Expert Report

of

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Prepared for Plaintiffs in:

Katrina Canal Breaches Consolidated Litigation
[Civil Action Number: 05-4182 "K" (2)]

United States District Court
Eastern District of Louisiana

Pertains to: MR-GO, Robinson

(C. A. No. 06-2268)

Moraga, California

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PREFACE

This Expert Report is submitted on behalf of the Plaintiffs in *Robinson v. United States* (Civil Action No. 06-2268, US District Court for the Eastern District of Louisiana, Section "k"(2), Judge Duval) in response to Defendant United States December 2008 Expert Reports by Mr. B. Ebersole, Dr. D. Resio, Dr. R. Mosher, and Dr. T. Wolff.

The purpose of this Expert Report is to evaluate the Defendant's experts observations, analyses, assessments, conclusions, and opinions about performance of the man-made flood protection structures adjacent to Reach 2 and Reach 1 of the Mississippi River Gulf Outlet (MR-GO) (Figure 1) during Hurricane Katrina and the effects of the MR-GO Deep Draft Navigation Channel on the performance of these structures, and to correlate and/or differentiate these opinions from those of the Plaintiffs experts.

Further, this report is intended to provide the Court and the Defendants with the basic background information relative to the scientific methodologies that I have applied in arriving with my observations, analyses, assessments, conclusions, and opinions contained in my July 2008 Expert Report,

This Expert Report consists of a Declaration and six (6) supporting Technical Reports.

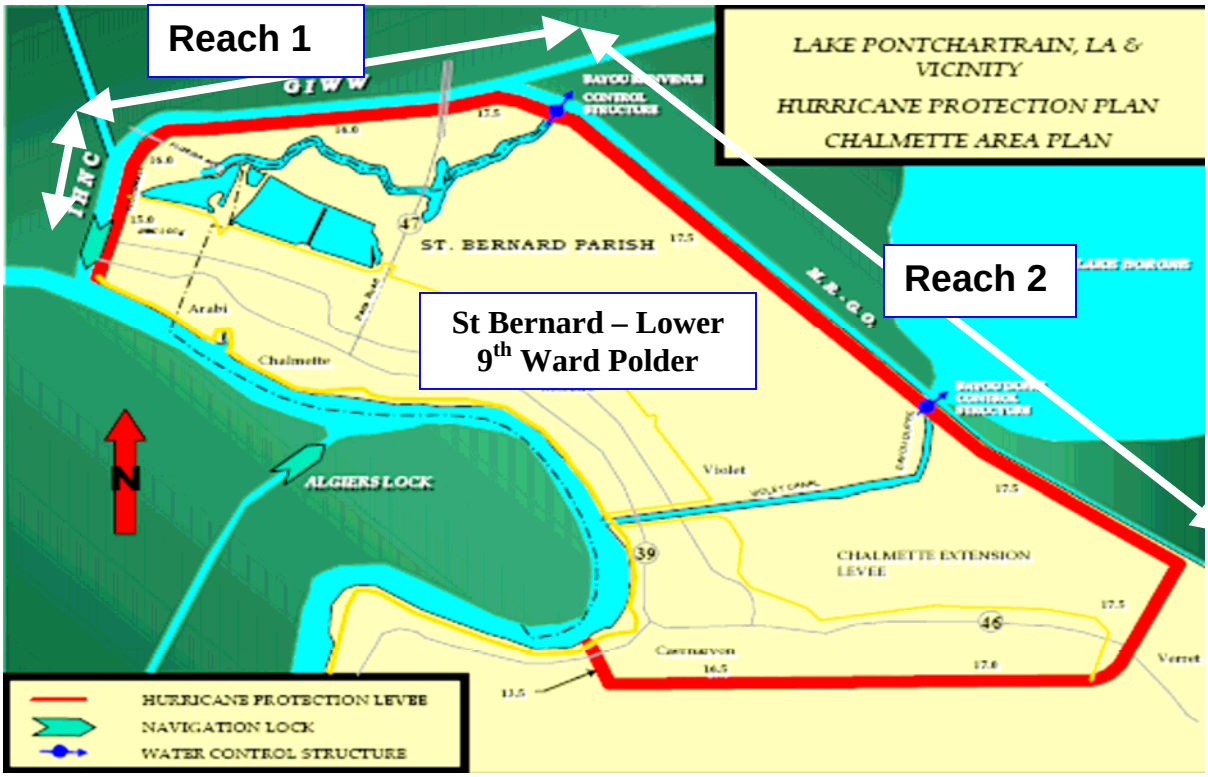

Figure 1: MR-GO Reach 1 and Reach 2 (after USACE IPET 2007).

EXECUTIVE SUMMARY

A. Reiteration of Plaintiffs Expert Opinions

Hurricane Katrina 'As Was' Conditions and Deleterious Effects of the MR-GO

1. It is my conclusion, based on my experience, my observations and analyses, and my forensic engineering studies, that the cumulative adverse effects associated with design, construction, maintenance, and operation of the MR-GO Deep Draft Navigation Channel from 1958 to the date of Hurricane Katrina were a primary cause for the failure of the man-made flood protection structures along Reach 2 of the MR-GO (Technical Report I).

2. The MR-GO Deep Draft Navigation Channel's cumulative negative effects, included loss and repression of natural wetland buffer and vegetation buffers, the

magnification of the waves in the deep channel, the accelerated and increased subsidence of the levee's crest elevation, and the rapid storm surge delivery (elevations, volumes, durations). These cumulative adverse effects were primary causes of the breaching of man-made flood protection structures in the vicinity of the MR-GO (Figure 2).

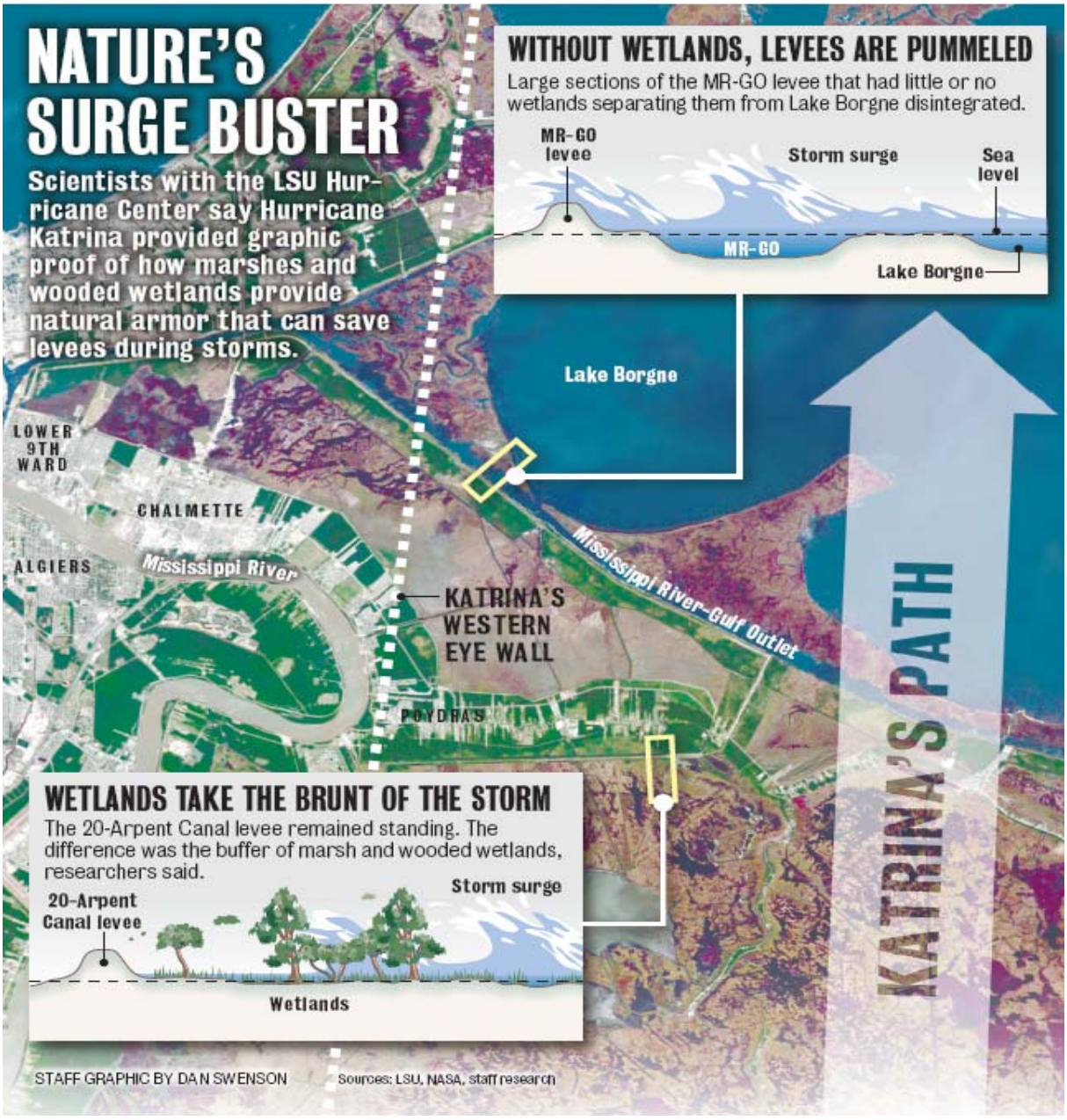

Figure 2: MR-GO Deep Water Navigation Channel's cumulative negative effects.

