Figure 79:

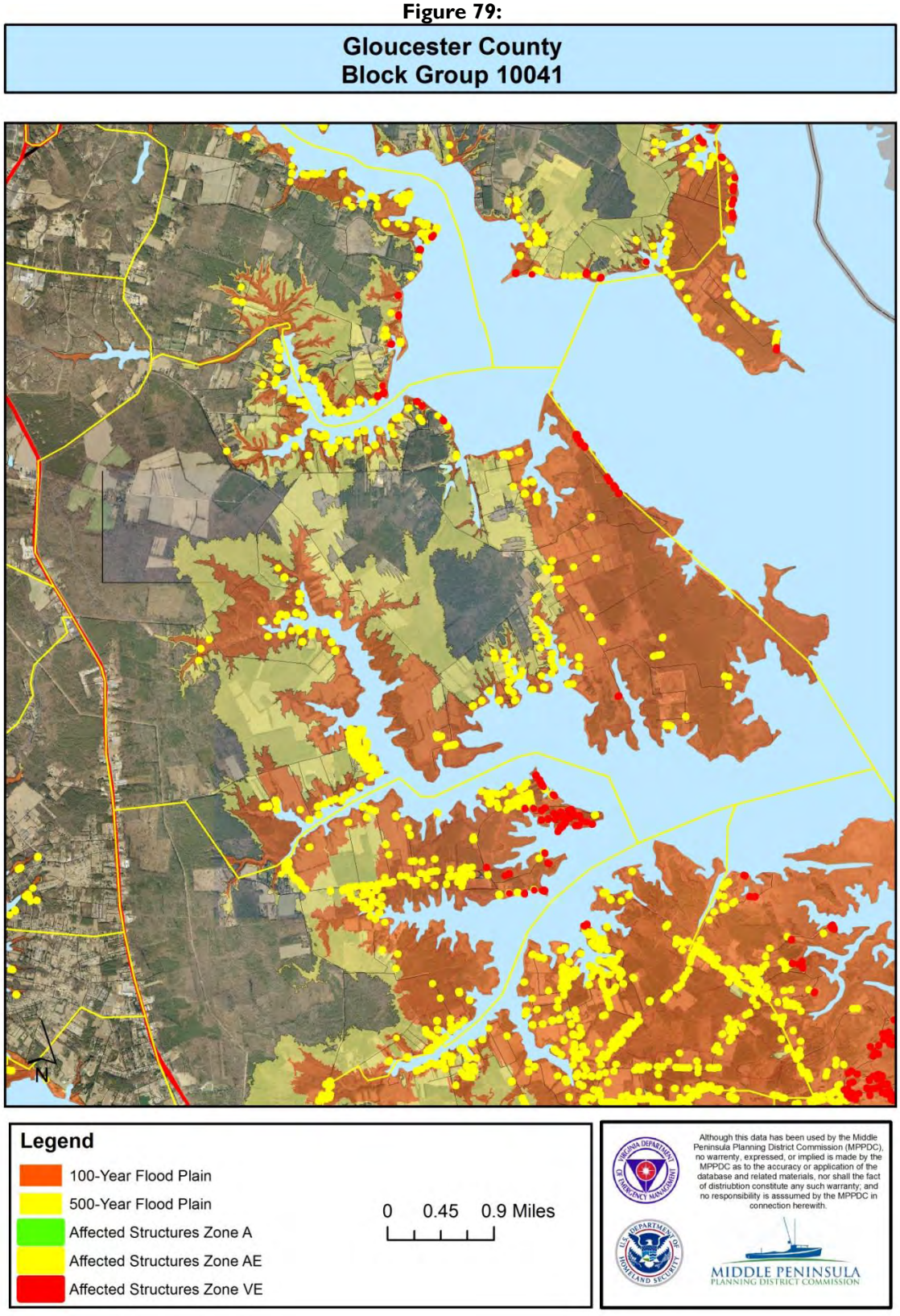
Gloucester County
Block Group 10041
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures Zone A
Affected Structures Zone AE
Affected Structures Zone VE
0 0.45 0.9 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
MIDDLE PENINSULA
PLANNING DISTRICT COMMISSION

Figure 80:

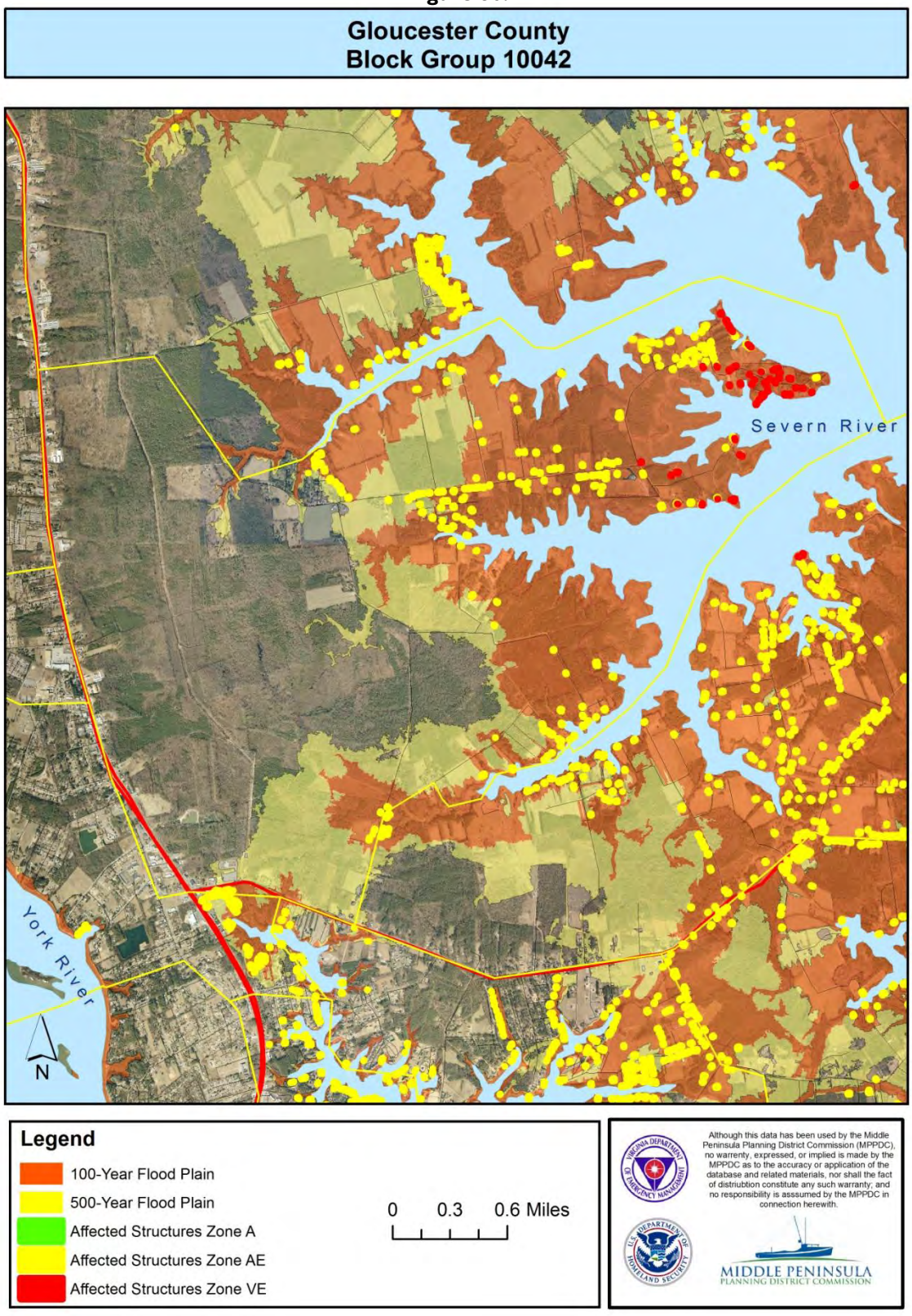
Gloucester County
Block Group 10042
Severn River
York River
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures Zone A
Affected Structures Zone AE
Affected Structures Zone VE
0 0.3 0.6 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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Figure 81:

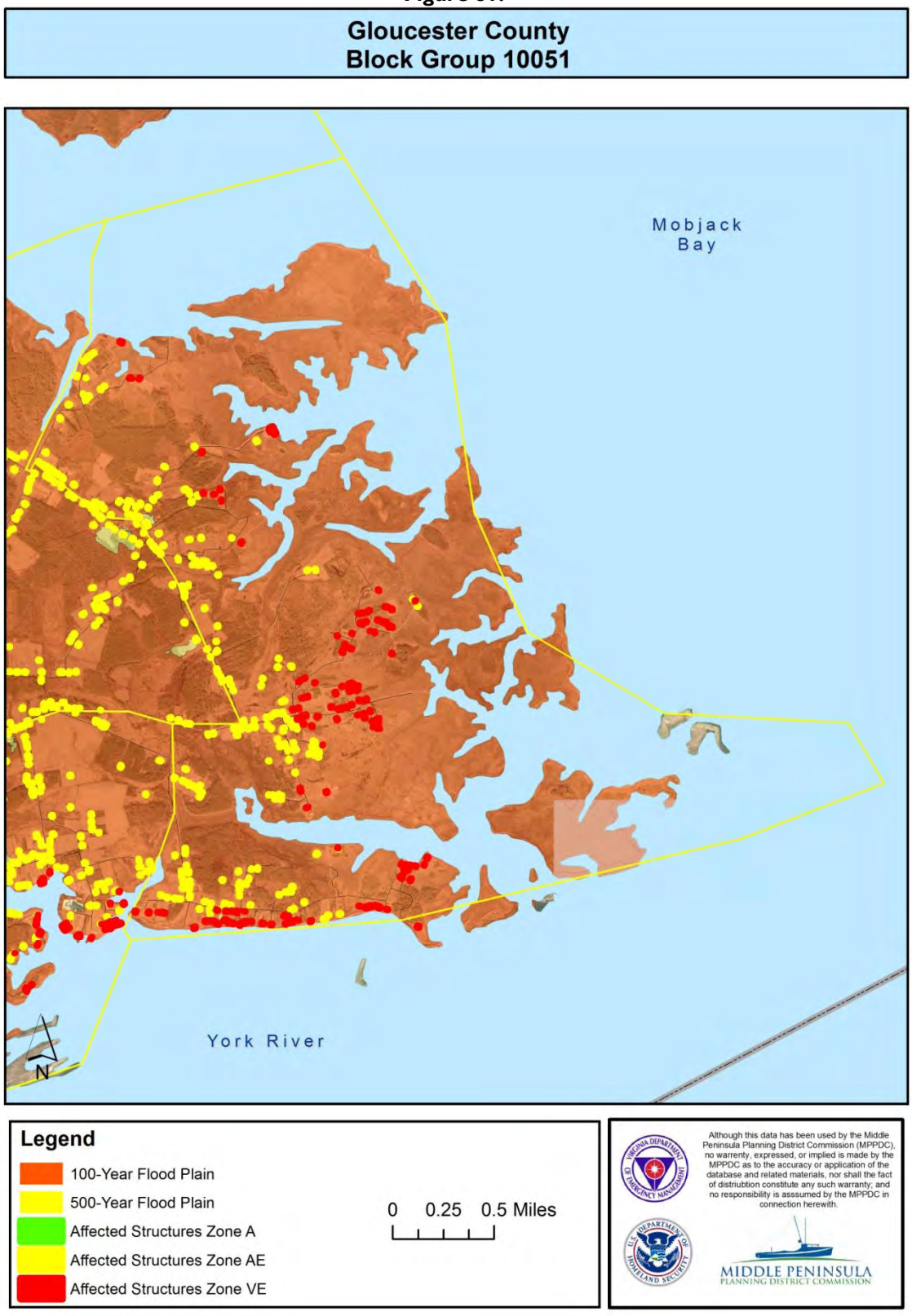
Gloucester County
Block Group 10051
Mobjack Bay
York River
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures Zone A
Affected Structures Zone AE
Affected Structures Zone VE
0 0.25 0.5 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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Figure 82:

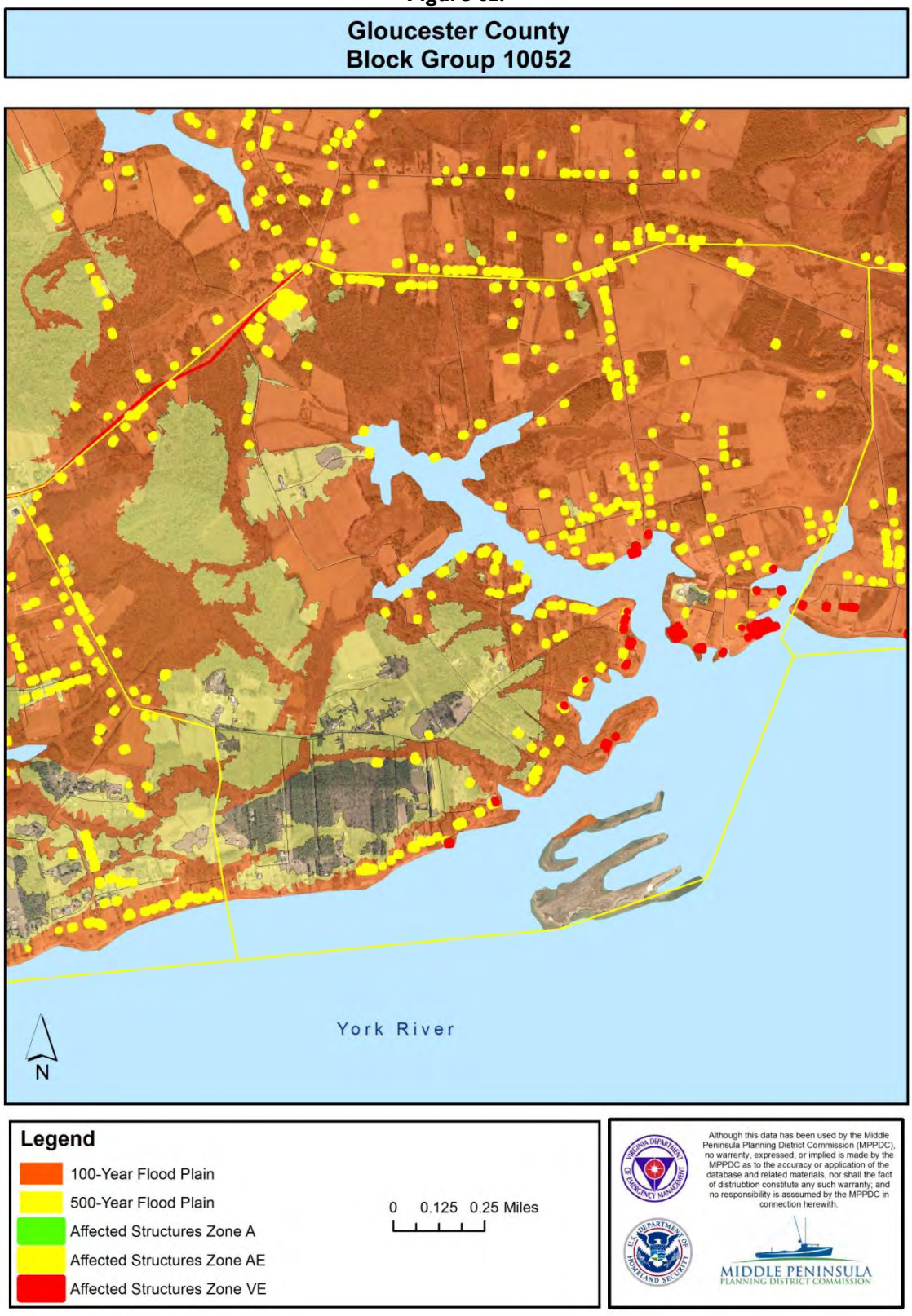
Gloucester County
Block Group 10052
York River
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures Zone A
Affected Structures Zone AE
Affected Structures Zone VE
0 0.125 0.25 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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Figure 83:

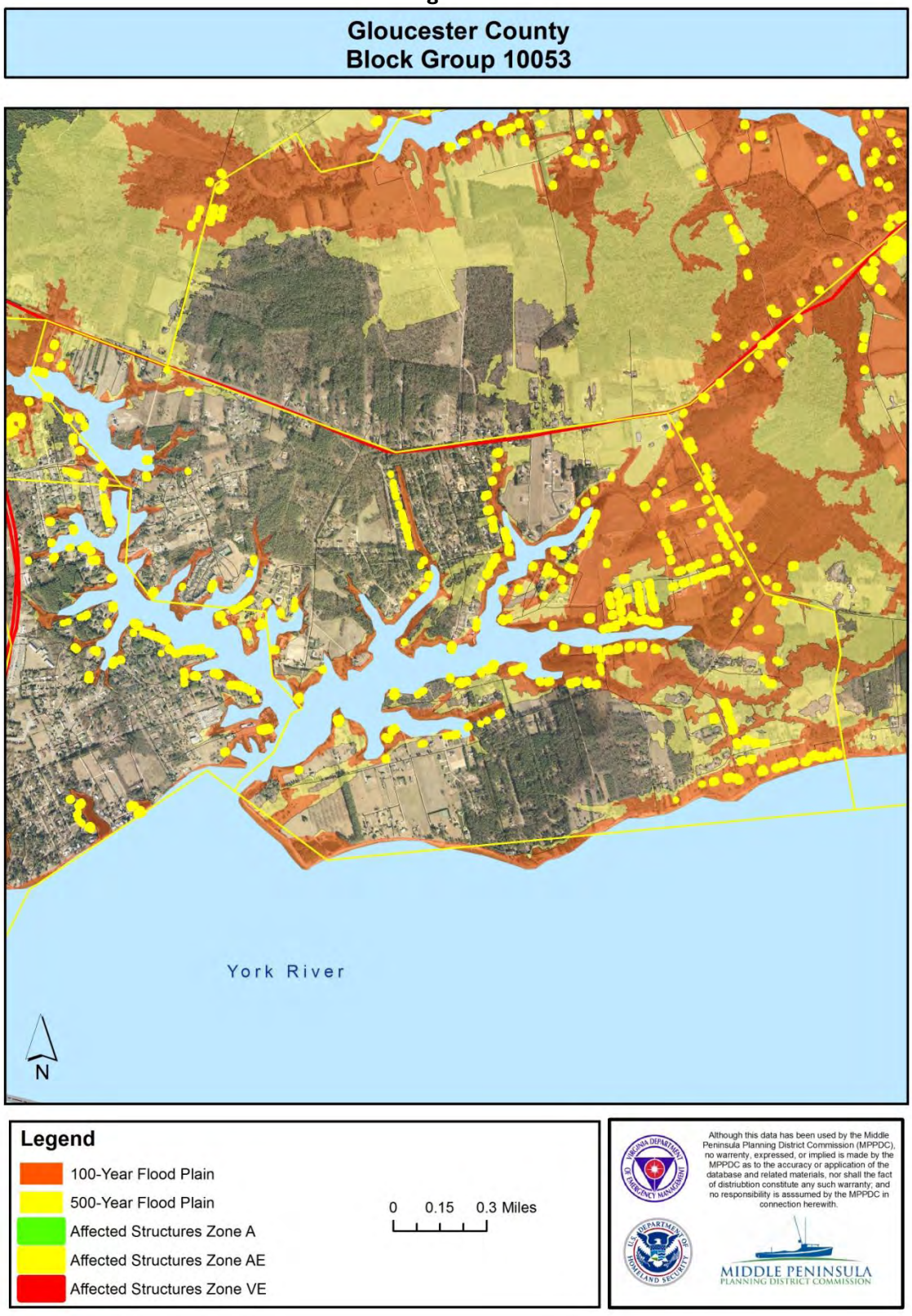
Gloucester County
Block Group 10053
York River
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures Zone A
Affected Structures Zone AE
Affected Structures Zone VE
0 0.15 0.3 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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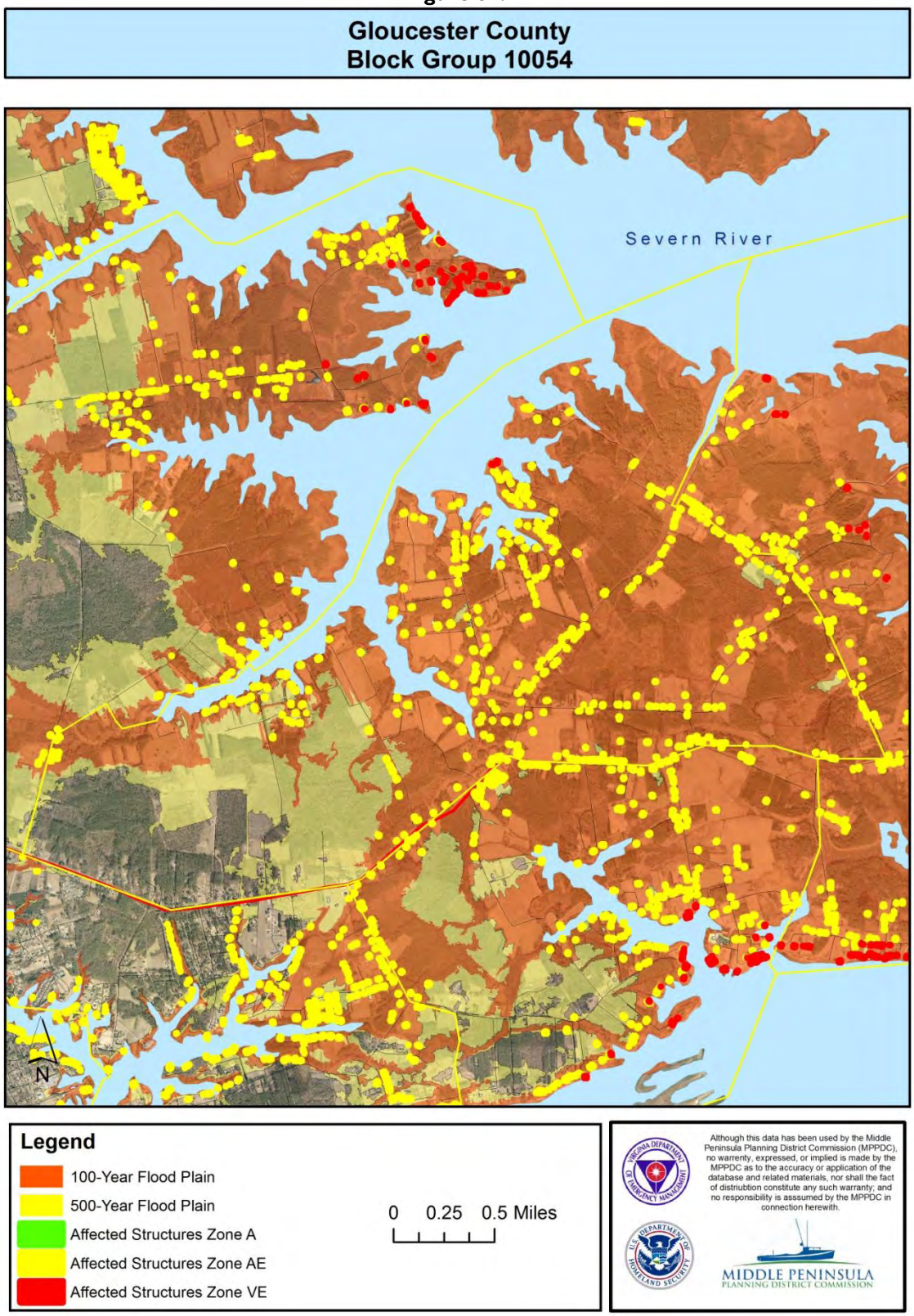
Figure 84:


Gloucester County
Block Group 10054
Severn River
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures Zone A
Affected Structures Zone AE
Affected Structures Zone VE
0 0.25 0.5 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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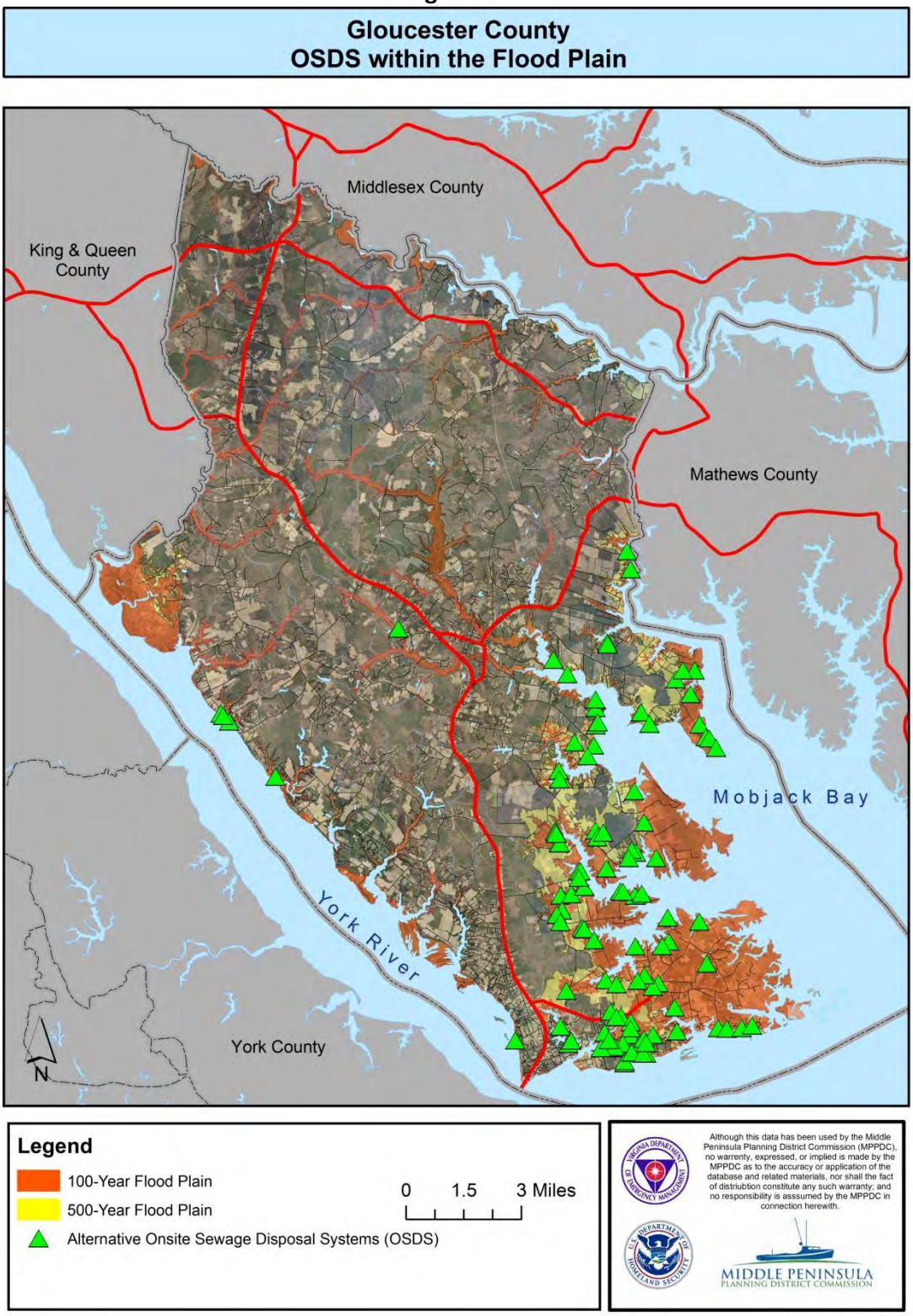
Alternative On-site Sewage Disposal Systems (OSDS)

The following maps (Figure 85) show the locations of the installed OSDS facilities constructed in the 100-year and 500-year floodplain in Gloucester County.

Figure 85:



4.5.5. Mathews Critical Facilities and Public Utilities

New Point Comfort Lighthouse, located at the southern tip of Mathews County, has undergone significant flood damage resulting from the lighthouse being separated from the mainland due to severe erosion. Mathews County owns the lighthouse facility and the locality has plans to undertake stabilization work to "weather-harden" the base/foundation of the structure.

According to VDOT officials, flood prone roads in Mathews County include the following:

Table 33: Mathews County Flood Prone Roads

Route	Road Name	Location
610	Marsh Hawk Road	From Rte. 614 to Rte. 611
600	Circle Drive	From Rte.14 to Rte. 14
600	Light House or Point Road	From Rte. 14 to ESM
611	Tabernacle Road	From Rte. 613 to Rte. 609
611	Tabernacle Road	From Rte. 610 to Rte. 609
609	Bethel Beach Road	From Rte. 610 to ESM
609	Bethel Beach Road	From Rte. 614 to Rte. 611
643	Haven Beach Road	From Rte. 704 to ESM
633	Old Ferry Road	From Rte. 704 to 636
608	Potato Neck Road	From Rte. 649 to ESM
644	Bandy Ridge Road	From Rte. 611 to Rte. 614

Public Boat Ramps

There is one public boat landing in Mathews County that is owned and operated by the VDGIF:

Water Body	Access Area	Barrier Free	Type	Ramps	Latitude	Longitude
East River	Town Point	Yes	Concrete Ramp	1	37° 24' 55" N 37.4143723	76° 20' 15"W -76.3375842
Directions: From Mathews, Rt 14 South (3.8 miles); Right onto Rt 615 (.6 miles)						
VDGIF, 2015						

Repetitive and Severe Repetitive Loss Residential Structures in Mathews County

According to FEMA's records, Mathews County has 169 (i.e. 164 Single family, 3 Non-resident, 1 Other resident, and 1 Assmd Condo) Repetitive Loss residential properties and 11Single Family Severe Repetitive Losses as of 5/31/15.

Public School Properties

During a Category 2 hurricane, the Thomas Hunter Middle School and the Lee Jackson Elementary School properties become flooded.

Properties In 100-year Floodplain by Census Block Groups

The following series of maps show the location of structures in Mathews County that are in Flood Zone AE or Flood Zone VE in the 100-year and 500-year floodplains. The legend is color coded to indicate the specific flood zone in which each structure lies.

