

Bradley Beach

Flood Hazard Assessment

Overview

- Profile: Bradley Beach
- FEMA-FIRM Flood Zones
- NJDEP Flood Inundation Models
- Land parcels vulnerable to flooding
- Hurricane Sandy – Storm Surge Extent
- Comparative estimates of flooded parcels
- Overburdened Communities
- Social Vulnerability
- Conclusions
- NJ Army Back Bay Corps Coastal Storm Risk Management Study, 2021

Bradley Beach, Monmouth County, NJ

Demographics (ACS, 2019)

Population	4,193
Growth Since 2010	-4.47% (-192)
Area	0.61 sq. mile.
Pop. Density	6852/ sq. mile
Average HH Size	2
Housing Units / Occupied	3,168 / 67.9%
Owner Occupied Units	1,024 (47.6%)
Median HH Income	\$64,246
Poverty	11%
Unemployment Rate	5.3%
Median Rental Cost	\$1,348 /month
Median House Value	\$567,400
Median Age	42.4 years
White Population	89.29%
Non-White Population	10.71%
Home Ownership Rate	47.6%
Less than HS Education	7.84%

Near Bradley Beach Park

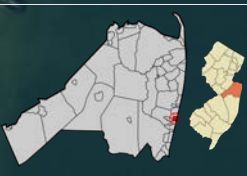
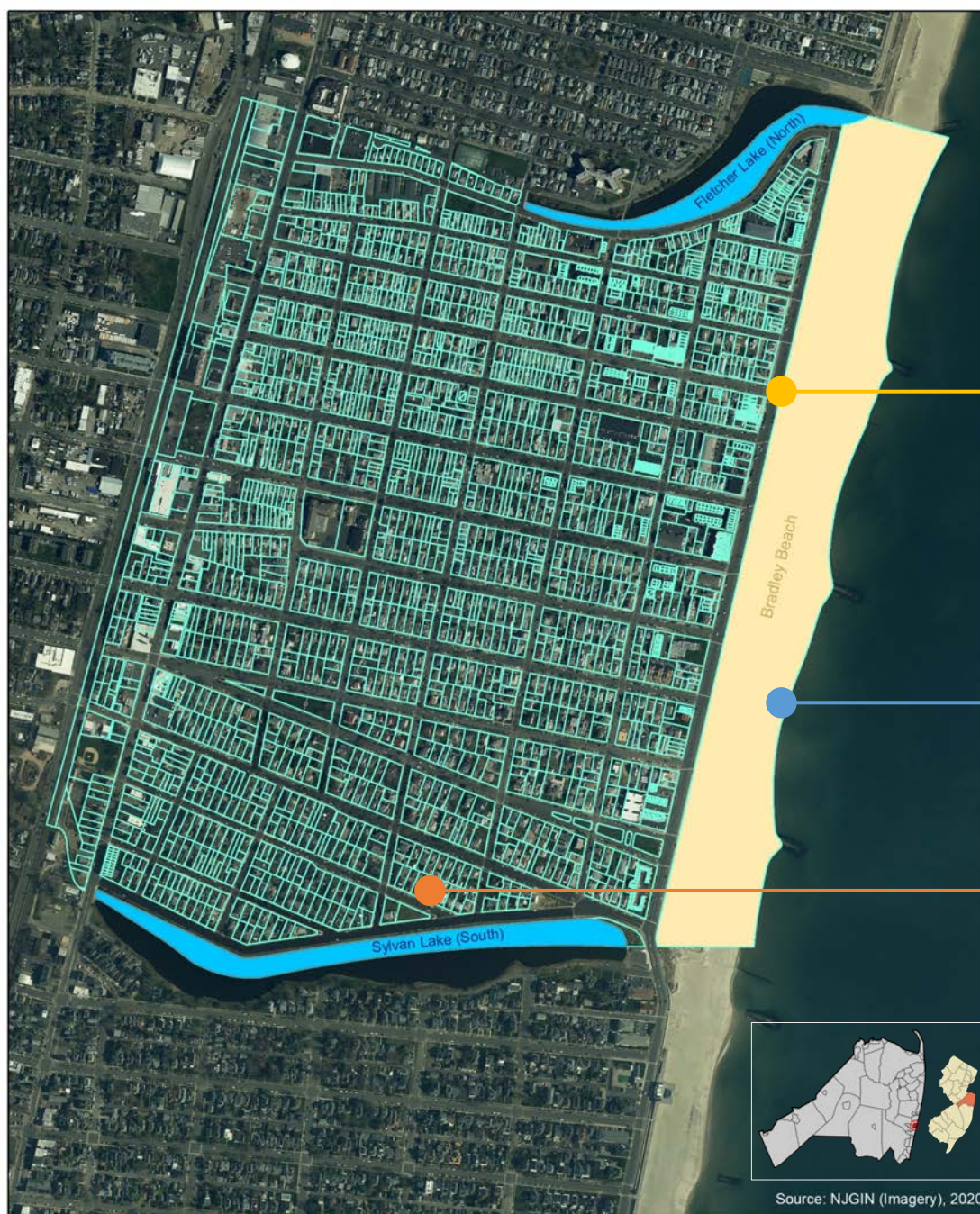


Bradley Beach Shore



Breakwater

Monmouth Avenue, Bradley Beach



Source: NJGIN (Imagery), 2020

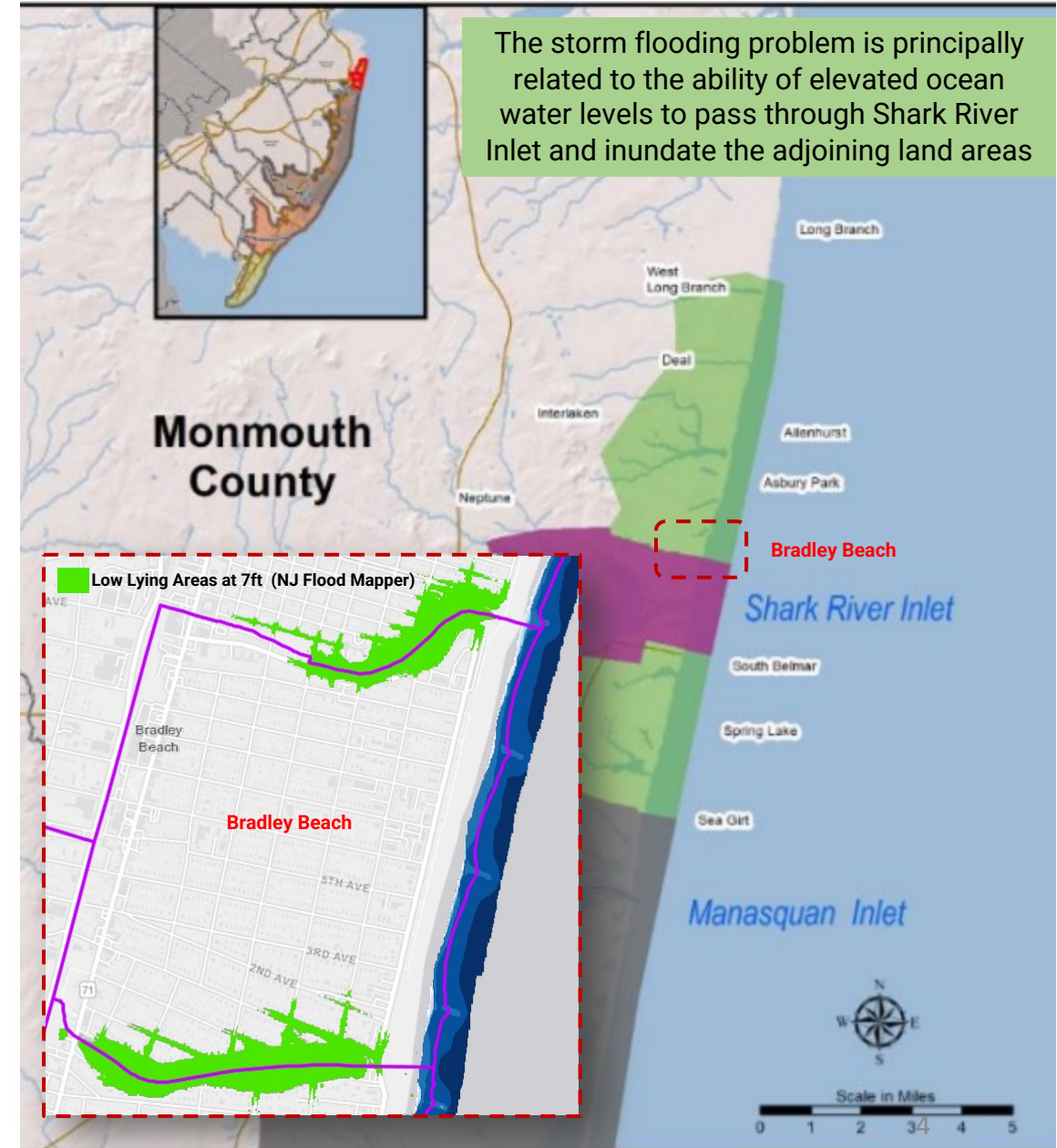
Bradley Beach, Monmouth County, NJ - Orthophoto 2020



Image Sources: Asbury Park Press, Katora Realty ,and Realtor.com (from top)

Bradley Beach Flood Vulnerability – Key Findings

- All of the coastal flooding in Bradley Beach occurs along the two lakes, Sylvan and Fletcher lakes, in the southern and northern end of the borough, respectively.
- According to the FEMA-FIRM Zones, the borough has a total of **191 parcels** in the floodplain; of which 51 are in the 100-year floodplain and the remaining 140 are in the 500-year floodplain.
- Based on the NJDEP flood inundation models
 - Minimal flooding is observed in **106 parcels** at the 7ft MHHW level, along the lakes
 - Minimal flooding is observed in **4 parcels** at the 5ft level, within existing water body parcels
 - **No flooding** observed at the 2ft and 3ft
- The extent of storm surge during Hurricane Sandy (2012) impacted **298 parcels**, along both lakes.
- However, the borough's **vegetated dunes** along the coast played a major role in minimizing inundation in the other mainland areas.



Source: NJ Back Bay Army Corps Coastal Storm Risk Management Study, 2021

FEMA-FIRM Flood Zones (FEMA-FIRM)

Federal Emergency Management Agency (FEMA):

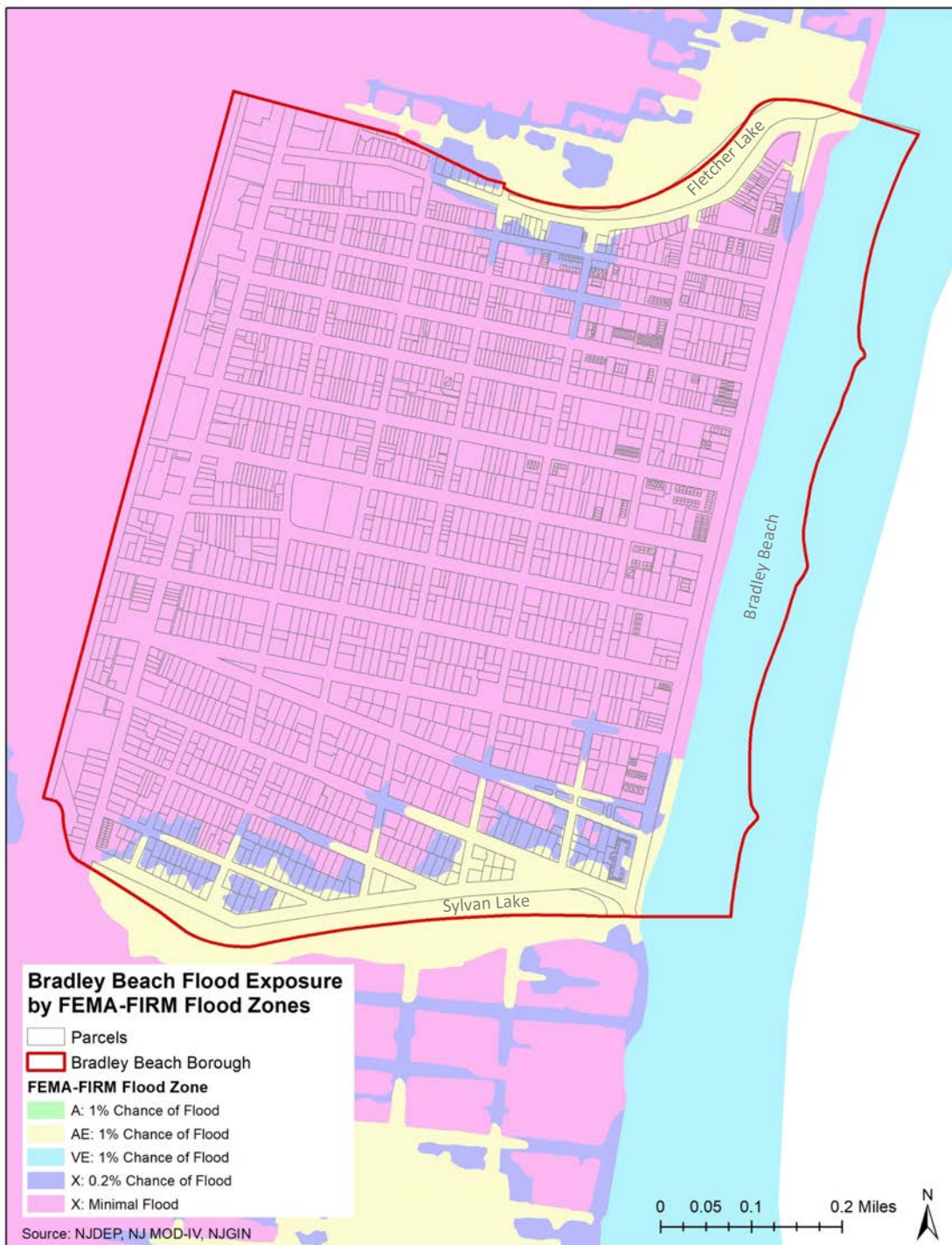
It is the federal agency within the U.S. Department of Homeland Security responsible for responding to, and mitigating, federally-designated disasters.

