Flooding Dynamic Modeling for Optimized Planning of CORE MPO Transportation Infrastructure Systems

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CORE MPO, TCC Meeting, Oct. 19, 2023

Presentation Outline

1. Financial Stewardship & Resiliency Planning
2. Sea Level Rise (SLR) Scenarios
3. Stormwater Modeling
4. Coastal Inundation Modeling & Roadway Vulnerability Assessment

Financial Stewardship & Resiliency Planning

Image credit: NOAA

Social Vulnerability Index

- Assess 16 variables associated with enhanced vulnerability to environmental threats

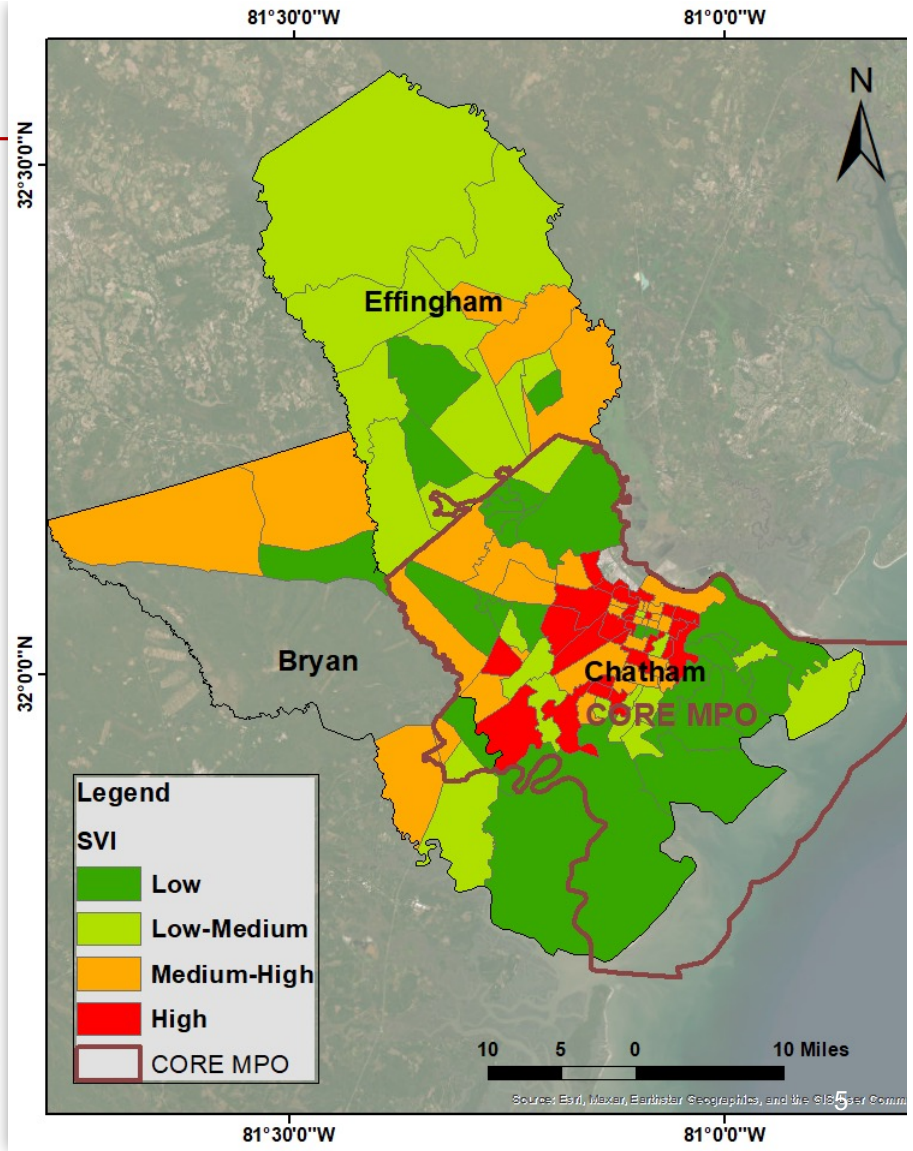
- Based on US Census Bureau data, compiled by the Centers for Disease Control (CDC ATSDR).

Table 1: CDC SoVI variables used. CDC utilizes data from the American Community Survey.

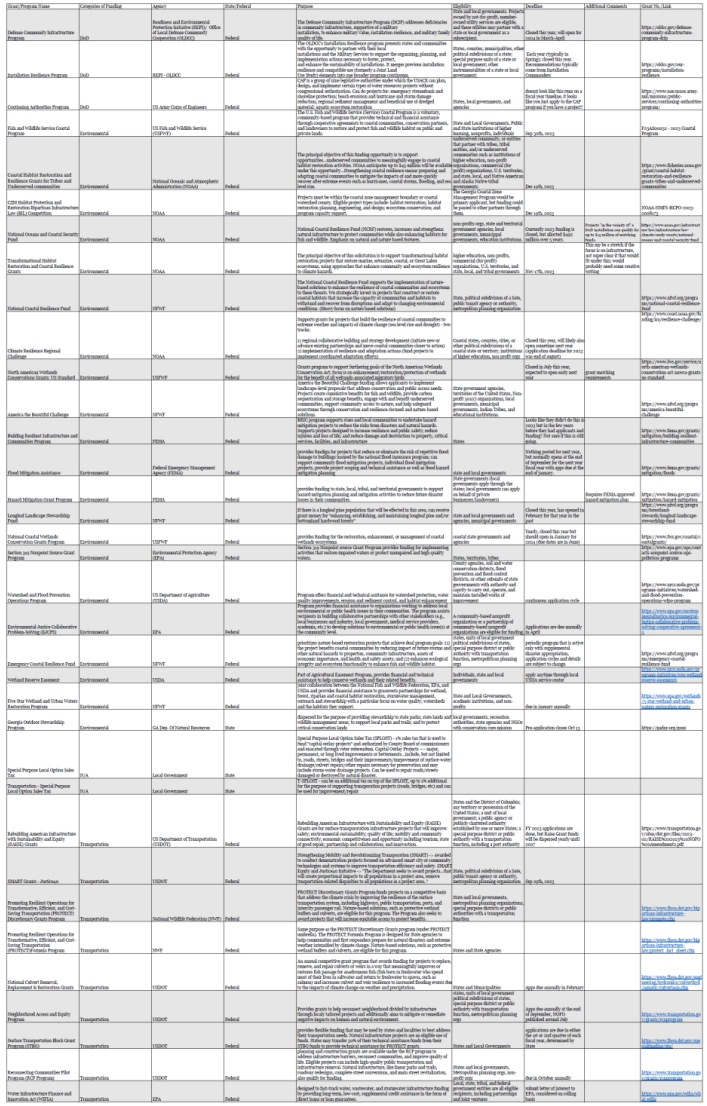
Socioeconomic Status	Below 150% Poverty
	Unemployed
	Housing Cost Burden
	No High School Diploma
	No Health Insurance
Household Characteristics	Aged 65 & Older
	Aged 17 & Younger
	Civilian with a Disability
	Single-Parent Household
	English Language Proficiency
Racial & Ethnic Minority Status	Hispanic or Latino (of any race) Black or African American, Not Hispanic or Latino Asian, Not Hispanic or Latino American Indian or Alaska Native, Not Hispanic or Latino Native Hawaiian or Pacific Islander, Not Hispanic or Latino Two or More Races, Not Hispanic or Latino Other Races, Not Hispanic or Latino
Housing Type & Transportation	Multi-Unit Structures
	Mobile Homes
	Crowding
	No Vehicle
	Group Quarters

Adapted from: https://www.atsdr.cdc.gov/placeandhealth/svi/documentation/pdf/SVI2020Documentation_08.05.22.pdf

SVI Map of the Project Area



Preparing a Technical Memo describing approx. **40 grant** funding opportunities to support improving resilience.



