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Introduction

This report provides an update on LPBF’s earlier reports on the dimensions of Mardi Gras Pass (A.K.A, Mardis Gras Cut), an emerging distributary pass of the Mississippi River located on the east bank of the Mississippi River in Plaquemines Parish in the northern end of the Bohemia Spillway. A report presented the results of initial surveys completed in April and May of 2012, while updated reports presented the surveys completed in August 2012, September 2012, January 2013, March 2013, May 2013, and August 2013. This report presents the results of our January, 2014 survey. A bank survey to assess channel width was conducted on January 24, 2014 and a bathymetric survey to assess channel depth was conducted on January 14, 2014. Figure 1 depicts an interpolated depth surface generated from the most January 14, 2014 survey points. Notice the scouring in reach 4B in comparison to a relatively constant 4A. This report contains additional statistics due to this phenomenon. Previous reports evaluated reach 4 as a single extent, but it has become clear that the two reaches are developing differently over time, so a differentiation of reaches 4A and 4B is necessary. Readers seeking further information are referred to the prior reports on Mardi Gras Pass and the larger report on the Bohemia Spillway, all of which will be available for download at www.saveourlake.org.

Figure 1: Mardi Gras Pass interpolated bottom surface based on a bank survey completed on January 24, 2014 and a bathymetric survey completed on January 14, 2014. Interpolated surface generated using Spatial Analysis Toolbox in ArcGIS 10.2.
**Data Collection and Processing**

All data points were obtained using a Trimble Geo Explorer 6000 GeoXR GPS attached to a Zephyr Model 2 GNSS receiver. Capable of Real Time Kinematic (RTK) data collection, this survey grade GPS system provides latitude, longitude, and elevation (XYZ) of land locations to a high degree of precision. When coupled with the boat mounted fathometer (SonarMite Echo Sounder), depth measurements can also be added to the XYZ data.

On January 14, LBPF scientists completed a bathymetric survey with the fathometer mounted on the front of a 14 ft. flat boat and run in “Continuous Topo” mode while traveling different paths up and down the pass. “Continuous Topo” mode means that the unit obtains data points at a specified distance (every 5 ft). The GPS-Fathometer combination measured and recorded latitude, longitude, and elevation of the fathometer (approximately 1 ft. below the water surface), and depth (measured by the fathometer) for each point along five survey paths. One of the survey paths roughly followed the center of the Pass, one on each side roughly halfway between the center and the bank, and one path zigzagged between the banks. The unit automatically calculates the “Depth applied elevation”, which is the elevation of the water bottom (elevation of fathometer minus the depth). Additional points were obtained in the Mississippi River at the mouth of Mardi Gras Pass, in the Back Levee Canal, and in a small canal that parallels the bar along the river, though this data is not analyzed here. Of note, downed trees blocking Reach 1 of the Pass prevented full coverage there and trees below the surface may have created spurious measurements when the fathometer signal bounced off of them instead of the water bottom.

On January 24, 2014, LPBF scientists used the GPS unit and receiver to complete a bank survey of Mardi Gras Pass. A small number of bends were either inaccessible or tree coverage blocked the GPS signal. For reach 4, the original Bohemia Spillway Diversion Culverts Conveyance Canal, the banks are relatively straight, except for three sections of scour and widening, and survey points were obtained every ~300 ft. At the scour sections, 3 - 5 points were obtained on each bank. Each point consisted of latitude, longitude, and elevation. After the field data collection, these points were imported into a GIS and a polygon feature was computer generated based on the bank survey points. This polygon feature represents the surface extent of Mardi Gras Pass for the current study period.

**Methods**

To interpret this data, a series of basic geoprocessing steps were completed in the GIS system to obtain summary information describing the width and depth of Mardi Gras Pass. Essentially, these steps involved breaking the Pass into distinct, non-overlapping segments and then assessing the observed depths and widths for each segment.

