

Exposure of Critical Facilities to Location-Specific Hazards

Critical Facility Name	Type	Address	Jurisdiction	100-year Flood	500-year Flood	Wildfire	Landslide	Hazmat
		SUITE 1270, POB 6001						
CHRISTIANACARE (WILMINGTON)	Hospital	501 WEST 14TH STREET, POB 1668	WILMINGTON	No	No	No	No	No
DELAWARE PSYCHIATRIC CENTER	Hospital	1901 NORTH DUPONT HWY	NEW CASTLE	No	No	No	No	No
ENCOMPASS HEALTH REHABILITATION HOSPITAL OF MIDDLETOWN	Hospital	250 EAST HAMPDEN RD	MIDDLETOWN	No	No	Yes	No	No
MEADOWWOOD BEHAVIORAL HEALTH SYSTEM	Hospital	575 SOUTH DUPONT HWY	NEW CASTLE	No	No	No	No	No
NEMOURS CHILDREN'S HOSPITAL DELAWARE	Hospital	1600 ROCKLAND RD	WILMINGTON	No	No	No	No	No
ROCKFORD CENTER	Hospital	100 ROCKFORD DR	NEWARK	No	No	No	No	No
SELECT SPECIALTY HOSPITAL OF WILMINGTON	Hospital	701 N CLAYTON ST, FIFTH FLOOR	WILMINGTON	No	No	No	No	No
ST FRANCIS HEALTHCARE	Hospital	701 N CLAYTON ST	WILMINGTON	No	No	No	No	No
WILMINGTON VA MEDICAL CENTER	Hospital	1601 KIRKWOOD HIGHWAY	WILMINGTON	No	No	No	No	No
AGT001 CENTERVILLE FUEL CELL	Power Plant	2850 CENTERVILLE ROAD	WILMINGTON	No	No	No	No	Yes
BROOKSIDE NEWARK	Power Plant	512 E. CHESTNUT HILL ROAD	NEWARK	No	No	No	No	No
CEDAR CREEK SOLAR	Power Plant	674 FLEMING LANDING ROAD (DE R	SMYRNA	No	No	No	No	No
CHRISTIANA	Power Plant	CHRISTIANA AVE & LOBDELL ST	WILMINGTON	Yes	Yes	No	No	No
CRODA ATLAS POINT CHP	Power Plant	315 CHERRY LANE	NEW CASTLE	No	No	No	No	Yes
DD HAY ROAD SOLAR 23 LLC	Power Plant	4503 HAY ROAD	NEW CASTLE	No	No	No	No	No

Exposure of Critical Facilities to Location-Specific Hazards

Critical Facility Name	Type	Address	Jurisdiction	100-year Flood	500-year Flood	Wildfire	Landslide	Hazmat
DELAWARE CITY 10	Power Plant	RT 9 & RIVER ROAD	DELAWARE CITY	No	No	No	No	No
DELAWARE CITY PLANT	Power Plant	2000 WRANGLE HILL ROAD	DELAWARE CITY	No	No	No	No	Yes
EDGE MOOR	Power Plant	200 HAY ROAD	WILMINGTON	Yes	Yes	No	No	Yes
HAY ROAD	Power Plant	198 HAY ROAD	WILMINGTON	No	Yes	No	No	No
RED LION ENERGY CENTER	Power Plant	1493 RIVER ROAD	NEW CASTLE	No	No	No	No	No
SOUTH CAMPUS SOLAR	Power Plant	880 POWDER MILL ROAD	WILMINGTON	No	No	No	No	No
WEST STATION (DE)	Power Plant	ROUTE 41	WILMINGTON	No	No	No	No	No
WHA SOUTHBRIDGE SOLAR PARK	Power Plant	900 SOUTH CLAYMONT ST	WILMINGTON	No	No	No	No	Yes
MOT WASTEWATER TREATMENT PLANT – NCC	WWTP	810 OLD CORBIT ROAD (COUNTY ROAD 424)	NEW CASTLE	Yes	Yes	Yes	No	No
ARDEN COURTS OF WILMINGTON	Nursing Home	700 1/2 FOULK RD.	WILMINGTON	No	No	No	No	No
BRACKENVILLE CENTER	Nursing Home	100 SAINT CLAIRE DR.	HOCKESSIN	No	No	No	No	No
BRANDYWINE NURSING AND REHABILITATION CENTER	Nursing Home	505 GREENBANK RD.	WILMINGTON	No	No	No	No	No
BROOKDALE HOCKESSIN	Nursing Home	6677 LANCASTER PIKE	HOCKESSIN	No	No	No	No	No
CADIA REHABILITATION BROADMEADOW	Nursing Home	500 SOUTH BROAD STREET	MIDDLETOWN	No	No	No	No	Yes
CADIA REHABILITATION PIKE CREEK	Nursing Home	3540 THREE LITTLE BAKERS BLVD.	WILMINGTON	No	No	No	No	No
CADIA REHABILITATION SILVERSIDE	Nursing Home	3322 SILVERSIDE ROAD	WILMINGTON	No	No	No	No	No
CHURCHMAN VILLAGE	Nursing Home	4949 OGLETOWN-STANTON RD.	NEWARK	No	No	Yes	No	No

Exposure of Critical Facilities to Location-Specific Hazards

Critical Facility Name	Type	Address	Jurisdiction	100-year Flood	500-year Flood	Wildfire	Landslide	Hazmat
EXCEPTIONAL CARE FOR CHILDREN	Nursing Home	11 INDEPENDENCE WAY	NEWARK	No	No	No	No	No
FIVE STAR FOULK MANOR NORTH LLC, ASSISTED LIVING	Nursing Home	1212 FOULK ROAD	WILMINGTON	No	No	No	No	No
FIVE STAR FOULK MANOR NORTH LLC, NURSING HOME	Nursing Home	1212 FOULK ROAD	WILMINGTON	No	No	No	No	No
FORWOOD MANOR ASSISTED LIVING	Nursing Home	1912 MARSH ROAD	WILMINGTON	No	No	No	No	No
FORWOOD MANOR NURSING HOME	Nursing Home	1912 MARSH ROAD	WILMINGTON	No	No	No	No	No
FOULK MANOR SOUTH ASSISTED LIVING	Nursing Home	407 FOULK ROAD	WILMINGTON	No	No	No	No	No
FOULK MANOR SOUTH NURSING HOME	Nursing Home	407 FOULK ROAD	WILMINGTON	No	No	No	No	No
GILPIN HALL NURSING HOME	Nursing Home	1101 GILPIN AVE.	WILMINGTON	No	No	No	No	No
GOVERNOR BACON HEALTH CENTER	Nursing Home	2546 COLTER ROAD	DELAWARE CITY	Yes	Yes	No	No	No
HARBOR CHASE OF WILMINGTON	Nursing Home	2004 SHIPLEY ROAD	WILMINGTON	No	No	Yes	No	No
HILLSIDE CENTER	Nursing Home	810 S. BROOM ST.	WILMINGTON	No	No	No	No	Yes
INGLESIDE ASSISTED LIVING, LLC	Nursing Home	1605 NORTH BROOM STREET	WILMINGTON	No	No	No	No	No
IVY GABLES LTD, LLC.	Nursing Home	2210 SWISS LANE	WILMINGTON	No	No	Yes	No	No
JEANNE JUGAN RESIDENCE NURSING HOME	Nursing Home	185 SALEM CHURCH RD.	NEWARK	No	No	No	No	No
KENTMERE REHABILITATION AND HEALTHCARE CENTER	Nursing Home	1900 LOVERING AVE.	WILMINGTON	No	No	No	No	Yes
KUTZ REHABILITATION AND NURSING	Nursing Home	704 RIVER ROAD	WILMINGTON	No	No	No	No	No
LODGE LANE ASSISTED LIVING	Nursing Home	1221 LODGE LANE	WILMINGTON	No	No	No	No	No

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Critical Facility Name	Type	Address	Jurisdiction	100-year Flood	500-year Flood	Wildfire	Landslide	Hazmat
LUTHER TOWERS I	Nursing Home	1201 NORTH HARRISON STREET	WILMINGTON	No	No	No	No	No
LUTHER TOWERS II	Nursing Home	1420 NORTH FRANKLIN STREET	WILMINGTON	No	No	No	No	No
MANORCARE HEALTH SERVICES - WILMINGTON	Nursing Home	700 FOULK ROAD	WILMINGTON	No	No	No	No	No
MEADOWCREST AT MIDDLETOWN SENIOR LIVING	Nursing Home	820 MIDDLETOWN ODESSA RD	MIDDLETOWN	No	No	Yes	No	No
MILLCROFT ASSISTED LIVING	Nursing Home	255 POSSUM PARK RD.	NEWARK	No	No	No	No	No
MILLCROFT NURSING HOME	Nursing Home	255 POSSUM PARK RD.	NEWARK	No	No	No	No	No
NEW CASTLE HEALTH AND REHABILITATION CENTER	Nursing Home	32 BUENA VISTA DR.	NEW CASTLE	No	No	No	No	No
NEWARK MANOR NURSING HOME	Nursing Home	254 W. MAIN ST.	NEWARK	No	No	No	No	No
OAKBRIDGE TERRACE AT COKESBURY VILLAGE	Nursing Home	726 LOVEVILLE ROAD	HOCKESSIN	No	No	No	Yes	No
OAKBRIDGE TERRACE AT COUNTRY HOUSE	Nursing Home	4830 KENNETT PIKE	WILMINGTON	No	No	No	No	No
PARAMOUNT SENIOR LIVING AT NEWARK	Nursing Home	200 E. VILLAGE ROAD	NEWARK	No	No	No	No	No
PARKVIEW NURSING & REHAB CENTER	Nursing Home	2801 W. 6TH ST.	WILMINGTON	No	No	No	No	No
PROMEDICA SKILLED NURSING AND REHABILITATION (PIKE CREEK)	Nursing Home	5651 LIMESTONE RD.	WILMINGTON	No	No	No	No	No
REGAL HEIGHTS HEALTHCARE & REHAB CENTER, LLC	Nursing Home	6525 LANCASTER PIKE	HOCKESSIN	No	No	No	No	No
REGENCY HEALTHCARE AND REHAB CENTER	Nursing Home	801 N. BROOM STREET	WILMINGTON	No	No	No	No	No

Exposure of Critical Facilities to Location-Specific Hazards

Critical Facility Name	Type	Address	Jurisdiction	100-year Flood	500-year Flood	Wildfire	Landslide	Hazmat
ROCKLAND PLACE	Nursing Home	1519 ROCKLAND ROAD	WILMINGTON	No	No	No	No	No
SERENITY GARDENS ASSISTED LIVING	Nursing Home	207 RUTH DRIVE	MIDDLETOWN	No	No	Yes	No	No
SHIPLEY MANOR ASSISTED LIVING	Nursing Home	2723 SHIPLEY ROAD	WILMINGTON	No	No	No	No	No
SHIPLEY MANOR HEALTH CARE NURSING HOME	Nursing Home	2723 SHIPLEY ROAD	WILMINGTON	No	No	No	No	No
SOMERFORD HOUSE	Nursing Home	501 SOUTH HARMONY ROAD	NEWARK	No	No	No	No	No
SOMERFORD PLACE	Nursing Home	4175 OGLETOWN-STANTON ROAD	NEWARK	No	No	No	No	No
STONEGATES	Nursing Home	4031 KENNETT PIKE	GREENVILLE	No	No	No	No	No
SUNRISE ASSISTED LIVING OF WILMINGTON	Nursing Home	2215 SHIPLEY ROAD	WILMINGTON	No	No	No	No	No
THE LORELTON	Nursing Home	2200 WEST 4TH ST.	WILMINGTON	No	No	No	No	No
THE MARY CAMPBELL CENTER	Nursing Home	4641 WELDIN RD.	WILMINGTON	No	No	No	No	No
THE SUMMIT ASSISTED LIVING	Nursing Home	5850 LIMESTONE ROAD	HOCKESSIN	No	No	Yes	No	No
THE VERO AT NEWARK ASSISTED LIVING	Nursing Home	924 BARKSDALE ROAD	NEWARK	No	No	No	No	No
WESTON SENIOR LIVING CENTER AT HIGHFIELD	Nursing Home	4800 LANCASTER PIKE	WILMINGTON	No	No	No	No	No
WILLOWBROOKE COURT AT COKESBURY VILLAGE	Nursing Home	726 LOVEVILLE ROAD	HOCKESSIN	No	No	No	No	No
WILLOWBROOKE COURT AT COUNTRY HOUSE	Nursing Home	4830 KENNETT PIKE	WILMINGTON	No	No	No	No	No
ACADEMY OF MASSAGE AND BODYWORK	College/University	1218 PULASKI HWY STE 324	BEAR	No	No	No	No	No

