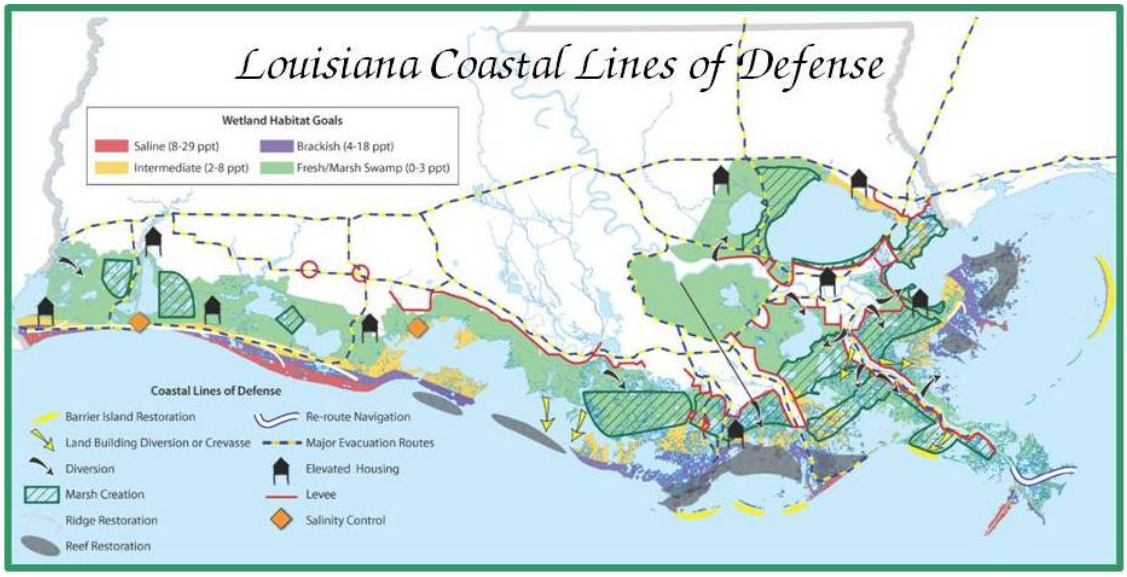
Comprehensive Recommendations Supporting the Use of the Multiple Lines of Defense Strategy to Sustain Coastal Louisiana

2008 Report (Version I)

This report recommends integrated coastal projects and levee alignments for the entire coast of Louisiana with the overriding goal of improving hurricane flood protection and sustaining the coastal estuaries.



Summary Map of Multiple Lines of Defense

"It may be hubris to think we could ever engineer our way out of this fix, when nature seems so aligned against us. It is certainly hubris to think we could do it without taking nature's assistance when it is offered."

Quote from comments on the draft report by David Yeargin

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Report is available at MLODS.org, SaveOurLake.org, or CRCL.org

SAVE OUR COAST
LAKE PONTCHARTRAIN BASIN FOUNDATION

Coalition to Restore Coastal Louisiana

Planning Unit 3b (Atchafalaya/Vermilion Basin)

General Description

Compared to other planning units, Planning Unit 3b has the greatest extent of sustainable wetlands along the Louisiana coast. There is historic and ongoing land loss, but these rates are modest. Although there is a net land loss, this loss is offset approximately 60% by the land gain associated with the two active emergent deltas, the Atchafalaya and Wax Lake Outlet Deltas. This numeric offset of land loss does not suggest that the land loss in all areas of Planning Unit-3b is acceptable. Localized areas that are not affected by the landbuilding deltas are experiencing great loss of wetlands. The largest area of historically high loss and ongoing loss is the Penchant Basin area southeast of Morgan City (**Figure 95**). This area is characterized by widespread floatant marsh, and in some places, the water underneath is deep, eliminating the potential for restoration of land and emergent vegetation. Break-up of floatant marsh has occurred and contributes to the land loss classification of conversion of "land" to "open water."

Land gain is occurring at the Atchafalaya and Wax Lake Outlet Deltas (**Figure 95**). The Wax Lake Outlet receives approximately 1/3 of the Atchafalaya River discharge (~90,000 cfs). The Atchafalaya Delta receives approximately 2/3s of the Atchafalaya River discharge (~180,000 cfs).

