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A Post-Katrina Assessment of the "Freshwater Diversion to Lake Pontchartrain Basin and Mississippi Sound"

Introduction

In 1965, a federally authorized deep-draft navigation canal was completed in Louisiana's marshes south of Mississippi and immediately began to have damaging effects to both Louisiana and Mississippi. Salt water intrusion by the Mississippi River Gulf Outlet (MRGO) and wetland loss were causing catastrophic impact to oysters. Perret estimated oyster production declined by 60% to 65% just a few years after construction.[1] As a result, a project was developed by the U.S. Army Corps of Engineers to address the deleterious impacts by "introducing water in the Lake Pontchartrain Basin and western Mississippi Sound to improve the habitat and the fish and wildlife productivity".[2] The multi-state goals described in the 1984 Feasibility Study were laudable, but a consensus on the means to achieving these goals was never accomplished.[3] The devastating effects of Hurricane Katrina on the physical landscape in Louisiana and Mississippi and the ongoing threat of future hurricanes are compelling arguments to reassess the goals and options to a project that would influence the economic and ecologic viability of the Louisiana and Mississippi coastlines.

Project Goals

In the 1984 Feasibility Study of the "Freshwater Diversion to Lake Pontchartrain Basin and Mississippi Sound", the proposed project management goal to improve the wetland productivity was to be benchmarked by oyster productivity of the target areas in Louisiana and Mississippi.[2] Oysters are an important commercial species to both states but are also considered "the best indicator species to determine the optimum salinity range for the overall commercial fishery in Louisiana".[4,5] Oysters also directly contribute to the larger ecosystem by filtering water and providing reef surface for other organisms to grow. **Figure 1** depicts the area targeted in the Biloxi Marsh and Mississippi Sound to increase oyster productivity by attempting to optimize the salinity most conducive to oyster health. When salinity is too high, predators invade and reduce production, or when too much fresh water is present, the oyster's growth is inhibited [6] or may kill an entire population[7].

In 2003, a team of scientists and engineers were requested by the Lake Pontchartrain Basin Foundation to re-assess the Comprehensive Habitat Management Plan for the Pontchartrain Basin in southeast Louisiana. This team recently completed their report[8] and it includes restoration goals for the entire basin including the area in the Louisiana portion of the 1984 Feasibility Study. The restoration goals were determined by conditions existing prior to the MRGO (circa 1912 to 1932) and are shown in **Figure 2**. Comparison of **Figures 1 & 2** shows that there is good agreement on the target areas of oysters in the Biloxi Marsh and Mississippi Sound. The areas are aligned with the large historic reefs along the Louisiana and Mississippi coasts. It appears that Louisiana and Mississippi may now have agreement restoration goals for oyster production.

