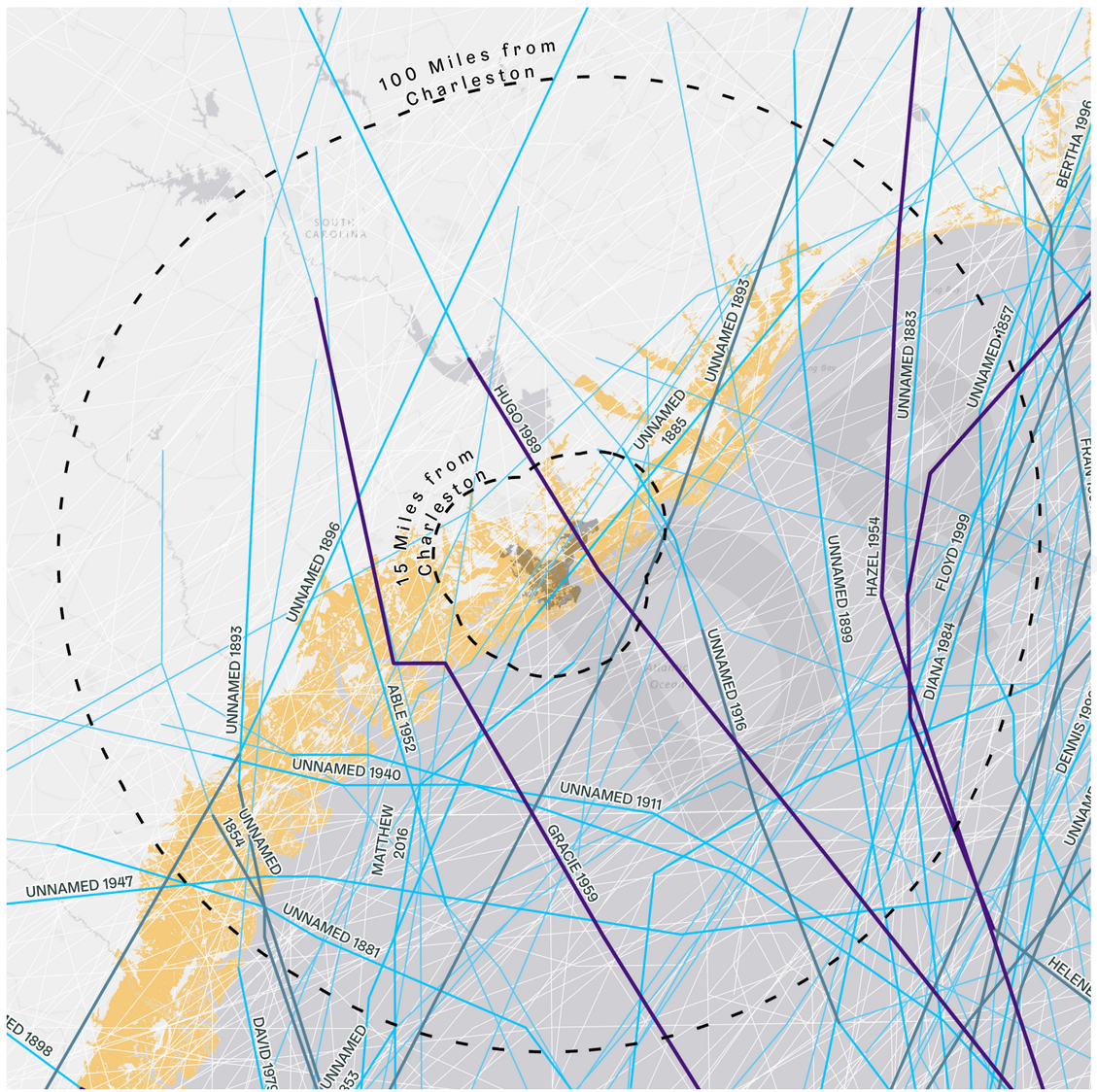
WATER CONTEXT: TIDE

SEA LEVEL RISE SCENARIOS (NOAA)
CHARLESTON, SOUTH CAROLINA



	2010	2020	2030	2040	2050	2060	2070	2080	2090	2100
Extreme	0.4	0.9	1.5	2.2	3.2	4.4	5.7	7.1	8.8	10.8
High	0.4	0.8	1.3	1.9	2.7	3.7	4.7	5.9	7.3	8.8
;ermediateHigh	0.3	0.7	1.1	1.5	2.1	2.8	3.5	4.3	5.3	6.3
Intermediate	**0.3**	**0.5**	**0.8**	**1.2**	**1.5**	**1.9**	**2.4**	**2.9**	**3.4**	**4.0**
.termediateLow	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0

HURRICANES & STORM SURGE
CHARLESTON, SOUTH CAROLINA



HURRICANE PATHS OVER THE LAST 150 YEARS

	within 100 miles	within 15 miles
Category 5	0	0
Category 4	4	1
Category 3	7	1
Category 2	13	3
Category 1	27	8
Total	51	13

Used for "100 Year Storm Surge"
(NOAA SLOSH Model)

Hugo (1989): 12.9' storm tide in Charleston Harbor
(National Weather Service)

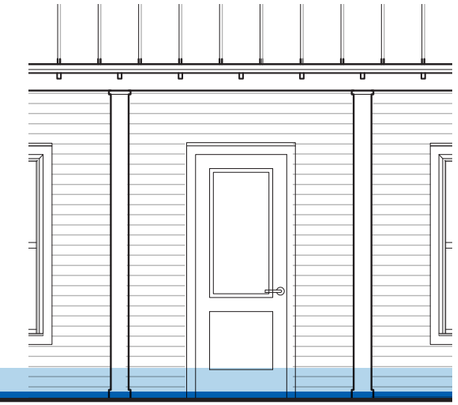
WHAT DOES "FLOOD" MEAN?

DRY FEET

1" (SHOE SOLE) - 12" (TOP OF RAINBOOT)

DRY FLOOR

+1" (SLAB ON GRADE)

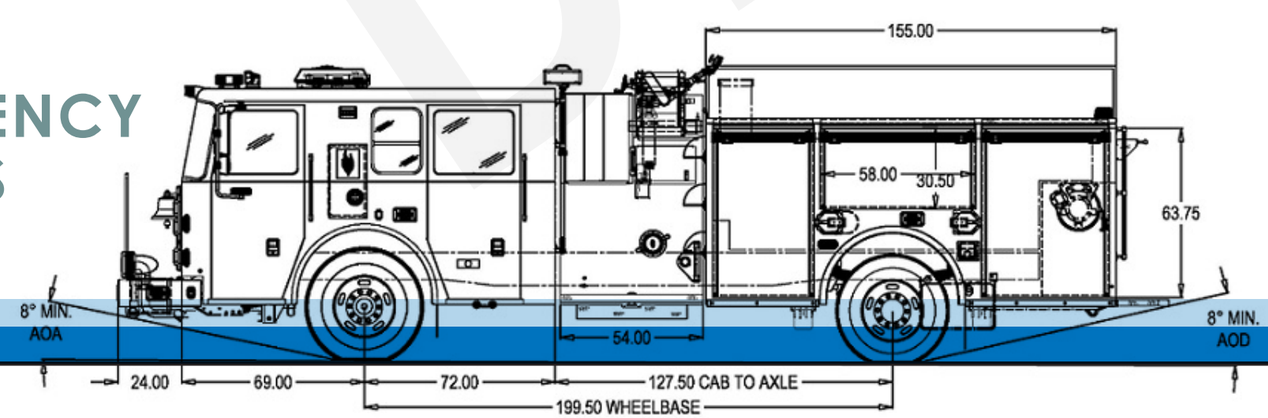


SAFE EGRESS

~12" (IMPASSABLE TO CARS)

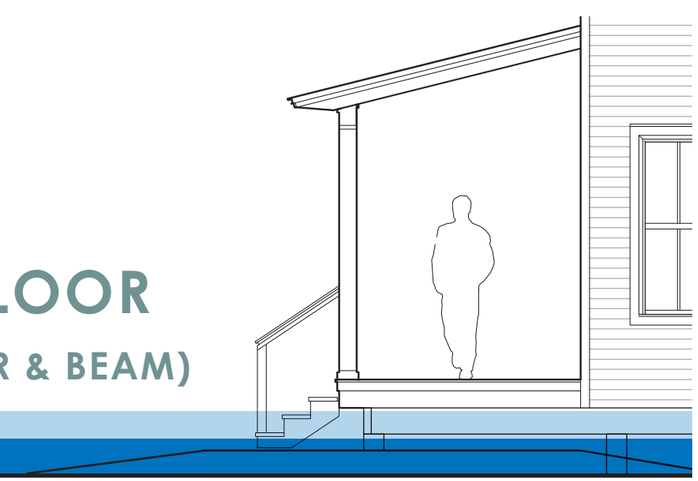
EMERGENCY ACCESS

14" - 24"



DRY FLOOR

+24" (PIER & BEAM)



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WATERSHED APPROACH

9/23/2020
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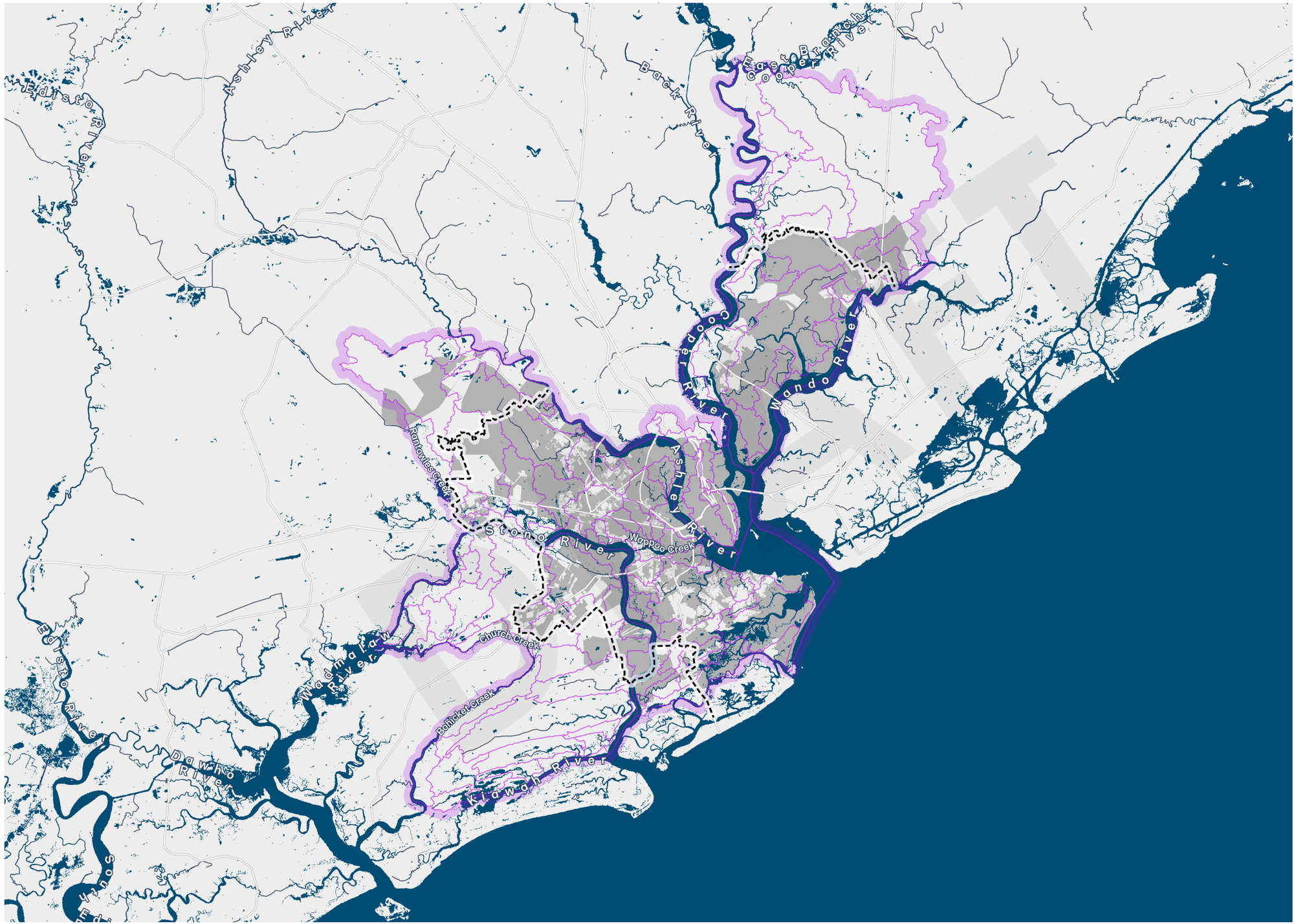
CHARLESTON CITY PLAN
LAND & WATER ANALYSIS



Legend

Project Watersheds

Urban Growth Boundary

Charleston City Limits

Miles 5

LAND SURFACE ELEVATION: ELEVATION

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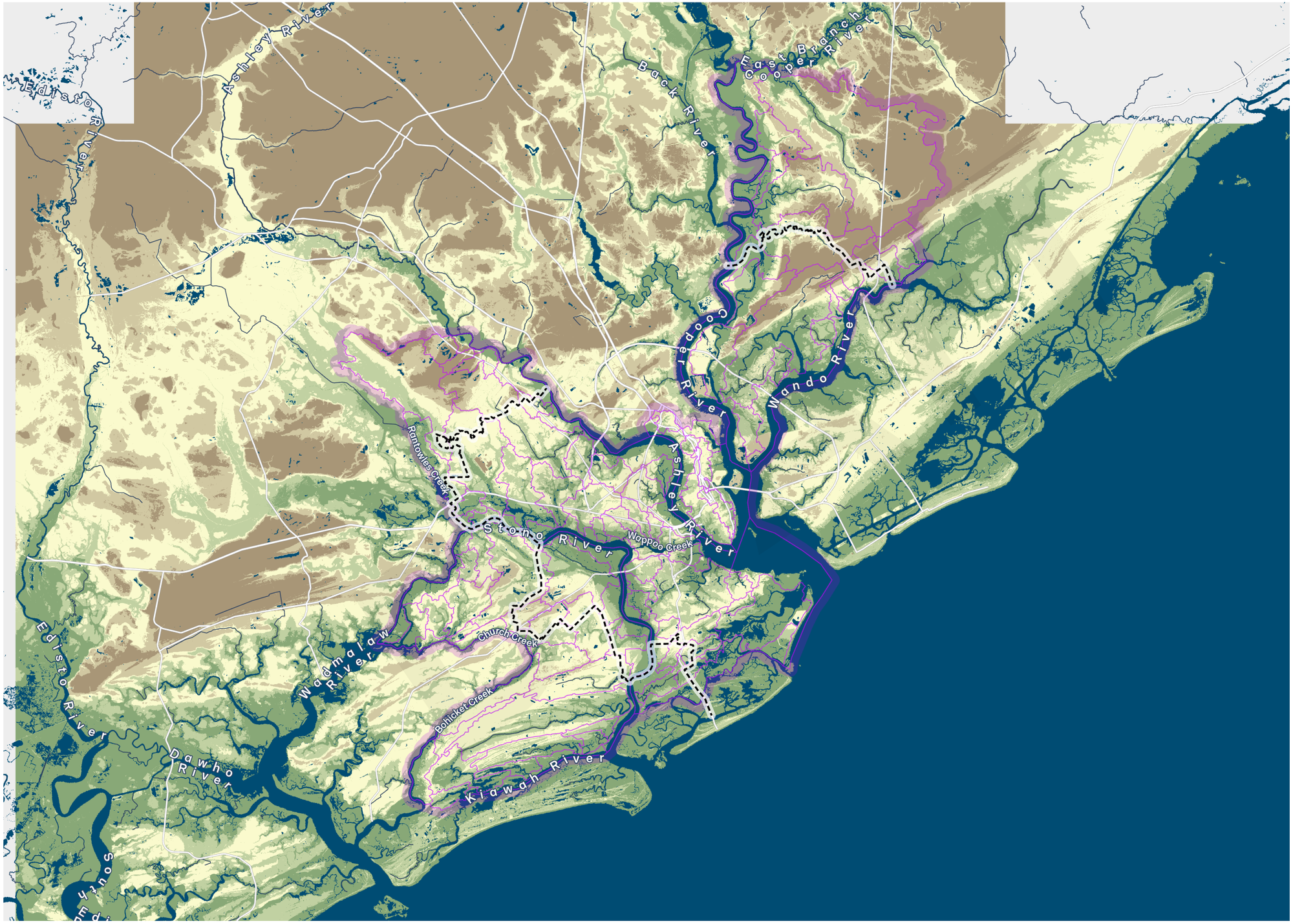
CHARLESTON CITY PLAN
LAND & WATER ANALYSIS



