River Engineering in the St. Louis District

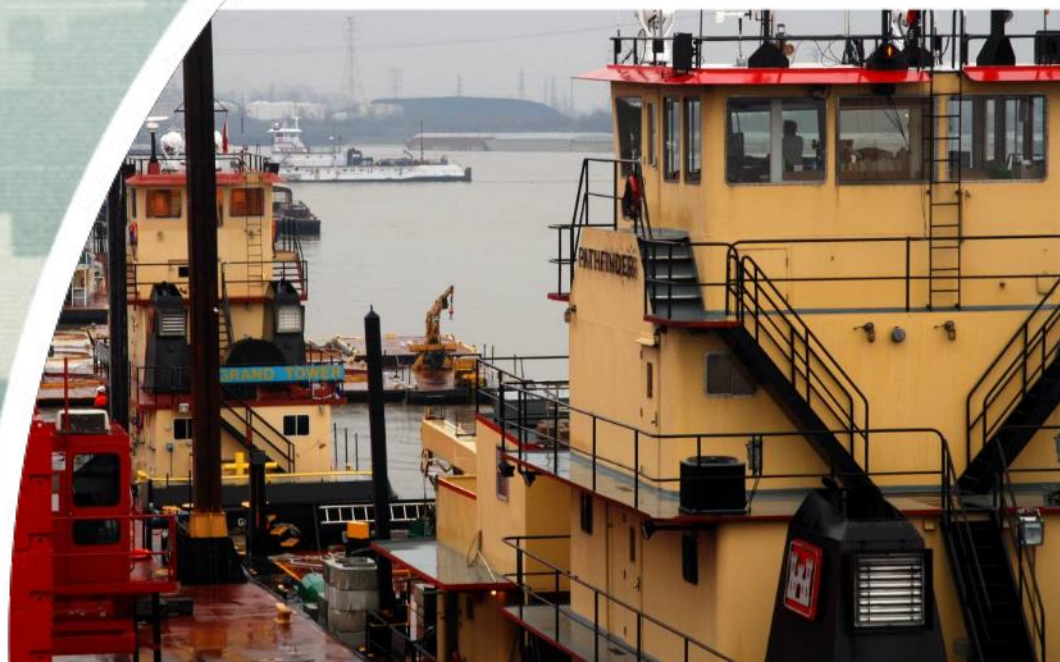
Presented to the Changjiang (Yangtze) River Administration of Navigation Affairs

Mike Rodgers

James Wallace

Brad Krischel

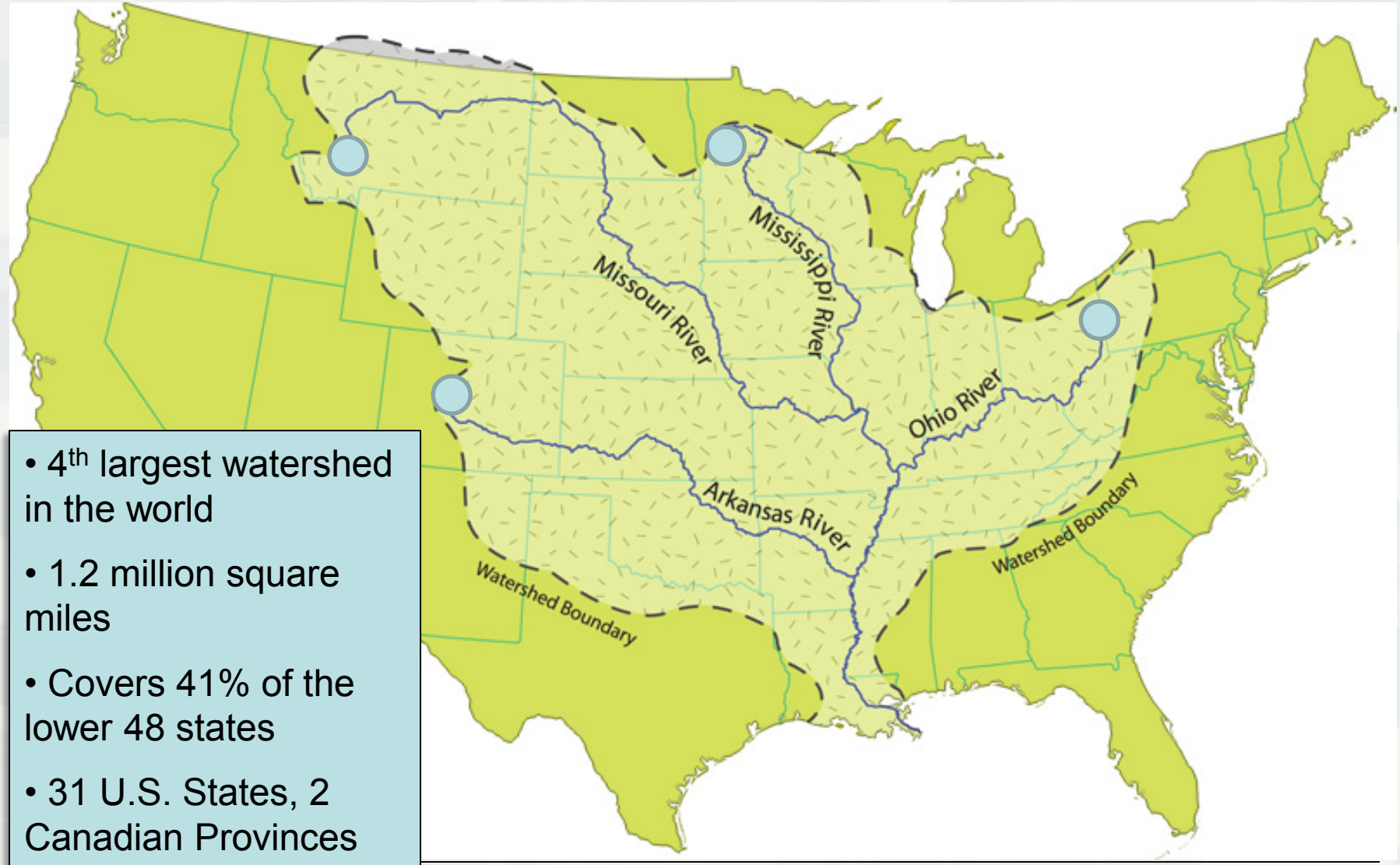
St. Louis, Missouri



August 12, 2019

US Army Corps of Engineers
BUILDING STRONG®

Mississippi River Watershed

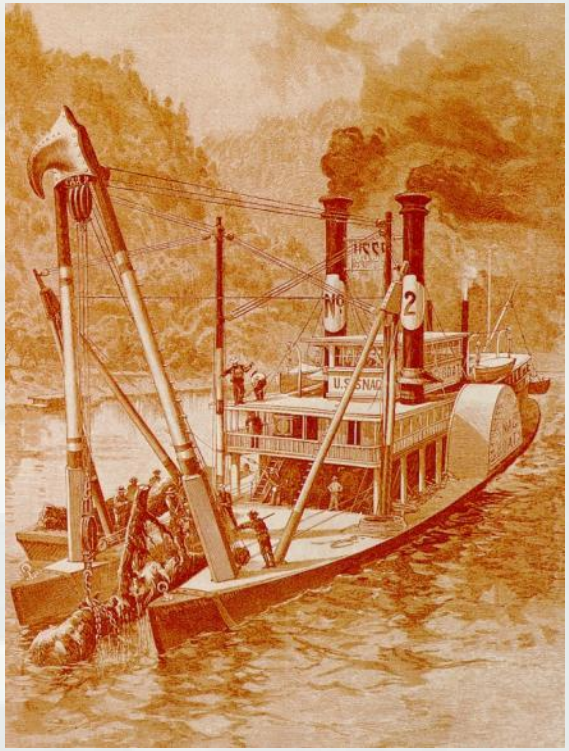


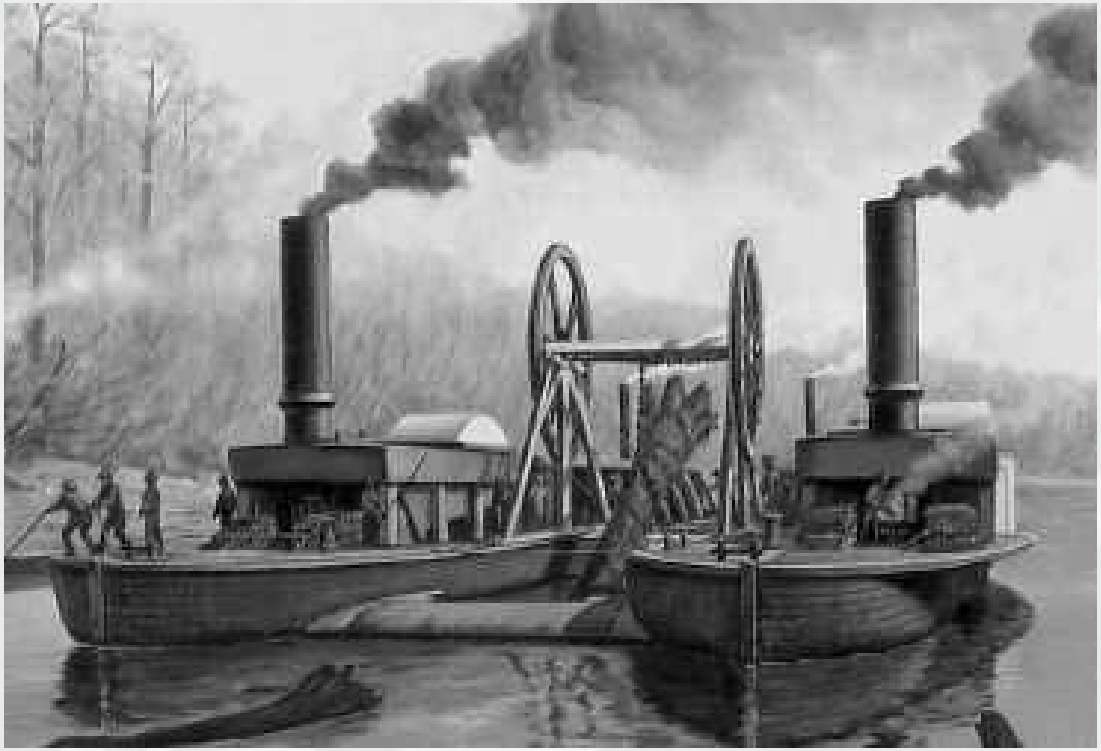
- 4th largest watershed in the world
- 1.2 million square miles
- Covers 41% of the lower 48 states
- 31 U.S. States, 2 Canadian Provinces

Mississippi River History

- Lifespan of steamboat in 1800's was 18 months.
- Between 1810 and 1850 over 4,000 people died in steamboat accidents
- Snags, Fire, explosions and collisions were the major causes

