Harnessing the Mississippi River and Delta:
The Natural System, Infrastructure, Risks and Impact
University of Notre Dame Civil and Environmental Engineering and Earth Sciences
Junior Class Field Trip
September 26 – September 30, 2012

"One who knows the Mississippi will promptly aver...that ten thousand River Commissions, with the mines of the world at their back, cannot tame the lawless stream, cannot curb it or confine it, cannot say to it Go here or Go there, and make it obey; cannot save a shore that it has sentenced." - Mark Twain, Life on the Mississippi

Red times are in Eastern Time, all other times are in Central Time

Wednesday, September 26

4:45 am	**Meet at Royal Excursion bus – pick up at Eck Visitor Center by bookstore**
5:00 am	**Departure** ***Bus leaves promptly at 5:00 am*** **We'll be stopping along the way (either two 15 minutes stops or one 30 minutes stop) at rest stop for break so you can buy snacks/drinks prior to arrival in St. Louis** ***Need to have sturdy shoes or workboots, long sleeves, long pants for bridge site.***

Map from www.geography.howstuffworks.com

Driving To and Along the Mississippi River: *The muddy Mississippi has wound its way through this country's history since the first European settlers set foot on the shores of America. To the settlers of Mid-America, the Mississippi River was one of their most valuable resources. It provided them with a means of transportation for developing commerce and industry, as well as water for crops and irrigation. While settlers enjoyed their ready access to the river, they did not enjoy its ready access to them. Floods frequently swept away their attempts at permanent settlements. The consensus grew that the Mississippi would need to be artificially controlled in order for society to benefit from its proximity.*

The history of man's attempts to control the Mississippi is full of both success and failure. Levees already existed when the first French trappers ventured into the wilds of Louisiana. These levees were formed naturally by the Mississippi's fluvial processes and tended to be no more than a meter or two in height. Building up these natural levees was the first solution to the flooding problem. In 1717, the first manmade levee system was started by Bienville, the founder of the city of New Orleans. The construction of the first levees, which reached only three feet in height, was completed in 1727. After that, it was left to private interests to extend the levees. By 1743, French landowners were required to build and maintain the levees along their riverfront property or forfeit their lands to the French crown. However, it soon became obvious that these small levees, although augmented through the efforts of the settlers, were not enough protection against Mississippi flood waters. During large floods, the river would frequently break through at weakened points in the levees, referred to as crevasses. Many crevasses, such as the Macarty Crevasse of 1816, took many lives and caused extensive property damage.

The unorganized levee system was finally turned over to the Army Corps of Engineers. The levees were designed to protect populated areas from potentially disastrous flooding and keep the Mississippi safely within its banks. However, not everyone agreed that levees were the best way to decrease flooding. In 1852, the federal government appropriated $50,000 in order to conduct studies on how to further eliminate the flooding problem. The first study was done by an engineer named Charles Ellet Jr., whose study produced some startling conclusions. His report to Congress attributed the increase of flooding in the Mississippi River Basin to four major developments, including: "The extension of the levees along the borders of the Mississippi, and of its tributaries and outlets, by means of which the water that was formerly allowed to spread over many thousand square miles of low lands is becoming more and more confined to the immediate channel of the river, and is therefore, compelled to rise higher and flow faster, until, under the increased power of the current, it may have time to excavate a wider and deeper trench to give vent to the increased volume which it conveys."

Ellet also mentioned the effects of increased cultivation, manmade cutoffs/shortcuts, and the lengthening of the delta all of which will increase the probability and magnitude of floods. He concluded that the flooding problem would worsen with time as the Mississippi Basin becomes more settled. According to Ellet, "It is shown that each of these causes is likely to be progressive, and that the future floods throughout the length and breadth of the delta, and along the great streams tributary to the Mississippi, are destined to rise higher and higher, as society spreads over the upper States, as population adjacent to the river increases, and the inundated low lands appreciate in value."

