Cape Fear River Basin Flood Analysis and Mitigation Strategies Study

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Contents

List of Acronyms

ARC – Antecedent Runoff Condition

B/C – Benefit Cost Ratio

BFE – Base Flood Elevation

CFS – Cubic Feet per Second

COOP – Cooperative Observer Program

CRONOS – Climate Retrieval and Observations Network of the Southeast

DEM – Digital Elevation Model

FEMA – Federal Emergency Management Agency

FFE – Finished Floor Elevation

FIS – Flood Insurance Study

FIMAN – Flood Inundation Mapping Network

FRIS – Flood Risk Information System

HEC-RAS – Hydraulic Engineering Center River Analysis System

HEC-HMS – Hydraulic Engineering Center Hydrologic Modeling System

HMGP – Hazard Mitigation Grant Program

IHRM – Integrated Hazard Risk Management

Lidar – Light Detection and Ranging

NAVD88 – North American Vertical Datum of 1988

NCDEQ – North Carolina Department of Environmental Quality

NCDOT – North Carolina Department of Transportation

NC DPS – North Carolina Department of Public Safety

NCEM – North Carolina Emergency Management

NCFMP – North Carolina Floodplain Mapping Program

NFIP – National Flood Insurance Program

NLCD – National Land Cover Database

NOAA – National Oceanic and Atmospheric Administration

NRCS – Natural Resources Conservation Service

NWS – National Weather Service

ORW – Outstanding Resource Waters

SCO – State Climate Office

SCS – Soil Conservation Service

TMDL – Total Maximum Daily Load

USACE – United States Army Corps of Engineers

USGS – United States Geologic Survey

WSEL – Water Surface Elevation

Executive Summary

Communities along the Cape Fear River and its tributaries have experienced major flooding events over the past 25 years with Hurricanes Fran (1996), Floyd (1999), Matthew (2016), and Florence (2018) all ranking among the most destructive storms in state history. The majority of the damage from these storms was due primarily to flooding that resulted from the widespread heavy rains associated with these storms. In response to Hurricane Florence, and the need to improve the resiliency of communities to flooding, the North Carolina General Assembly funded a river basin study on the Cape Fear as part of House Bill 200. The objective of this study was to (1) identify the primary sources of flooding, and (2) identify and assess possible mitigation strategies to prevent future flood damage. This study was performed by the North Carolina Division of Emergency Management. This report provides assessments of flooding sources, structural flood impact, and planning level mitigation strategies for the Cape Fear Basin, including Little River and Northeast Cape Fear River.

Mitigation Strategies and Scenarios

Eight strategies for flood mitigation were developed by North Carolina Emergency Management (NCEM) in coordination with stakeholders. All strategies are addressed in the body of this report and appendices. Of the eight broad strategies, a total of eighteen scenarios were analyzed fully. The inserts Figure ES.1 and Table ES.1 show these eighteen scenarios along with location, costs, and benefits associated with each. Direct losses include estimates of losses based on structural damage and loss of property and contents. Indirect losses include estimates for items such as temporary relocation, lost income and wages, lost sales, and lost rent.

As indicated on the Figure ES.1, certain scenarios such as the White Oak Dike (Scenario CF1), Bridge Conveyance Improvements (LR6) and Channel and Overbank Improvements (LR7, NECF8, NECF9, and NECF10) target specific reaches along the river, while others such as detention alternatives (CF2, CF3, LR4, and LR5) provide a broader damage reduction.

Non-Structural alternatives (Scenarios NS12 – NS18) can provide benefits to the most vulnerable structures along the Cape Fear River mainstem and major tributaries Little River and Northeast Cape Fear River that are subject to the most severe flooding, depending on how they are implemented.

Analysis and Findings

In order to provide a high-level comparison of the mitigation scenarios analyzed, a series of tables ranking the scenarios using different criteria are provided.

A consideration for selecting which scenario to pursue further is implementation time. **Table ES.2 shows the strategies pursued and estimated timeframes for implementation.** The shortest timeframe is the roadway elevation (bridge conveyance improvements) that is estimated at 2-to-5 years. The non-structural strategies are estimated at 3-to-5 years. There on ongoing non-structural mitigation programs following Hurricanes Matthew and Florence that should be considered closely when implementing additional efforts. Floodplain expansion/protection (channel and overbank improvements) are also estimated at a 3-to-5-year implementation timeframe based on planning, design, permitting, and construction. Channel modification (diversion channel) and existing levee repair (Whit Oak Dike) are both estimated at 10-to-15 years with more significant planning, design, permitting, and construction requirements. For new detention facilities two types of impoundment were considered. A dry detention facility has no permanent pool and allows the daily normal discharge for the stream to continue downstream unimpeded. It will only impound water during a flooding event where the flow is outside the banks of the river. A wet detention facility does have a permanent pool. Implementation of a wet

Table ES.1

Mitigation Scenario	Time Horizon	Implementation Costs				Ongoing Costs		Benefits						Benefit Cost Ratio	
		Property Acquisition	Design/ Construction	Envrionmental	Road Impacts	Maintenance	Tax Revenue Loss	Direct Losses Avoided	Direct & Indirect Losses Avoided	Leasing	Recreation	Tax Revenue Increase	Property Value Increase	Direct	Direct & Indirect
CF1 *White Oak Dike*	30-yr	$ -	$ 30,000,000	$ -	$ -	$ 720,000	$ -	$ 8,729,964	$ 45,569,642	$ -	$ -	$ -	$ -	0.28	1.48
	50-yr	$ -	$ 30,000,000	$ -	$ -	$ 1,200,000	$ -	$ 14,549,941	$ 75,949,403	$ -	$ -	$ -	$ -	0.47	2.43
CF2 *Wet Dam on Upper Little River*	30-yr	$ 66,933,722	$ 76,480,511	$ 141,662,513	$ 19,764,203	$ 300,000	$ -	$ 1,686,530	$ 6,029,655	$ -	$ 135,785,000	$ 20,436,047	$ 116,113,902	0.90	0.91
	50-yr	$ 66,933,722	$ 76,480,511	$ 141,662,513	$ 19,764,203	$ 500,000	$ -	$ 2,810,883	$ 10,049,425	$ -	$ 158,764,000	$ 40,872,093	$ 116,113,902	1.04	1.07
CF3 *Dry Dam on Upper Little River*	30-yr	$ 66,933,722	$ 49,526,479	$ 401,935	$ 15,219,797	$ 300,000	$ 16,829,050	$ 1,945,940	$ 6,451,963	$ 5,632,317	$ -	$ -	$ -	0.05	0.08
	50-yr	$ 66,933,722	$ 49,526,479	$ 401,935	$ 15,219,797	$ 500,000	$ 28,048,417	$ 3,243,234	$ 10,753,271	$ 9,387,194	$ -	$ -	$ -	0.08	0.13
LR4 *Wet Dam*	30-yr	$ 16,880,925	$ 60,784,030	$ 81,907,232	$ 250,000	$ 300,000	$ -	$ 828,268	$ 1,856,689	$ -	$ 44,590,000	$ 3,710,304	$ 33,730,036	0.52	0.52
	50-yr	$ 16,880,925	$ 60,784,030	$ 81,907,232	$ 250,000	$ 500,000	$ -	$ 1,380,447	$ 3,094,481	$ -	$ 52,136,000	$ 7,420,608	$ 33,730,036	0.59	0.60
LR5 *Dry Dam*	30-yr	$ 16,880,925	$ 51,220,431	$ 3,838,760	$ 250,000	$ 300,000	$ 2,652,717	$ 759,014	$ 1,741,164	$ 1,121,760	$ -	$ -	$ -	0.03	0.04
	50-yr	$ 16,880,925	$ 51,220,431	$ 3,838,760	$ 250,000	$ 500,000	$ 4,421,195	$ 1,265,024	$ 2,901,939	$ 1,869,600	$ -	$ -	$ -	0.04	0.06
LR6 *Bridge Conveyance Improvements*	30-yr	$ -	$ 1,434,240	$ -	$ -	$ -	$ -	$ 30,880	$ 141,844	$ -	$ -	$ -	$ -	0.02	0.10
	50-yr	$ -	$ 1,434,240	$ -	$ -	$ -	$ -	$ 51,467	$ 236,407	$ -	$ -	$ -	$ -	0.04	0.16
LR7 *Channel & overbank n improvements*	30-yr	$ 1,011,772	$ 4,132,843	$ 2,932,381	$ -	$ 3,616,830	$ 236,617	$ 780,125	$ 1,617,322	$ -	$ -	$ -	$ -	0.07	0.14
	50-yr	$ 1,011,772	$ 4,132,843	$ 2,932,381	$ -	$ 6,028,049	$ 394,362	$ 1,300,208	$ 2,695,536	$ -	$ -	$ -	$ -	0.09	0.19
NECF8 *Channel Cleaning - Area 1*	30-yr	$ -	$ 174,173	$ -	$ -	$ 1,045,037	$ -	$ 1,249,443	$ 2,105,464	$ -	$ -	$ -	$ -	1.02	1.73
	50-yr	$ -	$ 174,173	$ -	$ -	$ 1,741,728	$ -	$ 2,082,405	$ 3,509,107	$ -	$ -	$ -	$ -	1.09	1.83
NECF9 *Channel Cleaning - Area 2*	30-yr	$ -	$ 617,102	$ -	$ -	$ 3,702,614	$ -	$ 3,397,411	$ 6,865,646	$ -	$ -	$ -	$ -	0.79	1.59
	50-yr	$ -	$ 617,102	$ -	$ -	$ 6,171,024	$ -	$ 5,662,352	$ 11,442,743	$ -	$ -	$ -	$ -	0.83	1.69
NECF10 *Overbank Clearing*	30-yr	$ 102,101	$ 3,731,898	$ 7,816,535	$ -	$ 2,282,250	$ -	$ 2,011,468	$ 4,666,519	$ -	$ -	$ -	$ -	0.14	0.33
	50-yr	$ 102,101	$ 3,731,898	$ 7,816,535	$ -	$ 3,803,750	$ -	$ 3,352,447	$ 7,777,531	$ -	$ -	$ -	$ -	0.22	0.50
NECF11 *Diversion channel*	30-yr	$ 481,295	$ 10,360,193	$ 22,768,439	$ -	$ 3,354,750	$ -	$ 3,764,641	$ 11,481,191	$ -	$ -	$ -	$ -	0.10	0.31
	50-yr	$ 481,295	$ 10,360,193	$ 22,768,439	$ -	$ 5,591,250	$ -	$ 6,274,402	$ 19,135,318	$ -	$ -	$ -	$ -	0.16	0.49

Table ES.1

Mitigation Scenario	Time Horizon	Implementation Costs				Ongoing Costs		Benefits						Benefit Cost Ratio	
		Property Acquisition	Design/ Construction	Envrionmental	Road Impacts	Maintenance	Tax Revenue Loss	Direct Losses Avoided	Direct & Indirect Losses Avoided	Leasing	Recreation	Tax Revenue Increase	Property Value Increase	Direct	Direct & Indirect
NS12 *Acquisition All*	30-yr	$ -	$ 516,510,477	$ -	$ -	$ -	$ -	$ 67,620,707	N/A	$ -	$ -	$ -	$ -	0.13	N/A
	50-yr	$ -	$ 516,510,477	$ -	$ -	$ -	$ -	$ 112,701,179	N/A	$ -	$ -	$ -	$ -	0.22	N/A
NS12a *Acquisition BC>1*	30-yr	$ -	$ 24,654,492	$ -	$ -	$ -	$ -	$ 32,896,580	N/A	$ -	$ -	$ -	$ -	1.33	N/A
	50-yr	$ -	$ 24,654,492	$ -	$ -	$ -	$ -	$ 54,827,634	N/A	$ -	$ -	$ -	$ -	2.22	N/A
NS13 *Elevation All*	30-yr	$ -	$ 51,858,804	$ -	$ -	$ -	$ -	$ 16,730,292	N/A	$ -	$ -	$ -	$ -	0.32	N/A
	50-yr	$ -	$ 51,858,804	$ -	$ -	$ -	$ -	$ 16,730,292	N/A	$ -	$ -	$ -	$ -	0.32	N/A
NS13a *Elevation BC>1*	30-yr	$ -	$ 3,652,649	$ -	$ -	$ -	$ -	$ 6,503,052	N/A	$ -	$ -	$ -	$ -	1.78	N/A
	50-yr	$ -	$ 3,652,649	$ -	$ -	$ -	$ -	$ 6,503,052	N/A	$ -	$ -	$ -	$ -	1.78	N/A
NS14 *Relocation All*	30-yr	$ -	$ 235,108,677	$ -	$ -	$ -	$ -	$ 21,161,190	N/A	$ -	$ -	$ -	$ -	0.09	N/A
	50-yr	$ -	$ 235,108,677	$ -	$ -	$ -	$ -	$ 35,268,650	N/A	$ -	$ -	$ -	$ -	0.15	N/A
NS14a *Relocation BC>1*	30-yr	$ -	$ 6,177,270	$ -	$ -	$ -	$ -	$ 7,475,571	N/A	$ -	$ -	$ -	$ -	1.21	N/A
	50-yr	$ -	$ 6,177,270	$ -	$ -	$ -	$ -	$ 12,459,285	N/A	$ -	$ -	$ -	$ -	2.02	N/A
NS15 *Dry Floodproofing All*	30-yr	$ -	$ 655,974,867	$ -	$ -	$ -	$ -	$ 64,239,672	N/A	$ -	$ -	$ -	$ -	0.10	N/A
	50-yr	$ -	$ 1,093,291,444	$ -	$ -	$ -	$ -	$ 107,066,120	N/A	$ -	$ -	$ -	$ -	0.10	N/A
NS15a *Dry Floodproofing BC>1*	30-yr	$ -	$ 12,699,419	$ -	$ -	$ -	$ -	$ 18,712,403	N/A	$ -	$ -	$ -	$ -	1.47	N/A
	50-yr	$ -	$ 21,165,699	$ -	$ -	$ -	$ -	$ 31,187,339	N/A	$ -	$ -	$ -	$ -	1.47	N/A
NS16 *Wet Floodproofing All*	30-yr	$ -	$ 3,130,197	$ -	$ -	$ -	$ -	$ 8,779,499	N/A	$ -	$ -	$ -	$ -	2.80	N/A
	50-yr	$ -	$ 3,130,197	$ -	$ -	$ -	$ -	$ 8,779,499	N/A	$ -	$ -	$ -	$ -	2.80	N/A
NS16a *Wet Floodproofing BC>1*	30-yr	$ -	$ 2,736,418	$ -	$ -	$ -	$ -	$ 8,569,840	N/A	$ -	$ -	$ -	$ -	3.13	N/A
	50-yr	$ -	$ 2,736,418	$ -	$ -	$ -	$ -	$ 8,569,840	N/A	$ -	$ -	$ -	$ -	3.13	N/A
NS17 *Mitigation Reconstruction All*	30-yr	$ -	$ 164,047,015	$ -	$ -	$ -	$ -	$ 41,230,674	N/A	$ -	$ -	$ -	$ -	0.25	N/A
	50-yr	$ -	$ 164,047,015	$ -	$ -	$ -	$ -	$ 41,230,674	N/A	$ -	$ -	$ -	$ -	0.25	N/A
NS17a *Mitigation Reconstruction BC>1*	30-yr	$ -	$ 10,348,868	$ -	$ -	$ -	$ -	$ 15,463,445	N/A	$ -	$ -	$ -	$ -	1.49	N/A
	50-yr	$ -	$ 10,348,868	$ -	$ -	$ -	$ -	$ 15,463,445	N/A	$ -	$ -	$ -	$ -	1.49	N/A
NS18 *Best Technique All*	30-yr	$ -	$ 345,922,664	$ -	$ -	$ -	$ -	$ 63,743,522	N/A	$ -	$ -	$ -	$ -	0.18	N/A
	50-yr	$ -	$ 345,922,664	$ -	$ -	$ -	$ -	$ 100,386,204	N/A	$ -	$ -	$ -	$ -	0.29	N/A
NS18a *Best Technique BC>1*	30-yr	$ -	$ 24,655,878	$ -	$ -	$ -	$ -	$ 38,819,237	N/A	$ -	$ -	$ -	$ -	1.57	N/A
	50-yr	$ -	$ 24,655,878	$ -	$ -	$ -	$ -	$ 58,985,502	N/A	$ -	$ -	$ -	$ -	2.39	N/A

Mitigation Scenario	Description
CF1	White Oak Dike Repair
CF2	Detention Structure: Upper Little River (wet)
CF3	Detention Structure: Upper Little River (dry)
LR4	Detention Structure: Little River (wet)
LR5	Detention Structure: Little River (wet)
LR6	Bridge Conveyance Improvements
LR7	Channel and Overbank Improvements
NECF8	Channel Cleaning Area 1
NECF9	Channel Cleaning Area 2
NECF10	Overbank Clearing
NECF11	Diversion Channel
NS12 - 18*	Non-structural Mitigation of All Applicable Buildings (Acquisition, Elevation, Relocation, Dry Floodproofing, Wet Floodproofing, Mitigation Reconstruction)
NS12a - 18a*	Non-structural Mitigation of Buildinngs with Benefit/Cost >1 Over 50 Years (Acquisition, Elevation, Relocation, Dry Floodproofing, Wet Floodproofing, Mitigation Reconstruction)
*Non-Strucural Scenarios Not Pictured	

0 8 16 32 Miles

1 in = 16 miles

Cape Fear Basin Flood Mitigation Scenario Summary

Figure ES.1

facility will likely require a longer timeframe since the permitting and environmental impact considerations will be greater.

Mitigation Strategy	Mitigation Scenario	Implementation Time
Roadway Elevation	Scenario LR6	2 to 5 Years
Non-Structural	Scenarios 12 – 18	3 to 5 Years
Floodplain Expansion/Protection	Scenario LR7, NECF8, NECF9, NECF10	3 to 5 Years
New Dry Detention Facilities	Scenario CF3, LR5	7 to 15 Years
Channel Modification	Scenario NECF11	10 to 15 Years
Existing Levee Repair	Scenario CF1	10 to 15 Years
New Wet Detention Facilities	Scenario CF2, LR4	15 to 30+ Years

Table ES.2: Implementation Time

Table ES.3 shows estimates of the number of buildings that will be removed from flood risk at the modeled 100-year recurrence interval level with the mitigation scenario implemented. These top five strategies for total building reduction include the non-structural strategies of acquisition, dry floodproofing, relocation, mitigation reconstruction, and elevation. It is important to note however, that not all these strategies will fully remove the structure from all flooding. Some of these strategies (floodproofing) will reduce, but not remove flood damage while others (elevation) will remove the structure from some, but not all flood events. Aside from these non-structural alternatives, Scenario CF1 for the White Oak Dike repair had the highest number of buildings removed from flooding at 329 structures.

Mitigation Strategy	Mitigation Scenario	Building Count Reduction
Non-Structural	Scenario NS12, NS15, NS18	2,374
Non-Structural	Scenario NS14	1,080
Non-Structural	Scenario NS17	751
Non-Structural	Scenario NS18a	539
Non-Structural	Scenario NS13	480

Table ES.3: Greatest Reduction in Impacted Structures (Top 5 Scenarios – 100-year Recurrence Event)

Table ES.4 shows the lowest cost mitigation scenarios that were investigated. None of these alternatives also made the list for the top five for building count reduction.

For the non-structural alternatives listed, it should be noted that they are not a one-shot allocation of funding, therefore implementation can be gradual based on available funding and focus on the highest risk properties first.

Mitigation Strategy	Mitigation Scenario	50-Year Cost
Roadway Elevation	Scenario LR6	$1,434,000
Floodplain Expansion/Protection	Scenario NECF8	$1,916,000
Non-Structural	Scenario NS16a	$2,736,000
Non-Structural	Scenario NS16	$3,130,000
Non-Structural	Scenario NS13a	$3,653,000

Table ES.4: Lowest Cost to Implement (Top 5 Scenarios)

Tables ES.5 and ES.6 show the top 5 scenarios for highest direct losses avoided and best direct benefit to cost (BC) ratio. Aside from the non-structural alternatives listed below, Scenario CF1 (White Oak Dike) had the highest direct losses avoided ($14,550,000) while Scenarios NECF8 (1.09) and CF2 (1.04) were the only two alternatives that were not non-structural that had 50-yr Benefit-to-Cost ratios greater than 1.0. Again, it should be noted that for non-structural alternatives the losses avoided and BC ratio will be variable depending on how the stages of the program are implemented.

Mitigation Strategy	Mitigation Scenario	50-Year Benefit
Non-Structural	Scenario NS12	$112,701,000
Non-Structural	Scenario NS15	$107,066,000
Non-Structural	Scenario NS18	$100,386,000
Non-Structural	Scenario NS18a	$58,986,000
Non-Structural	Scenario NS12a	$54,828,000

Table ES.5: Highest Direct Losses Avoided (Top 5 Scenarios)

Mitigation Strategy	Mitigation Scenario	50-Year Benefit / Cost
Non-Structural	Scenario NS16a	3.13
Non-Structural	Scenario NS16	2.80
Non-Structural	Scenario NS18a	2.39
Non-Structural	Scenario NS12a	2.22
Non-Structural	Scenario NS14a	2.02

Table ES.6: Highest Benefit to Cost Ratio (Top 5 Scenarios)

Scenario 18a which implements the most cost-effective non-structural mitigation alternative for buildings with a benefit-to-cost ratio greater than 1.0 is the only Scenario to rank in the top 5 for building count reduction, 50-year benefit, and 50-yr benefit/cost while also having one of the shortest implementation timeframes.

Results on a community level basis for each of the mitigation scenarios investigated is useful for determining which scenario performs best for an individual community. Detailed flood damage estimates on a community level can be found in Appendix A – Community Specific Flood Damage Estimates.

Other Findings

A trend analysis was performed to assess whether increasing population and associated development is resulting in increased peak flows on the Cape Fear River. The analysis was performed using gage recorded annual flood discharge peaks from available USGS data. A trend of increasing discharges for peak annual flow was not detected at a statistically significant level.

Conclusions

The following are the conclusions based on this planning level study:

- Non-Structural strategies were most effective for flood damage mitigation based on the following criteria:
    - Timeframe to implement
    - Scalability of funding allocation
    - Ability to target most vulnerable structures and communities
    - Best Benefit/Cost ratio of the options considered
    - Positive environmental impact
- With the Elevation, Acquisition, and Relocation strategy there may be a gap between funds for buyout and the money needed to acquire comparable living space outside of a flood prone area. This was not accounted for in the analysis but needs to be considered during funding.
- Ongoing buyout programs as part of the Hurricanes Matthew and Florence recovery efforts will impact the BC analysis for all scenarios. When current buyout programs have concluded, a reassessment of the BC analysis should be performed.
- Detailed information on potential White Oak Dike repair was not available from the US Army Corps of Engineers (USACE). Additional data and coordination is needed to further evaluate the feasibility of repair and ongoing maintenance.
- The effect of implementation of each strategy on other strategies should be investigated. Non-structural mitigation of the most at-risk buildings in a community would impact the B/C of a structural alternative such as a new detention structure that would otherwise benefit those buildings. A combination of strategies may prove to be more cost-effective.
- If a scenario involving wet detention is pursued in conjunction with municipal water supply, the volume reserved for water supply would reduce the available storage for flood control and likely make the facility much less effective for flood control purposes.
- Further investigation of environmental impacts should be considered prior to selecting a mitigation strategy, particularly for new detention facilities. The purpose of this study was to evaluate strategies for effectiveness in flood damage reduction. As such, considerations of water quality impacts and environmental concerns were not fully developed. Of particular concern are the Total Maximum Daily Load (TMDL) rules for the Cape Fear Basin and the presence of rare and endangered species within the basin.

For a digital copy of this report and associated Appendices, please visit https://rebuild.nc.gov.

1. Background

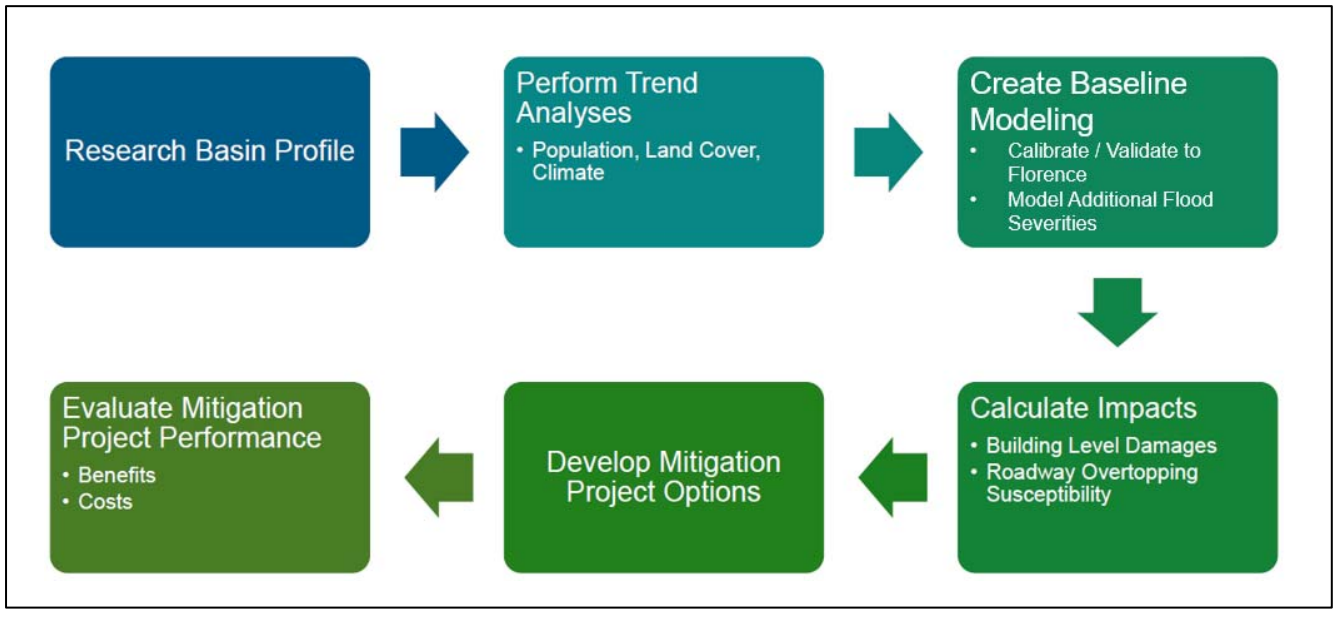
Purpose, Scope, and Goals

On Friday September 14, 2018 Hurricane Florence made landfall near Wrightsville Beach, North Carolina and began slowly working its way inland along the South Carolina and North Carolina border before eventually turning north. The storm produced extreme rainfall over the eastern Piedmont and Coastal Plain counties of North Carolina with some areas receiving over 30 inches of rainfall during the event. More than fifteen river gauges registered flood conditions at or greater than a 500-yr event. Flooding from Hurricane Florence was exacerbated by saturated ground due to flooding earlier that summer. The widespread flooding that resulted caused extensive damage to homes and businesses throughout the Cape Fear River Basin. This type of rainfall event is not new to communities in Eastern North Carolina. Flooding from Hurricane Fran (1996), Hurricane Floyd (1999), and Hurricane Matthew are still fresh in the memories of many of the citizens throughout the river basin as recovery efforts from Hurricane Matthew were still ongoing as Hurricane Florence made landfall.

The scope and goals of this study are as follows:

- Research the primary causes and magnitude of flooding in communities along the Cape Fear River and major tributaries Little River and Northeast Cape Fear River.
- Calculate the impacts of flooding on built environment, living environment, and economies for multiple flood frequencies including the 20-, 10-, 4-, 2-, 1-, 0.5-, 0.2-, and 0.1-percent annual chance events.
- Identify and assess mitigation strategies that will reduce the impacts of the flooding.
- Assess short and long-term benefits to costs of these mitigation strategies.
- Provide potential solutions that protect the communities from damaging flooding, are cost effective, and offer ancillary benefits to the communities.

This will be accomplished using the following study methodology:



The following partners were involved to help gain valuable input and feedback as well as communicate results:

- NC Department of Public Safety (NC DPS) – Emergency Management
- NC Department of Transportation (NCDOT)
- Impacted County Governments and Municipalities
- US Army Corps of Engineers (USACE)
- NC Department of Commerce
- NC Department of Agriculture and Consumer Services
- Engaged Stakeholders and Non-Profits
- Congressional and Legislative Representatives

As a part of this study, public meetings were held to keep stakeholders informed on progress of the analysis as well as receive feedback to incorporate into the analysis or the reporting as appropriate. Two meetings were held virtually. The first meeting occurred on July 21, 2021 and topics covered included scope, goals, baseline analysis, baseline damage results, the mitigation options to be investigated, and a discussion of the next steps for the project. Feedback was solicited at this first meeting to identify mitigation strategies of particular interest of the attendees. At the second meeting on June 15th, 2022 the results of the analyses were reviewed including benefit/cost results and discussion on approach and methodology for each of the mitigation scenarios explored.

The scope of this study is analysis of flooding on the mainstem of the Cape Fear River. The major tributaries of Little River and Northeast Cape Fear River are included in this study as well.

2. Basin Profile

Description of Basin

Geography, Topography, and Hydrography - The Cape Fear River Basin is the largest river basin in North Carolina and one of just four river basins that are entirely within the state. The Cape Fear River Basin drains approximately 9,000 square miles at its outlet into the Atlantic Ocean. The headwaters of the Cape Fear River Basin are found near Greensboro, NC in Guilford County where both the Deep River and Haw River form. The Cape Fear River itself originates at the confluence of the Deep River and Haw River in the town of Moncure, NC. The Cape Fear River stretches over 190 miles downstream where it empties into the Atlantic Ocean near Cape Fear, NC. The study area for this flood analysis includes the Cape Fear River and its tributaries downstream to the confluence of the Cape Fear River and Northeast Cape Fear River in the City of Wilmington in New Hanover County. From that point southeast, the river is coastally influenced. Figure 2-1 below depicts the entire Cape Fear River Basin as well as the area of study. For the duration of this report, the term Cape Fear Basin refers to the blue study area outlined below.

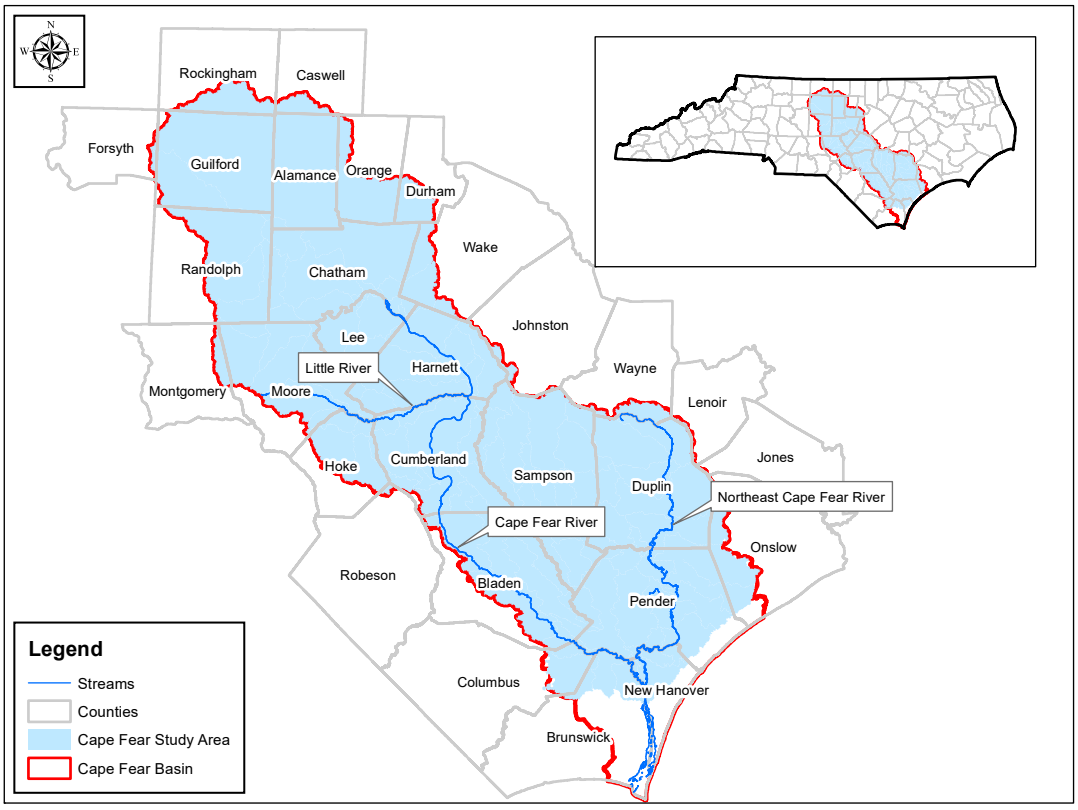


Figure 2-1: Cape Fear River Basin

Elevations in the Cape Fear Basin range from approximately 1,000 feet at the headwaters in Forsyth County to sea level as the river approaches the Atlantic Ocean. A key geographic feature within the basin that impacts the nature of the floodplain is the fall line. The fall line separates the rolling hills and eroded valleys of the piedmont from the rolling sand hills and flatter land of the coastal plain. As the Cape Fear River moves east of the fall line the dramatic flattening in the slope of the river is reflected by a significant widening of the floodplain. Within the Cape Fear Basin study area, the fall line occurs roughly along the county boundaries between Harnett and Lee, and through Moore County.

The fall line separates the reddish, clayey soils of the piedmont from the darker and sandier loams found in the coastal plain that formed as a result of wave action and deposits left by the advancing and retreating Atlantic Ocean throughout the years. The different soils in these regions result in a difference in direct runoff experienced in the piedmont region and the coastal plain. Figure 2-2 shows the delineation of the hydrographic regions in the Cape Fear Basin based on the United States Geological Survey (USGS) Report "Methods for Estimating the Magnitude and Frequency of Floods for Urban and Small Rural Streams in Georgia, South Carolina, and North Carolina, 2011". Areas toward the headwaters are in hydrographic region 1 (Ridge and Valley-Piedmont) while areas to the east are in region 4 (Coastal Plain).

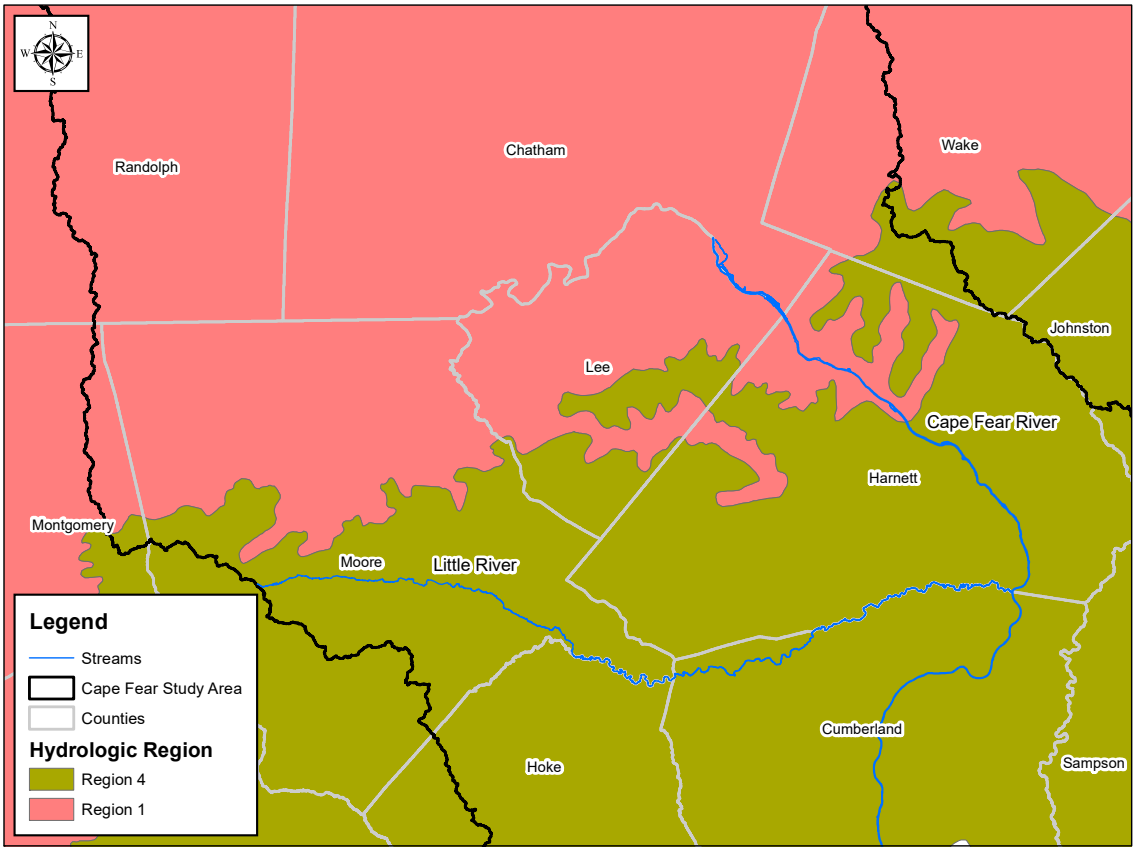


Figure 2-2: Hydrologic Regions in the Cape Fear Basin

The graph in Figure 2-3 illustrates that there is a substantial difference in discharges based on hydrographic region. This is primarily due to the nature of the soils.

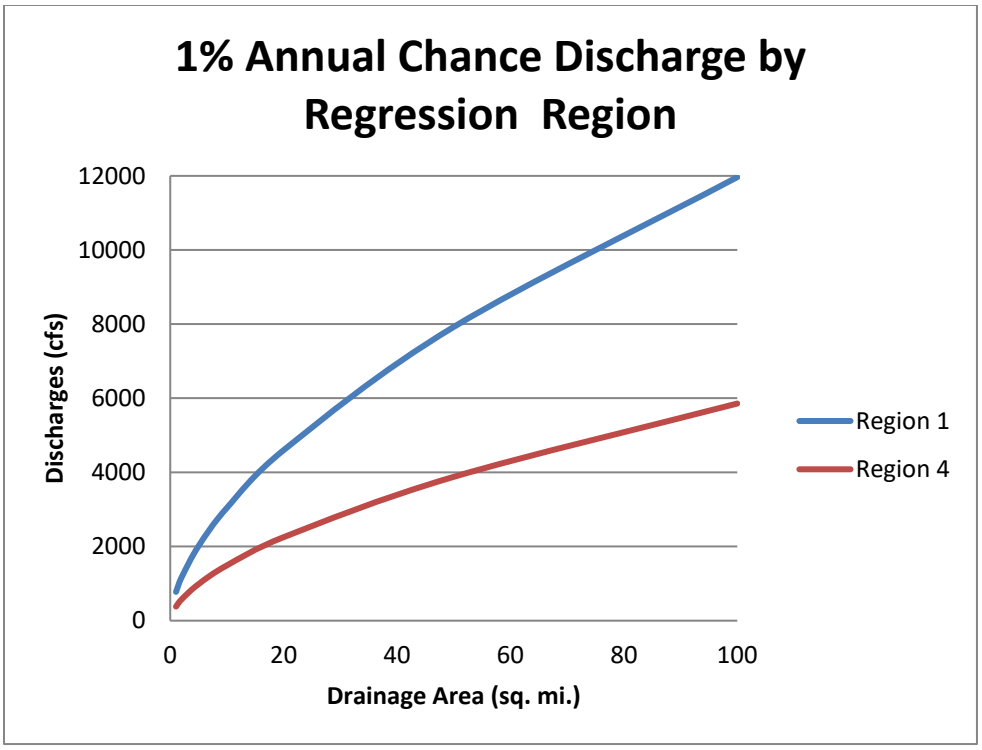


Figure 2-3: Relationship of Discharge to Drainage Area for Regression Regions 1 and 4

Key Cities – The Cape Fear Basin study area encompasses all or part of 11 counties and 37 incorporated communities. The population centers in the study area as well as the key cities for this study are listed in Table 2-1.

Community	Population (2020)
Archdale	11,894
Asheboro	26,954
Boiling Spring Lakes	5,963
Burlington	57,346
Clinton	8,077
Dunn	8,457
Durham	283,547
Fayetteville	208,871
Graham	17,153
Greensboro	297,899
High Point	113,887
Mebane	17,768
Raeford	4,722
Randleman	4,612
Reidsville	14,580
Robbins	1,169
Sanford	30,227
Wilmington	115,955

Table 2-1: Population of Key Cities within the Study Area

Rivers and Streams – Figure 2-4 depicts the major streams located within the study area. Table 2-2 lists the major streams in the watershed and their associated contributing drainage area.

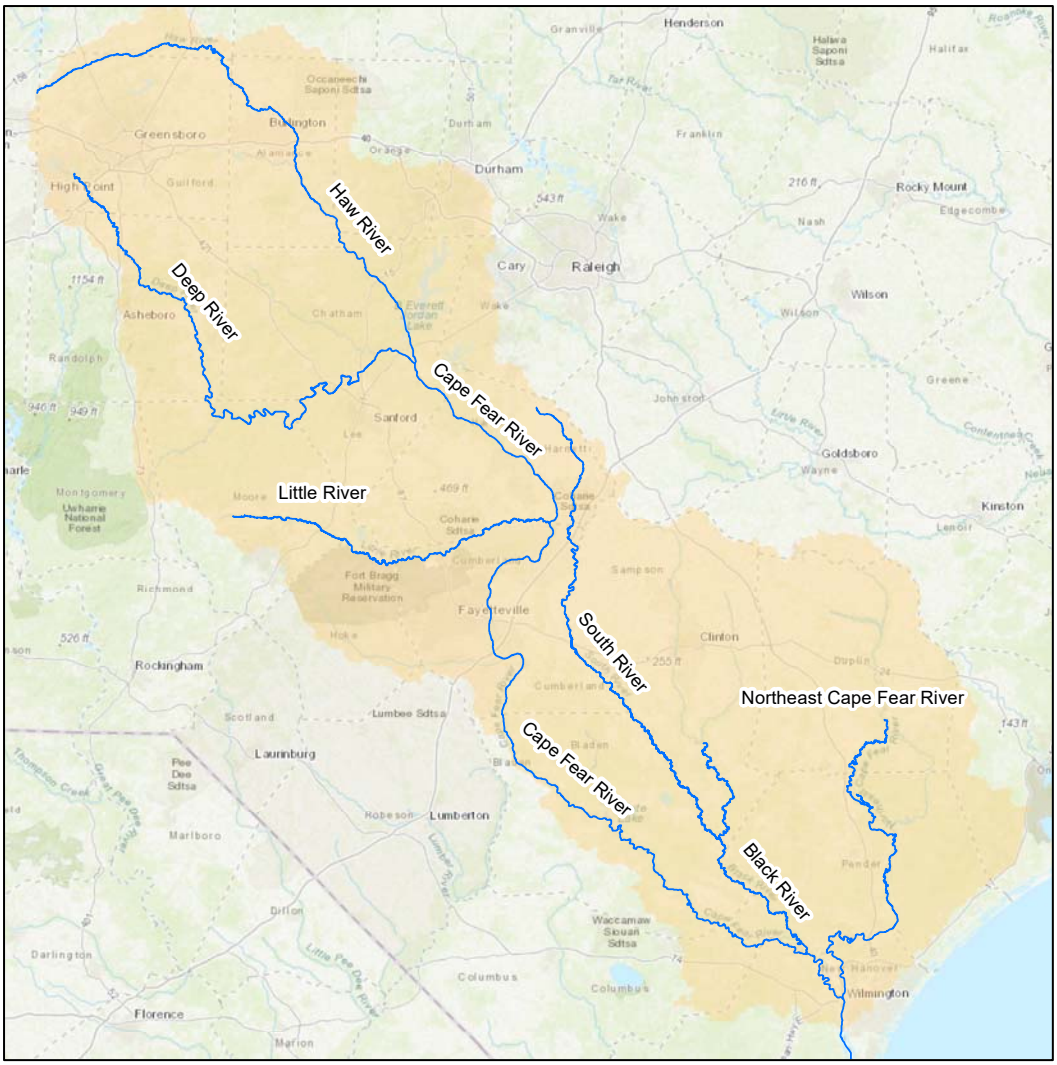


Figure 2-4: Major Streams within Cape Fear Basin

Watershed	Contributing Area (sq. mi.)	Watershed	Contributing Area (sq. mi.)
Haw River	1,707	NE Cape Fear River	1,751
Deep River	1,452	Black River	1,574
Little River	476	Cape Fear River	1,887

Table 2-2: Key Streams Contributing to the Cape Fear River

Key Infrastructure – Many reservoirs, including Lake Brandt (816 acres), Lake Townsend (1,542 acres), Lake Mackintosh (1,150 acres), Lake Cammack (800 acres), and Graham-Mebane Lake (650 acres) are located in the upper portion of the Cape Fear Basin within the Haw River watershed. The primary purpose of these reservoirs is water supply serving nearby communities Greensboro, Burlington, Graham, and Mebane. Duke Energy operates Harris Lake (4,100 acres) as a source of cooling water for the Shearon Harris Nuclear Power Plant. Although these reservoirs may provide some flood attenuation, flood control is not their primary purpose.

Following significant flooding that occurred along the Cape Fear River as a result of a tropical storm in September of 1945, Congress directed the U.S. Army Corps of Engineers (USACE) to perform a flood study for the area. As a result of the study, New Hope Lake (now named B. Everett Jordan Lake) was authorized in 1963 and construction began in 1967. The reservoir formed between 1973 and 1983 along the Haw River and New

Hope River and currently impounds an area of 13,940 acres. Although the primary purpose of the reservoir is flood control, it also functions as a major water supply facility, providing water to communities in Chatham, Orange, and Wake Counties.

The White Oak Dike is a 14.5-mile-long existing flood control dike located along the Cape Fear River in the southeast section of Bladen County and northwest section of Pender County, NC approximately 35 miles north of Wilmington, NC. The dike was constructed in sections beginning in 1911, extended in 1934 by the Works Progress Administration, repaired in 1946-47 under Section 5 of the Flood Control Act of 1941, and repaired, raised, and extended as authorized in 1960 by Section 205 of the Flood Control Act of 1948. In 2001, a Continuing Eligibility Inspection by the USACE resulted in the dike being rated unacceptable and therefore classified inactive in the Public Law PL 84-99 program that provides reimbursement for certain damages to levees that result from high-water events. The White Oak Dike is a Non-Accredited Levee System according to the Federal Emergency Management Agency (FEMA).

Ecology – The Cape Fear Basin faces a range of environmental challenges, many of which are discussed in detail in the "Cape Fear 2005 River Basinwide Water Quality Plan" developed by the NC Department of Environment and Natural Resources Division of Water Quality in 2005.

The report notes that most often the source of water quality impairment is based on land use in a watershed. Sources of water quality impairment were identified in the Cape Fear River basin as urban or impervious surface areas, construction sites, road building, land clearing, agriculture, and forestry. The Cape Fear Basin is one of the fastest developing basins in North Carolina, which is the leading cause of impacted water quality within the basin. The increase in development and growing populations lead to large amounts of waste and pollutants in the streams and groundwater within the watershed. There are over 150 stream miles with impaired water quality within the Cape Fear Basin. An increase in development has resulted in the increase of surface run off and higher flood frequency events. This has led to higher flashy peak flows in streams causing enlarged urban streams and suspended sediment. Another issue with a quickly growing population and increase in development is stream channelization. Stream channelization is the process of reducing stream sinuosity by straightening out the channel to increase the transport of drainage downstream, and as a result has led to an endless cycle of erosion and entrenchment. The combination of streambank erosion and higher peaked stream flows has led to the increase of suspended sediment in the streams. The suspended sediment in streams is a leading cause of the degradation of macroinvertebrates and aquatic life. Good instream habitat is necessary for the survival of aquatic life. Streams that typically show signs of habitat degradation are in watersheds that have a large percentage of impervious surface area. In the Cape Fear River basin, over 149.2 stream miles are impaired in the form of habitat degradation. There are an additional 236.0 stream miles where habitat degradation is impacting water quality in the stream.

Urban growth is not just the main driver of water quality impairment in the Cape Fear Watershed, it is also the largest threat to aquatic resources. So, in addition to water quality concerns, attention needs to be focused on the many rare plants and animals that reside in the Cape Fear River Basin. The Cape Fear River Basin supports many different aquatic species including at least 95 species of commercial and recreational fish as well as 42 rare aquatic species. The Cape Fear shiner, a fish that is federally listed as endangered, has been found nowhere in the world except the Cape Fear River Basin.

Figure 2-5: The Cape Fear Shiner

Within the Cape Fear Basin, there are several other endangered species such as the Shortnose Sturgeon the Red-Cockaded Woodpecker, the Saint Francis' Satyr and the West Indian Manatee. Other endangered species include the American Alligator and the Loggerhead and Kemp's Ridley Sea Turtle. There are several mollusks under the Federal Species of Concern list. These mollusks are the Carolina Creekshell, the Atlantic Pigtoe, the Magnificent Rams-horn and the Barrel Floater.

Of these species, the greatest concern may be the endangered Cape Fear Shiner (Figure 2-5). Besides competition with invasive species, sedimentation, nutrient loading, and increased insolation from reduced tree canopy are the major factors affecting aquatic organisms in the Cape Fear Basin tributaries. The loss of river habitat or separation due to dams are some of the biggest concerns with these endangered species. Declining water quality at previously occupied habitats make those areas unsuitable for shiners today. Other potential threats to the species and its habitat could come from such activities as changes in streamflow, runoff from agriculture and communities, road construction, impoundments, wastewater discharge, and other development projects in the watershed.

Despite challenges with vulnerable species, the North Carolina Department of Environmental Quality (NCDEQ) along with many conservation organizations continue to monitor, research, and manage the Cape Fear Basin. The sub-basins of Haw River, Deep River, Little River, Cape Fear River, Northeast Cape Fear River, and smaller streams in the headwaters of the Cape Fear Basin are of most concern to the NCDEQ. Portions of the Black River, South River, Little River, Deep River and Northeast Cape Fear River are classified as an Outstanding Resource Waters (ORW) Special Management Strategy Area due to their excellent water quality conditions (Figure 2-6). The headwaters of the Cape Fear River are also a concern as several areas are susceptible to future development where smaller streams may be impacted. Current impaired streams and bioclass data of the most recent macroinvertebrate sampling for the entire Cape Fear Basin are shown in Figure 2-6.

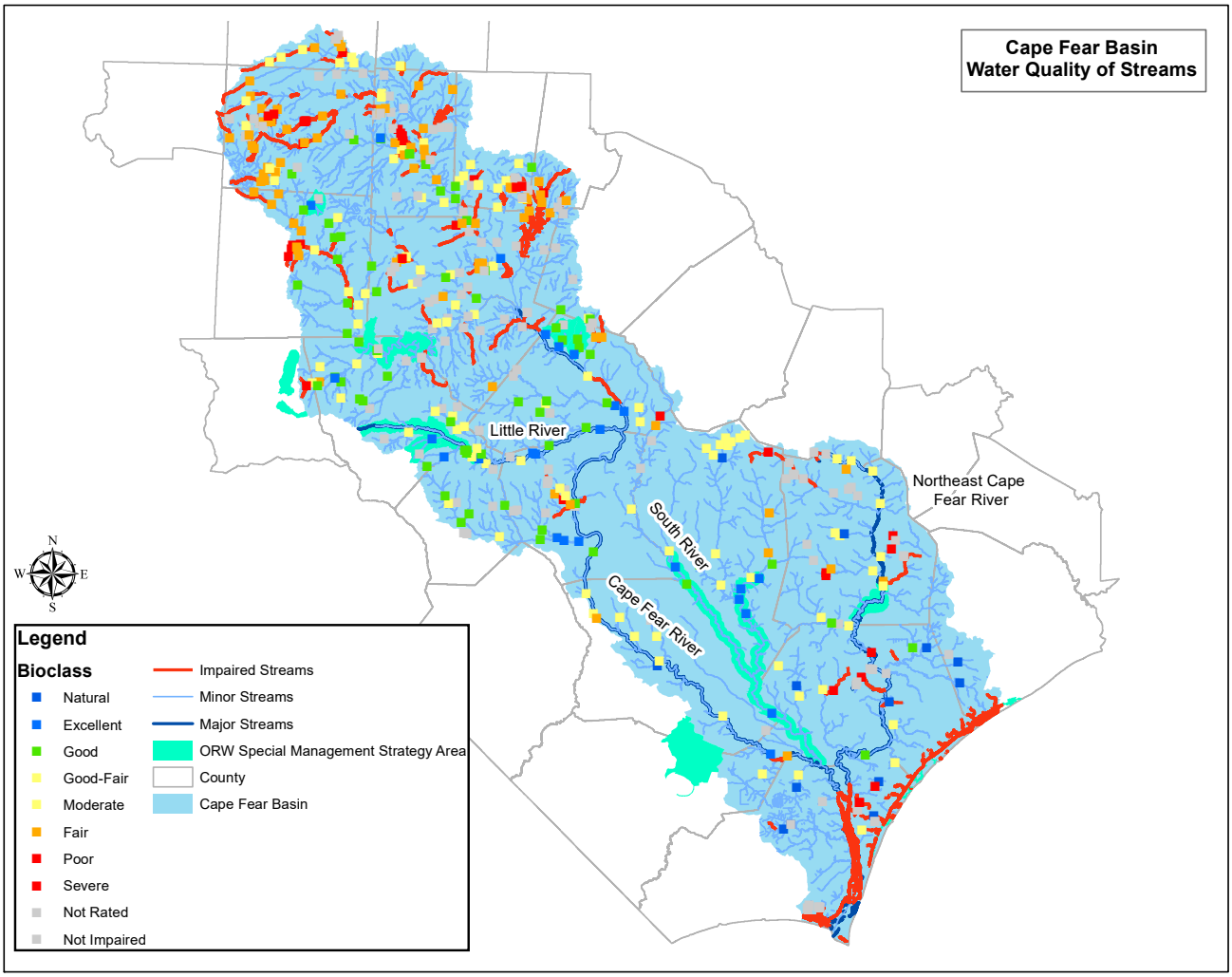


Figure 2-6: Cape Fear River Basin Water Quality

Habitat structure and water quality are improved with surrounding trees. Diverse tree species are found across the Cape Fear Basin. Within the basin are deciduous, longleaf pine, and maritime forests. Closer to the headwaters within the deciduous forest there are hickory, oak, and pine trees. The upper portions of the coastal plain are made up of the Longleaf Pine Forests, which are the most diverse tree systems. There are approximately 900 plant species unique to the longleaf pine forest. The trees and plants within this forest include the Longleaf Pine, Roughleaf Loosestrife, Venus Fly-Traps, and Pitcher Plants. Lastly, the Maritime Forests are found along the coastal areas within the Cape Fear Basin. The trees within this forest are live oak, sand laurel oak, wax myrtle and yaupon hollow.

Demographics

Growth Rate – As of 2020 census estimates, approximately 2,686,000 people live in the Cape Fear River basin. Table 2-3 shows intermediate and short-term population changes for cities in the study area. Comparing Figures 2-7 and 2-8 below, it is evident that the basin has seen significant population growth in existing urbanized areas around the primary population centers while much of the more rural unincorporated areas have seen much less growth.

Community	Population (1990)	Population (2000)	Population (2010)	Population (2020)	Percent Change (1990-2020)	Percent Change (2010-2020)
Archdale	6,629	7,394	9,005	11,894	79%	32%
Asheboro	11,272	13,512	14,712	26,954	139%	83%
Boiling Spring Lakes	1,404	2,226	3,726	5,963	325%	60%
Burlington	40,239	44,956	47,878	57,346	43%	20%
Clinton	6,320	6,151	6,199	8,077	28%	30%
Dunn	6,416	6,125	6,024	8,457	32%	40%
Durham	79,819	98,342	112,464	283,547	255%	152%
Fayetteville	192,724	200,902	198,769	208,871	8%	5%
Graham	9,808	11,562	11,970	17,153	75%	43%
Greensboro	197,637	231,653	255,836	297,899	51%	16%
High Point	54,881	66,297	74,965	113,887	108%	52%
Mebane	4,996	6,625	8,445	17,768	256%	110%
Raeford	2,604	2,570	2,705	4,722	81%	75%
Randleman	2,167	2,443	2,773	4,612	113%	66%
Reidsville	6,591	6,965	7,460	14,580	121%	95%
Robbins	226	275	245	1,169	417%	377%
Sanford	17,468	19,798	22,014	30,227	73%	37%
Wilmington	73,360	89,080	105,013	115,955	58%	10%

Table 2-3: Intermediate and Short-Term Population Change in the Cape Fear Basin Study Area

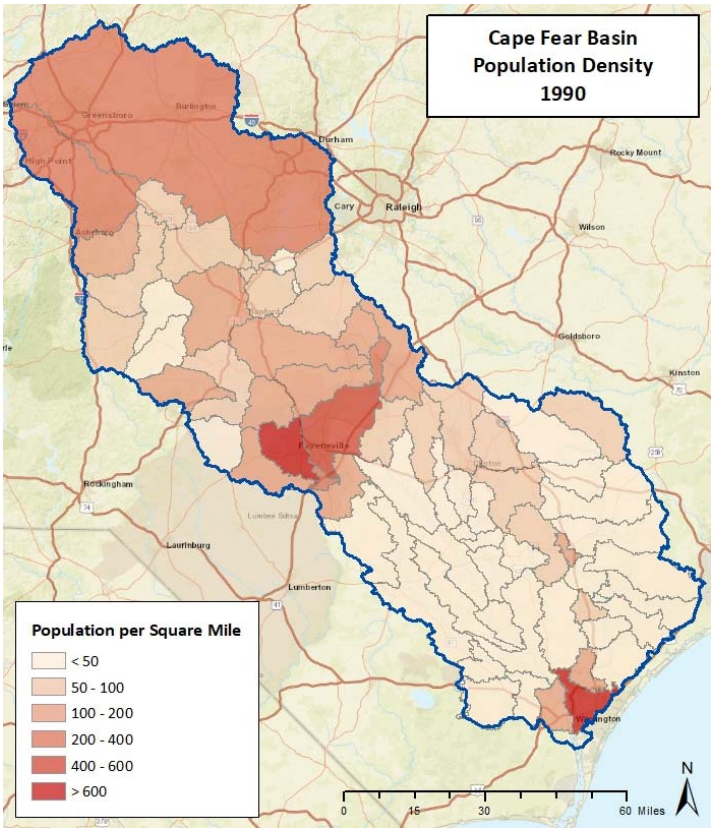


Figure 2-7: Cape Fear Basin Population Density 1990

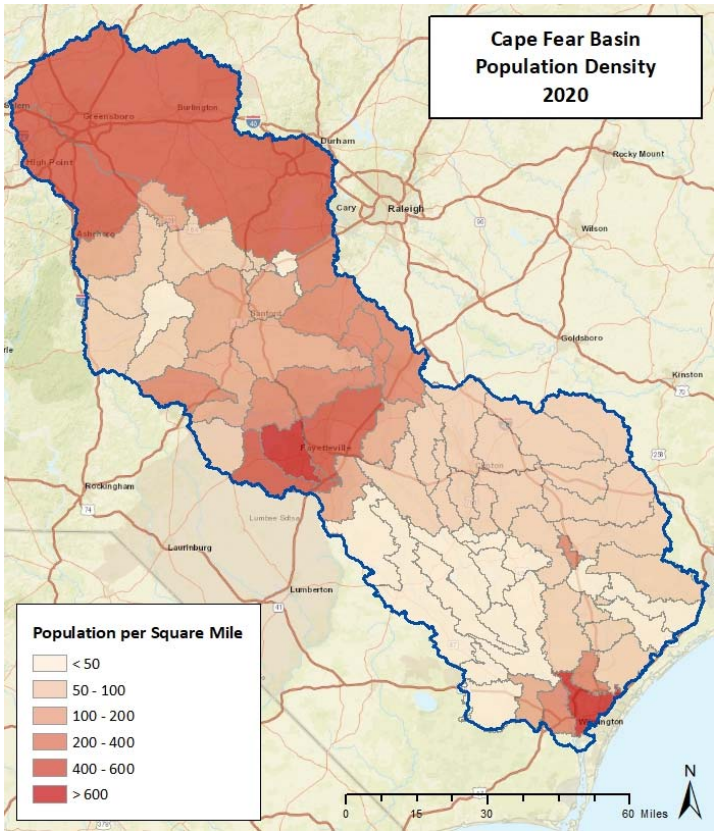


Figure 2-8: Cape Fear Basin Population Density 2020

Population Profile – Demographics for the populations in the counties that are connected to the Cape Fear Basin Study Area are shown in Table 2-4. These statistics were taken from the 2019 American Community Survey.

		Ethnicity			Economic			Housing	
County	Median Age	**White**	**Black**	**Other**	**Below Poverty Line**	**Median Household Income**	**Zero Car House-holds**	**Owner / Renter Occupied**	**Median Value**
Alamance	39.1	62%	20%	18%	15%	$51,580	5%	67%	$160,900
Bladen	44.8	54%	32%	13%	24%	$37,188	8%	72%	$98,700
Brunswick	54.7	82%	8%	9%	11%	$59,763	3%	81%	$220,400
Caswell	46.2	63%	30%	7%	16%	$47,938	9%	74%	$113,600
Chatham	47.3	71%	10%	18%	11%	$69,799	4%	77%	$310,000
Columbus	41.9	60%	29%	11%	22%	$38,487	6%	72%	$94,800
Cumberland	31.4	42%	38%	19%	19%	$48,177	7%	51%	$139,700
Duplin	40.7	54%	24%	23%	18%	$43,422	5%	72%	$89,500
Durham	35.5	43%	34%	23%	14%	$62,812	7%	55%	$241,800
Guilford	37.4	49%	34%	18%	15%	$54,794	6%	59%	$172,900
Harnett	34.7	61%	21%	18%	16%	$54,565	5%	66%	$160,700
Hoke	33	40%	32%	27%	19%	$51,140	4%	68%	$146,200
Johnston	38.4	66%	16%	18%	12%	$61,806	5%	74%	$180,200
Lee	39.4	61%	17%	22%	16%	$52,294	5%	65%	$145,600
Montgomery	43.9	66%	16%	18%	17%	$45,147	5%	73%	$120,500
Moore	44.1	77%	11%	12%	11%	$63,324	4%	77%	$229,400
New Hanover	39	76%	12%	12%	15%	$56,689	6%	58%	$258,200
Onslow	26.5	67%	14%	19%	12%	$51,560	4%	54%	$162,400
Orange	35.1	67%	11%	23%	12%	$74,803	5%	64%	$331,800
Pender	42.7	75%	13%	12%	14%	$60,044	3%	81%	$198,100
Randolph	41.8	77%	6%	17%	15%	$48,984	4%	73%	$128,800
Rockingham	45	72%	18%	10%	18%	$45,697	7%	70%	$114,900
Sampson	40.3	53%	24%	23%	22%	$42,914	6%	72%	$97,500
Wake	36.4	59%	18%	23%	9%	$83,567	4%	64%	$301,600
Wayne	37.6	53%	31%	16%	19%	$47,221	8%	63%	$125,900
North Carolina	**38.9**	**68%**	**21%**	**10%**	**14%**	**$56,642**	**6%**	**66%**	**$193,200**

Table 2-4: Demographic Data for Counties in the Cape Fear Basin Study Area

Economic / Industry Profile - According to NC Department of Commerce, there are approximately 1,600,000 jobs within the Cape Fear River Basin. This estimate was calculated using the county profile data from the Labor and Economic Analysis Division and applying a percent of area for each county that is part of the Cape Fear Basin. According to the data, the most prominent employment sectors within the Cape Fear River Basin are "Private Industry" (42%) followed by "Government" (9%) and "Health Care" (8%). The smallest employment sectors are "Mining" (<1%), "Utilities" (<1%), and "Agriculture, Forestry, Fishing, and Hunting" (<1%). Figure 2-9 provides an employment profile for the studied portion of the river basin.

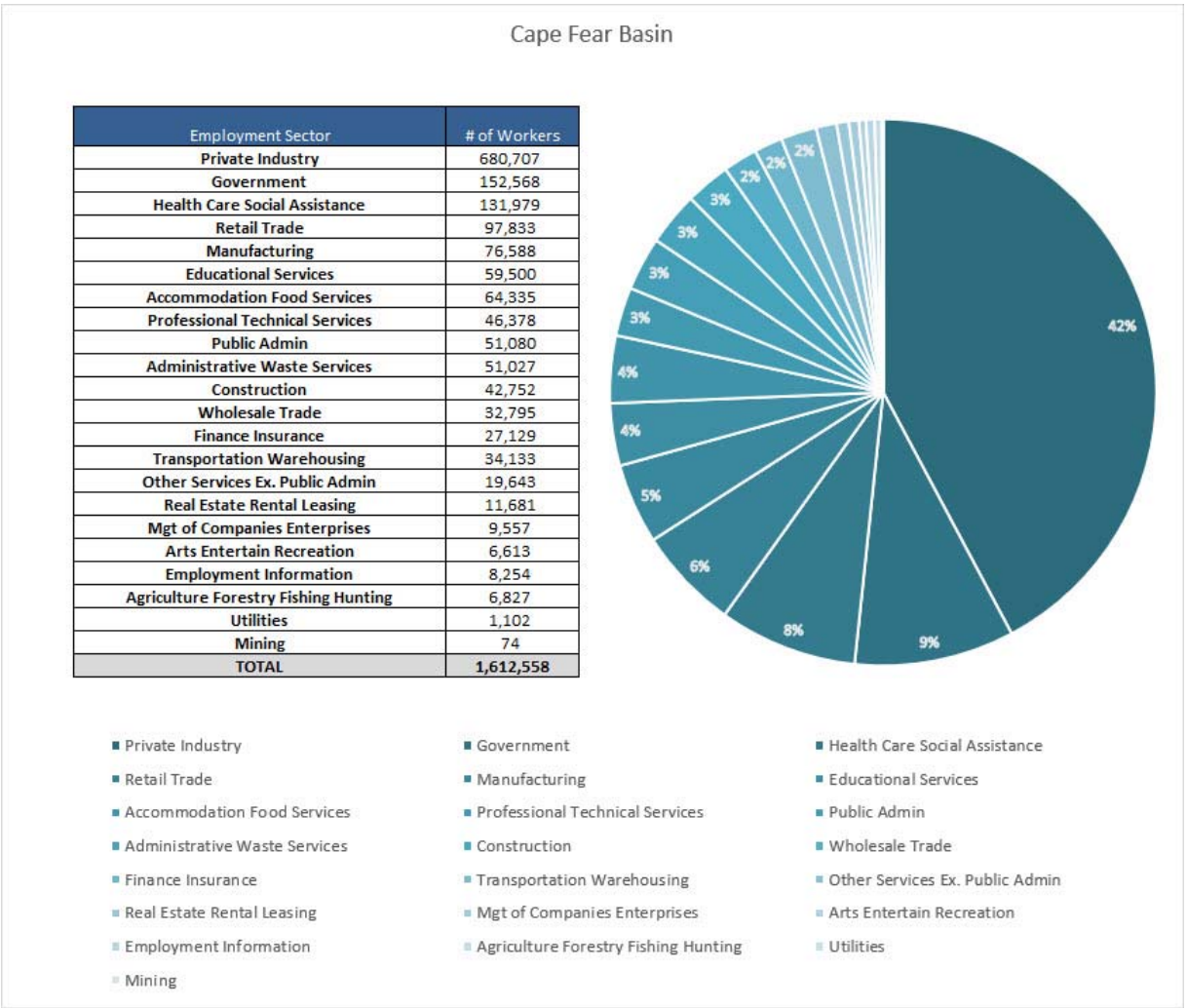


Figure 2-9: Cape Fear River Basin Employment Sectors

Land Cover and Development – Land cover in the Cape Fear Basin was assessed using the 2019 National Land Cover Dataset (NLCD) compiled by the Multi-Resolution Land Characteristics Consortium. Table 2-5 lists the types of land cover classified in the NLCD:

Class \ Value		Classification Description	Class \ Value		Classification Description
Water	11	Open Water	Shrubland	51	Dwarf Scrub
	12	Perennial Ice/Snow		52	Shrub/Scrub
Developed	21	Developed, Open Space	Herbaceous	71	Grassland/Herbaceous
	22	Developed, Low Intensity		72	Sedge/Herbaceous
	23	Developed, Medium Intensity		73	Lichens
	24	Developed High Intensity		74	Moss
Barren	31	Barren Land (Rock/Sand/Clay)	Planted / Cultivated	81	Pasture/Hay
Forest	41	Deciduous Forest		82	Cultivated Crops
	42	Evergreen Forest	Wetlands	90	Woody Wetlands
	43	Mixed Forest		95	Emergent Herbaceous Wetlands

Table 2-5: NLCD Land Cover Classifications

Previous versions of the NLCD from 2001, 2006, 2011, and 2016 were also analyzed. Table 2-6 presents changes in land cover across the Cape Fear Basin study area from the various datasets.

Cape Fear Basin Landcover					
	2001	2006	2011	2016	2019
Developed	10.6%	11.2%	11.5%	12.1%	13.8%
Forest	36.3%	34.8%	33.0%	39.0%	37.8%
Water/Wetlands	18.4%	18.4%	18.4%	19.4%	19.6%
Crops	13.0%	13.1%	13.0%	14.2%	13.8%
Pasture	8.9%	8.7%	8.6%	7.8%	7.5%
Grassland/Scrub	12.5%	13.3%	15.0%	7.2%	7.2%
Barren	0.4%	0.5%	0.5%	0.3%	0.3%
Total	100%	100%	100%	100%	100%

Table 2-6: Land Cover Trends in the Cape Fear Basin

Overall changes in land cover across the Cape Fear Basin have been minimal. There has been a slight increase in developed areas that coincide with reductions in forest, pasture, grassland, and scrubs.

Land cover classified as developed in the 2019 NLCD dataset was used to determine the percentage of developed land for different areas in the Cape Fear Basin. Figure 2-10 shows that the most developed areas are in the those of greatest population density in the Greensboro, Fayetteville, and Wilmington areas.

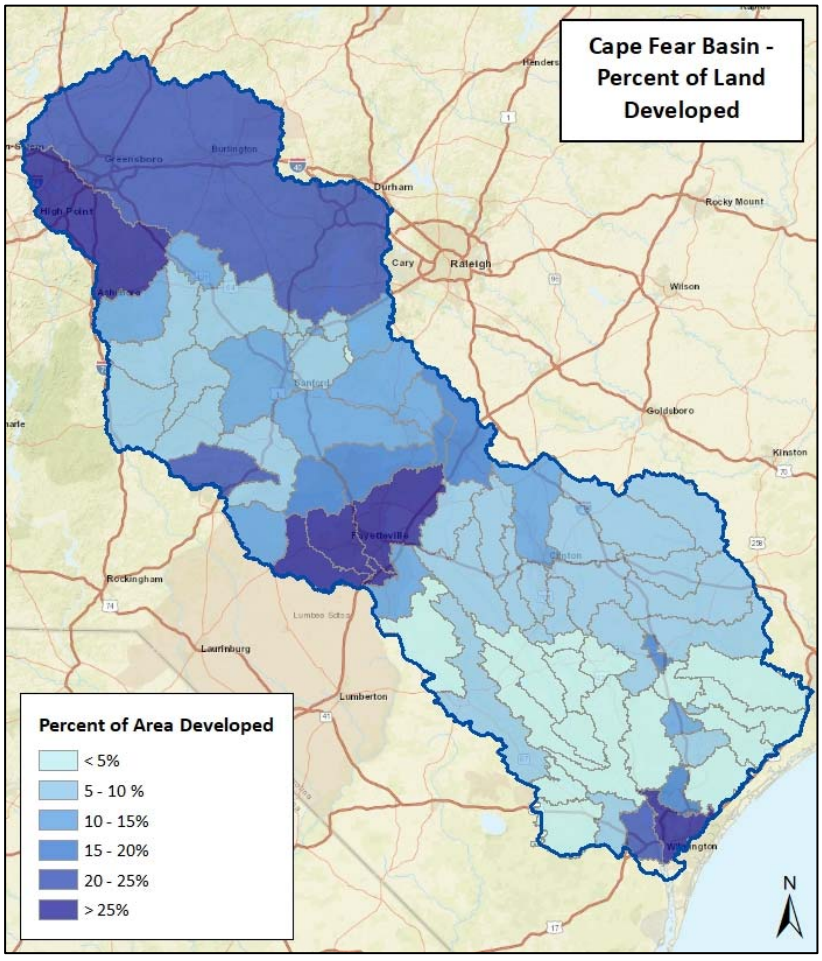


Figure 2-10: Percent Developed Area in Cape Fear Basin Study Area

Table 2-7 shows the changes in developed area for communities with the highest percentage of development, according to the NLCD dataset. As shown in the table, increases in developed area have been minor, even in the most developed portions of the Cape Fear River Basin.

Percent Developed					
Community	**2001**	**2006**	**2011**	**2016**	**2019**
Archdale	62%	64%	64%	64%	65%
Burlington	71%	72%	75%	76%	77%
Clinton	66%	67%	68%	69%	72%
Dunn	68%	70%	71%	73%	75%
Fayetteville	45%	49%	51%	52%	54%
Graham	64%	66%	69%	71%	73%
Greensboro	72%	74%	76%	76%	77%
Wilmington	34%	35%	35%	36%	38%

Table 2-7: Changes in Percent Developed for Cape Fear Basin Communities

Rainfall and Streamflow Data

Rainfall – Average annual rainfall in the Cape Fear Basin ranges from 43.7 inches to 58.6 inches with the larger totals occurring in the coastal part of the basin. Figure 2-11 shows the average annual rainfall for the basin for the period between 1980 and 2010 according to data collected by the PRISM Climate Group.

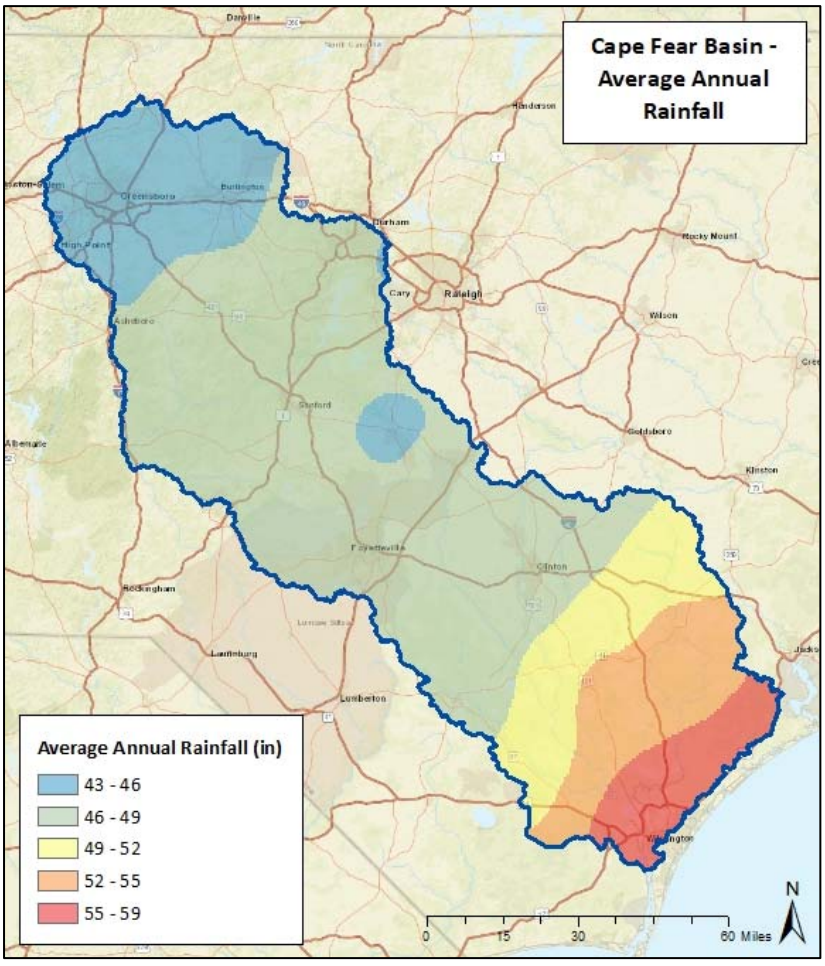


Figure 2-11: Average Annual Rainfall for the Cape Fear Basin

To characterize a flooding event, the point frequency rainfall depth is used. Estimates for these values for different locations within the Cape Fear Basin can be acquired from the National Ocean and Atmospheric Administration (NOAA) Atlas 14 Volume 2 or digitally from NOAA's Precipitation Frequency Data Server at https://hdsc.nws.noaa.gov/hdsc/pfds/. Table 2-7 lists rainfall depth frequencies for a 24-hour period at different locations in the basin. The coordinates used are located in the largest city in the county. In the full report these statistics are available for time periods ranging from 5 minutes to 60 days.

	Average Recurrence Interval (Depths in Inches)						
County	2-Yr	10-Yr	25-Yr	50-Yr	100-Yr	500-Yr	1000-Yr
Alamance	2.86	4.30	4.97	5.86	6.56	8.01	9.00
Bladen	3.09	4.84	5.78	7.20	8.44	11.40	13.80
Brunswick	4.01	6.30	7.55	9.48	11.20	15.40	18.80
Caswell	2.82	4.27	4.96	5.91	6.69	8.34	9.53
Chatham	2.96	4.47	5.18	6.13	6.89	8.46	9.56
Columbus	3.17	4.96	5.93	7.40	8.68	11.70	14.20
Cumberland	3.02	4.69	5.51	6.66	7.61	9.65	11.10
Duplin	3.17	4.97	5.95	7.45	8.78	11.90	14.50
Durham	2.92	4.40	5.08	6.00	6.72	8.21	9.24
Forsyth	2.81	4.25	4.92	5.84	6.58	8.11	9.19
Guilford	2.80	4.21	4.87	5.75	6.45	7.91	8.93
Harnett	3.04	4.67	5.46	6.55	7.43	9.29	10.60
Hoke	3.05	4.66	5.44	6.51	7.37	9.16	10.40
Johnston	2.96	4.62	5.45	6.64	7.62	9.80	11.40
Jones	3.37	5.30	6.33	7.86	9.18	12.30	14.80
Lee	3.03	4.60	5.34	6.36	7.17	8.86	10.00
Lenoir	3.18	4.99	5.97	7.47	8.78	11.90	14.50
Montgomery	2.99	4.53	5.25	6.24	7.02	8.63	9.75
Moore	3.10	4.70	5.46	6.49	7.31	9.02	10.20
New Hanover	4.69	7.29	9.16	10.80	12.70	18.20	21.20
Onslow	3.59	5.64	6.74	8.40	9.85	13.30	16.00
Orange	2.91	4.38	5.05	5.95	6.66	8.12	9.13
Pender	3.52	5.53	6.63	8.31	9.81	13.40	16.40
Randolph	2.90	4.37	5.06	5.98	6.71	8.23	9.28
Robeson	2.95	4.55	5.35	6.48	7.42	9.46	11.00
Rockingham	2.82	4.31	5.06	6.13	7.02	9.01	10.50
Sampson	3.08	4.82	5.75	7.13	8.32	11.10	13.30
Wake	2.88	4.37	5.07	6.03	6.78	8.36	9.46
Wayne	3.08	4.83	5.79	7.24	8.51	11.60	14.10

Table 2-8: Precipitation Frequency Depth Estimates for a 24-hr Storm

The temporal distribution of rainfall for a storm even can have an impact on the flooding response. A storm with a steady rain throughout the storm will result in a different flooding response than a storm where the majority of the rainfall is concentrated into a small portion of the overall length of the storm. Figure 2-12 shows a temporal distribution for a second quartile 24-hour duration storm. This figure is adopted from Atlas 14 Volume 2.

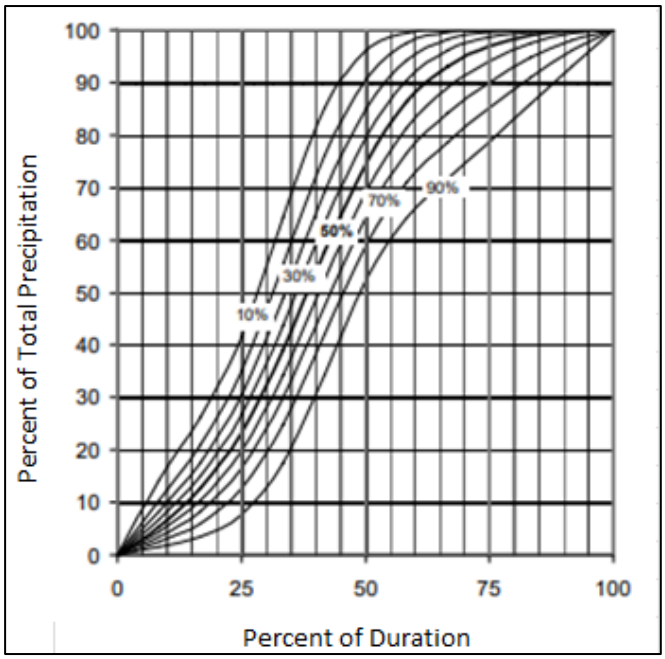


Figure 2-12: Temporal Distribution for a 2nd Quartile 24-hr Storm

The National Weather Service (NWS) operates a network of rainfall gages across North Carolina, the majority of which are part of the Cooperative Observer Program (COOP) network. COOP network gages in North Carolina have some of the longest periods of rainfall records in the State, including several with records in excess of 100 years. The State Climate Office of North Carolina (SCO) compiles and archives records from more than 37,000 North Carolina weather sites, including those in the COOP network, in the North Carolina Climate Retrieval and Observations Network of the Southeast (CRONOS) Database. The SCO compiled monthly rainfall records from twelve long term rainfall gages in and adjacent to the Cape Fear Basin that could be used for this study. The gage name, identifying number, period of record, and other characteristics for these twelve rainfall gages are shown in Table 2-10. The locations of these twelve rainfall gages in relation to the Cape Fear Basin are shown in Figure 2-13.

Rainfall Gage Location and Number	River Basin	County	Period of Record	Latitude	Longitude	Elevation
Wilmington Intl Airport (319457)	Cape Fear	New Hanover	1933 - 2021	34.2675	-77.8997	33
Fayetteville PWC (313017)	Cape Fear	Cumberland	1871 - 2021	35.0583	-78.8583	96
Dunn 4 NW (312500)	Cape Fear	Harnett	1962 - 2021	35.3247	-78.6881	200
High Point (314063)	Cape Fear	Guilford	1921 - 2021	35.9672	-79.9722	900
Greensboro WTP (313625)	Cape Fear	Guilford	1948 - 2021	36.0811	-79.8047	765
Graham 2 ENE (313555)	Cape Fear	Alamance	1902 - 2021	36.0503	-79.3728	660
Chapel Hill 2 W (311677)	Cape Fear	Orange	1900 - 2021	35.9086	-79.0794	500
Asheboro 2 W (310286)	Cape Fear	Randolph	1926 - 2021	35.7044	-79.8378	870
Raleigh State Univ (317079)	Cape Fear	Wake	1900 - 2021	35.7944	-78.6989	400
Carthage WTP (311515)	Cape Fear	Moore	1948 - 2021	35.3319	-79.4067	440
Randleman (317097)	Cape Fear	Randolph	1905 - 2021	35.8222	-79.7917	810
Greensboro Ap (313630)	Cape Fear	Guilford	1903 - 2021	36.0833	-79.9500	890

Table 2-9: Long Term Rain Gages in the vicinity of the Cape Fear Basin Study Area

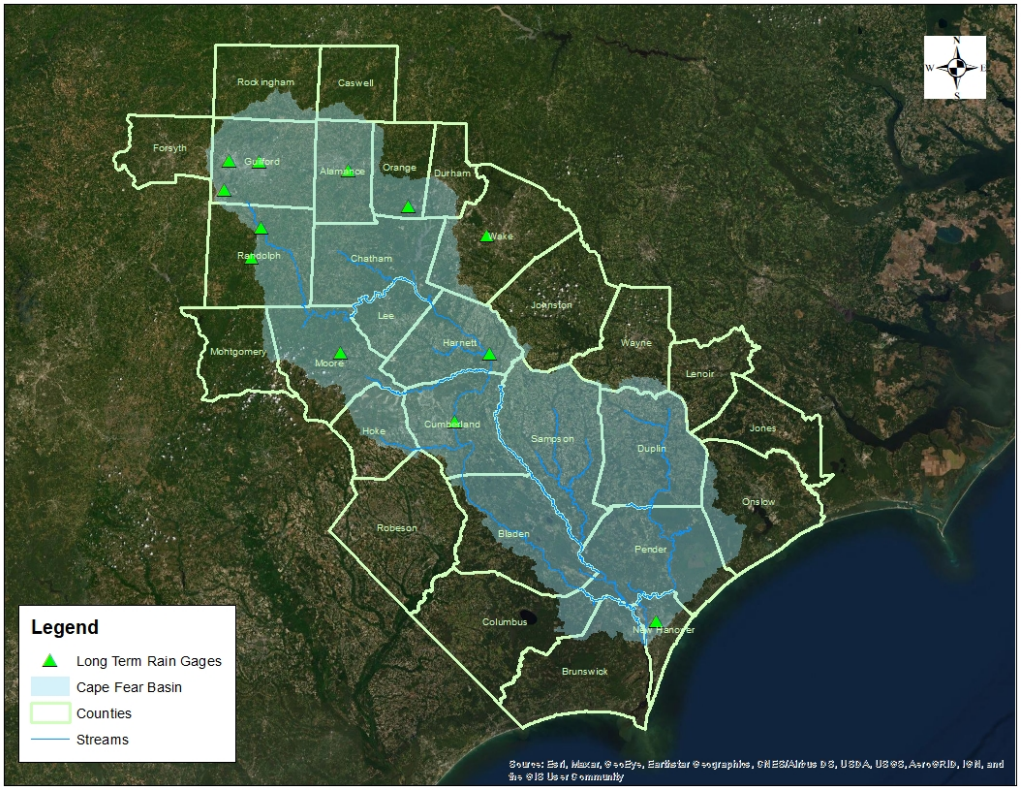


Figure 2-13: Location of Long Term Rain Gages around the Cape Fear Basin Study Area

Stream Gages – The USGS currently maintains 49 active stream gages in the Cape Fear Basin study area. Of these, 8 collect and record long term peak flow measurements. Figure 2-14 provides the location of active gages considered in the study.

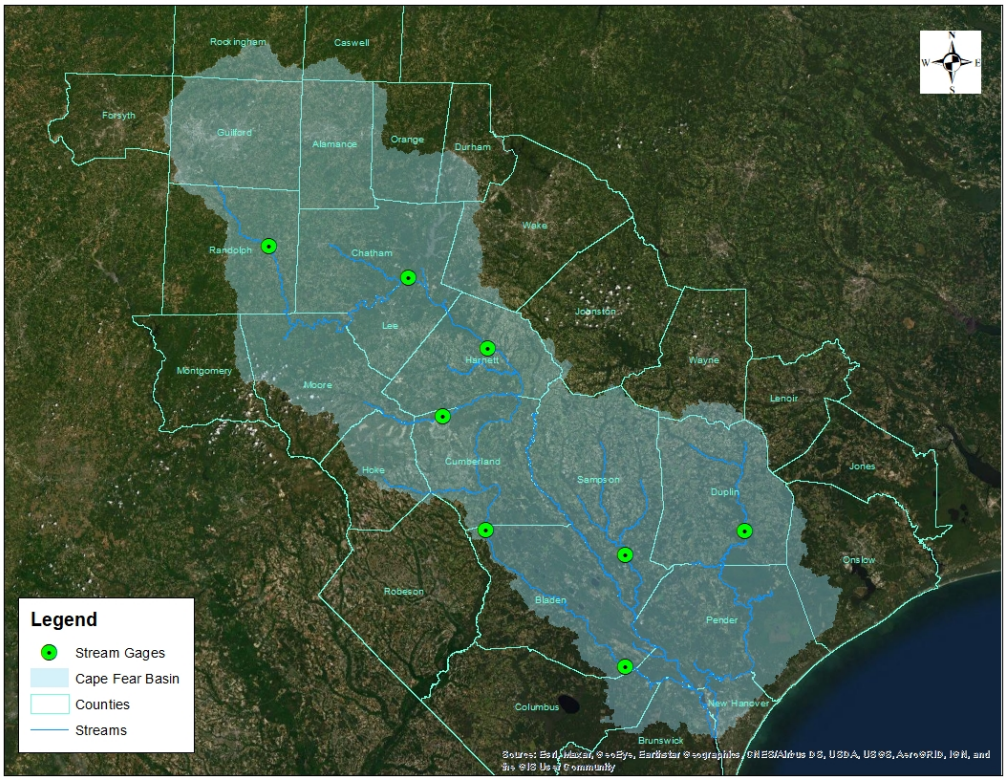


Figure 2-14: Location of Active USGS Gages with Peak Flow records for Cape Fear Basin

Major floods along the Cape Fear River occur most often in association with hurricanes or tropical storms. Available peak flow records within the study area go back as far as 1928. Table 2-10 shows the floods of record for the Cape Fear River in order of magnitude at several active gaging stations throughout the Cape Fear Basin. As seen in the table, the Homestead Hurricane in September of 1945 serves as the flood of record for most gages dating back that far. For gages with more recent periods of record, Hurricane Florence is the flood of record.