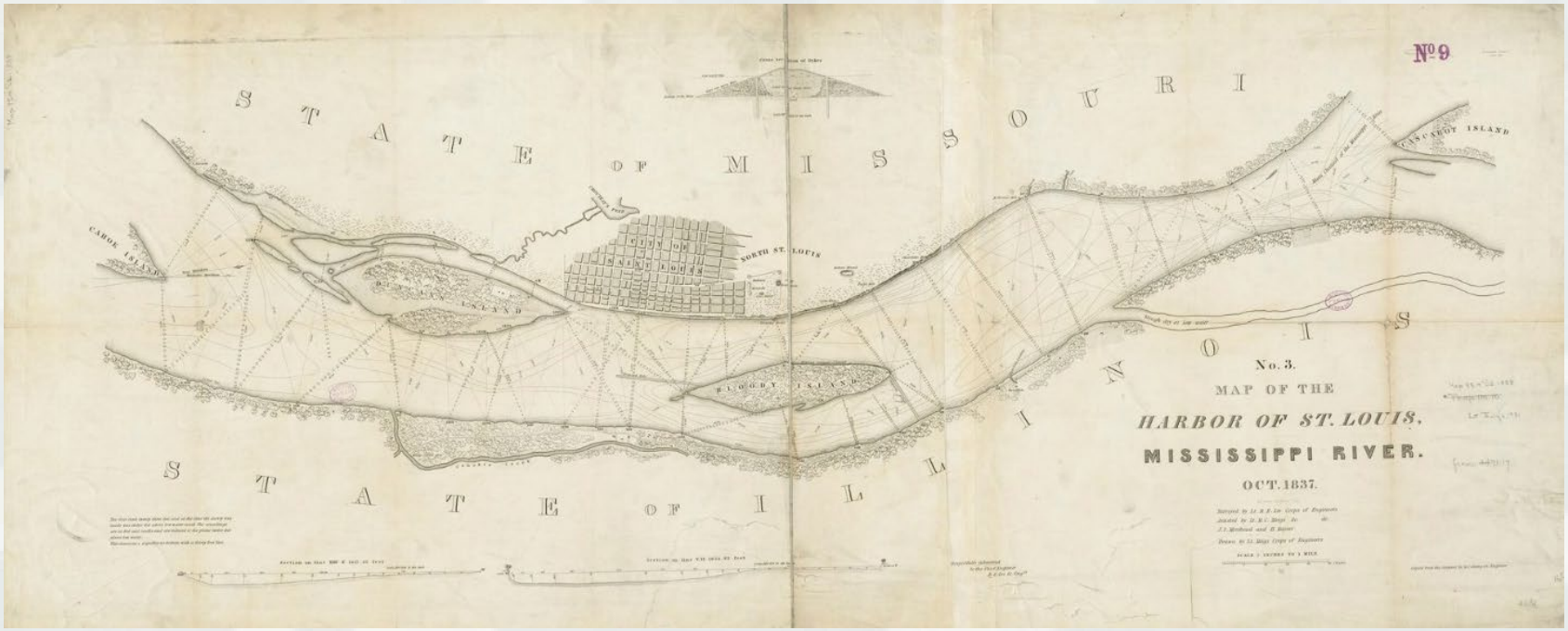
Early Navigation Mission

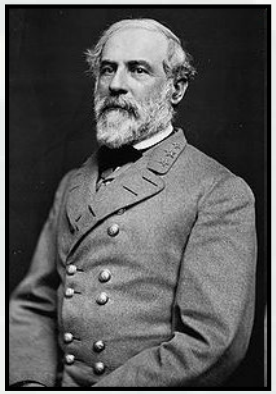




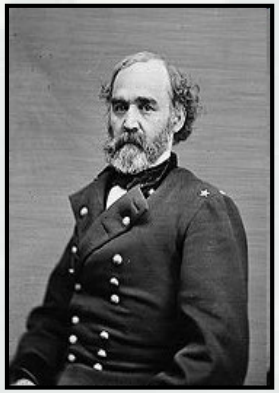
1824: Congress ordered the Corps of Engineers to clear snags on the Ohio and Mississippi Rivers.

Early River Engineering Structures





Lt. Robert E. Lee



Lt. Montgomery C. Meigs

1837: Lt. Robert E. Lee and 2nd Lt. Montgomery C. Meigs arrive in St. Louis to perform work on the harbor

Navigation and Flood Control

1872: The goal of the improvements on the Mississippi was to regularize a channel through the St. Louis harbor, sufficiently narrow and deep to accommodate the large amount of river traffic.

1879: Mississippi River Commission (MRC) created to execute a comprehensive flood control and navigation plan on the Lower Mississippi.

Navigation Channel

1939: A Nine foot navigation channel was completed on the Mississippi.

The St Louis District was responsible for the design and construction of three locks and dams. No. 24 at Clarksville, and No. 25 at Winfield in Missouri. And No. 26 in Alton Illinois

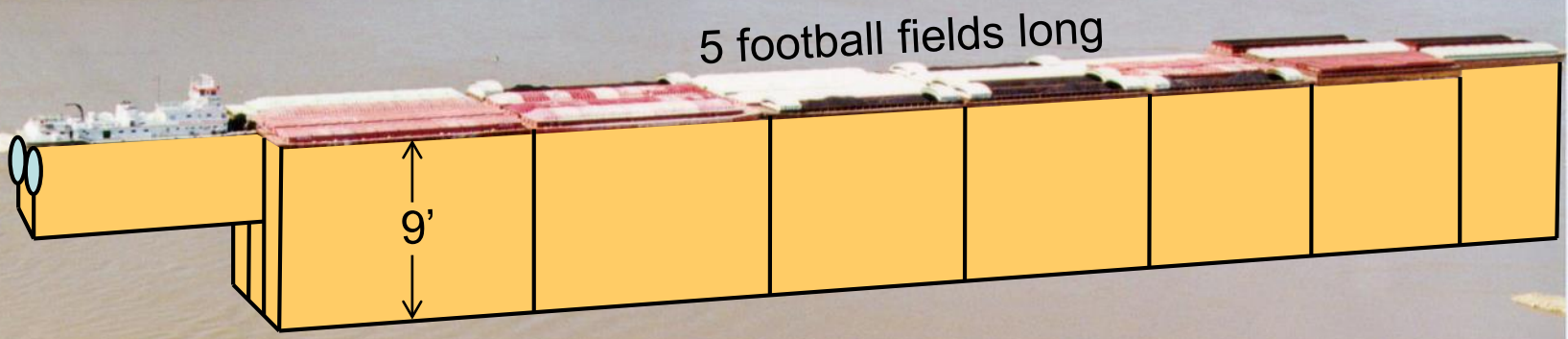
Lock and Dam #26 Under Construction

Navigation Mission

- St. Louis District maintains 9-foot deep, 300-foot wide navigation channel on 300 miles of the Mississippi, 80 miles on lower Illinois and 36 miles on lower Kaskaskia.
- 12,000 miles of commercially active waterway system maintained by the Corps.
- St. Louis 3rd busiest port on inland waterway system, handling 110 million tons annually.

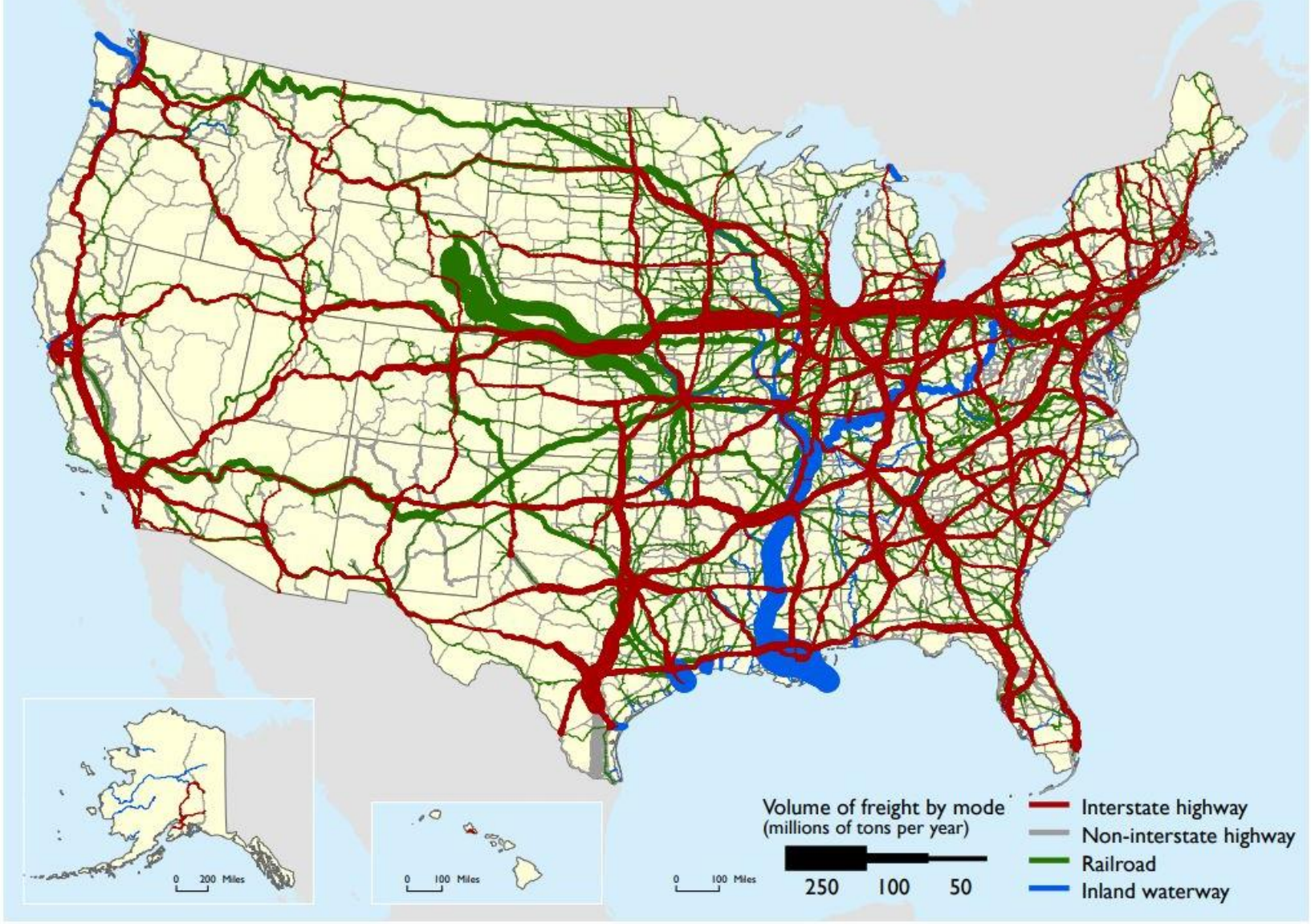
Navigation Channel Design

Develop a Reliable, Safe, and Environmentally Sustainable Navigation Channel on the Middle Mississippi River



During Low Water, 9 feet deep, 300 feet wide, with additional width in bends as required

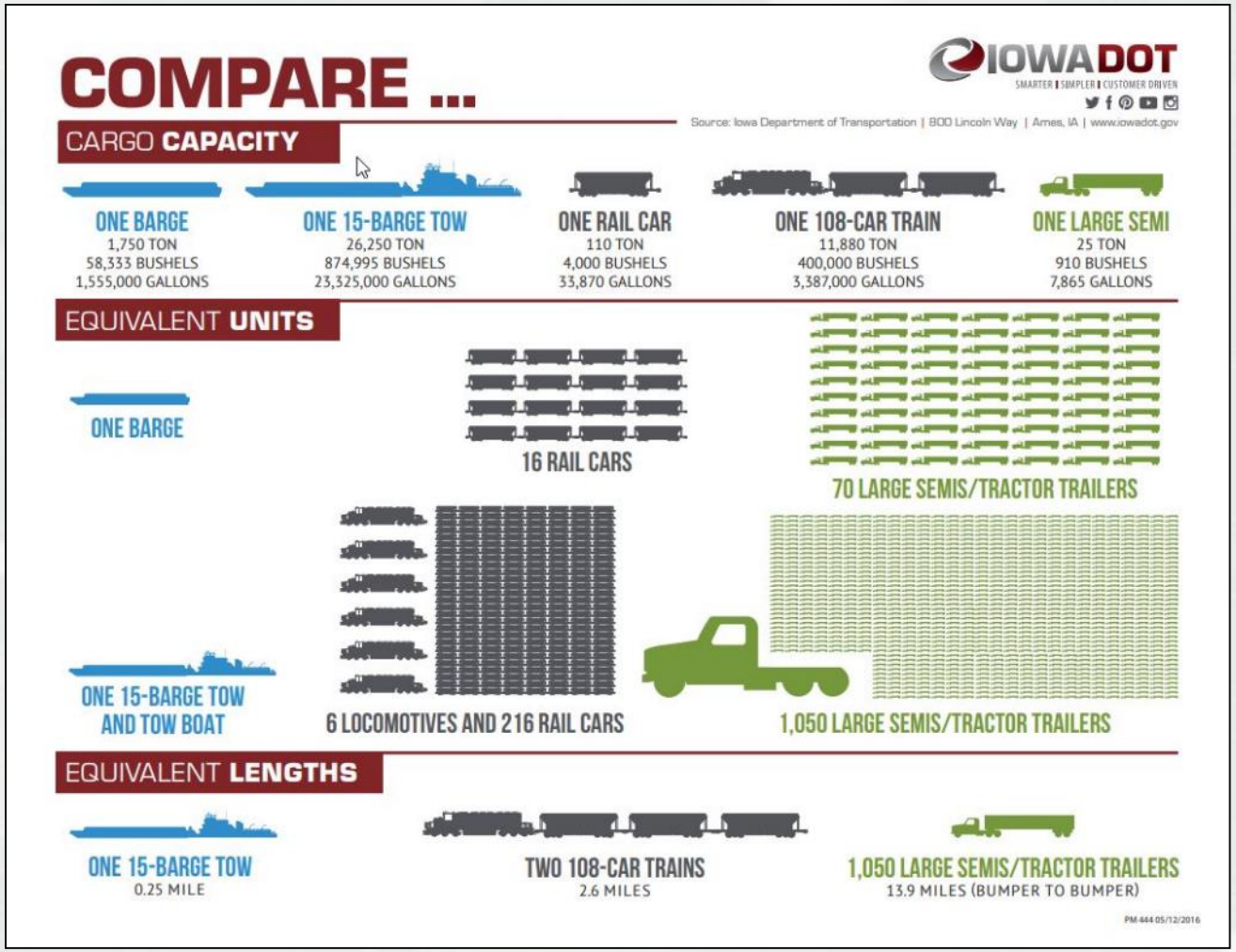
The Inland Waterway System



NOTE: The Freight Analysis Framework (FAF) is based in large part on results from the Commodity Flow Survey (CFS), last administered in 2012.

