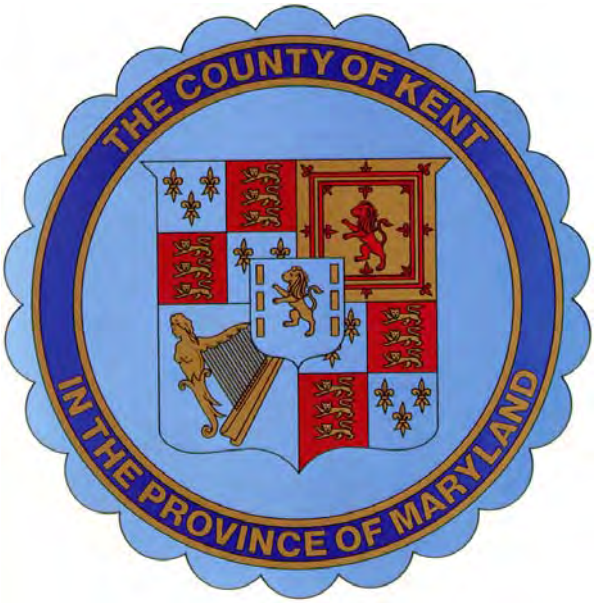
HAZARD MITIGATION PLAN

2014



KENT COUNTY, MARYLAND

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Introduction

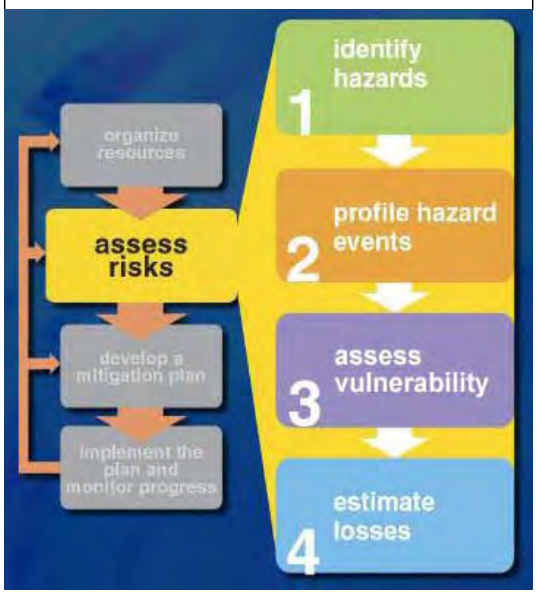
The following Hazard Mitigation Plan for Kent County and its 5 municipalities (Betterton, Chestertown, Galena, Millington, and Rock Hall) is a collaborative effort and is meant to satisfy the requirements of the following:

- Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act)
- Disaster Mitigation Act of 2000
- 44 CFR, Part 201.6 (Code of Federal Regulations)

The ongoing implementation of this Plan represents the essential aspect of comprehensive disaster mitigation planning through evaluation and understanding of potential hazards, vulnerabilities, and risks.

The four major steps in the Risk Assessment for Kent County include Hazard Identification, Hazard Profiles, Vulnerability Assessment, and Loss Estimation (Figure 1). This Chapter comprises the first step in the risk assessment, wherein hazards that may affect Kent County are identified. Each hazard will be profiled by nature, history and local profile, assessed for vulnerability, and outlined for mitigation measures in their own subsequent chapters. The nature of the hazard, history of previous occurrences, and the impact and potential severity of an occurrence have been documented in chapters by hazard event. Assessment of vulnerability and loss are also outlined in subsequent chapters.

Figure 1 – Risk Assessment Planning



The Planning Process

Beginning in Spring 2013, a series of public meetings were conducted by the Kent County Planning Commission, the Kent County Local Emergency Planning Committee, the Kent County Commissioners, and all five municipalities. The purpose of these meetings was to identify goals and objectives to help guide Kent County in building its disaster resistance and in identifying and selecting mitigation actions to address its hazard vulnerabilities. The mitigation actions addressed in each chapter identify measures that will help the County avoid, prevent, or otherwise reduce damages from hazards.

Aside from public meetings, the Draft Hazard Mitigation Plan received local media attention from the Kent County News and The Chestertown Spy, an e-newspaper. Input was received from the municipalities, the Kent County Local Emergency Planning Committee, the American Red Cross, Kent County Emergency Management, the Maryland and the National Forest Service, Maryland Department of the Environment, State and County Roads Departments, County and Municipal Waste Water Treatment Facility staff, Kent County Soil and Water Conservation District, Kent

County Public Works, Kent County Engineer, Kent County Housing and Community Development, area insurance providers, area farmers, and the American Farm Bureau. Also, County staff conferred with surrounding counties and reviewed their Draft Hazard Mitigation Plans. No public comments were received at the Planning Commission's public hearing, at the Safety Fair or from on-line review.

Copies of the Draft Plan were available for review in the Kent County Department of Planning and Zoning and in all 5 town offices. Once finalized, the Plan will be posted on the Kent County Government website: www.kentcounty.com.

Step 1 – Organizing Resources

The hazard identification process for Kent County involved investigating various types of natural hazards faced by the County over the past several decades. Since it is assumed that hazards experienced by the County in the past may be experienced in the future, the hazard identification process includes a history and an examination of various hazards and their occurrences. Information of past hazards was based on history and research from historical documents and newspapers; County plans and reports; conversations with County residents; and Internet websites. Data and maps that were available online included sources such as the United States Geological Survey (USGS) and the National Weather Service.

Profiling hazards involved determining the frequency or probability of future events, their severity, and factors that may affect their severity. Each hazard type has unique characteristics that can impact the County. For example, no two flood events will impact a community in the same manner. Also, the same hazard events can affect different communities in different ways based on geography, development, population distribution, age of buildings, etc. Developing hazard event profiles enables us to answer the question "how bad could a hazard get?"

Step 2 – Risk Assessment

The following natural hazards have been documented in Kent County and have been assessed as risks for the purpose of this study. They have been ranked by the Hazard Mitigation Planning Committee in order of importance (number 1 being the most important hazard) based on their past occurrences, damages, claims, etc.

1. Hurricanes
2. Riverine and Coastal Flooding
3. Winter Storm/Winter Weather
4. Other Severe Storms (thunderstorms, lightning, hail)
5. Drought
6. Soil Movement/Steep Slopes
7. Wildfire
8. Extreme Heat
9. Tornadoes
10. Earthquakes

Hazards 1 through 3 have been considered high priority; hazards 4 through 7 have been considered medium priority; and hazards 8 and 9, low priority. The County has been assessed based on its vulnerability to the high and medium priority hazards. Based on the hazard history and profiles of the aforementioned hazards, they have been ranked as low, medium, or high priority or improbable. The hazards that have a high frequency of occurrence and have caused significant damage to the area will be assessed in the following chapters for their vulnerability. The list of hazards was obtained from the 2011 Maryland All-Hazard Mitigation Plan Update completed by the Maryland Emergency Management Agency. The Overall Risk: State Plan ranks Coastal Flooding and Hurricane as High; Drought as Medium-High; Winter Weather, Wildfire, and Wind as Medium; Thunderstorms as Medium-Low; and Tornadoes and Earthquakes as Low.

Step 3 – Identify Hazard Mitigation Measures

The cost analysis of each disaster and subsequent mitigation strategy was based on a comparison of mitigation cost and overall benefit to the property owner and the County. When the mitigation strategies outlined in subsequent chapters were established, they were prioritized based on cost analysis compared to benefits to the community. Mitigation projects are outlined in Chapter 10. These overall hazard mitigation measures have been prioritized according to their cost versus their overall benefit to the community.

Step 4 – Plan Maintenance

Following adoption of the Hazard Mitigation Plan by the County and all 5 municipalities, the Plan will be implemented and evaluated both annually and within a five-year period. The Plan will be updated every 5 years at which time the County's list of prioritized projects (see Table 27 in Chapter 11) will be adjusted according to project completion. The Local Emergency Planning Committee will review the Plan annually. Secondly, prioritized projects will be tracked annually in the Kent County Annual Report. This report is reviewed by the Planning Commission and submitted to the Kent County Commissioners annually. At the end of each 5-year cycle, the entire Plan will be reassessed and mitigation projects which have been completed will be documented accordingly and the Prioritized List of Mitigation Projects revised. During the first 5-year cycle, the County did not complete annual evaluations of the Plan; however, the County will strive to ensure that annual reviews occur during the next cycle.

The Plan's annual review is also identified in the Kent County Comprehensive Plan. The County, as required by State laws, has prepared and continues to prepare a variety of specific plans and ordinances (Comprehensive Water and Sewerage, Solid Waste, Zoning Ordinance, Subdivision Regulations, Sediment Control, Stormwater Management, etc.). While providing more detailed information and policy, all plans and laws shall be in compliance with, and conform to, the Comprehensive Plan. The Comprehensive Plan provides policy direction and guides the development of these other plans.

The Hazard Mitigation Plan will augment the County Comprehensive Plan in a number of ways. The Comprehensive Plan addresses the County's accelerated erosion by high winds and high tides, overland flow, and shoreline cliff sluffing and identifies strategies to reduce erosion along Kent

County's 268 miles of tidal shoreline. Both the Comprehensive Plan and the Hazard Mitigation Plan identify shoreline control/stabilization measures and both residential and agricultural best management practices as viable means of reducing accretion/erosion of Kent's highly erodible soils. Both plans also emphasize the maintenance, enforcement, and strengthening of floodplain regulations and participation in the Community Rating System. All county projects will be evaluated for consistency with both the Comprehensive Plan and the Hazard Mitigation Plan.

Furthermore, during technical review of all applicable projects that are submitted to the Kent County Technical Advisory Committee, projects will be reviewed for consistency with Hazard Mitigation Plan strategies. The Technical Advisory Committee meets twice per month and is comprised of local agencies such as the Kent County Health Department, Department of Water and Waste Water Services, Public Works, State and County Roads Departments, and Fire Chiefs Associations.

Public comment and input will be sought as the Hazard Mitigation Plan is implemented. Not only are hardcopies of the Plan available for public review in the Kent County Department of Planning, Housing and Zoning and all 5 town offices, but the Plan will also be posted on the Kent County Government website on which all municipalities have homepages. These individual homepages will have links to the Hazard Mitigation Plan. Recommended by the Kent County Planning Commission in September 2014, the Commissioners of the County of Kent adopted the Plan in ____ 2014. The Towns of Betterton, Galena, Rock Hall, Millington and Chestertown are in the process of Plan adoption.

Background

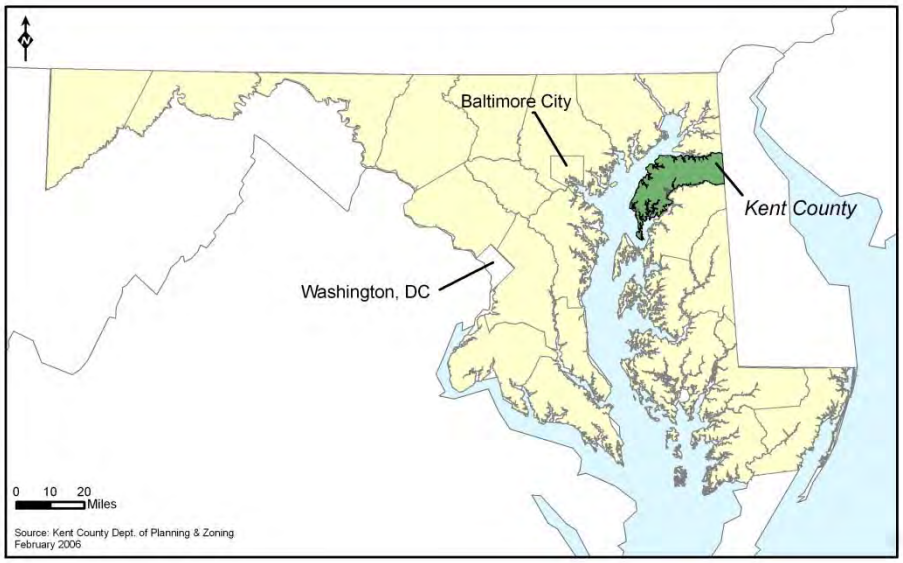
A. Physical Condition

Kent County, founded in 1642, is the second oldest County in Maryland. Prior to European colonization, the area was inhabited by a mosaic of different native societies, including the Tockwoghs and Wicomisses. Early settlers were greeted with the magnificent expanse of the Chesapeake Bay, the beautiful Chester and Sassafras Rivers, waters teeming with fish; myriads of waterfowl, mighty forests, and rich soil. Although much has changed since then, much remains the same. The hallmarks of Kent County continue to be the Chesapeake Bay, its tributaries, and our rich farmland. These resources shaped much of our economy, culture and character and they continue to serve as the foundation of this Comprehensive Plan.

Kent County is located on the northern portion of the Delmarva Peninsula on the eastern side of the Chesapeake Bay directly opposite Baltimore. The County is bordered on the north by the Sassafras River, which separates it from Cecil County, and on the south by the Chester River, which separates it from Queen Anne's County. The western border is formed by the Chesapeake Bay, and the eastern boundary is formed by the Delaware State Line. The County has a total land area of 178,428 acres or approximately 281 square miles and has 79,006 acres of water within its boundaries. Five incorporated towns—Betterton, Chestertown, Galena, Millington, and Rock Hall—are located in Kent County. Chestertown is the County seat.

A railroad line runs from Chestertown north to Worton and eastward through the County to Delaware and points north. Both Maryland Route 213 (Chesapeake Country National Scenic Byway) and U.S. Route 301 cross the County in a generally north-south direction. These highways are parts of the main connection to the Baltimore-Washington area by way of the Bay Bridge and U.S. Route 40 and Interstate 95.

Figure 2: Location Map



The Development Pattern

The early development of Kent County was devoted almost exclusively to the conversion of wooded land to agricultural use. Several early settlements were established on waterways as shipping points for agricultural products. These settlements grew into the towns of Chestertown on the Chester River, Rock Hall on the Bay, and Georgetown and Betterton on the Sassafras River. Betterton later grew more as a resort center than as a trade center or shipping point. As more land was converted to agriculture, small trading communities formed in the central County at crossroads, or later where roads crossed the Pennsylvania Railroad. Galena, Still Pond, and Fairlee are examples of the former; Massey, Kennedyville and Worton grew up at railroad crossings. Rock Hall with a good harbor off the Bay grew as a center for fishing and boat building. Millington grew around a grain mill near the headwaters of the Chester River. Chestertown, as the County seat, became the largest town and principal trade and business center for the County and later home to Washington College and some agriculture-related industry.

In addition to the residences clustered around the towns, small groups of houses grew in isolated locations originally in strips along existing roads and later in subdivisions. Some of these were occupied by farm workers, but an increasing number were occupied by families supported by jobs in the towns. The scattered pattern of rural, non-farm residences is supplemented by a substantial number of dwellings along the waterfront. This scattered pattern of development continued as Kent County's population began to increase and the interest in vacation and retirement homes increased. In particular, the number of waterfront and rural subdivisions increased. The desire for large rural lots increased with the desire for second homes.

Main elements of the commercial pattern are located in the towns and along the highways on the outskirts of the towns. Other small spots of commerce are located along highways or at crossroads in outlying areas. Most industry is also located near the towns and villages. Larger public and semi-public uses include the country club golf courses near Chestertown and at Great Oak on Fairlee Creek, Worton Park, Betterton Beach, Turners Creek Park, and the four wildlife reservations: the federal area on Eastern Neck Island, the two state areas – Sassafras Natural Resources Management area and the Millington Wildlife Management Area and Chesapeake Farms, a private demonstration area on the west fork of Langford Creek.

Land Use/Land Cover data from the Maryland Department of Planning is shown in Table 1. Between 2002 and 2010, the County saw an 8% increase in developed lands but only a 0.7% decrease in resource lands. Overall the County has been successful in encouraging development in areas where it is appropriate and out of the countryside.

Table 1: Land Use

	Land Use in Acres		Land Use Change	
	2002[3]	2010[2]	2002-2010	
	Acres	Acres	Acres	Percent
Very Low Density Residential[1]	3,681	4,184	503	13.7%
Low Density Residential	6,096	6,371	275	4.5%
Medium Density Residential	1,987	2,128	141	7.1%
High Density Residential	165	227	62	37.9%
Commercial	887	994	107	12.1%
Industrial	38	38	0	0.0%
Other Developed Lands/ Institutional/Transportation[1]	1,465	1,518	53	3.6%
Total Developed Lands[4]	**14,319**	**15,460**	**1,141**	**8.0%**
Agriculture	117,228	116,526	-702	-0.6%
Forest	42,460	41,997	-464	-1.1%
Extractive/Barren/Bare	49	49	0	0.0%
Wetland	4,372	4,397	24	0.6%
Total Resource Lands[4]	**164,109**	**162,968**	**-1,141**	**-0.7%**
Total Land	178,428	178,428		
Water	79,006	79,006		

1. Two new categories have been added to the 2010 Land Use/Land Cover layer update; very low density residential development (191,192) and transportation (80).
2. Updates/modifications to the 2010 land use/land cover layers used the 2007 NAIP aerial imagery and parcel information from Maryland Property View 2008.
3. The original 2002 data were mapped using geo-rectified LANDSAT satellite imagery and 2000 MD Property View. In 2010 two new land use categories were added, transportation and very low density residential making it necessary to modify the 2002 land use/land cover layer to incorporate these categories for comparative purposes. Additionally, better imagery and property data information were used to make further modifications. The enhanced 2002 dataset is available upon request.
4. As noted above, new land use categories were added in 2010 and associated adjustments were made to 2002 data. Similar adjustments were not made to 1973 data, making it impossible to know how much change from 1973 is due to new development since then, versus misclassified land uses at that time. For these reasons, we suggest reliance only on change statistics for the aggregate land use categories, Total Developed and Total Resource Lands

Source: Maryland Department of Planning, Land Use/Land Cover (with one change: 213 acres was subtracted from 2010 Very Low Density Residential and added to 2010 Agriculture to correct for a parcel that was mistakenly identified as being developed.)

Natural Features

Located in the Atlantic Coastal Plain, Kent County is comparatively low-lying, with relief seldom exceeding 80 feet. The eastern and central portions of the County are characterized by a broad, gently rolling plain; the northwestern section is deeply incised by streams. These streams have steep banks along their shorelines and in some cases bluffs 20 to 80 feet high. The character of the southwestern portion of the County is one of flat plains and terraces sloping toward the water.

Kent County is underlain by deposits of sand, clay, sandy clay and silt, greensand, and marls resting on crystalline rocks. These rocks slope to the south and southeast at the rate of 60-150 feet per mile. The depth of the Coastal Plain sediments ranges from 900 feet in the northeastern portion to 2,200 feet in the southeastern portion.

Soils

The open, flat expanses of rich fertile soil that blankets the County is a gift of immeasurable value. Approximately 57% of the County is defined as prime farmland as compared with 23% of Maryland as a whole. The County has some of the best farmland in the United States and this combined with the proximity to a variety of markets makes Kent County an ideal location for agribusinesses to thrive.

Natural, Historic, and Cultural Resources

The natural resources important to Kent County are clean air, prime agricultural land, tidal marshes, non-tidal wetlands, woodlands, large forests, ground water, the Chesapeake Bay, the Chester River, the Sassafras River and their tributaries, ponds, mineral resources, landscapes of agriculture, waterfront, open space, historic sites, dark nighttime skies and a peaceful, unhurried atmosphere.

The County also values its diverse ecosystems. We have hedgerows, cropped fields, shorelines, meadows, forests, wetlands, submerged aquatic vegetation, and other plants. The varied wildlife include deer, small mammals, reptiles and amphibians, waterfowl, game birds, songbirds, colonial nesting water birds, raptors, fish, crabs, and many species of shellfish.

The Chesapeake Bay, Chester and Sassafras Rivers and their major tributaries are the most significant water bodies in the County. Kent is in the Upper Eastern Shore Watershed which may be divided into the Sassafras, Still Pond/Fairlee, Langford, Lower Chester, Middle Chester, and Upper Chester subwatersheds. Each of these subwatersheds has a diverse assemblage of sensitive species, wetlands, forest, and other significant habitat areas.

Kent County is one of the oldest working landscapes in North America and one of the last intact colonial and early American landscapes anywhere. Archeological sites, historic buildings, old churches, and traditional landscapes are all evidence of Kent County's long and significant history. These historic sites and structures remind us of our cultural richness and provide a reassuring sense of time and place. The importance of these resources has been recognized by the state and federal governments through the designation of Maryland Routes 213, 20, and a portion of 445 as a National Scenic Byway and the inclusion of the majority of the County in the Stories of the Chesapeake Heritage Area.

B. Current and Projected Demographic Characteristics

Kent County continues to have the lowest population of any County in Maryland, but in 2010, the Census reported the County's highest population to date. The County's 2010 population of 20,197 represents approximately an 5.2% increase since 2000. This growth rate has been significantly lower than nearby counties, the Upper Eastern Shore region, and the State and is projected to continue to slowly increase at least through the year 2010. The Maryland Department of Planning projects Kent County's population will reach 20,500 by the year 2010, 21,250 by the year 2015 and 22,050 by 2020.

The County's population density (people per square mile) did not change significantly from 1960 to 1980. However, the County's population density has increased slightly from 2000 to 2010 to 72.9 people per square mile.

Table 2: Population

	2000 Census	2010 Census	Percent Change
State of Maryland	5,296,486	5,773,552	9.0
Upper Eastern Shore	209,295	239,951	14.6
Kent County	19,197	20,197	5.2
Betterton	376	345	-8.2
Chestertown	4796	5,252	10.7
Galena	428	612,	43.0
Millington	416	642	54.3
Rock Hall	1396	1,310	-6.2

Source: Census of Population 2000, 2010

Kent County's population reflects an out-migration of young adults and an in-migration of older age groups, especially those of retirement age. Since 1997, there has been a slow but steady decline in the number of school-age children, while the number of citizens over 60 has continued to increase. The Maryland Department of Planning projects this trend to continue. In 2000, the median age for the County was 41.3 years compared to 36 years for the entire State, and in 2010 the median age was 45.6 compared to 38 years for the State. Over 29% of the County's population was over 60 years old compared to almost 18% for the State.

Table 3: Population Projections by Age

	2010		2020		2030		2040	
Age	Pop.	%	Pop.	%	Pop.	%	Pop.	%
0-4	1,000	5.0	900	4.2	910	4.0	970	4.1
5-19	3,440	17.0	3,520	16.4	3,420	15.1	3,500	14.8
20-44	5,500	27.2	5,370	25.0	5,490	24.2	5,350	22.7
45-64	5,870	29.1	5,810	27.0	5,050	22.2	5,480	23.2
65+	4,400	21.8	5,900	27.4	7,830	34.5	8,300	35.2
Total	20,200		21,500		22,700		23,600	

Source: Census of Population, Maryland Department of Planning, May 2012

C. Business and Economic Characteristics

The county's 730 businesses employ 6,600 workers. Such diverse businesses as Chester River Health System, Washington College, Dixon Valve & Coupling and David A. Bramble call Kent County home. Washington College, the first college founded in the new United States, offers over 25 major fields of study in both undergraduate and graduate programs to 1,500 students.

Kent County encourages growth and development of clean industrial and agriculture-related businesses. Close proximity to the Chesapeake Bay and major tributaries offer opportunities for environmental, aquaculture and tourism businesses.

Table 4: Top 10 Employers (2013)

Employer	Product/Service	Employment
Washington College	Higher education	723
Shore Medical Center at Chestertown	Medical services	547
Dixon Valve & Coupling	Valves and couplings	375
Angelica Nurseries*	Plants and flowers	230
Heron Point of Chestertown	Nursing care	191
LaMotte	Chemical testing equipment	166
David A. Bramble	Paving and road constr.	164
YMCA Camp Tockwogh*	Recreation facility	120
Waterman's Crab House*	Restaurant	110
Gillespie & Son	Concrete products	97

Excludes post offices, state and local governments; includes higher education
* Includes seasonal workers
Source: "Brief Economic Facts, Kent County, Maryland," Maryland DBED, 2014

D. Future Trends

As development in the county and population density increase, natural hazards may present an increased threat to the people and structures of the County and also an increased need to mitigate. Between 2000 and 2010, the County's population increased by 5.2 percent. The U.S. Census projects a 2.5 percent increase from 2010 to 2015.

Building codes currently in place do not always address extreme conditions occasionally experienced in the County. Older structures built before 1940 or the establishment of building codes are particularly susceptible to damage. Natural hazards can also cause power supply disruptions and upset transportation systems.

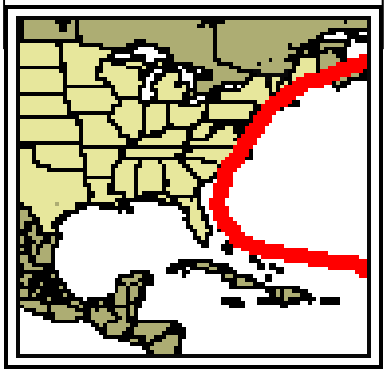
The entire county may be affected by natural hazards. However, aged, dilapidated, and poorly constructed buildings, and buildings not constructed to applicable building codes are more susceptible to weather hazards. According to the 2010 Census, Kent County consists of a total of 10,549 housing units. According to the 2006-2010 American Community Survey 5-Year Estimates, approximately 2,338 (+/-273) of those housing units were built prior to 1940, approximately 22% percent of the County's housing units. Manufactured housing units are especially susceptible to extreme weather events.

Chapter I: Hurricanes

Section I: Nature, History, and Local Profile

A. Nature

Figure 3 – Hurricane Path



Hurricanes and tropical storms, as well as tropical depressions, are all tropical cyclones defined by the National Weather Service's National Hurricane Center (NHC) as warm-core non-frontal synoptic-scale cyclones, originating over tropical or subtropical waters, with organized deep convection and a closed surface wind circulation about a well-defined center. Once formed, a tropical cyclone is maintained by extracting heat energy from the ocean at high temperatures and releasing heat energy at the low temperatures of the upper troposphere. They tend to develop in the Atlantic Ocean off the coast of Africa and travel in a northwesterly direction (Figure 3). Hurricanes and tropical storms bring heavy rainfalls, storm surge, and high winds, all of which can cause significant damage. These storms can last for several days, and, therefore, have the potential to cause sustained flooding, high wind, and erosion conditions.

Hurricanes are classified using the Saffir-Sampson Hurricane Scale which rates the intensity of hurricanes based on wind speed and barometric pressure measurements and is used by the National Weather Service to predict potential property damage and flooding levels from imminent storms.

Table 5: Saffir-Sampson Scale and Typical Damages

Category	Sustained Wind Speeds (mph)	Surge (ft)	Pressure (mb)	Typical Damage
Tropical Depression	<39	~	~	
Tropical Storm	39-73	~	~	
Hurricane 1	74-95	4-5	>980	*Minimal* – Damage is done primarily to shrubbery and trees, unanchored manufactured homes are damaged, some signs are damaged, no real damage is done to structures on permanent foundations.
Hurricane 2	96-110	6-8	965-980	*Moderate* – Some trees are toppled, some roof coverings are damaged, major damage is done to manufactured homes.