Location and USGS Gage Station	Known Magnitude	Date	Contributing Area (sq. mi.)	Peak Stage (ft.)	Peak Discharge (cfs)	Years of Record
DEEP RIVER AT RAMSEUR, NC (02100500)	1	18-Sep-1945	349	34.04	43,000	1901-2020
	2	15-Oct-1954		30.47	34,000	
	3	30-Sep-1944		29.22	30,900	
	4	17-Sep-2018		30.43	27,800	
	5	6-Sep-1996		26.51	23,500	
DEEP RIVER AT MONCURE, NC (02102000)	1	18-Sep-1945	1434	17.2	80,300	1931-2020
	2	17-Sep-2018		15.21	64,500	
	3	6-Sep-1996		12.94	47,900	
CAPE FEAR RIVER AT LILLINGTON, NC (02102500)	1	19-Sep-1945	3464	33.19	150,000	1924-2020
	2	2-Oct-1929		27.55	107,000	
	3	20-Sep-1928		24.8	84,000	
	4	18-Sep-2018		21.1	62,600	
	5	9-Oct-2016		19.41	53,400	
LITTLE RIVER AT MANCHESTER, NC (02103000)	1	18-Sep-2018	348	38.305	17,400	1939-2020
	2	10-Oct-2016		32.19	10,500	
CAPE FEAR R AT WILM O HUSKE LOCK NR TARHEEL, NC (02105500)	1	19-Sep-2018	4852		87,400	1938-2020
	2	10-Oct-2016		35.902	81,000	
	3	7-Oct-1964		29.85	53,800	
BLACK RIVER NEAR TOMAHAWK, NC (02106500)	1	18-Sep-2018	676	31.345	54,800	1952-2020
	2	10-Oct-2016		27.92	39,100	
	3	18-Sep-1999		27.14	28,500	
NORTHEAST CAPE FEAR RIVER NEAR CHINQUAPIN, NC (02108000)	1	17-Sep-2018	599	25.77	41,300	1908-2020
	2	18-Sep-1999		23.51	30,700	
	3	6-Jul-1962		20.16	20,400	
	4	11-Oct-2016		19.98	18,200	
CAPE FEAR R AT LOCK #1 NR KELLY, NC (02105769)	1	21-Sep-2018	5255	30.68	76,700	1970-2020
	2	13-Oct-2016		28.62	66,600	

Table 2-10: Floods of Record in the Cape Fear River Basin from available USGS Gage Data

Trend Analysis

Population and Land Use Trends – As noted in the discussion of demographics and in Table 2-3, the Cape Fear Basin has seen significant intermediate and short term population growth in cities. To analyze population

growth across the entire Cape Fear Basin study area (including unincorporated areas), a spatial representation of population growth from 1990 to 2020 was developed, which can be seen below in Figure 2-15.

As shown in the figure, significant (>25%) population growth has been experienced in the majority of the basin with the greatest increases in areas around Fayetteville and near the coast.

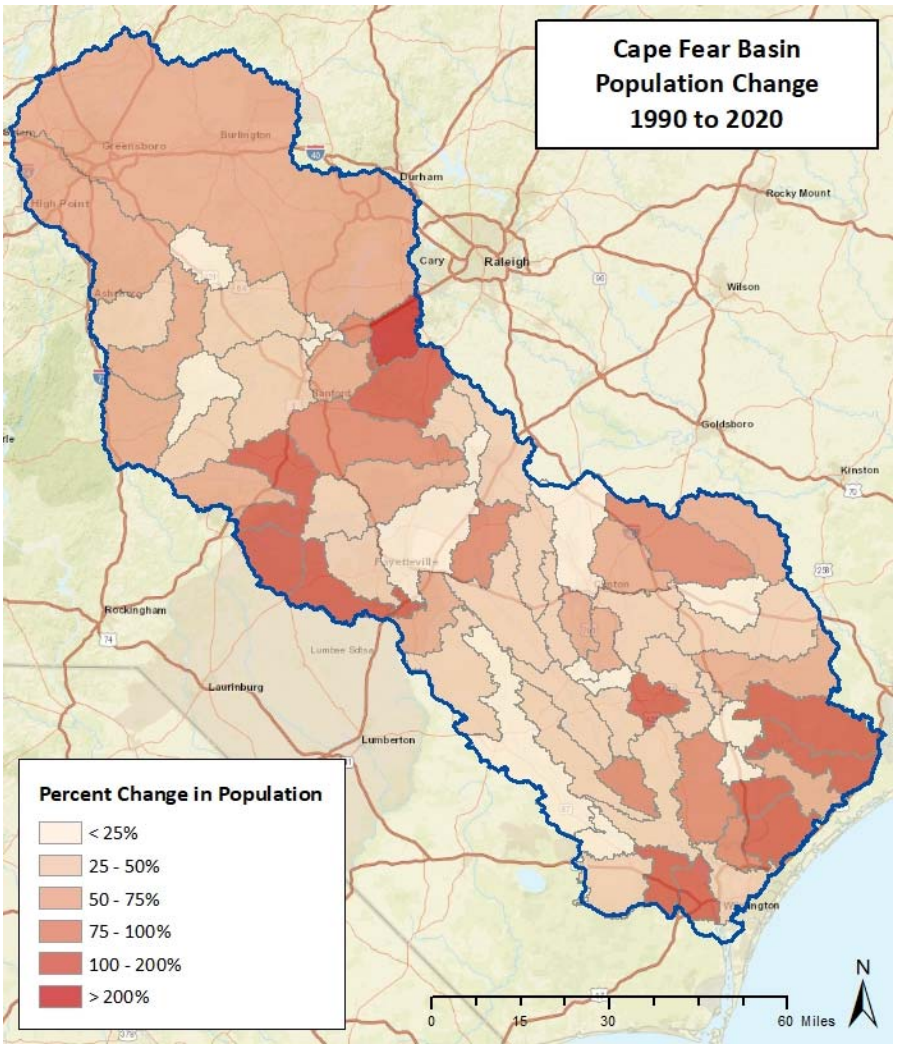


Figure 2-15: Percent Change in Population (1990-2020)

A similar pattern of growth can be seen in land use across the basin. Figure 2-16 shows new developed area as the increase in percent developed area as defined by the NLCD dataset. Similar to population growth, the figure depicts increases in developed land throughout the entire basin with the greatest increases seen on the outskirts of existing areas of high urbanization.

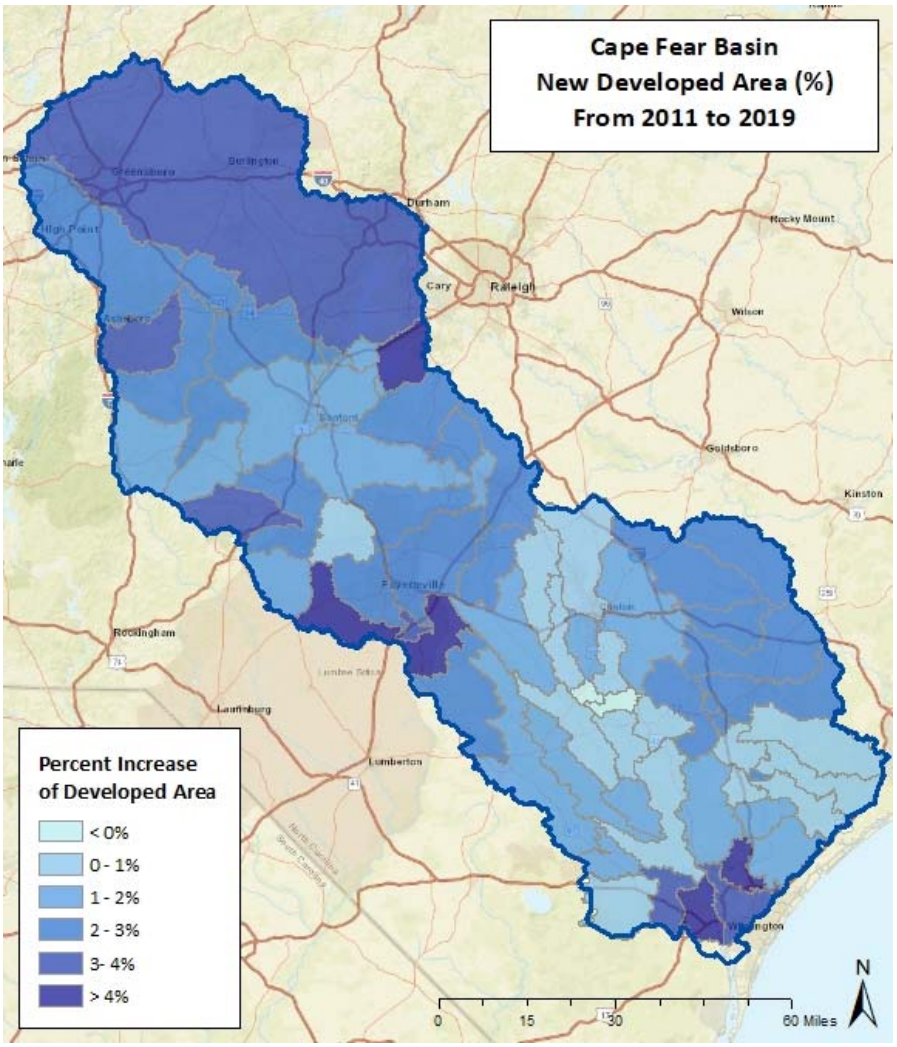


Figure 2-16: Change in Developed Land in the Cape Fear River Basin (2011 – 2019)

Hydrologic Trend Analysis – Given the increases in population and development within the Cape Fear Basin, along with the occurrence of extreme flood events such as Hurricanes Fran, Floyd, Matthew, and Florence, it is reasonable to review the hydrology of the Cape Fear River Basin to determine if there is a potential increasing trend in flooding. Flooding is the result of extreme stream discharge resulting from extreme rainfall events. The relation between stream discharge and rainfall is dependent on the conditions of the basin, including land use and land cover as well as the antecedent moisture conditions in the basin, which can vary with time. Also, it needs to be noted that regulating structure such as dams, detention structures and diversion weirs are likely to interrupt the rainfall runoff relationship due to routing impacts in reservoirs. Stream discharge and rainfall are natural processes and as such have large variations in magnitude from year to year. The large variance in the discharge and rainfall data can make trends in the observed records difficult to detect data. In order to review the data for trends, statistical methods can be used to account for the natural variation in the data.

Several statistical methods are typically used to detect trends in time series data. One of the common methods used to test for trends in time series data is the Mann-Kendall test. The Mann-Kendall test uses Kendall's tau (τ) as the test statistic to detect and measure the strength of any increasing or decreasing relation between observed hydrologic data and time. The Mann-Kendall test is the recommended test for trends in annual peak flow data in "Guidelines for Determining Flood Flow Frequency – Bulletin 17C", developed by the Advisory

Committee on Water Information (USGS, 2018) as the guidelines for use by Federal agencies in performing flood-flow frequency analyses to determine annual chance of exceedance of peak discharges for use in flood risk management and flood damage abatement programs. Trend testing is a key step prior to performing flood-flow frequency analyses in order to ensure that the peak flow data used in the analyses does not exhibit time-dependent trends that would violate the assumptions of stationarity and homogeneity that are required for the flow frequency analytical methods.

An important characteristic of the Mann-Kendall test is that it is nonparametric, meaning the test does not require that the observed data fit any specific statistical distribution. The Kendall τ statistic is nonparametric because it is calculated using the ranked values of the observed data rather than the actual data values. Positive values for Kendall τ indicate that the observed data are increasing with time for the period of record while negative values of τ indicate that the observed data are decreasing with time for the period of record.

The statistical significance of the Mann-Kendall trend test, like other statistical tests, is represented by the p-value that is calculated for the test. The null hypothesis tested by the Mann-Kendall trend test is that there is no trend. The null hypothesis is accepted (or technically, not rejected), confirming the absence of trend, if the computed p-value is greater than selected significance level. A significance level of 0.05 or 5% is used for this investigation, such that for p-values greater than 0.05, the probability that that the null hypothesis of no trend detected in the data is equal to (1.00 - 0.05) or 95%. In addition to the statistical significance of a trend, the actual magnitude of the trend should be considered. The Theil-Sen slope (Helsel and Hirsch, 1992) was calculated in conjunction with Kendall's τ for this investigation to quantify the magnitude of change in the data over the period of record.

Rainfall Trend Analysis – As noted above there are twelve rainfall gages with long term record available in or adjacent to the Cape Fear Basin. Monthly rainfall data from these gages was obtained from the NC SCO, and annual rainfall totals for the period of record were compiled. In several cases, there were one or more missing months for a given year in the rainfall record. The annual totals for these incomplete years were not included in the analyses.

The annual rainfall totals for each rainfall gage were plotted versus time and the linear regression of rainfall depth to time was computed using ordinary least squares regression. In addition, the Mann-Kendall trend test was performed for the annual rainfall totals for each rainfall gage and the Theil-Sen slope was computed as a measure of the magnitude of trend. Statistically significant trends are detected at four gages, the null hypothesis of no trend was accepted (not rejected) at remaining eight rainfall gages. The Mann-Kendall and linear regression slope lines of four gages that show significant trends are shown in Figure 2-17 to Figure 2-10. Additional plots for the trend analysis at the remaining gages can be found in Appendix B - Rainfall and Discharge Trend Analysis.

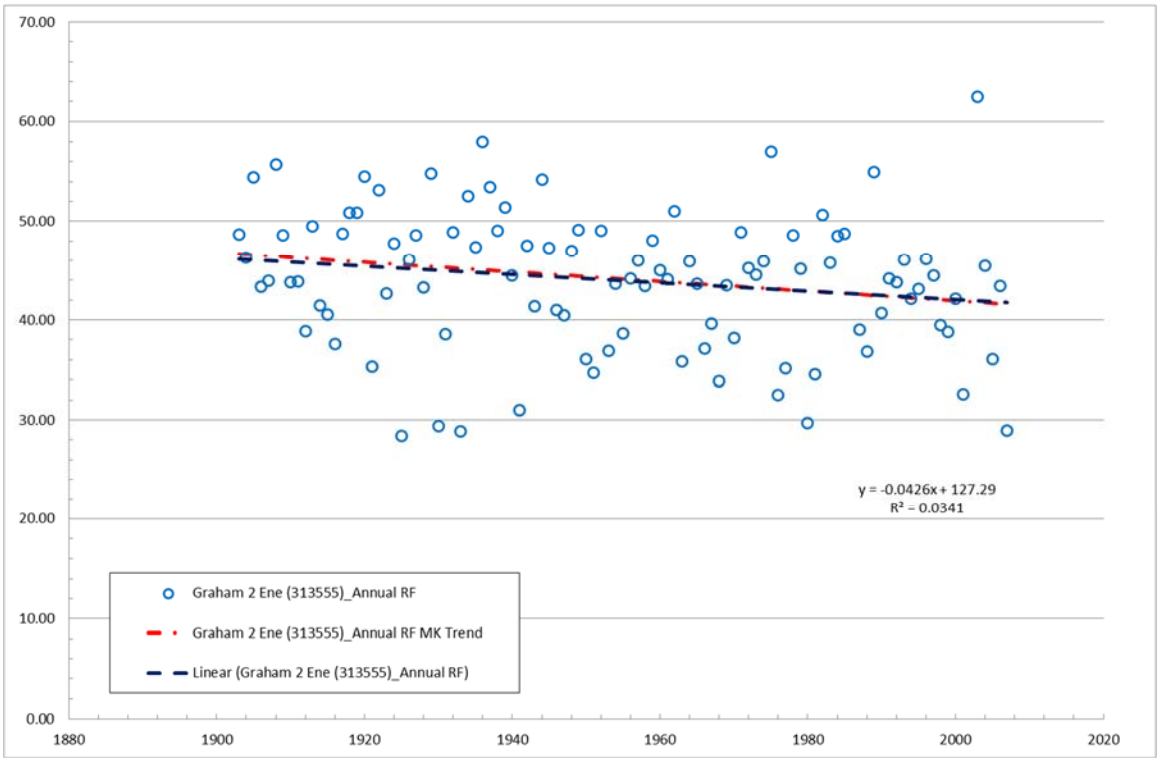


Figure 2-17: Rainfall Trend Analysis for Graham 2 Ene, NC (313555)

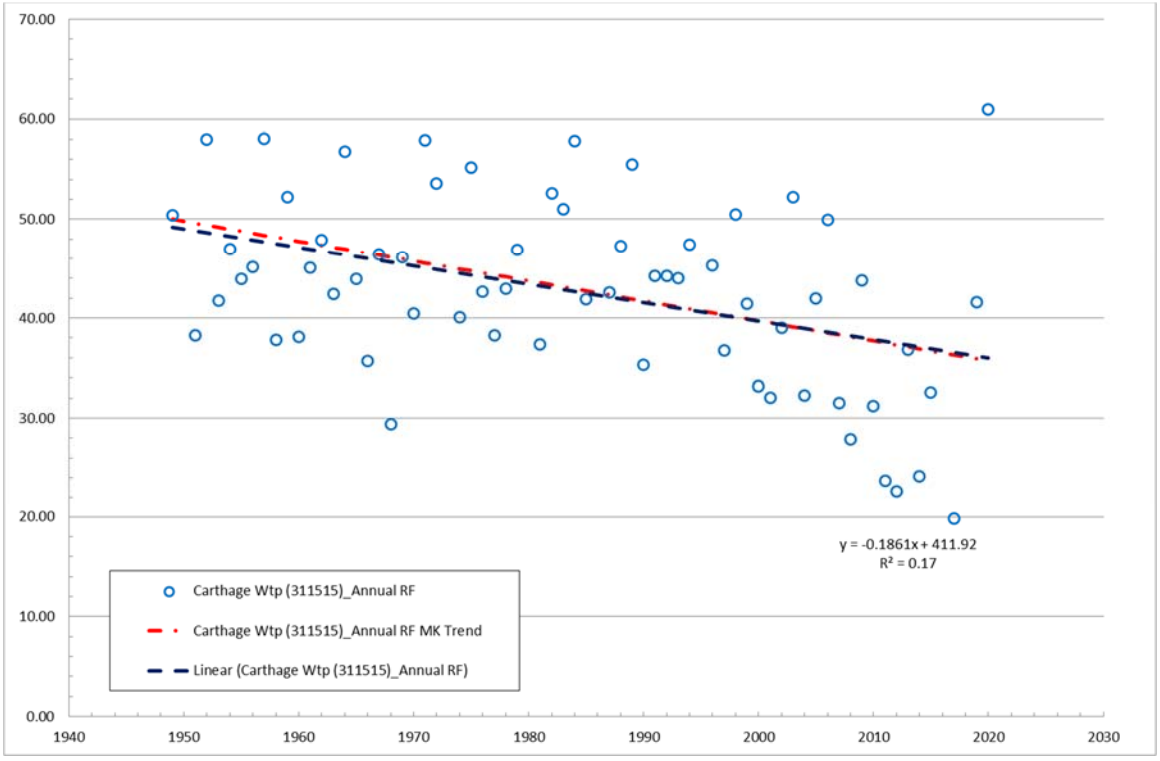


Figure 2-18: Rainfall Trend Analysis for Carthage WTP, NC (311515)

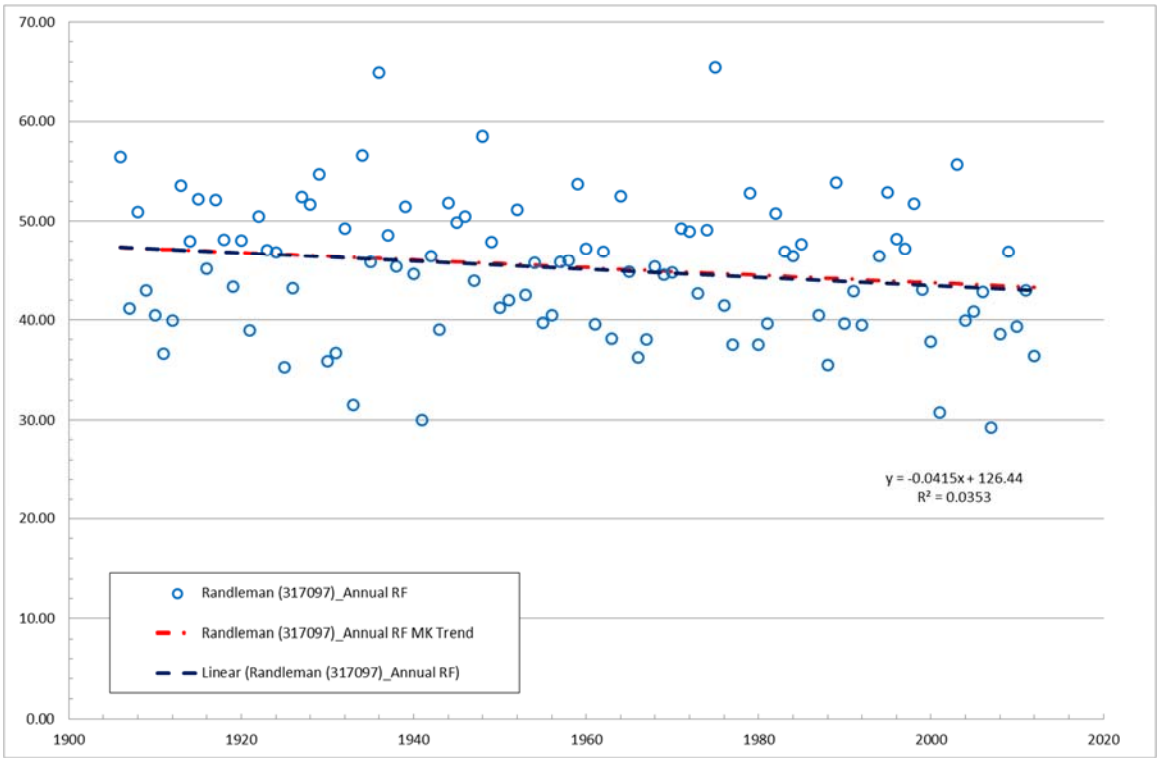


Figure 2-19: Rainfall Trend Analysis for Randleman, NC (317097)

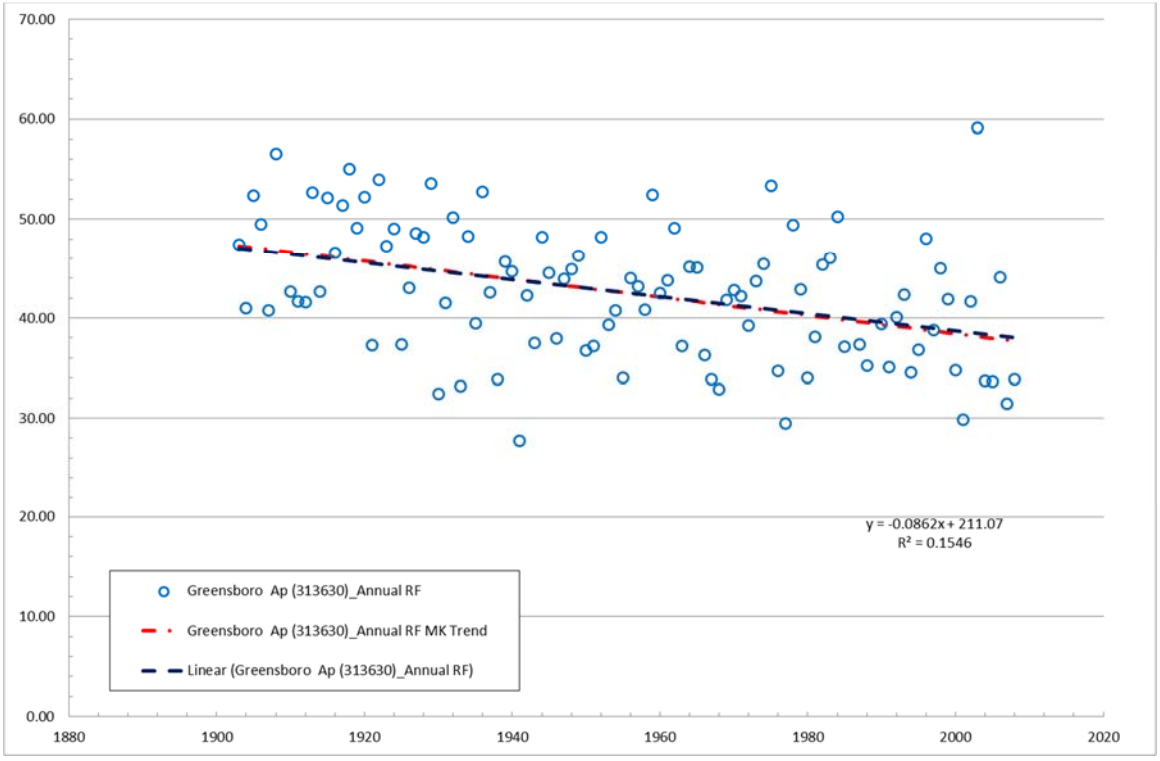


Figure 2-20: Rainfall Trend Analysis for Greensboro Ap, NC (313630)

Results of the rainfall trend analysis for all analyzed gages in the Cape Fear Basin study area are in Table 2-11.

Site	Period of Record	Kendall TAU	P-VALUE (Significance Test)	SLOPE (inches/year)	Years of Record	Statistically Significant Trend?	Comment
Wilmington Intl Ap (319457)	1933 - 2021	-0.004	0.959	-0.003	87	No	
Fayetteville Pwc (313017)	1871 - 2021	-0.032	0.630	-0.007	116	No	
Dunn 4 Nw (312500)	1962 - 2021	0.107	0.263	0.088	53	No	
High Point (314063)	1921 - 2021	0.042	0.550	0.016	96	No	
Greensboro Wtp (313625)	1948 - 2021	0.024	0.808	0.013	50	No	
Graham 2 Ene (313555)	1902 - 2021	-0.147	0.028	-0.049	116	Yes	slight downward trend with an avarage decrease of 0.049 inches per
Chapel Hill 2 W (311677)	1900 - 2021	0.006	0.930	0.002	105	No	
Asheboro 2 W (310286)	1926 - 2021	-0.054	0.457	-0.022	89	No	
Raleigh State Univ (317079)	1900 - 2021	0.102	0.126	0.022	118	No	
Carthage Wtp (311515)	1948 - 2021	-0.283	0.001	-0.201	65	Yes	downward trend with an avarage decrease of 0.201 inches per year
Randleman (317097)	1905 - 2021	-0.134	0.045	-0.038	111	Yes	slight downward trend with an avarage decrease of 0.038 inches per year
Greensboro Ap (313630)	1903 - 2021	-0.270	0.000	-0.092	115	Yes	slight downward trend with an avarage decrease of 0.092 inches per year

Table 2-11: Rainfall Trend Analysis Results

Stream Discharge Trend Analysis - There are 49 active USGS stream gages in the Cape Fear Basin, eight of which are included in the trend analysis. The gages are selected in order to reflect the longest period of time for annual peak discharge records and to reflect distributed spatial coverage. The available records used in the analysis date back to at least 1970. The annual peak discharge record for the eight stream gages were obtained from the USGS, and the annual peak discharges for each stream gage were plotted versus time. The linear regression of peak discharge to time was computed using ordinary least squares regression. In addition, the Mann-Kendall trend test was performed for the annual peak discharges for each stream gage and the Theil-Sen slope was computed as a measure of the magnitude of trend. The null hypothesis of no trend was accepted (not rejected) at six of the eight gages analyzed (Table 2-12).

USGS Gage Number	Streamgage name	No. of Peak Records	Kendall's Tau	p-value	Median Slope (cfs/year)	Statistically significant trend?	Comment
02100500	DEEP RIVER AT RAMSEUR, NC	98	-0.11	0.12	-27.57	No	
02102000	DEEP RIVER AT MONCURE, NC	90	0.09	0.22	46.67	No	
02102500	CAPE FEAR RIVER AT LILLINGTON, NC	58	-0.15	0.10	-193.75	No	
02103000	LITTLE RIVER AT MANCHESTER, NC	29	0.22	0.09	82.74	No	
02105500	CAPE FEAR R AT WILM O HUSKE LOCK NR TARHEEL, NC	36	-0.12	0.30	-192.03	No	
02106500	BLACK RIVER NEAR TOMAHAWK, NC	69	0.17	0.04	36.36	Yes	slight upward trend with an avarage increase of 36.36 cfs per year
02108000	NORTHEAST CAPE FEAR RIVER NEAR CHINQUAPIN, NC	80	0.16	0.04	28.61	Yes	slight upward trend with an avarage increase of 28.61 cfs per year
02105769	CAPE FEAR R AT LOCK #1 NR KELLY, NC	11	-0.02	1.00	-220.00	No	

Table 2-12: Stream Discharge Trend Analysis Results

Additional data and plots for all the discharge trend analysis can be found in Appendix B - Rainfall and Discharge Trend Analysis.

It is important to note that Hurricane Florence being near the end of the record can skew results. However, Hurricane Florence was included to introduce conservatism to the analysis. As seen in Table 2-12 above, with Hurricane Florence included, the analysis indicated a slight upward trend. An additional analysis was performed excluding Florence as a high outlier. If Florence is excluded, both the Black River near Tomahawk and the Northeast Cape Fear River near Chinquapin would not have statistically significant trends.

Both gages that showed statistical significance are located in the south-east portion of the basin in adjacent sub-basins where the 'Cultivated Lands' are the largest land use type (36% - 38%). The second largest land use type is 'Evergreen Forest' and 'Woody Wetland'. This relation may indicate increased agricultural land by transforming forests which can lead to more runoff.

However, based on rainfall and peak discharge trend results, there is not sufficient data to indicate a clear trend of increased flooding throughout the basin, especially since the rainfall and discharge data indicate trends in different directions. It should be noted that there are major storages that provide flood routing and flatten the peak flows, therefore the direct rainfall runoff relation is interrupted in parts of the study area.

Hydrologic Profile

Characteristics of Major Streams - The Cape Fear Basin can be sub-divided into several key watersheds that are listed in Table 2-13 along with drainage area.

Watershed	Contributing Area (sq. mi.)
Haw River	1710
Deep River	1450
Upper Cape River	1630
Lower Cape River	1060
Black River	1570
Northeast Cape River	1740

Table 2-13: Key Streams Contributing to the Cape Fear River

Figure 2-21 below shows the primary watersheds contributing to the Cape Fear River graphically.

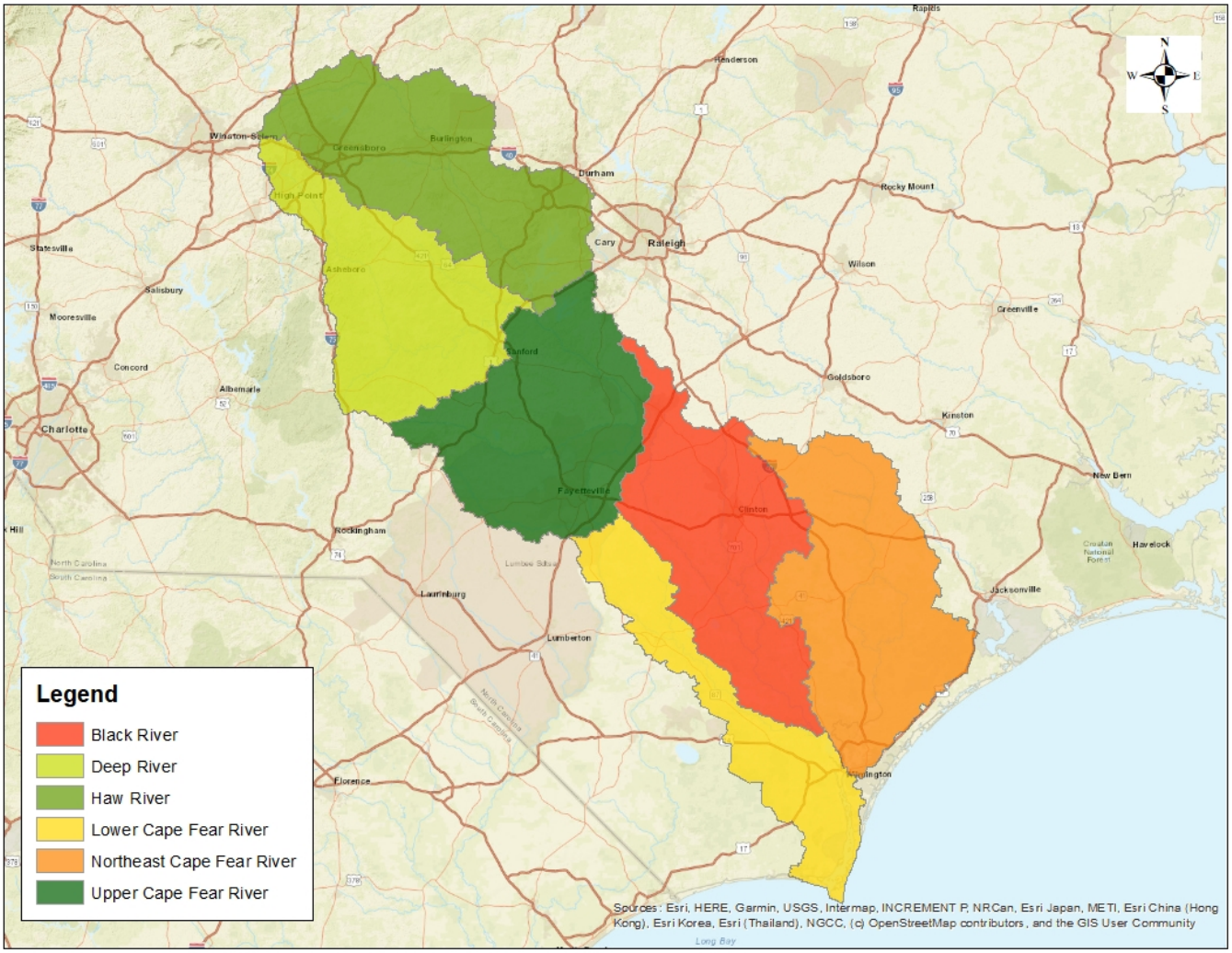


Figure 2-21: Watersheds Contributing to the Cape Fear River

As seen in Table 2-13 and Figure 2-21, the Cape Fear River Basin is fairly uniform and well distributed in terms of drainage area accumulation. The most downstream portion of the study area where the Black River and Northeast Cape Fear River confluence with the Cape Fear River mainstem in a fairly short reach presents the most dramatic change in accumulated drainage area.

Discharges as reported in the North Carolina Flood Database and available in the state's Flood Risk Information System (FRIS) are shown in Table 2-14 at selected points along the Cape Fear River and major tributaries.

Location	Drainage Area (sq.mi.)	Percent Annual Chance Discharges (cfs)			
		10%	2%	1%	0.20%
Big Alamance Creek					
Confluence with Haw River	261.80	15300	23800	27800	38700
Approximately 370 feet upstream of NC 87 (South Main Street)	243.00	14600	22700	26500	37000
Approximately 0.6 mile upstream of Rodgers Road (SR 2309)	158.00	11000	17200	20300	28500
Confluence of West Back Creek	129.50	*	*	17900	*
Confluence of Beaver Creek	116.90	*	*	16800	*
Big Swamp					
Approximately 4.4 miles downstream of Old Allentown Road	444.35	*	*	9749	*
At the confluence of Brier Creek	426.52	*	*	9478	*
At the confluence of Horsepen Branch	403.68	*	*	9126	*
At the confluence of Bryant Swamp	374.22	*	*	8662	*
Approximately 1,400 feet upstream of NC 211	339.27	*	*	8097	*
At the confluences of Jackson Swamp and Crawley Swamp	293.68	*	*	7332	*
At the confluence of Black Swamp	255.66	*	*	6665	*
At the confluence of Crooked Bay Branch	235.08	*	*	6291	*
At the confluence of Tenmile Swamp	156.72	*	*	4760	*
At the confluence with Big Marsh Swamp	87.73	*	*	3193	*
Black River					
Just upstream of confluence with Cape Fear River	1573.92	16313	25597	30131	40164
Approximately 10.7 miles downstream of NC Hwy 210	1544.60	*	*	29900	*
Approximately 3.6 miles downstream of NC Hwy 210	1439.36	*	*	28700	*
At confluence with Moores Creek (near Atkinson)	1417.66	15294	24040	28316	37789
Approximately 0.6 mile upstream of NC Hwy 210	1301.11	*	*	27100	*
Approximately 3.7 miles downstream of Beattys Bridge Road	1277.40	15300	23100	26800	36500
Approximately 10 feet upstream of confluence of Wildcat Creek	706.70	*	*	22000	*
Approximately 545 feet upstream of Harrells Highway	661.94	9855	16801	20355	29616

Location	Drainage Area (sq.mi.)	Percent Annual Chance Discharges (cfs)			
		10%	2%	1%	0.20%
Cape Fear River					
Approximately 9.8 miles downstream of Pender/Brunswick/New Hanover county boundaries	7065.03	71590	107550	130280	193740
At confluence with Black River	5465.78	66920	104540	124150	177920
Approximately 2.5 miles upstream of Pender/Brunswick/ Columbus county boundaries	5407.97	66730	104420	123910	177290
Approximately 1.8 miles downstream of Pender/Bladen/Columbus county boundaries	5298.65	66370	104180	123430	176100
Approximately 0.3 mile downstream of US 701	5271.60	*	*	123000	*
At the Bladen/Columbus County boundary	5022.30	*	*	121000	*
Below Rockfish Creek	4727.00	57000	88000	103000	150000
Below (Lower) Little River	4231.00	57000	88000	103000	150000
At the Harnett/Lee County boundary	3374.00	*	*	79004	*
Approximately 430 feet upstream of confluence of Buckhorn Creek	3355.00	*	*	78803	*
At the Chatham/Harnett County boundary	3324.20	*	*	79004	*
Approximately 1,350 feet downstream of State Highway 42	3244.00	*	*	77673	*
Approximately 50 feet upstream of confluence of Lick Creek	3218.00	*	*	77399	*
Approximately 500 feet downstream of confluence of Lonnie Wombles Creek	3168.00	*	*	76880	*
Colly Creek					
At the Bladen/Pender County boundary	122.50	*	*	2773	*
Approximately 0.9 mile upstream of NC 53	102.90	*	*	2626	*
Approximately 0.4 mile downstream of Bivens Bridge Road	63.70	*	*	2372	*
Approximately 1.8 miles downstream of NC 41	47.90	*	*	2146	*
Approximately 1.1 miles upstream of NC 41	25.90	*	*	1639	*
Approximately 1.4 miles downstream of US 701	14.50	*	*	1226	*
Crane Creek					
Confluence with Little River	100.9	3,915	6,159	7,164	10,386
McLaughlin Road	81.1	*	*	5,630	*
Approximately 1.2 miles upstream of McLaughlin Road	63.3	*	*	4,900	*
Approximately 1,100 feet downstream of US Highway 1	33.0	*	*	3,850	*
Deep River					

Location	Drainage Area (sq.mi.)	Percent Annual Chance Discharges (cfs)			
		10%	2%	1%	0.20%
At the confluence with Cape Fear River	1451.80	*	*	54900	*
At the confluence with Cape Fear River	1385.40	*	*	54900	*
Approximately 950 feet upstream of confluence of Rocky River	1191.60	*	*	53200	*
At the confluence of Big Buffalo Creek	1085.00	*	*	52700	*
Approximately 0.7 mile upstream of Carbonton Road	879.6	*	*	49,000	*
At the confluence of Fork Creek	577.20	*	*	39628	*
At the confluence of Mill Creek (into Deep River)	368.80	*	*	35120	*
Approximately 1,220 feet upstream of West Main Street	269.40	15600	23300	27000	36600
Approximately 1,360 feet upstream of Worthville Road	179.00	*	*	19900	*
Just upstream of confluence of Richland Creek (Stream No. 30)	79.70	7000	12500	16000	28000
At High Point Lake Dam	61.40	5800	10700	13800	24000
Drowning Creek					
Just downstream of confluence of Aberdeen Creek	221.33	*	*	8,228	*
Just upstream of confluence of Aberdeen Creek	184.38	*	*	8,057	*
Just upstream of confluence of Horse Creek	137.78	*	*	6,488	*
Just upstream of confluence of Naked Creek	83.33	*	*	4,528	*
Just upstream of confluence of Jackson Creek	37.08	*	*	2,684	*
Just upstream of confluence of Drowning Creek Tributary 2	11.14	*	*	1,173	*
Goshen Swamp					
Just upstream of the confluence with Northeast Cape Fear River	185.58	*	*	9000	*
Just upstream of the confluence of Herring Marsh Run	161.19	*	*	8310	*
Just upstream of the confluence of Nahunga Creek	125.52	*	*	7210	*
Approximately 2.9 miles upstream of the confluence of Nahunga Creek	111.19	*	*	6730	*
Just upstream of the confluence of Bear Swamp	79.42	*	*	5570	*
Just upstream of the confluence of White Oak Branch	62.47	*	*	4860	*
Just upstream of the confluence of Youngs Swamp	21.39	*	*	2650	*
Great Coharie Creek					
At confluence with Black River/ Six Runs Creek	378.79	6774	10890	12929	17507
Approximately 10 feet upstream of confluence of Little Coharie Creek	206.70	*	*	9494	*

Location	Drainage Area (sq.mi.)	Percent Annual Chance Discharges (cfs)			
		10%	2%	1%	0.20%
Approximately 1.3 miles downstream of Roseboro Highway	162.01	4011	6542	7807	10670
Approximately 10 feet upstream of confluence of Merkle Swamp	80.30	*	*	5600	*
Approximately 10 feet upstream of confluence of Ward Swamp	56.60	*	*	4590	*
Approximately 10 feet upstream of confluence of Beaverdam Swamp 3	15.20	*	*	2180	*
Haw River					
Immediately downstream of Jordan Lake Dam	1707.46	16400	17400	18000	20300
Approximately 1.9 miles downstream of US Highway 64	1299.91	43800	63000	71100	91400
Immediately downstream of US Highway 15-501	1272.11	43700	62800	70800	91100
Immediately upstream of confluence of Dry Creek	1229.05	42000	60500	68300	87900
Immediately upstream of confluence of Terrells Creek	1210.84	41300	59600	67200	86500
Approximately 1.8 miles upstream of Chicken Bridge Road	1156.12	39300	56700	64000	82400
Immediately downstream of E Greensboro-Chapel Hill Road	1080.00	36500	52900	59700	76800
Immediately downstream of confluence of Varnals Creek	987.10	33200	48300	54500	70100
Immediately downstream of Swepsonville-Saxapahaw Road	693.40	23500	35100	40200	48100
Immediately downstream of Interstate 40/85	605.48	22000	32900	38000	44200
At confluence of Servis Creek	583.99	21400	32100	37000	43300
Approximately 2,400 feet upstream of NC Highway 62	477.43	18500	27800	31900	38700
Immediately downstream of Gerringer Mill Road	450.38	17800	26700	30600	37500
Approximately 300 feet upstream of NC Highway 87	187.46	10100	15300	17400	22700
At Church Street	48.50	2500	5200	7000	13400
Just Upstream of confluence of Mears Fork Creek	34.80	2200	4600	6100	11500
At the confluence with B. Everett Jordan Lake	8.40	*	*	2813	*
Holly Shelter Creek					
The confluence with Northeast Cape Fear River	270.27	*	*	12000	*
Approximately 3.1 miles upstream of Shaw Highway	249.25	*	*	11500	*
Approximately 6.5 miles downstream of Old Maple Hill Road	176.74	*	*	9420	*
Approximately 0.4 mile downstream of Old Maple Hill Road	101.27	*	*	6850	*

Location	Drainage Area (sq.mi.)	Percent Annual Chance Discharges (cfs)			
		10%	2%	1%	0.20%
Approximately 2.1 miles upstream of Old Maple Hill Road	22.51	*	*	2900	*
Approximately 0.6 mile downstream of Maple Hill School Road	4.79	*	*	1200	*
Juniper Branch					
Approximately 1.9 miles downstream of Juniper Creek Road	173.00	*	*	8340	*
Just downstream of Little Swamp	148.00	*	*	7620	*
Just upstream of Little Swamp	130.00	*	*	7060	*
Just upstream of Alligator Swamp	111.00	*	*	6460	*
Just downstream of Leonard Branch	75.60	*	*	5190	*
Just downstream of First Cross Swamp	67.60	*	*	4870	*
Little Coharie Creek					
Approximately 65 feet upstream of confluence with Great Coharie Creek	158.76	3961	6463	7713	10545
Approximately 10 feet upstream of confluence of Bearskin Swamp	99.40	*	*	4700	*
Approximately 30 feet upstream of confluence of Rice Swamp	78.20	*	*	4310	*
Just upstream of confluence with Mill Swamp	59.87	2170	3600	4322	5972
Approximately 940 feet upstream of High House Road	33.50	*	*	3100	*
Approximately 380 feet downstream of Sinclair Lake Road	12.80	*	*	1910	*
Little River					
Approximately 1,950 feet upstream of mouth	475.91	*	*	11900	*
Approximately 0.6 mile upstream of State Route 217/ Mill Road	457.38	*	*	11800	*
Approximately 330 feet upstream of McCormick Bridge Road	364.70	5130	7990	9370	13300
Approximately 0.3 mile upstream of North Bragg Boulevard	328.70	4610	7210	8450	12000
Moore/Cumberland County boundary	301.30	*	*	9390	*
Approximately 300 feet upstream of confluence of Crane Creek	159.7	2,500	4,000	4,690	6,750
Confluence of James Creek	111.6	*	*	3,670	*
Approximately 700 feet upstream of US 1	79.5	*	*	2,900	*
At Niagra Carthage Road	29.6	1,424	2,821	3,553	6,070
Approximately 700 feet upstream of NC State Highway 22	17.3	532	862	1,020	1,480
Long Creek					

Location	Drainage Area (sq.mi.)	Percent Annual Chance Discharges (cfs)			
		10%	2%	1%	0.20%
Approximately 3.5 miles upstream of the confluence with the Northeast Cape Fear River	134.29	3830	8050	10100	16300
Approximately 1.7 miles downstream of NC Hwy 210	83.90	2870	6150	7740	12500
Approximately 3.3 miles downstream of Malpass Corner Road	68.06	*	*	6870	*
Approximately 0.8 mile downstream of Horse Branch Road	35.31	*	*	4740	*
Downstream of confluence of Horse Branch Creek	21.30	1285	2440	3115	5205
Northeast Cape Fear River					
Approximately 0.3 mile downstream of NC Hwy 210	1381.98	16100	30500	37900	59700
Approximately 6.6 miles downstream of NC Hwy 210	1347.56	15800	30100	37400	58800
Approximately 9.1 miles downstream of NC Hwy 53	1304.66	15500	29500	36700	57800
Approximately 4.3 miles downstream of NC Hwy 53	1245.22	15100	28800	35700	56300
Approximately 2.2 miles upstream of Croomsbridge Road	955.10	*	*	30736	*
Just upstream of the confluence of Washington Creek	938.90	*	*	30440	*
At confluence with Oakie Branch	745.15	*	*	26599	*
Approximately 1.6 miles downstream of Deep Bottom Road	698.96	*	*	24175	*
Just upstream of the confluence of Limestone Creek	411.80	*	*	18453	*
Just upstream of the confluence of Grove Creek	349.01	*	*	17124	*
Just upstream of the confluence of Goshen Swamp	143.07	*	*	7767	*
Just upstream of Matthews Creek	103.11	*	*	6453	*
Just upstream of the confluence of Mire Branch	61.11	*	*	4829	*
At confluence of Polly Run Creek	31.65	1510	2490	2980	4160
At confluence of Lewis Branch	14.36	901	1530	1850	2600
At confluence of Pasture Branch River	3.86	400	695	848	1210
Reedy Fork					
Immediately downstream of NC Highway 87	255.34	12100	18300	20900	27100
Just upstream of confluence of Buffalo Creek (Stream No. 65)	133.00	2700	5420	7600	15000
At U.S. Route 29	110.00	1880	4020	5650	11600
At U.S. Route 220	33.50	2850	5850	7750	14900
At State Route 68	11.50	1650	3600	4950	9700
At Ingram Road	3.10	900	1800	2350	4300
Rockfish Creek					
Confluence with Northeast Cape Fear River	180.70	4475	7945	9880	15615
Approximately 1.0 mile downstream of US 117	157.20	*	*	11000	*

Location	Drainage Area (sq.mi.)	Percent Annual Chance Discharges (cfs)			
		10%	2%	1%	0.20%
Approximately 1.5 miles upstream of the confluence of Sills Creek	128.86	*	*	9870	*
Just upstream of the confluence of Doctors Creek	72.06	*	*	7260	*
Just upstream of the confluence of Dufis Creek	44.66	*	*	5450	*
Approximately 470 feet downstream of the confluence of Big Beaverdam Branch	15.66	*	*	2990	*
Approximately 0.9 mile upstream of Blue Newkirk Road	1.34	*	*	740	*
Rocky River					
At the confluence with Deep River	243.30	*	*	23096	*
Approximately 1,740 feet upstream of Chatham Church Road	181.80	*	*	22520	*
Approximately 0.5 mile downstream of the confluence of Harlands Creek	156.20	*	*	18658	*
Approximately 1.0 mile downstream of the confluence of Tick Creek	104.00	*	*	15309	*
At the confluence of Mud Lick Creek	27.70	*	*	7211	*
At the confluence of Greenbriar Creek	14.80	*	*	5940	*
Approximately 260 feet downstream of Staley Snow Camp Road	6.90	*	*	2612	*
Six Runs Creek					
At mouth	273.00	*	*	11198	*
Approximately 10 feet upstream of confluence of Crane Creek	228.00	*	*	10112	*
Approximately 10 feet upstream of confluence of Turkey Creek	87.60	*	*	5883	*
Approximately 10 feet upstream of confluence of Tenmile Swamp	57.20	*	*	4621	*
Approximately 10 feet upstream of confluence of Hoe Swamp	15.00	*	*	2168	*
Approximately 0.7 mile upstream of North McCullen Road crossing	2.40	*	*	776	*
South River					
At mouth	488.20	*	*	9848	*
Approximately 2.3 miles downstream of Greens Bridge Road	386.19	4290	6643	7833	10755
Approximately 1.05 miles downstream of S Gray Street	249.08	3604	5789	6880	9387
Approximately 990 feet upstream of the confluence of Jones Swamp	179.90	*	*	6076	*

Location	Drainage Area (sq.mi.)	Percent Annual Chance Discharges (cfs)			
		10%	2%	1%	0.20%
Approximately 1.4 miles upstream of the confluence of South River Tributary 3	80.70	*	*	5414	*
Stony Creek					
At the confluence with Haw river	104.72	7020	10800	12300	16100
Immediately downstream of Union Ridge Road	63.11	5140	7940	9100	12000
Immediately downstream of Stony Creek Church Road	46.76	4270	6640	7620	10100
Approximately 2.4 miles upstream of Sartin Road (SR 1611)	24.50	*	*	5507	*

Table 2-14: Discharges at selected locations on the Cape Fear River and Major Tributaries

3. Flooding Profile

Historic Flooding Problems

Significant Events – The historic floods for the Cape Fear River Basin are listed in Table 2-10 of this report. Outside of Hurricane Florence, the three that are most familiar to the residents of the basin are the 1996, 1999, and 2016 floods that were a result of rainfall from Hurricanes Fran, Floyd, and Matthew respectively.

Hurricane Fran made its way through North Carolina on September 5-6, 1996. For the Cape Fear River basin, the heaviest rainfall occurred in the southwest portion of the basin where totals exceeded eight inches. Figure 3-1 provides a graphical representation of rainfall depths for Hurricane Fran that were developed by the North Carolina State Climate Office.

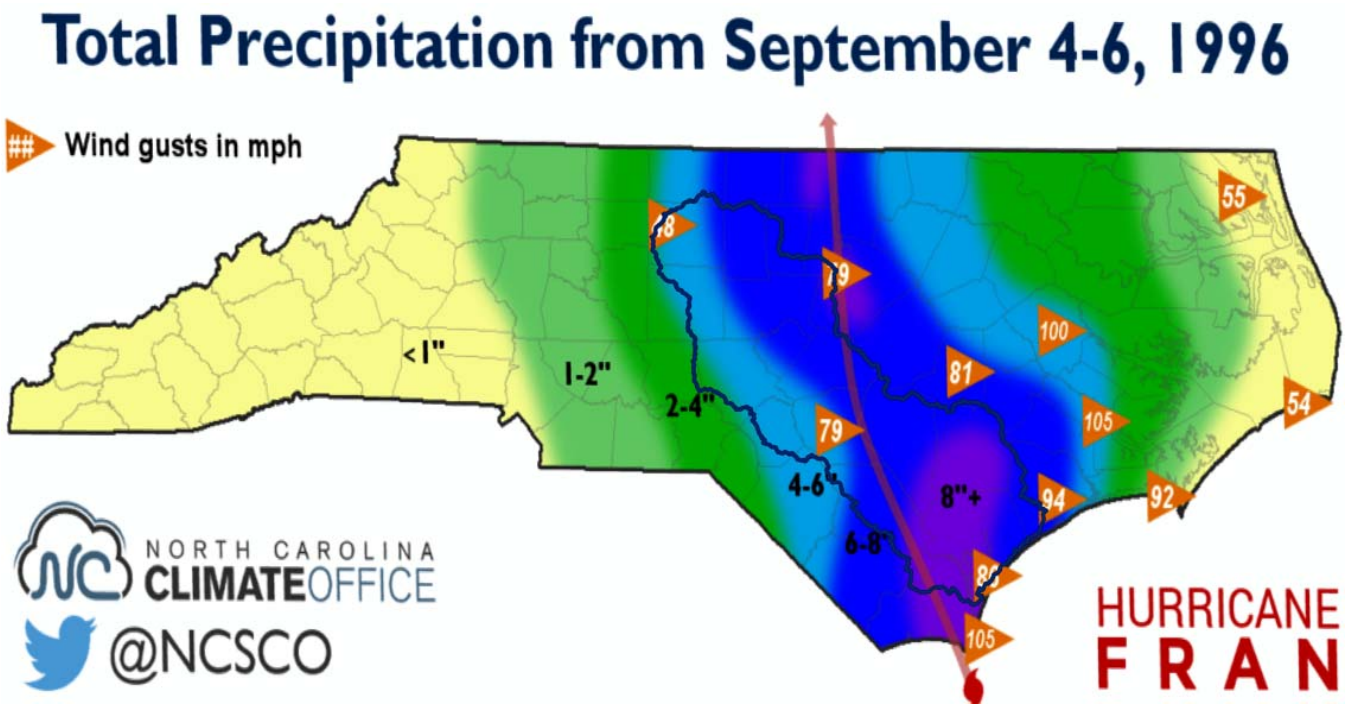


Figure 3-1: Estimated Rainfall over North Carolina during Hurricane Fran

Although the greatest rainfall from the event did not occur in the headwaters, peak flows from Fran rank in the top 5 events only for gages in the Deep River watershed. Having the greatest rainfall occur relatively low in the Cape Fear basin helped prevent a much worse riverine flooding event.

Damages from Hurricane Fran were estimated to be $2.4 billion statewide for homes and businesses. Additional damages related to public property and agricultural concerns totaled an estimated $1.8 billion. Additional details on flooding experienced during Hurricane Fran can be found in Appendix C: USGS Open-File Report 96-499.

Hurricane Floyd came onshore in North Carolina on September 16, 1999. The storm followed closely behind Hurricane Dennis, which made landfall in North Carolina less than two weeks earlier and dumped heavy rain across the eastern part of the state. Luckily for residents of the Cape Fear basin, the most intense rainfall from Dennis stayed east in the Neuse and Tar basins. Many areas in the Tar River basin received between 8 and 16 inches. This served to provide wet soil conditions which increased runoff from rainfall during Hurricane Floyd and resulted in higher flood elevations than would have otherwise occurred. Figures 3-2 and 3-3 developed by

the North Carolina State Climate Office show rainfall depths for Hurricane Dennis and Hurricane Floyd for eastern North Carolina.

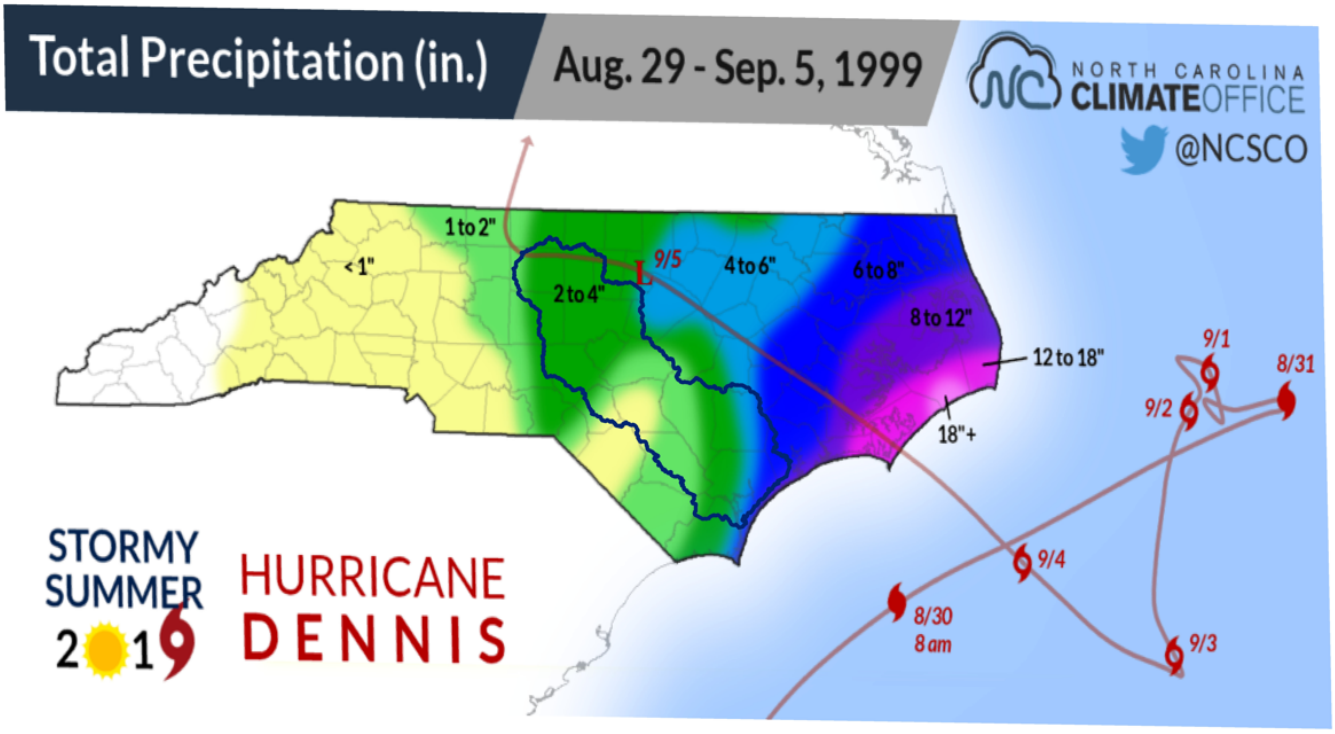


Figure 3-2: Estimated Rainfall Over NC During Hurricane Dennis

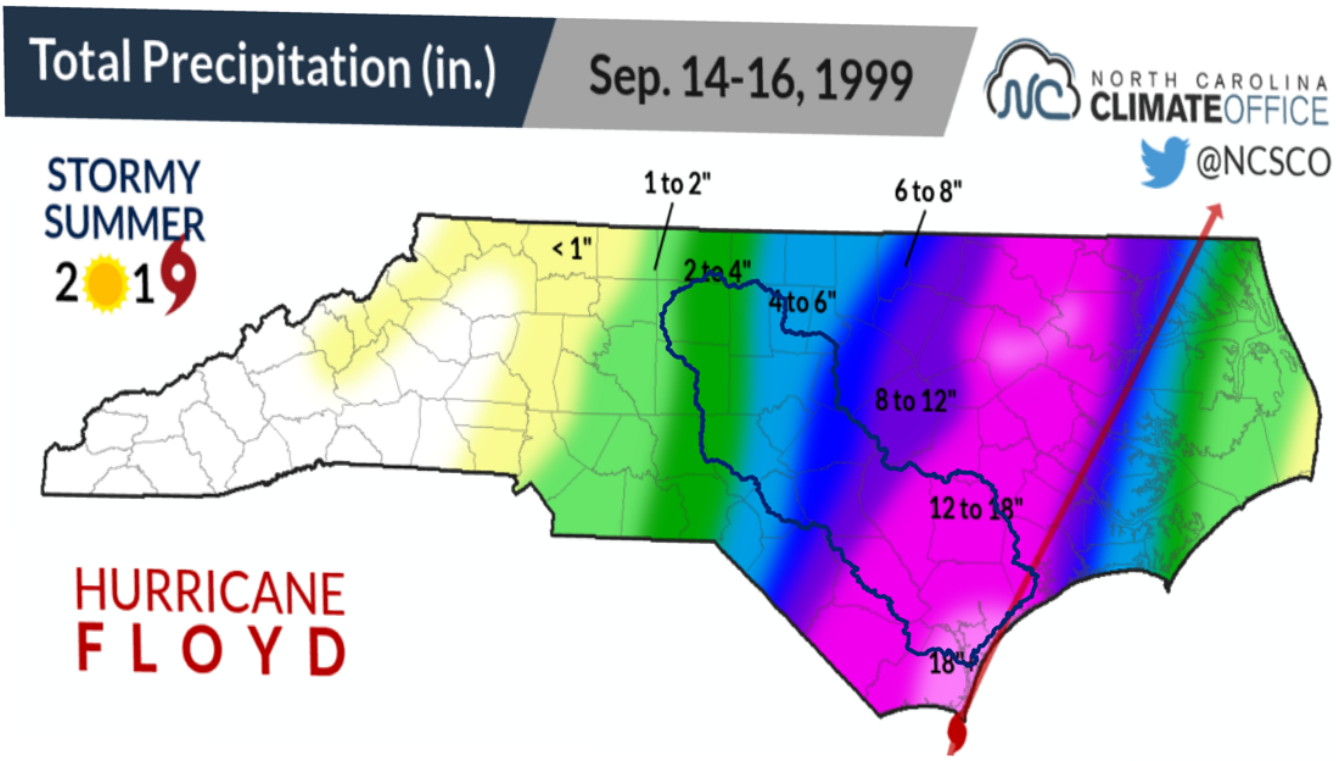


Figure 3-3: Estimated Rainfall Over NC During Hurricane Floyd

Unlike Hurricane Fran where the heaviest rainfall was centered near the bottom of the Cape Fear basin and along the boundary between the Cape Fear and Neuse basins, Floyd dropped the most rainfall in a band

spanning the Lumber, Cape Fear, Neuse, and Tar with the greatest amount falling near the coast in the Wilmington area where over 18 inches were recorded. The water levels were recorded as record values at that time for gages along Black River and Northeast Cape Fear River.

Damages to homes and businesses were estimated at $8.6 billion statewide, which makes it the second costliest hurricane on record for North Carolina. Additional information on Hurricane Floyd is provided in Appendix D: USGS Water-Resources Investigations Report 00-4093.

Similar to tropical systems Fran and Floyd, rainfall for Hurricane Matthew was extreme both in the widespread nature as well as the depth of precipitation it generated. Figure 3-4 shows the depth of rainfall for the study area.

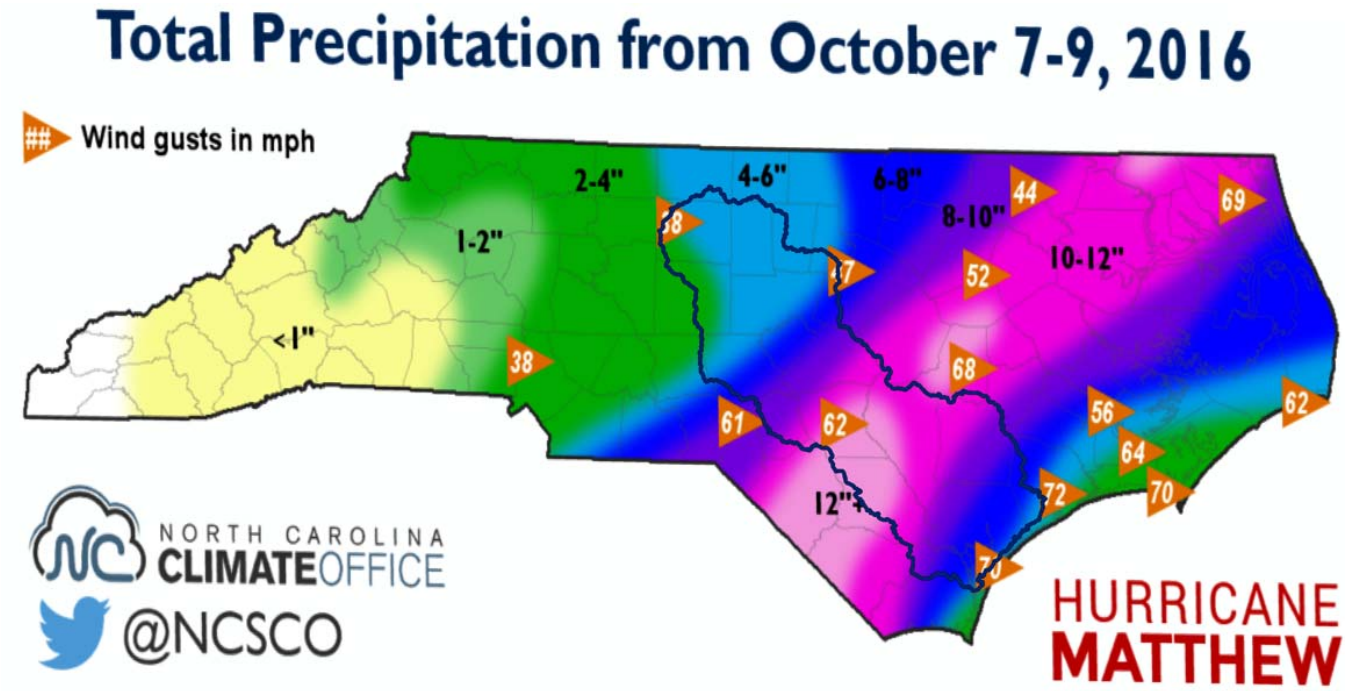


Figure 3-4: Estimated Rainfall over North Carolina during Hurricane Matthew

Rainfall depths recorded in the Cape Fear River basin exceeded 12 inches in the lower half of the basin in parts of Bladen and Cumberland counties.

Damages from Hurricane Matthew were estimated around $1.5 billion statewide with 28 fatalities reported. During the height of the flooding there were over 600 road closures reported in the state including portions of Interstates 40 and 95, and repairs were required for over 2,100 locations as a result of storm damage. The North Carolina Floodplain Mapping Program (NCFMP) reported approximately 99,000 structures were affected by floodwaters statewide. Additional information on Hurricane Matthew is provided in Appendix E: USGS Open File Report 2016-1205.

Hurricane Florence Flooding Event

Recurrence Interval – September 2018 brought with it Hurricane Florence and unprecedented rainfall across much of North Carolina. The lower portions of the Lumber, Cape Fear, and Neuse basins experienced more than 30 inches of rain in areas as the storm moved at a walking pace after making landfall due to surrounding high pressure systems. A CoCoRaHS observation station in Bladen County reported a preliminary total rainfall of 35.93 inches. More than any other prior event during the modern recording era, Hurricane Florence produced

heavy rainfall across nearly the entire Cape Fear River basin. As seen in Figure 3-5 below, nearly the entire basin experienced at least 6 inches of rainfall.

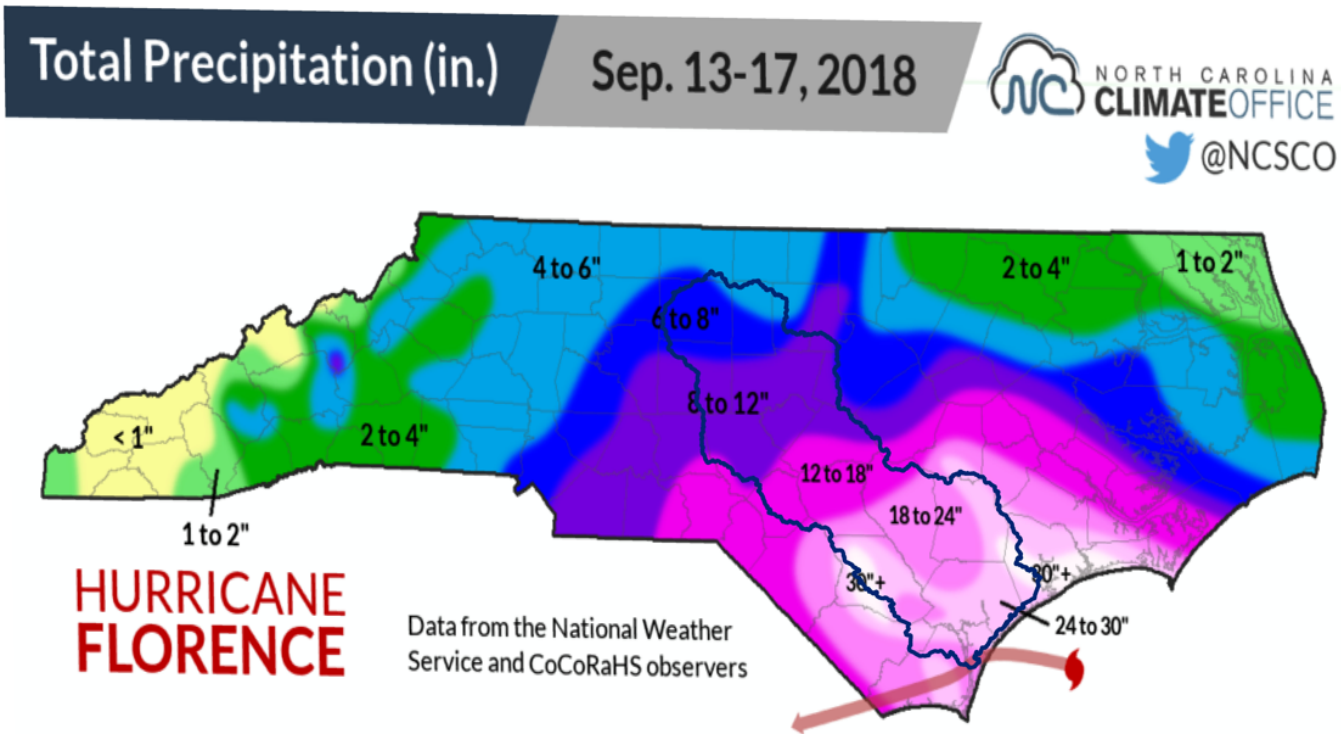


Figure 3-5: Estimated Rainfall Over NC During Hurricane Florence

Estimated recurrence intervals for the Hurricane Florence rainfall were equally impressive. Portions of the Cape Fear River basin were hit with rainfall estimated as greater than a 1 in 1,000-yr event. Nearly the entire basin with the exception of the headwaters in Rockingham, Caswell, Guilford, Alamance, Orange, and Randolph counties saw 100-yr or greater rainfall. Figure 3-6 depicts this graphically.

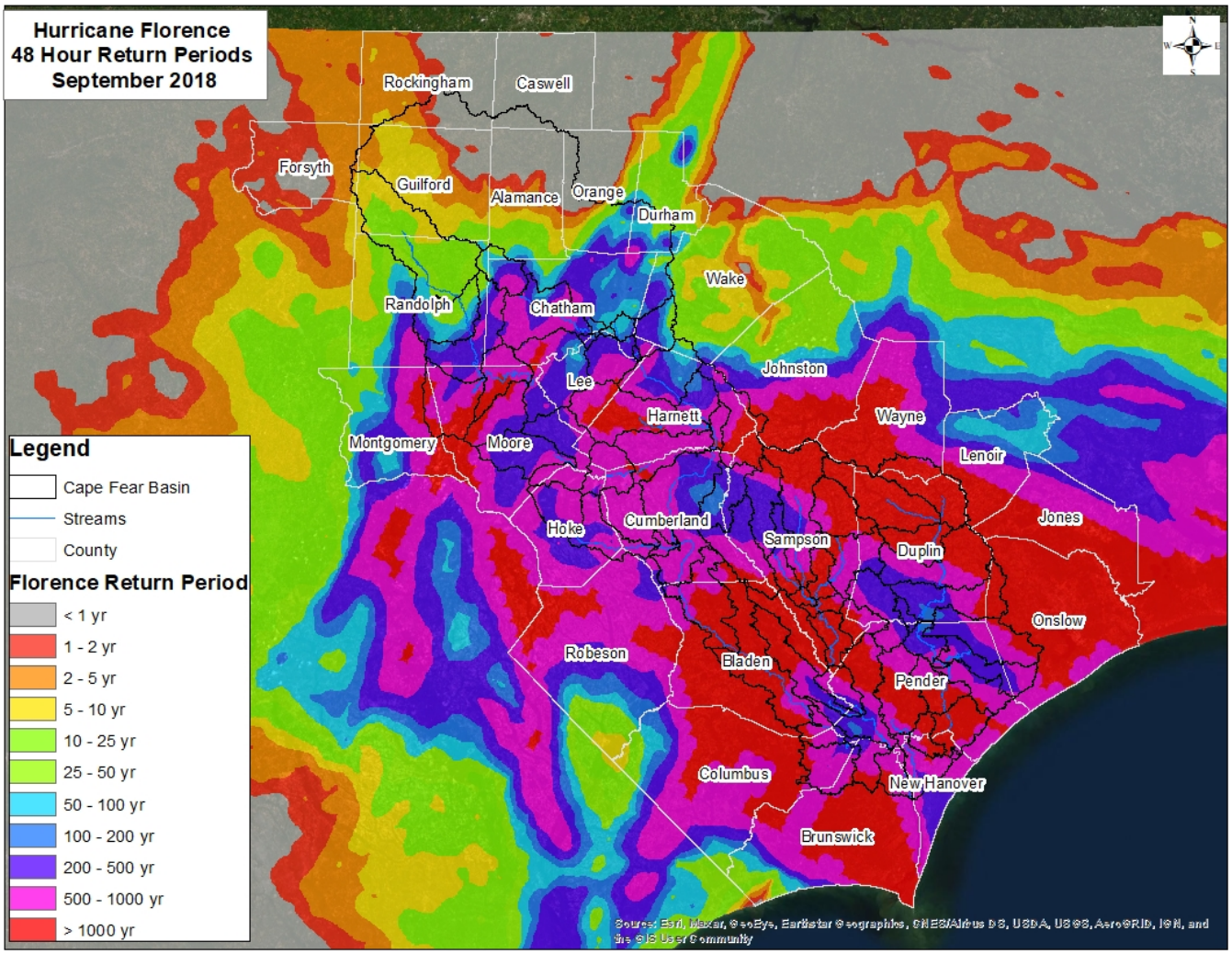


Figure 3-6: Hurricane Florence Estimated Rainfall Return Periods for the Cape Fear River Basin

As expected, the associated return periods for the peak stream flows for Hurricane Florence also reflect an extreme event. Table 3-1 shows estimated return periods based on flows recorded by USGS gages. Nine gages in the Cape Fear River basin recorded flows greater than the 100-yr event while six were estimated greater than the 500-yr event. The gage near Chinquapin on the Northeast Cape Fear River reached a stage of 24.21 feet before going underwater.

Gaging Station Event Return Periods

				Hurricane Florence (2018)	
SITE_ID	Type (Riverine or Coastal)	NAME	County	Flood Elevation (NAVD88 ft)	Est. Recurrent Interval (years
02105544	Riverine	CAPE FEAR RIVER AT LOCK 2 NEAR ELIZABETHTOWN, NC	Bladen	51.1	>500-yr
30001	Riverine	Lockwoods Folly River - Southport-Supply Rd SE	Brunswick	15.8	>500-yr
WHSN7	Riverine	Soules Swamp at S. Madison St in Whiteville	Columbus	60.6	>500-yr
FBLN7	Riverine	Lumber River at NC904 in Fair Bluff	Columbus	67.0	>500-yr
02103000	Riverine	Little River at Manchester	Cumberland	158.3	>500-yr
02108000	Riverine	NE Cape Fear River near Chinquapin	Duplin	40.6	>500-yr
TOWN7	Riverine	Town Creek at Us 258 near Pinetops	Edgecombe	61.6	>500-yr
TRTN7	Riverine	Trent R. at Trenton at N. Weber St	Jones	28.8	>500-yr
02092500	Riverine	Trent River near Trenton	Jones	42.0	>500-yr
02093000	Riverine	New River near Gum Branch	Onslow	27.2	>500-yr
02108619	Riverine	NE Cape Fear River at Castle Hayne	Pender	11.8	>500-yr
02108566	Riverine	Northeast Cape Fear River near Burgaw	Pender	24.6	>500-yr
02134500	Riverine	Lumber River at Boardman	Robeson	85.5	>500-yr
02133624	Riverine	Lumber River near Maxton	Robeson	191.8	>500-yr
02106500	Riverine	Black River near Tomahawk	Sampson	53.0	>500-yr
02092554	Riverine	Trent R. at Pollocksville	Jones	16.5	500-yr
02087359	Riverine	Walnut Ck at Sunnybrook Dr, Raleigh	Wake	199.3	500-yr
02128000	Riverine	Little River near Star	Montgomery	430.9	400-yr
CHBN7	Riverine	Booker Creek at E. Franklin St	Orange	265.6	350-yr
02102908	Riverine	Flat Creek near Inverness	Hoke	199.7	300-yr
02102000	Riverine	Deep River at Moncure	Lee	199.5	300-yr
02105769	Riverine	Cape Fear River at Lock #1 near Kelly	Bladen	26.7	200-yr
BCUN7	Riverine	Black River at NC 210	Pender	20.3	175-yr
02126000	Riverine	Rocky River near Norwood	Stanly	248.4	175-yr
02146750	Riverine	Mcalpine Cr Blw Mcmullen Cr near Pineville	Mecklenburg	534.2	105-yr
0212467595	Riverine	Goose Ck at SR1525 near Indian Trail	Union	559.7	100-yr
WSNN7	Riverine	Hominy Swamp at Forest Hills Rd near Wilson	Wilson	119.7	100-yr

Table 3-1: Peak Discharges Recorded During Hurricane Florence

Damages – The North Carolina governor's office estimates statewide damages of $17 billion from Hurricane Florence, making it the costliest Hurricane in the state's history. The estimated damage is more than the combined estimates from Hurricanes Floyd and Matthew.

Other Impacts – Statewide there were 45 fatalities confirmed due to Hurricane Florence, making it the fourth deadliest storm on record for the state.

According to NCDOT, approximately 2,500 road closures occurred across the state due to Florence. This included long sections of I-40 and I-95, essentially shutting down traffic in the southeast part of the state. The most severely damaged section of road in the state occurred in the Cape Fear basin as over 500 feet of four lane highway of US 421 at the New Hanover-Pender County line was washed away, cutting off a critical route into Wilmington.

Additional information on Hurricane Florence is provided in Appendix F: USGS Open File Report 2018-1172.

4. Engineering Analysis

Hydrology

Development of Rainfall-Runoff Model – The existing hydraulic models for the Cape Fear River Basin all rely on regression analysis calibrated using discharge gage data. This is an excellent method for determining peak discharges; however, in order to fully assess mitigation options, it was necessary to develop a hydrologic model that takes into account volume and timing of the flood. To accomplish this, a high-level, rainfall-runoff model was created for the study. The United States Army Corps of Engineers Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS) v4.5 software package was selected for the hydrologic calculations. Three linked HEC-HMS models were developed for various regions of the Cape Fear River basin to facilitate model calibration using rainfall/runoff methodologies. The models were initially set up and calibrated to data collected during the September 2018 Hurricane Florence event. Once the models were calibrated they were then used to establish existing conditions discharges for the 24-hr, 5, 10, 25, 50, 100, 200, 500, and 1000-year return period events. For additional information on development of the hydrologic data and the data inputs please refer to Appendix G: Cape Fear River Draft Hydrology Report.

Basin Delineation - Sub-basins within the Cape Fear River Basin were delineated using a 50-foot, hydro-corrected grid developed from the legacy Light Detection and Ranging (lidar) data collected between January and March 2001 by North Carolina Emergency Management (NCEM) in support of the North Carolina Floodplain Mapping Program (NCFMP). Basins were delineated to reflect gage locations and areas of mitigation interest within the watershed. The average drainage area was roughly 120 square miles with larger and smaller basins, as necessary. While the model includes basins with large drainage areas, its development is appropriate to achieve the project goals of analyzing the impact of mitigation alternatives in the Cape Fear River basin. Figure 4-1 shows the overall Cape Fear River basin delineation.

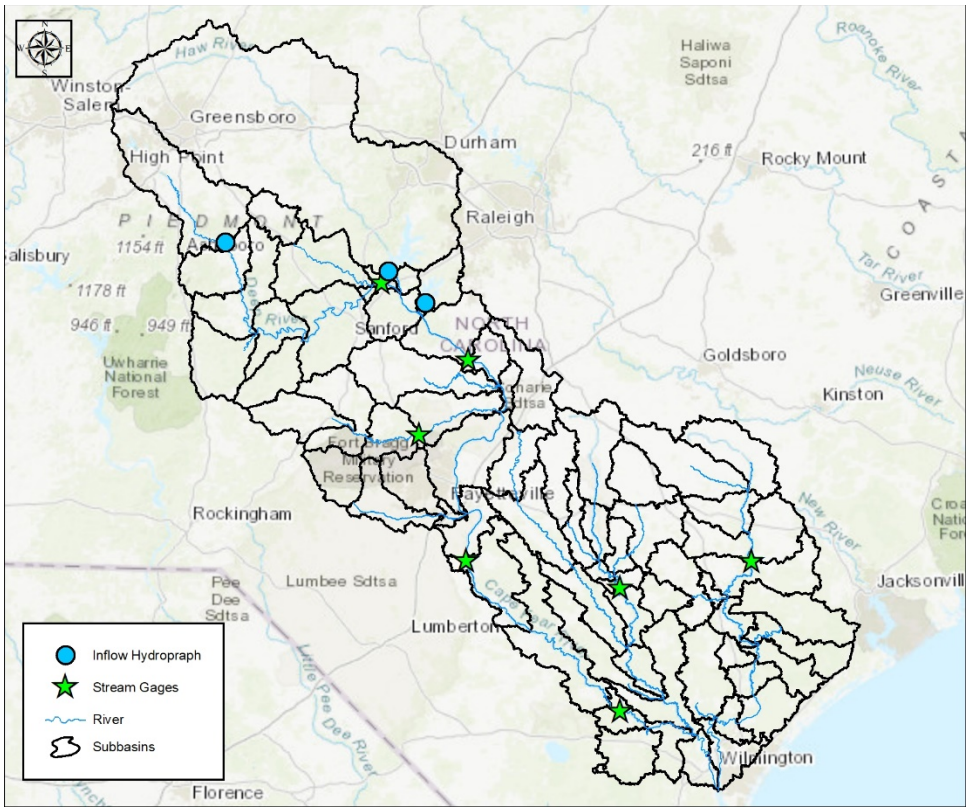


Figure 4-1: Basin Delineation for Cape Fear River Hydrologic Model

Inflow Hydrographs – The large drainage areas in the upper Cape Fear River Basin were delineated to facilitate use of USGS Flow Gage data as source inflow hydrographs to the HMS model at two locations:

- Outfall from Harris Lake – Buckhorn Creek near Corinth, NC – USGS 02102192
- Deep River at Ramseur, NC – USGS 02100500

US Army Corp of Engineers daily outflow data for Lake Jordan was used to develop source model inflow from Jordan Lake over the simulation period for Hurricane Florence.

Areas upstream of the source hydrographs were not a focus of this study. Source hydrograph locations are shown on Figure 4-1.

Curve Number Development - Curve numbers are used to describe the amount of rainfall that makes it to the stream as opposed to being intercepted by vegetation, absorbed into the soil, or otherwise prevented from contributing to riverine flooding. The Soil Conservation Service (SCS) Curve Number method was used to compute runoff depths and losses. Inputs for this method are land use and hydrologic soil group. Soil data was acquired from the Natural Resources Conservation Service (NRCS) and combined with the 2016 National Land Cover Database (NLCD) to generate average Antecedent Runoff Condition – II (ARC-II) curve numbers. Table 4-1: Curve Numbers for Associated Land Cover and Hydrologic Soil Group (ARC II) shows the curve number matrix used to estimate curve numbers for each basin. These values are based on ARC II, which implies an average moisture condition for the soil.

Land Cover	Hydrologic Soil Group			
	A	B	C	D
Barren Land	63	77	85	88
Cultivated Crops	64	75	82	85

Land Cover	Hydrologic Soil Group			
	A	B	C	D
Deciduous Forest	36	60	73	79
Developed, High Intensity	89	92	94	95
Developed, Low Intensity	51	68	79	84
Developed, Medium Intensity	61	75	83	87
Developed, Open Space	39	61	74	80
Evergreen Forest	30	55	70	77
Grassland	49	69	79	84
Hay/Pasture	39	61	74	80
Herbaceous Wetlands	72	80	87	93
Mixed Forest	36	60	73	79
Open Water	99	99	99	99
Shrub/Scrub	35	56	70	77
Woody Wetlands	36	60	73	79

Table 4-1: Curve Numbers for Associated Land Cover and Hydrologic Soil Group (ARC II)

Curve numbers were adjusted during the model calibration process as described in the calibration section of this report.

Time of Concentration - The lag time for a basin can be thought of as how long it takes from the peak of the rain event until the peak of the flooding event. Lag times were initially developed using the watershed SCS lag equation. More information on the SCS lag method can be found on the NRCS website at the following url: https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/water/manage/hydrology/?cid=stelprdb1043063. Lag times were adjusted during the model calibration process described in the Calibration section of this report.

Reach Routing - Channel routing helps take into account the time water spends travelling downstream from one basin to the next. Channel routing of discharges was performed using the Muskingum-Cunge method. Effective hydraulic models from NCFMP were used to develop 8-point cross-sections for reach routing, and legacy lidar-based 10-ft Digital Elevation Models (DEM) were used for any locations along unstudied streams. The Manning's "n" values used for each 8-point cross-section were estimated from the values used at nearby locations in the effective hydraulic models.

Rainfall Depths - Specific rainfall data for this region was discussed in Section 2 of this report. In developing the HEC-HMS rainfall-runoff models of the Cape Fear River basin, total rainfall data (using gage-adjusted radar information) from Hurricane Florence developed by NOAA was used to determine the total average basin rainfall amount for each modeled basin. Temporal rainfall patterns at these gages were assigned to subbasins based on geographic proximity to the gages and relative to the east-to-west storm progression as shown in Figure 4-2.

