121 Fed.Cl. 687
United States Court of Federal Claims.

ST. BERNARD PARISH GOVERNMENT and Other Owners of Real Property in St. Bernard Parish or the Lower Ninth Ward of the City of New Orleans,[1] Plaintiffs,
v.
The UNITED STATES, Defendant.

No. 05–1119
|
May 1, 2015

Synopsis

Background: Louisiana parish government, as owner of real property, and private owners of property filed suit claiming Fifth Amendment temporary taking by Army Corps of Engineers in constructing, expanding, operating, and failing to maintain navigational channel known as Mississippi River Gulf Outlet (MRGO), that significantly increased storm surge and caused flooding on owners' property during Hurricanes Katrina, Rita, Gustav, and Ike and subsequent tropical storms before Corps deauthorized MRGO.

Holdings: The Court of Federal Claims, Braden, J., held that:

[1] owners had property interest protected by Fifth Amendment;

[2] owners had reasonable investment-backed expectations in their property;

[3] flooding of property was foreseeable;

[4] MRGO caused flooding that effected temporary taking;

[5] Hurricane Katrina was not intervening event that broke chain of causation; and

[6] owners' injury from flooding was substantial and severe.

Ordered accordingly.

Attorneys and Law Firms

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William James Shapiro, Environmental and Natural Resources Division, United States Department of Justice, Washington, D.C., Counsel for the Government.

Temporary Takings Claim; U.S. CONST. amend. V.

MEMORANDUM OPINION AND ORDER ON LIABILITY REGARDING A TEMPORARY TAKING BY FLOODING

BRADEN, Judge.

On October 17, 2005, St. Bernard Parish, a governmental entity of the State of Louisiana, and owner of real property, together with private owners of real property, located either in St. Bernard Parish or the Lower Ninth Ward of the City of New Orleans, filed a Complaint in the United States Court of Federal Claims under the Takings Clause of the Fifth Amendment to the United States Constitution, alleging that the United States Army Corps of Engineers ("Army Corps") ***691** constructed, expanded, operated, and failed to maintain a seventy-six-mile-long navigational channel, known as the Mississippi River–Gulf Outlet ("MR–GO"),[2] that significantly increased storm surge and caused flooding on their properties from August 29, 2005 into early September during Hurricane Katrina, as well as "inevitably recurring" flooding thereafter during Hurricane Rita (September 24, 2005); Hurricane Gustav (September 1, 2008); and Hurricane Ike (September 13, 2008). As a result of the likelihood that storm surge would cause flooding in subsequent hurricanes and severe storms, on June 5, 2008, the Army Corps decided to "deauthorize" the MR–GO. Final closure took place by July 2009.

In the aftermath of Hurricane Katrina, over 400 lawsuits were filed in the United States District Court by other plaintiffs, alleging that the Army Corps' construction and operation of the MR–GO violated the Federal Torts Claims Act, 28 U.S.C. § 2671 *et seq*., and Louisiana negligence laws. These cases were consolidated before the Honorable Judge Stanwood R. Duval, Jr. ("the District Court").[3] On November 18, 2009, after a nineteen day bench trial, the District Court issued Findings Of Fact And Conclusions Of Law determining that the Army Corps' negligent failure to maintain and properly operate the MR–GO was a substantial cause of the fatal breaching of the Reach 2 levee and the catastrophic flooding during Hurricane Katrina. *See In re Katrina Canal Breaches Consol. Litig.,* 647 F.Supp.2d 644, 679–98 (E.D.La.2009) ("*Robinson* "). In addition, the District Court held that those actions: (1) were not subject to the Flood Control Act immunity; (2) did not satisfy the "due care" exception to the waiver of sovereign immunity; and (3) did not satisfy the discretionary function exception to the Federal Tort Claims Act. *Id*. at 698–734.

On March 2, 2012, the United States Court of Appeals for the Fifth Circuit summarized the District Court's "impressive rulings" of fact, as follows:

> In 1943, Congress requested a report from the Chief of Engineers, Secretary of the Army, investigating ways to make the Port of New Orleans more accessible for maritime and military use. That request led to the authorization of MRGO in 1956. The channel was built to its full dimensions by 1968 and afforded a shorter shipping route between the Gulf of Mexico and New Orleans. As the district court noted, the channel, as originally designed, "was to be 36 feet deep and 500 feet wide, increasing at the Gulf of Mexico to 38 feet deep and 600 feet wide." *In re Katrina Canal Breaches Consol. Litig*., 647 F.Supp.2d 644, 717 (E.D.La.2009). MRGO was cut through virgin coastal wetlands at a depth that exposed strata of so-called "fat clay," a form of soil soft enough that it will move if made to bear a load. The channel's original designers considered and rejected armoring its banks with foreshore protection, leaving them vulnerable to erosion.
>
> During the design and construction of MRGO, the Corps also implemented the Lake Pontchartrain and Vicinity Hurricane Protection Plan ("LPV"). Pursuant to that plan, the Corps constructed, *inter alia,* the New Orleans East Unit, levees protecting New Orleans East; the Chalmette Area Unit, levees protecting the Ninth Ward and St. Bernard Parish; and higher floodwalls in the outfall canals at 17th Street, Orleans Avenue, and London Avenue.
>
> Over the years, MRGO's lack of armoring or foreshore protection resulted in substantial erosion of its banks, largely from wave wash from wakes left by channel-going vessels. MRGO eventually reached ***692** a total average width of 1970 feet, well over three times its authorized width.
>
> Though the Corps eventually added foreshore protection in the 1980s, that delay allowed the channel to widen

> considerably, destroying the banks that would have helped to protect the nearby Reach 2 levee (in the Chalmette Area Unit) from front-side wave attack as well as loss of height. The increased channel width added more fetch as well, allowing for a more forceful frontal wave attack on the levee.
>
> MRGO's expansion thus allowed Hurricane Katrina to generate a peak storm surge capable of breaching the Reach 2 Levee and flooding the St. Bernard polder. Separately from MRGO, the hurricane also caused the 17th Street, Orleans Avenue, and London Avenue levees to breach.

In re Katrina Canal Breaches Litig., 673 F.3d 381, 385–86 (5th Cir.2012).

The United States Court of Appeals for the Fifth Circuit also affirmed the District Court's legal conclusions. *See id*. at 399 ("The district court's careful attention to the law ... allow us to uphold its expansive ruling in full, excepting our minor restatement of FCA immunity."). But, on September 24, 2012, that federal appellate court decided to consider the Government's petition for rehearing, withdrew its prior opinion, and reversed the District Court's legal ruling that the Army Corps was not immune from claims arising from levee breaches caused by MR–GO under the discretionary function exception to the Federal Tort Claims Act. *SeeIn re Katrina Canal Breaches Litig.,* 696 F.3d 436, 441 (5th Cir.2012). In doing so, however, the District Court's factual findings were not disturbed. *Id.* at 441–43.

Since the Federal Tort Claims Act and Louisiana negligence claims in the United States District Court's case are now final, the court's disposition of the substantive merits of Plaintiffs' Takings Clause claim alleged in this case is now ripe for adjudication.

To facilitate review of this Memorandum Opinion And Order, the court has provided the following outline:

I. RELEVANT FACTUAL BACKGROUND.

A. The Geographic Topology And Environmental Conditions In The New Orleans Area Prior To 1914.

B. Beginning In 1914, Navigational And Flood Protection Projects Were Constructed By The State Of Louisiana And The Army Corps Of Engineers In The New Orleans Area.

1. The Inner Harbor Navigation Canal (1914).

2. The Gulf Intracoastal Waterway (1925).

3. Lake Pontchartrain And The Hurricane Protection Project (1955).

C. During 1958–1968, The Army Corps Of Engineers' Constructed And Implemented The First Expansion Of The Mississippi River Gulf Outlet.

D. From 1998–2004, Army Corps Of Engineers' And Other Governmental Studies Identified That The Construction, Expansions, Operation, And Failure To Maintain The Mississippi River Gulf Outlet Could Significantly Increase Storm Surge And Flooding During Hurricanes Or Severe Storms, But No Remedial Action Was Taken.

E. Hurricane Katrina.

F. After Hurricane Katrina, Storm Surge Continued To Cause Intermittent Flooding, And The Army Corps Of Engineers Closed The Mississippi River Gulf Outlet In July 2009.

II. DISCUSSION.

A. Jurisdiction.

B. Standing.

C. Admissibility And Weight Of Witness Testimony.

1. Lay Witness Testimony.

2. Expert Witness Testimony.

D. Plaintiffs Established That The Army Corps Of Engineers' Construction, Expansions, Operation, And Failure To Maintain The Mississippi River Gulf Outlet Effected A Temporary Taking By Increased Storm Surge And Flooding Of Plaintiffs' Properties ***693** During Hurricane Katrina And Subsequent Hurricanes And Severe Storms.

1. Plaintiffs Established That They Held Protectable Property Interests Recognized Under Louisiana Law.

2. Plaintiffs Established That, Based On The Character Of Their Property Interests, They Had "Reasonable Investment–Backed Expectations."

3. Plaintiffs Established That It Was Foreseeable To The Army Corps Of Engineers That The Construction, Expansions, Operation, and Failure To Maintain The Mississippi River Gulf Outlet Would Substantially Increase Storm Surge During Hurricanes And Other Severe Storms And Cause Flooding.

a. Because Of Increased Salinity.

b. Because Of Increased Habitat/Wetland Loss.

c. Because Of Increased Erosion.

d. Because Of Increased Storm Surge.

e. Because Of The "Funnel Effect."

4. Plaintiffs Established A Causal Link Between The Army Corps Of Engineers' Construction, Expansions, Operation, And Failure To Maintain The Mississippi River Gulf Outlet And Significant Increase In Storm Surge And Flooding During Hurricane Katrina And Subsequent Hurricanes And Severe Storms That Flooded Plaintiffs' Properties.

a. Because Of Increased Salinity.

c. Because Of Increased Habitat And Wetland Loss.

d. Because Of Increased Erosion.

e. Because Of Increased Storm Surge.

f. Because Of The "Funnel Effect."

g. The Government's Arguments Are Not Supported By The Law Or The Record.

i. Flooding On Plaintiffs' Properties Did Not Occur On A Single Occasion, But Instead Was "Inevitably Recurring."

ii. Hurricane Katrina Was Not An Intervening Event That Broke The Chain Of Causation.

iii. Neither Subsidence, Sea Level Rise, Nor Land Loss Was The Cause Of Flooding On Plaintiffs' Properties.

iv. Economic Development Was Not The Cause Of Habitat/Wetland Loss.

v. Post–Katrina Remedial And Restoration Efforts Do Not Negate The Army Corps' Liability For A Temporary Taking Of Plaintiffs' Properties By Flooding.

vi. Plaintiffs' Claims Are Not Barred By The Statute Of Limitations.

5. Plaintiff Established That The Injury From Flooding Was Substantial And Severe.

III. CONCLUSION.

I. RELEVANT FACTUAL BACKGROUND.[4]

A. The Geographic Topology And Environmental Conditions In The New Orleans Area Prior To 1914.

In 1718, France founded Nouvelle–Orléans on the St. Bernard Delta. When that land ***694** was acquired in 1803 by the United States, as part of the Louisiana Purchase, it was surrounded by natural water sources: Lake Pontchartrain to the north; Lake Borgne to the east, until it merges into the Gulf of Mexico; Brendon Sound to the southwest, until it merges into the Gulf of Mexico; the Mississippi River arriving from the west of Lake Pontchartrain and undulating south; Lake Salvador to the south; Lake Allemands to the southwest; and Lake Maurepas to the northwest.

St. Bernard Parish is bordered by the Mississippi River to the south, Lake Borgne to the north, the Lower Ninth Ward to the west, and the Gulf of Mexico to the east. St. Bernard Parish is covered by wetlands and marsh, except for approximately forty-two square miles of developed land. 1/13/11 Taffaro Dep. 24–25. The Lower Ninth Ward is bordered by St. Bernard Parish to the east and the Inner Harbor Navigation Canal ("IHNC") to the west. 12/12/11 TR 86 (Estopinal). St. Bernard Parish and the Lower Ninth Ward together comprise what is known as the St. Bernard Polder.[5] Most of the area adjacent to the St. Bernard Polder was a swamp comprised of flooded forests and marshes or freshwater marshes in inland flat open water areas with few trees, vegetated by sedges, reed, and grasses. *See Hurricane on the Bayou, Educator's Guide,* AUDUBON NATURE INST. 2 ("AUDUBON EDUCATOR'S GUIDE"), *available at* http://www.hurricaneonthebayou.com; SPX.0472 at 10–11 (same). This area also had numerous saltwater marshes behind barrier islands or river estuaries, vegetated by grasses. Historically, these wetlands were relatively stable and protected the New Orleans area from catastrophic storms. 12/6/11 Kemp[6] Direct at 109.

To better depict the geography of the area, the following map shows St. Bernard Parish in 1998:

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http://www.westlaw.com/Link/Document/Blob/I17b59920f46c11e4ac1c010000000000.png?originationContext=document&vr=3.0&rs=cblt1.0&transitionType=DocumentImage&contextData=(sc.UserEnteredCitation)

The following map shows New Orleans and the St. Bernard Polder area in 2009:

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B. Beginning In 1914, Navigational And Flood Protection Projects Were Constructed By The State Of Louisiana And The Army Corps Of Engineers In The New Orleans Area.

1. The Inner Harbor Navigation Canal (1914).

In 1914, the State of Louisiana authorized the Port of New Orleans to build a 5.5-mile long shipping waterway, known as the IHNC, to connect the Mississippi River to Lake Pontchartrain. SPX.0001 at I–31 fig. 6. The IHNC also hydrologically links Lake Pontchartrain to Lake Borgne. SPX.0210 at 1–4 (U.S. ARMY CORPS OF ENG'RS, MRGO ECOSYSTEM RESTORATION PLAN DRAFT FEASIBILITY REPORT (2010)) ("2010 FEASIBILITY REPORT"). Docks were constructed along the IHNC after it was completed, so that it could be used as a harbor and an industrial zone.

2. The Gulf Intracoastal Waterway (1925).

In 1925, Congress authorized the construction of the Louisiana and Texas Intracoastal Waterway, known as the Gulf Intracoastal Waterway ("GIWW") that extends from Brownsville, Texas east to Carrabelle, Florida. Initially, the purpose of the GIWW was to facilitate tugboat and barge transport of petroleum, food, building materials, and manufactured goods, but it later served as a strategic transportation route during World War II. Today, the GIWW is used for commercial transport, as well as for recreational boating.

3. Lake Pontchartrain And The Hurricane Protection Project (1955).

On June 15, 1955, Congress authorized the Army Corps to study the need for additional hurricane protection along the southern United States coast, including New Orleans and Lake Pontchartrain. *See* ***697** Pub.L. No. 84–71, 69 Stat. 132, 132 (1955); *see also* SPX.0169 at 2–3. The result was a comprehensive report, known as the "Barrier Plan," that recommended construction of floodgates to act as "surge barriers," levees, and floodwalls along the IHNC and GIWW to protect New Orleans from "Standard Project Hurricane"[7] wave action and surges, according to Army Corps and U.S. Weather Bureau projected parameters. SPX.0169 at ES–6.

On October 27, 1965, Congress authorized funding to implement the "Barrier Plan." *See* Flood Control Act of 1965, Pub.L. No. 89–298, 79 Stat. 1073, 1077 (1965); *see also* SPX.0169 at ES–6. The Barrier Plan was implemented as the Lake Pontchartrain and Vicinity Hurricane Project, known as the LPV, which was to be comprised of 125 miles of levees and floodwalls. SPX.0001 at I–28.

The Mississippi River Flood Protection System runs along the Mississippi River and was designed to control "river-flood flows and forms the [St. Bernard] basin's Western border." 11/12/13 FitzGerald Direct at 4. The LPV was designed for

"hurricane-flood waters" and borders the remainder of the basin area. 11/12/13 FitzGerald Direct at 4. The 40 Arpent levee and eight pump stations provided local protection between the Central Wetlands and New Orleans. 11/12/13 FitzGerald Direct at 4.

The following map shows the geography of the St. Bernard Polder and relevant flood protection systems prior to Hurricane Katrina:

SPX.0001 at I–31.
As of May 2005, however, only 90% of the LPV was completed in Orleans Parish, 70% in Jefferson Parish, 90% in Chalmette, and 60% in St. Charles Parish. SPX.0001 at I–28. In June 2009, an Army Corps report stated, "At no time has the entire New Orleans and Vicinity area had a reasonably uniform level of protection around its perimeter. At no time has any individual parish or basin had the full authorized protection planned for in 1965." SPX.0001 at I–28.

***698 C. During 1958–1968, The Army Corps Of Engineers' Constructed And Implemented The First Expansion Of The Mississippi River Gulf Outlet.**
The environmental conditions in southeastern Louisiana prior to 1956 were summarized in the 2007 Day–Schaffer[8] Report as follows:

> [T]here were extensive bald cypress-water tupelo swamps in the [Central Wetlands Unit] and adjacent to the Bayou La Loutre Ridge. The semi-enclosed and protected nature of this area—and the exclusion of deadly salt water—allowed the survival of these swamps.... Water budget analyses for southeastern Louisiana show that about one third of rainfall remains after evaporation. Thus there was sufficient fresh water to maintain the bald cypress-water tupelo swamps in the [Central Wetlands Unit], so long as the system did not have a direct input of salt water.

SPX.0472 at 4 (internal citations omitted); *see also* 12/6/11 Kemp Direct at 109. Cypress trees, in particular, were critical to preventing storm surge and allowing "typical tidal flow within the Breton Sound area [to be] reduced as it moved across the marshes and wetlands towards Lake Borgne." Gov't 11/7/08 S.J. Ex. A at xiii ("2008 ARMY CORPS REPORT") (internal citations omitted); *see also* 12/12/11 TR 292–93, 481–82 (Kemp).

On March 29, 1956, Congress authorized the Army Corps to construct the MR–GO "substantially in accordance with" a May 5, 1948 Army Corps Report that recommended the construction of a deep-draft channel on the west side of the Mississippi River from the IHNC east towards the GIWW to Michoud. *See* Pub.L. No. 84–455, 70 Stat. 65 (1956). This area became known as Reach 1. Public Law 84–455 also authorized the Army Corps to construct: "(1) protective jetties at the entrance to the MR–GO from the Gulf of Mexico; (2) a permanent retention dike through the Chandeleur Sound and a wing dike along the islands[,] as required; (3) a turning basin with a project depth of 36 feet Mean Low Gulf (MLG), a width of 1,000 feet and a depth of 2,000 feet at the junction of the new channel and Inner Harbor Navigational Canal; and (4) a highway bridge ... to carry Louisiana State Highway 61 over the [MR–GO]." 2008 ARMY CORPS REPORT at v.

On September 3, 1957, the St. Bernard Tidal Channel Advisory Committee convened a meeting with the Army Corps to warn that the MR–GO "will have adverse effects on the entire marsh area with consequent erosive action and the intrusion of high saline content water into areas normally fresh or only slightly [brackish]." RDX–1145 at 2. The Committee also predicted that the MR–GO channel would "be an enormous danger to the heavily populated areas of the parish due to the rapidity of the rising waters [during a hurricane] reaching the protected areas in full force through the avenue of this proposed canal." RDX–1145 at 3; *see also* 12/6/11 Kemp Direct at 48.

Nevertheless, on September 11, 1957, the Army Corps proceeded to construct the first section of the MR–GO. RDX–1042 at EDP–023–667 (Design Memorandum No. 2). The MR–GO was to provide a sixty-mile, "shorter navigation route from the Gulf of Mexico to the Port of New Orleans tidewater facilities," than using the Mississippi River to "access the port." 2008 ARMY CORPS REPORT at iv. The Army Corps "chose the MRGO channel alignment partly to reduce future costs of maintaining the authorized channel by routing it as much as possible within the marsh, and partly to allow for development of potential industrial sites on the relatively high land created in the spoil disposal area along its south bank." 12/6/11 Kemp Direct at 54.

On September 23, 1957, the Secretary of Interior wrote a letter to the Secretary of the Army to express "great concern" about the proposed construction of the MR–GO:

> Dredging and deposition of spoil involved in the construction of this project may be highly destructive to important producing ***699** areas for shrimp and other shellfish, nursery areas for finfishes, and highly valuable water-fowl marshes.
>
> The project plans have not been investigated by fish and wildlife conservation agencies as contemplated in the Wildlife Coordination Act of August 14, 1946 (60 Stat. 1050). The U.S. Fish and Wildlife Service of this Department is now initiating such investigations[.]
>
> * * *
>
> We urge that detailed planning for the project consider fully the effects of fish and wildlife resources of constructing the canal and that your department accept reasonable modifications in alignment of the canal and in the plan for deposition of spoil to hold to a minimum the destructive effects on those resources, even though this may increase project costs to some degree.
>
> It will be apparent that the fish and wildlife investigations are far behind the stage reached in the engineering investigations. We trust, therefore, that the [Army] Corps of Engineers will take the necessary steps to bring the investigations of all phases of this project into balance.

RPX.0161 at 1–2.

In 1958, the United States Fish & Wildlife Service (the "F & W Service") also warned the Army Corps that "[t]he excavation of a channel 36 feet deep, 500 feet wide, and over 70 miles long from New Orleans to the Gulf of Mexico through the Lake Borgne marshes and shallow inlets of Chandeleur Sound, in effect, could result in a major ecological change of the area." RDX–1685 at 24 (U.S. DEP'T OF FISH & WILDLIFE, AN INTERIM REPORT ON FISH & WILDLIFE RES. AS RELATED TO MISS. RIVER–GULF OUTLETT (1958)); *see also* RJX–0199 (Day/Shaffer Report at 5 (stating that the F & W Service predicted that the MR–GO construction "particularly by breaching the natural east-west ridges between fresh/brackish and salt water" would "introduce salt water into the wetlands and destroy tens of thousands of acres of marshes and mature bald cypress-water tupelo swamps.")); 12/6/11 Kemp Direct at 48 n.2 (summarizing the 1958 Service Report as "predict[ing] the very environmental disaster that the MRGO would inflict on the region of the Central Wetlands Unit."). The F & W Service also advised the Army Corps that these environmental changes could "have widespread and severe consequences." RDX–1685 at 25. In addition, the F & W Service warned the Army Corps that "[c]hanges in the water circulation pattern and sedimentation pattern" could "subject important fish and wildlife areas to changes in salinities, with perhaps damaging changes in salinity zones." RDX–1685 at 25. And, the F & W Service also predicted increased temporary

and permanent turbidity that could damage the local environment. RDX–1685 at 25. In light of these adverse environmental consequences, the F & W Service recommended that the Army Corps delay construction of MR–GO pending further study. RDX–1685 at 26; *see also* 12/13/11 TR 500 (Kemp). The Army Corps did not respond to concerns exposed by the Secretary of Interior or the F & W Service and began construction of the MR–GO. RDX–1042 at EDP–23–667.

On January 27, 1959, the second section of the MR–GO was approved. RDX–1042 at EDP–023–667 (Design Memorandum No. 2). This section, known as "Reach 2," extended southeast-northwest from just east of the Paris Road Bridge down through Breton Sound for approximately twenty-four miles into the Gulf of Mexico and was supposed to function as a "hurricane protection levee [on top of a] dredged material placement bank on the southwest side of the channel and Lake Borgne and open marsh ... to the northeast." Gov't 11/7/08 S.J. Ex. E at 1–2 ("2006 WESTERINK NOTE").[9]

In 1959, the Army Corps also considered a revision to the initial MR–GO design to take into account the likelihood of salinity intrusion, but rationalized its decision not to do so as follows: "[i]f the [MRGO] channel is separated by spoil from the surrounding area—except for a few openings—the salinities in the area inland from Shell Beach to the west ***700** of the channel will tend to be fresher, and Lake Borgne should remain essentially unchanged." RPX0699 at PDF 3. A 1959– 1961 Army Corps hydrologic study stated that salinity increased at five stations the year after the MR–GO was opened, although the "Bayou La Loutre ridge provided a basin boundary that limited the flow of saline water from the Breton Sound area into Lake Borgne and nearby wetlands."[10] 2010 FEASIBILITY REPORT at 2–10. But, the Army Corps ignored the fact that, over time the design of the MRGO would result in:

> the dissection of the Bayou La Loutre natural levees ... accelerating the process of saltwater intrusion and contributing to land loss. Therefore, to the extent the MRGO caused an increase in salinity into the study area and the [Central Wetlands Unit] it was the direct result of the design of the channel and the altered hydrology resulting from the dissection of these natural levees.

RJX–0202 at 17.

