Global Sea Level Has Been Rising for Over a Century

Disruptive High Tide Flooding by Mid-Century

Storm Drain Backflow at High Tide

Disruptive High Tide Flooding by Mid-Century

Groundwater Inundation

Rain + High Tide = Flooding

Disruptive High Tide Flooding by Mid-Century

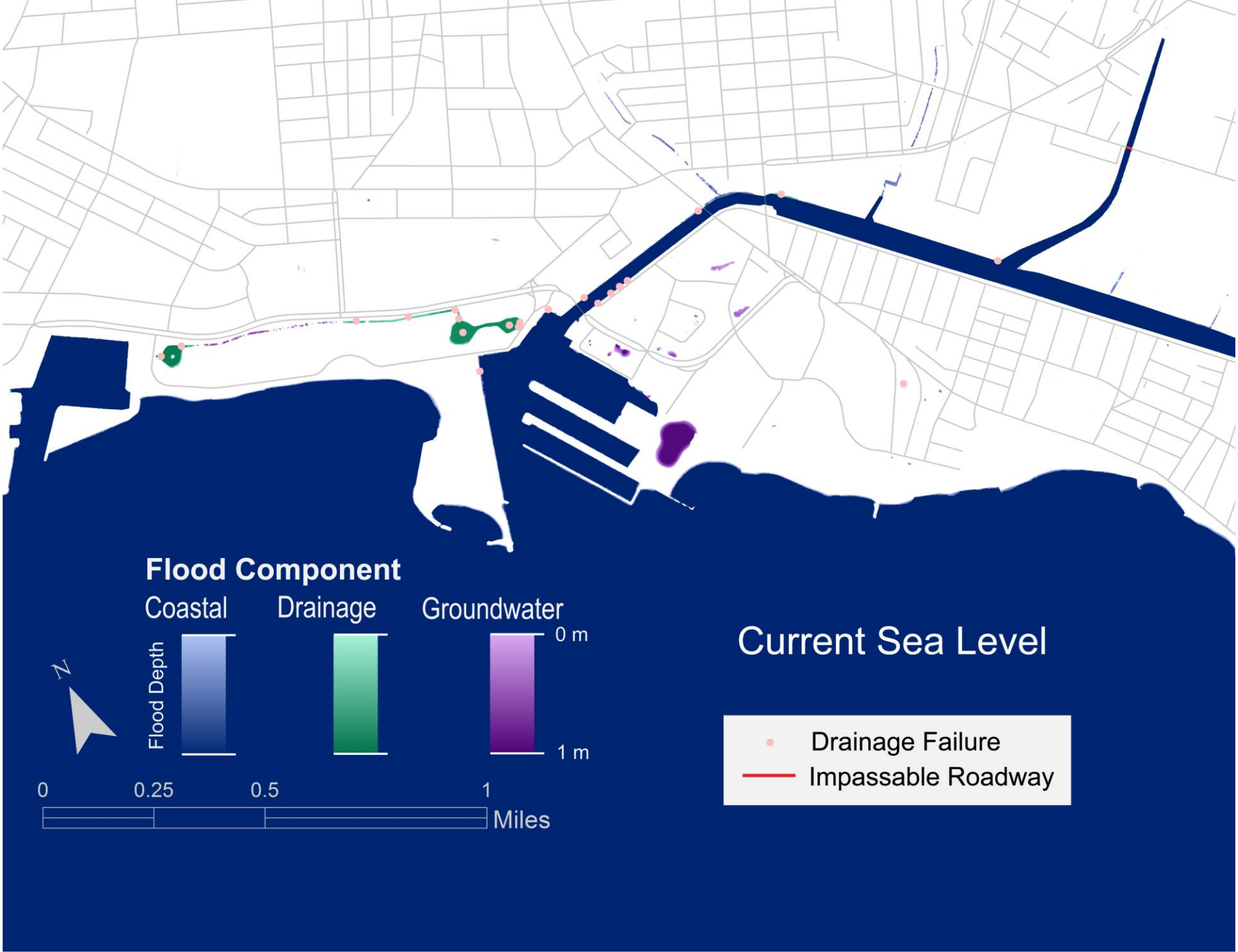
Groundwater Pollution

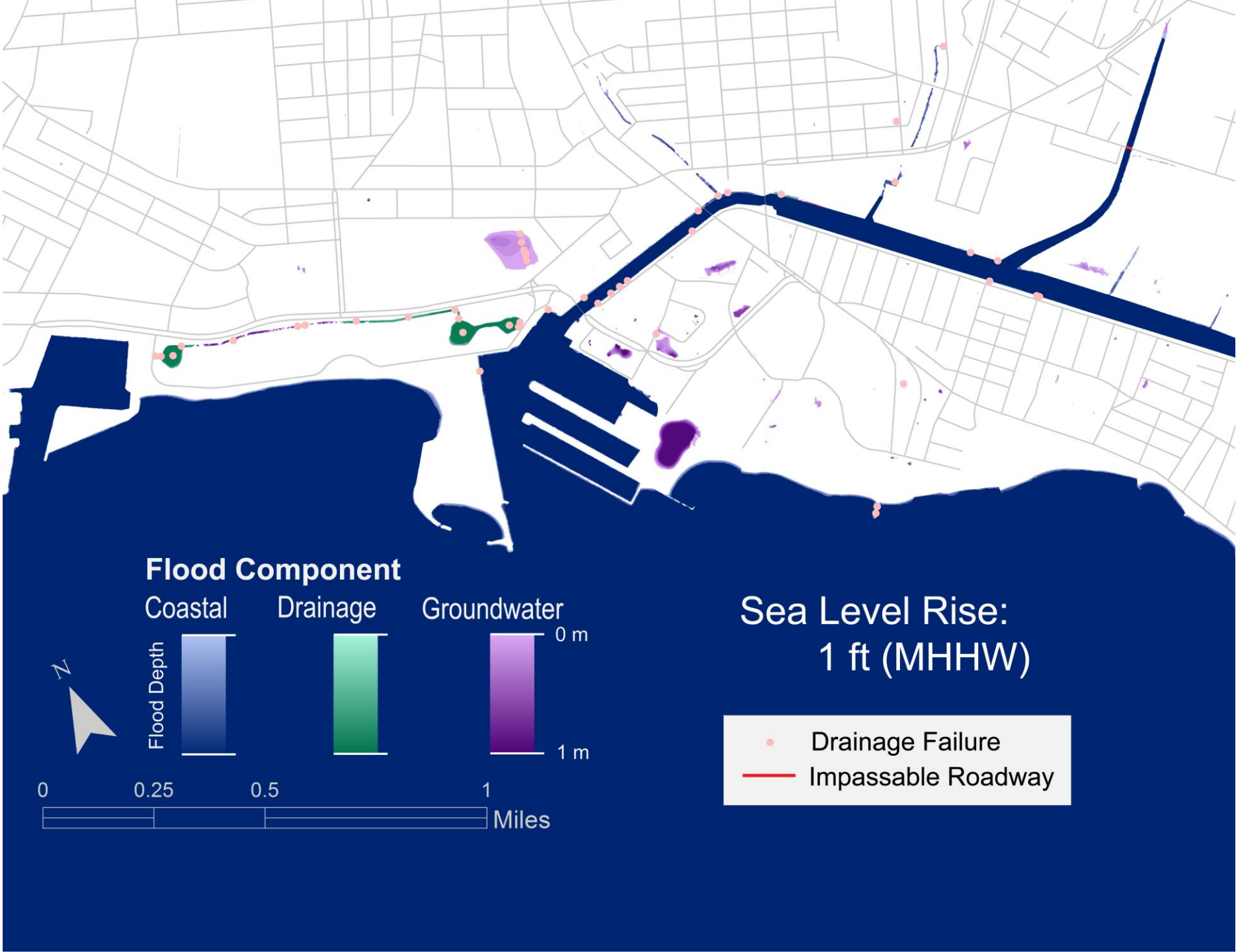

Search address or 9-digit TMK...
or use <Shift>-drag to zoom
O'ahu
Select a site...
BASEMAPS
COASTAL EROSION
SEA LEVEL RISE BY YEAR
SEA LEVEL RISE BY FEET
WAVE INUNDATION
OTHER OVERLAYS
expand • collapse • clear
Summer wave run-up 2ft
Wave Inundation
water depth (ft)
16
12
8
4
200 m
500 ft
PacIOOS