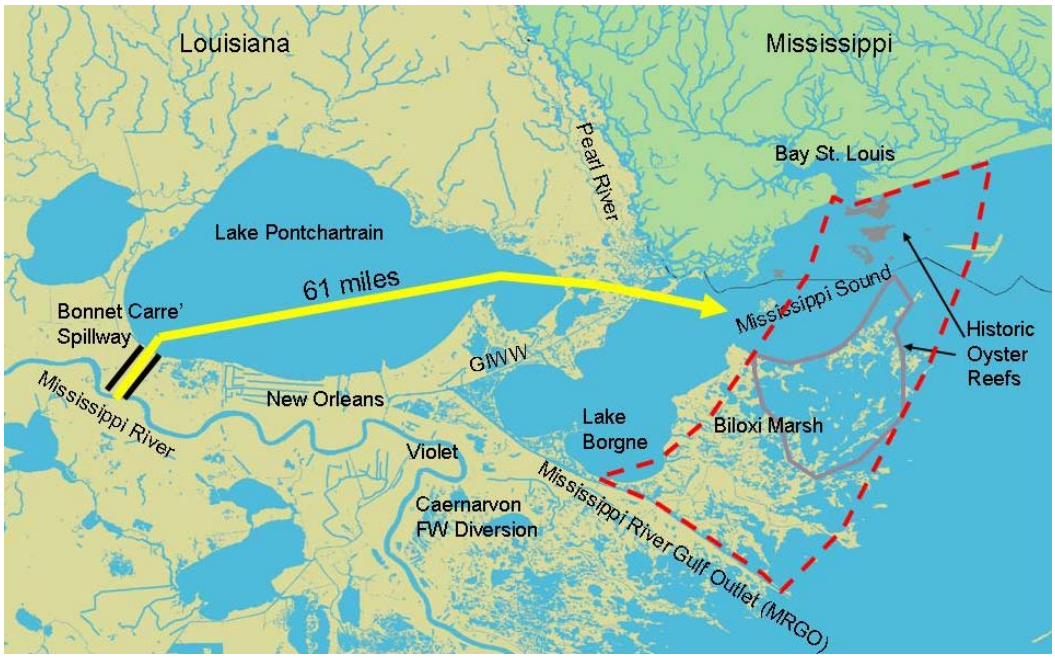

Figure 1: Map depicting the 1984 Feasibility Study's preferred alternative to construct a new Mississippi River diversion at the Bonnet Carre' Spillway. The project assumed the MRGO would remain open and continue to elevate salinity in Lake Borgne. The target benefit area for oyster enhancement is outlined in red. (source, 1984 Feasibility Study [2]). Historic reefs are shown in gray.

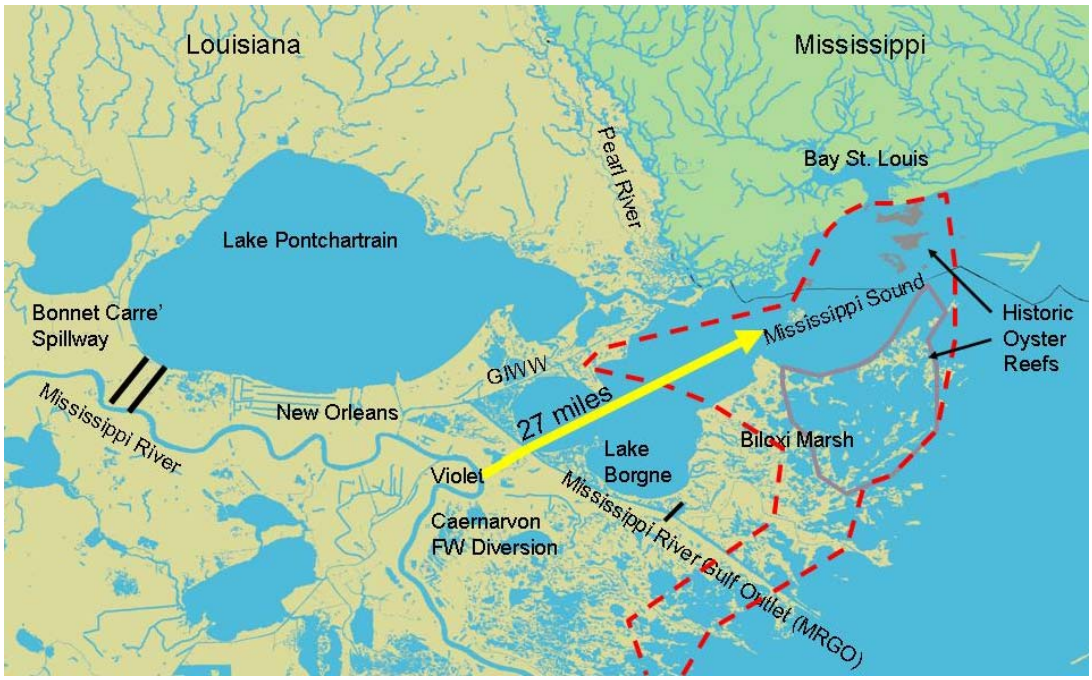

Figure 2: Map depicting the 2006 proposal to expand the Mississippi River freshwater diversion at Violet, LA. The project proposes a constriction of the MRGO channel south of Lake Borgne. The target benefit area for oyster enhancement (brackish marsh) is outlined in red. Historic reefs are shown in gray. (source, 2006 LPBF [8 & 9]).