Grant/Program Name	Categories of Funding	Agency	State/Federal	Purpose	Eligibility	Deadline	Additional Comments	Grant To_Link
Defense Community Infrastructure Program	DoD	Readiness and Environmental Protection Initiative (REPI) - Office of Local Defense Community Cooperation (OLDCC)	Federal	The Defense Community Infrastructure Program (DCIP) addresses deficiencies in community infrastructure, supportive of a military installation, to enhance military value, installation resilience, and military family quality of life.	State and local governments. Projects owned by not-for-profit, member-owned utility services are eligible, and these utilities may partner with a state or local government as a subrecipient.	Closed this year, will open for 2024 in March-April.		https://oldcc.gov/defense-community-infrastructure-program-dcip
Installation Resilience Program	DoD	REPI - OLDCC	Federal	The OLDCC's installation Resilience program presents states and communities with the opportunity to partner with their local installations to protect the military mission. Projects support the organizing, planning, and implementation actions necessary to hone, protect, and enhance the sustainability of installations. It merges previous installation resilience and compatible use (formerly a Joint Land Use Study) category into one broader program contingent	States, counties, municipalities, other local governments, tribes, and special purpose units of a state or local government; other instrumentalities of a state or local government	Each year (typically in Spring), closed this year. Recommendations typically come from Installation Commanders		https://oldcc.gov/our-programs/installation-resilience
Continuing Authorities Program	DoD	US Army Corps of Engineers	Federal	The Continuing Authorities Program (CAP) authorizes the USACE can plan, design, and implement certain types of water resources projects without congressional authorization. Can do projects for: emergency streambank and shoreline protection, beach erosion and hurricane and storm damage reduction, regional sediment management and beneficial use of dredged material, aquatic ecosystem restoration	States, local governments, and agencies	doesnt look like this was on a fiscal year timeline, it looks like you just apply to the CAP program if you have a project		https://www.nan.usace.army.mil/missions/public-services/continuing-authorities-program/
Fish and Wildlife Service Coastal Program	Environmental	US Fish and Wildlife Service (USFWS)	Federal	The U.S. Fish and Wildlife Service (Service) Coastal Program is a voluntary, community-based program that provides technical and financial assistance for the restoration of coastal habitats primarily for the benefit of trust resources, and habitat needed to restore and protect fish and wildlife habitat on public and private lands.	State and Local Governments, Public and State institutions of higher learning, nonprofits, individuals	Sep 30th, 2023		Fycodocs23 - 2023 Coastal Program
Coastal Habitat Restoration and Resilience Grants for Tribes and Underserved communities	Environmental	National Oceanic and Atmospheric Administration (NOAA)	Federal	The principal objective of this funding opportunity is to support opportunities...underserved communities to meaningfully engage in coastal habitat restoration and resilience projects that will benefit them. To help build capacity under this opportunity...Strengthening coastal resilience means preparing and adapting coastal communities to mitigate the impacts of and more quickly recover after extreme events such as hurricanes, coastal storms, flooding, and sea level rise.	Tribal governments, institutions of higher education, non-profit organizations, U.S. territories, and state, local, and Native American and Alaska Native tribal governments	Dec 14th, 2023		https://www.fishwire.noaa.gov/grant/coastal-habitat-restoration-and-resilience-grants-tribes-and-underserved-communities
CZM Habitat Protection and Restoration Bipartisan Infrastructure Law (BIL) Competition	Environmental	NOAA	Federal	Projects must be within the coastal zone management boundary or coastal watershed county. Eligible project types include: habitat restoration; habitat restoration planning, engineering, and design; access conservation; and program capacity support.	The Georgia Coastal Zone Management Program would be primary applicant, but funding could be passed to other partners through them.	Dec 14th, 2023		NOAA-NMFS-HCPO-2023-2006172
National Oceans and Coastal Security Fund	Environmental	NOAA	Federal	National Coastal Resilience Fund (NCRF) restores, increases and strengthens habitats that improve resilience to coastal hazards, while providing additional fish and wildlife. Emphasis on natural and nature-based features.	non-profits orgs, state and territorial government agencies, local governments, federally recognized tribal governments, education institutions	Currently 2023 funding is closed, but NCRF has $160 million every 5 years.	Projects "in the vicinity of" a fresh waterbody can qualify for funding by a mile as the crow flies. This my be a stretch if the fresh waterbody is separated by a major river if that would fit under this, would probably need some creative writing	https://www.noaa.gov/inflation-reduction/how-to-apply-for-the-national-coastal-resilience-fund
Transformational Habitat Restoration and Coastal Resilience Grants	Environmental	NOAA	Federal	The principal objective of this solicitation is to support transformational habitat restoration projects that restore marine, estuarine, coastal, or Great Lakes ecosystems, using approaches that enhance community and ecosystem resilience to climate hazards.	higher education, non-profits, commercial (for-profit) organizations, U.S. territories, and state, local, and tribal governments	Nov 17th, 2023		
National Coastal Resilience Fund	Environmental	NFWF	Federal	The National Coastal Resilience Fund supports the implementation of nature-based solutions to enhance the resilience of coastal communities and ecosystems to the impacts of climate change. Projects that construct or restore coastal habitats that increase the capacity of communities and habitats to withstand and recover from disruptions and adapt to changing environmental conditions. (Heavy focus on nature-based solutions)	State, political subdivision of a late, public transit agency or authority, metropolitan planning organization			https://www.nfwf.org/programs/national-coastal-resilience-fund
Climate Resilience Regional Challenge	Environmental	NOAA	Federal	Supports grants for projects that build the resilience of coastal communities to extreme weather and impacts of climate change (sea level rise and drought) - two tracks: 1) regional collaborative building and strategy development (options new or strengthening partnerships and assessing communities closer to action) 2) implementation of resilience and adaptation actions (final projects to implement coordinated adaptation efforts)	Coastal states, counties, cities, or other political subdivisions of a coastal state or territory; institutions of higher education, non-profit orgs	Closed this year, will likely also open sometime next year (application deadline for 2023 was end of August)		https://www.fws.gov/service/15-north-american-wetlands-conservation-act-nawca-grants-us-standard
North American Wetlands Conservation Grants: US Standard	Environmental	USFWS	Federal	Grants program to support furthering goals of the North American Wetlands Conservation Act; focus is on enhancement/restoration/protection of wetlands for the benefit of all wetlands associated migratory birds	State government agencies, territories of the United States, Non-profit (501c) organizations, local governments, Federally recognized governments, Indian Tribes, and educational institutions		grant matching requirements	https://www.fws.gov/service/15-north-american-wetlands-conservation-act-nawca-grants-us-standard
America the Beautiful Challenge	Environmental	NFWF	Federal	America the Beautiful Challenge directs applicants to implement projects that increase the capacity of communities to meet their needs. Projects create cumulative benefits for fish and wildlife, provide carbon sequestration and storage benefits, engage with and benefit underserved communities, support community action to address and help reduce local uncertainty through conservation and resilience-focused and nature-based solutions				https://www.nfwf.org/programs/america-beautiful-challenge
Building Resilient Infrastructure and Communities Program	Environmental	FEMA	Federal	BRIC program supports State and local communities to make risk-based mitigation projects to reduce the risks from disasters and natural hazards. Projects must address current and future risks and reduce the risk to lives and loss of life, and reduce damage and destruction to property, critical services, facilities, and infrastructure	States	Looks like they didn't do this in 2023 but in the few years before it was in the Fall and funding? Not sure if this is still going.		https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities
Flood Mitigation Assistance	Environmental	Federal Emergency Management Agency (FEMA)	Federal	provides funding for projects that reduce or eliminate the risk of repetitive flood damage to buildings insured by the national flood insurance program; can support community flood mitigation projects, individual flood mitigation projects, provide project scoping and technical assistance as well as flood hazard mitigation planning	State and local governments	Nothing posted for next year, but normally opens at the end of September for the next year's fiscal year with apps due at the end of January.		https://www.fema.gov/grants/mitigation/floods
Hazard Mitigation Grant Program	Environmental	FEMA	Federal	provides funding to state, local, tribal, and territorial governments to support hazard mitigation planning and mitigation activities to reduce future disaster losses in their communities	State governments (local governments apply through the states; local governments can apply on behalf of private businesses/individuals)		Requires FEMA approved hazard mitigation plan	https://www.fema.gov/grants/mitigation/hazard-mitigation
Longleaf Landscape Stewardship Fund	Environmental	NFWF	Federal	If there is a longleaf pine population that will be reflected in this area, can receive grant money for "enhancing, establishing, and maintaining longleaf pine and/or agricultural hardwood forests"	State and local governments and agencies, municipal governments	Closed this year, has opened in February in the last year in the past		https://www.nfwf.org/programs/longleaf-landscape-stewardship-fund
National Coastal Wetlands Conservation Grants Program	Environmental	USFWS	Federal	provides funding for the restoration, enhancement, or management of coastal wetland ecosystems	coastal state governments and agencies	Yearly, closed this year but should open in January for 2024 (the data set is June)		https://www.fws.gov/coastal/grants
Section 319 Nonpoint Source Grant Program	Environmental	Environmental Protection Agency (EPA)	Federal	The Section 319 Nonpoint source Grant Program provides funding for implementing activities that reduce impaired waters of greater unimpaired and high quality waters.				https://www.epa.gov/nps/clean-water-nonpoint-source-pollution-program
Watershed and Flood Prevention Operations Program	Environmental	US Department of Agriculture (USDA)	Federal	Program offers financial and technical assistance for watershed protection, water supply conservation, and flood prevention; and, habitat enhancement, fish and wildlife habitat improvement, and wetland creation and restoration	States, territories, tribes, District agencies, soil and water conservation districts, flood prevention and flood control districts, or other subunits of state governments with the authority to carry out, operate, and maintain installed works of improvement	continuous application cycle		https://www.nrcs.usda.gov/programs-initiatives/watershed-and-flood-prevention-operations-wfpo-program
Environmental Justice Collaborative Problem-Solving (EJCPS)	Environmental	EPA	Federal	The EJCPS cooperative agreement program provides recipients with the resources to address environmental or public health issue(s) in the community. The program assists recipients in building collaborative partnerships with other stakeholders (e.g., local businesses and industry, local government, medical service providers, etc.) that can help develop solutions to environmental or public health issue(s) in the community.	A community-based nonprofit organization or a partnership of community-based nonprofit organizations are eligible for funding.	Applications are due annually in April		https://www.epa.gov/environmentaljustice/environmental-justice-collaborative-problem-solving-cooperative-agreement
Emergency Coastal Resilience Fund	Environmental	NFWF	Federal	prioritizes nature-based restoration projects that achieve dual program goals: (1) the project benefits coastal communities by reducing impacts of extreme storms and other coastal hazards, and (2) the project restores habitats of ecological, economic importance, and health and safety assets; and (3) enhances ecological integrity and ecosystem functionality to enhance fish and wildlife habitat.	political subdivisions of states, special purpose district or public authority with a transportation function, metropolitan planning orgs	periodic program that is active only with supplemental appropriations; application criteria and details are subject to change.		https://www.nfwf.org/programs/emergency-coastal-resilience-fund
Wetland Reserve Easement	Environmental	USDA	Federal	Part of agricultural Easement Program, provides financial and technical assistance to help conserve wetlands and their related benefits	Individuals, state and local governments	apply anytime through local USDA service center		https://www.nrcs.usda.gov/programs-initiatives/wre-wetland-reserve-easements
Five Star Wetland and Urban Waters Restoration Program	Environmental	NFWF	Federal	NFWF collaboration between the National Fish and Wildlife Foundation, EPA, and USDA and provides financial assistance to grassroots partnerships for wetland, stream, and riparian habitat restoration projects that build community capacity, outreach and stewardship with a particular focus on water quality, watersheds and the habitats they support.	State and Local Governments, academic institutions, and non-profits	due in January annually		https://www.epa.gov/wetlands/five-star-wetland-and-urban-waters-restoration-grant
Georgia Outdoor Stewardship Program	Environmental	GA Dep. Of Natural Resources	State	Approved for the purpose of providing stewardship to state parks; state lands and wildlife management areas; to support local parks and trail; and to protect critical conservation lands	local governments, recreation authorities, state agencies and NGOs with conservation core mission	Pre-application closes Oct 15		https://gadnr.org/gosp
Special Purpose Local Option Sales Tax	N/A	Local Government	State	Special Purpose Local Option Sales Tax (SPLOST) - (% sales tax that is used to fund "capital outlay projects" and authorized by County Board of commissioners and enacted through voter referendum. Capital Outlay Projects ---- major, nonrecurring, tangible, physical improvements or additions to real property, such as roads, streets, bridges and those improvements necessary for the preservation of surface water drainage, culvert repair and replacement, recreational facilities and other items which include storm water drainage projects. Can be used to repair roads/streets damaged or destroyed by natural disaster				
Transportation - Special Purpose Local Option Sales Tax	N/A	Local Government	State	Transportation - Special Purpose Local Option Sales Tax (TSPLOST) - up to 1% additional tax for the purpose of supporting transportation projects (roads, bridges, etc) and can be used for improvement/repair				
Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Grants	Transportation	US Department of Transportation (USDOT)	Federal	Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Grants are for surface transportation infrastructure projects that will improve safety; environmental sustainability; quality of life; mobility and community connectivity; economic competitiveness and opportunity including tourism; state of good repair; partnership and collaboration; and innovation.	States and the District of Columbia; any territory or possession of the United States; a unit of local government; a public agency or authority; a tribal government; a group of two or more States or special purpose district or public authority with a transportation function, including a port authority	FY 2023 applications are done, but Raise Grant funds will be disposed yearly until 2027		https://www.transportation.gov/sites/dot.gov/files/2023-01/RAISENOFO%20Announcement.pdf
SMART Grants - Pathway	Transportation	USDOT	Federal	Strengthening Mobility and Revolutionizing Transportation (SMART) — awarded to conduct demonstration projects focused on advanced smart city or community technologies and systems to improve transportation efficiency and safety. Equity and Justice40 Initiative — The Department seeks to award projects...that will create proportional impacts to all populations in a project area, remove transportation-related disparities to all populations in a project area.	State, political subdivision of a late, public transit agency or authority, metropolitan planning organization	Sep 19th, 2023		
Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Discretionary Grant Program	Transportation	National Wildlife Federation (NWF)	Federal	PROTECT Discretionary Grants Program funds projects on a competitive basis that address the climate crisis by improving the resilience of the surface transportation system, including highways, public transportation, ports, and intercity passenger rail. States, territories, tribes, metropolitan planning orgs, federal land managers, and others, are eligible for this program. The Program also seeks to award projects that will increase equitable access to project benefits.	State and local governments, metropolitan planning organizations, special purpose districts or public authorities with a transportation function			https://www.fhwa.dot.gov/bipartisan-infrastructure-law/protect_fact_sheet.cfm
Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Formula Program	Transportation	NWF	Federal	Same purpose as the PROTECT Discretionary Grants program (under PROTECT Act) - to help States, MPOs, and Tribes improve the resilience of the surface transportation and first responders prepare for natural disasters and extreme weather intensified by climate change. Nature-based solutions, such as protective wetland buffers and culverts, are eligible for this program.	States and State Agencies			https://www.fhwa.dot.gov/bipartisan-infrastructure-law/protect_fact_sheet.cfm
National Culvert Removal, Replacement & Restoration Grants	Transportation	USDOT	Federal	An annual competitive grant program that awards funding for projects to replace, remove, and repair culverts or weirs in a way that meaningfully improves or restores fish passage for anadromous fish (fish born in freshwater who spend most of their lives in saltwater before returning to freshwater to spawn, like salmon) and increases culvert and weir resilience to the road flooding events due to the impacts of climate change on weather and precipitation.	States and Municipalities	Apps due annually in February		https://www.fhwa.dot.gov/bipartisan-infrastructure-law/national_culvert_removal_restoration.cfm
Neighborhood Access and Equity Program	Transportation	USDOT	Federal	Provides grants to help reconnect neighborhood divided by infrastructure through locally tailored projects and additionally aims to mitigate or remediate negative impacts on human and natural environment.	States, and local governments, public authorities or public authority with transportation function, metropolitan planning orgs	Apps due annually at the end of September; NOFO published around July		https://www.transportation.gov/grants/naap/grant-info
Active Transportation Stock Grant Program (ATSG)	Transportation	USDOT	Federal	provides flexible funding that may be used by states and localities to best address their transportation needs. Federal infrastructure projects are an eligible use of funds. States may transfer 50% of their technical assistance funds from their State Planning and Research program funds to the ATSG	States and Local Governments	applications are due in either the 1st or 2nd quarter of each fiscal year, determined by DOT		https://www.fhwa.dot.gov/innovation/atsg/
Reconnecting Communities Pilot Program (RCP Program)	Transportation	USDOT	Federal	planning and construction grants are available under the RCP program to address infrastructure barriers, reconnect communities, and improve quality of life. Eligible projects include removing, retrofitting, or mitigating an infrastructure barrier. Natural infrastructure, like lower parks and trails, roadway redesigns, complete street conversions, and main street revitalization, are eligible for funding.	States and local governments, Metropolitan planning orgs, non-profit orgs	due in October annually		https://www.transportation.gov/grants/reconnecting-communities
Water Infrastructure Finance and Innovation Act (WIFIA)	Transportation	EPA	Federal	designed to fast-track water, wastewater, and stormwater infrastructure funding by providing long-term, low-cost, supplemental credit assistance in the form of direct loans or loan guarantees.	Local, state, tribal, and federal governments are all eligible recipients, including partnerships and joint ventures	submit letter of interest to EPA, considered on rolling basis		https://www.epa.gov/wifia/wifia-fact-sheet

Sea Level Rise Scenarios

Year	CRD Low (ft)	CRD High (ft)
2050	1.23	2.18
2075	2.14	4.08
2100	3.28	6.56

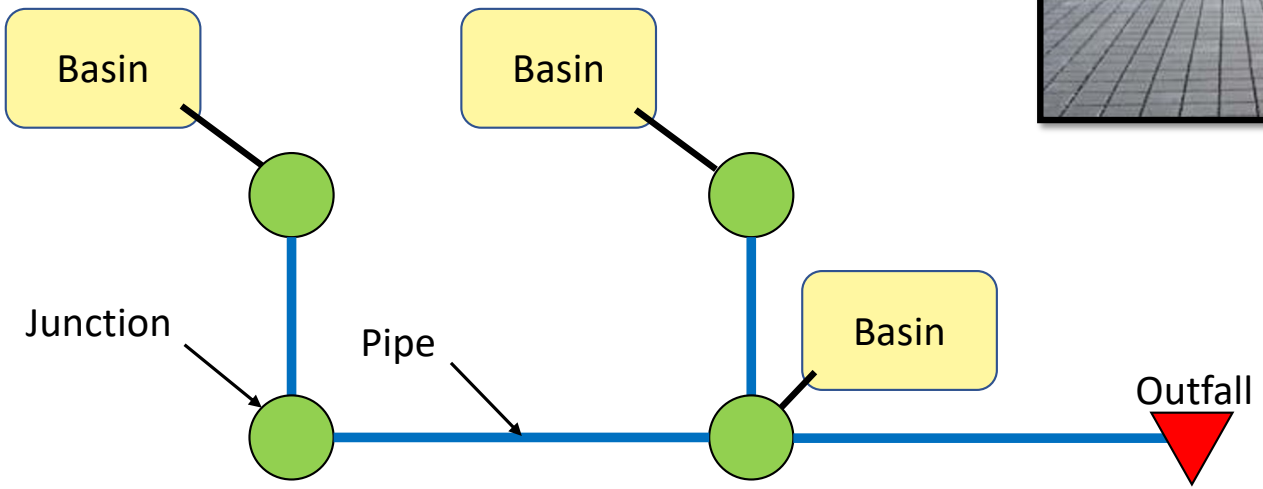
SLR scenarios were obtained from the Chatham County Stormwater System Sea-Level-Rise Vulnerability Assessment (2020)

Stormwater Modeling

Image Source: City of Savannah
Midtown Savannah (6/20/18)

SWMM (Stormwater Management Model)

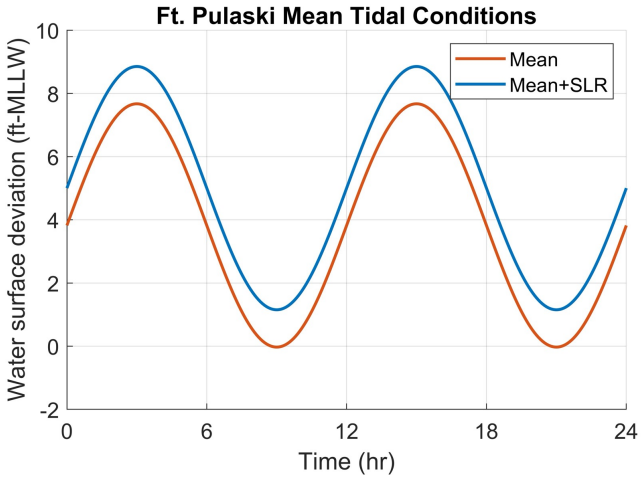
- Simulate runoff quantity & quality
- Good for small homogeneous sub-basins
- Rainfall on a basin → Runoff → Pipe network → Routed to the outfall