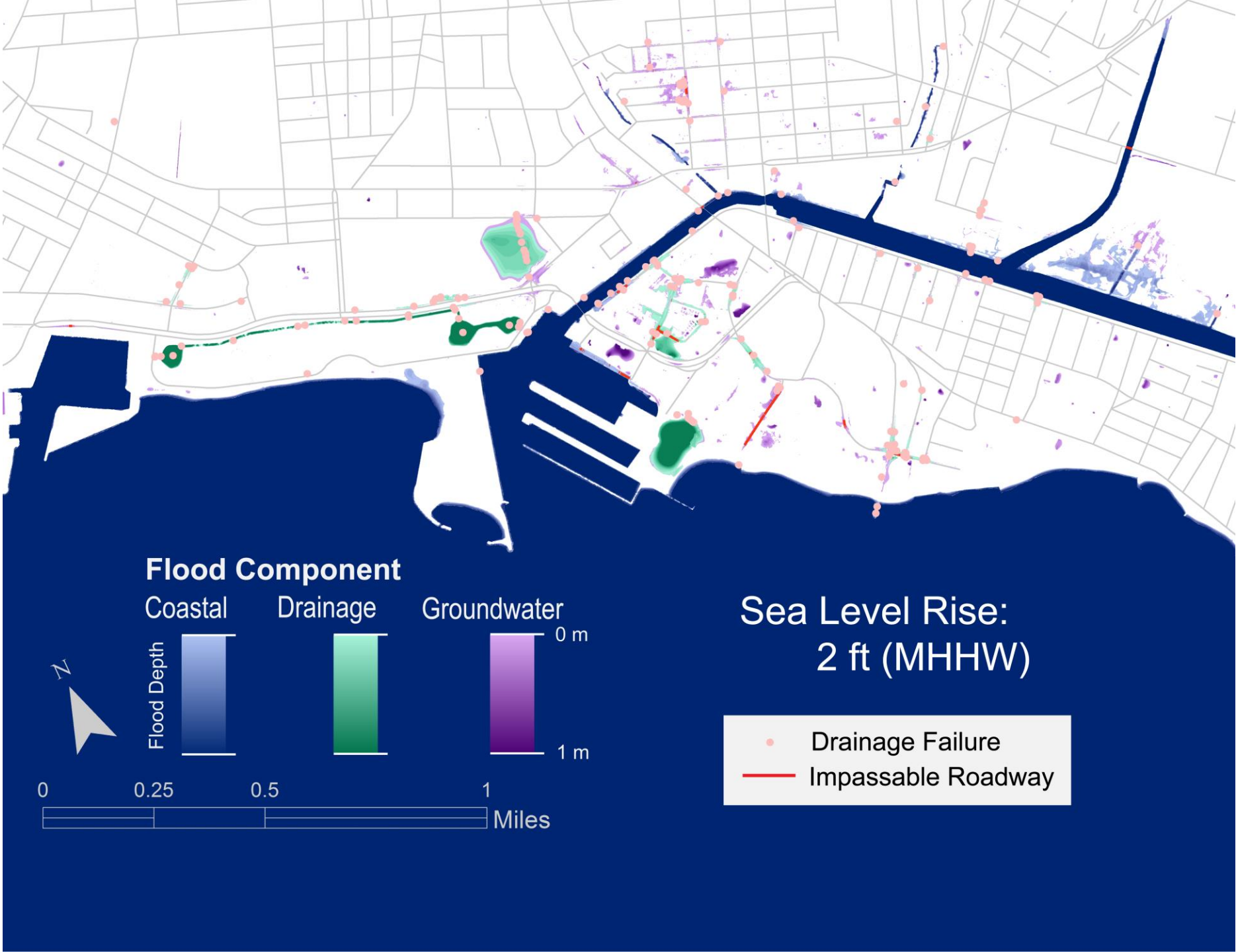

Search address or 9-digit TMK...
or use <Shift>-drag to zoom
O'ahu
Select a site...
BASEMAPS
COASTAL EROSION
SEA LEVEL RISE BY YEAR
SEA LEVEL RISE BY FEET
WAVE INUNDATION
OTHER OVERLAYS
expand • collapse • clear
Summer wave run-up 3ft
Wave Inundation
16
12
8
4
water depth (ft)
200 m
500 ft
opacity:
75%
cursor: 21.3162°, -158.0010°
PacIOOS

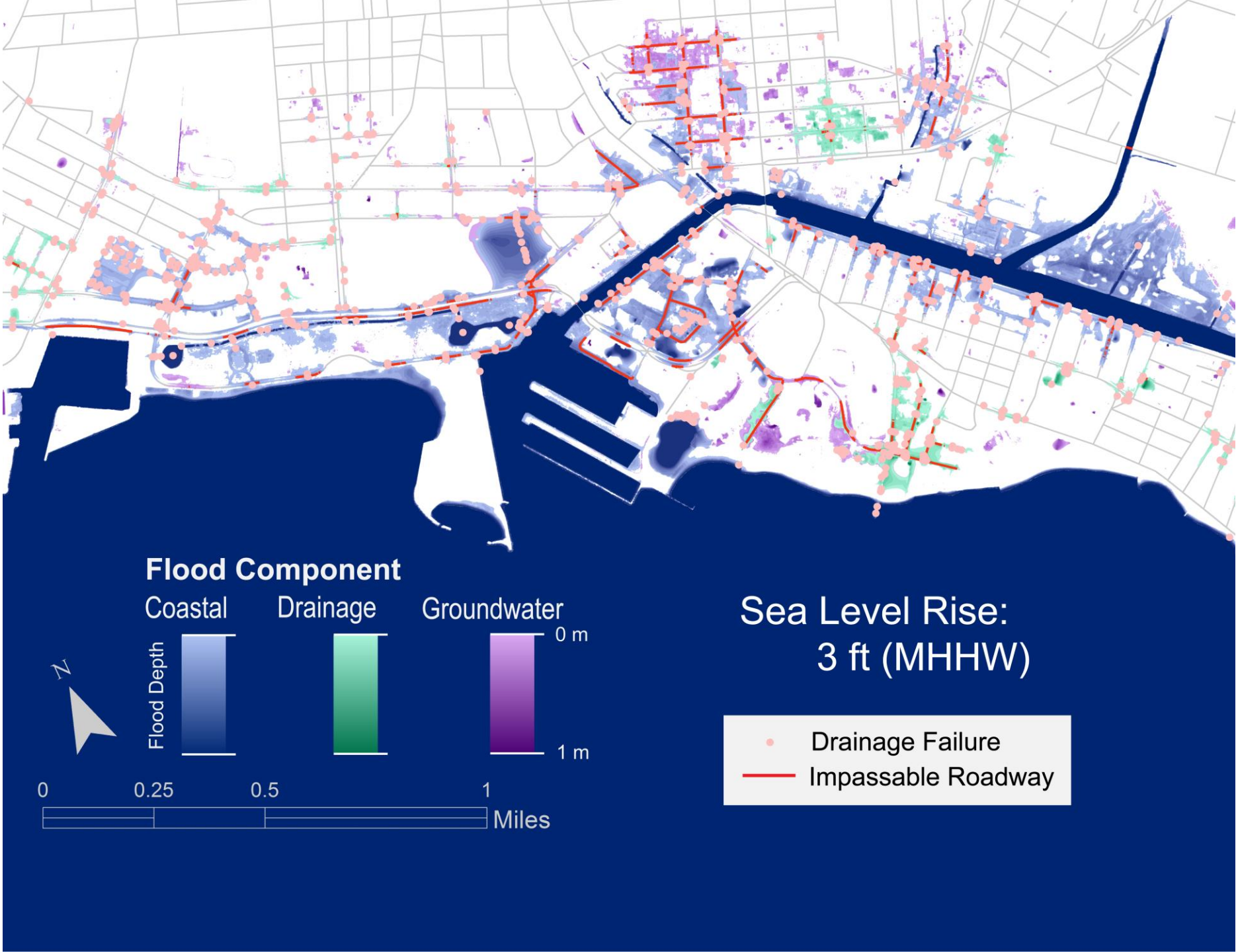
Department of Transportation

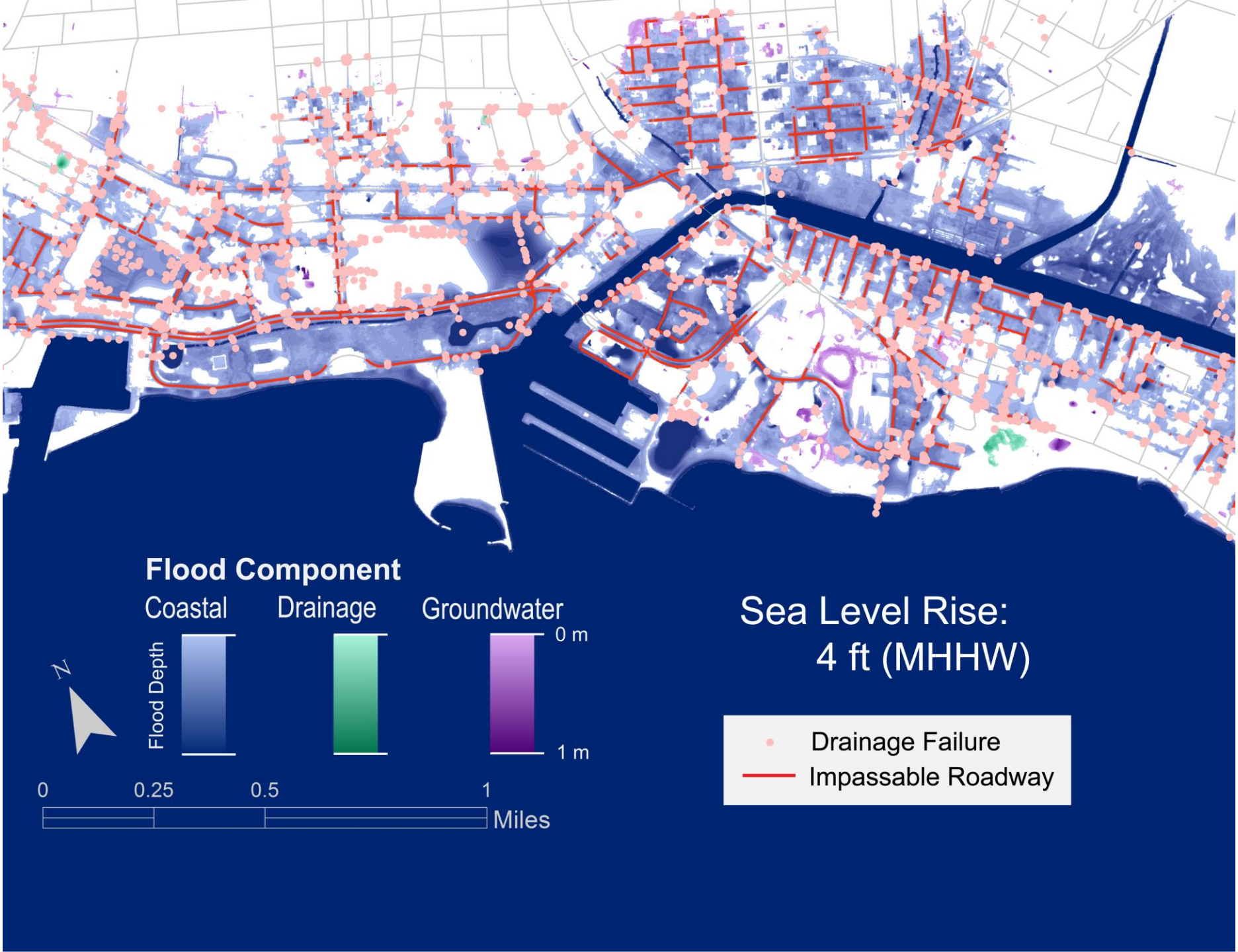
- 140 miles
- 120 bridges
- 10-15% all roads
- $7.5M per lane mile
- $14M per bridge
- $15B total

