APPENDIX 2: HURRICANE EMERGENCY

DESCRIPTION

Storm surge, high winds, and rainfall are the three major hazards produced by a hurricane. Of these, storm surge is historically the most dangerous, causing nine out of ten hurricane-related deaths. The high winds of a hurricane can also have a devastating effect on persons outdoors or inside unsound structures during the passage of the storm. Although rainfall usually does not directly cause death in a hurricane, it may inundate potential evacuation routes and prevent persons from evacuating areas vulnerable to storm surge.

A. Storm Tides

1. Storm tides and floods cause most of the deaths and destruction associated with hurricanes. This results from the sudden rise of the tide. Storm surge is the name for the swell or dome of water pushed against the shore as a hurricane approaches land, and the rising sea floor block's the water's escape. The surge is not noticeable until the hurricane approaches land and the coastal water becomes shallower. Storm surge may reach depths of 18 feet or more above the normal (astronomical) tide level depending on the configuration of the shore and ocean bottom. Many factors influence storm surge. They include: the intensity of the hurricane, the forward speed of the hurricane, the size of the hurricane, bottom conditions where the surge comes ashore, the angle of the hurricane's track in relationship to the coastline when it come ashore, and the physical configuration of the coastline where the surge comes ashore.

2. Surge will be higher the more intense the hurricane. Generally, shallow water found off a coast where the hurricane comes ashore increases the surge height. Also, the surge will be higher the closer to perpendicular the track of the hurricane follows in relation to the coastline. The presence of a major bay, inlet or river mouth where the surge comes ashore can greatly amplify the height of the surge. Water is trapped as it travels with a "funneling effect" to the back of the bay or up the river during the hurricane.

3. The second important effect of the storm surge is its ability to inundate coastal roadways hours before the landfall of the hurricane's eye. This can sometimes render such potential evacuation routes useless to vehicles attempting to flee areas vulnerable to surge.

4. The City of Newport News has areas of the City that are vulnerable to all categories of Hurricanes. The Category 1 through 4 surge zones are shown on a map of the City of Newport News.

B. High Winds

1. Certain segments of the population are vulnerable to the effects of high winds of a passing hurricane and should be evacuated. Many structures are unable to withstand the stress and uplift forces from hurricane force winds, and residents from these structures should find safer shelter. Hurricane force winds are defined as winds with a maximum sustained velocity exceeding 74 miles per hours (mph) and have been recorded as high as 190 mph. The storm system may also cause tornadoes that can be even more destructive over a small area.

2. Mobile homes are particularly susceptible to hurricane force winds because of their lightweight construction. The winds of hurricanes can toss mobile homes around, totally destroying them. In addition, mobile home can be hit and smashed by other rolling mobile homes.

3. Local regulations require that mobile homes be anchored to withstand high winds. Frame tie-downs are used to anchor mobile homes and anchorage system requirements usually are designed to withstand a wind velocity of 70 to 110 mph. Because hurricane winds can be stronger than 110 mph, the National Weather Service recommends that all residents of mobile homes evacuate to a more sound structure when threatened by the direct hit of a hurricane.

4. Timing of the arrival of high winds must be taken into effect. High winds usually arrive at the coastline hours before the eye of the hurricane makes landfall. Because of the dangerous nature of high winds, evacuation should be completed before the arrival of sustained tropical storm force winds (39 mph including significantly higher gusts).

5. Hurricanes are categorized according to the strength of their winds using the Saffir-Simpson Scale (Appendix 1). It must not be forgotten that these categories are relative. Lower category storms may inflict greater damage than expected depending upon hydrological conditions of the area before the storm makes landfall. Trees that have been weaken by drought or are standing in saturated soil will sustain greater damage than normally expected.

C. Rainfall

1. Meteorologists still do not have a tool to determine the exact rate and ultimate geographic distribution of the expected six to twelve inches of rainfall generally accompanying a hurricane. This unpredictable rainfall exerts only a minor influence on the water levels of a storm surge.