By May 1959, the Army Corps anticipated that the unarmored banks of the MR–GO would experience "erosion due to wave wash in open areas ... in the upper part of the channel slope," but recommended "[n]o channel protection" initially, because "[p]rotection ... can be provided if and when the need for it becomes necessary." RPX0699 at PDF 14. Since the Army Corps did not have the budget for bank armoring, it relied on dredging "to sustain the critical function of providing serviceable dimensions for shipping." RPX0716 at 5–6. It was aware, however, that a hurricane swell could travel up the MR–GO from the Gulf of Mexico and "some effect could be felt in New Orleans," but estimated that a maximum thirty-five foot wave at the Gulf entrance would lose 97% of its height traveling up the channel. RPX0699 at PDF 12–14 (U.S. ARMY CORPS OF ENG'RS, MISS. RIVER–GULF OUTLET, LA., DESIGN MEMORANDUM NO. 1–B).

By 1961, the Army Corps also was aware that larger storm surge could occur on the Gulf Coast, because of the shallow, broad shelf off that coast, and that "[s]torm surges may also be increased by a funneling effect in the converging estuaries." RPX1332 at 1–9 (ARMY CORPS COASTAL ENG'G CTR., SHORE PROT. MANUALL, Vol. I (1961)).

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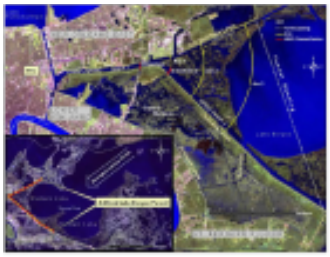


12/6/11 Kept Direct at 3 (fig. 1).
In response, the Army Corps developed a plan to build a levee to block the funnel opening. RPX1030 ("Alternate Plan C"); *see also* RDX–1297 at 123 (U.S. ARMY COASTAL ENG'G RESEARCH CTR., SHORE PROT., PLANNING & DESIGN (3d ed. 1966) ("1966 ARMY PLAN") ("Storm surge may also be increased, particularly in coastal areas, by a funneling effect in converging open bay mouths.")); 12/6/11 Kemp Direct at 32 ("The GIWW and the MRGO Reach 2 form a triangle [at Marker 60] that opens east to Lake Borgne.... This layout has been described as a 'funnel' by virtually everyone who has taken a bird's-eye look at the plan developed by the [Army Corps]."). But, the Army Corps took no action, and the initial construction of the MR–GO was completed in 1963. Pls. 2/9/09 S.J. Ex. 7 at 2–1 ("2000 EPA REPORT").

On September 9–10, 1965, Hurricane Betsy arrived just south of New Orleans as a category 5 storm, damaging six thousand homes near the Port of New Orleans and flooding the Lower Ninth Ward with twelve feet of water. SPX.0169 at 2–5; *see also* 12/12/11 TR 107, 109 (Estopinal); David Roth, *Louisiana Hurricane History,* NAT'L WEATHER SERV., *available at* http:// www.hpc.ncep.noaa.gov/research/lahur.pdf at 41 ("NAT'L WEATHER SERV.") (describing a ten-foot storm surge from Hurricane Betsy).

On November 24, 1965, the Citizens Committee for Hurricane Flood Control wrote a letter to the Army Corps requesting action to avoid the type of flooding experienced with Hurricane Betsy and recommending that the Army Corps build flood gates on the Intercostal Waterway, Bayou Bienvenue, Gulf Outlet, instead of a proposed levee that "would form a funnel, channeling all hurricane surges and wind driven water in the Intercostal Waterway and Industrial Canal [.]" RPX0006 at 3.

In 1966, the Army Corps retained Charles Bretschneider and J. Ian Collins of the National ***702** Engineering Science Company ("NESCO"), who published a September 1966 Report ("NESCO Report"). SPX.0105. The NESCO Report used computer modeling to evaluate the impact of storm surge on existing and proposed levees, with and without the MR–GO. But, the levee running parallel to the MR–GO was not constructed when Bretschneider and Collins conducted their research; instead, excavation material was piled six to eight feet high on the south side of the channel. 12/6/11 Kemp Direct at 69. Although the NESCO Report predicted that the MR–GO and the proposed levee configuration would increase conveyance of storm surge into the IHNC, it concluded that "the effect of the Mississippi River–Gulf Outlet is almost negligible for all large hurricanes accompanied by slow rising storm surges." SPX.0105 at 4. But, it observed that, in the case of "more rapidly rising surge," there "may [be] a very marked effect." SPX.0105 at 4; *see also* 2006 WESTERINK NOTE at 3 (describing the NESCO Report); *see also* RJX–0278 at 1 (Nov. 21, 1962 ARMY CORPS INTERIOR SURVEY REPORT, LAKE PONTCHARTRAIN, LA. & VICINITY) (stating that "[h]urricane damages result from surges entering Lake Pontchartrain from Lake Borgne through natural tidal passes at the Rigolets and Chef Menteur Pass and through improved channels of the [MR–GO] Outlet and [IHNC]"); *see also id.* ("The [MR–GO] provides a deep, direct route for the inflow of saline currents from the Gulf of Mexico to the area along its channel and to Lake Pontchartrain, with resultant adverse effect on fishery resources in the area. The [MR–GO] will also produce high velocity currents in the [INHC].").

In October 1973, a report prepared by Dr. S.A. Hsu[11] for St. Bernard Parish criticized the NESCO Report, because none of the storm tracks selected were within "a dead hit radius of the MRGO.... What would happen if the radius of high flooding hit the end of the MRGO?" SPX 0707 at A–12. The modeling for the NESCO Report also was criticized, because it was based on data that preceded the expansions of the MR–GO. 12/6/11 Kemp Direct at 75. Dr. Kemp also criticized the NESCO

Report on other grounds. 12/6/11 Kemp Direct at 75 (citing SPX.0707 at A–12 ("[A]ny numerical model should be verified at least by statistically significant samples such as the one developed by Jelesnianski (1967)[.]")). The 1966 NESCO Report downplayed the role of the funnel, because the authors believed that the funnel was made up of mostly wetlands. According to Dr. Kemp, "this is a naïve view of the funnel, even if it was truer in 1967 than it was ... in 2005, after the wetlands at issue were decimated.... As the funnel converges to the west toward its apex, the relative contribution of the channels to cross-sectional area ... rise[s]." 12/6/11 Kemp Direct at 136–37; *see also* 12/16/11 Kemp Direct at 71 ("[Bretschneider and Collins's] model predicted a dramatic increase in storm surge" as water moved into the funnel created by the MR–GO and the GIWW, but estimated that area wetlands would reduce the surge three times more effectively than the channel.).

In 1966, the Army's Coastal Engineering Research Center also conducted a study observing that storm surge depends on:

> the wind velocity, the distance over which it blows, the wind direction, and the water depth. Storm surge is greater in lesser depths, and this is the reason for the generally greater values of storm surge along the Gulf Coast [.] Storm surge may ... be increased, particularly in coastal areas, by a funneling effect in converging open bay mouths.

1966 ARMY PLAN at 123.

In 1968, Congress authorized an expansion of the MR–GO. *See* The River and Harbor Act of 1968 Pub. Law No. 90–483, 82 Stat. 731 (1968). By the time the third segment of the MR–GO was completed in 1968, the Army Corps had dug through 2,116 acres of salt marsh and swamp and thirty-six acres of trees. RJX–0195 at 2–4 (9/11/08 Expert Report of Dr. Duncan FitzGerald[12]). The ***703** dredge spoil placed along the south bank of MR–GO buried more than 10,000 additional acres of marsh, swamp, and trees. RJX–0195 at 2–4. "Ship wave erosion," subsequently, increased the surface width of the channel, at a rate of up to 15 ft per year from 1968 to 2006. 2006 WESTERINK NOTE at 2.

The MR–GO has been described as extending:

> southeast to northwest from the Gulf of Mexico to a point where it first merges with the [GIWW], and then continues westward until it intersects the [IHNC].... The first 9 miles, the bar channel, are in the open Gulf. The next 23 miles of the channel lie in the shallow open waters of Breton Sound. From there, the inland cut extends 14 miles to the northwest with open marsh on the northeast and a 4,000–ft wide dredged material placement bank on the southwest side. At this point[,] the channel cuts across the ridge of a relict distributary of the Mississippi River, Bayou La Loutre. For nearly the next 24 miles, there is a hurricane protection levee atop a dredged material placement bank on the southwest side of the channel[,] and Lake Borgne and open marsh lie to the northeast. A portion of the levee protecting St. Bernard Parish/Chalmette and the portion of the hurricane protection levee along the south side of Orleans East Parish, north of the GIWW, form the "funnel" that is often referenced. The point where the MRGO and GIWW channels merge is just to the east of the Paris Road Bridge.... From this point, the merged GIWW/MRGO channel continues west for about 6 miles to the point where it intersects the IHNC; this portion has hurricane protection levees on both banks. The IHNC extends from Lake Pontchartrain, to the north, to the Mississippi River to the south. The IHNC has levees or floodwalls along both banks. The IHNC Lock, which connects the IHNC to the Mississippi River, is located at the southern limit of the IHNC.
>
> * * *
>
> It is important to distinguish between two sections of the MRGO and the role each plays in tide and storm surge propagation. One is the east-west oriented section that runs between the IHNC and the confluence of the GIWW/MRGO near the Paris Road Bridge, labeled as the GIWW/MRGO ..., and hereafter referred to as Reach I. The other is the much longer southeast-northwest section ... referred to as the Reach 2.
>
> The critical section of the MRGO is Reach I, the combined GIWW/MRGO. It is through this section of channel that Lake Pontchartrain and Lake Borgne are hydraulically connected to one another via the IHNC. Reach I existed as the GIWW prior to the construction of the MRGO, although the maintained depth was lower. Because of this connectivity, the local

> storm surge and astronomical tide in the IHNC and in the section designated GIWW/MRGO is influenced by the tide and storm surge in both Lake Pontchartrain and Lake Borgne. The two Lakes are also connected to each other via the Rigolets and Chef Menteur Pass; the IHNC is the smallest of the three connections. The Reach 1 GIWW/MRGO section of channel is very important in determining the magnitude of storm surge that reaches the IHNC from Lake Borgne and Breton Sound. If the hydraulic connectivity between Lake Pontchartrain and Lake Borgne is eliminated at a point within this section of channel, tide or surge to the west of this point will become primarily influenced by conditions at the IHNC entrance to Lake Pontchartrain; and tide or storm surge to the east of this point will become primarily influenced by conditions in Lake Borgne.
>
> Much concern seems to be focused on MRGO/Reach 2 that runs from the GIWW/MRGO confluence, just east of the Paris Road Bridge, to the southeast. Past work ... has shown that this section of the MRGO channel, along with the critical section, the GIWW/MRGO/Reach 1, plays an important role in the propagation of the astronomical tide wave and in the flux of more saline water from Lake Borgne/Breton Sound into Lake Pontchartrain via the IHNC. The significant role of the MRGO ***704** in the propagation of the low-amplitude tide has been established.

2006 WESTERINK NOTE at 2.

The following map shows the location of the INHC; Reach 1 and Reach 2 of the MR–GO; the federal levee system; and the 40 Arpent Levee.

11/12/13 FitzGerald Direct at 4 fig. 1.
On August 17–18, 1969, Hurricane Camille arrived in Louisiana, as a Category 5 storm, the "most intense hurricane [measured by barometric pressure] known to ever make landfall in the United States." NAT'L WEATHER SERV. at 42. St. Bernard Parish experienced wind gusts reaching 160 miles per hour. NAT'L WEATHER SERV. at 42. Although Hurricane Camille flooded New Orleans, the St. Bernard Polder did not flood. 12/13/11 TR 487 (Kemp); 12/6/11 Kemp Direct at 136 fig. 6.8 (showing New Orleans flooding from Hurricane Camille).

D. From 1998–2004, Army Corps Of Engineers' And Other Governmental Studies Identified That The Construction, Expansions, Operation, And Failure To Maintain The Mississippi River Gulf Outlet Could Significantly Increase Storm Surge And Flooding During Hurricanes Or Severe Storms, But No Remedial Action Was Taken.
In 1990, in response to the increased public awareness about the adverse environmental impact of the MR–GO, Congress enacted the Coastal Wetlands Planning, Protection, and Restoration Act of 1990, Pub.L. No. 101–646, 104 Stat. 4761, Title III (1990), known as the "Breaux Act." A central feature of this Act called for a comprehensive Louisiana Coastal Wetlands Restoration Plan. Recognizing the need for a single plan, the Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority brought together private, public, and institutional entities to issue a comprehensive report. In 1998, that group ***705** issued Coast 2050: Toward A Sustainable Coastal Louisiana. Gov't 11/7/08 S.J. Ex. G ("COAST 2050 REPORT"). The Coast 2050 Report estimated that by the 1990s, the rate of coastal land loss would be between twenty-five and thirty-five square miles per year. COAST 2050 REPORT at 1. The Report concluded that the construction of the MR–GO in the early 1960s "caused loss of marsh from both its 'footprint' (area of impact) and the saline water it allowed to enter the basin once the La Loutre Ridge was breached. These events led to high loss in the

areas surrounding the MRGO and in areas more removed such as the Pontchartrain/Maurepas Land Bridge." COAST 2050 REPORT at 47. New Orleans and Yscloskey (St. Bernard Parish) were characterized as "[c]ommunities at risk." COAST 2050 REPORT at 63– 65. More importantly, the 1998 2050 Report made this observation:

> The current hurricane protection system, to be completed in 2002, protects the city from a storm surge associated with a fast moving Category 3 hurricane. *But what if the storm is more intense ... or the storm moves slowly, allowing more time for the storm surge to build? Storm surge models show that a hurricane could produce an 18–foot storm surge in Lake Pontchartrain, which could be topped with 10 foot waves. None of the current or planned protection measures would be effective under those circumstances*.... Unfortunately, storm surge heights will only increase as subsidence and sea-level rise continue and more wetlands are lost.

COAST 2050 REPORT at 64 (emphasis added).

In response, on December 15, 1998, the Parish Council of the St. Bernard Parish Government unanimously moved to adopt the following resolution:

> WHEREAS, the construction of the Mississippi River Gulf Outlet, which opened in 1963, destroyed a 4750 foot wide, 37 mile long strip of wetlands and swamps. Ship traffic has aggravated erosion of the banks and caused the channel to widen up to 2000 feet from suction that pulls on sediments in the outlet's banks. The ship's wake creates waves that batter the banks, causing them to fall apart; and
>
> WHEREAS, *the MRGO provides a superhighway for storm surges caused by hurricanes and winter cold fronts*. No longer blocked by natural levees formed by winding bayous, water from the Gulf of Mexico moves unimpeded and more quickly inland, and can *cause severe flooding in St. Bernard, Orleans and Plaquemines Parishes*; and
>
> WHEREAS, salt water intrusion has virtually destroyed intermediate water marshes and freshwater swamps surrounding [L]ake Borgne, resulting from opening the MRGO; and
>
> WHEREAS, the hydrology, animal and plant life of the Lake Pontchartrain and Breton Sound Basins have been dramatically altered, "dead zones" created, yields and species of seafood decreased and open water areas have appeared where intermediate once flourished; and
>
> WHEREAS, the 1998 hurricane season destroyed over 50 percent of the Chandeleur Islands, a land mass that forms a natural storm barrier for southeastern Louisiana; and
>
> WHEREAS, *the land loss from the MRGO, combined with the hurricane damage* now makes residents from Planquemines, Orleans, and St. Bernard Parishes *more vulnerable to tropical storms than at any time in history*; and
>
> * * *
>
> WHEREAS, in September, 1998 Hurricane Georges swept mountains of silt into the MRGO sealing the waterway to larger ships, thereby necessitating the U.S. Army Corps of Engineers to dredge the channel at a cost of $35 million dollars, in addition to average annual dredging costs of $7–$10 million dollars and $3 million for rock retention annually, equating to $72 thousand dollars per ship or $143,000 dollars daily for two ships, such annual expenses obviously are not cost-effective; and
>
> WHEREAS, the U.S. Army Corps of Engineers has proposed to spend $35 million dollars to rock the channel's north face in addition to dredging a channel that 2 ships (1.8) per day use ...; and
>
> ***706** WHEREAS, the continuing deterioration of the ship channel and wetland loss has caused flooding in the lower portion of St. Bernard Parish to increase drastically and scientists have measured the tidal surges that flow with speeds of

over 18 ft/second! Flooding is expected to increase; and

WHEREAS, the economic benefits derived from the MRGO are now far outweighed by the increasing risk to lives and property; and

WHEREAS, the State of Louisiana's official coastal restoration plan, Coast 2050, calls for phasing out of the MRGO; and

WHEREAS, St. Bernard Parish never evolved into the "Industrial Frontier of the Great Gulf South" as symbolized by the MRGO nor has the MRGO had any military strategic use as first legislated by Congressman F. Edward Herbert in the appropriation funding the channel.

THE ST. BERNARD PARISH COUNCIL DOES HEREBY RESOLVE

SECTION I. That this Council does hereby request Louisiana's Southeast Congressional Delegation establish a task force to develop a process that will result in the timely closure of the Mississippi River Gulf Outlet.

SECTION II. That the task force, consisting of a policy committee and a technical advisory committee (Addendum A) will, within the next twelve months, design and develop a cost effective program to phase out the MRGO that will focus on: public safety, maintaining the Port's economic viability, mitigation and habitat preservation, protection and, where possible, restoration.

Gov't 11/7/08 S.J. Ex. L at 2–3 (Resolution SBPC# 1336–12–98, Resolution to Close the Mississippi River Gulf Outlet) (emphasis added).

On May 25, 1999, the United States Environmental Protection Agency ("EPA") established a Task Force "to develop alternative futures for the MRGO, for identifying the various issues which must be resolved if the channel is to be closed to deep draft navigation, and to facilitate the resolution of stakeholder issues, including related issues of navigational facilities, environmental restoration, and hurricane protection." 2000 EPA REPORT at 2–5.

In 1999, the Army Corps estimated that "MRGO channel construction ... resulted in the conversion of 19,400 acres of wetlands and 4,750 acres of shallow open water to deep open water or dredge material banks." SPX.1154 at 1–13 (12/9/10 U.S. ARMY CORPS OF ENG'RS, MRGO ECOSYSTEM RESTORATION STUDY DRAFT ENVTL. IMPACT STATEMENT) ("2010 DRAFT EIS"); *see also* 2010 DRAFT EIS at 1–16 ("The construction, operation and maintenance of the MRGO caused the loss of approximately 24,610 acres and indirectly to an additional loss of 33,920 acres. Approximately 63,178 acres of land is estimated to have been lost in the study area from 1985 through 2010.").

On October 20, 2000, the EPA commissioned a study concluding:

[T]here has been a tremendous loss to St. Bernard Parish as a result of salt water intrusion in land, trapping and forestry due to the change in the ecosystem.

After eighteen (18) years of meeting and public hearings held by the St. Bernard Coastal Zone Management Advisory Committee, and taking their advice into consideration, th[e Environmental S]ubcommittee's recommendations are:

1. A closure structure at the Bayou la Loutre Ridge incorporating a gated system to protect St. Bernard Parish from a hurricane surge from the MRGO. Several structures need to be in place. This could be implemented at a relatively low cost. The rocks from the landmass into the sound should be removed and used for these additional structures.

2. Bank stabilization/marsh re-creation in Lake Borgne from Bayou Bienvenue to the Mississippi River Levee encompassing St. Bernard and Plaquemines Parishes. This is our number one concern and should be addressed as soon as possible.

> 3. Implementation of a ten (10) year program to restore and manage our resources that includes a freshwater diversion structure into the Central Wetlands area.
>
> 4. Land loss due to salt water intrusion and wave action along the MRGO has been ***707** devastating. The right of way, purchased by the Federal Government for the construction and maintenance of the MRGO, has long been out of their boundaries. The result is that the property of private landowners is being literally washed away. This committee feels that it is only fair these property owners be compensated at fair market value.
>
> The total dollar figures for the projects necessary to mitigate the damages inflicted upon St. Bernard Parish has not been determined. This committee feels that the overall cost will be in the hundreds of millions of dollars.

2000 EPA REPORT at 3–13–14.

Importantly, the 2000 EPA Report included the Army Corps' "first official estimate of the ecological impacts caused by the [MR–GO] it built and maintains." 2000 EPA REPORT at 3–14. An Executive Summary of that Report stated that:

> The MRGO is a 36–foot deep, 500–foot wide, 76–mile long navigation channel from the Gulf of Mexico to the city of New Orleans, completed in 1965. It has been controversial from the beginning since it destroyed several thousand acres of wetlands in St. Bernard Parish. Wave wash erodes the channel by about 15 feet per year. St. Bernard Parish has long requested the closure of the channel because, in addition to the environmental damage, they believe that the channel serves as a funnel for hurricane surges to enter the parish. In the fall of 1999, the Environmental Protection Agency convened a group to "facilitate and lend structure to the issues involved with the MRGO."
>
> The group formed an Environmental Subcommittee and tasked it with preparing a report on the environmental impacts of the MRGO. The Corps of Engineers agreed to draft this report. There were three basic impacts caused by construction of the MRGO: 1) habitat loss due to channel excavation, spoil disposal and erosion; 2) shifts in habitat type due to salinity brought in by the MRGO, and 3) increased land loss due to hydrological changes caused by the MRGO. The habitat loss due to construction was estimated by placing the MRGO footprint on maps, superimposing the habitat types in the mid–1960's, and calculating the amounts of various habitat types that were destroyed. Habitat shifts were estimated using a database from Louisiana Department of Natural Resources that consisted of the habitat composition of various mapping units in 1956 and 1990: Possible increased land loss due to the MRGO was very roughly estimated by first calculating the "baseline" loss by mapping unit. Then the percent of this "baseline" loss that was caused by the hydrological change due to the MRGO was estimated to determine the "without MRGO" loss rate. This loss rate was applied to acres present in 1956; the resulting 1990 acres were compared to existing acres to calculate the possible increased loss.
>
> All of these calculations represent best professional judgment since it is difficult to know the exact location of habitats 35 years ago. The estimate of increased land loss is especially speculative.
>
> Construction of the MRGO and subsequent erosion has caused extensive loss of land in St. Bernard Parish. Nearly 3,400 acres of fresh/intermediate marsh, over 10,300 acres of brackish marsh and over 4,200 acres of saline marsh have been converted to open water or spoil. Over 1,500 acres of cypress swamp and levee forest have become disposal area. A total of nearly 20,000 acres of wetlands have been lost and nearly 4,800 acres of shallow open water have been converted ... into deep water or disposal area. Habitat shifts caused by saline waters brought in by the MRGO have caused 3,350 acres of fresh/intermediate marsh and 8,000 acres of cypress swamp to shift to brackish marsh. Approximately 7,500 acres of swamp have convened to intermediate marsh. Also, 19,170 acres of brackish marsh and swamp have shifted to saline marsh. If the roughly estimated amount of increased loss is considered, the area influenced by the MRGO could have lost over 3,400 acres of wetlands due to increased tides and salinity.

2000 EPA REPORT at 3–14–15.

But, the 2000 EPA Report recognized that "there is no current consensus [on] the rate ***708** of ongoing environmental damage from the MR–GO" and so concluded:

> • Preliminary results of the Reevaluation Study indicate that MRGO is a relatively minor factor impacting storm surge impacts. Small surges that do not overtop the Bayou La Loutre Ridge but do gain access via the MRGO are too small to overtop flood protection levees, and thus only impact unprotected areas where development is limited. Larger surges (e.g. from hurricanes) are simulated as being negligibly impacted by a small topographic feature such as the MRGO passage through the ridge.
>
> • Assuming these results are confirmed, questions about the overall safety of the hurricane protection system have not been resolved to everyone's satisfaction. For example, inquiries made during this study determined that there is no audit to confirm the level of protection afforded by the existing (uncompleted) levee system. Annual monitoring addresses adequacy of maintenance, not the more fundamental issue of hydrologic competence. A fundamental problem is the need for reliable benchmarks to use in surveys of levee heights and marsh and channel elevations.

2000 EPA REPORT at 3–15, 4–7–8. The 2000 EPA Report estimated that "it could be 5 or more years before a closure decision is even reached, and 15 years or longer before it is implemented." 2000 EPA REPORT at 4–8.

In August and September 2001, two public meetings were held where several hundred people attended as well as representatives from the Army Corps. SPX.0298 at 15. At these meetings, the public representatives expressed these concerns: "1) perception that the MR–GO presents a flooding threat from hurricane storm surge; 2) the environmental damage caused by increased salinity; 3) the erosion of the MR–GO banklines; 4) the decrease in deep-draft traffic using the channel; and 5) the need to keep deep-draft access to the IHNC and Michoud Canal facilities." SPX.0298 at 15.

In December 2001, the Army Corps considered a total closure of the MR–GO, but no action was taken. SPX.0298 at 16.