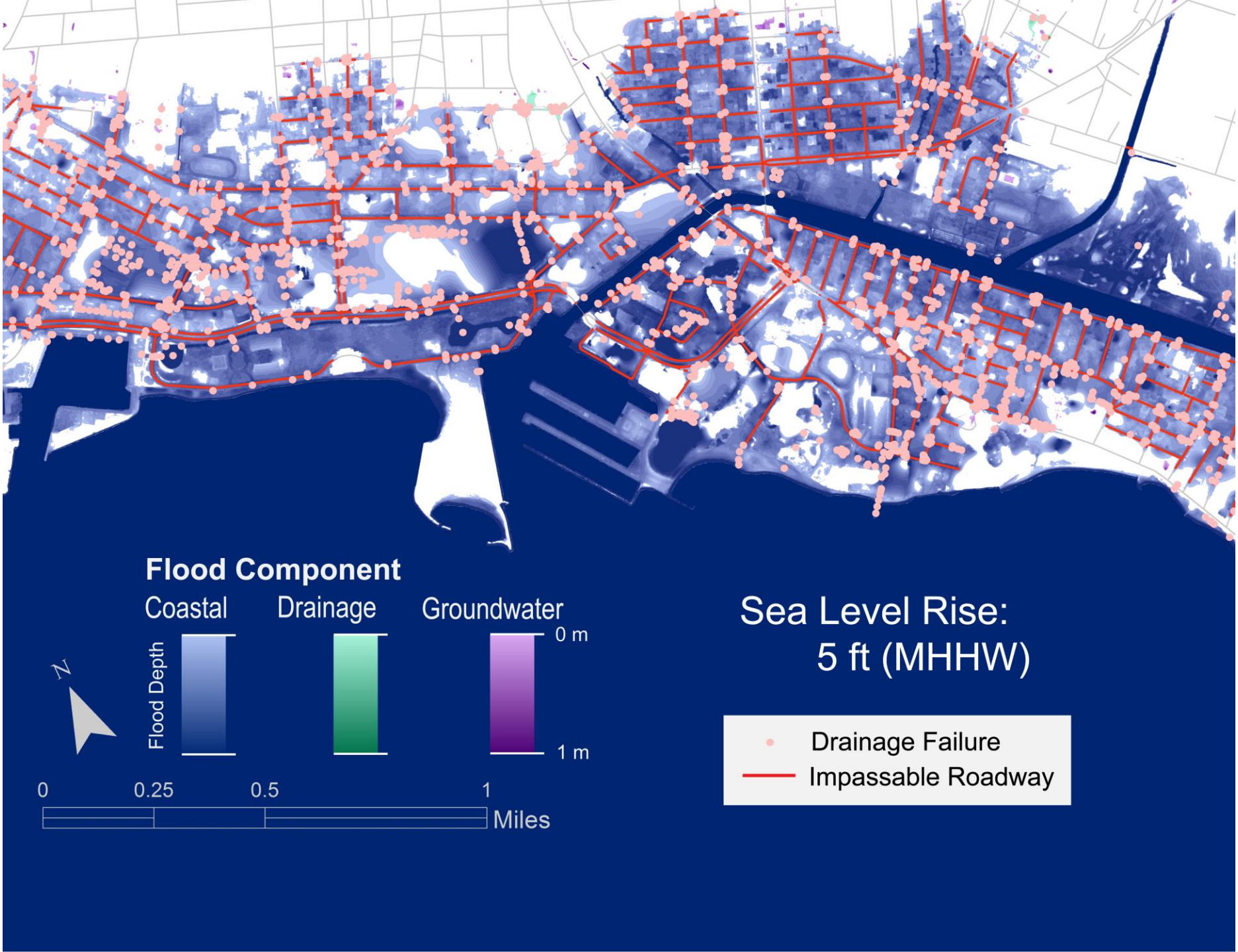

Flood Component
Coastal
Drainage
Groundwater
Flood Depth
0 m
1 m
N
0
0.25
0.5
1
Miles
Current Sea Level
Drainage Failure
Impassable Roadway


Flood Component
Coastal
Drainage
Groundwater
Flood Depth
0 m
1 m
N
0
0.25
0.5
1
Miles
Sea Level Rise:
1 ft (MHHW)
Drainage Failure
Impassable Roadway

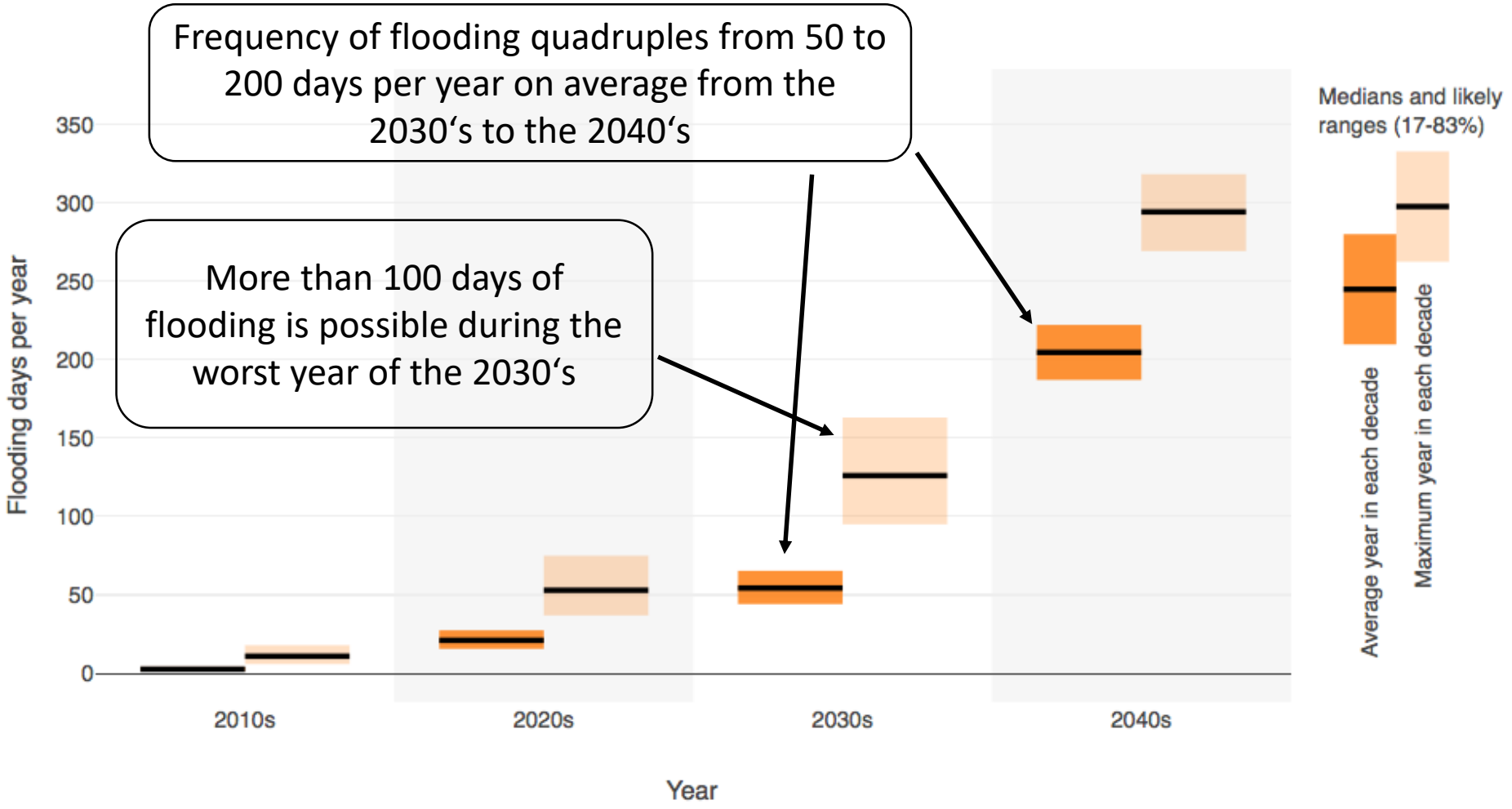

Flood Component
Coastal
Drainage
Groundwater
Flood Depth
0 m
1 m
N
0
0.25
0.5
1
Miles
Sea Level Rise:
2 ft (MHHW)
Drainage Failure
Impassable Roadway


Flood Component
Coastal
Drainage
Groundwater
Flood Depth
0 m
1 m
N
0
0.25
0.5
1
Miles
Sea Level Rise:
3 ft (MHHW)
Drainage Failure
Impassable Roadway


Flood Component
Coastal
Drainage
Groundwater
Flood Depth
0 m
1 m
N
0
0.25
0.5
1
Miles
Sea Level Rise:
4 ft (MHHW)
Drainage Failure
Impassable Roadway


Flood Component
Coastal
Drainage
Groundwater
Flood Depth
0 m
1 m
N
0
0.25
0.5
1
Miles
Sea Level Rise:
5 ft (MHHW)
Drainage Failure
Impassable Roadway

High Tide Flooding in Coastal Honolulu by Decade



Thompson et al. (2019) A statistical model for frequency of coastal flooding in Honolulu Hawaii, during the 21st Century, JGR Oceans, 10.1029/2018JC014741
UH Sea Level Center: https://uhslc-flooding-test.soest.hawaii.edu

nature climate change

Letter

Projected increase in tropical cyclones near Hawaii

Hiroyuki Murakami, Bin Wang, Tim Li & Akio Kitoh

Nature Climate Change **3**, 749–754 (2013)
doi:10.1038/nclimate1890
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Climate sciences

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Abstract

Projections of the potential impacts of global warming on regional tropical cyclone activity are challenging owing to multiple sources of uncertainty in model physical schemes and different assumptions for future sea surface temperatures[1]. A key factor in projecting climate change is to derive robust signals of future changes in tropical cyclone activity across different model physical schemes and different future patterns in sea surface temperature. A suite of future warming experiments (2075–2099), using a state-of-the-art high-resolution global climate model[1,2,3], robustly predicts an increase in tropical cyclone frequency of occurrence around the Hawaiian Islands. A physically based empirical model analysis[3,4] reveals that the substantial increase in the likelihood of tropical cyclone frequency is primarily associated with a northwestward shifting of the tropical cyclone track

Associated Content

Nature | Research Highlights

Climate science: More cyclones for Hawaiian Islands

Sections | Figures | References

Figure 1: Annual mean of TCF (number per year, colour scale) counted at every 5°×5° grid cell.

