Historical River Morphology Study of the Middle Mississippi River

US Army Corps of Engineers
St. Louis District

APPLIED RIVER ENGINEERING CENTER
St. Louis- Memphis- Rock Island

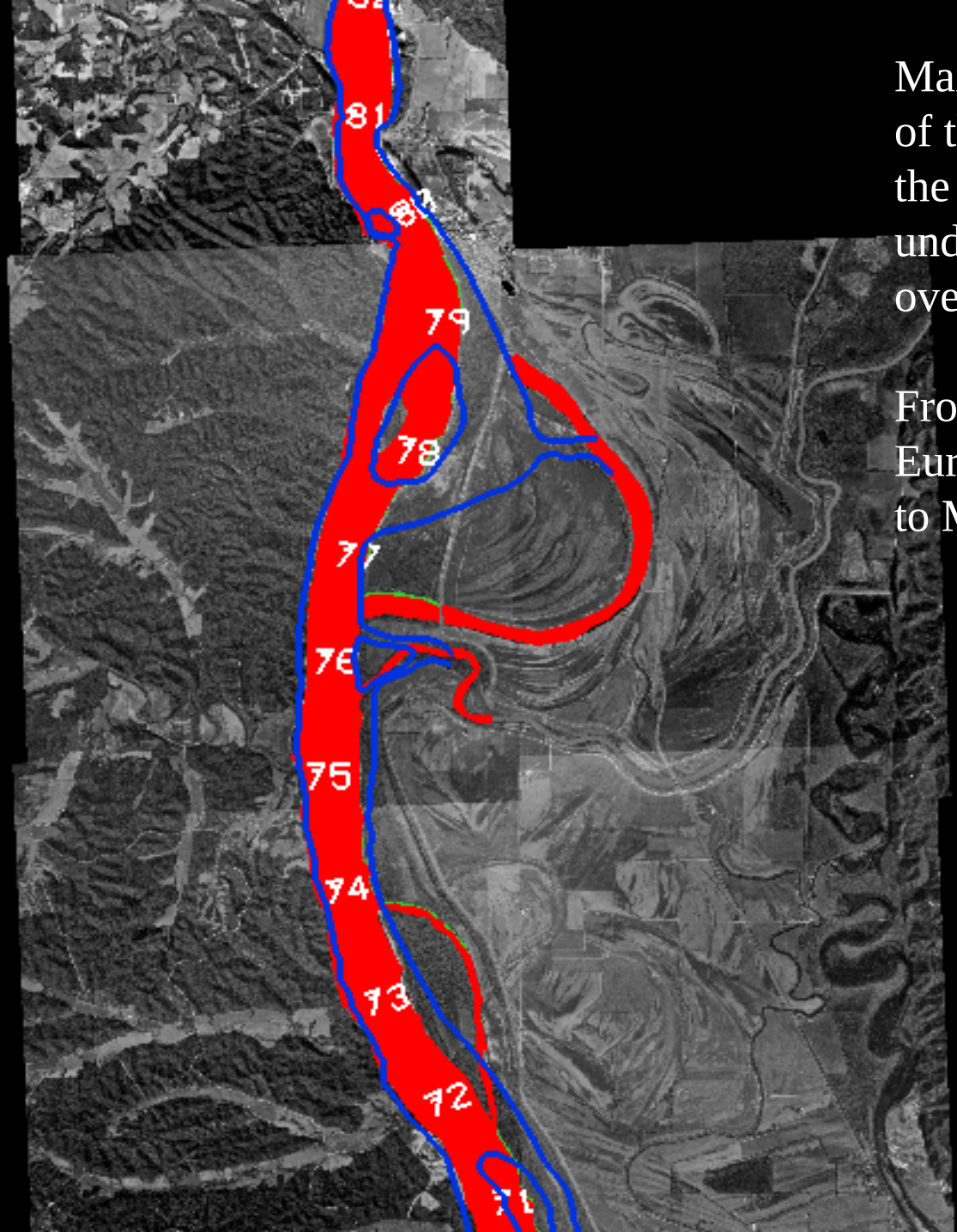
QUESTION:????

Engineers Can’t Spell! …..myth…..

It’s not that they can’t, there are just more important things in the world to worry about……

Catch my mistakes, and I will reward you with recognition before the group!!!!

Dear Claude: this study was simply not possible without your love and dedication to the river. You have been criticized in the past for being a pack-rat, well, your staff thanks the heavens for this, for everything you saved was worth saving, every map, every historical construction log, every memo, was worth the price of gold. Thank you "mouth of the river".

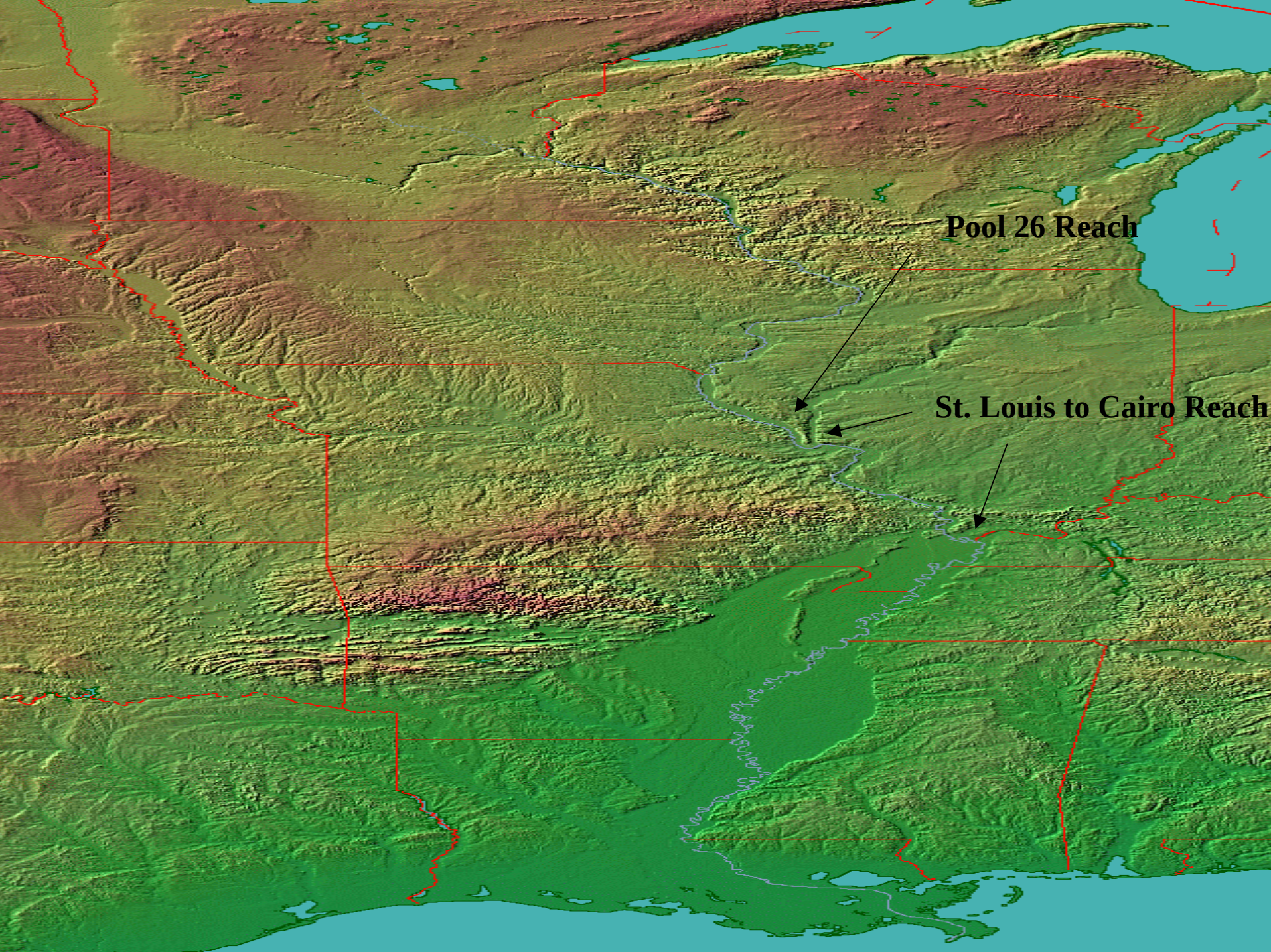


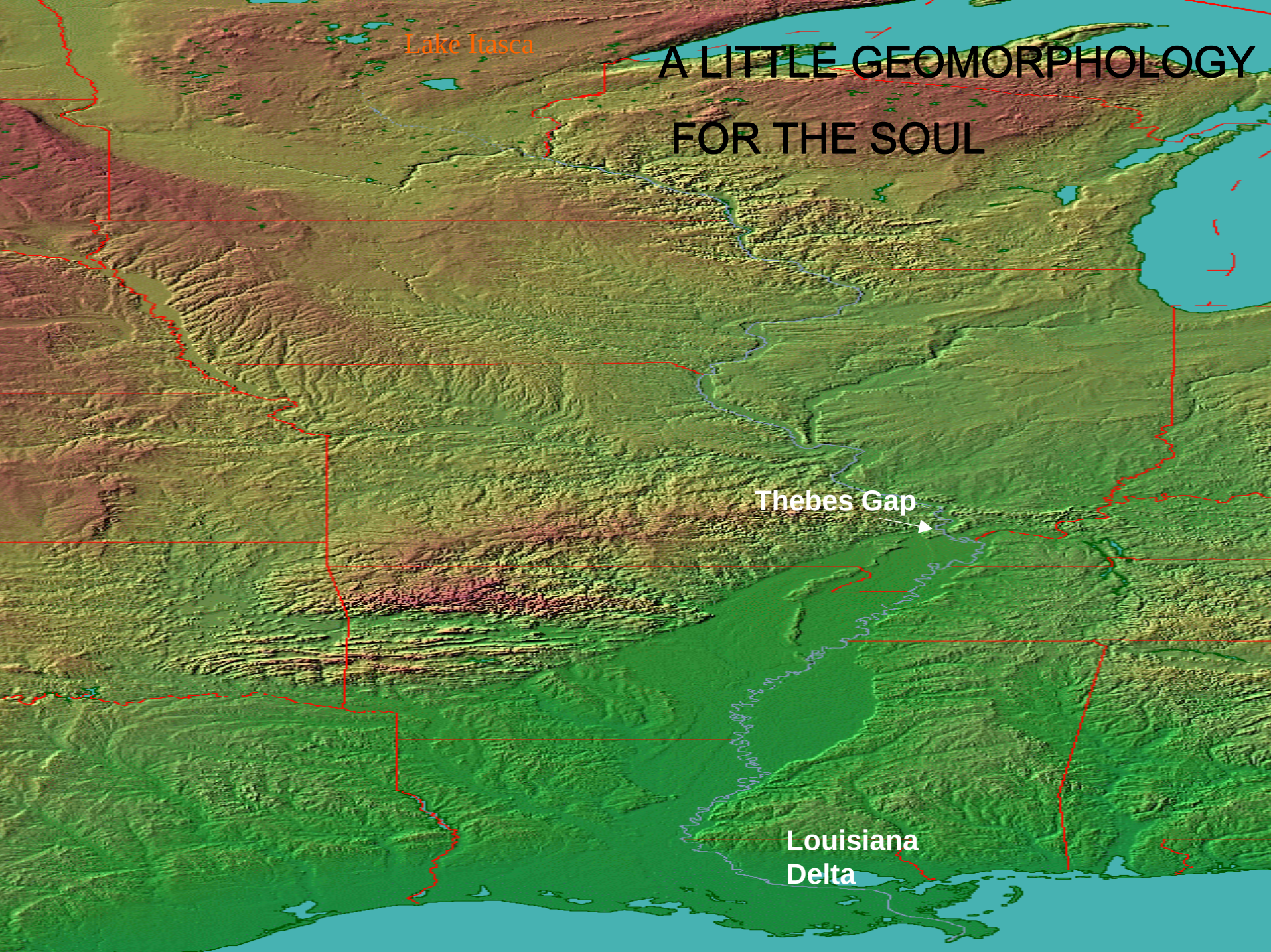
Main Goal: Gain an understanding of the historical physical changes the Middle Mississippi River has undergone
over time.