The 1984 Feasibility Study estimated that the annual oyster harvest would increase from 8-million pounds to 15.5-million pounds. Since the study, the Caernarvon Freshwater Diversion structure has been operated for 14-years just south of the study area and it has doubled annual oyster production. This project proves the viability of stimulating oyster production with a local freshwater diversion.

In addition to its revision of its Comprehensive Habitat Movement Plan, the Lake Pontchartrain Basin Foundation also implemented a Post-Katrina strategy prompted by the urgency for hurricane protection. The Pontchartrain Coastal Lines of Defense Program prioritizes restoration projects which also have some significant flood protection benefit.[9] Restoration of the Biloxi Marsh with oyster reefs is a priority project. The improved reefs will help sustain the outer marsh which provides a critical natural buffer from hurricane storm surge for both Louisiana and Mississippi. This additional goal of structural reef development may also be of common interest to both Louisiana and Mississippi.

Proposed Project Designs

The 1984 Feasibility Study considered as many as six alternatives to introduce Mississippi River water into the Pontchartrain Basin to manage salinity in the target area to achieve the oyster productivity goals. All of these alternatives shared a common assumption which now appears to be invalid. The alternatives assumed that the MRGO channel would continue as an authorized deep-draft channel. The resulting preferred alternative was a to build a new large freshwater diversion at the site of the existing Bonnet Carre' Spillway structure built for Mississippi River flood control for New Orleans. As a result of the selected alternative, the entire project is often causally referred to as the "Bonnet Carre' Diversion Project", which unfortunately obscures the original goal of the project to enhance the Biloxi Marsh and Mississippi Sound.

The design alternative to build a new diversion at Bonnet Carre Spillway would discharge Mississippi River water 61-miles west of the target area. Two problems with this alternative surfaced following release of the 1984 Feasibility Study. First, effective management of the discharge would be challenging due to the distance water would need to travel and because, along its course, there would be significant and hard to predict influence of the Pearl River discharge from the north and the MRGO to the south. Modeling implied the need to forecast rainfall months in advance to determine the correct discharge. Second, the ecology of Lake Pontchartrain as a conveyance for the diverted water would be jeopardized due to the significant introduction of overly nutrient-rich river water into an algal-bloom prone lake. A re-analysis suggested lower discharges might be acceptable, but a reduction would further inhibit the chance of success in achieving the salinity goals. The design alternative creates an acute dilemma of too little water for the marsh or too much water for the lake. Since the original assumption regarding the MRGO may be invalid, other options may exist which will work in concert rather than in conflict.

The MRGO is now infamous for its role in the devastation due to Hurricane Katrina. It has been documented that during Hurricane Katrina surge water was "funneled" by the configuration of the spoil banks and levees along the MRGO and the Gulf Intracoastal Waterway (GIWW). The accumulated wetland loss, channel, and bank geometry conspired to bring great devastation to the region. The Mississippi Gulf Coast suffered equally from the enormous storm surge impacting the coast. One positive outcome may be the deauthorization of deep-draft navigation on the MRGO. On May 5, 2006, the U.S. Senate passed deauthorization language for the MRGO. It's likely this language will survive some monetary adjustments in the Supplemental

Appropriations bill and achieve passage in the House of Representative. Finally, the problems first identified three decades earlier can be addressed directly at the source of the problems – the MRGO.

With the MRGO closed to deep-draft navigation, there is great opportunity to achieve the original goals of the 1984 Feasibility Study. With a shallow draft requirement, it is possible to reduce the channel profile in St. Bernard, and thus dramatically reduce the salinity highway of the MRGO. However, modeling has already proven that a constriction by itself will not be sufficient. Therefore, the Lake Pontchartrain Basin Foundation has proposed to expand an existing diversion in the Lake Pontchartrain Basin near Violet, Louisiana. **Figure 2** illustrates the new project design elements. A Violet freshwater diversion and choking of the MRGO can achieve the salinity targets originally proposed in the 1984 Feasibility Study. Compared to the Bonnet Carre' diversion, this alternate location reduces the distance the water would travel to Mississippi Sound by 56% (27-miles), and so has promise of being more effective. A diversion at Violet is also highly desirable to restore wetlands that buffer the St. Bernard levees, and a candidate diversion project has been nominated by EPA and NMFS under the Coastal Wetlands Planning, Protection and Restoration Act.[10] Modeling funded by the Pontchartrain Restoration Program is currently underway at the University of New Orleans to determine the needed discharge to reestablish the salinity goals. Results are expected this summer.

