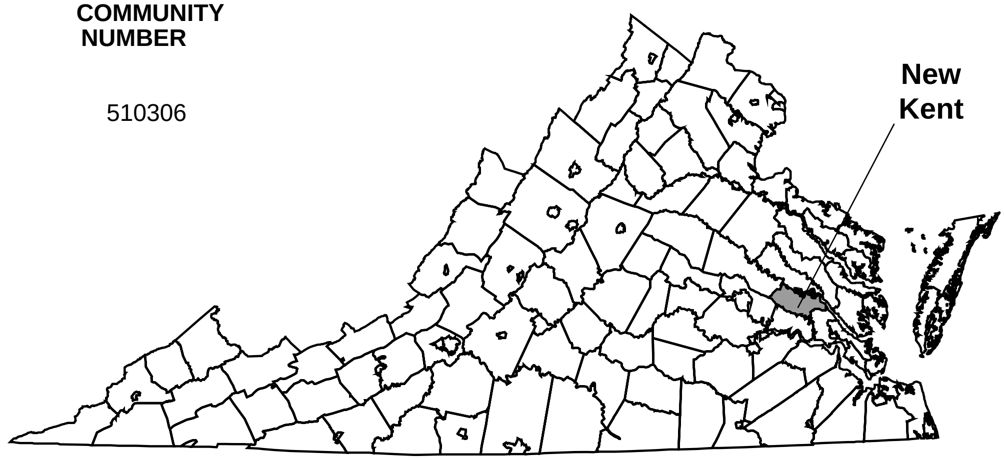
FLOOD INSURANCE STUDY

NEW KENT COUNTY, VIRGINIA (ALL JURISDICTIONS)

COMMUNITY NAME	COMMUNITY NUMBER
NEW KENT COUNTY (UNINCORPORATED AREAS)	510306



REVISED DATE

AUGUST 3, 2015

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
51127CV000B

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Countywide FIS Effective Date: September 25, 2009

Revised Countywide FIS Date: August 3, 2015

TABLE OF CONTENTS

TABLE OF CONTENTS - continued

Page

FIGURES

TABLES

EXHIBITS

FLOOD INSURANCE STUDY
NEW KENT COUNTY, VIRGINIA (ALL JURISDICTIONS)

1.0 INTRODUCTION

1.1 Purpose of Study

This countywide Flood Insurance Study (FIS) revises and updates previous FIS's / Flood Insurance Rate Maps (FIRMs) in the geographic area of New Kent County, Virginia, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This FIS has developed flood-risk data for various areas of the community that will be used to establish actuarial flood insurance rates. This information will also be used by New Kent County to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), and will also be used by local and regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the NFIP are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence, and the State (or other jurisdictional agency) shall be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this FIS are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The September 25, 2009, FIS was prepared to include the unincorporated areas of New Kent County in a countywide format FIS. Information on the authority and acknowledgments for each jurisdiction included in the September 25, 2009, countywide FIS, as compiled from their previously printed FIS reports, is shown below.

The hydrologic and hydraulic analyses for the September 25, 2009, study were prepared by the Norfolk District of the U. S. Army Corps of Engineers (COE) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-87-E-2509, Project Order No. 3, Amendment No. 1. This work was completed in September 1988.

For the September 25, 2009, countywide FIS, no revised hydrologic and hydraulic analyses were prepared.

Planimetric base map information is provided in digital format for all FIRM panels. In the September 25, 2009, countywide FIS, these files were compiled at scales of 6000 and 12000 from aerial photography dated 2003. Additional information was derived from transportation, political and hydrographic line features provided by the New Kent County GIS Services. Users of this FIRM should be aware that minor adjustments may have been made to specific base map features.

The coordinate system used for the production of the September 25, 2009, countywide FIS and FIRM is Universal Transverse Mercator (UTM), Zone 18 North, North American Datum of 1983 (NAD 83), GRS 80 spheroid. Corner coordinates shown on the FIRM are in latitude and longitude referenced to the UTM projection, NAD 83. Differences in the datum and spheroid used in the production of FIRMs for adjacent counties may result in slight positional differences in map features at the county boundaries. These differences do not affect the accuracy of information shown on the FIRM.

The Digital Flood Insurance Rate Map (DFIRM) conversion for the September 25, 2009, countywide FIS was performed by AMEC, Earth & Environmental, Inc. for FEMA, under Contract No. HSFE03-07-D-0030, Task Order HSFE03-07-J-0005. In addition, AMEC used the existing hydraulic analyses for New Kent County to redelineate floodplains based on more detailed and up-to-date topographic information submitted by the County. This work was completed in February 2008. The extents of these redelineated flooding sources are listed in Section 2.0 of this report.

For the August 3, 2015 FIS, a new coastal storm surge analysis was incorporated for the Chickahominy River, Pamunkey River, and York River and their estuaries. In addition the Stillwater elevations were updated. The Leonard Jackson Associates under RAMPP assisted FEMA in the development and application of a state-of-the-art storm surge risk assessment. The coastal analysis and mapping was conducted for FEMA under Contract No. HSFEHQ-09-D-0369, Task Order HSFE03-11-J-0007. The coastal analysis involved transect layout, field reconnaissance, erosion analysis, and overland wave modeling including wave setup, wave height analysis and wave run-up. In addition, a storm surge study was conducted for FEMA by the USACE and its project partners under HSFE03-06-X-0023, "NFIP Coastal Storm Surge Model for Region III" and Project HSFE03-09-X-1108, Phase II Coastal Storm Surge Model for FEMA Region III" (Reference 1). The work was performed by the Coastal Processes Branch (HF-C) of the Flood and Storm Protection Division (HF), U.S. Army Engineer Research and Development Center – Coastal & Hydraulics Laboratory (ERDC-CHL) (Reference 2).

In the August 3, 2015 FIS, planimetric base map information is provided in digital format for all FIRM panels. The files are compiled at scales of 6000 and 12000 from aerial photography dated 2009.