Hurricane 3	111-129	9-12	945-965	*Extensive Damage* – Large trees are toppled, some structural damage is done to roofs, manufactured homes are destroyed, structural damage is done to small homes and utility buildings.
Hurricane 4	130-156	13-18	920-945	*Extreme Damage* – Extensive damage is done to roofs, windows, and doors; roof systems on small buildings completely fail some curtain walls fail.
Hurricane 5	>157	>18	<920	*Catastrophic Damage* – Roof damage is considerable and widespread, window and door damage is severe, there are extensive glass failures, some buildings fail completely.

The potential for a storm surge, which is an abnormal rise in sea level accompanying a hurricane of other intense storm, cannot be overlooked when assessing hazards. Storm surge can be modeled by various techniques; one such technique is the use of the National Weather Service's Sea, Lake and Overland Surges from Hurricanes (SLOSH) model. The model is used to predict storm surge heights based on hurricane category. Surge inundation areas are classified based on the category of hurricane that would cause flooding. From the SLOSH maps, it may be concluded that the VE zones (high velocity zones) would be inundated during a Category 1 storm. As the category of the storm increases, more land area will become inundated. Storm surge is also a major component of nor'easter storms along the East Coast of the U.S. because winds move from a north and/or eastward position across the ocean towards shore and form large waves.

For Kent County, the maximum SLOSH model surge values, NGVD29, are:

Category 1 hurricanes 5 - 7 feet
Category 2 hurricanes 7 - 11 feet
Category 3 hurricanes 11 - 19 feet
Category 4 hurricanes 19 - 24 feet

The Delmarva Hurricane Evacuation Study includes a storm surge map that identifies the following approximate areas in Kent County that experience various degrees of storm surge.

Category 1 – Mainly in and around Rock Hall
Category 2 – Mainly in and around Rock Hall and Millington
Category 3 – Inland along the Chesapeake Bay and Chester River (Rock Hall, Millington and Chestertown)
Category 4 – Inland along the Chesapeake Bay, Langford Creek, and the Chester and Sassafras Rivers and their tributaries (Rock Hall, Millington, Chestertown and Betterton)

B. History

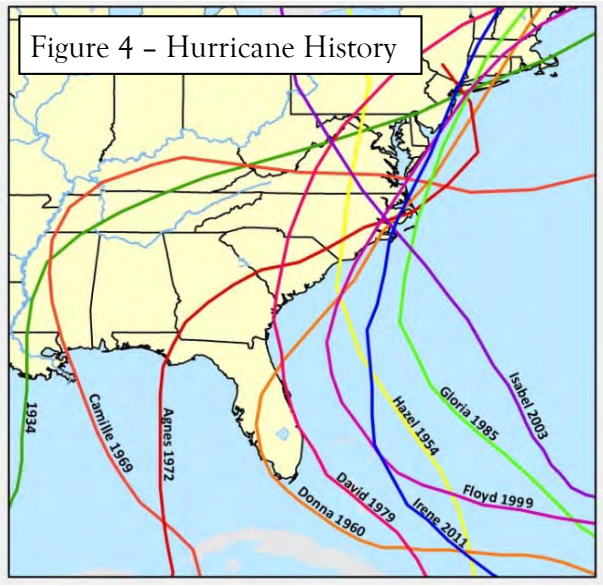


Figure 4 – Hurricane History

From 1954 to 2012, ten major hurricanes or tropical storm systems affected Kent County, causing large-scale interruption of power, impassable roads, and extensive property damage (See Table 6 at the end of this section). In October 1954, Hurricane Hazel struck the Eastern Shore with winds up to 100 miles per hour. The resulting damage was the worst in history, prompting President Eisenhower to declare Kent County a critical disaster area. Damage estimates in the county are unknown, but county residents lost power for 18 hours. In 1960, Hurricane Donna produced 8 inches of rain and caused extensive damage to roads and crops in the County. Hurricane Camille is said to have been the worst storm ever to hit the mainland of the United States. Said to have brought wind gusts in excess of 200 miles per hour and tidal surges over 20 feet, Camille hit Kent County in 1969. Tropical Storm Agnes brought winds up to 55 miles per hour during late June 1972; 341 Kent County citizens applied for individual assistance. September of 1979 brought Hurricane David, a powerful Category 4 hurricane.

In 1995, Hurricane Gloria caused localized flooding, downed trees, and interrupted power in the County. A State of Emergency was declared and shelters were opened in Chestertown, Millington, and Rock Hall. In 1999 Hurricane Floyd (down-graded to a tropical storm when it hit Kent County) yielded another Declaration of Disaster and caused flooding in Millington and Worton. Several homes in Millington were later acquired through FEMA and county funding. In 2003, Kent County was struck by Isabel, a category 2 hurricane. Isabel's tidal surge destroyed homes in and around Rock Hall and Chestertown. High winds brought down trees and power lines throughout the County.

In August 2011, the county was affected by Hurricane Irene. Approximately 30-40% of the Town of Millington was under water and one shelter was opened for one night. Eleven homes sustained major or minor damage which left them uninhabitable, and five homes were affected (some damage but useable without repairs). In addition, there were 42 separate road closures due to downed trees or powerlines, encroaching water and complete washouts. In October 2012, Superstorm Sandy caused widespread impacts throughout the county. There was minor flooding, downed trees and power outages. Schools and county offices were closed for two days.

Nor'easters are extra tropical storms occurring during the period from late fall to early spring and affect the east coast of the United States. Low pressure systems develop off the east coast leading to storms that bring strong northeast winds, heavy rains/precipitation and storm surge to coastal areas. Although nor'easter winds and storm surge might be less intense than that of hurricanes,

nor'easters can hover for several days over a given area. These long duration storms allow larger accumulations of precipitation as well as more damage to structures as they are exposed to wind and flooding for long periods of time. Additionally, the long duration of nor'easters typically leads to wide spread coastal change though erosion and accretion along the shoreline.

Table 6: History of Hurricanes

Year	Event	Description	Amount of Damages
1954	HURRICANE HAZEL	Hurricane Hazel produced power outages for 18 hours in Kent County.	Unknown
1960	HURRICANE DONNA	Hurricane Donna produced 8" of rain and caused excessive damage to roads and crops in Kent County.	Unknown
1969	HURRICANE CAMILE	Hurricane Camille is said to be the worst storm ever to hit mainland United States, with winds in excess of 200 mph and tides over 20 feet.	Unknown
1972	HURRICANE AGNES (DECLARATION OF DISASTER)	Disaster was declared and 341 citizens applied for individual assistance.	Unknown
1979	HURRICANE DAVID	Hurricane David was a powerful Category 4 hurricane that hit the Southeastern United States in early September 1979 after killing over 2,000 in the Dominican Republic. It had been a Category 5 storm for 36 hours in late August.	Unknown
1985	HURRICANE GLORIA (DECLARATION OF DISASTER)	Shelters were opened at the following schools: Millington Elementary School, Chestertown Middle School and Rock Hall Middle School. Localized flooding and downed trees and power outages were reported throughout the County. State of Emergency declared for all of the Eastern Shore and counties surrounding the Chesapeake Bay. There were no storm related injuries.	Unknown
1999	HURRICANE FLOYD (DECLARATION OF DISASTER)	The Kent County Emergency Operations Center was activated to respond to the hundreds of calls for help as a result of Tropical Storm Floyd as it skirted Kent County. Especially hard hit was the Millington area where inland flooding occurred. Many families were evacuated to a shelter at the Millington Fire House. Dams spilled over resulting in riverine flooding in the area of Montebello Lake Road.	Several homes were later bought out by FEMA.

2003	HURRICANE ISABEL (DECLARATION OF DISASTER)	Storm surge peaked around 0330 hours on September 19, 2003 in Kent County and measured 9-11 feet in some areas. Hardest hit areas were from Cottage Ave in Rock Hall to the Rock Hall Harbor, Gratitude Point, Swan Creek, Piney Neck, Skinners Neck, Langford Neck, Quaker Neck and the Chestertown waterfront. A FEMA Disaster Field Office was opened in Rock Hall and over 300 citizens registered for assistance.	Unknown
2011	HURRICANE IRENE (DECLARATION OF DISASTER)	30-40% of Millington experienced flooding. Over 42 road closures and widespread power outages.	Unknown
2012	HURRICANE SANDY (DECLARATION DISASTER)	Widespead power outages, downed trees, minor flooding	Unknown

Source: Kent County Emergency Management Hazard Analysis

C. Profile

All of Kent County could be affected by a hurricane or tropical storm. Since they can disrupt power and inundate roads, they can wreak havoc on the entire community. The Chester and Sassafras Rivers run through developed areas with considerable potential for flooding. Communities also sit on the Chesapeake Bay and are susceptible to tidal surge and accretion. Kent County is surrounded by water bodies, most of them tidal. Nearly all of the County's municipalities, villages, and communities have been affected by hurricane and tropical storm affects.

Section II: Vulnerability – Hurricane Winds

For vulnerability analysis of storm surge and flooding (riverine, flash, and coastal) refer to Chapter 2: Riverine, Flash, and Coastal Flooding.

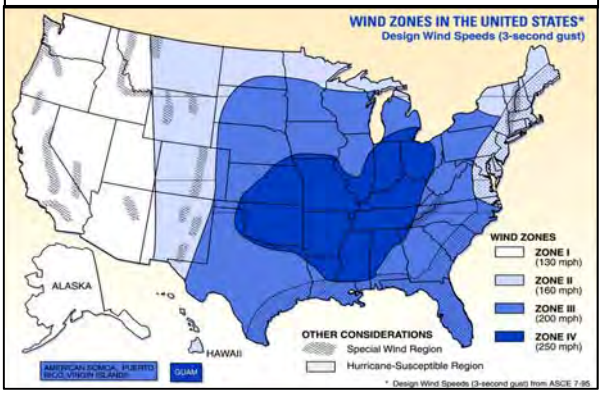
A. Current Trends

The primary hazard caused by winds is the transport of debris, which can cause casualties and property loss. Another significant hazard caused by winds is the toppling of trees (namely trees with extensive root structures located in highly erodible soils along shorelines). A less probable hazard involves the dislodging of mobile homes from their foundations or displacing vehicles. High winds may also cause damage to poles and lines carrying electric, telephone, and cable television service.

Since high wind events may affect the entire County, it is important to identify specific critical facilities and assets that are most vulnerable to the hazard. Evaluation criteria include age of the building (and what building codes may have been in effect at the time of construction), type of construction, and condition of the structure (i.e., how well has the structure been maintained). Data for individual structures were not available for this study rendering it difficult to determine the exact number and types of structures in Kent County that have a heightened vulnerability to wind hazards.

FEMA's publication, Taking Shelter from the Storm, October 1998, presents a map of four wind zones in the U.S. (Figure 5) and provides design wind speeds for shelters and other critical facilities. Zone IV shows the areas of highest wind activity which are situated in the Midwest and Tornado Alley, while Zone I shows the areas of lowest activity which are in the western U.S. All of Kent County is mapped in Zone II. For shelters and critical facilities in this zone, a design wind speed of 160 mph is recommended.

Figure 5: Wind Speed Zones



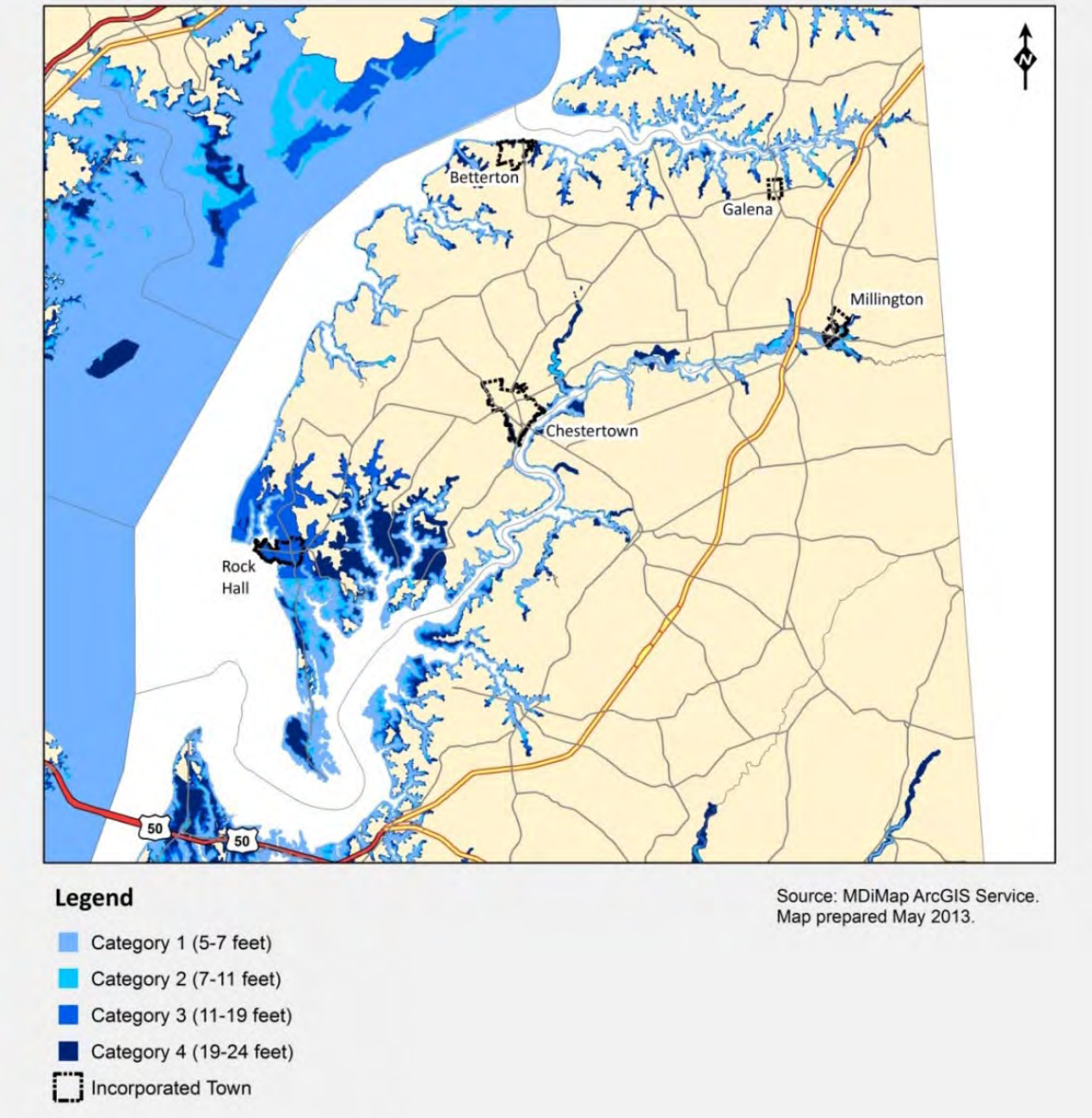
Kent County's coastal location lends itself to being somewhat vulnerable to hurricanes originating in the Atlantic and working their way up to the mid-Atlantic region. These hurricanes, although rare in occurrence, bring not only the threat of flooding, but also damage from wind. Figure 6-1 of The American Society of Civil Engineers (ASCE) publication, Minimum Design Loads for Buildings and Structures, 1998 (also referred to as ASCE 7-98) shows that for Kent County the design wind speed (3-second gust) for structures ranges from 90 to 100 mph. While most of the continental U.S. is mapped as having a design wind speed of 90 mph, the Atlantic and Gulf Coast areas have design wind speeds ranging from 100 mph to 150 mph (along the tip of the Florida peninsula and a portion of the Gulf Coast).

Critical facilities are typically vulnerable to wind damage due to the age of construction and possible poor condition, especially in the more rural and isolated areas of the County. No specific critical facilities were identified as vulnerable to strong winds; however, the County's emergency communications capabilities may be vulnerable to disruption. The County has uninterrupted power source (UPS) and generator back-up. There are 15 critical facilities identified in the floodplain in Chapter 3; however none of these facilities are located within the Velocity Zone. Not categorized as Critical Facilities, the County does own structures which are located in VE zones. They are Bayside public landing in Rock Hall, the public bathhouse in Betterton, and the Coast Guard Station in Still Pond.

From the MEMA storm surge inundation map (Figure 6), it may be concluded that the VE zones would be inundated during a Category 1 storm. As the category of the storm increases, more land

area will become inundated. Storm surge is a major component of nor'easter storms along the East Coast of the U.S. Because winds are moving from a north and/or eastward position, winds move across the ocean towards shore and form large waves.

Figure 6 – Storm Surge Inundation



B. Data Limitations

Vulnerability to severe weather hazards is primarily determined by structure-specific information such as age, condition, and type of construction; however, this level of information was not available during the development of this Plan. As GIS and other administrative and technical capabilities of the County and its municipalities improve, structure-specific information will be developed and used in the subsequent versions of this plan.

Section III: Mitigation

A. Ensure adequate protection of critical facilities and infrastructure.

Reduce possibility of damage and loss to existing community assets including public structures, critical facilities and infrastructure due to flooding and other hazard events.

1. *Discussion*: Warning systems like sirens could be used to alert critical facilities that house or service large numbers of people to give them extra time to reach emergency shelters.

   Project: Install early warning devices (NOAA weather radios) in critical facilities such as all schools and nursing homes and other facilities such as group homes, marinas, and seasonal camp sites in the County. Ensure there is adequate coverage from the NOAA towers to the whole county. Areas located within inundation areas should be equipped with early warning devices.

   Responsible Organizations: Kent County Emergency Management, municipalities

   Possible Funding Sources: To be investigated

   Timeline for Implementation: 1 year

   Program: Capital Improvements Project

2. *Discussion*: The availability of backup power sources (generators) for medical facilities, nursing homes, police and fire departments, and rescue and emergency management personnel is critical for the efficient function of any community during a disaster.

   Project: Engineering services should provide specifications for backup generators and fuel tanks to provide the municipalities and County with a continuous source of electrical power. Pre-wiring should be considered in all new buildings (schools and emergency shelters) or when upgrades or retrofits are made to these facilities.

   Responsible Organizations: Kent County Planning, Kent County Emergency Management, municipalities

   Possible Funding Sources: No funding necessary

   Timeline for Implementation: 6 months

   Program: Capital Improvements Project

B. Increase public awareness and need for hurricane mitigation.

1. *Discussion*: Develop a hurricane readiness public awareness campaign that will be a long-term initiative providing consistent educational opportunities to advance the community's knowledge and skills.

   Project: Identify and solicit low/no cost partners to create awareness and promote outreach and conduct a business continuity planning workshop to promote disaster resistance, mitigation, and preparedness to help businesses develop contingency plans to minimize loss during disasters.

   Responsible Organizations: Kent County Emergency Management, Kent County Public Works, municipalities

   Possible Funding Sources: Regular employee pay

   Timeline for Implementation: 1 year

   Program: Kent County Emergency Management

2. *Discussion*: Develop a plan to make guidance documents available to the general public regarding hurricane preparedness.

   Project: The Delmarva Emergency Task Force (DETF) has developed a guidance document to ensure regional coordination in the event of a hurricane, tropical storm, or nor'easter event in the region and to provide guidance in terms of communications, public information, alerting and warning, shelters, evacuation, re-entry and recovery, training and education. This guidance document must be available in the County library and at the County's Office of Emergency Services.

   Responsible Organizations: Kent County Planning, Kent County Tourism and Economic Development, Kent County Emergency Management, municipalities

   Possible Funding Sources: To be investigated

   Timeline for Implementation: 1 year

3. *Discussion*: The County's Office of Emergency Services should continue to work with the American Red Cross to develop and implement a hurricane preparedness plan. Coordinate between agencies such as volunteer fire companies, emergency management, and police departments.

   Responsible Organizations: Kent County, Emergency Management, American Red Cross

   Possible Funding Sources: No funding necessary

   Timeline for Implementation: Ongoing

   Program: Kent County Emergency Management's public outreach program.

C. Ensure County residents are aware of evacuation procedures.

Discussion: The Delmarva Task Force provides guidelines for who should evacuate and who should shelter-in-place so that visitors and residents may make appropriate decisions. It is also the policy of the Evacuation Work Group of the Delmarva Task Force to review regional evacuation plans annually and make recommendations for changes to the County's

transportation and law enforcement departments. The Task Force recommends encouraging visitors and local residents to contact the Office of Emergency Services (OES) to obtain evacuation information. Refer to the Delmarva Evacuation Study for information on evacuation routes, timing, capacities, inundation areas, etc.

Project: The Office of Emergency Services should have available all information needed for residents and visitors to make informed decisions regarding evacuating the County.

Program: Kent County Office of Emergency Services

Responsible Organizations: Kent County, Emergency Management, State Highway Administration, municipalities

Possible Funding Sources: No funding necessary

Timeline for Implementation: 3 months

Discussion: The advent of social media has provided new mechanisms for broadcasting information to a wider audience and in real time. The County OES currently has accounts on Facebook, Twitter, Pinterest and Instagram. The County also uses Global Connect's Emergency Notification System which allows staff to record and send a message to telephone numbers within a matter of minutes. All land lines are included in the database and the system allows residents to register for cell phone, email, text and other phone services.

Project: Continue to make use of available technology and social media outlets that allow for quick desimmination of information.

Program: Kent County Office fo Emergency Services.

Responsible Organizations: Kent County, Office of Emergency Services

Possible Funding Sources: No funding necessary

Timeline for Implementation: Ongoing

Chapter 2: Riverine/Flash Flooding and Coastal Flooding/Tidal Surge

Section I: Nature, History, and Local Profile

Floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and the related probability of occurrence. The probability of a flood is based on a statistical chance of a particular size flood (expressed as cubic feet per second of water flow) occurring in any given year. The annual flood is usually considered the single greatest event expected to occur in any given year. Flood studies use historical records to determine the probability of occurrence for different extents of flooding. The probability of occurrence is expressed as the percentage chance that a flood of a specific extent will occur in any given year. The extent of flooding associated with a 1% annual probability of occurrence—the base flood—is used as the regulatory boundary by a number of agencies.

Also referred to as the "Special Flood Hazard Area" (SFHA), this boundary is a convenient tool for assessing vulnerability and risk in flood prone communities since many communities have maps available that show the extent of the base flood and likely depths that will be experienced. The base flood is often referred to as the "100-year flood." Experiencing a 100-year flood does not mean a similar flood cannot happen for the next 99 years; rather, it reflects the probability that over a long period of time, a flood of that magnitude should occur in only 1% of all years. Smaller floods occur more often than larger and more widespread ones. Table 7 shows a range of flood recurrence intervals and their probabilities of occurrence. So every year, a 10-year flood has a greater likelihood of occurring (10% chance) than a 100-year flood (1% chance).

Table 7: Flood Probability Terms

Flood Recurrence Intervals	Chance of occurrence in any given year
10-year	10%
50-year	2%
100-year	1%
500-year	0.2%

A. Riverine and Flash Flooding

Riverine and Flash Flooding – Nature

Flash floods, as the name suggests, occur suddenly after a brief but intense downpour. They move fast and terminate quickly. Although the duration of these events is usually brief, the damages can be quite severe. Flash floods also result as a secondary effect from other types of disasters including large wildfires and dam breaks. Wildfires remove vegetative cover and alter soil characteristics, increasing the quantity and velocity of stormwater runoff and dam breaks release large quantities of water into receiving drainageways in a very short timeframe. Flash floods are the number one weather-related killer. For the period of 1988-2012, there was an average of 80 deaths each year due to the direct results of flash flooding and flood events across the United States.

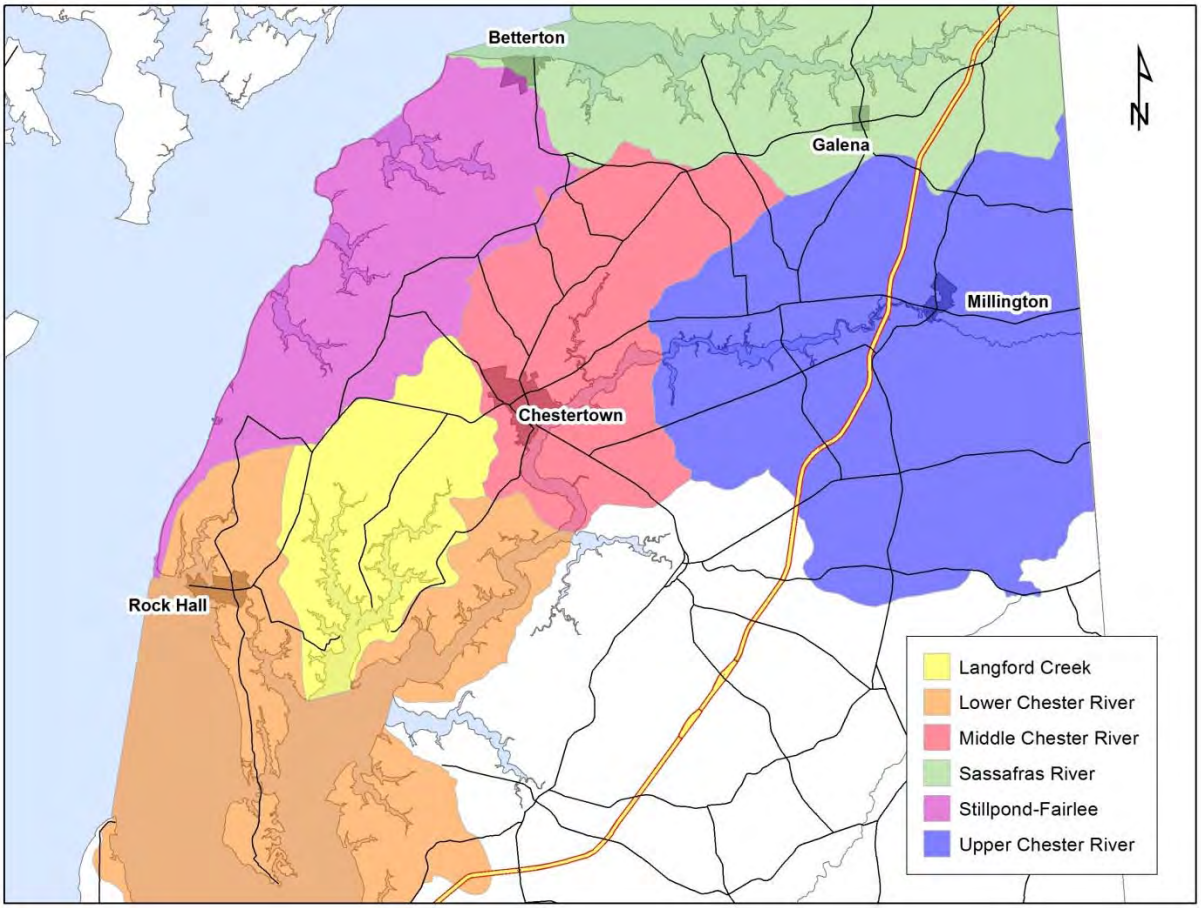
Based on the Maryland Hazard Analysis (January 2000), Kent County is prone to various forms of flooding. The Summary of Hazard Risk table for Kent County from the aforementioned report categorizes the County as being at medium-high risk for coastal, flash, and riverine flooding. The floodplain map for the County indicates floodplains intersecting urban areas in Chestertown, Millington, Rock Hall, and the Chesapeake Bay in general.

