



2011 CoreLogic® Storm Surge Report

Residential Storm-Surge
Exposure Estimates
for 10 U.S. Cities

Executive Summary

2011 Storm Surge Report

Coastal storm surge is one of the most destructive natural flooding catastrophes that can occur in areas prone to tropical storms. In addition to the property damage and lives lost to flood waters, the impact of high-speed waves crashing over the coast often significantly heightens geographic and economic damage in hurricane disaster areas. Flood zones defined by the Federal Emergency Management Agency (FEMA) in high-risk coastal regions provide a great deal of exposure data for homes in the path of flood waters, but understanding the additional layer of risk posed by a storm surge is critical for homeowners, emergency response teams, insurance companies and many others to plan and prepare for a disaster event. This report examines single-family residential structures (homes) exposed to hurricane-driven storm-surge damage in ten major urban areas along the Gulf and Atlantic coasts in the U.S.

Storm surge is triggered primarily by winds associated with cyclonic storms. The high winds and low pressure created by a hurricane cause water to amass inside the storm, gaining energy as the hurricane moves toward the coast and releasing as a powerful surge over land when the storm moves on shore. Storm surges can cause extensive property damage as the seawater is pushed inland, breaking through structures and carrying with it dangerous debris. The height of a storm surge and the extent of inland inundation in coastal areas can be influenced by both off-shore characteristics, such as wind speed, atmospheric pressure, forward speed, tide, bathymetry (water depth) and the angle of coastal impact and on-shore characteristics like elevation, levees and barriers, bays, rivers and canals.

The 2011 CoreLogic Storm Surge Report provides an analysis of the potential exposure to storm surge property damage in ten major U.S. coastal areas: Charleston, SC; Corpus Christi, TX; Houston-Galveston, TX; Jacksonville, FL; Long Island, NY; Miami-Dade, FL; Mobile, AL; New Orleans, LA; Tampa, FL and Virginia Beach, VA. The study first identified all residential properties located within a predicted storm surge polygon, then extracted the associated property value of each home using the comprehensive CoreLogic parcel database. Valuation for each geographic area was totaled by storm surge risk, then further divided within each area by ZIP Code. The final results depict the current value of the total residential properties exposed to each potential storm surge event. In addition, the flood zone information was appended to allow

for the comparison of properties at risk for storm-surge damage to those properties that may also be located within a FEMA flood zone.

The findings show that of the ten metro areas studied, Long Island has the most residential property at risk with \$99 billion of exposure, followed by the Miami-Palm Beach region with \$44.9 billion of exposure and Virginia Beach with \$44.6 billion of exposure. The metro areas identified as having the lowest economic risk are Mobile, AL with \$3 billion of exposure and Corpus Christi, TX with \$4.7 billion. Among the densely populated coastal regions with the highest number of individual properties at risk are Virginia Beach, with nearly 289,000 properties, New Orleans, with more than 278,000 properties and Tampa, with more than 277,000 properties at risk.

Important to note is that in many cases, homes exposed to potential storm-surge inundation are located outside of a defined FEMA flood zone. The study in fact showed the majority of homes at risk within the ten metro areas are in designated surge zones only and are not included in local flood zones. For example, 87.4 percent of surge-inundation zone properties are not in a flood zone in Virginia Beach, while only 12.2 percent of at-risk properties are positioned in both surge and flood zones. Similarly, 78 percent of surge-inundation zone properties in Long Island are considered surge zone only, with just 21.8 percent of at-risk properties falling within the boundaries of both surge and flood zones.

One notable finding unique to the 2011 CoreLogic Storm Surge Report reflects the efforts over the last six years to rebuild the New Orleans area in the wake of hurricane Katrina. Now that the Army Corps of Engineers has completed raising the area levees, rebuilding flood walls and creating a massive Lake Borgne Surge Barrier to provide a greater level of protection against hurricane storm-surge damage, many of the properties previously designated as in a high-risk surge zone have a significantly lower chance of exposure to property destruction.

This is the second annual Storm Surge Report that CoreLogic has produced. The methodology was recalibrated to provide a more robust analysis of potential damage and therefore, comparing the 2011 report with the 2010 report might lead to inaccurate comparisons.

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Hurricane Ike alerted the nation to the dangers and devastation of hurricane-driven storm surge.

Bluewater Drive on the Bolivar Peninsula following Hurricane Ike.
Image supplied by Pictometry

Understanding Storm Surge

Beginning with Hurricane Katrina and continuing through the recent Japanese tsunamis, public awareness has been sharply focused on the destructive impact of ocean waves driven by natural events. For the U.S., with its exposure to tropical storms along the Atlantic and Gulf Coasts, hurricane-driven storm-surge inundation is one of the most disastrous natural flooding events that can occur. With billions of dollars in property damage and countless lives lost to storm surge, the U.S. in recent years has seen more than its fair share of destruction produced by these natural catastrophes.

Storm surge is triggered primarily by winds associated with cyclonic storms and is further influenced by bathymetry (water depth) and underwater topography (ocean floor terrain). As a hurricane moves across the ocean, the high winds and low pressure created by the storm cause water to mound at the center of the storm, while the strong winds inside the hurricane act like a plow, causing water to pile-up along the front of the storm, with the highest water levels accumulating along the right-front quadrant. Hurricanes spin counterclockwise, so when a storm strikes the coast it is the right side of the eye of the storm that has the on-shore winds, while the left side of the eye has the off-shore winds. Storm surge is driven by on-shore winds and, in most cases, it is the right side or right quadrant of the storm that will drive the highest surge levels of the rotation coming from the northeast. These two effects contribute to a swelling of water in front of the storm. Over deep water, far from land, the water bulge or rise in sea level is usually minimal since the energy generating the surge is able to dissipate downward or off to the side of the storm. As the storm moves closer to shore, where the water depth becomes shallow, the water cannot dissipate and the height of the water column increases. When the hurricane moves on shore, and particularly if landfall is at high tide, large volumes of water are amassed along the coastline and are pushed overland to flood large areas of land. High waves further serve to augment the flooding. The storm surge will push inland via rivers, creeks and canals and can cause extensive damage over large areas far from the coast. Additional damage from standing water can occur where low-lying coastlines are protected by levees and other barriers, in the event seawater that was pushed by the power of the surge is trapped inland and cannot flow back into the sea.

Storm surge moves with the forward speed of the hurricane—typically 10–15 mph. The hydraulic impact created by these waves is incredibly destructive, given that one cubic yard of sea water weighs 1,728 pounds—almost a ton. Compounding the destructive power of the rushing water is the large amount of floating debris that typically accompanies the surge. Trees, autos, boats, pieces of buildings and other debris are carried by the storm surge and act as battering rams that can damage or even collapse buildings in the wave's path. As a precursor to the hurricane, the storm surge can begin to rise a day before the storm hits and affect areas which are not in the direct path of the hurricane. This is particularly true along the Gulf of Mexico shore, where the coast often experiences storm surge tangential to the hurricane track.

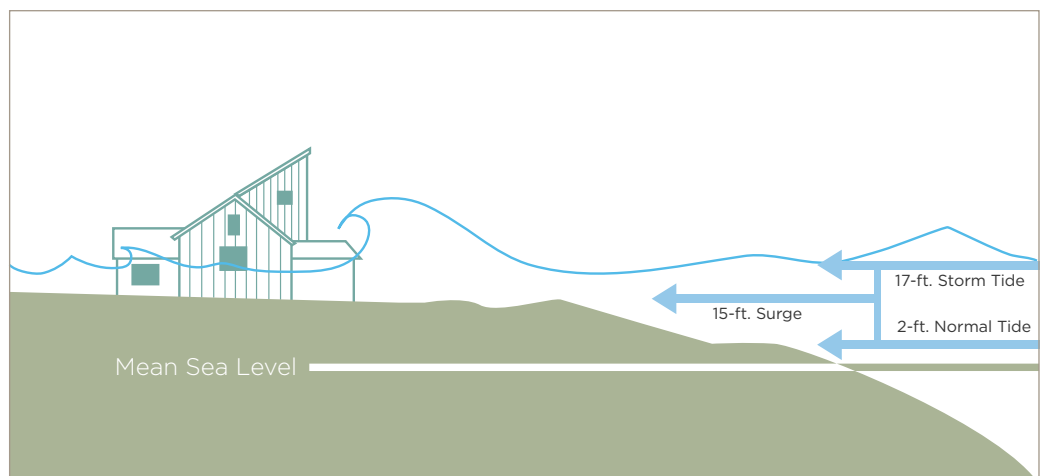
While the wind intensity of a hurricane may make up the majority of headlines as it bowls its way across the Atlantic or Gulf towards a major U.S. city, storm-surge inundation will be the primary culprit, causing residential damage due to intense flooding and residual standing water.

Report Methodology

This report examines the exposure of single residential structures (homes) to storm surge within ten predefined geographic areas in the U.S. The figures used reflect current structure value and do not consider replacement costs, contents, auto, life and business interruption. While wind would certainly contribute significantly to the loss incurred in the event of a hurricane, the properties identified in this report are only those that would be “wet” in a storm-surge event. The CoreLogic storm-surge polygons used in this study assume the worst-case scenario for each category of hurricane. This includes:

- ▶ Maximum wind speed for each category at time of landfall
- ▶ Right-front quadrant and on-shore facing winds of the storm at landfall
- ▶ The storm striking perpendicular to the coast
- ▶ Peak high tide at time of landfall

For this study, the CoreLogic extensive database of parcels has been used to identify the properties that fall within the perimeter of each category of the storm-surge inundation polygon. A parcel is the individual property associated with an address and is the most granular way to identify properties exposed to natural hazards. To date, CoreLogic has collected or converted over 127.1 million properties in the U.S. To determine residential exposure value, CoreLogic paired its expertise in storm-surge modeling and FEMA flood zone boundaries with the company's residential valuations for structures at the parcel level. CoreLogic identified every property contained within each category of the storm-surge polygon and matched the structure valuation for each residence identified. Valuation for each geographic area was totaled by hurricane category. The totals were then further divided within each geographic area by ZIP Code. The final result is the current value of the total structures exposed to each storm-surge event. Additionally, the flood zone information was appended so that it is possible to compare the properties at risk from storm surge to those properties which may also be located within a FEMA flood zone.



Loss Processes Considered

Although this report examines potential exposure and not actual loss, storm surge can cause massive damage to structures in several ways that result in a total loss of the structure. The loss processes involved in a storm-surge event are catastrophic and include:

Water Depth: Water can cause many different types of damage. Absorptive materials, such as drywall or wood swell and burst or warp. Electrical systems short circuit. Empty fuel oil and gas tanks become destabilized and their supply lines spring leaks. Metals corrode in the salt water. Another damage-relevant factor is that the surge waters transport particulates and are polluted by chemical and/or biological substances. These substances tend to seep into the smallest cracks and cavities and are deposited there. Later, when the water is removed during remediation, these pollutants are not. They eventually damage or destroy materials in addition to compromising the health of the homeowner. Higher water levels are correlated with increased rates of saturation and result in greater damage.

Storm Surge Velocity: Wind-driven water moving at 10–15 mph has tremendous power. A single cubic yard of sea water weighs 1,728 pounds—almost a ton—and the energy released by the movement of this water can easily erode shorelines and banks and undercut pilings and slabs. This often results in the collapse of the affected structure. The effect of large surge generated waves breaking on the coastline can easily sweep away entire structures.

Transportation of Debris: Depending on the velocity of the flow and the ground conditions, storm surge can deposit large amounts of sand, sediment and gravel within a structure. Surge water that breaches a structure will slow dramatically, potentially depositing tons of sediment. Additionally, uprooted trees, pilings, boats, cars and other large objects often cause damage when swept up against structures.