The Digital Flood Insurance Rate Map (DFIRM) conversion for the August 3, 2015 FIS study was performed by Leonard Jackson Associates for FEMA, under Contract No. HSFEHQ-09-D-0369, Task Order HSFE03-11-J-0007.

1.3 Coordination

For the September 25, 2009, countywide FIS revision, New Kent County was notified by phone in July 2007 that the FIS would be updated and converted to countywide format.

An initial CCO meeting is held typically with representatives of Federal Emergency Management Agency (FEMA), the community, and the study contractor to explain the nature and purpose of a FIS and to identify the streams to be studied by detailed methods. A final CCO meeting is held typically with representatives of FEMA, the community, and the study contractor to review the results of the study.

On June 17, 1986, an initial Consultation and Coordination Officer's (CCO) meeting was held with representatives of FEMA, the county, and the COE (the study contractor) to determine the streams to be studied by detailed methods.

Contacts with various Federal and State agencies were made during the preparation of the study in order to minimize possible hydrologic and hydraulic conflicts. A search for basic data was made at all levels of government.

On August 28, 1989, a final CCO meeting was held with representatives of FFMA, the county, and the study contractor to review the results of the study.

For the September 25, 2009, countywide FIS revision, a final meeting was held on November 19, 2008 and was attended be representatives of New Kent County, the study contractor, and FEMA.

For the August 3, 2015 FIS, an initial CCO meeting held on November 11, 2008, with representatives of FEMA, the study contractor (RAMPP) and New Kent County.

2.0 <u>AREA STUDIED</u>

2.1 Scope of Study

This FIS covers the geographic area of New Kent County.

Tidal flooding from the York, Pamunkey, and Chickahominy Rivers and their adjoining estuaries was studied by detailed methods. All areas within the county affected by tidal flooding were included in the detailed study. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through September 1993.

All or portions of the following flooding sources were studied by approximate methods: Black Creek, the Chickahominy River, Crumps Swamp, Toe Ink Swamp, the Pamunkey River, St. Peters Swamp, and Davis Pond. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and New Kent County.

For the September 25, 2009, revision, no new flood hazard areas were identified.

For the August 3, 2015 FIS revision, new detailed coastal flood hazard analyses for the Diascund Reservoir, Chickahominy River, Pamunkey River, and York River and their estuaries is incorporated.

No Letters of Map Revision (LOMRs) were recorded for the August 3, 2015 FIS study.

2.2 Community Description

New Kent County is located in southeastern Virginia. The county is bordered by the unincorporated areas of King William County to the north, the Town of West Point and the unincorporated areas of King and Queen County to the east, the unincorporated areas of James City County and Charles City County to the south, and the unincorporated areas of Henrico County and Hanover County to the west. The following flooding sources also border the county: the Pamunkey River to the north, the York River to the east, and the Chickahominy River to the south. New Kent County encompasses an area of approximately 221 square miles, of which nine square miles are water (Reference 3).

The population of New Kent County was 8,731 in 1980 (Reference 4). Growth in the county has steadily continued since the 1960’s with the population as determined by the 2000 Census at 13,462, and the 2006 estimated population at 16,852, an increase of 25.2% since 2000 and the 2012 estimated population was 19,169, an increase of 42.3% since 2000 (Reference 5). Although the county is primarily agricultural and rural, most residents are employed in the manufacturing and trade industries. Many of these residents are employed in the nearby Cities of Richmond and Williamsburg and in the Town of West Point. The principal sources of the county's farm income are corn, wheat, and soybean production (Reference 3). The floodplains of the county consist of scattered residential structures, businesses, croplands, and forests. With the county's many miles of shoreline, increased pressure for development of the floodplains is expected.

New Kent County enjoys a temperate climate, with moderate seasonal changes characterized by warm summers and cool winters. Temperatures average approximately 79 degrees Fahrenheit (°F) in July, the warmest month; and 40°F in January, the coolest month. Annual precipitation over the area averages approximately 43 inches per year (Reference 1). There is some variation in the monthly averages; however, this rainfall is distributed uniformly throughout the year. Snowfall is infrequent, generally occurring in light amounts and usually melting in a short period of time.

New Kent County is located in the Coastal Plain province and is underlain primarily by clay, sand, marl, shell, and gravel strata. Elevations within the county range from sea level to approximately 178 feet.

2.3 Principal Flood Problems

The areas along the shoreline of New Kent County are vulnerable to tidal flooding from major storms, commonly referred to as hurricanes and northeasters. Both storms produce winds that push large volumes of water against the shore.

Hurricanes, with their high winds and heavy rainfall, are the most severe storms to which the county is subjected. The term "hurricane" is applied to an intense cyclonic storm originating in tropical or subtropical latitudes in the Atlantic Ocean just north of the equator. While hurricanes may affect the area from May through November, nearly 80 percent occur during the months of August, September, and October with approximately 40 percent occurring during September. The most severe hurricane to strike the county occurred in August 1933.

Another type of storm that can cause severe damage to the county is the northeaster. This is also a cyclonic storm, and originates with little or no warning along the middle and northern Atlantic Coast. These storms occur most frequently in the winter months but may occur at any time. Accompanying winds are not of hurricane force, but are persistent, causing above-normal tides for long periods of time. The March 1962 northeaster was the most severe to ever hit the county.

The amount and extent of damage caused by any tidal flood will depend upon the topography of the area flooded, rate of rise in floodwaters, depth and duration of flooding, exposure to wave action, and the extent to which damageable property has been placed in the floodplain. The depth of flooding during these storms depends upon the velocity, direction, and duration of the wind; the size and depth of the body of water over which the wind is acting; and the astronomical tide. The duration of flooding depends upon the duration of the tide-producing forces. Floods caused by a hurricane are usually of a much shorter duration than the ones caused by a northeaster. Flooding from hurricanes rarely lasts more than one tidal cycle; however, flooding caused by northeasters may last several days, during which the most severe flooding takes place at the time of the peak astronomical tide.

The timing or coincidence of the maximum storm surge with the normal high tide is an important factor in the consideration of flooding from tidal sources. The mean range of tide in the York River at West Point is 2.8 feet. The range of tide may be somewhat less in the connecting bays and inlets (Reference 6).