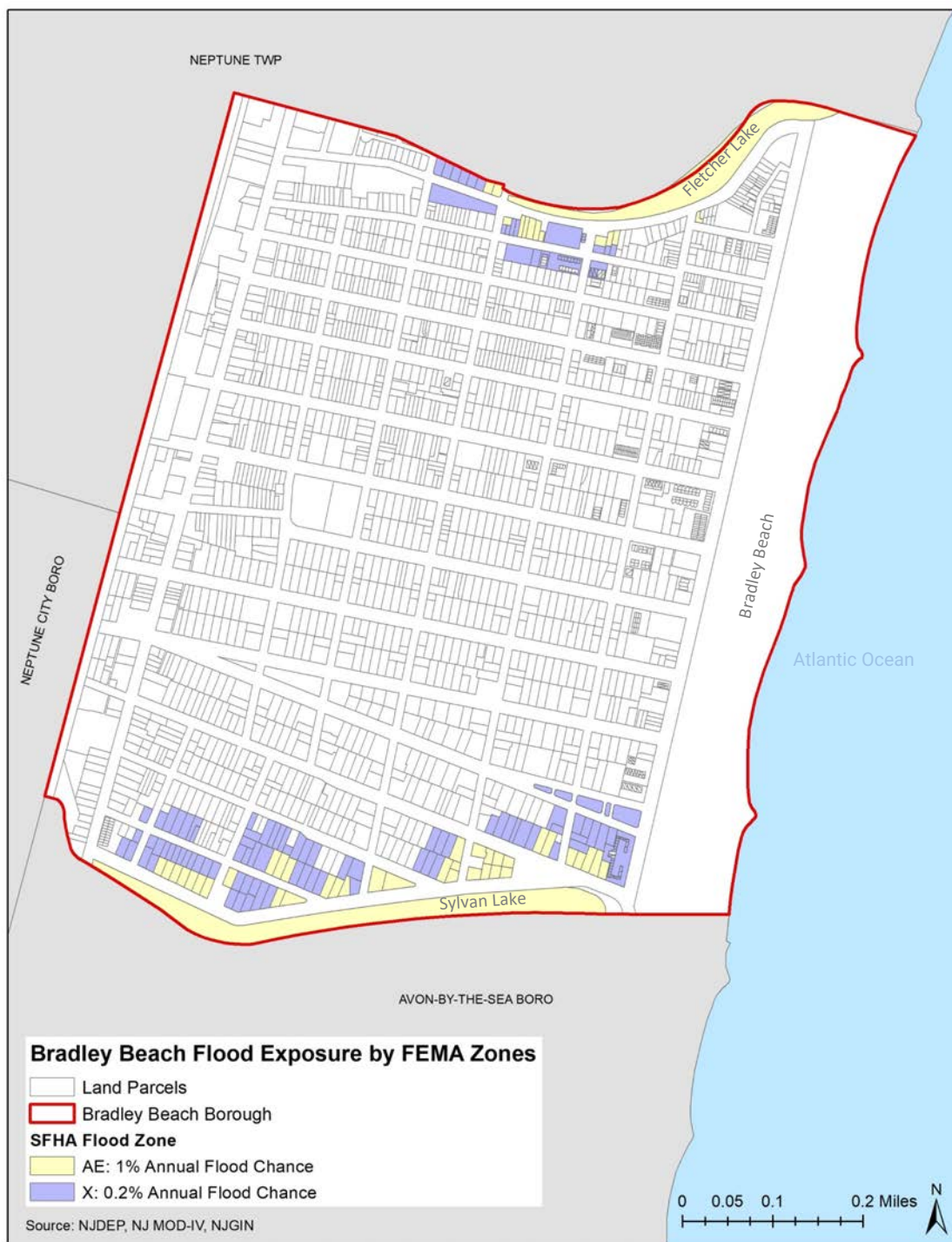
Flood Insurance Rate Map (FIRM):

Official map of a community on which FEMA has delineated

1. Flood Zones
 2. Special Flood Hazard Areas (SFHAs)
 3. Base Flood Elevations (BFEs)
 4. Risk premium zones applicable to the community.
- **Flood Zones include A, AE, VE which are 1% chance of flood zones (High Risk Zones), the X-500 or the 0.2% chance of flood (Low Risk Zone) , and X which is the least risk zone.**
 - **Special Flood Hazard Area (SFHA):** Flood hazard areas identified on the **Flood Insurance Rate Map** that are defined as the area that will be inundated by the flood event having a 1% chance of being equaled or exceeded in any given year. **The 1% annual chance flood is also referred to as the base flood or 100-year flood.**

The SFHA is the area where the National Flood Insurance Program's (NFIP's) Floodplain Management Regulations must be enforced and the area where the mandatory purchase of flood insurance applies.





Parcels in FEMA-FIRM Flood Zones

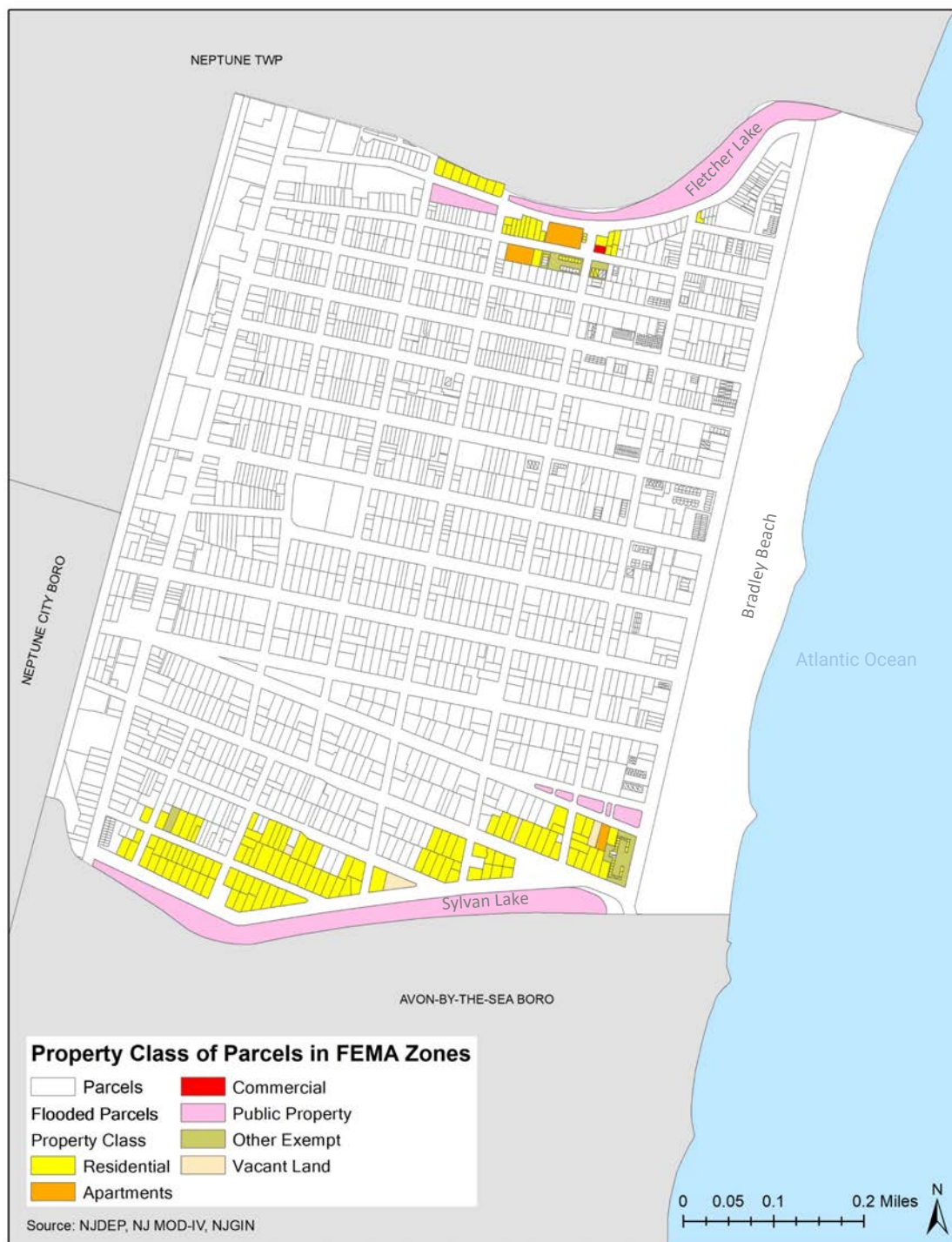
Parcels Flooded in FEMA-FIRM Zones			
Zone	Parcels	Net Value*	NV (%)
AE: 1% Annual Flood Chance	51	\$39,556,900	32%
X: 0.2% Annual Flood Chance	140	\$83,568,200	68%
TOTAL	191	\$123,125,100	100%

*Net Value = Total assessed value of land + Total assessed value of buildings

Fletcher Lake (North) - Parcels Flooded in FEMA-FIRM Zones			
AE: 1% Annual Flood Chance	13	\$7,312,000	29.1%
X: 0.2% Annual Flood Chance	35	\$17,854,700	70.9%
TOTAL	48	\$25,166,700	100%

Sylvan Lake (South) - Parcels Flooded in FEMA-FIRM Zones			
AE: 1% Annual Flood Chance	38	\$32,244,900	32.9%
X: 0.2% Annual Flood Chance	105	\$65,713,500	67.1%
TOTAL	143	\$97,958,400	100%

Property Class of Parcels in FEMA-FIRM Zones

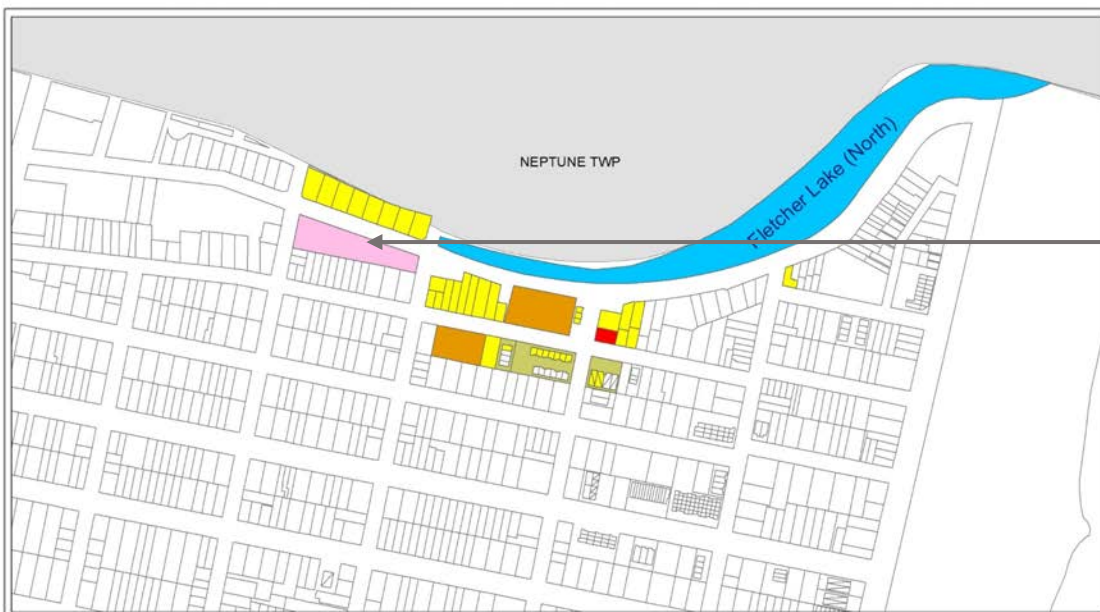


Property Class of Parcels in FEMA-FIRM Zones				
Class	Property Type	Parcels	Net Value*	NV (%)
2	Residential	170	\$113,052,500	91.8%
4C	Apartments	3	\$4,685,900	3.8%
4A	Commercial	1	\$652,800	0.5%
15C	Public Property	8	\$2,757,600	2.2%
15F	Other Exempt	5	\$698,100	0.6%
1	Vacant Land	4	\$1,278,200	1%
TOTAL		191	\$123,125,100	100%

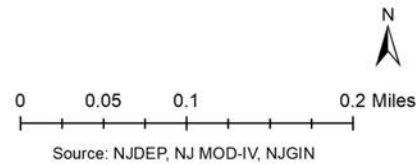
*Net Value = Total assessed value of land + Total assessed value of buildings

- Based on the analysis, there are 170 residential parcels with a total net value of roughly \$113 million.
- These may be eligible for buyouts as per the NJDEP Superstorm Sandy Recovery, Flood Mitigation and Buyout Program – Blue Acres Floodplain Acquisitions

Property Class of Parcels in FEMA-FIRM Zones



Property Class of Parcels in FEMA Zones



Fletcher Lake (North) – Property Class of Parcels in FEMA Zones

Class	Property Type	Parcels	Net Value*	NV (%)
2	Residential	40	\$19,933,400	79.2%
4C	Apartments	2	\$3,440,000	4.5%
4A	Commercial	1	\$652,800	0%
15C	Public Property	2	\$1,140,500	2.6%
15F	Other Exempt	3	\$0	13.7%
TOTAL		48	\$25,166,700	100%

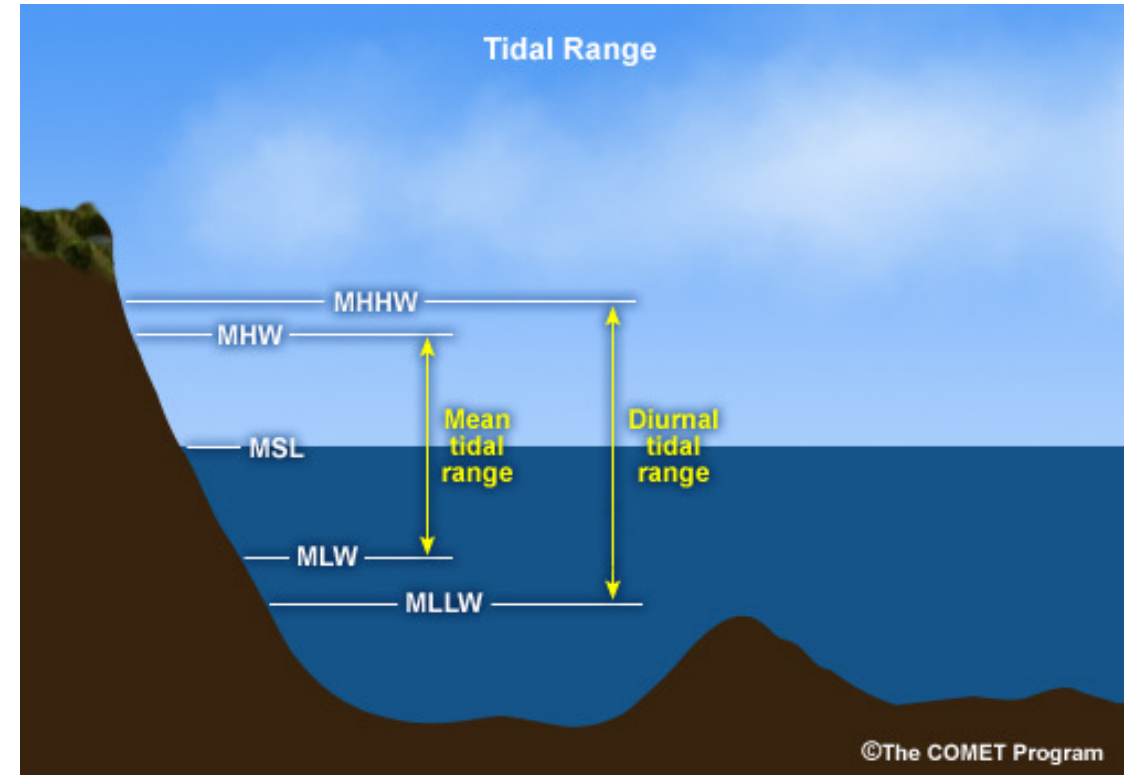
Sylvan Lake (South) - Property Class of Parcels in FEMA Zones

Class	Property Type	Parcels	Net Value*	NV (%)
2	Residential	130	\$93,119,100	95.1%
4C	Apartments	1	\$1,245,900	1.3%
15C	Public Property	6	\$1,617,100	1.7%
15F	Other Exempt	2	\$698,100	0.7%
1	Vacant Land	4	\$1,278,200	1.3%
TOTAL		143	\$97,958,400	100%

*Net Value = Total assessed value of land + Total assessed value of buildings

NJDEP Flood Inundation Models – MHHW Levels

- Mean Higher High Water (MHHW) is a tidal datum developed by the National Oceanic and Atmospheric Administration (NOAA). It is the average of the higher high water height of each tidal day observed over the National Tidal Datum Epoch.
- Total Water Level - The 'still water' inundation above Mean Higher High Water (MHHW). These water levels allow you to visualize the impact of future sea level rise combined with potential flood events up to 20ft of inundation.
- **Seawater that rises past the MHHW line is considered inundation**, and therefore water level measurements relative to MHHW can be considered as proxies for measurements of inundation.