Likewise, in 2003, another study commissioned by the Army Corps concluded that:

> for low-amplitude storm surges (peak surge having a magnitude of 4 feet or less), the presence of MRGO/Reach 2 increased the storm surge.... [but] did not cause a significant change or the increase was less than 0.3 feet. In a few situations, notably a slow moving weak storm, the presence of the MRGO/Reach 2 channel actually led to a very small decrease in peak surge/level at the four locations. For higher amplitude storm surges, peak surges on the order of 7 to 12 feet (which included Hurricane Betsy [1965]), changes induced by MRGO/Reach 2 were 0.3 ft or less for all situations.[13] *The MRGO did however considerably enhance drainage from Lake Pontchartrain through the* [*Inner Harbor Channel/Gulf Intracoastal Waterway*] *out to Breton Sound following passage of the storms*.

2006 WESTERINK NOTE at 3 (emphasis added).

The 2000 EPA Report and 2003 Army Corps Study, however, present a very different picture than a November 2004 Army Corps Report that warned that "[t]he Lake Borgne estuarine complex is deteriorating and recent analysis indicates that the rate of wetland loss in the area is accelerating. Rapid action is required to protect the integrity of the southern Lake Borgne shoreline and to prevent continued erosion of the MRGO channel banks from ocean going vessel wakes. Additional ecosystem restoration features are required to address serious ecological problems[.]" 2/9/09 Pls. S.J. Ex. 8 at MRGO 31 ("2004 ARMY CORPS STUDY"). The Army Corps Study also warned of:

> [c]ritical action points to avoid near-term (3 to 5 years) threats of shoreline and bayou breaches located [along the MR–GO]. These sites face significant risk of losing the integrity of bayou banks along the shoreline and a potential major breach of the navigational channel into [Lake Borgne].... *A breach between the lake* ***709** *and the MRGO navigation channel would result in rapid wetlands loss as storm waves from the lake and ship wakes from the* [*MR–GO*] *channel impact sensitive interior wetlands*[.]

2004 ARMY CORPS STUDY at MRGO 32 (emphasis added).

On June 23, 2005, a draft Army Corps shoreline protection study reported that "[c]hanges in salinity and water circulation in the Lake Pontchartrain Basin caused by the MRGO have increased the rate of wetland loss in the area, and these changes to geomorphic structure in this part of the Deltaic Plain would increase the storm surge of hurricanes and tropical storms that impact this area of coastal Louisiana." SPX.01148 at 1–15 (U.S. ARMY CORPS OF ENG'RS & LA. DEP'T OF NATURAL RES., MRGO CRITICAL SHORELINE PROTECTION FEASIBILITY STUDY (Draft June 23, 2005) ("2005 ARMY CORPS DRAFT STUDY")).

The Army Corps' 2004 and 2005 studies were prophetic.

E. Hurricane Katrina.

On August 26, 2005, a Category 1 storm known as Hurricane Katrina crossed the southern tip of Florida and moved westward into the Gulf of Mexico, becoming a Category 2 storm. SPX.0004 at IV–13.[14]

On August 28, 2005, at approximately 12:00 a.m. Central Daylight Time ("CDT"), as Hurricane Katrina rapidly intensified and turned northwest; by 12:00 a.m., that storm reached Category 5 status. SPX.0004 at IV–15.

On August 28, 2005, at 6:00 p.m., Hurricane Katrina was centered 170 miles south-southeast from the mouth of the Mississippi River. SPX.0004 at IV–15–16. By this time, surface winds in southeast Louisiana blew from the east at thirty-five to forty miles per hour. SPX.0004 at IV–16. The wind pushed water into Lake Borgne, which was then three feet above normal levels, and into Lake Pontchartrain, raising the water level there to one foot above normal. SPX.0004 at IV–16. Wave heights east of the Mississippi River entrance reached twenty feet; wave heights north of the Chandeleur barrier islands reached ten feet. SPX.0004 at IV–16. As a result, water "began to inundate the coastal wetlands of [s]outheast Louisiana, east of the Mississippi River." SPX.0004 at IV–16.

As Hurricane Katrina turned north, its intensity decreased by 12:00 a.m. on August 29, 2005, but the water level continued to rise and wave height increased. SPX.0004 at IV–16. Water levels in Lake Borgne (at Paris Road over the GIWW/MRGO) rose 5.5 feet above normal, "completely inundat[ing] much of the wetland system east of the Mississippi River Levees." SPX.0004 at IV–16. Water levels along the southern shore of Lake Pontchartrain reached three feet above normal; waves in the Gulf of Mexico, just east of the mouth of the Mississippi River, reached nearly thirty-five feet; and wave heights north of the Chandeleur Islands reached seventeen feet. SPX.0004 at IV–16.

Hurricane-force winds drove water east and then north into Lake Borgne and against the federal levee system that paralleled the MR–GO:

> During the [twelve]-h[ou]r period prior to Katrina making its final landfall, despite its decreasing intensity, the storm pushed a considerable volume of water against the Mississippi River delta and the east-facing levees along the Mississippi River, and in ***710** the "pocket" formed by the delta and the Mississippi coast. The storm then pushed that volume of water northward with hurricane strength winds toward the Mississippi coast and into Lakes Borgne and Pontchartrain as the storm tracked to the north. Locally, hurricane force winds from east and east-northeast in advance of the storm center also pushed water against the east-facing levees and floodwalls of the hurricane protection system in Plaquemines, St. Bernard, and Orleans Parishes. The increased water levels in Breton Sound and Lake Borgne allowed considerable wave energy that was generated in the gulf to propagate over and through gaps between the barrier islands, across the inundated wetlands, to the hurricane protection system in Plaquemines, St. Bernard, and Orleans Parishes. Local wave generation also occurred in these inundated areas.
>
> High water levels in Lake Borgne acted to drive water into Lake Pontchartrain (because of the water level difference between the two lakes). In addition to this filling action, locally high winds in Lake Pontchartrain acted to tilt the water surface in the lake, raising the water surface on the downwind side and lowering the water surface on the upwind side of

> the lake. These same winds created high wave conditions on the downwind side of the lake. Winds blew counterclockwise about the hurricane's eye, and the storm tracked to the east of Lake Pontchartrain. So as the storm made landfall in Louisiana, tracked north, made final landfall again, and then continued north into Mississippi, wind direction in Lake Pontchartrain changed steadily (winds first from the east, then northeast, then from the north, then northwest, and finally from the west). In response to this changing wind direction, the region of maximum storm surge and high waves translated along the southern half of the lake, moving from west to east.

SPX.0004 at IV–16–17 (March 26, 2007 ARMY CORPS FINAL REPORT).

On August 29, 2005, around 6:00 a.m., Hurricane Katrina made landfall near Buras, Louisiana, as a Category 3 hurricane, with maximum sustained surface winds of 100 knots (115 miles per hour). SPX.0004 at IV–16. Around 9:45 a.m., Katrina crossed the coastline at the border of Mississippi and Louisiana, having weakened only slightly. SPX.0004 at IV–16. By 1:00 p.m., Katrina moved inland and was downgraded to a Category 2. SPX.0004 at IV–16. Throughout landfall, the storm maintained "its large spatial extent." SPX.0004 at IV–16.

Next, three breaches occurred on the west side of the IHNC canal: one breach at a railroad line near Interstate 10; and two breaches in the floodwall and earth levees further south. SPX.0004 at IV–180. Water began entering low-lying land west of the IHNC early that morning. SPX.0004 at IV–186. Around 6:30 a.m., a small breach of the Seventeenth Street Canal floodwall occurred. SPX.0004 at IV–172. A full breach occurred by around 9:00 a.m., when eyewitnesses reported a rush of water. SPX.0004 at IV–170, IV–172. Floodwater reached six to seven feet near that breach. SPX.0004 at IV–170.[15] At that location, the Seventeenth Street floodwall water reached about 12.4 feet high. SPX.0004 at IV–172. Water in the Seventeenth Street Canal may have been only about 7.3 feet in elevation at the time of the full breach, but eyewitnesses estimated that the water elevation was closer to ten or eleven feet. SPX.0004 at IV–172; *see also* SPX.0004 at IV–194 (flooding in St. Bernard Parish and the Lower Ninth Ward came ***711** from two breaches along the IHNC, "overtopping and numerous breaches along the GIWW and MRGO"); 12/6/11 Kemp Direct at 36. At the IHNC Lock, the water level continued to rise one foot per hour between 11:00 p.m. on August 28, 2005, and 9:00 a.m. on August 29, 2005, peaking at around 14.3 feet before 9:00 a.m. SPX.0004 at IV–33–34.

At this juncture, two specific levees within the LPV system become relevant. The first is the Chalmette Levee, designed to protect St. Bernard Parish and the Lower Ninth Ward, that runs along the southern side of Reach 1 and the west side of Reach 2, separating the MR–GO from the Central Wetlands to the southwest. The Chalmette Levee then circles around the southern end of St. Bernard Polder to meet up with the Mississippi River. The second is the New Orleans East Back Levee that runs along the north side of Reach 1 of the MR–GO and the GIWW. The heights of each of these levees ranged from 11.5 to 17.5 feet above mean sea level.[16] 12/6/11 Kemp Direct at 159.

By 5:30 a.m. on August 29, 2005, flood water began entering the Lower Ninth Ward through breaches in the IHNC floodwall. SPX.0004 at IV–196, IV–200. Water overtopped the IHNC floodwall at around 7:30 a.m. SPX.0004 at IV–200. Flood levels in the St. Bernard Parish and the Lower Ninth Ward eventually reached eleven feet. SPX.0004 at IV–200.

Floodwater also came from the Central Wetlands Unit east, as evidenced by the presence of marsh grass on properties east of Paris Road around the Chalmette area. SPX.0004 at IV–199. The interior Forty Arpent Levee, "was completely overtopped [at a 6.5 feet in height,] when floodwaters from the MRGO flowed through breaches to fill the Central Wetlands beyond this level." 12/6/11 Kemp Direct at 36.

By August 29, 2005, around 8:25 a.m. water overtopped the Forty Arpent levee as a result of breaches along the MRGO Reach 2 levees that occurred earlier that morning. 12/6/11 Kemp Direct at 74; *see also* RPX1975, RPX2121 (videos showing flooding at the Forty Arpent Levee). Simultaneously, floodwater also arrived in Chalmette, quickly inundating the area with approximately ten feet of water. SPX.0004 at IV–199. By mid-morning, floodwaters from the IHNC breaches to the west merged with the floodwaters from the Chalmette area to the east. SPX.0004 at IV–199.

During Hurricane Katrina, the level of the GIWW/MRGO and IHNC intersection was approximately 15 to 15.4 feet above

normal, with similar levels experienced at the confluence between the GIWW and MR–GO. SPX.0004 at IV–39. The surge along Reach 2 ranged from 16.5 to 21.7 feet. SPX.0004 at IV–40.

After Hurricane Katrina, approximately 70% of the MR–GO levee was breached; most of those breaches occurred along Reach 2. SPX.0005 at V–115–16. The water from those breaches entered the Central Wetlands Unit and subsequently flooded St. Bernard Parish. 12/6/11 Kemp Direct at 87. As for the Lower Ninth Ward, "water originating in Lake Borgne traveled up the MRGO, into the IHNC, and through the breached IHNC flood walls." 12/6/11 Kemp Direct at 87.

On December 20, 2005, the National Hurricane Center summarized the flooding that resulted from substantially increased storm surge during Hurricane Katrina as follows:

> High water mark data ... also indicate a storm surge of 15 to 19 ft occurred in eastern New Orleans, St. Bernard Parish, and Plaquemines Parish, while the surge was 10 to 14 ft in western New Orleans along the southern shores of Lake Pontchartrain. Farther west, observations indicate a storm surge of 5 to 10 ft along the shores of western Lake Pontchartrain. The surge severely strained the levee system in the New Orleans area. Several of the levees and floodwalls were overtopped and/or breached at different times on the day of landfall. Most of the floodwall and levee breaches were due to erosion on the back side caused by overtopping, but a few breaches occurred before the waters ***712** reached the tops of the floodwalls. The surge overtopped large sections of the levees east of New Orleans, in Orleans Parish and St. Bernard Parish, and it also pushed water up the Intracoastal Waterway and into the Industrial Canal. The water rise in Lake Pontchartrain strained the floodwalls along the canals adjacent to its southern shore, including the 17th Street Canal and the London Avenue Canal. Breaches along the Industrial Canal east of downtown New Orleans, the London Avenue Canal north of downtown, and the 17th Street Canal northwest of downtown appear to have occurred during the early morning on 29 August. Overall, about 80% of the city of New Orleans flooded, to varying depths up to about 20 ft, within a day or so after landfall of the eye.

SPX.0500 at 9.

The court was unable to determine the precise percentage of residences in St. Bernard Parish and the Lower Ninth Ward that were severely damaged or destroyed by Hurricane Katrina, but sources indicate that between 68% and 98% of homes were severely damaged or destroyed. *See, e.g., Hurricane Katrina Statistics Fast Facts,* CNN, http://www.cnn.com/2013/08/23/us/hurricane-katrina-statistics-fast-facts/ (last visited April 30, 2015); THE DATA CTR., CURRENT HOUS. UNIT DAMAGE ESTIMATES, HURRICANE KATRINA, RITA, & WILMA at 25 (Feb. 12, 2006), *available at* https://gnocdc.s3.amazonaws.com/reports/Katrina_Rita_Wilma_Damage_ 2_12_06 _revised.pdf (showing that 9,777 of 14,037, *i.e.,* 70%, of owner-occupied housing and 13,695 of 20,229, *i.e.,* 68%, of renter-occupied housing in St. Bernard Parish was classified as "Severe/Destroyed")[17]; THE DATA CTR., CURRENT HOUS. UNIT DAMAGE ESTIMATES, HURRICANE KATRINA, RITA, & WILMA at 39 (Feb. 12, 2006), *available at* https:// gnocdc.s3.amazonaws.com/reports/Katrina_Rita_Wilma_Damage_2_12_06_revised.pdf (showing that 2,595 of 2,975, *i.e.,* 87%, of owner-occupied housing and 4,679 of 5,701, *i.e.,* 72%, of renter-occupied housing in the Lower Ninth Ward was classified as "Severe/Destroyed")[18]; CMTY. CTR. OF ST. BERNARD PARISH, ANNUAL REPORT 2008, *available at* http:// www.ccstb.org/images/annrep2008.pdf (stating that "93% of homes in St. Bernard Parish were rated as 'severely damaged' or 'destroyed' "); 12/6/11 Kemp Direct at 38 (estimating that flooding damaged 98% of all structures in St. Bernard Parish and the Lower Ninth Ward). Properties in Delacroix and Yscloskey, outside the federal levees, had to be torn down and rebuilt due to flooding. 12/12/11 TR 128–29 (Walsh).

On September 30, 2005, the Army Corps and the Louisiana Department of Natural Resources issued a Project Management Plan recognizing the need "to investigate various environmental restoration strategies requested in response to public concerns over the proposed plan to stabilize the MRGO navigation channel [.]" SPX.01146 at 1–9.

A 2006 Senate Report on Hurricane Katrina concluded, as for the areas within the federal levee system, that the MRGO:

> contributed to a potential "funnel" for storm surges emerging from Lake Borgne and the Gulf into the New Orleans area.... Prior to Hurricane Katrina, many warned that the potential funnel would accelerate and intensify storm surges emerging from Lake Borgne and the Gulf into the downtown New Orleans area. The funnel had been described as a "superhighway" for storm surges or the "Crescent City's Trojan Horse" that had the potential to "amplify storm surges by 20 to 40 percent," according to some storm modeling. Researchers at LSU believed that in creating this funnel, "the U.S. Army Corps of Engineers had inadvertently designed an excellent storm surge delivery system—nothing less—to bring this mass of water with simply tremendous ***713** 'load'—potential energy—right into the middle of New Orleans."

SPX.0692 at 123–24 (footnotes omitted).

As for the immediately adjacent areas outside the federal levee system, where some of the representative Plaintiffs' properties were located,[19] Plaintiffs' expert, Dr. Kemp testified at trial:

> Based on my observations and analysis, as well as my familiarity with the area under consideration, I conclude that if the MRGO had not been constructed, the areas in and around present-day Shell Beach, Yscloskey and Alluvial City would not have been so exposed to wind-driven water under non-hurricane conditions. Not only would the very wide and deep MRGO channel not exist, the buffering wetlands that were destroyed or greatly reduced by the MRGO would still largely be in place, as would the so-called Lake Borgne land bridge. In addition, Bayou Yscloskey would have remained the dead-end tidal creek that it was prior to the MRGO's construction, and would not serve as the highly efficient hydraulic connection between Lake Borgne and these communities that it has been in more recent years.

12/6/11 Kemp Direct at 239–40.

Figure 2.12. Area east of the LPV flood protection system along Bayou Yscloskey and the Bayou LaLoutre ridge, showing location of MRGO Reach Bnm where the LaLoutre Ridge was bisected by the MRGO.

12/6/11 Kemp Direct at 43 (fig 2.12) (limit of the Chalmette Levee).

F. After Hurricane Katrina, Storm Surge Continued To Cause Intermittent Flooding, And The Army Corps Of Engineers Closed The Mississippi River Gulf Outlet In July 2009.

On September 24, 2005, Hurricane Rita, a Category 3 storm, flooded significant portions of the St. Bernard Polder a second time with an average elevation of five to six feet. NAT'L WEATHER SERV. at 54–55 (describing the progression of Hurricane Rita). In addition, all of Plaintiffs' properties outside the levees flooded. 12/6/11 Kemp Direct at 254–59.

In 2006, Congress authorized the restoration of the hurricane protection system. Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico, ***714** Pub.L. No. 109–148, 119 Stat. 2680, 2761–63 (2006); *see also* Emergency Supplemental Appropriations Act, Pub.L. No. 109–234, 120 Stat. 418, 453–55 (2006).

As a result, the Hurricane and Storm Damage Risk Reduction System ("HSDRRS") recommended:

> a perimeter of levees, floodwalls, pump stations, closure structures, [and] surge barriers that provide

> storm damage risk reduction for the area interior to that perimeter. In the greater New Orleans area the authorizations for construction of this system were provided to build this to a level of risk reduction for a storm that has a one percent annual probability of occurrence. In New Orleans it's comprised of two distinct projects. The Lake Pontchartrain and Vicinity Project which is on the east side of the Mississippi River, and of course the Mississippi River traverses the city more or less in an east/west orientation, so it's the project features that you see depicted on the map north of the river. Then on the west bank, the West Bank and Vicinity Project, a similar perimeter of levees, floodwalls, pump stations, surge barriers, and closure structures.

12/14/11 TR 862–63 (Park); *see also* DX–49, DX215 (HSDRRS Map as of Oct. 31, 2011).

The HSDRRS substantially increased the height of the levees surrounding St. Bernard Polder to between 26 and 32 feet above mean sea level. 2/9/11 Gilmore Dep. 10. Shell Beach, Yscloskey, Hopedale and Delacroix, however, are outside the perimeter of the HSDRRS. 12/14/11 TR 881–82 (Park).

On June 5, 2008, the Army Corps also decided to "deauthorize" the MR–GO. *See* 73 Fed.Reg. 57340, 57341 (Oct. 2, 2008). On that same date, the Assistant Secretary of the Army for Civil Works sent a Final MR–GO Deep–Draft De-authorization Report to Congress. *Id.*

On September 1, 2008, Hurricane Gustav made landfall in southeast Louisiana as a Category 2 storm, with winds gusting to 117 miles per hour. NAT'L WEATHER SERV. at 10, 56. A ten-foot surge overtopped some levees in New Orleans, but flooding was not widespread. NAT'L WEATHER SERV. at 56. Minimal flooding occurred in St. Bernard Polder (inside the levees) except near the IHNC floodwall (2414 Deslonde St. property). 12/6/11 Kemp Direct at 264. But, Gustav caused flooding outside the levees, with a nine-foot surge at Shell Beach and a ten-foot surge at Delacroix. 12/6/11 Kemp Direct at 265. As the Government expert further testified:

> This Category 2 hurricane ... threatened to once again flood New Orleans [and] was important in waking the [Army Corps] to the true threat of the MRGO funnel. One ship and two large barges broke loose in the IHNC and piled up on the railroad bridge threatening to cause far worse overtopping of the newly refurbished IHNC floodwalls. It was after this near tragedy that planning began in earnest for the IHNC Surge Barrier.

12/6/11 Kemp Direct at 265; *see also* 12/13/11 TR 631–32 (Robin) (testifying that Gustav flooded Mr. Robin's property in Yscloskey with several feet of water).

The Government's 2008 FEMA flood insurance studies predicted that "[d]amaged levees, decimated wetlands, and the still-open MRGO have left the parish vulnerable to future storms." SPX.0423 at 3; *see also id.* (citing other risk analyses performed by FEMA and the Army Corps, described at Pls. 4/13/12 Prop. FOF ¶¶ 396–406).

Two weeks later, on September 13, 2008, Hurricane Ike made landfall as a Category 1 storm. Dr. Kemp testified that Hurricane Ike resulted in an 8.5–foot surge at Delacroix. 12/6/11 Kemp Direct at 265; *see also* 12/13/11 TR 632 (Robin) (Hurricane Ike flooded Mr. Robin's property.).

After Hurricane Katrina other hurricanes and severe storms continued to generate storm surge that repeatedly flooded all of Plaintiffs' properties.[20]

***715** In late July 2009, the Army Corps closed the MR–GO permanently. *See* U.S. ARMY CORPS OF ENG'RS, MRGO NAVIGATION CHANNEL CLOSURE, http://www.mvn.usace.army.mil/Missions/Environmental/MRGOEcosystemRestoration/MRGODeAuthorization.aspx (last visited Apr. 30, 2015) ("MR–GO CLOSURE").

II. DISCUSSION.

A. Jurisdiction.

[1]The United States Court of Federal Claims has jurisdiction under the Tucker Act, 28 U.S.C. § 1491, "to render judgment upon any claim against the United States founded either upon the Constitution, or any Act of Congress or any regulation of an executive department, or upon any express or implied contract with the United States, or for liquidated or unliquidated damages in cases not sounding in tort." 28 U.S.C. § 1491(a)(1). The Tucker Act, however, is "a jurisdictional statute; it does not create any substantive right enforceable against the United States for money damages.... [T]he Act merely confers jurisdiction upon [the United States Court of Federal Claims] whenever the substantive right exists." *United States v. Testan,* 424 U.S. 392, 398, 96 S.Ct. 948, 47 L.Ed.2d 114 (1976).

[2] [3] [4]Therefore, to pursue a substantive right under the Tucker Act, a plaintiff must identify and plead an independent contractual relationship, Constitutional provision, federal statute, and/or executive agency regulation that provides a substantive right to money damages. *See Todd v. United States,* 386 F.3d 1091, 1094 (Fed.Cir.2004) ("[J]urisdiction under the Tucker Act requires the litigant to identify a substantive right for money damages against the United States separate from the Tucker Act[.]"); *see also Fisher v. United States,* 402 F.3d 1167, 1172 (Fed.Cir.2005) (*en banc*) ("The Tucker Act ... does not create a substantive cause of action; ... a plaintiff must identify a separate source of substantive law that creates the right to money damages.... [T]hat source must be 'money-mandating.' "). Specifically, a plaintiff must demonstrate that the source of substantive law upon which he relies "can fairly be interpreted as mandating compensation by the Federal Government[.]" *United States v. Mitchell,* 463 U.S. 206, 216, 103 S.Ct. 2961, 77 L.Ed.2d 580 (1983) (quoting *Testan,* 424 U.S. at 400, 96 S.Ct. 948). And, the plaintiff bears the burden of establishing jurisdiction by a preponderance of the evidence. *See Reynolds v. Army & Air Force Exch. Serv.,* 846 F.2d 746, 748 (Fed.Cir.1988) ("[O]nce the [trial] court's subject matter jurisdiction [is] put in question.... [the plaintiff] bears the burden of establishing subject matter jurisdiction by a preponderance of the evidence.").

