Of the population exposed, the most vulnerable include the economically disadvantaged and the population over the age of 65. Economically disadvantaged populations are more vulnerable because they are likely to evaluate their risk and make decisions to evacuate based on the net economic impact to their family. The population over the age of 65 is also more vulnerable because they are more likely to seek or need medical attention which may not be available to due isolation during a flood event and they may have more difficulty evacuating. Special consideration should be taken when planning for disaster preparation, response, and recovery for these vulnerable groups.

Using 2010 U.S. Census data, HAZUS-MH 2.2 estimates the potential sheltering needs as a result of a 1-percent chance flood event. These statistics, by hazard, are presented in Table 5-13.

Table 5-13. Estimated Population Displaced or Seeking Short-Term Shelter by the 1-percent Annual Chance Event

Hazard	Displaced Households	Persons Seeking Short-Term Sheltering
1-percent Annual Chance Flood Event	11,443	9,807
SLOSH Category 1	7,549	6,529
SLOSH Category 2	17,331	14,865
SLOSH Category 3	31,530	27,838
SLOSH Category 4	43,477	38.998

Source: HAZUS-MH 2.2

The total number of injuries and casualties resulting from flooding is generally limited based on advance weather forecasting, blockades and warnings. Therefore, injuries and deaths generally are not anticipated if proper warning and precautions are in place. Ongoing mitigation efforts should help to avoid the most likely cause of injury, which results from persons trying to cross flooded roadways or channels during a flood.

Impact on General Building Stock

After considering the population exposed and potentially vulnerable to the hazard areas, the built environment was evaluated. Exposure includes those buildings located in the hazard areas. Potential damage is the modeled loss that could occur to the exposed inventory, including structural and content value.

Overall, there are a total of 40,489 structures in the Township with a total replacement cost value of greater than $18 billion and a total tax ratable amount of greater than $10 billion. To provide a general estimate of the building value exposed to the flood hazards, the 1- and 0.2-percent floodplain boundaries, SLOSH zones, and sea-level rise scenarios were overlaid upon the Township's updated building stock inventory at the structure level. The buildings with their centroid in the hazard areas were totaled. Tables 5-14 and 5-15 and Figures 5-26 through 5-28 summarize these results.

Table 5-14. Estimated General Building Stock Exposure to All Flood Hazard Areas

Hazard	Number of Structures Exposed	% of Total	Total RCV Exposed	% of Total	Total Tax Ratable Exposed	% of Total
1-percent Annual Chance Flood Event	7,488	18.5%	$3,481,039,250	18.6%	$1,418,745,677	13.2%
0.2% Annual Chance Flood Event	10,166	25.1%	$4,659,704,863	24.8%	$2,440,230,651	22.7%

Table 5-14. Estimated General Building Stock Exposure to All Flood Hazard Areas

Hazard	Number of Structures Exposed	% of Total	Total RCV Exposed	% of Total	Total Tax Ratable Exposed	% of Total
SLOSH Category 1	5,005	12.4%	$2,313,165,139	12.3%	$917,559,002	8.5%
SLOSH Category 2	11,395	28.1%	$5,180,357,074	27.6%	$3,080,119,761	28.6%
SLOSH Category 3	19,230	47.5%	$8,676,175,170	46.3%	$4,993,605,576	46.4%
SLOSH Category 4	25,494	63.0%	$11,221,622,025	59.8%	$6,422,371,185	59.7%
2050 Intermediate-High Scenario Sea-Level Rise	9,237	22.8%	$4,215,445,897	22.5%	$1,745,934,419	16.2%
2050 Highest Scenario Sea-Level Rise	10,105	25.0%	$4,581,928,097	24.4%	$2,222,444,719	20.7%

Source: FEMA 2015, NJOEM 2013, NOAA 2012, Brick Township
Note: % - Percent
RCV – Replacement Cost Value

Table 5-15. Estimated Number of Buildings Exposed by Occupancy Type to All Flood Hazard Areas

Hazard	Number of Residential Structures	Number of Commercial Structures	Number of Industrial Structures	Number of Government Structures	Number of Education Structures	Number of Religion/ Non-Profit Structures
1-percent Annual Chance Flood Event	7,285	193	0	2	0	7
0.2% Annual Chance Flood Event	9,881	259	1	3	2	19
SLOSH Category 1	4,871	130	0	0	0	0
SLOSH Category 2	11,068	288	1	3	14	18
SLOSH Category 3	18,533	619	4	14	19	37
SLOSH Category 4	24,522	859	9	21	23	55
2050 Intermediate-High Scenario Sea-Level Rise	8,958	234	1	3	0	11
2050 Highest Scenario Sea-Level Rise	9,818	261	1	3	2	17

