Dale Morris
Chief Resilience Officer

Charleston, SC

- "The overarching need before us is to figure out how to discover, preserve, expand, and apply nature's value." US Army Corps of Engineers. Engineering with Nature, An Atlas, Volume 2, 2021.

Grounding, Part 1: the place

WATER BENCHMARKS

2/3 OF CHARLESTON

INSIDE THE URBAN GROWTH BOUNDARY IS IN THE FEMA 100 YEAR FLOODPLAIN

10.2 INCHES OF RAIN

OVER 24 HOURS EVERY 100 YEARS

17 FEET STORM SURGE

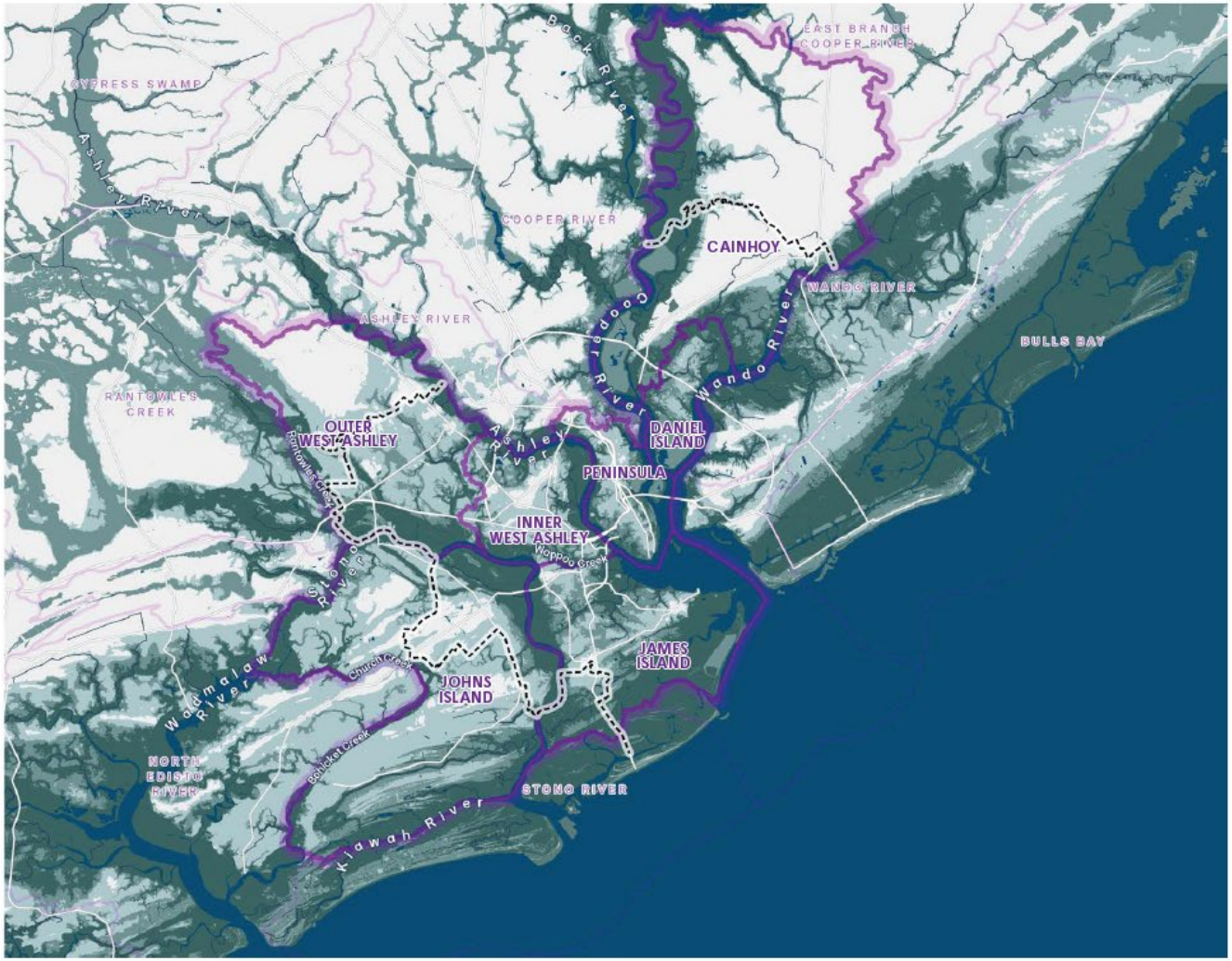