The court previously determined that it had jurisdiction to adjudicate the Fifth Amendment Takings Clause claim alleged in Plaintiffs' January 13, 2006 First Amended Complaint and January 31, 2008 Second Amended Complaint. *See Tommaseo I,* 75 Fed.Cl. at 802–07; *St. Bernard Parish I,* 88 Fed.Cl. at 545–49. In *Tommaseo I,* the court determined that it also had subject matter jurisdiction, pursuant to the Tucker Act, to adjudicate claims alleged in the January 13, 2006 First Amended Complaint, but leave was granted to allow Plaintiffs to amend their Complaint to specify when Plaintiffs became property owners and to show cause why Counts I and III of the January 13, 2006 First Amended Complaint were not barred by the statute of limitations for failure to specify the precise dates of the alleged takings. *See Tommaseo I,* 75 Fed.Cl. at 803–07. In addition, Count II of the January 13, 2006 First Amended Complaint was dismissed as not ripe for adjudication, because the MR–GO was not closed. *See id.* at 803. But, Plaintiffs could refile if and when the MR–GO closed. *See id.* In *St. Bernard Parish I,* the court denied: the Government's Motion For Summary Judgment on statute of limitations grounds, because the stabilization doctrine applied, delaying ***716** the accrual of Plaintiffs' claims; and the Government's Motion To Dismiss, pursuant to RCFC 12(b)(6), for failure to state a claim upon which relief can be granted, because Plaintiffs' January 31, 2008 Second Amended Complaint and the record established the plausibility of Plaintiffs' claims. *See St. Bernard Parish I,* 88 Fed.Cl. at 552–59. In addition, the court dismissed Paragraph 48 of Count I of Plaintiffs' January 31, 2008 Second Amended Complaint that "request[ed] 'lost benefits' and 'profits' of Plaintiffs' 'commercial ventures,' " because "[t]he Just Compensation Clause only affords a financial remedy for property loss caused by the physical taking of private property." 88 Fed.Cl. at 549 (citations omitted).[21]

On July 6, 2011, Plaintiffs filed a Third Amended Complaint that also pled a Fifth Amendment Takings Clause claim. *See* U.S. CONST. amend. V ("[P]rivate property [shall not] be taken for a public purpose, without just compensation."); *see also Ark. Game & Fish Comm'n v. United States,* ——U.S. ——, 133 S.Ct. 511, 519, 184 L.Ed.2d 417 (2012) ("[T]akings temporary in duration can be compensable."); *id.* at 522 ("We rule today, simply and only, that government-induced flooding temporary in duration gains no automatic exemption from Takings Clause inspection.").

Accordingly, the court has determined that it has jurisdiction to adjudicate the Takings Clause claim in Plaintiffs' July 6, 2011 Third Amended Complaint.

B. Standing.

[5] [6]Article III standing is a jurisdictional prerequisite that the court must ascertain, even if not raised by the parties. *See Fuji Photo Film Co. v. Int'l Trade Comm'n,* 474 F.3d 1281, 1289 (Fed.Cir.2007) ("Because Article III standing is jurisdictional, this court must consider the issue sua sponte[.]"). The United States Supreme Court has instructed that the plaintiff has the burden to establish three elements before a federal trial court may adjudicate an alleged takings claim. First, " 'injury in fact,' by which we mean an invasion of a legally protected interest that is '(a) concrete and particularized, and (b) actual or imminent, not conjectural or hypothetical [.]' " *Ne. Fla. Chapter of Associated Gen. Contractors v. City of Jacksonville,* 508 U.S. 656, 663, 113 S.Ct. 2297, 124 L.Ed.2d 586 (1993) (quoting *Lujan v. Defenders of Wildlife,* 504 U.S. 555, 560, 112 S.Ct. 2130, 119 L.Ed.2d 351 (1992)). Second, "a causal relationship between the injury and the challenged conduct[.]" *Id.* Third, "a likelihood that the injury will be redressed by a favorable decision, by which we mean that the 'prospect of obtaining relief from the injury as a result of a favorable ruling' is not 'too speculative.' " *Id.* at 663–64, 113 S.Ct. 2297 (quoting *Allen v. Wright,* 468 U.S. 737, 752, 104 S.Ct. 3315, 82 L.Ed.2d 556 (1984)). "These elements are the 'irreducible minimum' required by the Constitution." *Id.* at 664, 113 S.Ct. 2297 (quoting *Valley Forge Christian Coll. v. Americans United for Separation of Church & State, Inc.,* 454 U.S. 464, 472, 102 S.Ct. 752, 70 L.Ed.2d 700 (1982)).

The court previously determined that "the January 31, 2008 Second Amended Complaint ... alleged sufficient facts to establish standing, as each of the [ ] Plaintiffs owned property in St. Bernard Parish or the Ninth Ward of the City of New Orleans that has experienced severe flooding in 2005 and intermittent reoccurring flooding fairly traceable to the construction, operation (expansion), or maintenance (dredging) of the MR–GO, and a favorable decision will redress injury from the flooding." *St. Bernard Parish I,* 88 Fed.Cl. at 548. The Plaintiffs identified in Plaintiffs' January 31, 2008 Second Amended Complaint and July 6, 2011 Third Amended Complaint are identical, and the parcels of representative Plaintiffs are substantially similar. *Compare* 2nd Am. Compl. ¶¶ 2 (Representative Plaintiffs), 15–45 (properties of representative Plaintiffs), *with* 3rd Am. Compl. ¶¶ 2 (Representative Plaintiffs), ***717** 15–45 (properties of representative Plaintiffs).[22]

For these reasons, the court has determined that Plaintiffs' July 6, 2011 Third Amended Complaint alleges sufficient facts to establish standing, as each owned property in St. Bernard Parish or the Ninth Ward of the City of New Orleans that was flooded during Hurricane Katrina in 2005 and experienced intermittent flooding fairly traceable to increased storm surge resulting from the construction, expansions, operation, and failure to maintain the MR–GO, and a favorable decision will redress injury from the flooding.

C. Admissibility And Weight Of Witness Testimony.

1. Lay Witness Testimony.

According to the Government, causation in complex flooding cases requires the court to rely primarily, if not exclusively, on the testimony of experts instead of lay witnesses. Gov't 4/13/12 Br. 37 (citing *Hendricks v. United States,* 14 Cl.Ct. 143, 149 (1987) ("Causation of flooding is a complex issue which must be addressed by experts."); *Loesch v. United States,* 227 Ct.Cl. 34, 645 F.2d 905, 914 (1981) (observing that expert testimony "is particularly appropriate" where "the trier of fact is presented with evidence of a highly technical nature involving geotechnical, hydrologic, hydraulic, geological and climatic matters")). Lay testimony should receive "little weight in determining causation" in flooding cases. Gov't 4/13/12 Br. 37 (quoting *Alost v. United States,* 73 Fed.Cl. 480, 495 (2006), *aff'd,* 25 Fed.Appx. 823 (Fed.Cir.2007)); *see also Leeth v. United States,* 22 Cl.Ct. 467, 486–87 (1991) ("While a lay person merely through observation can identify that a backwater effect is occurring at a particular point, the source of that effect cannot be identified by that lay person because it would 'look the

same' regardless of its cause.").

The Government overstates relevant caselaw. It is true that the Court of Claims in *Hendricks* observed that "[c]ausation of flooding is a complex issue which must be addressed by experts," but it elaborated, in the very next sentence, that "the bulk of the lay testimony is accorded very little weight in the court's decision of the *legal* issues." *See* 14 Cl.Ct. at 149 (emphasis added). As such, the Court of Claims did not endorse the concept that only experts could proffer relevant evidence of causation, instead that lay evidence is not dispositive of legal issues.

It is also true that the United States Court of Federal Claims determined, in *Alost,* that the lay evidence presented in that case was "entitled to little weight." 73 Fed.Cl. at 495. But, the only evidence presented in that case was adduced from lay witnesses with little knowledge about the history of flooding in that case. *Id*. In this case, the record includes a plethora of Government and academic reports and studies and expert testimony. In addition, the record includes extensive testimony of lay witnesses who were intimately familiar with the history of flooding in the area and were able to share their first-hand observations about the adverse environmental conditions created by the construction, expansions, operation, and failure to maintain the MRGO and substantially increased storm surge during Hurricane Katrina and subsequent hurricanes and severe storms that repeatedly flooded Plaintiffs' properties.[23] For these reasons, the ***718** court rules that the lay testimony in this case, though not dispositive, is relevant and probative.

2. Expert Witness Testimony.

The Government also argues that the United States Court of Claims previously has rejected expert testimony about flooding and erosion, where the expert "failed to give reasonable consideration to other clearly shown possibilities." Gov't 4/13/12 Br. 39 (quoting *Loesch,* 227 Ct.Cl. 34, 645 F.2d at 915). Therefore, absent "supportive empirical data and study," the expert's "opinion ... was not very helpful to the trier of fact." Testifying as to the existence of a temporal relationship does not establish causation, and therefore, courts have rejected "this type of *post hoc ergo propter hoc* (literally, 'after this, therefore because of this')" reasoning as a "logical fallacy." Gov't 4/13/12 Br. 39 (citing *Loesch,* 645 F.2d at 914).

[7]The Government does not cite to a single case holding that causation cannot be established without expert modeling. And, as the trial court in *Ark. Game & Fish* aptly observed, computer modeling is not the only or, even, the best form of expert analysis. *See* 87 Fed.Cl. at 628 ("[T]he fact that the model was 'very reliable and more accurate than [other] simulation models' and offered output that was 'far better than what you would typically expect from river modeling' does not indicate that results from its use should be employed to displace actual observations.") (internal quotation marks omitted); *see also* 12/13/11 TR 574 (Kemp) (stating that the hydrologic influence of the MR–GO was obvious through observation alone).

In this case, Plaintiffs proffer the expert testimonies of: Dr. G. Paul Kemp (12/6/11 Kemp Direct 1–272 & Exs. 1–8; 12/12/11 TR 188–399; 12/13/11 TR 400–582); and Dr. Joseph N. Suhayda (12/6/11 Suhayda Direct 1–32; 12/13/11 TR 657–798; 12/14/11 TR 799–836). The Government proffers the expert testimonies of: Dr. Louis D. Britsch III (12/8/11 Britsch Direct 1–31; 12/14/11 TR 892–995); and Donald T. Resio (12/8/11 Resio Direct 1–43; 12/14/11 TR 996–1199). As more fully explained in the court's May 1, 2015 Memorandum Opinion And Final Order On Evidentiary Issues, the court rules that Drs. Kemp, Suhayda, Britsch, and Resio are all qualified as expert witnesses and that their testimony: "will help the trier of fact to understand the evidence"; "is based on sufficient facts or data"; "is the product of reliable principles and methods"; and "the expert has reliably applied the principles and methods to the facts[.]" FED. R. EVID. 702.

For these reasons, the court rules that the expert testimony in this case, though not dispositive, is relevant and probative.

D. Plaintiffs Established That The Army Corps Of Engineers' Construction, Expansions, Operation, And Failure To

Maintain The Mississippi River Gulf Outlet Effected A Temporary Taking By Increased Storm Surge And Flooding Of Plaintiffs' Properties During Hurricane Katrina And Subsequent Hurricanes And Severe Storms.
The June 7, 2011 Third Amended Complaint alleges at Count II a "temporary taking of property." 6/7/11 Third Am. Compl. ¶¶ 53–55.

[8]The Takings Clause of the Fifth Amendment to the United States Constitution provides that "private property [shall not] be taken for public use, without just compensation." U.S. CONST. amend. V. "[I]t is most reasonable to construe the reference to 'private property' in the Takings Clause ... as encompassing the property of state and local governments when it is condemned by the United States. Under this construction, the same principles of just compensation presumptively apply to both private and public condemnees." *United States v. 50 Acres of Land,* 469 U.S. 24, 30, 105 S.Ct. 451, 83 L.Ed.2d 376 (1984).

[9] [10]Whether a compensable taking has occurred requires the court to resolve "a ***719** question of law based on factual underpinnings." *Wyatt v. United States,* 271 F.3d 1090, 1096 (Fed.Cir.2001) (citations omitted). In *Arkansas Game & Fish,* the United States Supreme Court held that where a temporary taking is alleged, as in this case, plaintiffs must establish: (1) a protectable property interest under state law; (2) the character of the property and the owners' "reasonable-investment backed expectations"; (3) foreseeability; (4) causation; and (5) substantiality. *See* 133 S.Ct. at 522–23.

1. Plaintiffs Established That They Held Protectable Property Interests Recognized Under Louisiana Law.

The Third Amended Complaint alleges that Plaintiffs in this case have real property interests in fee ownership under Louisiana law. 6/7/11 3rd Am. Compl. ¶¶ 15–19, 25, 29, 30–31, 33–36, 38, 40–42, 43–45.

To maintain an action for a compensable taking under the Fifth Amendment, Plaintiffs must show that they have a protectable property interest under state law. *See Phillips v. Wash. Legal Found.,* 524 U.S. 156, 164, 118 S.Ct. 1925, 141 L.Ed.2d 174 (1998) ("Because the Constitution protects rather than creates property interests, the existence of a property interest is determined by reference to 'existing rules or understandings that stem from an independent source such as state law.' ") (quoting *Bd. of Regents of State Colls. v. Roth,* 408 U.S. 564, 577, 92 S.Ct. 2701, 33 L.Ed.2d 548 (1972)).

Section 1 of Title 19, Part I of the Louisiana Revised Statute, governing expropriation states: "As used in this part, the term 'property' means immovable property, including servitudes and other rights in or to immovable property." LA. REV. STAT. ANN.. § 19:1 (1975).

Title 33 further provides that:

> "Owner" is defined as any person with care, custody, or control of the property at issue, including but not limited to record owners, seizing creditors, mortgage holders, lien holders, loan servicers of foreclosed property pending title transfer, or an agent of assignee of the seizing creditor, mortgage holders, lien holders, or loan servicer.

LA. REV. STAT. ANN.. § 33:5066(5) (2012).

[11]At trial, Plaintiffs presented evidence that each had an ownership interest in "property," as defined by the Louisiana Revised Statute. *See* Court Exhibit B.

For these reasons, the court has determined that Plaintiffs established that they held protectable property interests, recognized under Louisiana law.

2. Plaintiffs Established That, Based On The Character Of Their Property Interests, They Had "Reasonable Investment–Backed Expectations."

Plaintiffs' properties consisted of vacant land, modest personal residences, and small businesses. Court Exhibit B; *see also* 3rd Am. Compl. ¶¶ 15–45.

[12]In a temporary takings case concerning flooding, a property owner's "reasonable investment-backed expectations" necessarily must consider knowledge of any prior flooding. *See Ark. Game & Fish,* 133 S.Ct. at 521 ("Flooding cases like other takings cases, should be assessed with reference to the 'particular circumstances of each case[.]' ").

The Government argues that Plaintiffs were aware of the risks of owning property in a floodplain after Hurricane Betsy on September 19, 1965 and:

> were aware of significant ecological changes in the St. Bernard region almost immediately after construction of the MRGO began.... Whatever the impact on the environment generally, Plaintiffs' own testimony proves that, during the period between the completion of the MRGO and Hurricane Katrina, the LPV protected Plaintiffs' properties within the levee system from flooding.

Gov't 4/13/12 Br. 7–8 (citing SPX.0704 at 66 (COASTAL ENV'TS, INC., ENVTL. BASELINE STUDY (Oct. 1972) ("1972 BASELINE STUDY") (stating that the "MRGO has introduced higher salinities into the study area" and reporting that "[t]estimony of parish residents reveals that most of the swamp has died since the construction of the MRGO"))).

***720** Although the Army Corps represented to the public that their properties were protected by the LPV that was constructed *after* Hurricane Betsy, the public "was not informed about the flooding risks that the selection of the SPH [Standard Project Hurricane] as a basis for design implied [and] ... the SPH .... was not revised as knowledge improved after the 1960s." SPX.0027 at 12–13 (July 31, 2006 ILIT Report); *see also* SPX.0029 at 98 ("Clearly, by 1972, at a relatively early stage in the construction of the GNO HPS [Greater New Orleans Hurricane Protection System], the SPH used as a basis for design was obsolete."); RDX–377 at 1 (Dec. 1982 USACE Project Reevaluation Study) (noting that the draft reevaluation study did not emphasize the "catastrophic flooding potential of the area"); 12/14/11 TR 1039–40 (Resio) (explaining that the current estimates of 100–year surge level far surpass the estimates used for the old SPH); 12/6/11 Kemp Direct at 268 (same).

[13]In this case, as in *Arkansas Game & Fish,* although Plaintiffs' properties were in a floodplain and "had experienced flooding in the past," that flooding was not "comparable" to the flooding during Hurricane Katrina and subsequent hurricanes and severe storms giving rise to the temporary takings claim at issue. *See* 133 S.Ct. at 522.

For these reasons, the court has determined that Plaintiffs established that they had "reasonable investment-backed expectations" concerning the use and value of their vacant land, modest personal residences, and small businesses.

3. Plaintiffs Established That It Was Foreseeable To The Army Corps Of Engineers That The Construction, Expansions, Operation, and Failure To Maintain The Mississippi River Gulf Outlet Would Substantially Increase Storm Surge During Hurricanes And Other Severe Storms And Cause Flooding.

[14]In *Arkansas Game & Fish,* the United States Supreme Court held that "relevant to the taking inquiry is the degree to which the [government's] invasion is intended *or* the foreseeable result of government action." *See* 133 S.Ct. at 522 (citing *John Horstmann Co. v. United States,* 257 U.S. 138, 42 S.Ct. 58, 66 L.Ed. 171 (1921)). Furthermore, the United States Court of Appeals for the Federal Circuit held on remand that "[i]n order for a taking to occur it is not necessary that the [G]overnment

intend to invade the property owner's rights, as long as the invasion that occurred was 'the foreseeable or predictable result' of the [G]overnment's actions." 736 F.3d 1364, 1372 (Fed.Cir.2013) (citing *Moden v. United States,* 404 F.3d 1335, 1343 (Fed.Cir.2005) ("[W]e conclude that ... [plaintiffs] must point to some evidence ... with regard to whether the [alleged Fifth Amendment taking] was the foreseeable or predictable result of [the Government's actions].")); *see also Ridge Line Inc. v. United States,* 346 F.3d 1346, 1356 (Fed.Cir.2003) ("[S]ince [the plaintiff] does not allege that the [G]overnment intentionally appropriated its property, on remand the court must first determine whether [the plaintiff] proved that the increased storm runoff was the direct, natural, or probable result of the [Government's action], rather than merely an incidental or consequential injury, perhaps compensable as a tort[.]").

a. Because Of Increased Salinity.

[15]By 1958, the Army Corps was aware of the adverse effects of salt water on freshwater wetlands and predicted that "[t]he excavation of a channel 36 feet deep, 500 feet wide, and over 70 miles long ... through the Lake Borgne marshes and shallow inlets of Chandeleur Sound ... could result in a major ecological change of the area." RDX–1685 at 24. The Army Corps also knew of the risk posed by the destruction of the land bridge separating the MR–GO from Lake Borgne that would allow higher saline water to move inland. 2005 ARMY CORPS DRAFT STUDY at 1–15 ("Changes in salinity and water circulation in the Lake Pontchartrain Basin caused by the MRGO have increased the rate of wetland loss in the area, and these changes to geomorphic structure in this part of the Deltaic Plain would increase the storm surge of hurricanes and tropical storms that impact this area of coastal Louisiana."); 12/6/11 Kemp Direct at 239–40.

***721 b. Because Of Increased Habitat/Wetland Loss.**

The fact that the Army Corps was aware that the construction, expansions, operation, and failure to maintain the MR–GO caused adverse environmental impacts, and that those "adverse impacts on the regional environment and ecology" could result in substantial increased storm surge during hurricanes and severe storms, is well documented in this record. *See, e.g.,* RDX–1685 at 24 (prior to the construction of the MR–GO, the Army Corps was aware that it "could result in a major ecological change of the area"); RPX0699 (September 1958 Army Corps Memorandum); SPX.0129 at MRGO 12, PDF 362 (Army Corps study stating "The data indicates that land loss rates have accelerated since 1990 and that the rate of wetlands loss now exceeds the rates experienced in the area during the period of MRGO channel construction.").

c. Because Of Increased Erosion.

Army Corps documents evidence that, as early as 1959, it was aware that foreshore protection was required to prevent erosion of the MR–GO's banks (RPX0699 at 5 (1959 Army Corps Memorandum); SPX.0241 (1983 Army Corps form)), but instead the Army Corps recommended expanding the MR–GO without channel protection to prevent the erosion:

> No channel protection is recommended initially, however, erosion due to wave wash in open areas can be expected in the upper part of the channel slope where the peat and highly organic clay are exposed. Protection for this area can be provided if and when the need for it becomes necessary.... It is presumed that sufficient rights of way will be furnished by local interests to preclude use of channel protection or that additional rights of ways will be furnished when the need arises.

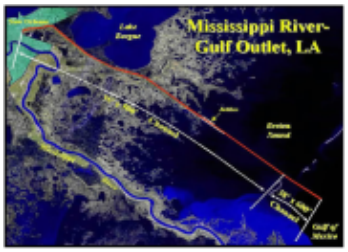
SPX.0213 at 7 (1957 Army Corps Memorandum).

After construction of the MRGO in 1968, the banks eroded at an estimated twenty-seven to thirty-eight feet per year on the Inland Reach. 2008 ARMY CORPS REPORT at vi. Between 1964 and 1996, 5,324 additional acres of marsh adjacent to the MRGO were lost. 2008 ARMY CORPS REPORT at vi. The Army Corps had to construct additional project features to stabilize the banks. 2008 ARMY CORPS REPORT at vi. By 2006, the MR–GO had expanded well beyond its authorized parameters:

> The MRGO bar channel authorized depth is 38 ft; the authorized bottom width is 600 ft. The remainder of the channel has an authorized depth of 36 ft and an authorized bottom width of 400 or 450 ft, depending on location. Due to ship wave erosion, the surface width of the channel has increased since its construction at a rate of up to 15 ft per year. The additional eroded open water typically has a depth of six feet or less. Therefore, even an additional 1000 feet of open water adds no more than 6000 square feet of conveyance, about a 21% increase over the authorized channel (assuming the channel is 40 feet deep, has a 600 ft wide dredged bottom and a 1 to 3 side slope).

2006 WESTERINK NOTE at 1–3 (internal references omitted).

***722**



Pls. 2/9/09 S.J. Ex. 12 at iv.
By 1984, the Army Corps concluded:

> Construction of the MR–GO has accelerated the natural changes occurring in the St. Bernard Parish wetlands near Lake Borgne.... Wind- and wave-generated erosion is also steadily widening the MR–GO. Because of this expansion, the east bank along Lake Borgne is dangerously close to being breached. Once the bank is breached, development to the southwest [*i.e.,* the communities in which Plaintiffs' properties are located] would be exposed to direct hurricane attacks from Lake Borgne.

RPX1639 at 7 (U.S. ARMY CORPS OF ENG'RS, LA. COASTAL AREA: SHORE & BARRIER ISLAND EROSION (1984)).

The Army Corps' policy was to allow bank erosion of the MR–GO to continue unabated. *See* RPX2082 at 2 (restating the Army Corps' "long standing policy against repairing bank erosion"); *see also* SPX.0241 (In 1983, the Army Corps decided to defer "erosion protection to allow for future widening" of MR–GO.). Consequently, by 2004, one year prior to Hurricane Katrina, the majority of the banks of the MR–GO were unprotectable. RPX0716 at 5 (2004 Fact Sheet) ("[T]he MRGO banks remain unlined with protection.").

d. Because Of Increased Storm Surge.

Increased salinity, increased habitat/wetland loss, and increased erosion of the MR–GO's banks cumulatively contributed to increased storm surge. In February 1967, the Army Corps considered, but rejected as too costly, an alternative plan for the flood protection system that would have closed off the mouth of the funnel. RPX1030 (map showing rejected alternate plan); 12/6/11 Kemp Direct at 245 (comparing the rejected alternate plan to the 100–year protection plan).

The Government is correct that knowledge of potential storm surge is not necessarily knowledge of potential flooding. Gov't 4/13/12 Br. 27. But, the trial court in *Arkansas Game & Fish* rejected the same argument. *See* 87 Fed.Cl. 594, 621 (2009) (the fact that the Army Corps initially did not know that "increased river levels caused by deviations from the water control plan would cause additional flooding" on plaintiff's timber land was not dispositive of foreseeability). As *Arkansas Game & Fish* recognized, foreseeability is measured by an objective ***723** standard of what the Government should have known. *See id.* ("The question thus presented becomes whether such flooding *should* have been foreseen, based, for instance, on information that the Corps had or could have gathered[.]").

e. Because Of The "Funnel Effect."

The funnel effect caused by the MR–GO further exacerbated the increased storm surge that resulted from Hurricane Katrina. Around September 3, 1957, the St. Bernard Tidal Channel Advisory Committee warned the Army Corps and the public-at-large that "[d]uring times of hurricane conditions, the existence of the [MR–GO] will be an enormous danger to the heavily populated areas of the Parish due to the rapidity of the rising waters reaching the protected areas in full force through the avenue of this proposed channel." RDX–1145. In 1965, after Hurricane Betsy, a similar warning was published in the *Federal Register* by the Citizens Committee for Hurricane Flood Control. RPX0006 at 3.

In response, the Army Corps developed a plan to build a levee to block the funnel opening. RPX1030 ("Alternate Plan C"); *see also* 1966 ARMY PLAN at 123 ("Storm surge may also be increased, particularly in coastal areas, by a funneling effect in converging open bay mouths.").

On November 24, 1965, the Citizens Committee for Hurricane Flood Control wrote a letter to the Army Corps requesting action to avoid the type of flooding experienced with Hurricane Betsy and recommending that the Army Corps construct flood gates on the Intercostal Waterway, Bayou Bienvenue, Gulf Outlet, instead of a proposed levee that "would form a funnel, channeling all hurricane surges and wind driven water in the Intercostal Waterway and Industrial Canal [.]" RPX0006 at 3.

