United States Department of the Interior
National Park Service

National Register of Historic Places Registration Form

This form is for use in nominating or requesting determinations for individual properties and districts. See instructions in National Register Bulletin, *How to Complete the National Register of Historic Places Registration Form*. If any item does not apply to the property being documented, enter "N/A" for "not applicable." For functions, architectural classification, materials, and areas of significance, enter only categories and subcategories from the instructions. **Place additional certification comments, entries, and narrative items on continuation sheets if needed (NPS Form 10-900a).**

1. Name of Property

historic name New Orleans Levee Breach Sites–17th Street and Inner Harbor Navigation Canals
other names/site number Breach Site of the 17th Street Canal (Metairie Outlet Canal/Upperline Canal) and East Side North Breach of the Inner Harbor Navigation Canal (IHNC)

2. Location

street & number 6900 block of Bellaire Drive, Lakeview Area
2400 Block of Surekote Road, Lower Ninth Ward Area
NA not for publication
X vicinity

city or town New Orleans

state Louisiana code LA county Orleans code 071 zip code 70124, 70117

3. State/Federal Agency Certification

As the designated authority under the National Historic Preservation Act, as amended,

I hereby certify that this **x** nomination ___ request for determination of eligibility meets the documentation standards for registering properties in the National Register of Historic Places and meets the procedural and professional requirements set forth in 36 CFR Part 60.

In my opinion, the property _x_ meets ___ does not meet the National Register Criteria. I recommend that this property be considered significant at the following level(s) of significance:

x national ___ **statewide** __**local**

Pam Breaux, State Historic Preservation Officer
Signature of certifying official/Title Date

Louisiana Department of Culture, Recreation and Tourism
State or Federal agency/bureau or Tribal Government

In my opinion, the property ___ meets ___ does not meet the National Register criteria.

Signature of commenting official Date

Federal Preservation Officer U.S. Army Corps of Engineers
Title State or Federal agency/bureau or Tribal Government

4. National Park Service Certification

I hereby certify that this property is:

___ entered in the National Register
___ determined eligible for the National Register
___ determined not eligible for the National Register
___ removed from the National Register
___ other (explain:) _____

Signature of the Keeper Date of Action

New Orleans Levee Breach Sites–17th Street and Inner Harbor Navigation Canals
Name of Property

Orleans Parish, LA
County and State

5. Classification

Ownership of Property
(Check as many boxes as apply.)

	private
x	public - Local
	public - State
x	public - Federal

Category of Property
(Check only **one** box.)

	building(s)
	district
x	site
	structure
	object

Number of Resources within Property
(Do not include previously listed resources in the count.)

Contributing	Noncontributing	
		buildings
		district
2		site
		structure
		object
2	0	**Total**

Name of related multiple property listing
(Enter "N/A" if property is not part of a multiple property listing)

NA

Number of contributing resources previously listed in the National Register

0

6. Function or Use

Historic Functions
(Enter categories from instructions.)

Government/Public Works

Current Functions
(Enter categories from instructions.)

Government/Public Works

7. Description

Architectural Classification
(Enter categories from instructions.)

NA

Materials
(Enter categories from instructions.)

foundation:
walls:
roof:
other: Earth, concrete, and steel

Narrative Description

(Describe the historic and current physical appearance of the property. Explain contributing and noncontributing resources if necessary. Begin with **a summary paragraph** that briefly describes the general characteristics of the property, such as its location, setting, size, and significant features.)

Summary Paragraph

This nomination focuses upon two sites where earthen levees and flood walls breached (failed) catastrophically in the City of New Orleans, (Orleans Parish, Louisiana) on August 29, 2005 as pressure loads due to storm surge occurred resulting from the winds of Hurricane Katrina. One site is located on the 17th Street Canal adjacent to the 6900 block of Bellaire Drive along the western edge of the City in the Lakeview neighborhood. This canal is a drainage channel that provides for flows from the central portion of the city to Lake Pontchartrain on the north. The second site, located on the east side of the Inner Harbor Navigation Canal (IHNC) is adjacent to the 2400 block of Surekote Road (parallel to Jourdan Road) in the southeastern portion of the City. The IHNC connects Lake Pontchartrain to the Mississippi River, and forms the boundary between the Lower and Upper Ninth Ward neighborhoods. The nominated areas include only the locations of the actual breach sites; they do not include the city-wide drainage, flood protection, and navigation systems of which the sites are a part. Despite the subsequent reconstruction of the levees and floodwalls, the breach sites are easily identifiable. Thus, their integrity and National Register eligibility remain intact.

Narrative Description

Description of Levee/Floodwall Breaches of Canals

Before Hurricane Katrina, at the sites of both breaches, the canals were bounded by protective levees (sloped earthen walls) with steel sheet pilings driven from the tops (crowns) into the ground to a depth of between 10 and 50 feet. The sheet pilings were capped with concrete above the ground and were called floodwalls.

The original size of the 17th Street Canal breach was 30 feet. This occurred when one 30-foot long monolith (concrete capped section of sheet pile) was pushed toward the protected side by the water pressure in the canal thus creating the initial 30-foot wide breach. The ensuing deluge of floodwater caused more monoliths to fail resulting in a 450-foot wide gap. The hydraulic force was so great that it completely obliterated the levee, the sheet pilings and the soil that supported them.

The east side north breach of the IHNC failed in a nearly identical manner except that the final size of the breach was slightly narrower (250 feet) and the sheet pilings came to rest in a dramatic way because they remained interconnected and looked like a giant metal grosgrain ribbon. As Robert Bea and Diego Cobos-Roa explain in an article in the Electronic Journal of Geotechnical Engineering,

> The movement and resting place of the sheet pile indicates that the supporting levee and foundation materials were washed away beneath the sheet pile and the water force pushed away the steel sheet piles and twisted them until a section of the sheet piles rotated 90 degrees – against the rising surge waters in the IHNC.[1]

Current Description of Canal Breach Sites:

In New Orleans, levees are sloped, earthen embankments that prevent water from flooding the bordering lands. There are levees along the Mississippi River, Lake Pontchartrain and along hundreds of miles of navigation and drainage canals. In areas like New Orleans, where it is known or feared that water levels will rise higher than the adjacent land, levees are often supplemented and their heights extended by means of more structural components comprised of concrete and steel. Most of the navigation, drainage, and flood protection canals have been enhanced by embedding sheet piling and concrete caps called I-walls (see Figure 1) to a depth of between 10 and 50 feet and rising between 2 and 10 feet higher than the earthen levees.

[1] Robert Bea and Diego Cobos-Roa, "Failure of the I-Wall Flood Protection Structures at the New Orleans Lower 9th Ward During Hurricane Katrina," *Electronic Journal of Geotechnical Engineering,* Volume 13 Bundle H (2008): 7.

Post Katrina, the repaired breach site of the 17th Street Canal and east side north breach site of the Inner Harbor Navigation Canal consist of new flood walls in the T-wall design rather than I-wall design. A T-wall is a reinforced concrete structure supported by foundation pilings with a non-structural steel sheet pile assembly beneath the levee. T-walls are not typically earth supported, are a significantly sturdier design, and are also three or more times more expensive to build than I-walls. (See Figure 1 for a visual representation of I-walls, T-walls, and their differences.)

At both breach sites, the earthen levees rise about 10 feet high from the ground beneath them to the crowns (levee tops) and are about 50 – 75 feet wide from the land side of the levee to the water side at ground level. At both sites, the visible parts of the T-walls installed post flood are similar in scale to the original I-walls installed pre-flood. However, they are easily differentiated from the remaining, older parts of the floodwalls, as is visible in the attached photographs.

The east side north breach of the IHNC, one of the subjects of this nomination, must not be confused with a second breach that occurred in the same neighborhood just to the south. This other breach was highly photographed in the weeks after Katrina, because a large barge, the ING 472 had been pushed through the breach by hurricane winds and had beached upon a small school bus. However, the subject of this nomination is the north breach.

When viewing the rebuilt levee and floodwall on the 17TH Street Canal from the land side of the canal, the new levee and floodwall (T-wall) is a different texture and a different color from the adjacent I-wall. When viewed from above, the new T-wall is two feet thicker in width than the adjacent I-wall. At the Inner Harbor Navigation Canal, when the floodwall is viewed from the land side of the levee, the new T-wall can easily be differentiated from the older I-wall because it is two feet higher. Like at the 17TH Street Canal, when viewed from above, the new T-wall is two feet thicker in width.

At both breach site locations, the adjacent land is vacant of homes and buildings. In the vacant area, many foundations or slabs where homes once stood are all that remain. At both areas, all trees have been removed either due to the initial flooding or due to removal by governmental agencies post Katrina.

Historic Description of Canal Breach Sites

The 17th Street Canal is the largest and most important drainage canal for the city of New Orleans and is capable of moving approximately 10,000 cubic feet of water per second. The canal is usually 100 feet wide but is narrowed to about 60 feet in places where bridges and other elements are located. It is about 10 feet deep and extends over 2 ½ miles south from Lake Pontchartrain along the west edge of the main basin of the city to a point where it accepts flow from Pump Station #6. Pump Station #6 is in the canal right of way near the intersection of Orpheum and Frisco avenues on the north side of the Metairie Ridge.

The Sewage and Water Board's Pump Station #6 moves over 9,000 cubic feet per second from the south side to the north side of that pump station. Other pump stations in the vicinity of the canal collect water from nearby areas of New Orleans and Metairie (an adjacent suburb), and discharge flow into the canal north of Pump Station #6, for the total potential flow in the 17th St. Canal of about 10,000 cubic feet per second.

The 17th Street Canal extends about another mile further into the main basin south of Pump station #6 along the same alignment where it joins to and accepts drainage water flow from two other canals. One of these canals conveys flow from Metairie and nearby neighborhoods into the 17th Street Canal. The other is almost 2 miles long and accepts flow from surrounding neighborhoods and from a pump station that handles the drainage from nearly all of the Uptown areas, some of Downtown, and other neighborhoods in the city's main basin. A series of street drains, culverts and large box culverts (underground canals) provide a way for rainwater to travel from neighborhoods to the series of pump stations and canals and ultimately to Lake Pontchartrain.

The floodwall enhancements built into the earthen levees of the 17th Street Canal following Hurricane Betsy (1965) and prior to Hurricane Katrina (2005) were made up of an above-and below-ground I-wall structure which rose to an average height of seven feet above the crown of the levee (see Figure 1). The enhancements are designed to increase the height of an earthen levee when additional real estate necessary to construct even

larger earthen levees is difficult to acquire. The concrete and steel floodwalls were often used to achieve increased crest height without the extra weight of additional earthen levee fill, and/or without the need to widen the earthen levee embankment section.

The Inner Harbor Navigational Canal (IHNC) (also known locally as the Industrial Canal) is a 5.5 mile long navigation canal which connects Lake Pontchartrain to the Mississippi River via a lock located near the latter. It allows for the transit of large cargo ships and barges into the City of New Orleans. The IHNC from Lake Pontchartrain to the lock near the Mississippi River was constructed with a 30 foot depth. At the lake end of the canal, the width is 300 feet; at the lock near the Mississippi River its width is approximately150 feet. The lock system to connect the river with the lake has gates, a width of 74 feet, and a depth of 50 feet, with a capability to function to up to 20 feet in difference of levels between the river and lake. Like those of the 17th Street Canal, the earthen levees of the IHNC were enhanced with floodwalls constructed in the I-wall design.

The IHNC separates eastern New Orleans from the rest of the city of New Orleans and separates the Lower 9th Ward neighborhood from the Upper 9th Ward neighborhood. Approximately half of the waterway's length, from the Industrial Lock on the Mississippi River to a point north of the Florida Avenue Bridge, is confluent with the Gulf Intracoastal Waterway (GIWW).

Pre-Katrina, the areas immediately in front of both breach sites were dense thriving neighborhoods, primarily of owner-occupied single dwellings. The portion of the Lakeview neighborhood directly affected by the catastrophic flooding of the 17th Street Canal was a predominantly white middle to upper class neighborhood with homes filling the area right up to the canal floodwall. Huge oak and pecan trees graced the yards of these homes, and were found throughout the neighborhood as well. At the IHNC, homes also filled the immediate vicinity of the breach site. A dense early 20th century neighborhood of primarily African American lower to middle class homeowners was built right up to near the navigational canal's walls. There were also huge oak and cypress trees in the yards of the homes and throughout the neighborhood.

Integrity

Introduction

The areas under consideration for nomination to the National Register are the breach site located at the 17th Street Canal and the site known as the east side, north breach of the Inner Harbor Navigation Canal. The drainage, flood protection, and navigation systems of which the sites are a part are not under consideration for nomination. The SHPO believes both nominated sites to have sufficient integrity to qualify for National Register nomination.

The seven aspects of integrity recognized by the National Register apply to all candidates for listing. However, the importance of each factor will change depending upon the type of resource being nominated and the Eligibility Criteria under which it qualifies. In the case of the 17th Street Canal and east side, north Inner Harbor Navigation Canal levee breach sites, the integrity factors of prime importance are Location, Association, Setting, and Feeling. These factors are closely related, and in the case of Setting and Feeling, are difficult to separate.

For the sites to retain integrity, vestiges of these physical features as they existed before the Katrina flooding must remain on the landscape. Only by viewing these features is it possible to visualize how the breach and flood events impacted the neighborhoods or to understand the importance of the improvements to levee/floodwall policy and practice that followed. (The latter are discussed in detail in Part 8.) To provide the necessary background for evaluating the seven aspects of integrity, a brief description of the original settings follows.

Prior to August 29, 2005, the historic setting of each breach site consisted of an urban neighborhood bounded on the east by a levee/floodwall protecting it from a large, powerful waterway. Each neighborhood included a street grid, mature vegetation, and multiple residences, most of which were single family homes standing on individual lots. At the 17th Street Canal that neighborhood was part of the Lakeview subdivision and consisted of middle and upper class homes. The neighborhood included several blocks containing houses standing parallel and adjacent to the drainage canal built to move water from the city to Lake Pontchartrain. On these blocks, the floodwall formed each lot's rear property line. At the INHC, the neighborhood was part of the Lower 9th Ward. It consisted of early twentieth century homes owned mainly by African American members of New Orleans' lower and middle classes. Like at the 17th Street Canal, this neighborhood contained a series of properties (houses on individual lots) for which the navigation canal's floodwall formed the rear property line.