3. **Loss of Existing Wetlands** - Selection of land route for the MR-GO Deep Draft Navigation Channel and subsequent salt water intrusion and channel erosion caused catastrophic damage to existing trees, swamp, and wetland vegetation, ground cover, and inhibited the natural sustenance of these features after channel construction was completed (Figure 3). This damage and the absence of sufficient sustenance significantly reduced the areas natural ability to reduce surge heights and wave action.

4. **Channel Growth** – The MR-GO channel was allowed to grow to several times its originally authorized width (Figure 4). Maintenance dredging and dredging to provide a source of material for construction of the earthen man-made flood protection structures contributed to this growth as did wave erosion of the channel banks. The growth of the channel had multiple negative environmental impacts including development of a hydrologic system that facilitated salt water intrusion, encroachment of the channel banks into areas near the man-made flood protection structures thereby threatening their performance, and development of a wide and deep water body that would intensify hurricane surge, currents, and waves.

5. **Wave Magnification** - The fact that the channel was allowed to grow to several times the authorized size caused it to serve as a wave regeneration basin during Hurricane Katrina. The regenerated waves at the MR-GO Reach 2 flood protection structures were significantly larger and more powerful than they would have been had the pre-channel wetlands and vegetation been present (Figure 5). The contribution to the destruction of the man-made flood protection structures caused by waves, which were larger and more powerful than they would have been had the natural vegetation be present, was a direct cause of flooding due to the MR-GO channel.

6. **Accelerated and Increased Settlement** - The close proximity of the deep water MRGO navigation channel to the MR-GO hurricane flood protection structures increased settlement (due to soil creep and 'squeezing') and loss of levee crest elevation (Figure 6). The proximity of the MR-GO channel to the hurricane flood protection structures also threatened their stability. The low areas of the levee crest had an increased exposure to both erosive wave action and overtopping. Many of the portions of the levee that were the lowest at the time of Katrina experienced the most breaching. This series of connections provides a direct link between the MR-GO channel and the flooding of populated areas.

7. **Intensified Storm Surge Delivery** - The route selection of the MR-GO Deep Draft Navigation Channel created an artificial 'Funnel' shape, and served as a direct deep water conduit to the open ocean (Figure 7). The direct connection and funnel geometry caused earlier, increased, and prolonged propagation of storm surge. The deep water channel served as a conduit which carried the storm surge water into the St. Bernard Parish, New Orleans East, and IHNC areas earlier, more rapidly, in greater volumes, and for a longer time period than the natural vegetation would have allowed in absence of the MR-GO channel.

8. **The Legacies of the MR-GO -** It is important to note that had the Reach 2 of the MRGO Levee merely been overtopped, without major breaching, Chalmette and St. Bernard Parish would not have been flooded by storm surge waters (Figure 8). The volume of water from overtopping would not have overtopped the Forty Arpent levee. Peak storm surge heights, above the height of the MR-GO Levee, only existed for a few hours. If the Reach 2 MR-GO levees had withstood this brief peak water level, as did many other levees in the area which were not subjected to all of the negative impacts of the MR-GO channel, much of the flooding of the populated areas would not have occurred.

9. The cumulative and multiple adverse effects of the MR-GO resulted in exposing the man-made flood protection structures adjacent to Reach 2 of the MR-GO to the open waters of the Gulf of Mexico. These man-made flood protection structures were originally designed and constructed as a ‘backwater’ protected hurricane flood protection system. The dramatic changes in the natural environment in which the Reach 2 man-made hurricane flood protection system was designed and constructed were not properly recognized and mitigated before the arrival of Hurricane Katrina. Since the painful experiences associated with Hurricane Katrina, there have been dramatic changes in how this hurricane flood protection system is ‘viewed’ and how the current environment is being properly ‘accommodated’ in design and construction of the facilities to ‘Close the MR-GO’ and to re- engineer the ‘100-year hurricane flood protection’ that was authorized by Congress following Hurricane Betsy in 1965.

Figure 3: Destruction of wetlands caused by MR-GO.

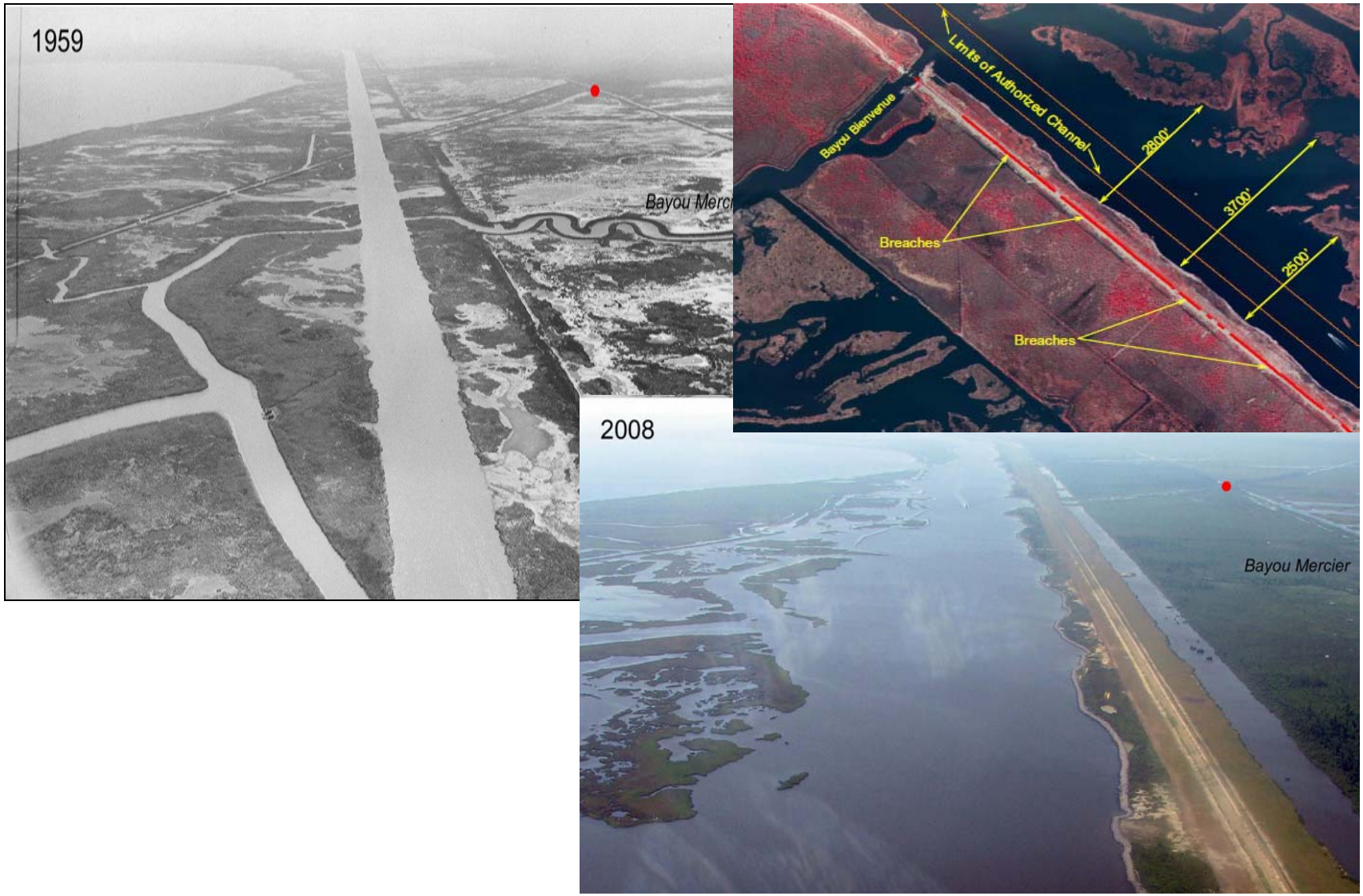

Figure 4: MR-GO channel expansion.

