Hurricane Tracks

Isaac versus previous storms
Impacts and solutions

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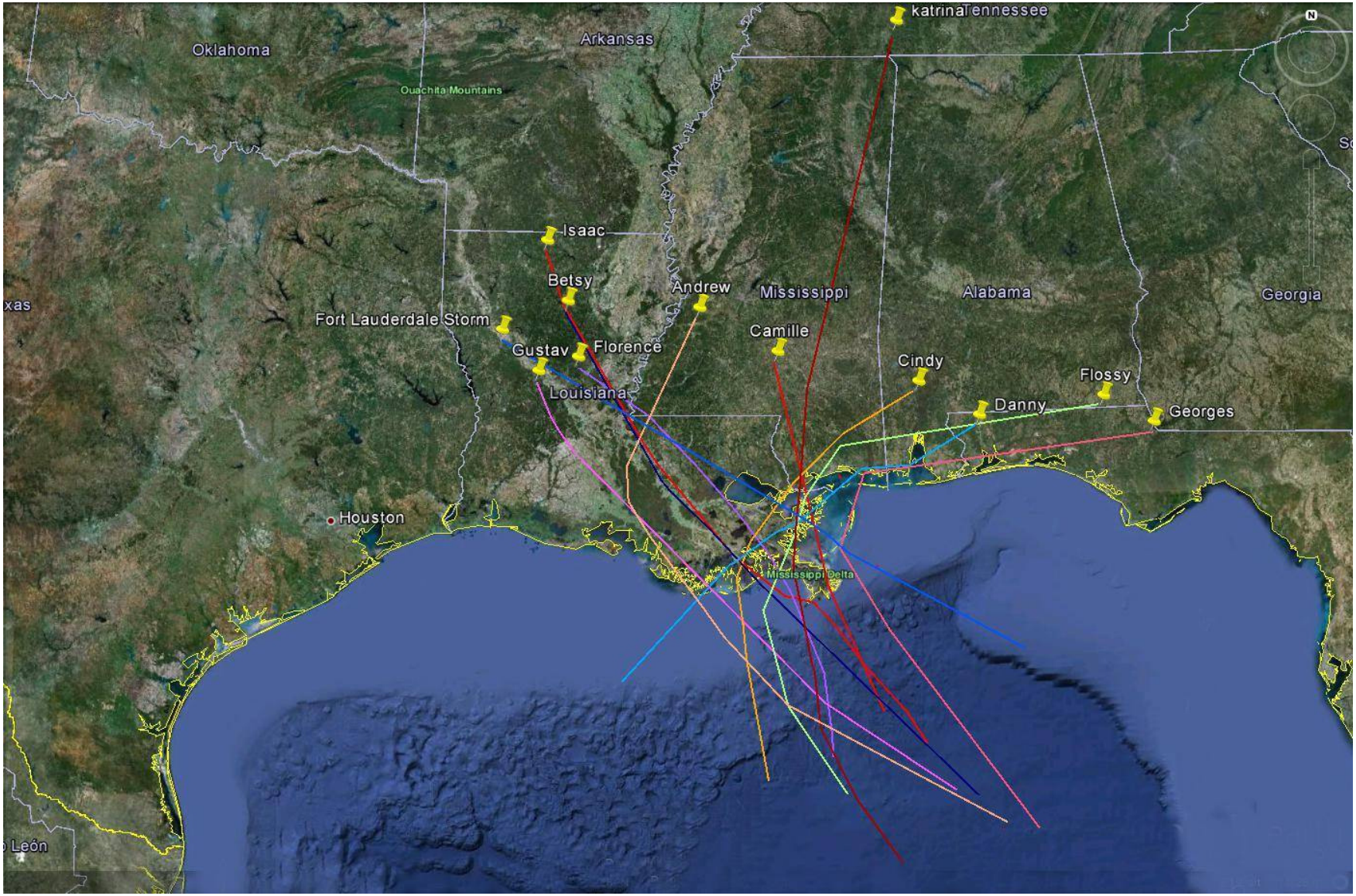
Hurricane Tracks



Sample Hurricanes

The sample hurricanes selected were chosen based upon their paths:

- Andrew, Betsy, Florence, Gustav, and the Fort Lauderdale storm were chosen as western influences.
- Camille, Flossy, Georges and Katrina, were chosen as eastern influences.
- Cindy and Danny were chosen as storms crossing from the west to the east to demonstrate their surge influences.
- All of these storms passed with in 60 miles of New Orleans.
- Size, speed, surge, and strength of each storm was compared.
- The surge of these storms was compared by height in Lake Borgne and Lake Pontchartrain.
- The sample storms represent all factors which are pertinent in the comparison.
- Over the past 65 years there have been other tropical storms and hurricanes that have taken the same general paths.