NOAA MAXIMUM POSSIBLE CATEGORY 3 STORM SURGE

3 FT OF SEA LEVEL RISE

BY 2080

7 WATERSHED AREAS

PENINSULA, INNER WEST ASHLEY, OUTER WEST ASHLEY, JAMES ISLAND, JOHNS



Watersheds Neighborhood

Urban Growth Boundary

Water

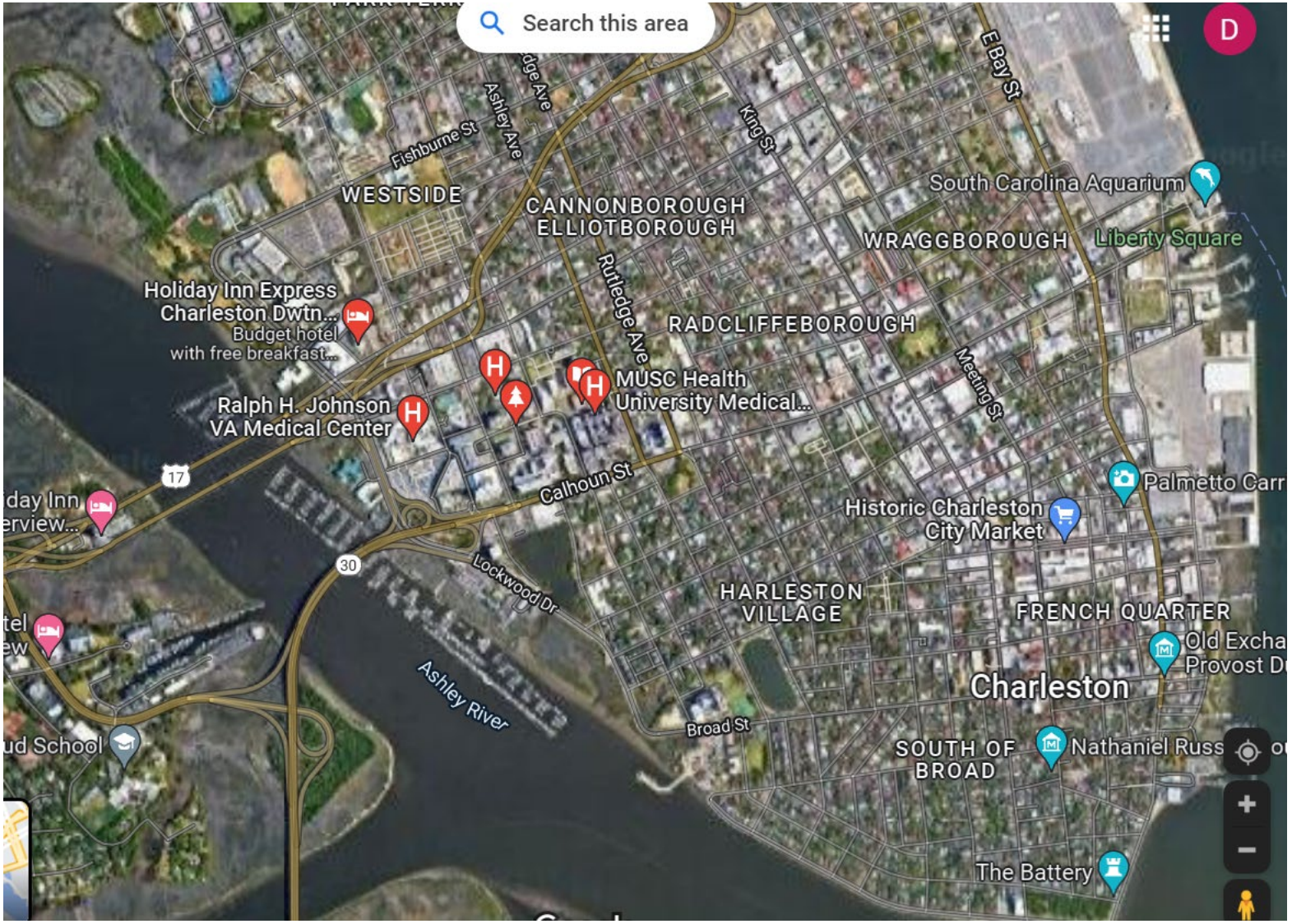
1 inch = 4 miles

Miles 10


F150

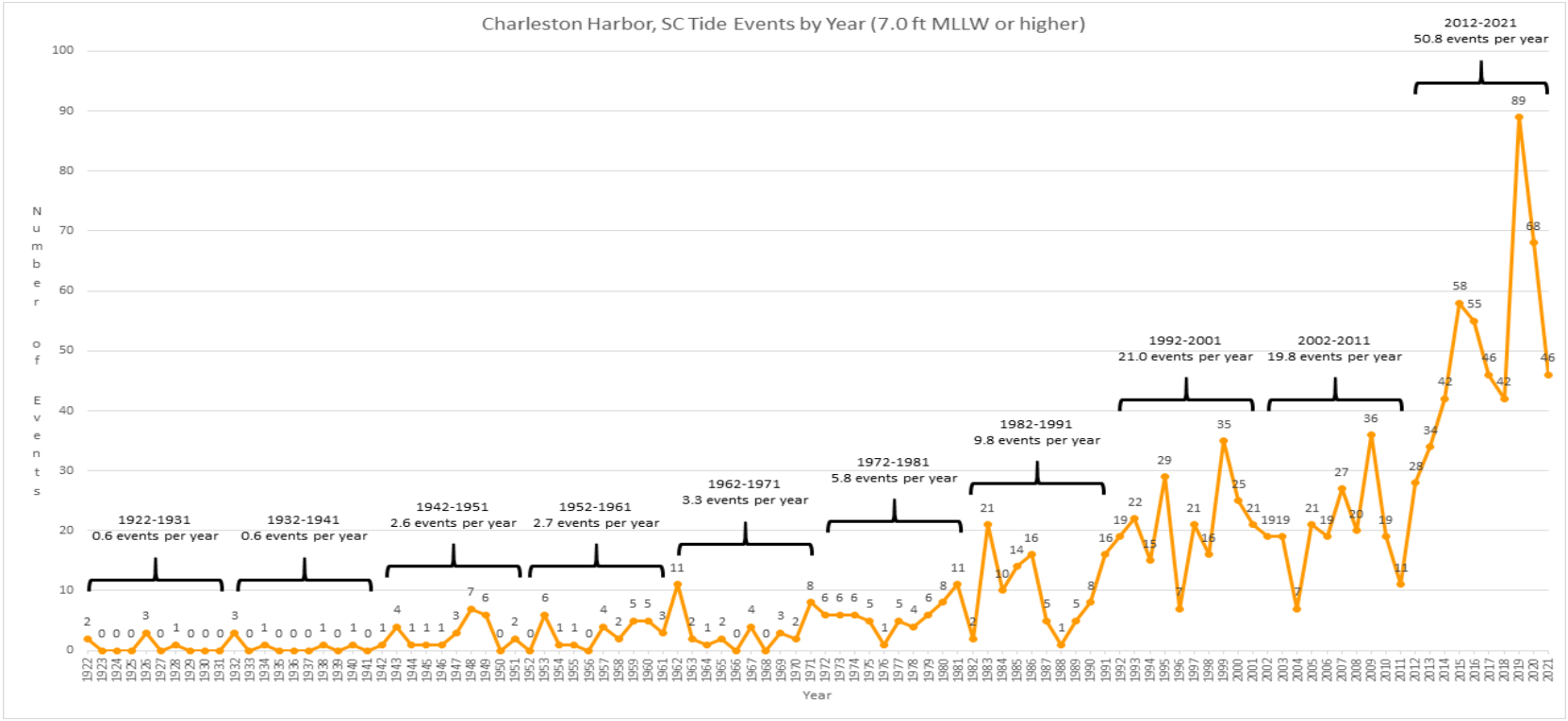

108
24 Hour Protection
843-760-4822
Monitronics


MORRISON
YARD

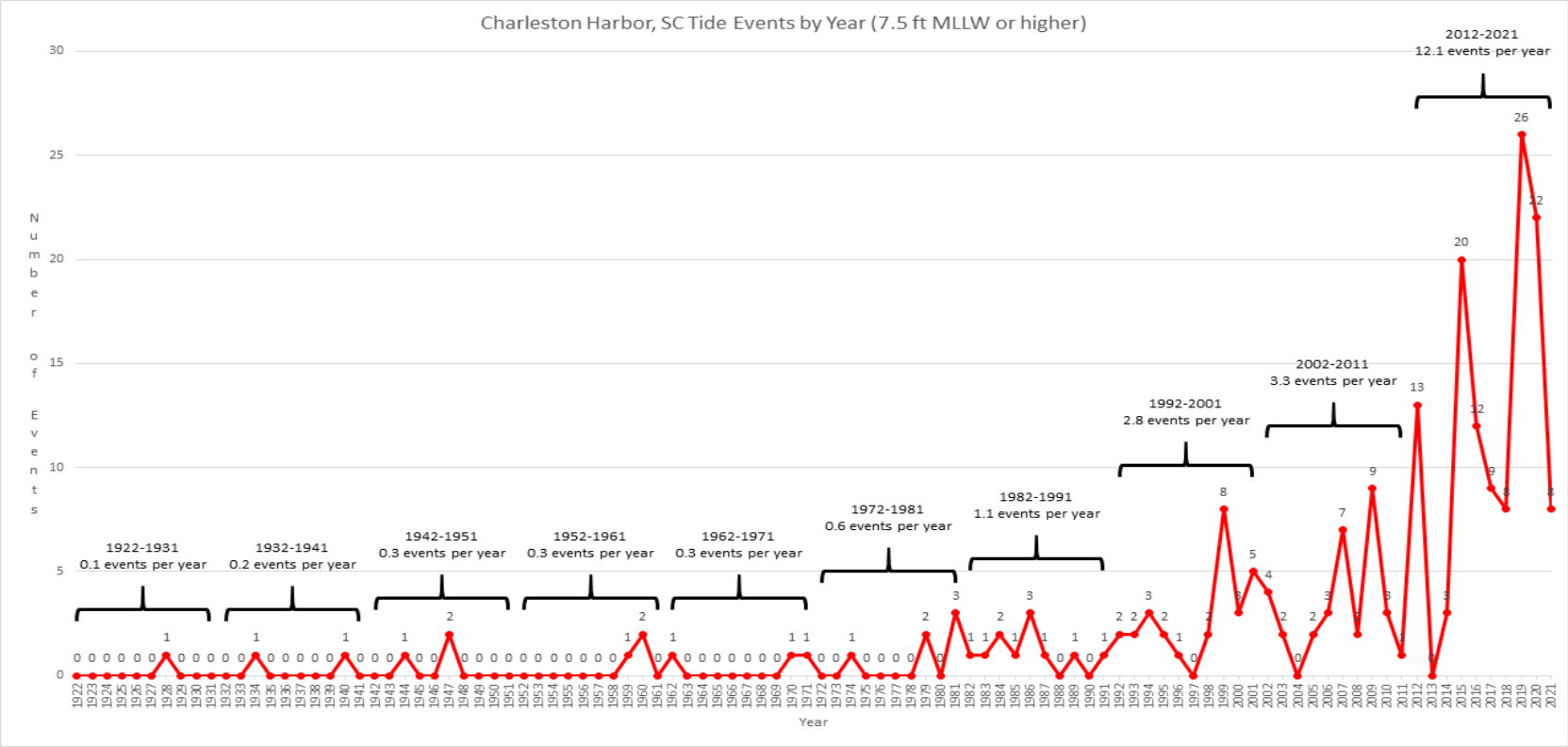

Search this area
D
Fishburne St
Ashley Ave
King St
E Bay St
WESTSIDE
CANNONBOROUGH
ELLIOTBOROUGH
WRAGGBOROUGH
South Carolina Aquarium
Liberty Square
Holiday Inn Express
Charleston Dwtn...
Budget hotel
with free breakfast...
Rutledge Ave
RADCLIFFEBOROUGH
MUSC Health
University Medical...
Ralph H. Johnson
VA Medical Center
Meeting St
17
Calhoun St
Palmetto Carr
Historic Charleston
City Market
30
Lockwood Dr
HARLESTON
VILLAGE
FRENCH QUARTER
Old Excha
Provost D
Charleston
Ashley River
Broad St
SOUTH OF
BROAD
Nathaniel Russ
The Battery