Figure 86:

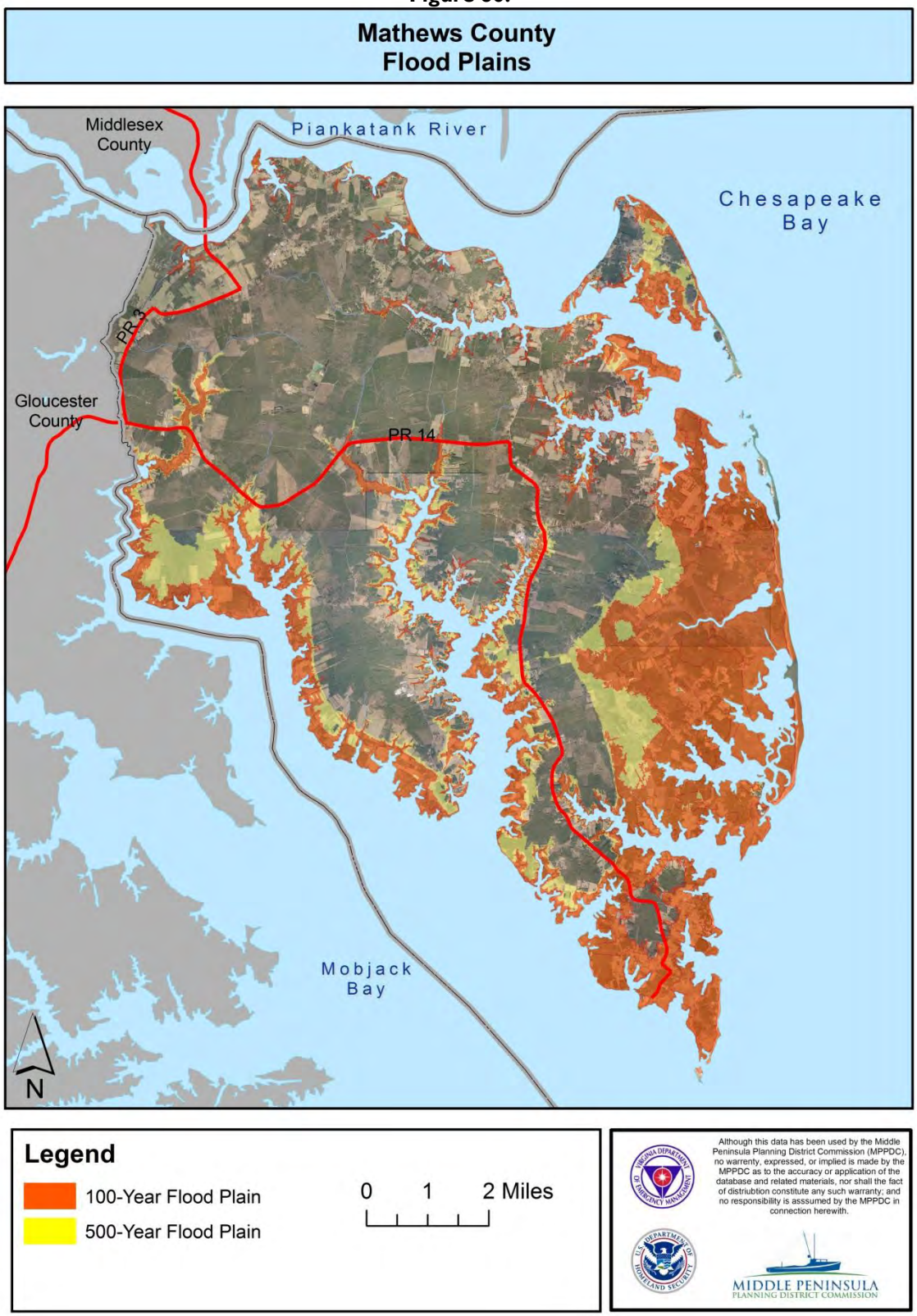

Mathews County
Flood Plains
Middlesex County
Piankatank River
Chesapeake Bay
PR 3
Gloucester County
PR 14
Mobjack Bay
N
Legend
100-Year Flood Plain
500-Year Flood Plain
0 1 2 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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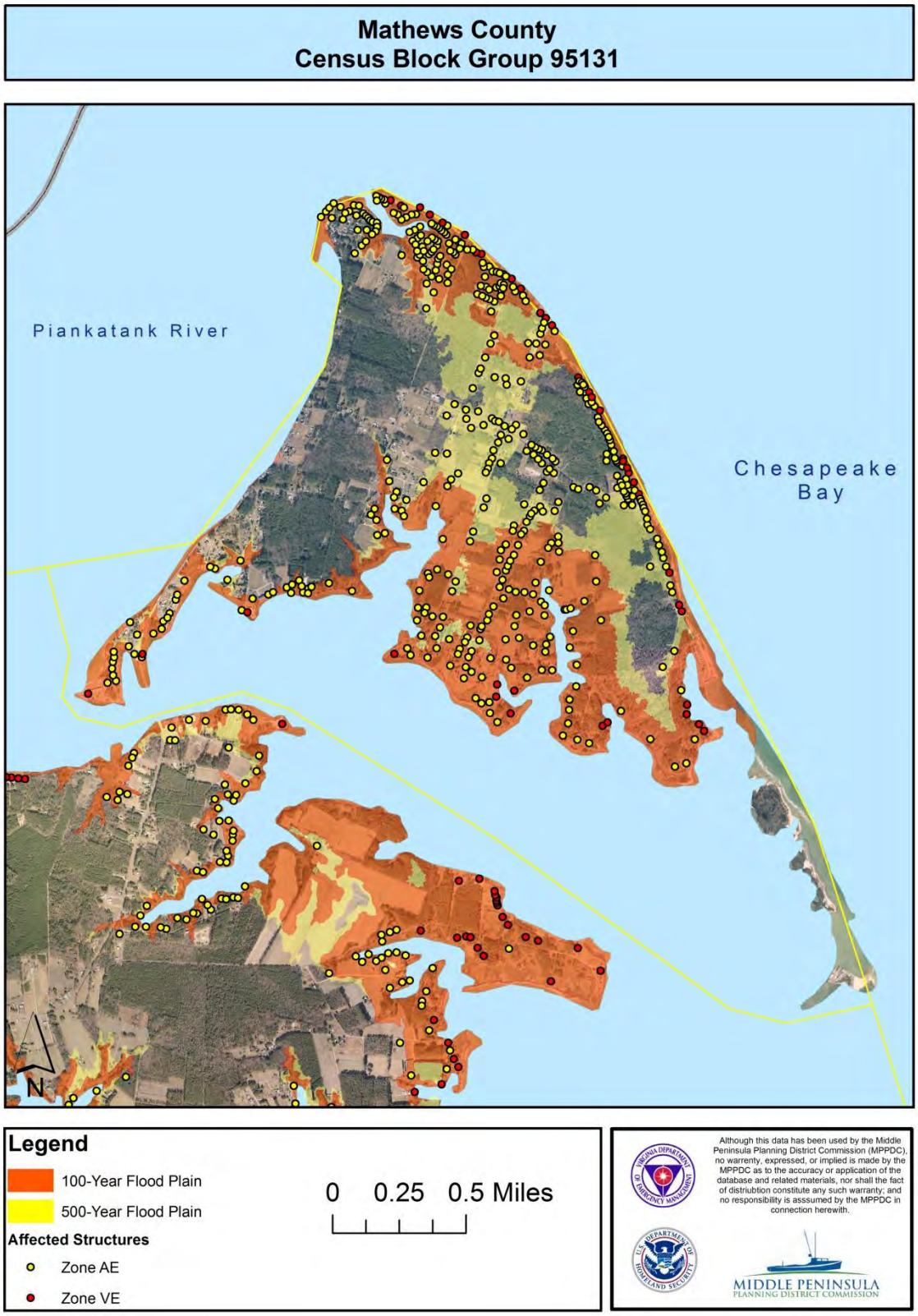
Figure 87:


Mathews County
Census Block Groups
Middlesex County
Piankatank River
Chesapeake Bay
PR 3
Gloucester County
PR 14
Mobjack Bay
N
Legend
Census Block Groups
0 1 2 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
MIDDLE PENINSULA
PLANNING DISTRICT COMMISSION

Figure 88:


Mathews County
Census Block Group 95131
Piankatank River
Chesapeake Bay
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
Zone AE
Zone VE
0 0.25 0.5 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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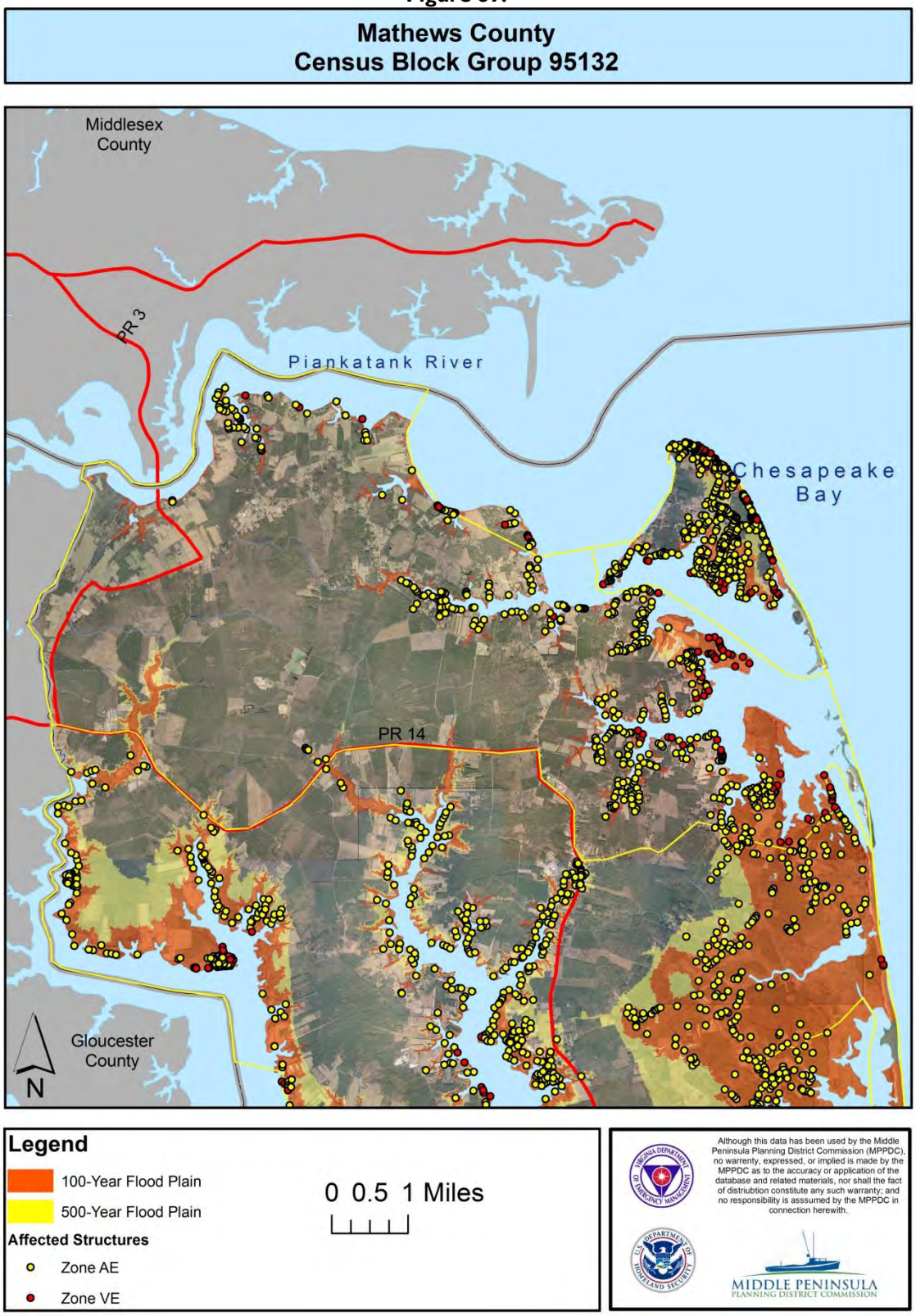
PLANNING DISTRICT COMMISSION

Figure 89:


Mathews County
Census Block Group 95132
Middlesex County
PR 3
Piankatank River
Chesapeake Bay
PR 14
Gloucester County
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
Zone AE
Zone VE
0 0.5 1 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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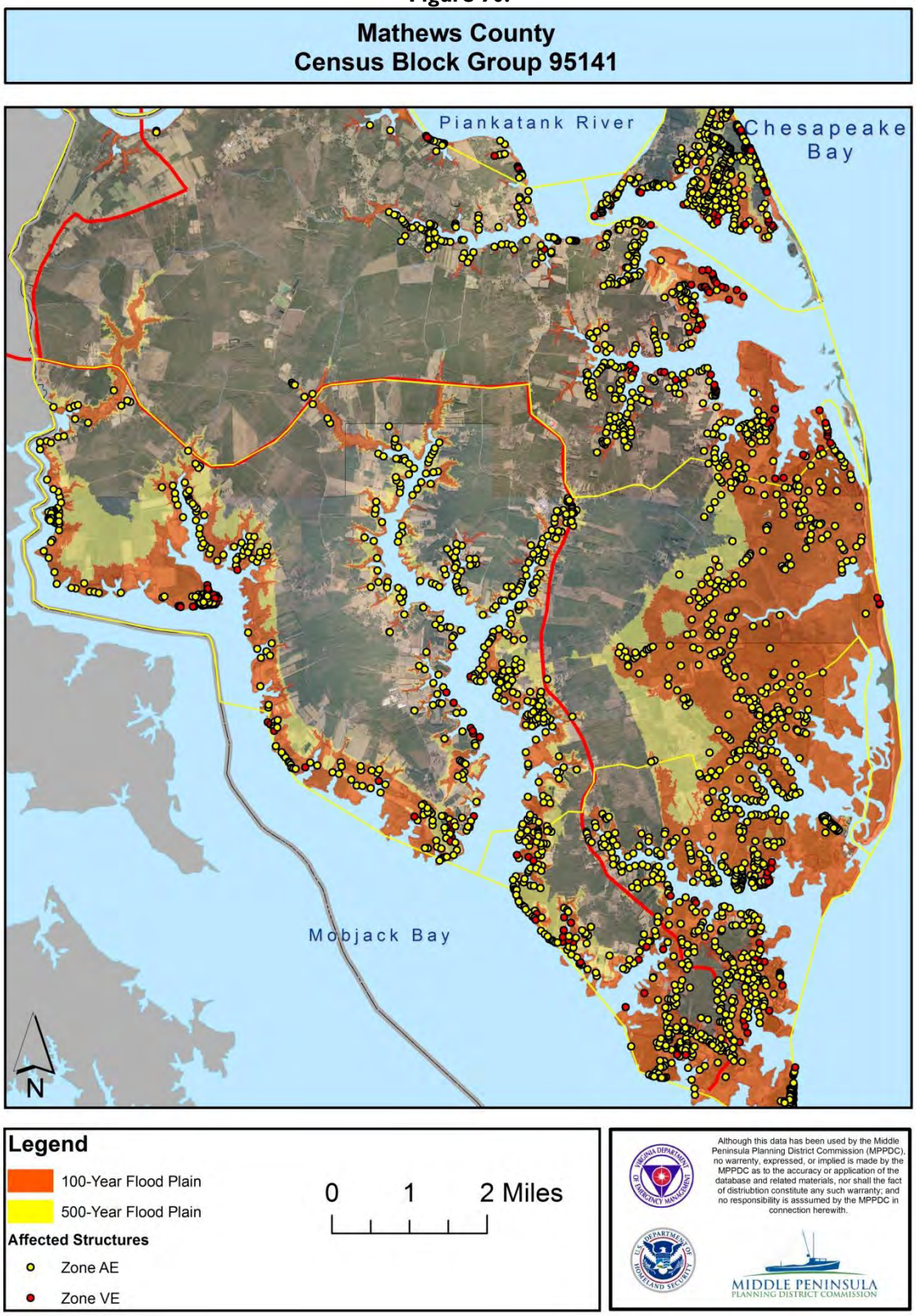
PLANNING DISTRICT COMMISSION

Figure 90:


Mathews County
Census Block Group 95141
Piankatank River
Chesapeake Bay
Mobjack Bay
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
Zone AE
Zone VE
0 1 2 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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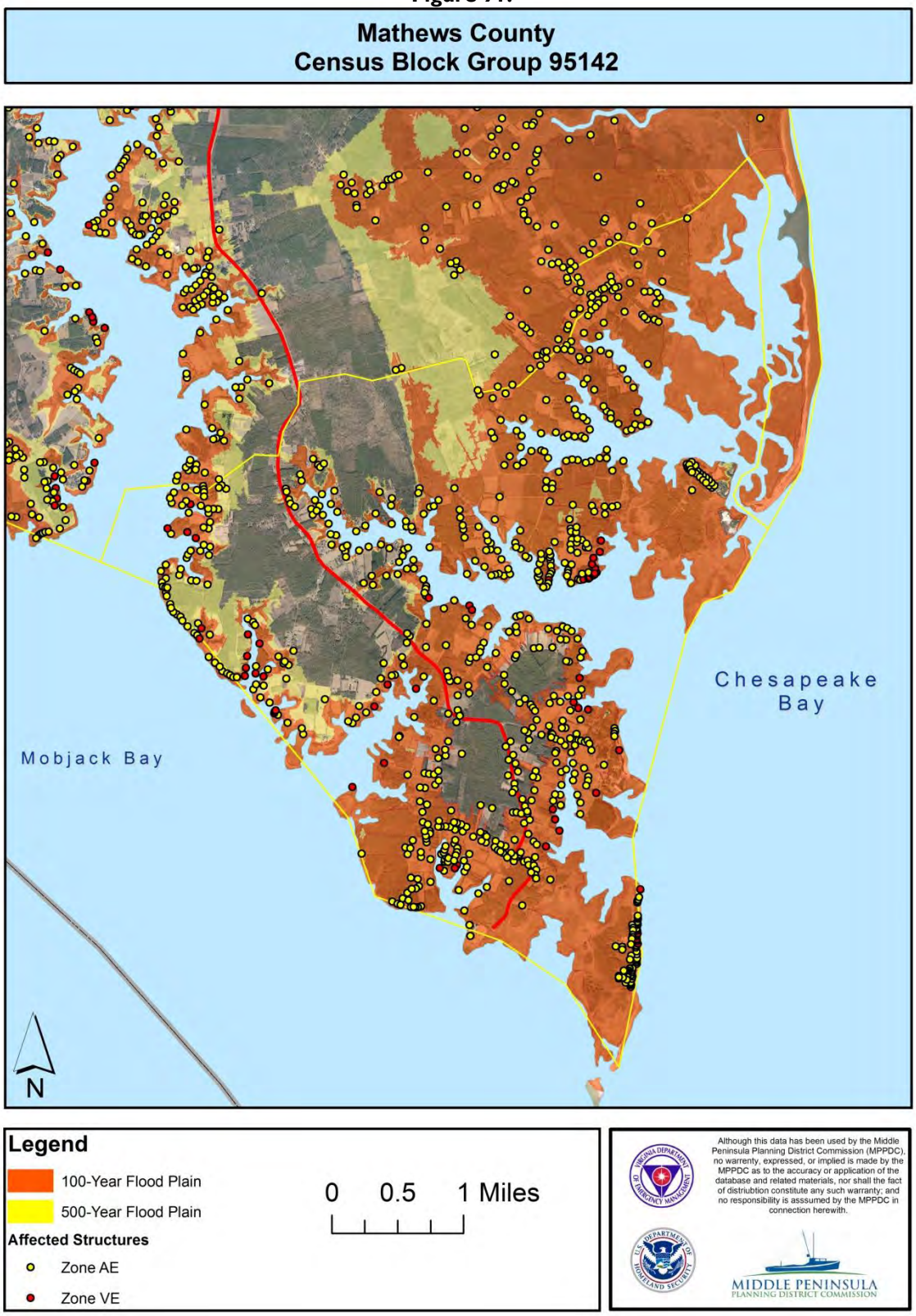
PLANNING DISTRICT COMMISSION

Figure 91:


Mathews County
Census Block Group 95142
Chesapeake Bay
Mobjack Bay
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
Zone AE
Zone VE
0 0.5 1 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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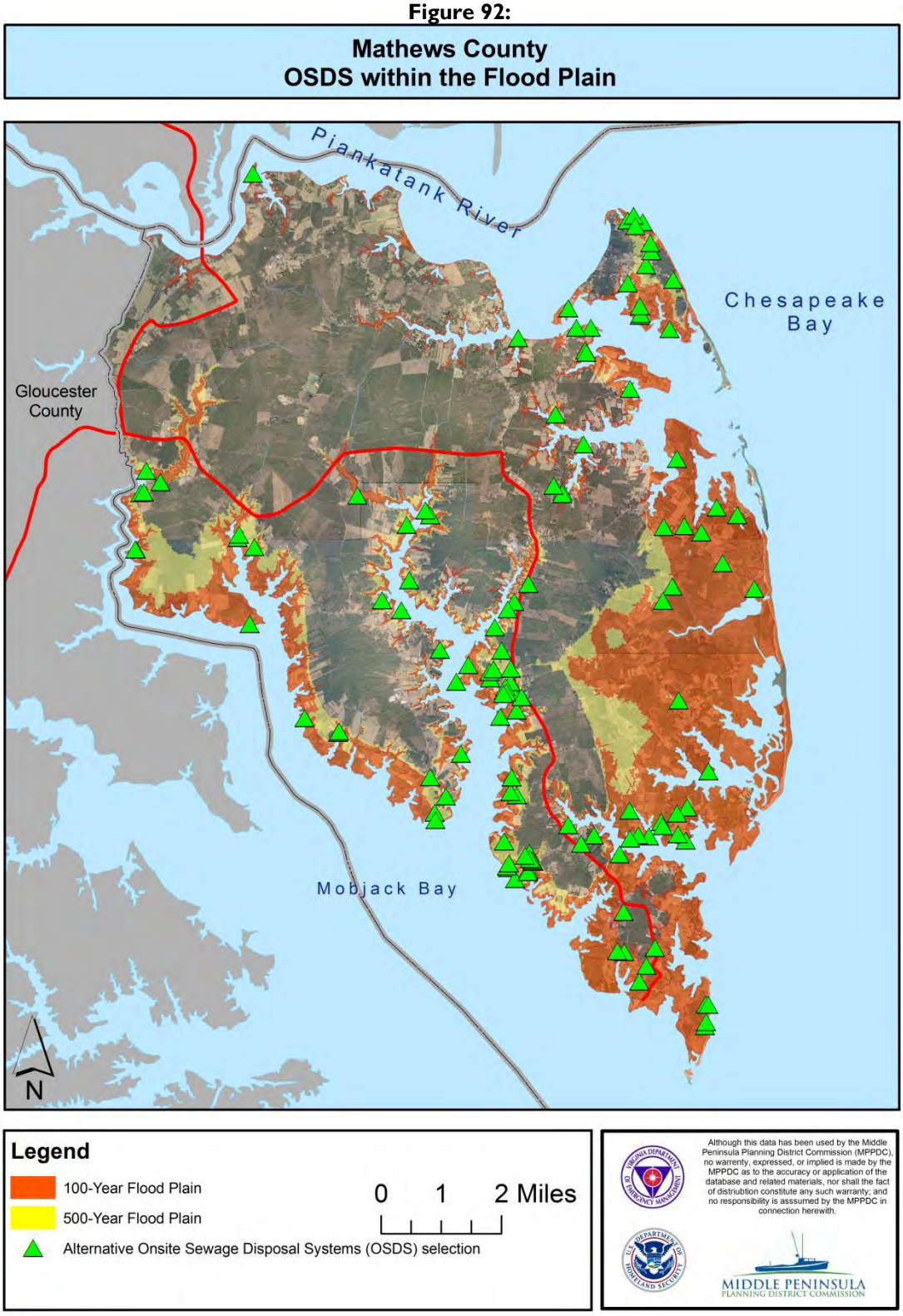
PLANNING DISTRICT COMMISSION

Alternative On-site Sewage Disposal Systems (OSDS)

The following map (Figure 92) show the location of the OSDS facilities constructed in the 100-year and 500-year floodplains in Mathews County.

Figure 92:



4.5.6. Middlesex County Critical Facilities and Public Utilities

The county does not currently operate any public water systems. However, there are community water systems operated by private companies serving the Village of Saluda and some of the larger residential subdivisions in the lower portion of the county in the Hartfield and Deltaville areas. These water systems do not sustain flood damages from severe hurricanes and nor'easters.

The County does have a public sewerage system in the planning stages that will serve the Village of Saluda and properties east along the Route 33 corridor towards the Cook's Corner area. The wastewater treatment plant and outfall for this proposed system will be built along a tributary of Urbanna Creek, located between Saluda and Cook's Corner.

Since this project is in the permitting/design stage, it is assumed that the facility will be designed and constructed in a manner to avoid any future adverse impacts from floodwaters.

According to VDOT officials, flood prone roads in Middlesex County/Urbanna include the following:

Table 34: Middlesex County/Urbanna Flood Prone Roads

Route	Road Name	Location
648	Montague Island Road	From Rte.604 to ESM
651	Smokey Point	From Rte. 640 to Rte. 685
1103	Irma's Lane	From Rte. 33 to Rte. 1102
628	Mill Creek Road	From Rte. 702 to ESM
636	Timber Neck Road	From Rte. 643 to Rte. 659

Public Boat Ramps

There are 3 public boat landings in Middlesex County that are owned and operated by the VDGIF:

Water Body	Access Area	Barrier Free	Type	Ramps	Latitude	Longitude
Parrotts Creek	Mill Stone	Yes	Concrete Ramp	1	37° 43' 36" N 37.7266569	76° 37' 19"W -76.6219992
Directions: Church View, Rt 17 North (1.1 miles); Right on Rt 640 (4.4miles; Left on Rt 608 (0.8 miles)						
Rappahannock River	Mill Creek	Yes	Concrete Ramp	1	37° 35' 3" N 37.5842494	76° 25' 28"W -76.4244480
Directions: From Hartfield, Rt 3 North (0.5 miles); Right on Rt 626 (3.1 miles)						
Rappahannock River	Saluda	Yes	Concrete Ramp	1	37° 37' 21" N 37.6225893	76° 34' 54"W -76.5816117
Directions: Rt 618 North (1.4 miles) of Saluda						
VDGIF, 2015						

Repetitive and Severe Repetitive Loss Residential Structures in Middlesex County

According to FEMA's records, Middlesex County has 35 Single Family Repetitive Loss properties and 2 Single Family Severe Repetitive Loss properties as of 5/31/15.

Properties in 100-year Floodplain by Census Block Group

The following series of maps show the location of structures in Middlesex County that are in Flood Zone A, Flood Zone AE or Flood Zone VE in the 100-year and 500-year floodplains. The legend is color coded to indicate the specific flood zone in which each structure lies.

Figure 93:

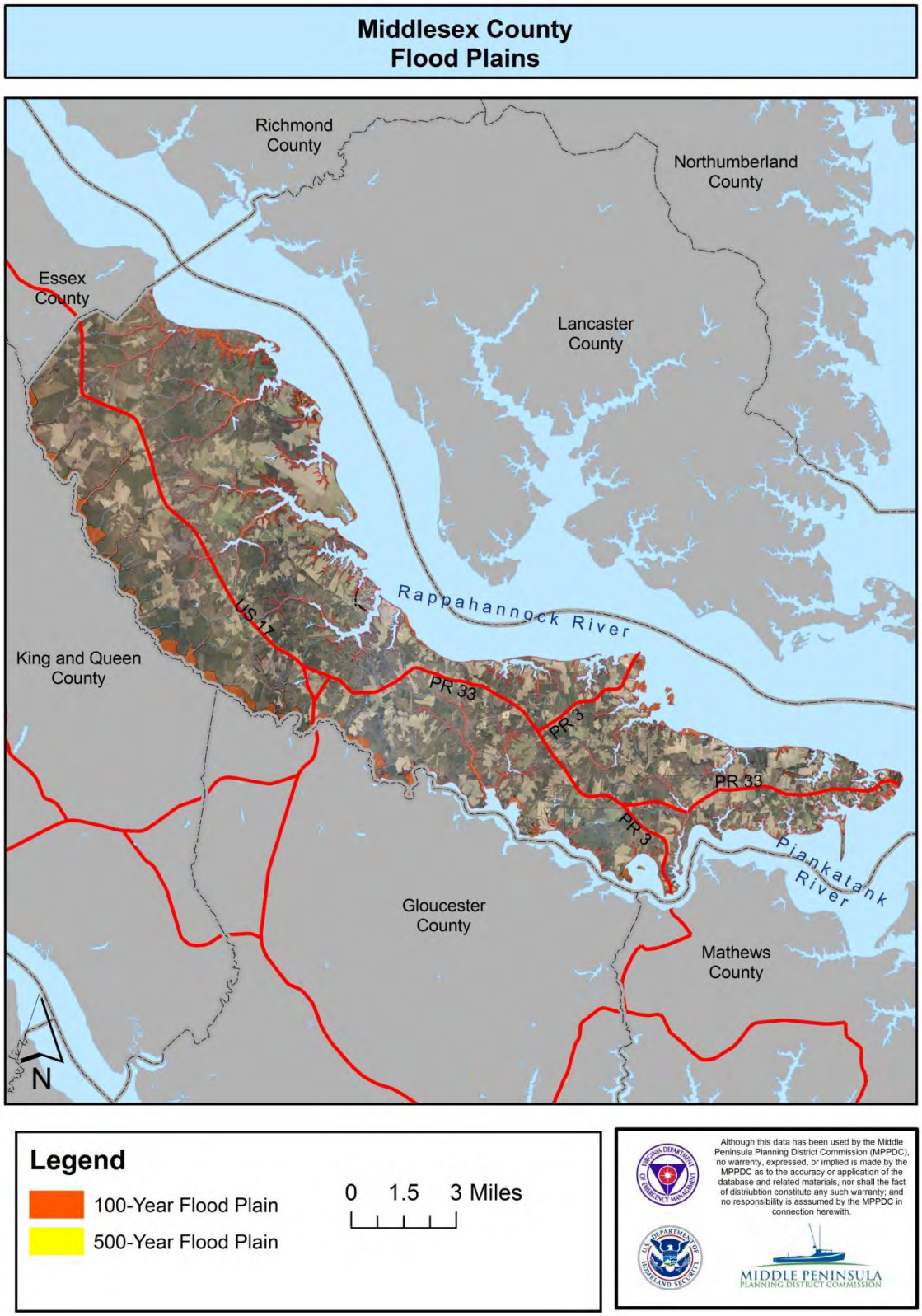

Middlesex County
Flood Plains
Richmond County
Northumberland County
Essex County
Lancaster County
Rappahannock River
US 17
King and Queen County
PR 33
PR 3
PR 33
PR 3
Piankatank River
Gloucester County
Mathews County
N
Legend
100-Year Flood Plain
500-Year Flood Plain
0 1.5 3 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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Figure 94:

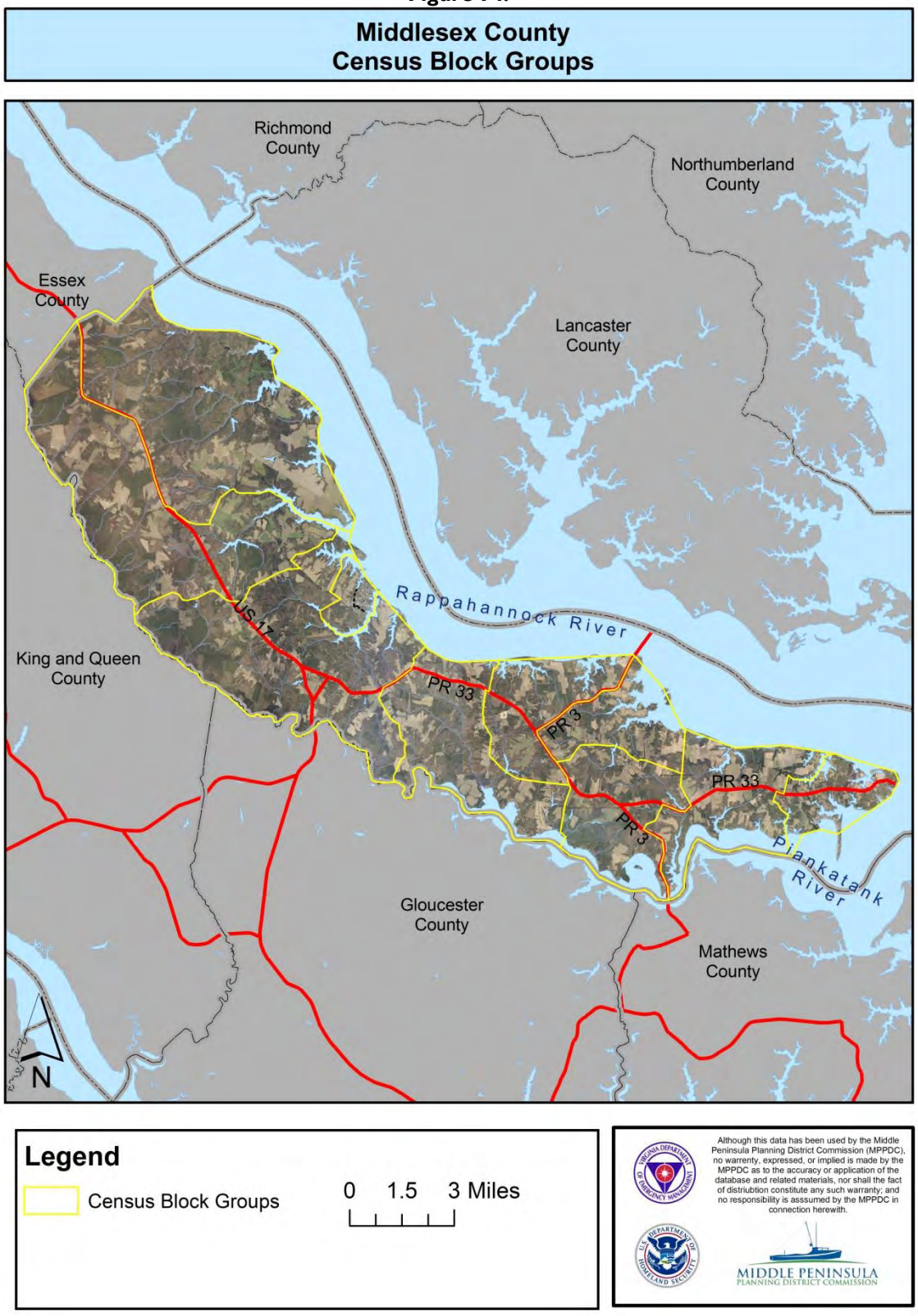
Middlesex County
Census Block Groups
Richmond County
Northumberland County
Essex County
Lancaster County
Rappahannock River
US 17
King and Queen County
PR 33
PR 3
PR 33
PR 3
Plankatank River
Gloucester County
Mathews County
N
Legend
Census Block Groups
0 1.5 3 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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Figure 95:

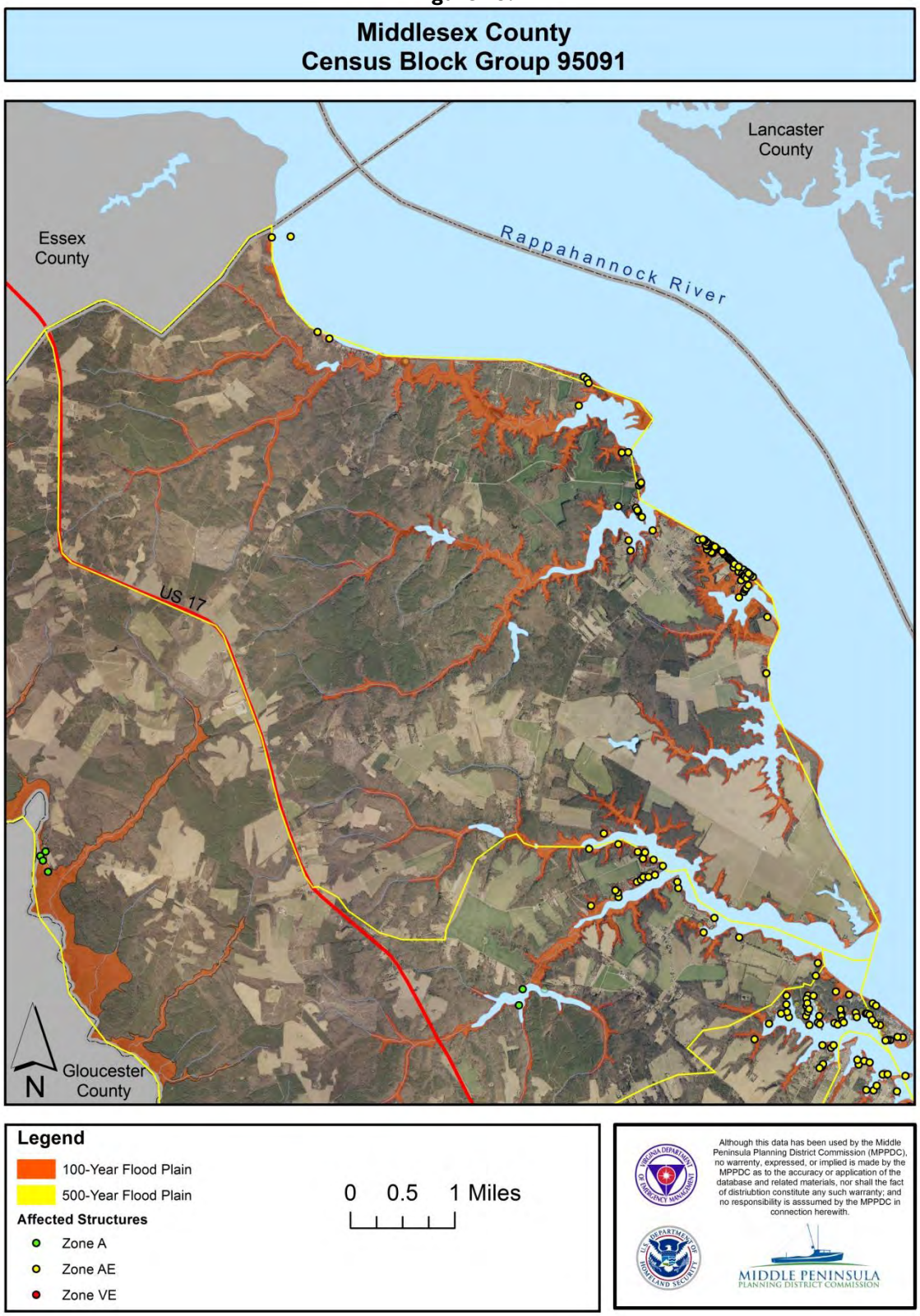
Middlesex County
Census Block Group 95091
Lancaster County
Essex County
Rappahannock River
US 17
N
Gloucester County
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
Zone A
Zone AE
Zone VE
0 0.5 1 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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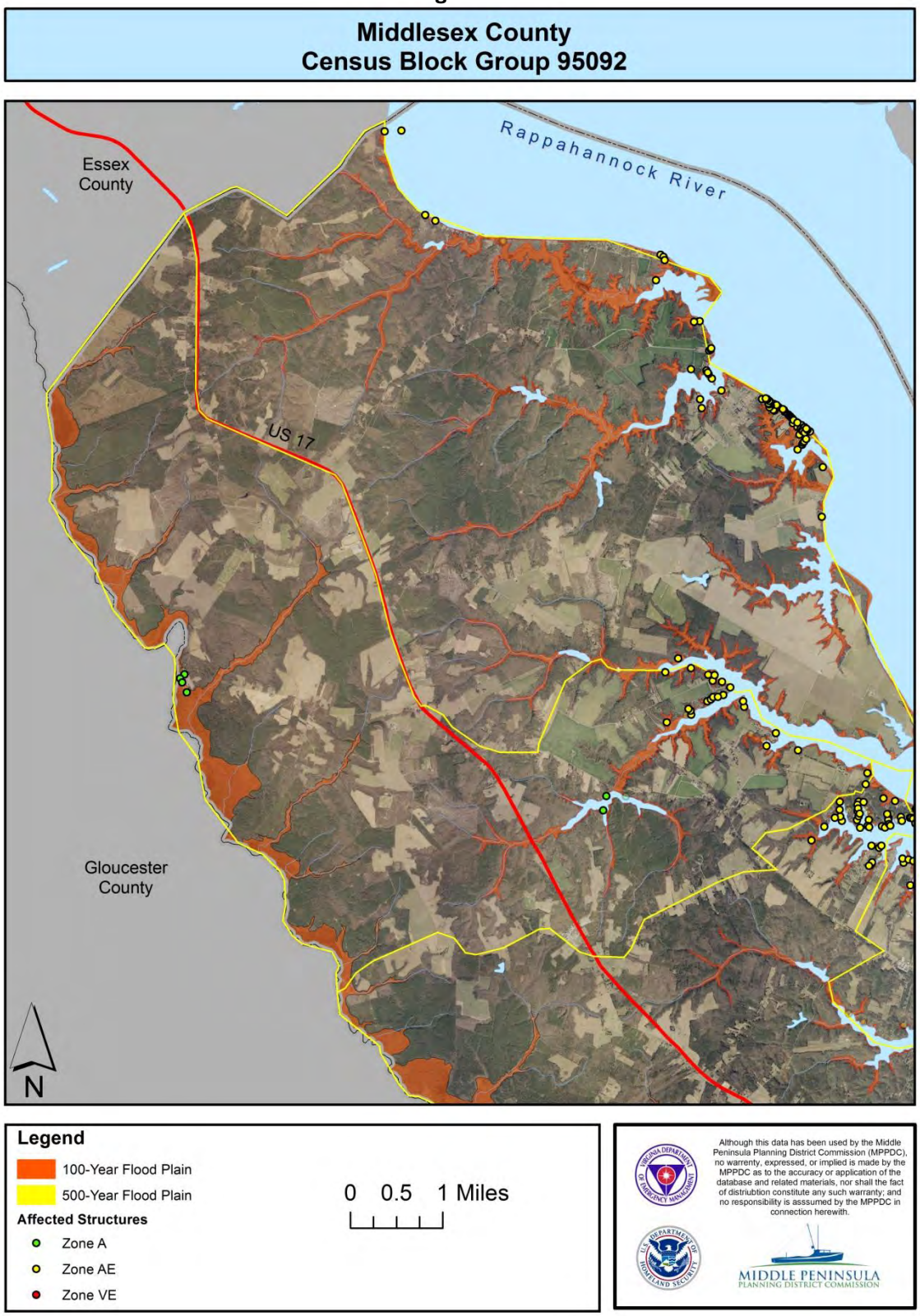
Figure 96:


Middlesex County
Census Block Group 95092
Rappahannock River
Essex County
US 17
Gloucester County
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
Zone A
Zone AE
Zone VE
0 0.5 1 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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PLANNING DISTRICT COMMISSION

Figure 97:

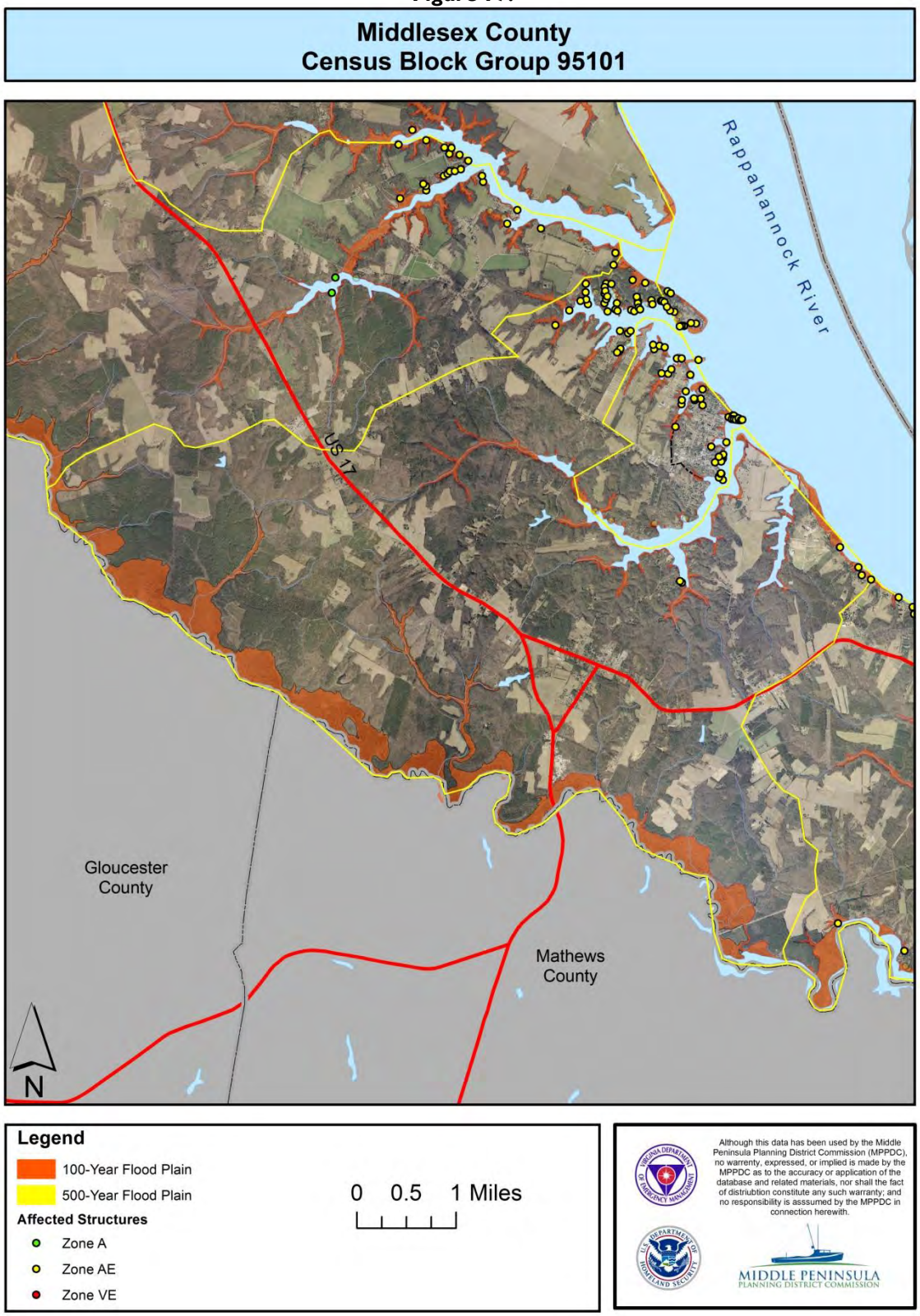
Middlesex County
Census Block Group 95101
Rappahannock River
US 17
Gloucester County
Mathews County
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
Zone A
Zone AE
Zone VE
0 0.5 1 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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Figure 98:

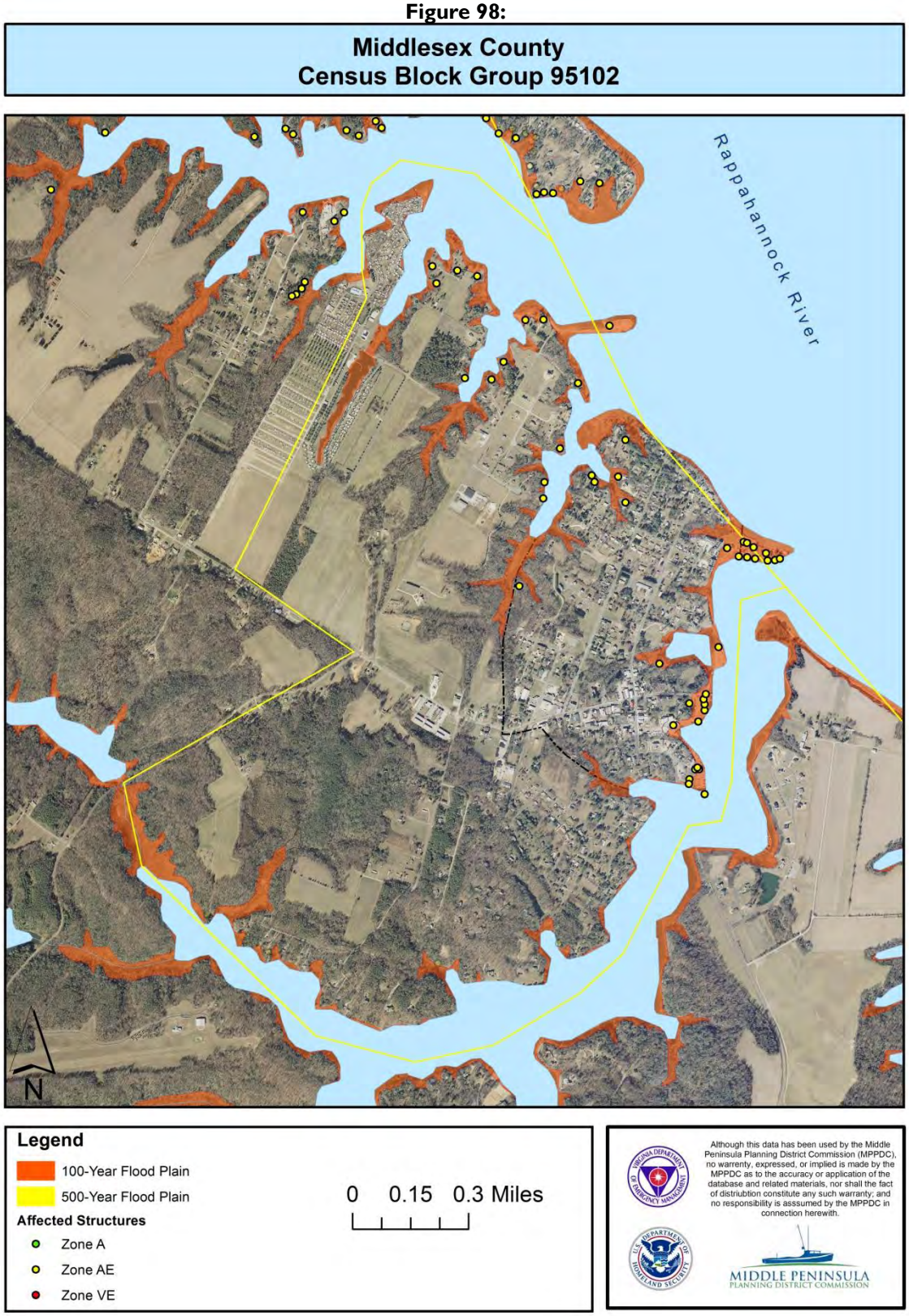
Middlesex County
Census Block Group 95102
Rappahannock River
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
Zone A
Zone AE
Zone VE
0 0.15 0.3 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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Figure 99:

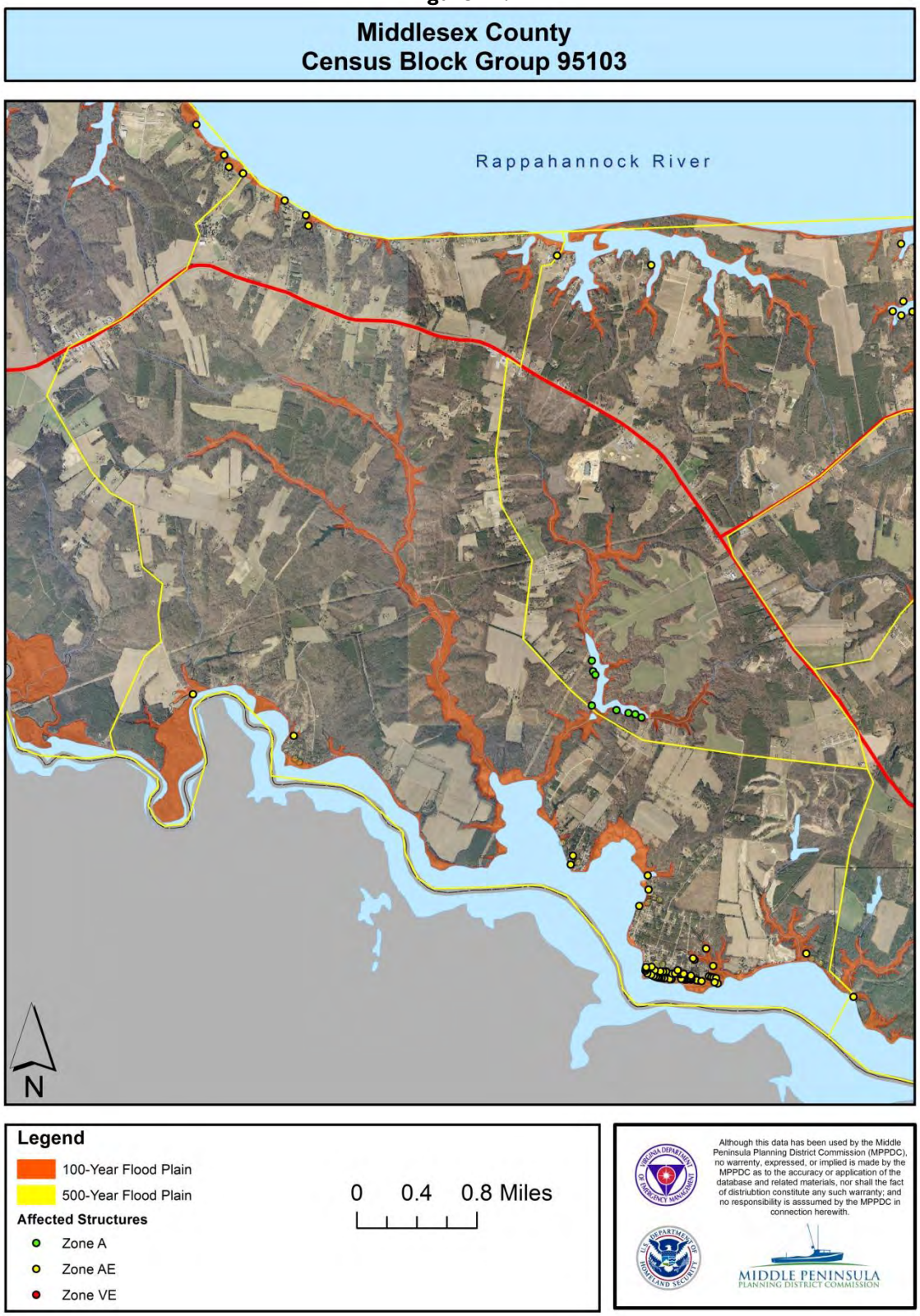
Middlesex County
Census Block Group 95103
Rappahannock River
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
Zone A
Zone AE
Zone VE
0 0.4 0.8 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
MIDDLE PENINSULA
PLANNING DISTRICT COMMISSION

Figure 100:


Middlesex County
Census Block Group 95111
Rappahannock River
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
Zone A
Zone AE
Zone VE
0 0.3 0.6 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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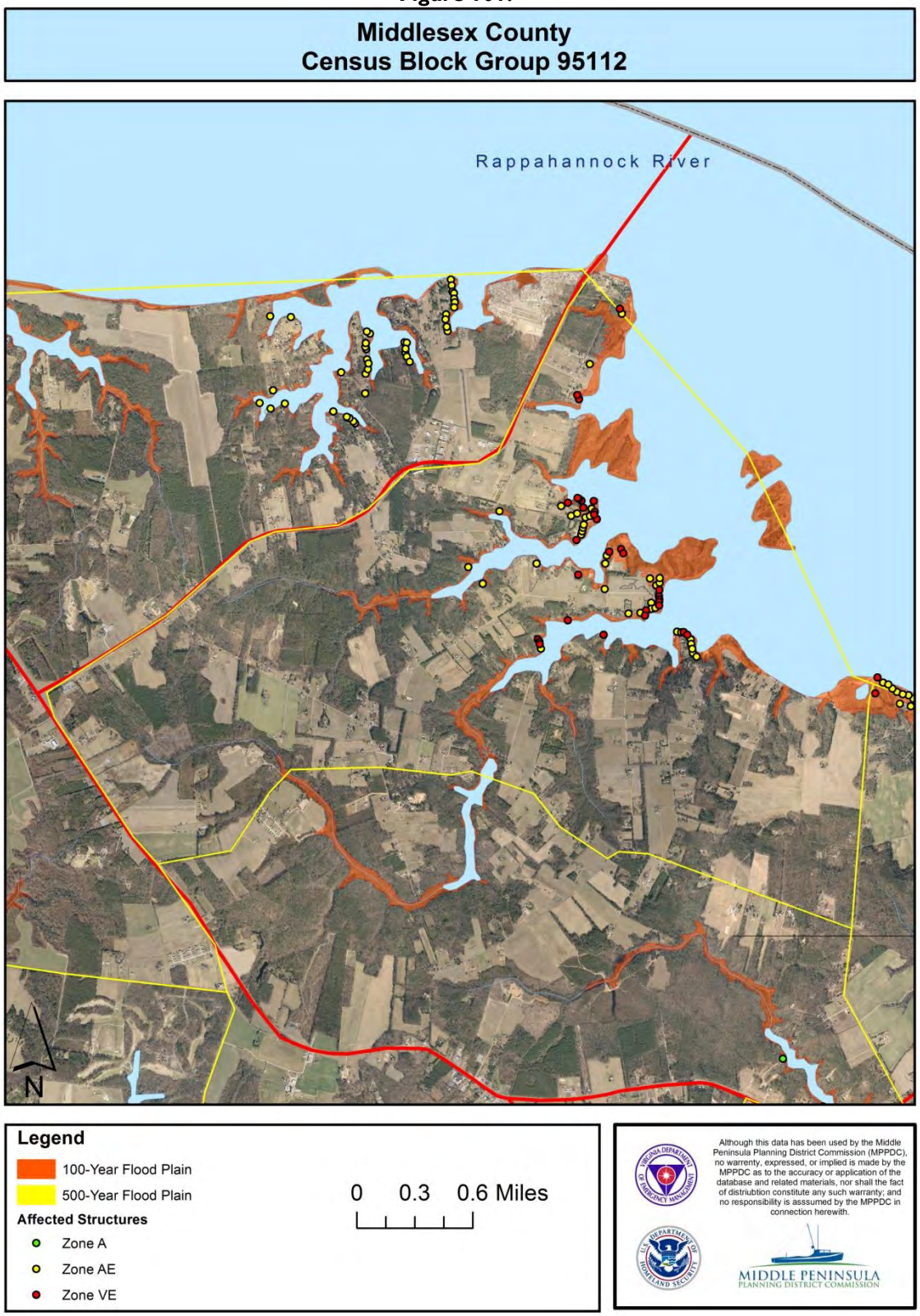
Figure 101:


Middlesex County
Census Block Group 95112
Rappahannock River
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
Zone A
Zone AE
Zone VE
0 0.3 0.6 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
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PLANNING DISTRICT COMMISSION

Figure 102:

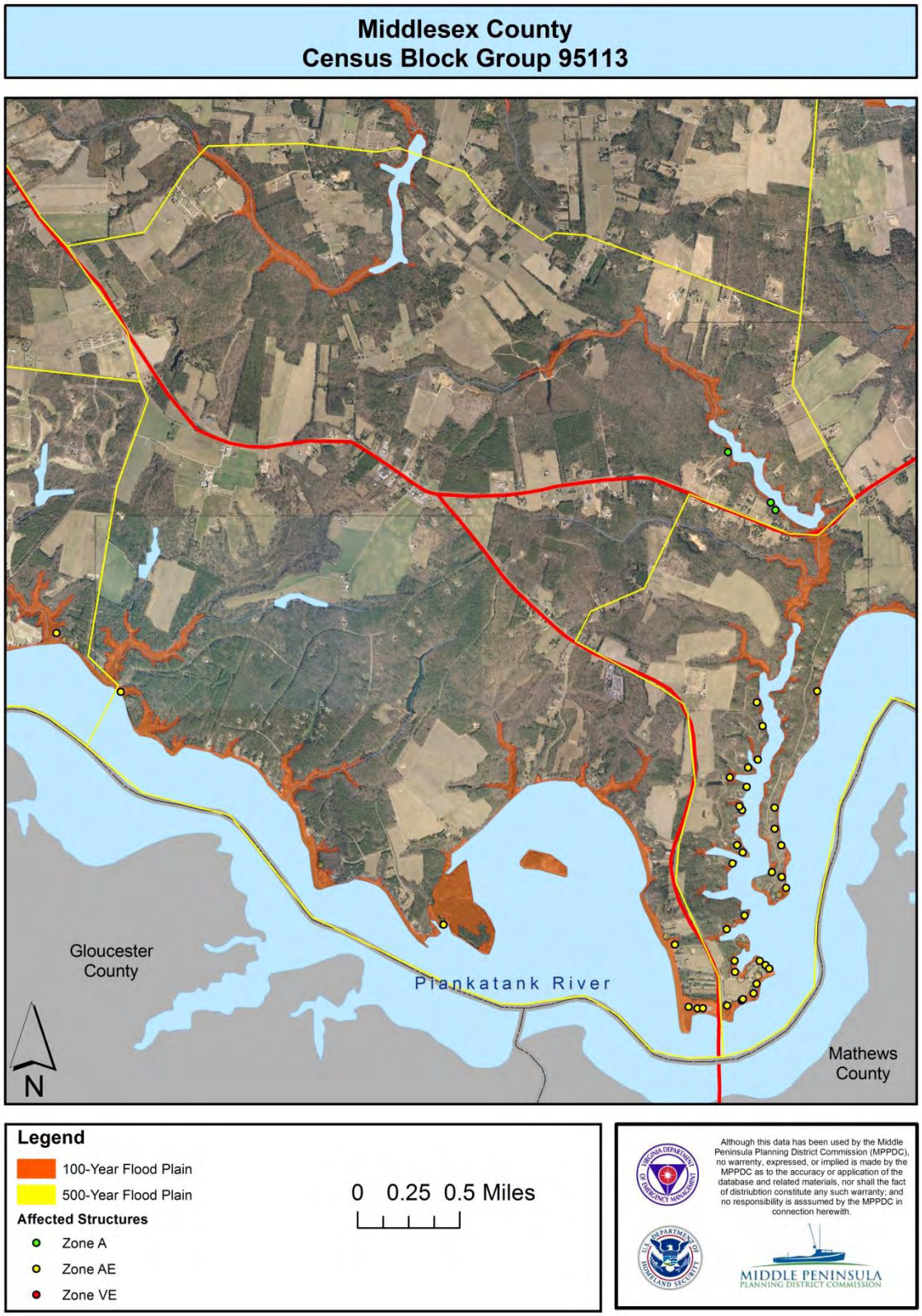
Middlesex County
Census Block Group 95113
Gloucester County
Plankatank River
Mathews County
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
Zone A
Zone AE
Zone VE
0 0.25 0.5 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
MIDDLE PENINSULA
PLANNING DISTRICT COMMISSION

Figure 103:


Middlesex County
Census Block Group 95121
Rappahannock River
Piankatank River
Mathews County
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
Zone A
Zone AE
Zone VE
0 0.375 0.75 Miles
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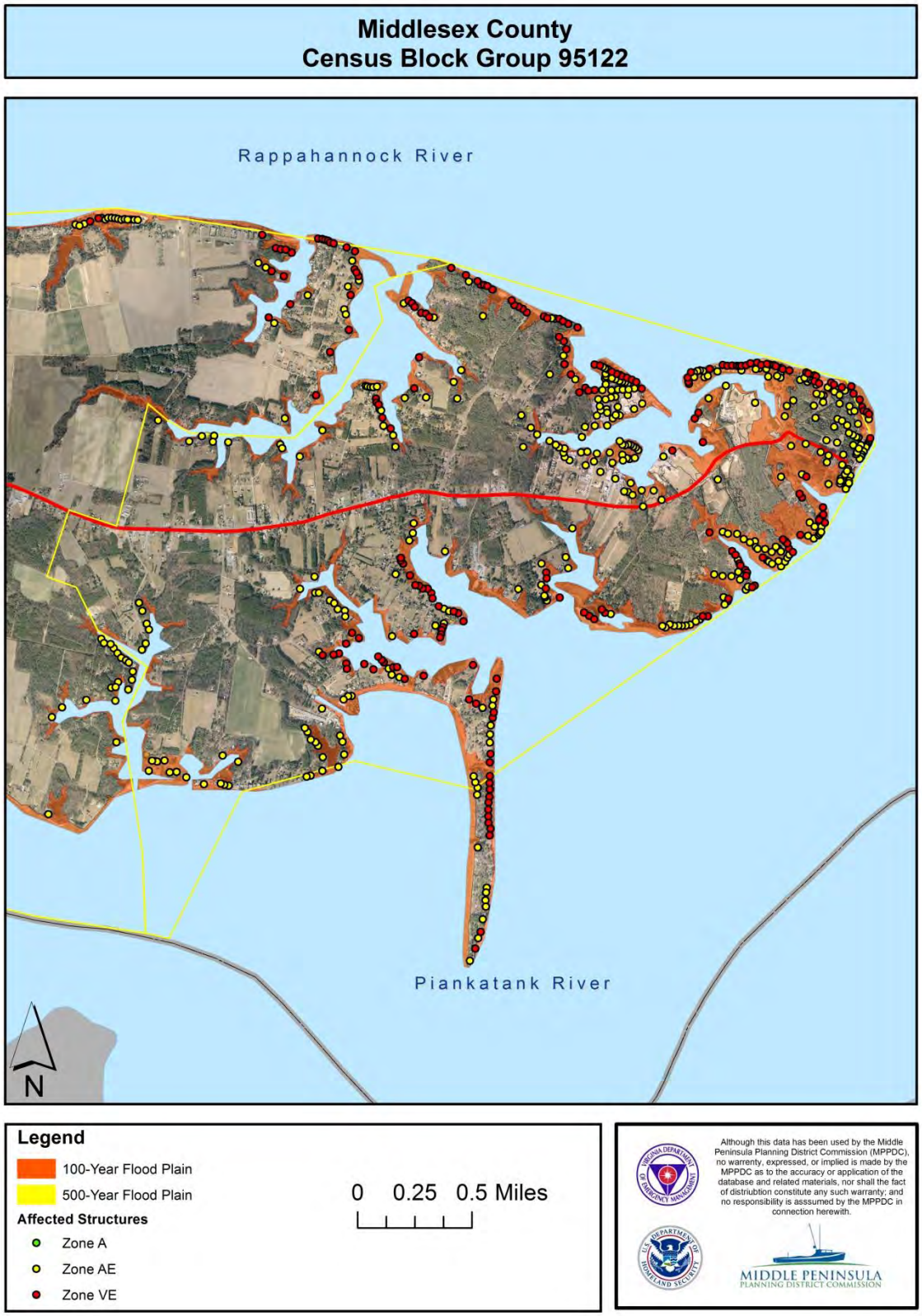
MIDDLE PENINSULA
PLANNING DISTRICT COMMISSION

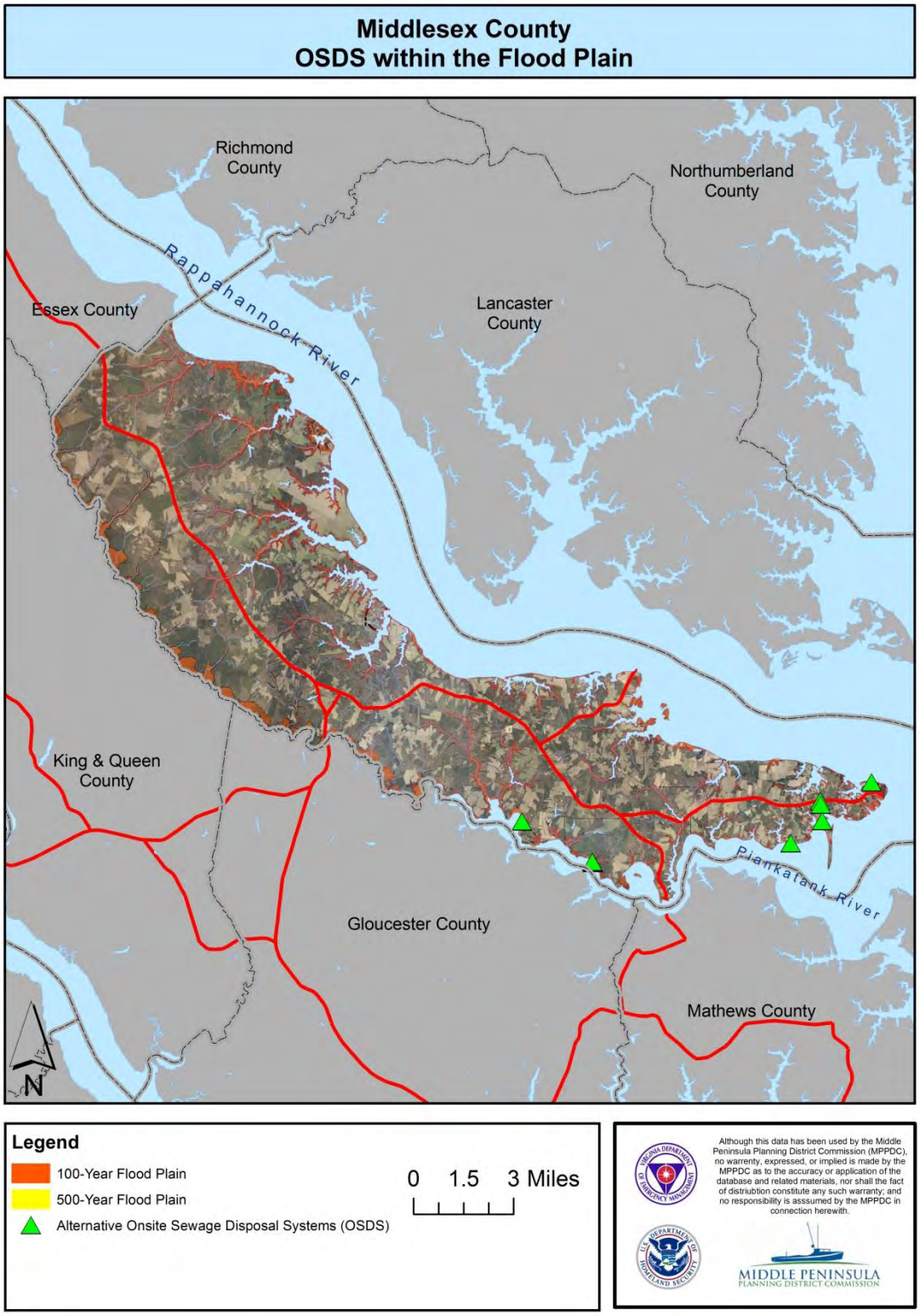
Figure 104:


Middlesex County
Census Block Group 95122
Rappahannock River
Piankatank River
N
Legend
100-Year Flood Plain
500-Year Flood Plain
Affected Structures
Zone A
Zone AE
Zone VE
0 0.25 0.5 Miles
Although this data has been used by the Middle Peninsula Planning District Commission (MPPDC), no warrenty, expressed, or implied is made by the MPPDC as to the accuracy or application of the database and related materials, nor shall the fact of distriubtion constitute any such warranty; and no responsibility is asssumed by the MPPDC in connection herewith.
MIDDLE PENINSULA
PLANNING DISTRICT COMMISSION

Alternate On-site Sewage Disposal Systems (OSDS)

The map (Figure 105) below show the location of the OSDS facilities constructed in the 100-year and 500-yer floodplain in Middlesex County.

Figure 105:



Urbanna Critical Facilities and Public Utilities
The Town of Urbanna provides public water and sewer service to its residents. The town operates the public water system which serves town residents as well as some nearby customers in surrounding Middlesex County.

The sewerage collection and treatment system is operated by the Hampton Roads Sanitation District (HRSD). When flood waters are anticipated, the staff at HRSD turn off the pumps at the sewerage pump stations in order to prevent pumping floodwaters into the wastewater treatment plant.

The wastewater treatment plant is located on high land next to the town's water tower, which is an area that does not flood.

The town operates the Urbanna Town Marina that includes a boat/fishing dock, a small beach area, a small park and a small operations building - all located at Upton's Point along the Rappahannock River. This facility suffered significant damage in 2003 from Hurricane Isabel and has been completely rebuilt since then at an approximate cost of $850,000.

Repetitive and Severe Repetitive Loss Residential Structures in the Town of Urbanna
According to FEMA's records, the Town of Urbanna has 2 (ie. 1 Single Family and 1 Other resident property) Repetitive Loss residential properties and zero Severe Repetitive Loss properties as of 5/31/15.

In 2003, Hurricane Isabel damaged/destroyed 5 houses along low-lying Island Drive. When these houses were re-built by the property owners, they were elevated in order to prevent future damage from flood waters along this section of the Rappahannock River.

Section 5: Risk Assessment Analysis –
Flooding, Hurricane, and Sea Level Rise

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide methodology and software application to develop multi-hazard losses at a regional scale. The loss estimates are used primarily by local, state and regional officials to plan and stimulate efforts to reduce risk from multi-hazards and prepare for emergency response and recovery[1]. For specifics regarding methodology please see Appendix J.

Potential loss estimates analyzed in Hazus-MH include:

- Physical damage to residential and commercial buildings, schools, essential facilities, and infrastructure
- Economic loss including lost jobs, business interruptions, repair and reconstruction costs.

The Hazus Flood Model analyzes both riverine and coastal flood hazards. Flood hazard is defined by a relationship between depth of flooding and the annual chance of inundation to that depth. Statistical flood frequencies were modeled in this revision to be able to determine annualized loss for each of the counties in Middle Peninsula PDC. Statistical flood frequencies are modeled by looking at the damage that is likely to occur over a given period of time, known as a return period or recurrence interval.

Depth, duration and velocity of water in the floodplain are the primary factors contributing to flood losses. Other hazards associated with flooding that contribute to flood losses include channel erosion and migration, sediment deposition, bridge scour and the impact of flood-born debris. The Hazus Flood Model allows users to estimate flood losses primarily due to flood depth to the general building stock (GBS). While velocity is also considered, it is not a separate input parameter and is accounted within depth-damage functions (i.e., expected percent damage given an expected depth) for census blocks that are defined as either coastal or riverine influenced. The agricultural component will allow the user to estimate a range of losses to account for flood duration. The flood model does not estimate the losses due to high velocity flash floods at this time[1].