The area also contains estuaries of the York, Pamunkey, and Chickahominy Rivers that are subject to tidal flooding in their lower reaches but fluvial flooding on the upper reaches. Flooding on the upper reaches of these streams may be caused by heavy rains occurring at any time during the year. Flooding may also occur as a result of intense rainfall produced by local thunderstorms or tropical disturbances such as hurricanes, which move into the area from the Gulf or Atlantic coasts. The effects of riverine flooding are not addressed in this study.

New Kent County has experienced major storms since the early settlement of the area. Historical accounts of severe storms in the area date back several hundred years. The following paragraphs discuss some of the large storms that have occurred in recent history.

The hurricane of August 23, 1933 was one of the most severe storms that ever occurred in the Middle Atlantic region. This tropical hurricane passed inland near Cape Hatteras on August 22, passed slightly west of Norfolk, and continued towards the north accompanied by extreme high wind and tide. The storm surge in the bay and tidal estuaries was the highest of record and coincided with astronomical high tide. The water level reached a maximum of 8 feet in Hampton Roads (Reference 7).

Hurricane "Hazel," the second most destructive of recent hurricanes to strike the area, entered the mainland south of Wilmington, North Carolina, during the morning of October 15, 1954, and moved rapidly northward, passing over Norfolk and Fredericksburg in the early afternoon. The winds were from the east and southeast until the eye passed. When the eye passed, the winds shifted to the southwest with higher velocities. The hurricane surge was not as high as the August 1933 storm, although the tidal surge was superimposed on the normal high tide. In addition to damage by tidal flooding, much damage was caused to roofs, communication lines, and other structures by the high wind. Damage of this nature is characteristic of that to be expected during hurricanes (Reference 7).

The most recent flood of major proportions in the area occurred during the northeaster of March 6-8, 1962. Disastrous flooding and high waves occurred along the Atlantic seaboard from New York to Florida. This flood was unusual, even for a northeaster, since it was caused by a low pressure cell that moved from south to north past Hampton Roads and then reversed its course, moving again to the south and bringing with it huge volumes of water and high waves. The maximum flood height occurred on the morning of March 7 and reached 7.4 feet in Hampton Roads (Reference 8).

Hurricane “Floyd” tracked across the Commonwealth of Virginia on September 17, 1999. Significant rainfall from Hurricane “Floyd” exceeded 15 inches in some areas which caused major wide spread flooding to various jurisdictions along with wind damage (Reference 9). Peak streamflow measured at Chickahominy River near Providence Forge, VA (USGS gaging station 02042500) was at 5,370 cfs at a gage height of 10.95 feet (Reference 10).

Hurricane “Isabel” entered Virginia September 18, 2003 after making landfall along the North Carolina Outer Banks. The Commonwealth sustained winds near 100 mph and tropical storm winds for 29 hours. The hurricane produced storm surge of 5 to 8 feet along the coast and in the Chesapeake Bay with rainfall totals between 2 to 11 inches along its track. Damages due to wind, rain, and storm surge resulted in flooding, electrical outages, debris, transportation interruption, and damaged homes and businesses (Reference 11). New Kent County sustained $6.0M in property damages and $3.7M in crop damages (Reference 12). Peak streamflow measured at Chickahominy River near Providence Forge, VA (USGS gaging station 02042500) was at 4,510 cfs at a gage height of 10.62 feet (Reference 10).

Hurricane “Gaston” produced torrential rainfall, with nearby Richmond, VA, receiving the highest precipitation amount. The rainfall from Gaston caused the Chickahominy River to crest above flood stage. The flood swamped businesses and closed several roads. In New Kent County, the floods damaged a campground, while further downstream the flooding damaged a transformer, leaving several thousand people without electricity. Because there were no flood gauges for the Chickahominy River, the flooding was unpredictable (Reference 13).

The Virginia Hurricane Katrina Evacuation occurred between August 29, 2005 to October 1, 2005 (Reference 14). On January 4, 2013, New Kent County designated for FEMA public Assistance for Hurricane Sandy (Reference 15).

2.4 Flood Protection Measures

There are no existing flood control structures that would provide protection during major floods in New Kent County. There are several measures that have provided some protection against flooding. These include bulkheads, seawalls, jetties, and nonstructural measures for floodplain management, such as zoning codes. The "Uniform Statewide Building Code," which went into effect in September 1973, states, "where a structure is located in a 100-year flood plain, the lowest floor of all future construction or substantial improvement to an existing structure… must be built at or above that level, except for nonresidential structures which may be floodproofed to that level" (Reference 16).

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 2-, 1-, and 0.2-percent annual chance floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 1 percent annual chance flood in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Coastal Analyses

Coastal analyses, considering storm characteristics and the shoreline and bathymetric characteristics of the flooding sources studied, were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of the shorelines. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS report in conjunction with the data shown on the FIRM.

Pre-countywide Analyses

Tide records for New Kent County are limited and by themselves are inadequate to establish a tide-frequency relationship. However, mean tide levels at several locations in the county and limited high-water data at West Point on the York River were correlated with mean tide levels and tide-frequency curves developed for both the Norfolk Harbor gage and the Gloucester Point gage. The Norfolk Harbor gage is located approximately 10 miles inside the Chesapeake Bay, while the Gloucester Point gage is located near the mouth of the York River. Historical accounts of tidal flooding are available for nearly 300 years, but a reasonably accurate indication of the heights reached in Norfolk Harbor is available only since 1908 and a complete record since 1928. The Gloucester Point gage was established in 1950.

The adopted tide-frequency curve for the York and Pamunkey Rivers and their estuaries in New Kent County is based on the Norfolk Harbor gage. To develop the tidal frequencies for the Norfolk Harbor, a statistical analysis was performed in accordance with procedures outlined in U. S. Geological Survey (USGS) Bulletin 17B (Reference 17). The Pearson Type III methodology, without the logs, was incorporated for the selected period of record, 1928 through 1978. Consideration was given to separating hurricane and non-hurricane events. Although objective statistical approaches are available for incomplete samples (a hurricane-related tide exists for less than 50 percent of the years on record), they do not always provide reasonable results. Therefore, all tropical and extratropical events were included together in the analysis of the annual maximum tides.