Each floodwall consisted of a tall concrete and steel structure standing atop a purpose-built compacted earthen berm. Despite its location behind the houses it paralleled, each levee and accompanying floodwall visually dominated its site. At the 17th Street Canal site, the waterway flowed directly adjacent to the western face of the floodwall, which literally prevented it from flooding the neighborhood. This water usually reached heights above that of the nearby land. At the Inner Harbor Navigation Canal, a parcel of vacant land normally occupied the space between the floodwall's western face and the canal's bank. During flooding episodes the waterway would expand over the vacant land until it reached the floodwall, and then would rise up the wall until it was above the height of the land on the barrier's opposite side. The presence of both walls made residents and visitors well aware of the power and potential destructive force being held at bay, even though neither waterway could be seen from the developed side of its floodwall.

Location

The candidates being nominated have integrity of location because they are the actual sites where the historic events (the breaches of the 17th Street Canal and east side, north Inner Harbor Navigation Canal levee/floodwall s) occurred.

Association

The candidates also have integrity of association because they have a direct link to the historic events (levee/floodwall breaches) which are the basis of their nomination. They are the places where the events occurred. Because enough physical features survive to convey historic character, these sites are sufficiently intact to communicate that relationship to an observer.

Setting and Feeling

At these sites, Setting and Feeling are closely related because it is the setting that creates the feeling of the historic events and time. Thus, these characteristics of Integrity should be discussed simultaneously.

Today most of the features that make up the Setting and contribute to the Feeling survive with their integrity intact at both sites. The Katrina flooding damaged or destroyed block after block of dwellings. In Lakeview, many concrete slabs are all that remain of the homes. In the Lower 9th Ward, many buildings were washed off their pier foundations and floated several blocks away. However, the street grids remain intact; and enough houses have been rebuilt or repaired to convey the urban and residential character of the areas. Nevertheless, only concrete slabs remain on many lots. Additionally, a conscious decision has been made not to rebuild the homes which stood closest to the 17th Street Canal breach. Furthermore, as of this writing, no rebuilding has occurred at the Inner Harbor Navigation Canal east side, north breach site. The large holes in the cityscape of both neighborhoods, plus the presence of dead but un-removed vegetation, contribute to the awareness that a historic catastrophic event occurred there. Of course, both waterways remain in place, as do their accompanying levees and floodwalls. The latter continue to dominate the landscape visually, especially in the areas directly adjacent to the breaches where the land remains vacant. In short, a visitor's awareness of the events of August 29, 2005, is a direct result of the surviving components of the settings. Thus, the integrity aspects of Setting and Feeling retain enough integrity to contribute to the National Register eligibility of the candidates.

Design

The design of the repaired floodwalls is admittedly different from that of the original floodwalls that failed. This is a result of numerous engineering studies that have found the newer T-wall design to be stronger, and thus safer, than the previously used I-wall design. The State Historic Preservation Office believes that the difference in design is critical to understanding the need for upgrades in levee floodwall policy and practice occasioned by the Katrina breaches and floods. Additionally, this design difference reinforces the sense of location. The new walls are slightly wider, and the points at which they join the remaining walls and abut the levee are constructed differently. It is these differences that allow the visitor to identify the specific locations of the breaches and comprehend their size.

Materials

The two breach locations lack integrity of Materials because the original floodwalls standing at the sites on August 29, 2005, were destroyed. The materials used in the replacement walls are slightly different in color from the originals. However, this inconsistency, like the difference in design, reinforces the sense of location because it helps to differentiate the breach sites from the surviving floodwalls.

Workmanship

Because the original floodwalls at both sites were destroyed, the resources do not retain integrity of Workmanship. Additionally, when comparing the historic and replacement portions of the floodwalls, differences in workmanship are not visible. One distinguishes between the old and new because of design rather than workmanship. Thus, this aspect is the least important of the seven aspects of integrity that must be evaluated for National Register eligibility.

Conclusion

As can be understood from the above discussion, the sites of the 17th Street Canal and Inner Harbor Navigation Canal floodwall breaches retain integrity in several important aspects of this National Register eligibility requirement. There is no doubt that a person visiting these sites today would understand that an event of extraordinary historical significance occurred at these locations. This opinion is based on an inspection performed and documented by the Louisiana State Historic Preservation Office on September 29, 2010, and reconfirmed via a second visit on December 12, 2011. In conclusion, it is the professional opinion of the Louisiana SHPO that both sites retain sufficient integrity to qualify for Register listing.

New Orleans Levee Breach Sites–17th Street and Inner Harbor Navigation Canals
Name of Property

Orleans Parish, LA
County and State

8. Statement of Significance

Applicable National Register Criteria
(Mark "x" in one or more boxes for the criteria qualifying the property for National Register listing.)

- [X] A Property is associated with events that have made a significant contribution to the broad patterns of our history.
- [ ] B Property is associated with the lives of persons significant in our past.
- [ ] C Property embodies the distinctive characteristics of a type, period, or method of construction or represents the work of a master, or possesses high artistic values, or represents a significant and distinguishable entity whose components lack individual distinction.
- [ ] D Property has yielded, or is likely to yield, information important in prehistory or history.
- [ ] Not applicable

Criteria Considerations
(Mark "x" in all the boxes that apply.)

Property is:

- [ ] A Owned by a religious institution or used for religious purposes.
- [ ] B removed from its original location.
- [ ] C a birthplace or grave.
- [ ] D a cemetery.
- [ ] E a reconstructed building, object, or structure.
- [ ] F a commemorative property.
- [X] G less than 50 years old or achieving significance within the past 50 years.
- [ ] Not applicable

Areas of Significance
(Enter categories from instructions.)

Other: Disaster (Levee Breaches)

Period of Significance

August 29, 2005

Significant Dates

August 29, 2005

Significant Person
(Complete only if Criterion B is marked above.)

NA

Cultural Affiliation

NA

Architect/Builder

United States Army Corps of Engineers

Period of Significance (justification)

The period of significance is August 29, 2005, the date of Hurricane Katrina and the subsequent flooding of New Orleans.

Criteria Considerations (explanation, if necessary)

The 2005 breaches of the 17th Street Canal and Inner Harbor Navigation Canal floodwalls, important components of the New Orleans drainage, flood protection, and navigation systems, meet Criteria Consideration G for Exceptional Significance because, as the American Society of Civil Engineers' Hurricane Katrina External Review Panel wrote in its June 2007 report, "…the failures in New Orleans' hurricane protection system constitute one of the worst catastrophes ever to befall this country. The flaws uncovered as a result of Hurricane Katrina must serve as a sobering reminder to engineers everywhere that their work has life-or death implications."[2] With regard to the loss of life and property, only the Johnstown, Pennsylvania flood of 1889, the Galveston, Texas hurricane of 1900, and the San Francisco, California earthquake and subsequent fire of 1906 caused as much destruction and suffering as the New Orleans flood of 2005.

According to geotechnical engineers Robert Bea and Diego Cobos-Roa, these two breaches, triggered by Katrina's storm surge, were part of a pervasively flawed flood defense system for the Greater New Orleans area.[3] The short term impacts of the disaster included the flooding of over 80% of the city and 100% of nearby St. Bernard Parish, the deaths of over 2,000 people (directly and indirectly), destruction of approximately $150 billion worth of private property and municipal infrastructure, widespread deforestation due to salt water intrusion, and the temporary and permanent displacement of hundreds of thousands of people who had lost or could no longer live in their homes.

Although one cannot gauge the total long term impact of the catastrophic flooding event for New Orleans and its environs at this time, several important changes in national flood control policies and practices have been implemented. The New Orleans levee and floodwall breaches prompted an immediate national levee inventory which identified levees in danger of imminent failure, recommendations for a National Levee Safety Program, the creation of updated national flood zone maps which led to changes in the National Flood Insurance Program (NIFP), passage of state flood control legislation in Louisiana, California and Texas and the passage of reform measures impacting practices by the U.S. Army Corps of Engineers. These policy changes have national implications for 55% of the American population who live in counties protected by levees.[4]

The long-term national impacts will be discussed in more detail in the Significance Statement.

Statement of Significance Summary Paragraph (Provide a summary paragraph that includes level of significance and applicable criteria.)

Note: A master map depicting locations of the most important sites discussed in the following narrative is included in this document as Figure 2.

The levee breach of New Orleans' 17th Street Canal floodwall and the east-side north levee breach of the Inner Harbor Navigation Canal floodwall are nationally significant under Criterion A: Event in the area of Other: Disaster (Levee Breaches) because according to expert geotechnical engineer Raymond M. Seed, the flooding during Katrina was the worst civil engineering catastrophe in our nation's history to date.[5] Additionally, it caused significant, and in some cases potentially life-saving, changes to the nation's flood control policies and practices.

On August 29, 2005, the period of significance for these events, Hurricane Katrina passed to the east of New Orleans, causing storm surge from the Gulf of Mexico and Lake Pontchartrain to move into the canals forming the city's drainage, flood protection and navigation systems. These canals were bounded by protective levees (sloped earthen walls) often with steel sheet pilings driven from the tops (crowns) into the ground to a depth of between 10 and 50 feet. Most of the sheet pilings were capped with concrete above the ground and were

[2] Andersen Battjes and others, *New Orleans Hurricane Protection System, What Went Wrong and Why*, (Reston VA, American Society of Civil Engineers, 2007), 80.
[3] Bea and Cobos-Roa, 1.
[4] Response to Request under FOIA – FEMA 09-325 September 18, 2009.
[5] Ray M. Seed, Letter to American Society of Civil Engineers (October 30, 2007), 2.

called floodwalls. (See Figure 1) These levees and floodwalls breached (failed) in more than 50 locations across the metropolitan area. (See Figure 3) The result of the flooding was approximately 2,000 deaths (immediate, delayed, on-site, off-site) and total costs estimated to exceed U.S. $150 billion (direct, indirect, immediate, delayed, on-site, off-site). By 2008, there were more than $2 trillion in Katrina flood damage claim lawsuits in New Orleans Federal District Court.[6]

The breaches of the 17th Street and Inner Harbor Navigation canals are deemed among the most significant of the levee and floodwall failures, and are the subjects of this nomination, for the following reasons:

Because of its size and location in central New Orleans, the 17th Street Canal is the largest and most important drainage canal in the city. Moving water pushed by the pumps in Pumping Station #6, it conveys rainwater away from the city and into Lake Pontchartrain. The breach of this canal is significant because the resulting floodwaters rendered the canal's pump station ineffectual, preventing it from pushing the storm surge waters back into Lake Pontchartrain and stopping it from removing any water from the city's main basin. Had the floodwall not breached, the main basin of the city might have been spared much of the serious flooding that resulted.

The east side north breach of the Inner Harbor Navigation Canal is significant because, due to the large size of the navigation channel coupled with the localized high level of storm surge, the resulting flooding may have been the most violent caused by the hurricane protection and navigation systems failures. In addition, the adjacent neighborhood it affected -- due to media coverage – quickly became the "face" of the catastrophic event.

The two locations demonstrate that people of all ages, races and economic status were impacted.

Narrative Statement of Significance (Provide at least **one** paragraph for each area of significance.)

HISTORIC CONTEXT OF NEW ORLEANS

Natural Geography of New Orleans

Drainage issues caused by climate and geography have been a major concern since the founding of New Orleans in the early 1700s. Knowledge of the area's geography is essential to an understanding of the drainage and flooding challenges the city faces.

The subjects of this nomination lie in what is called the Pontchartrain Basin, which encompasses all of Louisiana that is east of the Mississippi River (See Figure 4). On its Web site, the Lake Pontchartrain Basin Foundation describes the the Pontchartrain Basin as bounded to the north by the Louisiana-Mississippi border, to the west by Thompson Creek (which forms the boundary between East Feliciana and West Feliciana parishes) and the Mississippi River, by the Breton and Chandeleur Sounds and Chandeleur Islands to the south, and to the east by the Pearl River.[7] The Pontchartrain Basin comprises over 10,000 square miles of land in 16 Louisiana parishes and four Mississippi counties. All the lands of the Pontchartrain Basin drain into rivers which empty into Lake Pontchartrain (north of New Orleans) and its connecting sister lakes, Maurepas (directly west) and Borgne (southeast).

Coastal Louisiana is characteristically low lying as it is composed of several river deltas. The New Orleans region is also dotted and snaked with slow moving bodies of water called bayous which are often boggy and stagnant, lush with vegetation and teeming with wildlife.

Early 19th-century maps of New Orleans show that Bayou St. John had tributaries and seasonal branches reaching into what are now the city's first developed neighborhoods. Some areas of the city (such as

[6] Bea and Cobos-Roa, 1.
[7] Lake Pontchartrain Basin Foundation, "History of the Pontchartrain Basin," http://www.saveourlake.org/basin-history.php (accessed on July 11, 2011).

the Metairie and Gentilly Ridges) are well above sea level because they are natural levees formed by an ancient branch of the Mississippi River. (See Figure 5).

The natural lowlands north and east of the original city were referred to as "back swamps" in the earliest maps, and "cypress swamps" on later maps made after 1816. Rainwater and effluent from the city originally drained into these low lands lying between the river and Lake Pontchartrain directly north. "This low-lying area between the lake and the river was historically known as 'back-of-town.' "[8] Elevations increase to above sea level again at the Metairie and Gentilly ridges.

Manmade Geography of New Orleans

New Orleans is a deep water port established in 1718 about 50 miles up the main stem of the Mississippi River, on the eastern flank of the Mississippi River Delta. Until the twentieth century, the urban portion of New Orleans was largely confined to the areas along the Mississippi River, where a natural levee provided the city with the highest (approximately ten feet) elevations above sea level. These natural levees were a result of soil deposits left from the river's annual floods.