Conclusion: A Partnership

This is the time for Louisiana and Mississippi to work together with the new reality of our coasts, and re-assess alternatives to achieve the original goals of the "Freshwater Diversion to Lake Pontchartrain Basin and Mississippi Sound" project. The MRGO deauthorization language recently passed by the U.S. Senate allows six-months to develop an environmental restoration plan for the region. This interim plan is then to be integrated with the Louisiana Coastal Protection and Restoration[11] to be completed in December 2007. The President's initiative of the Gulf of Mexico Alliance encourages cross-state cooperation and provides another timely opportunity for joint planning.[12] A "combined restoration design" which includes choking-off salinity from the MRGO and a freshwater introduction at Violet in St. Bernard Parish has great promise to restore the estuaries and to help protect our coasts in both Louisiana and Mississippi.. The Lake Pontchartrain Basin Foundation welcomes any opportunity to discuss these developments and opportunities.

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2 U. S. Army Corps of Engineers, 1984, Mississippi and Louisiana Estuarine areas: Freshwater Diversion to Lake Pontchartrain Basin and Mississippi Sound- Feasibility Study- New Orleans District

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5 Lindall, W. N. Jr., J. R. Hall, J. E. Sykes, and E. L. Arnold, 1972, Louisiana Coastal Zone: Analyses of Resources and Resource development needs in connection to estuarine ecology, National Marine Fisheries Laboratory, St. Petersburg Beach, Fla. U.S. Army Corps of Engineers Contract No. 14-17-002-430

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7 Gunter, G., 1953, The relationship of the Bonnet Carre' spillway to oyster beds in Mississippi Sound and the Louisiana Marsh, with a report on the 1950 opening. Publ. Inst. Marine Science University of Texas 3 (1): 17-71

8 Lake Pontchartrain Basin Foundation, 2006, Comprehensive Habitat Management Plan for the Pontchartrain Basin, http://www.saveourlake.org/wetlands.htm on April 2006

9 Lake Pontchartrain Basin Foundation, 2006, Pontchartrain Coastal Lines of Defense Program, http://www.saveourlake.org/wetlands.htm on April 2006

10 Mississippi River Reintroduction at Violet candidate project for PPL 16 see Task Force proceedings at http://www.mvn.usace.army.mil/pd/April_12_2006_Task_Force_Binder.pdf

11 The Louisiana Coastal Protection and Restoration was prompted by the devastation after Hurricanes Katrina and Rita and is being jointly developed by the U.S. Army Corps of Engineers and the State of Louisiana. See http://lacpr.usace.army.mil/

12 Gulf of Mexico Alliance home page http://www.dep.state.fl.us/gulf/files/default.htm

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Addendum: Report on Preliminary Results of the Hydrologic Modeling

Executive Summary

Preliminary hydrologic modeling indicates that the restoration proposal of a Violet Diversion coupled with a MRGO constriction at Bayou la Loutre may be capable of achieving the salinity reduction necessary for the 1912-1932 habitat goals. These goals would reestablish oyster beds in Louisiana and Mississippi as defined in the original Bonnet Carre' diversion plan. Of the discharge rates modeled, a discharge of 7,500 cubic feet per (cfs) second appears most promising. The nearby Caernarvon freshwater diversion (8000 cfs) has been used to successfully manage salinity in the estuary just a few miles south of Violet. The Caernarvon diversion has resulted in at least a 200% increase in oyster harvest in the Breton Basin and serves as a tangible precedent for salinity management and oyster production. Combining the preliminary modeling results and the fisheries success of the Caernarvon diversion strongly suggests that a Violet Diversion with an MRGO constriction has a very real probability of success and certainly justifies investigation as a viable alternative to the 1984 Bonnet Carre' diversion alternative.