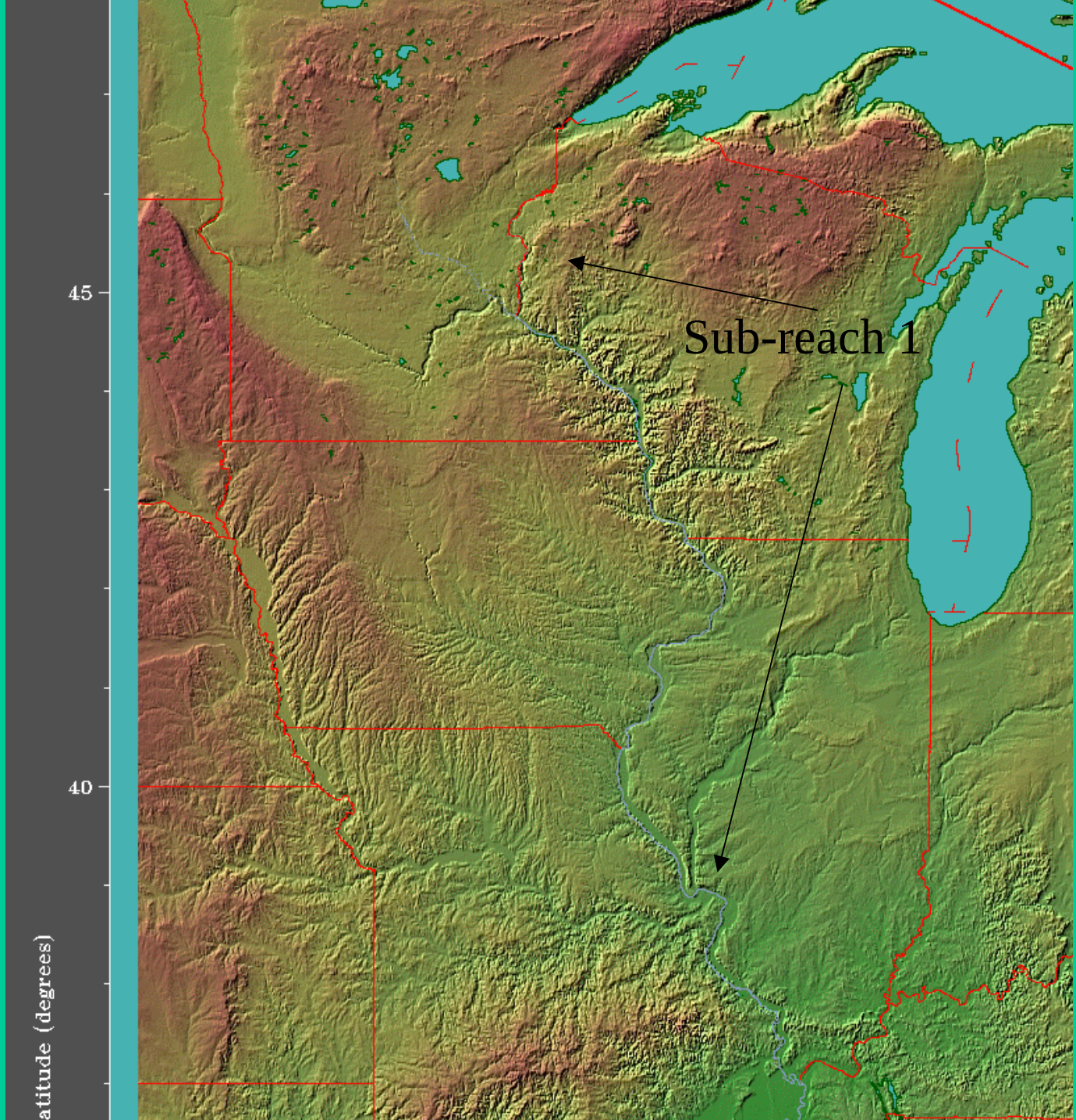
From Beginnings of European Settlement (1817-1821) to Modern Time (1994)

With a discussion into older geomorphology

Proposals For Future Restoration Measures


Pool 26 Reach
St. Louis to Cairo Reach


Lake Itasca
A LITTLE GEOMORPHOLOGY
FOR THE SOUL
Thebes Gap
Louisiana
Delta


45
40
atitude (degrees)
Sub-reach 1

8 14'01

Submerged
Topsoil (clay/silt)