The analysis of the 51 years of systematic record indicated that the 1933 and 1936 events could be high outliers. However, assuming that the true distribution is defined by the computed (non-adjusted) statistics, the estimated recurrence interval for the 1933 event is 10 years. It has been determined that, with 51 years of record, the probability of an event of this magnitude being exceeded is 40 percent. Since this risk is so high and it is known that several events as large if not larger than the 1933 event have historically occurred, the 1933 event (and any less severe events) was not considered to be a high outlier.

Historical accounts indicate that tides have occurred in Norfolk Harbor at approximately 8 feet in 1667 and 1785 and approximately 7.9 feet in 1846. There has been a gradual rise in sea level over the investigated period of record at Norfolk Harbor. There was some question as to the amount of adjustment that should be made to the historic events. To avoid overestimating the impact of sea level rise, the historic events were increased by only 0.50 foot (approximately the same adjustment for the 1924 to 1942 period). The analysis based on a historical period of 312 years resulted in a slight move to the left of the upper portion of the frequency curve when compared to the systematic record. Since the adjustment was not very large and there is some question as to the reliability of the historical data, the computed statistics based on the 51 years of systematic record were adopted.

The lower portion of the statistical curve was adjusted with a partial duration analysis using plotting positions in accordance with Weibull (Reference 17). It included all elevations above 4.26 feet.

Tidal flood-frequency elevations used in the September 25, 2009, countywide FIS revision for the Chickahominy River were taken from the Flood Insurance Study for the City of Norfolk (Reference 18).

Hydraulic analyses, considering storm characteristics and the shoreline and bathymetric characteristics of the flooding sources studied, were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of the shorelines.

Special consideration was given to the vulnerability of New Kent County to wave attack along shorelines of the York and Pamunkey Rivers during severe hurricanes and northeasters. Areas of shoreline subjected to significant wave attack are referred to as coastal high hazard zones. Methods have been developed to determine which sections of a shoreline fall into this category (Reference 19). The factors considered for such a determination include: choice of a suitable fetch, its length and width, sustained wind velocities, coastal water depths, and physical features of the shoreline that would appreciably affect wave propagation. All of these factors are analyzed to determine if a wave with a height of 3 feet could be generated. The 3-foot wave has been determined to be the minimum size wave capable of causing major damage to conventional wood-frame or brick veneer structures. This criterion has been adopted by FEMA for the determination of V zones. Based on the above criteria, the shoreline of New Kent County is not exposed to severe wave attack and has not been designated as part of a coastal high hazard zone.

Countywide Revision

No new hydrologic or hydraulic analyses were performed for the September 25, 2009, countywide FIS revision. However, this entire study was updated to the North American Vertical Datum of 1988 (NAVD 88).

Physical Map Revision

For this PMR, users of the FIRM should be aware that coastal flood elevations are provided in Table 2, “Summary of Coastal Stillwater Elevations” table in this report. If the elevation on the FIRM is higher than the elevation shown in this table, a wave height, wave runup, and/or wave setup component likely exists, in which case, the higher elevation should be used for construction and/or floodplain management purposes.

Development along the coastline of New Kent County consists of mainly private residences and agricultural land. Extensive residential development exists along the Chickahominy, York and Pamunkey Rivers. Undeveloped areas are located throughout New Kent County, consisting of mainly of farmlands, woodlands and marsh.

An analysis was performed to establish the frequency peak elevation relationships for coastal flooding in New Kent County. The Federal Emergency Management Agency (FEMA), Region III office, initiated a study in 2008 to update the coastal storm surge elevations within the states of Virginia, Maryland, and Delaware, and the District of Columbia including the Atlantic Ocean, Chesapeake Bay including its tributaries, and the Delaware Bay. The study replaces outdated coastal storm surge stillwater elevations for all Flood Insurance Studies (FISs) in the study area, including New Kent County, VA, and serves as the basis for updated Flood Insurance Rate Maps (FIRMs). Study efforts were initiated in 2008 and concluded in 2012.

The end-to-end storm surge modeling system includes the Advanced Circulation Model for Oceanic, Coastal and Estuarine Waters (ADCIRC) for simulation of 2-dimensional hydrodynamics (Luettich et. al, 2008). ADCIRC was dynamically coupled to the unstructured numerical wave model Simulating WAves Nearshore (unSWAN) to calculate the contribution of waves to total storm surge (USACE, 2012.). The resulting model system is typically referred to as SWAN+ADCIRC (USACE, 2012). A seamless modeling grid was developed to support the storm surge modeling efforts. The modeling system validation consisted of a comprehensive tidal calibration followed by a validation using carefully reconstructed wind and pressure fields from three major flood events for the Region III domain: Hurricane Isabel, Hurricane Ernesto, and extratropical storm Ida. Model skill was accessed by quantitative comparison of model output to wind, wave, water level and high water mark observations.

The stillwater elevations for the 10-, 2-, 1-, and 0.2-percent annual chance floods have been determined for the York, Pamunkey, and Chickahominy Rivers and are summarized in Table 1, "Summary of Stillwater Elevations."

TABLE 1 - SUMMARY OF STILLWATER ELEVATIONS

	ELEVATION (feet) NAVD88			
FLOODING SOURCE AND LOCATION	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
YORK RIVER AND ESTUARIES				
Entire shoreline within community	5.4-5.5	6.5-6.6	7.0-7.2	9.2-10.3
PAMUNKEY RIVER AND ESTUARIES				
Entire shoreline within community	4.3-5.5	5.3-6.6	5.4-7.2	6.5-10.3
CHICKAHOMINY RIVER AND ESTUARIES				
Shoreline from confluence of Diascund Creek to a point approximately 200 feet upstream of County Route 618 bridge	5.4-5.8	6.8-6.9	7.1-7.2	8.4-8.6

The tidal surge in the Chesapeake Bay affects approximately 58 miles on New Kent County coastline. The eastern coastline, from James City county border to West Point is more prone to damaging wave action during high wind events due to the significant fetch over which winds can operate. The widths of several embayments narrow considerably. In these areas, the fetch over which winds can operate for wave generation is significantly less.