The low lying, relatively undisturbed topography, high seasonal water tables, poor drainage and high runoff characteristics of the soils combine to expose Kent County with a high potential to be flooded. When heavy rainfall and a high river discharge combine with storm tides, low lying areas adjacent to rivers and estuaries become inundated with saltwater.

The areas within the County that are not within the 100-year flood plain have a relatively smaller risk of being flooded. However, flood risks could also arise from one or more of the following: drainage areas of less than one square mile; sewer backup; drainage system backup; dam breaches; and storm water runoff problems. The area of floodplain/urban intersection is evident around Chestertown, Millington, Rock Hall and near the Bay in general.

There are six major drainage areas in Kent County: The north-western portion of the county drains into the Sassafras River; the western portion drains into Still Pond and Fairlee Creeks; the south-western and eastern portion drains into the Lower Chester River; the southern portion of the county drains into Langford Creek; the eastern portion drains into the Middle Chester River basin; and the north-eastern portion drains into the Upper Chester River basin.

Figure 7 – Major Drainage Areas



Riverine and Flash Flooding – History
Kent County experienced heavy rains and flooding on October 4, 1975. A Declaration of Disaster was made and Kent County applied for individual and public assistance. Impacts of this flood and damage estimates are not available. Another flood event affected the County during Tropical Storm Floyd on September 16, 1999. Damage was extensive throughout the County, including damage to a dam in Worton and a bridge in Kennedyville. However, hardest hit by riverine flooding was Millington where many families were evacuated to a shelter at the Millington Fire House. A third flood event occurred during Hurricane Irene on August 27-28, 2011. Millington was again the hardest hit community, with 30-40% of the town under water. A shelter was open for one night, and nine homes sustained major damage.

Riverine and Flash Flooding – Profile
Riverine floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and the related probability of occurrence. Flooding is exacerbated by low lying, relatively undisturbed topography, high water tables, poor drainage, constrictions from filling or other obstructions and certain soil characteristics.Flood studies use historical records to determine the probability of occurrence for different extents of flooding. The probability of occurrence is expressed as the percentage chance that a flood of a specific extent will occur in any given year

On the other hand, flash floods cannot be predicted accurately and happen whenever there are heavy storms. Flash floods are more likely to occur in places with steep slopes and narrow stream valleys, and along small tributary streams. In urban areas, parking lots and other impervious surfaces that shed water rapidly contribute to flash floods. In rugged, hilly, and steep terrain, the high-velocity flows and short warning time make these floods hazardous and very destructive. Flash floods can also be a result of improper drainage.

Flood damage to residences can be devastating, both emotionally and financially. Flood damage to businesses can result in loss of income, wages, and tax revenues. Other effects include outbreaks of disease, widespread animal illness, disrupted utilities, water pollution, fire, and wash away of roads and culverts.

A total of five major floods were documented in the County between 1960 and 2003 based on information from the National Climatic Data Center. Of these, one that was devastating was the flashflood/riverine flooding caused by Hurricane Floyd in September 1999. The torrential downpours associated with Hurricane Floyd exceeded the 100-year-flood return period for most of the Eastern Shore. All of the Maryland Eastern shore was declared as a disaster area. Hurricane Irene in August 2011 caused serious flooding in Millington due to significant rain.

The Chester River Basin includes the drainage areas of Morgan Creek, Unicorn Branch, and Chesterville Branch. Flooding from Hurricane Floyd exceeded the estimated 500-year recurrence interval on Morgan Creek. The recurrence interval on Chesterville Branch was not computed because the gauging station has not been in operation long enough to provide the data needed to produce meaningful statistics. The flood level on Morgan Creek, located east of Kennedyville,

exceeded the stage experienced in 1972, when Tropical Storm Agnes hit the region. The peak stage in September 1999, 15.03 feet, exceeded the previous record in 1972 by almost 2 feet; the calculated peak discharge was 11,200 ft3/s.

Kent County has experienced a number of floods in the past several decades. Table 8 indicates that five major riverine and flash flooding events have taken place between 1960 and 1999 (40 year period). Few detailed records of these historical floods and the damage incurred is available.

Table 8: History of Riverine and Flash Floods

Year	Event	Description	Amount of Damages
1960	HURRICANE DONNA	Hurricane Donna produced 8" of rain and caused excessive damage to roads and crops in Kent County.	Unknown.
1972	HURRICANE AGNES (DECLARATION OF DISASTER)	Disaster was declared and 341 citizens applied for individual assistance.	Unknown.
1975	HEAVY RAINS & FLOODING (DECLARATION OF DISASTER)	A Disaster was declared and Kent County applied for individual and public assistance.	Unknown.
1985	HURRICANE GLORIA (DECLARATION OF DISASTER)	Shelters were opened at the following schools: Millington Elementary School, Chestertown Middle School and Rock Hall Middle School. Localized flooding and downed trees and power outages were reported throughout the County. State of Emergency declared for all Eastern Shore and counties surrounding Chesapeake Bay. No storm related injuries.	Unknown.
1999	HURRICANE FLOYD (DECLARATION OF DISASTER)	The Kent County Emergency Operations Center was activated to respond to the hundreds of calls for help as a result of Tropical Storm Floyd as it skirted Kent County. Especially hard hit was the Millington area where inland flooding occurred. Many families were evacuated to a shelter at the Millington Fire House. Dams spilled over resulting in riverine flooding in the area of Montebello Lake Road.	Several homes were later bought out by FEMA. 11.77" of rain in Millington, MD; 14" of rain in Chestertown, MD
2011	HURRICANE IRENE (DECLARATION OF DISASTER)	30-40% of Millington experienced flooding. Over 42 road closures and widespread power outages.	Unknown

Floods have caused extensive damage in the past to parts of Kent County. Most of the damage has occurred near a body of water. Erosion and its impact on shorelines and roads is the most significant problem associated with flooding in the County.

B. Coastal Flooding

Coastal Flooding – Nature
Coastal flooding is the inundation of land areas along the coast caused by waters over and above normal tidal action that may originate from the ocean front, back bays, sounds, tidal inlets, or other bodies of water. When this inundation occurs, the surrounding landmass is flooded. Ocean storms can unload significant amounts of water on a coast, raising the sea level in that area. These are known as storm surges and cause coastal flooding.

Coastal flooding usually occurs as a result of severe storms, either tropical or winter storms. Ocean waves intensify on the open ocean, and these storms make surface water more severe than normal. Raging winds can create huge waves that crash on unprotected beaches.

Coastal flooding can result from a combination of tide and surge levels that exceed the height of sea walls but is more commonly due to wave action in combination with high water levels. Close to the shore the maximum wave height is closely related to the water depth and the amount of wave run-up and overtopping is a function of the nature and configuration of the shoreline.

Coastal Flooding – History
Kent County is surrounded on three sides by tidal rivers, tributaries, creeks, and the Chesapeake Bay. Hurricane events bring high winds to the area and tidal surges. The County has experienced six major coastal flooding events since 1954. Along the Chesapeake Bay coastline and within its tributaries, wind driven waves on top of elevated tidal levels can severely damage coastal property and endanger lives of residents.

Intense rainfall and winds associated with hurricanes, such as Camille (1969) and Isabel (2003), has caused widespread damage along the County's rivers and streams. Coastal storms primarily affect the Atlantic Coast, but also cause flooding damage along the shoreline of the Chesapeake Bay and its tributaries.

While not all riverine flooding events are hurricane-related, most coastal flooding events are related to hurricane events. Three of the documented coastal flooding events were declared federal disasters. Along with the tidal surges associated with hurricane events, direct results of coastal flooding events include power outages, wind damage to structures, downed trees, and interruption of services.

Hardest hit by coastal flooding events are residents of the Town of Rock Hall and residents of all low-lying areas around Rock Hall and the following creeks: Grays Inn, Church, Herrington, and Langford's East and West Forks.

Table 9: History of Coastal Flooding

Year	Event	Description	Amount of Damages
1954	HURRICANE HAZEL	Hurricane Hazel produced power outages for 18 hours in Kent County.	Unknown.
1969	HURRICANE CAMILE	Hurricane Camille is said to be the worst storm ever to hit mainland United States, with winds in excess of 200 mph and tides over 20 feet.	Unknown.
1972	HURRICANE AGNES (DECLARATION OF DISASTER)	Disaster was declared and 341 citizens applied for individual assistance.	Unknown.
1979	HURRICANE DAVID	Hurricane David was a powerful Category 4 hurricane that hit the Southeastern United States in early September 1979 after killing over 2,000 in the Dominican Republic. It had been a Category 5 storm for 36 hours in late August.	Unknown.
1985	HURRICANE GLORIA (DECLARATION OF DISASTER)	Shelters were opened at the following schools: Millington Elementary School, Chestertown Middle School and Rock Hall Middle School. Localized flooding and downed trees and power outages were reported throughout the County. State of Emergency declared for all Eastern Shore and counties surrounding Chesapeake Bay. No storm related injuries.	Unknown.
2003	HURRICANE ISABEL (DECLARATION OF DISASTER)	Storm surge peaked around 0330 hours on September 19, 2003 in Kent County and measured 9-11 feet in some areas. Hardest hit areas were from Cottage Ave in Rock Hall to the Rock Hall Harbor, Gratitude Point, Swan Creek, Piney Neck, Skinners Neck, Langford Neck, Quaker Neck and the Chestertown waterfront. A FEMA Disaster Field Office was opened in Rock Hall and over 300 citizens registered for assistance.	Ongoing.

Coastal Flooding – Profile

Most of the SFHA is designated as "A" zone; the National Flood Insurance Program (NFIP) uses this label for riverine/inland areas of the SFHA where base flood elevations (BFEs), the elevations of the 100-year floodplain, are determined. In Kent County, within much of this A zone, floodwater levels are controlled by tidal influences and storm surge levels. Kent County also has areas in the western part of the County designated as VE zones, or Coastal High Hazard Areas. VE zones are parts of the SFHA that are prone to velocity/wave action at least 3 feet in height during a 100-year flood. The wave action that occurs during flooding in these zones generally causes more severe damage to structures, as well as erosion, than what is experienced in nearby A zones and riverine flooding areas.

The County's Flood Insurance Rate Maps (FIRMs) show that the majority of the County's land mass in the northern, western, and the southeastern rim lie within the 0.1 percent annual chance flood (100-year floodplain) or Special Flood Hazard Area (SFHA). The National Flood Insurance Program (NFIP) uses these general labels to mark areas subject to riverine and inland flooding (A zones) and coastal flooding (V zones) where flood hazards include velocity flows, wave action, and erosion. While the BFE has been identified in much of the County, the northeastern rim of the County has holes in its BFE documentation. Several of the county's streams are also regulated floodways in which the channel and adjacent land areas must be reserved in order to discharge the base flow without increasing the base flood elevation by more than one foot.

The following maps show the SFHA areas for Kent County and its incorporated towns.

Figure 8 – Kent County Floodplain

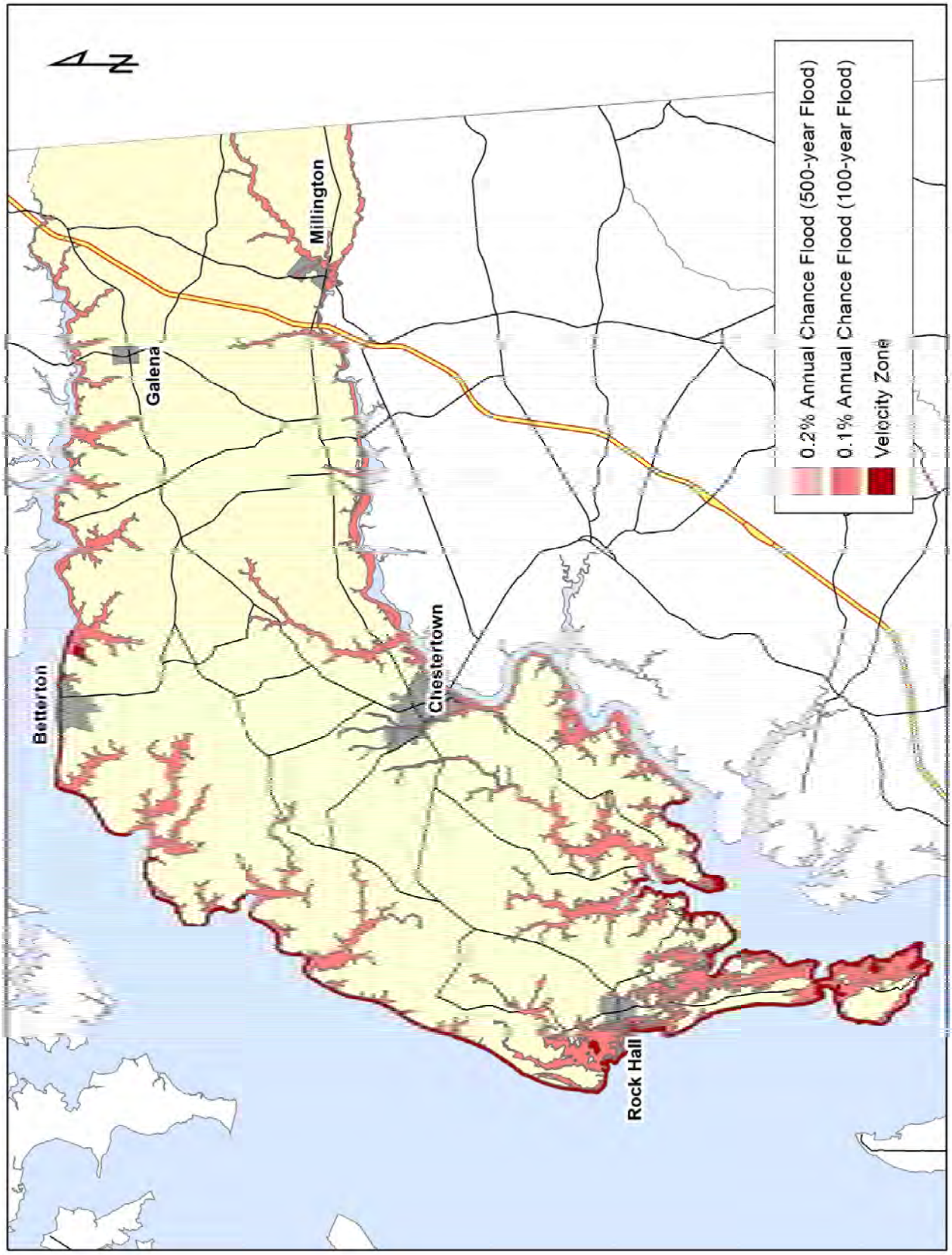


Figure 9 – Galena Floodplain

Figure 10 – Betterton Floodplain

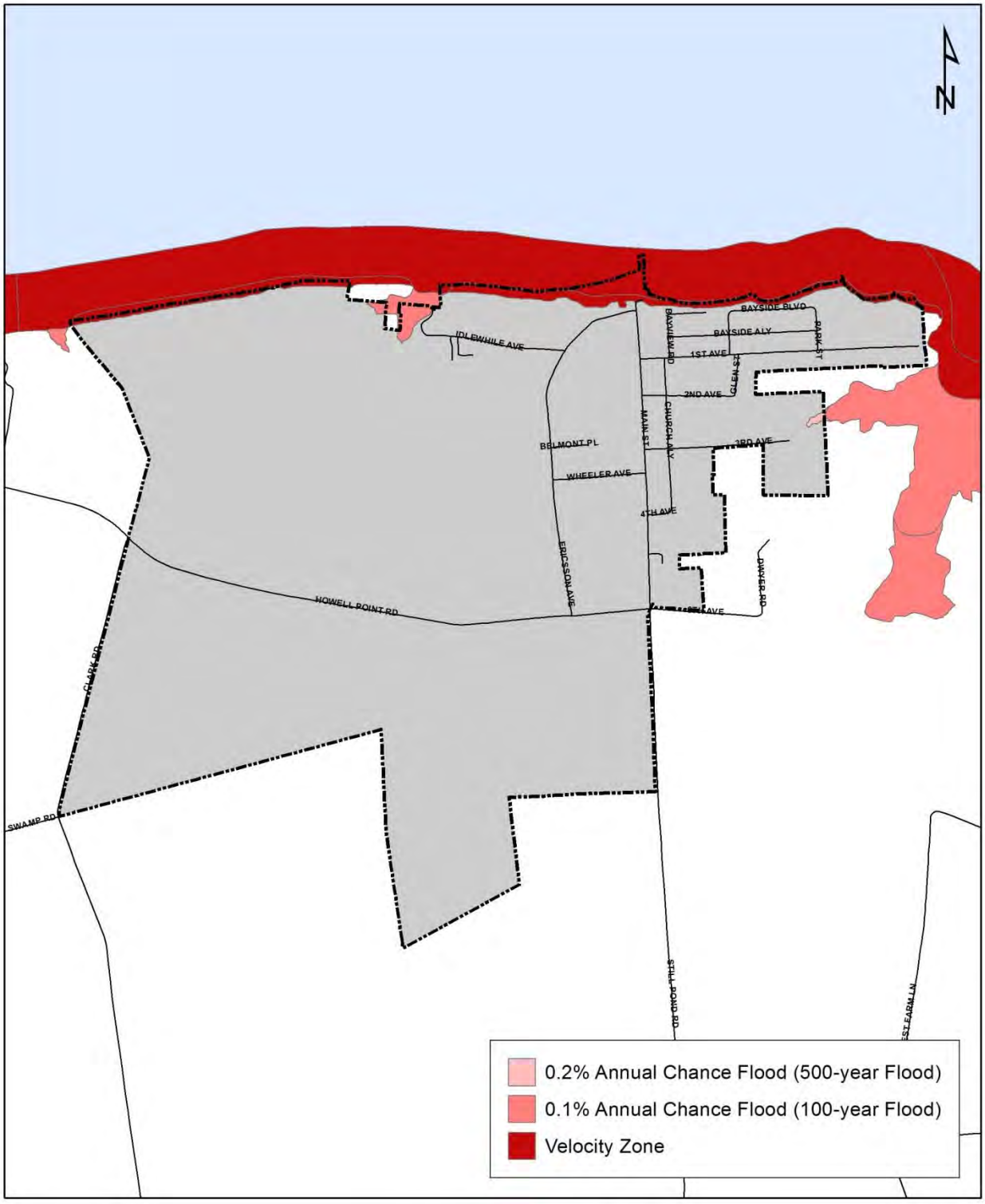


Figure 11 – Rock Hall Floodplain

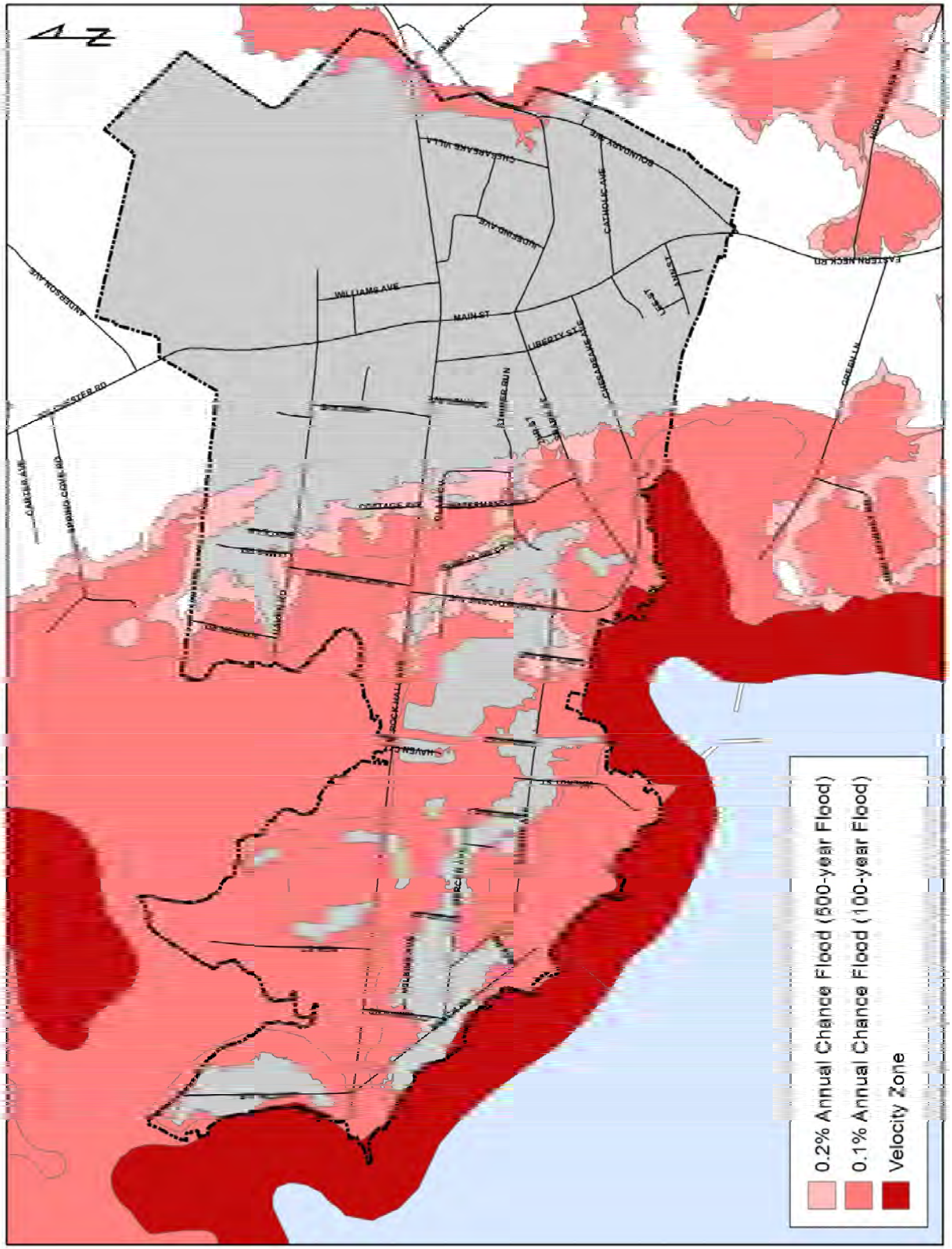


Figure 12 – Chestertown Floodplain

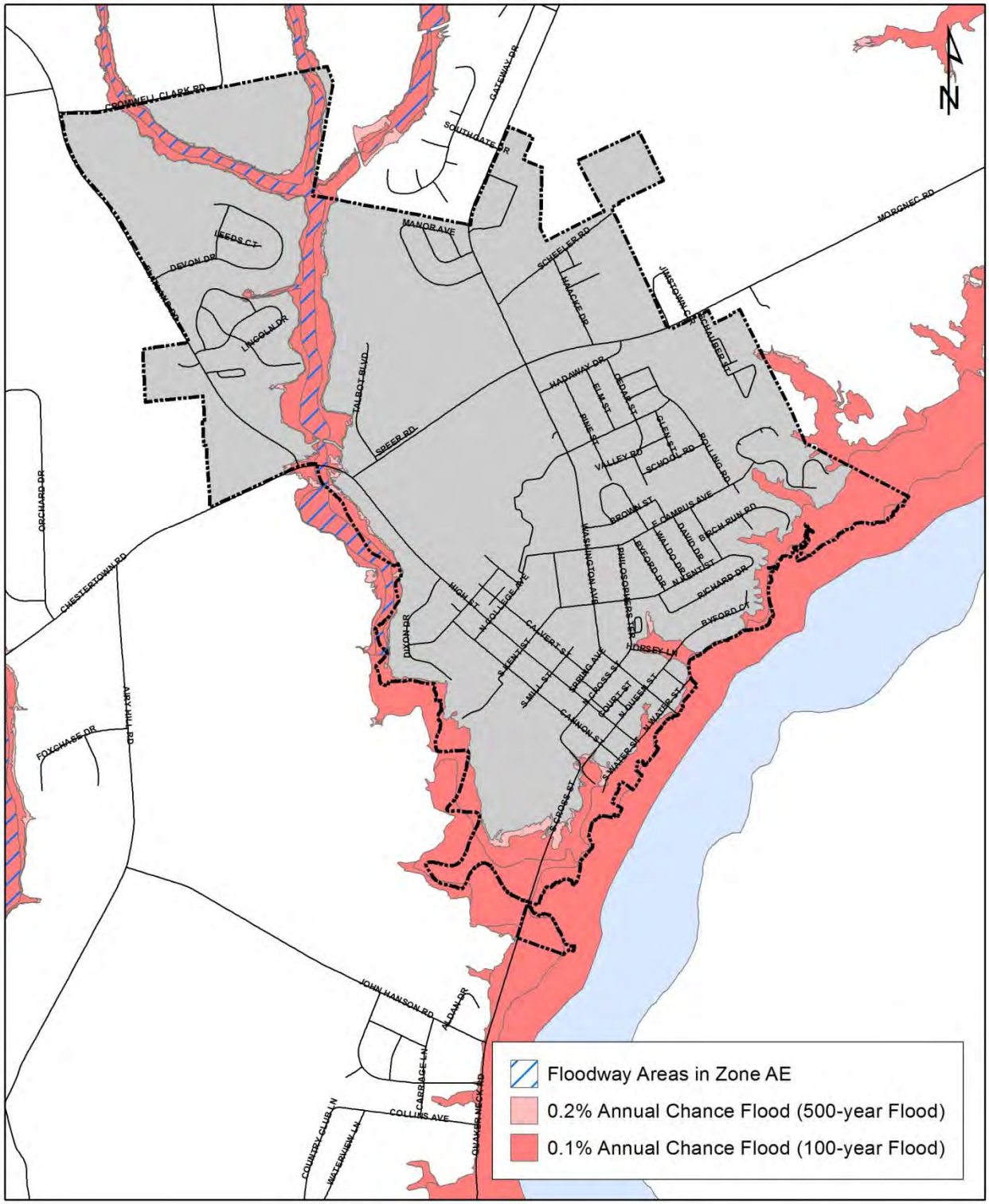
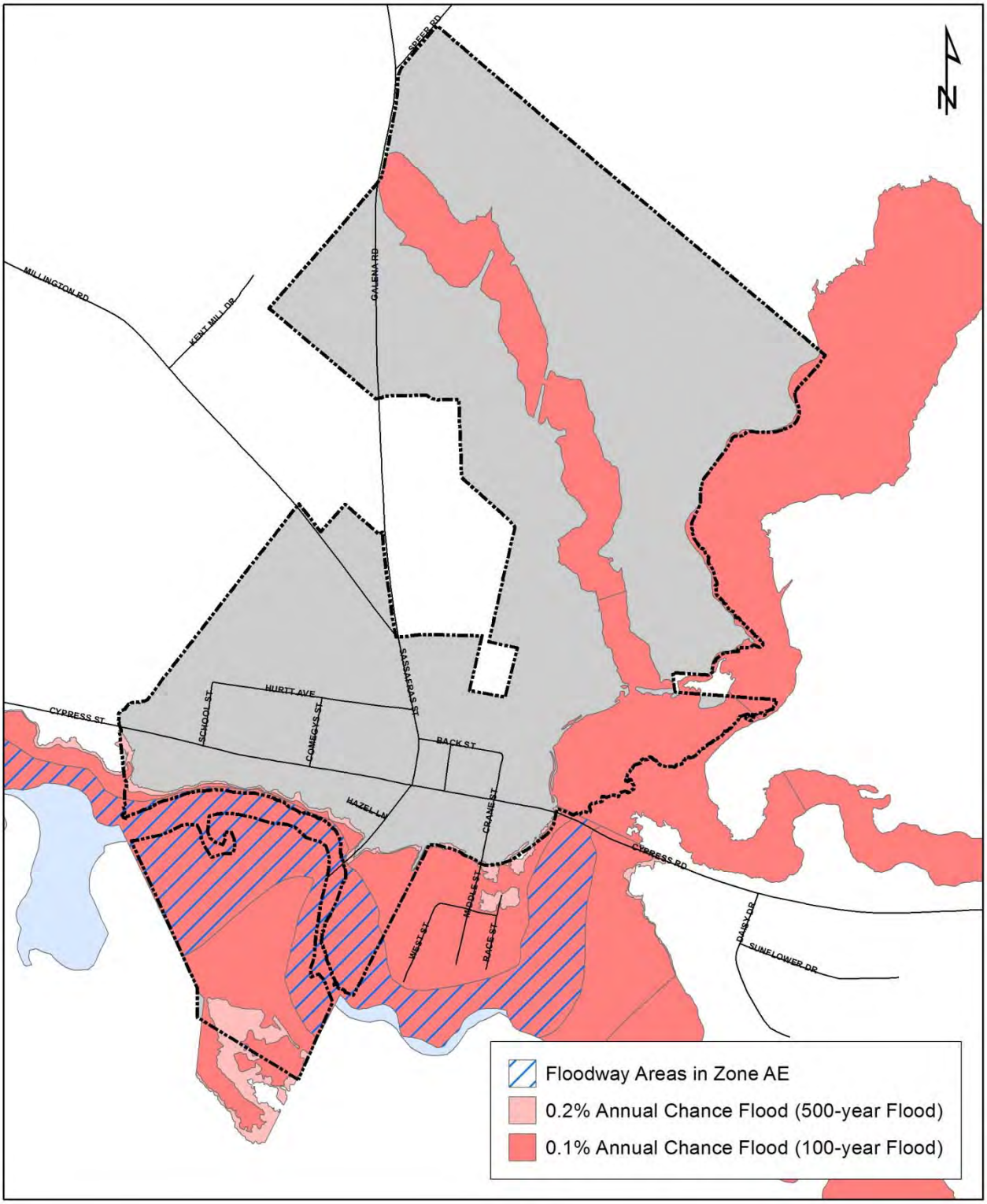


Figure 13 – Millington Floodplain



Section II: Vulnerability

Vulnerability to flood events is difficult to determine because local terrain, soil conditions, and construction play a role in how much storm water is able to run off, percolate into the soil, or cause flash flooding. Flood vulnerability is described in terms of the community assets that lay in the path of flood waters. The flood hazard vulnerability assessment for Kent County focuses on the base flood elevation, though floods of both greater and lesser flood depths are possible.