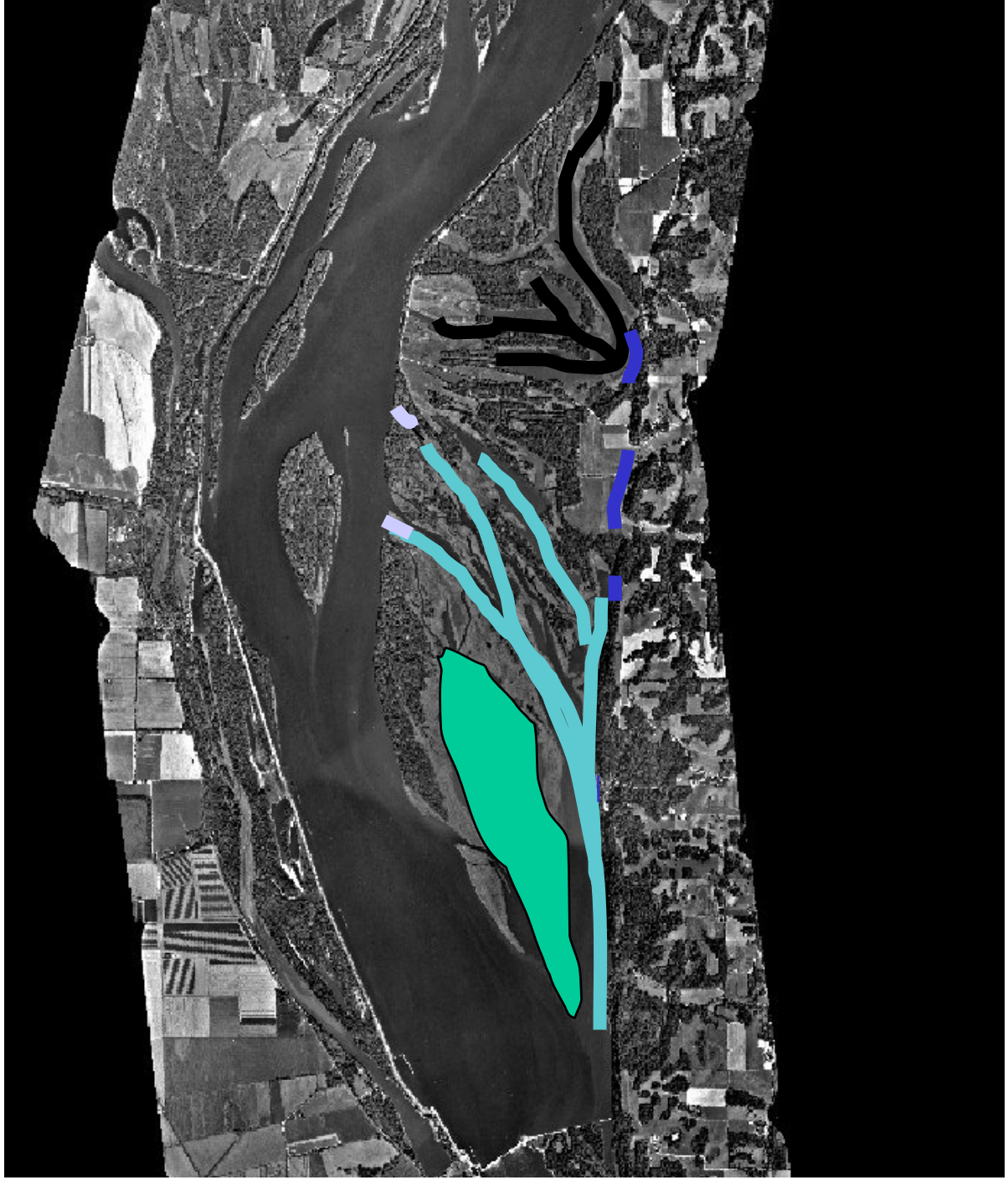
Hardbottom Clay

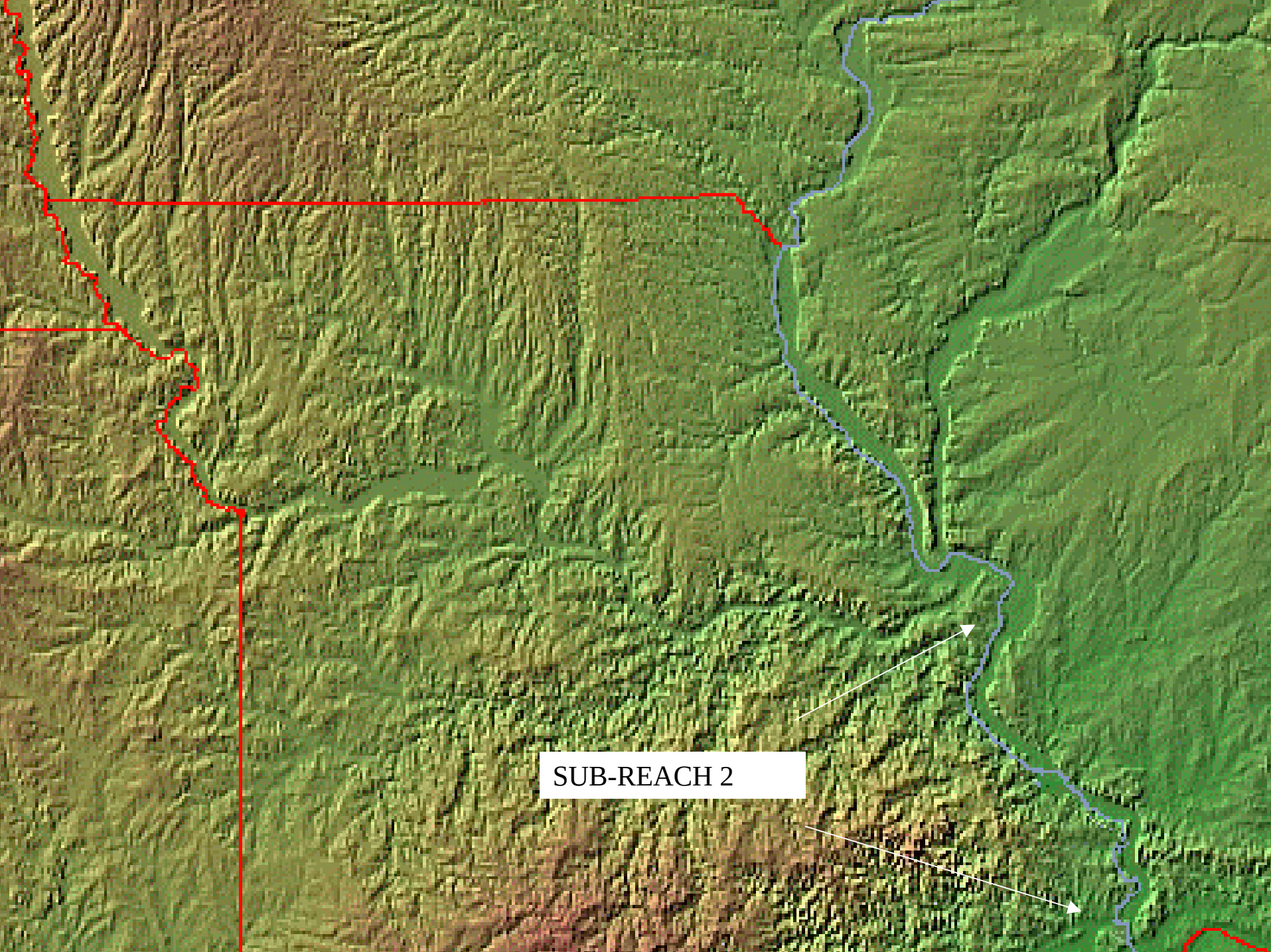
River Sand

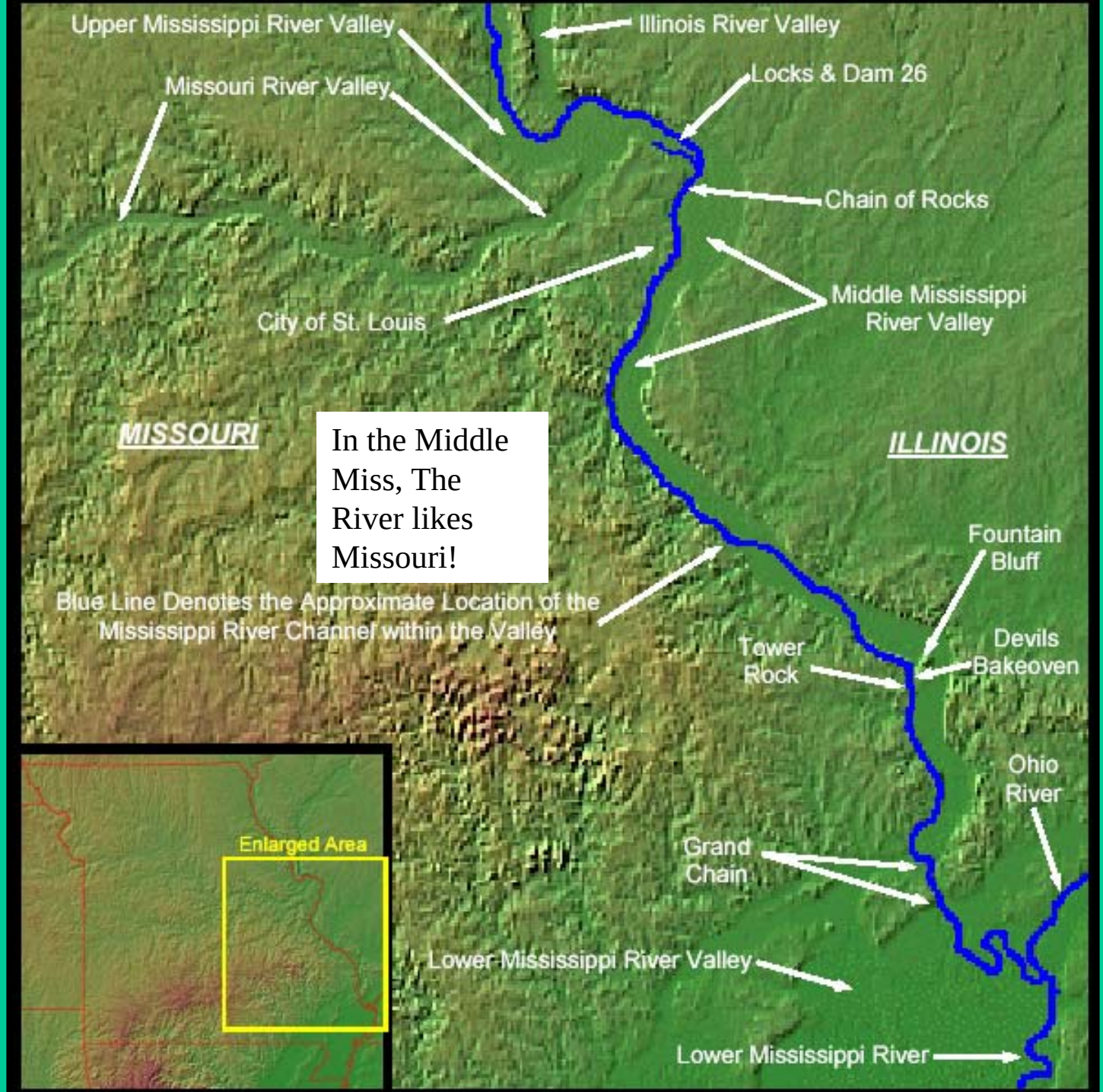
Deposited
Topsoil (clay/silt)

Hillside Fans

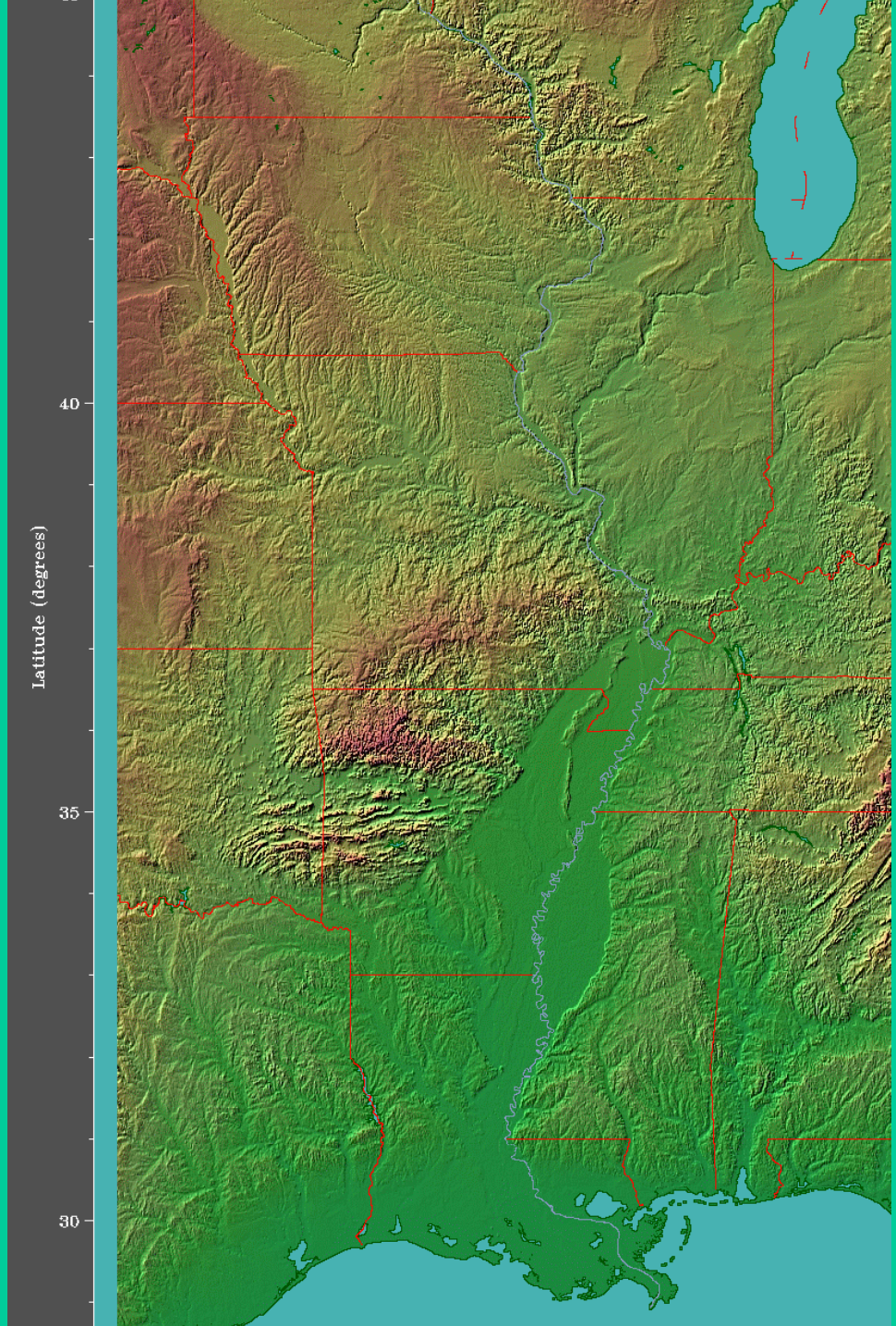
Most above areas overlaid with flocculent layer of silt, clay, and fine sand