Standing Period: After a storm surge, the water which has come on shore can stand for weeks, unable to escape to the sea, due to levees or other structural barriers such as raised railroad tracks. New Orleans, after Hurricane Katrina, was a compelling example of how water can become trapped in low-lying areas, creating a toxic lake of debris. The general rule is: the longer water stands, the more damage it does. Organic materials start to rot, mortar disintegrates, metals corrode, bacteria multiply very swiftly depending on water temperature and watertight buildings come loose of their moorings as a result of the rising ground water. The devastating interplay of these factors results in unpredictable damages for a property owner.

Geographic Areas

CoreLogic considered several factors when selecting the areas of the U.S. to study, including:

Hurricane Probability: The storm surge model utilizes a numerical index equated to a categorical score of low to extreme to assess relative vulnerability to hurricanes for U.S. coastal counties. The index includes measures of both incidence and exposure. Incidence is measured by the number of landfalling hurricanes impacting a county over the past century. Exposure is quantified by both population and property value subject to hurricanes.

Vulnerability: Storm surge is most pervasive in coastal areas that have a relatively shallow off-shore bathymetry, low-lying coastlines or river estuaries. Surge and wave heights on shore are affected by the configuration and bathymetry of the ocean bottom. A coastal zone with a narrow underwater shelf or one that has a steep increase in water depth and subsequently produces deep water in close proximity to the shoreline, tends to produce a lower surge, but a higher and more powerful wave. This situation is best exemplified by the southeast coast of Florida. Conversely, coastlines along the Gulf of Mexico, from Texas to Florida, have long, gently sloping shelves and shallow water depths. These areas are subject to higher storm surges, but smaller waves. This dichotomy is due to the fact that in deeper water, a surge can be dispersed down and away from the driving force of the hurricane; however, upon entering a shallow, gently sloping shelf, the surge is instead driven ashore by the wind stresses of the hurricane. In addition, topography of the land surface is a critically important element in storm-surge extent. Areas where the land elevation is less than a few meters above sea level are at particular risk from storm-surge inundation. The less relief to the terrain, the more likely the storm surge will continue overland. A final vulnerability factor is the rainfall effect, which is experienced predominantly in estuaries. Once they have made landfall, hurricanes may cause considerable rainfall within a 24-hour period over large areas and higher rainfall densities in localized areas. As a result, runoff within watersheds can quickly fill the rivers that drain them. This can increase the water level near the head of tidal estuaries as storm-driven waters surging in from the ocean meet rainfall flowing from the estuary.

Residential Density: Many of the nation's most densely populated areas are located along the coast. In fact, 23 of the 25 most densely populated U.S. counties are ocean-facing. Coastal counties average 300 persons per square mile, much higher than the national average of 98 persons per square mile. Since 1980, population density has increased in coastal counties by 65 persons per square mile or by 28 percent. To examine the impact of storm surge on densely settled areas, CoreLogic identified ten major urban areas at high risk:

- ▶ Charleston, SC
- ▶ Corpus Christi, TX
- ▶ Houston-Galveston, TX
- ▶ Jacksonville, FL
- ▶ Long Island, NY
- ▶ Miami-Dade, FL
- ▶ Mobile, AL
- ▶ New Orleans, LA
- ▶ Tampa, FL
- ▶ Virginia Beach, VA

Storm-Surge Inundation Versus Fresh-Water Flooding

With significant enhancements to building codes in hurricane wind-prone areas and through homeowner mitigation efforts, wind damage to structures from hurricanes has been greatly reduced. Homeowners, however, are powerless to mitigate against the impact of storm surge other than choosing to locate in areas out of the storm-surge zone. Many homeowners are under the misconception that if they have homes outside a FEMA flood zone they are safe from coastal storm-surge flooding. It's important to realize that extensive areas along the coast vulnerable to storm surge are not located within FEMA flood zones. To illustrate the risk exposure to homeowners not in FEMA flood zones, for each of the ten urban areas, the number of homes located in surge inundation zones was compared against those located in both surge and FEMA flood zones. Since homeowners insurance excludes flood losses from either fresh or salt water, those homeowners that are not located in FEMA flood zones, but are in high-risk surge zones, should consider buying National Flood Insurance Program (NFIP) coverage for their properties.

Comparing the ten metro areas in the table below illustrates the significant differences between properties found in storm surge and flood inundation zones, surge only and FEMA flood zones only. For example, 87.4 percent of surge-inundation zone properties are not in a flood zone in Virginia Beach, while only 12.2 percent of at-risk properties are positioned in both surge and flood zones. Similarly, 78 percent of surge-inundation zone properties in Long Island are considered surge zone only, with just 21.8 percent of at-risk properties falling within the boundaries of both surge and flood zones.

Metro Areas	Total Properties Exposed to Flood or Surge Inundation	Total Properties in a Flood Zone and a Surge Zone	% of Properties in Both a Flood Zone and a Surge Zone	Total Properties Located Only in a FEMA Flood Zone	% of Properties Located Only in a FEMA Flood Zone	Total Properties Located Only in a Surge Zone	% of Properties Located Only in a Surge Zone
Charleston	81,046	46,920	55.2%	3,935	4.6%	34,126	40.2%
Corpus Christi	44,306	9,153	18.6%	4,977	10.1%	35,153	71.3%
Houston	179,929	39,033	20.5%	10,832	5.7%	140,896	73.9%
Jacksonville	135,157	22,992	16.3%	5,846	4.1%	112,165	79.5%
Long Island	251,691	54,951	21.8%	467	0.2%	196,740	78.0%
Miami to Palm Beach	246,945	127,167	43.5%	45,563	15.6%	119,778	40.9%
Mobile	31,137	8,959	27.4%	1,564	4.8%	22,178	67.8%
New Orleans	278,185	158,004	56.3%	2,537	0.9%	120,181	42.8%
Tampa	277,324	99,871	34.9%	8,982	3.1%	177,453	62.0%
Virginia Beach	288,677	35,463	12.2%	952	0.3%	253,214	87.4%

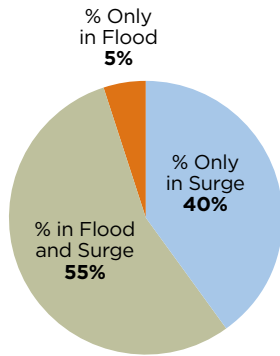
CHARLESTON, S. CAROLINA

CATEGORY 5 EXPOSURE:
\$17,743,046,566

HURRICANE PROBABILITY:
MEDIUM

**STORM-SURGE
VULNERABILITY:**
HIGH

RESIDENTIAL DENSITY:
MEDIUM



A Category 5 hurricane slamming Charleston, which is home to some of the most historic neighborhoods in the U.S. —over 81,000 properties—could affect a total of \$17.7B worth of residences. Even if the hurricane is only a Category 1 storm, it could cause area residents total property damage of over \$8B.

Residential areas that would be worst affected include Mount Pleasant, Johns Island, James Island and portions of the city of Charleston.

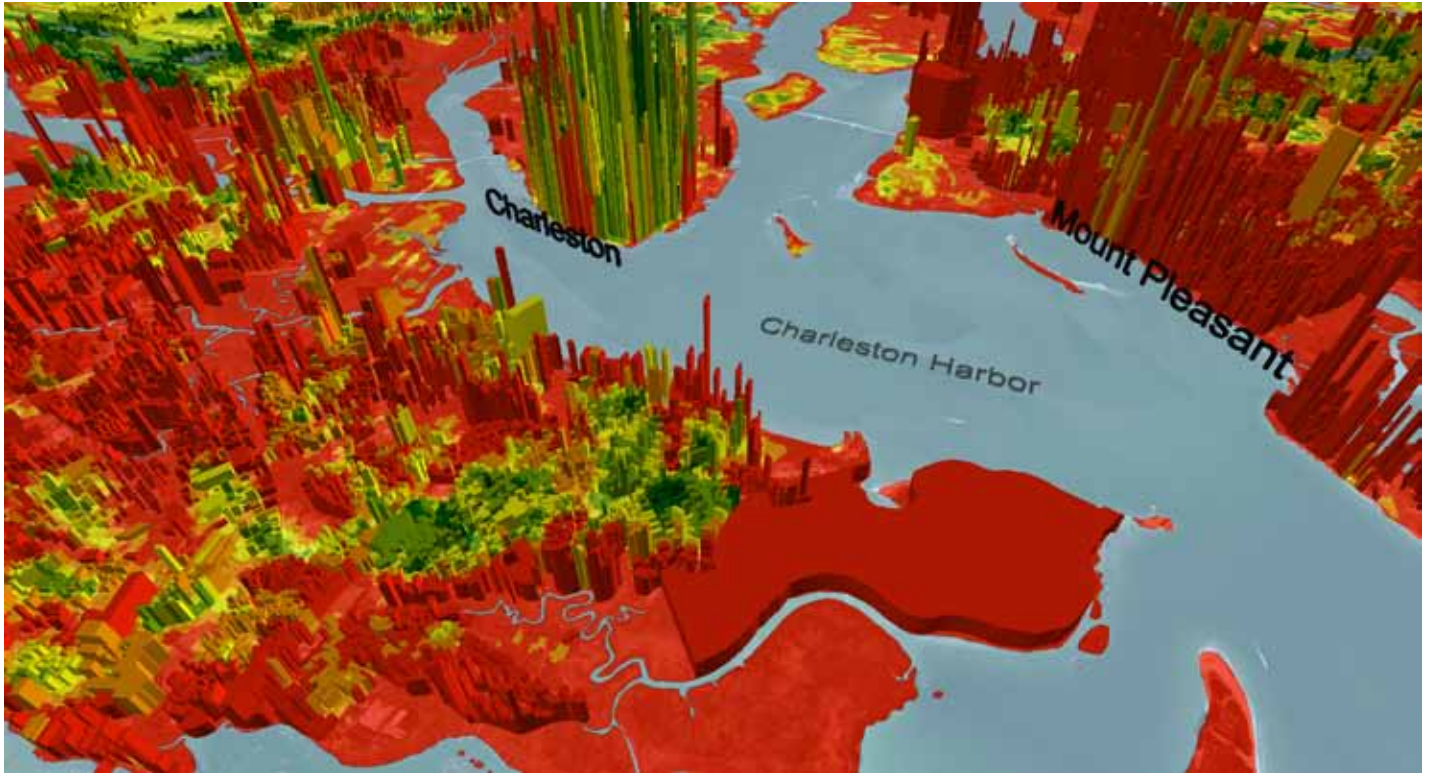
Hurricanes are a major threat to the Charleston area. The most notable hurricane was in 1989. Hurricane Hugo, which also impacted Myrtle Beach, caused severe destruction in the downtown and suburbs of Charleston. Storm surge inundated the coastline surrounding Charleston with tides reaching 20 feet in the areas between Cape Romain and Bulls Bay. In total, the damage from Hugo in South Carolina was \$4.2B.