Source: FEMA 2015, NJOEM 2013, NOAA 2012, Brick Township

Figure 27. Estimated General Building Stock Exposure to Flood Hazard Areas

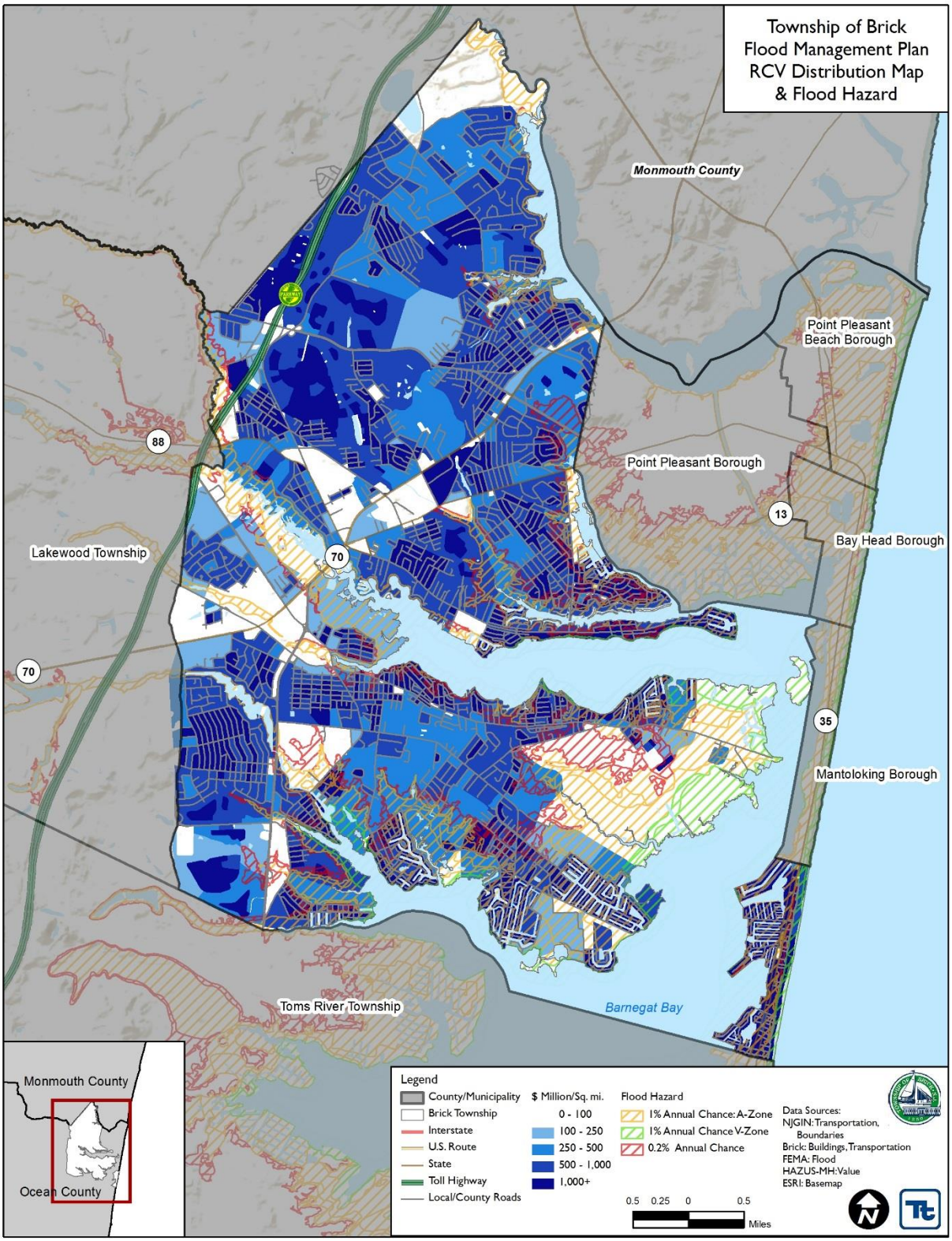