Table 10: Total Structures in Flood Zones

County	Total No. Parcels[1]	No. Parcels in SFHA	No. Parcels in SFHA with Improvements[2]		Avg. Household Size[3]		Est. No. of People in SFHA	2000 Population Data[3]	Est. Value of Improvements in SFHA[4]
Kent (Uninc.)	9,418	2,334	288	X	2.29	=	660	12,036	$54,036,000
Betterton	293	29	1	X	N/A	=	N/A	345	$222,300
Chestertown	1,995	228	97[5]	X	2.00	=	194	5,252	$27,353,400
Galena	314	0	0	X	2.26	=	0	612	$0
Millington	269	35	6	X	2.74	=	17	642	$549,900
Rock Hall	1,121	538	475	X	2.05	=	974	1,310	$65,546,800

[1] Parcel information from 2011 Edition of MdProperty View
[2] Found by locating address points for principal structures located within the SFHA. Over 2,315 parcels in the SFHA have improvements, but most improvements are located outside of the SFHA.
[3] 2010 Census Profile of General Population and Housing Characteristics.
[4] Found by totaling assessed value of improvements.
[5] Does not include 28 unbuilt units at Chester River Landing.

Critical facilities are vulnerable to flooding, but their vulnerability is dependent on their specific terrain and soil type and the amount of excess runoff from neighboring areas. Since flash floods frequently occur outside of established floodplains, one cannot say with absolute certainty that future development in a specific location in the county will be subjected to flash floods.

Floods have been and will continue to be a significant threat to the economic and social well-being of selected areas of Kent County. In particular, the towns have more population and economic assets that are vulnerable to flood damages. Exacerbating the effects of flooding in the County are areas with steep slopes or obstructions in the floodplain.

A. Current Trends

Table 10 indicates the total number or structures and total property value in each of the flood zones in the unincorporated and incorporated parts of the County. This number is useful only for illustrative purposes, as the number is representative of the number of parcels located within the 100 year floodplain with improvements. These improvements vary and are located on residential and commercial properties. The location of the flood hazard areas in the County is shown on the accompanying floodplain maps. Approximately 2,315 parcels with improvements are located in the base floodplain, but only 867 principal structures are within the base floodplain. The County's

Flood Insurance Rate Maps (FIRMs) show that 29.4 square miles (9.5%) of the County's land mass lies within the 100-year floodplain, or Special Flood Hazard Area (SFHA).

Based on the Flood Insurance Policies table and information from the State, the results of the analysis indicating the number of structures in Kent County and its incorporated areas that are vulnerable to flooding are explained. Approximately 2,315 of the parcels with improvements in Kent County lie within the 100-year floodplain. In the Town of Betterton, 1 parcel with improvements lies within the floodplain (the structure is a county-owned bathhouse). In Chestertown, 97 structures lie within the 100-year floodplain; in Millington, 6 structures lie within floodplain, and Rock Hall contains the most structures in the floodplain at 475 structures. There are approximately 288 parcels with improvements located within the 100-year floodplain in the unincorporated areas within the County. Thus a number of structures lie within areas vulnerable to flooding, where there is at least a 1 percent chance of being flooded in any given year.

Flood insurance policy information from the Maryland Department of the Environment (Table 11) indicates that as of June 30, 2013, there were no policies filed in the Town of Betterton; 83 policies filed for the Town of Chestertown; 3 for the Town of Millington, and 317 for the Town of Rock Hall. No policies have been filed for the Town of Galena. The total number of policies in the unincorporated county was 315. Kent County has a total of 718 flood insurance policies, including the incorporated towns listed above, with a total premium of $723,133 and coverages of $175,660,900.

Since 1978, a total of $8,206,350 in flood claims have been filed in Kent County. Rock Hall insurance claims total 40% of all county claims at $3,286,590. Chestertown residents have filed 12% of all county claims at $981,601. Millington resident claims total $204,082 (2.5%). Betterton resident claims total $303,618 (3.7%). Total claims filed in unincorporated areas of the County total $3,430,459 (41.8%). It should be noted that claims included within a town limit may in fact be located within the County but were captured within the incorporated towns. This may occur when a county resident has an incorporated town mailing address.

Table 11: Total Structures within the Floodplain & Flood Insurance Polices as of June 2013

	Total Principal Structures within Floodplain	Total Flood Insurance Policies	Total Claims Paid Since 1978
Kent County (unincorp.)	288	315	$3,430,459
Betterton	1	0	$303,618
Chestertown	97	83	$981,601
Millington	6	3	$204,082
Rock Hall	475	317	$3,286,590
County Total	867	718	$8,206,350

Note: Flood insurance is available to anyone in the County and even those structures outside of the mapped floodplain area. Therefore, in some cases, the number of policies includes polices for structures that are outside the mapped floodplain. Likewise, not all structures located within the mapped floodplain areas have flood insurance policies.

B. Critical Facilities

Kent County's critical facilities database was used for locating the facilities that were located in the 100-year floodplain. This database is a result of a December 2003 study conducted by the Center for Geographic Information Sciences at Towson University for the Maryland Emergency Management Agency. The list was reviewed and updated by the HMPC members. Critical facilities were identified based the following MEMA criteria:

MEMA Designation #1 – Medical, Emergency, & Educational: Schools, fire department facilities, police department facilities, hospitals and nursing homes, emergency operations centers, etc.

MEMA Designation #2 – Transportation: Bridges, overpasses, transportation terminals, etc.

MEMA Designation #3 – Lifeline Utility Systems: Fresh and waste water pumping stations, water treatment facilities, etc.

MEMA Designation #4 – High Potential Loss Facilities: Nuclear power plants, dams, etc.

MEMA Designation #5 – Hazardous Material Facilities: Facilities that house or generate industrial/hazardous materials, etc.

MEMA Designation #6 – State Owned Other: This is a designation added to account for state owned facilities that did not meet the above criteria for critical facilities (i.e. – office buildings, game preserves, state parks, etc.)

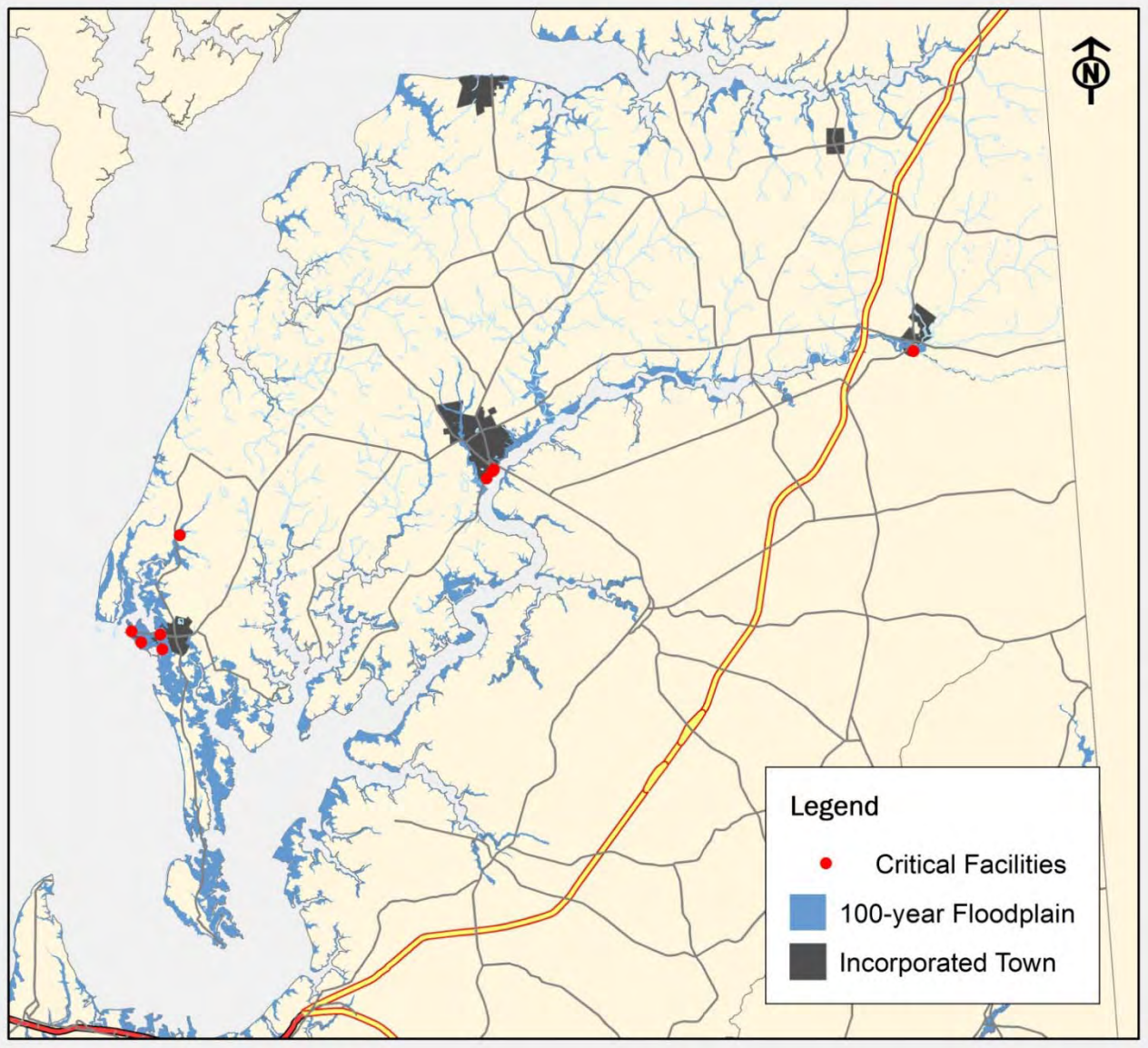
Based on the six MEMA designations and including town and county pump stations and water towers, a total of 205 facilities within the County were identified as critical. The analysis of these facilities revealed that 48 of them are located within the 100-year floodplain; most of which are in the A zone. For the purposes of this plan, those facilities have been narrowed to include only those facilities which are essential to operations in the event of an emergency or natural disaster bringing the total number of critical facilities located in the floodplain to 12. Table 12 lists the critical facilities which are located in the 100-year floodplain (See Critical Facilities Map, Figure 14). Of these, 3 are located in Chestertown, 1 is located in Millington, and 8 are located in Rock Hall. Five of Rock Hall's 7 pumping stations are located within the floodplain. All 5 pumping stations are elevated and equipped with backup generators.

Table 12: Critical Facilities in the 100-year Floodplain

Location	Flood Zone	Type	Facility
Chestertown	A6	School	Washington College/Custom House
Chestertown	A6	School	Washington College/Armory
Chestertown	A	Sanitary	Chestertown Pumping Station
Millington	A	Sanitary	County Pumping Station
Rock Hall	A8	Dam	Springfield Farms/Swan Creek
Rock Hall	A	Sanitary	Rock Hall Pumping Station

Rock Hall	A	Sanitary	Rock Hall Pumping Station
Rock Hall	A	Sanitary	Rock Hall Pumping Station
Rock Hall	A	Sanitary	Rock Hall Pumping Station
Rock Hall	A	Sanitary	Rock Hall Pumping Station
Rock Hall	A	Sanitary	Rock Hall Water Tower
Rock Hall	A10	Commercial Building	Maryland Food Center Authority

Figure 14 – Critical Facilities in the 100-year Floodplain



Also critical to emergency operations in the county are state and county roads and bridges and their structural integrity during storm events. While not all roads and bridges listed below in Tables 13 and 14 are located within floodzones or floodways, overland flow and improperly functioning drainage systems have a direct impact on these routes for residents and emergency vehicles. The roads and bridges listed below in Tables 13 and 14 commonly flood or hold water during flash flood events.

Table 13: County and State Roads

Ownership	Route #	Location
State Highway	MD292	Betterton to MD298
Kent County Roads		Chesterville Bridge Road
State Highway	MD444	Chesterville Rd. to Black Station Rd.
State Highway	MD290	Chesterville Rd. to Bolton Rd.
Kent County Roads		Cliffs City Road
Kent County Roads		Cumberland Street
Kent County Roads		Daves Hill Road
State Highway	MD213	Daves Hill Road to Galena
Kent County Roads		Edesville Road
State Highway	MD292	From Still Pond to Betterton
Kent County Roads		Handy Point Road
State Highway	MD213	Intersection of Rt. 213 and Rt. 298
Kent County Roads	North of Rt. 213	Kennedyville Road
State Highway	MD444	Locust Grove Rd. to Chesterville Rd.
Kent County Roads		Lovers Lane
Kent County Roads		McKinleyville Road
Kent County Roads	West of Rt. 298	Morgnec Road
Kent County Roads		Olivet Hill Road
Kent County Roads		Peacock Corner Road
Kent County Roads		Perkins Hill Road
Kent County Roads		Sheldrake Drive
Kent County Roads		Still Pond Creek Road
State Highway	MD291	To MD298 (Cherry Lane)
Kent County Roads		Walnut Point Road

Source: State Highway Administration, Kent County Roads

Table 14—Bridges in Kent County

Route Number	Road Name	Location	Waterway/Overpass
US 301 NB/SB	Blue Star Memorial Hwy	0.99 Miles S of Cecil Co.	MD 290
US 301 NB	Galena Sassafras Rd	0.99 Miles S of Cecil Co.	US 301
US 301	Blue Star Memorial Hwy	0.99 Miles S of Cecil Co.	US 301

US 301 NB/SB	Blue Star Memorial Hwy	On Cecil County Line	Sassafras River
MD 20	Rock Hall Rd	1.20 Miles W of MD 21	Shipyard Creek
MD 20	Chestertown Rd	0.77 Miles E of MD 446	Fannel Branch
MD 20	Chestertown Rd	0.06 Miles E of MD 514	Radcliff Creek
MD 213	Augustine Herman Hwy	0.09 Miles S of MD 537	Woodland Creek
MD 213	Augustine Herman Hwy	1.01 Miles S of MD 292	Branch of Morgan Crk
MD 289	Quaker Neck Rd	0.81 Miles S of MD 213	Radcliff Creek
MD 290	Galena Sassafras Rd	0.23 Miles S of US 301	Jacobs Creek
MD 290	Galena Sassafras Rd	1.91 Miles S of US 301	Sawmill Creek
MD 290	Galena Sassafras Rd	0.60 Miles N of MD 213	Olivet Hill Branch
MD 291	River Rd	0.19 Miles W of US 301	Mills Branch
MD 291	Cypress Rd	0.24 Miles W of MD 313	Cypress Branch
MD 299	Galena Sassafras Rd	On Cecil County Line	Sassafras River
MD 299	Galena Sassafras Rd	0.46 Miles S of Cecil Co.	Branch of Sassafras Riv.
MD 299	Massey Rd	1.27 Miles S of MD 290	Jacobs Creek
MD 445	Tolchester Rd	2.60 Miles S of MD 21	Swan Creek
MD 445	Tolchester Rd	2.90 Miles S of MD 21	Swan Creek
MD 446	Broad Neck Rd	0.80 Miles S of MD 20	Mill Pond Creek
MD 674	E Sharp St	0.25 Miles W of MD 20	Grays Inn Creek
MD 291	Morgnec Rd	1.82 Miles E of MD 213 (Morgan Creek Bridge)	Morgan Creek
MD 213	Augustine Herman Hwy	On Cecil County Line (Sassafras River Bridge)	Sassafras River
MD 290	Crumpton Rd	On Queen Anne's Co. Line	Chester River
MD 213	Maple Ave	On Queen Anne's Co. Line (Chester River Bridge)	Chester River
Co. Road 388	Langford Rd	0.01 Miles W of 0.02 County Rd 383	Mill Pond
Co. Road 388	Langford Rd	0.01 Miles E 0.02 County Rd 383	East Fork Langford Creek
Co. Road 233	Ricauds Branch Rd	0.01 Miles E 0.02 County Rd 379	West Fork Langford Crk
Co. Road 239	Still Pond Creek Rd	0.01Miles S of Co. Rd 356	Still Pond Creek
Co. Road 307	Morgnec Rd	0.2 Miles E of MD 298	Unnamed Stream
Co. Road 226	Chesterville Bridge Rd	0.4 Miles W of US 301	Mills Branch
Co. Road 26	Big Stone Rd	0.4 Miles S of MD 330	Cypress Branch
Co. Road 275	Rileys Neck Rd	0.05 Miles N of MD 291	Unnamed Stream
Co. Road 40	Perkins Hill Rd	0.3 Miles E of MD 213	Morgan Creek
Co. Road 25	Walnut Tree Rd	0.8 Miles NW of Co. Rd 3227	Cypress Branch
Co. Road 315	Kennedyville Rd	0.8 Miles SE of MD 213	Morgan Creek
Co. Road 15	Lambson Forest Rd	1 Miles E Of MD 290	Mills Branch

Source: MEMA/University of Towson

C. Repetitive Loss Areas

A repetitive loss structure is defined by FEMA as any structure for which two or more flood insurance claims have been paid for more than $1,000 in a 10-year period. While these properties make up only 1-2 percent of the flood insurance policies currently in force, they account for 40 percent of the country's flood insurance claim payments. A report on repetitive loss structures recently completed by the National Wildlife Federation found that 20 percent of these structures are listed as being outside of the 100-year floodplain. In 1998, FEMA reported that the NFIP's 75,000 repetitive loss properties have already cost $2.8 billion in flood insurance payments and numerous other floodprone properties continue to remain at high risk in the Nation's floodplains. Therefore, there are several programs that encourage communities to identify the causes of their repetitive losses and to work to mitigate these losses.

Table 15: Repetitive Loss Structures

Rep Loss Str	Insured	City	Type	Land Use	BFE	LFE	FFE	Foundation Type	No. Stories
1	No	Millington	Wood Frame	Residential	16	14.9	14.9	Crawlspace	1
2	Yes	Rock Hall	Wood Frame	Residential	11	5.1	5.1	Crawlspace	2
3	Yes	Rock Hall*	Wood Frame	Residential	11	19.2	19.2	Crawlspace	1
4	Yes	Chestertown*	Wood Frame	Commercial	7	N/A	N/A	Crawlspace	1
5	Yes	Rock Hall	Wood Frame	Residential	10	Unknown	Unknown	Crawlspace	2 ½

BFE=Base Floor Elevation
LFE= Lowest Floor Elevation
FFE= Finished Floor Elevation

Table 16: Repetitive Loss Structures - Payments

Repetitive Loss Structure	Square Footage	Occupancy	Year Built	1st Loss	2nd Loss	$ Paid for 2nd Loss
1	1,196	Residential	1973	12/14/96	9/16/99	$13,290.99
2*	3,212	Residential	1967	1/26/78	9/5/79	$2,007.25
3*	1,232	Residential	1985	12/02/85	4/11/88	$17,710.00
4*	4,387	Commercial	1950	11/07/95	9/19/03	$227,849.62
5	2,640	Residential	1937	9/16/99	9/18/03	$87,150.23

Identifying areas of repetitive losses within a community is a good indicator to use in determining areas of the highest flood damage vulnerability. Although flood damage is not necessarily limited to these areas, repetitive loss data provides location indicators for areas where structures are experiencing recurring and costly flooding damage.

Tables 15 and 16 indicate that Kent County has five repetitive loss structures, three residential structures in the Town of Rock Hall, one residential structure in Millington, and one commercial structure in Chestertown. All structures have filed 2 claims. The residential structures are single family residences and range in construction date from 1937 to 1985. The commercial structure was built in 1950.

First floor elevations and structure replacement values are useful for loss estimation. Replacement value is a necessary component in estimating the dollar amount of losses in a flood and when coupled with a range of flood probabilities from the 10-year to 500-year flood depths, can help in describing the benefits and costs of mitigation actions in monetary terms. First floor elevations were not readily available in Kent County for all repetitive loss properties at the time this plan was developed and should be gathered in the future to complete the analysis.

D. Data Limitations

The location and occurrence of flash floods is difficult to predict and dependent on local conditions of terrain, land use, and percent of impervious cover.

First floor elevations and structure replacement values are useful for loss estimation. Replacement value is a necessary component in estimating the dollar amount of losses in a flood and, when combined with a range of flood probabilities from the 100-500 year flood depths, can help in describing the costs and benefits of mitigation actions in monetary terms.

Section III: Mitigation

Determining the aspects of Kent County flood vulnerability that can be mitigated requires a review of the causal factors for floods and the assets that can be affected. In Kent County, flooding is primarily caused by tidal surge and rainfall (snow melt to much lesser degree in this area). Most flash flood events occur from runoff and erosion in developed areas. The municipalities have more population and economic assets and should focus on corrective measures for drainage and erosion, in both developed areas and future development areas.

A. Ensure that existing structures are resistant to flood-related damage.

1. *Discussion*: Consider the following measures:
   - Acquisition or relocation for structures that are repetitively flooded or have high flood depths;
   - Dry floodproofing for non-residential buildings on sound slab foundations that are subject to less than 27" of flooding.
   - Elevation of buildings when flood depths are less than 10 feet and have low velocity (less than 5ft/sec).

   Project: Conduct an assessment of all structures in the 100-year floodplain (867 principal structures) and obtain flood depths, foundation type, historic nature of property, etc. to determine the best flood protection measure that will keep the character of the structure intact. Project costs and benefits will be considered when projects are prioritized.

   Responsible Organizations: Kent County Assessment Office, Kent County Planning, Kent County Emergency Management, Middle Department Inspection Agency, and the Towns of Betterton, Chestertown, Millington, and Rock Hall.

   Possible Funding Sources: Pre-disaster Mitigation Assistance Funds administered by MEMA, Flood Mitigation Assistance Program Technical Assistance Funds, Watershed Surveys and Planning, Small flood control projects.

   Timeline for Implementation: 3 years

2. *Discussion*: Many residential structures located in the floodplain in Rock Hall, Millington, and Chestertown have been elevated by one or two feet above ground level but less than the base flood elevation. A preliminary analysis of the structures in this area shows that they are mostly 1 or 2 stories without basements. In the main areas, where residences are not adjacent to open space and form a cohesive neighborhood, elevation is appropriate.

   The County and each municipality has a floodplain ordinance in place which requires two feet of freeboard for structures in the regulatory floodplain, meaning that for any new construction or substantial improvements to structures, first floors will have to be elevated at least two feet above base flood elevation. Non-residential structures with slab foundations with less than two feet of flooding may be appropriate for dry flood proofing. Residential structures that lack stormwater systems should be paid particular attention.

   Project: Perform a detailed structural assessment of the buildings in the floodplain in Chestertown, Millington, Rock Hall and other communities within the County to determine appropriate mitigation measures (acquisition, relocation, elevation, or dry/wet flood proofing) to reduce low level repetitive flooding.

3. *Discussion*: Kent County adopted a floodplain management ordinance in full conformance with the National Flood Insurance Program in 1984. The floodplain ordinance is administered by the Planning Director in the County Department of Planning, Housing and Zoning. Since the last Community Assistance Visit in July 2012, 7 permits have been issued for residential additions/alterations, 2 new dwellings and 6 accessory structures in the County. Rock Hall has issued 16 permits in the floodplain (2 of which were for accessory structures).

   Following Hurricane Isabel in September 2003, the County documented 37 dwellings which sustained substantial damage as a result of the tidal surge. Most of this damage was documented within the Town of Rock Hall with 24 substantial damage reports completed within the town and an additional 10 outside of the Town but with Rock Hall addresses. One dwelling in Chestertown and two dwellings in Still Pond were also documented by the County as sustaining substantial damage.