Exposure of Critical Facilities to Location-Specific Hazards

Critical Facility Name	Type	Address	Jurisdiction	100-year Flood	500-year Flood	Wildfire	Landslide	Hazmat
DAWN CAREER INSTITUTE LLC	College/University	252 CHAPMAN ROAD, SUITE 100	NEWARK	No	No	No	No	No
DELAWARE COLLEGE OF ART AND DESIGN	College/University	600 N MARKET ST	WILMINGTON	No	No	No	No	Yes
GOLDEY-BEACOM COLLEGE	College/University	4701 LIMESTONE RD	WILMINGTON	No	No	No	No	No
HAIR ACADEMY SCHOOL OF BARBERING & BEAUTY	College/University	160 PENCADER PLAZA	NEWARK	No	No	No	No	No
HARRIS SCHOOL OF BUSINESS- WILMINGTON CAMPUS	College/University	1413 FOULK ROAD, SUITE 100	WILMINGTON	No	No	No	No	No
PAUL MITCHELL THE SCHOOL-DELAWARE	College/University	1420 PULASKI HWY	NEWARK	No	No	No	No	No
SCHILLING-DOUGLAS SCHOOL OF HAIR DESIGN LLC	College/University	211 LOUVIERS DRIVE	NEWARK	No	No	No	No	Yes
STRAYER UNIVERSITY-DELAWARE	College/University	800 NORTH KING STREET SUITE 101	WILMINGTON	No	No	No	No	No
UNIVERSITY OF DELAWARE	College/University	104 HULLIHEN HALL	NEWARK	No	No	No	No	No
WILMINGTON UNIVERSITY	College/University	320 DUPONT HWY	NEW CASTLE	No	No	No	No	No
Leonard L Williams Justice Center	Courthouse	500 North King Street	Wilmington	No	No	No	No	No
Cellco Partnership	Cell Tower	(Blackbird site) 3931 DUPONT PARKWAY	TOWNSEND	No	No	No	No	No
Cellco Partnership	Cell Tower	159 BRICK STORE LANDING RD	SMYRNA	No	No	No	Yes	No
Cellco Partnership	Cell Tower	(Winterthur) 4825 Kennett Pike	WILMINGTON	No	No	No	No	No
Cellco Partnership	Cell Tower	Thompson Station Rd.	Newark	No	No	No	Yes	No
NEW CINGULAR WIRELESS PCS, LLC	Cell Tower	5013 Kennett Pike (61916)	Wilmington	No	No	No	No	No
NEW CINGULAR WIRELESS PCS, LLC	Cell Tower	573 BLACK STALLION ROAD (78787)	CLAYTON	No	No	No	No	No

Exposure of Critical Facilities to Location-Specific Hazards

Critical Facility Name	Type	Address	Jurisdiction	100-year Flood	500-year Flood	Wildfire	Landslide	Hazmat
NEW CINGULAR WIRELESS PCS, LLC	Cell Tower	4860 South Dupont Hwy (43802)	Townsend	No	No	No	No	No
NEW CINGULAR WIRELESS PCS, LLC	Cell Tower	1000 PENNSYLVANIA AVENUE (3329)	CLAYMONT	No	No	No	No	No
NEW CINGULAR WIRELESS PCS, LLC	Cell Tower	142 Owensby Drive (13588)	Wilmington	No	No	No	No	No
NEW CINGULAR WIRELESS PCS, LLC	Cell Tower	2318 Knowles & Dorset Roads (78952)	Wilmington	No	No	No	No	No

Locations of Critical Facilities in New Castle County are provided in Figure 4.1.

4.3 Hazard Profiles

4.3.1 Flooding

Flooding is the temporary condition of partial or complete inundation of normally dry land, and it is the most frequent and costly of all natural hazards in Delaware. A large amount of rainfall over a short time span, like a cloudburst, can result in flash flood conditions. Small amounts of rain can result in floods in locations where the soil is frozen or saturated from a previous wet period or if the rain is concentrated in an area of impermeable surfaces such as large parking lots, paved roadways, or other impervious developed areas (MRCC, 2022). Winter flooding can include ice jams, which occur when warm temperatures and heavy rain cause snow to melt rapidly.

Flooding occurs when stream capacities are exceeded due to large volumes of water from precipitation or from winter snow melt, which enters streams as surface run-off. Flooding can also occur from undersized culverts, bridges, or storm pipes that cannot accept the increased flow of water during storm events. This causes water to back up behind the structures and overtop the natural stream channel banks in what is referred to as the “backwater effect.” Another form of flooding, flash flooding, occurs during a short but intense rainfall event. Although the total amount of precipitation is often much less than the standard 24-hour design storm (1-year, 2-year, 5-year, 10-year, 25-year, 50-year, or 100-year) precipitation depths, the precipitation falls in a short period. This leads to intense surface runoff, and stream levels rise quickly in response to the runoff. The effects of flash flooding are exacerbated by increases in impervious surfaces from new developments.

Location and Extent

Flooding is the temporary condition of partial or complete inundation on normally dry land, and it is the most frequent and costly of all hazards in Delaware. Flooding events are generally the result of excessive precipitation. General flooding is typically experienced when precipitation occurs over a given river basin for an extended period. Flash flooding is usually a result of heavy localized precipitation falling in a short time period over a given location, often along mountain streams and in urban areas where much of the ground is covered by impervious surfaces. The severity of a flood event is dependent upon a combination of creek, stream, and river basin topography and physiography, hydrology, precipitation and weather patterns, present soil moisture conditions, the degree of vegetative clearing, as well as the presence of impervious surfaces in and around flood-prone areas.

Winter flooding can include ice jams, which occur when warm temperatures and heavy rain cause snow to melt rapidly. Snow melt combined with heavy rain can cause frozen rivers to swell, which breaks the ice layer on top of a river. The ice layer often then breaks into large chunks, which float downstream, piling up in narrow passages and near other obstructions such as bridges and dams. All forms of flooding can damage infrastructure.

Severe flooding is generally restricted to the 100-year floodplain boundary (2012 FEMA Digital Flood Insurance Rate Map (DFIRM)), which is identified on the Flood Hazard Map. Floodplains are lowlands adjacent to rivers, streams, and creeks that are subject to recurring floods. In assessing the potential spatial extent of flooding, it is important to know that a floodplain associated with a flood that has a

10% chance of occurring in a given year is smaller than the floodplain associated with a flood that has a 0.2% annual chance of occurring.

The National Flood Insurance Program (NFIP) publishes digital flood insurance rate maps (DFIRMs). These maps identify the 1% annual chance of flood area. Special flood hazard area (SFHA) and base flood elevations (BFE) are developed from the 1% annual chance flood event. The SFHA serves as the primary regulatory boundary used by FEMA, the State of Delaware, and New Castle County local governments. Federal floodplain management regulations and mandatory flood insurance purchase requirements apply to high-risk special flood hazard areas.

Figure 4.2 Special Flood Hazard Area

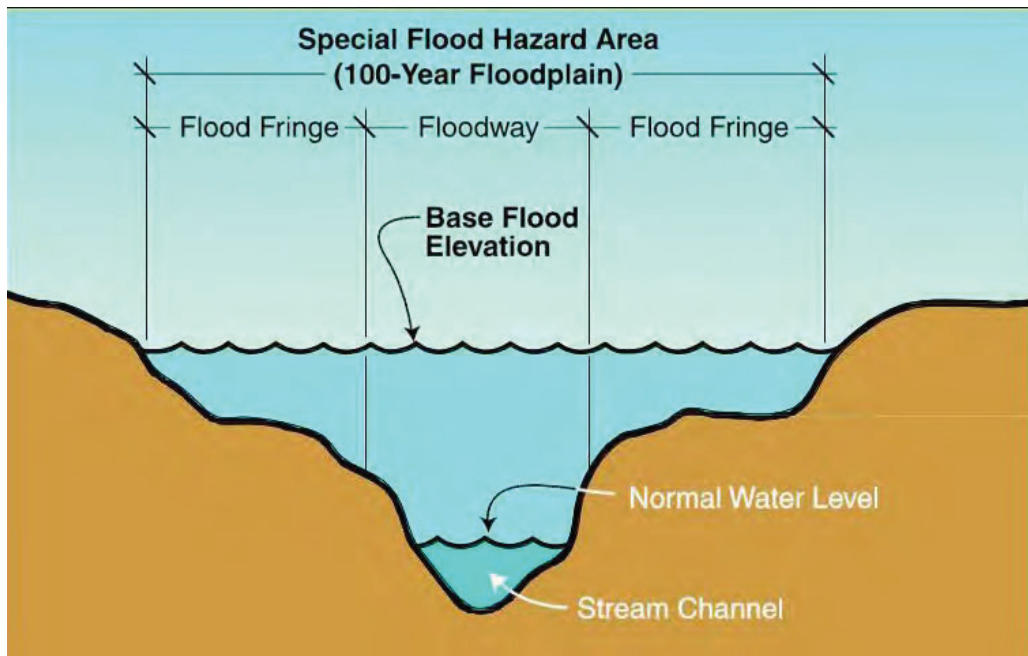


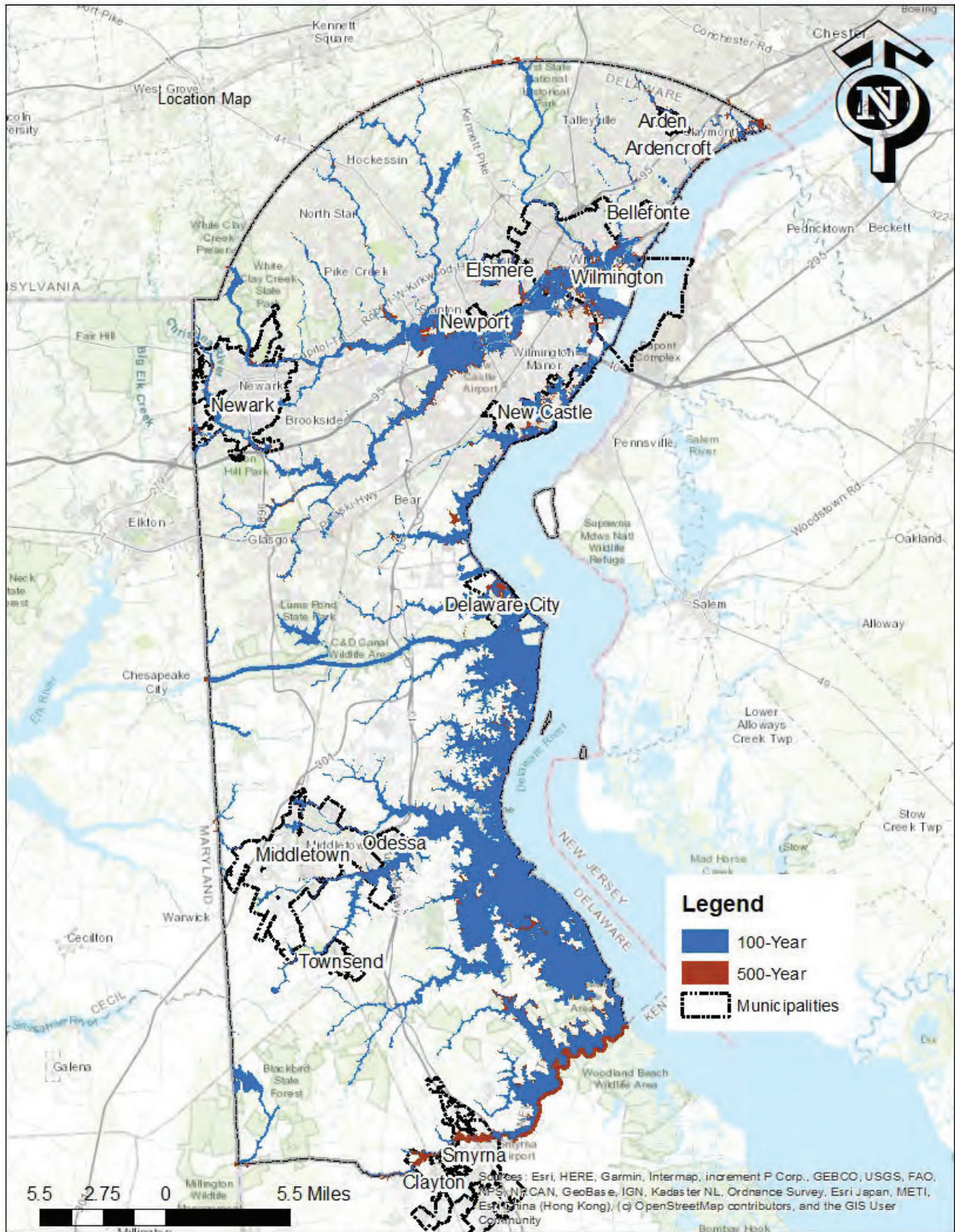
Table 4.3 Flood Hazard High Risk Zones

Flood Hazard High Risk Zones (FEMA, 2017)	
Zone	Description
A	Areas subject to inundation by the 1% annual chance flood event. Because detailed hydraulic analysis has not been performed, no base flood elevations or flood depths are shown
AE	Areas subject to inundation by the 1% annual chance flood event determined by detailed methods. BFEs are shown within these zones.
AH	Areas subject to inundation by the 1% annual chance shallow flooding (usually areas of ponding) where average depths are 1-3 feet. BFEs derived from detailed hydraulic analysis are shown in this zone.

Flood Hazard High Risk Zones <i>(FEMA, 2017)</i>	
Zone	Description
AO	Areas subject to inundation by the 1% annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are 1-3 feet. Average flood depths derived from detailed hydraulic analysis are shown within this zone.
AR	Areas that result from the decertification of a previously accredited flood protection system that is determined to be in the process of being restored to provide base flood protection.