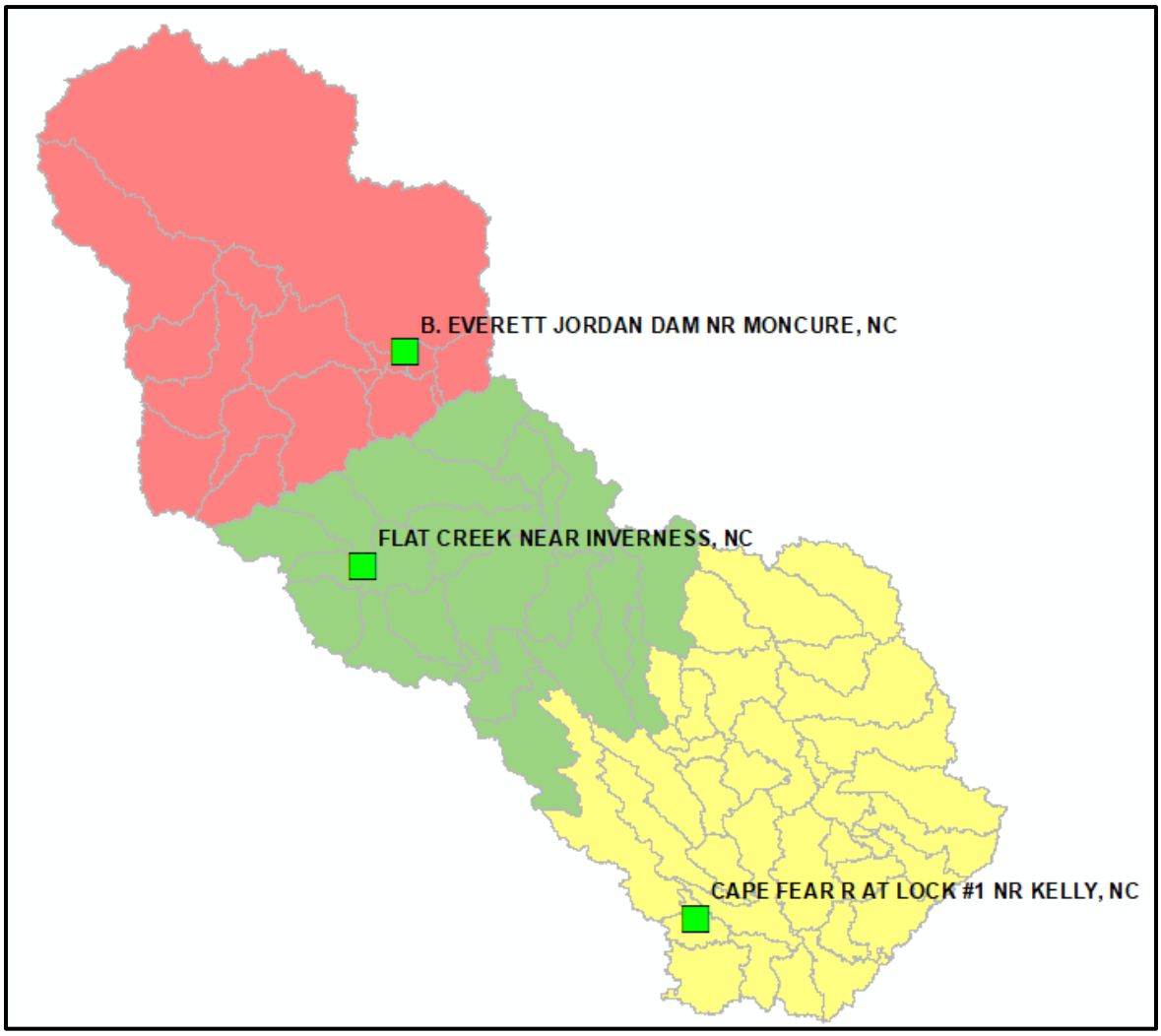


Figure 4-2 - Hurricane Florence Rainfall Gages and Subbasin Assignment

Once the model was calibrated, the 24-hr, 5, 10, 25, 50, 100, 200, 500, and 1000-year return period events were modeled. Project frequency discharges were developed from gridded rainfall data acquired from NOAA Atlas 14 Volume 2. The gridded data was used to determine rainfall depths for each of the studied frequencies. The rainfall depths were applied on a basin-by-basin basis using SCS Type II or Type III temporal distributions. Assignment of the Type II or Type III distribution to each basin is based on geographic basin location relative to the geographic boundaries for SCS storm distributions from SCS TR-55 shown in Figure 4-3.

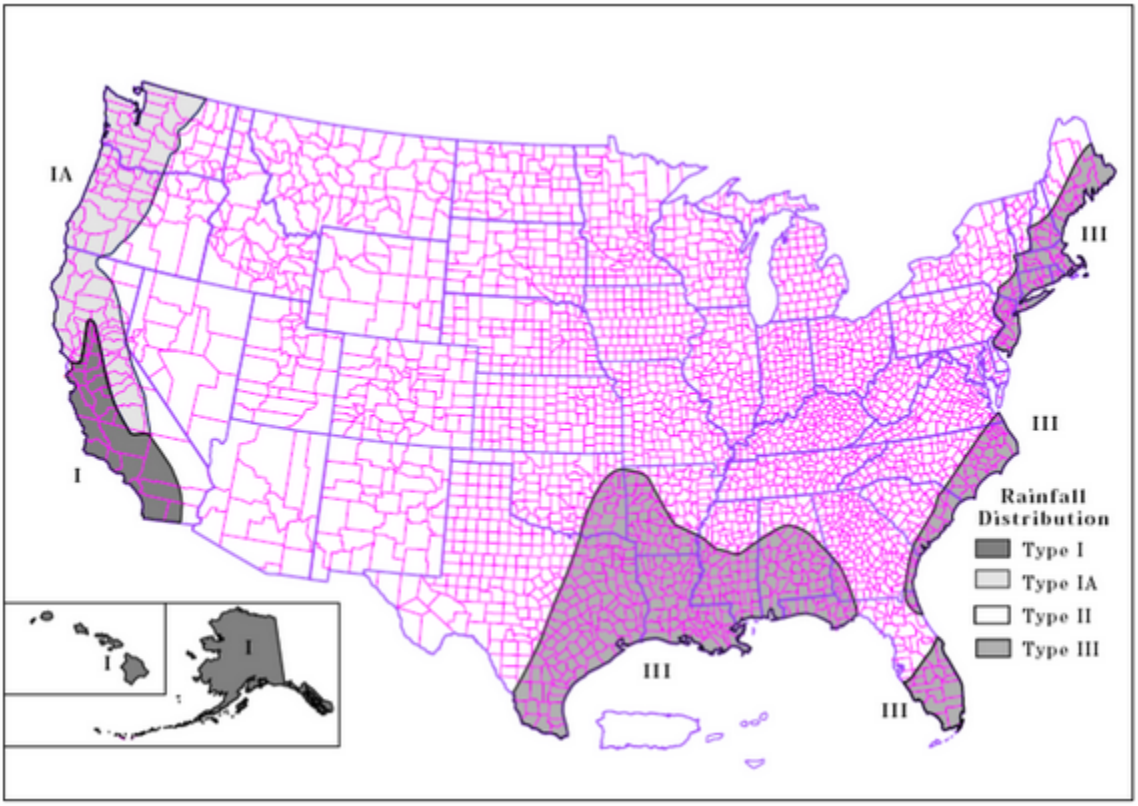


Figure 4-3 Approximate SCS Storm Distribution Boundaries

Calibration - The HEC-HMS models were calibrated to the Hurricane Florence stream gage data at seven locations, as shown in Figure 4-1. Observed stream gage hydrographs were added to the respective HEC-HMS model junctions for the following gages:

- Deep River at Moncure, NC – USGS 02102000 (J_DR004)
- Cape Fear River at Lillington, NC – USGS 02102500 (J_CF022)
- Little River at Manchester, NC – USGS 02103000 (J_LR004)
- Cape Fear River at William O. Huske Lock – USGS 02105500 (J_CF014)
- Cape Fear River at Lock #1 near Kelly, NC – USGS 02105769 (J_CF010)
- Black River at Tomahawk, NC – USGS 02106500 (J_BR008)
- Northeast Cape Fear near Chinquapin, NC – USGS 02108000 (J_NECF020)

The calibration process attempted to optimize the agreement between the modeled and observed runoff peak discharge, volume, and timing of the peak discharge at each location.

For the Northeast Cape Fear, Black, and Little River models SCS parameters were calibrated. Generally, CN's and Lag Times were varied for various Peak Rate Factors. Peak Rate Factors were selected based on general topographic description of each subbasin. In general, lower peak rate factors represent rural, slightly sloping or flat terrain with higher values representing urban and steep slope terrain. Curve numbers were allowed to vary between ARC-I and ARC-III as needed during the optimization process. Calibrated curve numbers for Northeast Cape Fear, Black, and Little River models is shown in Figure 4-4.

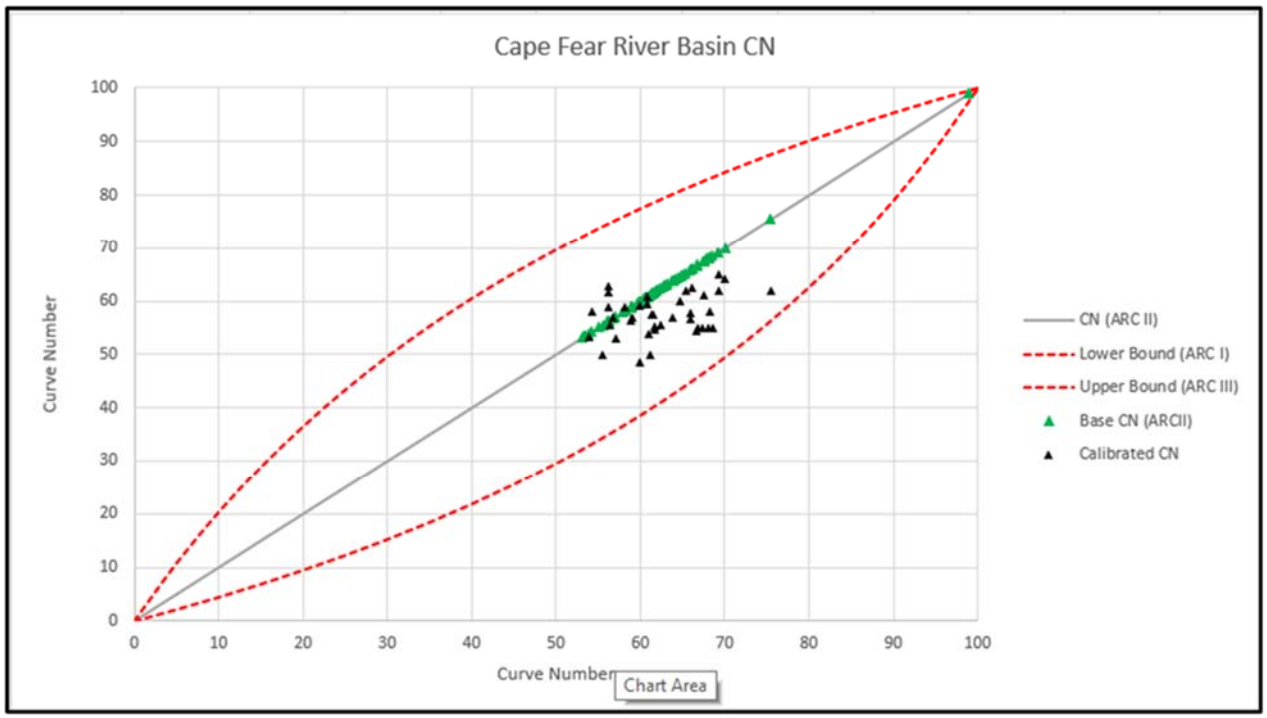


Figure 4-4 Calibrated Curve Number Variability

For the Deep River and Cape Fear River basins, the runoff methodology was changed to achieve better calibration results. For these basins, Initial and Constant infiltration and Snyder unit hydrograph transformation was used. Parameters were varied as need to achieve a best fit to observed hydrographs.

Baseflow discharge per unit area was calculated from gage records as the flow value at the beginning of simulation period divided by drainage area at the gage. The baseflow discharge was then applied to all subbasins upstream of the gage and not optimized. For the Deep River and Cape Fear HMS model, use of the Ratio to Peak Threshold Type was found to yield better results with the recession constant optimized. The Little River, Black River and Northeast Cape Fear River models were found to give better results utilizing the Threshold Discharge threshold type with threshold discharge set to reasonably match the hydrograph falling limb at calibration locations.

Calibration was performed in an iterative fashion, starting in the upstream basins and moving downstream with model parameters varied to achieve a close match of peak flow, volume, and timing to the observed hydrographs at the seven gage locations.

Parameters for subbasins below the USGS gages in the Black River basin and Northeast Cape Fear River basin were based on the calibrated parameters from gaged subbasins within those river basins. Calibrated parameters from gaged subbasins were generally averaged to determine representative parameters for ungaged subbasins.

A table showing the computed hydrologic parameters as well as the adjusted values that were used in the HEC-HMS model is provided in Appendix G.

In general, calibration was considered acceptable when the modeled hydrograph was within +-10% of gage peak flow and volume. Hydrograph peak timing along the Cape Fear River was found to match well with observed

hydrographs at all locations except at Cape Fear River at William O. Huske Lock – USGS 02105500. Calibrated runoff hydrographs match the observed hydrographs reasonably well on Little River at Manchester, Black River at Tomahawk and North East Cape Fear River near Chinquapin. At calibration points along Deep River and Cape Fear River, calibrated runoff hydrographs do not match as well, however peak flow does match reasonably well. Difficulty in obtaining a desirable fit between modeled hydrographs and observed hydrographs is likely due to many factors such as (but not limited to) limited model detail (due to scale of the study), limited availability of spatial rainfall data across the study area, and limited ability to adequately account for flood storage along river reaches and detention/retention structures throughout the basin. Due to these factors and keeping in mind that peak flows from the HEC-HMS model will be used in 1-dimensional (1D) HEC-RAS hydraulic models to evaluate potential mitigation strategies, it was decided that achieving a good match with the observed peak flows at the Deep River and Cape Fear River calibration points was most important. So, calibration parameters were adjusted as needed to match peak flow and in doing so this compromises the hydrograph volume and timing versus observed, primarily at the Cape Fear River at William O. Huske Lock – USGS 02105500 gage.

Calibrated runoff hydrographs match the observed hydrographs reasonably well for the purposes of this model. Table 4-2 presents the model results compared to the observed at the seven gages.

Modeled					USGS Gage			
Model	Hydrologic element	Peak Discharge (cfs)	Time of Peak	Volume (Ac-Ft)	Observed Peak Discharge (cfs)	Observed Time of peak	Observed Volume (Ac-ft)	USGS Gage #
Deep_Little_Cape_HMS	J_DR004	62,573	17Sep2018, 14:30	548,297	64,500.00	17Sep2018, 14:00	499,699	2102000 - Deep River at Moncure NC
Deep_Little_Cape_HMS	J_CF022	62,789	17Sep2018, 23:30	671,623	62,600.00	17Sep2018, 03:00	636,589	2102500 - Cape Fear At Lillington NC
Deep_Little_Cape_HMS	J_CF014	90,997	18Sep2018, 13:30	1,028,081	85,500.00	20Sep2018, 06:00	1,058,638	2105500 - William O Huske Lock near Tarheel NC
Deep_Little_Cape_HMS	J_CF010	78,259	21Sep2018, 18:45	1,425,989	76,700.00	21Sep2018, 16:00	1,437,811	02105769 - Cape Fear Lock #1 near Kelly NC
Deep_Little_Cape_HMS	J_LR004	17,284	18Sep2018, 00:00	123,257	17,400.00	18Sep2018, 03:00	121,046	2103000 - Little River at Manchester NC
Black_River	J_BR008	51,716	17Sep2018, 22:20	460,705	54,800.00	18Sep2018, 01:00	422,894	02106500 - Black River at Tomahawk NC
NE_Cape_Fear	J_NECF020	40,090	17Sep2018, 04:40	454,449	41,300.00	17Sep2018, 06:00	417,615	02108000 - NE Cape Fear near Chinquapin NC

Table 4-2: HEC-HMS Model Calibration Results

Figure 4-5 below shows a sample calibration location depicting the observed and modeled hydrographs. All final calibration hydrograph plots and data are provided in Appendix G.

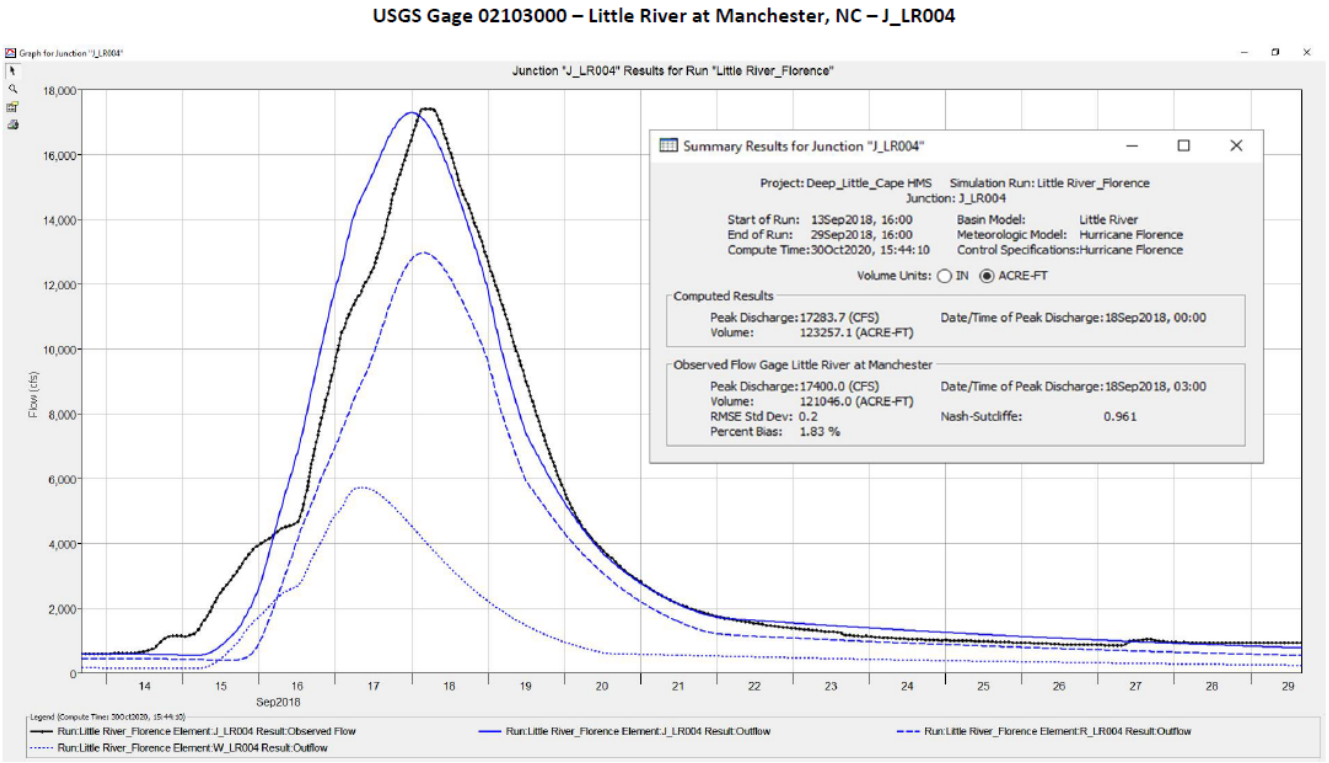


Figure 4-5: Modeled vs Observed Hydrographs at Little River at Manchester Gage

Modeled peak discharges range from 5.6% above to 6.4% below observed discharges at the gages. Modeled volumes range from -2.9% below to 9.7% above observed volumes at the gages. The modeled time to peak varies from 2,430 (40.5 hours) minutes earlier than observed to 165 minutes (2.75 hours) later than observed. Considering the total period of the model simulation (16 days), the modeled times to peak are reasonable. The 5, 10, 25, 50, 100, 200, 500, and 1000-year return period events were modeled using the calibrated parameters.

Comparison to Flood Insurance Study (FIS) Discharges – As noted above, the hydrologic model for this project was calibrated to Hurricane Florence. All storms have many variables that contribute to magnitude of flooding, which include duration, antecedent runoff condition, intensity, direction of movement, and spatial distribution of rainfall depth. The discharges reported in community Flood Insurance Study (FIS) reports are generally developed using regional regression equations based on hydrologic regions and proximity to stream gages or on rainfall-runoff models calibrated to a typical storm and then verified using additional storms or regression confidence limits. For this reason, the Hurricane Florence calibrated discharges, also referred to as the project discharges, will differ from the FIS discharges. Table 4-3 shows the comparison between effective and project discharges for the Cape Fear Basin study.

Modeled					FIS/USGS Gage		
Model	Hydrologic element	Peak Discharge (cfs)	Time of Peak	Volume (Ac-Ft)	Effective FIS Q100 (cfs)	USGS Gage Freq Q100	USGS Gage #
Deep_Little_Cape_HMS	J_DR004	65,799	02Jan2020, 02:30	452,757	54,600.00	55300	2102000 - Deep River at Moncure NC
Deep_Little_Cape_HMS	J_CF022	77,431	02Jan2020, 01:45	587,319	80,000.00	56,500[R]/107,000[U]	2102500 - Cape Fear At Lillington NC
Deep_Little_Cape_HMS	J_CF014	115,872	02Jan2020, 23:15	1,264,709	121,000.00	51,800[R]/66,600[U]	2105500 - William O Huske Lock near Tarheel NC
Deep_Little_Cape_HMS	J_CF010	88,922	06Jan2020, 22:00	1,630,678	123,000.00	64000[R]/92,100[U]	02105769 - Cape Fear Lock #1 near Kelly NC
Deep_Little_Cape_HMS	J_LR004	10,034	02Jan2020, 18:45	70,940	8,870.00	7100	2103000 - Little River at Manchester NC
Black_River	J_BR008	27,848	03Jan2020, 12:00	175,852	20,744.00	21900	02106500 - Black River at Tomahawk NC
NE_Cape_Fear	J_NECF020	20168.3	02Jan2020, 15:30	150624	22,075	21,500	02108000 - NE Cape Fear near Chinquapin NC

R – Regulated Flow Period. From USGS SIR 2009 5158
U – Unregulated Period. From USGS SIR 5158

Table 4-3: Modeled Discharges Compared to FIS Discharges

Variances in the modeled 100 Year return interval discharges versus the FIS discharges range from 34% higher at the Black River gage to 28% lower at the Cape Fear Lock #1 gage. These variances can primarily be attributed to the differences between hydrologic methodologies used in this study compared to methodologies used to determine FIS discharges.

Although modeled discharges vary from FIS discharges, as shown in Table 4-2 peak discharges match quite well with recorded Hurricane Florence discharges, which is not surprising since the model was calibrated to the Florence event.

Hydraulic Modeling

Approach – Hydraulic models are used to calculate the water surface for a particular storm event. For this project the latest hydraulic models developed by the NCFMP for the Cape Fear River study area were used for all streams with the exception of the Northeast Cape Fear River. A new one-dimensional HEC-RAS hydraulic model based on new field survey and the latest lidar topographic data was developed for the Northeast Cape Fear River. Details on the Northeast Cape Fear River model development can be found in Appendix H – Northeast Cape Fear River Draft 1D Hydraulics Report. All hydraulic models used for this project were run in United States Army Corps of Engineering Hydrologic Engineering Center – River Analysis Software (HEC-RAS) version 5.0.7. Once the hydrologic model was completed, the existing conditions project discharges (5-, 10-, 25-, 50-, 100-, 200-, 500-, and 1000-year return period events) along with the Hurricane Florence calibrated discharges were input in the hydraulic models to develop a set of baseline profiles for each stream.

For the Northeast Cape Fear River, the HEC-RAS model was calibrated using high water mark estimates collected during Hurricane Florence. Manning's "n" values and ineffective flow areas were adjusted in the model so that the Hurricane Florence model run produced elevations that matched the known Hurricane Florence elevations at USGS gage 02108000 - NE Cape Fear near Chinquapin NC.

Calibration of hydraulic models for the Cape Fear River and Little River was beyond the scope for this project, so no model calibration was performed. For these models, the project discharges developed from the calibrated HEC-HMS model were input with no additional model refinements.

These hydraulic model runs were the basis of the flood risk analysis described in the following section.

5. Flood Risk Analysis

Development of Water Surface Rasters

As described in the Section 4, project frequency discharges developed in the HEC-HMS hydrologic model were applied to FIS hydraulic models within the Cape Fear River study area. The resulting project frequency water surface elevations were then used to generate water surface elevation (WSEL) rasters. These are flood extent boundaries containing underlying elevation data and are visualized in 10-foot by 10-foot grid cells. These WSEL rasters were created for each of the project frequency water surface elevations, including 5-, 10-, 25-, 50-, 100-, 200-, 500-, and 1000-year events. Figure 5-1 displays the extents of the 1000-year (0.1% annual chance) for the Cape Fear River Basin study area.

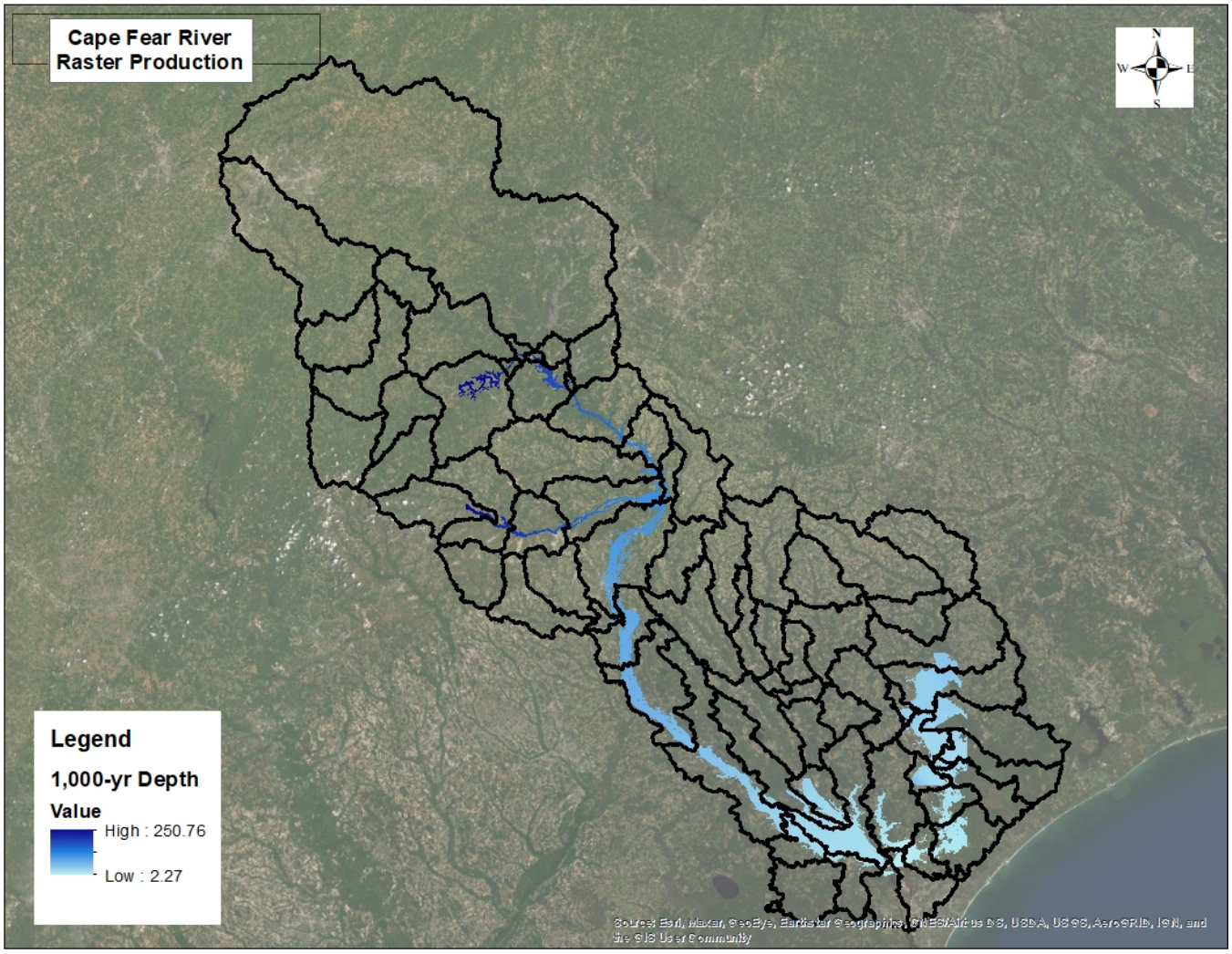


Figure 5-1: 1000-Year Project Frequency Water Surface Elevation Raster for the Cape Fear River Study Area

Damage Assessments

Associating Elevations to Building Footprints – A GIS dataset was provided by NCEM for building footprints in the Cape Fear River basin. This dataset was used to compute estimated damages for these structures for each project frequency flood event, including Hurricane Florence. Each structure is attributed with a wealth of data

including building type, finished floor elevation (FFE), foundation type, replacement value, contents value, heated square feet, and many other attributes.

A critical part in assessing impacts on structures during various events is the water surface elevation of the event in relation to the structure. The WSEL rasters for project frequency events, as well as Hurricane Florence modeled elevations, were used to define this relation. All project frequency elevations were associated with footprints so that damage assessments on these structures by each of these events could be assessed.

Development of Damage Estimates – As a part of the NCEM's integrated hazard risk management (IHRM) program, a tool was developed that is used to compute direct and indirect damages to structures based on the associated WSEL. The tool is used by NCEM for providing building risk assessments as shown on North Carolina's Flood Risk Information System (FRIS) website. Damage calculations for buildings were based on depth-damage curves specific to structure type, foundation, and occupancy type developed as part of IHRM. Direct impacts consider the value of structures and associated contents, while indirect impacts consider items such as displacement and relocation costs, lost rent, lost wages, lost income, and more. It is important to note that many of the building footprint attributes, such as contents value, are approximate and may be based on generalized assumptions. As such, the damage estimates performed as part of this analysis, although considered appropriate for this level of study, should be used for planning-level purposes only. A more detailed analysis to confirm building and contents value within a specified area of interest may likely produce different damage estimate results.

Once the project frequency flood elevations were associated with the structure footprints, the Damage Assessment Tool was used to estimate damages for each of the project frequency events presented below. Another important aspect of risk analysis is annualized loss, which takes into account the probability of an event when determining the damages experienced from a flood of a certain magnitude. For this study, 30-year and 50-year time horizons were considered in defining the costs of damages to structures affected by flooding events. Annualized loss for structures impacted by project frequency events were determined as described on pages 20 and 21 in Federal Emergency Management Agency's (FEMA) "Guidance for Flood Risk Analysis and Mapping, Flood Risk Assessments, May 2016", as shown in Figure 5-2 below.

$$\text{Annualized Loss} = (10\% - 4\%) * (\text{Loss } 10\% + \text{Loss } 4\%) / 2 +$$
$$(4\% - 2\%) * (\text{Loss } 4\% + \text{Loss } 2\%) / 2 +$$
$$(2\% - 1\%) * (\text{Loss } 2\% + \text{Loss } 1\%) / 2 +$$
$$(1\% - 0.2\%) * (\text{Loss } 1\% + \text{Loss } 0.2\%) / 2 +$$
$$0.2\% * \text{Loss } 0.2\%$$

Figure 5-2: Annualized Loss Calculations

Once an annualized loss is determined, that value can be multiplied by the time frame of interest, in this case 30 and 50 years, to determine a loss estimate for the timeframe.

Modeled Flood Impacts by Storm Frequency – Once damage assessments were complete, the data was compiled on a basin-wide basis and also on a community-by-community basis. These values represent the baseline to which other scenarios employing mitigation options can be compared. The difference in estimated damages between the baseline and a mitigation option represents the losses avoided by employing that

mitigation option. The input data and results for the baseline analysis can be found in Appendix I – Baseline Damage Analysis. Table 5-1 below shows baseline estimated direct damages for the Cape Fear Basin for the different project frequency events analyzed. It is important to note that these values represent only damages resulting from flooding on the mainstem of the Cape Fear River and major tributaries such as Little River and Northeast Cape Fear River as shown in the WSEL raster extent (Figure 5-1). Flood damages from other flooding sources in the basin are not accounted for in this analysis or any analysis shown as part of this study.

Cape Fear Basin Study Area								
Event	Residential		Non-Residential		Public		Total	
	Buildings	Damages	Buildings	Damages	Buildings	Damages	Buildings	Damages
5-yr	320	$2,037,408	41	$208,271	3	$0	364	$2,245,679
10-yr	513	$5,177,234	70	$430,219	7	$24,877	590	$5,632,331
25-yr	857	$12,562,062	120	$1,226,331	11	$168,242	988	$13,956,635
50-yr	1,326	$23,546,296	199	$3,306,915	15	$325,944	1,540	$27,179,155
100-yr	2,043	$42,038,083	335	$6,871,738	22	$883,734	2,400	$49,793,556
200-yr	2,791	$68,093,275	499	$14,363,588	31	$2,274,954	3,321	$84,731,817
500-yr	3,664	$128,139,869	686	$43,943,878	40	$4,855,807	4,390	$176,939,554
1000-yr	4,440	$195,372,316	820	$86,067,529	49	$8,548,434	5,309	$289,988,279

Table 5-1: Baseline Damage Estimates for the Cape Fear River Study Area

As shown in Table 5-1, it is evident that there is a significant increase in damages between the 100-yr project baseline event and the 500-yr event.

As mentioned above, taking into account the probability of each event occurring allows calculation of the contribution of each event to annualized loss. Table 5-2 below presents the average annual loss values for each event analyzed.

Cape Fear River Baseline AAL						
Event	Structure (ST)	Contents (CT)	Indirect (OT)	Probability	AAL (Direct)	AAL (w/Indirect)
5-yr	$ 1,256,429	$ 989,250	$ 3,077,860	0.2	$ 393,900	$ 1,148,006
10-yr	$ 3,002,018	$ 2,630,312	$ 12,004,243	0.1	$ 587,669	$ 1,578,709
25-yr	$ 7,268,799	$ 6,687,837	$ 21,030,419	0.04	$ 411,358	$ 1,086,348
50-yr	$ 13,570,106	$ 13,609,049	$ 46,468,621	0.02	$ 384,864	$ 963,524
100-yr	$ 24,887,890	$ 24,905,666	$ 69,263,377	0.01	$ 336,313	$ 803,987
200-yr	$ 42,071,872	$ 42,659,945	$ 117,806,076	0.005	$ 392,507	$ 910,521
500-yr	$ 83,103,959	$ 93,835,596	$ 227,536,875	0.002	$ 233,464	$ 555,430
1000-yr	$ 130,834,460	$ 159,154,390	$ 416,394,823	0.001	$ 289,989	$ 706,384

Table 5-2: Baseline Average Annual Loss for the Cape Fear River Study Area

It is noteworthy that although the 10-yr event produces a much lower total damage than many other events, its resulting annualized loss contribution is higher than all other larger events.

Table 5-2 shows baseline estimated damages on a community level. Note that the countywide damage value excludes those communities within the county already presented in the table.

Community	Baseline Damage Assessments for Project Frequency Events							
	5-Year	10-Year	25-Year	50-Year	100-Year	200-Year	500-Year	1,000-Year
Bladen County	$ 263,772	$ 594,182	$ 1,669,502	$ 3,985,325	$ 7,857,257	$ 11,672,296	$ 21,245,678	$ 31,877,528
Brunswick County	$ -	$ -	$ -	$ -	$ -	$ -	$ 505	$ 505
Burgaw	$ 1,740	$ 11,824	$ 17,317	$ 30,437	$ 52,843	$ 1,339,624	$ 2,614,581	$ 4,296,157
Chatham County	$ -	$ -	$ -	$ -	$ 60,158	$ 932,901	$ 2,144,801	$ 3,094,196
Columbus County	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cumberland County	$ 2,719	$ 41,778	$ 224,801	$ 529,681	$ 1,162,429	$ 2,196,797	$ 4,934,825	$ 10,245,319
Duplin County	$ 5,096	$ 43,210	$ 407,586	$ 1,534,827	$ 5,046,801	$ 12,547,975	$ 44,671,022	$ 94,414,715
Elizabethtown	$ 10,875	$ 20,869	$ 134,201	$ 261,037	$ 589,268	$ 854,306	$ 1,585,036	$ 2,436,814
Erwin	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Fayetteville	$ 17,421	$ 20,305	$ 24,676	$ 55,212	$ 309,832	$ 622,682	$ 1,992,999	$ 5,492,896
Fort Bragg	$ -	$ -	$ 3,394	$ 6,630	$ 30,521	$ 52,294	$ 65,571	$ 83,081
Harnett County	$ 1,309	$ 8,348	$ 174,601	$ 636,128	$ 1,620,074	$ 2,635,735	$ 5,444,264	$ 7,435,460
Hoke County	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Lee County	$ 51,086	$ 92,679	$ 136,469	$ 205,588	$ 257,792	$ 361,932	$ 665,308	$ 894,843
Lillington	$ -	$ -	$ -	$ 3,256	$ 7,403	$ 175,510	$ 338,179	$ 359,186
Moore County	$ 26,464	$ 72,454	$ 179,023	$ 350,033	$ 551,643	$ 781,387	$ 1,283,311	$ 1,680,833
New Hanover County	$ 790	$ 790	$ 4,714	$ 14,957	$ 76,587	$ 205,456	$ 370,056	$ 495,856
Pender County	$ 1,864,408	$ 4,725,893	$ 10,973,879	$ 19,555,468	$ 32,111,173	$ 50,175,907	$ 88,660,707	$ 123,498,127
Spring Lake	$ -	$ -	$ 6,473	$ 10,576	$ 57,794	$ 143,484	$ 673,889	$ 3,032,189
Wallace	$ -	$ -	$ -	$ -	$ 1,979	$ 33,533	$ 248,823	$ 650,573

Table 5-3: Baseline Damage Estimates for the Cape Fear River Study Area by Community

Detailed damage information including tables and charts for each community is provided in Appendix A.

Roadway Overtopping Analysis

Significant, indirect flooding risks occur when a major roadway becomes unpassable due to overtopping during a flood event. Overtopping of a roadway during a flood may not only restrict travel but may also significantly damage the stream crossing such that residents on one side become stranded without the ability to access food or medical care as needed. Using the hydraulic models, roadway overtopping was reviewed to analyze the vulnerability of major road crossings (Interstates and US Highways) to overtopping. If roadways overtopped in an overbank within the model at a lower elevation than the actual bridge or culvert, the lower elevation was used to designate overtopping of the road occurring. After determining the discharge required to overtop the road, the discharge was fit to a curve representing the Hurricane Florence-calibrated recurrence interval to determine the flood frequency of overtopping. As this analysis uses Hurricane Florence-calibrated flood frequencies, it may not match flood elevations as shown on FEMA's Flood Insurance Rate Maps (FIRM) or other sources. Table 5-3 below shows a summary of the overtopping recurrence of major road crossings in the Cape Fear River basin based on the Hurricane Florence calibrated frequency discharges. Supporting data for this analysis can be found in Appendix J – Roadway Overtopping Analysis.

Road	County	Stream	Recurrence Interval (yr)
US-117	Pender/NewHanover	NE Cape Fear River	>1000
NC-41	Duplin	NE Cape Fear River	396
NC-53	Pender	NE Cape Fear River	268
NC-210	Pender	NE Cape Fear River	502
I-40	Pender/NewHanover	NE Cape Fear River	>1000
US-701	Bladen	Cape Fear River	>1000
NC-11	Bladen	Cape Fear River	128
NC-12	Bladen	Cape Fear River	128
NC-13	Bladen	Cape Fear River	>1000
US-401	Harnett	Cape Fear River	586
NC-217	Harnett	Cape Fear River	>1000
I-295	Cumberland	Cape Fear River	450
I-93 BUS	Cumberland	Cape Fear River	>1000
NC-24	Cumberland	Cape Fear River	314
I-95	Cumberland	Cape Fear River	196
NC-42	Lee/Chatham	Cape Fear River	573
US-421	Lee/Chatham	Deep River	424
NS-99995	Lee/Chatham	Deep River	382
NC Highway 87 S	Lee/Chatham	Deep River	>1000
US-1	Lee/Chatham	Deep River	>1000
OLD US-1	Lee/Chatham	Deep River	550
US-1	Moore	Little River	>1000
NC -217	Cumberland/Harnett	Little River	902
NC-24	Cumberland	Little River	140
NC-210	Cumberland	Little River	115

Table 5-4: Major Roadway Overtopping Vulnerability

6. Mitigation Strategies

A master list of mitigation strategies to be explored was established by NCEM based on mitigation strategies used in similar projects, and feedback from partners and stakeholders. The master list consisted of the following strategies:

1. New Detention Structures
2. Retrofit of Existing Detention Structures
3. Channel Modification
4. New Embankment Structures
5. Existing Levee Repair / Enhancement
6. Roadway Elevation
7. Non-Structural
8. Floodplain Expansion/Protection

As discussed at the stakeholder meetings, due to basin characteristics and preliminary analyses, not all strategies may be pursued fully for the Cape Fear Basin study area. If a strategy was found to have limited flood reduction potential and/or significant challenges with implementation a full benefit/cost analysis may not have been performed. This section will discuss the methodology used for analyzing each strategy as well as evaluate the strategy performance from a benefit-cost standpoint.

Strategy 1 – New Detention Structures

Approach - This strategy consists of construction of new dams and reservoirs to provide flood detention and downstream discharge reduction. The analysis was performed as outlined in Section 5 for the baseline damage estimation. Using the Hurricane Matthew calibrated HEC-HMS hydrologic model, existing HEC-RAS hydraulic models, water surface elevation rasters, and the state's risk analysis procedures, potential dam sites were modeled to evaluate their impacts on downstream discharges, flood levels, and damages for various events throughout the Cape Fear Basin study area.

Sites Considered – Potential dam locations along the Cape Fear River were considered based on FEMA Effective mapping and lidar terrain. Due to very wide, flat floodplains, potential dams along the Cape Fear would be very long and thus very expensive, and have limited vertical height limiting flood storage capacity, especially for larger storm events. Based on a similar study of the Tar River Basin in 2018 containing multiple proposed reservoirs, a dam on the Cape Fear River was determined to be unrealistic, cost prohibitive, and likely to provide little flood reduction benefits. Therefore, no sites on the Cape Fear were considered for further analysis.

Six sites at locations along major tributaries to Cape Fear River were initially selected for study based on a review of topographic conditions. Of these six, four sites were eliminated either because they would cause excessive infrastructure impacts or would provide little beneficial flood reduction downstream. Two sites were found to provide good storage potential as either wet or dry detention facilities, and initial modeling was performed to further explore downstream discharge reduction and dam size. Based on initial modeling results, two sites providing good storage volume versus dam height and length were selected for benefit/cost analysis. The sites considered in this study are shown in Figure 6-1.

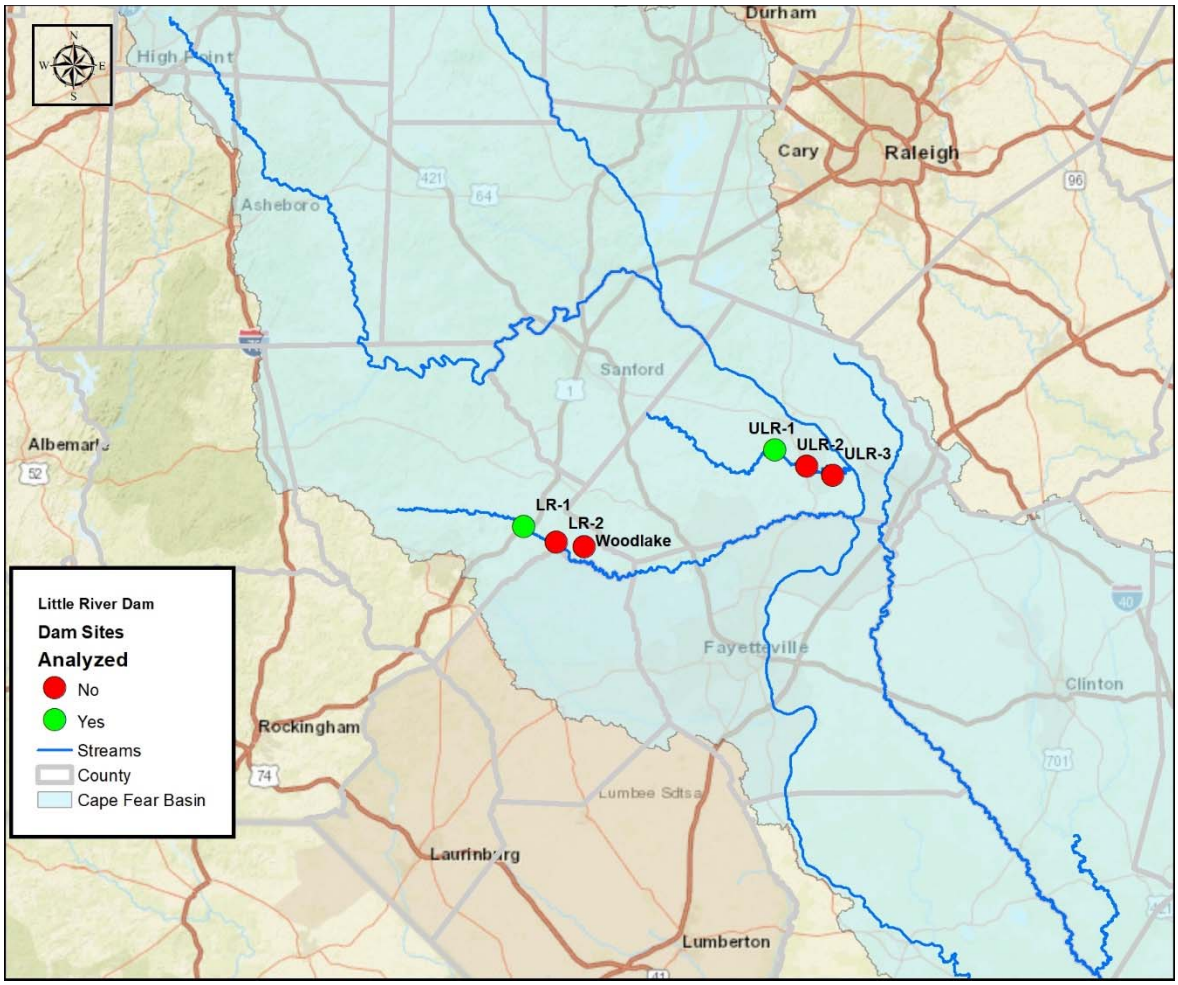


Figure 6-1: Potential Detention Storage Sites

Sites Selected – Two sites were selected for detailed analysis as wet and dry detention facilities.

Wet reservoirs permanently hold water (conservation pools) but still provide flood storage between the conservation pool elevation and the top of the dam. Sites with significant topographic relief generally offer better opportunity to permanently store water in the conservation pool.

Some considerations when planning a wet detention facility include:

- Reduced flood discharges downstream
- Opportunity for recreation including fishing boating, picnic area, camping
- Increased quality of life for surrounding population
- Increased property values adjacent to and in the vicinity of the lake
- Potential water supply for developing areas
- Potential for water quality issues
- Potential irrigation supply for agriculture
- Planning needs to account for sedimentation issues
- Often eliminates wetlands in favor of open water
- Disrupts connectivity of the waterway

Dry reservoirs are normally dry and only hold water during a flood event, similar to water backing up behind a road embankment with a culvert during a large storm. Temporarily stored water is normally released from the reservoir in a controlled manner over a period of time. These structures allow base flow and smaller storms to pass largely un-impeded. The outlet structures are sized to only detain water during larger events. As such, storms greater than the 50-yr event are often where they provide the most benefit. Some considerations when planning a dry detention facility include:

- Allows more flood storage with a lower dam height
- Opportunity for recreation facilities including parks, open space, or hunting grounds
- Property owner could be compensated in the form of an easement, or property could be purchased by dam owner and leased back to the previous owner for agricultural or other purposes
- Maintains river connectivity for species migration and sediment transport
- Less impact on streams and wetlands versus wet detention
- Reduced flood discharges downstream

The two sites were analyzed as both wet and dry reservoirs, one site on the Little River and one site on the Upper Little River.

Both wet or dry reservoir projects will require extensive engineering studies, land acquisition, design, permitting, and environmental impact studies. While actual construction of a dam may be accomplished in 2-4 years (for dams of the size considered in this study), these other factors can add significant lead time and cost to reservoir projects and need to be considered when comparing mitigation strategies. Dry reservoirs typically would not impact environmental features to the extent of a wet reservoir and therefore may be easier to implement. Project implementation for a dry reservoir is expected to be on the order of 7-15 years. The implementation timeframe for a wet reservoir could be on the order of 15-30 years or more.

- **Little River Dam**

  A hypothetical dam was considered just upstream of US-1 near Vass and Lakeview, NC and approximately 4.5 miles downstream of Whispering Pines, NC. This site was selected to leverage existing topography that will simultaneously provide significant storage volume and minimize the dam footprint and height. A dam at this location has the potential to reduce discharges downstream, primarily upstream of Spring Lake, NC. Figure 6-2 shows the location of the Little River Reservoir.

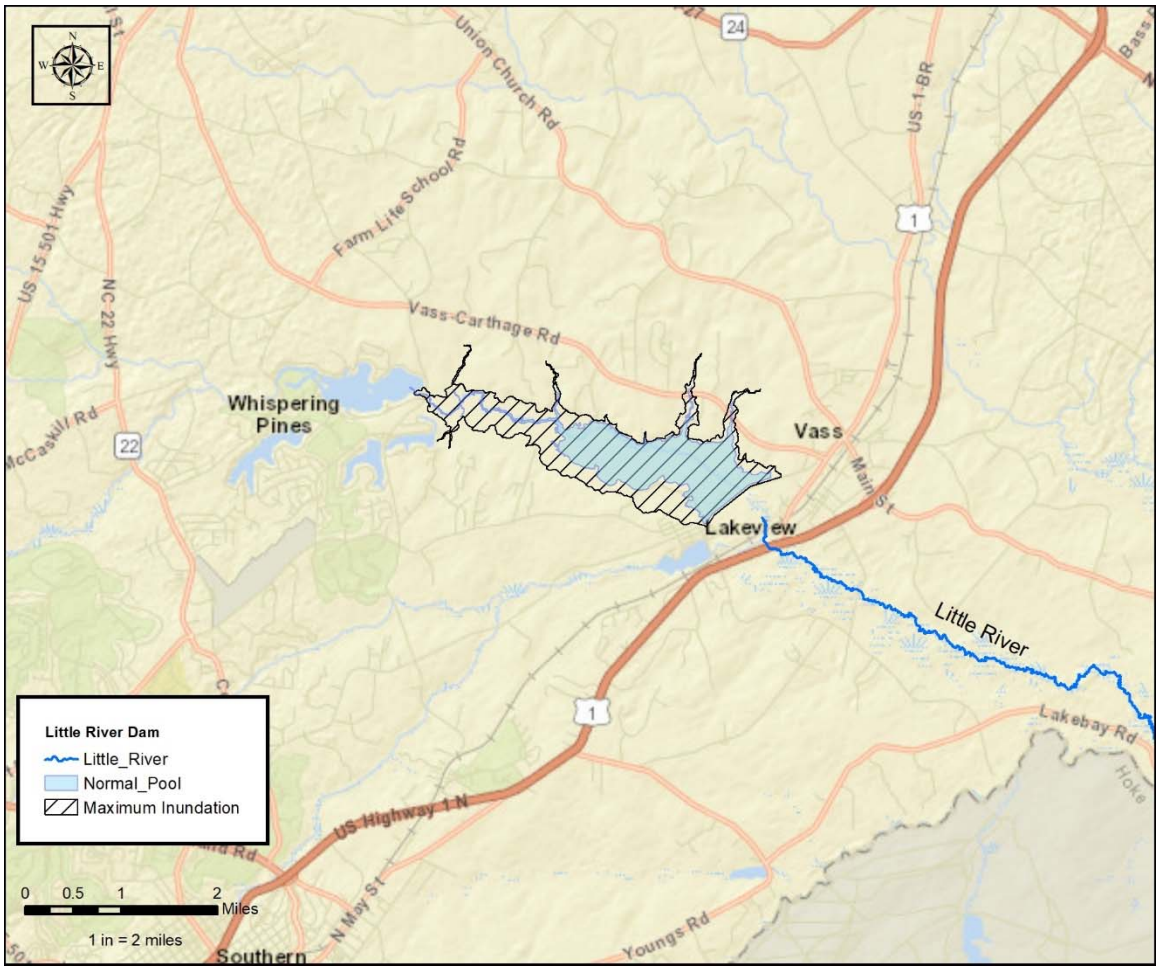


Figure 6-2: Little River Reservoir Location

The drainage area at this location is approximately 79.5 square miles. A dam in the narrow river channel topography just upstream of US Highway 1 at a height of approximately 34.0 feet (Elevation 281.0) would impound an area of approximately 1,400 acres and provide approximately 21,520 acre-feet of storage.

The hypothetical dam was assumed to be an earthen embankment dam with 3 horizontal to 1 vertical side slopes, a 25-foot crest width, and a riser/barrel primary spillway operating under barrel/inlet control. An earthen trapezoid channel was assumed for an auxiliary spillway.

Reservoir elevation-storage data was developed from lidar topographic data. The top of dam elevation was selected based on surrounding topography to minimize crest length. The primary spillway was modeled as a fixed, 12-foot x 12-foot concrete tower at crest elevation 266-ft (permanent pool elevation) with 2-sides open and a 48-inch diameter outlet conduit at the base elevation of the dam and

an 800-foot wide auxiliary spillway at elevation 276-ft was modeled as a weir. Initial model iterations indicated sufficient storage was available to allow the reservoir to be modeled as a wet detention feature. This dam was also modeled as a dry reservoir without the concrete tower but an otherwise a similar spillway configuration and a dam crest elevation 280.0

Peak flood elevations for each storm event are provided in the table below.

Little River Dam		
Description	Wet Configuration	Dry Configuration
Top of Dam (Elevation-ft)	281.0	280.0
Permanent Pool (Elevation-ft)	266.0	DRY
Dam Height (ft)	34.0	33.0
Crest Length (ft)	5100	5064
Auxiliary Spillway Elevation (ft)	276.0	275.0
Auxiliary Spillway Width (ft)	800	800
5-yr Peak Elevation (ft)	268.4	257.5
10-yr Peak Elevation (ft)	268.9	259.8
25-yr Peak Elevation (ft)	270.4	262.8
50-yr Peak Elevation (ft)	271.8	265.2
100-yr Peak Elevation (ft)	273.4	267.6
500-yr Peak Elevation (ft)	276.4	272.7
1000-yr Peak Elevation (ft)	276.7	274.9

Table 6-1: Little River Dam Summary

At a normal pool elevation of 266.0 feet, the maximum depth would be approximately 26.0 feet at the dam with an average lake depth of 8.0 feet.

Base flow was included in the basin wide hydrologic study, therefore base flow was also considered in the dam modeling. However, minimum stream flows requirements will need to be considered in future studies for this dam.

The Little River-1 reservoir storage capacity between normal pool and the top of the dam is approximately 16,000 acre-feet. Based on HEC-HMS modeling this is sufficient volume to capture and store all the modeled storm events and provide approximately 4 feet of freeboard to the top of the dam for the 1000-yr event.

- **Upper Little River Dam**
  A hypothetical dam was considered on Upper Little River just upstream of NC Highway 210 near Lillington, NC. This site was selected to leverage existing topography that will simultaneously provide significant storage volume and minimize the dam footprint and height. Figure 6-3 shows the location of the Upper Little River Dam.

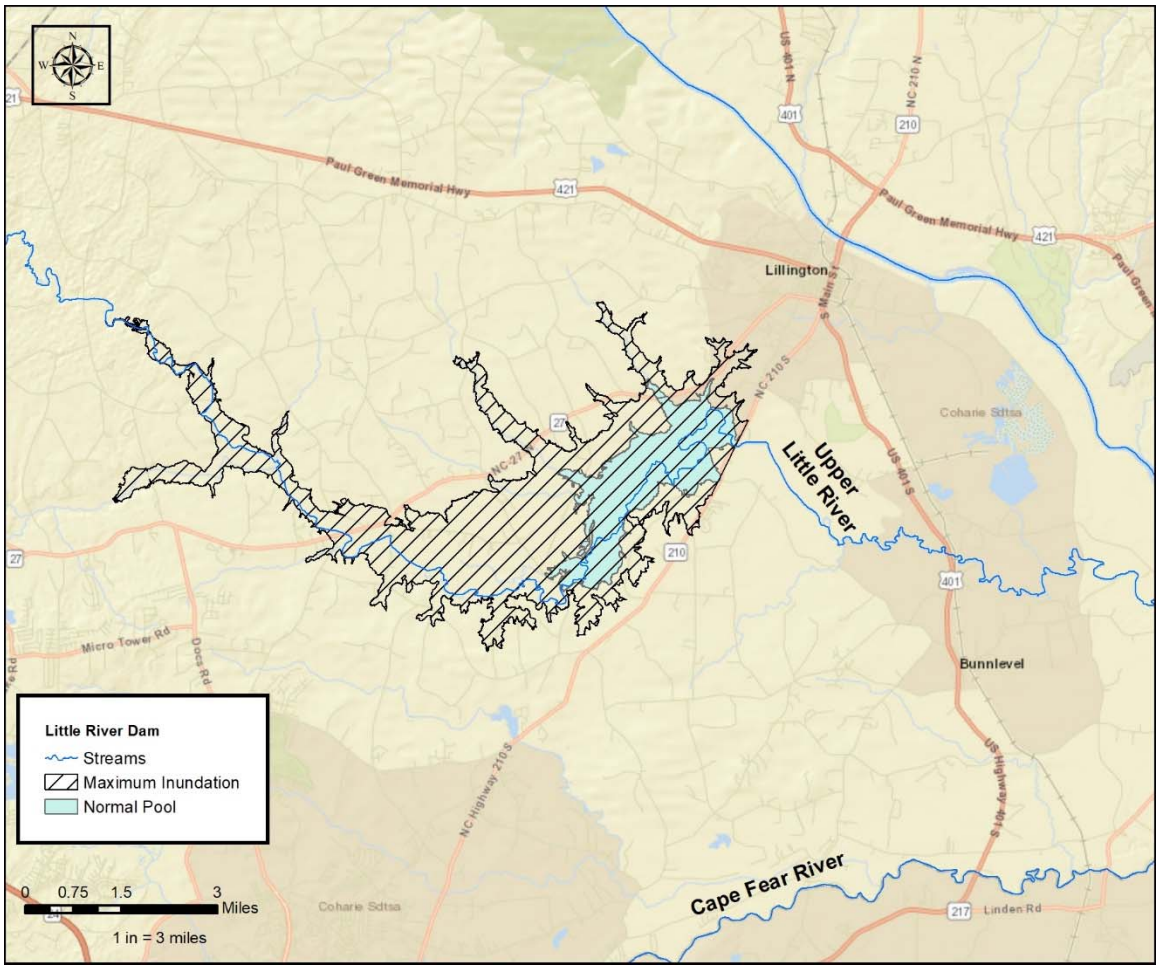


Figure 6-3: Upper Little River Reservoir Location

The drainage area at this location is approximately 187 square miles. A dam just upstream of NC Hwy 210 at a height of approximately 62.5 feet (Top elevation 200.0 for a wet configuration) and 61.0 feet (Top elevation 198.5 for a dry pond configuration) would impound an area approximately 9,600 acres (measured at elevation 200.0) and provide approximately 244,000 acre-feet of storage.

The hypothetical dam was assumed to be an earthen embankment dam with 3 horizontal to 1 vertical side slopes, a 25-foot crest width. In the wet configuration, the primary spillway was assumed to be a 14-ft X 14-ft concrete tower at crest elevation 160.0-ft (permanent pool elevation) with a 28.0-ft weir length and 72-inch diameter outlet conduit. An earthen, 500-foot-wide trapezoid channel was assumed for an auxiliary spillway at elevation 195.0. In the dry configuration, a riser is not used, and the outlet works simply consist of a single 72-inch diameter outlet conduit serving as the primary spillway and a 500-foot-wide trapezoid channel auxiliary spillway at elevation 194.5.

Reservoir elevation-storage data was developed from lidar topographic data. The top of dam elevation was selected based on surrounding topography to minimize crest length. Initial model iterations indicated sufficient storage was available to allow the reservoir to be modeled as a wet detention reservoir. Therefore, a starting water surface elevation was selected to maximize the wet reservoir volume, and the auxiliary spillway elevation was set to provide approximately four feet of freeboard to the top of dam. This dam was also modeled as a dry reservoir with the spillway configuration described above.

Modeling results indicate the entire 1000-yr event can be stored without activating the auxiliary spillway. Peak flood elevations for each storm event are provided in Table 6-2.

Upper Little River Dam		
Description	**Wet Configuration**	**Dry Configuration**
Top of Dam (Elevation-ft)	200.0	198.5
Permanent Pool (Elevation-ft)	160.0	144.0 (DRY)
Dam Height (ft)	62.5	61.0
Crest Length(ft)	6830	6750
Auxiliary Spillway Elevation (ft)	195.0	194.5
Spillway Width (ft)	500	500
5-yr Peak Elevation (ft)	174.0	170.5
10-yr Peak Elevation (ft)	176.9	173.8
25-yr Peak Elevation (ft)	180.9	178.1
50-yr Peak Elevation (ft)	183.9	181.4
100-yr Peak Elevation (ft)	186.8	184.5
200-yr Peak Elevation (ft)	189.8	187.7
500-yr Peak Elevation (ft)	193.4	191.5
1000-yr Peak Elevation (ft)	195.6	194.4

Table 6-2: Upper Little River Dam Summary

At a normal pool elevation of 160.0 feet, the maximum lake depth would be approximately 22.0 feet at the dam with an average depth of 8.7 feet. Base flow was included in the basin wide hydrologic study, therefore base flow was also considered in the dam modeling. However, minimum stream flows requirements will need to be considered in a more detailed study for this dam.

The Upper Little River-1 reservoir storage capacity between normal pool and the top of the dam is approximately 225,800 acre-feet. Based on HEC-HMS modeling this is sufficient to capture and store all of the modeled storm events and provide approximately four feet of freeboard to the top of the dam for the 1000-yr event.

Technical Analysis

Modeling showed that the Little River Dam will not reduce peak discharges along the Cape Fear River and therefore should be considered for flood mitigation benefits only along the Little River. The Upper Little River Dam modeling shows it can reduce peak discharges along the Cape Fear River. Based on the modeling results, there is no increased benefit to consider these dams in combination since they provide flow reduction benefits to different areas of the Cape Fear River Basin. This planning level approach seeks to provide a thorough representation of the potential benefits and costs at each site.

As was noted in Figure 5-3, there is a large increase in damages from the 100-Year project flood to the 500-Year project flood. This makes reduction of the 500-Year discharges down to the 100-Year baseline discharges a good target for the scenarios that were explored.

A high-level recreation estimation was conducted for the wet reservoir scenarios, which included the assumption that both lakes would be available for motorized boating. Recreational benefits could be applied to dry sites as well with the construction of parks and greenways, but for this study, that land was factored in as an opportunity for lease back for agriculture. Estimation of recreational benefits was based on analyses of recreational benefits for three potential wet detention sites from the Neuse River Basin study which developed a unit cost of recreation benefit per surface area of the normal pool. The unit cost for the Little River and Upper Little River Dams were derived from the Neuse study site closest in size. This analysis can be found in Appendix K – Cape Fear Basin Recreational Assessment.

Potential for municipal and agricultural water supply was not considered in the benefit analysis but should be investigated further for sites where there will be a need for additional water supply. It is recommended that a separate study focused on future water supply requirements in the basin be undertaken.

- **Little River Wet Reservoir**
  As shown below in Figure 6-4, this option assumes the Little River Dam is constructed as a wet detention facility to evaluate reduced discharges along the Little River downstream of the dam. This alternative is referred to as alternative LR4 for reporting purposes.

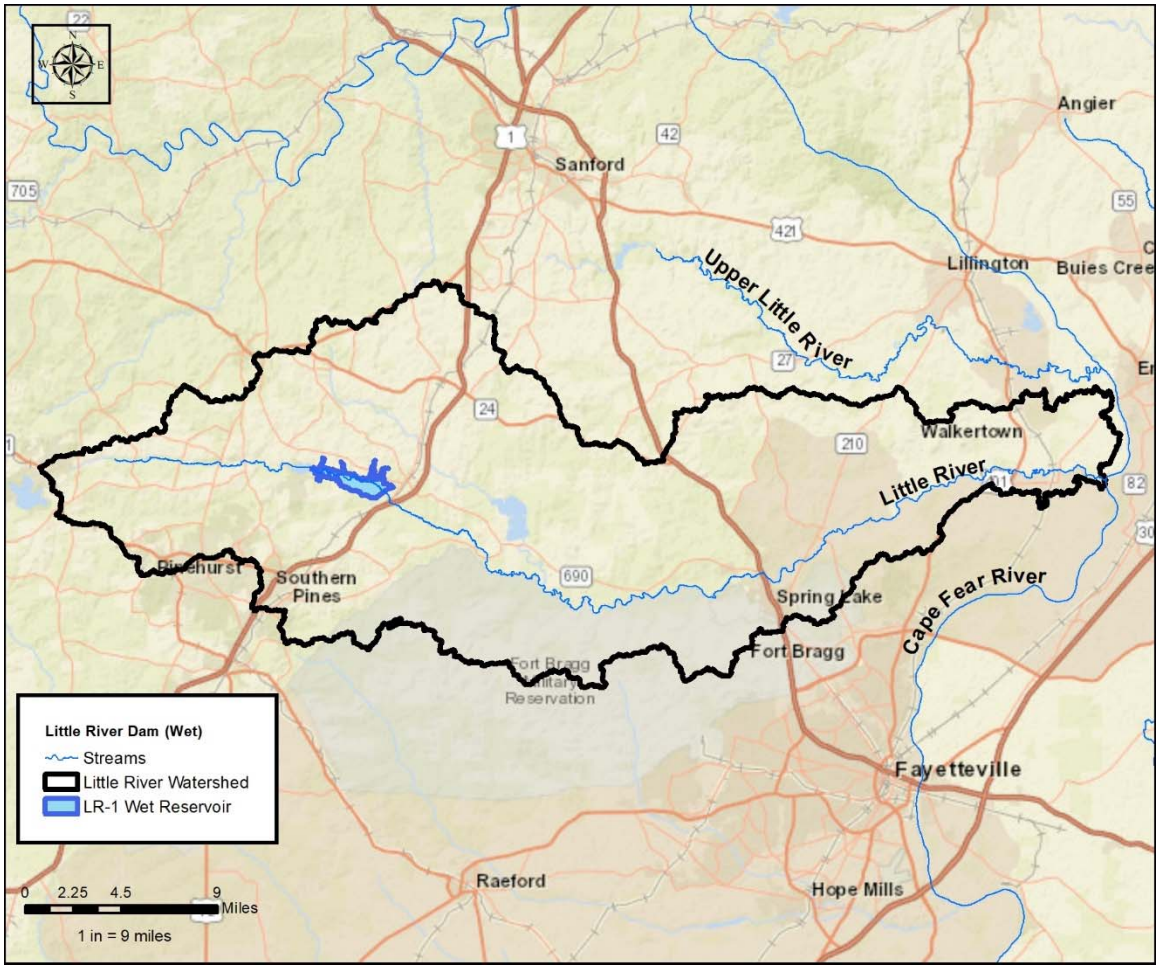


Figure 6-4: Little River Wet Reservoir

Peak discharges are reduced, and lower water surface elevations are realized with this option. Peak flow reduction and water surface elevation changes are summarized for key locations within the study area in Tables 6-3 and 6-4 below.

Wet Dam	Flood Event (return period), % Peak Reduction							
Location	5	10	25	50	100	200	500	1000
Below Dam (J_LR008)	42.5%	47.2%	56.2%	55.1%	54.4%	53.5%	53.2%	53.2%
Confluence with Crane Creek (J_LR006)	20.9%	21.0%	20.7%	20.3%	20.2%	19.9%	19.8%	19.7%
USGS Gage - Little River at Manchester (US Hwy 24 - Bragg Blvd., J_LR004)	15.2%	15.5%	15.3%	15.4%	13.0%	12.1%	12.7%	14.2%
Confluence with Cape Fear River (Outlet)	8.6%	11.0%	10.9%	11.1%	8.4%	5.8%	5.9%	8.6%

Table 6-3: LR4 Peak Discharge Reduction

Wet Dam	Flood Event (return period), WSEL Reduction (ft)							
Location	5	10	25	50	100	200	500	1000
Below Dam	0.6	0.8	1.2	1.3	1.4	1.5	1.6	1.7
Just downstream of Cane Creek Confluence	0.4	0.5	0.6	0.6	0.6	0.5	0.6	0.7
USGS Gage - Little River at Manchester (US Hwy 24 - Bragg Blvd.)	0.7	1.0	1.0	1.4	1.0	0.9	0.7	1.3
Confluence with Cape Fear River	0.7	1.1	1.3	1.5	1.3	0.9	1.1	1.7

Table 6-4: LR4 Peak Water Surface Elevation Reduction

LR4 - Losses Avoided – The Little River reservoir as a wet dam provides flood damage reduction in the Little River Basin area. Refer to Appendix A for community specific damage tables and curves for each modeled storm event for this configuration.

LR4– Other Benefits - Opportunities for recreation, property value increases/decreases, tax revenue increases/decreases, and land leasing were considered for the Little River Wet Dam. Table 6-5 outlines the benefits and costs estimated for the dam.

	Little River Dam (WET)
Property Acquisition	$ 16,880,925
Design/Construction	$ 60,784,030
Environmental Impacts	$ 81,907,232
Maintenance/year	$ 10,000
Road Impacts	$ 250,000
Property Value Increase*	$ 33,730,036
Tax Revenue Change/year*	$ 185,515
Leasing Benefit/year	$ -
* Property value and tax increase realized 10 years after dam construction	

Table 6-5: LR4 Benefits and Costs

LR4 – Benefit/Cost - Benefit/cost (B/C) ratios were calculated for 30-year and 50-year time horizons. B/C ratios included; costs (property acquisition, dam design and construction, highway impacts, environmental impacts, and operation and maintenance); benefits (property value increase, land leasing potential for agriculture and hunting, direct and indirect losses avoided); and other considerations (tax revenue change). Costs, benefits, and resulting B/C ratios are provided in Table 6-6 below.

Little River Wet Dam								
	Costs		Losses Avoided				Benefit Cost Ratio	
Time Horizon	Initial	Maintenance	Direct	Direct + Indirect	Other Benefit	Other Cost	Direct	Direct + Indirect
30-Year	$159,822,187	$300,000	$828,268	$1,856,689	$82,030,340	$0	**0.52**	**0.52**
50-Year	$159,822,187	$500,000	$1,380,447	$3,094,481	$93,286,644	$0	**0.59**	**0.60**

Table 6-6: LR4 Benefit/Cost Ratio

Additional information regarding the damage assessments for the Little River Wet Reservoir can be found in Appendix L– LR4 Data Development.

- **Little River Dry Reservoir**

  Figure 6-5 shows the location of the Little River Dry Reservoir. This option assumes the Little River Dam is constructed as a dry detention facility to evaluate reduced discharges along the Little River downstream of the dam. This alternative is referred to as alternative LR5 for reporting purposes.

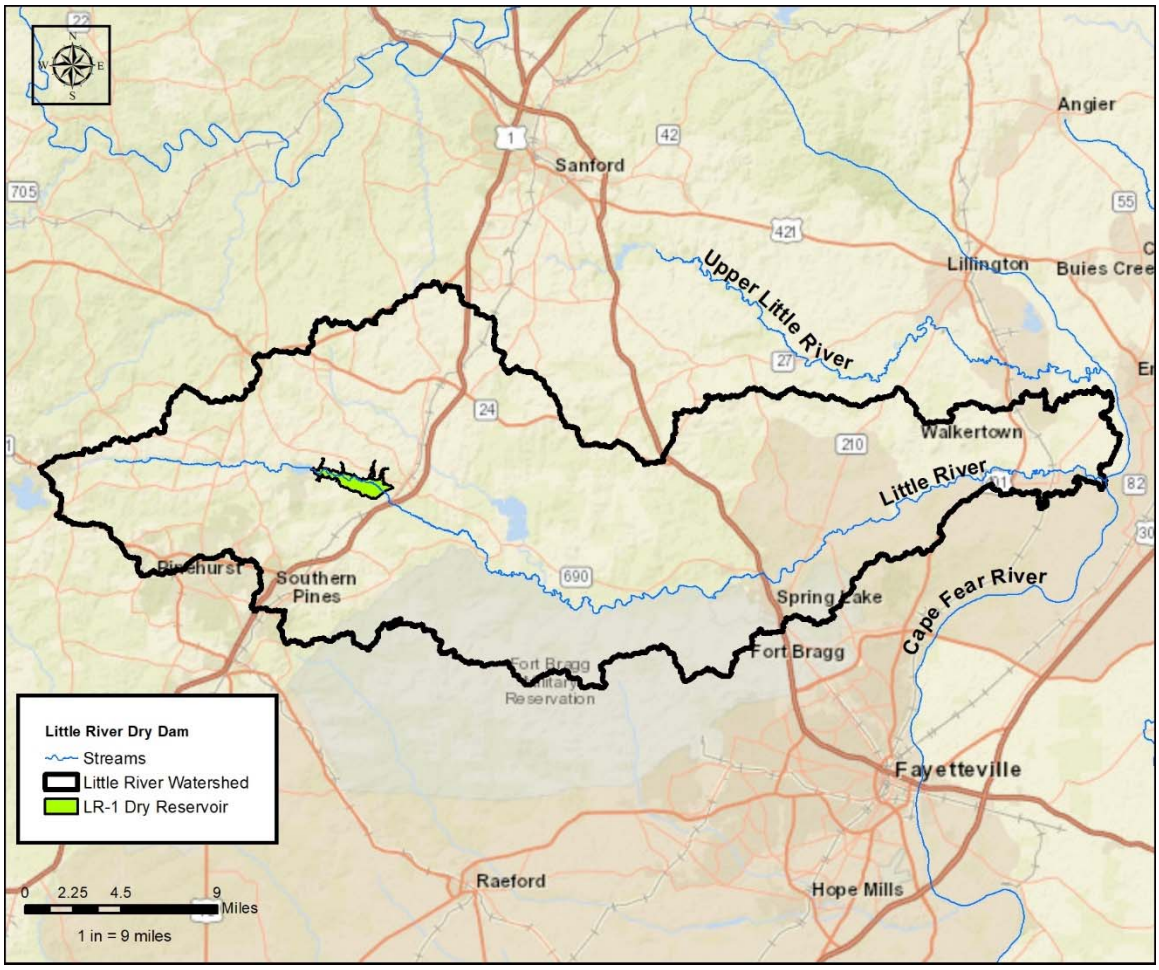


Figure 6-5: Little River Dry Reservoir

Peak discharges are reduced, and lower water surface elevations are realized with this option. Peak flow reduction and water surface elevation changes are summarized for key locations within the study area in Tables 6-7 and 6-8 below.

Dry Configuration	Flood Event (return period), % Peak Reduction							
Location	5	10	25	50	100	200	500	1000
Below Dam (J_LR008)	38.5%	44.3%	48.2%	50.0%	51.3%	52.1%	52.9%	53.3%
Confluence with Crane Creek (J_LR006)	13.5%	15.4%	16.9%	17.6%	18.2%	18.6%	19.1%	19.3%
USGS Gage - Little River at Manchester (US Hwy 24 - Bragg Blvd., J_LR004)	9.8%	11.3%	12.3%	13.2%	11.5%	11.1%	12.3%	13.7%
Confluence with Cape Fear River (Outlet)	6.7%	8.0%	8.8%	9.5%	7.1%	5.2%	5.6%	8.3%

Table 6-7: LR5 Peak Discharge Reduction

Dry Dam	Flood Event (return period), WSEL Reduction (ft)							
Location	5	10	25	50	100	200	500	1000
Below Dam	0.5	0.7	1.0	1.1	1.3	1.4	1.6	1.7
Just downstream of Cane Creek Confluence	0.3	0.4	0.5	0.5	0.6	0.5	0.6	0.7
USGS Gage - Little River at Manchester (US Hwy 24 - Bragg Blvd.)	0.6	0.7	0.8	1.3	0.8	0.8	0.7	1.2
Confluence with Cape Fear River	0.6	0.8	1.1	1.3	1.1	0.8	1.0	1.7

Table 6-8: LR5 Peak Water Surface Elevation Reduction

LR5 - Losses Avoided – The Little River Dry Reservoir provides flood damage reduction in the Little River Basin area. Refer to Appendix A for community specific damage tables and curves for each modeled storm event for this option.

LR5 – Other Benefits – It was assumed that the land inside the dry reservoir would be purchased by the State and that tax revenue would therefore decrease. This would be offset by leasing of the land for agriculture and other uses, such as hunting. No other recreational benefits were considered for this scenario. Refer to Table 6-9 below for additional information.

	Little River DRY
Property Acquisition	$ 16,880,925
Design/Construction	$ 51,220,431
Environmental Impacts	$ 3,838,760
Maintenance/year	$ 10,000
Road Impacts	$ 250,000
Property Value Increase	$ -
Tax Revenue Change/year	$ 88,424
Leasing Benefit/year	$ 37,392

Table 6-9: LR5 Benefits and Costs

LR5 – Benefit/cost - B/C ratios were calculated for 30-year and 50-year time horizons. B/C ratios included; costs (property acquisition, dam design and construction, highway impacts, environmental impacts, and operation and maintenance); benefits (property value increase, land leasing potential for agriculture and hunting, direct and indirect losses avoided); and other considerations (tax revenue change). Costs, benefits, and resulting B/C ratios are provided in Table 6-10 below.

Little River Dry Dam								
Time Horizon	Costs		Losses Avoided		Other Benefit	Other Cost	Benefit Cost Ratio	
	Initial	Maintenance	Direct	Direct + Indirect			Direct	Direct + Indirect
30-Year	$72,190,116	$300,000	$759,014	$1,741,164	$1,121,760	$2,652,717	**0.03**	**0.04**
50-Year	$72,190,116	$500,000	$1,265,024	$2,901,939	$1,869,600	$4,421,195	**0.04**	**0.06**

Table 6-10: LR5 Benefit/Cost Ratio

Additional information regarding the damage assessment for this option can be found in Appendix M – LR5 Data Development.

- **Upper Little River Wet Reservoir**
  This option considers the Upper Little River Dam as a wet detention facility to evaluate discharge reduction downstream along the Cape Fear River. Figure 6-6 shows the Upper Little River wet reservoir relative to the Cape Fear River. This alternative is referred to as alternative CF2 for reporting purposes.

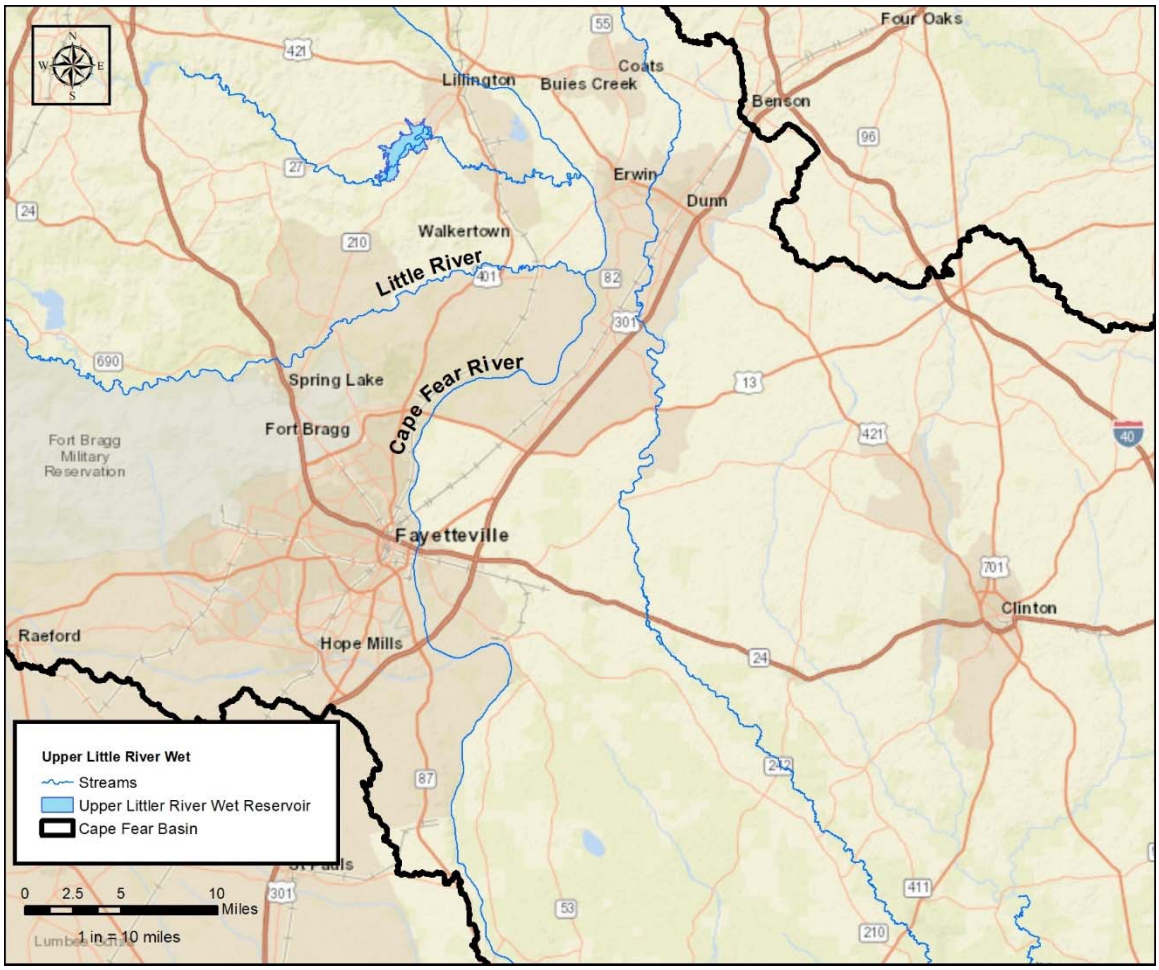


Figure 6-6: Upper Little River Wet Reservoir

Implementation of this option results in reduced peak flows downstream of the dam. However, peak discharge reduction occurs primarily for larger storm events. For smaller events little to no peak flow discharge reductions are realized. In general, peak flow reductions are relatively small because the Cape Fear River drainage basin at the confluence with Upper Little River is approximately 3,750 sq miles and the Upper Little River drainage basin is only 220 square miles. Peak flow reduction and water surface elevation changes are summarized for key locations within the study area in Tables 6-11 and 6-12.

Wet Configuration	Flood Event (return period), % Peak Reduction							
Location	5	10	25	50	100	200	500	1000
Cape Fear River just upstream of Little River Confluence	-3.2%	0.6%	0.8%	-1.8%	-2.6%	-2.5%	-2.4%	-2.3%
Cape Fear River just upstream of Rockfish Creek Confluence	-4.5%	-1.0%	-1.2%	-4.6%	-4.5%	-4.5%	-4.6%	-4.6%
Cape Fear Gage at William O. Huske Lock - 02105500	-3.6%	-0.7%	-0.9%	-3.7%	-3.3%	-3.4%	-3.5%	-3.5%
Cape Fear River at US Hwy 701 in Elizabethtown, NC	-2.0%	-0.4%	-0.5%	-3.2%	-3.3%	-3.4%	-3.4%	-3.4%
Cape Fear River Gage at Lock #1 - 02105769	-1.1%	0.3%	0.0%	-2.9%	-2.7%	-2.7%	-2.8%	-2.8%
Cape Fear River just upstream of Livingston Creek Confluence	-1.2%	0.4%	0.1%	-2.7%	-2.5%	-2.4%	-2.4%	-2.4%
Cape Fear River just upstream of Black River confluence	-1.3%	0.3%	0.1%	-2.7%	-2.5%	-2.4%	-2.3%	-2.3%
Cape Fear River model outlet	-1.2%	0.3%	0.0%	-2.4%	-2.4%	-2.3%	-2.2%	-2.2%

Note: Negative values in Table 6-11 indicate a reduction in peak flow, positive values indicate an increase in peak flow

Table 6-11: CF2 Peak Discharge Reduction

Wet Dam	Flood Event (return period), WSEL Reduction (ft)							
Location	5	10	25	50	100	200	500	1000
Just upstream of NC Hwy 217 near Erwin, NC	0.7	0.1	0.2	1.0	1.1	1.2	1.4	3.1
Just upstream of confluence with Cape Fear River	0.8	0.2	0.3	1.1	1.2	1.3	1.5	3.0
Just upstream of NC Hwy 24/210 in Fayetteville, NC	0.6	0.1	0.2	0.8	0.8	0.9	1.0	2.7
Just Upstream of I-95	0.5	0.1	0.1	0.7	0.7	0.7	0.7	1.4
Approximately 4.0 miles upstream of the William O. Huske Lock	0.4	0.1	0.1	0.6	0.5	0.6	0.6	1.1
William O. Huske Lock near Tarheel, NC	0.3	0.1	0.1	0.5	0.5	0.5	0.6	1.1
Just upstream of Tarheel Ferry Road	0.3	0.0	0.1	0.5	0.5	0.5	0.5	1.0
Lock # 2 near Elizabethtown, NC	0.1	0.0	0.0	0.3	0.3	0.3	0.3	0.7
Approximately 5.5 miles upstream of Lock #1	0.1	0.0	0.0	0.2	0.2	0.2	0.2	0.4
Just US of Lock # 1 near Kelly, NC	0.1	0.0	0.0	0.2	0.2	0.1	0.2	0.4
Just upstream of confluence with Livingston Creek	0.1	0.0	0.0	0.2	0.2	0.2	0.2	0.4

Table 6-12: CF2 Peak Water Surface Elevation Reduction

CF2 - Losses Avoided (direct damages) – This option provides flood damage reduction for areas along the Cape Fear River. Refer to Appendix A for community specific damage tables and curves for each modeled storm event for this option.

CF2 – Other Benefits - Opportunities for recreation, property value increases/decreases, tax revenue increases/decreases, and land leasing were considered for this option. Refer to Table 6-13 below for additional information.

	Upper Little River Dam (WET)
Property Acquisition	$ 66,933,722
Design/Construction	$ 76,480,511
Environmental Impacts	$ 141,662,513
Maintenance/year	$ 10,000
Road Impacts	$ 19,764,203
Property Value Increase*	$ 116,113,902
Tax Revenue Change/year*	$ 1,021,802
Leasing Benefit/year	$ -
* Property value and tax increase realized 10 years after dam construction	

Table 6-13: CF2 Benefits and Costs

CF2 – Benefit/Cost - B/C ratios were calculated for 30-year and 50-year time horizons. B/C ratios included; costs (property acquisition, dam design and construction, highway impacts, environmental impacts, operation and maintenance, and tax revenue decrease); benefits (land leasing potential for agriculture and hunting, direct and indirect losses avoided); Costs, benefits, and resulting B/C ratios are provided in Table 6-14 below.

Upper Little River Wet Dam								
	Costs		Losses Avoided				Benefit Cost Ratio	
Time Horizon	Initial	Maintenance	Direct	Direct + Indirect	Other Benefit	Other Cost	Direct	Direct + Indirect
30-Year	$304,850,948	$300,000	$1,686,530	$6,029,655	$272,334,949	$0	**0.90**	**0.91**
50-Year	$304,850,948	$500,000	$2,810,883	$10,049,425	$315,749,995	$0	**1.04**	**1.07**

Table 6-14 – CF2 Benefit/Cost Ratio

Additional information regarding the damage assessment for this option can be found in Appendix N – CF2 Data Development.