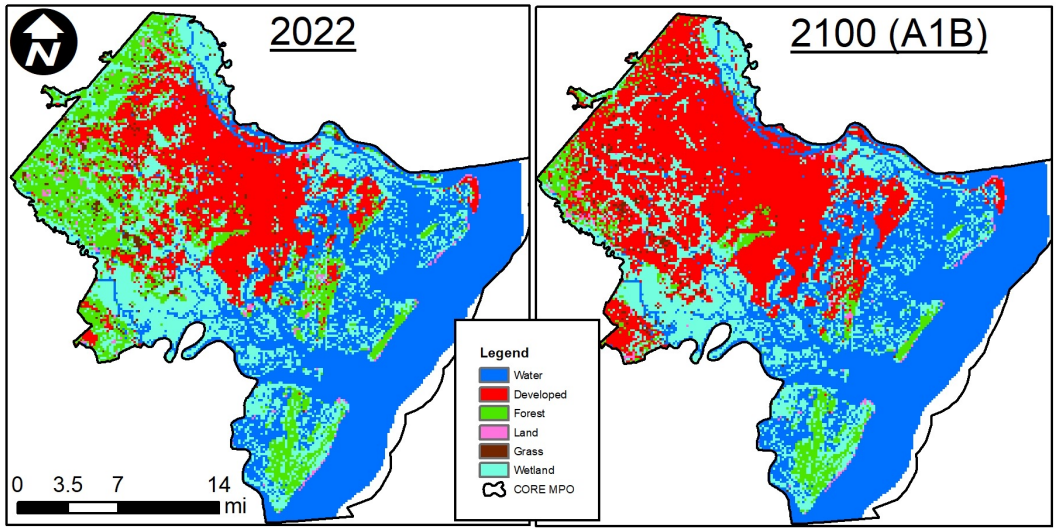


https://www.epa.gov/water-research/storm-water-management-model-swmm

SWMM Application

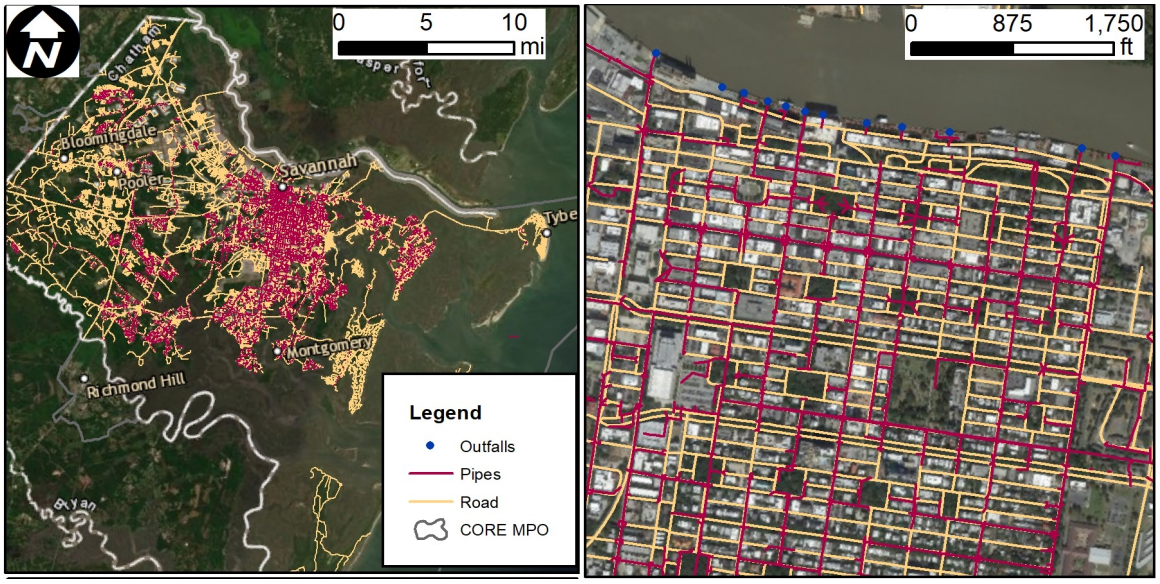
- Assess current vs future conditions
  - How might SLR creep upstream into the stormwater system?
  - How might future land use alter runoff and discharge?
- Develop a toolset to examine stormwater impacts to transportation infrastructure





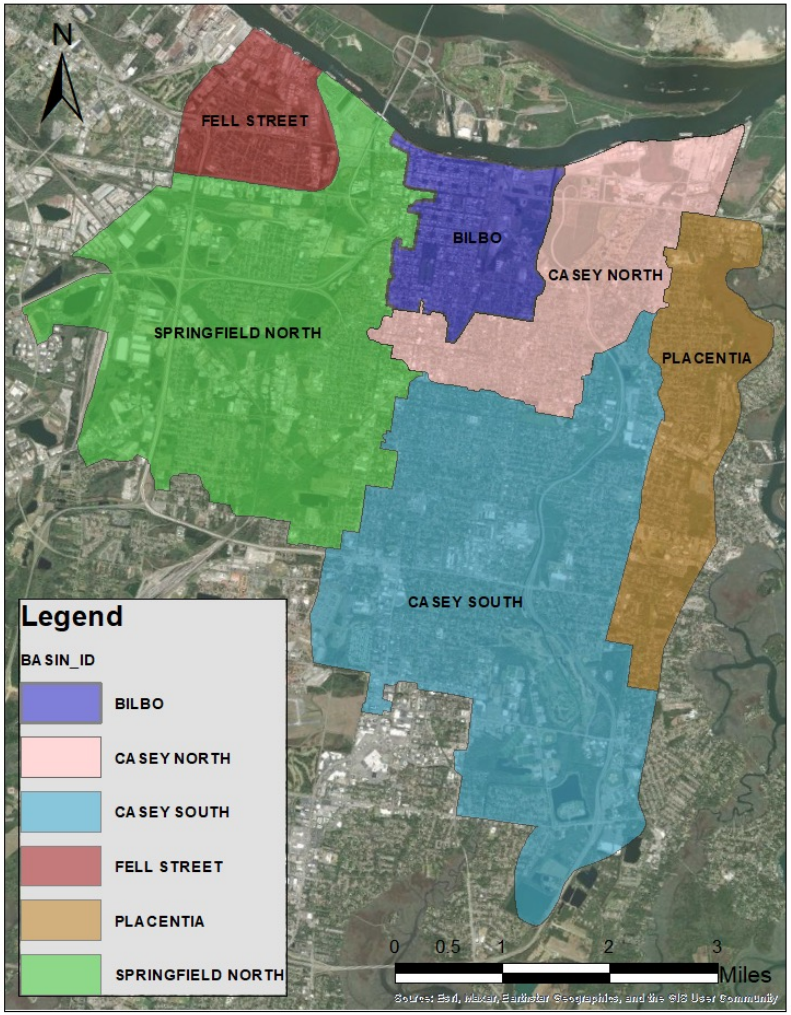
Data Collection

- Stormwater infrastructure
  - Outfalls, canals, ditches, pipes, reservoirs, pump stations, tide gates, headwalls, manholes, green infrastructure, etc.
  - Stormwater drainage basins
- Road centerlines
- Land use / land cover
- Soil types



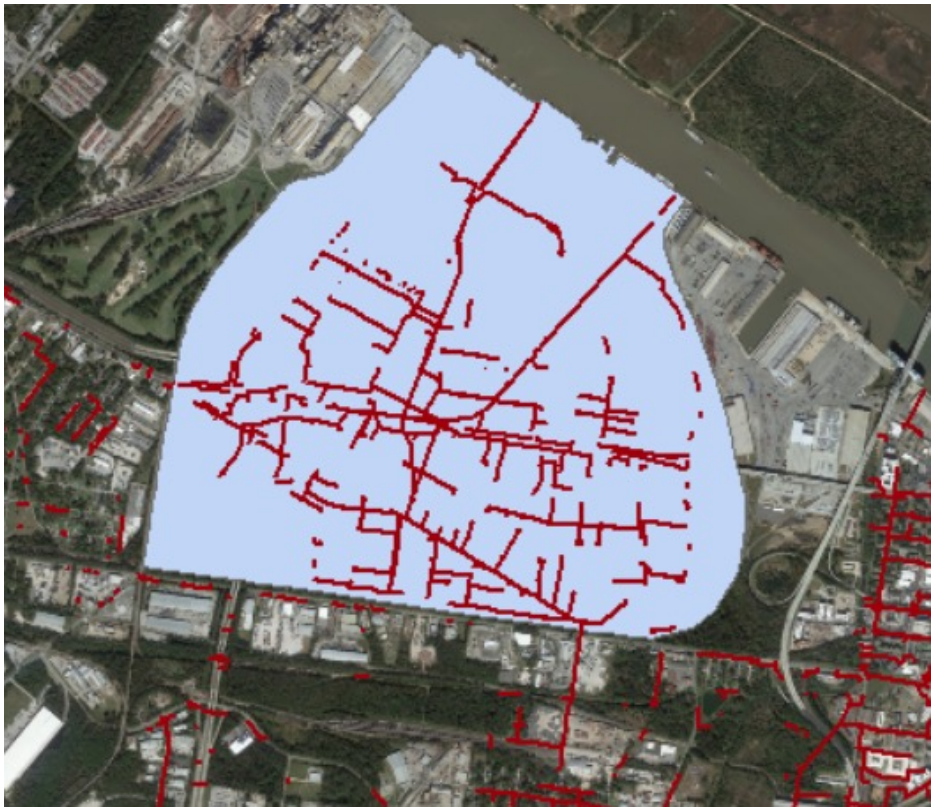
Study Domain

- Considerations:
  - enough stormwater infrastructure data
  - Direct connection to Savannah River or tidal creek
- Opportunity to expand to the entire county
  - Employ a more robust model



Fell Street Basin

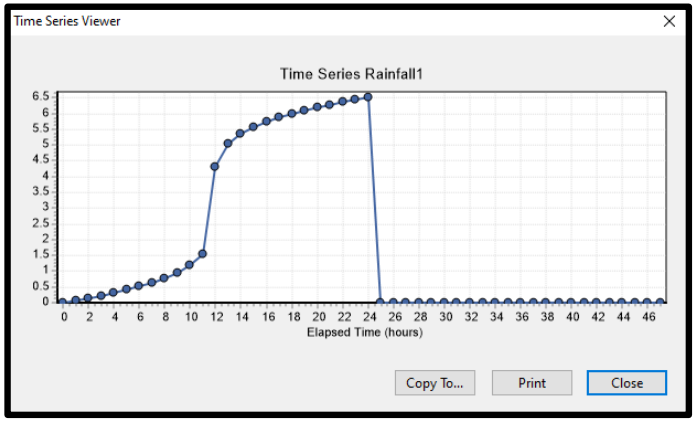
Stormwater Network

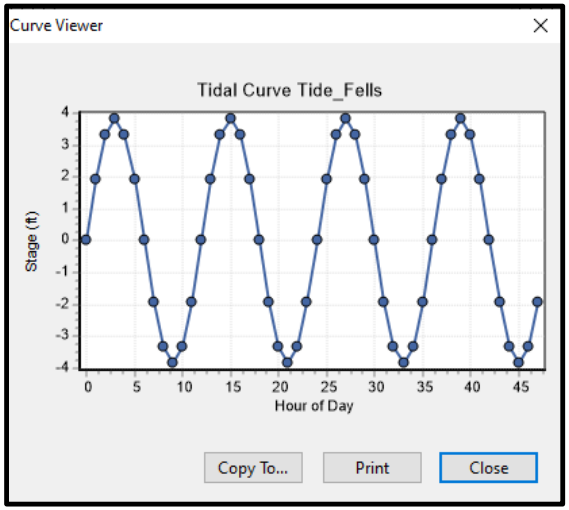


Simplification

Fell Street Basin

- Basin Information
  - 15 sub-catchments
  - 64 junction nodes
  - 2 outfalls
  - Curve numbers: 88-94
- Model Forcing
  - Type 2 cumulative rainfall 24-hr (6.51 in depth, T_R = 10-yr)
  - Mean tidal conditions
  - Various sea-level rise projections
- Flooding scenarios:
  - Rainfall only
  - Tidal (w/wo SLR)
  - Rainfall + Tidal = Compound event





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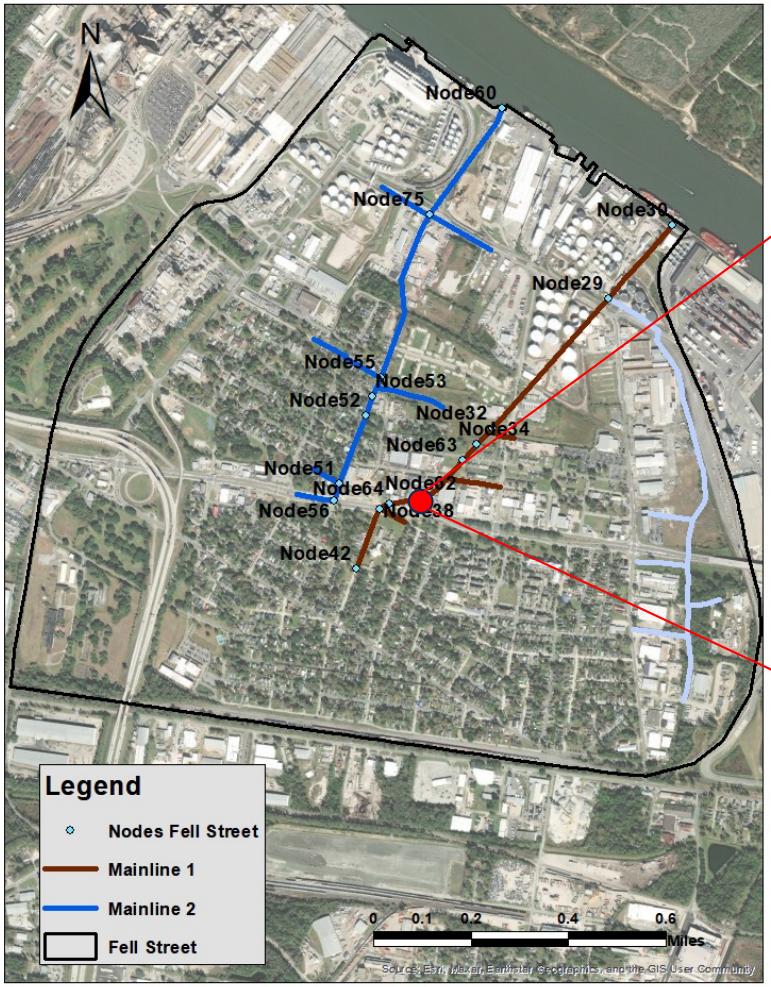

