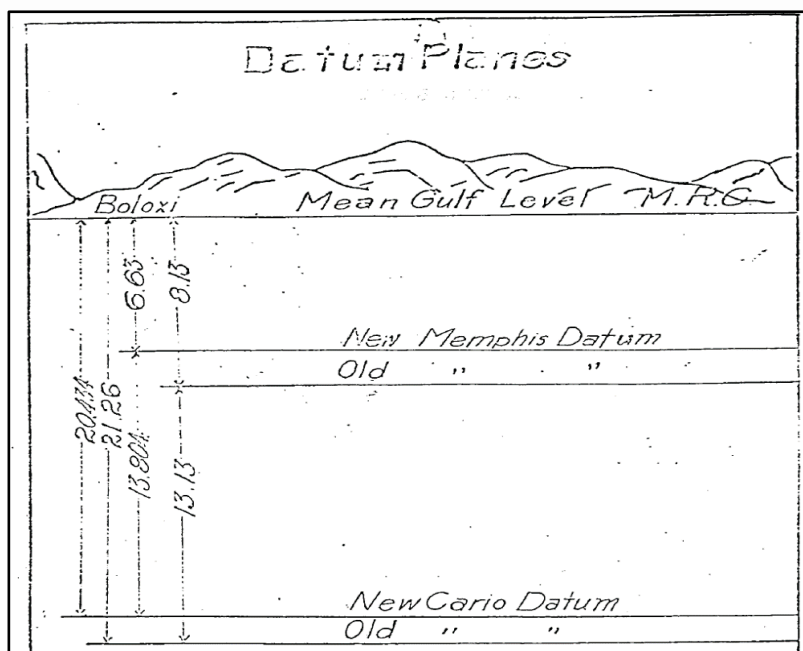




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Legacy Datums and Changes in Benchmark Elevation through Time at the Low Sill and Overbank Structures, Louisiana

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Geomorphology &
Potamology Program

Legacy Datums and Changes in Benchmark Elevation through Time at the Low Sill and Overbank Structures, Louisiana

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Final report

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Abstract

Vertical datums used in the study area at the Low Sill and Overbank Structures in southern Louisiana have involved Memphis Datum, Mean Gulf Level, Mean Sea Level, Mean Sea Level Datum of 1929, National Geodetic Vertical Datum of 1929, and the North American Vertical Datum of 1988. The focus of this study was to examine historic benchmarks in the study area to determine the magnitude of elevation changes associated with the different legacy datums that have been used by the US Army Corps of Engineers. Comparison of elevation values across these legacy datums has involved examining historic hydrographic surveys, compiling a list of known benchmarks from these surveys, and comparing their elevation values against publications involving spirit-leveling surveys from the Lower Mississippi Valley and the National Geodetic Survey database for benchmarks. This study describes the history of legacy datums, floodplain geology, potential subsidence impacts affecting the benchmarks, methods for identification and tracking benchmarks, and the results obtained from this study.

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Contents

Abstract	ii
Contents	iii
Figures and Tables	v
Preface	vi
1 Introduction	1
1.1 Background	1
1.2 Purpose	1
1.3 Objectives	2
1.4 Approach	2
1.5 Scope	2
1.6 Study area	2
2 Vertical Datums used in the Lower Mississippi Valley (LMV)	4
2.1 Introduction	4
2.2 Cairo and Memphis Datums	5
2.3 Mean Gulf Level (MGL)	6
2.4 Mean Sea Level (MSL) (1912 and 1929)	6
2.5 National Geodetic Vertical Datum 1929 (NGVD29)	8
2.6 North American Vertical Datum 1988 (NAVD88)	9
3 Methods	10
3.1 Introduction	10
3.2 Hydrographic surveys of the Mississippi River from 1880 and 1915	10
3.3 State-wide spirit-level surveys	12
3.4 National Geodetic Survey (NGS) database and datasheets	12
3.5 Post-1915 hydrographic surveys and maps	14
3.5.1 Introduction	14
3.5.2 Mississippi River benchmark book (MRC 1915b)	15
3.5.3 1933 Navigation book (MRC 1933)	16
3.5.4 1937 Hydrographic Survey (USACE 1937b)	16
3.5.5 1937 Hydrographic survey (USACE 1937a)	16
3.5.6 Batchelor 15-minute topographic map (MRC 1941)	17
3.5.7 1952 Hydrographic survey (USACE 1952) and stages and discharges of the Mississippi River and its outlets and tributaries (MRC 1953)	17
3.5.8 Artonish 15-minute topographic map (MRC USGS 1955)	18
3.5.9 1963 Hydrographic survey (USACE 1963)	18
3.5.10 1975 Hydrographic survey (USACE 1975)	18
3.5.11 1985 Hydrographic survey (USACE 1985)	18
3.5.12 1992 Hydrographic survey (USACE 1992)	18
3.5.13 2004 Hydrographic survey (USACE 2004a)	19
3.5.14 2013 Hydrographic survey (USACE 2013)	19

4	Geology	20
4.1	Introduction.....	20
4.2	General stratigraphy.....	20
4.3	Surface geology and environments of deposition	22
4.4	Regional subsidence	25
4.5	Subsidence in the study area	27
5	Mississippi River Commission (MRC) Benchmark Data	29
5.1	Introduction.....	29
5.2	Descriptions of marks and datums	29
5.3	MSL elevation (USGS 1916a,c).....	33
5.4	NGVD29 elevation	33
5.5	NAVD88 elevation.....	36
5.6	Vertical datum summary.....	36
5.7	Subsidence of benchmarks	37
5.8	Low water reference plane (LWRP).....	37
6	Summary, Conclusions, and Recommendations.....	40
6.1	Summary.....	40
6.2	Conclusions.....	40
6.3	Recommendations	41
	Bibliography	43
	Appendix: Benchmark Data Sheets.....	47
	Unit Conversion Factors	82
	Acronyms and Abbreviations	83
	Report Documentation Page	

Figures and Tables

Figures

Figure 1. Study area limits with topographic features and river miles.....	3
Figure 2. Historic datum planes used by the MRC in the LMV before 1929.	4
Figure 3. Notes from sheet 60b (MRC 1915a) regarding the vertical datum and types of benchmarks depicted on the maps.....	11
Figure 4. MRC benchmark name and elevations in Memphis and MGL datums, from sheet 60b (MRC 1915a). Mark is identified as N.E. Base (MRC) and LI (USCGS).....	11
Figure 5. Benchmark entry in USGS (1916a) describing the N.E. Base/LI benchmark and elevation in MSL in the Fort Adams Quadrangle area.	12
Figure 6. Longitudinal profile showing general Mississippi River stratigraphy with study area at upper end of Gulf of Mexico geosynclinal basin (Fisk 1943, 1944).	21
Figure 7. Cross-valley section F-F' near the vicinity of the LSOS (Saucier 1994). Section extends across the alluvial valley and view is looking north.	22
Figure 8. Environments of deposition on the Artonish 15-minute engineering geology map (Saucier 1964). Note the location of cross section A-A' (Figure 9).....	23
Figure 9. Cross section A-A' with environments of deposition mapped in profile. View is looking upstream (Saucier 1964).....	24
Figure 10. Rates of vertical change along major transportation routes in Louisiana and Mississippi (Shinkle and Dokka 2004).	26
Figure 11. Subsidence rates (millimeters/year) in southern Louisiana and Mississippi in the last 50 years (Dokka 2006).....	28
Figure 12. MRC benchmarks obtained from MRC (1915a).	32
Figure 13. LWRP changes between 1937 and 2005 (after USACE 2004a).	39

Tables

Table 1. Hydrographic survey and map datum characteristics.....	15
Table 2. MRC benchmarks and elevations, elevation headings are Memphis Datum (MD), Mean Gulf Level (GL), Mean Sea Level (MSL), National Geodetic Vertical Datum 1929 (NGVD29), North American Vertical Datum 1988 (NAVD 88).	30
Table 3. MRC benchmarks with PID related to NGS database. Datasheets are in the appendix.	35

Preface

The research documented in this report was conducted for the US Army Corps of Engineers (USACE), Mississippi Valley Division (MVD), as part of the Mississippi River Geomorphology and Potamology (MRG&P) Program, Project No. 492764 under a Cross Charge Labor Code. The MRG&P Program is part of the Mississippi River and Tributaries Project and is managed by the USACE MVD and Districts. At the time of publication of this report, the MRG&P program director was Dr. James W. Lewis. The MVD commander was MG Diana M. Holland, and the MVD director of programs was Mr. Edward E. Belk.

At the time of publication of this report, Mr. Christopher G. Price was chief of the Geotechnical Engineering Geosciences Branch, Geotechnical and Structures Laboratory (GSL), US Army Engineer Research and Development Center (ERDC). Mr. James L. Davis was the chief of the Geosciences and Structure Division, Mr. Charles W. Ertle II was deputy director of GSL, and Mr. Bartley P. Durst was chief of GSL.

COL Christian Patterson was commander of ERDC, and the director of ERDC was Dr. David W. Pittman.

1 Introduction

1.1 Background

The Low Water Reference Plane (LWRP) at the Low Sill and Overbank Structures (LSOS), Concordia Parish, Louisiana, has increased in elevation since the structure was placed into service as observed by comparison of the decadal hydrographic surveys at the structure¹. Vertical datums used for elevation control along the Mississippi River in the vicinity of the LSOS have involved Memphis Datum (MD), Mean Gulf Level (MGL), Mean Sea Level (MSL), National Geodetic Vertical Datum 1929 (NGVD29), and the current-day datum, the North American Vertical Datum 1988 (NAVD88). These different datums were used for elevation control for past hydrographic surveys of the river to show ground surface elevation along the riverbank, for displaying channel bathymetry, and for establishing the LWRP or its equivalent (Mean Low Water [MLW], as an example).

Hydrographic surveys along the river were made approximately each decade after 1915 and incorporated these different legacy datums. The LWRP or its equivalent varies in elevation along its longitudinal profile due to the river's slope for the different decadal surveys. Both short- and long-term geomorphic changes in the study area were noted by Biedenharn et al. (2017)¹. Thus, inherent differences from the vertical datums used between the different surveys complicates comparison by introducing datum differences between past surveys and comparisons to the current day datum. These differences affect the identification of vertical control in channel geomorphology and bathymetry as well as changes in historic channel erosion, channel aggradation, and systematic trends regarding the decadal LWRP elevation.

1.2 Purpose

The purpose for this study was to examine existing and legacy benchmarks in the vicinity of the LSOS to understand changes in vertical elevation through time due to differences in the legacy datums that have been used.

¹ Kelley, J. R., J. B. Dunbar, and M. K. Corcoran. 2020. *Changes in the Forebay at the Old River Control Structure, Low Sill Area from 1963 to 2019*. ERDC/GSL Technical Note. Final Draft. Vicksburg, MS: US Army Engineer Research and Development Center.

1.3 Objectives

Objectives for this study were to compile a list of the legacy MRC benchmark locations, examine their elevation datasheets, and track reported elevation from these specific marks through time. The primary goal for understanding changes in benchmark elevation through time is to understand the contribution of the respective datum and its impact for comparison of historic hydrographic survey information.

1.4 Approach

The focus of this study was to examine historic benchmarks in the study area to determine the magnitude of elevation changes caused by the different legacy datums used by the USACE. Comparison of elevation values across these legacy datums has involved examination and georeferencing of historic hydrographic surveys to their geospatial coordinates, compiling a list of known benchmarks from these historic surveys, and comparing their elevation values against publications involving spirit leveling surveys in the Lower Mississippi Valley and the National Geodetic Survey database for benchmarks. This study describes methods and results obtained from tracking USACE benchmarks through time.

1.5 Scope

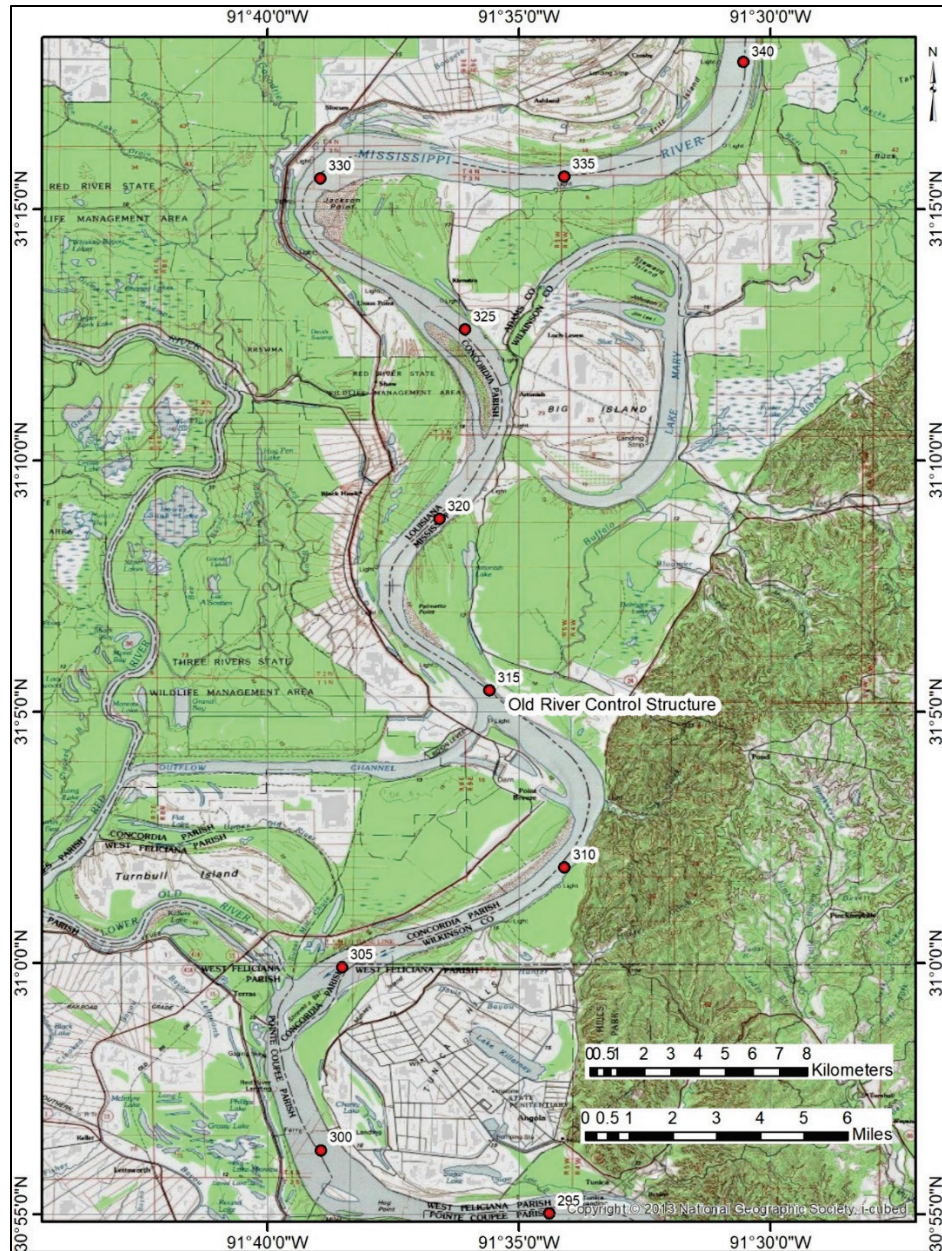
The scope of this study does not include field surveys of any benchmarks. This study was limited to evaluating the existing benchmarks that were identified on historic hydrographic surveys and examination of the individual benchmark data sheets that are available from the National Geodetic Survey (NGS) website (www.geodesy.noaa.gov). Activities performed during the course of this study involved reviewing the early leveling surveys in the study area, locating and evaluating the historic MRC hydrographic survey data from the study area, compiling a list of the early benchmark data, evaluating the benchmark data sheets, and preparing the following report.

1.6 Study area

The study area extends from river miles 300 to 336 above Head of Passes (Figure 1). This area incorporates parts of Concordia, Point Coupee, and West Feliciana Parishes in Louisiana, and Adams and Wilkinson Counties in Mississippi. The LSOS are located at the approximate midpoint of this river reach. The purpose for widening the area beyond the immediate

limits of the LSOS was to obtain a representative number of legacy benchmarks in addition to those in the immediate vicinity of the LSOS.

Figure 1. Study area limits with topographic features and river miles.

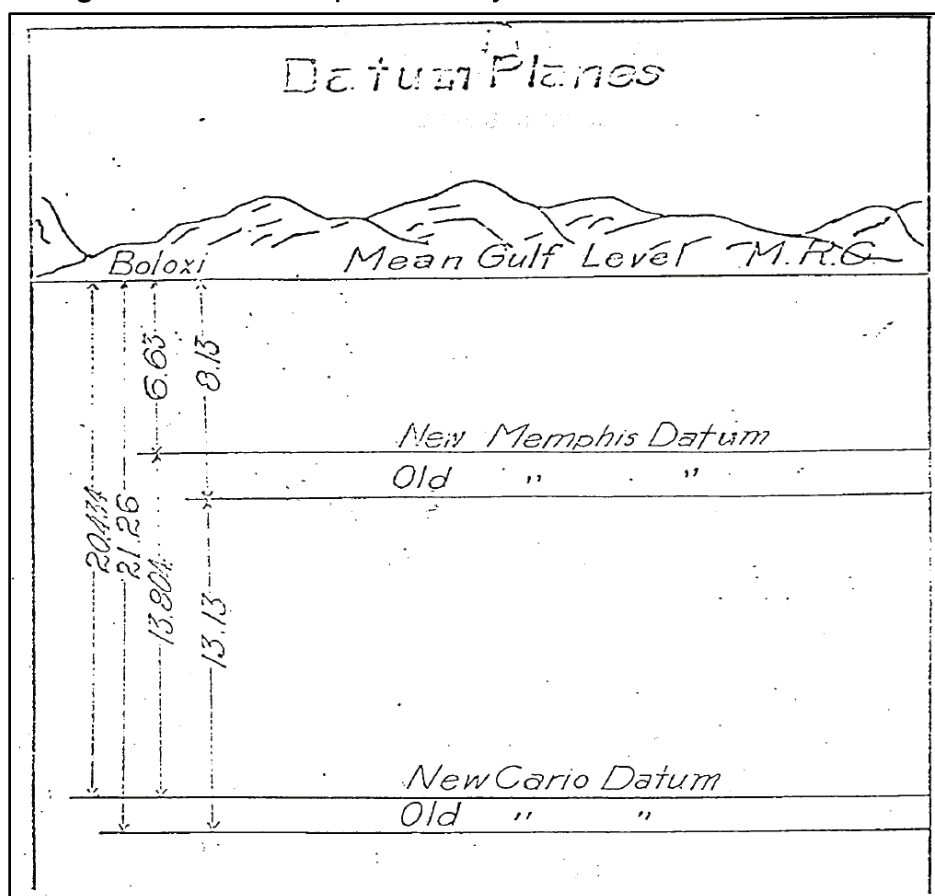


2 Vertical Datums Used in the Lower Mississippi Valley (LMV)

2.1 Introduction

A brief history and summary of the different datums that have been used to measure vertical control in the study area are presented. The chronology described herein is in order from oldest to youngest. Three legacy elevation datums have been used by the MRC prior to 1930 for surveys made on the Mississippi River. These legacy datums are identified as the Cairo datum, Memphis datum (MD), and MGL as shown by Figure 2. Vertical differences for these three datums are identified in Figure 2, and the relationship to MGL is described below.

Figure 2. Historic datum planes used by the MRC in the LMV before 1929¹.



¹ USACE. 1949. *Vertical Control*. Unpublished memo. US Army Engineer District, Vicksburg, Vicksburg, MS.

2.2 Cairo and Memphis datums

Prior to the MRC being established in 1879, an assumed vertical datum was established at Cairo, IL, in 1876 by Brevet Brigadier (BG) General Cyrus B. Comstock, US Army Corps of Engineers (USACE), in charge of field surveys at Cairo for the US Lake Survey. BG Comstock would later become President of the Mississippi River Commission (MRC) for two different periods: 1882 to 1884 and again in 1888 to 1895 (Camillo and Percy 2004). During the Civil War, BG Comstock was on General US Grant's staff and was his senior secretary. After the war, he became superintending engineer of the geodetic survey in charge of the Northern and Northwestern Lakes, and later for the progress of the Eads jetties at the mouth of the Mississippi River (Camillo and Percy 2004).

When the Cairo datum was established by BG Comstock, there was no connection by survey lines between Cairo and the Gulf of Mexico to accurately fix the elevation between these two points. The Cairo datum was based on the MLW on the Cairo gauge of 9.16 ft¹, and an arbitrary plane was established 300 ft below this water level. This datum would serve as a temporary vertical reference for many years before accurate elevation control was established with the Gulf of Mexico and this datum was abandoned.

BG Comstock in 1877 established a similar datum at Memphis, TN, as no direct level connection existed between Cairo and Memphis. The Memphis Datum was arbitrarily set at 225 ft below the high water mark of 23 June 1858, with a gage reading of 34.16 ft on the Memphis gauge. A precise level survey was completed by 1880 between Memphis and Cairo, and the Cairo datum was fixed at 13.3 ft below the MD.

Hydrographic surveys that were made on the Mississippi River in 1879–80 and 1914–15 in the LMV incorporate and or reference the Cairo and Memphis datums. Based on information presented in Figure 2, conversion of the older Memphis datums to MGL is accomplished by subtracting a

¹ For a full list of the spelled-out forms of the units of measure used in this document, please refer to *US Government Publishing Office Style Manual*, 31st ed. (Washington, DC: US Government Publishing Office 2016), 248-52, <https://www.govinfo.gov/content/pkg/GPO-STYLEMANUAL-2016/pdf/GPO-STYLEMANUAL-2016.pdf>.

value of 6.63 ft from the posted elevation values¹. Discussion about the conversion of these two datums to MGL is continued next.

