



U.S. Army Corps
of Engineers

Louisiana Coastal Protection and Restoration

ENCLOSURE B

History of Hurricane Occurrences

Preliminary Technical Report to Congress
June 2006

History of Hurricane Occurrences 1998 – 2005 Update

The following hurricanes and tropical storms have affected the Louisiana coast from 1998 through 2005. **Table B-1** is a summary of the storm occurrences. **Figure B-1** shows the location of the areas affected. **Figures B-2 through B-13** illustrate the path of each storm. The history of hurricane occurrences (from 1559 – 1985) and the 1986 – 1997 update are also included in this appendix.

1998, September 8-13 (T.S. Frances). On 4 September, Frances formed within a broad area of low pressure. The center moved inland across the Texas coast just north of Corpus Christi at 0600 Universal Time Coordinates (UTC) on the 11th. Maximum winds were 63 mph. Moderate beach erosion occurred along much of the upper Texas and western Louisiana coastlines. Frances caused one death and an estimated \$500 million in damage (1998 dollars). Frances dropped copious amounts of rain over east Texas and Cameron, Jefferson, Lafourche and Terrebonne Parishes in southern Louisiana. The highest total reported in Texas was over 16 inches in Brazoria County; the highest total from Louisiana was over 11 inches. Storm surge flooding of up to 6 to eight feet occurred along the middle and upper Texas coast and up to 5 feet along the Louisiana coast. Surge is measured as water height above normal astronomical tide level. Maximum water elevations were 5.25 feet (ft) NGVD at Calcasieu River and Pass near Cameron, LA and 4.71 ft NGVD at Freshwater Canal at Freshwater Bayou Lock (North).

1998, September 15 – October 1 (Georges). Hurricane Georges skirted the eastern marsh zones of Plaquemines and St. Bernard Parishes before making landfall near Biloxi, Mississippi on 28 September with maximum sustained winds of 105 mph. Rainfall totals averaged nearly 5 inches over metropolitan New Orleans. Maximum stages for this storm were 9.1 ft NGVD at the IWW near Paris Road Bridge, 6.6 ft NGVD at the Mississippi River Gulf Outlet at Shell Beach, 4.6 ft NGVD on Bayou Terre Aux Bouefs at Delacroix, 5.8 ft NGVD at the Rigolets Lake Pontchartrain, 4.7 feet NGVD at Mid Lake on the Lake Pontchartrain Causeway, 7.4 ft NGVD at Bayou Bienvenue, and 5.5 ft NGVD at West End.

1998, September 17-20 (T.S. Hermine). Tropical Storm Hermine developed from a tropical wave that crossed Dakar, Senegal on 5 September and moved westward across the Atlantic. On 17 September, the system acquired enough organization to be classified as a tropical depression and reached tropical storm status on 19 September. Tropical Storm Hermine moved on a general northward track and made landfall as a weakening 40 mph tropical storm near Cocodrie, LA on 20 September. Maximum sustained winds were 46 mph. There are no reports of casualty and damage. Tropical Storm Hermine produced rains of about 0.5 to 1 inches.

2001, June 5-17 (T.S. Allison). Tropical Storm Allison developed over the northwestern Gulf of Mexico and moved inland over the upper Texas coast, producing extremely heavy rainfall and catastrophic floods in the Houston area. The tropical storm made landfall on 5 June near Freeport, Texas. By 8 June, Allison was stalled and drifted south bringing more rain into the area. On 10 June, Allison reentered the Gulf of Mexico and made landfall near Morgan City, LA. Allison continued to produce heavy rainfall and flooding near its track from Louisiana eastward to North Carolina, and then northward along the east coast to Massachusetts. Maximum sustained winds associated with Allison were 52 mph. Forty-one deaths are directly related to the

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heavy rain, flooding, tornadoes, and high surf. Rainfall totals from the storm were Lafayette, LA 15.58 inches, Morgan City, LA 20.96 inches, and Thibodaux, LA 29.86 inches. Storm surge in Cameron, LA was approximately 2.5 ft.

2002, August 4-9 (T.S. Bertha). Tropical Storm Bertha was a minimal tropical storm that made landfall in southeastern Louisiana. Bertha had a non-tropical origin. On 4 August, a low pressure area became better organized just east of the mouth of the Mississippi River, developing into a tropical depression. The depression strengthened further as it moved west-northwestward. The broad center made landfall near Boothville, LA late on 4 August. After landfall, Bertha assumed a wobbly northwestward motion that took the center to the north of Lake Ponchartrain on 5 August. Bertha moved slowly westward then southward re-entering the Gulf of Mexico on 7 August. The storm made a second landfall in southern Texas on 9 August. The highest wind at coastal site was a gust of 41 mph at the National Ocean Service station in Waveland, MS. One death was reported. Rainfall totals averaged 3 to 6 inches, with locally heavier totals of 10.25 inches in Pascagoula MS and Norwood, LA. Storm tides reached as high as 3-4 ft above normal tide levels along portions of the Mississippi Gulf Coast and 1-2 ft along the southeastern Louisiana coast.

2002, September 14-27 (Isidore). A tropical depression in the Caribbean became Tropical Storm Isidore around 0600 UTC 18 September, and moved very slowly toward the northwest, passing just west of Jamaica. Isidore moved very slowly toward the west-northwest across the Cayman Islands and became a hurricane at 1800 UTC 19 September. Hurricane Isidore weakened to a minimal tropical storm before entering the Gulf of Mexico. Isidore never redeveloped an inner core of strong winds prior to making landfall just west of Grand Isle on 26 September 2002. Belle Chase Naval Air Station reported sustained winds of 58 mph with gusts of 69 mph. Isidore produced torrential rains throughout southeast Louisiana. As the storm continued north, it created a backlash tidal surge on Lake Pontchartrain that flooded the town of Mandeville and some subdivisions in St. Tammany Parish. Rainfall totals were 18.50 inches at Algiers, with 15.34 inches falling on the 26 September. Chalmette had a total of 14.82 inches with 11.02 inches on the 26th, the New Orleans Audubon gage had 11.83 inches with 9.21 inches observed on the 25th. Some of these maximum stages for this storm were 5.61 ft NGVD at the Rigolets near Lake Pontchartrain, 6.0 ft NGVD at Lake Pontchartrain at West End, and 6.84 ft NGVD at Bayou Terre Aux Boeufs at Delacroix.

2002, September 21 – October 4 (Lili). Hurricane Lili made landfall along the south-central coast of Louisiana near Intracoastal City on 3 October 2002 as a strong Category 2 storm with winds of 120 mph and gusts of 150 mph. Areas along the storm's path received 8 inches or more of rain in parts of central Louisiana, with a band of 5 inches to 8 inches or more also occurring along the eastern portions of the southeast and Florida parishes. Heavy rains produced minor to moderate flooding along the lower sections of several rivers and streams. These include the Pearl, Tangipahoa, Tickfaw, and Amite Rivers in the Lake Pontchartrain Basin, as well as those in south central and southwestern Louisiana such as the Mermentau, Calcasieu, and Vermilion Rivers. Storm tide was reported as 10.6 ft. NGVD at Castille Pass near Morgan City, 12.3 ft. NGVD in Crewboat Channel near Calumet, 4.46 ft. NGVD in Grand Isle, 6.04 ft. NGVD at the Rigolets Lake Pontchartrain and 11.7 ft. NGVD in Vermillion Bay.

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2003, June 29 – July 2 (T.S. Bill). Tropical Storm Bill made landfall near King Lake, about 20 miles west of Cocodrie on the south coast of Louisiana around 30 June. There were four deaths associated with Bill. A tornado with an intensity of F1 on the Fujita Scale touched down in Reserve, LA, damaging several buildings. The most significant storm surge flooding was noted in coastal sections of southeast Louisiana in the southern Terrebonne Parish where a local levee was breached and overtopped in the Montegut area. Total losses for Louisiana and Mississippi were estimated at \$50 million (2003 dollars). Peak gusts at Slidell and Boothville were measured at 51 mph, at New Orleans Lakefront 52 mph, New Orleans International Airport 46 mph, Rigolets 55 mph and Mandeville 62 mph. The rainfall associated with Bill was 6.26 inches in Slidell, 6.12 inches at New Orleans Airport, and 3.51 inches at New Orleans International Airport. Peak stages were 3.08 ft NGVD at Rigolets near Lake Pontchartrain, 5.04 ft NGVD at Lake Pontchartrain at Mandeville, 2.91 ft NGVD at Mid Lake on the Lake Pontchartrain Causeway, and 4.47 ft NGVD at Lake Pontchartrain at Frenier.

2004, October 8-10 (T.S. Matthew). The origin of Matthew can be traced to a tropical wave that moved across the west coast of Africa on 19 September and entered the southwestern Gulf of Mexico. Matthew made landfall on the Louisiana coast just west of Cocodrie, LA on 10 October. Maximum estimated winds were 40 mph. One tornado briefly occurred near Golden Meadow, and in Terrebonne Parish about 20 homes were flooded by combination of rains and storm surge. Grand Isle suffered extensive beachfront erosion. There were no known deaths or injuries. The rainfall associated with Matthew totaled 4.06 inches at New Orleans Lakefront Airport, 5.16 inches in Slidell, 7.42 inches in Baton Rouge, 14.28 inches in Galliano, 9.43 inches in Thibodeaux, 8.86 inches in Houma, 8.68 inches in Paradis, and 16.23 inches in Reserve. There was a report of a 3.61 ft storm surge at Grand Isle, 3.7 ft surge at Cocodrie, 5.3 ft surge at Mandeville, and 5.85 ft surge at Frenier.

2005, July 3-7 (Cindy). Hurricane Cindy was the third tropical storm and first hurricane of the 2005 Atlantic hurricane season. Cindy made landfall near Grand Isle late on July 5. Cindy was originally thought to be a tropical storm at peak strength, but it was upgraded to a minimal hurricane in the post-storm analysis. The maximum sustained winds were 75 mph. Rainfall associated with Cindy were 4.99 inches in Algiers, LA, 7.56 inches in Galliano, LA, 6.37 inches in Grand Isle, LA, 6.75 inches in Gretna/Terrytown, LA, 3.60 inches in Mandeville, LA, 2.95 inches at New Orleans Lakefront Airport, 3.42 inches in Slidell, LA, and 6.29 inches in the City of Slidell, LA. Cindy generated a storm surge of 4-6 feet above normal tide levels along the coasts of southeastern Louisiana and Mississippi and 2-3 feet along the coast of southwestern Louisiana.

2005, August 23-30 (Katrina). On 29 August 2005, Hurricane Katrina made landfall in Plaquemines Parish near Buras as a strong Category 3 storm with winds of 127 miles per hour (mph). The central pressure at landfall, 27.17 inches, was the lowest of record in the Atlantic Basin for a 127 mph storm and the fifth lowest of record overall. Gusts of over 100 mph were reported in New Orleans. The storm continued on its northerly track making its final landfall near Pearl River on the Louisiana/Mississippi border. The storm surge exceeded 18 ft. along the southeast Louisiana coast, overtopping and breaching protection levees, and flooding New Orleans metropolitan area (22,000 acres New Orleans East Bank), New Orleans East (18,000 acres), and virtually all of Plaquemines (37,888 acres) and St. Bernard Parishes (19,000 acres).

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The total amount of floodwater is estimated to be approximately 720,000 acre feet or 235 billion gallons. St. Tammany Parish sustained significant wind damage and flooding. Jefferson Parish also experienced widespread flooding. Final storm damage will be in the billions of dollars, and casualties from Katrina, still incomplete, exceed 1,300 dead, as of April 2006. Katrina is the most costly and one of the deadliest storms on record. Most gages were damaged or destroyed by the storm. Storm rainfall accumulations were estimated to exceed 8 –10 inches along much of Katrina's path. Some of the estimated high water elevations (all at North American Vertical Datum of 1988 correction 2004.65 – NAVD88 2004.65) associated with the storm were 13.5 ft. at the Inner Harbor Navigation Canal Lock; 11.1 ft. inside the Coast Guard Station near the 17th Street Canal; 11.4 ft. on West Levee of the London Avenue Canal, north of Robert E. Lee Blvd; 18.7 ft. at the Bayou Bienvenue Floodgate; 12.6 ft. at the New Orleans Lakefront Airport; 18.7 ft. at Shell Beach; 14.7 ft. at Entergy Michoud Power Plant in New Orleans East; 10.9 ft. in St. Bernard Parish near the Courthouse; 16.0 ft. in Slidell at Highway 90 and Salt Bayou, and 14.8 ft. at Empire Lock. Grand Isle had a maximum tide reading of 12 ft. LMSL (Local Mean Sea Level). Katrina also sprung off 33 reported tornadoes as she tracked inland causing further damage to communities north of the Gulf Coast.

2005, September 18-26 (Rita). Rita originated from a complex interaction between a tropical wave that formed off the west coast of Africa and the remnants of a cold front. As Hurricane Rita moved westward across the Gulf of Mexico during mid-September 2005, wind driven tides and surge raised water levels in Lake Borgne, Lake Pontchartrain, and the canals in New Orleans. The temporary repairs along the Inner Harbor Navigation Canal overtopped, and flooding occurred in some of the already heavily damaged areas of Orleans Parish. Additional flooding was reported in Slidell and Mandeville in St. Tammany Parish from high tides in Lake Pontchartrain. Rita made landfall on 24 September 2005 just east of the Texas/Louisiana border near Johnson's Bayou with 120 miles per hour (mph) winds and a central pressure of 27.67 inches. Rita's surge caused devastating damage all along the Louisiana and southeastern Texas coastal areas. Storm rainfall amounted to 2.07 inches in New Orleans, 9.30 inches in Baton Rouge, 6.24 inches in Lafayette, 8.13 inches in Cameron, and 7.68 inches in Lake Charles. Some of the Louisiana high water elevations were 8.7 ft. at Gueydan, 8.4 ft. at Lake Charles, 7.6 ft. at Moss Bluff, 4.0 ft. at Lake Arthur, 15.01 ft. at Cameron, 12.2 ft. at Windmill, and 10.4 ft. at Pecan Island (all readings at datum NAVD88 2004.65). Flooding in the Mermentau Basin remained for several weeks after the hurricane passed; unwatering of the basin was completed on 15th October. After coming ashore, Rita's circulation created an estimated 90 tornadoes that were reported in Alabama, Mississippi, Louisiana, and Arkansas.

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Table B-1. Storm Occurrences: 1998 – 2005.

Date and Storm Name	Storm Type ^a	Type of Damage	Areas Affected ^b	Minimum CPI (MB) ^c	Maximum Winds (mph)
8 – 13 Sep 1998 Francis	T	Minor	V	990	63
15 Sep – 01 Oct 1998 Georges	H	Minor	I, II, VI	937	105
17 – 20 Sep 1998 Hermine	T	Minor	V	999	46
5 – 17 Jun 2001 Allison	T	Minor	IV, V	1000	52
4 – 9 Aug 2002 Bertha	T	Minor	V	1007	41
14 – 27 Sep 2002 Isidore	H	Minor	I, II, III, IV, VI	934	126
21 Sep – 04 Oct 2002 Lili	H	Minor	I, III, IV	938	143
29 Jun – 02 Jul 2003 Bill	T	Minor	I, IV	997	57
8 – 10 Oct 2004 Matthew	T	Minor	I, III	997	47
3 – 7 Jul 2005 Cindy	H	Minor	I, III	997	70
23 – 30 Aug 2005 Katrina	H	Major	I, II, III, V1	902	173
18 – 26 Sep 2005 Rita	H	Major	V	895	178

^aT = Tropical Storm; H = Hurricane

^bI = Lake Pontchartrain and Vicinity; II = Mississippi River Delta below New Orleans; III = Grand Isle and Vicinity; IV = Morgan City and Vicinity; V = Southwest Louisiana

^c1 millibar (MB) = 0.2953 inches of mercury at 32° F

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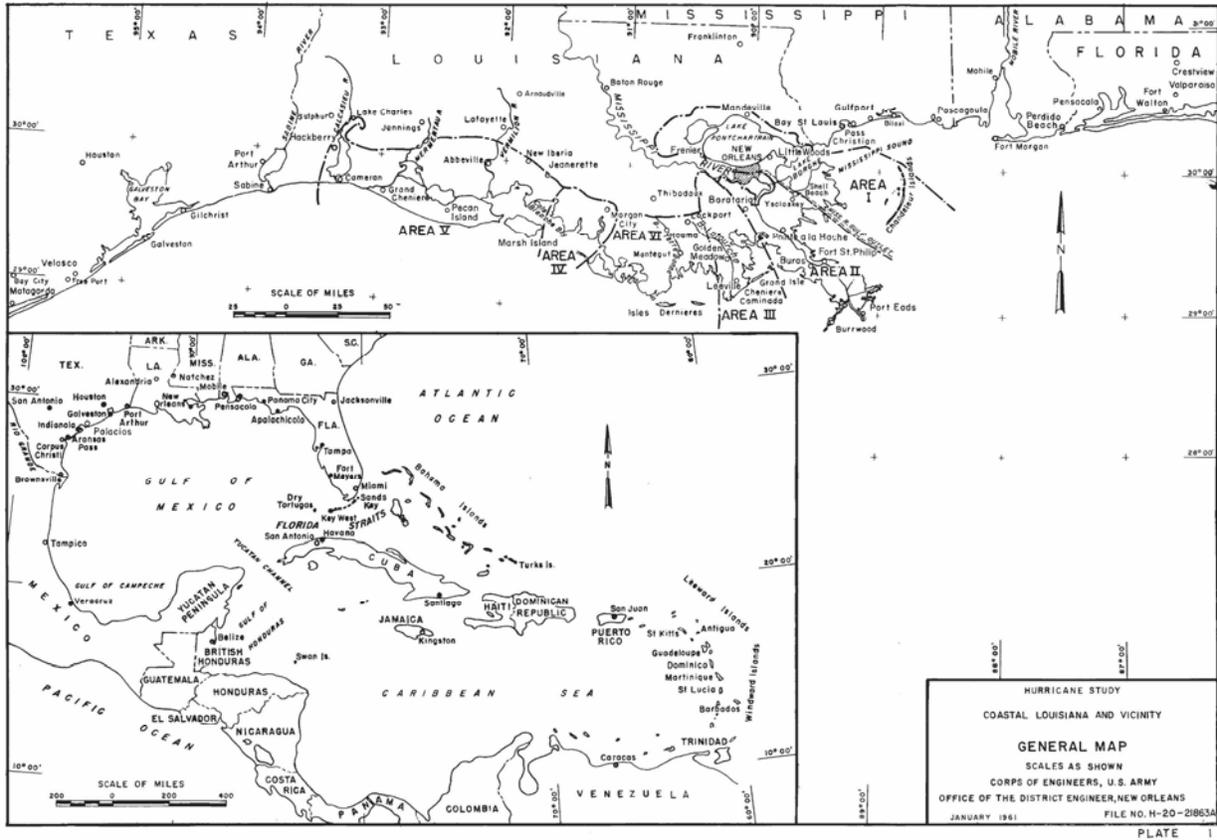


Figure B-1. Gulf Coast Areas Affected.

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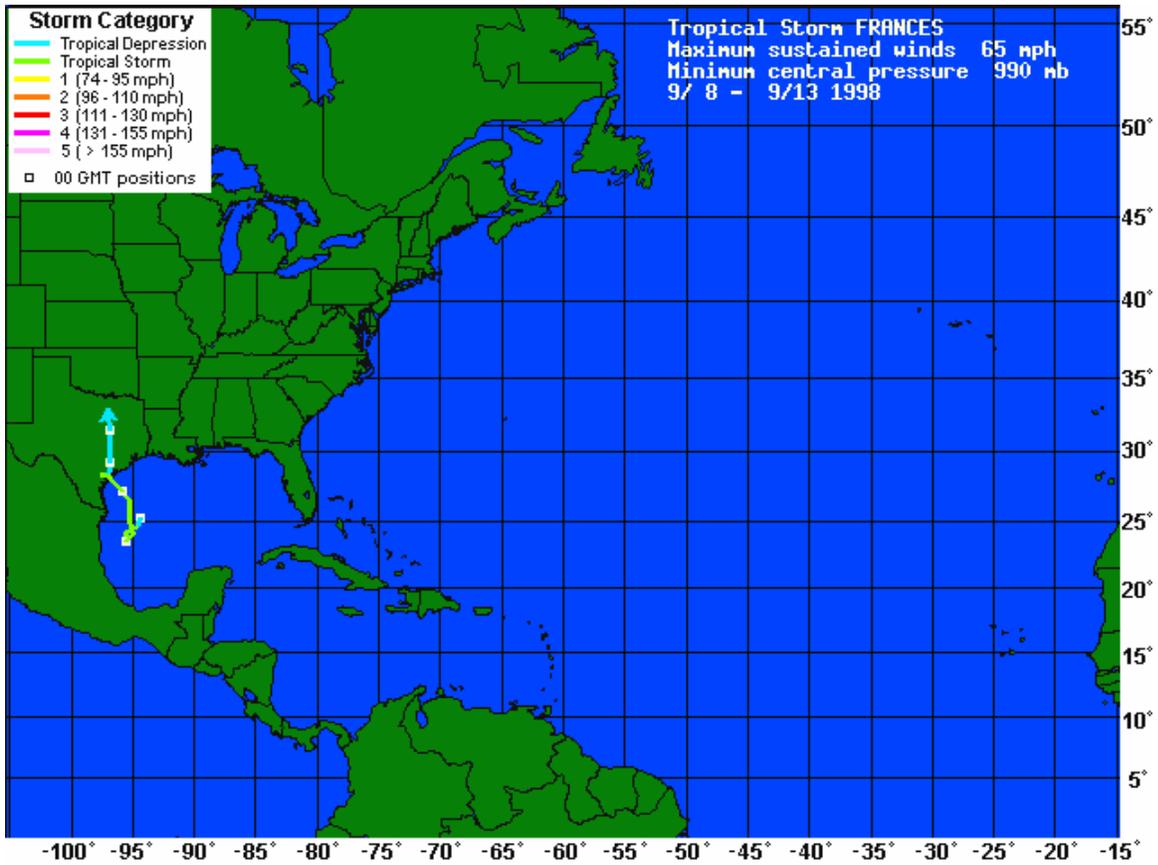


Figure B-2. TS Frances Storm Track.

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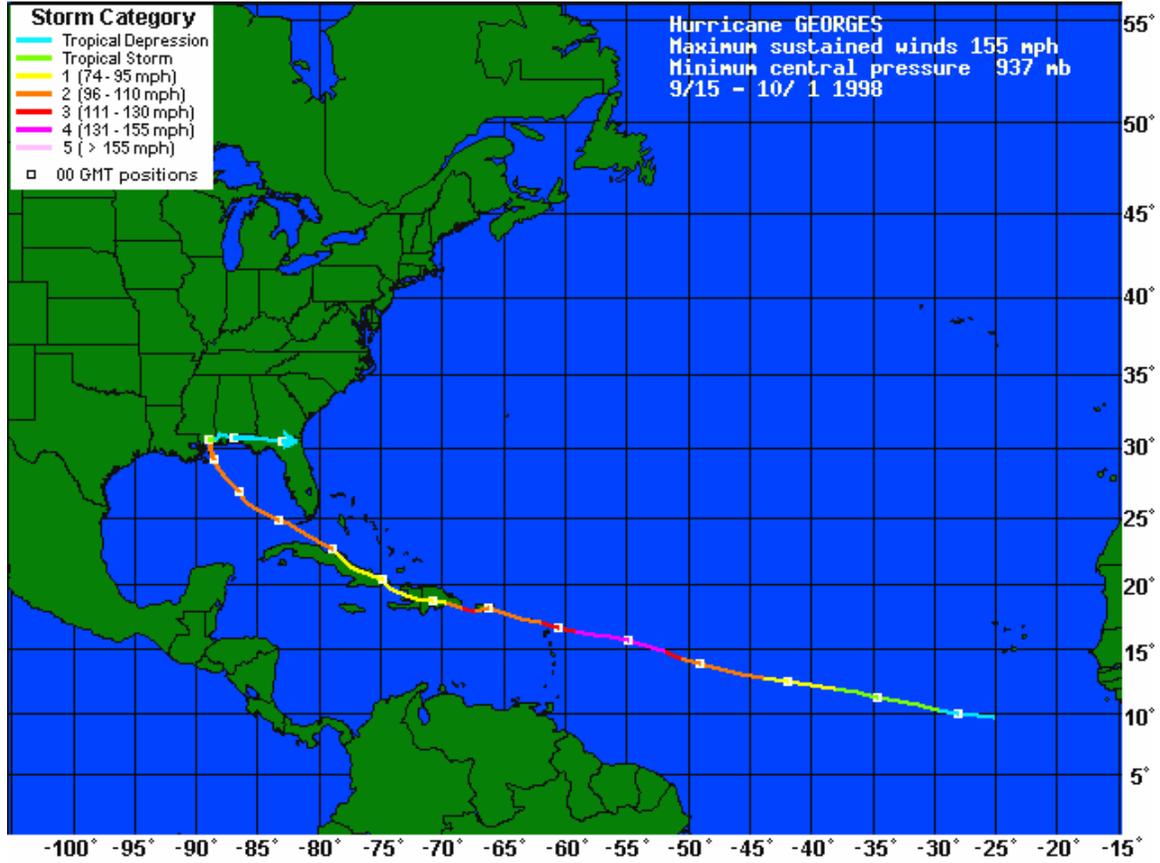


Figure B-3. Hurricane Georges Storm Track.

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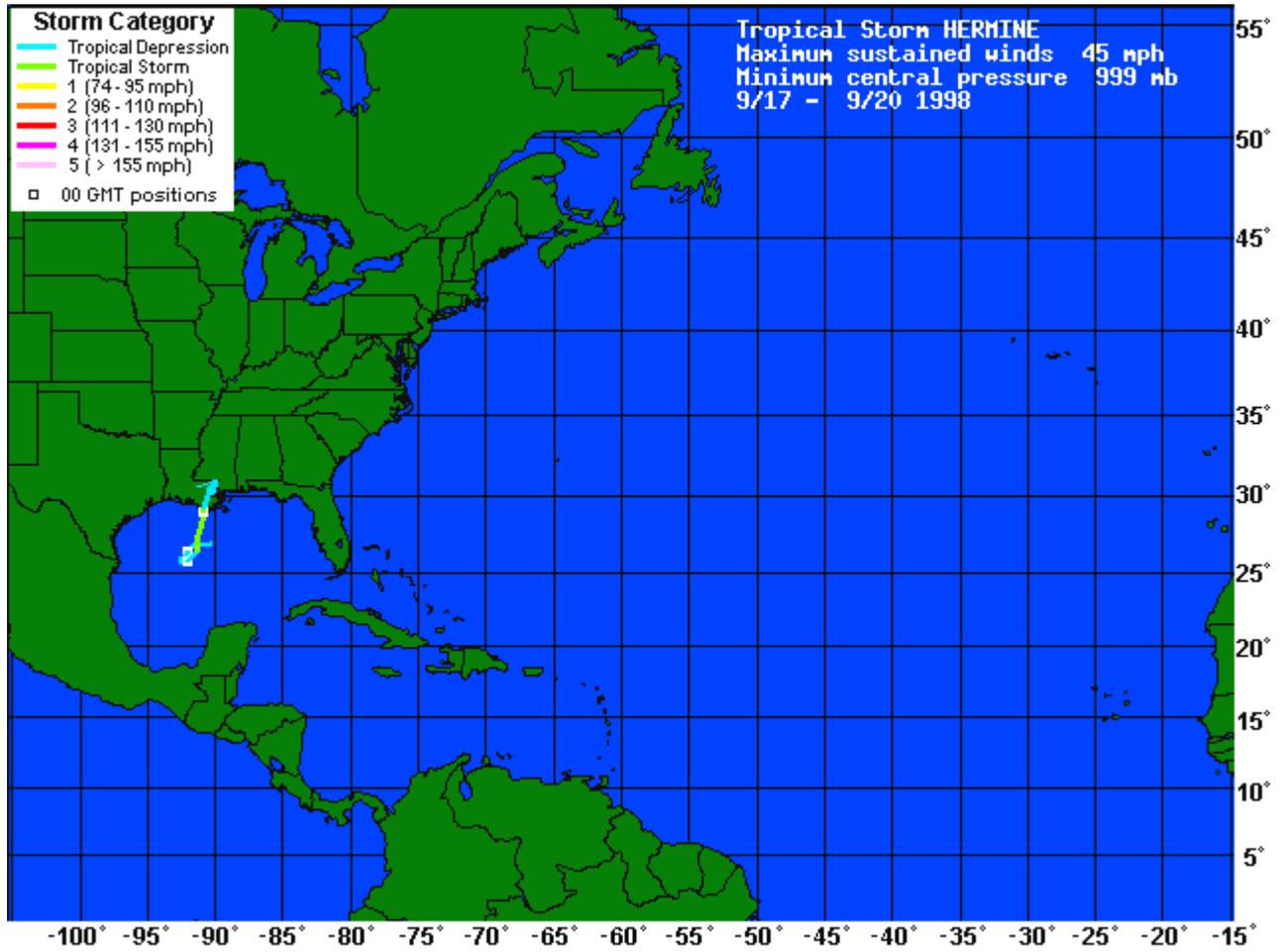


Figure B-4. TS Hermine Storm Track.

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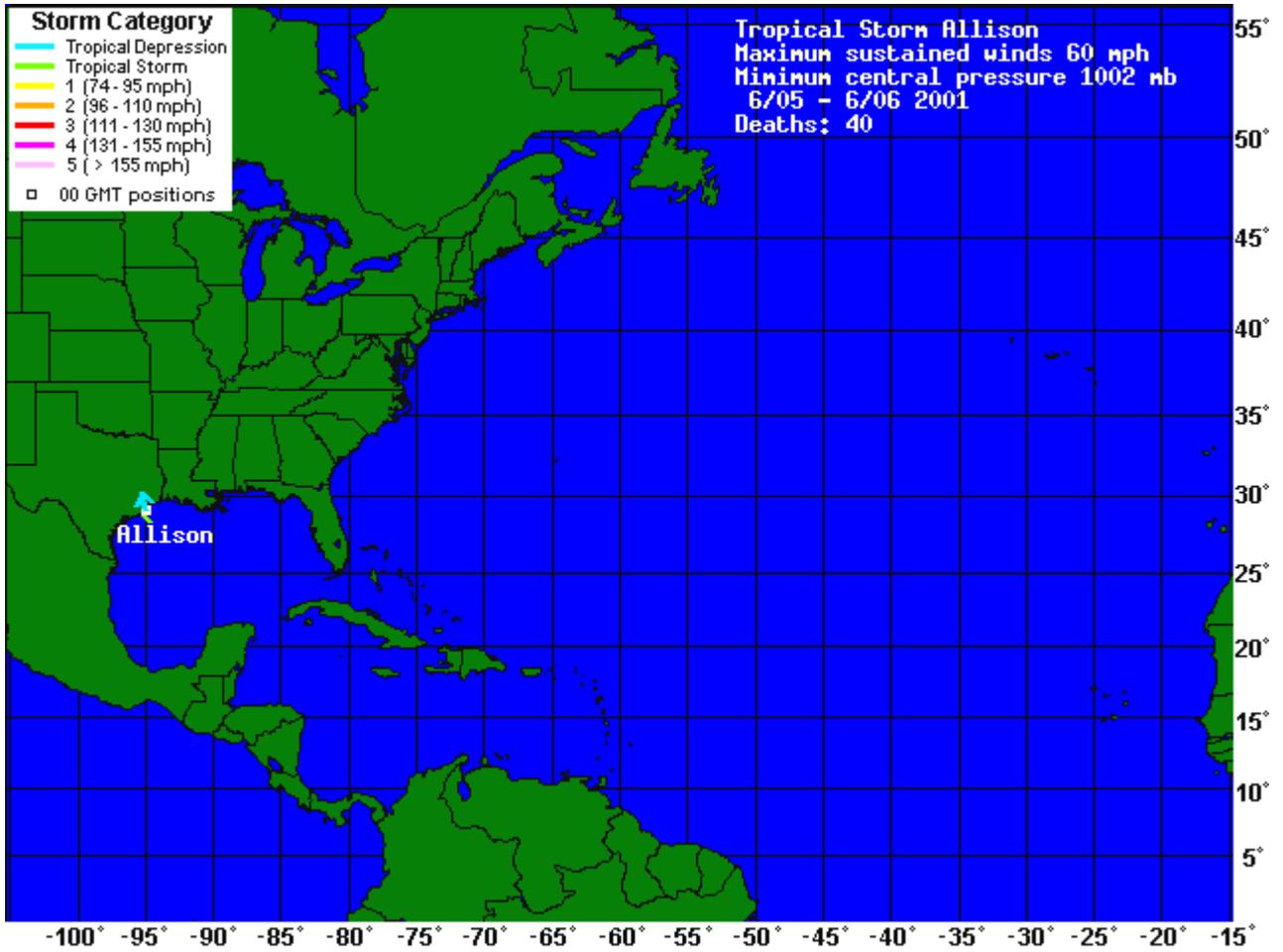


Figure B-5. TS Allison Storm Track.

