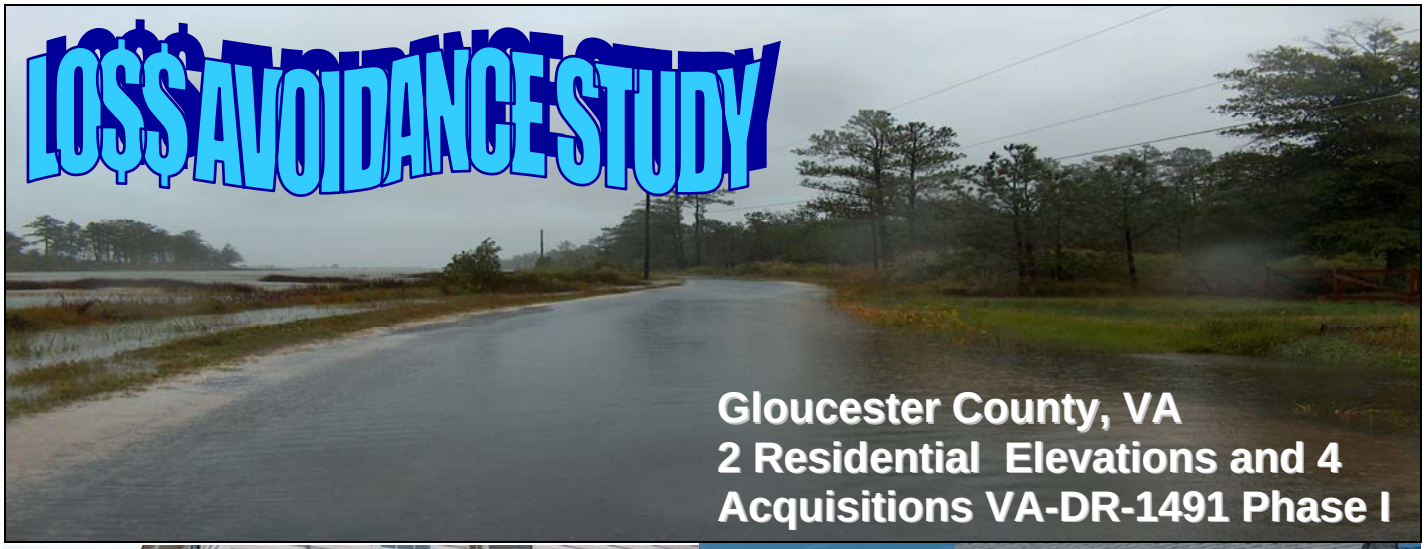
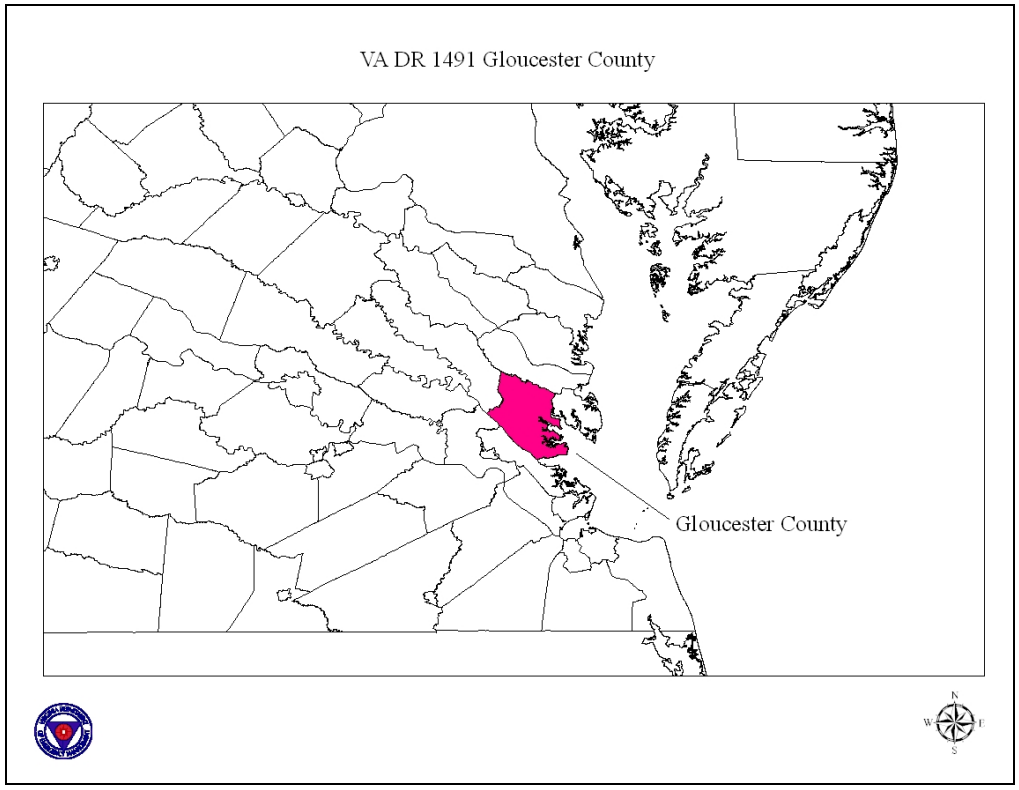