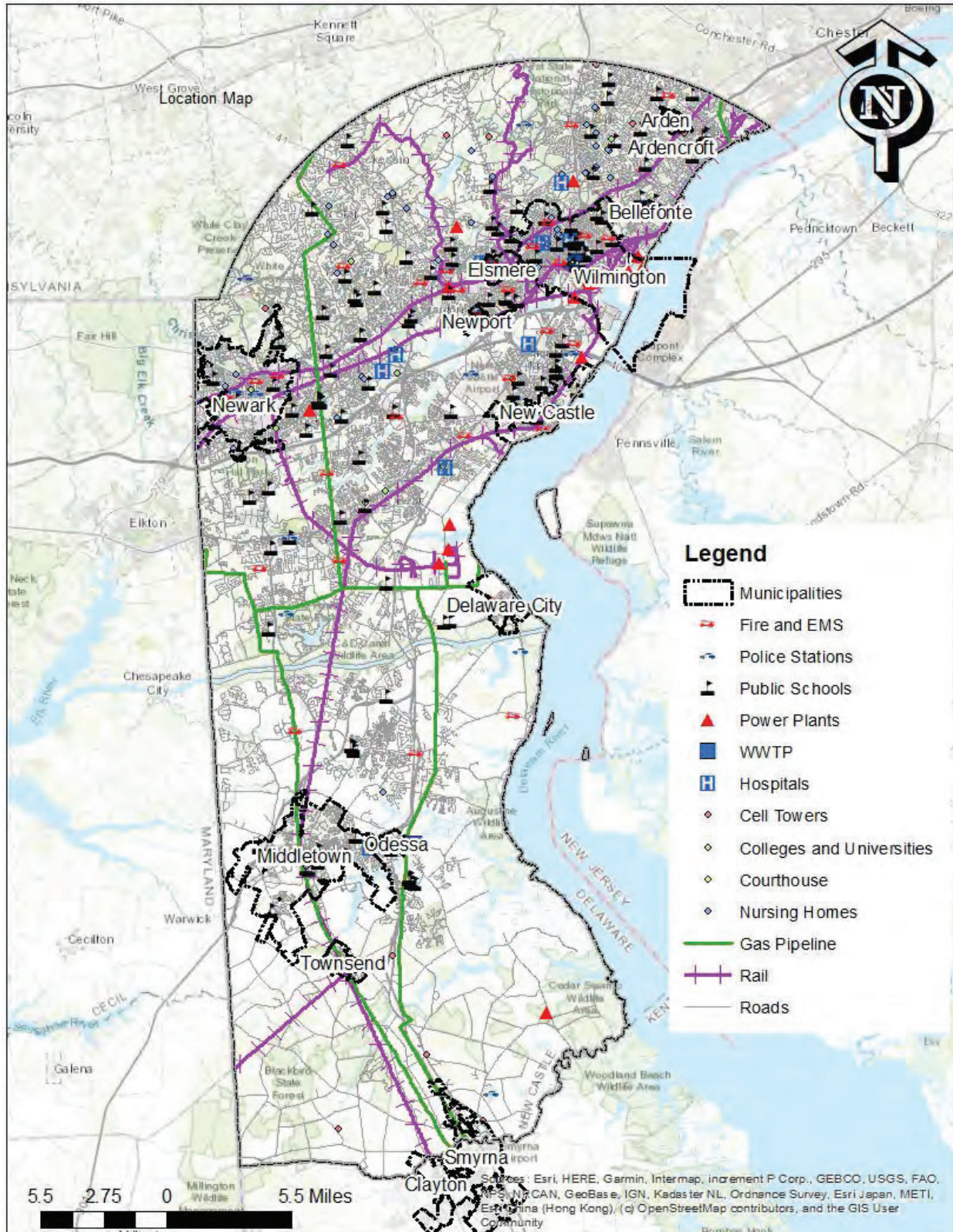
Flooding poses a threat to functional needs, facilities, agricultural areas, and those who reside or conduct business in the floodplain. The most significant hazard exists for facilities in the floodplain that process, use, and/or store hazardous materials. A flood could potentially release and transport hazardous materials out of these areas. As the water recedes, it would spread the hazardous materials throughout the area. Most flood damage to property and structures located in the floodplain is caused by water exposure to the interior, high-velocity water, and debris flow.

Figure 4.3 NCC Floodplains/Coastal Inundation Map



There are nine (9) critical facilities exposed and at risk to a 100-year flood event. These nine (9) facilities and their locations are shown in Figure 4.4.

Figure 4.4 Critical Facilities in 100-year Floodplain



Range of Magnitude

The Delaware River is the largest waterway that passes along the eastern shoreline of New Castle County. Other notable waterways include the Christina River and White Clay Creek, among others.

Several factors determine the severity of floods, including rainfall intensity and duration, topography, ground cover, tidal factors, and rate of snowmelt. Water runoff is greater in areas with steep slopes and little to no vegetative ground cover. Urbanization typically results in the replacement of vegetative ground cover with impermeable surfaces like asphalt and concrete, increasing the volume of surface runoff and stormwater, particularly in areas with poorly planned stormwater drainage systems. A large amount of rainfall over a short period can cause flash floods. Additionally, small amounts of rain can cause floods in locations where the soil is frozen, saturated from a previous wet period, or if the area is rife with impermeable surfaces such as large parking lots, paved roadways, and other developed areas. The county occasionally experiences intense rainfall from tropical storms in late summer and early fall, which can potentially cause flooding as well.

Although floods can cause deaths, injuries, and damage to property, they are naturally occurring events that benefit riparian systems, which have not been disrupted by human actions. Such benefits include groundwater recharge and the introduction of nutrient-rich sediments, which improve soil fertility. However, human development often disrupts natural riparian buffers by changing land use and land cover, and the introduction of chemical or biological contaminants that often accompany human presence can contaminate habitats after flood events.

Table 4.4 summarizes the range of magnitude for flood hazards.

Table 4.4 Flood Hazards Range of Magnitude

Severity	Causes	Frequency	Damage Extents
Minimum	Local Storms – Flash Floods	Annual	Minor road washouts; storm pipe failure
Moderate	Regional Storms – Heavy Rainfall	5 to 10 years	Bridge and culvert damage; some properties flooded
Maximum	Large Multi-Day Storms – Hurricanes	10 to 100 years	Major rivers and large streams experience overbank flooding; properties flooded; bridge and culvert failure

Past Occurrence

According to the NCEI Storm Events Database, there have only been 191 recorded flood or flash flood events in New Castle County, resulting in 4 deaths, 6 injuries, and causing over \$28 million in property damage. Those incidents which resulted in damage to life and/or property have been listed in the table below.

Table 4.5 Past Flood Occurrences²⁹

LOCATION	DATE	TYPE	DEATHS	INJURIES	Prop. Damage	Crop Damage
North Portion	01/18/1999	Flash Flood	0	1	0.00k	0.00k
Countywide	09/16/1999	Flash Flood	2	1	8.000M	0.00k

²⁹ [Storm Events Database - Search Results | National Centers for Environmental Information \(noaa.gov\)](#)

North Portion	09/15/2003	Flash Flood	0	1	16.100M	0.00k
Countywide	07/12/2004	Flash Flood	0	1	0.00k	0.00k
Coochs Bridge	12/09/2009	Flood	0	1	0.00k	0.00k
Duross Heights	07/13/2010	Flash Flood	0	0	5.00k	0.00k
Holly Oak	07/14/2010	Flash Flood	0	1	50.00k	0.00k
Milford Crossroads	10/01/2010	Flood	0	0	600.00k	0.00k
Milford Crossroads	08/27/2011	Flash Flood	2	0	0.00k	0.00k
Coochs Bridge	09/01/2021	Flash Flood	0	0	3.600M	0.00k
Totals:			4	6	28.355M	0.00K

Future Occurrence

Based on historical occurrence, with 191 flood events occurring over 35 years, it is expected that five (5) flood events will take place within the County on an annual basis.

Flooding is a frequent problem throughout Delaware. New Castle County will certainly be impacted by flooding events in the future. New Castle County experiences some degree of flooding annually. The threat of flooding is compounded in the late winter and early spring months, as melting snow can overflow streams, creeks, and tributaries, increasing the amount of groundwater, clogging stormwater, culverts, and bridge openings. Properties along the banks of a waterway are the most vulnerable. The property within the floodplain is broken into sections depending on its distance from the waterway. The ten-year flood zone is the area that has a ten percent chance of being flooded every year. However, this label does not mean that this area cannot flood more than once every ten years. It just designates the probability of a flood of this magnitude every year. Further away from this area is the fifty-year flood plain. This area includes all of the ten-year floodplain plus additional property. The probability of a flood of this magnitude occurring during a one-year period is two percent. A summary of flood probability is shown in Table 4.6 - Flood Probability Summary.

Table 4.6 Flood Probability Summary

Flood Probability Summary (FEMA)	
Flood Recurrence Intervals	Annual Chance of Occurrence
10-year	10.00%
50-year	2.00%
100-year	1.00%
500-year	0.20%

The New Castle County Hazard Mitigation Team will continue to work with municipalities to identify vulnerable locations to all types of flooding and identify vulnerable special needs populations and functional needs facilities. This will be a continuous process during the 2025-2030 mitigation plan period. As new data is developed and new special needs facilities appear, the interface between flooding locations and the new data will be analyzed to identify new vulnerabilities.

Vulnerability Assessment

Inventory and summary of vulnerable assets

Table 4.7 identifies the Flood exposure by building count and by occupancy for each New Castle County jurisdiction. There is a total of 3,598 buildings exposed to a potential 100-year flood event.

Table 4.7 Flood Exposure by Building Count and Jurisdiction

Flood Exposure by Building Count										
Jurisdiction	Agriculture	Single-Family Home	Manufactured Housing	Multi-Family Home	Commercial	Industrial	Government	Education	Religious	TOTAL
Arden	0	0	0	0	0	0	0	0	0	0
Ardencroft	0	0	0	0	0	0	0	0	0	0
Ardentown	0	0	0	0	0	0	0	0	0	0
Bellefonte	0	0	0	0	0	0	0	0	0	0
Clayton	0	0	0	0	0	0	0	0	0	0
Delaware City	20	211	53	2	32	44	4	2	0	368
Elsmere	8	111	0	9	10	15	0	0	0	153
Middletown	0	8	0	0	0	0	0	0	0	8
New Castle	19	244	0	19	33	7	6	3	1	332
Newark	4	77	0	5	5	21	1	0	0	113
Newport	3	1	0	0	4	0	0	0	0	8
Odessa	3	1	0	0	0	0	0	0	0	4
Smyrna	0	0	2	0	0	0	0	0	0	2
Townsend	0	1	0	0	0	0	0	0	0	1
Wilmington	84	276	33	0	150	254	42	1	9	849
Unincorporated	161	1037	65	47	210	208	25	4	3	1760
TOTAL	302	1967	153	82	444	549	78	10	13	3,598

Table 4.8 identifies the Flood exposure by structure value and by occupancy for each New Castle County jurisdiction. Throughout New Castle County, the structure value exposed to a flood event is \$1,843,239,996.

Table 4.8 Flood Exposure by Jurisdiction and Building Type

Jurisdiction	Agriculture	Single-Family Home	Manufactured Housing	Multi-Family Home	Commercial	Industrial	Government	Education	Religious	TOTAL
Arden	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Ardencroft	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Ardentown	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Bellefonte	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Clayton	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Delaware City	\$3,374,520	\$35,982,304	\$3,528,899	\$7,517,727	\$10,317,164	\$24,677,193	\$4,798,234	\$575,253	\$0	\$90,771,294
Elsmere	\$351,029	\$14,328,751	\$0	\$15,038,004	\$7,287,588	\$6,909,623	\$0	\$0	\$0	\$43,914,995
Middletown	\$0	\$223,249	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$223,249
New Castle	\$7,484,632	\$43,604,977	\$0	\$45,487,492	\$18,979,677	\$9,728,360	\$1,497,244	\$13,746,312	\$387,142	\$140,915,836
Newark	\$585,954	\$14,356,413	\$0	\$29,402,250	\$14,369,023	\$24,855,792	\$50,970	\$0	\$0	\$83,620,401
Newport	\$2,017,561	\$58,149	\$0	\$0	\$2,219,494	\$0	\$0	\$0	\$0	\$4,295,204
Odessa	\$263,808	\$112,216	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$376,023
Smyrna	\$0	\$0	\$102,155	\$0	\$0	\$0	\$0	\$0	\$0	\$102,155
Townsend	\$0	\$108,771	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$108,771
Wilmington	\$95,097,357	\$36,864,495	\$0	\$100,474,517	\$181,651,030	\$415,772,537	\$39,205,937	\$1,348,913	\$13,665,226	\$884,080,012
Unincorporated	\$25,798,183	\$145,149,906	\$3,747,424	\$62,587,314	\$141,746,091	\$204,208,265	\$5,020,752	\$5,246,012	\$1,328,109	\$594,832,056
TOTAL	\$134,973,044	\$290,789,230	\$7,378,478	\$260,507,304	\$376,570,065	\$686,151,771	\$50,573,138	\$20,916,490	\$15,380,477	\$1,843,239,996

Estimation of Losses

Tables 4.9 through 4.14 show the estimated losses for a flood event in New Castle County, including building exposure and damage count, potential damage in a 100-year flood (by damage category), 100-year flood estimated property losses, and estimated business interruptions.

Table 4.9 Flood Estimated Building Exposure and Damage Count

100-year Estimated Building Exposure and Damage Count			
Study Area	Exposed Structures	At Least Moderate Damage	Buildings Destroyed
New Castle County	1,035	122	11

Table 4.10 Potential Damage in a 100-year Flood Event, by Damage Category

Potential Damage in a 100-Year Flood, by Damage Category	
Degree of Damage	100-Year Count
1-10%	709
11-20%	204
21-30%	56
31-40%	44
41-50%	11
Greater than 50%	11

Table 4.11 Estimated Property Losses

100-year Estimated Property Losses (in Millions of Dollars)							
Study Area	Residential Building Loss	Residential Content Loss	Commercial Building Loss	Commercial Content Loss	Total Building Loss	Total Content Loss	Estimated Total Loss
New Castle County	84.45	48.84	127.36	220.84	231.28	330.16	203.5

Table 4.12 100-Yr Estimated Business Interruption Losses

100-year Estimated Business Interruption Losses (in Millions of Dollars)					
Business Interruption	Residential	Commercial	Industrial	Others	Total
Income	5.74	1409.14	1.98	38.38	1455.24
Relocation	46.57	363.79	1.64	19.67	431.67
Rental Income	27.34	273.1	0.35	2.1	302.89
Wage	13.56	614.14	2.38	155.21	785.29
Total	93.21	2660.17	6.35	215.36	2975.09

Table 4.13 100-Yr Debris Estimates

100-Year Debris Estimates				
Study Area	Finish Debris (tons)	Structure Debris (tons)	Foundation Debris (tons)	Debris (Total Tons)
New Castle County	4,549	1,294	942	6,785

Table 4.14 100-Yr Social Impacts

100-Year Social Impacts		
Study Area	Displaced Population	Persons Seeking Public Shelter
New Castle County	9,834	2,382

NFIP-Insured Structures/RL/SRL Properties

A repetitive loss property is an NFIP-insured property that has had at least four paid flood losses of more than \$1,000 or has had two paid flood losses within 10 years that, in aggregate, equal or exceed the value of the property, or has had three or more paid losses that, in aggregate, equal or exceed the value of the property. Addressing repetitive loss properties through the implementation of specific mitigation projects represents one of the most effective ways to reduce future flood losses. A severe repetitive loss property is a property that has had at least four claim payments greater than \$5,000, or the cumulative amount of the four payments exceeds \$20,000 or has had two cumulative claim payments that exceed the value of the property.