Residential Exposure by Storm Category

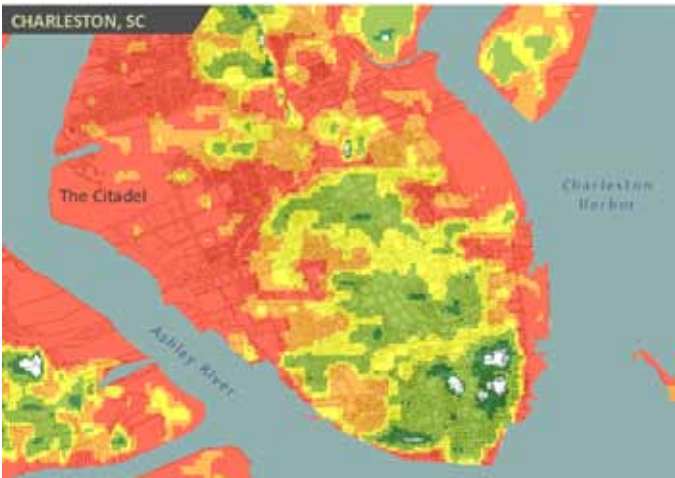
Storm Surge Risk Level	Total Properties Affected	Total Residential Structure Value
Extreme	31,040	\$8,119,156,835
Very High	46,924	\$11,795,260,025
High	59,973	\$14,204,397,095
Moderate	71,134	\$16,287,985,765
Low	81,046	\$17,743,046,566

Top 10 Areas Affected by Category 5 (Extreme) Storm

Area Name	ZIP	Properties Affected	Residential Structure Value
JOHNS ISLAND	29455	6,696	\$2,957,736,000
MOUNT PLEASANT	29464	12,492	\$2,853,918,200
MOUNT PLEASANT	29466	7,445	\$1,8482,87,700
JAMES ISLAND	29412	11,531	\$1,775,371,700
CHARLESTON	29407	9,380	\$1,299,926,500
CHARLESTON	29492	3,534	\$1,160,797,300
ISLE OF PALMS	29451	3,034	\$970,080,000
CHARLESTON	29401	1,577	\$890,766,900
CHARLESTON	29414	4,982	\$731,065,760
EDISTO ISLAND	29438	2,222	\$587,777,300



Parcel height is based on the structure value and colored based on storm surge risk



Storm surge risk with parcel boundaries



Greater Charleston storm surge risk

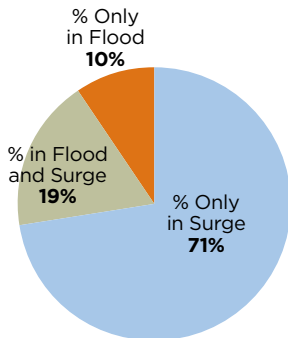
CORPUS CHRISTI, TEXAS

CATEGORY 5 EXPOSURE:
\$4,686,866,645

HURRICANE PROBABILITY:
EXTREME

**STORM-SURGE
VULNERABILITY:**
HIGH

RESIDENTIAL DENSITY:
MEDIUM



A Category 5 hurricane hitting the Corpus Christi area would expose nearly \$4.7B worth of residential property, affecting a total of over 44,000 properties. Even if the hurricane is only a Category 1 storm, it could cause Corpus Christi residents total property damage of over \$593M, affecting over 6,100 homes.

Residential areas that would be most affected by a hurricane would be the Gardendale and Southside neighborhoods of Corpus Christi, San Padre Island, Ingleside and Aransas Pass.

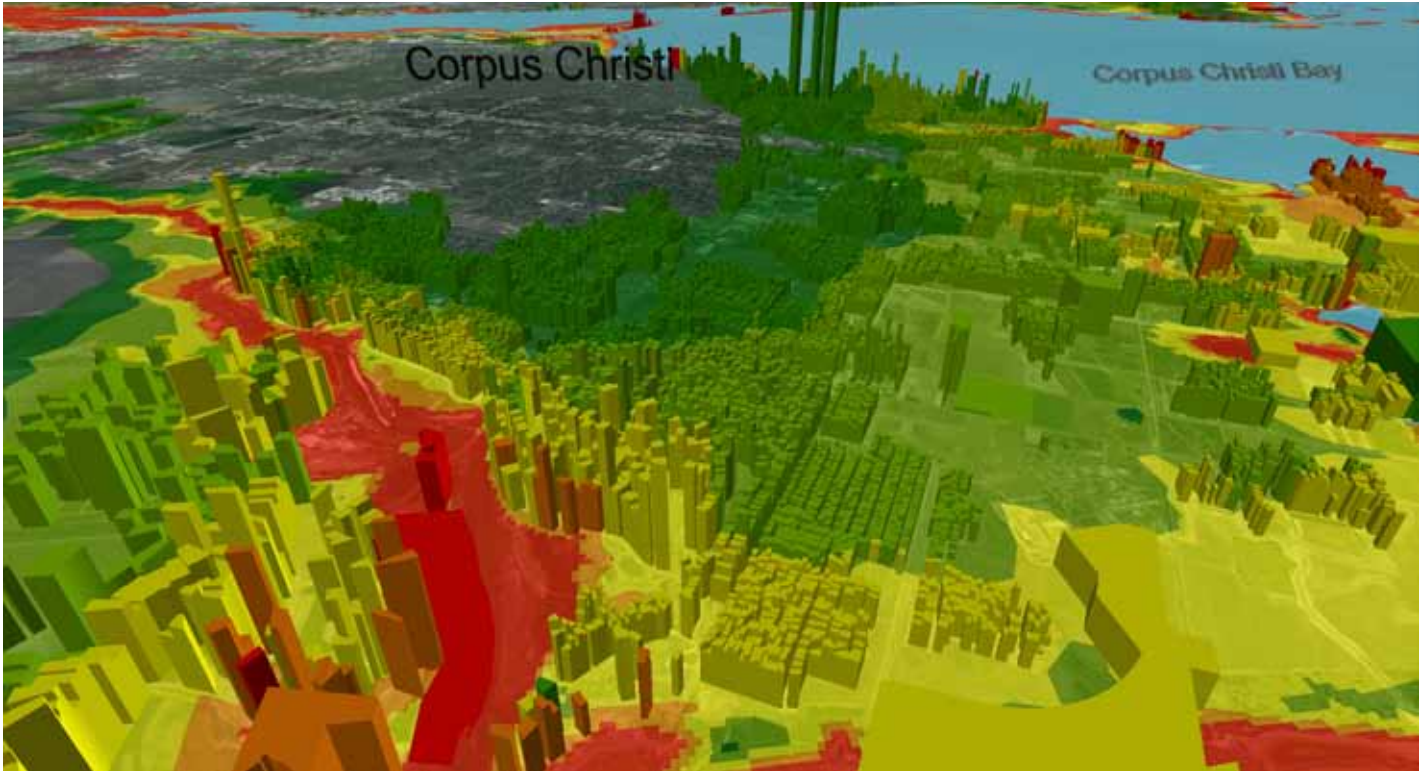
In 1919, a hurricane hit Corpus Christi making landfall on September 14, where the eye went inland south of the city. This unnamed storm was the fourth most intense and deadly storm of the 20th century. Tides rose 16 feet above normal and 287 lives were lost. As a main home to a number of Gulf of Mexico oil refineries and their workers, the Corpus Christi area was lucky to have avoided most of Hurricane Ike, which hammered the Texas coastline—in particular Galveston. While Corpus Christi has not been directly hit by a major hurricane in a number of years, it is often impacted by tropical storms, which can also have significant storm surge, the latest in 2007 with Tropical Storm Erin.

Residential Exposure by Storm Category

Storm Surge Risk Level	Total Properties Affected	Total Residential Structure Value
Extreme	6,169	\$593,085,500
Very High	8,973	\$846,857,840
High	15,060	\$1,505,992,908
Moderate	31,268	\$3,255,753,887
Low	44,306	\$4,686,866,645

Top 10 Areas Affected by Category 5 (Extreme) Storm

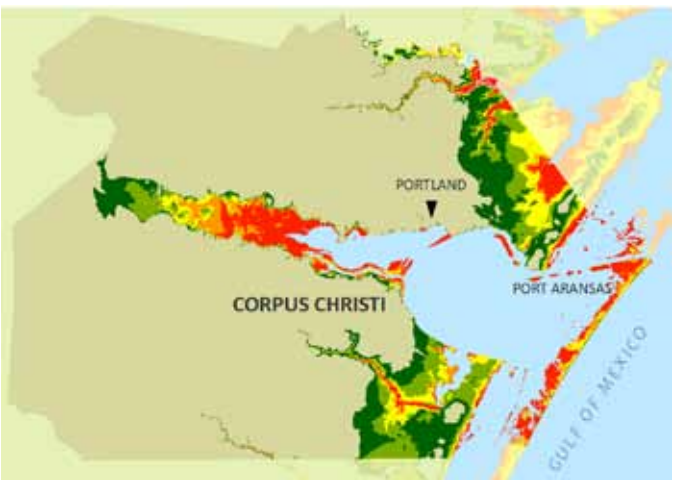
Area Name	ZIP	Properties Affected	Residential Structure Value
CORPUS CHRISTI / SOUTHSIDE	78414	8,546	\$1,186,135,488
GARDENDALE	78418	12,112	\$1,090,080,000
CORPUS CHRISTI / GULFWAY	78412	8,295	\$790,981,698
CORPUS CHRISTI / SOUTHSIDE	78413	4,859	\$656,496,060
INGLESIDE	78362	2,844	\$243,955,791
ARANSAS PASS	78336	2,938	\$241,849,523
CORPUS CHRISTI	78411	1,170	\$166,700,666
PORT ARANSAS	78373	1,747	\$15,7230,000
CORPUS CHRISTI	78410	430	\$53,117,019
PORTLAND	78374	154	\$25,160,933



Parcel height is based on the structure value and colored based on storm surge risk



Storm surge risk with parcel boundaries



Corpus Christi and surrounding area storm surge risk

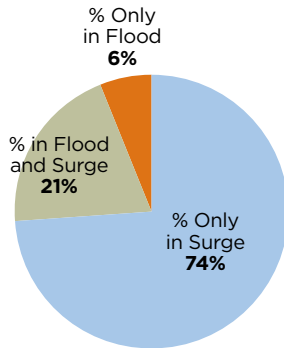
HOUSTON-GALVESTON, TEXAS

CATEGORY 5 EXPOSURE:
\$20,226,317,003

HURRICANE PROBABILITY:
EXTREME

**STORM-SURGE
VULNERABILITY:**
EXTREME

RESIDENTIAL DENSITY:
HIGH



A Category 5 hurricane slamming the Houston area could cause property damage of more than \$20B to residential properties and nearly 180,000 properties could be inundated with storm surge. Even if the hurricane is only a Category 1 storm, it could cause area residents total property damage of over \$1.9B.

Residential areas that would be worst affected include League City, Galveston, La Porte and the Clear Lake area of Houston.

In 2008, Hurricane Ike, the third costliest hurricane ever to make landfall in the U.S., cost residents of the Galveston area billions of dollars in property damage, wiping some of the coastal properties away. Ike made landfall as a Category 2 hurricane, but had a reported storm surge of a Category 5 overtopping the 17-foot seawall on Galveston Island.