NJDEP Sea-Level Rise Guidance for NJ (June, 2021)

Year	Low End	At least a 66% chance between			High End
	Greater than a 95% chance SLR exceeds	Greater than an 83% chance SLR exceeds	~50% chance SLR exceeds	Less than a 17% chance SLR exceeds	Less than a 5% chance SLR exceeds
2000			0		
2010			0.2 ft		
2020	0.1 ft	0.3 ft	0.5 ft	0.7 ft	0.9 ft
2030	0.3 ft	0.5 ft	0.8 ft	1.1 ft	1.3 ft
2040	0.5 ft	0.7 ft	1.1 ft	1.5 ft	1.9 ft
2050	0.7 ft	0.9 ft	1.4 ft	2.1 ft	2.6 ft
2060	0.8 ft	1.2 ft	1.8 ft	2.5 ft	3.1 ft
2070	1.0 ft	1.4 ft	2.2 ft	3.1 ft	3.8 ft
2080	1.1 ft	1.6 ft	2.6 ft	3.8 ft	4.8 ft
2090	1.2 ft	1.8 ft	3.0 ft	4.4 ft	5.8 ft
2100	1.3 ft	2.0 ft	3.3 ft	5.1 ft	6.9 ft
2110	1.6 ft	2.3 ft	3.7 ft	5.7 ft	8.1 ft
2120	1.6 ft	2.4 ft	4.1 ft	6.4 ft	9.4 ft
2130	1.7 ft	2.6 ft	4.5 ft	7.1 ft	10.9 ft
2140	1.9 ft	2.9 ft	4.9 ft	7.7 ft	12.4 ft
2150	2.1 ft	3.1 ft	5.2 ft	8.3 ft	13.8 ft

Notes: All values are 19-year means and are measured with respect to a 1991-2009 baseline. Projections are 19-year

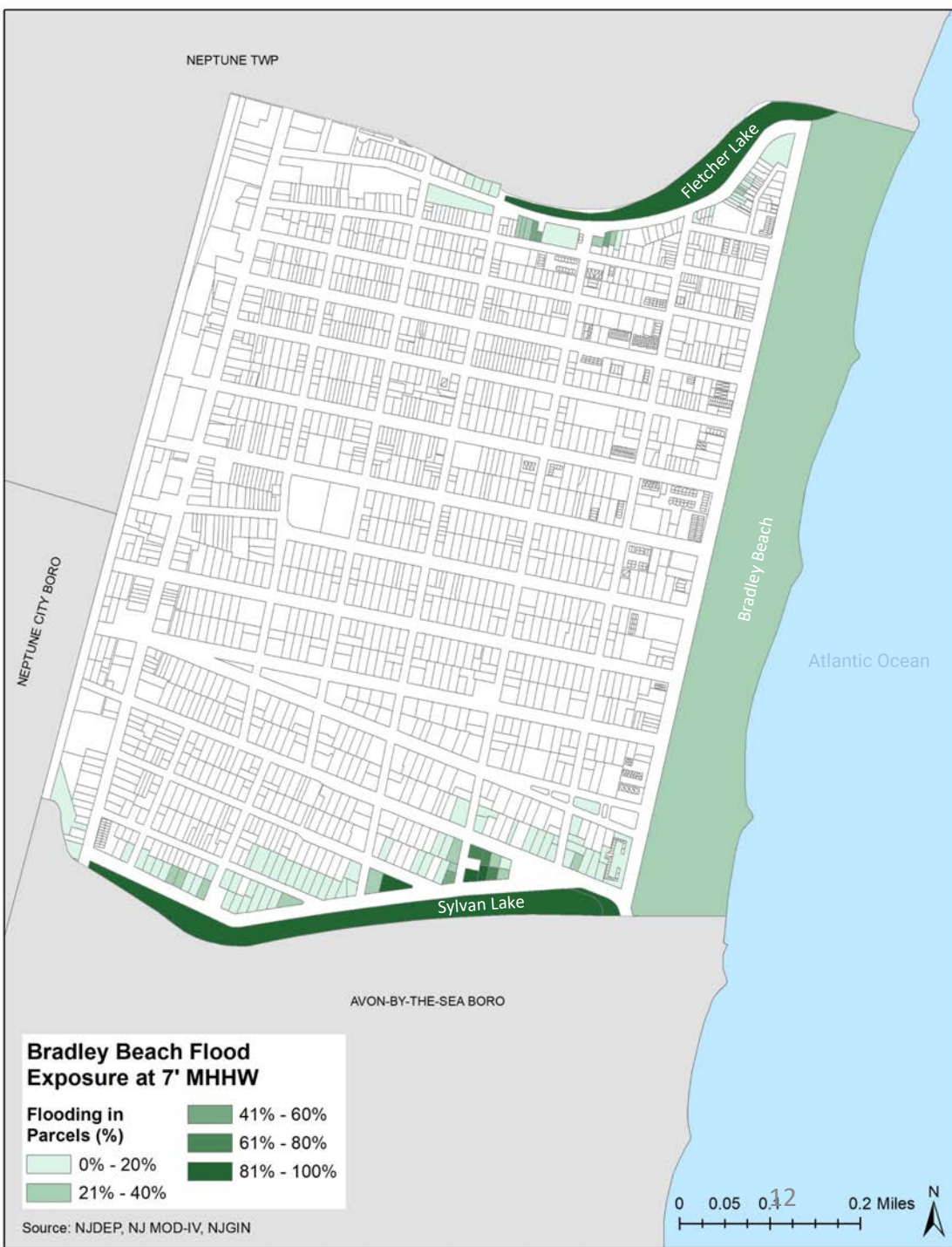
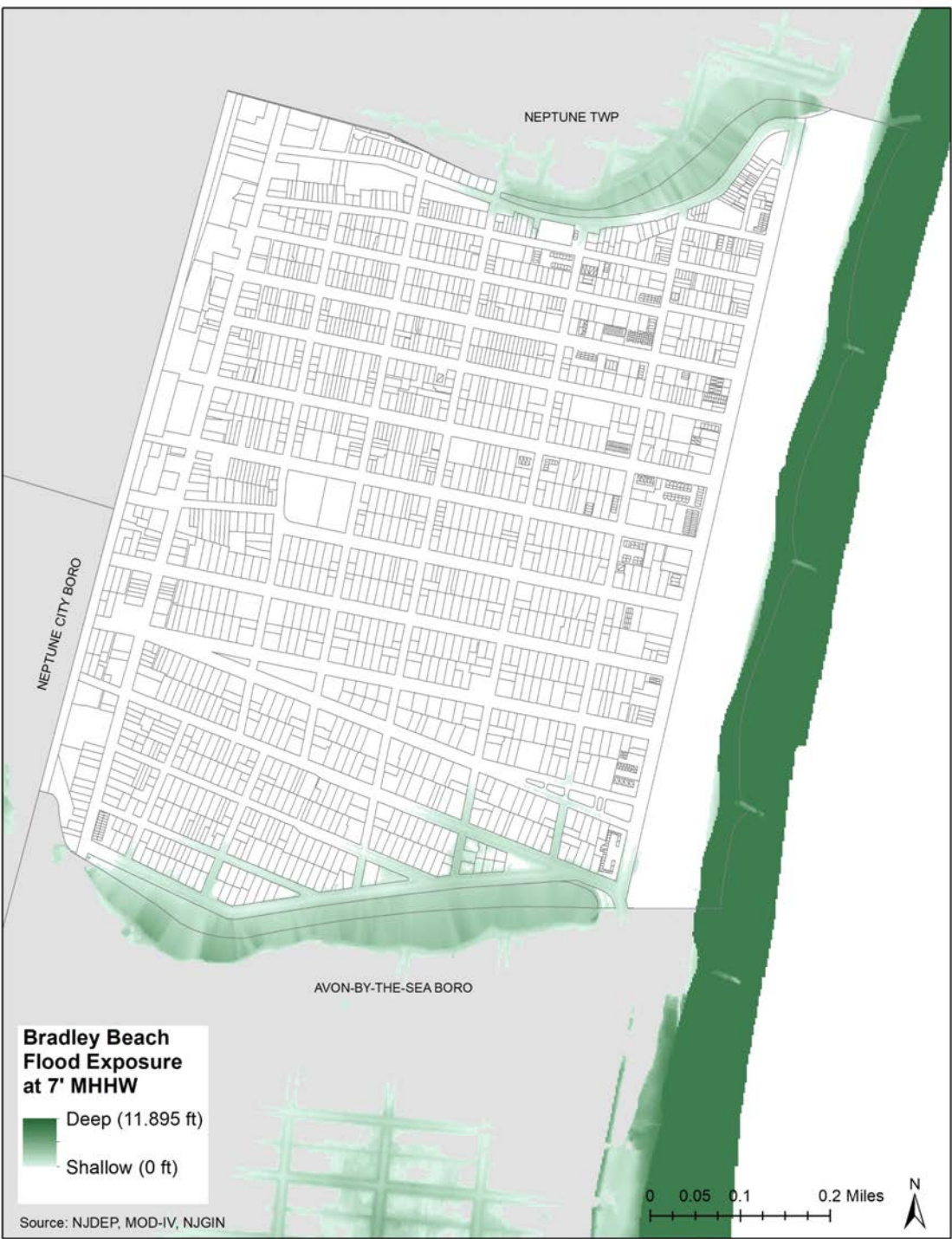
***Activities with less risk tolerance should plan for the upper end of the likely range (<17% Chance SLR exceeds).** These include most activities including single and multi-family residential structures, commercial developments, most energy transmission and water treatment infrastructure, evacuation routes and bridges, hospitals, or public transit facilities.

- Sea Level Rise (SLR) projections in feet for New Jersey from **2000 to 2150** under a moderate emissions scenario.
- The table gives the planning thresholds for the various years. Collectively, the 2ft, 3ft, 5ft, and 7ft levels are **standard state planning benchmarks**.
- NJDEP SLR Guidance for NJ recommends that planners analyze
 - 2ft SLR that is likely unavoidable
 - 5.1ft SLR sufficient to plan for most activities in a community, and
 - 6.9ft SLR for those **critical activities*** for which damages would have debilitating effects on public health and safety.
- Additionally, NJOPA's Municipal Plan Endorsement guidelines require that "Communities assess flood risks that at a minimum identifies areas within the municipality that are subject to exposure to 3-, 5-, and 7-foot of sea-level rise and the 1% (100-year) and 0.2% (500- year) storms as part of the Municipal Self-Assessment."

Flood Exposure at 5ft MHHW Level



Flood Exposure at 7ft MHHW Level



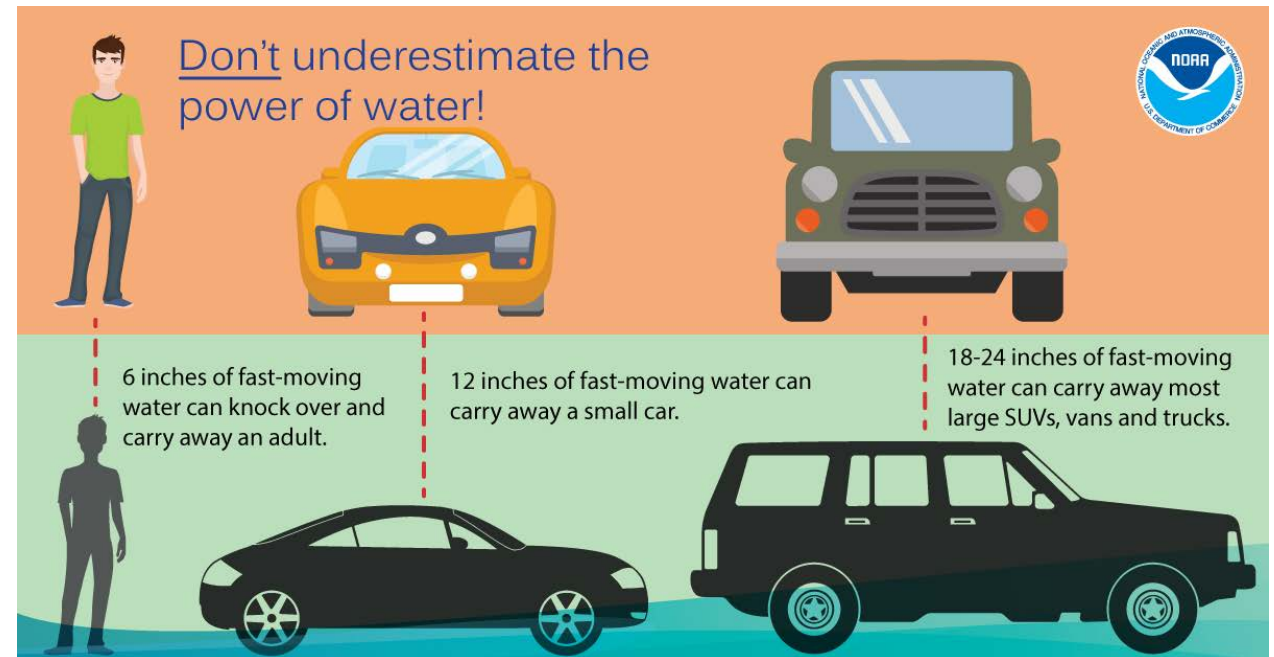
Flooding on Roads

- **According to FEMA:**

- **6 inches (0.5 ft)** of rushing water will reach the bottom of most passenger cars, causing loss of control and potential stalling.
- **12 inches (1 ft)** of rushing water can cause many vehicles to float.
- **18 to 24 inches (1.5 to 2 ft)** of rushing water can carry away most vehicles, including SUVs and pickups.

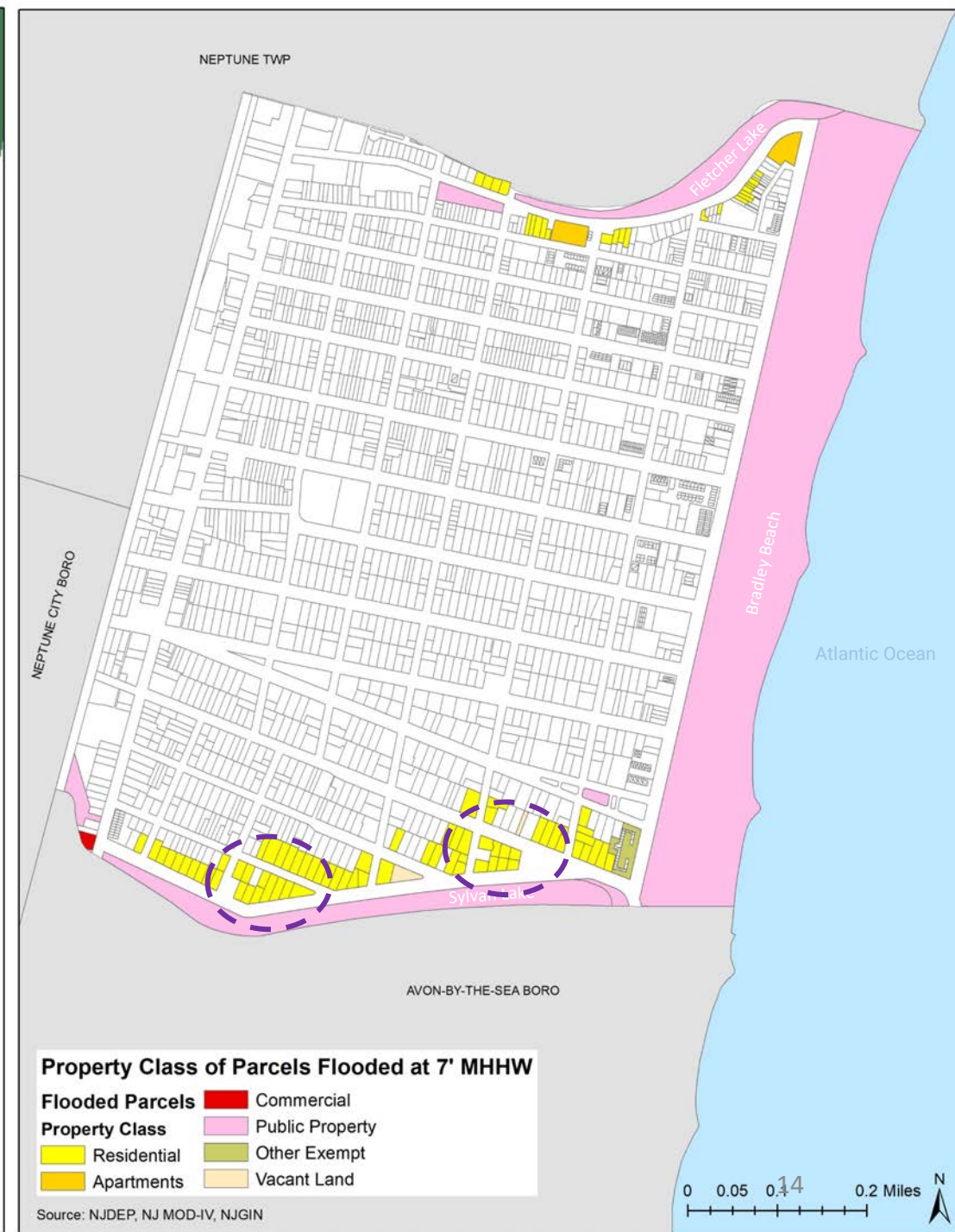
- **According to the U.S. Geological Survey:**

- Water at **1 foot** depth typically exerts 500 pounds of lateral force on a vehicle.
- Meaning, once the vehicle is floating, the floodwater becomes the steering wheel. If the water is moving, a vehicle could be swept away, tipped on its side, or flipped.