Upper Little River Dry Reservoir

This mitigation option considers the Upper Little River Dam as a dry detention facility to evaluate discharge reduction downstream along the Cape Fear River. Figure 6-7 shows the Upper Little River dry reservoir location. This alternative is referred to as alternative CF3 for reporting purposes.

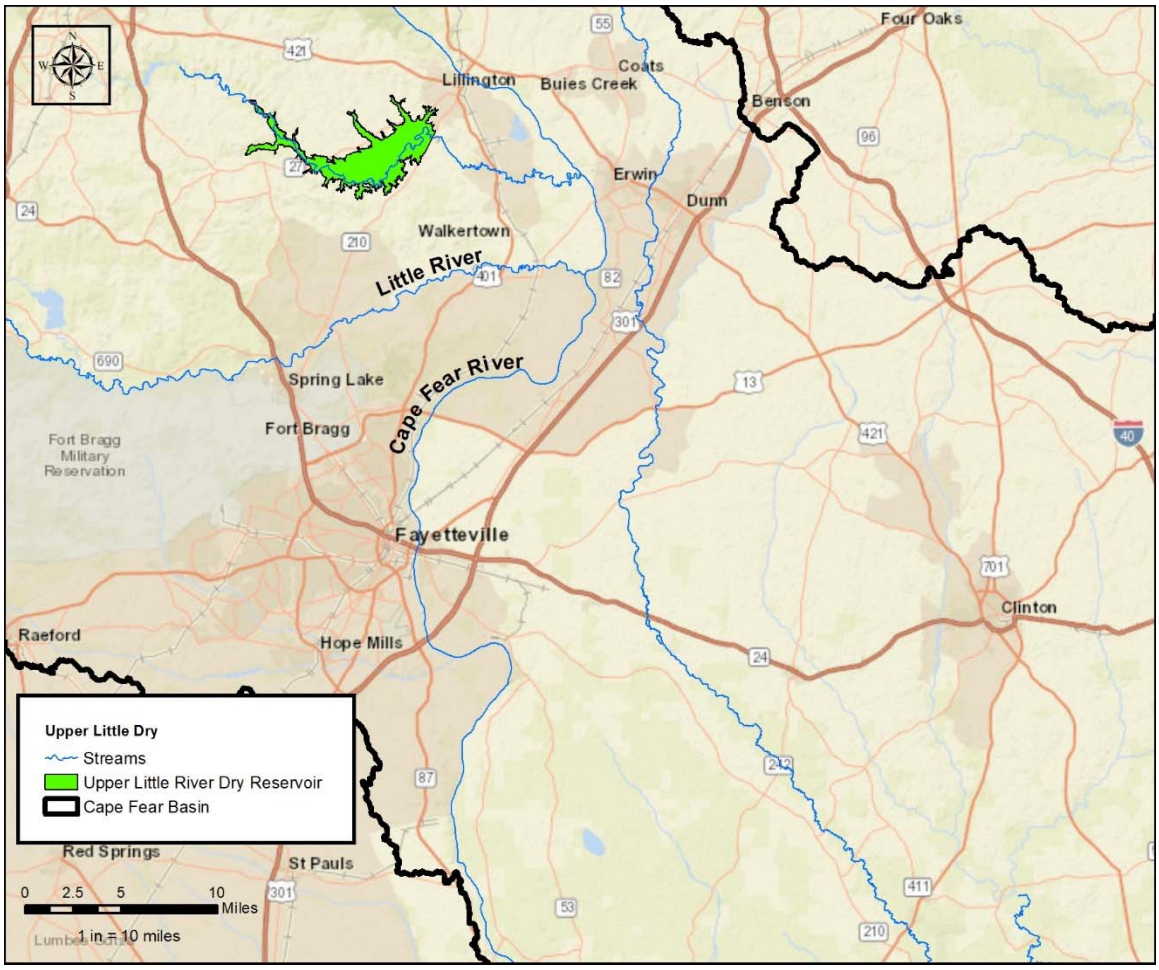


Figure 6-7: Upper Little River Dry Reservoir

Implementation of this option results in reduced peak flows downstream of the dam. However, peak discharge reduction occurs primarily for larger storm events. For smaller events little to no peak flow discharge reductions are realized. Generally, peak flow reductions are relatively small because the Cape Fear River drainage basin at the confluence with Upper Little River is approximately 3,750 sq miles and the Upper Little River drainage basin is only 220 square miles. Peak discharge reduction is summarized for key locations within the study area in Tables 6-15 and 6-16 below.

Dry Configuration	Flood Event (return period), % Peak Reduction							
Location	5	10	25	50	100	200	500	1000
Cape Fear River just upstream of Little River Confluence	-3.2%	0.6%	0.8%	-2.1%	-2.6%	-2.5%	-2.4%	-2.3%
Cape Fear River just upstream of Rockfish Creek Confluence	-4.7%	-1.2%	-1.4%	-4.7%	-4.6%	-4.7%	-4.7%	-4.7%
Cape Fear Gage at William O. Huske Lock - 02105500	-3.8%	-0.9%	-1.0%	-3.9%	-3.4%	-3.5%	-3.6%	-3.6%
Cape Fear River at US Hwy 701 in Elizabethtown, NC	-2.2%	-0.5%	-0.7%	-3.4%	-3.4%	-3.4%	-3.4%	-3.5%
Cape Fear River Gage at Lock #1 - 02105769	-1.2%	0.1%	-0.2%	-3.0%	-2.8%	-2.8%	-2.8%	-2.8%
Cape Fear River just upstream of Livingston Creek Confluence	-1.3%	0.2%	0.0%	-2.9%	-2.6%	-2.5%	-2.4%	-2.4%
Cape Fear River just upstream of Black River confluence	-1.5%	0.2%	-0.1%	-2.8%	-2.6%	-2.5%	-2.4%	-2.4%
Cape Fear River model outlet	-1.4%	0.1%	-0.1%	-2.5%	-2.5%	-2.4%	-2.3%	-2.2%

Note: Negative values in Table 6-14 indicate a reduction in peak flow, positive values indicate an increase in peak flow.

Table 6-15 – CF3 Peak Discharge Reduction

DRY Dam	Flood Event (return period), WSEL Reduction (ft)							
Location	5	10	25	50	100	200	500	1000
Just upstream of NC Hwy 217 near Erwin, NC	0.7	0.2	0.2	1.1	1.1	1.2	1.4	3.1
Just upstream of confluence with Little River	0.9	0.2	0.3	1.2	1.2	1.3	1.5	3.0
Just upstream of NC Hwy 24/210 in Fayetteville, NC	0.6	0.2	0.2	0.9	0.9	0.9	1.0	2.7
Just Upstream of I-95	0.5	0.1	0.2	0.7	0.7	0.7	0.7	1.4
Approximately 4.0 miles upstream of the William O. Huske Lock	0.4	0.1	0.1	0.6	0.6	0.6	0.6	1.1
William O. Huske Lock near Tarheel, NC	0.4	0.1	0.1	0.6	0.5	0.5	0.6	1.1
Just upstream of Tarheel Ferry Road	0.3	0.1	0.1	0.5	0.5	0.5	0.5	1.0
Lock # 2 near Elizabethtown, NC	0.1	0.0	0.0	0.3	0.3	0.3	0.4	0.7
Approximately 5.5 miles upstream of Lock #1	0.1	0.0	0.0	0.2	0.2	0.2	0.2	0.4
Just US of Lock # 1 near Kelly, NC	0.1	0.0	0.0	0.2	0.2	0.1	0.2	0.4
Just upstream of confluence with Livingston Creek	0.1	0.0	0.0	0.2	0.2	0.2	0.2	0.4

Table 6-16 – CF3 Peak Water Surface Elevation Reduction

CF3 - Losses Avoided – This option provides flood damage reduction in the Cape Fear River Basin area. Refer to Appendix A for community specific damage tables and curves for each modeled storm event.

CF3 – Other Benefits - For this option it is was assumed that the land inside the dry reservoir would be purchased by the State and that tax revenue would therefore decrease. This would be offset by leasing of the land for agriculture and other uses, such as hunting. No other recreational benefits were considered for this scenario. Refer to Table 6-17 below for additional information

	ULR Dam (Dry)
Property Acquisition	$ 66,933,722
Design/Construction	$ 49,526,479
Environmental Impacts	$ 401,935
Maintenance/year	$ 10,000
Road Impacts	$ 15,219,797
Property Value Increase	$ -
Tax Revenue Change/year	$560,968
Leasing Benefit/year	$ 187,744

Table 6-17 – CF3 Benefits and Costs

CF3 – Benefit/Cost - B/C ratios were calculated for 30-year and 50-year time horizons. B/C ratios included; costs (property acquisition, dam design and construction, highway impacts, environmental impacts, and operation and maintenance); benefits (property value increase, direct and indirect losses avoided, and recreational benefits); and other considerations (tax revenue change). Costs, benefits, and resulting B/C ratios are provided in Table 6-18 below.

Upper Little River Dry Reservoir								
	Costs		Losses Avoided				Benefit Cost Ratio	
Time Horizon	Initial	Maintenance	Direct	Direct + Indirect	Other Benefit	Tax Revenue Loss (cost)	Direct	Direct + Indirect
30-Year	$132,081,932	$300,000	$1,945,940	$6,451,963	$5,632,317	$16,829,050	**0.05**	**0.08**
50-Year	$132,081,932	$500,000	$3,243,234	$10,753,271	$9,387,194	$28,048,417	**0.08**	**0.13**

Table 6-18 – CF3 Benefit/Cost Ratio

Additional information regarding the damage assessment for this option can be found in Appendix O – CF3 Data Development.

Strategy 2 – Retrofit of Existing Detention Structures

Existing Structures in the basin were assessed for potential to be retrofitted for additional flood storage and reduction of downstream discharges. The B. Everett Jordan Dam near Moncure, NC is a large flood detention reservoir that reduces flooding downstream, especially in the vicinity of Fayetteville, NC. Operations of this dam of this dam are complex and adjusted based on downstream real time flooding conditions so this dam was not considered for potential retrofit. The Shearon Harris Reservoir primary purpose is to provide cooling water for the nuclear-powered Shearon Harris electric generating facility and due to elevation constraints cannot be retrofitted to provide flood storage without potentially increasing flooding around the nuclear plant, so this dam was not considered for potential retrofit.

The existing Woodlake Dam on Cane Creek in Moore County was also considered for retrofit. This dam failed during Hurricane Florence and was subsequently permanently breached. Based on research of publicly available

information, the current owner is exploring options to rebuild the dam. This site was considered for further evaluation but based on topographic conditions insufficient storage volume is available at the current dam elevation to provide flood reduction benefits downstream. Increasing the dam height to increase flood storage is not an option due to existing houses and community infrastructure around the perimeter of the former impoundment that would be flooded. Therefore, this site was considered unsuitable for further evaluation.

Strategy 3 – Channel Modification

Artificial channels were explored as a strategy to improve conveyance during flood events and reduce upstream backwater impacts caused by natural terrain features that may restrict flood conveyance. Reducing flow restrictions could decrease flooding impacts upstream. Based initial evaluations, several areas considered for this strategy were eliminated since implementing this strategy would be too costly and offer little benefit.

One area along the Northeast Cape Fear River was identified as a potential site to implement this strategy to reduce flooding in the River Landing community near Wallace, NC. This site was selected due to the combination of a high concentration of flood impacts in River landing and natural terrain restrictions just downstream Rockfish Creek. Low-lying, natural topography in the left overbank of the Northeast Cape Fear River forms a separate channel-like feature that allows flood water to flow in the overbank area independently of the main river channel during high flood events. Improvement of this channel feature by further channelizing the flow to improve conveyance was explored. Figure 6-8 shows the location of the potential conveyance channel. This alternative is referred to as alternative NECF11 for reporting purposes.

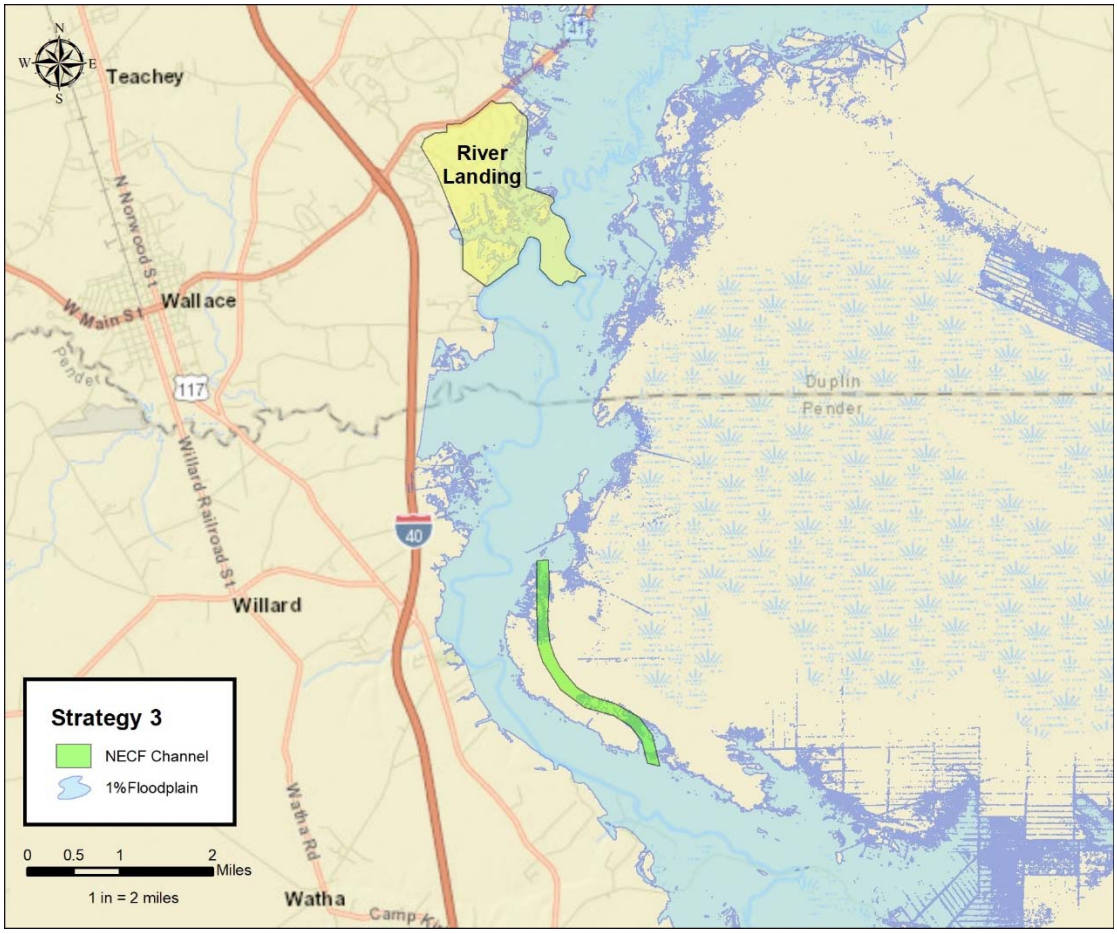


Figure 6-8: Northeast Cape Fear River – NECF11 Location

The hypothetical channelized feature is approximately 16,000 feet long. Water surface elevation reductions due to channel improvements were evaluated in a 1D HEC-RAS model. The natural terrain along the channel was modified to represent an approximately 630-feet wide, trapezoid channel with 2 horizontal to 1 vertical side slopes with a bottom sloped downstream at approximately 0.05%. The channel bottom elevation at the upstream end was set at the same elevation as the 10 percent annual chance storm baseline water surface elevation so that overall conveyance capacity is increased for all storm events larger than the 10 percent event. The graded channel and channelized Manning's "n" values were added to the HEC-RAS 1D model. Model water surface elevations from the HEC-RAS model were then compared to baseline water surface elevations for each storm event. Model results indicate the diversion channel reduces modeled water surface elevations in the River Landing area with the largest reductions seen around the Rockfish Creek confluence with Northeast Cape Fear River. Table 6-19 shows the maximum water surface elevation decreases of the HEC-RAS model overall and in the River Landing area.

Recurrence Interval (YR)	5	10	25	50	100	200	500	1000	FLORENCE
Max WSEL Difference - all sections (ft)	0.11	0.33	0.82	1.12	1.42	1.71	2.08	2.3	2.34
Max WSEL Difference in River Landing (ft)	0.05	0.21	0.56	0.79	1.04	1.3	1.62	1.84	1.85

Table 6-19: WSEL differences between Baseline and NECF11

As noted in Section 4 above, the study area along the Northeast Cape Fear River received a new one-dimensional HEC-RAS hydraulic model. In order to better identify and analyze potential mitigation options in the River Landing area which was heavily impacted during Hurricane Florence, a detailed two-dimensional HEC-RAS hydraulic model was developed as well. Details on the model development can be found in Appendix P - Northeast Cape Fear River Draft 2D Hydraulics Report.

The two-dimensional model was used to further investigate the effect of the artificial channel on magnitude and timing of flow throughout the study area. In order to perform this analysis, the Hurricane Florence event was modeled with the mitigation strategy in place and compared to the baseline model results. Implementation of the artificial channel would potentially have the following effects on an event similar to Hurricane Florence:

- Timing of the peak flow was reduced by 4 hours.
- Improved channel conveyance results in reduced flood storage which leads to flow increases of approximately 4% downstream.
- Recession timing of the flooding from the peak back down to a 50-yr level was reduced by 24 hours.

NECF11 - Losses Avoided – Mitigation Strategy NECF11 provides flood damage reduction in the Northeast Cape Fear River Basin, primarily upstream of the diversion channel. Refer to Appendix A for community specific damage tables and curves for each modeled storm event.

NECF11 – Benefit/cost – NECF11 B/C ratios were calculated for 30-year and 50-year time horizons. B/C ratios included; costs (property acquisition, design and construction, environmental impacts, and operation and maintenance); benefits (direct and indirect losses avoided); and other considerations (tax revenue change). Costs, benefits, and resulting B/C ratios are provided in Table 6-20 below.

Mitigation Strategy 3								
	Costs		Losses Avoided				Benefit Cost Ratio	
Time Horizon	Initial	Maintenance	Direct	Direct + Indirect	Other Benefit	Other Cost	Direct	Direct + Indirect
30-Year	$33,609,927	$3,354,750	$3,764,641	$11,481,191	$0	$127,635	**0.10**	**0.31**
50-Year	$33,609,927	$5,591,250	$6,274,402	$19,135,318	$0	$212,725	**0.16**	**0.49**

Table 6-20 – NECF11 Benefit/Cost Ratio

Additional information regarding the damage assessment for this scenario can be found in Appendix Q – NECF11 Data Development.

Strategy 4 – New Embankment Structures

Areas with significant floodplain development were investigated for potential flood protection using a levee. Criteria for feasible levee construction include the presence of densely concentrated development at risk of flooding and favorable natural topography. In addition, potential adverse impacts to other areas not protected by the levee must be considered and additional mitigation options may be required. No areas of concentrated structures vulnerable to flooding that could be adequately protected by a levee meeting the feasibility criteria were found, therefore this strategy was not pursued.

Strategy 5 – Existing Levee Repair or Enhancement

This strategy consists of repairs and rehabilitation of the existing US Army Corps of Engineers White Oak Dike near Kelly, NC. Repairs and rehabilitation to correct significant deficiencies such as man-made breaches from timbering operations, mature trees growing on the dike, and erosion of the dike profile could provide flood protection to buildings behind the dike. The location of the White Oak Dike is shown on Figure 6-9. This alternative is referred to as alternative CF1 for reporting purposes.

The White Oak Dike is a 14.5-mile-long existing flood control dike located along the Cape Fear River in the southeast section of Bladen County and northwest section of Pender County, NC approximately 35 miles north of Wilmington, NC. The dike was constructed in sections beginning in 1911, extended in 1934 by the Works Progress Administration, repaired in 1946-47 under Section 5 of the Flood Control Act of 1941, and repaired, raised, and extended as authorized in 1960 by Section 205 of the Flood Control Act of 1948. In 2001, a Continuing Eligibility Inspection by the Corps of Engineers resulted in the dike being rated unacceptable and therefore classified inactive in the Public Law PL 84-99 program that provides reimbursement for certain damages to levees that result from high-water events. The White Oak Dike is a Non-Accredited Levee System according to FEMA.

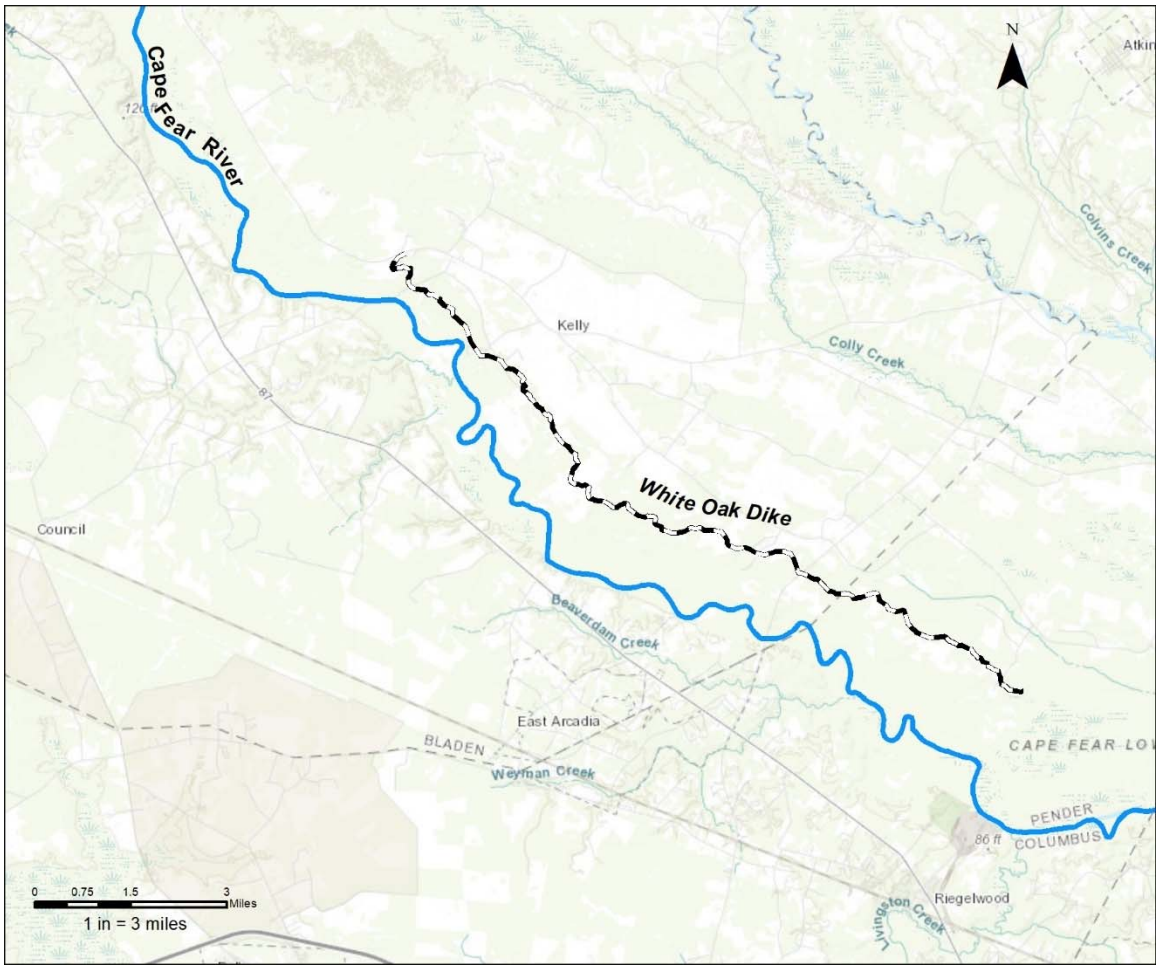


Figure 6-9: White Oak Dike

This strategy is assumed to include necessary actions to readmit the dike into the PL84-99 program. It is not expected to bring the dike into full compliance with FEMA regulations and achieve full certification and accreditation.

The White Oak Dike could potentially protect against modeled storm events up to the 0.5pct annual chance event based on the baseline modeled water surface elevations approved for this study. Since the dike does not completely encircle protected areas backwater flooding from downstream of the end of the dike was included in the benefit/cost analysis for this strategy.

This study also considered that the repaired dike will cause an increase in water surface elevations upstream of the dike. Water surface increases affect some structures upstream and would require supplemental mitigation efforts. However, for this study the increase in water surface elevations and impacts to upstream structures was included in the cost/benefit analysis as an impact, effectively reducing the losses avoided.

CF1 - Losses Avoided – This scenario provides flood damage reduction in the Cape Fear River Basin area. Refer to Appendix A for community specific damage tables and curves for each modeled storm event.

CF1 – Other Benefits – Although protection in the form of reduced or eliminated structure damages was accounted for in this study, no consideration was given to reduced flood insurance premiums in the

cost/benefit analysis since this strategy is not intended to bring the White Oak Dike into full compliance with FEMA regulations or achieve full certification and accreditation. Therefore, no other benefits were included in the analysis.

ESP researched publicly available information about the White Oak and its status. Based on a news article by WECT dated June 3, 2020 (https://www.wect.com/2020/06/03/with-possible-permanent-fix-white-oak-dike-still-far-future-kelly-braces-another-season-storms/) the cost to repair the dike has been estimated to be in the tens of millions of dollars and could be up to $30 million. ESP reached out to the Army Corps of Engineers in Wilmington to try and verify this information but was unsuccessful. It was beyond the scope of this planning level study to prepared detailed cost estimates, therefore, due to lack of available information it was assumed the dike will be repaired to standards needed to readmit the dike into the PL 84-99 program, and that the cost of that will be $30 million dollars. On-going maintenance will be required to maintain the dike.

Refer to Table 6-21 below for cost information used in this study.

	White Oak Dike
Property Acquisition	$ -
Design/Construction	$ 30,000,000
Environmental Impacts	$ -
Maintenance/year	$ 24,000
Road Impacts	$ -
Property Value Increase*	$ -
Tax Revenue Change/year*	$ -
Leasing Benefit/year	$ -
* Property value and tax increase realized 10 years after dam construction	

Table 6-21 – CF1 Costs

CF1 – Benefit/Cost - B/C ratios were calculated for 30-year and 50-year time horizons. B/C ratios included; costs (design and construction, and operation and maintenance) and benefits (direct and indirect losses avoided). Costs, benefits, and resulting B/C ratios are provided in Table 6-18 below.

White Oak Dike								
	Costs		Losses Avoided				Benefit Cost Ratio	
Time Horizon	Initial	Maintenance	Direct	Direct + Indirect	Other Benefit	Other Cost	Direct	Direct + Indirect
30-Year	$30,000,000	$720,000	$8,729,964	$45,569,642	$0	$0	**0.28**	**1.48**
50-Year	$30,000,000	$1,200,000	$14,549,941	$75,949,403	$0	$0	**0.47**	**2.43**

Table 6-22 – CF1 Benefit/Cost Ratio

Additional information regarding the damage assessment for this option can be found in Appendix R – CF1 Data Development.

No other levee repair or enhancement projects were identified for further investigation in this study.

Strategy 6 – Roadway Elevation

The purpose of this strategy is to determine if improvements to hydraulic structure conveyance will reduce flooding upstream of those structures. Hydraulic model water surface profiles along Little River, Cape Fear River and Northeast Cape Fear River were reviewed to identify bridges, culverts, or dams causing backwater flooding along those streams. Analyses of each of the rivers is discussed below.

- **Little River Bridge Elevation**

  Two bridges on Little River were identified as potentially causing water elevation increases upstream that coincide with a concentration of buildings identified as subject to flooding from the baseline modeling. Two bridges in Spring Lake, NC were identified as candidates for increasing conveyance. Other bridges along Little River are either located in rural areas with no flooding impacts to structures or are significantly overtopped and do not appear to be causing significant water surface increases upstream. Modifying bridges in rural areas will not generate a positive benefit/cost ratio and were not further evaluated.

  The NC Hwy 24 (Bragg Blvd.) and E. Manchester Road bridges in Spring Lake, NC were selected for evaluation. The bridge locations are shown below in Figure 6-10. This alternative is referred to as alternative LR6 for reporting purposes.

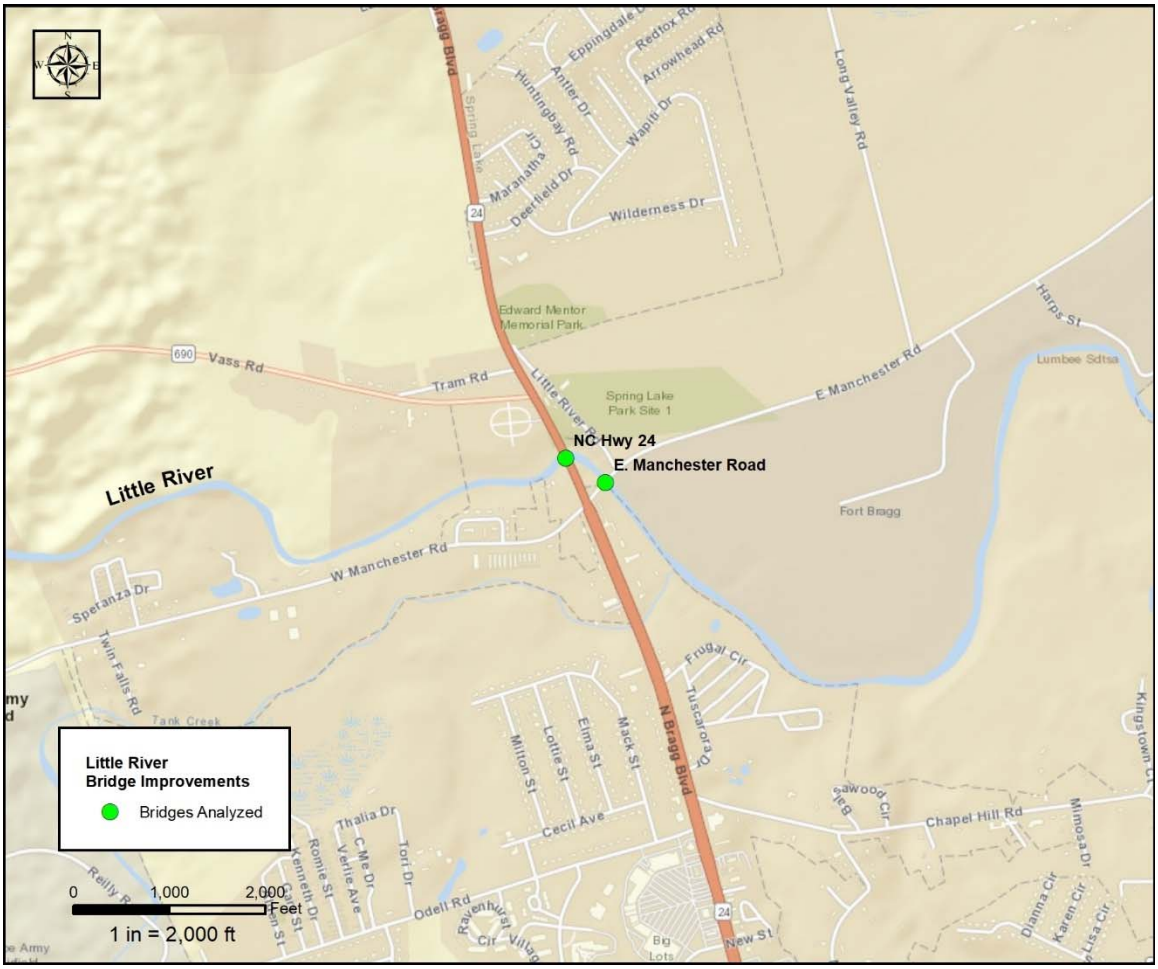


Figure 6-10 – Little River Bridge Conveyance Improvement Locations

This strategy was evaluated using the Little River HEC-RAS model with baseline flows. The two bridge structures were modified in the model to simulate overbank grading and bridge width opening increases, as well as updating manning's n values in overbank areas of the widened bridges and updating ineffective flow boundaries consistent with the widened bridges. Raising bridge low chord elevations was considered but due to roadway geometry constraints, raising the low chord is not likely possible due to roadway and terrain elevation constraints.

The E. Manchester Road bridge modification would increase the bridge opening width by 97 feet. The Bragg Blvd. bridge modification would increase the bridge opening width by 100 feet. These modifications decrease water surface elevations as described below.

E. Manchester Road Bridge – HEC-RAS model results indicate the modeled bridge modifications will cause water surface elevation reductions upstream of the bridge when compared to baseline water surface elevations. Maximum water surface elevation decreases occur within 500 feet upstream of the bridge and decreases up to 0.10 feet extend upstream for approximately 2.9 miles. Maximum elevation changes are shown in Table 6-23.

Recurrence Interval	20pct	10pct	4pct	2pct	1pct	0.5pct	0.2pct	0.1pct
Max WSE Decrease - all sections (ft)	0.01	0.01	0.02	0.33	0.3	0.4	0.31	0.21

Table 6-23 - E. Manchester Road Bridge Modifications - Water Surface elevation Changes

NC Hwy 24 (Bragg Blvd.) Bridge - HEC-RAS model results indicate the modeled bridge modifications will cause water surface elevation reductions upstream of the bridge when compared to baseline water surface elevations. However, maximum water surface elevation decreases of less than 0.1 feet occur upstream of the bridge. Maximum elevation changes are shown in Table 6-24.

Recurrence Interval	20pct	10pct	4pct	2pct	1pct	0.5pct	0.2pct	0.1pct
Max WSE Decrease - all sections (ft)	0.01	0.01	0.01	0.02	0.04	0.03	0.03	0.53

Table 6-24 - NC HWY 24 Bridge Modification - Water Surface Elevation Changes

Model results indicate that modifying the bridges can decrease water service elevations primarily upstream of Bragg Blvd. However, the water surface elevations decreases are primarily associated with the E. Manchester Road bridge. Given the size of the Bragg Blvd. bridge (length and width) cost estimates for replacing the bridge will far exceed any benefits gained since widening this bridge provides very little water surface elevation reduction. Therefore, based on model results, it appears that widening the E. Manchester Road bridge provides the greatest water surface elevation reductions.

Cost/Benefit analysis of the E. Manchester Road bridge was further evaluated and is presented below.

LR6 Losses Avoided – LR6 losses avoided was evaluated for the E. Manchester Road Bridge improvements. Widening the bridge provides flood damage reduction in the Little River Basin area. Refer to Appendix A for community specific damage tables and curves for each modeled storm event for this option.

LR6 - Other Benefits - Besides losses avoided, this scenario provides no other quantifiable benefits. Table 6-25 outlines the benefits and expected costs estimated for this Scenario.

	E. Manchester Road Bridge
Property Acquisition	$ -
Design/Construction	$ 1,434,240
Environmental Impacts	$ -
Maintenance/year	$ -
Road Impacts	$ -
Property Value Increase*	$ -
Tax Revenue Change/year*	$ -
Leasing Benefit/year	$ -

Table 6-25 – LR6 Benefits and Costs

LR6 Benefit Cost – B/C ratios were calculated for 30-year and 50-year time horizons. B/C ratios included costs (bridge design and construction) and benefits (direct and indirect losses avoided). Costs, benefits, and resulting B/C ratios are provided in Table 6-26 below.

Mitigation Scenario 6								
	Costs		Losses Avoided				Benefit Cost Ratio	
Time Horizon	Initial	Maintenance	Direct	Direct + Indirect	Other Benefit	Other Cost	Direct	Direct + Indirect
30-Year	$1,434,240	$0	$30,880	$141,844	$0	$0	**0.02**	**0.10**
50-Year	$1,434,240	$0	$51,467	$236,407	$0	$0	**0.04**	**0.16**

Table 6-26 – LR6 B/C Ratio

Additional information regarding the damage assessment for this scenario can be found in Appendix S – LR6 Data Development.

- **Northeast Cape Fear River Bridge Elevation**

There are 6 bridges crossing the Northeast Cape Fear River in the study area. The bridges crossing the Northeast Cape Fear River are significant structures varying in span from approximately 300-feet to over 1,000 feet. Bridges of this size are very costly to improve. In order to identify the maximum possible benefit of bridge conveyance improvements on water surface elevations, the Northeast Cape Fear HEC-RAS model was modified to completely remove the bridges.

Water surface elevations from the modified HEC-RAS model were compared to the baseline model elevations and summarized in Table 6-27 below.

Recurrence Interval (YR)	5	10	25	50	100	200	500	1000	FLORENCE
Max WSEL Difference - all sections (ft)	0.65	0.76	0.55	0.27	0.19	0.1	0.17	0.26	0.31
Max WSEL Difference in River Landing (ft)	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Table 6-27: Strategy 6 – Northeast Cape Fear River Water Surface Difference Between Baseline and Modified HEC-RAS Model

The results indicate that complete removal of modeled bridges crossing the Northeast Cape Fear River does cause lower water surface elevations, but the maximum difference occurs upstream of NC Hwy 41/50 near Chinquapin, NC.

Model results were evaluated in the River Landing area near Wallace, NC due to the concentration of building impacts that occurred during Hurricane Florence Removal of all bridges in the HEC-RAS model caused no appreciable change in water surface elevations as shown in Table 6-27.

Since modeling showed this Strategy would provide only minor changes in water surface at the Hwy 41/50 bridge and no appreciable changes elsewhere along the modeled reach of Northeast Cape Fear River, and bridge improvements are expected to be very costly, this Strategy would likely yield very low Benefit/Cost ratios and was not further pursued.

- **Cape Fear River Bridge Elevation**

  Hydraulic model profiles along the Cape Fear River below the confluence with Haw River (near Jordan Lake and Moncure, NC) were reviewed to determine if any of the bridges crossing the river cause higher water surface elevations that also impact a significant number of building structures. While there are bridges that cause increases in water surface elevations, these increases are minor and do not occur in areas with a concentrated number of buildings impacted by baseline flooding developed for this study. Since the bridges crossing Cape Fear River are long with significant spans and heights, and none of the bridges appears to be causing flooding of a large number of buildings, modifying these bridges to reduce flooding will have little benefit (in terms of losses avoided) while being very costly. Therefore, improving bridges along the Cape Fear River would likely yield very low Benefit/Cost ratios and was not further pursued.

Strategy 7 – Non-Structural

Non-Structural flood mitigation strategies include involve permanent or contingent measures that are applied to a building structure and/or its contents that prevent or provide resistance to damage from flooding. These strategies differ from structural measures such as detention structures or levee embankments because they focus on reducing the consequences of flooding instead of focusing on reducing the probability of flooding.

Approach – As mentioned in Section 5 above, NCEM maintains a database of statewide building footprints attributed with necessary information to perform not only damage calculations, but determination of implementation costs for non-structural mitigation strategies. Non-structural mitigation strategies evaluated as part of this analysis include the following:

- **Structure elevation**
  Structure elevation involves physically raising a building in place resulting in the finished floor being above a certain flooding level (typically the base flood elevation, BFE). For this analysis, buildings were assumed be elevated 1-ft above the baseline 100-yr water surface elevation.
- **Floodproofing (wet or dry)**
  Dry flood proofing can protect a building from water intrusion during a flood event. Typically, this strategy applies to commercial and industrial buildings and not to residential structures. Wet flood proofing techniques are typically used for residential structures and allow water to move through a

building and alleviate hydrostatic pressures on foundation walls. Wet flood proofing is only appropriate for areas of a structure that are not living spaces such as crawl spaces and basements. Wet flood proofing also includes elevation of utilities and electrical equipment above the BFE.

- **Property acquisition**
  Acquisition is when the building is purchased and demolished. Typically, the land where the building was relocated cannot be developed again and is maintained as open space.
- **Structure relocation**
  Relocation is when the structure is relocated to a property outside of the floodplain. Typically, the land where the building was relocated cannot be developed again and is maintained as open space.
- **Mitigation reconstruction**
  Mitigation reconstruction projects include demolition of an existing home and rebuilding it according to the local building code, floodplain management, and zoning requirements. It is only permitted if traditional structure elevation cannot be implemented.

FEMA's Hazard Mitigation Grant Program (HMGP) provides assistance to communities to implement mitigation measures following disaster declarations. Implementation of a program involving these mitigation options could be expected to take three to five years.

Technical Analysis - For this analysis, all buildings along the Cape Fear River mainstem, Little River, Northeast Cape River, and Burgaw Creek that fell within the baseline study footprint and were identified as incurring any flood damages in the baseline modeling were analyzed. For each of the six possible strategies, all buildings that were eligible (not all buildings will qualify for all mitigation strategies due to characteristics such as occupancy type, foundation type, etc) were evaluated for implementation of that strategy regardless of cost effectiveness. In addition, for each structure, the most cost-effective technique was identified. This approach results in all buildings that incurred damage in the baseline modeling getting mitigated. These alternatives are referred to as NS1 – NS7 for reporting purposes.

Following the analysis of all structures that incurred damage in the baseline modeling, another analysis was performed that just looked at the structures that had a benefit to cost ratio greater than 1.0 in the 50-yr time horizon. This would give priority to structures that are the most vulnerable and should be made a priority. This was performed for each strategy individually as well as combining the most cost-effective strategy for each structure. This approach results in only buildings with favorable mitigation cost-effectiveness being mitigated. These alternatives are referred to as NS1a – NS7a for reporting purposes.
Cost estimates for the non-structural mitigation options are based on values in the stored procedures developed as part of the NCEM's Integrated Hazard Risk Management (IHRM) program.

Table 6-28 shows the implementation costs and number of structures treated for each of the 6 strategies as well as selecting the best strategy only for each structure.

Cape Fear Basin				
	All Structures with Damage		BC>1 in 50-Yr Time Horizon	
Treatment	Cost	Treated Structures	Cost	Treated Structures
Acquisition	$ 516,510,477	2374	$ 24,654,492	170
Elevation	$ 51,858,804	480	$ 3,652,649	56
Relocation	$ 235,108,677	1080	$ 6,177,270	64
Dry Floodproofing	$ 655,974,867	2374	$ 12,699,419	55
Wet Floodproofing	$ 3,130,197	416	$ 2,736,418	390
Mitigation Reconstruction	$ 164,047,015	751	$ 10,348,868	58
Best Strategy	$ 345,922,664	2374	$ 24,655,878	539

Table 6-28 - Costs and Structures Treated for Cape Fear River Basin using Non-Structural Strategies

Benefit/Cost – Using the percent effective and useful life characteristics of each non-structural strategy stored in NCEM's IHRM database, losses avoided over 30-yr and 50-yr timeframes for each strategy were calculated. The losses avoided (benefits) could then be evaluated against the implementation costs. Benefit/Cost ratios for the seven scenarios explored for non-structural mitigation were calculated for 30-year and 50-year time horizons.

Cape Fear Basin - All Structures with Damage				
Treatment	Time Horizon	Cost	Losses Avoided	BC Ratio
Acquisition	30 Year	$ 516,510,477	$ 67,620,707	0.13
	50 Year	$ 516,510,477	$ 112,701,179	0.22

Table 6-29 – NS1 Benefit to Cost with Acquisition Implemented for All Structures with Damage

Cape Fear Basin - BC>1 in 50-Yr Time Horizon				
Treatment	Time Horizon	Cost	Losses Avoided	BC Ratio
Acquisition	30 Year	$ 24,654,492	$ 32,896,580	1.33
	50 Year	$ 24,654,492	$ 54,827,634	2.22

Table 6-30 – NS1a Benefit to Cost with Acquisition Implemented for Individual Structures with BC > 1.0

Cape Fear Basin - All Structures with Damage				
Treatment	Time Horizon	Cost	Losses Avoided	BC Ratio
Elevation	30 Year	$ 51,858,804	$ 16,730,292	0.32
	50 Year	$ 51,858,804	$ 16,730,292	0.32

Table 6-31 – NS2 Benefit to Cost with Elevation Implemented for All Structures with Damage

Cape Fear Basin - BC>1 in 50-Yr Time Horizon				
Treatment	Time Horizon	Cost	Losses Avoided	BC Ratio
Elevation	30 Year	$ 3,652,649	$ 6,503,052	1.78
	50 Year	$ 3,652,649	$ 6,503,052	1.78

Table 6-32 – NS2a Benefit to Cost with Elevation Implemented for Individual Structures with BC > 1.0

Cape Fear Basin - All Structures with Damage				
Treatment	Time Horizon	Cost	Losses Avoided	BC Ratio
Relocation	30 Year	$ 235,108,677	$ 21,161,190	0.09
	50 Year	$ 235,108,677	$ 35,268,650	0.15

Table 6-33 – NS3 Benefit to Cost with Relocation Implemented for All Structures with Damage

Cape Fear Basin - BC>1 in 50-Yr Time Horizon				
Treatment	Time Horizon	Cost	Losses Avoided	BC Ratio
Relocation	30 Year	$ 6,177,270	$ 7,475,571	1.21
	50 Year	$ 6,177,270	$ 12,459,285	2.02

Table 6-34 – NS3a Benefit to Cost with Relocation Implemented for Individual Structures with BC > 1.0

Cape Fear Basin - All Structures with Damage				
Treatment	Time Horizon	Cost	Losses Avoided	BC Ratio
Dry Floodproofing	30 Year	$ 655,974,867	$ 64,239,672	0.10
	50 Year	$ 655,974,867	$ 107,066,120	0.10

Table 6-35 – NS4 Benefit to Cost with Dry Floodproofing Implemented for All Structures with Damage

Cape Fear Basin - BC>1 in 50-Yr Time Horizon				
Treatment	Time Horizon	Cost	Losses Avoided	BC Ratio
Dry Floodproofing	30 Year	$ 12,699,419	$ 18,712,403	1.47
	50 Year	$ 12,699,419	$ 31,187,339	1.47

Table 6-36 – NS4a Benefit to Cost with Dry Floodproofing Implemented for Individual Structures with BC > 1.0

Cape Fear Basin - All Structures with Damage				
Treatment	Time Horizon	Cost	Losses Avoided	BC Ratio
Wet Floodproofing	30 Year	$ 3,130,197	$ 8,779,499	2.80
	50 Year	$ 3,130,197	$ 8,779,499	2.80

Table 6-37 – NS5 Benefit to Cost with Wet Floodproofing Implemented for All Structures with Damage

Cape Fear Basin - BC>1 in 50-Yr Time Horizon				
Treatment	Time Horizon	Cost	Losses Avoided	BC Ratio
Wet Floodproofing	30 Year	$ 2,736,418	$ 8,569,840	3.13
	50 Year	$ 2,736,418	$ 8,569,840	3.13

Table 6-38 – NS5a Benefit to Cost with Wet Floodproofing Implemented for Individual Structures with BC > 1.0

Cape Fear Basin - All Structures with Damage				
Treatment	Time Horizon	Cost	Losses Avoided	BC Ratio
Mitigation Reconstruction	30 Year	$ 164,047,015	$ 41,230,674	0.25
	50 Year	$ 164,047,015	$ 41,230,674	0.25

Table 6-39 – NS6 Benefit to Cost with Mitigation Reconstruction Implemented for All Structures with Damage

Cape Fear Basin - BC>1 in 50-Yr Time Horizon				
Treatment	Time Horizon	Cost	Losses Avoided	BC Ratio
Mitigation Reconstruction	30 Year	$ 10,348,868	$ 15,463,445	1.49
	50 Year	$ 10,348,868	$ 15,463,445	1.49

Table 6-40 – NS6a Benefit to Cost with Mitigation Reconstruction Implemented for Individual Structures with BC > 1.0

Cape Fear Basin - All Structures with Damage				
Treatment	Time Horizon	Cost	Losses Avoided	BC Ratio
Best Strategy	30 Year	$ 345,922,664	$ 63,743,522	0.18
	50 Year	$ 345,922,664	$ 100,386,204	0.29

Table 6-41 – NS7 Benefit to Cost with the Best Strategy Implemented for All Structures with Damage

Cape Fear Basin - BC>1 in 50-Yr Time Horizon				
Treatment	Time Horizon	Cost	Losses Avoided	BC Ratio
Best Strategy	30 Year	$ 24,655,878	$ 38,819,237	1.57
	50 Year	$ 24,655,878	$ 58,985,502	2.39

Table 6-42 – NS7a Benefit to Cost with the Best Strategy Implemented for Individual Structures with BC > 1.0

Other Considerations – When elevating, consideration should be taken for unprotected assets such as vehicles. Because this is a planning level study, structures to potentially be mitigated would need a detailed analysis to confirm whether any of the analyzed strategies would in fact be feasible and which would be the best option. Some structures may need to remain in their current locations, such as some types of public facilities and commercial buildings. In a more detailed analysis, special consideration for buyouts should be given to good candidate buildings that are grouped together which will allow for contiguous greenspace. Grouped open space can be used for flood conveyance as well as other benefits such as parks or greenways. Elevation of commercial structures, particularly retail structures, represents an opportunity for redevelopment giving a refreshed look to the area and may be eligible for redevelopment grants.

Additional information regarding the damage assessment for these scenarios can be found in Appendix T – NS Data Development.

Strategy 8 – Floodplain Expansion/Protection

This strategy considers two potential ways to reduce water surface elevations; riverbed cleaning and overbank clearing and maintenance. Both can reduce manning's n-values (surface roughness) resulting in lower modeled water surface elevations in reaches where this is implemented. Riverbed cleaning and overbank clearing are described below.

For purposes of this analysis, riverbed cleaning can be referred to as "snag-and-drag" and does not entail dredging. The goal of cleaning the trees and debris from the riverbed is to increase water velocity, thereby improving conveyance. Riverbed cleaning by removing downed trees and debris jams from the channel is reflected in the hydraulic model by decreasing the roughness of the channel bed along the designated extent.

Overbank clearing aims to decrease surface roughness in the floodplain thus increasing conveyance in overbank areas where manning's n values are high, such as heavily wooded areas. By clearing wooded areas and establishing a ground cover such as field crops or grassland that typically has a lower manning's n value, surface roughness is decreased and conveyance improved.

Increasing conveyance of flood waters is thought to decrease the water surface elevations for a given discharge and hence decrease potential flood damages to structures in the vicinity. Water surface decreases would typically be seen in the immediate vicinity and upstream of the improvements. It should be noted that on-going maintenance of stream channels and overbank areas would be needed to maintain the lower roughness values, and this was accounted for in the cost/benefit analysis for this strategy.

This strategy was considered along Little River and Northeast Cape Fear River as described below.

- **Little River – Riverbed Cleaning and Overbank Clearing**
  Along Little River, both riverbed cleaning and overbank clearing were evaluated in a combined approach. The baseline model results were reviewed to identify areas in the models where water surface profiles were affected by topographic constrictions or large, wooded, and undeveloped

riverbank areas are near areas of concentrated building impacts identified from the baseline study. Locations identified for analysis are shown below in Figures 6-11, 6-12, and 6-13. This alternative is referred to as alternative LR7 for reporting purposes.

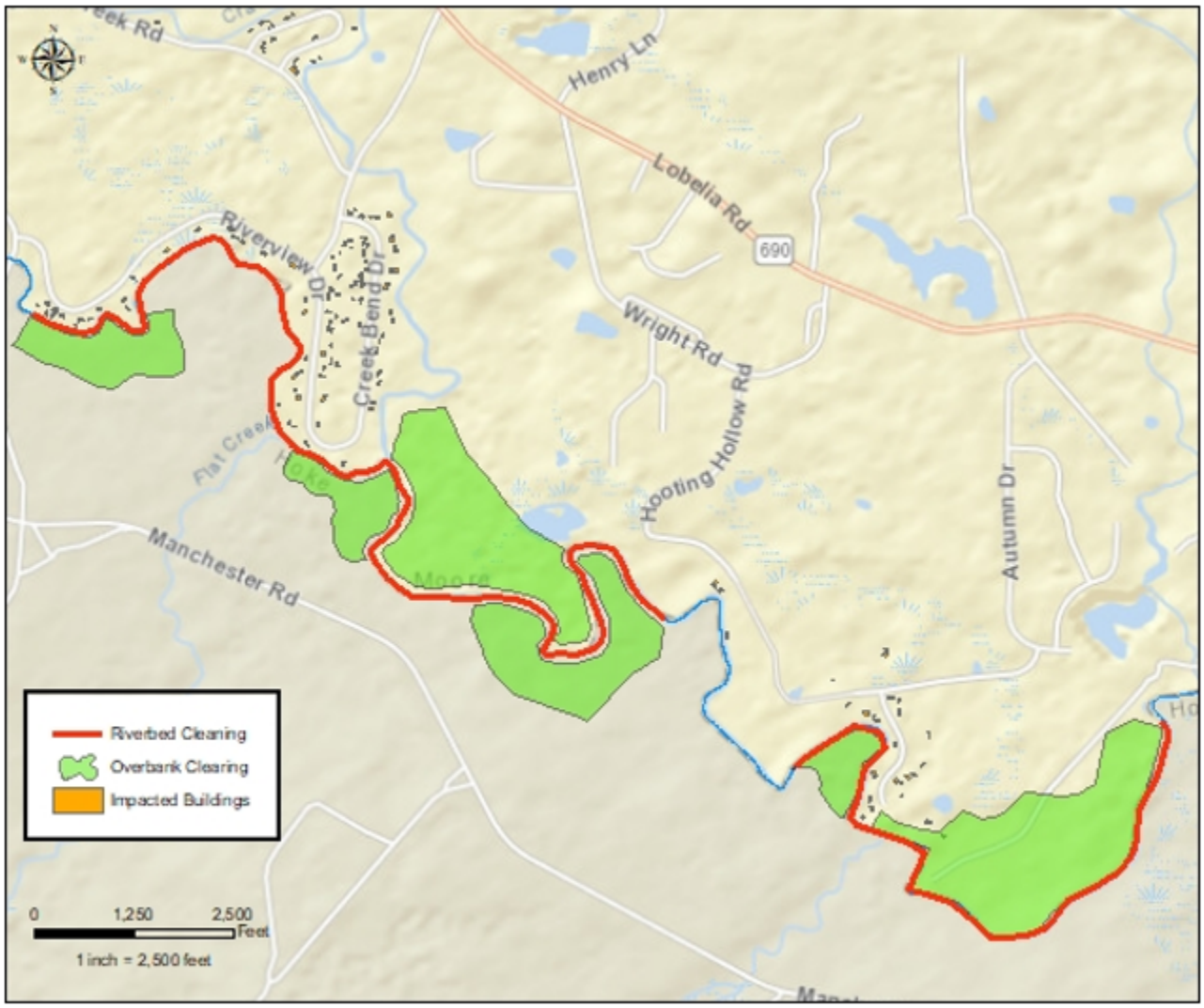


Figure 6-11 - Little River Riverbed Cleaning and Overbank Clearing (Section 1)

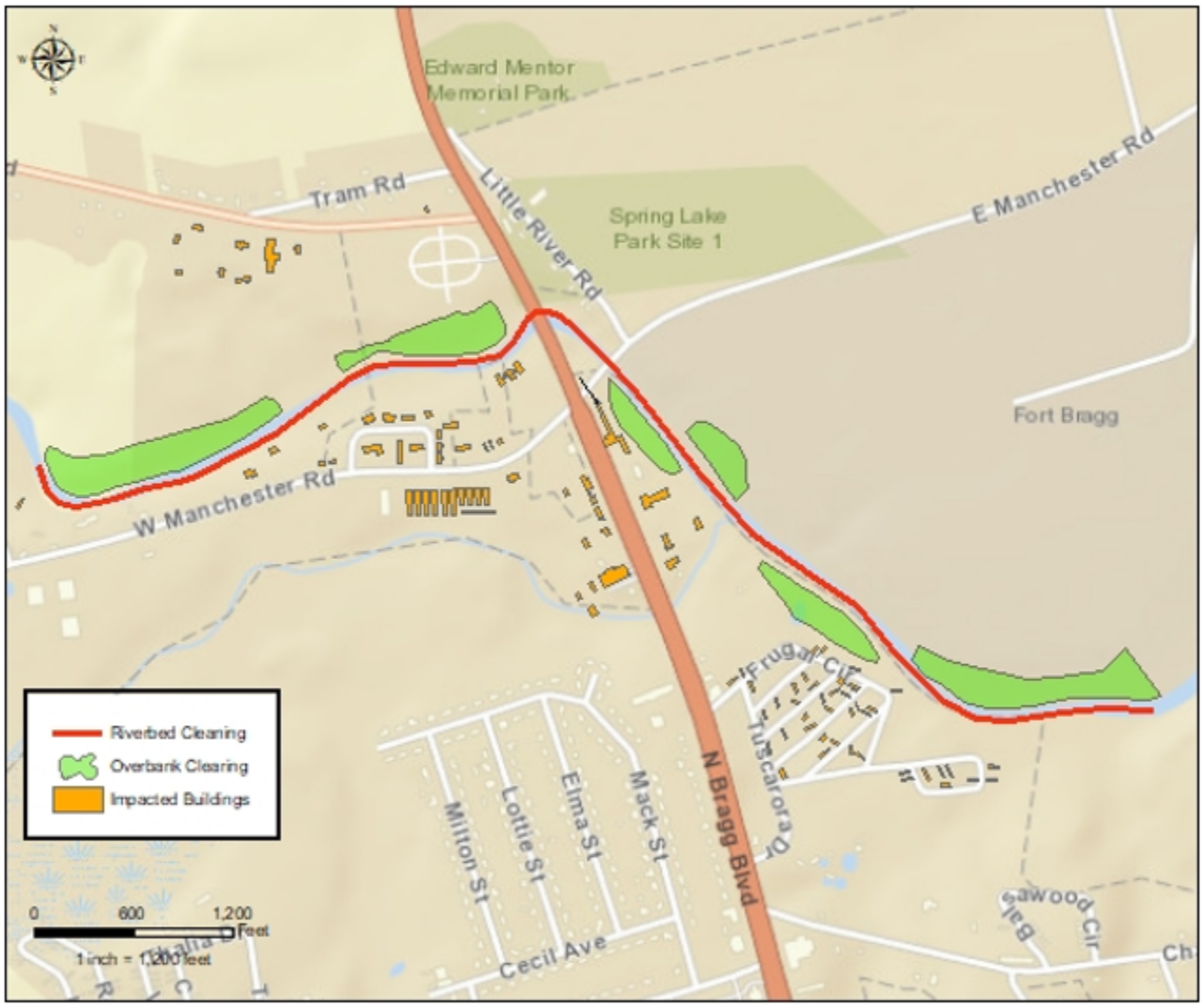


Figure 6-12 - Little River Riverbed Cleaning and Overbank Clearing (Section 2)

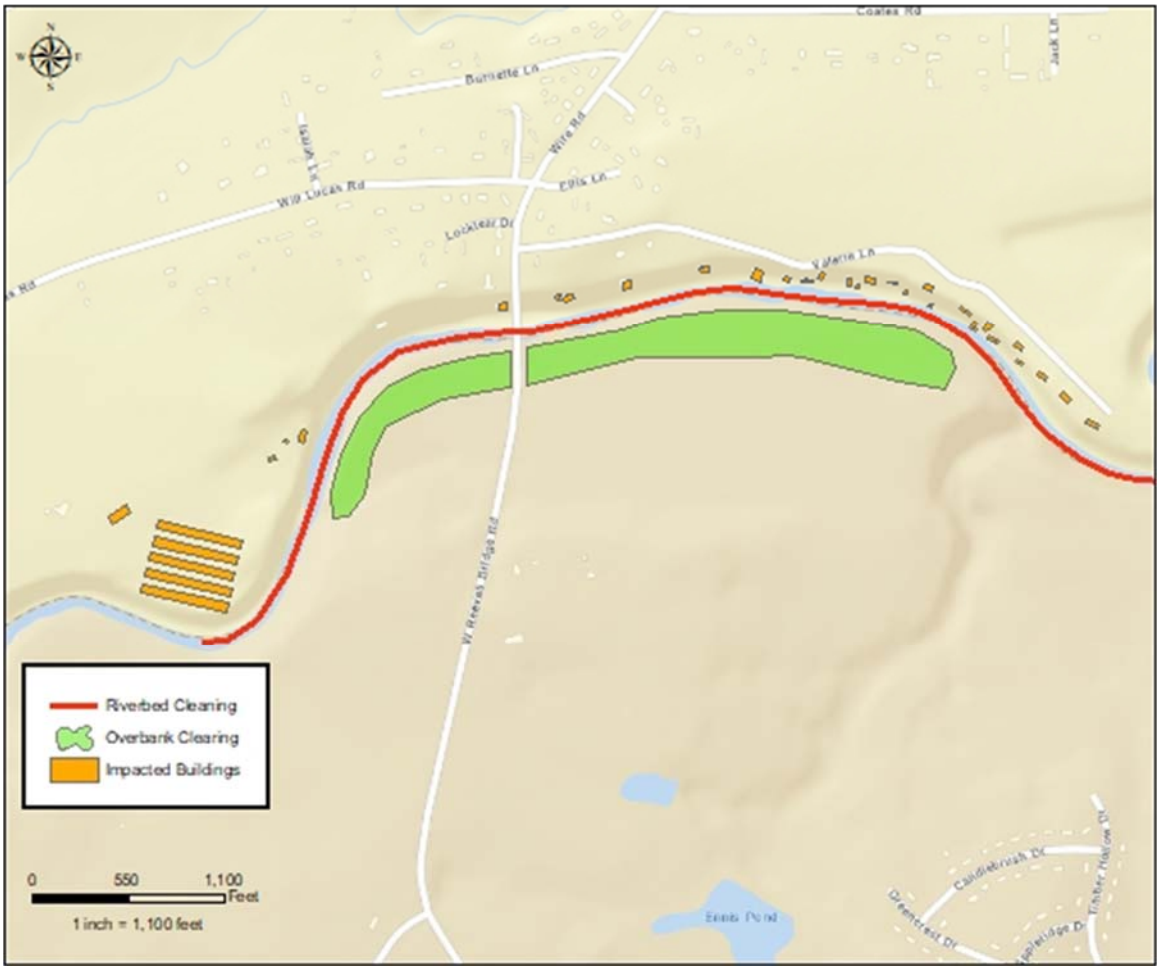


Figure 6-13 - Little River Riverbed Cleaning and Overbank Clearing (Section 3)

Iterative modeling was performed to identify possible combinations of channel cleaning and overbank manning's n value adjustment areas. The combinations of riverbed cleaning and overbank clearing shown in Figures 6-11, 6-12, and 6-13 above maximized modeled water surface elevation reductions while minimizing the length of channel cleaning and minimizing the areas of overbank modification. For each section the modeled water surface elevations at each HEC-RAS cross-section were compared to the baseline modeling and summarized into tables showing the maximum water surface elevation reduction. These results are provided below in Tables 6-28, 6-29, 6-30.

Recurrence Interval	20pct	10pct	4pct	2pct	1pct	0.5pct	0.2pct	0.1pct
Max of WSE difference to baseline (ft)	1.51	1.62	1.84	1.95	2.10	2.12	2.20	2.22

Table 6-43 – LR7 WSEL Reduction (Section 1)

Recurrence Interval	20pct	10pct	4pct	2pct	1pct	0.5pct	0.2pct	0.1pct
Max of WSE difference to baseline (ft)	0.45	0.52	0.68	0.81	0.91	0.99	0.95	0.98

Table 6-44 – LR7 WSEL Reduction (Section 2)

Recurrence Interval	20pct	10pct	4pct	2pct	1pct	0.5pct	0.2pct	0.1pct
Max of WSE difference to baseline (ft)	0.91	0.97	1.06	1.12	1.17	1.59	1.47	1.59

Table 6-45 – LR7 WSEL Reduction (Section 3)

LR7 - Losses Avoided - Losses avoided was evaluated assuming Strategy 8 is implemented for all three sections of Little River. Implementing this strategy along Little River provides flood damage reduction in the vicinity of the areas shown in Figures 6-11, 6-12, 6-13. Refer to Appendix A for community specific damage tables and curves for each modeled storm event for this option.

LR7 - Other Benefits –This analysis assumed no other benefits would be realized by this strategy. Costs included easement acquisition, design/construction, wetland impact mitigation in disturbed overbank areas, maintenance per year for overbank area mowing to maintain the desired surface cover, tax revenue decreases (assumes taxes are not paid on easement areas), and periodic channel cleaning (every 5 years was assumed) to maintain the desired river channel roughness. It was assumed that the channel cleaning portion of the strategy would not require environmental permits or require environmental impact mitigation.

Table 6-31 outlines the costs estimated for this strategy.

	Little River - Riverbed Cleaning and Overbank Clearing
Easement Acquisition	$ 1,011,772
Design/Construction	$ 4,132,843
Environmental Impacts	$ 2,932,381
Maintenance/year	$ 81,325
Tax Revenue Loss/year*	$ (7,887)
Periodic channel cleanout, 30-yr period	$ 1,177,085
Periodic channel cleanout, 50-yr period	$ 1,961,808
* Property tax decrease	

Table 6-46 – LR7 Costs

LR7 - Benefit Cost – B/C ratios were calculated for 30-year and 50-year time horizons. B/C ratios included costs (easements, design and construction, environmental impacts, maintenance, periodic channel cleanout, and tax revenue loss) and benefits (direct and indirect losses avoided). Costs, benefits, and resulting B/C ratios are provided in Table 6-32 below.

Little River - Riverbed Cleaning and Overbank Clearing									
	Costs			Losses Avoided		Other Benefit	Other Cost	Benefit Cost Ratio	
Time Horizon	Initial	Maintenance	Periodic Channel Clean	Direct	Direct + Indirect			Direct	Direct + Indirect
30-Year	$8,076,996	$2,439,745	$1,177,085	$780,125	$1,617,322	$0	$236,617	**0.07**	**0.14**
50-Year	$8,076,996	$4,066,241	$1,961,808	$1,300,208	$2,695,536	$0	$394,362	**0.09**	**0.19**

Table 6-47 – LR7 B/C Ratio

Additional information regarding the damage assessment for this scenario can be found in Appendix U – LR7 Data Development.

- **Northeast Cape Fear River – Riverbed Cleaning**
  For the Northeast Cape Fear River modeling indicated that water surface elevations are decreased by both channel cleaning and overbank clearing, but for this analysis these components were considered and evaluated independently.

  Riverbed cleaning was analyzed in two areas as presented below. Section 1 focused on the River Landing area where major flooding was observed during Hurricane Florence, and Section 2 was intended to reflect the maximum possible extent the cleaning could be conducted, covering over 20 miles along the NECF.

  Section 1 extent is shown in Figure 6-14 and extends from the upstream of River Landing to downstream of the Rockfish Creek confluence. This represents a river reach length of approximately 6.8 miles. The aim of this mitigation alternative is to increase river conveyance along the River Landing area and improve conveyance through the Rockfish Creek confluence to reduce backwater impacts of the confluence on the River Landing area. This alternative is referred to as alternative NECF8 for reporting purposes.

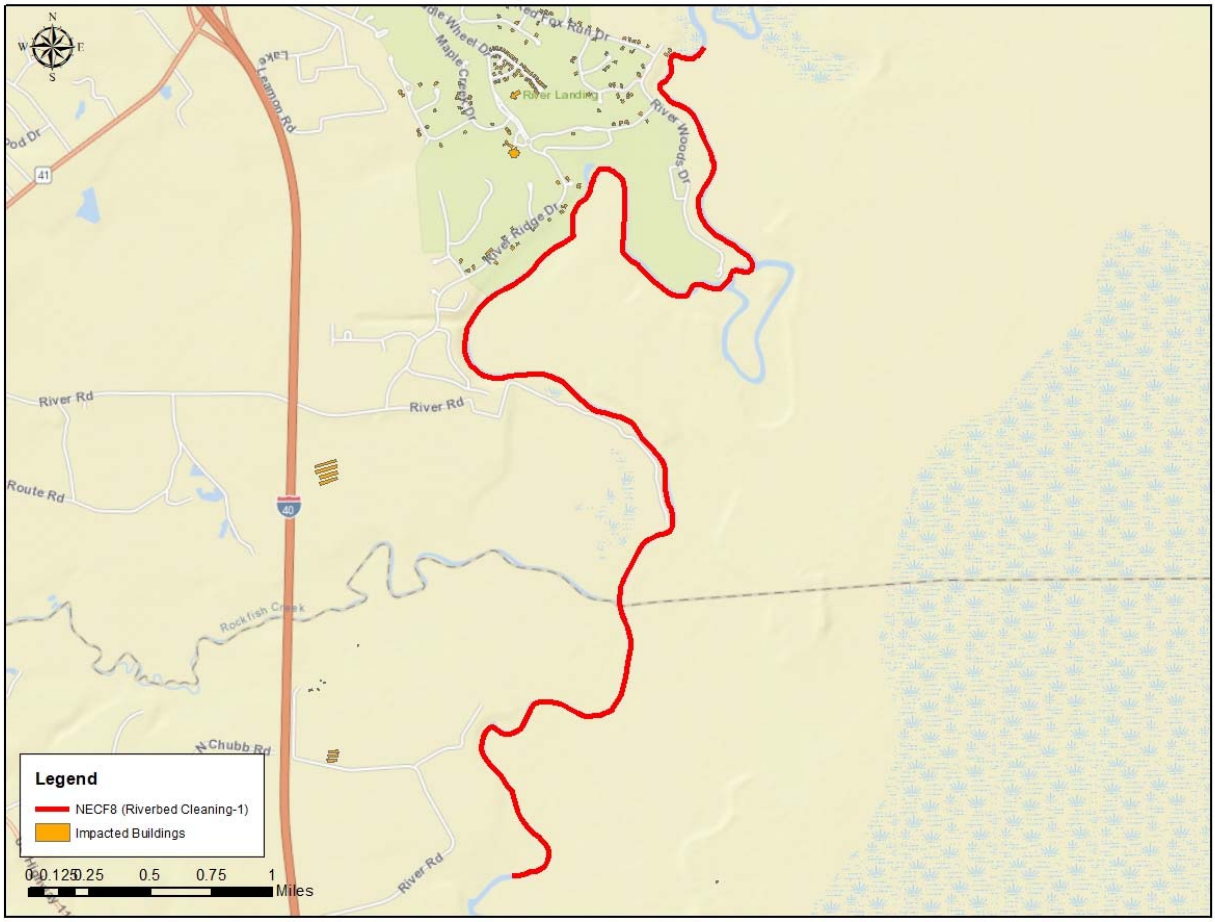


Figure 6-14 – NECF8 (Section1) Extent

Section 2 extent is shown in Figure 6-15 and extends from a point where the river thalweg elevation is approximately -10 ft elevation (NAVD88 vertical datum) to a point approximately 0.8 miles upstream of NC Hwy 41/50 near Chinquapin, NC. This represents a river reach length of approximately 24.3 miles. This represents the maximum extent where riverbed cleaning is believed to be practical and coincides with most of the impacted structures observed during Hurricane Florence along the Northeast Cape Fear River. This alternative is referred to as alternative NECF9 for reporting purposes.

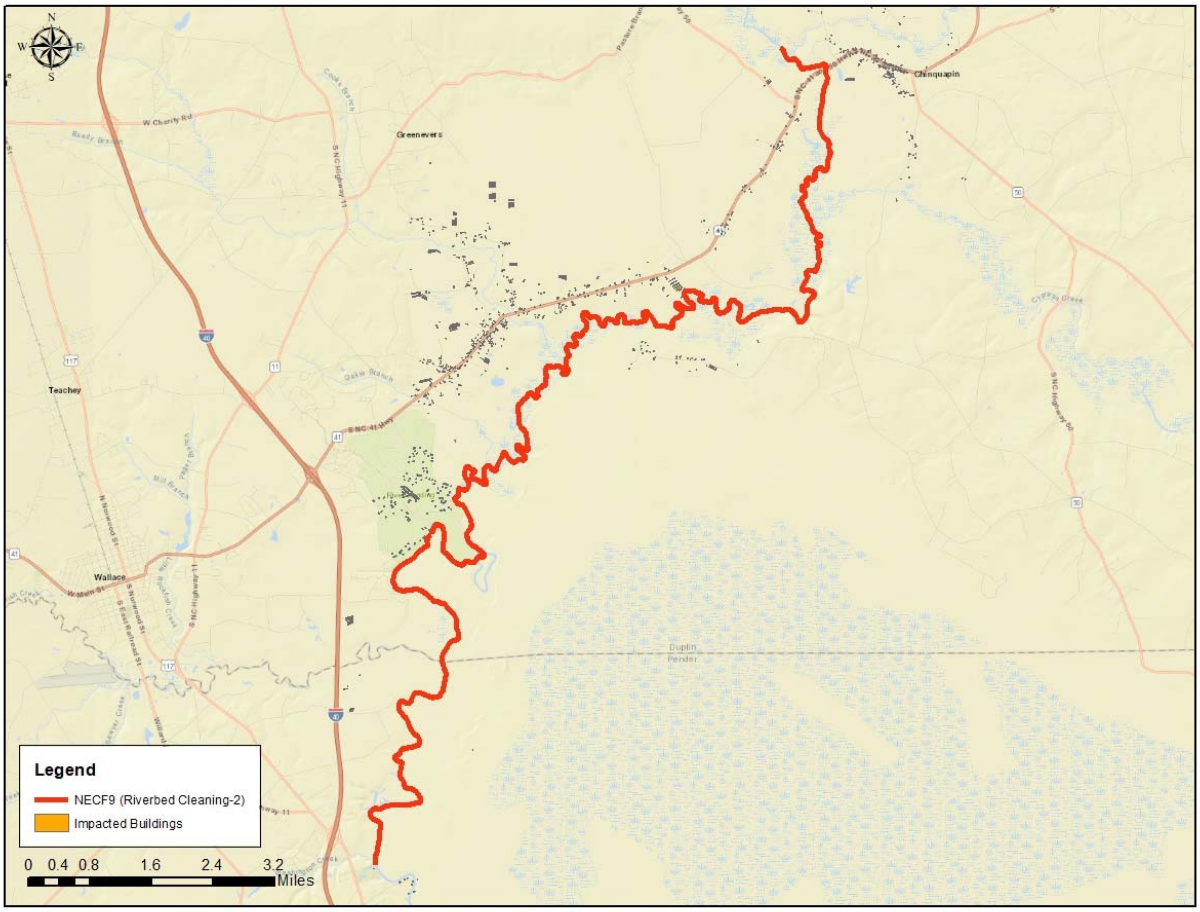


Figure 6-15 – NECF9 (Section 2) Extent

For each section the modeled water surface elevations at each HEC-RAS cross-section were compared to the baseline modeling and summarized into tables showing the maximum water surface elevation reduction. The maximum water surface elevation reduction along the River Landing Area was also considered. These results are provided below in Tables 6-33 and 6-34. As expected, more frequent events experience the greatest reduction in WSEL as a larger percentage of the flow for those events is contained within the channel.

Recurrence Interval (YR)	5	10	25	50	100	200	500	1000	FLORENCE
Max WSEL Difference - all sections (ft)	0.95	0.75	0.58	0.51	0.46	0.41	0.38	0.37	0.37
Max WSEL Difference along River Landing (ft)	0.95	0.75	0.58	0.51	0.46	0.41	0.38	0.37	0.37

Table 6-48 – NECF8 WSEL Reduction (Section 1)

Recurrence Interval (YR)	5	10	25	50	100	200	500	1000	FLORENCE
Max WSEL Difference - all sections (ft)	1.87	1.5	1.2	1.39	1.18	0.79	0.98	1.13	1.08
Max WSEL Difference in River Landing (ft)	1.2	0.98	0.81	0.72	0.65	0.58	0.54	0.52	0.52

Table 6-49 – NECF9 WSEL Reduction (Section 2)

The largest water surface reductions shown in Table 6-34 occur upstream of River Landing where there were fewer structures impacted by Hurricane Florence, however, maximum water surface elevations reductions in the River Landing area are higher than shown in Table 6-33.

As noted in Section 4 above, the study area along the Northeast Cape Fear River received a new one-dimensional HEC-RAS hydraulic model. In order to better identify and analyze potential mitigation options in the River Landing area which was heavily impacted during Hurricane Florence, a detailed two-dimensional HEC-RAS hydraulic model was developed as well. Details on the model development can be found in Appendix P.

The two-dimensional model was used to further investigate the effect of the riverbed cleaning described above on magnitude and timing of flow throughout the study area. In order to perform this analysis, the Hurricane Florence event was modeled with the mitigation strategy in place and compared to the baseline model results. Implementation of the riverbed cleaning for either of the sections outlined above would potentially have the following effects on an event similar to Hurricane Florence:

- Timing of the peak flow was unaffected.
- Improved channel conveyance results in slightly reduced flood storage which leads to minimal flow increases downstream.
- Recession timing of the flooding from the peak back down to a 50-yr level was reduced by 3 hours.

NECF8 and NECF9 - Losses Avoided - Losses avoided for the two river sections shown in Figures 6-14 and 6-15 were evaluated independently. Implementing this strategy along the Northeast Cape Fear River provides flood damage reduction. Refer to Appendix A for community specific damage tables and curves for each modeled storm event for both of these scenarios.

NECF8 and NECF9 - Other Benefits –This analysis assumed no other benefits would be realized by this strategy. Costs included and initial channel cleaning and periodic channel cleaning (every 5 years was assumed) to maintain the desired river channel roughness. It was assumed that the channel cleaning operation would not require environmental permits or require environmental impact mitigation.

Table 6-35 and 6-36 outline the costs estimated for this strategy.

	Northeast Cape Fear Riverbed Cleaning (Section1)
Initial Cleanout	$ 174,173
Periodic Cleanout (30-yr)	$ 1,045,037
Periodic Cleanout (50-yr)	$ 1,741,728

Table 6-50 – NECF8 Costs (Section 1)

	Northeast Cape Fear Riverbed Cleaning (Section 2)
Initial Cleanout	$ 617,102
Periodic Cleanout (30-yr)	$ 3,702,614
Periodic Cleanout (50-yr)	$ 6,171,024

Table 6-51 – NECF9 Costs (Section 2)

NECF8 and NECF9 - Benefit Cost – B/C ratios were calculated for 30-year and 50-year time horizons for each river section analyzed. B/C ratios included costs (initial channel cleanout and periodic channel cleanout) and benefits (direct and indirect losses avoided). Costs, benefits, and resulting B/C ratios are provided in Table 6-37 and 6-38 below.

Northeast Cape Fear River Riverbed Cleaning (Section 1)								
	Costs		Losses Avoided				Benefit Cost Ratio	
Time Horizon	Initial	Additional Cleanouts	Direct	Direct + Indirect	Other Benefit	Other Cost	Direct	Direct + Indirect
30-Year	$174,173	$1,045,037	$1,249,443	$2,105,464	$0	$0	**1.02**	**1.73**
50-Year	$174,173	$1,741,728	$2,082,405	$3,509,107	$0	$0	**1.09**	**1.83**

Table 6-52 – NECF8 (Section 1) B/C Ratio

Northeast Cape Fear Riverbed Cleaning (Section 2)								
	Costs		Losses Avoided				Benefit Cost Ratio	
Time Horizon	Initial	Additional Cleanouts	Direct	Direct + Indirect	Other Benefit	Other Cost	Direct	Direct + Indirect
30-Year	$617,102	$3,702,614	$3,397,411	$6,865,646	$0	$0	**0.79**	**1.59**
50-Year	$617,102	$6,171,024	$5,662,352	$11,442,743	$0	$0	**0.83**	**1.69**

Table 6-53 – NECF9 (Section 2) B/C Ratio

Additional information regarding the damage assessments can be found in Appendix V – NECF8 Data Development and Appendix W – NECF9 Data Development.

- **Northeast Cape Fear River Overbank Clearing**

  An area adjacent to River Landing was identified as an area where overbank clearing could increase flood conveyance. Large, wooded areas in the river overbank could contribute to flooding due to flow restriction caused by dense wooded vegetation. Locations identified for analysis are shown below in Figure 6-16. This alternative is referred to as alternative NECF10 for reporting purposes.

  Overbank clearing aims to decrease surface roughness thus increasing conveyance in overbank areas where manning's n values are high, such as heavily wooded areas. By clearing wooded areas and establishing a ground cover such as field crops or grassland that typically has a lower manning's n value,

surface roughness is decreased and flow conveyance improved.

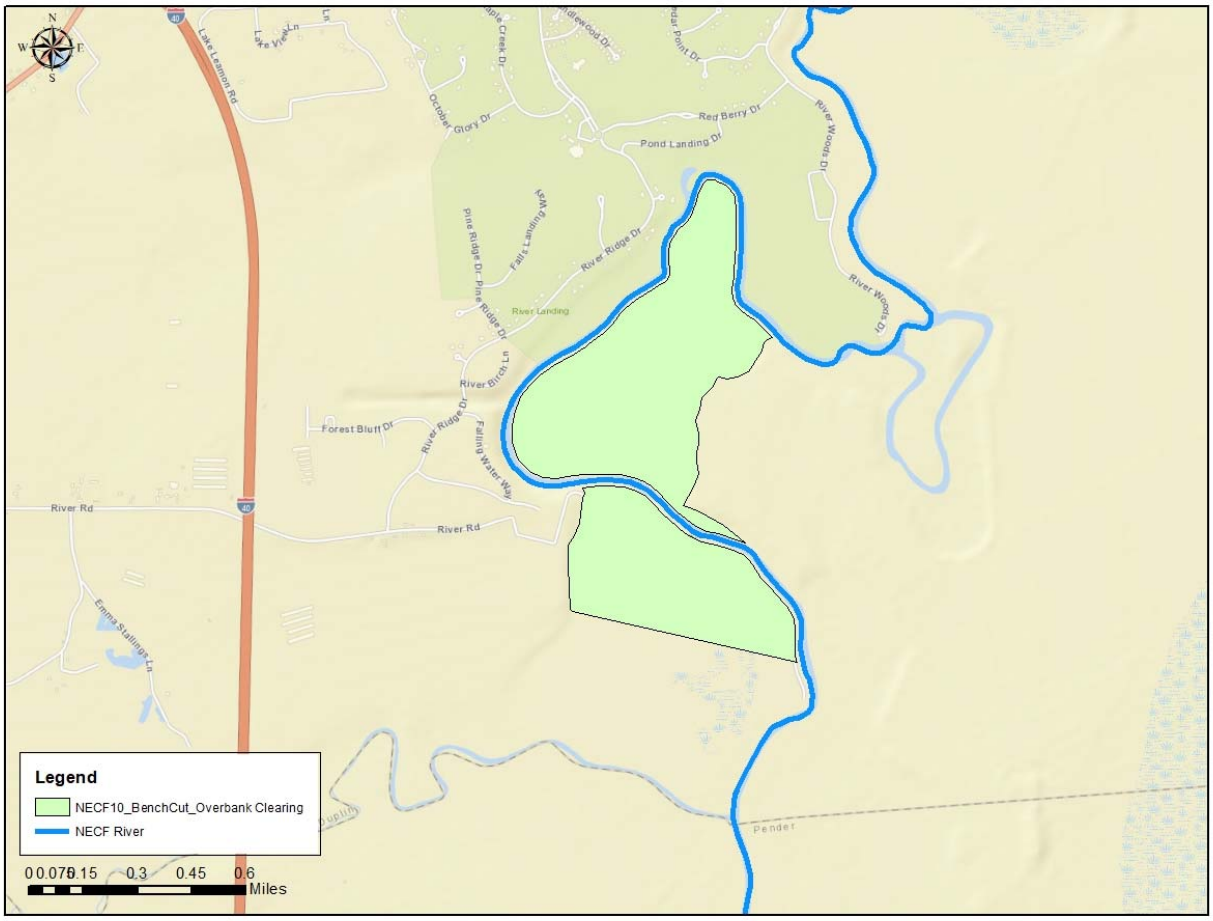


Figure 6-16 – NECF10 Extent

In the areas identified in Figure 6-16, the HEC-RAS cross sections were modified to reduce manning's n values. Modeled water surface elevations at each HEC-RAS cross-section were then compared to the baseline modeling and summarized to show the maximum water surface elevation reduction. These results are provided below in Table 6-39.

Recurrence Interval (YR)	5	10	25	50	100	200	500	1000	FLORENCE
Max WSEL Difference - all sections (ft)	0.96	0.98	0.89	0.84	0.79	0.73	0.71	0.69	0.73

Table 6-54 – NECF10 WSEL Reduction

These maximum water surface reductions occur in the River Landing area where there was a concentration of buildings impacted by Hurricane Florence.

As noted in Section 4 above, the study area along the Northeast Cape Fear River received a new one-dimensional HEC-RAS hydraulic model. In order to better identify and analyze potential mitigation options in the River Landing area which was heavily impacted during Hurricane Florence, a detailed two-dimensional HEC-RAS hydraulic model was developed as well. Details on the model development can be found in Appendix P.

The two-dimensional model was used to further investigate the effect of the overbank clearing described above on magnitude and timing of flow throughout the study area. In order to perform this analysis, the Hurricane Florence event was modeled with the mitigation strategy in place and compared to the baseline model results. Implementation of the overbank clearing outlined above would potentially have the following effects on an event similar to Hurricane Florence:

- Timing of the peak flow was reduced slightly.
- Improved conveyance results in reduced flood storage in the cleared area which leads to minimal flow increases downstream.
- Recession timing of the flooding from the peak back down to a 50-yr level was reduced by 6 hours.

NECF10 - Losses Avoided - Losses avoided was evaluated assuming overbank clearing is implemented for the areas shown in Figure 6-16. Refer to Appendix A for community specific damage tables and curves for each modeled storm event for this option.

NECF10 - Other Benefits –This analysis assumed no other benefits would be realized by this strategy. Costs included easement acquisition, design/construction, wetland impact mitigation in disturbed overbank areas, maintenance per year for overbank area mowing to maintain the desired surface cover, and tax revenue decreases (assumes taxes are not paid on easement areas).

Table 6-40 outlines the costs estimated for this strategy.

	Northeast Cape Fear River Overbank Clearing
Easement Acquisition	$ 102,101
Design/Construction	$ 3,731,898
Environmental Impacts	$ 7,816,535
Maintenance/year	$ 76,075
Tax Revenue Loss/year*	$ (775)
* Property tax decrease	

Table 6-55 – NECF10 Costs

NECF10 - Benefit Cost – B/C ratios were calculated for 30-year and 50-year time horizons. B/C ratios included costs (easements, design and construction, environmental impacts, maintenance, and tax revenue loss) and benefits (direct and indirect losses avoided). Costs, benefits, and resulting B/C ratios are provided in Table 6-41 below.

Northeast Cape Fear River Overbank Clearing								
Time Horizon	Costs		Losses Avoided		Other Benefit	Other Cost	Benefit Cost Ratio	
	Initial	Maintenance	Direct	Direct + Indirect			Direct	Direct + Indirect
30-Year	$11,650,534	$2,282,250	$2,011,468	$4,666,519	$0	$23,250	**0.14**	**0.33**
50-Year	$11,650,534	$3,803,750	$3,352,447	$7,777,531	$0	$38,750	**0.22**	**0.50**

Table 6-56 – NECF10 B/C Ratio

Additional information regarding the damage assessment for this scenario can be found in Appendix X – NECF10 Data Development.

7. Conclusions

Eighteen flood mitigation options for solutions to persistent flood damages were explored as part of this planning level study. Below are conclusions related to this study and potential future analyses.

Trend Analysis

The primary cause of flooding on the Cape Fear River is heavy rain resulting from tropical systems. Trend analyses performed for cumulative annual rainfall and peak annual discharge along the Cape Fear River resulting from increased development within the basin did not find statistically significant, conclusive evidence of an increasing trend of flooding along the mainstem of the Cape Fear River. Additional study is recommended to determine if there is an increasing trend in tropical events impacting North Carolina that may result in increased frequency of these widespread events in the future. Additional study is also needed to determine if intensity of rainfall is increasing. Additional years of record will be beneficial for trend detection at discharge gages.

Baseline Modeling

Hydrology: A coarse, basin-wide hydrologic model was developed to assess the impact to discharges that would result certain mitigation strategies including construction of detention facilities. This model was calibrated to the Hurricane Florence event which is a unique event as far as spatial distribution of rainfall and discharge gage readings throughout the basin. Prior to further analysis of mitigation alternatives affecting discharges throughout the basin, development and validation of a more detailed model using gage readings from multiple flood events with varying return intervals should be considered.