Virginia Enhanced Hazard Mitigation Plan



Introduction

When Hurricane Isabel (DR-1491-VA) passed through the Commonwealth in September of 2003, it caused severe damages to Gloucester County as well as many other communities. In response to the coastal flooding from Isabel, Gloucester County and it's citizens took advantage of the Hazard Mitigation Grant Program (HMGP) to either elevate or acquire and demolish flood prone structures. Since many of these projects have come to completion, a several flooding events have occurred. In September of 2006, Tropical Storm Ernesto (DR-1661-VA) caused flooding in Gloucester, as well as in August of 2008.

One of the questions that is always asked is how effective are FEMA, state, and local funded mitigation projects? When developing and implementing a project, it is designed to reduce risk and over time result in a cost savings. It isn't until after an event occurs at the location of the mitigated property that one can determine how much money or damages were avoided as a result of the project.

The purpose of this study is to determine the losses that were avoided by mitigating properties through FEMA Hazard Mitigation Assistance (HMA) programs in the Commonwealth. There were several target communities to conduct loss avoidance, but in this instance Gloucester County will be used as an example. The methodology and format for this study was modeled after the FEMA report titled *"Evaluated Losses Avoided Through Hazard Mitigation, City of Centralia, Washington."*

The Events

Tropical Storm Ernesto on August 31, 2006 caused a tide of 5.79 (MLLW) this tide did cause damage to several homes and on September 26, 2008 high tide occurred with 3.96 feet of water (MLLW) at the marker causing flooding yards, over the roads, and in the crawl spaces of some homes. Gloucester County provided the flood depths, and with assistance from the Virginia Institute for Marine Science, the high water mark was converted to NGVD29 datum. The flood events would then be 6.13 ft for Ernesto, and 4.3 ft for the 2008 event. It was VDEMs goal to perform loss avoidance calculations based on these events and mitigated properties from DR-1491-VA Phase I. There were many properties that were elevated or acquired and demolished in Gloucester County, but for this study only 6 where chosen. The number of properties was narrowed down to 6 due to high first floor elevations of the original structure (no losses), projects still in progress, or no final elevation certificate received as of this report.

Methodology

To be able to conduct a loss-avoidance study several important pieces of information are needed. They include:

- Location of Structure
- Flood Insurance Study (FIS)
- Structure Square Footage
- First Floor Elevation (for acquisition only pre-mitigation is needed)
- Number of Floors
- BCAR Software – Version 4.5.2
- Flood Depths of events occurring after mitigation

Assumptions

- Building replacement value of $81.41/sq foot (2006 prices and conditions) were obtained from R.S. Means 2006. This was a generic value of a one story economy structure with no basement or a mobile home. The value of $78.40/sq foot (2006 prices and conditions) were used for a 1.5 story structure with no basement. The value was the average of a 600sq/ft building through a 1400sq/ft building which was the range of the structures in this study.
- A contents value of 30 percent of the building replacement value was used
- Flood depths received from Gloucester were assumed to be the same throughout the County.
- Depth Damage functions from the BCAR 4.5.2 module were used for each structure to determine avoided building, contents, and displacement costs during both the 2006 and the 2008 events.