Introduction

In the 1984 Feasibility Study of the "Freshwater Diversion to Lake Pontchartrain Basin and Mississippi Sound", the proposed project management goal to improve the wetland productivity was to be benchmarked by oyster productivity of the target areas in Louisiana and Mississippi.[1] The resulting preferred project alternative was a to build a new large freshwater diversion at the site of the existing Bonnet Carre' Spillway structure built for Mississippi River flood control for New Orleans. As a result of the selected alternative, the entire project is often causally referred to as the "Bonnet Carre' Diversion Project", which unfortunately obscures the original goal of the project to enhance the Biloxi Marsh and Mississippi Sound.

In 2003, a team of scientists and engineers were requested by the Lake Pontchartrain Basin Foundation to re-assess the Comprehensive Habitat Management Plan (CHMP) for the Pontchartrain Basin in southeast Louisiana. This team recently completed their report[2] and it includes restoration goals for the entire basin including the area in the Louisiana portion of the 1984 Feasibility Study. The restoration goals were determined by conditions existing prior to the MRGO (circa 1912 to 1932). Comparison of the CHMP goals to the original Bonnet Carre' Diversion goals, demonstrates good agreement on the target areas of oysters in the Biloxi Marsh and Mississippi Sound. The areas are aligned with the large historic reefs along the Louisiana and Mississippi coasts. It appears that Louisiana and Mississippi may now have agreement on restoration goals for oyster production.

In 2005, the federally funded Pontchartrain Restoration Program (PRP) approved a grant for hydrologic modeling to be conducted at the University of New Orleans (UNO). The Principle

Investigator's (PI) include Dr. Ioannis Georgiou, Dr. Alex McCorquodale and Dr. Duncan Fitzgerald. Dr's Georgiou and McCorquodale are with UNO and the Pontchartrain Institute for Environmental Sciences, and have prior modeling experience for the Louisiana Coastal Area (LCA) Program through the Coastal Louisiana Ecosystem Assessment and Restoration (CLEAR) program. Dr. McCorquodale is the FMI Professor for Environmental Modeling at UNO. Dr. Duncan Fitzgerald is a coastal scientist with Boston University, who has also taken additional responsibilities with the Pontchartrain Institute for Environmental Sciences at UNO. The PRP grant focused on hydrologic modeling of the Pontchartrain Basin Estuary including predictions of salinity under various restoration scenarios.

The modeling software being utilized is the finite-volume coastal ocean model (FVCOM). This is a open source numerical model that has recognized 3-dimensional capability. For this project, the model simulations were run on a 3-dimensional landscape as previously used for LCA with several updates. The model domain and boundaries extends east from Lake Maurepas to approximately Long Beach Mississippi, and southward to include Breton Sound **(Figure 1**).

The modeling objectives are:

- To simulate hydrodynamics and transport for the Pontchartrain Basin Estuary
- Establish baseline conditions for water levels and salinity
- Determine the size of a freshwater diversion at Violet, La., along with MRGO modifications to achieve target salinities in the Biloxi Marsh and Mississippi Sound