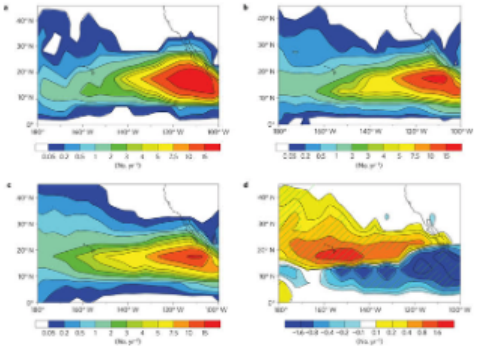

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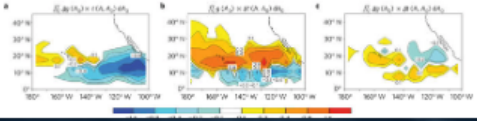
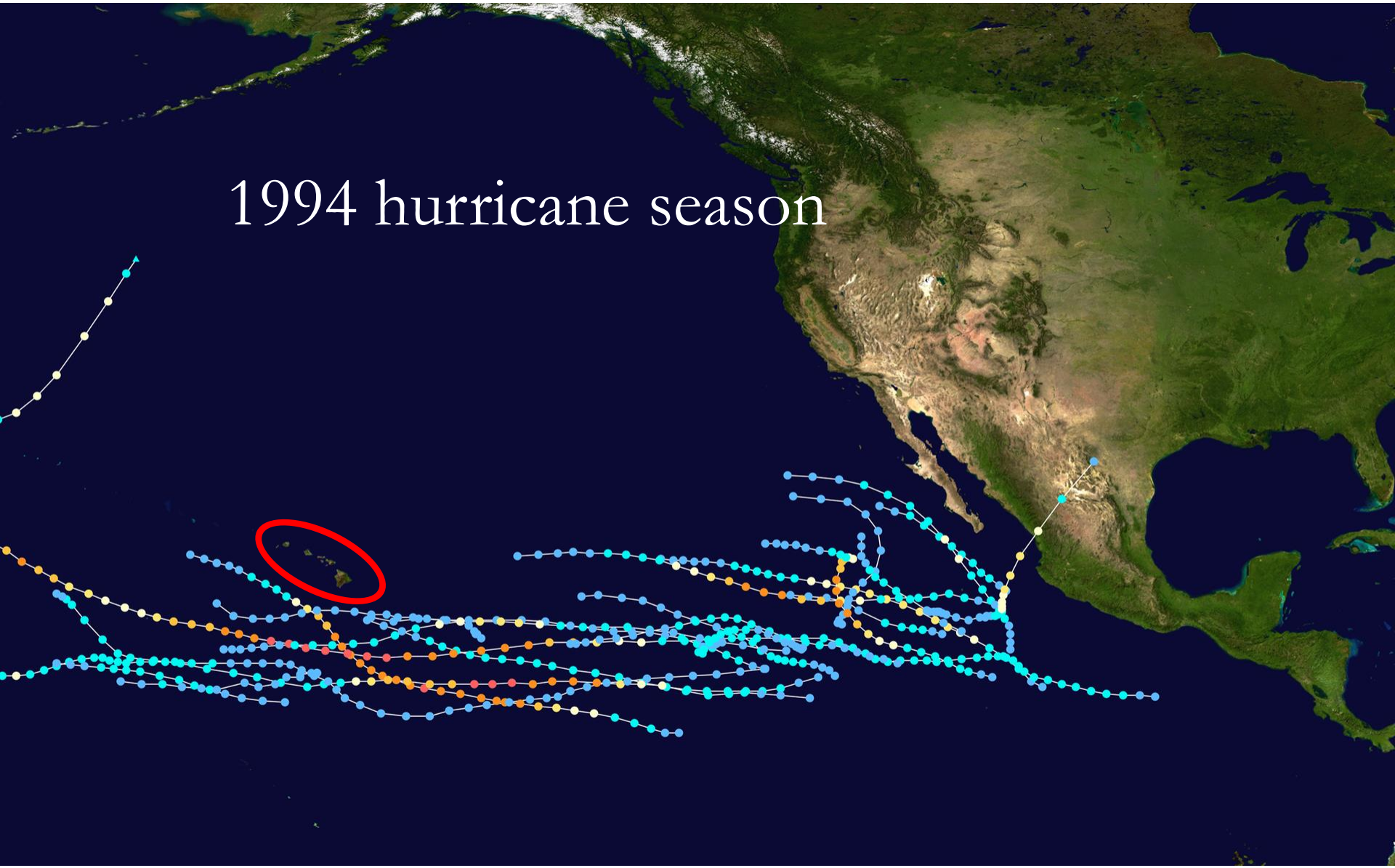
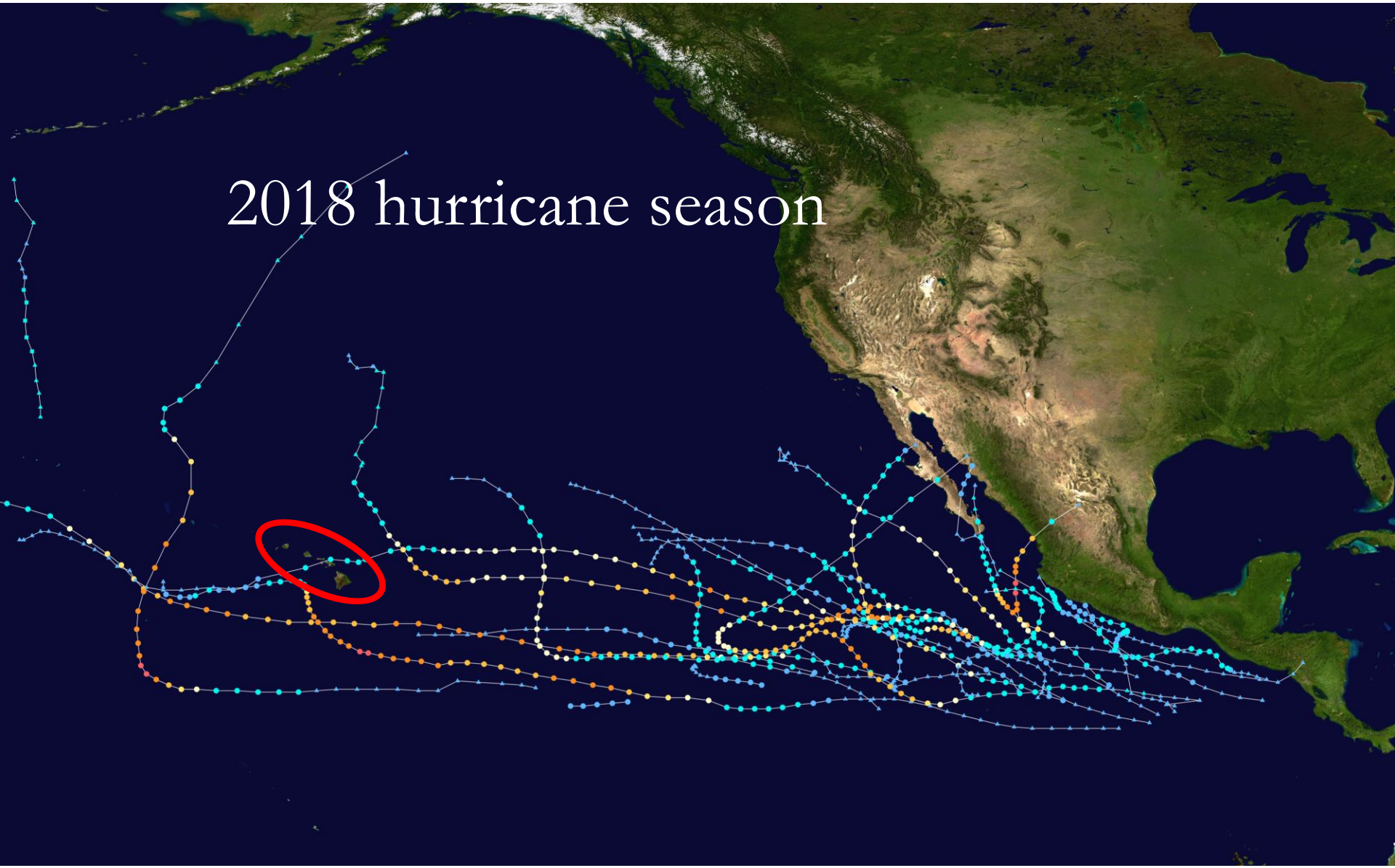
Figure 2: Ensemble mean contribution of each term to changes in TCF (colour scale) calculated by the empirical statistical analysis.




1994 hurricane season


2018 hurricane season

Miami Beach is a Barrier Island

Miami Beach

Blue Sky Flooding, King Tide Flooding, Nuisance Flooding

Miami is raising roads by 2 ft

Construction workers raise the height of the street and sidewalks; Miami


MIAMIBEACH
ART IN PUBLIC PLACES
STORM WATER


market


RoadSafe


Pronto!


Presto!

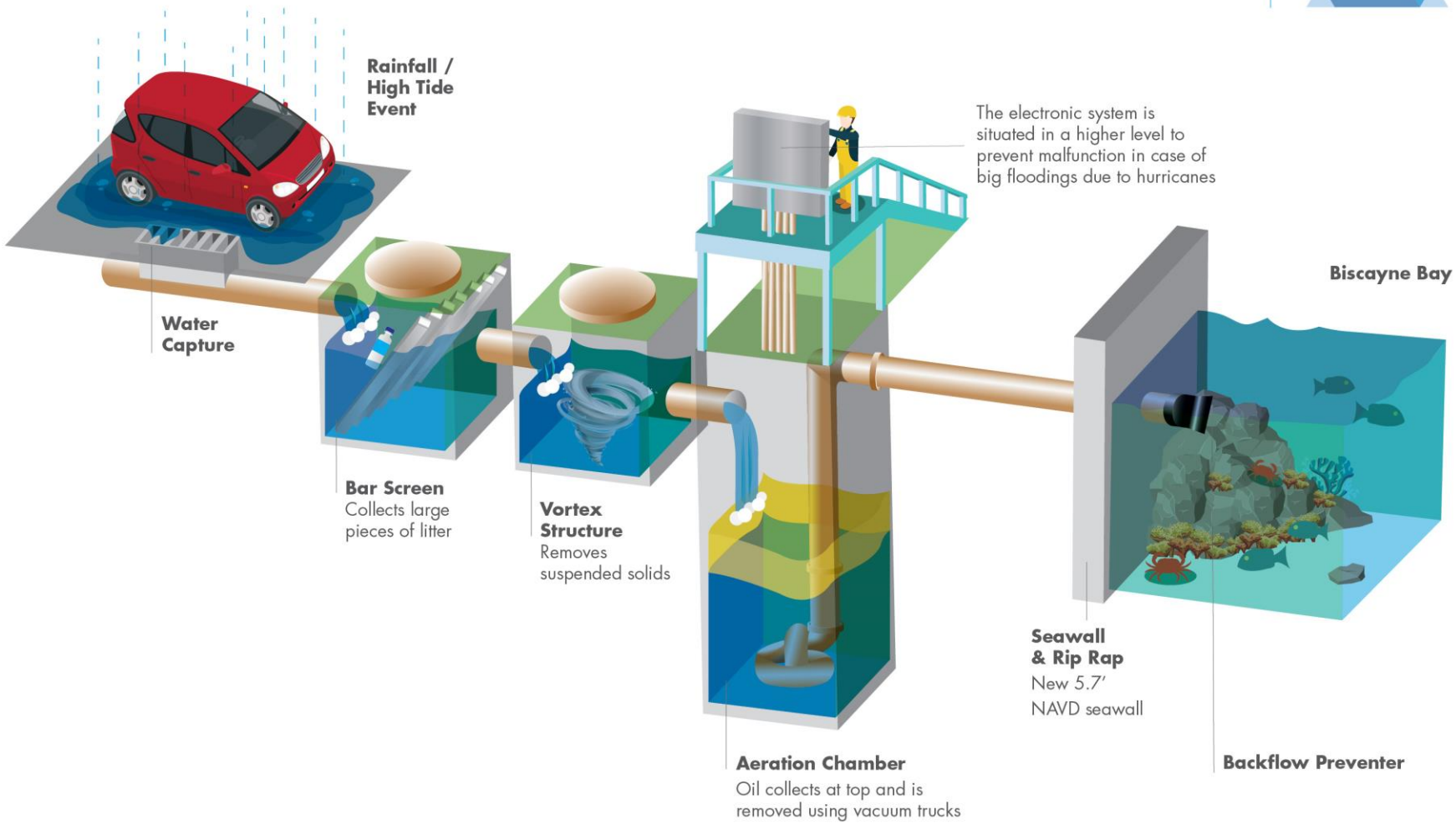
80 pump stations, $2-3 million each, 79,000 gal/minute