2. The heaviest rainfall associated with a tropical cyclone occurs to the east of the track. However if the tropical system takes on characteristics of a non-tropical system (this can happen in Virginia), the rainfall distribution will change markedly. This can be seen when cold/dry air wraps around the west and south sides of the circulation. The maximum rainfall can then be expected to be measured just west of the track and east of the dry air.[1]

3. Unlike surge, rainfall does not normally necessitate the emergency evacuation of large numbers of residents during the passage of a hurricane. However, rainfall may hamper evacuation from areas vulnerable to surge because of the early inundation of roadways. Rainfall from a hurricane, if preceded by recent wet weather, may also increase the risk of river flooding in areas usually not impacted by hurricanes. In the United States, inland flooding has been responsible for more than half the deaths associated with tropical cyclones in the last 30 years.[2]

4. Rainfall normally does not directly cause loss of life. It could though cause freshwater inundation of roadways preceding hurricane eye landfall and the severing of evacuation routes, adding critical hours to the overall evacuation time.

[1] Retrieved May 2004 from Hydrometeorological Prediction Center Web Site http://www.hpc.ncep.noaa.gov/research/roth/vaclimohur.htm

[2] Retrieved on July 2004 from National Hurricane Center Web Site http://www.nhc.noaa.gov/

HURRICANE HISTORY OF NEWPORT NEWS

A. The Hampton Roads area is, on average, affected by two hurricanes a year. Most of these hurricanes do not cause widespread damage; however, some hurricanes whose winds and tides produce considerable damage can significantly threaten life. The National Weather Service's data has shown that the area is affected by hurricane-strength winds approximately three times every twenty years, and three known storms have been powerful enough to alter coastal features. The majority of these storms occurred in the later half of August and in September.

B. Virginia has been affected by hurricanes since the early settlement days. The first historical reference to a hurricane that affected the Virginia coast is in 1635. On October 19, 1749, a massive hurricane washed up 800 acres of sand, and with the great coastal hurricane of 1806 the land became Willoughby Spit.

C. The three most destructive hurricanes affecting Virginia in modern times were the 1933 Chesapeake-Potomac Hurricane, and Hurricane Hazel. Hurricanes that significantly affected Newport News include the following:

1. ***1933 Chesapeake-Potomac Hurricane***, August 1933

   This was the first hurricane since to directly hit Hampton Roads. This was the eighth storm of the season.

   - Sustained winds: 57 mph in Norfolk.
   - Rainfall: 10 inches.
   - Surge: 9.8 ft above mean lower low water (MLLW) at Sewell's Point or 7.01 above sea level.
   - Damage: 18 fatalities and damages of $79 million (1969 dollars) were reported.

2. ***Hurricane Hazel*****,** October 1954

   This hurricane produced the largest swath of hurricane force winds in the 20th century over Virginia and North Carolina. A 130 mph gust was unofficially recorded in Hampton, VA.

   - Sustained winds: 78 mph in Norfolk.
   - Rainfall: not available.
   - Surge: not available.
   - Damage: Damage was extensive from high tides and strong winds. Trees, power lines, and radio towers were downed. Some areas lost power for as long as 48 hours. Several ships in the James River were wrecked or sunk.

3. ***Hurricane Bertha***, July 1996

   Bertha was an early season Cape Verde hurricane that made landfall on the North Carolina coast as a Category 2 hurricane. It spawned five tornadoes in Virginia.

   - Sustained winds: 35 mph.
   - Rainfall: 4.0 inches.
   - Surge: 2.5 water height above normal astronomical tide level at Sewell's Point.
   - Damage: Trees and power lines blown down resulting in power outages throughout Hampton Roads.

4. ***Hurricane Dennis***, August 1999

Hurricane Dennis was a western Atlantic hurricane whose track and intensity was erratic. It never made landfall as a hurricane but did cause major damage.

- Sustained winds: 28 mph in Norfolk.
- Rainfall: 3.23 inches.
- Surge: 3.0 feet at Sewell's Point water height above National Geodetic Vertical Datum (NGVD).
- Damage: Minor problems with wastewater treatment plant, and roads flooding in low–lying areas. Spawned a tornado in neighboring Hampton that tore through five apartment complexes and a retirement community, leaving about 1,000 residents without a home. Damage reports in Virginia and North Caroline were $157 million.

5. ***Hurricane Floyd***, September 1999

Floyd was a large Cape Verde hurricane[3] that produced a flood disaster of immense proportions in the eastern United States. It produced a 500-year flood of record in the area and the National Weather Service advised that this was a flash flood event.