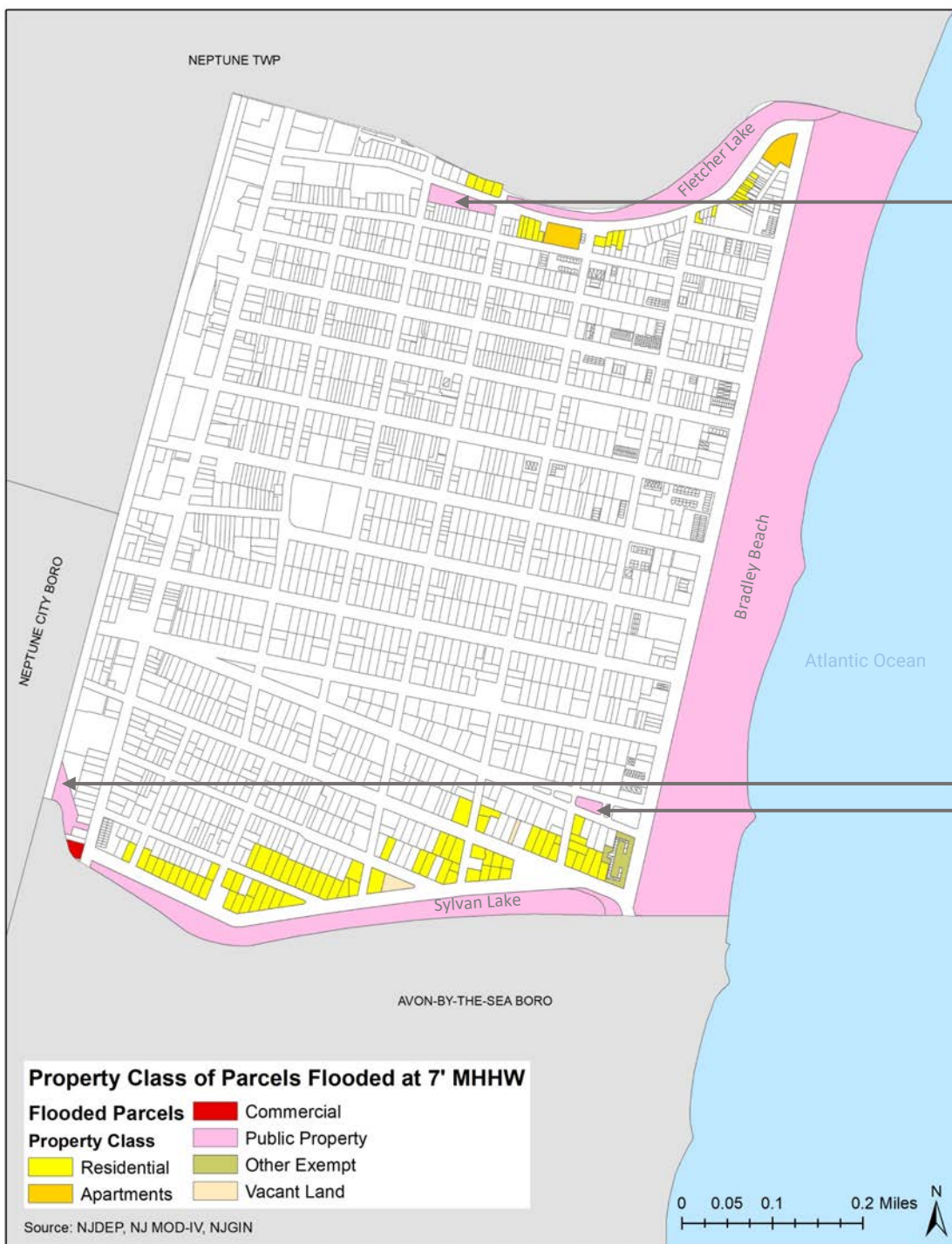


These thresholds are measured as the depth of flooding that renders a road unusable, making it unsafe for most passenger vehicles. Thus, a flood depth of 1 foot is considered to classify a road as **passable or impassable**.

Flood Exposure at 7ft MHHW Level



Property Class of Parcels Flooded at 7ft MHHW Level



Playground

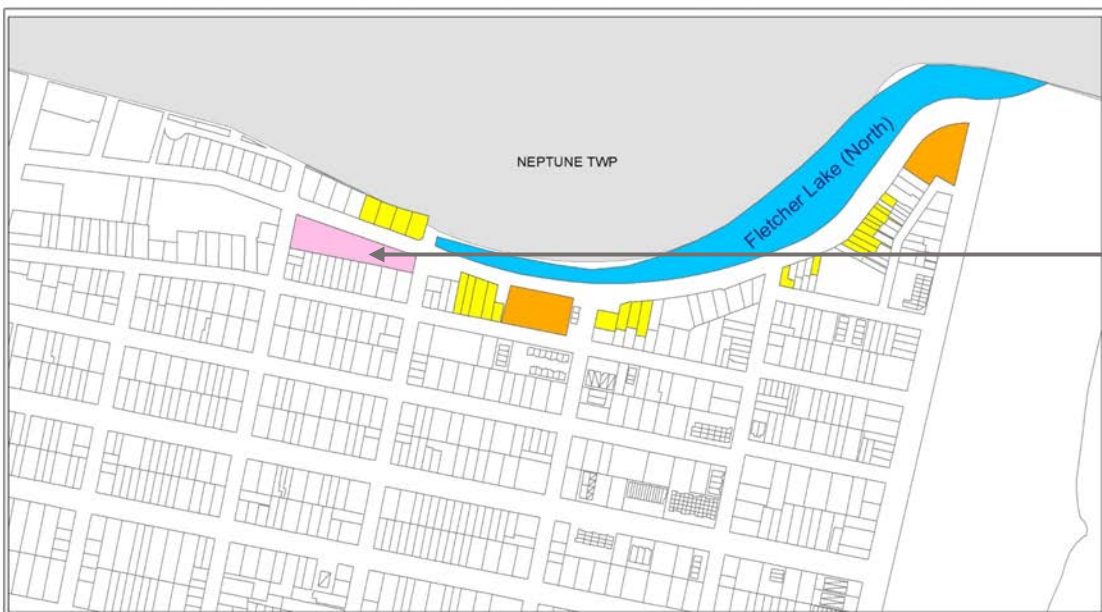
Recreational Space
Green Space

Parcels Flooded at 7' MHHW Level				
Class	Property Type	Parcels	Net Value*	NV (%)
2	Residential	93	\$73,098,500	74.1%
4C	Apartments	2	\$5,136,000	5.2%
4A	Commercial	1	\$336,800	0.3%
15C	Public Property	7	\$19,584,300	19.8%
15F	Other Exempt	1	\$0	0%
1	Vacant Land	2	\$519,700	0.5%
TOTAL		106	\$98,675,300	100%

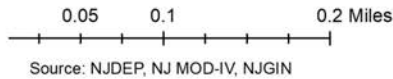
*Net Value = Total assessed value of land + Total assessed value of buildings

- Based on the analysis, there are 93 residential parcels that may be eligible for buyouts, with a total net value of roughly \$73 million.

Property Class of Parcels Flooded at 7ft MHHW Level



Property Class of Parcels Exposed at 7' MHHW Level



Fletcher Lake Area - Parcels Flooded at 7' MHHW Level

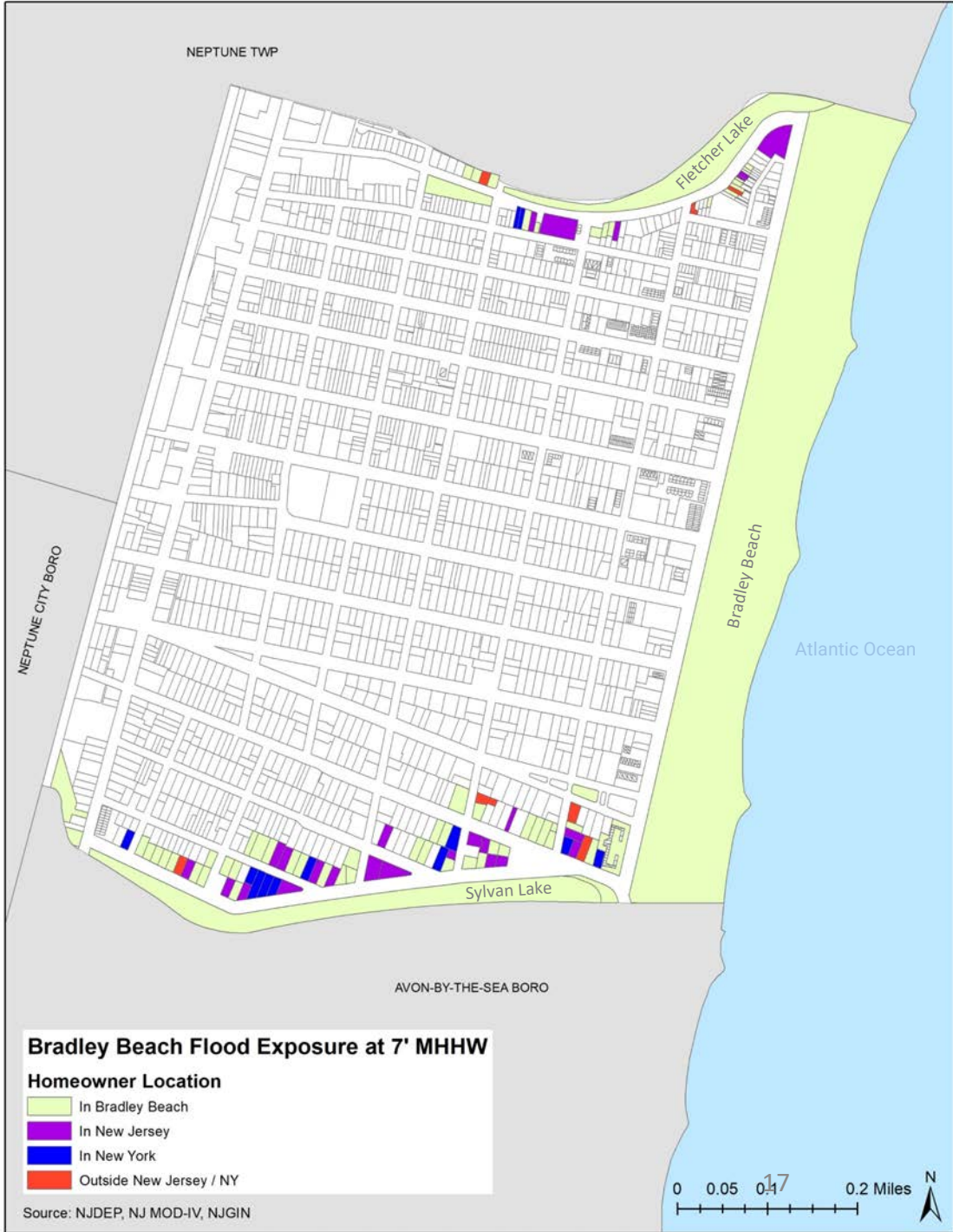
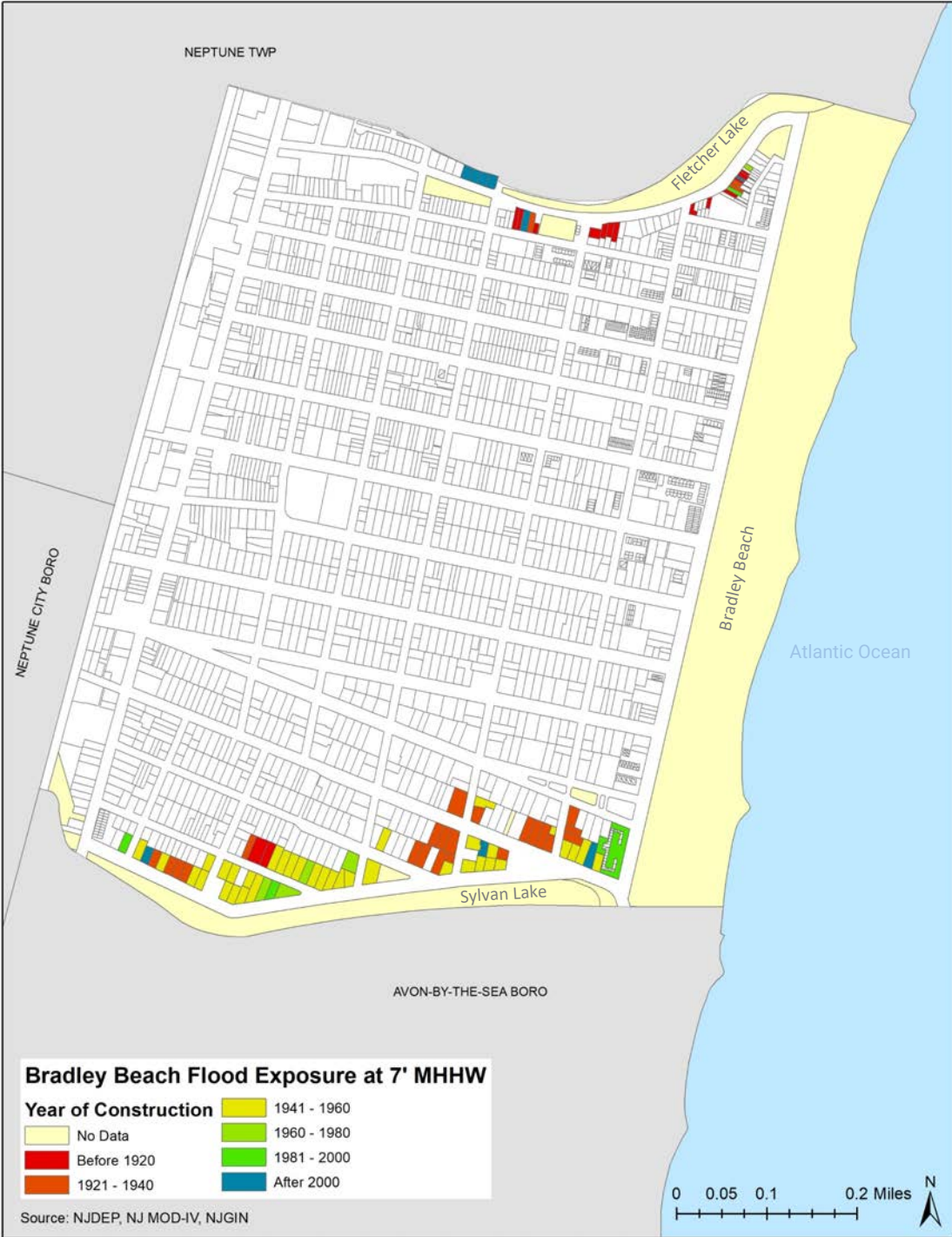
Class	Property Type	Parcels	Net Value*	NV (%)
2	Residential	24	\$14,465,500	69.7%
4C	Apartments	2	\$5,136,000	24.8%
15C	Public Property	1	\$1,140,500	5.5%
TOTAL		27	\$20,742,000	100%