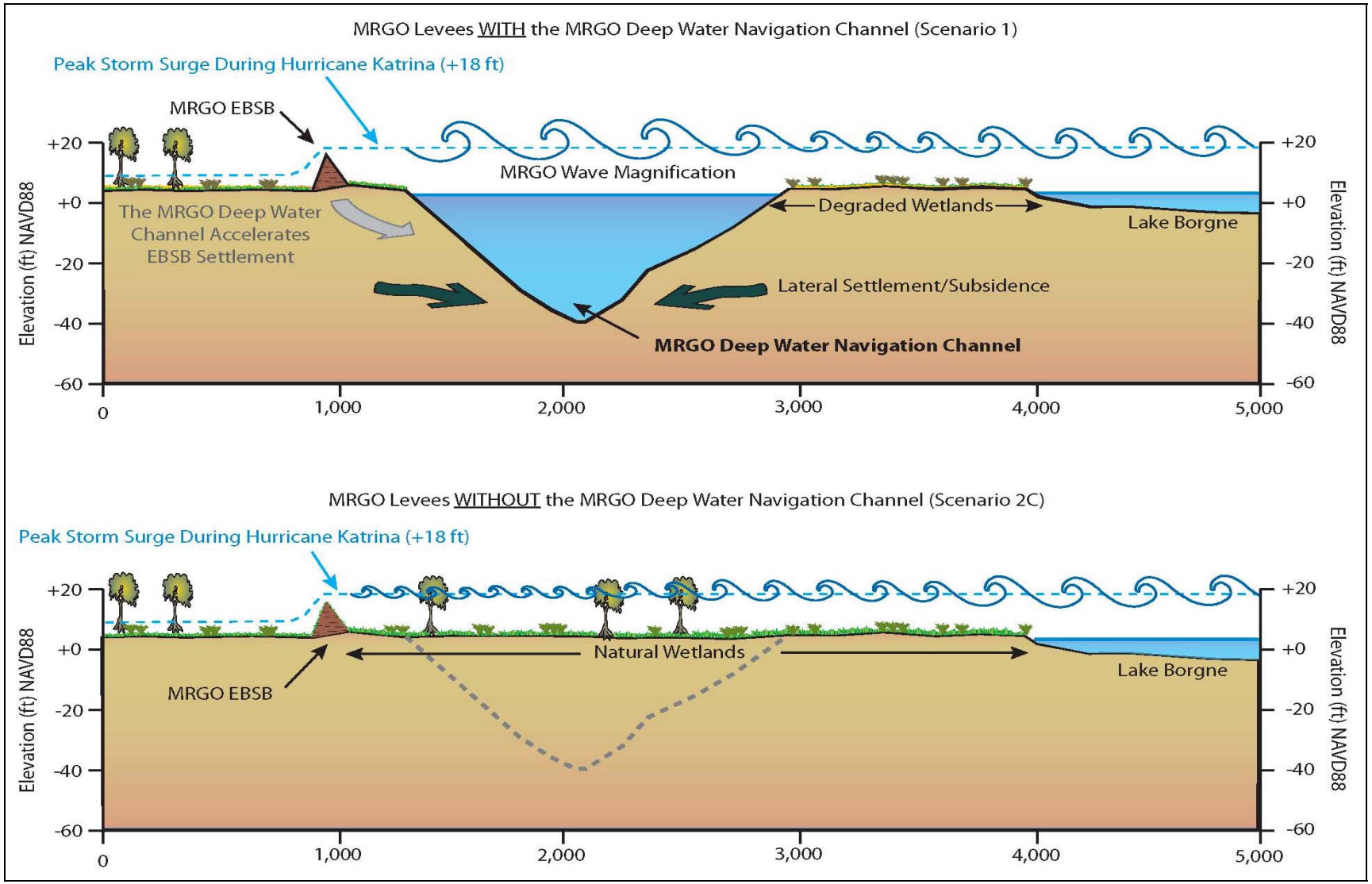

Figure 5: Wave magnification due to MR-GO.

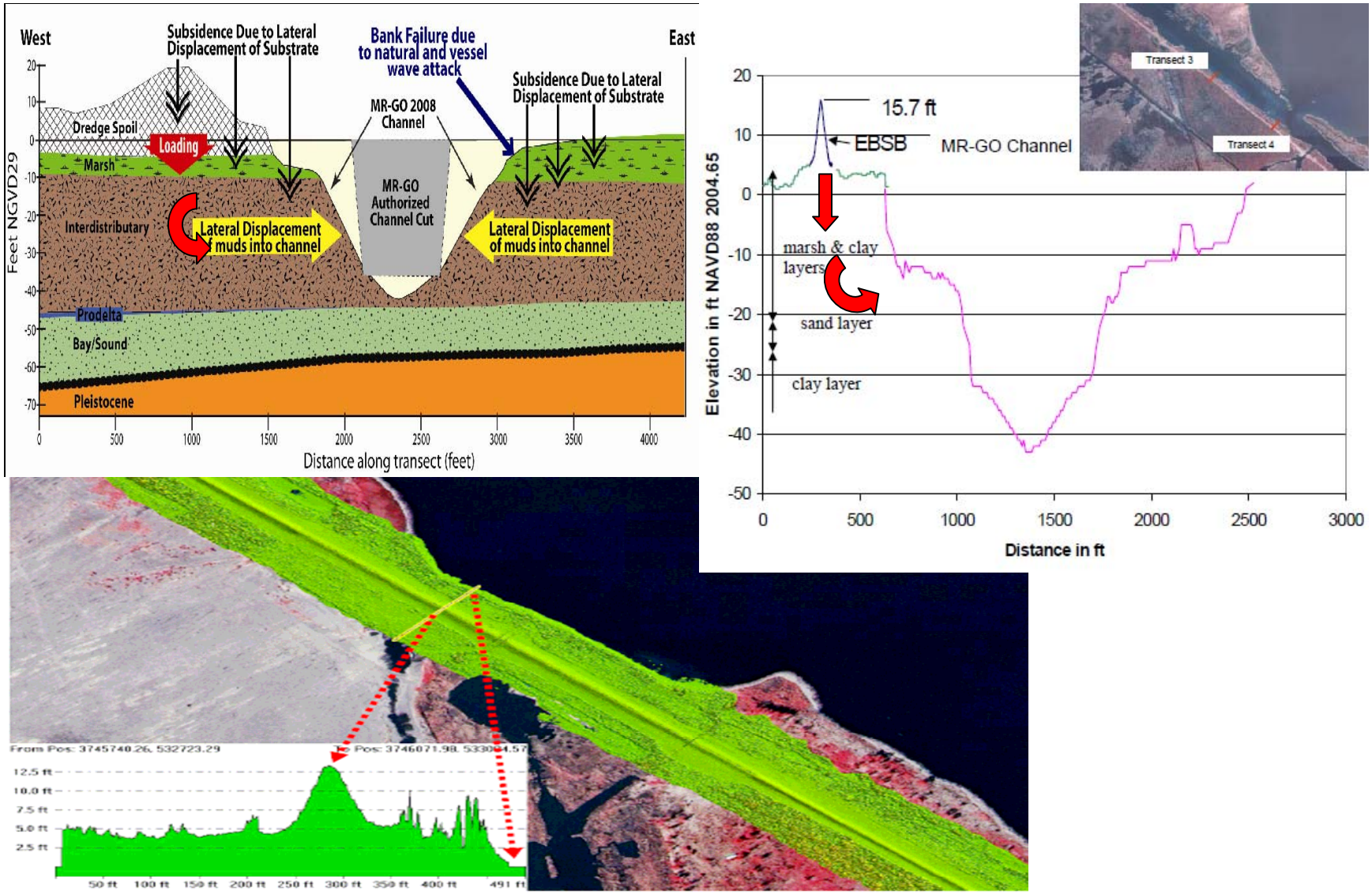

Figure 6: Accelerated and increased settlements caused by encroachment of MR-GO channel.