Manmade canals and waterways have altered the natural geography of New Orleans. The Inner Harbor Navigation Canal bisects New Orleans and runs in a primarily north-south direction connecting Lake Pontchartrain with the Mississippi River (See Figure 6). There are also two navigation canals to the east of New Orleans. The Gulf Intracoastal Waterway (GIWW), a navigable inland channel completed in 1949 and designed and used primarily for barge transportation, bisects the Industrial Canal and separates eastern New Orleans from the Lower Ninth Ward. A second channel, called the Mississippi River Gulf Outlet (MRGO), is a 76-mile channel constructed by the Army Corps of Engineers in the mid-20th Century just east of the city to provide a shorter route between the Gulf of Mexico and the IHNC via the Gulf Intracoastal Waterway.

In the forty years between Hurricanes Betsy (1965) and Katrina (2005) the outlying deltaic wetlands south and east of the city of New Orleans had become noticeably reduced in size. This was a significant factor in the devastation triggered by Katrina in that these wetlands once acted as a natural brake on hurricanes and their storm surges which might impact New Orleans. With the destruction of these wetlands, hurricane storm surges could approach the city more easily and with greater force than ever before threatening the levees and potentially being able to push immense amounts of storm surge water into the city's drainage and commercial canals.

While New Orleans is often depicted by authors and journalists as the "city in a bowl," the bowl-like quality is actually a by-product of man-made intervention. Structures including drainage canals, levee enhancements and levees along navigational canals built much later, transformed the original city built along the river to its present day more spread out configuration, which is called the Main Basin. Today, the Main Basin is bounded to the west by the 17th Street Canal, to the east by the Inner Harbor Navigation Canal, to the north by Lake Pontchartrain and to the south by the Mississippi River (See Figure 7).

The Levee Systems of New Orleans

Three different but related systems work together to keep New Orleans dry. These are:

- Raised and enhanced natural levees along the Mississippi River, which protect the city from the river's floodwaters annually from April through August,
- The Hurricane Protection System Levees, which during a hurricane event shield the city from the waters of Lake Pontchartrain and Lake Borgne, and
- the drainage system, which moves rain water out of the city all year long.

Mississippi River Levee System and Its Historical Development

[8] MacRostie Historic Advisors, Breiseth, Elizabeth and Henbree Jen, ed. "Mid-City Historic District Amendment and Expansion National Register Nomination Update"; draft manuscript, p. 51. July 2011; copy in National Register files.

New Orleans was established by the French in 1717-18 to guard the natural portage between the Mississippi River and Bayou St. John, leading to Lake Pontchartrain. Historically, the tendency for New Orleans to flood or be threatened by a flood annually from the Mississippi River during late spring and summer runoff came to characterize the city settlement. This was due to the fact that the Mississippi drains over 40% of the continental United States as part of the third largest watershed in the world.

In April 1719 the town's founder, Jean Baptiste le Moyne, Sieur de Bienville, reported that flood waters from the Mississippi River were regularly inundating the new settlement of New Orleans with half a foot of water each spring. He recommended and began to require the colonists to construct man-made levees on top of the natural levees along the Mississippi riverfront and to dig drainage canals from the town eastward into the back lowlands to drain water from the town during floods and heavy rains. The first man-made levee, one mile long, was erected along the New Orleans riverfront in recognition of the importance of protecting the new settlement from spring floods.

Throughout the first half of the nineteenth century, New Orleans changed in importance from being an anchor of France's North American colonial empire to becoming a major American port city exporting sugar and cotton from plantations up river. The attendant growth of New Orleans as a port city required the construction of larger riverfront levees to protect the port city. The construction of these levees was accomplished after 1824 with the assistance of the federal government and the US Army Corps of Engineers to the point that 1849 was the last time the area of the original city—the Vieux Carre—was flooded by water from the Mississippi.

In 1927, the Mississippi River overflowed its banks miles north of the City of New Orleans with a record flooding of 27,000 square miles and displacement of a million people, including 325,000 African Americans. In response to the Great Flood, which had posed a direct threat to – but did not actually flood - New Orleans, Congress passed massive flood control legislation. The Flood Control Act of 1928 authorized the Corps of Engineers to design and construct flood control structures, along with levees, on the Mississippi River to protect populated areas from floods.

Prior to 1928, the flood control efforts of the US Army Corps of Engineers were focused on major U.S. waterways for construction of levees and other flood control structures that enhanced interstate commerce. But in response to the Great Flood, new levee standards were adopted and the Army Corps of Engineers was ordered to upgrade river levees including those in New Orleans. Under Section 3 of the Act, once flood control structures were built by the Corps of Engineers, it would still be the responsibility of the local governments to maintain these structures.[9]

The Hurricane Protection Levee System and Its Historical Development

As discussed previously, the founders of New Orleans (1718) saw two primary flooding threats to the community, including the spring inundations from the Mississippi River and the drainage of rainwater. Water-related diseases from the lowlands were an additional problem that caused the deaths of hundreds annually. These threats were by far more dangerous to residents of New Orleans than hurricanes at this time. Coming from the Gulf of Mexico, hurricanes usually lost much of their strength once they made landfall. Storm surge created by hurricanes was greatly dissipated by the extensive buffering wetlands and cypress swamps south and east of the city.

Throughout the 20th century, however, the growth of oil and gas exploration in wetlands and cypress swamps to the south, and the creation of new navigation outlets for the Mississippi River had the combined effect of causing a substantial loss of the delta's wetlands which once served to limit the impact of hurricanes. Changes included the construction of major riverfront levees north of New Orleans to hold the river within its channel—encouraged before the Great Mississippi River Flood of 1927—and construction of dams and navigation channels. These manmade changes resulted in the reduction of the amount of sediment load carried by the

[9] Sovereign immunity was also given to the Corps of Engineers under Section 3 of the Flood Control Act of 1928, which states "no liability of any kind would attach or rest upon the United States for any damage from or by floods or flood waters at any place, provided that if on any stretch of the banks of the Mississippi River it was impracticable to construct levees." 33 U.S.C. § 702c. Section 702c is sometimes referred as "Section 3 of the act," based on where it appears in the public law.

Mississippi from 550 to 750 million tons per year (before 1950) to about 220 million tons of sediment per year at present. This drop in sediment load has meant the Mississippi Delta south of New Orleans is not being naturally replenished and has led to a massive loss of the wetlands. The result is that a hurricane coming out of the Gulf could approach New Orleans with greater sustained tidal surge than ever before.

The impact on the coastal wetlands of Louisiana, by depriving sediment from the river, was known and candidly recorded as early as December of 1897 in a *National Geographic* article entitled "The Delta of the Mississippi River."[10]

While the worst recorded flooding triggered by a hurricane in New Orleans occurred in 2005, the city had previously experienced flooding from hurricanes in the twentieth century. The second worst flooding occurred in 1965 when storm surge from Hurricane Betsy triggered a levee breach at approximately the same site as one of the subjects of this nomination. The breaches caused severe flooding in portions of eastern New Orleans including the Upper Ninth Ward, Lower Ninth Ward, and Gentilly. Arabi and Chalmette in neighboring St. Bernard Parish also flooded. (See Figure 8)

During the 20th century, and prior to 1965, the Orleans Levee Board (OLB) designed, built and maintained the city's drainage and hurricane protection levees and floodwalls and shouldered 100% of the cost. But as a result of Hurricane Betsy, Congress authorized the Lake Pontchartrain and Vicinity Hurricane Protection Project, which incorporated many of the city's drainage and navigation canals into a flood protection system (see Figure 9). Responsibility for designing and building this hurricane storm surge protection system was assigned to the U.S. Army Corps of Engineers with the passage of the Flood Control Act of 1965. The improvements included increasing the size and height of the canal earthen levees and the installation of concrete-capped steel sheet piling (I-walls) embedded in the earthen levees. When authorized in 1965, the project was supposed to take 13 years to complete. When Hurricane Katrina arrived in 2005, this system was 60% - 90% complete; and it was not slated for completion until 2017.[11] From 1965 until today, the OLB is responsible for operation and maintenance of the hurricane protection levee system and for paying the share of the federal project as mandated (between 30% and 35%) depending on the flood control project.

Drainage System and Its Historical Development

Another challenge to New Orleans' historical development as a major port city was the difficulty of adequate drainage created by the deltaic topography described above. Drainage of rainwater and ground water away from populated areas of the city has always been a local responsibility, and remains so up to the present.

The original French colonial settlement was laid out as 44 city blocks by 1721-23, with drainage ditches around each block to carry away heavy rainfall or heavy spring flooding from the Mississippi River. Due to the strategic location of the settlement, in addition to the riverfront earthen levees, the town was surrounded by a defensive earthen wall and bastions in the classic French style. This defensive system also reinforced the flood protection system.[12]

> Throughout the nineteenth century, the city's drainage system remained rudimentary and composed of gutters and canals to channel water toward the Metairie Ridge where there were several simple paddle wheel pumps. The pumps serving Canal Street were located on Bienville Street at its intersection with present-day Jefferson Davis Parkway; these pumps were designed to drain water into Bayou St. John. The system was intended to flush water over the ridge toward Lake Pontchartrain but was ineffective and mainly splashed water around. The system could not handle heavy rains, which would result in standing water throughout the flood-prone areas. Flooding was also caused by wind-driven water off Lake

[10] E.I. Corthell "The Delta of the Mississippi River," *National Geographic,* VIII, No. 12 (December 1897) 351-353.
[11] United States Government Accountability Office, GAO-05-1050T, Testimony Army Corps of Engineers, Lake Pontchartrain and Vicinity Hurricane Protection Project, September 28, 2005.
[12] Robert Bea and Ray M. Seed, Independent Levee Investigation Team Final Report, "Investigation of the Performance of the New Orleans Flood Protection Systems in Hurricane Katrina on August 29, 2005," 4-1.

Pontchartrain, against which the pumps were useless. Major lake surges occurred in 1871 and again in 1880, flooding the "back-of-town."[13]

By the 1890s, New Orleans was faced with the need for a meaningful system to drain sewage, rain, and floodwater away from the city. The city also needed to bolster the Lake Pontchartrain "back levee" and permanently drain lowlands all the way to the shore of Lake Pontchartrain to permit expansion of the city. In response, New Orleans voters approved a bond issue for new improvements to the drinking water, sewage disposal, and drainage systems. The answer to these needs was the construction of three major water drainage canals (17th Street, London, and Orleans) with massive new pumping stations, located a few miles from the shore of Lake Pontchartrain. (See Figure 10) Discussions of each follow.

The New Orleans Outfall Canals

The 17th Street Canal

The 17th Street Canal is the primary drainage canal for the City of New Orleans. (In the past, it was also known as the Metairie Outlet Canal and the Upperline Canal.) In conjunction with Pumping Station 6, the canal channels the largest volume of rainwater away from the city and into Lake Pontchartrain. The canal forms a significant portion of the boundary between the city of New Orleans and the adjacent suburb of Metairie, Louisiana.

The canal that was to become later known as the 17th Street Canal seems to have had its origin at the start of the 1850s as a hand dug drainage ditch, or borrow ditch, which was cut through low lying ground to raise a parallel right of way where the Jefferson and Lake Pontchartrain Railway was built. The railway, in business from 1853 through 1864, connected the town of Carrollton, Louisiana (along the Mississippi River front) with a shipping port on Lake Pontchartrain at what became Bucktown, Louisiana, a distance of about 6 miles. The drainage ditch and railway right of way, connecting Carrollton and Bucktown, cut mostly through land that was undeveloped lowland at that time.

In 1858, a hand dug ditch was built along the route of the present day Palmetto Canal to aid in drainage of the low area "back of town." This ditch began at what is now the intersection of Dublin and Palmetto Avenue in Carrollton and connected to the Jefferson and Lake Pontchartrain Railway drainage canal a short distance away, on the south side of the Metairie Ridge. The Jefferson and Lake Pontchartrain Railway was discontinued on December 31, 1864 as competing rail lines between the river and lake were more successful. When the city of New Orleans annexed Carrollton, the railway and adjacent drainage canal became a large part of the boundary line between Orleans and Jefferson parishes. As the spur canal marked the new up-river limit of Orleans Parish, it became known for a while as the Upperline Canal.

Located in the northern section of Carrollton, this spur drainage canal, now Palmetto was beside a projected street numbered "17th Street" (although at the time there was little actual development in back of Claiborne Avenue). Thus, the spur canal was the first to be known as the "17th Street Canal." The name would later come to commonly refer to the large canal to which this spur is connected.

By the 1870s, a steam-engine-powered pump known as the "Dublin Street Draining Machine," located at the back of the Carrollton neighborhood, was being used to drain that neighborhood, pumping water through the Upperline (now Palmetto and 17th Street) Canal toward Lake Pontchartrain. Increased use of the enlarged canal to pump rainwater from the streets of the city into the lake grew with the city. The Claiborne Canal connected with the Upperline/17th Street Canal system via a canal along Dublin Avenue; thus the canal served to carry rainwater to Lake Pontchartrain from the greater part of Uptown New Orleans upriver of the New Basin Canal. (The New Basin Canal connected the back side of the French Quarter with Lake Pontchartrain via Bayou St. John.)

[13] Peggy Scott Laborde and John Magill, *Canal Street*. Gretna: Pelican Publishing Company, 2006:187-8; as quoted in MacRostie Historic Advisors, "Mid-City Historic District Amendment and Expansion National Register Nomination Update," 40.

Another canal, Hoey's Canal, also along the parish boundary, was added connecting to the Upperline/17th Street Canal from upriver to help drain the back of the Jefferson Parish communities along the riverfront, now known as "Old Jefferson." In 1894, 17th Street was renamed Palmetto Street (later redesignated Palmetto Avenue), but by this time the entire drainage canal was popularly known by the old street name – 17th Street Canal.

In 1899 a new pumping station (Pumping Station 6) was opened in the 17th Street Canal a couple of blocks north of Metairie Road. A few years later, in the early 20th century, new high-efficiency pumps designed by A. Baldwin Wood were installed at this pumping station, and remain in operation to this date. This was just one of a number of pumping stations along the three major drainage canals (17th Street, London and Orleans) which in the next decades would remove nearly all the rainwater in the main basin from the Mississippi riverfront to the shores of Lake Pontchartrain. With this draining of the lowland and the construction of an earthen levee along the shoreline of the lake (in the late 1920s) the area was soon parceled out for residential development although some of it was slightly below sea level.