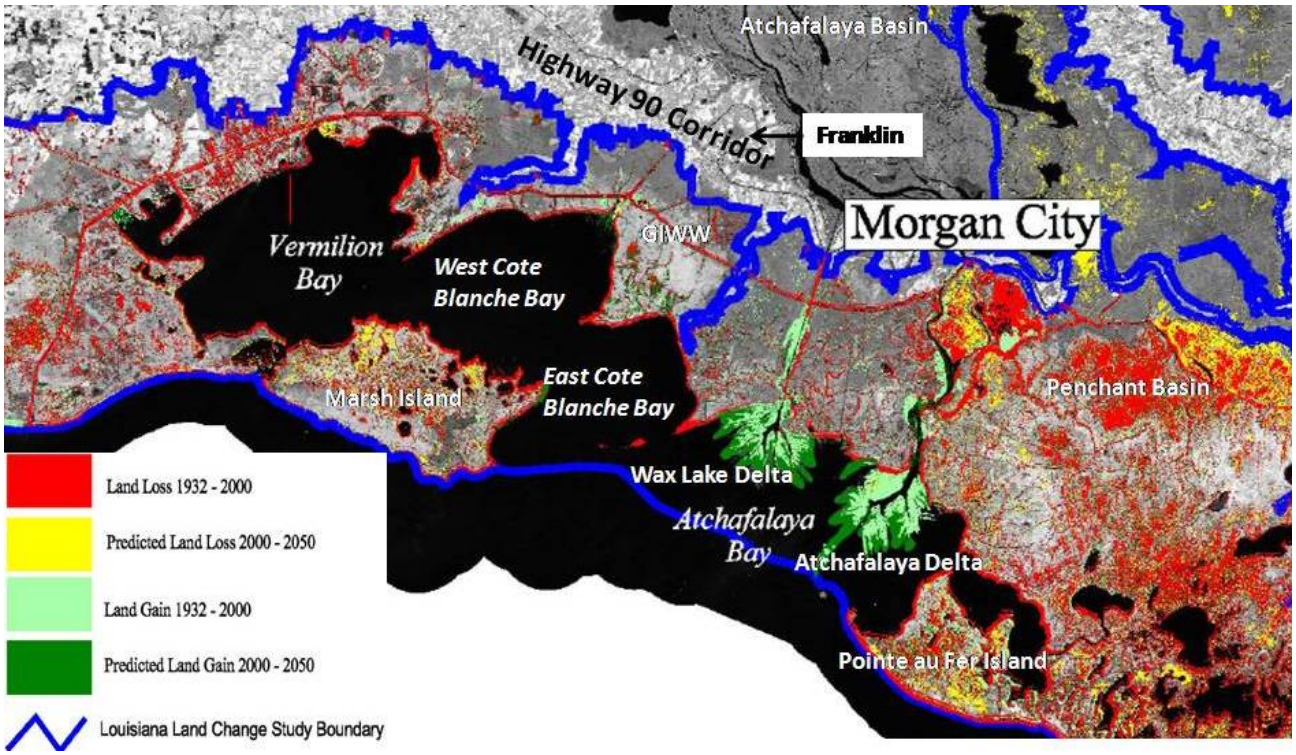

Figure 95: Historic and Projected Land Loss in Planning Unit 3b (NWRC map). Note the location and position of the Highway 90 corridor in relation to the coast and adjacent bays.

The Wax Lake Outlet Delta is a naturally forming delta from discharge by a man-made channel where Atchafalaya water flows through the GIWW into the Wax Lake Outlet. There has been little human manipulation of the Wax Lake Outlet Delta which is building land naturally. In contrast, the Atchafalaya Delta has had significant man-made "delta training," but is sourced by a natural river

(Atchafalaya River). The delta training is, in part, justified to address navigational needs through the continued maintenance of a navigation channel through the delta. The actively accreted land of both deltas is within the state's Atchafalaya Delta Wildlife Management Area.

The total Atchafalaya River discharge has increased dramatically from 1831 to 1963. This increase was primarily due to the channel improvements on the Atchafalaya River starting with Captain Henry Shreve dredging a channel between the Red and Mississippi Rivers (now the site of the Old River Control Structure) and his clearing of massive log jams on the Atchafalaya River (Lopez, 2003). These actions brought to critically unstable conditions on the Atchafalaya River and with the "levees only" policy of the USACE (1870 to 1927) on the Mississippi River, led to dramatic systematic rise in flood stage at its connection to the Atchafalaya River (Barry, 1997). The artificially improved Atchafalaya channel led to an artificially higher flood stage and artificially accelerated the capture of Mississippi River discharge (Gunter, 1952) so that, in 1963, the Old River Control Structure was built to control the flow between the Mississippi and Atchafalaya Rivers. The discharge was fixed at the artificially increased level of 30% of the total Mississippi and Red River discharges.

This higher discharge has resulted in significant deposition in the Atchafalaya Basin and infilling of laucustrine lakes. Once the accommodation space for sediment was reduced in the Atchafalaya Basin, deposition moved downriver into Atchafalaya Bay. The 1973 flood introduced 640,000 cfs through the channel. An emergent delta began to form in Atchafalaya Bay as a result of this significant depositional event. However, Kemp and Hyfield (2005) have shown that the Atchafalaya Delta has matured and is not efficient in creating land, which is evident by the fact that the delta is mostly built of sand. Approximately 10% of sediment delivered to the Atchafalaya Delta accounts for all of the ongoing land building. This implies that 90% of the sediment (nearly all of the suspended load) is not actively creating emergent delta. The sediment is being dispersed across Atchafalaya Bay and to the Gulf shoreline. The sediment contributes significantly to the Gulf shoreline mud-stream further west of Marsh Island.