Figure 28. Estimated General Building Stock Exposure to SLOSH Hazard Areas

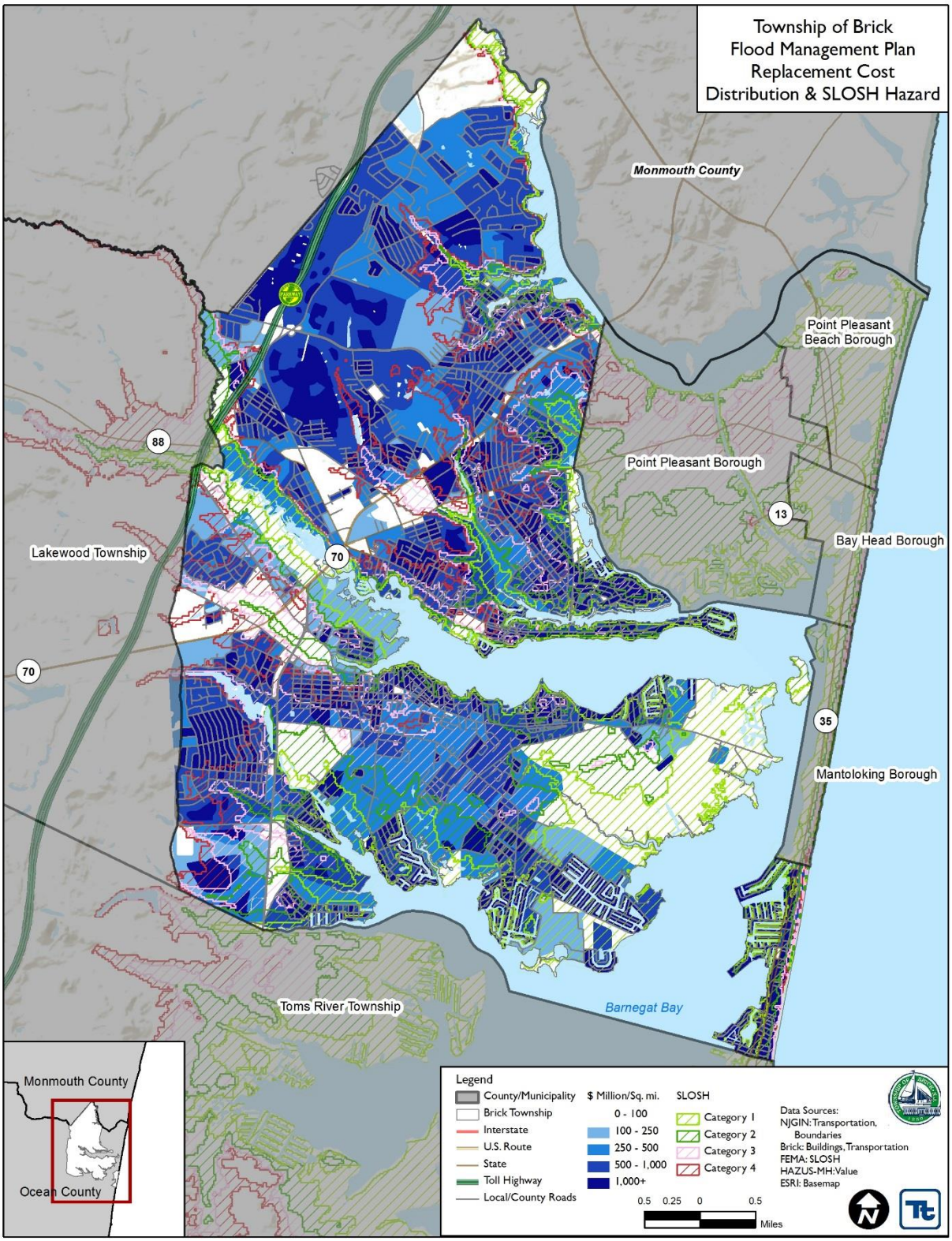
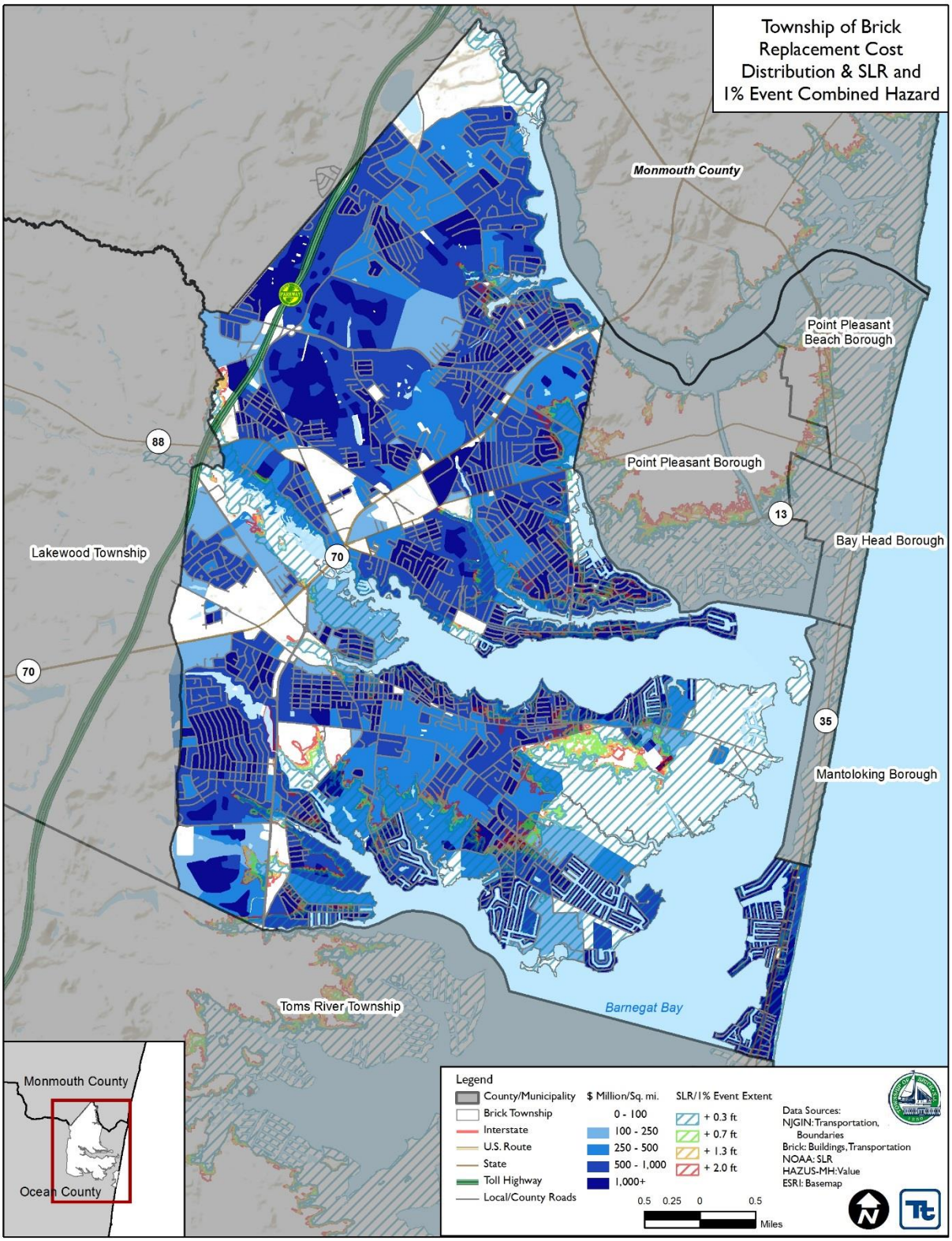