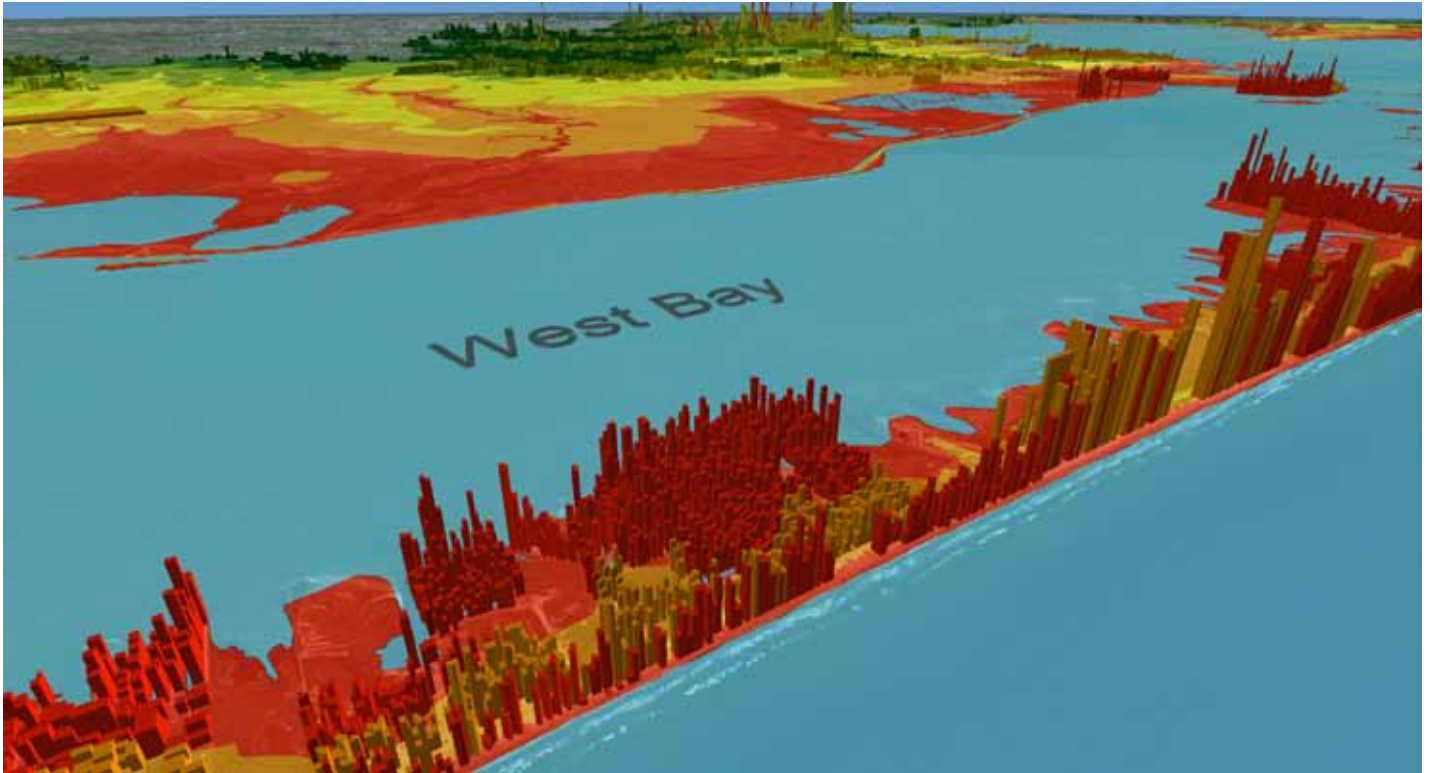
Prior to Ike, the Houston-Galveston area has had a long history with major hurricanes. In 1900, Galveston was hit with the deadliest natural disaster in U.S. history. A Category 4 hurricane, the storm surge inundated the entire island with 8- to 15-foot tides. At the time, the damage was estimated to be over \$30M. In 1983, Hurricane Alicia struck Galveston and Houston directly, initially making landfall on the western end of Galveston Island as a Category 3 storm causing \$2B in damage.

Residential Exposure by Storm Category

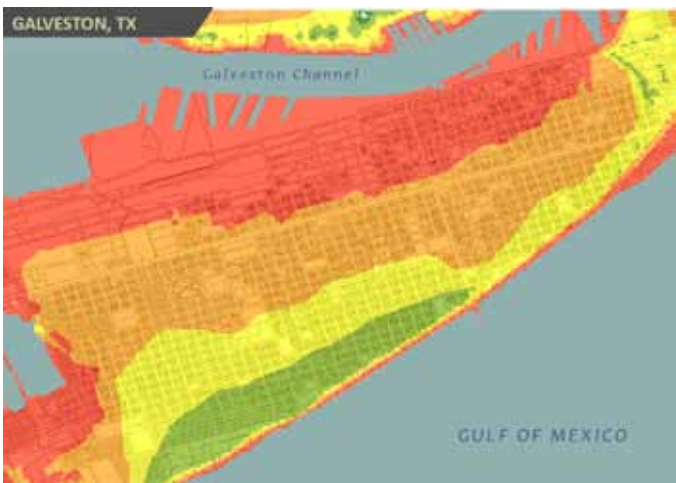
Storm Surge Risk Level	Total Properties Affected	Total Residential Structure Value
Extreme	15,584	\$1,910,838,702
Very High	35,126	\$3,760,928,079
High	81,228	\$8,520,424,972
Moderate	139,855	\$15,342,259,273
Low	179,929	\$20,226,317,003

Top 10 Areas Affected by Category 5 (Extreme) Storm

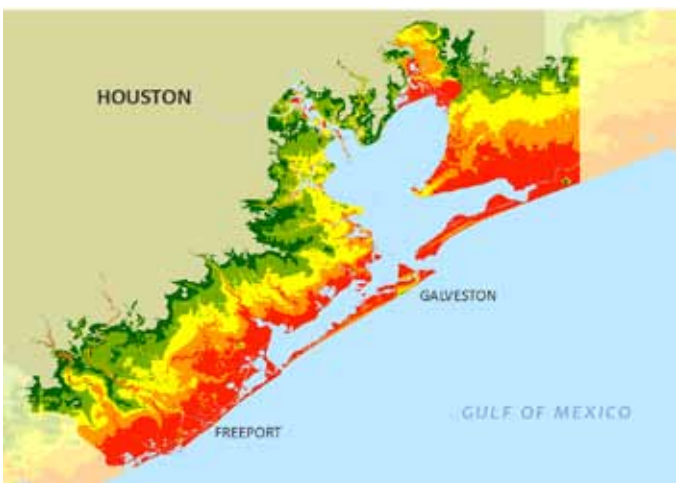
Area Name	ZIP	Properties Affected	Residential Structure Value
LEAGUE CITY	77573	19,921	\$2,894,447,935
GALVESTON	77554	7,531	\$1,341,196,841
CLEAR LAKE	77059	5,726	\$1,229,384,338
LA PORTE	77571	10,928	\$1,087,718,560
HOUSTON	77062	7,708	\$1,083,242,419
LAKE JACKSON	77566	9,066	\$1,070,383,346
SEABROOK	77586	6,446	\$1,036,174,311
DICKINSON	77539	11,275	\$1,031,848,017
FRIENDSWOOD	77546	4,316	\$993,401,386
BAYTOWN	77521	5,756	\$584,555,585



Parcel height is based on the structure value and colored based on storm surge risk



Greater Houston - Galveston storm surge risk



Storm surge risk with parcel boundaries

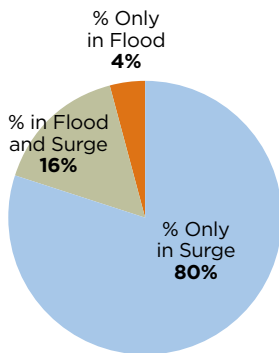
JACKSONVILLE, FLORIDA

CATEGORY 5 EXPOSURE:
\$19,612,946,046

HURRICANE PROBABILITY:
EXTREME

**STORM-SURGE
VULNERABILITY:**
HIGH

RESIDENTIAL DENSITY:
HIGH



A Category 5 hurricane striking the Jacksonville, Florida area could cause up to \$19.6B worth of damage and would affect over 135,000 properties in the area. Even if the hurricane is only a Category 1 storm, it could cause area residents total property damage of over \$3.5B, affecting over 16,000 homes.

In a Category 5 hurricane, six different areas would suffer property damage of over \$1B and one—the Ponte Vedra Beach area—would suffer property damage of over \$2.8B.

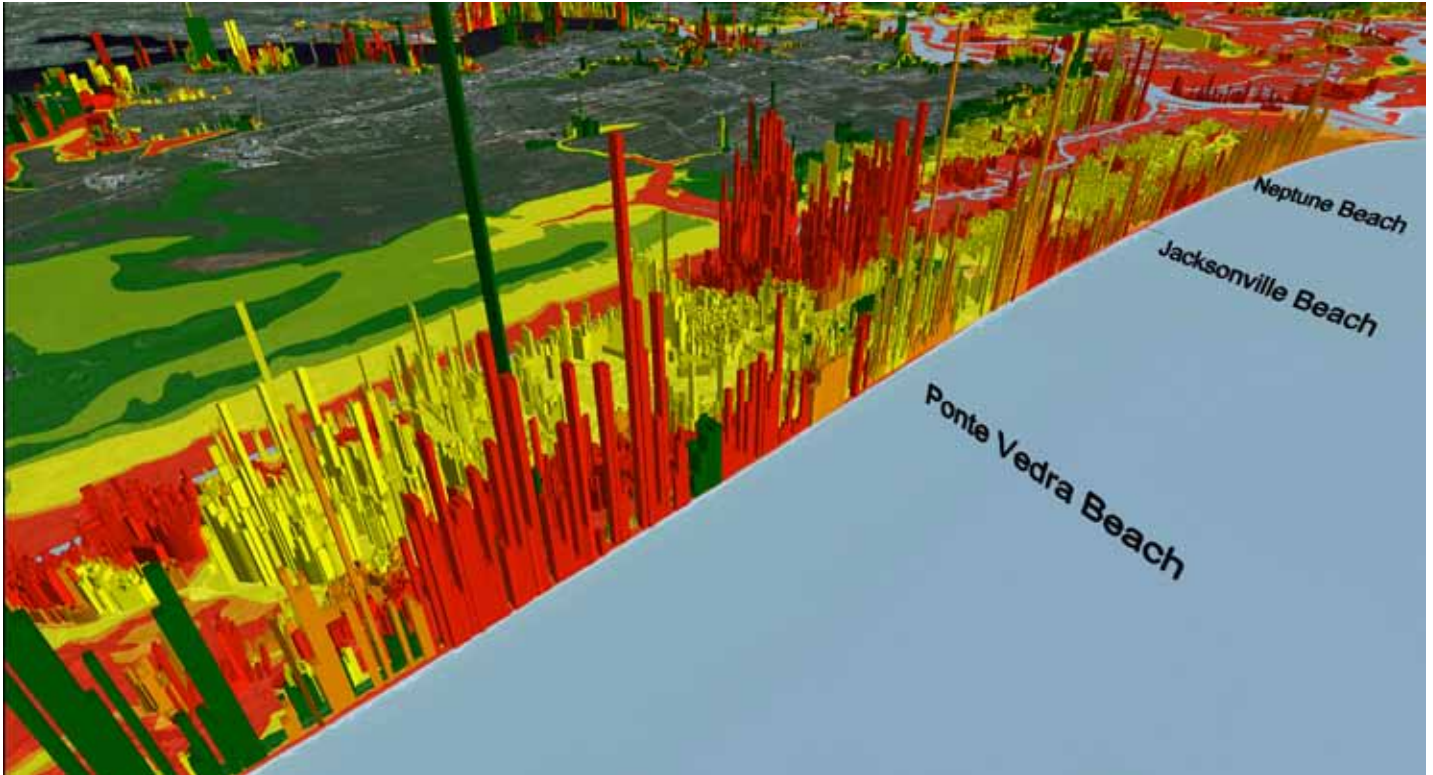
Jacksonville is one of the few cities on the Eastern coast of Florida that has been spared from the wrath of hurricanes. The only recorded hurricane to ever hit the First Coast directly was Dora, which made landfall on St. Johns County on September 10, 1964 as a Category 1 storm. Dora came ashore south of Mayport and her northeast winds sent an 8-foot surge into the St. Johns River.