Unfortunately, Ellet's opinion was ignored in favor of two Army Corps Engineers, Captain Andrew Humphreys and Lieutenant Henry Abbot, whose views became the consensus for the next 140 years. In their study, Report Upon the Physics and Hydraulics of the Mississippi River*, Humphreys and Abbot emphasized that levees were the best method of flood damage control. Since 1882, the USACE in conjunction with the Mississippi River Commission extended the levee system so that it included mainly the area from Cairo, Illinois to the mouth of the Mississippi delta in Louisiana. However, the relief brought by the levees would prove to be short-lived.*

As time progressed, it became increasingly apparent that the Mississippi was diverting more and more of its flow down the Atchafalaya River. In the 1950's, engineers observed that the Mississippi would soon cease to inhabit its current channel as the mainstream, and instead migrate to the Atchafalaya River Basin. The path by which the Mississippi would migrate was a small stretch of water, named the "Old River", that connected the Mississippi to the Red River… In their study of the Atchafalaya River, the USACE was able to deduce several possible effects of the diversion. The discharge of water into the current Mississippi channel would decrease until it resembled a bayou. All the levees along the previous Mississippi channel would no longer be needed to prevent flooding. In addition, towns such as Morgan City, located within the current Atchafalaya flood plain would be swept away by the newly expanded river. An expensive levee system would have to be built along the Atchafalaya in order to preserve current standards of flood control. The old Mississippi channel would no longer be able to be used for navigation by industry without expensive and extensive dredging. Industry would lack the water it needed to perform many of its processes such as cooling and the dumping of wastes. Agriculture would suffer from the lack irrigation water, and cities such as New Orleans would suffer economically from the lack of trade and drinking water. The only thing the diversion of the Atchafalaya promised to bring to society was disaster, and legislators decided to prevent this disaster at all costs.

Image from www.toptenz.net

The Army Corps of Engineers was given the job of maintaining the current distribution of water between the Lower Mississippi and the Atchafalaya River channels (70%-30%). They did so by building the Old River Flood Control Structure which consisted of massive floodgates that could be opened and closed as needed at the entrance to the Old River. This structure was completed in 1963. In 1973, a large flood tested the ORCS to its limits. Huge scour developed underneath the large steel pilings which anchored the structure to the river bottom. The structure was almost swept away, and emergency concrete was poured into the holes as a kind of large Band-Aid. After the '73 flood, the corps saw the need for a backup structure, and built the Old River Control Auxiliary Structure (ORCAS) to alleviate some of the pressure on the main control structure during large scale flooding.

Despite several close calls, the ORCS still manages to keep the Mississippi River in check. How long this will last, however, is a matter of opinion. The Army Corps claims to have the situation in control; the Mississippi will not divert to the Atchafalaya as long as they are there to prevent it. However, what if the control structures necessary to prevent the Mississippi's diversion to the Atchafalaya River were completely undermined and swept away during a flood such as the one in 1973? The ORCS has almost failed in the face of the Mississippi's might before, and it could still do so. Can the Army Corps withstand nature's might indefinitely, or will physics and the Mississippi River win out in the end?

In addition to the flooding problem, engineers now face problems caused by the lack of flooding. The channelization produced by the levees and control structures deprives natural wetlands of the sediments normally deposited during flooding. Wetlands rely on sediments from distributaries and flooding to counteract subsidence, the compaction of sediments under their own weight. Water flows faster in subsided areas, and distributaries can rapidly expand into wide channels, causing wetlands to disappear under the influx of water. The coastal marshes of Louisiana provide a natural barrier against the erosion causes by the fierce storms which often come from the Gulf. Because of the loss of these wetlands, the Louisiana coast has receded several thousands of feet over the past few decades, and commercial fishermen have also been deprived of a ready source of income.