Figure 29. Estimated General Building Stock Exposure to Sea-Level Rise Hazard Areas



The HAZUS-MH model estimated potential damages to the buildings in the Township of Brick at the structure level using the custom Township structure inventory developed for this plan. The potential damage estimated by HAZUS-MH to the general building stock inventory associated with the 1-percent annual chance flood is approximately $497 million or 2.6-percent of the total building stock replacement cost value. HAZUS-MH also estimated 1-percent, 6.6-percent, 16.2-percent, and 26.2-percent of the Township's total building stock replacement cost value for the Category 1, Category 2, Category 3, and Category 4 inundation areas, respectively.

Table 5-16. Estimated General Building Stock Potential Loss to the 1-percent Annual Chance Flood Event

Occupancy Type	Total Replacement Cost Value	1-percent Annual Chance Event			
		Total Estimated Loss	Estimated Building Loss	Estimated Contents Loss	% of Total RCV
All Occupancies	$18,755,258,907	$496,762,914	$289,741,798	$207,021,116	2.6%
Residential	$15,766,432,088	$432,651,836	$275,517,431	$157,134,405	2.7%
Commercial	$2,131,577,543	$60,258,950	$13,718,257	$46,540,693	2.8%
Industrial, Religious, Education and Government	$857,249,277	$3,852,128	$506,110	$3,346,017	<1%

Source: HAZUS-MH 2.2
Note: % - Percent

Table 5-17. Estimated General Building Stock Potential Loss to the SLOSH Hazard for All Occupancy Classes

Hazard Area	Total Replacement Cost Value	Estimated Loss	Estimated Building Loss	Estimated Contents Loss	% of Total
SLOSH Category 1	$18,755,258,907	$188,238,930	$116,144,074	$72,094,856	1.0%
SLOSH Category 2	$18,755,258,907	$1,242,639,405	$701,930,535	$540,708,870	6.6%
SLOSH Category 3	$18,755,258,907	$3,029,459,417	$1,665,429,040	$1,364,030,377	16.2%
SLOSH Category 4	$18,755,258,907	$4,918,850,388	$2,766,282,412	$2,152,567,976	26.2%

Source: HAZUS-MH 2.2
Note: % - Percent

NFIP Policy, Claim and Repetitive Loss Statistics

In addition to total building stock modeling, individual data available on flood policies, claims, Repetitive Loss (RL) properties and severe RL (SRL) properties were analyzed. FEMA Region 2 provided a list of properties with NFIP policies, past claims and multiple claims (RL and SRLs). According to the metadata provided: "The (*sic* National Flood Insurance Program) NFIP Repetitive Loss File contains losses reported from individuals who have flood insurance through the Federal Government. A property is considered a repetitive loss property when there are two or more losses reported which were paid more than $1,000 for each loss. The two losses must be within 10 years of each other & be as least 10 days apart. Only losses from (*sic* since) 1/1/1978 that are closed are considered."

SRLs were then examined for the Township. According to section 1361A of the National Flood Insurance Act, as amended (NFIA), 42 U.S.C. 4102a, an SRL property is defined as a residential property that is covered under an NFIP flood insurance policy and:

- Has at least four NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000; or
- For which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.
- For both of the above, at least two of the referenced claims must have occurred within any 10- year period, and must be greater than 10 days apart.

Tables 5-18 and Table 5-19 as well as Figure 5-29 summarize the NFIP policies, claims and repetitive loss statistics for Brick Township. According to FEMA, Table 5-17 summarizes the occupancy classes of the RL and SRL properties in Brick Township. The majority of the RL occupancy class is comprised of single family residences (95.4%). All of the SRL occupancy class is comprised of single family residences (100%) (FEMA Region 2, 2014). This information is current as of December 31st, 2014.

The location of the properties with policies, claims and repetitive and severe repetitive flooding were geocoded by FEMA with the understanding that there are varying tolerances between how closely the longitude and latitude coordinates correspond to the location of the property address, or that the indication of some locations are more accurate than others.

Table 5-18. Occupancy Class of Repetitive Loss Structures in Brick Township

Occupancy Class	Total Number of Repetitive Loss Properties	Total Number of Severe Repetitive Loss Properties	Total (RL + SRL)
Single Family	104	3	107
Condo	0	0	0
2-4 Family	3	0	3
Other Residential	1	0	1
Non-Residential	1	0	1
Brick Township	**109**	**3**	**112**