   Project: Identify older homes (built prior to 1940) and pre-FIRM residential structures in the floodplain that are in need of substantial improvement in order to bring them into compliance.

   Responsible Organizations: Kent County Assessment Office, Kent County Planning, Kent County Emergency Management, Middle Department Inspection Agency, Towns of Chestertown, Millington, and Rock Hall

   Possible Funding Sources: Pre-disaster Mitigation Assistance Funds administered by MEMA, Hazard Mitigation Grant Program Technical Assistance Funds administered by MEMA, Flood Mitigation Assistance Program Technical Assistance Funds.

   Timeline for Implementation: Ongoing

4. *Discussion*: Inform owners of the 2 remaining repetitive loss properties in the County when funding is available and explore mitigation options with them. Moving a building to higher ground is the surest and safest way to protect it from flooding. While almost any building can be moved, the cost goes up for heavier structures, such as those with exterior brick and stone walls, and for large or irregularly shaped buildings.

   Elevation of repetitive loss structures is also a viable way to protect a building from flooding. While many buildings can be elevated, the cost may make replacement at the proper elevation a more attractive option. When a dwelling has sustained a documented case of substantial damage, the homeowner incurs the increased cost of compliance. At this time, a property owner may be eligible for a total of $30,000.00 from the National Flood Insurance Program to come into compliance with floodplain regulations. This money mainly covers the cost of elevation of the foundation.

   Communities with areas subject to ice jams, flash flooding, deep waters, or other high hazard where the only safe approach is to remove the building should consider a relocation program. Relocation is also preferred for large lots that include building areas outside the floodplain or where the owner has a new flood-free lot (or portion of their existing lot) available.

   Relocation can be expensive. For example, as shown in the following Table 17, the cost of moving a 1,000-square-foot building could range from $27 to $61 per square foot, depending on the construction type (e.g., frame or masonry) and the type of existing foundation (e.g., basement, crawlspace, or slab-on-grade).

Table 17: Typical Building Relocation Costs

Construction Type	Existing Foundation	Cost/Square Foot
	Basement	$32
Frame (a)	Crawlspace	$27
	Slab-on-Grade	$51
	Basement	$49
Masonry (b)	Crawlspace	$32
	Slab-on-Grade	$61

(a) cost per square foot of building footprint
(b) for frame building with masonry veneer add 10%

It should be noted that the costs shown in this table do not represent the entire cost of a relocation project. Additional costs may be necessary for acquiring a new lot to place the relocated building and for restoring the old site. Site restoration costs would be approximately $12 per square foot of building footprint, regardless of the construction or foundation type. Also, relocation costs do not increase proportionally with the size of a building. The cost per square foot for relocating a building larger than 1,000 square feet may be less, but some larger buildings may have to be cut and the parts moved separately.

Kent County has not used relocation as a means of mitigation. There are currently no plans to relocate flood prone structures.

Project 1: Structure #1 located in Millington is a 1-story wood frame residential structure built in 1973 with a crawlspace. The base flood elevation is 16 feet and the first floor elevation is 14.9 feet. Evaluation for elevation in place if future flood claims are submitted is the recommendation made by MDE and FEMA. This is a high priority. In the meantime, all utilities and the HVAC unit should be elevated.

Project 2: Structure #5 in Rock Hall is a wood frame, 2 ½ -story residential structure with a crawlspace. The base flood elevation is 10 feet. Flooding occurred in the main dwelling in 1937 and again during Hurricane Isabel in 2003. Engineering analysis should be conducted for the property; in the meantime, flood resistant materials should be used below the base flood elevation and all utilities, including the HVAC unit, should be elevated.

Responsible Organizations: Kent County Assessment Office, Kent County Planning, Kent County Emergency Management, Middle Department Inspection Agency, Towns of Chestertown, Millington, and Rock Hall

Possible Funding Sources: Pre-disaster Mitigation Assistance Funds administered by MEMA, Flood Mitigation Assistance Program Technical Assistance Funds, Small Flood Control Projects.

Timeline for Implementation: Ongoing

5. *Discussion*: Each municipality with land in the regulatory floodplains is a participant in the National Flood Insurance Program (NFIP). The NFIP requires structures built within the floodplain to have first-floor elevations determined. Currently, neither the County nor the municipal governments maintain a database of elevation certificates, making enforcement of

floodplain management regulations and mitigation efforts difficult. The County has recently hired a GIS Specialist and is in the process of developing a County-wide GIS program. The county should partner with municipalities and the tax assessment office to generate a database of structures with elevation certificates and first floor elevations below the base flood elevation.

Project: Develop a system for recording and storing elevation certificates and first-floor elevation data using County GIS and database technology.

Responsible Organizations: Kent County Assessment Office, Kent County Planning, municipalities

Possible Funding Sources: Regular employee pay

Timeline for Implementation: Ongoing

Program: Capital Improvement Project

6. *Discussion*: Kent County and its municipalities which have structures located within regulatory floodplains have floodplain management ordinances in place which are not only in full compliance with the National Flood Insurance Program but also are stricter than the NFIP elevation standards. Kent County and its municipalities have sound land use ordinances in place that facilitate the protection of sensitive areas, structures, and life and limb. Due to land use regulations and limited permitted densities in Kent's countryside, fewer homes will be built in floodzones. In addition to these ordinances, county and municipal Comprehensive Plans also support the protection of resources and properties within flood prone areas. The Kent County Comprehensive Plan calls for participation in the Community Rating System Program.

   Project: Continue to enforce floodplain regulations and practice land use planning which protects resources and properties in flood prone areas.

   Responsible Organizations: Kent County Planning, municipalities

   Possible Funding Sources: Regular employee pay

   Timeline for Implementation: Ongoing

   Program: Kent County Floodplain Ordinance, Land Use Ordinance, and Comprehensive Plan and municipal floodplain ordinances, land use ordinances, and comprehensive plans

B. Create awareness of floodplain hazards and protective measures.

Discussion: Educate property owners about flood insurance, recommended property protection measures for their structures, costs, and funding. Most of the structures in the flood hazard area can be protected with mitigation measures that many property owners will be able to implement with their own funds. The County and municipalities with a high percentage of structures in the floodplain should increase their awareness of the National Flood Insurance Program.

Educate contractors and insurance agents about county and municipal floodplain regulations and inspections. Provide floodplain maps to both.

Project: Targeted mailings could be used to inform residents, while detailed information should be made available at the public library. The community library is a good place for residents to

obtain information on various issues. Libraries are usually the first place people turn to when they want to research a topic. It must be ensured that all local libraries are adequately stocked with information on hazard mitigation, property protection, and related topics. Libraries also have their own public information campaigns with displays, lectures, and other projects that can augment the activities of local government.

Responsible Organizations: Kent County Public Works, Kent County Planning, Middle Department Inspection Agency, municipalities

Possible Funding Sources: Regular employee pay

Timeline for Implementation: 3 months; annual activity

The County should create a Mitigation Library with educational resources for residents and business owners. The County's main public library in Chestertown and the branch libraries in Rock Hall and Galena should be equipped with hazard mitigation information, including a copy of the final Hazard Mitigation Plan. The libraries should also include pertinent FEMA publications such as the following:

- "The Homeowner's Guide to Retrofitting" (FEMA 312),
- "Answers to Questions about the NFIP" (FIA-2),
- "How to Use a Flood Map to Determine Flood Risk for a Property" (FEMA 258), and
- "Repairing Your Flooded Home" (FEMA 234).
- Additionally, information about other hazards faced by the County should also be included. Some anticipated materials include the pamphlet "Reduce Your Risk from Natural Disasters" and "Taking Shelter from the Storm."
- County and municipal floodplain ordinances

The American Red Cross has published several brochures on various hazards and they are available online at www.redcross.org\disaster.

Project: Provide floodplain regulation seminars to area contractors, real estate agents, and insurance providers on an annual basis.

Program: County Office of Emergency Servicesdatabase

C. Protect critical facilities

1. *Discussion*: Protecting critical facilities is important to ensure that County or town services continue during emergencies. The County or municipaplies should consider the most appropriate flood control measures such as acquisition and relocation, elevation, dry/wet floodproofing and retrofitting for critical facilties.

   Project: For the following critical facilities, a technical report should be completed to provide

Responsible Organizations: Kent County Public Works, Kent County Planning, Middle Department Inspection Agency, Washington College, State Highway Administration, Towns of Chestertown and Rock Hall

Possible Funding Sources: USACE's Floodplain Management Services Program, Pre-disaster Mitigation Assistance Funds administered by MEMA, Small Flood Control Projects, Watershed Protection and Flood Prevention Program, Watershed Surveys and Planning.

Timeline for Implementation: Ongoing

information on the first floor and base flood elevations. Mitigation measures and a detailed benefit/cost analysis should be conducted as well.

- Washington College, Custom House: Floodwaters entered the first floor of the Custom House during Hurricane Isabel (2003).
- Water tower in Rock Hall

Project: Explore check valve systems for installation in the Town of Rock Hall. A coastal community located on the Chesapeake Bay, the Town of Rock Hall is home to approximately 1,300 people. The Town experiences problems with its existing storm drain system, which allows tidal waters to backflow into the streets. This backflow causes repeated flood damage to homes, businesses and schools.

Responsible Organizations: Town of Rock Hall

Possible Funding Sources: To be determined

Timeline for Implementation: 2 years

For example, the City of Crisfield had similar drainage problems and installed 7 tideflex valves. The tideflex valve, which is made of flexible elastomer material reinforced with fabric, is manufactured by the Red Valve Company, Inc. Each valve is customized to open with a specified minimum head pressure and withstand maximum back pressure. Forward hydraulic pressure opens the valve automatically without any additional energy source and reverse hydraulic pressure seals the valve automatically.

Program: HMGP, Town of Rock Hall CIP

2. *Discussion*: Develop the floodplain management capabilities of the County's and municipalities' staff.

Project: Develop an enhanced flood warning system to include the use of GIS and loss estimation software (such as FEMA's HAZUS-MH software) in the development of flood stage forecast maps, flood depth maps and images of vulnerable structures linked to parcels and flood stage maps. This could be started with digital images of all structures in the County linked to structure center-points for its GIS data.

Program: CIP, County's Floodplain Ordinance

Project: Adopt new FIRMs and Floodplain Ordinance. Letter of final determination should be issued in December 2013 and new maps should become effective in June 2014.

2. Responsible Organizations: Kent County Public Works, Kent County Planning, municipalities

Possible Funding Sources: Flood Hazard Mapping Program.

Timeline for Implementation: 1 year

Program: County's Floodplain Ordinance

D. Prepare/update stormwater management plans for various areas in the County.

Discussion: Development outside the floodplain can contribute significantly to flooding problems. Runoff is increased when natural ground cover is replaced by urban development. Unconstrained watershed development often will aggravate downstream flooding and overload a community's drainage system. Runoff from developed areas picks up pollutants on the ground, such as road oil and lawn chemicals, and carries them to the receiving streams. With the increase in development and off-street parking as a means of improving emergency access and streetscaping, there is a projected increase in runoff. This is exacerbated by the increased risk of flooding and runoff.

Stormwater management regulations require developers to build retention or detention basins to minimize the increases in runoff caused by impervious surfaces and new drainage systems. Generally, each development must not let stormwater leave at a rate higher than that under pre-development conditions. The regulations may also require that runoff be held onsite long enough to allow the pollutants to be treated onsite so that they will not be carried to streams. Since detention controls only runoff rates, and not runoff volumes, there is a need for other measures to enhance the infiltration of stormwater. Swales, infiltration trenches, vegetative filter strips, and permeable paving blocks are recommended additions to the standard detention requirements.

The standard practice of requiring each development to manage stormwater to the same criteria has several shortcomings:

- It does not account for differences in stream and watershed conditions.
- Municipalities within the same watershed may require different levels of control of stormwater.
- It results in many small basins on private property that may or may not be properly maintained.

Kent County is experiencing erosion and drainage problems; property owners are requesting permission to build ditches that carry the runoff into existing channels and streets, particularly in the village of Massey, north of Millington and in Millington.

The municipalities of Betterton, Chestertown, Millington, and Rock Hall should focus on corrective measures for drainage and erosion in developed areas and future development in the municipalities.

Project: The way to correct these deficiencies is to study the watershed to determine the appropriate standards for different areas and, occasionally, to identify where a larger central basin would be more effective and efficient than many smaller ones. By preparing a Drainage Plan, Kent County would have a method of evaluating and managing

Responsible Organizations: Kent County Public Works, Kent County Planning, Kent County Soil and Water Conservation District, municipalities

Possible Funding Sources: Watershed Surveys and Planning

Timeline for Implementation: 3 months

the entire system. A Stormwater Management Program would then establish a mechanism to fund, implement, and maintain the Master Drainage Plan.

A plan for stormwater management for each drainage area should also be included. The Department of Environmental Protection funds master planning on a watershed basis. When the plans are completed, municipalities adopt new regulations based on the findings.

Program: Kent County, Chestertown, Millington, and Rock Hall Stormwater Management Plans and Capital Improvements Project

Project: The drainage system may be improved with the addition of new pipes and an outfall pond. Brick sidewalks, street trees, and underground utilities would also greatly enhance municipalities struggling with stormwater management. To respond to environmental issues of stormwater draining directly into the Chester River and the Chesapeake Bay, towns may create a stormwater outfall pond to collect rainwater and naturally filter pollutants before the water reaches the waterways.

Responsible Organizations: Towns of Chestertown, Millington, and Rock Hall

Possible Funding Sources: Farmers' Home Administration, Maryland Department of Housing and Community Development, Maryland State Highway Administration, Town's Critical Area and Forest Conservation mitigation funds.

Timeline for Implementation: Ongoing

The Town of Betterton recently has undergone a similar project working through the State Highway Administration Streetscapes Program.

Chapter 3: Winter Storms

Section 1: Nature, History and Local Profile

A. Nature

Winter storms are defined by cold temperatures and heavy snow or ice and include heavy snowstorms, sleet storms, ice storms, blizzards, and severe blizzards. Winter storms may contain one or more types of hazardous weather events, the definitions of which are included below.

- Heavy snowstorm: Accumulations of four inches or more in a six-hour period; or six inches or more in a 12-hour period. The most common impacts are traffic accidents, interruptions in power supply and communications; and the failure of inadequately designed and/or maintained roofing systems.
- Sleet storm: Significant accumulations of solid pellets that form from the freezing of raindrops or partially melted snowflakes, resulting in slippery surfaces and posing hazards to pedestrians and motorists.
- Ice storm: Significant accumulations of rain or drizzle freezing on objects such as trees, power lines and roadways, causing slippery surfaces and damage from the sheer weight of ice accumulation.
- Blizzard: Wind velocity of 35 miles per hour or more, temperatures below freezing, considerable blowing snow with visibility frequently below one-quarter mile, prevailing over an extended period of time.
- Severe Blizzard: Wind velocity of 45 miles per hour or more, temperatures of 10 degrees or. lower, a high density of blowing snow with visibility frequently measured in inches, prevailing over an extended period of time

B. History

Snow and winter storms are not uncommon in Kent County. Since the County is subjected to extreme cold weather conditions periodically, there have occassionaly been instances of severe winter storms. Some incidents over the past five decades have been detailed in Table 18. Since 2000, four major winter storms have occurred in the County which yielded Declarations of Disaster by FEMA.

Table 18: History of Winter Storms

Event	Description	Year
Snow and Ice Storm	Major disaster declaration	January 1977
Severe Snowfall and Winter Storm	Emergency declaration	March 1993
Blizzard	Major disaster declaration; County applied for public assistance	January 1996
Severe Winter Storm	Major disaster declaration; County applied for public assistance	January 2000

President's Weekend Snowstorm	Emergency declaration; MD National Guard and FEMA assisted residents; 30.5 inches of snow in 3-day period	February 2003
Severe Winter Storm	Major disaster declaration; County applied for public assistance	December 2009
Severe Winter Storm	Major disaster declaration; County applied for public assistance	February 2010

In addition to the storms listed in Table 18, winter storms also occurred in Kent County in January, February, and March of 1996. Impacts of these storms and damage estimates are not available. Heavy snow was recorded on March 9, 1999. Winter storms also occurred in January and December of 2000. More recently, the snowstorm that occurred February 2003 brought between 2 and 3 feet of snow to parts of the County, resulting in an emergency declaration and a loss of approximately $ 1.4 million in property damage due to high winds, drifting, and heavy snow on rooftops.

Maryland's greatest winter storms are the Nor'easters. The strong northeast winds that rack the coast and inland areas give the storm its name. For Nor'easters to occur in Maryland, an arctic air mass should be in place. While high pressure builds over New England, cold arctic air flows south from the high pressure area. The dense cold air is unable to move west over the Appalachian Mountains and so it funnels south down the valleys and along the Coastal Plain. Winds around the Nor'easter's center can become intense. The wind builds large waves that batter the coastline and sometimes pile water inland causing major coastal flooding and severe beach erosion. Unlike hurricanes, which usually come and go within one tide cycle, the Nor'easter can linger through several tides, each one piling more and more water on shore and into the bays and dragging more sand away from the beaches. Table 19 discusses the Nor'easters that have hit various parts of Maryland since 1950.

Table 19: History of Nor'easters

Date/Duration	Type of Storm	Impact	Comments
Nov. 6-7, 1953	Slow moving Nor'easter	Winds at 30 mph caused major drifing, closing down highways	Upper eastern shore counties saw 10-12 inches of snow
Feb. 15-17, 1958	Severe Nor'easter	Winds at 25-25 mph created blizzard conditions and subzero windchills	Eastern shore counties saw 10-16 inches of snow. Considerable wind damage in Talbot and Dorchester Counties. Damage estimated at $500 million in MD, DE, DC.

Mar. 19-21, 1958	Slow moving Nor'easter	Over one foot of snow. Thousands of homes without heat, light, power and telephone service	Damage was $10 million in Maryland and 8 deaths in the state were attributed to the storm.
Dec. 11-12, 1960	Snowstorm	Winds over 50 mph created blizzard conditions and heavy drifting snow.	Damage was upto $10 million in Maryland and 8 deaths in the state were attributed to the storm.
Mar. 5-9, 1962	Intense Nor'easter	Winds upto 70 mph. Ocean City, Maryland, sustained major damge.	Eastern shore counties experienced mixed precipitation.
Feb. 6, 1978	Intense Nor'easter	Brought 18 inches of snow to northern Maryland	
Dec. 10-12, 1992	Intense Nor'easter	Storm caused flooding in Ocean City and heavy rain over the Chesapeake Bay	Western Maryland was hit with 2-3 feet of snow.

Source: National Weather Service Forecast Office – Maryland Winters

C. Profile

All areas of Kent County are subject to the effects of winter storms. They are considered hazards when:

- local capabilities to handle disruptions to emergency services, traffic, communications, and electric power are overwhelmed;
- residents in isolated communities run out of basic supplies, including food and fuel;
- livestock suffer from severe cold and lack of feed; and
- building structural systems fail.

Major winter storms and occasional blizzard conditions bring bursts of heavy snow accumulating 3-6 inches in short periods or 1-2 feet in 12-24 hours. Blizzard conditions develop with winds over 35 miles per hour. Freezing rain and drizzle will create a coating of ice that is hazardous to walk on. Other impacts include hazardous conditions caused by falling trees and power lines, requirement of additional manpower to clear debris, snow removal and salting, and large scale use of public shelters, and traffic delays.

Section II: Vulnerability

Current Trends

Vulnerability to the effects of winter storms on buildings depends on the age of the building (and the building codes in effect at the time it was built), type of construction, and condition of the structure (how well it has been maintained).

The entire county would be affected by snow, ice and extreme cold. Kent County has a total area of 278.34 square miles and 343 miles of shoreline. Severe winter storms could result in the loss of utilities, expected increase in traffic accidents, impassable roads, and lost income since normal commuting may be hindered.

Snow and ice can be extremely hazardous. It can reduce visibility and when it accumulates on surfaces, it reduces traction and puts strain on power lines, roofs, and other structures. Severe winter storms have been and will continue to be a significant threat to the economic and social well being of Kent County. Disruptions of emergency and other essential services and critical facilities are the main threats to people and property. Inadequate snow removal equipment could exacerbate the effects of snow events in the County, although it is not an issue at the present time.

Severe storm activity poses a significant threat to unprotected or exposed lifeline systems. Generally, commercial power networks are very susceptible to interruption from lightning strikes, high winds, ice conditions, and hail. Other utilities, including underground pipelines, may be impacted if not protected from exposure.

All critical facilities in the County are vulnerable to the effects of severe winter storms, due to the potential disruption of services and transportation systems as well as possible structural failure due to heavy snow loads. The County's critical facilities include the following:

- SHA, Chestertown Office
- Highways
- Bridges
- Pipelines
- Waterways, including rivers and creeks
- Educational facilities
- University of Maryland Shore Medical Center at Chestertown
- Nursing homes
- Senior citizens centers
- Day care centers
- Kent County Health Department
- Kent County Detention Center
- Recreational facilities
- Utility, energy, and resource facilities
- All area fire departments

Section III: Mitigation

Although the entire county can be affected by winter storm hazards, aged, dilapidated, and poorly constructed buildings, as well as buildings not constructed to applicable building codes, are more susceptible to wind and weather hazards. Kent County has approximately 10,500 housing units. Approximately 2,375 of those units were built prior to 1940, almost 23 percent of the County's housing units. Manufactured housing units are especially susceptible to wind events. The strong

winds of a Nor'easter can rip roofs off houses, overturn manufactured homes, or cause total failure of poorly constructed structures. Gable-ended roofs area also especially vulnerable to strong winds.

Structures built prior to 1940 may be in poor condition and not be as able to weather storms due to poor building quality, plumbing, etc. and are thus more prone to damage by winter storms.

Forecasting and warning county residents as far in advance as possible would give them time to prepare for winter storms. Stocking adequate quantities of salt and sand expedites improving road clearing. Public education concerning safe driving and driving only if it is required, and also stocking up on food, water, batteries, and other supplies will equip people for the storm.

A. Building Construction

Discussion: Maintain high construction standards by ensuring current building codes and standards follow FEMA's basic guidelines and are properly enforced.

Project: The County, municipalities, or concerned property owners should identify homes that are in need of tie-downs to reduce the vulnerability to high wind damages.

Responsible Organizations: Kent County, Planning, Middle Department Inspection Agency, municipalities

Possible Funding Sources: No funding required

Timeline for Implementation: Ongoing

Project: Building codes specific to high wind resistance and resilience to heavy rooftop loads in high wind zones must be followed by contractors and enforced by building inspectors.

B. Winter Storm Impacts

1. *Discussion*: Ensure residents are forewarned, and the County prepared with supplies to face winter storms

   Project: Stock adequate quantities of salt and sand to expedite road clearing.

   Project: Identify areas of frequent snow drifting and install snow fencing in those areas.

   Project: Provide public education (concerning safe driving and driving only if it is required, and also stocking up on food, water, batteries, and other supplies) to prepare people for the storm.

   Responsible Organizations: Kent County Roads, Kent County Emergency Management, State Highway Administration

   Possible Funding Sources:

   Timeline for Implementation: 3 years

   Program: Kent County Emergency Management

2. *Discussion*: Winter events that produce ice and snow endanger Kent County in a variety of ways, including electrical and other utility system disruptions and transportation disruptions and hazards. The effects of ice and snow on utilities can be both direct and indirect in nature. For example, direct effects include failure (breaking) of electrical power lines by the weight of encrusted ice.

   Such events also correspond to higher electrical demands by consumers as they heat their homes and businesses. Large quantities of snow can prevent fuel oil or propane trucks from being able to reach customers. Loss of electric power also affects the operation of numerous pumping stations in Kent County. Failure of any of these stations would result in problems with sanitary and storm sewer discharges.

   Beyond increasing the likelihood for traffic accidents, snow and ice will reduce the ability of evacuation routes to effectively function as anticipated. The result would be longer periods to complete ordered evacuations—thus, less lead-time for emergency officials. In Kent County, tree branches are often a major cause of utility disruption and power outage, particularly in the wintertime when they are laden with ice or snow, and snap due to the increased load. Electrical service lines leading from the main power line to a structure can provide a route for fire as well.

   Project: Vegetation that lies in close proximity to utilities must be examined and trimmed on a regular basis by local utility companies particularly during the winter. Wherever possible, power lines should be installed underground.

   Program: Building Code, Subdivision Regulations

   Responsible Organizations: Kent County Roads, Kent County Emergency Management, State Highway Administration, Utility Companies, Kent County Planning

   Possible Funding Sources:

   Timeline for Implementation: 3 years

Chapter 4: Other Severe Storms

Section I: Nature, History, and Local Profile

The primary hazard caused by winds and storms is the transport of debris, which could cause casualties and property loss. A less probable hazard involves the dislodging of mobile homes from their foundations. High winds can separate roofs from their structures, and trees may blow over onto structures or vehicles. High winds may also damage the poles and lines carrying electric, telephone, and cable television service.

A. Hail

Nature

Hailstorms are violent and spectacular phenomena of atmospheric convection, always associated with heavy rain, gusty winds, thunder and lightning. Hail is a product of strong convection and occurs only in connection with a thunderstorm where the high velocity updrafts carry large raindrops into the upper atmosphere (where the temperature is well below the freezing point of water). Hail stones grow in size when the frozen droplet is repeatedly blown into the higher elevations. The hailstone ascends as long as the updraft velocity is high enough to hold the hailstone. As soon the size and weight of the hailstone overcomes the lifting capacity of the updraft, it begins to fall freely under the influence of gravity. The falling of hail stones, under thunderstorm conditions, is accompanied with a cold downdraft of air.

History/Local Profile

Hail is a fairly common occurrence in Kent County. Damaging or severe hail (0.75 to 2.00 inches) is most common between the months of June and August, although a significant number of hail reports also occur between April and June. The most extensive damage caused by hail occurs on the County's agricultural lands.

During a severe storm in June 1980, hail was reported along with severe thunderstorms, rain, and tornado-like wind. Damage was extensive in Fairlee and Tolchester.

B. Lightning

Nature

Lightning is defined as a sudden and violent discharge of electricity from within a thunderstorm due to a difference in electrical charges and represents a flow of electrical current from cloud-to-cloud or cloud-to-ground. Nationally, lightning causes extensive damage to buildings and structures, kills or injures people and livestock, starts untold numbers of forest fires and wildfires and disrupts electromagnetic transmissions. Lightning is extremely dangerous during dry lightning storms because people remain outside due to the lack of precipitation; however, lightning is still

present during the storm. Lightning usually occurs as a result of the thunderstorms that move through the area during the summer months. Peak lightning occurs between June and August.

History/Local Profile

Lightning events are common in Kent County. A severe thunderstorm brought lightning, high winds, and hail to the area on June 29, 1980. No information on injuries and property damage is available. On August 17, 1997, eight fires were started by lightning in Kent County by a storm around 6:30 pm.

Lightning is the most common culprit during power outages either directly by striking transformers or indirectly by striking trees causing limbs to fall into power lines.