A total of 148 repetitive loss and severe repetitive loss properties structures have been identified in New Castle County, according to FEMA’s Repetitive Loss Records. Table 4.15 presents a summary of these structures by building occupancy and by jurisdiction.

Table 4.15 Repetitive Loss and Severe Repetitive Loss Properties by Jurisdiction and Building Occupancy

Repetitive Loss Properties AND Severe Repetitive Loss	2-4 Family	Business-NonRes	Other-NonRes	Single Family	Total RL/SRL Properties	Total Claims	Total Paid
Arden	0	0	0	0	0	0	\$0.00
Ardencroft	0	0	0	0	0	0	\$0.00
Ardentown	0	0	0	0	0	0	\$0.00
Bellefonte	0	0	0	0	0	0	\$0.00
Delaware City	0	0	0	2	2	4	\$42,778.55
Elsmere	0	0	1	1	2	5	\$176,752.43
Middletown	0	0	0	9	9	26	\$265,411.05
New Castle	0	0	8	7	15	35	\$1,216,097.50
Newark	0	7	4	13	24	86	\$8,884,505.88

Repetitive Loss Properties AND Severe Repetitive Loss	2-4 Family	Business-NonRes	Other-NonRes	Single Family	Total RL/SRL Properties	Total Claims	Total Paid
Newport	0	0	0	0	0	0	\$0.00
Odessa	0	0	0	0	0	0	\$0.00
Townsend	0	0	0	1	1	2	\$91,934.19
Wilmington	1	4	26	39	70	210	\$7,306,419.16
New Castle County (Christiana)	1	2	0	3	6	42	\$1,058,051.24
New Castle County (Hockessin)	0	0	0	3	3	13	\$221,754.77
New Castle County (Marshallton)	1	0	3	0	4	11	\$2,741,983.89
New Castle County (Port Penn)	0	0	0	1	1	3	\$12,506.71
New Castle County (Stanton)	0	1	4	1	6	24	\$3,823,762.99
New Castle County (Yorklyn)	0	0	4	1	5	26	\$4,829,372.76
Total	3	14	50	81	148	487	\$30,671,331.12

Potential Impacts

Restrictions on future development in the floodplain will continue to be in place in New Castle County. Additionally, flood events may have a greater impact on vulnerable and underserved populations due to a lack of health and medical access to clean water following a flood event, and evacuation access. Flooding disproportionately impacts underserved communities, causing greater economic hardship, displacement, and health risks due to factors like inadequate housing, limited access to resources, and often being located in high-risk floodplains, stemming from historical discriminatory practices like redlining, leaving them more vulnerable to the damaging effects of floods compared to wealthier communities; this can further exacerbate existing inequalities and hinder their recovery process.

Severe flooding can cause injuries and deaths and can have long-term impacts on the health and safety of the citizens. Severe flooding can also result in significant property damage, potentially disrupting the regular function of functional needs facilities and having long-term negative impacts on local economies. Industrial, commercial, and public infrastructure facilities can become inundated with flood waters, threatening the continuity of government and business. The special needs population must be identified and located in flooding situations, as they are often homebound. Mobile homes are especially vulnerable to high water levels. Flooding can have significant environmental impacts when flood waters release and/or transport hazardous materials and can also result in the spread of diseases.

Severe flooding also comes with many secondary effects that could have long-lasting impacts on the population, economy, and infrastructure of New Castle County. Power failures are the most common secondary effect associated with flooding. Coupled with a shortage of critical services and supplies, power failures could cause a public health emergency. Critical infrastructure, such as sewage and water treatment facilities, can be severely damaged, having a significant effect on public health. High flood water can cause sewage systems to fail and overflow, contaminating groundwater

and drinking water. Flooding also has the potential to trigger other hazards, such as landslides, hazardous material spills, and dam failures.

The FEMA Community Lifelines most likely to be impacted include:

- Safety and Security
- Food, Water, Shelter
- Transportation
- Hazardous Materials

4.3.2 Winter Storms, Nor'easters, and Freezes

Winter storms are regional events and most often impact a large portion or all of Delaware. Winter storms consist of cold temperatures, heavy snow or ice, and sometimes strong winds. They begin as low-pressure systems that move through Delaware, usually following the jet stream (NOAA NSSL, 2022c). A winter storm can adversely affect roadways, utilities, business activities, and cause loss of life, frostbite, and freezing conditions. They can result in the closing of secondary roads, particularly in rural locations, loss of utility services, and depletion of oil heating supplies (FEMA, 2022d).

A winter storm is a storm in which the main types of precipitation are snow, sleet, or freezing rain. A winter storm can range from a moderate snowfall or ice event over a period of a few hours to blizzard conditions with wind-driven snow that last for several days. Most deaths from winter storms are not directly related to the storm itself, but result from traffic accidents on icy roads, medical emergencies while shoveling snow, or hypothermia from prolonged exposure to cold.

Winter weather poses threats to the safety of people and infrastructure in the following ways:

- Medical conditions such as frostbite, hypothermia, and serious injury or loss of life.
- Disruptions in electrical/utility systems, transportation systems, and business activities.
- Failure of power lines due to the weight or force of snow, wintry mix, etc., or indirectly because of the higher demand for electricity during these types of events.
- Prevention of the delivery of fuel sources such as oil and propane for heating purposes when roads close or become too dangerous to traverse.
- Increase in traffic accidents and blocking of evacuation routes.

Winter weather leaves the County vulnerable not only during the winter months, but also during the upcoming spring months. After a season of snow and ice, ice melt brings with it a flood threat.

Location and Extent

In New Castle County, the risk to people and property from winter storms cannot be distinguished by area, as the hazard is not spatially constrained and can occur anywhere within the County. Although different parts of the County may be impacted in different ways when a severe winter weather event strikes, generally, all people and assets are considered to have the same degree of exposure. Types of Winter Storms and Precipitation are shown in Table 4.16.

Table 4.16 Types of Winter Storms and Precipitation (NOAA NSSL, 2022f)

Type	Description
Blizzards	Storms consisting of snow, winds of at least 35mph, and visibility frequently reduced to less than a ¼ mile. These conditions must last for at least 3 hours
Ice Storms	Storms where at least ¼" of ice accumulates on exposed surfaces.

Type	Description
Lake Effect Storms	Storms that are created by cold, dry air moving through warm, moist air over lakes, adding moisture that is then deposited in the form of snow. They affect areas to the south and east of lakes.
Snow Squalls	Brief, intense snow events where strong and gusty winds can lead to large snow deposits and low visibility conditions.
Snow	Ice crystals that form in wintertime clouds that cling to each other as they fall forming snowflakes; they will remain in this form if the temperature from cloud to ground is at or below 0°C/32°F. Accumulation can range from none to significant. Wind conditions will impact visibility.
Sleet	Partially melted snowflakes that have passed through a small layer of warm air on their descent, only to refreeze as they approach the ground and from frozen rain drops.
Freezing Rain	Completely melted snowflakes that have passed through a large layer of warm air on their descent; they are then supercooled but not frozen by a small layer of cold air directly above the ground. The water drops will refreeze when contacting with anything that is 0°C/32°F or below, creating a layer of ice on exposed surfaces.

Range of Magnitude

Table 4.17 summarizes the range of magnitude for winter storms.

Table 4.17 Range of Magnitude - Winter Storms

Severity	Causes	Frequency	Damage Extents
Minimum	Light Snowfall	Annual	Minor traffic disruptions
Moderate	Heavy Snowfall; Freezing Rain	1 to 2 years	Road closures; some downed trees and power lines
Maximum	Excess Heavy Snowfall; Severe Icing	2 to 5 years	Substantial road closures; extensive power outages

Past Occurrence

According to the NCEI Storm Events Database, since 1996, there have been 169 recorded winter storms, blizzards, and/or winter weather events in New Castle County, resulting in 4 deaths and 46 injuries, and causing over \$5M in property damage. All events that caused damage or resulted in death or injury have been included in Table 4.18.

Table 4.18 Past Winter Storm Occurrences

Location	DATE	TYPE	DEATHS	INJURIES	Prop Damage	Crop Damage
NEW CASTLE (ZONE)	1/7/1996	Blizzard	0	0	\$1,000,000	\$0
NEW CASTLE (ZONE)	1/25/2000	Winter Storm	0	20	\$0	\$0
NEW CASTLE (ZONE)	2/16/2003	Winter Storm	0	0	\$1,300,000	\$0
NEW CASTLE (ZONE)	2/13/2007	Winter Storm	1	0	\$0	\$0
NEW CASTLE (ZONE)	2/25/2007	Winter Storm	2	0	\$0	\$0
NEW CASTLE (ZONE)	2/12/2008	Winter Weather	0	6	\$0	\$0
NEW CASTLE (ZONE)	1/18/2009	Winter Weather	0	10	\$0	\$0
NEW CASTLE (ZONE)	1/27/2009	Winter Storm	0	10	\$50,000	\$0
NEW CASTLE (ZONE)	2/9/2010	Winter Storm	1	0	\$3,000,000	\$0
Totals			4	46	\$5.350M	\$0

Future Occurrence

Based on New Castle County’s geography and location, winter storm occurrences are highly likely to occur annually. Although these will vary in intensity and type of winter storm, winter storms will continue to occur in New Castle County and all of Delaware. The frequency and intensity of winter storm events are expected to be impacted by climate change.

Vulnerability Assessment

Inventory and summary of vulnerable assets

All structures and critical facilities are considered to be vulnerable to winter storms. The DE 2023 State HMP identifies that the impact of severe winter weather can be catastrophic to both life and property.

Estimation of Losses

According to NCEI, the total estimated economic damage associated with the 169 winter storms/winter weather or freeze events in the period from 1996 to 2025 is over \$5M. According to the DE 2023 State HMP, between 2000 and 2022, there has been just over \$4M in property damage.

Potential Impacts

Winter storm events are not expected to impact future development in the County. Additionally, winter storms may have a greater impact on vulnerable and underserved populations due to a lack of access to transportation. Winter storms disproportionately affect underserved communities by exacerbating existing inequalities, making it harder for them to access essential services, increasing the risk of health complications due to cold exposure, causing significant financial strain due to potential power outages, transportation disruptions, and the added cost of heating their homes, often poorly insulated, during extreme cold weather. Winter storms can have different impacts on

different age groups, including direct impacts to the elderly, which must be accounted for in the County, especially in municipalities with the most elderly residents who may require more immediate assistance.

The FEMA Community Lifelines most likely to be impacted include:

- Safety and Security
- Food, Water, Shelter
- Energy
- Transportation

4.3.3 Hurricanes and Coastal Storms

Hurricanes, Coastal Storms, tropical storms, and nor'easters are classified as cyclones and are any closed circulation developing around a low-pressure center in which the winds rotate counterclockwise (in the Northern Hemisphere) and whose diameter averages 10-30 miles across. The Atlantic hurricane season runs from June 1 to November 30.

Tropical storm systems (i.e., hurricanes, tropical storms, tropical depressions) impacting Delaware develop in tropical or sub-tropical waters of the Atlantic Ocean, Gulf of Mexico, or Caribbean Sea (NOAA NOS, 2021). Nor'easters are extra-tropical storms that typically develop from low-pressure centers off the Atlantic Coast between Georgia and New Jersey during the winter months (NOAA NWS, n.d.b). Potential threats from these storms include powerful winds, heavy rainfall, storm surges, coastal and inland flooding, rip currents, tornadoes, and landslides.

Location and Extent

Owing to the county's proximity to the Atlantic and its shoreline along the Delaware Bay and River, New Castle County is highly susceptible to hurricane landfall and the storm surges associated with it. This can and has resulted in county-wide flooding and damage from high winds.

Range of Magnitude

Hurricanes are classified according to the Saffir-Simpson scale, ranging from Category 1 (weakest) to Category 5 (strongest). Table 4.19 provides a description of these categories.

Table 4.19 Saffir Simpson Hurricane Wind Scale³⁰

Category	Sustained Winds (mph)	Type of Damage Done
1	74-95	Well-constructed frame homes could have damage to the roof, shingles, vinyl siding and gutters. Large branches of trees will snap, and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96-110	Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3	111-129	Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.

³⁰ National Oceanic and Atmospheric Administration, National Weather Service, National Hurricane Center.