In 1966, the Army's Coastal Engineering Research Center also conducted a study observing that storm surge depends on

> the wind velocity, the distance over which it blows, the wind direction, and the water depth. Storm surge is greater in lesser depths, and this is the reason for the generally greater values of storm surge along the Gulf Coast [.] Storm surge may ... be increased, particularly in coastal areas, by a funneling effect in converging open bay mouths.

1966 ARMY PLAN at 123; 2006 WESTERINK NOTE at 2 ("A portion of the levee protecting St. Bernard Parish/Chalmette and the portion of the hurricane protection levee along the south side of Orleans East Parish, north of the GIWW, form the 'funnel' that is often referenced.").

A 2006 Senate Report on Hurricane Katrina concluded, concerning the areas within the federal levee system, that the MRGO:

> contributed to a potential "funnel" for storm surges emerging from Lake Borgne and the Gulf into the New Orleans area.... Prior to Hurricane Katrina, many warned that the potential funnel would accelerate and intensify storm surges emerging from Lake Borgne and the Gulf into the downtown New Orleans area. The funnel had been described as a "superhighway"

> for storm surges or the "Crescent City's Trojan Horse" that had the potential to "amplify storm surges by 20 to 40 percent," according to some storm modeling. Researchers at LSU believed that in creating this funnel, "the U.S. Army Corps of Engineers had inadvertently designed an excellent storm surge delivery system—nothing less—to bring this mass of water with simply tremendous 'load'—potential energy—right into the middle of New Orleans."

SPX.0692 at 123–24 (footnotes omitted).

* * *

For these reasons, the court has determined that it was foreseeable to the Army Corps that the construction, expansions, operation, and failure to maintain the MR–GO would increase salinity, increase habitat/land loss, increase erosion, and increase storm surge that could be exacerbated by a "funnel effect" and likely cause flooding of Plaintiffs' properties in a hurricane or severe storm. *See Ark. Game & Fish,* 133 S.Ct. at 522.

***724 4. Plaintiffs Established A Causal Link Between The Army Corps Of Engineers' Construction, Expansions, Operation, And Failure To Maintain The Mississippi River Gulf Outlet And Significant Increase In Storm Surge And Flooding During Hurricane Katrina And Subsequent Hurricanes And Severe Storms That Flooded Plaintiffs' Properties.**

a. Because Of Increased Salinity.

[16]The adverse effect of salt water on freshwater wetland vegetation in the New Orleans area concerned the academic community well before the construction of the MR–GO. *See* W.T. Penfound & E.S. Hathaway, PLANT COMMUNITIES IN THE MARSHLANDS OF SOUTHEASTERN LOUISIANA, ECOLOGICAL MONOGRAPHS (1938); *see also* AUDUBON EDUCATOR'S GUIDE at 4 ("When saltwater reaches a freshwater habitat, it burns the freshwater plants which are intolerant of the saltwater. The saltwater kills the existing plants, causing the soils to become loose and wash away. This process can also convert what was once a freshwater swamp into a saltwater marsh.").

In 1962, an Army Corps Report stated that the MR–GO "provides a deep direct route for the inflow of saline currents from the Gulf of Mexico to the area along its channel and to Lake Pontchartrain[.]" RJX0278 (ARMY CORPS INTERIM SURVEY REPORT, LAKE PONTCHARTRAIN, LA. & VICINITY (Nov. 21, 1962)).

A 1966 report also suggested that, "[b]ecause of its size, 500 feet wide by 36 feet deep, the [MRGO] channel will become a major avenue for intrusion of salt water into the marshlands and waters which it traverses." RPX0818 (LEROY W. GILES, MISS. BUREAU OF SPORT FISHERIES & WILDLIFE, RELATIONSHIP OF VEGETATION TO SALINITY IN A SE. LA. COASTAL MARSHH (1966)).

An October 1972 environmental baseline study conducted by Dr. Sherwood Gagliano,[24] for St. Bernard Parish was one of the first to discuss the increased salinity resulting from the MR–GO:

> A change in water regime seems to be the main cause of deterioration [in freshwater swamps along MRGO].... The MRGO has introduced higher salinities into the study area.... Thus, it can be expected that the brackish water zone has been moved into the area that was once fresh swamp and the trees have died. Testimony of parish residents reveals that most of the swamp has died since the construction of the MRGO and tends to support this theory.

1972 BASELINE STUDY at 66.

By 1981, the MR–GO provided a "more direct flow of higher salinity, stratified water inland toward areas of St. Bernard and Orleans Parishes." 2008 ARMY CORPS REPORT at xiii (citing WICKER et al. 1981).

The following chart shows salinity measurements during the period when the MR–GO was being constructed and afterwards:

***725**

http://www.westlaw.com/Link/Document/Blob/I17b28be0f46c11e4ac1c010000000000.png?originationContext=document&vr=3.0&rs=cblt1.0&transitionType=DocumentImage&contextData=(sc.UserEnteredCitation)
[**Editor's Note:** The preceding image contains the reference for footnote[25]].

2010 DRAFT EIS at 3–32 tbl. 3–13; *see also* 12/13/11 TR 616, 623 (Robin) (Mr. Robin is a local oyster farmer who observed salinity levels changes).
The impact of the MR–GO on salinity also is evidenced by the decrease of salinity from thirty-two percent to sixty-six percent after the Army Corps closed the MR–GO in 2008–2011.

Yearly Average Salinity (ppt) Pre- and Post-MRGO's Closure

Location	Pre–Closure	Post–Closure	% Change
Bayou La Loutre	17.01	8.87	48%
Lake Borgne	8.16	5.62	32%
Central Wetlands	14.67	5.26	64%
GIWW	14.72	5.07	66%
Lake Pontchartrain	6.12	4.01	35%

2010 DRAFT EIS at 3–33 tbl. 3–14; *see also* 1972 BASELINE STUDY at 90 (comparing monthly salinity ranges at Hopedale before and after the construction of the MR–GO, using 1957–1967 Army Corps data); *see also* 1972 BASELINE STUDY at 91 (comparing monthly salinity ranges at the Paris Road Bridge before and after the construction of the MR–GO, using 1948–1967 Army Corps data).
These Army Corps documents show that salinity increased substantially in the wetlands in and surrounding the New Orleans Polder after the Army Corps' construction, expansion, operation, and failure to maintain the MR–GO. They also show a significant decrease in salinity after the MR–GO was closed.

An Army Corps December 2010 draft Environmental Impact Statement also recognized that "since construction of the MRGO, circulation patterns have been altered along its length in areas from Breton Sound north to Lake Pontchartrain. The MRGO acted as a direct passage for tidal exchange, allowing a more direct flow of higher-density saline ***726** water inland." 2010 FEASIBILITY REPORT at 2–10. In sum, the decline of wetlands and swamp accelerated after the construction of MR–GO, in "response to changing salinity regimes (salt water intrusion) and hydrology (impoundment)." RJX–195 at 4–2 (7/11/08 Expert Report of Duncan FitzGerald); *see also* 12/14/11 TR 937 (Britsch[26]) ("I do agree that [the central wetlands unit] became more salty after the construction of the MRGO."); 12/14/11 TR 964 (Britsch) ("I don't disagree that the salinity increased due to the MRGO channel.").

For these reasons, the court has determined that Plaintiffs established a causal link between the construction, expansions, operation, and failure to maintain the MR–GO with increased salinization in the New Orleans Polder.

b. Because Of Increased Habitat And Wetland Loss.

The following table lists the different types of habitats and wetlands that exist within certain salinity ranges.

Habitat And Wetlands By Salinity Range.[27]

2010 FEASIBILITY REPORT at 2–16–17 (December 2010 Army Corps MRGO Ecosystem Restoration Plan).
***727** Freshwater swamps can support cypress and tupelo forests that are important for protecting areas from wind and surge. 2010 FEASIBILITY REPORT at 1–7. As salinity increases, however, taller cypress and tupelo die off. 2010 FEASIBILITY REPORT at 2–16. In fact, rapid shifts in salinity risk destroying vegetation altogether, leaving bare land that quickly can convert to water. 2010 FEASIBILITY REPORT at 2–42.

Prior to 1978, saline marsh was found only south of the Bayou La Loutre Ridge and in the outer Biloxi Marshes. 2008 ARMY CORPS REPORT at xiv. By 1990, however, estimated wetland loss in Region 1 of the Coastal Louisiana Hydrologic Basin Area, *i.e.,* St. Bernard Parish, Orleans Parish, and St. Charles Parish, was reported to be 74,800 acres or an average of 1,290 acres per year between 1932 and 1990. Pls. 2/9/09 S.J. Ex. 6 at 4 (LA. DEP'T OF NATURAL RES., COASTAL RESTORATION DIV. ANNUAL PROJ. REVIEWW (Dec. 2001)); *see also* at xiv ("Between 1956 and 1990, 68,600 acres of wetlands were lost [as a result of] subsidence, navigational channels, oil and gas exploration and production, development and storms.... Approximately 67 percent of the swamp ... was lost while saline marsh gained 8 percent.").

By 1984, the Army Corps recognized that:

> [c]onstruction of the MR–GO has accelerated the natural changes occurring in the St. Bernard Parish wetlands near Lake Borgne.... Wind-and-wave generated erosion is also steadily widening the MR–GO. Because of this expansion, the east bank along Lake Borgne is dangerously close to being breached. Once the [east] bank [along Lake Borgne] is breached, development to the southwest would be exposed to direct hurricane attacks from Lake Borgne, the rich habitat around the area would be converted to open water, and more marsh would be exposed to the higher salinity water.

RPX1639 at 7 (U.S. ARMY CORPS OF ENG'RS, LA. COASTAL AREA: SHORE & BARRIER ISLAND EROSION (1984)).

Between 1998 and 1999, saline marsh in the New Orleans area "encroached" up the MR–GO to about the Bayou Dupre and into the Biloxi Marshes near the MR–GO, past Bayou Dupre. 2008 ARMY CORPS REPORT at xiv.

By 1999, the Army Corps stated that "[e]stimated habitat shifts caused by saline waters brought in by the MRGO are believed to have caused 3,350 acres of fresh/intermediate marsh and 8,000 acres of swamp to convert to brackish marsh and 19,170 acres of brackish marsh and swamp to convert to saline marsh in areas adjacent to MRGO." 2010 DRAFT EIS App'x E at 2 (citing "USACE, 1999"); *see also* SPX.0773 at 52 (U.S. ARMY CORPS TECHNICAL COMM., HABITAT IMPACTS OF THE CONSTRUCTION OF THE MRGO (1999)); SPX.01146 at 1–9 (U.S. ARMY CORPS OF ENG'GS & LA. DEP'T OF NATURAL RES. PROJECT MGMT. PLAN: MISS. RIVER GULF OUTLETT (MRGO) ENVTL. RESTORATION PHASE II, FEASIBILITY STUDY (2005)); 12/14/11 TR 953 (Britsch) ("I do agree there was a lot of habitat conversion due to salinity.").

On October 20, 2000, the EPA published a "Status Report: Comprehensive Plan for Timely Modification of the Mississippi River Outlet" that summarized the situation:

> The construction, operation and maintenance of the MRGO have caused substantial environmental changes in the Pontchartrain and Breton Sound drainage basins of southeastern Louisiana east of the Mississippi River. The channel has *breached major hydrologic boundaries* and has extended marine conditions into formerly fresh, low energy swamp, marsh and lacustrine areas. More than 65,000 acres of natural habitat have been lost or modified as a result of the MRGO[.]

2000 EPA REPORT at 2–1 (emphasis added).

A 2010 Army Corps study enumerated the "direct and indirect effects" caused by the MR–GO as: "land loss, bank/shoreline erosion, habitat change and loss, modification of natural hydrology, retreating and eroding barrier islands, ridge habitat degradation and destruction, ... and increased susceptibility to storm surge[.]" 2010 DRAFT EIS App'x E at 2.

At trial, Dr. Kemp testified that the construction, expansion, operation, and failure to maintain the MR–GO was responsible for most of the land/habitat loss in the area. ***728** 12/13/11 TR 500 (Kemp) ("The salinity increase [due to MR–GO] was what set in motion the habitat change and much of the loss that occurred.").

Several of Plaintiffs' witnesses also testified about the habitat changes that occurred after the MR–GO was constructed and described the shift from freshwater wetland forests to brackish forests and open water. Forested areas along Shell Beach, Hopedale and Yscloskey "died away pretty quickly." 12/12/11 TR 89 (Estopinal). In the 1950s, Paris Road (Highway 47), in the Bayou Bienvenue area, had "scrub oaks, and some trees, and a lot of roseau, which is the local bamboo cane ... and had a lot of trees and brush." 12/12/11 TR 80 (Estopinal). Trees also disappeared, replaced with open water along Bayou Bienvenue. 12/12/11 TR 89 (Estopinal). These changes occurred "over the several decades," after the construction of the MR–GO. 12/12/11 TR 91 (Estopinal). For example, Mr. Robin testified that, as a child, he saw oak trees and cypress trees at the Shell Beach area, but now there are few oak trees and only dead cypress trees. 12/13/11 TR 611–12 (Robin). Mr. Robin last saw live cypress trees in the early 1970s. 12/13/11 TR 640 (Robin). The marshes near Hopedale and along MR–GO used to have cypress swamps, but no longer have living cypress trees. 12/14/11 TR 845–46 (Wilhoft). Bayou Bienvenue used to have vegetation but now is "[m]ostly water. Even the marshes [are] pretty much disappearing now." 12/14/11 TR 846 (Wilhoft).

> [T]here [are] no more [cypress] trees. It's just all marsh grass and water all the way up to the bridge, which would be over the Industrial MRGO, and coming from the south side coming in south that's all you see is water, and on the west side and east side all you see is water now, too.

12/12/11 TR 183 (Tommaseo).

Mr. Estopinal also recalled that Shell Beach, which fronted the Lake Borgne, was a beach he could swim in as a child, but today that area is gone. 12/21/11 TR at 78–80 (Estopinal).The Government argues that despite this evidence Plaintiffs failed to establish the causal link between habitat/wetlands loss and flooding on their properties within the federal levee system.

4/13/12 Gov't Br. 66; 5/18/12 Gov't Resp. 21 (citing 12/12/11 TR 292–95 (Kemp) (testifying that the role of wetlands in presenting storm surge varies between storms and has not been widely studied)). The Government also faults Plaintiffs habitat/wetland loss causation analysis outside the levee system, because Dr. Kemp failed to quantify the MR–GO's contribution to physical changes seen in Bayou Yscloskey. Gov't 4/13/12 Br. 68 (citing 12/13/11 TR 443–45, 47 (Kemp) (noting that Dr. Kemp had not examined historic maps, aerial photographs, or gauge readings to determine if Bayou Yscloskey had changed after the construction of the MR–GO)). In addition, the only information related to wetlands impact that Dr. Kemp considered was a study of wetlands during Hurricane Rita, but that area consisted of twenty-five miles of marsh with no levees. Gov't 5/18/12 Resp. 21 (citing 12/13/11 TR 437 (Kemp)).

The Government's expert, Dr. Britsch, however states that "the loss of land ... in the St. Bernard Delta ... has the potential effect of increasing the connectivity and water exchanges between large water bodies and the interior marshes resulting in changes in tides, and incursions of marine water further inland." 12/8/11 Britsch Direct at 24. Dr. Britsch also allowed that "MRGO was one of many things that increased the connectivity between large water bodies and the interior marshes." 12/14/11 TR 902–03 (Britsch). Dr. Britsch agreed "[the MR–GO] did do a lot of habitat type change. But I think the changes were more conversion of habitat types rather than conversion of land to water." 12/14/11 TR 995 (Britsch).

Dr. Britsch, however, testified that the MR–GO directly caused 7,087 acres of land loss out of a total of 103,870 acres in the St. Bernard Delta, but concluded that the portion of the loss attributable to the MR–GO is "small." 12/8/11 Britsch Direct 20; *see also* 12/14/11 TR 910 (Britsch). There are several problems with Dr. Britsch's conclusion. First, his study included 21,909 acres lost prior to the construction of the MR–GO in 1958, diluting the actual effect of the MR–GO. 12/14/11 TR 913 (Britsch). Second, his testimony in this case is inconsistent with his ***729** prior expert report in *Robinson* that considered a smaller study area. RJX 202 at 17 (studying approximately 113,643 acres and acknowledging that the MR–GO is one factor in changing land area and habitat). Third, Dr. Britsch accounted only for land lost in the MR–GO due to dredging and erosion; he did not consider land loss caused by destruction of wetlands by saltwater intrusion. 12/14/11 TR 909, 943–44 (Britsch). Fourth, Dr. Britsch also did not adequately explain how long-term factors, such as natural subsidence, contributed to the short-term land loss seen around Lake Borgne. *Compare* 12/8/11 Britsch Direct at 9–11, *with* 1972 BASELINE STUDY at 66–67 (1972 Coastal Environments, Inc. Envtl. Baseline Study) (noting that natural subsidence causes habitat destruction "over a long time span" and as such, "is probably only of secondary importance in accounting for the very rapid decay of the fresh swamp" near Lake Borgne). Finally, Dr. Britsch's testimony is contradicted by the Army Corps' land loss estimates and the 2010 MRGO Ecosystem Restoration Study Draft Environmental Impact Statement, to which Dr. Britsch was a contributor. *Compare* 2010 FEASIBILITY REPORT at 1–16, *with* SPX.0773 at 52 *and* 2010 DRAFT EIS at 1–7.

Given the conflicts between Dr. Kemp's and Dr. Britsch's testimony, the court has decided to rely on Army Corps documents and the testimony of Plaintiffs' witnesses as they are the most relevant evidence about the role of the MR–GO in increasing habitat and wetland loss in the St. Bernard Polder.

For these reasons, the court has determined that Plaintiffs established a causal link between the Army Corps' construction, expansions, operation, and failure to maintain the MR–GO and increased habitat and wetland loss in the St. Bernard Polder.

c. Because Of Increased Erosion.

In July 1957, the Army Corps finalized a Design Memorandum for the MR–GO that stated:

> No channel protection is recommended initially, however, *erosion due to wave wash in open areas can be expected* in the upper part of the channel slope where the peat and highly organic clays are exposed. Protection for this area can be provided if and when the need for it becomes necessary.

SPX.0213 at 7.

By November 8, 1983, the Chief of the Hydraulics & Hydrologic Branch of the Army Corps warned, "Future widening or erosion of [the MR–GO] could cause erosion of the hurricane levee berm[.]" SPX.0241.

In 1988, the Army Corps estimated that MRGO expanded from a top width of 650 feet in 1968 to 1,500 feet by 1987. RPX0009 (U.S. ARMY CORPS OF ENG'RS, MISS. RIVER–GULF OUTLET ST. BERNARD PARISH, LA. BANK EROSION RECONNAISSANCE REPORT (February 1988)). It is significant that at this early date, the Army Corps recognized that:

> [t]he alternative to completely close the MRGO waterway should be evaluated and a discussion of the evaluation should be included in the [Reconnaissance] report. The closure should be located in the vicinity of mile 23 [south of Bayou La Loutre Ridge] and .... will control all future channel maintenance problems by controlling bank erosion, prevent[ ] the associated biological resources problems, prevent[ ] saltwater intrusion, and lessen[ ] the recreational losses.... [I]t will also reduce the possibility of catastrophic damage to urban areas by a hurricane surge coming up this waterway[.]

RPX0009 at 1 (PDF at 10).

In a May 30, 1991 Memorandum, the Army Corps restated its "long standing policy against repairing bank erosion." RPX2082 at 2; *see also* SPX.0241 (In 1983, the Army Corps decided to defer "erosion protection to allow for future widening" of MR–GO). The Army Corps also concluded that bank stabilization for MR–GO was not worthwhile, because the "[l]ong term viability of MRGO [was] in question due to considerable public opposition to past and continuing (perceived and real) environmental damages and to [the] marginal competitiveness of [a] 36 ft channel." RPX 2082 at 2.

In July 2003, an independent study by two members of the Tulane University College of Engineering observed:

> ***730** Severe erosion occurs from vessel wakes, and materials liberated in the process migrate into the waterway. MRGO bank erosion has historically and is currently occurring at high rates, mainly due to ship wave impact. An analysis of bankline retreat from 1964 to 1996 shows that the banks are being lost at about 12 to 26 ft/yr.... Bank erosion results in channel shoaling, which requires periodic maintenance dredging. The current scenario is largely unsustainable from the engineering, environmental, and economic perspectives.

RJX–0243 at 3.

In 2004, prior to Hurricane Katrina, the Army Corps recognized that bank erosion of the MR–GO "is an ongoing problem, widely recognized by the Corps, other agencies, state and local governments, as well as the general public." RPX0716 at 5 (estimating annual erosion of fifteen feet along the south bank and thirty-two feet along the north bank); RJX–0243 at 3 (estimating bank erosion at twelve to twenty-six feet per year). Between 1961 and 2005, the Lake Borgne shoreline retreated around 235 feet. 12/6/11 Kemp Direct at 236–37. And, a September 2005 Army Corps "reevaluation study," dated days after Hurricane Katrina's landfall "documented the retreat of the unstable MRGO Reach 2 channel banks." 12/6/11 Kemp Direct at 56 (citing SPX.0298).

As a result of the increased erosion, the MR–GO allowed Bayou Yscloskey "to carry significantly more water at higher velocities." 12/6/11 Kemp Direct at 238.

> [T]he hydraulic connection between the Lake and the settlements along the banks of Bayou Yscloskey was undoubtedly made larger and more efficient, allowing it to serve as a more open route not only for surge during storms but also for water level fluctuations in the Lake during less extreme wind events. The enlargement of the hydraulic connection between Bayou Yscloskey and Lake Borgne was enhanced by dredging of the MRGO.

12/6/11 Kemp Direct at 238; *see also* 2006 WESTERINK NOTE at 2–3 (stating that the combination of erosion resulting from the Army Corps' authorized expansions and continued ship wave erosion played an "important role in the propagation of the astronomical tide wave and in the flux of more saline water from Lake Borgne/Brenton Sound into Lake Pontchartrain via the [INHC]").

On December 9, 2010, after Hurricane Katrina, the Army Corps issued a draft Environmental Impact Statement concluding that:

> The construction, operation, and maintenance of the MRGO caused the loss of approximately 24,610 acres and indirectly to an additional loss of 33,920 acres. Approximately 63,178 acres of land is estimated to have been lost in the study area from 1985 through 2010. Approximately 131,091 acres are projected to be lost between 2010 and 2065 within the study area.

2010 DRAFT EIS at 1–16 (internal citations omitted); *see also* 2010 FEASIBILITY REPORT at 1–7 (estimating that the "MR–GO channel construction, including the dredging of the canal and placement of dredged spoil, resulted in the conversion of 19,400 acres of wetlands and 4,750 acres of shallow open water to deep open water or spoil").

In sum,

> [t]he channelized nature of the MRGO induce[d] large ship waves during vessel passage. Ship waves strike the bank lines, which consist of very soft organic soils. Severe erosion occurs from these vessel wakes.... [As such, the] MRGO bank erosion has historically and is currently occurring at high rates, mainly due to ship wave impact.

RJX–0243 at 3 (EDMOND J. RUSSO, JR., EVALUATION OF BANK LINE REVETMENT ALTERNATIVES TO ABATE SHIP WAKE EROSION, MISS. RIVER—GULF OUTLET, LA. (July 2003)); 12/12/11 TR 83 (Estopinal) (testifying about the waves generated from ships passing through the MR–GO); 12/13/11 TR 602 (Robin) ("[T]he ships would come in and they would be sucking so much water that it .... would take the water away from the shores, and ... all of a sudden there's no water and their [small sport or recreation] boats will have accidents, either turn over or sink."); 12/13/11 TR 839–40 (Willhoft) (testifying how, as a ship operator, he observed the erosive waves generated by ship wake).

***731** A July 21, 2006 Report co-authored by the Army Corps reflected that the authorized bottom width of the MR–GO was 400–450 feet. 2006 WESTERINK NOTE at 2; *see also* RDX1042 at 4 (June 1959 Army Corps Design Memorandum No. 2) (revising the MR–GO's authorized dimensions from 36 feet by 500 feet to 38 feet by 600 feet). Because of erosion of the MR–GO due to ship traffic and the failure of the Army Corps to maintain the banks, the width of the MR–GO was approximately 3,000 feet at its widest point. The significance of this expansion is that the "[r]etreat of the south bank [of the MR–GO] affected the severity of wave attack on the Chalmette levee." 12/6/11 Kemp Direct at 28; 12/13/11 TR 426 (Kemp); *see also* 12/6/11 Kemp Direct at 30–32 (figures 2.6a–d) (showing the increased widening of the MR–GO over time).[28]

For these reasons, the court has determined that Plaintiffs established that the construction, expansions, operation, and failure to maintain the MR–GO caused increased erosion in the MR–GO.

d. Because Of Increased Storm Surge.