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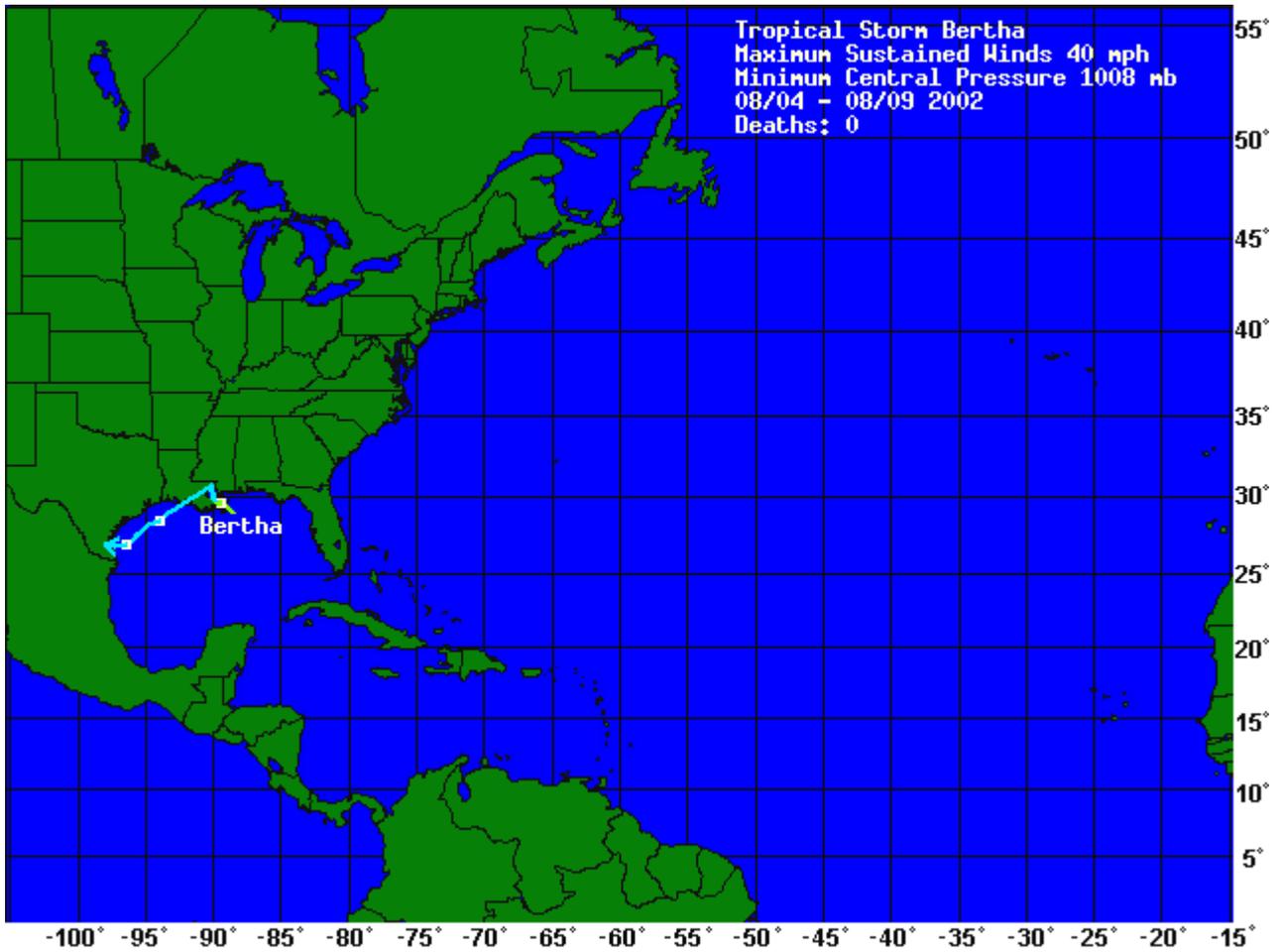


Figure B-6. TS Bertha Storm Track.

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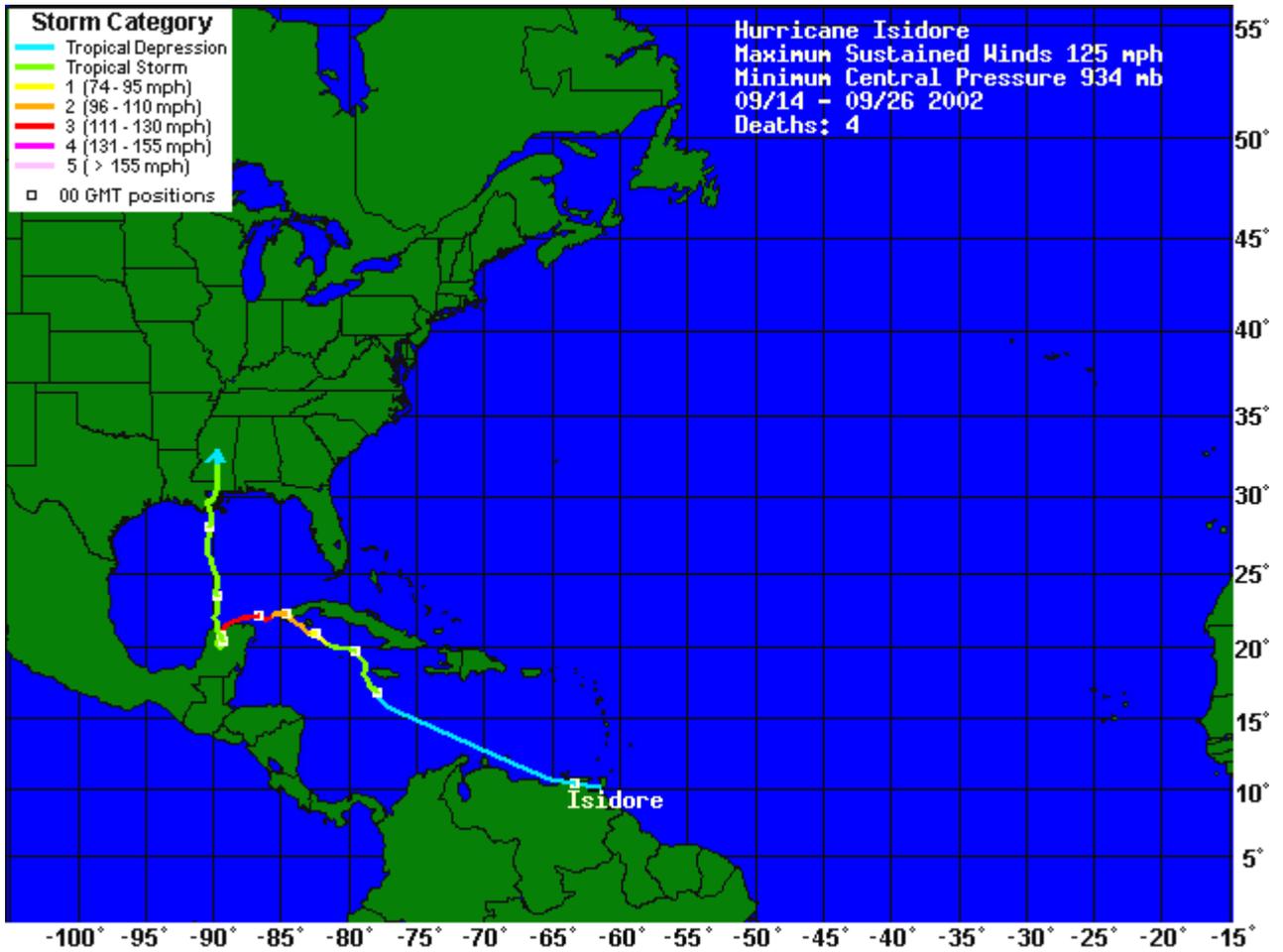


Figure B-7. Hurricane Isidore Storm Track.

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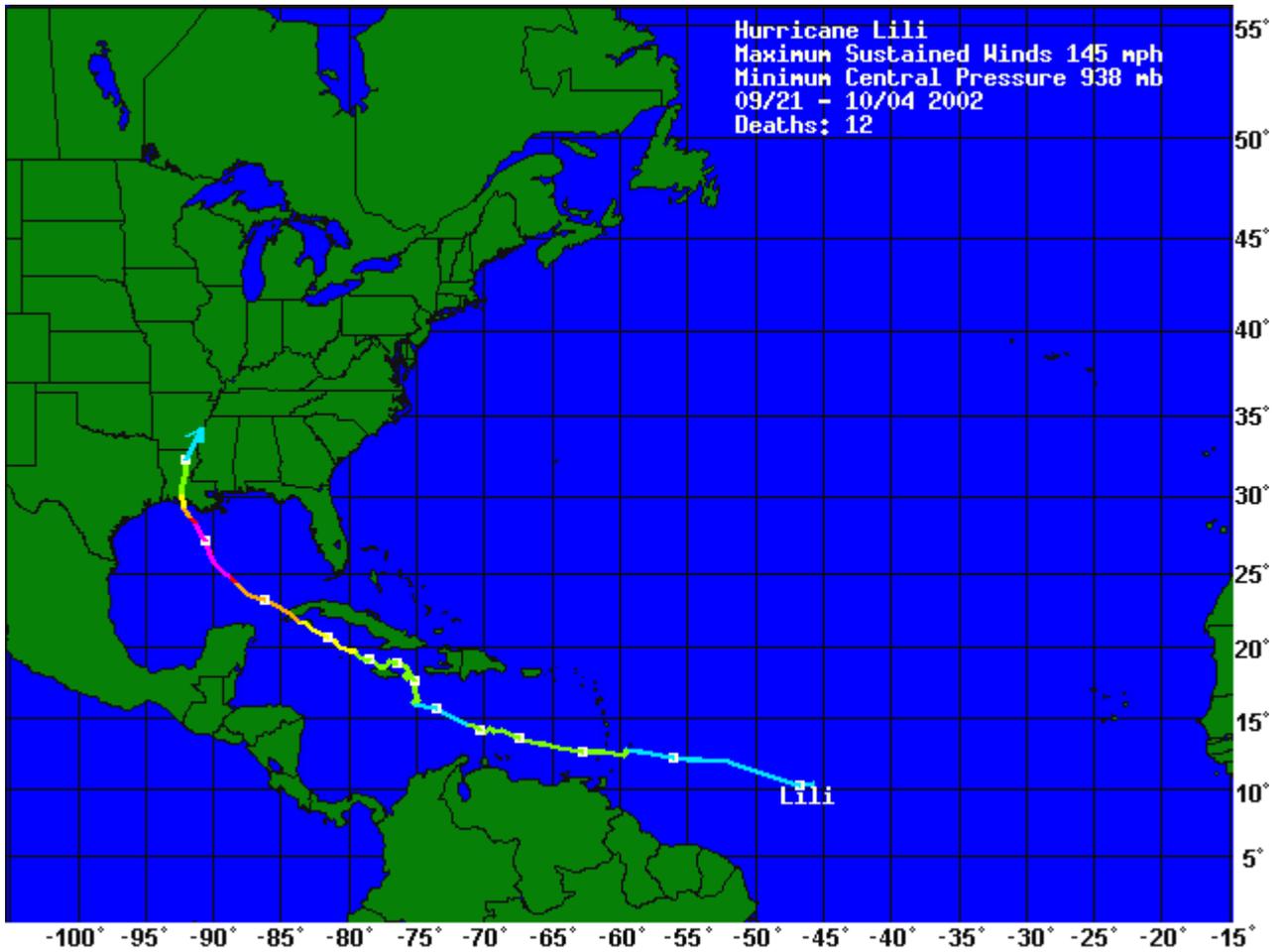


Figure B-8. Hurricane Lili Storm Track.

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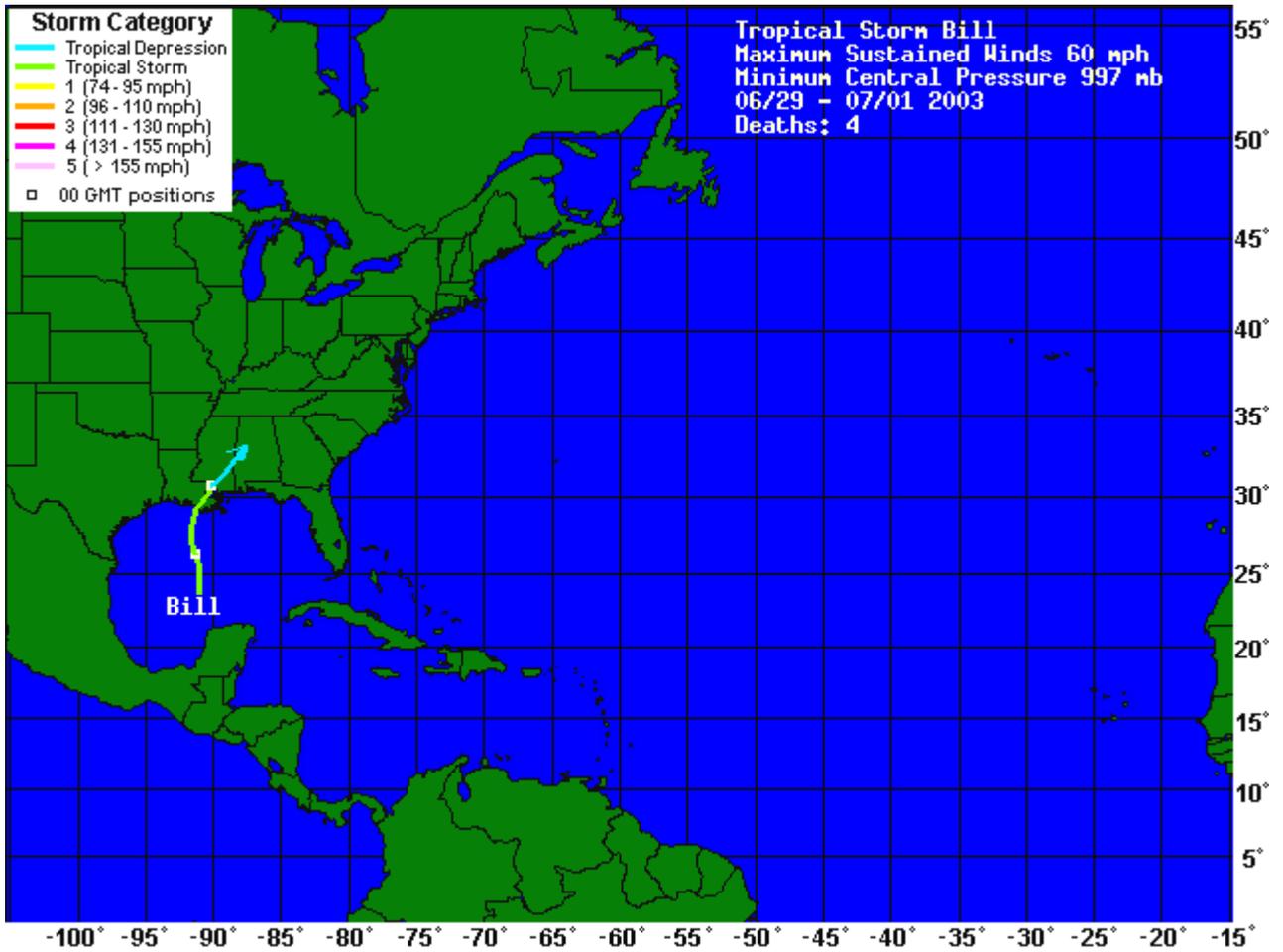


Figure B-9. TS Bill Storm Track.

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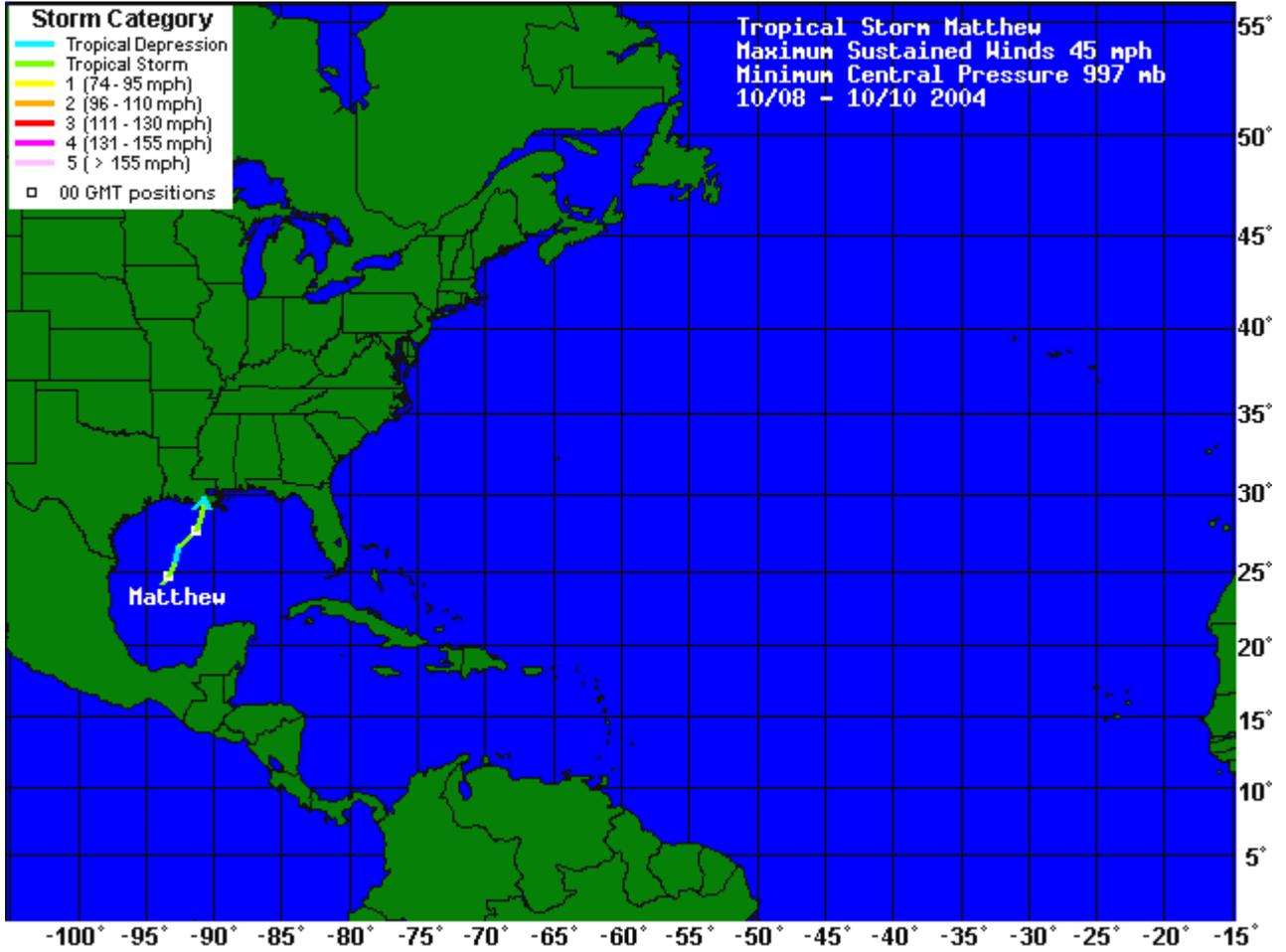


Figure B-10. TS Matthew Storm Track.

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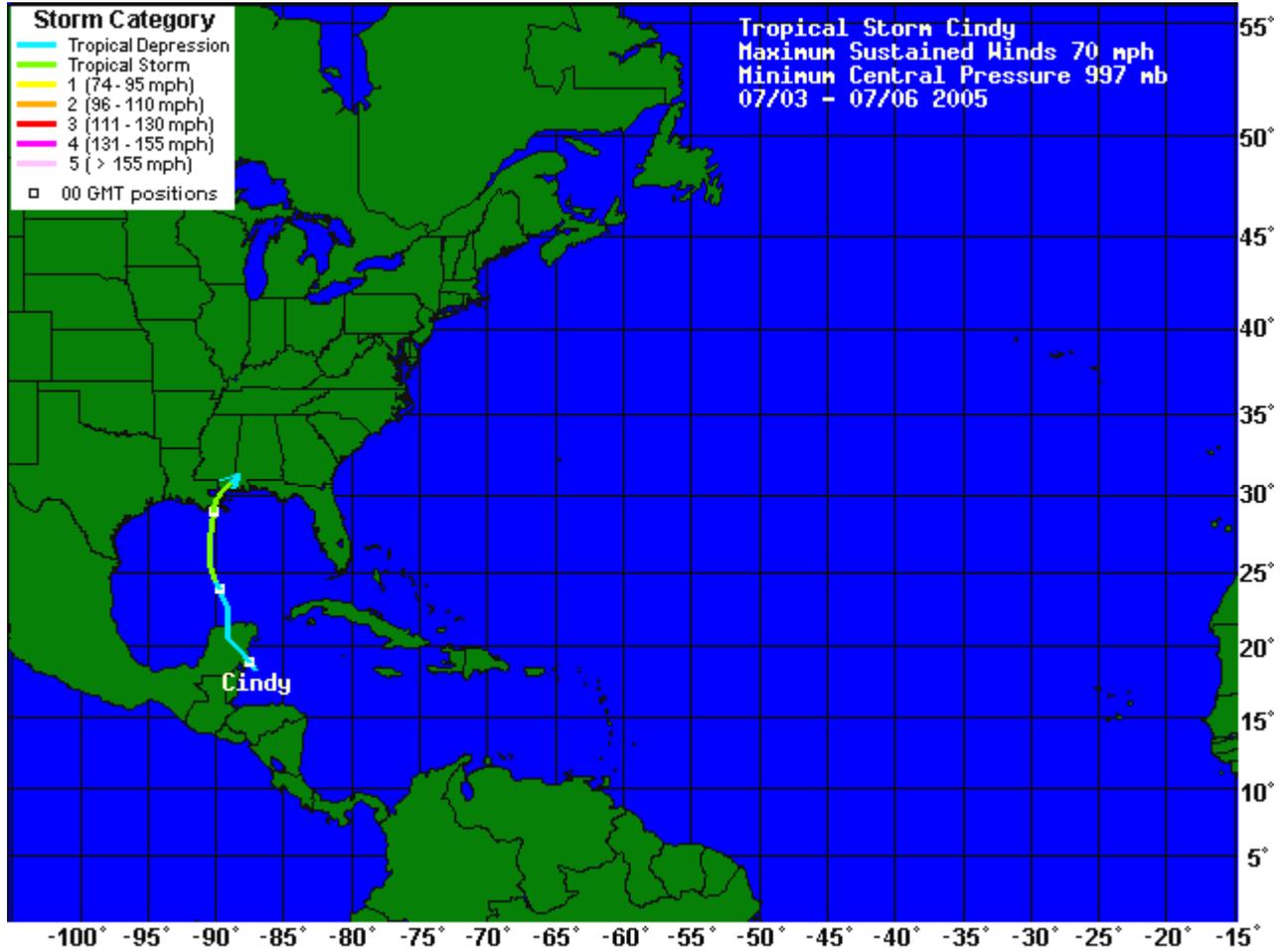


Figure B-11. TS Cindy Storm Track.

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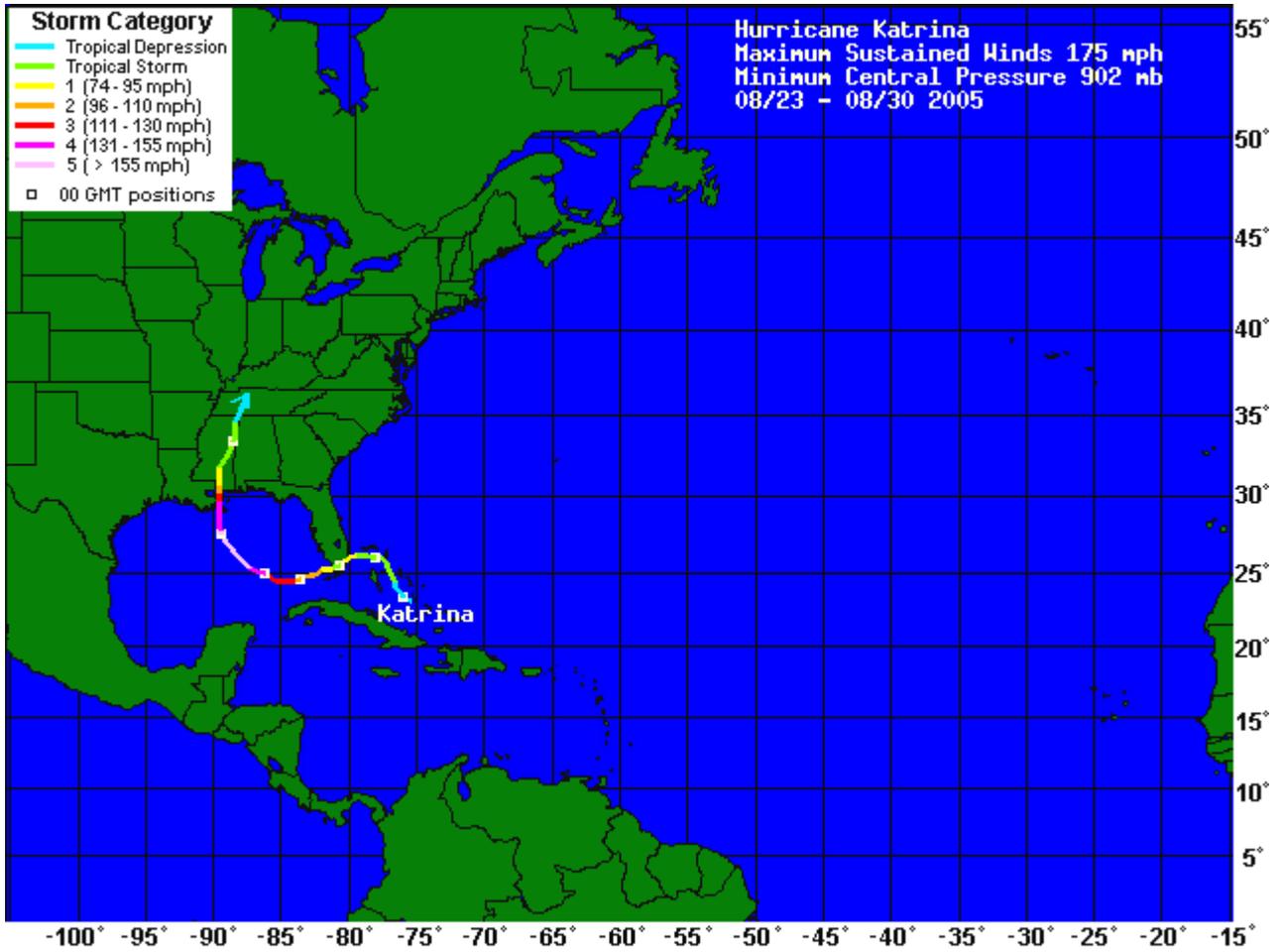


Figure B-12. Hurricane Katrina Storm Track.

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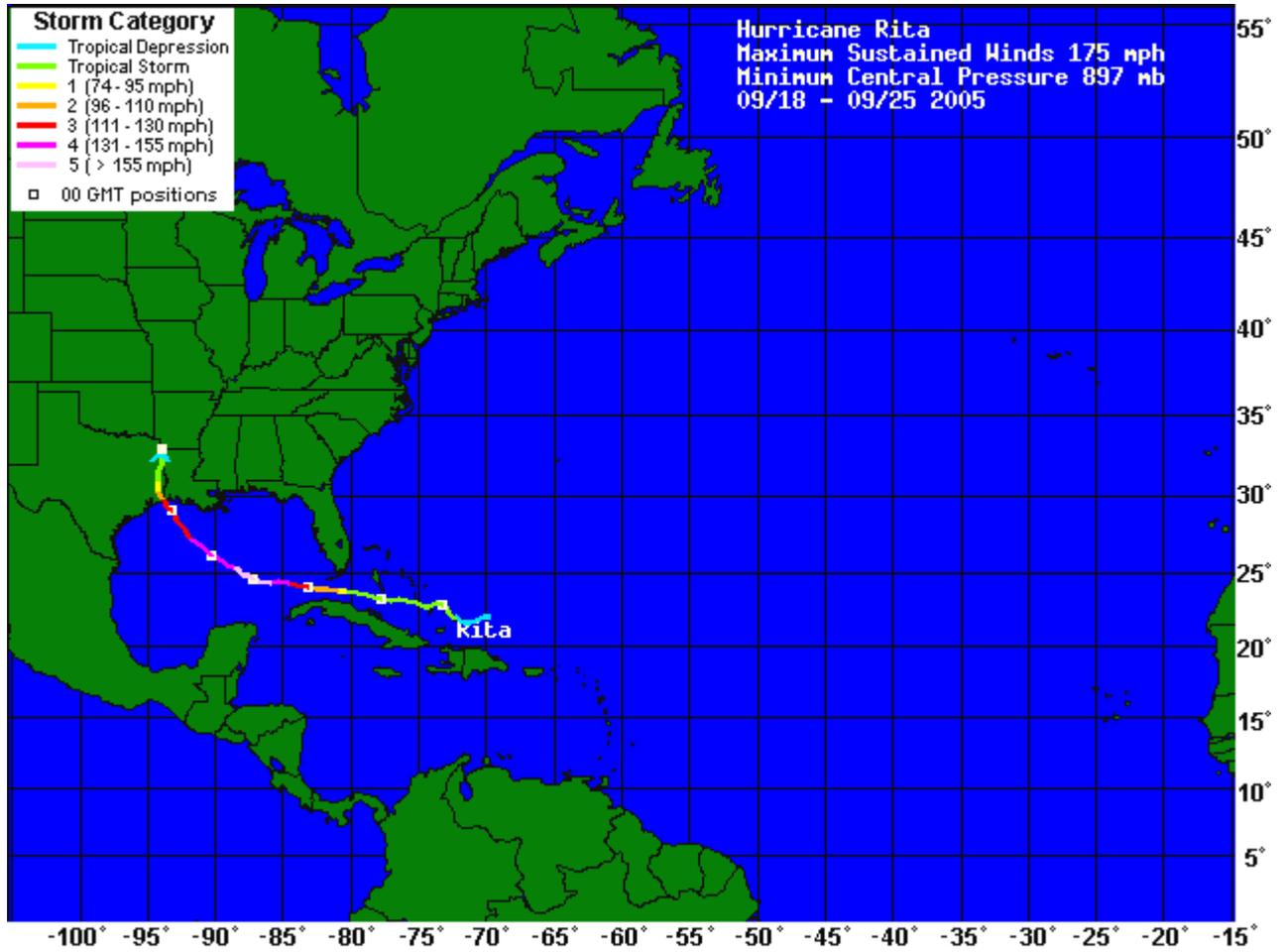


Figure B-13. Hurricane Rita Storm Track.