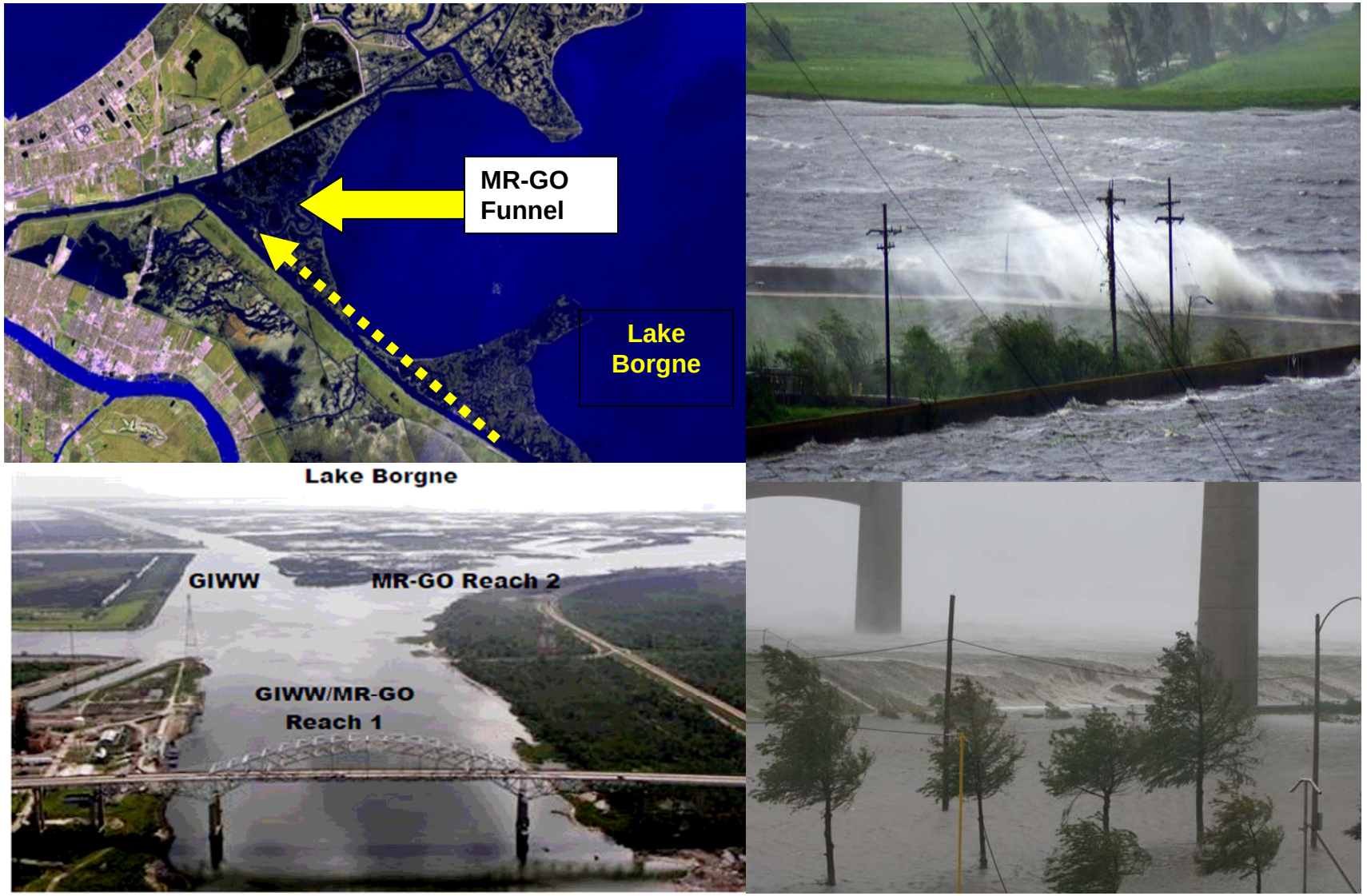

Figure 7: The MR-GO Channel and Funnel effects on hurricane surge, waves, and currents

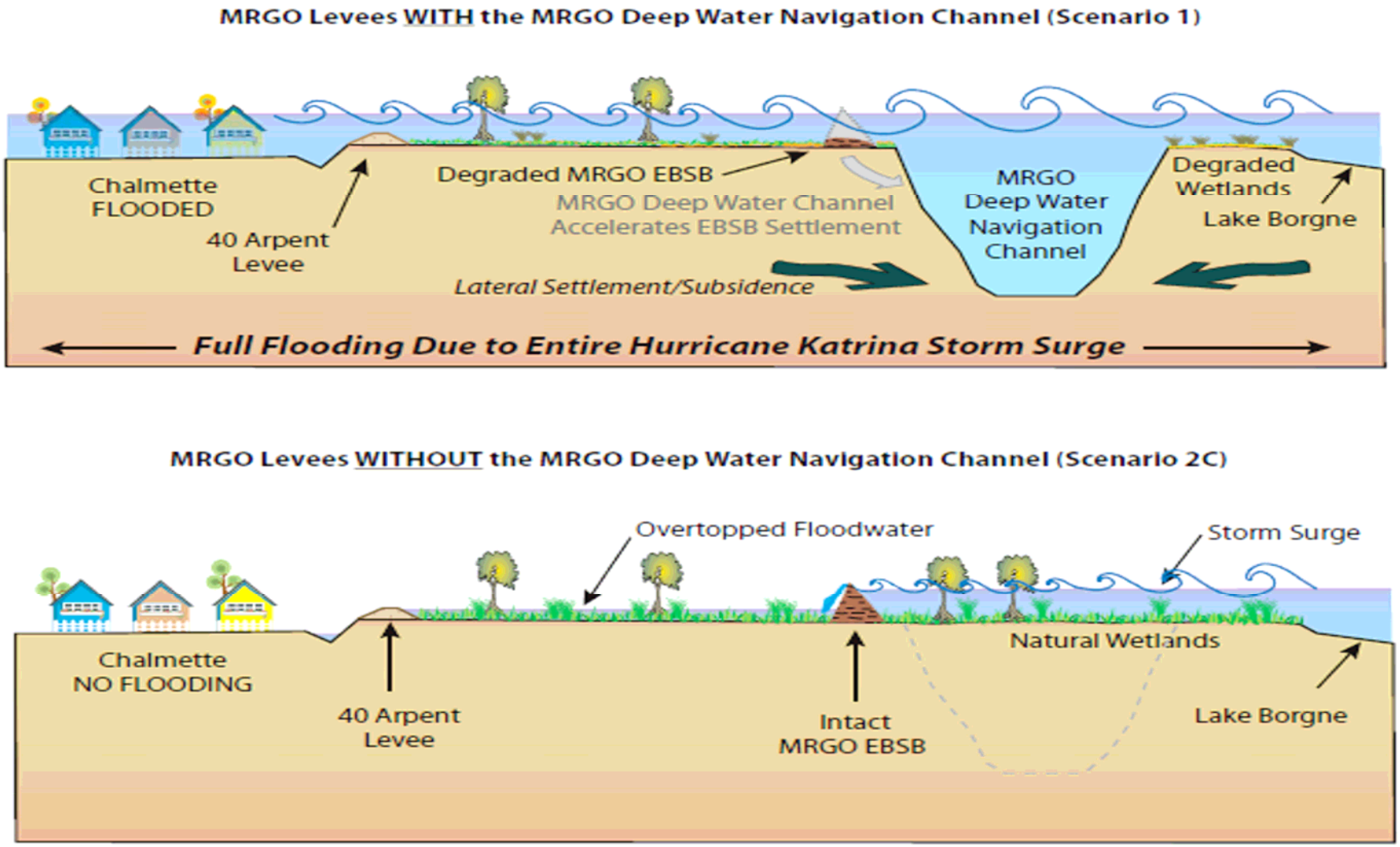

Figure 8: Flooding of St Bernard Parish due to Hurricane Katrina and due to Hurricane Katrina with a Neutral MR-GO.

Performance of the MR-GO Reach 2 Flood Protection Structures

10. The fundamental conclusion documented in my July 2008 Expert Report is that much of (not all) the extensive (wide and deep) breaching in the Reach 2 earthen flood protection structures (Earthen Berm – Spoil Banks; EBSBs) developed during Hurricane Katrina was (most probably) initiated with water side wave erosion propagated to the final observed conditions with a combination of overflow exploitation of the wave action induced breaches by the rising surge waters and waves (Figure 9). This early initiation and exploitation of the breaches by waves and rising surge waters explains how hurricane flood waters were able to penetrate in very large volumes at early times into Chalmette and St Bernard Parish.

11. The breach that developed at the Bayou Dupre navigation – water control structure developed as a result of erosion and scour caused by surge waters overtopping the adjacent EBSBs. The breach that developed at Bayou Bienvenue navigation – water control structure developed as a result of hydraulic seepage and uplift pressures which caused 'blow out' conditions in the underlying shell fill and lateral instability of the sheet pile interface with the adjacent EBSB.

