Mississippi River Science Forum

RIVER SCIENCE: A CORPS PERSPECTIVE

Andy Ashley, P.E.
Acting Director
Mississippi River Science & Technology Office
U.S. Army Corps of Engineers
Mississippi Valley Division
January 15th, 2023

US Army Corps of Engineers ®

1817 First river discharge records are recorded by the Corps of Engineers.

Since 1817, the Corps has intermittently collected vast amounts of data on the river, including hydrographic surveys, sediment sampling, velocity and current measurements, boring data, flow data, bed form data, geologic information, water surface slopes, and geomorphic assessments.

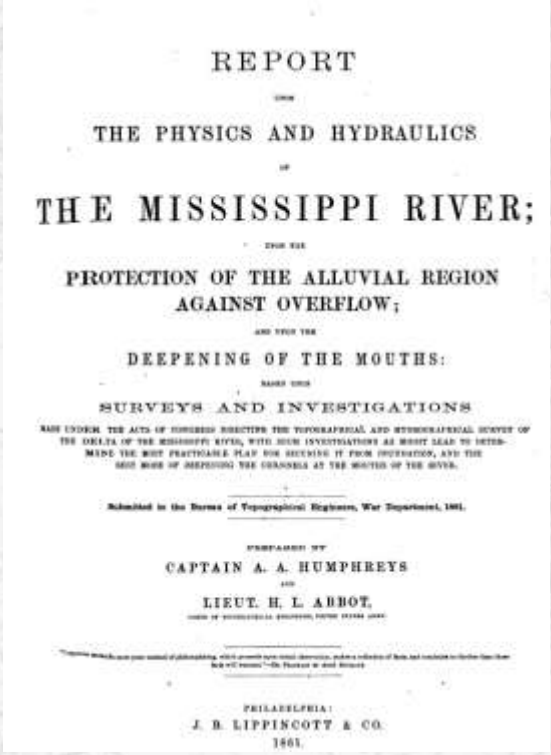
1822 Bernard and Totten Report, the first official U.S. survey of the Mississippi River.

1852

Charles Ellet Report

1861

Humphreys and Abbot complete the *Report Upon the Physics and Hydraulics of the Mississippi River*, commonly referred to as the Delta Survey, which influenced flood control policy into the 20TH century.



REPORT

THE PHYSICS AND HYDRAULICS

OF

THE MISSISSIPPI RIVER;

PROTECTION OF THE ALLUVIAL REGION AGAINST OVERFLOW;

AND THE

DEEPENING OF THE MOUTHS:

SURVEYS AND INVESTIGATIONS

CAPTAIN A. A. HUMPHREYS

AND

LIEUT. H. L. ABBOT.

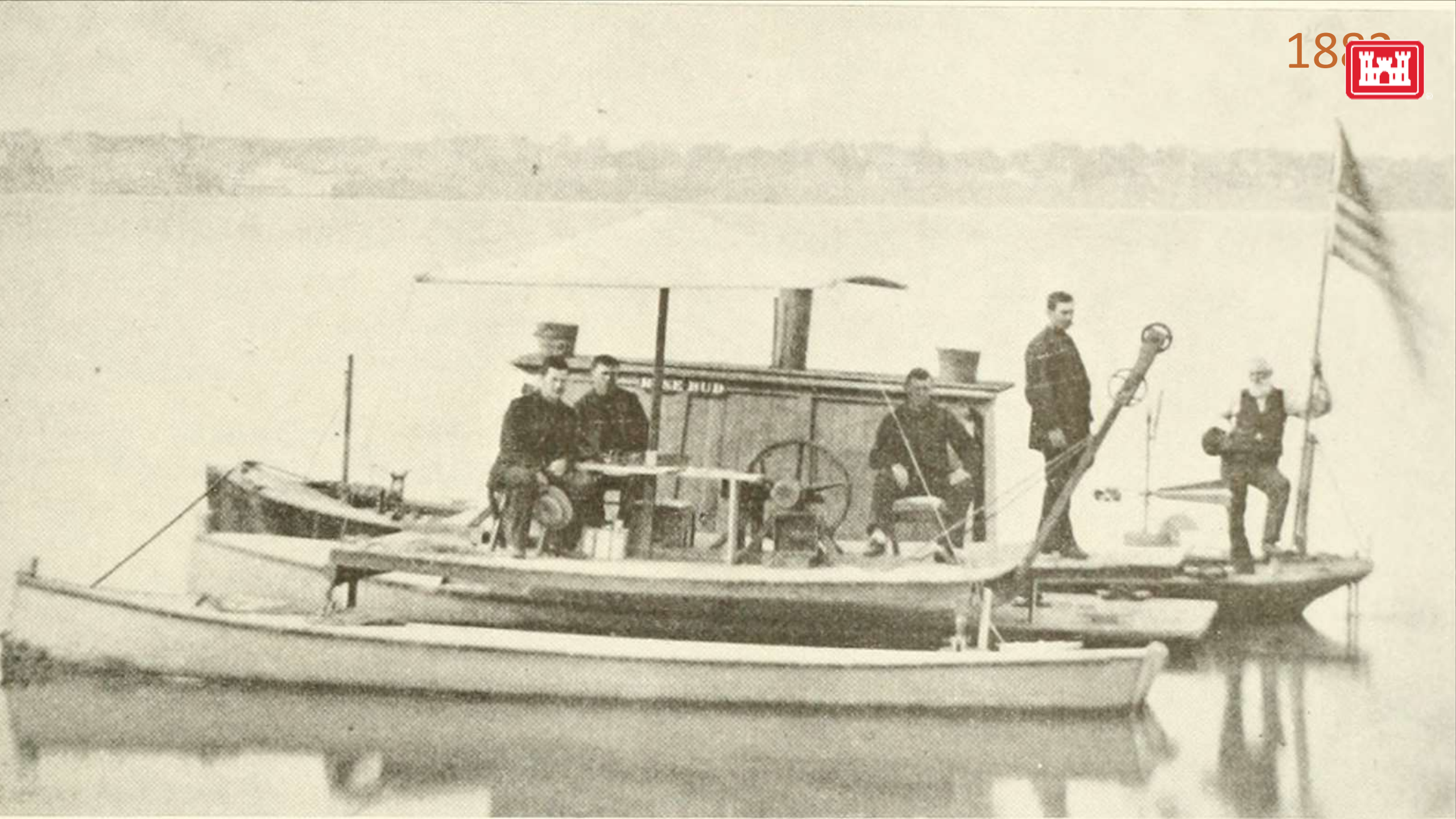
PHILADELPHIA:

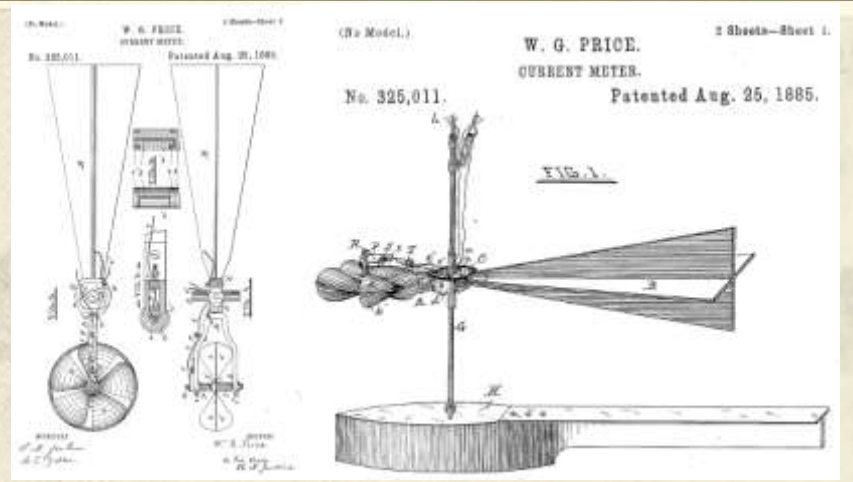
J. B. LIPPINCOTT & CO.