Grounding, Part 2: the challenge

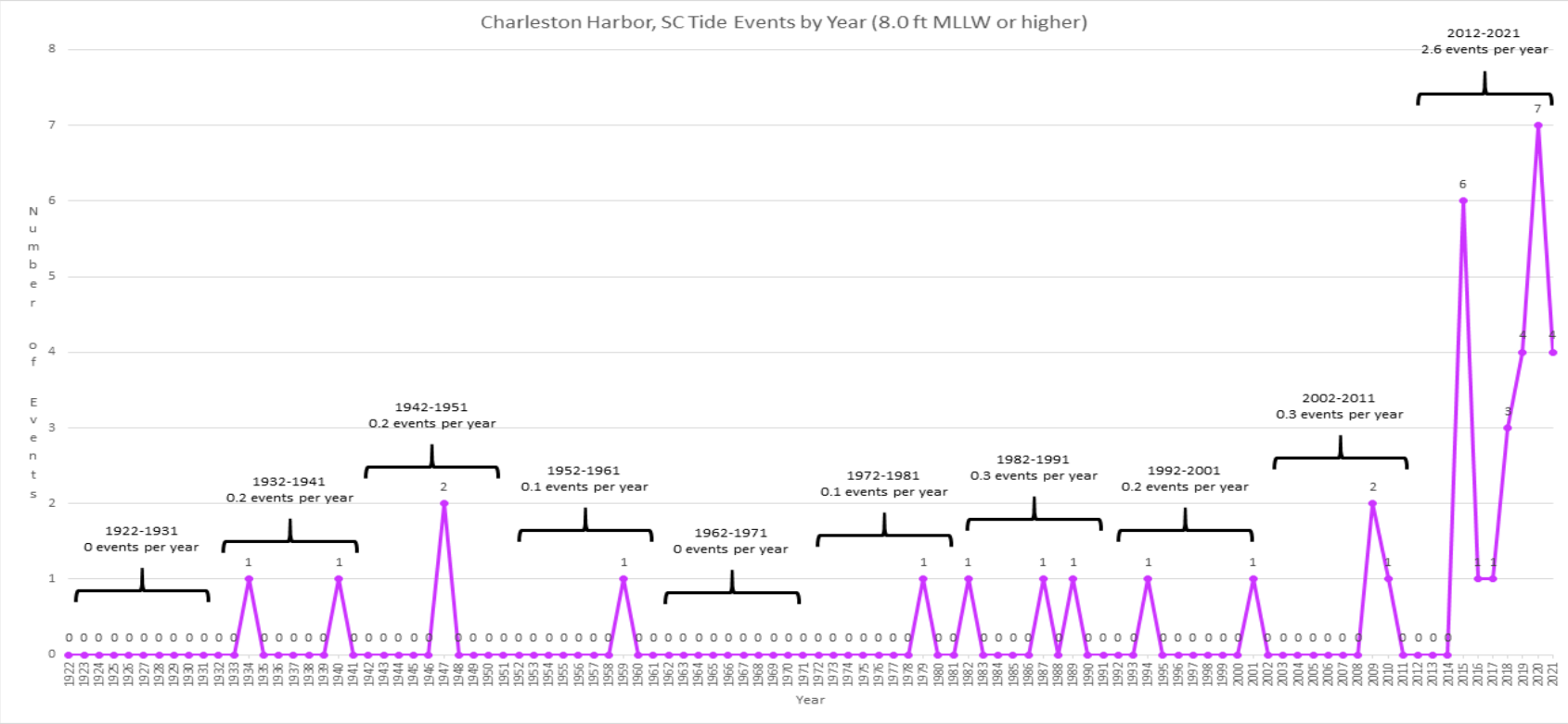
Minor tidal flooding



Moderate tidal flooding



Major tidal flooding



Surge: Low Battery
Hurricane Irma, September 2017

Surge: Lockwood/Medical District
Hurricane Irma, September 2017

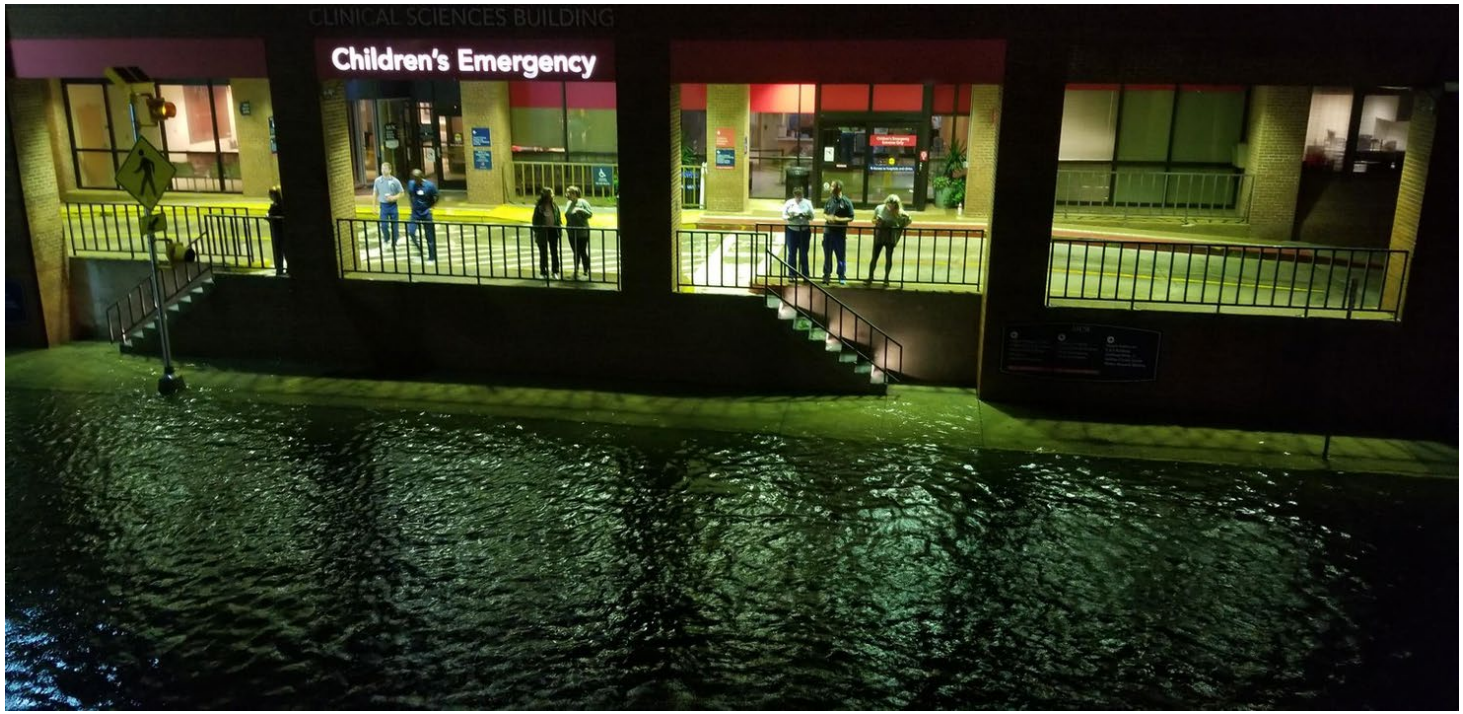
SEP 12, 2017

SHARE

The intersection of Lockwood Drive and Bee Street was submerged Monday as Hurricane Irma's effects were felt across the Lowcountry. (Photo/Provided by Erin Spencer)

Rainfall: 1,000 yr flood Oct 2015

Surge: Medical District- 96 Jonathan Lucas St
Hurricane Dorian, September 2019



All Hazard Vulnerability Analysis, 2019

Physical vulnerability: surge, tidal, rainfall, sea-level rise, earthquake, dam failure, heat, hazmat. Social vulnerability.

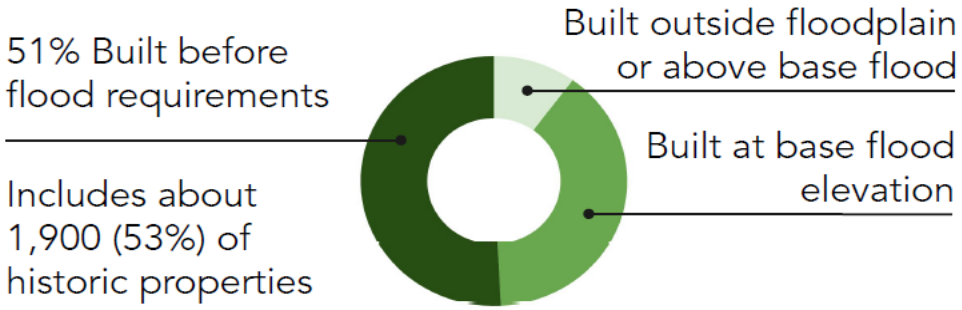
Key Finding 1

Flooding, storm surge, and earthquakes drive vulnerability citywide

	Floodplain Inundation	Storm Surge	Earthquake
Businesses	71%	84%	46%
Homes	70%	87%	39%
Critical Facilities	59%	72%	88%