Calculation of Losses Avoided

Building Data

Table 2 provides building data and HMGP Disaster number for 2 residential structures that were elevated as well as the 4 residential structures that were acquired and demolished after the 2003 FEMA Hurricane Isabel declaration. VDEM VA-DR-1491 project files contained structure specific information and FEMA Elevation Certificates for the 6 structures. Files contained address, structure square footage, first floor elevation, number of floors, type of foundation, and pictures of structures.

FIS Data Needed

- 10, 50, 100, 500 year flood still water elevation.
- Flood Profile Number
- Date of FIS
- FIRM Panel Number

Table 1 – Sample FIS Data Used for Study – Stillwater Elevation

Recurrence Interval	Elevation
10	5.0
50	6.5
100	7.3
200	9.3

Depth-Damage Function

Data from Tables 1 and 2 were entered into the BCAR version 4.5.2 for flooding for acquisition and elevation projects to determine the depth-damage relationship. The BCAR gave an output of expected building, contents, and displacement costs. Tables 3, 4, and 5 provide the depth-damage outputs used for the study. The building replacement values and contents values from Table 2 were multiplied by the depth damage functions associated with the 2006 and 2008 flood depths to get the losses avoided. Each of the 6 structures were run through the BCAR to confirm the results, and also to get the anticipated displacement costs.

The BCAR module recognizes flood depths on a 0.5ft interval, so for instance the damages associated with 1 foot of flooding is actually the damages associated with flooding from 0.5 feet to 1.5 feet. To simplify this study, 2006 flood depths that fell within that range were given the damage value associated with the whole number. So 1.2 feet would be assigned damages associated with a 1 ft flood depth. The depth damage function represents damages expected on a half foot interval. So for instance a flood depth of 1 foot would indicate flood damages expected from 0.5 ft to 1.5 ft.

Figure 1 – Gloucester County Property Acquisition

Before Mitigation *After Mitigation*

Figure 2 below shows the study area, the location of the 2 elevated and 4 acquired properties for this study.