Legend

Elevation

- ≤ 5
- ≤ 10
- ≤ 20
- ≤ 30
- > 30

Project Watersheds

Urban Growth Boundary

Miles 5

WATERSHED APPROACH: FLOODPLAIN

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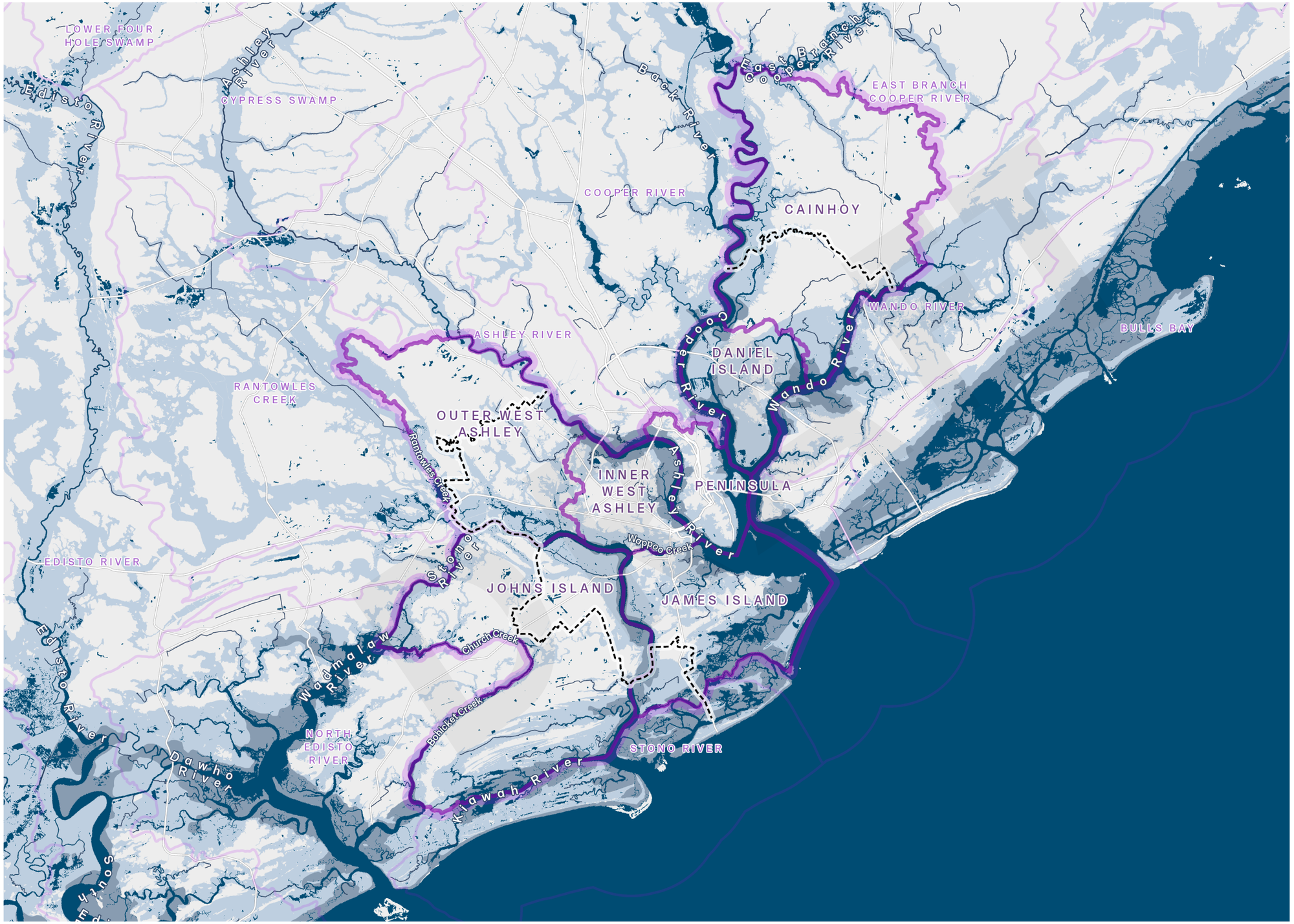
CHARLESTON CITY PLAN
LAND & WATER ANALYSIS



Legend

Watersheds Neighborhood

Other Watersheds

Urban Growth Boundary

Water

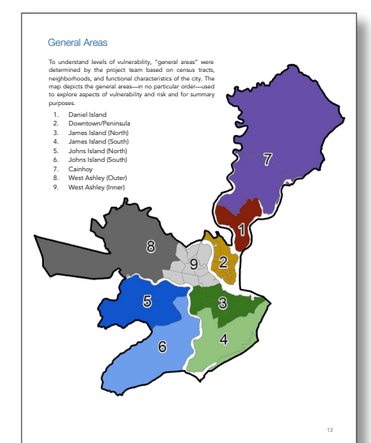
DFIRM

100 Year Floodplain

VE Zone

*VE Zone indicates areas with high potential water velocity and/or waves due to storm surge

*Building on the Charleston Vulnerability Analysis



Miles
5

WATERSHED APPROACH: FLOODPLAIN

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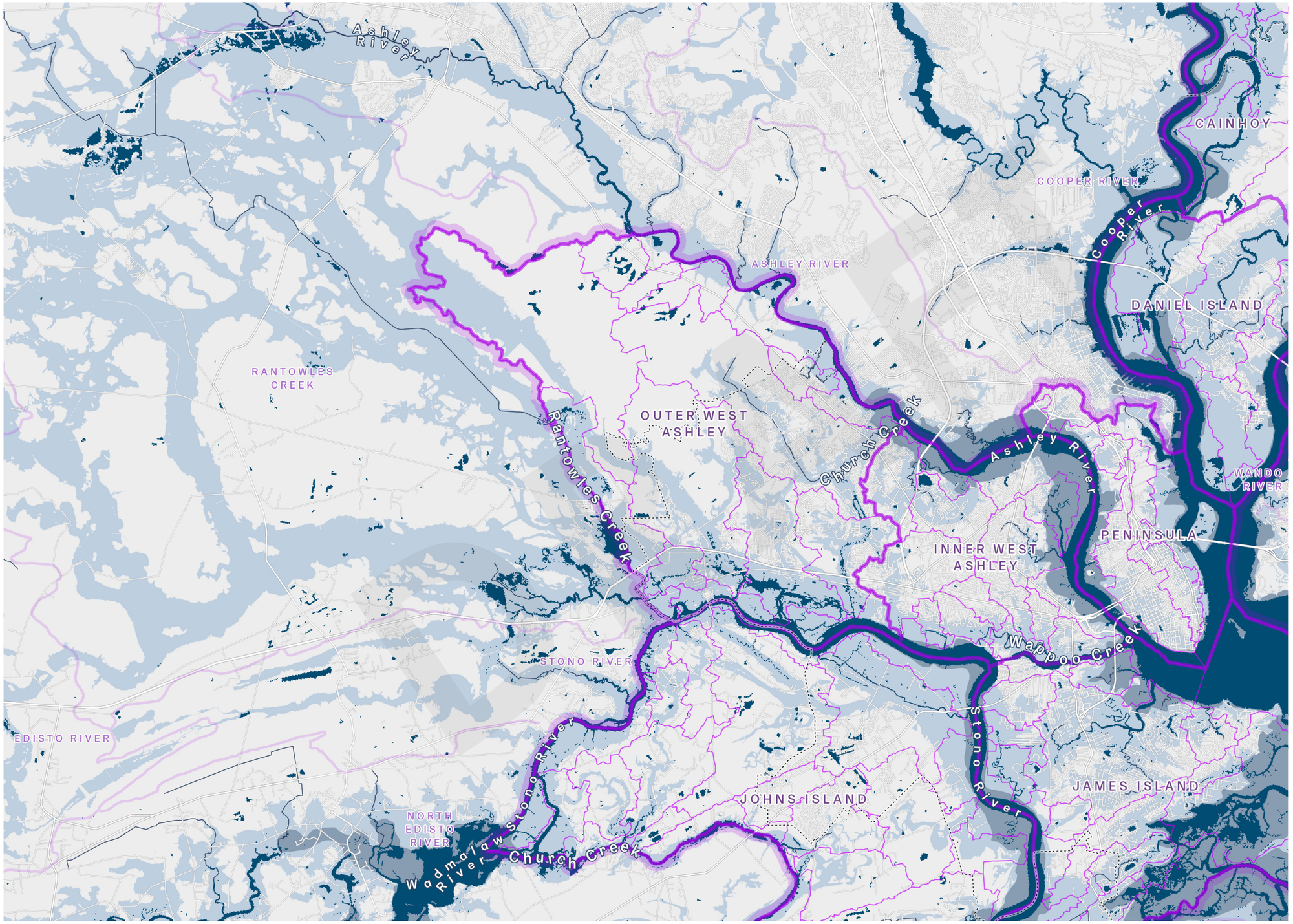
CHARLESTON CITY PLAN
LAND & WATER ANALYSIS



Legend

- Watersheds Neighborhood
- Project Watersheds
- Other Watersheds
- Urban Growth Boundary
- Water
- DFIRM
  - 100 Year Floodplain;
  - VE Zone

*VE Zone indicates areas with high potential water velocity and/or waves due to storm surge

WATERSHED APPROACH: FLOODPLAIN

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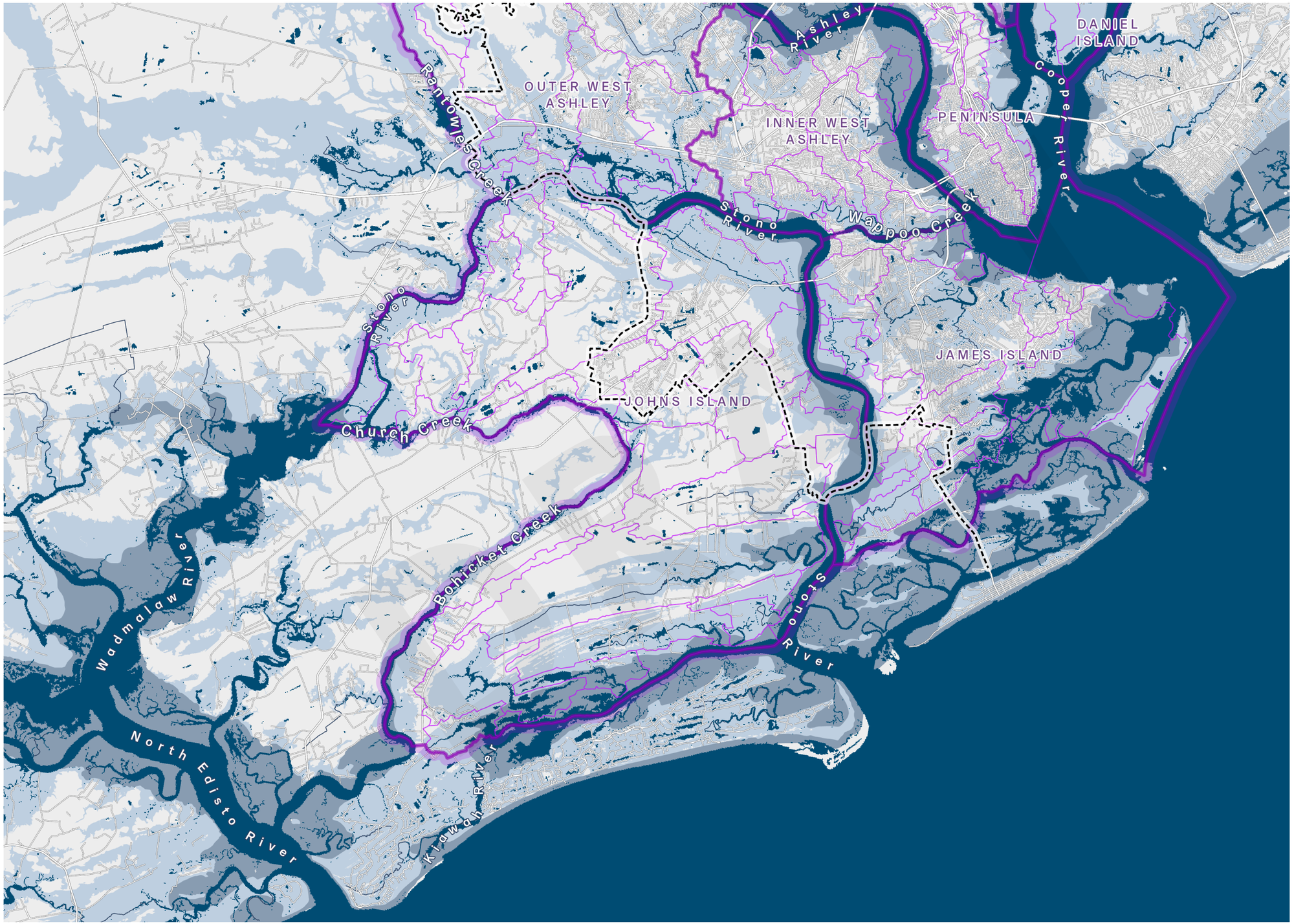
CHARLESTON CITY PLAN
LAND & WATER ANALYSIS



Legend

Watersheds Neighborhood

Project Watersheds

Urban Growth Boundary

Water

DFIRM

100 Year Floodplain

VE Zone

*VE Zone indicates areas with high potential water velocity and/or waves due to storm surge

Miles 1

WATERSHED APPROACH: FLOODPLAIN

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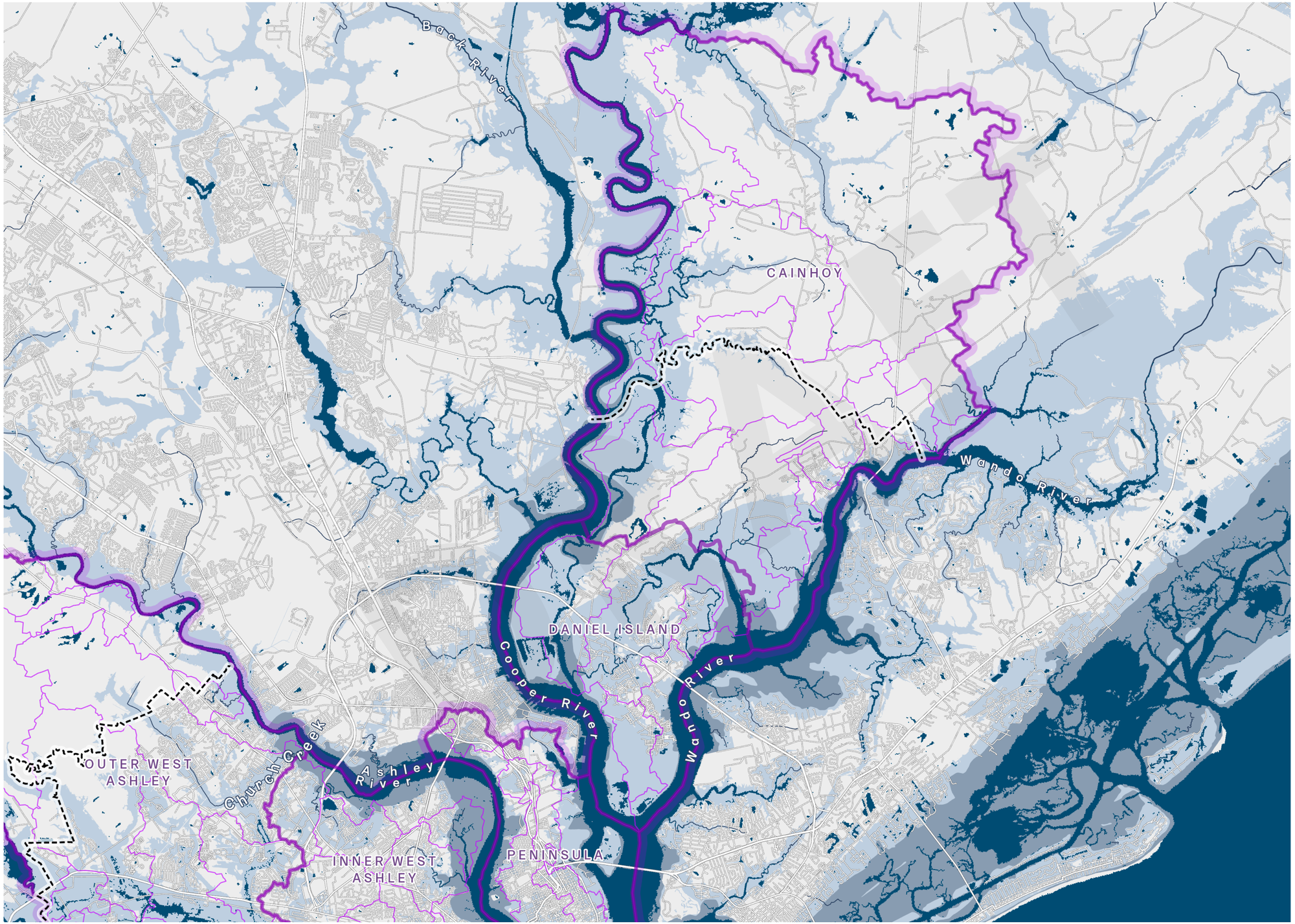
CHARLESTON CITY PLAN
LAND & WATER ANALYSIS



Legend

Watersheds Neighborhood

Project Watersheds

Urban Growth Boundary

Water

DFIRM

100 Year Floodplain

VE Zone

*VE Zone indicates areas with high potential water velocity and/or waves due to storm surge

Miles 1

WHAT DOES "FLOODPLAIN" MEAN?