Speed of Hurricanes

The speed of the sample hurricanes from land fall inland for 24hrs:

Name	Speed	Distance traveled in 24 hrs
• Betsy	Avg.16.2 mph	384 miles
• Camille	Avg.15.5 mph	372 miles
• Ft. Lauderdale	Avg.15.0 mph	360 miles
• Katrina	Avg.15.0 mph	360 miles
• Gustav	Avg.11.3 mph	278 miles
• Flossy	Avg.11.0 mph	264 miles
• Florence	Avg.10.2 mph	247 miles
• Andrew	Avg. 9.1 mph	220 miles
• Georges	Avg. 9.0 mph	216 miles
• Danny	Avg. 9.0 mph	216 miles
• Cindy	Avg. 8.0 mph	192 miles
• Isaac	Avg. 7.0 mph	170 miles

- The average speed of the hurricanes studied was 12 mph.
- Larger storms have a tendency to move slower because of their size

Size of Sample Hurricanes

Name	Size in miles	From center Hurricane force winds	From center Tropical Storm winds
• Katrina	300 miles	140 miles	240 miles
• Andrew	210 miles	35 miles	75 miles
• Isaac	238 miles	35 miles	75 miles
• Florence	190 miles	40 miles	65 miles
• Gustav	180 miles	58 miles	120 miles
• Danny	180 miles	35 miles	100 miles
• Cindy	175 miles	45 miles	100 miles
• Flossy	170 miles	40 miles	100 miles
• Betsy	160 miles	65 miles	100 miles
• Camille	100 miles	20 miles	90 miles

Comparing Isaac to other Hurricanes

Size

- Hurricane Isaac covered a large surface area, approximately 200 miles.

Strength

- Hurricane Isaac's winds were not very intense, only reaching hurricane strength just before landfall. Most other storms were full fledged hurricanes long before they reached the coast. Hurricane Isaac was described by meteorologists as a poorly defined storm throughout it's travels across the Gulf of Mexico.

Speed

- Hurricane Isaac traveled slower than the average storm at landfall. According to the hurricane storm track, the storm stalled for about 3 hours off the mouth of the river. From landfall through the next 24 hours, Hurricane Isaac traveled about 178 miles. The average speed was about 7.1 mph. The slowest speed being about 5 mph and the maximum being about 8 mph during the 24 hour period.

Surge

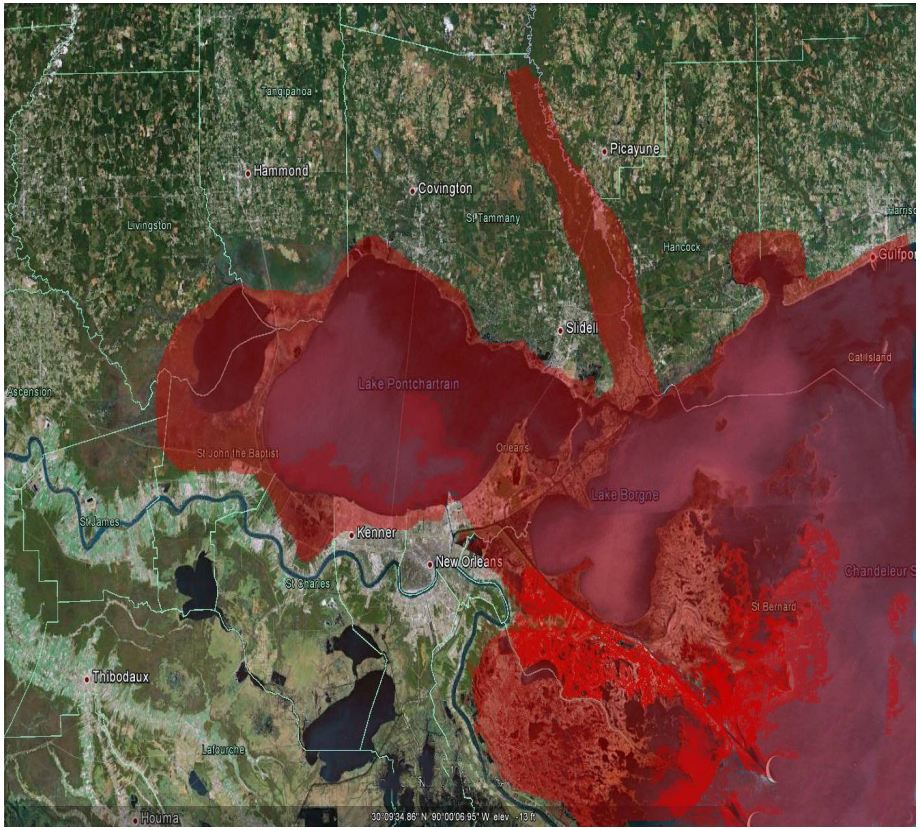
- Hurricane Isaac pushed an above average Cat.1 storm surge, when compared to previous storms of greater intensity. Flooding areas in the Lake Pontchartrain basin that have never flooded before.