4	130-156	Well-built framed homes can sustain severe damage with the loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted, and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5	>157	A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

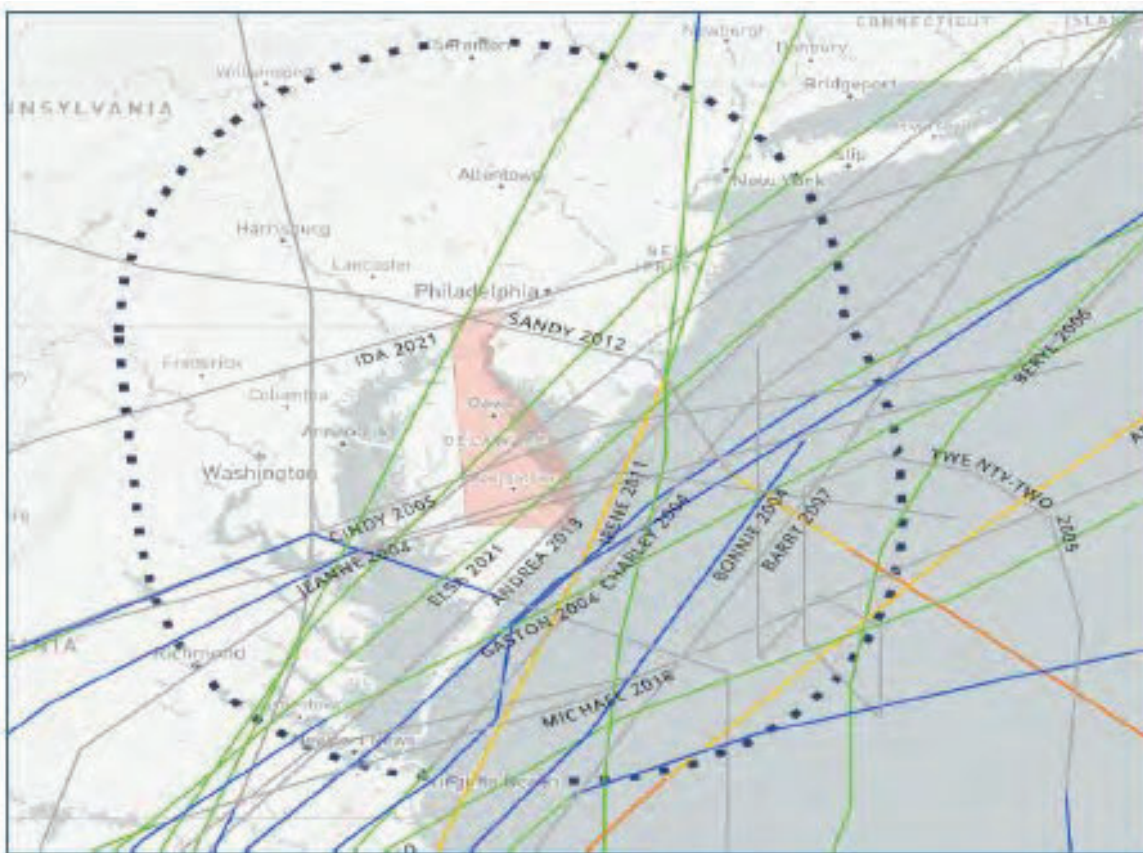
Past Occurrence

NCEI lists zero hurricane/tropical storm events to directly impact New Castle County from 1950 to 2023. However, the county has experienced the effects of as many as twenty-two hurricanes and at least one significant tropical storm since the 1920s. Those of most significant impact to New Castle County can be found in Table 4.20.

Table 4.20 Storm Impacts to Delaware and New Castle County

Storms to Impact Delaware and New Castle County	
1969	Hurricane Camille
1972	Hurricane Agnes
1996	Tropical Storm Bertha
1996	Hurricane Eduardo
1999	Hurricane Dennis
1999	Hurricane Floyd
2000	Hurricane Gordon (Remnants)
2001	Tropical Storm Allison (Remnants)
2003	Tropical Storm Henri (Remnants)
2003	Hurricane Isabel
2008	Tropical Storm Hanna
2011	Hurricane Irene
2012	Hurricane Sandy

Figure 4.5 Historical Hurricane Paths



Future Occurrence

In the future, it is likely that a hurricane will impact New Castle County in the future, causing flooding and damage due to wind. Climate change is likely to negatively impact the frequency and intensity of future hurricane/tropical storm events.

Vulnerability Assessment

Inventory and summary of vulnerable assets and Estimation of Losses

FEMA’s Hazus software version 6.0 was used to estimate the relative vulnerability to hurricanes across the state. The methodology uses Hazus default data on hurricane wind hazards and building stock, user-defined essential facilities data, and the software’s standard algorithms. Hazus was used to calculate two kinds of economic losses: 1) direct building losses, and 2) business interruption losses. Direct building losses consist of the damage to structures, contents, and inventory; while business interruption losses consist of the relocation expenses, employee wage loss, business income loss, and rental income loss that accrue during the time that businesses remain inoperable. Table 4.21 through Table 4.24 provide the results from the Hurricane/Tropical Storm risk and estimation of loss assessment.

Table 4.21 100-year Probabilistic Hurricane Event with 62mph peak gust wind speed

100-year Probabilistic Hurricane Event with 62mph peak gust wind speed		
Debris (total tons)	Eligible Tree Debris (tons)	Brick/Wood Debris (tons)

63,263	46,709	16,554
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Table 4.22 500-year Probabilistic Hurricane Event with 76mph peak gust wind speed

500-year Probabilistic Hurricane Event with 76mph peak gust wind speed		
Debris (total tons)	Eligible Tree Debris (tons)	Brick/Wood Debris (tons)
318,604	191,369	127,235

Table 4.23 1000-year Hurricane Building Damage County by General Occupancy

1000-year Hurricane Building Damage County by General Occupancy		
Occupancy	Minor Damage	Moderate Damage
Agriculture	45	21
Commercial	2,175	1,155
Education	60	38
Government	37	21
Industrial	493	297
Religion	124	44
Residential	42,533	8,885
Total Count	45,467	10,461

Table 4.24 Total Estimated Loss for 1000-year Hurricane (\$k)

Total Estimated Loss for 1000-year Hurricane (\$k)					
Loss Type	Residential	Commercial	Industrial	Others	Total
Property Damage	2,459,586.44	373,509.77	106,970.47	155,048.23	3,095,114.91
Business Interruption	200,968.44	124,700.38	9,616.79	68,997.08	404,282.69
Total	2,660,554.88	498,210.15	116,587.26	224,045.31	3,499,397.60

Potential Impacts

Hurricane/Tropical Storm events will likely have an impact on future development in the County, and it will continue to be recommended to have no new development in floodplain areas, and in areas with high levels of coastal erosion. Additionally, these events may have a greater impact on vulnerable and underserved populations due to a lesser ability to evacuate and/or have access to transportation and/or medical services. Hurricanes and tropical storms disproportionately affect underserved communities, particularly low-income and minority populations, due to factors like pre-existing economic inequalities, limited access to resources, poorer infrastructure in their neighborhoods, and evacuating difficulties, leaving them more vulnerable to the devastating impacts of a storm, including longer power outages, greater property damage, and slower recovery times compared to wealthier areas.

The FEMA Community Lifelines most likely to be impacted include:

- Safety and Security
- Food, Water, Shelter
- Transportation

4.3.4 Severe Thunderstorms and Tornadoes

A tornado is a narrow, violently rotating column of air that extends from the base of a thunderstorm to the ground. A tornado is a narrow, violently rotating column of air that extends from a thunderstorm to the ground (NOAA NSSL, 2022b). The impact of tornado or windstorm hazards is ultimately dependent on the population or amount of property (i.e., buildings, infrastructure, agricultural land, etc.) present in the area in which they occur. Tornado events are often so severe that property loss or human fatality is typically inevitable if evacuation or proper construction standards are not implemented.

About 1,250 tornadoes hit the U.S. each year. Damaging winds exceeding 50-60 miles per hour can occur during tornadoes, severe thunderstorms, winter storms, or coastal storms. These winds can have severe impacts on buildings, pulling off the roof covering, roof deck, or wall siding, and pushing or pulling off the windows.

Straight-line winds and windstorms are different from tornadoes in that they do not involve any rotation. They may accompany tornadoes and thunderstorms as straight-lined winds are caused by the movement of air from areas of higher pressure to areas of lower pressure (NOAA NSSL, 2022e). Stronger winds are the result of greater differences in pressure

Location and Extent

Tornado events are usually localized events. However, severe thunderstorms may result in conditions favorable to the formation of numerous or long-lived tornadoes. While tornadoes nationally can occur at any time during the day or night or any month of the year but are most frequent during late afternoon into early evening, the warmest hours of the day, and most likely to occur during the spring and early summer months of March through June (NOAA NSSL, 2022b), they are most frequent (and most violent) in May, June, and July for Delaware.

Wind events are typically experienced on a region-wide scale and can vary in spatial size from small microscale events to large-scale synoptic wind events often associated with warm or cold fronts (NOAA NSSL, 2022e).

Range of Magnitude

Tornadoes and “microbursts” can occur during thunderstorms and other weather systems where relatively high winds prevail. Tornadoes are classified according to the Enhanced Fujita (EF) scale, which is based on wind speed and degrees of damage applied to various structure types. There are six categories of tornadoes, with the weakest labeled as EF0 and the most intense, as EF5. Table 4.25 provides a description of each category.

Table 4.25 Enhanced Fujita Scale

Category	Wind Speed (mph)	Damage Level	Type of Damage Done
EF0	65-85	Light	Light Damage: Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.

Category	Wind Speed (mph)	Damage Level	Type of Damage Done
EF1	86-110	Moderate	Moderate Damage: Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111-135	Considerable	Considerable Damage: Roofs torn off well-constructed houses; mobile homes demolished; large trees snapped or uprooted; light object missiles generated; cars lifted off ground.
EF3	136-165	Severe	Severe Damage: Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF4	166-200	Devastating	Devastating Damage: Whole frame houses, well-constructed houses and whole frame houses completely leveled; cars thrown, and small missiles generated.
EF5	>200	Incredible	Incredible Damage: Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100m (109 yd.); high-rise buildings have significant structural deformation; incredible phenomena will occur.

Past Occurrence

According to the NCEI Storm Events Database, since 1950, there have been 466 recorded high wind, and/or thunderstorm wind events in New Castle County resulting in over \$12,719,000 in property damage. One death and nine injuries were reported as a result of these events. All events which resulted in death, injury, or damage can be found in Table 4.26. There have been two tornados reported since 1950. Both were an EF1 Tornado, and caused no damage. No deaths or injuries were reported as a result of the tornados.

Table 4.26 Past Thunderstorm/High Wind and Tornado Occurrences (1975-2023)³¹

Location	Date	Type	Magnitude	Deaths	Injuries	Prop Damage	Crop Damage
NEW CASTLE CO.	11/16/1989	Thunderstorm Wind	0 kts.	0	1	\$0	\$0
St. George	9/27/1993	Thunderstorm Wind	0 kts.	0	0	\$500	\$0
NEW CASTLE CO.	9/27/1993	Thunderstorm Wind	0 kts.	0	0	\$5,000	\$0
NEW CASTLE CO.	9/27/1993	Thunderstorm Wind	0 kts.	0	0	\$500	\$0
NEW CASTLE CO.	07/16/1995	Thunderstorm Wind	0 kts.	1	0	\$0	\$0
NEW CASTLE (ZONE)	9/18/2003	High Wind	50 kts.	0	0	\$9,500,000	\$0
NEW CASTLE (ZONE)	11/13/2003	High Wind	51 kts.	0	1	\$430,000	\$0

³¹ [Storm Events Database - Search Results | National Centers for Environmental Information \(noaa.gov\)](https://www.ncei.noaa.gov/stormevents/)