1861.

1879

Creation of Mississippi River Commission by Congress to develop and oversee navigation and flood control plans on the Mississippi River.





W.G. Price
Assistant Engineer
Mississippi River Commission
1879-1896

Price's streamgaging plant at Paducah, Kentucky in 1882

TRIBUTARIES OF MISSISSIPPI RIVER.

OHIO RIVER—Continued.

Paducah, Ky.—Continued.

DATE.	Gage reading.	Area of cross sec'n.	DEPTHS. Mean.	DEPTHS. Maximum.	Width.	Mean velocity per second.	Discharge per second.	Method.	REMARKS.
	Feet.	100 sq. ft.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	1000 cu. ft.		
1882.									
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" 30	48.7	2,330	52.4	76.0	4,443	5.12	1,192		
Feb. 2	48.8	2,291	51.6	73.0	4,443	5.26	1,206		
" 3	48.7	2,122	48.1	69.5	4,416	4.76	1,010		
" 10	45.0								
" 13	43.2	2,012	46.6	68.0	4,320	4.51	908	M	
" 14	43.0								
" 22	47.6	2,231	48.7	.....	4,584	4.85	1,081	M	
" 23	48.5	.....	.....	73.1	.....	.....	.....	.....	
" 24	49.3								
" 25	49.8	2,858	51.4	74.0	4,586	4.98	1,174	M	
" 27	49.8								
" 28	49.6	2,370	51.7	.....	4,587	4.62	*a* 1,095	M	
March 1	49.3	2,333	50.9	76.0	4,585	4.80	1,119	M	
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" 14	45.4	2,154	48.5	69.3	4,440	4.48	964		
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U. S. Engineer gage, zero 286.26 feet above mean Gulf level.

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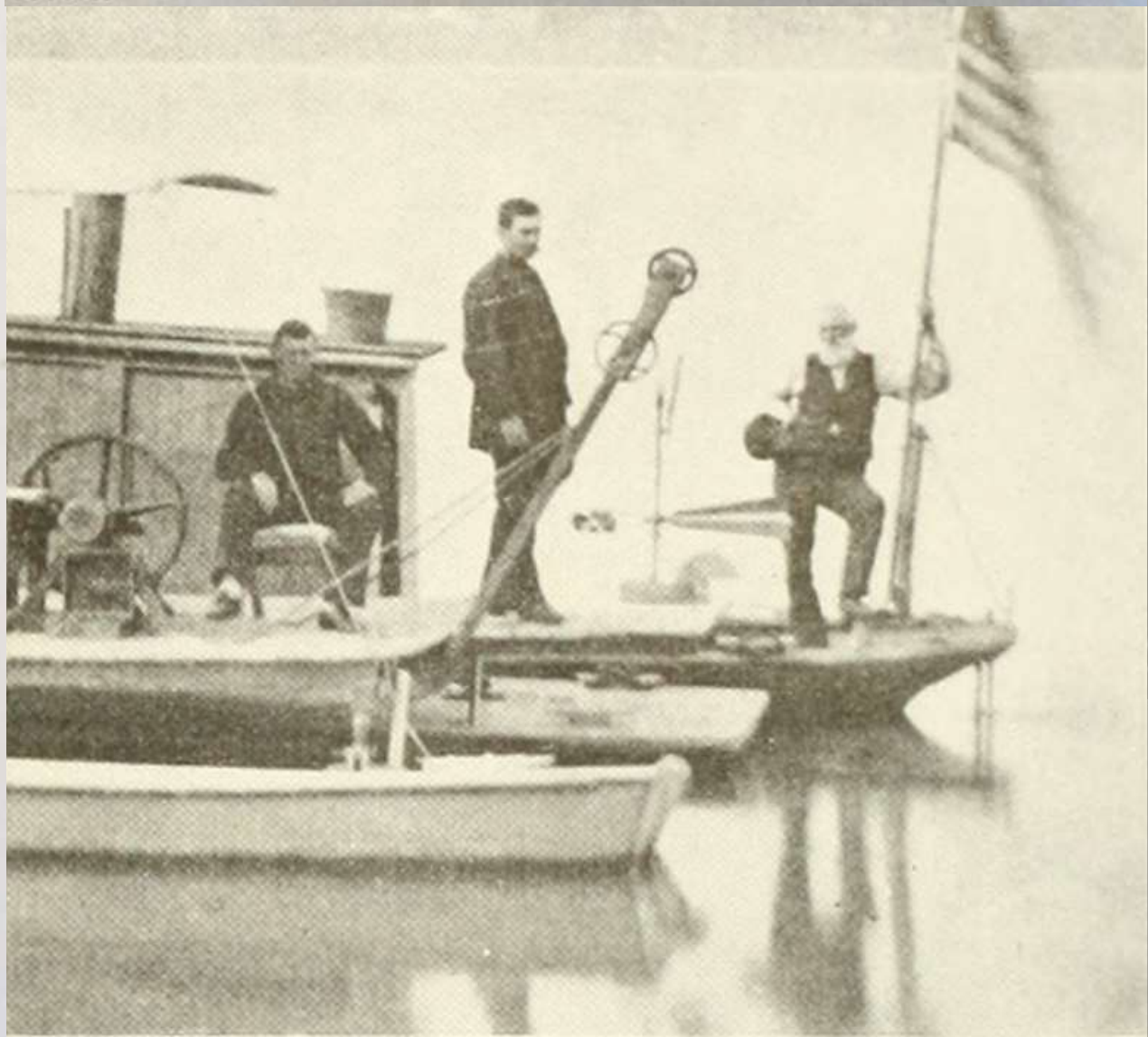
PADUCAH, KY.

U. S. Engineer gauge.

Gauge established by U. S. Signal Service in 1874, and the present iron gauge built under Major Merrill's direction in 1879. Zero of gauge 308.4 feet above the Cairo datum plane. Connection by railroad levels.



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RESULTS OF DISCHARGE OBSERVATIONS

MISSISSIPPI RIVER AND TRIBUTARIES.