Residential Exposure by Storm Category

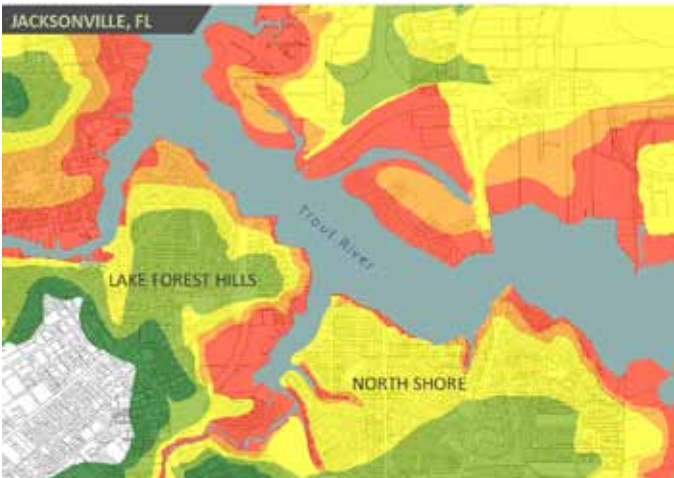
Storm Surge Risk Level	Total Properties Affected	Total Residential Structure Value
Extreme	16,246	\$3,548,673,071
Very High	30,665	\$5,941,893,119
High	72,036	\$12,440,070,903
Moderate	92,604	\$14,765,778,725
Low	135,157	\$19,612,946,046

Top 10 Areas Affected by Category 5 (Extreme) Storm

Area Name	ZIP	Properties Affected	Residential Structure Value
PONTE VEDRA BEACH	32082	9,902	\$2,841,125,301
FERNANDA BEACH	32034	10,450	\$1,740,800,173
JACKSONVILLE	32218	13,130	\$1,576,729,938
JACKSONVILLE	32225	6,086	\$1,275,270,736
SAINT AUGUSTINE	32080	7,515	\$1,196,311,596
JACKSONVILLE BEACH	32250	7,469	\$1,098,231,936
JACKSONVILLE	32210	5,932	\$999,792,309
JACKSONVILLE	32205	9,067	\$984,831,563
ATLANTIC BEACH	32233	6,252	\$929,922,385
JACKSONVILLE	32208	11,538	\$916,046,965



Parcel height is based on the structure value and colored based on storm surge risk



Storm surge risk with parcel boundaries



Jacksonville storm surge risk

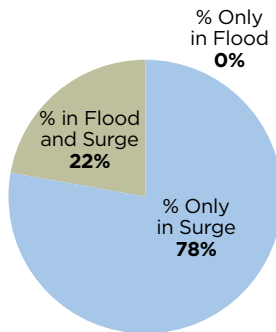
LONG ISLAND, NEW YORK

CATEGORY 4 EXPOSURE:
\$99,091,056,059

HURRICANE PROBABILITY:
LOW

**STORM-SURGE
VULNERABILITY:**
MEDIUM

RESIDENTIAL DENSITY:
EXTREME



There is a consensus among the scientific community that a Category 5 storm would not be sustainable off the coast of New York due to the cooler waters of the Atlantic. A Category 4 storm, however rare, is possible and would generate significant damage to the Long Island area of New York, if it were to make landfall. The storm surge from a Category 4 hurricane slamming Long Island, which is home to some of New York State's wealthiest residences, could cause property damage of nearly \$100B to residential properties. Over 250,000 properties could be exposed to the resulting storm surge. Even if the hurricane is only a Category 1 storm, it could cause Long Islanders total property damage of over \$32.1B impacting nearly 74,000 residential properties.

Residential areas that would be worst affected by the storm surge include the towns of West Islip, Massapequa and Riverhead and the Flatlands neighborhood in Brooklyn.

Long Island was hit with a Category 3 hurricane in the fall of 1938. The Great New England Hurricane of 1938, also known as the Long Island Express Storm, had storm surge along the Long Island coastline between 10- to 12-foot high, ultimately causing \$308M in damage at the time. The area was hit only a few years later by another Category 3 called the Great Atlantic Hurricane of 1944. This hurricane not only hit the coastline of Long Island, but moved along to Rhode Island and ultimately made landfall as a Category 2 in Maine with a total of \$100M in damage throughout these areas. In 1954, Hurricane Carol hit the coast of Long Island as a very fast-moving Category 3. The storm surge from this hurricane was reported between 8 to 10 feet causing \$461M in damage.

Residential Exposure by Storm Category

Storm Surge Risk Level	Total Properties Affected	Total Residential Structure Value
Extreme	77,673	\$32,172,176,579
Very High	130,029	\$53,391,342,005
High	197,375	\$79,049,198,222
Moderate	251,691	\$99,091,156,059

Top 10 Areas Affected by Category 5 (Extreme) Storm

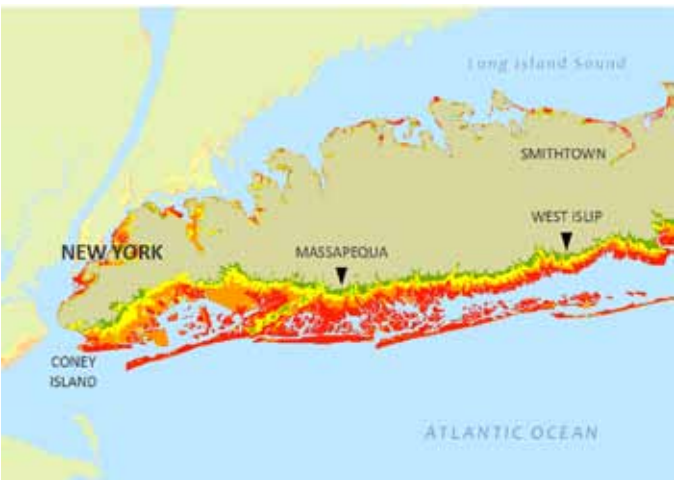
Area Name	ZIP	Properties Affected	Residential Structure Value
WEST ISLIP	11795	4,859	\$5,659,825,175
MASSAPEQUA	11758	8,482	\$5,457,451,492
RIVERHEAD	11901	2,190	\$4,994,020,625
FLATLANDS	11234	10,518	\$4,226,824,042
BAY SHORE	11706	2,777	\$3,440,586,475
EAST ISLIP	11730	3,066	\$3,186,495,575
BROOKLYN	11229	6,171	\$2,268,627,539
MERRICK	11566	6,942	\$2,226,349,684
BROOKLYN	11210	4,871	\$2,078,147,605
CUTCHOGUE	11935	1,107	\$2,010,266,550



Parcel height is based on the structure value and colored based on storm surge risk



Storm surge risk with parcel boundaries



Western Long Island storm surge risk

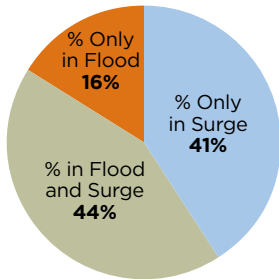
MIAMI-DADE TO PALM BEACH, FLORIDA

CATEGORY 5 EXPOSURE:
\$44,916,737,587

HURRICANE PROBABILITY:
EXTREME

STORM-SURGE VULNERABILITY:
HIGH

RESIDENTIAL DENSITY:
EXTREME



The Miami to Palm Beach area is uniquely situated to be impacted from hurricanes traveling from three different directions. These would include a direct hit from the Atlantic Ocean, an indirect hit from a Gulf hurricane passing over the Florida Peninsula and, in the worst scenario, a coast parallel hurricane moving up the coast, directly impacting the entire metro region.

If a Category 5 hurricane hits the greater Miami area, the cost to property could be nearly \$45B and would affect almost 247,000 properties in the area. Even if the hurricane is only a Category 1 storm, it could cause area residents total property damage of over \$15.8B, impacting nearly 52,000 homes.

In a Category 5 hurricane, the Pinecrest, Palmetto Bay, Jupiter, Palm Beach and Palm Beach Gardens areas would be worst hit, sustaining well over \$9.6B worth of damage.

The Great Miami Hurricane of 1926 hit downtown Miami Beach and downtown Miami as a Category 4. Storm surge from the storm was reported up to 15 feet. With every building in the downtown district damaged or destroyed, property loss at the time was estimated at \$100M.

Residential Exposure by Storm Category

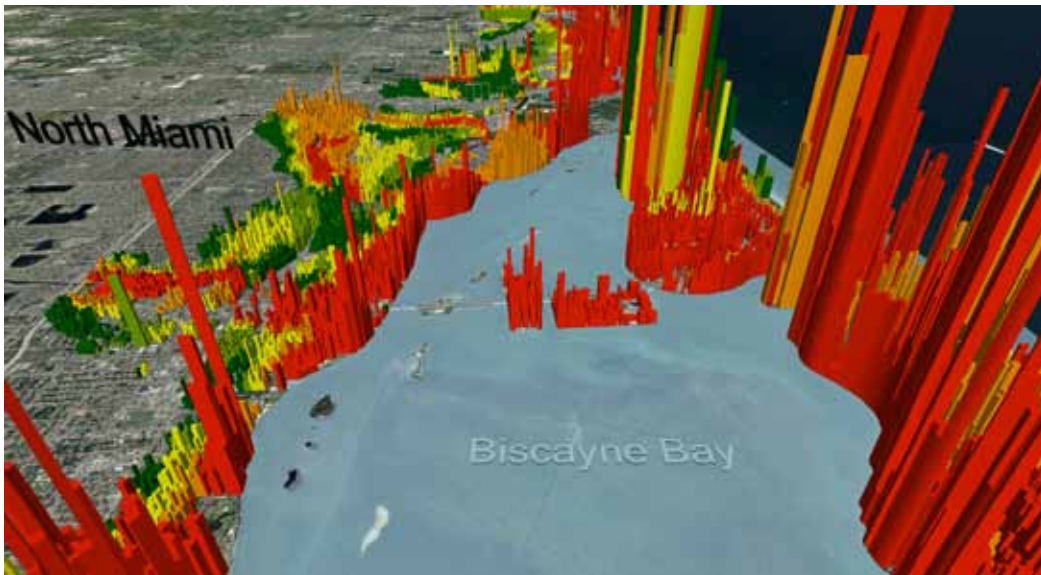
Storm Surge Risk Level	Total Properties Affected	Total Residential Structure Value
Extreme	51,842	\$15,841,502,340
Very High	76,878	\$20,351,815,769
High	145,644	\$29,996,121,353
Moderate	178,018	\$35,634,111,396
Low	246,945	\$44,916,737,587

Top 10 Areas Affected by Category 5 (Extreme) Storm

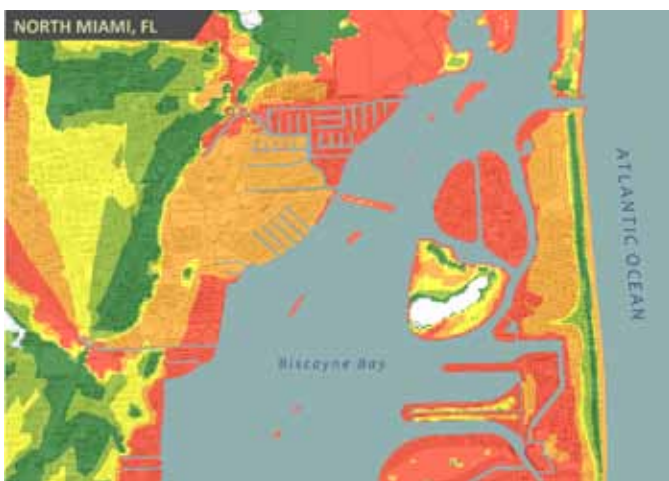
Area Name	ZIP	Properties Affected	Residential Structure Value
PINECREST	33156	6,626	\$2,516,829,970
PALMETTO BAY/PERRINE	33157	16,749	\$2,269,388,600
JUPITER	33458	10,546	\$1,8242,224,168
PALM BEACH GARDENS	33410	7,608	\$1,642,764,498
PALM BEACH	33480	2,143	\$1,404,867,918
JUPITER	33477	3,136	\$1,383,537,938
MIAMI	33143	2,615	\$1,338,468,021
MIAMI	33176	7,981	\$1,317,574,393
FORT LAUDERDALE	33301	2,959	\$1,304,530,545
FORT LAUDERDALE	33308	5,142	\$1,300,854,150

Miami is an area normally associated with severe hurricane seasons, although it has avoided a heavy one since Hurricane Andrew in 1992, which cost \$26.5B worth of damage in the area due to 17-foot storm surge and heavy winds.