*Net Value = Total assessed value of land + Total assessed value of buildings

Sylvan Lake Area - Parcels Flooded at 7' MHHW Level

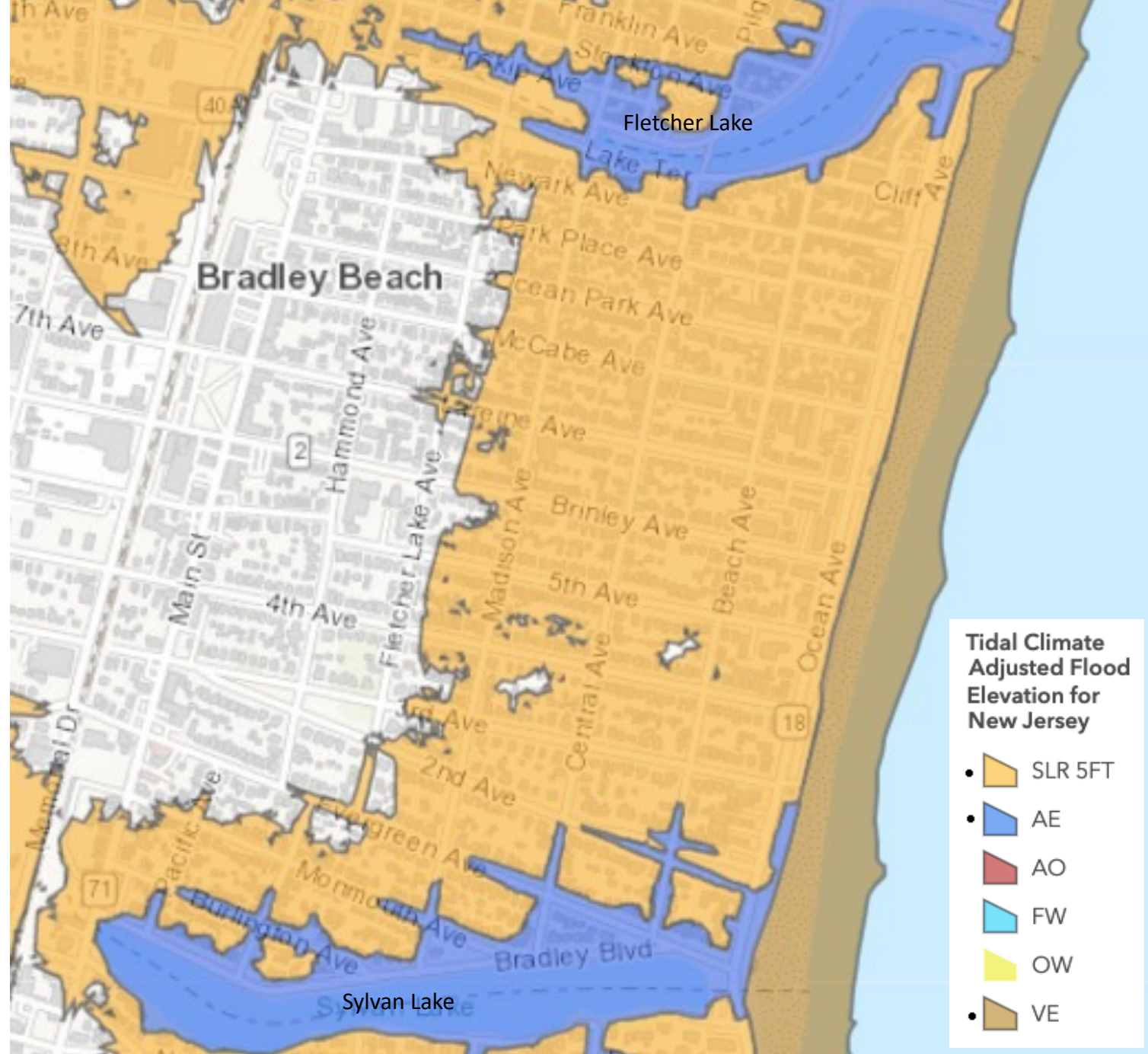
Class	Property Type	Parcels	Net Value*	NV (%)
2	Residential	69	\$58,633,000	96%
4A	Commercial	1	\$336,800	0.6%
15C	Public Property	3	\$1,604,900	2.6%
15F	Other Exempt	1	\$0	0%
1	Vacant Land	2	\$519,700	0.9%
TOTAL		76	\$61,094,400	100%

7ft MHHW Level
-
Year of Construction and
Homeowner Location

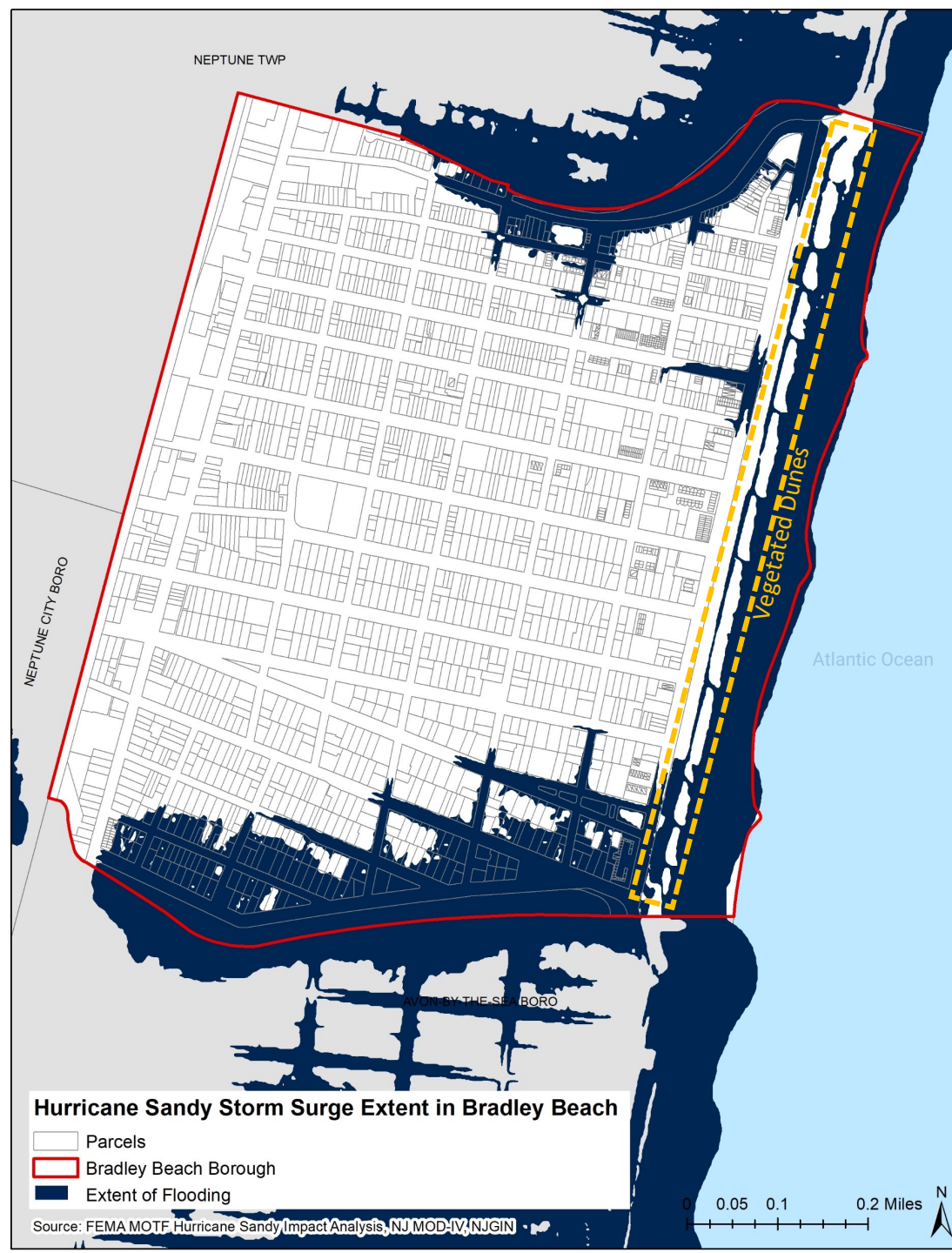


Proposed NJDEP Expansion of FHACA Regulated Area (December, 2020)

- Flood Hazard Area Control Act Rules 2007
- The proposed Climate Adjusted Flood Elevation (CAFE) in tidal areas is 5 feet above FEMA's 100-year flood elevation to account for expected rise in sea level
- This is a proposed State regulatory floodplain, not a scientific model of flood extent.
- In the current state rules, the flood hazard area design flood elevation is equal to the FEMA 100-year flood elevation, which is the same as the SFHA or 1% annual chance zone.



Extent of Flooding during Hurricane Sandy (2012)



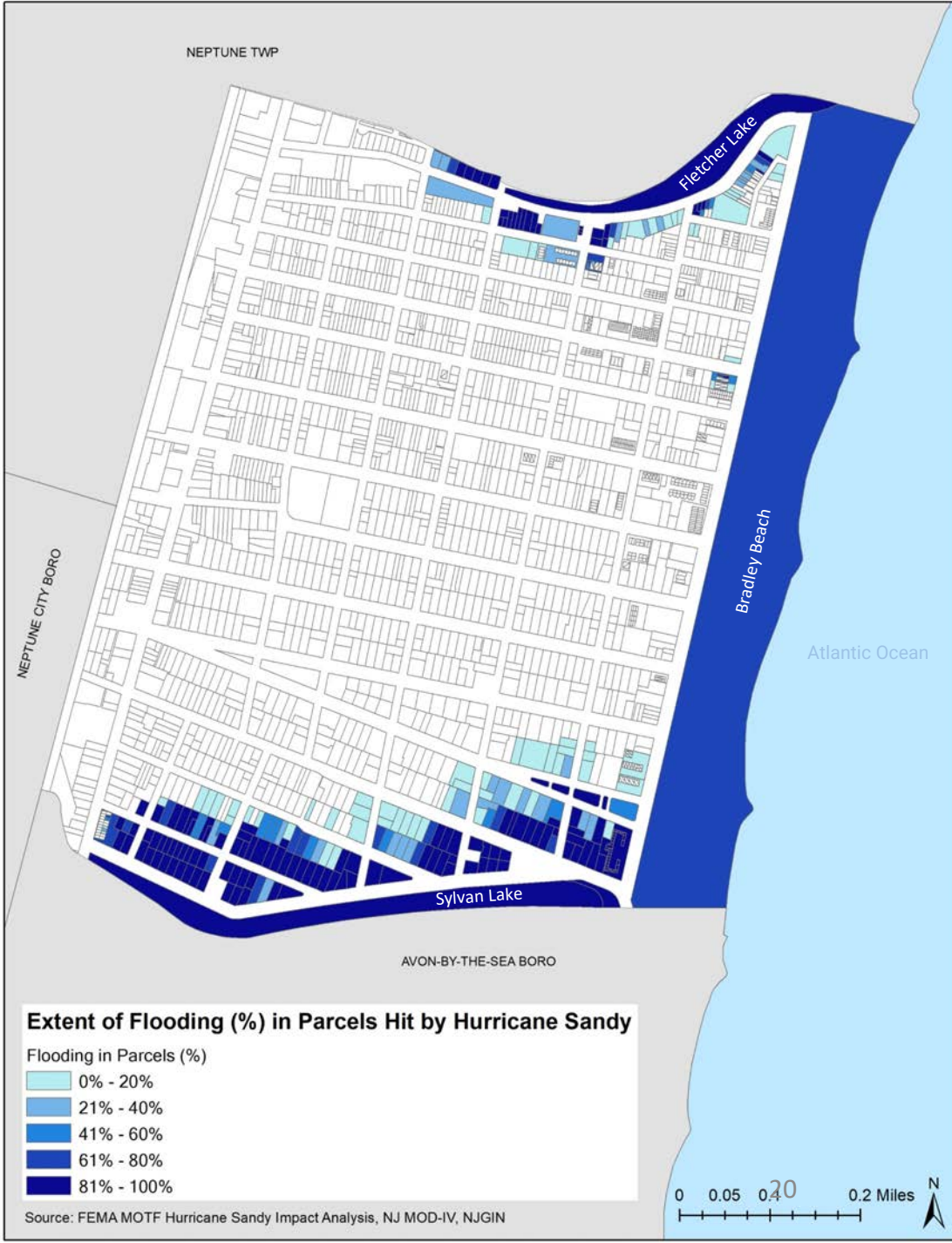
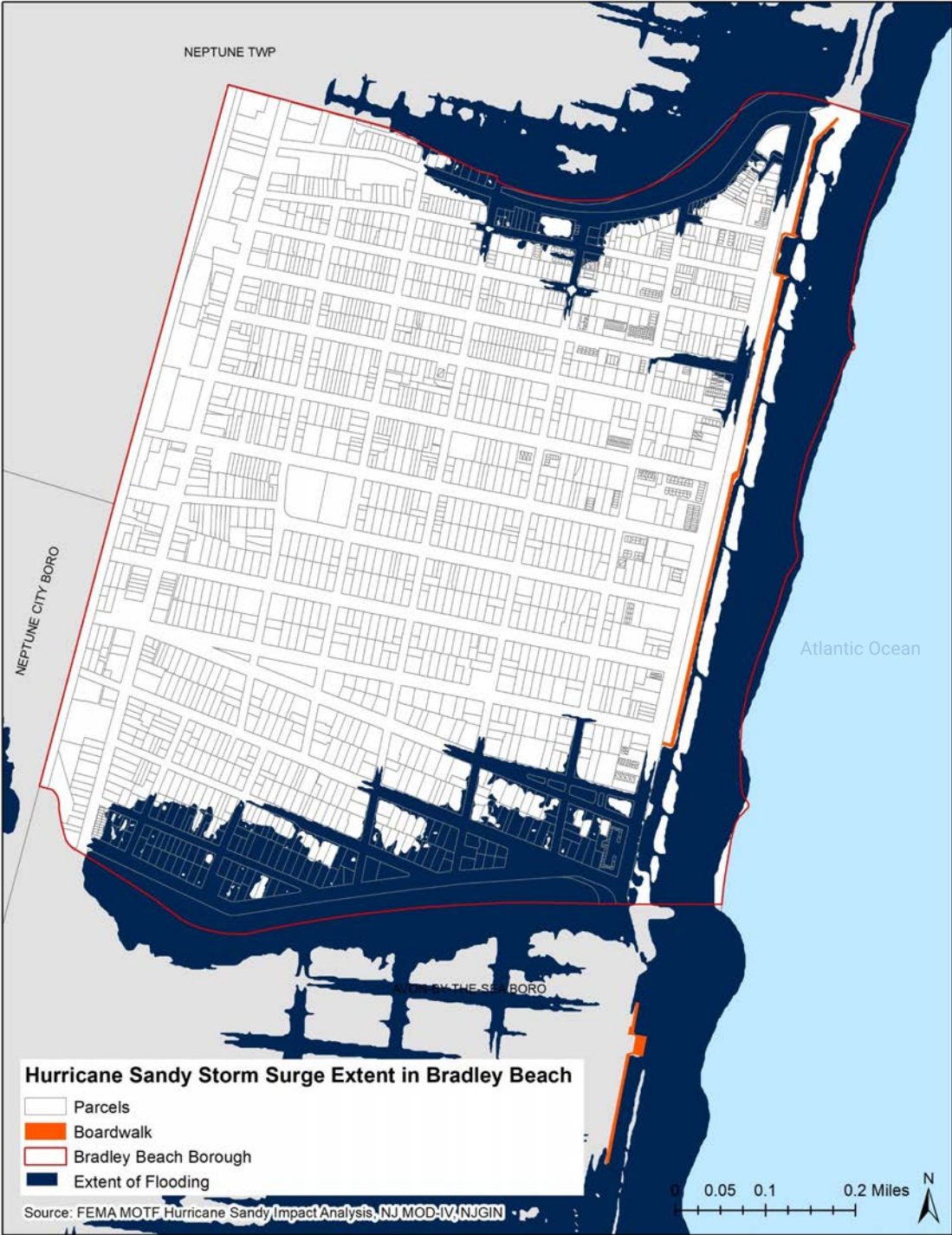
Hurricane Sandy (2012)