C. Thunderstorms

Nature

Thunderstorms are forms of convection produced when warm moist air is overrun by dry cool air. As the warm air rises, thunderhead clouds (cumulonimbus) form and cause the strong winds, lightning, thunder, hail and rain associated with these storms. Instability can be caused by surface heating or upper-tropospheric (≈50,000 feet) divergence of air (rising air parcels can also result from airflows over mountainous areas). Generally, the former "air mass" thunderstorms form on warm-season afternoons and are not severe. The latter "dynamically-driven" thunderstorms generally form in association with a cold front or other regional-scaled atmospheric disturbance. These storms can become severe, thereby producing strong winds, frequent lightning, hail, downbursts and even tornadoes.

Strong winds that can develop from thunderstorms are known as downbursts. Downbursts occur when rapidly descending air beneath a thunderstorm reaches the ground and begins to move horizontally. These winds have been observed in excess of 100 mph and can occur before, during, and after a thunderstorm.

History/Local Profile

Based on information from the 1998 Kent County Vulnerability Analysis, currently being updated, five major thunderstorms were recorded in the County between 1950 and 1985 (35-year period). In June 2012, a derecho swept across Maryland which downed many trees causing power outages and road closures. Thunderstorms are a common occurrence in Kent County with winds ranging from 0 to 69 knots (kts) in magnitude. Based on past occurrences of thunderstorms in Kent County, injuries have been minor and no fatalities have been recorded.

Thunderstorms can sometimes produce strong winds, dangerous electric storms, prolific hail accumulations, life-threatening flash floods, and occasional tornadoes.

Section II: Vulnerability

Current Trends

Vulnerability to the effects of severe storms on buildings depends on the age of the building (and the building codes in effect at the time it was built), type of construction, and condition of the structure (how well it has been maintained).

The entire county may be affected by lightning, thunderstorms, and hail. Agricultural land suffers the most damage from hail storms. Kent County has a total area of 278.34 square miles and 343 miles of shoreline. Severe lightning and thunderstorms may result in the loss of utilities, an increase in traffic accidents, impassable roads, lost income since normal commuting may be hindered, and loss to crops.

Thunderstorms, lightning, and hail can all be extremely hazardous. They may reduce visibility and put strain on power lines, roofs, and other structures. Severe storms have been and will continue to be a significant threat to the economic and social well being of Kent County. Disruptions of emergency and other essential services and critical facilities are the main threats to people and property. Particularly at risk are County crops which fall victim to hail storms.

Severe storm activity poses a significant threat to unprotected or exposed lifeline systems. Generally, commercial power networks are very susceptible to interruption from lightning strikes, high winds, and hail. Other utilities, including underground pipelines, may be impacted if not protected from exposure.

All critical facilities in the County are vulnerable to the effects of severe storms, due to the potential disruption of services and transportation systems as well as possible structure exposure to lightning strikes (directly or by tree limbs). The County's critical facilities include the following:

- SHA, Chestertown Office
- Highways
- Bridges (See Table 14)
- Pipelines
- Waterways including rivers and creeks
- Educational facilities
- Chester River Hospital
- Nursing homes
- Senior citizens centers
- Day care centers
- Kent County Health Department
- Kent County Detention Center
- Recreational facilities
- Utility, energy, and resource facilities
- All area fire departments

Section III: Mitigation

Although the entire county can be affected by severe storm hazards, aged, dilapidated, and poorly constructed buildings, as well as buildings not constructed to applicable building codes, are more susceptible to wind and weather hazards. Kent County has approximately 10,500 housing units. Approximately 2,375 of those units were built prior to 1940, almost 23 percent of the County's housing units. Manufactured housing units are especially susceptible to wind events. The strong winds of a Nor'easter can rip roofs off houses, overturn manufactured homes, or cause total failure of poorly constructed structures. Gable-ended roofs area also especially vulnerable to strong winds.

These structures built prior to 1940 may be older and in poor condition to weather storms due to poor building quality, plumbing, etc. and are thus more prone to damage by severe storms.

Forecasting and warning county residents as far in advance as possible would give them time to prepare for severe storms. Public education concerning safe driving and driving only if it is required, and also stocking up on food, water, batteries, and other supplies will equip people for the storm.

A. Building Construction

Discussion: Maintain high construction standards by ensuring current building codes and standards follow FEMA's basic guidelines and are properly enforced.

Project: The County, municipalities, or concerned property owners should identify homes that are in need of tie-downs to reduce the vulnerability to high wind damages.

Project: Building codes specific to high wind resistance and resilience to heavy rooftop loads in high wind zones must be followed by contractors and enforced by building inspectors.

Responsible Organizations: Kent County, Planning, Middle Department Inspection Agency, municipalities

Possible Funding Sources: No funding required

Timeline for Implementation: Ongoing

B. Severe Storm Impacts

1. *Discussion*: Ensure residents are forewarned, and prepared to face high winds, hail, or lightning strikes

   Project: Provide public education (concerning safe driving and driving only if it is required, and also stocking up on food, water, batteries, and other supplies) to prepare people for the storm.

   Program: Kent County Emergency Management

Responsible Organizations: Kent County Roads, Kent County Emergency Management, State Highway Administration

Possible Funding Sources:

Timeline for Implementation: 3 years

2. *Discussion*: Severe storm events that produce hail, high winds, and lightning strikes endanger Kent County in a variety of ways, including electrical and other utility system disruptions and transportation disruptions and hazards. The effects of lightning and wind on utilities can be both direct and indirect in nature. For example, direct effects include failure (breaking) of electrical power lines by a direct lightning strike. In Kent County, tree branches are often a major cause of utility disruption and power outage, particularly during severe thunderstorms. Electrical service lines leading from the main power line to a structure can provide a route for fire as well.

   Such events also correspond to higher electrical demands by consumers as they cool their homes and businesses. Loss of electric power also affects the operation of numerous pumping stations in Kent County. Failure of any of these stations would result in problems with sanitary and storm sewer discharges.

   Project: Vegetation that lies in close proximity to utilities must be examined and trimmed on a regular basis by local utility companies particularly during the winter. Wherever possible, power lines should be installed underground.

   Program: Building Code, Subdivision Regulations

   Responsible Organizations: Kent County Roads, Kent County Emergency Management, State Highway Administration, Utility Companies, Kent County Planning

   Possible Funding Sources:

   Timeline for Implementation: 3 years

3. *Discussion*: Hailstorms have a direct impact on the economic viability of County farm operations. Hail destroys crops annually.

   Project: Support farmland crop insurance through education and outreach.

   Responsible Organizations: Kent County Planning, Kent County Extension Office, Kent County Soil and Water Conservation District

   Timeline for Implementation: Ongoing

Chapter 5: Drought:

Section I: Nature, History, and Local Profile

A. Nature

Droughts are periods of time when natural or managed water systems do not provide enough water to meet established human and environmental uses because of natural shortfalls in precipitation or stream flow.

Although maintaining water supplies for human use is an important aspect of drought management, drought can also have many other dramatic and detrimental effects on the environment and wildlife, namely for livestock and crops. For instance, water suppliers using surface water sources must remain vigilant to ensure that sufficient flow remains in the rivers to meet other environmental needs. These indicators are designed to ensure that Maryland considers all potential impacts of extended periods of dry weather when evaluating drought conditions.

B. History

A total of 8 drought events were reported in Kent County between 1951 and 2012 (61-year period). In August 1951 a severe drought occurred resulting in a 15% crop loss. In July 1957 a drought occurred. While the county was turned down as a disaster area, farmers received $20,000 in crop insurance. In 1988 and again in 1993, severe droughts hit Kent County and declarations of disaster were made. In 1997 and in 2002, the County was hit by severe droughts yielding further declarations of disaster. Additional droughts occurred in 2007 and 2012 resulting in declarations of disaster.

C. Profile

Droughts result from prolonged periods of dry weather accompanied by extreme heat and usually occur during the summer months (July and August) in Kent County when high pressures settle in with prevailing dry west to southwest winds. The warmest time of the year is July when maximum temperatures average 89 degrees Fahrenheit. Extreme temperatures of 100 degrees Fahrenheit occur occasionally. The occurrence of drought cannot be predicted. The usual length of time does not exceed six weeks in mid summer.

When drought begins, agriculture is usually first to be affected because of its heavy dependence on stored soil moisture. Soil moisture can be rapidly depleted during extended dry periods. Dryland farming and ranching are the most at risk from drought. Water uses depending on in-stream flows, such as irrigated farms; aquatic, wetland, and riparian environmental communities; and recreational uses are at high risk but less exposed. Urban and agricultural water users who rely on reservoirs and wells that are not dependent on high rates of aquifer recharge are the last to feel the effects.

Section II: Vulnerability

A. Current Trends

Those who rely on surface water (reservoirs and lakes) and subsurface water (groundwater) are usually not adversely affected by a drought. A short-term drought that persists for three to six months may have little impact on these areas, depending on the characteristics of the hydrologic system and water use requirements. Droughts of longer duration affect areas that are dependent on stored surface or subsurface supplies while the impacts of a drought may be less in agricultural areas as rain quickly replenishes soil moisture. Ground water users, who are often the last to be affected by drought during its onset, may also be the last to experience a return to normal water levels. The length of a recovery period is a function of the intensity of the drought, its length, and the quantity of precipitation received as the drought ends.

At present, it is estimated that approximately one half of the County's population depends upon onsite disposal systems; ergo it can be discerned that approximately one half of County residents have individual wells. Since 1945, approximately 6,735 wells have been drilled in Kent County for individual residences. These wells draw their water from a variety of water-bearing formations—typically the nearest available formation—in the County, with no single formation being prevalent. In this same time period, 113 wells have been drilled for industrial and commercial use and 147 wells have been drilled for agricultural use.

Based on the 2007 Census on Agriculture, 72 percent of the county's land area was in farmland (128,220 acres). Land in farms has increased slightly since 1997. The County's major farm commodities include corn, soybeans, small grains, and dairy. Agricultural land in Kent County is comprised of mainly cropland and pasture, while there is also a considerable number of local nurseries. Most of the county falls into the cropland category. Small patches of pastoral land are found in the northern parts of the county.

Table 20: Agricultural Land Information

	1987	1992	1997	2002	2007
Number of farms	361	318	314	318	377
Ave. size of farms	370	413	374	369	340
Land in farms	133,597	131,283	117,526	117,372	128,220
Total cropland	109,652	113,211	97,863	95,051	101,394

Source: Census of Agriculture

Section III: Mitigation

Identifying the first stages of drought and conserving water will help mitigate drought to an extent. In the future, there is also the potential for limiting population growth and development dependent on groundwater. Mitigation management for drought is a proactive process. However, most of the process has been at the State level since there is no federal water conservation or drought policy.

The Maryland Statewide Water Conservation Advisory Committee, established by an executive order in 2000, developed recommendations for drought monitoring and response plan, as well as for ongoing water conservation measures. The final report recommended a staged process for defining drought conditions:

Stage 1: Normal Conditions (green)
Stage 2: Watch (yellow)
Stage 3: Warning (orange)
Stage 4: Emergency (red)

The full report can be found on the Maryland Department of the Environment website: http://www.mde.state.md.us/programs/Water/WaterConservation/GovernorsAdvisoryCommittee/Documents/www.mde.state.md.us/assets/document/water_cons/droughtreport.PDF

A. Loss Estimation

The 1999 Maryland Hazard Analysis puts Kent County in a medium risk category for drought. Produce and other crops are vulnerable to drought. Agricultural land covers approximately 128,000 acres. Of this, over 101,000 acres is cropland. Crop sales accounted for $46,364,000 of the total market value of products sold in 2007. Thus property damage would involve crop damage. Other impacts of drought would include economic hardship to farm operators and decline in farm related business. Agriculture and livestock operations dependent on rainfall are affected within weeks of reduced participation. Surface water used for crop irrigation will become scarce, further threatening agriculture and farming.

1. *Discussion*: Introduce farmers and residents to water saving methods and devices through an education process.

   Project: Through a public education process, introduce residents and the farming community to the following measures:
   - Encourage residents to use water-saving and drought-resistant landscaping techniques.
   - Encourage agricultural producers to use the information on subsoil moisture levels at the start of the growing season to decide which crops and varieties to plant, how much seed to order, and how to till the soil.
   - Encourage agricultural producers to install more efficient irrigation systems (such as drip systems) and/or devise long-term crop rotation plans that feature crops that require less water.
   - Encourage homeowners to "xeriscape" by selecting grass and flowers that require minimal water.
   - Encourage residents to fix leaky plumbing, and install water-conserving showerheads and toilets.

   Responsible Organizations: Kent County Planning, Kent County Emergency Management, Kent County Soil and Water Conservation District, American Red Cross

   Possible Funding Sources:

   Timeline for Implementation: 1 year

- Encourage residents to heed advice on water restrictions and inform county officials of cases that consistently disregard the mandate.

Program: Kent County Office of Emergency Servicesand Natural Resources Conservation Service

2. *Discussion*: Encourage participation in the Natural Resources Conservation Service's irrigation grant program.

Project: Encourage those members of the agricultural community who use irrigation practices to participate in the Natural Resources Conservation Service's irrigation grant program to upgrade existing irrigation systems to include water conservation measures.

Responsible Organizations: Natural Resources Conservation Service

Possible Funding Sources: Natural Resources Conservation Service

Timeline for Implementation: Ongoing

Program: Natural Resources Conservation Service

Chapter 6: Erosion and Steep Slopes:

Section I: Nature, History, and Local Profile

A. Nature

Erosion and accretion are long term, dynamic processes that occur along shorelines. Major erosion/accretion events are usually associated with coastal storms because floodwater forces have the ability to cause significant acts of erosion/accretion in a short time period. Erosion is considered a serious hazard in coastal areas because it can threaten coastal development by eroding beach areas including the flat berm portion and protective dunes. In general, shore erosion poses a significant threat to property owners, the public and natural resources, both terrestrial and aquatic.

B. History

A large percentage of Kent County's shorelines incur erosion accelerated by high winds and high tides, overland flow, and shoreline cliff sluffing. The greatest numbers of incidences occur during the fall and winter months. A small number of damaging wind events coupled with abnormally high tides, causing shoreline erosion occur each year.

Much of the County's soils are highly erodible and susceptible to storm damage. With shoreline cliffs and steep banks along the Sassafras and the Chesapeake Bay, overland flow meets storm surge events halfway and causes unique erosion problems for landowners. Highly erodible soils along the Sassafras River and county creeks also cause unique challenges for property owners.

C. Profile

All shorelines in the County are subject to the effects of erosion. The most severe impacts occur along those shorelines with the longest fetch or exposed distance over water in front of the shore. Although erosion is a natural process, it can create significant problems for property owners, businesses, and the public, especially when inappropriate planning and design activities either increase natural erosion rates or compound the impact of natural erosion processes. The Maryland Geological Survey (MGS) began to quantify the problem in 1914, documenting major reductions of various islands throughout the State such as Sharp, James and Tilghman Islands.

Studies estimate that 31 percent of the State's 4,360 miles of tidal shoreline currently experience some degree of erosion. Kent County's shoreline, 29% of 268 miles of tidal shoreline, currently experiences some degree of erosion (Table 21). The surrounding counties of Cecil and Queen Anne's experience comparable erosion rates (Cecil: 22% and Queen Anne's: 29%).

Table 21: Rate of Erosion – Miles of Shoreline Affected

Area	Erosion Rate 0-2 ft/year	Erosion Rate 2-4 ft/year	Erosion Rate > 4 ft/year	Total Eroding Shoreline	Total County Shoreline
Cecil	39	5	0	44 (22%)	200
Kent	64	12	2	78 (29%)	268
Queen Anne's	62	20	13	95 (29%)	323
Maryland (16 Coastal Counties)	965	234	142	1,341 (31%)	4,360

Source: US Army Corps of Engineers, 1990

Section II: Vulnerability

A. Current Trends

Erosion historically occurs along the County's 268 miles of tidal shoreline. Soils found in the northern shorelines along the Sassafras River and its creeks and tributaries are dominated by moderately sloping to steep, well-drained soils formed from loamy materials. The western and southern shorelines located along the Chesapeake Bay and its many creeks and tributaries are dominated by nearly level to moderately sloping, moderately well-drained and poorly-drained soils formed from clayey and silty materials. This clay layer often acts as a conduit to stop infiltration and to cause erosion in the form of sluffing along shoreline cliffs. The south-eastern shorelines located along the Chester River and its creeks and tributaries are dominated by level, poorly drained marsh soils formed from organic and mineral materials. Shorelines in this area are also nearly level to moderately sloping with well and poorly drained clayey and silty soils.

B. Loss Estimation/Data Limitations

Current standard loss estimation models and tables for erosion damages are not available. Structural damage to buildings could be simplified as either undamaged or severely damaged due to erosion. Although slight or moderate damage could occur due to erosion, the likelihood of this level of damage is considered small. The estimated structure loss from erosion is based on factors such as: past experience, location of the structure within the hazard area, rate of erosion, and the structure replacement value. The same applies to content damage as well. Relevant data should be collected to complete the vulnerability analysis for this hazard.

Section III: Mitigation

Reduce sediment and erosion

Discussion: Surface water runoff can erode soil from areas with bare, exposed soil, sending sediment into downstream waterways. Sediment tends to settle where the river, creek, or stream slows down and loses power, such as when it enters a lake. Sedimentation will gradually fill channels and lakes; thus, reducing their ability to carry or store floodwaters. Not only are the channels unable to drain but the sediment in the water reduces light, oxygen, and water quality.

Practices to reduce erosion and sedimentation have two principal components: (1) minimize erosion with vegetation and (2) capture sediment before it leaves the site. Slowing surface water runoff on the way to a drainage channel increases infiltration into the soil and reduces the volume of topsoil eroded from the site. Runoff can be slowed down by measures such as vegetation, terraces, contour strip farming, no-till farm practices, and impoundments (e.g., sediment basins, farm ponds, and wetlands).

Erosion and sediment control measures are necessary for agricultural plowing or tilling activities and for other earth disturbance activities, which are defined as "construction or other human activity which disturbs the surface of the land, including, but not limited to, clearing and grubbing, grading, excavations, embankments, land development, timber harvesting activities, road maintenance activities, mineral extraction, and the moving, depositing, stockpiling, or storing of soil, rock or earth materials."

Best Management Practices (BMPs) must be used to minimize the potential for accelerated erosion and sedimentation, for all activities, including those, which disturb less than 5,000 square feet. For areas greater than 5,000 square feet, an erosion and sediment control plan is required.

Article VI, Section 9 of Kent County's Land Use Ordinance addresses Erosion and Sediment Control. All municipalities also have adopted Erosion and Sediment Control Ordinances. The regulations outline applicability, procedures, and requirements specific to steep slopes, vegetation, and structural erosion control measures. Sediment control plans, hazardous conditions, securities, and inspections are also addressed. The purpose of this section is to protect, maintain and enhance the public health, safety, and general welfare by establishing minimum requirements and procedures to control the adverse impacts associated with increased stormwater runoff. Proper management of stormwater runoff will minimize damage to public and private property, reduce the effects of development on land, control stream channel erosion, reduce local flooding, and maintain after development, as nearly as possible, the predevelopment runoff characteristics.

1. *Project*: Continue to work with property owners, farmers, and contractors on restoration and stabilization measures that reduce erosion, improve water quality, and enhance aquatic conditions. Continue to collaborate with Maryland Department of the Environment, US Army Corps of Engineers, and other state agencies on stream condition evaluation, geomorphic assessment, wetland delineation, natural resources inventories, natural channel design, stabilization feature design, and grading, erosion and sediment control plans.

   Program: Kent County Erosion and Sediment Control provisions, Erosion and Sediment Control provisions in municipalities

   Responsible Organizations: Kent County Public Works, Kent County Planning, Kent County Soil and Water Conservation District, municipalities

   Possible Funding Sources: Hazard Mitigation Grant Program, Flood Mitigation Assistance Program, Pre-disaster Mitigation Grant Program, Emergency Streambank and Shoreline Protection.

   Timeline for Implementation: 3 years

2. *Project*: Work with Natural Resources Conservation Service to implement Best Management Practices on farms.

   Program: Kent County Erosion and Sediment Control provisions, Erosion and Sediment Control provisions in municipalities

3. *Project*: Strictly enforce sediment control regulations.

   Program: Kent County Erosion and Sediment Control provisions, Erosion and Sediment Control provisions in municipalities

Responsible Organizations: Kent County Planning, Kent County Soil and Water Conservation District, municipalities

Possible Funding Sources: None

Timeline for Implementation: Ongoing

4. *Project*: Continue to work with the Department of Natural Resources and County residents to utilize the Shore Erosion Control Program. The Shore Erosion Control Program is a technical and financial assistance program within Maryland's Department of Natural Resources (DNR) Capital Grants and Loans Administration. The Program's goal is to mitigate property damage associated with erosion. This goal is achieved by assisting communities and local governments in assessing existing conditions, determining the best course of action and providing interest-free loans for the implementation of the recommended action to resolve shoreline erosion problems. Since 1968, the Shore Erosion Control Program has administered over 1,200 loans, established 880 projects, stabilized 68.9 miles of shoreline and created 78.4 acres of wetlands.

   Mitigation strategies to control shore erosion can be structural or non-structural. Structural shore erosion control methods are usually implemented in areas with higher rates of erosion and consist of barrier-like structures that stabilize the shoreline, such as bulkheads, concrete walls, breakwaters, stone revetments, jetties and groins.

   Non-structural shore erosion control measures include the creation of protective vegetative buffers through beach nourishment, fringe marsh creation and dune management projects. Projects range from $100 to $200 per foot (non-structural) to $500 to $1200 per foot (structural).

   In 1964, State enabling legislation created the Shore Erosion Control Program (SEC). In 1968, program funding was established. Between 1968 and 1970, the Program administered matching grants to property owners in need of financial assistance to address shoreline erosion problems. From 1970 to 1992, the Program provided no-interest loans and technical assistance to coastal property owners. Currently, the Program provides loans to local governments, home owners associations and public lands:

   Program: DNR's Capital Grants and Loans Administration. The Program depends on State special funds, drawing appropriations from the Shore Erosion Control Revolving Loan Fund and the Waterway Improvement Fund.

Responsible Organizations: Kent County Planning, Kent County Soil and Water Conservation District, municipalities

Possible Funding Sources: DNR's Capital Grants and Loans Administration, Emergency Streambank and Shoreline Protection.

Timeline for Implementation: 3 years

5. *Project*: Continue to identify steep cliffs along County waterways and to enforce Shoreline Cliff conditions found in the Kent County Land Use Ordinance.

   Program: Kent County Land Use Ordinance

Chapter 7: Wildfires:

Section I: Nature, History, and Local Profile

A. Nature

A wildfire is an uncontrolled fire spreading through vegetative fuels, threatening and possibly consuming structures and other community assets. Wildfires often begin unnoticed and can spread quickly, creating dense smoke that can be seen for miles. A wildland fire is a fire in an area in which development is almost nonexistent, except for roads, power lines and similar facilities. An urban-wildland interface fire is a wildfire in an area where structures and other human development meet or intermingle with wildland or vegetative fuels. Fire may be rated as low, moderate, high, very high or extreme based on the type of fuels that help ignite them (Table 22).

Table 22: Wildfire Rating Scale

Rating	Description
Low	Fuels do not ignite readily from small firebrands although a more intense heat source, such as lightning, may start fires in duff or punky wood. Fires in open cured grasslands may burn freely for a few hours after rain, but woodland fires spread slowly by creeping or smoldering, and burn in irregular fingers. There is little danger of spotting.
Moderate	Fires can start from most accidental causes, but with the exception of lightning fires in some areas, the number of starts is generally low. Fires in open cured grasslands will burn briskly and rapidly on windy days. Timber fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel, especially draped fuel, may burn hot. Short-distance spotting may occur, but is not persistent. Fires are not likely to become serious and control is relatively easy.
High	All fine dead fuels ignite readily and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High-intensity burning may develop on slopes or in concentrations of fine fuels. Fires may become serious and their control difficult unless they are attacked successfully while small.
Very High	Fires start easily from all causes, and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop intensity characteristics such as long-distance spotting and fire whirlwinds when they burn into heavier fuels.
Extreme	Fires start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the very high fire danger class. Direct attack is rarely possible and may be dangerous except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions the only effective and safe control action is on the flanks until the weather changes or the fuel supply lessens.

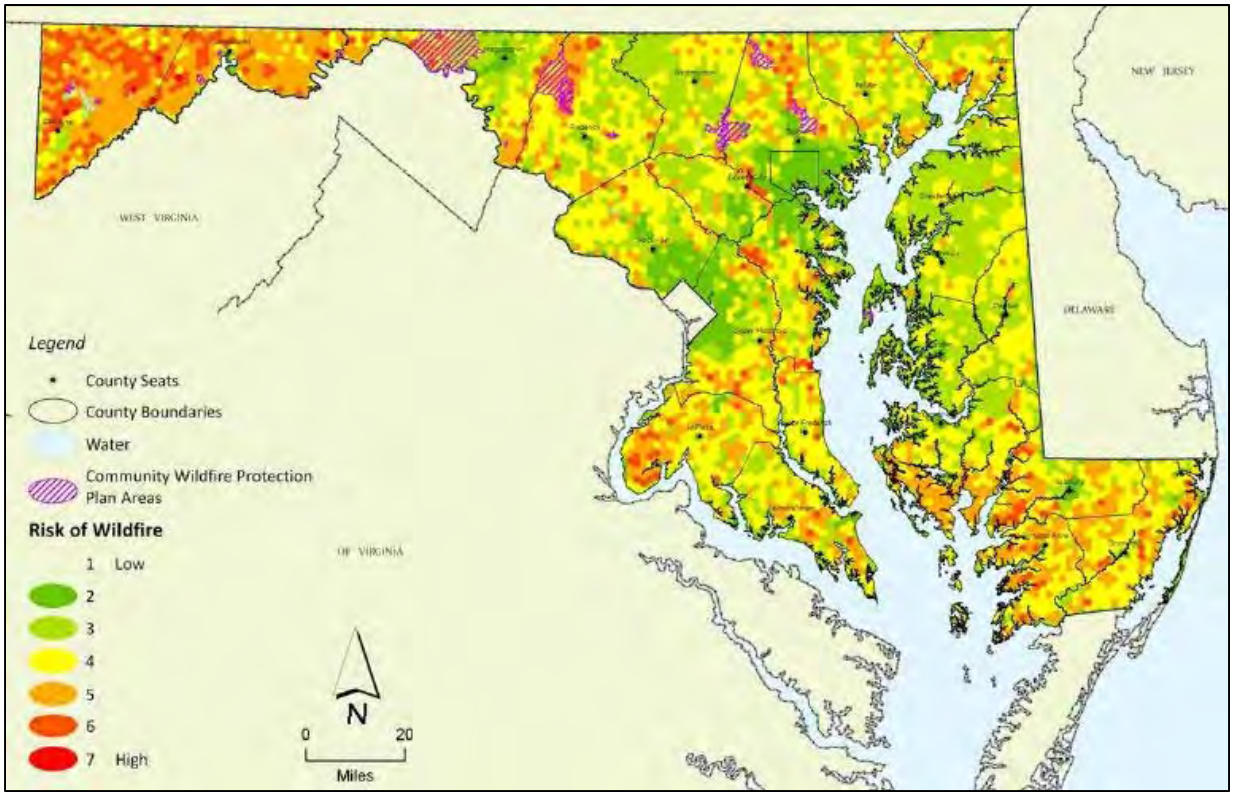
Source: USFS, Wildland Fire Assessment System

Wildfires can occur at any time of the year, but they mostly occur during long, dry hot spells. Any small fire in a wooded area, if not quickly detected and suppressed, could spread out of control. Human carelessness, negligence, and ignorance cause most wildfires. However, some are precipitated by lightning strikes and in rare instances, spontaneous combustion. Potential aftermath of wildfires includes severe erosion and silting of stream beds and reservoirs, resulting in damage to the watershed and flooding due to loss of ground cover.