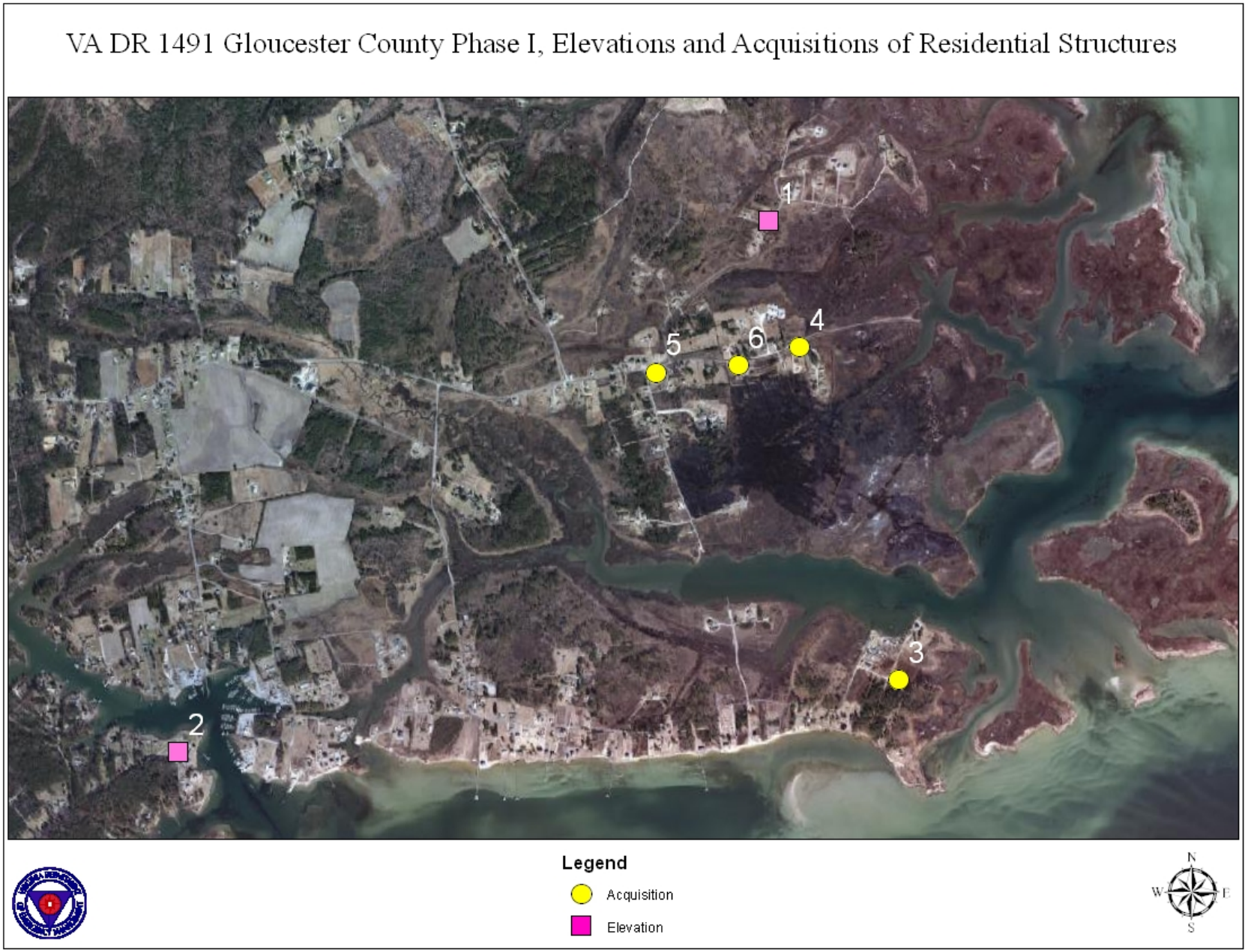


Table 2 – Building data for acquired structures in Southampton County.

Property ID	Flood Zone	BFE	FFE Before	FFE After	Structure Type	Sq. Ft.	BRV	Structure Replacement Value	Contents Value	2006 Flood Depths	2008 Flood Depths	Flood Depths at Structure 2006	Flood Depths at Structure 2008
FEMA DISASTER DR 1491 VA - Gloucester County													
1	VE	10	5.1	11.2	1	528	81.41	$42,984.48	$12,895.34	6.125	4.295	1.025	-0.805
2	AE	11	5.49	9.8	1	1305	81.41	$106,240.05	$31,872.02	6.125	4.295	0.635	-1.195
3	VE	11	5.2	Acquired	1.5	1280	78.44	$100,403.20	$30,120.96	6.125	4.295	0.925	-0.905
4	VE	11	4.7	Acquired	mobile	720	81.41	$58,615.20	$17,584.56	6.125	4.295	1.425	-0.405
5	AE	9	4.5	Acquired	1.5	892	78.44	$69,968.48	$20,990.54	6.125	4.295	1.625	-0.205
6	VE	11	7.2	Acquired	1	864	81.41	$70,338.24	$21,101.47	6.125	4.295	-1.075	-2.905

Assumption: Building Replacement Value is 81.41 per square foot, which is an average of the range of square footage from 600 to 1400 sq ft for one story buildings and mobile homes. One and a half story buildings have a BRV of 78.44. Source - 2006 RS Means, Economy Residential buildings.

Note: **FFE** designates First Floor Elevation
BRV designates Building Replacement Value
BFE designates Base Flood Elevation
Sq. Ft. designates Square Footage of the Structure
Contents Value is 30% of the Building Replacement Value
Structure Replacement Value is the BRV multiplied by the Square Footage
Base Flood Elevation and FFE referenced to NGVD 1929

Due to the different flood zones present in Gloucester County, AE and VE zones, different depth-damage functions exist. The fact that you have different structure types also change the depth-damage curves. The following tables display the depth-damage relationship, which is used in the loss avoidance calculation.