The methodology for analyzing the effects of wave heights associated with coastal storm surge flooding is described in the National Academy of Sciences (NAS) report (Reference 20). This method is based on three major concepts. First, depth-limited waves in shallow water reach a maximum breaking height that is equal to 0.78 times the stillwater depth, and the wave crest is 70 percent of the total wave height above the stillwater level. The second major concept is that the wave height may be diminished by the dissipation of energy due to the presence of obstructions such as sand dunes, dikes, seawalls, buildings, and vegetation. The amount of energy dissipation is a function of the physical characteristics of the obstruction and is determined by procedures described in Reference 20. The third major concept is that wave height can be regenerated in open fetch areas due to the transfer of wind energy to the water. This added energy is related to fetch length and depth.

The coastal analysis and mapping for New Kent County was conducted for FEMA by RAMPP (Leonard Jackson Associates) under Contract No. HSFEHQ-09-D-0369, Task Order HSFE03-11-J-0007. The coastal analysis involved transect layout, field reconnaissance, erosion analysis, and overland wave modeling including wave setup, wave height analysis and wave runup.

Wave heights were computed along transects (cross-section lines) that were located along the coastal areas, as illustrated in Figure 1, in accordance with the User's Manual for Wave Height Analysis (Reference 21). The transects were located with consideration given to the physical and cultural characteristics of the land so that they would closely represent conditions in their locality. Transects were spaced close together in areas of complex topography and dense development. In areas having more uniform characteristics, they were spaced at larger intervals. It was also necessary to locate transects in areas where unique flooding existed and in areas where computed wave heights varied significantly between adjacent transects. Table 2, "Transect Descriptions," provides a listing of the transect locations and stillwater elevations, as well as initial wave crest elevations.

Each transect was taken perpendicular to the shoreline and extended inland to a point where wave action ceased. Along each transect, wave heights and wave crest elevations were computed considering the combined effects of changes in ground elevation, vegetation, and physical features. The 1-percent-annual chance stillwater elevations were used as the starting elevations for these computations. Wave heights were calculated to the nearest 0.1 foot, and wave crest elevations were determined at whole-foot increments along the transect. The location of the 3-foot breaking wave for determining the terminus of the V zone (area with velocity wave action) was also computed at each transect. It was assumed that the beach area would erode during a major storm, thus reducing its effectiveness in decreasing wave heights.

Figure 2 is a profile for a typical transect illustrating the effects of energy dissipation and regeneration on a wave as it moves inland. This figure shows the wave crest elevations being decreased by obstructions, such as buildings, vegetation, and rising ground elevations, and being increased by open, unobstructed wind fetches. Actual conditions in New Kent County may not include all the situations illustrated in Figure 2.

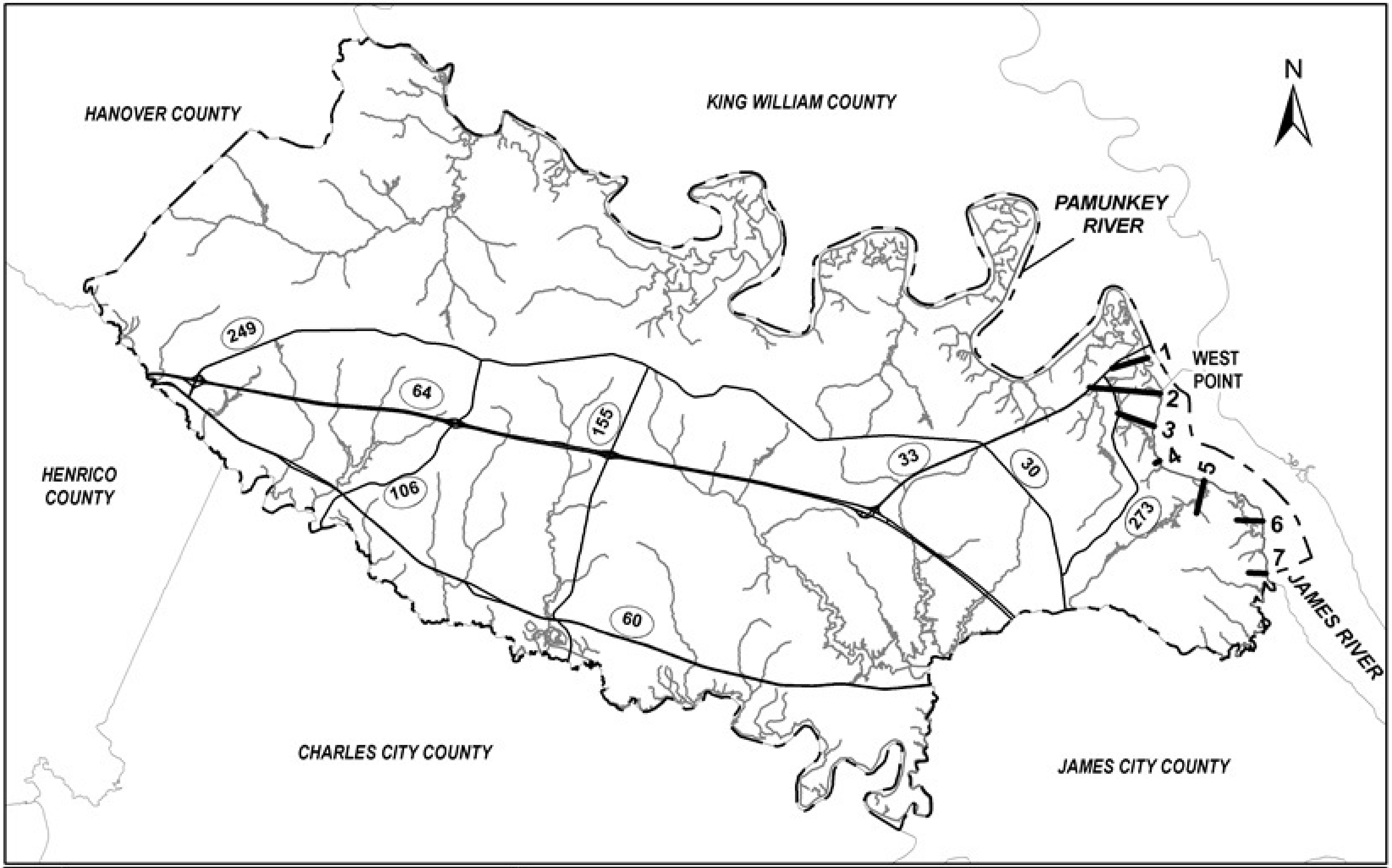


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW KENT COUNTY, VA (ALL JURISDICTIONS)