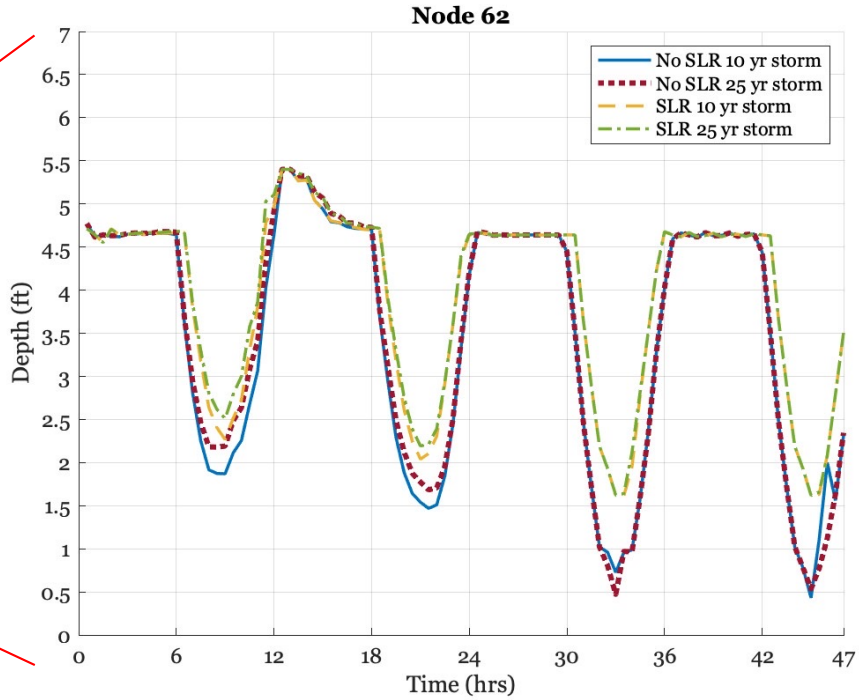

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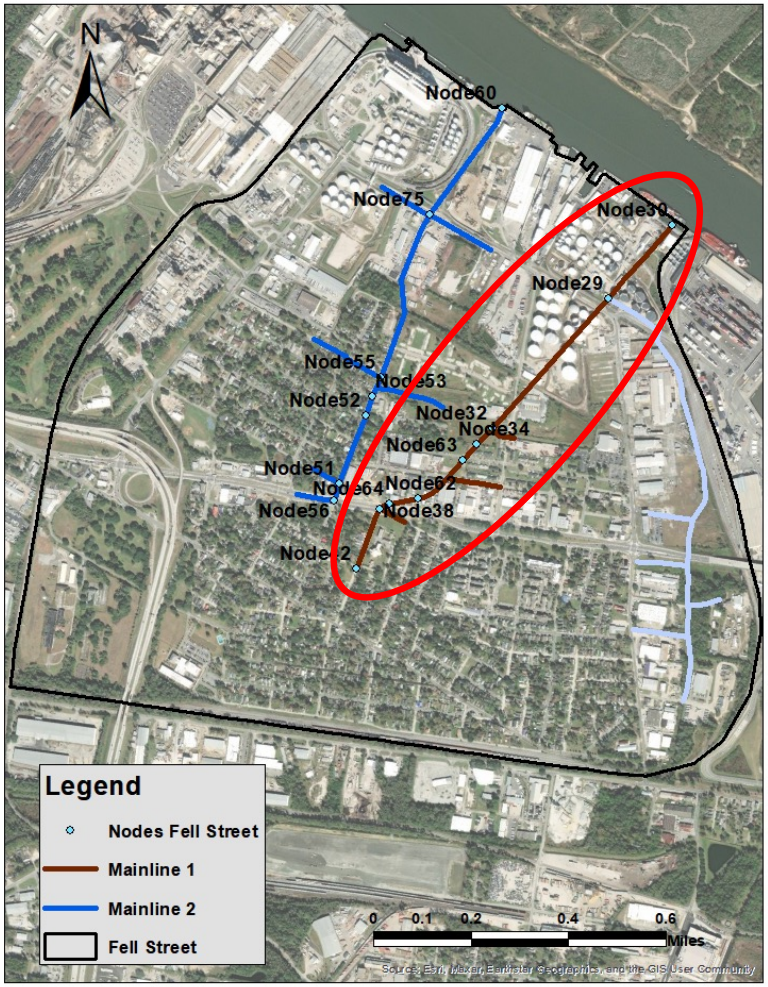
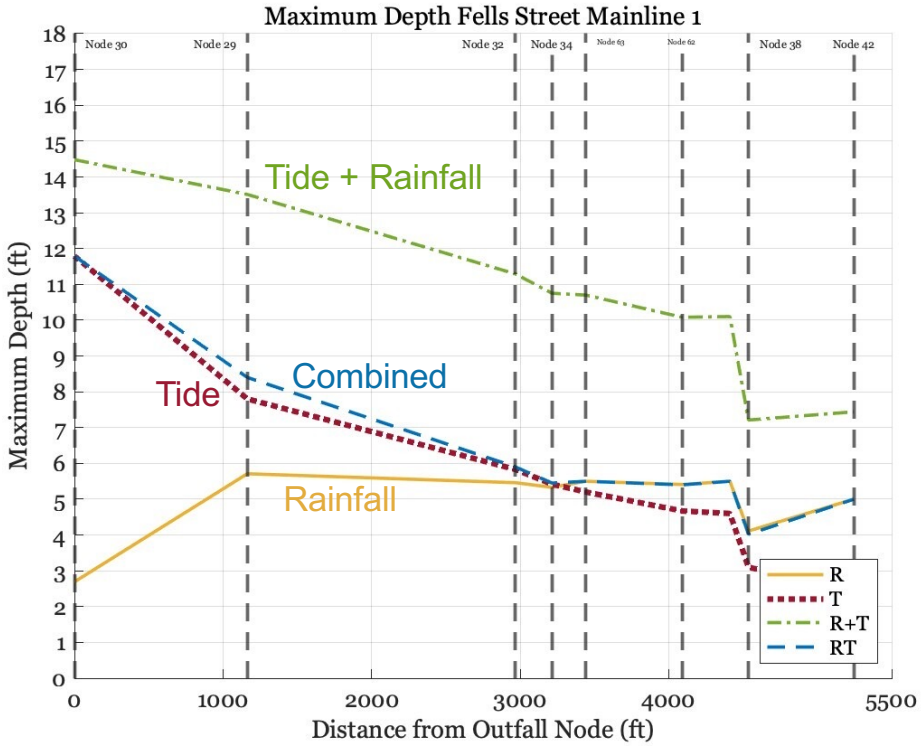
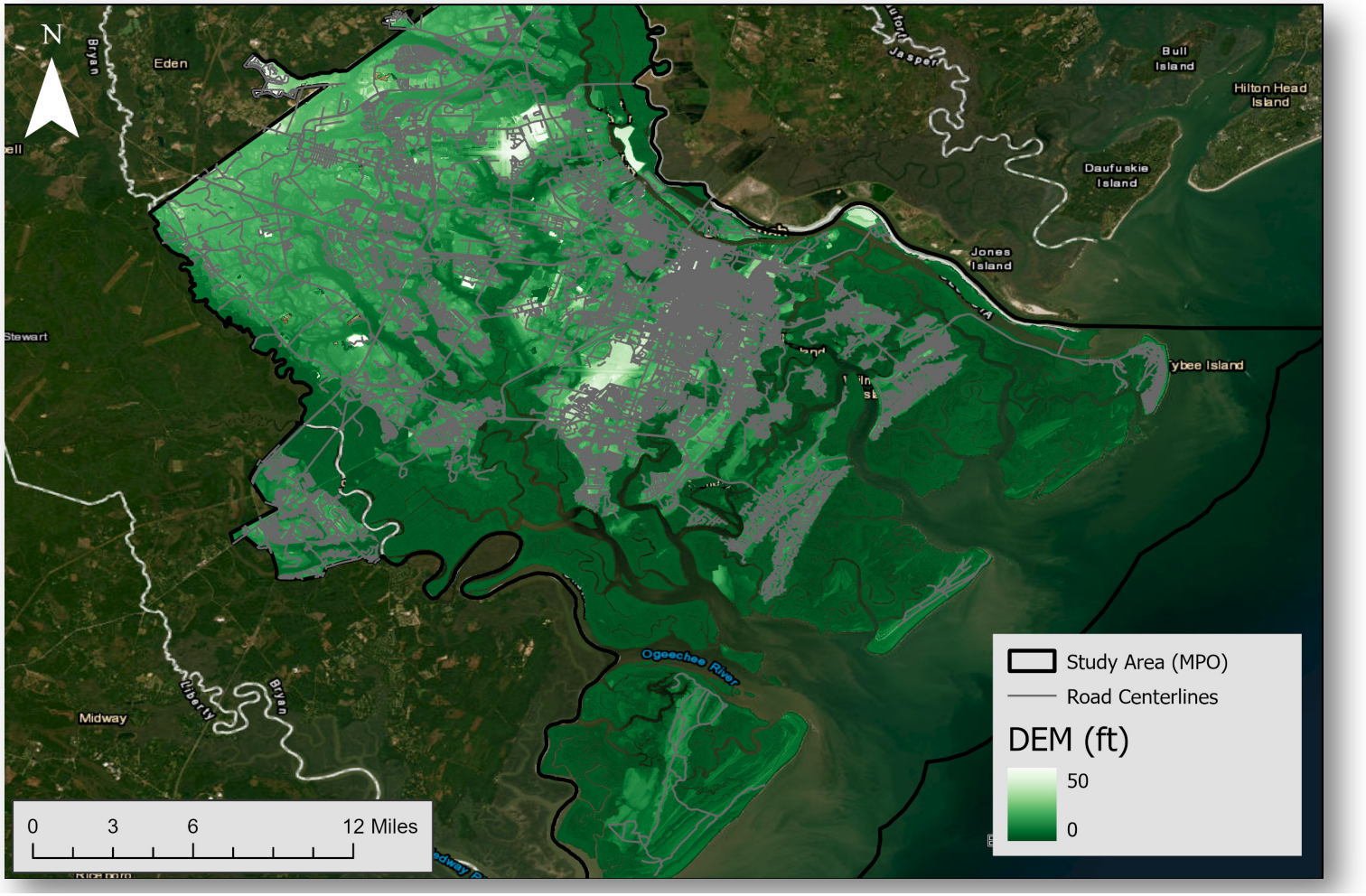




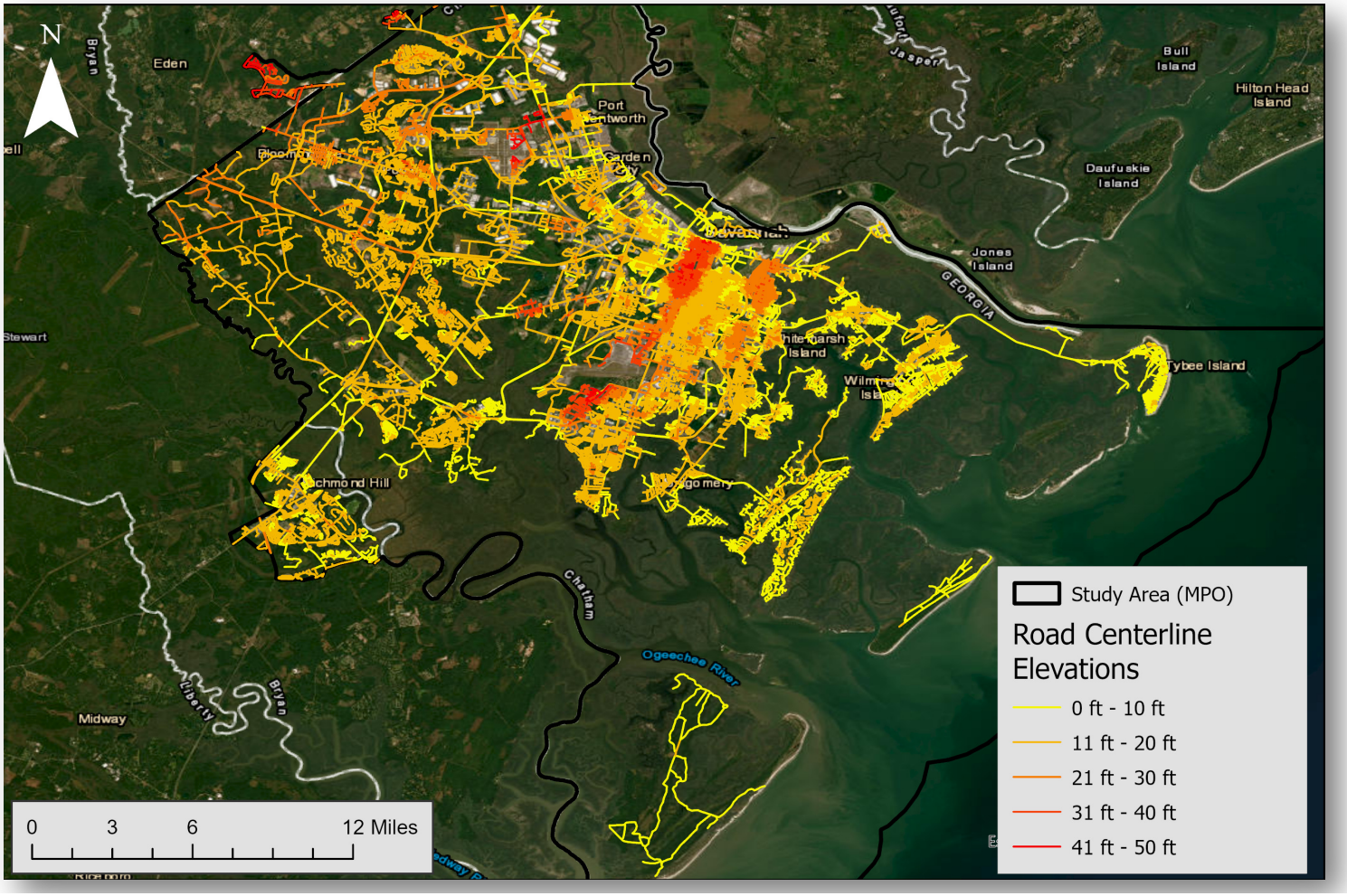
10-yr rainfall event + mean tides + SLR

Coastal Flood Modeling and Roadway Vulnerability

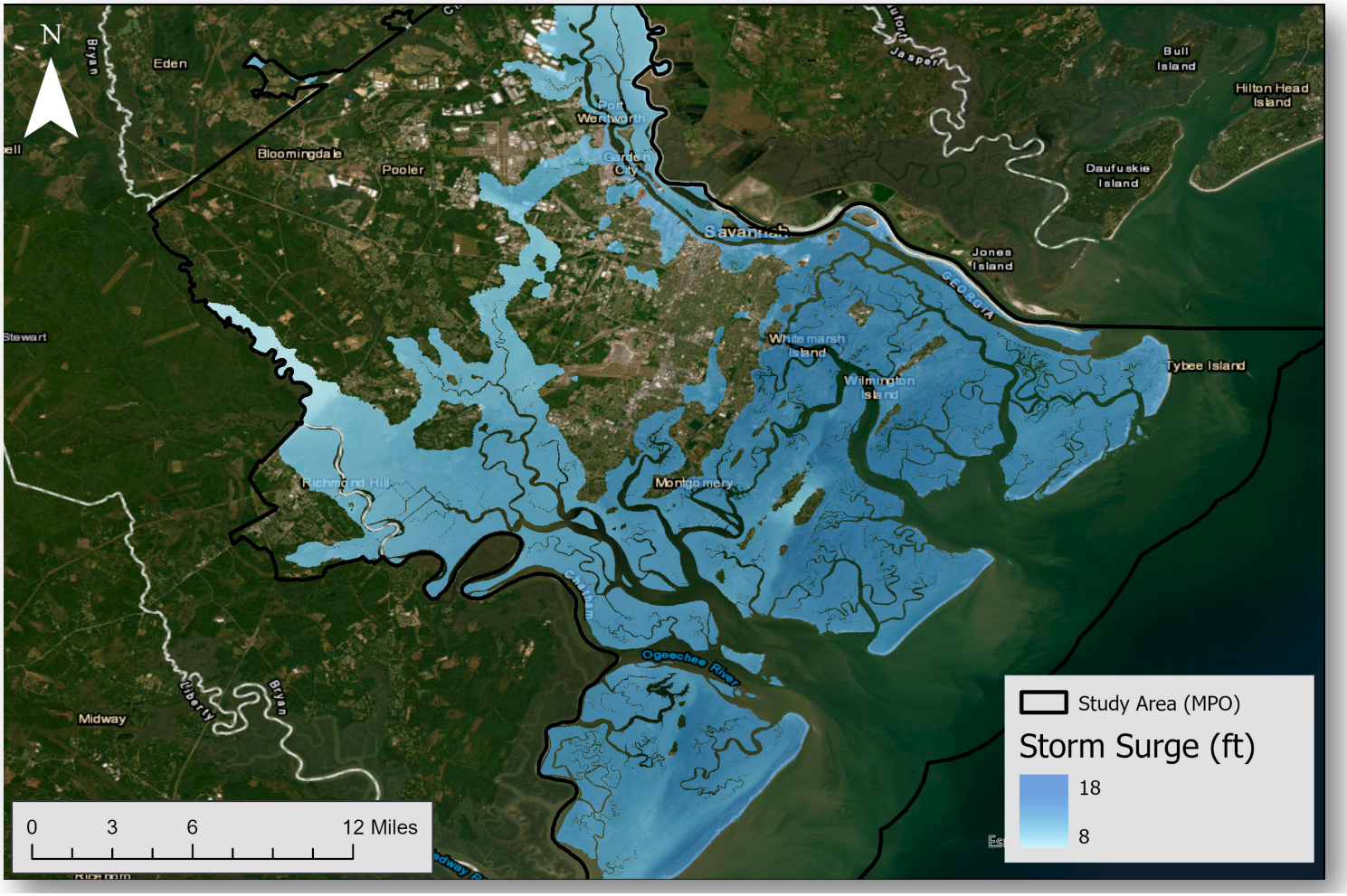
DEM & Road Network (Elevation NAVD88, ft)