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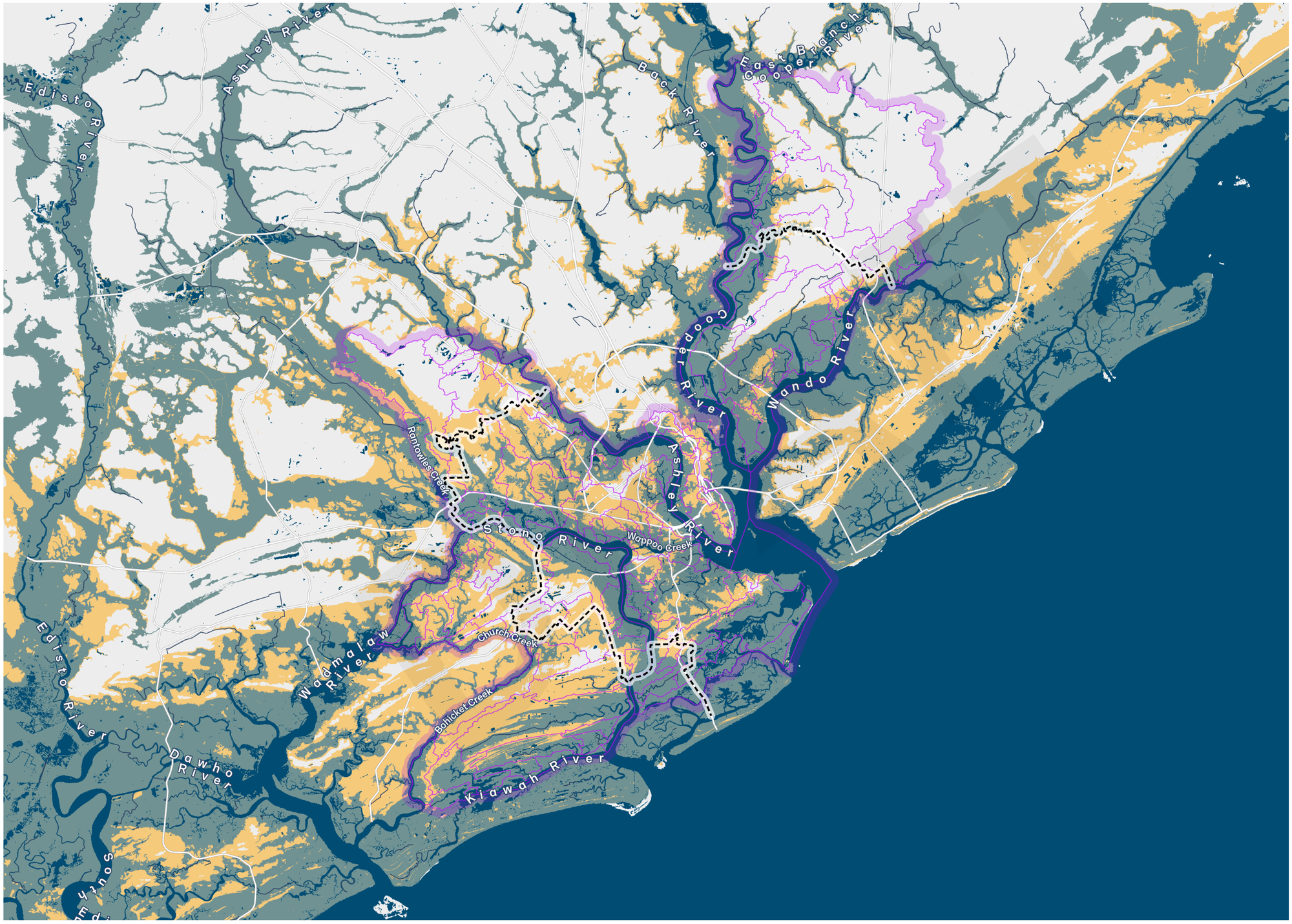
CHARLESTON CITY PLAN
LAND & WATER ANALYSIS



Legend

Project Watersheds

Urban Growth Boundary

Water

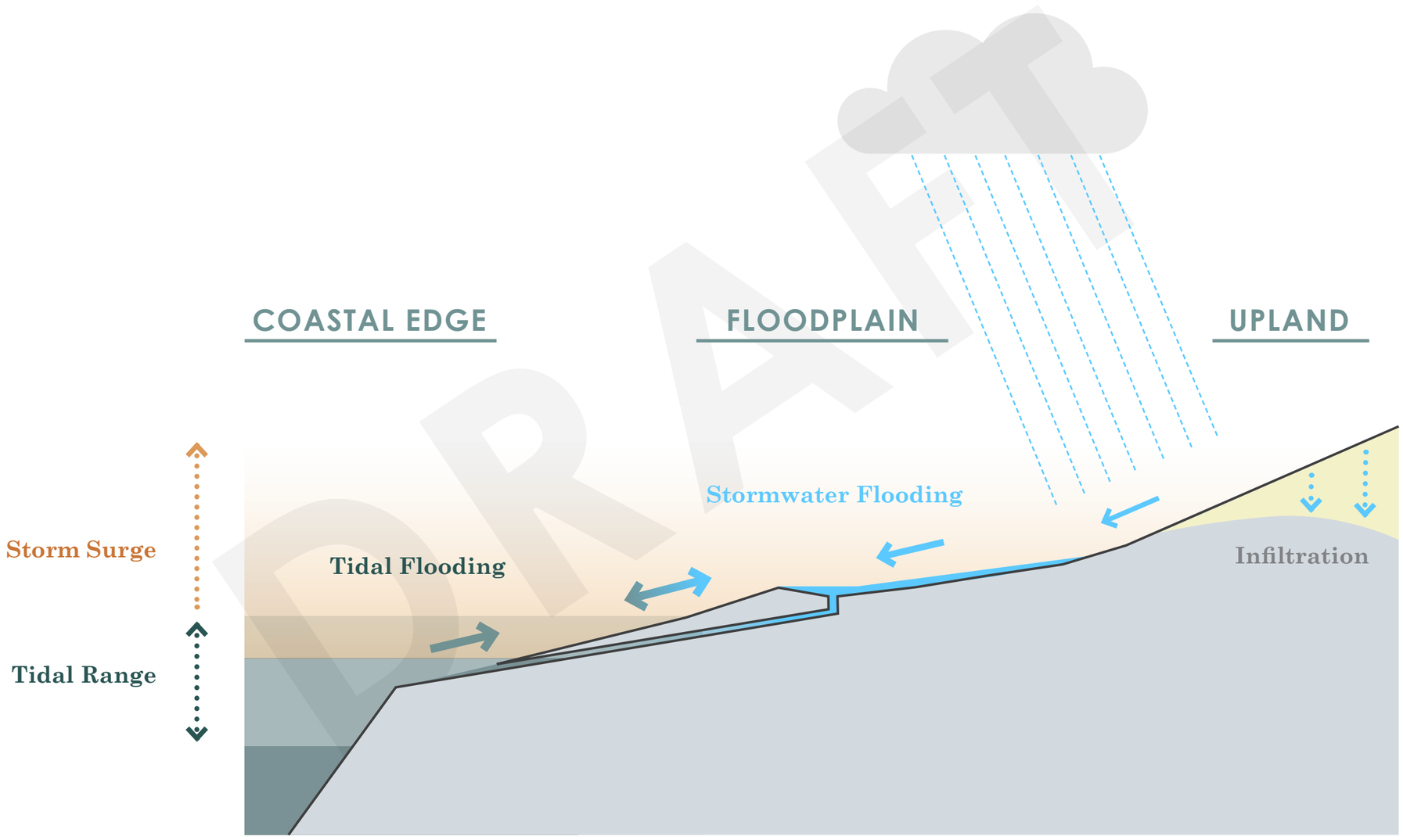
Cat 3 Max Storm Surge

DFIRM

100 Year Floodplain

Miles
5

WHAT DOES "FLOODPLAIN" MEAN?



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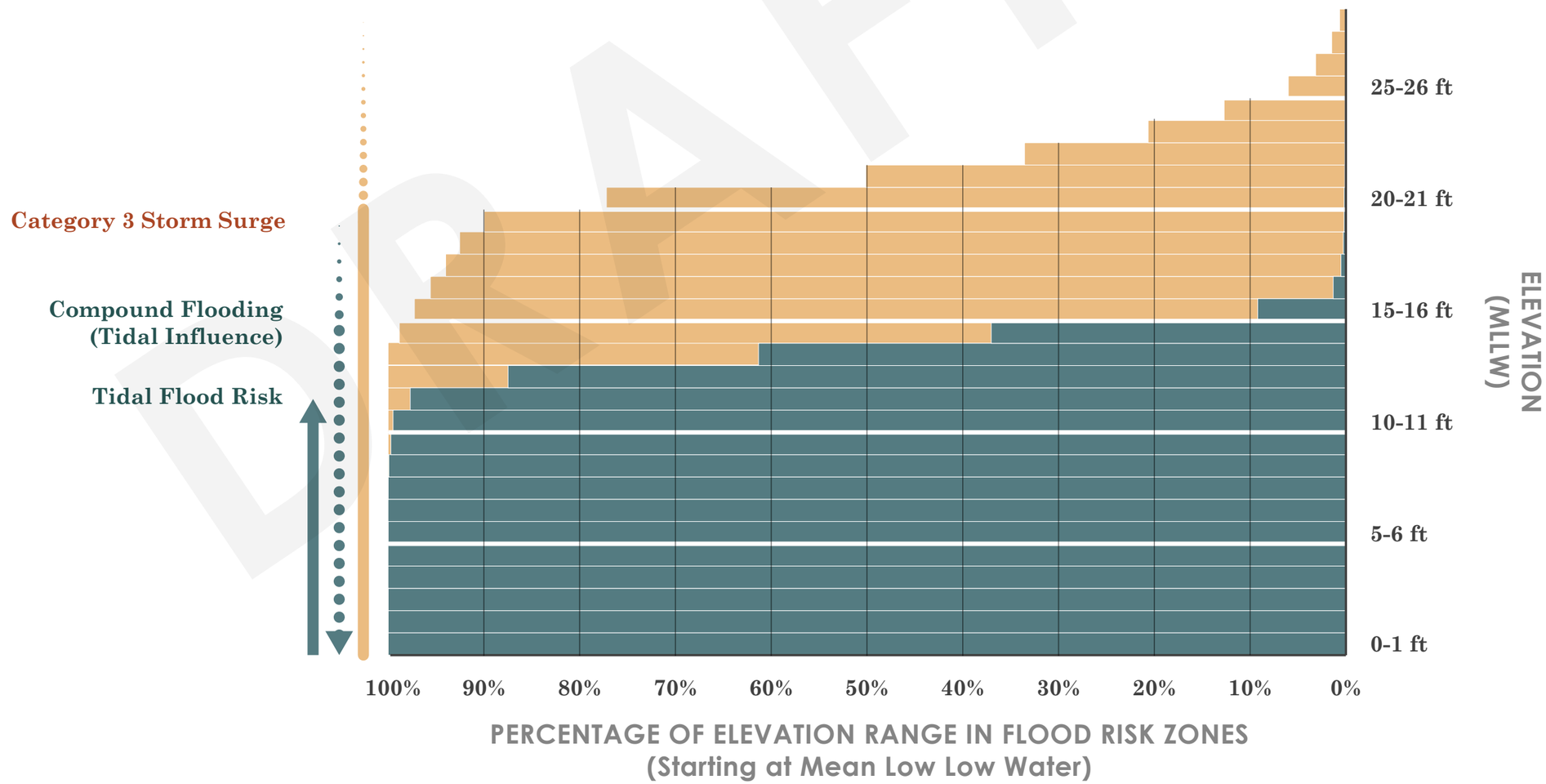
WHAT DOES "FLOODPLAIN" MEAN?

*2020 sea level data
**Within Urban Growth Boundary, excluding spoil islands

FLOODPLAIN LAND SURFACE ELEVATION

MAX CATEGORY 3 STORM SURGE (NOAA, SLOSH MODEL)
100 YEAR FLOODPLAIN (FEMA, REGULATORY MAP)