- Sustained winds: 38 mph.
- Rainfall: 16.57 inches.
- Surge: not significant.
- Damage: Floodwaters closed Interstate 64 and forced about 2,000 residents from their homes. A hundred public housing apartments were condemned. A local emergency was declared, and Warwick High School was opened as a shelter. Menchville High school was also opened as a back-up shelter. Seven hundred thirty-five (735) people were in shelters. There were wide spread power outages. Debris totaling 1,700 tons affected storm water and sanitary sewer infrastructure. Sixteen hundred (1,600) family units were condemned. Three public buildings were damaged. Overall total damage was 32 million dollars (4 million public and 28 million private).

6. ***Hurricane Isabel***, September 2003

Hurricane Isabel was a Cape Verde hurricane that reached Category 5 status on the Saffir-Simpson Hurricane scale. It made landfall on the Outer Banks of North Carolina as a Category 2 hurricane and weakened further as it entered southeastern Virginia. It is considered to be one of the most significant tropical cyclones to affect portions of east-central Virginia since Hurricane Hazel and the 1933 Chesapeake-Potomac Hurricane.

- Sustained winds: 44 mph before power outages.
- Rainfall: 3.7 inches.
- Surge: 7.9 feet above MLLW at Sewell's Point, 10.75 above MLLW at Smithfield, Virginia.
- Damage: High storm surges caused extensive flood damage and 6,564 people were evacuated from their homes. Sixteen hundred forty (1,640) of those evacuated went to a shelter. High winds changed the landscape by downing trees. Over 40,000 trees fell in the City, affecting overhead and underground utilities. Some areas of the City were without utilities for up to two weeks. Isabel caused the most extensive power outages ever in Virginia. Four hundred ninety-three (493) structures suffered major damage with 102 of those being condemned. Thirteen hundred four (1,304) structures suffered minor damage. Overall total damage was 83 million dollars (31 million public and 52 million private). Damage was considered that of a typical Category 2 hurricane because of saturated soil conditions.

[3] Cape Verde-type hurricanes develop into tropical storms within approximately 600 miles of the Cape Verde Islands and then become hurricanes before reaching the Caribbean.

SAFFIR-SIMPSON HURRICANE SCALE

CATEGORY 1 WINDS: 74-95 MPH	Damage primarily to shrubbery, tree foliage, and unanchored mobile homes. No real damage to other structures. Some damage to poorly constructed signs. Storm surge four to five feet above normal tide level. Low-lying coastal roads inundated, minor pier damage, some small craft in exposed anchorage torn from moorings. Potential for minimal damage only.
CATEGORY 2 WINDS: 96-110 MPH	Considerable damage to shrubbery and tree foliage; some trees blown down. Major damage to exposed mobile homes. Extensive damage to poorly-constructed signs. Some damage to roofing materials of buildings. Storm surge of six to eight feet above normal tide level. Coastal roads, low-lying escape routes inland, are cut by rising water two to four hours before arrival of hurricane center. Potential for moderate damage. Considerable damage to piers. Marinas flooded. Small craft in unprotected anchorages torn from moorings. Evacuation of some shoreline residences and low-lying areas required.
CATEGORY 3 WINDS: 111 to 130 MPH	Foliage torn from trees; large trees blown down. Practically all poorly-constructed signs blown down. Some damage to roofing materials of buildings; some window and door damage. Some structural damage to small buildings. Mobile homes destroyed. Storm surge nine to twelve feet above normal tide level. Serious flooding at coast and many small structures near coast destroyed. Potential for extensive damage. Larger structures near coast damaged by battering waves and floating debris. Major erosion of beaches. Low-lying escape routes inland cut by rising water three to five hours before hurricane center arrives. Possible evacuation of all residences within 500 yards of the shore line, and of single-story residences on low ground within two miles of the shore line.
CATEGORY 4 WINDS 131 to 155 MPH	Shrubs and trees blown down. All signs down. Extensive damage to roofing materials, windows, and doors. Complete failure of roofs on many residences. Complete destruction of mobile homes. Storm surge 13 to 18 feet above normal tide level. Flat terrain 10 feet or less above sea level flooding inland as far as six miles. Potential for extreme damage. Major damage to lower floors of structures near shore due to flooding and battering of waves and floating debris. Major erosion of beaches. Low-lying escape routes inland cut by rising water three to five hours before hurricane center arrives. Possible evacuation of all residences within 500 yards of the shore line, and of single-story residences on low ground within two miles of the shore line.
CATEGORY 5 WINDS MORE THAN 155 MPH	Shrubs and trees blown down. Considerable damage to roofs of buildings; all signs blown down. Very severe, extensive damage to windows and doors. Complete failure of roofs of many residences and industrial buildings. Extensive shattering of glass in windows and doors. Some complete destruction of mobile homes. Storm surge greater than 18 feet above normal tide level. Potential for catastrophic damage. Major damage to lower floors of all structures less than 15 feet above sea level within 500 yards of shore. Low-lying escape routes inland cut by rising water three to five hours before hurricane center arrives. Massive evacuation of residential areas on low ground within 5 to 10 miles of shore possibly required