Most of the problems resulting from the levee system, including wetland degradation, stem from channelization. While the levee system could not be scrapped without a large financial loss, the USACE realized that diversion structures could help alleviate some of the problems caused by channelization. Diversion structures diminish some of the force of flood waters and the likelihood of crevasses (breaks in the levee) by providing flood waters with established escape routes. The first diversion structure, the Bonnet Carre Spillway, was built in response to the great flood of 1927. It was designed to discharge excess flood waters into Lake Pontchartrain and thence into the Gulf of Mexico.

The USACE has recently built other diversion structures whose main purpose is to divert sediment-rich water into wetland areas in order to stop subsidence. The Caernarvon diversion structure, completed in 1991, was the first of these modern structures. It has significantly restored wetland acreage and wildlife in the area. The success of the Caernarvon diversion structure has encouraged the government to develop more of diversion structures.

The future seems uncertain for the lower Mississippi. Many questions regarding its fate reside in the hearts of both citizen and legislator alike. When will the next record-breaking flood take place, and what will be its effects? No one can tell whether the capricious river will flood its banks for a final time and permanently send its main flow to the Atchafalaya. Will the mighty Mississippi winding past New Orleans be reduced to a bayou? How much wetland habitat will be lost to subsidization and how far will the Louisiana coasts recede? These questions remain unanswered. Much work remains to be done to counteract the damage caused by our attempts to control nature; it is up to us to see that matters don't become worse. **from "The Mississippi Levee System and the Old River Control Structure," by Katherine Kemp, http://www.tulane.edu/~bfleury/envirobio/enviroweb/FloodControl.htm**

Wednesday, September 26, cont.

1:00pm CT (2:00pmET) **Arrive at New Mississippi River Bridge construction site, St. Louis**
Massman, Traylor, Aberici, JV, 4 Brooklyn St, St. Louis, MO 63102
Need to have sturdy shoes or workboots, long sleeves, long pants for bridge site.
Lunch will be provided

Safety gear, construction overview

Site tour

The ***New Mississippi River Bridge*** *(http://www.newriverbridge.org/)*

The New Mississippi River Bridge project is a four-year construction project to build a cable-stayed bridge across the Mississippi River between downtown St. Louis and St. Clair County, Illinois. This new bridge will move Interstate 70 off the Poplar Street Bridge (which currently carries three interstates and is the only interstate bridge into downtown St. Louis).

Wednesday, September 26, cont.

4pm	**Tour and walk around St. Louis Arch, Eads Bridge**
6pm	**Dinner at Soulard's Restaurant, 1731 South 7th Street, St. Louis**

*The **St. Louis Gateway Arch**, also known as the Gateway to the West, was built as a monument to the westward expansion of the United States. Designed by architect Eero Saarinen and structural engineer Hannskarl Bandel in 1947, it is 630 feet wide at its base, and stands 630 feet tall, making it the tallest monument in the United States. Construction started in 1963 and it was open to the public in July 1967.*

The design was chosen in a national architectural competition from 147 entries. The cross-sections of its legs are equilateral triangles. Each wall consists of a stainless steel covering a sandwich of two carbon steel walls with reinforced concrete in the middle from the ground level to 300 feet, with carbon steel and rebar from 300 feet to the peak. The Arch is hollow and contains a unique tram system that brings visitors to an observation deck at the top. The interior also contains two stairwells of 1,076 steps for use in emergencies.

The base of each leg at ground level had an engineering tolerance of one-64th of an inch or the two legs would not meet at the top. During construction, both legs were built simultaneously. When the time came to connect the legs at the apex, thermal expansion of the sunward-facing south leg prevented it from aligning precisely with the north leg. The St. Louis Fire Department sprayed the south leg with water from fire hoses, cooling it and aligning with the north leg.

