

= Hurricane Bob =

Hurricane Bob was one of the costliest hurricanes in New England history . The second named storm and first hurricane of the 1991 Atlantic hurricane season , Bob developed from an area of low pressure near The Bahamas on August 16 . The depression steadily intensified , and became Tropical Storm Bob late on August 16 . Bob curved north @-@ northwestward as a tropical storm , but re @-@ curved to the north @-@ northeast after becoming a hurricane on August 17 . As such , it brushed the Outer Banks of North Carolina on August 18 and August 19 , and subsequently intensified into a major hurricane ( Category 3 or greater on the Saffir @-@ Simpson Hurricane Scale ) . After peaking in intensity with maximum sustained winds of 115 mph ( 185 km / h ) , Bob weakened slightly as it approached the coast of New England .

Bob made landfall twice in Rhode Island as a Category 2 hurricane on August 19 , first on Block Island and then in Newport . Upon doing so , it became the only hurricane to make landfall in the contiguous United States during the 1991 season . Moving further inland , Bob rapidly weakened , and deteriorated to a tropical storm while emerging into the Gulf of Maine . Shortly thereafter , Bob made landfall in Maine as a strong tropical storm early on August 20 . Bob entered the Canadian province of New Brunswick a few hours later , where it transitioned into an extratropical cyclone . By August 21 , the remnants of Bob crossed Newfoundland and re @-@ emerged into the open Atlantic Ocean . The remnants traveled a long distance across the northern Atlantic Ocean , and finally dissipated west of Portugal on August 29 .

Bob left extensive damage throughout New England in its wake , totaling approximately \$ 1 @.@ 5 billion ( 1991 USD , \$ 2 @.@ 61 billion 2016 USD ) . This made it the second costliest United States hurricane at the time ; as of 2013 , it ranked thirty @-@ second in the category . In addition , seventeen fatalities were reported in association with Bob . The loss of life and most of the damage occurred as a result of high winds and rough seas . There were six confirmed tornadoes during its passage . Bob is the most recent hurricane to hit the New England states directly as a hurricane .

= = Meteorological history = =

Hurricane Bob originated from the remnants of a frontal trough to the southeast of Bermuda on August 12 . The system tracked towards the southwest and later west towards the Bahamas . By August 15th , satellite analysis of the system found a weak low pressure area a couple hundred miles east of the Bahamas . Operationally , the system was not declared a tropical depression until 0600 UTC on August 16 after a reconnaissance mission into the storm found a closed circulation and flight level winds of 37 mph ( 60 km / h ) . After post @-@ storm analysis , it was determined that the low had developed into a depression around 0000 UTC . Several hours after being designated , the system began to develop convective banding features . Roughly 18 hours after being declared a depression , the National Hurricane Center ( NHC ) upgraded it to a tropical storm , giving it the name Bob . At this time , Bob was situated roughly 140 mi ( 225 km ) northeast of Nassau , Bahamas . The storm tracked slowly towards the northwest in response to the deep layer mean flow it was embedded within .

A deepening trough over the eastern United States was forecast to turn the storm toward the north on August 16 . This turn took place earlier than forecasters anticipated . The storm slowly intensified as convection was displaced from the center of circulation ; however , upper @-@ level outflow was well @-@ defined and intensification of the storm was expected as it tracked over the Gulf Stream . Later that day , Bob began to consolidate and a reconnaissance plane recorded hurricane @-@ force winds at 1719 UTC , following this reading , the NHC upgraded the storm to a Category 1 hurricane on the Saffir ? Simpson Hurricane Scale . Shortly after , the hurricane began to turn towards the north @-@ northeast in response to a subtropical ridge over the Atlantic and the trough over the southeastern United States .