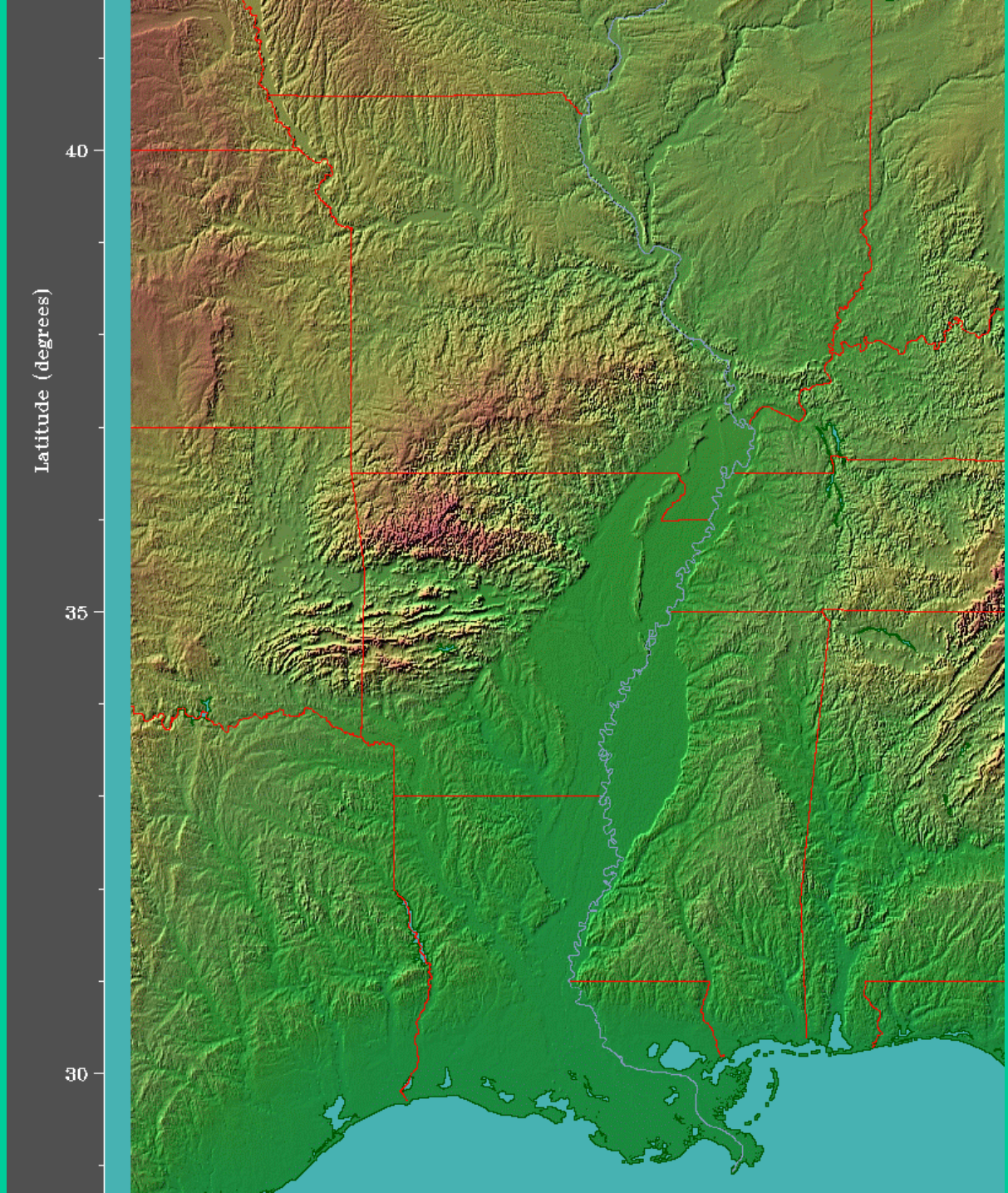

SUB-REACH 2

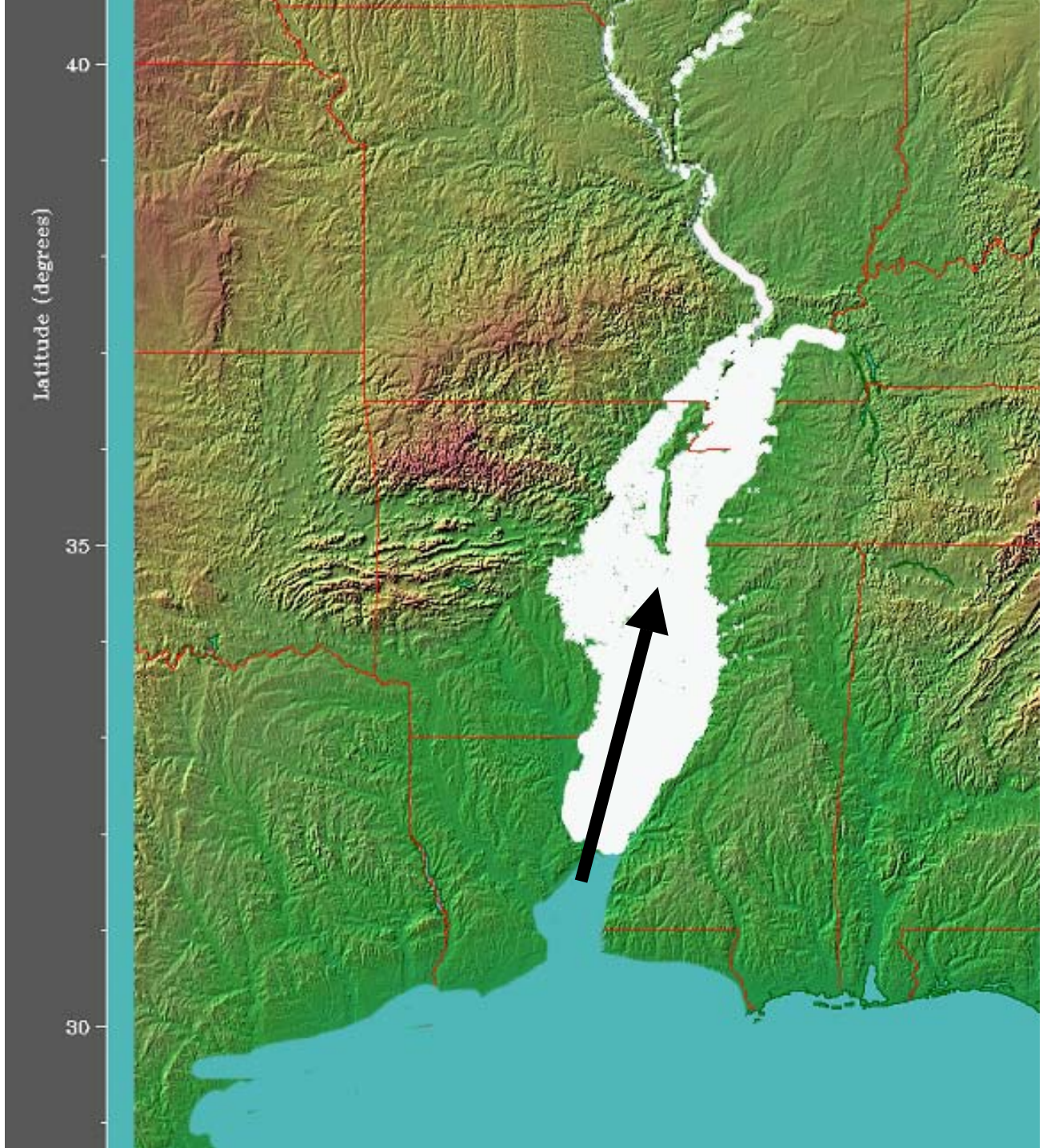

Upper Mississippi River Valley
Illinois River Valley
Missouri River Valley
Locks & Dam 26
Chain of Rocks
City of St. Louis
Middle Mississippi River Valley
MISSOURI
ILLINOIS
In the Middle Miss, The River likes Missouri!
Blue Line Denotes the Approximate Location of the Mississippi River Channel within the Valley
Fountain Bluff
Tower Rock
Devils Bakeoven
Ohio River
Enlarged Area
Grand Chain
Lower Mississippi River Valley
Lower Mississippi River

Latitude (de
35
30
Sub-Reach 3

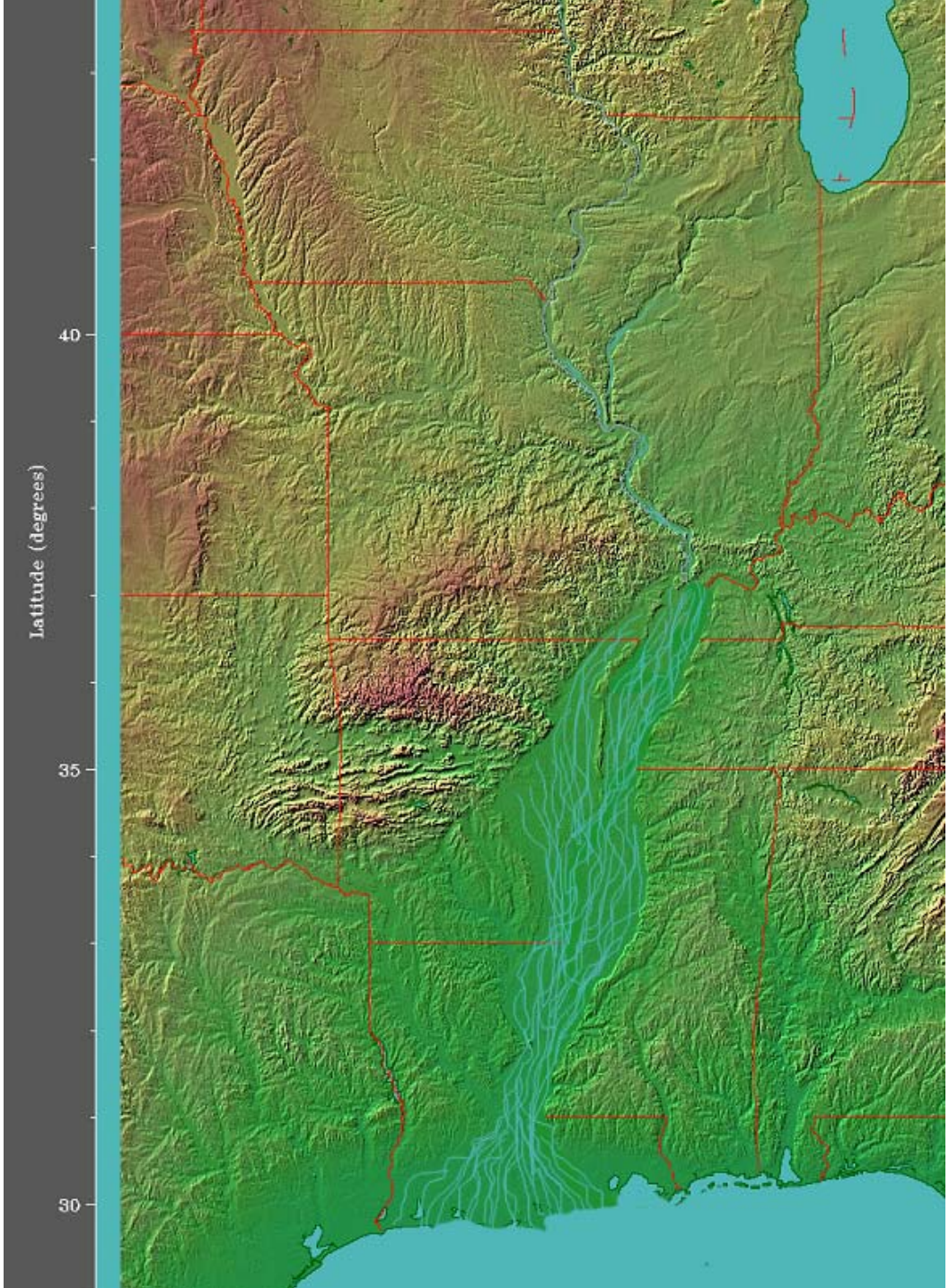


Did the River as we know it today move back and forth across the floodplain?