Hydraulics: With the exception of the Northeast Cape Fear River, which received a new one-dimensional hydraulic model, discharges from the hydrologic model were input into existing NFIP hydraulic models. Continual update and improvement of hydraulic models throughout the Cape Fear Basin should continue to be a focus of the NCFMP. Updated lidar data is available for many streams throughout the Cape Fear Basin with existing models and should be considered for use to update the hydraulic models where needed.

New Detention Facilities

A comparison table for benefits and costs associated with detention scenarios that were investigated is shown in Table 7-1. Implementation timeframe for a dry detention facility is estimated to be 7 to 15 years while development of a wet detention facility could take 15 to 30 years or more.

Mitigation Scenario	Time Horizon	Costs	Benefits			Benefit Cost Ratio	
			Direct Losses Avoided	Direct & Indirect Losses Avoided	Other	Direct	Direct & Indirect
CF2 *Wet Dam on Upper Little River*	30-yr	$ 305,141,000	$ 1,687,000	$ 6,030,000	$ 272,335,000	0.90	0.91
	50-yr	$ 305,341,000	$ 2,811,000	$ 10,049,000	$ 315,750,000	1.04	1.07
CF3 *Dry Dam on Upper Little River*	30-yr	$ 149,211,000	$ 1,946,000	$ 6,452,000	$ 5,632,000	0.05	0.08
	50-yr	$ 160,630,000	$ 3,243,000	$ 10,753,000	$ 9,387,000	0.08	0.13
LR4 *Wet Dam*	30-yr	$ 160,122,000	$ 828,000	$ 1,857,000	$ 82,030,000	0.52	0.52
	50-yr	$ 160,322,000	$ 1,380,000	$ 3,094,000	$ 93,287,000	0.59	0.60
LR5 *Dry Dam*	30-yr	$ 75,143,000	$ 759,000	$ 1,741,000	$ 1,122,000	0.03	0.04
	50-yr	$ 77,111,000	$ 1,265,000	$ 2,902,000	$ 1,870,000	0.04	0.06

Table 7-1: Benefits and Costs for all Detention Scenarios Analyzed

The numbers in Table 7-1 are planning level and all dam mitigation scenarios should be considered relative to one another. The recreation benefits assumed for wet detention were a driving factor that resulted in wet detention options having a higher benefit to cost than the dry scenarios.

If any of the wet detention facility options are to be pursued, further study must be considered including detailed sediment loading analysis, nutrient loading analysis, and development of a plan to mitigate against violation of state water quality standards, particularly in regard to any TMDL rules for nutrients in the Cape Fear River. A wet detention facility changes sediment transport dynamics downstream of the dam and sedimentation upstream of the dam could reduce recreation benefits after a number of years. These factors may have a large impact on the calculated BC ratios and need to be taken into account.

Northeast Cape Fear River Alternatives

As part of this study, a detailed two-dimensional hydraulic model for the reach of the Northeast Cape Fear River adjacent to the River Landing community was developed. This model supported identification of flow characteristics in the area as well as evaluation of mitigation alternatives considered. Results of the modeling showed that slow drainage through the area causes backwater effects that contribute to flooding impacts. As such, alternatives considered focused on improved conveyance throughout the reach. The cost analysis for this option is shown in Table 7-3.

Mitigation Scenario	Time Horizon	Costs	Benefits			Benefit Cost Ratio	
			Direct Losses Avoided	Direct & Indirect Losses Avoided	Other	Direct	Direct & Indirect
NECF8 *Channel Cleaning - Area 1*	30-yr	$ 1,219,000	$ 1,249,000	$ 2,105,000	$ -	1.02	1.73
	50-yr	$ 1,916,000	$ 2,082,000	$ 3,509,000	$ -	1.09	1.83
NECF9 *Channel Cleaning - Area 2*	30-yr	$ 4,320,000	$ 3,397,000	$ 6,866,000	$ -	0.79	1.59
	50-yr	$ 6,788,000	$ 5,662,000	$ 11,443,000	$ -	0.83	1.69
NECF10 *Overbank Clearing*	30-yr	$ 13,933,000	$ 2,011,000	$ 4,667,000	$ -	0.14	0.33
	50-yr	$ 15,454,000	$ 3,352,000	$ 7,778,000	$ -	0.22	0.50
NECF11 *Diversion channel*	30-yr	$ 36,965,000	$ 3,765,000	$ 11,481,000	$ -	0.10	0.31
	50-yr	$ 39,201,000	$ 6,274,000	$ 19,135,000	$ -	0.16	0.49

Table 7-2: Benefits and Costs for Northeast Cape Fear River Alternatives

Although these options can provide significant overall flood damage reduction across the study area (particularly in the area around the River Landing community), not all areas would benefit from them. Improved conveyance to more quickly drain the targeted area also result in decreased flood storage leading to minimal increases in flow further downstream. These flow increases may lead to minor increases in flood level and associated damages that would need to be addressed with supplemental mitigation efforts not accounted for in this study.

Non-Structural Mitigation

Non-structural building-level mitigation was considered for structures identified as receiving flood damage from the baseline modeling effort performed as part of this study. This analysis was further refined to focus on the most cost-effective structures that individually showed a BC ratio greater than 1.0. Implementation time for this option is estimated at 3 to 5 years. The benefit and costs for the most cost-effective structures are shown in Table 7-4.

Mitigation Scenario	Time Horizon	Costs	Benefits			Benefit Cost Ratio	
			Direct Losses Avoided	Direct & Indirect Losses Avoided	Other	Direct	Direct & Indirect
NS12a *Acquisition BC>1*	30-yr	$ 24,654,492	$ 32,897,000	NA	$ -	1.33	NA
	50-yr	$ 24,654,492	$ 54,828,000	NA	$ -	2.22	NA
NS13a *Elevation BC>1*	30-yr	$ 3,652,649	$ 6,503,000	NA	$ -	1.78	NA
	50-yr	$ 3,652,649	$ 6,503,000	NA	$ -	1.78	NA
NS14a *Relocation BC>1*	30-yr	$ 6,177,270	$ 7,476,000	NA	$ -	1.21	NA
	50-yr	$ 6,177,270	$ 12,459,000	NA	$ -	2.02	NA
NS15a *Dry Floodproofing BC>1*	30-yr	$ 12,699,419	$ 18,712,000	NA	$ -	1.47	NA
	50-yr	$ 21,165,699	$ 31,187,000	NA	$ -	1.47	NA
NS16a *Wet Floodproofing BC>1*	30-yr	$ 2,736,418	$ 8,570,000	NA	$ -	3.13	NA
	50-yr	$ 2,736,418	$ 8,570,000	NA	$ -	3.13	NA
NS17a *Mitigation Reconstruction*	30-yr	$ 10,348,868	$ 15,463,000	NA	$ -	1.49	NA
	50-yr	$ 10,348,868	$ 15,463,000	NA	$ -	1.49	NA
NS18a *Best Technique BC>1*	30-yr	$ 24,655,878	$ 38,819,000	NA	$ -	1.57	NA
	50-yr	$ 24,655,878	$ 58,986,000	NA	$ -	2.39	NA

Table 7-3: Benefits and Costs Associated with Non-Structural Alternatives for Buildings with B/C>1

Based on analysis performed as part of this effort, the Non-Structural options are the most effective flood mitigation strategy based on timeframe to implement, scalability of funding allocation, ability to target most vulnerable structures and communities, benefit/cost ratio and potential positive environmental impacts.

If this option is implemented the following should be considered:

- This analysis was performed at a high level with some general assumptions. A community mitigation implementation would require much more detailed analyses for each structure under consideration.
- Removal of structures from the floodplain could create open space which would be opportunity for recreational benefit such as parks or greenways. Acquisitions are most beneficial when done by grouping properties together. These benefits were not considered in the analysis.
- There may be a gap between funds for buyout and the money needed to acquire comparable living space outside of the flood prone area. This was not accounted for in the analysis.
- Relocating people out of the floodplain to other areas may result in stress to infrastructure in the new communities. These costs should be incorporated into the community buyout plans where possible.

General Considerations

- Ongoing buyout programs as part of Hurricanes Matthew and Florence recovery efforts will impact the BC analysis for all scenarios. When current buyout programs have concluded a reassessment of the BC analysis should be performed to reassess the benefit to cost ratios for all options.
- This analysis did not consider mixing of non-structural strategies with structural. Additional investigations could be considered to see, for example, how a scenario with parcel level mitigation would affect the benefit/cost of an upstream reservoir.

- National Flood Insurance Program (NFIP) hydraulic models assume no blockage at structural crossings of the river during storm events. This can result in under prediction of the water surface elevation during a flooding event. Local emergency officials should be aware of this. Planning officials should also consider this when new construction or reconstruction is planned following a flood. A study should be considered to investigate how best to prevent this issue. The study would include working with local officials to determine which crossings are causing the most significant flooding issues and options for solving the problem. These options may include routine maintenance solutions or reconstruction of the crossings in a way that minimizes blockage.
- The Flood Inundation Mapping Alert Network (FIMAN) site is a valuable tool for local officials that helps them anticipate flooding issues and issue warnings as well as take preventative and mitigating actions. Installation of additional gages and development of inundation mapping should be considered to continue to enhance emergency operations and disaster response.
- A study should be considered to determine how other communities throughout the country initially fund and then manage and maintain flood mitigation projects such as those discussed in this report.

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Work performed for this planning level analysis of flood mitigation strategies for the Cape Fear River basin within North Carolina was completed by ESP Associates, Inc. for North Carolina Emergency Management. This planning level study included no detailed design. All calculations, analyses, and cost estimates included in the study and contained in this report and associated appendices are conceptual and are not to be used for design or construction.

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Appendix A – Community Specific Flood Damage Estimates

Cape Fear River Baseline Damages 5-yr (20% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	32	$133,562	$183,251	10	$130,210	$1,429,187	1	$0	$0	43	$263,772	$1,612,438
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	5	$1,740	$2,670	1	$0	$0	0	$0	$0	6	$1,740	$2,670
Chatham County	0	$0	$0	1	$0	$0	1	$0	$0	2	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	3	$2,719	$4,253	0	$0	$0	0	$0	$0	3	$2,719	$4,253
Duplin County	3	$5,096	$6,226	0	$0	$0	0	$0	$0	3	$5,096	$6,226
Elizabethtown	0	$0	$0	1	$10,875	$26,766	0	$0	$0	1	$10,875	$26,766
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	0	$0	$0	3	$17,421	$825,112	0	$0	$0	3	$17,421	$825,112
Fort Bragg	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Harnett County	1	$1,309	$2,845	0	$0	$0	0	$0	$0	1	$1,309	$2,845
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	2	$51,086	$58,881	0	$0	$0	0	$0	$0	2	$51,086	$58,881
Lillington	0	$0	$0	0	$0	$0	1	$0	$0	1	$0	$0
Moore County	12	$26,464	$35,865	0	$0	$0	0	$0	$0	12	$26,464	$35,865
New Hanover County	1	$790	$1,552	0	$0	$0	0	$0	$0	1	$790	$1,552
Pender County	261	$1,814,642	$2,350,278	25	$49,766	$396,653	0	$0	$0	286	$1,864,408	$2,746,931
Spring Lake	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

Cape Fear River Baseline Damages 10-yr (10% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	58	$339,577	$453,829	13	$229,727	$1,833,541	1	$24,877	$3,307,356	72	$594,182	$5,594,725
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	16	$11,824	$16,959	3	$0	$0	0	$0	$0	19	$11,824	$16,959
Chatham County	0	$0	$0	1	$0	$0	1	$0	$0	2	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	8	$41,778	$62,352	1	$0	$0	0	$0	$0	9	$41,778	$62,352
Duplin County	15	$43,210	$58,774	5	$0	$0	0	$0	$0	20	$43,210	$58,774
Elizabethtown	0	$0	$0	1	$20,869	$43,216	3	$0	$0	4	$20,869	$43,216
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	0	$0	$0	3	$20,305	$917,044	0	$0	$0	3	$20,305	$917,044
Fort Bragg	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Harnett County	6	$8,348	$18,943	0	$0	$0	1	$0	$0	7	$8,348	$18,943
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	4	$92,679	$111,091	0	$0	$0	0	$0	$0	4	$92,679	$111,091
Lillington	0	$0	$0	0	$0	$0	1	$0	$0	1	$0	$0
Moore County	21	$72,454	$108,560	0	$0	$0	0	$0	$0	21	$72,454	$108,560
New Hanover County	1	$790	$1,557	0	$0	$0	0	$0	$0	1	$790	$1,557
Pender County	383	$4,566,575	$5,852,111	42	$159,318	$4,851,240	0	$0	$0	425	$4,725,893	$10,703,351
Spring Lake	1	$0	$0	1	$0	$0	0	$0	$0	2	$0	$0
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

Cape Fear River Baseline Damages 25-yr (4% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	121	$1,064,007	$1,388,656	28	$505,449	$2,931,924	2	$100,046	$3,867,892	151	$1,669,502	$8,188,471
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	22	$17,317	$29,570	4	$0	$0	0	$0	$0	26	$17,317	$29,570
Chatham County	0	$0	$0	1	$0	$0	2	$0	$0	3	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	11	$224,801	$300,670	3	$0	$0	0	$0	$0	14	$224,801	$300,670
Duplin County	68	$377,091	$482,870	16	$30,495	$332,647	0	$0	$0	84	$407,586	$815,517
Elizabethtown	5	$31,591	$41,513	4	$34,413	$180,026	3	$68,197	$494,270	12	$134,201	$715,808
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	2	$924	$1,020	6	$23,751	$1,003,571	1	$0	$0	9	$24,676	$1,004,591
Fort Bragg	1	$3,394	$3,503	0	$0	$0	0	$0	$0	1	$3,394	$3,503
Harnett County	16	$174,601	$303,217	0	$0	$0	1	$0	$0	17	$174,601	$303,217
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	4	$136,469	$159,689	0	$0	$0	0	$0	$0	4	$136,469	$159,689
Lillington	0	$0	$0	0	$0	$0	2	$0	$0	2	$0	$0
Moore County	39	$179,023	$276,976	0	$0	$0	0	$0	$0	39	$179,023	$276,976
New Hanover County	1	$4,714	$5,654	1	$0	$0	0	$0	$0	2	$4,714	$5,654
Pender County	565	$10,341,656	$13,207,500	56	$632,223	$9,966,746	0	$0	$0	621	$10,973,879	$23,174,246
Spring Lake	1	$6,473	$9,142	1	$0	$0	0	$0	$0	2	$6,473	$9,142
Wallace	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0

Cape Fear River Baseline Damages 50-yr (2% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	208	$2,629,972	$3,338,511	44	$1,130,141	$8,434,131	3	$225,212	$12,248,931	255	$3,985,325	$24,021,574
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	37	$30,437	$50,631	5	$0	$0	0	$0	$0	42	$30,437	$50,631
Chatham County	0	$0	$0	1	$0	$0	3	$0	$0	4	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	20	$459,207	$579,947	5	$70,474	$620,733	0	$0	$0	25	$529,681	$1,200,681
Duplin County	161	$1,201,017	$1,531,321	37	$333,810	$918,663	0	$0	$0	198	$1,534,827	$2,449,983
Elizabethtown	6	$86,464	$161,734	7	$77,097	$288,006	4	$97,477	$605,375	17	$261,037	$1,055,114
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	3	$12,124	$13,308	7	$43,088	$1,526,707	1	$0	$0	11	$55,212	$1,540,015
Fort Bragg	1	$6,630	$7,313	0	$0	$0	0	$0	$0	1	$6,630	$7,313
Harnett County	24	$636,128	$855,685	0	$0	$0	1	$0	$0	25	$636,128	$855,685
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	10	$205,588	$254,195	1	$0	$0	0	$0	$0	11	$205,588	$254,195
Lillington	0	$0	$0	0	$0	$0	2	$3,256	$29,442	2	$3,256	$29,442
Moore County	54	$350,033	$540,519	0	$0	$0	0	$0	$0	54	$350,033	$540,519
New Hanover County	3	$11,026	$12,290	2	$3,931	$171,579	0	$0	$0	5	$14,957	$183,868
Pender County	795	$17,907,095	$22,658,972	89	$1,648,373	$18,784,507	1	$0	$0	885	$19,555,468	$41,443,479
Spring Lake	3	$10,576	$15,277	1	$0	$0	0	$0	$0	4	$10,576	$15,277
Wallace	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0

Cape Fear River Baseline Damages 100-yr (1% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	355	$5,210,165	$6,624,506	56	$2,157,542	$12,715,748	4	$489,550	$13,822,568	415	$7,857,257	$33,162,821
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	57	$52,843	$85,781	5	$0	$0	0	$0	$0	62	$52,843	$85,781
Chatham County	0	$0	$0	1	$0	$0	5	$60,158	$78,417	6	$60,158	$78,417
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	45	$966,730	$1,189,429	9	$195,698	$1,555,848	0	$0	$0	54	$1,162,429	$2,745,277
Duplin County	398	$3,735,137	$4,855,960	91	$1,311,663	$3,708,220	1	$0	$0	490	$5,046,801	$8,564,179
Elizabethtown	7	$159,407	$256,159	12	$117,246	$445,448	4	$312,616	$1,771,501	23	$589,268	$2,473,109
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	5	$76,232	$89,358	12	$219,593	$2,736,642	3	$14,007	$18,383	20	$309,832	$2,844,383
Fort Bragg	1	$30,521	$36,383	0	$0	$0	0	$0	$0	1	$30,521	$36,383
Harnett County	40	$1,620,074	$2,170,385	5	$0	$0	1	$0	$0	46	$1,620,074	$2,170,385
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	12	$257,792	$317,569	1	$0	$0	0	$0	$0	13	$257,792	$317,569
Lillington	0	$0	$0	0	$0	$0	3	$7,403	$42,639	3	$7,403	$42,639
Moore County	65	$551,643	$843,460	0	$0	$0	0	$0	$0	65	$551,643	$843,460
New Hanover County	6	$21,625	$24,283	3	$54,962	$452,095	0	$0	$0	9	$76,587	$476,378
Pender County	1,040	$29,296,140	$36,794,353	137	$2,815,033	$28,343,972	1	$0	$0	1,178	$32,111,173	$65,138,325
Spring Lake	6	$57,794	$74,135	2	$0	$0	0	$0	$0	8	$57,794	$74,135
Wallace	6	$1,979	$3,690	1	$0	$0	0	$0	$0	7	$1,979	$3,690

Cape Fear River Baseline Damages 200-yr (0.5% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	454	$7,976,495	$10,140,137	79	$3,011,095	$15,949,754	6	$684,707	$15,102,268	539	$11,672,296	$41,192,159
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	156	$1,190,730	$1,498,559	17	$148,894	$1,137,816	0	$0	$0	173	$1,339,624	$2,636,375
Chatham County	1	$0	$0	1	$40,731	$113,428	5	$892,170	$938,406	7	$932,901	$1,051,834
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	71	$1,724,246	$2,115,603	11	$472,551	$2,696,378	0	$0	$0	82	$2,196,797	$4,811,981
Duplin County	617	$9,241,294	$12,043,723	152	$3,306,681	$10,124,149	4	$0	$0	773	$12,547,975	$22,167,871
Elizabethtown	10	$219,688	$326,639	15	$165,686	$1,008,201	4	$468,931	$3,829,608	29	$854,306	$5,164,448
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	14	$246,293	$340,304	19	$332,929	$4,100,874	5	$43,459	$54,957	38	$622,682	$4,496,135
Fort Bragg	1	$52,294	$60,082	0	$0	$0	0	$0	$0	1	$52,294	$60,082
Harnett County	58	$2,331,711	$3,082,768	7	$304,024	$1,386,996	1	$0	$0	66	$2,635,735	$4,469,764
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	13	$353,960	$431,788	4	$7,972	$39,350	0	$0	$0	17	$361,932	$471,138
Lillington	0	$0	$0	0	$0	$0	5	$175,510	$1,500,766	5	$175,510	$1,500,766
Moore County	82	$781,387	$1,160,212	2	$0	$0	0	$0	$0	84	$781,387	$1,160,212
New Hanover County	9	$38,734	$49,962	3	$166,722	$680,186	0	$0	$0	12	$205,456	$730,149
Pender County	1,281	$43,785,199	$54,772,175	185	$6,380,531	$54,120,359	1	$10,177	$2,401,408	1,467	$50,175,907	$111,293,942
Spring Lake	10	$117,711	$155,373	3	$25,773	$1,125,506	0	$0	$0	13	$143,484	$1,280,879
Wallace	14	$33,533	$50,158	1	$0	$0	0	$0	$0	15	$33,533	$50,158

Cape Fear River Baseline Damages 500-yr (0.2% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	667	$14,690,691	$18,622,273	107	$5,290,844	$27,601,982	6	$1,264,143	$19,236,943	780	$21,245,678	$65,461,198
Brunswick County	1	$505	$653	0	$0	$0	0	$0	$0	1	$505	$653
Burgaw	182	$1,947,148	$2,521,223	20	$667,433	$1,968,665	0	$0	$0	202	$2,614,581	$4,489,888
Chatham County	2	$4,658	$8,055	1	$18,837	$79,937	5	$2,121,306	$2,181,344	8	$2,144,801	$2,269,337
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	188	$3,754,117	$4,739,246	26	$1,180,709	$5,321,841	0	$0	$0	214	$4,934,825	$10,061,087
Duplin County	778	$29,680,941	$37,487,400	217	$14,956,117	$65,664,797	8	$33,964	$865,834	1,003	$44,671,022	$104,018,031
Elizabethtown	12	$325,296	$453,368	23	$426,984	$2,112,171	4	$832,756	$4,746,280	39	$1,585,036	$7,311,819
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	35	$567,898	$789,994	38	$1,346,548	$8,589,405	9	$78,553	$93,528	82	$1,992,999	$9,472,927
Fort Bragg	2	$65,571	$75,095	0	$0	$0	0	$0	$0	2	$65,571	$75,095
Harnett County	79	$3,486,175	$4,527,324	11	$1,909,570	$4,044,280	1	$48,519	$59,151	91	$5,444,264	$8,630,755
Hoke County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Lee County	16	$621,910	$751,416	5	$43,397	$164,778	0	$0	$0	21	$665,308	$916,194
Lillington	1	$0	$0	0	$0	$0	6	$338,179	$2,066,343	7	$338,179	$2,066,343
Moore County	105	$1,238,193	$1,831,174	4	$45,118	$278,576	0	$0	$0	109	$1,283,311	$2,109,750
New Hanover County	12	$85,490	$103,634	3	$284,566	$875,272	0	$0	$0	15	$370,056	$978,905
Pender County	1,517	$71,121,575	$87,702,103	222	$17,400,744	$92,888,829	1	$138,387	$2,826,268	1,740	$88,660,707	$183,417,201
Spring Lake	24	$309,444	$411,897	3	$364,445	$2,446,430	0	$0	$0	27	$673,889	$2,858,327
Wallace	43	$240,257	$316,241	5	$8,566	$22,680	0	$0	$0	48	$248,823	$338,921

Cape Fear River Baseline Damages 1000-yr (0.1% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	778	$22,464,615	$28,372,130	137	$7,870,122	$36,558,752	6	$1,542,791	$20,980,358	921	$31,877,528	$85,911,240
Brunswick County	1	$505	$855	0	$0	$0	0	$0	$0	1	$505	$855
Burgaw	204	$2,672,636	$3,440,346	23	$1,623,521	$5,018,718	0	$0	$0	227	$4,296,157	$8,459,064
Chatham County	3	$38,379	$44,909	1	$44,549	$119,268	5	$3,011,268	$3,083,465	9	$3,094,196	$3,247,642
Columbus County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Cumberland County	461	$7,517,682	$9,626,981	68	$2,727,637	$12,299,527	0	$0	$0	529	$10,245,319	$21,926,507
Duplin County	839	$54,877,513	$68,213,806	235	$38,927,688	$131,499,029	9	$609,514	$53,293,741	1,083	$94,414,715	$253,006,577
Elizabethtown	17	$455,886	$617,386	25	$1,007,267	$3,595,958	4	$973,662	$5,354,859	46	$2,436,814	$9,568,202
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	100	$1,793,552	$2,454,651	57	$2,016,634	$12,758,616	15	$1,682,710	$31,725,933	172	$5,492,896	$46,939,200
Fort Bragg	2	$83,081	$158,117	0	$0	$0	0	$0	$0	2	$83,081	$158,117
Harnett County	102	$4,709,207	$6,030,102	13	$2,571,453	$5,442,875	1	$154,800	$167,329	116	$7,435,460	$11,640,306
Hoke County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Lee County	17	$803,829	$962,807	5	$91,014	$249,972	0	$0	$0	22	$894,843	$1,212,779
Lillington	1	$0	$0	0	$0	$0	8	$359,186	$2,181,359	9	$359,186	$2,181,359
Moore County	117	$1,613,430	$2,321,894	4	$67,404	$354,231	0	$0	$0	121	$1,680,833	$2,676,125
New Hanover County	14	$149,888	$187,641	4	$345,968	$1,011,101	0	$0	$0	18	$495,856	$1,198,742
Pender County	1,645	$95,309,275	$116,747,030	233	$27,974,349	$130,599,999	1	$214,504	$3,175,342	1,879	$123,498,127	$250,522,371
Spring Lake	58	$2,257,335	$2,828,015	4	$774,853	$3,930,404	0	$0	$0	62	$3,032,189	$6,758,420
Wallace	81	$625,503	$909,091	9	$25,070	$65,896	0	$0	$0	90	$650,573	$974,987

Cape Fear Alt 1 Damages 5-yr (20% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	11	$14,459	$27,568	3	$70,257	$412,601	0	$0	$0	14	$84,716	$440,169
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	5	$1,740	$2,670	1	$0	$0	0	$0	$0	6	$1,740	$2,670
Chatham County	0	$0	$0	1	$0	$0	1	$0	$0	2	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	3	$2,719	$4,253	0	$0	$0	0	$0	$0	3	$2,719	$4,253
Duplin County	3	$5,096	$6,226	0	$0	$0	0	$0	$0	3	$5,096	$6,226
Elizabethtown	0	$0	$0	1	$10,949	$26,867	0	$0	$0	1	$10,949	$26,867
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	0	$0	$0	3	$17,421	$825,112	0	$0	$0	3	$17,421	$825,112
Fort Bragg	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Harnett County	1	$1,309	$2,845	0	$0	$0	0	$0	$0	1	$1,309	$2,845
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	2	$51,086	$58,881	0	$0	$0	0	$0	$0	2	$51,086	$58,881
Lillington	0	$0	$0	0	$0	$0	1	$0	$0	1	$0	$0
Moore County	12	$26,464	$35,865	0	$0	$0	0	$0	$0	12	$26,464	$35,865
New Hanover County	1	$790	$1,552	0	$0	$0	0	$0	$0	1	$790	$1,552
Pender County	232	$1,720,299	$2,205,799	18	$48,506	$389,200	0	$0	$0	250	$1,768,805	$2,594,999
Spring Lake	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

Cape Fear Alt 1 Damages 10-yr (10% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	17	$38,377	$67,560	5	$106,171	$567,607	0	$0	$0	22	$144,548	$635,167
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	16	$11,824	$16,959	3	$0	$0	0	$0	$0	19	$11,824	$16,959
Chatham County	0	$0	$0	1	$0	$0	1	$0	$0	2	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	8	$41,778	$62,352	1	$0	$0	0	$0	$0	9	$41,778	$62,352
Duplin County	15	$43,210	$58,774	5	$0	$0	0	$0	$0	20	$43,210	$58,774
Elizabethtown	0	$0	$0	1	$20,960	$43,391	3	$0	$0	4	$20,960	$43,391
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	0	$0	$0	3	$20,305	$917,044	0	$0	$0	3	$20,305	$917,044
Fort Bragg	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Harnett County	6	$8,348	$18,943	0	$0	$0	1	$0	$0	7	$8,348	$18,943
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	4	$92,679	$111,091	0	$0	$0	0	$0	$0	4	$92,679	$111,091
Lillington	0	$0	$0	0	$0	$0	1	$0	$0	1	$0	$0
Moore County	21	$72,454	$108,560	0	$0	$0	0	$0	$0	21	$72,454	$108,560
New Hanover County	1	$790	$1,557	0	$0	$0	0	$0	$0	1	$790	$1,557
Pender County	351	$4,354,696	$5,537,291	29	$156,386	$4,832,329	0	$0	$0	380	$4,511,082	$10,369,620
Spring Lake	1	$0	$0	1	$0	$0	0	$0	$0	2	$0	$0
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

Cape Fear Alt 1 Damages 25-yr (4% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	27	$204,719	$289,433	5	$185,490	$1,015,706	0	$0	$0	32	$390,209	$1,305,139
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	22	$17,317	$29,570	4	$0	$0	0	$0	$0	26	$17,317	$29,570
Chatham County	0	$0	$0	1	$0	$0	2	$0	$0	3	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	11	$224,801	$300,670	3	$0	$0	0	$0	$0	14	$224,801	$300,670
Duplin County	68	$377,091	$482,870	16	$30,495	$332,647	0	$0	$0	84	$407,586	$815,517
Elizabethtown	5	$32,768	$42,957	4	$35,357	$182,776	3	$69,608	$497,801	12	$137,733	$723,534
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	2	$924	$1,020	6	$23,751	$1,003,571	1	$0	$0	9	$24,676	$1,004,591
Fort Bragg	1	$3,394	$3,503	0	$0	$0	0	$0	$0	1	$3,394	$3,503
Harnett County	16	$174,601	$303,217	0	$0	$0	1	$0	$0	17	$174,601	$303,217
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	4	$136,469	$159,689	0	$0	$0	0	$0	$0	4	$136,469	$159,689
Lillington	0	$0	$0	0	$0	$0	2	$0	$0	2	$0	$0
Moore County	39	$179,023	$276,976	0	$0	$0	0	$0	$0	39	$179,023	$276,976
New Hanover County	1	$4,714	$5,654	1	$0	$0	0	$0	$0	2	$4,714	$5,654
Pender County	541	$9,831,758	$12,466,564	42	$620,630	$9,755,689	0	$0	$0	583	$10,452,388	$22,222,253
Spring Lake	1	$6,473	$9,142	1	$0	$0	0	$0	$0	2	$6,473	$9,142
Wallace	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0

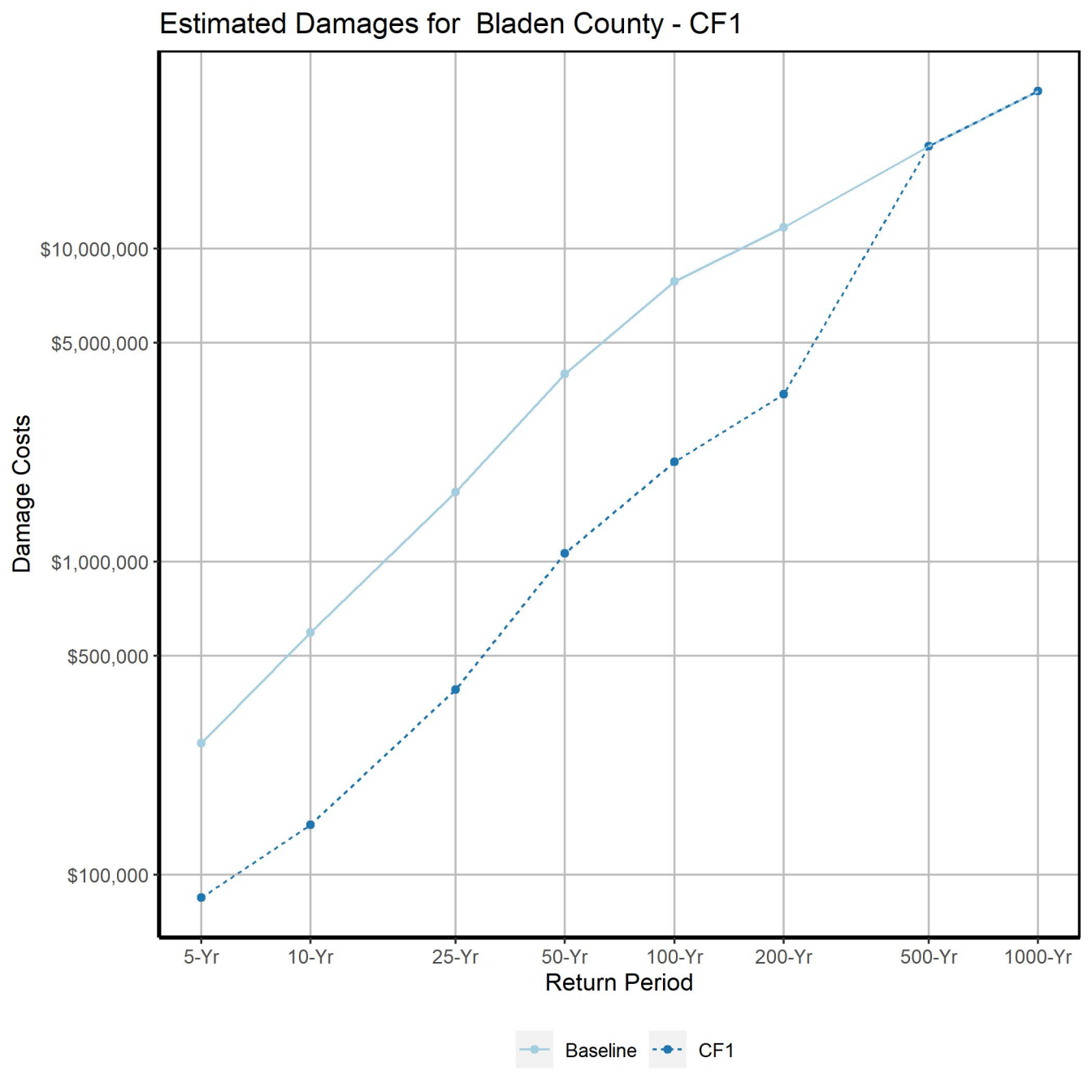
Cape Fear Alt 1 Damages 50-yr (2% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	55	$757,992	$980,574	7	$305,670	$1,989,712	0	$0	$0	62	$1,063,662	$2,970,286
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	37	$30,437	$50,631	5	$0	$0	0	$0	$0	42	$30,437	$50,631
Chatham County	0	$0	$0	1	$0	$0	3	$0	$0	4	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	20	$456,520	$577,194	5	$70,474	$620,733	0	$0	$0	25	$526,994	$1,197,928
Duplin County	161	$1,201,017	$1,531,321	37	$333,810	$918,663	0	$0	$0	198	$1,534,827	$2,449,983
Elizabethtown	6	$88,646	$164,392	7	$78,953	$292,902	4	$98,349	$609,793	17	$265,948	$1,067,087
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	2	$12,124	$13,308	7	$43,088	$1,526,707	1	$0	$0	10	$55,212	$1,540,015
Fort Bragg	1	$6,630	$7,313	0	$0	$0	0	$0	$0	1	$6,630	$7,313
Harnett County	24	$636,128	$855,685	0	$0	$0	1	$0	$0	25	$636,128	$855,685
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	10	$205,588	$254,195	1	$0	$0	0	$0	$0	11	$205,588	$254,195
Lillington	0	$0	$0	0	$0	$0	2	$3,256	$29,442	2	$3,256	$29,442
Moore County	54	$350,033	$540,519	0	$0	$0	0	$0	$0	54	$350,033	$540,519
New Hanover County	3	$11,026	$12,290	2	$3,931	$171,579	0	$0	$0	5	$14,957	$183,868
Pender County	774	$16,966,005	$21,365,737	83	$1,557,716	$18,290,463	1	$0	$0	858	$18,523,721	$39,656,200
Spring Lake	3	$10,576	$15,277	1	$0	$0	0	$0	$0	4	$10,576	$15,277
Wallace	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0

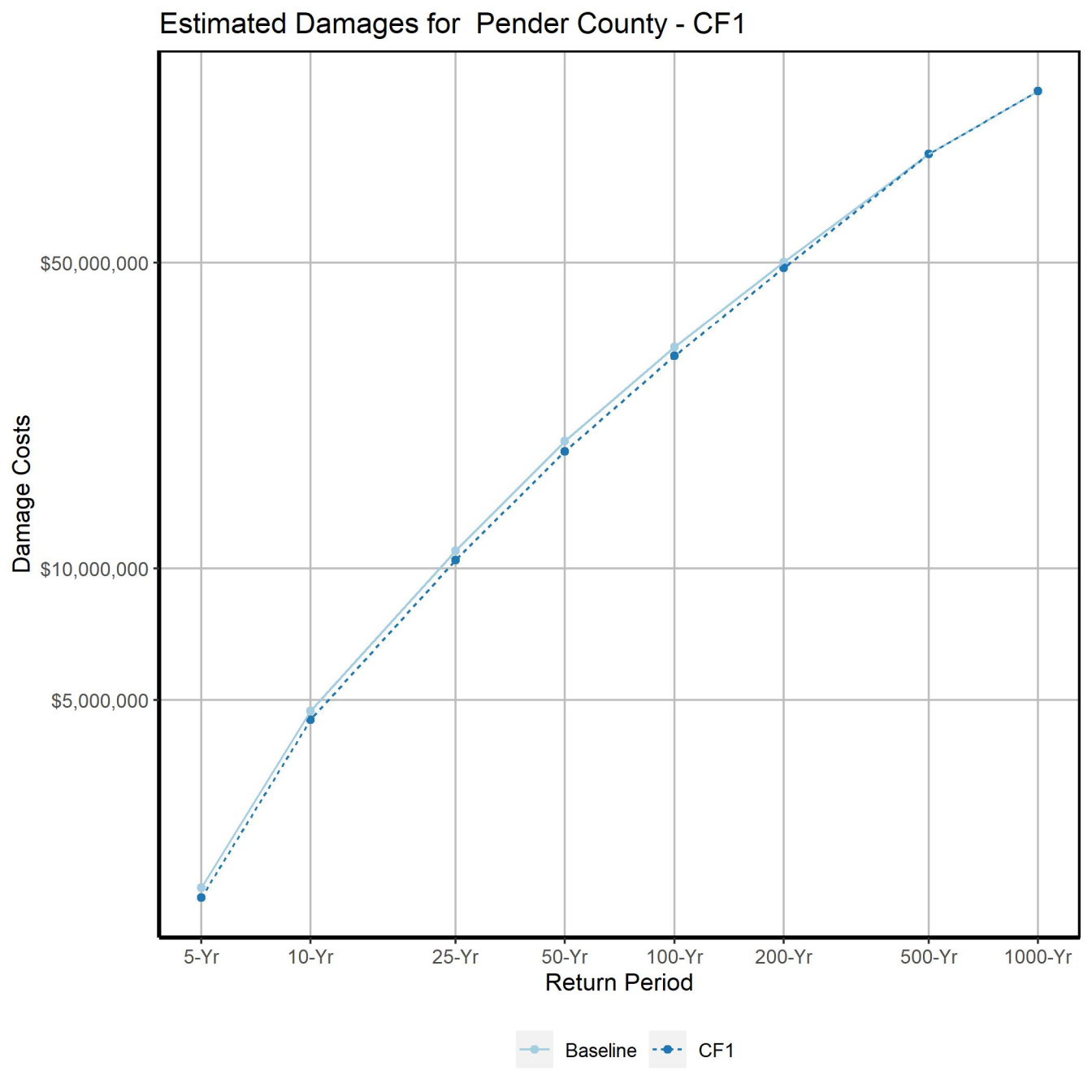
Cape Fear Alt 1 Damages 100-yr (1% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	105	$1,663,592	$2,103,866	9	$423,433	$2,489,651	1	$0	$0	115	$2,087,025	$4,593,517
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	57	$52,843	$85,781	5	$0	$0	0	$0	$0	62	$52,843	$85,781
Chatham County	0	$0	$0	1	$0	$0	5	$60,158	$78,417	6	$60,158	$78,417
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	43	$952,354	$1,173,362	9	$195,698	$1,555,848	0	$0	$0	52	$1,148,052	$2,729,210
Duplin County	398	$3,735,137	$4,855,960	91	$1,311,663	$3,708,220	1	$0	$0	490	$5,046,801	$8,564,179
Elizabethtown	7	$163,060	$260,398	12	$120,120	$452,855	4	$329,305	$1,802,611	23	$612,486	$2,515,864
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	5	$75,149	$88,233	12	$219,593	$2,736,642	3	$12,792	$17,034	20	$307,534	$2,841,910
Fort Bragg	1	$30,521	$36,383	0	$0	$0	0	$0	$0	1	$30,521	$36,383
Harnett County	40	$1,620,074	$2,170,385	5	$0	$0	1	$0	$0	46	$1,620,074	$2,170,385
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	12	$257,792	$317,569	1	$0	$0	0	$0	$0	13	$257,792	$317,569
Lillington	0	$0	$0	0	$0	$0	3	$7,403	$42,639	3	$7,403	$42,639
Moore County	65	$551,643	$843,460	0	$0	$0	0	$0	$0	65	$551,643	$843,460
New Hanover County	6	$21,625	$24,283	3	$54,962	$452,095	0	$0	$0	9	$76,587	$476,378
Pender County	1,017	$27,987,669	$35,187,162	133	$2,671,182	$28,115,846	1	$0	$0	1,151	$30,658,852	$63,303,008
Spring Lake	6	$57,794	$74,135	2	$0	$0	0	$0	$0	8	$57,794	$74,135
Wallace	6	$1,979	$3,690	1	$0	$0	0	$0	$0	7	$1,979	$3,690

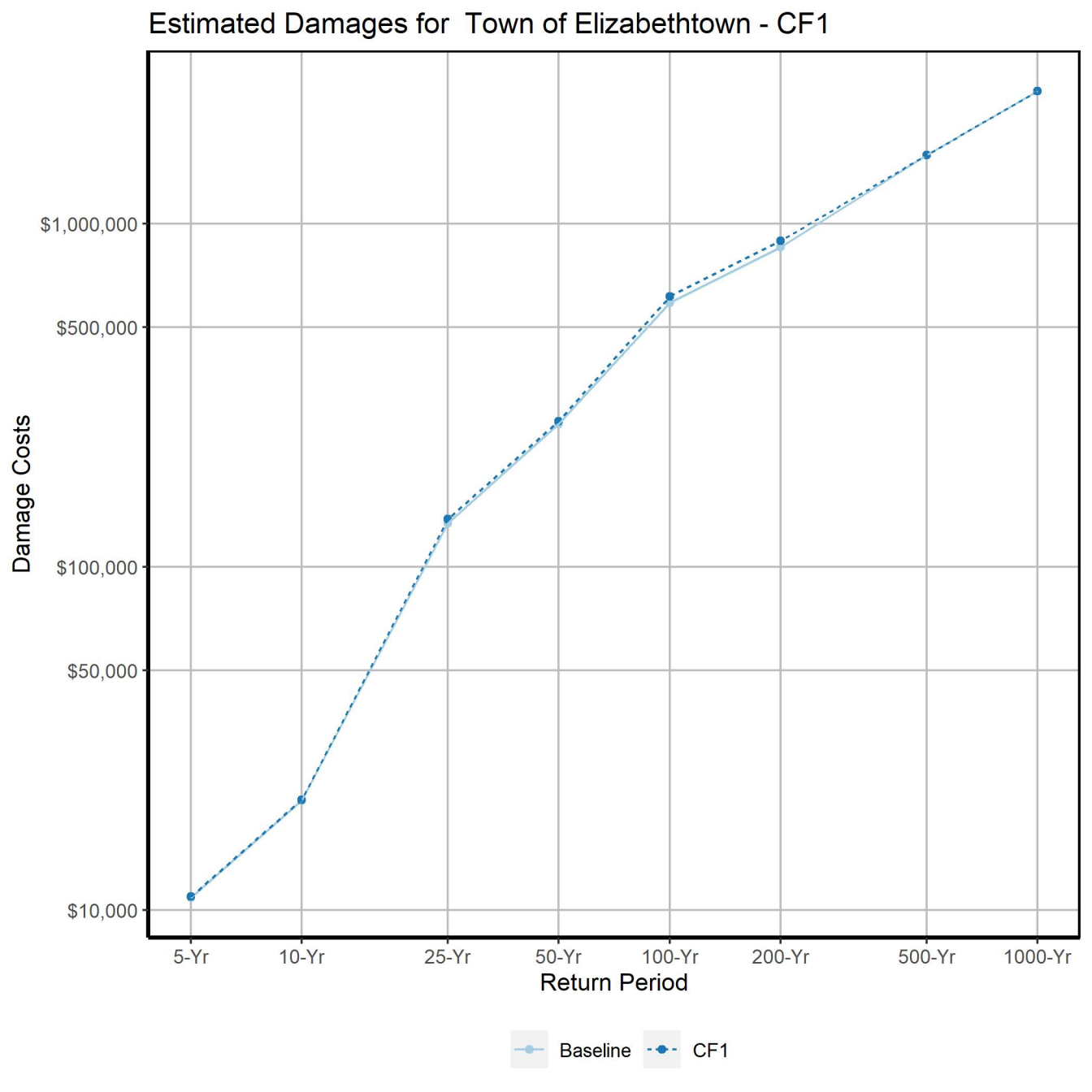
Cape Fear Alt 1 Damages 200-yr (0.5% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	164	$2,831,878	$3,640,442	23	$601,055	$3,064,444	2	$0	$0	189	$3,432,933	$6,704,886
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	156	$1,190,730	$1,498,559	17	$148,894	$1,137,816	0	$0	$0	173	$1,339,624	$2,636,375
Chatham County	1	$0	$0	1	$40,731	$113,428	5	$892,170	$938,406	7	$932,901	$1,051,834
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	71	$1,724,246	$2,115,603	11	$472,551	$2,696,378	0	$0	$0	82	$2,196,797	$4,811,981
Duplin County	617	$9,241,294	$12,043,723	152	$3,306,681	$10,124,149	4	$0	$0	773	$12,547,975	$22,167,871
Elizabethtown	10	$222,599	$330,345	16	$168,830	$1,024,999	4	$500,452	$3,900,232	30	$891,881	$5,255,576
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	14	$246,293	$340,304	19	$332,929	$4,100,874	5	$43,459	$54,957	38	$622,682	$4,496,135
Fort Bragg	1	$52,294	$60,082	0	$0	$0	0	$0	$0	1	$52,294	$60,082
Harnett County	58	$2,331,711	$3,082,768	7	$304,024	$1,386,996	1	$0	$0	66	$2,635,735	$4,469,764
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	13	$353,960	$431,788	4	$7,972	$39,350	0	$0	$0	17	$361,932	$471,138
Lillington	0	$0	$0	0	$0	$0	5	$175,510	$1,500,766	5	$175,510	$1,500,766
Moore County	82	$781,387	$1,160,212	2	$0	$0	0	$0	$0	84	$781,387	$1,160,212
New Hanover County	9	$38,734	$49,962	3	$166,722	$680,186	0	$0	$0	12	$205,456	$730,149
Pender County	1,254	$42,422,734	$53,179,035	184	$6,233,940	$53,625,474	1	$10,177	$2,401,408	1,439	$48,666,850	$109,205,917
Spring Lake	10	$117,711	$155,373	3	$25,773	$1,125,506	0	$0	$0	13	$143,484	$1,280,879
Wallace	14	$33,533	$50,158	1	$0	$0	0	$0	$0	15	$33,533	$50,158

Cape Fear Alt 1 Damages 500-yr (0.2% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	667	$14,690,691	$18,622,273	107	$5,290,844	$27,601,982	6	$1,264,143	$19,236,943	780	$21,245,678	$65,461,198
Brunswick County	1	$505	$653	0	$0	$0	0	$0	$0	1	$505	$653
Burgaw	182	$1,947,148	$2,521,223	20	$667,433	$1,968,665	0	$0	$0	202	$2,614,581	$4,489,888
Chatham County	2	$4,658	$8,055	1	$18,837	$79,937	5	$2,121,306	$2,181,344	8	$2,144,801	$2,269,337
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	188	$3,754,117	$4,739,246	26	$1,180,709	$5,321,841	0	$0	$0	214	$4,934,825	$10,061,087
Duplin County	778	$29,680,941	$37,487,400	217	$14,956,117	$65,664,797	8	$33,964	$865,834	1,003	$44,671,022	$104,018,031
Elizabethtown	12	$325,296	$453,368	23	$426,984	$2,112,171	4	$832,756	$4,746,280	39	$1,585,036	$7,311,819
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	35	$567,898	$789,994	38	$1,346,548	$8,589,405	9	$78,553	$93,528	82	$1,992,999	$9,472,927
Fort Bragg	2	$65,571	$75,095	0	$0	$0	0	$0	$0	2	$65,571	$75,095
Harnett County	79	$3,486,175	$4,527,324	11	$1,909,570	$4,044,280	1	$48,519	$59,151	91	$5,444,264	$8,630,755
Hoke County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Lee County	16	$621,910	$751,416	5	$43,397	$164,778	0	$0	$0	21	$665,308	$916,194
Lillington	1	$0	$0	0	$0	$0	6	$338,179	$2,066,343	7	$338,179	$2,066,343
Moore County	105	$1,238,193	$1,831,174	4	$45,118	$278,576	0	$0	$0	109	$1,283,311	$2,109,750
New Hanover County	12	$85,490	$103,634	3	$284,566	$875,272	0	$0	$0	15	$370,056	$978,905
Pender County	1,517	$71,121,575	$87,702,103	222	$17,400,744	$92,888,829	1	$138,387	$2,826,268	1,740	$88,660,707	$183,417,201
Spring Lake	24	$309,444	$411,897	3	$364,445	$2,446,430	0	$0	$0	27	$673,889	$2,858,327
Wallace	43	$240,257	$316,241	5	$8,566	$22,680	0	$0	$0	48	$248,823	$338,921

Cape Fear Alt 1 Damages 1000-yr (0.1% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	778	$22,464,615	$28,372,130	137	$7,870,122	$36,558,752	6	$1,542,791	$20,980,358	921	$31,877,528	$85,911,240
Brunswick County	1	$505	$855	0	$0	$0	0	$0	$0	1	$505	$855
Burgaw	204	$2,672,636	$3,440,346	23	$1,623,521	$5,018,718	0	$0	$0	227	$4,296,157	$8,459,064
Chatham County	3	$38,379	$44,909	1	$44,549	$119,268	5	$3,011,268	$3,083,465	9	$3,094,196	$3,247,642
Columbus County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Cumberland County	461	$7,517,682	$9,626,981	68	$2,727,637	$12,299,527	0	$0	$0	529	$10,245,319	$21,926,507
Duplin County	839	$54,877,513	$68,213,806	235	$38,927,688	$131,499,029	9	$609,514	$53,293,741	1,083	$94,414,715	$253,006,577
Elizabethtown	17	$455,886	$617,386	25	$1,007,267	$3,595,958	4	$973,662	$5,354,859	46	$2,436,814	$9,568,202
Erwin	2	$571	$1,180	0	$0	$0	0	$0	$0	2	$571	$1,180
Fayetteville	100	$1,793,552	$2,454,651	57	$2,016,634	$12,758,616	15	$1,682,710	$31,725,933	172	$5,492,896	$46,939,200
Fort Bragg	2	$83,081	$158,117	0	$0	$0	0	$0	$0	2	$83,081	$158,117
Harnett County	102	$4,709,207	$6,030,102	13	$2,571,453	$5,442,875	1	$154,800	$167,329	116	$7,435,460	$11,640,306
Hoke County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Lee County	17	$803,829	$962,807	5	$91,014	$249,972	0	$0	$0	22	$894,843	$1,212,779
Lillington	1	$0	$0	0	$0	$0	8	$359,186	$2,181,359	9	$359,186	$2,181,359
Moore County	117	$1,613,430	$2,321,894	4	$67,404	$354,231	0	$0	$0	121	$1,680,833	$2,676,125
New Hanover County	14	$149,888	$187,641	4	$345,968	$1,011,101	0	$0	$0	18	$495,856	$1,198,742
Pender County	1,645	$95,309,275	$116,747,030	233	$27,974,349	$130,599,999	1	$214,504	$3,175,342	1,879	$123,498,127	$250,522,371
Spring Lake	58	$2,257,335	$2,828,015	4	$774,853	$3,930,404	0	$0	$0	62	$3,032,189	$6,758,420
Wallace	81	$625,503	$909,091	9	$25,070	$65,896	0	$0	$0	90	$650,573	$974,987


Estimated Damages for Bladen County - CF1
Damage Costs
$10,000,000
$5,000,000
$1,000,000
$500,000
$100,000
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
CF1


Estimated Damages for Pender County - CF1
$50,000,000
$10,000,000
$5,000,000
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
CF1


Estimated Damages for Town of Elizabethtown - CF1
$1,000,000
$500,000
$100,000
$50,000
$10,000
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
CF1

Cape Fear Alt 2 Damages 5-yr (20% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	32	$123,988	$168,282	10	$124,755	$1,402,049	1	$0	$0	43	$248,742	$1,570,332
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	5	$1,740	$2,670	1	$0	$0	0	$0	$0	6	$1,740	$2,670
Chatham County	0	$0	$0	1	$0	$0	1	$0	$0	2	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	2	$2,268	$3,261	0	$0	$0	0	$0	$0	2	$2,268	$3,261
Duplin County	3	$5,096	$6,226	0	$0	$0	0	$0	$0	3	$5,096	$6,226
Elizabethtown	0	$0	$0	1	$9,506	$24,909	0	$0	$0	1	$9,506	$24,909
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	0	$0	$0	2	$16,931	$808,713	0	$0	$0	2	$16,931	$808,713
Fort Bragg	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Harnett County	1	$1,309	$2,845	0	$0	$0	0	$0	$0	1	$1,309	$2,845
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	2	$51,086	$58,881	0	$0	$0	0	$0	$0	2	$51,086	$58,881
Lillington	0	$0	$0	0	$0	$0	1	$0	$0	1	$0	$0
Moore County	12	$26,464	$35,865	0	$0	$0	0	$0	$0	12	$26,464	$35,865
New Hanover County	1	$790	$1,552	0	$0	$0	0	$0	$0	1	$790	$1,552
Pender County	257	$1,786,563	$2,317,403	25	$49,689	$396,255	0	$0	$0	282	$1,836,253	$2,713,657
Spring Lake	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

Cape Fear Alt 2 Damages 10-yr (10% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	58	$344,344	$463,133	14	$232,675	$1,840,921	1	$25,614	$3,313,271	73	$602,632	$5,617,324
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	16	$11,824	$16,959	3	$0	$0	0	$0	$0	19	$11,824	$16,959
Chatham County	0	$0	$0	1	$0	$0	1	$0	$0	2	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	8	$40,220	$60,481	1	$0	$0	0	$0	$0	9	$40,220	$60,481
Duplin County	15	$43,210	$58,774	5	$0	$0	0	$0	$0	20	$43,210	$58,774
Elizabethtown	0	$0	$0	1	$20,899	$43,273	3	$0	$0	4	$20,899	$43,273
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	0	$0	$0	3	$20,212	$914,742	0	$0	$0	3	$20,212	$914,742
Fort Bragg	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Harnett County	6	$8,348	$18,943	0	$0	$0	1	$0	$0	7	$8,348	$18,943
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	4	$92,679	$111,091	0	$0	$0	0	$0	$0	4	$92,679	$111,091
Lillington	0	$0	$0	0	$0	$0	1	$0	$0	1	$0	$0
Moore County	21	$72,454	$108,560	0	$0	$0	0	$0	$0	21	$72,454	$108,560
New Hanover County	1	$790	$1,557	0	$0	$0	0	$0	$0	1	$790	$1,557
Pender County	383	$4,579,196	$5,871,793	42	$159,473	$4,851,705	0	$0	$0	425	$4,738,669	$10,723,498
Spring Lake	1	$0	$0	1	$0	$0	0	$0	$0	2	$0	$0
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

Cape Fear Alt 2 Damages 25-yr (4% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	120	$1,060,378	$1,385,946	28	$504,933	$2,929,786	2	$100,046	$3,867,892	150	$1,665,356	$8,183,624
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	22	$17,317	$29,570	4	$0	$0	0	$0	$0	26	$17,317	$29,570
Chatham County	0	$0	$0	1	$0	$0	2	$0	$0	3	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	11	$219,379	$294,784	3	$0	$0	0	$0	$0	14	$219,379	$294,784
Duplin County	68	$377,091	$482,870	16	$30,495	$332,647	0	$0	$0	84	$407,586	$815,517
Elizabethtown	5	$31,590	$41,512	4	$34,104	$179,319	3	$68,197	$494,270	12	$133,891	$715,101
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	1	$0	$0	6	$23,646	$1,000,355	1	$0	$0	8	$23,646	$1,000,355
Fort Bragg	1	$3,394	$3,503	0	$0	$0	0	$0	$0	1	$3,394	$3,503
Harnett County	16	$174,601	$303,217	0	$0	$0	1	$0	$0	17	$174,601	$303,217
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	4	$136,469	$159,689	0	$0	$0	0	$0	$0	4	$136,469	$159,689
Lillington	0	$0	$0	0	$0	$0	2	$0	$0	2	$0	$0
Moore County	39	$179,023	$276,976	0	$0	$0	0	$0	$0	39	$179,023	$276,976
New Hanover County	1	$4,714	$5,654	1	$0	$0	0	$0	$0	2	$4,714	$5,654
Pender County	565	$10,345,557	$13,211,194	56	$632,374	$9,967,184	0	$0	$0	621	$10,977,931	$23,178,378
Spring Lake	1	$6,473	$9,142	1	$0	$0	0	$0	$0	2	$6,473	$9,142
Wallace	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0

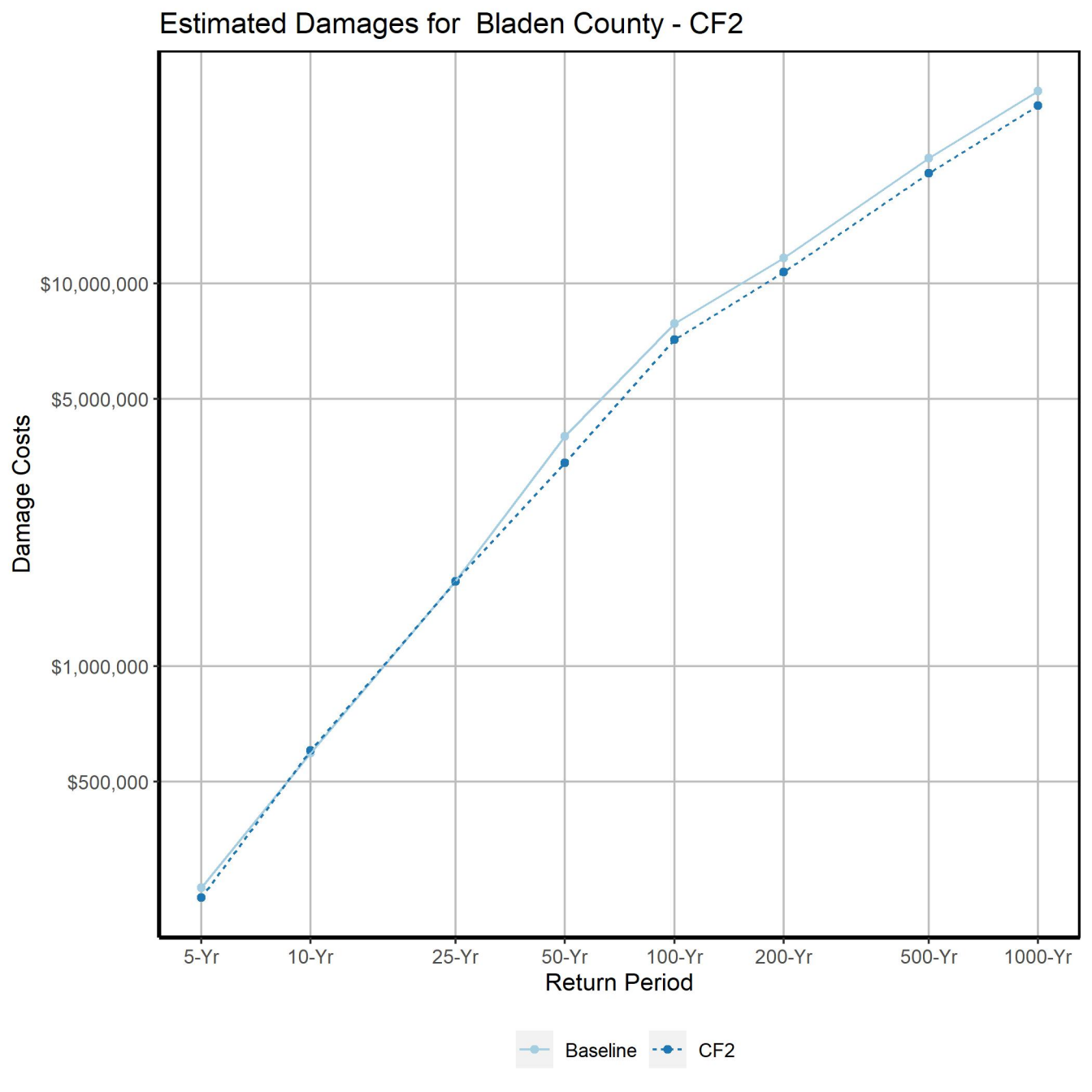
Cape Fear Alt 2 Damages 50-yr (2% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	194	$2,311,669	$2,959,023	41	$906,378	$6,254,105	3	$182,843	$11,383,198	238	$3,400,890	$20,596,326
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	37	$30,437	$50,631	5	$0	$0	0	$0	$0	42	$30,437	$50,631
Chatham County	0	$0	$0	1	$0	$0	3	$0	$0	4	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	20	$432,784	$540,484	5	$70,474	$620,733	0	$0	$0	25	$503,258	$1,161,217
Duplin County	161	$1,201,017	$1,531,321	37	$333,810	$918,663	0	$0	$0	198	$1,534,827	$2,449,983
Elizabethtown	6	$77,725	$117,425	6	$69,741	$267,823	4	$94,242	$591,973	16	$241,708	$977,220
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	2	$2,647	$3,579	7	$32,820	$1,391,042	1	$0	$0	10	$35,467	$1,394,621
Fort Bragg	1	$6,630	$7,313	0	$0	$0	0	$0	$0	1	$6,630	$7,313
Harnett County	24	$636,128	$855,685	0	$0	$0	1	$0	$0	25	$636,128	$855,685
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	10	$205,588	$254,195	1	$0	$0	0	$0	$0	11	$205,588	$254,195
Lillington	0	$0	$0	0	$0	$0	2	$3,256	$29,442	2	$3,256	$29,442
Moore County	54	$350,033	$540,519	0	$0	$0	0	$0	$0	54	$350,033	$540,519
New Hanover County	3	$11,026	$12,290	2	$3,931	$171,579	0	$0	$0	5	$14,957	$183,868
Pender County	789	$17,534,161	$22,176,707	89	$1,624,762	$18,713,200	1	$0	$0	879	$19,158,923	$40,889,907
Spring Lake	3	$10,576	$15,277	1	$0	$0	0	$0	$0	4	$10,576	$15,277
Wallace	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0

Cape Fear Alt 2 Damages 100-yr (1% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	314	$4,702,813	$5,958,088	55	$1,990,499	$12,102,268	3	$451,591	$13,584,947	372	$7,144,904	$31,645,303
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	57	$52,843	$85,781	5	$0	$0	0	$0	$0	62	$52,843	$85,781
Chatham County	0	$0	$0	1	$0	$0	5	$60,158	$78,417	6	$60,158	$78,417
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	38	$838,798	$1,038,779	8	$195,633	$1,548,704	0	$0	$0	46	$1,034,431	$2,587,483
Duplin County	398	$3,735,137	$4,855,960	91	$1,311,663	$3,708,220	1	$0	$0	490	$5,046,801	$8,564,179
Elizabethtown	7	$146,858	$241,625	9	$108,898	$403,446	4	$275,702	$1,702,657	20	$531,458	$2,347,727
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	5	$60,769	$72,228	11	$177,645	$2,500,393	2	$4,167	$7,684	18	$242,581	$2,580,304
Fort Bragg	1	$30,521	$36,383	0	$0	$0	0	$0	$0	1	$30,521	$36,383
Harnett County	40	$1,593,269	$2,140,852	5	$0	$0	1	$0	$0	46	$1,593,269	$2,140,852
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	12	$257,792	$317,569	1	$0	$0	0	$0	$0	13	$257,792	$317,569
Lillington	0	$0	$0	0	$0	$0	3	$7,403	$42,639	3	$7,403	$42,639
Moore County	65	$551,643	$843,460	0	$0	$0	0	$0	$0	65	$551,643	$843,460
New Hanover County	6	$21,625	$24,283	3	$54,962	$452,095	0	$0	$0	9	$76,587	$476,378
Pender County	1,036	$28,853,166	$36,263,007	137	$2,767,623	$27,296,038	1	$0	$0	1,174	$31,620,789	$63,559,045
Spring Lake	6	$57,794	$74,135	2	$0	$0	0	$0	$0	8	$57,794	$74,135
Wallace	6	$1,979	$3,690	1	$0	$0	0	$0	$0	7	$1,979	$3,690

Cape Fear Alt 2 Damages 200-yr (0.5% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	426	$7,241,892	$9,194,147	75	$2,827,382	$15,189,769	5	$646,071	$14,823,969	506	$10,715,345	$39,207,884
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	156	$1,190,730	$1,498,559	17	$148,894	$1,137,816	0	$0	$0	173	$1,339,624	$2,636,375
Chatham County	1	$0	$0	1	$40,731	$113,428	5	$892,170	$938,406	7	$932,901	$1,051,834
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	64	$1,492,851	$1,818,743	11	$407,087	$2,595,264	0	$0	$0	75	$1,899,938	$4,414,007
Duplin County	617	$9,241,294	$12,043,723	152	$3,306,681	$10,124,149	4	$0	$0	773	$12,547,975	$22,167,871
Elizabethtown	9	$207,408	$311,936	15	$155,183	$926,781	4	$409,458	$2,671,949	28	$772,049	$3,910,667
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	9	$170,087	$223,912	15	$286,936	$3,083,311	5	$27,009	$37,372	29	$484,032	$3,344,595
Fort Bragg	1	$52,294	$60,082	0	$0	$0	0	$0	$0	1	$52,294	$60,082
Harnett County	57	$2,311,097	$3,059,717	7	$304,024	$1,386,996	1	$0	$0	65	$2,615,121	$4,446,713
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	13	$353,960	$431,788	4	$7,972	$39,350	0	$0	$0	17	$361,932	$471,138
Lillington	0	$0	$0	0	$0	$0	5	$175,510	$1,500,766	5	$175,510	$1,500,766
Moore County	82	$781,387	$1,160,212	2	$0	$0	0	$0	$0	84	$781,387	$1,160,212
New Hanover County	9	$38,734	$49,962	3	$166,722	$680,186	0	$0	$0	12	$205,456	$730,149
Pender County	1,278	$43,299,824	$54,211,446	185	$6,279,146	$53,875,100	1	$10,177	$2,401,408	1,464	$49,589,147	$110,487,955
Spring Lake	10	$117,711	$155,373	3	$25,773	$1,125,506	0	$0	$0	13	$143,484	$1,280,879
Wallace	14	$33,533	$50,158	1	$0	$0	0	$0	$0	15	$33,533	$50,158

Cape Fear Alt 2 Damages 500-yr (0.2% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	640	$13,399,024	$17,040,985	102	$4,839,800	$26,177,731	6	$1,168,350	$18,822,840	748	$19,407,175	$62,041,556
Brunswick County	1	$505	$623	0	$0	$0	0	$0	$0	1	$505	$623
Burgaw	182	$1,947,148	$2,521,223	20	$667,433	$1,968,665	0	$0	$0	202	$2,614,581	$4,489,888
Chatham County	2	$4,658	$8,055	1	$18,837	$79,937	5	$2,121,306	$2,181,344	8	$2,144,801	$2,269,337
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	157	$3,319,473	$4,165,077	21	$1,123,702	$5,215,214	0	$0	$0	178	$4,443,175	$9,380,291
Duplin County	778	$29,680,941	$37,487,400	217	$14,956,117	$65,664,797	8	$33,964	$865,834	1,003	$44,671,022	$104,018,031
Elizabethtown	12	$303,252	$428,663	21	$352,613	$1,848,654	4	$788,247	$4,580,847	37	$1,444,112	$6,858,164
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	25	$373,503	$496,559	27	$911,969	$6,628,706	7	$63,458	$77,154	59	$1,348,930	$7,202,419
Fort Bragg	2	$65,571	$75,095	0	$0	$0	0	$0	$0	2	$65,571	$75,095
Harnett County	77	$3,424,872	$4,429,449	11	$1,909,570	$4,044,280	1	$48,519	$59,151	89	$5,382,961	$8,532,879
Hoke County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Lee County	16	$621,910	$751,416	5	$43,397	$164,778	0	$0	$0	21	$665,308	$916,194
Lillington	1	$0	$0	0	$0	$0	6	$338,179	$2,066,343	7	$338,179	$2,066,343
Moore County	105	$1,238,193	$1,831,174	4	$45,118	$278,576	0	$0	$0	109	$1,283,311	$2,109,750
New Hanover County	12	$85,490	$103,634	3	$284,566	$875,272	0	$0	$0	15	$370,056	$978,905
Pender County	1,515	$70,622,073	$87,126,306	222	$17,312,976	$92,660,177	1	$138,387	$2,826,268	1,738	$88,073,436	$182,612,751
Spring Lake	24	$309,444	$411,897	3	$364,445	$2,446,430	0	$0	$0	27	$673,889	$2,858,327
Wallace	43	$240,257	$316,241	5	$8,566	$22,680	0	$0	$0	48	$248,823	$338,921

Cape Fear Alt 2 Damages 1000-yr (0.1% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	750	$20,382,360	$25,806,198	129	$7,323,847	$34,940,433	6	$1,498,289	$20,653,375	885	$29,204,496	$81,400,006
Brunswick County	1	$505	$822	0	$0	$0	0	$0	$0	1	$505	$822
Burgaw	204	$2,672,636	$3,440,346	23	$1,623,521	$5,018,718	0	$0	$0	227	$4,296,157	$8,459,064
Chatham County	3	$38,379	$44,909	1	$44,549	$119,268	5	$3,011,268	$3,083,465	9	$3,094,196	$3,247,642
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	375	$6,231,274	$7,957,079	54	$2,631,533	$11,545,084	0	$0	$0	429	$8,862,807	$19,502,163
Duplin County	839	$54,877,513	$68,213,806	235	$38,927,688	$131,499,029	9	$609,514	$53,293,741	1,083	$94,414,715	$253,006,577
Elizabethtown	16	$426,866	$582,472	24	$839,824	$3,292,349	4	$952,631	$5,236,798	44	$2,219,322	$9,111,618
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	55	$867,366	$1,265,430	39	$1,223,515	$7,665,464	9	$77,958	$92,768	103	$2,168,840	$9,023,661
Fort Bragg	2	$83,081	$158,117	0	$0	$0	0	$0	$0	2	$83,081	$158,117
Harnett County	98	$4,557,042	$5,834,110	13	$2,571,453	$5,442,875	1	$154,800	$167,329	112	$7,283,295	$11,444,314
Hoke County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Lee County	17	$803,829	$962,807	5	$91,014	$249,972	0	$0	$0	22	$894,843	$1,212,779
Lillington	1	$0	$0	0	$0	$0	8	$359,186	$2,181,359	9	$359,186	$2,181,359
Moore County	117	$1,613,430	$2,321,894	4	$67,404	$354,231	0	$0	$0	121	$1,680,833	$2,676,125
New Hanover County	14	$149,888	$187,641	4	$345,968	$1,011,101	0	$0	$0	18	$495,856	$1,198,742
Pender County	1,645	$94,841,477	$116,168,826	232	$27,815,473	$130,156,584	1	$214,504	$3,175,342	1,878	$122,871,454	$249,500,752
Spring Lake	58	$2,257,335	$2,828,015	4	$774,853	$3,930,404	0	$0	$0	62	$3,032,189	$6,758,420
Wallace	81	$625,503	$909,091	9	$25,070	$65,896	0	$0	$0	90	$650,573	$974,987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$500,000
Damage Costs
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10-Yr
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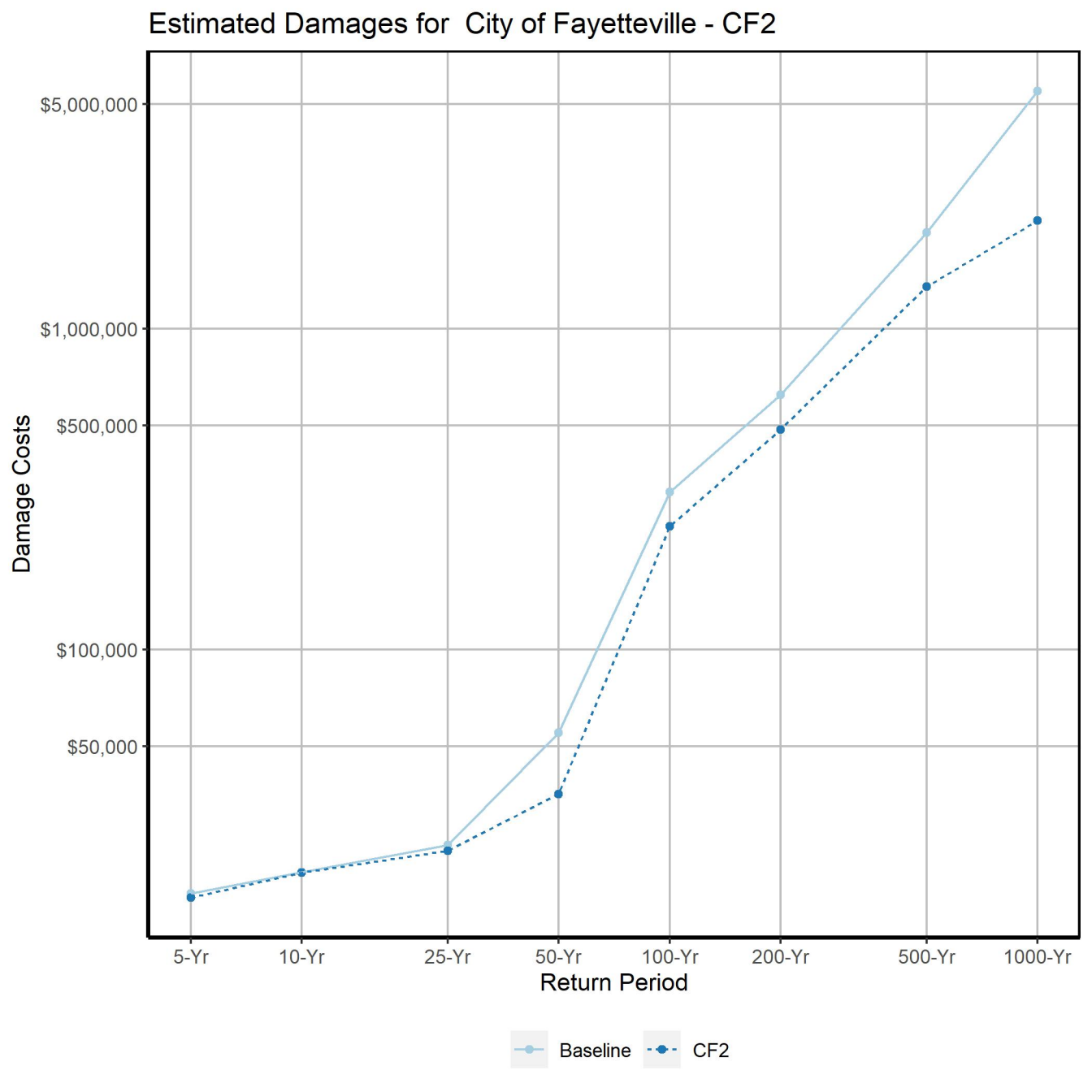
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
CF2


Estimated Damages for City of Fayetteville - CF2
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Damage Costs
5-Yr
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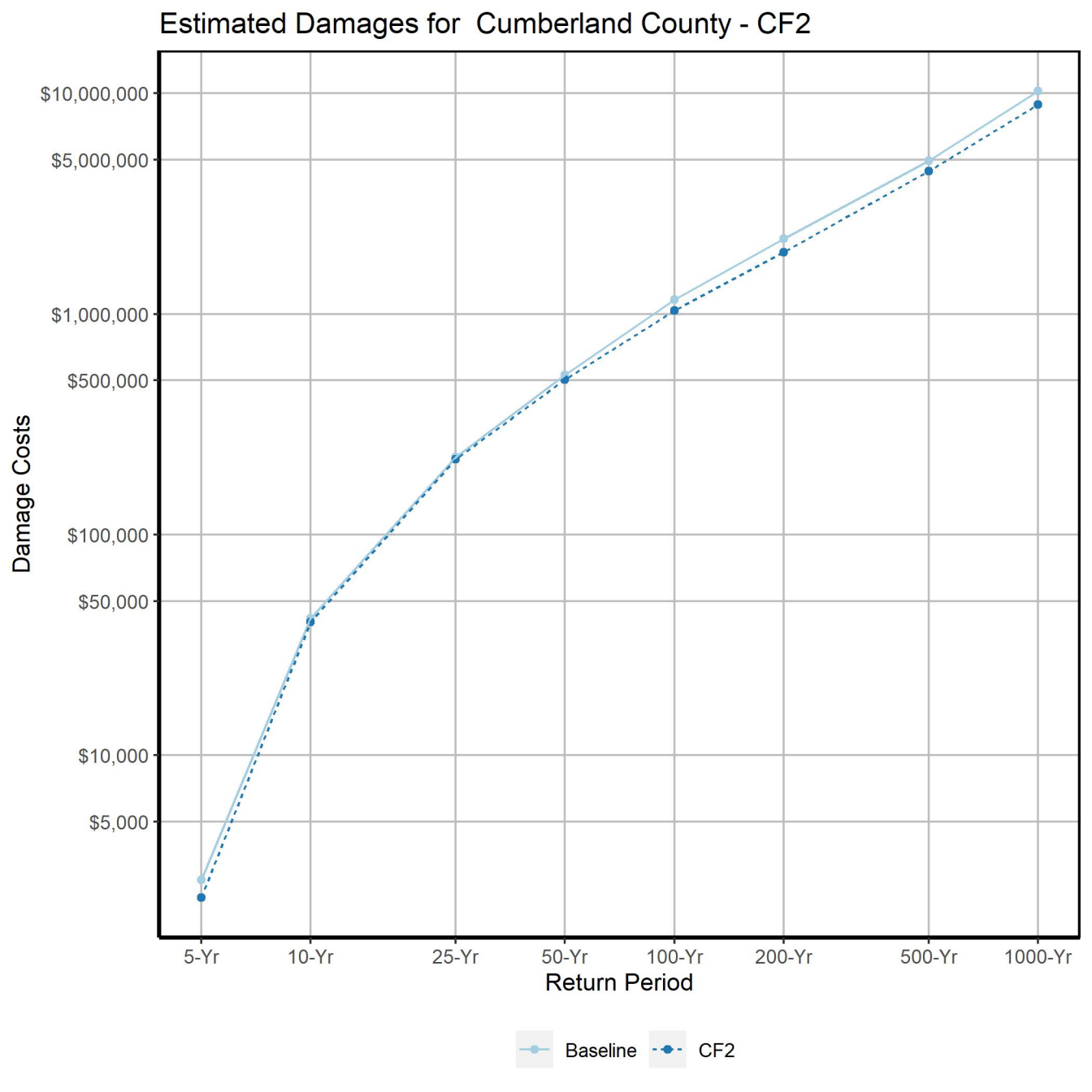
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
CF2


Estimated Damages for Cumberland County - CF2
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$50,000
$10,000
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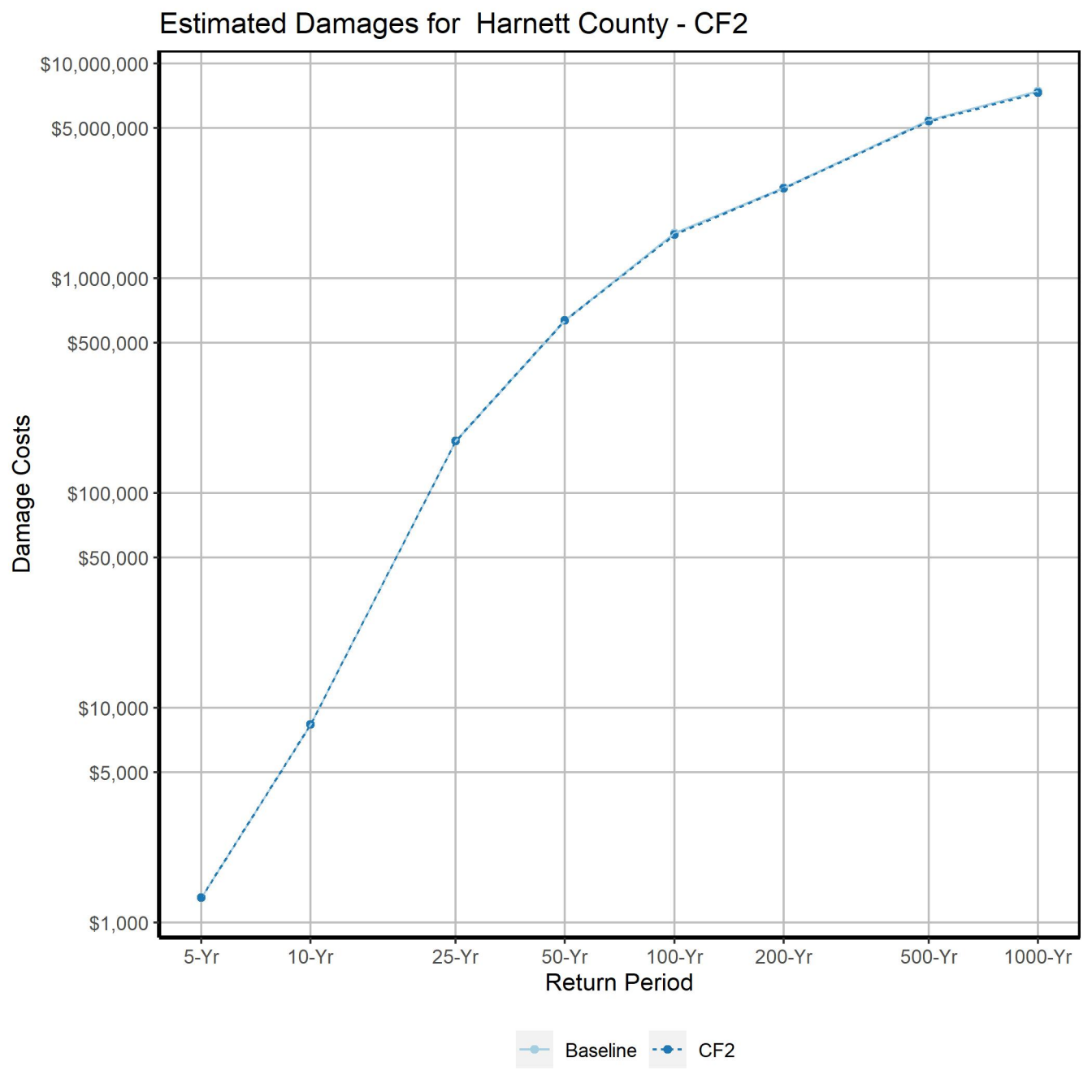
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
CF2


Estimated Damages for Harnett County - CF2
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$100,000
$50,000
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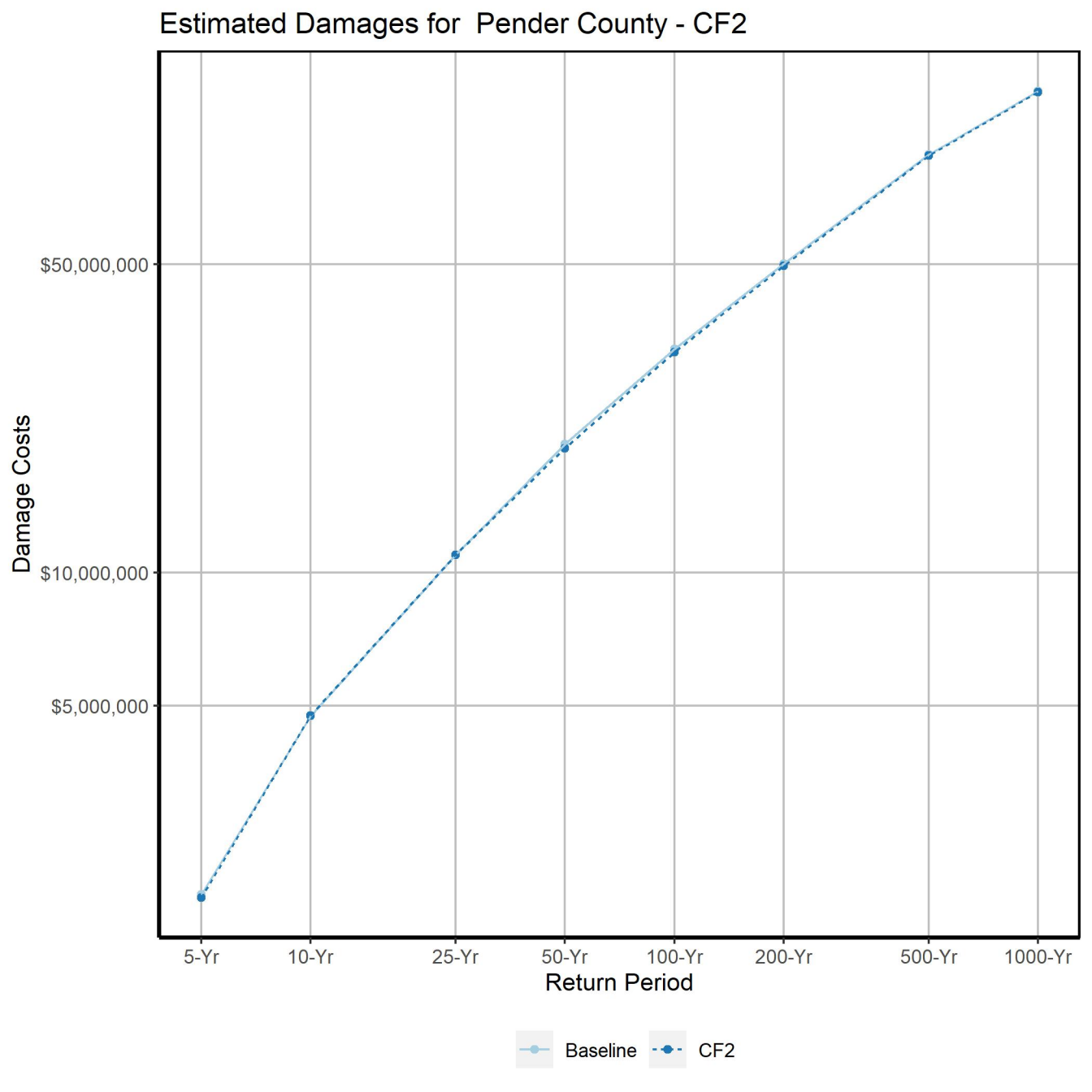
$5,000
$1,000
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
CF2