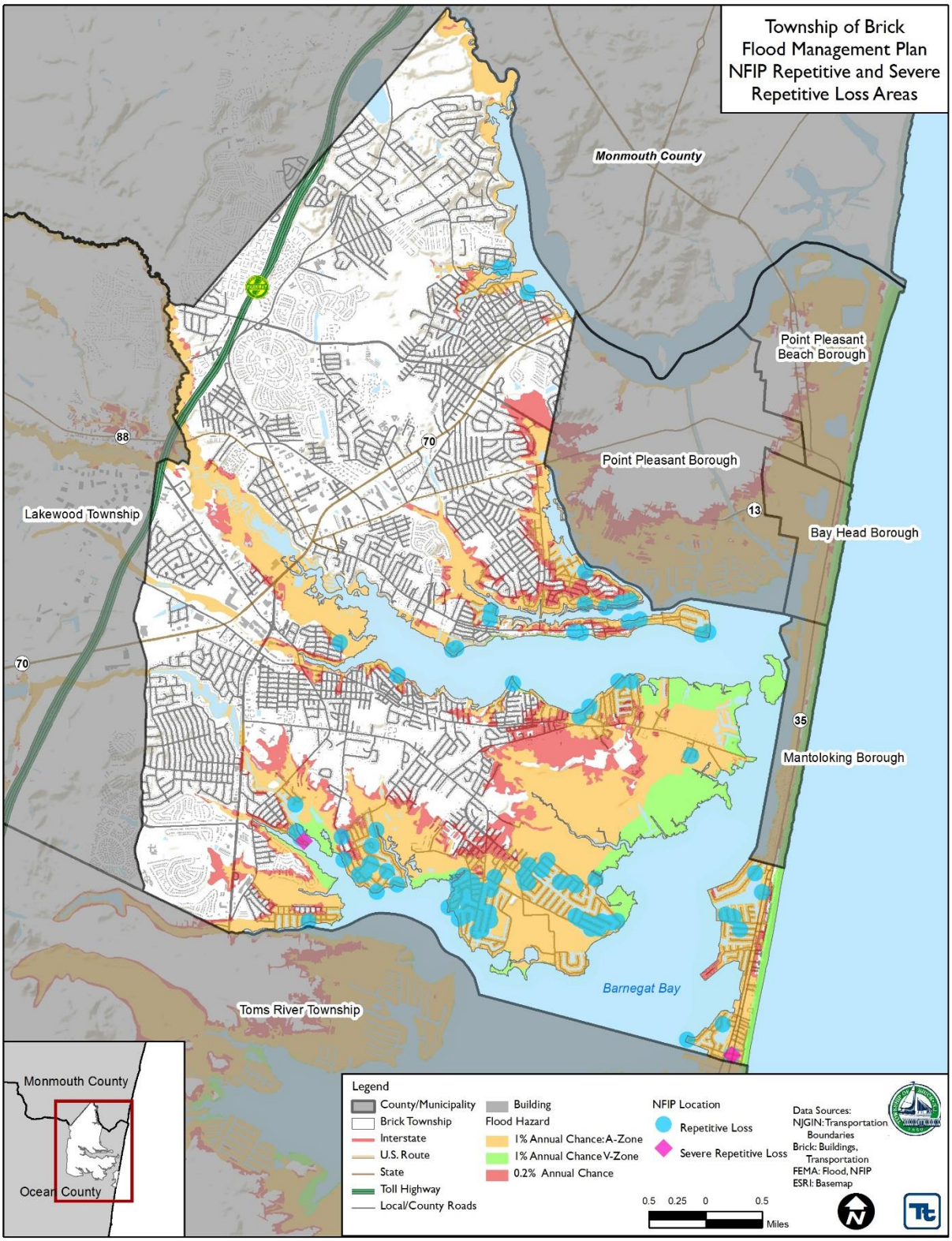
Source: FEMA Region 2 2014
Note (1): Policies, claims, repetitive loss and severe repetitive loss statistics provided by FEMA Region 2, and are current as of 12/31/2014
RL Repetitive Loss
SRL Severe Repetitive Loss

Table 5-19. NFIP Policies, Claims and Repetitive Loss Statistics

Municipality	# Policies (1)	# Claims (Losses) (1)	Total Loss Payments (2)	# Rep. Loss Prop. (1)	# Severe Rep. Loss Prop. (1)	# Policies in the 1-percent Flood Boundary (3)
Brick Township	4,083	3,471	$255,386,689	109	3	3,381

Source: FEMA Region 2, 2014
(1) Policies, claims, repetitive loss and severe repetitive loss statistics provided by FEMA Region 2, and are current as of 12/31/2014. Please note the total number of repetitive loss properties includes the severe repetitive loss properties. The number of claims represents claims closed by 12/31/14.
(2) Total building and content losses from the claims file provided by FEMA Region 2.
(3) The policies inside and outside of the flood zones is based on the latitude and longitude provided by FEMA Region 2 in the policy file.
Notes: FEMA noted that where there is more than one entry for a property, there may be more than one policy in force or more than one GIS possibility.
A zero percentage denotes less than 1/100th percentage and not zero damages or vulnerability as may be the case.

Figure 30. NFIP Repetitive Loss and Severe Repetitive Loss Areas in Relation to All Hazard Areas



Repetitive Loss Area Analysis (RLAA)

A repetitive loss area analysis was performed to enhance the information in this plan to support targeted outreach and more effective floodplain management for the community. The repetitive loss area includes both repetitive loss properties, as determined by FEMA, and properties that may undergo repetitive flood damage but are not technically considered repetitive loss properties by the NFIP. Properties that may undergo repetitive flood damage but are not classified as NFIP RLs or SRLs can occur for a variety of reasons, including the following:

- Property owners may not have flood insurance. Only properties within the floodplain and with a federally-backed mortgage are required to carry flood insurance.
- Owners of a flooded property may choose not to file a claim, even if the owner has flood insurance.
- The flood damage may not meet the minimum $1,000 threshold necessary for repetitive loss, but the property may still undergo recurring flood damage.