12. I have further concluded that the 'water-side-wave-erosion-initiated' and 'rising-surge-water-and-wave-exploited' breaching of the MR-GO Reach 2 EBSBs would (most probably) not develop during the 'do no harm'/'MR-GO Neutral' Hurricane Katrina conditions (Plaintiffs' Scenario 2C). Breaching would not develop at the Bayou Dupre navigation – water control structure under these conditions. Breaching would develop at the Bayou Bienvenue navigation – water control structure under these conditions. The Plaintiffs' experts flooding analyses indicates that under the 'MR-GO Neutral' Hurricane Katrina

conditions the rising surge waters flooding Chalmette and the adjacent portions of St Bernard Parish would have been largely contained within the Reach 2 – 40 Arpent levee basin (also known as the Central Wetlands Unit).

13. Had the man-made flood protection structures adjacent to Reach 2 of the MR-GO been overtopped without breaching, the Chalmette/St Bernard Parish area would not have been flooded by Hurricane Katrina storm surge waters. The volume of water from overtopping would not have overtopped the Forty Arpent levee. Peak storm surge heights, above the height of the MR-GO Reach 2 flood protection structures, only existed for a limited amount of time. If the Reach 2 MRGO flood protection structures had withstood this brief peak water level, as did many other flood protection structures in the area which were not subjected to all of the negative impacts of the MR-GO Deep Draft Navigation Channel, much of the flooding of the populated areas would not have occurred. Because of the reduced elevations of large sections of the Reach 2 man-made earthen flood protection structures caused by the MR-GO channel widening and because of the early water side wave induced breaching, the surge waters had many more hours to enter the St Bernard – Lower 9th Ward Polder causing the disastrous flooding experienced during Hurricane Katrina.

14. To examine the impact of wave action on performance of the earthen flood protection structures one should look at the impact of overtopping without wave action on nearby flood protection structures (Figure 10). Overtopping alone does not mean that a flood protection structure (e.g. earthen levee) will be breached or fail, as the following examples illustrate.

- The hurricane protection earthen levee south of Reach 2, in the area where the levee does not front along the deepwater navigation channel, suffered no breaching even though significant overtopping occurred in this area. It should be noted that this section of levee is fronted by natural wetlands.
- The hurricane protection levee that fronts the eastern side of New Orleans East west of the Paris Road Bridge was severely overtopped and did not fail. This levee was protected from hurricane waves by the fronting wetlands.
- The south side of the Intracoastal Waterway levees were exposed to significant overtopping, yet no breaching occurred.

Although overtopping will contribute to flooding, overtopping alone can explain the timing, duration, and volumes of flood waters that entered the St Bernard Parish – Lower 9th Ward Polder and the New Orleans East Polder during Hurricane Katrina. This catastrophic flooding had its roots firmly embedded in the Legacies of the MR-GO.

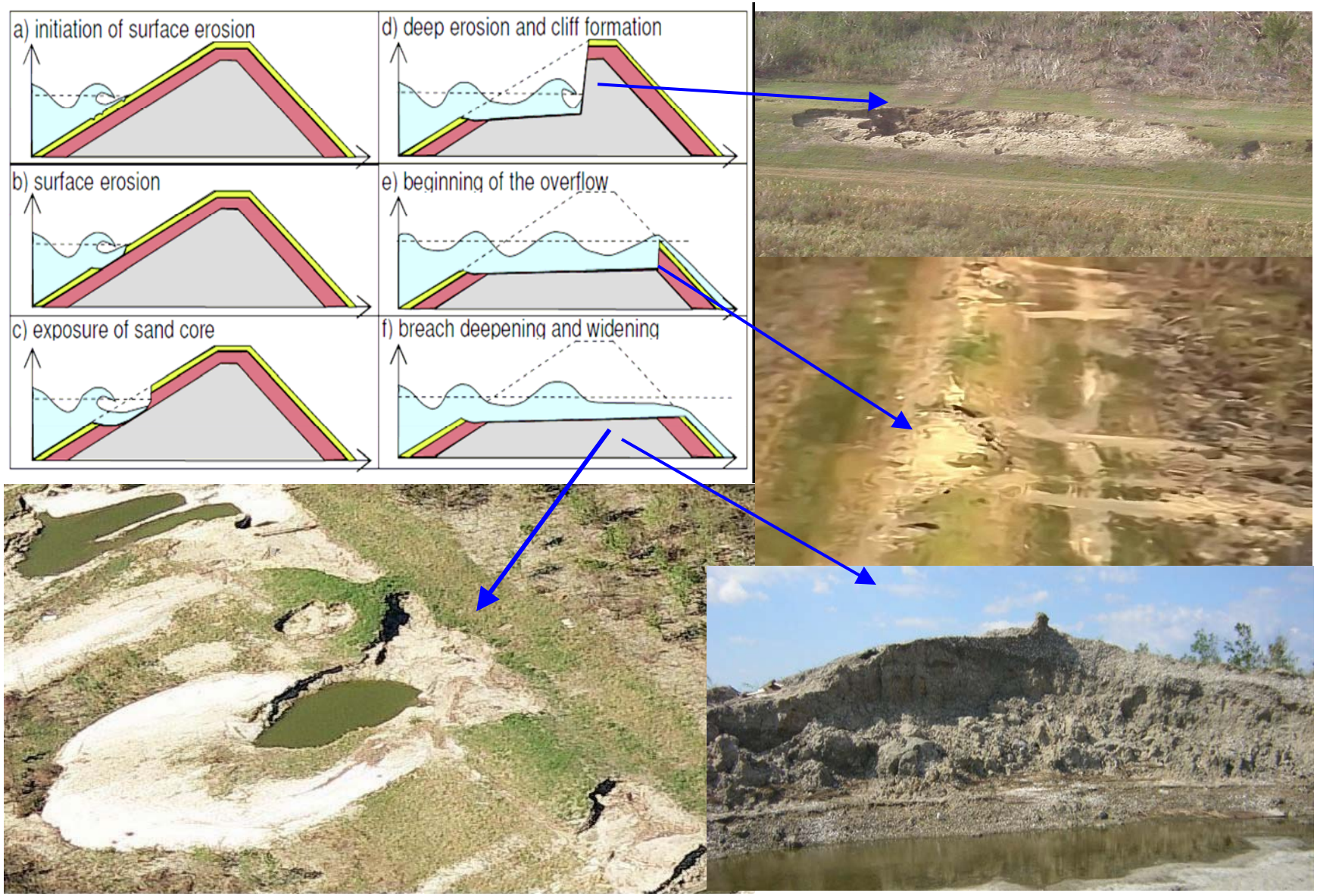

Figure 9: Initiation and development of wave-induced erosion and breaching of Reach 2 EBSBs.

Figure 10: Overtopping without breaching.

Performance of the MR-GO Reach 1 Lower 9th Ward Flood Protection Structures

15. The fundamental conclusion documented in my July 2008 Expert Report is that the breaches that developed in the man-made flood protection structures adjacent to the Lower 9th Ward during Hurricane Katrina was (most probably) initiated with surge water pressures developed on the water side of the flood protection structures (concrete floodwall and supporting sheet piling) and hydraulic seepage and uplift pressures generated in the marsh layers under the soil levee (Figure 11). Early development of the high hydraulic seepage and uplift pressures was further abetted by the nearby backfilled excavations developed during the USACE Lock Expansion Project East Bank Industrial Area (EBIA) site clearing activities (Figure 11). The North Breach fully developed early and before overtopping by the surge waters, and the South Breach fully developed later after overtopping by the surge waters.

16. As the breaches evolved, differential movements of the man-made flood protection structures resulted in opening the vertical joints (water stops) between sections of the concrete floodwall. These openings allowed flood waters to enter early into the adjacent Lower 9th Ward. As the breach development – failure process further developed there were failures of some interlocks – joints – between sections of the sheet piling. The Ingram barge found inside the Lower 9th Ward adjacent to the South Breach after Hurricane Katrina entered after the North Breach was well developed and after the South breach had developed (Figure 11). The Ingram barge did not contribute significantly to development of either the North Breach or the South Breach. Evidence indicates that the Ingram barge was drawn into the Lower 9th Ward by flood waters entering the Lower 9th Ward through the South Breach.