HISTORY OF HURRICANE OCCURRENCES ALONG
COASTAL LOUISIANA -1986 - 1997 UPDATE

NEW ORLEANS DISTRICT, NEW ORLEANS, LOUISIANA

History of Hurricane Occurrences 1986 - 1997 Update

1986, June 23-28 (Bonnie). Hurricane Bonnie developed in the central Gulf of Mexico on the 23rd, then moved toward the Texas-Louisiana coast. It became a hurricane on the 25th and made landfall southwest of Sabine Pass near noon of the 26th. Bonnie was a minimal hurricane that caused some beach erosion and coastal roadway damage in Cameron Parish. The maximum winds were 75 knots with reported gusts of over 85 knots. Tides along the southwest Louisiana coast were over 5 feet m.l.g. Bonnie caused heavy rainfall in north Louisiana with Shreveport receiving nearly 7 inches of rain in less than 24 hours.

1988, August 8-10 (T.S. Beryl). Tropical Storm Beryl was an unusual storm in that it spent its entire life over land. Forming inland over southeast Louisiana on the 8th. Beryl initially drifted to the southeast before looping towards the northwest. Heavy rains accompanied Beryl with Baton Rouge receiving 3.5" and Lafayette 5.0" in the three days of the storm. Heavier rains fell in Mississippi and east Texas with Biloxi getting over 6" in twenty-four hours and Pascagoula getting almost 16" in 3 days. High water elevations caused by Beryl were 6.03ft NGVD on the MRGO at Shell Beach, 7.0ft NGVD at Bayou Dupre, and 4.0ft NGVD in Lake Pontchartrain at Frenier Beach. Maximum winds were 45 knots.

1988, September 7-11 (Florence). A frontal low, which produced record low temperatures in the southeastern United States, developed tropical characteristics as it moved southward into the Gulf of Mexico. It was classified a tropical depression on the 7th in the southwestern Gulf of Mexico. It rapidly gained strength as it moved forward and became Hurricane Florence on the 9th. Hurricane Florence made landfall near Southwest Pass and Port Eads late on the 9th. Maximum sustained winds were 70 knots. Wind gusts of 80 mph were recorded in the Breton Sound. Peak gusts at New Orleans International Airport were measured at 53 mph and at Baton Rouge Airport the peak wind gusts were 38 mph. Maximum water elevations were 7.5ft NGVD on the IWW at the Paris Road Bridge, 6.89ft NGVD in the Inner Harbor Navigation Canal at the Florida Avenue Bridge, 6.5ft NGVD at Breton Sound near Gardner Island, 6.9ft NGVD at the Bayou Bienvenue Control Structure, and 5.14ft NGVD in Lake Pontchartrain at Mandeville. Damages caused by Hurricane Florence were around 2.5 million dollars.

1988, September 8-20 (Gilbert). Hurricane Gilbert was a monster hurricane that at one time covered most of the Gulf of Mexico. It was a classic Cape Verde hurricane that is common for hurricanes forming in late August and early September. Its maximum sustained winds were in excess of 200 mph and produced the lowest recorded pressure, 888 mb, of any Atlantic hurricane. Even though Hurricane Gilbert made landfall 120 miles south of Brownsville, Texas it still caused beach erosion along the Louisiana barrier islands. A high tide of 4.45ft m.l.g. occurred at Cameron and a 4.7ft m.l.g. stage was recorded at Freshwater Bayou Lock.

1989, June 24- July 1 (T.S. Allison). Tropical Storm Allison formed off the south Texas coast in the Gulf of Mexico. It made landfall on the 26th between Corpus Christi and Galveston. Allison was downgraded to an extratropical depression late on the 27th. It caused heavy rain in the western half of Louisiana with rainfall totals at Shreveport totaling 10" for a 6-day period. Elsewhere Lafayette received 8.2" of rain during a 4-day period and Lake Charles had 13.9" of rain during the same period. These heavy rains produced a high stage at Indian Bayou near Lake Charles of 11.07ft NGVD and a high stage of 9.4ft m.l.g. at the Calcasieu Salt Water Barrier (East) on the Calcasieu River. The effects of Allison to Louisiana were minimal comparing what it did in Texas and elsewhere with damages totaling \$500 million.

1989, July 30- August 3 (Chantal). Chantal was born off the northern coast of the Yucatan peninsula. It became a hurricane on the night of the 31st. The vast majority of hurricanes have their strongest winds in the right forward quadrant. Hurricane Chantal had its strongest winds in its left forward quadrant. Chantal made landfall east of Galveston on the 1st. Only minor damage was reported in Louisiana. High stages along the Louisiana coast were 5.1ft m.l.g. at Cameron, 6.9ft m.l.g. at Freshwater Lock, and 6.87ft m.l.g. on the Mermentau River at Grand Cheniere.

1992, August 16-28 (Andrew). On the morning of the 22nd Andrew became the first Atlantic hurricane to form by a tropical wave since 1990. Hurricane Andrew had its origin as a tropical wave moving off the west coast of Africa into the Atlantic Ocean on the 14th. It was upgraded to a tropical depression on the 16th and a tropical storm on the 17th. After being upgraded to a category 1 hurricane on the 22nd Andrew intensified rapidly to a category 4 hurricane, with sustained winds of 150 mph and gusts of up to 185 mph, by the evening of the 23rd. Hurricane Andrew, which had become one of the three most powerful storms to ever hit the continental U.S., wreaked havoc across the Bahamas and the southern tip of Florida. Its path of destruction in Florida resulted in 15 deaths and almost \$20 billion in damages. After leaving Florida, it quickly moved across the Gulf of Mexico in a west-northwest direction, taking aim at the Louisiana coastline. Andrew was expected to turn north and follow an area of high pressure that was moving to the east. This would have caused it to directly hit the city of New Orleans. However, the strong steering currents of the system, as well as its speed, delayed this turn. Shortly after midnight on the 26th, Andrew made landfall in St. Mary Parish, 80 miles west of Morgan City, with sustained winds of 140 mph and wind gusts of up to 165 mph. Following its landfall, Hurricane Andrew changed its course from northwest to north, and battered the Acadiana parishes of St. Mary, Iberia, Lafayette, Lafourche, and Terrebonne. After passing between Lafayette and Baton Rouge mid-day on the 26th, Andrew was downgraded to a tropical storm. Hurricane Andrew was responsible for 15 deaths and \$1.5 billion in damages. It was estimated that 1,250,000 people evacuated the parishes of southeastern and south-central Louisiana.

The forward direction of north-northwest and the forward speed of 15 mph helped reduced the storm surge from what normally would have been expected from a storm of this magnitude. The storm skirted the coast before coming ashore with the winds blowing from the land to the gulf helped to lower the stage before the surge hit. The moderate storm surge along the Louisiana coast eroded hundreds of acres of barrier island, uprooted and destroyed thousands of acres of marsh and killed millions of fish. At Grand Isle the storm surge and 85 mph winds tore up the island's beaches and left three quarters of the island under 3 feet of water. South of Houma the tidal surge was over 5 feet for most of the area with higher stages near the coast. The Terrebonne barrier islands lost 40% of their area. The maximum stage at Cocodrie was estimated by high water marks to have been 8 ft NGVD. High water surface elevations in southeast Louisiana are as follows: 7.3 ft NGVD at Lukes Landing, 6.8 ft NGVD on the Atchafalya River at Morgan City, 7.6 ft NGVD near Round Bayou at Deer Lake, 5.1 ft NGVD on Bayou Lafourche at Golden Meadow, and 6.0 ft NGVD estimated at Grand Isle. The rainfall associated with Andrew amounted to 11.92" in Hammond, 9.31" in Morgan City, 7.90" in Butte La Rose, 4.12" in New Orleans, 6.30" in Houma, and 5.06" in Slidell.

Winds and tornadoes associated with Andrew damaged homes, businesses, and government facilities as well as doing massive damage to crops, trees, and the ecosystem. The most severe was the tornado that touched down in St John the Baptist Parish that caused 2 deaths and \$7.3 million of damages. Winds from Hurricane Andrew were responsible for approximately 90% of the \$1 billion structural damage suffered. The oil and gas industry's offshore operations suffered an estimated \$200 million in damages. The Coast Guard closed the Mississippi River south of Baton Rouge to traffic throughout the storm. No Corps of Engineers flood control project was overtopped by the storm surge brought ashore by Hurricane Andrew. No Corps project was subjected to stages that even came close to design conditions. Minor wind damage was experienced at several Corps of Engineers Navigation Projects.

1995, September 27 - October 6 (Opal). On the 30th of September Opal became a tropical storm located in the Bay of Campeche. Two days later on the 2nd of October it was upgraded to a hurricane. Moving towards the northeast, early on the 3rd hurricane watches were posted from Morgan City to Suwanee, Florida. Hurricane Opal passed less than 100 miles to the south and southeast of the Mississippi River delta on the 4th as a category 4 storm with sustained winds at 130kts and a central pressure of 916mb. Opal did little damage in Louisiana even though it was one of the most destructive hurricanes to hit the mainline U.S. doing an estimated \$3 billion in damages. Late on the 4th Opal made landfall near Pensacola, Florida. High water elevations associated with Opal were 5.09ft NGVD on the MRGO at Shell Beach, 4.63ft NGVD at the Southwest Pass East Jetty, and 3.9ft NGVD in Lake Borgne at the Rigolets. All of these stages occurred on the 4th.

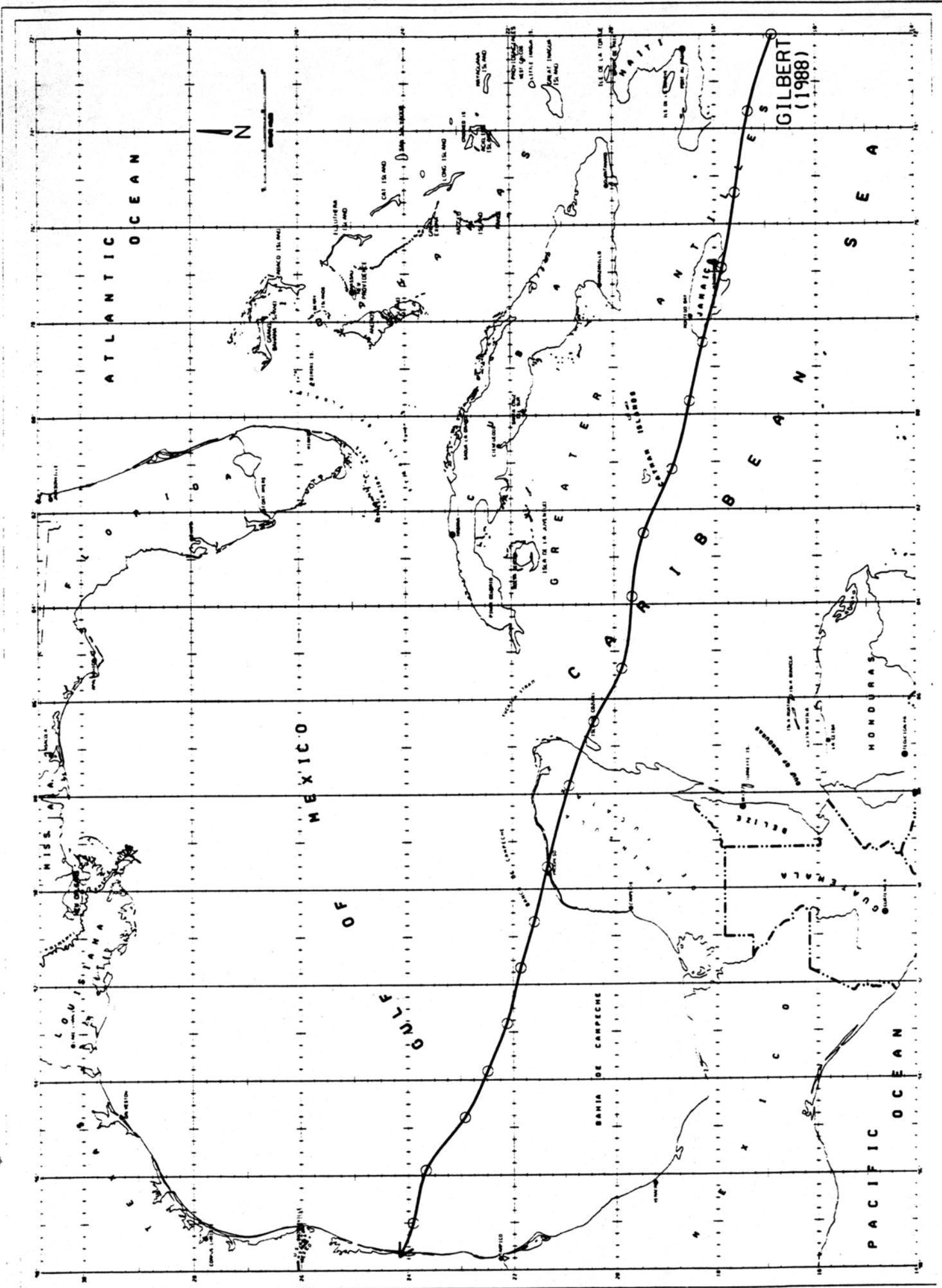
1997, July 16-20 (Danny). Danny formed in the northwest Gulf of Mexico on the 16th. Moving in a northeastward direction, Danny gained strength and on the 18th was upgraded to a hurricane. Hurricane Danny passed offshore of Grand Isle making landfall near Empire, Louisiana. From there it moved onward to the northeast towards Mobile, Alabama. After stalling around Mobile Bay and dumping heavy rains in that region, Danny moved across Georgia and the Carolinas regaining tropical storm strength as it moved out into the Atlantic Ocean. Grand Isle reported wind gusts up to 95 mph and a high stage of 5.4 ft (NOAA). Over 160 houses and 80 businesses were reported flooded with moderate to severe beach erosion as the tide inundated the island with 3 feet of water. Rainfall in Louisiana was generally light for this storm except down near the Mississippi River delta where Buras reported 9.32" of rain in 72 hours. The lower part of Plaquemine Parish reported some houses and trailers being damaged as well as over 170 boats. Other high stages caused by Hurricane Danny in the New Orleans District are as follows: 5.54 ft NGVD on the MRGO at Shell Beach, 4.24 ft NGVD at the Chef Menteur at Lake Borgne, 5.22 ft NGVD on the IHNC at Florida Avenue bridge, and 3.9 ft NGVD on the IHNC at the Seabrook bridge.

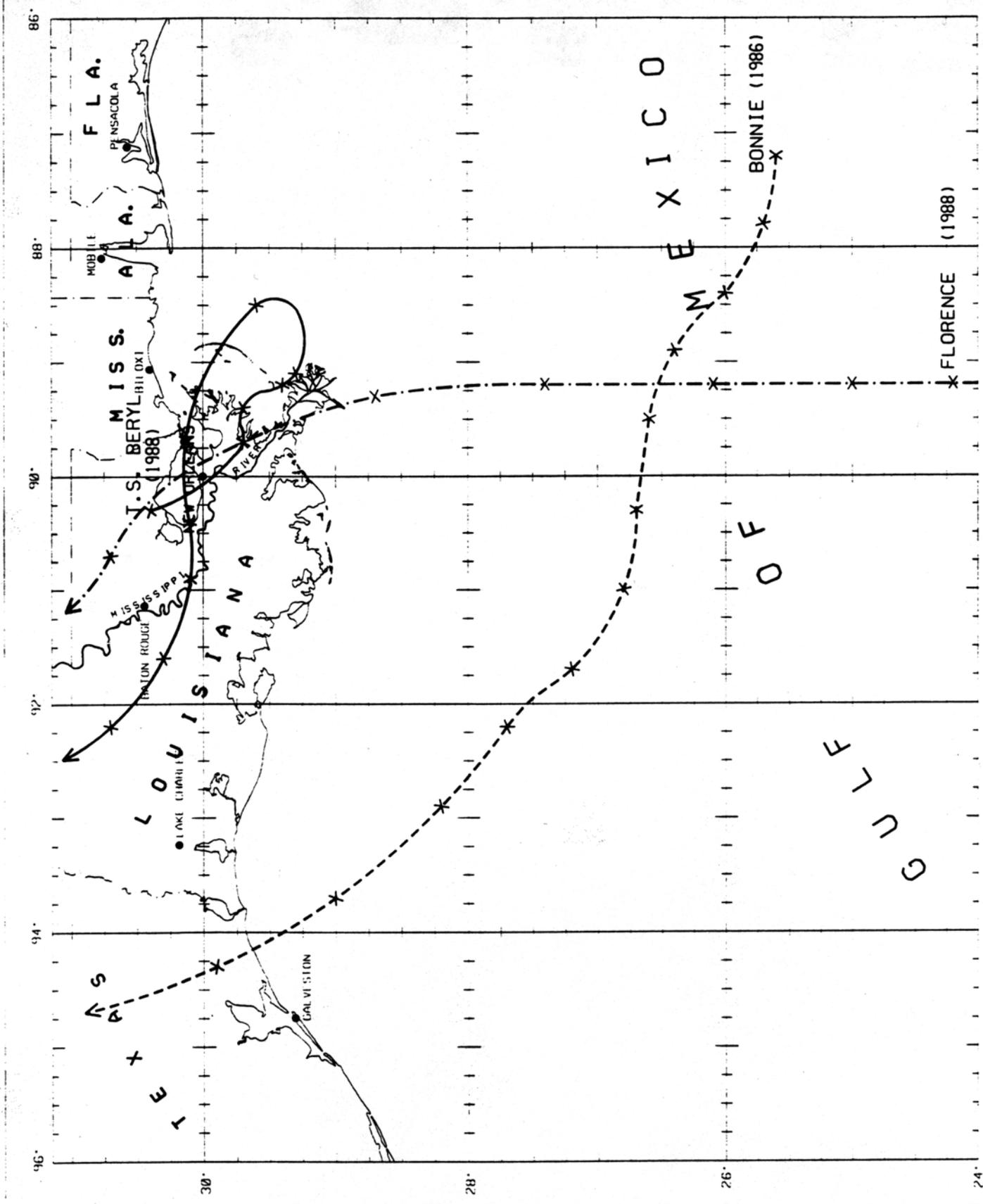
Date	Classification	Type of Damage	Areas Affected	CPI (MB)	Maximum Winds (kts)
23-28 Jun 86 Bonnie	H	Minor	V	992	75
8-10 Aug 88 Beryl	T	Minor	I	1001	45
7-11 Sep 88 Florence	H	Minor	I, II	983	70
8-20 Sep 88 Gilbert	H	Minor*	III, V, VI	888	160
24 Jun-1 Jul 89 Allison	T	Minor*	V	999	45
30 Jul-3 Aug 89 Chantal	H	Minor	V	984	70
16-28 Aug 92 Andrew	H	Major	I, II, III, IV, VI	937*	120*
27 Sep-6 Oct 95 Opal	H	Minor*	I, II	919	130
16-20 Jul 97 Danny	H	Minor*	II, III	984	70

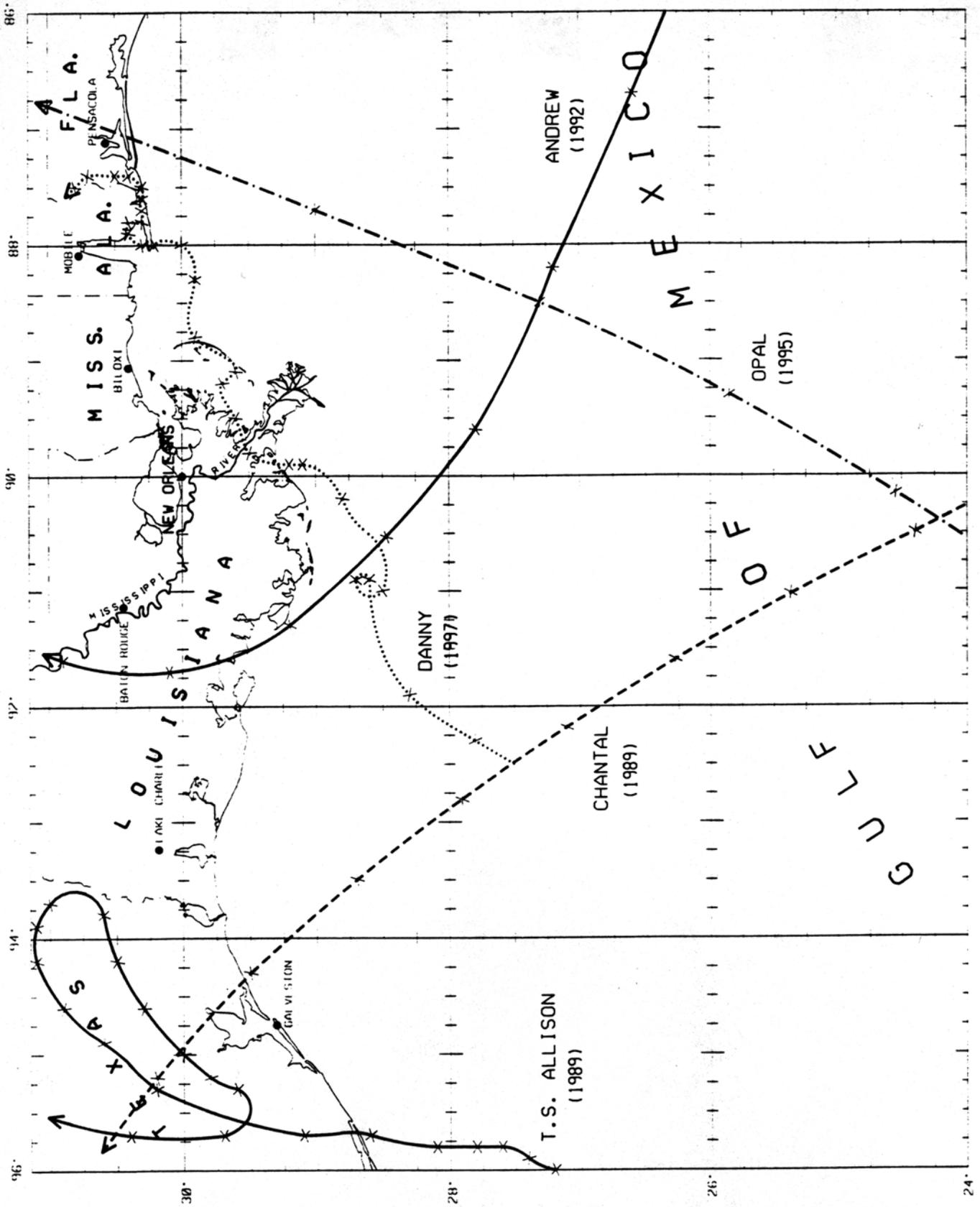
T - Tropical Storm
H - Hurricane

I - Lake Pontchartrain and Vicinity
II - Mississippi River Delta below New Orleans
III - Grand Isle and Vicinity
IV - Morgan City and Vicinity
V - Southwest Louisiana
VI - Interlying Area along Coastal Louisiana

* in Louisiana







HISTORY OF HURRICANE OCCURRENCES ALONG COASTAL LOUISIANA

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HISTORY OF HURRICANE OCCURRENCES ALONG COASTAL LOUISIANA

1. HISTORICAL RESEARCH

This discussion and description of the history of hurricanes affecting the Louisiana coast includes all hurricanes and tropical storms with hurricane potential which have caused damage to persons or property plus those with no record of damage which have struck this or adjacent coasts and which could have caused damage under slightly different meteorological conditions. The choice of storms was guided by the U. S. Weather Bureau National Research Project Report No. 5 for storms since 1893, the National Weather Service (formerly U. S. Weather Bureau) Hurricane Track Charts for storms since 1886, and other special bulletins from this organization. Prior to these records, there is only limited information available which gives accurate meteorological, hydrologic, and damage data. Records of several storms prior to these dates reveal only the location of inland movements along the coast and incidents of abnormal or dramatic damage. Because of the sparse population of much of the coastal areas there is only limited information available, even on later storms. Available data represents a summary from all known sources which include, in addition to National Weather Service Reports, publications by I. R. Tannehill and I. M. Cline, historical documents in the public archives, reports by the Corps of Engineers, and files of newspapers. In general, the information obtained from these sources, particularly for the earlier storms, consists of compilations of descriptions provided by individuals who apparently reported the events as observed. Conflicting statements in some of the earlier hurricane cases indicate that the compilations are not accurate in all respects. Where factual information is given, it has been examined and appraised for reasonableness or can be substantiated by published records. Often the lack of records obscured important storms that, by comparison to repeated similar storms, should have indicated considerable flooding and damages. For this reason, there are several storms which have been included even though they appear not to be pertinent to this area or had little or no assessed damage.

2. SUMMARY OF HURRICANE OCCURRENCES

A total of 66 known hurricanes and tropical storms has struck or threatened the Louisiana coast in the period of recorded history. Descriptions of these will be found in paragraph 4 and plots of the paths of the storms since 1886 are given in plates 2 through 8. Meteorological analyses of these storms are available only from 1893 and so for purposes of engineering analysis only storms since that date have been considered. Forty-six of these storms have been selected for frequency analysis purpose of the National Weather Service. The analysis of the hurricane problem for coastal Louisiana has been divided into six areas, plate 1. For convenience, the hurricanes which have occurred since 1893 are

tabulated chronologically in table 1. Selected meteorological information presented for these storms has been extracted from the U. S. Weather Bureau National Hurricane Research Report No. 5 and subsequent publications. Hurricanes for which there was only minor or unassessed damage since 1893 in each area are also tabulated but since these have not been analyzed, meteorological data are not given.

Area I has been struck by 13 hurricanes which have caused considerable damage and 23 hurricanes or tropical storms which have caused minor or unassessed damage. Area II had 15 damaging hurricanes and 28 hurricanes or tropical storms with minor or unassessed damages. Area III had 11 damaging and 23 other hurricanes or tropical storms. Area IV had 7 and 19, Area V had 5 and 24, and Area VI had 9 and 7, respectively, of the damaging hurricanes and nondamaging or unassessed hurricanes or tropical storms.

3. HURRICANE TRACKS

The tracks of hurricanes and tropical storms which have affected or threatened the Louisiana Coast are shown in plates 2 through 8. The paths were obtained from the National Weather Service and combined in chronological groups for concise presentations. Occurrences which produced flooding up to a serious extent are repeated individually in plates 9 through 21 to a smaller scale in order to delineate the extent of area flooded and observed hurricane tides in each.

TABLE 1

HURRICANE OCCURRENCES

Date	Classification*	Type of Damage	Areas Affected	Central Pressure Inches Mercury	Max. Recorded Wind Speed mph
27 Sept-5 Oct 1893	H	Major	I, II, III, VI	28.22	100
6-8 Aug 1894	H	Minor	I, II	-----	---
10-13 Sept 1897	H	Unassessed	I, II, III, IV, V, VI	-----	72
10-16 Sept 1900	T	Unassessed	I, II, III	-----	---
4-17 Aug 1901	H	Major	I, II	28.72	60
7-15 Oct 1902	H	Unassessed	I, II, III	29.72	34
29 Oct-10 Nov 1904	T	Unassessed	I, II, III	-----	---
24-30 Sept 1905	T	Minor	I, II	29.75	30
19-30 Sept 1906	H	Unassessed	I, II	-----	---
17-23 Sept 1907	T	Unassessed	I, II	-----	---
10-24 Sept 1909	T	Major	II, III, IV, VI	28.94	80
7-15 June 1912	H	Unassessed	II, V, IV	-----	---
14-18 Sept 1914	T	Unassessed	I, II	-----	---
5-24 Aug 1915	H	Major	I, II, III, IV, V, VI	28.14	---
22 Sept-2 Oct 1915	H	Major	I, II, III	27.87	94
21-29 Sept 1917	H	Major	I, II, III	28.48	79
1-6 Aug 1918	H	Major	V, VI	-----	125(estimated)
2-14 Sept 1919	T	Unassessed	I	-----	---
19-23 Sept 1920	T	Unassessed	I, II, III, IV, VI	-----	---
13-17 Oct 1923	H	Minor	I, II, III, IV, V, VI	29.25	---
21-27 Aug 1926	H	Major	II, III, IV, VI	28.31	90
11-17 July 1931	T	Unassessed	IV, VI	-----	---
18-21 Sept 1932	T	Unassessed	IV, V	-----	---
7-18 Oct 1932	T	Unassessed	IV, V	-----	---
4-21 June 1934	H	Minor	II, III, IV, VI	28.52	68
21-25 July 1934	H	Unassessed	II, III, V, VI	-----	---
26-27 July 1936	T	Unassessed	I, II, III	29.62	50
16-21 Sept 1937	T	Unassessed	II	-----	---
9-14 Aug 1938	T	Unassessed	V	29.56	50
2-10 Aug 1940	T	Major	I, II, III, IV, V, VI	28.76	---
11-16 Sept 1941	T	Unassessed	I, II, III, IV, V, VI	-----	---
17-22 Aug 1942	H	Unassessed	III, IV, V, VI	-----	---
25-28 July 1943	H	Unassessed	I, II, III, IV, V	-----	---
15-19 Sept 1943	H	Unassessed	V, VI	-----	---
8-10 Sept 1944	T	Unassessed	II, III	-----	---
3-6 Sept 1945	T	Unassessed	I	-----	---
13-16 June 1946	T	Unassessed	I, II, III, IV, V, VI	-----	---
4-21 Sept 1947	H	Major	I, II	28.57	98
28 Aug-6 Sept 1948	H	Unassessed	I, II, III	29.21	78
3-5 Sept 1949	T	Minor	II, III	29.50	50
31 July-2 Aug 1955(Brenda)	T	Unassessed	I, II	29.50	60
23-29 Aug 1955	T	Unassessed	I, II	29.54	50
12-14 June 1956	T	Minor	I, IV, VI	-----	---
21-30 Sept 1956(Flossy)	H	Major	II, III	28.76	90

TABLE 1 (cont'd)

HURRICANE OCCURRENCES

Date	Classification*	Type of Damage	Areas Affected	Central Pressure Inches Mercury	Max. Recorded Wind Speed mph
25-28 June 1957(Audrey)	H	Major	III, IV, V, VI	27.95	105
16-19 Sept 1957(Esther)	T	Unassessed	II, III, IV, VI	-----	---
28 May-2 June 1959(Arlene)	T	Unassessed	III, IV, V, VI	-----	---
4-14 Sept 1961(Carla)	H	Minor	I	-----	---
28 Sept-5 Oct 1964(Hilda)	H	Major	I, II, III, IV, VI	28.40	98
27 Aug-10 Sept 1965(Betsy)	H	Major	I, II, III, IV, VI	29.00	105
14 Aug-18 Aug 1969(Camille)	H	Major	I, II	26.61	160(estimated)
29 Aug-10 Sept 1974(Carmen)	H	Major	III	27.84	86
3-8 Sept 1977(Babe)	H	Minor	VI	29.85	46+
26-29 Aug 1978(Debra)	T	Minor	V	30.00	46
9-16 July 1979(Bob)	H	Minor	I, II, III	29.58	58
9-12 Sept 1982(Chris)	T	Minor	V	29.82	63
12-20 Aug 1985(Danny)	H	Minor	V	29.61	---
28 Aug-4 Sept 1985(Elena)	H	Major	---	28.53	127
26-31 Oct 1985(Juan)	H	Major	V, VI	29.13	74

- * H - Hurricane, T - Tropical Storm
+ Highest reported from a land station.

- AREA I -Lake Ponchartrain, LA and Vic.
II -Mississippi River Delta at and below New Orleans, LA
III -Grand Isle, LA and Vic.
IV -Morgan City, LA and Vic.
V -Southwest Louisiana
VI -Interlying Area Along Coastal Louisiana

4. DESCRIPTION OF HURRICANES

The following hurricanes and tropical storms have affected or threatened the Louisiana coast.