By August 18 , the NHC noted that the hurricane was asymmetrical , having uneven distribution of the wind radii . Later that day , deep convection continued to form and an eye later appeared on satellite imagery . Early the next day , the eye became increasingly defined as the center of Bob

passed roughly 35 mi ( 55 km ) from the North Carolina coastline . By 0600 UTC , Hurricane Hunters recorded flight level winds of 140 mph ( 225 km / h ) , corresponding to surface winds of 115 mph ( 185 km / h ) . At this time , the barometric pressure of the storm also decreased to 950 mbar ( hPa ; 28 @. @ 05 inHg ) , the lowest pressure recorded during the storm . After attaining this intensity , the hurricane tracked quickly northeast at 25 mph ( 35 km / h ) , steered by the trough over the southeast United States , an upper @-@ level cutoff low over the Great Lakes Region and the subtropical ridge over the Atlantic .

The track of Bob by August 19 was similar to that of Hurricane Carol in 1954 , another major hurricane that impacted New England . Significantly cooler sea surface temperatures in the path of the hurricane resulted in weakening , leading to the eye becoming cloud @-@ filled . Later on August 19 , the western portion of the eyewall brushed the eastern tip of Long Island . Around 1800 UTC , the center of Bob made landfall near Newport , Rhode Island with winds of 100 mph ( 155 km / h ) , making it a Category 2 hurricane . The storm quickly weakened as it tracked through Rhode Island and Massachusetts before entering the Gulf of Maine . Around 0130 UTC on August 20 , the now weakened Tropical Storm Bob made another landfall near Rockport , Maine with winds of 70 mph ( 110 km / h ) .

Later that day , Bob had crossed through Maine and part of New Brunswick , Canada and entered the Gulf of St. Lawrence . Around 1800 UTC , the former hurricane transitioned into an extratropical cyclone . Early the next day , the storm passed over northern Newfoundland before re @-@ entering the Atlantic Ocean . Rapidly tracking eastward , the storm briefly weakened to the equivalent of a tropical depression on August 22 . After restrengthening to tropical storm @-@ force winds , the remnants of Bob turned towards the southeast and slowed . Once more , the extratropical system weakened to the equivalent of a tropical depression ; however , it did not re @-@ intensify . The storm slowly tracked towards the east before dissipating off the coast of Portugal on August 29 .

= = Preparations = =

= = = Watches and warnings = = =

Several hours after the declaration of Tropical Storm Bob on August 16 , the Government of the Bahamas issued a tropical storm warning for the northwestern Bahamas , between the islands of Andros and Eleuthera . After the storm turned northward , this warning was discontinued as tropical storm @-@ force winds were no longer expected to affect the islands . Shortly before Bob was upgraded to a hurricane on August 17 , the NHC issued a hurricane watch for coastal areas of North Carolina between Little River Inlet northward to Virginia Beach , Virginia . Roughly four hours after this watch , it was upgraded to a hurricane warning . A new hurricane watch was issued late on August 17 , encompassing areas between Virginia Beach northward to Cape Henlopen , Delaware . This watch was also upgraded to a warning on August 18 as Bob paralleled the Mid @-@ Atlantic coastline . During the afternoon hours , a tropical storm warning was declared for areas in the lower Chesapeake Bay area , including Norfolk , Virginia .

A new , extensive hurricane warning was issued late on August 18 as forecasts showed Bob moving directly over southern New England . The warning covered areas between Cape Henlopen , Delaware to Plymouth , Massachusetts , including Long Island and Long Island Sound . Early on August 19 , all watches and warnings south of Cape Lookout , North Carolina were discontinued and the hurricane warning was extended northward to encompass areas south of Eastport , Maine . The Canadian Hurricane Centre began issuing warnings for Atlantic Canada later that day . Nova Scotia , Prince Edward Island and New Brunswick were placed under wind and heavy rain warnings . By the morning of August 20 , all watches and warnings in the United States were discontinued ; however , a brief tropical storm warning was declared for coastal Maine between Rockland and Eastport before the remnants of Bob moved through eastern Canada . The advisories for Atlantic Canada were later discontinued after the system moved out of the region .

= = = Mid @-@ Atlantic states and the Carolinas = = =

Following the issuance of a hurricane warning in North Carolina on August 17 , mandatory evacuation orders were declared for the outermost islands in the state . Local police assisted significant traffic as an estimated 50 @,@ 000 to 100 @,@ 000 people left the region . At the height of the evacuations , delays in some places exceeded three hours . Despite the large number of evacuees , an additional 50 @,@ 000 people were estimated to have stayed home and wait out the storm . Several bridges in the area were shut down prior to Bob 's arrival as hurricane @-@ force winds were likely to create life @-@ threatening conditions on them . The National Park Service in the state also shut down campgrounds across the Outer Banks . An evacuation shelter was also opened in Carteret County .