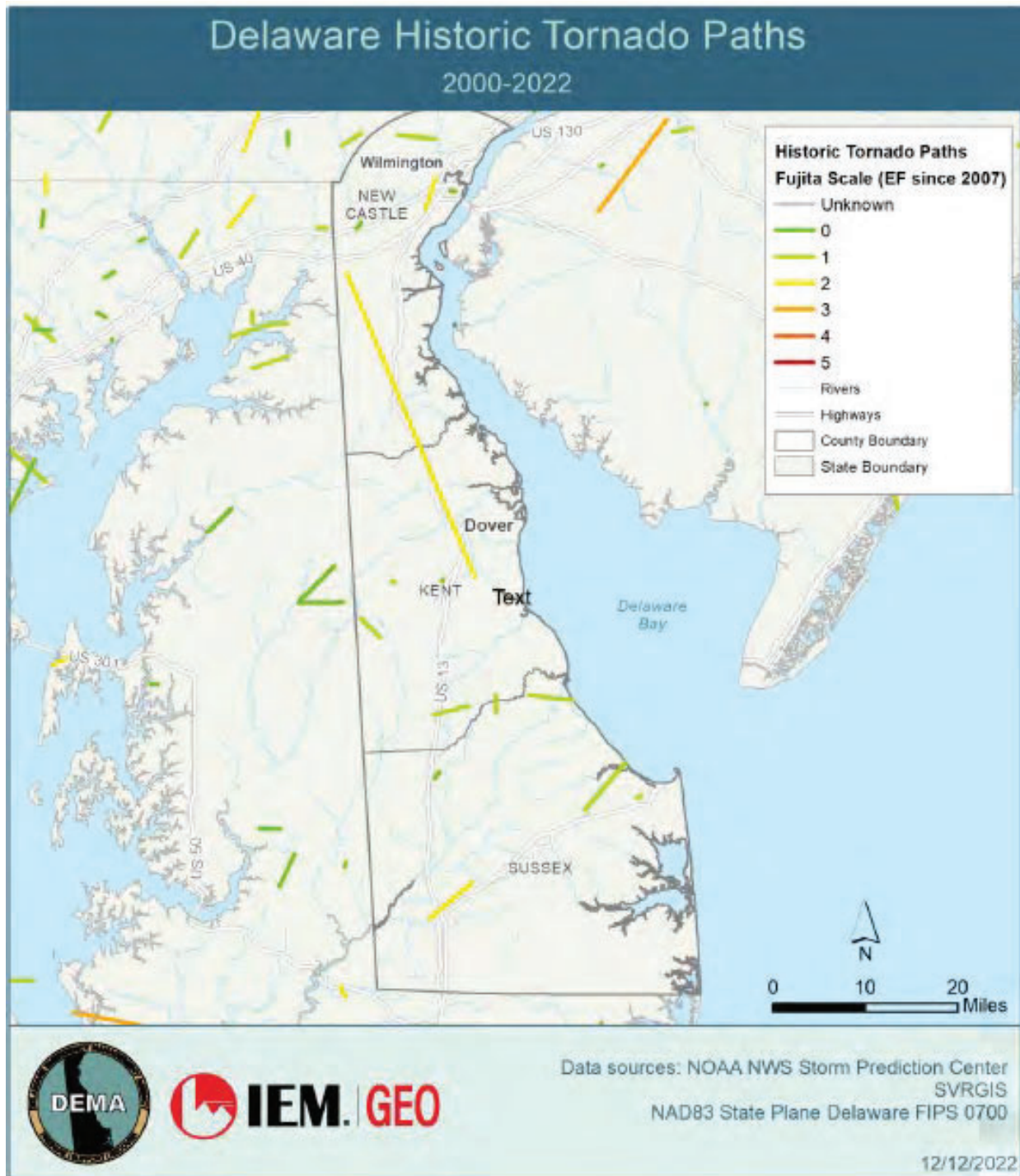
Location	Date	Type	Magnitude	Deaths	Injuries	Prop Damage	Crop Damage
MIDDLETOWN	6/14/2004	Thunderstorm Wind	50 kts.	0	0	\$75,000	\$0
NEW CASTLE (ZONE)	11/24/2005	High Wind	53 kts.	0	0	\$10,000	\$0
NEW CASTLE (ZONE)	1/14/2006	High Wind	54 kts.	0	0	\$5,000	\$0
GLASGOW	6/1/2006	Thunderstorm Wind	50 kts.	0	0	\$6,000	\$0
NEW CASTLE (ZONE)	4/16/2007	High Wind	52 kts.	0	0	\$5,000	\$0
KENTMERE	8/10/2008	Thunderstorm Wind	52 kts.	0	0	\$100,000	\$0
NEW CASTLE (ZONE)	12/31/2008	High Wind	51 kts.	0	0	\$10,000	\$0
NEW CASTLE (ZONE)	2/12/2009	High Wind	52 kts.	0	0	\$25,000	\$0
(ILG)WILMINGTON ARPT	6/2/2009	Thunderstorm Wind	66 kts.	0	0	\$250,000	\$0
NEWARK	8/9/2009	Thunderstorm Wind	56 kts.	0	0	\$500,000	\$0
HOCKESSIN	7/25/2010	Thunderstorm Wind	52 kts.	0	0	\$25,000	\$0
DUROSS HGTS	9/28/2010	Thunderstorm Wind	60 kts.	0	0	\$10,000	\$0
NEW CASTLE (ZONE)	12/27/2010	High Wind	54 kts.	0	0	\$25,000	\$0
NEW CASTLE (ZONE)	2/19/2011	High Wind	50 kts.	0	0	\$50,000	\$0
NEW CASTLE (ZONE)	2/25/2011	High Wind	50 kts.	0	0	\$125,000	\$0
HOCKESSIN	8/9/2011	Thunderstorm Wind	52 kts.	0	0	\$250,000	\$0
ELSMERE JCT	8/9/2011	Thunderstorm Wind	52 kts.	0	0	\$25,000	\$0
CHALFONTE	8/9/2011	Thunderstorm Wind	52 kts.	0	0	\$50,000	\$0
LANCASTER VLG	8/9/2011	Thunderstorm Wind	52 kts.	0	0	\$100,000	\$0
GLASGOW	6/22/2012	Thunderstorm Wind	54 kts.	0	0	\$100,000	\$0
NEWARK	6/29/2012	Thunderstorm Wind	65 kts.	0	0	\$100,000	\$0
TOWNSEND	7/18/2012	Thunderstorm Wind	52 kts.	0	0	\$1,000	\$0
LANCASTER VLG	7/28/2012	Thunderstorm Wind	56 kts.	0	0	\$10,000	\$0
NEW CASTLE (ZONE)	10/29/2012	High Wind	58 kts.	0	0	\$500,000	\$0
NEW CASTLE (ZONE)	12/21/2012	High Wind	52 kts.	0	0	\$10,000	\$0

Location	Date	Type	Magnitude	Deaths	Injuries	Prop Damage	Crop Damage
NEW CASTLE (ZONE)	3/6/2013	High Wind	56 kts.	0	0	\$30,000	\$0
HOCKESSIN	6/13/2013	Thunderstorm Wind	50 kts.	0	0	\$5,000	\$0
TALLEYVILLE	6/24/2013	Thunderstorm Wind	52 kts.	0	0	\$5,000	\$0
BRANDYWINE	6/24/2013	Thunderstorm Wind	52 kts.	0	0	\$50,000	\$0
WILMINGTON	6/24/2013	Thunderstorm Wind	50 kts.	0	0	\$25,000	\$0
NEWARK	8/13/2013	Thunderstorm Wind	65 kts.	0	0	\$25,000	\$0
ASHLAND	7/8/2014	Thunderstorm Wind	52 kts.	0	0	\$20,000	\$0
HARMONY HILLS	7/8/2014	Thunderstorm Wind	52 kts.	0	0	\$10,000	\$0
WINTERTHUR	7/8/2014	Thunderstorm Wind	52 kts.	0	0	\$20,000	\$0
AFTON	7/8/2014	Thunderstorm Wind	50 kts.	0	0	\$20,000	\$0
HAGLEY	7/8/2014	Thunderstorm Wind	52 kts.	0	0	\$20,000	\$0
NEW CASTLE (ZONE)	2/15/2015	High Wind	53 kts.	0	0	\$25,000	\$0
HARMONY	6/1/2015	Thunderstorm Wind	56 kts.	0	0	\$10,000	\$0
LANCASTER VLG	6/23/2015	Thunderstorm Wind	56 kts.	0	0	\$100,000	\$0
HOLLY OAK	6/23/2015	Thunderstorm Wind	52 kts.	0	0	\$30,000	\$0
MEADOWOOD	6/5/2016	Thunderstorm Wind	43 kts.	0	0	\$1,000	\$0
DUNLEITH	6/8/2016	Thunderstorm Wind	52 kts.	0	1	\$0	\$0
GREENVILLE	4/6/2017	Thunderstorm Wind	52 kts.	0	2	\$0	\$0
CLAYMONT	5/28/2019	Thunderstorm Wind	50 kts.	0	1	\$0	\$0
SILVERBROOK	6/26/2023	Thunderstorm Wind	50 kts.	0	0	\$20,000	\$0
HOCKESSIN	6/23/2024	Thunderstorm Wind	50 kts.	0	1	\$0	\$0
MONROE PARK	7/16/2024	Thunderstorm Wind	50 kts.	0	2	\$0	\$0
Totals				1	9	\$12,719,000	

Figure 4.6 Delaware High Wind Paths



Figure 4.7 Delaware Historic Tornado Paths



Future Occurrence

With 466 events occurring in a 75-year timeframe, it can be expected that high wind and/or thunderstorm wind events will affect New Castle County several times a year, similar to others, with tornadoes occurring infrequently. It is likely that climate change will continue to impact the frequency and intensity of winter storm events from year to year.

Vulnerability Assessment

Inventory and Summary of Vulnerable Assets

Wind impacts and associated damages from severe thunderstorms are generally greatest on utility transmission lines, specifically overhead electric power lines and communication lines, and older structures that were built before uniform code standards for wind loadings. Because it cannot be predicted where a tornado may touch down, all buildings and facilities are considered to be exposed to this hazard and could potentially be impacted. It is also not possible to estimate the number of residential, commercial, and other buildings or facilities that may experience losses.

Severe thunderstorms can also impact important county and local assets, such as damage or disruption to transportation and utility systems in New Castle County. Lightning and high winds associated with severe thunderstorms and tornadoes can knock out the electrical power grid in parts of the County, and in major events, throughout the entire county. This can result in loss of power for businesses and residences for potentially up to several days, depending on the severity of the event.

Estimation of Losses

Estimated losses due to severe thunderstorms and tornadoes will be explored further in the subsequent Plan Update.

Potential Impacts

Tornadoes and windstorms are not expected to impact future development in the County. Additionally, these hazard events may have a greater impact on vulnerable and underserved populations due to a lack of mitigation measures and access to financial resources following an event. Severe thunderstorms disproportionately impact underserved communities by exacerbating existing vulnerabilities due to factors like substandard housing, limited access to resources, and poorer infrastructure, leading to longer recovery times, increased health risks, and greater economic hardship after a storm hit compared to more affluent areas.

The most likely community lifelines to be impacted by a tornado or windstorm event include:

- Safety and Security
- Food, Water, Shelter
- Energy
- Hazardous Materials

4.3.5 Transportation Issues

Transportation accidents are technological hazards involving the nation's system of land, sea, and air transportation infrastructure. A flaw or breakdown in any component of this system can and often does result in a major disaster involving loss of life, injuries, property, environmental damage, and economic consequences.

Location and Extent

There are a number of major transportation arteries that run through New Castle County, including I-95, I-295, and I-495, US Routes 13, 40, 202, 301, and DE Routes 1, 2, 9, 141, 273, and 896. Additionally, several passenger and freight rail lines, including the Amtrak Northeast Corridor, which has stations in Wilmington and Newark, the SEPTA Regional Rail, and the Norfolk Southern and CSX

Transportation railways. In the air, the county is home to the Wilmington Airport, Summit Airport, and a number of smaller heliports and private airstrips. On the water, the Port of Wilmington is a major transportation nexus on the Delaware River.

Range of Magnitude

Transportation accidents can result in death or serious injury and extensive property loss or damage. In the United States, over 37,000 people die in road crashes annually (ASIRT, 2017). Inclement weather, higher traffic volume, and higher traffic speed increase the risk of automobile accidents.

Road and railway accidents, in particular, have the potential to result in hazardous material releases. Accidents involving hazardous materials can pose an environmental hazard and potentially contaminate the air, water, and/or soil.

Aviation incidents most often occur near landing or takeoff sites; the five-mile radius around the Wilmington Airport is considered a high-risk area for aircraft incidents.

Table 4.27 summarizes the range of magnitude for transportation issues related to the local industry.

Table 4.27 Transportation Hazards Range of Magnitude

Severity	Causes	Damage Extents
Minimum	Single vehicle accidents	Minor traffic disruptions; no loss of life
Moderate	Multiple vehicle accidents and/or moderate material spills	Temporary road closures; potential injuries; moderate release of hazardous chemicals restricted to a confined area
Maximum	Multiple vehicle accidents and major material spills	Road closures; injuries and fatalities; release of hazardous chemicals into streams and groundwater systems

Past Occurrence

Over the years, New Castle County has experienced a wide range of transportation accidents, from minor accidents to major crashes affecting public safety and infrastructure.

Delaware's 2024 State Annual Traffic Statistical Report identified a total of 16,070 crashes in 2024, with 67 fatalities.

The most recent recorded aviation accident in the county was the Beechcraft 55 Baron Crash in August of 2019. This crash resulted in two fatalities (pilot and passenger)

Future Occurrence

With the volume of goods and people moving through Delaware, transportation incidents will continue to occur routinely, especially passenger vehicle incidents. Changes to Delaware's climate will also have an impact on future occurrences of transportation incidents. Changes in precipitation, extreme weather events, and heat pose risks to transportation infrastructure, affecting performance, safety, and reliability. Flooding can weaken roadways and tunnels and potentially lead to landslides that affect highways, railways, and bridges.

The likelihood of an aviation incident in New Castle County is considered low; however, past events show that they are possible. While they are also infrequent, railroad accidents are considered more likely to affect larger areas of population and/or the environment.

The probability of transportation accidents is characterized as highly likely, as defined by the risk factor methodology probability criteria.

Vulnerability Assessment

Inventory and summary of vulnerable assets

Transportation incidents can occur along any roadway, and at any time, especially in locations with increased transport of goods, and at transportation nexuses, like major intersections, or where roadways cross railways.

Potential Impacts

It is unlikely that transportation incidents will impact future development in New Castle County. Additionally, these events may have a greater impact on vulnerable and underserved populations due to the lack of harmful impacts from hazardous materials and proximity to vulnerable areas. Transportation accidents disproportionately affect underserved communities by causing higher rates of injuries and fatalities due to factors like inadequate infrastructure, limited access to healthcare, higher reliance on walking and cycling, and often being located near high-traffic areas, leading to further economic hardship and exacerbating existing health disparities within these communities.

The FEMA Community Lifelines most likely to be impacted include:

- Safety and Security
- Health and Medical
- Hazardous Material

4.3.6 Hazardous Materials (HazMat)

Hazardous Material releases can contaminate air, water, and soils and have the potential to cause injury or death. Dispersion can take place rapidly when transported by water and wind. While often accidental, releases can occur as a result of human carelessness, intentional acts, or natural hazards. When caused by natural hazards, these incidents are known as secondary events.