SOURCES: Highway: U.S. Department of Transportation, Bureau of Transportation Statistics and Federal Highway Administration, Freight Analysis Framework, Version 4.3.1, 2016; **Rail**: Based on Surface Transportation Board, Annual Carload Waybill Sample and rail freight flow assignment done by Oakridge National Laboratory, 2016; **Inland Waterways**: U.S. Army Corps of Engineers, Institute of Water Resources, Annual Vessel Operating Activity and Lock Performance Monitoring System data, 2016.

Waterways: The Most Efficient Mode of Freight Transportation



1 tow = 1,050 semis

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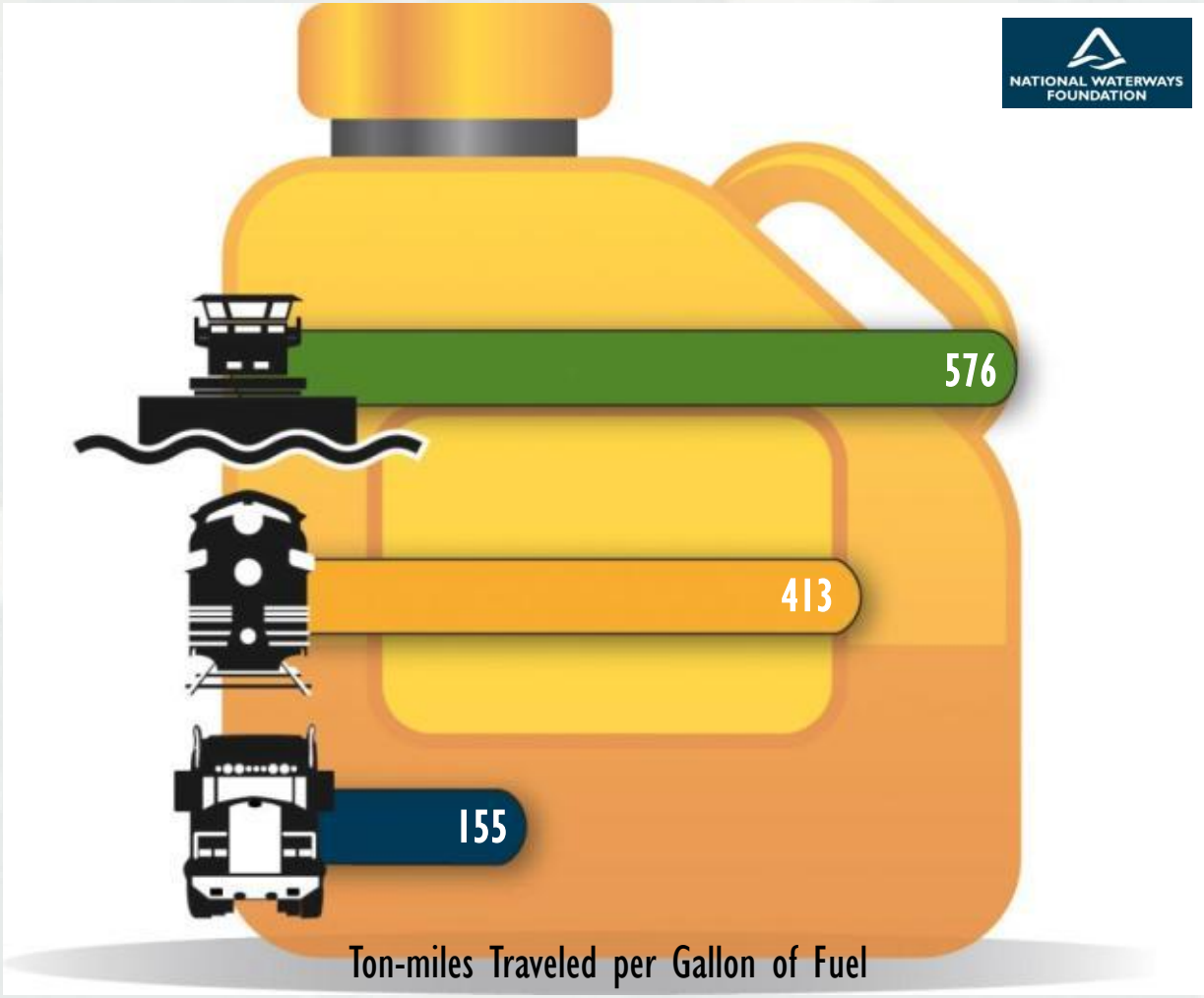
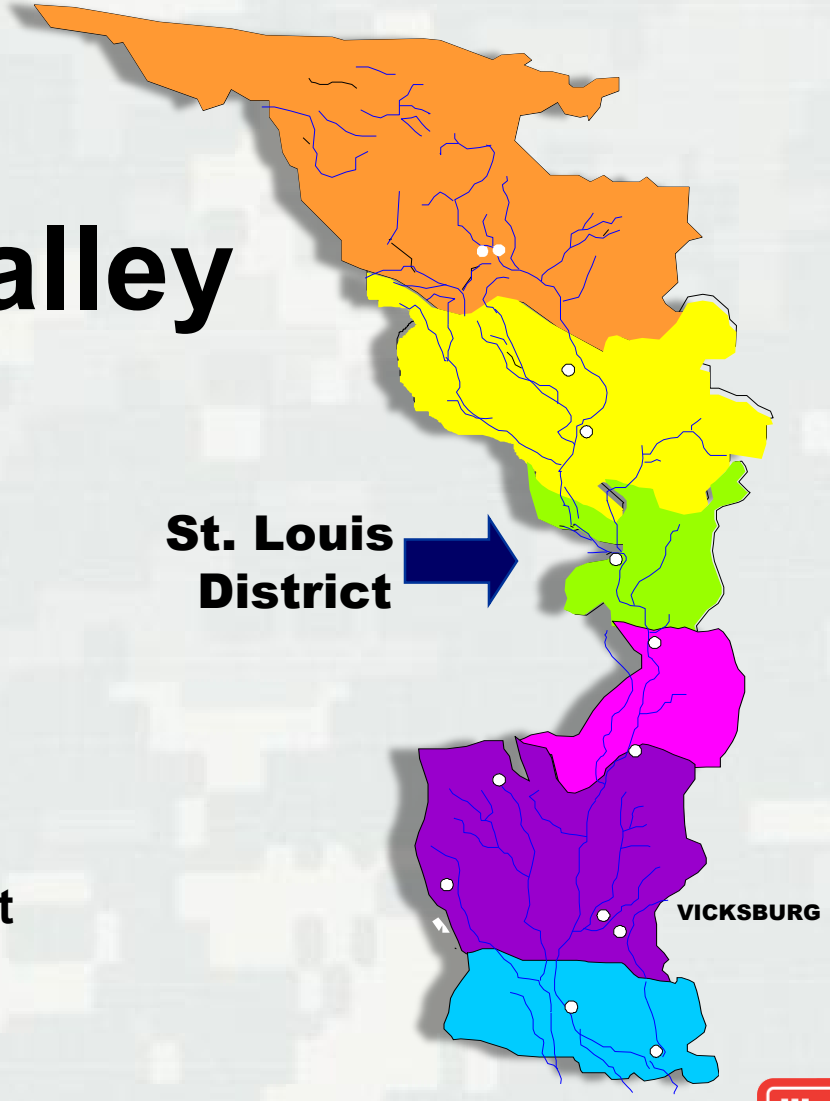
Waterways: The Most Efficient Mode of Freight Transportation