TRANSECT LOCATION MAP

TABLE 2: TRANSECT DESCRIPTIONS

Flood Source	Transect	Starting Wave Conditions for the 1% Annual Chance			Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations (ft NAVD88)				Zone Designation and BFE (ft NAVD 88)
		Coordinates	Significant Wave Height Hs (ft)	Peak Wave Period Tp (sec)	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	
York River	1	N 37.529646 W -76.809502	1.5	3.4	5.5	6.6	7.2	10.3	VE 10
York River	2	N 37.518449 W -76.803661	1.5	3.6	5.5	6.6	7.2	10.1	VE 10
York River	3	N 37.507975 W -76.805764	1.9	3.7	5.5	6.6	7.2	10.2	VE 10
York River	4	N 37.497118 W -76.803351	2.5	3.3	5.5	6.6	7.2	9.9	VE 10
York River	5	N 37.490997 W -76.785423	2.4	3.2	5.4	6.6	7.1	9.6	VE 10
York River	6	N 37.478315 W -76.761826	2.0	3.5	5.4	6.5	7.0	9.4	VE 10
York River	7	N 37.461595 W -76.759988	2.3	3.8	5.4	6.5	7.0	9.2	VE 10

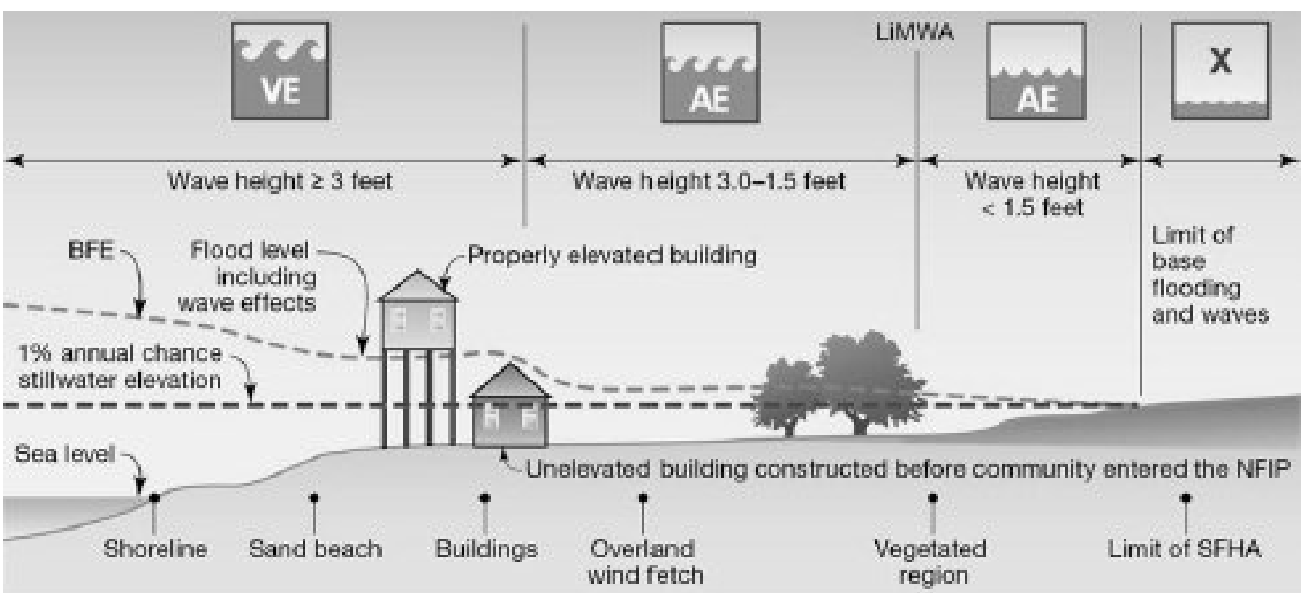


FIGURE 2 – TRANSECT SCHEMATIC

All qualifying benchmarks within a given jurisdiction that are catalogued by the National Geodetic Survey (NGS) and entered into the National Spatial Reference System (NSRS) as First or Second Order Vertical and have a vertical stability classification of A, B or C are shown and labeled on the FIRM with their 6-character NSRS Permanent Identifier.

Benchmarks catalogued by the NGS and entered into the NSRS vary widely in vertical stability classification. NSRS vertical stability classifications are as follows:

- Stability A: Monuments of the most reliable nature, expected to hold position/elevation (e.g., mounted in bedrock)
- Stability B: Monuments which generally hold their position/elevation (e.g., concrete bridge abutment)
- Stability C: Monuments which may be affected by surface ground movements (e.g., concrete monument below frost line)
- Stability D: Mark of questionable or unknown vertical stability (e.g., concrete monument above frost line, or steel witness post)

In addition to NSRS benchmarks, the FIRM may also show vertical control monuments established by a local jurisdiction; these monuments will be shown on the FIRM with the appropriate designations. Local monuments will only be placed on the FIRM if the community has requested that they be included, and if the monuments meet the aforementioned NSRS inclusion criteria.

To obtain current elevation, description, and/or location information for benchmarks shown on the FIRM for this jurisdiction, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their Web site at www.ngs.noaa.gov.