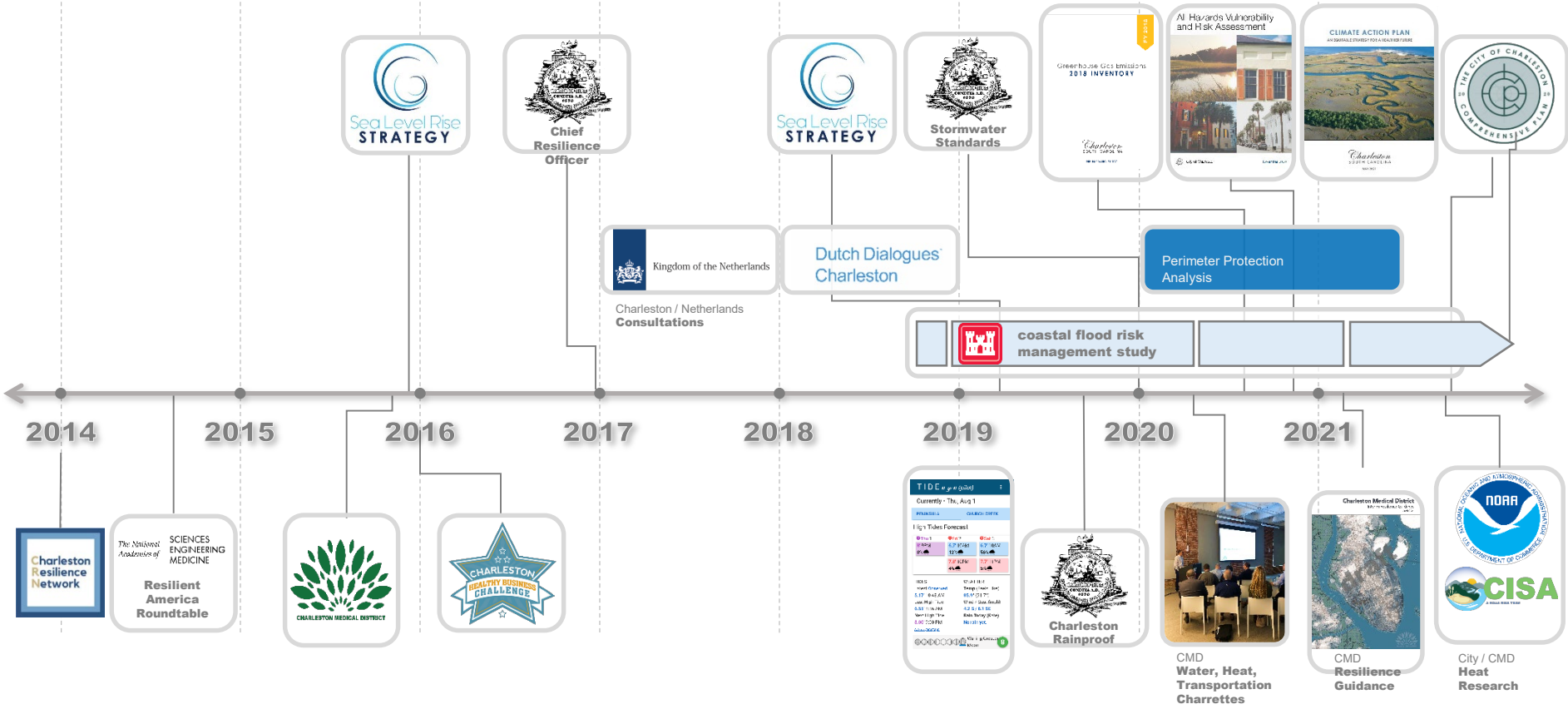
Key Finding 2

The ability to cope with flood inundation is a main driver of vulnerability



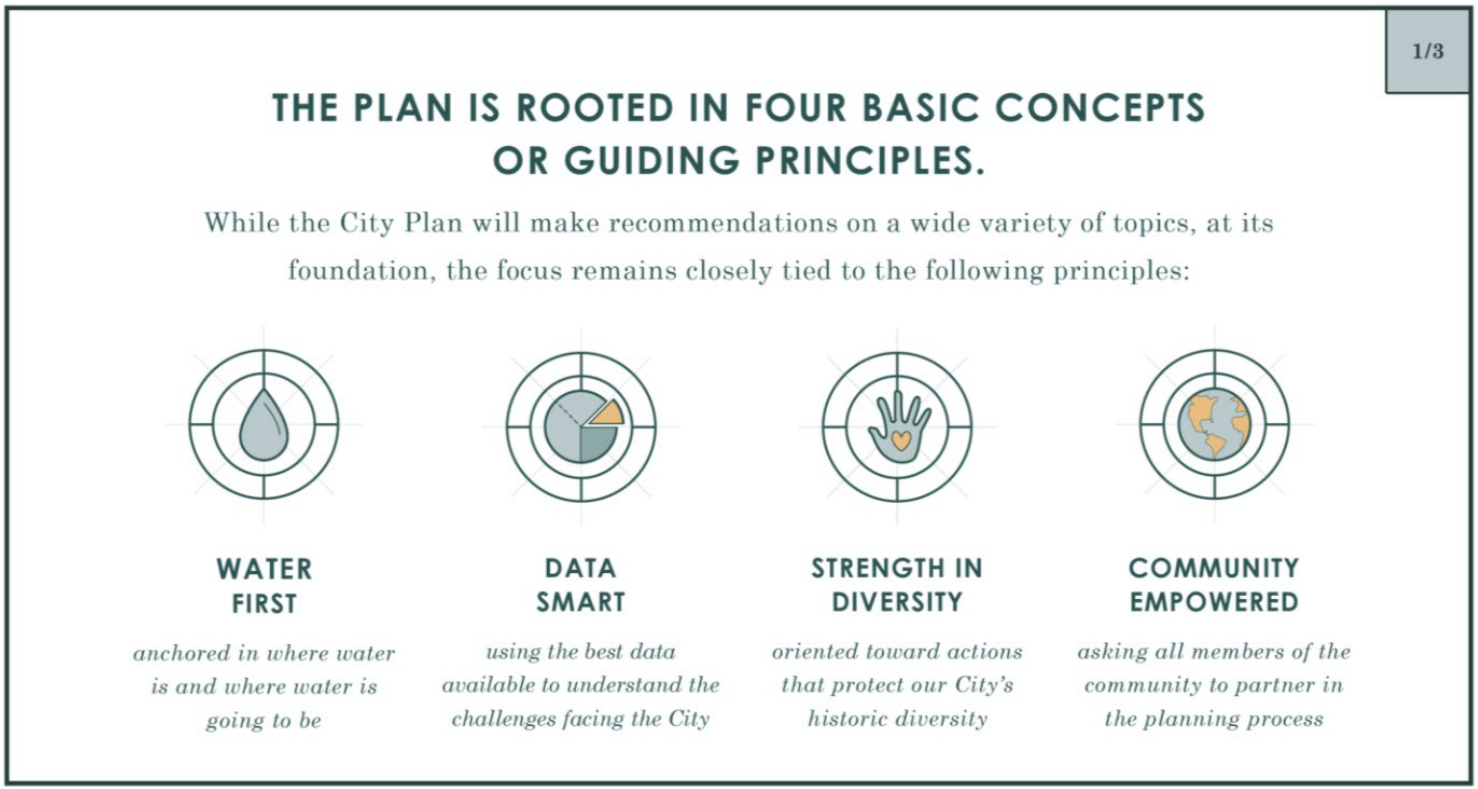
Grounding, Part 3: an engaged place

Knowledge, Studies, Plans, $$$ drainage



2021 City Comprehensive Plan (Land + Water Analysis). A Natural Systems Planning underlay

- Elevation-based development approach
- Protect low-lying undeveloped land
- Restore natural systems, connect upland + lowland
- Store and infiltrate stormwater upland
- Restrict use of fill
- Concentrate future growth on high ground



PLANNING STRATEGIES

GROW

Responsibly increase development and population density. Growth makes the most sense in areas with low sensitivity and low risk. Growth must occur in tandem with water management.