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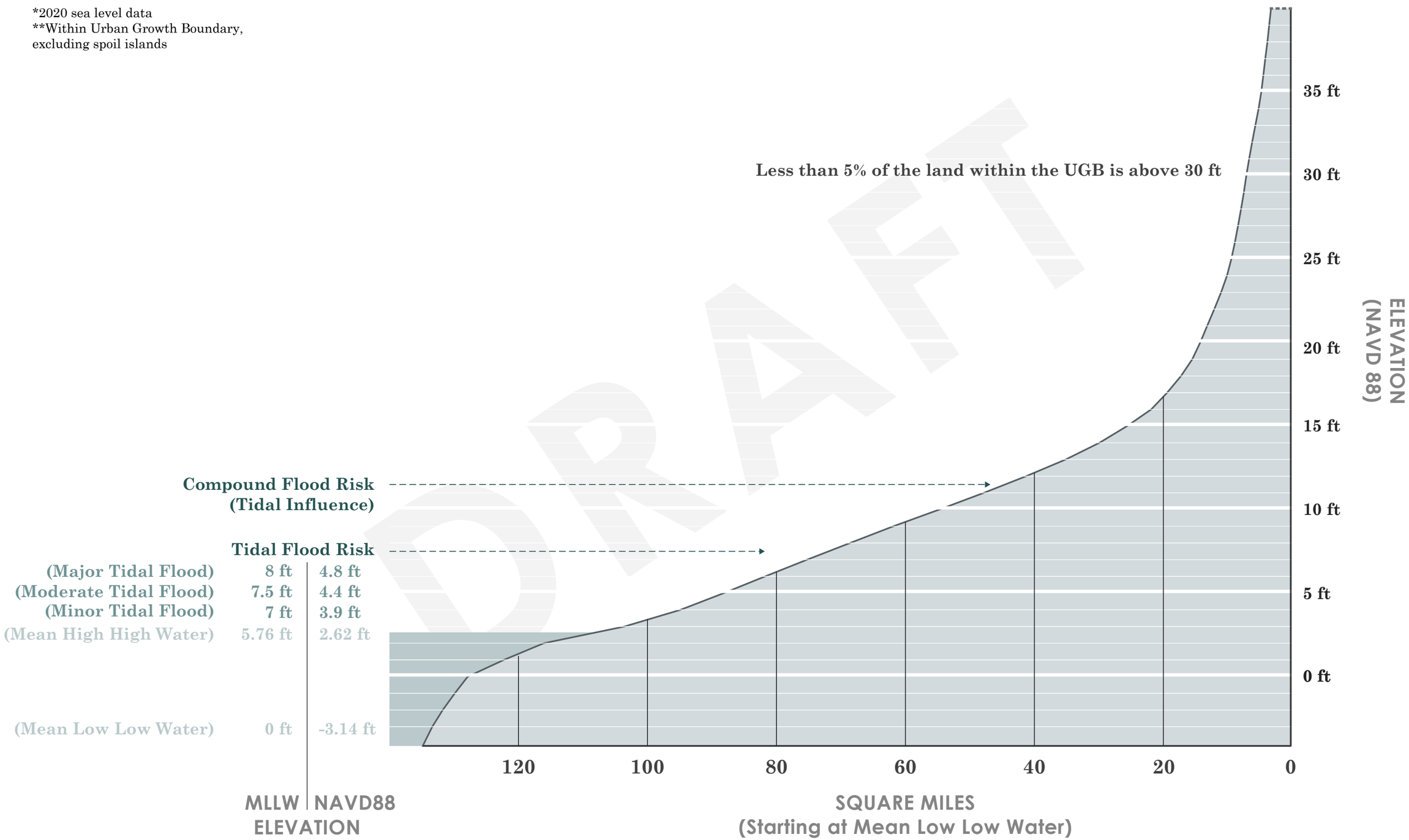
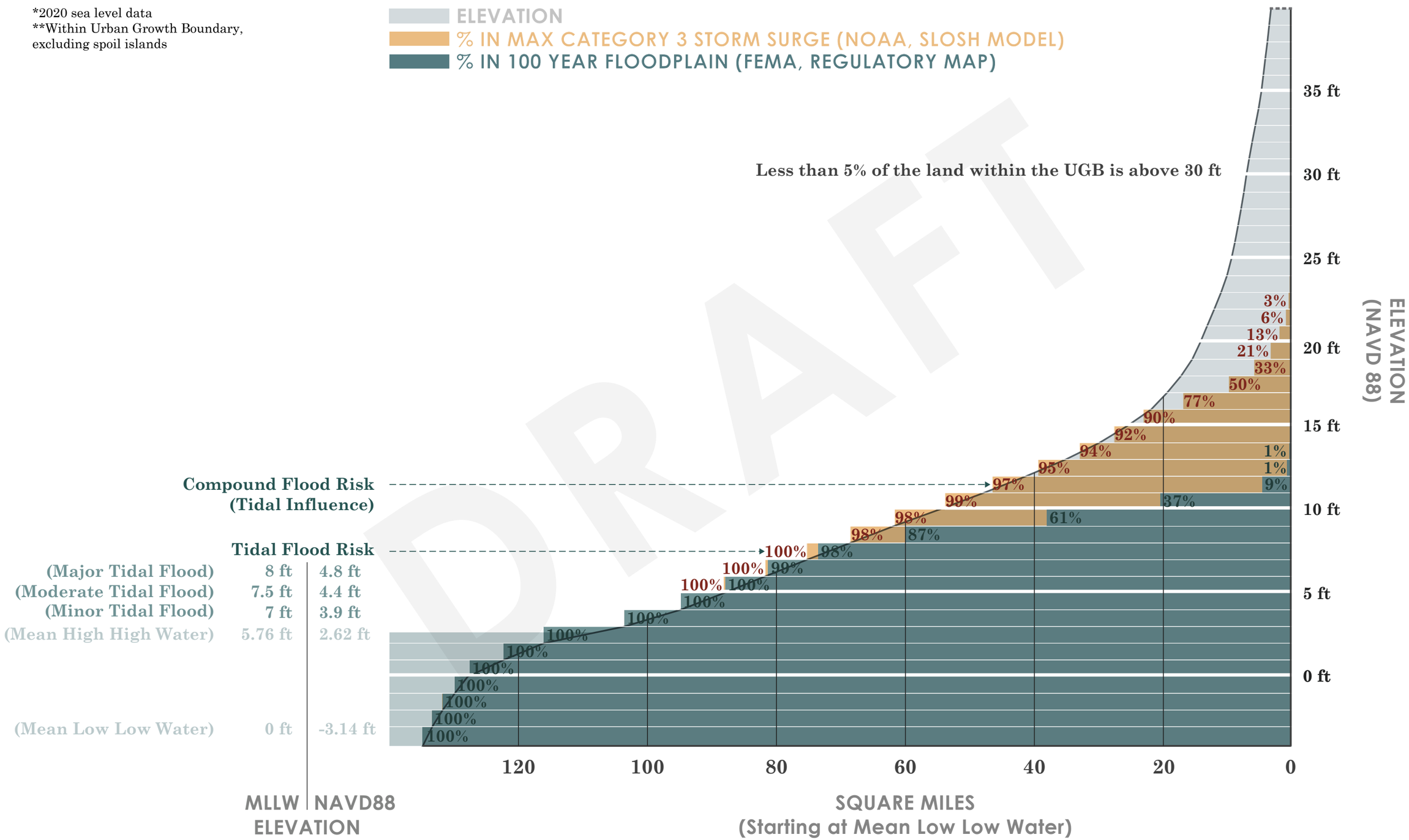
CITY LAND ELEVATION (WITHIN UGB)

*2020 sea level data
**Within Urban Growth Boundary, excluding spoil islands



LAND ELEVATION & FLOOD RISK (WITHIN UGB)

*2020 sea level data
**Within Urban Growth Boundary, excluding spoil islands



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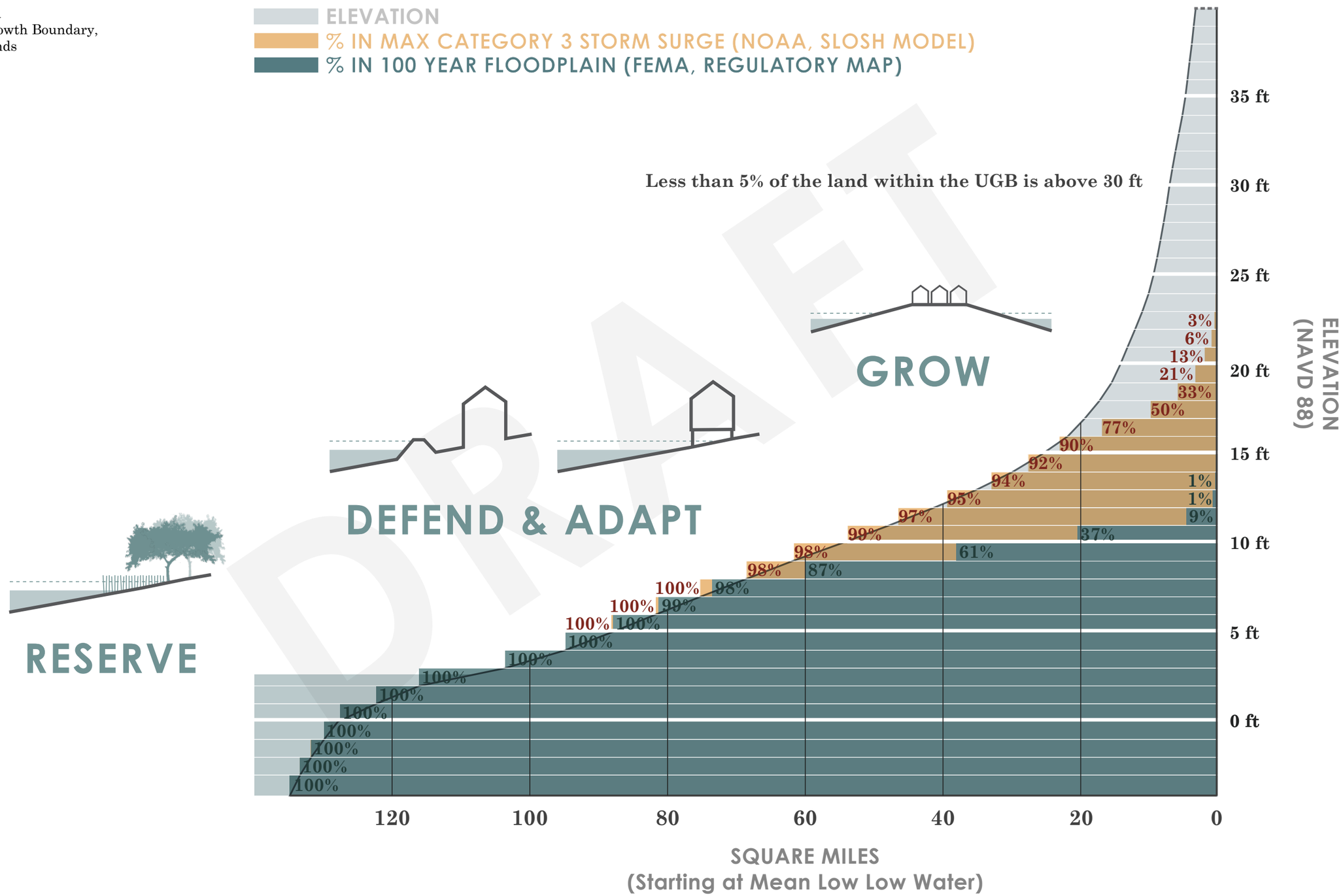
LAND ELEVATION & FLOOD RISK (WITHIN UGB)

*2020 sea level data
**Within Urban Growth Boundary, excluding spoil islands



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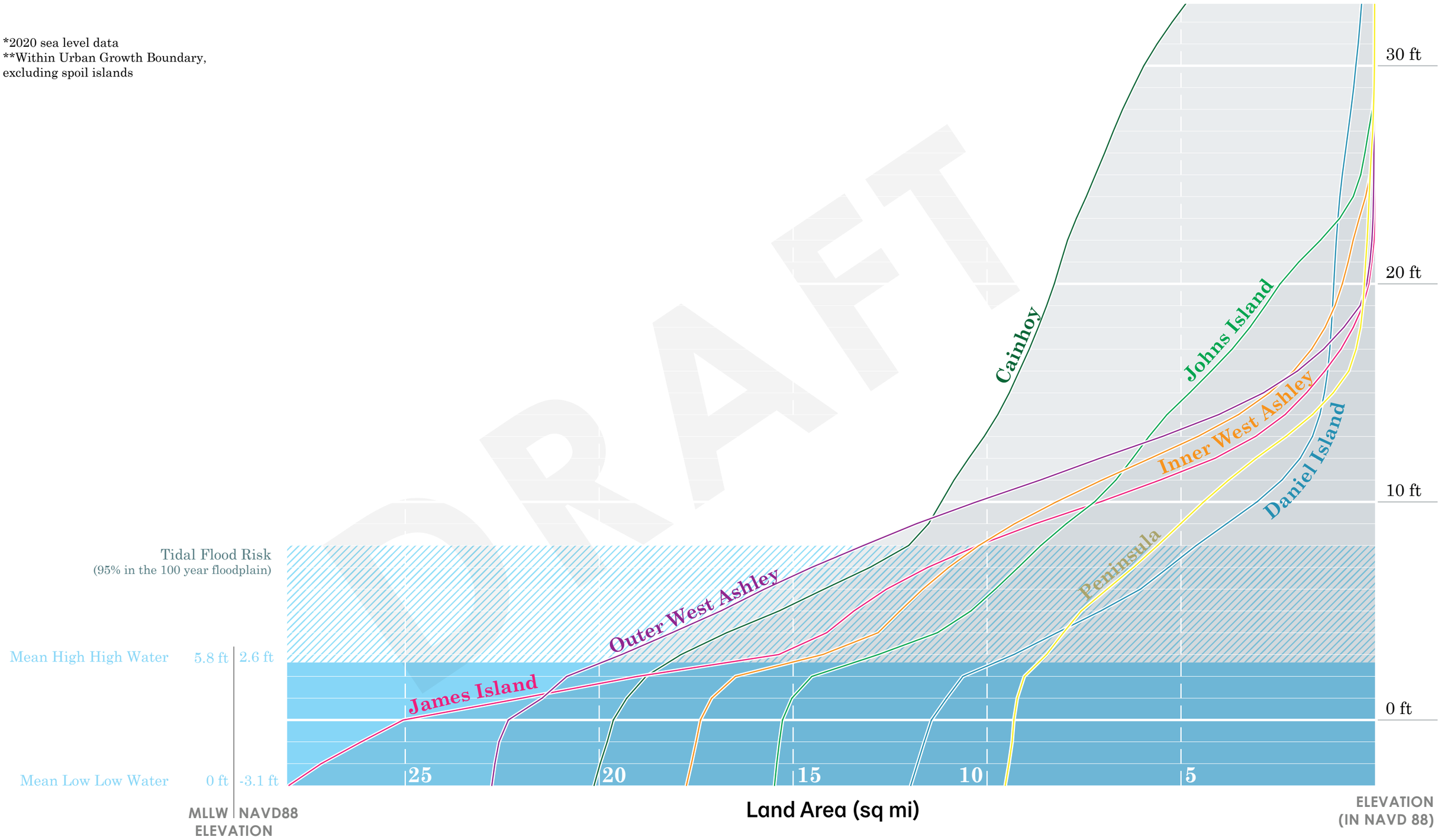
CRITICAL LAND & WATER LEVELS

*2020 sea level data
**Within Urban Growth Boundary, excluding spoil islands



CRITICAL LAND & WATER LEVELS (AREA AVGS)

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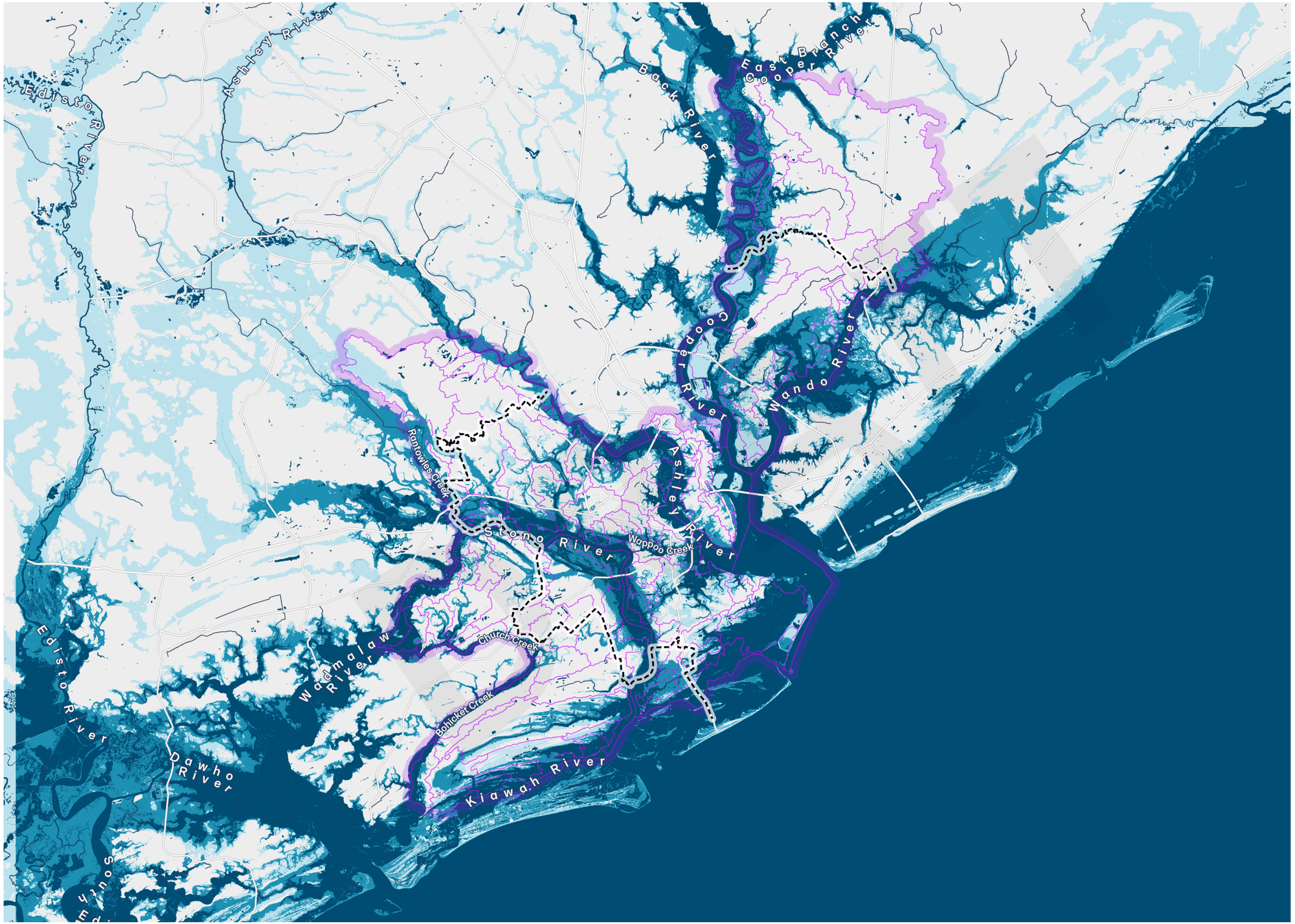
CHARLESTON CITY PLAN
LAND & WATER ANALYSIS