When the Metairie neighborhood was substantially developed for residential use after World War II, the earthen levees along the "back" sections of the canal, farther from the Mississippi River and closer to the lake, were raised. As a result, the water level of the 17th Street Canal could sometimes be higher than the surrounding residential areas and streets. Additional smaller pumping stations were built to add drainage water to the canal from areas along its length. Rainwater runoff from substantial areas of Uptown New Orleans, Mid-City, Metairie, and surrounding neighborhoods drained into the sub-canals of the 17th Street Canal system, then into the 17th Street Canal and Lake Pontchartrain.[14]

In 1965, Hurricane Betsy demonstrated that a major hurricane could overtop the earthen levees of the drainage canals and flood the residential and commercial areas of New Orleans. This despite the efforts of the canal pumping stations which had been continually increased in pumping capacity throughout the twentieth century. The U.S. Army Corps of Engineers determined that the existing earthen levees along the outfall canals, including the 17th Street Canal, were not sufficient in either grade or stability to contain hurricane storm surge.[15]

In the Flood Control Act of 1965 - legislation enacted in response to Hurricane Betsy - Congress directed the Army Corps to work in consultation with the Sewage and Water Board (SWB) and the Orleans Levee Board (OLB) (which had responsibility for interior drainage) to examine alternatives for providing hurricane protection at the three outfall canals. The Corps initially considered five alternatives for improved protection for the three canals but ultimately narrowed their choices to the two most cost-effective alternatives, which were 1) raising the height of the canal walls (parallel protection) or 2) installing floodgates at the canal mouths at the lakefront (frontage protection). There is no evidence in the project record that the Army Corps felt that there were differences between the two approaches in providing reliable hurricane surge protection for the 17th Street, London Avenue and Orleans Avenue Canals.[16]

For reasons unique to the 17th Street Canal, there was no stated difference in the cost between the two approaches. This was because with newly authorized sheet pile construction guidelines and other factors, the cost difference between parallel protection and frontage protection was minimal for the 17th Street Canal.[17] The Army Corps ultimately selected parallel protection as its final recommendation for the 17th Street Canal partly because the local sponsors (OLB and SWB) preferred it. The local sponsors "viewed the butterfly gates plan (to be installed at the canal outlets to the lake) as incompatible with their interior drainage responsibilities, and they also questioned whether the gates would always work properly during storm events."[18] It is also important to note

[14] Until the completion in 2011 of the West Closure Complex Pump Station in Belle Chasse, Louisiana, Pumping Station 6 held the title as the largest pump station in the world with 15 pumps capable of moving over six billion gallons of rainwater a day through the station toward Lake Pontchartrain.
[15] Douglas Woolley and Leonard Shabman, Decision-Making Chronology for the Lake Pontchartrain & Vicinity Hurricane Protection Project, Final Report for the Headquarters, U.S. Army Corps of Engineers, 2-47.
[16] Ibid, 2-48.
[17] Ibid.
[18] Ibid.

that the frontage protection plan initially proposed did not include auxiliary pumps like those at the new gates in place at the 17th Street Canal built after Hurricane Katrina.

As demonstrated by the final recommendation selected for the 17th Street Canal, the earthen levees in New Orleans were often supplemented and raised by the addition of more "structural" components of concrete and steel. The concrete and steel floodwalls were used to achieve increased crest height without the extra weight of additional earthen levee fill, and/or without the need to widen the earthen levee embankment section to accommodate additional earthen levee fill in situations where the available "footprint" was limited.[19]

The London Avenue Canal

The London Avenue Canal is located in the Gentilly area of New Orleans and extends in a straight line from just south of Dillard University to Lake Pontchartrain. The roughly two mile long canal separates the Filmore and St. Anthony neighborhoods. The London Avenue is an important drainage canal and is capable of flowing 5,200 cubic feet of water per second.

The Orleans Avenue Canal

The Orleans Avenue Canal is currently a drainage canal approximately two miles long and flowing along the western side of City Park through the Lakeview and the Lakeshore/Lake Vista neighborhoods before emptying into Lake Pontchartrain. The canal, with its pump station, has much less pumping capacity than the 17th Street Canal, pumping only 2,200 cubic feet per second (cfs) as compared to the 17th Street Canal's capacity of 9,200 cfs. Nonetheless, it is one of the three most important drainage canals for the city of New Orleans.

Waterways and Economics

Before 1800, three European powers, attempted to establish their dominance over the interior of North America. France, Spain and Britain were rivals and knew that the possessor of the port of New Orleans would have control over a vast area and could impede the expansion of the emerging United States. The United States negotiated with France to buy New Orleans in 1803 and ended up owning a third of what would ultimately become the USA.

Even before the railroad era began in the 1830s, New Orleans was strategically placed at the mouth of the river, and therefore was able to control the river commerce of the entire Mississippi River Valley. With the advent of the railroad, New Orleans' role continued to develop in the economy of the young United States as a major port city through which goods produced in the mid-section of the continent flowed out to world markets. It also served as a major port of immigration. By 1875 it was the ninth largest American port, shipping 7,000 tons annually. In 1880, after completion of the Mississippi River jetties (in 1879), New Orleans experienced a 65-fold increase in seaborne commerce, shipping 450,000 tons of goods, jumping it to the second largest port in America (New York then being the largest). New Orleans would retain its number two position until well after the Second World War, when Los Angeles-Long Beach emerged as the largest port, largely on the strength of its container traffic from the Far East. New Orleans remains the nation's busiest port for bulk goods, such as wheat, rice, corn, soy, and cement.[20]

To aid in commerce, city fathers in the 18th and 19th centuries built many navigation canals including the Carondelet (Old Basin) Canal, the New Basin Canal, the Inner Harbor Navigation Canal (IHNC) and others.

Carondelet (Old Basin) Canal

The concept of a shipping canal (that could also be used for drainage) connecting the Mississippi River to Lake Pontchartrain originated in the Spanish colonial period of Louisiana (1763-1803). The hand dug colonial era Carondelet Canal connected the back side of the French Quarter with Lake Pontchartrain via Bayou St. John. The Carondelet Canal

[19] Ibid, 4-18.
[20] Bea and Seed, 4-1.

allowed small ships to approach close to the French Quarter from Lake Pontchartrain, but the canal was not extended to the river because of the differing levels of the river and the lake. Without the construction of canal locks such a river-to-lake connection would be impractical. After some years, the Carondelet Canal silted up and was used solely for drainage. In the early nineteenth century, another navigation and shipping canal along the west side of the French Quarter was proposed but never built. However, the right-of-way for the proposed waterway gave its name to the city's Canal Street, which forms the western boundary of the French Quarter (Vieux Carre), a National Historic Landmark District.

New Basin Canal

The New Basin Canal, also known as the New Orleans Canal and the New Canal, was in use from the 1830s through the 1940s. It was constructed by the New Orleans Canal and Banking Company, incorporated in 1831 with a capital of 4 million dollars. The intent was to build a shipping canal from Lake Pontchartrain through the lowlands to the booming Uptown or "American" section of the city, to compete with the then existing Carondelet Canal in the Downtown part of the city. Work commenced the following year and by 1838, after an expense of one million dollars, the 60 foot wide, 6 mile long canal was complete enough to be opened to small vessels drawing 6 feet, with $0.375 per ton charged for passage. Over the next decade the canal was enlarged to 12 feet deep, 100 feet wide, and with shell roads alongside.

The canal joined with Lake Pontchartrain around the present day intersection of Robert E. Lee and West End Boulevards, but jetties were added on both sides extending into the lake, one with a lighthouse standing on the far end. From the lake the canal headed south through the lowland area at or slightly below sea level, then cut through the high ground of Metairie Ridge and through the mid-city lowlands before ending in a turning-basin at Rampart Street and Howard Avenue in what is now the New Orleans Central Business District.

The navigational canal was commercially successful through the 19th century, but its importance declined after World War I, especially with the opening of the Industrial Canal in 1923 (which is discussed in the next section). In 1936 the Louisiana Legislature passed a state constitutional amendment to close the New Basin Canal. In 1937-1938, this waterway was filled in between the turning basin downtown to just beyond Claiborne Avenue. The rest of the length continued functioning on a more limited scale until after World War II. The rest was filled in by about 1950, except for a half mile long stretch at the lakefront which was left as a small boat and yachting harbor and continues to exist. Much of the route became the Pontchartrain Expressway in the 1950s, which was incorporated into I-10 the following decade.

Inner Harbor Navigational Canal (IHNC) (Industrial Canal)

In July 1914 the Louisiana State Government authorized the Port of New Orleans to build a deep-water shipping canal to accommodate ocean-going cargo ships navigating between the Mississippi River and Lake Pontchartrain. Documents exist from March 1, 1827, drawn by Captain W. T. Possin, a topographical engineer, showing the route of a proposed canal to connect the Mississippi River and Lake Pontchartrain very close to the site chosen for the enterprise nearly a hundred years later. Considerable land was expropriated in the downriver (eastern) portion of the city for this project. Along the Mississippi riverfront, numerous buildings and homes were acquired and demolished to make room for the canal. The area toward Lake Pontchartrain was mostly little-developed lowland at this time so there was less need for developed private land to be acquired and for buildings to be demolished.

Dredging of the 5.5 mile long navigation canal began on June 6, 1918. The opening dedication ceremony was presided over by Louisiana Governor John M. Parker on 5 May 1923. The cost for the construction of the IHNC was $19 million dollars.

After the opening of the IHNC, slips and docks were added along its length, allowing it to function as a harbor and industrial zone in addition to serving as a navigation canal. A quarter of a century later, the IHNC became part of the growing Gulf Intracoastal Waterway (GIWW) system which allowed ships to move goods "inside the Gulf coast" and away from open-water conditions.[21] The connection of the GIWW to the IHNC is part of the reason the IHNC was considered successful for several decades. With the completion of the Gulf Intracoastal Waterway (GIWW) to New Orleans in the 1930s, the Industrial Canal served as a shipping channel linking the Lake Pontchartrain segment of the GIWW to its

[21] William R. Freudenburg, Robert Gramling, Shirly Laska, and Kai T. Erikson, *Catastrophe in the Making,* Washington DC: Island Press, 2009.

continuing segment, accessed via the Mississippi River. During World War II the GIWW was rerouted, and a newly-excavated segment extending through the marsh west from the Rigolets joined the Industrial Canal at its approximate midway point between the river and the lake just north of the present day Florida Avenue bridge. In 1944, the federal government leased the Industrial Canal lock and the southern 2.1 mile section of the canal and took over its operation and maintenance. In the 1960s the Industrial Canal/Intracoastal Waterway junction was enlarged in expectation of the anticipated increase in shipping traffic resulting from the completion (1965) of the Mississippi River Gulf Outlet (MRGO).

Along both sides of the IHNC, earthen levees were constructed to protect the Upper and Lower 9th Ward neighborhoods (which are partially below sea level and had developed since the 1920s) from storm surges which might rush into the canal and flow into these neighborhoods. A breach in the canal's earthen levees (just a few yards away from one of the subjects of this nomination) resulted in the flooding of the Lower 9th Ward during Hurricane Betsy in 1965. Subsequently, concrete I-wall floodwalls were constructed upon and within the earthen levees along both sides of this canal by the US Army Corps of Engineers.

Starting at the Mississippi riverfront, the IHNC constitutes the boundary between the Upper 9th Ward neighborhood on the upriver (or west) side of the canal and the Lower 9th Ward neighborhood on the downriver (or east) side. Near where the IHNC enters Lake Pontchartrain is generally considered to be the eastern boundary of the Gentilly area of the city and the western boundary of eastern New Orleans.

Between 2000 and 2002, an industrial complex was demolished adjacent to the earthen levee and concrete floodwall along the east side of the IHNC in the vicinity of what would become the east side, north breach site. This complex, called the East Bank Industrial Area (EBIA) and consisting of maritime service businesses in place for over 40 years, was situated along Surekote Road. The demolition was performed by contractors and was done to make way for a new navigational lock intended to replace the existing 1920's era lock located closer to the river in the IHNC. It is believed that the demolition of the businesses, buildings and improvements was performed in a manner which compromised the stability of the flood protection components compared to the stability which was available prior to 2000. According to Bea and Cobos-Roa,

> "The breaches along the East side of the IHNC-Lower Ninth Ward during Hurricane Katrina were influenced in major ways by the EBIA excavations performed for the USACE IHNC navigation Lock Expansion Project. These excavations resulted in facilitating significant increases in the hydraulic conductivity and pore water pressure development paths. This led to much quicker and greater increases in seepage pressures and hydraulic gradients and led to decreases in the lateral resistance of the levee floodwall sections."[22]

Mississippi River Gulf Outlet (MRGO)

New Orleans leaders in 1940 dreamed of a navigation canal that flowed not just to the relatively shallow waters of Lake Pontchartrain but all the way to the Gulf of Mexico, making the city a "real" seaport.[23] The intention was that the canal (now known as the MRGO) would shorten the distance from New Orleans to the Gulf from 120 miles to roughly 75 miles. The Corps of Engineers predicted that the outlet would add $1.45 to the economy for each $1 of taxpayer money spent for its construction, and ultimately the project was approved and built by the Corps.