DEFEND

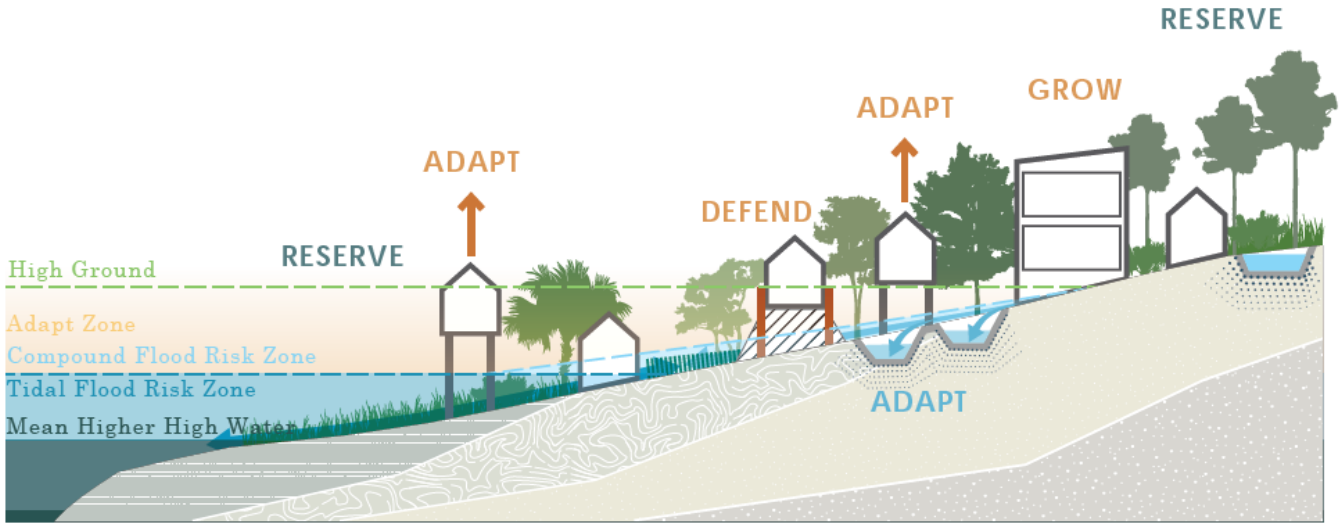
Protect buildings and infrastructure with engineered measures such as berms, flood walls and pumps. Defensive measures should be reserved for areas with the highest risk and lowest sensitivity (e.g. where the displacement of floodwater will not exacerbate risk elsewhere.)

ADAPT

Retrofit vulnerable existing infrastructure to be resilient to water risks. Raising structures reduces risk with limited to no increase in watershed sensitivity. However, adaptive capacity is limited by building typology.

RESERVE

Restore and preserve natural ecosystems. Reserve is applicable to all zones and should factor future change. Ecosystems providing stormwater benefits and essential wildlife habitats exist throughout Charleston and should be preserved.

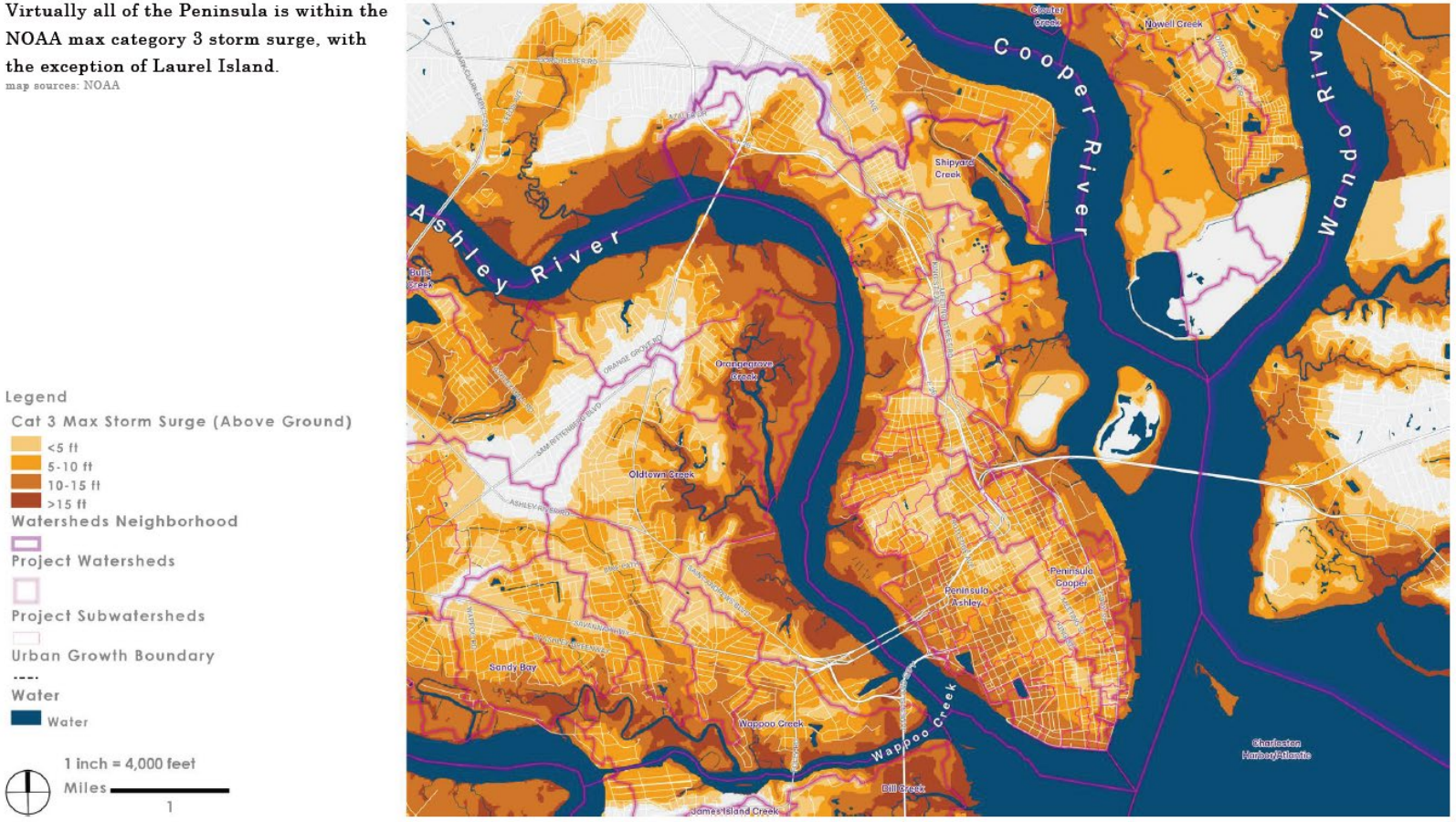


The CSRM Opportunity, Part 4: The City – USACE Partnership

NOAA Category 3 Storm Surge

Virtually all of the Peninsula is within the NOAA max category 3 storm surge, with the exception of Laurel Island.