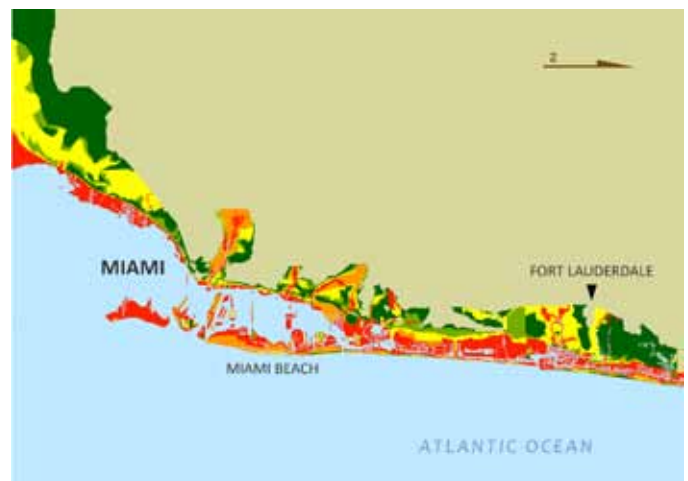
In 2005, Hurricane Katrina made landfall as a Category 1 on the border of Broward and Miami-Dade counties before heading into the Gulf Coast and hitting Louisiana. Storm surge along Florida was 3 to 5 feet with property damage running between \$1 and \$2B.



Parcel height is based on the structure value and colored based on storm surge risk



Storm surge risk with parcel boundaries



Miami to Fort Lauderdale storm surge risk

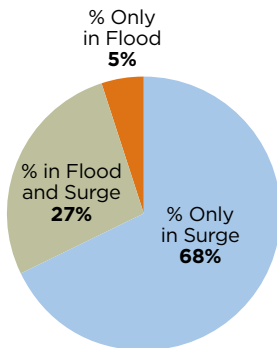
MOBILE - GULF SHORES, ALABAMA

CATEGORY 5 EXPOSURE:
\$3,037,177,310

HURRICANE PROBABILITY:
HIGH

**STORM-SURGE
VULNERABILITY:**
HIGH

RESIDENTIAL DENSITY:
MEDIUM



A Category 5 hurricane on the Saffir/Simpson schedule striking the Alabama shoreline of the Gulf of Mexico would expose over \$3B worth of residences to storm surge, affecting over 31,000 properties. Even if the hurricane is only a Category 1, it could cause residents total property damage of over \$250M, affecting over 2,100 homes.

Residential areas that would be most affected by a hurricane would be the neighborhoods of Mobile near the Dog River and the towns of Gulf Shores, Orange Beach, Satsuma, and Theodore.

In 1906, 1916 and 1926, unnamed hurricanes created a storm surge of 10 feet along the coast of Alabama. In 1950, Hurricane Baker, a Category 1 storm, came ashore August 30 with gusts up to 115 mph and produced storm surge that reached all the way to the panhandle of Florida. In 1969, Hurricane Camille, one of the most powerful storms in U.S. history, produced a record storm surge of 24.5 feet above sea level at Pass Christian, Mississippi. Alabama experienced damage all along U.S. Highway 90, with 26,000 homes and over 1,000 businesses wiped out completely. Camille's large circulation also resulted in a 3- to 5-foot storm surge in Apalachicola, Florida. On September 12, 1979, Hurricane Frederic passed 45 miles to the west of Gulf Shores as a Category 3. Storm-surge damage was reported along 80 miles of coastline from Mississippi to Florida, with tides 8 to 12 feet above normal. Near-total property damage occurred along the Alabama coastline between Fort Morgan and Gulf Shores, the latter seeing 80 percent of its buildings completely destroyed. The causeway linking Dauphin Island to the mainland was swept away in many areas and 70 percent of Dauphin Island was completely inundated by the storm surge from Camille.

Residential Exposure by Storm Category

Storm Surge Risk Level	Total Properties Affected	Total Residential Structure Value
Extreme	2,154	\$250,315,400
Very High	8,572	\$940,554,200
High	13,817	\$1,448,225,200
Moderate	20,736	\$2,140,762,110
Low	31,137	\$3,037,177,310

Top 10 Areas Affected by Category 5 (Extreme) Storm

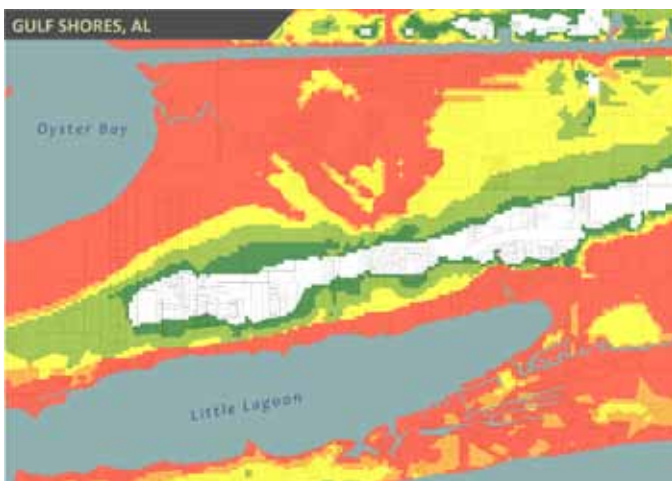
Area Name	ZIP	Properties Affected	Residential Structure Value
MOBILE/BAYSIDE	36605	8,316	\$536,143,100
GULF SHORES	36542	2,965	\$475,124,910
ORANGE BEACH	36561	1,967	\$283,670,700
MOBILE	36606	2,882	\$240,421,100
SATSUMA	36572	1,979	\$240,277,300
THEODORE	36582	1,546	\$214,583,100
MOBILE	36604	1,532	\$148,333,000
MOBILE	36693	520	\$97,166,100
MOBILE	36619	751	\$96,240,000
SARALAND	36571	1,205	\$86,301,900

More recently, the state of Alabama was heavily hit by Hurricane Ivan in 2004 and Katrina in 2005. In 2004, Ivan was a very powerful and unusual storm. It was the first major hurricane on record to form as low as 10 degrees latitude. Ivan broke several hydrological records; it is credited with possibly causing the largest ocean wave ever recorded, a 91-foot wave that may have been as high as 131 feet and the fastest sea-floor current, at 5 miles per hour. High surf and wind brought extensive damage to Orange Beach, near the Alabama border with Florida. There, two five-story condominium buildings

were undermined to the point of collapse by Ivan's storm surge of 14 feet. Both were made of steel-reinforced concrete. Debris gathered in piles along the storm tide, exacerbating the damage when the floodwaters crashed into homes sitting on pilings. In 2005, Hurricane Katrina made landfall in Louisiana, well to the west of Mobile, Alabama. However, Mobile was affected by a storm surge varying from 12 to 16 feet around Mobile Bay, with higher waves on top. The surge caused significant flooding several miles inland, along Mobile Bay, as well.



Parcel height is based on the structure value and colored based on storm surge risk



Storm surge risk with parcel boundaries



Greater Mobile storm surge risk

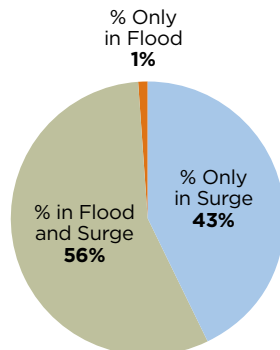
NEW ORLEANS, LOUISIANA

CATEGORY 5 EXPOSURE:
\$38,863,232,202

HURRICANE PROBABILITY:
HIGH

**STORM-SURGE
VULNERABILITY:**
EXTREME

RESIDENTIAL DENSITY:
MEDIUM



Six years after Katrina pushed a massive surge that overtopped levees and floodwalls in the greater New Orleans area, the Army Corps of Engineers has completed raising the area levees, rebuilding flood walls and creating a massive Lake Borgne Surge Barrier. The Hurricane and Storm Damage Risk Reduction System is designed to provide a 100-year level of protection for, and essentially to withstand, a surge created by a Category 1 to Category 3 hurricane. As a result of these changes, a significant number of properties previously in a storm-surge zone will now be out of the Extreme to High Risk zones.

A lack of coastal irregularities, such as substantial barrier islands or hills and the Gulf of Mexico's flat bottom make southern Louisiana especially susceptible to storm surge. New Orleans sits mostly below sea level on the east bank of the Mississippi River and south of Lake Pontchartrain. A Category 5 hurricane striking the New Orleans area would inundate nearly \$39B worth of residences and over 278,000 properties with storm surge. If levees are topped or fail, as they did in the case of Hurricane Katrina, the water would be trapped within these areas, causing additional damage. Even if the hurricane is only a Category 1 storm, it could still inundate over \$26B worth of property and affect over 196,000 homes.

In 2005, Hurricane Katrina battered the area, causing a monstrous \$85.6B worth of damage, with New Orleans taking the brunt of the economic and social damage. On Sunday, August 28, a day before making landfall, Katrina built up strength in the warm waters of the Gulf of Mexico and achieved Category 5 status with sustained winds of about 160 mph as it approached the Gulf Coast. A record 28-foot storm surge was projected for the New Orleans area.

Residential Exposure by Storm Category

Storm Surge Risk Level	Total Properties Affected	Total Residential Structure Value
Extreme	196,207	\$26,377,553,803
Very High	223,347	\$30,553,585,609
High	247,228	\$33,809,945,611
Moderate	265,025	\$36,482,462,006
Low	278,185	\$38,863,232,202

Top 10 Areas Affected by Category 5 (Extreme) Storm

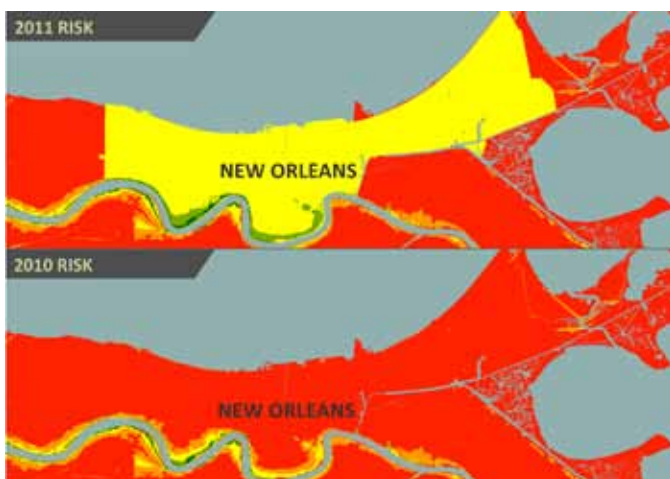
Area Name	ZIP	Properties Affected	Residential Structure Value
NEW ORLEANS	70115	7,041	\$1,996,036,500
MARRERO	70072	17,783	\$1,910,043,286
NEW ORLEANS	70118	7,026	\$1,848,315,125
KENNER	70065	12,813	\$1,818,485,375
COVINGTON	70433	7,495	\$1,633,316,702
METAIRIE	70003	13,566	\$1,552,058,362
METAIRIE	70005	7,466	\$1,538,853,674
SLIDELL	70458	12,593	\$1,466,570,700
HARVEY	70058	10,554	\$1,287,061,975
NEW ORLEANS	70131	7,340	\$1,283,874,375

Katrina weakened slightly to a Category 4 hurricane as it made landfall early Monday, August 29, but it maintained a storm surge that is only generally found in Category 5 storms. When the wind speed began to go down, the storm surge did not dissipate, due to the water momentum established by the storm in the shallow water. Although the storm surge to the east of the path of the eye in Mississippi was higher, a very significant surge affected the Louisiana coast. Katrina's storm surge inundated all parishes surrounding Lake Pontchartrain, including St. Tammany, Tangipahoa, St. John the Baptist and St. Charles Parishes. St. Tammany Parish received a two-part storm

surge: first, as Lake Pontchartrain rose, the storm blew water from the Gulf of Mexico into the lake. Second, as the eye of Katrina passed, westerly winds pushed water into a bottleneck at the Rigolets Pass, forcing it farther inland. The range of surge levels in eastern St. Tammany Parish is estimated at 13 to 16 feet. Katrina's storm surge led to 53 levee breaches in the levee system protecting New Orleans and the failure of the Arpent Canal levee. The major levee breaches in the city included the 17th Street Canal levee, the London Avenue Canal and the wide, navigable Industrial Canal, which left approximately 80 percent of the city flooded.