In the Township of Brick, the majority of repetitive loss properties are located in the floodplain. The cause of repetitive flooding at these properties is commensurate with the flood risk reflected on the current preliminary FIRM for the community. In many cases there are multiple causes of flooding as homes in the floodplain also experience stormwater flooding caused by inadequate flow with respect to issues related to local topography and drainage issues related to the low relative elevation of outfalls with respect to water surface elevations at high tide. The Township has identified 27 repetitive loss areas including 2,799 structures based on the methodology detailed below.

RLAA Methodology

Rationale

For the Township of Brick RLAA, building data was collected using a desktop method as an alternative to that outlined in Step 3 of the CRS Coordinator's Manual. The planning team selected the alternative approach, a topographic review based on flood damage NFIP claim history and surface gradients, to provide a delineation of the RL areas.

The Township of Brick has over 7,000 properties in the designated floodplain with over 3,000 insured properties in the same area. As the sheer magnitude of performing property inspection visits to gather data was unrealistic within the time and budget constraints of this process, initially a desktop "reverse damage function" methodology was utilized to estimate flood impacts on properties without known claims or flood history. The "reverse damage function" methodology included estimating the depth of water associated with NFIP claims using U.S. Army Corps of Engineers depth damage functions to assist with estimating damages to non-NFIP insured properties. However the results of this analysis indicated that the repetitive loss area (RLA) consisted of the entire floodplain and did not provide results adequate to define unique RL areas. Therefore an alternate approach based on the location of historical claims with respect to existing topography was performed to delineate the RL areas of concern.

The selected approach used available data and capabilities to reduce the expenditure of Township time and resources needed for the RLAA. The alternative approach addresses the intent of Section 512.b of the 2013 CRS Coordinator's Manual, while providing the Township a basis for maintaining this data in the future including the identification of properties in defined repetitive loss areas and determining the cause of repetitive flooding.

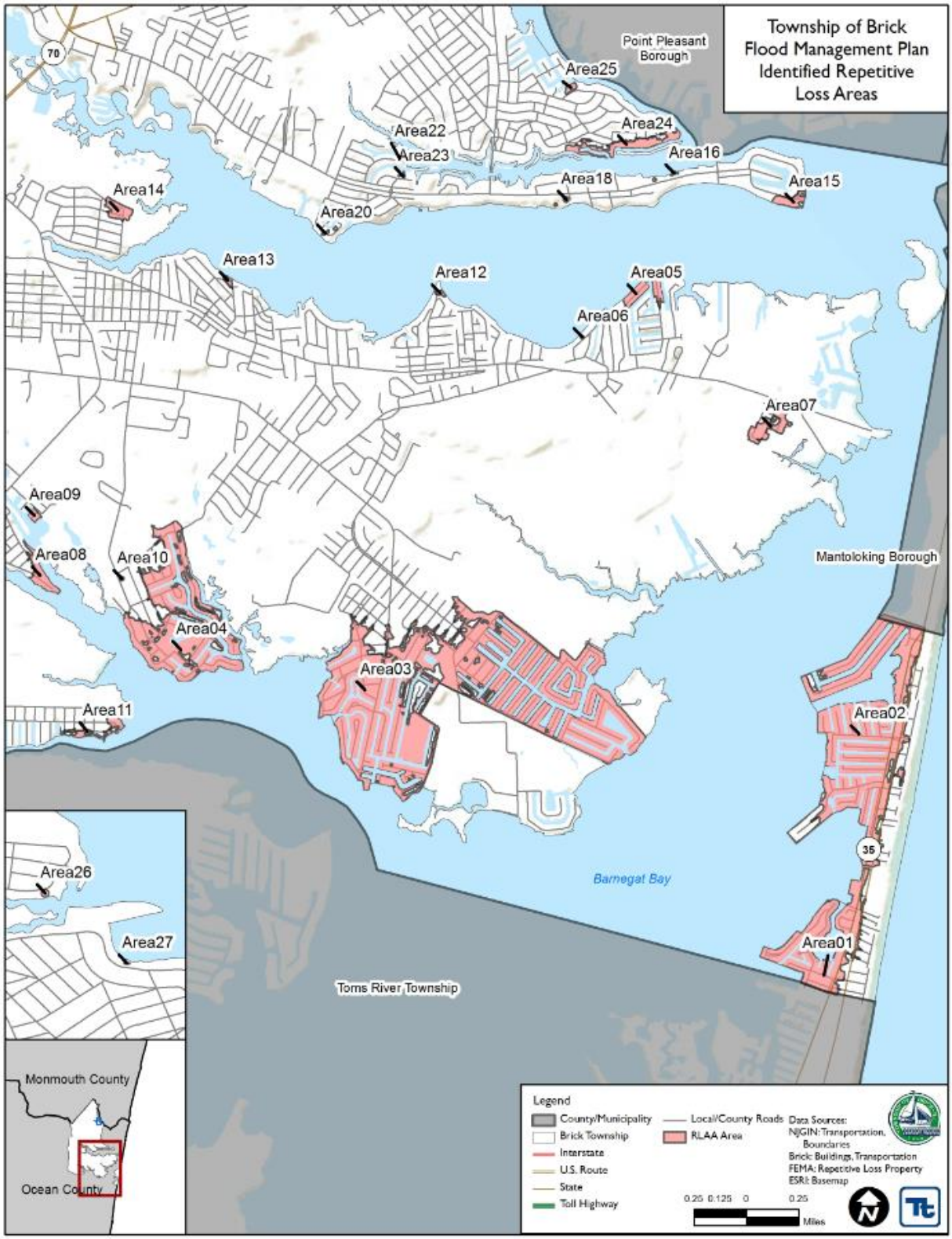
Description of Selected Approach - RLAA Delineation Process