In Virginia , 125 planes were relocated from Langley Air Force Base to Wright @-@ Patterson Air Force Base in Dayton , Ohio . Roughly 400 people evacuated from coastal areas in Maryland , and stores in Ocean City reported a substantial increase in sales related to storm preparation . Further north in New Jersey , casinos prepared sandbags to protect the structures and tape to cover windows .

In Suffolk County , New York , emergency officials were unsure of whether or not to issue evacuation orders for residents along coastal areas . This contemplation led to " mixed messages " on the ability of the government being sent to the public . By the evening of August 19 , the evacuation order was not issued ; however , the county was placed under a state of emergency and disaster centers were opened . The American Red Cross opened four shelters on Long Island that housed 800 people during the storm .

= = = New England and Canada = = =

Prior to Bob 's arrival in New England , officials in Connecticut and Rhode Island declared a state of emergency in anticipation of significant damage . All state workers in the area were told to go home early and prepare for the storm . The Connecticut Legislature canceled a session on the state 's budget and Governor Lowell P. Weicker , Jr. activated the emergency operations center . Submarines stationed in Groton left port and waited out the storm under water . Airplane and train service was disrupted throughout the Mid @-@ Atlantic states and New England in relation to Bob . The American Red Cross opened 23 shelters in 16 communities in Connecticut . In neighboring Rhode Island , the agency set up 40 shelters , and there were an additional 25 shelters unaffiliated with the agency . About 3 @,@ 500 people statewide evacuated , including 2 @,@ 000 on Block Island . Several people injured themselves while preparing for the storm .

In Massachusetts , thousands of residents evacuated Cape Cod , leading to an 11 mi ( 18 km ) backup on the Sagamore Bridge . There were nine shelters set up in the region , which became overcrowded with evacuees . There were about 50 @,@ 000 people who left their homes statewide , of which 6 @,@ 500 went to shelters . On Martha 's Vineyard , electronic stores reported their best business sales in years , with supplies of D @-@ batteries being cleaned off the shelves . Many residents purchased these as well as battery @-@ powered radios and flashlights . President George H. W. Bush , staying at his home in Kennebunkport , Maine , evacuated to Pease Air Force Base in New Hampshire . To avoid possible risks by using helicopter , he drove by motorcade to the base . During this time , portions of Interstate 95 were closed to allow him direct access to the Air Force base ; however , this created many miles of backup as thousands of residents moved inland . Eight shelters were opened in New Hampshire , and about 5 @,@ 200 people ? mostly tourists ? evacuated the coastline . There were 49 shelters opened in neighboring Maine , and about 8 @,@ 600 people evacuated along the coastline in York County .

In the Bay of Fundy , fishermen were urged to return to port in fears of large swells from Hurricane Bob .

= = Impact = =

Throughout the east coast of the United States , Hurricane Bob produced moderate rainfall and substantial damage . Damage totaled about \$ 1 @. @ 5 billion ( 1991 USD ) . That included about \$ 700 million through cleanup costs , uninsured losses , and food claims . That made it , at the time , the second costliest United States hurricane , although the total was due to the storm passing through a densely populated region . As of 2010 , Hurricane Bob ranked as the 22nd costliest tropical cyclone in the United States mainland . Across its track , the hurricane left 2 @. @ 1 million people without power . There were six confirmed tornadoes , along with thirteen unconfirmed tornadoes .

= = = Carolinas and Mid @-@ Atlantic = = =

As the center of the Hurricane Bob passed several hundred miles east of South Carolina with only slight effects on the state . However , the storm produced large swells that caught a swimmer in Myrtle Beach in strong undertow ; this swimmer drowned to death .