2.3 Mean Gulf Level (MGL)

The MGL was the first sea level datum established for the Mississippi Valley. The MRC in 1881 established a tide gauge station at Biloxi, MS, with a preliminary value of MGL based on the average of readings between 28 May to 13 October 1882. A precise level survey was eventually made in 1882 between Carrollton, LA, and Biloxi, MS, which made possible the connection to the Cairo and MD to MGL² (Elliott 1932). The Memphis datum was found to be 8.13 ft below MGL. This average value was used until 1899 when a new MGL value was established, based on a longer, 5 yr record of sea level readings.

Both the Cairo and Memphis level lines were subsequently rerun and adjusted to obtain a new value for MGL in 1899. The Cairo datum was set at 20.434 ft below MGL and the Memphis datum was set at 6.630 ft below MGL (Figure 2). The MRC officially established the new value for MGL on 21 June 1899. Some of the post-1927 flood-control engineering was constructed using this elevation base (Elliott 1932). MGL was made obsolete for a USACE datum except for historical studies in 1941, and there is no single equation which may be applicable to convert MGL to MSL in the LMV¹.

2.4 Mean Sea Level (MSL) (1912 and 1929)

Establishing a network of elevation benchmarks along the Mississippi River was an ongoing effort by the MRC to establish vertical control along the river corridor. The MRC published in three volumes in 1915, *Permanent Marks, Survey of the Mississippi River from Cairo to the Gulf of Mexico*, the benchmark descriptions used to establish vertical control in the LMV¹ (MRC 1915b). A complete copy of this three-volume set has not yet been found for examination and review. The US Army Engineer Research and Development Center (ERDC) Library has not been able to locate a complete set of the three volumes for study. The only known volume from this set is volume 1, which was found at the MRC Headquarters in Vicksburg, MS.

¹ USACE. 1949. *Vertical Control*. Unpublished memo. US Army Engineer District, Vicksburg, Vicksburg, MS.

However, the benchmark locations and values are identified on the 1879–1880 and 1913–1915 hydrographic surveys.

The US Coast and Geodetic Survey (USCGS) in 1912 standardized and adjusted selected benchmark elevations in the LMV to MSL (USCGS 1914). This adjustment was based on results of additional level surveys and compilation of all the known benchmarks by the USACE, the MRC, the Missouri River Commission, and other government agencies (USCGS 1914).

Elevations based on this adjustment were published by the US Geological Survey (USGS) for the respective states involved (USGS 1916a,b,c). An MSL datum was established in 1912 by the 4th General Adjustment of the Precise Level Net in the United States and the resulting Standard Elevations (USCGS 1914). The next adjustment occurred in 1929 with the addition of more reference stations to the network as described below. The background history of the MSL datum is further described here because it directly relates to the legacy of MRC benchmarks in the study area.

The number of tide station benchmarks and the length of precise level lines increased across the United States during the early 1900s by the USCGS (Zilkoski and Young 1985). It grew from five tide gauges in the network in 1900 (Boston, MA; Sandy Hook, NJ; Washington DC; New York, NY; and Biloxi, MS) to eight in 1903 and to nine stations by 1912.

This increase also involved vertical adjustments to benchmarks in the network as the leveling lines increased, with a total of 31,789 km in 1903; 38,359 km in 1907; and 46,462 km in 1912. An important network adjustment for vertical control occurred again in 1929 with the addition of the Canadian network. Together, the two networks accounted for nearly 107,000 geodetic quality level lines and comprised 21 tide stations in the United States and 5 tide stations in Canada (Zilkoski and Young 1985). This larger network of 26 tide gage stations in North America established the Sea Level Datum of 1929 (MSL 1929).

Both the 1912 and 1929 General Adjustments by the USCGS established local MSL at the various tide stations at the 0 ft elevation. The datum was defined by the observed heights of MSL at 12 tide gauges (1912) and then 26 (1929) tide gauges, and by the set of elevations of all benchmarks resulting from the 1912 and 1929 adjustment. The net difference for the adjustment between MSL 1929 and MSL 1912 is 0.48 ft. MSL 1912 is 0.48 ft higher than

MSL 1929 (Zenk 2012). Thus, early MRC benchmarks were referenced to MSL 1912 and MSL 1929 and were tied to the Biloxi gauge.

It was recognized during the 1929 adjustment that these tide stations could not be on the same equipotential surface because of local effects involving sea-surface topography, currents, water temperature, salinity, barometric pressure, and geological influences (gravity, uplift, subsidence, etc.) (Zilkoski and Young 1985). However, it was believed at this time that the differences were relatively minor and on the order of those observed from terrestrial level errors. In reality, the magnitude of the difference was estimated to be as much as 0.7 m from coast to coast (Zilkoski and Young 1985).

During the period from 1934 to 1939, a significant amount of first- and second-order leveling was run by the USACE and USCGS. Much of this work could not be fitted within allowable error limits, and at the request of the MRC, a supplementary adjustment of the entire alluvial valley region was made in 1941 by the USCGS¹. The difference between the 1929 and 1941 adjustments were negligible, and the question of vertical datum in this region was thought to have been settled for all time¹. This period was responsible for a new set of benchmarks being installed in the study area. This set of benchmarks was sequentially numbered and were located along both sides of the river in the study area.

2.5 National Geodetic Vertical Datum 1929 (NGVD29)

A change in terminology occurred in May 1973 with the Sea Level Datum of 1929 being renamed to the NGVD29 (Federal Register 1973). This datum was not MSL, and it was not based on a geoid model or any other equipotential surface. Therefore, it was renamed NGVD29 to reflect the legacy of points and elevations expressed by this datum.

In terms of this study, many of the early benchmarks that were first surveyed in the study area using MD and MGL were superseded by elevations using the 1912 Adjustment for MSL. These benchmark elevations were first reported using the Memphis Datum, followed by MGL, and then MSL using both the 1912 and 1929 Adjustments. Specific

¹ USACE. 1949. *Vertical Control*. Unpublished memo. US Army Engineer District, Vicksburg, Vicksburg, MS.

reporting of the benchmark elevations from the study area and the different datums will be described in a separate chapter of this report.

2.6 North American Vertical Datum 1988 (NAVD88)

A new vertical datum was established in 1991 with the next adjustment, which included the Canadian, Mexican, and US leveling observations. This datum consists of a leveling network across the North American continent, ranging from Alaska, through Canada, and throughout the United States, and consisted of an additional 625,000 km of leveling surveys after 1929 (<https://www.ngs.noaa.gov/datums/vertical/north-american-vertical-datum-1988.shtml>). Distortions amounting to as much as 9 m were observed to bring the new leveling to fit older NGDV29 height values. This datum is referenced to a point at Pointe-au-Pere, Rimouski, Quebec, Canada. The datum is based on the earth's gravity and uses a geoid as a surface for deriving height. Elevations are expressed by their orthometric height above an imaginary surface called the geoid, which is determined by the earth's gravity and approximated by MSL and is reported as elevations NAVD 1988, or NAVD88.

3 Methods

3.1 Introduction

Benchmark information used in this study involved three major sources. The first involves the historic hydrographic surveys by the MRC, especially those early surveys from 1879 to 1880 and 1914 to 1915 (MRC 1880; 1915a). The second category contains the results of the state-wide spirit leveling surveys performed in 1912 in Louisiana (USGS 1916a) and Mississippi (USGS 1916c). Last, the benchmark data sheets from the NGS website provide information about the benchmark, type, reference number, responsible agency, current elevation if applicable, and any superseded elevation data. These information sources are further described to provide the background framework upon which this study was conducted.

3.2 Hydrographic surveys of the Mississippi River from 1880 and 1915

Mississippi River hydrographic surveys from 1879 to 1880 (MRC 1880) and 1914 to 1915 (MRC 1915a) are centrally important to this study. These two surveys were the source for the benchmark locations and their naming by the MRC. Digital scans of the hydrographic sheets from the study area sheets were georeferenced to their geospatial (latitude and longitudinal) coordinates for horizontal control to permit comparison to later historic maps and surveys. Locations and the reported elevations for each benchmark were digitized from these source maps using the ESRI ArcMap software. Benchmarks were referenced to their spatial coordinates to create a table of the benchmarks that were present in the study area in 1915 and their reported elevations.

Details are presented here regarding the type of information contained on these early surveys. Benchmark symbols identified and described in the Notes section from sheet 60c are presented in Figure 3 (MRC 1915a). Three types of symbols were used to depict the marks for horizontal and vertical control: triangulation stations, precise level benchmarks, and ordinary benchmarks as shown by the legend.

Additionally, the portion of the 1915 survey shown in Figure 4 identifies the name of the benchmark and the corresponding elevations for the benchmark in both the MD and MGL or GL.

Figure 3. Notes from sheet 60b (MRC 1915a) regarding the vertical datum and types of benchmarks depicted on the maps.

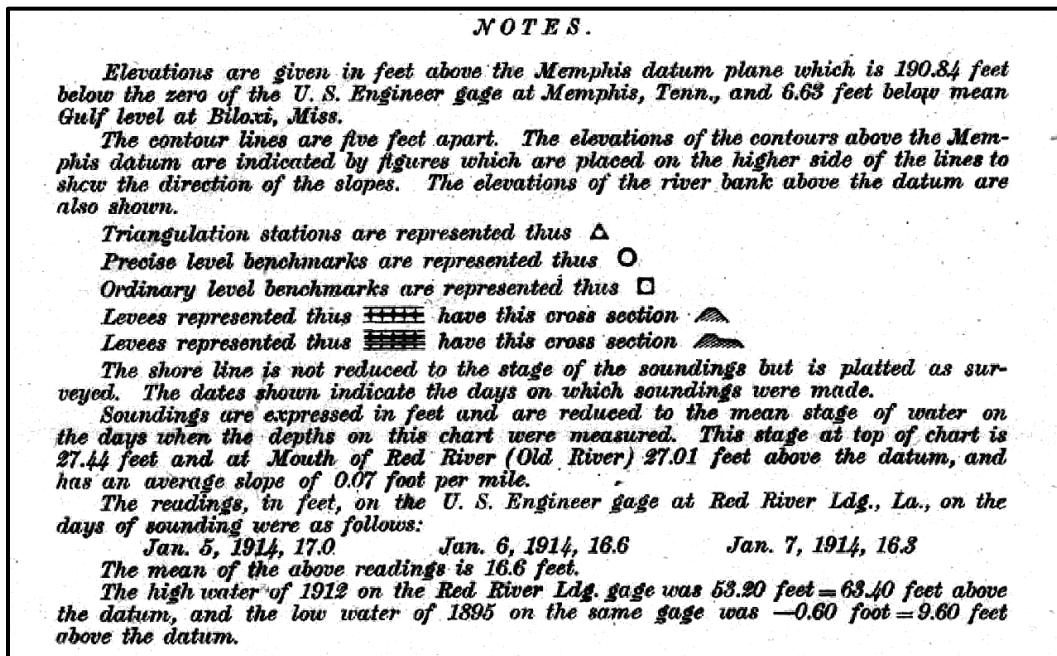
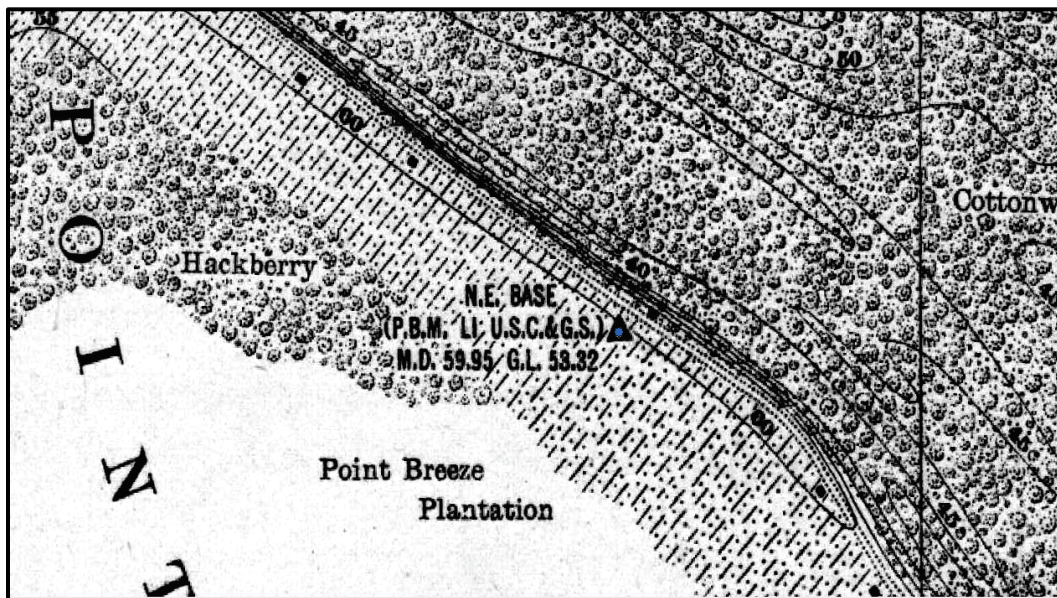


Figure 4. MRC benchmark name and elevations in Memphis and MGL datums, from sheet 60b (MRC 1915a). Mark is identified as N.E. Base (MRC) and LI (USCGS).



The vertical difference between MD and the GL datum in Figure 4 is 6.63 ft (see also Figure 2).

3.3 State-wide spirit-level surveys

The next task was to determine the benchmarks from the MRC (1915a) hydrographic survey that were identified by the USGS (1916a,c). These two publications involving Louisiana and Mississippi are important because of their reporting of benchmark elevations in feet MSL. Thus, the legacy MRC benchmarks on MRC (1915a) are identified by USGS (1916a,c) and are now related to three early datums: MSL, MGL, and MD. The USGS (1916a) entry for N.E. Base is shown in Figure 5.

Figure 5. Benchmark entry in USGS (1916a) describing the N.E. Base/LI benchmark and elevation in MSL in the Fort Adams Quadrangle area.

ELEVATIONS BY THE COAST AND GEODETIC SURVEY.		59
FORT ADAMS QUADRANGLE.		
[Latitude 31°-31° 07' 30''; longitude 91° 30'-91° 37' 30''.]		
Near Point Breeze.		
Point Breeze, 1 mile below the upper end of, on land of G. W. Reagan, 80 meters above the line fence between Reagan and Lemley, about 45 meters back of the road along the top of the main right bank, 7 meters south of the southwest corner of the garden fence back of the negro cabin owned by Eli Lennox, 23 meters southwest of the cabin, in the top of a stone monument, 14 inches square on top, standing nearly flush with the ground in a cotton row; top of a copper bolt (U. S. C. E. p. b. m. LI=triangulation station N. E. base).....		Feet. 53.271

Noteworthy for this benchmark example is the vertical difference in elevation between MSL (53.271 ft) in Figure 5 and MGL (53.32 ft) in Figure 4, corresponding to a vertical difference of only 0.049 ft.

3.4 National Geodetic Survey (NGS) database and datasheets

The NGS has a website to access benchmark locations and data. Their website permits pulling the respective datasheets at <https://geodesy.noaa.gov/datasheets/index.shtml> describing the benchmark. These data for each state are also available as an ESRI shapefile for download for use in ArcMap at ftp://ftp.ngs.noaa.gov/pub/DS_ARCHIVE/BETA_PRODUCTS/. Shapefiles for the Louisiana and Mississippi benchmarks were downloaded to examine and evaluate benchmark data from the study area.

County and parish benchmark data for the study area were extracted from the state-wide shapefiles. The NGS county-parish subset was then compared to the MRC benchmark locations. MRC benchmarks in close

proximity to the NGS locations were examined to verify they matched the legacy benchmark name for the information provided.

Exact location matches for MRC benchmarks and those in the NGS database were not expected because of differences in georeferencing of older surveys and other inherent sources of error. The earlier MRC surveys were originally tied to the MRC (or Memphis) horizontal datum instead of the North American Datum of 1927 (NAD27).

A brief explanation about the MRC-Memphis horizontal datum is provided for background information before proceeding with the datasheet discussion. In the period 1905 to 1910, the MRC established a network of third-order triangulation stations along the Mississippi River based on astronomical observations at Memphis, TN, and Natchez, MS¹. Early hydrographic surveys and maps by the MRC are based on the results of this triangulation. The USCGS in 1929 established a network of first-order triangulation stations in the Mississippi River valley making available a connection to the NAD27. Most of map production by the USACE adopted NAD27 as the official horizontal datum by the mid-1940s. The MRC-Memphis horizontal datum was routinely used until the late 1930s.

The horizontal difference between the MRC-Memphis and NAD27 datums amounts to between 74 to 84 ft in latitude and 3 to 15 ft in longitude, with the MRC datum being north and west of the NAD27 position¹. Registration marks for the MRC-Memphis datum were generally included on all published hydrographic surveys including the 1962 survey (MRC 1963). After this time, the inclusion of the MRC-Memphis datum ticks was generally discontinued.

Horizontal control in the LMV after 1941 was based on the North American datum of 1927¹. Thus, early MRC surveys and benchmark locations derived from these surveys are not an exact match with those shown by NGS locations. Horizontal datum issues and errors inherent with the georeferencing process will not create an exact match between NGS and locations on MRC (1915a). The georeferencing process has inherent errors because of the source of the maps themselves. These involve their paper origin, distortions caused by changes in humidity, which directly affects the paper, cartographic errors introduced during the

¹ USACE. 1949. *Vertical Control*. Unpublished memo. US Army Engineer District, Vicksburg, Vicksburg, MS.

map drafting and production process, as well as the map scanning and georeferencing process.

The NGS website requires the unique benchmark identification number to obtain the respective NGS benchmark datasheet. This number is called the Permanent Identifier (PID), which is contained in a field in the attribute table for the NGS benchmark shapefile. The PID number is required to manually pull the respective datasheet from the NGS website using its interactive tool to retrieve these sheets. There is also a link in the ESRI shapefile attribute table that can be hyperlinked to the NGS website and will permit a summary datasheet to be viewed in real time. Unfortunately, the hyperlink does not allow reporting of the older superseded elevation values (MSL and NGVD values) and requires manually pulling the datasheet from the NGS website for the older elevation reported for the subject benchmark.

The NGS website and the shapefile database reports elevations in NAVD88. Sometimes the datasheet contains the superseded elevations in NGVD29. If there is any movement suspected, the NAVD88 elevation value is not reported. Benchmark subsidence is further described in the next chapter.

The example benchmark identified in Figure 4 does not appear in the NGS database, and its location is not reported by the state-wide shapefile, despite its identification as a USCGS mark, which officially changed its name in 1970 to the NGS.

Contained in the appendix are the datasheets for known MRC benchmarks in the study area that have a valid PID number. These sheets are examples of the information available for the respective marks. Benchmark data sheets in the appendix are described in more detail in a subsequent chapter as they become relevant to this study.

3.5 Post-1915 hydrographic surveys and maps

3.5.1 Introduction

This section examines maps and hydrographic surveys that post date the 1915 survey (MRC 1915a). A brief summary is presented about the different data sources in their chronological order. Table 1 identifies and summarizes the survey and/or map year, type of data, and the horizontal

and vertical datums used to present the information, along with the reference source described in the reference section. Additionally, the map sheets used in this study for each survey are identified here for reference purposes.

Table 1. Hydrographic survey and map datum characteristics.

Survey	Type	Horizontal Datum	Vertical Datum	Map Sheets	Reference
1879-1880	Hydrographic Survey	Memphis	Memphis	59-60	MRC 1880
1914-1915	Hydrographic Survey	Memphis	Memphis and MGL	60a, 60b, 60c	MRC 1915
1933	Navigation Book	Memphis	MGL	36-38	MRC 1933
1937	Hydrographic Survey	Memphis	MGL	46-51	USACE 1937
1941	MRC Topographic Map	NAD 1927	MGL	Batchelor 15-min	MRC 1941
1949-1952	Hydrographic Survey	Memphis	MSL	1-2	USACE 1955
1955	MRC-USGS Topo 15-min	NAD 1927	MSL	Artonish 15-min	MRC and USGS 1955
1961-1963	Hydrographic Survey	NAD 1927, Gulf Coast	MSL	1-8	USACE 1965
1973-1975	Hydrographic Survey	NAD 1927	MSL	1-8	USACE 1975
1983-1985	Hydrographic Survey	NAD 1927	NGVD1929	1-8	USACE 1985
1991-1993	Hydrographic Survey	NAD 1983	NGVD1929	1-8	USACE 1992
2004	Hydrographic Survey	NAD 1983	NAVD 1988	1-8	USACE 2004a
2013	Hydrographic Survey	NAD 1983	NAVD 1988	1-8	USACE 2013

The limits of the various surveys are not identical in terms of their origin in the study area. The 1937 and 1952 surveys begin at Angola, LA (river mile 303), while the later surveys begin at Black Hawk, LA (river mile 321.8). Thus, identical coverage does not exist among the different surveys described. MRC Benchmarks shown on the 1915 survey were examined here for inclusion on the later surveys and maps to determine their presence and general reporting through time for the respective coverages.

A large number of the legacy hydrographic surveys that are described here are available in digital format from a New Orleans District website at the following link: https://www.mvn.usace.army.mil/Missions/Engineering/Geospatial-Section/MRHB_Historic/.

3.5.2 Mississippi River benchmark book (MRC 1915b)

As previously noted, the MRC (1915b) published a three-volume set: *Descriptions, Elevations, and Geodetic Positions of Permanent Marks Survey Mississippi River*¹. Unfortunately, the volumes that pertain to the study area covered by this three-volume report have not been located for review as previously described. However, the benchmark locations and their elevations were identified on the respective 1915 hydrographic survey sheets (MRC 1915a). Missing from the 1915 maps are the descriptions of the marks in terms of their location description, landowner information, type of mark (stone, pipe, rock, etc.), and other salient characteristics (e.g.,

¹ USACE. 1949. *Vertical Control*. Unpublished memo. US Army Engineer District, Vicksburg. Vicksburg, MS.

survey year, purpose). Likely this information is similar to the description in Figure 5.