Table 3 – BCAR depth damage relationship for Buildings 1, 3, 4, and 6 (VE Zone)

Flood Depth	Building (DDF)	Contents (DDF)	Displacement (Days)
-2	20.0%	0	0
-1	21.5%	11.0%	0
0	24.0%	24.0%	0
1	29.0%	29.0%	45
2	37.0%	37.0%	90
3	54.0%	54.0%	135
4	60.6%	60.5%	180
> 5	64.5%	64.5%	225

Table 4 – BCAR depth damage relationship for Building 2 (AE Zone, One Story)

Flood Depth	Building (DDF)	Contents (DDF)	Displacement (Days)
-2	0.0%	0.0%	0
-1	0.0%	0.0%	0
0	9.0%	13.5%	0
1	14.0%	21.0%	62
2	22.0%	33.0%	125
3	27.0%	40.5%	166
4	29.0%	43.5%	182
> 5	30.0%	45.0%	190

Table 5 – BCAR depth damage relationship for Building 5 (AE Zone, 1.5 Story)

Flood Depth	Building (DDF)	Contents (DDF)	Displacement (Days)
-2	0.0%	0.0%	0
-1	0.0%	0.0%	0
0	3.0%	4.5%	0
1	9.0%	13.5%	0
2	13.0%	19.5%	54
3	25.0%	37.5%	150
4	27.0%	40.5%	166
> 5	28.0%	42.0%	174

The depth damage function represents damages expected on a half foot interval. So for instance a flood depth of 1 foot would indicate flood damages expected from 0.5 ft to 1.5 ft.

Table 4 – Losses Avoided September 2006 Event (Ernesto)

Property ID	Water Depth above FFE Pre-Mitigation (feet)	Flood Depth Used	Building Repair Costs	Content Losses	Displacement Costs	Total
1	1.025	1	$12,465	$3,740	$1,125	$17,330
2	0.635	1	$14,874	$6,693	$3,830	$25,397
3	0.925	1	$29,117	$8,735	$2,727	$40,579
4	1.425	1	$16,998	$5,100	$1,534	$23,632
5	1.625	2	$9,096	$4,093	$2,280	$15,469
6	-1.075	-1	$15,123	$2,321	$0	$17,444
Total			$97,673	$30,682	$11,496	$139,851

Table 5 – Losses Avoided September 2008 Event

Property ID	Water Depth above FFE Pre-Mitigation (feet)	Flood Depth Used	Building Repair Costs	Content Losses	Displacement Costs	Total
1	-0.805	-1	$9,242	$1,418	$0	$10,660
2	-1.195	-1	$0	$0	$0	$0
3	-0.905	-1	$21,587	$3,313	$0	$24,900
4	-0.405	0	$14,068	$4,220	$0	$18,288
5	-0.205	0	$2,099	$945	$0	$3,044
6	-2.905	-3	$0	$0	$0	$0
Total			$46,995	$9,897	$0	$56,892

Table 6 – Total Losses Avoided

Property ID	Total for Both Events	Mitigation Funds Spent	% Savings in 5 Years
1	$27,990	$ 78,370	35.7%
2	$25,397	$ 40,056	63.4%
3	$65,479	$ 87,440	74.9%
4	$41,920	$ 41,985	99.8%
5	$18,513	$ 45,730	40.5%
6	$17,444	$ 158,678	11.0%
Total	$196,742	$ 452,259	43.5%

Summary

Had these structures not been mitigated all 6 residential structures in the study area would have inundation damage from both the 2006 and 2008 flood events. Five structures would have experienced one or less of water, and one structure would have received 2 feet of flooding during Tropical Storm Ernesto. Had these 6 homes not been mitigated, an estimated $195,742 in flood damages would have occurred. Since the total cost to mitigate these properties was $452,259, in just 4 years there was a savings in 43.5% of damages. It can be expected that the benefits or savings from this project will increase overtime due to the fact that Gloucester County is a coastal community.