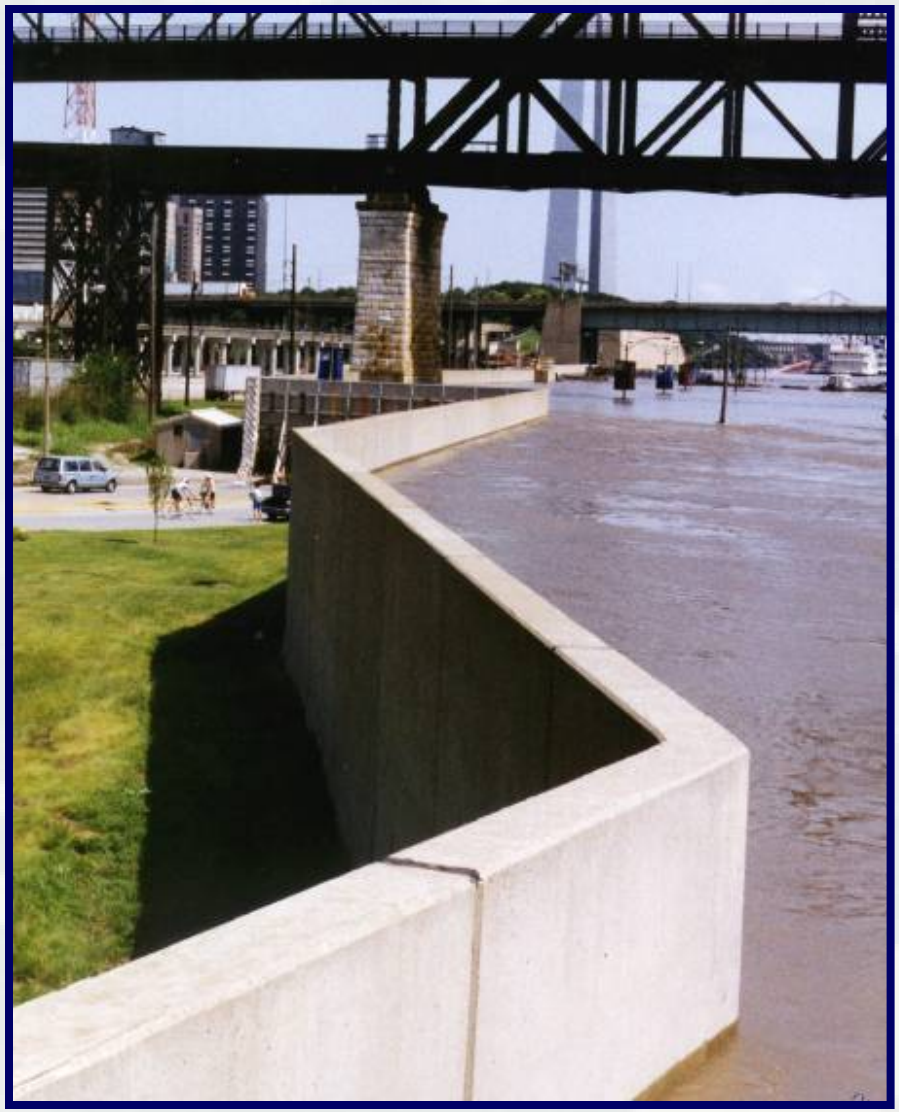


Mississippi Valley Division

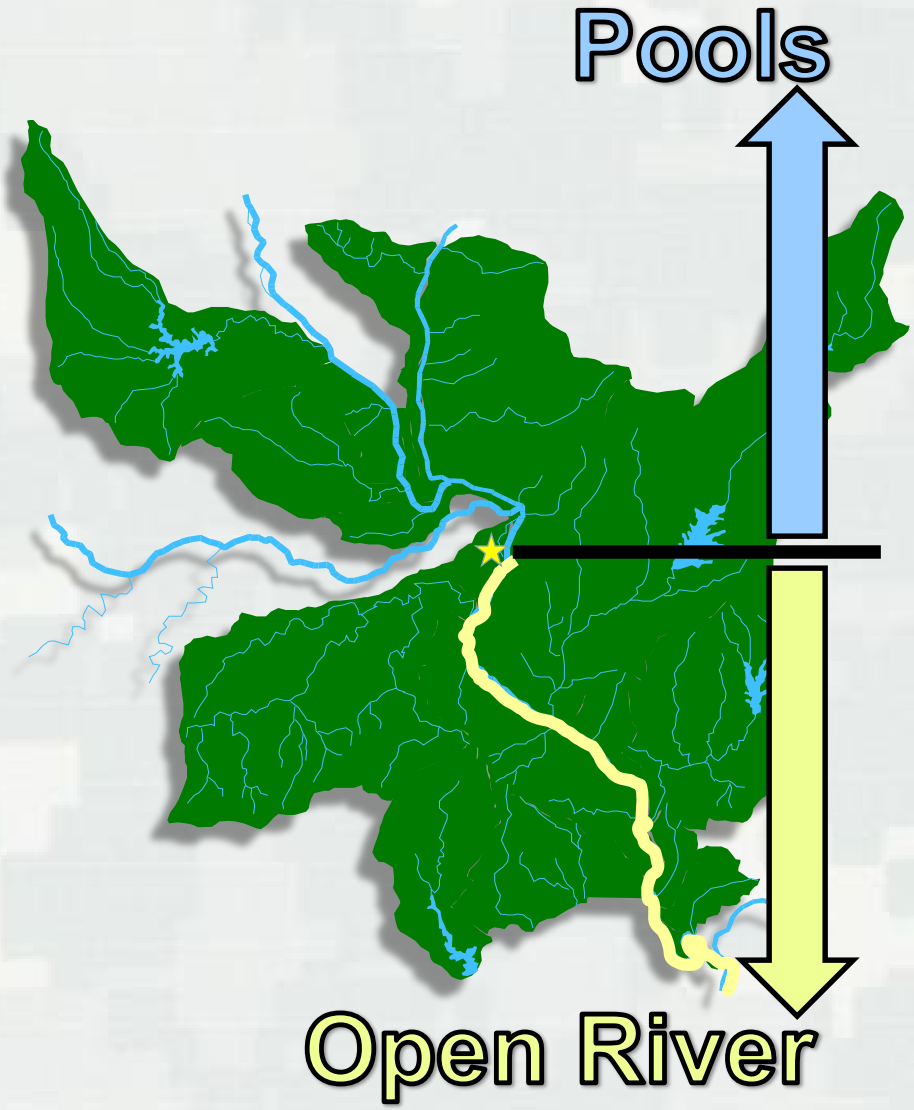
- St. Paul District
- Rock Island District
- St. Louis District
- Memphis District
- Vicksburg District
- New Orleans District