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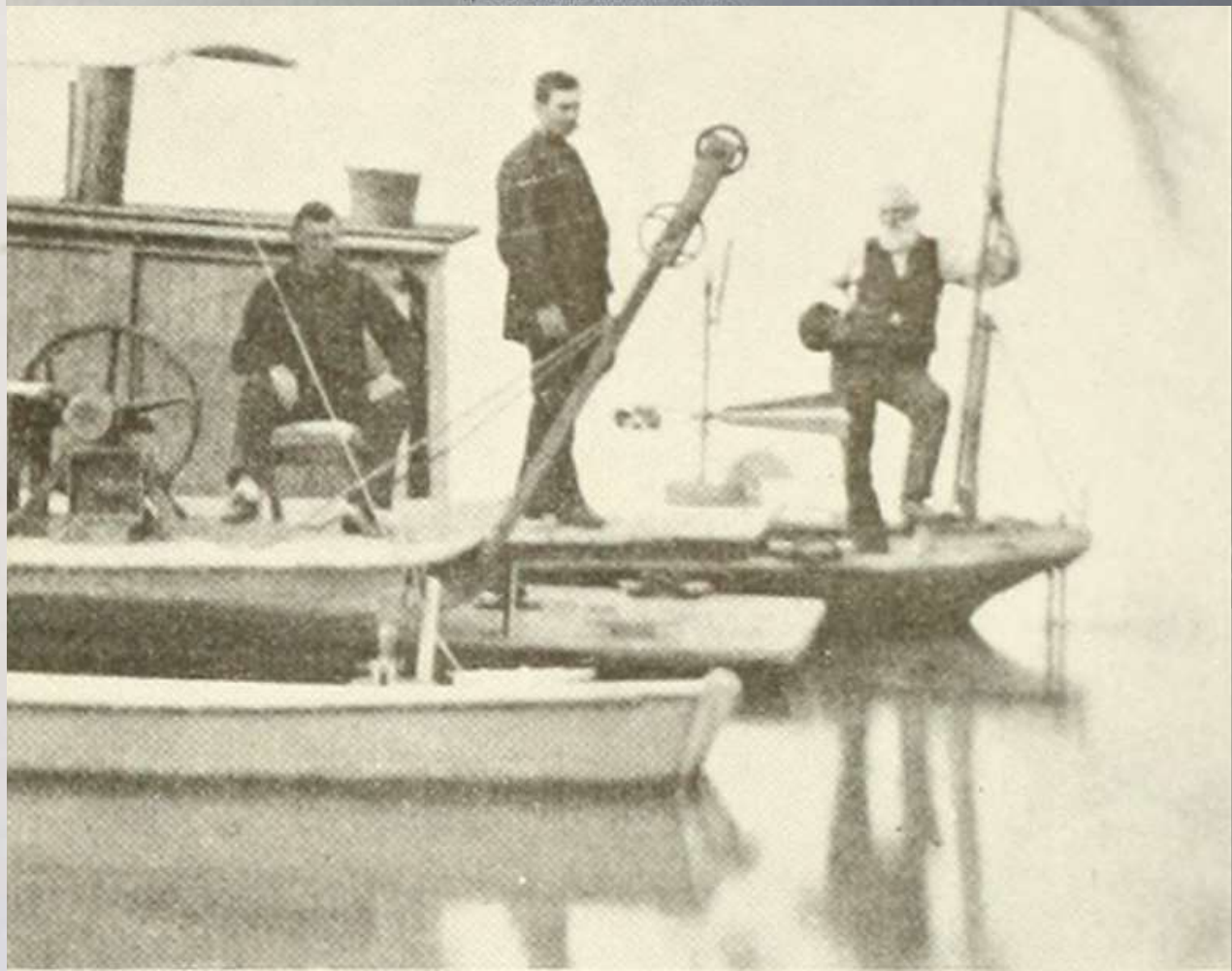
MISSISSIPPI RIVER.

LAKE ITASCA.

1,400 miles above Cairo.



USGS science for a changing world

Techniques of Water-Resources Investigations of the United States Geological Survey

Chapter A8

DISCHARGE MEASUREMENTS AT GAGING STATIONS

Floats

Floats have very limited use in stream gaging, but there are two occasions when they prove useful. A float can be used where the velocity is too low to obtain reliable measurements with the current meter. They are also used where flood measurements are needed and the measuring structure has been destroyed or it is impossible to use a meter.

Both surface floats and rod floats are used. Surface floats may be almost anything that floats, such as wooden disks, bottles partly filled, or oranges. Rod floats are wooden rods weighted on one end so they will float upright in the stream. Rod floats must not touch the streambed. Floating debris or ice cakes may serve as natural floats.

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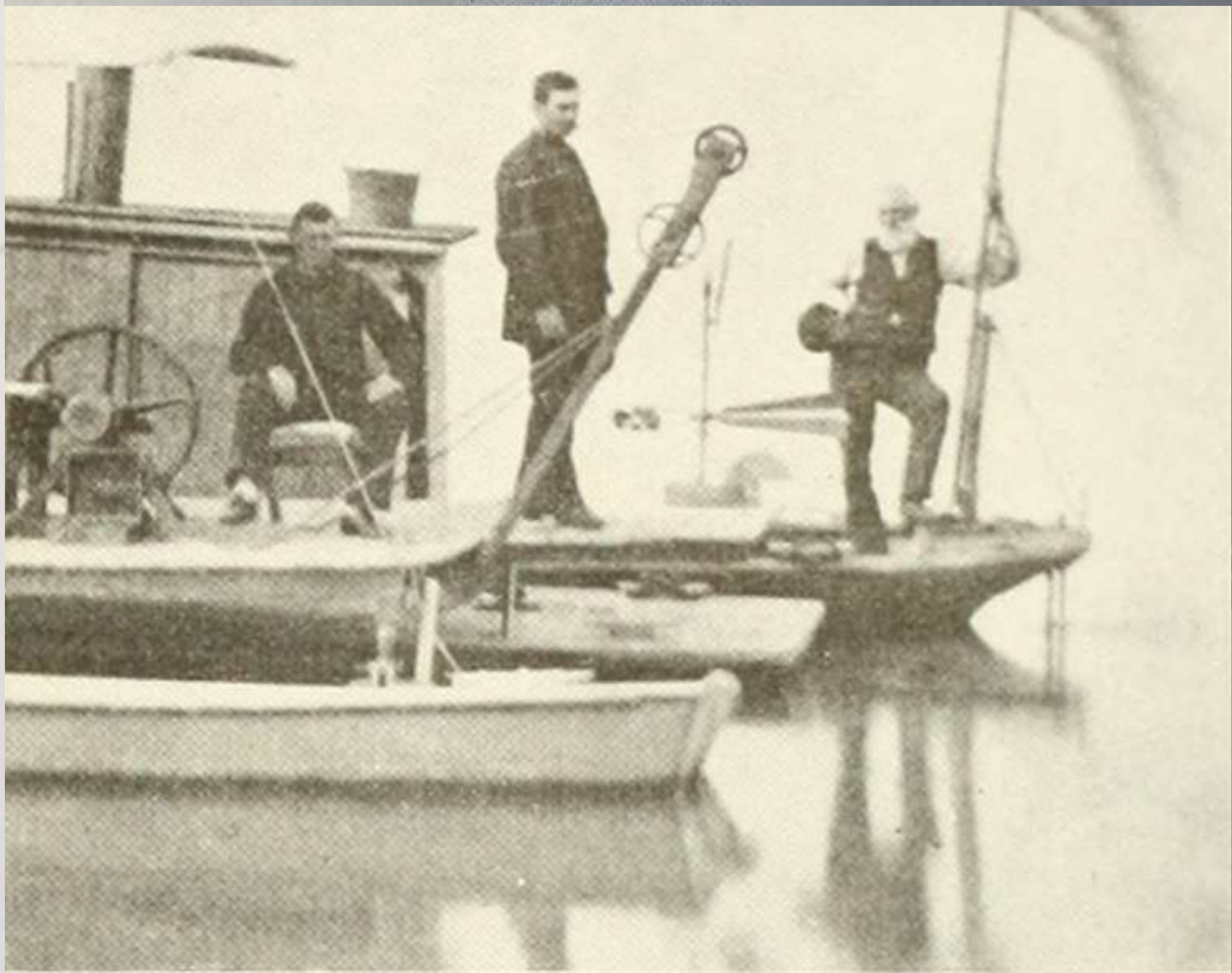

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OHIO RIVER—Continued.

Paducah, Ky.—Continued.