Legend

Project Watersheds

Urban Growth Boundary

Water

Risk Zones

DFIRM Tidal Influence

DFIRM Compound Flooding

Mean High High Water
2.64 ft

Miles
5

CRITICAL LAND & WATER LEVELS (AREA AVGS) +3' SLR

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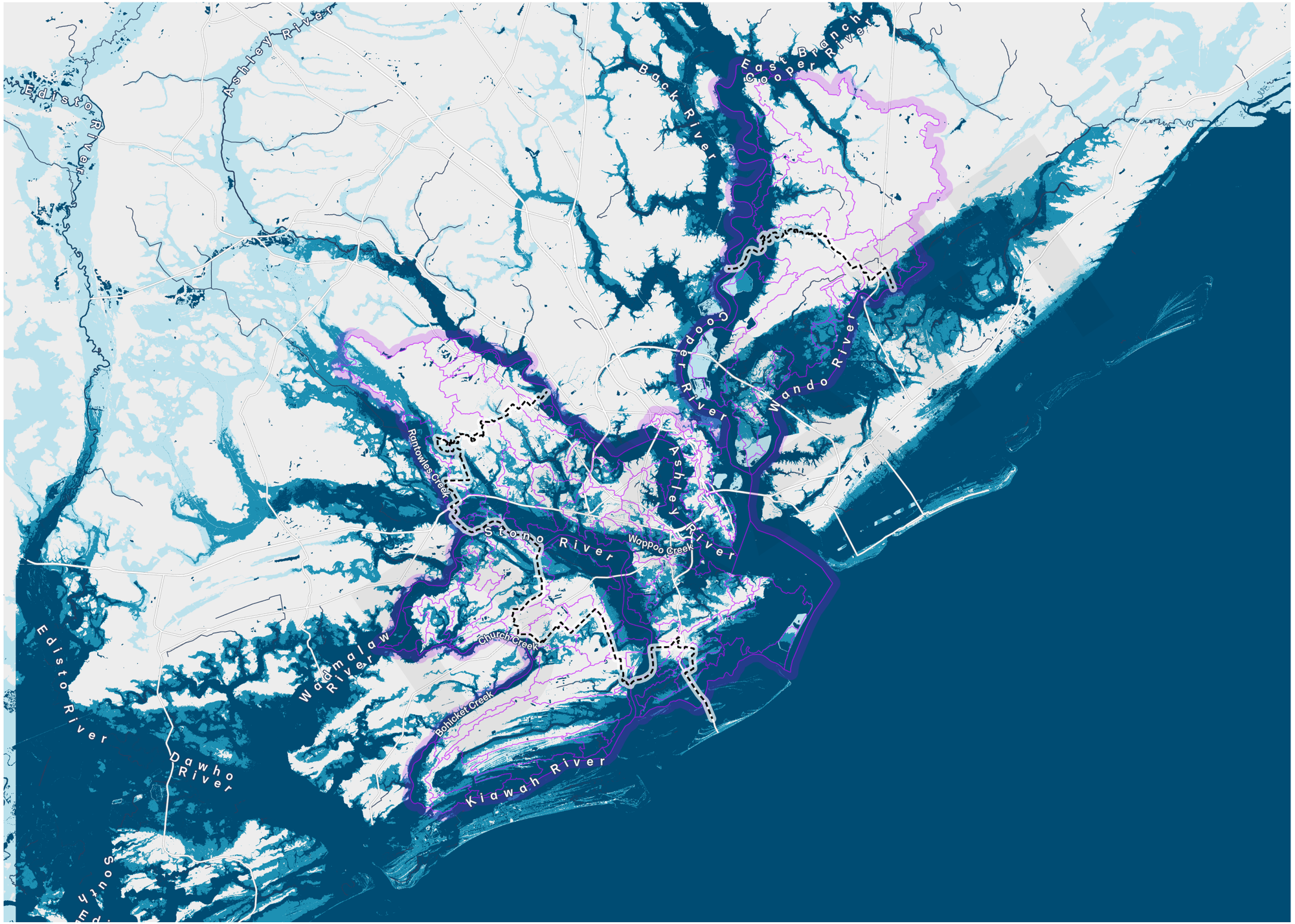
CHARLESTON CITY PLAN
LAND & WATER ANALYSIS



Legend

Project Watersheds

Urban Growth Boundary

Water

Risk Zones (3 ft of SLR)

DFIRM Tidal Influence

DFIRM Compound Flooding

Mean High High Water
5.64 ft

Miles
5

CHURCH CREEK OUTLET

MARSH MIGRATION & LOSS (+3' SLR)

9/23/2020
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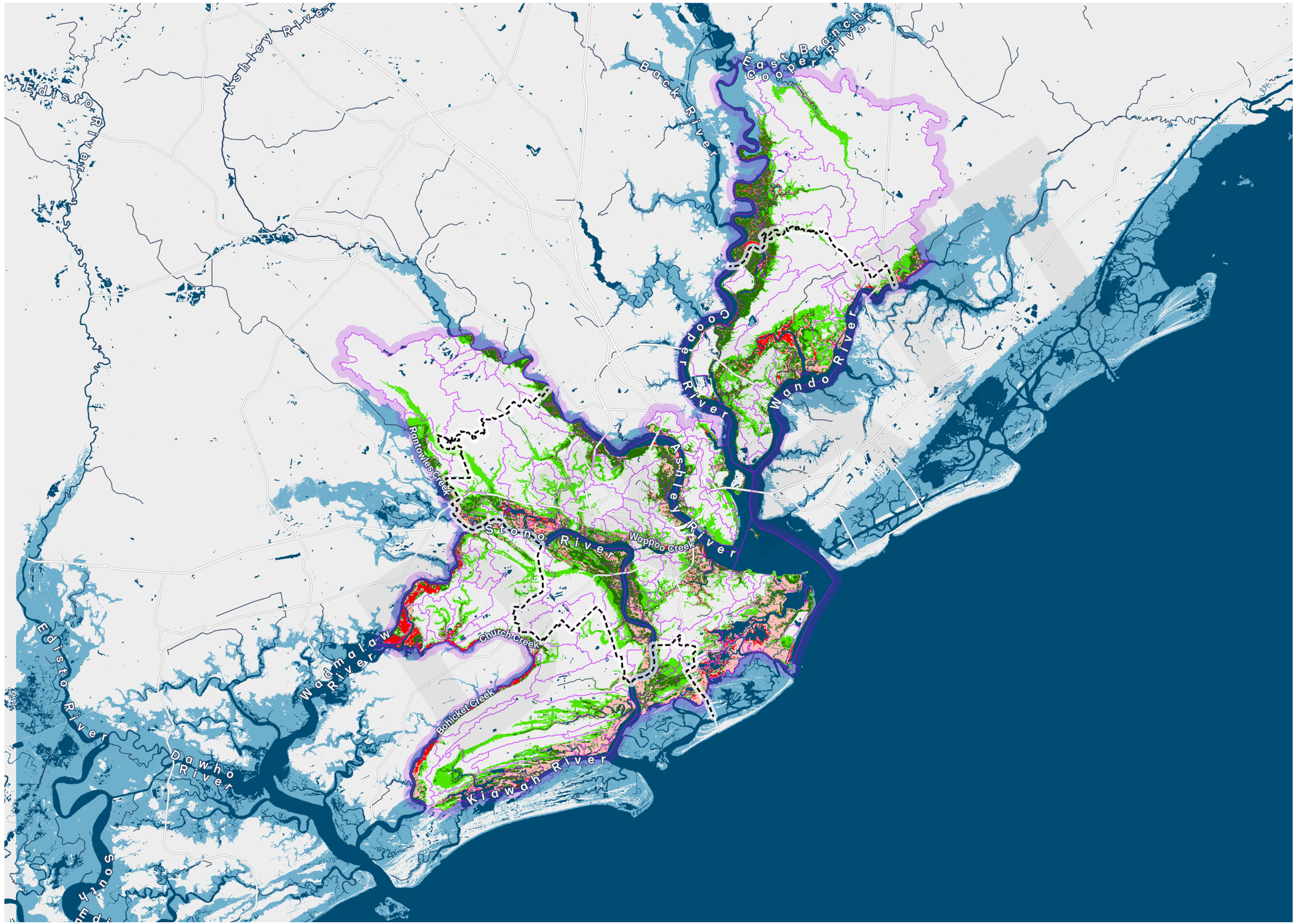
CHARLESTON CITY PLAN
LAND & WATER ANALYSIS



Legend
MARSH MIGRATION (3ft SLR)
New Wetland Range (2 ft - 6.75 ft)
New Possible Space for Wetlands
Existing Emergent Herbaceous Wetland
Existing Wetlands Below MLLW
Existing Wetlands at Risk
Project Watersheds
Urban Growth Boundary
Water
Sea Level Rise
MHHW +3 ft SLR

Miles
5

MARSH MIGRATION IMPACTS (+3' SLR)

9/23/2020
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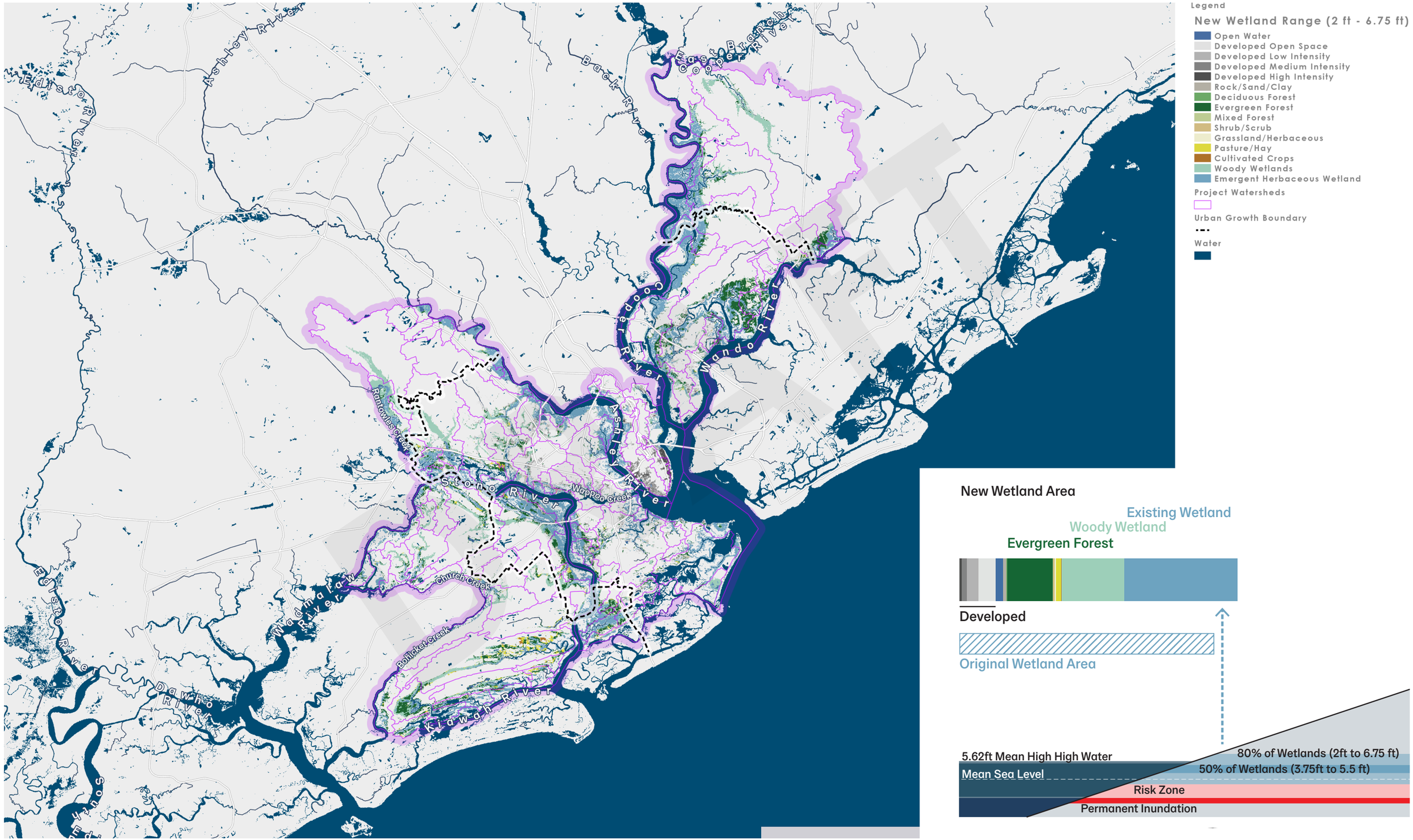
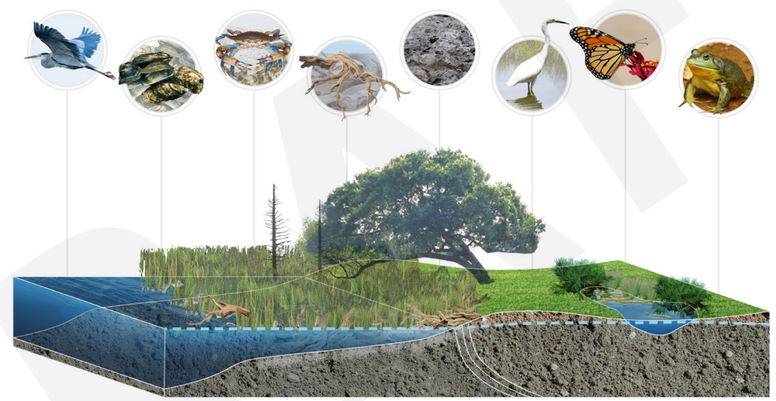
CHARLESTON CITY PLAN
LAND & WATER ANALYSIS

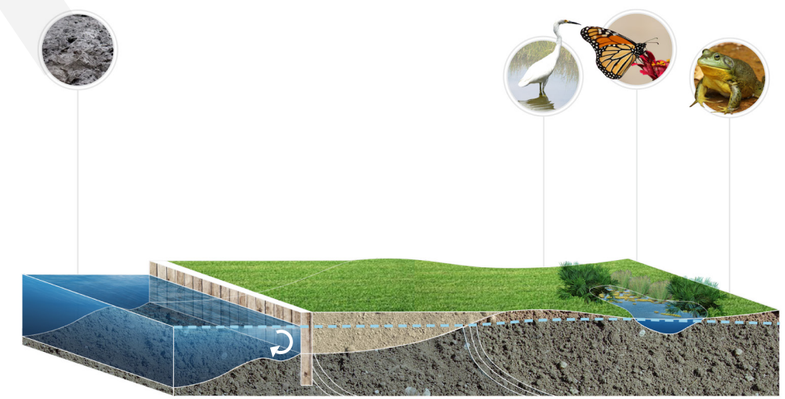


MARSH MIGRATION: WHAT TO EXPECT

EXISTING MARSH



MARSH MIGRATION &
GROUNDWATER SURFACING



SEAWALL / MARSH EXTINCTION

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LANDSCAPE TYPOLOGIES

COASTAL EDGE COMMUNITY

Coastal Edge Community can tolerate salt air and occasional inundation from major storms; most durable for locations identified for likely marsh migration

- Live oak *Quercus virginiana*
- Eastern red cedar *Juniperus virginiana*
- Pine *Pinus species*
- Palmetto *Sabal palmetto*
- Southern Magnolia *Magnolia grandiflora*

- Dwarf palm *Sabal minor*
- Yaupon holly *Ilex vomitoria*
- Red bay *Persea borbonia*
- Wax myrtle *Myrica cerifera*
- Salt myrtle *Baccharis halimifolia*

- Sea Oxeye Daisy *Borrichia frutescens*
- Sea beans *Salicornia virginica*
- Smooth cordgrass *Spartina alterniflora* (aka *Sporobolus alterniflorus*)
- Saltmeadow cordgrass *Spartina patens*
- Sand cordgrass *Spartina bakeri*
- Sweetgrass *Muhlenbergia capillaris*
- Needlerush *Juncus roemerianus*

LOWLAND FLOODPLAIN

Lowland Floodplain can tolerate periodic freshwater and / or brackish inundation; plants selected for tolerance of poorly drained soils due to soil composition or high water table (Hydrologic Groups C-D).