Information from http://en.wikipedia.org/wiki/Gateway_Arch
Arch Image from http://en.wikipedia.org/wiki/File:Gateway_Arch_complete.jpg

Bridge Image from stop.158.org

*The **Eads Bridge** is a combined road and railway bridge over the Mississippi River at St. Louis, connecting St. Louis and East St. Louis, Illinois. Eads Bridge was designed and built by engineer James Buchanan Eads (1820-1887), a celebrated American engineer. Eads first came to prominence by creating a diving bell for retrieving goods of steamboat disasters from the bottom of rivers and for devising barges to raise the remains of the sunken vessels. During the Civil War he was contracted to construct ironclads for the United States Navy, and impressed the Navy by producing 8 ships within 100 days. He continued to produce ironclad gunboats and mortar boats to be used securing the Mississippi and its tributaries throughout the war for the Union. By the end of the war Eads was a captain in the U.S. Army Corps of Engineers. The last great work with which* *he was connected was the improvement of the mouth of the Mississippi by designing a system of willow mattresses and stonework where the water was confined to a narrow passage to scour a deep channel.*

The need for a bridge across the Mississippi at St. Louis to provide a link for eastern and western railroads was discussed as early as 1939. The idea of a bridge was fiercely opposed by the riverboat industry, which regarded bridges as obstacles to navigation, and by the ferrymen, who controlled trans-Mississippi commerce between St. Louis and the cross channel Illinois communities. This opposition and the cost of a bridge made the project unfeasible. The expansion of the railroad systems after the Civil War made a bridge a matter of economic survival for St. Louis if it intended to remain a major link for eastbound and westbound transportation. In 1867 a group of bankers and businessmen formed the St. Louis Bridge and Iron Company and hired Eads to design the bridge.

Eads' design set a number of precedents in bridge building. It was the world's first true steel bridge, the first to use tubular cord members, and the first to use cantilever support methods exclusively. It was also the first bridge in the United States to make use of pneumatic caissons in the construction of the piers, which were sunk to unprecedented depths. Eads invented a sand pump to remove gravel, sand, and silt from the caissons so that the sinking operation would continue without interruption. The Eads Bridge was the first large bridge to span the Mississippi River and the first to carry railroad tracks.

The Eads Bridge was constructed over a period of seven years at a cost of over $10,000,000. The bridge consists of three spans and the piers are built of limestone carried down to bedrock. The bridge was dedicated and opened July 4, 1874 with great fanfare. After a 100-gun salute and a parade 14 miles long that wound through the streets of St. Louis' streets 150,000 people looked on as General William Tecumseh Sherman drove the last spike. An enormous fireworks display followed later that evening.

At the time it was built the Eads Bridge was the world's largest bridge with an overall length of 6,442 feet. The upper deck extended over the entire width with a vehicular roadway and two pedestrian walkways. After a tornado crumpled the superstructure of the east abutment in 1871, the bridge was redesigned to be tornado proof and survived being struck again by a tornado in 1896. The East St. Louis & Suburban Railway Co. opened electric railway in 1896 between East St. Louis and St. Louis over the Eads Bridge. This service continued until 1935. In 1947, this deck was replaced with concrete filled "I Beam Lok" and the roadway was widened.

The Eads Bridge was dedicated as a National Historic Landmark in 1964. The last train passed over the bridge in 1974 and the bridge was closed to automobile traffic in 1991 due to deterioration of the deck supports. The bridge was reopened to rail traffic when the first phase of MetroLink opened in 1993. A restoration project initiated by the City of St. Louis was completed in 2003 when the bridge was reopened to automobile traffic. Today the Eads Bridge supports automobile, MetroLink, bicycle and pedestrian traffic. The bridge can also be closed to automobile traffic and used as the site for various festivals and celebrations. **Information from http://www.greatriverroad.com/stlouis/eadsbridge.htm**

Wednesday, September 26, cont.