Due to the increase in freshwater into the Atchafalaya Bay through these two deltas, the adjacent estuary has shifted toward more freshwater habitats and away from the more brackish habitats of the early to mid 1900s. This shift is most evident by the lack of re-growth of the historic oyster reefs that were once so prominent in Atchafalaya Bay. O'Neil's 1949 map of vegetation types indicates large areas of brackish marsh around the bays in PU-3b.

Another major impact to Planning Unit-3b was the mining of major oyster barrier reefs in Atchafalaya Bay in the 1900s (Coast 2050, 1998). In the 1800s, these reefs were alive and extended from Point au Fer Island west to nearly Marsh Island (**Figure 96**). The reefs actually extended the peninsula of Point au Fer several miles into the bay. Mining of the live and fossil shell was allowed for decades so that most of the shell and reef had been removed. The freshening effect in Atchafalaya Bay has reduced the ability of the reefs to regenerate. Live reefs do currently exist on the Gulf shoreline of Marsh Island. *Coast 2050* includes a proposal to build a structure from Point Chevreuil to Marsh Island. The offshore rock dike is referred to as a reef proposal, but the actual goal is outfall management of discharge from the Atchafalaya River. It is unlikely that the structure would create an oyster reef of significant extent at this location because it would concentrate fresh water discharge along it. The goal of the project is to enhance brackish salinity conditions to the

west for recreational species such as speckled trout (*Cynoscion nebulosus*). This project is not recommended.