A crew of three sailed from Little River ( Horry County , South Carolina ) en route to Rhode Island . The hurricane destroyed the mast , leaving the crew stranded over the open ocean in shark @-@ infested waters . After 12 days , the United States Coast Guard rescued the three .

On 18 August 1991 , Hurricane Bob brushed the Outer Banks of North Carolina , bringing strong winds and heavy rains . Although a maximum of 5 @. @ 30 inches ( 135 mm ) of rain fell at the National Weather Service office building at Cape Hatteras , little heavy rain fell inland of the Outer Banks . One person was killed in the state in relation to Bob , and damage from the storm was estimated at \$ 8 million ( 1991 USD ) . The community of Duck , North Carolina , received the highest recorded onshore sustained winds in the state , 62 miles per hour ( 100 km / h ) , whereas the highest gusts reached 74 miles per hour ( 119 km / h ) at Cape Hatteras . Diamond Shoal Light recorded a sustained wind of 85 @. @ 0 knots ( 157 @. @ 4 km / h ; 97 @. @ 8 mph ) with a gust of 106 @. @ 7 knots ( 197 @. @ 6 km / h ; 122 @. @ 8 mph ) and a minimum pressure of 962 @. @ 1 millibars ( 962 @. @ 1 hPa ) on the evening of 18 / 19 August 1991 . Cape Hatteras also recorded a storm surge of 2 @. @ 6 to 4 @. @ 6 ft ( 0 @. @ 79 to 1 @. @ 40 m ) .

Flooding was reported throughout the Outer Banks in relation to the heavy rains and storm surge of the storm . The storm required the shutdown of North Carolina Highway 12 , the only highway connecting the area to the mainland , isolating those who decided to stay behind . Many residents lost power as numerous power lines fell from strong winds . Six brief tornadoes , ranging between F0 and F1 on the Fujita scale , struck the state within squall lines in the outer rainbands of Hurricane Bob. were recorded . Four tornadoes in Dare County , North Carolina , caused \$ 256 @, @ 000 in damage . Near Cape Hatteras , wind severely damaged one structure , which lost its roof and some siding .

As the hurricane passed east of Virginia , it produced minimal rainfall and wind gusts of up to 40 miles per hour ( 64 km / h ) . No one reported damage beyond some minor beach erosion in Sandbridge , Virginia Beach , Virginia .

In Ocean City , Maryland , a brief period of heavy rainfall caused street flooding . High waves caused minimal beach erosion and overwash along the coastline .

High tides to 5 @. @ 9 feet ( 1 @. @ 8 m ) occurred along the Delaware coastline .

Farther north , the storm caused widespread beach erosion along the Jersey Shore , while heavy rains caused street flooding .

The heaviest rains outside New England fell in Bridgehampton , New York , where 7 @. @ 18 inches ( 182 mm ) fell during the passage of the storm . Two reported tornadoes struck Long Island . High winds destroyed apple , corn , and peach fields along Long Island . After a dry summer , the sudden deluge wrecked potato crops , resulting in \$ 20 million in crop damage ; , about one @-@ sixth of the agricultural output of the region . High winds caused power outages for 477 @, @ 765 Long Island Lighting Company customers for a period of nearly five days . Most power outages occurred in the East End . One person died in a car accident while a traffic light was offline , and another person died when a falling tree struck a train conductor . The high waves destroyed fish

nets offshore and caused beach erosion and the widespread destruction of boats along the coast . Statewide damage totaled over \$ 75 million .

= = = New England = = =

Before Bob made landfall in New England , it passed directly over Block Island , Rhode Island . Stations on the island recorded gusts to 105 mph ( 169 km / h ) near the upper end of their range , indicating that the winds were likely stronger . On the mainland , winds peaked at 90 mph ( 144 km / h ) in Narragansett . In the state , the storm surge ? the rise of water above the normal tide ? was 6 @. @ 6 ft ( 2 @. @ 0 m ) in the capital city of Providence , while the peak storm tide ? the rise of water including the normal high tide ? was 16 @. @ 5 ft ( 5 @. @ 0 m ) at the mouth of the Sakonnet River . At the latter location , the estimate was based on high @- @ water marks , which included wave effects . The high waves resulted in extensive beach erosion along the state 's coastline , which washed out several roads in Coventry . There was flooding reported along the Pocasset River . Rainfall in the state peaked at 7 @. @ 13 in ( 181 mm ) in North Foster . In Rhode Island , where the hurricane made landfall , Bob caused about 200 @, @ 000 power outages ; about 60 % of residents in the state and southeastern Massachusetts were left without power . During the storm , treatment plants spilled over 100 million tons of sewage due to overflow into Narragansett Bay . Damage totaled over \$ 115 million .