Estimated Damages for Pender County - CF2
Damage Costs
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$5,000,000
5-Yr
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25-Yr
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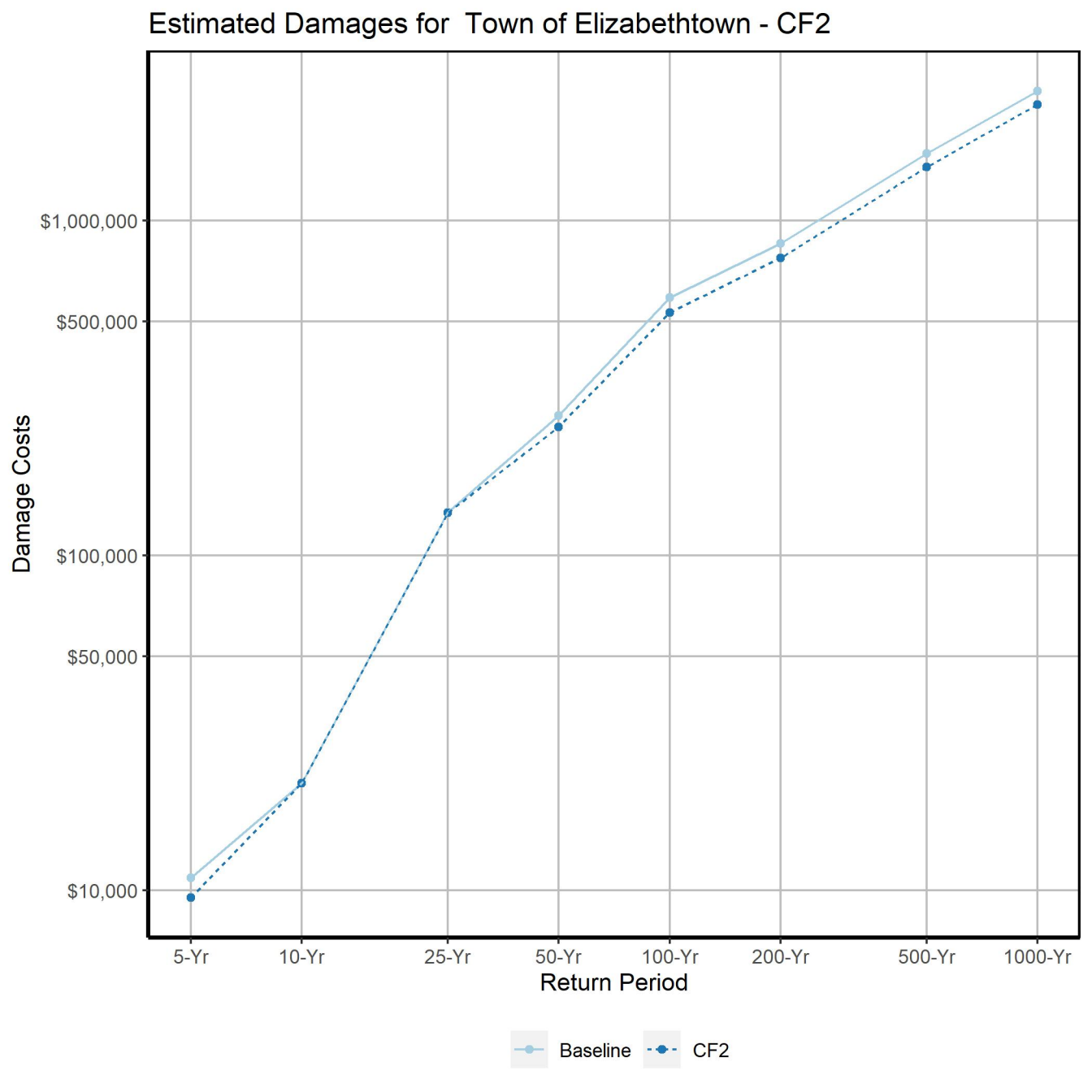
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
CF2


Estimated Damages for Town of Elizabethtown - CF2
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$10,000
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
CF2

Cape Fear Alt 3 Damages 5-yr (20% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	32	$122,945	$167,123	10	$124,061	$1,398,419	1	$0	$0	43	$247,005	$1,565,542
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	5	$1,740	$2,670	1	$0	$0	0	$0	$0	6	$1,740	$2,670
Chatham County	0	$0	$0	1	$0	$0	1	$0	$0	2	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	2	$2,261	$3,242	0	$0	$0	0	$0	$0	2	$2,261	$3,242
Duplin County	3	$5,096	$6,226	0	$0	$0	0	$0	$0	3	$5,096	$6,226
Elizabethtown	0	$0	$0	1	$9,442	$24,822	0	$0	$0	1	$9,442	$24,822
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	0	$0	$0	2	$16,904	$807,849	0	$0	$0	2	$16,904	$807,849
Fort Bragg	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Harnett County	1	$1,158	$2,517	0	$0	$0	0	$0	$0	1	$1,158	$2,517
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	2	$51,086	$58,881	0	$0	$0	0	$0	$0	2	$51,086	$58,881
Lillington	0	$0	$0	0	$0	$0	1	$0	$0	1	$0	$0
Moore County	12	$26,464	$35,865	0	$0	$0	0	$0	$0	12	$26,464	$35,865
New Hanover County	1	$790	$1,552	0	$0	$0	0	$0	$0	1	$790	$1,552
Pender County	257	$1,783,552	$2,313,939	25	$49,679	$396,199	0	$0	$0	282	$1,833,231	$2,710,138
Spring Lake	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

Cape Fear Alt 3 Damages 10-yr (10% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	58	$342,243	$456,909	13	$231,584	$1,837,956	1	$25,271	$3,310,520	72	$599,098	$5,605,385
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	16	$11,824	$16,959	3	$0	$0	0	$0	$0	19	$11,824	$16,959
Chatham County	0	$0	$0	1	$0	$0	1	$0	$0	2	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	8	$39,523	$59,644	1	$0	$0	0	$0	$0	9	$39,523	$59,644
Duplin County	15	$43,210	$58,774	5	$0	$0	0	$0	$0	20	$43,210	$58,774
Elizabethtown	0	$0	$0	1	$20,844	$43,168	3	$0	$0	4	$20,844	$43,168
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	0	$0	$0	3	$20,181	$913,984	0	$0	$0	3	$20,181	$913,984
Fort Bragg	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Harnett County	6	$7,532	$17,579	0	$0	$0	1	$0	$0	7	$7,532	$17,579
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	4	$92,679	$111,091	0	$0	$0	0	$0	$0	4	$92,679	$111,091
Lillington	0	$0	$0	0	$0	$0	1	$0	$0	1	$0	$0
Moore County	21	$72,454	$108,560	0	$0	$0	0	$0	$0	21	$72,454	$108,560
New Hanover County	1	$790	$1,557	0	$0	$0	0	$0	$0	1	$790	$1,557
Pender County	383	$4,574,970	$5,866,923	42	$159,424	$4,851,554	0	$0	$0	425	$4,734,394	$10,718,477
Spring Lake	1	$0	$0	1	$0	$0	0	$0	$0	2	$0	$0
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

Cape Fear Alt 3 Damages 25-yr (4% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	118	$1,054,547	$1,379,435	28	$503,440	$2,927,421	2	$99,503	$3,864,736	148	$1,657,491	$8,171,592
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	22	$17,317	$29,570	4	$0	$0	0	$0	$0	26	$17,317	$29,570
Chatham County	0	$0	$0	1	$0	$0	2	$0	$0	3	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	11	$218,086	$293,385	3	$0	$0	0	$0	$0	14	$218,086	$293,385
Duplin County	68	$377,091	$482,870	16	$30,495	$332,647	0	$0	$0	84	$407,586	$815,517
Elizabethtown	4	$30,896	$40,491	4	$33,743	$178,321	3	$67,792	$493,258	11	$132,431	$712,071
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	1	$0	$0	6	$23,628	$999,786	1	$0	$0	8	$23,628	$999,786
Fort Bragg	1	$3,394	$3,503	0	$0	$0	0	$0	$0	1	$3,394	$3,503
Harnett County	15	$142,857	$266,442	0	$0	$0	1	$0	$0	16	$142,857	$266,442
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	4	$136,469	$159,689	0	$0	$0	0	$0	$0	4	$136,469	$159,689
Lillington	0	$0	$0	0	$0	$0	2	$0	$0	2	$0	$0
Moore County	39	$179,023	$276,976	0	$0	$0	0	$0	$0	39	$179,023	$276,976
New Hanover County	1	$4,714	$5,654	1	$0	$0	0	$0	$0	2	$4,714	$5,654
Pender County	565	$10,337,541	$13,202,453	56	$632,177	$9,966,471	0	$0	$0	621	$10,969,718	$23,168,924
Spring Lake	1	$6,473	$9,142	1	$0	$0	0	$0	$0	2	$6,473	$9,142
Wallace	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0

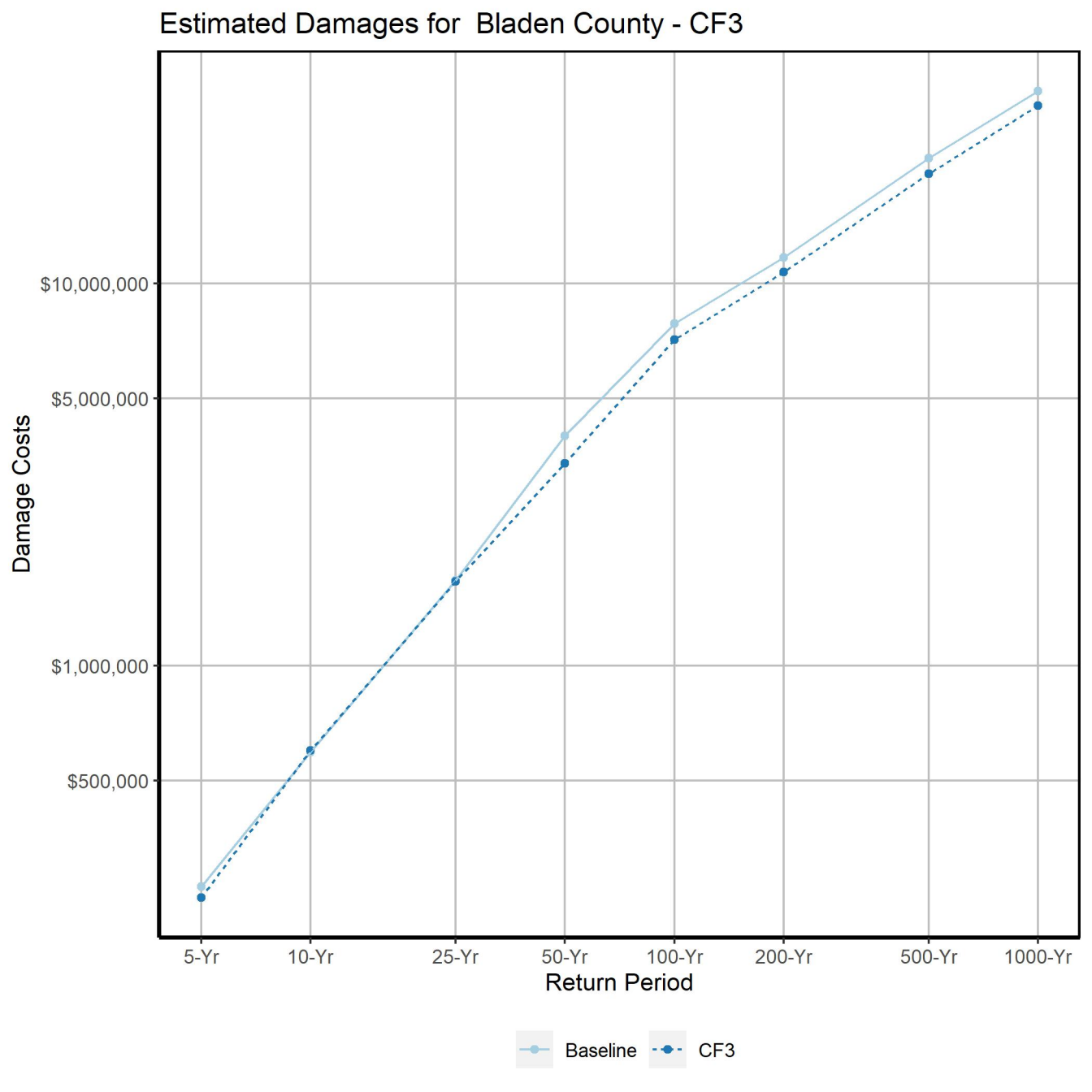
Cape Fear Alt 3 Damages 50-yr (2% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	194	$2,298,472	$2,944,468	41	$902,649	$6,243,165	3	$181,502	$11,373,423	238	$3,382,623	$20,561,055
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	37	$30,437	$50,631	5	$0	$0	0	$0	$0	42	$30,437	$50,631
Chatham County	0	$0	$0	1	$0	$0	3	$0	$0	4	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	20	$431,886	$539,404	5	$70,474	$620,733	0	$0	$0	25	$502,360	$1,160,138
Duplin County	161	$1,201,017	$1,531,321	37	$333,810	$918,663	0	$0	$0	198	$1,534,827	$2,449,983
Elizabethtown	6	$77,421	$117,074	6	$69,254	$266,776	4	$94,141	$591,554	16	$240,816	$975,403
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	2	$2,203	$3,124	7	$32,260	$1,385,592	1	$0	$0	10	$34,463	$1,388,716
Fort Bragg	1	$6,630	$7,313	0	$0	$0	0	$0	$0	1	$6,630	$7,313
Harnett County	23	$553,418	$760,939	0	$0	$0	1	$0	$0	24	$553,418	$760,939
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	10	$205,588	$254,195	1	$0	$0	0	$0	$0	11	$205,588	$254,195
Lillington	0	$0	$0	0	$0	$0	2	$3,256	$29,442	2	$3,256	$29,442
Moore County	54	$350,033	$540,519	0	$0	$0	0	$0	$0	54	$350,033	$540,519
New Hanover County	3	$11,026	$12,290	2	$3,931	$171,579	0	$0	$0	5	$14,957	$183,868
Pender County	789	$17,520,544	$22,162,043	89	$1,624,351	$18,712,547	1	$0	$0	879	$19,144,895	$40,874,590
Spring Lake	3	$10,576	$15,277	1	$0	$0	0	$0	$0	4	$10,576	$15,277
Wallace	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0

Cape Fear Alt 3 Damages 100-yr (1% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	314	$4,683,389	$5,936,432	55	$1,982,528	$12,075,344	3	$449,762	$13,573,552	372	$7,115,680	$31,585,328
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	57	$52,843	$85,781	5	$0	$0	0	$0	$0	62	$52,843	$85,781
Chatham County	0	$0	$0	1	$0	$0	5	$60,158	$78,417	6	$60,158	$78,417
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	39	$844,300	$1,044,896	8	$195,633	$1,548,704	0	$0	$0	47	$1,039,932	$2,593,600
Duplin County	398	$3,735,137	$4,855,960	91	$1,311,663	$3,708,220	1	$0	$0	490	$5,046,801	$8,564,179
Elizabethtown	7	$146,487	$241,196	9	$108,636	$402,806	4	$274,511	$1,700,436	20	$529,634	$2,344,438
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	5	$60,477	$71,879	11	$176,015	$2,491,817	2	$3,904	$7,399	18	$240,396	$2,571,095
Fort Bragg	1	$30,521	$36,383	0	$0	$0	0	$0	$0	1	$30,521	$36,383
Harnett County	39	$1,524,221	$2,044,989	5	$0	$0	1	$0	$0	45	$1,524,221	$2,044,989
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	12	$257,792	$317,569	1	$0	$0	0	$0	$0	13	$257,792	$317,569
Lillington	0	$0	$0	0	$0	$0	3	$7,403	$42,639	3	$7,403	$42,639
Moore County	65	$551,643	$843,460	0	$0	$0	0	$0	$0	65	$551,643	$843,460
New Hanover County	6	$21,625	$24,283	3	$54,962	$452,095	0	$0	$0	9	$76,587	$476,378
Pender County	1,036	$28,837,615	$36,246,143	137	$2,765,669	$27,291,310	1	$0	$0	1,174	$31,603,284	$63,537,453
Spring Lake	6	$57,794	$74,135	2	$0	$0	0	$0	$0	8	$57,794	$74,135
Wallace	6	$1,979	$3,690	1	$0	$0	0	$0	$0	7	$1,979	$3,690

Cape Fear Alt 3 Damages 200-yr (0.5% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	425	$7,227,786	$9,169,619	75	$2,824,999	$15,181,903	5	$645,698	$14,822,399	505	$10,698,482	$39,173,922
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	156	$1,190,730	$1,498,559	17	$148,894	$1,137,816	0	$0	$0	173	$1,339,624	$2,636,375
Chatham County	1	$0	$0	1	$40,731	$113,428	5	$892,170	$938,406	7	$932,901	$1,051,834
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	64	$1,383,759	$1,698,189	11	$405,813	$2,593,296	0	$0	$0	75	$1,789,572	$4,291,485
Duplin County	617	$9,241,294	$12,043,723	152	$3,306,681	$10,124,149	4	$0	$0	773	$12,547,975	$22,167,871
Elizabethtown	9	$207,081	$311,551	15	$154,854	$925,162	4	$408,146	$2,669,037	28	$770,082	$3,905,751
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	9	$168,418	$222,000	15	$286,082	$3,079,535	5	$26,631	$36,969	29	$481,131	$3,338,504
Fort Bragg	1	$52,294	$60,082	0	$0	$0	0	$0	$0	1	$52,294	$60,082
Harnett County	56	$2,195,905	$2,909,870	7	$304,024	$1,386,996	1	$0	$0	64	$2,499,928	$4,296,866
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	13	$353,960	$431,788	4	$7,972	$39,350	0	$0	$0	17	$361,932	$471,138
Lillington	0	$0	$0	0	$0	$0	5	$175,510	$1,500,766	5	$175,510	$1,500,766
Moore County	82	$781,387	$1,160,212	2	$0	$0	0	$0	$0	84	$781,387	$1,160,212
New Hanover County	9	$38,734	$49,962	3	$166,722	$680,186	0	$0	$0	12	$205,456	$730,149
Pender County	1,278	$43,282,049	$54,192,045	185	$6,275,675	$53,865,006	1	$10,177	$2,401,408	1,464	$49,567,900	$110,458,459
Spring Lake	10	$117,711	$155,373	3	$25,773	$1,125,506	0	$0	$0	13	$143,484	$1,280,879
Wallace	14	$33,533	$50,158	1	$0	$0	0	$0	$0	15	$33,533	$50,158

Cape Fear Alt 3 Damages 500-yr (0.2% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	638	$13,382,469	$17,007,710	102	$4,828,105	$26,144,736	6	$1,166,519	$18,811,267	746	$19,377,093	$61,963,713
Brunswick County	1	$505	$622	0	$0	$0	0	$0	$0	1	$505	$622
Burgaw	182	$1,947,148	$2,521,223	20	$667,433	$1,968,665	0	$0	$0	202	$2,614,581	$4,489,888
Chatham County	2	$4,658	$8,055	1	$18,837	$79,937	5	$2,121,306	$2,181,344	8	$2,144,801	$2,269,337
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	157	$3,232,097	$4,068,518	21	$987,292	$4,672,246	0	$0	$0	178	$4,219,389	$8,740,764
Duplin County	778	$29,680,941	$37,487,400	217	$14,956,117	$65,664,797	8	$33,964	$865,834	1,003	$44,671,022	$104,018,031
Elizabethtown	12	$302,790	$428,154	21	$351,643	$1,845,804	4	$786,897	$4,577,358	37	$1,441,331	$6,851,315
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	25	$371,329	$493,924	27	$905,641	$6,606,300	7	$63,147	$75,906	59	$1,340,117	$7,176,130
Fort Bragg	2	$65,571	$75,095	0	$0	$0	0	$0	$0	2	$65,571	$75,095
Harnett County	76	$3,200,913	$4,165,709	11	$1,909,570	$4,044,280	1	$48,519	$59,151	88	$5,159,002	$8,269,140
Hoke County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Lee County	16	$621,910	$751,416	5	$43,397	$164,778	0	$0	$0	21	$665,308	$916,194
Lillington	1	$0	$0	0	$0	$0	6	$338,179	$2,066,343	7	$338,179	$2,066,343
Moore County	105	$1,238,193	$1,831,174	4	$45,118	$278,576	0	$0	$0	109	$1,283,311	$2,109,750
New Hanover County	12	$85,490	$103,634	3	$284,566	$875,272	0	$0	$0	15	$370,056	$978,905
Pender County	1,515	$70,616,959	$87,120,684	222	$17,311,977	$92,658,560	1	$138,387	$2,826,268	1,738	$88,067,323	$182,605,513
Spring Lake	24	$309,444	$411,897	3	$364,445	$2,446,430	0	$0	$0	27	$673,889	$2,858,327
Wallace	43	$240,257	$316,241	5	$8,566	$22,680	0	$0	$0	48	$248,823	$338,921

Cape Fear Alt 3 Damages 1000-yr (0.1% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	750	$20,346,515	$25,767,121	129	$7,313,106	$34,906,978	6	$1,497,904	$20,650,872	885	$29,157,525	$81,324,972
Brunswick County	1	$505	$821	0	$0	$0	0	$0	$0	1	$505	$821
Burgaw	204	$2,672,636	$3,440,346	23	$1,623,521	$5,018,718	0	$0	$0	227	$4,296,157	$8,459,064
Chatham County	3	$38,379	$44,909	1	$44,549	$119,268	5	$3,011,268	$3,083,465	9	$3,094,196	$3,247,642
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	372	$6,079,956	$7,778,808	54	$2,304,469	$10,361,668	0	$0	$0	426	$8,384,425	$18,140,476
Duplin County	839	$54,877,513	$68,213,806	235	$38,927,688	$131,499,029	9	$609,514	$53,293,741	1,083	$94,414,715	$253,006,577
Elizabethtown	16	$426,307	$581,819	24	$835,761	$3,285,498	4	$952,605	$5,236,604	44	$2,214,673	$9,103,922
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	55	$859,237	$1,256,302	38	$1,218,659	$7,650,126	9	$77,885	$92,675	102	$2,155,781	$8,999,103
Fort Bragg	2	$83,081	$158,117	0	$0	$0	0	$0	$0	2	$83,081	$158,117
Harnett County	95	$4,481,534	$5,743,117	13	$2,571,453	$5,442,875	1	$154,800	$167,329	109	$7,207,787	$11,353,321
Hoke County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Lee County	17	$803,829	$962,807	5	$91,014	$249,972	0	$0	$0	22	$894,843	$1,212,779
Lillington	1	$0	$0	0	$0	$0	8	$359,186	$2,181,359	9	$359,186	$2,181,359
Moore County	117	$1,613,430	$2,321,894	4	$67,404	$354,231	0	$0	$0	121	$1,680,833	$2,676,125
New Hanover County	14	$149,888	$187,641	4	$345,968	$1,011,101	0	$0	$0	18	$495,856	$1,198,742
Pender County	1,645	$94,839,539	$116,166,657	232	$27,815,373	$130,156,422	1	$214,504	$3,175,342	1,878	$122,869,416	$249,498,421
Spring Lake	58	$2,257,335	$2,828,015	4	$774,853	$3,930,404	0	$0	$0	62	$3,032,189	$6,758,420
Wallace	81	$625,503	$909,091	9	$25,070	$65,896	0	$0	$0	90	$650,573	$974,987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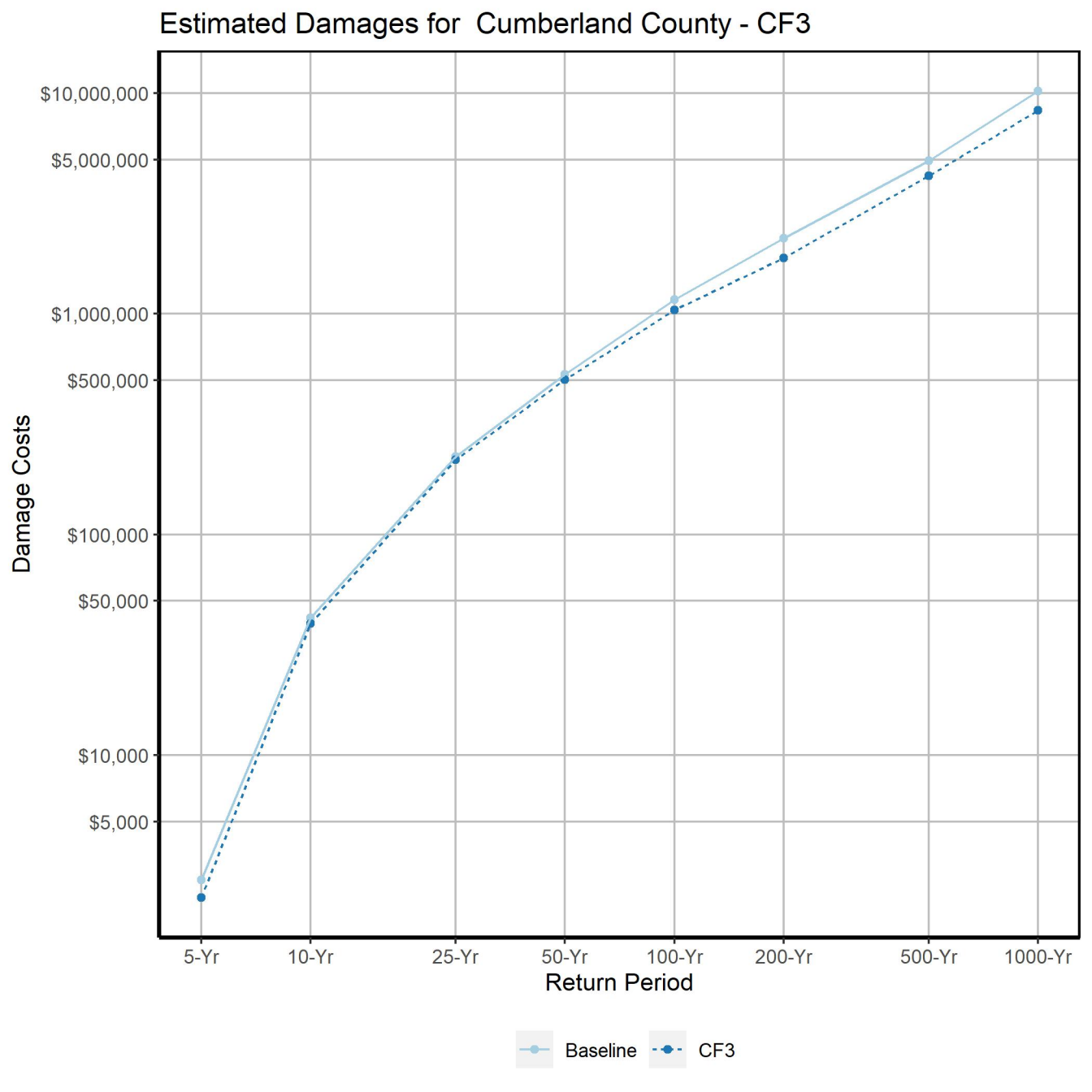
$1,000,000
$500,000
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
CF3


Estimated Damages for Cumberland County - CF3
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$5,000,000
$1,000,000
$500,000
$100,000
$50,000
$10,000
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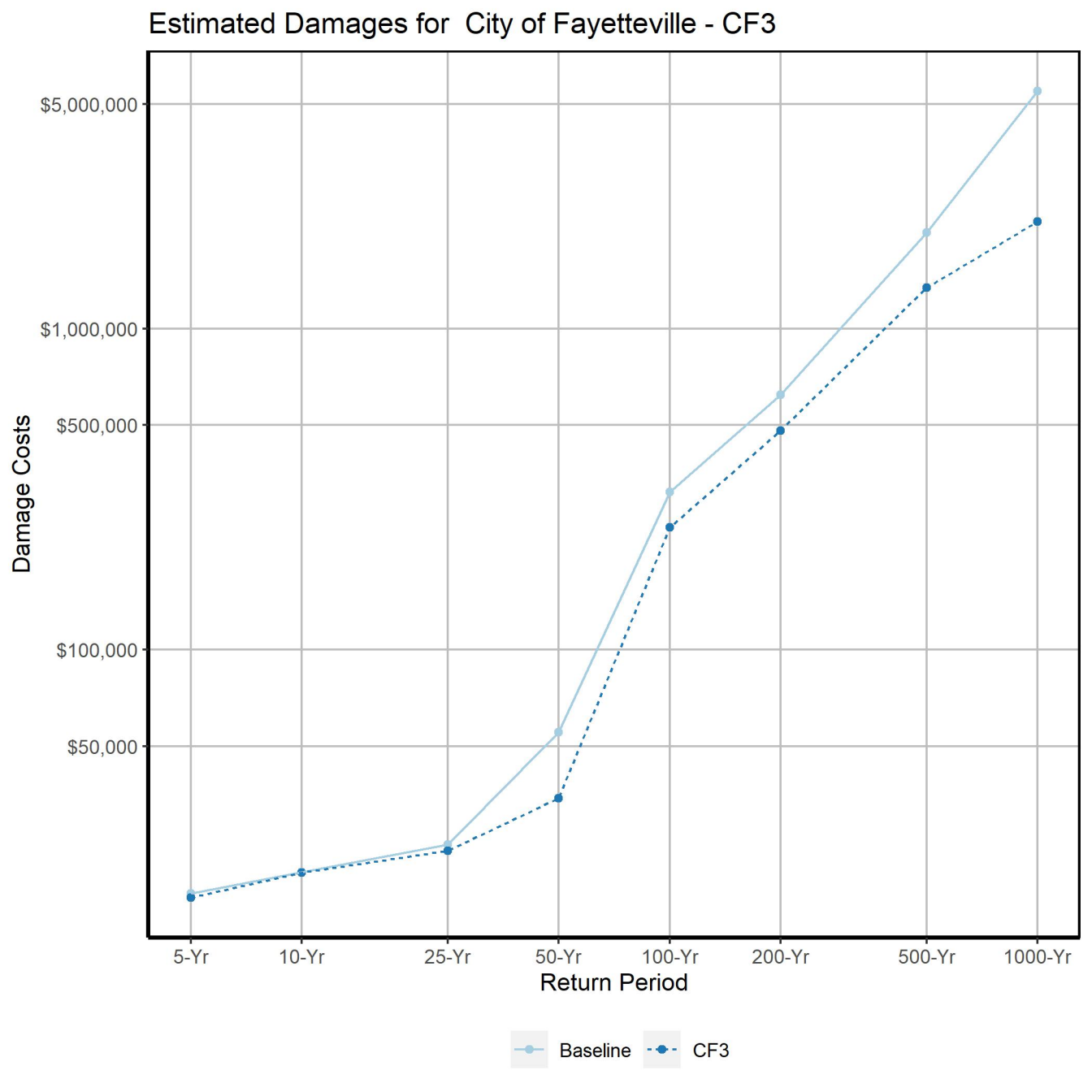
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
CF3


Estimated Damages for City of Fayetteville - CF3
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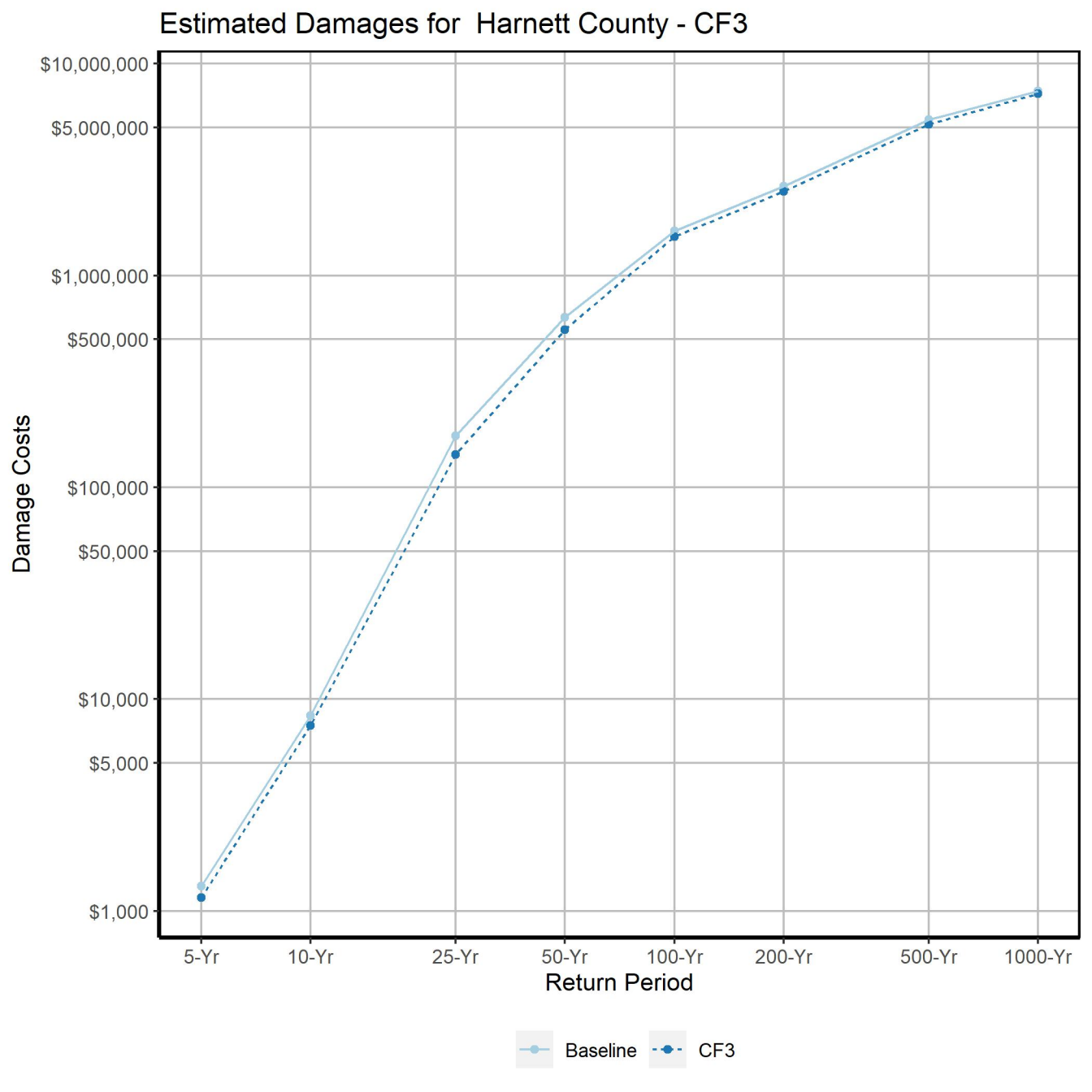
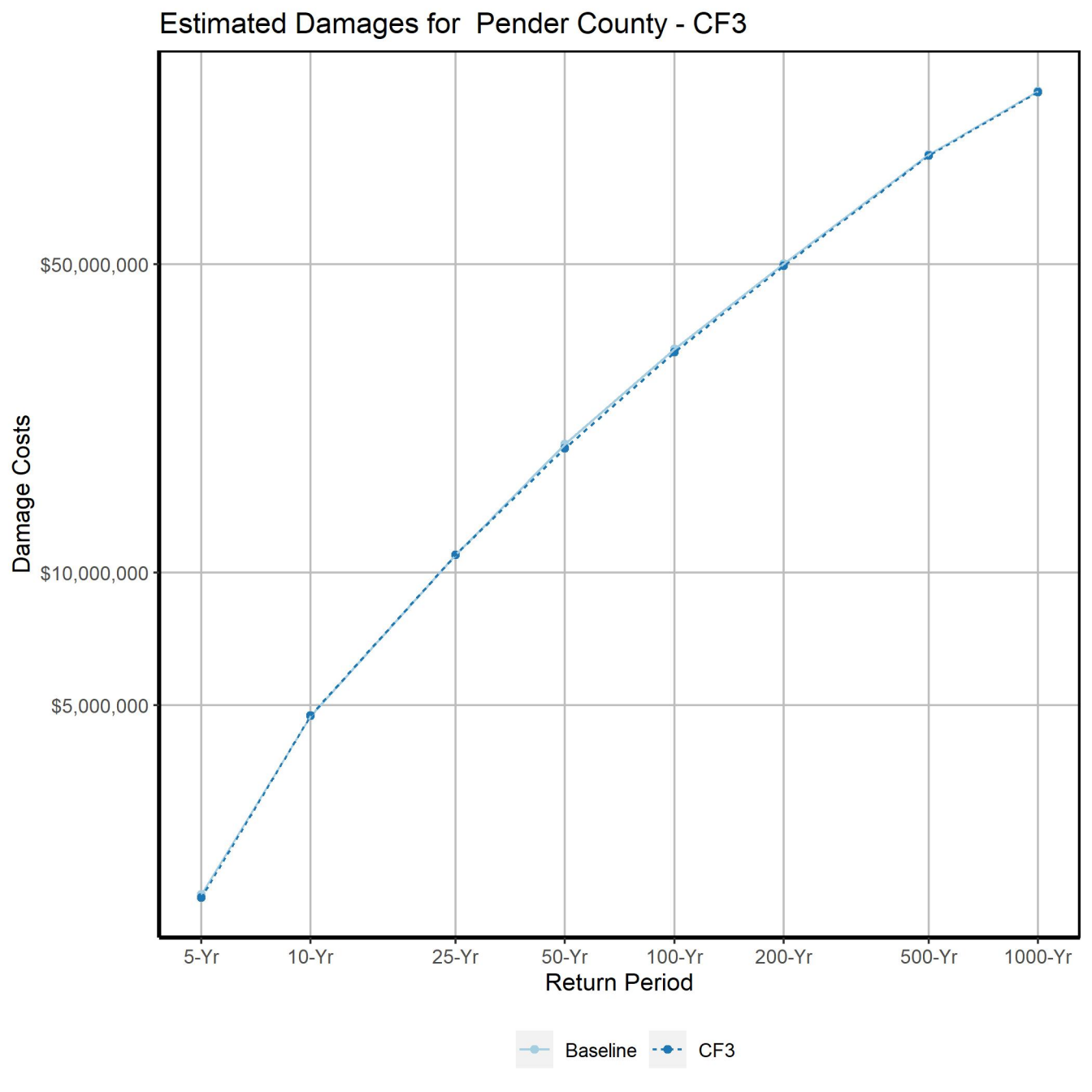
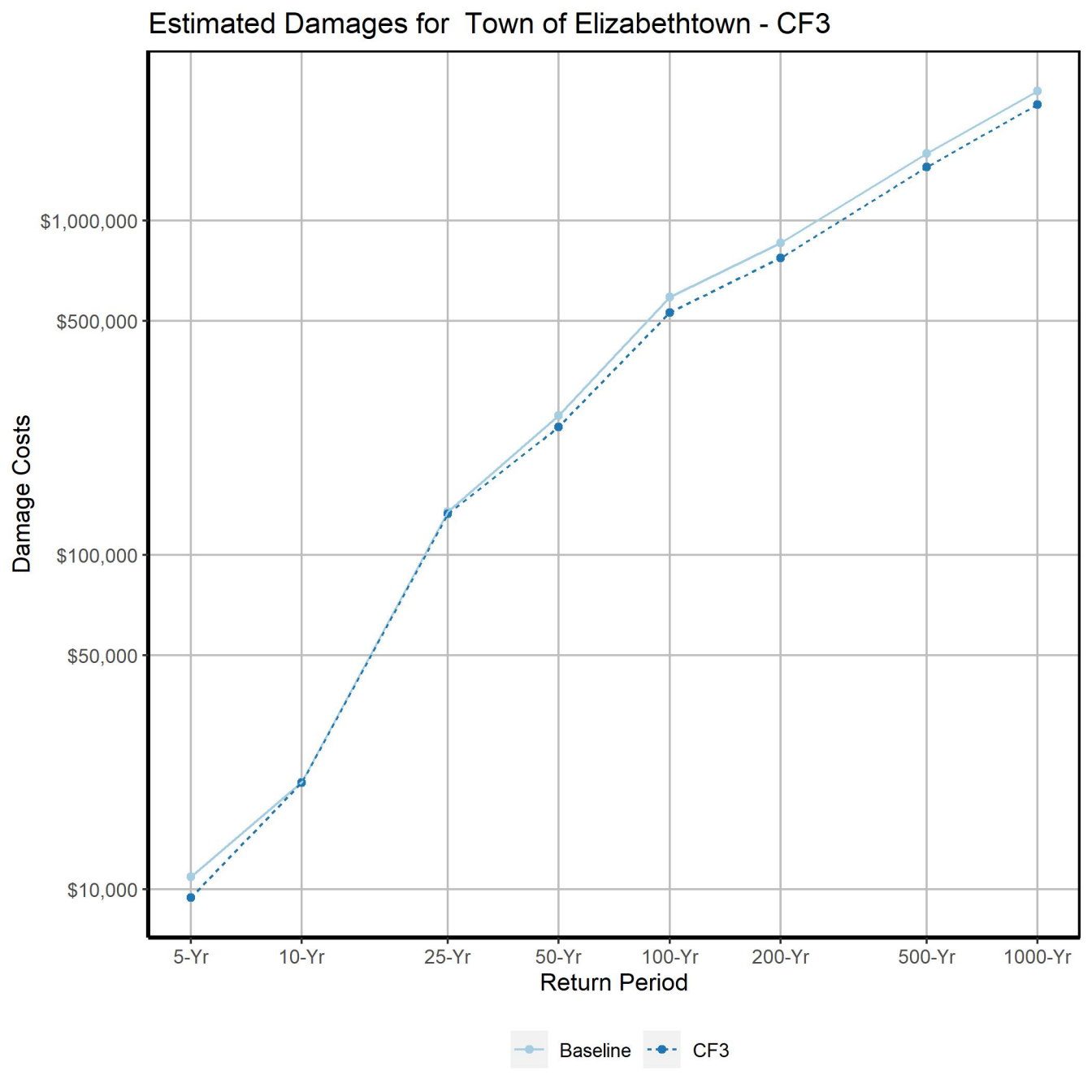
$500,000
$100,000
$50,000
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
CF3


Estimated Damages for Harnett County - CF3
$10,000,000
$5,000,000
$1,000,000
$500,000
$100,000
$50,000
$10,000
$5,000
$1,000
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
CF3


Estimated Damages for Pender County - CF3
Damage Costs
$50,000,000
$10,000,000
$5,000,000
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
CF3


Estimated Damages for Town of Elizabethtown - CF3
$1,000,000
$500,000
$100,000
$50,000
$10,000
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
CF3

Little River Alt 4 Damages 5-yr (20% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	32	$133,562	$183,251	10	$130,210	$1,429,187	1	$0	$0	43	$263,772	$1,612,438
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	5	$1,740	$2,670	1	$0	$0	0	$0	$0	6	$1,740	$2,670
Chatham County	0	$0	$0	1	$0	$0	1	$0	$0	2	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	3	$2,719	$4,253	0	$0	$0	0	$0	$0	3	$2,719	$4,253
Duplin County	3	$5,096	$6,226	0	$0	$0	0	$0	$0	3	$5,096	$6,226
Elizabethtown	0	$0	$0	1	$10,875	$26,766	0	$0	$0	1	$10,875	$26,766
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	0	$0	$0	3	$17,421	$825,112	0	$0	$0	3	$17,421	$825,112
Fort Bragg	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Harnett County	1	$1,309	$2,845	0	$0	$0	0	$0	$0	1	$1,309	$2,845
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	2	$51,086	$58,881	0	$0	$0	0	$0	$0	2	$51,086	$58,881
Lillington	0	$0	$0	0	$0	$0	1	$0	$0	1	$0	$0
Moore County	7	$12,650	$17,118	0	$0	$0	0	$0	$0	7	$12,650	$17,118
New Hanover County	1	$790	$1,552	0	$0	$0	0	$0	$0	1	$790	$1,552
Pender County	261	$1,814,642	$2,350,278	25	$49,766	$396,653	0	$0	$0	286	$1,864,408	$2,746,931
Spring Lake	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

Little River Alt 4 Damages 10-yr (10% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	58	$339,577	$453,829	13	$229,727	$1,833,541	1	$24,877	$3,307,356	72	$594,182	$5,594,725
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	16	$11,824	$16,959	3	$0	$0	0	$0	$0	19	$11,824	$16,959
Chatham County	0	$0	$0	1	$0	$0	1	$0	$0	2	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	8	$41,778	$62,352	1	$0	$0	0	$0	$0	9	$41,778	$62,352
Duplin County	15	$43,210	$58,774	5	$0	$0	0	$0	$0	20	$43,210	$58,774
Elizabethtown	0	$0	$0	1	$20,869	$43,216	3	$0	$0	4	$20,869	$43,216
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	0	$0	$0	3	$20,305	$917,044	0	$0	$0	3	$20,305	$917,044
Fort Bragg	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Harnett County	5	$6,812	$16,477	0	$0	$0	1	$0	$0	6	$6,812	$16,477
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	4	$92,679	$111,091	0	$0	$0	0	$0	$0	4	$92,679	$111,091
Lillington	0	$0	$0	0	$0	$0	1	$0	$0	1	$0	$0
Moore County	14	$45,865	$66,642	0	$0	$0	0	$0	$0	14	$45,865	$66,642
New Hanover County	1	$790	$1,557	0	$0	$0	0	$0	$0	1	$790	$1,557
Pender County	383	$4,566,575	$5,852,111	42	$159,318	$4,851,240	0	$0	$0	425	$4,725,893	$10,703,351
Spring Lake	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

Little River Alt 4 Damages 25-yr (4% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	121	$1,064,007	$1,388,656	28	$505,449	$2,931,924	2	$100,046	$3,867,892	151	$1,669,502	$8,188,471
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	22	$17,317	$29,570	4	$0	$0	0	$0	$0	26	$17,317	$29,570
Chatham County	0	$0	$0	1	$0	$0	2	$0	$0	3	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	10	$214,213	$289,456	3	$0	$0	0	$0	$0	13	$214,213	$289,456
Duplin County	68	$377,091	$482,870	16	$30,495	$332,647	0	$0	$0	84	$407,586	$815,517
Elizabethtown	5	$31,591	$41,513	4	$34,413	$180,026	3	$68,197	$494,270	12	$134,201	$715,808
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	2	$924	$1,020	6	$23,751	$1,003,571	1	$0	$0	9	$24,676	$1,004,591
Fort Bragg	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0
Harnett County	16	$150,722	$257,354	0	$0	$0	1	$0	$0	17	$150,722	$257,354
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	4	$136,469	$159,689	0	$0	$0	0	$0	$0	4	$136,469	$159,689
Lillington	0	$0	$0	0	$0	$0	2	$0	$0	2	$0	$0
Moore County	31	$112,261	$161,508	0	$0	$0	0	$0	$0	31	$112,261	$161,508
New Hanover County	1	$4,714	$5,654	1	$0	$0	0	$0	$0	2	$4,714	$5,654
Pender County	565	$10,341,656	$13,207,500	56	$632,223	$9,966,746	0	$0	$0	621	$10,973,879	$23,174,246
Spring Lake	1	$5,909	$7,595	1	$0	$0	0	$0	$0	2	$5,909	$7,595
Wallace	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0

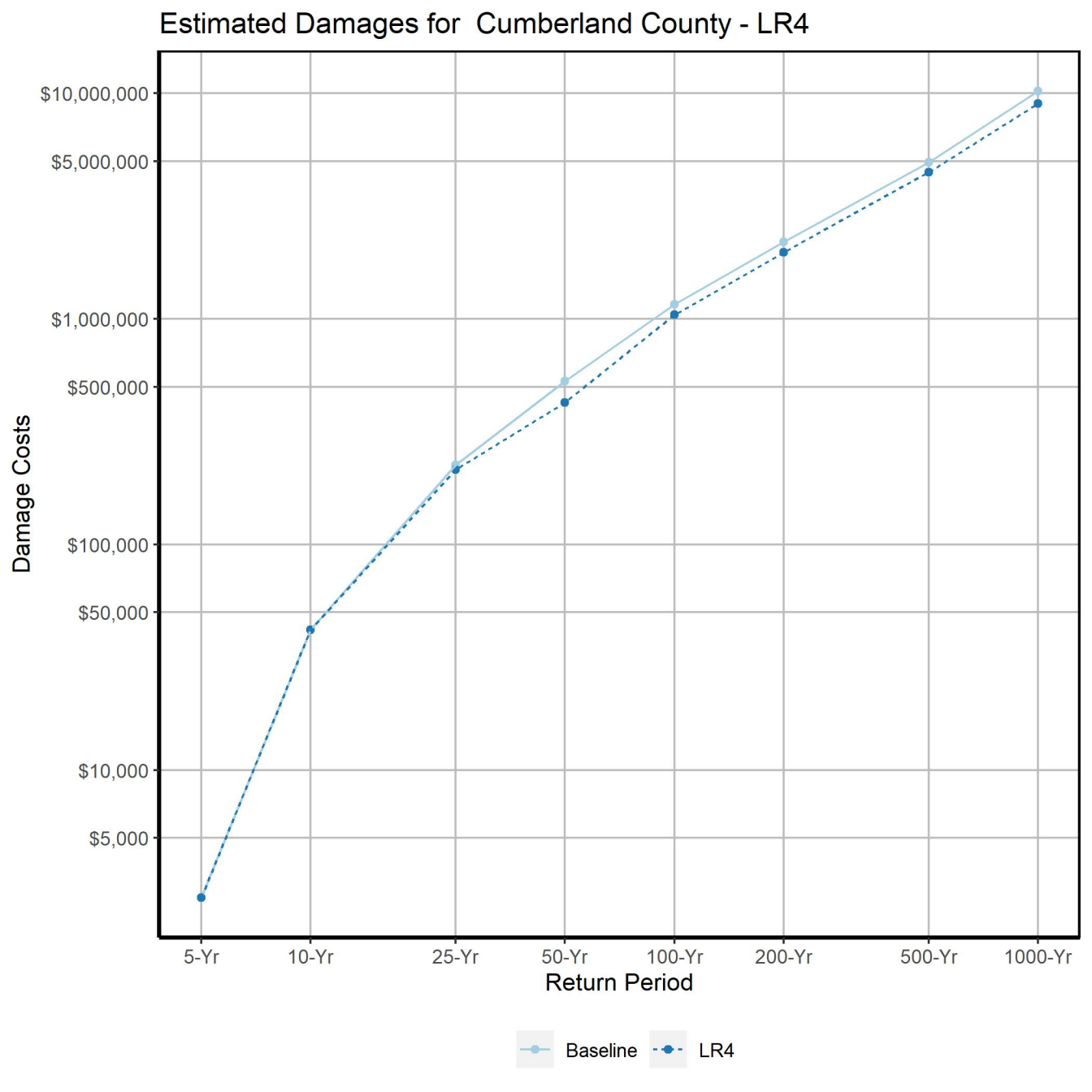
Little River Alt 4 Damages 50-yr (2% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	208	$2,629,972	$3,338,511	44	$1,130,141	$8,434,131	3	$225,212	$12,248,931	255	$3,985,325	$24,021,574
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	37	$30,437	$50,631	5	$0	$0	0	$0	$0	42	$30,437	$50,631
Chatham County	0	$0	$0	1	$0	$0	3	$0	$0	4	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	18	$422,065	$538,583	5	$3,466	$329,137	0	$0	$0	23	$425,531	$867,720
Duplin County	161	$1,201,017	$1,531,321	37	$333,810	$918,663	0	$0	$0	198	$1,534,827	$2,449,983
Elizabethtown	6	$86,464	$161,734	7	$77,097	$288,006	4	$97,477	$605,375	17	$261,037	$1,055,114
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	3	$12,124	$13,308	7	$43,088	$1,526,707	1	$0	$0	11	$55,212	$1,540,015
Fort Bragg	1	$3,690	$4,004	0	$0	$0	0	$0	$0	1	$3,690	$4,004
Harnett County	23	$605,299	$821,862	0	$0	$0	1	$0	$0	24	$605,299	$821,862
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	10	$205,588	$254,195	1	$0	$0	0	$0	$0	11	$205,588	$254,195
Lillington	0	$0	$0	0	$0	$0	2	$3,256	$29,442	2	$3,256	$29,442
Moore County	42	$219,864	$352,089	0	$0	$0	0	$0	$0	42	$219,864	$352,089
New Hanover County	3	$11,026	$12,290	2	$3,931	$171,579	0	$0	$0	5	$14,957	$183,868
Pender County	795	$17,907,095	$22,658,972	89	$1,648,373	$18,784,507	1	$0	$0	885	$19,555,468	$41,443,479
Spring Lake	1	$7,216	$10,565	1	$0	$0	0	$0	$0	2	$7,216	$10,565
Wallace	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0

Little River Alt 4 Damages 100-yr (1% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	355	$5,210,165	$6,624,506	56	$2,157,542	$12,715,748	4	$489,550	$13,822,568	415	$7,857,257	$33,162,821
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	57	$52,843	$85,781	5	$0	$0	0	$0	$0	62	$52,843	$85,781
Chatham County	0	$0	$0	1	$0	$0	5	$60,158	$78,417	6	$60,158	$78,417
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	43	$925,358	$1,142,691	8	$120,640	$1,212,060	0	$0	$0	51	$1,045,998	$2,354,751
Duplin County	398	$3,735,137	$4,855,960	91	$1,311,663	$3,708,220	1	$0	$0	490	$5,046,801	$8,564,179
Elizabethtown	7	$159,407	$256,159	12	$117,246	$445,448	4	$312,616	$1,771,501	23	$589,268	$2,473,109
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	5	$76,232	$89,358	12	$219,593	$2,736,642	3	$14,007	$18,383	20	$309,832	$2,844,383
Fort Bragg	1	$10,440	$11,306	0	$0	$0	0	$0	$0	1	$10,440	$11,306
Harnett County	37	$1,573,869	$2,109,846	0	$0	$0	1	$0	$0	38	$1,573,869	$2,109,846
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	12	$257,792	$317,569	1	$0	$0	0	$0	$0	13	$257,792	$317,569
Lillington	0	$0	$0	0	$0	$0	3	$7,403	$42,639	3	$7,403	$42,639
Moore County	53	$380,859	$616,099	0	$0	$0	0	$0	$0	53	$380,859	$616,099
New Hanover County	6	$21,625	$24,283	3	$54,962	$452,095	0	$0	$0	9	$76,587	$476,378
Pender County	1,040	$29,296,140	$36,794,353	137	$2,815,033	$28,343,972	1	$0	$0	1,178	$32,111,173	$65,138,325
Spring Lake	5	$20,561	$26,273	2	$0	$0	0	$0	$0	7	$20,561	$26,273
Wallace	6	$1,979	$3,690	1	$0	$0	0	$0	$0	7	$1,979	$3,690

Little River Alt 4 Damages 200-yr (0.5% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	454	$7,976,495	$10,140,137	79	$3,011,095	$15,949,754	6	$684,707	$15,102,268	539	$11,672,296	$41,192,159
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	156	$1,190,730	$1,498,559	17	$148,894	$1,137,816	0	$0	$0	173	$1,339,624	$2,636,375
Chatham County	1	$0	$0	1	$40,731	$113,428	5	$892,170	$938,406	7	$932,901	$1,051,834
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	69	$1,616,786	$1,983,828	11	$358,019	$2,189,283	0	$0	$0	80	$1,974,805	$4,173,110
Duplin County	617	$9,241,294	$12,043,723	152	$3,306,681	$10,124,149	4	$0	$0	773	$12,547,975	$22,167,871
Elizabethtown	10	$219,688	$326,639	15	$165,686	$1,008,201	4	$468,931	$3,829,608	29	$854,306	$5,164,448
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	14	$246,293	$340,304	19	$332,929	$4,100,874	5	$43,459	$54,957	38	$622,682	$4,496,135
Fort Bragg	1	$39,897	$46,394	0	$0	$0	0	$0	$0	1	$39,897	$46,394
Harnett County	54	$2,248,148	$2,968,158	7	$0	$0	1	$0	$0	62	$2,248,148	$2,968,158
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	13	$353,960	$431,788	4	$7,972	$39,350	0	$0	$0	17	$361,932	$471,138
Lillington	0	$0	$0	0	$0	$0	5	$175,510	$1,500,766	5	$175,510	$1,500,766
Moore County	65	$548,186	$855,129	0	$0	$0	0	$0	$0	65	$548,186	$855,129
New Hanover County	9	$38,734	$49,962	3	$166,722	$680,186	0	$0	$0	12	$205,456	$730,149
Pender County	1,281	$43,785,199	$54,772,175	185	$6,380,531	$54,120,359	1	$10,177	$2,401,408	1,467	$50,175,907	$111,293,942
Spring Lake	9	$81,996	$109,373	3	$0	$0	0	$0	$0	12	$81,996	$109,373
Wallace	14	$33,533	$50,158	1	$0	$0	0	$0	$0	15	$33,533	$50,158

Little River Alt 4 Damages 500-yr (0.2% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	667	$14,690,691	$18,622,273	107	$5,290,844	$27,601,982	6	$1,264,143	$19,236,943	780	$21,245,678	$65,461,198
Brunswick County	1	$505	$653	0	$0	$0	0	$0	$0	1	$505	$653
Burgaw	182	$1,947,148	$2,521,223	20	$667,433	$1,968,665	0	$0	$0	202	$2,614,581	$4,489,888
Chatham County	2	$4,658	$8,055	1	$18,837	$79,937	5	$2,121,306	$2,181,344	8	$2,144,801	$2,269,337
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	171	$3,524,694	$4,447,254	22	$939,484	$4,604,862	0	$0	$0	193	$4,464,178	$9,052,116
Duplin County	778	$29,680,941	$37,487,400	217	$14,956,117	$65,664,797	8	$33,964	$865,834	1,003	$44,671,022	$104,018,031
Elizabethtown	12	$325,296	$453,368	23	$426,984	$2,112,171	4	$832,756	$4,746,280	39	$1,585,036	$7,311,819
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	35	$567,898	$789,994	38	$1,346,548	$8,589,405	9	$78,553	$93,528	82	$1,992,999	$9,472,927
Fort Bragg	1	$57,675	$66,512	0	$0	$0	0	$0	$0	1	$57,675	$66,512
Harnett County	75	$3,324,869	$4,315,005	9	$1,417,098	$3,277,155	1	$0	$0	85	$4,741,966	$7,592,160
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	16	$621,910	$751,416	5	$43,397	$164,778	0	$0	$0	21	$665,308	$916,194
Lillington	1	$0	$0	0	$0	$0	6	$338,179	$2,066,343	7	$338,179	$2,066,343
Moore County	83	$825,362	$1,210,639	2	$14,802	$216,585	0	$0	$0	85	$840,164	$1,427,224
New Hanover County	12	$85,490	$103,634	3	$284,566	$875,272	0	$0	$0	15	$370,056	$978,905
Pender County	1,517	$71,121,575	$87,702,103	222	$17,400,744	$92,888,829	1	$138,387	$2,826,268	1,740	$88,660,707	$183,417,201
Spring Lake	19	$221,826	$290,503	3	$232,501	$1,762,232	0	$0	$0	22	$454,327	$2,052,736
Wallace	43	$240,257	$316,241	5	$8,566	$22,680	0	$0	$0	48	$248,823	$338,921

Little River Alt 4 Damages 1000-yr (0.1% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	778	$22,464,615	$28,372,130	137	$7,870,122	$36,558,752	6	$1,542,791	$20,980,358	921	$31,877,528	$85,911,240
Brunswick County	1	$505	$855	0	$0	$0	0	$0	$0	1	$505	$855
Burgaw	204	$2,672,636	$3,440,346	23	$1,623,521	$5,018,718	0	$0	$0	227	$4,296,157	$8,459,064
Chatham County	3	$38,379	$44,909	1	$44,549	$119,268	5	$3,011,268	$3,083,465	9	$3,094,196	$3,247,642
Columbus County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Cumberland County	422	$7,036,347	$8,993,440	66	$1,980,381	$7,658,313	0	$0	$0	488	$9,016,728	$16,651,753
Duplin County	839	$54,877,513	$68,213,806	235	$38,927,688	$131,499,029	9	$609,514	$53,293,741	1,083	$94,414,715	$253,006,577
Elizabethtown	17	$455,886	$617,386	25	$1,007,267	$3,595,958	4	$973,662	$5,354,859	46	$2,436,814	$9,568,202
Erwin	2	$571	$1,180	0	$0	$0	0	$0	$0	2	$571	$1,180
Fayetteville	100	$1,793,552	$2,454,651	57	$2,016,634	$12,758,616	15	$1,682,710	$31,725,933	172	$5,492,896	$46,939,200
Fort Bragg	2	$67,299	$77,001	0	$0	$0	0	$0	$0	2	$67,299	$77,001
Harnett County	98	$4,243,151	$5,475,689	13	$2,242,096	$4,665,357	1	$154,800	$166,260	112	$6,640,048	$10,307,305
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	17	$803,829	$962,807	5	$91,014	$249,972	0	$0	$0	22	$894,843	$1,212,779
Lillington	1	$0	$0	0	$0	$0	8	$359,186	$2,181,359	9	$359,186	$2,181,359
Moore County	95	$1,131,427	$1,667,909	2	$46,036	$280,454	0	$0	$0	97	$1,177,463	$1,948,363
New Hanover County	14	$149,888	$187,641	4	$345,968	$1,011,101	0	$0	$0	18	$495,856	$1,198,742
Pender County	1,645	$95,309,275	$116,747,030	233	$27,974,349	$130,599,999	1	$214,504	$3,175,342	1,879	$123,498,127	$250,522,371
Spring Lake	45	$930,399	$1,231,238	3	$575,072	$3,208,818	0	$0	$0	48	$1,505,471	$4,440,056
Wallace	81	$625,503	$909,091	9	$25,070	$65,896	0	$0	$0	90	$650,573	$974,987


Estimated Damages for Cumberland County - LR4
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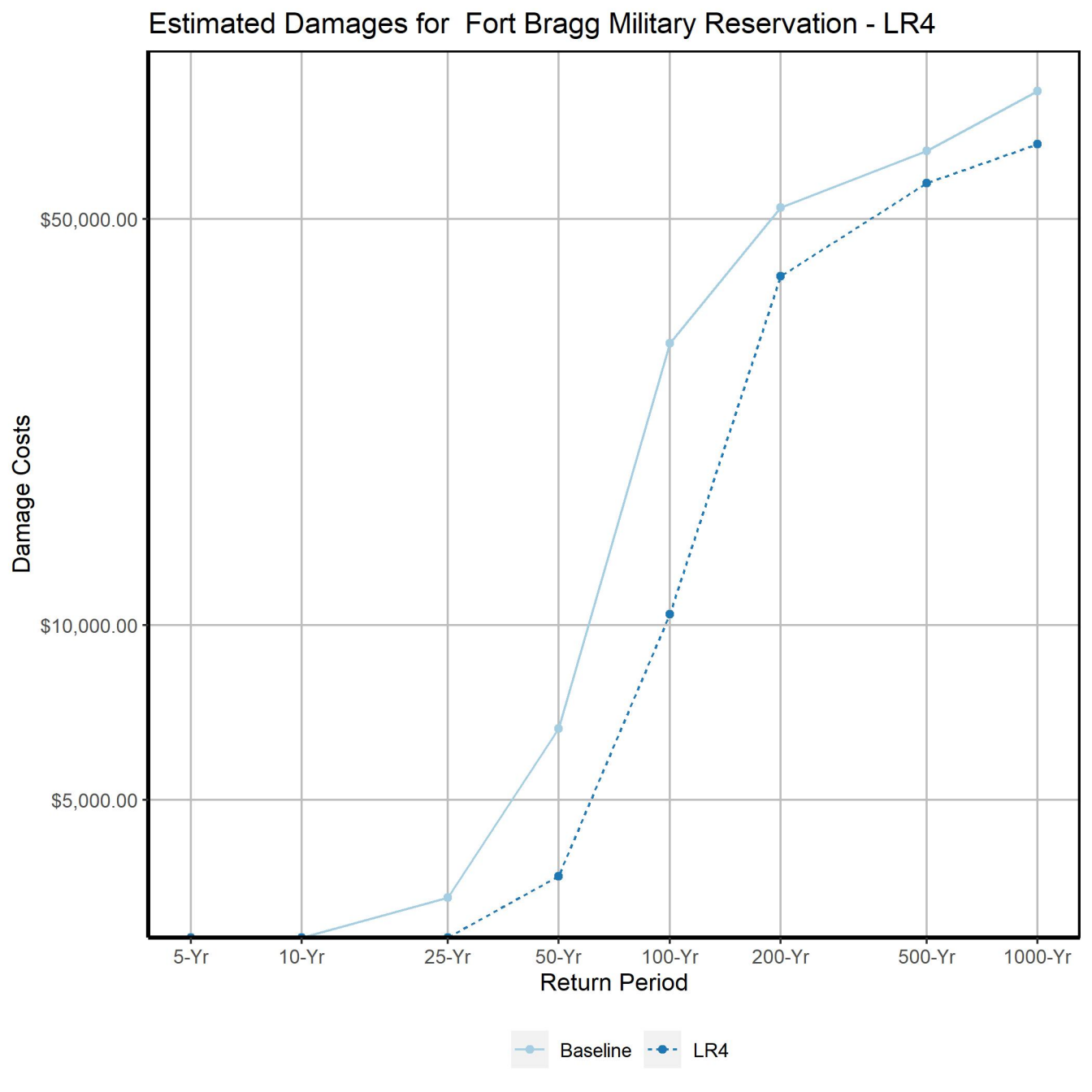
$5,000,000
$1,000,000
$500,000
$100,000
$50,000
$10,000
$5,000
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
LR4


Estimated Damages for Fort Bragg Military Reservation - LR4
Damage Costs
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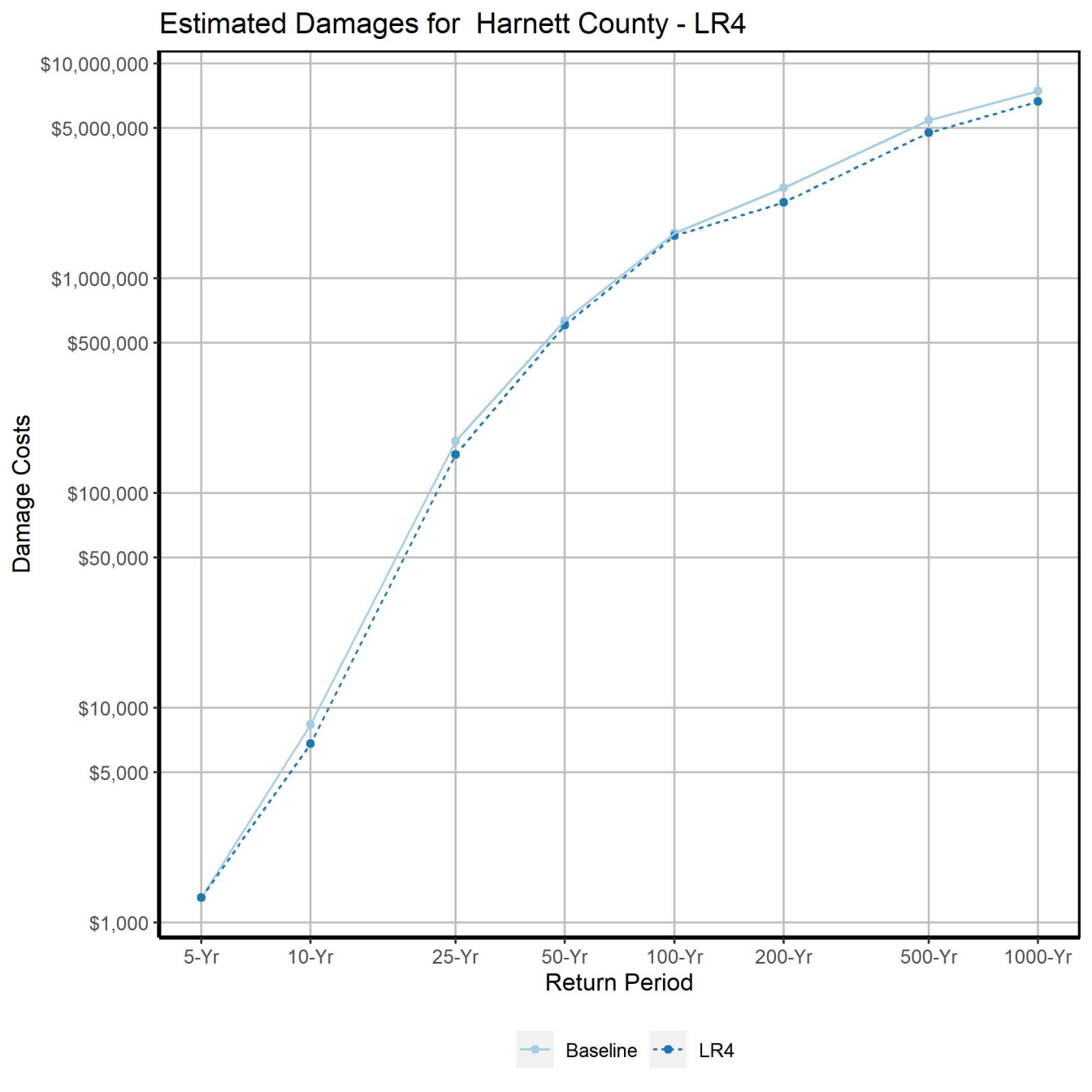
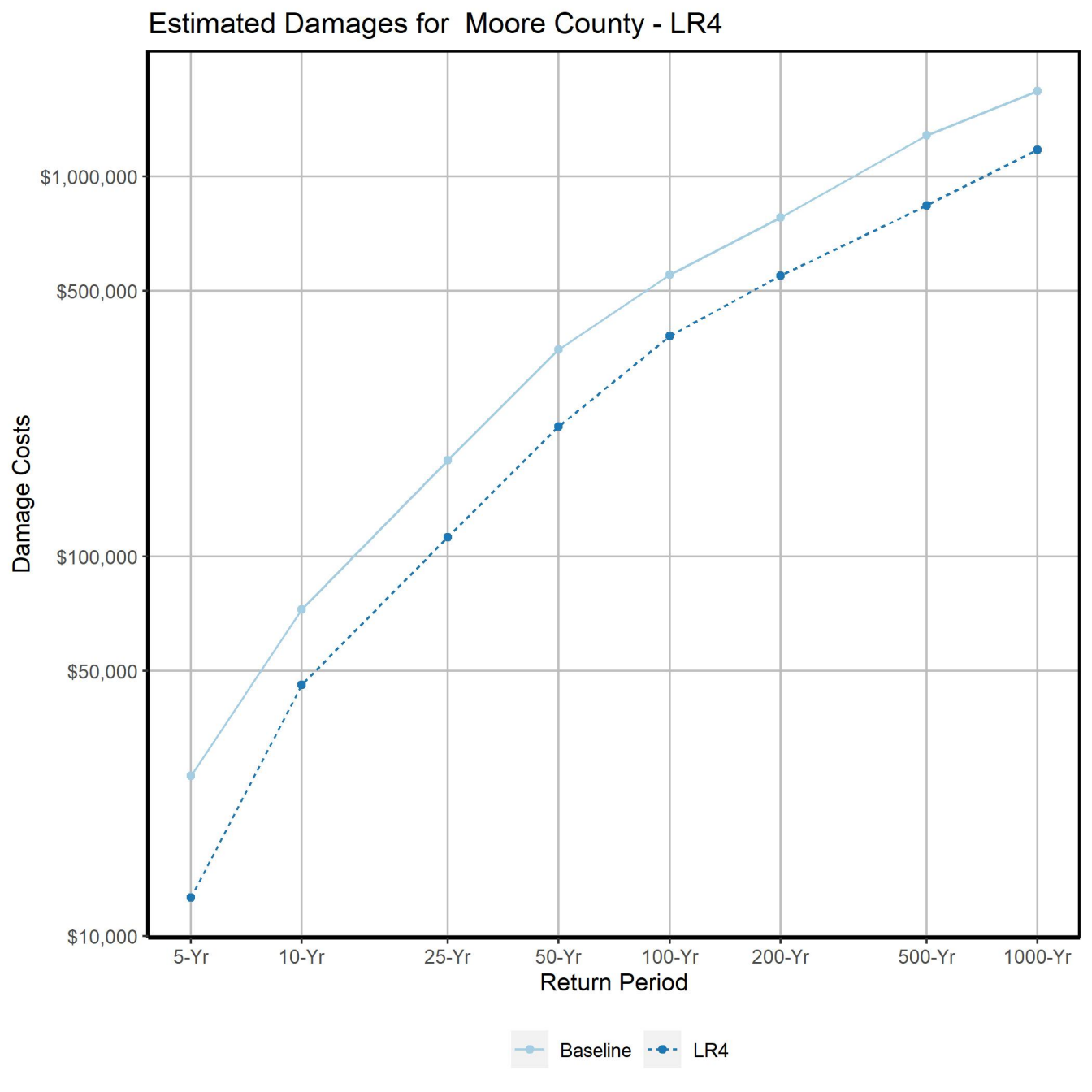
$10,000.00
$5,000.00
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
LR4


Estimated Damages for Harnett County - LR4
$10,000,000
$5,000,000
$1,000,000
$500,000
$100,000
$50,000
$10,000
$5,000
$1,000
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
LR4


Estimated Damages for Moore County - LR4
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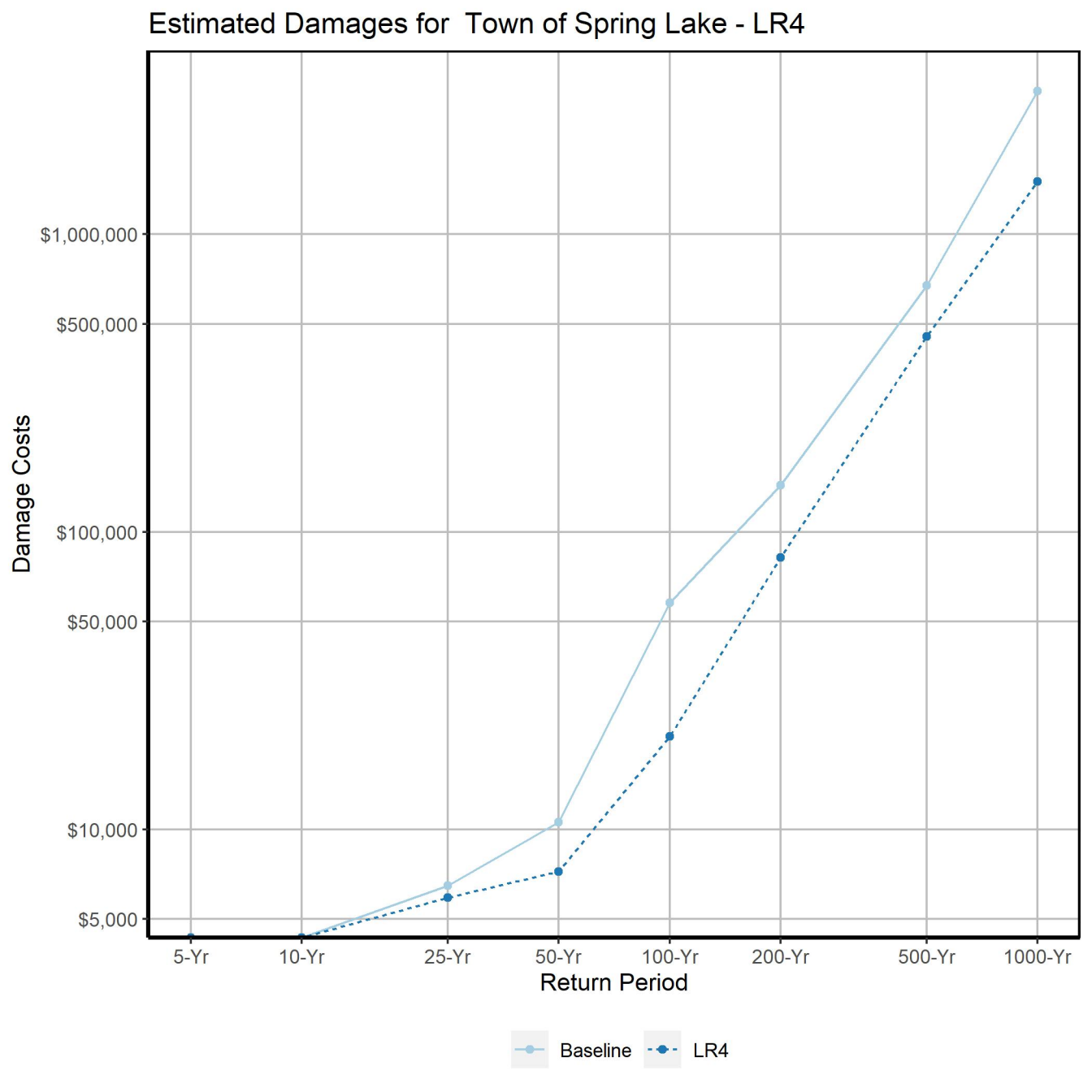
$500,000
$100,000
$50,000
$10,000
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
LR4


Estimated Damages for Town of Spring Lake - LR4
Damage Costs
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$100,000
$50,000
$10,000
$5,000
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
LR4

Little River Alt 5 Damages 5-yr (20% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	32	$133,562	$183,251	10	$130,210	$1,429,187	1	$0	$0	43	$263,772	$1,612,438
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	5	$1,740	$2,670	1	$0	$0	0	$0	$0	6	$1,740	$2,670
Chatham County	0	$0	$0	1	$0	$0	1	$0	$0	2	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	3	$2,719	$4,253	0	$0	$0	0	$0	$0	3	$2,719	$4,253
Duplin County	3	$5,096	$6,226	0	$0	$0	0	$0	$0	3	$5,096	$6,226
Elizabethtown	0	$0	$0	1	$10,875	$26,766	0	$0	$0	1	$10,875	$26,766
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	0	$0	$0	3	$17,421	$825,112	0	$0	$0	3	$17,421	$825,112
Fort Bragg	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Harnett County	1	$1,309	$2,845	0	$0	$0	0	$0	$0	1	$1,309	$2,845
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	2	$51,086	$58,881	0	$0	$0	0	$0	$0	2	$51,086	$58,881
Lillington	0	$0	$0	0	$0	$0	1	$0	$0	1	$0	$0
Moore County	10	$16,311	$21,728	0	$0	$0	0	$0	$0	10	$16,311	$21,728
New Hanover County	1	$790	$1,552	0	$0	$0	0	$0	$0	1	$790	$1,552
Pender County	261	$1,814,642	$2,350,278	25	$49,766	$396,653	0	$0	$0	286	$1,864,408	$2,746,931
Spring Lake	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

Little River Alt 5 Damages 10-yr (10% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	58	$339,577	$453,829	13	$229,727	$1,833,541	1	$24,877	$3,307,356	72	$594,182	$5,594,725
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	16	$11,824	$16,959	3	$0	$0	0	$0	$0	19	$11,824	$16,959
Chatham County	0	$0	$0	1	$0	$0	1	$0	$0	2	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	8	$41,778	$62,352	1	$0	$0	0	$0	$0	9	$41,778	$62,352
Duplin County	15	$43,210	$58,774	5	$0	$0	0	$0	$0	20	$43,210	$58,774
Elizabethtown	0	$0	$0	1	$20,869	$43,216	3	$0	$0	4	$20,869	$43,216
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	0	$0	$0	3	$20,305	$917,044	0	$0	$0	3	$20,305	$917,044
Fort Bragg	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Harnett County	5	$6,915	$16,702	0	$0	$0	1	$0	$0	6	$6,915	$16,702
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	4	$92,679	$111,091	0	$0	$0	0	$0	$0	4	$92,679	$111,091
Lillington	0	$0	$0	0	$0	$0	1	$0	$0	1	$0	$0
Moore County	15	$51,388	$75,209	0	$0	$0	0	$0	$0	15	$51,388	$75,209
New Hanover County	1	$790	$1,557	0	$0	$0	0	$0	$0	1	$790	$1,557
Pender County	383	$4,566,575	$5,852,111	42	$159,318	$4,851,240	0	$0	$0	425	$4,725,893	$10,703,351
Spring Lake	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

Little River Alt 5 Damages 25-yr (4% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	121	$1,064,007	$1,388,656	28	$505,449	$2,931,924	2	$100,046	$3,867,892	151	$1,669,502	$8,188,471
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	22	$17,317	$29,570	4	$0	$0	0	$0	$0	26	$17,317	$29,570
Chatham County	0	$0	$0	1	$0	$0	2	$0	$0	3	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	11	$215,562	$290,928	3	$0	$0	0	$0	$0	14	$215,562	$290,928
Duplin County	68	$377,091	$482,870	16	$30,495	$332,647	0	$0	$0	84	$407,586	$815,517
Elizabethtown	5	$31,591	$41,513	4	$34,413	$180,026	3	$68,197	$494,270	12	$134,201	$715,808
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	2	$924	$1,020	6	$23,751	$1,003,571	1	$0	$0	9	$24,676	$1,004,591
Fort Bragg	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0
Harnett County	16	$153,507	$260,449	0	$0	$0	1	$0	$0	17	$153,507	$260,449
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	4	$136,469	$159,689	0	$0	$0	0	$0	$0	4	$136,469	$159,689
Lillington	0	$0	$0	0	$0	$0	2	$0	$0	2	$0	$0
Moore County	32	$119,697	$171,892	0	$0	$0	0	$0	$0	32	$119,697	$171,892
New Hanover County	1	$4,714	$5,654	1	$0	$0	0	$0	$0	2	$4,714	$5,654
Pender County	565	$10,341,656	$13,207,500	56	$632,223	$9,966,746	0	$0	$0	621	$10,973,879	$23,174,246
Spring Lake	1	$6,020	$7,900	1	$0	$0	0	$0	$0	2	$6,020	$7,900
Wallace	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0

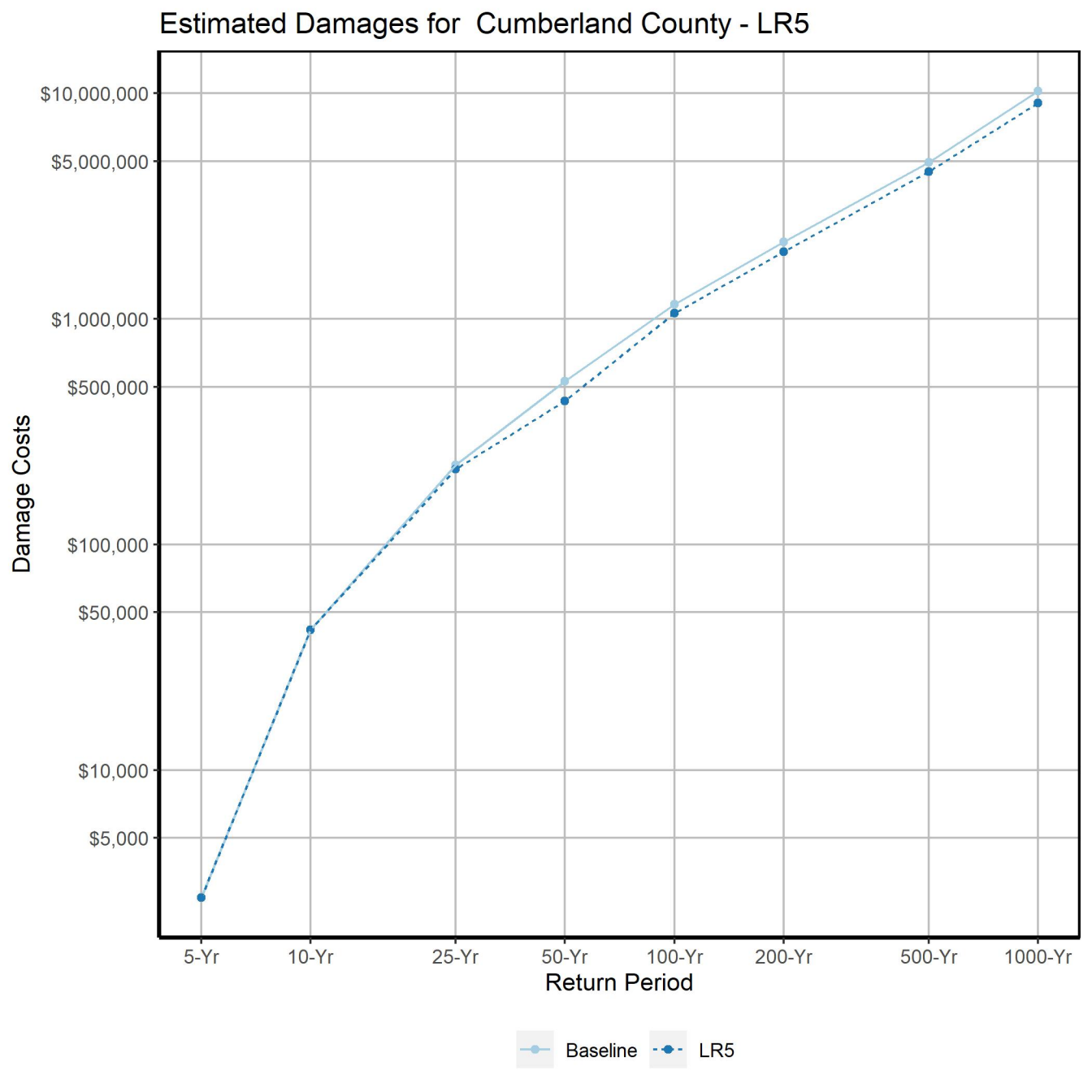
Little River Alt 5 Damages 50-yr (2% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	208	$2,629,972	$3,338,511	44	$1,130,141	$8,434,131	3	$225,212	$12,248,931	255	$3,985,325	$24,021,574
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	37	$30,437	$50,631	5	$0	$0	0	$0	$0	42	$30,437	$50,631
Chatham County	0	$0	$0	1	$0	$0	3	$0	$0	4	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	19	$428,784	$545,811	5	$4,477	$345,779	0	$0	$0	24	$433,261	$891,589
Duplin County	161	$1,201,017	$1,531,321	37	$333,810	$918,663	0	$0	$0	198	$1,534,827	$2,449,983
Elizabethtown	6	$86,464	$161,734	7	$77,097	$288,006	4	$97,477	$605,375	17	$261,037	$1,055,114
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	3	$12,124	$13,308	7	$43,088	$1,526,707	1	$0	$0	11	$55,212	$1,540,015
Fort Bragg	1	$3,885	$4,252	0	$0	$0	0	$0	$0	1	$3,885	$4,252
Harnett County	23	$608,752	$825,546	0	$0	$0	1	$0	$0	24	$608,752	$825,546
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	10	$205,588	$254,195	1	$0	$0	0	$0	$0	11	$205,588	$254,195
Lillington	0	$0	$0	0	$0	$0	2	$3,256	$29,442	2	$3,256	$29,442
Moore County	43	$236,752	$374,472	0	$0	$0	0	$0	$0	43	$236,752	$374,472
New Hanover County	3	$11,026	$12,290	2	$3,931	$171,579	0	$0	$0	5	$14,957	$183,868
Pender County	795	$17,907,095	$22,658,972	89	$1,648,373	$18,784,507	1	$0	$0	885	$19,555,468	$41,443,479
Spring Lake	1	$7,411	$10,931	1	$0	$0	0	$0	$0	2	$7,411	$10,931
Wallace	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0

Little River Alt 5 Damages 100-yr (1% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	355	$5,210,165	$6,624,506	56	$2,157,542	$12,715,748	4	$489,550	$13,822,568	415	$7,857,257	$33,162,821
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	57	$52,843	$85,781	5	$0	$0	0	$0	$0	62	$52,843	$85,781
Chatham County	0	$0	$0	1	$0	$0	5	$60,158	$78,417	6	$60,158	$78,417
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	43	$928,993	$1,146,734	8	$132,532	$1,266,367	0	$0	$0	51	$1,061,526	$2,413,101
Duplin County	398	$3,735,137	$4,855,960	91	$1,311,663	$3,708,220	1	$0	$0	490	$5,046,801	$8,564,179
Elizabethtown	7	$159,407	$256,159	12	$117,246	$445,448	4	$312,616	$1,771,501	23	$589,268	$2,473,109
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	5	$76,232	$89,358	12	$219,593	$2,736,642	3	$14,007	$18,383	20	$309,832	$2,844,383
Fort Bragg	1	$11,306	$12,211	0	$0	$0	0	$0	$0	1	$11,306	$12,211
Harnett County	37	$1,574,957	$2,111,417	0	$0	$0	1	$0	$0	38	$1,574,957	$2,111,417
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	12	$257,792	$317,569	1	$0	$0	0	$0	$0	13	$257,792	$317,569
Lillington	0	$0	$0	0	$0	$0	3	$7,403	$42,639	3	$7,403	$42,639
Moore County	54	$396,149	$633,625	0	$0	$0	0	$0	$0	54	$396,149	$633,625
New Hanover County	6	$21,625	$24,283	3	$54,962	$452,095	0	$0	$0	9	$76,587	$476,378
Pender County	1,040	$29,296,140	$36,794,353	137	$2,815,033	$28,343,972	1	$0	$0	1,178	$32,111,173	$65,138,325
Spring Lake	6	$22,336	$28,684	2	$0	$0	0	$0	$0	8	$22,336	$28,684
Wallace	6	$1,979	$3,690	1	$0	$0	0	$0	$0	7	$1,979	$3,690