Flood Analysis

The flood analysis for the HIRA was completed using the FEMA Hazus – MH V2.2 software for both riverine and coastal flood hazards. Varying flood analyses have been performed to both identify and characterize the flood hazard and the subsequent loss-potential or risk. The standard methodology of defining loss potential for any given hazard, includes annualizing the potential over a series of statistical return periods. Annualization is the mathematical method of converting individual losses to a weighted-average that may be experienced in any given year. The standard scope pertaining to flood risk corresponds to annualizing the 0.2%, 1%, 2%, 4%, and 10% flooding return periods. In layman's-terms these same annual-chance return periods are often described as the 500-year, 100-year, 50-year, 25-year and 10-year events as shown in Table 35 below:

[1] HAZUS-MH Flood User Manual

Table 35: Annual probability base on flood recurrence intervals.	
Flood Recurrence Interval	**Annual Chance of Occurrence**
10 year	10.0%
25 year	4.0%
50 year	2.0%
100 year	1.0%
500 year	0.2%

Practically, these statistical events represent the chance of being equaled or exceeded in any given year; i.e., the likelihood that a particular event with a given intensity occurs on average at least once every x-years. Once each of these statistical return periods are calculated, an annualized value is computed thus offering a perspective for any given year.

The various flood modeling performed as part of the current Plan update, along with the respective risk results, represent the primary goal of producing estimated flood losses for the aforementioned statistical return periods and then the annualized flood losses. However, it is important to note that the idiom of 'comparing apples with oranges' very-much applies to the various elements of flood modeling as well as modeling risk from flooding potential. Therefore, where appropriate differing modeling methodologies and their respective results have been separated for comparative purposes as described and highlighted in the bulleted List below. The same list also presents the order in which Hazus modeling information is presented:

The various modeling performed includes the following:

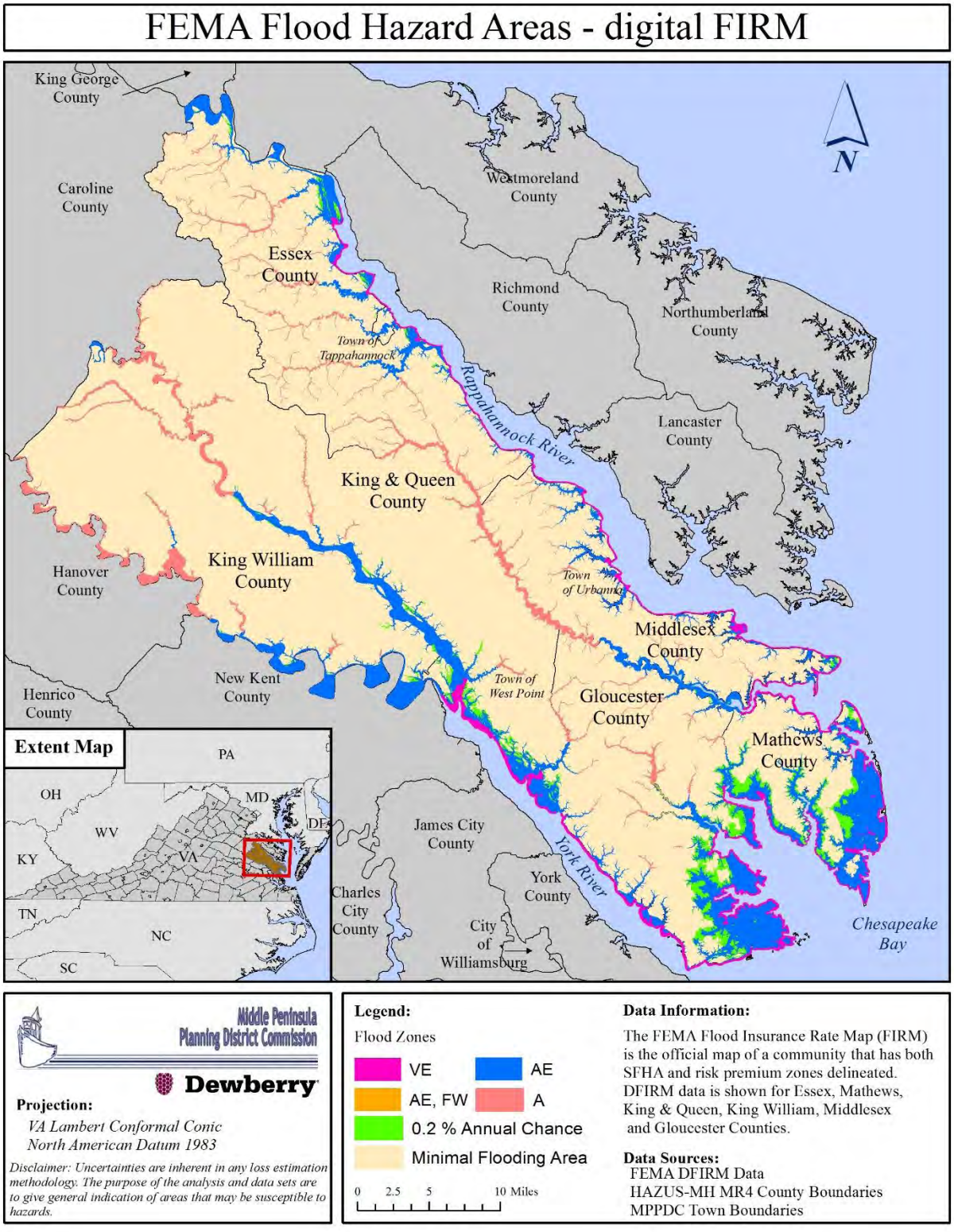
- **FEMA Floodplains and Depth Grid Information**
- **Hazus Building Stock (Inventory of Buildings)**:
  - All modeling utilized stock Hazus inventory values (Version 2.2 – Census 2010)
  - All modeling utilized Hazus Dasymetric Census Geographies
  - All modeling utilized stock Hazus facilities
- **Hazus Level 1 Multi-frequency Flood Modeling** – Hazus Level 1 methodology employed
  - Core Inputs or Parameters:
    - Digital Elevation Model (DEM) – National Elevation Dataset (NED) One-Arc Second (~30 meter resolution)
    - Frequencies (Both Riverine & Coastal) - 0.2%, 1%, 2%, 4%, and 10%
    - Riverine:
      - One-Square Mile (1 mi^2)Drainage Threshold
    - Coastal:
      - Stillwater elevations from Table 2 – Transect Data from each respective FEMA Flood Insurance Study (FIS):
        - ESSEX COUNTY – Revised May 4, 2015
        - GLOUCESTER COUNTY – Revised November 19, 2014
        - KING AND QUEEN COUNTY – Preliminary October 3, 2013
        - KING WILLIAM COUNTY – Preliminary October 3, 2013
        - MIDDLESEX COUNTY – Revised May 18, 2015
        - MATHEWS COUNTY – Revised December 9, 2014
      - NOTE: Hazus stock shoreline data was modified to extend up the York River so that Level 1 coastal modeling could be completed for King William County, King and Queen County and portions of Gloucester County upstream of the George Washington Memorial Highway Bridge (US 17).

- **Hazus Level 1 Annualized Loss** - Hazus Level 1 methodology employed (from Multi-frequency above)
- **Comparative Flood Modeling**:
    - FEMA RiskMAP 1% Coastal - Hazus Level 2 methodology employed
        - Hazus Level 2 – Only use of the updated or refined flood hazard produced and provided by Army Corps of Engineers (USACE) for FEMA Risk MAP studies
    - Hazus Level 1 – Only 1% Coastal (from Multi-frequency above)
        - Use only the Level 1 Coastal 1% frequency to compare to the FEMA RiskMAP Coastal 1% frequency

FEMA Floodplains and Depth Grid Information

FEMA initiates Flood Insurance Studies (FIS) on a national prioritization schedule. The most recent FIS's have been incorporated into this Plan as outlined by date in the list above; dates ranging from October 2013 to May 2015. These various new studies have produced updated coastal flood hazards for all of the jurisdictions in the MPPDC planning area; and riverine flood hazards remain from previous flood insurance studies. Figure 106 illustrates the extent of flood hazards as defined by the most recent FEMA flood insurance studies.

Figure 106:

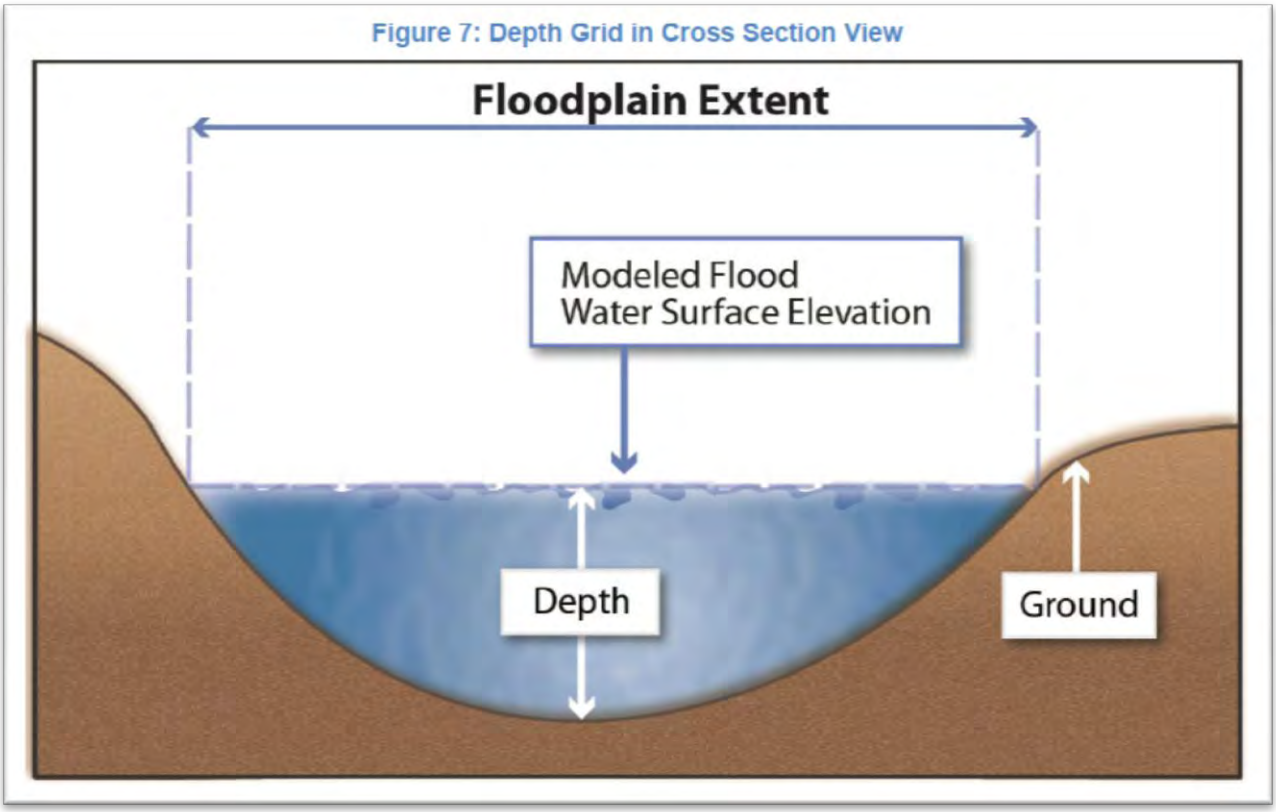


The new coastal flood hazards associated with the most recent FEMA studies have been produced under the RiskMAP Program. In short, the RiskMAP Program seeks to include risk assessments as part

of a flood insurance study to better communicate the risk of flooding. Consequently, a RiskMAP study includes all of the regulatory Flood Insurance Study products; namely engineering, floodplain mapping, digital FIRM data and report text. However, in addition to the traditional regulatory products, RiskMAP also includes new non-regulatory products aimed at communicating risk. One of the core non-regulatory datasets includes the creation of depth grids from the digital FIRM data. These new depth grids are the key to performing risk assessments in the Hazus software as they are able to be directly imported.

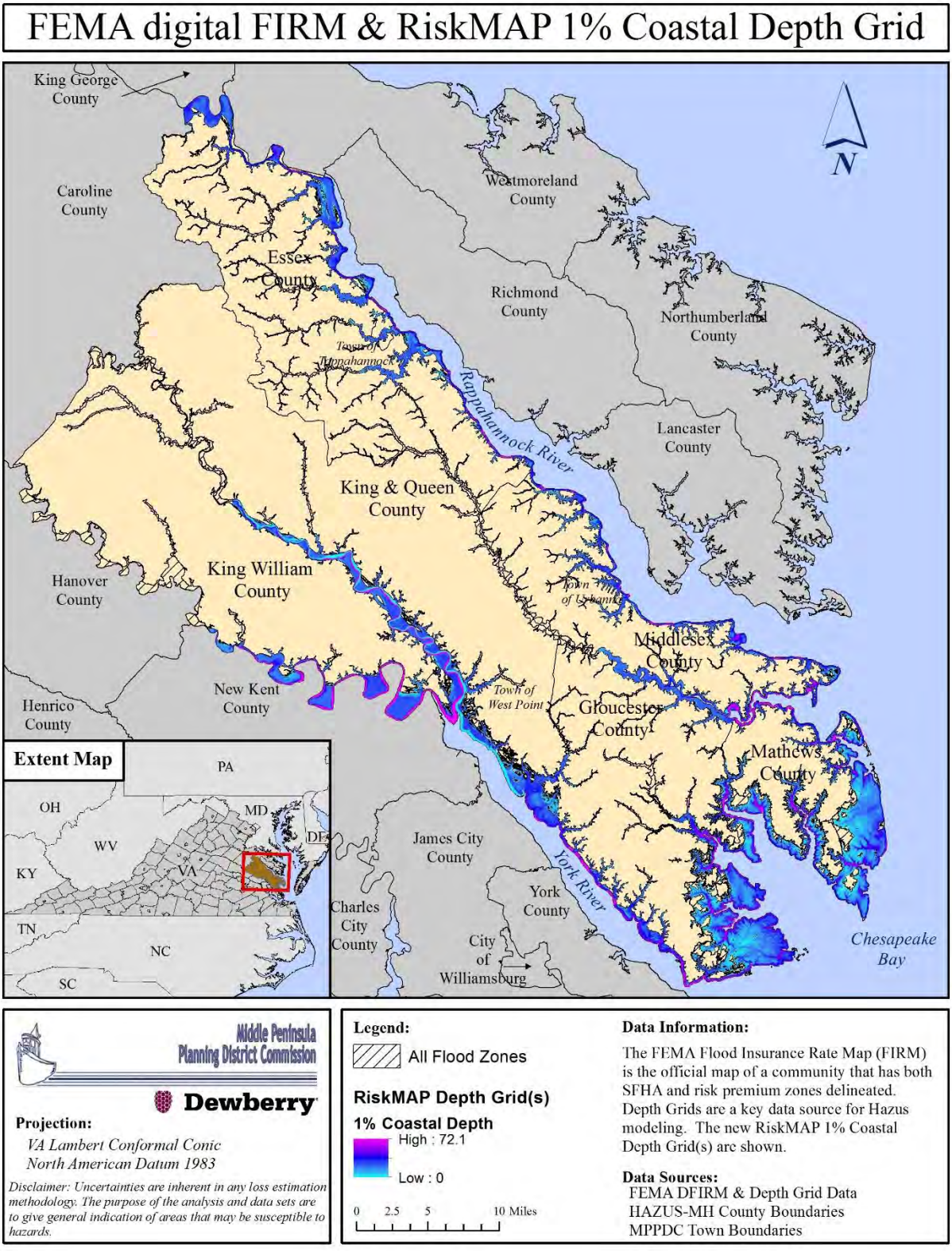
The flood hazard within Hazus is ultimately defined by a depth grid which is a representation of the difference between the estimated water surface and ground elevations for each respective flood frequency or annual chance. The following image is a simplified representation as shown in FEMA's Guidance for Flood Risk Analysis and Mapping, Flood Depth and Analysis Grids (May 2014):

Figure 7: Depth Grid in Cross Section View



The new RiskMAP projects for each of the counties in the MPPDC planning area include new coastal 1% Annual Chance depth grids. Figure 107 below shows these new coastal 1% Annual Chance depth grids and the new FEMA digital FIRM floodplains:

Figure 107:


FEMA digital FIRM & RiskMAP 1% Coastal Depth Grid
King George County
Caroline County
Westmoreland County
Essex County
Richmond County
Northumberland County
Town of Tappahannock
Rappahannock River
Lancaster County
King & Queen County
King William County
Hanover County
Town of Tappahannock
Middlesex County
New Kent County
Town of West Point
Gloucester County
Henrico County
Mathews County
James City County
York River
York County
Charles City County
City of Williamsburg
Chesapeake Bay
N
Extent Map
PA
OH
MD
DE
WV
KY
VA
TN
NC
SC
Middle Peninsula Planning District Commission
Dewberry
Projection:
VA Lambert Conformal Conic
North American Datum 1983
Disclaimer: Uncertainties are inherent in any loss estimation methodology. The purpose of the analysis and data sets are to give general indication of areas that may be susceptible to hazards.
Legend:
All Flood Zones
RiskMAP Depth Grid(s)
1% Coastal Depth
High : 72.1
Low : 0
0 2.5 5 10 Miles
Data Information:
The FEMA Flood Insurance Rate Map (FIRM) is the official map of a community that has both SFHA and risk premium zones delineated. Depth Grids are a key data source for Hazus modeling. The new RiskMAP 1% Coastal Depth Grid(s) are shown.
Data Sources:
FEMA DFIRM & Depth Grid Data
HAZUS-MH County Boundaries
MPPDC Town Boundaries

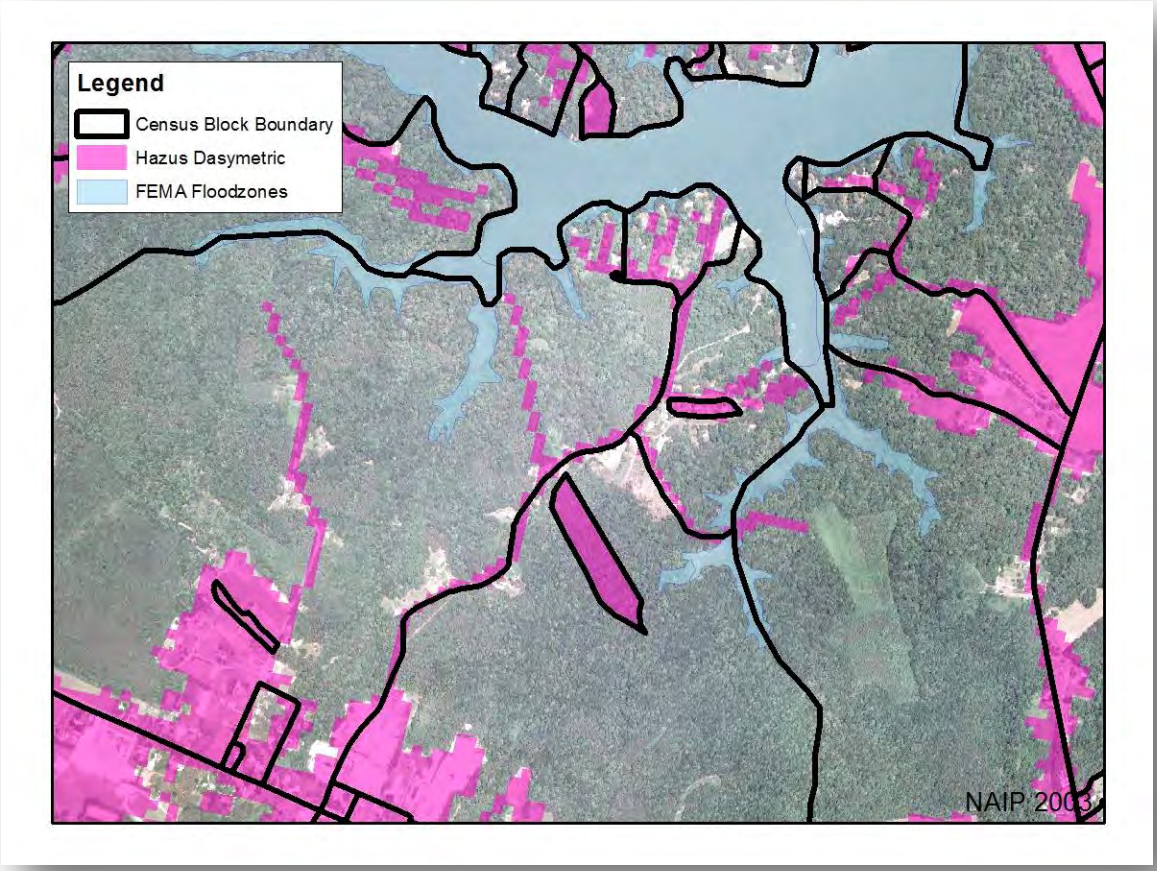
RiskMAP depth grids are considered to be superior to depth grids created from typical out-of-the-box Hazus analyses for a variety of reasons. However, users should understand that RiskMAP coastal projects are only scoped to produce 1% Annual Chance depth grids; i.e., multi-frequency depth grids are not prescribed for coastal projects. Armed with this information, it therefore becomes necessary to model multiple-frequencies in Hazus to arrive at annualized loss results. Fortunately, Hazus is a tool that offers flexibility and enables the user to provide more detailed inputs or specify input parameters that can introduce an increased level of reliability of depth values produced. Notwithstanding, RiskMAP depth grids are considered superior because of the guidelines under which they were created and the precision and accuracy of the inputs to their creation. Ultimately, where RiskMAP projects produce new multi-frequency depth grids, these grids can all be run through Hazus and a new annualized values can be produced. And where multi-frequency depth grids do not exist, it best to refrain from 'mixing apples and oranges' and rather, compare results for relative differences or similarities.

Ultimately, the Hazus flood modeling and risk assessments for this Plan update have been produced with the intent to improve upon previous Plan Hazus modeling and to incorporate any new RiskMAP-based depth grids. Riverine flood hazards were not updated in the most recent FIS's and there are no new RiskMAP depth grids. Therefore, this Plan update includes Hazus Level 1 multi-frequency modeling for both riverine and coastal. Improvements to the riverine modeling from the previous Plan are related to the drainage area threshold defined. In most cases, the FEMA flood maps have been developed for streams with contributing drainage area of 1 square mile. The previous Plan Hazus flood modeling only utilized a one-square mile drainage threshold for Mathews County and the remainder were completed at ten-square mile. However, this Plan revision has utilized one-square mile drainage threshold for all counties in the MPPDC region. As for the Level 1 multi-frequency modeling for coastal influences, the new Stillwater elevations from Table 2 – Transect Data from each respective FEMA Flood Insurance Study (FIS) was entered into the Hazus software.

Results from the various Hazus flood modeling are covered in sections below with primary focus on the annualized results. However, first the inventory of building stock is discussed.

Building Stock

Hazus building stock is the inventory of buildings (i.e., square-footage) of each respective type or sub-type of buildings in the following categories; residential, commercial, industrial, agricultural, religious, government, and education. Hazus assumes that all square-footage (i.e., buildings) are evenly distributed throughout a given census block and therefore damage is estimated as a percent and is weighted by the area of inundation at a given depth for a given census block. The methodology therefore, is known as an area-weighted methodology. FEMA has initiated recent improvements to the area-weighted methodology by further refining the distribution of building square-footage to land areas characterized by development and removing land areas typical of non-developed land classes (e.g., forests, wetlands, etc…). This refinement is called dasymetric mapping and the current Plan modeling utilizes the FEMA dasymetric building stock. The following shows a small example area in which the developed areas are pink:



Use of the new dasymetric data will typically reduce the total area subject to area-weighted loss estimations - particularly for those census blocks that have flood risk yet actual development does not exist within the floodplains. An area analysis of the dasymetric versus full stock census blocks is exemplified in the chart below:

Digital FIRM Acreage Type	Census Block Type	
	Dasymetric	**Full Stock**
Acres of 0.2% Annual Chance Floodplains (500-year)	5,909 Ac (1% of Total Acres)	14,806 Ac (2% of Total Acres)
Acres of 1% Annual Chance Floodplains (100-year)	23,216 Ac (3% of Total Acres)	85,736 Ac (11% of Total Acres)
Total Acres of Census Blocks MPPDC Region		**794,644 Ac**

A comparison of FEMA digital FIRM data intersecting the two types of Hazus census blocks reveals that an estimated four-percent (4%) of the dasymetric data is within the extents of the 0.2% Annual Chance Floodplains versus thirteen-percent (13%) when using full census blocks. And, considering the 1% Annual Chance Floodplains, there is approximately three-percent (3%) intersecting the dasymetric data versus eleven-percent (11%) when using full census blocks. Consequently, this refinement can be considered a benefit to the risk analyses in that the expectation of over-estimations are mitigated by limiting potential losses ONLY to developed areas.

As noted earlier, loss estimations are first based on inundation area for specified sub-types of building square-footage. The second type of data includes information on the local economy that is used in estimating losses. Table 36 displays the economic loss categories used to calculate annualized losses by Hazus. Data for this analysis has been provided at the census block level.

Table 36: Hazus direct economic loss categories and descriptions.

Category Name	Description of Data Input into Model	Hazus Output
Building	Cost per sq ft to repair damage by structural type and occupancy for each level of damage	Cost of building repair or replacement of damaged and destroyed buildings
Contents	Replacement value by occupancy	Cost of damage to building contents
Inventory	Annual gross sales in $ per sq ft	Loss of building inventory as contents related to business activities
Relocation	Multiple factors; primarily a function of Rental Costs ($/ft^2/month) for non-entertainment buildings where damage ≥10%	Relocation expenses (for businesses and institutions); disruption costs to building owners for temporary space.
Income	Income in $ per sq ft per month by occupancy	Capital-related incomes losses as a measure of the loss of productivity, services, or sales
Rental	Rental costs per month per sq ft by occupancy	Loss of rental income to building owners
Wage	Wages in $ per sq ft per month by occupancy	Employee wage loss as described in income loss

Middle Peninsula currently has approximately 43,501 structures with an estimated exposure value of approximately $17.7 billion. Average estimated replacement value of buildings in the study area range from approximately $94,000 to $297,000, with the mean approximation value of $134,000 [2]. Eighty-one percent of the planning district's general occupancy is categorized as residential, followed by commercial (12%). Table 37 below provides inventory information for each of the six counties that were included in the analysis. Gloucester County occupies a large percentage (40%) of the building stock exposure for the region.

Table 37: Building stock exposure for general occupancies by county.

County	Residential	Commercial	Industrial	Agriculture	Religion	Govt.	Education	Total
Gloucester	$5,698,054	$831,318	$147,429	$32,557	$84,190	$32,437	$190,065	$7,016,050
King William	$2,463,239	$274,254	$110,725	$32,549	$41,687	$24,273	$24,786	$2,971,513
Middlesex	$2,151,683	$354,607	$65,244	$14,045	$26,670	$11,736	$40,679	$2,664,664
Essex	$1,578,275	$402,650	$146,178	$25,395	$28,679	$18,661	$31,423	$2,231,261
Mathews	$1,566,770	$149,340	$45,066	$9,877	$19,875	$6,830	$12,042	$1,809,800
King & Queen	$886,914	$52,850	$29,064	$6,710	$19,927	$2,968	$7,284	$1,005,717
Total	$14,344,935	$2,065,019	$543,706	$121,133	$221,028	$96,905	$306,279	$17,699,005
All values are in thousands of dollars								

[2] Previous Plan values adjusted per BLS CPI Inflation Calculator (2000 to 2010) to match Hazus/Census years.

Building stock exposure is also classified by building type. General Building Types (GBTs) have been developed as a means to classify the different buildings types. This provides an ability to differentiate between buildings with substantially different damage and loss characteristics. Model building types represent the characteristics of core construction of buildings in a class. The damage and loss prediction models are developed for model building types and the estimated performance is based upon the "average characteristics" of the total population of buildings within each class. Five general classifications have been established, including wood, masonry, concrete, steel and manufactured homes (MH). A brief description of the building types is available in Table 38. The Hazus inventory serves as the default when a user does not have better data available.

Table 38: Hazus General Building Type classes.

General Building Type	Description
Wood	Wood frame construction
Masonry	Reinforced or unreinforced masonry construction
Steel	Steel frame construction
Concrete	Cast-in-place or pre-cast reinforced concrete construction
MH	Factory-built residential construction

Wood construction represents the majority (61%) of building types in the planning district. Masonry construction accounts for a quarter of the building type exposure. Table 39 below provides building stock exposure for the five main building types.

Table 39: Building stock exposure for general building type by county.

County	Wood	Masonry	Concrete	Steel	Manufactured Home	Total
Gloucester	$4,338,118	$1,782,044	$177,833	$591,235	$126,913	$7,016,143
King William	$1,895,656	$751,978	$61,374	$227,445	$35,155	$2,971,608
Middlesex	$1,631,388	$678,395	$67,789	$225,948	$61,315	$2,664,835
Mathews	$1,166,398	$450,836	$32,534	$113,035	$47,165	$1,809,968
Essex	$1,202,922	$558,827	$102,763	$319,225	$47,615	$2,231,352
King & Queen	$661,413	$247,318	$11,118	$49,521	$36,527	$1,005,897
Total	$10,895,895	$4,469,398	$453,411	$1,526,409	$354,690	$17,699,803
All values are in thousands of dollars						

Multi-frequency Flood Modeling – Hazus Level 1 methodology

As explained earlier, annualized loss is the preferred manner with which to express potential risk for hazard mitigation planning as it is useful for creating a common denominator by which different types of hazards can be compared. The tables below (Table 40 – Table 46) show the multi-frequency results for the MPPDC Region and each County. The following section will present details of the annualized losses; see General Building Stock Loss Estimation (Annualized Flood Loss).

Table 40: Hazus Level 1 Multi-frequency GBS Losses for the MPPDC Region.

Area	Scenario	Total Loss	Building Loss	Contents Loss	Business Disruption
MPPDC Region	Level 1 - 10YR	$107,113	$57,802	$48,644	$1,126
MPPDC Region	Level 1 - 25YR	$137,228	$74,580	$61,788	$1,375
MPPDC Region	Level 1 - 50YR	$194,731	$105,823	$87,602	$1,941
MPPDC Region	Level 1 - 100YR	$245,562	$133,342	$110,570	$2,427
MPPDC Region	Level 1 - 500YR	$842,030	$460,912	$375,607	$7,497
MPPDC Region	Level 1 - Annualized	$18,102	$9,921	$8,111	$116
		Data in Thousands of Dollars			

Table 41: Hazus Level 1 Multi-frequency GBS Losses for Essex County.

Area	Scenario	Total Loss	Building Loss	Contents Loss	Business Disruption
Essex County	Level 1 - 10YR	$7,226	$3,729	$3,432	$80
Essex County	Level 1 - 25YR	$8,994	$4,676	$4,243	$89
Essex County	Level 1 - 50YR	$12,846	$6,599	$6,126	$140
Essex County	Level 1 - 100YR	$16,813	$8,843	$7,846	$144
Essex County	Level 1 - 500YR	$31,230	$16,306	$14,666	$287
Essex County	Level 1 - Annualized	$1,047	$548	$493	$6
Data in Thousands of Dollars					

Table 42. Hazus Level 1 Multi-frequency GBS Losses for Gloucester County.

Area	Scenario	Total Loss	Building Loss	Contents Loss	Business Disruption
Gloucester County	Level 1 - 10YR	$53,037	$27,925	$24,750	$25,491
Gloucester County	Level 1 - 25YR	$68,606	$36,345	$31,788	$32,684
Gloucester County	Level 1 - 50YR	$98,481	$52,381	$45,397	$46,610
Gloucester County	Level 1 - 100YR	$121,998	$64,526	$56,568	$58,085
Gloucester County	Level 1 - 500YR	$565,571	$310,999	$251,301	$255,854
Gloucester County	Level 1 - Annualized	$9,984	$5,394	$4,552	$79
Data in Thousands of Dollars					

Table 43. Hazus Level 1 Multi-frequency GBS Losses for King & Queen County.

Area	Scenario	Total Loss	Building Loss	Contents Loss	Business Disruption
King & Queen County	Level 1 - 10YR	$3,850	$2,295	$1,512	$43
King & Queen County	Level 1 - 25YR	$5,152	$3,088	$2,011	$53
King & Queen County	Level 1 - 50YR	$7,086	$4,294	$2,735	$57
King & Queen County	Level 1 - 100YR	$7,535	$4,612	$2,878	$45
King & Queen County	Level 1 - 500YR	$19,376	$11,714	$7,506	$156
King & Queen County	Level 1 - Annualized	$585	$355	$224	$6
Data in Thousands of Dollars					

Table 44: Hazus Level 1 Multi-frequency GBS Losses for King William County.

Area	Scenario	Total Loss	Building Loss	Contents Loss	Business Disruption
King William County	Level 1 - 10YR	$12,037	$5,882	$6,084	$107
King William County	Level 1 - 25YR	$14,339	$7,084	$7,169	$124
King William County	Level 1 - 50YR	$17,689	$8,729	$8,851	$147
King William County	Level 1 - 100YR	$20,858	$10,332	$10,395	$191
King William County	Level 1 - 500YR	$65,545	$29,037	$35,462	$1,584
King William County	Level 1 - Annualized	$1,656	$797	$852	$11
Data in Thousands of Dollars					

Table 45: Hazus Level 1 Multi-frequency GBS Losses for Mathews County.

Area	Scenario	Total Loss	Building Loss	Contents Loss	Business Disruption
Mathews County	Level 1 - 10YR	$21,094	$12,426	$8,575	$104
Mathews County	Level 1 - 25YR	$29,509	$17,341	$12,025	$167
Mathews County	Level 1 - 50YR	$45,778	$26,496	$19,003	$325
Mathews County	Level 1 - 100YR	$60,800	$35,055	$25,356	$451
Mathews County	Level 1 - 500YR	$134,862	$78,353	$55,815	$798
Mathews County	Level 1 - Annualized	$3,682	$2,170	$1,500	$13
Data in Thousands of Dollars					

Table 46: Hazus Level 1 Multi-frequency GBS Losses for Middlesex County

Area	Scenario	Total Loss	Building Loss	Contents Loss	Business Disruption
Middlesex County	Level 1 - 10YR	$9,869	$5,545	$4,291	$51
Middlesex County	Level 1 - 25YR	$10,628	$6,046	$4,552	$46
Middlesex County	Level 1 - 50YR	$12,851	$7,324	$5,490	$59
Middlesex County	Level 1 - 100YR	$17,558	$9,974	$7,527	$79
Middlesex County	Level 1 - 500YR	$25,446	$14,503	$10,857	$119
Middlesex County	Level 1 - Annualized	$1,148	$657	$490	$1
Data in Thousands of Dollars					

General Building Stock Loss Estimation (Annualized Flood Loss)

Annualized loss is the preferred manner with which to express potential risk for hazard mitigation planning as it is useful for creating a common denominator by which different types of hazards can be compared. While annualized loss values in and of themselves do not necessarily determine if the values are too high or too low, when compared across a region the relative difference in values can indicate problem areas for prioritization or justification for further and more detailed analyses. Next, we consider the annualized losses of the Hazus Level 1 analyses.