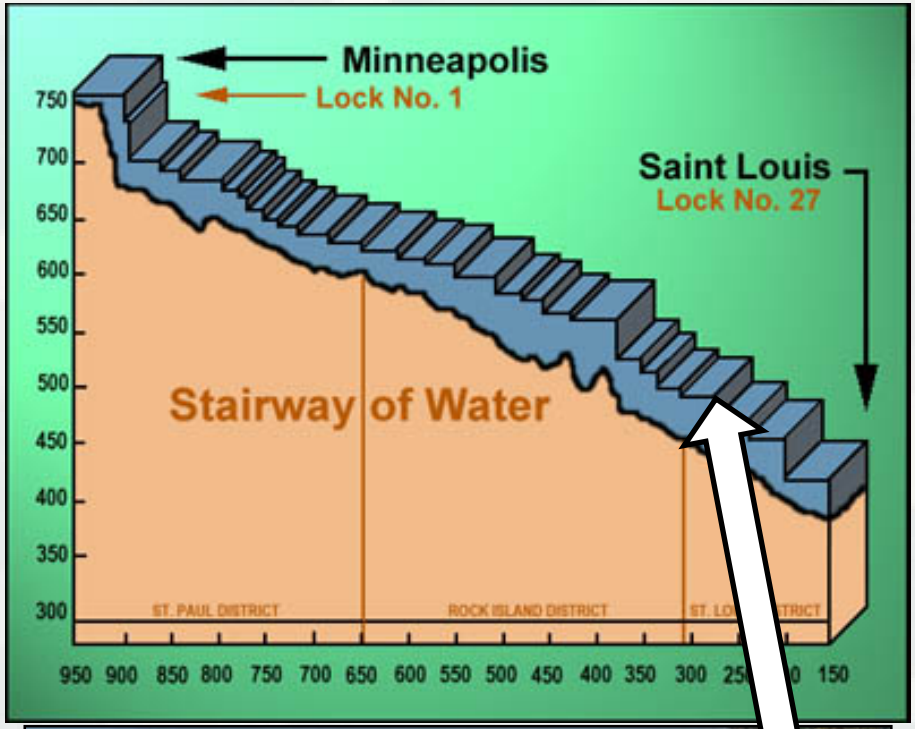


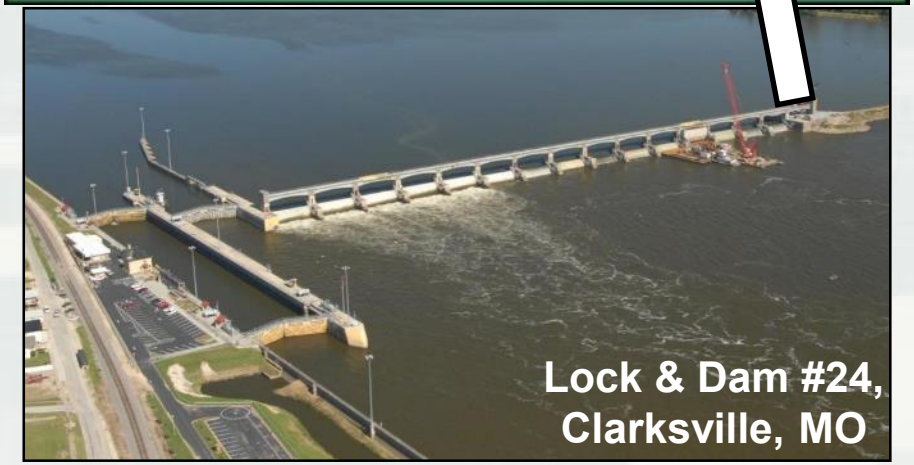
St. Louis District



St. Louis District: The Transition Point

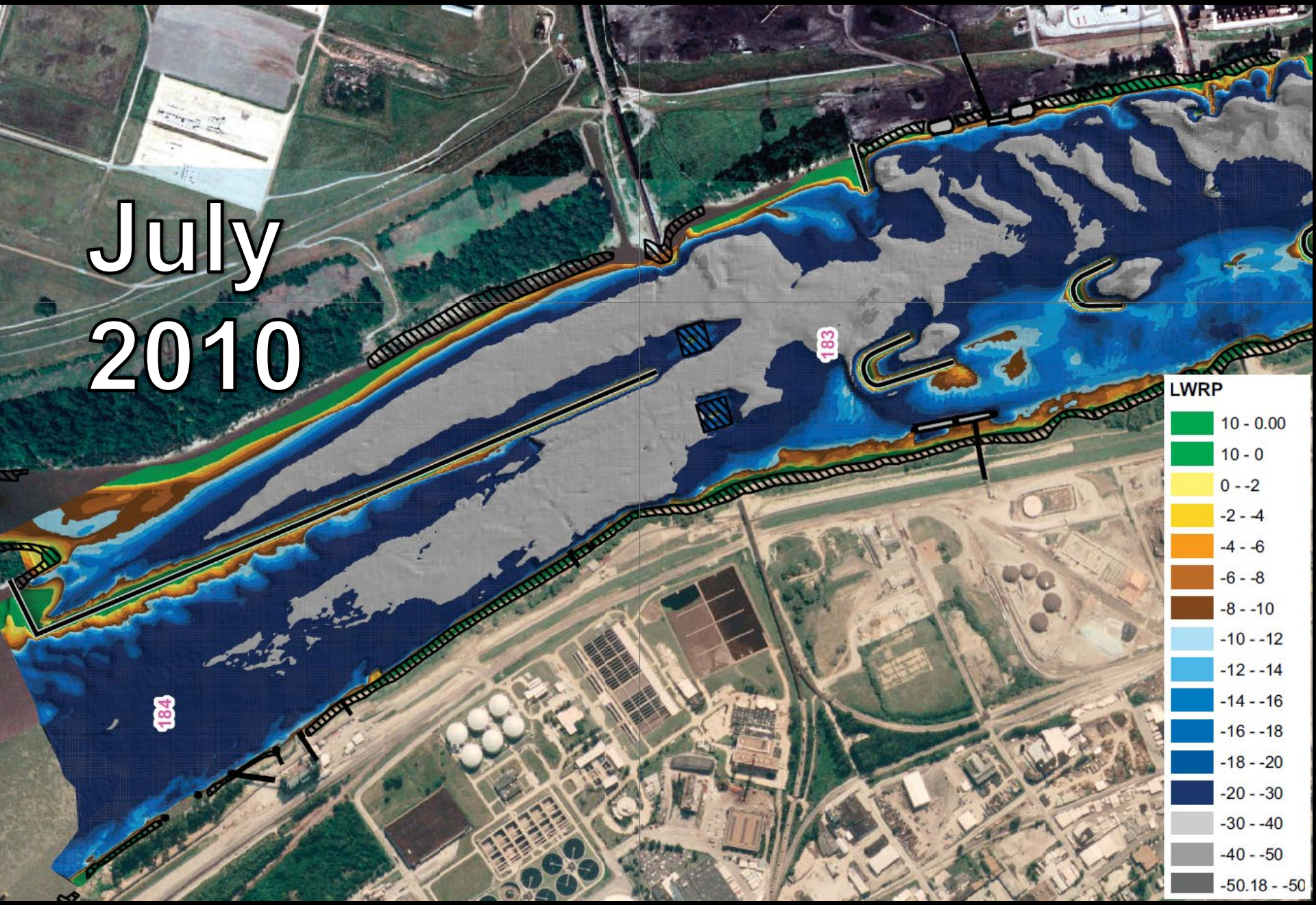


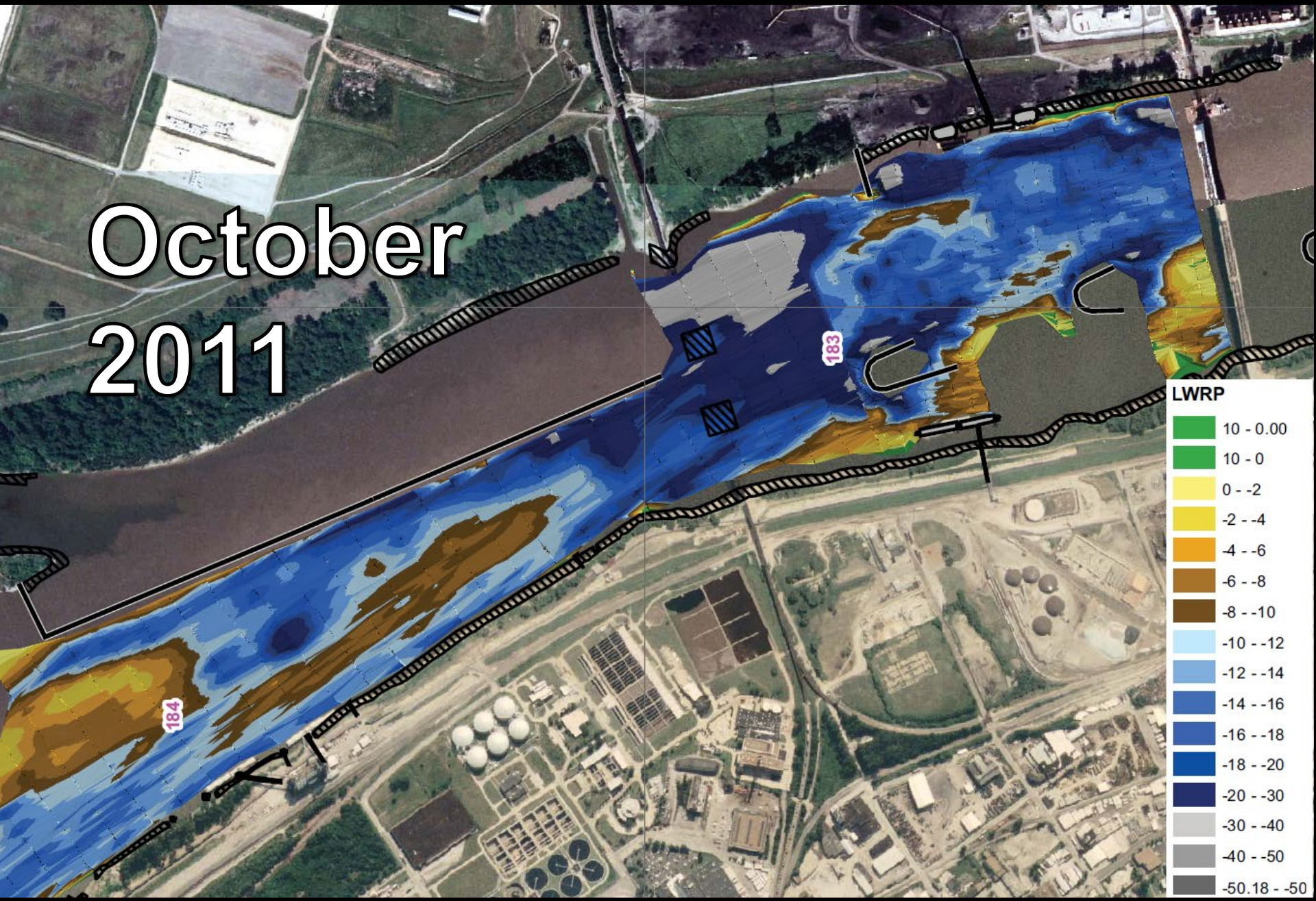




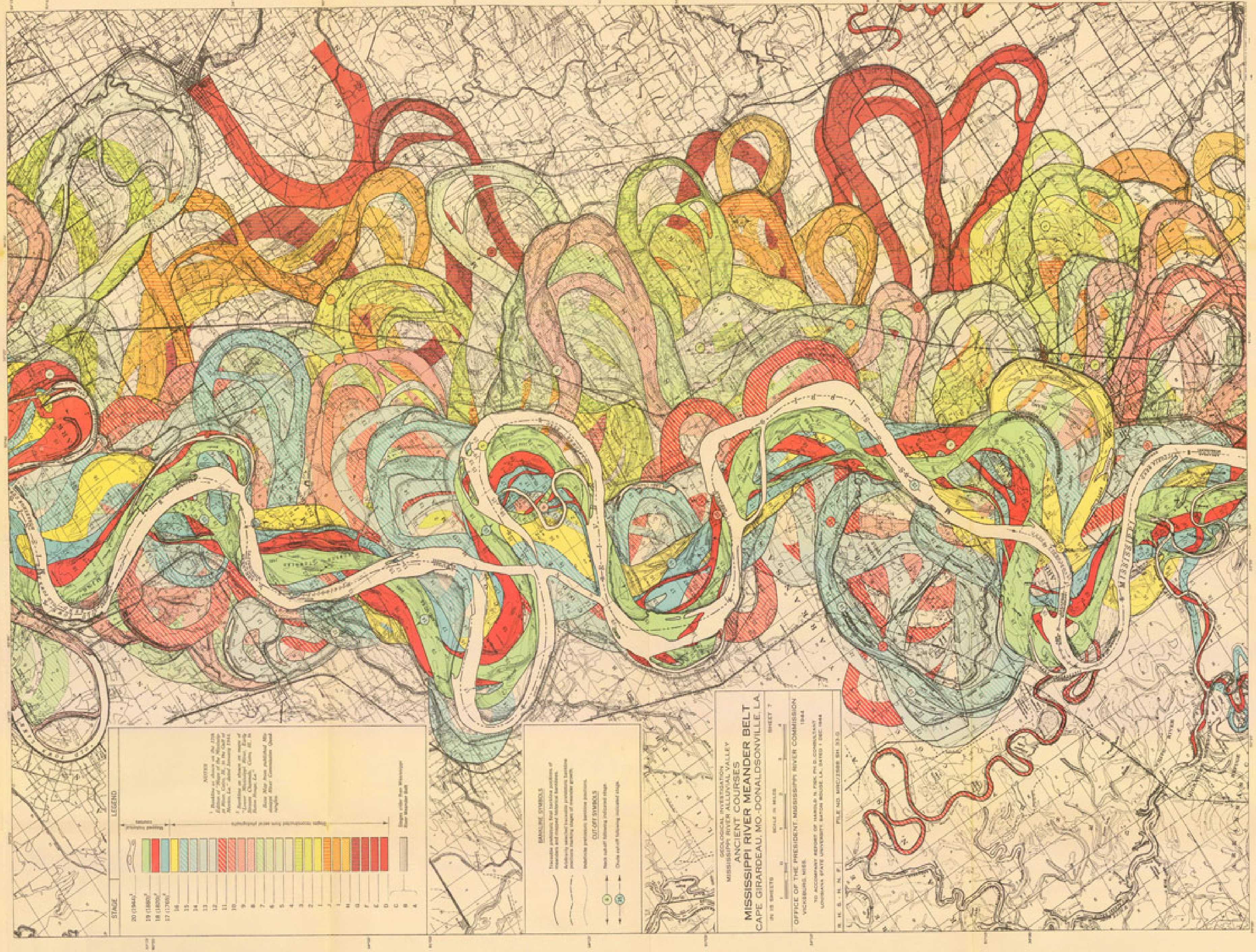
Tools Used for Maintaining Authorized Navigation Channel Dimensions on Open River

Sediment Management

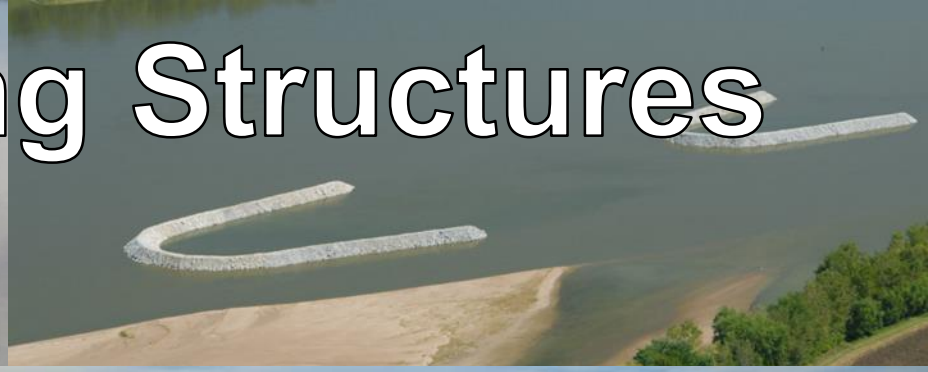

July
2010
183
184
LWRP
10 - 0.00
10 - 0
0 - -2
-2 - -4
-4 - -6
-6 - -8
-8 - -10
-10 - -12
-12 - -14
-14 - -16
-16 - -18
-18 - -20
-20 - -30
-30 - -40
-40 - -50
-50.18 - -50


October
2011
183
184
LWRP
10 - 0.00
10 - 0
0 - -2
-2 - -4
-4 - -6
-6 - -8
-8 - -10
-10 - -12
-12 - -14
-14 - -16
-16 - -18
-18 - -20
-20 - -30
-30 - -40
-40 - -50
-50.18 - -50

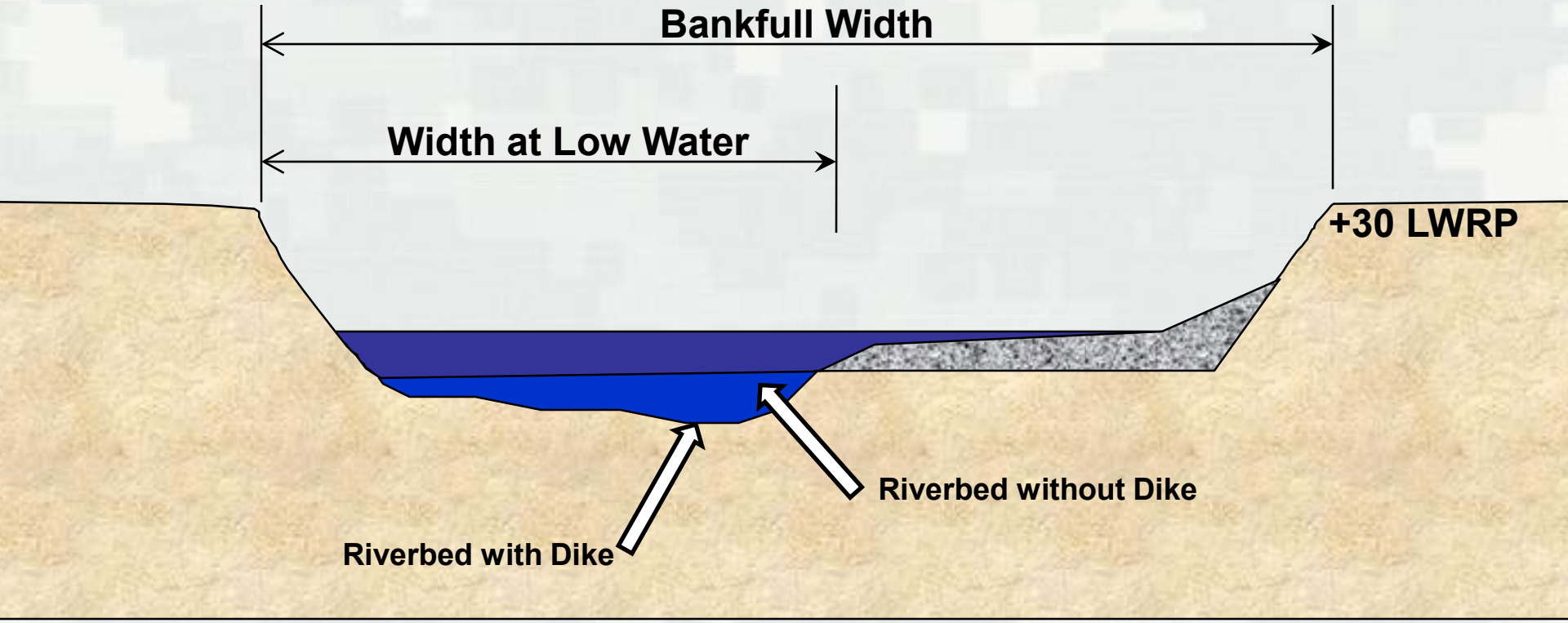
Channel Maintenance Dredging


MISSISSIPPI
LEGEND
STAGE
20 (1944)
19 (1880)
18 (1820)
17 (1765)
NOTES
BANKLINE SYMBOLS
CUT-OFF SYMBOLS
GEOLOGICAL INVESTIGATION
MISSISSIPPI RIVER ALLUVIAL VALLEY
ANCIENT COURSES
MISSISSIPPI RIVER MEANDER BELT
CAPE GIRARDEAU, MO.-DONALDSONVILLE, LA.
IN 15 SHEETS
SHEET 7
SCALE IN MILES
OFFICE OF THE PRESIDENT MISSISSIPPI RIVER COMMISSION
1944
VICKSBURG, MISS.