- Bald Cypress *Taxodium distichum*
- Black Gum *Nyssa sylvatica*
- American Beech *Fagus grandifolia*
- Swamp chestnut oak *Quercus michauxi*
- Water Oak *Quercus nigra*
- Laurel oak *Quercus laurifolia*
- American Hornbeam *Carpinus caroliniana*

- Summersweet *Clethra alnifolia*
- Inkberry holly *Ilex glabra*
- Irises *Iris species*
- Swamp sunflower *Helianthus angustifolius*
- Wax myrtle *Myrica cerifera*
- Dwarf palm *Sabal minor*
- Swamp lily *Crinum americanum*
- Rosemallow hibiscus *Hibiscus moscheutos*
- White top sedge *Rhynchospora colorata*
- Fakahatchee grass *Tripsachum dactyloides*
- Common rush *Juncus effusus*

UPLAND RIDGES

Upland Ridges can tolerate periodic freshwater inundation if well-draining soils are present (Hydrologic Groups A-B)

PINE FOREST
- Longleaf pine Pinus palustris
- Carolina wiregrass Aristida stricta
- Little bluestem Schizachyrium scoparium
- Indian grass Sorghastrum nutans
- Switch grass Panicum virgatum
- Inland sea oats Chasmanthium latifolium
- Slender wood oats Chasmanthium latifolium
- Pitcher plants Sarracenia purpurea
- Partridge pea Chamaecrista fasciculata
- Black-eyed Susan Rudbeckia hirta

MIXED HARDWOOD FOREST
- Southern magnolia Magnolia grandiflora
- Live oak Quercus virginiana
- Water oak Quercus nigra
- Sweetgum Liquidambar styraciflua
- American beech Fagus grandifolia
- Red oak Quercus falcata
- Laurel oak Quercus laurifolia
- American hornbeam Carpinus caroliniana
- Sweetbay magnolia Magnolia virginiana
- Tulip poplar Liriodendron tulipifera
- American holly Ilex opaca
- American beautyberry Callicarpa americana
- Inkberry holly Ilex glabra
- Yaupon holly Ilex vomitoria
- Carolina Cherry Laurel Prunus caroliniana

URBAN/SUBURBAN REFORESTATION

Urban / Suburban Reforestation requires native species tolerant of poor nutrient soil, root constriction, and other urban / suburban conditions

- Southern magnolia Magnolia grandiflora
- Live oak Quercus virginiana
- Willow oak Quercus phellos
- Bald cypress Taxodium distichum
- American hornbeam Carpinus caroliniana
- Sweetbay magnolia Magnolia virginiana
- Eastern red cedar Juniperus virginiana
- Palmetto Sabal palmetto

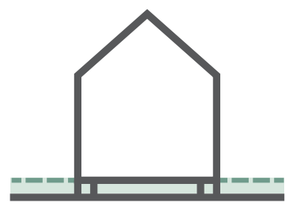
- Itea Itea virginica
- Yaupon holly Ilex vomitoria
- Inkberry holly Ilex glabra
- Beautyberry Callicarpa americana
- Oakleaf hydrangea Hydrangea quercifolia
- Wax myrtle Myrica cerifera
- Sweetgrass Muhlenbergia capillaris
- Switch grass Panicum virgatum
- Inland sea oats Chasmanthium latifolium

BUILDING TYPOLOGIES

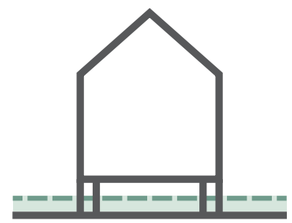
FLOOD ADAPTIVE

NON-ADAPTIVE

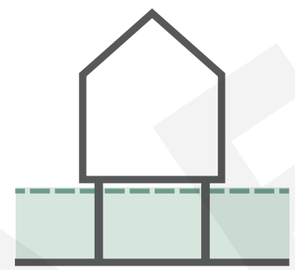
RESIDENTIAL



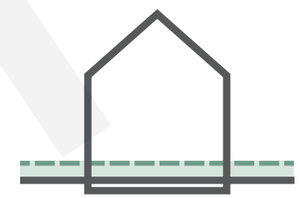
Pier & Beam



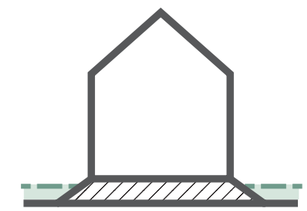
Pier & Beam (raised)



Pier & Beam (coastal zone)

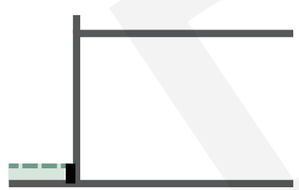


Slab on Grade

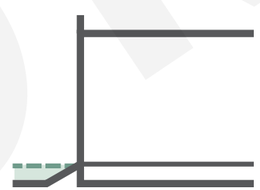


Slab on Fill

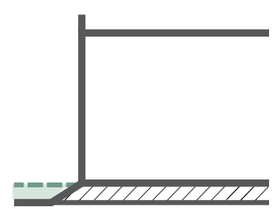
COMMERCIAL & INSTITUTIONAL



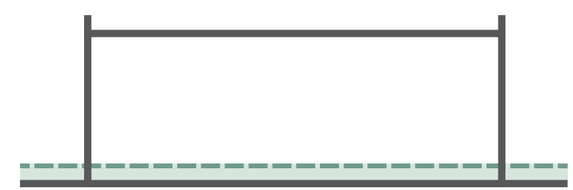
Dry Flood Proof*



Interior Elevated*



Elevated on Fill**



Unmodified Slab on Grade

*If renovated, only if existing construction type allows
**If sufficient additional runoff mitigation & water storage features are in place

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WATERSHEDS + LAND COVER

9/23/2020
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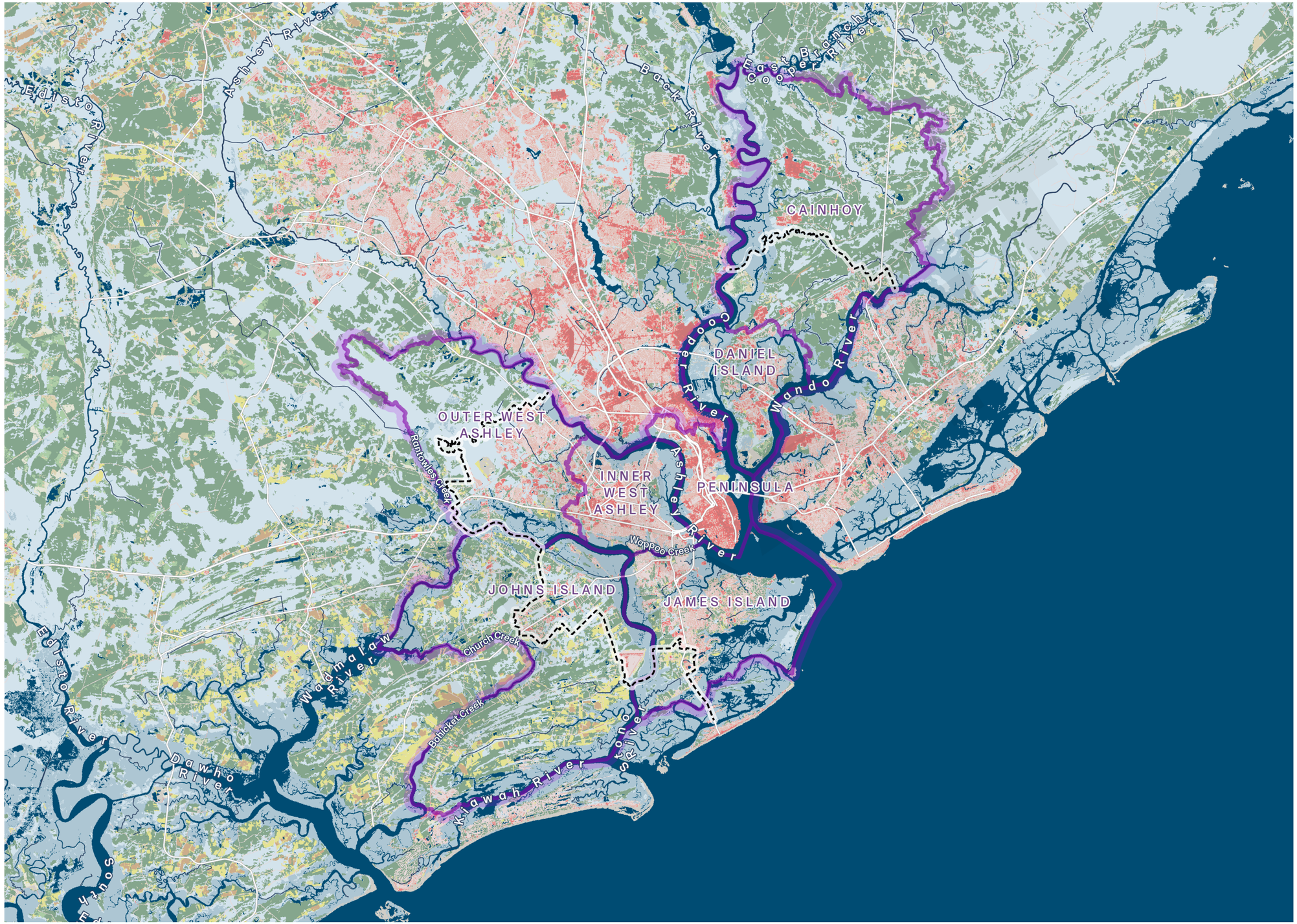
CHARLESTON CITY PLAN
LAND & WATER ANALYSIS



Legend

Watersheds Neighborhood

Urban Growth Boundary

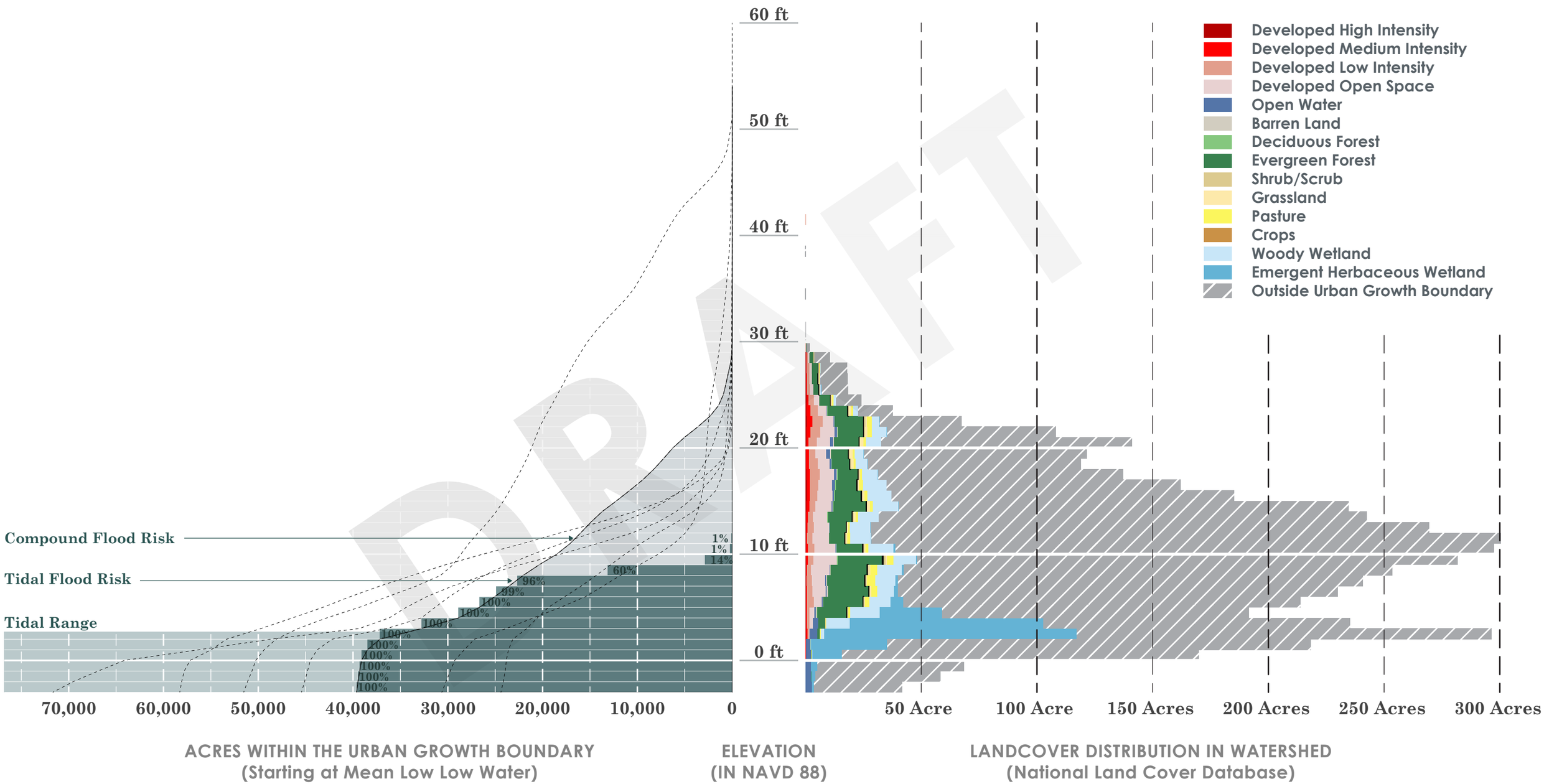
Water

Land Cover

- Developed High Intensity
- Developed Medium Intensity
- Developed Low Intensity
- Developed Open Space
- Open Water
- Barren Land
- Deciduous Forest
- Evergreen Forest
- Shrub/Scrub
- Grassland
- Pasture
- Crops
- Woody Wetland
- Emergent Herbaceous Wetland

Miles
5

LAND COVER BY ELEVATION (JOHNS ISLAND)



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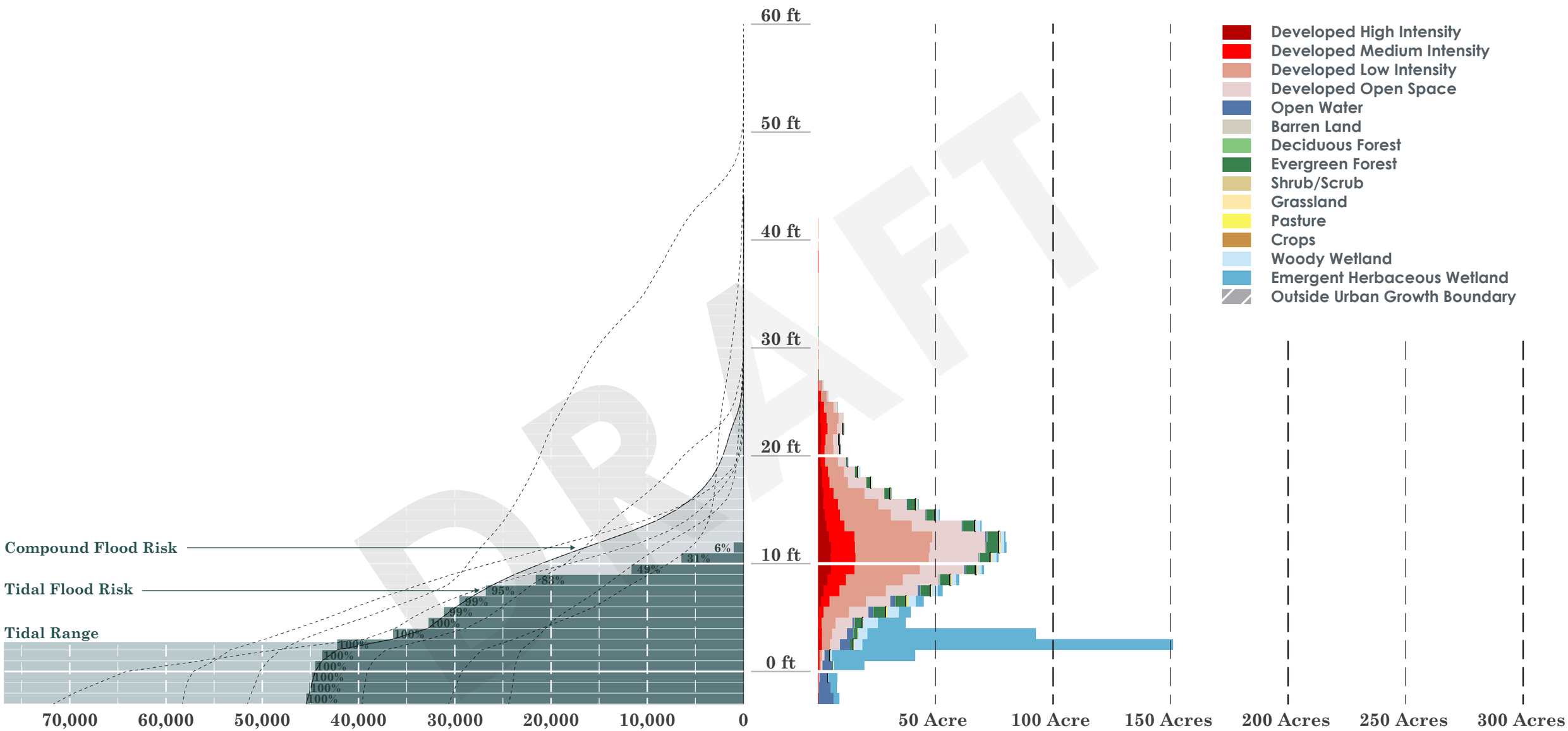
LAND COVER BY ELEVATION (INNER WEST ASHLEY)