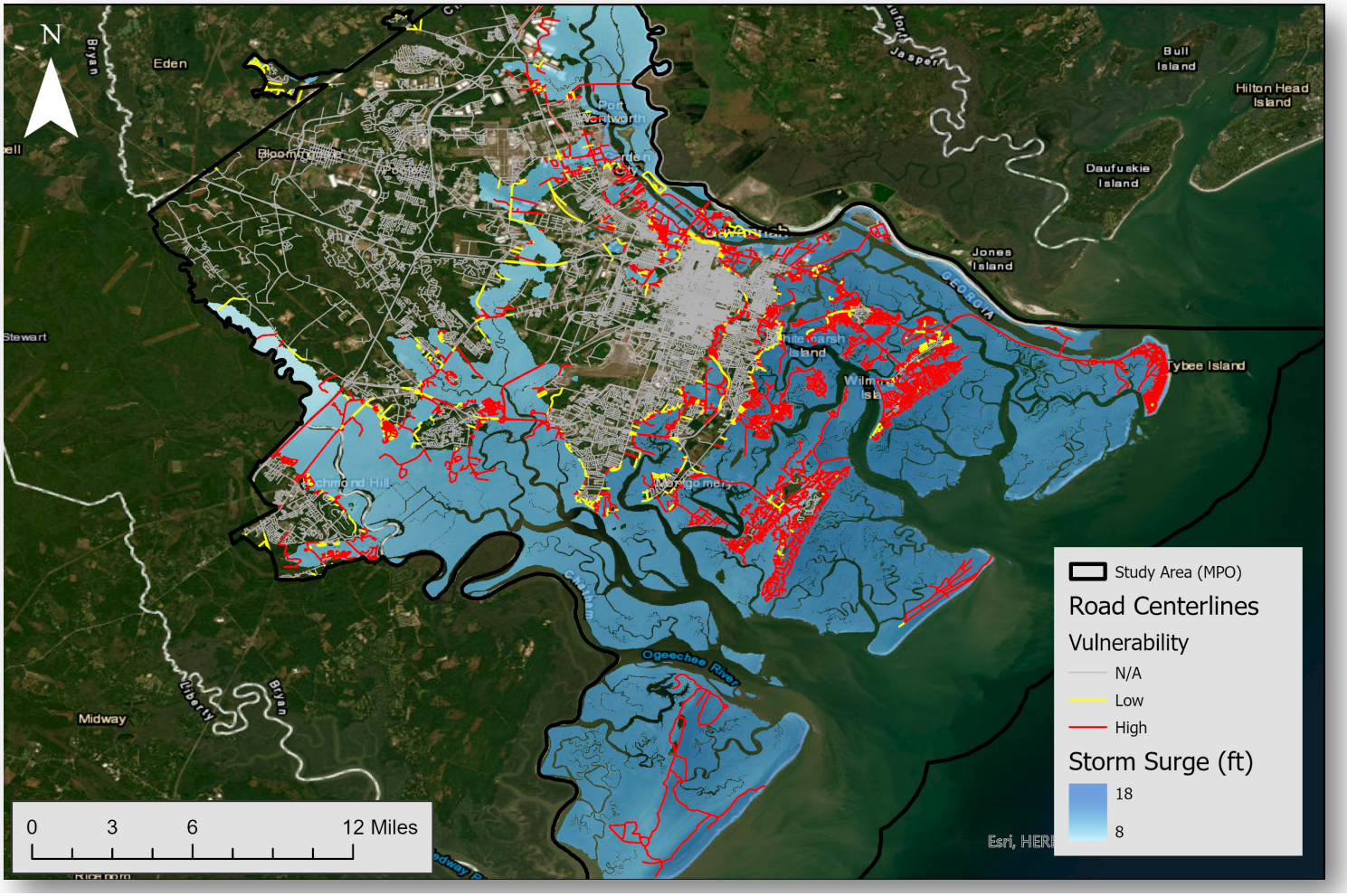
Road Network (Elevation NAVD88, ft)



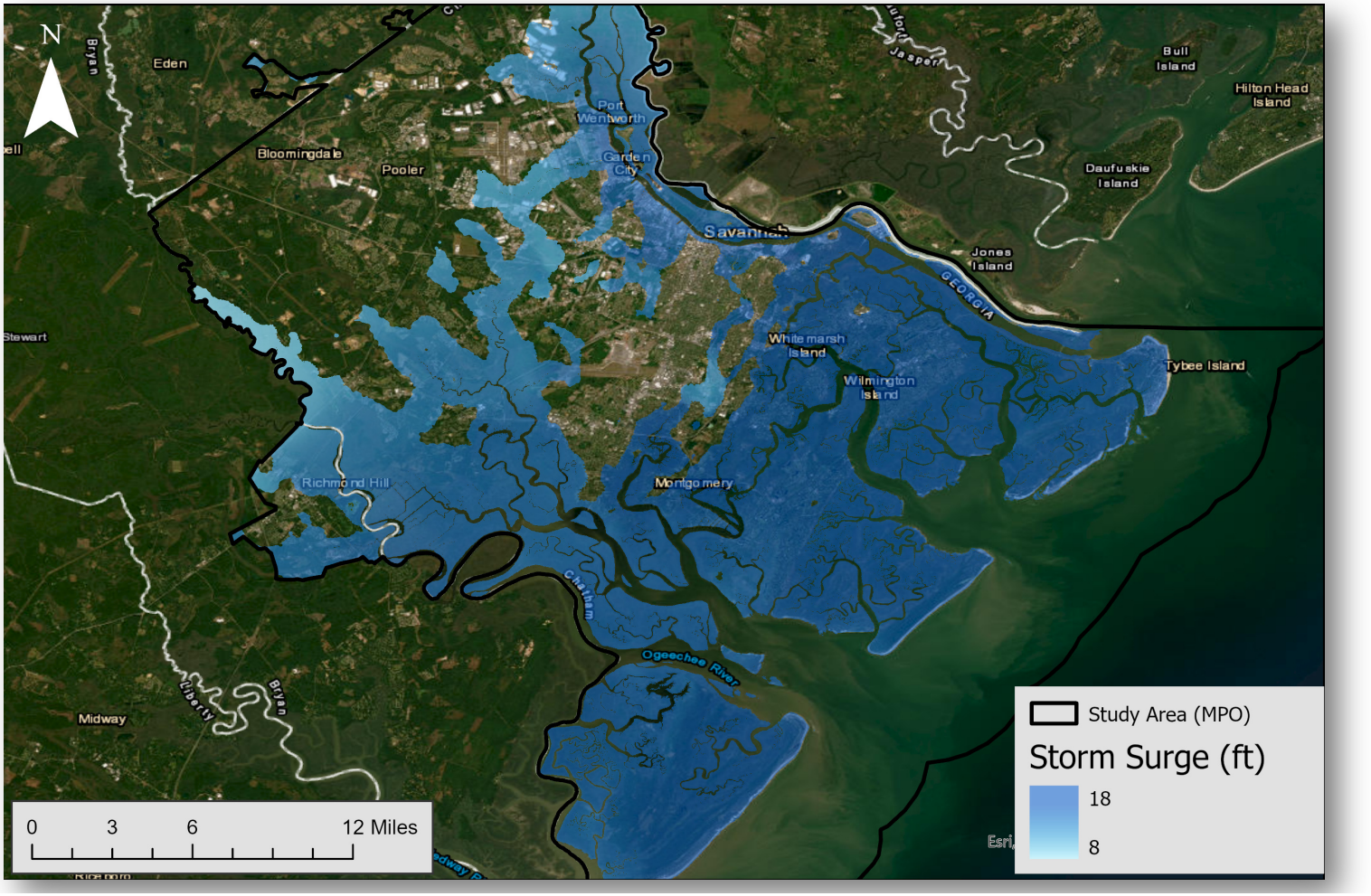
1% AEP Simulated Water Levels (NAVD88, ft)



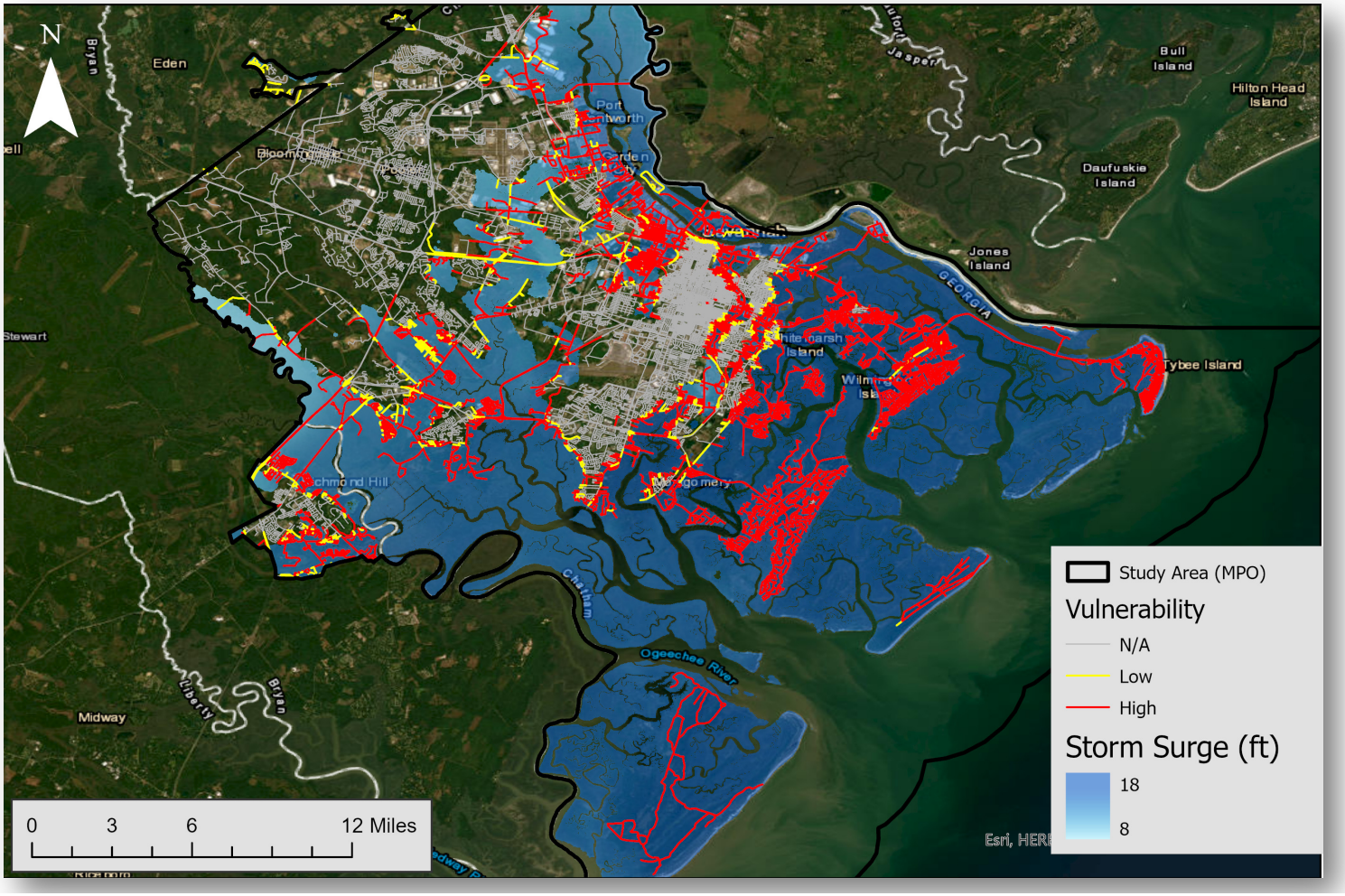
Roadway Vulnerability – 1% AEP (770 miles)