- 1559, September 19. This hurricane, known as the "Tempest," is the earliest of record occurring on the gulf coast. According to Tannehill's reference to Poey it passed between Mobile and Pensacola and is report to have lasted 24 hours.
- 1711, September 11-13. The principal localities damaged by this hurricane were New Orleans, where it destroyed the St. Louis church, and Mobile, where high tides overflowed the settlement. The city of Mobile was established originally in 1702 at a site located approximately 27 miles above the mouth of the Mobile River and it is said that flooding by this hurricane was the principal reason for relocating the town at its present site.
- 1722, September 11-13. Hurricane winds reached New Orleans on the night of the 11th and continued for 15 hours. Thirty-six huts, including two which served as a church and rectory, were destroyed. Several patients were injured when the hospital was destroyed. The storm was disastrous to shipping in the port where two 12-cannon ships went aground, the Capital's Flotilla was put out of commission, and flat boats and pirogues sank with their loads of grain. The water level at New Orleans rose 3 feet in Bayou St. John and nearly 8 feet in the Mississippi River.
- 1723, September 11. This hurricane is reported in Poey's list to have been a remarkable one which nearly destroyed all buildings in New Orleans. A Newspaper account, written in 1864, stated that the church, hospital and 30 houses in New Orleans were blown down by wind and that the storm extended to Natchez and Biloxi.
1732. This storm struck Mobile, and is reported to have been very destructive.
1736. During the passage of this hurricane the village of Pensacola was swept away.
- 1740, September 12. This hurricane passed near the mouth of the Mississippi river and near Mobile. Occurring in the fall of the year, it destroyed a large portion of the crops and left a great number of the colonists without shelter.
- 1766, September 4. Struck Galveston; no further details available.

1766, October 22. This hurricane struck Pensacola. The Spanish fleet enroute from Vera Cruz, Mexico, to Havana, Cuba, was wrecked.

1772, August 31 - September 4. This hurricane is reported to have struck the Louisiana coast but details are not available. In its path over the West Indies it caused great havoc along the Leeward Islands. Eighteen vessels were driven ashore and lost at Dominica. Several warships were driven ashore at Antigua. At two locations every house was blown down, several people were killed and many injured.

1776. Struck New Orleans; no further details available.

1779, October 7-10. Struck New Orleans; no further details available.

1780, August 24. Struck New Orleans and swept over the province of Louisiana, destroying buildings and crops, and sinking every vessel and boat afloat in the vicinity on the Mississippi River.

1871, August 23. Struck New Orleans; no further details available.

1793, August. Struck New Orleans and destroyed unharvested crops and devastated rural sections.

1794, August. Struck New Orleans during the harvest season and did considerable damage to crops.

1800, August. Struck New Orleans.

1811. Struck New Orleans.

1812, August 19-20. On the 20th a gale of dreadful violence struck New Orleans and raged for 4 hours. Destruction to buildings, trees, fences, boats, and other property was very extensive. Reports from the surrounding country areas indicated that buildings and sugar crops suffered severely.

1813, August 19. This hurricane is reported to have struck the gulf coast.

1818. Struck Galveston. Four of Lafitte's vessels sank or were driven ashore.

1819, August 25-28. Moved into Louisiana and Alabama.

1821. Struck New Orleans.

1822, July 11. Struck Mobile.

1831, June 23. Occurred in Gulf of Mexico; no further details available.

1831, August 10 - 18. "The Great Barbados Hurricane" struck the island of Barbados with tremendous force. This hurricane is said to have produced more damage than all previous ones combined. It moved to Haiti then to Cuba and continued over the Gulf of Mexico. It crossed the coast east of New Orleans and is reported to have caused much damage. Most of the vessels in the New Orleans harbor suffered serious damage. Many buildings under construction were blown down and some homes were unroofed in New Orleans. Sugar cane crops suffered severely from Baton Rouge to Pointe a la Hache. Other crops were a partial or total loss in some localities. This isle of Barataria, now probably Grand Isle, was completely inundated, the water having risen 6 feet. One hundred and fifty persons disappeared from Barataria, their huts were washed away and the boats in which they fled disappeared.

1835, August 12-18. Struck Antigua, Cuba and Galveston. The barometer fell an inch in 1 hour and 27 minutes at Antigua.

1837, September 27 - October 10. "Racer's Storm," named after a British sloop of war that encountered the hurricane, was first observed southeast of Jamaica. On the 27th and 28th it caused severe gales on the island. On the 29th the sloop "Racer" experienced the full force of the hurricane as it approached the Yucatan Channel. This storm reached the Mexican gulf coast south of Brownsville, curved and followed the coast line, passing near Galveston, on the 6th. It then crossed the Louisiana coast and moved on toward the Atlantic Ocean. In New Orleans, the lower portions of the city were submerged, many buildings were damaged or carried away and six lives were lost. All boats in their pens near Lake Ponchartrain were completely wrecked along with four steamboats on the lake.

1839, November 5. Struck Galveston.

1842, September 18 - 22. Occurred in the Gulf of Mexico; no further details available.

1842, October 5. Stuck Galveston.

1844, September 1. Occurred in eastern Gulf of Mexico; no further details available.

1846, April 3. This storm was classified as the worst since the hurricane of 1831 in the vicinity of Balize near the mouth of the Mississippi River.

1851, September 18. Occurred in Gulf of Mexico; no further details available.

1852, August 23 - 27. A tide of 8.8 feet mean low water* occurred at Mobile during this storm. Details of wind velocities and damages are not available.

1854, September 16 - 19. Struck between Matagorda and Galveston. According to W. H. Emory's U. S. and Mexican Boundary Report, Vol. 1, Chapter IV, page 54, C. C. Perry encountered a violent hurricane in the gulf between New Orleans and Indianola. Matagorda was leveled. Water was blown out of the back bay through the channel and its entrance was straightened and deepened 9 to 11 feet over the bar. All docks in the bay but one were destroyed.

1856, August 9 - 12. This celebrated hurricane completely destroyed the Isle Derniere pleasure resort, which was located about 50 miles west-southwest of Grand Isle. A high northeast wind prevailed on the 9th and 10th. When the storm was at its height, the wind shifted to the southeast, flooding the island with 5 feet of water and destroyed everything on it. It is estimated that 320 persons perished on this island. Thirteen inches of rain fell at New Orleans. The storm appears to have dissipated near the coast of Louisiana and Mississippi.

1856, August 27 - September 2. This violent hurricane moved westward across Cuba in its passage. The barometer fell to 28.62 inches at Havana, Cuba. The storm moved inland near Mobile on the 30th. Details of its influence on the coastal areas are lacking but it was considered the most disastrous hurricane since 1846.

1860, August 11. Struck Mobile, where a tide of 7.2 feet mean low water was experienced.

1860, September 15. This hurricane produced a tide of 7.8 feet mean low water at Mobile. According to an article in a newspaper on 22 September 1947, a tide of 16.5 feet occurred at Biloxi, during 1860.

1860, October 2 - 3. This hurricane is reported to have caused severe damage to houses, places of business, boats with their cargoes, and crops in the coastal parishes and as far inland as Baton Rouge. The portion of New Orleans adjacent to Lake Ponchartrain was completely submerged. Many livestock and approximately 13 lives were lost.

* The referenced datums refer to the local datum at the gage and have an unestablished relationship with the subsequent national mean sea level datum plane.

1865, September. This hurricane struck the coast near the town of Calcasieu in southwest Louisiana. The place was inundated and several persons killed.

1865, October 22 - 23. This storm was evidence in the area from Cuba to the Louisiana coast.

1866. Struck Galveston.

1867, October 1 - 3. This severe hurricane passed near Galveston. Much of the city was flooded and property damage was placed at \$1 million. The towns of Bagdad and Clarksville at the mouth of the Rio Grande were destroyed. This storm is believed to have moved northwestward toward the mouth of the Rio Grande then curved toward the north-northeast following a course somewhat like that of Racer's storm of 1837.

1870, July 3. Recorded as the hurricane which occurred earliest in the year at Mobile during the season. The tide rose to an elevation of 7.8 feet mean low water.

1871, June 1 - 4. Struck the Texas coast. The barometer at Galveston registered a low pressure of 29.51 inches.

1871, June 9. Struck the east Texas coast.

1871, October 2 - 3. Struck Galveston.

1873, September 18 - 20. Struck the gulf and southeastern states; very severe along the coast.

1877, September 15 - 21. This storm moved over the gulf in a northerly direction toward Galveston, where it veered easterly as it neared the coast. Wind velocity at New Orleans was 39 m.p.h. and some of the lower portions of the city were overflowed.

1879, September 1 - 4. The center moved inland slightly west of Morgan City on the 1st. Winds of 75 to 80 m.p.h. were estimated between Morgan City and New Iberia. The lowest barometer reading at Morgan City was 28.70 inches. Berwick Bay at Morgan City rose 9 feet on the 1st as a result of the hurricane and all streets in the town were flooded. Extensive damage to buildings, boats, and crops was experienced. One human life was lost.

1880, August 26 - 30. The coastal area from Mobile to Pensacola was reported to have been struck by this hurricane, but details as to its intensity and damages are not available.

1882, September 2 - 15. The center moved in near Apalachicola advancing in a northeasterly direction after having caused damage to Turks Island and then moved on to Cuba and the gulf

1882, September 2-15 (con't)

coast. Wind velocity was 70 m.p.h. at Port Eads with a barometer reading of 29.38 inches. The land was overflowed 14 miles northwest of Port Eads at Quarantine Station where the tide rose 2 feet.

1885, September 17 - 21. This hurricane struck Brownsville after paralleling the coast of Mexico, then skirting the southeast Louisiana coast, it moved east-northeast across Florida. Winds were not strong enough to cause damage in Louisiana.

1886, June 13 - 14. This hurricane passed inland near Sabine causing inundation which extended several miles inland. Galveston reported wind velocities of 40 m.p.h. and a low pressure of 29.43 inches on the 14th. Observed 24-hour rainfall at Alexandria was 21.40 inches.

1886, October 8 - 13. This hurricane passed between Galveston and Sabine. It was the second in 1886 to cause destruction at Sabine. Nearly every house was moved from its foundation, and 89 lives were lost. Gale-force winds were reported for the Sabine Pass and flooding extended 20 miles inland. A wind velocity of 43 m.p.h. was recorded at Port Eads at 2 p.m. on the 11th, and at 7 p.m. winds of 70-100 m.p.h. were estimated. The barometer at New Orleans recorded a low pressure of 29.79 inches. See plate 8 for extent of tidal flooding in Louisiana.

1887, October 9 - 23. This storm paralleled the entire coast of Texas and passed inland close to New Orleans on the 19th. Flooding occurred in the rear of the city as well as in some localities through levee breaks along drainage canals. Wind velocities were 40 m.p.h. at Mobile and 34 m.p.h. at New Orleans. The barometer at New Orleans recorded a low of 29.22 inches.

1888, July 5. Struck Galveston.

1888, August 14 - 24. Moving across the southern tip of Florida and across the gulf, this hurricane passed near Burrwood and moved inland west of Grand Isle on the 19th. Maximum wind for New Orleans was estimated at 90 m.p.h. while the 5-minute velocity was 47 m.p.h. Rainfall at New Orleans was 7.9 inches for the storm.

1889, September 11 - 26. This hurricane passed over the area at the mouth of the Mississippi River and then struck the Mississippi coast.

1891, July 3 - 12. This hurricane moved across the western gulf of Mexico from the Gulf of Campeche and moved inland east of Galveston.

1892, September 9 - 17. This storm struck the middle gulf coast area in the vicinity of Morgan City.

1893, September 6 - 10. Occurred in Gulf of Mexico; no further details available.

1893, September 27 - October 5. Forming in the Caribbean Sea, this hurricane of great violence moved northwest to the central Gulf of Mexico, thence recurving to the northeast, it moved across the Louisiana coast between New Orleans and Port Eads on the 1st. The hurricane produced inundation, being the most severe in history is reported to have engulfed everything before it, and caused a loss of life estimated at 2,000 persons. On Cheniere Caminada, adjacent to Grand Isle, 1150 persons perished, and on Grand Isle 18 died. Immense destruction of shipping and property was caused and the damage amounted to millions of dollars. Estimated wind velocities of 100 m.p.h. were reported at Grand Isle and Pointe a la Hache. The lowest barometric pressure of 28.65 inches was observed by the captain of a schooner lying at anchor at Moss Point, approximately 4 miles north of Pascagoula. The highest tide measured was 9.3 feet on Deer Island near Biloxi, although newspaper accounts reported that gulf waters rose 15 feet in Louisiana bays and overflowed into the river.

1894, August 6 - 8. Struck the middle gulf coast with winds of small force.

1894, October 1 - 12. This hurricane formed in the western Caribbean Sea and moved into the gulf where it traveled in a northeasterly direction, crossing the coast at the mouth of the Apalachicola River. Port Eads experienced a wind velocity of 56 m.p.h. with a low barometric pressure of 29.42 inches on the 8th. A wind velocity of 61 m.p.h. was observed at Fort Morgan.

1895, August 16. The storm was not of hurricane strength. It passed through the New Orleans and lower Mississippi River areas without causing much damage.

1895, October 2 - 7. This storm passed close to Brownsville, and moved inland in the Galveston area. It was not of hurricane intensity.

1896, July 4 - 12. This storm moved in a northerly direction from the gulf, crossing the coast between Pensacola and Fort Walton. A wind velocity of 56 m.p.h. and severe damages appraised at \$400,000 were reported for the Pensacola area.

1897, September 10 - 13. Moving from the Florida Straits this hurricane struck Port Eads on the morning of the 12th, thence skirting the Louisiana coast, it passed inland near Galveston, where a pressure of 29.58 inches was recorded. The wind velocity was 72 m.p.h. at Port Eads.

1898, September 12 - 25. Struck Yucatan and Louisiana; no further details available.

1898, September 20 - 28. This storm of minor intensity moved from the western Caribbean through Yucatan to the east Texas coast.

1900, August 27 - September 15. This hurricane of great intensity originated in the Cape Verde region off of the African coast, on the 27th and moved west-northwest into the Gulf of Mexico on the 6th. It progressively developed destructive energy, and at the time the center passed southwest of Galveston, it was a hurricane of tremendous fury. After passing inland the storm lost force rapidly but regained marked intensity near the Great Lakes. Wind and precipitation records for Galveston are incomplete due to storm damage of the instruments. The maximum wind velocity is estimated to have been 120 m.p.h. and the barometer registered a low of 28.48 inches on the 8th as the center passed. The tide rose rapidly to a height of 15 feet. Loss of life was in excess of 6,000 and property damage exceeded \$20 million.

1900, September 10 - 16. There was little damage reported on this tropical storm that struck the New Orleans area.

1901, June 10 - 14. This hurricane formed in the Caribbean Sea and moved north-northwest over the western tip of Cuba, thence across the Gulf of Mexico, and passed inland near Mobile on the 13th.

1901, August 4 - 17. First observed northeast of Puerto Rico this hurricane crossed southern Florida, moved across the gulf from the east-southeast towards Port Eads, and curved sharply to the north after crossing the Louisiana coast. High winds and extensive damage were reported from the area between the mouth of the Mississippi River and Pensacola. At Port Eads, where the full force of the hurricane was felt, practically all of the meteorological records were lost. The 5-minute wind velocity was 56 m.p.h. before the anemometer was blown away. At Mobile, winds reached a velocity of 60 m.p.h. The barometric pressure was 29.41 inches and the wind velocity was 39 m.p.h. at New Orleans, which was west of the hurricane center. The barometric pressure at Mobile was 29.32 inches. At Pilottown, 12 miles north-northwest of Port Eads, the tide was reported to have risen 4 feet in 10 minutes. In the Mississippi River at New Orleans the stage rose from 1.5 feet on the 12th to a maximum of 7.6 feet on the 14th, a rise of 6.1 feet. Various towns along both sides of the Mississippi River suffered severe flooding. Pointe a la Hache had water 3.5 feet in the town; Buras reported 4 feet of water. River water was blown over the levees from Fort St. Philip to Port Eads. Port Eads was almost totally destroyed except for the

1901, August 4 - 17 (con't)

Lighthouse. On the coast of Lake Borgne, Yscloskey and Shell Beach were flooded to depths of 3.7 feet. The south shore of Lake Pontchartrain experienced high tides and parts of the city of New Orleans were flooded when a levee on an interior canal broke. The tide at Mobile is reported to have risen to 8.2 feet above mean low water. Damages along the Louisiana coast were estimated to exceed \$1 million, exclusive of crops. Ten lives are known to have been lost. See plate 9 for map of flooded area in Louisiana for this storm.

1901, September 9 - 19. This storm approached St. Kitts on the 11th and passed inland on the gulf coast near Biloxi on the 17th. It did not develop into a full-fledged hurricane.

1902, October 7 - 15. Moving across the central Gulf of Mexico this tropical disturbance passed inland east of Mobile. The lowest barometer reading was 29.72 inches at Mobile. Maximum wind velocity at New Orleans was 34 m.p.h. Damages recorded were the sinking of a steamer in the Mississippi River and the wrecking of a schooner at Chandeleur Island.

1904, October 29 - November 10. This storm, not of hurricane intensity, passed near the mouth of the Mississippi River and moved inland near Mobile. Other records are not available.

1905, September 24 - 30. Originating in the western Caribbean, this storm, which was not of hurricane force, crossed Yucatan and moved inland on the middle gulf coast between New Orleans and the Sabine River. High winds and tides prevailed along the central gulf coast. This was the first storm in the history of New Orleans to be reported by wireless. Low areas were overflowed by storm tides. Stages 6 feet above normal were reported in Lake Pontchartrain at Mandeville and 2 feet at Morgan City. Wind velocities at New Orleans and Port Eads were 27 and 30 m.p.h., respectively. The barometric pressure fell below 29.75 inches at New Orleans.

1905, October 5 - 10. This small tropical storm passed over the Morgan City area without causing damage.

1906, September 19 - 30. This hurricane, of great violence, was first observed in the western Caribbean Sea on the 22nd. Moving in a north-northwesterly direction it reached the middle gulf coast area west of Mobile on the 27th. Widespread damage from tidal flooding and high winds extended along the gulf coast from Apalachicola to New Orleans. Mobile and Pensacola were heavily damaged and the storm is described as being the most destructive in their meteorological history. Wind velocities reached 94 m.p.h. at Fort Morgan, which is at the entrance to Mobile bay, and 83 m.p.h. at Pensacola. A velocity of 54 m.p.h. was sustained at Pensacola for 1 hour. At Fort Morgan, the maximum wind was 72 m.p.h., and the average was 54 m.p.h. for a period of

1906, September 19 - 30 (con't)

8 hours and 45 minutes before the instrument was blown away. Maximum wind at New Orleans was 39 m.p.h. Tides were extremely high at several locations, reaching maximum elevations 9.9 mean low water at Mobile; and in the vicinity of Pensacola 10.6 feet m.l.w. at the city water front, and 12.6 feet m.l.w. at Bayou Grande. At Mobile, the barometer fell to 28.84 inches while the U. S. Revenue Steamer "Winona" at Scranton recorded a pressure of 28.50 inches. The storm claimed 151 lives in Alabama and Florida and an evaluation of damages to property estimated at \$5 million.

1907, September 17 - 23. A slight tropical disturbance appeared north of Haiti, moved westward across northern Cuba and thence to the middle gulf coast. The highest wind observed was at Pensacola, where a velocity of 37 m.p.h. was recorded.

1908, September 16 - 18. This tropical storm passed over the Lake Charles section without causing much damage.

1909, July 13 - 22. This tropical hurricane moved in a northwesterly direction from the Yucatan Channel on the 18th, thence across the Gulf of Mexico, attaining hurricane force by the time it entered the coast at Velasco. The barometric pressure dropped to 29.00 inches on the 21st at Bay City, which is 40 miles west of Velasco, where the wind velocity was estimated at 110 m.p.h. Galveston experienced tides 10 feet above normal. The storm caused property damages estimated at \$2 million and 41 lives were lost.

1909, September 10 - 24. This tropical cyclone, of great intensity and extent, advanced westward over the Caribbean Sea and reached the extreme western part of Cuba on the 17th. From Cuba its course began veering in a north-northwesterly direction, thence through the Yucatan Channel and the Gulf of Mexico. The center moved inland about 50 miles west of New Orleans on the 20th. Wind velocities of 80 m.p.h. were reported for Thibodaux, and for the mouth of Bayou Terrebonne which is 40 miles south thereof. The 5-minute velocity at New Orleans was placed at 51 m.p.h. The lowest barometer reading reported was 28.68 inches at Abbeville while New Orleans recorded 29.22 inches on the 20th. Tides inundated much of the low coastal areas and caused considerable damage. The highest tides were experienced at the mouth of Bayou Terrebonne in Lafourche Parish, where an elevation of 15 feet was attained at sea breeze. Tides along the Mississippi coast were from 8 to 12 feet. The damage was inland. Extensive damage was caused to coal barges, small crafts, and other property along the river front, to railroads, communication lines, crops, and public and private property in New Orleans and its surroundings. Total damages amounted to \$6 million and 353 lives were lost. See plate 10 for extent of tidal flooding in Louisiana.

1911, August 9 - 14. Developing in the Florida Straits this storm moved northwest across the gulf and passed inland near Pensacola on the 11th. The wind, which reached a maximum velocity of 62 m.p.h., was of a fairly steady character, causing less damage than it would have by blowing in severe gusts. The total damage at Pensacola was estimated at \$12,000 and there was no loss of life reported.

1912, June 7 - 15. Originating near western Cuba this storm crossed the gulf and moved inland near the western coast of Louisiana. No other data are available.

1912, September 11 - 23. Moving in a northwesterly direction from a point off the west-central Florida coast on the 11th, the center of this storm passed inland near Mobile on the 14th. High winds were of short duration and tides comparatively low. Very little rain was experienced and damages estimated at \$35,000 occurred at Mobile and Pensacola. One person was drowned at Mobile.

1912, October 2 - 4. This tropical storm passed from west to east just south of Burrwood.

1914, September 14 - 18. This disturbance was of slight intensity. It moved north-northwest from Cuba to Georgia where it curved to the west and thence to the Mississippi Gulf Coast.

1915, August 5 - 24. This hurricane, originating in the Cape Verde Region of the African coast, advanced through the Yucatan Channel and thence in a northerly direction across the Gulf of Mexico. Whole gale winds were experienced at Kingston, Jamaica, while winds of tremendous force were felt in the storm's passage over San Antonio, Cuba. By the time it reached the Texas coast, where it passed inland slightly west of Galveston on the 16th, it was of great diameter and fearful violence. The lowest barometer reading of 28.14 inches occurred on the 16th at Velasco. Galveston recorded a pressure of 28.64 inches and wind velocities of 62 m.p.h. were reported for Houston. This storm caused high tides along the gulf coast from a point 100 miles west of Galveston to the vicinity of New Orleans although the nearest the center passed to the Louisiana coast was not less than 100 miles. The highest tide reported was 15.3 feet mean low gulf at Virginia Point which is immediately west of Galveston. A height of 14.8 feet m.l.g. was reached near the mouth of the Brazos River in the vicinity of Freeport. In Louisiana, there were tides of 10 feet at Grand Cheniere, 10.3 feet at Cameron, 5 feet at Pecan Island, 9.5 feet at Cote Blanche, Northeast of Marsh Island, 9.5 feet at Marsh Island, 6.0 feet at Hackberry, and 11 feet at Calcasieu near Cameron.* Barataria was damaged by an 8 foot tidal wave and Grand Isle

1915, August 5 - 24. (Cont'd)

had water 6 feet deep in some places. Damages to property was estimated as high as \$50 million and 275 lives were lost. Plate 11 shows the extend of flooding in Louisiana for this storm.

1915, September 22 - October 2. This hurricane moved in a northwesterly direction from the Caribbean Sea through the Yucatan Channel, curved over the northern portion of the Gulf of Mexico and reached the southeastern Louisiana coast on the 29th. On this date, a barometer reading of 28.01 inches, the lowest of record in the United States at that time, was recorded on a ship docked in the New Orleans harbor. Other extremely low pressures reported were 28.03 inches at Lockport, over which the center passed, and 28.10 inches at Tulane University in New Orleans, which was 9 miles to the right of the hurricane center. The U. S. Weather Bureau 5-minute sustained and extreme wind velocities for the 29th were 66 and 75 m.p.h. at New Orleans, and 94 and 106 m.p.h. at Burrwood, respectively. Torrential rains occurred over the southeastern portion of Louisiana. New Orleans had a total of 8.20 inches and a maximum of 1.59 inches in 1 hour. The U. S. Weather Bureau Station at Franklinton reported a total storm rainfall of 14.43 inches, of which 10.28 inches occurred in a 24-hour period. Storm tides rose to a height of 13 feet at the Biloxi harbor lights and 10 to 12 feet at other locations along the Mississippi-Louisiana coast. Leeville and Golden Meadow on Bayou Lafourche, reported stages of 9 and 5 feet, respectively. East of the Mississippi River and below New Orleans, a tide of 12 feet was experienced at Pointe a la Hache, tides of 11.6 feet at Yscloskey and Fort St. Philip, and lesser stages elsewhere in the general area. On the southwest shore of Lake Pontchartrain, the stage at Frenier reached an elevation of 13 feet, and at West End (New Orleans), 6.1 feet. Destruction of property was extensive. In New Orleans, 25,000 buildings suffered damage or destruction amounting to \$5 million. The city was flooded to depths of 1 to 8 feet in the center of the city, due to a combination of rainfall, canal backflow, and overtopping of some levees. Failure of the drainage pumps caused the impounding water to remain for several hours. At several places below New Orleans and on Lake Pontchartrain 90 percent of the buildings were destroyed. In Leeville, approximately 13 miles west of Grand Isle, only 1 of the 100 houses remained standing. Over 50 percent of U. S. Highway no. 90 along the coast of Mississippi was destroyed. Total property losses exceeded \$13 million and 275 lives were lost on the middle gulf coast. Plate 12 shows the extent of tidal flooding in Louisiana for this storm.

1916, June 29 - July 10. This hurricane originated in the western Caribbean Sea, moved through the Yucatan Channel on the 3rd, and reached the Mississippi Coast near Gulfport, on the afternoon of the 5th. Widespread damage was inflicted by tide and wind at Mobile and Pensacola. Thirteen persons were killed and property damage amounted to over \$3.5 million. Barometric pressure at Fort Morgan near Mobile was 28.33 inches while Mobile recorded 28.92 inches. Corrected wind velocities at Mobile and Pensacola were 81 and 79 m.p.h., respectively. The tide at Mobile reached 11.6 feet above mean low water, a record for that port.

1916, October 12 - 22. Moving inland near Mobile, this storm was accompanied by very high winds over a wide area. At Pensacola the 5-minute wind velocity was 87 m.p.h. and the extreme velocity was 91 m.p.h with a low barometer reading of 28.76 inches. Due to the precautions taken the storm did very little damage. Pensacola reported damage amounting to \$100,000 but other localities reported only minor damage.

1917, September 21 - 29. This hurricane caused heavy swells on the Leeward Islands on the 21st. Moving west-northwest over Jamaica, it did considerable damage to the northern part of the island. Curving sharply to the right over the northern gulf and approximately 50 miles south of Port Eads, the hurricane moved inland near Pensacola on the 28th. The barometric pressure dropped to 28.51 inches at Pensacola and the maximum wind velocity at this location was 79 m.p.h. for a 5 minute period with an extreme velocity of 95 m.p.h. The tide in the vicinity of Pensacola rose to 4.5 feet above normal high. Damages for Pensacola and vicinity were estimated at \$170,000. Five persons were killed at Crestview, which is approximately 50 miles northeast of Pensacola.

1918, August 1 - 6. This disturbance was of small diameter but of marked intensity. First observed on the 1st it passed south of the Jamaica on the 3rd and through the Yucatan Channel during the night of the 4th. Moving across the Gulf of Mexico in a northwesterly direction it passed over Lake Charles on the 6th. Tide records near the path of the hurricane are not available, but at Morgan City, which is 150 miles to the right of the line of advance of the storm center, the tide rose 3 feet and at Johnson's Bayou, 28 miles to the left of the center, a tide of 2.5 feet was experienced. Ten miles west of Lake Charles at Sulphur, the lowest observed barometric pressure was 28.36 inches, and the maximum estimated wind velocity was 125 m.p.h. Estimated damages amounted to \$5 million and 34 deaths were reported for Louisiana.

- 1919, July 2 - 4. In July a slight disturbance developed in the gulf not far from western Cuba and moved north-northwest to the vicinity of Pensacola. The maximum wind velocity at Pensacola was 58 m.p.h. as the storm moved inland on the 4th.
- 1919, September 2 - 14. On the 2nd this disturbance was of a minor nature. By the time it reached the Florida Straits on the 9th it had become a storm of terrific force. At Key west the anemometer cups were blown away at 62 m.p.h. and the recorded rainfall was 13.39 inches. At Sand Key the anemometer cups were blown away at 65 m.p.h. and the barometer registered a low of 28.35 inches. In the vicinity of Dry Tortugas, west of the Florida Strait, a low pressure of 27.36 inches was recorded on the steamship Fred W. Weller. Moving slowly westward through the Gulf of Mexico a the center of the hurricane passed approximately 160 miles south of Burrwood and moved inland south of Corpus Christi on the 14th. Tides experienced were 5 to 6 feet in Lakes Borgne and Pontchartrain; 6 feet at Montegut, which is approximately 13 miles southeast of Houma; 3.6 feet at Burrwood; 7 feet at Grand Chenier; 8.8 feet at Galveston; and 12.5 feet (some records show 16 feet) at Corpus Christi. The barometer fell to 28.65 inches at Corpus Christi and the wind velocity was estimated at 95 m.p.h. During the passage of this hurricane Burrwood recorded a 5-minute wind velocity of 29 m.p.h. and gusts to 47 m.p.h. on the 13th. Property damage was placed at \$20 million and 284 lives were lost.
- 1920, September 19 - 23. Originating in the western Caribbean on the 19th and moving north-northwest over Yucatan and across the gulf, this tropical hurricane moved inland between Grand Isle and Morgan City on the night of the 21st. The barometer fell to 28.99 inches at Houma. The tide at Burrwood rose to 3.8 feet while Lake Borgne and Mississippi Sound had tides of 5 to 6 feet. The center did not pass near any U. S. Weather Bureau station, therefore records are meager. Maximum wind velocity for Grand Isle was estimated at 90 m.p.h. New Orleans recorded 35 m.p.h. Total damages amounted to \$1 million.
- 1922, October 12 - 17. This disturbance formed on the 12th east of Swan Island in the Caribbean Sea and struck inland in the vicinity of Pensacola on the 17th.
- 1923, October 13 - 17. This storm developed over Mexico and moved over the gulf where two ships reported pressures of 29.20 inches and high winds on the 15th. It crossed the Louisiana coast line early on the 16th just west of Morgan City and continued moving in a northerly direction. It was of a small diameter and there were no reports to indicate exceptional intensity. The barometer at Morgan City recorded 29.25 inches and the tide in that area rose to 3.6 feet.

1926, August 21 - 27. This disturbance began moving northwest from Jamaica to the gulf on the 21st, gradually increasing in intensity, and passing inland near Houma late on the 25th. Lowest barometer readings were 28.31 inches at Houma and 28.80 inches at Morgan City. Wind velocity was estimated to be 100 m.p.h. at Grand Isle and 90 m.p.h. at Morgan City. Tides were approximately 4 feet at Grand Isle and 10-15 feet along the Terrebone Parish coast, behind Isle Derniere. Twenty-five lives were lost and damage to property, exclusive of crops in the field, was estimated between \$3 and \$4 million.