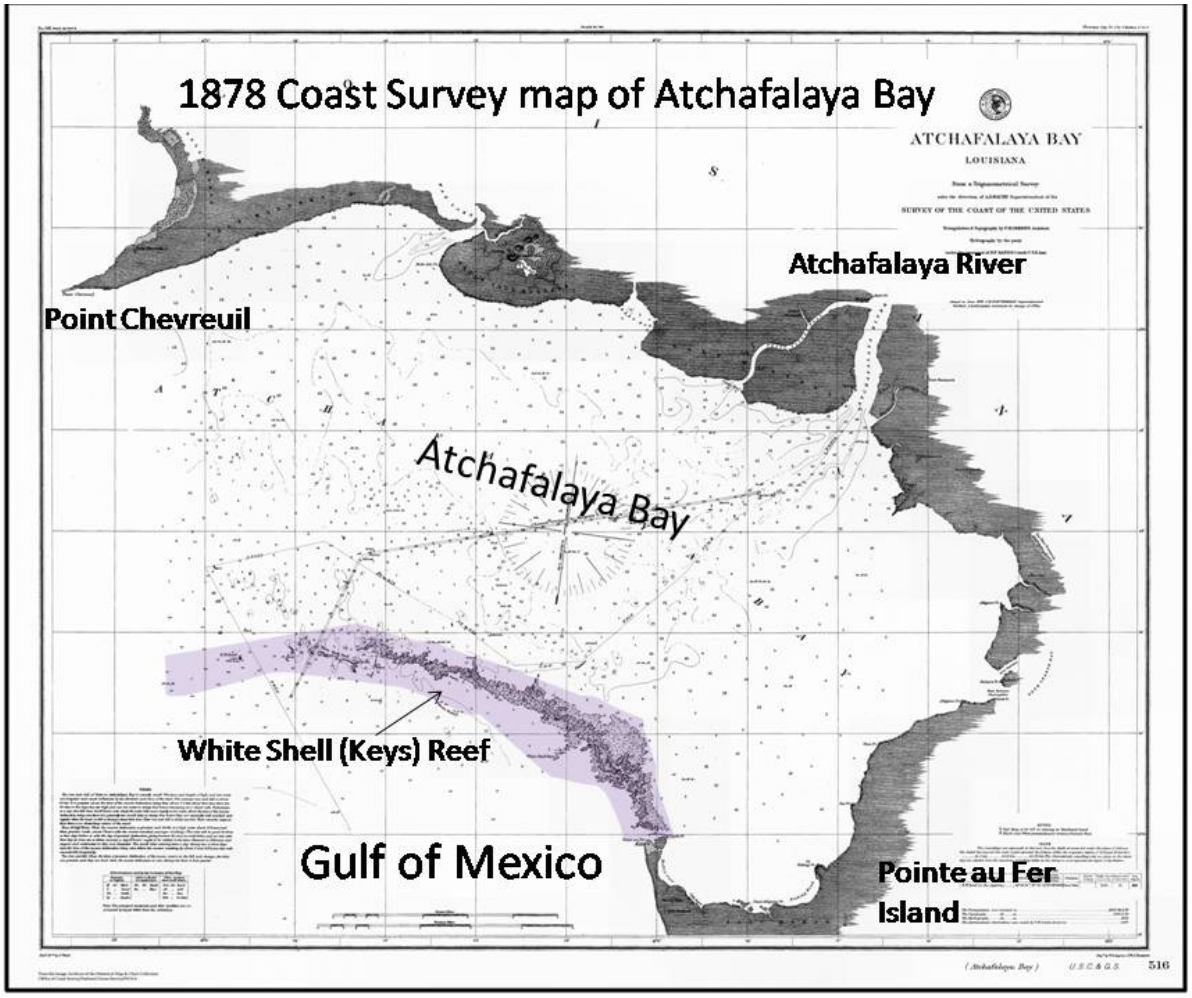

Figure 96: 1878 Coast Survey Map of Atchafalaya Bay and White Shell Keys Reef (highlighted). This oyster reef was mined, and subsequent increases in freshwater limit the recovery of the barrier reef. The recommendation is to restore the barrier reef seaward of the historic reef where salinity regime is more appropriate for oyster productivity.

The USACE's Preliminary Technical Report (PTR) indicates that the highest surge for an extreme Category 5 storm in the entire state is generated along an alternative GIWW levee alignment in Planning Unit -3b (USACE, 2006). **Table 2** indicates still water surge height for the extreme Category 5 storm may be as high as 40 feet with 15 foot waves above that. Even with a levee alignment further north along the Highway 90 corridor, surge heights will still be significant. New modeling in LACPR Draft Technical report (USACE, 2008) shows that surge without this GIWW alignment is much less (**see Figures 8, 9, and 10**). The LACPR report models demonstrate that levee along the GIWW would need to be 28 feet for 400 y protection. Levees along the GIWW in Planning Unit 3b are ill-advised. It is apparent that modeling demonstrates that surge builds up

significantly due to the long continuous GIWW levee alternative, that is located so close to Vermillion and Atchafalaya Bays. This report recommends levees be placed further north adjacent Bayou Teche natural ridge protecting the developed corridor on this ridge such as Highway 90.

During Hurricane Rita, surge around the bays was highest at the west end and onshore of Vermilion Bay. Surge was 12 feet just 7 miles south of Abbeville (**Figure 36 -** FEMA 2006 Inundation Map). The Highway 90 corridor was also threatened by flooding from the north side of the ridge. Surge during Hurricane Rita was as high as eight feet within the Atchafalaya Basin (**Figure 36**). The loss of the historic barrier oyster reefs has contributed to the openness of the Atchafalaya Bay and probably to the higher surge heights.

The orientation and proximity of the Highway 90 corridor to the Gulf is a direct result of the location of the Bayou Teche ridge on which Highway 90 and several communities are located. This atypical bayou orientation has created a development corridor (Patterson to New Iberia) which is nearly continuous for forty miles and just eleven miles (average) from the adjacent bays. Locally, the bays are as little as six miles from the Highway 90 corridor and may produce some focusing of surge. The Highway 90 corridor includes at least three significant state Highways (Highways 90, 182, and 87), two railroads, and the towns of Morgan City, Berwick, Franklin, Jeanerette, Patterson, New Iberia, and others. Also, nearby is the Henry's Hub, which is a regional natural gas gathering point for interstate gas transmission.

PU-3b #	Location	Measure Description	New or Existing levee	Maximum Design Discharge Controlled Diversions	Maximum Discharge Flood year-pulse events w/spillways	
1	Morgan City	Existing levee - improve to 400year protection provided by flood protection system	existing			
2	Berwick/Paterson	Existing levee - improve to 400year protection provided by flood protection system	existing			
3	Bayou Sale	Existing levee - improve to 400year protection provided by flood protection system	existing			
4	Franklin to New Iberia	New levee alignment 400year protection provided by flood protection system	new			
5	South Marsh Island	Restore to ~1978 marsh extent with marsh creation (500 acres)				500
6	Outer Atchafalaya Bay	Restore structural oyster reefs at appropriate isohaline conditions				
7	Point au Fer Island	Restore to ~1978 marsh extent with marsh creation (1000 acres)				1000
8	Wax Lake Outlet	Maintain status quo of active delta		50000	200000	
9	Atchafalaya delta	Reduced discharge for the Lake Poulourde diversion (-20,000 cfs)		140000	260000	
10	Lake Palourde to Penchant Basin (East Atchafalaya Restoration Spillway)	Atchafalaya River diversion, maximum design discharge 20,000 cfs		140,000	140000	
11	GIWW - Hwy 317 to Hwy 82	Outfall management to convey freshwater east of Hwy 82				
			Sub-Totals	**330000**	**600000**	
			Total maximum discharge Diversion & Crevasses		**600,000**	
			Total Marsh Creation			**1500**

Table 14: Planning Unit 3b – Lines of Defense Measures (Evacuation, municipal drainage, and non-structural excluded, see text)