Interesting Facts

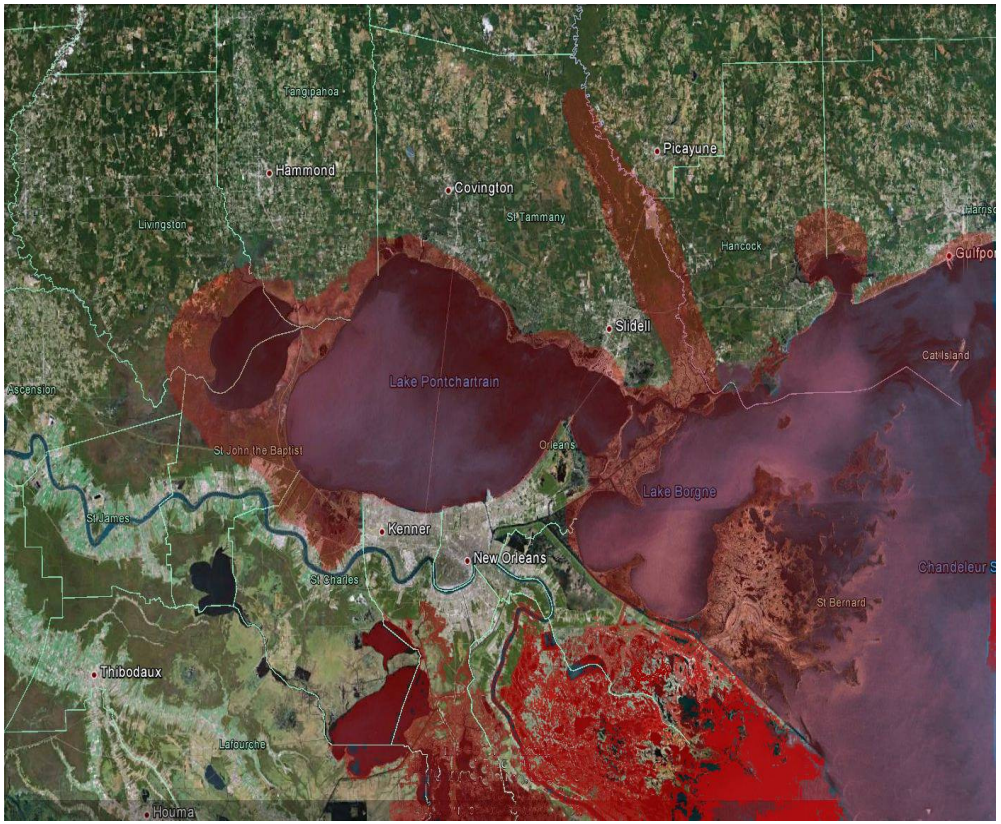
- In comparing the sample storms, the storm surges pushed into Lake Borgne and subsequently into Lake Pontchartrain were consistent throughout the 65 years of sample storms.
- This 65 year period covered a time frame with and without levee systems.
- The storm surge did not seem to decrease in Lake Pontchartrain even after the levees were built, however some indications show the surge height may have increased in the past few years.
- The method in which the storm surge enters and exits Lake Pontchartrain has changed over the past 65 years.
- Prior to 1965 Lake Pontchartrain had few low levee systems protecting the New Orleans and Jefferson areas.
- New Orleans East, from Parish Road eastward, was marshland for the most part and was in the flood plain.
- With the construction of the high level levee system by the Corps of Engineers and the raising of Hwy 90, the flood plain changed drastically.
- The storm surge is now re-directed by the levee system and forces the surge to only enter and exit through the Rigolets and Chef Pass.
- The surge begins to enter Lake Pontchartrain over several days, prior to the storm making landfall. The pre-surge is already in place when the eye-surge enters the lake, adding to the total of the surge.
- After the storm is inland, the wind shifts and all the surge water in the lake tries to exit through the only two openings, which are the Rigolets and Chef Pass. These two openings can not handle all this water at once, which helps to create flooding on the north and east shores of the lake.