map sources: NOAA



Vulnerability Analysis: Surge

- **Residential**: 99% of Peninsula residential properties at risk from surge.
- **Business:** 98% of Peninsula commercial properties at risk from storm surge.
- **Infrastructure:** 100% of critical Peninsula roads inaccessible during surge event.
- **Critical Facilities**: 90% of critical facilities vulnerable (CMD, colleges / universities). +50% of fire and police stations.
- **Economy and Medical Provisioning:** 47k tourism jobs, 20k Charleston Medical District jobs and 4 hospitals at risk

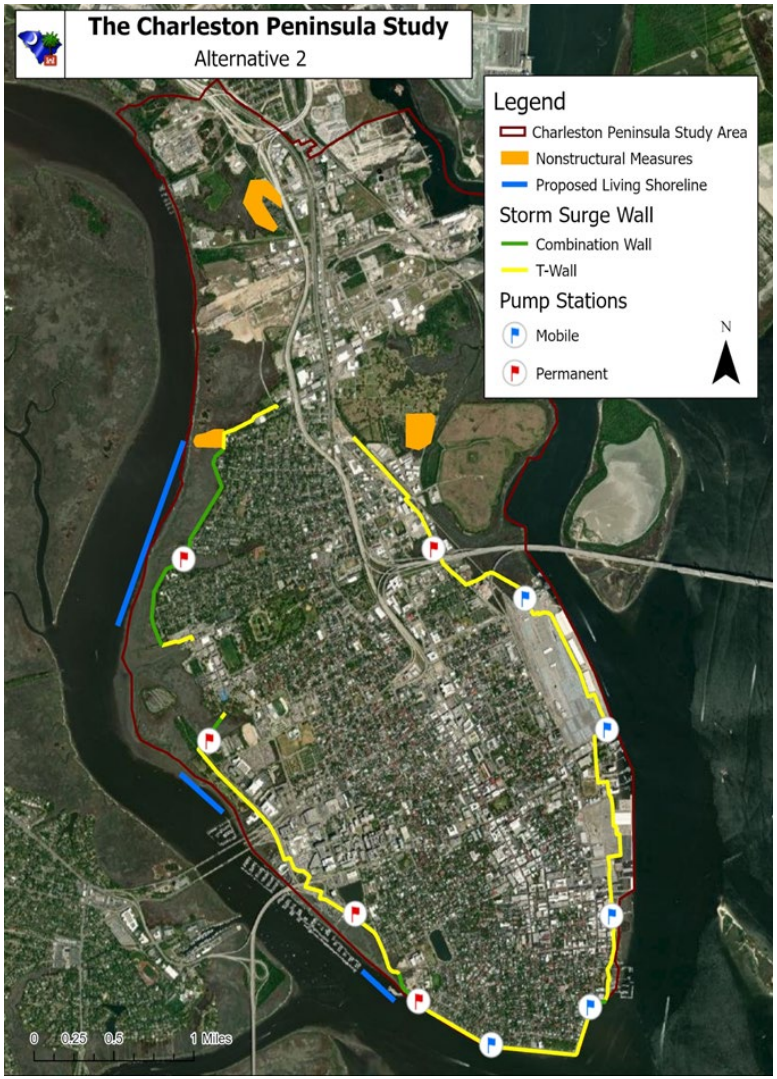
NED plan: $1.1b, 10.8 BCR

- 8 mile long surge structure, 12ft NAVD 88 around peninsula
- T-Wall, Combo Wall, Nonstructural
- 10 Pumps (overtopping / impoundment)
- 85 closure structures
- 3 nonstructural areas (2 EJ)

- $350m Breakwater – screened out
- Brittlebank
- Living Shorelines (after EIS) added, but reclassified to only mitigation
- NNBFs Newmarket Creek, Halsey, Wagener Terrace – screened out
- NNBFs Rosemont: only PED, as Betterment
- Alignment
- **Realignment: Port Terminals**

- Discovery Analysis
- City Design Division
- Design Agreement / PED goals

- **“Lowest Cost, Highest Value”**



City / public / stakeholder perception – is this the optimal approach?

CSRM Peninsula:

Local stakeholder frustration with “only surge,” when tidal and stormwater have higher salience (recency bias)

Skepticism that surge structure will be monofunctional and aesthetically disruptive (Berlin Wall)

Local preference: “more NNBFs, please.”

NNBFs and surge? Dis / mis-information

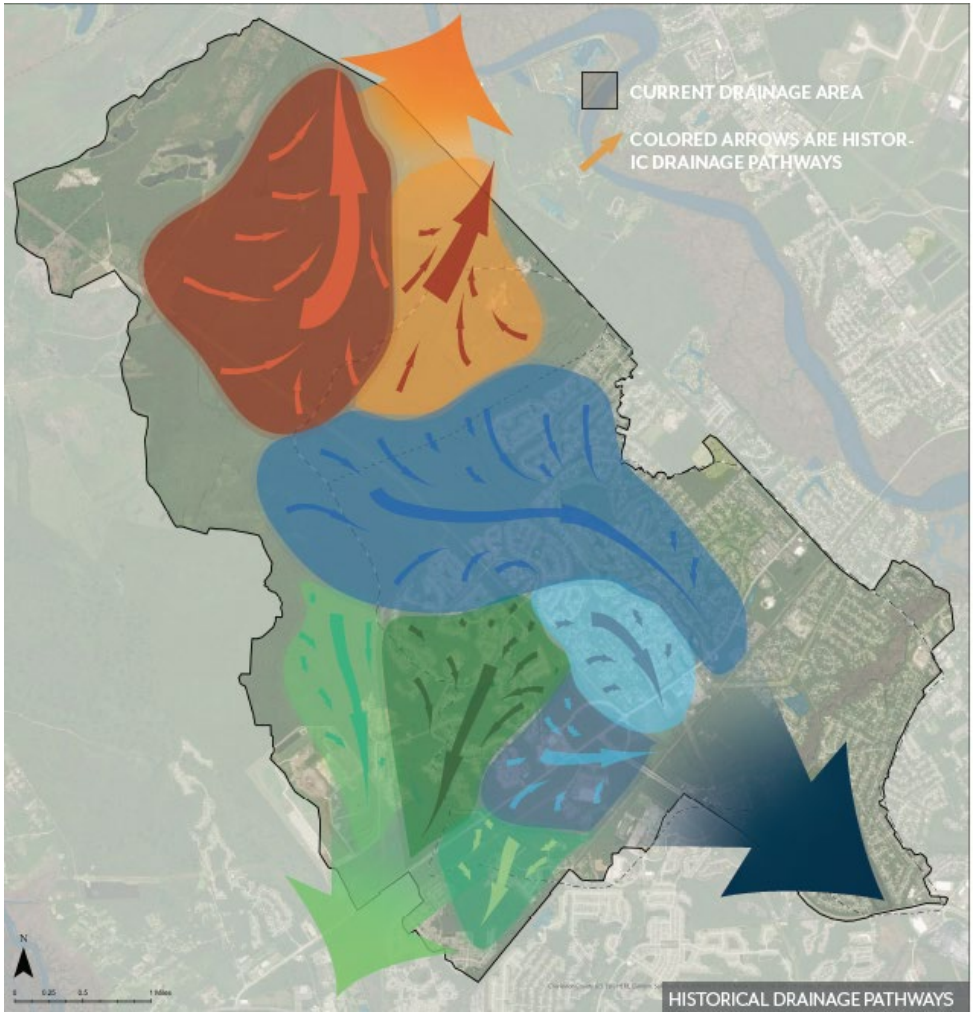
Knowledge that NNBFs will help with SLR adaptation, tidal, and stormwater, **if properly designed**