3.5.3 1933 Navigation book (MRC 1933)

Newer benchmarks than those shown on the MRC (1915a) hydrographic survey are identified on an early Navigation Book by the MRC (1933). *Maps of the Mississippi River, Cairo, Illinois, to the Gulf of Mexico* presents a set of maps at a scale of 1:62,500, in a Mississippi River Navigation Book format, and was probably the first publication in the Navigation Map Book series.

This map set uses NAD 1927 for horizontal control and MGL for vertical control. Noteworthy are the sequential benchmarks that postdate the MRC (1915a) survey and the newer benchmarks identified. These newer benchmarks occur on both the right and left descending banks. These benchmarks are fairly orderly in terms of their numbering and distance apart, ranging between 3,000 and 7,500 ft. Elevation values for these newer marks are not shown on the navigation book.

3.5.4 1937 Hydrographic survey (USACE 1937b)

This Mississippi River hydrographic survey from October 1937 by the New Orleans District begins at Angola, LA. The vertical datum is in MGL. Horizontal control is referenced to the Memphis Datum. Unfortunately, only sheet 50 from the southern limits of the study area was available for examination at the vicinity of Angola, LA. at

https://www.mvn.usace.army.mil/Missions/Engineering/Geospatial-Section/MRHB_Historic/MRHB_1935/. MRC benchmarks from the 1915 survey are shown on sheet 50 along with their elevation values in MGL.

3.5.5 1937 Hydrographic survey (USACE 1937a)

The study area is covered by two hydrographic surveys that span both the Vicksburg and New Orleans District area of operations in 1937. The Vicksburg District survey begins at Vicksburg, MS, and extends to Angola, LA. The New Orleans District survey extends from Angola, LA, to Head-of-Passes. The Vicksburg area sheets between Blackhawk and Angola, LA, were obtained from the Vicksburg District for review. MRC benchmarks are shown on these maps but do not identify elevation values. The vertical

datum for the study is MGL. MLW is based on 40 yr of low water gage readings on regular gages from 1891 to 1930.

3.5.6 Batchelor 15-minute topographic map (MRC 1941)

The MRC was responsible for the production of 15 min topographic map coverage in the LMV prior to 1941. Contained on the Batchelor map from this period are levee stationing points, names of river landings, district boundaries, and the names of the benchmarks that are consistent with those from the 1915 survey sheets. The horizontal datum for the map is NAD27, and the vertical datum is MGL.

Contained within the legend and collar data from the 1941 Batchelor, LA.-Miss. 15 min topographic map is an important note about the relationship between MGL and MSL that states “Datum is mean gulf level at Biloxi, Mississippi. Elevations differ from mean sea level elevations as determined by the US Coast and Geodetic Survey, by small fractions of a foot.”

This note is important as it provides a direct linkage between MGL and MSL from an organizational (USACE and USCGS) context. Direct comparison of benchmark elevation values across different datums for individual benchmarks will be presented in Chapter 5 of this report. This section is intended to provide an overview of the sources of information that were examined as part of this study.

3.5.7 1952 Hydrographic survey (USACE 1952) and stages and discharges of the Mississippi River and its outlets and tributaries (MRC 1953)

This hydrographic survey begins at Angola, LA, in the southern portion of the study area and presents the 1915 benchmarks along with their reported elevations. A check of these elevation values against the 1915 survey indicates the 1952 values are in MGL despite the map legend identifying all elevations expressed in feet and refer to MSL. The exact relationship between MGL and MSL identified on the Batchelor (MRC 1941) topographic map would imply that “small fractions of a foot” denotes equivalency on the 1952 benchmark elevations identified.

Another important publication from this time frame with references to MGL and NGVD1929 for river gages in the Middle and Lower Mississippi River (MLMR) is presented in *Stages and Discharges of the Mississippi*

River and its Outlets and Tributaries (MRC 1953). This document provides flow discharges for 1953 and contains the elevation values for MGL and NGVD 1929 for selected river gages along the MLMR.

3.5.8 Artonish 15-minute topographic map (MRC USGS 1955)

The 1955 Artonish 15-minute topographic map is a joint publication between the MRC and USGS (MRC USGS 1955). The horizontal datum for this map is NAD27, and vertical control corresponds to MSL. Elevation values for the named benchmarks are not shown. Included on the map are levee station, names of river landings, river miles, and the locations of the newer sequential benchmarks along both banks of the river.

3.5.9 1963 Hydrographic survey (USACE 1963)

This map series has both the Memphis and NAD27 horizontal datums identified. Vertical control is based on MSL. Elevation values for the different benchmarks are not displayed, but the name and/or number of the benchmark are identified. Shown on the 1963 maps are the locations and names of the 1915 benchmarks.

3.5.10 1975 Hydrographic survey (USACE 1975)

This set of maps has NAD27 for horizontal control and MSL for vertical control. The names for the 1915 and later MRC benchmarks have generally been omitted from the maps.

3.5.11 1985 Hydrographic survey (USACE 1985)

This set of maps has NAD27 for horizontal control and NGVD29 for vertical control. Also absent are the names of the benchmarks except for a few that were deemed important and/or significant because of current survey control.

3.5.12 1992 Hydrographic survey (USACE 1992)

This set of maps has NAD 1983 for horizontal control and vertical control is referenced to NGVD29. These maps follow the general trend where the names of the benchmarks are not identified.

3.5.13 2004 Hydrographic survey (USACE 2004a)

Vertical control for this series of maps is NAVD88. Horizontal control is NAD 1983. These maps follow the general trend where the names of the benchmarks are not identified.

3.5.14 2013 Hydrographic survey (USACE 2013)

Vertical control for this series of maps is NAVD88. Horizontal control is NAD 1983. These maps follow the general trend where the names of the benchmarks are not identified.

4 Geology

4.1 Introduction

The following section examines the geology of the study area and important considerations from a geological perspective in terms of factors directly affecting long-term benchmark stability involving regional subsidence and/or uplift. This section will examine the general stratigraphy, the surface geology, and potential subsidence issues that may affect the study area.

4.2 General stratigraphy

A generalized longitudinal profile of the Mississippi River stratigraphy from Cairo to the Gulf of Mexico is presented in Figure 6. This section illustrates the location of study area in relationship to its position in the alluvial valley. The study area is located in the alluvial valley section as reflected by the Miocene (5.3 to 23 million years (my)) sediments that outcrop in the valley walls on both the east and west sides of the valley (Figure 7). The study area is located a short distance upstream (< 50 mi) of the boundary between the alluvial valley and deltaic plain sections. Deltaic plain geology begins south of Baton Rouge, LA (Figure 7). This area was an embayment during Holocene sea level rise with maximum flooding of the embayment coinciding with the deepest part of the alluvial valley fill.

The cross-valley section in Figure 7 identifies the general Holocene stratigraphy between the upland valley walls as comprising a fine-grained top stratum and coarse-grained substratum deposits (alluvial aquifer), which are divided according to various ages of Mississippi River Holocene meander belt deposits (i.e., Holocene Mississippi meander (Hmm 1 to 3) caused by migration of the Mississippi River across its alluvial valley and creation of inset Pleistocene Prairie terraces.

Important to this discussion is the close proximity of the study area to the eastern valley wall and the outcropping Tertiary (Miocene) deposits on the east bank of the river (Figure 7). The presence of upland Tertiary deposits nearby, their age, and weathering over millions of years would imply long-term stability involving vertical movements during the short term.

Figure 6. Longitudinal profile showing general Mississippi River stratigraphy with study area at upper end of Gulf of Mexico geosynclinal basin (Fisk 1943, 1944).

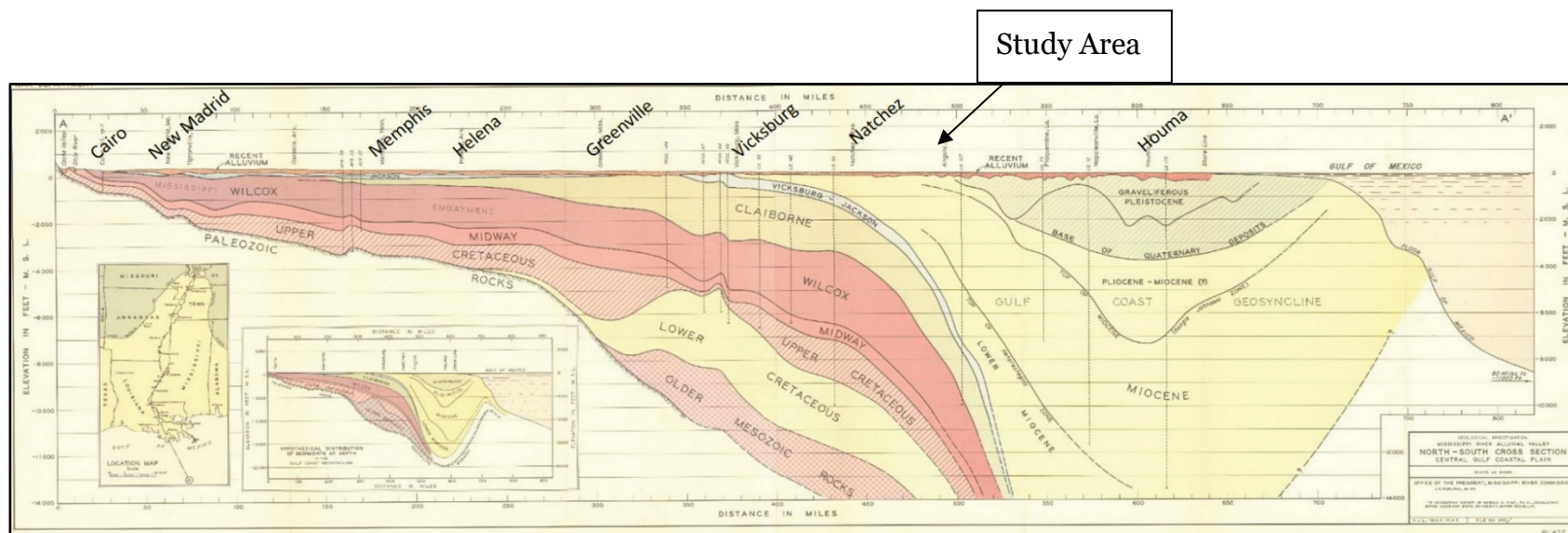
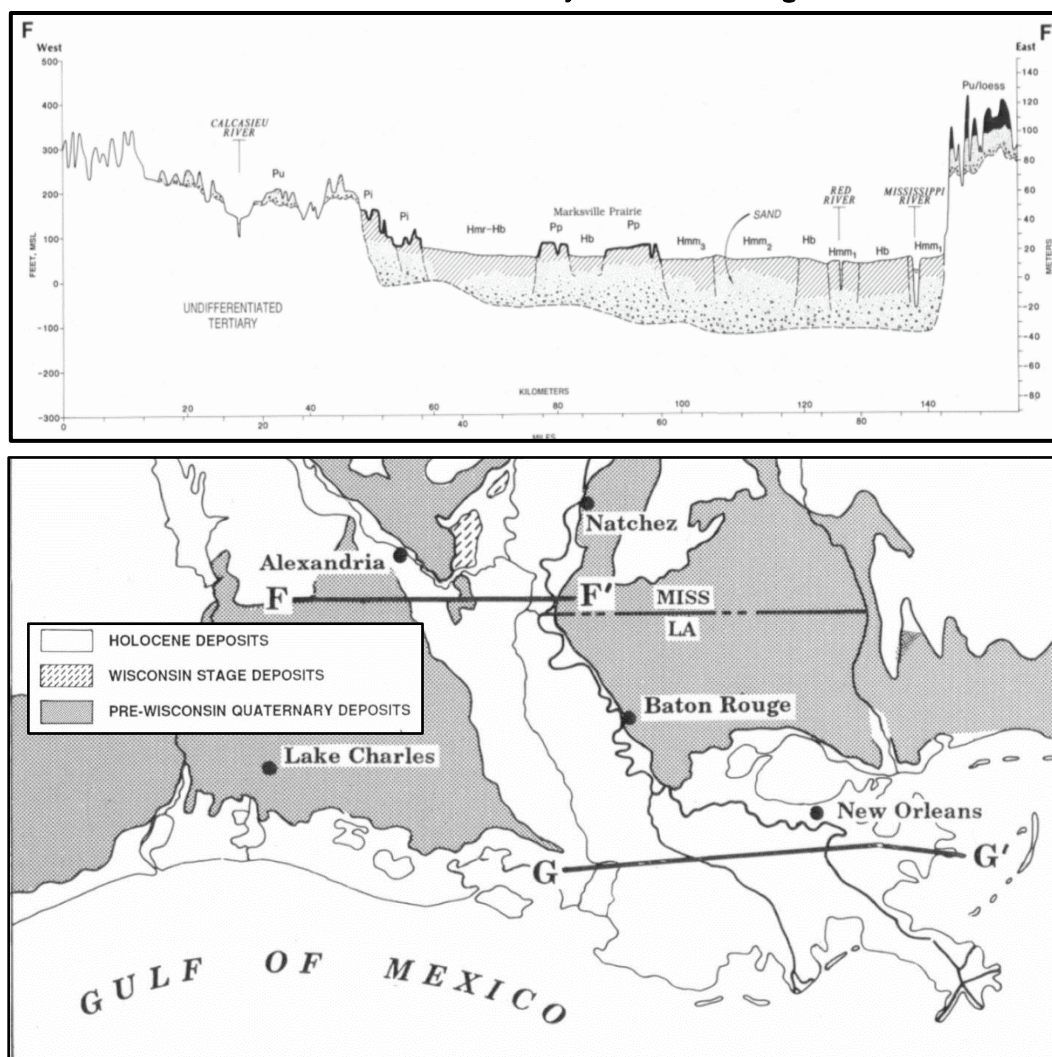


Figure 7. Cross-valley section F-F' near the vicinity of the LSOS (Saucier 1994). Section extends across the alluvial valley and view is looking north.



4.3 Surface geology and environments of deposition

A generalized surface geology map from the LSOS floodplain is presented in Figure 8. The floodplain surface in the study area consists primarily of natural levee, point bar, and backswamp deposits that are associated with the most recent Mississippi River meander belt (Hm1), which is less than 2,500 yr in Figure 7. The vertical extent of these deposits is shown by the representative cross section in Figure 9. This section crosses the river and is a view looking north. It extends onto the eastern valley wall, which is only a short distance from the river's edge. The Tertiary surface is relatively shallow along the east bank of the river and deepens to elevation 100 to 160 ft MSL on the west bank of the river.

Figure 8. Environments of deposition on the Artonish 15-minute engineering geology map (Saucier 1964). Note the location of cross section A-A' (Figure 9).

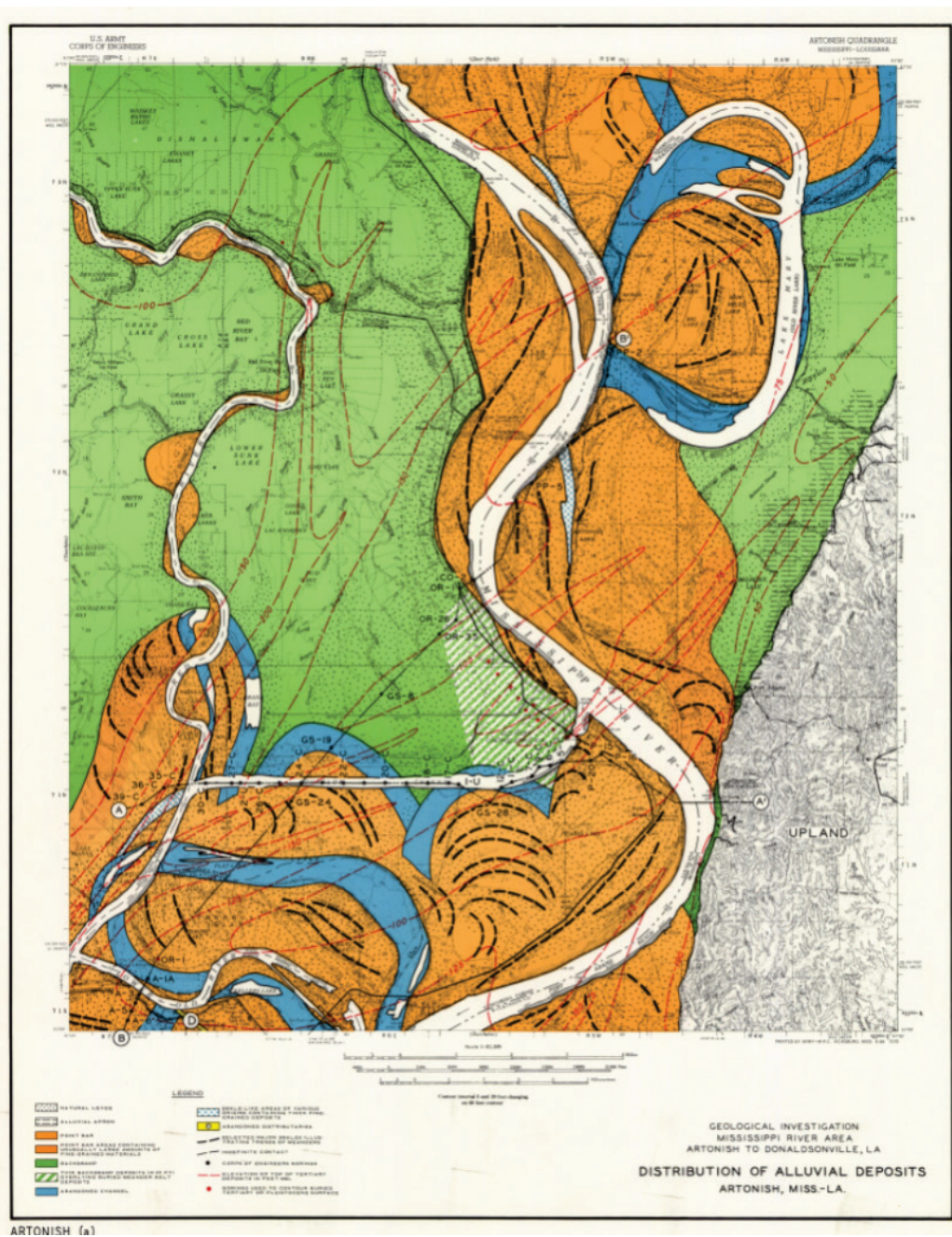
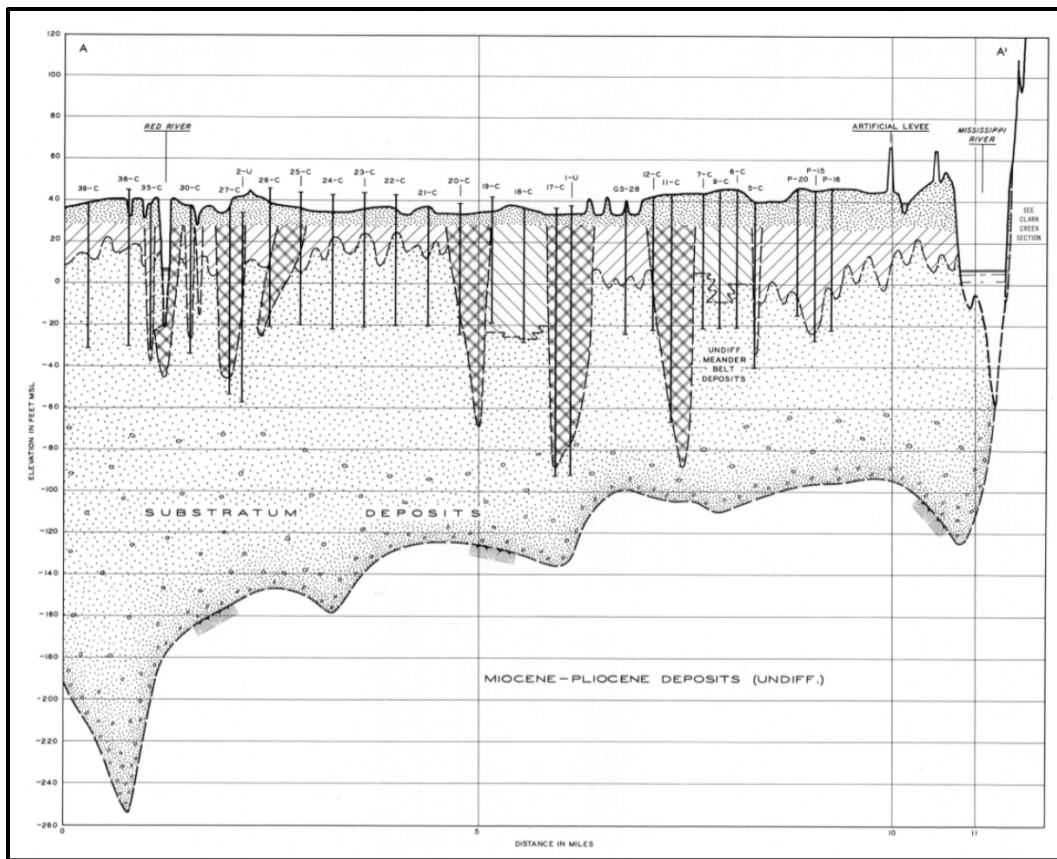


Figure 9. Cross section A-A' with environments of deposition mapped in profile. View is looking upstream (Saucier 1964).



The nearly west-to-east cross section identifies a variably thick fine-grained top stratum, which is overlain by silty natural levee deposits and underlain by fine to coarse substratum sands and gravels comprising the alluvial aquifer. In terms of their consolidation and compaction characteristics, point bar deposits are relatively stable in terms of their potential for vertical movements (Saucier and Dunbar 1993). Annual flooding and vertical accretion from overbank sedimentation on the landside have been limited by historic construction of artificial levees. However, riverside sedimentation onto the west and east bank of the Mississippi River has not been prevented.