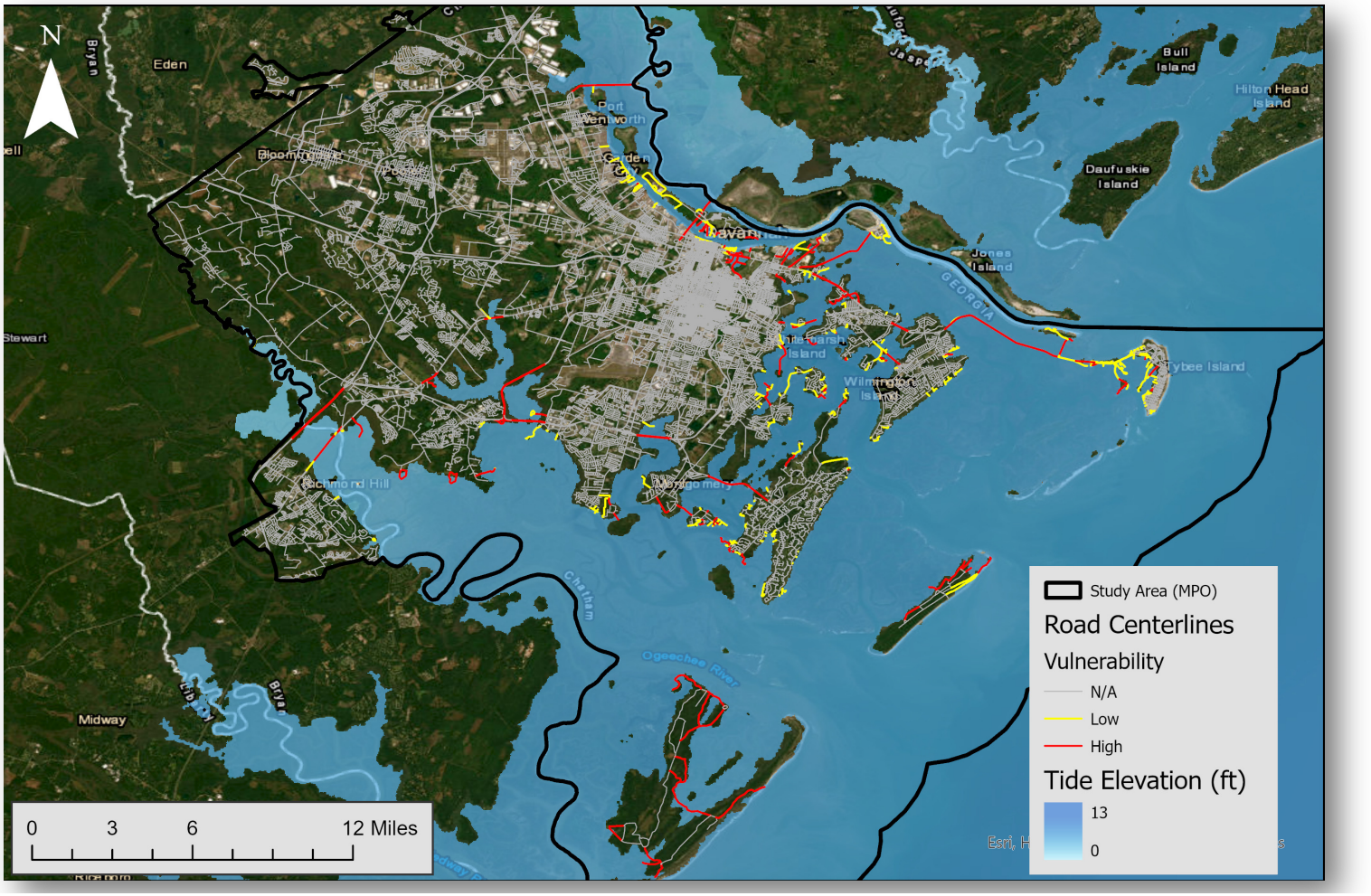
0.2% AEP Simulated Water Levels (NAVD88, ft)



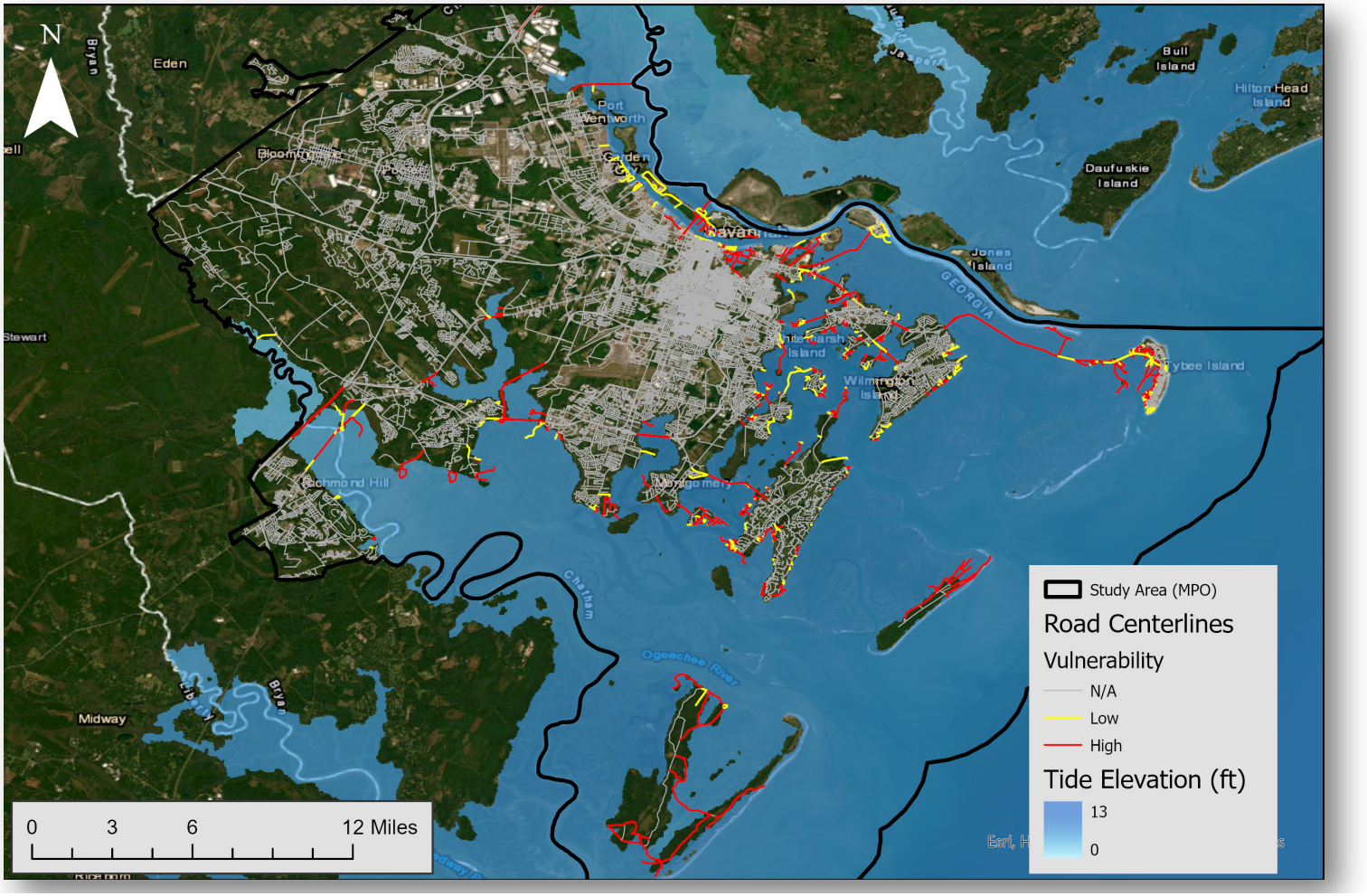
Roadway Vulnerability – 0.2% AEP (1,119 miles)



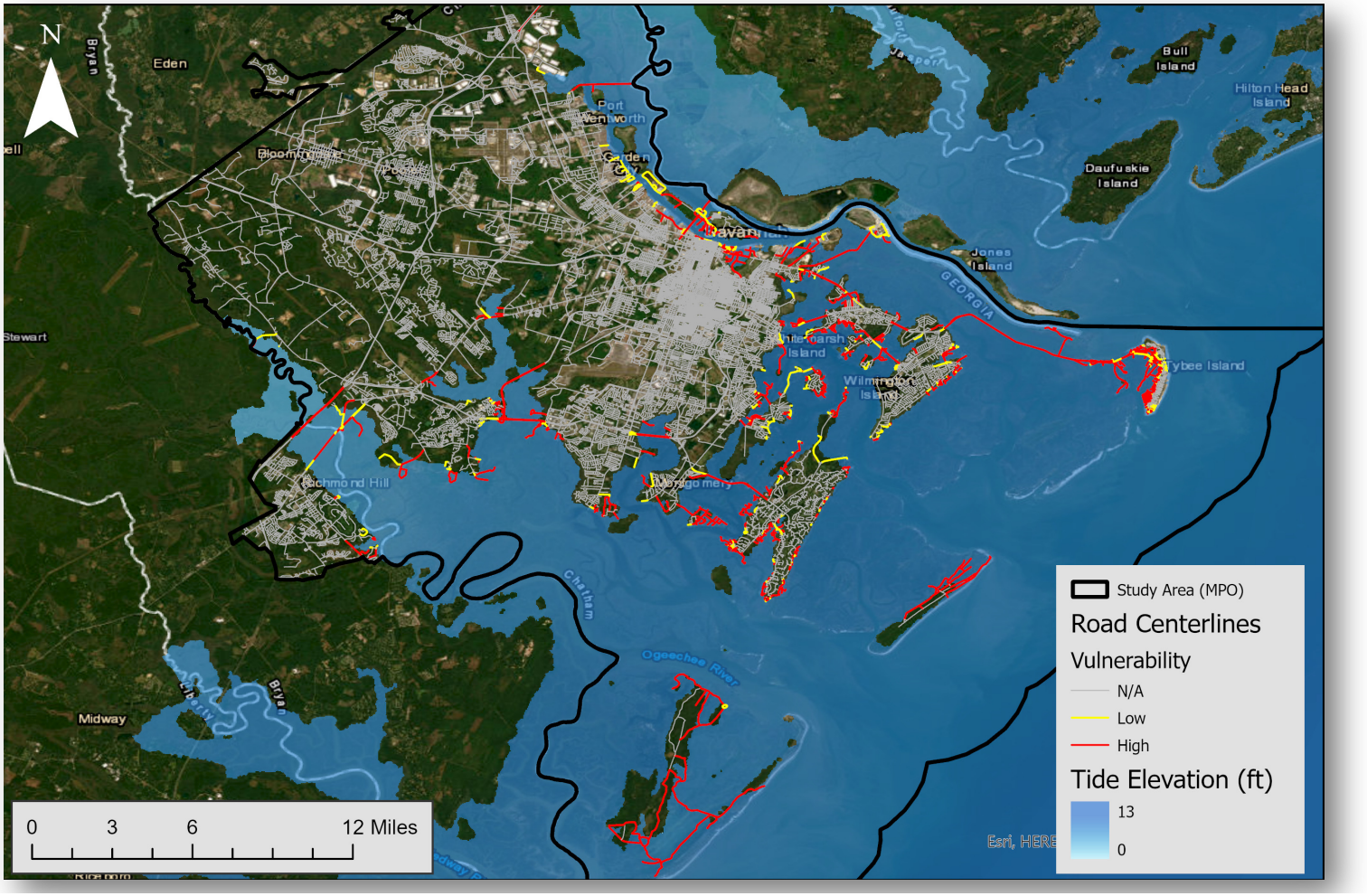
Roadway Vulnerability – Present Tides (154 miles)



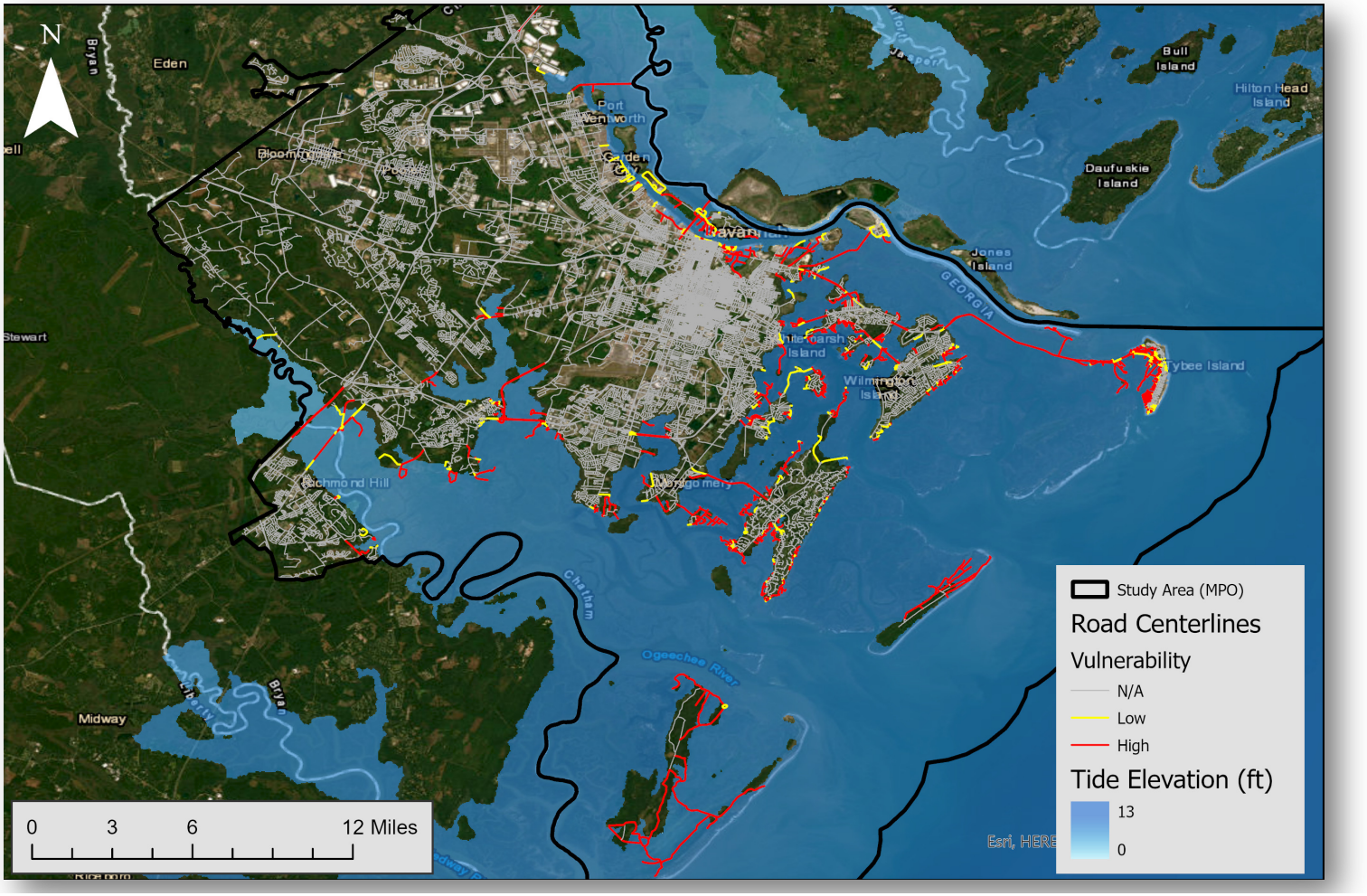
Roadway Vulnerability - CRD Low 2050 (1.23 ft, 213 miles)