Little River Alt 5 Damages 200-yr (0.5% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	454	$7,976,495	$10,140,137	79	$3,011,095	$15,949,754	6	$684,707	$15,102,268	539	$11,672,296	$41,192,159
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	156	$1,190,730	$1,498,559	17	$148,894	$1,137,816	0	$0	$0	173	$1,339,624	$2,636,375
Chatham County	1	$0	$0	1	$40,731	$113,428	5	$892,170	$938,406	7	$932,901	$1,051,834
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	69	$1,624,877	$1,999,102	11	$362,926	$2,204,459	0	$0	$0	80	$1,987,804	$4,203,560
Duplin County	617	$9,241,294	$12,043,723	152	$3,306,681	$10,124,149	4	$0	$0	773	$12,547,975	$22,167,871
Elizabethtown	10	$219,688	$326,639	15	$165,686	$1,008,201	4	$468,931	$3,829,608	29	$854,306	$5,164,448
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	14	$246,293	$340,304	19	$332,929	$4,100,874	5	$43,459	$54,957	38	$622,682	$4,496,135
Fort Bragg	1	$41,627	$48,242	0	$0	$0	0	$0	$0	1	$41,627	$48,242
Harnett County	56	$2,255,403	$2,976,733	7	$0	$0	1	$0	$0	64	$2,255,403	$2,976,733
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	13	$353,960	$431,788	4	$7,972	$39,350	0	$0	$0	17	$361,932	$471,138
Lillington	0	$0	$0	0	$0	$0	5	$175,510	$1,500,766	5	$175,510	$1,500,766
Moore County	66	$563,738	$873,386	0	$0	$0	0	$0	$0	66	$563,738	$873,386
New Hanover County	9	$38,734	$49,962	3	$166,722	$680,186	0	$0	$0	12	$205,456	$730,149
Pender County	1,281	$43,785,199	$54,772,175	185	$6,380,531	$54,120,359	1	$10,177	$2,401,408	1,467	$50,175,907	$111,293,942
Spring Lake	9	$82,813	$111,084	3	$0	$0	0	$0	$0	12	$82,813	$111,084
Wallace	14	$33,533	$50,158	1	$0	$0	0	$0	$0	15	$33,533	$50,158

Little River Alt 5 Damages 500-yr (0.2% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	667	$14,690,691	$18,622,273	107	$5,290,844	$27,601,982	6	$1,264,143	$19,236,943	780	$21,245,678	$65,461,198
Brunswick County	1	$505	$653	0	$0	$0	0	$0	$0	1	$505	$653
Burgaw	182	$1,947,148	$2,521,223	20	$667,433	$1,968,665	0	$0	$0	202	$2,614,581	$4,489,888
Chatham County	2	$4,658	$8,055	1	$18,837	$79,937	5	$2,121,306	$2,181,344	8	$2,144,801	$2,269,337
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	171	$3,535,343	$4,459,181	22	$954,180	$4,648,192	0	$0	$0	193	$4,489,523	$9,107,374
Duplin County	778	$29,680,941	$37,487,400	217	$14,956,117	$65,664,797	8	$33,964	$865,834	1,003	$44,671,022	$104,018,031
Elizabethtown	12	$325,296	$453,368	23	$426,984	$2,112,171	4	$832,756	$4,746,280	39	$1,585,036	$7,311,819
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	35	$567,898	$789,994	38	$1,346,548	$8,589,405	9	$78,553	$93,528	82	$1,992,999	$9,472,927
Fort Bragg	1	$57,993	$66,855	0	$0	$0	0	$0	$0	1	$57,993	$66,855
Harnett County	75	$3,338,841	$4,329,901	9	$1,446,866	$3,323,033	1	$0	$0	85	$4,785,707	$7,652,934
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	16	$621,910	$751,416	5	$43,397	$164,778	0	$0	$0	21	$665,308	$916,194
Lillington	1	$0	$0	0	$0	$0	6	$338,179	$2,066,343	7	$338,179	$2,066,343
Moore County	84	$833,474	$1,219,850	2	$15,720	$218,464	0	$0	$0	86	$849,194	$1,438,314
New Hanover County	12	$85,490	$103,634	3	$284,566	$875,272	0	$0	$0	15	$370,056	$978,905
Pender County	1,517	$71,121,575	$87,702,103	222	$17,400,744	$92,888,829	1	$138,387	$2,826,268	1,740	$88,660,707	$183,417,201
Spring Lake	20	$232,134	$302,448	3	$239,343	$1,778,378	0	$0	$0	23	$471,476	$2,080,826
Wallace	43	$240,257	$316,241	5	$8,566	$22,680	0	$0	$0	48	$248,823	$338,921

Little River Alt 5 Damages 1000-yr (0.1% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	778	$22,464,615	$28,372,130	137	$7,870,122	$36,558,752	6	$1,542,791	$20,980,358	921	$31,877,528	$85,911,240
Brunswick County	1	$505	$855	0	$0	$0	0	$0	$0	1	$505	$855
Burgaw	204	$2,672,636	$3,440,346	23	$1,623,521	$5,018,718	0	$0	$0	227	$4,296,157	$8,459,064
Chatham County	3	$38,379	$44,909	1	$44,549	$119,268	5	$3,011,268	$3,083,465	9	$3,094,196	$3,247,642
Columbus County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Cumberland County	423	$7,053,693	$9,013,785	66	$1,997,340	$7,700,049	0	$0	$0	489	$9,051,033	$16,713,834
Duplin County	839	$54,877,513	$68,213,806	235	$38,927,688	$131,499,029	9	$609,514	$53,293,741	1,083	$94,414,715	$253,006,577
Elizabethtown	17	$455,886	$617,386	25	$1,007,267	$3,595,958	4	$973,662	$5,354,859	46	$2,436,814	$9,568,202
Erwin	2	$571	$1,180	0	$0	$0	0	$0	$0	2	$571	$1,180
Fayetteville	100	$1,793,552	$2,454,651	57	$2,016,634	$12,758,616	15	$1,682,710	$31,725,933	172	$5,492,896	$46,939,200
Fort Bragg	2	$67,556	$77,287	0	$0	$0	0	$0	$0	2	$67,556	$77,287
Harnett County	98	$4,245,601	$5,478,506	13	$2,249,034	$4,678,617	1	$154,800	$166,298	112	$6,649,435	$10,323,421
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	17	$803,829	$962,807	5	$91,014	$249,972	0	$0	$0	22	$894,843	$1,212,779
Lillington	1	$0	$0	0	$0	$0	8	$359,186	$2,181,359	9	$359,186	$2,181,359
Moore County	95	$1,144,007	$1,698,869	2	$47,414	$283,272	0	$0	$0	97	$1,191,421	$1,982,140
New Hanover County	14	$149,888	$187,641	4	$345,968	$1,011,101	0	$0	$0	18	$495,856	$1,198,742
Pender County	1,645	$95,309,275	$116,747,030	233	$27,974,349	$130,599,999	1	$214,504	$3,175,342	1,879	$123,498,127	$250,522,371
Spring Lake	45	$982,798	$1,350,113	3	$583,119	$3,236,552	0	$0	$0	48	$1,565,917	$4,586,665
Wallace	81	$625,503	$909,091	9	$25,070	$65,896	0	$0	$0	90	$650,573	$974,987


Estimated Damages for Cumberland County - LR5
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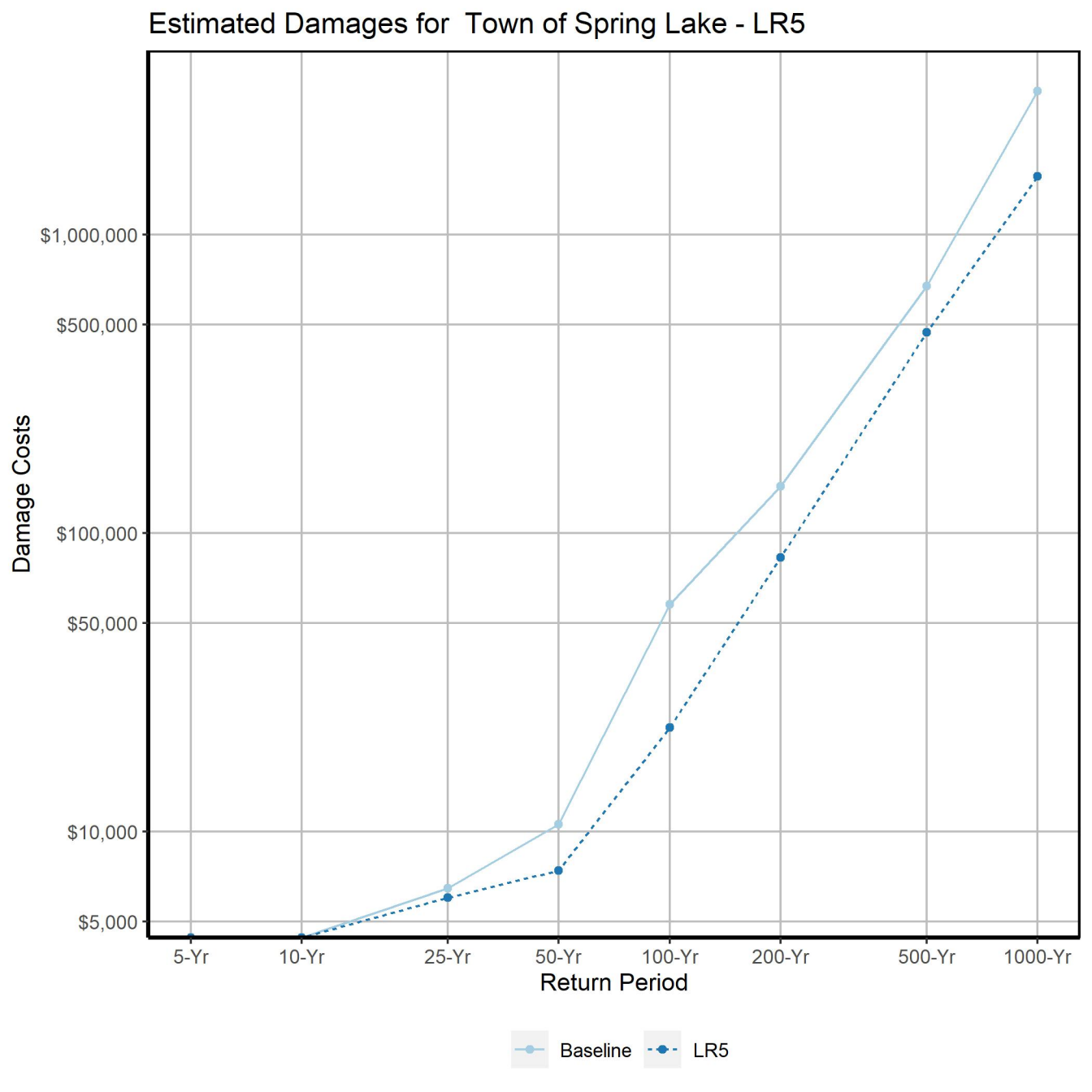
$5,000,000
$1,000,000
$500,000
$100,000
$50,000
$10,000
$5,000
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
LR5


Estimated Damages for Town of Spring Lake - LR5
$1,000,000
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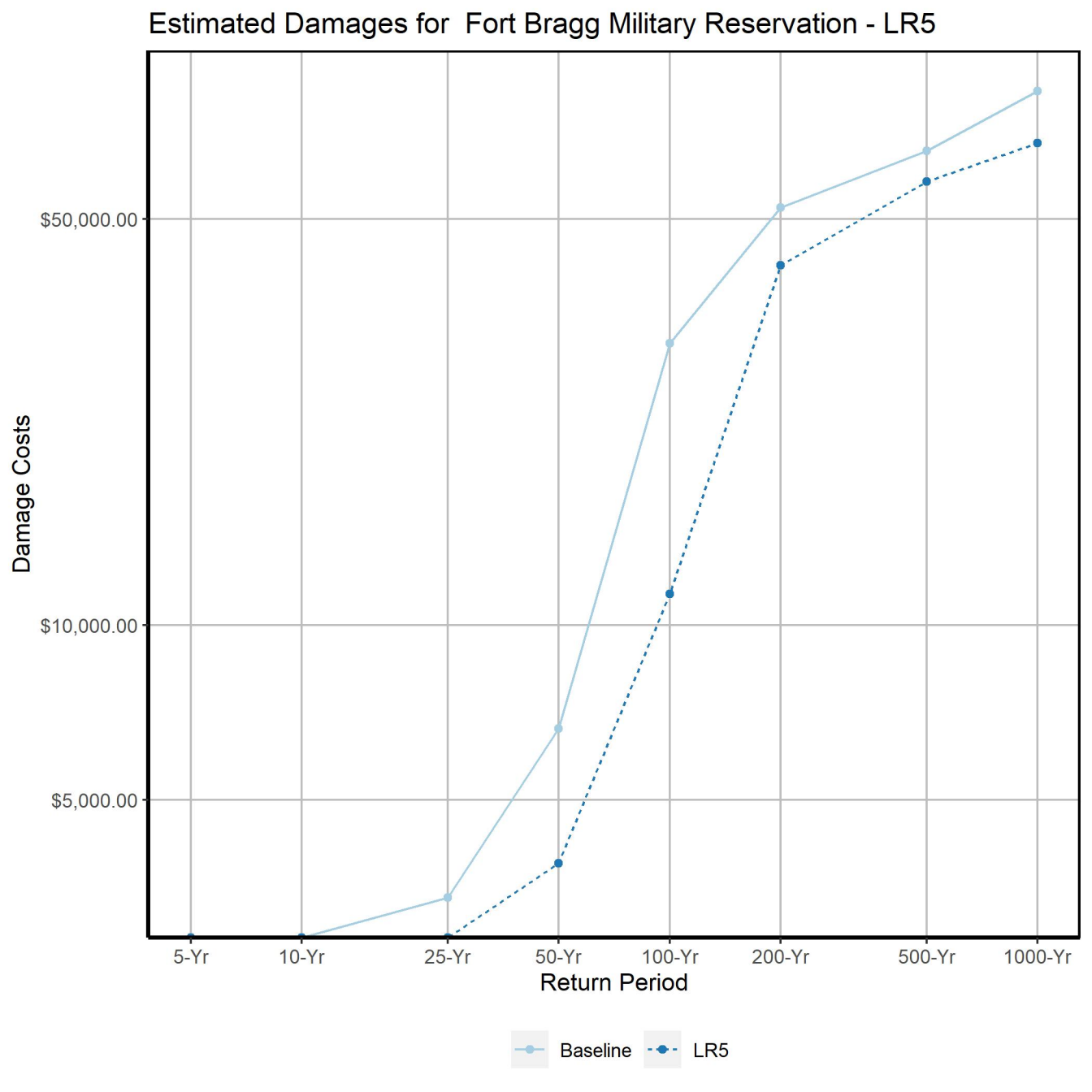
$100,000
$50,000
$10,000
$5,000
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
LR5


Estimated Damages for Fort Bragg Military Reservation - LR5
Damage Costs
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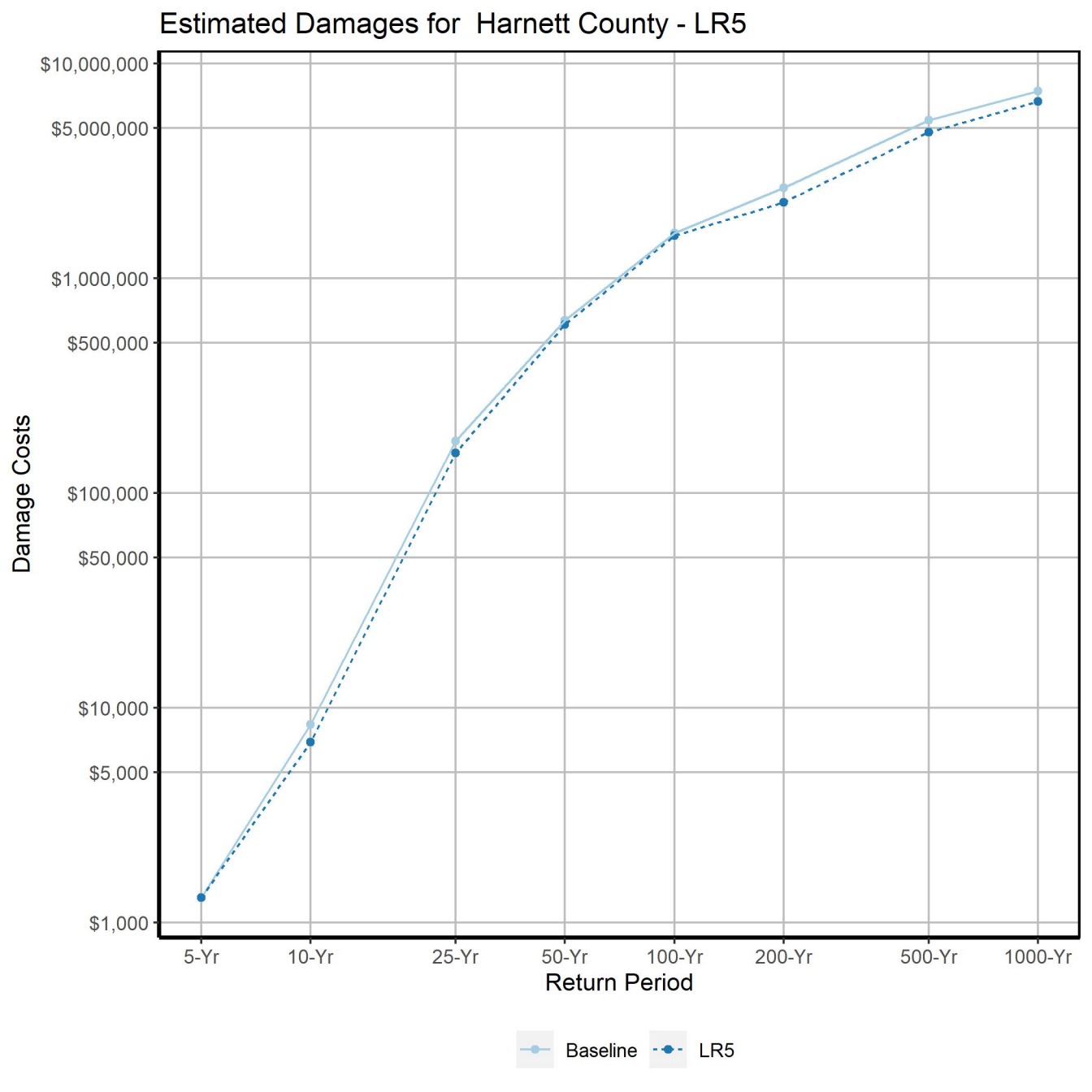
$10,000.00
$5,000.00
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
LR5


Estimated Damages for Harnett County - LR5
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$5,000,000
$1,000,000
$500,000
$100,000
$50,000
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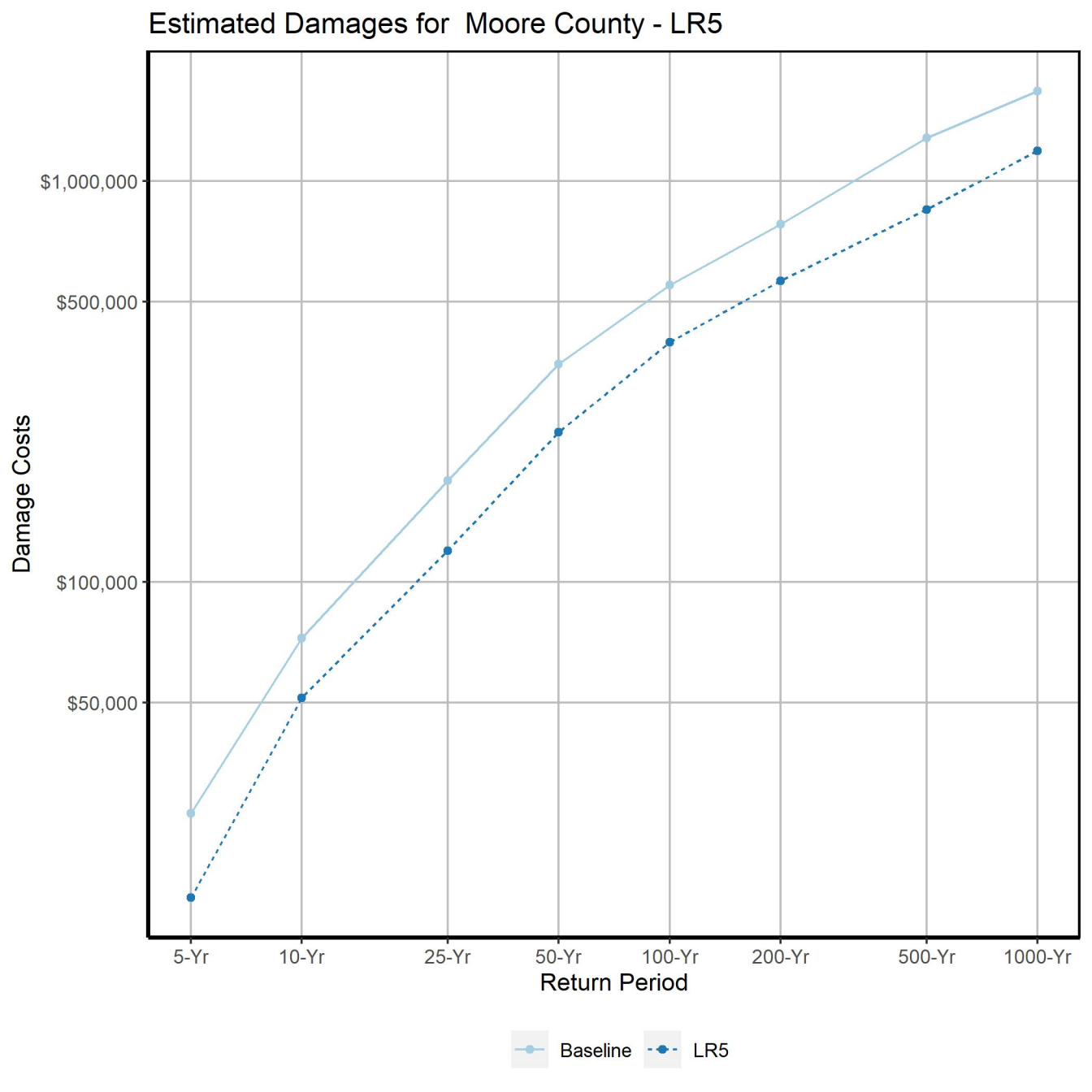
$5,000
$1,000
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
LR5


Estimated Damages for Moore County - LR5
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Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
LR5

Little River Alt 6 Damages 5-yr (20% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	32	$133,562	$183,251	10	$130,210	$1,429,187	1	$0	$0	43	$263,772	$1,612,438
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	5	$1,740	$2,670	1	$0	$0	0	$0	$0	6	$1,740	$2,670
Chatham County	0	$0	$0	1	$0	$0	1	$0	$0	2	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	3	$2,719	$4,253	0	$0	$0	0	$0	$0	3	$2,719	$4,253
Duplin County	3	$5,096	$6,226	0	$0	$0	0	$0	$0	3	$5,096	$6,226
Elizabethtown	0	$0	$0	1	$10,875	$26,766	0	$0	$0	1	$10,875	$26,766
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	0	$0	$0	3	$17,421	$825,112	0	$0	$0	3	$17,421	$825,112
Fort Bragg	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Harnett County	1	$1,309	$2,845	0	$0	$0	0	$0	$0	1	$1,309	$2,845
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	2	$51,086	$58,881	0	$0	$0	0	$0	$0	2	$51,086	$58,881
Lillington	0	$0	$0	0	$0	$0	1	$0	$0	1	$0	$0
Moore County	12	$26,464	$35,865	0	$0	$0	0	$0	$0	12	$26,464	$35,865
New Hanover County	1	$790	$1,552	0	$0	$0	0	$0	$0	1	$790	$1,552
Pender County	261	$1,814,642	$2,350,278	25	$49,766	$396,653	0	$0	$0	286	$1,864,408	$2,746,931
Spring Lake	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

Little River Alt 6 Damages 10-yr (10% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	58	$339,577	$453,829	13	$229,727	$1,833,541	1	$24,877	$3,307,356	72	$594,182	$5,594,725
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	16	$11,824	$16,959	3	$0	$0	0	$0	$0	19	$11,824	$16,959
Chatham County	0	$0	$0	1	$0	$0	1	$0	$0	2	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	8	$41,778	$62,352	1	$0	$0	0	$0	$0	9	$41,778	$62,352
Duplin County	15	$43,210	$58,774	5	$0	$0	0	$0	$0	20	$43,210	$58,774
Elizabethtown	0	$0	$0	1	$20,869	$43,216	3	$0	$0	4	$20,869	$43,216
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	0	$0	$0	3	$20,305	$917,044	0	$0	$0	3	$20,305	$917,044
Fort Bragg	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Harnett County	6	$8,348	$18,943	0	$0	$0	1	$0	$0	7	$8,348	$18,943
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	4	$92,679	$111,091	0	$0	$0	0	$0	$0	4	$92,679	$111,091
Lillington	0	$0	$0	0	$0	$0	1	$0	$0	1	$0	$0
Moore County	21	$72,475	$108,586	0	$0	$0	0	$0	$0	21	$72,475	$108,586
New Hanover County	1	$790	$1,557	0	$0	$0	0	$0	$0	1	$790	$1,557
Pender County	383	$4,566,575	$5,852,111	42	$159,318	$4,851,240	0	$0	$0	425	$4,725,893	$10,703,351
Spring Lake	1	$0	$0	1	$0	$0	0	$0	$0	2	$0	$0
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

Little River Alt 6 Damages 25-yr (4% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	121	$1,064,007	$1,388,656	28	$505,449	$2,931,924	2	$100,046	$3,867,892	151	$1,669,502	$8,188,471
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	22	$17,317	$29,570	4	$0	$0	0	$0	$0	26	$17,317	$29,570
Chatham County	0	$0	$0	1	$0	$0	2	$0	$0	3	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	11	$224,801	$300,670	3	$0	$0	0	$0	$0	14	$224,801	$300,670
Duplin County	68	$377,091	$482,870	16	$30,495	$332,647	0	$0	$0	84	$407,586	$815,517
Elizabethtown	5	$31,591	$41,513	4	$34,413	$180,026	3	$68,197	$494,270	12	$134,201	$715,808
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	2	$924	$1,020	6	$23,751	$1,003,571	1	$0	$0	9	$24,676	$1,004,591
Fort Bragg	1	$3,394	$3,501	0	$0	$0	0	$0	$0	1	$3,394	$3,501
Harnett County	16	$174,601	$303,217	0	$0	$0	1	$0	$0	17	$174,601	$303,217
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	4	$136,469	$159,689	0	$0	$0	0	$0	$0	4	$136,469	$159,689
Lillington	0	$0	$0	0	$0	$0	2	$0	$0	2	$0	$0
Moore County	39	$179,023	$276,976	0	$0	$0	0	$0	$0	39	$179,023	$276,976
New Hanover County	1	$4,714	$5,654	1	$0	$0	0	$0	$0	2	$4,714	$5,654
Pender County	565	$10,341,656	$13,207,500	56	$632,223	$9,966,746	0	$0	$0	621	$10,973,879	$23,174,246
Spring Lake	1	$6,468	$9,128	1	$0	$0	0	$0	$0	2	$6,468	$9,128
Wallace	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0

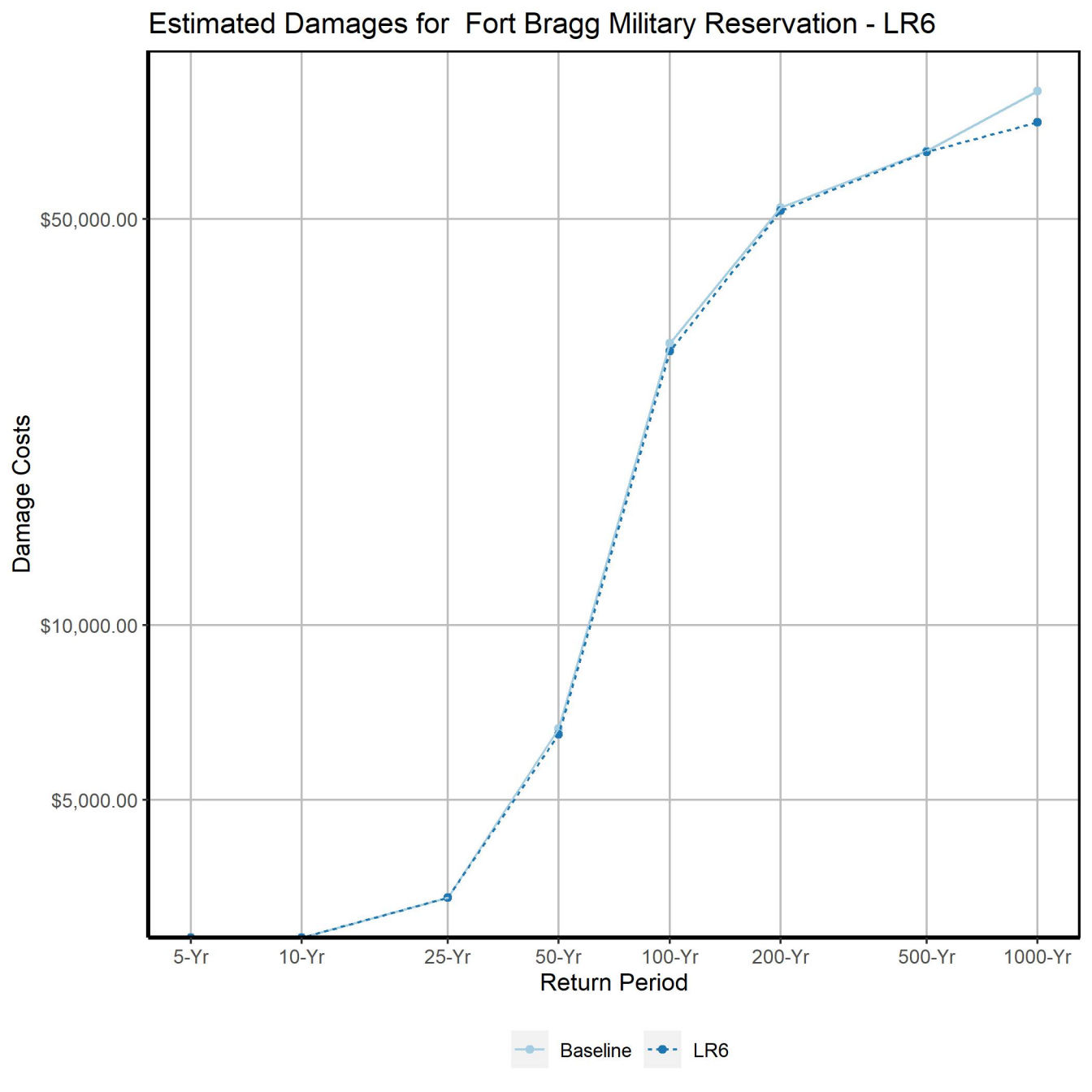
Little River Alt 6 Damages 50-yr (2% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	208	$2,629,972	$3,338,511	44	$1,130,141	$8,434,131	3	$225,212	$12,248,931	255	$3,985,325	$24,021,574
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	37	$30,437	$50,631	5	$0	$0	0	$0	$0	42	$30,437	$50,631
Chatham County	0	$0	$0	1	$0	$0	3	$0	$0	4	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	20	$458,169	$578,671	5	$51,783	$545,140	0	$0	$0	25	$509,952	$1,123,810
Duplin County	161	$1,201,017	$1,531,321	37	$333,810	$918,663	0	$0	$0	198	$1,534,827	$2,449,983
Elizabethtown	6	$86,464	$161,734	7	$77,097	$288,006	4	$97,477	$605,375	17	$261,037	$1,055,114
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	3	$12,124	$13,308	7	$43,088	$1,526,707	1	$0	$0	11	$55,212	$1,540,015
Fort Bragg	1	$6,477	$7,147	0	$0	$0	0	$0	$0	1	$6,477	$7,147
Harnett County	24	$636,128	$855,685	0	$0	$0	1	$0	$0	25	$636,128	$855,685
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	10	$205,588	$254,195	1	$0	$0	0	$0	$0	11	$205,588	$254,195
Lillington	0	$0	$0	0	$0	$0	2	$3,256	$29,442	2	$3,256	$29,442
Moore County	54	$350,033	$540,519	0	$0	$0	0	$0	$0	54	$350,033	$540,519
New Hanover County	3	$11,026	$12,290	2	$3,931	$171,579	0	$0	$0	5	$14,957	$183,868
Pender County	795	$17,907,095	$22,658,972	89	$1,648,373	$18,784,507	1	$0	$0	885	$19,555,468	$41,443,479
Spring Lake	1	$9,342	$13,783	1	$0	$0	0	$0	$0	2	$9,342	$13,783
Wallace	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0

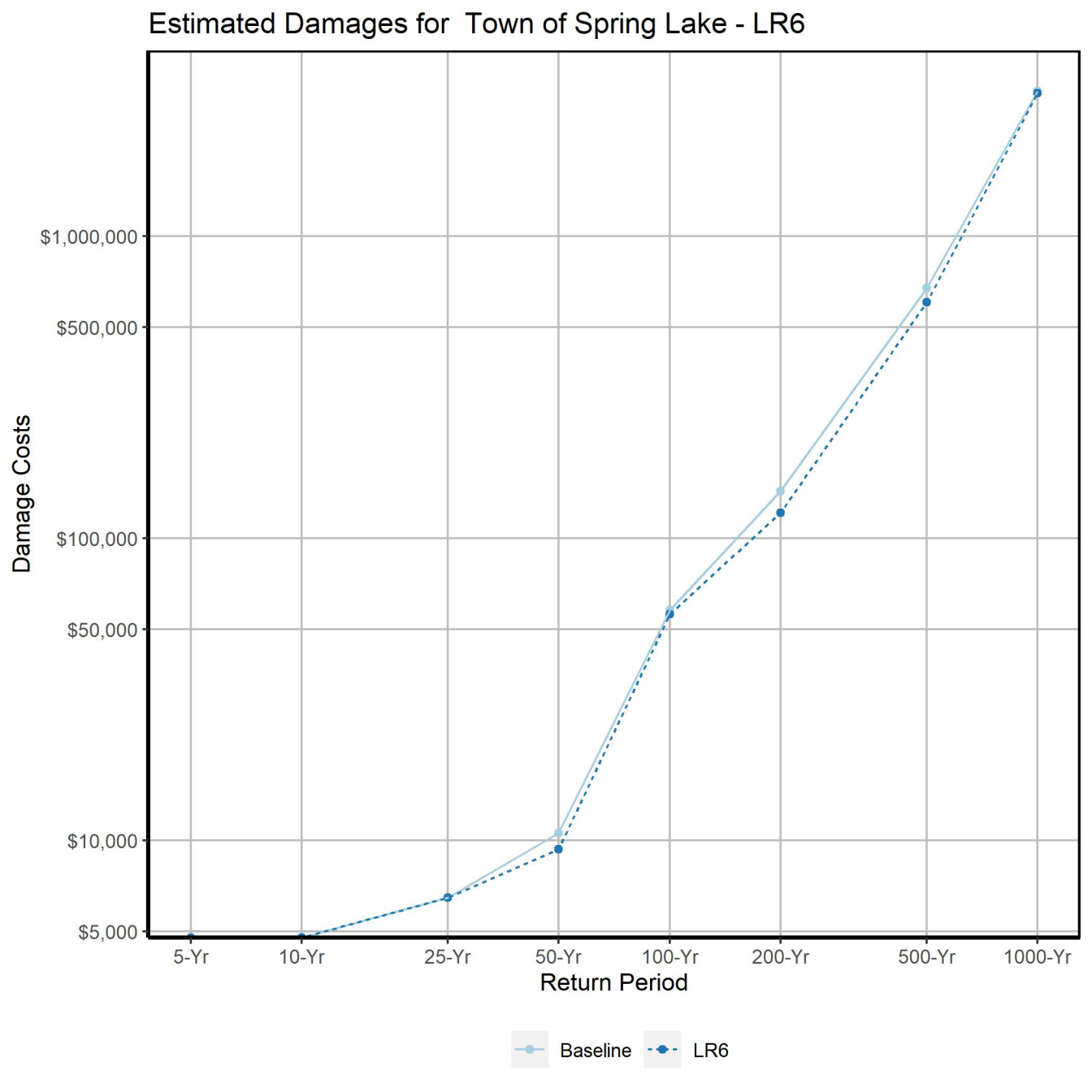
Little River Alt 6 Damages 100-yr (1% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	355	$5,210,165	$6,624,506	56	$2,157,542	$12,715,748	4	$489,550	$13,822,568	415	$7,857,257	$33,162,821
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	57	$52,843	$85,781	5	$0	$0	0	$0	$0	62	$52,843	$85,781
Chatham County	0	$0	$0	1	$0	$0	5	$60,158	$78,417	6	$60,158	$78,417
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	45	$959,330	$1,181,264	9	$187,822	$1,490,680	0	$0	$0	54	$1,147,152	$2,671,944
Duplin County	398	$3,735,137	$4,855,960	91	$1,311,663	$3,708,220	1	$0	$0	490	$5,046,801	$8,564,179
Elizabethtown	7	$159,407	$256,159	12	$117,246	$445,448	4	$312,616	$1,771,501	23	$589,268	$2,473,109
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	5	$76,232	$89,358	12	$219,593	$2,736,642	3	$14,007	$18,383	20	$309,832	$2,844,383
Fort Bragg	1	$29,646	$35,450	0	$0	$0	0	$0	$0	1	$29,646	$35,450
Harnett County	40	$1,620,074	$2,170,385	5	$0	$0	1	$0	$0	46	$1,620,074	$2,170,385
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	12	$257,792	$317,569	1	$0	$0	0	$0	$0	13	$257,792	$317,569
Lillington	0	$0	$0	0	$0	$0	3	$7,403	$42,639	3	$7,403	$42,639
Moore County	65	$551,644	$843,461	0	$0	$0	0	$0	$0	65	$551,644	$843,461
New Hanover County	6	$21,625	$24,283	3	$54,962	$452,095	0	$0	$0	9	$76,587	$476,378
Pender County	1,040	$29,296,140	$36,794,353	137	$2,815,033	$28,343,972	1	$0	$0	1,178	$32,111,173	$65,138,325
Spring Lake	6	$56,132	$70,923	2	$0	$0	0	$0	$0	8	$56,132	$70,923
Wallace	6	$1,979	$3,690	1	$0	$0	0	$0	$0	7	$1,979	$3,690

Little River Alt 6 Damages 200-yr (0.5% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	454	$7,976,495	$10,140,137	79	$3,011,095	$15,949,754	6	$684,707	$15,102,268	539	$11,672,296	$41,192,159
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	156	$1,190,730	$1,498,559	17	$148,894	$1,137,816	0	$0	$0	173	$1,339,624	$2,636,375
Chatham County	1	$0	$0	1	$40,731	$113,428	5	$892,170	$938,406	7	$932,901	$1,051,834
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	70	$1,697,688	$2,078,366	11	$443,903	$2,635,818	0	$0	$0	81	$2,141,590	$4,714,184
Duplin County	617	$9,241,294	$12,043,723	152	$3,306,681	$10,124,149	4	$0	$0	773	$12,547,975	$22,167,871
Elizabethtown	10	$219,688	$326,639	15	$165,686	$1,008,201	4	$468,931	$3,829,608	29	$854,306	$5,164,448
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	14	$246,293	$340,304	19	$332,929	$4,100,874	5	$43,459	$54,957	38	$622,682	$4,496,135
Fort Bragg	1	$51,668	$59,368	0	$0	$0	0	$0	$0	1	$51,668	$59,368
Harnett County	58	$2,331,711	$3,082,737	7	$304,024	$1,386,996	1	$0	$0	66	$2,635,735	$4,469,733
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	13	$353,960	$431,788	4	$7,972	$39,350	0	$0	$0	17	$361,932	$471,138
Lillington	0	$0	$0	0	$0	$0	5	$175,510	$1,500,766	5	$175,510	$1,500,766
Moore County	83	$781,849	$1,161,067	2	$0	$0	0	$0	$0	85	$781,849	$1,161,067
New Hanover County	9	$38,734	$49,962	3	$166,722	$680,186	0	$0	$0	12	$205,456	$730,149
Pender County	1,281	$43,785,199	$54,772,175	185	$6,380,531	$54,120,359	1	$10,177	$2,401,408	1,467	$50,175,907	$111,293,942
Spring Lake	10	$112,969	$147,251	3	$8,441	$1,058,724	0	$0	$0	13	$121,409	$1,205,974
Wallace	14	$33,533	$50,158	1	$0	$0	0	$0	$0	15	$33,533	$50,158

Little River Alt 6 Damages 500-yr (0.2% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	667	$14,690,691	$18,622,273	107	$5,290,844	$27,601,982	6	$1,264,143	$19,236,943	780	$21,245,678	$65,461,198
Brunswick County	1	$505	$653	0	$0	$0	0	$0	$0	1	$505	$653
Burgaw	182	$1,947,148	$2,521,223	20	$667,433	$1,968,665	0	$0	$0	202	$2,614,581	$4,489,888
Chatham County	2	$4,658	$8,055	1	$18,837	$79,937	5	$2,121,306	$2,181,344	8	$2,144,801	$2,269,337
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	184	$3,707,331	$4,683,113	23	$1,116,332	$5,126,964	0	$0	$0	207	$4,823,664	$9,810,077
Duplin County	778	$29,680,941	$37,487,400	217	$14,956,117	$65,664,797	8	$33,964	$865,834	1,003	$44,671,022	$104,018,031
Elizabethtown	12	$325,296	$453,368	23	$426,984	$2,112,171	4	$832,756	$4,746,280	39	$1,585,036	$7,311,819
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	35	$567,898	$789,994	38	$1,346,548	$8,589,405	9	$78,553	$93,528	82	$1,992,999	$9,472,927
Fort Bragg	2	$65,198	$74,683	0	$0	$0	0	$0	$0	2	$65,198	$74,683
Harnett County	79	$3,484,829	$4,526,052	11	$1,909,570	$4,044,280	1	$48,519	$59,151	91	$5,442,919	$8,629,482
Hoke County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Lee County	16	$621,910	$751,416	5	$43,397	$164,778	0	$0	$0	21	$665,308	$916,194
Lillington	1	$0	$0	0	$0	$0	6	$338,179	$2,066,343	7	$338,179	$2,066,343
Moore County	105	$1,238,196	$1,831,497	4	$45,118	$278,576	0	$0	$0	109	$1,283,314	$2,110,072
New Hanover County	12	$85,490	$103,634	3	$284,566	$875,272	0	$0	$0	15	$370,056	$978,905
Pender County	1,517	$71,121,575	$87,702,103	222	$17,400,744	$92,888,829	1	$138,387	$2,826,268	1,740	$88,660,707	$183,417,201
Spring Lake	23	$283,228	$379,926	3	$322,532	$1,984,249	0	$0	$0	26	$605,760	$2,364,175
Wallace	43	$240,257	$316,241	5	$8,566	$22,680	0	$0	$0	48	$248,823	$338,921

Little River Alt 6 Damages 1000-yr (0.1% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	778	$22,464,615	$28,372,130	137	$7,870,122	$36,558,752	6	$1,542,791	$20,980,358	921	$31,877,528	$85,911,240
Brunswick County	1	$505	$855	0	$0	$0	0	$0	$0	1	$505	$855
Burgaw	204	$2,672,636	$3,440,346	23	$1,623,521	$5,018,718	0	$0	$0	227	$4,296,157	$8,459,064
Chatham County	3	$38,379	$44,909	1	$44,549	$119,268	5	$3,011,268	$3,083,465	9	$3,094,196	$3,247,642
Columbus County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Cumberland County	463	$7,675,476	$9,800,669	68	$2,629,446	$11,720,810	0	$0	$0	531	$10,304,921	$21,521,480
Duplin County	839	$54,877,513	$68,213,806	235	$38,927,688	$131,499,029	9	$609,514	$53,293,741	1,083	$94,414,715	$253,006,577
Elizabethtown	17	$455,886	$617,386	25	$1,007,267	$3,595,958	4	$973,662	$5,354,859	46	$2,436,814	$9,568,202
Erwin	2	$571	$1,180	0	$0	$0	0	$0	$0	2	$571	$1,180
Fayetteville	100	$1,793,552	$2,454,651	57	$2,016,634	$12,758,616	15	$1,682,710	$31,725,933	172	$5,492,896	$46,939,200
Fort Bragg	2	$73,322	$83,795	0	$0	$0	0	$0	$0	2	$73,322	$83,795
Harnett County	104	$4,770,987	$6,096,312	13	$2,571,188	$5,442,281	1	$154,800	$167,328	118	$7,496,975	$11,705,920
Hoke County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Lee County	17	$803,829	$962,807	5	$91,014	$249,972	0	$0	$0	22	$894,843	$1,212,779
Lillington	1	$0	$0	0	$0	$0	8	$359,186	$2,181,359	9	$359,186	$2,181,359
Moore County	117	$1,614,701	$2,323,275	4	$67,371	$354,138	0	$0	$0	121	$1,682,072	$2,677,413
New Hanover County	14	$149,888	$187,641	4	$345,968	$1,011,101	0	$0	$0	18	$495,856	$1,198,742
Pender County	1,645	$95,309,275	$116,747,030	233	$27,974,349	$130,599,999	1	$214,504	$3,175,342	1,879	$123,498,127	$250,522,371
Spring Lake	58	$2,230,161	$2,796,678	3	$750,297	$3,849,507	0	$0	$0	61	$2,980,458	$6,646,185
Wallace	81	$625,503	$909,091	9	$25,070	$65,896	0	$0	$0	90	$650,573	$974,987


Estimated Damages for Fort Bragg Military Reservation - LR6
Damage Costs
$50,000.00
$10,000.00
$5,000.00
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
LR6


Estimated Damages for Town of Spring Lake - LR6
$1,000,000
$500,000
$100,000
$50,000
$10,000
$5,000
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
LR6

Little River Alt 7 Damages 5-yr (20% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	32	$133,562	$183,251	10	$130,210	$1,429,187	1	$0	$0	43	$263,772	$1,612,438
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	5	$1,740	$2,670	1	$0	$0	0	$0	$0	6	$1,740	$2,670
Chatham County	0	$0	$0	1	$0	$0	1	$0	$0	2	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	3	$2,719	$4,253	0	$0	$0	0	$0	$0	3	$2,719	$4,253
Duplin County	3	$5,096	$6,226	0	$0	$0	0	$0	$0	3	$5,096	$6,226
Elizabethtown	0	$0	$0	1	$10,875	$26,766	0	$0	$0	1	$10,875	$26,766
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	0	$0	$0	3	$17,421	$825,112	0	$0	$0	3	$17,421	$825,112
Fort Bragg	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Harnett County	1	$1,309	$2,845	0	$0	$0	0	$0	$0	1	$1,309	$2,845
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	2	$51,086	$58,881	0	$0	$0	0	$0	$0	2	$51,086	$58,881
Lillington	0	$0	$0	0	$0	$0	1	$0	$0	1	$0	$0
Moore County	6	$5,843	$8,448	0	$0	$0	0	$0	$0	6	$5,843	$8,448
New Hanover County	1	$790	$1,552	0	$0	$0	0	$0	$0	1	$790	$1,552
Pender County	261	$1,814,642	$2,350,278	25	$49,766	$396,653	0	$0	$0	286	$1,864,408	$2,746,931
Spring Lake	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

Little River Alt 7 Damages 10-yr (10% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	58	$339,577	$453,829	13	$229,727	$1,833,541	1	$24,877	$3,307,356	72	$594,182	$5,594,725
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	16	$11,824	$16,959	3	$0	$0	0	$0	$0	19	$11,824	$16,959
Chatham County	0	$0	$0	1	$0	$0	1	$0	$0	2	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	8	$41,778	$62,352	1	$0	$0	0	$0	$0	9	$41,778	$62,352
Duplin County	15	$43,210	$58,774	5	$0	$0	0	$0	$0	20	$43,210	$58,774
Elizabethtown	0	$0	$0	1	$20,869	$43,216	3	$0	$0	4	$20,869	$43,216
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	0	$0	$0	3	$20,305	$917,044	0	$0	$0	3	$20,305	$917,044
Fort Bragg	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Harnett County	6	$8,322	$18,907	0	$0	$0	1	$0	$0	7	$8,322	$18,907
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	4	$92,679	$111,091	0	$0	$0	0	$0	$0	4	$92,679	$111,091
Lillington	0	$0	$0	0	$0	$0	1	$0	$0	1	$0	$0
Moore County	11	$26,712	$35,370	0	$0	$0	0	$0	$0	11	$26,712	$35,370
New Hanover County	1	$790	$1,557	0	$0	$0	0	$0	$0	1	$790	$1,557
Pender County	383	$4,566,575	$5,852,111	42	$159,318	$4,851,240	0	$0	$0	425	$4,725,893	$10,703,351
Spring Lake	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

Little River Alt 7 Damages 25-yr (4% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	121	$1,064,007	$1,388,656	28	$505,449	$2,931,924	2	$100,046	$3,867,892	151	$1,669,502	$8,188,471
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	22	$17,317	$29,570	4	$0	$0	0	$0	$0	26	$17,317	$29,570
Chatham County	0	$0	$0	1	$0	$0	2	$0	$0	3	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	11	$224,801	$300,670	3	$0	$0	0	$0	$0	14	$224,801	$300,670
Duplin County	68	$377,091	$482,870	16	$30,495	$332,647	0	$0	$0	84	$407,586	$815,517
Elizabethtown	5	$31,591	$41,513	4	$34,413	$180,026	3	$68,197	$494,270	12	$134,201	$715,808
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	2	$924	$1,020	6	$23,751	$1,003,571	1	$0	$0	9	$24,676	$1,004,591
Fort Bragg	1	$3,394	$3,468	0	$0	$0	0	$0	$0	1	$3,394	$3,468
Harnett County	16	$174,292	$302,896	0	$0	$0	1	$0	$0	17	$174,292	$302,896
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	4	$136,469	$159,689	0	$0	$0	0	$0	$0	4	$136,469	$159,689
Lillington	0	$0	$0	0	$0	$0	2	$0	$0	2	$0	$0
Moore County	21	$70,131	$103,377	0	$0	$0	0	$0	$0	21	$70,131	$103,377
New Hanover County	1	$4,714	$5,654	1	$0	$0	0	$0	$0	2	$4,714	$5,654
Pender County	565	$10,341,656	$13,207,500	56	$632,223	$9,966,746	0	$0	$0	621	$10,973,879	$23,174,246
Spring Lake	1	$6,158	$8,279	1	$0	$0	0	$0	$0	2	$6,158	$8,279
Wallace	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0

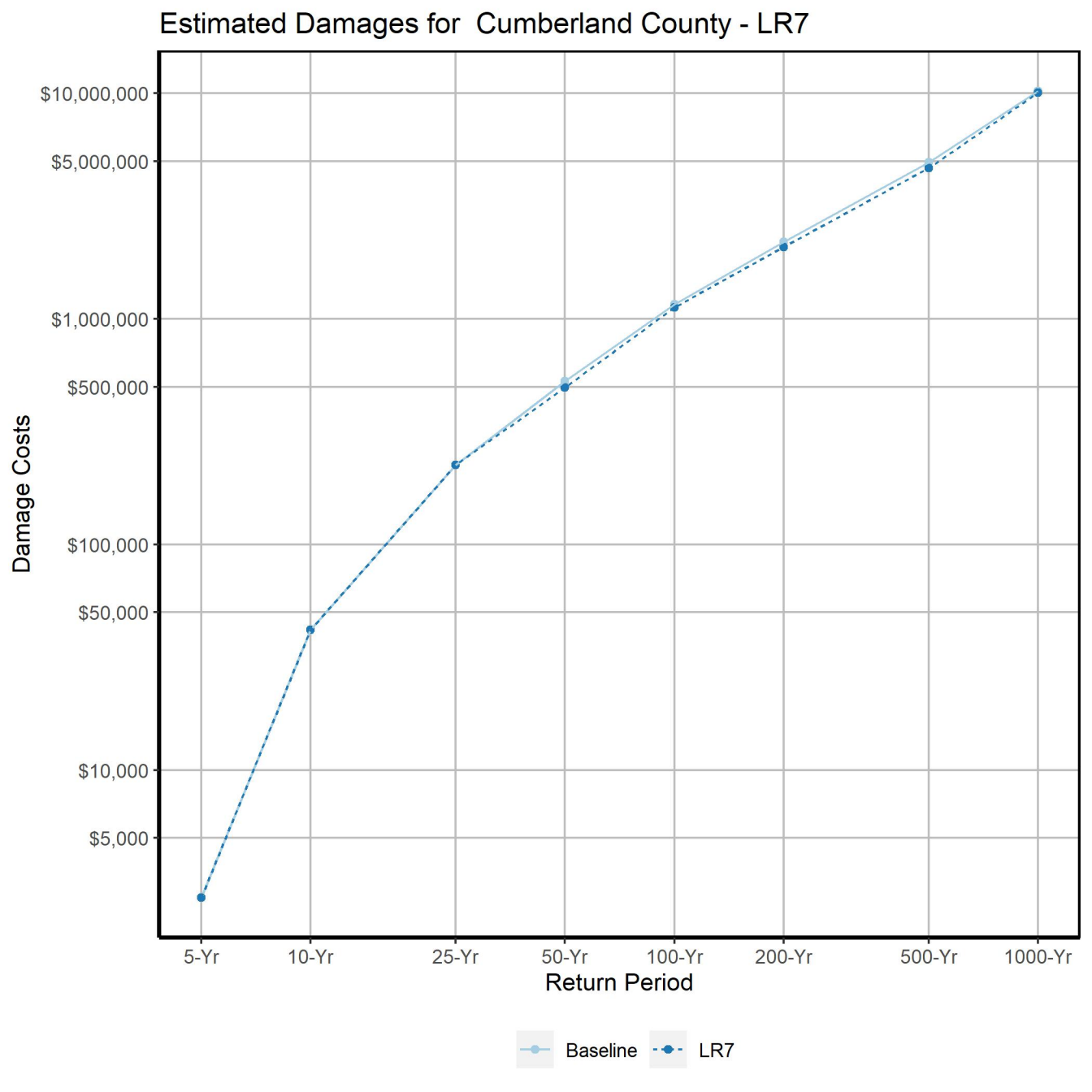
Little River Alt 7 Damages 50-yr (2% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	208	$2,629,972	$3,338,511	44	$1,130,141	$8,434,131	3	$225,212	$12,248,931	255	$3,985,325	$24,021,574
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	37	$30,437	$50,631	5	$0	$0	0	$0	$0	42	$30,437	$50,631
Chatham County	0	$0	$0	1	$0	$0	3	$0	$0	4	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	19	$457,304	$577,343	5	$38,263	$492,791	0	$0	$0	24	$495,567	$1,070,133
Duplin County	161	$1,201,017	$1,531,321	37	$333,810	$918,663	0	$0	$0	198	$1,534,827	$2,449,983
Elizabethtown	6	$86,464	$161,734	7	$77,097	$288,006	4	$97,477	$605,375	17	$261,037	$1,055,114
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	3	$12,124	$13,308	7	$43,088	$1,526,707	1	$0	$0	11	$55,212	$1,540,015
Fort Bragg	1	$6,121	$6,758	0	$0	$0	0	$0	$0	1	$6,121	$6,758
Harnett County	23	$633,929	$852,899	0	$0	$0	1	$0	$0	24	$633,929	$852,899
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	10	$205,588	$254,195	1	$0	$0	0	$0	$0	11	$205,588	$254,195
Lillington	0	$0	$0	0	$0	$0	2	$3,256	$29,442	2	$3,256	$29,442
Moore County	35	$139,469	$228,949	0	$0	$0	0	$0	$0	35	$139,469	$228,949
New Hanover County	3	$11,026	$12,290	2	$3,931	$171,579	0	$0	$0	5	$14,957	$183,868
Pender County	795	$17,907,095	$22,658,972	89	$1,648,373	$18,784,507	1	$0	$0	885	$19,555,468	$41,443,479
Spring Lake	1	$8,526	$12,612	1	$0	$0	0	$0	$0	2	$8,526	$12,612
Wallace	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0

Little River Alt 7 Damages 100-yr (1% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	355	$5,210,165	$6,624,506	56	$2,157,542	$12,715,748	4	$489,550	$13,822,568	415	$7,857,257	$33,162,821
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	57	$52,843	$85,781	5	$0	$0	0	$0	$0	62	$52,843	$85,781
Chatham County	0	$0	$0	1	$0	$0	5	$60,158	$78,417	6	$60,158	$78,417
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	45	$942,971	$1,162,479	8	$178,848	$1,419,677	0	$0	$0	53	$1,121,819	$2,582,156
Duplin County	398	$3,735,137	$4,855,960	91	$1,311,663	$3,708,220	1	$0	$0	490	$5,046,801	$8,564,179
Elizabethtown	7	$159,407	$256,159	12	$117,246	$445,448	4	$312,616	$1,771,501	23	$589,268	$2,473,109
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	5	$76,232	$89,358	12	$219,593	$2,736,642	3	$14,007	$18,383	20	$309,832	$2,844,383
Fort Bragg	1	$26,083	$31,690	0	$0	$0	0	$0	$0	1	$26,083	$31,690
Harnett County	39	$1,592,972	$2,133,009	0	$0	$0	1	$0	$0	40	$1,592,972	$2,133,009
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	12	$257,792	$317,569	1	$0	$0	0	$0	$0	13	$257,792	$317,569
Lillington	0	$0	$0	0	$0	$0	3	$7,403	$42,639	3	$7,403	$42,639
Moore County	42	$252,403	$378,382	0	$0	$0	0	$0	$0	42	$252,403	$378,382
New Hanover County	6	$21,625	$24,283	3	$54,962	$452,095	0	$0	$0	9	$76,587	$476,378
Pender County	1,040	$29,296,140	$36,794,353	137	$2,815,033	$28,343,972	1	$0	$0	1,178	$32,111,173	$65,138,325
Spring Lake	6	$53,149	$65,183	2	$0	$0	0	$0	$0	8	$53,149	$65,183
Wallace	6	$1,979	$3,690	1	$0	$0	0	$0	$0	7	$1,979	$3,690

Little River Alt 7 Damages 200-yr (0.5% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	454	$7,976,495	$10,140,137	79	$3,011,095	$15,949,754	6	$684,707	$15,102,268	539	$11,672,296	$41,192,159
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	156	$1,190,730	$1,498,559	17	$148,894	$1,137,816	0	$0	$0	173	$1,339,624	$2,636,375
Chatham County	1	$0	$0	1	$40,731	$113,428	5	$892,170	$938,406	7	$932,901	$1,051,834
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	70	$1,654,367	$2,032,192	11	$429,202	$2,605,419	0	$0	$0	81	$2,083,570	$4,637,611
Duplin County	617	$9,241,294	$12,043,723	152	$3,306,681	$10,124,149	4	$0	$0	773	$12,547,975	$22,167,871
Elizabethtown	10	$219,688	$326,639	15	$165,686	$1,008,201	4	$468,931	$3,829,608	29	$854,306	$5,164,448
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	14	$246,293	$340,304	19	$332,929	$4,100,874	5	$43,459	$54,957	38	$622,682	$4,496,135
Fort Bragg	1	$49,815	$57,289	0	$0	$0	0	$0	$0	1	$49,815	$57,289
Harnett County	56	$2,265,639	$3,005,680	7	$0	$0	1	$0	$0	64	$2,265,639	$3,005,680
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	13	$353,960	$431,788	4	$7,972	$39,350	0	$0	$0	17	$361,932	$471,138
Lillington	0	$0	$0	0	$0	$0	5	$175,510	$1,500,766	5	$175,510	$1,500,766
Moore County	56	$398,695	$606,874	0	$0	$0	0	$0	$0	56	$398,695	$606,874
New Hanover County	9	$38,734	$49,962	3	$166,722	$680,186	0	$0	$0	12	$205,456	$730,149
Pender County	1,281	$43,785,199	$54,772,175	185	$6,380,531	$54,120,359	1	$10,177	$2,401,408	1,467	$50,175,907	$111,293,942
Spring Lake	10	$89,296	$120,001	3	$0	$0	0	$0	$0	13	$89,296	$120,001
Wallace	14	$33,533	$50,158	1	$0	$0	0	$0	$0	15	$33,533	$50,158

Little River Alt 7 Damages 500-yr (0.2% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	667	$14,690,691	$18,622,273	107	$5,290,844	$27,601,982	6	$1,264,143	$19,236,943	780	$21,245,678	$65,461,198
Brunswick County	1	$505	$653	0	$0	$0	0	$0	$0	1	$505	$653
Burgaw	182	$1,947,148	$2,521,223	20	$667,433	$1,968,665	0	$0	$0	202	$2,614,581	$4,489,888
Chatham County	2	$4,658	$8,055	1	$18,837	$79,937	5	$2,121,306	$2,181,344	8	$2,144,801	$2,269,337
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	178	$3,654,768	$4,612,675	23	$1,009,323	$4,834,641	0	$0	$0	201	$4,664,092	$9,447,316
Duplin County	778	$29,680,941	$37,487,400	217	$14,956,117	$65,664,797	8	$33,964	$865,834	1,003	$44,671,022	$104,018,031
Elizabethtown	12	$325,296	$453,368	23	$426,984	$2,112,171	4	$832,756	$4,746,280	39	$1,585,036	$7,311,819
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	35	$567,898	$789,994	38	$1,346,548	$8,589,405	9	$78,553	$93,528	82	$1,992,999	$9,472,927
Fort Bragg	1	$64,264	$73,655	0	$0	$0	0	$0	$0	1	$64,264	$73,655
Harnett County	77	$3,412,652	$4,428,248	10	$1,004,824	$2,623,803	1	$44,262	$54,862	88	$4,461,738	$7,106,913
Hoke County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Lee County	16	$621,910	$751,416	5	$43,397	$164,778	0	$0	$0	21	$665,308	$916,194
Lillington	1	$0	$0	0	$0	$0	6	$338,179	$2,066,343	7	$338,179	$2,066,343
Moore County	73	$611,665	$925,837	3	$0	$0	0	$0	$0	76	$611,665	$925,837
New Hanover County	12	$85,490	$103,634	3	$284,566	$875,272	0	$0	$0	15	$370,056	$978,905
Pender County	1,517	$71,121,575	$87,702,103	222	$17,400,744	$92,888,829	1	$138,387	$2,826,268	1,740	$88,660,707	$183,417,201
Spring Lake	23	$256,702	$349,715	3	$265,104	$1,839,172	0	$0	$0	26	$521,806	$2,188,887
Wallace	43	$240,257	$316,241	5	$8,566	$22,680	0	$0	$0	48	$248,823	$338,921

Little River Alt 7 Damages 1000-yr (0.1% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	778	$22,464,615	$28,372,130	137	$7,870,122	$36,558,752	6	$1,542,791	$20,980,358	921	$31,877,528	$85,911,240
Brunswick County	1	$505	$855	0	$0	$0	0	$0	$0	1	$505	$855
Burgaw	204	$2,672,636	$3,440,346	23	$1,623,521	$5,018,718	0	$0	$0	227	$4,296,157	$8,459,064
Chatham County	3	$38,379	$44,909	1	$44,549	$119,268	5	$3,011,268	$3,083,465	9	$3,094,196	$3,247,642
Columbus County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Cumberland County	449	$7,589,496	$9,682,186	67	$2,487,343	$10,647,994	0	$0	$0	516	$10,076,840	$20,330,179
Duplin County	839	$54,877,513	$68,213,806	235	$38,927,688	$131,499,029	9	$609,514	$53,293,741	1,083	$94,414,715	$253,006,577
Elizabethtown	17	$455,886	$617,386	25	$1,007,267	$3,595,958	4	$973,662	$5,354,859	46	$2,436,814	$9,568,202
Erwin	2	$571	$1,180	0	$0	$0	0	$0	$0	2	$571	$1,180
Fayetteville	100	$1,793,552	$2,454,651	57	$2,016,634	$12,758,616	15	$1,682,710	$31,725,933	172	$5,492,896	$46,939,200
Fort Bragg	2	$72,366	$82,719	0	$0	$0	0	$0	$0	2	$72,366	$82,719
Harnett County	100	$4,577,523	$5,874,566	13	$2,159,871	$4,510,415	1	$154,800	$167,282	114	$6,892,195	$10,552,263
Hoke County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Lee County	17	$803,829	$962,807	5	$91,014	$249,972	0	$0	$0	22	$894,843	$1,212,779
Lillington	1	$0	$0	0	$0	$0	8	$359,186	$2,181,359	9	$359,186	$2,181,359
Moore County	88	$841,216	$1,255,090	3	$23,419	$234,206	0	$0	$0	91	$864,635	$1,489,296
New Hanover County	14	$149,888	$187,641	4	$345,968	$1,011,101	0	$0	$0	18	$495,856	$1,198,742
Pender County	1,645	$95,309,275	$116,747,030	233	$27,974,349	$130,599,999	1	$214,504	$3,175,342	1,879	$123,498,127	$250,522,371
Spring Lake	58	$2,189,264	$2,748,037	3	$700,274	$3,646,062	0	$0	$0	61	$2,889,537	$6,394,099
Wallace	81	$625,503	$909,091	9	$25,070	$65,896	0	$0	$0	90	$650,573	$974,987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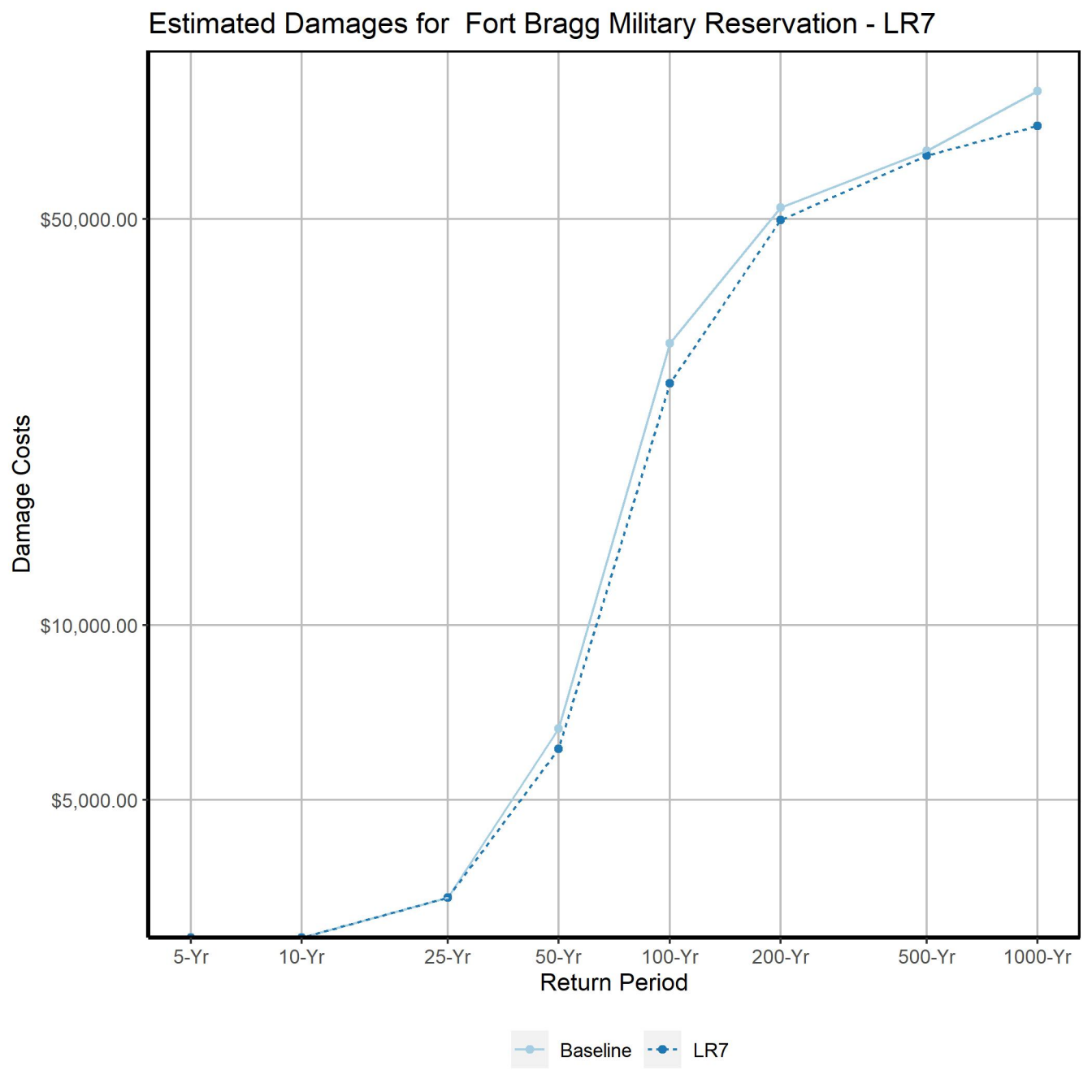
$1,000,000
$500,000
$100,000
$50,000
$10,000
$5,000
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
LR7


Estimated Damages for Fort Bragg Military Reservation - LR7
Damage Costs
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$10,000.00
$5,000.00
5-Yr
10-Yr
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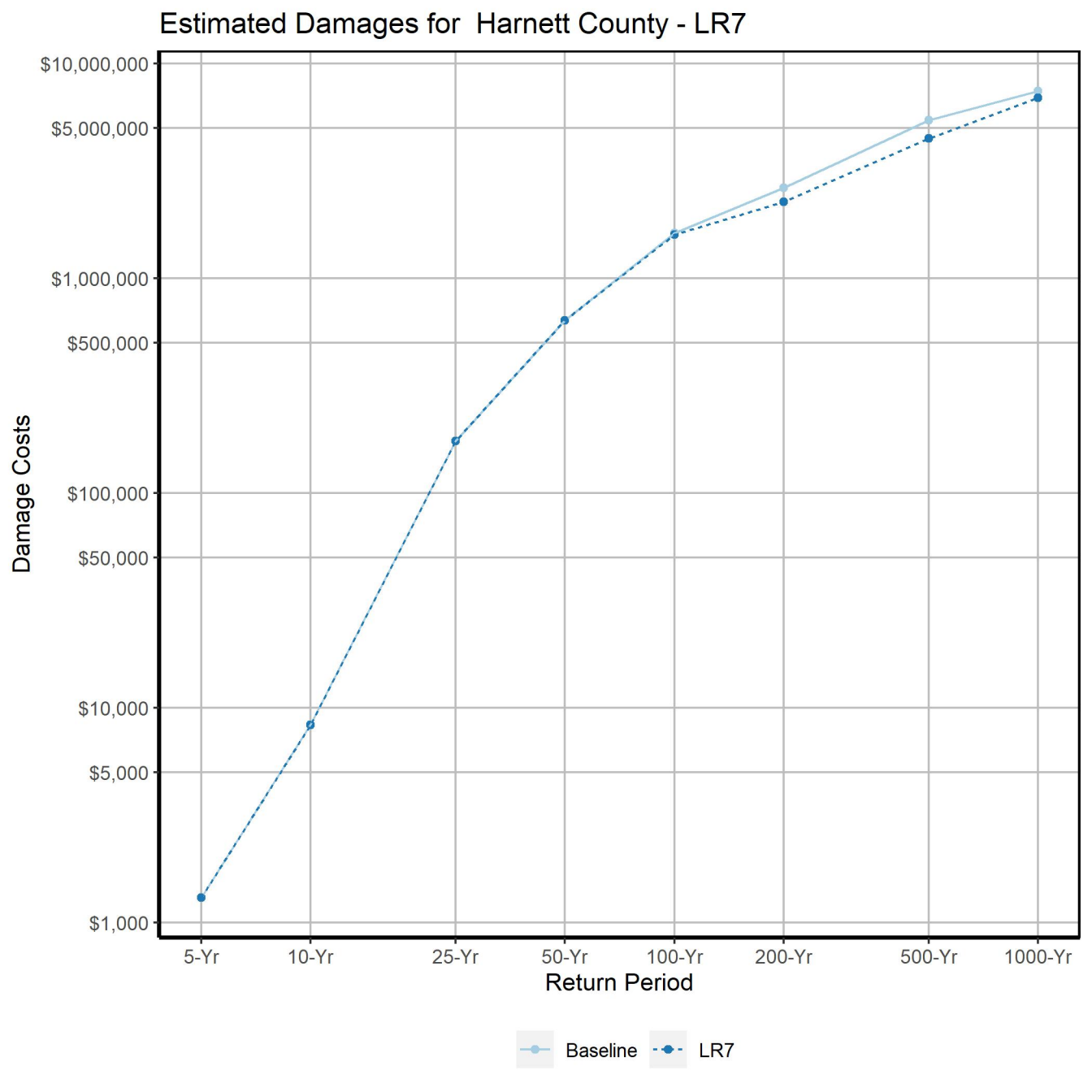
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
LR7


Estimated Damages for Harnett County - LR7
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$1,000,000
$500,000
$100,000
$50,000
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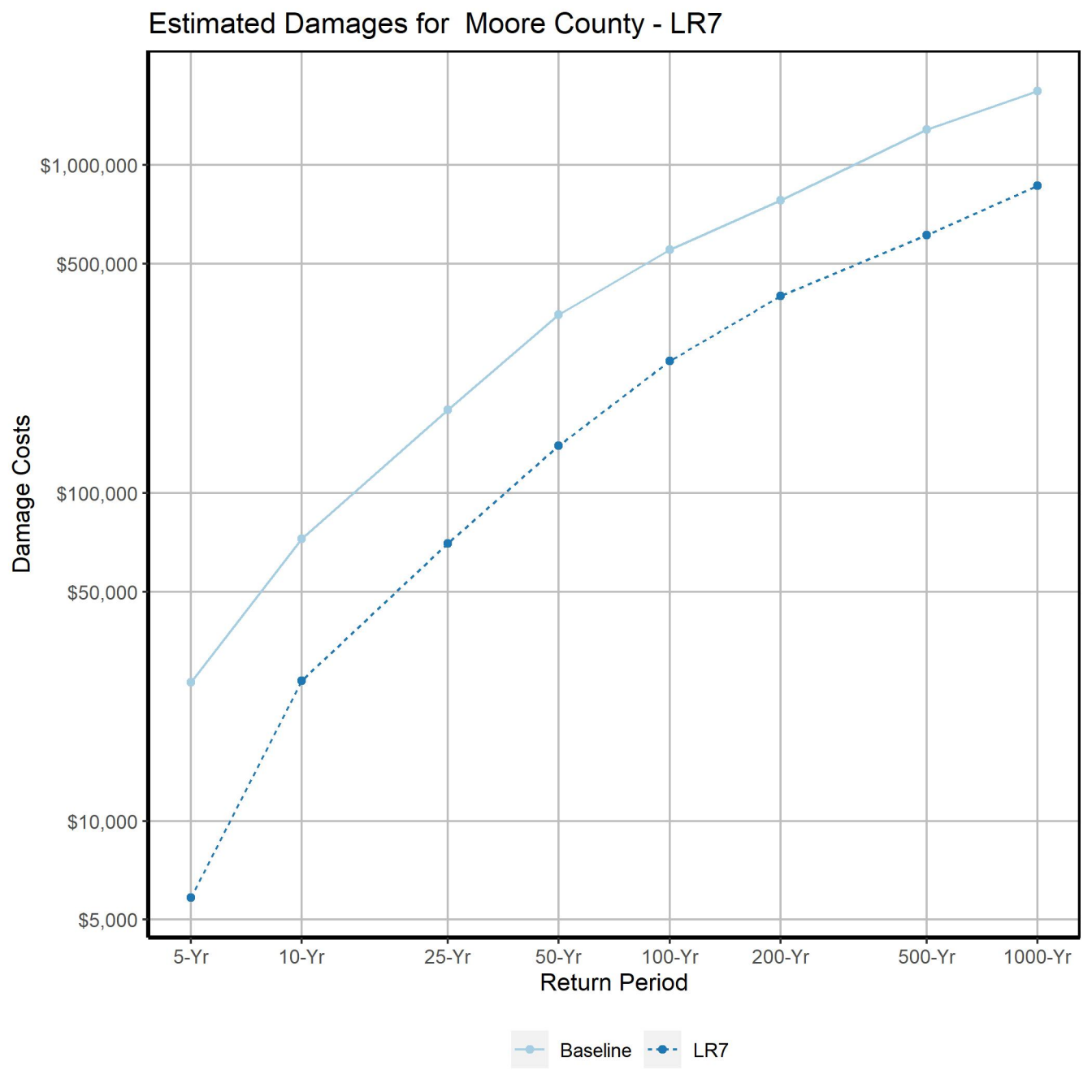
$5,000
$1,000
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
LR7


Estimated Damages for Moore County - LR7
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$500,000
$100,000
$50,000
$10,000
$5,000
Damage Costs
5-Yr
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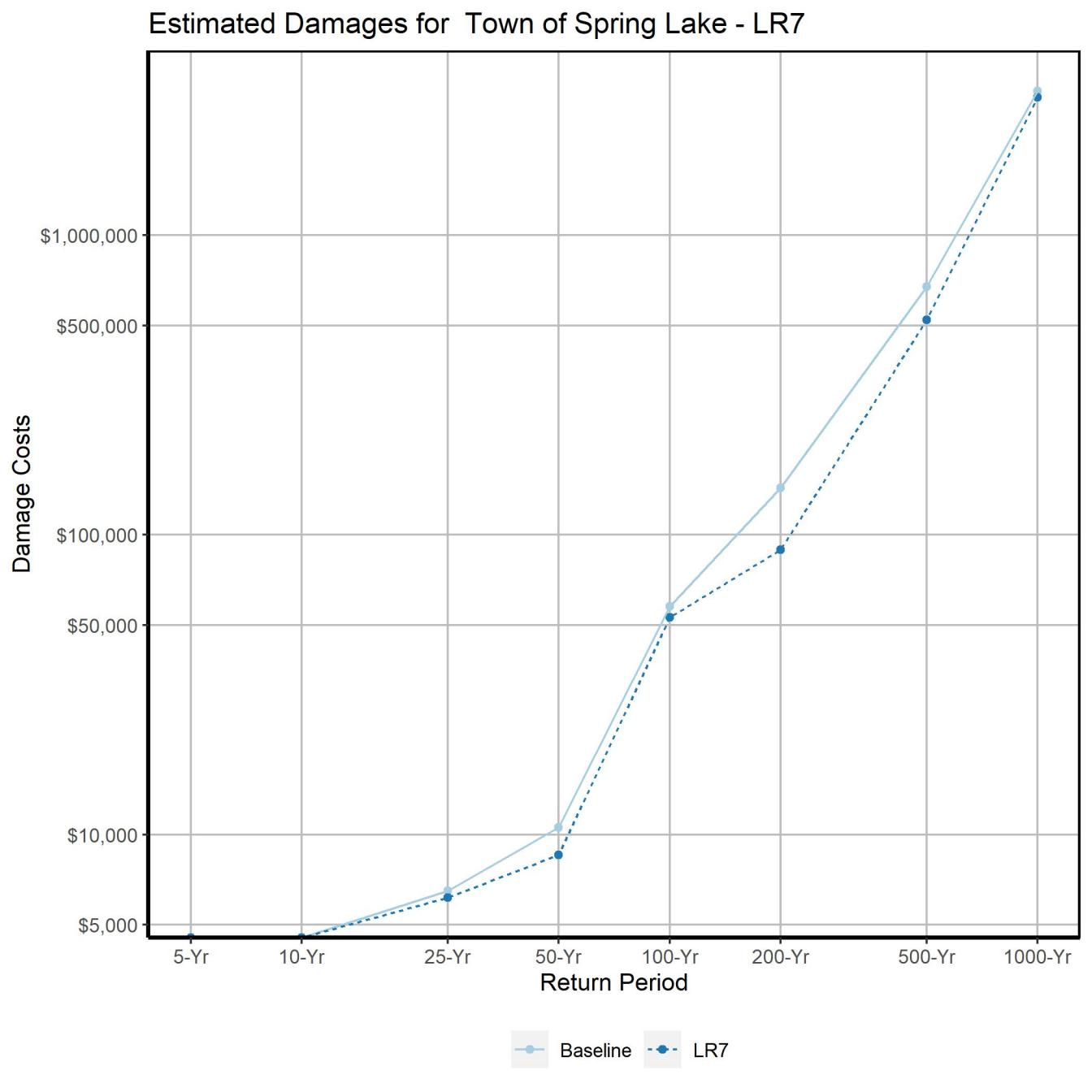
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
LR7


Estimated Damages for Town of Spring Lake - LR7
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Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
LR7

NE Cape Fear Alt 8 Damages 5-yr (20% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	32	$133,562	$183,251	10	$130,210	$1,429,187	1	$0	$0	43	$263,772	$1,612,438
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	5	$1,740	$2,670	1	$0	$0	0	$0	$0	6	$1,740	$2,670
Chatham County	0	$0	$0	1	$0	$0	1	$0	$0	2	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	3	$2,719	$4,253	0	$0	$0	0	$0	$0	3	$2,719	$4,253
Duplin County	3	$4,820	$5,944	0	$0	$0	0	$0	$0	3	$4,820	$5,944
Elizabethtown	0	$0	$0	1	$10,875	$26,766	0	$0	$0	1	$10,875	$26,766
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	0	$0	$0	3	$17,421	$825,112	0	$0	$0	3	$17,421	$825,112
Fort Bragg	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Harnett County	1	$1,309	$2,845	0	$0	$0	0	$0	$0	1	$1,309	$2,845
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	2	$51,086	$58,881	0	$0	$0	0	$0	$0	2	$51,086	$58,881
Lillington	0	$0	$0	0	$0	$0	1	$0	$0	1	$0	$0
Moore County	12	$26,464	$35,865	0	$0	$0	0	$0	$0	12	$26,464	$35,865
New Hanover County	1	$790	$1,552	0	$0	$0	0	$0	$0	1	$790	$1,552
Pender County	261	$1,814,604	$2,350,238	25	$49,766	$396,653	0	$0	$0	286	$1,864,369	$2,746,891
Spring Lake	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

NE Cape Fear Alt 8 Damages 10-yr (10% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	58	$339,577	$453,829	13	$229,727	$1,833,541	1	$24,877	$3,307,356	72	$594,182	$5,594,725
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	16	$11,824	$16,959	3	$0	$0	0	$0	$0	19	$11,824	$16,959
Chatham County	0	$0	$0	1	$0	$0	1	$0	$0	2	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	8	$41,778	$62,352	1	$0	$0	0	$0	$0	9	$41,778	$62,352
Duplin County	11	$40,103	$53,751	4	$0	$0	0	$0	$0	15	$40,103	$53,751
Elizabethtown	0	$0	$0	1	$20,869	$43,216	3	$0	$0	4	$20,869	$43,216
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	0	$0	$0	3	$20,305	$917,044	0	$0	$0	3	$20,305	$917,044
Fort Bragg	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Harnett County	6	$8,348	$18,943	0	$0	$0	1	$0	$0	7	$8,348	$18,943
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	4	$92,679	$111,091	0	$0	$0	0	$0	$0	4	$92,679	$111,091
Lillington	0	$0	$0	0	$0	$0	1	$0	$0	1	$0	$0
Moore County	21	$72,454	$108,560	0	$0	$0	0	$0	$0	21	$72,454	$108,560
New Hanover County	1	$790	$1,556	0	$0	$0	0	$0	$0	1	$790	$1,556
Pender County	384	$4,566,564	$5,852,098	42	$159,318	$4,851,240	0	$0	$0	426	$4,725,882	$10,703,338
Spring Lake	1	$0	$0	1	$0	$0	0	$0	$0	2	$0	$0
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

NE Cape Fear Alt 8 Damages 25-yr (4% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	121	$1,064,007	$1,388,656	28	$505,449	$2,931,924	2	$100,046	$3,867,892	151	$1,669,502	$8,188,471
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	22	$17,317	$29,570	4	$0	$0	0	$0	$0	26	$17,317	$29,570
Chatham County	0	$0	$0	1	$0	$0	2	$0	$0	3	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	11	$224,801	$300,670	3	$0	$0	0	$0	$0	14	$224,801	$300,670
Duplin County	54	$277,300	$359,179	14	$15,557	$293,892	0	$0	$0	68	$292,857	$653,071
Elizabethtown	5	$31,591	$41,513	4	$34,413	$180,026	3	$68,197	$494,270	12	$134,201	$715,808
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	2	$924	$1,020	6	$23,751	$1,003,571	1	$0	$0	9	$24,676	$1,004,591
Fort Bragg	1	$3,394	$3,503	0	$0	$0	0	$0	$0	1	$3,394	$3,503
Harnett County	16	$174,601	$303,217	0	$0	$0	1	$0	$0	17	$174,601	$303,217
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	4	$136,469	$159,689	0	$0	$0	0	$0	$0	4	$136,469	$159,689
Lillington	0	$0	$0	0	$0	$0	2	$0	$0	2	$0	$0
Moore County	39	$179,023	$276,976	0	$0	$0	0	$0	$0	39	$179,023	$276,976
New Hanover County	1	$4,717	$5,657	1	$0	$0	0	$0	$0	2	$4,717	$5,657
Pender County	568	$10,346,766	$13,213,514	58	$630,984	$9,964,213	0	$0	$0	626	$10,977,750	$23,177,726
Spring Lake	1	$6,473	$9,142	1	$0	$0	0	$0	$0	2	$6,473	$9,142
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