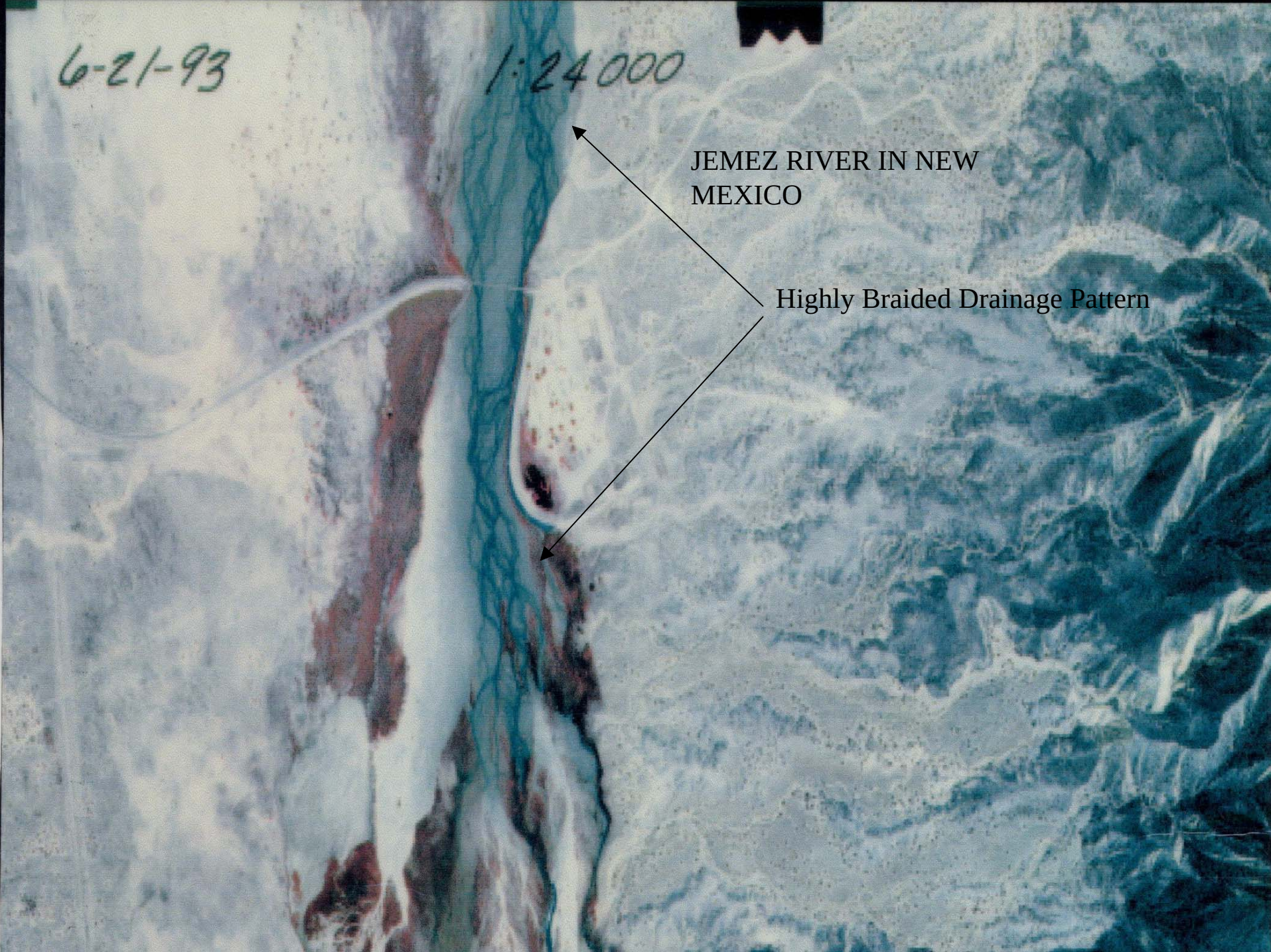

Latitude (degrees)
40
35
30

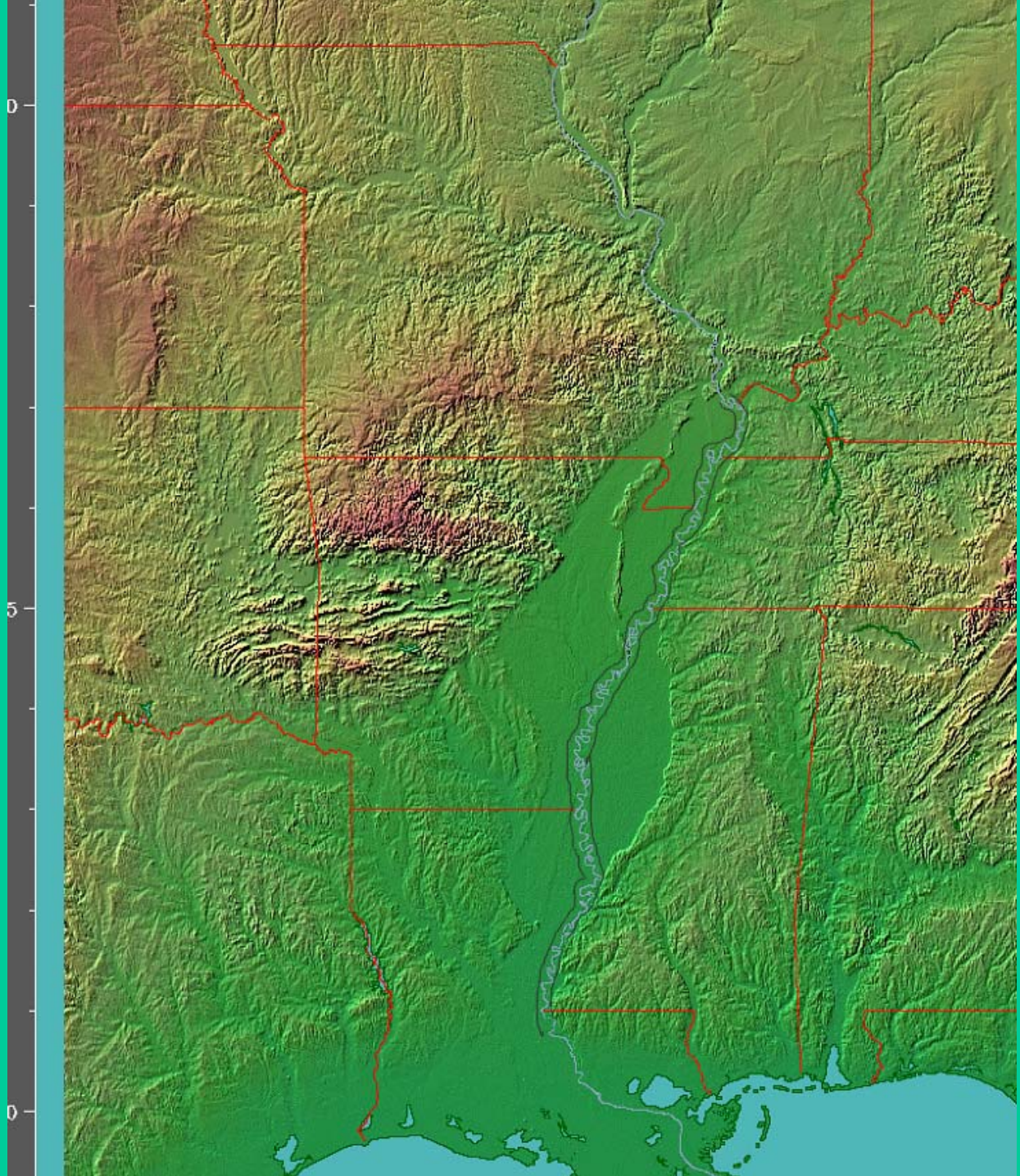


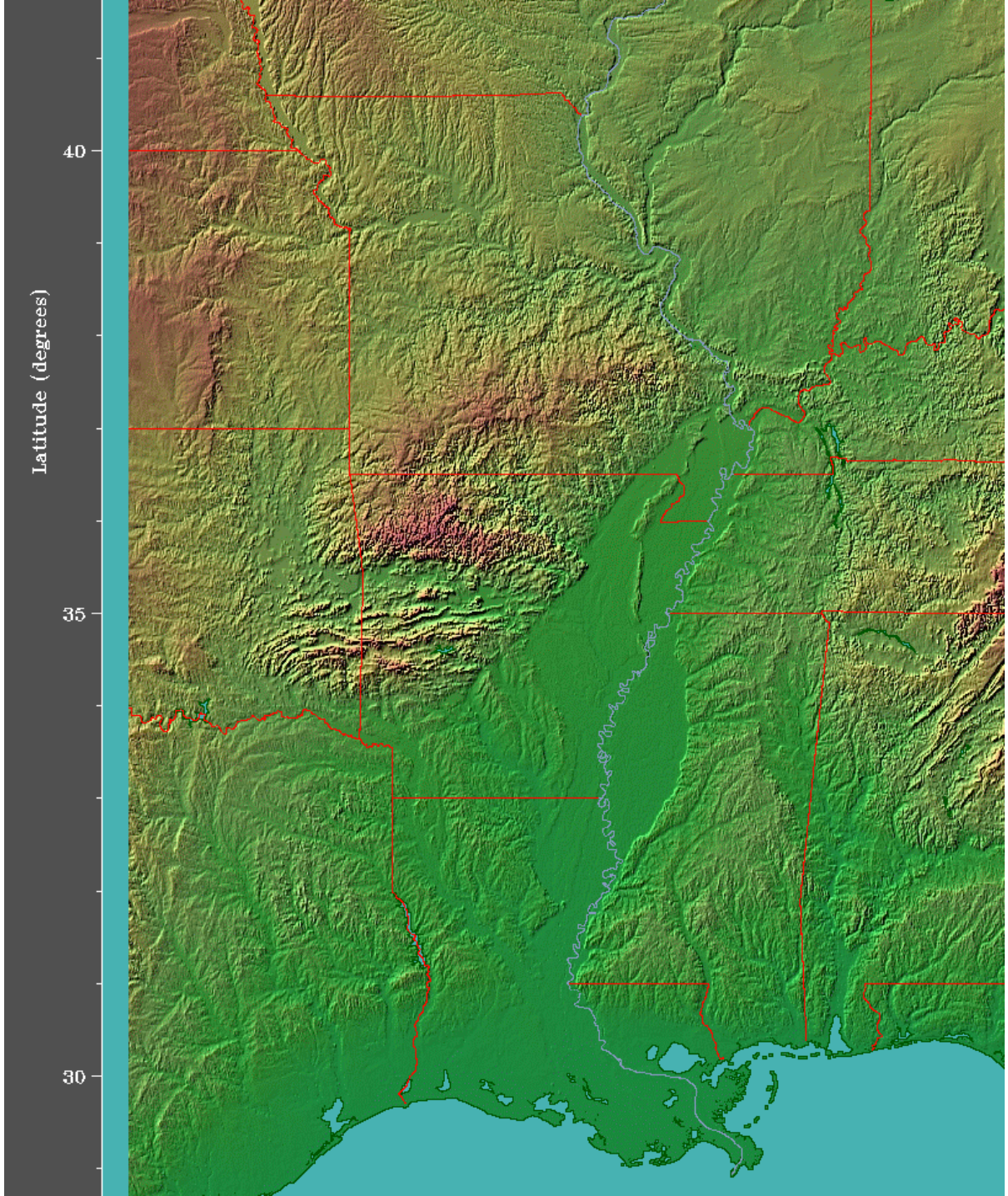
Glacial Retreat



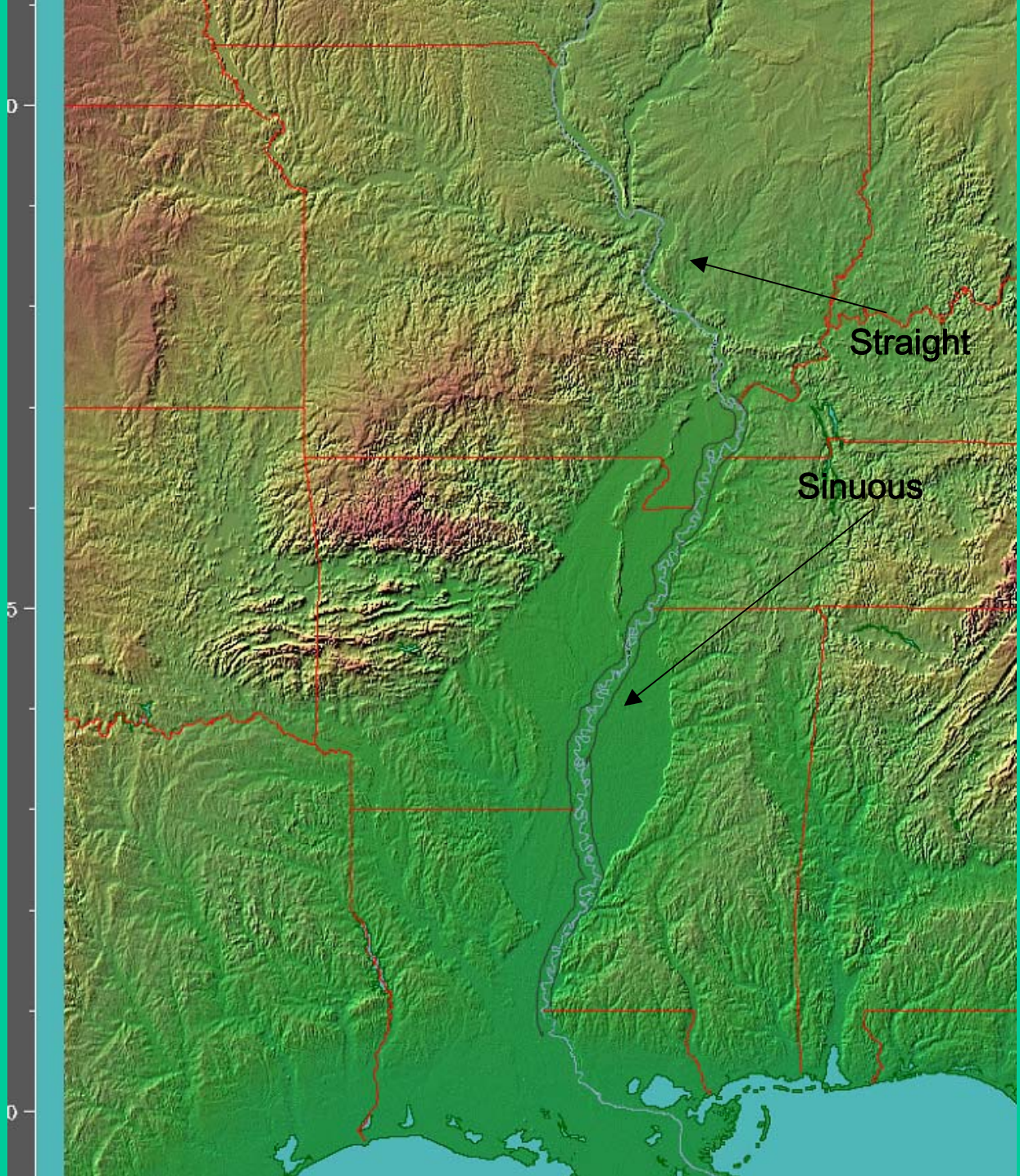
Highly Braided Drainage Pattern resulting From Glacial Retreat, Many Smaller Rivers and Streams Draining Glacial Runoff and Sediment, Forming Floodplain