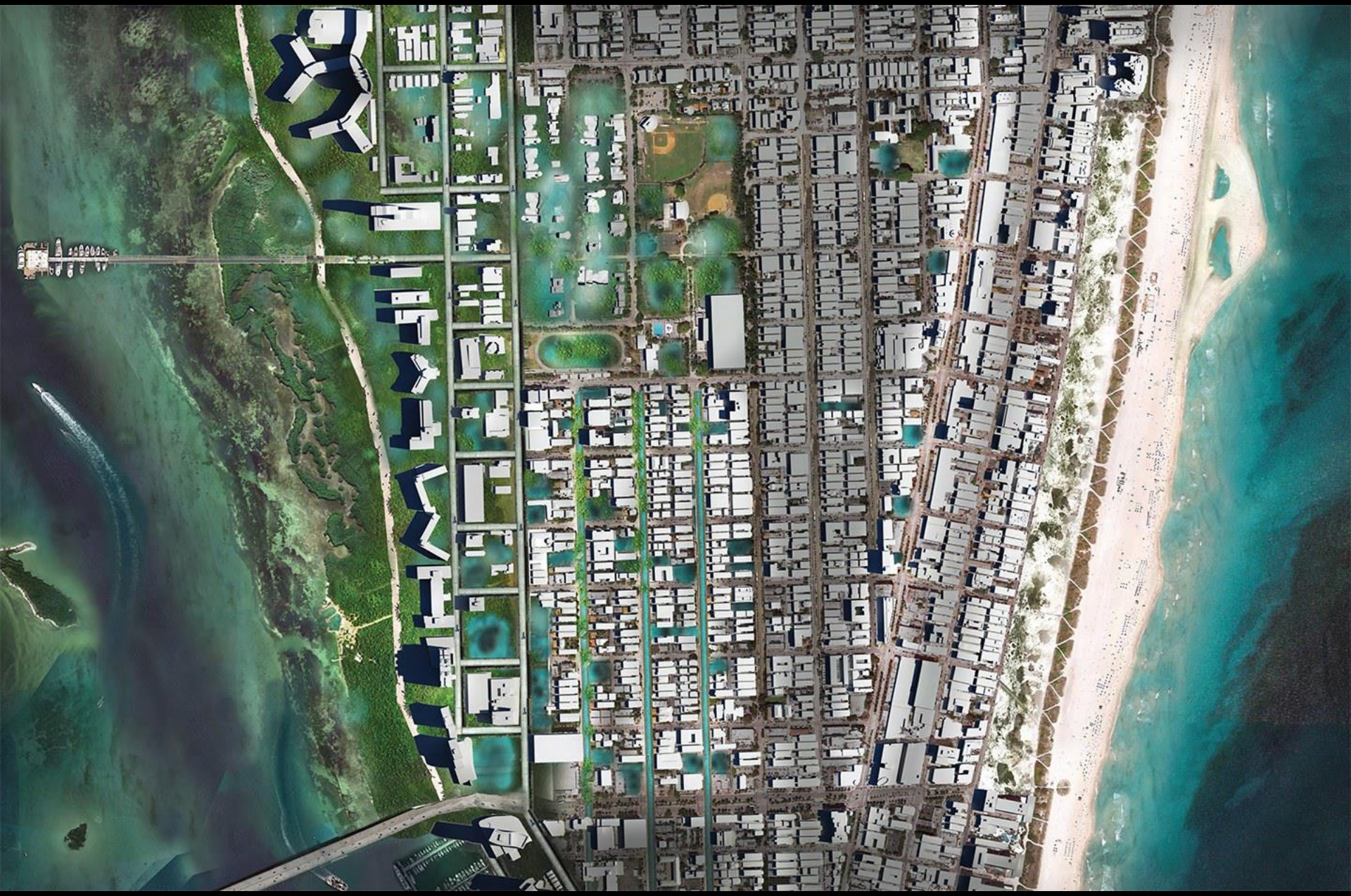
Miami Pump Station

https://www.businessinsider.com/miami-floods-sea-level-rise-solutions-2018-4

Stormwater Pump Station UPGRADES

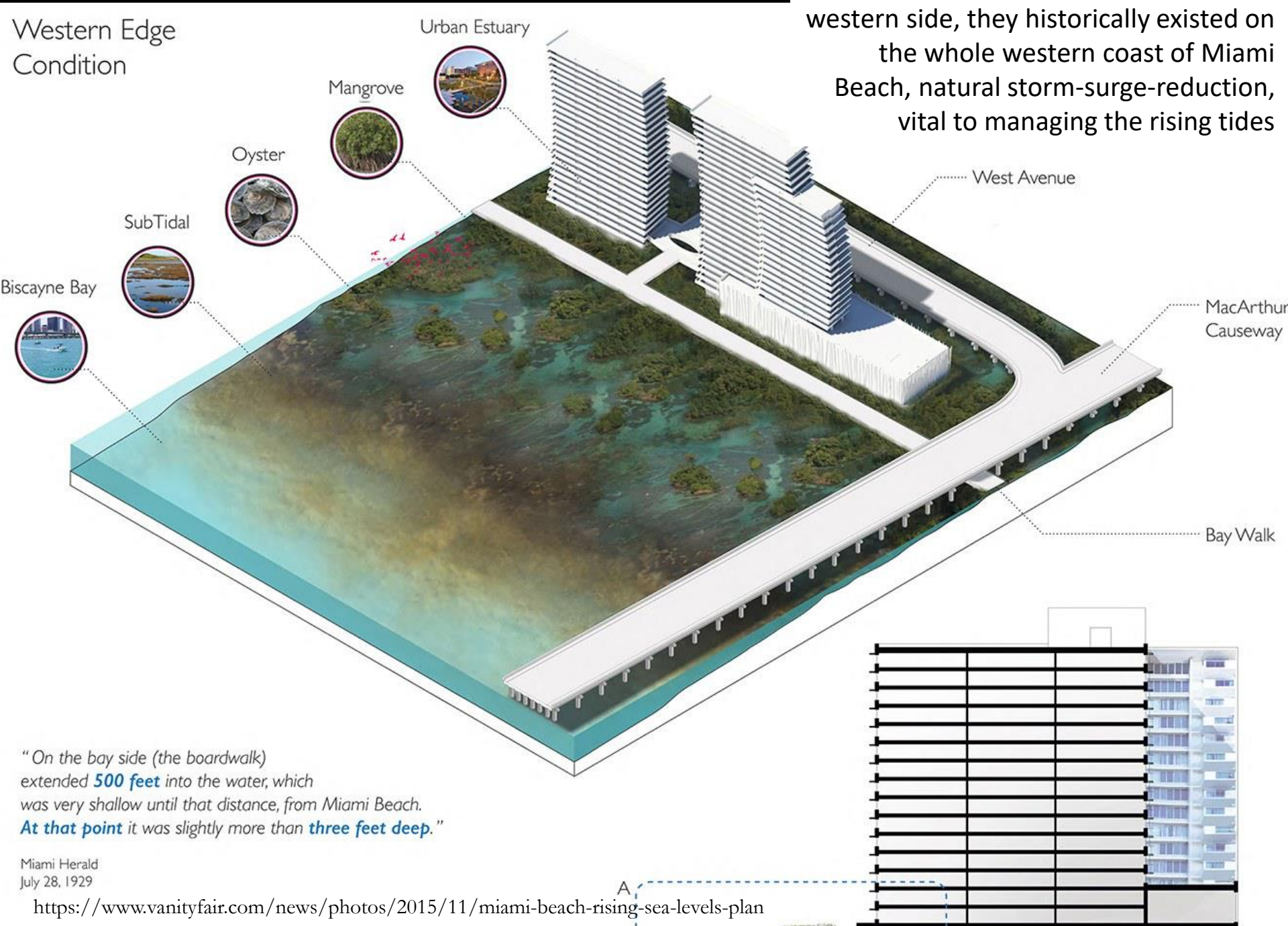
MIAMIBEACH RISING ABOVE





https://www.vanityfair.com/news/photos/2015/11/miami-beach-rising-sea-levels-plan

plant mangroves everywhere on the western side, they historically existed on the whole western coast of Miami Beach, natural storm-surge-reduction, vital to managing the rising tides



https://www.vanityfair.com/news/photos/2015/11/miami-beach-rising-sea-levels-plan

”Once mangroves get established, have raised walkways going through them, and recreational waterways. existing high-rise towers sacrifice the bottom one or two floors before nature reclaims them. And then the new ‘first’ floor is five or six feet above the new sea level.”

https://www.vanityfair.com/news/photos/2015/11/miami-beach-rising-sea-levels-plan

“There used to be trams in Miami Beach, bringing them back is the first step. The key to mitigation is to reduce reliance on cars, and have smaller-footprint modes of transit, leaving more room for water.”

https://www.vanityfair.com/news/photos/2015/11/miami-beach-rising-sea-levels-plan

“Six feet of fill is cut to form an ecological canal and raise the grade of Lenox, Michigan, and Jefferson Avenues. The grade surrounding these residences would go up 1.5 feet. Long term, the cut-and-fill strategy only protects residences for up to six feet of sea-level rise. Eventually, as the ground floors of residences are inundated, it might be best to build atop the existing historic envelope of these buildings. Like a contemporary addition, set back enough, so, when you’re on the street, you still only see the main façade.”

https://www.vanityfair.com/news/photos/2015/11/miami-beach-rising-sea-levels-plan

“The canals divert water and are pleasant to walk along. The canal area would be like an American Amsterdam. It would become a sort of urban delta, a watershed. It would lose its park capabilities on flood days.”

https://www.vanityfair.com/news/photos/2015/11/miami-beach-rising-sea-levels-plan