Storm surge risk and the New Orleans levee system



Storm surge risk with parcel boundaries



Greater New Orleans storm surge risk

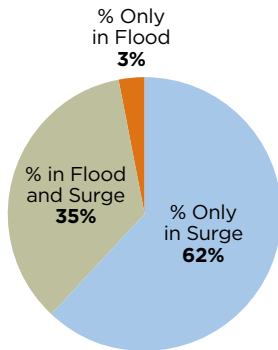
TAMPA, FLORIDA

CATEGORY 5 EXPOSURE:
\$27,506,921,999

HURRICANE PROBABILITY:
EXTREME

STORM-SURGE
VULNERABILITY:
HIGH

RESIDENTIAL DENSITY:
HIGH



A Category 5 hurricane striking the Tampa shoreline of the Gulf of Mexico could cause over \$27B worth of property damage and inundate over 277,000 properties with storm surge. Even if the hurricane is only a Category 1 storm, it could cause area residents total property damage of over \$8B, affecting nearly 64,000 homes.

Residential areas that would be most affected by a hurricane would be the Palma Ciega, Westchase and Town N' Country neighborhoods of Tampa, as well as portions of St. Petersburg and Palm Harbor.

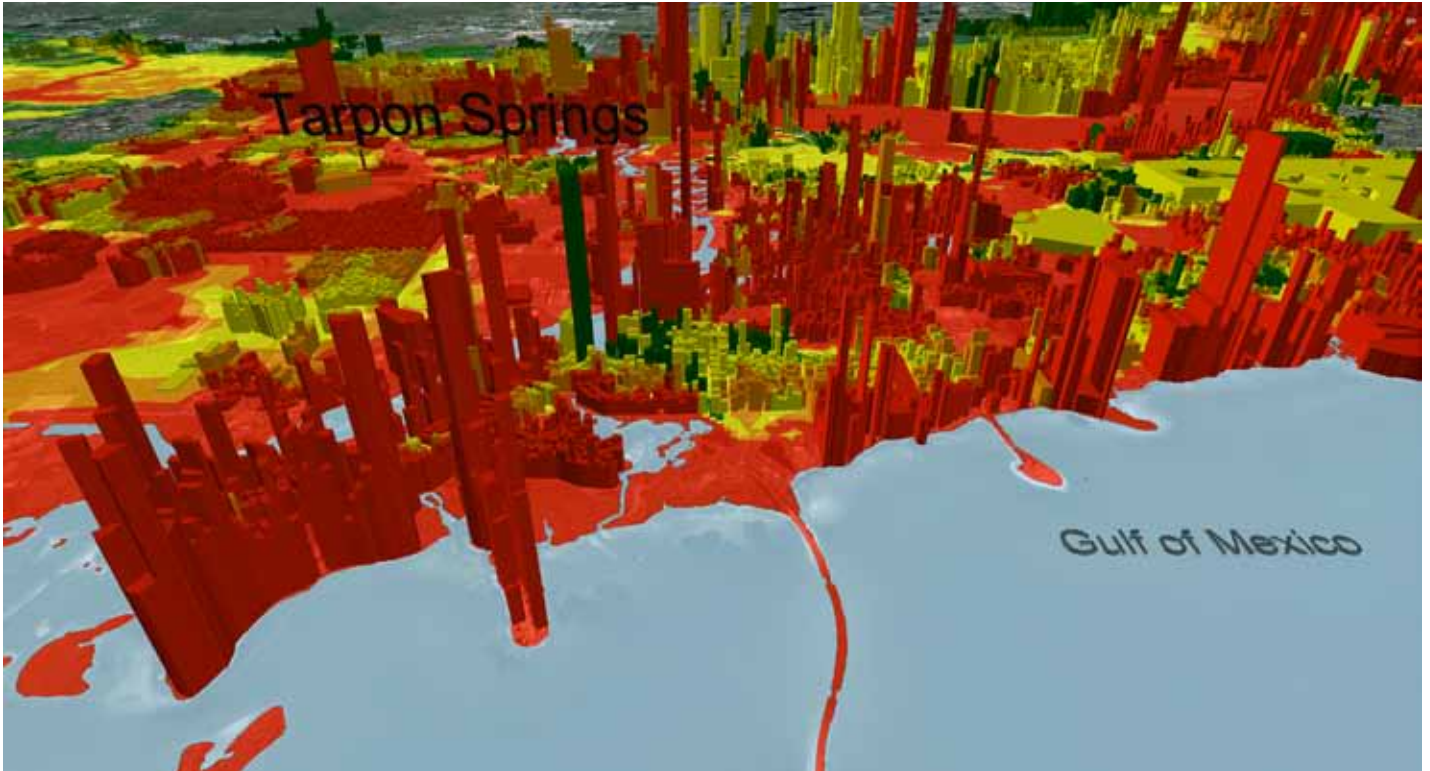
The first hurricane to make landfall directly in Tampa was in 1921. Known as the Tampa Bay Hurricane of 1921, the Category 2 hurricane brought storm surge of 10 to 12 feet causing \$10B in property damage at the time. Tampa was also impacted by Hurricane Andrew in 1992 as it crossed the southern peninsula of Florida. It hammered the Tampa/Miami area of Florida, causing \$43.7B worth of damage, one of the most destructive U.S. hurricanes on record.

Residential Exposure by Storm Category

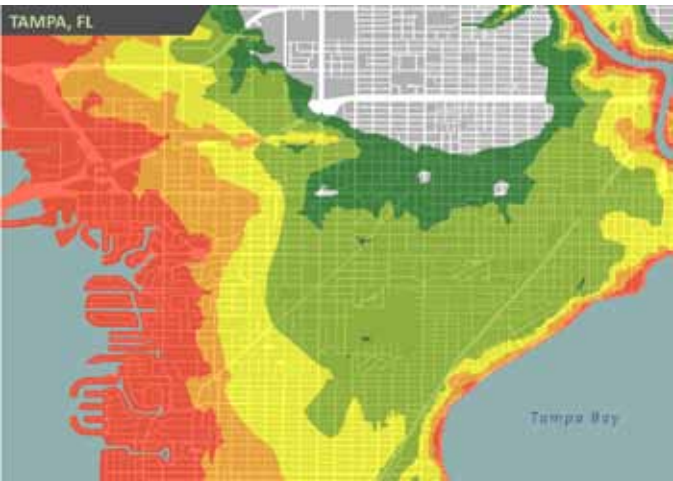
Storm Surge Risk Level	Total Properties Affected	Total Residential Structure Value
Extreme	63,914	\$8,055,316,959
Very High	117,663	\$13,491,654,928
High	182,613	\$19,365,170,572
Moderate	235,189	\$23,934,027,790
Low	277,324	\$27,506,921,999

Top 10 Areas Affected by Category 5 (Extreme) Storm

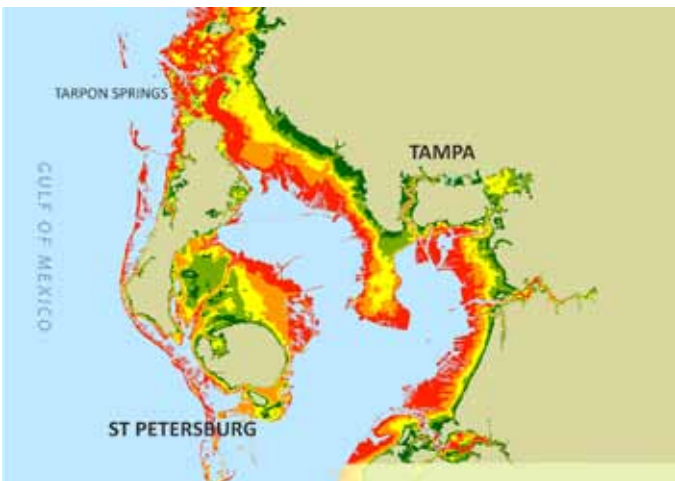
Area Name	ZIP	Properties Affected	Residential Structure Value
PALM CIEA	33629	7,756	\$1,234,193,136
WESTCHASE	33626	5,434	\$1,108,319,550
TOWN N' COUNTRY	33615	9,562	\$836,701,435
TAMPA	33611	8,026	\$827,750,401
SAINT PETERSBURG	33703	8,097	\$820,790,674
PALM HARBOR	34685	3,992	\$794,627,952
NEW PORT RICHEY	34655	8,085	\$791,530,552
PORT RICHEY	34668	15,613	\$776,196,164
HUDSON	34667	10,223	\$739,002,445
TARPON SPRINGS	34689	6,864	\$722,554,519



Parcel height is based on the structure value and colored based on storm surge risk



Storm surge risk with parcel boundaries



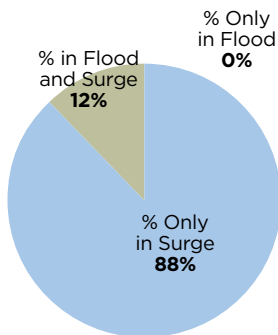
Tampa Bay regional storm surge risk

VIRGINIA BEACH, VIRGINIA

CATEGORY 5 EXPOSURE:
\$44,614,891,132

HURRICANE PROBABILITY:
MEDIUM

**STORM-SURGE
VULNERABILITY:**
HIGH



Virginia Beach sits on the Atlantic Ocean at the mouth of the Chesapeake Bay, which is the largest estuary in the U.S., covering more than 64,000 square miles and spanning across several states. The Hampton Roads Core Based Statistical Area (officially known as the Virginia Beach–Norfolk–Newport News, VA–NC CBSA) is the 36th largest in the U.S., with a total population of 1,671,683 according to the 2010 U.S. Census.

A Category 5 hurricane striking the Virginia Beach area could cause nearly \$45B worth of residential damage and would affect almost 289,000 properties in the area. Even if the hurricane is only a Category 1 storm, it could still cause area residents total property damage of close to \$10B, impacting over 59,000 homes.