Tertiary stratigraphy within the study area limits involves the upper Pascagoula and lower Hattiesburg Formations (Childress 1973). The Pascagoula Formation consists of green, gray and blue clays which are locally calcareous and fossiliferous. They are interbedded with green and gray sands. Thickness is over 1,000 ft. Overlying the Pascagoula formation is the Citronelle Formation.

Underlying the Pascagoula Formation is the Hattiesburg Formation, which consists of massive non-marine, blue and gray clay with minor sand and sandstone. Maximum thickness in Mississippi is 450 ft.

4.4 Regional subsidence

Regional subsidence is an important issue affecting benchmark stability long term. An important study involving regional subsidence and uplift in the LMV and the northern Gulf Coast was published by Shinkle and Dokka (2004). Their study looked at 2,700 benchmarks and the leveling data collected between 1920 and 1995 across Louisiana, Mississippi, Texas, and Alabama. Benchmarks along the major transportation corridors in these states were examined, and the rates of vertical velocity changes across the four states examined are shown in Figure 10.

The vertical velocities identified in Figure 10 in the Mississippi River Deltaic and Chenier Plains are not unexpected. These sediments are young (<7,500 yr) because of deltaic processes responsible for land formation in these areas. Additionally, these soft sediments have been undergoing active consolidation and compaction since they were deposited. High subsidence rates along the Kenner, LA, to Jackson, MS, route however are surprising, considering the Tertiary age and character of the stratigraphy crossed by the highway corridor where the benchmarks occur. Likewise, the trends for the Jackson, MS, to Monroe, LA, route are equally surprising as it crosses Tertiary, Pleistocene, and Holocene stratigraphy. These unconsolidated sediments range from marine to alluvial deposits, and these sediments range from a few thousand years old (floodplain deposits at Delta Point, LA) to millions of years. Uplift in eastern Mississippi and western Alabama identified by Figure 10 indicates the transportation corridor may have expansive foundation soils and regional scale processes, and tectonism is also at play.

extraction (0 to -3 mm/yr), water pumping (0 to -50 mm/yr), and salt evacuation (i.e., displacements involving the deep seated Louaan Salt layer beneath the Gulf Coast, 0 to -15 mm/yr). Dokka (2006) identifies the vertical motions as having a regional component associated with active Holocene loading of the crust by the Mississippi River's sediment mass onto the coastal plain.

4.5 Subsidence in the study area

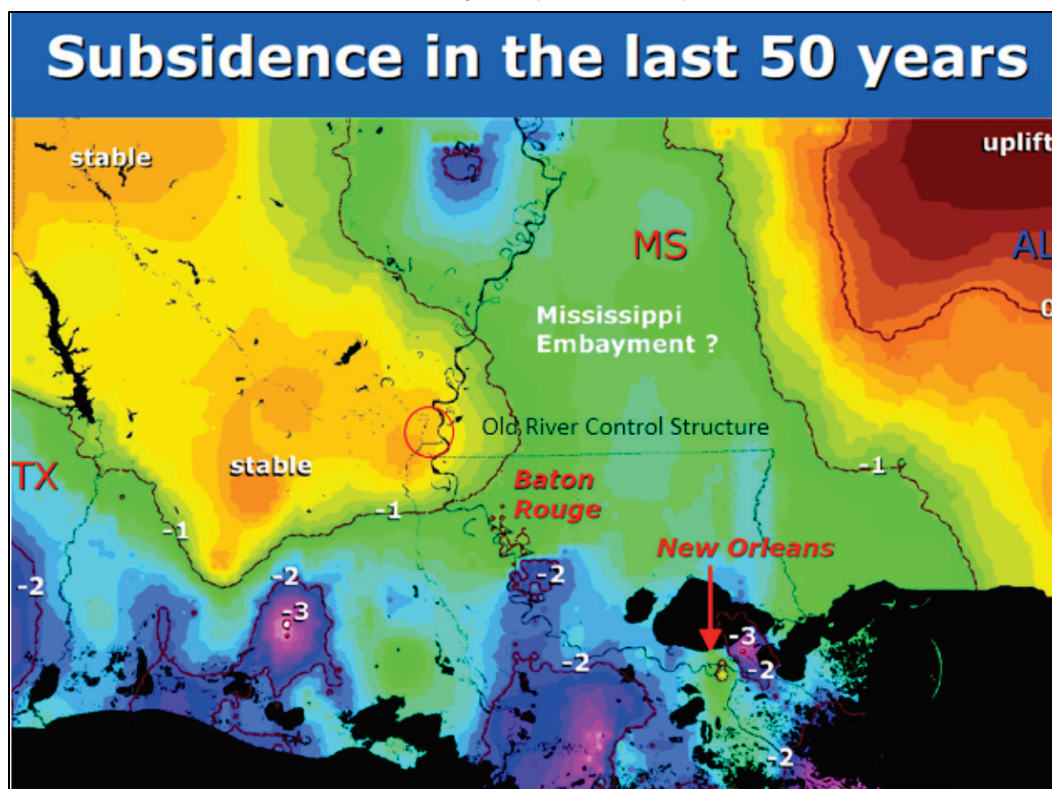
The preceding section has provided a general overview of regional stratigraphy, subsidence, and uplift trends and rates of vertical displacements from evaluation of leveling data across the major transportation corridors in four states. The current study is only concerned with the reach of river shown by Figure 1. The central question here is whether the studied benchmarks have been impacted by subsidence since their placement due to regional and tectonic processes.

Examination of the study area geology and its close proximity to the Tertiary stratigraphy in the uplands and beneath the river would suggest there should be little to no impact from subsidence. Confirmation of this viewpoint was provided by Dokka (2006) as shown by Figure 11.

The LSOS and the study area have been relatively stable during the past 50 years based on several complementary data sources. These include the vertical monuments for monitoring settlement at the LSOS, which have not identified any significant vertical movements. Next, the geology in terms of the river's location, which is in the alluvial valley section instead of the deltaic plain geographic section. Finally, the presence of Tertiary sediments outcropping nearby in the valley walls, and the river channel having incised into the Tertiary surface, indicates longer-term stability (Figure 9).

In summary, active subsidence areas occur farther south of the study area, in the deltaic plain section, where the Quaternary sediment mass is much thicker, relatively young, and where the Tertiary surface dips sharply beneath the Quaternary sedimentary deposits in the Gulf of Mexico synclinal basin (Figure 6).

Figure 11. Subsidence rates (millimeters/year) in southern Louisiana and Mississippi in the last 50 years (Dokka 2006).



5 Mississippi River Commission (MRC) Benchmark Data

5.1 Introduction

This chapter focuses on selected benchmarks from MRC (1915a) through time. The discussion first examines information contained in the notes section for both the 1880 and 1915 surveys (Figures 3 and 4) and important differences that are described between the two surveys.

5.2 Descriptions of marks and datums

There are 58 benchmarks in the study area that were identified on MRC (1915a) as shown by Figure 12. Benchmarks are fairly evenly distributed across the study area and are in close proximity to the river, along both banks. The majority of the benchmarks are located landside of the levee right-of-way. The names, latitude-longitude (lat-long) locations, and reported elevations for each mark are summarized in Table 2 (oversized table).

The lat-long coordinates shown on Table 2 require additional explanation. These coordinate pairs are derived from the georeferenced MRC (1915a) hydrographic survey sheets for the study area. These coordinates may differ in their exact location as reported on the NGS datasheets for those benchmarks. The PIDs were closely examined, and these shown in Table 2 are considered to be an exact match with the MRC (1915a) benchmark name and their general locations (Figure 12). The PIDs were obtained from the ESRI shapefile locations that closely match the corresponding MRC benchmark location.

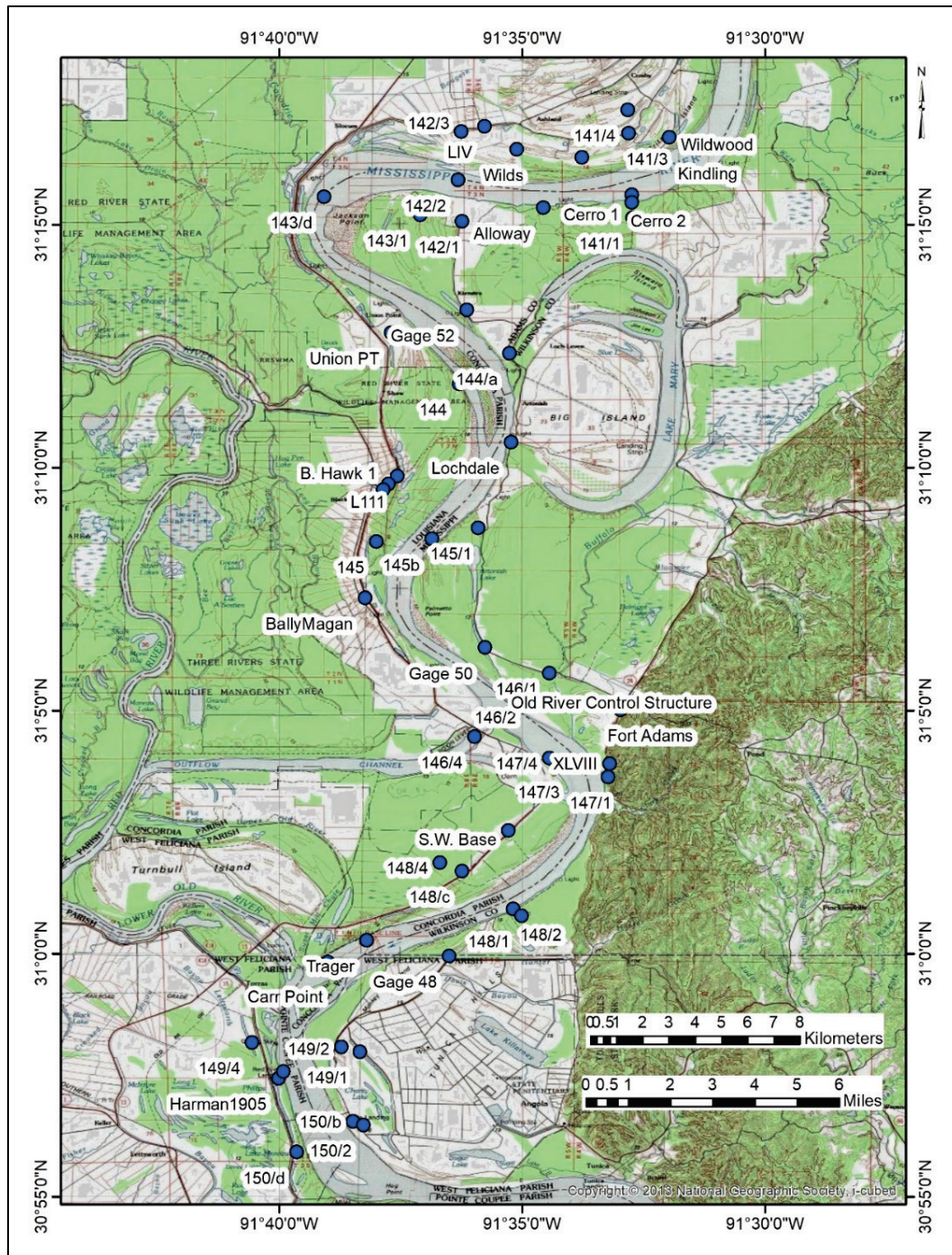
Forty-one benchmarks in Table 2 contained two elevations identified at their respective MRC (1915a) location. The two elevations corresponded to a stone post and a cast iron pipe set on a flat stone, respectively (MRC 1880). The lower most elevation corresponds to the stone post and the higher elevation corresponds to the cast iron pipe. The description of the benchmark type, whether a stone post or cast iron pipe, is described only in the notes section from the 1880 survey. This specific note describing type, whether a stone post or cast iron pipe, does not appear anywhere on the 1915 survey notes for the sheets incorporating the study area (MRC 1915a).

Table 2. MRC benchmarks and elevations, elevation headings are Memphis Datum (MD), Mean Gulf Level (GL), Mean Sea Level (MSL), National Geodetic Vertical Datum 1929 (NGVD29), North American Vertical Datum 1988 (NAVD 88).

MRC Name	Type	NGS PID	MD_1	MD_2	GL_1	GL_2	MSL_1	MSL_2	NGVD29_ft	NGVD29_ft2	NAVD88_ft	NAVD88_ft2
144	BM		54.74	58.7	48.11	52.07						
Lochdale	BM		58.05	62.04	51.42	55.41						
L111	PBM		59.23		52.6		52.556					
B. Hawk 1	BM		56.83	60.84	50.2	54.21						
B Hawk 2	BM		57.56	61.56	50.93	54.93						
145/1	BM		58.44	62.44	51.81	55.81						
BallyMagan	PBM		57.21	61.29	50.68	54.66	50.633	54.619				
145	BM		50.56	54.54	43.93	47.91						
146/2	BM		56.6		49.9							
XLVIII	PBM		85.35		78.76		78.724					
N.E. Base	PBM		59.95		53.32		53.271					
148/4	BM		44.25	49.35	37.62	42.72						
148/2	BM		56.89		50.26							
148/1	BM		52.23	56.22	45.6	49.59						
149/4	BM		45.6	50.7	39	44.1						
149/2	BM		52.7		46.1							
149/1	BM		49.37	54.47	42.74	47.84						
150/b	BM		56.25	60.25	49.62	53.62						
150/2	BM		50.7		44.1							
148/c	BM		50.18	54.18	43.55	47.55						
Union PT	PBM		59.77	63.75	53.14	57.12	53.084	57.073				
Gage 52	BM		56.89	60.87	50.26	54.24						
142/3	PBM		62.37		55.74		55.679					
Wilds	BM		59.73		53.1							
Home Place	BM		62.03		55.4							
141/3	PBM		60.58	64.56	53.95	57.93	53.884	57.867				
Wildwood	BM		59.01	63.01	52.38	56.38						
141/4	BN		60.99	66.07	5436	59.44						
Alloway	BM		52.89	56.88	46.26	50.25						
142/1	BM		59.7	64.79	53.07	58.16						
143/1	BM		58.12	56.59	51.49	56.59						
150/d	BM	BJ2615/5231	46.05	50.03	39.42	43.4			39.42	46?	39.5	46?
Harman1905	PBM	BJ2607	46.88	50.84	40.26	44.21				43.67		43.73

MRC Name	Type	NGS PID	MD_1	MD_2	GL_1	GL_2	MSL_1	MSL_2	NGVD29_ft	NGVD29_ft2	NAVD88_ft	NAVD88_ft2
S.W. Base	PBM	BW0022	59.81		53.18		53.13		52.83		52.9	
LIV	PBM	BW1246	63.79		57.16		57.096		57.22		57.3	
Cerro 1	BM	BW1350	61.13	65.13	54.5	58.5			58.25		58.31	
141/1	BM		50.29	55.35	43.66	48.72					59.196	
144/a	BM	BW1357/58	59.28	63.26	52.65	56.63			52.77	56.8	52.842	56.872
146/1	BM	BW1374/75	52.1	56.12	45.47	49.49			45.6	49.66	45.685	49.745
Gage 50	BM	BW1369/70	55.98	59.96	49.35	53.33			49.39	53.49	49.472	53.572
Fort Adams	PBM	BW1380/81	58.31	62.28	51.68	55.65	51.647	55.613	51.8	55.87	51.889	55.959
147/1	PBM		71.29	76.38	64.66	69.75						
Gage 48	BM	BW1394/95	56.77	60.77	50.14	54.14			49.56	53.64	49.626	53.706
145b	BM	Destroyed	56.57	60.55	49.94	53.92						
146/4	BM	Destroyed	47.83	52.92	41.2	46.29						
Pt Breeze	PBM	Destroyed	56.82	60.79	50.19	54.16	50.151	54.121				
Trager	BM	Destroyed	53.74	57.73	47.11	51.1						
Old River	BM	Destroyed	57.13		50.5							
Carr Point	BM	Destroyed	58.99		52.36		52.316					
Ewens 1890	PBM	Destroyed	47.6	51.67	40.97	45.04	41.01	45.079				
147/4	BM	Destroyed	50.72	55.5								
147/3	BM	Destroyed	51.12				54.501					
143/d	BM	Destroyed	46.1	50.09	39.47	43.45						
Kindling	PBM	Destroyed	55.52	59.51	48.89	52.88	48.825	52.818				
Cerro 2	BM	Destroyed	62.05	66.07	55.42	59.44			61.89			
142/2	BM	Destroyed	59.74	63.73	53.11	57.1						

Figure 12. MRC benchmarks obtained from MRC (1915a).



The difference in elevation values reported for the stone post and cast iron pipe combination is generally approximately 4 ft. Again, only the 1880 survey identifies the elevations as being associated with either a stone post or an iron pipe. The 1915 survey does not distinguish whether the mark with two elevation values is a stone or a pipe. For purposes of compiling the reported benchmark elevations, the lower elevation value in Table 2

was assumed to be a stone post, and the upper elevation value represents the cast iron pipe. A single elevation value with no description of the benchmark type was judged to represent a stone post.

The 1915 survey (MRC 1915a) contains both Memphis and MGL elevation values, which are reported in Table 2. The 1880 survey only displays the MD elevation values since the relationship between MD and MGL was not officially resolved until 1882 as previously described in Chapter 2 in the summary for MGL.

Identified in Table 2 are elevations values for the 58 benchmarks according to MD and MGL herein referenced as GL based on map descriptions. The difference between the two elevation pairs in MD versus GL is 6.63 ft (Figure 2). Elevation values for each datum are identified in columns with headings corresponding to MD_1, MD_2, GL_1, and GL_2, respectively. Where only a single elevation value was reported, the second column (for MD_2 or GL_2) is blank.

5.3 MSL elevation (USGS 1916a,c)

Benchmarks used in the 1912 Adjustment and published in USGS (1916a,c) were next evaluated to determine the MRC benchmarks where elevation values in MSL were reported. Elevation values in column headings identified as MSL_1 and MSL_2 correspond to those benchmarks that were used in the 1912 Adjustment. There are 15 benchmarks out of 58, or nearly 26% of the identified benchmarks, that were identified by USGS (1916a,c). These 15 benchmarks contain the earliest three vertical datums used by the MRC. Seven of the 15 benchmarks contained the higher top of pipe elevation as well as the lower elevation value. A review of the net differences for the reported elevation values for MGL (or GL) and MSL in Table 2 from the 1912 Adjustment elevation values presented indicates the differences were relatively minor, between 0.03 to 0.06 ft.

5.4 NGVD29 elevation

Examination was next made for MRC (1915a) benchmarks that are reported in the NGS benchmark database. These benchmarks were screened based on their spatial proximity to the NGS benchmark location in the parish/county data using the ESRI shapefile and the linked description of the mark from the online datasheet, specifically the benchmark name, and its NGVD elevation in relation to the MGL or MSL

value. Based on the results from this screening, there were 10 benchmarks in the NGS database that match the MRC (1915a) location and description.

Description information used to evaluate a match between the MRC-NGS benchmark was its name, the history of the mark, when the mark was first surveyed, and the agency responsible for the mark. MRC benchmarks were generally identified as being either a Department of Defense (DOD) or an MRC mark. These marks were identified as existing in 1937, 1938, or a prior year when these benchmarks were incorporated into the USCGS inventory.

Benchmarks in Table 2 that were considered to be a match are identified by their PID number in Table 2 and will contain either an NGVD_1 or NGVD_2 elevation. The NGS benchmark database contains a separate datasheet or PID entry for the dual elevation reporting (post versus pipe) that was reported by the MRC (1880, 1915a). These PIDs are sequential in numbering as identified by Table 2. The higher PID number identified for dual elevation cases corresponds to the lower elevation.

The Cero Gordo 1 benchmark only has a single NGS datasheet (BW1350), despite having two elevations reported for this benchmark on MRC (1915a). The datasheet for BW1351 should contain the lower elevation reference for Cerdo Gordo 1, based on the normal order of presentation observed by the NGS database, but this datasheet does not exist. Therefore, only a single entry occurs, and this PID and corresponding datasheet describe the higher elevation.

Ten benchmarks, or 17% of the original 58 MRC marks, have a corresponding NGS datasheet containing an NGVD29 elevation as shown by Table 3. It was found that elevations reported in MSL by USGS (1916a,c) do not appreciably vary from their MGL values. Consequently, NGVD29 values should be fairly similar in their differences between MGL(or GL) and MSL.

The datasheet for benchmark 150d (BJ5231) has a note about “scaled” for both the NGV29 and NAV88 elevation values (46 ft). A note on the datasheet states the orthorhombic height was scaled from a topographic map (see datasheet in the appendix). The upper elevation value therefore should be regarded as being suspect and not a surveyed elevation.

Table 3. MRC benchmarks with PID related to NGS database. Datasheets are in the appendix.