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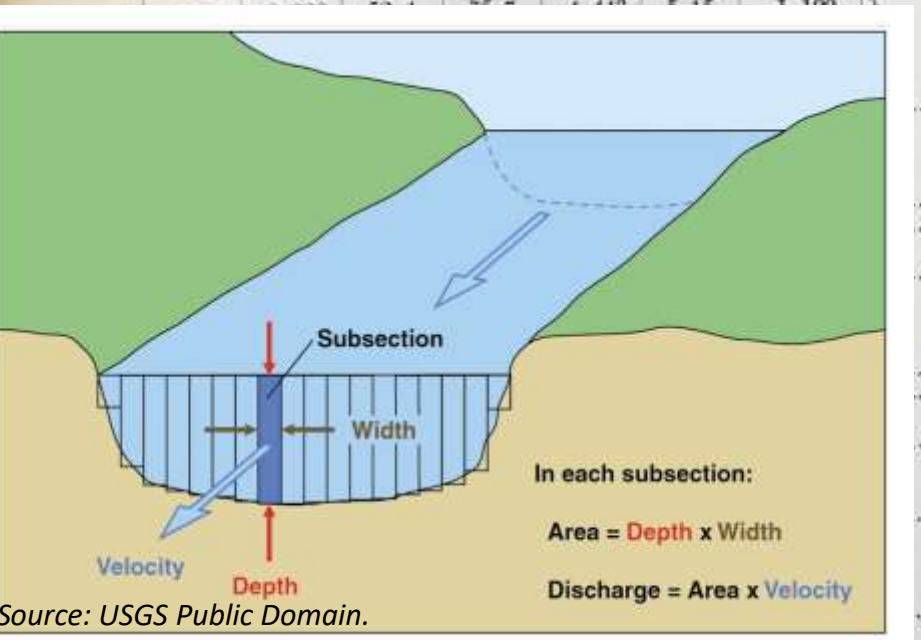

Source: USGS Public Domain.

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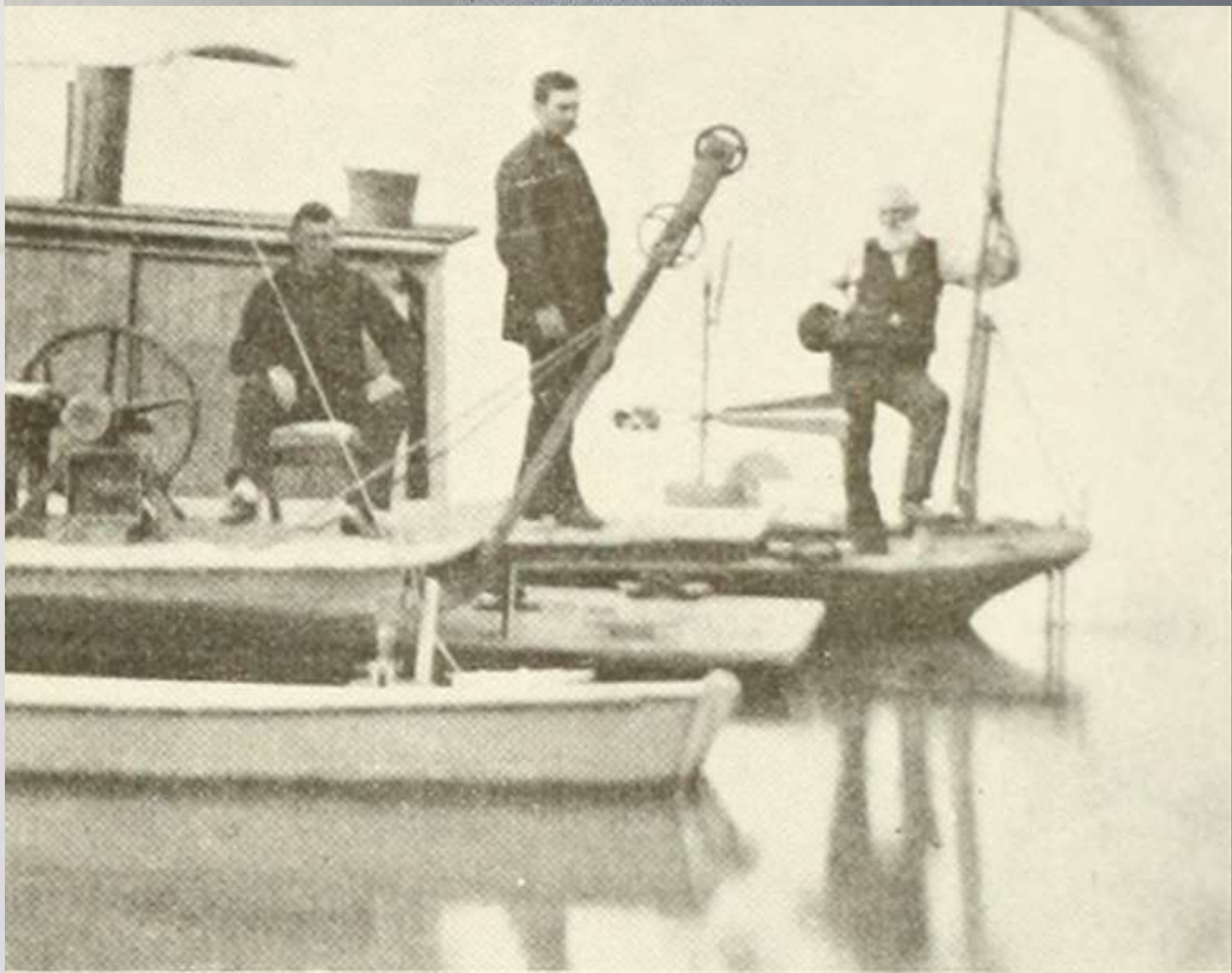

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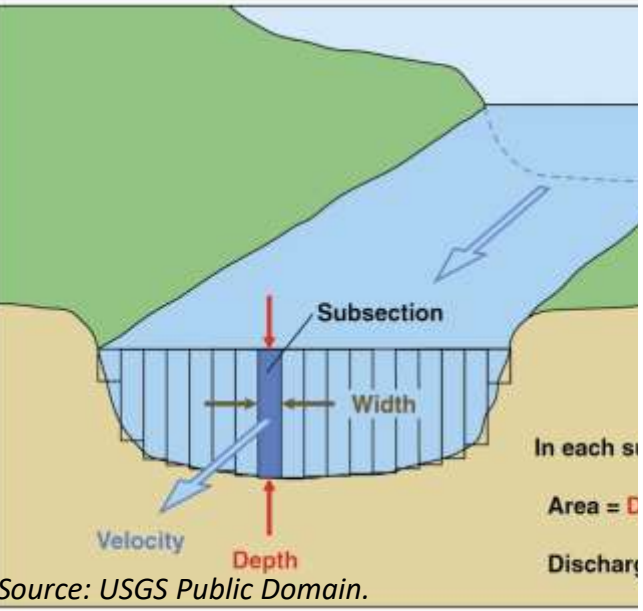