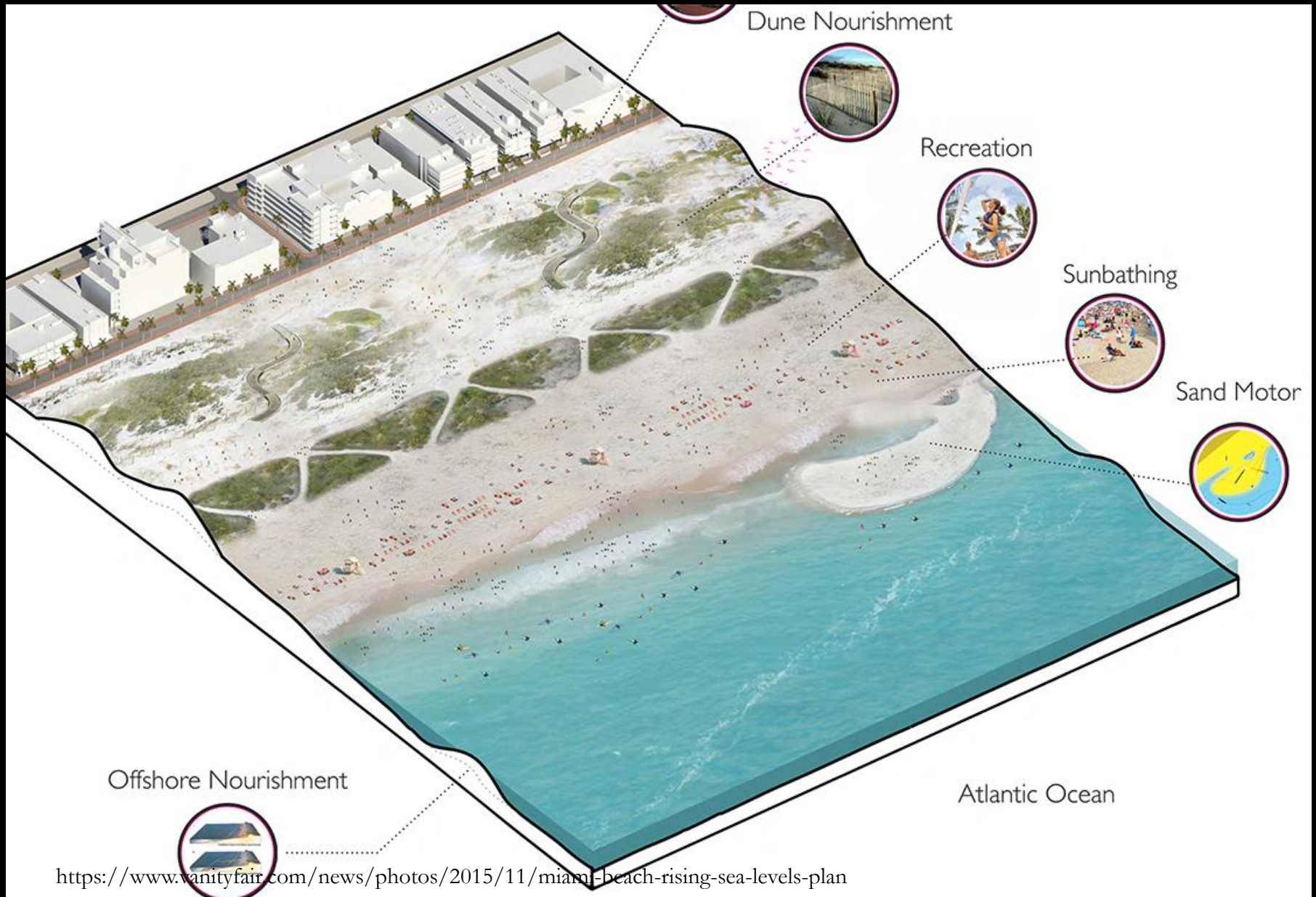
“This is Washington Avenue, with a trolley and a wide bike lane. You have these old roads that were built 70 feet wide. By reducing the cars, not only are you making Miami Beach a nicer place to live and visit, but you’re also creating space for the city to adapt in the future.”

https://www.vanityfair.com/news/photos/2015/11/miami-beach-rising-sea-levels-plan

“By the ocean side, basically, it’s ‘Let’s build sand dunes that are even higher and wider than the ones that naturally existed,’ from Ocean Drive all the way to the ocean. You lose some recreational space, but you’re better protected against hurricanes and devastation.”

https://www.vanityfair.com/news/photos/2015/11/miami-beach-rising-sea-levels-plan

"Pathways can be integrated into these natural barriers. The 'sand motor' is a peninsula built of sand brought in from off-site. As the waves hit it, the sand will spread across the shoreline, reducing the need for sand-replenishment."



https://www.vanityfair.com/news/photos/2015/11/miami-beach-rising-sea-levels-plan