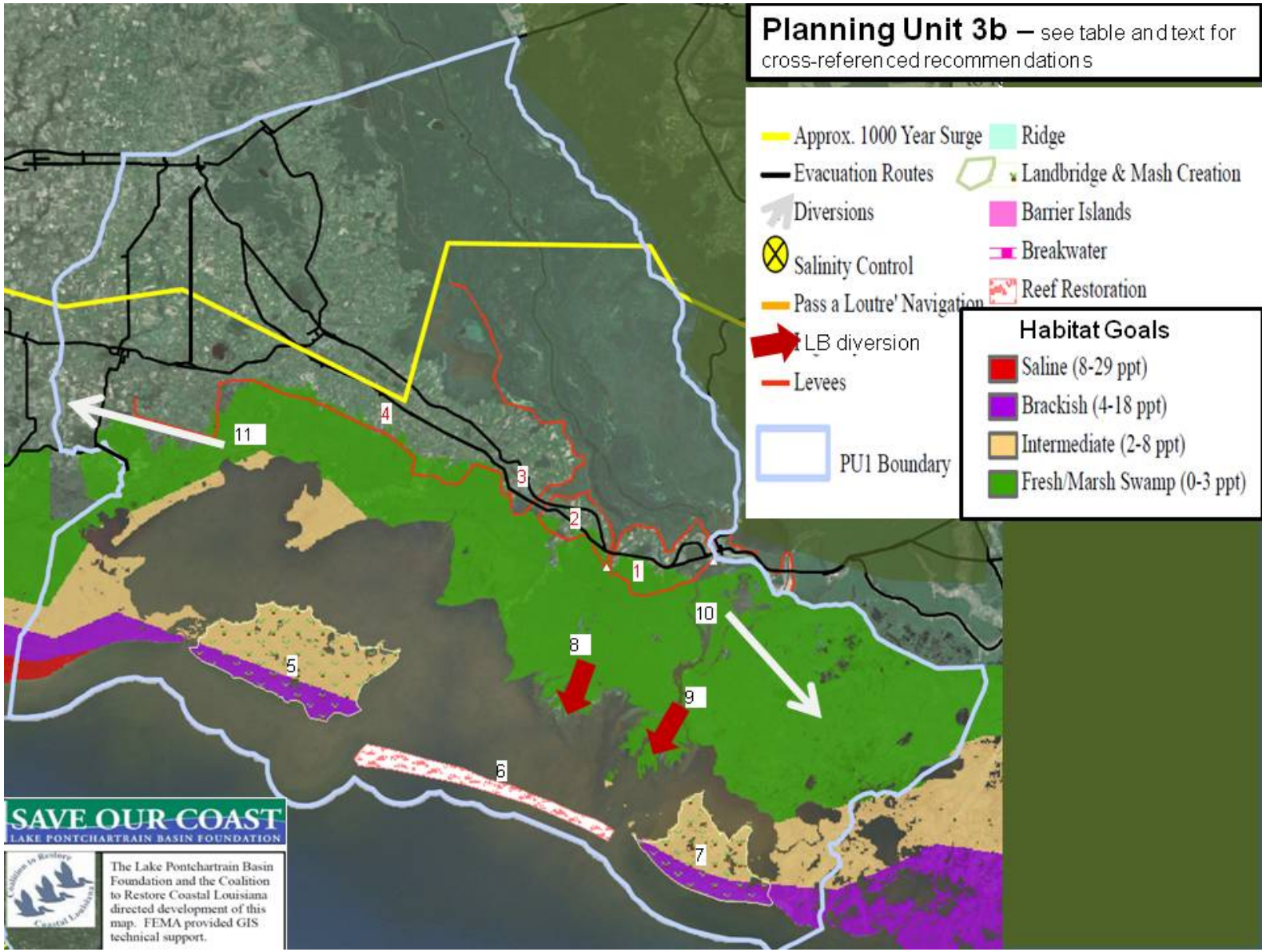

Figure 97: Planning Unit 3b Lines of Defense measures map (excluding municipal drainage, and non-structural measures).

General Recommendations

Planning Unit 3b

(See Figure 97 and Table 14)

Non-Structural Measures - Non-structural flood mitigation measures need to be considered as an essential Line of Defense Strategy and an integral part of the Comprehensive Protection Plan for Planning Unit 3b. Non-structural mitigation measures such as elevating homes or businesses are a fundamental element of flood risk reduction and an additional measure of redundancy or security. (For more detailed information, see the Non-Structural Section under Overview of the Proposed Integration of The Lines of Defense and Restoration Measures).

Non-structural measures must be placed in a geographic context of the other Lines of Defense measures. Many areas within Planning Unit 3b consist of assets located within and outside a levee protection system. As experienced during Hurricanes Katrina and Rita, assets within the levee system should expect the indirect impact of a storm and require non-structural (elevation) approaches commensurate with the exposure of life and assets due to heavy precipitation, the risk of overtopping, and the risk of failure of a levee, flood gates, flood wall, etc.