River Training Structures



River Contraction



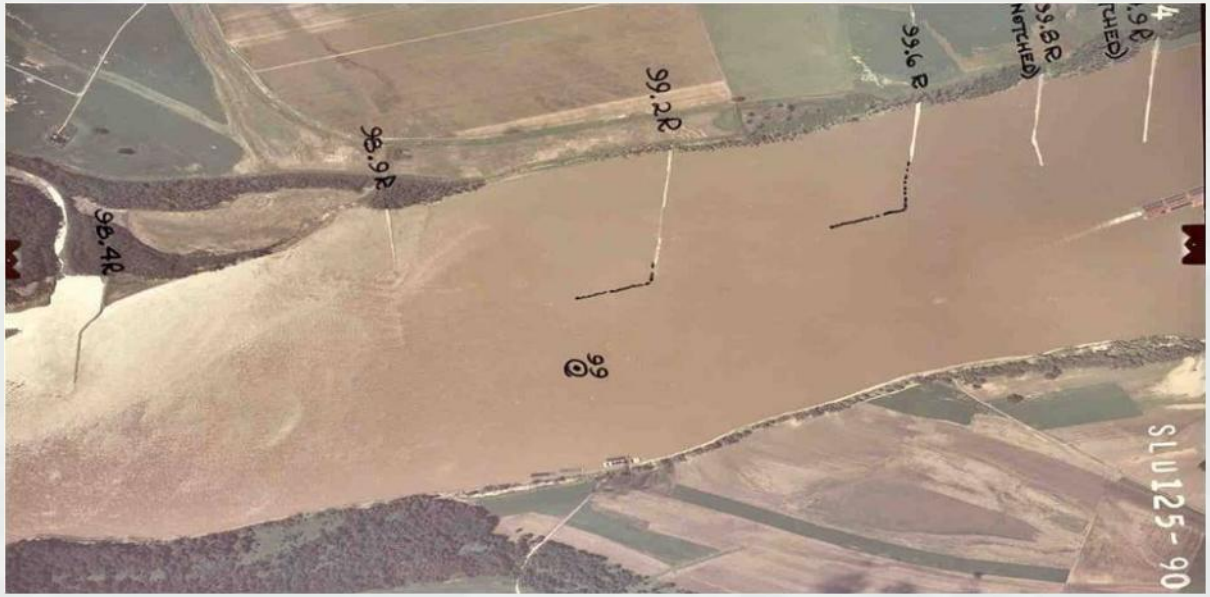
BRIEF HISTORY ON MVS DIKE PROGRAM

- River training structures (timber pile dikes), revetments (wooden mattresses)
- 1960's transitioned from timber structures and revetments to rock.
- 1990's bendway weirs and blunt nose chevrons were introduced to the Mississippi River.
- Early 2000's the benefits of the Regulating Works Project developments are evident with the reduction of dredging, increased reliability of the navigation channel during the low water period, and reduced accidents & groundings

Dikes (Wingdams)