The MRGO which has been called as "straight as an engineer's ruler," begins just east of Interstate-55's crossing of the GIWW east of New Orleans and takes a path south-southeast through the St. Bernard Parish wetlands just west of Lake Borgne to the Gulf of Mexico. (See Figure 6) On the day it opened in 1965, the MRGO was already nearly obsolete because it was too narrow and too shallow to provide for larger vessels. The advantage of water transportation is greatest when cargo is the heaviest.[24] Furthermore, the straight design and lack of outward flow into the Gulf allowed the MRGO to become "the perfect shortcut for salt-water intrusion"

[22] Bea and Cobos-Roa, 42.
[23] Freudenburg,73.
[24] Ibid, 65.

which damaged buffering cypress forests and wetlands which historically had protected New Orleans from storm surge.[25]

The channel was designed to have a surface width of 625 feet, bottom width of 500 feet and 36-feet depth. But the Louisiana Ecosystem Restoration Study by the Corps of Engineers in late 2004 calculated that the ship traffic had caused the north bank of the channel to erode at a rate of 35 feet per year leading to "the direct loss of approximately 100 acres of shoreline brackish marsh every year and the additional losses of interior wetlands and shallow ponds."[26]

In addition to the impact of the MRGO on the marsh and wetlands, there was a second problem predicted by storm surge researcher Hassan Mashriqui:

> "Storm surge pushing across shallow Lake Borgne from the east is constrained by these MRGO levees to the south and, to the north, by the long-standing levees of the Intracoastal Waterway (GIWW). Initially ten or more miles apart, these two channels meet, and when they do, the water building between their levees is squeezed into a single channel–the Funnel–only 260 yards wide, constrained by levees 14 feet to 16 feet high….In concert with the denuded marshes, it could increase the local storm surge hitting the Intracoastal Waterway by 20 percent to 40 percent–a critical and fundamental flaw."[27]

On August 29, 2005, the date of significance for this nomination, the channel was nearly a half a mile wide.

In June 2008, the Army Corps of Engineers New Orleans District submitted a Deep-Draft De-authorization Study of the MRGO[28] that stated that "an economic evaluation of channel navigation use does not demonstrate a Federal interest in continued operation and maintenance of the channel." Congress ordered the MRGO closed as a direct result.

In conclusion, the construction of navigation canals was important in the commercial viability of the city of New Orleans. The Old and New Basin Canals, in particular, were considered highly successful and productive ventures for many years.

Neighborhood Development

In the 18th and 19th centuries, the city's residential district did not stray much beyond the old Mississippi River natural levee mound. However, after 1895, the city made serious attempts to bolster the Lake Pontchartrain "back levee" in order to establish a meaningful system of rain water and flood water drainage. Most of the cypress lowland between Mid-Town New Orleans and Lake Pontchartrain was subdivided between 1900-1914, after the City established and funded a Drainage Advisory Board to prepare ambitious plans for keeping New Orleans dry all the way from the Mississippi riverfront to Lake Pontchartrain's shoreline. This development allowed New Orleanians to move to new, lower lying but dry neighborhoods with less anxiety; thus, building activity, especially white residential development, in "back-of-town" increased dramatically following improvements to the drainage systems. However, the farther into these areas the city expanded, the more dependent it became on man-made flood controls and drainage systems to create new buildable land and keep it dry.

This real estate bonanza after the First World War (1917-18) increased the City's urban acreage by 700% and their assessed property values by 80% during the same interim.[29] Another 1,800 acres was reclaimed from the south shore of Lake Pontchartrain in 1928-31, between the mouth of the 17th Street Canal on the west and the Inner Harbor

[25] Ibid, 120.
[26] Ibid, 121.
[27] Ivor van Heerden and Mike Bryan. *The Storm, What Went Wrong and Why During Hurricane Katrina—the Inside Story from One Louisiana Scientist,* (New York: Viking Press, 2006), 81.
[28] US Army Corps of Engineers, "Integrated Final Report to Congress and Legislative Environmental Impact Study for the Mississippi River-Gulf Outlet Deep-Draft De-authorization Study," USACE New Orleans District, June 2008, 2.
[29] Bea and Seed, 4-2.

Navigation Canal (IHNC) on the east. The entire area was subsequently built out following the Second World War, from 1945 to 1970.

Lakeview Neighborhood Affected by 17th Street Canal Breach

When Pumping Station 6 was constructed in 1899, it was at the "back" end of the developed part of town. As the area alongside the 17th Street Canal closer to the lake was largely undeveloped lowland, it was of little concern if waters pumped out of the city occasionally topped the Canal and flowed into this area during heavy rains.

In the late 1920s and the 1930s, an Orleans Levee Board (OLB) project used fill dredged from the lake to create new land in what had been Lake Pontchartrain and to create a sizable, but somewhat low, levee along the lake side.

At that time the largest pump station in the world, Pumping Station 6 at the 17th Street Canal along with pumps at other canals had sufficiently drained the land between the pumping stations and the new levees along the lakefront to permit residential development. The areas along the 17th Street Canal from Metairie Ridge to the Lake were substantially developed for residential use after World War II. To protect these areas from storm surges from Lake Pontchartrain, earthen levees along the "back" sections of the Canal farther from the Mississippi River and closer to the lake were raised. As a result, the water level of the 17th Street Canal could sometimes be higher than the surrounding residential areas and streets. Additional smaller pumping stations were built to add drainage water to the canal from areas along its length.

Today, the Lakeview neighborhood is bounded by Robert E. Lee Boulevard to the north, the 17th Street Canal to the west, Veterans Boulevard to the south and Orleans Avenue to the east. The residents are primarily white middle to upper class homeowners. (See Figure 11)

Historic Lower 9th Ward Neighborhood Affected by IHNC Breach

The IHNC passes through the 9th Ward of the City separating the Lower 9th Ward from the Upper 9th Ward. Approximately half of the waterway's length, from the Industrial Lock at the Mississippi River to a point north of the Florida Avenue Bridge, is confluent with the Gulf Intracoastal Waterway.

Historically, flooding frequently occurred in this region, which was originally a cypress swamp. The area contained many natural bayous where residents would grow okra and catch crawfish. In the mid 1800's working class African Americans and immigrant laborers from Ireland, Germany and Italy seeking affordable housing migrated to the area.[30] The 9th Ward grew into a unique neighborhood with intergenerational and familial relationships over decades.

In 1923, the IHNC was completed and separated the Lower 9th Ward area from the rest of the City. Today, the IHNC forms the western border of the historic Lower Ninth Ward neighborhood. The Lower Ninth Ward is bound to the north by the Southern Railway tracks and Florida Avenue Canal, to the east by the parish line and to the south by the Mississippi River. The area from St Claude Ave to the River has been recently designated by City Planning as the Holy Cross Historic District, named after a high school that developed in the area.

Brisk industrial development along the IHNC created considerable employment due to wharves along both sides of the navigation canal, and to dry docks north of the GIWW. These employment opportunities were in addition to employment on wharves along the Mississippi River. During the same decade, the city installed numerous components of an improved drainage system. This better drainage combined with good employment opportunities resulted in many people migrating to the Lower 9th Ward from both the rest of New Orleans and surrounding rural areas.

[30] Greater New Orleans Community Data Center. "Lower Ninth Ward Neighborhood Snapshot." http://www.gnocdc.org/orleans/8/22/snapshot.html (accessed July 11, 2011).

In the late 1950s, the second bridge between the City and the Lower Ninth Ward, the Judge William Seeber Bridge, known locally as the Claiborne Avenue Bridge, was built across the Industrial Canal at Claiborne Avenue. Retail development in the Lower 9th Ward became notable during this period with a trend of corner stores throughout the neighborhood and commercial development on St Claude Ave.

In September 1965, Hurricane Betsy pushed storm surge into the IHNC and the east side of the IHNC canal wall breached in the same general area where it later breached during Hurricane Katrina. Eighty percent of the Lower Ninth Ward area went under water and hundreds of people lost their lives, with an official count of eighty–one reported by the City at that time. The following year, Congress passed the Demonstration Cities and Metropolitan Development Act. Through the Act, employment in the Lower Ninth Ward increased and neighborhood revitalization occurred as agencies were established to assist and encourage metropolitan development. Until its devastation in 2005, the Lower Ninth Ward retained its heterogeneous population, including socio-economically disadvantaged and middle class residents, predominately African Americans. (See Figure 11)

Hurricane Katrina Chronology

In the forty years between hurricanes Betsy (1965) and Katrina (2005) the outlying deltaic wetlands south and east of the city of New Orleans had become noticeably reduced in size. This was a significant factor in that these wetlands once acted as a natural brake on hurricanes and their storm surges which might impact New Orleans. With the destruction of these wetlands, hurricane storm surges could approach the city more easily and with greater force than ever before, threatening the levees and potentially pushing immense amounts of storm surge water into the city's drainage and commercial canals.

In 1998 Hurricane Georges did just that, raising the level of Lake Pontchartrain and pushing lake waters into the city's drainage canals. Therefore, another upgrade of the canal levees, floodwalls, and bridges began in 1999. By early 2005, the city had a total of 148 drainage pumps in stations throughout the city. The 17th Street Canal was considered in good condition when the 2005 Atlantic hurricane season began.

The year of 2005 had been one of the more active hurricane seasons on record. By early August of that year eleven tropical storms had been plotted, but fortunately, most of the storms which became hurricanes had not made landfall. Then around August 15th the trade winds off West Africa "encountered the unstable air of a tropical wave moving west toward North America, approaching the Bahamas."[31] Moving westward across the Atlantic Ocean over the next week, this unstable air merged with the remnants of deteriorating Tropical Depression 10. On August 23, the National Hurricane Center named the invigorated wave Tropical Depression 12 and noted that it was moving west toward Florida. The next day it was dubbed Tropical Storm Katrina by the National Hurricane Center. [32]

Katrina now had top sustained winds of only about 40 mph, but as it moved west and strengthened, it was tracking to pose a threat to Florida and the Gulf. On Thursday, August 25th, a high pressure system was pushing the hurricane south taking it exactly between Miami and Fort Lauderdale, Florida.[33] Between 6 p.m. and midnight, the storm passed over the swamplands of the Everglades, weakened and was downgraded to a tropical storm. But it cleared the Florida peninsula and entered the warmer waters of the Gulf of Mexico early Friday morning, quickly transforming into a Category 3 Hurricane with sustained winds of 115 mph. As Friday wore on, Katrina continued to strengthen and New Orleans had entered its strike zone. Friday night, the National Weather Service's models shifted in unison and New Orleans moved to the center of the 'cone of certainty' better known as the bull's-eye.[34]

[31] John McQuaid and Mark Schleifstein, *Path of Destruction* (New York: Little Brown and Company, 2006), 159-160.
[32] Meteorologists classify storms using the Saffir-Simpson scale, developed in 1969 by engineer Herbert Saffir and Hurricane Center director Bob Simpson. The scale ranked storms by their sustained wind speed: a tropical storm was defined as having winds of 39 to 73 mph; a Category 1 hurricane, 74 to 95 mph; Category 2, 95 to 110 mph; Category 3, 111 to 130 mph; Category 4, 131 to 155 mph. A Category 5 was anything over 155 mph (McQuaid 2006:163).
[33] Ibid, 62-63.
[34] Ibid, 169.

At midday Saturday, (August 27) as the storm moved northwest through the Gulf toward New Orleans it doubled in size within a few hours and by late afternoon the hurricane watch had expanded to include everything from western Louisiana to the Alabama-Florida border.[35] Just after sunrise on Sunday morning, Katrina's maximum sustained winds reached 167 mph and the storm officially became a Category 5 Hurricane. But when Hurricane Katrina began to make landfall on the Mississippi Delta on a due north track that would take it east of New Orleans and over Lake Borgne, the storm lost strength. According to John McQuaid and Mark Schleifstein, the track:

> … brought Katrina over cooler water, and it began to lose the terrifying strength it exhibited over the open Gulf. At the same time, a stream of dry air began to leach into its western rim, draining strength from bands of thunderstorms. The knot of winds around the eye lost speed, and the barometric pressure rose. The inner core of Katrina's eye wall — the continually regenerating heart of its convection engine — began to erode. The storm weakened like a deflating balloon, dropping from Category 5 to Category 3 in the space of twelve hours.[36]

On its website, the New Orleans *Times Picayune* states that Katrina made its second landfall at the southwest pass of the Mississippi River in Louisiana at 3 a.m. CDT on Monday, August 29. As a Category 3 hurricane, it had sustained winds of 127 mph. The hurricane began pushing a storm surge of seawater from the Gulf of Mexico into Lake Borgne. Initially, around 5 a.m., levee sections in seventeen different locations along the MRGO protecting St. Bernard Parish crumbled and gave way, mainly due to erosion following excessive overtopping of the levees. Also, a levee section along the east side of the IHNC, the subject of this nomination, began to breach before water reached the top of the floodwall. By 6:30, levees along the GIWW protecting eastern New Orleans gave way, mainly due to the presence of sand in the levees. At 6:50 a.m. storm surge that had been pushing across shallow Lake Borgne from the east became constrained and funneled by the remaining MRGO levees to the south and the GIWW levees to the north. This forced even higher water into the Inner Harbor Navigation Canal, which then breached in additional locations. Finally, between 9:30 and 10:30 a.m. storm surge that had passed through the Rigolets into Lake Pontchartrain flowed into the openings of the city's drainage canals prompting the breaching of the 17th Street Canal and the London Avenue Canal. In the next few days, with Katrina's eye moving north of the city, surge levels dropped, but water continued to flow into the city until the water level in the city equalized with that of Lake Pontchartrain on September 1.[37]

Breach of the 17th Street Canal

At about 9:45 a.m, a 30-foot long section of the concrete I-wall floodwall (called a monolith) embedded in the eastern side of the 17th Street Canal earthen levee adjacent to the 6900 block of Bellaire Drive failed sending torrents of water into New Orleans's Lakeview neighborhood. The water level in the Canal at the time of failure was about 5 feet lower than the top of the I-wall. As the storm surge water poured through this initial breach it weakened adjacent concrete floodwall sections and the breach quickly expanded into a 450 foot wide gap (the length of almost two city blocks) through which storm surge water poured, carrying with it concrete floodwall sections and the earthen levee, killing hundreds (directly and indirectly), destroying hundreds of residences, and causing millions of dollars in property damage. Thirty-one (31) bodies were recovered from areas directly flooded by the breach in the 17th Street Canal levee.[38]

The floodwaters resulting from the breach of the 17th Street Canal rendered its pump station (#6) ineffectual, preventing it from pushing the storm surge waters back into Lake Pontchartrain and stopping it from removing rain and other floodwater from the city's main basin. Had the 17th Street Canal not breached, Pump Station #6 and the large pump station in the Broadmoor neighborhood could have remained in operation and drained rainwater and breach floodwater from Metairie, Downtown, Uptown, Central City, Broadmoor and Lakeview. This would have resulted in the lowering of flood levels by several feet and thus would have minimized

[35] Ibid, 170.
[36] Ibid, 187.
[37] Times Picayune Interactive Graphic by Staff Artist Dan Swenson, research compiled by Bob Marshall, http://www.nola.com/katrina/graphics/flashflood.swf (accessed July 11, 2011)
[38] Ezra Boyd, "Estimating and Mapping the Direct Flood Fatality Rate for Flooding in Greater New Orleans Due To Hurricane Katrina," *Risk, Hazards & Crisis in Public Policy* (2010). Vol. 1: Iss. 3, Article 6.

the destruction in the Main Basin of New Orleans.