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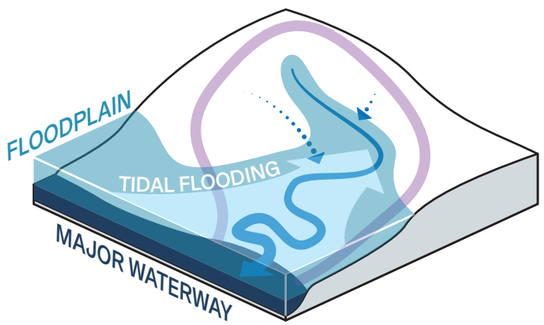
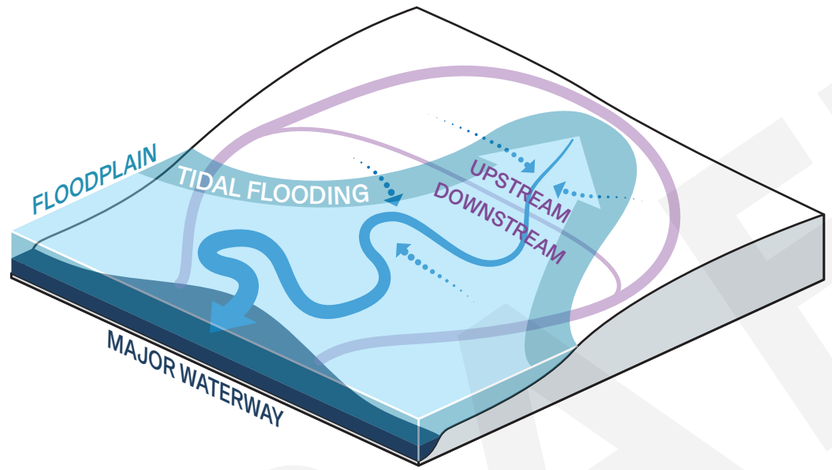
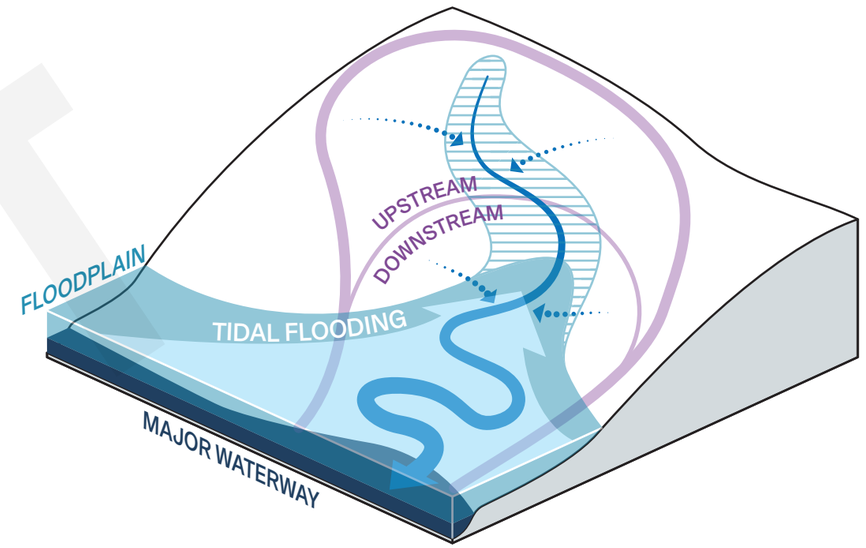
WATERSHED SIZE & TYPE







SMALL

- Directly drain into major waterways (sheet-flow, small ditches or creeks)
- Flood risk is predominantly tidal
- Tidal areas typically have high groundwater
- Elevated structures and no-fill building are adaptive strategies in tidal watersheds

LARGE (TIDAL)

- Drainage through long, well defined channels and often multiple branches
- Identifiable upstream and downstream subwatersheds defined by total channel length
- Tidal areas typically have high groundwater
- Elevated structures and no-fill building are adaptive strategies in tidal watersheds
- Upstream areas can be tidal and tidal-influenced
- Upland areas tend to have favorable soils for stormwater infiltration

LARGE (UPLAND)

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WATERSHED SIZE

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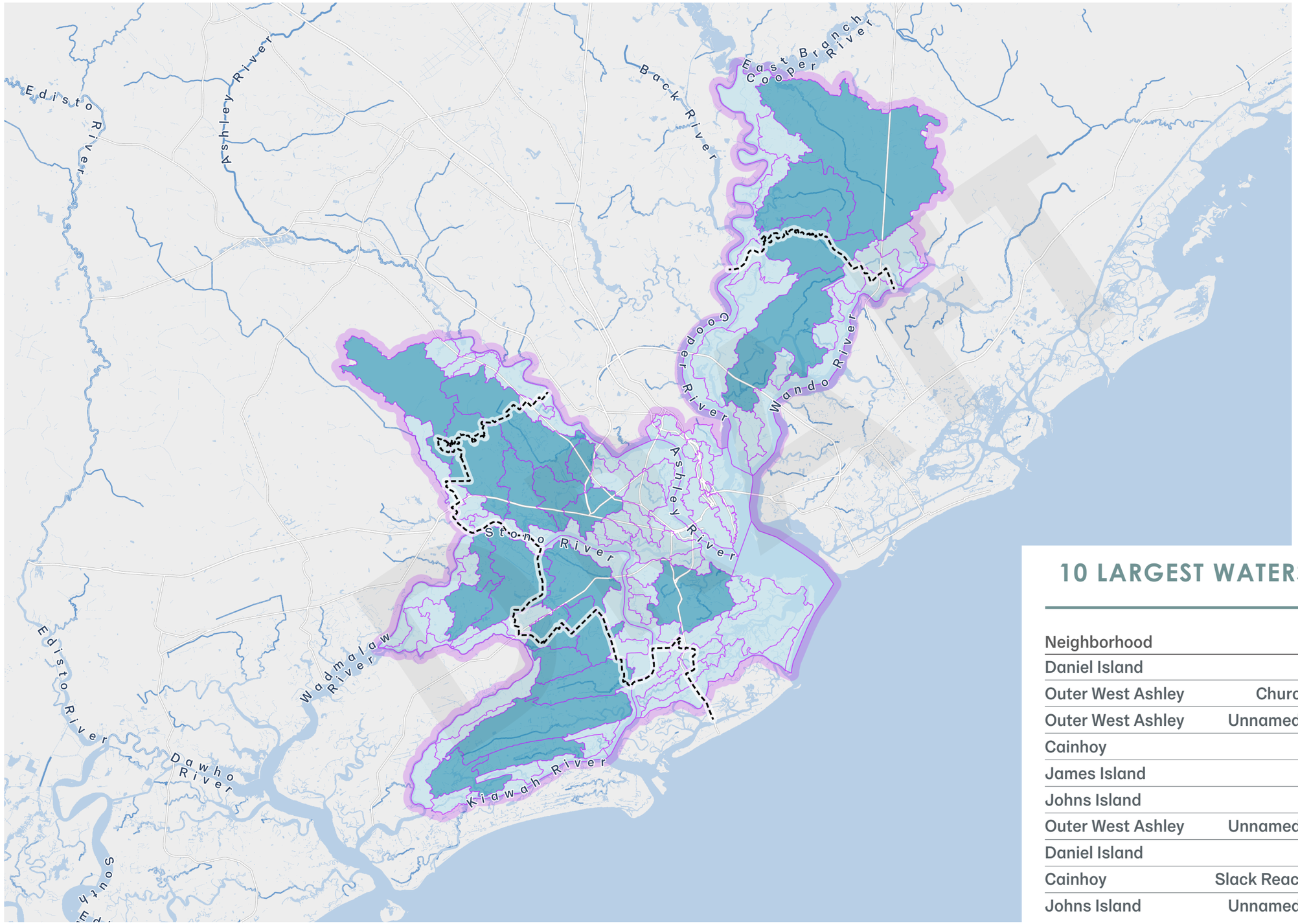
CHARLESTON CITY PLAN
LAND & WATER ANALYSIS



Legend

Watershed Size

- Large
- Small

Project Watersheds

Urban Growth Boundary

Water

*Defined by maximum runoff flow distance; correlates with overall area and flow volume

10 LARGEST WATERSHEDS (WITHIN UGB)

Neighborhood	Name	Sq. Miles
Daniel Island	Nowell Creek	13.8
Outer West Ashley	Church Creek - West Ashley	10.3
Outer West Ashley	Unnamed Stono River Tributary	8.3
Cainhoy	Flagg Creek	7.7
James Island	James Island Creek	7.4
Johns Island	Pennys Creek	6.0
Outer West Ashley	Unnamed Stono River Tributary	4.5
Daniel Island	Clouter Creek	4.3
Cainhoy	Slack Reach/Yellow House Creek	4.0
Johns Island	Unnamed Stono River Tributary	3.9

UPSTREAM ZONES

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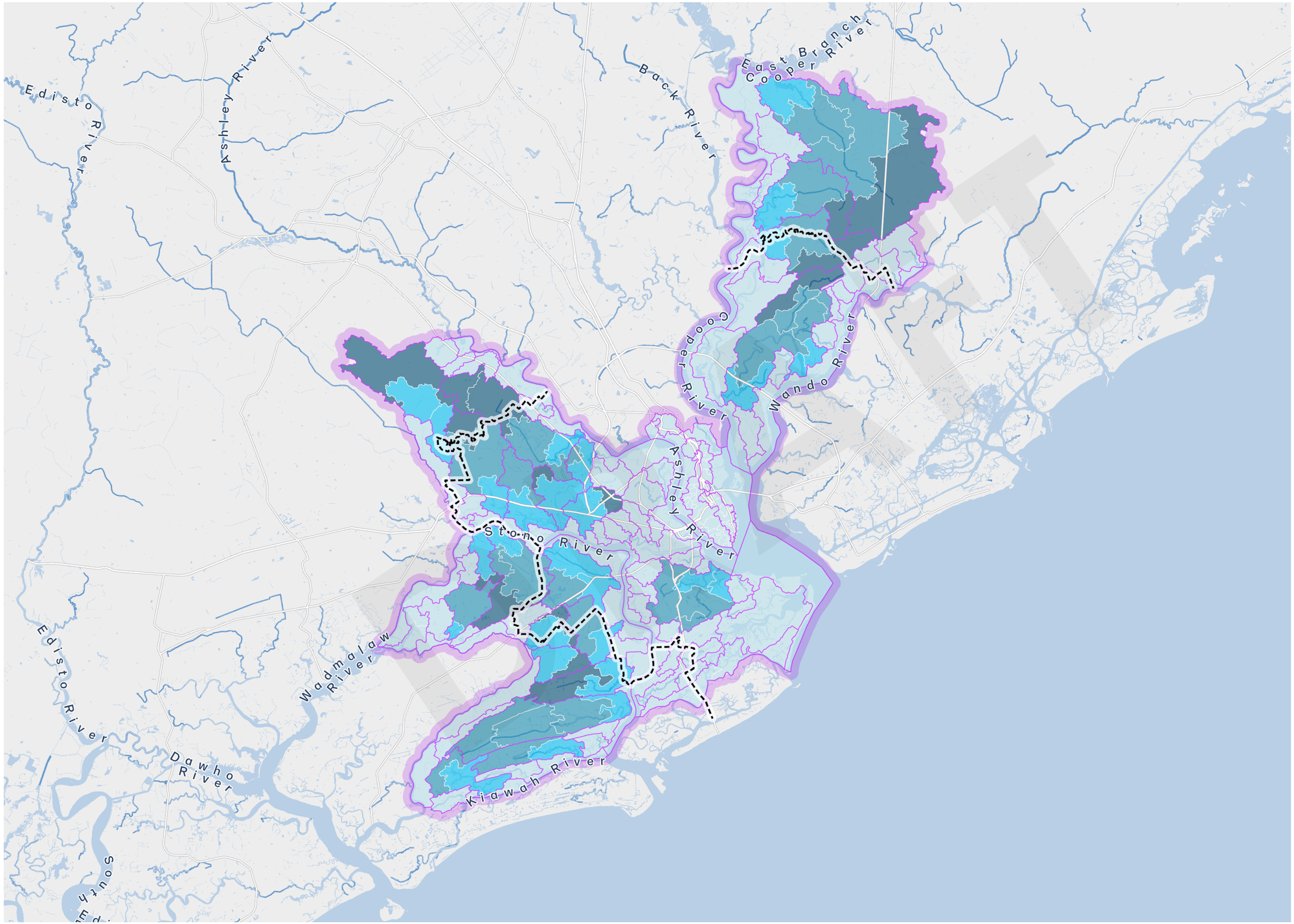
CHARLESTON CITY PLAN
LAND & WATER ANALYSIS



Legend

Watershed Size & Type

- Small Tidal
- Large Outlet Tidal
- Large Upstream Tidal
- Large Upstream Tidal Influence

Project Watersheds

Urban Growth Boundary

Water

*Defined by tidal range and maximum runoff flow distance

Miles
5

WATERSHEDS + SOIL TYPE

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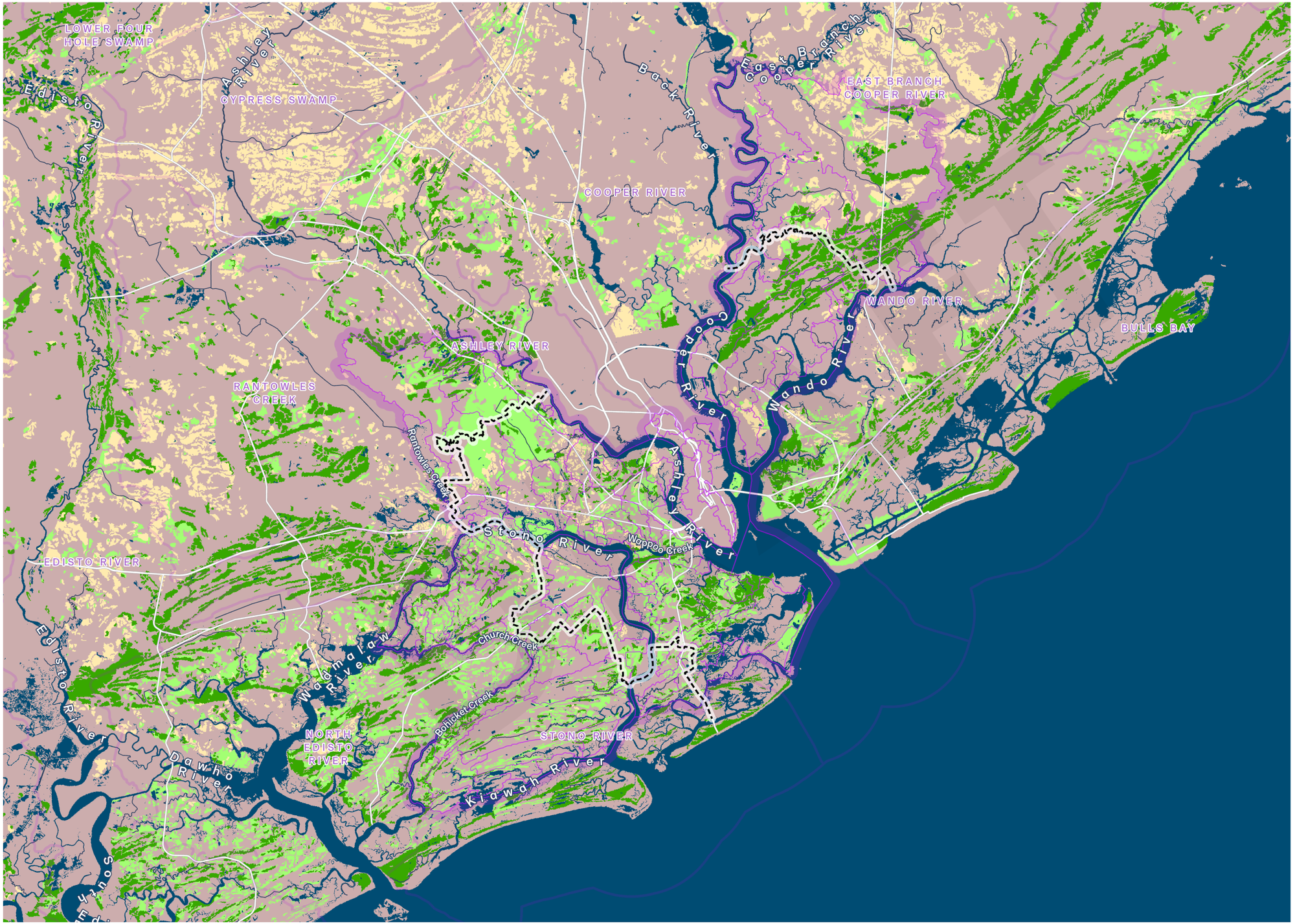
CHARLESTON CITY PLAN
LAND & WATER ANALYSIS