8:00pm	**Drive on to Marion, Illinois (2 hours)**
Overnight at:	**Hampton Inn Marion** **2710 West DeYoung, Marion, Illinois 62959, 618-998-9900**

Thursday, September 27

6am – 8am	**Breakfast buffet in hotel available beginning at 6am**
8:00am	**Meet at bus – departure for [Olmsted Lock and Dam]** **Bring Massman hats vests glasses!** ***Important! Fill in waivers on bus on way to Olmsted. Need to have sturdy shoes or workboots, long sleeves, long pants for site.***
9:00am	**Arrival Olmsted Resident Office**
9:15am	**Project overview**
10:15am-12:15pm	**Tour project site**

Olmsted Locks and Dam Construction

The continuing growth in demand for water-borne commerce on the Ohio River requires periodic improvements in the waterways transportation infrastructure. Locks and Dams No. 52 and 53 located on the Ohio River between Paducah, Ky. and Cairo, Ill. were completed in 1929. Temporary 1,200 foot long lock chambers were added later. The antiquated design and age of these structures make it impossible to meet current traffic demands without significant delays. Over the last five years tonnages have averaged 90 million tons at Locks and Dam 52 and 79 million tons at Locks and Dam 53. The U.S. Army Corps of Engineers and the navigation industry, in a continuing effort to provide for the nation's navigation needs, will replace these aged facilities with one of the largest civil works projects undertaken by the Corps. This new locks and dam project is under construction near the community of Olmsted, Ill.

This strategic reach of the Ohio River provides a connection between the Ohio, Tennessee, Cumberland and Mississippi Rivers. The area has been described as the "hub" of the Ohio and Mississippi rivers waterway system. Barge traffic moving between the Mississippi River system and the Ohio, Tennessee and Cumberland rivers must pass through this stretch of river. More tonnage passes this point than any other place in America's inland navigation system. The Olmsted project will consist of two 110 foot by 1,200 foot lock chambers located along the Illinois shoreline.

http://www.lrl.usace.army.mil/poi/default.asp?mycategory=297

Brochure on the project:
http://www.lrl.usace.army.mil/poi/article.asp?id=688&MyCategory=297

Info on project:
http://www.lrl.usace.army.mil/poi/default.asp?mycategory=297

http://www.youtube.com/louisvilleUSACE

http://watch.discoverychannel.ca/#clip438573

Thursday, September 27, cont.

1:00pm	**On road to Vicksburg, Mississippi**
2:00pm	**Late lunch at Lambert's Café, The Only Home of the Throwed Rolls, 2305 E. Malone, Sikeston, MO 63801**
3:30pm	**Drive on to Vicksburg**
8:00pm	**Dinner at McAlister's, 4200 Clay Street, Vicksburg, MS 39183, 601-619-8222**
Overnight at	**Hampton Inn and Suites, Vicksburg, MS** **3300 Clay Street, Vicksburg, MS 39183, 601-636-6100**

Friday, September 28

6am – 8am	**Breakfast buffet in hotel available beginning at 6am**
8:00am	**Meet at bus – departure for USACE ERDC, 3909 Halls Ferry Road. Vicksburg, MS** ***Business casual or work construction dress.***
8:30am	**Arrive USACE Engineer Research and Development Center, Vicksburg**
0835--0900	*Auditorium, Bldg. 1006,* Welcome and Recruiting Video—Public Affairs Office Careers in Engineering—Mr. Devin Sham
0910—1010	*Bldg. 8000, Information Technology Laboratory* ITL Overview—Mr. Ken Pathak/Ms. Rachelle Hintson DoD Supercomputing Resource Center—Dr. Bob Maier Scientific Visualization—Dr. Mike Stephens and Staff
1010—1040	*Coastal and Hydraulics Laboratory, Bldg. 3200,* CHL Overview—Mr. Jose Sanchez Ship Simulator—Mr. Dennis Webb
1045—1100	*Bldg. 3050,* Bluestone General Model—Ms. Yameretsy Pagan-Albelo
1105—1145	*Hudson Bldg.* , Waves and Vegetation—Ms. Mary Anderson Long Shore Sediment Transport Facility—Dr. Ernie Smith
1145--- 1200	*Bldg. 3270/Environmental Laboratory Conference Room* **Distribute Heavenly Ham Box Lunches** *Poster Sessions*
1200—1205	Welcome—Dr. Jack Davis
1205---1215	Field Deployable Instrumentation and Analysis—Mr. Will Jones
1215—1225	In Vitro Nanotoxicology: Predicting Nanoparticle Behavior in Biological Systems—Dr. David Johnson
1225—1235	Electrochemical Destruction of Process Waste Water Energetic Compounds—Mr. Jared Johnson
1235---1245	Dredged Material Management Through Beneficial Use—Mr. Richard A. Price
12:45—12:55	Electrical Barrier Fish Research---Dr. Tim Lewis
12:55---13:05	Coastal Wetlands Landscape Change, Dredged Materials BU, Invasive Aquatic Plant Species Sensing/Mapping—Glenn Suir, Yvonne Allen and Christina Saltus
1305—1315	Animation Screens Project—Ms. Kelly Burks-Copes
1320---1350	*Geotechnical and Structures Laboratory* Centrifuge Research Facility—Dr. Johannes Wibowo
1350	Depart ERDC