Communities outside of levees are not protected by structural measures. Those communities should expect the direct impact of storm surge including waves and currents. The non-structural approaches should be commensurate to the life-threat and economic exposure expected from flooding with waves and currents by direct interaction with storm surge and precipitation. In terms of mitigating effects of moving surge water the first choice is to relocate. In terms of coastal construction, the #1 rule in areas subject to moving water is to elevate above the expected still water plus wave elevation assuming at least a 100 year storm. Many homes and businesses are already elevated in Planning Unit 3b, but may need additional elevation. Programs to subsidize home elevation inside or outside of the proposed levee system should be immediately expanded.

In south Louisiana, elevated structures within or outside of levee protection, in general, are much more likely to be sustainable. Considering the combined long-term threats of subsidence damage, flood damage, and termite damage, the wisdom of slab homes or businesses built on grade anywhere in coastal Louisiana is seriously questioned.

Don't Wait, Elevate!

Evacuation Routes - The MLODS proposes that evacuation routes are Lines of Defense and that the routes need to be geographically integrated with other Lines of Defense to anticipate their performance and evaluate the requirements to be effective evacuation routes **(Figures 28 and 29)**. The MLODS recommendations include the evaluation of evacuation routes and integration of these state evacuation routes into the Comprehensive Protection Plan for Planning Unit 3b. (For more detailed information, see the Evacuation Routes Section under Overview of the Proposed Integration of the Lines of Defense and Restoration Measures).

Municipal Drainage - Areas within structural protection systems need adequate capacity for drainage. This will generally require pump capacity to pump water to the flood side of the levee. With ridge alignments, it is more likely that treated waste water and storm water can be diverted to adjacent wetlands to establish robust marsh and wetland forest buffers directly in front of back levees reducing municipal cost for wastewater treatment. In these areas, utilizing outfall management of storm water and treated wastewater may establish a cypress buffer that can provide significant additional protection benefit.

Specific Recommendations

Planning Unit 3b

(See **Figure 97** and **Table 14**)

1) Morgan City Hurricane Protection
Levees and floodwalls around Morgan City should be improved to the 400 year level of protection, utilizing the existing alignment and providing protection from both storm surge and flooding from the Atchafalaya River. This levee alignment is entirely within the habitat goal of fresh wetlands and is historically swamp habitat. Restoration of sustainable wetland forests outside and adjacent to the levees should be an adjunct to levee design, construction, and maintenance. The treated wastewater from locally protected communities can also be used to rejuvenate local forests.

2) Berwick/Patterson Hurricane Protection
Levees and floodwalls around Berwick Bayou Vista, Patterson, and Calumet should be improved to the 400 year level of protection, utilizing the existing alignment and providing protection from both storm surge and flooding from the Atchafalaya River. This levee alignment is entirely within the habitat goal of fresh wetlands and is historically swamp habitat. Restoration of sustainable wetland forests outside and adjacent to the levees should be an adjunct to levee design, construction, and maintenance. The treated wastewater from locally protected communities can also be used to rejuvenate local forests.

3) Bayou Sale Hurricane Protection
Levees and floodwalls around Bayou Sale are to be improved or constructed to the 400 year level of protection, providing protection from flooding from both surge directly from the Gulf or indirectly through the Atchafalaya River.

4) Franklin to New Iberia Hurricane Protection
Levees and floodwalls around Franklin, New Iberia and communities between these two are to be constructed to the 400 year level of protection, providing protection from both storm surge and flooding from the Atchafalaya River. This levee alignment is entirely within the habitat goal of fresh wetlands and is historically swamp habitat. Restoration of sustainable wetland forests outside and adjacent to the levees should be an adjunct to levee design, construction, and maintenance. The treated wastewater from locally protected communities can also be used to rejuvenate local forests.

5) Marsh Island Restoration
Marsh Island provides a vital benefit to flood protection as a significant barrier to surge into West Cote Blanche and Vermilion Bays. Land loss is modest, but some restoration is recommended. Marsh Island should be restored, utilizing marsh creation (500 acres) in areas of significant loss, such as the western end of the island. Selective shoreline protection should be utilized for sections of shoreline with very high retreat rates, such as the northeast shoreline near Lake Point.

6) Atchafalaya Bay Oyster Barrier Reef Restoration
As described previously, the historic oyster reefs have been lost in Atchafalaya Bay due to mining and changes in salinity. A barrier reef is still desirable to provide the ecologic benefits of a reef and to provide surge reduction for the Atchafalaya and adjacent bays. It is recommended that a new oyster barrier reef be constructed further seaward of the historic reef at a location where salinity is

optimum for oyster habitat (see map for approximate location). Hard material of vertical relief should be deployed at the site of the new barrier reef. Suitable and environmentally acceptable material should be used. One option to consider is the deployment of decommissioned military vessels that have been approved for such purposes.

7) Point au Fer Island
Point au Fer Island provides a vital benefit to flood protection as a significant barrier to surge into the Atchafalaya and Four League Bays. Land loss is modest but some restoration is recommended. Point au Fer Island should be restored utilizing marsh creation (1,000 acres) in areas of significant loss, such as the central area of the island. Selective shoreline protection should be utilized for sections of shoreline with very high retreat rates, such as the northeast shoreline Point au Fer Island.

