APPENDIX B.

PROCESS FOR HAZUS RISK ANALYSIS

PRE-MODELING DATA SETS

A-NPDC used the Hazus Multi-Hazard Model (version 2.2, with service pack 02) hurricane wind and the flood hazard modules using data prepared by FEMA Region III and the U.S. Army Corps of Engineers. The user-defined database contains building stock data and attributes for both counties, including such characteristics as building assessment value, year built, footprint location, and zoning classification.

However, the database contains many other fields for which there were no data, and FEMA made assumptions after consulting with ANPDC and county staff based upon the general building and development characteristics. In cases where the data wasn't complete, values were derived from the values of other structures with like land use, building value, year built and neighboring location.

The table below explains the variables used.

Table 1: UDF Analysis for Variables for Risk

UDF Analysis Variables for Risk					
Address	Structure Address	County	County where structure exists	Latitude	Coordinate in Decimal Degrees
Area	Total square footage of structure	DesignLevel	Associated with year built. Value found in CDMS dictionary Appendix C	Longitude	Coordinate in Decimal Degrees
BldgDamageFnId	Derived from the general building stock (GBS) Depth-Damage Function Library. Found at - Analysis/Damage Functions/Buildings/Library - for Structure	ContDamageFnId	Derived from the general building stock (GBS) Depth-Damage Function Library. Analysis/Damage Functions/Buildings/Library - for Contents	InvDamageFnId	Derived from the general building stock (GBS) Depth-Damage Function Library. Analysis/Damage Functions/Buildings/Library - for Inventory
BldgType	Construction material type. Value found in CDMS Dictionary Appendix C	FloodProtection	Presence of flood protection	NumStories	Number of stories
BUPower	Presence of back up Power	FoundationType	Type of foundation. Value found in CDMS Dictionary Appendix C	Occupancy	Hazus value related to land use
City	Municipality	FirstFloorHt	Height of the first floor or lowest adjacent grade. Related to foundation type	Phone	Phone number for owner
Contact	Contact information for property owner	YearBuilt	Year structure was built	ShelterCapacity	Availability to use the structure as a shelter or presence of a shelter
Name	Name of owner	ZipCode	Zip code where structure exists	State	State where structure exists
ContentCost	Value of contents in actual $	Cost	Value of Structure in actual $		

The results were delivered to A-NPDC in three files: two Hazus .hpr files, which contain county-level assessment data, and one Microsoft .mdb files, which contains all of the building stock data. Documentation for the files was also submitted.

The second product group was the depth grids for each county – digital representations of the water depths within the area of the one percent annual chance flood. Taken together – the .hpr files, the .mdb files, and the depth grids – are the inputs required to run the Hazus model.

HAZUS HURRICANE WIND MODEL

Because the Eastern Shore is roughly 70 miles long, hurricanes affect areas of the Shore differently, depending upon their direction of approach, approach speed, circumference, and other factors. So rather than model the entire area as one region, two different regions were created – one for each county – and each was modeled separately. The wind model was run for each county, using the Hazus probabilistic scenario. Model results provided wind speed estimates for the 10, 25, 50, 100, 200, 500, and 1000-year storm return periods. At the December 2, 2015 Steering

Committee meeting, A-NPDC staff chose the 20-year and 100-year scenarios to present in GIS format at meeting, but other scenarios and their associated wind speeds were discussed during the meeting as well.

The table below provides general wind speed ranges for each of the scenarios for each of the counties:

Return period (years)	Accomack County Wind speed –Peak gusts (mph)	Northampton County Wind speed –Peak gusts (mph)
10	43-62	52-56
20	58-73	64-67
50	79-89	80-84
100	90 -100	88-96
200	80-115	98-103
500	106-122	107-115
1000	99-136	114-119

Source: Hazus Multi-Hazard Model, Hurricane Wind module version 2.2, with service pack 02, run separately for each county with user-supplied inventory data and probabilistic scenarios for each run.

The Hazard Mitigation Steering Committee, in consultation with the Planning Council, selected the 100-year return period as the scenario they wished to study, because the wind speeds of the lesser return periods were viewed as similar to routine storms for the Eastern Shore. Because wind results are not available at the town level, county results were clipped to the town level to give an idea of the level of damage at that level.