17. I have further concluded that during the defined "do no harm" MR-GO 'Neutral' Hurricane Katrina conditions (Plaintiffs' Scenario 2C), that the breaches that developed at the Lower 9th Ward would develop in similar ways and at similar times. In the absence of the backfilled excavations developed during the USACE Lock Expansion Project EBIA site clearing activities, the breaches that developed at the Lower 9th Ward would (probably) not develop in similar ways, locations, and times. I conclude the excavations were a primary factor in causation of the breaches because they facilitated development of destabilizing hydraulic uplift pressures acting on and seepage effects developed in the soils supporting the flood protection structures at the North and South Breaches. Floodwall failures did not develop adjacent to open EBIA excavations (e.g. flooded borrow pit) between the North and South Breaches because the walls of these excavations had been lined with low permeability clays – thereby insulating the underlying soils from the destabilizing hydraulic uplift pressures and seepage effects.

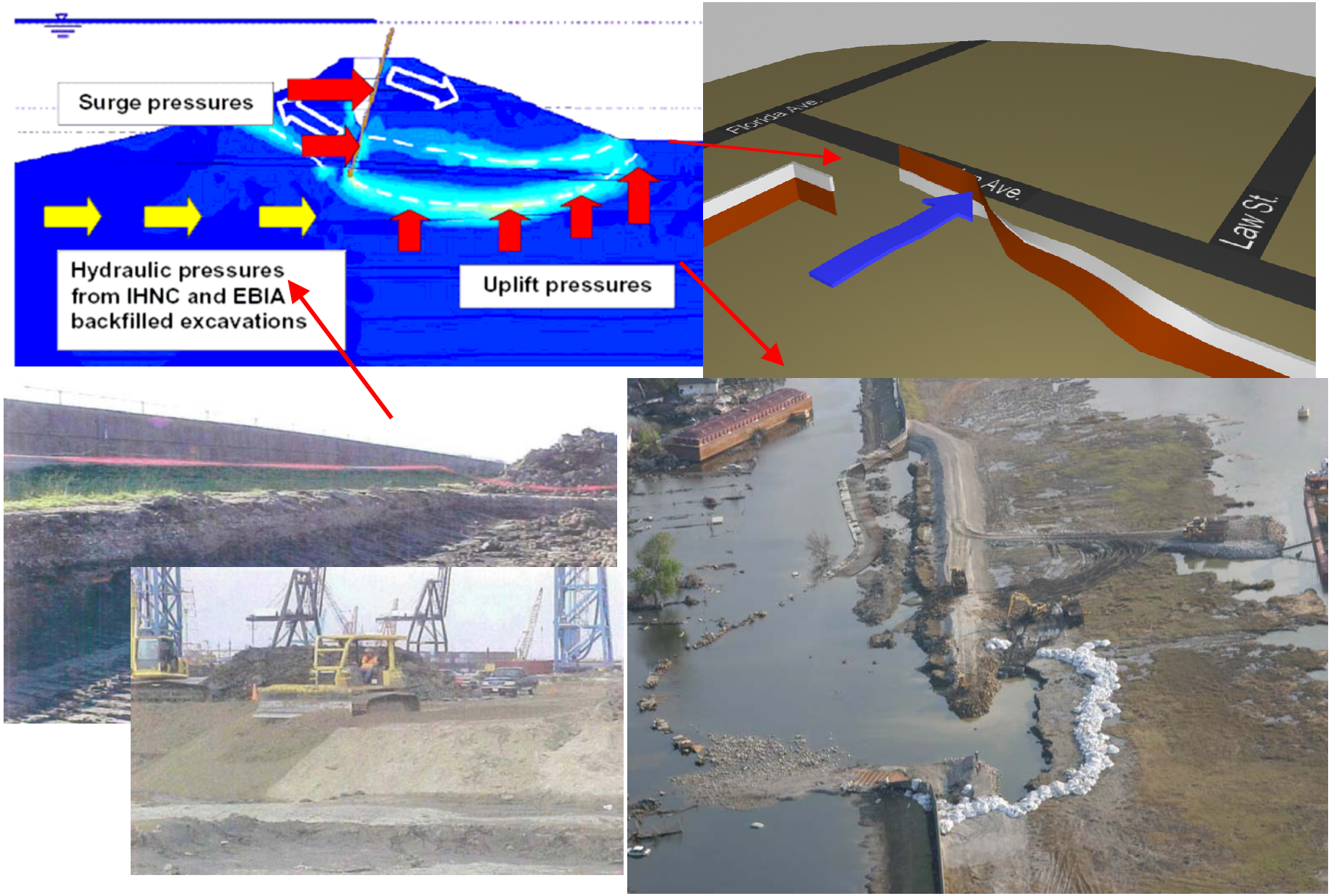

Figure 11: Mechanics of breach development at the Lower 9th Ward.

B. Preliminary Observations of Defendants Experts Opinions

Schematic Structure of Reviews

18. Figure 12 is a schematic structure (mental map) of the primary 'elements' that I have considered in my July 2008 Expert Report pertaining to the effects that the MR-GO had on the performance of the man-made earthen flood protection structures (Earthen Berm – Spoil Banks; EBSBs) sited along Reach 2 of the MR-GO (Bea 2008). I have used the same approach during my review of the observations, analyses, and opinions documented in the December 2008 Defense Expert Reports by Mr. B. Ebersole, Dr. D. Resio, Dr. R. Mosher, and Dr. T. Wolff.

19. This schematic does not address the following:

- Performance of the man-made navigation and flood protection structure interfaces with the earthen flood protection structures located at Bayous Dupre and Bienvenue. Extensive observations, qualitative and quantitative analyses of the performance characteristics of these structures are documented in my July 2008 Declarations and Technical Reports. Section II of this Expert Report (Declaration) provides additional information regarding analyses of evidence concerning the breaches that developed at these structure interfaces.
- Performance of the man-made flood protection structures adjacent to the Lower 9th Ward portion of Reach 1 of the MR-GO. The performance characteristics of these man-made flood protection structures will be addressed in Section III of my Declaration.
- Performance characteristics of the other man-made flood protection structures (e.g. sections of EBSBs 'repaired' with sheet piling) along Reach 1 and Reach 2 of the MR-GO. I documented my observations and analyses of the performance characteristics of

these structures in my July 2008 Expert Report. Due to the limitations in the time available to perform and document the work summarized in this Expert Report, I will not address the performance characteristics of these other man-made hurricane flood protection structures.

20. Two general categories of environmental conditions are defined in Figure 12 (Figure 5): MR-GO 'As Was' Hurricane Katrina conditions (Scenario 1), and MR-GO 'Neutral' Hurricane Katrina conditions (Scenario 2C). 'D&C Factors' refers to the factors involved in design and construction of the MR-GO channel. 'O&M Factors' refers to the factors involved in the operation and maintenance of the MR-GO channel. The combination – integration - of multiple effects from the MR-GO D&C and O&M factors had very important cumulative adverse effects on the performance of the man-made flood protection structures adjacent to Reach 2 of the MR-GO during Hurricane Katrina. The integrated effects of the MR-GO life-cycle activities on the 'hydrologic system' are addressed in greater detail in my October 2008 Declaration (responding to Defendant's Motion for Partial Summary Judgment).

21. For the MR-GO 'As Was' conditions, the factors are those associated with the history of the design, construction, operation, and maintenance of the MR-GO channel from the 1950s until Hurricane Katrina in 2005. For the 'MR-GO Neutral' conditions, the factors are those associated with a configuration of the MR-GO that would 'do no harm' to the adjacent man-made flood protection structures and to the surrounding environment's natural protective features and characteristics (defined in my July 2008 Declaration). The 'Neutral' MR-GO conditions are based on the Reach 2 man-made flood protection structures in the

basic configuration and alignment they had at the time of Hurricane Katrina. The factors which were 'mitigated' in the Neutral MR-GO conditions (Figure 12) are as follows (from my July 2008 Expert Report):

- *"Destruction and degradation of the natural hurricane flood protection features;*
- *Salinity increases resulting in degradation of protective vegetation (marshes, swamps, wetlands, forests) both natural and associated with other constructed works (e.g. protective berms for flood protection levees and other man-made structures);*
- *Water flow increases resulting in increases in surge elevations, currents, and waves;*
- *Channel effects resulting in increases in the intensity of the hurricane waves and currents;*
- *Erosion and scour of both natural and man-made flood protection elements and the Reach 2 channel banks thereby reducing their stability; and*
- *Channel erosion which caused the MR-GO channel to encroach into the protective berm of the man-made hurricane flood protection structures thereby exacerbating subsidence and settlement of the flood protection structures and endangering their stability."*

22. Design and Construction factors under the 'Neutral' MR-GO conditions include those elements that would provide mitigations of the adverse effects of the adjacent MR-GO at the time the man-made flood protection structures were designed and constructed (e.g. foreshore protection, increased elevations and increased resilience due to different wave set up and fetch). Operations and Maintenance factors under the 'Neutral' MR-GO conditions include those elements that would provide mitigations of the adverse effects of the adjacent MR-GO during its operation and maintenance (e.g. increased elevations, decreased surge and wave conditions, increased natural protective features).