In GIS, RLAs were identified focusing on clusters of RL and SRL properties and defining the areas based on Township-provided two-foot contours, and FEMA flood hazard areas. For each RLA, a water surface elevation was identified using the average lowest adjacent grade (LAG) for each cluster of RL/SRL properties, plus 1 foot. One foot of water was selected as a reasonable estimate because this was the average water depth for all non-basement properties determined by the reverse damage function methodology. After identifying the water surface elevation, the appropriate two- foot contour was selected and used to identify areas that were lower in elevation than the RL/SRL properties. It is reasonable to assume these areas would also experience flooding. In some cases, the identified RL/SRL properties were the only structures exposed to this repetitive flooding. However, in most cases there were additional properties impacted. Supporting GIS data was used to review the surrounding properties and ensure that all appropriate properties were included. In addition to the two-foot contour layer, LAG data was extracted for each property using the Ocean County Digital Elevation Model (DEM) and used during the review process.

The same process was used for RL/SRL properties with basements, focusing only on surrounding properties that also had basement construction. The RLAs indicate potentially impacted structures.

An overview map of the RLAs is provided below to illustrate the relationship of the areas with documented NFIP RL properties and the probable causes of flooding. Areas 26 and 27 are included as an inset map, and are located within the blue box on the Township inset map. Individual maps indicating each area as well as a list of the properties in each delineated area are provided in Appendix E for further information.

Figure 31. NFIP Repetitive Loss Areas – Brick Township.



Impact on Critical Facilities

HAZUS-MH was used to estimate the flood loss potential to critical facilities exposed to the flood hazard. Using depth-damage function curves, HAZUS estimates the percent of damage to the building and contents of critical facilities. Due to the sensitive nature of facility-specific information, the results of this detailed analysis is not included in the plan. Table 5-20 summarizes the number of critical facilities located in the hazard areas by type.

In cases where short-term functionality is impacted by a hazard, other facilities of neighboring municipalities may need to increase support response functions during a disaster event. Mitigation planning should consider means to reduce impact to critical facilities and ensure sufficient emergency and school services remain when a significant event occurs.

Table 5-20. Number of Critical Facilities Located in the Hazard Areas

Facility Type	Hazard								
	1-percent Annual Chance Event	0.2% Annual Chance Event	SLOSH Category 1	SLOSH Category 2	SLOSH Category 3	SLOSH Category 4	2050 Intermediate-High Scenario SLR	2050 Highest Scenario SLR	Insured by Township (Y or N)
Bridge	10	10	6	8	9	11	7	7	
County Building	2	2	-	1	3	3	1	1	
Dam	1	2	1	2	3	3	-	1	
EMS	-	1	-	1	1	2	1	1	
EOC	1	1	-	1	1	3	1	1	
Fire	1	2	-	2	5	5	2	2	
Library	-	-	-	-	-	1	-	-	
Police	1	1	-	1	1	2	1	1	
Post Office	-	-	-	-	1	2	-	-	
Potable Pump	3	3	3	3	4	4	2	3	
School	-	1	-	2	7	14	1	1	
Shelter	-	-	-	-	2	3	-	-	
Substation	2	3	1	3	3	4	2	3	
Potable Tank	-	-	-	1	2	2	-	-	
Town Hall	-	-	-	-	-	1	-	-	
Well	8	9	11	11	11	11	8	9	
Wastewater Pump	13	15	7	15	16	18	15	15	
Wastewater Treatment Facility	-	-	-	-	1	1	-	-	

Source: FEMA 2015, NJOEM 2013, NOAA 2012, Brick Township
Notes: Cumulative analysis conducted.

Impact on the Economy

For impact on economy, estimated losses from a flood event are considered. Losses include but are not limited to general building stock damages, business interruption, impacts to tourism and tax base to the Township. Estimated damages to the general building stock can be quantified using HAZUS-MH as discussed above.

Other economic components such as loss of facility use, functional downtime and social economic factors are less measurable with a high degree of certainty.

Flooding can cause extensive damage to public utilities and disruptions to the delivery of services. Loss of power and communications may occur; and drinking water and wastewater treatment facilities may be temporarily out of operation. As indicated in Table 5-20, 42 facilities are located in the 1-percent annual chance flood hazard area, and eight (8) additional facilities in the 0.2% annual chance flood area. There are 29 facilities located in the Category 1 SLOSH inundation area, 51 facilities in the Category 2 SLOSH inundation area, 70 facilities in the Category 3 SLOSH inundation area, and 90 facilities in the Category 4 SLOSH inundation area; all of which are cumulative in nature.