The Northampton County assessing database does not indicate a building's number of stories, and one assumption made by FEMA in building the county's database was that all buildings were one story. This could lead to an understatement of loss, as roof loss is a major indicator of building, contents, and inventory loss, roof loss is typically higher with two-story structures.

HAZUS FLOOD ANALYSIS

The flood analysis was run for each of the two counties, and for each coastal community, using the one-percent annual chance flood depth grids provided by FEMA.

The regions were easily defined in Hazus for the counties, but defining the municipalities required one extra step. FEMA staff conducted a teleconference training during which Central Data Management System (CDMS) data – the data in FEMA's default national database - were replaced with data from the Accomack and Northampton-specific databases that were prepared by FEMA. This step had to be completed before the municipal regions could be created and the model could be run for municipalities.

BUGS!

There were problems with running Hazus at the town level. Staff noticed that results extended beyond the boundaries of the towns that were being modeled. A request was put in through the FEMA Help Desk for assistance. It appeared that the region was being defined correctly, as the description of the region in the summary report was correct in terms of the geographic size of the towns, and the number of housing units compared favorably to Census numbers. However, when results were mapped, they appeared to be at the Census block group or tract level, and the losses in the summary tables were exaggerated based on what was known to exist in the towns. Unfortunately, this did not come to light until after several towns were run, and inexperience of A-NPDC staff caused staff members to assume the error was their own, and multiple attempts were made to rectify the issue locally. At this point it was

not clear if ALL of the results were wrong, or just the building, contents, and inventory results (as opposed to debris, income, etc.) As an interim fix to the problem, staff began using a GIS tool to clip the results to the town boundaries, which at least provided an estimate of the buildings affected, along with an estimate of building, contents, and inventory losses. Other model data were determined to be unreliable without additional information from FEMA.

It took several months to get a response from the FEMA help desk, but it was finally determined that A-NPDC staff had discovered a previously unknown software bug. (According to Help Desk staff, Hazus is not run very often at the small town level). The recommended solution was the one A-NPDC had already employed: clipping results to the town boundaries. However, Help Desk employees did verify that other model results were reliable. The building data, they explained, are point specific and are the only data affected. The income, wages, and rents data are from an econometric model that runs by Census block, and those were mapped and verified as running accurately.

One recommendation was to download the update of Hazus 3.0 and see whether that would fix the problem. However, that course would have required all of the regions to be rebuilt. Both counties' flood models had already been reviewed with the Steering Committee and the Planning Council, and well as wind results, and had been incorporated into report chapters, that it was felt it was too far along to re-start the process with no guarantees the problem would be fixed, and A-NPDC staff had already encountered significant study delays trying to resolve the problem. The decision was made to continue clipping results to town boundaries for coastal towns.

FLOOD RESULTS - COMPARISON TO PREVIOUS HAZARD MITIGATION PLANS AND FEMA REGION III HAZUS MODEL RUN

Other benchmarks exist to which results from the Hazus model runs used in this analysis can be compared. The first is the previous Hazard Mitigation Plan, which produced higher flood loss estimates, and lower wind loss estimates. That plan, and its predecessor, did not use Hazus, but could still be helpful to examine in order to understand differences between the previous plan's estimates and this plan's estimates. The second is a Hazus flood model run undertaken by FEMA Region III for the Eastern Shore area, which produced lower flood loss estimates than the model run used in this Hazard Mitigation Plan.

The table below shows the three in comparison.

Table 2: Discrepancies in Hazus estimates

Loss Estimate Methodology	Accomack	Northampton	Total	Difference from 2016 HMP (Hazus)
Hazus – Flood Model Run for 2016 HMP*	$292,590,000 $293,480,000	$57,000,000 $57,770,000	$349,590,000 $351,250,000	$0
2011 HMP**	$382,963,000	$87,906,000	$470,869,000	+ $121,279,000***
Hazus – Flood Model Run by FEMA	$58,040,000	$2,700,000	$60,740,000	($290,510,000)
Hazus – Wind Model for 2016 HMP+	$37,958,540 $63,170,460	$14,906,990 $22,037,930	$52,865,530 $85,208,390	$0 $0
2011 HMP++	$15,538,000	$16,700,000	$32,238,000	($20,627,530)+++

* Since the 2011 estimate was building and contents only, the 2016 Hazus results are presented for both building and contents first, and then for all damage (building, contents, inventory, and business interruption).