Hazus Level 1 flood model annualized losses for the Middle Peninsula PDC are $18,102,000 US Dollars. Property or "capital stock" losses are $18,093,000 US Dollars and make up about 99.95% of the

damages which includes the values for building, content, and inventory. Business interruption accounts for $9,000 US Dollars (0.05%) of the annualized losses and includes relocation, income, rental and wage costs.

The flood model incorporates National Flood Insurance Program (NFIP) entry dates to distinguish Pre-FIRM and Post-FIRM census blocks. The results provided in this report show the combined total losses for both pre- and post-FIRM values combined.

Table 47 illustrates the expected annualized losses broken down by county and Table 48 includes the annualized losses along with Population and Per-Capita losses.

Table 47: County based Hazus annualized loss for both Pre- and Post-FIRM by building type.

County	Building	Content	Inventory	Relocation	Income	Rental	Wage	Annualized Loss
Gloucester	$5,394	$4,552	$31	$0	$1	$0	$6	$9,984
Mathews	$2,170	$1,500	$12	$0	$0	$0	$0	$3,682
King William	$797	$852	$5	$0	$0	$0	$2	$1,656
Middlesex	$657	$490	$1	$0	$0	$0	$0	$1,148
King & Queen	$355	$224	$6	$0	$0	$0	$0	$585
Essex	$548	$493	$6	$0	$0	$0	$0	$1,047
Total	$9,921	$8,111	$61	$0	$1	$0	$8	$18,102
All values in Thousands of Dollars								

Table 48: County based Census 2010 population, Hazus Annualized Loss & Per-Capita Loss.

County	Population[1]	Annualized Loss (US Dollar)	Per-Capita Loss (US Dollar)
Mathews	8,978	$3,682,000	$410.11
Gloucester	36,858	$9,984,000	$270.88
Middlesex	10,959	$1,148,000	$104.75
King William	15,935	$1,656,000	$103.92
Essex	11,151	$1,047,000	$93.89
King & Queen	6,945	$585,000	$84.23
MPPDC Region	**90,826**	**$18,102,000**	**$199.30**
[1] *2010 Census-based population counts - as exists within Hazus stock data.*			

Gloucester County has the highest annualized loss, $9,984,000 US Dollars, accounting for 55.2% of the total losses for Middle Peninsula and 40% of the county's building stock, and ranks second (2nd) in terms of per-capita losses at $270.88. The majority of the expected damages can be attributed to building and content value.

Mathews County has the second highest loss, $3,682,000 US Dollars, accounting for 20.34% of the total annualized losses for Middle Peninsula and 17% of the county's building stock, however has the greatest annualized per-capita loss at $410.11.

Building value loss accounts for approximately 55% of the expected annualized damages and 45% is attributed to content value loss. Table 43 summarizes the property losses and business interruption losses shown for pre- and post-FIRM structures.

Residential building damage represents the majority of the damages, followed closely by the residential content damages. Wood buildings account for $11,529,000 US Dollars, or 62.1% of the annualized damages of which the majority (54.06%) are in Gloucester County. Occupancy results indicate that agricultural, non-profit and industrial have the largest percent of exposure at risk; i.e. these are the predominant occupancy types that intersect the flood hazard. Manufactured homes only account for 5.05% of the total annualized damages but have the highest percentage of building stock at risk to yearly damages. Tables 49 and 50 summarize the property losses and business interruption losses shown by occupancy and building type. The slight differences in the annualized losses for building type and occupancy can be attributed to the Hazus classification methodology (Table 51 and 52).

Table 49: Annualized loss by building type.

Building Type	Building	Contents	Inventory	Relocation	Income	Rental	Wage	Annualized Loss
Wood	$6,886	$4,641	$2	$0	$0	$0	$0	$11,529
Masonry	$2,459	$2,122	$6	$0	$0	$0	$2	$4,589
Steel	$329	$1,088	$42	$0	$0	$0	$2	$1,461
Manufactured Housing	$444	$147	$0	$0	$0	$0	$0	$591
Concrete	$80	$289	$5	$0	$0	$0	$1	$375
Annualized Loss	$10,198	$8,287	$55	$0	$0	$0	$5	$18,545
% of Ann. Loss	54.99%	44.69%	0.30%	0%	0%	0%	0.03%	*Hazus-MH (V2.2) results*
Values In Thousands of Dollars								

Table 50: Annualized loss by general occupancy type.

Occupancy Type	Building	Contents	Inventory	Relocation	Income	Rental	Wage	Annualized Loss
Residential	$9,244	$5,732	$0	$0	$0	$0	$0	$14,976
Commercial	$426	$1,408	$19	$0	$0	$0	$2	$1,855
Industrial	$161	$352	$41	$0	$0	$0	$0	$554
Non-Profit	$36	$207	$0	$0	$0	$0	$0	$243
Agricultural	$8	$71	$1	$0	$0	$0	$0	$80
Education	$44	$321	$0	$0	$1	$0	$4	$370
Government	$2	$20	$0	$0	$0	$0	$2	$24
Annualized Loss	$9,921	$8,111	$61	$0	$1	$0	$8	$18,102
% of Ann. Loss	54.81%	44.81%	0.34%	0%	0.01%	0%	0.04%	*Hazus-MH (V2.2) results*
Values in Thousands of Dollars								

Table 51: County based Hazus annualized loss by general building type.

County	Total Exposure	Concrete	Masonry	Manufactured Homes	Steel	Wood	Annualized Loss
Gloucester	$7,016,050	$182	$2,549	$320	$904	$6,233	$10,188
Mathews	$1,809,800	$33	$907	$192	$154	$2,543	$3,829
King William	$2,971,513	$103	$440	$3	$212	$903	$1,661
Middlesex	$2,664,664	$13	$292	$23	$57	$813	$1,198
King & Queen	$1,005,717	$6	$136	$31	$25	$404	$602
Essex	$2,231,261	$38	$265	$22	$109	$633	$1,067
Annualized Loss		$375	$4,589	$591	$1,461	$11,529	$18,545
% of Annualized Loss		2.02%	24.75%	3.19%	7.88%	62.17%	*Hazus-MH (V2.2) results*
% of Total Exposure		2.56%	25.25%	2.00%	8.62%	61.56%	
All values in Thousands of Dollars							

Table 52: County based Hazus annualized loss by general occupancy type.

County	Total Exposure	Residen-tial	Comm-ercial	Indust-rial	Non-Profit	Educa-tion	Govern-ment	Agricul-ture	Annualized Loss
Gloucester	$7,016,050	$7,948	$1,227	$249	$153	$354	$8	$45	$9,984
Mathews	$2,231,261	$3,350	$139	$123	$36	$5	$3	$26	$3,682
King William	$2,971,513	$1,285	$243	$65	$39	$6	$12	$6	$1,656
Middlesex	$2,664,664	$1,017	$98	$18	$14	$1	$0	$0	$1,148
King & Queen	$1,005,717	$543	$0	$42	$0	$0	$0	$0	$585
Essex	$1,809,800	$833	$148	$57	$1	$4	$1	$3	$1,047
Annualized Loss		$14,976	$1,855	$554	$243	$370	$24	$80	$18,102
% of Annualized Loss		82.73%	10.25%	3.06%	1.34%	2.04%	0.13%	0.44%	*Hazus-MH (V2.2) results*
% of Exposure		81.05%	11.67%	3.07%	1.25%	1.73%	0.55%	0.68%	

Figures 108 through 114 on the following pages show the total annualized loss for the planning district and individual counties culminating in Figure 115 which categorizes the Total Annualized Losses by Top Ten ranking and a Hotspot overlay representing those areas throughout the MPPDC Region that may require mitigation measures.

Figure 108:

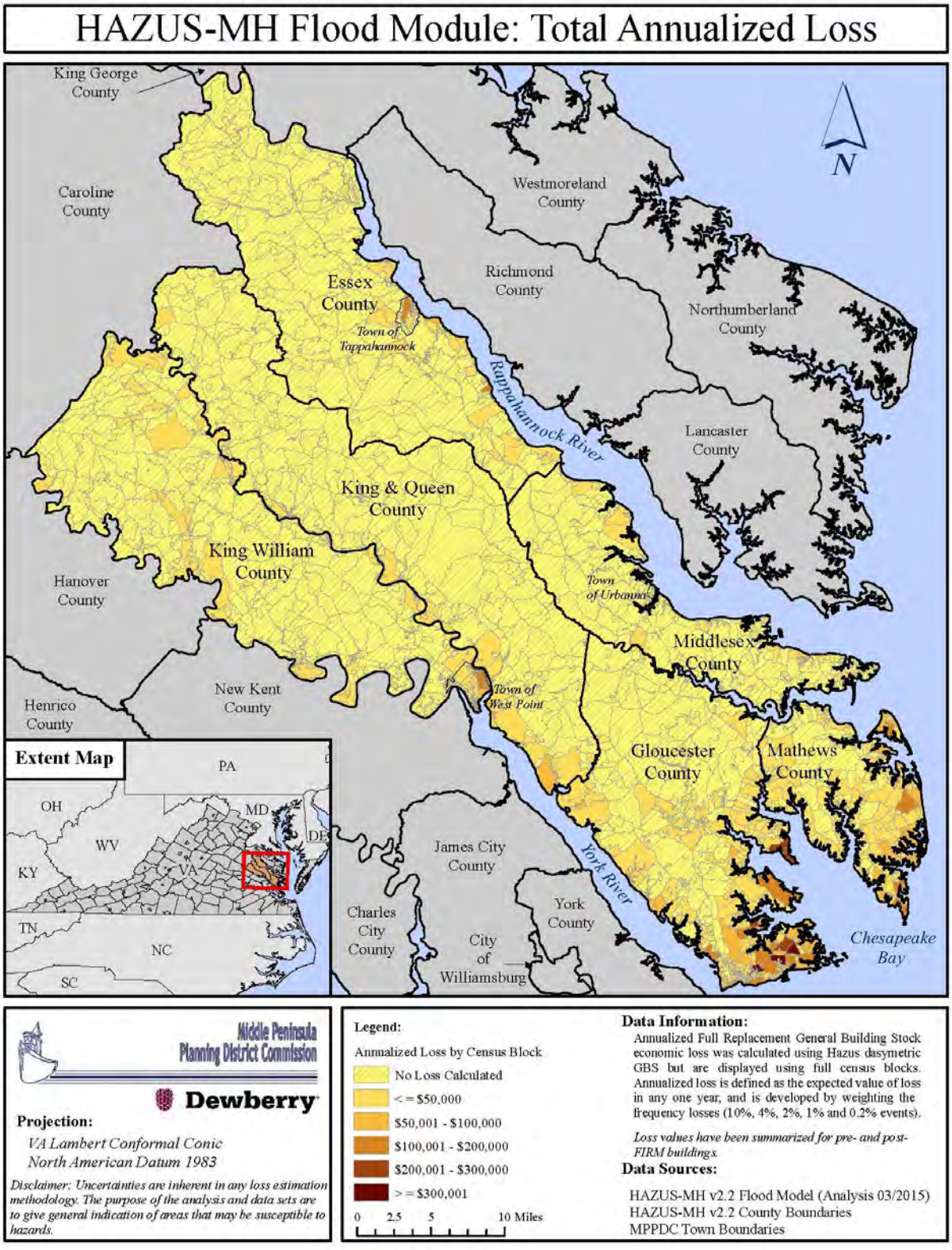

HAZUS-MH Flood Module: Total Annualized Loss
King George County
Caroline County
Westmoreland County
Richmond County
Northumberland County
Essex County
Town of Tappahannock
Rappahannock River
Lancaster County
King & Queen County
King William County
Hanover County
Town of Urbanna
Middlesex County
New Kent County
Town of West Point
Henrico County
Gloucester County
Mathews County
James City County
York River
Charles City County
York County
City of Williamsburg
Chesapeake Bay
N
Extent Map
PA
OH
MD
DE
WV
KY
VA
TN
NC
SC
Middle Peninsula Planning District Commission
Dewberry
Projection:
VA Lambert Conformal Conic
North American Datum 1983
Disclaimer: Uncertainties are inherent in any loss estimation methodology. The purpose of the analysis and data sets are to give general indication of areas that may be susceptible to hazards.
Legend:
Annualized Loss by Census Block
No Loss Calculated
< = $50,000
$50,001 - $100,000
$100,001 - $200,000
$200,001 - $300,000
> = $300,001
0 2.5 5 10 Miles
Data Information:
Annualized Full Replacement General Building Stock economic loss was calculated using Hazus dasymetric GBS but are displayed using full census blocks. Annualized loss is defined as the expected value of loss in any one year, and is developed by weighting the frequency losses (10%, 4%, 2%, 1% and 0.2% events).
Loss values have been summarized for pre- and post-FIRM buildings.
Data Sources:
HAZUS-MH v2.2 Flood Model (Analysis 03/2015)
HAZUS-MH v2.2 County Boundaries
MPPDC Town Boundaries

Figure 109:

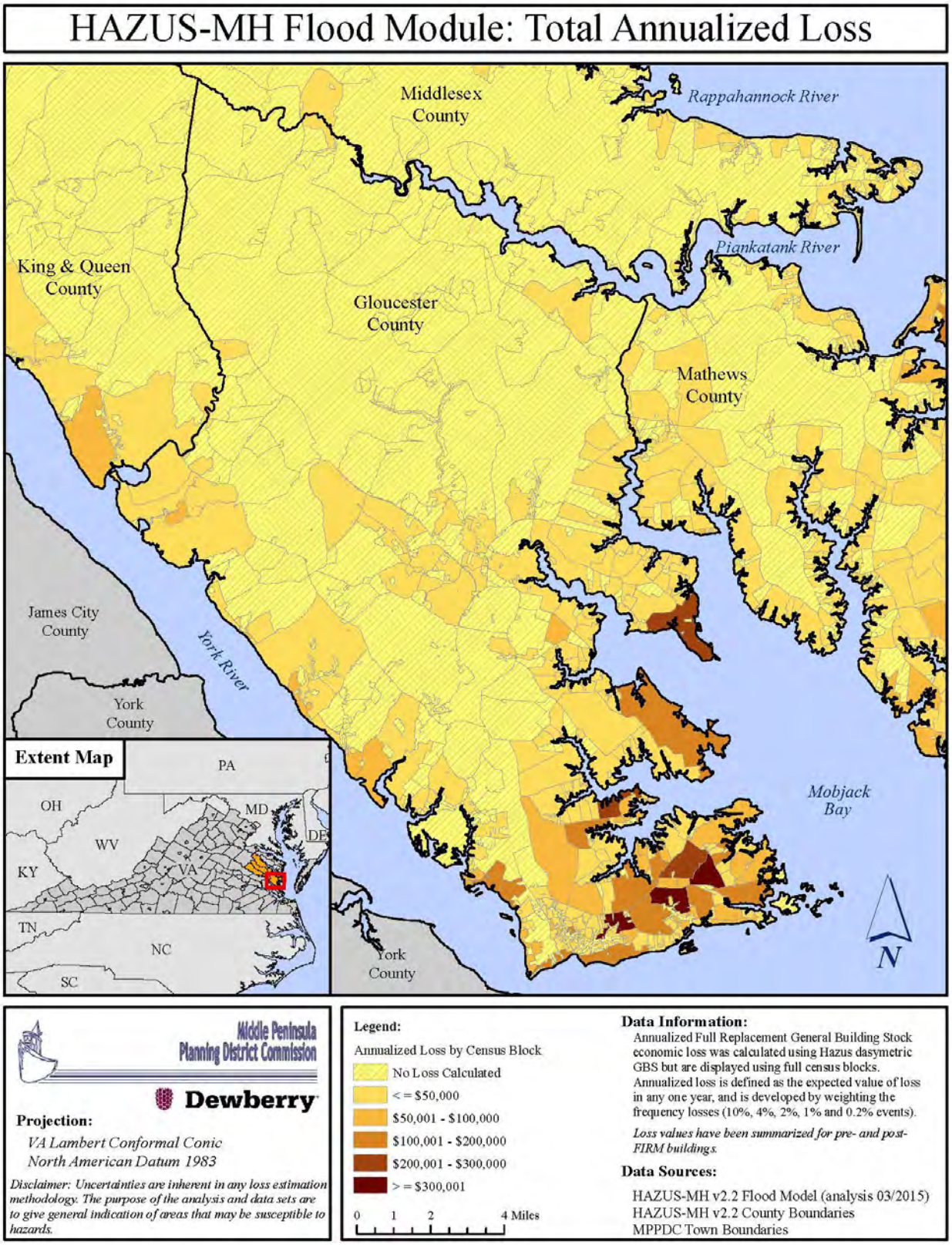

HAZUS-MH Flood Module: Total Annualized Loss
Middlesex County
Rappahannock River
Piankatank River
King & Queen County
Gloucester County
Mathews County
James City County
York River
York County
Mobjack Bay
N
Extent Map
PA
OH
MD
DE
WV
KY
VA
TN
NC
SC
Middle Peninsula Planning District Commission
Dewberry
Projection:
VA Lambert Conformal Conic
North American Datum 1983
Disclaimer: Uncertainties are inherent in any loss estimation methodology. The purpose of the analysis and data sets are to give general indication of areas that may be susceptible to hazards.
Legend:
Annualized Loss by Census Block
No Loss Calculated
< = $50,000
$50,001 - $100,000
$100,001 - $200,000
$200,001 - $300,000
> = $300,001
0 1 2 4 Miles
Data Information:
Annualized Full Replacement General Building Stock economic loss was calculated using Hazus dasymetric GBS but are displayed using full census blocks. Annualized loss is defined as the expected value of loss in any one year, and is developed by weighting the frequency losses (10%, 4%, 2%, 1% and 0.2% events).
Loss values have been summarized for pre- and post-FIRM buildings.
Data Sources:
HAZUS-MH v2.2 Flood Model (analysis 03/2015)
HAZUS-MH v2.2 County Boundaries
MPPDC Town Boundaries

Figure 110:

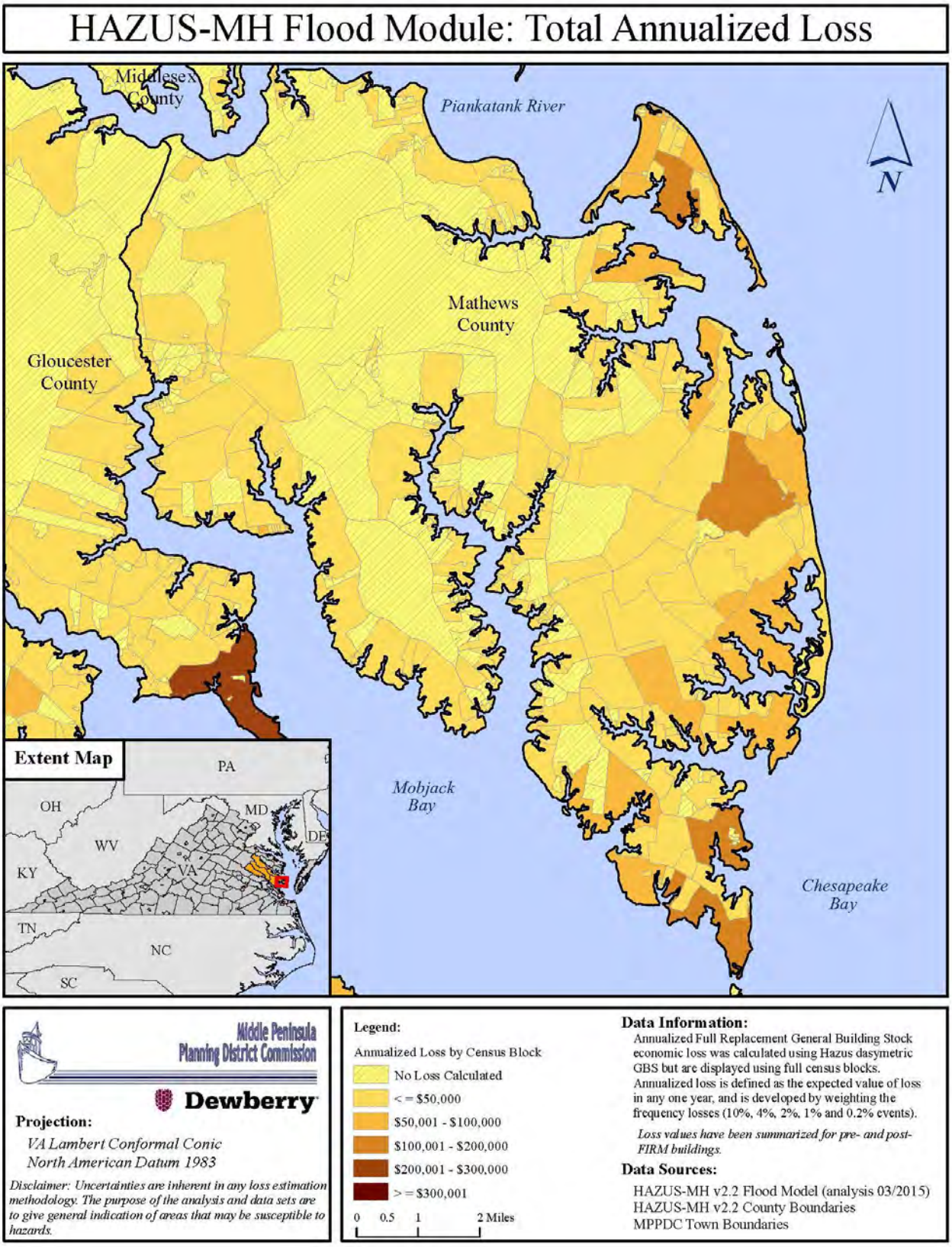

HAZUS-MH Flood Module: Total Annualized Loss
Middlesex County
Piankatank River
N
Mathews County
Gloucester County
Mobjack Bay
Chesapeake Bay
Extent Map
PA
OH
MD
DE
WV
KY
VA
TN
NC
SC
Middle Peninsula Planning District Commission
Dewberry
Projection:
VA Lambert Conformal Conic
North American Datum 1983
Disclaimer: Uncertainties are inherent in any loss estimation methodology. The purpose of the analysis and data sets are to give general indication of areas that may be susceptible to hazards.
Legend:
Annualized Loss by Census Block
No Loss Calculated
< = $50,000
$50,001 - $100,000
$100,001 - $200,000
$200,001 - $300,000
> = $300,001
0 0.5 1 2 Miles
Data Information:
Annualized Full Replacement General Building Stock economic loss was calculated using Hazus dasymetric GBS but are displayed using full census blocks. Annualized loss is defined as the expected value of loss in any one year, and is developed by weighting the frequency losses (10%, 4%, 2%, 1% and 0.2% events).
Loss values have been summarized for pre- and post-FIRM buildings.
Data Sources:
HAZUS-MH v2.2 Flood Model (analysis 03/2015)
HAZUS-MH v2.2 County Boundaries
MPPDC Town Boundaries

Figure 111:

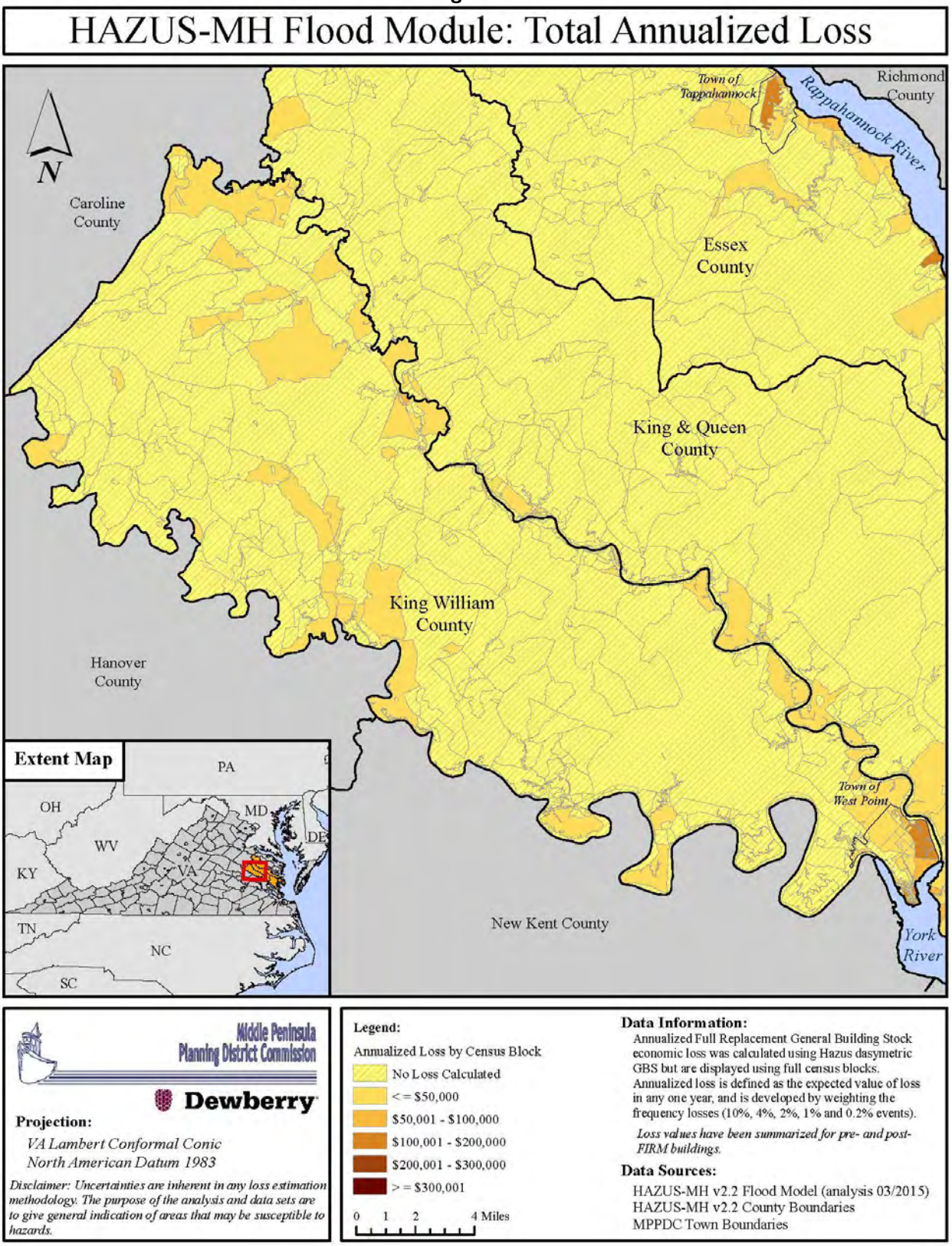

HAZUS-MH Flood Module: Total Annualized Loss
N
Caroline County
Town of Tappahannock
Richmond County
Rappahannock River
Essex County
King & Queen County
King William County
Hanover County
New Kent County
Town of West Point
York River
Extent Map
PA
OH
MD
DE
WV
KY
VA
TN
NC
SC
Middle Peninsula Planning District Commission
Dewberry
Projection:
VA Lambert Conformal Conic
North American Datum 1983
Disclaimer: Uncertainties are inherent in any loss estimation methodology. The purpose of the analysis and data sets are to give general indication of areas that may be susceptible to hazards.
Legend:
Annualized Loss by Census Block
No Loss Calculated
< = $50,000
$50,001 - $100,000
$100,001 - $200,000
$200,001 - $300,000
> = $300,001
0 1 2 4 Miles
Data Information:
Annualized Full Replacement General Building Stock economic loss was calculated using Hazus dasymetric GBS but are displayed using full census blocks. Annualized loss is defined as the expected value of loss in any one year, and is developed by weighting the frequency losses (10%, 4%, 2%, 1% and 0.2% events).
Loss values have been summarized for pre- and post-FIRM buildings.
Data Sources:
HAZUS-MH v2.2 Flood Model (analysis 03/2015)
HAZUS-MH v2.2 County Boundaries
MPPDC Town Boundaries

Figure 112:

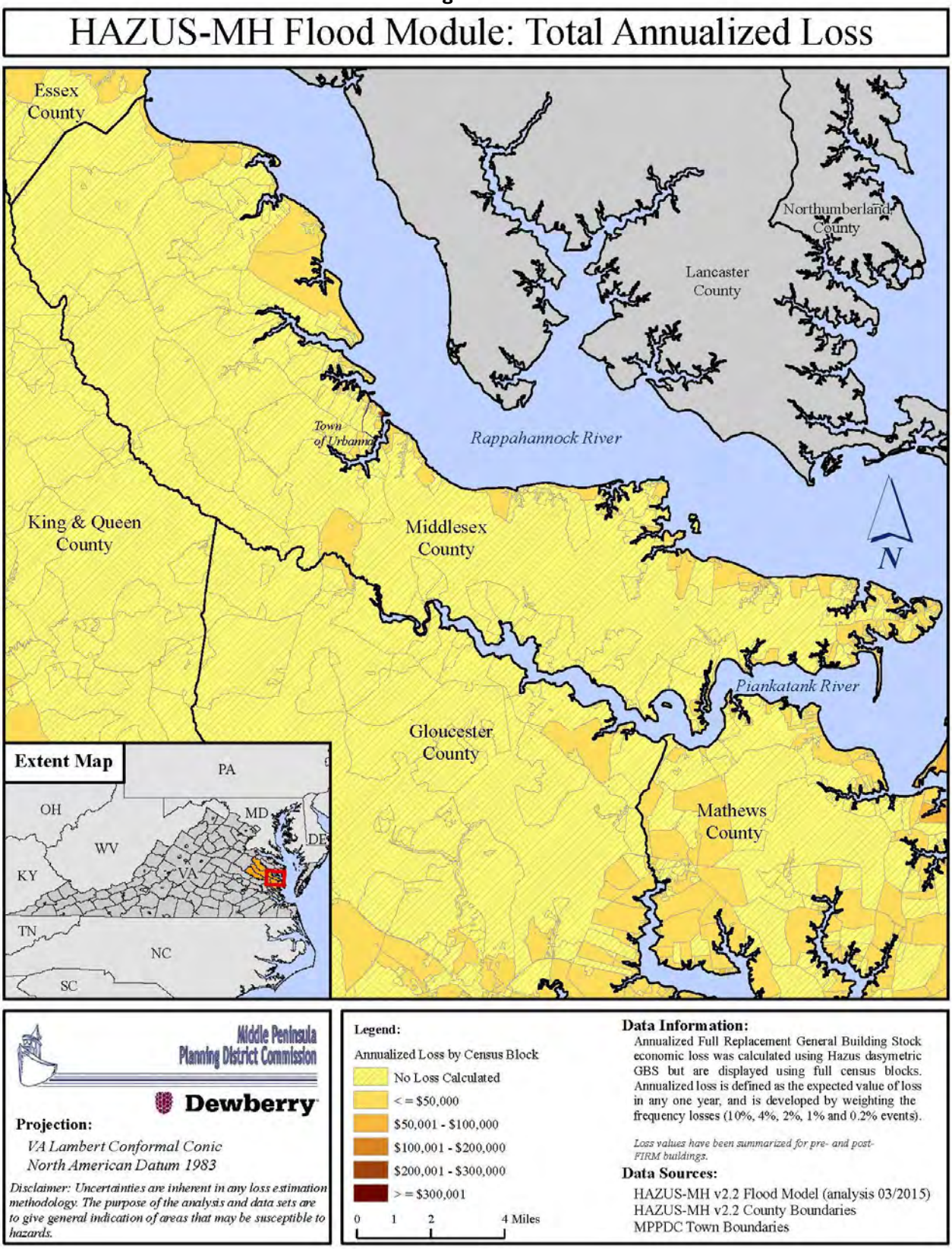

HAZUS-MH Flood Module: Total Annualized Loss
Essex County
Northumberland County
Lancaster County
Town of Urbanna
Rappahannock River
King & Queen County
Middlesex County
N
Piankatank River
Gloucester County
Mathews County
Extent Map
PA
OH
MD
DE
WV
KY
VA
TN
NC
SC
Middle Peninsula Planning District Commission
Dewberry
Projection:
VA Lambert Conformal Conic
North American Datum 1983
Disclaimer: Uncertainties are inherent in any loss estimation methodology. The purpose of the analysis and data sets are to give general indication of areas that may be susceptible to hazards.
Legend:
Annualized Loss by Census Block
No Loss Calculated
< = $50,000
$50,001 - $100,000
$100,001 - $200,000
$200,001 - $300,000
> = $300,001
0 1 2 4 Miles
Data Information:
Annualized Full Replacement General Building Stock economic loss was calculated using Hazus dasymetric GBS but are displayed using full census blocks. Annualized loss is defined as the expected value of loss in any one year, and is developed by weighting the frequency losses (10%, 4%, 2%, 1% and 0.2% events).
Loss values have been summarized for pre- and post-FIRM buildings.
Data Sources:
HAZUS-MH v2.2 Flood Model (analysis 03/2015)
HAZUS-MH v2.2 County Boundaries
MPPDC Town Boundaries

Figure 113:

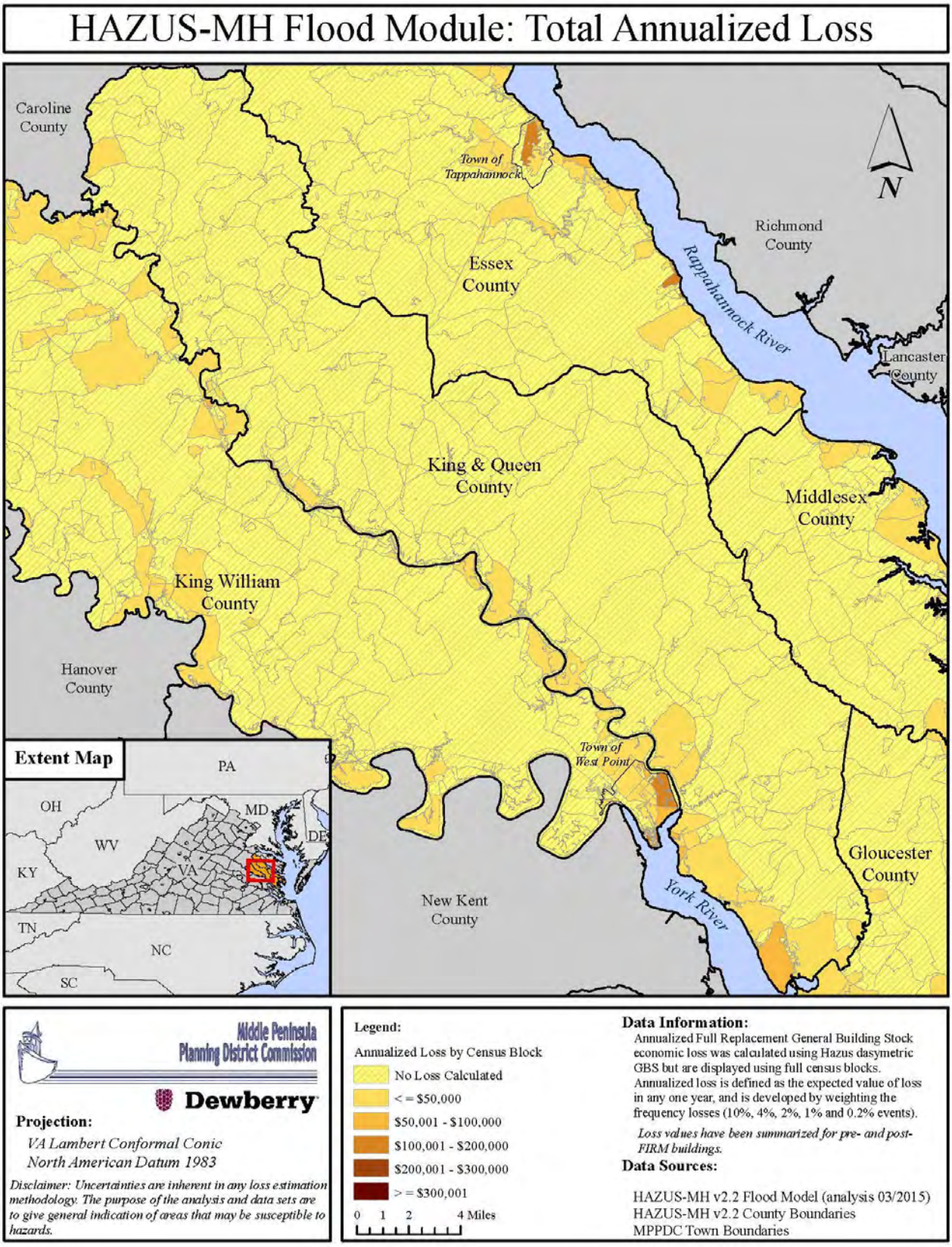

HAZUS-MH Flood Module: Total Annualized Loss
Caroline County
Town of Tappahannock
N
Richmond County
Essex County
Rappahannock River
Lancaster County
King & Queen County
Middlesex County
King William County
Hanover County
Extent Map
PA
OH
MD
DE
WV
KY
VA
TN
NC
SC
Town of West Point
Gloucester County
New Kent County
York River
Middle Peninsula Planning District Commission
Dewberry
Projection:
VA Lambert Conformal Conic
North American Datum 1983
Disclaimer: Uncertainties are inherent in any loss estimation methodology. The purpose of the analysis and data sets are to give general indication of areas that may be susceptible to hazards.
Legend:
Annualized Loss by Census Block
No Loss Calculated
< = $50,000
$50,001 - $100,000
$100,001 - $200,000
$200,001 - $300,000
> = $300,001
0 1 2 4 Miles
Data Information:
Annualized Full Replacement General Building Stock economic loss was calculated using Hazus dasymetric GBS but are displayed using full census blocks. Annualized loss is defined as the expected value of loss in any one year, and is developed by weighting the frequency losses (10%, 4%, 2%, 1% and 0.2% events).
Loss values have been summarized for pre- and post-FIRM buildings.
Data Sources:
HAZUS-MH v2.2 Flood Model (analysis 03/2015)
HAZUS-MH v2.2 County Boundaries
MPPDC Town Boundaries

Figure 114:

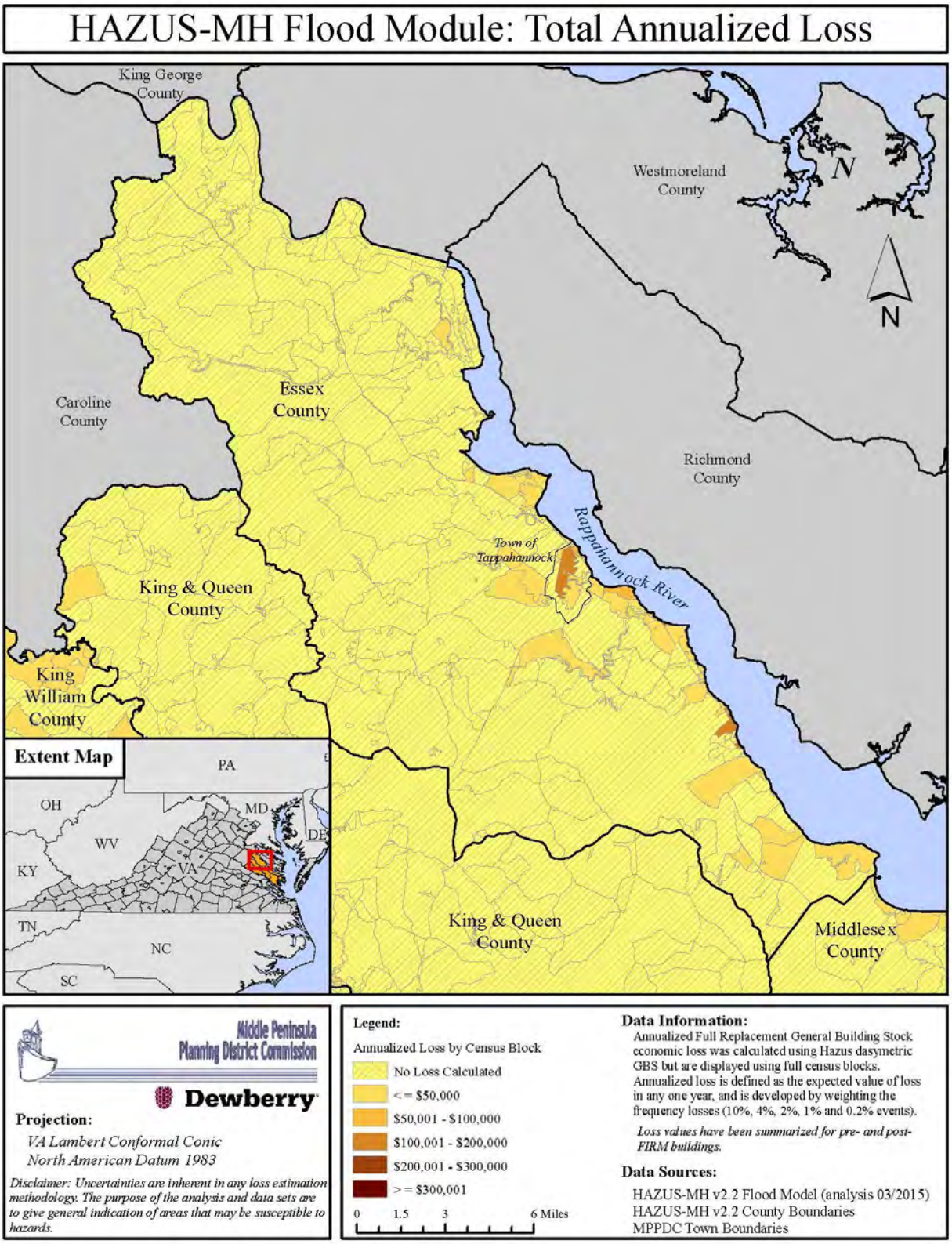
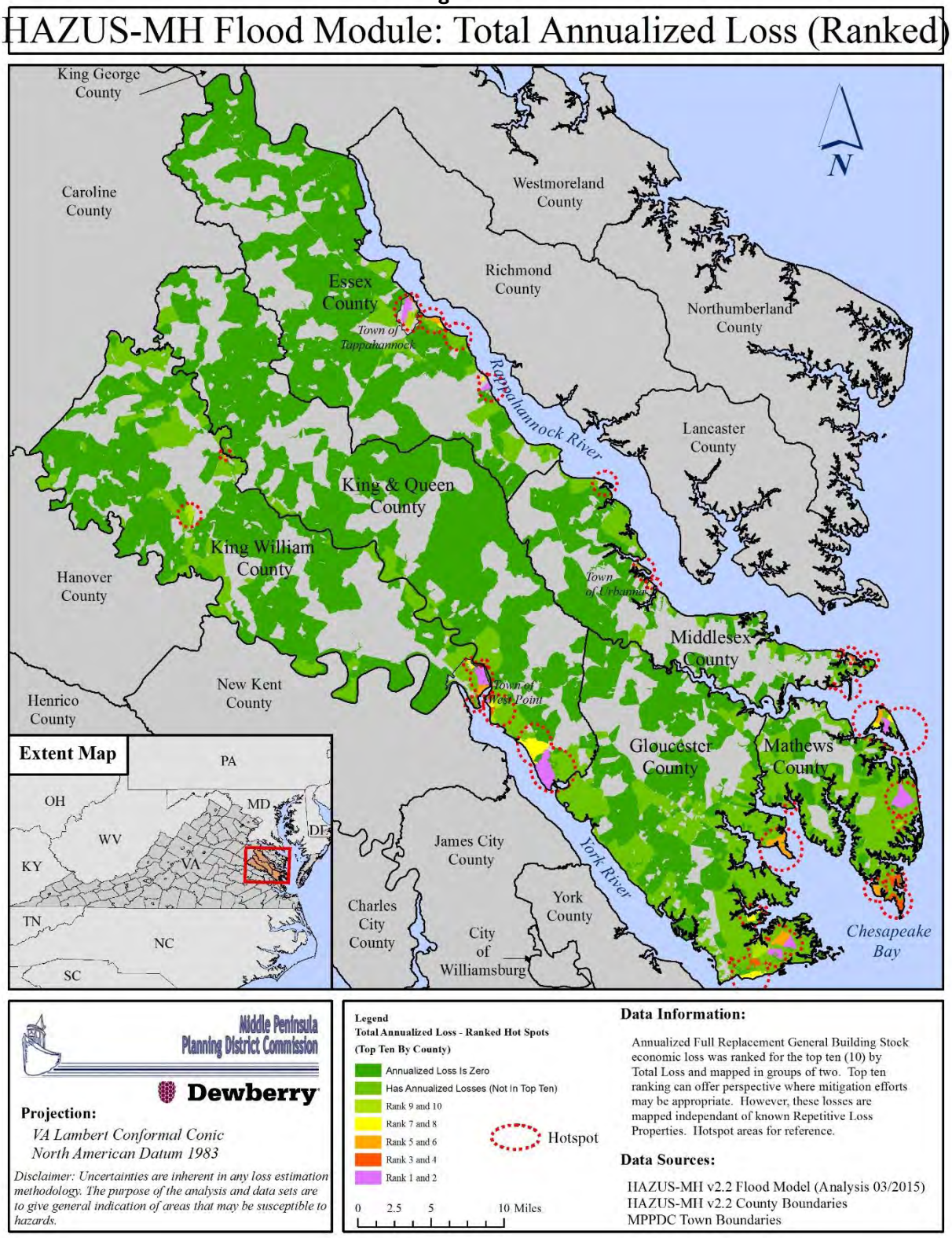

HAZUS-MH Flood Module: Total Annualized Loss
King George County
Westmoreland County
N
N
Caroline County
Essex County
Richmond County
Rappahannock River
Town of Tappahannock
King & Queen County
King William County
Extent Map
PA
OH
MD
DE
WV
KY
VA
TN
NC
SC
King & Queen County
Middlesex County
Middle Peninsula Planning District Commission
Dewberry
Projection:
VA Lambert Conformal Conic
North American Datum 1983
Disclaimer: Uncertainties are inherent in any loss estimation methodology. The purpose of the analysis and data sets are to give general indication of areas that may be susceptible to hazards.
Legend:
Annualized Loss by Census Block
No Loss Calculated
<= $50,000
$50,001 - $100,000
$100,001 - $200,000
$200,001 - $300,000
>= $300,001
0 1.5 3 6 Miles
Data Information:
Annualized Full Replacement General Building Stock economic loss was calculated using Hazus dasymetric GBS but are displayed using full census blocks. Annualized loss is defined as the expected value of loss in any one year, and is developed by weighting the frequency losses (10%, 4%, 2%, 1% and 0.2% events).
Loss values have been summarized for pre- and post-FIRM buildings.
Data Sources:
HAZUS-MH v2.2 Flood Model (analysis 03/2015)
HAZUS-MH v2.2 County Boundaries
MPPDC Town Boundaries

Figure 115:


HAZUS-MH Flood Module: Total Annualized Loss (Ranked)
King George County
Caroline County
Westmoreland County
Richmond County
Essex County
Town of Tappahannock
Northumberland County
Rappahannock River
Lancaster County
King & Queen County
King William County
Hanover County
Town of Urbanna
Middlesex County
New Kent County
Henrico County
Town of West Point
Gloucester County
Mathews County
James City County
York River
Charles City County
York County
City of Williamsburg
Chesapeake Bay
N
Extent Map
PA
OH
MD
DE
WV
KY
VA
TN
NC
SC
Middle Peninsula Planning District Commission
Dewberry
Projection:
VA Lambert Conformal Conic
North American Datum 1983
Disclaimer: Uncertainties are inherent in any loss estimation methodology. The purpose of the analysis and data sets are to give general indication of areas that may be susceptible to hazards.
Legend
Total Annualized Loss - Ranked Hot Spots
(Top Ten By County)
Annualized Loss Is Zero
Has Annualized Losses (Not In Top Ten)
Rank 9 and 10
Rank 7 and 8
Rank 5 and 6
Rank 3 and 4
Rank 1 and 2
Hotspot
0 2.5 5 10 Miles
Data Information:
Annualized Full Replacement General Building Stock economic loss was ranked for the top ten (10) by Total Loss and mapped in groups of two. Top ten ranking can offer perspective where mitigation efforts may be appropriate. However, these losses are mapped independant of known Repetitive Loss Properties. Hotspot areas for reference.
Data Sources:
HAZUS-MH v2.2 Flood Model (Analysis 03/2015)
HAZUS-MH v2.2 County Boundaries
MPPDC Town Boundaries

Gloucester County accounts for almost 55.15% of the planning district's annualized losses. The census blocks bordering the York River and Mobjack Bay have higher loss values as compared to the larger census blocks in the northwest portions of the county. Collective damages between both the York River and Mobjack Bay are nearly equivalent. The southeast portion of the County contains the greatest concentration of loss. The vicinity of Guinea Road and Kings Creek Road; beginning in the locale of Hayes and heading east to Kings Creek being bordered on the north by the Severn River and on the south by the York River exhibits the greatest concentration of loss. Additionally, the land area of Saddlers Neck to Stump Point being bounded on the north by the Northwest Branch Severn River and Willetts Creek to the south exhibits a second concentration of risk. Finally, the peninsula and vicinity of Ware Neck Point -where the Ware River and North River converge – is another location exhibiting a concentration of losses.

Losses in Mathews County are spread throughout the county with a high frequency of census block having damages greater than $50,000 US Dollars along the Chesapeake Bay to include the various harbor/haven inlets and also at the confluences of the Piankatank River in the north as well as Mobjack Bay in the south. Another location that exhibits relatively higher loss estimates includes Roys Point in the area around Daniel Avenue. Ultimately, Mathews County ranks second of the six counties and accounts for 20.4% of the total annualized losses in the MPPDC planning district.

The census blocks bordering the Pamunkey and Mattaponi rivers contain almost all of the annualized damages for King William County with the greatest concentration of losses in the Town of West Point. Wood framed structures across the county account for more than 50% of the losses. The total annualized damages for the Town of West Point is approximately $1.3 million US Dollars. Total annualized losses of the Pamunkey Indian Reservation is approximately $40,000 US Dollars and the Mattaponi Indian Reservation is $14,000 US Dollars. Two (2) locations in the northwestern portion of the County exhibit relatively higher annualized loss values; the two areas are in the vicinity of both Manquin and Aylett with Aylett experiencing the greater losses near $145,000 US Dollars and Manquin having estimated losses of $40,000 US Dollars.

Middlesex County's annualized losses account for 6.3% of the total risk with wood framed structures accounting for nearly 68% of the losses. The census blocks along the Rappahannock River collectively account for the greatest amount of losses within the County. Losses in the vicinity of Mud Creek, Balls Point, The Town of Urbanna, and the confluence with the Chesapeake Bay constitute the areas having the highest loss values. The Town of Urbana has an estimated $300,000 US Dollars in annualized damages and includes the census block having the highest estimated loss ($226,000 US Dollars) within the County. The second highest census block loss ($70,000) is located at the confluence between the Rappahannock River and the Chesapeake Bay in the southeastern portion of the County.

King and Queen County has the lowest annualized loss values for the region, accounting for 3.2% of the total damages. Residential occupancy makes up the majority of the losses in the county. A relatively small group of census blocks along the York River account for most of the damages near $400,000 US Dollars. In comparison, along the Mattaponi River damages are in the range of near $100,000 or roughly one-quarter of the expected damages along the York River. Notwithstanding, a small pocket of development at the end of Limehouse Road along the Mattaponi River downstream of Muddy Point and opposite the Town of West Point is an area with annualized losses near $20,000 US Dollars. The majority of damage within Essex County is along the Rappahannock River with the greatest concentration of annualized losses from the Town of Tappahannock in the north, extending downstream to the vicinity of Wares Warf. Total annualized damages along the length of the Rappahannock are approximately $1.34 million. The concentrated damages from Tappahannock to Wares Point is approximately $0.67 million or nearly one-half of the expected damages along the Rappahannock River.

The Town of Tappahannock accounts for approximately $0.34 million or nearly one-half of the expected damages in the area of concentrated damages along the Rappahannock. The county and town combined, account for approximately 5.8% of annualized damages for the MPPDC region.

Comparative Flood Modeling:

Noting the existence of new RiskMAP-based depth grids from recent FEMA studies, presented below are results of running the new coastal-only 1% Annual Chance Flood Hazard (Tables 53-59). As discussed earlier, the new RiskMAP-based depth grid was not utilized to replace the Hazus Level 1 depth grids. However, the study data (i.e., the same study data that would have been used to create the RiskMAP-based depth grid) was utilized in the Level 1 analysis. Again, this included use of the Stillwater Elevations reported for coastal transects in Table 2 – Transect Data for each FEMA Flood Insurance Study. Consequently, the loss values presented below for general comparison, effectually exhibit that losses are relatively close. Consequently, knowing that losses are relatively close is confirmation that the Hazus Level 1 methodology is quite reasonable for the regional estimations and analyses presented. However, in the event that further analyses at smaller mapping scales (e.g., Parcel-level) are warranted in other projects, it would be advisable to use the RiskMAP-based data.

Table 53: MPPDC Loss Comparison – 1% Coastal (RiskMAP vs. Level 1 Methodology).

Area	Scenario	Total Loss	Building Loss	Contents Loss	Business Disruption
MPPDC Region	100YR_RiskMapCstlOnly [A]	$233,744	$128,057	$104,166	$2,220
MPPDC Region	100YR_LVL1CstlOnly [B]	$236,591	$128,430	$106,547	$2,389
Data in Thousands of Dollars					
Notes:					
[A] Scenario uses depth grids produced for FEMA RiskMAP Studies by USACE circa March 2015.					
[B] Scenario uses depth grids produced from Hazus Level 1 methodology; NED 1-Arc DEMs, 1 mi² Drainage Threshold, most recent coastal water surfaces from FEMA FIS text (Table 2 – Transect Data) for each respective county.					

Table 54: Essex County Loss Comparison – 1% Coastal (RiskMAP vs. Level 1 Methodology).

Area	Scenario	Total Loss	Building Loss	Contents Loss	Business Disruption
Essex County	100YR_RiskMapCstlOnly [A]	$14,695	$7,541	$7,014	$162
Essex County	100YR_LVL1CstlOnly [B]	$16,421	$8,637	$7,663	$141
Data in Thousands of Dollars					
Notes:					
[A] Scenario uses depth grids produced for FEMA RiskMAP Studies by USACE circa March 2015.					
[B] Scenario uses depth grids produced from Hazus Level 1 methodology; NED 1-Arc DEMs, 1 mi² Drainage Threshold, most recent coastal water surfaces from FEMA FIS text (Table 2 – Transect Data) for each respective county.					

Table 55: Gloucester County Loss Comparison – 1% Coastal (RiskMAP vs. Level 1 Methodology).

Area	Scenario	Total Loss	Building Loss	Contents Loss	Business Disruption
Gloucester County	100YR_RiskMapCstlOnly [A]	$108,158	$58,259	$49,148	$50,416
Gloucester County	100YR_LVL1CstlOnly [B]	$118,631	$62,714	$55,018	$56,528
Data in Thousands of Dollars					
Notes:					
[A] Scenario uses depth grids produced for FEMA RiskMAP Studies by USACE circa March 2015.					
[B] Scenario uses depth grids produced from Hazus Level 1 methodology; NED 1-Arc DEMs, 1 mi² Drainage Threshold, most recent coastal water surfaces from FEMA FIS text (Table 2 – Transect Data) for each respective county.					

Table 56: King & Queen County Loss Comparison – 1% Coastal (RiskMAP vs. Level 1 Methodology).

Area	Scenario	Total Loss	Building Loss	Contents Loss	Business Disruption
King Queen County	100YR_RiskMapCstlOnly [A]	$5,152	$3,094	$2,004	$54
King Queen County	100YR_LVL1CstlOnly [B]	$7,140	$4,375	$2,720	$45
Data in Thousands of Dollars					
Notes:					
[A] Scenario uses depth grids produced for FEMA RiskMAP Studies by USACE circa March 2015.					
[B] Scenario uses depth grids produced from Hazus Level 1 methodology; NED 1-Arc DEMs, 1 mi² Drainage Threshold, most recent coastal water surfaces from FEMA FIS text (Table 2 – Transect Data) for each respective county.					

Table 57: King William County Loss Comparison – 1% Coastal (RiskMAP vs. Level 1 Methodology).

Area	Scenario	Total Loss	Building Loss	Contents Loss	Business Disruption
King William County	100YR_LVL1CstlOnly [B]	$16,553	$7,961	$8,489	$163
King William County	100YR_RiskMapCstlOnly [A]	$18,428	$8,564	$9,737	$194
Data in Thousands of Dollars					
Notes:					
[A] Scenario uses depth grids produced for FEMA RiskMAP Studies by USACE circa March 2015.					
[B] Scenario uses depth grids produced from Hazus Level 1 methodology; NED 1-Arc DEMs, 1 mi² Drainage Threshold, most recent coastal water surfaces from FEMA FIS text (Table 2 – Transect Data) for each respective county.					

Table 58: Mathews County Loss Comparison – 1% Coastal (RiskMAP vs. Level 1 Methodology).

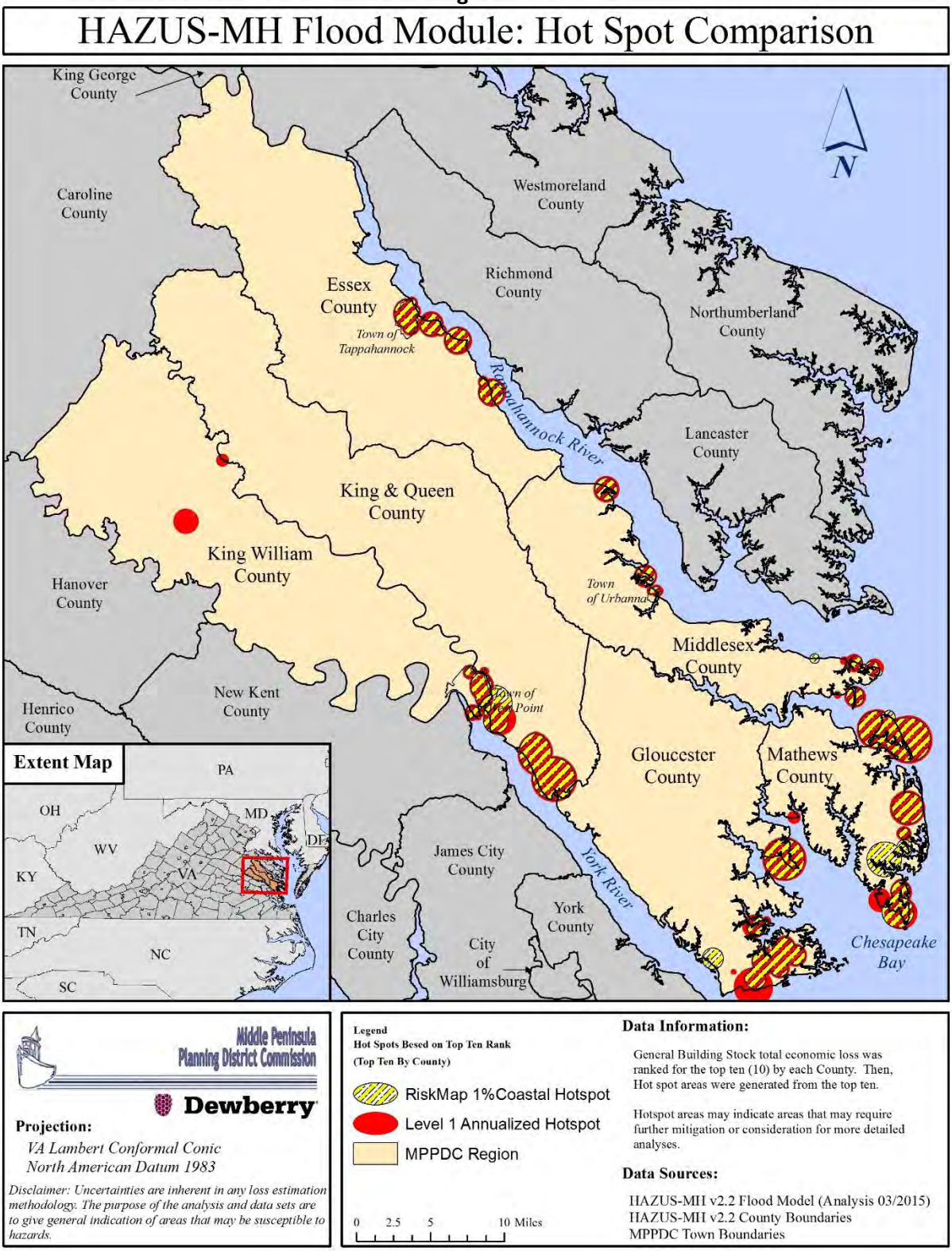
Area	Scenario	Total Loss	Building Loss	Contents Loss	Business Disruption
Mathews County	100YR_LVL1CstlOnly [B]	$60,614	$34,946	$25,279	$451
Mathews County	100YR_RiskMapCstlOnly [A]	$65,453	$37,867	$27,188	$466
Data in Thousands of Dollars					
Notes:					
[A] **Scenario uses depth grids produced for FEMA RiskMAP Studies by USACE circa March 2015.**					
[B] **Scenario uses depth grids produced from Hazus Level 1 methodology; NED 1-Arc DEMs, 1 mi² Drainage Threshold, most recent coastal water surfaces from FEMA FIS text (Table 2 – Transect Data) for each respective county.**					

Table 59: Middlesex County Loss Comparison – 1% Coastal (RiskMAP vs. Level 1 Methodology).

Area	Scenario	Total Loss	Building Loss	Contents Loss	Business Disruption
Middlesex County	100YR_LVL1CstlOnly [B]	$17,232	$9,797	$7,378	$79
Middlesex County	100YR_RiskMapCstlOnly [A]	$21,858	$12,732	$9,075	$76
Data in Thousands of Dollars					
Notes:					
[A] **Scenario uses depth grids produced for FEMA RiskMAP Studies by USACE circa March 2015.**					
[B] **Scenario uses depth grids produced from Hazus Level 1 methodology; NED 1-Arc DEMs, 1 mi² Drainage Threshold, most recent coastal water surfaces from FEMA FIS text (Table 2 – Transect Data) for each respective county.**					

A comparison of the "hot spots" that exist form the Level 1 Annualized and the new RiskMAP-based 1% Annual Chance loss estimates reveals very similar results. Figure 116 below, shows the hot spots generated from the two different types of modeling. It can be seen that the new RiskMAP-based analysis shows a number of similarities in the potential flood losses. Any location where the two hot spot types overlap, are locations where the relative risk is considered to be comparative or relatively similar. However, it is important to note that the two (2) Level 1 Annualized Hotspots in northwestern King William County (vicinity of Manquin and Aylett) are areas attributed to Riverine flooding influence. Therefore, the RiskMAP 1% Coastal Hotspots will not reveal these same areas as potential hot spots. Consequently, the RiskMAP 1% Coastal Hotspots will reveal the addition of other new areas given the extents of the costal flood hazard (see Figure 117 – FEMA digital FIRM & RiskMAP 1% Coastal Depth Grid).

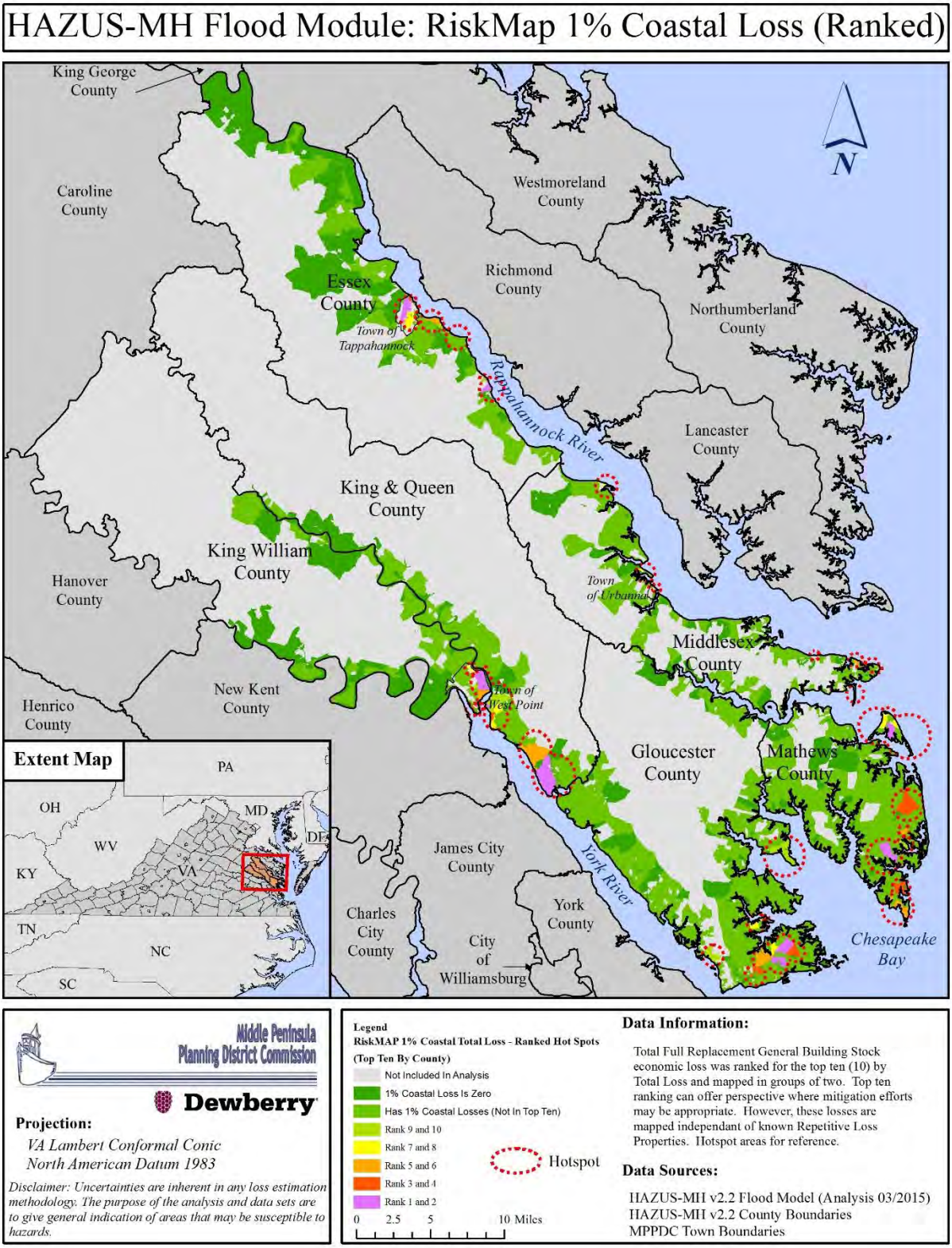
Figure 116:


HAZUS-MH Flood Module: Hot Spot Comparison
King George County
Caroline County
Westmoreland County
Richmond County
Essex County
Town of Tappahannock
Northumberland County
Rappahannock River
Lancaster County
King & Queen County
King William County
Hanover County
Town of Urbanna
Middlesex County
New Kent County
Henrico County
Gloucester County
Mathews County
James City County
York River
Charles City County
York County
City of Williamsburg
Chesapeake Bay
N
Extent Map
PA
OH
MD
DE
WV
KY
VA
TN
NC
SC
Middle Peninsula Planning District Commission
Dewberry
Projection:
VA Lambert Conformal Conic
North American Datum 1983
Disclaimer: Uncertainties are inherent in any loss estimation methodology. The purpose of the analysis and data sets are to give general indication of areas that may be susceptible to hazards.
Legend
Hot Spots Besed on Top Ten Rank
(Top Ten By County)
RiskMap 1%Coastal Hotspot
Level 1 Annualized Hotspot
MPPDC Region
0 2.5 5 10 Miles
Data Information:
General Building Stock total economic loss was ranked for the top ten (10) by each County. Then, Hot spot areas were generated from the top ten.
Hotspot areas may indicate areas that may require further mitigation or consideration for more detailed analyses.
Data Sources:
HAZUS-MH v2.2 Flood Model (Analysis 03/2015)
HAZUS-MH v2.2 County Boundaries
MPPDC Town Boundaries

Given the coastal focus of the RiskMAP study, it can be seen that a few new areas of consideration include the following:

- Middlesex County – an area along the Rappahannock River where the River confluences with Woods Creek.
- Gloucester County – an area along the York River, east of the Carmines Islands and situated between Carmines Island Road (in the west) and Pigeon Hill Road (in the east).
- Mathews County – portions of land on the northern banks of Horn Harbor and also along Winter Harbor.
- King and Queen County – a greater area (as compared to the Level 1 Annualized Hot Spot) in the vicinity of Mattaponi; i.e., confluence of Mattaponi and York Rivers near State Highway 33 (Lewis B. Puller Memorial Highway).