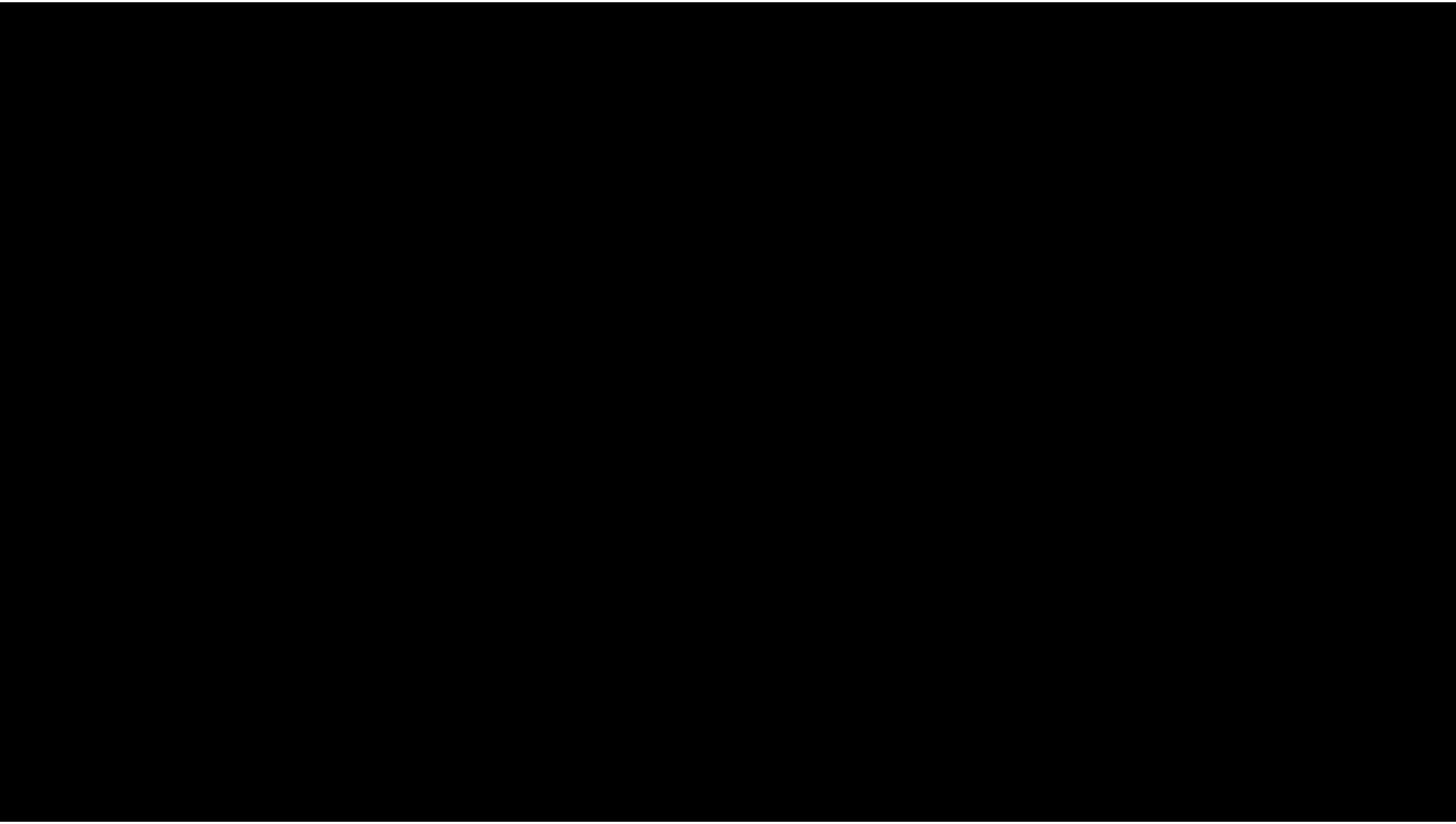
Thank you for your Time

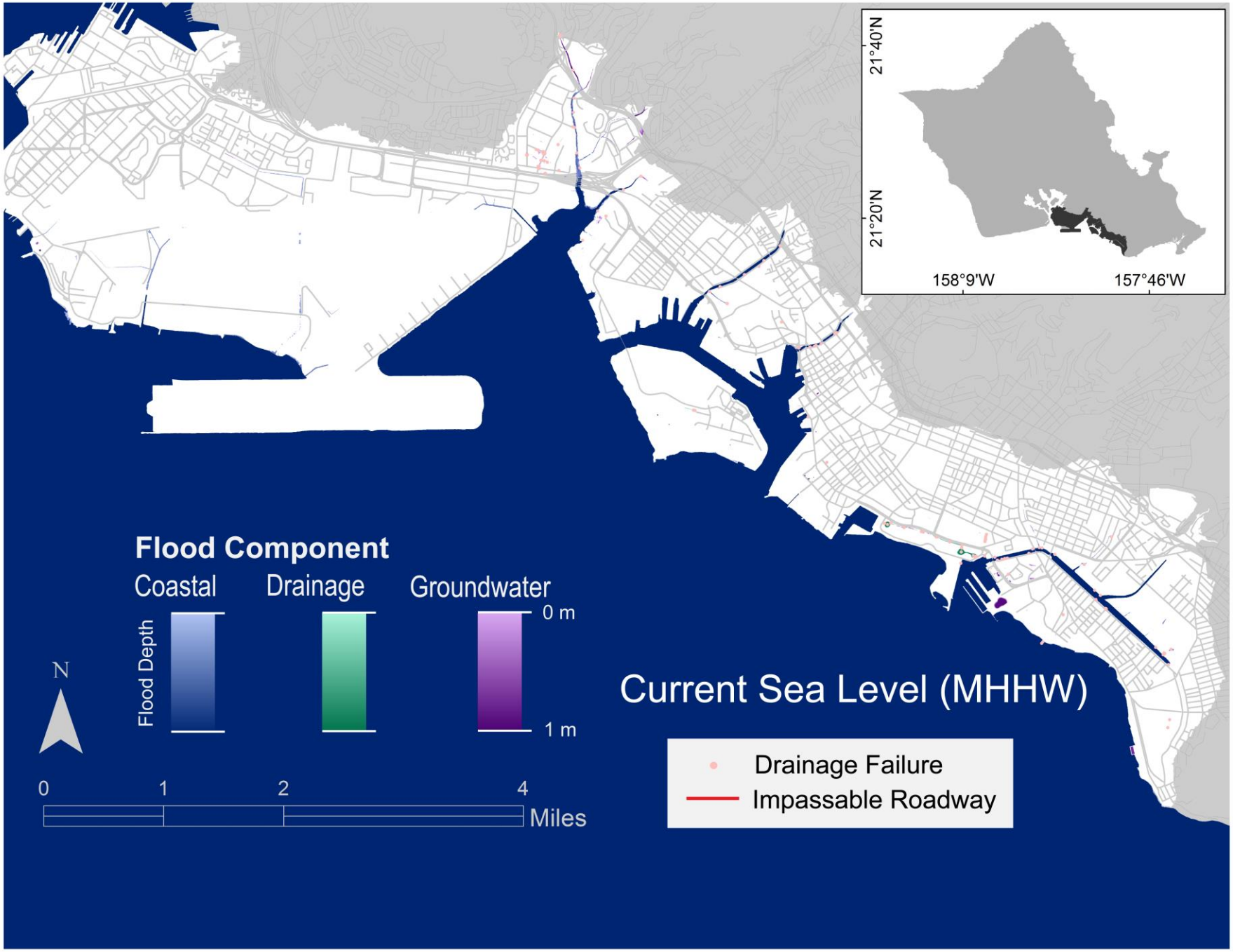
https://science2017.globalchange.gov

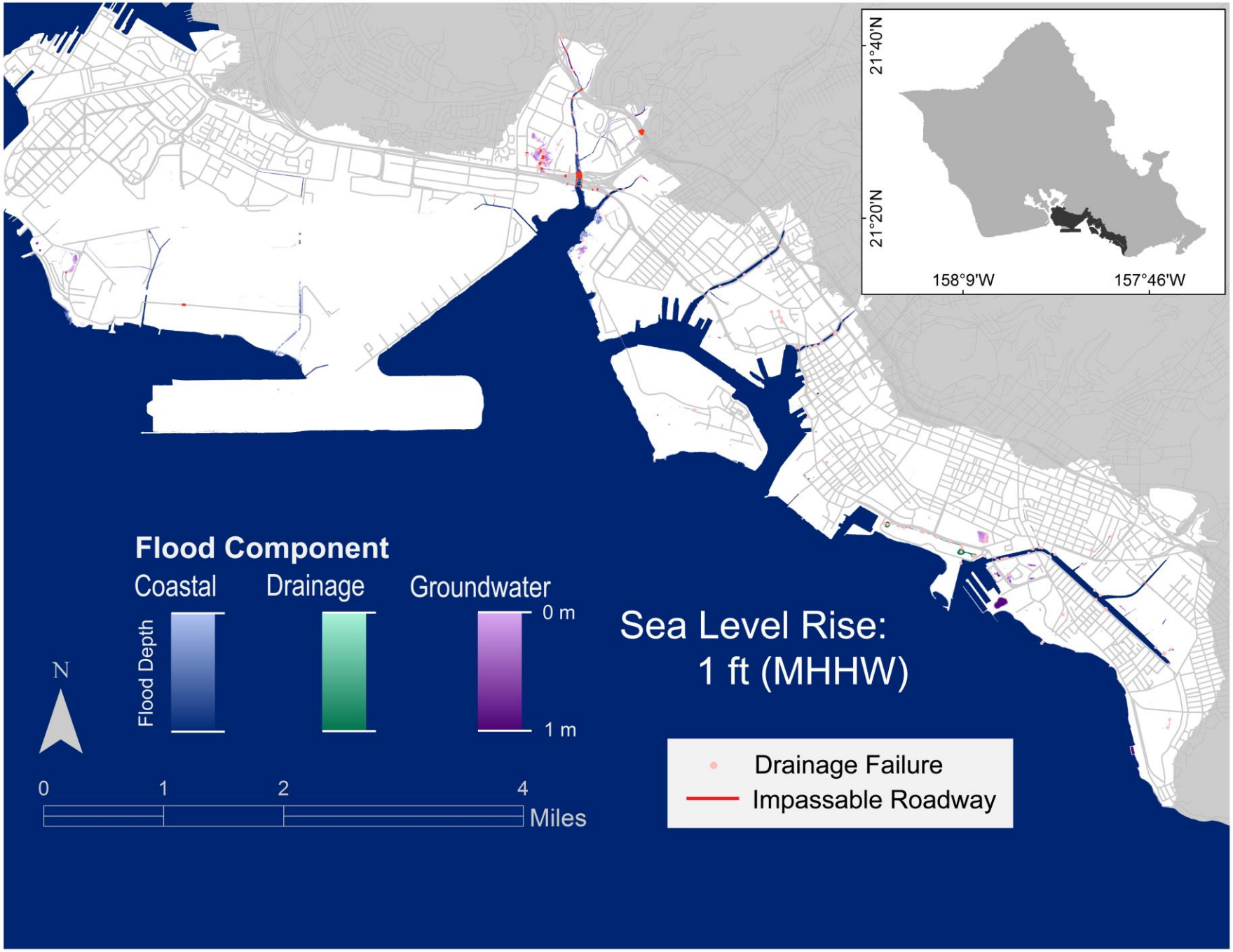
How High Sea Level?

- *Very likely* to rise 0.3–0.6 feet by 2030
- 0.5–1.2 feet by 2050
- 1.0–4.3 feet by 2100
- Future emissions have little effect on SLR in the first half of the century
- But significantly affect SLR for the second half of the century
- Emerging science on Antarctica suggests, for high emission scenarios, a SLR exceeding 8 ft by 2100 is physically possible
- It is *extremely likely* that SLR rise will continue beyond 2100 (*high confidence*).