B. History

The Maryland Hazard Analysis categorizes Kent County at a medium-high risk for wildfires. The following table prepared by the Maryland Forest Service documents the number of fires in the County over the past 13 years and compares it to surrounding counties, the Eastern Shore and the State as a whole.

Figure 15 – Wildfire Risk



Source: Maryland Forest Resource Assessment 2010, June 18, 2010.

The Maryland Forest Service lists approximately 78 reports of fires in Kent County requiring emergency response by the Maryland Forest Service between 2003 and 2012, with an average of 7.8 fires each year. Kent County's wildfire average is just over one-third that of Cecil County and nearly half of Queen Anne's wildfire average. In the last four years, less than 7 acres per year has burned. The highest acreage total for the last 10 years is 2007 when 62 acres burned. These totals do not include all fires in the County, but only wildfire responses by the Maryland Forest Service.

Table 23: History of Wildfires

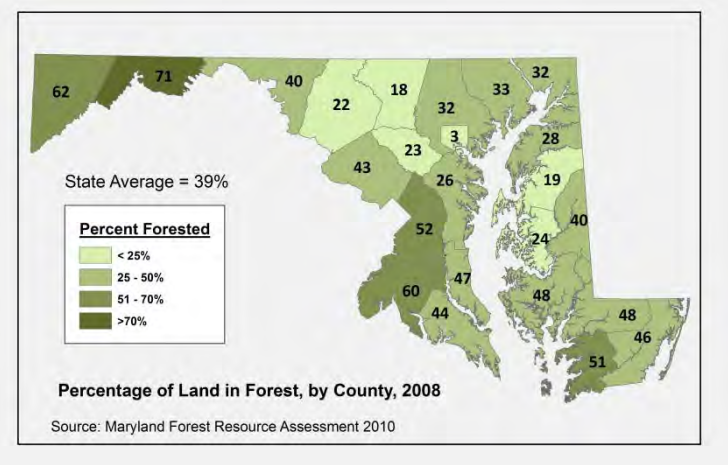
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Average
Kent	3	3	7	24	14	17	5	2	2	1	7.8
Cecil	13	10	23	58	35	33	30	10	5	9	22.6
Queen Anne	3	7	12	31	31	32	21	6	1	7	15.1
Eastern Shore	40	101	173	257	309	312	139	68	73	60	153.2
Maryland	128	253	441	753	622	583	408	170	125	159	364.2

Source: Maryland Forest Service

C. Profile

Kent County has approximately 28 percent of its land delineated as forested lands Approximately 50,235 acres were forested, as estimated in 2008. An additional 49 acres are categorized as barren, adding to the acreage susceptible to wildfire conditions. Counties to Kent's north have more forested land, but counties to Kent's south are similar. Allegheny and Garrett Counties have over 60 percent forested land cover and are thus more susceptible to wildfires.

Figure 16 – Percentage of Forest by County



Section II: Vulnerability

A. Existing Community Assets

Future wildfires could cause substantial loss of property along with direct and indirect economic effects for residents and community businesses. All forestlands are subject to wildfire due to human negligence, lightening strike, or combustion. Currently 50,235 acres of Kent County are forested. Agricultural land is also susceptible to brush fires caused by human negligence or combustion. There is a total of 101,394 acres currently in cropland use.

Note from the Department of Natural Resources – Forest Service: Fuel Classification was all rated at medium because it is hard to assess the classification based on forest type alone. Fuel classifications are generally based on the fuel layer that is available to burn for a given wildfire. For example; grasses and litter fuel (leaves and needles) are classified as light; small twigs and shrub layers as medium; and downed logs and logging slash as heavy. All of these layers could potentially exist within the Forest Classifications given.

B. Data Limitations

Information on the total number of critical fire weather days per year in the County and degrees of slopes should be gathered and applied to the Fire Hazard Severity table in the How-To Guide (page 2-30) to determine specific high or extreme fire hazard areas.

Section III: Mitigation

As people move to the more rural and forested areas to reside, increased development in these areas creates danger for both forests and the population residing there. Mitigation options for wildland fire need to address not only the management of fuels, but also the potential for growing population in wildfire threat areas. These measures may also define the necessary interface between private property needs and natural resource needs.

A. Loss Estimation

In assessing physical vulnerability, the most important factor is the extent to which structures are damaged when they are exposed to fire and heat. Current standard loss estimation tables do not exist for wildfires. The local fire departments and structural engineers should help estimate structure and content damage from wildfires.

Most wildfire related deaths occur as a result of fire suppression activities. However, if roads are damaged or there is insufficient warning time, other injuries and deaths could occur. Since there are no death or injury curves for wildfire, they are estimated based on past wildfire events.

More information about specific properties in or near wooded areas would help in determining the relative vulnerability. In addition, an assessment of the vegetation types is necessary in determining specific risk factors. This information should be further researched.

B. Mitigation

1. *Discussion*: Reduce damage and loss to existing community assets including residential structures, critical facilities, and infrastructure due to wildfires.

   Project: Conduct a county-wide assessment to identify structures located in areas where trees are thick and recommend fire-resistant walls or glass that can withstand higher temperatures.

   Responsible Organizations Kent County Emergency Management, Fire Departments

   Timeline for Implementation: 6 months

   Program: Capital Improvement Project

2. *Discussion*: Reduce the exposure of residences and infrastructure to wildfire hazard incidents.

Project: Introduce residents to the concept of defensible space practices in urban interface areas that requires trees around new homes to be thinned or cut down, creating a buffer zone to reduce the potential for damage from wildfire.

Responsible Organizations: Kent County Emergency Management, Fire Departments

Timeline for Implementation: 6 months

Program: Kent County Emergency Management

Project: Integrate procedures (prepared by the County's Office of Emergency Servicesin conjunction with local Fire Departments) regarding training, suppression efforts, use of incident command systems during fire events, and the roles of various local, State and Federal agencies during wildfire events into a single document.

Program: Kent County Emergency Management

Chapter 8: Extreme Heat

Section I: Nature, History, and Local Profile

A. Nature

Episodes of extreme heat typically involve high temperature and high humidity. In addition to being hazardous to people, livestock and crops, extreme heat can cause water shortages, fire hazards, excessive energy demands, and damage to infrastructure. When the air temperature is above 90°F and the relative humidity is high, the body is under great stress to maintain its normal temperature; heat exhaustion can result, followed by heat stroke. The National Weather Service headlines the heat index in its forecasts when the index is expected to reach 100°F. At index temperatures of 105°F and greater, a heat advisory is in effect and heat disorders such as cramps, heat exhaustion, and heat stroke are possible. Excessive heat warnings are issued when the heat index reaches 115°F, a stage considered dangerous for a large portion of the population.

B. History

Kent County typically enjoys variably moderate temperatures throughout the summer months with occasional peaks of high temperature and humidity. However, the National Climate Data Center database has documented a few notable events of unusually hot and humid weather (greater than 90 degrees) lasting several weeks during the past seven years. The average temperature in the State of Maryland is 87 degrees. A record 109 degrees was reached in Cumberland and Frederick, Maryland in 1936.

A heat wave hit the Delmarva Peninsula, namely Kent County, beginning on July 11 and continuing for several weeks into August 1995. Again July and August 1999 saw a 16-day heat wave consisting of temperatures above 90 degrees and a high temperature of 103 degrees on 5 July. Beginning in July 2001, extreme heat was recorded in the area and peaked on August 9. The Eastern Shore experienced one of the ten hottest summers on record in 2002. There were 6 periods of excessive heat totaling 35 days according to the National Climate Data Center.

C. Local Profile

Extreme drought or unseasonably dry weather often precedes extreme heat, because a portion of the sun's energy that would normally be utilized for evaporation of water is now available to heat land surfaces. A total of 8 drought events were reported in Kent County between 1951 and 2012 (61-year period). The drought in 2012 contributed to the extremely hot summer in Maryland and Kent County. Many regions in the mid-Atlantic and Northeast reported the summer of 2012 to be one of the hottest on record.

Droughts result from prolonged periods of dry weather accompanied by extreme heat and usually occur during the summer months (July and August) in Kent County when high pressure settles in with prevailing dry west to southwest winds. The warmest time of the year is July when maximum temperatures average 89 degrees Fahrenheit. Extreme temperatures of 100 degrees Fahrenheit occur occasionally.

Kent County faces about 2 extreme heat events every 10 years. This impacts the health of both humans and livestock and can impact agriculture. Also, demand for cooling can put a significant strain on power companies and other utilities. The combined effect of drought and heat in 1999 resulted in losses exceeding one million dollars due to crop losses and other damages. In severe cases of prolonged extreme heat, monetary losses could run even higher.

When extreme heat begins a drought event, agriculture is usually first to be affected because of its heavy dependence on stored soil moisture. Soil moisture can be rapidly depleted during extended dry periods. Dryland farming and ranching are the most at risk from drought. Water uses depending on in-stream flows, such as irrigated farms; aquatic, wetland, and riparian environmental communities; and recreational uses are at high risk but less exposed. Urban and agricultural water users who rely on reservoirs and wells that are not dependent on high rates of aquifer recharge are the last to feel the effects.

Section II: Vulnerability

Current Trends

Extreme heat events tend to be regional in occurrence; therefore, there is no particular hazard or impact zone within the County, aside from agricultural land. There are certain population subgroups which may be more susceptible to the effects of extreme heat and may require relocation in extreme cases. These populations include the elderly and younger people, as well as households that lack air conditioning. According to the 2010 Census, 21.8 percent of the County's total population is 65 or over (4,397 people). The county's youth population (3,548 people 17 and under) makes up 17.6 percent of the total population. A total of 7,945 people in Kent County (or 39 percent) are at risk in an extreme heat event.

Based on the 2007 Census on Agriculture, in 2007, 72 percent of the county's land area was in farmland (128,220 acres). Most of the county falls into the cropland category. Small patches of pastoral land are found in the northern parts of the county. Approximately 72 percent of the County's land mass is at risk during an extreme heat event.

Section III: Mitigation

Identifying the first stages of extreme heat and conserving water and energy will help mitigate a prolonged heat event to an extent. Also, youth and elderly populations must follow air quality recommendations during heat events and must, in extreme cases, be relocated to air conditioned areas when necessary. Mitigation measures for the agricultural community in an extreme heat event are addressed in Chapter 6: Drought.

A. Educate the public regarding heat index and energy conservation measures.

Project: Prepare education materials to:

- Encourage residents to heed advice on air quality on extreme heat days.

- Encourage local media sources to announce air quality and heat indices and to relay warnings and recommendations.
- Encourage elderly residents and families without air conditioning to have relocation sites with air conditioning during extreme heat events.
- Encourage residents to make provisions for pets during extreme heat waves (shade, water, air conditioning when appropriate).
- Encourage local residents to heed advice on water restrictions and inform county officials of cases that consistently disregard the mandate.
- Encourage local residents to heed advice on electricity conservation during extreme heat events due to increased demand on utilities and emergency services.

Responsible Organizations: Kent County Emergency Management, local media

Timeline for Implementation: Ongoing

Program: Kent County Office of Emergency Services

B. Educate the public regarding the benefits of natural and man-made shade.

Project: Prepare education materials to:

- Encourage businesses to plant shade trees in parking areas to relieve extreme heat reflected off of concrete surfaces.
- Encourage the agricultural community to plant shade trees and/or erect tarp systems for livestock to congregate under during extreme heat events.

Responsible Organizations: Agricultural community, local businesses

Timeline for Implementation: Ongoing

Chapter 9: Tornadoes

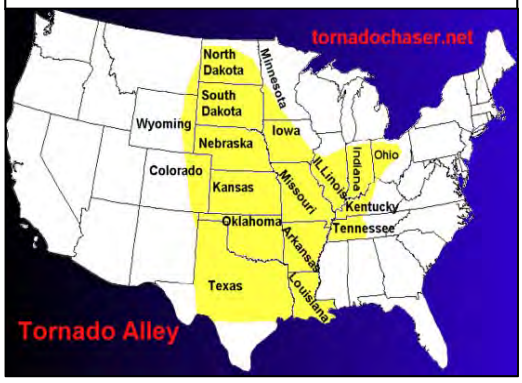
Section I: Nature, History, and Local Profile

A. Nature

The National Weather Service defines a tornado as a violently rotating column of air, usually pendant to a thunderstorm, with circulation reaching the ground. Tornados are generally considered the most destructive of all atmospheric-generated phenomena, with an average of 1,200 being reported annually in the United States. In the southern states, peak tornado season is March through May; peak months in the northern states are during the summer . Additionally, over 30 percent of recorded tornado activity has occurred between the hours of 3:00 pm and 6:00 pm, and an additional estimated 25 percent have occurred between 6:00 pm and 9:00 pm.

Tornados are considered a major natural hazard threat for areas in the Midwest known as Tornado Alley. Tornado Alley includes portions of Texas, Oklahoma, Arkansas, Missouri and Kansas. Tornados follow the path of least resistance and therefore valleys and flatter land areas are most susceptible to them.

Figure 17 – Tornado Alley



The Fujita Scale (F-Scale) was first published in 1971. It relates the damage caused by a tornado to the fastest ¼ mile wind at the height of the damaged structure. The Enhanced Fujita Damage Scale (EF-Scale), indicated in Table 24, was implemented in 2007. The EF-Scale utilizes 28 damage indicators and 8 degrees of damage to estimate tornado strength. The damage scale increases in intensity from a weak EF0 (65-85 mph 3 second gust) to a EF5 (over 200 mph 3 second gust). The Enhanced Fujita Scale indicates that tornadoes at the EF0 classification cause light damage to chimneys, tree branches, and signboards. Tornadoes of EF1 magnitude can cause moderate damage to road surfaces, automobiles, and mobile homes. The impact of tornadoes primarily depends upon their occurrence in developed areas—tornadoes in undeveloped areas may cause damage only to a few trees and may even go unreported.

Table 24: Enhanced Fujita Damage Scale

FUJITA SCALE			OPERATIONAL EF SCALE	
F Number	Fastest 1/4-mile (mph)	3 Second Gust (mph)	EF Number	3 Second Gust (mph)
0	40-72	45-78	0	65-85
1	73-112	79-117	1	86-110
2	113-157	118-161	2	111-135
3	158-207	162-209	3	136-165
4	208-260	210-261	4	166-200
5	261-318	262-317	5	Over 200

The Maryland Risk Assessment indicates that between 1950 and 1998 (48-year period), there were three tornado touchdowns. All three reported were of the F1 category and occurred in 1967, 1975, and 1978, respectively. F1 tornadoes are classified as moderate with wind speeds between 73 and 112 miles per hour. The tornado in 1967 and 1978 occurred in the Neavitt/Bozman area. Each of these resulted in approximately $25,000 worth of property damage. A recent tornado occurred in Newcomb in July 2000. It was of an F0 category and resulted in property damage of approximately $1,000.

On April 28, 2002, a lethal tornado (or tornadoes) damaged property in a line between La Plata and St. Leonard, Maryland. The winds produced by the storm had a peak rating of F4. Its effects were felt in neighboring counties. Although Kent County did not experience any impact from this storm, it could have occurred pretty much anywhere and could have caused major destruction to structures in its path.

B. History

Kent County has experienced tornadoes and tornado-like storm events throughout its history. Many tornado events are unreported and result in the loss of agricultural buildings or residential damage. Several events have been documented by Kent County Emergency Management. In June 1980, several residences and a business in the Fairlee and Tolchester areas suffered approximately $121,500 in damage caused by a severe storm with tornado-like winds. Downed trees and high winds damaged homes and a local marina. The marina suffered damage to buildings and piers. In Millington, a tornado touched down on November 16, 1989, resulting in $250,000 in damages. No injuries were reported; however, a church and a mobile home were destroyed and hundreds of Millington residents lost electricity. Tolchester was hit by tornado-like conditions again in October 1990 from a storm bringing heavy rain and damaging winds.

In what appears to be the largest event in Kent County, tornadoes touched down in several areas on July 27, 1994. Civil defense sirens were sounded in Chestertown as citizens were warned to take shelter. The tornado made landfall in the Chestertown area, damaging 12 homes and multiple outbuildings, as well as, crops and trees on Smithville Road. Extensive damage to homes, outbuildings, automobiles, and trees was also reported on Flatland Road. The path of the tornado proceeded on a northwesterly course through forested areas and cropland toward Coopers Lane and Still Pond. Twisted trees, downed barns, fences, and roofs were reported in this area. In these and other locations throughout the county, fallen trees damaged automobiles, as well as dwellings. Damage to the agricultural community was extensive in the form of destruction to crops, agricultural buildings and machinery. Further, the roof of an airplane hanger at Scheeler Field on Route 213 collapsed and damaged at least one airplane. No injuries were reported.

Table 25: History of Tornadoes

Year	Event	Description
8/11/50	Tornado	F1 torndao caused minor damage south east of Galena
7/14/75	Tornado	F0 tornado touched down near Still Pond but caused no damage
6/29/80	Severe Storm Damage/ Tornado-like conditions	Downed trees, collapsed chimneys, property damages in Fairlee and Tolchester totaling $121,500
11/16/89	Tornado	F1 tornado destroyed a church and mobile home near Millington/damages totaling $250,000
5/13/90	Tornado	F0 tornado caused minor damage near Kennedyville
10/90	Tornado-like conditions	Heavy damage in Tolchester
7/27/94	Tornado	F2 tornado damaged 12 homes, crops, and downed trees in Chestertown, Worton, and Still Pond

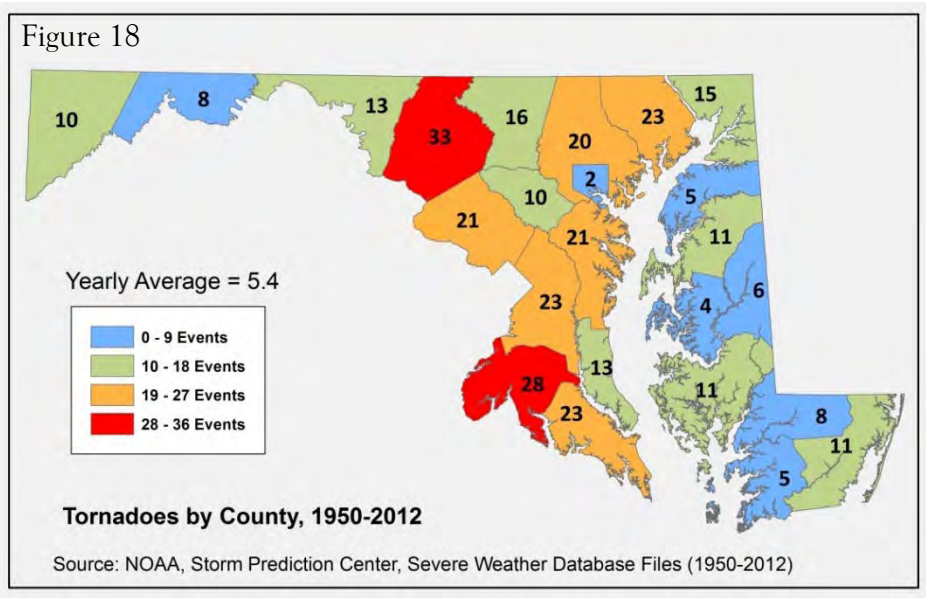
C. Profile

Tornadoes are not a common occurrence in Kent County. While the magnitude and location of tornadoes are unpredictable, most of those occurring in the County over the last 60 years have been classified as low intensity (F0 and F1). These tornadoes have had no history of fatalities although they have resulted in road blocks and delays, and increased workload from clearing fallen trees and debris. Kent County is located in Wind Zone II (wind speed of 160 miles per hour).

Unlike some other hazards, mapping tornado risk is not as important because it is unlikely that a community has variable tornado risks within its jurisdiction and tornadoes are not likely to touchdown in the same place each time. In most cases, communities need only to determine if they have a tornado risk and then proceed to determine their design wind speed.

Figure 18 indicates that Kent County experienced five tornadoes between 1950 and 2012, with no fatalities.

Figure 18



Section II: Vulnerability

A. Current Trends

Tornadoes are not an extremely common occurrence in Kent County. While the magnitude and location of tornadoes are unpredictable, all that have occurred in Kent County in the past fifty years have been classified as low intensity (F0 and F1) and have done relatively little damage.

However the April 2002 tornado which hit La Plata, in Charles County, caused major damage to Southern Maryland. La Plata buildings were left with missing roofs, signs were uprooted, power lines and trees were knocked over, homes and water towers destroyed, and several cars were damaged.

B. Loss Estimation

In assessing vulnerability, the most important factor is how likely structures are to fail when they are subjected to wind loads that exceed their design or to flying debris that penetrates the building. In general, building damages can range from cosmetic to complete structural failure, depending on wind speed and location of the building with respect to the tornado path and can be analyzed by a structural engineer.

Approximately one quarter of the County's housing units were built prior to 1939. These older structures may be in poor condition and not be able to weather high winds due to poor building quality, plumbing, etc. and are thus more prone to damage by winds. Approximately 72 percent of the County's total land area is in agricultural use. Crops, farm buildings, and farm equipment are susceptible to tornadoes and strong wind damage due to their exposure to tornadoes and wind conditions.

Since there are not any standard loss estimation models and tables for tornadoes currently, it is difficult to calculate actual losses. In terms of calculating human losses, shelters throughout the community should be assessed for their location, capacity, and strength in order to ensure they are able to house residents and withstand the design wind speed.

Section III: Mitigation

1. *Discussion*: Improve the County's ability to identify structures that are vulnerable to high winds.

   Project: Conduct further assessments to identify structures with high risk/vulnerability to wind. Determine if additional Permits and Inspections Officers are required to assess the vulnerability of structures. Conduct engineering inspections of Kent County's fire stations and schools to assess each facility's ability to sustain damage from both flood and wind events and recommend specific retrofitting measures for each building as appropriate to better protect them from flooding and high winds.

   Several of the County's fire stations also serve as housing for County emergency service workers. These facilities have been built at different times and to different building performance standards. As a result, some of them are able to withstand significant flood and wind events while others require building fortification measures. As with most structures, integrity of the building envelope during a wind event is a major concern. Given the size of building openings for most fire stations (doors to truck and vehicle storage areas), they are of particular concern for fire stations.

   With the implementation of the International Building Code, there are now certain requirements for construction of fire station doors to protect against building envelope penetration which leads to building failure during a wind event. The County should adopt this standard for all fire stations since these stations are critical facilities that play a vital role in community protection and emergency response immediately prior to, during, and after disaster events.

   Responsible Organizations: Kent County Emergency Management, Middle Department Inspection Agency

   Possible Funding Sources: To be determined

   Timeline for Implementation: 2 years

   Program: Building Code

2. *Discussion*: Consider actions for wind mitigation wherever appropriate.

   Project: Enforce the county and municipal Floodplain Ordinance design standards in high wind areas (velocity zones). Also enforce tie down requirements in the mobile home communities in Rock Hall and Worton and identify homes that are in need of tie-downs to reduce their vulnerability to high wind damages.

   Responsible Organizations: Kent County Emergency Management, Middle Department Inspection Agency, Kent County Planning, municipalities

   Possible Funding Sources: To be determined

   Timeline for Implementation: 2 years

   Program: Kent County Zoning Ordinance, municipal zoning ordinances

Project: Increase community awareness and introduce the concept of buffers (pruning back overhanging branches from trees) and windbreaks (planting tall trees to reduce wind velocity or low shrubs to trap snow) to protect against winds.

Program: Kent County Emergency Management's public outreach program

3. *Discussion*: High winds can originate from a number of events: tropical cyclones, other coastal storms, and tornadoes, which generate the most significant wind hazards. High winds are capable of imposing large lateral (horizontal) and uplift (vertical) forces on buildings. Residential buildings can suffer extensive wind damage when they are improperly designed and constructed and when wind speeds exceed design levels. The effects of high winds on a building will depend on several factors: wind speed and duration of high winds, height of building above ground, exposure or shielding of the building relative to wind direction, strength of the structural frame, connections, and envelope (walls and roof), shape of building and building components, number, size and location of openings, and type, quantity and velocity of windborne debris. Based on the ASCE Standard of Minimum Design Loads for Building sand Other Structures, Kent County, Maryland, lies in a 90 mile per hour (mph) wind speed zone and should design and construct all new buildings that will stand up to winds of 90 mph (3 second gust) to resist damage from strong winds

   Project: Proper design and construction of structures particularly those close to open water or near the coast demand that every factor be investigated and addressed. Failure to do so may ultimately result in building damage or destruction by wind. All improvements to critical facilities should include strengthening measures to withstand wind speeds greater than 90 mph.

   Responsible Organizations: Kent County Emergency Management, Middle Department Inspection Agency, Kent County Planning, municipalities

   Possible Funding Sources: To be determined

   Timeline for Implementation: This could begin immediately, for buildings that are being improved.

   Program: Building Codes

Chapter 10: Earthquakes

Section I: Nature, History and Local Profile

A. Nature*

An earthquake, also known as a seismic event, is a shaking of the ground caused by the sudden breaking and movement of large sections (tectonic plates) of the earth's rocky outermost crust. The edges of the tectonic plates are marked by faults (or fractures). Most earthquakes occur along the fault lines when the plates slide past each other or collide against each other. The shifting masses send out shock waves that may be powerful enough to:

- Alter the surface of the Earth, thrusting up cliffs and opening great cracks in the ground and
- Cause great damage … collapse of buildings and other man-made structures, broken power and gas lines (and the consequent fire), landslides, snow avalanches, tsunamis (giant sea waves) and volcanic eruptions.