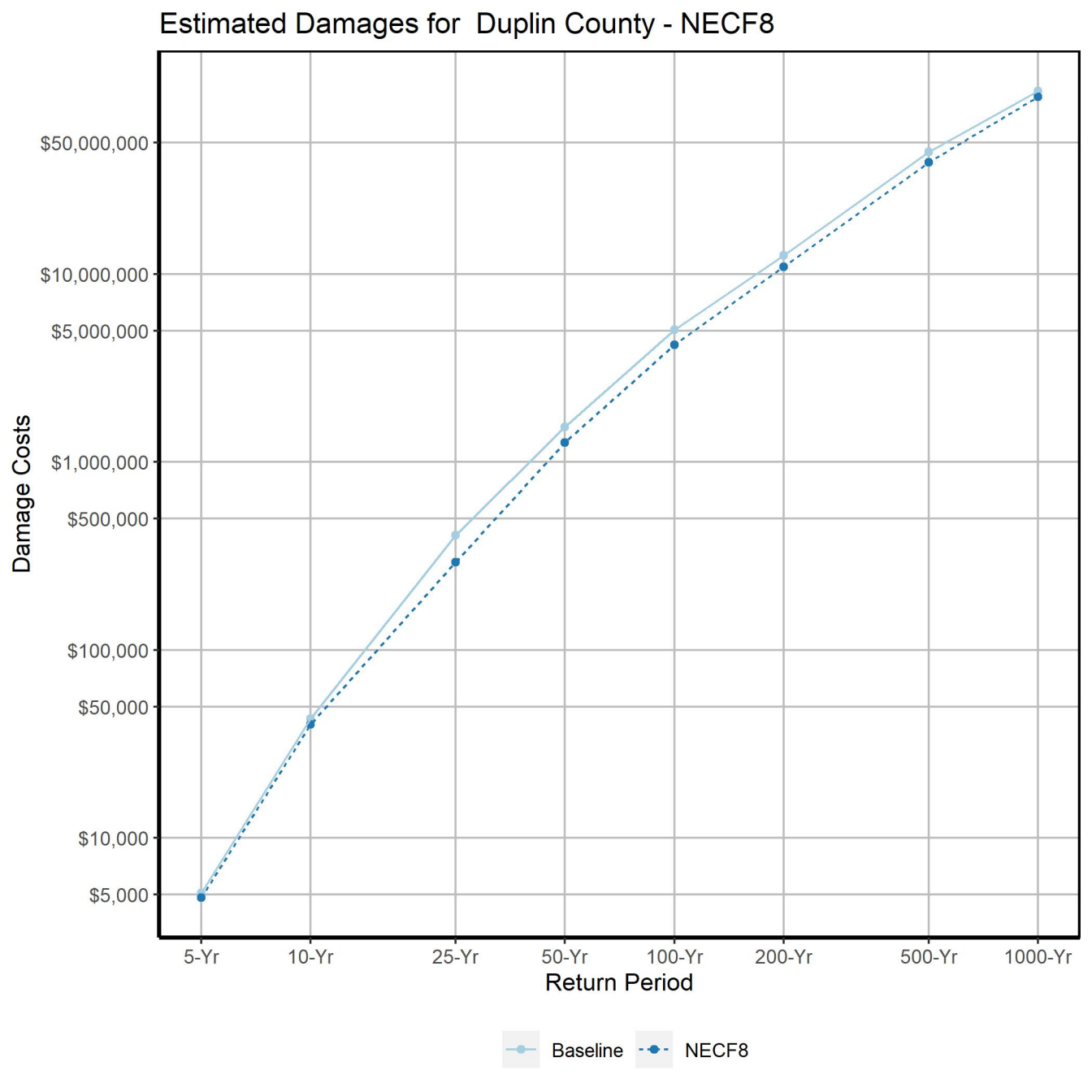
NE Cape Fear Alt 8 Damages 50-yr (2% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	208	$2,629,972	$3,338,511	44	$1,130,141	$8,434,131	3	$225,212	$12,248,931	255	$3,985,325	$24,021,574
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	37	$30,437	$50,631	5	$0	$0	0	$0	$0	42	$30,437	$50,631
Chatham County	0	$0	$0	1	$0	$0	3	$0	$0	4	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	20	$459,207	$579,947	5	$70,474	$620,733	0	$0	$0	25	$529,681	$1,200,681
Duplin County	131	$1,009,810	$1,291,024	36	$260,834	$802,610	0	$0	$0	167	$1,270,644	$2,093,634
Elizabethtown	6	$86,464	$161,734	7	$77,097	$288,006	4	$97,477	$605,375	17	$261,037	$1,055,114
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	3	$12,124	$13,308	7	$43,088	$1,526,707	1	$0	$0	11	$55,212	$1,540,015
Fort Bragg	1	$6,630	$7,313	0	$0	$0	0	$0	$0	1	$6,630	$7,313
Harnett County	24	$636,128	$855,685	0	$0	$0	1	$0	$0	25	$636,128	$855,685
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	10	$205,588	$254,195	1	$0	$0	0	$0	$0	11	$205,588	$254,195
Lillington	0	$0	$0	0	$0	$0	2	$3,256	$29,442	2	$3,256	$29,442
Moore County	54	$350,033	$540,519	0	$0	$0	0	$0	$0	54	$350,033	$540,519
New Hanover County	3	$11,034	$12,298	2	$3,931	$171,579	0	$0	$0	5	$14,966	$183,877
Pender County	796	$17,907,046	$22,658,880	89	$1,647,405	$18,778,468	1	$0	$0	886	$19,554,451	$41,437,348
Spring Lake	3	$10,576	$15,277	1	$0	$0	0	$0	$0	4	$10,576	$15,277
Wallace	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0

NE Cape Fear Alt 8 Damages 100-yr (1% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	355	$5,210,165	$6,624,506	56	$2,157,542	$12,715,748	4	$489,550	$13,822,568	415	$7,857,257	$33,162,821
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	57	$52,843	$85,781	5	$0	$0	0	$0	$0	62	$52,843	$85,781
Chatham County	0	$0	$0	1	$0	$0	5	$60,158	$78,417	6	$60,158	$78,417
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	45	$966,730	$1,189,429	9	$195,698	$1,555,848	0	$0	$0	54	$1,162,429	$2,745,277
Duplin County	352	$3,184,810	$4,136,861	84	$1,018,931	$3,111,793	1	$0	$0	437	$4,203,741	$7,248,654
Elizabethtown	7	$159,407	$256,159	12	$117,246	$445,448	4	$312,616	$1,771,501	23	$589,268	$2,473,109
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	5	$76,232	$89,358	12	$219,593	$2,736,642	3	$14,007	$18,383	20	$309,832	$2,844,383
Fort Bragg	1	$30,521	$36,383	0	$0	$0	0	$0	$0	1	$30,521	$36,383
Harnett County	40	$1,620,074	$2,170,385	5	$0	$0	1	$0	$0	46	$1,620,074	$2,170,385
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	12	$257,792	$317,569	1	$0	$0	0	$0	$0	13	$257,792	$317,569
Lillington	0	$0	$0	0	$0	$0	3	$7,403	$42,639	3	$7,403	$42,639
Moore County	65	$551,643	$843,460	0	$0	$0	0	$0	$0	65	$551,643	$843,460
New Hanover County	6	$21,610	$24,268	3	$54,962	$452,095	0	$0	$0	9	$76,573	$476,363
Pender County	1,041	$29,295,051	$36,793,715	137	$2,814,104	$28,339,974	1	$0	$0	1,179	$32,109,155	$65,133,689
Spring Lake	6	$57,794	$74,135	2	$0	$0	0	$0	$0	8	$57,794	$74,135
Wallace	6	$1,967	$3,641	1	$0	$0	0	$0	$0	7	$1,967	$3,641

NE Cape Fear Alt 8 Damages 200-yr (0.5% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	454	$7,976,495	$10,140,137	79	$3,011,095	$15,949,754	6	$684,707	$15,102,268	539	$11,672,296	$41,192,159
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	155	$1,190,730	$1,498,559	17	$148,894	$1,137,816	0	$0	$0	172	$1,339,624	$2,636,375
Chatham County	1	$0	$0	1	$40,731	$113,428	5	$892,170	$938,406	7	$932,901	$1,051,834
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	71	$1,724,246	$2,115,603	11	$472,551	$2,696,378	0	$0	$0	82	$2,196,797	$4,811,981
Duplin County	580	$7,972,542	$10,442,883	147	$2,951,644	$9,360,480	2	$0	$0	729	$10,924,186	$19,803,362
Elizabethtown	10	$219,688	$326,639	15	$165,686	$1,008,201	4	$468,931	$3,829,608	29	$854,306	$5,164,448
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	14	$246,293	$340,304	19	$332,929	$4,100,874	5	$43,459	$54,957	38	$622,682	$4,496,135
Fort Bragg	1	$52,294	$60,082	0	$0	$0	0	$0	$0	1	$52,294	$60,082
Harnett County	58	$2,331,711	$3,082,768	7	$304,024	$1,386,996	1	$0	$0	66	$2,635,735	$4,469,764
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	13	$353,960	$431,788	4	$7,972	$39,350	0	$0	$0	17	$361,932	$471,138
Lillington	0	$0	$0	0	$0	$0	5	$175,510	$1,500,766	5	$175,510	$1,500,766
Moore County	82	$781,387	$1,160,212	2	$0	$0	0	$0	$0	84	$781,387	$1,160,212
New Hanover County	9	$38,691	$49,912	3	$166,722	$680,186	0	$0	$0	12	$205,413	$730,098
Pender County	1,281	$43,781,422	$54,768,232	185	$6,380,004	$54,118,020	1	$10,177	$2,401,408	1,467	$50,171,603	$111,287,660
Spring Lake	10	$117,711	$155,373	3	$25,773	$1,125,506	0	$0	$0	13	$143,484	$1,280,879
Wallace	14	$31,864	$48,124	1	$0	$0	0	$0	$0	15	$31,864	$48,124

NE Cape Fear Alt 8 Damages 500-yr (0.2% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	667	$14,690,691	$18,622,273	107	$5,290,844	$27,601,982	6	$1,264,143	$19,236,943	780	$21,245,678	$65,461,198
Brunswick County	1	$505	$653	0	$0	$0	0	$0	$0	1	$505	$653
Burgaw	182	$1,947,148	$2,521,223	20	$667,433	$1,968,665	0	$0	$0	202	$2,614,581	$4,489,888
Chatham County	2	$4,658	$8,055	1	$18,837	$79,937	5	$2,121,306	$2,181,344	8	$2,144,801	$2,269,337
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	188	$3,754,117	$4,739,246	26	$1,180,709	$5,321,841	0	$0	$0	214	$4,934,825	$10,061,087
Duplin County	770	$26,440,026	$33,385,496	215	$13,034,304	$59,777,727	8	$10,779	$822,736	993	$39,485,109	$93,985,959
Elizabethtown	12	$325,296	$453,368	23	$426,984	$2,112,171	4	$832,756	$4,746,280	39	$1,585,036	$7,311,819
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	35	$567,898	$789,994	38	$1,346,548	$8,589,405	9	$78,553	$93,528	82	$1,992,999	$9,472,927
Fort Bragg	2	$65,571	$75,095	0	$0	$0	0	$0	$0	2	$65,571	$75,095
Harnett County	79	$3,486,175	$4,527,324	11	$1,909,570	$4,044,280	1	$48,519	$59,151	91	$5,444,264	$8,630,755
Hoke County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Lee County	16	$621,910	$751,416	5	$43,397	$164,778	0	$0	$0	21	$665,308	$916,194
Lillington	1	$0	$0	0	$0	$0	6	$338,179	$2,066,343	7	$338,179	$2,066,343
Moore County	105	$1,238,193	$1,831,174	4	$45,118	$278,576	0	$0	$0	109	$1,283,311	$2,109,750
New Hanover County	12	$85,470	$103,612	3	$284,566	$875,272	0	$0	$0	15	$370,036	$978,883
Pender County	1,516	$71,113,181	$87,692,441	222	$17,400,594	$92,887,426	1	$138,387	$2,826,268	1,739	$88,652,162	$183,406,135
Spring Lake	24	$309,444	$411,897	3	$364,445	$2,446,430	0	$0	$0	27	$673,889	$2,858,327
Wallace	42	$235,246	$309,694	5	$8,264	$22,270	0	$0	$0	47	$243,509	$331,964

NE Cape Fear Alt 8 Damages 1000-yr (0.1% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	778	$22,464,615	$28,372,130	137	$7,870,122	$36,558,752	6	$1,542,791	$20,980,358	921	$31,877,528	$85,911,240
Brunswick County	1	$505	$855	0	$0	$0	0	$0	$0	1	$505	$855
Burgaw	204	$2,672,636	$3,440,345	23	$1,623,521	$5,018,718	0	$0	$0	227	$4,296,157	$8,459,064
Chatham County	3	$38,379	$44,909	1	$44,549	$119,268	5	$3,011,268	$3,083,465	9	$3,094,196	$3,247,642
Columbus County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Cumberland County	461	$7,517,682	$9,626,981	68	$2,727,637	$12,299,527	0	$0	$0	529	$10,245,319	$21,926,507
Duplin County	831	$51,457,977	$64,076,628	233	$36,109,372	$124,514,756	9	$459,158	$52,230,327	1,073	$88,026,506	$240,821,711
Elizabethtown	17	$455,886	$617,386	25	$1,007,267	$3,595,958	4	$973,662	$5,354,859	46	$2,436,814	$9,568,202
Erwin	2	$571	$1,180	0	$0	$0	0	$0	$0	2	$571	$1,180
Fayetteville	100	$1,793,552	$2,454,651	57	$2,016,634	$12,758,616	15	$1,682,710	$31,725,933	172	$5,492,896	$46,939,200
Fort Bragg	2	$83,081	$158,117	0	$0	$0	0	$0	$0	2	$83,081	$158,117
Harnett County	102	$4,709,207	$6,030,102	13	$2,571,453	$5,442,875	1	$154,800	$167,329	116	$7,435,460	$11,640,306
Hoke County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Lee County	17	$803,829	$962,807	5	$91,014	$249,972	0	$0	$0	22	$894,843	$1,212,779
Lillington	1	$0	$0	0	$0	$0	8	$359,186	$2,181,359	9	$359,186	$2,181,359
Moore County	117	$1,613,430	$2,321,894	4	$67,404	$354,231	0	$0	$0	121	$1,680,833	$2,676,125
New Hanover County	13	$142,600	$180,017	4	$345,966	$1,011,096	0	$0	$0	17	$488,566	$1,191,113
Pender County	1,645	$95,287,655	$116,723,587	233	$27,937,773	$130,526,210	1	$214,492	$3,175,291	1,879	$123,439,921	$250,425,088
Spring Lake	58	$2,257,335	$2,828,015	4	$774,853	$3,930,404	0	$0	$0	62	$3,032,189	$6,758,420
Wallace	80	$604,000	$884,009	9	$24,324	$64,713	0	$0	$0	89	$628,325	$948,723


Estimated Damages for Duplin County - NECF8
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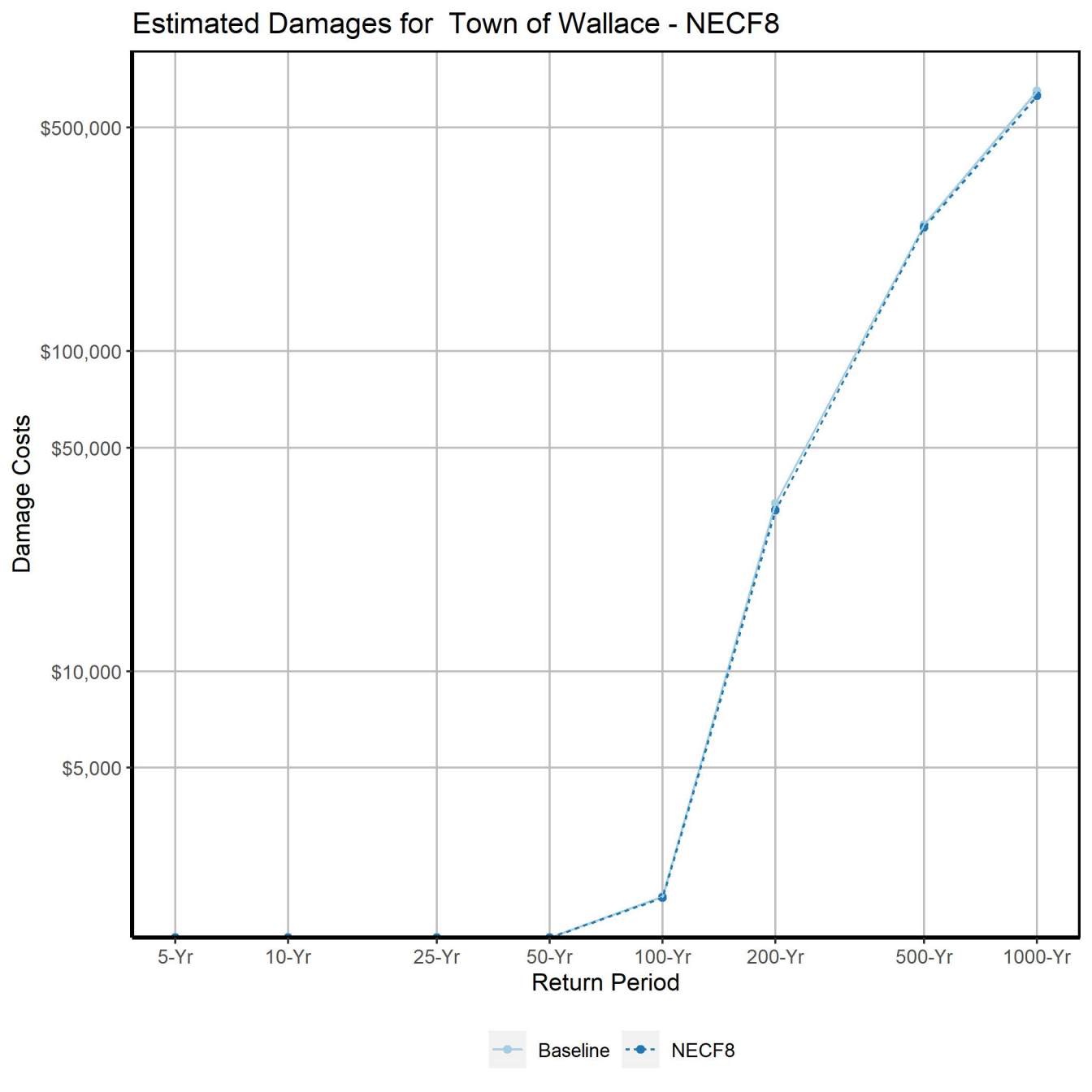
$10,000,000
$5,000,000
$1,000,000
$500,000
$100,000
$50,000
$10,000
$5,000
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
NECF8


Estimated Damages for Town of Wallace - NECF8
$500,000
$100,000
$50,000
$10,000
$5,000
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
NECF8

NECF 9 Damages 5-yr (20% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	32	$133,562	$183,251	10	$130,210	$1,429,187	1	$0	$0	43	$263,772	$1,612,438
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	5	$1,740	$2,670	1	$0	$0	0	$0	$0	6	$1,740	$2,670
Chatham County	0	$0	$0	1	$0	$0	1	$0	$0	2	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	3	$2,719	$4,253	0	$0	$0	0	$0	$0	3	$2,719	$4,253
Duplin County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Elizabethtown	0	$0	$0	1	$10,875	$26,766	0	$0	$0	1	$10,875	$26,766
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	0	$0	$0	3	$17,421	$825,112	0	$0	$0	3	$17,421	$825,112
Fort Bragg	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Harnett County	1	$1,309	$2,845	0	$0	$0	0	$0	$0	1	$1,309	$2,845
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	2	$51,086	$58,881	0	$0	$0	0	$0	$0	2	$51,086	$58,881
Lillington	0	$0	$0	0	$0	$0	1	$0	$0	1	$0	$0
Moore County	12	$26,464	$35,865	0	$0	$0	0	$0	$0	12	$26,464	$35,865
New Hanover County	1	$790	$1,552	0	$0	$0	0	$0	$0	1	$790	$1,552
Pender County	261	$1,814,642	$2,350,280	25	$49,766	$396,653	0	$0	$0	286	$1,864,408	$2,746,933
Spring Lake	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

NECF 9 Damages 10-yr (10% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	58	$339,577	$453,829	13	$229,727	$1,833,541	1	$24,877	$3,307,356	72	$594,182	$5,594,725
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	16	$11,824	$16,959	3	$0	$0	0	$0	$0	19	$11,824	$16,959
Chatham County	0	$0	$0	1	$0	$0	1	$0	$0	2	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	8	$41,778	$62,352	1	$0	$0	0	$0	$0	9	$41,778	$62,352
Duplin County	4	$12,318	$14,731	0	$0	$0	0	$0	$0	4	$12,318	$14,731
Elizabethtown	0	$0	$0	1	$20,869	$43,216	3	$0	$0	4	$20,869	$43,216
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	0	$0	$0	3	$20,305	$917,044	0	$0	$0	3	$20,305	$917,044
Fort Bragg	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Harnett County	6	$8,348	$18,943	0	$0	$0	1	$0	$0	7	$8,348	$18,943
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	4	$92,679	$111,091	0	$0	$0	0	$0	$0	4	$92,679	$111,091
Lillington	0	$0	$0	0	$0	$0	1	$0	$0	1	$0	$0
Moore County	21	$72,454	$108,560	0	$0	$0	0	$0	$0	21	$72,454	$108,560
New Hanover County	1	$790	$1,557	0	$0	$0	0	$0	$0	1	$790	$1,557
Pender County	384	$4,566,559	$5,852,094	41	$159,318	$4,851,240	0	$0	$0	425	$4,725,877	$10,703,334
Spring Lake	1	$0	$0	1	$0	$0	0	$0	$0	2	$0	$0
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

NECF 9 Damages 25-yr (4% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	121	$1,064,007	$1,388,656	28	$505,449	$2,931,924	2	$100,046	$3,867,892	151	$1,669,502	$8,188,471
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	22	$17,317	$29,570	4	$0	$0	0	$0	$0	26	$17,317	$29,570
Chatham County	0	$0	$0	1	$0	$0	2	$0	$0	3	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	11	$224,801	$300,670	3	$0	$0	0	$0	$0	14	$224,801	$300,670
Duplin County	31	$98,512	$128,161	8	$1,509	$53,713	0	$0	$0	39	$100,021	$181,874
Elizabethtown	5	$31,591	$41,513	4	$34,413	$180,026	3	$68,197	$494,270	12	$134,201	$715,808
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	2	$924	$1,020	6	$23,751	$1,003,571	1	$0	$0	9	$24,676	$1,004,591
Fort Bragg	1	$3,394	$3,503	0	$0	$0	0	$0	$0	1	$3,394	$3,503
Harnett County	16	$174,601	$303,217	0	$0	$0	1	$0	$0	17	$174,601	$303,217
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	4	$136,469	$159,689	0	$0	$0	0	$0	$0	4	$136,469	$159,689
Lillington	0	$0	$0	0	$0	$0	2	$0	$0	2	$0	$0
Moore County	39	$179,023	$276,976	0	$0	$0	0	$0	$0	39	$179,023	$276,976
New Hanover County	1	$4,714	$5,654	1	$0	$0	0	$0	$0	2	$4,714	$5,654
Pender County	567	$10,346,654	$13,213,402	58	$616,614	$9,934,829	0	$0	$0	625	$10,963,268	$23,148,232
Spring Lake	1	$6,473	$9,142	1	$0	$0	0	$0	$0	2	$6,473	$9,142
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

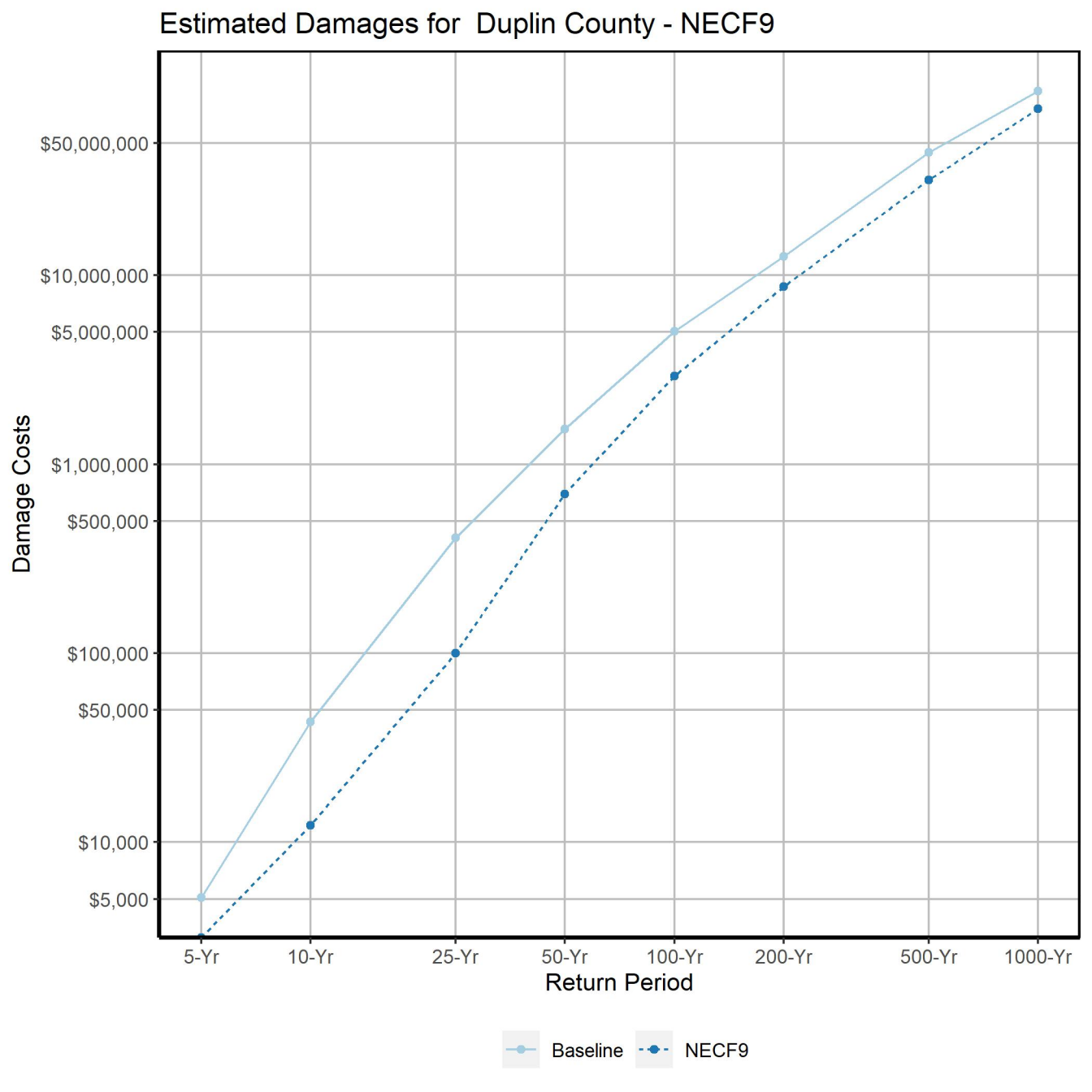
NECF 9 Damages 50-yr (2% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	208	$2,629,972	$3,338,511	44	$1,130,141	$8,434,131	3	$225,212	$12,248,931	255	$3,985,325	$24,021,574
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	37	$30,437	$50,631	5	$0	$0	0	$0	$0	42	$30,437	$50,631
Chatham County	0	$0	$0	1	$0	$0	3	$0	$0	4	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	20	$459,207	$579,947	5	$70,474	$620,733	0	$0	$0	25	$529,681	$1,200,681
Duplin County	87	$608,614	$781,555	22	$87,613	$450,767	0	$0	$0	109	$696,227	$1,232,322
Elizabethtown	6	$86,464	$161,734	7	$77,097	$288,006	4	$97,477	$605,375	17	$261,037	$1,055,114
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	3	$12,124	$13,308	7	$43,088	$1,526,707	1	$0	$0	11	$55,212	$1,540,015
Fort Bragg	1	$6,630	$7,313	0	$0	$0	0	$0	$0	1	$6,630	$7,313
Harnett County	24	$636,128	$855,685	0	$0	$0	1	$0	$0	25	$636,128	$855,685
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	10	$205,588	$254,195	1	$0	$0	0	$0	$0	11	$205,588	$254,195
Lillington	0	$0	$0	0	$0	$0	2	$3,256	$29,442	2	$3,256	$29,442
Moore County	54	$350,033	$540,519	0	$0	$0	0	$0	$0	54	$350,033	$540,519
New Hanover County	3	$11,026	$12,290	2	$3,931	$171,579	0	$0	$0	5	$14,957	$183,868
Pender County	796	$17,906,688	$22,658,087	89	$1,636,486	$18,744,992	1	$0	$0	886	$19,543,173	$41,403,079
Spring Lake	3	$10,576	$15,277	1	$0	$0	0	$0	$0	4	$10,576	$15,277
Wallace	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0

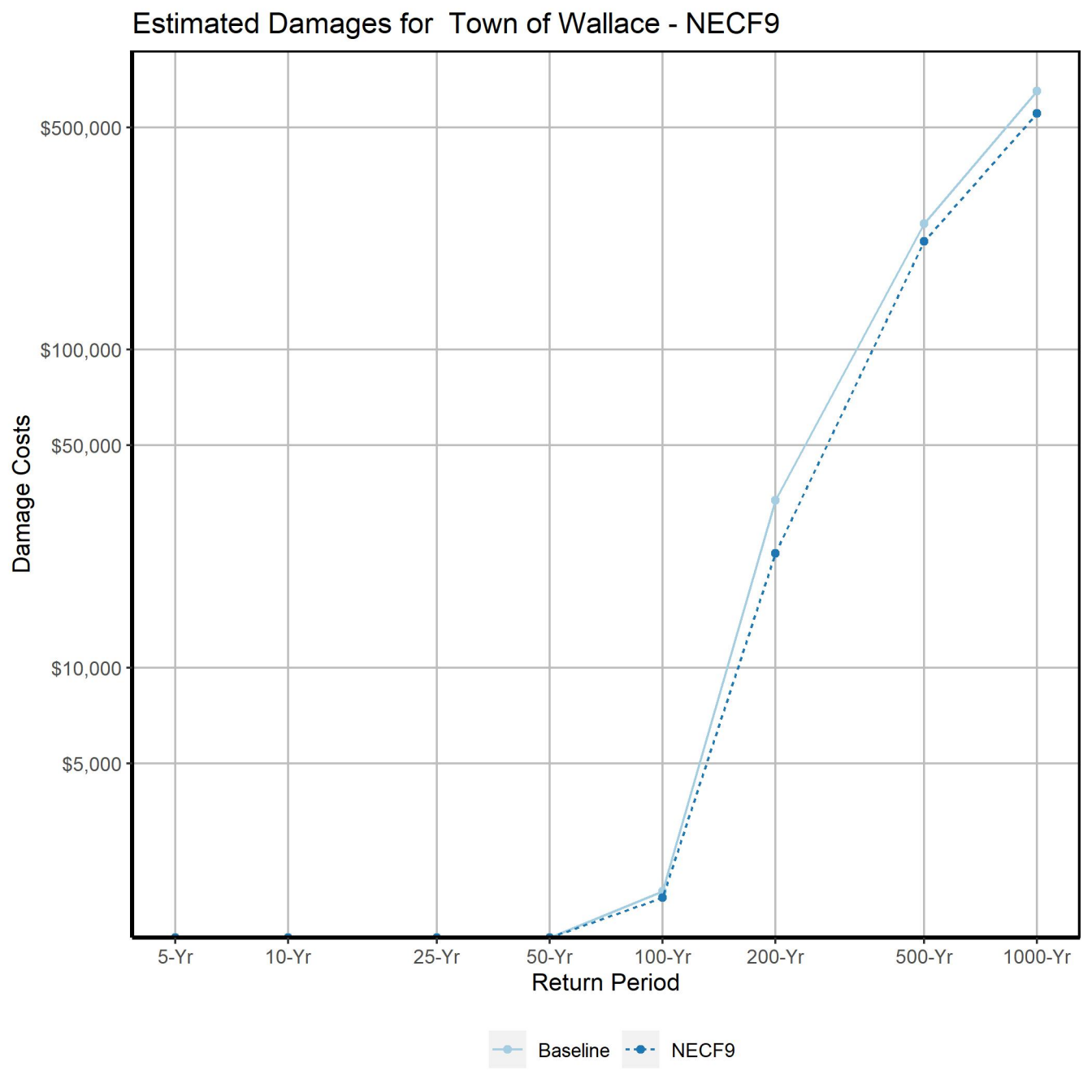
NECF 9 Damages 100-yr (1% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	355	$5,210,165	$6,624,506	56	$2,157,542	$12,715,748	4	$489,550	$13,822,568	415	$7,857,257	$33,162,821
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	57	$52,843	$85,781	5	$0	$0	0	$0	$0	62	$52,843	$85,781
Chatham County	0	$0	$0	1	$0	$0	5	$60,158	$78,417	6	$60,158	$78,417
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	45	$966,730	$1,189,429	9	$195,698	$1,555,848	0	$0	$0	54	$1,162,429	$2,745,277
Duplin County	275	$2,296,254	$2,954,660	63	$622,362	$2,194,717	0	$0	$0	338	$2,918,616	$5,149,377
Elizabethtown	7	$159,407	$256,159	12	$117,246	$445,448	4	$312,616	$1,771,501	23	$589,268	$2,473,109
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	5	$76,232	$89,358	12	$219,593	$2,736,642	3	$14,007	$18,383	20	$309,832	$2,844,383
Fort Bragg	1	$30,521	$36,383	0	$0	$0	0	$0	$0	1	$30,521	$36,383
Harnett County	40	$1,620,074	$2,170,385	5	$0	$0	1	$0	$0	46	$1,620,074	$2,170,385
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	12	$257,792	$317,569	1	$0	$0	0	$0	$0	13	$257,792	$317,569
Lillington	0	$0	$0	0	$0	$0	3	$7,403	$42,639	3	$7,403	$42,639
Moore County	65	$551,643	$843,460	0	$0	$0	0	$0	$0	65	$551,643	$843,460
New Hanover County	6	$21,625	$24,284	3	$54,962	$452,095	0	$0	$0	9	$76,587	$476,379
Pender County	1,041	$29,280,991	$36,774,821	136	$2,807,253	$28,320,980	1	$0	$0	1,178	$32,088,245	$65,095,801
Spring Lake	6	$57,794	$74,135	2	$0	$0	0	$0	$0	8	$57,794	$74,135
Wallace	4	$1,891	$3,335	1	$0	$0	0	$0	$0	5	$1,891	$3,335

NECF 9 Damages 200-yr (0.5% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	454	$7,976,495	$10,140,137	79	$3,011,095	$15,949,754	6	$684,707	$15,102,268	539	$11,672,296	$41,192,159
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	155	$1,190,730	$1,498,559	17	$148,894	$1,137,816	0	$0	$0	172	$1,339,624	$2,636,375
Chatham County	1	$0	$0	1	$40,731	$113,428	5	$892,170	$938,406	7	$932,901	$1,051,834
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	71	$1,724,246	$2,115,603	11	$472,551	$2,696,378	0	$0	$0	82	$2,196,797	$4,811,981
Duplin County	535	$6,502,975	$8,513,616	130	$2,212,835	$6,702,166	2	$0	$0	667	$8,715,811	$15,215,782
Elizabethtown	10	$219,688	$326,639	15	$165,686	$1,008,201	4	$468,931	$3,829,608	29	$854,306	$5,164,448
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	14	$246,293	$340,304	19	$332,929	$4,100,874	5	$43,459	$54,957	38	$622,682	$4,496,135
Fort Bragg	1	$52,294	$60,082	0	$0	$0	0	$0	$0	1	$52,294	$60,082
Harnett County	58	$2,331,711	$3,082,768	7	$304,024	$1,386,996	1	$0	$0	66	$2,635,735	$4,469,764
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	13	$353,960	$431,788	4	$7,972	$39,350	0	$0	$0	17	$361,932	$471,138
Lillington	0	$0	$0	0	$0	$0	5	$175,510	$1,500,766	5	$175,510	$1,500,766
Moore County	82	$781,387	$1,160,212	2	$0	$0	0	$0	$0	84	$781,387	$1,160,212
New Hanover County	9	$38,734	$49,962	3	$166,722	$680,186	0	$0	$0	12	$205,456	$730,149
Pender County	1,280	$43,771,078	$54,756,821	185	$6,376,713	$54,109,732	1	$10,177	$2,401,408	1,466	$50,157,968	$111,267,961
Spring Lake	10	$117,711	$155,373	3	$25,773	$1,125,506	0	$0	$0	13	$143,484	$1,280,879
Wallace	11	$22,868	$28,346	1	$0	$0	0	$0	$0	12	$22,868	$28,346

NECF 9 Damages 500-yr (0.2% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	667	$14,690,691	$18,622,273	107	$5,290,844	$27,601,982	6	$1,264,143	$19,236,943	780	$21,245,678	$65,461,198
Brunswick County	1	$505	$653	0	$0	$0	0	$0	$0	1	$505	$653
Burgaw	182	$1,947,148	$2,521,223	20	$667,433	$1,968,665	0	$0	$0	202	$2,614,581	$4,489,888
Chatham County	2	$4,658	$8,055	1	$18,837	$79,937	5	$2,121,306	$2,181,344	8	$2,144,801	$2,269,337
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	188	$3,754,117	$4,739,246	26	$1,180,709	$5,321,841	0	$0	$0	214	$4,934,825	$10,061,087
Duplin County	740	$22,112,534	$28,016,946	203	$9,754,401	$49,855,365	7	$0	$0	950	$31,866,935	$77,872,311
Elizabethtown	12	$325,296	$453,368	23	$426,984	$2,112,171	4	$832,756	$4,746,280	39	$1,585,036	$7,311,819
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	35	$567,898	$789,994	38	$1,346,548	$8,589,405	9	$78,553	$93,528	82	$1,992,999	$9,472,927
Fort Bragg	2	$65,571	$75,095	0	$0	$0	0	$0	$0	2	$65,571	$75,095
Harnett County	79	$3,486,175	$4,527,324	11	$1,909,570	$4,044,280	1	$48,519	$59,151	91	$5,444,264	$8,630,755
Hoke County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Lee County	16	$621,910	$751,416	5	$43,397	$164,778	0	$0	$0	21	$665,308	$916,194
Lillington	1	$0	$0	0	$0	$0	6	$338,179	$2,066,343	7	$338,179	$2,066,343
Moore County	105	$1,238,193	$1,831,174	4	$45,118	$278,576	0	$0	$0	109	$1,283,311	$2,109,750
New Hanover County	12	$85,490	$103,634	3	$284,566	$875,272	0	$0	$0	15	$370,056	$978,905
Pender County	1,514	$71,090,565	$87,666,969	222	$17,399,513	$92,881,493	1	$138,387	$2,826,268	1,737	$88,628,465	$183,374,731
Spring Lake	24	$309,444	$411,897	3	$364,445	$2,446,430	0	$0	$0	27	$673,889	$2,858,327
Wallace	36	$212,336	$278,478	4	$6,723	$20,179	0	$0	$0	40	$219,060	$298,658

NECF 9 Damages 1000-yr (0.1% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	778	$22,464,615	$28,372,130	137	$7,870,122	$36,558,752	6	$1,542,791	$20,980,358	921	$31,877,528	$85,911,240
Brunswick County	1	$505	$855	0	$0	$0	0	$0	$0	1	$505	$855
Burgaw	204	$2,672,636	$3,440,345	23	$1,623,521	$5,018,718	0	$0	$0	227	$4,296,157	$8,459,064
Chatham County	3	$38,379	$44,909	1	$44,549	$119,268	5	$3,011,268	$3,083,465	9	$3,094,196	$3,247,642
Columbus County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Cumberland County	461	$7,517,682	$9,626,981	68	$2,727,637	$12,299,527	0	$0	$0	529	$10,245,319	$21,926,507
Duplin County	809	$45,739,296	$57,036,424	228	$30,227,957	$106,823,030	8	$226,236	$40,700,267	1,045	$76,193,489	$204,559,721
Elizabethtown	17	$455,886	$617,386	25	$1,007,267	$3,595,958	4	$973,662	$5,354,859	46	$2,436,814	$9,568,202
Erwin	2	$571	$1,180	0	$0	$0	0	$0	$0	2	$571	$1,180
Fayetteville	100	$1,793,552	$2,454,651	57	$2,016,634	$12,758,616	15	$1,682,710	$31,725,933	172	$5,492,896	$46,939,200
Fort Bragg	2	$83,081	$158,117	0	$0	$0	0	$0	$0	2	$83,081	$158,117
Harnett County	102	$4,709,207	$6,030,102	13	$2,571,453	$5,442,875	1	$154,800	$167,329	116	$7,435,460	$11,640,306
Hoke County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Lee County	17	$803,829	$962,807	5	$91,014	$249,972	0	$0	$0	22	$894,843	$1,212,779
Lillington	1	$0	$0	0	$0	$0	8	$359,186	$2,181,359	9	$359,186	$2,181,359
Moore County	117	$1,613,430	$2,321,894	4	$67,404	$354,231	0	$0	$0	121	$1,680,833	$2,676,125
New Hanover County	13	$142,507	$179,915	4	$345,964	$1,011,092	0	$0	$0	17	$488,471	$1,191,007
Pender County	1,645	$95,241,544	$116,602,978	233	$27,889,229	$130,442,392	1	$214,492	$3,175,291	1,879	$123,345,265	$250,220,661
Spring Lake	58	$2,257,335	$2,828,015	4	$774,853	$3,930,404	0	$0	$0	62	$3,032,189	$6,758,420
Wallace	78	$530,505	$755,906	9	$21,578	$60,353	0	$0	$0	87	$552,083	$816,260


Estimated Damages for Duplin County - NECF9
$50,000,000
$10,000,000
$5,000,000
$1,000,000
$500,000
$100,000
$50,000
$10,000
$5,000
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
NECF9


Estimated Damages for Town of Wallace - NECF9
$500,000
$100,000
$50,000
$10,000
$5,000
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
NECF9

NE Cape Fear Alt 10 Damages 5-yr (20% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	32	$133,562	$183,251	10	$130,210	$1,429,187	1	$0	$0	43	$263,772	$1,612,438
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	5	$1,740	$2,670	1	$0	$0	0	$0	$0	6	$1,740	$2,670
Chatham County	0	$0	$0	1	$0	$0	1	$0	$0	2	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	3	$2,719	$4,253	0	$0	$0	0	$0	$0	3	$2,719	$4,253
Duplin County	3	$4,868	$5,992	0	$0	$0	0	$0	$0	3	$4,868	$5,992
Elizabethtown	0	$0	$0	1	$10,875	$26,766	0	$0	$0	1	$10,875	$26,766
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	0	$0	$0	3	$17,421	$825,112	0	$0	$0	3	$17,421	$825,112
Fort Bragg	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Harnett County	1	$1,309	$2,845	0	$0	$0	0	$0	$0	1	$1,309	$2,845
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	2	$51,086	$58,881	0	$0	$0	0	$0	$0	2	$51,086	$58,881
Lillington	0	$0	$0	0	$0	$0	1	$0	$0	1	$0	$0
Moore County	12	$26,464	$35,865	0	$0	$0	0	$0	$0	12	$26,464	$35,865
New Hanover County	1	$790	$1,552	0	$0	$0	0	$0	$0	1	$790	$1,552
Pender County	261	$1,814,604	$2,350,238	25	$49,766	$396,653	0	$0	$0	286	$1,864,369	$2,746,891
Spring Lake	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

NE Cape Fear Alt 10 Damages 10-yr (10% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	58	$339,577	$453,829	13	$229,727	$1,833,541	1	$24,877	$3,307,356	72	$594,182	$5,594,725
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	16	$11,824	$16,959	3	$0	$0	0	$0	$0	19	$11,824	$16,959
Chatham County	0	$0	$0	1	$0	$0	1	$0	$0	2	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	8	$41,778	$62,352	1	$0	$0	0	$0	$0	9	$41,778	$62,352
Duplin County	11	$40,103	$53,768	4	$0	$0	0	$0	$0	15	$40,103	$53,768
Elizabethtown	0	$0	$0	1	$20,869	$43,216	3	$0	$0	4	$20,869	$43,216
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	0	$0	$0	3	$20,305	$917,044	0	$0	$0	3	$20,305	$917,044
Fort Bragg	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Harnett County	6	$8,348	$18,943	0	$0	$0	1	$0	$0	7	$8,348	$18,943
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	4	$92,679	$111,091	0	$0	$0	0	$0	$0	4	$92,679	$111,091
Lillington	0	$0	$0	0	$0	$0	1	$0	$0	1	$0	$0
Moore County	21	$72,454	$108,560	0	$0	$0	0	$0	$0	21	$72,454	$108,560
New Hanover County	1	$790	$1,556	0	$0	$0	0	$0	$0	1	$790	$1,556
Pender County	384	$4,566,564	$5,852,098	42	$159,318	$4,851,240	0	$0	$0	426	$4,725,882	$10,703,338
Spring Lake	1	$0	$0	1	$0	$0	0	$0	$0	2	$0	$0
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

NE Cape Fear Alt 10 Damages 25-yr (4% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	121	$1,064,007	$1,388,656	28	$505,449	$2,931,924	2	$100,046	$3,867,892	151	$1,669,502	$8,188,471
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	22	$17,317	$29,570	4	$0	$0	0	$0	$0	26	$17,317	$29,570
Chatham County	0	$0	$0	1	$0	$0	2	$0	$0	3	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	11	$224,801	$300,670	3	$0	$0	0	$0	$0	14	$224,801	$300,670
Duplin County	53	$269,319	$350,088	14	$14,200	$110,533	0	$0	$0	67	$283,519	$460,621
Elizabethtown	5	$31,591	$41,513	4	$34,413	$180,026	3	$68,197	$494,270	12	$134,201	$715,808
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	2	$924	$1,020	6	$23,751	$1,003,571	1	$0	$0	9	$24,676	$1,004,591
Fort Bragg	1	$3,394	$3,503	0	$0	$0	0	$0	$0	1	$3,394	$3,503
Harnett County	16	$174,601	$303,217	0	$0	$0	1	$0	$0	17	$174,601	$303,217
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	4	$136,469	$159,689	0	$0	$0	0	$0	$0	4	$136,469	$159,689
Lillington	0	$0	$0	0	$0	$0	2	$0	$0	2	$0	$0
Moore County	39	$179,023	$276,976	0	$0	$0	0	$0	$0	39	$179,023	$276,976
New Hanover County	1	$4,717	$5,657	1	$0	$0	0	$0	$0	2	$4,717	$5,657
Pender County	568	$10,346,766	$13,213,514	58	$632,223	$9,966,746	0	$0	$0	626	$10,978,989	$23,180,260
Spring Lake	1	$6,473	$9,142	1	$0	$0	0	$0	$0	2	$6,473	$9,142
Wallace	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0

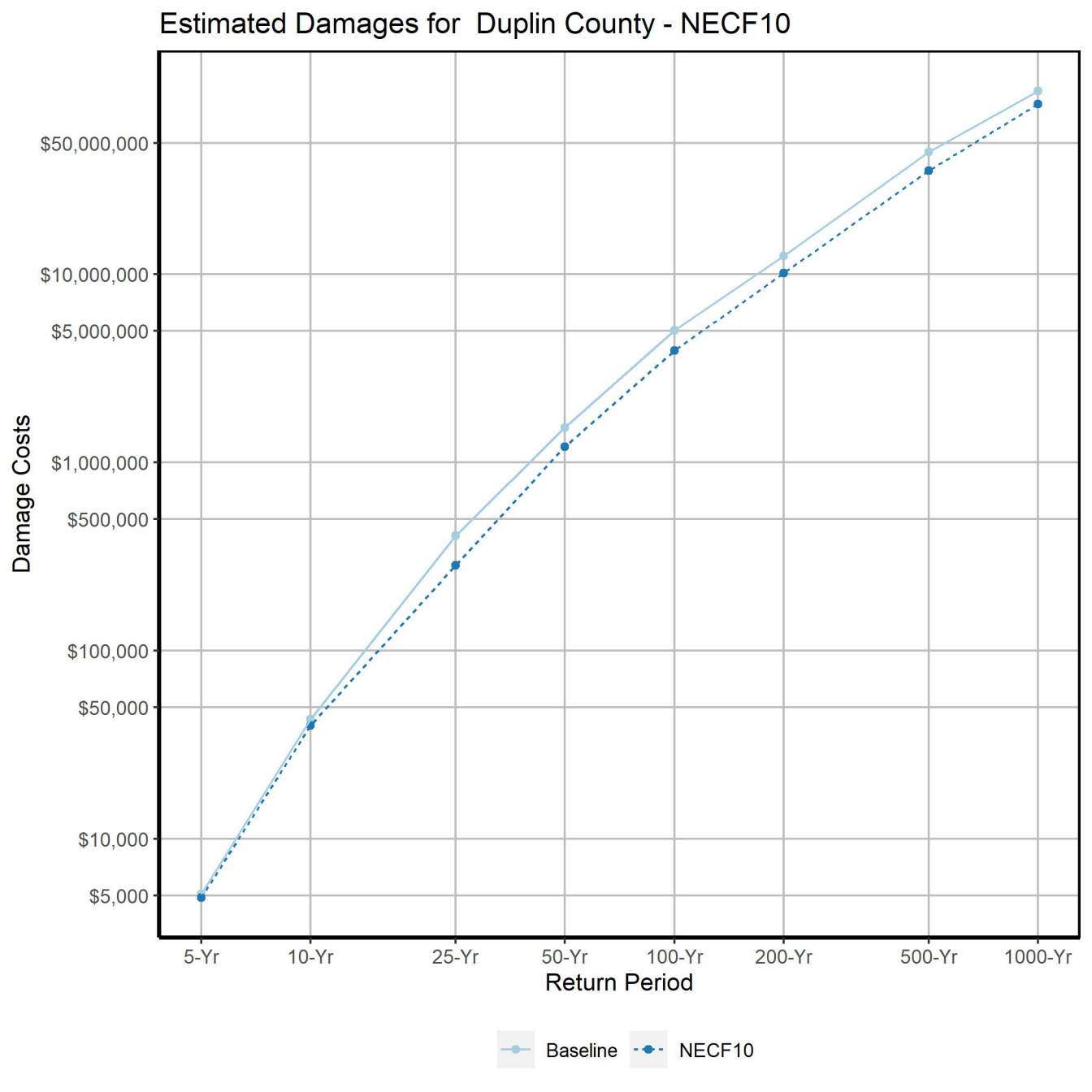
NE Cape Fear Alt 10 Damages 50-yr (2% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	208	$2,629,972	$3,338,511	44	$1,130,141	$8,434,131	3	$225,212	$12,248,931	255	$3,985,325	$24,021,574
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	37	$30,437	$50,631	5	$0	$0	0	$0	$0	42	$30,437	$50,631
Chatham County	0	$0	$0	1	$0	$0	3	$0	$0	4	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	20	$459,207	$579,947	5	$70,474	$620,733	0	$0	$0	25	$529,681	$1,200,681
Duplin County	125	$969,568	$1,241,488	35	$239,223	$744,722	0	$0	$0	160	$1,208,791	$1,986,210
Elizabethtown	6	$86,464	$161,734	7	$77,097	$288,006	4	$97,477	$605,375	17	$261,037	$1,055,114
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	3	$12,124	$13,308	7	$43,088	$1,526,707	1	$0	$0	11	$55,212	$1,540,015
Fort Bragg	1	$6,630	$7,313	0	$0	$0	0	$0	$0	1	$6,630	$7,313
Harnett County	24	$636,128	$855,685	0	$0	$0	1	$0	$0	25	$636,128	$855,685
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	10	$205,588	$254,195	1	$0	$0	0	$0	$0	11	$205,588	$254,195
Lillington	0	$0	$0	0	$0	$0	2	$3,256	$29,442	2	$3,256	$29,442
Moore County	54	$350,033	$540,519	0	$0	$0	0	$0	$0	54	$350,033	$540,519
New Hanover County	3	$11,034	$12,298	2	$3,931	$171,579	0	$0	$0	5	$14,966	$183,877
Pender County	796	$17,907,082	$22,658,958	89	$1,648,372	$18,780,887	1	$0	$0	886	$19,555,454	$41,439,844
Spring Lake	3	$10,576	$15,277	1	$0	$0	0	$0	$0	4	$10,576	$15,277
Wallace	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0

NE Cape Fear Alt 10 Damages 100-yr (1% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	355	$5,210,165	$6,624,506	56	$2,157,542	$12,715,748	4	$489,550	$13,822,568	415	$7,857,257	$33,162,821
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	57	$52,843	$85,781	5	$0	$0	0	$0	$0	62	$52,843	$85,781
Chatham County	0	$0	$0	1	$0	$0	5	$60,158	$78,417	6	$60,158	$78,417
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	45	$966,730	$1,189,429	9	$195,698	$1,555,848	0	$0	$0	54	$1,162,429	$2,745,277
Duplin County	331	$2,994,627	$3,871,875	80	$941,198	$2,971,427	1	$0	$0	412	$3,935,826	$6,843,302
Elizabethtown	7	$159,407	$256,159	12	$117,246	$445,448	4	$312,616	$1,771,501	23	$589,268	$2,473,109
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	5	$76,232	$89,358	12	$219,593	$2,736,642	3	$14,007	$18,383	20	$309,832	$2,844,383
Fort Bragg	1	$30,521	$36,383	0	$0	$0	0	$0	$0	1	$30,521	$36,383
Harnett County	40	$1,620,074	$2,170,385	5	$0	$0	1	$0	$0	46	$1,620,074	$2,170,385
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	12	$257,792	$317,569	1	$0	$0	0	$0	$0	13	$257,792	$317,569
Lillington	0	$0	$0	0	$0	$0	3	$7,403	$42,639	3	$7,403	$42,639
Moore County	65	$551,643	$843,460	0	$0	$0	0	$0	$0	65	$551,643	$843,460
New Hanover County	6	$21,610	$24,268	3	$54,962	$452,095	0	$0	$0	9	$76,573	$476,363
Pender County	1,041	$29,297,048	$36,795,819	137	$2,815,031	$28,342,718	1	$0	$0	1,179	$32,112,079	$65,138,537
Spring Lake	6	$57,794	$74,135	2	$0	$0	0	$0	$0	8	$57,794	$74,135
Wallace	6	$1,978	$3,685	1	$0	$0	0	$0	$0	7	$1,978	$3,685

NE Cape Fear Alt 10 Damages 200-yr (0.5% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	454	$7,976,495	$10,140,137	79	$3,011,095	$15,949,754	6	$684,707	$15,102,268	539	$11,672,296	$41,192,159
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	155	$1,190,730	$1,498,559	17	$148,894	$1,137,816	0	$0	$0	172	$1,339,624	$2,636,375
Chatham County	1	$0	$0	1	$40,731	$113,428	5	$892,170	$938,406	7	$932,901	$1,051,834
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	71	$1,724,246	$2,115,603	11	$472,551	$2,696,378	0	$0	$0	82	$2,196,797	$4,811,981
Duplin County	555	$7,368,280	$9,673,435	144	$2,793,930	$8,781,299	2	$0	$0	701	$10,162,210	$18,454,734
Elizabethtown	10	$219,688	$326,639	15	$165,686	$1,008,201	4	$468,931	$3,829,608	29	$854,306	$5,164,448
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	14	$246,293	$340,304	19	$332,929	$4,100,874	5	$43,459	$54,957	38	$622,682	$4,496,135
Fort Bragg	1	$52,294	$60,082	0	$0	$0	0	$0	$0	1	$52,294	$60,082
Harnett County	58	$2,331,711	$3,082,768	7	$304,024	$1,386,996	1	$0	$0	66	$2,635,735	$4,469,764
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	13	$353,960	$431,788	4	$7,972	$39,350	0	$0	$0	17	$361,932	$471,138
Lillington	0	$0	$0	0	$0	$0	5	$175,510	$1,500,766	5	$175,510	$1,500,766
Moore County	82	$781,387	$1,160,212	2	$0	$0	0	$0	$0	84	$781,387	$1,160,212
New Hanover County	9	$38,691	$49,912	3	$166,722	$680,186	0	$0	$0	12	$205,413	$730,098
Pender County	1,281	$43,782,637	$54,769,547	185	$6,380,530	$54,119,485	1	$10,177	$2,401,408	1,467	$50,173,343	$111,290,441
Spring Lake	10	$117,711	$155,373	3	$25,773	$1,125,506	0	$0	$0	13	$143,484	$1,280,879
Wallace	14	$33,456	$50,019	1	$0	$0	0	$0	$0	15	$33,456	$50,019

NE Cape Fear Alt 10 Damages 500-yr (0.2% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	667	$14,690,691	$18,622,273	107	$5,290,844	$27,601,982	6	$1,264,143	$19,236,943	780	$21,245,678	$65,461,198
Brunswick County	1	$505	$653	0	$0	$0	0	$0	$0	1	$505	$653
Burgaw	182	$1,947,148	$2,521,223	20	$667,433	$1,968,665	0	$0	$0	202	$2,614,581	$4,489,888
Chatham County	2	$4,658	$8,055	1	$18,837	$79,937	5	$2,121,306	$2,181,344	8	$2,144,801	$2,269,337
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	188	$3,754,117	$4,739,246	26	$1,180,709	$5,321,841	0	$0	$0	214	$4,934,825	$10,061,087
Duplin County	761	$23,925,894	$30,247,169	215	$11,759,500	$42,445,483	8	$0	$0	984	$35,685,394	$72,692,652
Elizabethtown	12	$325,296	$453,368	23	$426,984	$2,112,171	4	$832,756	$4,746,280	39	$1,585,036	$7,311,819
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	35	$567,898	$789,994	38	$1,346,548	$8,589,405	9	$78,553	$93,528	82	$1,992,999	$9,472,927
Fort Bragg	2	$65,571	$75,095	0	$0	$0	0	$0	$0	2	$65,571	$75,095
Harnett County	79	$3,486,175	$4,527,324	11	$1,909,570	$4,044,280	1	$48,519	$59,151	91	$5,444,264	$8,630,755
Hoke County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Lee County	16	$621,910	$751,416	5	$43,397	$164,778	0	$0	$0	21	$665,308	$916,194
Lillington	1	$0	$0	0	$0	$0	6	$338,179	$2,066,343	7	$338,179	$2,066,343
Moore County	105	$1,238,193	$1,831,174	4	$45,118	$278,576	0	$0	$0	109	$1,283,311	$2,109,750
New Hanover County	12	$85,470	$103,612	3	$284,566	$875,272	0	$0	$0	15	$370,036	$978,883
Pender County	1,517	$71,116,973	$87,697,216	222	$17,400,745	$92,888,325	1	$138,387	$2,826,268	1,740	$88,656,105	$183,411,809
Spring Lake	24	$309,444	$411,897	3	$364,445	$2,446,430	0	$0	$0	27	$673,889	$2,858,327
Wallace	43	$239,364	$315,050	5	$8,511	$22,605	0	$0	$0	48	$247,875	$337,656

NE Cape Fear Alt 10 Damages 1000-yr (0.1% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	778	$22,464,615	$28,372,130	137	$7,870,122	$36,558,752	6	$1,542,791	$20,980,358	921	$31,877,528	$85,911,240
Brunswick County	1	$505	$855	0	$0	$0	0	$0	$0	1	$505	$855
Burgaw	204	$2,672,636	$3,440,345	23	$1,623,521	$5,018,718	0	$0	$0	227	$4,296,157	$8,459,064
Chatham County	3	$38,379	$44,909	1	$44,549	$119,268	5	$3,011,268	$3,083,465	9	$3,094,196	$3,247,642
Columbus County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Cumberland County	461	$7,517,682	$9,626,981	68	$2,727,637	$12,299,527	0	$0	$0	529	$10,245,319	$21,926,507
Duplin County	828	$47,999,983	$59,962,891	233	$31,937,311	$112,558,051	9	$344,070	$51,415,597	1,070	$80,281,364	$223,936,539
Elizabethtown	17	$455,886	$617,386	25	$1,007,267	$3,595,958	4	$973,662	$5,354,859	46	$2,436,814	$9,568,202
Erwin	2	$571	$1,180	0	$0	$0	0	$0	$0	2	$571	$1,180
Fayetteville	100	$1,793,552	$2,454,651	57	$2,016,634	$12,758,616	15	$1,682,710	$31,725,933	172	$5,492,896	$46,939,200
Fort Bragg	2	$83,081	$158,117	0	$0	$0	0	$0	$0	2	$83,081	$158,117
Harnett County	102	$4,709,207	$6,030,102	13	$2,571,453	$5,442,875	1	$154,800	$167,329	116	$7,435,460	$11,640,306
Hoke County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Lee County	17	$803,829	$962,807	5	$91,014	$249,972	0	$0	$0	22	$894,843	$1,212,779
Lillington	1	$0	$0	0	$0	$0	8	$359,186	$2,181,359	9	$359,186	$2,181,359
Moore County	117	$1,613,430	$2,321,894	4	$67,404	$354,231	0	$0	$0	121	$1,680,833	$2,676,125
New Hanover County	13	$142,600	$180,017	4	$345,966	$1,011,096	0	$0	$0	17	$488,566	$1,191,113
Pender County	1,645	$95,297,581	$116,734,126	233	$27,947,352	$130,540,839	1	$214,492	$3,175,291	1,879	$123,459,425	$250,450,256
Spring Lake	58	$2,257,335	$2,828,015	4	$774,853	$3,930,404	0	$0	$0	62	$3,032,189	$6,758,420
Wallace	81	$621,184	$903,994	9	$24,946	$65,701	0	$0	$0	90	$646,131	$969,695


Estimated Damages for Duplin County - NECF10
$50,000,000
$10,000,000
$5,000,000
$1,000,000
$500,000
$100,000
$50,000
$10,000
$5,000
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
NECF10

NE Cape Fear Alt 11 Damages 5-yr (20% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	32	$133,562	$183,251	10	$130,210	$1,429,187	1	$0	$0	43	$263,772	$1,612,438
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	5	$1,740	$2,670	1	$0	$0	0	$0	$0	6	$1,740	$2,670
Chatham County	0	$0	$0	1	$0	$0	1	$0	$0	2	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	3	$2,719	$4,253	0	$0	$0	0	$0	$0	3	$2,719	$4,253
Duplin County	3	$5,057	$6,186	0	$0	$0	0	$0	$0	3	$5,057	$6,186
Elizabethtown	0	$0	$0	1	$10,875	$26,766	0	$0	$0	1	$10,875	$26,766
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	0	$0	$0	3	$17,421	$825,112	0	$0	$0	3	$17,421	$825,112
Fort Bragg	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Harnett County	1	$1,309	$2,845	0	$0	$0	0	$0	$0	1	$1,309	$2,845
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	2	$51,086	$58,881	0	$0	$0	0	$0	$0	2	$51,086	$58,881
Lillington	0	$0	$0	0	$0	$0	1	$0	$0	1	$0	$0
Moore County	12	$26,464	$35,865	0	$0	$0	0	$0	$0	12	$26,464	$35,865
New Hanover County	1	$790	$1,540	0	$0	$0	0	$0	$0	1	$790	$1,540
Pender County	261	$1,810,575	$2,345,987	25	$49,766	$396,653	0	$0	$0	286	$1,860,340	$2,742,641
Spring Lake	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

NE Cape Fear Alt 11 Damages 10-yr (10% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	58	$339,577	$453,829	13	$229,727	$1,833,541	1	$24,877	$3,307,356	72	$594,182	$5,594,725
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	16	$11,824	$16,959	3	$0	$0	0	$0	$0	19	$11,824	$16,959
Chatham County	0	$0	$0	1	$0	$0	1	$0	$0	2	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	8	$41,778	$62,352	1	$0	$0	0	$0	$0	9	$41,778	$62,352
Duplin County	14	$42,486	$57,742	5	$0	$0	0	$0	$0	19	$42,486	$57,742
Elizabethtown	0	$0	$0	1	$20,869	$43,216	3	$0	$0	4	$20,869	$43,216
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	0	$0	$0	3	$20,305	$917,044	0	$0	$0	3	$20,305	$917,044
Fort Bragg	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Harnett County	6	$8,348	$18,943	0	$0	$0	1	$0	$0	7	$8,348	$18,943
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	4	$92,679	$111,091	0	$0	$0	0	$0	$0	4	$92,679	$111,091
Lillington	0	$0	$0	0	$0	$0	1	$0	$0	1	$0	$0
Moore County	21	$72,454	$108,560	0	$0	$0	0	$0	$0	21	$72,454	$108,560
New Hanover County	1	$790	$1,545	0	$0	$0	0	$0	$0	1	$790	$1,545
Pender County	381	$4,557,675	$5,842,049	41	$159,318	$4,851,240	0	$0	$0	422	$4,716,993	$10,693,290
Spring Lake	1	$0	$0	1	$0	$0	0	$0	$0	2	$0	$0
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

NE Cape Fear Alt 11 Damages 25-yr (4% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	121	$1,064,007	$1,388,656	28	$505,449	$2,931,924	2	$100,046	$3,867,892	151	$1,669,502	$8,188,471
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	22	$17,317	$29,570	4	$0	$0	0	$0	$0	26	$17,317	$29,570
Chatham County	0	$0	$0	1	$0	$0	2	$0	$0	3	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	11	$224,801	$300,670	3	$0	$0	0	$0	$0	14	$224,801	$300,670
Duplin County	56	$317,794	$404,418	15	$19,443	$306,292	0	$0	$0	71	$337,237	$710,710
Elizabethtown	5	$31,591	$41,513	4	$34,413	$180,026	3	$68,197	$494,270	12	$134,201	$715,808
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	2	$924	$1,020	6	$23,751	$1,003,571	1	$0	$0	9	$24,676	$1,004,591
Fort Bragg	1	$3,394	$3,503	0	$0	$0	0	$0	$0	1	$3,394	$3,503
Harnett County	16	$174,601	$303,217	0	$0	$0	1	$0	$0	17	$174,601	$303,217
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	4	$136,469	$159,689	0	$0	$0	0	$0	$0	4	$136,469	$159,689
Lillington	0	$0	$0	0	$0	$0	2	$0	$0	2	$0	$0
Moore County	39	$179,023	$276,976	0	$0	$0	0	$0	$0	39	$179,023	$276,976
New Hanover County	1	$4,222	$5,141	1	$0	$0	0	$0	$0	2	$4,222	$5,141
Pender County	566	$10,311,732	$13,167,243	58	$600,336	$9,744,008	0	$0	$0	624	$10,912,068	$22,911,250
Spring Lake	1	$6,473	$9,142	1	$0	$0	0	$0	$0	2	$6,473	$9,142
Wallace	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0

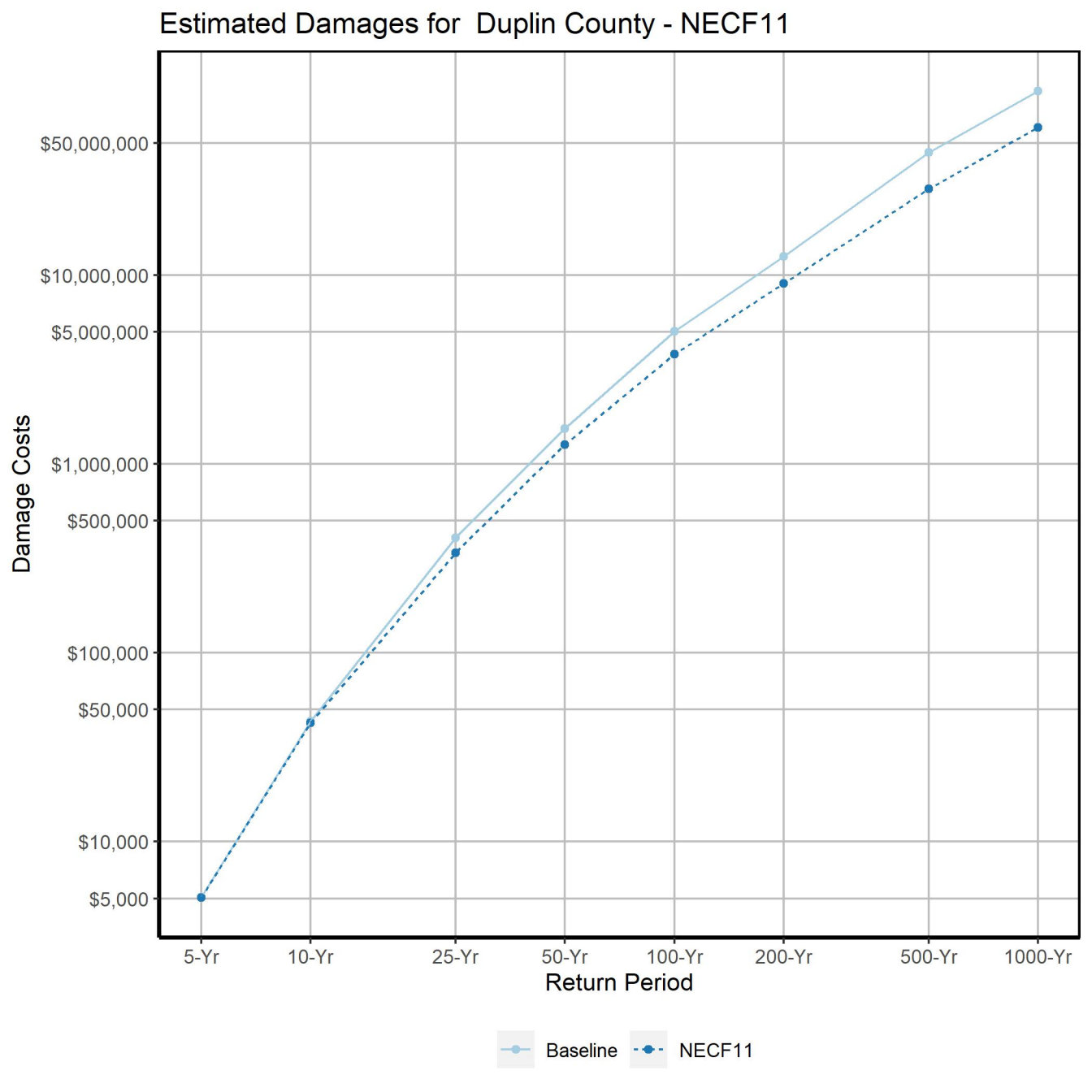
NE Cape Fear Alt 11 Damages 50-yr (2% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	208	$2,629,972	$3,338,511	44	$1,130,141	$8,434,131	3	$225,212	$12,248,931	255	$3,985,325	$24,021,574
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	37	$30,437	$50,631	5	$0	$0	0	$0	$0	42	$30,437	$50,631
Chatham County	0	$0	$0	1	$0	$0	3	$0	$0	4	$0	$0
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	20	$459,207	$579,947	5	$70,474	$620,733	0	$0	$0	25	$529,681	$1,200,681
Duplin County	129	$1,007,365	$1,287,738	36	$258,160	$798,350	0	$0	$0	165	$1,265,525	$2,086,088
Elizabethtown	6	$86,464	$161,734	7	$77,097	$288,006	4	$97,477	$605,375	17	$261,037	$1,055,114
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	3	$12,124	$13,308	7	$43,088	$1,526,707	1	$0	$0	11	$55,212	$1,540,015
Fort Bragg	1	$6,630	$7,313	0	$0	$0	0	$0	$0	1	$6,630	$7,313
Harnett County	24	$636,128	$855,685	0	$0	$0	1	$0	$0	25	$636,128	$855,685
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	10	$205,588	$254,195	1	$0	$0	0	$0	$0	11	$205,588	$254,195
Lillington	0	$0	$0	0	$0	$0	2	$3,256	$29,442	2	$3,256	$29,442
Moore County	54	$350,033	$540,519	0	$0	$0	0	$0	$0	54	$350,033	$540,519
New Hanover County	2	$8,712	$9,794	2	$3,931	$171,579	0	$0	$0	4	$12,643	$181,373
Pender County	795	$17,747,373	$22,482,735	88	$1,620,062	$13,617,296	1	$0	$0	884	$19,367,435	$36,100,030
Spring Lake	3	$10,576	$15,277	1	$0	$0	0	$0	$0	4	$10,576	$15,277
Wallace	1	$0	$0	0	$0	$0	0	$0	$0	1	$0	$0

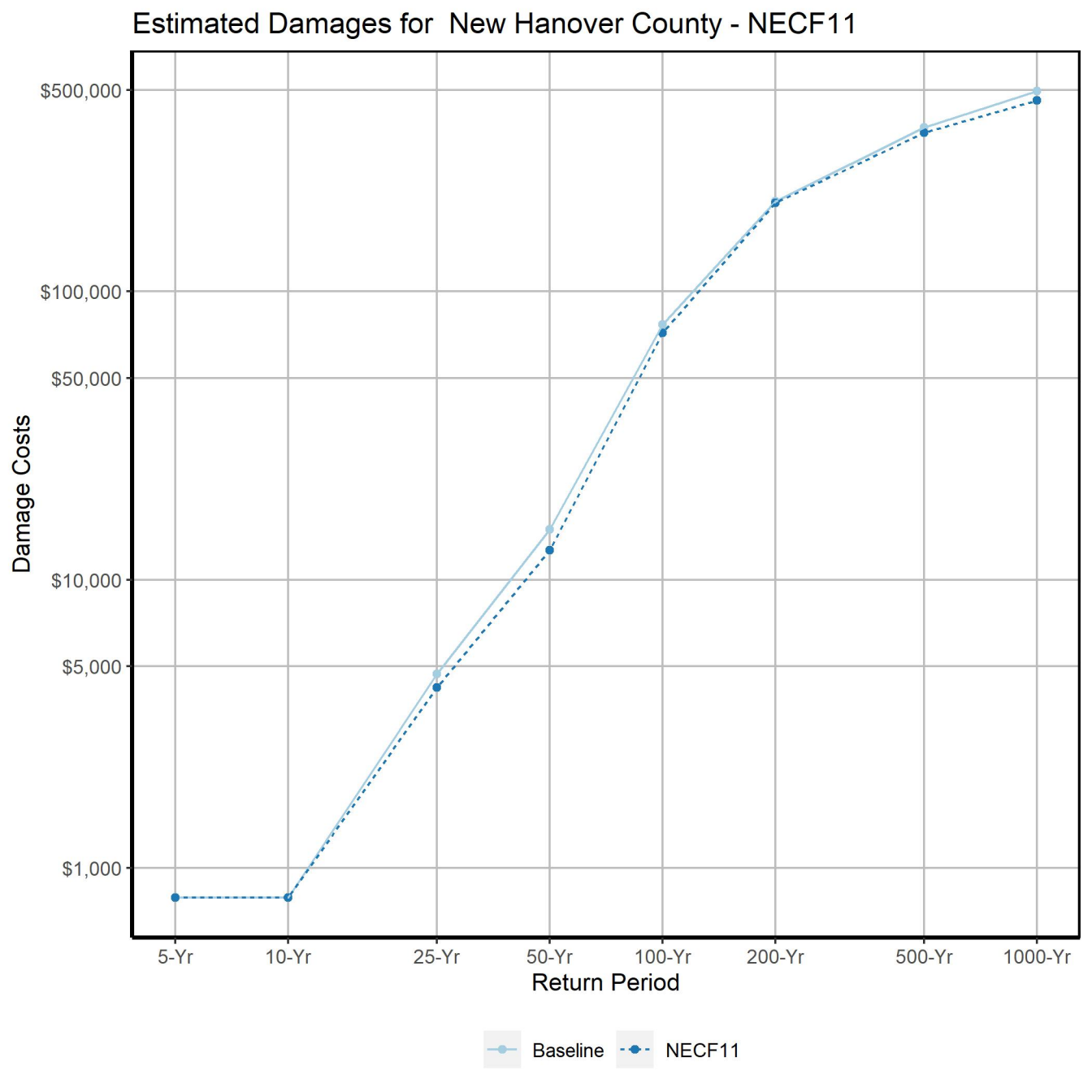
NE Cape Fear Alt 11 Damages 100-yr (1% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	355	$5,210,165	$6,624,506	56	$2,157,542	$12,715,748	4	$489,550	$13,822,568	415	$7,857,257	$33,162,821
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	57	$52,843	$85,781	5	$0	$0	0	$0	$0	62	$52,843	$85,781
Chatham County	0	$0	$0	1	$0	$0	5	$60,158	$78,417	6	$60,158	$78,417
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	45	$966,730	$1,189,429	9	$195,698	$1,555,848	0	$0	$0	54	$1,162,429	$2,745,277
Duplin County	324	$2,917,390	$3,777,593	74	$899,038	$2,902,887	1	$0	$0	399	$3,816,428	$6,680,480
Elizabethtown	7	$159,407	$256,159	12	$117,246	$445,448	4	$312,616	$1,771,501	23	$589,268	$2,473,109
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	5	$76,232	$89,358	12	$219,593	$2,736,642	3	$14,007	$18,383	20	$309,832	$2,844,383
Fort Bragg	1	$30,521	$36,383	0	$0	$0	0	$0	$0	1	$30,521	$36,383
Harnett County	40	$1,620,074	$2,170,385	5	$0	$0	1	$0	$0	46	$1,620,074	$2,170,385
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	12	$257,792	$317,569	1	$0	$0	0	$0	$0	13	$257,792	$317,569
Lillington	0	$0	$0	0	$0	$0	3	$7,403	$42,639	3	$7,403	$42,639
Moore County	65	$551,643	$843,460	0	$0	$0	0	$0	$0	65	$551,643	$843,460
New Hanover County	4	$16,874	$18,751	3	$54,962	$452,095	0	$0	$0	7	$71,836	$470,847
Pender County	1,041	$29,029,202	$36,476,237	136	$2,777,606	$28,186,261	1	$0	$0	1,178	$31,806,809	$64,662,498
Spring Lake	6	$57,794	$74,135	2	$0	$0	0	$0	$0	8	$57,794	$74,135
Wallace	2	$851	$1,213	0	$0	$0	0	$0	$0	2	$851	$1,213

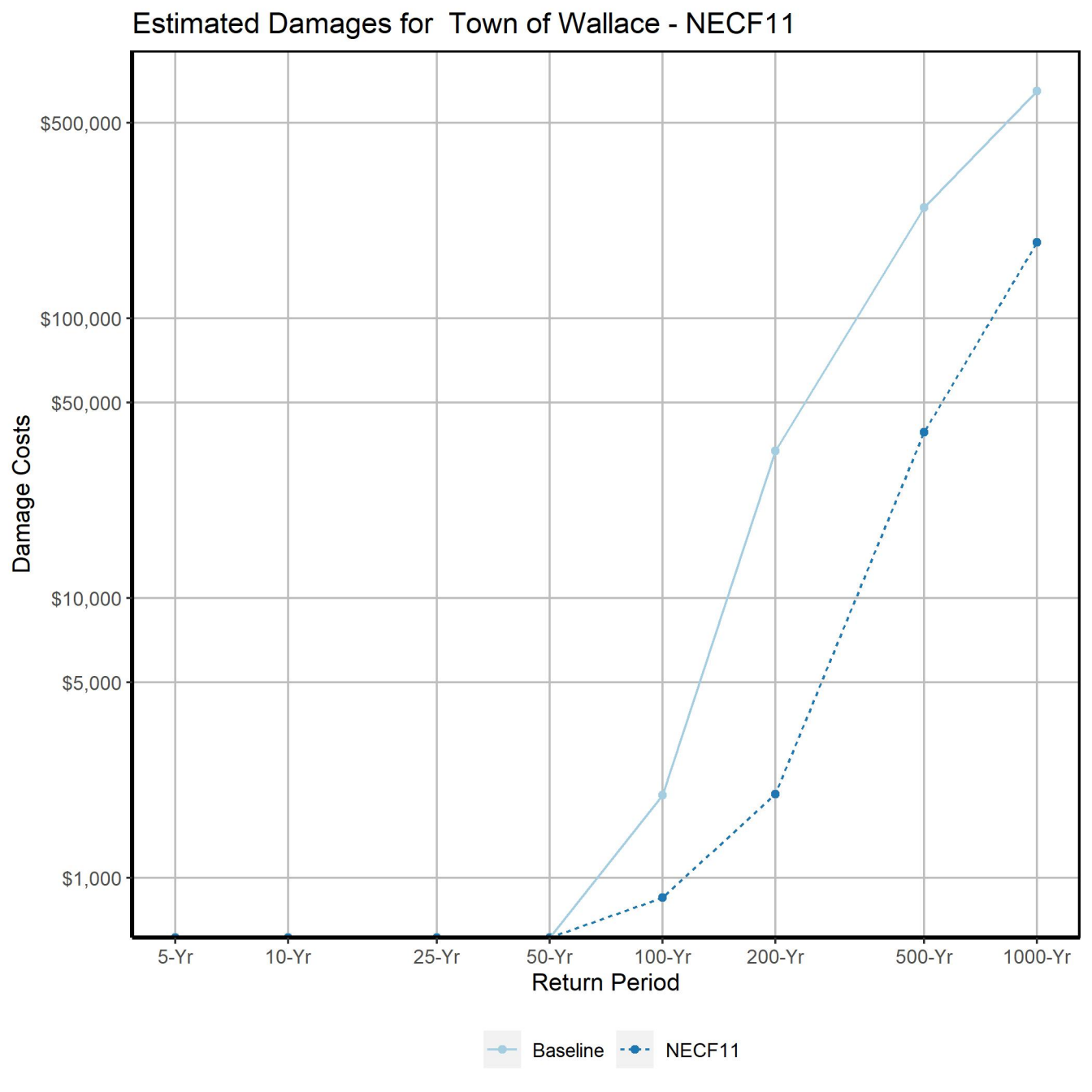
NE Cape Fear Alt 11 Damages 200-yr (0.5% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	454	$7,976,495	$10,140,137	79	$3,011,095	$15,949,754	6	$684,707	$15,102,268	539	$11,672,296	$41,192,159
Brunswick County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Burgaw	155	$1,190,730	$1,498,559	17	$148,894	$1,137,816	0	$0	$0	172	$1,339,624	$2,636,375
Chatham County	1	$0	$0	1	$40,731	$113,428	5	$892,170	$938,406	7	$932,901	$1,051,834
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	71	$1,724,246	$2,115,603	11	$472,551	$2,696,378	0	$0	$0	82	$2,196,797	$4,811,981
Duplin County	522	$6,519,644	$8,606,767	130	$2,521,504	$7,715,792	2	$0	$0	654	$9,041,147	$16,322,559
Elizabethtown	10	$219,688	$326,639	15	$165,686	$1,008,201	4	$468,931	$3,829,608	29	$854,306	$5,164,448
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	14	$246,293	$340,304	19	$332,929	$4,100,874	5	$43,459	$54,957	38	$622,682	$4,496,135
Fort Bragg	1	$52,294	$60,082	0	$0	$0	0	$0	$0	1	$52,294	$60,082
Harnett County	58	$2,331,711	$3,082,768	7	$304,024	$1,386,996	1	$0	$0	66	$2,635,735	$4,469,764
Hoke County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Lee County	13	$353,960	$431,788	4	$7,972	$39,350	0	$0	$0	17	$361,932	$471,138
Lillington	0	$0	$0	0	$0	$0	5	$175,510	$1,500,766	5	$175,510	$1,500,766
Moore County	82	$781,387	$1,160,212	2	$0	$0	0	$0	$0	84	$781,387	$1,160,212
New Hanover County	9	$35,687	$46,393	3	$166,722	$680,186	0	$0	$0	12	$202,409	$726,579
Pender County	1,278	$43,519,114	$54,453,130	183	$6,355,930	$53,974,563	1	$10,177	$2,401,408	1,462	$49,885,220	$110,829,102
Spring Lake	10	$117,711	$155,373	3	$25,773	$1,125,506	0	$0	$0	13	$143,484	$1,280,879
Wallace	6	$1,990	$3,736	1	$0	$0	0	$0	$0	7	$1,990	$3,736

NE Cape Fear Alt 11 Damages 500-yr (0.2% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	667	$14,690,691	$18,622,273	107	$5,290,844	$27,601,982	6	$1,264,143	$19,236,943	780	$21,245,678	$65,461,198
Brunswick County	1	$505	$653	0	$0	$0	0	$0	$0	1	$505	$653
Burgaw	182	$1,947,148	$2,521,223	20	$667,433	$1,968,665	0	$0	$0	202	$2,614,581	$4,489,888
Chatham County	2	$4,658	$8,055	1	$18,837	$79,937	5	$2,121,306	$2,181,344	8	$2,144,801	$2,269,337
Columbus County	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Cumberland County	188	$3,754,117	$4,739,246	26	$1,180,709	$5,321,841	0	$0	$0	214	$4,934,825	$10,061,087
Duplin County	735	$19,355,669	$24,711,942	207	$9,201,280	$34,294,412	8	$0	$0	950	$28,556,949	$59,006,354
Elizabethtown	12	$325,296	$453,368	23	$426,984	$2,112,171	4	$832,756	$4,746,280	39	$1,585,036	$7,311,819
Erwin	0	$0	$0	0	$0	$0	0	$0	$0	0	$0	$0
Fayetteville	35	$567,898	$789,994	38	$1,346,548	$8,589,405	9	$78,553	$93,528	82	$1,992,999	$9,472,927
Fort Bragg	2	$65,571	$75,095	0	$0	$0	0	$0	$0	2	$65,571	$75,095
Harnett County	79	$3,486,175	$4,527,324	11	$1,909,570	$4,044,280	1	$48,519	$59,151	91	$5,444,264	$8,630,755
Hoke County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Lee County	16	$621,910	$751,416	5	$43,397	$164,778	0	$0	$0	21	$665,308	$916,194
Lillington	1	$0	$0	0	$0	$0	6	$338,179	$2,066,343	7	$338,179	$2,066,343
Moore County	105	$1,238,193	$1,831,174	4	$45,118	$278,576	0	$0	$0	109	$1,283,311	$2,109,750
New Hanover County	12	$70,915	$87,901	3	$284,566	$875,272	0	$0	$0	15	$355,481	$963,173
Pender County	1,504	$70,842,827	$87,371,319	218	$17,386,999	$92,729,283	1	$138,387	$2,826,268	1,723	$88,368,214	$182,926,870
Spring Lake	24	$309,444	$411,897	3	$364,445	$2,446,430	0	$0	$0	27	$673,889	$2,858,327
Wallace	14	$39,187	$56,849	1	$0	$0	0	$0	$0	15	$39,187	$56,849

NE Cape Fear Alt 11 Damages 1000-yr (0.1% Annual Chance Event)												
Community	Residential			Non-Residential			Public			Total		
	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages	Buildings	Direct Damages	All Damages
Bladen County	778	$22,464,615	$28,372,130	137	$7,870,122	$36,558,752	6	$1,542,791	$20,980,358	921	$31,877,528	$85,911,240
Brunswick County	1	$505	$855	0	$0	$0	0	$0	$0	1	$505	$855
Burgaw	204	$2,672,636	$3,440,345	23	$1,623,521	$5,018,718	0	$0	$0	227	$4,296,157	$8,459,064
Chatham County	3	$38,379	$44,909	1	$44,549	$119,268	5	$3,011,268	$3,083,465	9	$3,094,196	$3,247,642
Columbus County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Cumberland County	461	$7,517,682	$9,626,981	68	$2,727,637	$12,299,527	0	$0	$0	529	$10,245,319	$21,926,507
Duplin County	816	$38,033,674	$47,790,657	228	$22,275,648	$88,517,574	8	$120,191	$20,871,404	1,052	$60,429,513	$157,179,634
Elizabethtown	17	$455,886	$617,386	25	$1,007,267	$3,595,958	4	$973,662	$5,354,859	46	$2,436,814	$9,568,202
Erwin	2	$571	$1,180	0	$0	$0	0	$0	$0	2	$571	$1,180
Fayetteville	100	$1,793,552	$2,454,651	57	$2,016,634	$12,758,616	15	$1,682,710	$31,725,933	172	$5,492,896	$46,939,200
Fort Bragg	2	$83,081	$158,117	0	$0	$0	0	$0	$0	2	$83,081	$158,117
Harnett County	102	$4,709,207	$6,030,102	13	$2,571,453	$5,442,875	1	$154,800	$167,329	116	$7,435,460	$11,640,306
Hoke County	0	$0	$0	1	$0	$0	0	$0	$0	1	$0	$0
Lee County	17	$803,829	$962,807	5	$91,014	$249,972	0	$0	$0	22	$894,843	$1,212,779
Lillington	1	$0	$0	0	$0	$0	8	$359,186	$2,181,359	9	$359,186	$2,181,359
Moore County	117	$1,613,430	$2,321,894	4	$67,404	$354,231	0	$0	$0	121	$1,680,833	$2,676,125
New Hanover County	12	$116,608	$141,958	4	$343,193	$995,681	0	$0	$0	16	$459,801	$1,137,639
Pender County	1,633	$94,845,749	$116,132,133	230	$27,682,525	$129,576,606	1	$214,492	$3,175,291	1,864	$122,742,766	$248,884,030
Spring Lake	58	$2,257,335	$2,828,015	4	$774,853	$3,930,404	0	$0	$0	62	$3,032,189	$6,758,420
Wallace	35	$182,041	$242,591	4	$5,290	$17,999	0	$0	$0	39	$187,332	$260,591


Estimated Damages for Duplin County - NECF11
Damage Costs
$50,000,000
$10,000,000
$5,000,000
$1,000,000
$500,000
$100,000
$50,000
$10,000
$5,000
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
NECF11


Estimated Damages for New Hanover County - NECF11
$500,000
$100,000
$50,000
$10,000
$5,000
$1,000
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
NECF11


Estimated Damages for Town of Wallace - NECF11
$500,000
$100,000
$50,000
$10,000
$5,000
$1,000
Damage Costs
5-Yr
10-Yr
25-Yr
50-Yr
100-Yr
200-Yr
500-Yr
1000-Yr
Return Period
Baseline
NECF11