In terms of sea level rise, there are 41 facilities located in both the intermediate-high and high sea-level rise scenario inundation areas, with four (4) additional facilities exposed to the highest sea-level rise scenario inundation area. In addition to critical facility potential damages and loss of function, flooded streets and road blocks make it difficult for emergency vehicles to respond to calls for service. Floodwaters can wash out sections of roadway and bridges (Foster, Date Unknown). In addition to travel along the roadways, public transit will be greatly impacted, causing problems for emergency responders.

Direct building losses are the estimated costs to repair or replace the damage caused to the building. Refer to the 'Impact on General Building Stock' subsection which discusses these potential losses. These dollar value losses to the Township's total building inventory replacement value, in addition to damages to roadways and infrastructure, would greatly impact the local economy.

HAZUS-MH estimates the amount of debris generated from the 1-percent annual chance flood event. The model breaks down debris into three categories: 1) finishes (dry wall, insulation, etc.); 2) structural (wood, brick, etc.) and 3) foundations (concrete slab and block, rebar, etc.). The distinction is made because of the different types of equipment needed to handle the debris. The HAZUS-MH Flood Model focuses on building-related debris and does not estimate debris generated for building contents such as household appliances (e.g., ovens or refrigerators), electronics and other personal items, or environmental (trees, shrubs, sediment etc.) debris. Table 5-20 summarizes the debris HAZUS-MH 2.2 estimates for these events. As a result of the 1-percent event, HAZUS-MH estimates a total of approximately 30,571 tons of debris will be generated. As a result of the Category 1 storm surge scenario, HAZUS-MH estimates approximately 5,062 tons of debris. HAZUS-MH also estimates approximately 53,692 tons, 249,871 tons, and 463,331 tons of debris as a results of the Category 2, Category 3, and Category 4 storm surge scenarios, respectively.

Please note this table only represents estimated debris generated by coastal flooding and does not include additional potential damage and debris which may be generated with the presence of wind.

Table 5-21. Estimated Debris Generated from the 1-Percent Flood Event and SLOSH Category 1-4 Scenarios

Hazard	1-percent Flood Event			
	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
1-percent Annual Chance Event	30,571	20,564	6,083	3,924
SLOSH Category 1	5,062	4,081	602	380
SLOSH Category 2	53,692	31,780	13,425	8,487
SLOSH Category 3	249,871	72,165	103,917	73,788
SLOSH Category 4	463,331	109,826	203,772	149,732

Source: HAZUS-MH 2.2

Differences between Flood Management Plan and Ocean County HMP (2014)

Several differences exist between the vulnerability assessments of this plan (FMP) and the 2014 Ocean County Hazard Mitigation Plan (HMP). In terms of hazard data, the 2014 HMP used a combination of the 2006 Effective FEMA DFIRM flood maps for inland communities, and 2013 Preliminary FEMA Digital Flood Insurance Rate Map (DFIRM) flood maps for coastal communities. This plan uses 2015 Preliminary FEMA DFIRM flood maps. Additionally, the 2014 HMP used a NOAA sea-level rise dataset that displayed the permanent extent of the mean higher high water mark (MHHW) as a result of various sea-level rise scenarios. As discussed above, this plan used a NOAA dataset that provided a combined flooding and sea-level rise hazard area. Differences between these datasets, such as varying hazard extents, can cause differences between the reported overall exposure estimates.

Differences also exist between the structure values used in both plans. The 2014 HMP used the improvement value at the parcel level from the most current tax assessor data at the time. For this plan, a custom building inventory was generated using 2015 tax assessor data and a Township-wide building footprint spatial layer. The improvement value is the assessed value of the structure that does not directly correlate to the cost of construction. The replacement cost value calculated for the custom building stock provides a more accurate estimate of the construction costs of a structure; the costs that are needed to repair or replace the building post-flood event. To calculate the replacement cost value for each structure for the purposes of the FMP, the number of stories, square footage, occupancy type, and 2015 RS Means data were used. The RS Means is a nationally accepted reference on building construction costs that is published annually. The RS Means data takes into account occupancy class, regional factors, and materials and the cost to transport materials to the site. Additionally, multiple structures may be present on a single parcel that may not be represented in the improvement value. Using the Township-wide building footprint layer, the replacement cost value of each structure was calculated based on the provided attributes.

Effect of Climate Change on Vulnerability

Climate is defined not simply as average temperature and precipitation but also by the type, frequency and intensity of weather events. Both globally and at the local scale, climate change has the potential to alter the prevalence and severity of extremes such as flood events and hurricanes. While predicting changes of flood events and the prevalence or intensity of hurricanes under a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating future climate change impacts on human health, society and the environment (U.S. Environmental Protection Agency [EPA], 2006).

Future Growth and Development

As discussed in Section 4, areas targeted for future growth and development have been identified across the Township. Any areas of growth could be potentially impacted by the flood hazard if located within the identified hazard areas. It is the intention of the Township to discourage development in vulnerable areas or to encourage higher regulatory standards on the local level.

Additional Data and Next Steps

A HAZUS-MH flood analysis was conducted for the Township of Brick using the most current and best available data including updated building and critical facility inventories, and DFIRM. As additional FEMA Risk Mapping, Assessment, and Planning (Risk MAP) products become available, these may be used to further enhance this assessment (e.g. depth grids for additional recurrence intervals). Further, as additional

climate change and sea-level rise scenarios and depth grids are generated, these may also be incorporated into HAZUS-MH and potential losses calculated.

Specific mitigation actions addressing improved data collection and further vulnerability analysis is included in Section 6 of this plan.