1926, September 11 - 22. This storm was one of the most destructive of the century. On the 18th the barometer fell to 27.61 inches at Miami and the wind velocity for 2 minutes reached 104 m.p.h. The tide rose 11.7 feet above mean low water. After crossing the Florida Peninsula it entered the gulf with only a slight decrease in fury, and passed 30 miles south of Mobile. The center moved almost directly over Biloxi, Gulfport, and Pass Christian, and slightly north of Lake Ponchartrain, finally dissipating its energy in eastern Texas. At Pensacola the pressure fell to 28.56 inches on the 20th, and 25 miles to the west, at Perdido Beach, the lowest was 28.20 inches. Maximum wind velocity was 91 m.p.h. from the east at Pensacola and 72 m.p.h. from the north at Mobile. With the wind at Mobile blowing from the north an unprecedented low tide of 10.3 feet below sea level was experienced. The maximum tide along the gulf coast was 9.4 feet and occurred at Pensacola. This storm claimed 242 lives and inflicted damages amounting to some \$100 million. Very little damage occurred in Louisiana.

*1929, September 22 - October 8. This hurricane skirted the western coast of Florida, struck in the vicinity of Pensacola and then veered to the east as it passed overland.

1931, July 11 - 17. On the 11th a disturbance was observed in the Caribbean Sea. It moved generally in a northerly direction across the gulf and reached the Louisiana coast west of Morgan City on the 15th. The lowest pressure was 29.78 inches.

1932, August 10 - 14. Moving across Yucatan and over the gulf this hurricane developed with great rapidity. The center crossed the Texas coast slightly east of Freeport on the 13th. Wind velocities of 100 m.p.h. were estimated 25 miles northwest of Freeport at East Columbia and the minimum pressure observed was 27.83 inches at the same location.

* Reference to elevations after 1929 refer to sea level datum of 1929, unless otherwise stated. In 1977 the term "mean sea level" was changed to National Geodetic Vertical Datum.

1932, August 24 - September 3. This tropical disturbance of very slight intensity was first observed on the 24th. It moved over the Puerto Rico and was located about 50 miles south-southwest of Miami on the 29th. The storm continued across the Gulf of Mexico and the center moved inland a short distance west of Mobile. Hurricane winds covered a limited area due to its small diameter.

1932, September 18 - 21. Originating in the western gulf on the 18th, this storm passed inland west of Morgan City on the 19th. A wind velocity of 35 m.p.h. was reported for Morgan City with a low pressure of 29.54 inches.

1932, October 7 - 18. The disturbance moving west-northwest came from the western Caribbean on the 7th. It recurved over the gulf and passed inland across the Louisiana coast on the 15th. No winds of hurricane force were reported. The minimum pressure was 29.28 inches at Gulfport.

1934, June 4 - 21. This hurricane developed over the Gulf of Honduras. Its path described two counter-clockwise loops before taking a northerly direction and crossing the Louisiana coast on the 16th. Its center passed to the west of Morgan City and moved over Jeanerette where the lowest barometer reading was 28.52 inches. A wind velocity of 68 m.p.h. was reported for Morgan City. In Louisiana seven persons were killed and damage was placed at \$2.605 million.

1934, July 21 - 25. This hurricane deviated from the usual pattern in that it began in the Atlantic Ocean off of North Carolina and proceeded to move in a southwesterly direction, crossing Florida in the Middle of the state. It then swept in a due westerly direction in the Gulf of Mexico and finally struck land in the vicinity of the Texas-Mexican Border. No damage was reported in Louisiana although it threatened the entire coastal area.

1934, August 26 - September 1. This storm developed in the central gulf on the 26th, then moved toward Port Arthur, Texas. When approximately 50 miles from the coast it turned and moved along the western gulf and went inland on the Mexican coast near Tampico. It did very little damage in Louisiana or Texas.

1934, October 1 - 6. This disturbance originated near the northwestern end of Cuba on the 3rd. Its movement was northwesterly until it reached the middle of the gulf when it curved and began moving in a north-northeasterly direction. Reaching the coast near Mobile on the 5th it was attended by a record rainfall of 15.29 inches in 24 hours.

1936, July 26 - 27. This tropical storm developed off the extreme western portion of Cuba on the 26th and moved across the gulf in a north-northwesterly direction to reach the Louisiana coast, slightly west of Grand Isle, on the 27th. At Grand Isle the tide rose to approximately 2 feet above normal. Approximately 30 miles southwest of New Orleans at Delta Farms, a low pressure of 29.62 inches and a wind velocity of 50 m.p.h. were reported. No loss of life was reported and no important storm damages occurred in Louisiana.

1936, July 27 - August 1. This hurricane crossed Florida about 30 miles south of Miami on the 28th. Moving slowly across the gulf in a north-westerly direction it passed inland over Valparaiso on the 31st. High tides were produced along the northwest Florida coast. The minimum barometric pressure was 28.73 inches and winds were estimated at 90-100 m.p.h. at Valparaiso. Property damage was placed at \$123,000 and damages to newly constructed jetties at Panama City incurred repair costs of about \$547,000. Four fishermen lost their lives.

1936, August 20 - 22. This storm passed into Florida on the east coast and passed just inside the coast line, dropping in intensity until it reached New Orleans where it diminished below storm intensity.

1937, September 16 - 21. This disturbance moved in a north-easterly direction from the west gulf on the 16 and passed over Port Eads on the 19th, changing its course to an east-northeasterly direction. The storm moved inland between Panama City and Apalachicola on the 20th, and dissipated itself on the 21st in the vicinity of Jacksonville. At Port Eads the lowest pressure was 29.64 inches and the wind velocity was 34 m.p.h. with gust to 41 m.p.h. No damages were reported.

1937, September 29 - October 3. First located on the 30th, this storm passed through the Yucatan Channel on the 1st thence across the Gulf of Mexico to move inland slightly west of Morgan City on the 3rd. Port Eads reported a wind velocity of 36 m.p.h. The S. S. Morozan, located in the Gulf of Mexico approximately 100 miles south of Grand Isle and to the right of the storm path, reported a low pressure of 29.62 inches on the 2nd. New Orleans reported 16.66 inches of rainfall, of which 13.68 inches fell in a 24 hour period. This rainfall produced local flooding and considerable damage to crops in the vicinity of the city.

1938, August 9 - 14. This hurricane was first observed northwest of Trinidad on the 9th. It passed through the Caribbean Sea and Yucatan Channel, then across the Gulf of Mexico and into the Louisiana coast. The center passed a little west of Lake Charles on the 14th. A wind velocity of 50 m.p.h. with gusts

to 60 m.p.h. were reported at Lake Charles while Grand Cheniere reported winds of hurricane force. The lowest pressure recorded was 29.56 inches at Lake Charles. The tide rose 4 feet at Sabine Pass and 4 to 5 feet above mean low water along the southwestern Louisiana coast. One life was reported lost.

1938, October 10 - 17. This storm of minor character moved in a north-northwesterly direction across the Yucatan Peninsula and into the gulf. When located in the central gulf it veered sharply to the right, traveled a short distance toward the Florida coast, then recurved and moved toward the Texas coast where it went inland near Matagorda.

1939, June 12 - 16. This minor storm developed in the Gulf of Honduras on the 12th and moved in a northerly direction across the Gulf of Mexico. As it neared the Mississippi-Alabama coast it described a counter-clockwise loop, then proceeded inland over Mobile on the 16th. The S. S. Kofresi, which was located in the path of the storm and approximately 60 miles south of Mobile, reported heavy squalls, gales and rough seas and the lowest pressure aboard ship was 29.54 inches. At Mobile, the pressure was 29.66 inches. Pensacola was located east of the center and experienced a wind velocity of 54 m.p.h. and a tide of 3.4 feet. The tide rose to 3.3 feet at Port Eads and 3.6 feet at Mobile.

1939, September 23 - 26. This minor storm moved in a northerly direction over the gulf and crossed the Louisiana coast near Grand Isle on the 26th. Wind velocities of 47 to 54 m.p.h. were reported by a ship in the gulf while another reported a pressure of 29.64 inches. Fresh winds were reported as the storm moved inland.

1940, August 2 - 10. This tropical disturbance, originating in the Atlantic on the 2nd followed an unusual path across Florida, thence across the northern gulf, moving inland near Port Arthur on the 7th. It was accompanied by high tides and torrential rains in Louisiana. Port Arthur reported a wind velocity of 83 m.p.h. and a low barometric pressure of 28.87 inches. The hurricane produced tides of 4 feet at Port Eads; 6.4 feet at Frenier on the southwest shore of Lake Pontchartrain; 3.8 feet at Grand Isle; 4 to 5 feet near the mouth of Vermilion river; 5.6 feet at Schooner Bayou Control Structure, 16 miles south-southwest of Abbeville; 4.8 feet at Calcasieu Pass in the vicinity of Cameron; and 4.3 feet near Sabine. The torrential rains produced extremely high stages in tidal streams several days after the passage of the hurricane. Stages of particular note were: on Vermilion River at Abbeville, 13.5 feet on the 9th; and on Calcasieu River at Lake Charles, 6.7 feet on the 10th. The storm rainfall 12 miles south of Abbeville, at Miller Island, was 37.5 inches of which, 23.8 inches fell in a 24-hour period. This station established record intensities for eastern

1940, August 2 - 10. (cont'd)

United States for periods of 1 to 6 days. Flooding was extensive in all coastal and in several inland parishes. Many people were marooned and thousands were evacuated to higher ground. The high winds and heavy rains caused extensive damage to crops, homes and utilities. Muskrat losses were heavy and estimates of livestock drowned or lost ran as high as 75,000 head. Six persons lost their lives and damages from wind, tide and rain were estimated in excess of \$6 million. Plate 13 shows the extent of tidal flooding in Louisiana in this storm.

1940, September 19 - 24. This storm of small diameter developed in the Caribbean Sea off the coast of Nicaragua on the 19th. It moved in a north-northwesterly direction across the Yucatan Peninsula and the Gulf of Mexico. Upon nearing the Texas coast east of Corpus Christi, it curved abruptly to the right and traveled east-northeast into the Louisiana coast near Cameron and continued to the west of Lafayette on the 24th. The maximum wind velocity gale force reported was by the S.S. Dannedaika, located in the gulf to the right of the storm path, with a low pressure of 29.65 inches.

1941, September 11 - 16. Appearing in the north central gulf on the 11th and moving generally in a west-northwesterly direction, the storm center passed about 50 miles south of Burrwood, and moved inland west of Port Arthur on the 14th. Ships southeast of Burrwood reported a maximum wind velocity of 64 to 75 m.p.h. while a ship west of the storm experienced a low barometric pressure of 29.61 inches. Tides slightly over 3 feet were reported along the coast and very little damage occurred.

1941, September 16 - 26. This hurricane, originated in the northern gulf on the 16th, described a small loop in the central gulf and progressed west-northwesterly to move inland near Matagorda and west of Houston on the 23rd. Wind velocity reported for Houston was 75 m.p.h. with a maximum of 90 m.p.h. and minimum pressure of 28.66 inches. The maximum velocity 10 miles northwest of Galveston at Texas City was reported to be 83 m.p.h. Tides were considerably high along the coast, a maximum of 11 feet occurring at Matagorda. Considerable damage was caused by the wind as the center passed near Houston. Property damage was estimated at \$2 million and the rice crop ruined to the extent of about \$4 million. Due to warnings of the storm's approach approximately 25,000 persons left their homes in low areas and moved to higher ground. As a result only four lives were lost in this severe hurricane.

1942, August 17 - 22. Indications are that the storm developed in the Yucatan Channel and moved across the gulf toward Louisiana. When approximately 70 miles from the mouth of the Mississippi River its course changed to a westerly direction

1942, August 17 - 22 (cont'd)

and, paralleling the coast, the storm crossed the coastline between Galveston and Port Arthur. It then took a northerly course and dissipated over eastern Texas. The highest winds reported were 66 m.p.h. at Port Arthur. The lowest pressure recorded was 29.35 inches at Gilchrist and the highest tide reported in the vicinity was 7 feet. High tides and wind caused crop and property losses estimated at \$600,000.

1943, July 25 - 28. Moving generally in a west-northwesterly direction this hurricane struck the Texas coast east of Galveston on the 27th. It was intense but small, having a diameter of about 12 to 14 miles as the calm center moved inland. Over 17 inches of rain fell at La Porte, which is 25 miles east of Houston, and at Port Arthur. The airport at Houston reported 85 m.p.h. winds while Texas City, which is 10 miles northwest of Galveston, had gusts to 104 m.p.h. The lowest barometer reading was 28.78 inches at Ellington Field, an Air force Base located 16 miles southeast of Houston. Tides along the Texas coast were not unusually high at any time but there was a great deal of wind damage. Total damages were estimated at \$17 million. Eighteen lives were lost, eleven being drownings as the result of foundering of the U. S. Corps of Engineers Dredge Galveston at the entrance to Galveston Bay. Aircraft reconnaissance flights made of this hurricane marked the first recorded intentional flight of a plane into the calm center of a hurricane.

1943, September 15 - 19. This storm developed in the southwestern Gulf of Mexico. It moved towards the Texas coast on the 16th, then, due to high pressure and cool weather to the north, it described a loop, changed its course, and moved inland east of Lake Charles on the 19th. Freeport reported a wind velocity of 62 m.p.h., and a barometric pressure of 29.84 inches for the 16th. The tide rose to 4.5 feet at this location. Lake Pontchartrain experienced tides of 4 feet on the 19th. Heavy rains occurred throughout the southern section of Louisiana with 19.26 inches falling at Morgan City. No loss of life was reported.

1944, September 8 - 10. A weak tropical disturbance was observed in the western Gulf of Mexico on the 8th. It moved in a northerly direction toward the Texas coast, but when approximately 100 miles south of Galveston it turned to the right and proceeded in an east-northeasterly direction, crossing over the Mississippi River Delta, and over Mobile on the 10th. Wind velocities at Burrwood and the Naval air Station at Pensacola were 34 and 54 m.p.h., respectively. Pointe a la Hache reported a wind velocity estimated at 40 m.p.h. The minimum pressure was 29.63 inches at Mobile. Heavy rains occurred on the coast of Alabama and northwestern Florida and 11 inches were reported for Bellingrath Gardens near Mobile.

1945, September 3 - 6. This storm passed through the Lake Borgne area in a northwesterly direction. It was not of hurricane intensity and there were no reports of damage.

1946, June 13 - 16. This tropical disturbance that developed in the northern gulf moved parallel to the Louisiana coast, thence curving slightly toward the right, moved inland at Port Arthur. The maximum wind velocity reported was 36 m.p.h. at Grand Isle. No loss of life or damage was reported.

1947, August 18 - 27. This storm developed moderate force while in the Florida Straits, weakened while in the middle gulf and then gained intensity as it passed inland in the vicinity of Galveston on the 24th. Galveston recorded a pressure of 29.30 inches with highest winds at 72 m.p.h. One person was killed and damages were estimated at \$750,000.

1947, September 7 - 8. Originating in the gulf south of Apalachicola, this storm passed inland near Pascagoula. The highest wind velocity reported was 51 m.p.h. at Pensacola.

1947, September 4 - 21. This hurricane, ranking as one of the greatest of record, may have originated as a disturbance over West Africa on the 1st. Reconnaissance planes followed it daily after a radio message from a ship reported its location on the 10th. Progressing in a westerly direction it crossed the Florida peninsula with damaging force. On the morning of the 18th the hurricane entered the Gulf of Mexico moving at approximately 18 m.p.h. Early on the morning of the 19th the center of the hurricane passed due south of the Mississippi coast, within 50 miles of Bay St. Louis, thence curved northwesterly and reached New Orleans at 10 a.m. Rainfall due to the hurricane was generally very light and no flooding of coastal streams occurred. However, the path of the storm center in relation to the converging coasts of Mississippi and southeastern Louisiana was conducive to generation of maximum tidal surge in that zone. The peak tide was reached on the morning of the 19th along the Mississippi coast. The highest wind recorded by a reliable instrument on the east coast of Florida was 155 m.p.h. on the 17th, on which date the lowest reliable pressure reading of 27.97 inches was also recorded. Upon reaching the west coast of Florida winds with gust of 120 m.p.h. were recorded. Fort Myers reported winds estimated at 90 m.p.h. with gust to 110 m.p.h. By 6 a.m. on the 19th hurricane force winds were being felt on the Mississippi and Louisiana coasts and similar winds reached the edge of metropolitan New Orleans about 2 hours later. The anemometer on the Mississippi River Bridge near the city recorded a maximum velocity of 98 m.p.h. The U. S. Weather Bureau Station at Moisant International Airport, just west of New Orleans, reported a special observation of 98 m.p.h. from the northeast and gusts to 112 m.p.h. This station

1947, September 4 - 21. (cont'd)

estimated the wind velocity to be 110 m.p.h. with gusts of 125 m.p.h. from the north just before the calm center. The minimum barometer reading at the New Orleans Weather Bureau Office was 28.57 inches. The entire gulf coast from Florida to Louisiana experienced a tidal surge from the hurricane with the western end of Mississippi sound receiving the greatest buildup. At Bay St. Louis an unprecedented high tide of 15.2 feet overtopped the seawall and inundated a considerable area inland. Maximum water surface elevation in Lake Pontchartrain was 6.6 feet at Mandeville and North Shore. Water came over the seawall at New Orleans lakefront causing flooding of the lakefront area. Water was reported as standing 12 inches over the first floor of the Veterans' Hospital near Franklin Avenue by the lake. The heaviest flooding was in Jefferson Parish adjacent to New Orleans on the west, where the poor condition and low height of a lakeshore highway embankment allowed water in great sheets to top the embankment. Once inside, the water could not be removed because the ground level was lower than lake level and the drainage pumps were not in operation for a considerable period of time. Water stood 6 feet deep in some sections. Moisant Airport had one-half foot of water on the runways and could not operate. Other locations in Louisiana experiencing high tides were Shell Beach, 11.2 feet; Bohemia, 8.2 feet and Ostrica, 11.5 feet, the latter two on the east side of the Mississippi River near Pointe a la Hache. On the gulf coast 1,642 houses were destroyed and 25,000 damaged. The tidal damage in all areas was estimated at \$110 million, 51 lives were lost, of which 17 were in Florida, 12 in Louisiana, and 22 in Mississippi. Extent of flooding in Louisiana for this storm is shown on plate 14.

1948, August 28 - September 6. Originating in the west-central Gulf of Mexico on the 28th this tropical hurricane moved in a north-northeast direction, passed inland just west of Grand Isle and moved over New Orleans on the 4th. The highest wind was 78 m.p.h. with gusts to 90 m.p.h. at Moisant International Airport near New Orleans with a low pressure of 29.21 inches recorded at the New Orleans Weather Bureau Office. Heaviest damage was to oil rigs and equipment located offshore from Grand Isle. High tides and heavy rainfall produced flooding in low areas and although no lives were lost many people had to be evacuated to higher ground. Crops suffered damages from both wind and rain. Total damages were placed at approximately \$1 million. The tide in Lake Ponchartrain rose to 4.4 feet at West End. Other high tides experienced were 5.3 feet at Mobile; 5.6 feet at Biloxi; 4 to 5 feet at Chandeleur Island; 3.4 feet at Burrwood; and 2.5 feet at Grand Isle.

1949, September 3 - 5. This tropical disturbance moved northward from the central gulf on the 3rd and passed just west of Grand Isle on the 4th. Wind velocities were 42 m.p.h., with gust to 50 m.p.h. at Grand Isle. Bay St. Louis reported wind of 45 to 50 m.p.h. and a low pressure of 29.50 inches. The gulf tide rose to 4.4 feet at Biloxi and the Lake Ponchartrain tide was 4.8 feet at Mandeville. Damage were slight and no loss of life was reported.

1949, September 27 - October 6. This storm developed off the west coast of Central America, crossed the Yucatan Peninsula and moved into the western Gulf of Mexico and attained hurricane force when it reached the Texas coast near Freeport. The lowest pressure was 28.88 inches at Freeport with highest winds of 100 m.p.h. This hurricane produced heavy rainfall in Texas and Louisiana. Several stations had over 10 inches with a maximum of 14.50 inches occurring at Goodrich, 65 miles north of Houston. The storm tide exceeded 11 feet at several locations along the coast of Texas. Damages were estimated at \$7 million, of which \$5 million were damages to the rice crop in Texas.

1950, August 20 - September 1. This was a full developed hurricane when located east of the Leeward Islands but it weakened as it moved over Puerto Rico and Cuba. Moving through the gulf it regenerated and struck between Mobile and Pensacola on the 30th. Highest winds were estimated at 75 to 85 m.p.h. south of the Alabama coast. Mobile had wind velocities of 40 m.p.h. and Pensacola, 45 m.p.h. Two tornadoes were reported in connection with the hurricane. The tide rose to 4.5 feet at Pensacola and 6.8 feet at Apalachicola. One person killed and damage to crops and property were estimated as high as \$2.55 million.

1953, September 23 - 28. Hurricane "Florence" developed in the Caribbean Sea on the 23rd, moved through the Yucatan Channel and passed inland on the 26th between Fort Walton and Panama City. Winds reached an intensity of 80 to 90 m.p.h. and the tides rose to 4.7 feet at Panama City and 6.4 feet at Carrabelle, which is 22 miles east of Apalachicola. No injuries or loss of life were reported and damages amounted to about \$200,000.

1954, July 28 - 30. Tropical storm "Barbara" developed in the gulf south of Morgan City and moved inland southeast of Lake Charles. It did not attain hurricane intensity. The highest winds were estimated at 60 m.p.h. at Catfish Point, 35 miles southeast of Lake Charles. Grand Isle had a low pressure of 29.62 inches. Only slight damages were incurred but those were offset by the benefit derived from the rain which fell during the storm.

1955, July 31 - August 2. The tropical storm "Brenda" originated about 150 miles south-southeast of Burrwood on the 31st. Moving north-northwesterly to Bay St. Louis, it then veered to the left and eventually passed over Alexandria on the 2nd. A barometric pressure of 29.50 inches were observed by aircraft and a wind velocity of 60 m.p.h. was estimated for the storm as it moved inland. The tide increased to 5.4 feet on Lake Borgne at Shell Beach; 3.6 feet on Lake Pontchartrain; and 3 to 6 feet along the Mississippi coast. Damage was small and limited to piers, and fishing and pleasure craft.

1955, August 23 - 29. Progressing in a north-northwesterly direction from the Caribbean Sea this storm crossed over western Cuba and the Gulf of Mexico. When approximately 125 miles from Mobile, it began curving to the west-northwest and passed over New Orleans. Maximum wind velocity at New Orleans was 40 to 45 m.p.h. with gusts to 50 m.p.h. The lowest barometric pressure was 29.54 inches. Highest tide observed was 3.6 feet on Lake Borgne at Shell Beach.

1956, June 12 - 14. This minor storm originated in the Yucatan Peninsula area and proceeded almost due north, striking the Louisiana coast in the vicinity of Morgan City. No damage of any consequence was reported.

1956, September 21 - 30. Hurricane "Flossy" developed in the western part of the Caribbean Sea near Belize, British Honduras, on the 21st. It moved north-northwest across the Yucatan Peninsula and entered the Gulf of Mexico on the 22nd. Slowly increasing in intensity as it moved northward across the gulf, it reached hurricane force on the 23rd when approximately 100 miles south of the Louisiana Coast. It turned sharply to the east-northeast and, crossing the Mississippi River Delta a little north of Burrwood, continued on and passed inland near Fort Walton, southeast of Pensacola. The highest wind velocity estimated at Burrwood was 90 m.p.h., while Pensacola recorded winds at 64 m.p.h. and gust to 88 m.p.h. with a low barometric pressure of 28.92 inches. Heavy rains, varying in amount from 4 to 10 inches, fell along the path of the hurricane in southeastern Louisiana, southern Mississippi, southern Alabama, and northwest Florida. Tides were unusually high along the coast from about 20 miles west of Grand Isle to northwest Florida. Tides of 13 feet at Ostrica Lock; 11 feet at Cox Bay; 10.5 feet at Potash camp; and 10.9 feet at Shell Beach Occurred in the delta area east of the Mississippi River near Pointe a la Hache. Ostrica, near Fort St. Philip, was almost entirely wiped out by flood water coming from the bay side and flooding into the area, which is unprotected back levees. Portions of the Mississippi River levee system suffered wash damage from this bay water, as it plunged over the levees and into the river. Fort St. Philip and nearby Olga likewise were subjected to heavy flooding from this same cause.

1956, September 21 - 30 (cont'd)

The tide rose to 8 feet at Grand Isle and the highest elevations in Lake Pontchartrain were 7.3 feet at Frenier Against a railroad embankment and 7.1 feet at Little Woods. The seawall protecting New Orleans was overtopped by waves, but the local storm drains were able to handle the overflow except in the eastern lakefront sections of Gentilly and Lakeview, where many house were flooded. The Jefferson Parish levee, adjacent to New Orleans on the west, which had been built since the 1947 storm, held the water back and there was no damage. Golden Meadow, which is 20 miles northwest of Grand Isle, reported 16.70 inches of rain in a 24 hour period. Fifteen death were attributed to this hurricane and property damage along the gulf coast is estimated to exceed \$20 million. A detailed report on Hurricane Flossy was issued by the U.S. Army Engineer District, New Orleans. Tidal flooding in Louisiana in this storm is shown on plate 15.

1957, June 25 - 28. Hurricane Audrey was one of the most devastating hurricanes to strike the west Louisiana coast. Over 556 lives were lost, primarily because people failed to evacuate the coast in to time to escape the rapidly rising waters. Offshore waves were reported as high as 45-50 feet and waves striking the area at Cameron were reported to be 18-20 feet above sea level. Winds were reported up to 105 m.p.h. at Cameron. Tides were very high along the coast with reports of 11.9 feet at Grand Cheniere, 10.9 feet at Pecan Island, 8.5 feet at Morgan City and 3.6 feet at Burrwood. Heavy rains accompanied the storm and at least two tornadoes were reported to have been caused by the hurricane. One struck New Orleans and the other Arnaudville. Plate 16 shows the extent of flooding in Louisiana in this hurricane.

1957, August 8 - 11 (Bertha). This storm was not of hurricane intensity and did very little damage as it struck the Louisiana coast near Morgan City. Morgan City reported a maximum gage reading of 6.45 feet mean gulf level. Other points in the area are as follows; Schooner Bayou, 16 miles south-southwest of Abbeville, 4.8 feet; Vermilion Lock, in the same vicinity, 4.3 feet; Catfish Point Control Structure, near Grand Chenier, 3.5 feet; Calcasieu Lock, near Hackbaerry, 2.7 feet, and Lake Charles Dock, 2.45 feet.

1957, September 16 - 19 (Ester). This tropical storm passed over the lower Mississippi River area causing substantial damage due to tidal flooding and excessive rainfall. Heaviest flooding took place in the area south of Port Sulphur on the west bank of the river. There was some local flooding in the suburbs of New Orleans, where local drainage facilities could not handle the rainfall.

1959, May 28 - June (Arlene). This tropical storm began in the gulf and headed for Grand Isle. It passed south of the Island on a westerly track, staying offshore of the Louisiana coast.

1961, September 4 - 14 (Carla). This is considered one of the major gulf hurricanes of the century. Preliminary reports indicate that there were 43 deaths, approximately half attributable to tornadoes and floods accompanying the hurricane and property damage estimated at over \$300 million. Loss of life was held to a minimum by prompt evacuations. Over a quarter-million persons were reported evacuated from coastal and low-lying areas. Carla moved through the Yucatan Channel close off the Mexican coast on the 7th and began moving toward the central Texas coast. On the early afternoon of the 11th, the center moved over Matagorda and inland in the vicinity of Indianola. Sustained winds (fastest mile) were reported at 115 m.p.h. at Matagorda, 110 at Victoria, 35 miles northwest of Indianola, and 98 at Galveston. A peak gust of 170 m.p.h. was estimated at Port Lavaca, 10 miles northwest of Indianola. Gusts of 150 m.p.h. were estimated at Victoria and Aransas Pass. Maximum winds of 44 m.p.h. with gusts to 58 m.p.h. were reported at Lake Charles. a low pressure of 27.50 inches was observed by reconnaissance aircraft, and 27.62 inches was reported at port Lavaca and 28.60 inches at Matagorda. The lowest pressures at Cameron and Lake Charles were 29.50 and 29.60 inches, respectively. Tides exceeding 10 feet were estimated along the Texas coast from Sabine to Aransas Pass. The highest tide reported was 18.5 feet at Port Lavaca. Other locations experiencing high tides were Matagorda with 12.6 feet, Aransas Pass 10.9 feet, Galveston 10.0 feet and Port Arthur 7.8 feet. Along the Louisiana coast, Grand Cheniere had a high tide of 7.5 feet while Cameron experienced a tide of 6.6 feet, Morgan City 4.5 feet, and Lake Pontchartrain averaged 5.2 feet. Torrential rains of 10 to 16.5 inches accompanied the hurricane 50 miles inland. Galveston Airport recorded 16.5 inches and Galveston City Office 14.9 inches. see plate 17 for flooding in Louisiana areas caused by Carla.

1963, September 16 - 19 (Cindy). Hurricane Cindy formed in the Gulf of Mexico about 200 miles east-northeast of Brownsville, Texas, and moved inland midway between Galveston and Port Arthur. Since it was a small compact storm of rare hurricane intensity and of short duration, tides along the Texas and Louisiana coast were moderate. The highest tides reported along the Louisiana coast were 5.5 to 6.0 feet in the vicinity of the mouth of the Calcasieu River. The storm center became almost stationary after moving inland resulting in an extended period of heavy rainfall in southeastern Texas and southwestern Louisiana. Storm rainfall totals were generally from 4 to 8 inches in southern Louisiana, however, Houma, Louisiana, received 7.90 inches as a result of Cindy. Three deaths were reported and overall property damage was \$11,700,000.

1964, September 28 - October 5 (Hilda). On 28 September 1964 Hurricane "Hilda" developed as a low pressure area just off the southern coast of western Cuba. the disturbance quickly reached tropical force and advanced in a west-northwestward direction and graduated into a storm of hurricane force by 30 September. The maximum surface wind velocity of 150 m.p.h. was attained on 1 October, with the lowest central pressure being 27.79 inches while the hurricane was located 350 miles south of New Orleans. For the next two days, "Hilda" took a more northerly course while decreasing slightly in intensity and crossed the Louisiana coast south of Franklin during the evening of 3 October. Maximum winds were 98 m.p.h. and the central pressure was 28.00 inches at the time the storm reached the coast. Tornadoes were generated by the hurricane at Golden Meadow, Galliano, Larose, Kenner Metairie, and New Orleans. One tornado passing through Larose caused 24 deaths, 345 injuries, and complete devastation to more than 27 homes over a path of one mile long. The town of Franklin was the first to feel the onslaught of "Hilda's" full force. Mass evacuation of the populace residing in the area had been accomplished preceding the hurricane. At Franklin, maximum winds of 135 m.p.h. were reached, with five-minute 30-foot winds averaging 98 m.p.h., and a central pressure of 28.40 inches was recorded. Rainfall at Franklin was measured in excess of 9 inches, while neighboring Iberia Parish recorded 17.71 inches. Many sections of the town of New Iberia flooded. Although sustaining heavy wind damage, Franklin was spared from serious flooding. "Hilda" caused flooding of more than 3,000,000 acres of land. Offshore and coastal oil installations suffered heavy damage and camps located along the south shore of Lake Pontchartrain in the Citrus-Little Woods area were damaged severely by high waves in the lake. Maximum stages resulting from Hurricane "Hilda", expressed in feet, were as follows: Cocodrie, 7.8; Lake Pelto, 7.4; Leeville, 5.5; Chauvin-Montegut area, 7.0; Lower Atchafalaya River, 6.4; and West End, 5.3. Total damage assessed to Hurricane "Hilda" was in excess of \$53 million, while the death toll was 39 persons. Twenty-four were victims of the Larose tornado, 8 were victims in Erath where a water tower collapsed, and 7 were victims of miscellaneous causes. Plate 18 shows the extent of flooding in Louisiana during Hurricane "Hilda".