23. The structure in Figure 12 defines two categories of:

- EBSB conditions - (i) those that existed at the time of Hurricane Katrina, and (ii) those that should have existed at the time of Hurricane Katrina given prevention and mitigation of the negative impacts of the adjacent MR-GO.
- Hurricane Katrina environmental conditions - (i) those that existed at the time of Hurricane Katrina (As Was), and (ii) those that should have existed at the time of Hurricane Katrina given prevention and mitigation of the negative impacts of the adjacent MR-GO (Neutral). Other Plaintiffs Expert Declarations will address these EBSB configurations and environmental conditions. Consequently, these aspects will not be addressed further in this Declaration.
- Performance of the EBSBs - (i) observed following Hurricane Katrina 'As Was' conditions, and (ii) predicted following Hurricane Katrina Neutral conditions. This Declaration will address these two categories of EBSB performance.
- Flooding resulting from the Hurricane Katrina environmental conditions (As Was, Neutral) and performance of the adjacent Reach 2 man-made flood protection structures (As Was, Neutral) - (i) the observed flooding of the St Bernard Parish – Lower 9th Ward 'Polder' (Figure 1) following Hurricane Katrina, and (ii) the predicted flooding the St Bernard Parish – Lower 9th Ward 'Polder' following the Hurricane Katrina Neutral conditions.

The differences between the observed and predicted flooding developed during Hurricane Katrina are the differences attributed to the negative impacts of the MR-GO on the environment and the adjacent man-made hurricane flood protection structures.

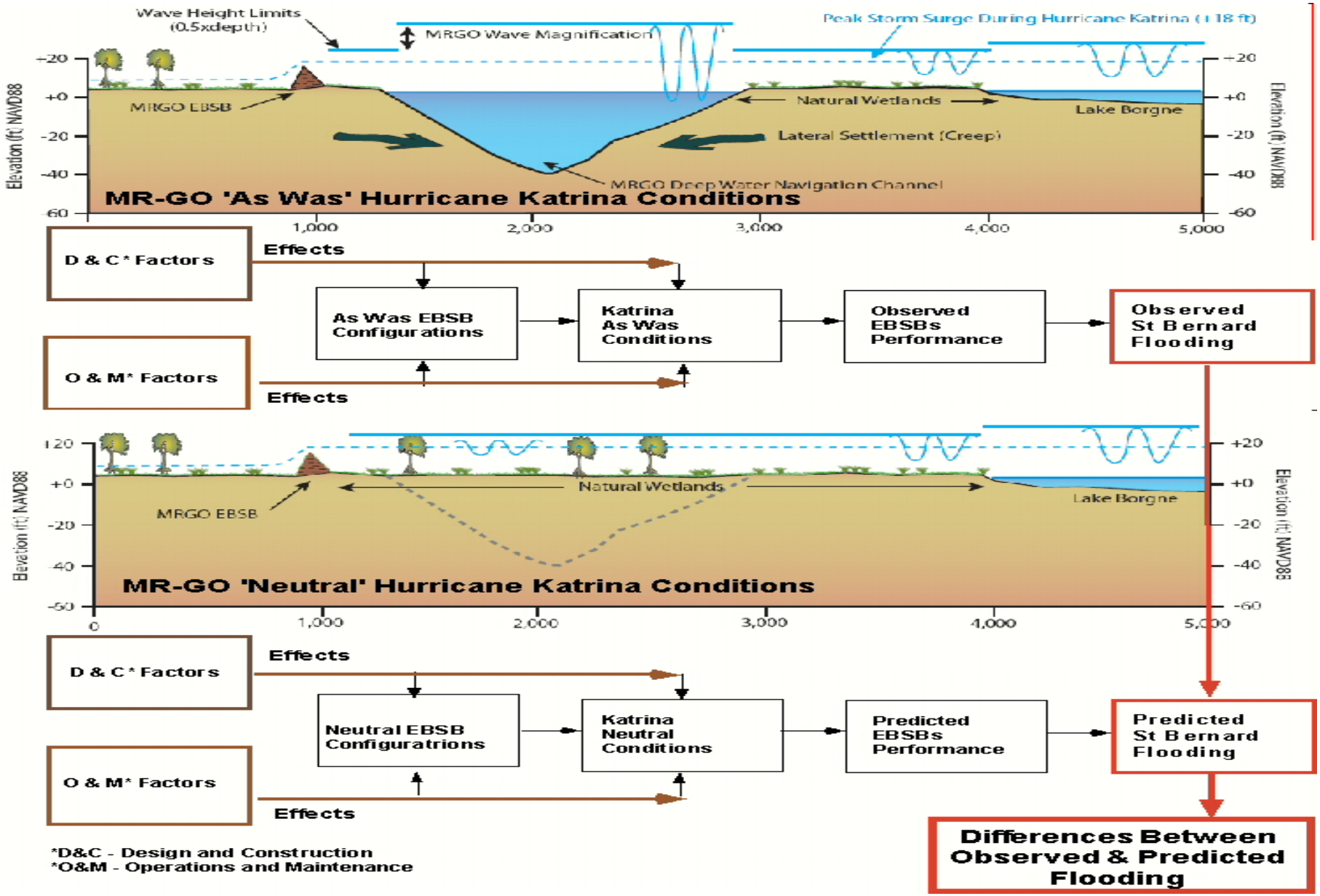

Figure 12: Schematic structure of review of Defense Expert Reports.

Preliminary Review Observations

24. There are many fundamental and important points of agreement between the Defense and Plaintiff Experts that background these analyses, conclusions, and expert opinions. There is much more agreement than disagreement. The Defense Experts are well qualified by training, knowledge, and experience to render their observations, analyses, assessments and conclusions. Based on the work documented in their Expert Reports, it is my assessment that the primary differences in the Expert's conclusions and opinions are focused in a few major issues of critical importance. To develop clear understanding of what most likely happened and what most likely should have happened, it is important to strive to "sort the wheat from the chaff."

25. In the context of the man-made flood protection structures existing at the time of Hurricane Katrina, my conclusion is that the fundamental differences between the Defense Experts and Plaintiffs Experts assessments are focused on an understanding of the most probable or likely modes of performance of the man-made flood protection structures during Hurricane Katrina (As Was, Neutral or Ideal Conditions).

26. Relative to the performance of the man-made flood protection structures adjacent to Reach 2 of the MR-GO during Hurricane Katrina, the Plaintiffs Experts have concluded that the major breaching of the man-made earthen flood protection structures was due in large measure to breaching initiated by water side wave erosion which was propagated to the final breach condition by overtopping flows and waves. The breaching that developed at the interfaces of the navigation – water control structures with the adjacent earthen flood protection structures was due primarily to a combination of wave and overtopping surge erosion (Bayou Dupre north and south interfaces) and lateral instability caused by the surge water pressures developed on and under the structures (Bayou Bienvenue south interface).

27. The Defense Experts have concluded that the major breaching of the man-made earthen flood protection structures and that which developed at the interfaces between these structures and the two navigation – water control structures during Hurricane Katrina was due primarily to surge overtopping and wave erosion.

28. The primary differences between the opinions developed by the Defense Experts and the Plaintiffs Experts concerning development of the breaches that developed along Reach 2 of the MR-GO during Hurricane Katrina are centered in the water side wave erosion initiated development of the breaches in the earthen protection structures and at the interfaces with the navigation – water control structures (Bayou Dupre and Bayou Bienvenue) and the effects of the hydraulic conductivity on the lateral stability of the navigation structure – earthen structure interface at Bayou Bienvenue.

29. Relative to the performance of the man-made flood protection structures adjacent to the portion of Reach 1 of the MR-GO during Hurricane Katrina, the Plaintiffs Experts have concluded that the North Breach and South Breach that developed at this location were due to multiple causes including surge water pressures imposed on and developed under these structures, reduced cross section of the levee at the North Breach, with hydraulic conductivity effects at both breaches exacerbated by the backfilled excavations at the EBIA developed as a result of the IHNC Lock Expansion Project. The North Breach developed before overtopping and the South Breach developed after overtopping.

30. The Defense Experts have concluded that the North Breach developed as a result of surge water pressures imposed on the flood protection structure and the reduced cross section of the levee at this location before overtopping and that the South Breach developed as a result of surge water pressures imposed on the flood protection structure and overtopping erosion of the

supporting soils on the protected side. The North Breach developed before overtopping and the South Breach developed after overtopping.