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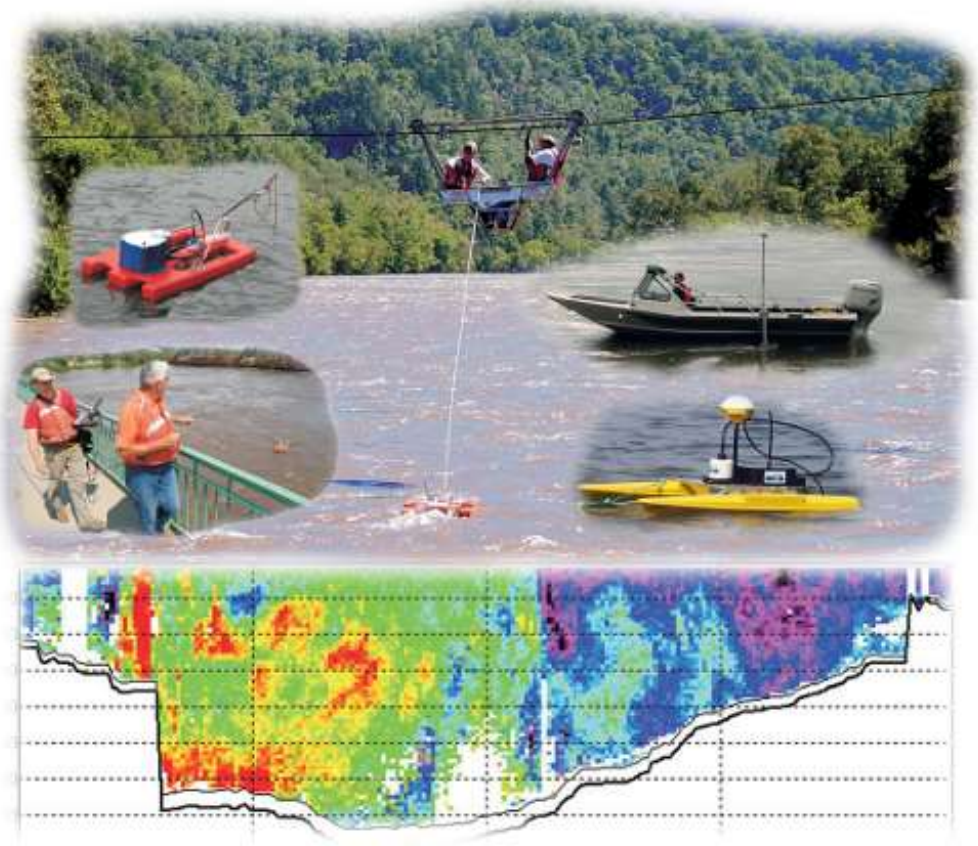
USGS
science for a changing world

Measuring Discharge with Acoustic Doppler Current Profilers from a Moving Boat

Chapter 22 of Book 3, Section A



Techniques and Methods 3–A22

U.S. Department of the Interior
U.S. Geological Survey

RESULTS
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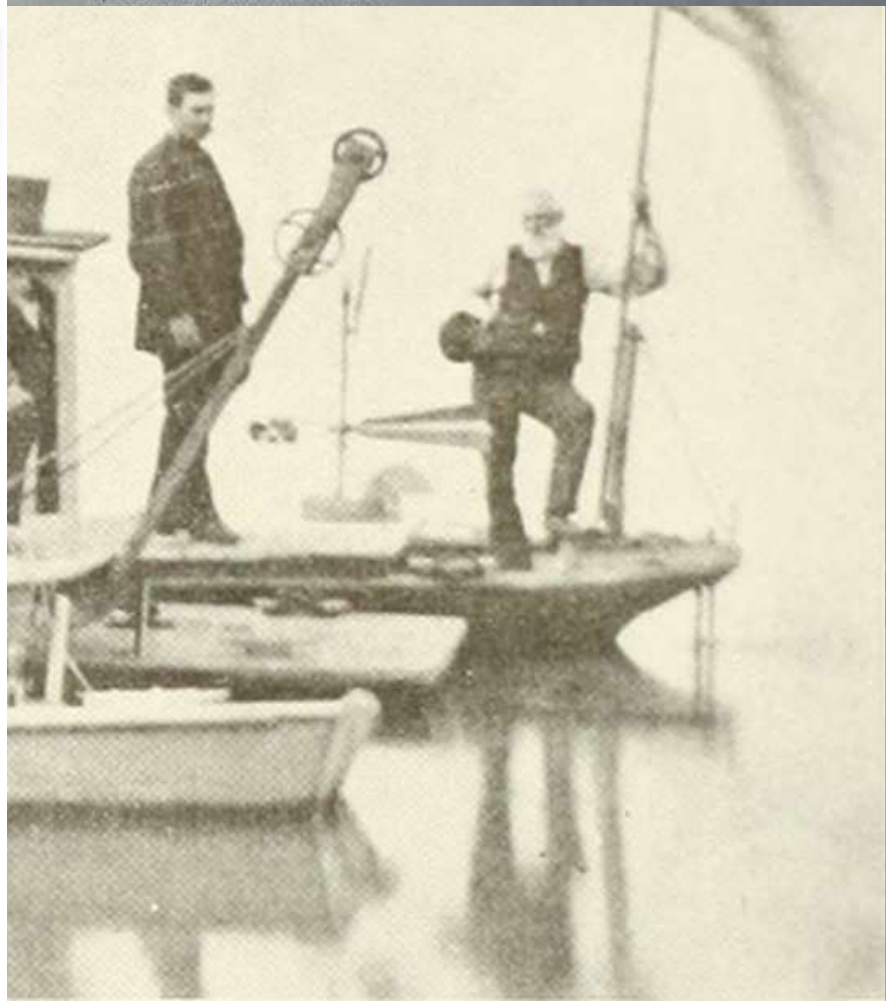
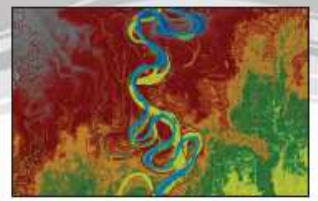
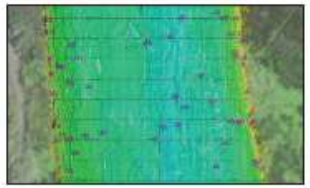


MRG&P

US Army Corps of Engineers®



The Mississippi River Geomorphology and Potamology (MRG&P) Program addresses the need for the U.S. Army Corps of Engineers (USACE) to have access to the most up-to-date and technically competent scientific data and analysis for providing navigation and flood risk management in an environmentally responsible manner. Motivated in large part by the 2011 Mississippi River flood, the MRG&P Program began not only from the viewpoint of what went wrong during an epic flood, but from the perspective of what went right, and understanding the reasons for the difference in river response to recent major floods. The primary purpose of the current MRG&P Program is to improve our understanding of the evolving geomorphology and potamology of the Mississippi River from the confluence of the Missouri River to the Gulf of Mexico.



What is geomorphology?

Mississippi River geomorphology is the study of how the geometric features of the river have changed over time. Geomorphic assessment provides the foundation for projecting future trends with and without proposed project features. It integrates field surveys, existing gage data, sediment data, measurements of channel geometry, and other hydraulic data to characterize hydrologic trends, interactions of the river, and natural and anthropogenic changes to the waterway.

What is potamology?

Mississippi River potamology includes the studies of ecology, hydraulics, hydrology, and geomorphology. A primary goal of potamology is to understand the impacts from changes in river features.

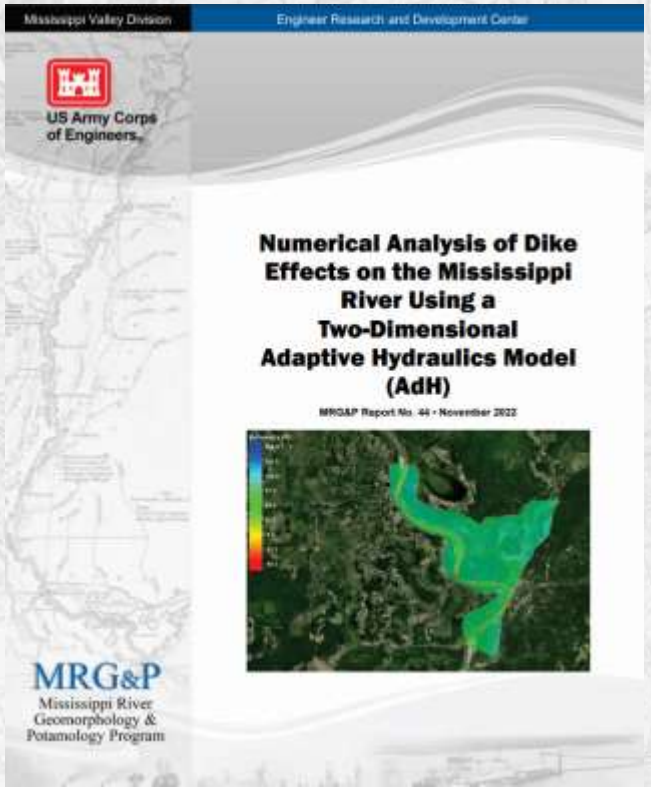
The Mississippi River Geomorphology and Potamology (MRG&P) Program is a joint effort of the U.S. Army Corps of Engineers (USACE), St. Louis, Memphis, Vicksburg, and New Orleans Districts, conducted with the oversight of the Mississippi Valley Division and technical contributions from the Engineering Research and Development Center.