Notched Dikes

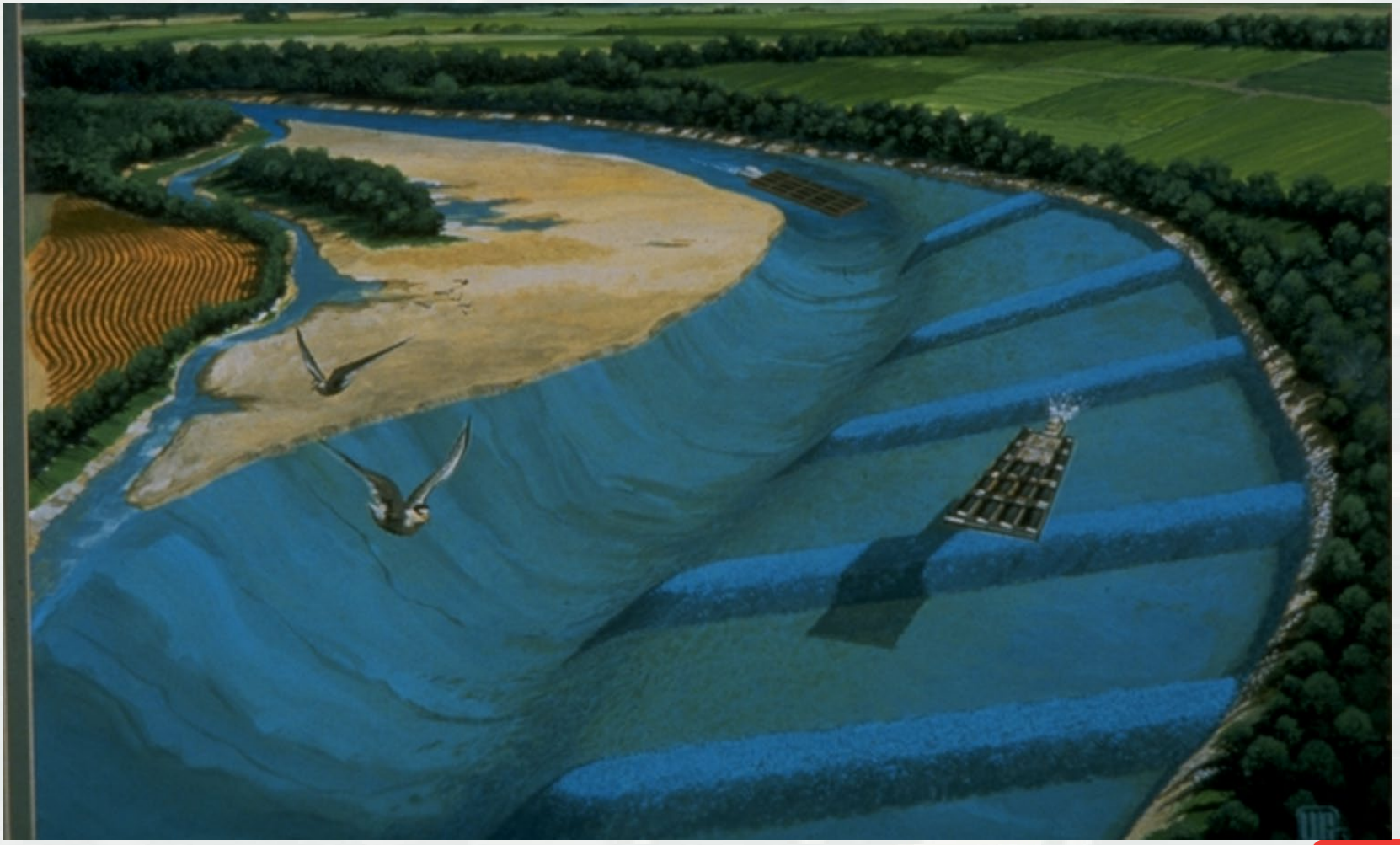
Notched Dikes



1974

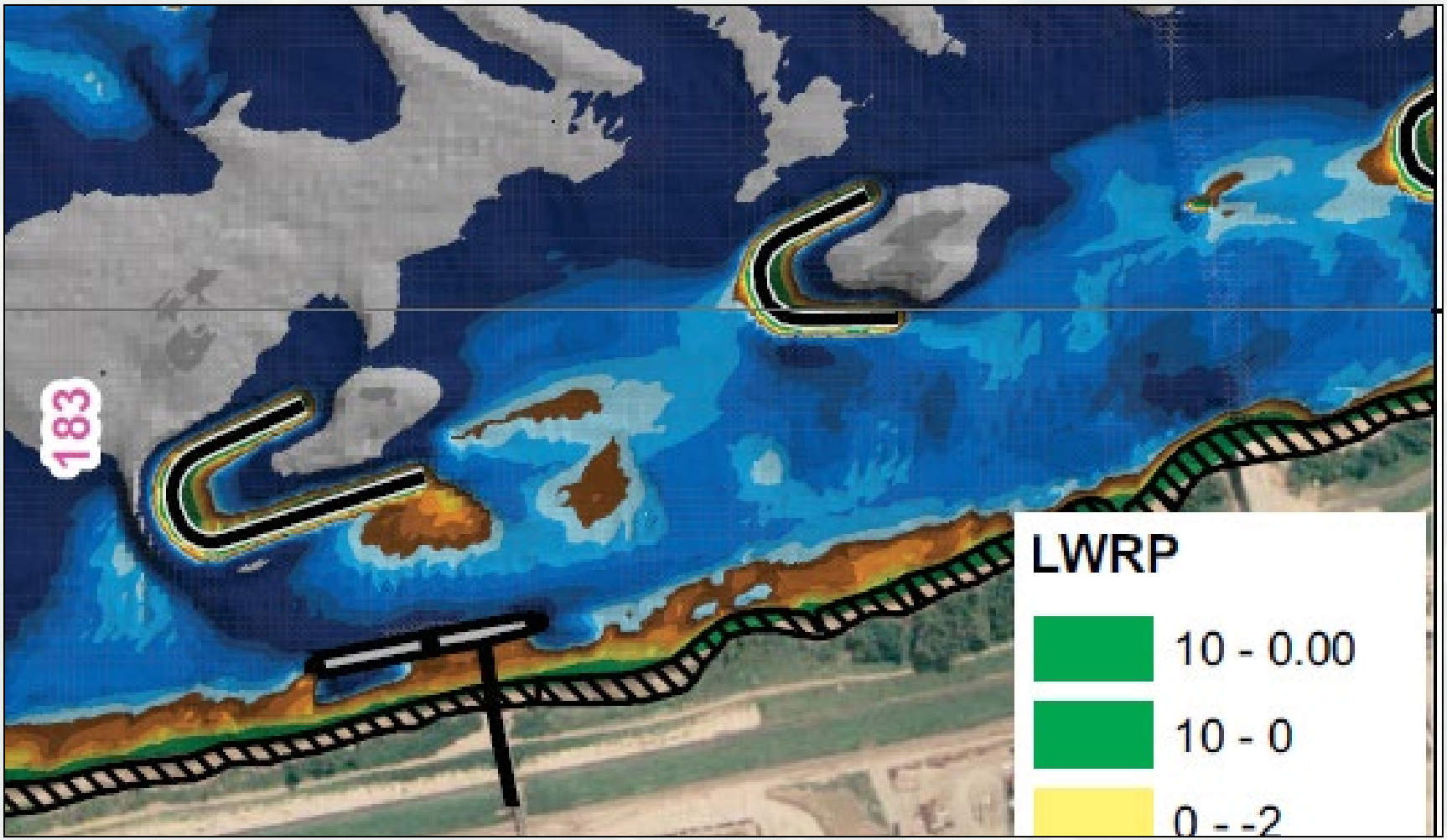
1998

Bendway Weirs



Chevrons

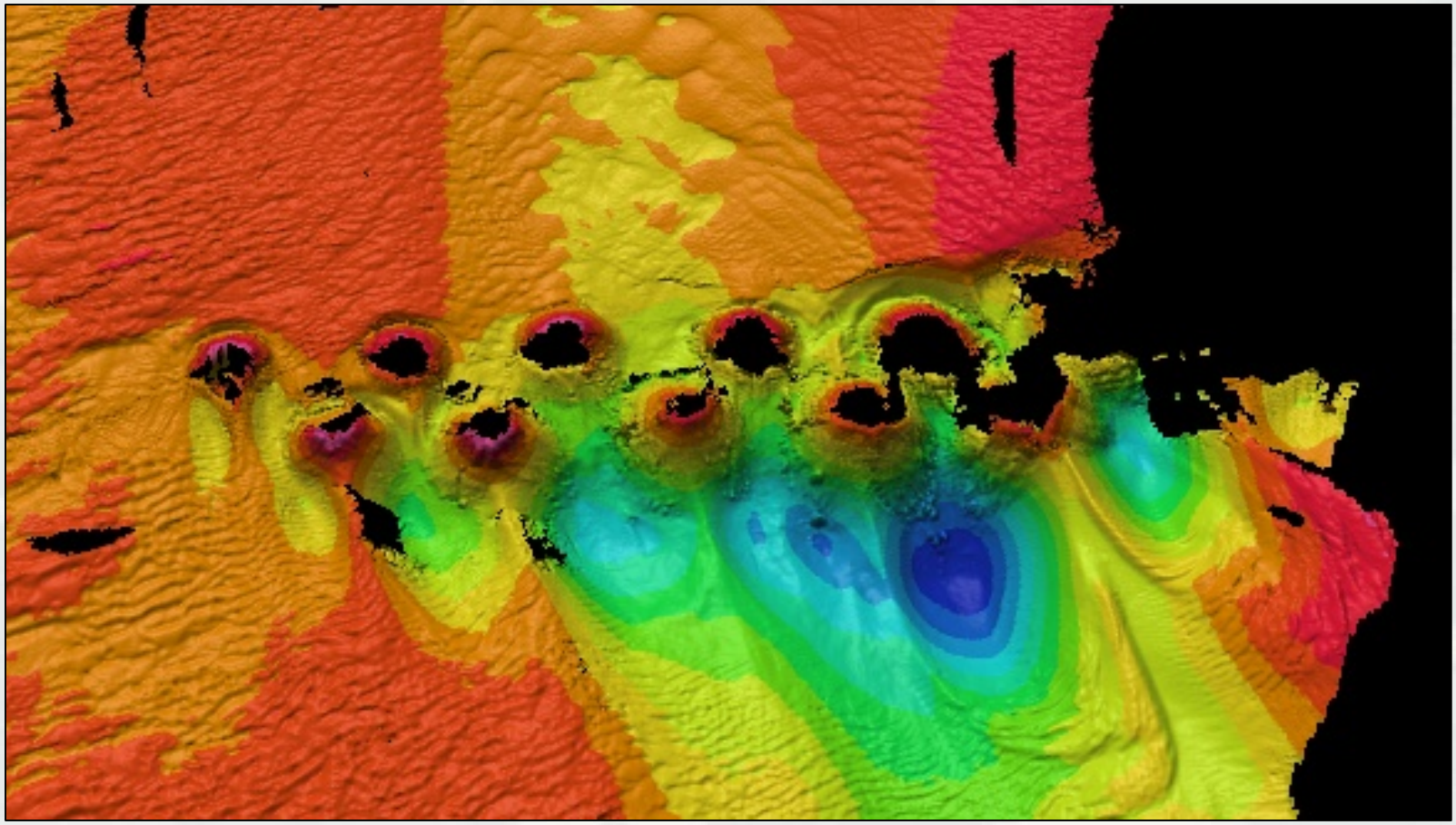
Chevrons



Bullnose

Multiple Roundpoint Structures

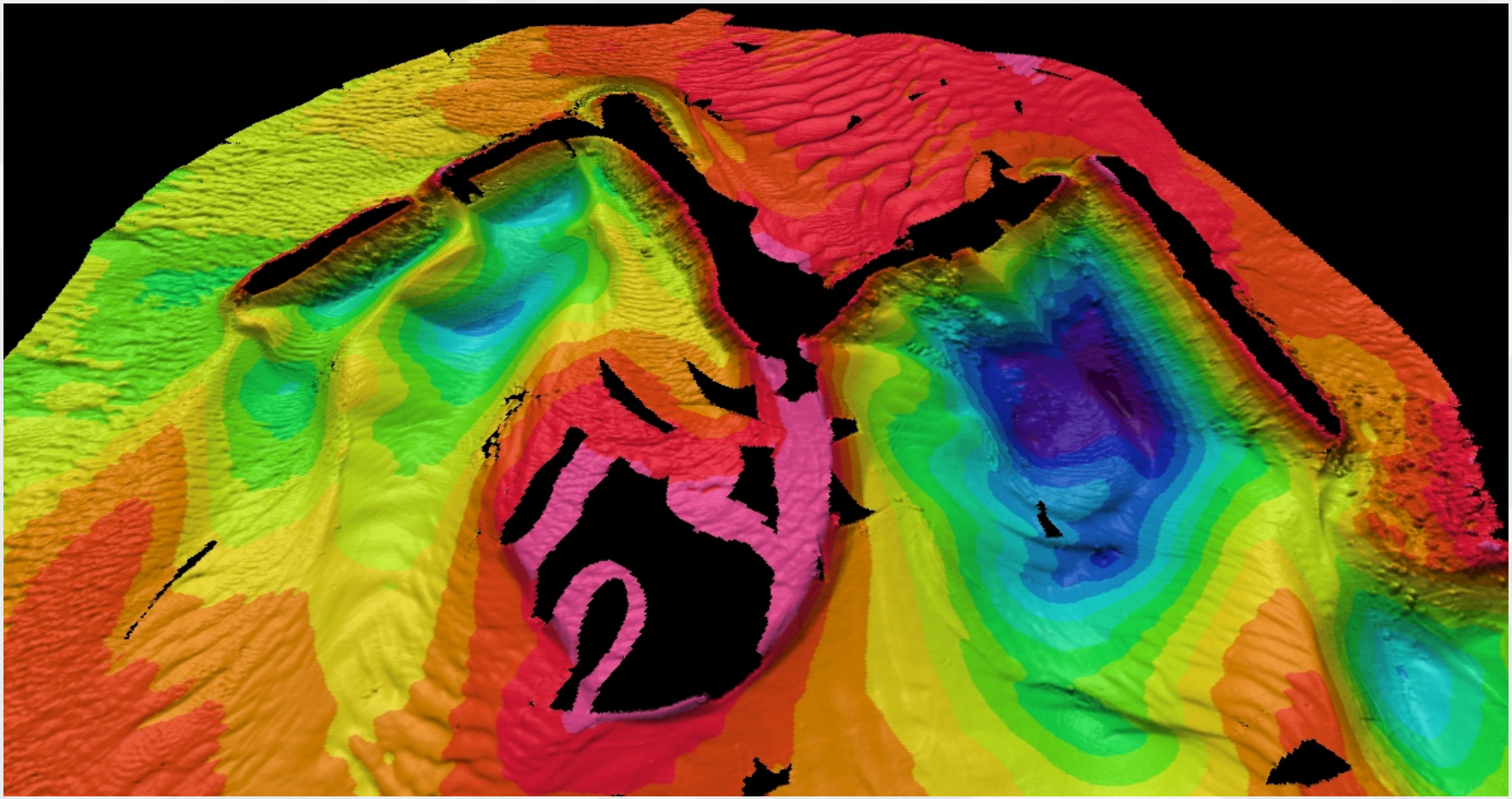
Multiple Roundpoint Structures



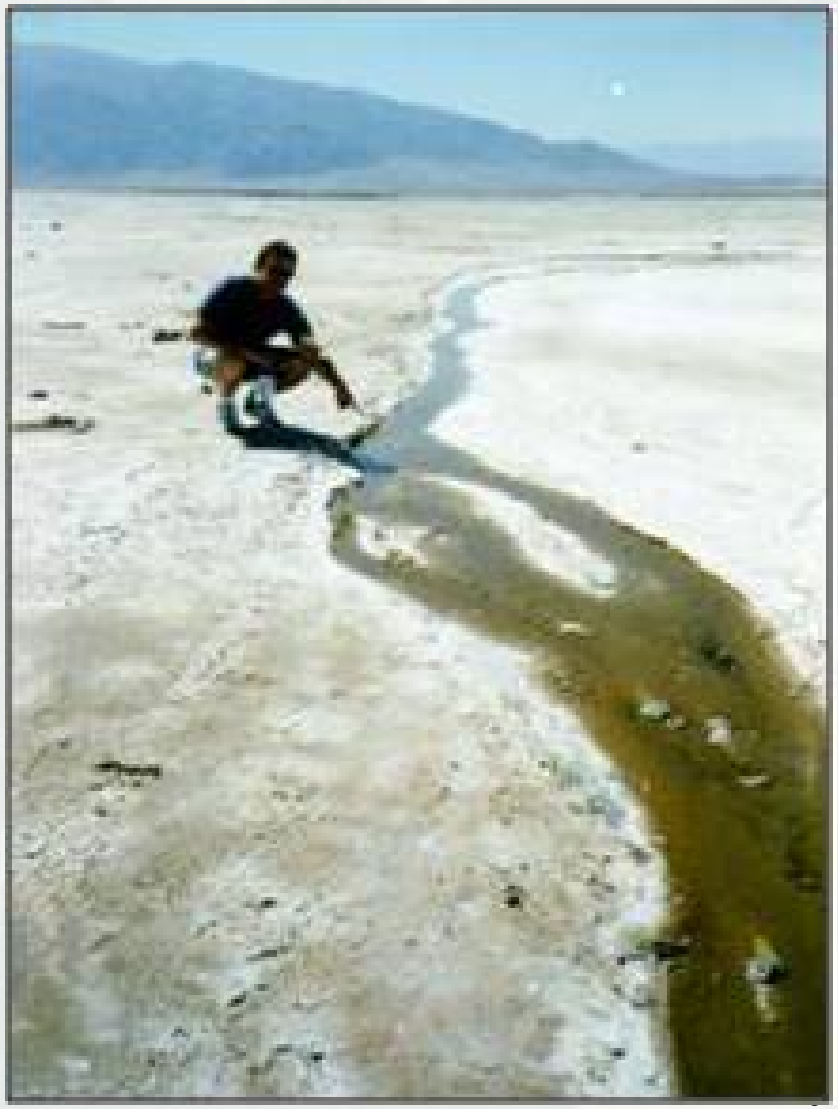
Z-Dikes

W-Dikes

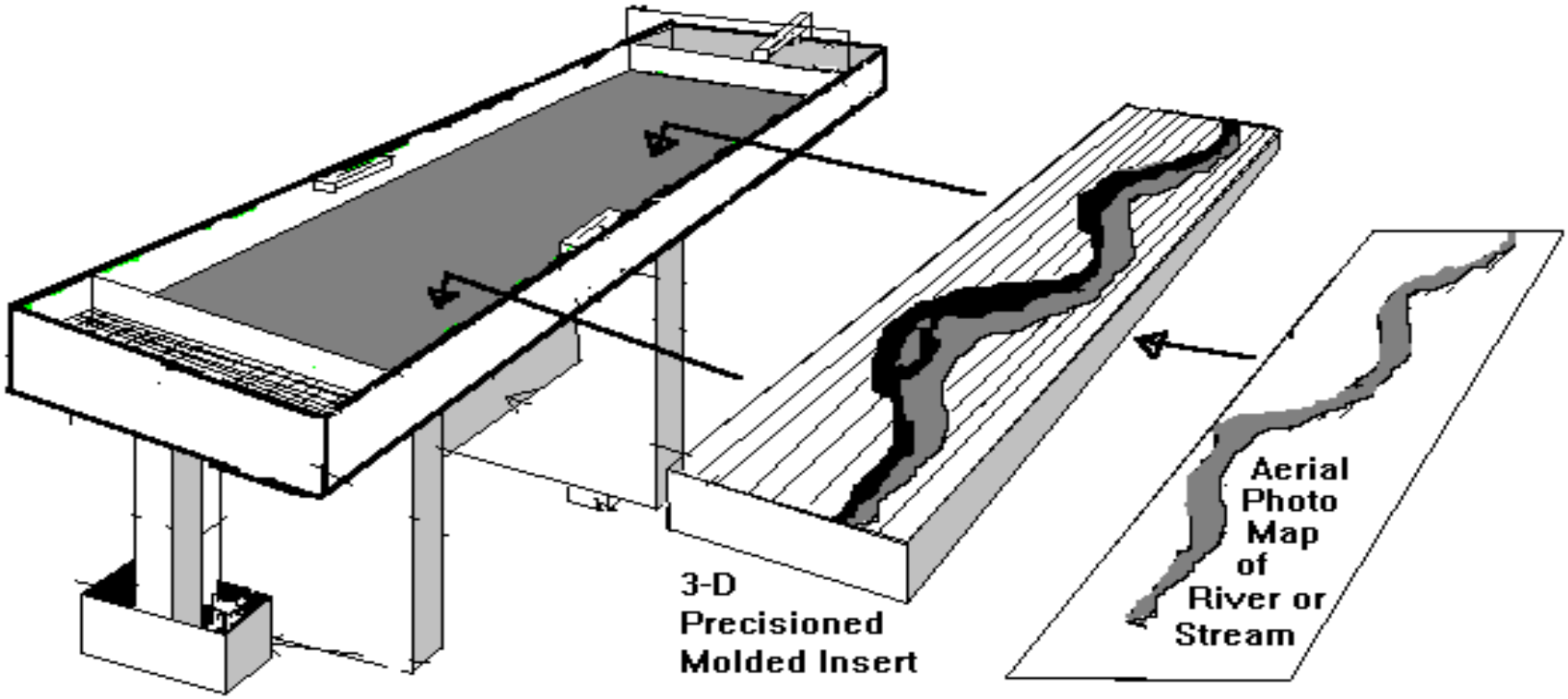
W-Dikes



HSR Modeling Basic Principle



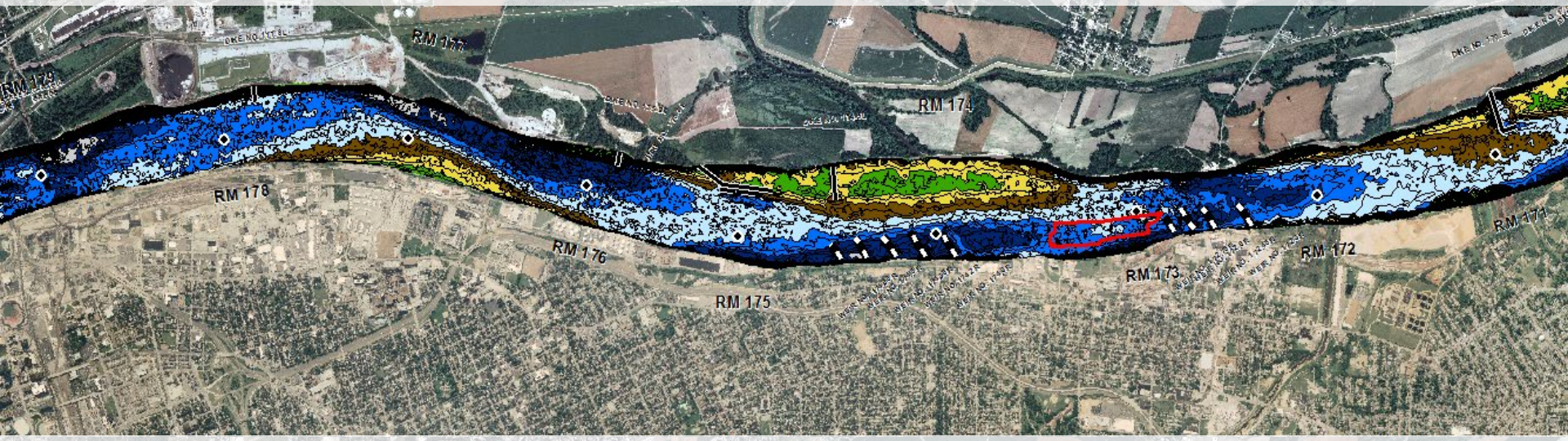
HSR Model


3-D
Precisioned
Molded Insert
Aerial
Photo
Map
of