1965, August 27 - September 10 (Betsy). The most destructive storm of record on the Louisiana coast and one of the great hurricanes of this century, "Betsy," developed as a disturbed area in the eastern Atlantic on August 28. the storm took a northward path and intensified into hurricane force on the 29th and then began a westward movement on September 1 and 2, accompanied by a central pressure of 27.82 inches and winds of 150 m.p.h. The fury of the storm abated somewhat as it neared the Florida coast and the path then assumed a rather unusual southwestward movement on September 5 and entered the

1965, August 27 - September 10 (Betsy) (cont'd)

Gulf of Mexico on September 8. Hurricane parameters again intensified with its passage over water, and wind velocities were estimated again at 150 m.p.h. As it gained momentum with increased forward speed, the eye of the storm entered the Louisiana coast at Grand Isle between 9 p.m. and 10 p.m. on September 9. Winds at Grand Isle were reported at 105 m.p.h. with gusts to 160 m.p.h.

Storm tides swept over Grand Isle and practically all buildings except the church, U. S. Coast guard Station, and a housing development owned by one of the major oil companies were swept either away, demolished, or severely damaged by the onrushing surge and waves. Just to the east of Grand Isle, a combination of storm surges entering the Mississippi river from the south and east overtopped both east and west river levees, inundating the Venice-Buras-Empire and Port Sulphur areas with water depths up to 11.5 feet. The storm surges overtopped the back levee in the Bohemia-Pointe a la Hache Phoenix area flooding and heavily damaging all structures located within the area. Many homes were washed off foundations and were driven upon the landside slopes of the Mississippi River levees by the combination of floodwaters and wind. Further north, practically all communities were flooded and suffered heavy damage. Notably among those were Delacroix, Reggio, Hopedale, Yscloskey, Alluvial City, Shell Beach, and Verret. Again, in addition to flooding, many structures were washed off foundations and floated some distance away. Some flooding was evidenced in the Violet to Verret area when the back protection levee was overtopped.

The eastern portion of New Orleans and the adjacent Chalmette area of St. Bernard Parish suffered severe damage from floodwaters and winds. The waters overtopped and poured in from breaks in the Inner Harbor Navigation Canal levees and the Chalmette back levee. The Citrus and New Orleans East back levees, located along the G.I.W.W., were also overtopped. Many camps and homes located along Chef Menteur, Rigolets, Lake Catherine, and on the south shore of Lake Ponchartrain in the Citrus-Little Woods area were completely demolished or heavily damaged by the combination of floodwaters, wind, and waves. Serious flooding occurred in the areas mentioned above with the depth of flooding ranging up to 9 feet. Waves caused overtopping of the New Orleans seawall on Lake Pontchartrain, but a secondary levee constructed by the local levee board prevented serious overflow into the city proper.

Damages and expenditures related to Hurricane "Betsy" are estimated at over \$2 billion. More than 2 1/2 million acres of land were flooded; approximately 300,000 persons were evacuated or changed living quarters; and more than 27,000 homes were destroyed or flooded. In addition, offshore and coastal oil installations and public utilities reported

1965, August - September 10 (Betsy) (cont'd)

unprecedented damage. Sugar cane, pecan, and fall crops were heavily damaged and much livestock drowned. Severe damage resulted to all types of fish and wildlife. Deaths in Louisiana resulting from Hurricane "Betsy" are listed at 81 persons. The residents of the low lying areas heeded the warnings of the U. S. Weather Bureau and local responsible agencies and evacuated promptly. Otherwise, it is conceivable that the death toll may have exceeded the record high of more than 556 persons caused by hurricane "Audrey" in June 1957.

Maximum stages resulting from Hurricane "Betsy," listed in feet, were as follows: Mississippi River - West Pointe a la Hache, 15.2; Chalmette, 12.3; New Orleans, 12.4 (a rise of 10.2 feet); Bonnet Carre, 13.1. Other maximum stages were: Pointe a la Hache, 14.4; Ostrica, 13.6; Empire, 10.4; below Venice, 8.8; Phoenix, 8.3; Delacroix, 11.0; Yscloskey, 11.7; Shell Beach, 9.3; Violet, 10.1; Lake Borgne at Rigolets, 10.6; Rigolets at U. S. Hwy. 90, 7.0; Chef Menteur at U. S. Hwy. 90, 9.1; Paris Road (Mississippi River-Gulf Outlet), 9.0; Seabrook Bridge, 6.2; causeway (mid-lake), 5.5; West End, 7.6; Mandeville, 6.5; Frenier, 12.1; Biloxi, 8.6; Gulfport, 10.7; Lake Maurepas, 4.1; Leeville, 5.4; Grand Isle, 8.8; south Pass Bar, 5.5; and Head of Passes, 6.6. A highwater mark of 11.6 was established at the junction of the Mississippi River Gulf Outlet and the Inner Harbor navigation Canal. the extent of flooding caused by Hurricane Betsy is shown on Plate 19.

1969, August 14 - 22 (Camille). One of the most intense and destructive hurricanes ever recorded struck the coast of Mississippi just east of the Louisiana State line and caused read destruction and serious loss of lives. Camille began as a tropical wave off the coast of Africa on 5 August and by 9 August had moved to about 480 miles east of the Leeward Islands where it was classed as a tropical disturbance. By 14 August, the storm had moved to about 480 miles south of Miami, Florida. Camille then developed rapidly into a tropical storm as it moved northwesterly and was reclassified as a hurricane during the early morning of 15 August with the highest winds estimated at 90 m.p.h. Later in the day, Camille was classified as a major hurricane whose maximum winds were estimated at 115 m.p.h. by late afternoon of 15 August, Camille was called a small but dangerous hurricane." By early Sunday morning, 17 August, Camille had shifted to the west and in the danger zone with gale warnings extending westward to include Grand Isle and New Orleans. Later in the day, warnings were given that the hurricane would pass close to the mouth of the Mississippi River. At that time, winds were estimated to be 190 m.p.h. near the center. By 7 p.m. Sunday night, 17 August, Camille was 70 miles east-southeast of new Orleans and 60 miles south of Gulfport, Mississippi. Shortly before midnight, Camille

1969, August 14 - 22 (Camille) (cont'd)

went inland in the Waveland-Bay St. Louis area. Winds were then estimated at 160 m.p.h. and the Weather Bureau received estimates of gusts up to 200 m.p.h. a reliable highwater mark of 22.6 feet m.s.l. was found at Pass Christian. Maximum hurricane surges of 15.0 feet or more extended from Waveland to Ocean Springs, Mississippi, with tidal surges of 20 feet or more above m.s.l. concentrated in an area from Bay St. Louis eastward to Mississippi City. Camille then moved inland and blanketed parts of Mississippi, Louisiana, Tennessee, Kentucky, Virginia, and West Virginia with torrential rains, high winds, and tornadoes before moving out into the Atlantic Ocean. While Camille was in the Gulf of Mexico, a central barometric pressure of 26.61 inches was recorded, second only to the Labor Day hurricane of 1935, which developed a central pressure of 26.35 inches. Monetary damages as a result of Camille was in excess of \$1 billion, while at least 262 lives were lost. Of this total, 137 persons perished along the Mississippi Gulf Coast and nine deaths were reported in Louisiana, while deaths were reported at 114 and two in Virginia and West Virginia, respectively.

The most devastating damage wrought by Camille was in the coastal area of Mississippi and the Mississippi River Delta area in Louisiana. Almost total destruction occurred in these areas. As Camille passed near the Mississippi River Delta, hurricane tides overwhelmed the protective systems and inundated protected areas located along the west bank of Mississippi River from Venice to Empire. The area from Venice to Buras was almost completely destroyed. Oil, sulphur, and fishing industries suffered severe damages inside and outside the protected area. As the hurricane moved toward landfall, heavy damage was sustained by all types of installations in and near the Rigolets-Chef Menteur-Lake Catherine area. In addition, camps and homes located on both the north and south shores of Lake Pontchartrain were damaged heavily. At the hurricane approached landfall, record high tides engulfed the entire Mississippi coast, which suffered damages far in excess of that caused by any hurricane in history.

Maximum stages resulting from Hurricane Camille, listed in feet (1951)* were as follows: Mississippi River-Inner Harbor Navigation Canal Lock, 11.5; Chalmette, 11.3; Algiers Lock, 11.4; west Pointe a la Hache, 11.8; Empire, 10.9; Fort Jackson, 15.3; Ostrica Lock, 15.9; and below Venice, 9.1. Other maximum stages, located along the Mississippi River Delta, were: Boothville, 14.6; Buras, 13.4; Sunrise, 10.9; Bohemia, 11.0. Maximum stages in and near the Lake Borgne-Lake Pontchartrain area were: Hopedale, 8.9; Yscloskey, 8.0; Shell Beach, 11.1; Mississippi River Gulf Outlet at Paris Road, 9.7; Inner Harbor navigation Canal at Florida Avenue, 9.8; Seabrook Bridge, 6.5; Citrus, 7.0; Little Woods, 6.9;

* These elevations are referenced to the 1951 epoch adjustments to the 1929 datum.

1969, August 14 - 22 (Camille) (cont'd)

Irish Bayou, 7.2; vicinity of U. S. Highways 11 and 90, 7.6; Chef Menteur, 8.7; U. S. Highway 90 near Lake Catherine, 10.0; Rigolets, 9.0; Rigolets at Long Point, 12.3; and Bayou Bonfouca near Slidell, 6.8. Maximum stages of 7.0 and 8.2 were recorded at U. S. Highway 90 bridges spanning the West and East Pearl Rivers, respectively. flooding in Louisiana as a result of the occurrence of Hurricane Camille is depicted on plate 20.

1971, September 3 - 13 (Fern). Hurricane Fern was spawned by a tropical wave that has moved out of the Caribbean in the beginning of the month. Early on the 3rd, a tropical depression, moving northwestward was located in the gulf. The depression moved north of Lake Pontchartrain by the 5th, and then turned southward. New Orleans received 6- to 7-inch rains as the storm began to intensify as it moved over the warm waters of the gulf and was classed as a hurricane on the 8th. The eye of the hurricane entered the Texas coast near Freeport on the 10th and then veered southwestward as it traversed inland. Hurricane Fern produced only moderate tides but extra heavy rainfall was responsible for destructive floods in Texas.

1971, September 5 - 17 (Edith). Hurricane Edith began as a tropical storm and made landfall three times during her lifetime. Nicaragua and Honduras felt her blow first and were hardest hit. Then British Honduras and the Yucatan Peninsula were stung. Finally, Edith swept shore for the last time on the Louisiana coast between Grand Cheniere and the Rockefeller Wildlife Refuge at about 8 a.m. on 16 September.

As Edith passed through the Gulf of Mexico, the fringe effects of the hurricane caused minimal damage along the Texas coast. As the hurricane track neared the Louisiana coast on the 15th, winds and tides increased. Highest winds measured onshore were 69 m.p.h. with gusts to 96 m.p.h. at Cameron. Due to the fast forward movement of Edith, only moderate buildup of tides was experienced along the Louisiana coast, as the tides ranged generally from 5 feet to slightly more than 8 feet. The highest storm tides occurred in the Vermilion and Cote Blanche bay areas.

As the hurricane swept across southern Louisiana, several tornadoes were spawned, with the most serious damaging residences, schools, and shopping centers in eastern Baton Rouge. Damages resulting from the occurrence of Edith were classed as light to moderate in southern Louisiana as trees were uprooted, windows broken, billboards toppled, and mobile home damaged. The greatest damage was suffered by crops while some damage to roads, levees and drainage structures was reported by the Rockefeller and March Island Wildlife Refuge areas.

1971, September 5 - 17 (Edith) (cont'd)

Some of the maximum stages recorded as a result of the occurrence of Hurricane Edith were: Cameron, 4.3; Grand Cheniere, 5.9; Freshwater Bayou Lock, 7.4; Schooner Bayou Lock, 4.6; Vermilion Lock, 4.0; Charenton Drainage Canal near Baldwin, 5.2; Calumet, 5.5; Morgan City, 5.8; and Bayou Boeuf Lock, 6.0. Elevation of highwater marks along the Bayou Sale Ridge, which is located near East Cote Blanche Bay, ranged from 5.3 at Ellerslie to 9.3 at the mouth of Bayou Sale.

1974, August 29 - September 10 (Carmen). The central core of Carmen was the most severe hurricane since Camille of 1969. However, as it reached the Louisiana coast south of New Orleans, it veered to the northwest, sparing the city from considerable damage. The highest sustained wind measured over Louisiana was 75 knots. Rainfall amounts over land were generally 6 inches or less, and storm tides ranged up to 6 feet along the coast. The highest known storm tide, 11.6 feet, occurred at Cocodrie.

In Louisiana, damage was estimated at \$90 million, primarily to the sugar cane crop, but some damage was sustained by offshore oil installations. Three fatalities were connected with Carmen; two were by downed electrical wires while the other resulted from an automobile accident.

1977, September 3 - 8 (Babe). On September 3rd, Babe was named a tropical storm and gale warnings were posted from Morgan City, LA to Pensacola, FL. On the 4th, it was moving northward with winds reported at 70 knots Babe was then upgraded to a hurricane and warnings were posted along the Louisiana coast from Vermilion Bay to the mouth of the Mississippi River.

Babe maintained hurricane strength for only a few hours until she made landfall in southcentral Louisiana on the morning of the 5th of September. A 40-knot wind readings from Boothville, LA was the highest reported from a land station. Tides along the coast were up to 5 feet. Damage was estimated at \$10 million. There were no known fatalities in connection with Babe.

1978, August 26 - 29 (Debra). A tropical depression formed on August 26, approximately 400 miles south of New Orleans. On the 28th, winds were reported between 35 and 40 knots, and Tropical Storm Debra was named. Gale warnings were posted from Galveston, TX to Grand Isle, LA.

At landfall, tides ranged from 1 foot above normal at Corpus Christi, TX, to 4 to 5 feet above normal along portions of the Louisiana coast. Rainfall of up to 10 inches and several tornadoes were reported. Storm damage was considered minimal. An estimated 3000 people were evacuated from low-lying coastal sections of Louisiana. Maximum sustained winds reported were 50 knots.

1979, July 9 - 16 (Bob). On the morning of July 9th an Air Force reconnaissance aircraft reported a developing tropical storm about 400 miles south of the Louisiana coast with maximum winds estimated at 50 knots. The storm was upgraded to hurricane in the late afternoon and it remained a minimal hurricane as the center moved inland west of Grand Isle, LA early on the morning of the 11th. After making landfall, Bob moved north-northeast up the Mississippi Valley.

The statistics associated with Bob were typical of a minimal hurricane. Tides were generally 3 to 5 feet above normal, and rainfall totals between 3 and 6 inches. No serious flooding was reported in Louisiana. Highest winds were 45 to 55 knots, and the forward speed was 15 knots.

1982, September 9 - 12 (Chris). On September 9th, a low-pressure area forming over the central Gulf of Mexico began to exhibit tropical characteristics as it moved westward. By the morning of the 10th, the system had developed into Tropical Storm Chris as it turned and headed north. The storm moved into southwestern Louisiana on the morning of September 11th, with its maximum winds of 55 knots reached just prior to landfall.

Offshore oil rigs observed wind gusts up to 70 knots, and tides in excess of 6 feet were reported along the Louisiana coast. There were no casualties reported, and damage estimates were less than \$2 million.

1985, August 12 - 20 (Danny). Hurricane Danny made landfall over a sparsely populated area near Pecan Island in Vermilion Parish on August 15. Since Danny's wind damage was minimal, its primary effects were in the form of flooding from localized heavy rains and high tides. The tides ranged up to 8 feet above normal near and to the right of the storm's center as it moved ashore. A 5 to 6 foot storm surge inundated the barrier islands and coastal marshes.

At Grand Isle, the storm surge plus wave action destroyed a 100 foot section of the fishing pier, and also eroded 60 to 100 feet of shoreline at the state park. Overall, there was 75,000 cubic yards of sand washed away from Grand Isle Hurricane Protection levee.

Rainfall amounts ranged from 3 to 4 inches over some areas. The maximum gradient winds reached 80 knots.

1985, August 28 - September 4 (Elena). On August 29, 1985, Tropical Storm Elena entered the Gulf of Mexico, and rapidly intensified into a hurricane. As it headed northwest toward the Louisiana coast, the storm unexpectedly slowed and turned east toward the Florida peninsula. Elena threatened the Florida gulf coast for nearly 2 days, sending in damaging

1985, August 28 - September 4 (Elena) (cont'd)

waves and winds as it made a looping track offshore. The storm then sped west-northwest, making landfall at Biloxi, Mississippi on September 2nd.

Elena was the third storm of tropical origin to make landfall in the U. S. this year, and was by far the most destructive. Prior to landfall, Elena's maximum winds were estimated at 110 knots (127 mph) and a minimum pressure of 951 mb was measured by NOAA reconnaissance aircraft. Total losses due to hurricane damage are likely to exceed one billion dollars.

Dauphin Island, Alabama suffered the brunt of the storm as it did when Hurricane Frederic struck there in September 1979. A 6 to 8 foot storm surge washed beach sand all the way across the width of the island for much of its length.

In Louisiana at Grand Isle, 30,000 cubic yards of sand was washed away from Hurricane Protection levee by the storm surge.

Water surface elevations at various locations along the coast and in Lake Pontchartrain are as follows: Lukes Landing-3.5 feet; Eugene Island-1.9 feet; East Jetty SWP-4.10 feet; Grand Isle East Point-6.4 feet; Leeville-2.9 feet; Rigolets at Lake Pontchartrain-3.3 feet; and Irish Bayou 4.0 feet.

1985, October 26 - 31 (Juan). Juan, which moved slowly and erratically during most of its life, lingered near the Louisiana coast and coastal plain over the five day period 22 thru 31 October. This allowed persistent southerly winds to push a 5 to 8 foot storm surge up into Bayous, inland lakes and low-lying areas in the southeast coastal parishes. This surge contributed toward the breaking of many high water records throughout the area. The Louisiana Office of Emergency Preparedness reported about 5000 homes and 100 businesses were flooded. In addition, 8 to 13 inches of rainfall occurred in southeast Louisiana. Juan did \$304 million damage to property and \$250 million damage to crops, mainly soybeans and sugar cane.

In Lafourche Parish, the storm surge literally broke up Louisiana Hwy 1 below Leeville and Louisiana 3090 near Fourchon. The surge continued inland washing out two sections of local levees from Golden Meadow to Larose, causing extensive flooding in homes and low-lying cropland. Damage of \$3.2 millions was done to public property such as roads and levees.

At Grand Isle in Jefferson Parish, the storm surge leveled 6000 feet of the Hurricane Protection Levee and caused significant damage to another 14,000 feet, which amounted to about 370,000 cubic yards of sand. About 4 feet of water

1985, October 26 - 31 (Juan) (cont'd)

covered the island with damage estimated to be around \$20 million.

On the west bank of Jefferson Parish, three local interest levees were breached and an area along the west bank of Harvey Canal was protected from flooding by sandbagging. A crevasse in the Vee-levee near a pipeline canal was also controlled by sandbagging. Nearby, a smaller crevasse was not closed until after the hurricane had passed. Low areas in the levee between Lincolnshire and Westminster were overtopped and resulted in flooding of these subdivisions. A low area in the levee south of Westwego, Louisiana resulted in a crevasse and flooded some areas of the city.

In St. Tammany, Tangipahoa, and Livingston Parishes, storm waters of from 3 to 7 feet from Lake Pontchartrain and Maurepas covered low-lying land areas. About 1000 homes and some businesses were flooded with from 2 to 4 feet of water. Three bridges were washed out near Lacombe, Louisiana.

In St. John, St. Charles and Ascension Parishes, some areas were flooded with 3 to 5 feet of water from Lakes Pontchartrain and Maurepas. Approximately 280 homes were flooded. In St. John Parish, the storm surge undermined about 3 miles of the ICRR track bed near Ruddock, Louisiana.

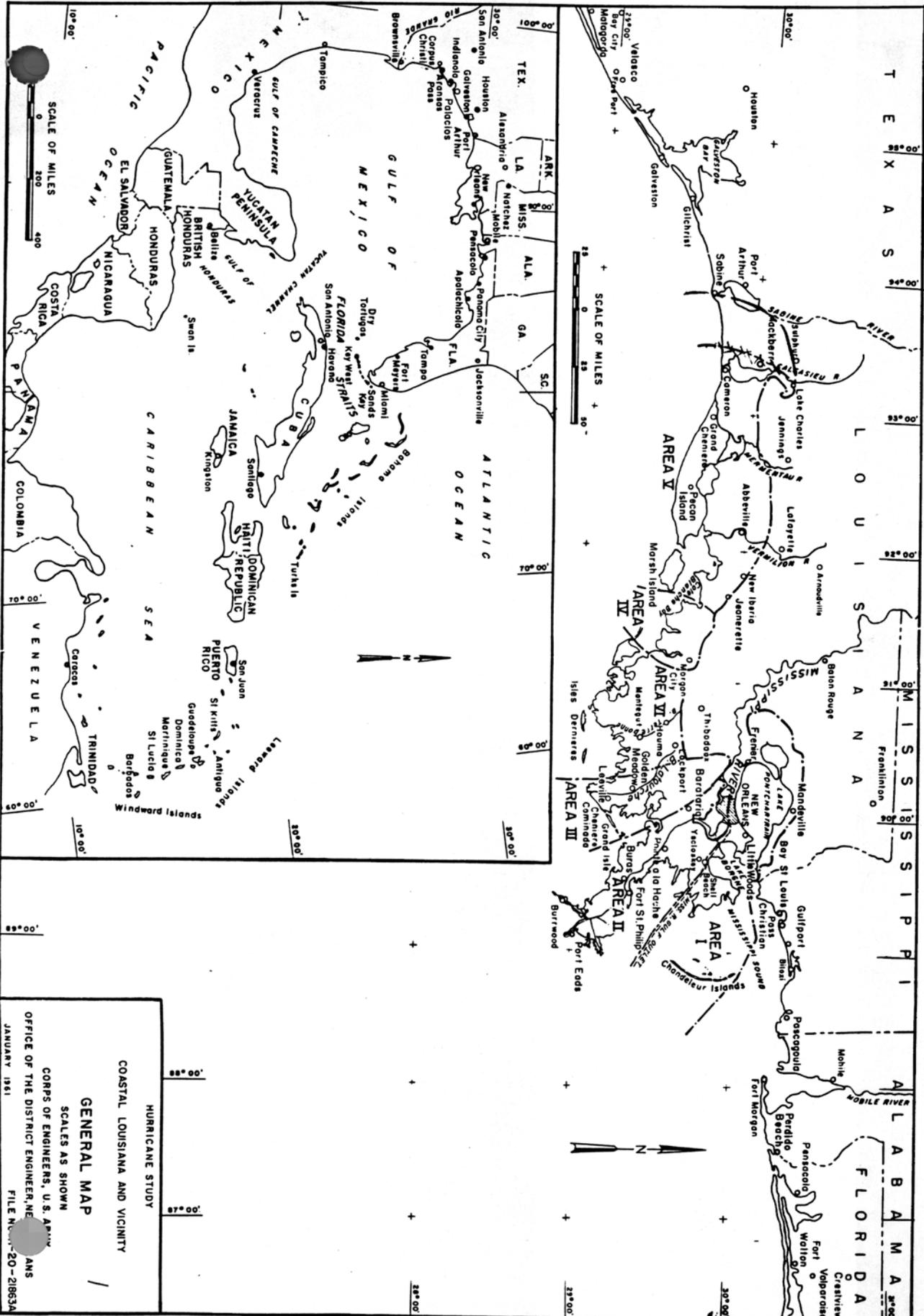
In St. Bernard Parish, a 5 to 6 foot storm surge inundated Yscloskey, Alluvial City, Hopedale, Reggio and Delacroix for several days.

Juan produced maximum sustained winds of 64 knots and a central pressure of 29.13 inches. Although a minimum hurricane, Juan set many new high-water marks along the landward margin of the coastal zone in Louisiana. A tabulation of these marks follows.

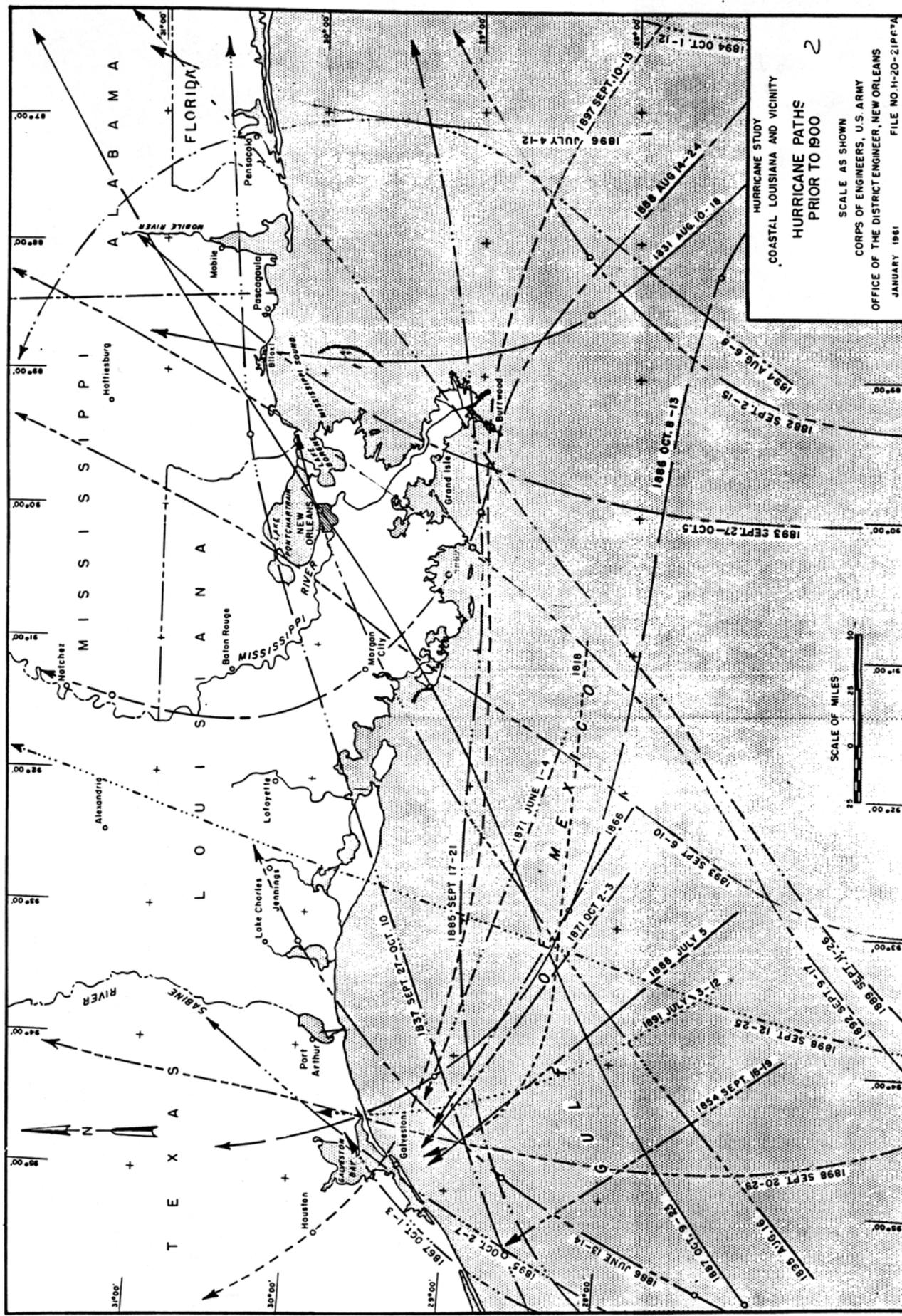
HURRICANE JUAN, 27 OCT - 7 NOV 85

Record High	Date	Time Hrs.	Water Surface Elev. Ft. NGVD
Atchafalaya Bay nr Eugene Island, LA	28 Oct 85	1000	4.68
Bayou Terre Aux Boeufs @ Delacroix, LA	28 Oct 85	0400	6.86
Lake Pontchartrain @ West End, LA	28 Oct 85	1000	6.11
Lake Pontchartrain @ Mid Lake nr N. O. LA	29 Oct 85	1400	6.14
Bayou Barataria @ Lafitte, LA	29 Oct 85	0330	5.05
Bayou DesAllemonds @ DesAllemonds, LA	29 Oct 85	1600	3.92
Bayou LaFourche @ Leeville, LA	28 Oct 85	0400	6.62
Intracoastal Waterway @ Houma, LA	29 Oct 85	1530	5.16
IWW @ Algiers Lock, LA	29 Oct 85	1300	4.45
IWW @ Harvey Lock, LA	29 Oct 85	1200	4.74
Bayou Bienvenue @ Floodgate (East), LA	28 Oct 85	1415	7.98
Bayou Dupre @ Floodgate (East), LA	28 Oct 85	1420	7.61
Belle River nr Pierre Pass, LA	1 Nov 85	0800	5.10
Round Bayou @ Deer Island, LA	28 Oct 85	1100	4.98
Southwest Pass @ East Jetty	27 Oct 85	2015	5.59

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P. 1



HURRICANE STUDY
 COASTAL LOUISIANA AND VICINITY
GENERAL MAP
 SCALES AS SHOWN
 CORPS OF ENGINEERS, U.S. ARMY
 OFFICE OF THE DISTRICT ENGINEER, NEW ORLEANS
 JANUARY 1951
 FILE NO. 20-218634A