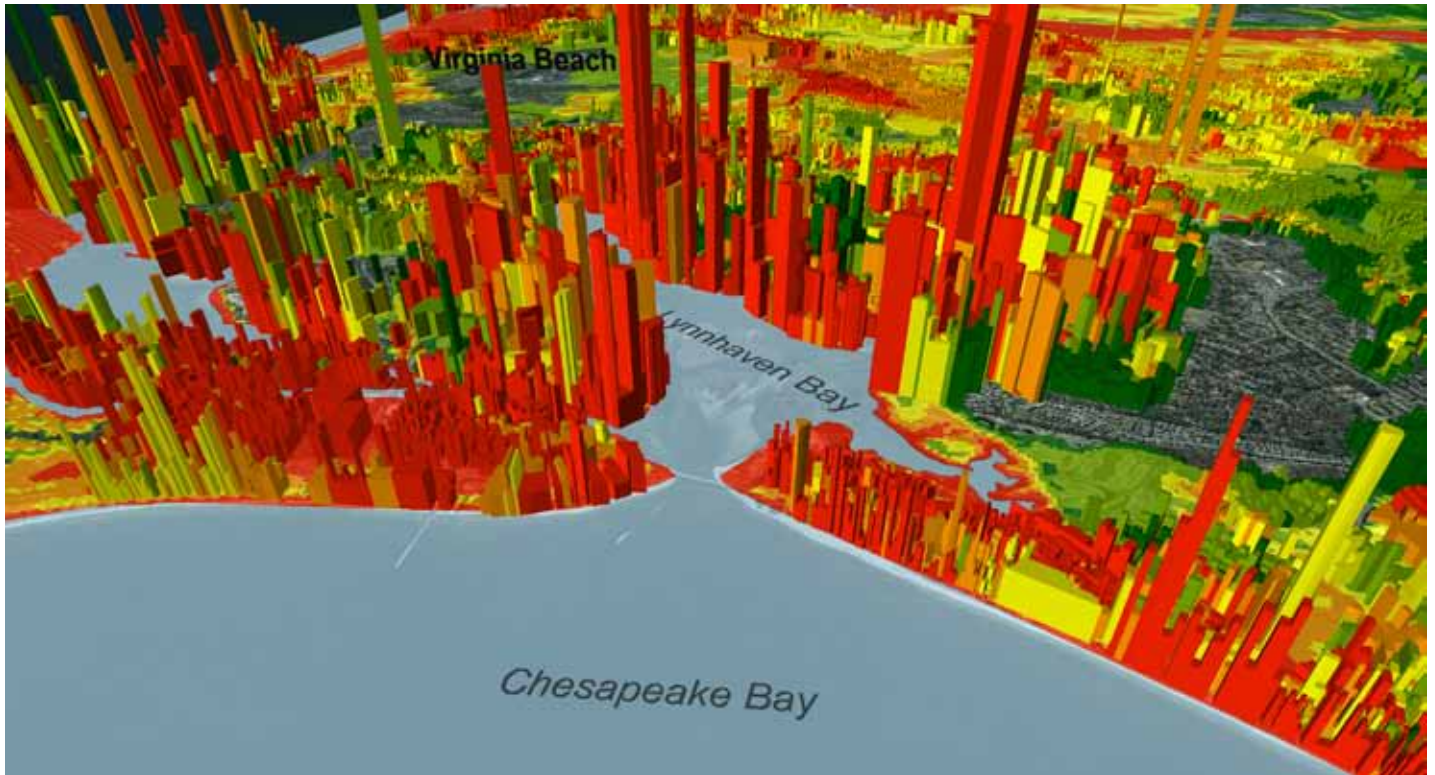
Virginia has not been seriously hit since Hurricane Floyd in 1999. That hurricane had storm surge between 9 to 10 feet with total damage of \$30–40M caused by flood damage from rain, surge and hurricane-spawned tornados.

Residential Exposure by Storm Category

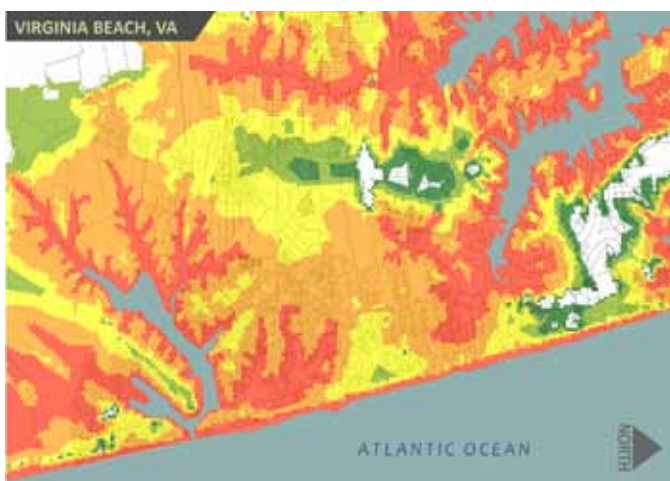
Storm Surge Risk Level	Total Properties Affected	Total Residential Structure Value
Extreme	59,168	\$9,923,690,733
Very High	144,340	\$22,474,221,762
High	212,143	\$32,508,608,705
Moderate	270,310	\$41,290,103,763
Low	288,677	\$44,614,891,132

Top 10 Areas Affected by Category 5 (Extreme) Storm

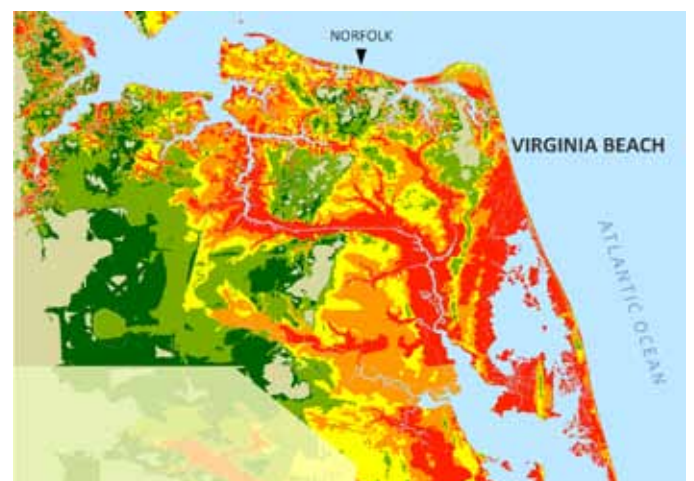
Area Name	ZIP	Properties Affected	Residential Structure Value
VIRGINIA BEACH	23456	15,404	\$2,938,554,000
CHESAPEAKE	23322	13,508	\$2,669,253,700
VIRGINIA BEACH	23464	16,351	\$2,313,187,000
VIRGINIA BEACH	23452	14,302	\$1,891,023,918
VIRGINIA BEACH	23454	11,197	\$1,842,503,405
HAMPTON	23669	12,069	\$1,710,872,290
HAMPTON	23666	10,810	\$1,645,273,000
CHESAPEAKE	23320	9,053	\$1,593,053,500
CHESAPEAKE	23321	9,016	\$1,529,943,400
CHESAPEAKE	23323	10,444	\$1,527,750,100



Parcel height is based on the structure value and colored based on storm surge risk



Storm surge risk with parcel boundaries

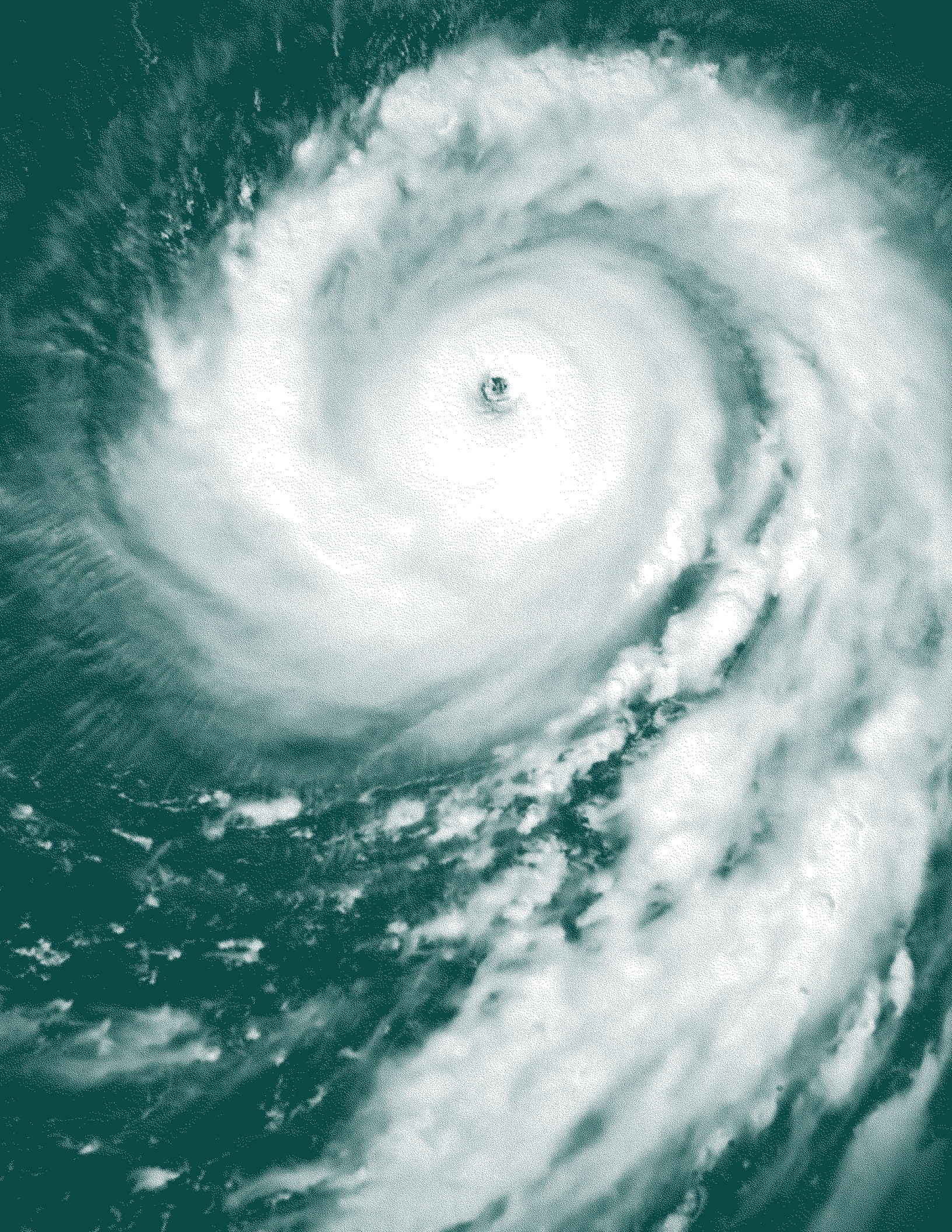


Greater Virginia Beach storm surge risk

Conclusion

Coastal storm surges are very complex events that consist of many different components that significantly impact loss of life and property damage. Surge-risk data provide an effective tool for understanding geographically localized risk. A critical component of using this information effectively is to analyze the data at the highest level of granularity possible. By using predefined surge-inundation areas updated annually, insurance companies, homeowners, emergency planners and others can understand surge risk at the parcel level. This report makes clear both the geographic and economic impact of hurricane-driven storm surge. While it would be easy to lump storm surge with the traditional flood risk element, it would be incorrect to assume that these risks are identical. One of the most important elements of this study is realizing that having a coastal property located outside a FEMA-defined flood zone doesn't necessarily mean the homeowner is free from risk since, as is clearly indicated, there are many areas with little correlation between flood zones and storm surge inundation zones.

From an insurance perspective, as demonstrated by this research, American Atlantic and Gulf Coastal cities are at risk from storm surge. Insurers have been abandoning the coastal market due to an inability to quantify risk at the micro level. Yet as coastal population density continues to grow, so does the need for insurance coverage. CoreLogic Coastal Storm Surge Risk provides an increase in accuracy and overall granularity by combining five data sets: coastal surge risk, hurricane propensity, coastal water feature and mainland determination and elevation into a logical scoring method. CoreLogic Coastal Risk provides insurers with a highly accurate property-based methodology for understanding hazard risk information, so insurers can better understand a property's coastal risk exposure for improved underwriting without resorting to broad brush exclusion strategies. With Coastal Risk, insurers will not only improve underwriting decisions, they will be able to: reduce the potential for loss and adverse selection over traditional insurance practices; understand their potential for surge loss; and determine the potential for hurricane losses resulting from storm surge. Coastal surge and hurricane propensity files are available for the Atlantic and Gulf coastal areas, while the other data sets cover all coastal waters and the Great Lakes.



ABOUT CORELOGIC

CoreLogic is a leading provider of consumer, financial and property information, analytics and services to business and government. The company combines public, contributory and proprietary data to develop predictive decision analytics and provide business services that bring dynamic insight and transparency to the markets it serves. CoreLogic has built the largest and most comprehensive U.S. real estate, mortgage application, fraud and loan performance databases and is a recognized leading provider of mortgage and automotive credit reporting, property tax, valuation, flood determination and geospatial analytics and services. More than one million users rely on CoreLogic to assess risk, support underwriting, investment and marketing decisions, prevent fraud and improve business performance in their daily operations. Formerly, the information solutions group of The First American Corporation, CoreLogic began trading under the ticker CLGX on the NYSE on June 2, 2010. The company, headquartered in Santa Ana, Calif., has more than 10,000 employees globally with 2010 revenues of \$1.6 billion. For more information visit www.corelogic.com.



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