It is important to note that temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with the FIS report and FIRM for this community. Interested individuals may contact FEMA to access these data.

3.2 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum used for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD 29). With the completion of the North American Vertical Datum of 1988 (NAVD 88), many FIS reports and FIRMs are now prepared using NAVD 88 as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are now referenced to NAVD 88. In order to perform this conversion, effective NGVD 29 elevation values were adjusted downward by 1.11 feet. Structure and ground elevations in the community must, therefore, be referenced to NAVD 88. It is important to note that adjacent communities may be referenced to NGVD 29. This may result in differences in base flood elevations across the corporate limits between the communities.

For more information on NAVD 88, see Converting the National Flood Insurance Program to the North American Vertical Datum of 1988, FEMA Publication FIA-20/June 1992, or contact the National Geodetic Survey at the following address:

Spatial Reference System Division
National Geodetic Survey, NOAA
Silver Spring Metro Center 3
1315 East-West Highway
Silver Spring, Maryland 20910
(301) 713-3191
http://www.ngs.noaa.gov/

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS report provides 1 percent annual-chance floodplain data, which may include a combination of the following: 10-, 2-, 1-, and 0.2 percent annual chance flood elevations; delineations of the 1 percent and 0.2 percent annual chance floodplains; and a 1 percent annual-chance floodway. This information is presented on the FIRM and in many components of the FIS report, including Flood Profiles, and Floodway Data tables. Users should reference the data presented in the FIS report as well as additional information that may be available at the local community map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2 percent annual chance flood is employed to indicate additional areas of flood risk in the county. For the streams studied in detail, the 1 percent annual chance and 0.2 percent annual chance boundaries have been delineated using the best available topographic information.

Countywide Revision

The approximate and detailed floodplains have been digitally redelineated using previous effective base flood elevations and new, two-foot contour topographic data.

The 1 percent and 0.2 percent annual chance floodplain boundaries are shown on the FIRM. On this map, the 1 percent annual chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE), and the 0.2 percent annual chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1 percent and 0.2 percent annual chance floodplain boundaries are close together, only the 1 percent annual chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 1 percent annual chance floodplain boundary is shown on the FIRM (Exhibit).

Physical Map Revision

The 1 percent and 0.2 percent annual chance floodplain boundaries are shown on the FIRM. On this map, the 1 percent annual chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, and VE), and the 0.2 percent annual chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1 percent and 0.2 percent annual chance floodplain boundaries are close together, only the 1 percent annual chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data. Floodplain boundaries were delineated from 2011 LiDAR based mass points complied to meet a 3.5 foot horizontal accuracy (Reference 22).

Areas of coastline subject to significant wave attack are referred to as coastal high hazard zones. The USACE has established the 3-foot breaking wave as the criterion for identifying the limit of coastal high hazard zones (Reference 23). The 3-foot wave has been determined the minimum size wave capable of causing major damage to conventional wood frame of brick veneer structures. The one exception to the 3-foot wave criteria is where a primary frontal dune exists. The limit the coastal high hazard area then becomes the landward toe of the primary frontal dune or where a 3-foot or greater breaking wave exists, whichever is most landward. The coastal high hazard zone is depicted on the FIRMs as Zone

VE, where the delineated flood hazard includes wave heights equal to or greater than three feet.

Post-storm field visits and laboratory tests have confirmed that wave heights as small as 1.5 feet can cause significant damage to structures when constructed without consideration to the coastal hazards. Additional flood hazards associated with coastal waves include floating debris, high velocity flow, erosion, and scour which can cause damage to Zone AE-type construction in these coastal areas. To help community officials and property owners recognize this increased potential for damage due to wave action in the AE zone, FEMA issued guidance in December 2008 on identifying and mapping the 1.5-foot wave height line, referred to as the Limit of Moderate Wave Action (LiMWA). While FEMA does not impose floodplain management requirements based on the LiMWA, the LiMWA is provided to help communicate the higher risk that exists in that area. Consequently, it is important to be aware of the area between this inland limit and the Zone VE boundary as it still poses a high risk, though not as high of a risk as Zone VE.

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 1 percent annual chance floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 1 percent annual chance floodplains that are determined in the FIS by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 1 percent annual chance coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2 percent annual chance floodplain, areas within the 0.2 percent annual chance floodplain, and to areas of 1 percent annual chance flooding where average depths are less than 1 foot, areas of 1 percent annual chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1 percent annual chance flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0. In the 1 percent annual chance floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 1 percent and 0.2 percent annual chance floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

The current FIRM presents flooding information for the entire geographic area of County. Previously, separate Flood Hazard Boundary Maps and/or FIRMs were prepared for each identified flood-prone incorporated community and the unincorporated areas of the county. This countywide FIRM also includes flood hazard information that was presented separately on Flood Boundary and Floodway Maps (FBFMs), where applicable. Historical data relating to the maps prepared for each community, prior to the initial countywide mapping, are presented in Table 3, "Community Map History."

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
New Kent County (Unincorporated Areas)	January 31, 1975	None	December 5, 1990	

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEW KENT COUNTY, VA
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

There is an on-going PMR FIS for the Charles City County (All Jurisdictions) (Reference 24). The results in that FIS will be in complete agreement with the results of the Flood Insurance Study. FIS has been prepared for King William County and Incorporated Areas (Reference 27), James City County and Incorporated Areas (Reference 28), and King and Queen County and Incorporated Areas (Reference 30). The results of those studies are in agreement with this study.

Information pertaining to revised and unrevised flood hazards for each jurisdiction within New Kent County has been complied into this FIS. Therefore, this FIS supersedes all previously printed FIS reports, and FIRMs for all of the incorporated and unincorporated jurisdictions within New Kent County.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting Federal Insurance and Mitigation Division, Federal Emergency Management Agency, One Independence Mall, Sixth Floor, 615 Chestnut Street, Philadelphia, Pennsylvania 19106-4404.