Although other natural hazards account for much greater annual loss in the United States earthquakes pose the largest risk in terms of sudden loss of life and property. Risk factors that impact the extent of damage include:

- Amount of seismic energy released: The greater the vibrational energy, the greater the chance for destruction.
- Duration of shaking: This is one of the most important parameters of ground motion for causing damage.
- Depth of focus, or hypocenter: The shallower the focus (the point of an earthquake's origin within the earth), usually the greater the potential for destructive shock waves reaching the earth's surface. Even stronger events of much greater depth typically produce only moderate shaking at ground level.
- Distance from epicenter: The potential for damage tends to be greatest near the epicenter (the point on the ground directly above the focus), and decreases away from it.
- Geologic setting: A wide range of foundation materials exhibits a similarly wide range of responses to seismic vibrations. For example, in soft unconsolidated material, earthquake vibrations last longer and develop greater amplitudes, which produce more ground shaking, than in areas underlain by hard bedrock. Likewise, areas having active faults are at greater risk.
- Geographic and topographic setting: This characteristic relates more to secondary effects of earthquakes than to primary effects such as ground shaking, ground rupture, and local uplift and subsidence. Secondary effects include landslides (generally in hilly

* Description copied from 2011 Maryland State Hazard Mitigation Plan Update, Chapter 3. Hazard Identification, Risk Assessment and Vulnerability Analysis.

or mountainous areas), seismic sea waves, or tsunamis (pretty much restricted to oceans and coastal areas), and fires (from ruptured gas lines and downed utility lines).

- Population and building density: In general, risk increases as population and building density increase. Types of buildings: Wooden frame structures tend to respond to earthquakes better than do more rigid brick or masonry buildings. Taller buildings are more vulnerable than one- or two-story buildings when located on soft, unconsolidated sediments, but taller buildings tend to be the more stable when on a hard bedrock foundation.

- Time of day: Experience shows there are fewer casualties if an earthquake occurs in late evening or early morning because most people are at home and awake and thus in a good position to respond properly[1].

Measuring Earthquakes.[2] Earthquakes are measured in terms of their magnitude and intensity. Magnitude is measured using the Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake through a measure of shock wave amplitude. On the Richter Scale, magnitude is expressed in whole numbers and decimal fractions. For example, a magnitude 5.3 might be computed for a moderate earthquake, and a strong earthquake might be rated as magnitude 6.3. Because of the logarithmic basis of the scale, each whole number increase in magnitude represents a tenfold increase in measured amplitude; as an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value.

Earthquakes with magnitude of about 2.0 or less are usually called micro earthquakes; they are not commonly felt by people and are generally recorded only on local seismographs. Events with magnitudes of about 4.5 or greater - there are several thousand such shocks annually - are strong enough to be recorded by sensitive seismographs all over the world. Great earthquakes, such as the 1964 Good Friday earthquake in Alaska, have magnitudes of 8.0 or higher. On the average, one earthquake of such size occurs somewhere in the world each year. The Richter Scale has no upper limit.

The Richter Scale is not used to express damage. An earthquake in a densely populated area which results in many deaths and considerable damage may have the same magnitude as a shock in a remote area that has no direct impact. Large-magnitude earthquakes that occur beneath the oceans may not even be felt by humans.

The effect of an earthquake on the Earth's surface is called the intensity. The intensity scale consists of a series of certain key responses such as people awakening, movement of furniture, damage to chimneys, and, finally, total destruction. Although numerous intensity scales have been developed over the last several hundred years to evaluate the effects of earthquakes, the one currently used in the United States is the Modified Mercalli Intensity (MMI) Scale. It was developed in 1931 by the American seismologists Harry Wood and Frank Neumann. This scale,

[1] Maryland Geological Survey www.mgs.md.gov
[2] United States Geological Survey www.usgs.gov

composed of 12 increasing levels of intensity that range from imperceptible shaking to catastrophic destruction, is designated by Roman numerals. It does not have a mathematical basis; instead, it is an arbitrary ranking based on observed effects.

The MMI value assigned to a specific site after an earthquake has a more meaningful measure of severity to the nonscientist than the magnitude because intensity refers to the effects actually experienced at a particular place.

The lower numbers of the intensity scale deal with the manner in which people feel the earthquake. The higher numbers of the scale are based on observed structural damage. Structural engineers usually contribute information for assigning intensity values of VIII or above. A detailed description of the MMI Scale of earthquake intensity and its correspondence to the Richter Scale is given in Table 26.

Table 26: Richter Magnitude Scale and Modified Mercalli Intensity Scale.

Richter Magnitude Scale	**Modified Mercalli Intensity Scale**
1.0 to 3.0	I
3.0 to 3.9	II to III
4.0 to 4.9	IV to V
5.0 to 5.9	VI to VII
6.0 to 6.9	VII to IX
7.0 or Higher	VIII or Higher
Defined Modified Mercalli Intensity Rating Scale	
I	Not felt except by a very few under especially favorable conditions
II	Felt only be a few persons at rest, especially on upper floors of buildings.
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck.
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors, disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Damage negligible in buildings of good design and construction; slight to moderate

	in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factor stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
XII	Damage total. Lines of sight and level are distorted. Objects thrown in the air.

B. History

The USGS National Earthquake Information Center maintains a national database of significant earthquake epicenters from 1568-2010. USGS defines significant earthquakes as those that caused deaths, property damage, or geological effects, or that were experienced by populations in the epicentral area.[3] The Maryland Geological Survey maintains the history of earthquakes in Maryland.

The earliest recorded earthquake in Maryland occurred in Annapolis, on April 25, 1758. The shock lasted 30 seconds and was preceded by subterranean noises. Additional felt reports were received from a few points in Pennsylvania. The most recent significant event was on July 16, 2010 when a 3.6 magnitude earthquake occurred near Germantown. Ground shaking was felt as far away as Annapolis and Northern Virginia.

The most significant event to affect Kent County was the 2011 Virginia Earthquake which occurred on August 23, 2011 approximately 5 miles south-southwest from the town of Mineral in Louisa County. The 5.8 magnitude quake was felt across more than a dozen states. The quake cause minor damage to several historic structures in Chestertown.

C. Profile

Although no earthquake epicenters have been documented within Kent County, all of the county could be affected by earthquakes occurring on the Western Shore or in neighboring states. Earthquakes are unpredictable and can happen at anytime without warning. Although Kent County has experienced several earthquakes, the small magnitude and minimal economic damage has not warranted the need for considerable earthquake retrofit or similar mitigation programs.

[3] United States Geological Survey, http://www.nationalatlas.gov/mld/quksigx.html (June 2011).

Section II: Vulnerability

Earthquakes are low probability, high-consequence events. Although earthquakes may occur infrequently they can have devastating impacts. Ground shaking can lead to the collapse of buildings and bridges; disrupt gas, life lines, electric, and phone service. Deaths, injuries, and extensive property damage are possible vulnerabilities from this hazard. Some secondary hazards caused by earthquakes may include fire, hazardous material release, landslides, flash flooding, avalanches, tsunamis, and dam failure. Moderate and even very large earthquakes are inevitable, although very infrequent, in areas of normally low seismic activity. Consequently, buildings in these regions are seldom designed to deal with an earthquake threat; therefore, they are extremely vulnerable.

Most property damage and earthquake-related injuries and deaths are caused by the failure and collapse of structures due to ground shaking. The level of damage depends upon the amplitude and duration of the shaking, which are directly related to the earthquake size, distance from the fault, site, and regional geology. Other damaging earthquake effects include landslides, the down-slope movement of soil and rock (mountain regions and along hillsides), and liquefaction, in which ground soil loses shear strength and the ability to support foundation loads. In the case of liquefaction, anything relying on the substrata for support can shift, tilt, rupture, or collapse.

In the 2008 HAZUS Study, FEMA assessed several categories including; economic loss, debris generation, casualties, and displaced households. Maryland's rankings were consistent in the low to mid thirties indicating that although earthquakes are a threat, in comparison with the rest of the United States, it is not the most susceptible for significant impacts from an earthquake event.

- Maryland was ranked 33 with an estimated annualized loss of 7.218 million.
- With an annualized estimate of 5,000 tons of debris Maryland ranked 32nd.
- Maryland ranked 34 with an annualized estimate of 8 displaced households. In comparison, Pennsylvania ranked 18 with 35 displaced households, Virginia ranked 27 with 16 displaced household, and ranked Delaware 45th with 2 displaced households.
- Regarding annualized casualty estimates Maryland ranked 37 with 4 minor, 0 life threatening and 0 fatalities during both the daytime and nighttime. In comparison Pennsylvania ranked 25 with 14/18 day/night minor injuries, no fatalities, Virginia ranked 28th with 9 minor day/night injuries, and Delaware ranked 43 with 1 day/night minor injury and no fatalities.

Section III: Mitigation

Kent County is at low risk for earthquakes and as far as mitigation is concerned, the County will maintain high construction standards by ensuring current building codes and standards are properly enforced.

Chapter 11: Crosswalk

Kent County has identified and analyzed nearly 50 mitigation projects within its Hazard Mitigation Plan. Each mitigation project was developed considering the reduction of effects of each hazard outlined with the Plan, with particular emphasis on new and existing buildings and infrastructure. The cost analysis of each disaster and subsequent mitigation strategy was based on a comparison of mitigation cost and overall benefit to the property owner and the County.

In addition to the overall list of projects identified in Table 28, a prioritized list of projects that, based on cost benefit analysis, the county plans to implement within the first 5-year-cycle is outlined in Table 27. These 9 projects were prioritized with special emphasis on the extent to which benefits are maximized according to cost benefit review of the proposed 50 projects and their associated costs. These initial strategies will be reviewed annually by the Local Emergency Planning Committee. The projects will also be tracked in the Kent County Annual Report. In addition to this annual tracking process, the Kent County Technical Advisory Committee will review projects for consistency with Hazard Mitigation Plan strategies.

Table 27: Prioritized List of Mitigation Projects

Mitigation	Project	Responsible Organization
Ensure adequate protection of critical facilities and infrastructure throughout the County.	Engineering services should provide specifications for backup generators and fuel tanks to provide the municipalities and County with a continuous source of electrical power.	Kent County Planning, Kent County Emergency Management, municipalities
Create awareness among county residents, of the potential hazards associated with floodplain areas and the ways they can protect themselves and their properties from flood events.	Provide floodplain regulation seminars to area contractors, real estate agents, and insurance providers on an annual basis.	Kent County Public Works, Kent County Planning, Middle Dept. Inspection Agency, municipalities
Reduce sediment and erosion at the Chester River, Sassafras River, Chesapeake Bay, creeks and tributaries	Continue to work with the Dept. of Natural Resources and County residents in the Shore Erosion Control Program.	Kent County Planning, Soil and Water Conservation District, municipalities
Educate the public regarding heat index and energy conservation measures.	Continue to encourage local media sources to announce air quality and heat indexes and to relay warnings and recommendations. Kent OES has a Facebook page, a twitter account and is on Pinterest. Email blasts are sent to local media sources.	Kent County Emergency Management, local media

Educate the public regarding the benefits of natural and man-made shade.	Encourage businesses to plant shade trees in parking areas to relieve extreme heat reflected off of concrete surfaces.	Agricultural community, local businesses
Ensure residents are forewarned, and prepare County with supplies to face winter storms	Identify areas of frequent snow drifting and install snow fencing in those areas.	Kent County Roads, Kent County Emergency Management, State Highway Administration
Ensure that existing structures in the floodplain are resistant to flood related damage.	Conduct an assessment of all structures in the 100-year floodplain and obtain data to determine the best flood protection measure that will keep the character of the structure intact. Project costs and benefits will be considered when projects are prioritized.	Kent County Assessment Office, Kent County Planning, Kent County Emergency Management, Middle Dept. Inspection Agency, and the Towns of Betterton, Chestertown, Millington, and Rock Hall.
Ensure that existing structures in the floodplain are resistant to flood related damage.	Identify older homes (built prior to 1940) and pre-FIRM residential structures in the floodplain that are in need of substantial improvement in order to bring them into compliance.	Kent County Assessment Office, Kent County Planning, Kent County Emergency Management, Middle Dept. Inspection Agency, and the Towns of Betterton, Chestertown, Millington, and Rock Hall.
Protect critical facilities in the 100-year flood plain.	For the following critical facilities located within the floodplain, a technical report should be completed. Mitigation measures and a detailed benefit/cost analysis should be conducted as well, for these critical facilities. * Washington College, Custom House and Armory * Water tower in Rock Hall	Kent County Public Works, Kent County Planning, Middle Dept. Inspection Agency, Washington College, Towns of Chestertown and Rock Hall

Table 28: Overall List of Mitigation Projects

Hurricane Mitigation	Project	Responsible Organization
Ensure adequate protection of critical facilities and infrastructure throughout the County.	Install early warning devices	Kent County Emergency Management, municipalities
	Engineering services should provide specifications for backup generators and fuel tanks to provide the municipalities and County with a continuous source of electrical power.	Kent County Planning, Kent County Emergency Management, municipalities
Increase public understanding, support, and demand for hurricane mitigation.	Identify and solicit low/no cost partners to create awareness and promote outreach and conduct a business continuity planning workshop to promote disaster resistance, mitigation, and preparedness to help businesses develop contingency plans to minimize loss during disasters.	Kent County Emergency Management, Kent County Public Works, municipalities
	Provide the Delmarva Emergency Task Force guidance document for public review in the county libraries and at County offices	Kent County Emergency Management, Kent County Public Works, municipalities
Ensure County residents are aware of evacuation procedures.	Office of Emergency Servicesshould have available all information needed for residents and visitors to make informed decisions regarding evacuating the County.	Kent County Emergency Management, Kent County Public Works, municipalities
Flooding Mitigation	Project	Responsible Organization
Ensure that existing structures in the floodplain are resistant to flood related damage.	Conduct an assessment of all structures in the 100-year floodplain and obtain data to determine the best flood protection measure that will keep the character of the structure intact. Project costs and benefits will be considered when projects are prioritized.	Kent County Assessment Office, Kent County Planning, Kent County Emergency Management, Middle Dept. Inspection Agency, and the Towns of Betterton, Chestertown, Millington, and Rock Hall.
	Identify older homes (built prior to 1940) and pre-FIRM residential structures in the flood plain that are in need of substantial improvement in order to bring them into compliance.	Kent County Assessment Office, Kent County Planning, Kent County Emergency Management, Middle Dept. Inspection Agency, and the Towns of Betterton, Chestertown, Millington, and Rock Hall.

	Inform owners of the remaining 2 repetitive loss properties in the County when funding is available and explore mitigation options with them.	Kent County Assessment Office, Kent County Planning, Kent County Emergency Management, Middle Dept. Inspection Agency, and the Towns of Millington, and Rock Hall.
	Develop a system for recording and storing elevation certificates and first-floor elevation data using County GIS and database technology.	Kent County Assessment Office, Kent County Planning, municipalities
Create awareness among county residents of the potential hazards associated with floodplain areas and the ways they can protect themselves and their properties from flood events.	Targeted mailings could be used to inform residents, while detailed information should be made available at the public library.	Kent County Public Works, Kent County Planning, Middle Dept. Inspection Agency, municipalities
	Provide floodplain regulation seminars to area contractors, real estate agents, and insurance providers on an annual basis.	Kent County Public Works, Kent County Planning, Middle Dept. Inspection Agency, municipalities
Protect critical facilities in the 100-year flood plain.	For the following critical facilities located within the floodplain, a technical report should be completed. Mitigation measures and a detailed benefit/cost analysis should be conducted as well. * Washington College, Custom House * Washington College, Armory * Water tower in Rock Hall	Kent County Public Works, Kent County Planning, Middle Dept. Inspection Agency, Washington College, State Highway Administration, Towns of Chestertown and Rock Hall
	Explore tideflex valves in the Town of Rock Hall.	Town of Rock Hall
	Develop an enhanced flood warning system to include the use of GIS and loss estimation software (such as FEMA's HAZUS-MH software) in the development of flood stage forecast maps, flood depth maps and images of vulnerable structures linked to parcels and flood stage maps.	Kent County Public Works, Kent County Planning, municipalities
Prepare/update stormwater management plans for areas in the County.	Prepare a Drainage Plan and a subsequent stormwater management plan to outline a method of evaluating and managing the entire drainage system.	Kent County Public Works, Kent County Planning, Kent County Soil and Water Conservation District, municipalities

Winter Storm Mitigation	Project	Responsible Organization
Maintain high construction standards by ensuring current building codes and standards follow FEMA's basic guidelines and are properly enforced.	The County, municipalities, or concerned property owners should identify homes that are in need of tie-downs to reduce the vulnerability to high wind damages.	Kent County Planning, Middle Dept. Inspection Agency, municipalities
	Building codes specific to high wind resistance and resilience to heavy rooftop loads in high wind zones must be followed by contractors and enforced by building inspectors.	Kent County Planning, Middle Dept. Inspection Agency, municipalities
Ensure residents are forewarned, and prepare County with supplies to face winter storms	Stock adequate quantities of salt and sand to expedite road clearing.	Kent County Roads, Kent County Emergency Management, State Highway Administration
	Identify areas of frequent snow drifting and install snow fencing in those areas.	Kent County Roads, Kent County Emergency Management, State Highway Administration
	Provide public education (concerning safe driving and driving only if it is required, and also stock up on food, water, batteries, and other supplies) to prepare people for the storm.	Kent County Roads, Kent County Emergency Management, State Highway Administration
	Vegetation that lies in close proximity to utilities must be examined and trimmed on a regular basis by local utility companies, particularly during the winter. Wherever possible, power lines should be installed underground.	Kent County Roads, Kent County Emergency Management, State Highway Administration, Utility Companies, Kent County Planning
Severe Storm Mitigation	Project	Responsible Organization
Maintain high construction standards by ensuring current building codes and standards follow FEMA's basic guidelines and are properly enforced.	The County, municipalities, or concerned property owners should identify homes that are in need of tie-downs to reduce the vulnerability to high wind damages.	Kent County Planning, Middle Dept. Inspection Agency, municipalities
	Building codes specific to high wind resistance and resilience to heavy rooftop loads in high wind zones must be followed by contractors and enforced by building inspectors.	Kent County Planning, Middle Dept. Inspection Agency, municipalities

Ensure residents are forewarned, and prepared to face high winds, hail, or lightning strikes	Provide public education (concerning safe driving and driving only if it is required, and also stock up on food, water, batteries, and other supplies) to prepare people for the storm.	Kent County Roads, Kent Couny Emergency Management, State Highway Administration
	Vegetation that lies in close proximity to utilities must be examined and trimmed on a regular basis by local utility companies, particularly during the winter. Wherever possible, power lines should be installed underground.	Kent County Roads, Kent County Emergency Management, State Highway Administration, Utility Companies, Kent County Planning
	Support farmland crop insurance through education and outreach.	Kent County Planning, Kent County Extension Office; Kent County Soil and Water Conservation District
Drought Mitigation	Project	Responsible Organization
Introduce farmers and residents on water saving methods and devices through an education process.	Through a public education process, introduce residents and the farming community of to a wide variety of water conservation measures outlined in the Plan.	Kent County Planning, Kent County Emergency Management, Kent County Soil and Water Conservation District, American Red Cross
Encourage participation in the NRCS's irrigation grant program.	Encourage those members of the agricultural community who use irrigation practices to participate in the Natural Resources Conservation Service's irrigation grant program to upgrade existing irrigation systems to include water conservation measures.	Natural Resources Conservation Service
Erosion Mitigation	Project	Responsible Organization
Reduce sediment and erosion at the Chester River, Sassafras River, Chesapeake Bay, and Creeks and Tributaries	Work with Natural Resources Conservation Service to implement Best Management Practices on farms.	Kent County Planning, Kent County Soil and Water Conservation District, municipalities
	Strictly enforce sediment control regulations.	Kent County Planning, Kent County Soil and Water Conservation District, municipalities
	Continue to work with the Department of Natural Resources and County residents in the Shore Erosion Control Program.	Kent County Planning, Kent County Soil and Water Conservation District, municipalities

	Continue to identify steep cliffs along County waterways and to enforce Shoreline Cliff regulations found in the Kent County Land Use Ordinance.	Kent County Planning, Kent County Soil and Water Conservation District
Wildfire Mitigation	Project	Responsible Organization
Reduce damage and loss to existing community assets including residential structures, critical facilities, and infrastructure due to wildfires.	Conduct a county-wide assessment to identify structures located in areas where trees are thick and recommend fire-resistant walls or glass that can withstand higher temperatures.	Kent County Emergency Management, Fire Departments
Reduce the exposure of residences and infrastructure to wildfire hazard incidents.	Introduce residents to the concept of defensible space practices in urban interface areas that requires trees around new homes to be thinned or cut down, creating a buffer zone to reduce the potential for damage from wildfire.	Kent County Emergency Management, Fire Departments
	Integrate procedures (prepared by the County's Office of Emergency ServicesDepartment in conjunction with local Fire Departments) regarding training, suppression efforts, use of incident command systems during fire events, and the roles of various local, State and Federal agencies during wildfire events into a single document.	Kent County Emergency Management, Fire Departments
Extreme Heat Mitigation	Project	Responsible Organization
Educate the public regarding heat index and energy conservation measures.	Encourage residents to heed advice on air quality on extreme heat days.	Kent County Emergency Management, local media
	Encourage local media sources to announce air quality and heat indexes and to relay warnings and recommendations.	Kent County Emergency Management, local media
	Encourage elderly residents and families without air conditioning to have relocation sites with air conditioning during extreme heat events.	Kent County Emergency Management, local media
	Encourage residents to make provisions for pets during extreme heat waves (shade, water, air conditioning when appropriate).	Kent County Emergency Management, local media

	Encourage local citizens to heed advice on water restrictions and inform county officials of cases that consistently disregard the mandate.	Kent County Emergency Management, local media
	Encourage local citizens to heed advice on electricity conservation during extreme heat events due to increased demand on utilities and emergency services.	Kent County Emergency Management, local media
Educate the public regarding the benefits of natural and man-made shade.	Encourage businesses to plant shade trees in parking areas to relieve extreme heat reflected off of concrete surfaces.	Agricultural community, local businesses
	Encourage the agricultural community to plant shade trees and/or erect tarp systems for livestock to congregate under during extreme heat events.	Agricultural community, local businesses
Tornado Mitigation	Project	Responsible Organization
Improve the County's ability to identify structures that are vulnerable to high winds.	Conduct further assessment to identify structures with high risk/vulnerability to wind and determine if an increase in the number of Permits and Inspections officers is required to assess the vulnerability of structures.	Kent County Emergency Management, Middle Dept. Inspection Agency
	Conduct engineering inspections of Kent County's fire stations and schools to assess each facility's ability to sustain damage from both flood and wind events and recommend specific retrofitting measures for each building as appropriate to better protect them from flooding and high winds.	Kent County Emergency Management, Middle Dept. Inspection Agency
	Include strengthening measures to all improvements to critical facilities to withstand wind speeds greater than 90 mph.	Kent County Emergency Management, Middle Dept. Inspection Agency, municipalities
Consider actions for wind mitigation wherever appropriate.	Enforce the county and municipal Floodplain Ordinance design standards in high wind areas (velocity zones). Enforce tie down requirements in the mobile home communities in Chestertown, Rock Hall and Worton and identify homes that are in need of tie-downs.	Kent County Emergency Management, Middle Dept. Inspection Agency, Kent County Planning, municipalities
	Increase community awareness and introduce the concept of buffers (pruning back overhanging branches) and windbreaks (planting tall trees to reduce wind velocity or low shrubs to trap snow) to protect against winds.	Kent County Emergency Management, Middle Dept. Inspection Agency, Kent County Planning, municipalities

Completed Mitigation Projects

Mitigation of repetitive loss structures: Three of the County's 5 repetitive loss structures have been mitigated. See Tables 15 and 16 for more information.

Structure #2 in Rock Hall is a wood frame, 2-story residential structure with a crawlspace. The base flood elevation is 11 feet and the first floor elevation is 5.1 feet. This structure has been moved and flood damage has not been documented onsite since September 1979. All utilities including the HVAC unit were to be elevated. This structure is located within the V zone and should meet engineering requirements. It was recommended by FEMA and MDE that the structure be evaluated for elevation in place.

Structure #3 in Rock Hall is a wood frame, 1-story residential structure with a crawlspace. The base flood elevation is 11 feet and the first floor elevation is 19.2 feet. Flooding has not occurred in the main dwelling but in an accessory structure located closer to the Chesapeake Bay. This is identified as a low priority by MDE/FEMA. The primary dwelling is elevated. The accessory structure which sustained repetitive damage has been removed.

Structure #4 in Chestertown was a 1-story wood frame building built in 1950 with a crawlspace that was used for commercial purposes (restaurant). The base flood elevation is 7 feet. During the tidal surge following Hurricane Isabel in September 2003, this building was substantially damaged and subsequently demolished. It was rebuilt onsite to meet floodplain regulations and is still used as a restaurant.

Installation of Global Connect Reverse 911 Emergency Notification System: The County received a grant from the Local Emergency Planning Committee to purchase Global Connect's Emergency Notification System which allows staff to record and send a message to telephone numbers within a matter of minutes. All land lines are included in the database and the system allows residents to register for cell phone, email, text and other phone services.

Appendix: List of Planning Team Members

Members of the Kent County Planning Commnission include:

Elizabeth Morris, Chairman
Randy Bellows
Edward Birkmire
William Crowding
Joseph Hickman
Kim Kohl
William Sutton
Mitchell Mowell, Attorney

Agencies with representatives on the Local Emergency Planning Committee:

Kent County Amateur Radio Society (KARS)
Kent County Commissioners
University of Maryland Agricultural Extension
Kent County Humane Society/Animal Control
Delmarva Power
Rock Hall Police Dept.
Kent County Health Dept.
Chestertown Police Dept.
Kent County Public Schools
Kent County Office of Emergency Services
Emergency Management
Communications
Emergency Medical Services
LaMotte Chemical
University of Maryland Shore Health System
Kent County Administrator
Maryland Dept. of the Environment (MDE)
Maryland State Firemens Association (MSFA)
Kent County Chiefs Association
Kent County Emergency Medical Services Council
Kent County Department of Tourism
Kent County Department of Economic Development
Washington College
Eastman Chemical
Maryland Institute for Emergency Medical Services Systems (MIEMSS)
Kent County Department of Social Services
Kent County Department of Human Resources
Maryland State Police (MSP)
Heron Point

Lewis Environmental
American Red Cross (ARC)
Faith Based Community
Maryland State Police - Vehicle Enforcement
Kent County Sheriff's Office
Kent County Detention Center
Maryland Emergency Management Agency (MEMA)
Chesapeake Helps!

Agencies with representatives on the Health Care Emergency Response Coalition

A. F. Whitsitt Center
Chester River Home Health
Chestertown Nursing and Rehabilitation
Cross Roads
DaVita Inc. Chestertown Dialysis
Heron Point
J. D. Carter Deweese Center
Kent Center, Inc.
Kent County Detention Center
Kent County Office of Emergency Services
Kent County Health Department
Kent & Queen Anne's Rescue Squad
Shore Nursing and Rehab Center
University of MD Shore Medical Center at Chestertown
Washington College

Support Agencies
- MDE, Wetlands & Waterways Program
- MEMA, Upper Shore
- HHP, Region IV
- MIEMSS, Region IV

Representatives from incorporated towns who were consulted on the plan:

Shelley Herman, BettertonTown Manager
Bill Ingersoll, ChestertownTown Manager
Sharon Weygand, Galena Town Manager
Jo Manning, Millington Town Manager
Ron Fithian, Rock Hall Town Manager