Flood plains overview

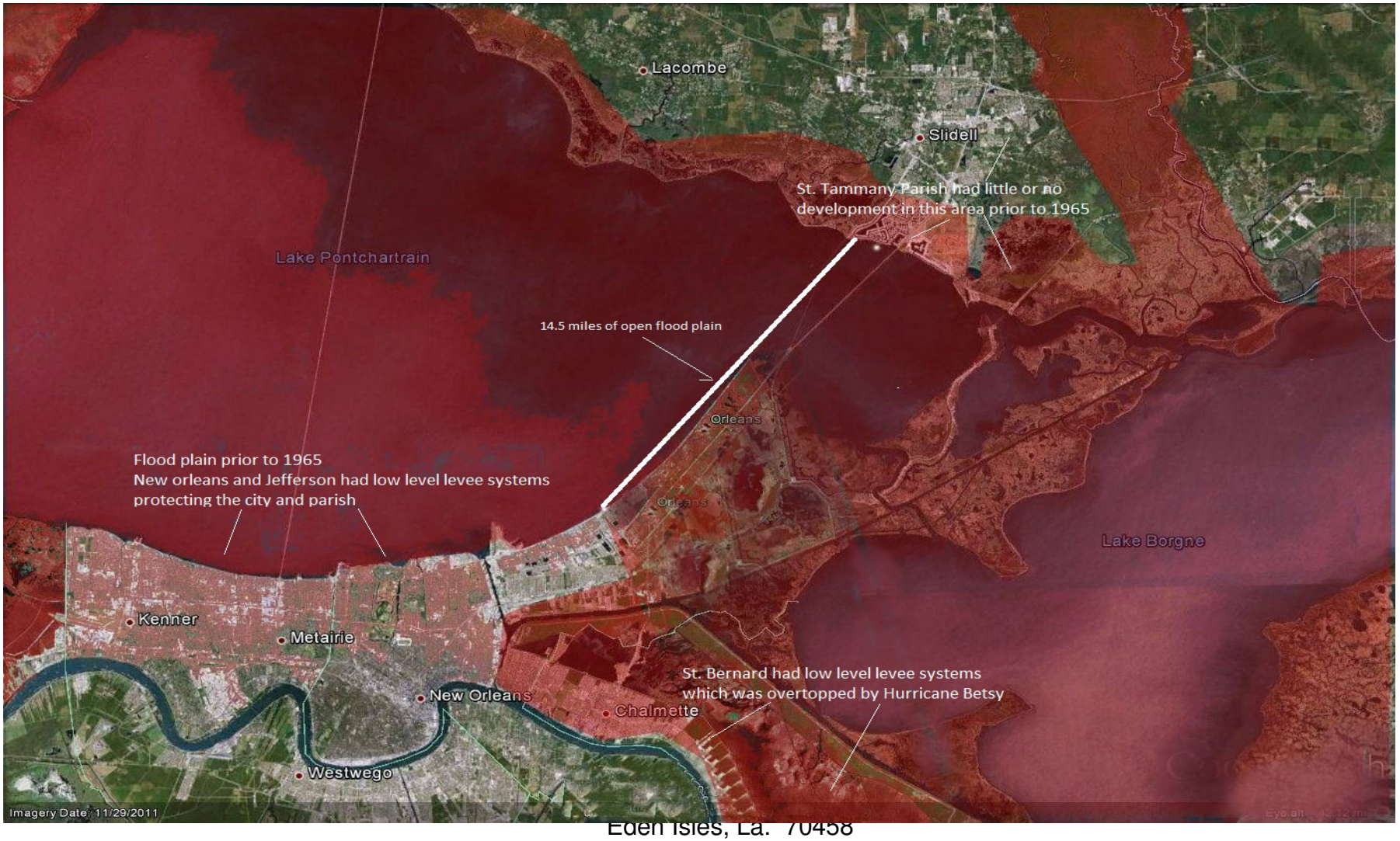
- Flood plain prior to 1965



Flood plain after 1978



Close up of flood plain prior to 1965