Wetlands play a critical role in reducing the impact of hurricanes and severe storms:

> When storms move over open water, there is nothing to slow the wind and wave action. This creates a storm surge—a gigantic wall of water pushed forward by the storm's winds. The vegetation of the

> wetlands helps minimize the storm surge. When powerful waves from a hurricane crash into the land, wetland plants act as brakes, slowing down the waves and reducing their destructive power. For every 3 miles of marsh, the storm surge of a hurricane is reduced in height by 1 foot[.]

AUDUBON EDUCATOR'S GUIDE 3; *see also* SPX.0180 at 4–44 (U.S. ARMY CORPS OF ENG'RS, FINAL ENVTL. IMPACT STATEMENT FOR THE MISS. RIVER–GULF OUTLET (MRGO), LA., & LAKE BORGNE–WETLAND CREATION & SHORELINE PROT. PROJ.. (2009) ("Protecting wetlands (preventing their loss) has a net effect of lowering storm surge and wave heights[.]")); 12/12/11 TR 290 (Kemp) (In 1965, the Army Corps estimated that storm surge is reduced by one foot for every 2.75 miles of wetland.).

According to a Louisiana State University report, "an area about the size of a football field with the tree density equal to that also in most Louisiana swamps would reduce wave energy in a storm by 90 percent." SPX.0692 at 122–23 (S. Rep. 109–322, 109th Cong. 2d sess. (2006)); 12/12/11 TR 292–93 (Kemp) (testifying that "cypress trees [provide protection from wind surge], because they don't allow the wind to reach the water. The[ ] wind hits the top of the cypress trees and the cypress trees don't care. [But, if the wind goes] down to the water[,] then it would start to build wind surge.").[29]

In other words, habitat and wetlands are "horizontal levees" that absorb surge and dissipate storm energy.

> [The wetlands] are much rougher than a channel, and so they retard the advance of the surge. So it builds up at a slower rate. Remember a surge is always a race against time because the hurricane is not stopping, it keeps going, and so the surge builds up and then it drops. And if you can slow it down enough you just don't build it up the same way.

12/12/11 TR 289 (Kemp); *see also* 12/8/11 Britsch Direct 24 ("In general, land areas serve as storm buffers and influence the hydrology. Accordingly, the loss of land we have been discussing in the St. Bernard Delta, and elsewhere in coastal Louisiana has the potential effect of increasing the connectivity ***732** and water exchange between large waterbodies and the interior marshes resulting in changes in tides, and incursions of marine water further inland."); 12/12/11 TR 290 (Kemp) (In 1965, the Army Corps estimated that storm surge is reduced by one foot for every 2.75 miles of wetland.); RPX1332 (U.S. ARMY COASTAL ENG'G RESEARCH CTR., SHORE PROT. MANUALL, Vol. I at I–9 (1975)) ("The height of storm surge depends on wind velocity and direction, fetch, water depth, and nearshore slope.").

One of the first academic studies to recognize the potential of increased storm surge from the construction and early expansions of the MR–GO was conducted in October 1972 and warned that, since "[t]he build up of tides in naturally constricted estuaries is a well known phenomenon," the Army Corps should "re-evaluat[e the] ... hurricane storm surge threat in the funnel formed by the MRGO and the GIWW and associated hurricane protection levees." SPX.0705 at 54 (ENVTL. IMPACT STUDY, SHIP CHANNEL PROJ. (1972)).

To remedy this situation, the Coast 2050 Report recommended implementation of seventeen specific "Regional Ecosystem Strategies," including closing the MR–GO to deep-draft navigation:

> The MRGO is perceived as a major problem in the Pontchartrain Basin. Wave erosion causes a 15–foot per year loss along 37 miles of the north bank. When the MRGO was completed in the 1960's salinity increased in the basin, causing massive environmental damage.... *The north bank of the MRGO should be stabilized as soon as possible*[, *i.e.,* by 2003 at the latest.]

COAST 2050 REPORT at 88–90 (emphasis added); COAST 2050 REPORT at 88, 90. In addition, within the "Long Term (16–50 years)," the Coast 2050 Report recommended that the MR–GO be closed to deep-draft navigation. COAST 2050 REPORT at 90. Of course, that did not happen until six years later—after Hurricane Katrina, followed by Rita, Gustav, and Ike.

And, in 2000, the EPA expressed great concern about the MR–GO's

> *potential role in creating an avenue for surge movement during storms*; erosion of the wetlands that provide an apron benefitting flood protection levees; erosion caused by ships that commonly exceed unenforced speed limits and or that exceed depth limits; and breach of wetlands that buffer large lakes from the channel.

2000 EPA REPORT at 2–1–2 (emphasis added).

On June 23, 2005, a draft MR–GO Critical Shoreline Protection Feasibility Study stated, "Changes in salinity and water circulation ... caused by the MRGO have increased the rate of wetlands loss in the area, and these changes to geomorphic structure in this part of the Deltaic Plain would increase the storm surge of hurricanes and tropical storms that impact this area[.]". 2005 ARMY CORPS DRAFT STUDY at 1–15.

Dr. Britsch concluded that waters from the Gulf of Mexico in the southeast, not the MR–GO in the northeast, governs the hydrology of the area, and therefore the MR–GO was not a substantial cause of flooding. 12/14/11 TR 984–87 (Britsch).[30] The testimony of Mr. Robin, explaining that flooding on his property occurred when wind originated in the southeast, is also consistent with this point. 12/13/11 TR 647, 654 (Robin); 8/24/07 Robin Dep. 90.[31]

But, the March 26, 2007 Army Corps IPE Report directly contradicted Mr. Britsch and concluded that within the levee system in New Orleans East:

> ***733** [T]*he dominant source of water appears to be from the overtopping and breaching of the levee system along the GIWW between the IHNC and the confluence with the MRGO*. It appears that this overtopping occurred earlier on Monday morning by about 1100 UTC (6:00 a.m. CDT) or possibly earlier. These floodwaters moved both north and east, eventually merging with the floodwaters coming from the overtopping and breaching of the GIWW Levees to the east of the MRGO confluence.

SPX.0004 at IV–193 (emphasis added); *see also* SPX.0004 at IV–194 (stating that the flooding in St. Bernard Parish and the Lower Ninth Ward came from two breaches along the IHNC, overtopping, and numerous breaches along the GIWW and the MR–GO); *see also* 12/6/11 Kemp Direct at 36 (identifying breach locations).

A 2010 Army Corps draft environmental impact statement also reported that:

> Construction and maintenance of the MRGO caused widespread wetland loss and damages to estuarine habitats from the outer marshes in Breton Sound to the swamps and tidal fresh marsh in the western reaches of the Lake Borgne basin. Land loss, bank/shoreline erosion, habitat change and loss, modification of natural hydrology, retreating and eroding barrier islands, ridge habitat degradation and destruction, invasive species introduction and spread, marsh herbivory, and *increased susceptibility to storm surge are some of the direct and indirect effects the MRGO channel has caused*.

2010 DRAFT EIS App'x E at 2 (emphasis added); *see also* 2010 FEASIBILITY REPORT at 1–7 ("Construction and operation of the MRGO contributed to wetland loss and damages to estuarine habitats in Louisiana from the outer tidal marshes in Breton Sound to the cypress forest and fresh ma[r]shes in the western reaches of the Lake Borgne basin. Loss of marsh and cypress swamp habitats has resulted in the decline of important ecological habitat as well as natural surge and wave buffers.").

Dr. Kemp testified that the MR–GO strengthened the hydrological connection between the Gulf and Lake Borgne. 12/6/11 Kemp Direct at 236–38. This allowed storm surge to increase substantially during Hurricane Katrina, severing the natural bridge between the MR–GO and Lake Borgne. 12/6/11 Kemp Direct at 235–40. As a result, storm surge traversed up Lake Borgne without any barrier into Bayou Yscloskey. 12/6/11 Kemp Direct at 235–40.

The altered Bayou Yscloskey and other minor streams in the area created "much more active tidal pass[es]" that expanded to become capable of conveying larger volumes of water. 12/6/11 Kemp Direct at 238. This increased storm surge caused

flooding of Plaintiffs' properties outside the levees after Hurricane Katrina. 12/6/11 Kemp Direct at 236–38 ("The enlargement of the hydraulic connection between Bayou Yscloskey and Lake Borgne was enhanced by the dredging of the MRGO."); *see also* 2010 DRAFT EIS at 2–50 ("The spatial integrity of the MRGO/Lake Borgne Landbridge was compromised by the construction of the channel.").

Dr. Kemp attributed the flooding of Plaintiffs' properties within the levee system primarily to storm surge caused by the MR–GO:

> St. Bernard has some of the highest land on the east bank of New Orleans, following as it does the natural levee of the Mississippi River and some of its abandoned distributaries.... Despite being relatively high by local standards, the St. Bernard polder experienced the most violent, spatially expansive and deepest flooding in the entire metro area during the Katrina event.... Except for a limited contribution from rainfall, all flooding of the St. Bernard polder was caused by water that passed through or across one or more reaches of the MRGO.

12/6/11 Kemp Direct at 36 (figures omitted).

For these reasons, the court has determined that Plaintiffs established the construction, expansions, operation, and failure to maintain the MR–GO caused substantially increased storm surge during Hurricane Katrina and subsequent hurricanes and severe storms.

***734 e. Because Of The "Funnel Effect."**

As reflected in a 2006 Senate Report, "Prior to Hurricane Katrina, many warned that the potential funnel [created by the MR–GO] would accelerate and intensify storm surges emerging from Lake Borgne and the Gulf into the downtown New Orleans area. The funnel had been described as a superhighway for storm surges or the Crescent City's Trojan Horse that had the potential to amplify storm surges by 20 to 40 percent[.]" SPX.0692 at 124 (S.Rep. No. 109–332 (2006) (internal quotation marks omitted)).

A "funnel effect" occurs when channels and levees compress the storm surge into an increasingly confined space, causing it to rise faster and higher. 12/6/11 Kemp Direct at 184; *see also Robinson* 4/21/09 TR 380 (FitzGerald) (describing the funnel effect). Several of the Government's documents also discuss this phenomenon. SPX.0167 at 52 (2008 U.S. ARMY CORPS OF ENG'RS, DRAFT INDIVIDUAL ENVTL. REPORT: IMPROVED PROT. ON THE INNER HARBOR NAVIGATION CANALL ("2008 DRAFT ENVTL. REPORT") ("[S]urge height increases as it moves from east to west in the Borgne complex, due to the narrowing of the corridor between the GIWW and the MRGO as it approaches the IHNC.")); SPX.0692 at 123–24 (S. Rep. 109–322, 109th Cong.2d sess.(2006) ("The MRGO also contributed to a potential 'funnel' for storm surge emerging from Lake Borgne and the Gulf into the New Orleans area.... The funnel has been described as a 'superhighway' for storm surges ... that had the potential to 'amplify storm surges by 20 to 40 percent,' according to some surge modeling.")). During Hurricane Katrina, the MR–GO funneled water westward, substantially increasing storm surge to higher elevations. 12/6/11 Kemp Direct at 28–30, 72–73.

As part of the new HSDRRS, the Army Corps constructed a surge barrier to close off the mouth of the funnel to protect the most populated parts of the St. Bernard Polder from MRGO-related storm surge attributable to the funnel effect. 12/14/11 TR 871–73 (Park). This closure was done to "reduce the possibility of catastrophic damage to urban areas by a hurricane surge coming up this waterway[.]" RPX0009 at PDF 10 (U.S. ARMY CORPS OF ENG'RS, MISS. RIVER–GULF OUTLET ST. BERNARD PARISH, LA., BANK EROSION, RECONNAISSANCE REPORT (1988)).

The Government's position that the funnel was "natural" and pre-dated the MR–GO was contradicted by an August 2008

Army Corps draft environmental report acknowledging the MR–GO's funnel effect, stating that "[s]urge modeling and flood risk assessment ... demonstrates that surge height increases as it moves from east to west in the Borgne complex, due to the narrowing of the corridor between the GIWW and the MRGO as it approaches the IHNC." 2008 DRAFT ENVTL. REPORT at 52. That report also reflects a considerable amount of supporting evidence in this record.

As Plaintiffs' expert testified[32]:

> The GIWW and the MR–GO Reach 2 form a triangle that opens to the east to Lake Borgne and from there to the Mississippi Sands at the Gulf of Mexico.... This layout has been described as a "funnel" .... [that is] dominated by Lake Borgne, a very large, shallow lake similar to Lake Pontchartrain that is elongated along a southwest to northwest axis, providing more than 40 miles of open water in this direction. Forty miles of open water is a very long "fetch" over which hurricane winds can build surge and waves. Any hurricane generating winds from the north, northeast or east will cause a buildup of surge[.]

12/6/11 Kemp Direct at 32 (figures omitted).

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http://www.westlaw.com/Link/Document/Blob/I17b3eb70f46c11e4ac1c010000000000.png?originationContext=document&vr=3.0&rs=cblt1.0&transitionType=DocumentImage&contextData=(sc.UserEnteredCitation)

12/6/11 Kemp Direct at 137 (Tbl.6.9).
In 2006, the Senate Committee on Homeland Security and Governmental Affairs issued a Special Report on Hurricane Katrina that made the following findings about the funnel effect of the MR–GO:

> The "funnel" was created by the intersection of the MRGO from the southeast and the GIWW from the northeast into the confined channel, referred to as the GIWW/MRGO[,] that separates New Orleans East and the Ninth Ward/St. Bernard Parish. The levees on the south side of the MRGO and the levees on the north side of the GIWW converge from being about 10 miles apart where they straddle Lake Borgne to a few hundred yards apart where the MRGO merges into the GIWW. The western part of the "funnel" is a six-mile-long section of the combined GIWW/MRGO, which was enlarged by a factor of three when the MRGO was built in order to expand it from a barge channel to accommodate ocean-going vessels.
>
> Prior to Hurricane Katrina, many warned that the potential funnel would accelerate and intensify storm surges emerging from Lake Borgne and the Gulf into the downtown New Orleans area. The funnel had been described as a "superhighway" for storm surges or the "Crescent City's Trojan Horse" that had the potential to "amplify storm surges by 20 to 40 percent," according to some storm modeling. 33 Researchers at LSU believed that in creating this funnel, "the U.S. Army Corps of Engineers had inadvertently designed an excellent storm surge delivery system—nothing less–to bring this mass of water with simply tremendous 'load'–potential energy–right into the middle of New Orleans."
>
> The extent to which MRGO, and the funnel it helped create actually contributed to the hurricane's damage is still being investigated, but there have been some preliminary findings. A recent report issued by the Corps' IPET concluded that the portion of MRGO running from the GIWW to ***736** the Gulf (called "Reach 2") did not significantly impact the height of Katrina's storm surge, not because the "funnel" effect was nonexistent, but because the storm was so great it nullified the impact of either the wetlands or the intersection of the MRGO and the GIWW—the funnel—at the height of the surge.
>
> While the IPET report concluded that the Reach 2 portion of MRGO had little impact on Katrina's storm surge, it did find that the six-mile combined section of the GIWW/MRGO (called "Reach 1") carried the storm surge from Lake Borgne into New Orleans. The combined GIWW/MRGO served as a link between Lake Borgne and Lake Pontchartrain, enabling the storm surge in one lake to affect the storm surge in the other. During Katrina, a 14 to 17–foot surge coming from Lake

> Borgne into the funnel between MRGO and the GIWW was as much as 10 feet above water levels in Lake Pontchartrain. This large difference in the water levels between the two lakes increased the flow of water in the direction of the city and eventually into Lake Pontchartrain.
>
> To address this problem, the IPET report recommended that flow through the combined channels "must be dramatically reduced or eliminated," either by a permanent closure or a structure that can be selectively used to block storm surges flowing between Lakes Pontchartrain and Borgne along the combined GIWW/MRGO.
>
> Researchers at the LSU Hurricane Center who have looked at models of Katrina have concluded that it is not just the volume of water that is important, but also the velocity. These researchers found that the funnel accelerated the speed of the water when the larger volume in the funnel, and especially the water in the MRGO, was forced into the single merged GIWW/MRGO channel. The increased velocity of the water as it made its way through the channel pounded on the floodwalls lining the sides, weakening them and making them more vulnerable to the overtopping and scouring that occurred during the storm. Maximum current velocities in the combined GIWW/MRGO channel were greater than eight feet per second, which is nearly three times the velocity necessary to cause serious potential for erosion in the soils of the adjacent levee.
>
> Investigations continue into MRGO's contribution to damage caused by Katrina, but there is general agreement that the presence of the MRGO destroyed wetlands that otherwise would have provided additional defenses. This happened because the MRGO served as a conduit for saltwater from the Gulf of Mexico to intrude into the freshwater wetlands. The saltwater damaged and destroyed wetlands, which resulted in the loss of land that had served as part of the city's defenses against hurricanes and other storms. According to the National Academy of Sciences, MRGO has resulted in "tremendous environmental damage, including saltwater intrusion, land loss, and worsening the effects of wave damage during hurricanes and storms."

SPX.0692 at 123–24 (S.Rep. 109–322, 109th Cong.2d sess. (2006)) (footnotes omitted); *see also* RPX1030 (depicting an alternative plan for the MR–GO that would have closed the funnel opening); 2008 DRAFT ENVTL. REPORT at 52 (acknowledging that the funnel effect); 12/6/11 Kemp Direct at 32–41.

In sum, as Dr. Kemp testified:

> [T]he St. Bernard polder experienced the most violent, spatially expansive and deepest flooding in the entire metro area during the Katrina event. Except for a limited contribution from rainfall, all flooding of the St. Bernard polder was caused by water that passed through or across one or more reaches of the MRGO. This water entered the developed area as a result of catastrophic floodwall failures along the IHNC on the western margin, by overtopping of berms on MRGO Reach 1, and by flow through breaches in the Chalmette levee along Reach 2 of the MRGO. The interior 40 Arpent Levee was protected by over two miles of wetlands and was relatively undamaged, but it averaged only 6.5 feet high and was completely overtopped when floodwaters from the MRGO flowed through breaches to fill the Central Wetlands beyond this level.
>
> * * *
>
> ***737** [T]he maximum elevation of flooding experienced in each of the three east bank GNO polders during Katrina was quite different, reaching 10 to 12 feet above sea level in populated areas of the Lower [Ninth] Ward and St. Bernard Parish, but only a little over a foot above sea level in the much lower New Orleans East polder.... The average land elevations in each of the flooded polders also varied, ranging from nearly 6 feet below the NAVD88 datum (–7 feet relative to mean sea level) to +2.5 feet in St. Bernard.... In the Lower [Ninth] Ward and St. Bernard, 98 percent of all structures were seriously damaged by flooding. While the maximum elevation of water is important to property damage, the maximum rate of rise, estimated at 8 feet per hour in the Lower [Ninth] Ward ..., was perhaps the most important factor contributing to greater loss of life there.
>
> The difference among the polders in maximum flood elevation during Katrina was independent of the relative elevation of the land flooded, attaining its highest level in the St. Bernard Polder, which has the highest average land elevation of all of

> the GNO polders that flooded. The peak elevation that floodwaters attained in each of the GNO polders was governed by the time of flooding onset and the length of time during which water continued to flow in through breaches. The St. Bernard polder flooded to such a high elevation because the inundation started earlier in the surge sequence, while water in the MRGO was still rising. Because the onset of breaching and flooding was advanced by the presence of the MRGO navigation project, it is apparent ... that the MRGO project contributed substantially to the severity of flooding in the St. Bernard and other polders surrounding the Lake Borgne funnel.
>
> All breaching of LPV structures, whether floodwalls or earthen berms, within the Lake Borgne funnel took place where these structures were inboard of, and in close proximity to the artificial channels. Except for the New Orleans East Back Levee inboard of the GIWW, all of the LPV structures that breached were adjacent to some part of the MRGO project, whether between the lock and the MRGO junction in the IHNC, along the north bank of MRGO Reach 1 or along the south side of MRGO Reach 2. Conversely, no LPV structures separated from artificial channels breached, even though many of them experienced overtopping.... [T]hat breaching was initiated by the excess stress applied to LPV structures as a result of proximity to deep channels, either by a surge that reached a higher elevation or lasted longer as in the IHNC, or, as along MRGO Reach 2 and the GIWW, by a higher intensity of wave attack than would have occurred if the channel were not there or farther away. The LPV and MRGO projects were never explicitly integrated with each other though they occupied the same landscape. In all of my work, I found no evidence that the MRGO project was ever modified to reduce the predictable excess surge stresses and wave attack caused by the encroachment of the channels on LPV structures, or, alternatively, that the LPV structures were bolstered in any way to withstand the obviously increasing threat.
>
> Reduced to fundamentals, the extent of damage posed by the MRGO in each of these areas was affected, first, by the timing and duration of flooding during the storm, namely, whether flooding started early in the surge sequence or later. Because storm surge is a transient phenomenon, flooding that begins later, at or after the peak of the surge hydrograph, is not as great as flooding that begins earlier, while the surge is still rising. The Katrina storm surge rose first in Lake Borgne and later in Lake Pontchartrain, but it dropped from its peak everywhere at about the same time, as the storm completed its northerly traverse through the area, where both lakes are at similar latitude. Multiple features of the landscape affect the onset of surge at any given location, most notably proximity to large lakes and bays where surge is generated, as well as to large channels which preferentially convey it. The end of the surge event is, in contrast, determined rather simply by the ***738** speed of translation of the storm, which sets the schedule for reversal of the prevailing winds as it leaves the area.
>
> Some LPV floodwalls and levees failed during the passage of Katrina, while others did not. The *Robinson* team showed that segments adjacent to the MRGO project, whether in the IHNC, or on MRGO Reaches 1 or 2, were exposed to greater stress—the effect of higher surge and/or more damaging waves—for a longer period than would have occurred during Katrina if the MRGO project had never been built and maintained in the manner that did not harm to the safety function of the LPV project ... [T]his spelled the difference between survivable flooding caused by overtopping and catastrophic flooding through breaches that occurred in many cases prior to overtopping.

12/6/11 Kemp Direct at 36, 38–41.

A computer model of the increased storm surge that occurred during Hurricane Rita also implicates the MR–GO funnel as a contributor to flooding during that storm. Pls. 4/13/12 Br. 65 (citing 12/6/11 Kemp Direct at 254, 257).

For these reasons, the court has determined that Plaintiffs established the Army Corps of Engineers' construction, expansions, operation, and failure to maintain the MR–GO caused a "funnel effect" that exacerbated storm surge during Hurricane Katrina and subsequent hurricanes and severe storms.

f. The Government's Arguments Are Not Supported By The Law Or The Record.

The Government posits several legal arguments and factual scenarios to support its position that Plaintiffs failed to establish

that increased salinization, increased habitat/wetland loss, increased erosion, and substantially increased storm surge, exacerbated by the "funnel effect," resulting from the Army Corps' construction, expansions, operation, and failure to maintain the MR–GO, caused flooding on their properties during Hurricane Katrina and subsequent hurricanes and severe storms.

i. Flooding On Plaintiffs' Properties Did Not Occur On A Single Occasion, But Instead Was "Inevitably Recurring."

First, the Government argues, "Flooding experienced on a single occasion—even if attributable to [G]overnment action—cannot constitute a taking." Gov't 4/13/12 Br. 1. "Plaintiffs ask the Court to ignore well-established and controlling law and become the first court ever to sustain a takings claim on the basis of one flood." Gov't 5/18/12 Resp. 1. Nor can the "inevitably recurring" standard be established by a single flood event. Gov't 4/13/12 Br. 29–30 (citing *Ridge Line,* 346 F.3d at 1357 (quoting *Eyherabide v. United States,* 170 Ct.Cl. 598, 604, 345 F.2d 565 (1965) ("Isolated invasions, such as one or two floodings ..., do not make a taking[.]"))); *see also Fromme v. United States,* 188 Ct.Cl. 1112, 1118–19, 412 F.2d 1192 (1969) ("[O]ne flooding or two floodings of land ... cannot be regarded as a taking of a permanent interest in the affected land.") (internal citations omitted); *Hartwig v. United States,* 202 Ct.Cl. 801, 809, 485 F.2d 615 (1973) ("The principle may be reduced to the simple expression: 'One flooding does not constitute a taking.' ") (quoting *B Amusement Co. v. United States,* 148 Ct.Cl. 337, 341, 180 F.Supp. 386 (1960)). Therefore, Plaintiffs cannot establish causation without evidence of "a permanent liability to intermittent but inevitably recurring overflows." Gov't 4/13/12 Br. 29 (quoting *United States v. Cress,* 243 U.S. 316, 328, 37 S.Ct. 380, 61 L.Ed. 746 (1917)).

The Government accurately quotes one phrase in *Cress,* but the full context of that phrase, although dictum, recognizes that non-permanent flooding may be a temporary taking:

> There is no difference of kind, but only of degree, between a permanent condition of continual overflow by backwater and a permanent liability to intermittent but inevitably recurring overflows; and, on principle, the right to compensation must arise in the one case as in the other. If any substantial enjoyment of the land still remains to the owner, it may be treated as a partial ***739** instead of a total devesting of his property in the land.