The Engineer Research and Development Center (ERDC) is the US Army Corps of Engineers distributed research and development command. The Vicksburg facility houses the Coastal and Hydraulics Lab, Environmental Lab, Geotechnical and Structures Lab and the Information Technology Lab. The Mission of ERDC is to provide science, technology, and expertise in engineering and environmental sciences in support of our Armed Forces and the Nation to make the world safer and better.

The ERDC hosts one of six Department of Defense High Performance Computing Centers; the center's Cray XT3 and XT4 supercomputers are some of the most powerful and fastest in the world, with a capability of 115 trillion calculations per second. Computing capacity will soon reach 287 trillion calculations per second with the addition of the SGI supercomputer. Other unique and world-class facilities include the world's most powerful centrifuge, blast effects facilities, physical models of river and coastal projects, endangered species laboratories, heavy vehicle simulators, hazardous waste research laboratories, frost and ice engineering facilities, and an 1800-foot coastal research pier.

Images and text from http://www.erdc.usace.army.mil/

1:50-5:30pm	**Depart ERDC, drive to New Orleans, 3 ½ hours**
6pm	**Board Steamboat Natchez**
7pm-9pm	**Dinner/Jazz Cruise on the Mississippi aboard the Natchez**
Overnight at:	**Le Pavillon Hotel,** **833 Poydras Street, New Orleans, 504-581-3111**

Natchez has been the name of several steamboats, and four naval vessels, each named after the city of Natchez, Mississippi or the Natchez people. The current one has been in operation since 1975. The previous Natchez were all operated in the nineteenth century, most by Captain Thomas P. Leathers. Each of the steamboats since Leathers' first had as its ensign a cotton bale between its stacks. The ninth and current Natchez, the SS. Natchez, is a sternwheel steamboat based in New Orleans, Louisiana. Built in 1975, she is sometimes referred to as the Natchez IX. She is operated by the New Orleans Steamboat Company and docks at the Toulouse Street Wharf. Day trips include harbor and dinner cruises along the Mississippi River. Its steam engines were originally built in 1925 for the steamboat Clairton, from which the steering system also came. From the S.S. J.D. Ayres came its copper bell, made of 250 melted silver dollars. The bell has on top a copper acorn that was once on the Avalon, now known as the Belle of Louisville, and on the Delta Queen. It also features a steam calliope that can play 32 notes. The wheel is made of white oak and steel, is 25 feet (7.6 m) by 25 feet (7.6 m), and weigh over 26 tons. The whistle came from a ship that sank in 1908 on the Monagabola River. It was launched from Braithwaite, Louisiana. It is 265 feet (81 m) long and 46 feet (14 m) wide. It has a draft of six feet and weighs 1384 tons. It's mostly made of steel, due to United States Coast Guard rules. In 1982 the Natchez won the Great Steamboat Race, which is held every year on the Wednesday immediately before the first Saturday in May, as part of the Kentucky Derby Festival held in Louisville. During the Hurricane Katrina disaster, the Natchez temporarily moved upriver to Baton Rouge, Louisiana. Since then, operations have returned to New Orleans.