To assess the depths of Mardi Gras Pass, first the “Center Line” of the pass was automatically generated using a geoprocessing algorithm. (Due to various irregularities, this center line had to be manually adjusted). In this analysis, points along the centerline were generated every 33 ft. and for each point a rectangle 33 ft. long was drawn. The GIS snapping tool then allowed the rectangle center to be snapped to the centerline points. Where bends and other irregularities were present, the rectangles had to be manually adjusted into a three or four sided irregular polygon. After clipping the set of rectangles by the polygon representing the boundaries of the pass, the resultant polygon layer divided the entire pass into a set of evenly spaced rectangles and other polygons. Next, a spatial join calculated summary statistics (minimum, maximum, and average) for each point within a polygon and joined those values to the corresponding polygon. These attributes for the polygon layer provide a generalized summary of the depths observed in the pass.
January 2014 Results
Along the pass, there are 50 transects representing width measurements and 139 polygons representing depth measurements. The transect widths ranged from 63.0 ft. to 180.0 ft. with the average width being 95 ft. Reach 3 had the greatest average width at 117.5 ft., while reach 4A had the lowest average width at 71.2 ft. The average depth of the polygons ranged from 6.1 ft. (in reach 4A) to 28.6 ft. (in reach 4B). Reach 2 had the greatest average depth at 15.0 ft., and reach 4A had the lowest average depth at 7.9 ft. The average depth for the entire pass was 12.8 ft.

A more illustrative assessment of the depths through Mardi Gras Pass can be obtained by looking at the thalweg depth. For the purposes of this analysis, the thalweg depth was calculated as the average of the top five depth measurements for each polygon. Over the entire pass, this value ranges from 8.0 ft. to 33.4 ft., with an average of 16.5 ft. Significantly, our January survey suggests that the Mardi Gras Pass continues to have a navigable thalweg depth of over 6 ft. for its entire length.

Table 1 provides summary statistics of the dimensions of Mardi Gras Pass, while Figures 2 – 8 present the data points and analysis steps.

Table 1: Summary statistics by reach for transects and polygons used to assess the width and depth of Mardi Gras Pass based on the January 2014 survey.

<table>
<thead>
<tr>
<th>Reach</th>
<th>Number of Width Transects</th>
<th>Avg. Width (ft)</th>
<th>Min. Width (ft)</th>
<th>Max. Width (ft)</th>
<th>Number of Depth Polygons</th>
<th>Avg. Depth (ft) (*)</th>
<th>Min. Depth (ft) (*)</th>
<th>Max. Depth (ft) (*)</th>
<th>Avg. Thalweg Depth (ft) (**)</th>
<th>Approx. Cross Sectional Area (ft²) (***)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 thru 4</td>
<td>50</td>
<td>94.6</td>
<td>62.5</td>
<td>179.6</td>
<td>139</td>
<td>12.8</td>
<td>6.1</td>
<td>28.6</td>
<td>16.5</td>
<td>1,215</td>
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<td>1</td>
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<td>102.7</td>
<td>90.1</td>
<td>109.5</td>
<td>13</td>
<td>11.8</td>
<td>8.7</td>
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<td>91.5</td>
<td>156.7</td>
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<td>10.8</td>
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<td>87.9</td>
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<td>23</td>
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<td>63</td>
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<td>7.5</td>
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</table>

(*) The average, minimum, and maximum values refer to summary statistics based on values for the set of polygons in each reach. In turn, values for each polygon are averages for the set of points within the polygon. So, the minimum and maximum refer to the minimum and maximum average depth for the set of polygons within the reach and not the minimum or maximum value of the individual points within a polygon or reach.

(**) For the purposes of this analysis, the Thalweg Depth for each polygon is defined as average of five highest depth measurements for the polygon, and then the Average Thalweg Depth for each reach is calculated from these values.

(***) For the purpose of this analysis, the Cross Sectional area is approximated by multiplying the average depth and average width.
Figure 2: Bank survey points of Mardi Gras Pass completed January 24, 2014, along with the inferred polygon representing the extent of the pass.

Figure 3: Transects used to summarize the width of the Mardi Gras Pass at various locations along with the length (ft) of each transect (bank-to-bank distance).
Figure 4: Bathymetric survey points of Mardi Gras Pass, obtained January 14, 2014.

Figure 5: Polygons (rectangles and irregular four sided polygons) used to summarize the depths of the Mardi Gras Pass in Reaches 1-3.
Figure 6: Polygons (rectangles and irregular four sided polygons) used to summarize the depths of Mardi Gras Pass in Reach 4.

Figure 7: Approximate thalweg depths of Mardi Gras Pass in Reaches 1 -3.
Figure 8: Approximate thalweg depths of Mardi Gras Pass in Reach 4.

References