- In Bradley Beach, the 15 x 25 foot sand dunes planted with 20,000 Christmas trees gave the beach community protection from Sandy.
- Built in 1996, the dunes stretch across the beach and are just 75 to 100 feet away from many properties.
- Sandy battered shore communities up and down the Jersey coast. Boardwalk and beach huts were torn to pieces. Ocean front homes were ripped from their foundations. **But in Bradley Beach, the boardwalk was largely intact.**

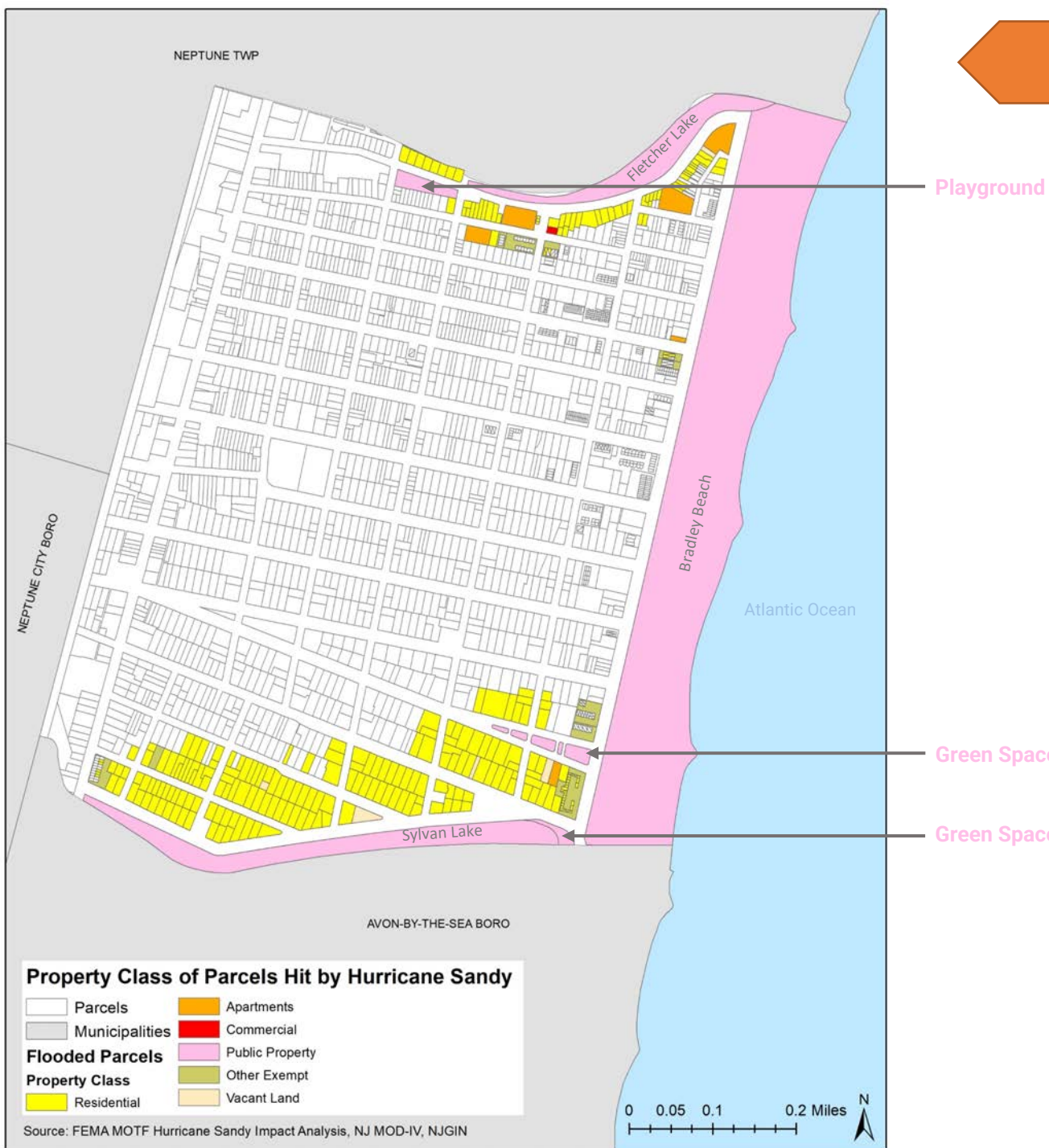


© The Dunes At Bradley Beach Photograph by Natalie Markova

Extent of
Flooding
during
Hurricane
Sandy
(2012)



Property Class of Parcels Hit by Hurricane Sandy

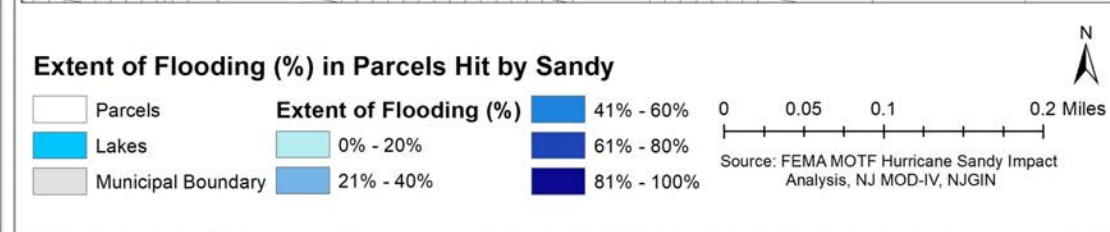
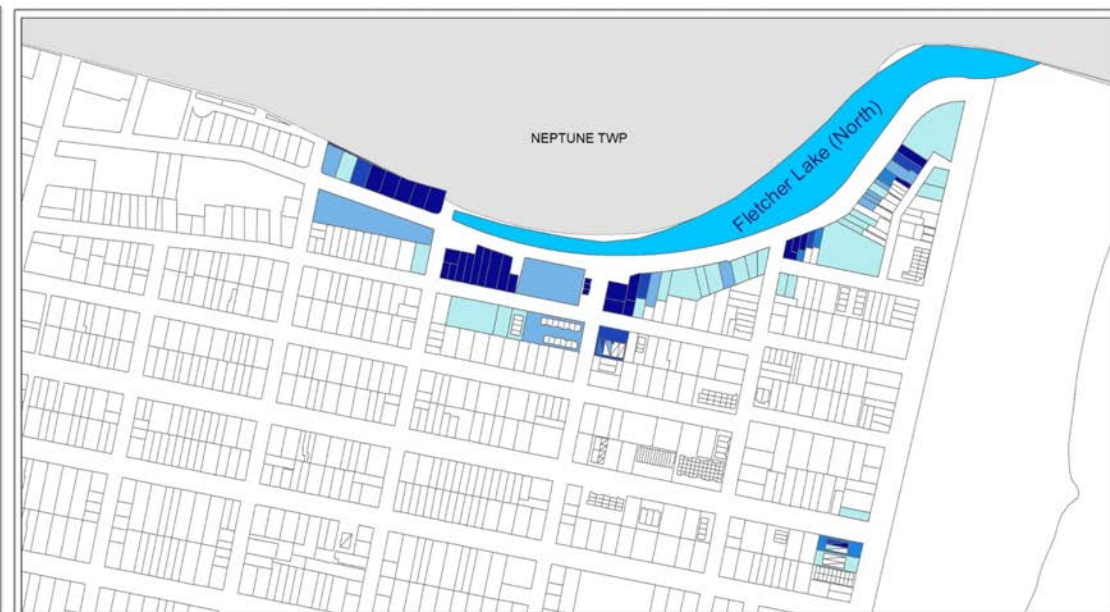
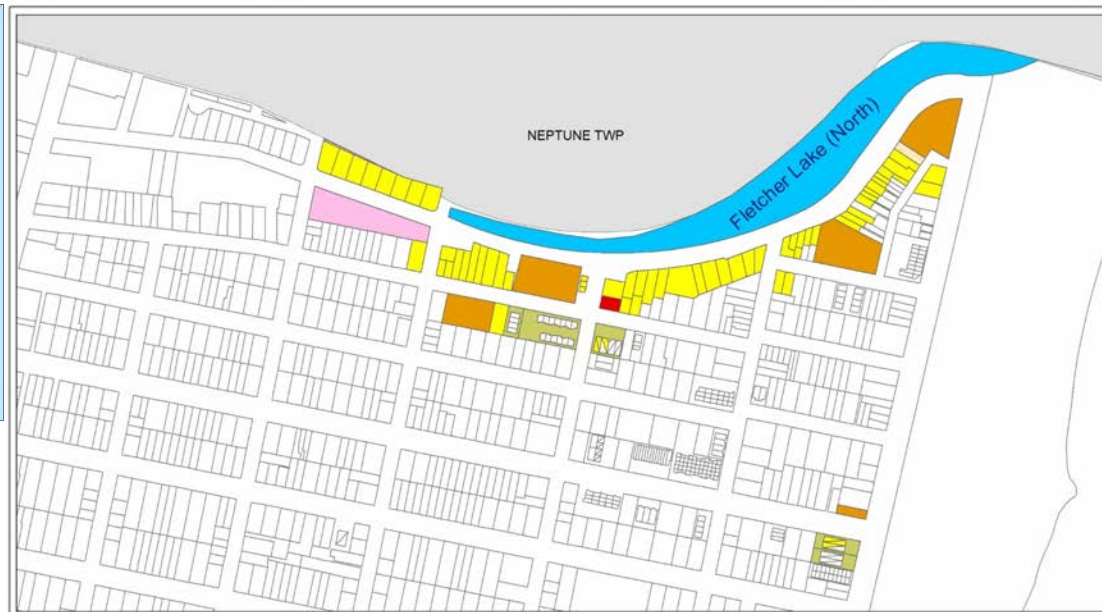
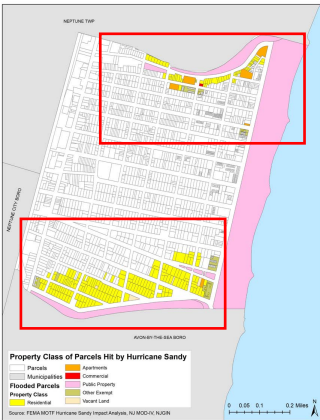


Parcels Flooded during Hurricane Sandy				
Class	Property Type	Parcels	Net Value*	NV (%)
2	Residential	264	\$184,801,600	84%
4C	Apartments	6	\$12,278,700	5.6%
4A	Commercial	1	\$652,800	0.3%
15C	Public Property	10	\$19,996,500	9.1%
15F	Other Exempt	10	\$698,100	0.3%
1	Vacant Land	7	\$1,526,300	0.7%
TOTAL		298	\$219,954,000	100%

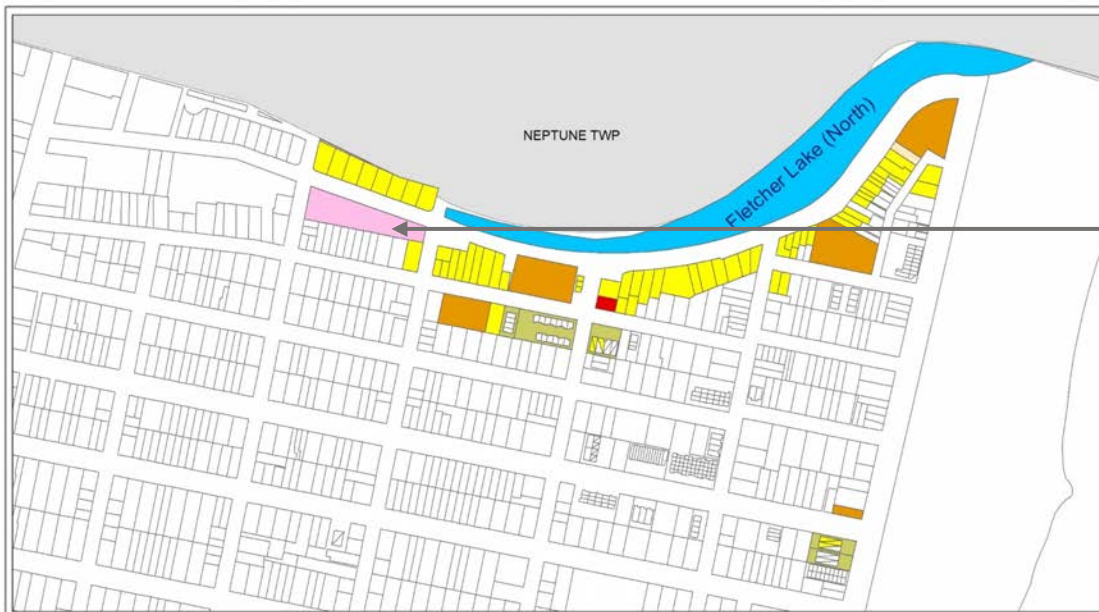
*Net Value = Total assessed value of land + Total assessed value of buildings

- Based on the analysis, there are 264 residential parcels that may be eligible for buyouts, with a total net value of roughly \$185 million.

Parcels
Flooded
during
Hurricane
Sandy
(2012)



Property Class of Parcels Hit by Hurricane Sandy



Property Class of Parcels Hit by Hurricane Sandy



0 0.05 0.1 0.2 Miles

Source: FEMA MOTF Hurricane Sandy Impact Analysis, NJ MOD-IV, NJGIN



Fletcher Lake Area - Parcels Flooded at 7' MHHW Level

Class	Property Type	Parcels	Net Value*	NV (%)
2	Residential	66	\$40,501,700	75.6%
4C	Apartments	5	\$11,032,800	20.6%
4A	Commercial	1	\$652,800	1.2%
15C	Public Property	1	\$1,140,500	2.1%
15F	Other Exempt	5	\$0	0%
1	Vacant Land	3	\$248,100	0.5%
TOTAL		81	\$53,575,900	100%

*Net Value = Total assessed value of land + Total assessed value of buildings

Sylvan Lake Area - Parcels Flooded at 7' MHHW Level

Class	Property Type	Parcels	Net Value*	NV (%)
2	Residential	198	\$144,299,900	96.5%
4C	Apartments	1	\$1,245,900	0.8%
15C	Public Property	6	\$2,017,100	1.3%
15F	Other Exempt	5	\$698,100	0.5%
1	Vacant Land	4	\$1,278,200	0.9%
TOTAL		214	\$149,539,200	100%