Legend

Project Watersheds

Soil Hydrologic Groups

- Group A
- Group B
- Group C
- Group D, /D

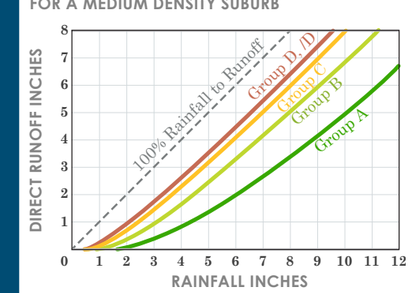
WATERSHED (purple)

Other Watersheds

Urban Growth Boundary

Water

RAINFALL TO RUNOFF BY SOIL TYPE
FOR A MEDIUM DENSITY SUBURB

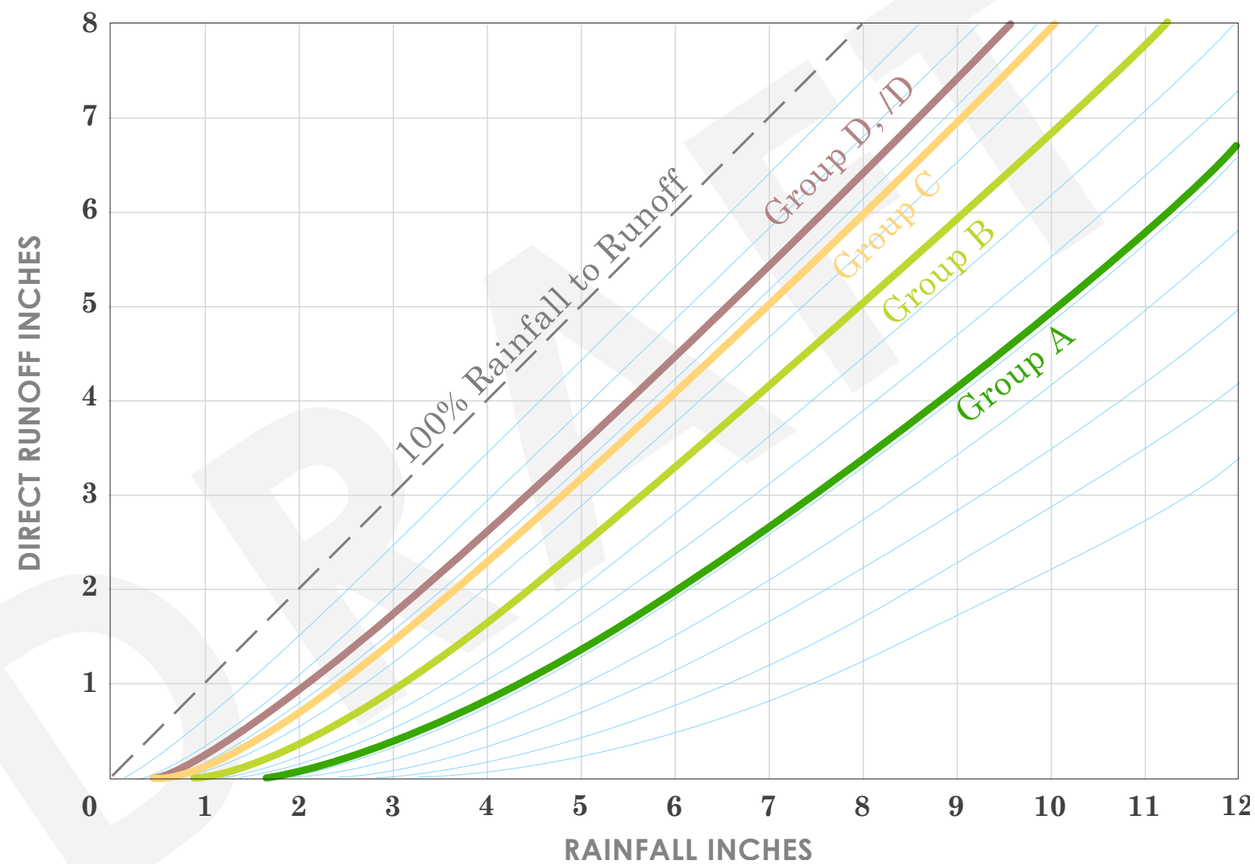


Miles
5

WATERSHEDS + SOIL TYPE

RUNOFF ESTIMATE BY SOIL AND LAND COVER TYPE

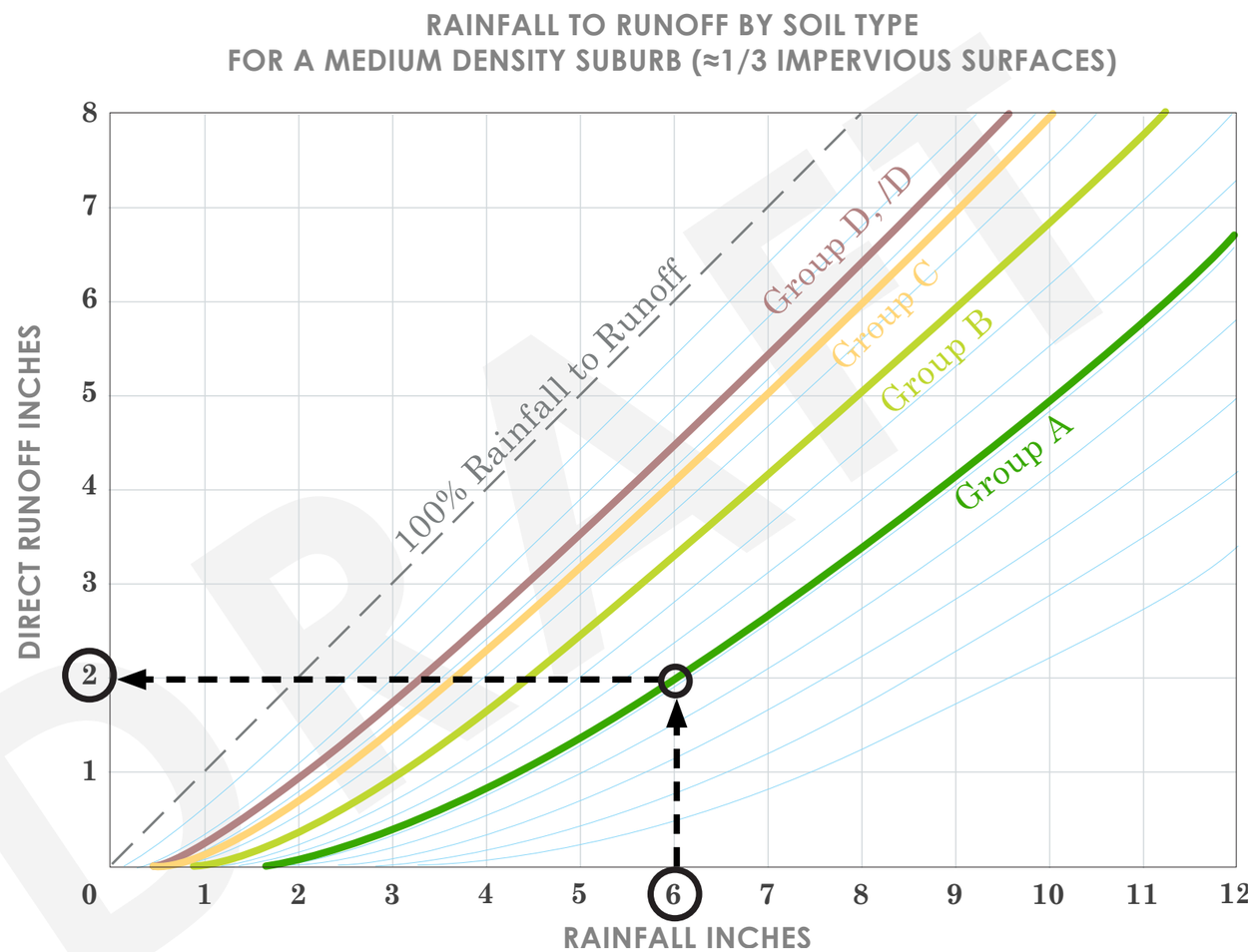
RAINFALL TO RUNOFF BY SOIL TYPE
FOR A MEDIUM DENSITY SUBURB (≈1/3 IMPERVIOUS SURFACES)



Hydrologic groups classify how well soils infiltrate and retain water. Hydrologic groups are matched with land cover characterizations to estimate runoff. For paved surfaces, around 98% of rain becomes runoff, while sandy or gravelly soils with little to no impervious surfaces have a much lower runoff ratios.

WATERSHEDS + SOIL TYPE

RUNOFF ESTIMATE BY SOIL AND LAND COVER TYPE



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WATERSHEDS + POLITICS

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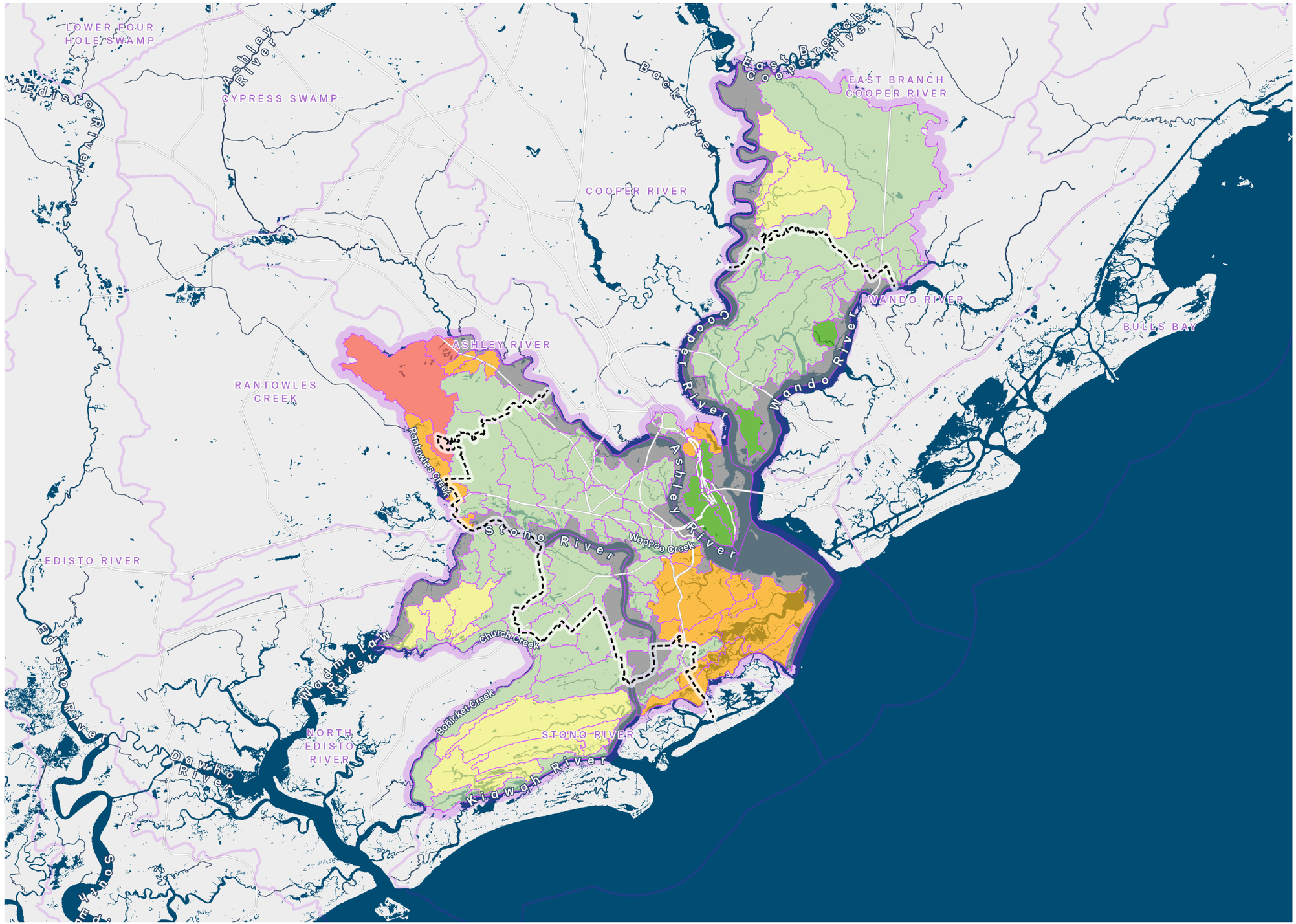
CHARLESTON CITY PLAN
LAND & WATER ANALYSIS



Legend

Watershed Jurisdiction

- Entirely Within Charleston City
- Single-City, Single-County
- No City, Single-County
- Multi-City, Single-County
- Multi-City, Multi-County
- Excluded

Project Watersheds

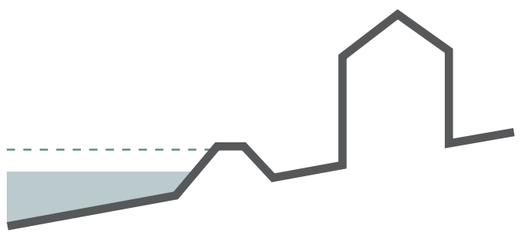
Other Watersheds

Urban Growth Boundary

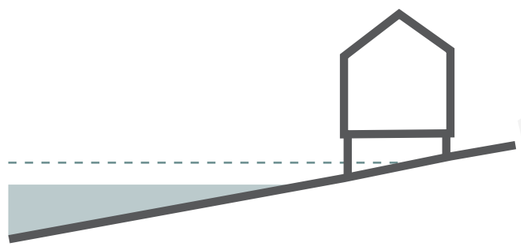
Water

Miles
5

PLANNING STRATEGIES



DEFEND



ADAPT

RESERVE

GROW

DRAFT

QUESTIONS

STAY INFORMED. KEEP IN TOUCH. SPREAD THE WORD.

CHARLESTONCITYPLAN.COM/GET-INVOLVED

Participate in more community conversations

Take the survey: **CHARLESTONCITYPLAN.COM/SURVEY**

Lead your own discussion

Subscribe and Follow: City Plan Newsletter, City of Charleston on Facebook & Twitter, City Plan YouTube Playlist

COMMUNITY MEETINGS

Peninsula *Community Conversation*
Tuesday, Aug. 25, 9-11:30 am
OR 6-7:30 pm

West Ashley *Community Conversation*
Tuesday, Sept. 1, 9-11:30 am
OR 6-7:30pm

Cainhoy Peninsula *Community Conversation*
Thursday, Sept. 3, 9-11:30am
OR 6-7:30pm

Open *Listening Session*
Saturday, Sept. 19, 2-3:30pm

Water *Lab*
Wednesday, September 23, 11:30am-1:00pm
OR 6-7:30pm

Johns Island *Community Conversation*
Thursday, Sept. 24, 9-11:30am
OR 6-7:30pm

Housing *Lab*
Friday, Sept. 25, 9-11:30am

James Island *Community Conversation*
Tuesday, Sept. 29, 9-11:30am
OR 6-7:30pm

Housing *Lab*
Thursday, Oct. 1, 6-7:30pm

Charla Comunitaria ***(en español)***
Lunes, Oct. 5, 8-9:30pm

Register at:
charlestoncityplan.com/get-involved