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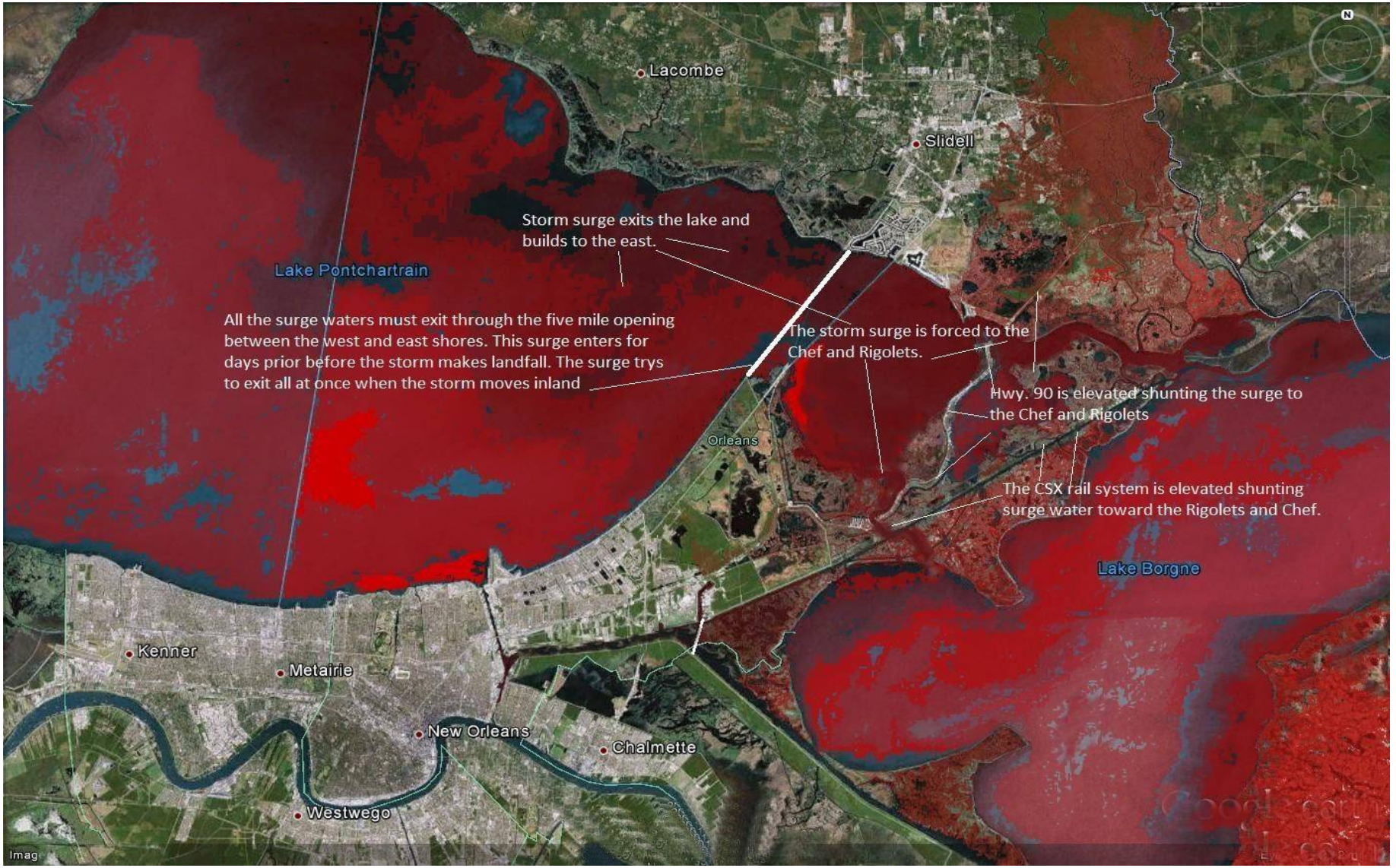
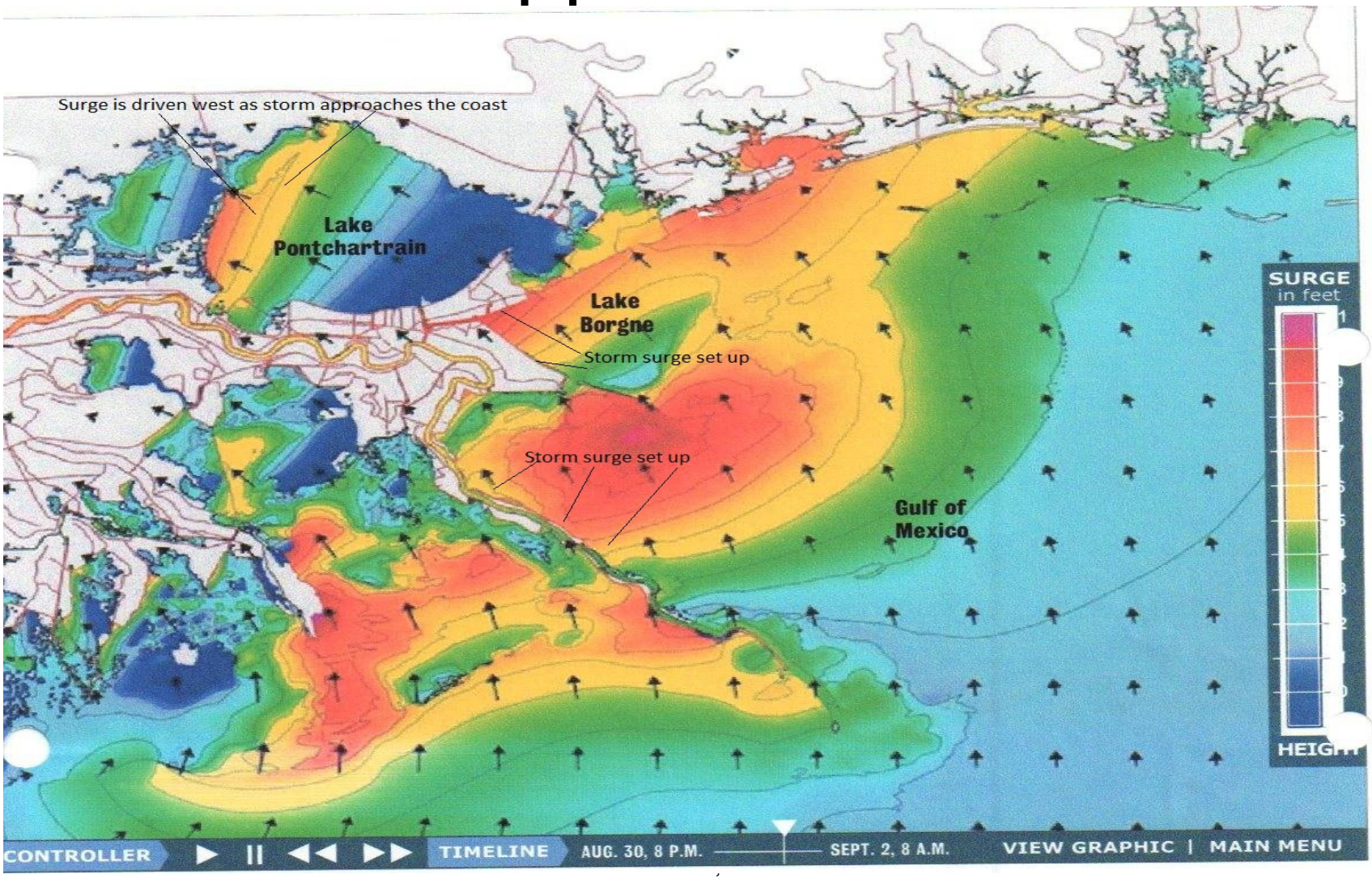
Close up of flood plain after 1965