The floodwaters combined with two breaches in the London Avenue Canal and two breaches in the western side of the IHNC, eventually submerging most of the Main Basin of New Orleans.

East Side North Beach of the Inner Harbor Navigation Canal

Four breaches occurred in the IHNC's levees and floodwalls. At about 5 a.m., a section of the I-wall on the eastern side of the IHNC in the Lower Ninth Ward began to breach and catastrophically released storm surge from Hurricane Katrina. This first breach - which is the subject of this nomination - occurred adjacent to the 2400 block of Surekote Road next to the Florida Avenue bridge. This breach took place in front of a Sewerage and Water Board pump station (PS#5) and was likely the source of the earliest flooding on the east side of the IHNC.[39] Other pump station operators elsewhere in the city listened to the PS#5 operators beg for help as the water flooded their station.

At approximately 7:45 a.m., a second breach occurred about six blocks to the south, adjacent to the 1800 block of Surekote Drive and eventually widened into a 1,000 foot gap. Floodwaters from the two breaches combined to submerge the city's entire Lower Ninth Ward, killing hundreds (directly and indirectly) and destroying commercial buildings, homes and infrastructure. Eight-four (84) bodies were recovered from areas directly flooded by the breach in the IHNC.[40] According to Bea and Cobos-Roa,

> Eyewitness reports and recorded water levels (Figure 4) [this refers to the figure in Cobos-Roa's work rather than the figure that is part of this nomination] indicated that the failures initiated about 5:00 a.m. (all times given in Central Daylight Time, CDT) on August 29, 2005 when the water level was at about +9 ft (3 m) (all elevations NGVD88) well below the top of the concrete steel sheetpile supported I-wall (+12 ft, 4 m) (IPET 2007). These are failures that should not have happened. The failures were initiated well before the design conditions were reached.[41]

The water from both east breaches also flowed into the cities of Arabi and Chalmette in adjacent St. Bernard Parish, Louisiana. There were also several breaches on the western side of the IHNC. Floodwaters from these western breaches combined with floodwaters released from the 17th Street Canal and the London Avenue Canal to flood the Gentilly area in the main basin of New Orleans. These western breaches resulted from different causes and are not the subject of this nomination.

Before the storm, an empty barge (the ING 4727 owned by Ingram Marine) had been moored across from the area that would become one of the breach sites. At some point it came loose, and after Katrina's winds and the eye had passed into Mississippi, the barge was pushed across the IHNC by west wind. It then floated through the east side, south breach and was deposited in the Lower 9th Ward.[42]

In summary, before and during Hurricane Katrina's landfall, breaches in four I-walls developed – all before water levels in the adjacent canals overtopped them. They were the 17th Street Canal and the east side north breach of the Inner Harbor Navigation Canal (the subjects of this nomination) and two breaches of the London Avenue Canal.

Short Term Repairs Following the Disaster (Levee Breaches)

Within a few days emergency crews had sealed the breach along the 17th Street Canal with 7000 sandbags, each weighing 10,000 pounds—for a total of 35,000 tons of sand, gravel, rocks and crushed concrete.[43] By early September a similar patch had been installed along the Industrial Canal and both the

[39] US Army Corps of Engineers, *Interagency Evaluation Performance Task Force*, Volume V, (2007): V-53.
[40] Boyd, Vol. 1: Iss. 3, Article 6.
[41] Bea and Cobos-Roa, 2.
[42] Case 2:05-cv-05724-SRD-JCW Document 28.
[43] McQuaid and Schleifstein, 333.

residential areas of Lakeview and the Lower 9th Ward were pumped dry.[44] Unfortunately, the arrival of Hurricane Rita's storm surge approximately three weeks later washed out the patch at the Industrial Canal and reflooded the Lower 9th Ward, which was finally pumped dry again on October 14, 2005.[45]

The US Army Corps of Engineers established Task Force Guardian immediately after Hurricane Katrina struck the Louisiana and Mississippi coasts. Task Force Guardian's main mission was to repair and restore the levee system to pre-Katrina conditions, a feat largely accomplished by the beginning of the 2006 hurricane season.

In January 2006, the Corps awarded eight contracts to repair and completely rebuild damaged and destroyed levees and floodwalls along the IHNC. The rebuilt section of levee was completed by the start of Hurricane Season, June 1, 2006.

Also in January 2006 the Army Corps of Engineers announced it had finished the repair of the breached section of the 17th Street Canal levee. Five months later, the Corps completed interim gated closure structures at the mouths of 17th Street, Orleans Avenue, and London Avenue canals to prevent potential storm surge from entering those canals. The Corps also initially installed 34 temporary pumps near the closure structures to drain floodwaters from the sub-basin.[46]

In October 2010, the Corps of Engineers announced a plan to shore up the rest of the floodwalls and levees along the three outfall drainage canals. (FOOTNOTE?) The remediation plan for the 17th Street Canal called mainly for deep soil mixing to strengthen the levees. For the IHNC, contracts were awarded to build buttress slabs to improve the ability of floodwalls to withstand high water levels. Work also included building relief wells which prevent water from seeping beneath a wall or levee and, thus, prevent failure. (FOOTNOTE?)

In April 2011, the Corps announced it had awarded a $675 million contract to design and build permanent pump stations at the Lake Pontchartrain entrances of the 17th Street, London Avenue and Orleans Avenue canals. (FOOTNOTE?). This is expected to be the final major levee-related construction project and should be completed by January 2015.

Congress appropriated a total of nearly $15 billion to the US Army Corps of Engineers to rebuild the Lake Pontchartrain and Vicinity Hurricane Protection Project, renamed the Hurricane & Storm Damage Risk Reduction System. The project was 95% complete by June of 2011. In addition to remediated levee and canal walls, and gates and pumps at the mouths of the outfall canals, the Corps of Engineers has built a surge barrier east of New Orleans to prevent hurricane storm surge from entering the IHNC. The surge barrier, similar to a floodwall but much larger, was constructed near the confluence of the GIWW and the now closed MRGO, generally running north-south from a point just east of Michoud Canal on the north bank of the GIWW and just south of the existing Bayou Bienvenue flood control structure. (See Figure 12)

Lawsuits filed in response to Disaster (Levee Breaches)

In January of 2008, federal Judge Stanwood Duval, of the US District Court for Eastern Louisiana, held the US Army Corps of Engineers responsible for defects in the design of the concrete I-wall floodwall constructed in the earthen levees of the 17th Street Canal in the period following Hurricane Betsy (1965). However, the agency could not be held financially liable due to sovereign immunity provided in the Flood Control Act of 1928.[47]

[44] Ibid, 334
[45] Ibid.
[46] United States Government Accountability Office, Hurricane Katrina, "Strategic Planning Needed to Guide Future Enhancements Beyond Interim Levee Repairs," GAO-06-934.
[47] Prior to 1928, the US Army Corps of Engineers role in flood control among the major waterways of the United States was limited only to the construction of levees and other flood control structures which enhanced interstate commerce. In response to the Great Mississippi Flood of 1927, which had posed a direct threat to New Orleans, Congress passed the Flood Control Act of 1928 which authorized the Corps of Engineers to design and construct flood control structures, such as levees, on the Mississippi River to protect populated areas from floods. Under Section 3 of the Act once these flood control structures were built by the Corps of Engineers, it would be the responsibility of the local governments to maintain these structures. Also under Section 3 of the Act "no liability of any kind would attach or rest upon the United States for any damage from or by floods or flood waters at any place, provided that if on any stretch of the banks of the Mississippi River it was impracticable to construct levees."

The following year, in November of 2009, Judge Duval, held the US Army Corps of Engineers responsible for the flooding from the two east IHNC levee breaches (and dozens of others) because the federal agency failed to properly maintain the Mississippi River Gulf Outlet (MRGO). At the time of this nomination, the federal government has appealed the ruling.

Investigations of the Levee Breaches

Post-catastrophe investigations soon made apparent that the levee breaches which are the subject of this nomination, as well as many others in the hurricane protection system, could have occurred in a weather event much less severe than Hurricane Katrina.

In a postscript to the devastation caused during the storm, investigators with the Corps issued a preliminary report in March of 2006 that included a theory of why the IHNC and17th Street Canal concrete I-walls atop the earth levees had failed. It appeared that rising storm surge water had pushed the concrete floodwalls outward, opening a gap between the soil and the sheet pile foundation of the floodwalls. Water poured into the gap, weakening the entire structure, then a layer of soft organic clay underneath it slid, prompting the levee to suddenly slide away from the canal.[48] Since then, the Corps has rebuilt the levee breach sites and the agency has recommended providing permanent floodgates for the drainage canals where they enter Lake Pontchartrain. It has also recommended adding permanent pumping stations to the lake front. Finally, it also recommended that some levees be strengthened and armored with rocks.[49]

Numerous other post-catastrophe studies were done at both the national and local levels. Descriptions of the three major studies which focused on the mechanisms of the levee failures follow.

The National Science Foundation awarded the University of California, Berkeley a grant of $350,000 to convene an Independent Levee Investigation Team (ILIT) to conduct an investigation of the levee and floodwall failures. The study was chaired by geotechnical engineering experts Robert Bea and Raymond Seed.

On behalf of the State of Louisiana, DOTD Secretary Johnny B. Bradberry commissioned a team of Louisiana scientists to gather and document all available data relevant to the failures. “Team Louisiana" chaired by Ivor van Heerden, received $150,000 from the State of Louisiana and $150,000 from the McKnight Foundation.

In October 2005, Lt. General Carl Strock, commanding Chief of the Army Corps of Engineers, commissioned an Interagency Performance Evaluation Task Force (IPET), made up of representatives from the Corps and other federal and state government agencies. The IPET would evaluate the performance of hurricane protection systems in New Orleans and the surrounding areas. The study was paid for by the United States of America’s taxpayers and ultimately cost $35 million.

In addition, other important but less extensive studies were conducted by the National Institute of Standards and Technology (NIST), Risk Management Solutions (insurance industry), both houses of Congress, the White House, FEMA, MRGO plaintiff and defense attorneys, and others.

At the time of this nomination, all studies agree on the failure mechanisms of the levee and floodwall breaches. The unanimous consensus of these studies is that engineering errors created the catastrophe. The results will be summarized based mostly upon comments appearing in the Corps’ report (IPET).

17th Street Canal

Studies conducted immediately after the catastrophe assert that the breach at the 17th Street Canal was due to faulty design, rather than from conditions more severe than the earthen levee /I-wall configuration of the canal was intended to survive. The Interagency Performance Evaluation Task Force (IPET), convened and managed

[48] McQuaid and Schleifstein, 342-3.
[49] Ibid, 344.

by the Corps of Engineers, confirmed that the canal floodwall failed at a significantly lower water level than the top of the floodwall due to faulty design.

More specifically, the 17th Street Canal levee and floodwall, at the breach site, was built over a layer of organic soil called peat or marsh, which, in turn, overlays a layer of very soft clay. A principal concern with levees built on soft soil is the possibility that the entire levee might slide either into the canal or away from the canal because of the low strength of the soft soil. Indeed, the mechanism of failure at the Canal was the levee sliding away from the canal.

Those responsible for the design of the Canal levee and the I-wall over-estimated the soil strength, meaning that the soil strength used in the design calculations was greater than what actually existed under and near the levee during Hurricane Katrina. According to the authors of *New Orleans Hurricane Protection System, What Went Wrong and Why,* "The engineers made an unconservative (i.e., erring toward unsafe) interpretation of the data: the soil below the levee was actually weaker than that used in the I-wall design."[50]

Another critical engineering oversight that led to the failure of the 17th Street Canal involved not taking into account the possibility of a water-filled gap which turned out to be a very important aspect of the failures of the I-walls around New Orleans.

> "Analyses indicate that, with the presence of a water-filled gap, the factor of safety is about 30 percent lower. Because a factor of safety of 1.3 was used for design, a reduction of 30 percent would reduce the factor of safety to approximately one: a condition of incipient failure."[51]

In 2007, the Corps of Engineers announced the results of an engineering analysis applying more stringent post-Katrina design criteria. This study showed that the maximum safe water load on some of the surviving floodwalls is only 7 feet above sea level, which is one-half the original 14 foot design intent of these concrete floodwalls.[52]

IHNC

Available evidence indicates the east side north breach (one of the subjects of this nomination) initiated before the wall was overtopped (about 5:00 am), with the breach fully developing between 6:00 and 7:00 am. "Stability analyses indicate that foundation instability would occur before overtopping at the north breach on the east side of the IHNC. This breach location is thus the likely source of the early flooding in the 9th Ward."[53]

> "Photographic evidence and post failure investigations indicate the [east side] North Breach was a narrow (250 ft) movement that apparently started under the landside toe and progressed toward the waterside. All of this happened before this section of the flood wall was overtopped. The concrete I-wall failed and the steel sheet pile underneath the I-wall was stretched landward. The movement and resting place of the sheet pile indicates that the supporting earthen levee and foundation materials were washed away beneath the sheet pile and the water force pushed away the steel sheet pile and twisted them until a section of the sheet piles rotated 90 degrees – against the rising surge waters in the IHNC."[54]

Criterion A: Event in the Area of Other: Disaster (Levee Breaches)

Long Term National Impacts of Disaster (Levee Breaches)

Although it occurred only six years ago, the New Orleans hydrologic catastrophe of 2005 has strongly influenced long-term, nationwide flood control policies and practices. The results of this influence include:

[50] Christine F. Anderson, Jurjen A. Battjes, David E. Daniel, and Billy Edge, *New Orleans Hurricane Protection System, What Went Wrong and Why.* (Reston, VA: American Society of Civil Engineers, 2007), 48.
[51] Ibid, 51.
[52] Sheila Grissett, "Corps analysis shows canal's weaknesses," *New Orleans Times Picayune*, August 5, 2007, Page A-1.
[53] USACE, IPET, 53.
[54] Bea and Cobos-Roa, 7.

