Technical Report
Discharge Study At Bayou Tortillon

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1. Introduction

This report describes the evolution of a crevasse in the lower Mississippi River. The crevasse is approximately 55 miles southeast of New Orleans, about 22 river miles upstream of Head of Passes, and on the opposite side of the Mississippi River from Buras, Louisiana. It is located about 1.3 miles downstream of the Ostrica Locks, about 4.5 miles upriver of the Fort St. Philip crevasse complex, Different names have been attached to this pass including Bayou Tortillon, Avulsion Pass or Neptune Pass. Noting that Bayou Tortillon appears to be the original name of this system, this report uses the name, "Bayou Tortillon" for this system.

Figure 1. Map of southeast Louisiana, with Bayou Tortillon marked. Image source; Google Earth.

Crevasses are essentially cuts or holes in the natural or manmade Mississippi River levee. They form channels where water flows from the Mississippi River to a bay or lake. Engineering activities such as levees have been built to protect human infrastructure along the river in the floodplain and delta plain, especially in the last century, and have rendered crevasses all but non-existent. However, south of Bohemia, LA there are no communities, and the levees along the east bank of the Mississippi River are not maintained, and Crevasses occur in this region. (Levees along the West Bank of the river are maintained to Venice, LA, and crevasse do not occur where those levees are maintained.) Crevasse examples include "Mardi Gras Pass," the Fort St Philip region, and the Cubit's Gap/Delta Wildlife Refuge (Wells and Coleman 1987).

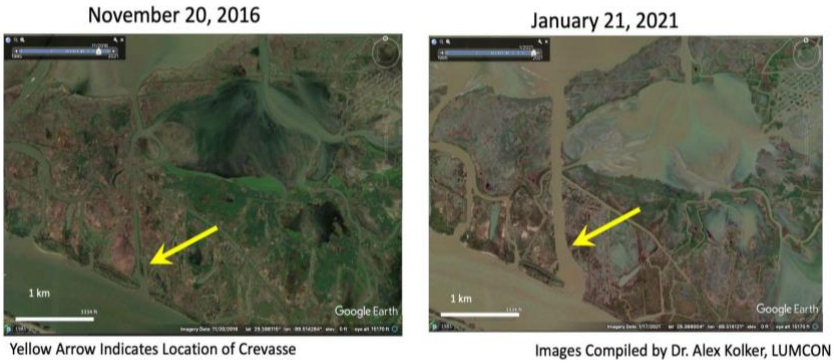

Figure 2. Crevasse development at Bayou Tortillon. Image: Google Earth

Figure 3. NASA/Modis satellite image of the Birdsfoot Delta from April 22, 2022. Note the northward extending sediment plume that is likely liked to Bayou Tortillon.

Satellite imagery suggest that the Bayou Tortillon crevasse has grown substantially in the past two to three years. A brief analysis indicates that the width of the Bayou Tortillon channel that connects the receiving basin, Quarantine Bay, to the Mississippi River was approximately 150 ft (45 m) in 2016. Figure 2 illustrates that by 2021, the crevasse had increased nearly 6-fold to about 850 ft (258 m). As the main channel in Bayou Tortillon expanded and straightened, several islands eroded. An April 27, 2022 satellite image suggests that when the Mississippi River was at high flow, Bayou Tortillon can discharge a plume of sediment-rich water into Breton Sound that reaches the mouth of the Mississippi River Gulf Outlet (Figure 3).

2. Methods

A discharge survey was conducted on May 24, 2022 to determine the flow in Bayou Tortillon and nearby areas. The survey was conducted using an acoustic current doppler profiler (ADCP) mounted to a small survey boat, the R/V Penland.

Figure 4 shows the areas that were surveyed. The goals of the survey were to:

1) Quantify total discharge in Bayou Tortillon.

2) Quantify flow leaving the Mississippi River from an upstream boundary above the Ostrica Lock to a downstream boundary above Baptiste Collette to determine the outflow to the receiving basin to the east of the Mississippi River along this reach.

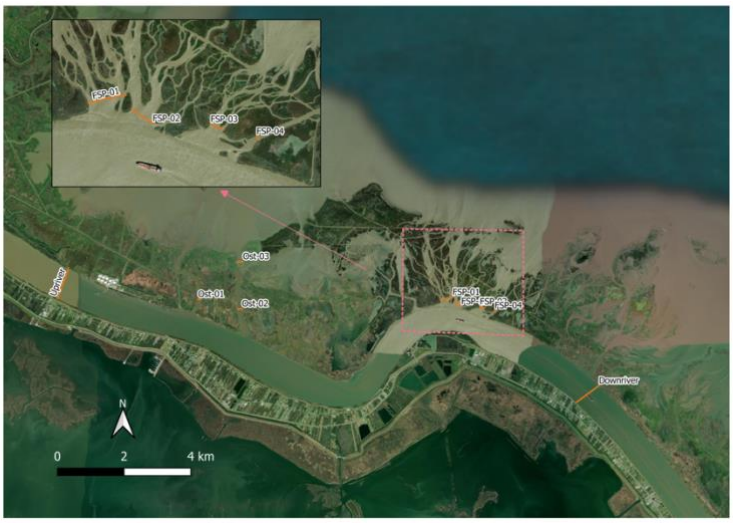

Figure 4. Location of survey transects, and their discharge in $ft^3 s^{-1}$.