Cress, 243 U.S. at 328, 37 S.Ct. 380.

[17]Of course, this is precisely the situation this case presents. That being said, the Government misses the point of the United States Supreme Court's holding that is found *prior* to its explanation of the difference between a permanent and a temporary taking. That holding states, "[I]t is the *character of the invasion,* not the amount of damage resulting from it, ... that determines the question whether it is a taking." *Id.* at 328, 37 S.Ct. 380 (emphasis added). And, for that reason, the Court affirmed the trial judge's awarding compensation to the plaintiffs for the taking of lands, as well as water rights. *Id.* at 332, 37 S.Ct. 380.

The Government also argues that without evidence of multiple floods of "inevitable recurrence," Plaintiffs cannot establish a taking. Gov't 5/18/12 Resp. 14. In *Fromme,* for example, the United States Court of Claims rejected a takings claim where plaintiffs had alleged a single flood and a future risk of flooding, on average, of once every fifteen years. Gov't 5/18/12 Resp. 14 (citing *Fromme,* 188 Ct.Cl. at 1119, 412 F.2d 1192). Similarly, *Singleton* rejected a takings claim based on a single flood, plus the expectation of flooding once every seventy-five to one hundred years. Gov't 5/18/12 Resp. 14 (citing *Singleton v. United States,* 6 Cl.Ct. 156, 162–63 (1984)). According to the Government, *Baird* also reached the same result, rejecting a takings claim where the plaintiffs established one flooding event and a likelihood of future flooding once every 120–130years. Gov't 5/18/12 Resp. 14–15 (citing *Baird v. United States,* 5 Cl.Ct. 324, 329 (1984)).

Again, the record in this case evidences, after Hurricane Katrina, increased storm surge during Hurricanes Rita, Gustav, and

Ike and severe storms continued to flood Plaintiffs' properties. As such, the record in this case is substantially different from in *Fromme, Singleton,* and *Baird*. Likewise, in *Hartwig,* the Army Corps' operation of a dam flooded more than 100 acres of the plaintiffs' land, permanently destroying more than thirty-five acres and improvements thereon. *See* 202 Ct.Cl. at 804, 485 F.2d 615. But, the Court of Claims rejected the plaintiffs' taking claim, because they did not establish that a similar flood would inevitably recur. *See id.* at 809–10, 485 F.2d 615. Of course, that is not the case here, where several subsequent hurricanes and severe storms occurred after Hurricane Katrina satisfying the "inevitably recurring" element discussed in *Cress*. In fact, it was the "inevitably recurring" concern about future flooding from post-Katrina hurricanes and severe storm surge that was the impetus for the Army Corps' June 5, 2008 decision to "deauthorize" the MR–GO, at the direction of Congress. 2010 FEASIBILITY REPORT at S–2.

[18]It is also now settled that "[G]overnment-induced flooding of limited duration may be compensable." *Ark. Game & Fish,* 133 S.Ct. at 519.[33] To ascertain whether a temporary taking by Government-induced flooding occurred, the trial court should consider the "character" of the invasion. The substantially increased MR–GO–induced storm surge during Hurricane Katrina, *i.e.,* the invasion, had a "character" that evidences a taking *per Cress*. In addition, Plaintiffs' properties also experienced "intermittent, but inevitably recurring" flooding thereafter until July 2009, when the Army Corps permanently closed the MR–GO. 12/6/11 Kemp Direct at 76–77, 135–36, 253 (describing similar storm surge patterns in Hurricane Rita).

For these reasons, the court has determined that a temporary taking may arise from one occasion of flooding, in light of its character, as was the case during Hurricane Katrina. But, as the record in this case evidences, Plaintiffs also experienced flooding that was "inevitably recurring."

ii. Hurricane Katrina Was Not An Intervening Event That Broke The Chain Of Causation.

Second, the Government argues that Plaintiffs have not met their evidentiary burden, ***740** because "an intervening and unpredictable natural force—like a hurricane or tropical storm"—precludes the court from finding that the flooding was "the direct, natural and probable result" of the MR–GO. Gov't 4/13/12 Br. 26. Therefore, the Government posits that "[t]he question is not whether the United States could have foreseen a potential set of circumstances in which indirect effects of the MRGO might exacerbate storm surge in the region." Gov't 4/13/12 Br. 26. Hurricane Katrina was an "intervening, and unpredictable natural force" that broke the chain of causation. Gov't 4/13/12 Br. 26. In support, the Government relies on *Cary v. United States,* 552 F.3d 1373, 1378–81 (Fed.Cir.2009), where the United States Court of Appeals for the Federal Circuit in a takings case held that the illegal action of a hunter, who started a fire that spread to plaintiffs' properties, was an intervening act that broke the chain of causation, where Forest Service policies may have made forest fires more likely.

The Government correctly states that increased risk or knowledge of a risk does not establish a direct, natural, or probable result. Gov't 5/18/12 Resp. 8 (citing *Cary,* 552 F.3d at 1377–78 (holding that "charging the [G]overnment with increasing the risk" that wildfires in a national park could spread to neighboring private property is not equivalent to "plead[ing] that the loss of property would be the likely, foreseeable result" of the Government's actions)); *see also Cary,* 552 at 1378, (observing that "[t]aking a calculated risk, or even increasing a risk of a detrimental result, does not equate to making the detrimental result direct, natural, or probable"). Therefore, in this case, Plaintiffs must show that their property loss was "the likely, foreseeable result of a [an authorized government action or] policy [.]" *Id.* at 1377; *see also Moden,* 404 F.3d at 1343 (explaining that "direct, natural, or probable result" means that "the injury [must be] the likely result of the act," not "that the act was the likely cause of the injury").

The Government misreads *Cary*. The analysis in *Cary* began with a discussion of the *Ridge Line* two-part test "characterized as causation and appropriation." *Cary,* 552 F.3d at 1377. As to causation, the United States Court of Appeals for the Federal Circuit held that a plaintiff in a takings case must establish that "the government intend[ed] to invade a protected property interest *or* [that] the asserted invasion [was] the direct, natural, or probable result of an authorized activity and not the incidental or consequential injury inflicted by the action." *Id*. at 1377 (quoting *Ridge Line,* 346 F.3d at 1355) (emphasis

added).

Plaintiffs do not contend that the Army Corps built the MR–GO with the intention to invade Plaintiffs' properties by flooding. But, by December 2001, the Army Corps considered a total closure of the MR–GO, because of the environmental conditions it created. SPX 0298 at 16 (citing twenty-two "ecosystem restoration alternatives," including total closure of the MR–GO). Other Army Corps documents evidence that, in November 2004 and in 2005—prior to Hurricane Katrina—the conditions created by the MR–GO had escalated into a dangerous situation because increased storm surge during any hurricane or tropical storm was predicted to breach the navigational channel into Lake Borgne, causing flooding. 2004 ARMY CORPS STUDY at MRGO 31 ("*Rapid action is required* to project the integrity of the southern Lake Borgne shoreline and to prevent continued erosion of the MRGO channel banks from ocean going vessel wakes." (emphasis added)); 2005 ARMY CORPS DRAFT STUDY at 1–15 (U.S. ARMY CORPS OF ENG'GS LA. DEPT. OF NATURAL RES. MRGO CRITICAL SHORELINE PROT. FEASIBILITY STUDYDY (Draft Jun. 23, 2005) ("Changes in salinity and water circulation in the Lake Pontchartrain Basin caused by the MRGO have increased the rate of wetlands loss in the area, and these changes to geomorphic structure in this part of the Deltaic Plain would increase the storm surge of hurricanes and tropical storms that impact this area of coastal Louisiana.")). Therefore, by 2004–2005 at the latest—and prior to Hurricane Katrina—it can be fairly said that the risk of injury by flooding was imminent.

[19]As the record reflects, the flooding of Plaintiffs' properties was the "direct, natural, or probable result" of the Army Corps' ***741** authorized construction, expansions, operation, and failure to maintain the MR–GO and not "incidental or consequential" injury. *See Cary* at 1377, (quoting *Ridge Line,* 346 F.3d at 1355). In other words, the substantially increased storm surge-induced flooding of Plaintiffs' properties that occurred during Hurricane Katrina and subsequent hurricanes and severe storms was the direct result of the Army Corps' cumulative actions, omissions, and policies regarding the MR–GO that occurred over an extended period of time. *See Ark. Game & Fish Comm'n v. United States,* 87 Fed.Cl. 594, 624 (2009) ("Because the [G]overnment set this chain of events into motion through authorized deviations from the water control plan, the fact that there was some later incident that may have 'tilted the scale,' *Cary,* 552 F.3d at 1379, does not break the chain of foreseeable results of the government's authorized action."). Here too, the Army Corps set a chain of events into motion that substantially increased storm surge and caused flooding during Hurricane Katrina and subsequent hurricanes and severe storms. *See Cary,* 552 F.3d at 1379 ("The landowners would be correct that the [G]overnment did not need to light the match to be liable, but to be a taking, it must have at least authorized supplying the fuel."). In this case, the Army Corps provided that fuel—the MR–GO.

For these reasons, the court has determined that Hurricane Katrina was not an intervening event that broke the chain of events of causation.

iii. Neither Subsidence, Sea Level Rise, Nor Land Loss Was The Cause Of Flooding On Plaintiffs' Properties.

[20]Third, the Government insists that wetland loss from recurring storms in the St. Bernard Polder must be considered a secondary factor at best. 5/30/12 Gov't Resp. 26–27; *see also* 1972 BASELINE STUDY at 66. As Plaintiffs' expert, Dr. Kemp, admits, causation is complicated by the mix of natural and man-made contributions to the flooding that Plaintiffs experienced. Gov't 4/13/12 Br. 38 (citing 12/12/11 TR 472 (Kemp)). The St. Bernard Polder "has always been vulnerable to flooding." Gov't 4/13/12 Br. 4 (citing 12/14/11 TR 989–90 (Britsch)); *see also United States v. Sponenbarger*, 308 U.S. 256, 261, 60 S.Ct. 225, 84 L.Ed. 230 (1939) (observing that small levees were built around New Orleans as early as 1717). In fact, local subsidence[34] and sea level rise have contributed significantly to the St. Bernard Delta's vulnerability to flooding. Gov't 4/13/12 Br. 5– 6. Everything else being equal, land subsidence increases the risk of flooding. 12/12/11 TR 103 (Estopinal). Mr. Estopinal, in his experience as a land surveyor, estimated that the land in St. Bernard Parish sunk approximately two-tenths of a foot per decade. 12/12/11 TR 103 (Estopinal); see also 12/8/11 Britsch Direct at 25–26 (estimating a subsidence rate of 0.5 to 0.7 feet per century); 12/13/11 TR 469 (Kemp) (agreeing with Dr. Britsch's subsidence estimate). But, due to the age of the delta and the relatively thin layer of more recent sediment—which is more easily compacted over

time, the St. Bernard delta is "one of the more stable areas with respect to subsidence." 12/13/11 TR 466 (Kemp).

In addition, according to the Government's expert, Dr. Britsch, although the rate of land loss dramatically increased after the construction of the MR–GO:

> I feel that it's only one of numerous things that have been going on in this basin, many of which were occurring well before the MRGO was built. Things like subsidence, sea level rise, land loss, thousands and thousands of acres of land loss that were unrelated to the MRGO and lots of men's activities in these same wetlands that all fit together, combine[d] to change the hydrology, affect the tides, and ultimately impact the flooding in this area.

12/14/11 TR 899 (Britsch); *see also* 12/8/11 Britsch Direct at 29 ("[I]n the aggregate, the overwhelming amount of land loss in the St. Bernard Delta is unrelated to the MRGO."); 12/14/11 TR 951 (Britsch) (explaining that land loss is distinct from habitat loss).

In addition, Plaintiffs made no attempt to distinguish the impact of the MR–GO from the natural conditions outside the levee system. Gov't 4/13/12 Br. 71–77. For example, ***742** properties along Paris Road are only two feet above sea level, and thus a half-foot of subsidence could "be a determining factor in the frequency and magnitude of flooding." Gov't 4/13/12 Br. 73 (quoting 12/8/11 Britsch Direct at 26). Therefore, elevated water levels near Plaintiffs' properties "are neither novel nor unprecedented and pre-date the construction of the MRGO." Gov't 4/13/12 Br. 74 (citing 12/8/11 Britsch Direct at 24, 29).

Finally, the Government points out that globally, sea levels have risen approximately three inches from 1961 to 2003, or about 0.07 inches per year. 12/8/11 Britsch Direct at 25 (citing INT'L PANEL ON CLIMATE CHANGE (IPCC), FOURTH ASSESSMENT REPORT: CLIMATE CHANGE (2007) at 2). But, as Dr. Britsch explained that, "really what contributes to flooding is relative sea level rise—*i.e.,* sea levels relative to the height of land. In coastal Louisiana, the land is sinking locally at the same time that sea levels are rising globally." 12/8/11 Britsch Direct at 25. These estimates, however, "are likely conservative because they represent long-term averages and may not fully reflect recent short-term changes, such as rapid rises in sea level." 12/8/11 Britsch Direct at 25– 26.

Dr. Britsch correctly notes that "[h]alf a foot [of subsidence plus sea level rise] may not seem like a lot of change, but in areas that are only slightly above sea level or near sea level, a half a foot can make the difference between whether your land is flooded or not." 12/14/11 TR 991 (Britsch).[35] But, Dr. Britsch concludes:

> [W]hile I agree that the MRGO is a contributor, I think the amount of land loss that's happening on this coast, in this area, the subsidence that's occurring, sea level rises occurring, I think those are the dominant factors in the changes we've seen in the hydrology and ultimately in the flooding in these areas.

12/14/11 TR 995 (Britsch); 12/8/11 Britsch Direct at 12 (testifying that land loss in the St. Bernard Polder occurred during the MRGO's construction, or immediately thereafter).

The Government further adds that since Plaintiffs did not attempt to quantify independently total land loss in the St. Bernard Polder or estimate the portion that could be contributed to the MR–GO, they failed to establish the causal link between the MR–GO and land loss in the St. Bernard Delta. 12/14/11 TR 897 (Britsch). Other factors also explain the flooding experienced on Plaintiffs' properties outside the levee system. 12/8/11 Britsch Direct at 23 (Erosion from 1930–1960 outpaced erosion from 1960–1995, along the southern shoreline of Lake Borgne).

In addition, the Government notes that the movement of water via natural channels explains the increased flooding during Hurricane Katrina and thereafter because these conditions predated the MR–GO. Gov't 4/13/12 Br. 73–74. East winds have always blown across Lake Borgne and raised water levels along the southern shoreline. 12/6/11 Kemp Direct at 239, 250–51. But, the Government misses the point that prior to the construction of the MR–GO, land barriers and wetlands prevented this

water from infiltrating far inland. 12/6/11 Kemp Direct at 236–38. The record evidences that the construction and expansions of the MR–GO in particular allowed this water to infiltrate inland. SPX.01103 at 4–61; SPX.01100 at 1; 12/6/11 Kemp Direct at 236–38. Moreover, the Government points to no evidence that an increase in the rate of subsidence after MR–GO's construction and the slow acceleration of global sea level rise explain the substantially increased storm surge during Hurricane Katrina. In fact, one report relied upon by Dr. Britsch comes to the opposite conclusion: "Regional subsidence or slight sea level ***743** rise would also account for dying of the fringes of fresh swamp.... However, subsidence is probably only of secondary importance in accounting for the very rapid decay of the fresh swamp unit of the study area." 1972 BASELINE STUDY at 66–67. Plaintiffs did not need to qualify "independently" what amount is attributed to the MR–GO, because the Army Corps Environmental Restoration Phase II, Feasibility Study reports evidence of that fact. 2010 DRAFT EIS at 1–16 ("The construction, operation, and maintenance of the MRGO caused the loss of approximately 24,610 acres and indirectly to an additional loss of 33,920 acres. Approximately 63,178 acres of land is estimated to have been lost in the study area from 1985 through 2010. Approximately 131,091 acres are projected to be lost between 2010 and 2065 within the study.") (internal citations omitted); *see also* SPX.0773 at 17; SPX.0129 at App'x 5, MRGO 12 ("The data indicates that land loss rates have accelerated since 1990"). Although subsidence, sea level rise, and land loss took their toll on the region, the evidence in this case demonstrates that the MR–GO had the principal causal role in creating the environmental damage in St. Bernard Polder.

For these reasons, the court has determined that the record does not evidence that subsidence, sea level rise, or land loss was the cause of flooding that occurred on Plaintiffs' properties during Hurricane Katrina and subsequent hurricanes and severe storms.

iv. Economic Development Was Not The Cause Of Habitat/Wetland Loss.

[21]Fourth, the Government argues that "economic development," occurring throughout the Louisiana coast, was more damaging to wetlands than the MR–GO.[36] It is true that St. Bernard Parish developed economically between the construction of the MR–GO and Hurricane Katrina. 12/12/11 TR 95 (Estopinal). Many of the areas that were wooded lowlands in the 1950s and 1960s are now developed, leveed, and drained. 12/12/11 TR 95–96 (Estopinal). And, canals other than MR–GO have been used for navigation, as well as to install gas pipelines and access well heads. 12/12/11 TR 97 (Estopinal). But the Government's experts and witnesses offered no evidence that development was a primary factor in the flooding experienced during Hurricane Katrina and thereafter. In any event, the influence of other artificial channels in the area was overshadowed by the footprint of the MR–GO. 12/6/11 Kemp Direct at 240.

For these reasons, the court has determined that the record did not evidence that economic development was the cause of habitat/wetland loss in the St. Bernard Polder.

v. Post–Katrina Remedial And Restoration Efforts Do Not Negate The Army Corps' Liability For A Temporary Taking Of Plaintiffs' Properties By Flooding.

[22]The Government argues that it "has now completed construction of one of the most impressive hurricane protection systems in the world (and taken extraordinary steps to address the wetland degradation in this area)[.]" Gov't 5/18/12 Resp. 42.[37] But, the Government acknowledges that "Plaintiffs are entirely correct" that "[i]t is a bedrock ***744** principle of takings law that where the Government has already taken private property for public use, 'no subsequent action by the [G]overnment can relieve it of the duty to provide compensation for the period during which the taking was effective.' " Gov't 5/18/12 Resp. at 43 (citing Pl. 4/13/12 Resp. at 108 (quoting *First English Evangelical Lutheran Church v. Cnty. of L.A.,* 482 U.S. 304, 321, 107 S.Ct. 2378, 96 L.Ed.2d 250 (1987))).

The fact that the Government closed the MR–GO in July 2009 does not affect the Government's liability for a temporary taking. *See United States v. Dickinson,* 331 U.S. 745, 751, 67 S.Ct. 1382, 91 L.Ed. 1789 (1947) ("[The landowner] reclaimed most of his land which the Government originally took by flooding. The Government claims that this disentitled him to be paid for the original taking. The courts below properly rejected this defense.... [N]o use to which [the landowner] could subsequently put the property by his reclamation efforts changed the fact that the land was taken when it was taken and an obligation to pay for it then arose."). The date of closure, however, places a definitive end date on the duration of the temporary taking at issue in this case and precludes future claims arising from these facts.

For these reasons, the court has determined that the duration of the temporary taking in this case was from August 28, 2005 to July 2009.

vi. Plaintiffs' Claims Are Not Barred By The Statute Of Limitations.

The Government also argues that the timing of Plaintiffs' claims is inconsistent with a causal relationship between the environmental effects of the MR–GO and flooding experienced during Hurricane Katrina. The evidence suggests that "MRGO's impact on the environment was widespread and obvious ... shortly after the project's construction." Gov't 4/13/12 Br. 70[38] (citing 1972 BASELINE STUDY at 66 (describing the degradation of the swamp prior to 1972)); 12/13/11 TR 640 (Robin) (testifying that the cypress trees had all died by the early 1970s). As Dr. Britsch testified, "the most significant portion of the land loss in the St. Bernard Delta occurred during the construction of the MRGO, or immediately thereafter." Gov't 5/18/12 Resp. 22 (citing 1972 BASELINE STUDY at 66; 12/8/11 Britsch Direct at 12). In fact, the rate of erosion along the southern shoreline of Lake Borgne was higher prior to the completion of the MR–GO. Gov't 4/13/12 Br. 74 (citing 12/8/11 Britsch Direct at 23 ("[S]horeline erosion ... rates [along the southern shoreline of Lake Borgne close to the MRGO] were actually higher pre-MRGO [1930–1960], than post-MRGO [1960–1995]."")).

As such, "the potential for increased conveyance was also present ... shortly after the project's construction," but "Plaintiffs allege that their properties did not experience any floods that could constitute the basis of a takings claim until more than thirty years later." Gov't 4/13/12 Br. 70 (citing *St. Bernard Parish I,* 88 Fed.Cl. at 553 (finding that prior to "October 17, 1999 ... [P]laintiffs had not experienced flooding ... so substantial and frequent as to constitute a taking") (internal quotation omitted)). In fact, Plaintiffs testified that hurricanes and tropical storms caused flooding prior to Hurricane Katrina. Gov't 5/18/12 Resp. 22, 37–38 (citing 12/13/11 TR 624 (Robin); 12/13/11 TR 487 (Kemp)); *see also* 12/8/11 Britsch Direct at 29; 12/14/11 TR 989 (Britsch). For example, at Shell Beach, near several of Plaintiffs' properties outside the levee system, nine documented floodings occurred during major storms between 1901 and 1965. Gov't 4/13/12 Br. 5 (citing 12/8/11 Britsch Direct at 29); *see also* RJX–195 at 3–10 (depicting thirteen major hurricanes between 1889 and 2005). In addition, the evidence supports "a connection between winds from the northeast and high water levels in the wetland areas south of Lake Borgne" that existed prior to the ***745** MR–GO's construction and Plaintiffs have not established that the MR–GO changed the relationship between easterly winds and flooding on Plaintiffs' properties. Gov't 4/13/12 Br. 66–67 (citing 12/8/11 Britsch Direct at 29). Moreover, Plaintiffs failed to analyze the relationship between winds and water levels prior to the construction of the MR–GO and did not consider whether the relationship intensified over time. 12/13/11 TR 449, 461, 463 (Kemp). Instead, Plaintiffs' expert witness "merely note[s] that flooding has been observed and then opine[s] that the MRGO is the cause." Gov't 4/13/12 Br. 71.

Therefore, the Government concludes that the statute of limitations bars Plaintiffs' claims. Gov't 5/18/12 Resp. 2 ("If Plaintiffs are correct that risk of future flooding alone is sufficient to sustain a takings claim, Plaintiffs' papers prove definitively that the statute of limitations bars any such claim."); Gov't 5/18/12 Resp. 9–10 ("Plaintiffs now contend that the [Army] Corps of Engineers knew of the risk the MRGO created at least from the early 1970s.... If Plaintiffs are correct that an increased risk of flooding without proof of inevitably recurring flooding can show a violation of the Fifth Amendment, the statute of limitations bars Plaintiffs' claims [.]") (internal quotation marks omitted). The Government adds that any "funnel

effect" also came into existence at the time of the construction of the MR–GO, decades prior to Plaintiffs' July 6, 2011 Third Amended Complaint. Gov't 5/18/12 Resp. 24. As such, the statute of limitations bars any claim arising from the existence of a funnel. Gov't 5/18/12 Resp. 24 ("Plaintiffs failed to present any technical or scientific evidence explaining how the MRGO could exacerbate the natural funnel effect, have that effect exist for decades, but not manifest into increased flooding on their properties until some undefined time within six years of the filing of their lawsuit.").

On August 3, 2009, the court determined that the statute of limitations does not bar Plaintiffs' claims because the "the stabilization doctrine applies in this case." *See St. Bernard Parish I,* 88 Fed.Cl. at 555; *see also Dickinson,* 331 U.S. at 749, 67 S.Ct. 1382 (holding that where injury from water intrusion emerges gradually over time, such as recurrent flooding, a cause of action for a taking by a "continuing process of physical events" does not arise "until the situation becomes stabilized"). The factual evidence adduced at the trial in this case demonstrated that the environmental condition created by the construction, expansions, operation, and failure to maintain the MR–GO took place over many years, as it did in *Cotton Land Co. v. United States,* where "a poorly constructed dam caused sediment to deposit in the riverbed upstream of the dam. Over time, the sediment raised the level of the river bottom until the waters crested the banks, flooding the plaintiff's land. *The court found a taking even though the injury occurred years after the act of constructing* the dam, because the flooding was the 'natural consequence [ ] of the collision of the sediment-bearing flowing water with still water, and the progress upstream, of the deposit begun by that collision.' " *Cary,* 552 F.3d at 1378 (quoting *Cotton Land,* 109 Ct.Cl. 816, 829, 75 F.Supp. 232 (1948)). The evidence in this case established that the substantial increase in storm surge and flooding was the "direct, natural or probably result" of the construction, expansions, operation, and failure to maintain the MR–GO. Therefore, no intervening changes in the law or facts require the court to reconsider its prior ruling that the statute of limitations does not bar Plaintiffs' temporary takings claim in this case.