**Includes building and contents losses only. No loss estimate was made for inventory or business interruption.

***Difference is based on building and contents losses only.

+Since the 2011 estimate was for building losses only, the 2016 Hazus results are presented for both building losses only, and then for all losses (building, contents, inventory, and business interruption).

++Includes losses to buildings only.

+++Difference is based on building losses only.

PREVIOUS HAZARD MITIGATION PLANS

Previous hazard mitigation plans utilized loss estimation methodology that was devised specifically for the hazard mitigation plan using local data. In short, the methodology estimated the number of pre-FIRM and post-FIRM buildings, made assumptions about the number of those that were and were not covered by insurance - and in what amount - in order to calculate potential insured and potential uninsured losses. Further assumptions were made about the value of contents and potential uninsured losses were calculated for each locality.

Total estimated losses from the most recent plan completed in 2011 show losses for Accomack County, including incorporated towns, of $382,963,000. Uninsured losses were estimated to be around $240 million. For Northampton County, total losses were estimated at $87,906,000, with about $64 million estimated to be uninsured. While this methodology did include contents losses, it did not include inventory or business interruption loss estimates.

It is worth noting that the Flood Insurance Rate Maps changed in between the time that the 2011 plan and the time that the 2016 plan were completed. The changes resulted in a net reduction of 3,198 buildings in the Special Flood Hazard Areas (both counties), and a net removal of 409 from the velocity zones.

HAZUS FLOOD MODEL RUN BY FEMA REGION III

FEMA Region III ran the Hazus Flood Model (version 2.1) as part of a series of Risk Mapping, Assessing, and Planning (MAP) program information to provide local governments with flood information to help increase resilience to flooding. A refined dataset was used (instead of the Hazus defaults), and they appear to be similar to the datasets developed by FEMA and the Army Corps of Engineers, with the help of the counties, for A-NPDC to use with Hazus, but it is not clear whether they are identical. What does appear to be different is the depth grids, which could be what accounts for the vastly different results.

Through research (when the riskmap3.com website was still active), it appeared that Hurricane Isabel was viewed as the storm of record for Region III, and perhaps depth grids were calibrated using that storm's depths. If that is the case, a general consensus among emergency personnel and planners for the Eastern Shore area is that Isabel was not a storm of record, nor did it approximate a one percent annual chance storm.

However, the storm grid was downloaded from the FEMA map portal, and the flood boundaries seemed compatible with the boundaries of the one percent annual chance flood, although there was some difference in depths between the two, with the grid used for the Risk MAP product showing shallower depths in the locations that were spot checked. Most locations were about 6 inches to one foot shallower than the depth grid provided by FEMA to A-NPDC to run HAZUS for the Hazard Mitigation Plan.

Several phone calls and conversations with Region III FEMA staff did not provide a resolution to the discrepancies between the two model runs. Staff was encourage by FEMA to use the locally-obtained results.

WIND RESULTS – COMPARISON TO 2011 HAZARD MITIGATION PLAN

The 2011 Hazard Mitigation Plan used a methodology that assumed structures within one-mile of the coast would be exposed to 3-second wind gusts of 110 mph. Most building types were assumed to be damaged at 7.5 percent, except for mobile homes, which were assumed to be complete losses.

For the 2016 Hazard Mitigation Plan, the Hurricane Wind Model was run, with a separate run for each county. Hazus has a number of built-in functions that allow the model to account for terrain, building materials, building height, and other factors. As mentioned before, one short-coming of the model's performance in Northampton County is the lack of information in assessing records for the number of stories a building has. In the absence of that information, one story was entered for all Northampton buildings. That could lead to under-estimating losses in towns like Cape Charles where most of the buildings are two-stories.