Figure 117:


HAZUS-MH Flood Module: RiskMap 1% Coastal Loss (Ranked)
King George County
Caroline County
Westmoreland County
Essex County
Town of Tappahannock
Richmond County
Northumberland County
Rappahannock River
Lancaster County
King & Queen County
King William County
Hanover County
Town of Urbanna
Middlesex County
New Kent County
Town of West Point
Henrico County
Gloucester County
Mathews County
James City County
York River
Charles City County
York County
City of Williamsburg
Chesapeake Bay
N
Extent Map
PA
OH
MD
DE
WV
KY
VA
TN
NC
SC
Middle Peninsula Planning District Commission
Dewberry
Projection:
VA Lambert Conformal Conic
North American Datum 1983
Disclaimer: Uncertainties are inherent in any loss estimation methodology. The purpose of the analysis and data sets are to give general indication of areas that may be susceptible to hazards.
Legend
RiskMAP 1% Coastal Total Loss - Ranked Hot Spots
(Top Ten By County)
Not Included In Analysis
1% Coastal Loss Is Zero
Has 1% Coastal Losses (Not In Top Ten)
Rank 9 and 10
Rank 7 and 8
Rank 5 and 6
Rank 3 and 4
Rank 1 and 2
Hotspot
0 2.5 5 10 Miles
Data Information:
Total Full Replacement General Building Stock economic loss was ranked for the top ten (10) by Total Loss and mapped in groups of two. Top ten ranking can offer perspective where mitigation efforts may be appropriate. However, these losses are mapped independant of known Repetitive Loss Properties. Hotspot areas for reference.
Data Sources:
HAZUS-MH v2.2 Flood Model (Analysis 03/2015)
HAZUS-MH v2.2 County Boundaries
MPPDC Town Boundaries

Essential Facilities

Level 1 analysis of essential facilities typically involves using the data provided with Hazus (i.e., Out-of-the-Box). This means the Hazus data of Essential Facilities is used as-is and no local data inputs are utilized. Essential facilities were modeled in this manner which includes the following feature types:

- Medical Care Facilities
- Emergency Operation Centers
- Fire Stations
- Police Stations
- Schools

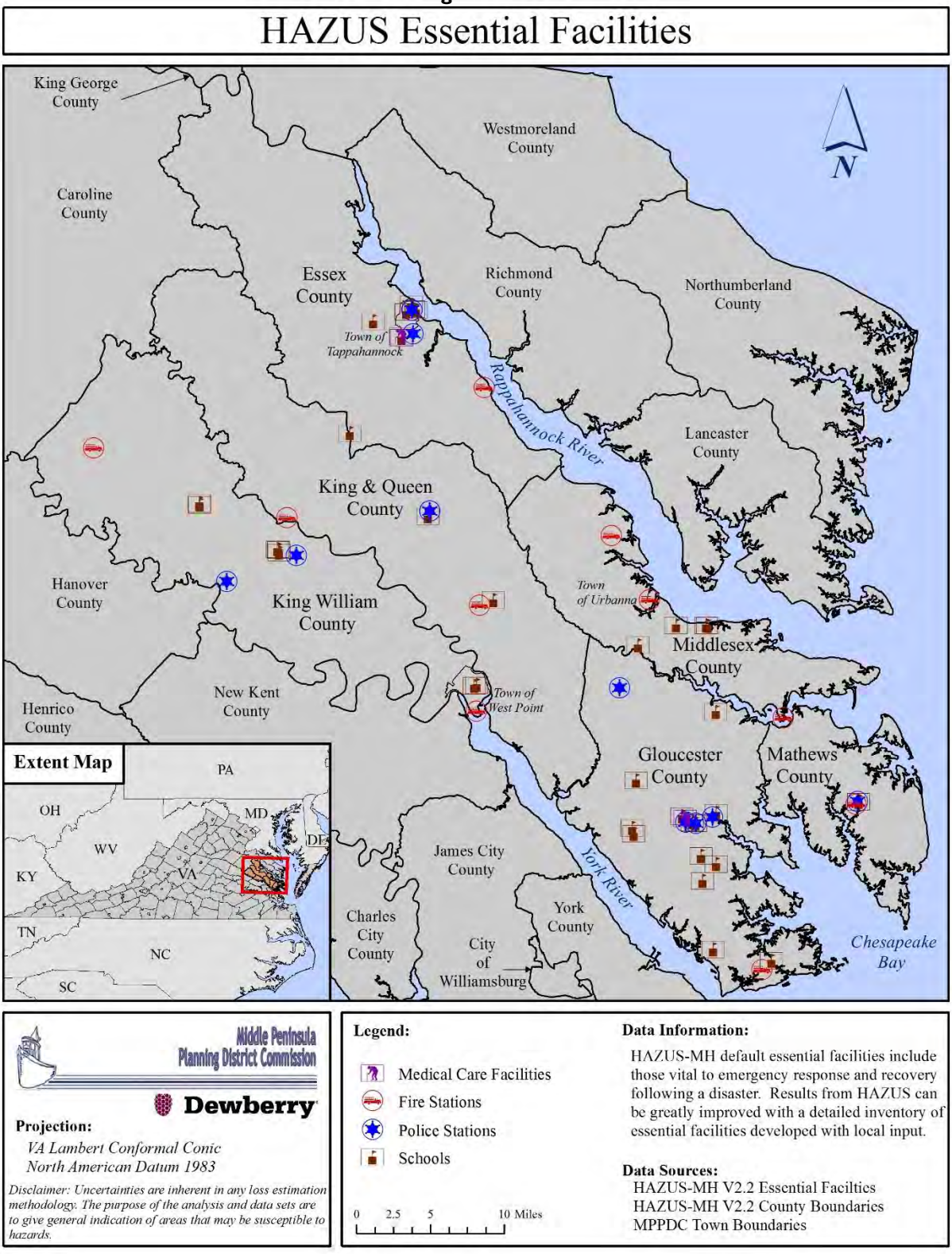
Essential facilities are typically those facility types that are vital to emergency response and recovery following a disaster. School buildings are included in this category because of the key role they often play in sheltering people displaced from damaged homes. Generally there are very few of each type of essential facilities in a census tract, making it easier to obtain site-specific information for each facility. Thus, damage and loss-of-function are evaluated on a building-by-building basis for this class of structures, even though the uncertainty in each such estimate is large[3].

Figure 118 displays the spatial location of the mapped essential facilities as provided with the Hazus software. Thereafter, Figure 114 highlights those facilities that are damaged by the Hazus Level 1 multi-frequency flood hazard(s) – thus experiencing estimated damage and loss.

Future versions of this plan can be enhanced, as illustrated in the mitigation actions, with further Level 2 refinements and Level 3 analyses.

[3] Multi-hazard Loss Estimation Methodology HAZUS-MH V2.2, Chapter 1: Introduction, 1-6

Figure 118:

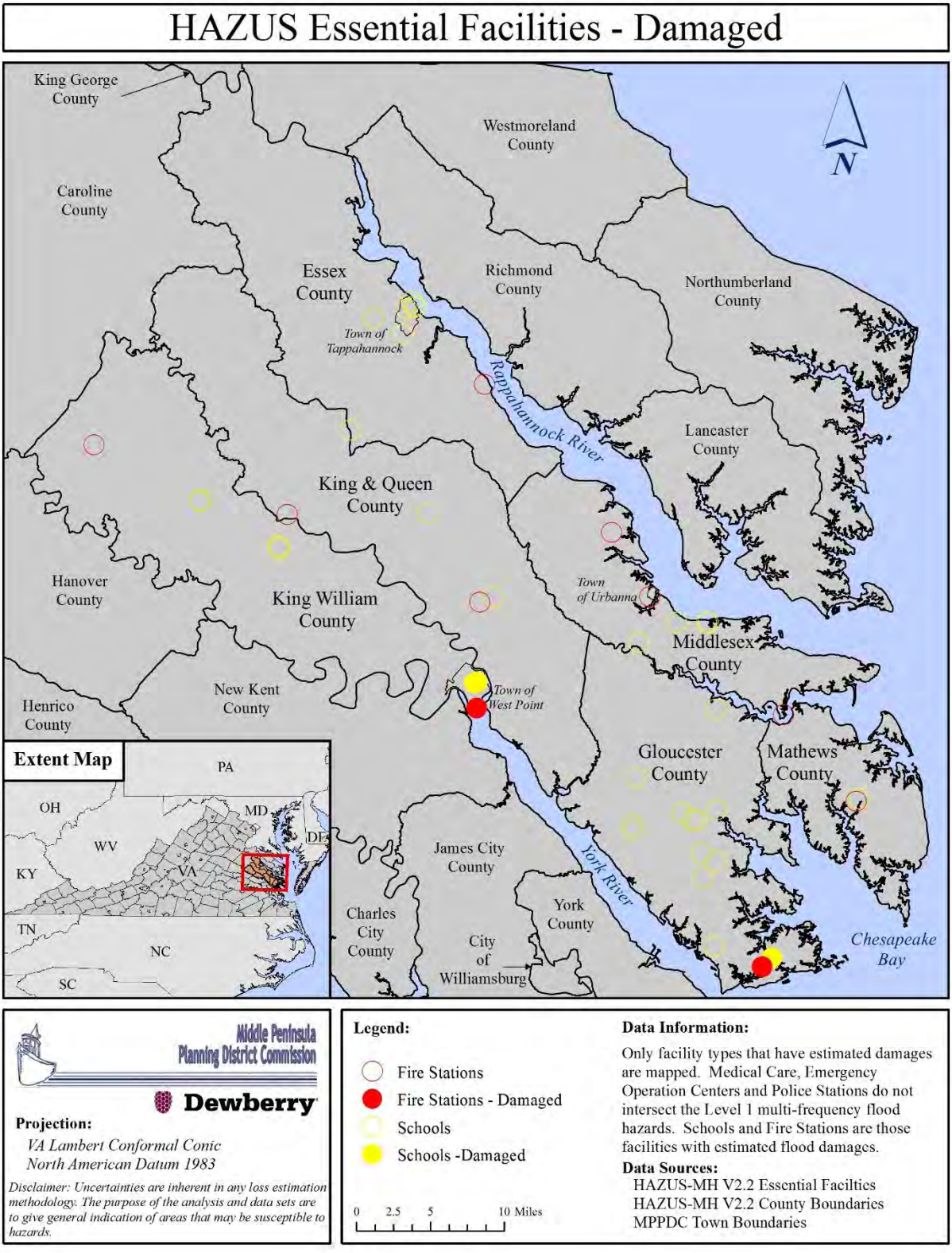

HAZUS Essential Facilities
King George County
Westmoreland County
Caroline County
Essex County
Richmond County
Northumberland County
Town of Tappahannock
Rappahannock River
Lancaster County
King & Queen County
Hanover County
King William County
Town of Urbanna
Middlesex County
New Kent County
Town of West Point
Henrico County
Gloucester County
Mathews County
James City County
York River
Charles City County
York County
City of Williamsburg
Chesapeake Bay
N
Extent Map
PA
OH
MD
DE
WV
KY
VA
TN
NC
SC
Middle Peninsula Planning District Commission
Dewberry
Projection:
VA Lambert Conformal Conic
North American Datum 1983
Disclaimer: Uncertainties are inherent in any loss estimation methodology. The purpose of the analysis and data sets are to give general indication of areas that may be susceptible to hazards.
Legend:
Medical Care Facilities
Fire Stations
Police Stations
Schools
0 2.5 5 10 Miles
Data Information:
HAZUS-MH default essential facilities include those vital to emergency response and recovery following a disaster. Results from HAZUS can be greatly improved with a detailed inventory of essential facilities developed with local input.
Data Sources:
HAZUS-MH V2.2 Essential Facilties
HAZUS-MH V2.2 County Boundaries
MPPDC Town Boundaries

Name	City	Return Period	Control Hazard	Bldg DmgPct	Bldg Loss (US Dollar)	Contents DmgPct	Cont Loss (US Dollar)	MaxTime toFull Restoration
ACHILLES ELEM.	Hayes	50-YR	Coastal	4.9	$190,476	26.2	$1,028,573	480 days
ACHILLES ELEM.	Hayes	100-YR	Coastal	6.7	$261,818	36.2	$1,420,380	480 days
ACHILLES ELEM.	Hayes	500-YR	Coastal	18.8	$737,641	81.4	$3,194,153	720 days
WEST POINT MIDDLE	West Point	500-YR	Coastal	5.5	$133,548	29.8	$722,392	480 days
WEST POINT ELEM.	West Point	500-YR	Coastal	3.1	$124,359	16.5	$671,537	481 days
WEST POINT HIGH	West Point	500-YR	Coastal	0.5	$15,976	2.4	$86,268	482 days
West Point Volunteer Fire Department & R	West Point	500-YR	Coastal	1.8	$ -	2.0	$ -	483 days
Abingdon Volunteer Fire and Rescue Inc.	Hayes	25-YR	Coastal	9.9	$ -	19.4	$ -	484 days
Abingdon Volunteer Fire and Rescue Inc.	Hayes	50-YR	Coastal	10.9	$ -	35.8	$ -	485 days
Abingdon Volunteer Fire and Rescue Inc.	Hayes	100-YR	Coastal	11.2	$ -	42.0	$ -	486 days
Abingdon Volunteer Fire and Rescue Inc.	Hayes	500-YR	Coastal	27.7	$ -	100.0	$ -	720 days

NOTES:

Fire Station facilities in the stock Hazus Data do not have estimated replacement values associated with the facilities; therefore estimated dollar losses are NULL or void of any valid values.

Figure 119:


HAZUS Essential Facilities - Damaged
King George County
Westmoreland County
Caroline County
Essex County
Richmond County
Northumberland County
Town of Tappahannock
Rappahannock River
Lancaster County
King & Queen County
Hanover County
King William County
Town of Urbanna
Middlesex County
New Kent County
Town of West Point
Henrico County
Gloucester County
Mathews County
James City County
York River
Charles City County
York County
City of Williamsburg
Chesapeake Bay
N
Extent Map
PA
OH
MD
DE
WV
KY
VA
TN
NC
SC
Middle Peninsula Planning District Commission
Dewberry
Projection:
VA Lambert Conformal Conic
North American Datum 1983
Disclaimer: Uncertainties are inherent in any loss estimation methodology. The purpose of the analysis and data sets are to give general indication of areas that may be susceptible to hazards.
Legend:
Fire Stations
Fire Stations - Damaged
Schools
Schools -Damaged
0 2.5 5 10 Miles
Data Information:
Only facility types that have estimated damages are mapped. Medical Care, Emergency Operation Centers and Police Stations do not intersect the Level 1 multi-frequency flood hazards. Schools and Fire Stations are those facilities with estimated flood damages.
Data Sources:
HAZUS-MH V2.2 Essential Facilties
HAZUS-MH V2.2 County Boundaries
MPPDC Town Boundaries

Potential Mitigation Actions:
The potential mitigation actions noted are those that are Hazus-specific and would benefit refinement of Hazus analyses. The previous Plan update included the following items (below). Those items that have been accomplished in the current Plan update are symbolized with a check-mark (☑) and those that still remain for future efforts (☐). New potential Hazus Mitigation actions are denoted with the following (➢).

- ☑ Complete Hazus flood runs for the 1 sq mi threshold. In most cases, this will need to be done on priority stream reaches as the program does not run efficiently at this level.
- ☑ Re-run Hazus for plan update to reflect 2010 census data.
- ☐ Refine and update data sets for GBS and essential facilities.
    - Improvements in the future should aim to further refine the building stock. Notably, one improvement should include adding any new development that may not have been in the land use/land cover data; e.g., new housing developments, new construction, etc…
    - Perform localized building-level assessments in known areas of loss and or areas subject to likely losses.

Hurricane Wind Analysis

The hurricane wind analysis for the HIRA was completed using the FEMA Hazus – MH V2.2 software. The model uses state of the art wind field models, calibrated and validated hurricane data. Wind speed has been calculated as a function of central pressure, translation speed, and surface roughness. This assessment has been completed for Probabilistic Level 1 analysis. The standard methodology of defining loss potential for any given hazard, includes annualizing the potential over a series of statistical return periods. Annualization is the mathematical method of converting individual losses to a weighted-average that may be experienced in any given year. The standard probabilistic scope pertaining to Hazus Level 1 hurricane wind risk corresponds to annualizing the 0.1%, 0.2%, 0.5%, 1%, 2%, 5%, and 10% wind return periods. In layman's-terms these same annual-chance return periods are often described as the 1,000-year, 500-year, 200-year, 100-year, 50-year, 20-year and 10-year events as shown in Table 60 below:

Table 60: Annual probability based on wind recurrence intervals.

Wind Recurrence Interval	Annual Chance of Occurrence
10 year	10.0%
20 year	5.0%
50 year	2.0%
100 year	1.0%
200 year	0.5%
500 year	0.2%
1000 year	0.1%

Practically, these statistical events represent the chance of being equaled or exceeded in any given year; i.e., the likelihood that a particular event with a given intensity occurs on average at least once every x-years. Once each of these statistical return periods are calculated, an annualized value is computed thus offering a perspective for any given year.

In addition to the Level 1 probabilistic methodology employed, Level 1 analysis is performed on stock data provided with the Hazus software; i.e., no local data inputs. This is an acceptable level of information for mitigation planning; future versions of this plan can be enhanced, as illustrated in the mitigation actions, with additional Level 1 scenarios and/or Level 2 and 3 analyses. Dollar values shown

in this report should only be used to represent cost of large aggregations of building types. Highly detailed, building specific, loss estimations have not been completed for this analysis as they require additional local data inputs. Note that combined wind, storm surge and wave-type scenarios have not been implemented in this Plan update however, the Flood modeling includes various scenarios that include the effects of storm surge and wave-action. Storm surge risk and coastal flooding is discussed in Section 4.

Loss estimation for this Hazus module is based on specific input data. The first type of data includes square footage of buildings for specified types or population. The second type of data includes information on the local economy that is used in estimating losses. Table 61 displays the economic loss categories used to calculate annualized losses by Hazus.

Table 61: Hazus direct economic loss categories and descriptions.

Category Name	Description of Data Input into Model	Hazus Output
Building	Cost per sq ft to repair damage by structural type and occupancy for each level of damage	Cost of building repair or replacement of damaged and destroyed buildings
Contents	Replacement value by occupancy	Cost of damage to building contents
Inventory	Annual gross sales in $ per sq ft	Loss of building inventory as contents related to business activities
Relocation	Multiple factors; primarily a function of Rental Costs ($/ft^2/month) for non-entertainment buildings where damage ≥10%	Relocation expenses (for businesses and institutions); disruption costs to building owners for temporary space.
Income	Income in $ per sq ft per month by occupancy	Capital-related incomes losses as a measure of the loss of productivity, services, or sales
Rental	Rental costs per month per sq ft by occupancy	Loss of rental income to building owners
Wage	Wages in $ per sq ft per month by occupancy	Employee wage loss as described in income loss

A probabilistic scenario Hazus analysis was completed using the planning district as the study area. The individual county results have been derived from this data set.

Middle Peninsula currently has approximately 43,501 structures with an estimated exposure value of approximately $17.7 billion. Average estimated replacement value of buildings in the study area range from $94,000 to $297,000, with the mean approximation value of $134,000 [4]. Eighty-one percent of the planning district's general occupancy is categorized as residential, followed by commercial (12%). Table 62 below provides inventory information for each of the six counties that were included in the analysis. Gloucester County occupies a large percentage (40%) of the building stock exposure for the region.

[4] Previous Plan values adjusted per BLS CPI Inflation Calculator (2000 to 2010) to match Hazus/Census years.

Table 62: Building stock exposure for general occupancies by county.

County	Residential	Commercial	Industrial	Agriculture	Religion	Govt.	Education	Total
Gloucester	$5,698,054	$831,318	$147,429	$32,557	$84,190	$32,437	$190,065	$7,016,050
King William	$2,463,239	$274,254	$110,725	$32,549	$41,687	$24,273	$24,786	$2,971,513
Middlesex	$2,151,683	$354,607	$65,244	$14,045	$26,670	$11,736	$40,679	$2,664,664
Essex	$1,578,275	$402,650	$146,178	$25,395	$28,679	$18,661	$31,423	$2,231,261
Mathews	$1,566,770	$149,340	$45,066	$9,877	$19,875	$6,830	$12,042	$1,809,800
King & Queen	$886,914	$52,850	$29,064	$6,710	$19,927	$2,968	$7,284	$1,005,717
Total	$14,344,935	$2,065,019	$543,706	$121,133	$221,028	$96,905	$306,279	$17,699,005
All values are in thousands of dollars								

Building stock exposure is also classified by building type. General Building Types (GBTs) have been developed as a means to classify the different buildings types. This provides an ability to differentiate between buildings with substantially different damage and loss characteristics. Model building types represent the average characteristics of buildings in a class. The damage and loss prediction models are developed for model building types and the estimated performance is based upon the "average characteristics" of the total population of buildings within each class. Five general classifications have been established, including wood, masonry, concrete, steel and manufactured homes (MH). A brief description of the building types is available in Table 63.

Table 63: Hazus General Building Type classes.

General Building Type	Description
Wood	Wood frame construction
Masonry	Reinforced or unreinforced masonry construction
Steel	Steel frame construction
Concrete	Cast-in-place or pre-cast reinforced concrete construction
MH	Factory-built residential construction

Wood construction represents the majority (61%) of building types in the planning district. Masonry construction accounts for a quarter of the building type exposure. Table 64 below provides building stock exposure for the five main building types.

Table 64: Building stock exposure for general building type by county.

County	Wood	Masonry	Concrete	Steel	Manufactured Home	Total
Gloucester	$4,338,118	$1,782,044	$177,833	$591,235	$126,913	$7,016,143
King William	$1,895,656	$751,978	$61,374	$227,445	$35,155	$2,971,608
Middlesex	$1,631,388	$678,395	$67,789	$225,948	$61,315	$2,664,835
Essex	$1,202,922	$558,827	$102,763	$319,225	$47,615	$2,231,352
Mathews	$1,166,398	$450,836	$32,534	$113,035	$47,165	$1,809,968
King & Queen	$661,413	$247,318	$11,118	$49,521	$36,527	$1,005,897
Total	$10,895,895	$4,469,398	$453,411	$1,526,409	$354,690	$17,699,803
All values are in thousands of dollars						

Multi-frequency Hurricane Modeling – Probabilistic Level 1 methodology

Annualized loss is defined as the expected value of loss in any one year, and is developed by aggregating the losses and exceedance probabilities for the 10-, 20-, 50-, 100-, 200-, 500-, and 1000-year return periods. The following figures illustrate the 3-second peak gust wind speeds for the 100-, 500-, and 1000-year return periods. Wind speeds are based on estimated 3-second gusts in open terrain at 10 meters above the ground at the centroid of each census track. Buildings that must be designed for a 100-year mean recurrence interval wind event include[5]:

- Buildings where more than 300 people congregate in one area
- Buildings that will be used for hurricane or other emergency shelter
- Buildings housing a day care center with capacity greater than 150 occupants
- Buildings designed for emergency preparedness, communication, or emergency operation center or response
- Buildings housing critical national defense functions
- Buildings containing sufficient quantities of hazardous materials

[5] Whole Building Design Guide (WBDG) Wind Safety of the Building Envelop by Tom Smith 5/26/2008

Figure 120:

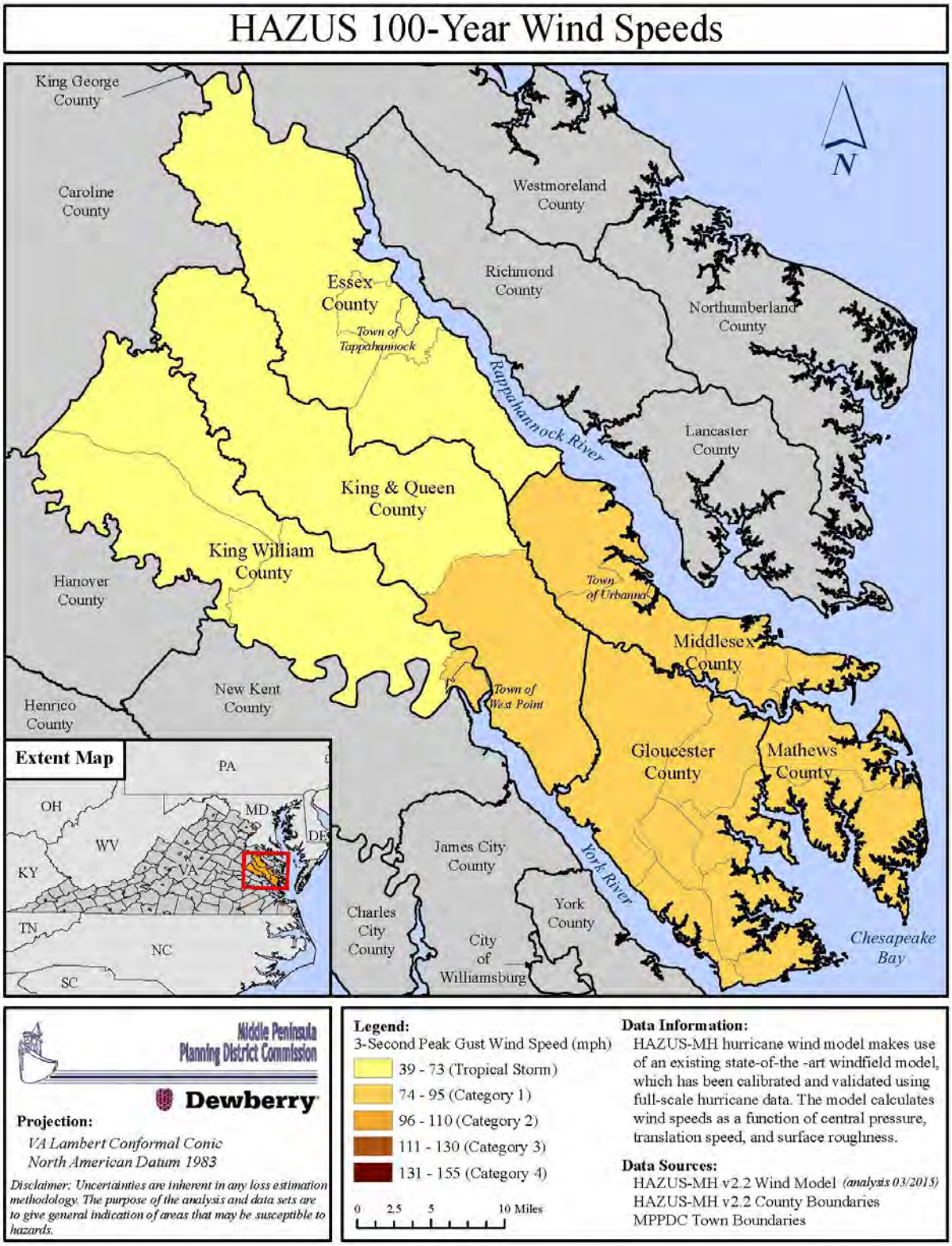

HAZUS 100-Year Wind Speeds
King George County
Caroline County
Westmoreland County
Essex County
Town of Tappahannock
Richmond County
Northumberland County
Rappahannock River
Lancaster County
King & Queen County
King William County
Hanover County
Town of Urbanna
Middlesex County
New Kent County
Town of West Point
Henrico County
Gloucester County
Mathews County
James City County
York River
Charles City County
York County
City of Williamsburg
Chesapeake Bay
N
Extent Map
PA
OH
MD
DE
WV
KY
VA
TN
NC
SC
Middle Peninsula Planning District Commission
Dewberry
Projection:
VA Lambert Conformal Conic
North American Datum 1983
Disclaimer: Uncertainties are inherent in any loss estimation methodology. The purpose of the analysis and data sets are to give general indication of areas that may be susceptible to hazards.
Legend:
3-Second Peak Gust Wind Speed (mph)
39 - 73 (Tropical Storm)
74 - 95 (Category 1)
96 - 110 (Category 2)
111 - 130 (Category 3)
131 - 155 (Category 4)
0 2.5 5 10 Miles
Data Information:
HAZUS-MH hurricane wind model makes use of an existing state-of-the -art windfield model, which has been calibrated and validated using full-scale hurricane data. The model calculates wind speeds as a function of central pressure, translation speed, and surface roughness.
Data Sources:
HAZUS-MH v2.2 Wind Model (analysis 03/2015)
HAZUS-MH v2.2 County Boundaries
MPPDC Town Boundaries

Figure 121:

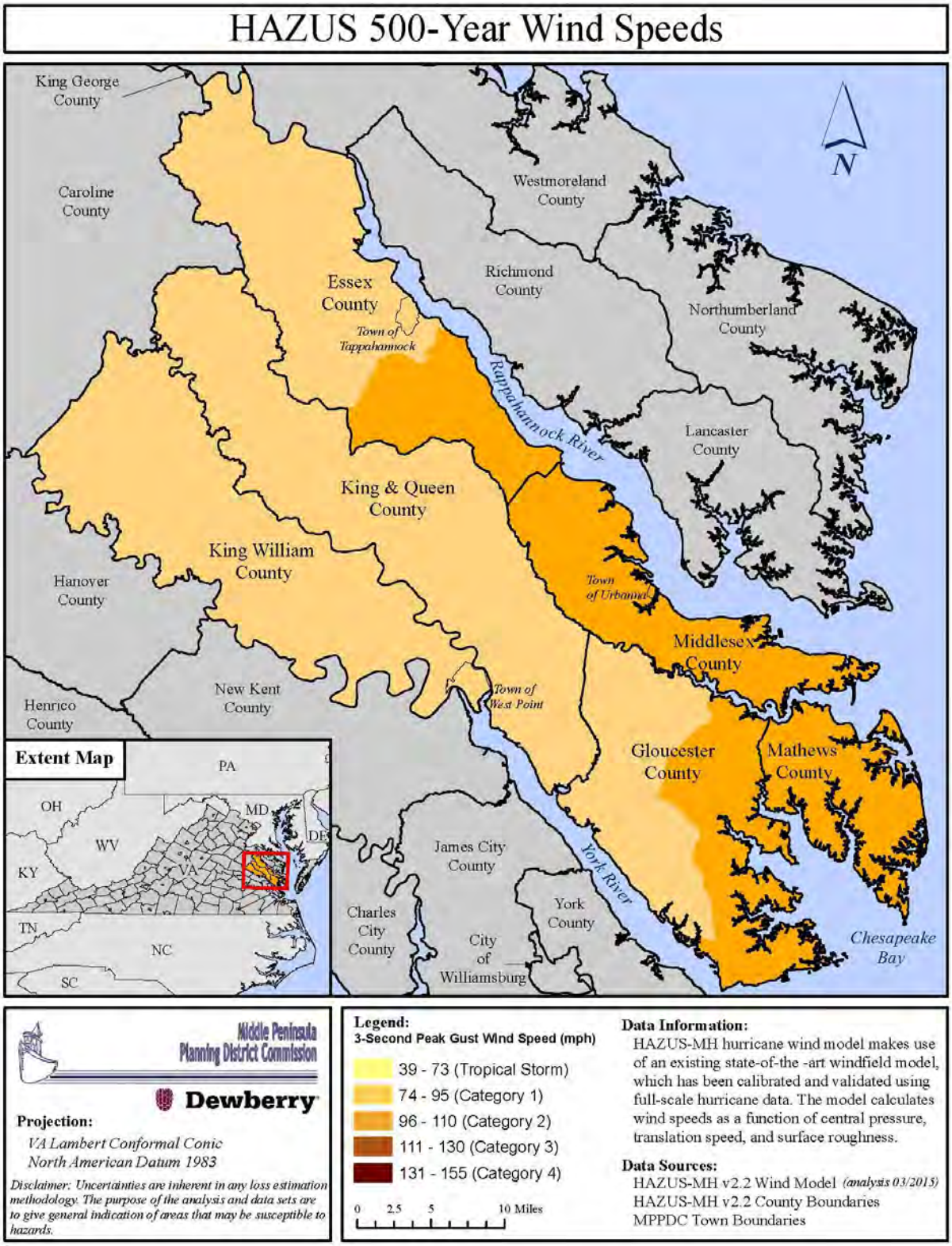
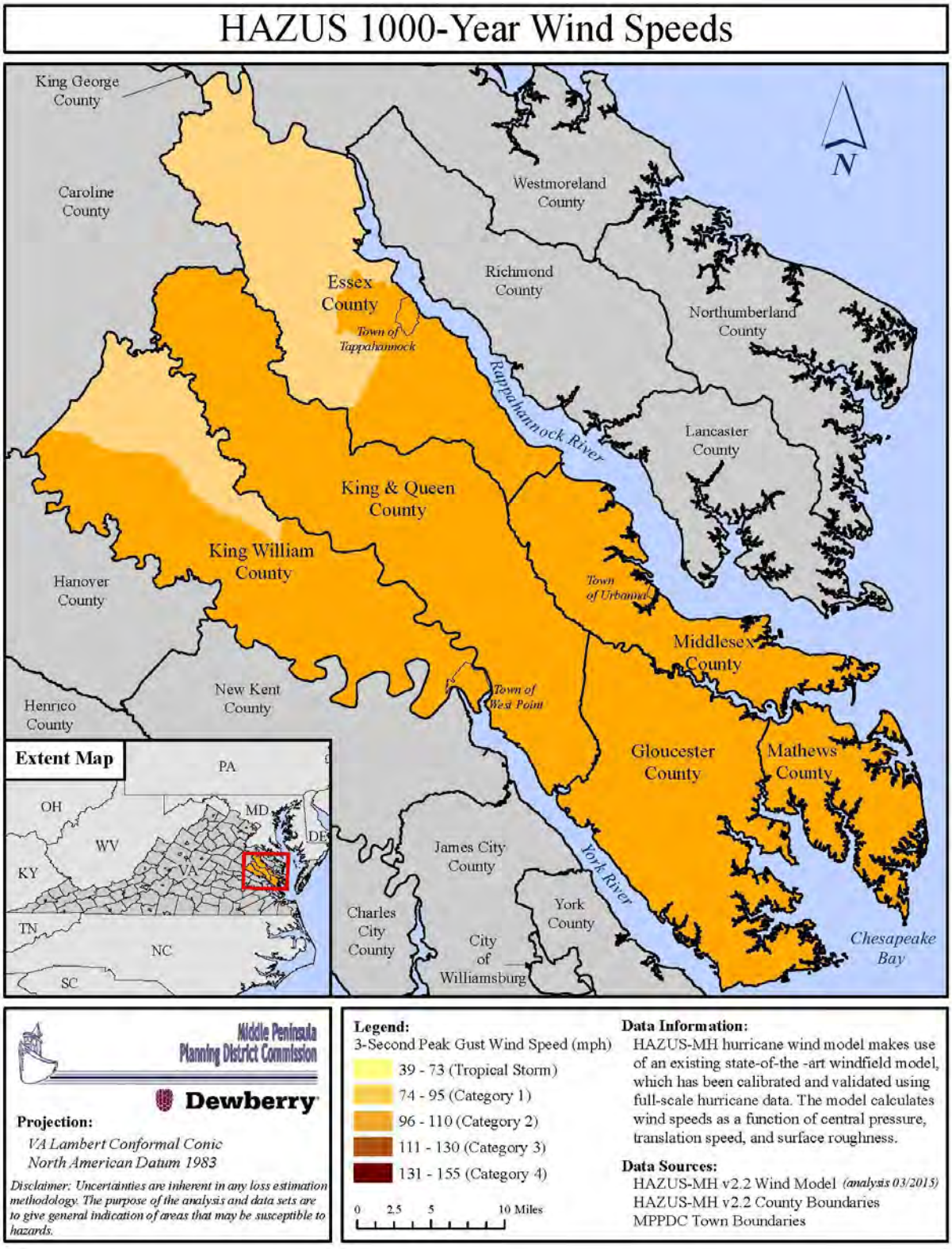

HAZUS 500-Year Wind Speeds
King George County
Caroline County
Westmoreland County
Essex County
Town of Tappahannock
Richmond County
Northumberland County
Rappahannock River
Lancaster County
King & Queen County
King William County
Hanover County
Town of Urbanna
Middlesex County
New Kent County
Town of West Point
Henrico County
Gloucester County
Mathews County
James City County
York River
Charles City County
York County
City of Williamsburg
Chesapeake Bay
N
Extent Map
PA
OH
MD
DE
WV
KY
VA
TN
NC
SC
Middle Peninsula Planning District Commission
Dewberry
Projection:
VA Lambert Conformal Conic
North American Datum 1983
Disclaimer: Uncertainties are inherent in any loss estimation methodology. The purpose of the analysis and data sets are to give general indication of areas that may be susceptible to hazards.
Legend:
3-Second Peak Gust Wind Speed (mph)
39 - 73 (Tropical Storm)
74 - 95 (Category 1)
96 - 110 (Category 2)
111 - 130 (Category 3)
131 - 155 (Category 4)
0 2.5 5 10 Miles
Data Information:
HAZUS-MH hurricane wind model makes use of an existing state-of-the -art windfield model, which has been calibrated and validated using full-scale hurricane data. The model calculates wind speeds as a function of central pressure, translation speed, and surface roughness.
Data Sources:
HAZUS-MH v2.2 Wind Model (analysis 03/2015)
HAZUS-MH v2.2 County Boundaries
MPPDC Town Boundaries

Figure 122:


HAZUS 1000-Year Wind Speeds
King George County
Caroline County
Westmoreland County
Richmond County
Essex County
Town of Tappahannock
Northumberland County
Rappahannock River
Lancaster County
King & Queen County
King William County
Hanover County
Town of Urbanna
Middlesex County
New Kent County
Town of West Point
Henrico County
Gloucester County
Mathews County
James City County
York River
Charles City County
York County
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KY
VA
TN
NC
SC
Middle Peninsula Planning District Commission
Dewberry
Projection:
VA Lambert Conformal Conic
North American Datum 1983
Disclaimer: Uncertainties are inherent in any loss estimation methodology. The purpose of the analysis and data sets are to give general indication of areas that may be susceptible to hazards.
Legend:
3-Second Peak Gust Wind Speed (mph)
39 - 73 (Tropical Storm)
74 - 95 (Category 1)
96 - 110 (Category 2)
111 - 130 (Category 3)
131 - 155 (Category 4)
0 2.5 5 10 Miles
Data Information:
HAZUS-MH hurricane wind model makes use of an existing state-of-the -art windfield model, which has been calibrated and validated using full-scale hurricane data. The model calculates wind speeds as a function of central pressure, translation speed, and surface roughness.
Data Sources:
HAZUS-MH v2.2 Wind Model (analysis 03/2015)
HAZUS-MH v2.2 County Boundaries
MPPDC Town Boundaries

General Building Stock Loss Estimation

The probabilistic Hazus-MH hurricane analysis predicts that the Middle Peninsula can annually expect close to $2,516,200 US Dollars in damages due to hurricane wind events. Property or "capital stock" losses of $2,359,300 US Dollars make up about 94% of the damages. This includes the values for buildings, contents, and inventory. Business interruption accounts for approximately $156,900 US Dollars of the annualized losses, or 6%, and includes relocation, income, rental, and wage costs.