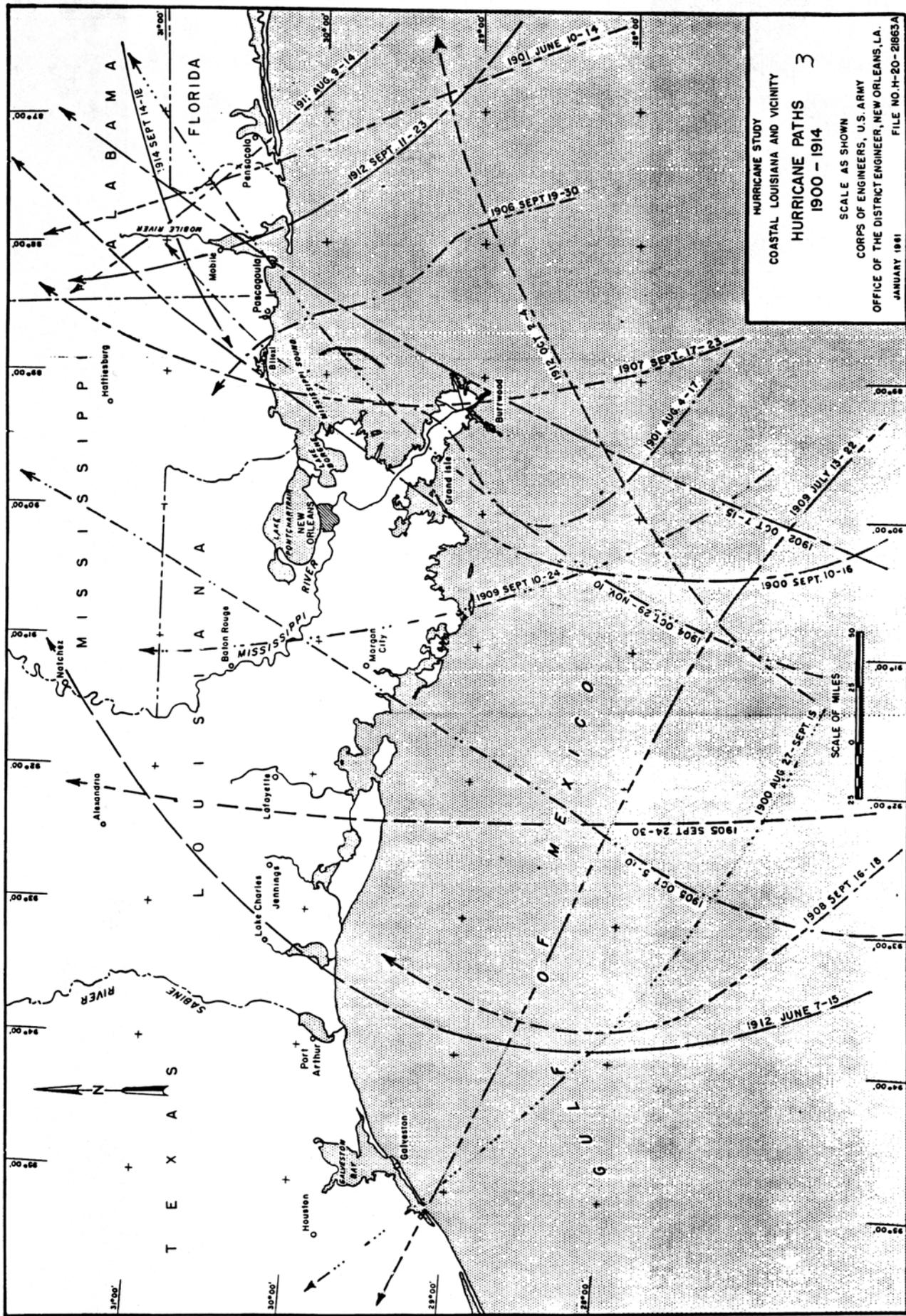


HURRICANE STUDY
 COASTAL LOUISIANA AND VICINITY
 HURRICANE PATHS
 PRIOR TO 1900

2

SCALE AS SHOWN
 CORPS OF ENGINEERS, U.S. ARMY
 OFFICE OF THE DISTRICT ENGINEER, NEW ORLEANS
 JANUARY 1961
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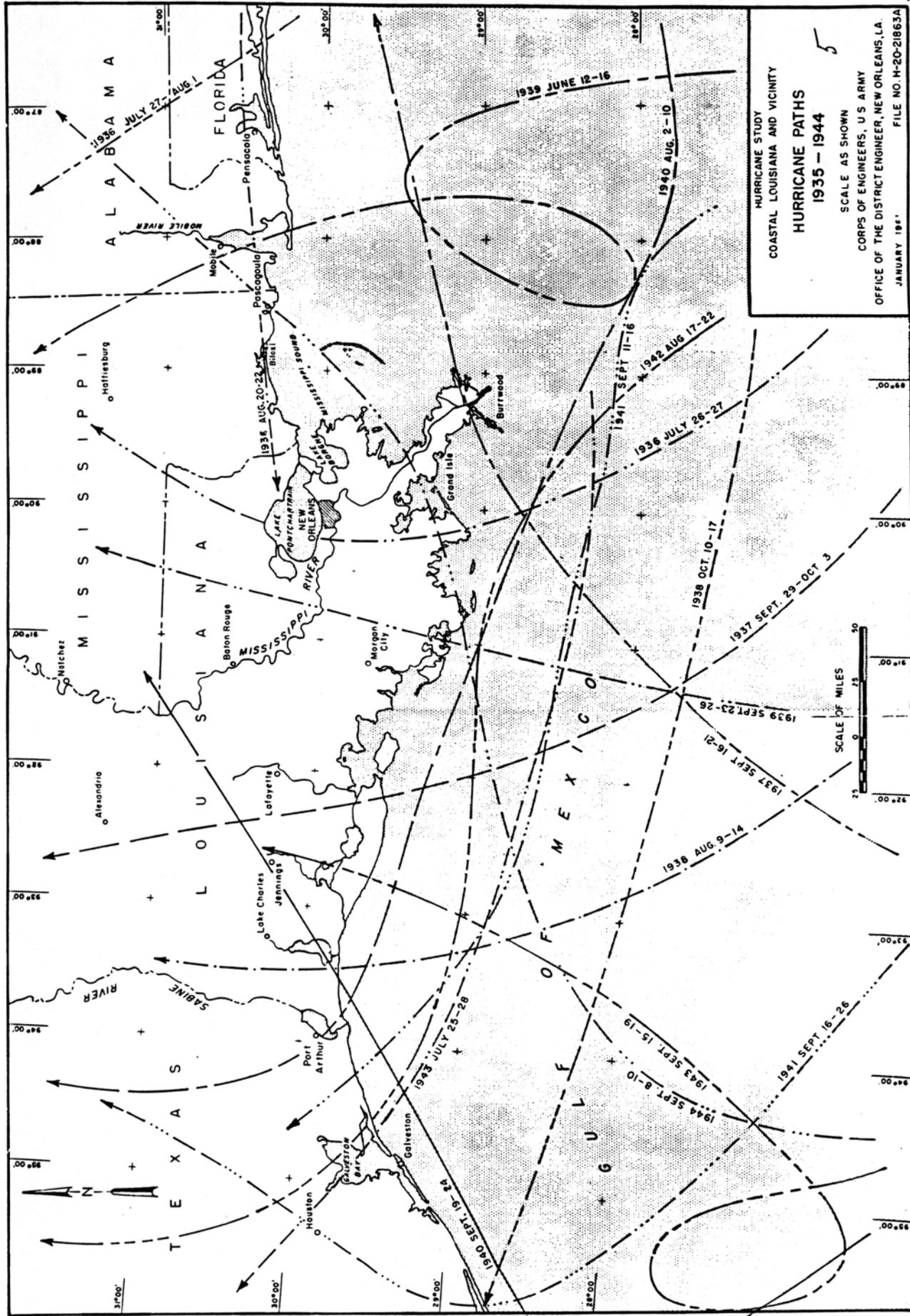




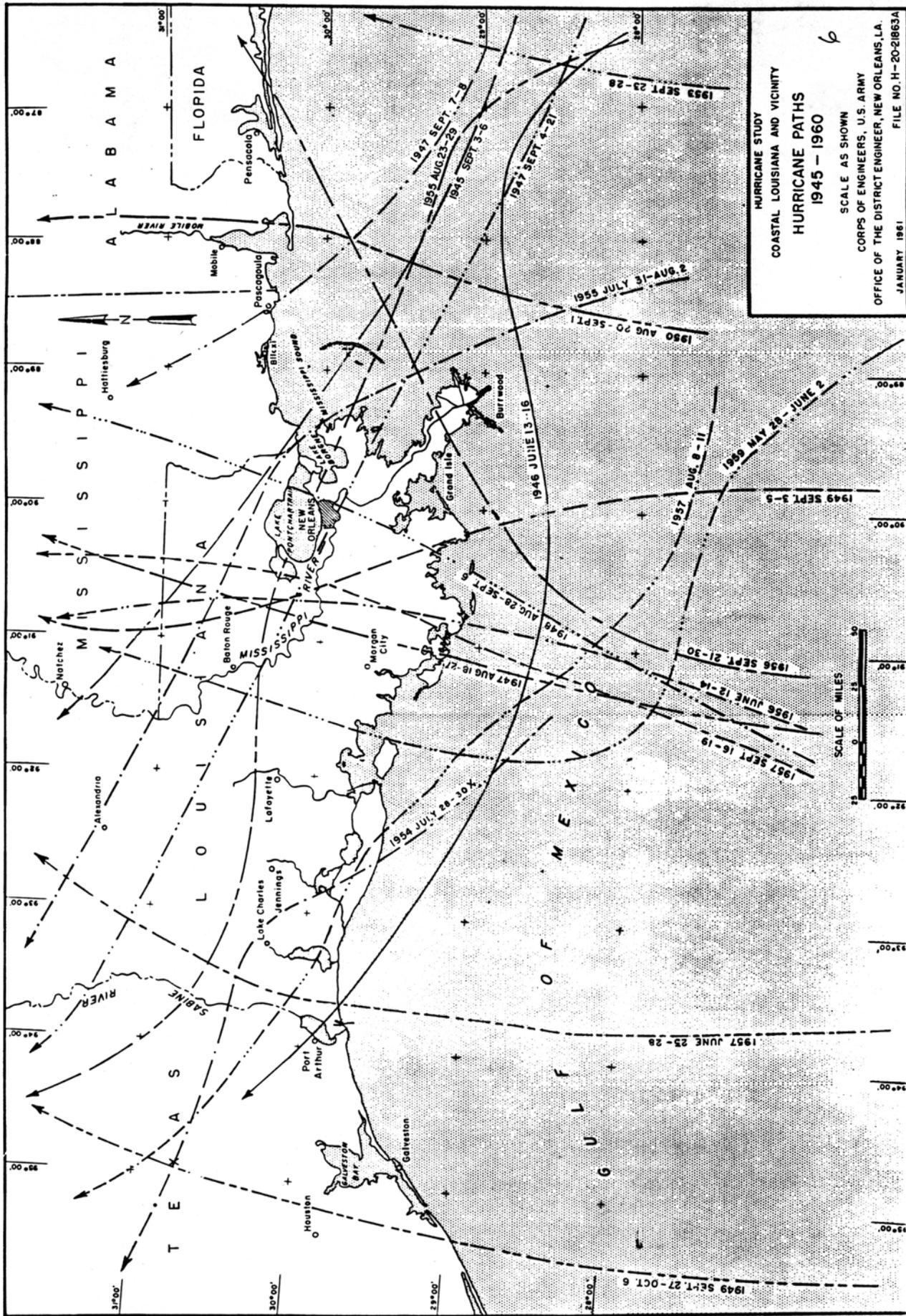
HURRICANE STUDY
 COASTAL LOUISIANA AND VICINITY
 HURRICANE PATHS
 1900 - 1914

SCALE AS SHOWN
 CORPS OF ENGINEERS, U.S. ARMY
 OFFICE OF THE DISTRICT ENGINEER, NEW ORLEANS, LA.
 JANUARY 1961

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 FILE NO H-20-2863A
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HURRICANE STUDY
 COASTAL LOUISIANA AND VICINITY
HURRICANE PATHS
 1935 - 1944
 SCALE AS SHOWN
 CORPS OF ENGINEERS, U S ARMY
 OFFICE OF THE DISTRICT ENGINEER, NEW ORLEANS, LA.
 JANUARY 1951
 FILE NO. H-20-21863A
 PLATE 5

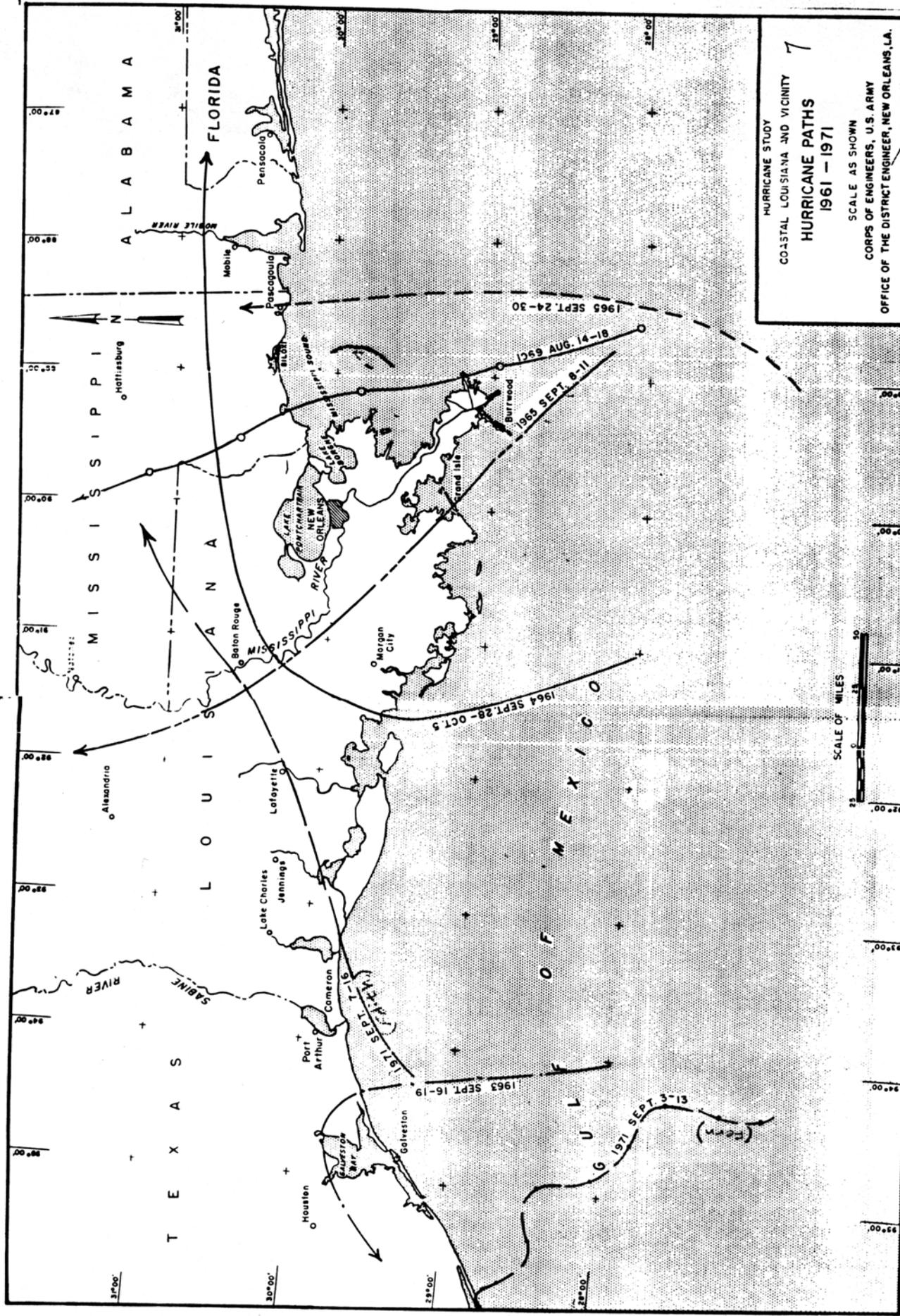


HURRICANE STUDY
 COASTAL LOUISIANA AND VICINITY
HURRICANE PATHS
 1945 - 1960

SCALE AS SHOWN
 CORPS OF ENGINEERS, U.S. ARMY
 OFFICE OF THE DISTRICT ENGINEER, NEW ORLEANS, LA.
 JANUARY 1961

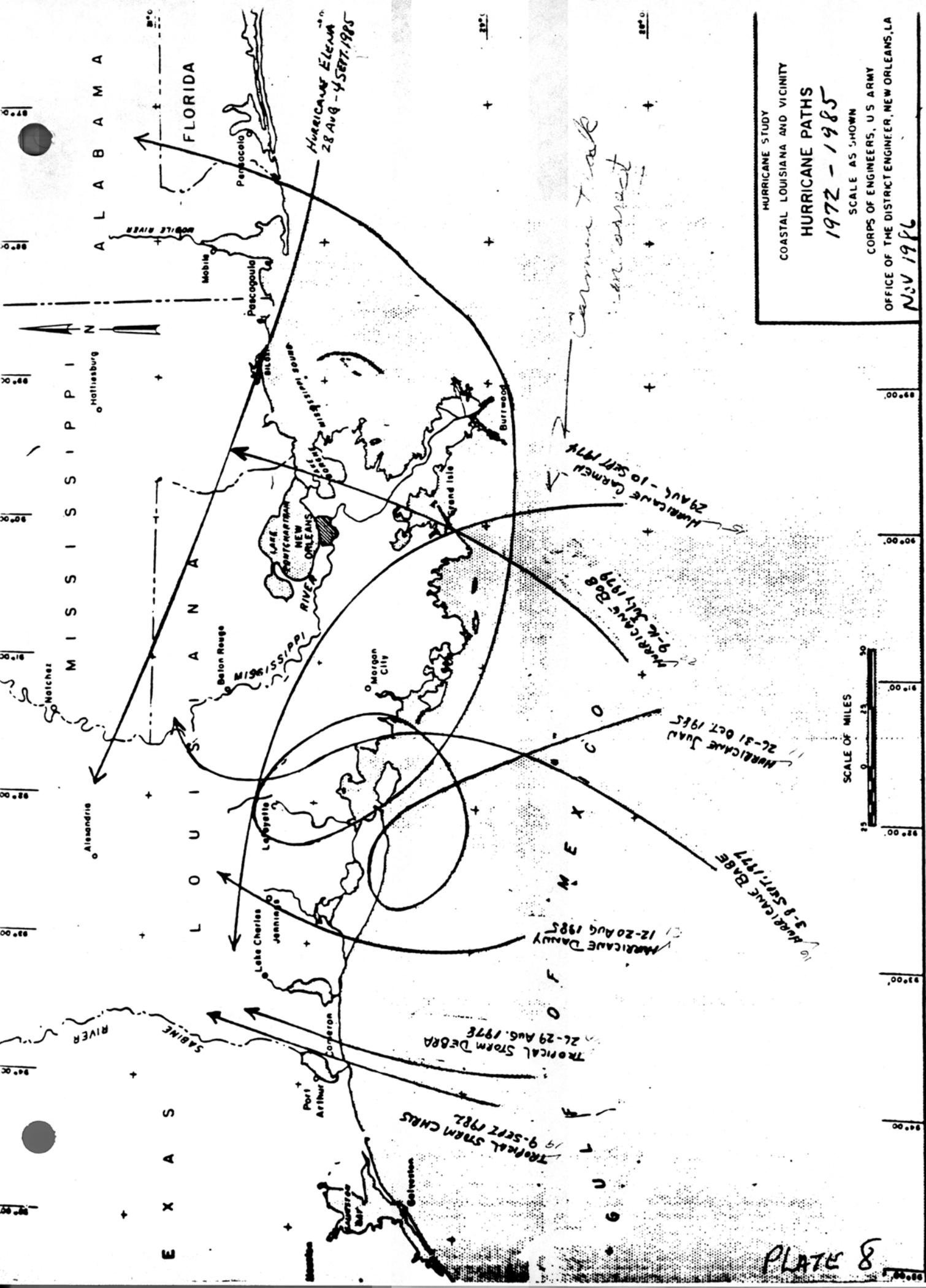
FILE NO. H-20-21863A

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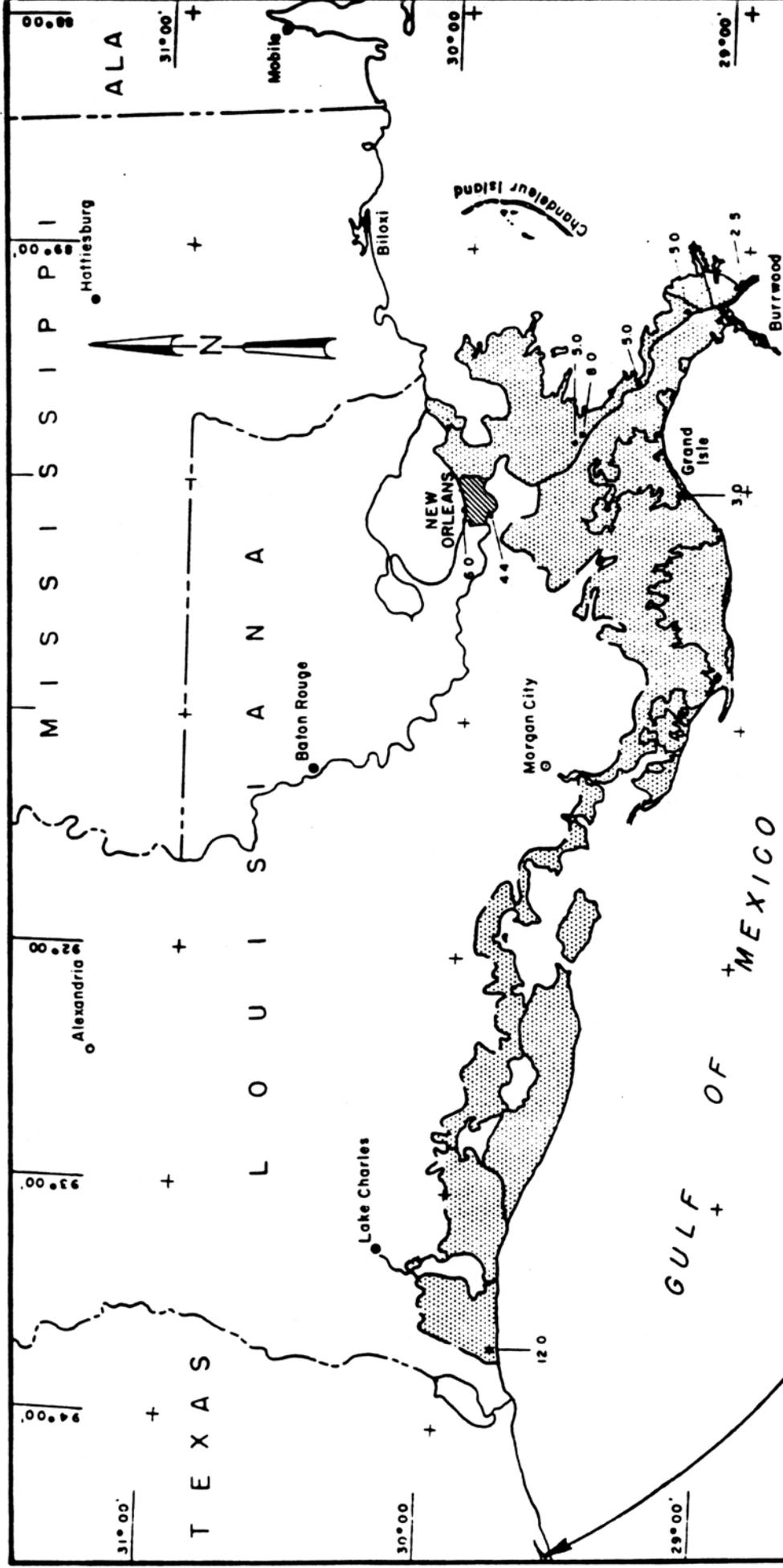


HURRICANE STUDY
 COASTAL LOUISIANA AND VICINITY
**HURRICANE PATHS
 1961 - 1971**
 SCALE AS SHOWN
 CORPS OF ENGINEERS, U.S. ARMY
 OFFICE OF THE DISTRICT ENGINEER, NEW ORLEANS, L.A.
 AUG. 1972
 FILE NO. H-20-21863A

SCALE OF MILES
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HURRICANE STUDY
 COASTAL LOUISIANA AND VICINITY
HURRICANE PATHS
 1972 - 1985
 SCALE AS SHOWN
 CORPS OF ENGINEERS, U S ARMY
 OFFICE OF THE DISTRICT ENGINEER, NEW ORLEANS, LA
 NOV 1986

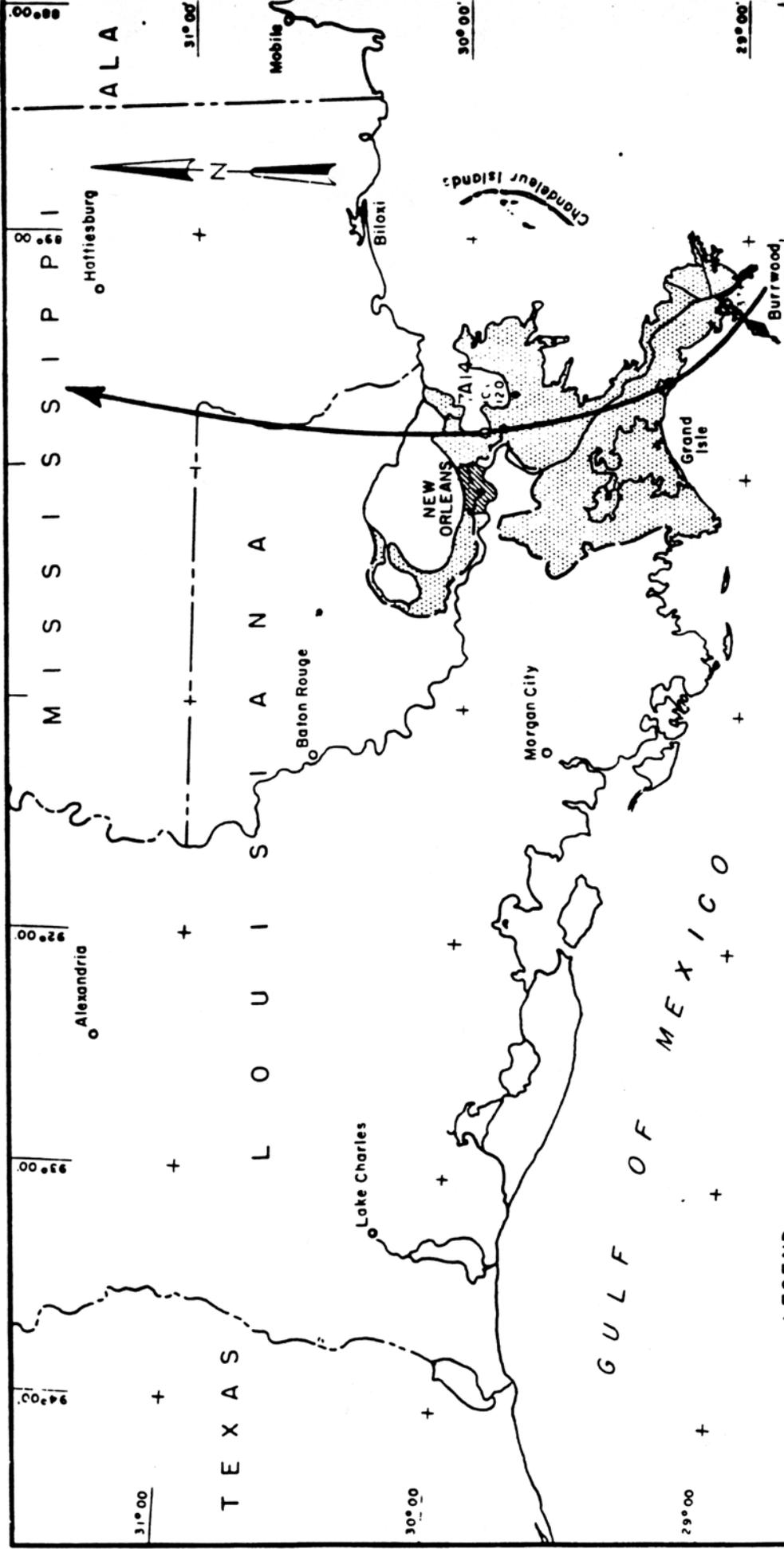


HURRICANE STUDY
 COASTAL LOUISIANA AND VICINITY
HURRICANE PATH
8-13 OCTOBER 1886
 SCALE AS SHOWN
 CORPS OF ENGINEERS, U.S. ARMY
 OFFICE OF THE DISTRICT ENGINEER, N.O.
 JANUARY 1961 FILE NO. M-20-21663A

LEGEND

- Path of hurricane center
- ▨ Limits of flooding in Louisiana
- 3.0 Maximum tide - m. s. l.
- Location Est





LEGEND

— Path of hurricane center

▨ Limits of flooding in Louisiana

○ 1' Max. tide-feet msl.