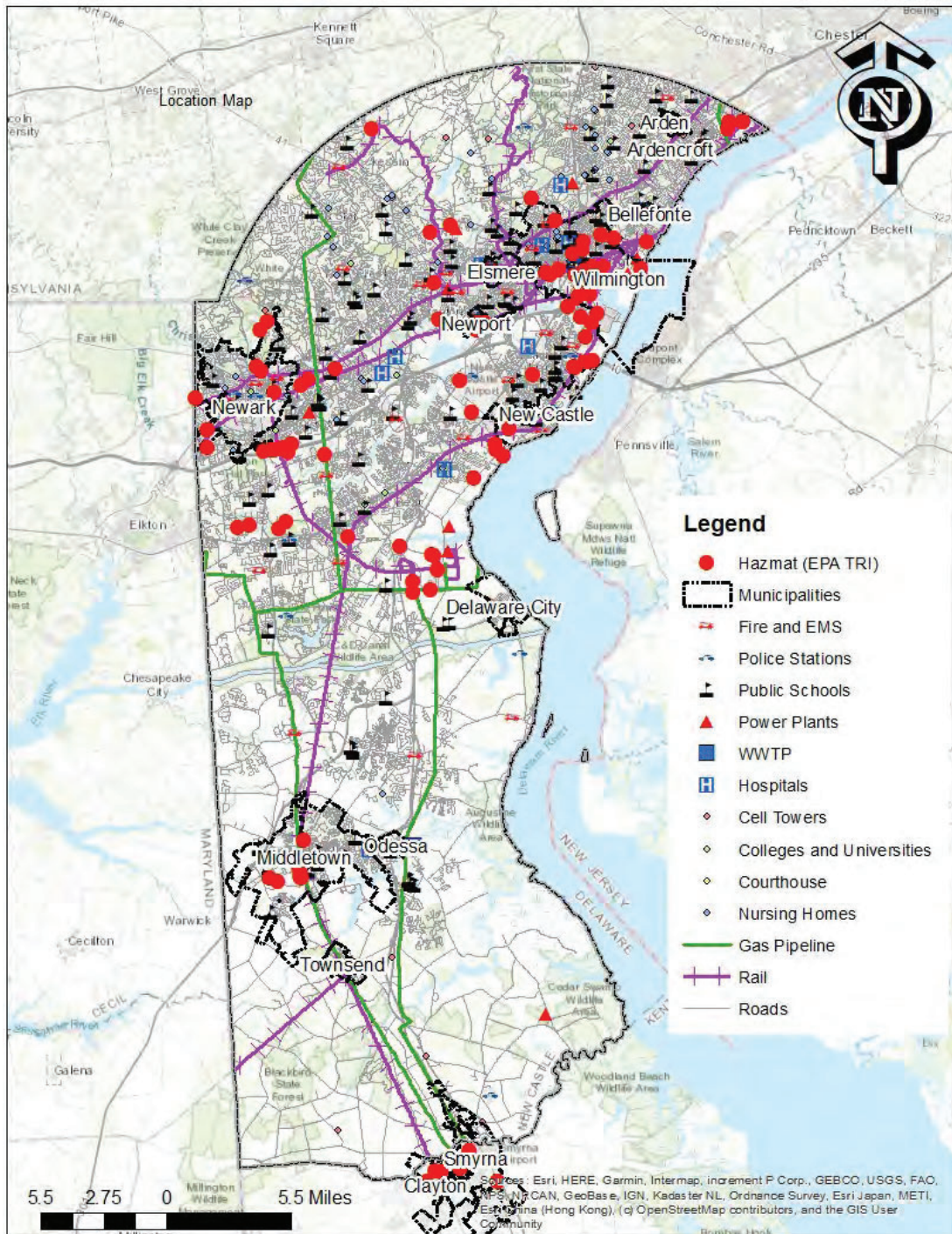
Location and Extent

Hazardous material releases can occur wherever hazardous materials are manufactured, used, stored, or transported. Such releases can occur along transportation routes or at fixed-site facilities. Transportation of hazardous materials on highways involves tanker trucks or trailers, which are responsible for the greatest number of hazardous material release incidents (FEMA, 1997).

Potential also exists for hazardous material releases to occur along rail lines as collisions and derailments of train cars can result in large spills. Pipelines also transport hazardous liquids and flammable substances such as natural gas, as incidents can occur when pipes corrode, are damaged during excavation, incorrectly operated, or damaged by other forces. Fixed-site facilities that use, manufacture, or store hazardous materials in Delaware pose significant risk to public health and the environment and must comply with both Title III of the federal Superfund Amendments and Reauthorization Act (SARA). These statutes require that all owners or operators of facilities that manufacture, produce, use, import, export, store, supply, or distribute any extremely hazardous substance, as defined by the EPA, at or above the threshold planning quantity, as established by EPA, report to the county where the facility is located and the State.

The list of SARA Title III facilities is not an exhaustive, fully comprehensive inventory of all hazardous material locations within the State. The EPA also tracks key information about chemicals handled by industrial facilities through its Toxics Release Inventory (TRI) database.

Figure 4.8 Potential Hazardous Materials Release Locations



Range of Magnitude

Hazardous material releases can contaminate air, water, and soils, possibly resulting in death and/or injuries, and dispersion can take place rapidly when transported by water and wind. While often accidental, releases can occur as a result of human carelessness, intentional acts, or natural hazards, and when caused by natural hazards, these incidents are known as secondary events

Hazardous materials fall under nine (9) hazard classes:

Class 1: Explosives

Class 2: Gases (flammable, non-flammable, non-toxic, and toxic)

Class 3: Flammable and combustible liquids

Class 4: Flammable solids (spontaneously combustible materials and dangerous when wet materials/water reactive substances)

Class 5: Oxidizing substances and organic peroxides

Class 6: Toxic substances and infectious substances

Class 7: Radioactive materials

Class 8: Corrosive substances

Class 9: Miscellaneous hazardous materials/products, substances, or organisms

As previously mentioned, materials can include toxic chemicals, radioactive materials, infectious substances, and hazardous wastes. Such releases can affect nearby populations and contaminate critical or sensitive environmental areas. Exacerbating conditions, characteristics that can enhance or magnify the effects of a hazardous material release include:

- Weather conditions: affects how the hazard occurs and develops
- Micro-meteorological effects of buildings and terrain alter dispersion of hazardous materials
- Non-compliance with applicable codes (e.g., building or fire codes) and maintenance failures (e.g., fire protection and containment features): can substantially increase the damage to the facility itself and to surrounding buildings.

The severity of the incident is dependent not only on the circumstances described above, but also on the type of material released and the distance and related response time for emergency response teams (FEMA, 2019). The areas within closest proximity to the releases are generally at greatest risk, yet depending on the agent, a release can travel great distances or remain present in the environment for a long period of time (e.g., centuries to millennia for radioactive materials), resulting in extensive impacts on people and the environment

Past Occurrence

There have been several previous and ongoing hazardous materials incidents in New Castle County.

The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA) maintain information on highway-related hazardous material release incidents, rail incidents, air-related incidents, and pipeline-related incidents. Pipeline releases can also result in fatality, injury, damage, the release highly volatile liquids, or liquid releases that result in unintentional fire or explosion.

Future Occurrence

While hazardous materials release incidents have occurred in New Castle County in the past, they are generally considered difficult to predict. An occurrence is largely dependent upon the accidental or intentional actions of a person or group. Risk associated with hazardous materials release is

expected to remain moderate. The incidence rate and impacts from a HazMat Release are not expected to be impacted by future climate change.

Vulnerability Assessment

Inventory and summary of vulnerable assets

Assessing vulnerability to a hazardous materials (HazMat) release on a countywide scale can consist of several factors, such as the type(s) of hazardous materials present, the potential for mass casualties, potential consequences for the surrounding area, accessibility, public awareness, and the likelihood of being a terrorist target. The assessment conducted for New Castle County focuses on identifying the buildings around (1) Hazmat sites, (2) rail, and (3) highways. For the analysis, a 500-foot buffer was created around these elements to determine what was at risk.

Table 4.28 identified the HazMat exposure by building count and by occupancy for each New Castle County jurisdiction. There is a total of 15,935 buildings exposed to a potential HazMat release.

Table 4.28 HazMat Exposure by Building Count

HazMat Exposure by Building Count										
Jurisdiction	Agriculture	Single-Family Home	Manufactured Housing	Multi-Family Home	Commercial	Industrial	Government	Education	Religious	TOTAL
Arden	0	0	0	0	0	0	0	0	0	0
Ardencroft	0	0	0	0	0	0	0	0	0	0
Ardentown	0	0	0	0	0	0	0	0	0	0
Bellefonte	0	0	0	0	0	0	0	0	0	0
Clayton	0	0	0	0	0	0	0	0	0	0
Delaware City	1	0	0	0	0	0	0	0	0	1
Elsmere	0	0	0	0	0	0	0	0	0	0
Middletown	24	488	0	21	75	88	6	14	1	717
New Castle	16	102	0	0	4	12	3	0	0	137
Newark	17	778	6	165	71	126	9	42	2	1216
Newport	72	156	4	31	55	74	2	0	4	398
Odessa	0	0	0	0	0	0	0	0	0	0
Smyrna	0	0	0	0	0	0	0	0	0	0
Townsend	0	0	0	0	0	0	0	0	0	0
Wilmington	179	5243	15	554	740	294	54	35	68	7182
Unincorporated	211	3994	159	132	661	1095	13	3	16	6284
TOTAL	520	10761	184	903	1606	1689	87	94	91	15,935

Table 4.29 identifies the HazMat exposure by structure value and by occupancy for each New Castle County jurisdiction. Throughout New Castle County, the structure value exposed to a HazMat Release is \$9,624,383,264.

Table 4.29 HazMat Exposure by Structure Value

Jurisdiction	Agriculture	Single-Family Home	Manufactured Housing	Multi-Family Home	Commercial	Industrial	Government	Education	Religious	TOTAL
Arden	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Ardencroft	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Ardentown	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Bellefonte	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Clayton	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Delaware City	\$46,407	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$46,407
Elsmere	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Middletown	\$9,946,228	\$91,703,191	\$0	\$70,655,805	\$129,053,777	\$430,718,671	\$9,153,243	\$14,088,133	\$619,429	\$755,938,476
New Castle	\$1,684,472	\$15,728,663	\$0	\$0	\$6,032,384	\$169,471,406	\$5,877,780	\$0	\$0	\$198,794,705
Newark	\$4,847,979	\$183,883,618	\$620,661	\$303,840,762	\$121,615,522	\$298,861,491	\$1,922,400	\$128,339,401	\$1,508,943	\$1,045,440,777
Newport	\$34,711,998	\$27,810,985	\$471,403	\$27,695,608	\$35,460,525	\$85,477,358	\$3,477,920	\$4,606,984	\$0	\$219,712,781
Odessa	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Smyrna	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Townsend	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Wilmington	\$128,867,051	\$668,323,425	\$1,484,000	\$659,706,537	\$792,275,492	\$639,356,937	\$66,551,263	\$180,804,743	\$96,188,424	\$3,233,557,871
Unincorporated	\$156,381,085	\$756,481,060	\$8,783,950	\$265,883,251	\$798,696,739	\$2,152,016,804	\$1,630,460	\$15,437,705	\$15,581,193	\$4,170,892,247
TOTAL	\$336,485,220	\$1,743,930,942	\$11,360,014	\$1,327,781,963	\$1,883,134,438	\$3,775,902,668	\$88,613,066	\$343,276,965	\$113,897,988	\$9,624,383,264

Estimation of Losses

Estimation of losses for hazardous materials incidents can vary based on the scale and makeup of the incident. Likely, most buildings will not be impacted during a hazardous materials spill, while most losses would come in the form of loss of life due to inhalation/ingestion of a hazardous material. Due to a lack of data, loss estimations for New Castle County were not determined for this hazard, although exposure estimates are provided in the Table above.

Potential Impacts

A hazardous materials release would likely have an impact on future development in the County, as development may be directed away from pipelines, unconventional wells, and hazardous materials storage sites. Additionally, these events may have a greater impact on vulnerable and underserved populations back to limited evacuation access and limited healthcare access. The placement of hazardous waste sites across the United States has disproportionately affected minority and low-income communities for several decades. The majority of these facilities have been deliberately constructed in communities that lack an effective local government, allowing them to operate with little to no impunity for the damage caused to the local communities.

During a hazardous material release, the community lifelines that are most likely to be impacted include:

- Safety and Security
- Food, Water, and Shelter
- Health and Medical
- Transportation