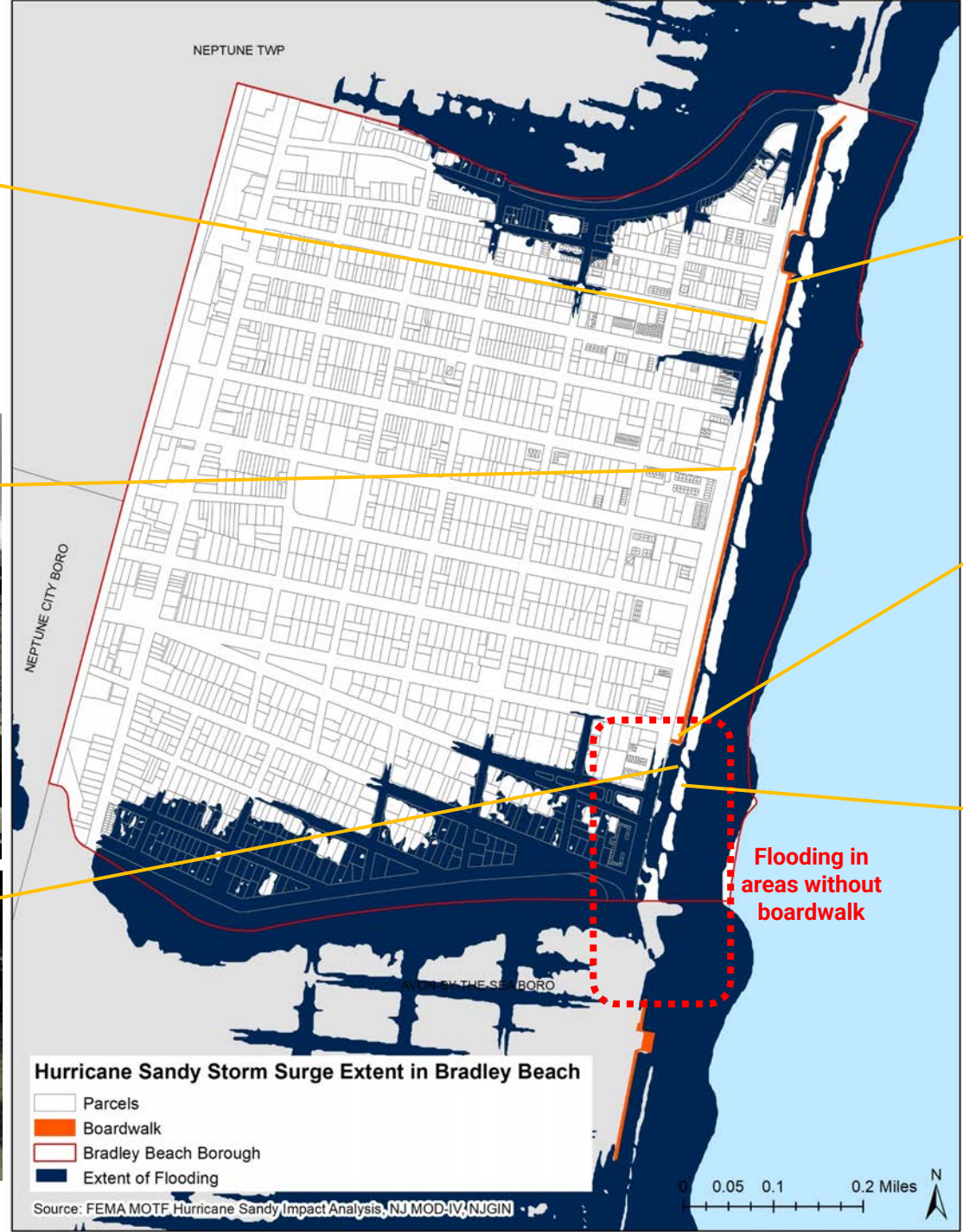
Promenade in area at dog leg location, east of Newark Ave



Looking north in front of lifeguard station; damaged bulkhead railing



Looking south in area without the bulkhead



Looking north between Park Place and Newark Ave

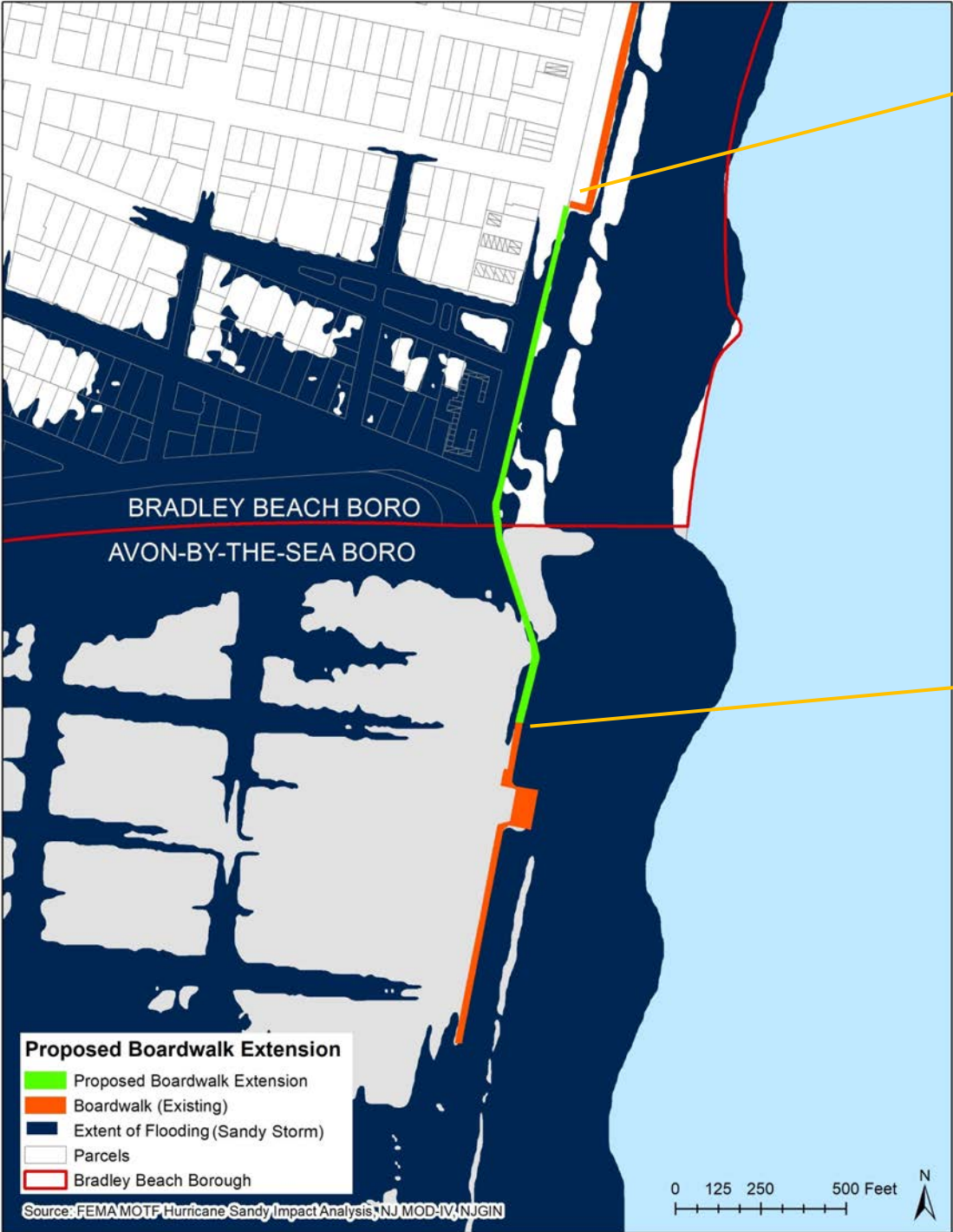


South end of promenade, looking towards Avon; End of Bulkhead



South end of town looking east; damage to area without bulkhead

Proposed Boardwalk Extension to Avon-By-The-Sea Borough



Comparative of Estimates

Table: Cumulative Net Value of Properties Exposed to Coastal Flooding Under Different Scenarios

Flood Scenarios		1 Vacant	2 Residential	4C Apartments	4A Commercial	15C Public Property	15F Other Exempt	GRAND TOTAL
5ft MHHW	Net Value*	\$0	\$0	\$0	\$0	\$17,238,900	\$0	\$17,238,900
	Number	0	0	0	0	4	0	4
7ft MHHW	Net Value*	\$519,700	\$73,098,500	\$5,136,000	\$336,800	\$19,584,300	\$0	\$98,675,300
	Number	2	93	2	1	7	1	106
FEMA-FIRM AE: 1% Zone	Net Value*	\$490,400	39066500	\$0	\$0	\$0	\$0	\$39,556,900
	Number	1	48	0	0	2	0	51
FEMA-FIRM (both AE & X-500)	Net Value*	\$1,278,200	\$113,052,500	\$4,685,900	\$652,800	\$2,757,600	\$698,100	\$123,125,100
	Number	4	170	3	1	8	5	191
HURRICANE SANDY	Net Value*	\$1,526,300	\$184,801,600	\$12,278,700	\$652,800	\$19,996,500	\$698,100	\$219,954,000
	Number	7	264	6	1	10	10	298

*Net Value = Total assessed value of land + Total assessed value of buildings

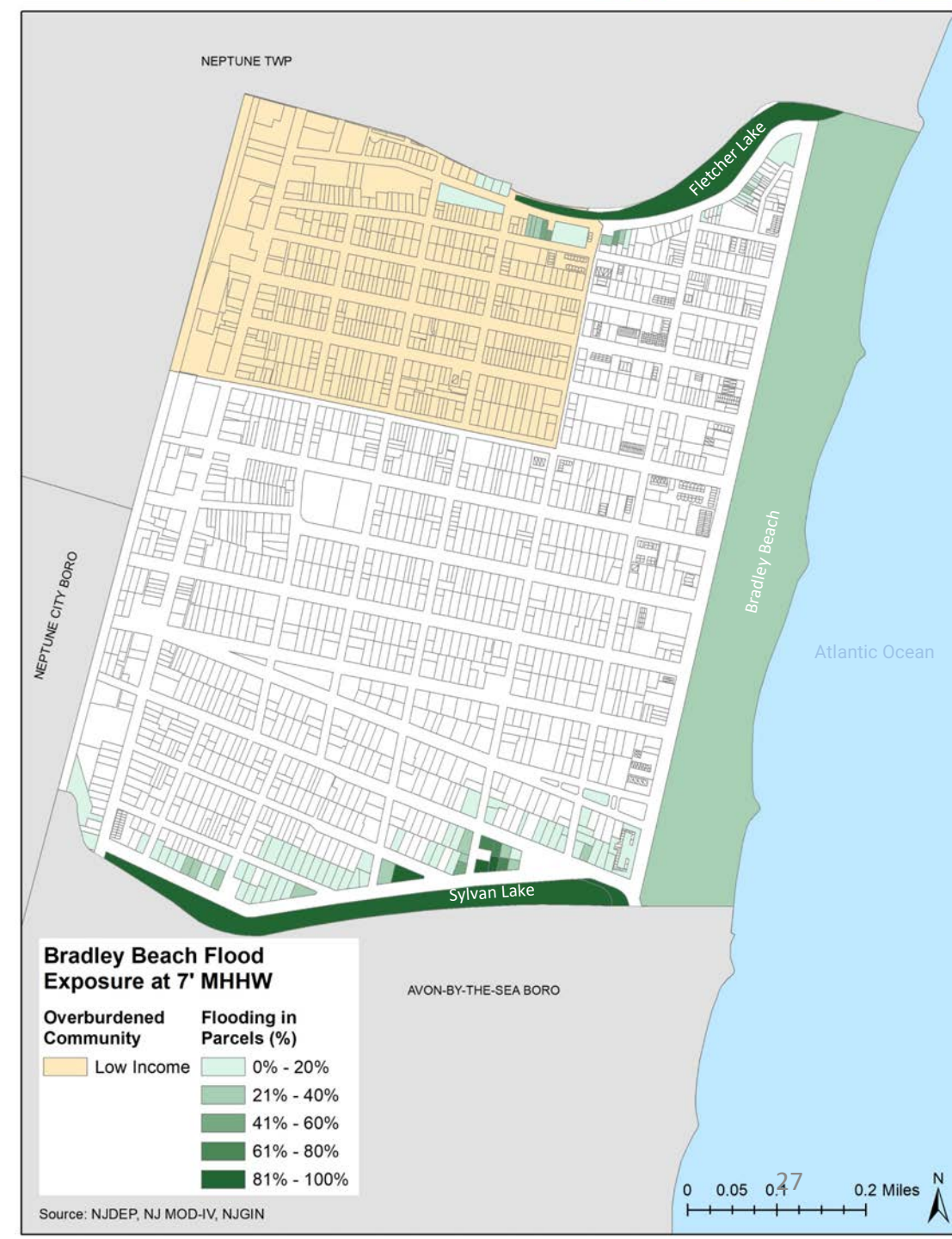
Overburdened Communities

An **Overburdened Community (OBC)** is any census block group having:

1. At least 35% of the HHs qualifying as low-income HHs (at or below twice the poverty threshold of the US Census);
2. At least 40% of the residents identify as minority / tribal
3. At least 40% of the HHs have limited English proficiency

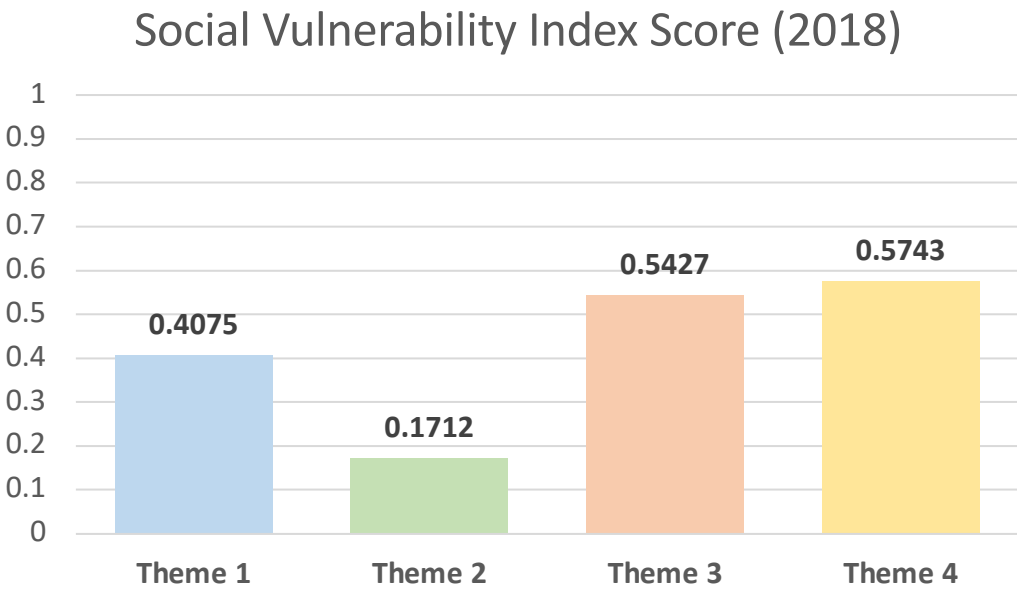
Overburdened Community in Bradley Beach Statistics 2019	
Total Population	1294
Total Households (HHs)	521
Low-Income Population	555 (42.89%)
Minority Population	513 (39.64%)
HHs with limited English Proficiency	0

- Economically disadvantaged populations are disproportionately affected by disasters; so are people with lower levels of education
- Housing quality is an important factor in evaluating disaster vulnerability; poor people often live in more poorly-constructed or deteriorating houses or mobile homes



Social Vulnerability in Bradley Beach

- Overall Social Vulnerability Index Score for Bradley Beach in 2018 = 0.4133
(Source: CDC and ACS 5-year estimates 2014-18)
- **SVI Score = 0.4133** indicates a low to moderate level of vulnerability in the tract



Overall Social Vulnerability (Tract Level)	Themes	15 Variables (Census)	Estimate	Percent
	Theme 1: Socioeconomic Status	Below Poverty	485	11.5%
		Unemployed	143	5.8%
		No High School Diploma	371	11.2%
		Median Income	\$55,081	
	Theme 2: Household Composition & Disability	Age 65 or older	696	16.5%
		Age 17 or younger	593	14%
		Age 5 or older with Disability	443	10.5%
		Single-parent Household	152	10.5%
	Theme 3: Minority Status & Language	Minority	1056	25%
		Speaks English "Less than Well"	89	2.2%
	Theme 4: Housing Type & Transportation	Multi-unit Structures	950	31.2%
		Mobile Homes	0	0
		Crowding	33	1.6%
		No Vehicle	212	10%
		Group Quarters	7	0.2%