8) Wax Lake Outlet Channel & Delta
No changes to this naturally functioning delta are recommended.

9) Atchafalaya Delta
Delta training has not always been optimal for landbuilding processes. Improved planning of beneficial use of dredged material and dredging of channels for land building is recommended.

10) East Atchafalaya Restoration Spillway near Lake Palourde and Bayou Penchant Alternative
Kemp and Hyfield (2006) proposed an "East Atchafalaya River Restoration Spillway" to be constructed just north of Morgan City for restoration benefit to areas of Penchant Basin (**Figure 98**). A spillway or a similar water diversion structure into Bayou Penchant is recommended. The maximum design discharge should be 140,000 cfs. Average discharge is proposed to be 20,000 cfs. The spillway discharge would proportionately reduce the discharge flowing south of Morgan City. Kemp and Hyfield (2006) concluded that only 10% of sediment delivered to the Atchafalaya Delta is actually utilized to build land. The remaining sediment is carried further into the bay or Gulf of Mexico. The sediment diverted through the proposed spillway would entirely be captured by the wetland outfall area. Therefore, this project should have small influence on the land-building at the Atchafalaya Delta while providing significant benefit to the Penchant Basin region.

The goal is to sustain and rebuild weakened floatant marsh of the Penchant Land Bridge and to maintain habitat targets for Planning Unit-3b and PU-3a. Some marsh creation may be justified in the Penchant Basin for areas of significant historic wetland loss.

An alternative to the East Atchafalaya Restoration Spillway is a diversion across Avoca Island and into Bayou Penchant. This diversion should target discharge into the Bayou Penchant Land Bridge **(Figure 99)**, which is identified as a critical land form. Routing the water south of the Penchant Basin may avoid some problems of water velocity through the Penchant Basin, which has significant floatant marsh. Either alternative for discharge into this region requires additional measures to prevent backwater flooding northward toward Morgan City.