Notes:

1. It is important to consider hydrological conditions before estimating damage or flooding. Hurricane Isabel was a low category 1 when it passed over Hampton Roads, but still downed thousands of trees because of the saturated soil conditions.

2. It is important to remember that strong winds and rain will precede the arrival of the storm center several hours before actual landfall.

3. A category 4 hurricane is the worst-case storm anticipated to impact Virginia. The tropical and warm water conditions needed to sustain a category 5 hurricane generally occurs in more southern latitudes.

CRITICAL TRANSPORTATION LINKS AND INTERSECTIONS

Critical Links (30,000 vehicles per day)

Bland Blvd. – Jefferson to Warwick
Denbigh Blvd. – Jefferson to Warwick
Ft. Eustis Blvd. – Jefferson to Warwick
J. Clyde Morris Blvd. – Warwick Blvd to City Limits (EAST)
Jefferson Ave. – 39th Street to Kings Ridge Drive
Mercury Blvd. – Warwick Blvd. to City Limits (EAST)
Oyster Point Rd. – Warwick Blvd. to Interstate 64
Victory Blvd – Interstate 64 to City Limits (EAST)
Warwick Blvd. – Huntington Ave. to Center Ave.
Warwick Blvd. – Main Street to Fort Eustis Blvd.

Intersections

Huntington Ave. at 39th Street
Huntington Ave. at 35th Street
Huntington Ave. at 26th Street
J. Clyde Morris Blvd. at Diligence Dr.
J. Clyde Morris Blvd. at Harpersville Rd.
Jefferson Ave at Mercury Blvd.
Jefferson Ave. at Harpersville Rd.
Jefferson Ave. at J. Clyde Morris Blvd.
Jefferson Ave. at Oyster Point Rd.
Jefferson Ave. at Operations Dr.
Jefferson Ave. at Bland Blvd.
Jefferson Ave. at Denbigh Blvd.
Jefferson Ave. at Ft. Eustis Blvd.
Jefferson Ave. at Yorktown Rd.
Oyster Point Rd. at Canon Blvd.
Warwick Blvd. at Denbigh Blvd.
Warwick Blvd. at Ft. Eustis 2nd Access/Ashton Green Blvd.
Warwick Blvd. at Bland Blvd.
Warwick Blvd. at Oyster Point Rd.
Warwick Blvd. at J. Clyde Morris Blvd.