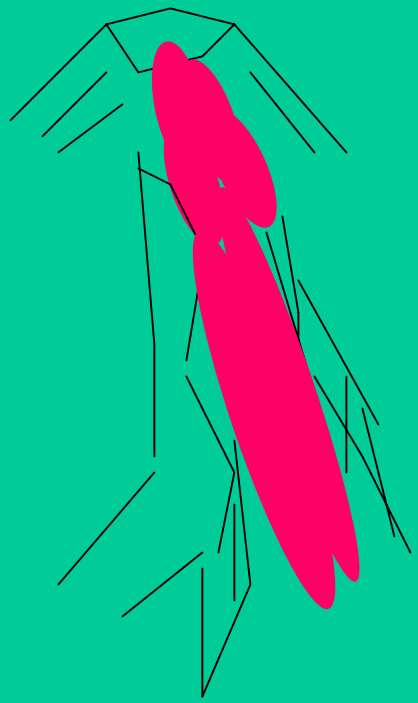

6-21-93
1:24000
JEMEZ RIVER IN NEW MEXICO
Highly Braided Drainage Pattern





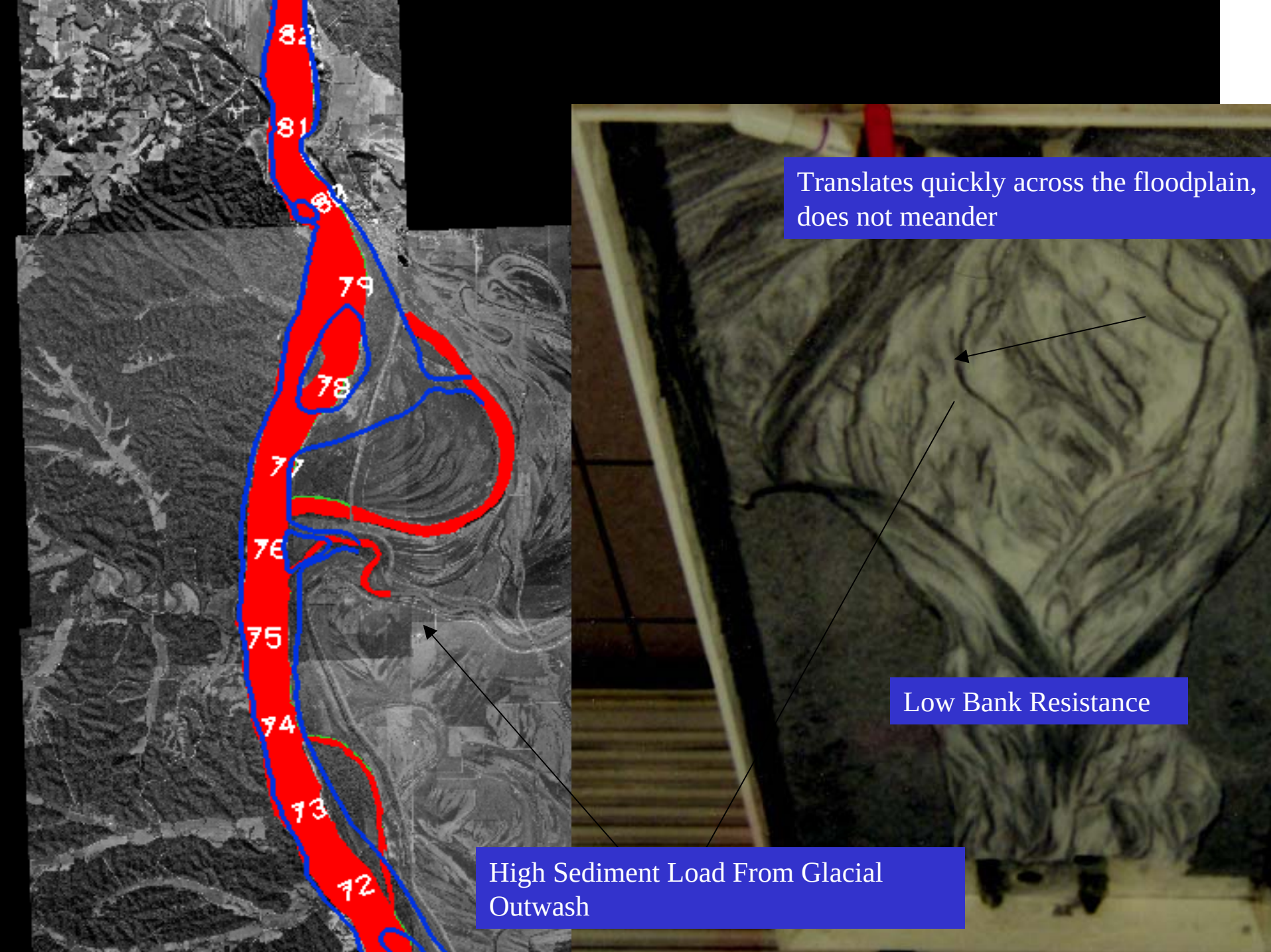
Single Meandering Canaliform Incised within Already Formed Floodplain


Straight
Sinuous

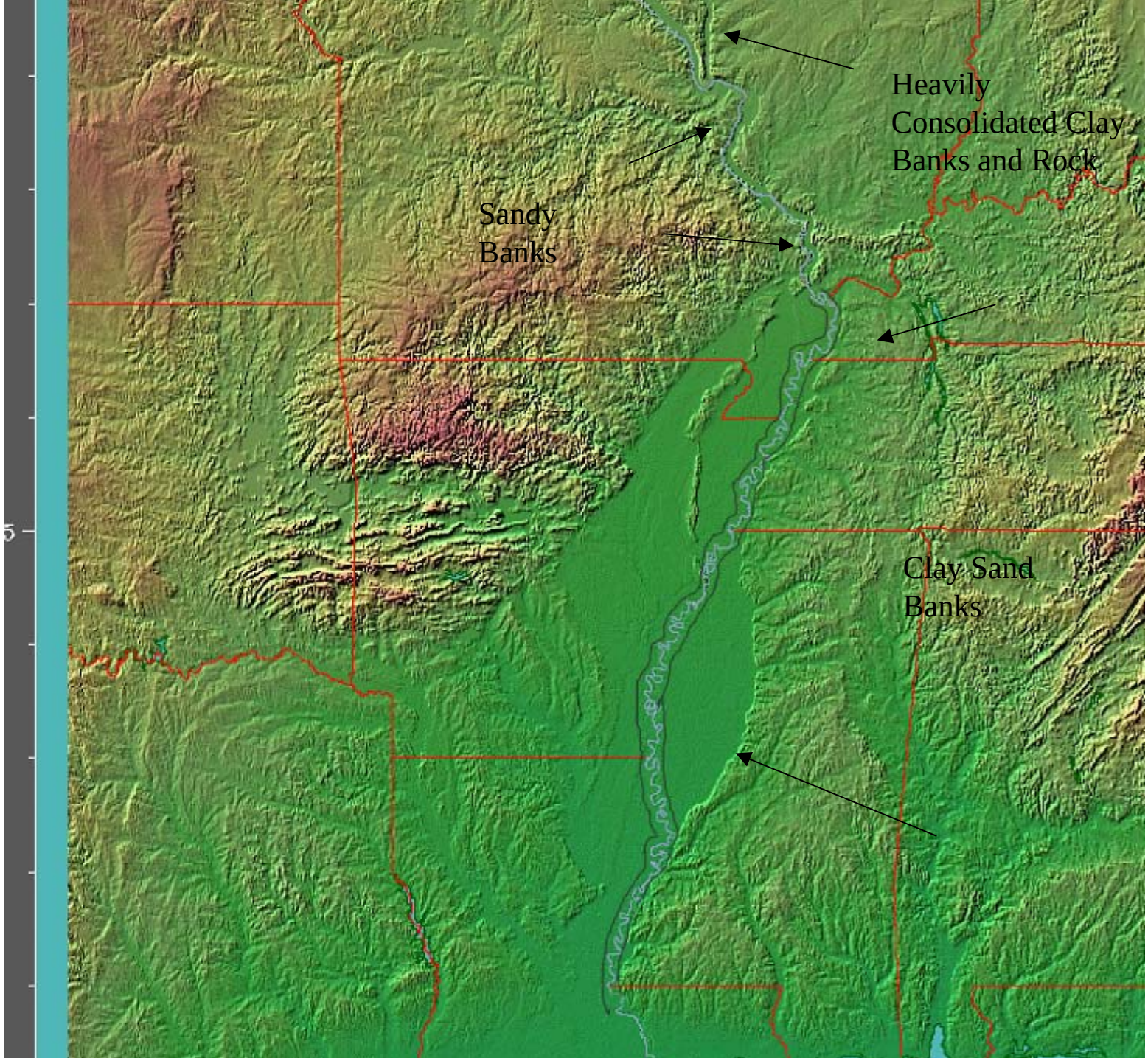


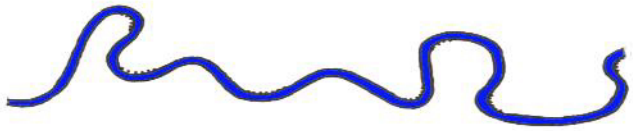
Is there a recent precedence for the floodplain coming before the river?