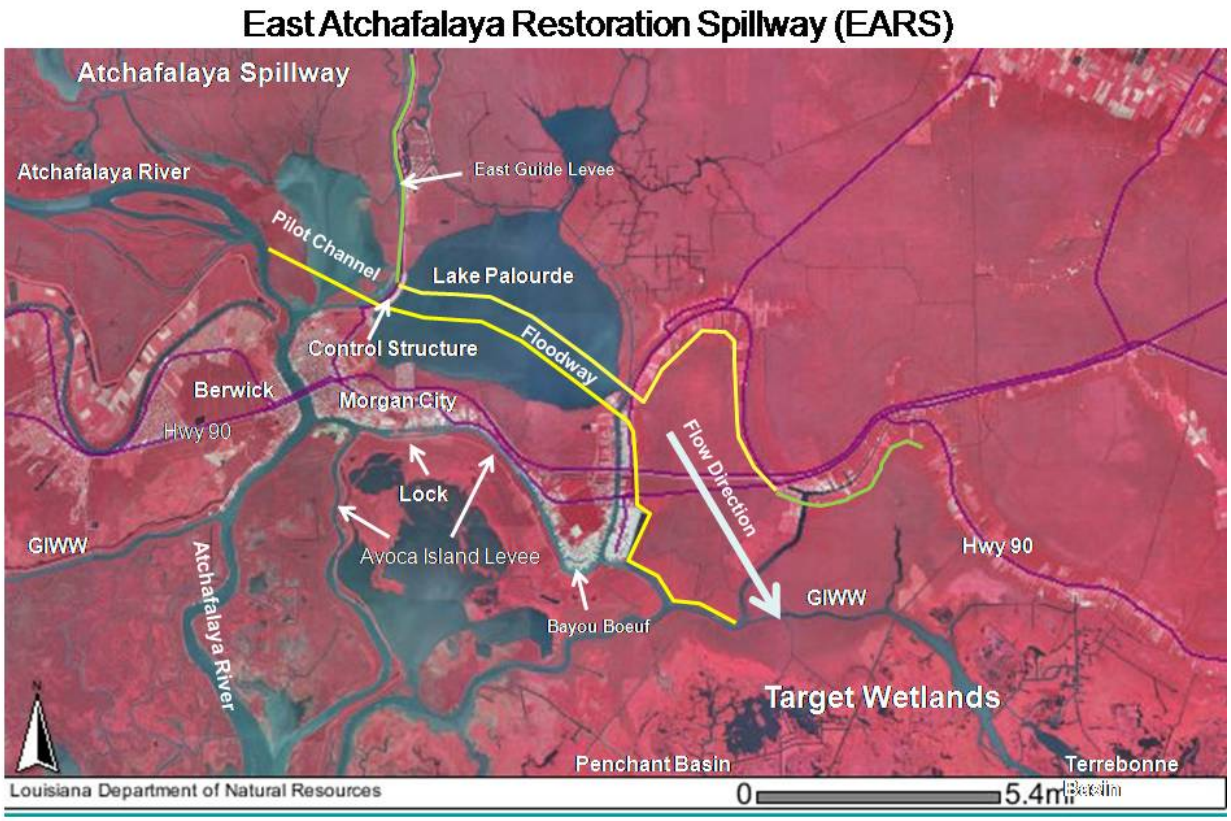

Figure 98: Location of proposed East Atchafalaya Restoration Spillway. Map by Kemp and Hyfield (2006). This spillway would divert as much as 140,000 cfs water from the Atchafalaya River eastward into the Penchant Basin where the highest land loss in Planning Unit 3b has occurred. A spillway or similar diversion structure is recommended (Basemap 2005 CIR - LA DNR – SONRIS).

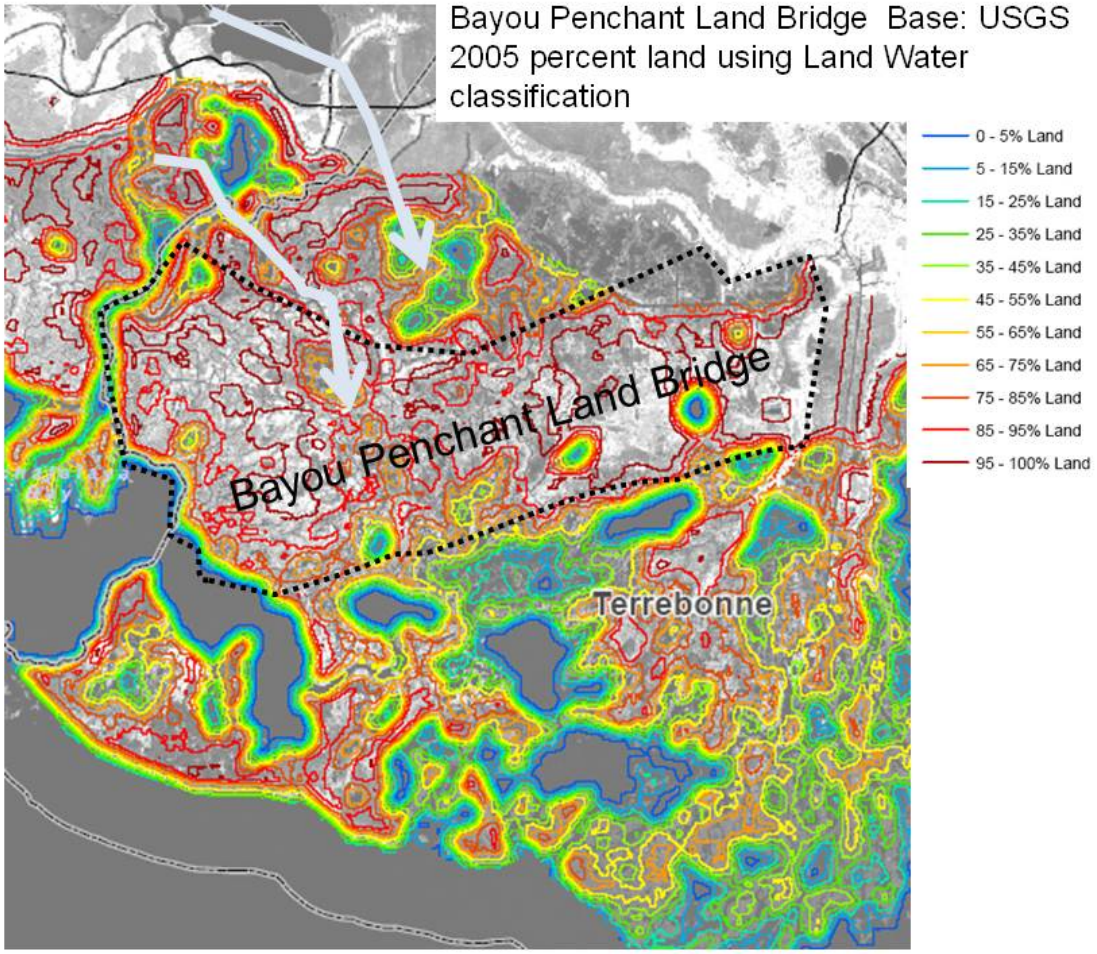

Figure 99: Map of percent land using USGS land water classification in 2005. The Bayou Penchant Land Bridge is identified as a key land form that could be sustained by a diversion into Bayou Penchant and across the land bridge.

11) Outfall Management of the GIWW

Additional freshwater is needed for Planning Unit-4 and is recommended by utilizing the GIWW (see Planning Unit 4 #17). One possible source of additional freshwater is the Atchafalaya River via the GIWW. Additional discharge or better conveyance is recommended for the GIWW in Planning Unit-3b to introduce additional freshwater into Planning Unit-4.