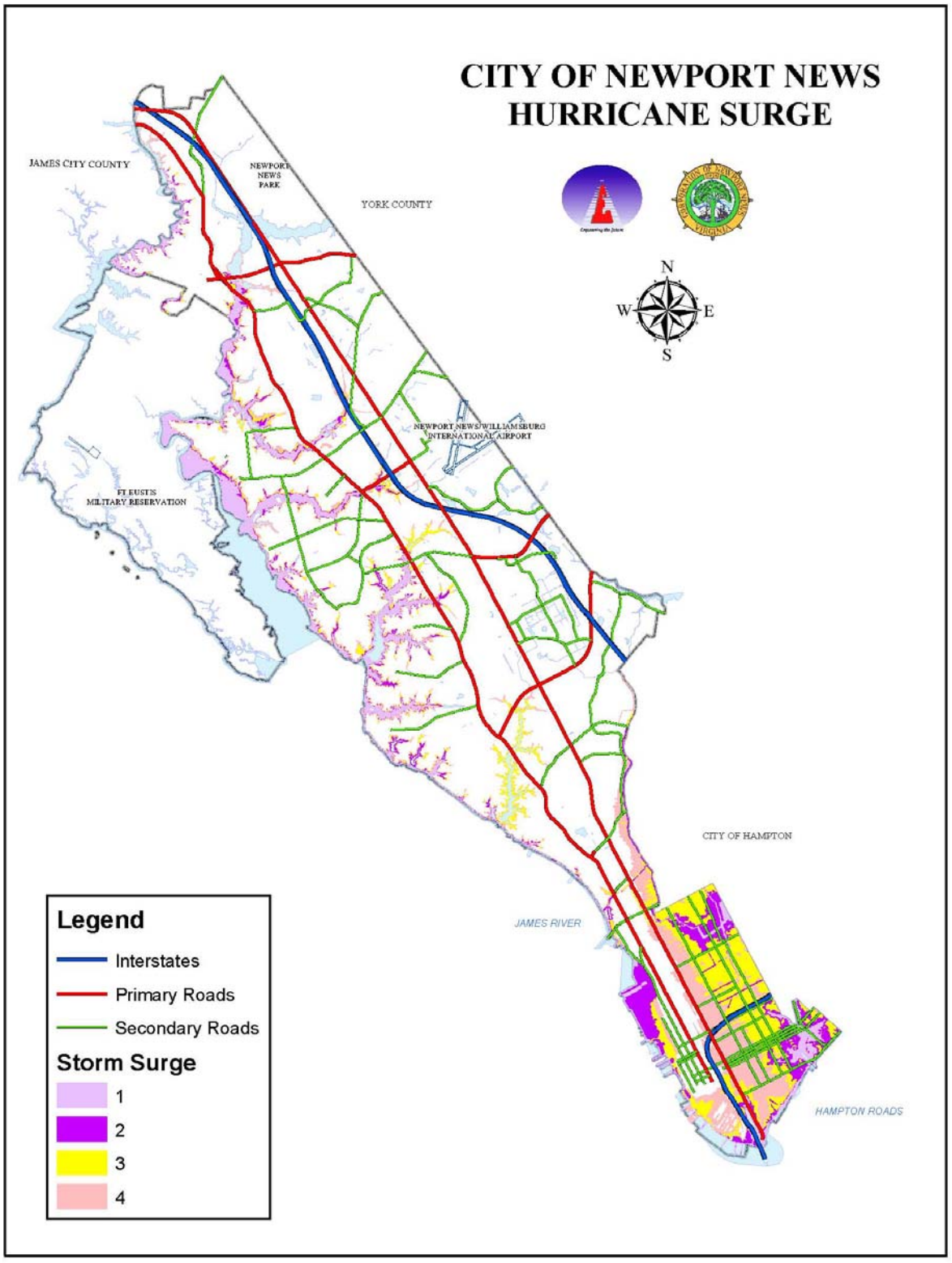
Interstate and Limited Access Interchanges

I-64 at Jefferson Avenue
I-64 at J. Clyde Morris Blvd.
I-64 at Oyster Point Road
I-64 at Fort Eustis Blvd.
I-64 at Yorktown Road
I-664 at Exit #4 – Chestnut Ave.
I-664 at Exit #5 – 35th Street
I-664 at Exit #6 – 26th Street
Warwick Blvd. at Mercury Blvd.
Warwick Blvd. at Ft. Eustis Blvd.

5d. Estimated Clearance Times (in hours)

Saffir-Simpson Category	Response	Tourist Occupancy Low	Tourist Occupancy High
	Rapid		
1-2	**Medium**		
	Slow		
	Rapid		
3-4	**Medium**		
	Slow		

Only new data reflecting the 2000 Census data that was provided to the Office of Emergency Management by the Virginia Hurricane Evacuation Restudy. Tables will be completed, as data is available.


CITY OF NEWPORT NEWS
HURRICANE SURGE
JAMES CITY COUNTY
NEWPORT NEWS PARK
YORK COUNTY
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FT EUSTIS MILITARY RESERVATION
CITY OF HAMPTON
JAMES RIVER
HAMPTON ROADS
Legend
Interstates
Primary Roads
Secondary Roads
Storm Surge
1
2
3
4