Table 65 illustrates the expected annualized losses broken down by county. Gloucester County has the highest annualized loss, $1,242,600 US Dollars, accounting for 49% of the total losses for Middle Peninsula. The majority of the expected damages can be attributed to building and content value.

Mathews County has the second highest loss, $464,930 US Dollars, accounting for 18% of the total annualized losses for Middle Peninsula.

Building value accounts for approximately 66% of the expected annualized damages; residential occupancy makes up the vast majority of these losses. More than 70% of the buildings are categorized as wood frame and 22% masonry construction. Tables 66 and 67 summarize the property losses and business interruption losses shown by occupancy and building type. The slight differences in the annualized losses for building type and occupancy can be attributed to the Hazus classification methodology.

Table 65: County based Hazus annualized loss by all building and occupancy types.

County	Building	Content	Inventory	Relocation	Income	Rental	Wage	Annualized Loss
Gloucester	$801.30	$371.43	$0.67	$45.98	$2.89	$15.13	$5.22	$1,242.61
Mathews	$291.59	$145.16	$0.22	$19.93	$0.76	$6.31	$0.96	$464.93
King William	$121.47	$37.33	$0.22	$6.17	$0.27	$2.04	$0.76	$168.26
Middlesex	$263.93	$69.84	$0.25	$24.91	$1.11	$8.21	$1.60	$369.86
King & Queen	$66.90	$27.37	$0.09	$3.70	$0.08	$1.07	$0.13	$99.35
Essex	$111.93	$49.34	$0.27	$6.40	$0.38	$2.19	$0.69	$171.21
Annualized Loss	**$1,657.12**	**$700.47**	**$1.73**	**$107.10**	**$5.49**	**$34.96**	**$9.35**	**$2,516.23**
All values are in thousands of dollars								

Table 66: Annualized loss by general building type in the Middle Peninsula Region.

Building Type	Building	Contents	Inventory	Relocation	Income	Rental	Wage	Annualized Loss
Wood	$1,207.35	$550.42	$0.18	$71.02	$1.19	$22.84	$1.76	**$1,853.00**
Masonry	$368.21	$126.01	$0.35	$26.27	$1.62	$8.91	$2.85	**$531.38**
MH	$49.06	$10.01	$0	$4.41	$0	$0.67	$0	**$64.14**
Steel	$26.61	$11.64	$0.99	$4.28	$2.20	$1.85	$3.72	**$47.57**
Concrete	$5.89	$2.39	$0.21	$1.12	$0.48	$0.69	$1.03	**$10.79**
Annualized Loss	**$1,657.12**	**$700.47**	**$1.73**	**$107.10**	**$5.49**	**$34.96**	**$9.35**	**$2,506.88**
% of Ann. Loss	**66.10%**	**27.94%**	**0.07%**	**4.27%**	**0.22%**	**1.39%**	**0.37%**	*Hazus-MH (V2.2) results*
All values (except percentages) are in thousands of dollars								

Table 67: Annualized loss by general occupancy type in the Middle Peninsula Region.

Occupancy Type	Building	Contents	Inventory	Relocation	Income	Rental	Wage	Annualized Loss
Residential	$1,585.15	$671.08	$0	$97.18	$0.05	$31.23	$0.11	**$2,384.69**
Commercial	$39.99	$14.15	$0.37	$6.25	$4.30	$3.36	$4.88	**$68.42**
Industrial	$10.77	$7.10	$1.24	$0.71	$0.14	$0.11	$0.23	**$20.08**
Non-Profit	$5.47	$0.90	$0	$0.91	$0.54	$0.08	$1.27	**$7.90**
Education	$5.42	$3.09	$0	$1.08	$0.35	$0.08	$0.83	**$10.04**
Government	$1.42	$0.62	$0	$0.28	$0.02	$0.06	$1.83	**$2.40**
Agricultural	$2.09	$1.64	$0.12	$0.40	$0.01	$0.02	$0.01	**$4.28**
Annualized Loss	**$1,650.32**	**$698.58**	**$1.73**	**$106.81**	**$5.41**	**$34.95**	**$9.17**	**$2,497.81**
% of Ann. Loss	**65.83%**	**27.97%**	**0.07%**	**4.28%**	**0.22%**	**1.40%**	**0.37%**	*Hazus-MH (V2.2) results*
All values (except percentages) are in thousands of dollars								

Residential occupancy accounts for the majority of the damages. Tables 68 and 69 summarize the annualized loss values by county. These values are broken down by building type and general occupancy for comparison. Total exposure has been included as a reference point for damages. Wood structures account for the greatest percentage (62%) of the total annualized damages, with masonry structures next representing near 25% of the total annualized damages.

Table 68: County based Hazus annualized loss by general building type.

County	Total Exposure	Concrete	Masonry	Manufactured Homes	Steel	Wood	Annualized Loss
Gloucester	$7,016,050	$6.27	$257.37	$27.17	$26.51	$925.30	$1,242.61
Mathews	$1,809,800	$1.26	$93.60	$14.09	$6.15	$349.84	$464.93
Middlesex	$2,664,664	$1.99	$87.52	$12.50	$9.04	$258.82	$369.86
Essex	$2,231,261	$1.20	$37.51	$4.48	$5.01	$123.01	$171.21
King William	$2,971,513	$0.90	$38.42	$2.38	$3.56	$123.01	$168.26
King & Queen	$1,005,717	$0.19	$19.81	$3.53	$1.03	$74.79	$99.35
Annualized Loss		$11.82	$534.23	$64.14	$51.29	$1,854.75	$2,516.23
% of Annualized Loss		0.5%	21.2%	2.5%	2.0%	73.7%	*Hazus-MH (V2.2) results*
% of Total Exposure		< 1%	< 1%	< 1%	< 1%	< 1%	
All values (except percentages) are in thousands of dollars							

Table 69: County based Hazus annualized loss by general occupancy type.

County	Total Exposure	Residential	Commercial	Industrial	Non-Profit	Education	Gov.	Agriculture	Annualized Loss
Gloucester	$7,016,050	$1,174.83	$37.91	$7.07	$4.62	$11.14	$2.20	$1.67	$1,239.45
Essex	$2,231,261	$449.32	$8.26	$3.26	$1.41	$0.38	$0.31	$0.70	$463.63
Middlesex	$2,664,664	$345.81	$15.04	$3.02	$1.40	$1.29	$0.60	$0.63	$367.80
Mathews	$1,809,800	$159.34	$6.92	$3.25	$0.50	$0.45	$0.36	$0.55	$171.37
King William	$2,971,513	$158.87	$4.08	$2.63	$0.80	$0.35	$0.72	$0.59	$168.03
King and Queen	$1,005,717	$96.63	$1.09	$1.08	$0.44	$0.05	$0.05	$0.14	$99.49
Annualized Loss		$2,384.80	$73.30	$20.32	$9.17	$13.66	$4.23	$4.29	$2,509.77
% of Annualized Loss		95.02%	2.92%	0.81%	0.37%	0.54%	0.17%	0.17%	*Hazus-MH (V2.2) results*
% of Exposure		< 1%	< 1%	< 1%	< 1%	< 1%	< 1%	< 1%	
All values (except percentages) are in thousands of dollars									

Figures 123 through 130 on the following pages show the total annualized losses mapped for the planning district and individual counties.

Figure 123:

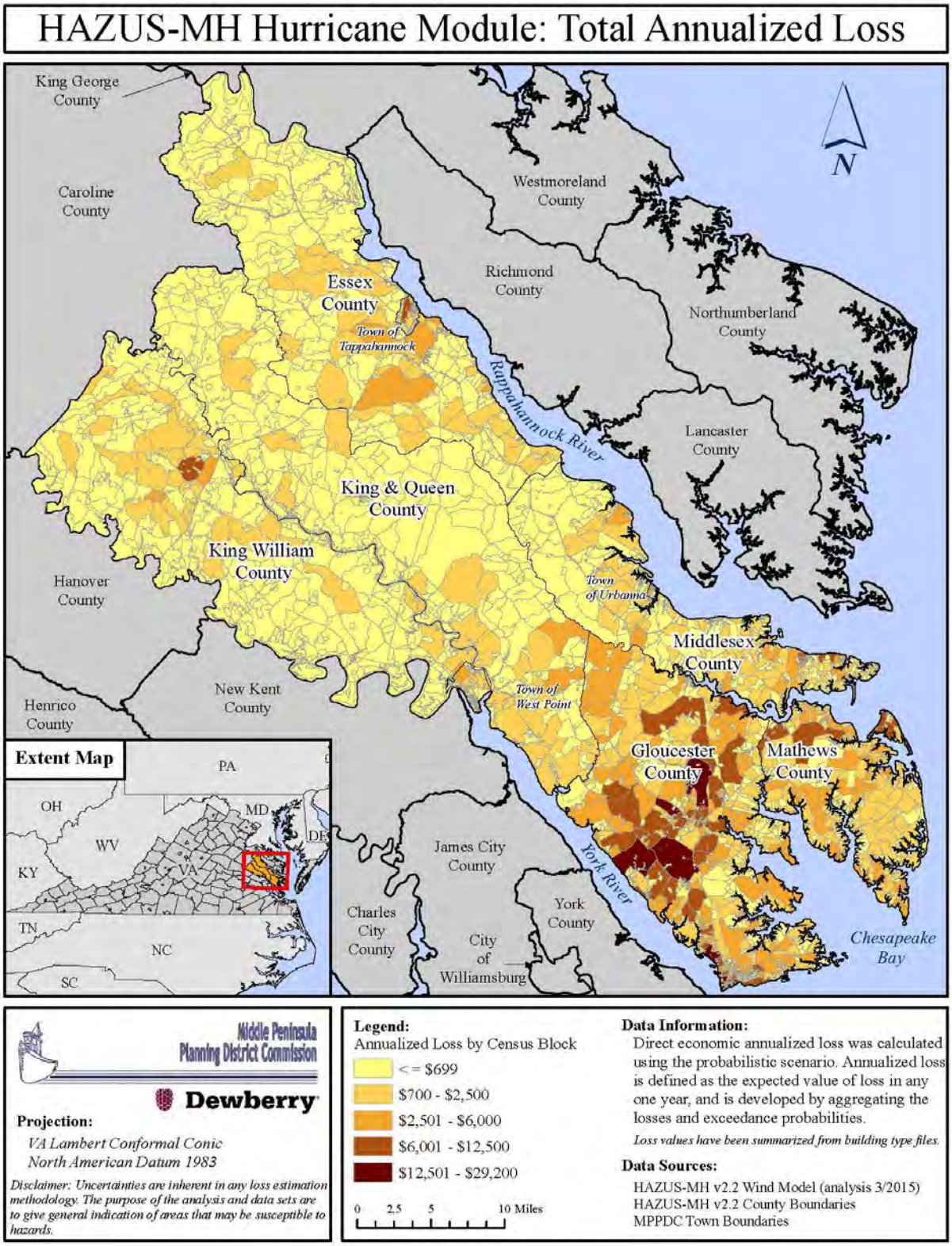

HAZUS-MH Hurricane Module: Total Annualized Loss
King George County
Caroline County
Westmoreland County
Richmond County
Northumberland County
Essex County
Town of Tappahannock
Rappahannock River
Lancaster County
King & Queen County
King William County
Hanover County
Town of Urbanna
Middlesex County
New Kent County
Henrico County
Town of West Point
Gloucester County
Mathews County
James City County
York River
Charles City County
York County
City of Williamsburg
Chesapeake Bay
N
Extent Map
PA
OH
MD
DE
WV
KY
VA
TN
NC
SC
Middle Peninsula Planning District Commission
Dewberry
Projection:
VA Lambert Conformal Conic
North American Datum 1983
Disclaimer: Uncertainties are inherent in any loss estimation methodology. The purpose of the analysis and data sets are to give general indication of areas that may be susceptible to hazards.
Legend:
Annualized Loss by Census Block
<= $699
$700 - $2,500
$2,501 - $6,000
$6,001 - $12,500
$12,501 - $29,200
0 2.5 5 10 Miles
Data Information:
Direct economic annualized loss was calculated using the probabilistic scenario. Annualized loss is defined as the expected value of loss in any one year, and is developed by aggregating the losses and exceedance probabilities.
Loss values have been summarized from building type files.
Data Sources:
HAZUS-MH v2.2 Wind Model (analysis 3/2015)
HAZUS-MH v2.2 County Boundaries
MPPDC Town Boundaries

Figure 124:

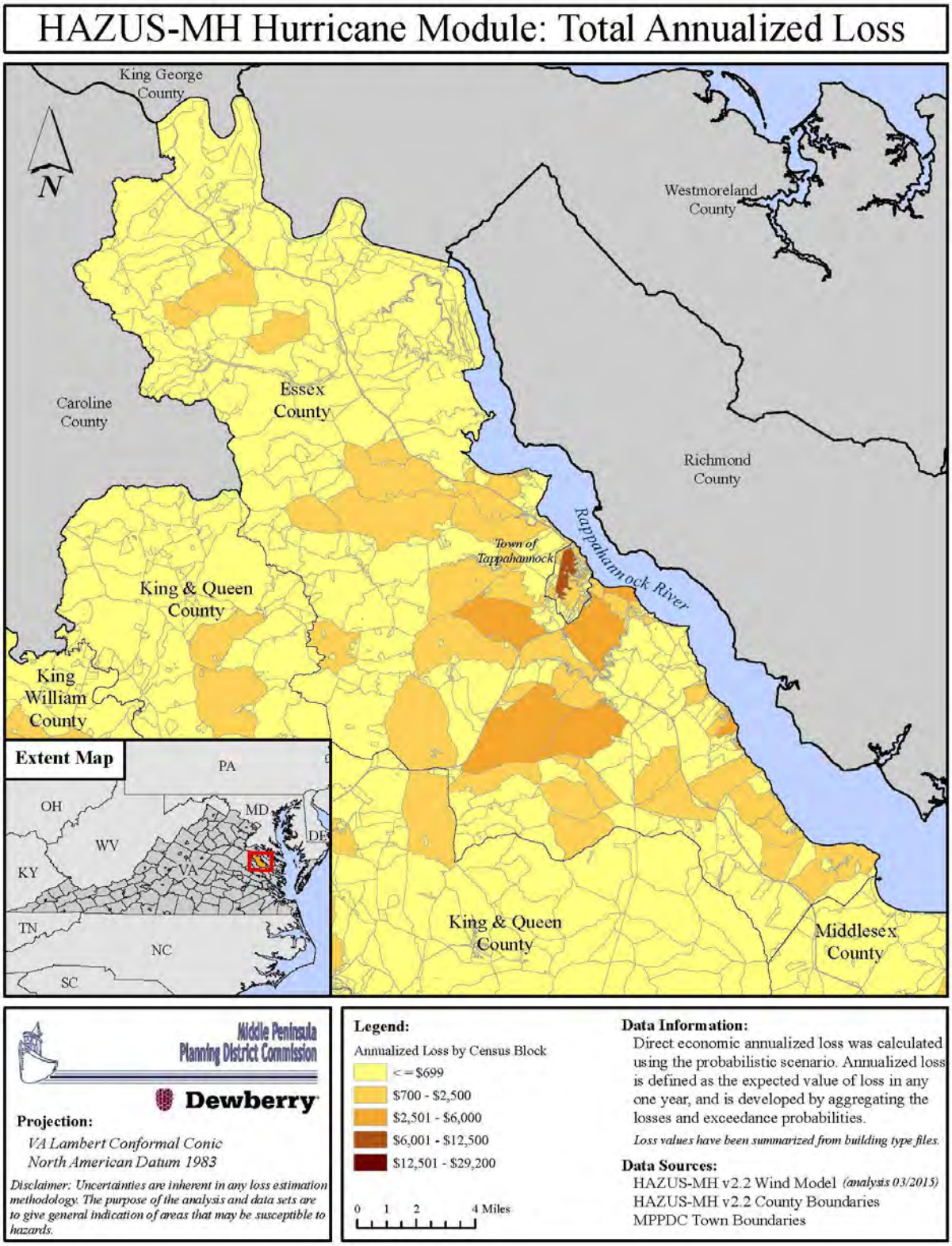

HAZUS-MH Hurricane Module: Total Annualized Loss
King George County
N
Westmoreland County
Caroline County
Essex County
Richmond County
Rappahannock River
Town of Tappahannock
King & Queen County
King William County
Extent Map
PA
OH
MD
DE
WV
KY
VA
TN
NC
SC
King & Queen County
Middlesex County
Middle Peninsula Planning District Commission
Dewberry
Projection:
VA Lambert Conformal Conic
North American Datum 1983
Disclaimer: Uncertainties are inherent in any loss estimation methodology. The purpose of the analysis and data sets are to give general indication of areas that may be susceptible to hazards.
Legend:
Annualized Loss by Census Block
<= $699
$700 - $2,500
$2,501 - $6,000
$6,001 - $12,500
$12,501 - $29,200
0 1 2 4 Miles
Data Information:
Direct economic annualized loss was calculated using the probabilistic scenario. Annualized loss is defined as the expected value of loss in any one year, and is developed by aggregating the losses and exceedance probabilities.
Loss values have been summarized from building type files.
Data Sources:
HAZUS-MH v2.2 Wind Model (analysis 03/2015)
HAZUS-MH v2.2 County Boundaries
MPPDC Town Boundaries

Figure 125:

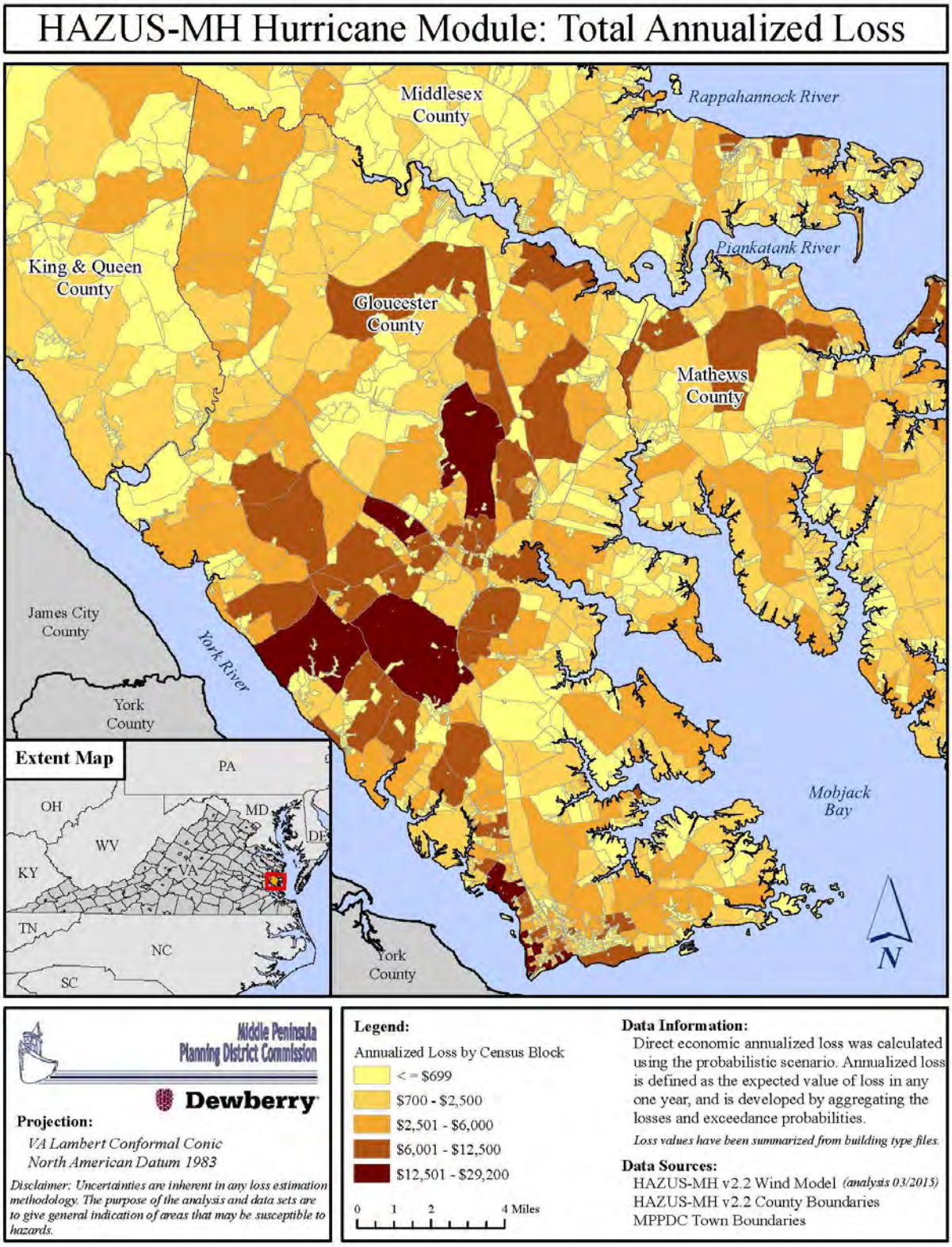
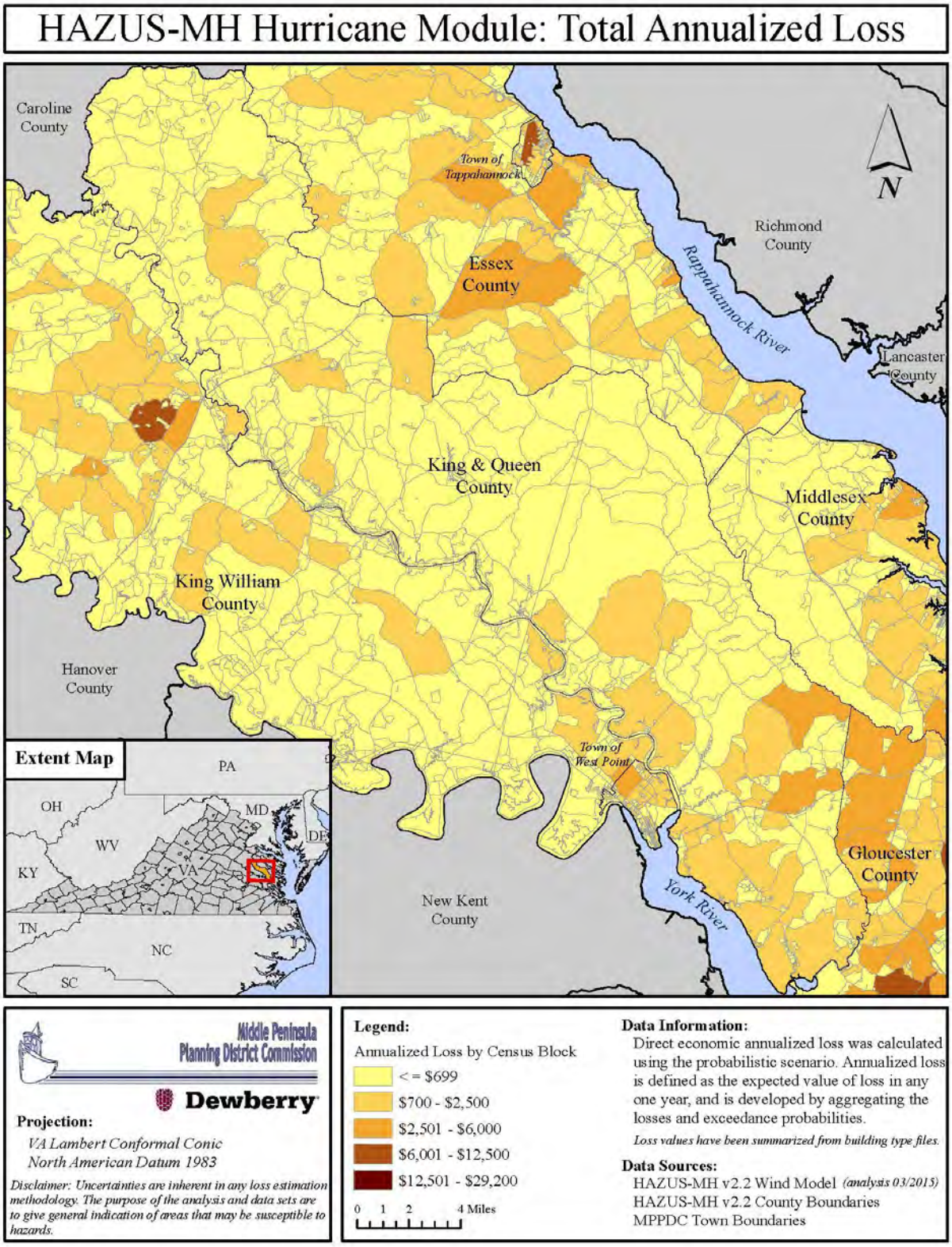

HAZUS-MH Hurricane Module: Total Annualized Loss
Middlesex County
Rappahannock River
King & Queen County
Piankatank River
Gloucester County
Mathews County
James City County
York River
York County
Extent Map
PA
OH
MD
DE
WV
KY
VA
TN
NC
SC
Mobjack Bay
York County
N
Middle Peninsula Planning District Commission
Dewberry
Projection:
VA Lambert Conformal Conic
North American Datum 1983
Disclaimer: Uncertainties are inherent in any loss estimation methodology. The purpose of the analysis and data sets are to give general indication of areas that may be susceptible to hazards.
Legend:
Annualized Loss by Census Block
< = $699
$700 - $2,500
$2,501 - $6,000
$6,001 - $12,500
$12,501 - $29,200
0 1 2 4 Miles
Data Information:
Direct economic annualized loss was calculated using the probabilistic scenario. Annualized loss is defined as the expected value of loss in any one year, and is developed by aggregating the losses and exceedance probabilities.
Loss values have been summarized from building type files.
Data Sources:
HAZUS-MH v2.2 Wind Model (analysis 03/2015)
HAZUS-MH v2.2 County Boundaries
MPPDC Town Boundaries

Figure 126:


HAZUS-MH Hurricane Module: Total Annualized Loss
Caroline County
Town of Tappahannock
Essex County
Richmond County
Rappahannock River
Lancaster County
King & Queen County
Middlesex County
King William County
Hanover County
Town of West Point
Gloucester County
New Kent County
York River
N
Extent Map
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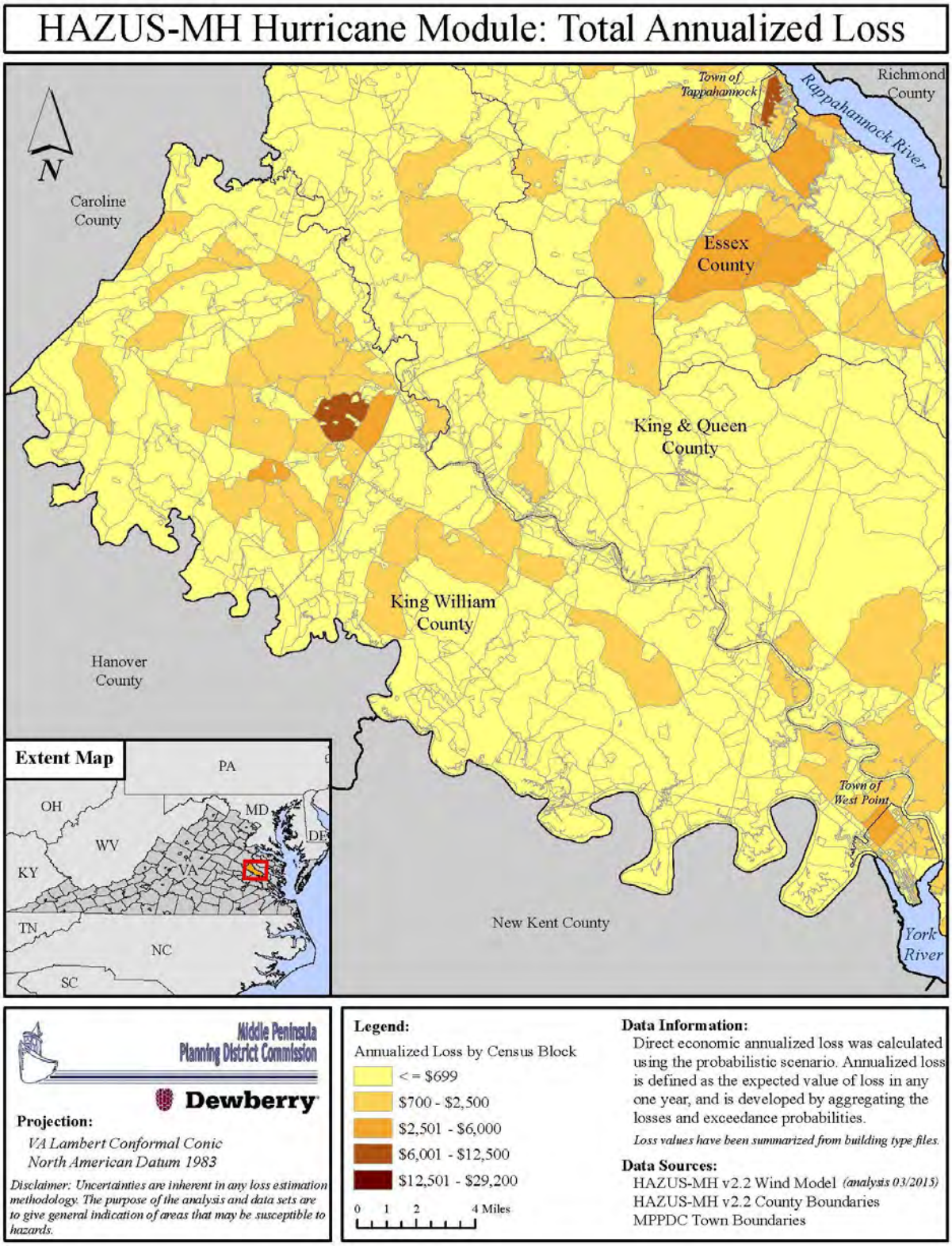
KY
VA
TN
NC
SC
Middle Peninsula Planning District Commission
Dewberry
Projection:
VA Lambert Conformal Conic
North American Datum 1983
Disclaimer: Uncertainties are inherent in any loss estimation methodology. The purpose of the analysis and data sets are to give general indication of areas that may be susceptible to hazards.
Legend:
Annualized Loss by Census Block
< = $699
$700 - $2,500
$2,501 - $6,000
$6,001 - $12,500
$12,501 - $29,200
0 1 2 4 Miles
Data Information:
Direct economic annualized loss was calculated using the probabilistic scenario. Annualized loss is defined as the expected value of loss in any one year, and is developed by aggregating the losses and exceedance probabilities.
Loss values have been summarized from building type files.
Data Sources:
HAZUS-MH v2.2 Wind Model (analysis 03/2015)
HAZUS-MH v2.2 County Boundaries
MPPDC Town Boundaries

Figure 127:


HAZUS-MH Hurricane Module: Total Annualized Loss
N
Caroline County
Hanover County
King William County
King & Queen County
Essex County
Richmond County
Town of Tappahannock
Rappahannock River
Town of West Point
New Kent County
York River
Extent Map
PA
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VA
TN
NC
SC
Middle Peninsula Planning District Commission
Dewberry
Projection:
VA Lambert Conformal Conic
North American Datum 1983
Disclaimer: Uncertainties are inherent in any loss estimation methodology. The purpose of the analysis and data sets are to give general indication of areas that may be susceptible to hazards.
Legend:
Annualized Loss by Census Block
< = $699
$700 - $2,500
$2,501 - $6,000
$6,001 - $12,500
$12,501 - $29,200
0 1 2 4 Miles
Data Information:
Direct economic annualized loss was calculated using the probabilistic scenario. Annualized loss is defined as the expected value of loss in any one year, and is developed by aggregating the losses and exceedance probabilities.
Loss values have been summarized from building type files.
Data Sources:
HAZUS-MH v2.2 Wind Model (analysis 03/2015)
HAZUS-MH v2.2 County Boundaries
MPPDC Town Boundaries