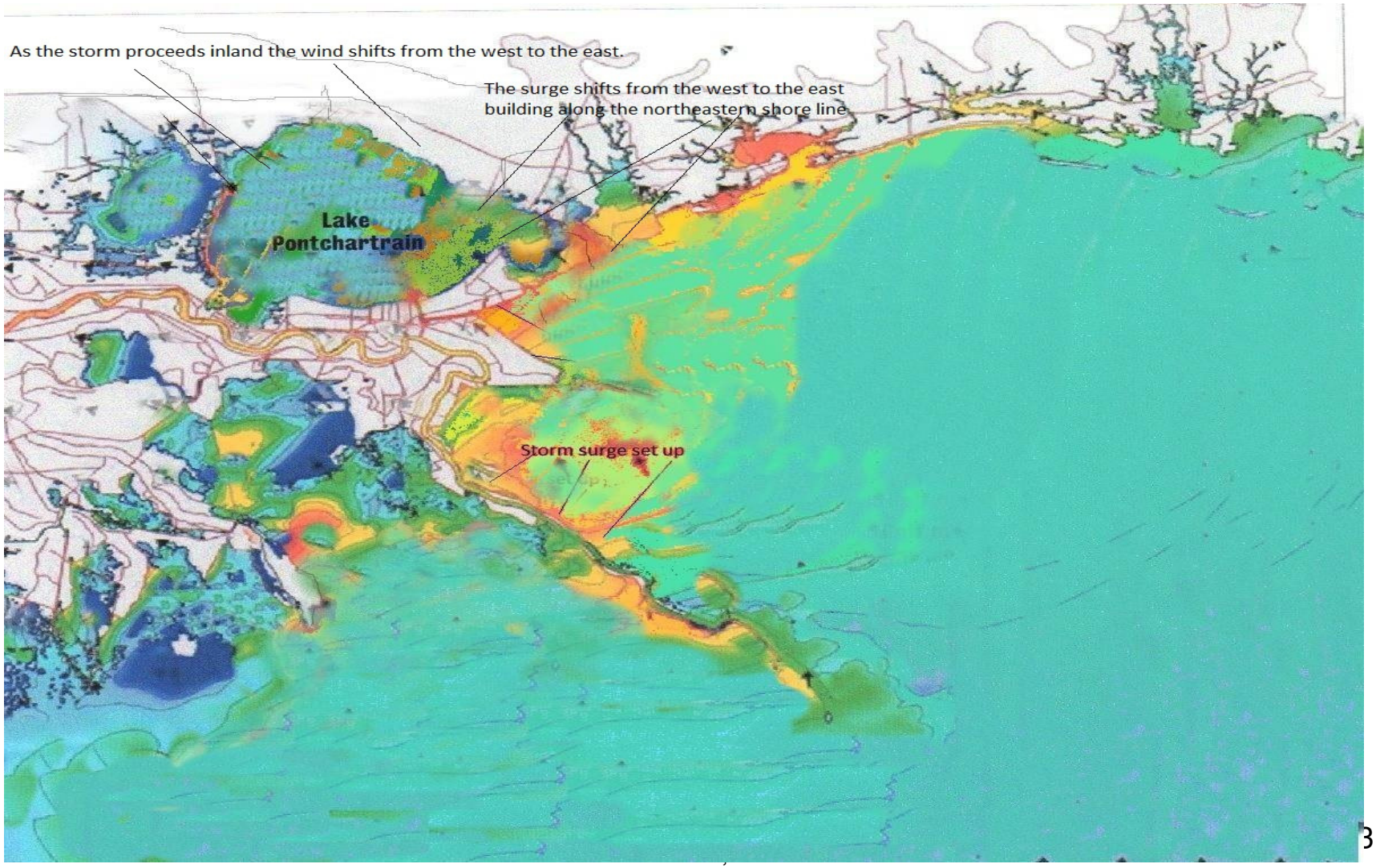
The storm surge set up

- Models and data involving storm surge shows that the easterly winds drive and holds the surge in place against the levees built to protect St. Bernard and Orleans parishes.
- The models show that the surge set-up is much higher against the levee, extending about 5 miles into Lake Borgne.
- This set-up forms a higher surge structure which creates a higher volume of water.
- This additional volume of water moves north and enters through the Chef Pass and Rigolets waterways.
- Subsequently adding more water to Lake Pontchartrain surge height.

The Storm surge set up as the hurricane approaches the coast



Surge shifts to the east as storm moves inland.



Questions

- How much of the total storm surge entering the lake is influenced by the levees protecting St. Bernard and Orleans?
- What would the difference in surge height be if there were no levee systems built?
- What modeling has been done to show the difference between the flood plain for Lake Pontchartrain prior to 1965 and after 1978?
- The Corps of Engineers has stated that the “Barrier Plan” would have an adverse effect on the surge, which enters the state of Mississippi. If this is the case, why doesn’t the levee systems they built to protect Orleans and St. Bernard have an adverse effect on the surge felt on the Lake Pontchartrain basin?
- If it can be shown that Corps projects have increase surge risk to the Lake Pontchartrain basin then can the Corps be forced to mitigate the damage similar to the fast tracking of the MRGO project?