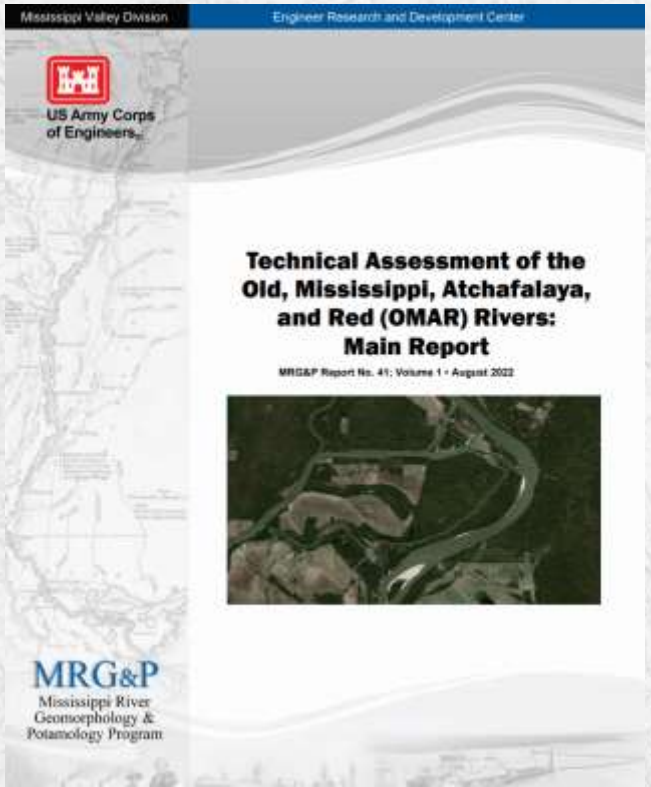
MRG&P
Mississippi River Geomorphology & Potamology Program

Mississippi River Geomorphology and Potamology Program

FY23 Funding: $4,650,000

- 58 Current Publications
- 17 Additional Publications scheduled for FY23
- 36 Ongoing studies for FY23





Environmental Lab Fish & Invertebrate Ecology Team

ERDC

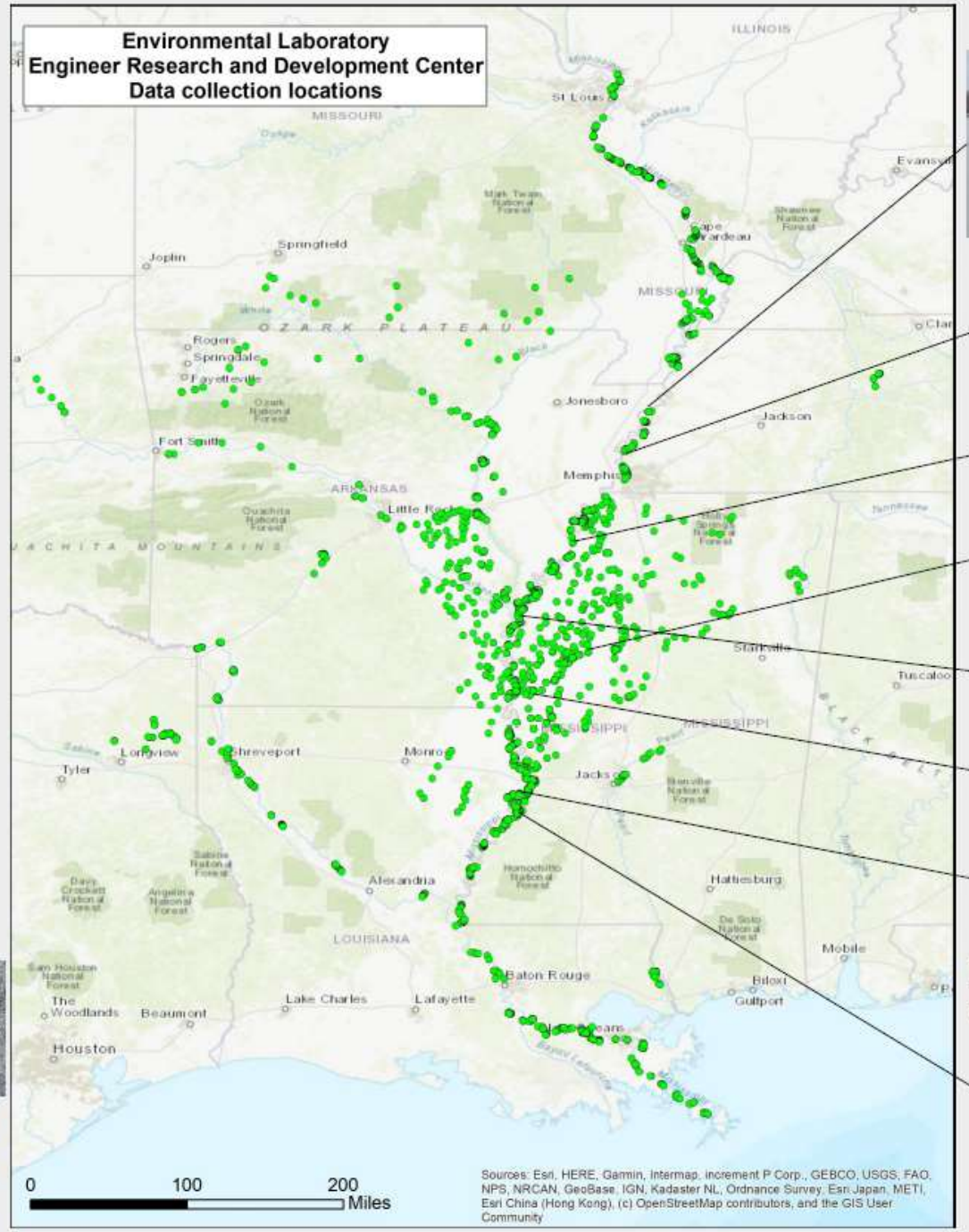
FOCUS AREAS:

- Biotic Communities & Habitat Assessment
- Threatened & Endangered Species Research
- Habitat Restoration Guidance & Pre/Post-Construction Monitoring
- Geomorphology & Ecohydrology Studies
- Water Chemistry
- Invasive Species Research
- Environmental Assessments
- Ecological Modeling







WHERE WE WORK:


Mississippi River Mainstem


Gravel Bars


Channel borders


Tributaries

Backwaters & Floodplains


Secondary Channels


Oxbow Lakes

Meander Scarps and Chutes

Aquatic Assessment of the LMR Main Channel

PROBLEM

- The LMR main channel comprises up to 70% of the aquatic habitat area but the aquatic biota remains relatively unstudied compared to other riverine habitats because of sampling constraints.
- Deep water, strong velocities in the main channel, and navigation traffic hamper the deployment and retrieval of sampling gear such as benthic trawls and trotlines.
- Lack of ecological data in the main channel creates uncertainty on impacts of river engineering projects.