○ Location Est

SCALE OF MILES



HURRICANE STUDY

COASTAL LOUISIANA AND VICINITY

**HURRICANE PATH
4-17 AUGUST 1901**

SCALE AS SHOWN

CORPS OF ENGINEERS US ARMY

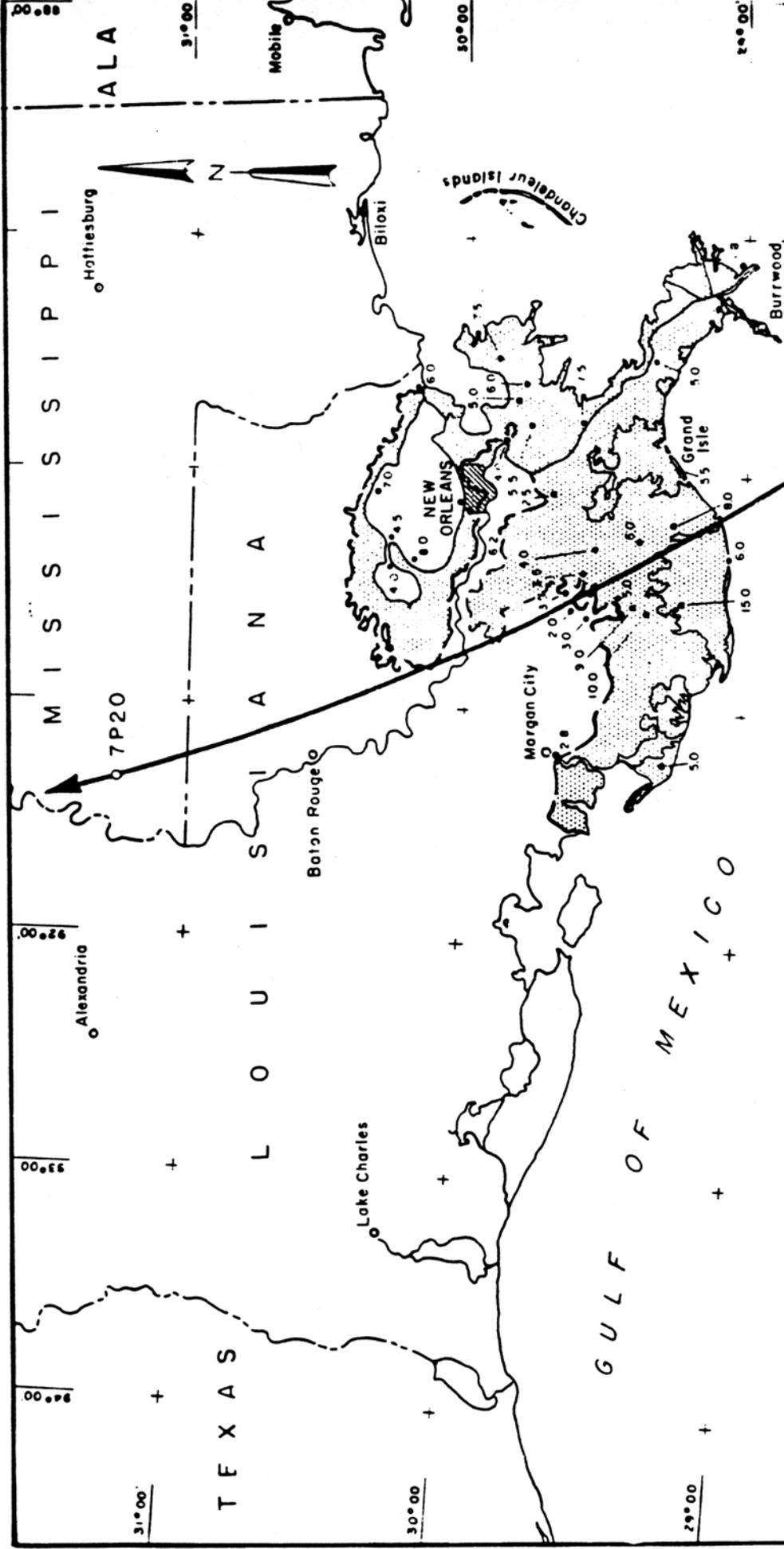
OFFICE OF THE DISTRICT ENGINEER, MO

JANUARY 1961

FILE NO. H-20-2.863A

PLATE 10

PLATE 10



MISSISSIPPI ALA

Hoffriesburg

Mobile

Biloxi

Chondoleur Islands

Burrwood

NEW ORLEANS

Grand Isle

55

50

60

70

80

90

100

110

120

130

140

150

Morgan City

Baton Rouge

Louisiana

TEXAS

GULF OF MEXICO

Alexandria

Lake Charles

7P20

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999°00'

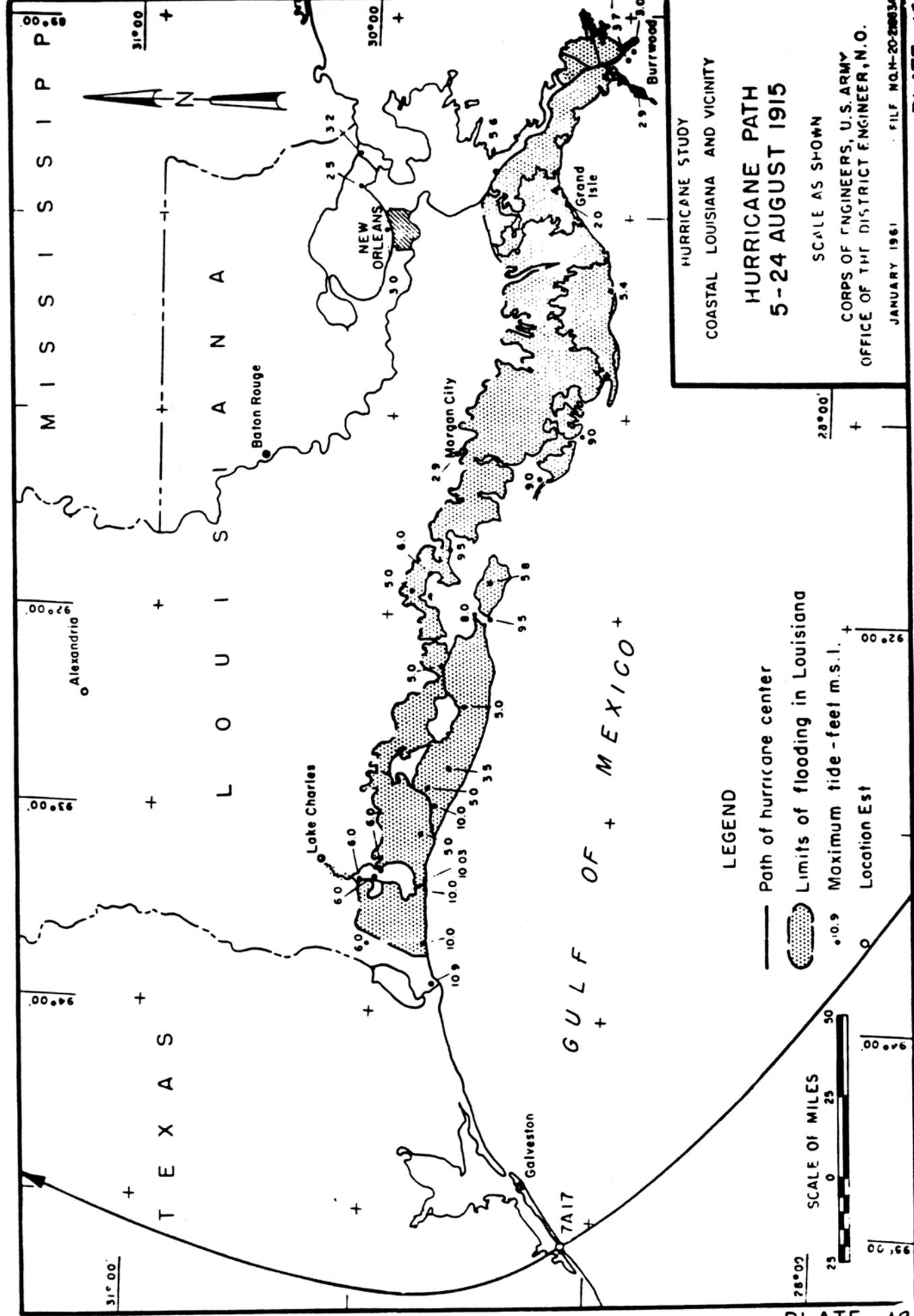
1000°00'

LEGEND

- Path of hurricane center
- Limits of flooding in Louisiana
- 7.5 Maximum tide-feet msl
- Location Est



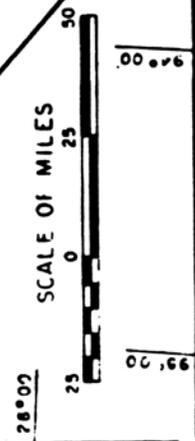
HURRICANE STUDY
 COASTAL LOUISIANA AND VICINITY
HURRICANE PATH
10-24 SEPTEMBER 1909
 SCALE AS SHOWN
 CORPS OF ENGINEERS, U.S. ARMY
 OFFICE OF THE DISTRICT ENGINEER, MO
 JANUARY 1961 FILE NO. 20-21869A

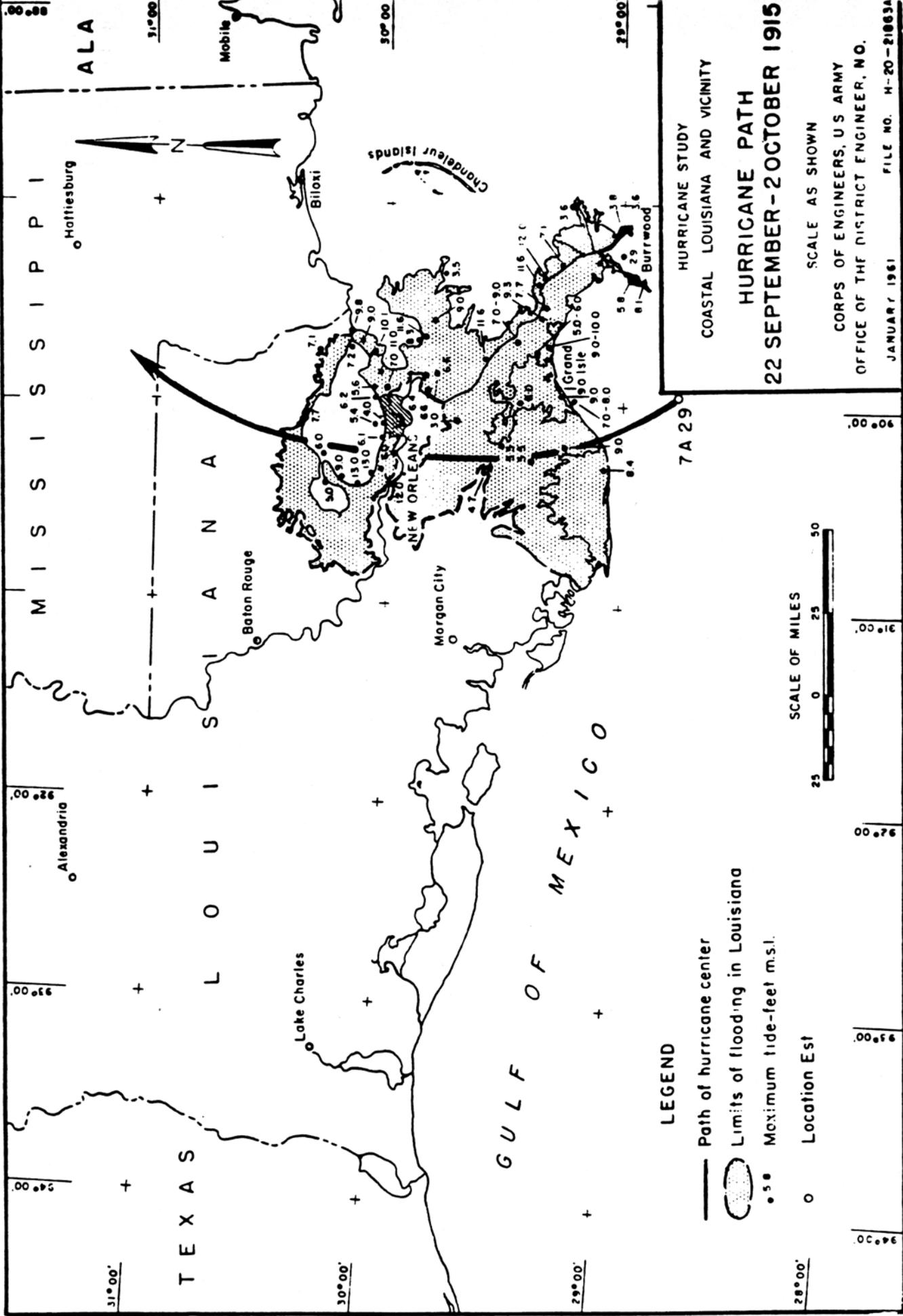


HURRICANE STUDY
 COASTAL LOUISIANA AND VICINITY
HURRICANE PATH
5-24 AUGUST 1915
 SCALE AS SHOWN
 CORPS OF ENGINEERS, U.S. ARMY
 OFFICE OF THE DISTRICT ENGINEER, N.O.
 JANUARY 1961
 FILE NO. H-20-28834

LEGEND

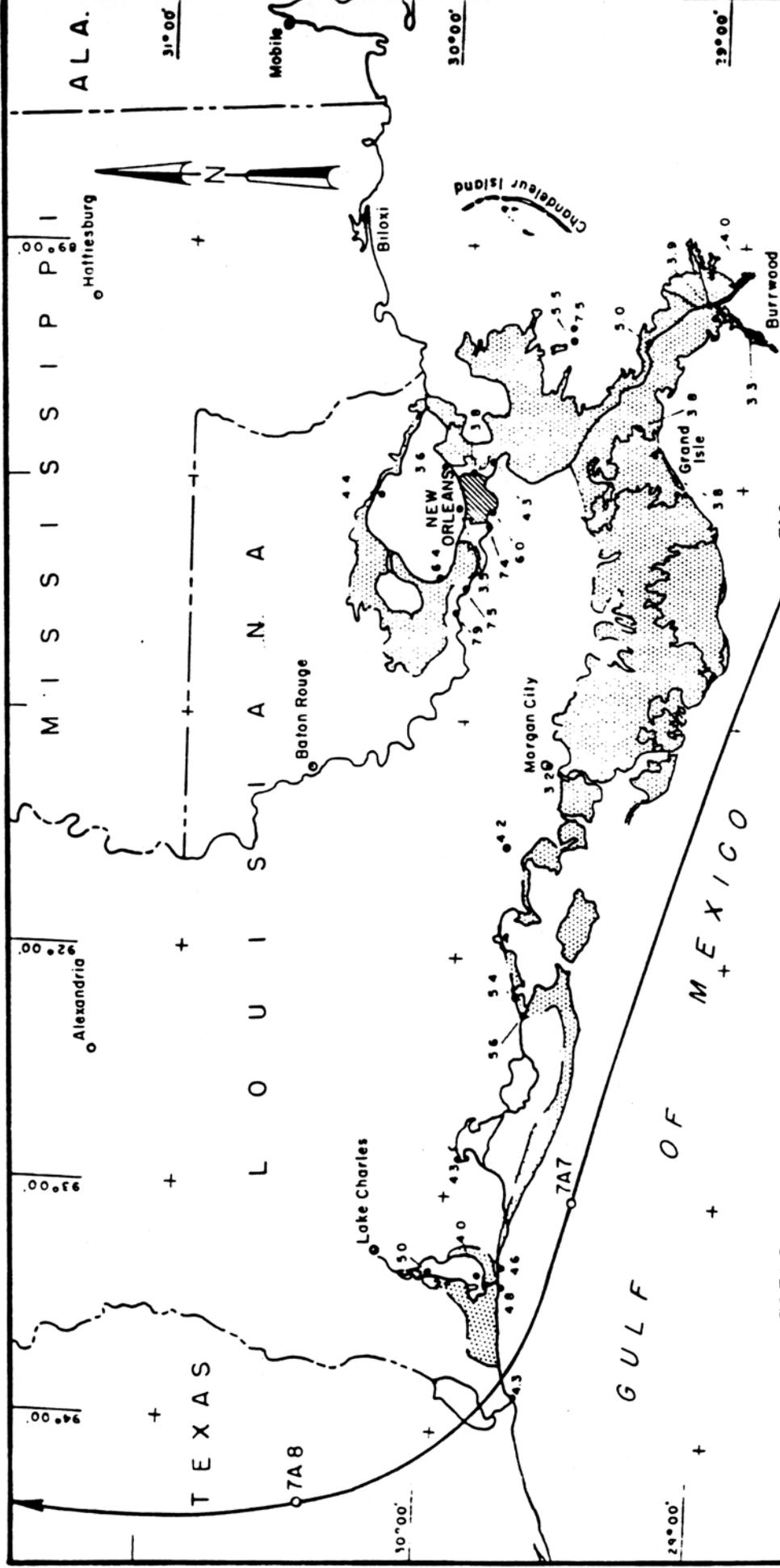
- Path of hurricane center
- ▨ Limits of flooding in Louisiana
- 10.9 Maximum tide - feet m.s.l.
- Location Est





HURRICANE STUDY
 COASTAL LOUISIANA AND VICINITY
HURRICANE PATH
22 SEPTEMBER - 2 OCTOBER 1915
 SCALE AS SHOWN
 CORPS OF ENGINEERS, U.S. ARMY
 OFFICE OF THE DISTRICT ENGINEER, MO.
 JANUARY 1961
 FILE NO. H-20-21863A

7A 29



HURRICANE STUDY
 COASTAL LOUISIANA AND VICINITY
HURRICANE PATH
2-10 AUGUST 1940
 SCALE AS SHOWN
 CORPS OF ENGINEERS, U.S. ARMY
 OFFICE OF THE DISTRICT ENGINEER, NO
 JANUARY 1961
 FILE NO. H-2C-21897A

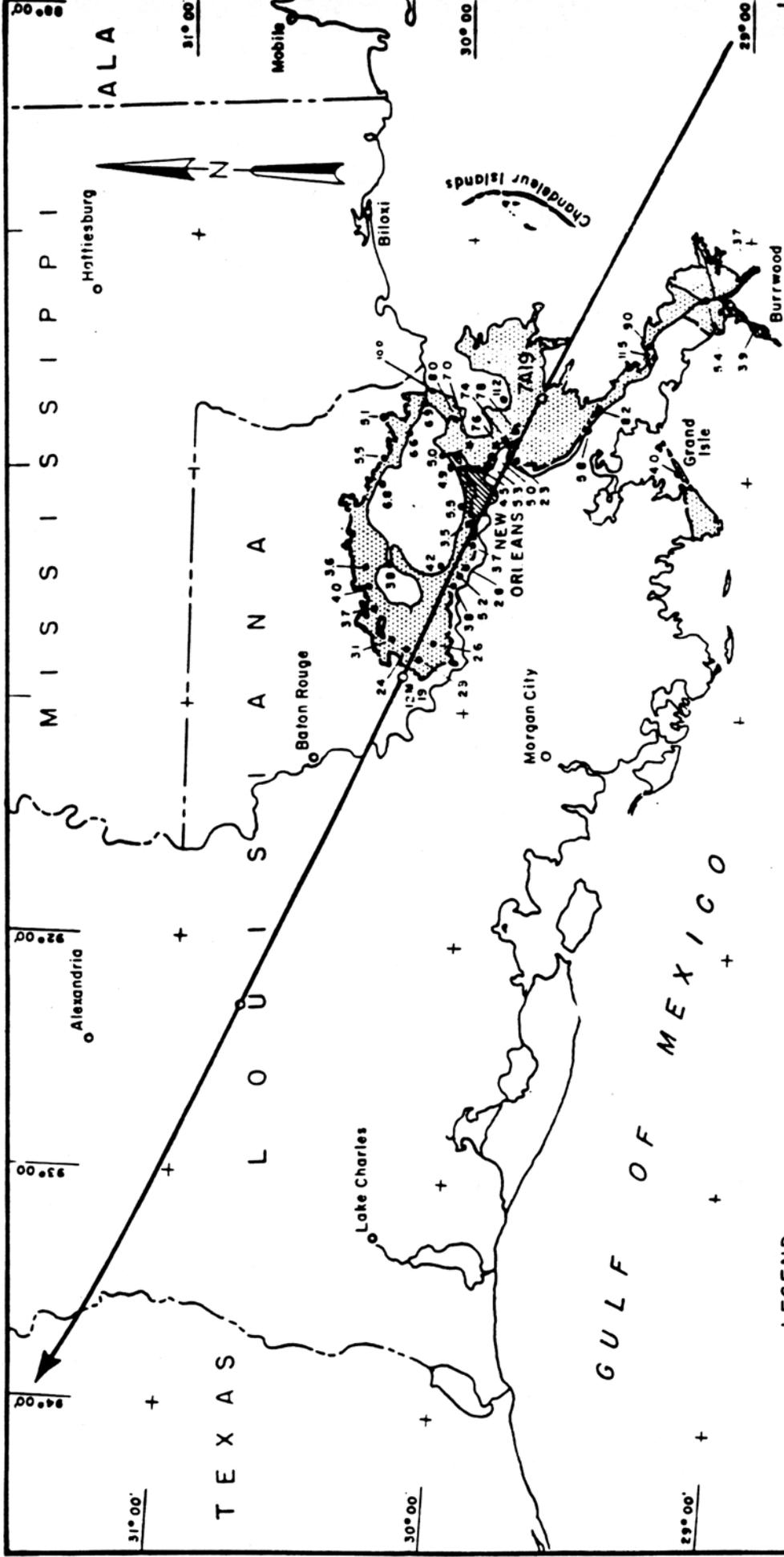
LEGEND

- Path of hurricane center
- ▨ Limits of flooding in Louisiana
- 4.2 Maximum tide - feet m.s.l
- Location Est

SCALE OF MILES
 0 25 50

28°00' 29°00' 30°00'

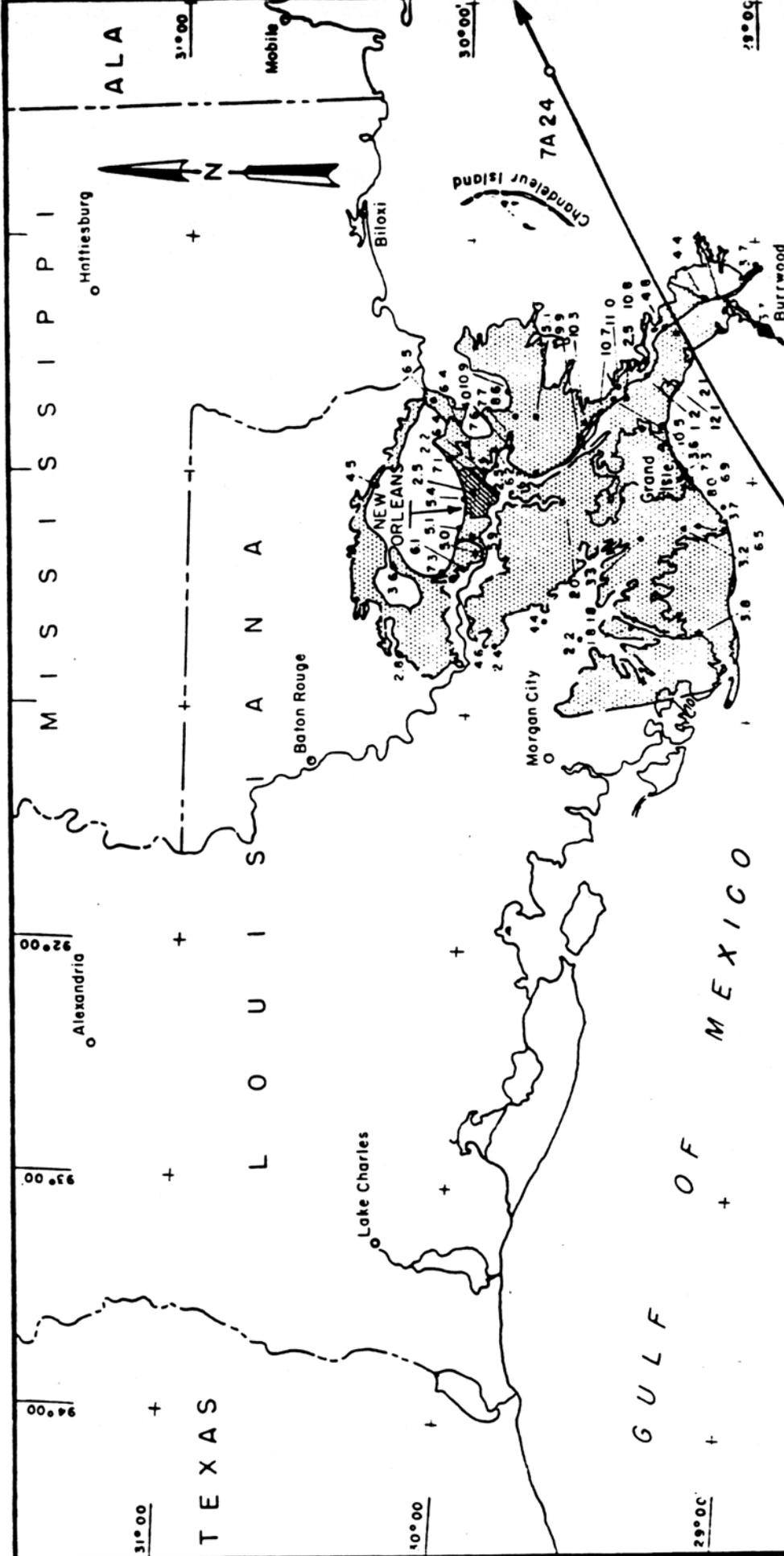
92°00' 93°00' 94°00'



HURRICANE STUDY
 COASTAL LOUISIANA AND VICINITY
HURRICANE PATH
4-21 SEPTEMBER 1947
 SCALE AS SHOWN
 CORPS OF ENGINEERS, U.S. ARMY
 OFFICE OF THE DISTRICT ENGINEER, MO
 JANUARY 1961 FILE NO. H-20-21863A

- LEGEND**
- Path of hurricane center
 - ▨ Limits of flooding in Louisiana
 - 37 Maximum tide-feet msl.
 - Location Est



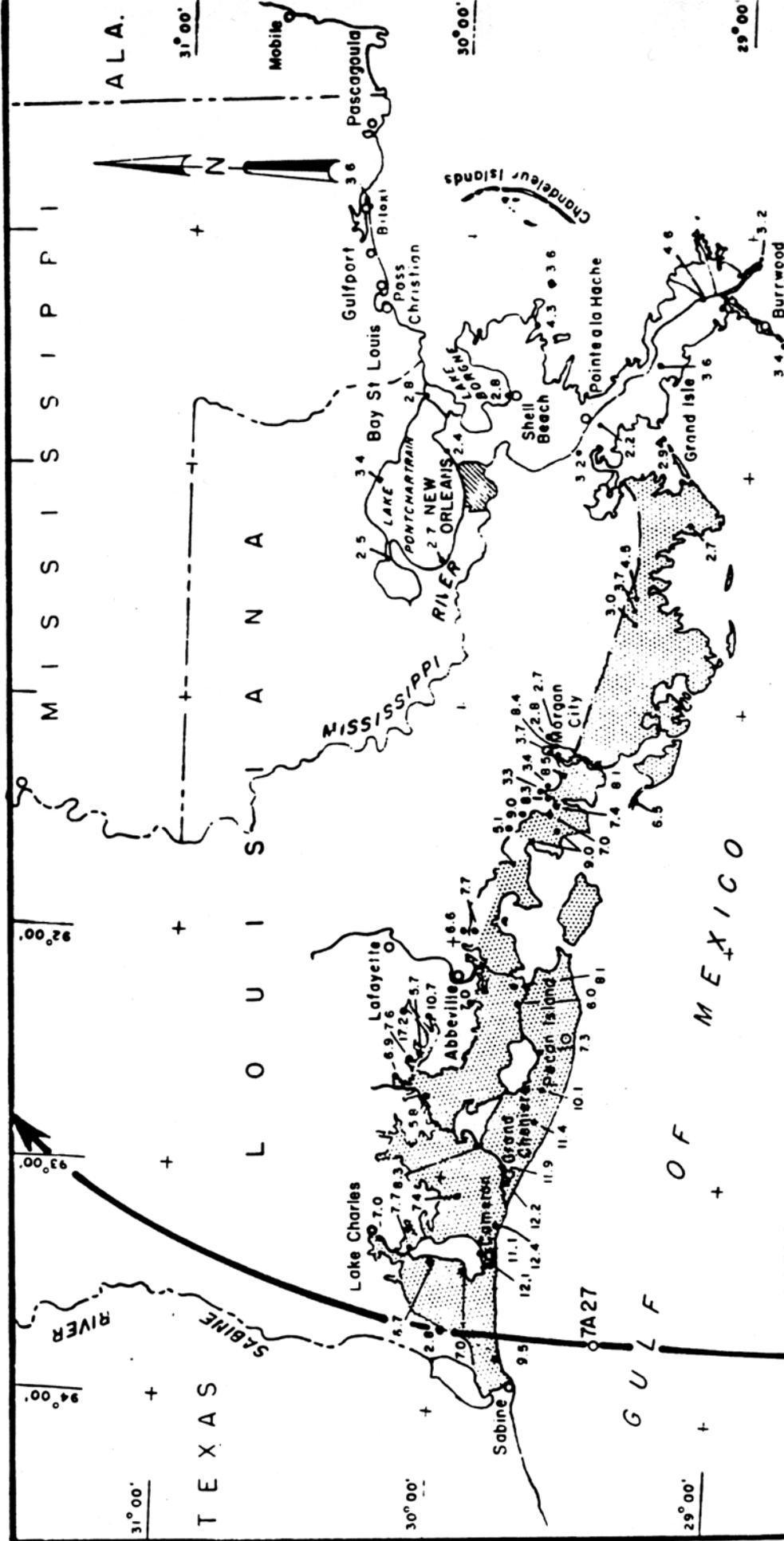


HURRICANE STUDY
 COASTAL LOUISIANA AND VICINITY
HURRICANE PATH
21-30 SEPTEMBER 1956
 (FLOSSY)
 SCALE AS SHOWN
 CORPS OF ENGINEERS, U.S. ARMY
 OFFICE OF THE DISTRICT ENGINEER, NO.
 JANUARY 1961
 FILE NO. H-20-21863A

LEGEND

- Path of hurricane center
- ▨ Limits of flooding in Louisiana
- 37 Maximum tide - feet m. s. l.
- Location Est

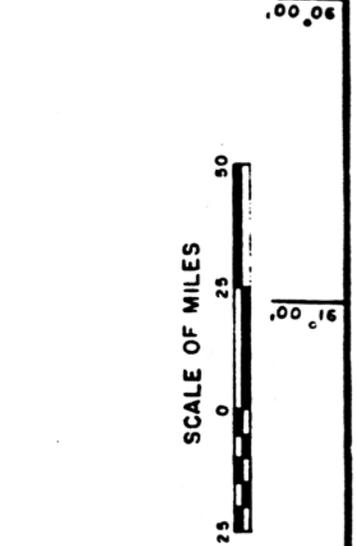
SCALE OF MILES
 0 25 50
 00.00 00.16 00.32 00.48 00.64 00.80 00.96 01.12 01.28 01.44 01.60 01.76 01.92 02.08 02.24 02.40 02.56 02.72 02.88 03.04 03.20 03.36 03.52 03.68 03.84 04.00



HURRICANE STUDY
 COASTAL LOUISIANA AND VICINITY

HURRICANE PATH
25-28 JUNE 1957
 (AUDREY)

SCALE AS SHOWN
 CORPS OF ENGINEERS, U.S. ARMY
 OFFICE OF THE DISTRICT ENGINEER, NO.
 JANUARY 1961 FILE NO. H-20-21093A



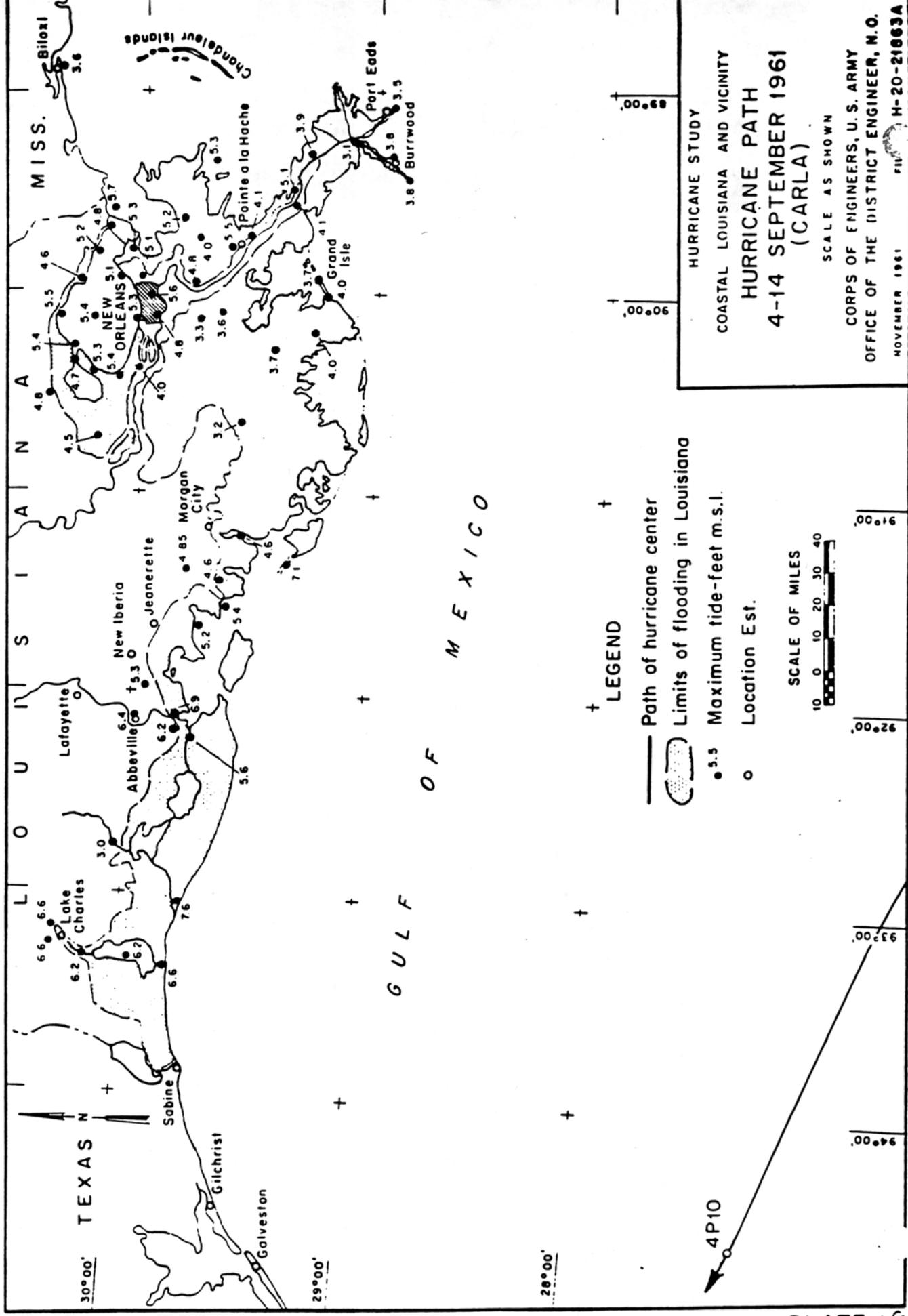
LEGEND

— Path of hurricane center

▨ Limits of flooding in Louisiana

- - - Maximum tide - feet msl.

○ Location Esj



HURRICANE STUDY
 COASTAL LOUISIANA AND VICINITY
HURRICANE PATH
4-14 SEPTEMBER 1961
(CARLA)
 SCALE AS SHOWN
 CORPS OF ENGINEERS, U.S. ARMY
 OFFICE OF THE DISTRICT ENGINEER, N.O.
 NOVEMBER 1961
 FILE NO. H-20-21063A

LEGEND

- Path of hurricane center
- ▨ Limits of flooding in Louisiana
- 5.5 Maximum tide-foot m.s.l.
- Location Est.

SCALE OF MILES
 0 10 20 30 40

4P10