While moving over Rhode Island , the strong winds of Bob extended westward into Connecticut , peaking at 75 mph ( 120 km / h ) near Groton ; there , a gust of 100 mph ( 160 km / h ) was reported . High winds downed trees in every county in the state , although wind damage was heaviest in the southeastern portion near the coast . Overall there were about 315 @, @ 000 people left without power in Connecticut . A man in Sterling died after being struck by a falling tree limb . The highest storm surge was 5 ft ( 1 @. @ 5 m ) in New London . Coastal flooding was limited to New London County , although coastal damage was minimal . One woman died while on a capsized sailboat . In Norwich , a rainfall total of 6 @. @ 22 in ( 158 mm ) was reported , which was the statewide peak . Flooding was minor , limited to streams and small rivers . Total damage in the state was estimated around \$ 49 million , including \$ 4 @. @ 5 million in crop damage . There was one death due to a fire that occurred during the storm 's passage , and there were five other deaths across the state .

The most significant area affected by Bob was Massachusetts , where over \$ 1 billion in damage occurred . A C @- @ MAN station in Buzzards Bay recorded winds every hour and observed peak sustained winds of 77 mph ( 124 km / h ) , along with gusts to 89 mph ( 143 km / h ) . Sustained winds in the state peaked at 100 mph ( 161 km / h ) in Provincetown , and there was an unofficial report of a gust of 125 mph ( 201 km / h ) in Brewster . The highest rainfall total in the state was 7 @. @ 06 in ( 179 mm ) in Westfield . Storm surges in the state were most significant along Buzzards Bay , peaking at 5 @. @ 8 ft ( 1 @. @ 8 m ) in New Bedford and Woods Hole . High waves eroded the beach around Chatham Light , leaving behind a 5 ft ( 1 @. @ 5 m ) cliff . Other locations , including southward @- @ facing shores along Martha 's Vineyard and Nantucket , lost 50 ft ( 15 m ) of beach from erosion . Boat damage was significant in the region . The hurricane left over 500 @, @ 000 people without power , including all of Cape Cod . Damage was heaviest from Buzzards Bay eastward to Cape Cod , and at least 61 houses were destroyed . Damage was also extensive to apple and peach orchards across these areas , and agricultural damage was estimated around \$ 10 million . The state also suffered \$ 69 million in damage to public property .

Although it remained offshore of the state , Bob produced strong winds in New Hampshire , with gusts reaching 60 mph ( 97 km / h ) at Pease Air National Guard Base . Mount Washington experienced 7 @. @ 46 in ( 189 mm ) of precipitation during the storm 's passage . Both the Lovell and Contoocook rivers experienced flooding due to the storm , and widespread flooding occurred in urban areas in the south and central portions of the state . There were two deaths in the state , one from an automobile accident and the other due to a capsized boat . High winds downed widespread trees and power lines , causing 30 @, @ 000 people to lose power statewide . Damage was estimated around \$ 2 million . In neighboring Vermont , the highest rainfall report was 4 @. @ 27 in ( 108 mm ) in Vernon .