Conclusion

- When storm surges enter and exit Lake Pontchartrain they are influenced by the levee systems; the magnitude of influence has yet to be determined.
- Pre-storm surge would not enter the Lake Pontchartrain basin if control structures at the Chef Pass and Rigolets were constructed.
- Control structures will also stop the storm surge up to the structures' height.
- In the 1960's the Corps concluded that the "Barrier Plan" was the most cost effective means to provide regional surge protection for 9 Parishes (Orleans, Jefferson, St. Charles, St. John, St. James, Livingston, Ascension, Tangipahoa and St. Tammany). In 2012 the Louisiana CPRA Master Plan came to the same conclusion.
- Congress approved Storm Surge Control structures at the Rigolets and Chef Menteur Pass under the flood Control Act of 1965; that approval has never been rescinded.
- The Corps has the ability to shift funding; the Corps shifted funding from the Rigolets and Chef Menteur Pass barriers to south shore projects and in 2012 the Corps is shifting funds from east bank projects to west bank protects. Therefore the Corps has the ability to shift funding to build Rigolets and Chef Menteur Pass structures.
- Most if not all of Isaac's storm surge flooding would not have occurred if control structures were in place.
- The Corps of Engineers has not shown proof that control structures would influence the surge entering inhabited areas of Mississippi or have an adverse environmental impact.

Resources

- Weather Underground Tropical storm archives
  www.wunderground.com
- Katrina graphics
- www.nola.com-Katrina-graphics-depths.swf.url
- The impact of La. Levees and marshlands on Katrina's surge
- www.AMS.confex.com
- ADcirc
- www.nd.edu-ADcric/examples
- Greater New Orleans Hurricane and Storm damage risk reduction system
- www.mun.usace.army.mil
- Lake Pontchartrain and Vicinity Servey
- www.iwr.usace.army.mil

Hurricane Isaac

- August 28, 2012

- Hurricane strength in gulf: Tropical storm then hurricane just before land fall
- Hurricane size: Hurricane winds extended out 40 miles & tropical storm winds extended out 190 miles
- Hurricane max. winds: 80 mph
- Hurricane strength at landfall: cat. 1
- Hurricane strength experienced in New Orleans: Tropical storm (less than 75 mph)
- Hurricane speed in gulf: avg.12 mph
- Hurricane speed at landfall: 6 mph; Stationary for about 3 hours along the coast
- Average speed for 24 hours inland: 7.1 mph
- Hurricane surge height in gulf: 14 ft.
- Hurricane surge height at landfall: 13 ft. east of the river
- Hurricane surge height in Lake Pontchartrain: 6.5 ft.
- Hurricane surge height in east St. Tammany Parish: 6.5 ft.

Hurricane Florence

- September 7, 1988

- Hurricane strength in gulf: Cat. 1
- Hurricane size: Hurricane winds extended out 30 miles & tropical storm winds extended out 95 miles
- Hurricane max winds: 80 mph
- Hurricane strength at landfall: cat. 1
- Hurricane strength experienced in New Orleans: Tropical storm
- Hurricane speed in Gulf: 13.2 mph
- Hurricane speed at landfall: 11 mph
- Hurricane surge height in Gulf: 12 ft.
- Hurricane surge height at landfall: 10 feet east of the river
- Hurricane surge height in Lake Pontchartrain: 6.0 ft.
- Hurricane surge height in east St. Tammany Parish: 4.5 ft.

Hurricane Andrew

- August 16, 1992

- Hurricane strength in Gulf : Cat. 4
- Hurricane size: Hurricane winds extended out 50 miles & tropical storm winds extended out 160 miles
- Hurricane max winds :145mph
- Hurricane strength at landfall: Cat. 3
- Hurricane strength experienced in New Orleans: Tropical Storm
- Hurricane speed in Gulf: 14 mph
- Hurricane speed at landfall: 9.5mph
- Hurricane surge height in Gulf: 15 ft
- Hurricane surge height at landfall: 10 ft east of the river
- Hurricane surge height in Lake Pontchartrain: 6.5 ft
- Hurricane surge height in east St. Tammany Parish: 4.5 ft

Hurricane Betsy

- September 14, 1964

- Hurricane strength in gulf: Cat. 4
- Hurricane size: Hurricane winds extended out 55 miles & tropical storm winds extended out 160 miles
- Hurricane max winds: 145 mph
- Hurricane strength at landfall: cat. 3
- Hurricane strength experienced in New Orleans: Cat. 2
- Hurricane speed in Gulf: 22 mph
- Hurricane speed at landfall: 19 mph
- Hurricane surge height in gulf 13 ft.
- Hurricane surge height at landfall: 10 ft. east of the river
- Hurricane surge height in Lake Pontchartrain: 7.5 ft.
- Hurricane surge height in east St. Tammany Parish: unknown; was not developed

Hurricane Gustav

- September 1, 2008

- Hurricane strength in gulf: Cat 2
- Hurricane size: Hurricane winds extended out 60 miles & tropical storm winds extended out 170 miles
- Hurricane max winds: 105mph
- Hurricane strength at landfall: Cat. 2
- Hurricane strength experienced in New Orleans: tropical storm
- Hurricane speed in gulf: 14 mph
- Hurricane speed at landfall: 12.5 mph
- Hurricane surge height in gulf: 12 ft.
- Hurricane surge height at landfall: 12 ft. east of the river
- Hurricane surge height in Lake Pontchartrain: 6.5 ft.
- Hurricane surge height in east St. Tammany Parish: 4.5 ft.