Emergency Nationwide Assessment of Federally Built Levees

After the 2005 levee breaches, Congress directed the Army Corps of Engineers to conduct a nationwide assessment of levees built by the agency which had previously been turned over to local communities for operations and maintenance. As a national public safety initiative, the Corps was tasked to determine if the levees were at risk of failing in a "100 year storm" or a storm with a 1% chance of occurring any given year. In accomplishing this, the Corps, for the first time, identified and mapped all levees in the USACE program (levees which the USACE operates, maintains or inspects). More than 14,000 levee miles were identified as falling under its authority.[55] As a result of these inspections, by January of 2007, 122 levees were identified as posing an unacceptable risk of failing in a major flood. Communities whose levees received an unacceptable rating were alerted they needed to fix the problems that included "movement of floodwalls, faulty culverts, animal burrows, erosion and/or tree growth."[56] The funding for this initial levee assessment came from a 2006 Flood Control and Coastal Emergencies Appropriation.[57]

Passage of the National Levee Safety Act of 2007

After the levee failures in New Orleans, members of Congress made three attempts to attach levee safety legislation to the Water Resources Development Act. The third attempt, which was successful, was H.R. 1495 and was called in short, the National Levee Safety Act of 2007. The legislation ordered the Secretary of the Army to administer several reforms and new programs. These included the creation of a:

1. national data base of federal and non-federal levees,
2. first-ever nationwide levee safety program,
3. levee safety inspection tool using global positioning technology,
4. sixteen member levee safety committee, and
5. program to inform the public of the risks of living near levees.

These new initiatives were to be completed over the course of five years, from fiscal years 2008 through 2013. Section 9006 of the legislation authorized the appropriation to the Secretary of $20,000,000.00 for each year. A more detailed discussion of the law's five main initiatives follows.

1. Creation of a National Levee Data Base (NLD)

While it was known before the 2005 disaster in New Orleans that there were levees in all fifty states, the total mileage, location and condition of levees in the nation - and the population and property they protect - were unknown. The National Levee Safety Act directed the U.S. Army Corps of Engineers to undertake a first-ever nationwide levee inventory called the National Levee Database (NLD). It included both federal and non-federal levees which translated into approximately 100,000 levee miles and was completed at federal expense. The database would describe the location and condition of the nation's levees but also key information including the estimate of the number of structures and population at risk and protected by each levee.[58] Prior to this, there was no existing national database for levees that could be used in assessing and managing their condition, location, level of protection and/or maintenance activities.[59] The gathering of data for the NLD received additional funding later in a one-time $90 million appropriation through the American Recovery and Reinvestment Act of 2009 (ARRA).

2. Creation of a Levee Safety Program

[55] Tammy Conforti," USACE National Levee Safety Program," Powerpoint presented at Association of Flood Plain Managers annual conference in Reno-Sparks, Nevado, May 2008.
[56] Associated Press, "122 levees across the nation at risk of failing," February 2, 2007.
[57] Congressional Research Service Report for Congress, Order Code RL33298, "*Supplemental Appropriations: Iraq and Other International Activities; Additional Hurricane Katrina Relief,"* June 9, 2006.
[58] Public Law 110-114, title IX, §9004, Nov. 8, 2007, 121 Stat. 1290.
[59] American Public Works Association, National Committee on Levee Safety, "The Need for a National Levee Data Base, http://www2.apwa.net//Documents/DraftFinal_ncls%20nld%20rec_20Apr.pdf (accessed on July 25, 2011).

The National Levee Safety Act established the Levee Safety Program administered by the Secretary of the Army with a mission of assessing the integrity and viability of levees and of recommending courses of action to make sure the levee systems do not present unacceptable risks to the public, property and environment.[60] In November of 2007, the Corps, under the direction of the Secretary issued new guidelines on levee safety:

- Establish Levee Safety Officers,
- Establish Levee Safety Program Managers,
- Submit plans for organizational structure, and
- Use revised inspection checklists with different tiers of inspections.

In the case of non-federal levees, the Corps allowed a one-time, one year grace period for communities to undertake the necessary upgrades. The deficiencies, mainly due to poor maintenance, required communities in every state to invest millions of dollars in repairs.

3. Creation of a New Levee Inspection Tool

The National Levee Safety Act directed the use of a new levee inspection tool using global positioning. So the Corps of Engineers fast tracked development of a Geographic Information Systems (GIS) / Global Positioning System (GPS) based inspection tool which incorporates a levee inspection checklist that links directly with the NLD. This tool is being used for all routine annual inspections performed by USACE beginning in 2008.[61] On its website, the Corps describes the new screening tool in that it "combines inspection data with a preliminary engineering assessment and maximizes the use of existing information and local knowledge of levee performance."[62] The screening will be used to rank levees by relative risk. The new program is also intended to communicate with local levee sponsors the overall condition of the levee system and recommend actions to reduce flood risk to local communities.

4. Creation of a Levee Safety Committee

The National Levee Safety Act ordered the creation of a 16-member committee tasked with ensuring that the new Levee Safety Program meets the following goals:

- Ensuring the protection of human life and property by levees through the development of technologically, economically, socially, and environmentally feasible programs and procedures for hazard reduction and mitigation relating to levees,
- Encouraging use of the best available engineering policies and procedures for levee site investigation, design, construction, operation and maintenance, and emergency preparedness.
- Encouraging the establishment and implementation of an effective national levee safety program that may be delegated to qualified States for implementation, including identification of incentives and disincentives for State levee safety programs,
- Ensuring that levees are operated and maintained in accordance with appropriate and protective standards by conducting an inventory and inspection of levees.[63]

5. Enactment of Public Education Programs

The National Levee Safety Act of 2007 ordered the development of public education programs to "build public awareness of the residual risks associated with living in levee protected areas." For example, in October 2009, the American Society of Civil Engineers released an educational pamphlet entitled, "So You Live Behind a Levee" designed to educate the public about flood risk. The publication included a new map showing the United

[60] Conforti, 2008.
[61] Ibid.
[62] U.S. Army Corps of Engineers, Levee Safety Program http://www.usace.army.mil/LeveeSafety/Documents/fs_safety.pdf (accessed July 25, 2011).
[63] Public Law 110-114, title IX, §9004, Nov. 8, 2007, 121 Stat. 1288.

States counties where levees are found. Also the Corps of Engineers developed educational videos and uploaded them to YouTube.

Creation of National Flood Risk Management Program

In May 2006, the Army Corps of Engineers established the National Flood Risk Management Program for the purpose of integrating and synchronizing USACE flood risk management programs and activities both internally and with counterpart activities of the Department of Homeland Security, FEMA and other Federal agencies, state organizations, and regional and local agencies. As stated on the Corps' website, the goals of the program include:

- Providing current accurate floodplain information to the public and decision makers,
- Identifying and assessing flood hazards posed by aging flood damage reduction infrastructure,
- Improving public awareness and comprehension of flood hazards and risk,
- Integrating flood damage and flood hazard reduction programs across local, state, and Federal agencies, and
- Improving capabilities to collaboratively deliver and sustain flood damage reduction and flood hazard mitigation services to the nation.[64]

New More Stringent Guidelines for Levee Certification Process

The data gathered for the NLD was made available to assist in creating more robust guidance in levee certification necessary for homeowners and communities to be able to acquire flood insurance. In September 2007, the Corps of Engineers drafted and later issued new guidelines for inspecting and certifying federal levees in Engineer Circular 1110-2-6067.[65] The new guidelines stated there would no longer be grandfathering, exemptions and/or partial certifications. There must be a full and complete engineering analysis with a field inspection. Further, all document findings and certifications must be signed by the Physical Engineer, Chief of Engineering Division for the USACE. Levee inspections were made more uniform across the nation to ensure compliance and were required quarterly instead of annually.

The Federal Emergency Management Agency (FEMA) began scrutinizing older flood control projects much more closely and began decertifying many of them due to age or unknown maintenance.[66] By 2010, FEMA had determined that hundreds of levees nationwide (mostly in California and Arizona) did not meet its standards, a decision that meant that thousands of property owners had to buy federal flood insurance.

The consequences of the new stricter, more rigorous inspections and recertification of levees was immediately felt by elected officials and residents in states all over the nation. Some examples follow.

In August of 2007, local officials announced that five levees protecting metropolitan East St. Louis, Illinois from the Mississippi River do not meet FEMA's new standards for flood protection and were removed from its flood maps. According to Terry Reuss, regional chief of FEMA's floodplain management and insurance branch, "the assessment of those five levees is part of a nationwide effort to update flood maps, incorporating lessons learned from the flooding brought by Hurricane Katrina."[67] While the East St. Louis levees were high enough, they failed new requirements regarding ability of the levees to withstand water seepage underneath the structures. Under seepage, as demonstrated by what happened at the nominated levee breach sites, can undermine stability.

In Lawrence, Kansas, city leaders were alerted in 2007 that they must spend hundreds of thousands of dollars to inspect the city's Kansas River levee system as part of the new federal requirements.[68]

[64] U.S. Army Corps of Engineers, National Flood Risk Management Program, Homepage, http://www.nfrmp.us/index.cfm (accessed on July 25, 2011).
[65] Christopher N. Dunn, USACE Hydrologic Engineering Center, *"Revised USACE Levee Certification Guidelines,* October 20, 2009.
[66] Joy Brown, "FEMA frowns on old levee: Findlay official unconcerned," *The Courier (Ohio)*, July 5, 2011.
[67] John Schwartz, "East St. Louis Levees Fail Test," *The New York Times,* August 23, 2007.
[68] Chad Lawhorn, "Levee recertification will cost city, "*LJ World*, March 31, 2007.

Failure of the I-walls in New Orleans well below design specifications prompted the Corps of Engineers to do a complete inspection of I-walls in the United States in fiscal year 2008.[69]

Also in 2008, Drainage District 12 in northeast Oklahoma was given an "unacceptable" rating by the Corps of Engineers, meaning the levee had one or more deficiencies that could prevent it from functioning as designed. The extent of the stricter new standards was evidenced by the reaction from the District 12 Levee Commissioner, Frank Keith, who says he has never been criticized for a bad operation in 28 years on the job. "Suddenly, since they've changed the rules and ratings and come in with a new inspector, he immediately started picking everything he can find," Keith said.[70]

In 2009, the Corps rated Dallas's primary flood protection, the Trinity River Levees, as unacceptable due to the new standards when a layer of sand was discovered in the floodway during the installation of a pier for a new bridge under construction. This move temporarily halted the Trinity River Corridor Project, a transformational public project in Dallas history.[71]

The FEMA-ordered recertification also brought a halt in 2010 to a long planned $17 million project in Cheyenne, Idaho which would have improved east-west traffic flow and also created a bypass of a dangerous railroad crossing, the site of several fatal accidents over its history. The new certification protocols resulted in decertification of the Pocatello Portneur River levees.[72]

Levee districts to the south and west of Memphis, Tennessee were notified by the Corps of Engineers in April 2010 that inspectors found flaws that could lead to some levees being decertified. This translated into thousands of residents being forced to buy costly flood insurance.[73]

Broward County officials in south Florida learned in December 2010 that due to "new post-Hurricane Katrina standards," the Corps of Engineers gave a failing grade to a 100-mile long Everglades levee that had just one year earlier received an acceptable rating. What was considered sturdy construction in the 1950s did not meet the new federal levee standards, according to Leslie Bromwell, one of the consultants who led the levee review.[74]

Enforcement and Improvement of the Corps of Engineers' Levee Inspection System

Before August of 2005, there was usually only one type of levee inspection. These routine inspections, also called annual inspections, were a visual-only inspection to verify proper levee system operation and maintenance. The levee breaches in New Orleans demonstrated that these visual-only inspections could not always reveal design/and or construction problems deep underground. In response, the Army Corps of Engineers began to require more risk-informed levee inspections and assessments including:

- Continuous inspections by local sponsors with more rigorous standards and new checklists,
- Annual robust inspections by Corps District offices that are professionally managed,
- Periodic inspections and a screening assessment every five years, and
- Risk assessments, a rigorous data intensive effort every ten years.[75]

Routine inspections are now conducted more frequently than once a year and verify that proper operation and maintenance activities are being conducted by the local public sponsor. For example, in New Orleans, Louisiana, the Corps of Engineers, responding to 'lessons learned' after the 2005 failures, now requires inspections quarterly rather than annually.[76] Periodic Inspections (PI) are more rigorous assessments that are conducted every five years. These new Periodic Inspections consist of three key steps: 1) collection of data on operation and maintenance, previous inspection

[69] Conforti, 2008.
[70] Kevin Canfield, "Corps finds levee district 'unacceptable'," *Tulsa World* (Oklahoma), May 2, 2008
[71] Rudolph Bush, "Corps of Engineers rates Dallas Trinity River levees unacceptable," *Dallas Morning News*, February 24, 2009.
[72] Sean Ellis, "Cheyenne project stuck in design stage, *Idaho State Journal,* February 2, 2010.
[73] Tom Charlier, "New levee inspection standards could cost residents," *The Commercial Appeal* (Memphis), April 11, 2010.
[74] Andy Reid, "Levee that protects South Florida from Everglades flooding fails to meet federal standards, *WPTV Channel 5*, December 19, 2010.
[75] Ibid.
[76] United States Army Corps of Engineers, Public Affairs Office, "Miss., Atchafalaya inspections begin Friday," New Release, October 8, 2006.

reports and flood-fighting records, 2) a field inspection with more detail, performed by a multidisciplinary team and led by a professional engineer, and 3) an inspection report that includes a rating for operations and maintenance and may include additional recommendations of items to monitor or areas that need further evaluation.[77] The new requirements include more frequent removal of debris, vegetation and silt from levees, and more frequent mowing.[78]

While the Levee Inspection System was in place before the August 2005 catastrophe, the event prompted rapid updates, improvements and uniformity. For example, in 2007-2008, all U.S Army Corps of Engineers districts throughout the country and several inspectors in California, Louisiana and Texas were trained as part of the Levee Inspection System.[79]

Funding for the periodic levee inspections was appropriated in the American Recovery and Reinvestment Act of 2009 (ARRA).[80] The first periodic levee inspections were conducted in California's Central Valley.[81]

Updates to the National Flood Insurance Program

Following the 2005 flooding, the National Flood Insurance Program (NFIP) significantly changed some policy and procedures for dealing with claim losses. In a May 2006 keynote speech, David Maurstad, Federal Insurance Administrator and Director of FEMA's Mitigation Division, stated at the 2006 National Flood Conference held in Philadelphia, PA, "…the 2005 hurricane season presented the NFIP with trials it had never seen. …the Program … is flexible, and … we worked together to implement innovative changes that enabled us to better serve our Gulf Coast policyholders when they needed help the most."