31. The primary differences between the opinions developed by the Defense Experts and the Plaintiffs Experts concerning development of the breaches at the Lower 9th Ward during Hurricane Katrina are centered in the hydraulic conductivities of the marsh layers that underlie this area, the effects of the hydraulic conductivities on the lateral stability of the structures, consideration of and the effects of the back filled EBIA excavations, and the role of the overtopping erosion of the protected soils in development of the South Breach.

32. Relative to the performance of the man-made flood protection structures adjacent to Reach 2 of the MR-GO during 'Neutral' ("do no harm") Hurricane Katrina conditions, the Plaintiffs Experts have concluded that there would not have been any major breaching of the man-made earthen flood protection structures. The breaching that developed at the interfaces of the navigation – water control structures with the adjacent earthen flood protection structures at Bayou Dupre would not have developed; however the breach at the south end of the Bayou Bienvenue navigation – water control structure would still develop due to lateral instability caused by the surge water pressures developed on and under the structure.

33. The Defense Experts have concluded that the major breaching of the MR-GO Reach 2 man-made earthen flood protection structures and that which developed at the interfaces between these structures and the two navigation – water control structures during "Ideal MR-GO" Hurricane Katrina conditions would develop at similar times and ways as during the 'actual' Hurricane Katrina (as was) conditions.

34. The Defense Experts have concluded that the major breaching of the MR-GO Reach 1 man-made flood protection structures adjacent to the Lower 9th Ward during "Ideal MR-

GO" Hurricane Katrina conditions would develop at similar times and ways as during the 'actual' Hurricane Katrina (as was) conditions.

35. My understanding as summarized above indicates that there are the following primary points of primary contention between the Defense Experts and the Plaintiffs Experts opinions:

- The roles of wave erosion in development of breaching of the Reach 2 man-made earthen flood protection structures (EBSBs) during Hurricane Katrina,
- The roles of hydraulic conductivity in development of breaching of the man-made flood protection structures at the Lower 9th Ward and at the interface of the navigation – water control structure at Bayou Bienvenue (south side) with the adjacent earthen flood protection structure during Hurricane Katrina,
- The roles of the IHNC Lock Expansion Project EBIA backfilled excavations in development of the breaches (North Breach and South Breach) at the Lower 9th Ward during Hurricane Katrina,
- The roles of overtopping erosion of the protected side soils adjacent to the flood protection structures at the Lower 9th Ward during Hurricane Katrina,
- The conditions and characteristics that properly characterize "do no harm" MR-GO Hurricane Katrina conditions along Reach 2 and Reach 1 of the MR-GO, and
- The performance characteristics of the Reach 2 and Reach 1 man-made flood protection structures during "do no harm" MR-GO Hurricane Katrina conditions.

36. The Defense Experts have expressed concerns regarding the analytical models I have used in developing quantitative assessments of wave erosion of the earthen flood protection structures. In my Declaration (Part II) and the supporting Technical Reports (Part III), I have

provided responses to these concerns that utilize multiple ways to validate the analytical models we have used (the EBSB Wave Erosion Model). It has been shown that this model possesses both internal and external validity. Also, I have addressed '*Daubert Tes*t' criteria to evaluate the validity of this analytical model. Similar validation processes have been applied to the other analytical models we have used to evaluate the stability and performance characteristics of the flood protection structures. In my review of the cited December 2008 Expert Reports I have not been able to find any substantial evidence that the Defense Experts have diligently applied either tests to demonstrate internal and external validity or 'Daubert Test' criteria to demonstrate the validity of the analytical models they have used to in development of their expert opinions.

37. The Defense Experts have expressed concerns regarding the parameters used in our analytical models to determine the effects of hydraulic conductivity in development of breaching of the man-made flood protection structures at the Lower 9th Ward and at the interface of the navigation – water control structure at Bayou Bienvenue (south side) with the adjacent earthen flood protection structure during Hurricane Katrina. In this Declaration and the supporting Technical Reports, I have provided responses to these concerns that utilize multiple ways to validate the analytical parameters we have used (seepage and hydraulic uplift effects). It has been shown that these analytical model parameters possess both internal and external validity.

38. The Defense Experts have not addressed the roles of the IHNC Lock Expansion Project EBIA backfilled excavations in development of the breaches (North Breach and South Breach) at the Lower 9th Ward during Hurricane Katrina. In this Declaration I have addressed the importance and effects of these excavations in an attempt to answer the question: why did these breaches develop where they did and not somewhere else? Thus far in these investigations,

detailed analyses of the presence, locations, and effects of the EBIA excavations are the only way that the specific locations of the North Breach and South Breach have been explained. The Defense Experts have not offered any substantial explanation for the development of the breaches at these specific locations.

39. In my previous July 2008 Expert Report, I specifically addressed the roles of overtopping erosion of the protected side soils adjacent to the flood protection structures at the Lower 9th Ward during Hurricane Katrina. These analyses included quantitative analyses of development of the erosion 'trenches' (using three different methods) and analyses of the effects of these erosion trenches on the lateral stability of the flood protection structure associated with the South Breach. It was determined that the erosion trenches could have contributed to and likely participated in the concluding phase of development of the South Breach. Contrary to assertions made by the Defense Experts, these analyses addressed the performance of other very similar flood protection structures that had experienced the effects of development of very similar erosion trenches – in some cases deeper trenches. These other flood protection structures did not experience lateral stability failure – breaching. My analyses indicate that the major difference between the flood protection structures that did not fail and the structure that did fail and develop the South Breach was the lack of the water pressure hydraulically conductive marsh layers under the flood protection structures. The Defense Experts have not offered any explanation of the contrast between the failed and non-failed flood protection structures.

40. It is evident that the Defense Experts and Plaintiffs Experts have defined the "do no harm" MR-GO Hurricane Katrina conditions and characteristics along Reach 2 and Reach 1 differently (contrasting the Plaintiffs Experts Neutral MR-GO with the Defense Experts Ideal MRGO conditions). In their definition of the Neutral MR-GO conditions and characteristics, the

Plaintiffs have provided mitigations for all of the major deleterious effects that were developed during the life-cycle (design through decommissioning) of the MR-GO. These mitigations have been specifically cited and the reasons for their descriptions documented. As could be expected, the Defense Experts have not done likewise; their MR-GO mitigations have been far more restrictive and do not address several of the critical elements associated with true mitigation of the negative impacts of the design, construction, operation, and maintenance of the MR-GO. As a result, an important series of "apples and oranges" analyses and conclusions develop that contrast the studies performed by the Defense Experts and the Plaintiffs Experts. These contrasts can only be resolved by continued deliberations of what properly defines the "do no harm" conditions and characteristics of the MR-GO.

41. The Plaintiffs Experts have addressed comprehensively the performance characteristics of the Reach 2 and Reach 1 man-made flood protection structures during "do no harm" MR-GO Hurricane Katrina conditions. The Plaintiffs Experts have concluded that the Reach 2 flood protection structures that existed at the time of Hurricane Katrina would perform acceptably under the Neutral MR-GO Hurricane Katrina conditions – no major breaches would develop and there would not be any substantial flooding of St Bernard Parish. The Defense Experts have concluded that the Reach 2 flood protection structures that existed at the time of Hurricane Katrina would perform in the Ideal MRGO conditions in a manner similar to that experienced during Hurricane Katrina and that the flooding of St Bernard Parish would be similar to or the same as experienced during Hurricane Katrina. In addition, the two groups of experts have used similar, but in some cases very different means to analyze the performance characteristics of the flood protection structures and develop conclusions and opinions based on the results of their analyses. The differences in expert conclusions and opinions can only be

resolved when the differences in 'inputs' conditions and characteristics and analytical methods used to evaluate and assess performance characteristics of the flood protection structures – the 'outputs' are resolved.

42. My analyses, evaluations, assessments and conclusions have been based on reviews I made of the information provided in the cited Defense Expert Reports and supporting documentation during the period December 29 through January 13, 2009. The approximately 20 working days available for these reviews, development of responses, and the documentation contained in this Declaration have not permitted a complete evaluation of either the contents of the cited Expert Reports nor preparation of a complete response to the contents of these Expert Reports. Consequently, I reserve the right to modify my analyses, evaluations, assessments, and conclusions as more time is provided to develop and document these elements and in the case that new or additional information becomes available in the future.

I declare under the penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed on January 29, 2009 in Moraga, California.

Robert Bea, Ph.D, PE