5. Plaintiff Established That The Injury From Flooding Was Substantial And Severe.

[23] [24]The United States Supreme Court has discussed the "substantiality" element of causation, in the context of a takings clause case using different descriptive terms. In *Penn Central Transportation Co. v. New York City,* 438 U.S. 104, 124, 98 S.Ct. 2646, 57 L.Ed.2d 631 (1978), the Court stated that a plaintiff in a takings case must show the economic impact of a taking on Plaintiff's property interests. In *Arkansas Game & Fish,* the Court stated that a plaintiff alleging a temporary takings claim must establish "the severity of the [Government's] interference" with a cognizable property interest. 133 S.Ct. at 522; *see also* ***746** *Ridge Line,* 346 F.3d at 1356 ("[T]o constitute a taking, an invasion must ... at least preempt the owner[']s right to enjoy his property for an extended period of time rather than merely inflict an injury that reduces its value.").

[25]The record evidences that multiple flood events occurred to properties outside the federal levee system. Dr. Kemp testified that twelve of Plaintiffs' properties outside the levees flooded during Hurricanes Camille, Carmen, Andrew, Katrina, and Rita. 12/6/11 Kemp Direct at 266. In addition, Plaintiffs provided expert and testimonial evidence of flooding during Hurricanes Gustav, Ike and Tropical Storm Lee. 12/6/11 Kemp Direct at 265; 4/13/12 Pls. Prop. FOF ¶¶ 26– 43, 55–64, 76–80 (describing flooding on specific properties during and after Hurricane Katrina); 12/13/11 TR 631–32, 634–35, 653 (Robin); 12/14/11 TR 847–48 (Willhoft). Thus, Plaintiffs have provided evidence of flooding during hurricanes and severe storms.

There is no question that flooding on Plaintiffs' properties during Hurricane Katrina was severe. In addition, Plaintiffs established that their properties were flooded and that they had no ability to access or use their properties for a significant time period following Hurricanes Katrina and Rita. *See, e.g.,* Pls. 4/13/12 Prop. FOF ¶¶ 26–43, 55–64, 76–80, 89; Gov't 5/18/12 Resp. To Pls. 4/13/12 Prop. FOF ¶ 89 (acknowledging that the Bordelons were not allowed access to their property for more than four weeks after the flooding); 12/12/11 TR 171, 177 (Tommaseo) (testifying that he could not visit his properties on Fenelon for one month after Hurricane Katrina, and did not return to live in his St. Bernard Parish residence for eighteen months after Hurricane Katrina); 10/15/10 Adams Dep. 18–19 (describing how the Adams family were not allowed

back to their property for months after Hurricane Katrina). In addition, the same evidence shows that many of Plaintiffs' properties experienced flooding during subsequent hurricanes and severe storms. 12/13/11 TR 631–35 (Robin) (describing flooding after Hurricane Katrina from Hurricanes Gustav, Ike and Tropical Storm Lee and severe storms).

For these reasons, the court has determined that Plaintiffs established that flooding during Hurricane Katrina and subsequent hurricanes and severe storms "preempted" access and use of their properties and that preemption was "substantial" and "severe."

III. CONCLUSION.

In *Arkansas Game & Fish,* the United States Supreme Court held that "[f]looding cases, like other takings cases, should be assessed with reference to the 'particular circumstances of each case,' and not by resorting to blanket exclusionary rules." 133 S.Ct. at 521; *see also Loretto v. Teleprompter Manhattan CATV Corp.,* 458 U.S. 419, 102 S.Ct. 3164, 73 L.Ed.2d 868 (1982) ("[N]o 'set formula' exists to determine, in all cases, whether compensation is constitutionally due for a [G]overnment restriction on property. Ordinarily, the Court must engage in 'essentially ad hoc, factual inquiries.' " (quoting *Penn Central,* 438 U.S. at 124, 98 S.Ct. 2646)); *Ridge Line,* 346 F.3d at 1352 ("A determination of whether a taking ... has occurred is a question of law *based on factual underpinnings*.") (emphasis added).

Weighing all the evidence in this case, the court has determined that Plaintiffs established that the Army Corps' construction, expansions, operation, and failure to maintain the MR–GO caused subsequent storm surge that was exacerbated by a "funnel effect" during Hurricane Katrina and subsequent hurricanes and severe storms, causing flooding on Plaintiffs' properties that effected a temporary taking under the Fifth Amendment to the United States Constitution.

* * *

Going back to the origins of causation in this case, in 1956, Congress authorized the Army Corps to construct the MR–GO to promote economic development in the New Orleans area and provide jobs. At that time, the environmental footprint of a project of this size was not considered. It was not until 1970, when President Richard M. Nixon had the foresight to champion legislation to authorize the EPA that any federal agency had ***747** the resources to conduct science-based cost/benefit analyses when important environmental resources were placed at risk by Government action.

Certainly by 2004, the Army Corps no longer had any choice but to recognize that a hurricane inevitably would provide the meteorological conditions to trigger the ticking time bomb created by a substantially expanded and eroded MR–GO and the resulting destruction of wetlands that had shielded the St. Bernard Polder for centuries.

In August 2005, when Hurricane Katrina struck the St. Bernard Polder, the Army Corps was still discussing whether to close the MR–GO and whether Congress would fund the closure. Neither Congress nor the Army Corps had the opportunity to correct the situation before the MR–GO induced substantially increased storm surge that caused catastrophic flooding on private property—as well as the loss of human life.

Subsequently, Congress authorized the Army Corps to close the MR–GO permanently and to build substantial protective structures to minimize, if not prevent, the impact of a Katrina-like hurricane in the future. The court has had the benefit of touring the new HSDRRS, and by any measure the Army Corps' work is impressive.

Since this case began, the court has found that the Army Corps' leadership and staff were open, transparent, and helpful in educating the court to understand what happened. In contrast, the Department of Justice pursued a litigation strategy of contesting each and every issue—whether evidentiary or substantive—as the twenty-two page Memorandum Opinion and

Final Order on Evidentiary Issues, filed herewith, manifests.

Today, the court has issued a liability opinion and scheduled a non-public conference with all parties on May 6, 2015 in New Orleans to ascertain whether they will agree to have damages assessed by a knowledgeable and accomplished mediator—and, in short order. In light of the United States Supreme Court's recent decision in *Arkansas Game & Fish* and the weight of the evidence in this case, it is the considered view of the undersigned judge that further litigation in this matter is not in the interest of the Army Corps and will not serve the interests of justice. It is time for this final chapter of the MR–GO story to come to an end.

IT IS SO ORDERED.

All Citations

121 Fed.Cl. 687

Footnotes

1 This case was filed on October 17, 2005, under the caption *Tommaseo v. United States,* No. 05–1119L. On March 19, 2009, this case was re-captioned, with the consent of the parties.

2 The acronym "MR–GO" is used herein, and is interchangeable with the term "MRGO."

3 Shortly after this case was filed in the spring of 2006, the undersigned judge initiated a conference with the District Court to avoid duplicative discovery and coordinate the adjudication of both cases, although each case had different plaintiffs and alleged different legal causes of action. Both judges agreed that the federal tort and state negligence claims first should proceed to adjudication and final judgment. Thereafter, this court would convene a bench trial on the Takings Clause claim, but would not issue an opinion until any appellate review of the District Court's decision was final. The parties in this case were advised of and agreed to this procedural agreement, in the presence of the District Court and the undersigned judge.

4 The facts herein have been discussed in the following prior opinions: *Tommaseo v. United States,* 75 Fed.Cl. 799, 800–01 (2007) ("*Tommaseo I* ") (denying, as premature, the Government's October 4, 2006 Motion To Dismiss, because Plaintiffs' claims were not barred by the statute of limitations); *Tommaseo v. United States,* 80 Fed.Cl. 366, 367–68 (2008) ("*Tommaseo II* ") (granting Plaintiffs' November 30, 2007 Motion For Leave To File A Second Amended Complaint); *St. Bernard Parish v. United States,* 88 Fed.Cl. 528, 531–42 (2009) (denying, without prejudice: the Government's November 7, 2008 Motion For Summary Judgment on statute of limitations grounds, because the stabilization doctrine applied, delaying the accrual of Plaintiffs' claims; and the Government's Motion To Dismiss, pursuant to RCFC 12(b)(6), for failure to state a claim upon which relief can be granted, because Plaintiffs' January 31, 2008 Second Amended Complaint and the record established the plausibility of Plaintiffs' claims) ("*St. Bernard Parish I* "); and *St. Bernard Parish v. United States,* 99 Fed.Cl. 765, 766–67 (2011) (denying the Government's May 23, 2011 Motion To Stay) ("*St. Bernard Parish II* ").

Additional facts have been derived from: the exhibits to the parties' pleadings; testimony adduced at a liability trial in this case conducted in New Orleans, Louisiana on December 12–15, 2011 (Court Exhibit A); and the exhibits admitted into evidence by the court's May 1, 2015 Memorandum Opinion And Order On Evidentiary Issues.

On May 1, 2015, the court issued a Memorandum Opinion And Final Order On Evidentiary Issues. As explained therein, the court has taken judicial notice of testimony and documents admitted in evidence in *In re Katrina Canal Breaches Litig.,* 647 F.Supp.2d at 649–79. *See* FED. R. EVID. 201(b)(2) (describing the kinds of adjudicative facts subject to judicial notice). For ease of reference, the court has labeled all exhibits from *Robinson* with "R," *i.e.,* "RPX" for plaintiffs' exhibits, "RDX" for the Government's exhibits, and "RJX" for joint exhibits. Plaintiffs' exhibits from this case are labeled "SPX," and the Government's exhibits are labeled "DX."

5 A polder is "a piece of low-lying land reclaimed from the sea, a river, etc. and protected by d[i]kes." OXFORD ENGLISH DICTIONARY ONLINE. Oxford Univ. Press, March 2015 (last visited April 30, 2015).

6 Dr. George Paul Kemp a geologist and oceanographer, and is Vice President of the National Audubon Society and Director of the

Louisiana Gulf Coast Initiative. He obtained his B.S. in Natural Resources from Cornell University, and his M.S. and Ph.D in Marines Sciences from Louisiana State University.

7 The Army Corps defined a "Standard Project Hurricane" as "one having a frequency of once in about every 200 years[.]" SPX.0219 at 24. After Hurricane Betsy, five storms exceeded the "Standard Projection Hurricane," including: Camille, Carmen, Andrew, Katrina, and Rita.

8 Professor John W. Day, Jr., Department of Oceanography and Coastal Sciences, Louisiana State University at Baton Rouge, Louisiana, and Professor Gary P. Shaffer, Department of Biological Sciences, Southern Louisiana University, issued an Expert Report admitted in Robinson (RJX–0199) and in this case (SPX.0472) that discussed, in depth, the environmental conditions in New Orleans before and after construction, expansions, operation, and failure to maintain the MR–GO by the Army Corps.

9 This report was authored by: Joannes Westerink, Dep't of Civil Eng'g & Geological Sci., Univ. of Notre Dame; Bruce Ebersole, Coastal & Hydraulics Lab., U.S. Army Eng'g Research & Dev. Ctr.; Harley Winer, New Orleans Dist., U.S. Army Corps of Eng'rs.

10 On an unspecified date during the early stages of construction, the Army Corps constructed a scale physical model of the MR–GO that predicted the precise movement of salinity through the channel, but continued with construction. 12/13/11 TR 500 (Kemp).

11 Dr. Hsu was Assistant Professor at Louisiana State University, specializing oceanographic meteorology.

12 Mr. FitzGerald is Chief Engineer of the Harris County Flood Control District in Houston, Texas. He obtained his B.S. in Civil Engineering from Stanford University. He obtained his M.S. in Civil Engineering from the University of Illinois at Champaign–Urbana.

13 Hurricane Betsy, however, occurred in 1965 prior to the 1968 expansion of the MR–GO by the Army Corps and thereafter by ship wave erosion. SPX.0169 at 2–5.

14 Saffir–Simpson Hurricane Wind Scale:

Category 1	64 to 82 knots	74 to 95 miles per hour
Category 2	83 to 95 knots	96 to 110 miles per hour
Category 3	96 to 112 knots	111 to 129 miles per hour
Category 4	113 to 136 knots	130 to 156 miles per hour
Category 5	137 knots or higher	157 miles per hour or higher

SPX.0004 at IV–13; *see also* NAT'L WEATHER SERV., NAT'L HURRICANE CTR., *Saffir–Simpson Hurricane Wind Scale, available at* http:// www.nhc.noaa.gov/aboutsshws.php.

15 High-water marks ("HWMs") occur where storm surge debris is left behind, indicating the maximum floodwater height during the storm. SPX.0004 at IV–17–18 (describing HWMs). After Katrina, the United States Geological Survey, the Army Corps, the Federal Emergency Management Agency, and the Louisiana State University identified approximately 790 HWMs. SPX.0004 at IV–18–19; *see also id.* at IV–1–180–274 (Plate 1–1) (summarizing high water marks). Approximately ninety-five of the HWMs were found to be the most reliable, because they were measured on interiors that sheltered the storm water level from waves and wind-blown water effects. SPX.0004 at IV–19. Hydrographs also can be used to measure water level over time, with better accuracy and less bias, but most failed prior to Katrina's peak. SPX.0004 at IV–18. Photographs and visual observation, however, were used to make "constructed hydrographs." SPX.0004 at IV–18. Over 200 eyewitnesses were interviewed. SPX.0004 at IV–164–65.

16 The developed portion of St. Bernard Polder averages 2.5 feet above mean sea level. SPX.0029 at 13; 12/6/11 Kemp Direct at 38.

17 In St. Bernard Parish, an additional 3,906 owner-occupied residences were classified as "Major Damage" and 286 as "Minor

Damage" from flooding. And, 1,947 renter-occupied residences were classified as "Major Damage" and 228 as "Minor Damage" from flooding.

18 In the Lower Ninth Ward, an additional 331 owner-occupied residences were classified as "Major Damage" and 44 as "Minor Damage" from flooding. And, 515 renter-occupied residences were classified as "Major Damage" and 109 as "Minor Damage" from flooding.

19 Some of Plaintiffs' properties in Shell Beach, Yscloskey and Alluvial City were close to the expanded MR–GO channel and the retreating Lake Borgne shoreline. Near Shell Beach, the MR–GO width expanded from 500 feet in 1965 to 1600 feet to date. 12/6/11 Kemp Direct at 235 (collecting sources).

20 Specifically, after Hurricane Katrina, approximately sixteen percent of Plaintiffs' properties, located within the federal levees and the Forty Arpent Levee in St. Bernard Parish and the Lower Ninth Ward, flooded three times, thirty-nine percent flooded twice, and forty-five percent flooded once, *i.e.* totaling 100%. 12/6/11 Kemp Direct at 266. One property, Paris Road Shipyard, inside the federal levee but outside the Forty Arpent Levee, flooded during Hurricanes Rita and Gustav. 12/6/11 Kemp Direct at 266. The Adams property nearest the IHNC floodwall also flooded during Hurricane Rita. 12/6/11 Kemp Direct at 266. The overtopping of the IHNC floodwall during Hurricane Gustav also flooded Plaintiffs' properties in the area. 12/6/11 Kemp Direct at 266.

21 In its April 13, 2013 Post–Trial Brief, the Government argued that the court did not have jurisdiction to adjudicate Plaintiffs' July 6, 2011 Third Amended Complaint, because: Plaintiffs did not prove that any alleged flooding was the direct, natural, or probable result of the MR–GO. Gov't 4/13/12 Br. at 24–36. But, these arguments go to the merits and thus are addressed below.

22 One hundred four properties identically are listed in both the January 31, 2008 Second Amended Complaint and July 6, 2011 Third Amended Complaint. In addition, eighteen properties are identified in the January 31, 2008 Second Amended Complaint, but not in the July 6, 2011 Third Amended Complaint. Thirteen properties are identified in the July 6, 2011 Third Amended Complaint, but not in the January 31, 2008 Second Amended Complaint. Eleven properties are identified in both the January 31, 2008 Second Amended Complaint and the July 6, 2011 Third Amended Complaint, but the individual registered owner changed. *Compare* 2nd Am. Compl. ¶¶ 15–45 (properties of representative Plaintiffs), *with* 3rd Am. Compl. ¶¶ 15–45 (properties of representative Plaintiffs). In sum, the January 31, 2008 Second Amended Complaint lists a total of 133 properties, whereas the July 6, 2011 Third Amended Complaint lists a total of 128 properties.

23 The court would be remiss if it did not state that it was not impressed with the Government's attempt to belittle and trivialize the "lay" testimony of Louisiana natives with firsthand knowledge of the ecology of the area, equal to if not more relevant than that of an expert. For example, Mr. Robin has been a commercial fisherman and observed marsh ecology since he was a child. 12/13/11 TR 591, 610–13, 615–16, 647–48 (Robin). Likewise, Mr. Estopinal, a local resident, land surveyor, and civil engineer, was competent to testify about the adverse environmental impact of the construction, expansions, operation, and failure to maintain the MR–GO. 12/12/11 TR 75–77, 80–83, 89–90, 109 (Estopinal).

24 Dr. Gagliano, P.E., Ph.D, is President of Coastal Environments, Inc. He earned his B.S., M.S., and Ph.D from Louisiana State University.

25 The acronym "ppt" stands for "parts per thousand."

26 Dr. Louis D. Britsch, III is a geologist who manages the Geology Unit of the New Orleans District of the United States Army Corps of Engineers. He obtained his B.S. in Geology from Nicholls State University, his M.S. in Geology from Tulane University, and his Ph.D in Coastal Geology from the University of New Orleans. He has worked for the Army Corps for the past twenty-seven years. *See* 12/8/11 Britsch Direct at 1.

27 A salinity score of 0 indicates undetectable levels of saline in the water; seawater has a saline score of around 35. *See Background Papers & Supporting Data on the Practical Salinity Scale 1978,* 37 UNESCO TECHNICAL PAPERS IN MARINE SCI. 5–7 (1981), *available at* http:// unesdoc.unesco.org/images/0004/000479/047932eb.pdf.

Habitat/ Wetlands	**Salinity**	**Description**
Swamp	0–3	Forested coastal wetlands in the study area are dominated by bald cypress and water tupelo, which

		are the remnants of extensive logging of virgin forest more than 70 years ago. The Louisiana swamps generally lack a mature canopy as was present in colonial forests and have lower productivity where isolated from riverine influences (Shaffer et al 2003).
Fresh Marsh	0–3	Fresh marsh has the highest plant diversity of all the coastal habitat types including as many as 93 species. Floating aquatic and submerged plants are common and are significant for waterfowl. Soils may be highly organic and prone to settlement. Many species of duck and waterfowl use coastal Louisiana and Mississippi as overwintering grounds for foraging of diverse invertebrates, plant roots, and tubers.
Intermediate Marsh	2–8	Intermediate marsh has lower species diversity than fresh marsh, but may have higher productivity. This habitat provides important nurseries for brown shrimp, white shrimp, blue crab, and Gulf menhaden or pogy. Soils may be very poor due to very high organic content. Submerged aquatic vegetation within lakes and bays are vital to secondary productivity.
Brackish Marsh	4–18	Brackish marsh has the lowest plant diversity, but may be the most productive type of marsh. The dominant species is marshhay grass. Oysters are exceptionally significant due to filtration, biomass, reef building, and commercial harvest and other fish found in reef communities.
Salt Marsh and Barrier Islands	8–29	Salt Marsh and barrier islands have high overall species diversity due to plants and animals. Bird rookeries are an important use of these habitat types. Nesting for sea turtles occurs on some islands. Some islands in the study area also have true seagrasses on their bay side lagoons and provide habitat for the endangered West Indian manatee during migration.

[28] In 2008, the Army Corps stated that as a result of subsequent "tropical storms and hurricanes, supplemental expenditures have often been required to return the MRGO to the authorized dimensions." *See* 2008 ARMY CORPS REPORT at vi-vii. Since 1998, however, no funds have been spent to restore the MR–GO to its authorized dimensions. *Id*. at vii. In addition, the GIWW Reach has not been dredged since 1998. *Id*. The Inland Reach, however, was maintained at a minimum 300–foot bottom width until 2005; the Sound Reach was maintained to a minimum 450–foot bottom width; and the Bar Channel to a minimum 500–foot bottom reach. *Id*. After Hurricane Katrina in 2005, there was no channel maintenance. *Id*.

[29] On April 9, 2008, the Army Corps arranged an aerial tour of the St. Bernard Polder for the court and the parties. During this tour, the court observed miles of dead cypress trees and the proximity of habitat loss to the MR–GO.

[30] In response to Plaintiffs' criticism of Dr. Britsch's study, the Government notes that "Dr. Britsch appropriately tailored his report in this case to the specific location of Plaintiffs' properties and in a manner that makes his analysis relevant to the facts and legal questions this case presents—something the Plaintiffs' experts did not do." Gov't 5/18/12 Resp. 41 (citing 12/13/11 TR 920–21 (Britsch) (explaining that he adjusted the study parameters from *Robinson* to accommodate the different locations of properties at issue in this case) (emphasis omitted)).

31 The Government clarified, however, that although Mr. Robin used the word "northeast" wind during his deposition, he meant a wind moving northwest, originating from the southeast. Gov't 4/13/12 Br. 73 (citing 12/13/11 TR 647, 654–55 (Robin)).

32 For Plaintiffs' properties outside the federal levee system, the Government incorrectly states that lay evidence is entitled to little or no weight. Gov't 4/13/12 Br. 39–40. Plaintiffs are not relying solely on lay witnesses, but also expert testimony and documents, to demonstrate that the Army Corps' construction, expansion, operation, and failure to maintain the MR–GO injured Plaintiffs' properties outside the federal levees.

33 The holding in *Cress,* on which the United States Supreme Court recently relied in *Arkansas Game & Fish,* also appears to diminish the precedential import of *Ridge line's* conclusion that "one or two floodings do not make a taking." 346 F.3d at 1357.

34 Land subsidence refers to land sinking relative to local mean sea level.

35 Dr. Britsch also opined that areas outside the federal levee system may be particularly vulnerable to subsidence and sea level rise:

> Government Counsel: And the land features we're talking about in Yscloskey, Shell Beach, Hopedale, Alluvial City, these type of areas, how significant is a half a foot of subsidence over a century?
> Dr. Britsch: Again, it depends on the elevation of each individual property. But as you can see, we're right on the edge of the delta here with water a stone's throw away from your property. So obviously small changes in relative sea levels have an impact.

12/14/11 TR 992–93 (Britsch).

36 Dr. Britsch had little or nothing to say about the impact of economic development in the region. Dr. Britsch only testified that, as the swamp land drained, areas within the Forty Arpent Levee would subside at a greater rate than other areas. 12/8/11 Britsch Direct at 26–27. In fact, Dr. Britsch's explanation that drained wetlands may subside at a greater rate helps explain the increased subsidence after salinity increased and habitat/wetland loss caused by the Army Corps' construction, expansions, operation, and failure to maintain the MR–GO.

37 *See* U.S. ARMY CORPS OF ENG'RS, GREATER NEW ORLEANS HURRICANE & STORM DAMAGE RISK REDUCTION SYS., FACTS & FIGURES (Sept. 2004), at 2 (showing that $2.2 billion has not been obligated as of September 2014), *available at* http://www.mvn.usace.army.mil/Portals/56/docs/HSDRRS/Facts-figuresSeptember2014.pdf (last visited Apr. 30, 2015). As of September 2014, the Army Corps has spent $12.4 billion to construct the Hurricane & Storm Damage Risk Reduction System. An additional $2.2 billion has been budgeted, but not obligated. In addition, on December 2, 2010, The Army Corps' proposed to spend $2.9 billion to restore part of the ecosystem that the MRGO destroyed. Pls. 4/13/12 Prop. FOF ¶¶ 407–12 (referencing a $3.1 billion restoration plan); 2010 DRAFT EIS at 2–55 (listing four possible plans of up to $3.1 billion), ES–7 (recommending a $2.9 billion plan).

38 On this point, the Government's briefs are internally inconsistent. *Compare* Gov't 4/13/12 Br. 74 ("[M]ost of the land loss in the St. Bernard Delta is *not related to the MRGO*[.]") (emphasis added), *with* Gov't 5/18/12 Resp. 22 ("[T]he *most significant* portion of the land loss in the St. Bernard Delta occurred *during the construction of the MRGO,* or immediately thereafter.") (emphases added) *and* SPX.0129 at MRGO 12 (U.S. ARMY CORPS OF ENG'RS, LA. COASTAL AREA (LCA), LA., ECOSYSTEM RESTORATION STUDY (2004) ("[L]and loss rates have accelerated since 1990," exceeding the rate of loss experienced during construction of the MR–GO)).

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