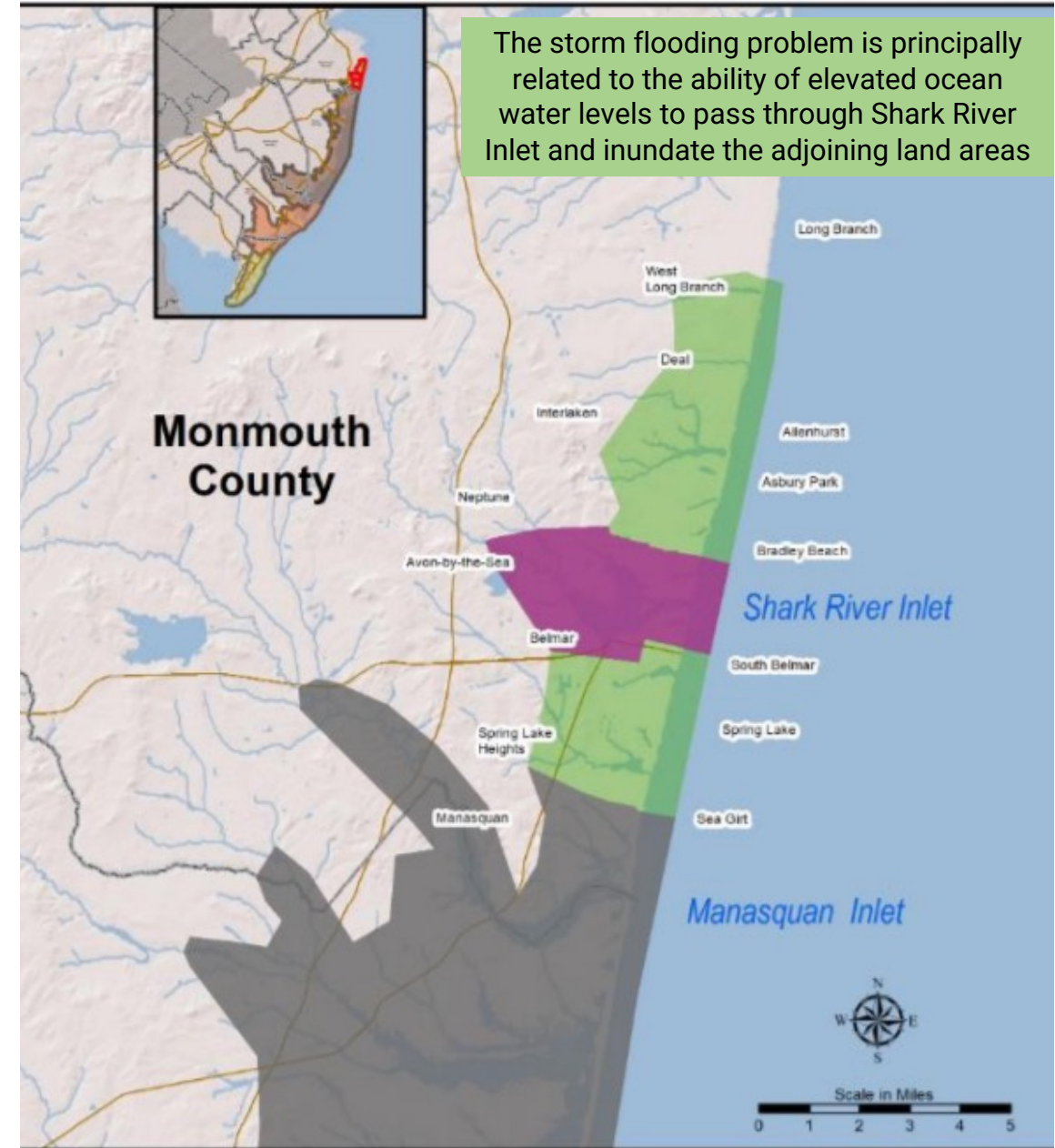
Conclusions

- Majority of the flooding around the lakes can be mitigated through municipal interventions.
- There are **51 properties in the AE: 1% Annual Flood Chance** FEMA-FIRM Zones with a total net value of roughly \$40 million, that should be a priority.
- There are **106 properties in the 7ft MHHW** Level Inundation Model with a total net value of \$98,675,300
- Hurricane Sandy impacted roughly 300 properties while majority of the inundation along the mainland was obstructed by the **vegetated dunes**. Hence, the municipality can focus on strengthening/expanding these natural buffers. The borough's interest in **extending the boardwalk to Avon-by-the-sea borough** can be pursued.
- Comparative estimates of flooded parcels revealed there is a significant increase in the number of parcels from 5ft to 7ft MHHW level (93 parcels).
- Fortunately, the **overburdened community in Bradley Beach is minimally impacted** in all these flood scenarios. However, the overall SVI Score 0.4133 is still indicative of a low to moderate level of vulnerability that can be targeted for future disaster planning.
- By 2100, the SLR is expected to rise with 66% probability from anywhere between 2ft to 5ft with a high end (5% chance) rise to 7ft (NJDEP SLR Guidance for New Jersey 2021)

Sea Level Rise is slow, but inexorable, and the best way to mitigate flood risk is to plan for it now. This can be done using various nonstructural options recommended by CSRSM studies in NJ and applying for state and federal funding assistance in order to implement them.

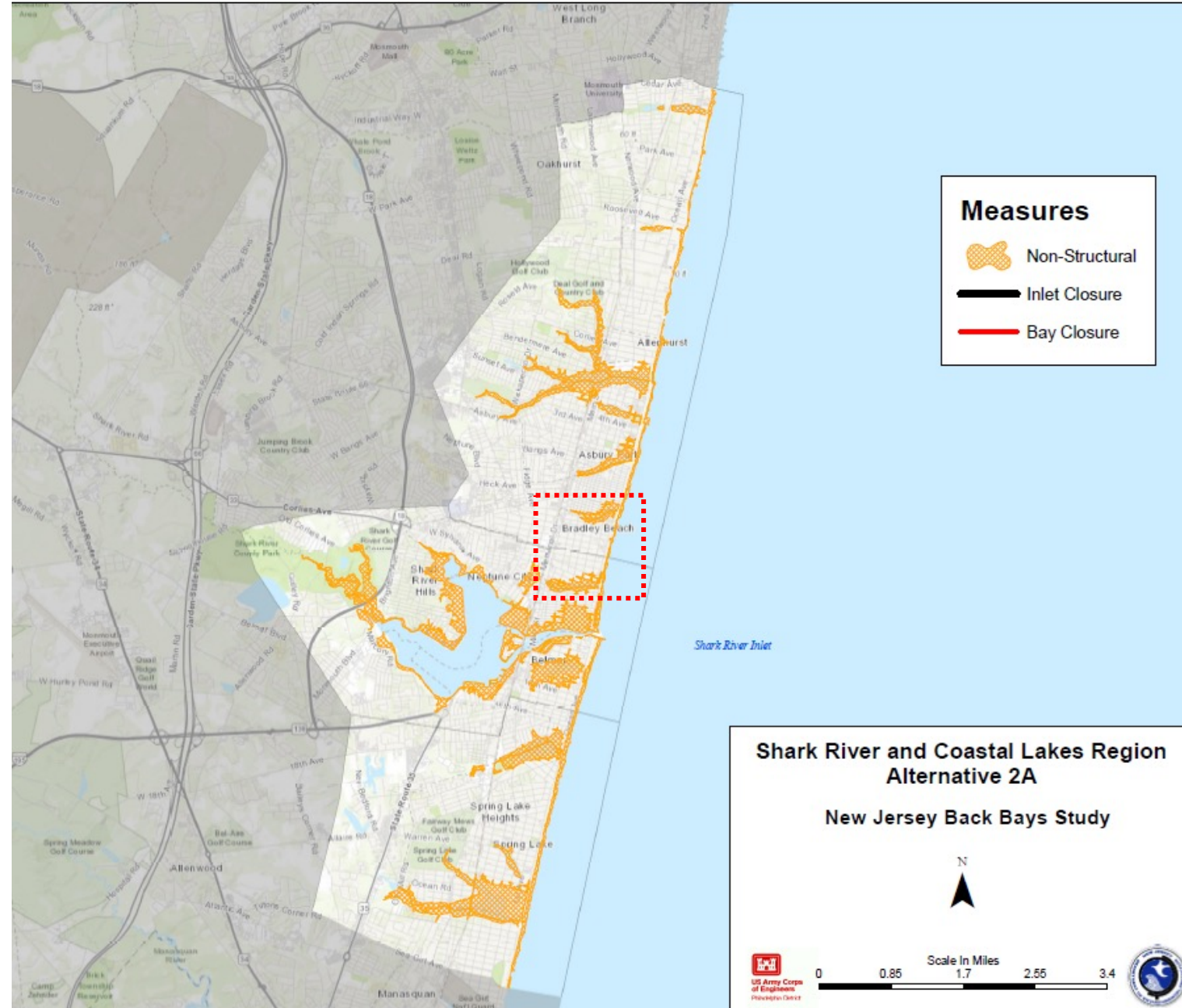
NJ Army Back Bay Corps Coastal Storm Risk Management Study (2021)

- The Draft Integrated Feasibility Report and Tier1 Environmental Impact Statement (EIS), August 2021
- **Background:** The Atlantic Ocean Coast of New Jersey is fronted by a Federal CSRM program (consisting of beach nourishment including dune construction along the oceanfront shoreline). However, the NJBB region currently lacks a comprehensive CSRM program that will protect communities on the bay side of the barrier islands. The NJBB is one of nine focus areas identified in the North Atlantic Coast Comprehensive Study (NACCS).
- **The NJBB Region is a major populated low-lying area stretching over 5 counties (Cape May, Ocean, Atlantic, Monmouth, and Burlington)**
- **Study Area:** Divided into 5 regions based on problems and opportunities, geomorphology, and hydraulic interconnectedness of water bodies.
- The Shark River & Coastal Lakes Region includes two discontinuous segments separated by the Shark River (pink) and Coastal Lakes Region (green).
- 8 of the 16 lakes in the Coastal Lakes Region were evaluated as part of the TSP. **Sylvan Lake** was included in this region.
- None of the lakes in the Coastal Lakes Region are presently connected to the Atlantic Ocean via a tidal inlet. Most of the lakes have some form of water level management that allows high lake levels to be reduced by discharge to the ocean



NJ Army Corps Back Bay Study (USACE)

- In the Shark River & Coastal Lakes Region, the recommended actions are ALL nonstructural, along Fletcher and Sylvan Lakes and along the beach itself.
- This is because Bradley Beach is not like the barrier island communities of New Jersey, and has no actual back bays (or inlets to back bays) for the USACE to alter.
- **Nonstructural measures are permanent or contingent measures applied to a structure and/or its contents that prevent or provide resistance to damage from flooding.** They differ from Structural measures as they focus on reducing the consequences of flooding instead of focusing on reducing the probability of flooding.
- Physical Nonstructural measures include:
 - Elevation
 - Relocation
 - Buyout / Acquisition
 - Dry flood proofing
 - Wet flood proofing
- Nonphysical Nonstructural measures include:
 - Flood Warning Systems
 - Flood Insurance
 - Floodplain Mapping
 - Flood Emergency Preparedness Plans
 - Land Use Regulation
 - Zoning
 - Evacuation Plans
 - Risk Communication



Natural and Nature-Based Features - NJ Army Corps Study (Appendix G)

- This section contains an overview of the **initial suite of Nature and Nature Based features (NNBF) opportunities identified** by the Project Delivery Team (PDT) during the workshops.
- The reduction of flood risk is something that must be considered on a lake-by-lake basis. However, the opportunity of terracing or lining lakes with vegetation that could serve as stormwater filters, habitat, and increased recreational amenities is one overall strategy that may be applicable.

Shark River/Coastal Lakes			
<i>Project Idea</i>	<i>Description</i>	<i>General Vicinity</i>	<i>Comments</i>
Dune Enhancement	Not sure of existing dune height in this area - consider up to 20'	Belmar and Bradley Beach Area	Although not part of NJBB study per se; building up dunes on ocean-side of barrier islands represents another potential defense strategy.
Expand Shark River Island	Buy out residences located on Shark River Island; Create larger island with more complex topography	Shark River Island	Create more complex topography on the island w/ diverse habitat to slow surge at Shark River Inlet.
Improve shoreline for lakes	Create naturalized shoreline with shallower slopes or terraced shoreline to provide habitat benefits	Examples: Wesley Lake, Sunset Lake, Deer Lake, and Sylvan Lake	Lakes become part of strategy to deal with compound flooding during coastal storms (stormwater runoff+surge); Dredge out lakes to ~water table for additional storage capacity; Add pumps to draw down lake water levels prior to storms to provide flood storage (a la Harvey) Consider maintaining some at lower normal water levels to provide more opportunity for community interactions with lakes, i.e., parkland
Improve tidegates/culverts for Lakes	Modify tide gates/culverts to provide better circulation to lakes during calm conditions and block surge during storms	Examples: Wesley Lake, Sunset Lake, Deer Lake, and Sylvan Lake	Need to think more about EWN strategy here, if this is prioritized.

Army Corps Back Bay CSRM Study – Management Measures			
Structural Measures		Non-Structural Measures	Natural & Nature Based
SSBs/CBBs (Barriers)	Beach Restoration/ Groins/Breakwaters	Managed Coastal Retreat	Living Shorelines, Submerged Aquatic Veg.
Tide Gates	Bulkheads	Building Retrofit	Reefs, Shallows
Road Rail Elevation	Seawalls, Crown Walls	Hazard Mitigation Plan	Wetland Restoration
Levees	Revetments	Emergency Evacuation Plans	Living Breakwaters
Ring walls	Storm Surge Drainage Improv.	Early Warning Systems	Horizontal Levees
Floodwalls	Deployable Floodwalls	Public Education & Comm.	Surge Filters, Green SW Mgmt.



Army Corps Recommendations – Shark River Region (Includes BB)	
Non-Structural Measures only	
Managed Coastal Retreat	Setbacks, Rolling Easements, Exactions, Mitigation fee, Building Restrictions, Zoning Changes, Conservation easements, TDRs, Buyout (Blue Acres), Relocations, Eminent Domain
Building Retrofit	Elevation, Dry Flood Proofing, Wet Flood Proofing, Replace Str.
Hazard Mitigation Plans	
Emergency Evacuation Plans	
Early Warning Systems	
Public Education/Comm.	

Target Design Elevation = BFE + 3ft (considering 1% AEP stage height + SLR (1.84 ft.) + Wave)

Comparison of Recommended Measures for Bradley Beach Area

NJ Resilience Toolkit – Actions (Nature Based)	
Berms	Dune Planting And Restoration
Seagrass	Protect And Restore Natural Coastal Buffers
Living Shoreline	Establish Shoreland Protection Districts
Dune Management Program	Wave Attenuation Devices
Oyster Reefs	Beach Stabilization Using Biopolymers

Restoration Explorer
Beach Restoration
Breakwater
Ecologically Enhanced Revetment

It is a web-based decision support tool, that empowers communities to visualize what types of “**Living Shoreline**” techniques may be appropriate at a given location along the coast, based on past and present shoreline conditions.

It combines engineering criteria developed by Stevens Institute of Technology and geo-spatial data on current shoreline conditions from Rutgers University, to help communities visualize where a living shoreline project may be appropriate.

It suggests 6 shoreline enhancement techniques viz. Nature based living shoreline, Living Reef Breakwater, Marsh Sil, etc.

Final Conclusions

- The USACE's Back Bay study emphasizes **protecting from storm surges (like Sandy)**.
- The NJDEP's guidance emphasizes **planning for Sea Level Rise** (SLR).
- In Bradley Beach, vegetated dunes already offer surge protection in the center of the beach, but less protection at the northern and southern ends.
- However, the northern and southern ends, where the lakes are, are also more exposed to future SLR.
- A reasonable **plan of action** will be to pursue the following actions:
 - Continue to maintain funding for the existing sand dunes; protect the center of town
 - Seek expanded funding to restore the dunes and Bulkhead to the south
 - Target the highest priority lake-adjacent parcels that have been identified through our analysis using non-structural strategies.

THANK YOU !