Tour of Oahu at 1 m SLR




21°40'N
21°20'N
158°9'W
157°46'W
Flood Component
Coastal
Drainage
Groundwater
Flood Depth
0 m
1 m
N
0
1
2
4
Miles
Current Sea Level (MHHW)
Drainage Failure
Impassable Roadway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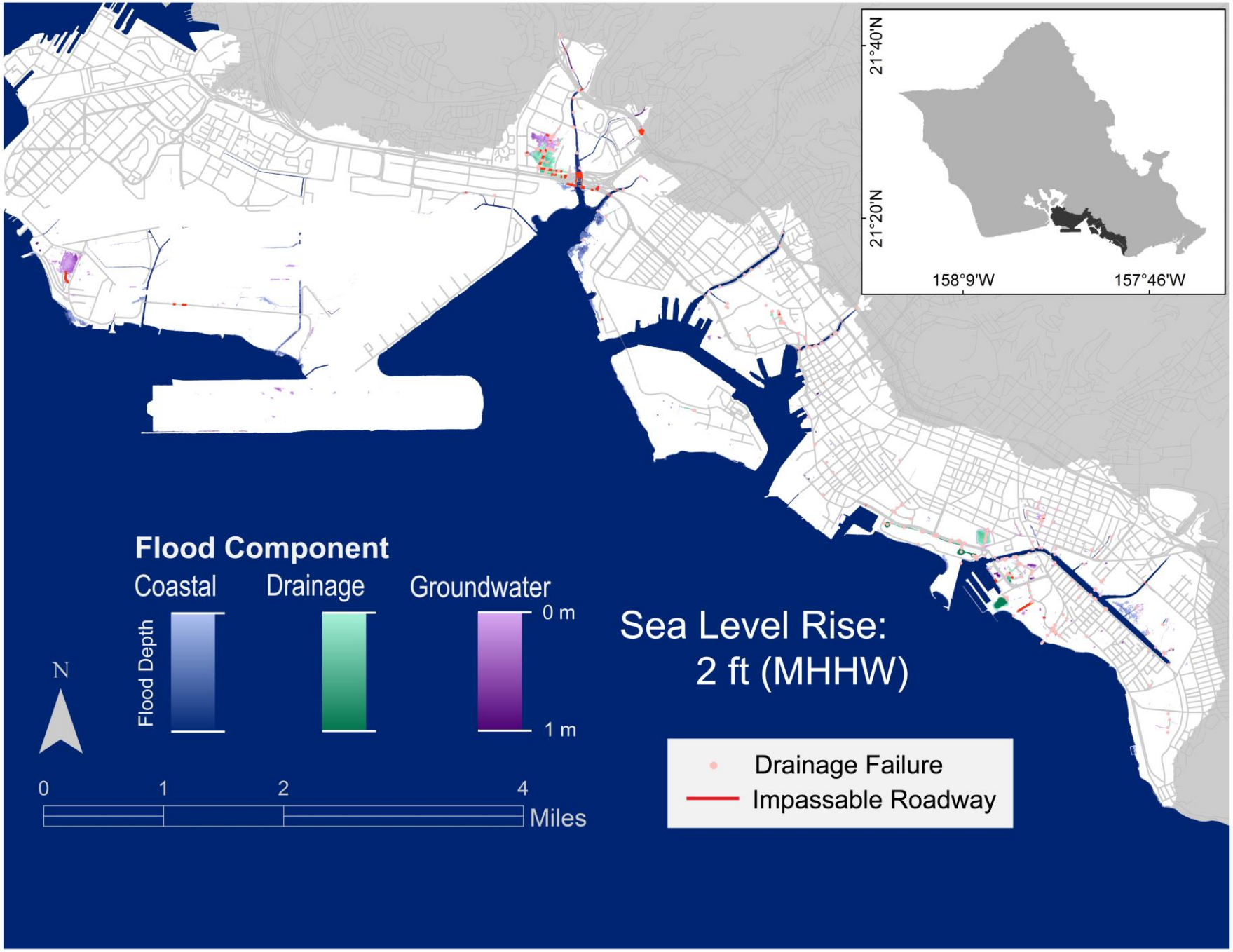
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4
Miles
Sea Level Rise:
2 ft (MHHW)
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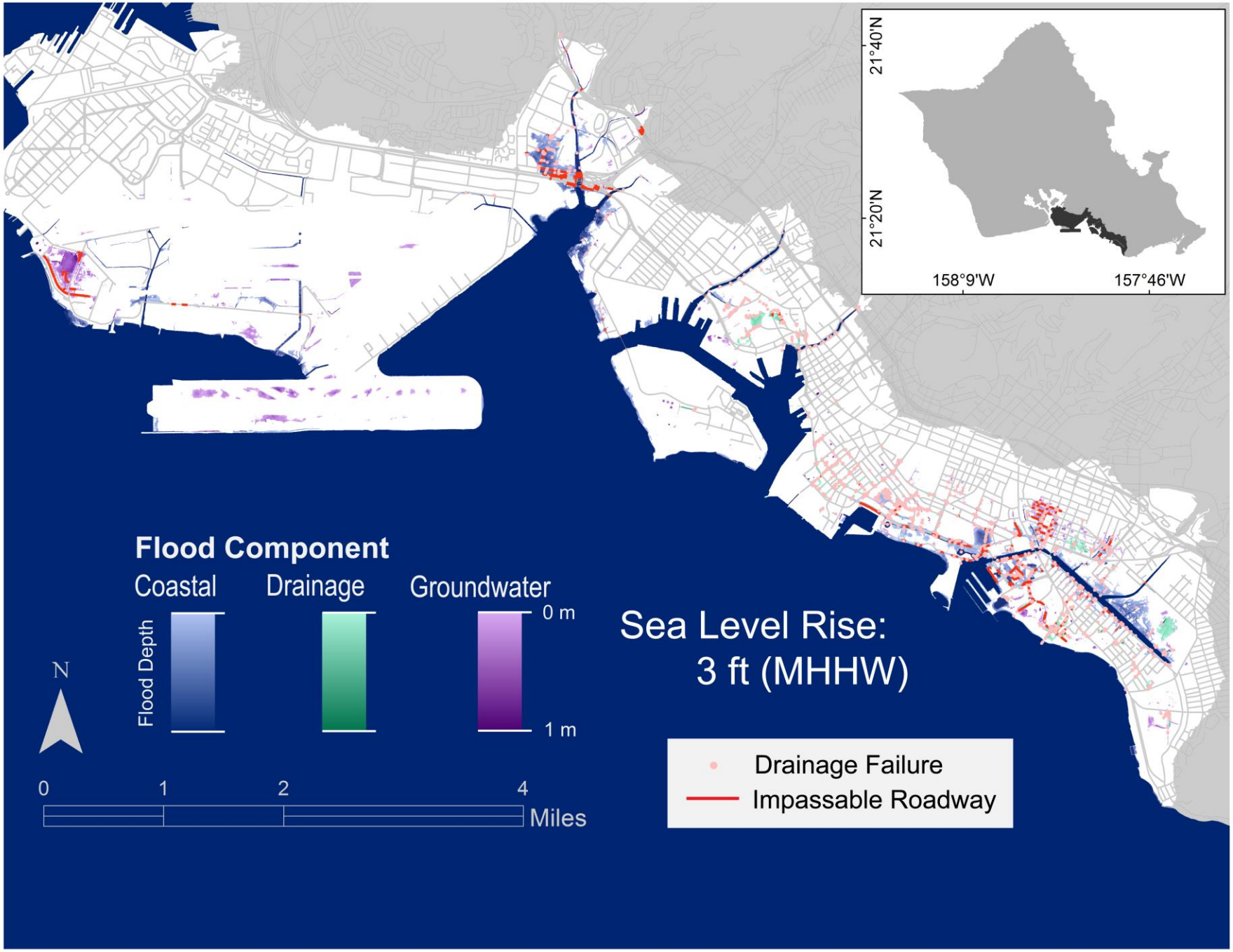
Impassable Roadway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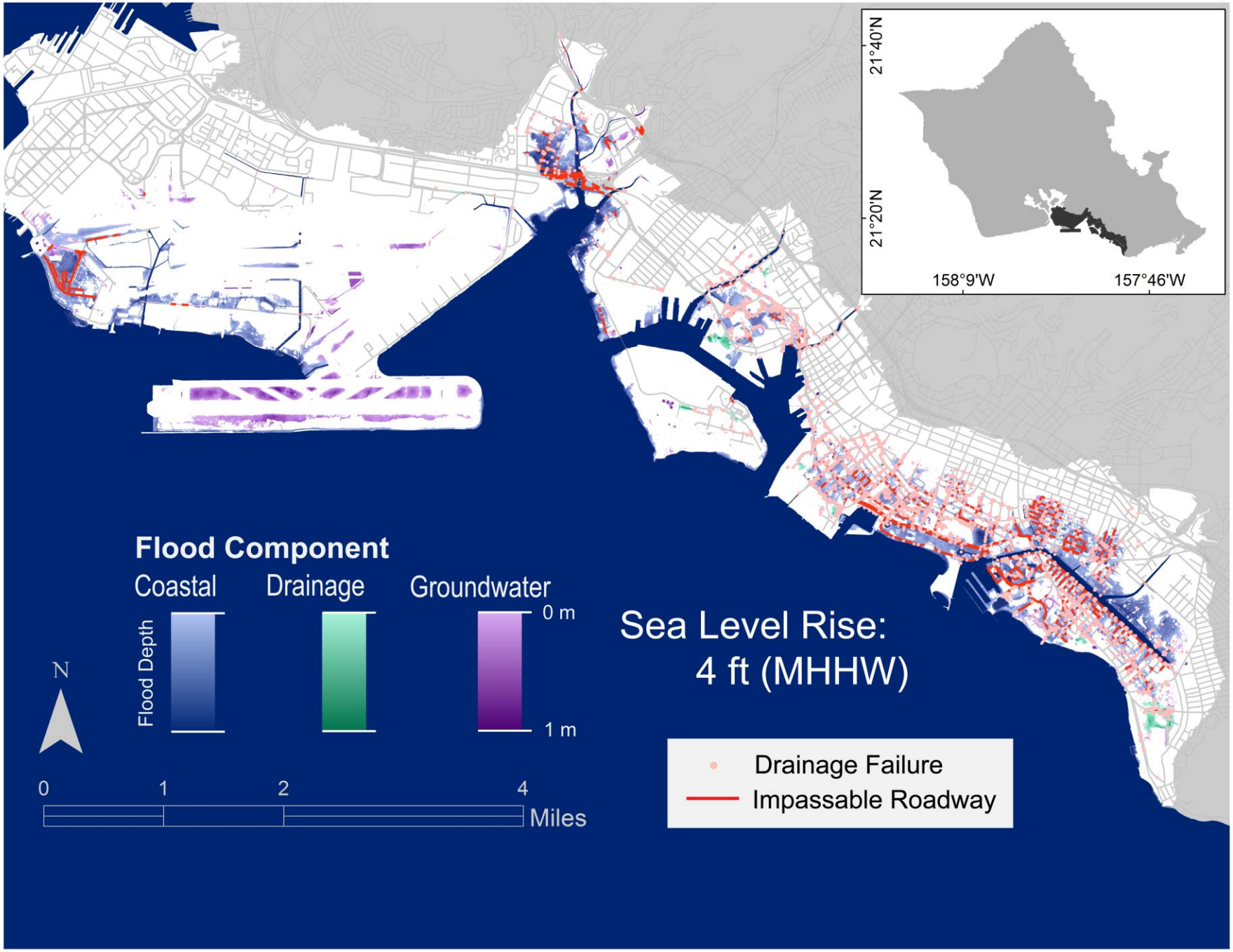
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Groundwater
Flood Depth
0 m
1 m
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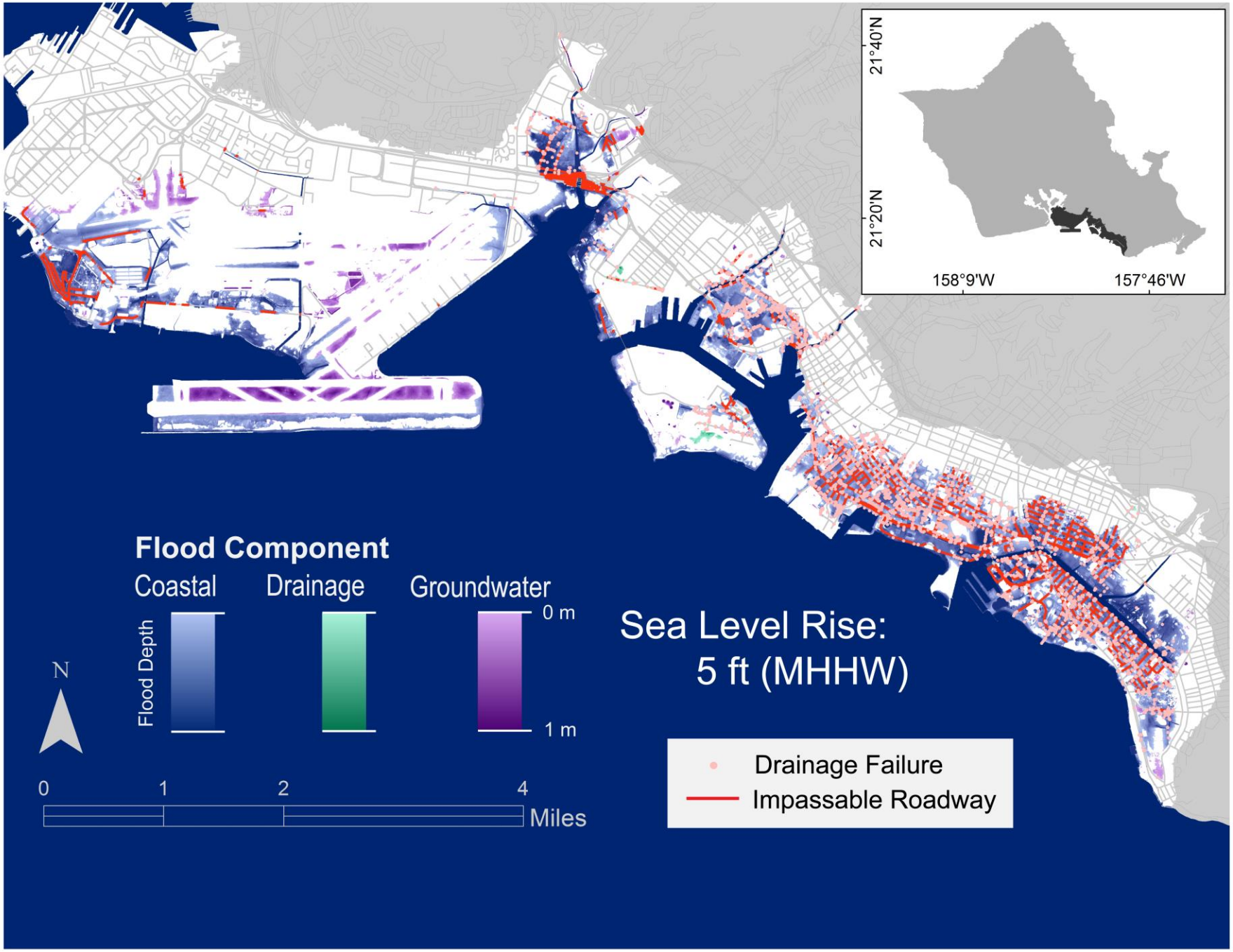
2
4
Miles
Sea Level Rise:
4 ft (MHHW)
Drainage Failure
Impassable Roadway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