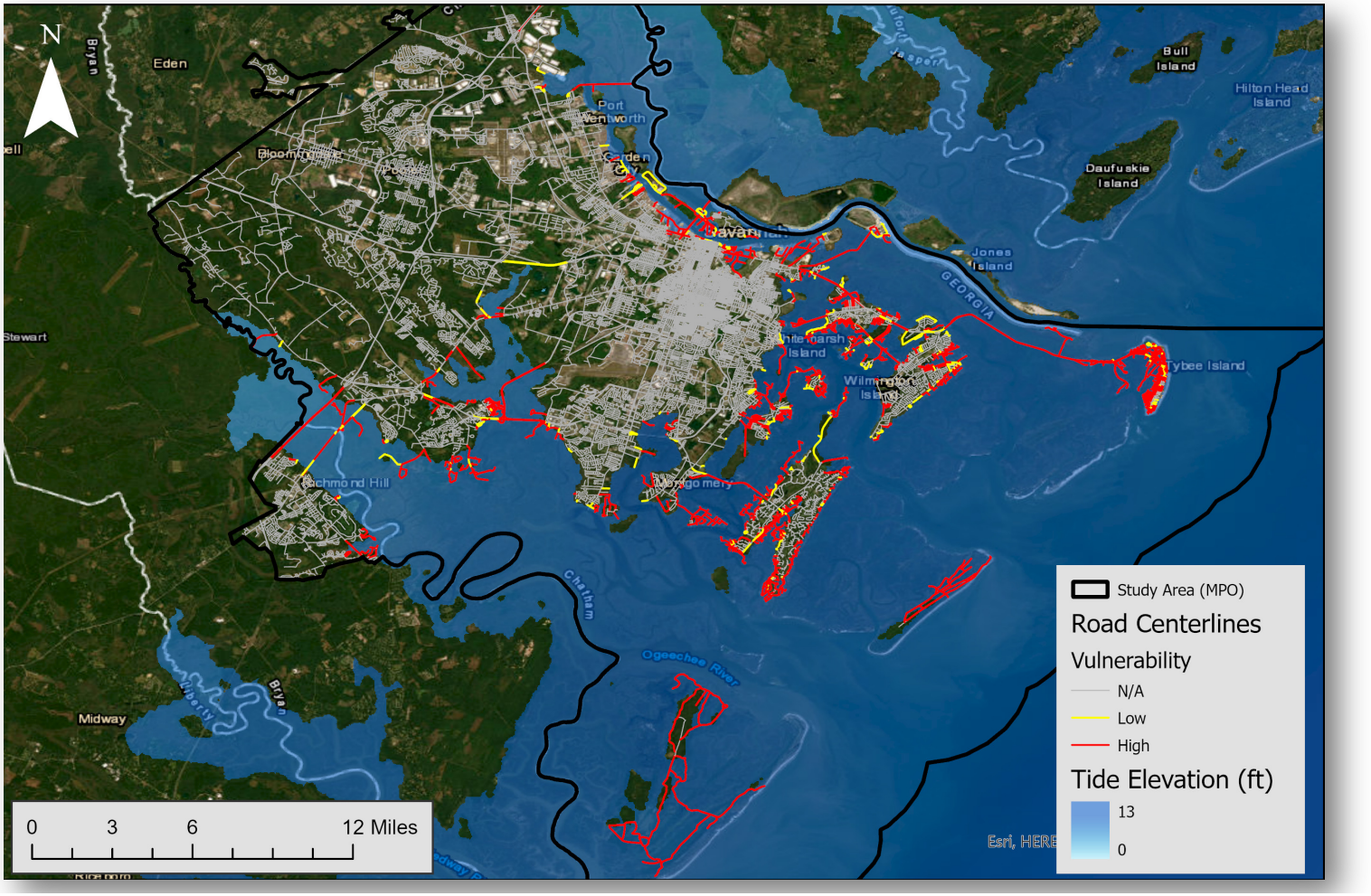
Roadway Vulnerability – CRD High 2050 (2.18 ft, 258 miles)



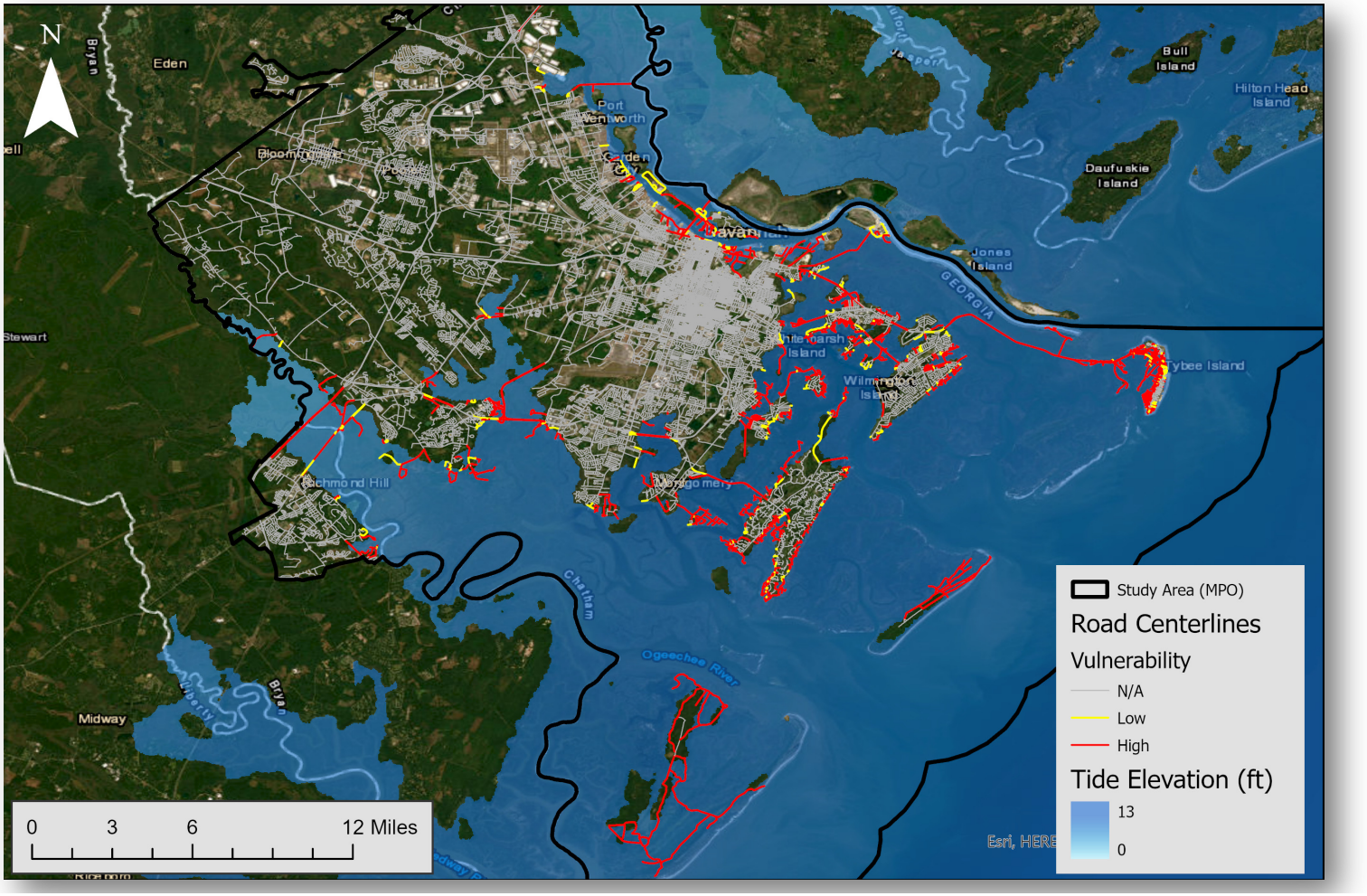
Roadway Vulnerability – CRD Low 2075 (2.14 ft, 256 miles)



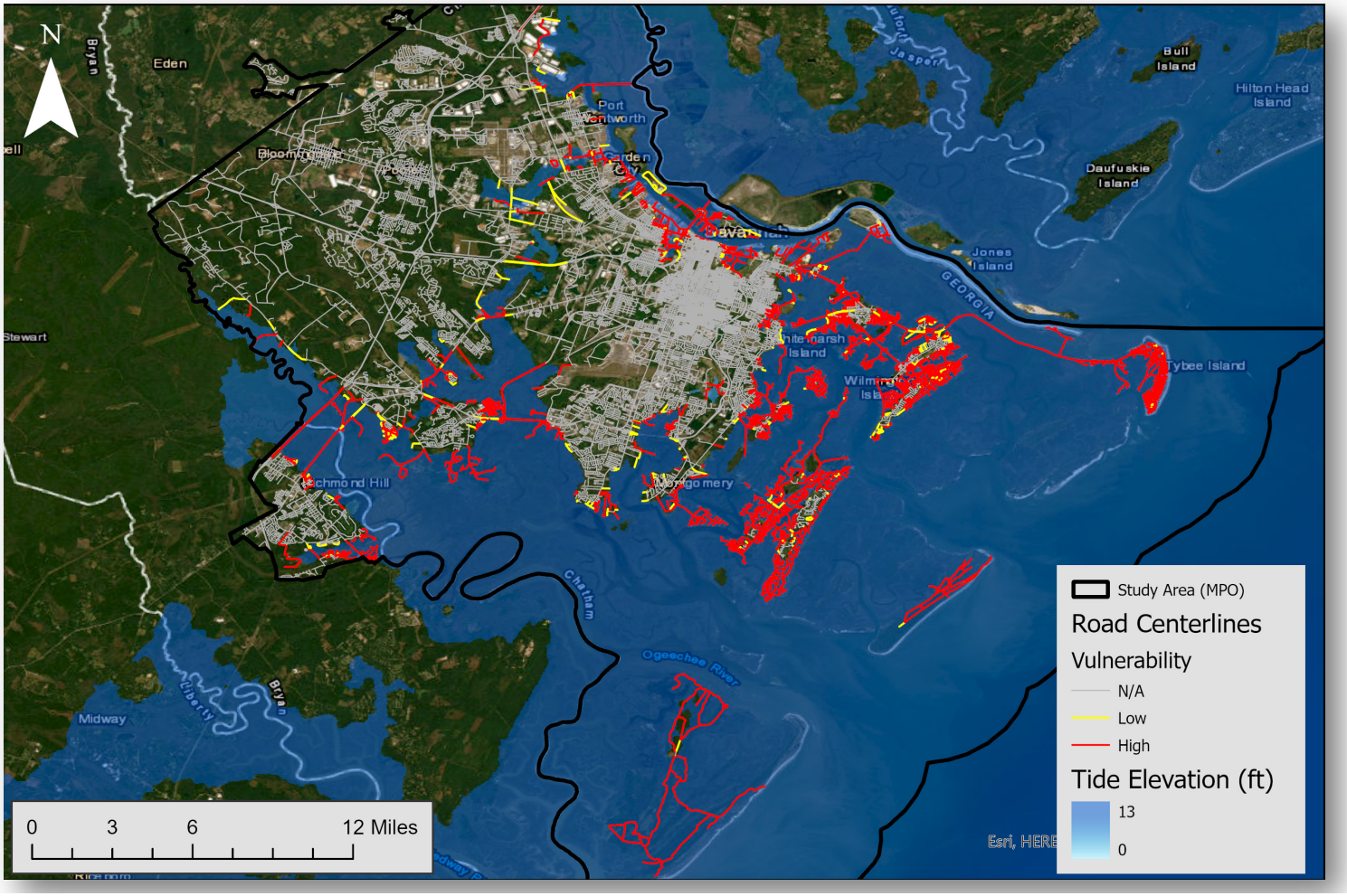
Roadway Vulnerability – CRD High 2075 (4.08 ft, 379 miles)



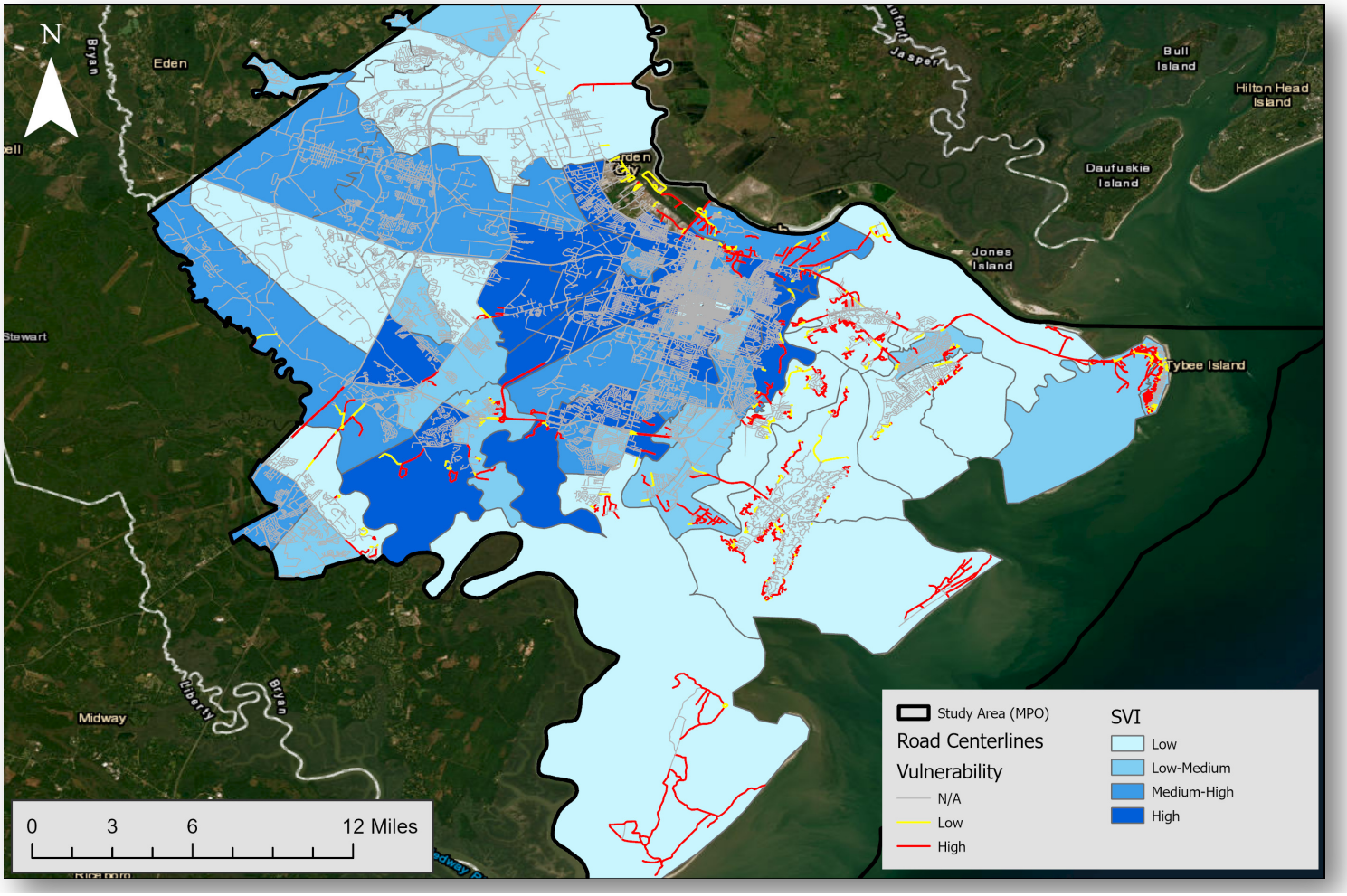
Roadway Vulnerability – CRD Low 2100 (3.28 ft, 327 miles)



Roadway Vulnerability – CRD High 2100 (6.56 ft, 590 miles)