River or
Stream

Carondelet HSR Model

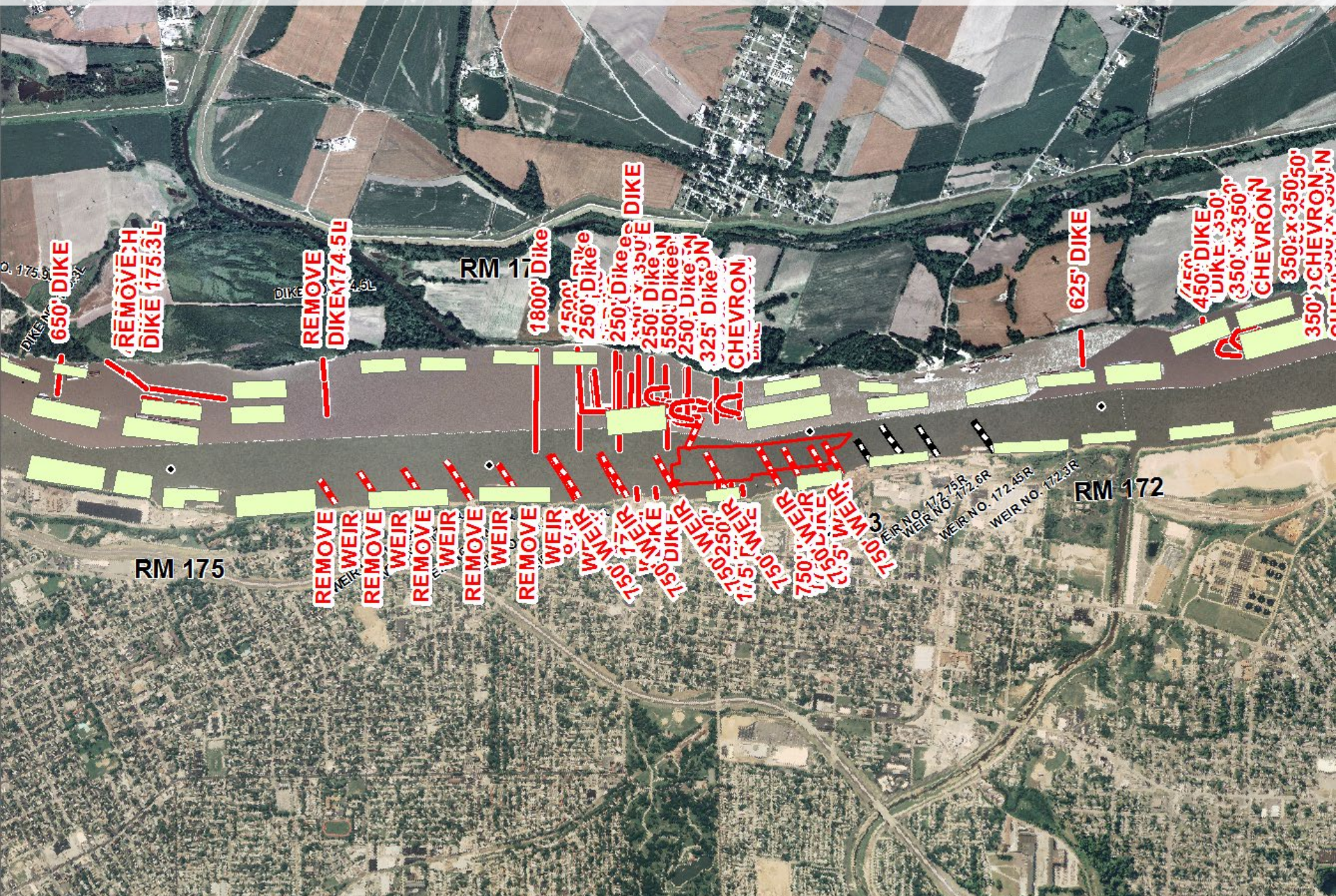
- River Miles 181.0 – 165.0
- Regulating Works Program

Model Replication

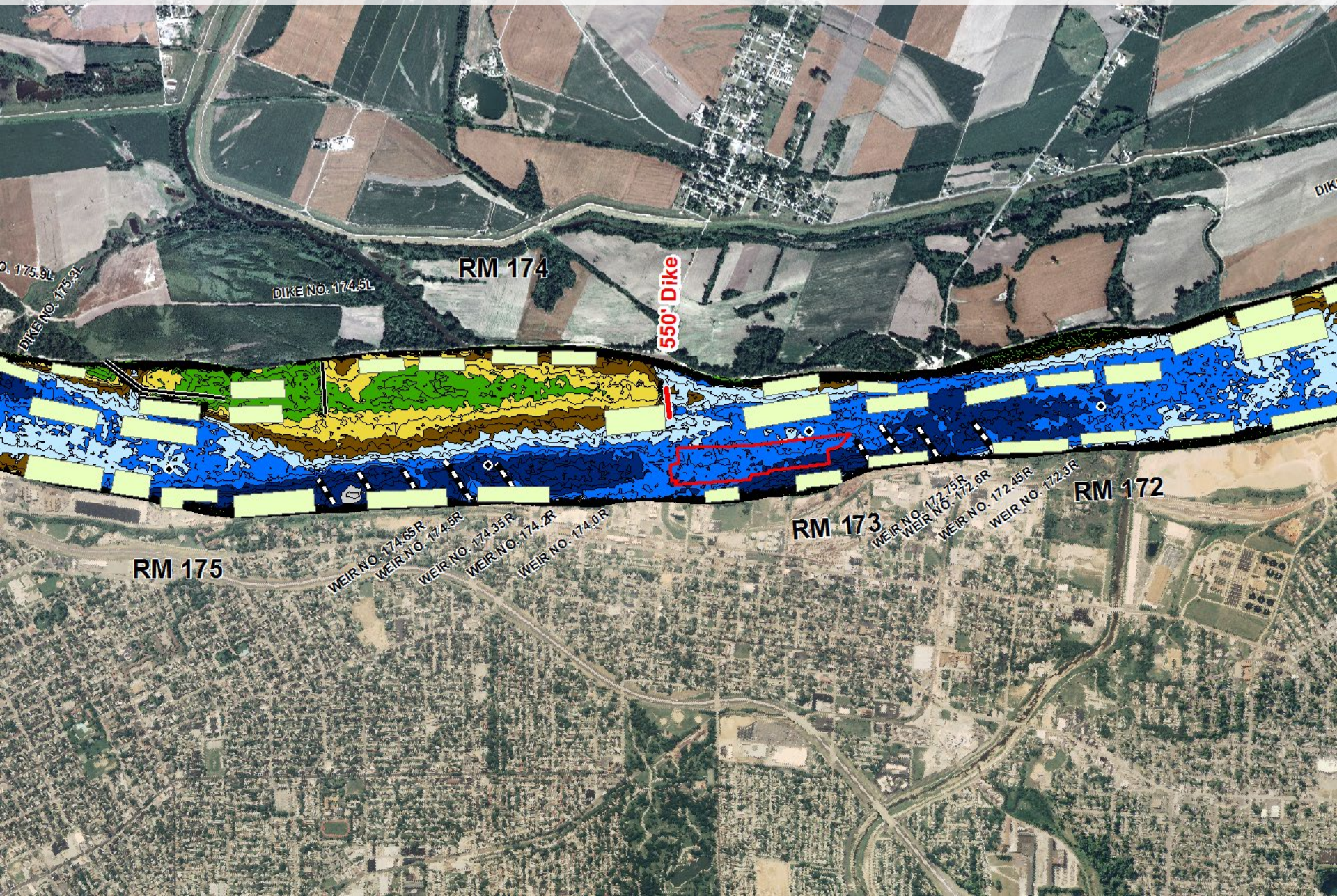


2010 Prototype

Alternative Testing



Recommended Alternative



Proven Design Capabilities of HSR Models

- Design and optimization of river training structures
- Thalweg realignment
- Reduction of costly, chronic dredging
- Modification of bathymetry and far-field flow patterns to improve navigation
- Environmental- i.e. Side Channels
- Demonstration & Education

Questions?