3) Quantify discharge at major channels in the Ft. St. Phillip crevasse complex and compare with the measurements of an earlier high flow study (Weathers et. al., 2016) to assess whether and how the flow in these channels is changing as Bayou Tortillon crevasse evolves.

The location of these survey transects, and their discharge is noted in Figure 4.

3. Results

During this study, discharge at the following locations was measured. Results are presented in cubic feet per second ($ft^3\ s^{-1}$):

Location	Discharge ($ft^3 s^{-1}$)
Mississippi River (Upriver)	
Mississippi River at Belle Chassse (from USGS)	776,000
Estimated Flow leaving the River through Mardi Gras Pass	25,000
Estimate of flow loss to groundwater from Belle Chasse to Ostrica	25,000
Measured Flow Mississippi River Above Ostrica Locks	713,000
Ostrica	
Ostrica Locks	13,400
Bayou Tortillon	118,000
Ft. St. Phillip	
Measured channels along Ft. St. Phillip	63,600
Estimated flow of unmeasured channels along Ft. St. Phillip	40,500
Mississippi River (Downriver)	
Mississippi River Below Fort St Philip Crevasse Complex	433,000
Estimated Missing Flow (either unmeasured or measurement error)	44,700
Total Eastward Flow, Ostrica Locks - Fort St. Philip	
Low, Does Not Include Missing Flow	235,500
High, Includes Missing Flow	280,000
Percent of River at Belle Chasse (Low)	30%
Percent of River at Belle Chasse (High)	36%

The estimated flow in unmeasured channels at the Fort St Philip Crevasse Complex was calculated from a simple linear model relating the flow at unmeasured channels on May 24, 2022 to flow at these channels that were measured during a 2016 high flow survey (Weathers et al. 2016). During that study, the flow at Belle Chasse was 1,200,000 $ft^3\ s^{-1}$ (Weathers et al. 2016), whereas during this study the flow at Belle Chasse was 776,000 $ft^3\ s^{-1}$, representing about 65% of the 2016 flow. The estimated missing flow in the Mississippi River (unmeasured, or resulting from measurement error) was calculated as the amount needed to complete the hydrological budget for the river based

the May, 24, 2022 survey. The estimated loss to groundwater follows research on groundwater flow in lower Mississippi River (Kolker et al. 2013). Flow estimates at Mardi Gras Pass come from M. Hopkins, (pers, comm), and are based on a ratings curve used by the Pontchartrain Conservancy.

4. Findings and Implications

The survey on May 24, 2022 yielded a discharge of 118,000 ft^3 s^{-1} at Bayou Tortillon at moderately high flow in the main river (776,000 ft^3 s^{-1} at Belle Chasse). While this discharge of this scale may have long-term management implications (see below), we feel it is important to note that we do not see any near-term safety related issues.

Figure 5. Sediment plume, with potentially semi-permanent features, as indicated by Sentinel-2 satellite true color imagery. Image source: https://scihub.copernicus.eu/dhus/#/home

Results suggest that the total amount of water that leaves the Mississippi River in the Ostrica Locks/Bayou Tortillon/Fort St. Phillip reach, is between 230,000 and 280,000 ft^3 s^{-1}. This accounts for 30 to 36% of the flow of the Mississippi River at Belle Chasse. When one examines the flow entering this reach of the river (below Mardi Gras Pass), the eastward flow amounts to up 39% of the Mississippi River. For comparison, a study conducted at high flow in early 2016 indicated that this reach of the river area discharged approximately 159,800 ft^3 s^{-1} eastward. That discharge amounted to about 14% of the total flow of the Mississippi River at Belle Chasse, 1,200,000 ft^3 s^{-1} at that time (Weathers et al. 2016). The present study suggests a substantial increase in flow eastward. This reach of the Mississippi River, from the Ostrica Locks to south of Fort St Philip, including Bayou Tortillon, now appears to be one of the largest distributaries of Mississippi River.

Satellite imagery indicates the development of features in Breton Sound that resemble mouth bars and distributary channels (Fig. 5). These features suggest the potential for land formation in this region, though a full understanding of land development needs to be confirmed by additional surveys.

A crevasse of this size has potentially important implications for the region. As previously noted, we do not see any near-term safety related issues though we do note reports dredging near Fort Jackson that may be related to this crevasse (R. Blink, pers comm). Longer term issues for discussion may include the potential for continued expansion, potential for land building, impacts to navigation in the Mississippi River, and effects to regional oceanography. Addressing these issues will likely require additional measurements, numerical modeling decision support tools.

5. Acknowledgements.

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6. Works Cited

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