MRC Name	Type	NGS PID	MD_1	MD_2	GL_1	GL_2	MSL_1	MSL_2	NGVD29_ft	NGVD29_ft2	NAVD88_ft	NAVD88_ft2
150/d	BM	BJ2615/BJ5231	46.05	50.03	39.42	43.4			39.42	46?	39.5	46?
Harman1905	PBM	BJ2607	46.88	50.84	40.26	44.21				43.67		43.73
S.W. Base	PBM	BW0022	59.81		53.18		53.13		52.83		52.84	
LIV	PBM	BW1246	63.79		57.16		57.096		57.22		57.3	
Cerro 1	BM	BW1350	61.13	65.13	54.5	58.5				58.25		58.31
144/a	BM	BW1357/58	59.28	63.26	52.65	56.63			52.77	56.8	52.842	56.872
146/1	BM	BW1374/75	52.1	56.12	45.47	49.49			45.6	49.66	45.685	49.745
Gage 50	BM	BW1369/70	55.98	59.96	49.35	53.33			49.39	53.49	49.472	53.572
Fort Adams	PBM	BW1380/81	58.31	62.28	51.68	55.65	51.647	55.613	51.8	55.87	51.889	55.959
Gage 48	BM	BW1395/94	56.77	60.77	50.14	54.14			49.56	53.64	49.626	53.706

5.5 NAVD88 elevation

Some of the benchmarks in Tables 2 and 3 with an NGS datasheet identified by a PID number contained an NAVD88 elevation value. The remaining marks without an NAVD88 value from this smaller subset had their NAVD88 elevations calculated using Corpscon, Version 6.0.1 (USACE 2004b), for consistency purposes. Conversions using the Corpscon software were checked at selected locations with an available NAVD88 value and confirmed to be accurate within a range of 0.028 ft or less (likely involving rounding errors between 2- and 3-digit values reported). Thus, the NAVD88 elevation values for a subset of the benchmarks in Tables 2 and 3 provide a means to directly compare differences in elevation values across the different datums for the past 100 yrs. to the newer gravity based ellipsoid datum.

5.6 Vertical datum summary

Note that MGL, MSL, and NGVD29 vertical datum are approximately equivalent despite their differences in naming convention (Table 3). Elevation values reported in MSL reference the US Coast and Geodetic Survey 1912 Adjustment (USGS 1916a,c), which superseded MGL. However, USACE continued to use MGL as its vertical datum for hydrographic surveys and navigation charts until the early 1940s before officially adopting MSL (see USACE [1937a, 1937b], Batchelor [1941], as examples). As the Batchelor (MRC-USGS 1941) 15-minute topographic legend notes, the differences amount to “small fractions of a foot” between MGL and MSL, which is clearly evident by Tables 2 and 3 for elevation values reported for the same mark using the different legacy and current datums.

The MSL datum was originally based on the overall average for sea level at 9 (1912) and then 26 (1929) tide gage stations. The official elevation at any particular tide station did not necessarily reflect the actual local MSL. Therefore, it was proposed to change the name of the datum on 7 May 1973 to NGVD29 because of problems associated with what constitutes MSL along the US coast (White 1973).

However, the name change in 1973 did not change the original standard or the reference that was used previously for the earlier elevation values derived in 1912 and adjusted again in 1929. This MSL datum was used until 1992 when the datum was finally abandoned and replaced with a

gravity-based ellipsoid model. Thus, comparison of elevation values across the different legacy vertical datums in the study area indicates differences are generally less than 0.25 ft for the past 100 yr of reporting elevation values for these benchmarks (Table 3).

5.7 Subsidence of benchmarks

Minor differences in elevation values identified by Table 3 provide further support for the general stability of the study area in terms of subsidence because of its close proximity to the stable Tertiary stratigraphy that outcrops in the nearby uplands. This stratigraphy extends at relatively shallow depths beneath the river (Figure 10). Confirmation of vertical stability for this area was further supported by Dokka (2006). Elevation values identified in Table 3 that cross multiple datums indicate the subsidence rates occur much farther to the south in the deltaic plain region and do not extend northward into the alluvial valley section where the study area occurs (Figure 12). If this area was subsiding, the magnitude of elevation changes would likely be much greater than what is currently observed.

5.8 Low water reference plane (LWRP)

The LWRP is the low water slope represented by a 97% exceedance discharge based on an observed period of record (Minyard 2007). Comparison of the LWRP across multiple datums is possible because of increased confidence observed in negligible elevation differences between the various datums from the study of benchmarks, especially those based on MSL.

A nearly 70 yr period of record was chosen to illustrate general trends occurring in the study area (Figure 13). Only selected time intervals were picked for the comparison to simplify the graph but still show the magnitude of change that has occurred during the past 70 yr. The study area has experienced approximately 7 ft of vertical change since 1963 during a 40 yr period of record because of sediment aggradation. The graph also displays a similar trend for selected high water events.

The 1963 hydrographic survey is the first decadal survey following the LSOS being placed into service near river mile 315. Long-term trends are not reflected by this survey because the structure was only recently placed into service. Thus, the 1963 hydrographic survey represents a base upon

which older and younger surveys are compared to better understand geomorphic trends in the study area.

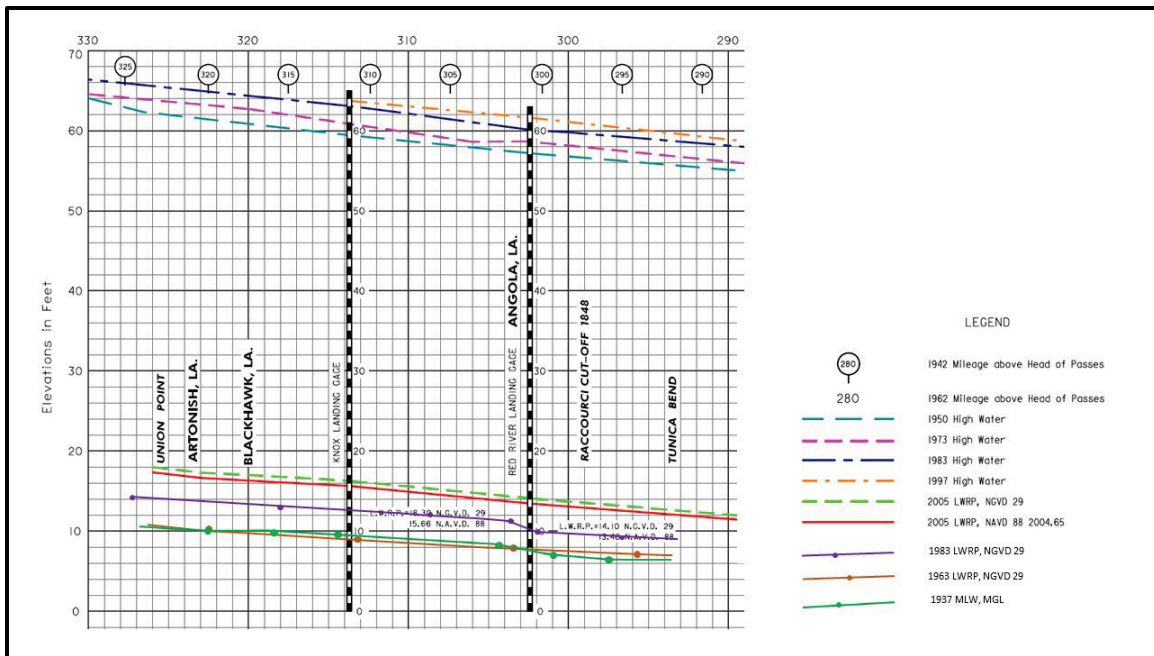
The 1937 hydrographic survey (USACE 1937a, b) uses MLW and MGL for vertical control in Figure 13 and shows that the slope of the MLW is generally comparable to the LWRP slope for the 1963 hydrographic survey through the study area. Comparison of selected MLW locations from the 1952 hydrographic survey against the corresponding river mile for the 1963 hydrographic surveys tentatively indicates there was approximately 0.5 ft of aggradation in the decade prior to the LSOS being fully operational. Unfortunately, not all of the hydrographic survey sheets from this earlier survey were available for examination and review to confirm if this trend is valid for the larger reach above Angola, LA.

As shown by Table 1, the district boundaries began at Angola, LA, on the earlier surveys, while most of the later surveys start at Black Hawk, LA. Thus, it was not possible to completely determine the extent of vertical changes before the LSOS was placed into service without the earlier survey sheets being available for study.

The significance of the LWRP elevation change directly impacts the stage-discharge relationship for the structure and the water level in the forebay during floods. Low to moderate river flows are now occurring at higher bank elevations along the Mississippi River in the study area as shown by Figure 13. Similar trends were identified by Biedenharn et al. (2017) from historic gage records between St. Louis, MO, and Donaldsonville, LA, by Heath et al. (2015) from a bathymetric/sedimentation study at the LSOS and by Kelley et al. (2022) from an evaluation study of the forebay channel morphology.

The earliest MRC surveys from 1880 and 1915 show only river soundings between the banks. The concept of MLW or LWRP was not yet developed for these earlier surveys to reflect a low water slope based on a 97% discharge exceedance. Depth measurements involving these surveys were made along range lines between the existing banks without formal reference to the concept of MLW or LWRP as developed on later surveys.

Figure 13. LWRP changes between 1937 and 2005 (after USACE 2004a).



6 Summary, Conclusions, and Recommendations

6.1 Summary

The focus of this study was to examine historic benchmarks in the study area to determine the magnitude of elevation changes caused by the different legacy datums used by the USACE. Vertical datums used in the study area have involved MD, MGL, MSL, Mean Sea Level Datum of 1929, NGVD29, and NAVD88. Comparison of elevation values across these legacy datums has involved examination and georeferencing of historic hydrographic surveys to their geospatial coordinates, compiling a list of known benchmarks from these surveys, and comparing their elevation values against publications involving spirit leveling surveys in the Lower Mississippi Valley and the National Geodetic Survey database for benchmarks. This study describes methods and results obtained from this study.

6.2 Conclusions

Approximately 17% of the benchmarks present in 1915 have elevation values that extend across multiple legacy datums and have datasheets listed in the NGS benchmark database. Comparison of elevation values from these benchmarks across the different legacy vertical datums used in the study area indicates the vertical differences are generally on the order of less than 0.25 ft during the past 100 yrs of reporting elevation values.

Minor differences observed in elevation values from the benchmarks in the study area across multiple datums provide additional support for the general stability of the study area in terms of subsidence because of underlying geologic conditions. A major reason for vertical stability in the study area is its longitudinal position within the alluvial valley section, as compared to the deltaic plain section, where maximum subsidence rates are occurring and involving Quaternary (< 2 million yr) sediments. The floodplain foundation for the study area is underlain by stable Tertiary stratigraphy at relatively shallow depths and outcrops in the uplands on the river's left bank. The Tertiary stratigraphy is formed by 5.3 to 23 million yr old terrestrial and marine sediments.

The Mississippi River channel through the study area has experienced approximately +7 ft of vertical elevation change in the LWRP during the period 1963 to 2004. Sediment aggradation within the river channel through the study reach has occurred between 1963 and 2004, which is responsible for the increase in the height of the LWRP. A similar trend was observed for selected high water events.

The LSOS was placed into service in 1963. Thus, the 1963 hydrographic survey represents a baseline condition for comparison to other historic hydrographic surveys for determining changes in the channel and the LWRP in the study reach. The slope of the MLW for the 1937 hydrographic survey closely matches the LWRP for the 1963 hydrographic survey. Later surveys identify an increase in elevation for the LWRP.

Datum results and elevation values obtained from this comparison should not be universally applied to the entire LMV area, as regional variations are possible, especially in the Mississippi River deltaic plain, which is prone to subsidence in Holocene age deposits. The study area chosen for this evaluation is well constrained in terms of its aerial extent, and the results obtained are considered specific to the study area examined. Study of representative sections along the river's length would confirm the variability of changes for other reaches.

6.3 Recommendations

Comparison of the slope of the MLW or its equivalent (LWRP) should be performed for the earlier surveys to provide a long-term record of change. The LSOS was placed into service in 1963, and the early surveys compared to those afterwards are an important method to predict the magnitude and rate of changes that can be expected in the future.

The benchmark comparison performed in this study should be performed for other representative reaches along the Mississippi River to determine whether elevation trends extend well beyond the study area boundaries upstream. A similar study of legacy benchmarks along the river below Baton Rouge would determine where subsidence rates are at their maximum.

Historic changes in benchmark elevation provide a means to measure the impact of the underlying stratigraphy on benchmark subsidence. A benchmark study below Baton Rouge would support and confirm other

methods that have been used for determination of subsidence rates across the Louisiana Plain. Benchmark stability generally occurs where point bar and natural levee deposits are present in the foundation landside of the levee right-of-way. The Tertiary/Pleistocene stratigraphy transition longitudinally needs to be better defined for purposes of understanding subsidence trends.

It is recommended that benchmarks identified in Table 3 should be field located to confirm their presence and resurveyed using modern-day methods for long-term baseline studies involving potential vertical changes involving the underlying geology.

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Appendix: Benchmark Data Sheets

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.10

Starting Datasheet Retrieval...

1 National Geodetic Survey, Retrieval Date = NOVEMBER 2, 2020

BJ2615 *****

BJ2615 DESIGNATION - 150/D BOLT

BJ2615 PID - BJ2615

BJ2615 STATE/COUNTY- LA/POINTE COUPEE

BJ2615 COUNTRY - US

BJ2615 USGS QUAD - INNIS (2018)

BJ2615

BJ2615 *CURRENT SURVEY CONTROL

BJ2615

BJ2615* NAD 83(1986) POSITION- 30 55 51. (N) 091 39 31. (W) SCALED

BJ2615* [NAVD 88](#) ORTHO HEIGHT - 12.03 (+/-2cm) 39.5 (feet) VERTCON

BJ2615

BJ2615 GEOID HEIGHT - -27.021 (meters) GEOID18

BJ2615 VERT ORDER - ? (See Below)

BJ2615

BJ2615.The horizontal coordinates were scaled from a map and have

BJ2615.an estimated accuracy of +/- 6 seconds.

BJ2615.

BJ2615.The NAVD 88 height was computed by applying the VERTCON shift value to

BJ2615.the NGVD 29 height (displayed under SUPERSEDED SURVEY CONTROL.)

BJ2615

BJ2615.Significant digits in the geoid height do not necessarily reflect accuracy.

BJ2615.GEOID18 height accuracy estimate available [here](#).

BJ2615

BJ2615.The vertical order pertains to the NGVD 29 superseded value.

BJ2615

BJ2615.Click [photographs](#) - Photos may exist for this station.

BJ2615

	North	East	Units	Estimated Accuracy
BJ2615; SPC LA S -	269,500.	968,910.	MT	(+/- 180 meters Scaled)

BJ2615

BJ2615_U.S. NATIONAL GRID SPATIAL ADDRESS: 15RXQ281227(NAD 83)

BJ2615

BJ2615 SUPERSEDED SURVEY CONTROL

BJ2615

BJ2615 NGVD 29 (11/26/84) 12.015 (m) 39.42 (f) ADJUSTED

BJ2615

BJ2615.Superseded values are not recommended for survey control.

BJ2615

BJ2615.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

BJ2615.See file [dsdata.pdf](#) to determine how the superseded data were derived.

BJ2615

BJ2615_MARKER: B = BOLT

BJ2615_SETTING: 17 = SET INTO TOP OF METAL PIPE DRIVEN INTO GROUND

BJ2615_STABILITY: D = MARK OF QUESTIONABLE OR UNKNOWN STABILITY

BJ2615

	HISTORY	- Date	Condition	Report By
BJ2615	HISTORY	- UNK	MONUMENTED	DOD
BJ2615	HISTORY	- 1964	MARK NOT FOUND	CGS

BJ2615

BJ2615

BJ2615

BJ2615 STATION DESCRIPTION

BJ2615

BJ2615'DESCRIBED BY COAST AND GEODETIC SURVEY 1964

BJ2615'4.8 MI SE FROM TORRAS.

BJ2615'PBM IS TILE AND PIPE ON RIGHT BANK OF THE MISSISSIPPI RIVER IN POINTE
BJ2615'COUPEE PARISH, LA. 1/4 MILE ABOVE SMITHLAND LANDING. 1/4 MILE FROM
BJ2615'RIVER BANK, 23.7 MILES BACK OF BASE OF LEVEE, IN E. AND W. WIRE FENCE.
BJ2615'14 MILES BACK OF SMALL DRY SLOUGH. 7.2 MILES SW OF 15 IN. PECAN
BJ2615'TREE. 17.5 MILES SE OF 28 IN. DOUBLE PECAN TREE. 75 MILES SE OF
BJ2615'CABIN OCCUPIED BY BERTHA PATE. TOP OF PIPE 12 IN. ABOVE GROUND.

*** retrieval complete.

Elapsed Time = 00:00:01

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.10

Starting Datasheet Retrieval...

1 National Geodetic Survey, Retrieval Date = NOVEMBER 2, 2020

BJ5231 *****

BJ5231 DESIGNATION - 150/D

BJ5231 PID - BJ5231

BJ5231 STATE/COUNTY- LA/POINTE COUPEE

BJ5231 COUNTRY - US

BJ5231 USGS QUAD - INNIS (2018)

BJ5231

BJ5231 *CURRENT SURVEY CONTROL

BJ5231

BJ5231* NAD 83(1992) POSITION- 30 55 52.98797(N) 091 39 33.43759(W) ADJUSTED

BJ5231* [NAVD 88](#) ORTHO HEIGHT - 14. (meters) 46. (feet) SCALED

BJ5231

BJ5231 GEOID HEIGHT - -27.020 (meters) GEOID18

BJ5231 LAPLACE CORR - -0.14 (seconds) DEFLEC18

BJ5231 HORZ ORDER - SECOND

BJ5231

BJ5231.The horizontal coordinates were established by classical geodetic methods

BJ5231.and adjusted by the National Geodetic Survey in January 1993.

BJ5231.

BJ5231.The orthometric height was scaled from a topographic map.

BJ5231

BJ5231.Significant digits in the geoid height do not necessarily reflect accuracy.

BJ5231.GEOID18 height accuracy estimate available [here](#).

BJ5231

BJ5231.Click [photographs](#) - Photos may exist for this station.

BJ5231

BJ5231.The Laplace correction was computed from DEFLEC18 derived deflections.

BJ5231

BJ5231. The following values were computed from the NAD 83(1992) position.

BJ5231

BJ5231;

	North	East	Units	Scale Factor	Converg.
BJ5231;SPC LA S	- 269,561.297	968,845.906	MT	1.00005739	-0 09 46.7
BJ5231;SPC LA S	- 884,385.69	3,178,621.94	sFT	1.00005739	-0 09 46.7
BJ5231;SPC MS W	- 159,423.706	573,276.037	MT	1.00014802	-0 40 53.9
BJ5231;SPC MS W	- 523,042.61	1,880,823.13	sFT	1.00014802	-0 40 53.9
BJ5231;UTM 15	- 3,422,768.174	628,089.579	MT	0.99980238	+0 41 21.2

BJ5231;SPC LA S - 269,561.297 968,845.906 MT 1.00005739 -0 09 46.7

BJ5231;SPC LA S - 884,385.69 3,178,621.94 sFT 1.00005739 -0 09 46.7

BJ5231;SPC MS W - 159,423.706 573,276.037 MT 1.00014802 -0 40 53.9

BJ5231;SPC MS W - 523,042.61 1,880,823.13 sFT 1.00014802 -0 40 53.9

BJ5231;UTM 15 - 3,422,768.174 628,089.579 MT 0.99980238 +0 41 21.2

BJ5231

BJ5231! - Elev Factor x Scale Factor = Combined Factor

BJ5231!SPC LA S - 1.00000204 x 1.00005739 = 1.00005943

BJ5231!SPC MS W - 1.00000204 x 1.00014802 = 1.00015006

BJ5231!UTM 15 - 1.00000204 x 0.99980238 = 0.99980442

BJ5231

BJ5231_U.S. NATIONAL GRID SPATIAL ADDRESS: 15RXQ2808922768(NAD 83)

BJ5231

BJ5231 SUPERSEDED SURVEY CONTROL

BJ5231

BJ5231 NAD 83(1986)- 30 55 53.00514(N) 091 39 33.43193(W) AD() 2

BJ5231 NAD 27 - 30 55 52.35516(N) 091 39 33.00456(W) AD() 2

BJ5231 NGVD 29 (07/19/86) 14. (m) 46. (f) SCALED

BJ5231

BJ5231.Superseded values are not recommended for survey control.

BJ5231

BJ5231.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

BJ5231. See file [dsdata.pdf](#) to determine how the superseded data were derived.

BJ5231

BJ5231_MARKER: P = PIPE CAP

BJ5231_SETTING: 0 = UNSPECIFIED SETTING

BJ5231

BJ5231	HISTORY	- Date	Condition	Report By
BJ5231	HISTORY	- 1919	MONUMENTED	MRC

BJ5231

BJ5231

STATION DESCRIPTION

BJ5231

BJ5231'DESCRIBED BY MISSISSIPPI RIVER COMMISSION 1919 (LHZ)

BJ5231'ON RIGHT BANK OF MISSISSIPPI RIVER, ABOUT 1/4 MILE ABOVE

BJ5231'SMITHLAND LANDING, ABOUT 1/4 MILE FROM RIVER BANK, 250 METERS

BJ5231'(820 FEET) BACK OF LEVEE, IN E-W WIRE FENCE LINE, 14 METERS

BJ5231'(46 FEET) BACK OF SMALL DRY SLOUGH, AND ABOUT 250 METERS

BJ5231'(820 FEET) SW OF CABIN NEAR LEVEE.

BJ5231'

BJ5231'STATION IS MARKED AT THE SURFACE BY A STANDARD MISSISSIPPI

BJ5231'RIVER COMMISSION, BRASS CAP IN A 4-INCH STEEL PIPE 4 FEET LONG,

BJ5231'AND UNDERGROUND BY A COPPER BOLT IN AN 18-INCH SQUARE VITRIFIED

BJ5231'TILE 4 INCHES THICK.

BJ5231'

BJ5231'A BLAZED 10-INCH ELM TREE IS 10.5 METERS (34 FEET) FROM

BJ5231'STATION N 55 DEG E.

BJ5231'

BJ5231'STATION SMITH IS 51.93 METERS (170.4 FEET) FROM STATION

BJ5231'N 84 DEG 54 MIN E.

*** retrieval complete.

Elapsed Time = 00:00:01

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.11

Starting Datasheet Retrieval...