Image from rrikbeck.com , Information from http://en.wikipedia.org/wiki/Natchez_%28boat%29

Saturday, September 29

6:30am -8:00am	**Breakfast in hotel in dining room, dining room opens at 6:30am**
8:00am	**Meet at bus** **Mark Spillers, Public Affairs Office, USACE MVN will meet at bus to give tour** ***Need to have sturdy shoes or workboots, long sleeves, long pants for sites.***
8:15am	**Drive to IHNC Lake Borgne Surge Barrier**
8:30am-8:45am	**Briefing**
9:00am-10:00am	**Tour IHNC Lake Borgne Surge Barrier**

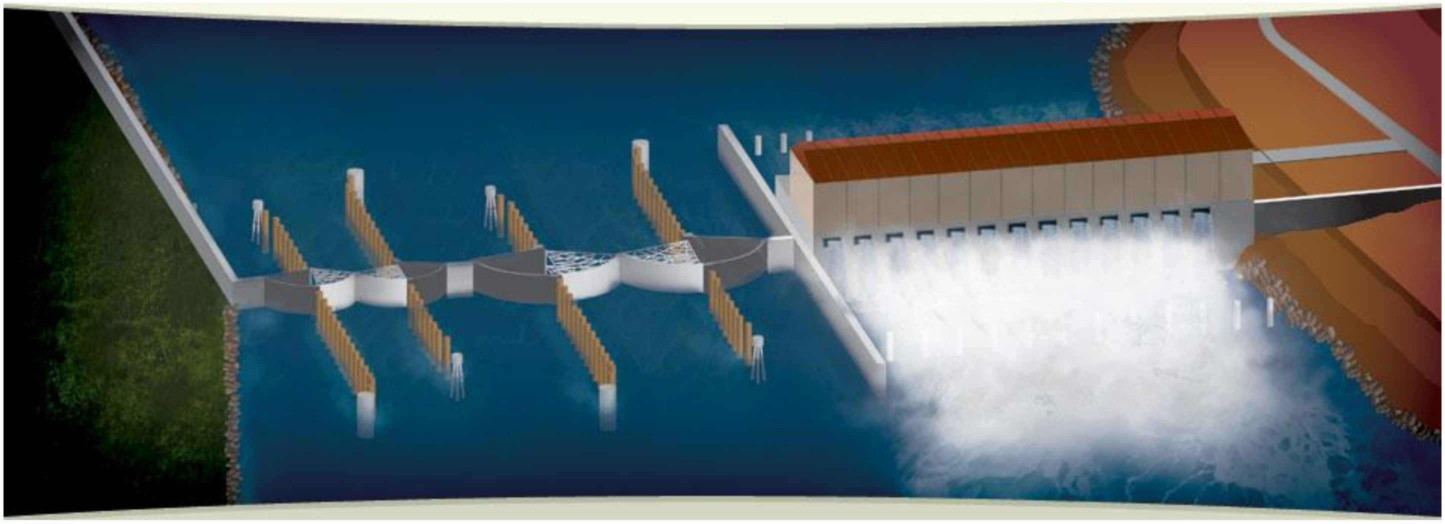
Inner Harbor Navigation Canal (IHNC) – Lake Borgne Surge Barrier: *The IHNC storm surge barrier is considered the most critical component of the Greater New Orleans Hurricane and Storm Damage Risk Reduction System (HSDRRS), which consists of 325 miles of earthen levees, concrete floodwalls, pump stations and gate structures. The IHNC barrier is about two miles long and includes the steel-braced concrete wall, a sector gate, bypass barge gate and navigable sector gate. The barrier is designed to block storm surge at what is considered the Achilles' heel of the system, the confluence of the IHNC, the Gulf Intracoastal Waterway, and the Mississippi River Gulf Outlet. The three waterways form a geographical funnel that invites storm surge into the city from Lake Borgne and the Gulf of Mexico.* **Information and images from http://www.mvn.usace.army.mil/pao/videos/pao_videos.asp**