SOLUTION

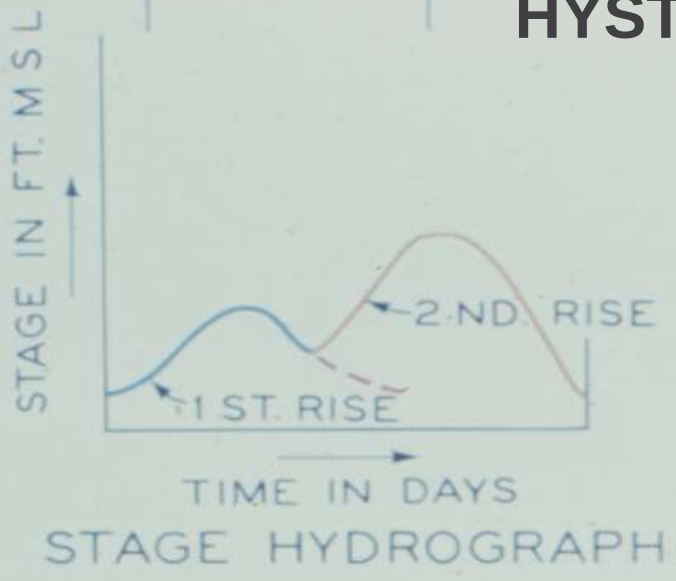
- Alternative sampling approaches are needed to fully understand the ecological community inhabiting the main channel of the LMR.
- We will use a commercial shrimp trawler to provide a safer and more efficient platform to deploy and retrieve trawls compared to smaller research vessels typically used to conduct this type of sampling.

IMPACT

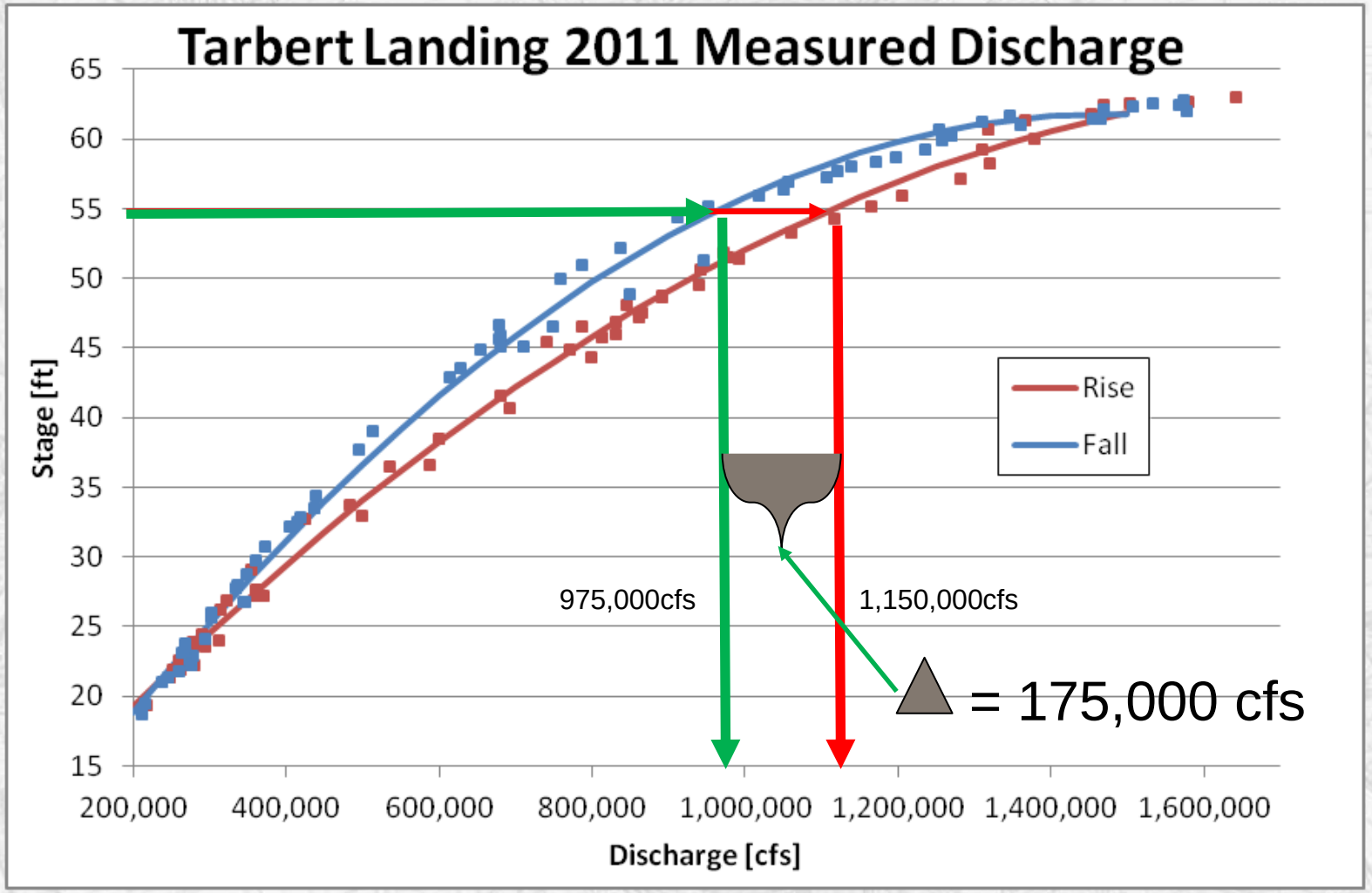
- This initial study will provide a quantitative assessment (number, diversity) of benthic fish and invertebrates in the main channel that is currently unavailable.