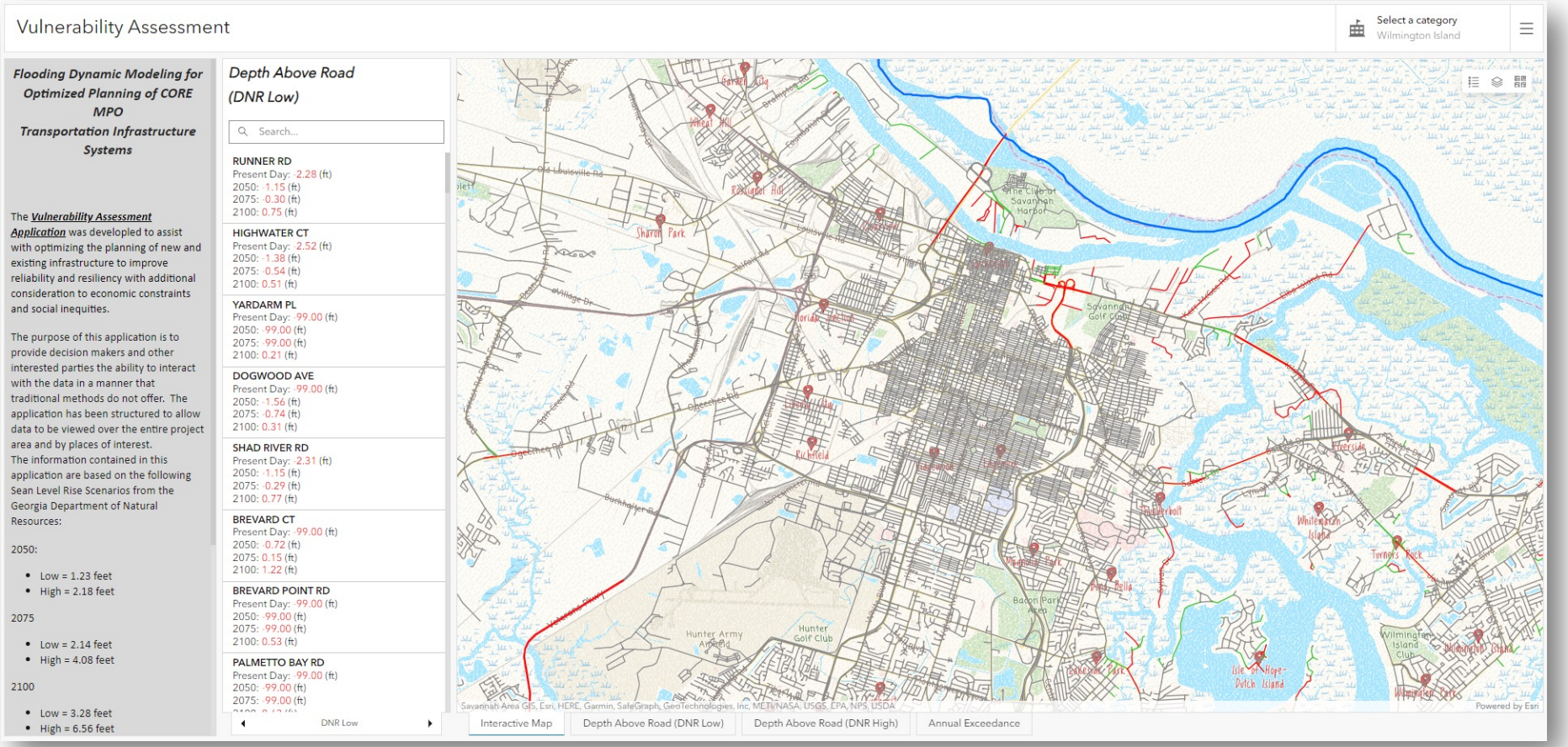


SVI + 2050 High SLR Road Vulnerability

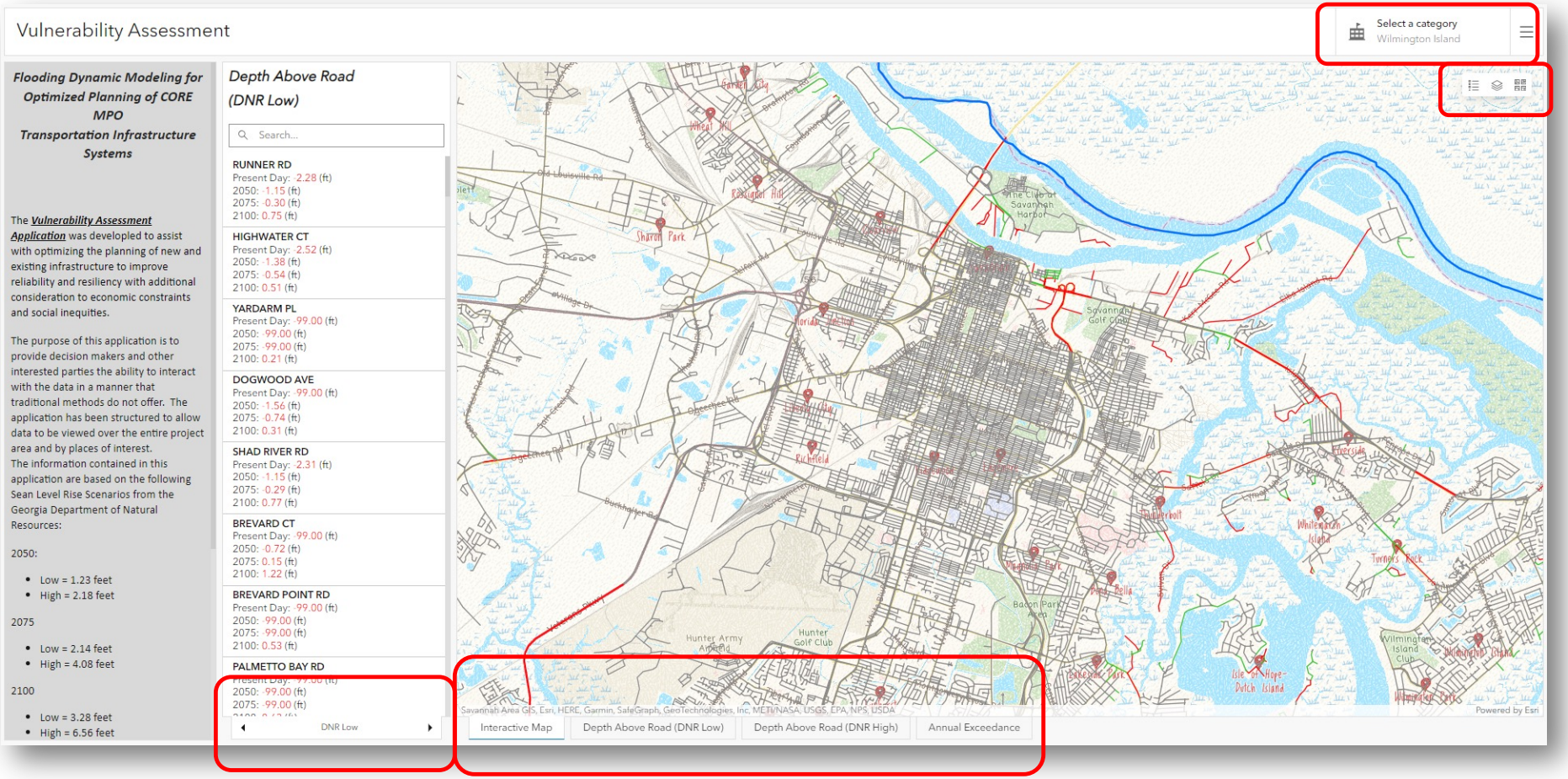


ESRI Dashboard DEMO

Roadway Vulnerability Application

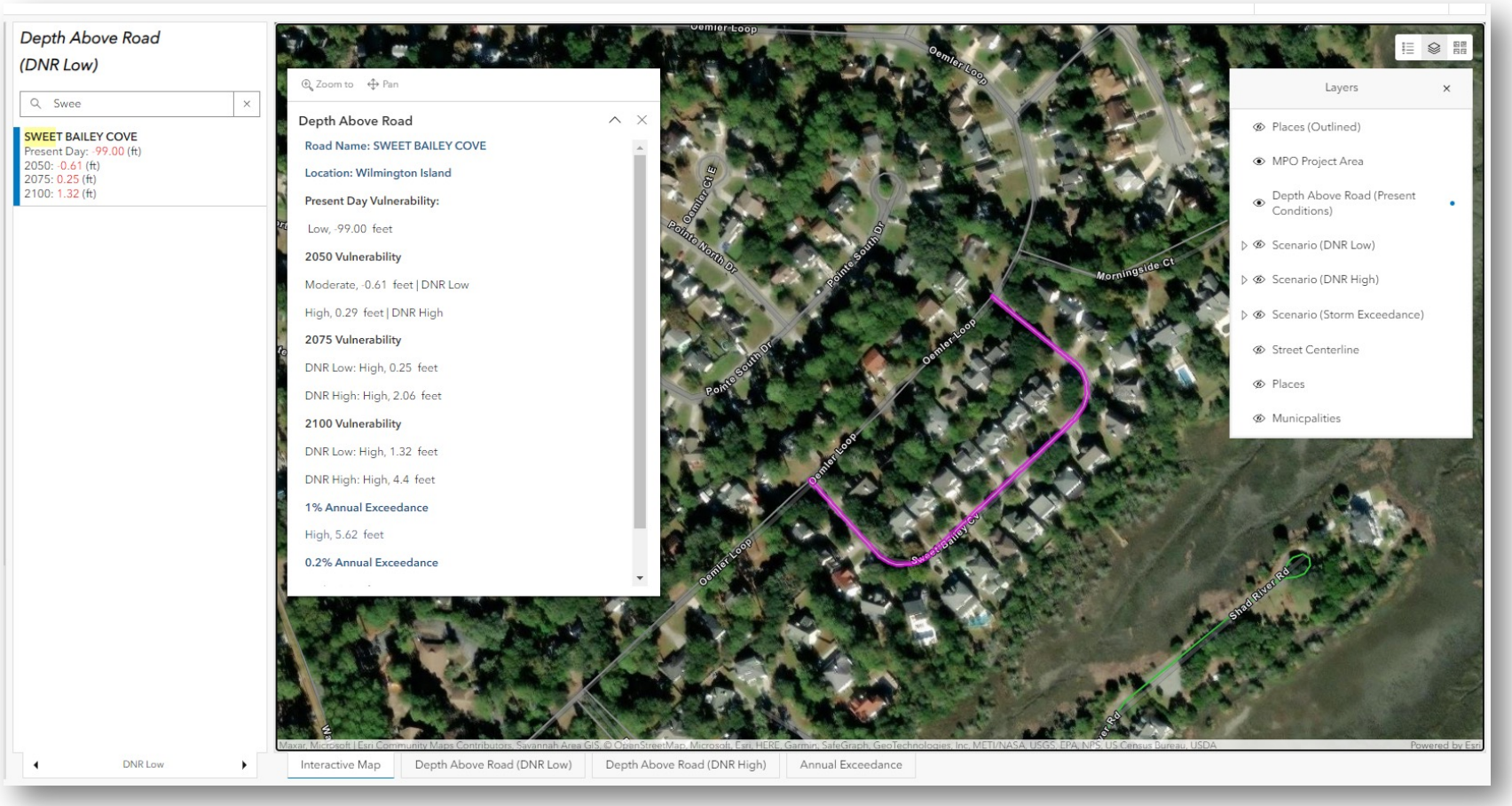


Roadway Vulnerability Application

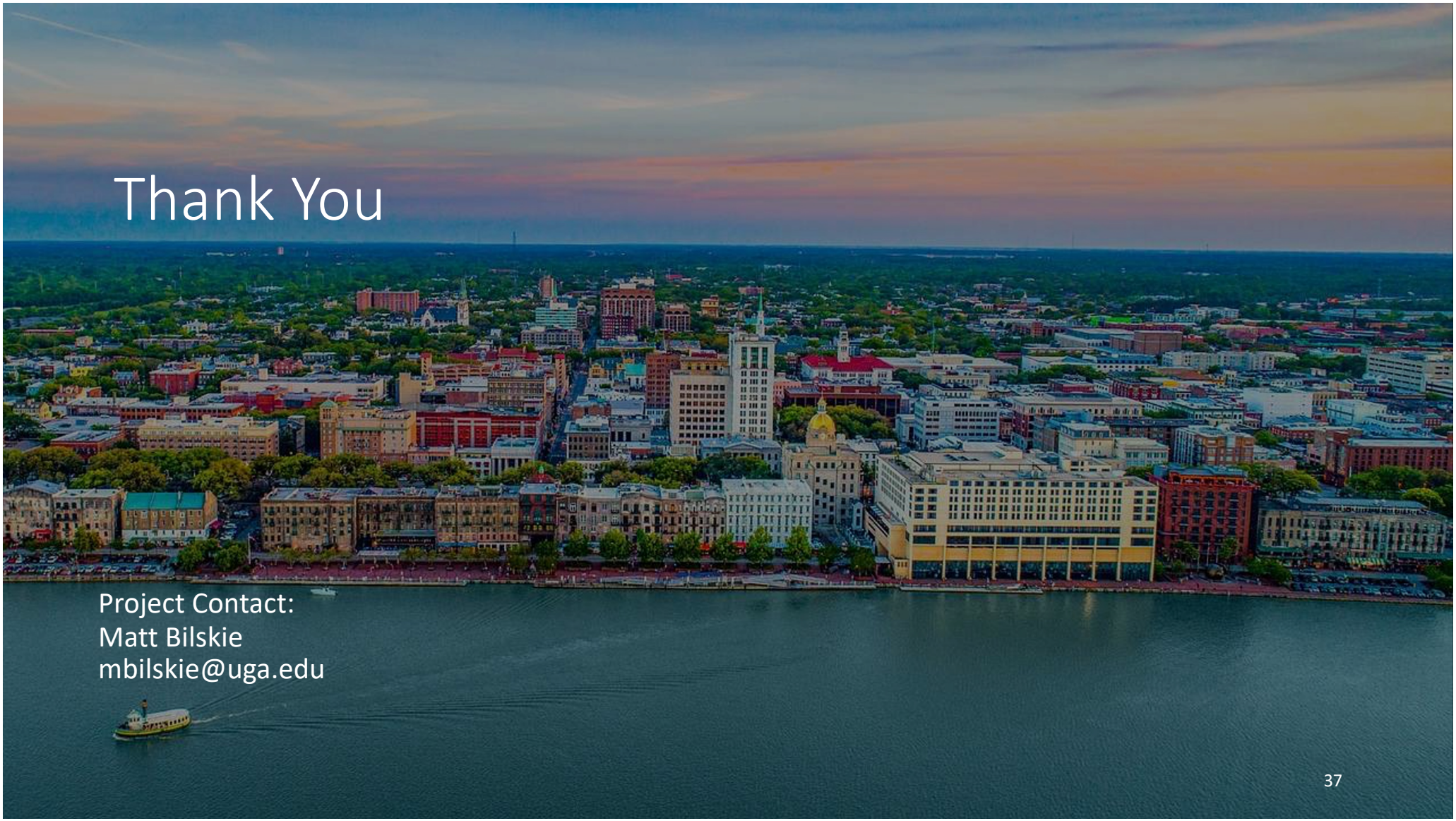


Roadway Vulnerability Application

Roadway Vulnerability Application



Thank You



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