The Army Corps of Engineers closed the barge gate on the Lake Borgne Surge Barrier for the first time this past August in advance of Hurricane Isaac. The $1.1 billion, 1.8-mile long Inner Harbor Navigation Canal-Lake Borgne Surge Barrier was built after Hurricane Katrina where the Gulf Intracoastal Waterway and the Mississippi River Gulf Outlet come together to block storm surge from Lake Borgne coming into eastern New Orleans and the Lower Ninth Ward. The structure is 26 feet high and is anchored by 1,271 pilings that are 140 feet long. Another battery of pilings was driven at an angle to reinforce the great wall. **http://www.nola.com/hurricane/index.ssf/2012/08/lake_borgne_surge_barrier_clos.html**

Saturday, September 29, cont.

10:00-11am	**Drive to Gulf Intracoastal Waterway West Closure Complex (GIWW WCC)**
11am-noon	**Tour closure complex**

Gulf Intracoastal Waterway West Closure Complex (GIWW WCC): *Owner: US Army Corps of Engineers, New Orleans District. Contractor: Gulf Intracoastal Constructors Lead: District: South Central, Participating Districts: Central, Kiewit Bridge and Marine, Kiewit Federal Group, Project Value: $963 million*



One of the largest of its kind, GIWW WCC features a pumping station capable of pumping storm water at a rate 20,000 cubic feet per second and two navigable gates spanning more than 300 feet, as well as construction and relocation of levees and flood walls. Located just south of the confluence of Harvey and Algiers canals, GIWW WCC will ultimately reduce risk and provide safety for the 240,000 people who live on the West Bank of the Mississippi River in New Orleans.

Information from Kieways October 2009 – The Magazine of Kiewit Corporation, Image from http://westclosure.com/index.php

"When a major storm threatens, the waterway's new West Closure Complex will mount a two-point defense. First, operators will shut the 32-foot-tall, 225-foot-wide metal gates to block the surge. Then they'll fire up the world's largest pumping station, which pulls 150,000 gallons of floodwater per second. And unlike the city's notorious levees, the WCC won't break when residents need it most. 'This station is designed to withstand almost everything,' including 140mph winds and runaway barges, says Tim Connell, the U.S. Army Corps of Engineers's project manager for the complex."

http://www.popsci.com/scitech/article/2009-08/saving-new-orleans-worlds-largest-water-pump

Hurricane and Storm Damage Risk Reduction System (HSDRRS) Flyover Video:
http://youtu.be/4wMnFxWqlMQ

IHNC System Video: http://youtu.be/FcVe_t4uySc

Seabrook Gate and Storm Event: http://youtu.be/iFupaOqGOtk

IHNC Surge Barrier and Storm Event: http://youtu.be/2M1DpJeLLPs

IHNC Interior System Improvements: http://youtu.be/nkKpXK3NCCc

Seabrook Gate Construction: http://youtu.be/RmTXTA5CaPw

IHNC-Lake Borgne Surge Barrier: http://youtu.be/StfzeAXVz1I

Saturday, September 29 cont.

Noon – 1pm	Back to Hotel
1pm-4:30pm	Free afternoon in French Quarter
4:45pm	Roll call at entrance to St. Louis Cathedral, Jackson Square
5:00pm	Mass at St. Louis Cathedral
6:00pm-9:00pm	Free time
9:00pm	Dinner at The Pelican Club, 312 Exchange Place, New Orleans, LA 70130 504-523-1504

Saturday, September 29, cont.

Overnight at Le Pavillon Hotel, 833 Poydras Street, New Orleans, 504-581-3111

Sunday, September 30

5am departure for Notre Dame (~16 hours)