- We waived our proof of loss requirement,
- We worked with insurance companies to provide advance payments on contents coverage,
- We identified claims categories that lent themselves to an expedited adjustment process, and
- When … data indicated areas of total loss, the insurance companies administering the NFIP fast-tracked claims payments up to the maximum insured value. For example, in New Orleans, where the levees broke…there were many claims where it was readily apparent that damages would exceed the total limits of flood insurance purchased by the property owner. … through information already contained in underwriting files, other sources, and dialogue with the property owners, these claims were adjusted without a site visit and without the customary level of detailed documentation.[82]

In addition, Mr. Maurstad stated,

> "Hurricane Katrina forced Congress to get real familiar with the National Flood Insurance Fund and the financial matters that unavoidably arise when the nation's largest single-line property insurance provider encounters the nation's most catastrophic flood event… In the aftermath of the 2005 hurricane season, we're pushing forward with our 5-year, $1 billion initiative to modernize our Flood Insurance Rate Maps."[83]

The problem lies in the flood insurance program itself —- a rigged actuarial system that doesn't even try to balance its books or calibrate premiums in ways that would encourage safer housing practices in areas that flood repeatedly.

http://levees.org/2/wp-content/uploads/2011/04/After-Katrina-Pundits-Criticized-New-Orleans.pdf

[77] United States Army Corps of Engineers, Levee Safety Program – Inspections, http://www.usace.army.mil/LeveeSafety/Background/Documents/arra_brochure.pdf (accessed July 25, 2011).
[78] US Army Corps of Engineers, "Periodic Inspection Report 9 Update" (report presented to Dallas City Council, Dallas, Texas, June 3, 2009).
[79] Kevin Carlock, Deanna Sarro, Timothy Baldwin, "*U.S. Army Corps of Engineers Levee Inspection System"* Powerpoint presented at USACE Infrastructure Conference, Atlanta, Georgia, July 2011.
[80] American Recovery and Reinvestment Act of 2009, H.R. 1, 111th Congress (2009-2010).
[81] United States Army Corps of Engineers, News Release #2010-G-026, "*Corps announces Central Valley levee inspection results*," September 14, 2010.
[82] David Maurstad, "Putting the NFIP to the Test, *Watermark,* FEMA, 2006, Number 2, 5.
[83] Ibid, 31.

On both a national and regional level, the USACE coordinated its new levee inspection findings and the new levee data base with the Federal Emergency Management Agency (FEMA) for their use in making decisions for the NFIP. As the Federal agency that is responsible for administering the National Flood Insurance Program, FEMA identifies flood hazards, assesses flood risks, and provides appropriate flood hazard and risk information to communities nationwide. This new information was provided to communities in the form of the previously mentioned maps. After the Corps of Engineers' initial levee inventory was completed, FEMA modernized and updated flood insurance rate maps which are widely used to calculate risk and liability for floods. This has presently been done for most of the United States.

In March 2010, sixteen U.S. Senators signed a letter to FEMA and the Corps of Engineers citing challenges in the flood map modernization process. As stated in a joint hearing on map modernization, levee inspection and levee repairs, "since the epic failure of the federal levees in New Orleans in August 2005, additional levee failures occurred during the Midwest floods in 2008 and the historic spring floods earlier this year in Rhode Island and Tennessee."[84] Among the concerns listed in the letter were:

- lack of communication and outreach with local stakeholders,
- lack of coordination between FEMA and USACE in answering questions about both flood mapping, flood insurance and flood control infrastructure repairs,
- lack of recognition of locally funded flood control projects when determining flood zones,
- the affordability of flood insurance
- inadequate time and resources to complete repairs to flood control structures before flood maps are finalized, and
- potential impacts new flood maps might have on economic development.

Stronger Levees and Evacuation Plans along the Missouri River

The levee failures in New Orleans prompted the federal government to realize that there were shortcomings in its levee systems, according to Southern Illinois University professor Nicholas Pinter.[85] Since then, officials in Omaha, Nebraska and across the river in Council Bluffs, Iowa, have developed plans to evacuate roughly 40,000 people from areas near the river in case levees fail.

Before August of 2005, levees were often constructed using whatever material was near or could be delivered cheaply. Omaha's levees outside the city's main floodwall are built almost entirely out of clay, but barriers around the city's airport and in Council Bluffs were designed with a clay cap over a different filler material.

But since the New Orleans catastrophe, the standards for levee construction have changed, with modern designers concerned more about fortifying the foundation material. Newer levees are likely to be built entirely out of clay or another nonporous material.[86]

Passage of State Flood Protection Legislation

The lessons learned during the catastrophic flooding of New Orleans have been rapidly implemented with regard to improvement of flood protection systems across the rest of the nation. The earliest example is in Louisiana.

Louisiana

[84] U.S. Senate, Joint Hearing with the Subcommittee on Disaster Recovery, Ad Hoc Subcommittee on Disaster Recovery and Intergovernmental Affairs, "Flood Preparedness and Mitigation: Map Modernization, levee inspection, and levee repairs," July 28, 2010.
[85] Josh Funk, "Experts expect more Missouri River levee failures," Associated Press, July 9, 2011.
[86] Ibid.

Prior to Katrina, Greater New Orleans did not have "a levee agency with the ability to push back against the U.S. Army Corps of Engineers. A single, professional-minded levee agency would have the power, the technical expertise and the singular focus necessary to hold the corps accountable for its work."[87]

On December 30, 2005, Congress inserted language into the 3rd Supplemental Public Law 109-148 requiring the establishment in Louisiana of "a single state or quasi-state entity to act as local sponsor for construction, operation and maintenance of all of the hurricane, storm damage reduction and flood control projects in the greater New Orleans and southeast Louisiana area..."[88]

Ultimately, Louisiana voters passed legislation for two regional flood authorities – one for the east bank of the Mississippi River within the Pontchartrain Basin and one for the west bank of the river. They were put in place so that the Army Corps of Engineers could work with two local sponsors instead of nearly a dozen. The local flood authorities were required to include hydrologists, engineers, civil engineers and other professionals and were tasked to hold the Corps of Engineers accountable for its work.[89]

Creation of the two local superboards in Louisiana and populating them with non-political experts became a new model for the United States. In 2006, California followed suit and voted for a historic package of Flood Bills that put requirements on professional backgrounds of its board members similar to those in Louisiana.[90]

California

A second early example of a response to the levee breaches is the suite of massive flood protection efforts in California. In 2007, its State Legislature passed a pair of bills (different from that mentioned above) allocating $6.5 billion as the first phase of an overhaul of California's Central Valley flood protection systems providing protection for approximately 2 million people.[91] Lessons from the catastrophe also include development of new design standards and guidelines that in some cases deliberately exceed the standards already set by the U.S. Army Corps of Engineers. In other cases, new standards and design methods have been developed to address issues of particular importance in California that are not covered by current USACE policies and standards.

A second response of similar scale and perceived urgency is California's parallel efforts to address and resolve the seismic fragility of 1,100 miles of levees in the Sacramento Delta. Approximately 60% of California's fresh water supply passes through a system of levees before being drawn for use in the greater San Francisco Bay area and the regions of greater Los Angeles and San Diego. Twenty five million people depend on these waters. Spurred by the lessons from the New Orleans catastrophe, California's Legislature passed a historic suite of six bills in 2009 and the State is advancing with development and implementation of comprehensive solutions to this risk.

Reform of the Corps of Engineers Peer Review Process

The 2005 flooding in New Orleans also spurred Congress to pass legislation impacting how the U.S. Army Corps of Engineers handles feasibility studies for levee improvements. The McCain Feingold Corps Reform Amendment to the Water Resources Development Act of 2007 was passed by a narrow margin of 54-46 by the 109th Congress – 2nd Session.[92] The law established clear triggers for review of costly (over $40 million) or controversial feasibility studies by an independent panel, gave panel members discretion to review whatever they deemed significant, and imposed a modicum of pressure to encourage the USACE to consider outside recommendations. A decision to ignore the panel's advice could be used against the Corps in legal proceedings.

87

[88] Department of Defense, "Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico and Pandemic Influenza Act, 2006," Public Law 109-148- December 30, 2005.
[89] Editorial: "Divided We Flood," The Times Picayune, February 8, 2006.
[90] Frank D. Russo, "Historic Package of California Flood Bills Becomes Law," Dean Florez, California State Senate, October 11, 2007 (accessed July 11, 2011).
[91] Central Valley Flood Management, State of California, "*Draft Communications and Engagement Framework,* July 12, 2009, 2-1.
[92] United States Senate, U.S. Senator Mary Landrieu, "Landrieu Votes for Corps Reform," Press Release, July 19, 2006.

Could we add that changes to evacuation procedures???

Conclusion

As can be seen from the above narrative, there is no doubt that the New Orleans hydrologic event of 2005 was a catastrophic historic event of unprecedented nature. As previously mentioned, the short term impacts of the catastrophe caused by the levee breaches which are the subject of this nomination included the flooding of over 80% of the city and 100% of nearby St. Bernard Parish, the deaths of over 2,000 people, destruction of approximately $150 billion worth of private property and municipal infrastructure, widespread deforestation due to salt water intrusion, and the temporary and permanent displacement of hundreds of thousands of people who had lost or could no longer live in their homes. Furthermore, the event has seriously impacted and continues to impact national flood control policy and flood safety considerations as described above. For these reasons, the sites of the 17th Street Canal and east side north Inner Harbor Navigation Canal levee breaches clearly qualify for the National Register of Historic Places under Criterion A and Criteria Consideration G.

Developmental history/additional historic context information (if appropriate)

See above.

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Previous documentation on file (NPS): NA **Primary location of additional data:**

New Orleans Levee Breach Sites–17th Street and Inner Harbor Navigation Canals
Name of Property

Orleans Parish, LA
County and State

____preliminary determination of individual listing (36 CFR 67 has been requested)
____previously listed in the National Register
____previously determined eligible by the National Register
____designated a National Historic Landmark
____recorded by Historic American Buildings Survey
____recorded by Historic American Engineering Record
____recorded by Historic American Landscape Survey
____Not Applicable

__x__State Historic Preservation Office
__x__Other State agency
__x__Federal agency
__x__Local government
____University
____Other
Name of repository: _____

Historic Resources Survey Number (if assigned): NA

10. Geographical Data

Acreage of Property less than an acre (total for both resources
(Do not include previously listed resource acreage.)

UTM References
(Place additional UTM references on a continuation sheet.)

17th Street Canal

	Zone	Easting	Northing		Zone	Easting	Northing
1	15	777660	3324040	3			
2				4			

East Side, North Breach Inner Harbor Navigation Canal

	Zone	Easting	Northing		Zone	Easting	Northing
1	15	787550	3320240	3			
2				4			

Verbal Boundary Description (Describe the boundaries of the property.)

The boundaries for both resources are depicted on the attached sketch maps.

Boundary Justification (Explain why the boundaries were selected.)

Boundaries were selected to include the sites of the specific levee breaches being nominated rather than the areas that flooded as a result of the breaches. These boundaries convey information about the immediate setting as well as the design and materials of the resources.

11. Form Prepared By

name/title Sandy Rosenthal, Founder and Director, and H. J. Bosworth, Jr., P.E.

organization Levees.org date Spring - Summer 2011

New Orleans Levee Breach Sites–17th Street and Inner Harbor Navigation Canals — Name of Property
Orleans Parish, LA — County and State

street & number 1421 Soniat Street telephone 504 891-8437
city or town New Orleans state LA zip code 70115
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Technical assistance in the production of this nomination was provided by:

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770-424-6826, Spring and Summer 2011

In addition, Ms. Heather Ruoss, Architectural Consultant, Ms. Patricia Duncan of the Louisiana SHPO office and Mr. James Gabbert of the National Park Service, National Register office also provided significant assistance to the preparers by their review of drafts, providing recommendations, and development of selected sections for this nomination."

Additional Documentation

Submit the following items with the completed form:

- **Maps:** A **USGS map** (7.5 or 15 minute series) indicating the property's location.

  A **Sketch map** for historic districts and properties having large acreage or numerous resources. Key all photographs to this map.

- **Continuation Sheets**

- **Additional items:** (Check with the SHPO or FPO for any additional items.)

Photographs:

Submit clear and descriptive photographs. The size of each image must be 1600x1200 pixels at 300 ppi (pixels per inch) or larger. Key all photographs to the sketch map.

Name of Property: New Orleans Levee Breach Sites–17th Street and Inner Harbor Navigation Canals

City or Vicinity: New Orleans

County: Orleans State: LA

Photographer:

Date Photographed:

Description of Photograph(s) and number:

1 of x

Property Owner: East Side, North Breach Site of the Inner Harbor Navigation Canal

(Complete this item at the request of the SHPO or FPO.)

New Orleans Levee Breach Sites–17th Street and Inner Harbor Navigation Canals | Orleans Parish, LA
Name of Property | County and State

name The United States of America, US Army Corps of Engineers, Linda LaBure, Chief, Real Estate Division-Region South, New Orleans District

street & number 7400 Leake Avenue telephone 504 862-1295

city or town New Orleans state LA zip code 70118

Property Owner: 17th Street Canal Breach Site

(Complete this item at the request of the SHPO or FPO.)

name Gerry Gillen Executive Director, Orleans Levee District

street & number 6920 Franklin Avenue telephone (504) 286-3100 x1007

city or town New Orleans state LA zip code 70122