Although moving across Maine as a tropical storm , Bob still maintained strong winds , producing gusts to 70 mph ( 110 km / h ) in Portland . A station in Wiscasset reported a gust of 92 mph ( 148 km / h ) before it was blown away , and another station recorded a gust of 93 mph ( 150 km / h ) . A total of 169 @, @ 200 customers lost power during the hurricane , some of whom remaining without electricity for a week . There was a tornado reported in St. Albans , which downed multiple trees , damaged a few houses , and moved a boathouse three blocks away ; its status as a tornado was not confirmed . As it passed the region , the storm produced a 2 @. @ 77 ft ( 0 @. @ 84 m ) storm tide . The heaviest rainfall nationwide from the hurricane fell at the Portland International Jetport , where 8 @. @ 24 in ( 209 mm ) fell during its passage . This contributed to August 1991 being the wettest month on record in Portland . At the time , its 24 ? hour rainfall total of 7 @. @ 83 in ( 199 mm ) was the highest on record , although it was surpassed in October 1996 by an extratropical system fueled by Hurricane Lili . The rains from Bob led to a record flow rate along the Presumpscot River , although that record was also surpassed by the 1996 system . River flooding washed out five bridges and roads across southwestern Maine . One man died due to being swept away by floodwaters , and another died in the ocean while on a life raft . A total of 700 houses were affected by the storm , including one that was destroyed and three that sustained major damage . Damage in the area around Portland totaled over \$ 25 @. @ 7 million , and there were three deaths .

= = = Atlantic Canada = = =

After causing severe damage in the United States , the remnants of Hurricane Bob moved into Atlantic Canada . The highest rainfall amount in the country was 4 @. @ 37 in ( 111 mm ) in northern New Brunswick . St. John 's , Newfoundland and Labrador recorded a record 1 inch ( 26 mm ) of rainfall during the storm 's passage . Gusty winds were observed across the region , and winds reached 68 mph ( 109 km / h ) in Digby , Nova Scotia . In Nova Scotia , two 17 @- @ year @- @ old girls were washed out to sea near Cape Forchu after being caught in rough swells produced by the storm . Rescue officials quickly began searching operations ; however , it was later confirmed that the two had drowned . In Fredericton , New Brunswick , tropical storm @- @ force winds downed trees and power lines , resulting in scattered power outages . Lightning associated with strong storms also reportedly struck some trees in the area . A two @- @ story home in Pointe @- @ Verte collapsed due to high winds . In Petit @- @ Rocher , five fishing boats sank after being overwhelmed by large swells at port . Firefighters in the area were surveying the town all night on August 20 , checking for downed power lines and trees . Power outages were also reported on Prince Edward Island . The storm left about \$ 1 million in damage ( 1991 CAD ) on Grand Manan Island in the Bay of Fundy .

= = Aftermath = =

Following the storm 's passage , the Long Island Lighting Company used 165 workers to restore the power outages on Long Island . In Connecticut , state officials deployed about 200 trucks to remove debris on roads . The Massachusetts National Guard was activated to assist in relief efforts . In Rhode Island , a man was killed while repairing damage caused by Bob . Beaches in the state re @- @ opened by five days after the storm . The hurricane mixed the waters in Long Island Sound and prevented the algae bloom that happened in previous summers . In the days after Bob , the Commonwealth Electric Company brought electricians from outside the company and put their own workers on 16 ? hour shifts to restore power across Massachusetts . Most Massachusetts residents , excluding those living on Cape Cod , had their power restored within five days . The hurricane struck toward the end of the summer , which significantly impacted the tourism season already in the midst of a recession . The New England coast was affected by a powerful nor 'easter known as the Perfect Storm about two months after the hurricane struck the region . Some locations experienced worse damage from the October storm than from Bob .

Due to the high damage from Hurricane Bob , president George H.W. Bush declared the following states as disaster ( in order ) : Rhode Island , Massachusetts , Maine , Connecticut , New

Hampshire , and New York . Damage in Maine was insufficient to qualify for individual family assistance . Instead , the declaration allocated federal funding to reimburse cities for debris removal , repairing damaged public buildings , and other municipal expenses for each of the states . Despite the declaration , the federal government did not immediately provide aid to the affected region . This was partially due to President Bush considering the storm a " disaster but not an emergency " , which therefore required cuts from other budgets to offset the relief aid . This was in opposition to the Democratic @-@ controlled Congress , who requested an expedited process . Because of its impact , the name Bob was retired by the World Meteorological Organization in the spring of 1992 , and will never be used again for an Atlantic hurricane . It was replaced with " Bill " in the 1997 season .