January 2023

HYSTERESIS IN HYDRAULICS, LOOP EFFECT



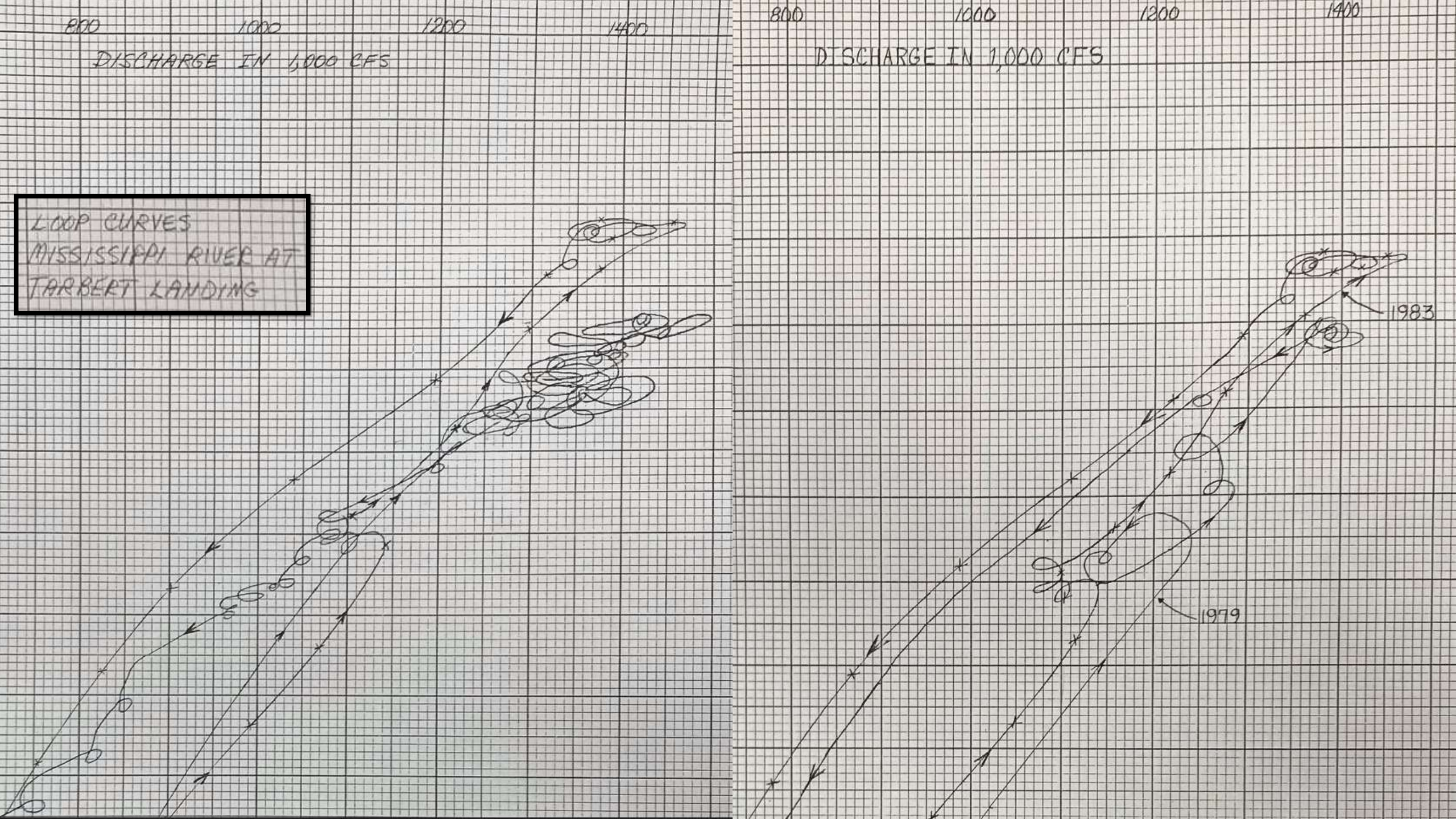
Loop effect is a phenomenon of river hydraulics where a falling river will pass a given discharge at a higher stage than a rising river.


Tarbert Landing 2011 Measured Discharge
Stage [ft]
65
60
55
50
45
40
35
30
25
20
15
200,000
400,000
600,000
800,000
1,000,000
1,200,000
1,400,000
1,600,000
Discharge [cfs]
Rise
Fall
975,000cfs
1,150,000cfs
= 175,000 cfs

800 1000 1200 1400

DISCHARGE IN 1,000 CFS

LOOP CURVES
MISSISSIPPI RIVER AT
TARBERT LANDING



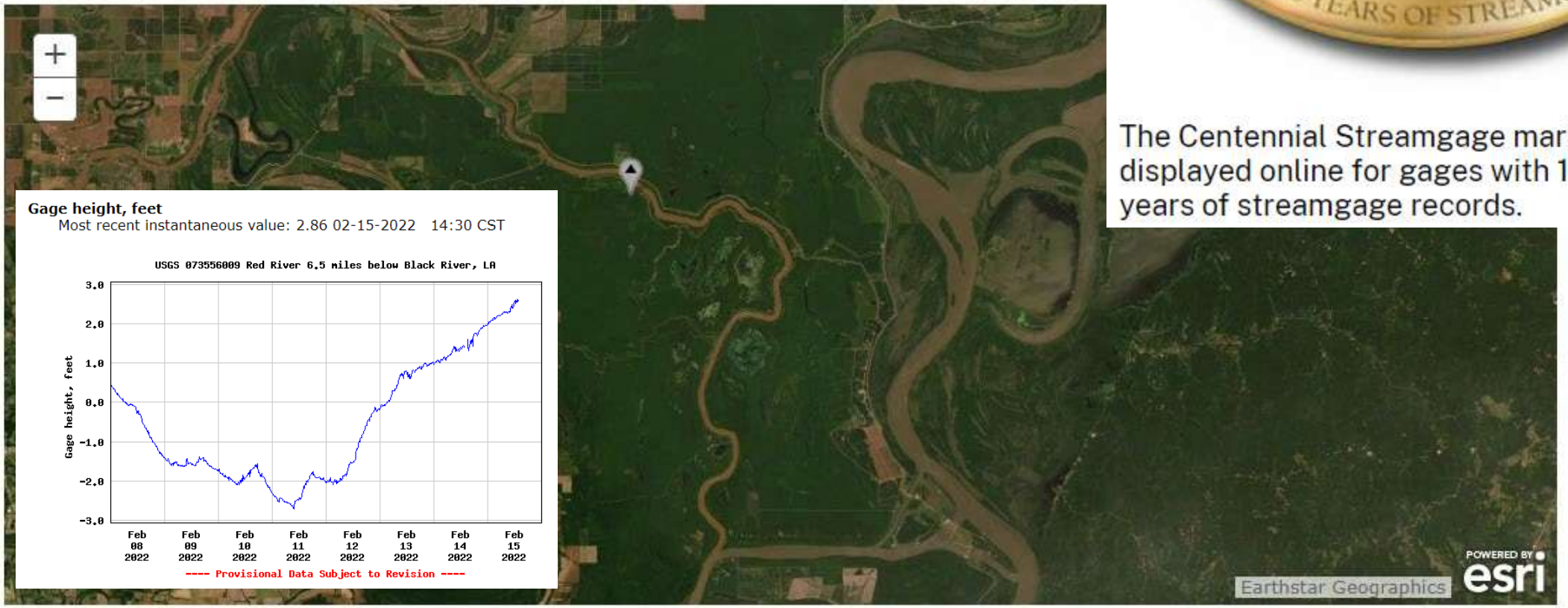
NEW RED RIVER GAGE @ MADAME LEE

USGS 073556009 Red River 6.5 miles below Black River, LA

Available data for this site | Location map

Concordia Parish, Louisiana
Hydrologic Unit Code 08040301
Latitude 31°13'10.1", Longitude 91°45'08.7" NAD83
Gage datum 32 feet above NAVD88

Location of the site in Louisiana



The Centennial Streamgage marker is displayed online for gages with 100 or more years of streamgage records.

OLD RIVER CONTROL COMPLEX

DAILY READINGS AND PROPOSED GATE CHANGES

DAY AND DATE: Tue , 14-Feb-23

LOW SILL STRUCTURE

GATE CONFIGURATION:

ALL GATES CLOSED

AUXILIARY STRUCTURE

GATE CONFIGURATION:

ALL GATES CLOSED

	LOW SILL STR.	AUXILIARY STR.	HYDROPOWER
HEADWATER	45.10	44.40	45.20
TAILWATER	- 26.10	- 26.10	- 25.80
DELTA HEAD	19.00	18.30	19.40
DISCHARGE	0	0	81

DISCHARGE ORC ------ 81

DISCHARGE, MAIN STEM	739	DISCHARGE, ORC	81
DISCHARGE, ORC	- 81	DISCHARGE, RED RIVER	+ 213
DISCHARGE, RED RIVER LDG	658	DISCHARGE, SIMMS	294
STAGE, RED RIVER LDG	43.00	STAGE, SIMMS	24.20

Low Water LiDAR and Aerial Imagery Data Collection

- Levee to levee data collection from Cairo, IL to the Gulf of Mexico. Collection completed DEC 2022 with data processing underway.
- Data will serve to update existing and future modeling, provide data for geomorphic assessment, and allow structural health assessment capability of existing river training structures.

Thank you!