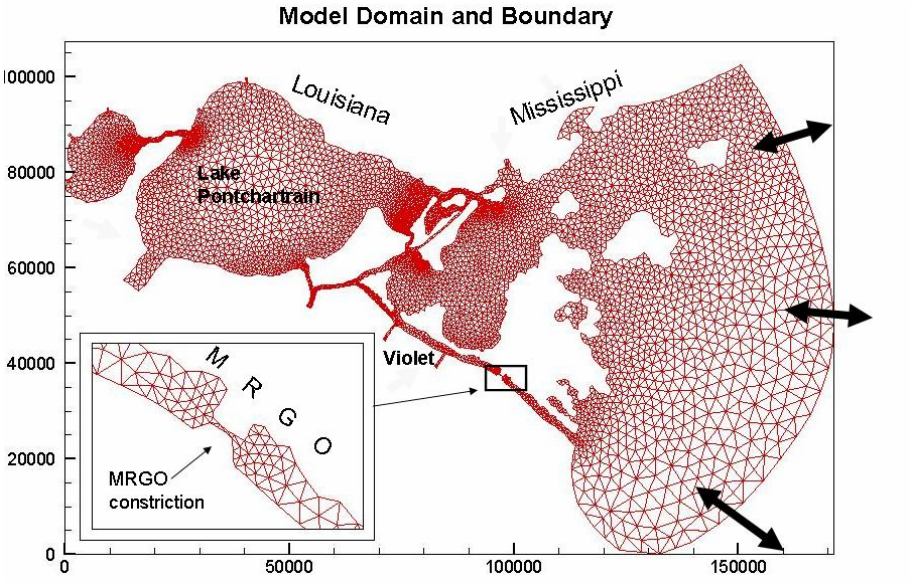

Figure 1: Model domain and boundaries being utilized for the Pontchartrain Restoration Program grant project to model the hydrodynamics of the Pontchartrain Basin Estuary. Graphic provided by Dr. Ioannis Georgiou

Preliminary Results

On September 2, 2006, Dr. Georgiou presented preliminary results of the hydrologic modeling regarding the proposed Violet Diversion to the MRGO stakeholder meeting being held by the US Army Corps of Engineers (New Orleans). The restoration assumption for the model was that the Mississippi River Gulf Outlet at Bayou la Loutre had new channel dimensions of the Gulf Intracoastal Waterway (125 feet X 14 feet). The question then posed, was what discharge level was necessary to re-establish the salinity regime for the historic habitat goals (1912-1932).

Simulated discharges were hypothetical direct discharges from the Mississippi River to the MRGO via a conveyance channel; the model neglects marsh interaction in the immediate vicinity of the structure. The water flow and transport of salinity beyond the conveyance channel was then driven by realistic meteorological conditions such as wind, tides etc. Simulated discharges were 2,500 cfs, 5,000 cfs, 7,500 cfs and 10,0000 cfs for 60 day periods.

All of these results are preliminary because model sensitivity analysis has not been completed. When completed, the sensitivity analysis may require changes to the landscape model or assumed hydrologic conditions which would alter model outcomes. In addition, the post-discharge recovery of salinity has not been modeled. Since a diversion cannot be expected to flow year-round, it is necessary to estimate how quickly salinity rebounds once the discharge terminates. This has not yet been modeled, but will be done as quickly as possible.

With these caveats, the preliminary modeling does show promise that the restoration proposal of a Violet Diversion coupled with a MRGO constriction at Bayou la Loutre may be capable of achieving the salinity reduction necessary for the 1912-1932 habitat goals. These goals would reestablish oyster beds in Louisiana and Mississippi as defined in the original Bonnet Carre' diversion plan. Of the discharge rates modeled for the 60 day periods, a discharge of 7,500 cfs appears most promising. The Caernarvon freshwater diversion, in operation since 1991, has a maximum discharge of 8,000 cfs and has been used to successfully manage salinity in the estuary just a few miles south of Violet.[3] The Caernarvon discharge is isolated from the Biloxi marsh and so cannot be used to affect the target area for a Violet Diversion. Nevertheless, the Caernarvon diversion has resulted in a at least a 200% increase in oyster harvest in the Breton Basin and serves as a tangible precedent for salinity management and oyster production. The Caernarvon diversion was built in the 1980's for $26.1 million.

Conclusion

The preliminary modeling results and the engineering success of the Caernarvon diversion strongly suggest that a Violet Diversion with an MRGO constriction has a very real probability chance of success and certainly justifies investigation as an alternative to the 1984 Bonnet Carre' diversion alternative.

Citations

1 U. S. Army Corps of Engineers, 1984, Mississippi and Louisiana Estuarine areas: Freshwater Diversion to Lake Pontchartrain Basin and Mississippi Sound- Feasibility Study- New Orleans District

2 Lake Pontchartrain Basin Foundation, 2006, Comprehensive Habitat Management Plan for the Pontchartrain Basin, http://www.saveourlake.org/wetlands.htm on April 2006

3 Caernarvon Freshwater Diversion Project, Mississippi Delta Region, LA: LA Coast website supported by the Louisiana Department of Natural Resources http://www.lacoast.gov/programs/Caernarvon/factsheet.htm