9.0 BIBLIOGRAPHY AND REFERENCES

1. USACE, 2012b. FEMA Region III Storm Surge Study, Coastal Storm Surge Analysis: Storm Surge Results, Intermediate Data Submittal No. 3 in Draft Form, July, 2012, USACE ERDC/CHL, Vicksburg, MS

2. USACE, 2012b. FEMA Region III Storm Surge Study, Coastal Storm Surge Analysis: Storm Surge Results, Intermediate Data Submittal No. 3 in Draft Form, July, 2012, USACE ERDC/CHL, Vicksburg, MS

3. Commonwealth of Virginia, Division of State Planning and Community Affairs, Data Summary-New Kent County, Richmond, Virginia, April 1975.

4. U. S. Department of Commerce, Bureau of the Census, 1980 Census of Population, Number of Inhabitants, Virginia, Washington, D. C., U.S. Government Printing Office, 1981.

5. U.S. Department of Commerce, Census Bureau, State & County QuickFacts, http://quickfacts.census.gov/

6. U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Tide Tables 1988, High and

Low Water Predictions, East Coast of North and South America Including Greenland, Washington, D. C., 1987.

7. U. S. Army Corps of Engineers, House Document 354, 87th Congress, 2nd Session, Norfolk, Virginia-Interim Hurricane Survey, 1962.

8. U. S. Army Corps of Engineers, Norfolk District, March 1962 Storm on the Coast of Virginia, Norfolk, Virginia, August 10, 1962.

9. Virginia Department of Emergency Services, Hurricane Floyd VEOC Situation Report, As of 1400 hrs 09/24/99, http://www.vdem.state.va.us/newsroom/sitreps/1999/floyd/dfo4.htm

10. U. S. Geological Survey, Department of the Interior, Peak Streamflow, http://nwis.waterdata.usgs.gov/nwis/

11. Virginia Department of Emergency Services, Hurricane Isabel Disaster Field Office, Situation Report #44 As of 01/13/04, http://www.vaemergency.com/newsroom/sitreps/2003/isabel/isabelsitrep44.pdf

12. NOAA Satellite and Information Service, National Environmental Satellite, Data, and Information Service, National Climatic Data Center, U.S. Department of Commerce, Storm Events, http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms

13. Wikimedia Foundation, Inc. , November 19, 2007, Hurricane Gaston (2004), Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/Hurricane_Gaston

14. http://www.city-data.com/county/New_Kent_County-VA.html (Accessed on January, 2014)

15. http://www.fema.gov/news-release/2013/01/04/new-kent-countydesignated-fema-public-assistance-sandy (Accessed on January, 2014)

16. Commonwealth of Virginia, Virginia Uniform Statewide Building Code, Article 3, Part C, Section 872.6, September 1973.

17. U. S. Department of the Interior, Geological Survey, Office of Water Data Collection, Interagency Advisory Committee on Water Data, "Guidelines for Determining Flood Flow Frequency," Bulletin 17B, Reston, Virginia, Revised September 1981.

18. Federal Emergency Management Agency, Flood Insurance Study, City of Norfolk, Independent City, Virginia, Washington, D. C., April 17, 1984.

19. U. S. Army Corps of Engineers, Galveston District, General Guidelines

for Identifying Coastal High Hazard Zones, Galveston, Texas, 1975.

20. National Academy of Sciences, Methodology for Calculating Wave Action Effects Associated with Storm Surges, Washington, D. C., 1977

21. Federal Emergency Management Agency, User's Manual for Wave Height Analysis, Washington, D. C., February 1981

22. U.S. Geological Survey, Eleven County VA LiDAR Project, Rolla, Missouri, 2011

23. U. S. Army Corps of Engineers, Galveston District, General Guidelines for Identifying Coastal High Hazard Zones, Galveston, Texas, 1975.

24. Federal Emergency Management Agency, Flood Insurance Study, Charles City County (All Jurisdictions), Virginia, July 6, 2015.

25. U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Intervals 5 and 10 Feet: Manquin, Virginia, 1968; King William, Virginia, 1968; Quinton, Virginia, 1965, Photorevised 1974; Tunstall, Virginia, 1966, Photorevised 1974; New Kent, Virginia, 1965, Photoinspected 1978; West Point, Virginia, 1965, Photoinspected 1973; Roxbury, Virginia, 1965, Photorevised 1974, Photoinspected 1979; Providence Forge, Virginia, 1966, Photorevised 1974; Walkers, Virginia, 1965, Photorevised 1973; Toano, Virginia, 1965, Photorevised 1979; and Gressitt, Virginia, 1965, Photorevised 1972 and 1973.

26. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, Unincorporated Areas of New Kent County, Virginia, January 11, 1975.

27. Federal Emergency Management Agency, Flood Insurance Study, King William County and Incorporated Areas, Virginia, September 2, 2015.

28. Federal Emergency Management Agency, Flood Insurance Study, James City County and Incorporated Areas, Virginia, March 28, 2014 (Preliminary Release).

29. Federal Emergency Management Agency, Flood Insurance Study, Town of West Point, King William County and Incorporated Areas, Virginia, September 2, 2015.

30. Federal Emergency Management Agency, Flood Insurance Study, King and Queen County and Incorporated Areas, Virginia, October 3, 2013 (Preliminary Release).

31. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Unincorporated Areas of

Henrico County, Virginia, Washington, D. C., February 4, 1981.

32. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Unincorporated Areas of Hanover County, Virginia, Washington, D. C., September 2, 1981.

33. Federal Emergency Management Agency, Flood Insurance Study, New Kent County and Incorporated Areas, Virginia, September 25, 2009.

34. Luettich, R.A. and Westerink, J.J. (February 6, 2008). A (Parallel) Advanced Circulation Model for Oceanic, Coastal and Estuarine Waters (ADCIRC). Version 45.12. University of North Carolina at Chapel Hill, Institute of Marine Sciences. Morehead City, North Carolina.

35. National Academy of Sciences. (1977). Methodology for Calculating Wave Action Effects Associated with Storm Surges. Washington, D.C.

36. U.S. Army Corps of Engineers, Galveston District. (June 1975). Guidelines for Identifying Coastal High Hazard Zones. Galveston, Texas