- 2018 – 2022 CSRM Peninsula (surge only) Study
- 2020 Tidal and Inland (stormwater) 3x3 (authorized)
- 2018 – 2022 Harbor Deepening construction (LPP)

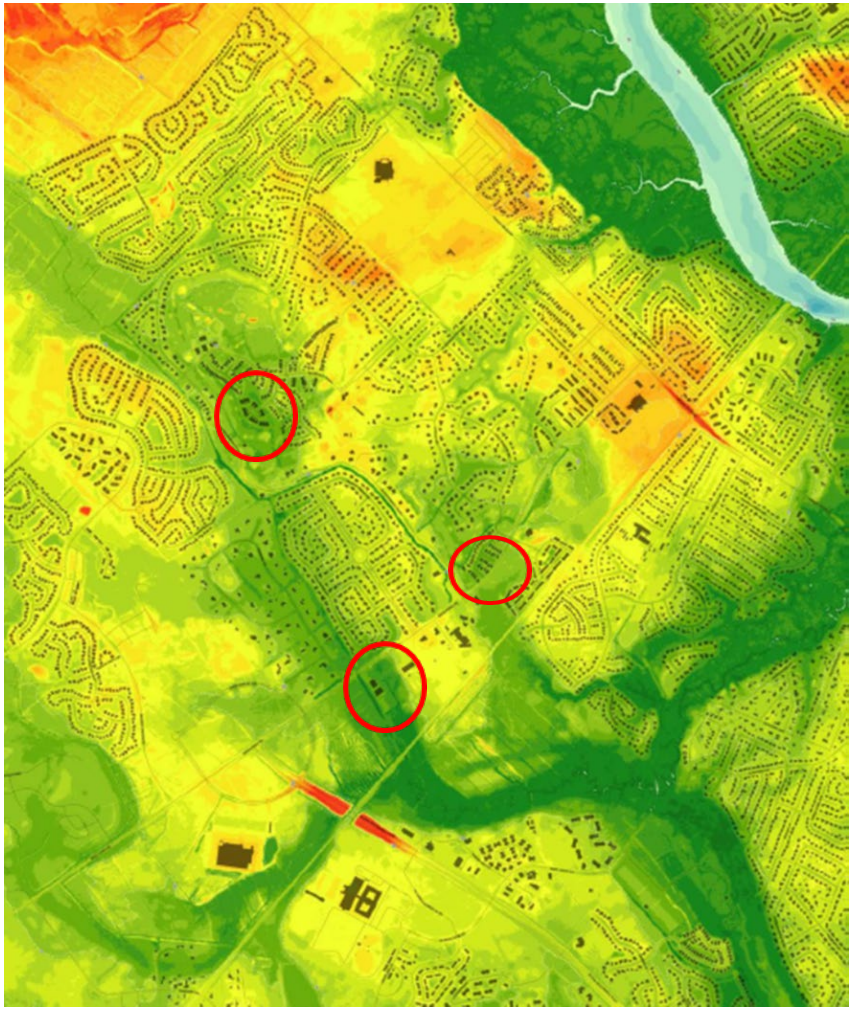
  54’ Harbor Entrance, 52’ Lower Channel, 48’ Upper Channel

  Massive disposal sites. BUDMAT?

Constrained basin



Pilot sites

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60

Three pilot sites, *templates* for rest of City

Overcoming Challenges, Part 5: Policy changes for better partnerships, please.

Policy Challenges

- How to modernize the 65-yr old "coastal storm" focus to enable USACE to help coastal communities respond to **diverse and compounding flood risks?**
- Does PR&G impede NED, NER, OSE from being robustly combined? Can we change it to require NNBFs in feasibility alternatives and design efforts?
- Does the NED mandate implicitly screen from feasibility and design the environmental, social and future adaptation benefits, or default such benefits to "betterments."
- IF NNBFs get screened away in feasibility, they will never get planned, designed, built **and *monitored*** to improve the economic science of their benefits.
- Missed EJ opportunity: what would **Rosemont** feasibility recommendation have been if PDT had authority (waiver?) to respond to surge, tidal, stormwater with structural, non-structural and NNBFs?
- Rosemont Resilience Plan.

Policy / BCA conundrums (international experience)

- **Immediacy Conundrum**: "NBS approaches…are at a disadvantage to grey solutions which operate immediately and produce benefits soon after implementation. European Union, 2018

- **Business Case Conundrum:** "With **NBS…the business case is evident given the wider range of benefits** and co-benefits in the larger physical, ecological and social system, and also in the longer term when the benefits of the resilient and adaptive nature of NBS become fully apparent." EcoShape, 2021

- **"Who Pays" Conundrum:** NBS benefits are disperse. "…**more habitats or biodiversity can be intangible and subjective and…valued differently by different stakeholders;** and the party that foots the bill may not always be the party that enjoys the benefits." EcoShape, 2021

- **Engagement Conundrum:** NBS projects that also posit social benefits need robust engagement during the project conceptualization, design and planning processes. Can the 3x3 process encompass this?

Learning

- UK Environment Agency, new NBS policy 2021, applies also to Scotland and Wales
- International Atlas: Germany, Australia, New Zealand, Netherlands
- World Bank-funded projects – SE Asia and Africa; IADB projects Central and South America. LT adaptation benefits and (possibly) lower O&M; BCAs are more open.
- SHORRE Act: Shoreline Health Oversight, Restoration, Resilience, and Enhancement Act
- Pilots / EWN Proving Grounds?
- Targeted Waivers from CSRM / 3x3x3 / NED for research and learning projects.
- Worry for USACE and local sponsors: Without increased flexibility on integrated FRM (surge, tidal, stormwater, groundwater, compound and SLR) and a mandate to include NNBFs or hybrid infra, USACE risks becoming a post-disaster response agency and not a pre-disaster mitigation agency in / for complex urban environments.

Thank you

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