4.3.7 Dam/Levee Failure

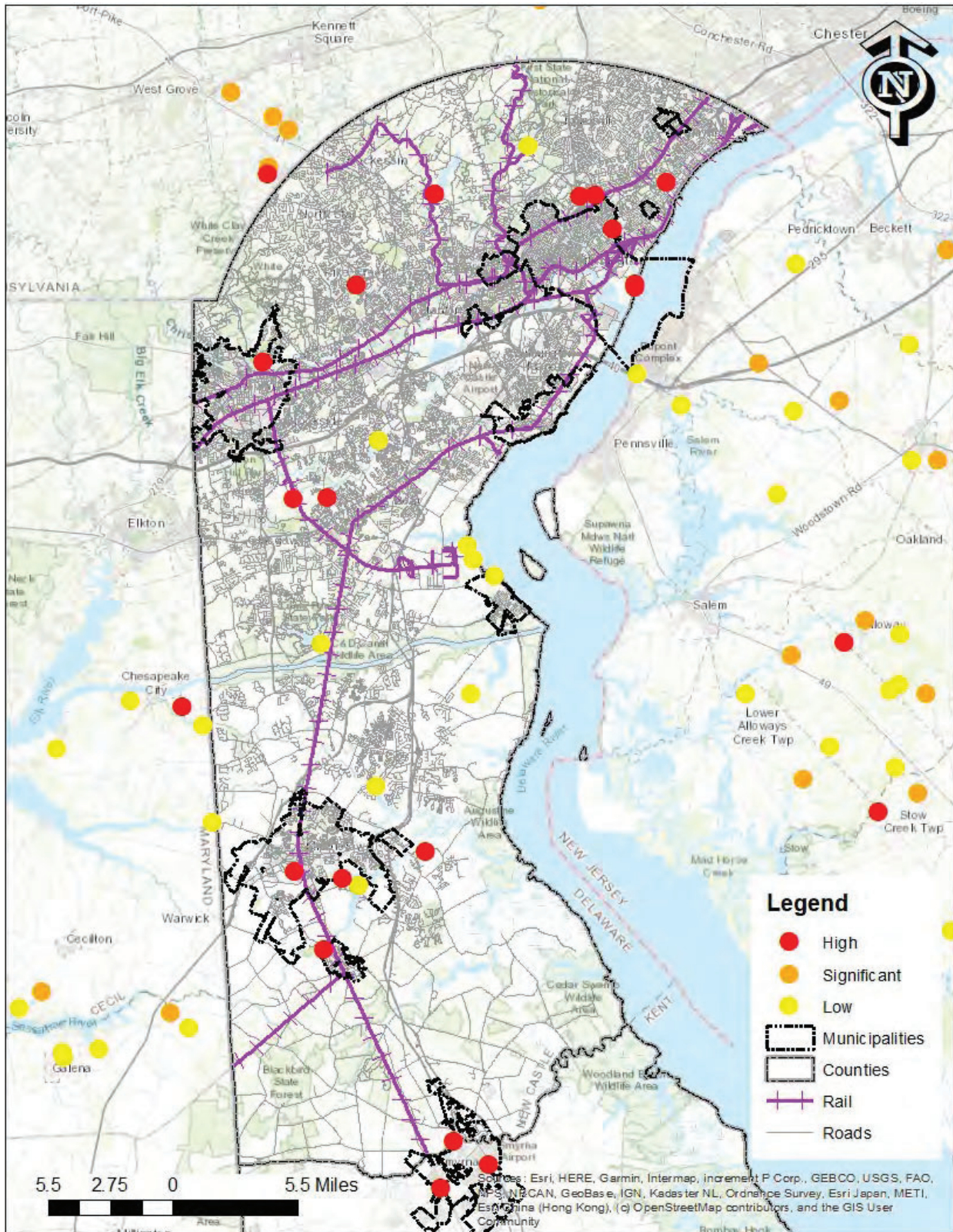
Dam failure is the uncontrolled release of water (and any associated waste) from a dam. This hazard often results from a combination of natural and human causes, and can follow other hazards such as hurricanes, earthquakes, and landslides. The consequences of dam failures can include property and environmental damage and loss of life.

A levee is a human-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water to provide protection from temporary flooding (FEMA, 2016). A levee failure or breach occurs when a levee fails to prevent flooding on the landside of the levee. The consequences of a sudden levee failure can be catastrophic, with the resulting flooding causing loss of life, emergency evacuations, and significant property damage.

Location and Extent

The location of all dams is provided in Figure 4.9, and all dam failure analysis, data, and information are included in Appendix A – New Castle County High Hazard Potential Dam Analysis.

Figure 4.9 Dam Locations in New Castle County and Surrounding Region (all dams)



The New Castle–Army Creek levee is an earthen embankment stretching roughly 3,100 feet with a minimum crest elevation of 8.75 feet NAVD88 and a 17-foot-wide top. The levee includes a paved pedestrian trail and maintenance drive. A floodgate at the confluence of Army Creek and the Delaware River consists of five 48-inch corrugated metal pipes with flap gates to prevent backflow, secured by concrete headwalls. Upgraded in 2013 by the State of Delaware and sponsored by the City of New Castle, the levee has functioned as intended. The protected area includes businesses, wetlands, parkland, and a section of Delaware Route 9.

The Broad Dyke levee system extends approximately 2,350 feet and consists of northern and southern sections. The northern section, about 1,350 feet long, includes a 16-foot-wide crest with gravel maintenance access and riverside rock riprap, along with a floodgate system of concrete vaults and pipes at the Broad Dyke Canal–Delaware River confluence. The southern section, roughly 1,000 feet, features a 13-foot-wide earthen embankment, partially riprapped and partially vegetated, with a drainage swale leading to a piped outlet with flap gates. Upgraded in 2013 by the State and sponsored by the City, the levee has performed as designed. The leveed area encompasses businesses, residences, wetlands, a rail line, parkland, and Delaware Route 9.

The Buttonwood levee is an earthen embankment approximately 1,850 feet in length with a 17-foot-wide crest at 8.5 feet NAVD88. A gravel maintenance drive spans the top, and a floodgate structure near the northern third includes reinforced concrete pipes on both marsh and river sides. Upgraded in 2013 under the State’s guidance and City sponsorship, the levee continues to function effectively. Protected areas include businesses, wetlands, and an active rail line.

The Gambacorta levee stretches about 2,300 feet with a 17-foot crest at a minimum elevation of 8.5 feet NAVD88, including a paved trail and maintenance drive. A floodgate near West 3rd Street consists of a concrete outlet structure with a 42-inch HDPE drainage pipe and flap gate to manage marsh runoff. This levee, upgraded in 2013 and sponsored by the City, has performed as intended. The leveed area contains businesses, wetlands, and parkland.

The Red Lion Creek levee extends roughly 1,900 feet along the Delaware River, with crest widths of 10–15 feet and typical 9-foot height. Both riverside and most landside slopes are armored with riprap, with some northern areas vegetated. A flood gate at the confluence with the Delaware River includes five 48-inch pipes with flap gates and 500 feet of steel sheet pile wing walls. Upgraded in 2013 by the State of Delaware, the levee has largely performed as designed, with prior drainage issues corrected. The protected area includes businesses and wetlands.

The locations of the levee systems in New Castle County are shown in Table 4.30.

Table 4.30 New Castle County Levee Details

New Castle County Levee Details (NLD, 2019)						
Levee Name	Muni.	Leveed Waterway	Accredited	People at Risk	Structures at Risk	Property Value at Risk
New Castle-Army Creek Levee	New Castle City	Delaware River	NO	2	1	\$240,000
New Castle-Broad Dyke Levee	New Castle City	Delaware River	NO	195	95	\$52 Million
New Castle-Buttonwood Levee	New Castle City	Delaware River	NO	152	65	\$22 Million
New Castle-Gambacorta Levee	New Castle City	Delaware	NO	34	18	\$48 Million
Red Lion Levee	Delaware City	Delaware River	NO	2	1	\$400,000

Range of Magnitude

Levee failures can pose a serious threat to communities located in flat or low-lying areas near bodies of water that are protected by levees. The impact of a levee failure is dependent on the volume of water behind the levee, the size of the failure, and the number of people or assets located in the protected area.

Levees require maintenance to continue to provide the level of protection they were designed and built for. Maintenance responsibility belongs to a variety of entities, including local, state, and federal government, as well as private landowners. Levee owners need to both maintain levees and pay for an independent inspection to have the levee certified as providing flood protection. The impacts of an uncertified levee include levee failure and insurance rate increases because FEMA identifies that the structures are not designed to protect the 1% annual-chance flood height on Flood Insurance Rate Maps. Regardless of whether a levee is accredited, there is concern that property in these areas lacks flood insurance.

Past Occurrence

Information and records of past levee failures in Delaware are not comprehensive. There is no documented history of levee failures in New Castle County.

Future Occurrence

Similar to dam failures, given certain circumstances, a levee failure can occur at any time. However, the probability of future occurrences can be reduced through proper design, construction, and maintenance measures. Most levees are designed to operate safely at specified levels of flooding. The age of the levee system, if not maintained, should also be considered regarding the potential for failures.

A levee failure can occur at any time, especially during times of the year when there are traditionally heavy rains, especially during hurricane season, and snowmelt.

Vulnerability Assessment

The U.S Army Corps of Engineers uses three (3) questions to help to identify the potential impacts of a levee failure.

What event could occur? (flood, storm, earthquake, other)

How will the levee perform during these events?

What are the consequences if the levee does not perform well, in particular, will loss of life occur?

These three questions help to form a basic understanding of the potential damage that is expected from a levee failure and can provide valuable insight into where to prepare in the future.

There are three inspection levee rating classifications, which are shown in Table 4.31 - Levee System Inspection Ratings.

Table 4.31 Levee System Inspection Ratings

Levee System Inspection Ratings	
Rating	Description
Acceptable	All inspection items are rated as Acceptable.
Minimally Acceptable	One or more inspection items are rated as Minimally Acceptable or one or more items are rated as Unacceptable and an engineering determination concludes that the Unacceptable inspection items would not prevent the segment/system from performing as intended during the next flood event.
Unacceptable	One or more inspection items are rated as Unacceptable and would prevent the segment/system from performing as intended, or a serious deficiency noted in past inspections (previous Unacceptable items in a Minimally Acceptable overall rating) has not been corrected within the established timeframe, not to exceed two years.

Inventory and summary of vulnerable assets

Inventory and summary of assets vulnerable to levee failure will be explored further in the subsequent Plan Update.

Estimation of Losses

Due to the lack of data and information regarding addition significantly impacting the County, a risk factor was determined, although no loss analysis will be conducted for this hazard at this time.

Potential Impacts

With respect to critical facilities, the types of facilities most vulnerable to levee failure include fire departments, public schools, police departments, and water facilities. The environmental impacts of a levee failure result in significant water quality and debris disposal issues. Floodwaters will back up sanitary sewer systems and inundate wastewater treatment plants, causing raw sewage to contaminate residential and commercial buildings, as well as the flooding waterway. The contents of unsecured containers of oil, fertilizers, pesticides, and other chemicals get added to flood water. Water supplies and wastewater treatment could be offline for weeks. After the flood waters subside, contaminated and flood-damaged building materials and contents must be properly disposed. Contaminated sediment must be removed from buildings, yards, and properties.

The FEMA Community Lifelines most likely to be impacted include:

- Safety and Security
- Food, Water, Shelter
- Hazardous Materials

4.3.8 Terrorism

Terrorism is the use of force or violence against persons or property with the intent to intimidate or coerce. Acts of terrorism include threats of terrorism; assassinations; kidnappings; hijackings; bomb scares and bombings; cyber-attacks (computer-based); and the use of chemical, biological, nuclear, and radiological weapons. Cyber-attacks have become an increasingly pressing concern.

Location and Extent

Critical facilities like police stations, hospitals, military installations, fire stations, schools, water treatment plants, and nuclear generation stations, and critical infrastructure like bridges, tunnels, electric generation and distribution facilities, public water supplies, and government buildings are potential targets for a terrorist attack.

Range of Magnitude

Terrorism is divided into two (2) categories:

- **International Terrorism:** Violent acts committed by individuals and/or groups inspired by or associated with designated foreign terrorist organizations or nations (state-sponsored).

- **Domestic Terrorism:** Violent, criminal acts carried out by individuals and/or groups to further ideological goals stemming from domestic influences, such as those of a political, religious, social, racial, or environmental nature.

Within those two categories, FEMA identifies the following as some of the common tactics for terrorist events and/or terrorist organizations:

- Agriterrorism – food contamination or destruction of crops via pest introduction or disease agents
- Arson/incendiary attack
- Armed attack
- Assassination
- Biological agent
- Chemical agent
- Cyberterrorism
- Conventional bomb
- Hijackings
- International hazardous material releases
- Kidnapping
- Nuclear bomb
- Radiological agent

Past Occurrence

New Castle County has not been directly impacted by any significant international terrorist incident.

Future Occurrence

The likelihood of a major terrorist attack occurring in New Castle County is low. The most common future occurrence will likely come in the form of bomb threats at schools and other facilities.

Vulnerability Assessment

Both civilian populations and more rural areas are subject to impacts from terrorism. Dense population centers like the City of Wilmington, in particular, are likely targets for adversarial or terrorist attacks. Additionally, the close proximity of the Dover base, another potential target of adversarial or terrorist attack, could result in indirect impacts to the County.

Inventory and summary of vulnerable assets

All communities in New Castle County are vulnerable at some level to a terrorist attack, whether directly or indirectly. Site specific assessments should be based on the relative importance of a particular site to the surrounding population, threats that are known to exist, and vulnerabilities, including:

Inherent Vulnerability:

- Visibility – How aware is the public of the existence of the facility?
- Utility – How valuable might the place be in meeting the objectives of a potential terrorist?
- Accessibility – How accessible is the place to the public?

- Asset Mobility – Is the asset’s main location fixed or mobile?
- Presence of Hazardous Materials – Are flammable, explosive, biological, chemical, and/or radiological materials present on site? If so, are they well secured?
- Occupancy – What is the potential for mass casualties based on the maximum number of individuals on site at a given time?

Tactical Vulnerability:

Site Perimeter

- Site Planning and Landscape Design – Is the facility designed with security in mind – both site-specific and with regard to adjacent land uses?
- Parking Security – Are vehicle access and parking managed in a way that separates vehicles and structures?

Building Envelope

- Structural Engineering – Is the building’s envelope designed to be blast-resistant? Does it provide collective protection against chemical, biological, and radiological contaminants?

Facility Interior

- Architectural and Interior Space Planning – Does security screening cover all public and private areas?
- Mechanical Engineering – Are utilities and HVAC systems protected and/or backed up with redundant systems?
- Electrical Engineering – Are emergency power and telecommunications available? Are alarm systems operational? Is lightning sufficient?
- Fire Protection Engineering – Are the building’s water supply and fire suppression systems adequate, code-compliant, and protected? Are on-site personnel trained appropriately? Are local first responders aware of the nature of the operations at the facility?
- Electronic and Organized Security – Are systems and personnel in place to monitor and protect the facility?

Estimation of Losses

Due to the lack of data and information regarding terrorism significantly impacting the County, a risk factor was determined, although no loss analysis will be conducted for this hazard at this time.

Potential Impacts

The severity and scale of impacts of terrorist incidents depends upon the method of attack, the proximity of the attack to people, animals, or other assets and the duration of exposure to the incident or attack device. For example, chemical agents are poisonous gases, liquids or solids that have toxic effects on people, animals, or plants. Many chemical agents can cause serious injuries or death. In this case, severity of injuries depends on the type and amount of the chemical agent used and the duration of exposure.

The FEMA Community Lifelines most likely to be impacted include:

- Safety and Security