1 National Geodetic Survey, Retrieval Date = DECEMBER 28, 2020

BJ5233 *****

BJ5233 DESIGNATION - BM A

BJ5233 PID - BJ5233

BJ5233 STATE/COUNTY- LA/POINTE COUPEE

BJ5233 COUNTRY - US

BJ5233 USGS QUAD - INNIS (2018)

BJ5233

BJ5233 *CURRENT SURVEY CONTROL

BJ5233

BJ5233* NAD 83(1992) POSITION- 30 57 24.21021(N) 091 39 58.66035(W) ADJUSTED

BJ5233* [NAVD 88](#) ORTHO HEIGHT - 13. (meters) 43. (feet) SCALED

BJ5233

BJ5233 GEOID HEIGHT - -27.002 (meters) GEOID18

BJ5233 LAPLACE CORR - -0.09 (seconds) DEFLEC18

BJ5233 HORZ ORDER - SECOND

BJ5233

BJ5233.The horizontal coordinates were established by classical geodetic methods

BJ5233.and adjusted by the National Geodetic Survey in January 1993.

BJ5233.

BJ5233.The orthometric height was scaled from a topographic map.

BJ5233

BJ5233.Significant digits in the geoid height do not necessarily reflect accuracy.

BJ5233.GEOID18 height accuracy estimate available [here](#).

BJ5233

BJ5233.Click [photographs](#) - Photos may exist for this station.

BJ5233

BJ5233.The Laplace correction was computed from DEFLEC18 derived deflections.

BJ5233

BJ5233. The following values were computed from the NAD 83(1992) position.

BJ5233

BJ5233;

	North	East	Units	Scale Factor	Converg.
BJ5233;SPC LA S	- 272,372.736	968,184.422	MT	1.00006467	-0 09 59.3
BJ5233;SPC LA S	- 893,609.55	3,176,451.72	sFT	1.00006467	-0 09 59.3
BJ5233;SPC MS W	- 162,241.268	572,639.988	MT	1.00015001	-0 41 08.7
BJ5233;SPC MS W	- 532,286.56	1,878,736.36	sFT	1.00015001	-0 41 08.7
BJ5233;UTM 15	- 3,425,568.733	627,386.525	MT	0.99980017	+0 41 10.1

BJ5233

BJ5233! - Elev Factor x Scale Factor = Combined Factor

BJ5233!SPC LA S - 1.00000220 x 1.00006467 = 1.00006687

BJ5233!SPC MS W - 1.00000220 x 1.00015001 = 1.00015221

BJ5233!UTM 15 - 1.00000220 x 0.99980017 = 0.99980237

BJ5233

BJ5233_U.S. NATIONAL GRID SPATIAL ADDRESS: 15RXQ2738625568(NAD 83)

BJ5233

BJ5233 SUPERSEDED SURVEY CONTROL

BJ5233

BJ5233 NAD 83(1986)- 30 57 24.22736(N) 091 39 58.65463(W) AD() 2

BJ5233 NAD 27 - 30 57 23.57982(N) 091 39 58.22779(W) AD() 2

BJ5233 NGVD 29 (07/19/86) 13. (m) 43. (f) SCALED

BJ5233

BJ5233.Superseded values are not recommended for survey control.

BJ5233

BJ5233.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

BJ5233. See file [dsdata.pdf](#) to determine how the superseded data were derived.

BJ5233

BJ5233_MARKER: P = PIPE CAP

BJ5233_SETTING: 0 = UNSPECIFIED SETTING

BJ5233

BJ5233	HISTORY	- Date	Condition	Report By
BJ5233	HISTORY	- 1919	MONUMENTED	MRC
BJ5233	HISTORY	- 1957	MARK NOT FOUND	CGS

BJ5233

BJ5233

STATION DESCRIPTION

BJ5233

BJ5233'DESCRIBED BY MISSISSIPPI RIVER COMMISSION 1919 (LHZ)

BJ5233'ON RIGHT BANK OF MISSISSIPPI RIVER, BACK OF RED RIVER LANDING,

BJ5233'ON SMALL RIDGE, IN EXTERIOR ANGLE OF FENCES 7 METERS (23 FEET)

BJ5233'SE OF CABIN ON LAND OF M.F. RODECH, 100 METERS (328 FEET)

BJ5233'BACK OF LEVEE, ABOUT 400 METERS (1,312 FEET) BACK OF RIVER BANK,

BJ5233'AND 90 METERS (295 FEET) BACK OF JUNCTION WHERE ROAD FROM

BJ5233'LANDING CROSSES LEVEE AND JOINS ROAD BACK OF LEVEE.

BJ5233'

BJ5233'STATION MARKED AT THE SURFACE BY A MISSISSIPPI RIVER COMMISSION

BJ5233'BRASS CAP IN A 4-INCH STEEL PIPE 4 FEET LONG, AND UNDERGROUND

BJ5233'BY A COPPER BOLT IN AN 18-INCH SQUARE VITRIFIED TILE 4 INCHES

BJ5233'THICK.

BJ5233

BJ5233

STATION RECOVERY (1957)

BJ5233

BJ5233'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1957 (IRR)

BJ5233'A THOROUGH SEARCH WAS MADE FOR THE STATION, BUT DUE TO THE

BJ5233'NATURE OF THE PREVIOUS DESCRIPTION THE STATION COULD NOT BE

BJ5233'FOUND.

*** retrieval complete.

Elapsed Time = 00:00:01

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.10

Starting Datasheet Retrieval...

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1      National Geodetic Survey,      Retrieval Date = OCTOBER 30, 2020
BW0022 *****
BW0022 DESIGNATION - L=SOUTHWEST BASE
BW0022 PID - BW0022
BW0022 STATE/COUNTY- LA/CONCORDIA
BW0022 COUNTRY - US
BW0022 USGS QUAD - FORT ADAMS (2018)
BW0022
BW0022 *CURRENT SURVEY CONTROL
BW0022
BW0022* NAD 83(1986) POSITION- 31 02 32. (N) 091 35 15. (W) SCALED
BW0022* NAVD 88 ORTHO HEIGHT - 16.125 (meters) 52.90 (feet) ADJUSTED
BW0022
BW0022 GEOID HEIGHT - -26.921 (meters) GEOID18
BW0022 DYNAMIC HEIGHT - 16.105 (meters) 52.84 (feet) COMP
BW0022 MODELED GRAVITY - 979,391.2 (mgal) NAVD 88
BW0022
BW0022 VERT ORDER - FIRST CLASS I
BW0022
BW0022.The horizontal coordinates were scaled from a map and have
BW0022.an estimated accuracy of +/- 6 seconds.
BW0022.
BW0022.The orthometric height was determined by differential leveling and
BW0022.adjusted by the NATIONAL GEODETIC SURVEY
BW0022.in February 1994.
BW0022
BW0022.Significant digits in the geoid height do not necessarily reflect accuracy.
BW0022.GEOID18 height accuracy estimate available here.
BW0022
BW0022.Click photographs - Photos may exist for this station.
BW0022
BW0022.The dynamic height is computed by dividing the NAVD 88
BW0022.geopotential number by the normal gravity value computed on the
BW0022.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
BW0022.degrees latitude (g = 980.6199 gals.).
BW0022
BW0022.The modeled gravity was interpolated from observed gravity values.
BW0022
BW0022; North East Units Estimated Accuracy
BW0022;SPC LA N - 60,490. 1,087,110. MT (+/- 180 meters Scaled)
BW0022
BW0022_U.S. NATIONAL GRID SPATIAL ADDRESS: 15RXQ347351(NAD 83)
BW0022
BW0022 SUPERSEDED SURVEY CONTROL
BW0022
BW0022 USVN - 31 02 29.11300(N) 091 35 17.08700(W) AD( ) 3
BW0022 NAVD 88 (06/15/91) 16.150 (m) 52.99 (f) SUPERSEDED 1 1
BW0022 NGVD 29 (11/26/84) 16.103 (m) 52.83 (f) ADJUSTED 1 1
BW0022
BW0022.Superseded values are not recommended for survey control.
BW0022
BW0022.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
BW0022.See file dsdata.pdf to determine how the superseded data were derived.
BW0022

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BW0022_MARKER: B = BOLT
BW0022_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
BW0022_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
BW0022+STABILITY: SURFACE MOTION

BW0022

BW0022	HISTORY	- Date	Condition	Report By
BW0022	HISTORY	- UNK	MONUMENTED	DOD
BW0022	HISTORY	- 1966	GOOD	CGS
BW0022	HISTORY	- 1976	GOOD	NGS

BW0022

BW0022 STATION DESCRIPTION

BW0022

BW0022'DESCRIBED BY COAST AND GEODETIC SURVEY 1966

BW0022'6.2 MI NE FROM OLD RIVER LOCKS.

BW0022'ABOUT 6.2 MILES NORTHEAST ALONG STATE HIGHWAY 15 FROM THE LOCKS AT OLD

BW0022'RIVER, IN SECTION 14, T 1 N, R 9 E, ABOUT 0.1 MILE NORTHEAST OF BENCH

BW0022'MARK Y 253 1966, ABOUT 0.1 MILE NORTH OF A CATTLE GUARD, ABOUT 114

BW0022'YARDS NORTH-NORTHEAST OF THE NORTH CORNER OF A LARGE CORRUGATED METAL

BW0022'BUILDING, 292 FEET NORTHWEST OF THE CENTER LINE OF THE HIGHWAY, 186

BW0022'FEET NORTHWEST OF THE NORTHWEST HIGHWAY RIGHT-OF-WAY FENCE, 188 FEET

BW0022'SOUTHEAST OF A POWER POLE BEARING A METER AND A TRANSFORMER, 150 FEET

BW0022'SOUTHWEST OF A POWER POLE, 120 FEET NORTHEAST OF A 23-INCH PECAN TREE,

BW0022'2.0 FEET SOUTHWEST OF A METAL WITNESS POST, ABOUT 22 FEET BELOW THE

BW0022'LEVEL OF THE HIGHWAY, A COPPER BOLT SET IN THE TOP OF A LIMESTONE POST

BW0022'WHICH PROJECTS ABOUT 6 INCHES.

BW0022

BW0022 STATION RECOVERY (1976)

BW0022

BW0022'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1976

BW0022'7.2 MILES NORTHEAST ALONG STATE HIGHWAY 15 FROM THE JUNCTION OF STATE

BW0022'HIGHWAY 418 AT TORRAS, 0.1 MILE NORTHEAST OF A CATTLE GUARD, 114

BW0022'YARDS NORTH-NORTHEAST OF THE NORTH CORNER OF A LARGE CORRUGATED METAL

BW0022'HOUSE, 292 FT. NORTHWEST OF THE CENTER LINE OF THE HIGHWAY, 188 FT,

BW0022'EAST OF A POWER LINE POLE WITH A METER AND TRANSFORMER, 150 FT.

BW0022'SOUTHWEST OF A POWER LINE POLE, A COPPER BOLT IN TOP OF A LIMESTONE

BW0022'POST THAT PROJECTS 1 FT. AND HAS THE NUMBER 1880 INSCRIBED ON THE

BW0022'SOUTH SIDE AND THE LETTERS US ON THE NORTH SIDE OF THE LIMESTONE POST

BW0022'NOTE-POST WAS FLUSH WITH GROUND IN 1934. PROJECTED 6 INCHES IN 1966.

*** retrieval complete.

Elapsed Time = 00:00:01

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.11

Starting Datasheet Retrieval...

1 National Geodetic Survey, Retrieval Date = DECEMBER 21, 2020

BW1246 *****

BW1246 DESIGNATION - LIV

BW1246 PID - BW1246

BW1246 STATE/COUNTY- LA/CONCORDIA

BW1246 COUNTRY - US

BW1246 USGS QUAD - FAIRVIEW (2018)

BW1246

BW1246 *CURRENT SURVEY CONTROL

BW1246

BW1246* NAD 83(1986) POSITION- 31 17 01.28 (N) 091 35 46.31 (W) HD_HELD1

BW1246* [NAVD 88](#) ORTHO HEIGHT - 17.46 (+/-2cm) 57.3 (feet) VERTCON

BW1246

BW1246 GEOID HEIGHT - -26.636 (meters) GEOID18

BW1246 VERT ORDER - FIRST CLASS II (See Below)

BW1246

BW1246.The horizontal coordinates were determined by differentially corrected

BW1246.hand held GPS observations or other comparable positioning techniques

BW1246.and have an estimated accuracy of +/- 3 meters.

BW1246.

BW1246.The NAVD 88 height was computed by applying the VERTCON shift value to

BW1246.the NGVD 29 height (displayed under SUPERSEDED SURVEY CONTROL.)

BW1246

BW1246.Significant digits in the geoid height do not necessarily reflect accuracy.

BW1246.GEOID18 height accuracy estimate available [here](#).

BW1246

BW1246.The vertical order pertains to the NGVD 29 superseded value.

BW1246

BW1246.Click [photographs](#) - Photos may exist for this station.

BW1246

BW1246; North East Units Estimated Accuracy

BW1246;SPC LA N - 87,251.6 1,086,057.3 MT (+/- 3 meters HH1 GPS)

BW1246

BW1246_U.S. NATIONAL GRID SPATIAL ADDRESS: 15RXQ3362361892(NAD 83)

BW1246

BW1246 SUPERSEDED SURVEY CONTROL

BW1246

BW1246 NGVD 29 (??/??/92) 17.440 (m) 57.22 (f) ADJ UNCH 1 2

BW1246

BW1246.Superseded values are not recommended for survey control.

BW1246

BW1246.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

BW1246.See file [dsdata.pdf](#) to determine how the superseded data were derived.

BW1246

BW1246_MARKER: Z = SEE DESCRIPTION

BW1246_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT

BW1246_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO

BW1246+STABILITY: SURFACE MOTION

BW1246

BW1246 HISTORY - Date Condition Report By

BW1246 HISTORY - 1880 MONUMENTED CGS

BW1246 HISTORY - 1934 GOOD USACE

BW1246 HISTORY - 1966 MARK NOT FOUND CGS

BW1246

BW1246 STATION DESCRIPTION
BW1246
BW1246'DESCRIBED BY US ARMY CORPS OF ENGINEERS 1934
BW1246'9.75 MI NE FROM SHAW.
BW1246'P.B.M. IS STONE POST EXTENDING ABOUT 4 IN. ABOVE GROUND. ON RIGHT
BW1246'BANK OF MISSISSIPPI RIVER IN CONCORDIA PARISH, LA. ABOUT 1 MILE
BW1246'UPSTREAM FROM BOUGERE LDG. ON ASHLAND PLANTATION. IN FRONT YARD OF
BW1246'PLANTATION RESIDENCE. ABOUT HALF WAY BETWEEN STEPS LEADING UP TO
BW1246'FRONT GALLERY AND WEST END OF RESIDENCE. P.B.M. IS 35 METERS LANDWARD
BW1246'FROM CENTER LINE OF LEVEE, AT A POINT 75 METERS DOWNSTREAM FROM A
BW1246'PROMINENT ANGLE.

BW1246
BW1246 STATION RECOVERY (1966)
BW1246
BW1246'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1966
BW1246'MARK NOT FOUND.

*** retrieval complete.
Elapsed Time = 00:00:01

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.10

Starting Datasheet Retrieval...