Hurricane Danny

- September 12, 1998

- Hurricane strength in gulf: Cat. 1
- Hurricane size: Hurricane winds extended out 35 miles & tropical storm winds extended out 100 miles
- Hurricane max winds: 80mph
- Hurricane strength at landfall: Cat. 1
- Hurricane strength experienced in New Orleans: Tropical Storm
- Hurricane speed in gulf: 11 mph
- Hurricane speed at landfall: 9 mph
- Hurricane surge height in gulf: 10 ft.
- Hurricane surge height at landfall: 9 ft. east of the river
- Hurricane surge height in Lake Pontchartrain: 5.5 ft.
- Hurricane surge height in east St. Tammany Parish: 4.2 ft.

Hurricane Cindy

- July 11, 2005

- Hurricane strength in Gulf: Cat. 1
- Hurricane size: Hurricane winds extended out 35 miles & tropical storm winds extended out 100 miles
- Hurricane max winds: 80mph
- Hurricane strength at landfall: Cat. 1
- Hurricane strength experienced in New Orleans: Tropical storm
- Hurricane speed in gulf: 9 mph
- Hurricane speed at landfall: 8 mph; hurricane surge height in Gulf 11 ft.
- Hurricane surge height at landfall: 8.5 ft. east of the river
- Hurricane surge height in Lake Pontchartrain: 5.0 ft.
- Hurricane surge height in east St. Tammany Parish: 4.0 ft.

Hurricane Katrina

- August 29, 2005

- Hurricane strength in gulf: Cat. 5
- Hurricane size: Hurricane winds extended out 90 miles & tropical storm winds extended out 200 miles
- Hurricane max winds: 170 mph
- Hurricane strength at landfall: Cat. 3
- Hurricane strength experienced in New Orleans: Hurricane force
- Hurricane speed in gulf: 13 mph
- Hurricane speed at landfall: 15 mph
- Hurricane surge height in gulf: 16 ft.
- Hurricane surge height at landfall: 26 ft. east of the river
- Hurricane surge height in Lake Pontchartrain: 14.4 ft.
- Hurricane surge height in east St. Tammany Parish: 13.2 ft.

Hurricane Georges

- September 28, 1998

- Hurricane strength in gulf: Cat. 2
- Hurricane size: Hurricane winds extended out 28 miles & tropical storm winds extended out 90 miles
- Hurricane max winds: 110 mph
- Hurricane strength at landfall: Cat. 2
- Hurricane strength experienced in New Orleans: Tropical storm
- Hurricane speed in gulf: 10 mph
- Hurricane speed at landfall: 9 mph
- Hurricane surge height in gulf: 12 ft.
- Hurricane surge height at landfall: 11 ft. east of the river
- Hurricane surge height in Lake Pontchartrain: 5.8 ft.
- Hurricane surge height in east St. Tammany Parish: 4.2 ft.

Hurricane Camille

- August 18, 1969

- Hurricane strength in Gulf: cat. 5
- Hurricane size: Hurricane winds extended out 25 miles & tropical storm winds extended out 100 miles
- Hurricane max winds: 190mph
- Hurricane strength at landfall: cat. 5
- Hurricane strength experienced in New Orleans: Tropical Storm
- Hurricane speed in Gulf: 16 mph
- Hurricane speed at landfall: 15 mph
- Hurricane surge height in Gulf: 21 ft
- Hurricane surge height at landfall: 21 ft. east of the river
- Hurricane surge height in Lake Pontchartrain: 6.0 ft.
- Hurricane surge height in east St. Tammany Parish: 5.2 ft.

Hurricane Flossy

- September 28, 1956

- Hurricane strength in gulf: Cat. 1
- Hurricane size: Hurricane winds extended out 28 miles & tropical storm winds extended out 96 miles
- Hurricane strength at landfall: Cat. 1
- Hurricane strength experienced in New Orleans: Tropical storm
- Hurricane speed in gulf: 12 mph
- Hurricane speed at landfall: 11 mph
- Hurricane surge height in gulf: 14 ft.
- Hurricane surge height at landfall: 14 ft. east of the river
- Hurricane surge height in Lake Pontchartrain: 4.8 ft.
- Hurricane surge height in east St. Tammany Parish: unknown; not built then

Fort Lauderdale Hurricane

- September 20, 1947

- Hurricane strength in gulf: Cat. 1
- Hurricane size: Hurricane winds extended out 35 miles & tropical storm winds extended out 150 miles
- Hurricane max winds: 90 mph
- Hurricane strength at landfall: Cat. 1
- Hurricane strength experienced in New Orleans: Cat. 2
- Hurricane speed in gulf: 16 mph
- Hurricane speed at landfall: 15 mph
- Hurricane surge height in gulf: 12 ft.
- Hurricane surge height at landfall: 11.2 ft. east of the river
- Hurricane surge height in Lake Pontchartrain: 9.8 ft.
- Hurricane surge height in east St. Tammany Parish: unknown; not built then