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1      National Geodetic Survey,   Retrieval Date = NOVEMBER  4, 2020
BW1350 *****
BW1350 DESIGNATION -  CERRO GORDO 1 BOLT
BW1350 PID          -  BW1350
BW1350 STATE/COUNTY-  MS/ADAMS
BW1350 COUNTRY      -  US
BW1350 USGS QUAD    -  FAIRVIEW (2018)
BW1350
BW1350                                *CURRENT SURVEY CONTROL
BW1350
BW1350* NAD 83(1986) POSITION- 31 15 27.      (N) 091 32 45.      (W) SCALED
BW1350* NAVD 88 ORTHO HEIGHT -                *(meters)          *(feet) NOT PUB
BW1350 **This station is located in a suspected subsidence area (see below).
BW1350
BW1350 GEOID HEIGHT      -          -26.679 (meters)                      GEOID18
BW1350 VERT ORDER       -  FIRST      CLASS II (See Below)
BW1350
BW1350.The horizontal coordinates were scaled from a map and have
BW1350.an estimated accuracy of +/- 6 seconds.
BW1350.
BW1350 ** This station is in an area of known vertical motion. If an
BW1350 ** orthometric height was ever established but is not available
BW1350 ** in the current survey control section, the orthometric height
BW1350 ** is considered suspect. Suspect heights are available in the
BW1350 ** superseded section only if requested.
BW1350
BW1350.Significant digits in the geoid height do not necessarily reflect accuracy.
BW1350.GEOID18 height accuracy estimate available here.
BW1350
BW1350.The vertical order pertains to the NGVD 29 superseded value.
BW1350
BW1350.Click photographs - Photos may exist for this station.
BW1350
BW1350;
BW1350;SPC MS W      -          North      East      Units Estimated Accuracy
BW1350;              -  195,460.      584,520.      MT  (+/- 180 meters Scaled)
BW1350
BW1350_U.S. NATIONAL GRID SPATIAL ADDRESS: 15RXQ384590(NAD 83)
BW1350
BW1350                                SUPERSEDED SURVEY CONTROL
BW1350
BW1350 NGVD 29 (??/??/92)  17.756 (m)                      58.25 (f) ADJ UNCH  1 2
BW1350
BW1350.Superseded values are not recommended for survey control.
BW1350
BW1350.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
BW1350.See file dsdata.pdf to determine how the superseded data were derived.
BW1350
BW1350_MARKER: B = BOLT
BW1350_SETTING: 31 = SET IN A PAVEMENT SUCH AS STREET, SIDEWALK, CURB, ETC.
BW1350_SP_SET: TILE
BW1350_MARK LOGO: USACE
BW1350_STABILITY: D = MARK OF QUESTIONABLE OR UNKNOWN STABILITY
BW1350
BW1350 HISTORY      -  Date      Condition      Report By

```

11/4/2020

DATASHEETS

BW1350	HISTORY	- UNK	MONUMENTED	USACE
BW1350	HISTORY	- 1938	GOOD	CGS

BW1350

BW1350

BW1350

STATION DESCRIPTION

BW1350'DESCRIBED BY COAST AND GEODETIC SURVEY 1938

BW1350'12 MI N FROM FORT ADAMS.

BW1350'IN ADAMS COUNTY, 12 MILES NORTH OF FORT ADAMS, WILKINSON COUNTY, ON

BW1350'THE EAST BANK OF MISSISSIPPI RIVER, 1450 FEET SOUTH OF CERRO GORDO

BW1350'LANDING, 7 FEET ABOVE A FENCE ON THE UPPER SIDE OF THE OLD LANE

BW1350'LEADING BACK FROM THE LANDING, AND ON THE LOWER SIDE OF THE PRESENT

BW1350'ROAD LEADING BACK FROM THE LANDING. A COPPER BOLT, SET IN THE TOP OF

BW1350'A TILE ABOUT 3 FEET UNDER GROUND, ACCESS TO WHICH IS HAD THROUGH AN

BW1350'IRON PIPE BEARING A CORPS OF ENGINEERS, U. S. ARMY STANDARD CAP.

*** retrieval complete.

Elapsed Time = 00:00:02

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.10

Starting Datasheet Retrieval...

1 National Geodetic Survey, Retrieval Date = NOVEMBER 4, 2020

BW1352 *****

BW1352 DESIGNATION - D 130

BW1352 PID - BW1352

BW1352 STATE/COUNTY- MS/ADAMS

BW1352 COUNTRY - US

BW1352 USGS QUAD - FAIRVIEW (2018)

BW1352

BW1352 *CURRENT SURVEY CONTROL

BW1352

BW1352* NAD 83(1986) POSITION- 31 15 07. (N) 091 32 42. (W) SCALED

BW1352* [NAVD 88](#) ORTHO HEIGHT - *(meters) *(feet) NOT PUB

BW1352 **This station is located in a suspected subsidence area (see below).

BW1352

BW1352 GEOID HEIGHT - -26.686 (meters) GEOID18

BW1352 VERT ORDER - FIRST CLASS II (See Below)

BW1352

BW1352.The horizontal coordinates were scaled from a map and have

BW1352.an estimated accuracy of +/- 6 seconds.

BW1352.

BW1352 ** This station is in an area of known vertical motion. If an

BW1352 ** orthometric height was ever established but is not available

BW1352 ** in the current survey control section, the orthometric height

BW1352 ** is considered suspect. Suspect heights are available in the

BW1352 ** superseded section only if requested.

BW1352

BW1352.Significant digits in the geoid height do not necessarily reflect accuracy.

BW1352.GEOID18 height accuracy estimate available [here](#).

BW1352

BW1352.The vertical order pertains to the NGVD 29 superseded value.

BW1352

BW1352.Click [photographs](#) - Photos may exist for this station.

BW1352

BW1352; North East Units Estimated Accuracy

BW1352;SPC MS W - 194,840. 584,590. MT (+/- 180 meters Scaled)

BW1352

BW1352_U.S. NATIONAL GRID SPATIAL ADDRESS: 15RXQ385584(NAD 83)

BW1352

BW1352 SUPERSEDED SURVEY CONTROL

BW1352

BW1352 NGVD 29 (??/??/92) 18.022 (m) 59.13 (f) ADJ UNCH 1 2

BW1352

BW1352.Superseded values are not recommended for survey control.

BW1352

BW1352.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

BW1352.See file [dsdata.pdf](#) to determine how the superseded data were derived.

BW1352

BW1352_MARKER: DB = BENCH MARK DISK

BW1352_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT

BW1352_STAMPING: D 130 1938

BW1352_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO

BW1352+STABILITY: SURFACE MOTION

BW1352

BW1352 HISTORY - Date Condition Report By

11/4/2020

DATASHEETS

BW1352	HISTORY	- 1938	MONUMENTED	CGS
BW1352	HISTORY	- 1961	MARK NOT FOUND	USGS
BW1352	HISTORY	- 1979	MARK NOT FOUND	USGS

BW1352

BW1352

BW1352

STATION DESCRIPTION

BW1352'DESCRIBED BY US GEOLOGICAL SURVEY 1961

BW1352'11.75 MI N FROM FORT ADAMS.

BW1352'IN ADAMS COUNTY, 11-3/4 MILES NORTH OF FORT ADAMS, WILKINSON COUNTY,

BW1352'ON THE EAST BANK OF MISSISSIPPI RIVER, 0.6 MILE SOUTH OF CERRO GORDO

BW1352'LANDING, ON A RIDGE 200 FEET DIRECTLY BEHIND THE TOP BANK OF THE

BW1352'RIVER, ON RANGE 741.2, AND 100 FEET RIVERSIDE OF A CONTROL LINE. A

BW1352'STANDARD DISK SET IN THE TOP OF A CONCRETE POST.

BW1352

BW1352

STATION RECOVERY (1979)

BW1352

BW1352'RECOVERY NOTE BY US GEOLOGICAL SURVEY 1979

BW1352'MARK NOT FOUND.

*** retrieval complete.

Elapsed Time = 00:00:02

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.10

Starting Datasheet Retrieval...

1 National Geodetic Survey, Retrieval Date = NOVEMBER 13, 2020

BW1357 *****

BW1357 DESIGNATION - 144/A CAP

BW1357 PID - BW1357

BW1357 STATE/COUNTY- MS/ADAMS

BW1357 COUNTRY - US

BW1357 USGS QUAD - LAKE MARY (2018)

BW1357

BW1357 *CURRENT SURVEY CONTROL

BW1357

BW1357* NAD 83(1986) POSITION- 31 12 21. (N) 091 35 15. (W) SCALED

BW1357* [NAVD 88](#) ORTHO HEIGHT - *(meters) *(feet) NOT PUB

BW1357 **This station is located in a suspected subsidence area (see below).

BW1357

BW1357 GEOID HEIGHT - -26.750 (meters) GEOID18

BW1357 VERT ORDER - FIRST CLASS II (See Below)

BW1357

BW1357.The horizontal coordinates were scaled from a map and have

BW1357.an estimated accuracy of +/- 6 seconds.

BW1357.

BW1357 ** This station is in an area of known vertical motion. If an

BW1357 ** orthometric height was ever established but is not available

BW1357 ** in the current survey control section, the orthometric height

BW1357 ** is considered suspect. Suspect heights are available in the

BW1357 ** superseded section only if requested.

BW1357

BW1357.Significant digits in the geoid height do not necessarily reflect accuracy.

BW1357.GEOID18 height accuracy estimate available [here](#).

BW1357

BW1357.The vertical order pertains to the NGVD 29 superseded value.

BW1357

BW1357.Click [photographs](#) - Photos may exist for this station.

BW1357

BW1357; North East Units Estimated Accuracy

BW1357;SPC MS W - 189,770. 580,480. MT (+/- 180 meters Scaled)

BW1357

BW1357_U.S. NATIONAL GRID SPATIAL ADDRESS: 15RXQ345532(NAD 83)

BW1357

BW1357 SUPERSEDED SURVEY CONTROL

BW1357

BW1357 NGVD 29 (??/??/92) 17.312 (m) 56.80 (f) ADJ UNCH 1 2

BW1357

BW1357.Superseded values are not recommended for survey control.

BW1357

BW1357.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

BW1357.See file [dsdata.pdf](#) to determine how the superseded data were derived.

BW1357

BW1357_MARKER: P = PIPE CAP

BW1357_SETTING: 17 = SET INTO TOP OF METAL PIPE DRIVEN INTO GROUND

BW1357_MARK LOGO: USACE

BW1357_STABILITY: D = MARK OF QUESTIONABLE OR UNKNOWN STABILITY

BW1357

BW1357 HISTORY - Date Condition Report By

BW1357 HISTORY - UNK MONUMENTED USACE

BW1357 HISTORY - 1938 GOOD CGS

BW1357

BW1357

STATION DESCRIPTION

BW1357

BW1357'DESCRIBED BY COAST AND GEODETIC SURVEY 1938

BW1357'8.5 MI NW FROM FORT ADAMS.

BW1357'IN ADAMS COUNTY, 8-1/2 MILES NORTHWEST OF FORT ADAMS, WILKINSON

BW1357'COUNTRY, ON THE EAST BANK OF MISSISSIPPI RIVER, 1/4 MILE NORTHEAST OF

BW1357'PANDELLA LANDING, 1400 FEET FROM THE BANK OF THE RIVER, 46 FEET

BW1357'NORTHWEST OF THE BANK OF THE NARROWS, 215 FEET SOUTH OF A HOUSE, 8

BW1357'FEET EAST OF A LARGE GATE, AND 6 FEET NORTH OF AN EAST-AND-WEST FENCE

BW1357'ON THE NORTH SIDE OF THE ROAD RUNNING ALONG THE BANK OF THE NARROWS.

BW1357'AN IRON PIPE BEARING A CORPS OF ENGINEERS, U. S. ARMY STANDARD CAP.

*** retrieval complete.

Elapsed Time = 00:00:01

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.10

Starting Datasheet Retrieval...

1 National Geodetic Survey, Retrieval Date = NOVEMBER 13, 2020

BW1358 *****

BW1358 DESIGNATION - 144/A BOLT

BW1358 PID - BW1358

BW1358 STATE/COUNTY- MS/ADAMS

BW1358 COUNTRY - US

BW1358 USGS QUAD - LAKE MARY (2018)

BW1358

BW1358 *CURRENT SURVEY CONTROL

BW1358

BW1358* NAD 83(1986) POSITION- 31 12 21. (N) 091 35 15. (W) SCALED

BW1358* [NAVD 88](#) ORTHO HEIGHT - *(meters) *(feet) NOT PUB

BW1358 **This station is located in a suspected subsidence area (see below).

BW1358

BW1358 GEOID HEIGHT - -26.750 (meters) GEOID18

BW1358 VERT ORDER - FIRST CLASS II (See Below)

BW1358

BW1358.The horizontal coordinates were scaled from a map and have

BW1358.an estimated accuracy of +/- 6 seconds.

BW1358.

BW1358 ** This station is in an area of known vertical motion. If an

BW1358 ** orthometric height was ever established but is not available

BW1358 ** in the current survey control section, the orthometric height

BW1358 ** is considered suspect. Suspect heights are available in the

BW1358 ** superseded section only if requested.

BW1358

BW1358.Significant digits in the geoid height do not necessarily reflect accuracy.

BW1358.GEOID18 height accuracy estimate available [here](#).

BW1358

BW1358.The vertical order pertains to the NGVD 29 superseded value.

BW1358

BW1358.Click [photographs](#) - Photos may exist for this station.

BW1358

BW1358; North East Units Estimated Accuracy

BW1358;SPC MS W - 189,770. 580,480. MT (+/- 180 meters Scaled)

BW1358

BW1358_U.S. NATIONAL GRID SPATIAL ADDRESS: 15RXQ345532(NAD 83)

BW1358

BW1358 SUPERSEDED SURVEY CONTROL

BW1358

BW1358 NGVD 29 (??/??/92) 16.085 (m) 52.77 (f) ADJ UNCH 1 2

BW1358

BW1358.Superseded values are not recommended for survey control.

BW1358

BW1358.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

BW1358.See file [dsdata.pdf](#) to determine how the superseded data were derived.

BW1358

BW1358_MARKER: B = BOLT

BW1358_SETTING: 31 = SET IN A PAVEMENT SUCH AS STREET, SIDEWALK, CURB, ETC.

BW1358_SP_SET: TILE

BW1358_MARK LOGO: USACE

BW1358_STABILITY: D = MARK OF QUESTIONABLE OR UNKNOWN STABILITY

BW1358

BW1358 HISTORY - Date Condition Report By

BW1358	HISTORY	- UNK	MONUMENTED	USACE
BW1358	HISTORY	- 1938	GOOD	CGS

BW1358

BW1358

BW1358

STATION DESCRIPTION

BW1358'DESCRIBED BY COAST AND GEODETIC SURVEY 1938

BW1358'8.5 MI NW FROM FORT ADAMS.

BW1358'IN ADAMS COUNTY, 8-1/2 MILES NORTHWEST OF FORT ADAMS, WILKINSON

BW1358'COUNTRY, ON THE EAST BANK OF MISSISSIPPI RIVER, 1/4 MILE NORTHEAST OF

BW1358'PANDELLA LANDING, 1400 FEET FROM THE BANK OF THE RIVER, 46 FEET

BW1358'NORTHWEST OF THE BANK OF THE NARROWS, 215 FEET SOUTH OF A HOUSE, 8

BW1358'FEET EAST OF A LARGE GATE, AND 6 FEET NORTH OF AN EAST-AND-WEST FENCE

BW1358'ON THE NORTH SIDE OF THE ROAD RUNNING ALONG THE BANK OF THE NARROWS. A

BW1358'COPPER BOLT, SET IN THE TOP OF A TILE ABOUT 3 FEET UNDERGROUND, ACCESS

BW1358'TO WHICH IS HAD THROUGH AN IRON PIPE BEARING A CORPS OF ENGINEERS, U.

BW1358'S. ARMY STANDARD CAP.

*** retrieval complete.

Elapsed Time = 00:00:02

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.10

Starting Datasheet Retrieval...

1 National Geodetic Survey, Retrieval Date = OCTOBER 30, 2020

BW1374 *****

BW1374 DESIGNATION - 146/1 CAP

BW1374 PID - BW1374

BW1374 STATE/COUNTY- MS/WILKINSON

BW1374 COUNTRY - US

BW1374 USGS QUAD - FORT ADAMS (2018)

BW1374

*CURRENT SURVEY CONTROL

BW1374

BW1374* NAD 83(1986) POSITION- 31 05 46. (N) 091 34 25. (W) SCALED

BW1374* [NAVD 88](#) ORTHO HEIGHT - ** (meters) ** (feet) NOT PUB

BW1374 **This station is located in a suspected subsidence area (see below).

BW1374

BW1374 GEOID HEIGHT - -26.872 (meters) GEOID18

BW1374 VERT ORDER - FIRST CLASS II (See Below)

BW1374

BW1374.The horizontal coordinates were scaled from a map and have

BW1374.an estimated accuracy of +/- 6 seconds.

BW1374.

BW1374 ** This station is in an area of known vertical motion. If an

BW1374 ** orthometric height was ever established but is not available

BW1374 ** in the current survey control section, the orthometric height

BW1374 ** is considered suspect. Suspect heights are available in the

BW1374 ** superseded section only if requested.

BW1374

BW1374.Significant digits in the geoid height do not necessarily reflect accuracy.

BW1374.GEOID18 height accuracy estimate available [here](#).

BW1374

BW1374.The vertical order pertains to the NGVD 29 superseded value.

BW1374

BW1374.Click [photographs](#) - Photos may exist for this station.

BW1374

BW1374; North East Units Estimated Accuracy

BW1374;SPC MS W - 177,590. 581,670. MT (+/- 180 meters Scaled)

BW1374

BW1374_U.S. NATIONAL GRID SPATIAL ADDRESS: 15RXQ360411(NAD 83)

BW1374

SUPERSEDED SURVEY CONTROL

BW1374

BW1374 NGVD 29 (??/??/92) 15.136 (m) 49.66 (f) ADJ UNCH 1 2

BW1374

BW1374.Superseded values are not recommended for survey control.

BW1374

BW1374.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

BW1374.See file [dsdata.pdf](#) to determine how the superseded data were derived.

BW1374

BW1374_MARKER: C = CAP OF CAP-AND-BOLT PAIR

BW1374_SETTING: 17 = SET INTO TOP OF METAL PIPE DRIVEN INTO GROUND

BW1374_STAMPING: 146/1

BW1374_STABILITY: D = MARK OF QUESTIONABLE OR UNKNOWN STABILITY

BW1374

BW1374 HISTORY - Date Condition Report By

BW1374 HISTORY - UNK MONUMENTED DOD

BW1374 HISTORY - 1938 GOOD CGS

BW1374

BW1374 STATION DESCRIPTION

BW1374

BW1374'DESCRIBED BY COAST AND GEODETIC SURVEY 1938

BW1374'2 MI W FROM FORT ADAMS.

BW1374'2 MILES WEST ALONG A ROAD FROM FORT ADAMS, WILKINSON COUNTY, 984 FEET

BW1374'NORTHWEST OF THE BRIDGE OVER BUFFALO RIVER, 755 FEET NORTHWEST OF THE

BW1374'NEAREST POINT OF BUFFALO RIVER, AND 7 FEET WEST OF THE ROAD. AN IRON

BW1374'PIPE BEARING A CORPS OF ENGINEERS, U. S. ARMY, STANDARD CAP.

*** retrieval complete.

Elapsed Time = 00:00:01

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.10

Starting Datasheet Retrieval...

1 National Geodetic Survey, Retrieval Date = OCTOBER 30, 2020

BW1375 *****

BW1375 DESIGNATION - 146/1 BOLT

BW1375 PID - BW1375

BW1375 STATE/COUNTY- MS/WILKINSON

BW1375 COUNTRY - US

BW1375 USGS QUAD - FORT ADAMS (2018)

BW1375

*CURRENT SURVEY CONTROL

BW1375

BW1375* NAD 83(1986) POSITION- 31 05 46. (N) 091 34 25. (W) SCALED

BW1375* [NAVD 88](#) ORTHO HEIGHT - ** (meters) ** (feet) NOT PUB

BW1375 **This station is located in a suspected subsidence area (see below).

BW1375

BW1375 GEOID HEIGHT - -26.872 (meters) GEOID18

BW1375 VERT ORDER - FIRST CLASS II (See Below)

BW1375

BW1375.The horizontal coordinates were scaled from a map and have

BW1375.an estimated accuracy of +/- 6 seconds.

BW1375.

BW1375 ** This station is in an area of known vertical motion. If an

BW1375 ** orthometric height was ever established but is not available

BW1375 ** in the current survey control section, the orthometric height

BW1375 ** is considered suspect. Suspect heights are available in the

BW1375 ** superseded section only if requested.

BW1375

BW1375.Significant digits in the geoid height do not necessarily reflect accuracy.

BW1375.GEOID18 height accuracy estimate available [here](#).

BW1375

BW1375.The vertical order pertains to the NGVD 29 superseded value.

BW1375

BW1375.Click [photographs](#) - Photos may exist for this station.

BW1375

BW1375; North East Units Estimated Accuracy

BW1375;SPC MS W - 177,590. 581,670. MT (+/- 180 meters Scaled)

BW1375

BW1375_U.S. NATIONAL GRID SPATIAL ADDRESS: 15RXQ360411(NAD 83)

BW1375

SUPERSEDED SURVEY CONTROL

BW1375

BW1375 NGVD 29 (??/??/92) 13.89 (m) 45.6 (f) COMPUTED 1 2

BW1375

BW1375.Superseded values are not recommended for survey control.

BW1375

BW1375.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

BW1375.See file [dsdata.pdf](#) to determine how the superseded data were derived.

BW1375

BW1375_MARKER: B = BOLT

BW1375_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT

BW1375_STAMPING: 146/1

BW1375_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO

BW1375+STABILITY: SURFACE MOTION

BW1375

BW1375 HISTORY - Date Condition Report By

BW1375	HISTORY	- UNK	MONUMENTED	DOD
BW1375	HISTORY	- 1938	GOOD	CGS

BW1375

BW1375 STATION DESCRIPTION

BW1375

BW1375'DESCRIBED BY COAST AND GEODETIC SURVEY 1938

BW1375'2 MI W FROM FORT ADAMS.

BW1375'2 MILES WEST ALONG A ROAD FROM FORT ADAMS, WILKINSON COUNTY, 984 FEET

BW1375'NORTHWEST OF THE BRIDGE OVER BUFFALO RIVER, 755 FEET NORTHWEST OF THE

BW1375'NEAREST POINT OF BUFFALO RIVER, AND 7 FEET WEST OF THE ROAD. A COPPER

BW1375'BOLT, SET IN THE TOP OF A STONE ABOUT 3 FEET UNDER GROUND, ACCESS TO

BW1375'WHICH IS HAD THROUGH AN IRON PIPE BEARING A CORPS OF ENGINEERS, U. S.

BW1375'ARMY, STANDARD CAP.

*** retrieval complete.

Elapsed Time = 00:00:01

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.10

Starting Datasheet Retrieval...

1 National Geodetic Survey, Retrieval Date = OCTOBER 30, 2020

BW1369 *****

BW1369 DESIGNATION - GAGE 50 CAP

BW1369 PID - BW1369

BW1369 STATE/COUNTY- MS/WILKINSON

BW1369 COUNTRY - US

BW1369 USGS QUAD - FORT ADAMS (2018)

BW1369

BW1369 *CURRENT SURVEY CONTROL

BW1369

BW1369* NAD 83(1986) POSITION- 31 06 18. (N) 091 35 43. (W) SCALED

BW1369* [NAVD 88](#) ORTHO HEIGHT - *(meters) *(feet) NOT PUB

BW1369 **This station is located in a suspected subsidence area (see below).

BW1369

BW1369 GEOID HEIGHT - -26.869 (meters) GEOID18

BW1369 VERT ORDER - FIRST CLASS II (See Below)

BW1369

BW1369.The horizontal coordinates were scaled from a map and have

BW1369.an estimated accuracy of +/- 6 seconds.

BW1369.

BW1369 ** This station is in an area of known vertical motion. If an

BW1369 ** orthometric height was ever established but is not available

BW1369 ** in the current survey control section, the orthometric height

BW1369 ** is considered suspect. Suspect heights are available in the

BW1369 ** superseded section only if requested.

BW1369

BW1369.Significant digits in the geoid height do not necessarily reflect accuracy.

BW1369.GEOID18 height accuracy estimate available [here](#).

BW1369

BW1369.The vertical order pertains to the NGVD 29 superseded value.

BW1369

BW1369.Click [photographs](#) - Photos may exist for this station.

BW1369

BW1369; North East Units Estimated Accuracy

BW1369;SPC MS W - 178,600. 579,610. MT (+/- 180 meters Scaled)

BW1369

BW1369_U.S. NATIONAL GRID SPATIAL ADDRESS: 15RXQ339420(NAD 83)

BW1369

BW1369 SUPERSEDED SURVEY CONTROL

BW1369

BW1369 NGVD 29 (??/??/92) 16.304 (m) 53.49 (f) ADJ UNCH 1 2

BW1369

BW1369.Superseded values are not recommended for survey control.

BW1369

BW1369.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

BW1369.See file [dsdata.pdf](#) to determine how the superseded data were derived.

BW1369

BW1369_MARKER: C = CAP OF CAP-AND-BOLT PAIR

BW1369_SETTING: 17 = SET INTO TOP OF METAL PIPE DRIVEN INTO GROUND

BW1369_STAMPING: GAGE 50

BW1369_STABILITY: D = MARK OF QUESTIONABLE OR UNKNOWN STABILITY

BW1369

BW1369 HISTORY - Date Condition Report By

BW1369 HISTORY - UNK MONUMENTED DOD

BW1369 HISTORY - 1938 GOOD CGS

BW1369

BW1369 STATION DESCRIPTION

BW1369

BW1369'DESCRIBED BY COAST AND GEODETIC SURVEY 1938

BW1369'3.5 MI W FROM FORT ADAMS.

BW1369'3-1/2 MILES WEST ALONG A ROAD FROM FORT ADAMS, WILKINSON COUNTY, 1

BW1369'MILE NORTHEAST OF STAMPS LANDING, NEAR A PROMINENT TURN IN THE ROAD,

BW1369'AT STAMPS PLANTATION, IN THE SOUTHWEST CORNER OF THE YARD OF THE

BW1369'HOUSE, 820 FEET NORTHEAST OF THE MISSISSIPPI RIVER BANK, AND 39 FEET

BW1369'LANDWARD FROM THE OLD RIVER BANK. AN IRON PIPE BEARING A CORPS OF

BW1369'ENGINEERS, U. S. ARMY, STANDARD CAP.

*** retrieval complete.

Elapsed Time = 00:00:02

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.10

Starting Datasheet Retrieval...

1 National Geodetic Survey, Retrieval Date = OCTOBER 30, 2020

BW1370 *****

BW1370 DESIGNATION - GAGE 50 BOLT

BW1370 PID - BW1370

BW1370 STATE/COUNTY- MS/WILKINSON

BW1370 COUNTRY - US

BW1370 USGS QUAD - FORT ADAMS (2018)

BW1370

BW1370 *CURRENT SURVEY CONTROL

BW1370

BW1370* NAD 83(1986) POSITION- 31 06 18. (N) 091 35 43. (W) SCALED

BW1370* [NAVD 88](#) ORTHO HEIGHT - *(meters) *(feet) NOT PUB

BW1370 **This station is located in a suspected subsidence area (see below).

BW1370

BW1370 GEOID HEIGHT - -26.869 (meters) GEOID18

BW1370 VERT ORDER - FIRST CLASS II (See Below)

BW1370

BW1370.The horizontal coordinates were scaled from a map and have

BW1370.an estimated accuracy of +/- 6 seconds.

BW1370.

BW1370 ** This station is in an area of known vertical motion. If an

BW1370 ** orthometric height was ever established but is not available

BW1370 ** in the current survey control section, the orthometric height

BW1370 ** is considered suspect. Suspect heights are available in the

BW1370 ** superseded section only if requested.

BW1370

BW1370.Significant digits in the geoid height do not necessarily reflect accuracy.

BW1370.GEOID18 height accuracy estimate available [here](#).

BW1370

BW1370.The vertical order pertains to the NGVD 29 superseded value.

BW1370

BW1370.Click [photographs](#) - Photos may exist for this station.

BW1370

BW1370; North East Units Estimated Accuracy

BW1370;SPC MS W - 178,600. 579,610. MT (+/- 180 meters Scaled)

BW1370

BW1370_U.S. NATIONAL GRID SPATIAL ADDRESS: 15RXQ339420(NAD 83)

BW1370

BW1370 SUPERSEDED SURVEY CONTROL

BW1370

BW1370 NGVD 29 (??/??/92) 15.053 (m) 49.39 (f) ADJ UNCH 1 2

BW1370

BW1370.Superseded values are not recommended for survey control.

BW1370

BW1370.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

BW1370.See file [dsdata.pdf](#) to determine how the superseded data were derived.

BW1370

BW1370_MARKER: B = BOLT

BW1370_SETTING: 30 = SET IN A LIGHT STRUCTURE

BW1370_SP_SET: TILE

BW1370_STAMPING: GAGE 50

BW1370_STABILITY: D = MARK OF QUESTIONABLE OR UNKNOWN STABILITY

BW1370

BW1370 HISTORY - Date Condition Report By

BW1370	HISTORY	- UNK	MONUMENTED	DOD
BW1370	HISTORY	- 1938	GOOD	CGS

BW1370

BW1370 STATION DESCRIPTION

BW1370

BW1370'DESCRIBED BY COAST AND GEODETIC SURVEY 1938

BW1370'3.5 MI W FROM FORT ADAMS.

BW1370'3-1/2 MILES WEST ALONG A ROAD FROM FORT ADAMS, WILKINSON COUNTY, 1
BW1370'MILE NORTHEAST OF STAMPS LANDING, NEAR A PROMINENT TURN IN THE ROAD,
BW1370'AT STAMPS PLANTATION, IN THE SOUTHWEST CORNER OF THE YARD OF THE
BW1370'HOUSE, 820 FEET NORTHEAST OF THE MISSISSIPPI RIVER BANK, AND 39 FEET
BW1370'LANDWARD FROM THE OLD RIVER BANK. A COPPER BOLT SET IN THE TOP OF A
BW1370'TILE ABOUT 3 FEET UNDERGROUND, ACCESS TO WHICH IS HAD THROUGH AN IRON
BW1370'PIPE BEARING A CORPS OF ENGINEERS, U. S. ARMY, STANDARD CAP.

*** retrieval complete.

Elapsed Time = 00:00:02

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.11

Starting Datasheet Retrieval...

1 National Geodetic Survey, Retrieval Date = DECEMBER 28, 2020

BW1380 *****

BW1380 DESIGNATION - FORT ADAMS CAP

BW1380 PID - BW1380

BW1380 STATE/COUNTY- MS/WILKINSON

BW1380 COUNTRY - US

BW1380 USGS QUAD - FORT ADAMS (2018)

BW1380

BW1380 *CURRENT SURVEY CONTROL

BW1380

BW1380* NAD 83(1986) POSITION- 31 05 01. (N) 091 32 58. (W) SCALED

BW1380* [NAVD 88](#) ORTHO HEIGHT - *(meters) *(feet) NOT PUB

BW1380 **This station is located in a suspected subsidence area (see below).

BW1380

BW1380 GEOID HEIGHT - -26.871 (meters) GEOID18

BW1380 VERT ORDER - FIRST CLASS II (See Below)

BW1380

BW1380.The horizontal coordinates were scaled from a map and have

BW1380.an estimated accuracy of +/- 6 seconds.

BW1380.

BW1380 ** This station is in an area of known vertical motion. If an

BW1380 ** orthometric height was ever established but is not available

BW1380 ** in the current survey control section, the orthometric height

BW1380 ** is considered suspect. Suspect heights are available in the

BW1380 ** superseded section only if requested.

BW1380

BW1380.Significant digits in the geoid height do not necessarily reflect accuracy.

BW1380.GEOID18 height accuracy estimate available [here](#).

BW1380

BW1380.The vertical order pertains to the NGVD 29 superseded value.

BW1380

BW1380.Click [photographs](#) - Photos may exist for this station.

BW1380

BW1380; North East Units Estimated Accuracy

BW1380;SPC MS W - 176,180. 583,960. MT (+/- 180 meters Scaled)

BW1380

BW1380_U.S. NATIONAL GRID SPATIAL ADDRESS: 15RXQ383397(NAD 83)

BW1380

BW1380 SUPERSEDED SURVEY CONTROL

BW1380

BW1380 NGVD 29 (??/??/92) 17.030 (m) 55.87 (f) ADJ UNCH 1 2

BW1380

BW1380.Superseded values are not recommended for survey control.

BW1380

BW1380.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

BW1380.See file [dsdata.pdf](#) to determine how the superseded data were derived.

BW1380

BW1380_MARKER: C = CAP OF CAP-AND-BOLT PAIR

BW1380_SETTING: 17 = SET INTO TOP OF METAL PIPE DRIVEN INTO GROUND

BW1380_STAMPING: FORT ADAMS

BW1380_STABILITY: D = MARK OF QUESTIONABLE OR UNKNOWN STABILITY

BW1380

BW1380 HISTORY - Date Condition Report By

BW1380 HISTORY - UNK MONUMENTED DOD

BW1380 HISTORY - 1938 GOOD CGS

BW1380

BW1380

STATION DESCRIPTION

BW1380

BW1380'DESCRIBED BY COAST AND GEODETIC SURVEY 1938

BW1380'IN FORT ADAMS.

BW1380'AT FORT ADAMS, WILKINSON COUNTY, IN THE LOWER PART OF TOWN, 600 FEET
BW1380'SOUTH ALONG A ROAD FROM THE POST OFFICE AND A GENERAL STORE OWNED IN
BW1380'1942 BY S. B. CURRY, 215 FEET WEST OF WELL-DEFINED FOOTHILLS, 203 FEET
BW1380'SOUTHEAST OF A NEGRO CHURCH AND SCHOOL, 63 FEET NORTH OF A BLACKSMITH
BW1380'SHOP OWNED BY HOWARD STUTZMAN, 54 FEET NORTHEAST OF THE INTERSECTION
BW1380'OF A DIRT AND A GRAVEL ROAD (THE GRAVEL ROAD CIRCLES AT THIS POINT TO
BW1380'THE FOOTHILLS AND THE DIRT ROAD LEADS TO FORT ADAMS LANDING ON
BW1380'MISSISSIPPI RIVER), 10 FEET SOUTHWEST OF THE FORMER STUTZMAN RESIDENCE
BW1380'(UNOCCUPIED IN 1942 AND USED AS A WAREHOUSE), 12.5 FEET EAST OF A
BW1380'FENCE CORNER, AND 1.4 FEET NORTH OF THE EAST-AND-WEST PICKET FENCE. AN
BW1380'IRON PIPE BEARING A CORPS OF ENGINEERS, U. S. ARMY, STANDARD CAP.

*** retrieval complete.

Elapsed Time = 00:00:01

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.11

Starting Datasheet Retrieval...

1 National Geodetic Survey, Retrieval Date = DECEMBER 28, 2020

BW1381 *****

BW1381 DESIGNATION - FORT ADAMS BOLT

BW1381 PID - BW1381

BW1381 STATE/COUNTY- MS/WILKINSON

BW1381 COUNTRY - US

BW1381 USGS QUAD - FORT ADAMS (2018)

BW1381

BW1381 *CURRENT SURVEY CONTROL

BW1381

BW1381* NAD 83(1986) POSITION- 31 05 01. (N) 091 32 58. (W) SCALED

BW1381* [NAVD 88](#) ORTHO HEIGHT - *(meters) *(feet) NOT PUB

BW1381 **This station is located in a suspected subsidence area (see below).

BW1381

BW1381 GEOID HEIGHT - -26.871 (meters) GEOID18

BW1381 VERT ORDER - FIRST CLASS II (See Below)

BW1381

BW1381.The horizontal coordinates were scaled from a map and have

BW1381.an estimated accuracy of +/- 6 seconds.

BW1381.

BW1381 ** This station is in an area of known vertical motion. If an

BW1381 ** orthometric height was ever established but is not available

BW1381 ** in the current survey control section, the orthometric height

BW1381 ** is considered suspect. Suspect heights are available in the

BW1381 ** superseded section only if requested.

BW1381

BW1381.Significant digits in the geoid height do not necessarily reflect accuracy.

BW1381.GEOID18 height accuracy estimate available [here](#).

BW1381

BW1381.The vertical order pertains to the NGVD 29 superseded value.

BW1381

BW1381.Click [photographs](#) - Photos may exist for this station.

BW1381

BW1381; North East Units Estimated Accuracy

BW1381;SPC MS W - 176,180. 583,960. MT (+/- 180 meters Scaled)

BW1381

BW1381_U.S. NATIONAL GRID SPATIAL ADDRESS: 15RXQ383397(NAD 83)

BW1381

SUPERSEDED SURVEY CONTROL

BW1381

BW1381 NGVD 29 (??/??/92) 15.78 (m) 51.8 (f) COMPUTED 1 2

BW1381

BW1381.Superseded values are not recommended for survey control.

BW1381

BW1381.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

BW1381.See file [dsdata.pdf](#) to determine how the superseded data were derived.

BW1381

BW1381_MARKER: B = BOLT

BW1381_SETTING: 30 = SET IN A LIGHT STRUCTURE

BW1381_SP_SET: TILE

BW1381_STAMPING: FORT ADAMS

BW1381_STABILITY: D = MARK OF QUESTIONABLE OR UNKNOWN STABILITY

BW1381

BW1381 HISTORY - Date Condition Report By

BW1381	HISTORY	- UNK	MONUMENTED	DOD
BW1381	HISTORY	- 1938	GOOD	CGS

BW1381

BW1381

BW1381

STATION DESCRIPTION

BW1381'DESCRIBED BY COAST AND GEODETIC SURVEY 1938

BW1381'IN FORT ADAMS.

BW1381'AT FORT ADAMS, WILKINSON COUNTY, IN THE LOWER PART OF TOWN, 600 FEET
BW1381'SOUTH ALONG A ROAD FROM THE POST OFFICE AND A GENERAL STORE OWNED IN
BW1381'1942 BY S. B. CURRY, 215 FEET WEST OF WELL-DEFINED FOOTHILLS, 203 FEET
BW1381'SOUTHEAST OF A NEGRO CHURCH AND SCHOOL, 63 FEET NORTH OF A BLACKSMITH
BW1381'SHOP OWNED BY HOWARD STUTZMAN, 54 FEET NORTHEAST OF THE INTERSECTION
BW1381'OF A DIRT AND A GRAVEL ROAD (THE GRAVEL ROAD CIRCLES AT THIS POINT TO
BW1381'THE FOOTHILLS AND THE DIRT ROAD LEADS TO FORT ADAMS LANDING ON
BW1381'MISSISSIPPI RIVER), 10 FEET SOUTHWEST OF THE FORMER STUTZMAN RESIDENCE
BW1381'(UNOCCUPIED IN 1942 AND USED AS A WAREHOUSE), 12.5 FEET EAST OF A
BW1381'FENCE CORNER, AND 1.4 FEET NORTH OF THE EAST-AND-WEST PICKET FENCE. A
BW1381'COPPER BOLT, SET IN THE TOP OF A TILE ABOUT 3 FEET UNDER GROUND,
BW1381'ACCESS TO WHICH IS HAD THROUGH AN IRON PIPE BEARING A CORPS OF
BW1381'ENGINEERS, U. S. ARMY, STANDARD CAP.

*** retrieval complete.

Elapsed Time = 00:00:01

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.10

Starting Datasheet Retrieval...

1 National Geodetic Survey, Retrieval Date = NOVEMBER 2, 2020

BW1394 *****

BW1394 DESIGNATION - PBM GAGE 48 CAP

BW1394 PID - BW1394

BW1394 STATE/COUNTY- MS/WILKINSON

BW1394 COUNTRY - US

BW1394 USGS QUAD - ANGOLA (2018)

BW1394

*CURRENT SURVEY CONTROL

BW1394

BW1394* NAD 83(1986) POSITION- 30 59 58. (N) 091 36 26. (W) SCALED

BW1394* [NAVD 88](#) ORTHO HEIGHT - ** (meters) ** (feet) NOT PUB

BW1394 **This station is located in a suspected subsidence area (see below).

BW1394

BW1394 GEOID HEIGHT - -26.963 (meters) GEOID18

BW1394 VERT ORDER - FIRST CLASS II (See Below)

BW1394

BW1394.The horizontal coordinates were scaled from a map and have

BW1394.an estimated accuracy of +/- 6 seconds.

BW1394.

BW1394 ** This station is in an area of known vertical motion. If an

BW1394 ** orthometric height was ever established but is not available

BW1394 ** in the current survey control section, the orthometric height

BW1394 ** is considered suspect. Suspect heights are available in the

BW1394 ** superseded section only if requested.

BW1394

BW1394.Significant digits in the geoid height do not necessarily reflect accuracy.

BW1394.GEOID18 height accuracy estimate available [here](#).

BW1394

BW1394.The vertical order pertains to the NGVD 29 superseded value.

BW1394

BW1394.Click [photographs](#) - Photos may exist for this station.

BW1394

BW1394; North East Units Estimated Accuracy

BW1394;SPC MS W - 166,910. 578,340. MT (+/- 180 meters Scaled)

BW1394

BW1394_U.S. NATIONAL GRID SPATIAL ADDRESS: 15RXQ329303(NAD 83)

BW1394

SUPERSEDED SURVEY CONTROL

BW1394

BW1394 NGVD 29 (11/26/84) 16.350 (m) 53.64 (f) ADJUSTED 1 2

BW1394

BW1394.Superseded values are not recommended for survey control.

BW1394

BW1394.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

BW1394.See file [dsdata.pdf](#) to determine how the superseded data were derived.

BW1394

BW1394_MARKER: C = CAP OF CAP-AND-BOLT PAIR

BW1394_SETTING: 17 = SET INTO TOP OF METAL PIPE DRIVEN INTO GROUND

BW1394_STABILITY: D = MARK OF QUESTIONABLE OR UNKNOWN STABILITY

BW1394

BW1394 HISTORY - Date Condition Report By

BW1394 HISTORY - UNK MONUMENTED DOD

BW1394 HISTORY - 1964 GOOD CGS

BW1394

BW1394

STATION DESCRIPTION

BW1394

BW1394'DESCRIBED BY COAST AND GEODETIC SURVEY 1964

BW1394'10.1 MI NW FROM ANGOLA, LA.

BW1394'ABOUT 4.3 MILES SOUTHWEST ALONG THE LEVEE ROAD FROM THE HOSPITAL AT

BW1394'THE MAIN ENTRANCE TO THE ANGOLA STATE PRISON, THENCE 5.65 MILES

BW1394'NORTHEAST ALONG A GRAVELED ROAD AND A LEVEE TO A SHARP CURVE IN BOTH,

BW1394'THENCE 0.15 MILE NORTHEAST ALONG A TRAIL ROAD. 230 FEET NORTHEAST OF A

BW1394'WOODEN GATE IN AN EAST-WEST FENCE LINE WHICH FOLLOWS THE

BW1394'MISSISSIPPI-LOUISIANA STATE LINE, 23 FEET SOUTHEAST OF THE CENTER LINE

BW1394'OF A TRACK ROAD, 9 1/2 FEET SOUTHWEST OF A 12-INCH HACKBERRY TREE

BW1394'BEARING A WITNESS SHIELD, 3 1/2 FEET NORTHWEST OF A FENCE, A 4-INCH

BW1394'IRON PIPE BEARING A CAP WHICH PROJECTS 10 INCHES, AND ABOUT 2 FEET

BW1394'ABOVE THE ROAD.

*** retrieval complete.

Elapsed Time = 00:00:01

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.10

Starting Datasheet Retrieval...

1 National Geodetic Survey, Retrieval Date = NOVEMBER 2, 2020

BW1395 *****

BW1395 DESIGNATION - PBM GAGE 48 BOLT

BW1395 PID - BW1395

BW1395 STATE/COUNTY- MS/WILKINSON

BW1395 COUNTRY - US

BW1395 USGS QUAD - ANGOLA (2018)

BW1395

*CURRENT SURVEY CONTROL

BW1395

BW1395* NAD 83(1986) POSITION- 30 59 58. (N) 091 36 26. (W) SCALED

BW1395* [NAVD 88](#) ORTHO HEIGHT - ** (meters) ** (feet) NOT PUB

BW1395 **This station is located in a suspected subsidence area (see below).

BW1395

BW1395 GEOID HEIGHT - -26.963 (meters) GEOID18

BW1395 VERT ORDER - FIRST CLASS II (See Below)

BW1395

BW1395.The horizontal coordinates were scaled from a map and have

BW1395.an estimated accuracy of +/- 6 seconds.

BW1395.

BW1395 ** This station is in an area of known vertical motion. If an

BW1395 ** orthometric height was ever established but is not available

BW1395 ** in the current survey control section, the orthometric height

BW1395 ** is considered suspect. Suspect heights are available in the

BW1395 ** superseded section only if requested.

BW1395

BW1395.Significant digits in the geoid height do not necessarily reflect accuracy.

BW1395.GEOID18 height accuracy estimate available [here](#).

BW1395

BW1395.The vertical order pertains to the NGVD 29 superseded value.

BW1395

BW1395.Click [photographs](#) - Photos may exist for this station.

BW1395

BW1395; North East Units Estimated Accuracy

BW1395;SPC MS W - 166,910. 578,340. MT (+/- 180 meters Scaled)

BW1395

BW1395_U.S. NATIONAL GRID SPATIAL ADDRESS: 15RXQ329303(NAD 83)

BW1395

SUPERSEDED SURVEY CONTROL

BW1395

BW1395 NGVD 29 (11/26/84) 15.105 (m) 49.56 (f) ADJUSTED 1 2

BW1395

BW1395.Superseded values are not recommended for survey control.

BW1395

BW1395.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

BW1395.See file [dsdata.pdf](#) to determine how the superseded data were derived.

BW1395

BW1395_MARKER: B = BOLT

BW1395_SETTING: 0 = UNSPECIFIED SETTING

BW1395_STABILITY: D = MARK OF QUESTIONABLE OR UNKNOWN STABILITY

BW1395

BW1395 HISTORY - Date Condition Report By

BW1395 HISTORY - UNK MONUMENTED DOD

BW1395 HISTORY - 1964 GOOD CGS

BW1395

BW1395

STATION DESCRIPTION

BW1395

BW1395'DESCRIBED BY COAST AND GEODETIC SURVEY 1964

BW1395'10.1 MI NW FROM ANGOLA, LA.

BW1395'ABOUT 4.3 MILES SOUTHWEST ALONG THE LEVEE ROAD FROM THE HOSPITAL AT

BW1395'THE MAIN ENTRANCE TO THE ANGOLA STATE PRISON, THENCE 5.65 MILES

BW1395'NORTHEAST ALONG A GRAVELED ROAD AND A LEVEE TO A SHARP CURVE IN BOTH,

BW1395'THENCE 0.15 MILE NORTHEAST ALONG A TRAIL ROAD, 230 FEET NORTHEAST OF A

BW1395'WOODEN GATE IN AN EAST-WEST FENCE LINE WHICH FOLLOWS THE

BW1395'MISSISSIPPI-LOUISIANA STATE LINE, 23 FEET SOUTHEAST OF THE CENTER LINE

BW1395'OF A TRACK ROAD, 9 1/2 FEET SOUTHWEST OF A 12-INCH HACKBERRY TREE

BW1395'BEARING A WITNESS SHIELD, 3 1/2 FEET NORTHWEST OF A FENCE, A COPPER

BW1395'BOLT SET IN CONCRETE ABOUT 3 FEET BELOW THE LEVEL OF THE GROUND, ACCES

BW1395'TO WHICH IS HAD THROUGH A 4-INCH IRON PIPE BEARING A CAP WHICH

BW1395'PROJECTS 10 INCHES, AND ABOUT 2 FEET ABOVE THE ROAD.

*** retrieval complete.

Elapsed Time = 00:00:01

Unit Conversion Factors

Multiply	By	To Obtain
Feet	0.3048	meters
miles (nautical)	1,852	meters
miles (US statute)	1,609.347	meters
square feet	0.09290304	square meters
square inches	6.4516 E-04	square meters
square miles	2.589998 E+06	square meters
square yards	0.8361274	square meters

Acronyms and Abbreviations

BG	Brigadier General
ERDC	US Army Engineer Research and Development Center
lat-long	Latitude-longitude
LMV	Lower Mississippi Valley
LSOS	Low Sill and Overbank Structures
LWRP	Low Water Reference Plane
MD	Memphis Datum
MGL	Mean Gulf Level
MLMR	Middle and Lower Mississippi River
MLW	Mean Low Water
MRC	Mississippi River Commission
MSL	Mean Sea Level
NAD27	North American Datum of 1927
NAVD88	North American Vertical Datum 1988
NGS	National Geodetic Survey
NGVD29	National Geodetic Vertical Datum 1929
PID	Permanent Identifier
USACE	US Army Corps of Engineers
USCGS	US Coast and Geodetic Survey
USGS	US Geological Survey

REPORT DOCUMENTATION PAGE					Form Approved OMB No. 0704-0188	
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14. ABSTRACT Vertical datums used in the study area at the Old River Control Structure in southern Louisiana have involved Memphis Datum, Mean Gulf Level, Mean Sea Level, Mean Sea Level Datum of 1929, National Geodetic Vertical Datum of 1929, and the North American Vertical Datum of 1988. The focus of this study was to examine historic benchmarks in the study area to determine the magnitude of elevation changes associated with the different legacy datums that have been used by the US Army Corps of Engineers. Comparison of elevation values across these legacy datums has involved examining historic hydrographic surveys, compiling a list of known benchmarks from these surveys, and comparing their elevation values against publications involving spirit-leveling surveys from the Lower Mississippi Valley and the National Geodetic Survey database for benchmarks. This study describes the history of legacy datums, floodplain geology at the Old River Control Structure, potential subsidence impacts affecting the benchmarks, methods for identification and tracking benchmarks, and the results obtained from this study.						
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