- **Mount St. Helens…..Lava Flowed Over nearby Topography after eruption**
- **Canyon was formed in a matter of a few hours**
- **Denderic Pattern Ensued for drainage of water and sediment, forming resultant floodplain**
- **Single, semi-braided, entrenched channel eventually formed**

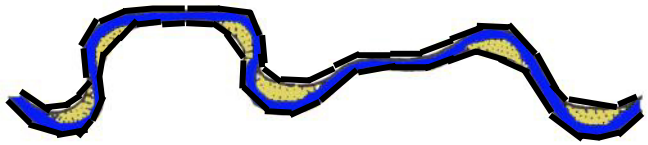

Translates quickly across the floodplain, does not meander
Low Bank Resistance
High Sediment Load From Glacial Outwash

Geomorphology Magazine
First Streamtable to Form Meandering Pattern of Lower Mississippi River…Used Kalonite and very low energy


Heavily
Consolidated Clay
Banks and Rock
Sandy
Banks
Clay Sand
Banks



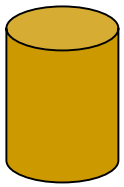
Sinuous Canaliform

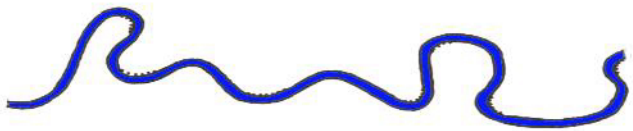


Sinuous Braided Canaliform

Sediment Load and River Morphology

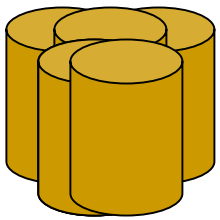
Qs =

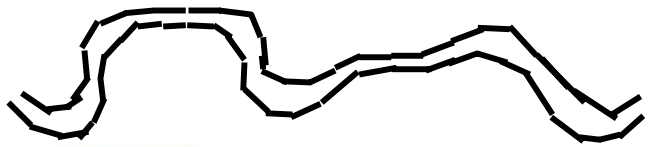




Planform Width is Relatively Uniform

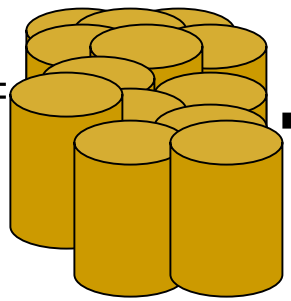
Qs =

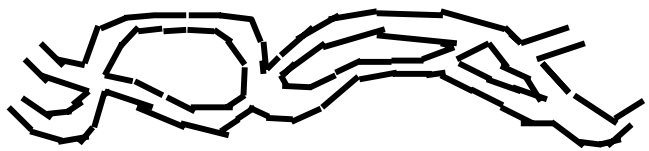




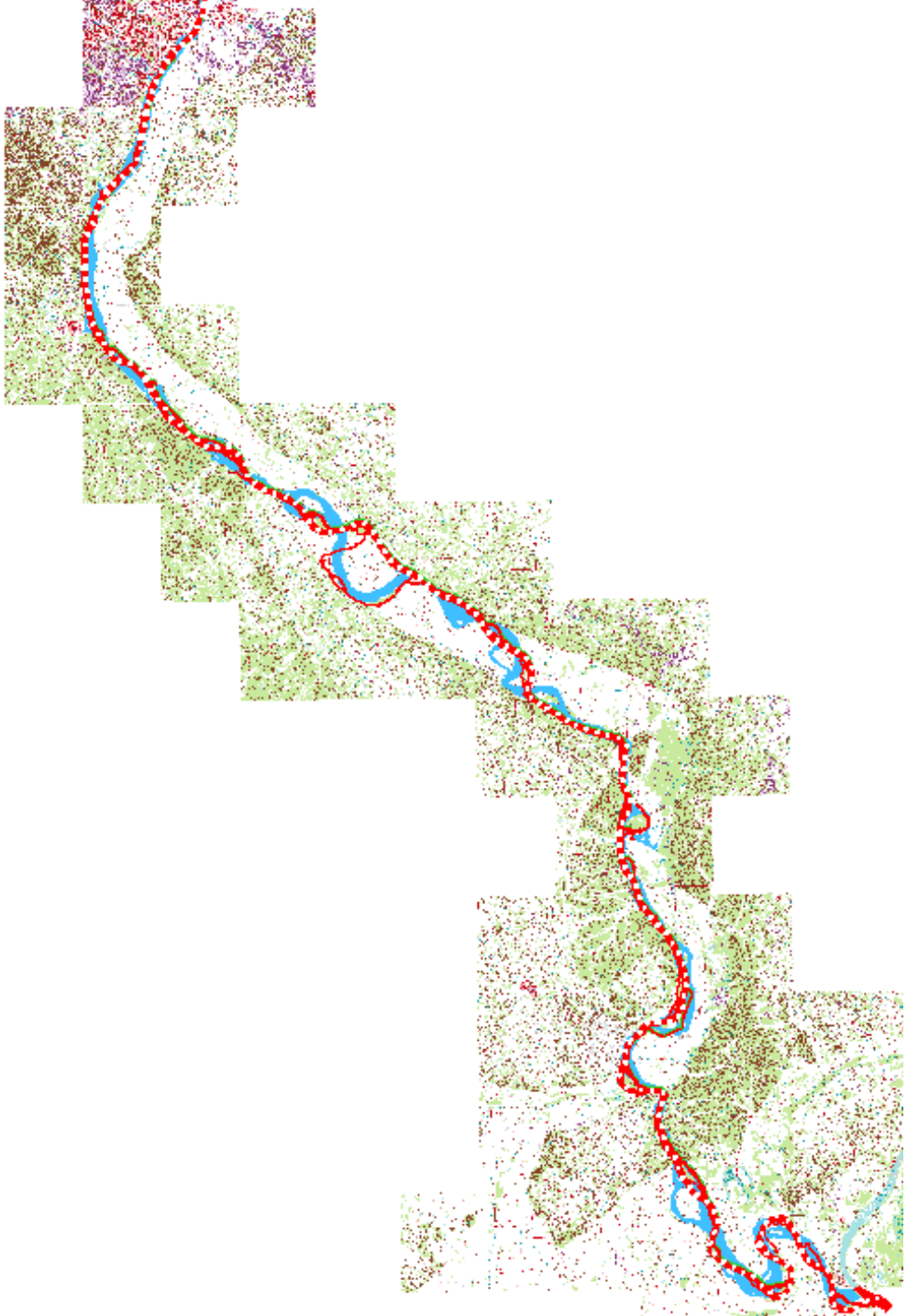
Planform Width Increases

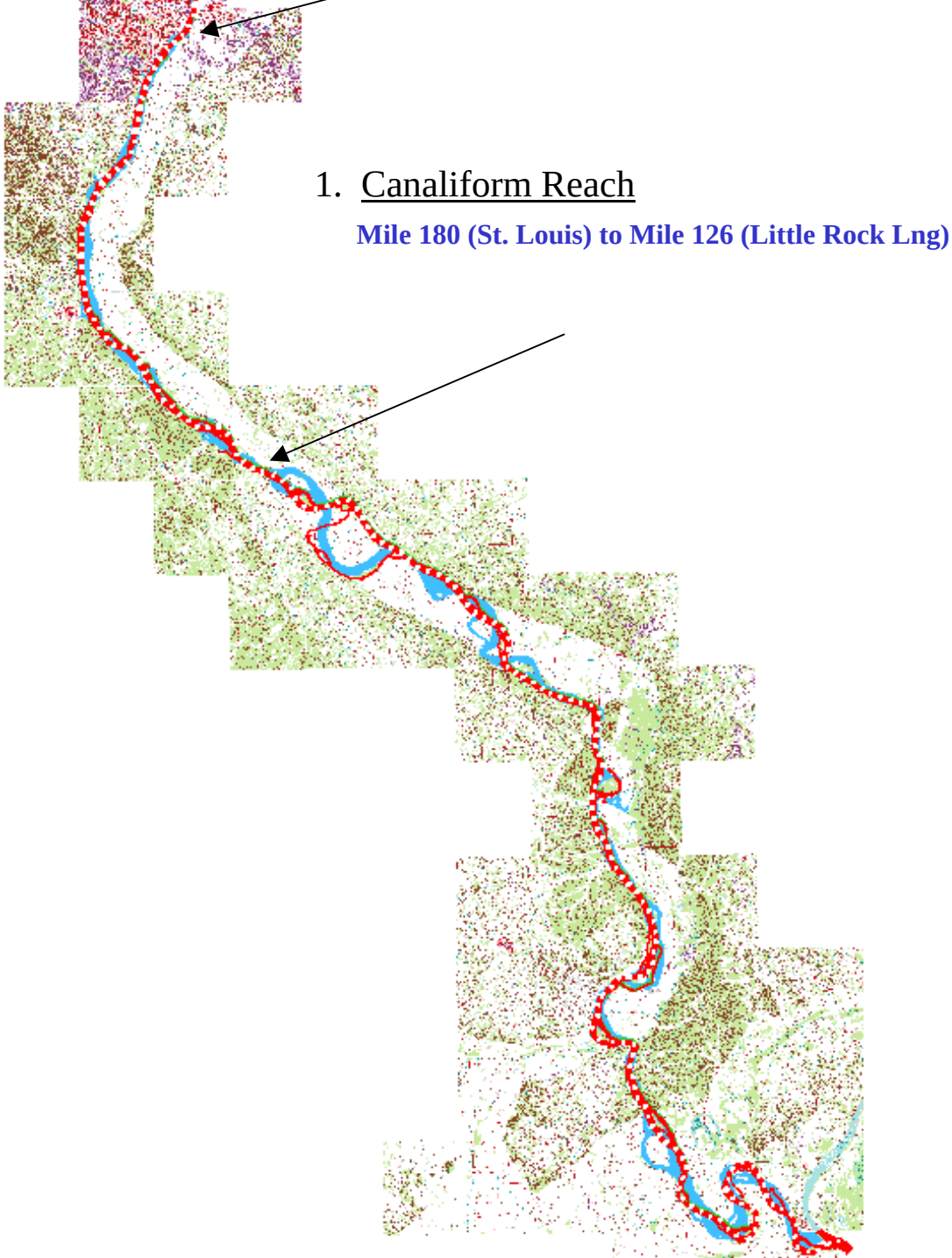
Qs =





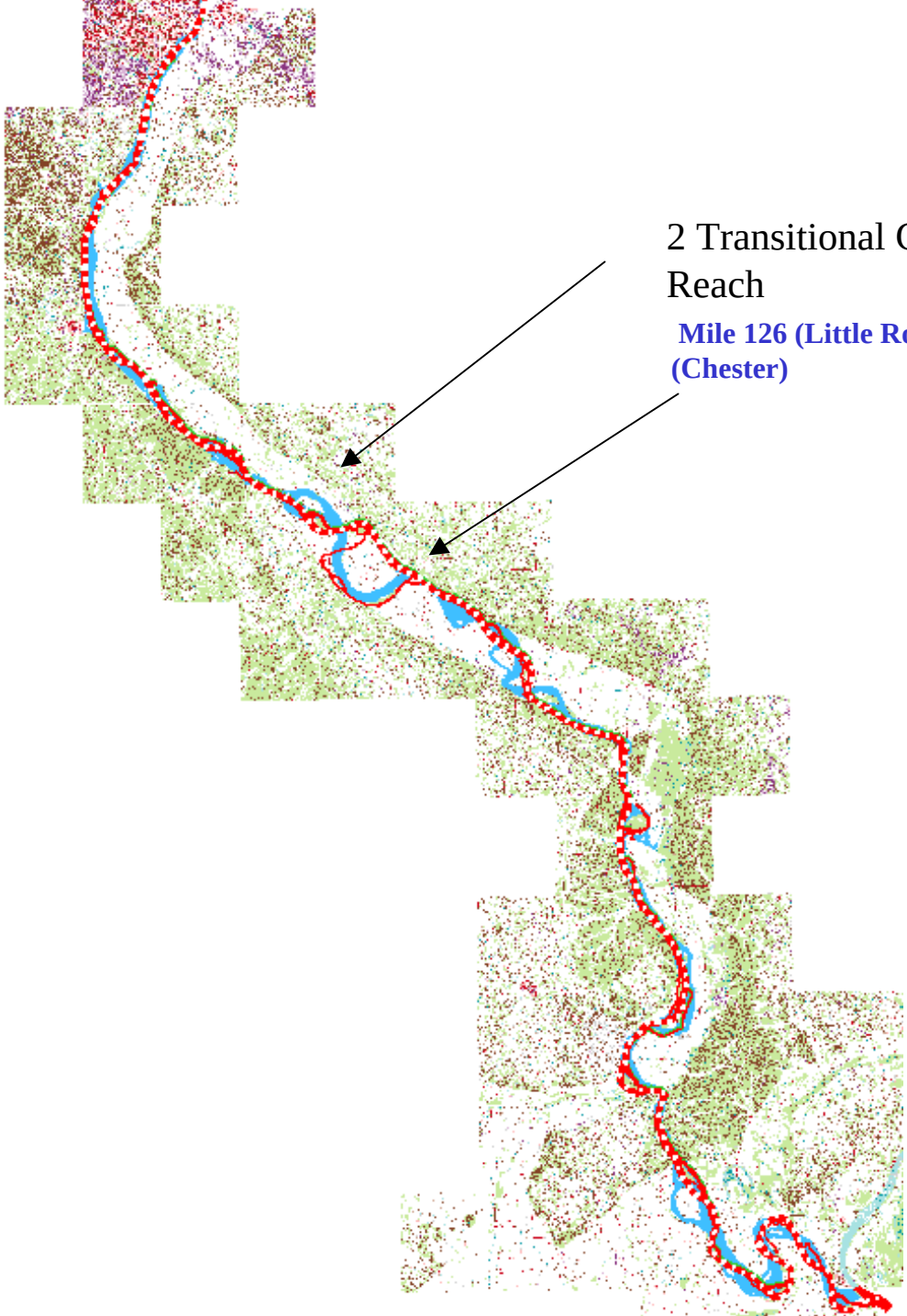
Braided Planform

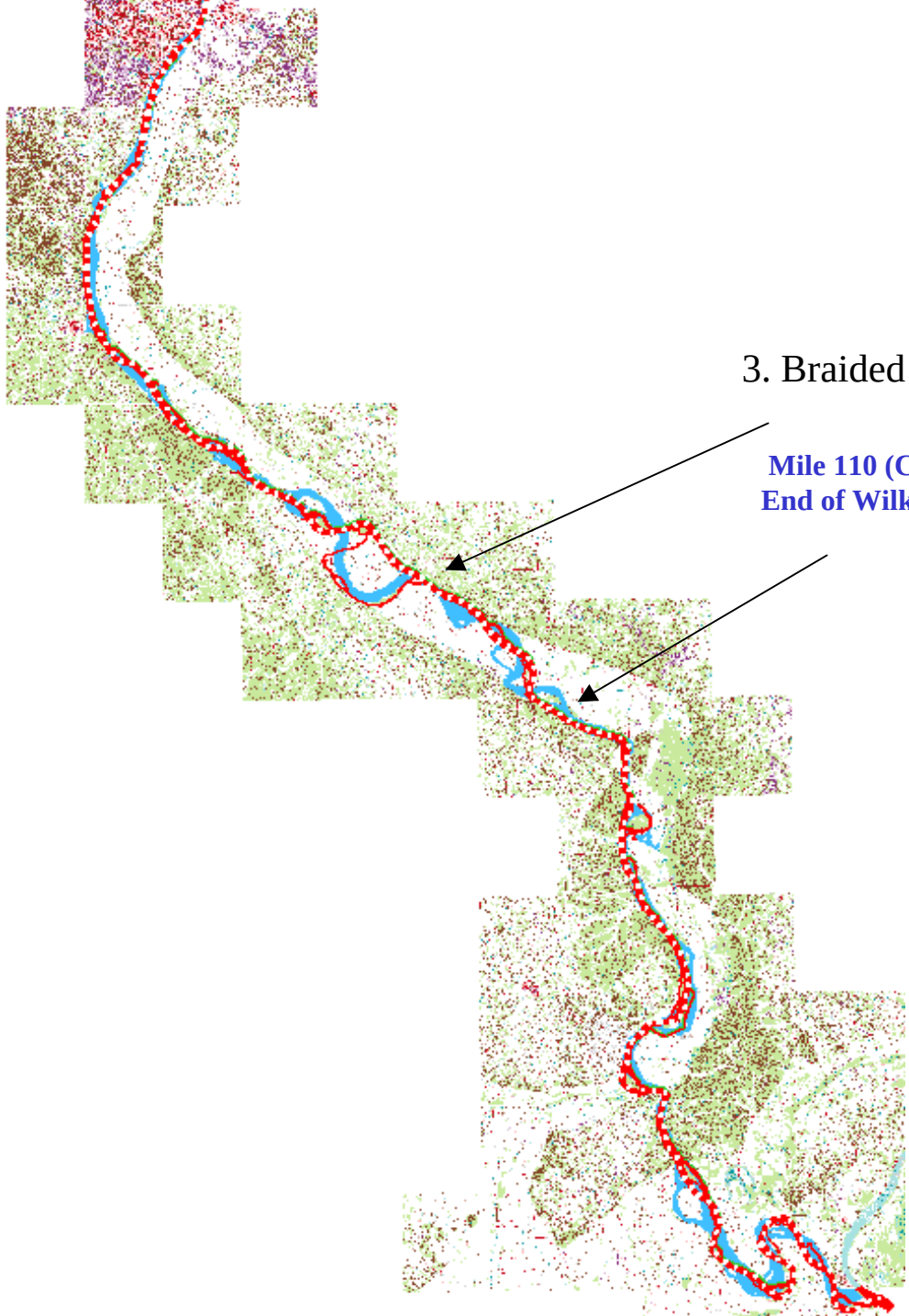




1. Canaliform Reach

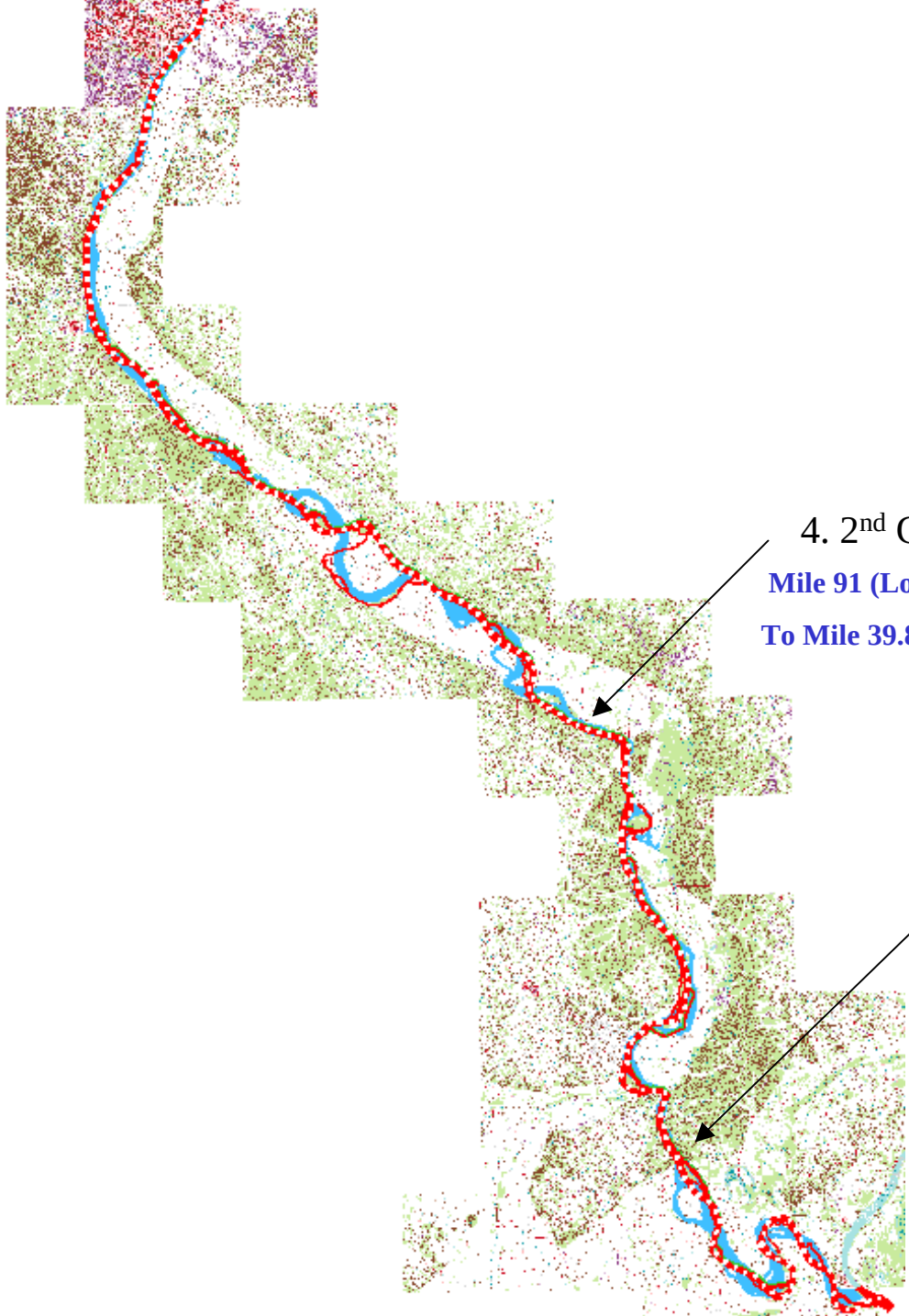
Mile 180 (St. Louis) to Mile 126 (Little Rock Lng)

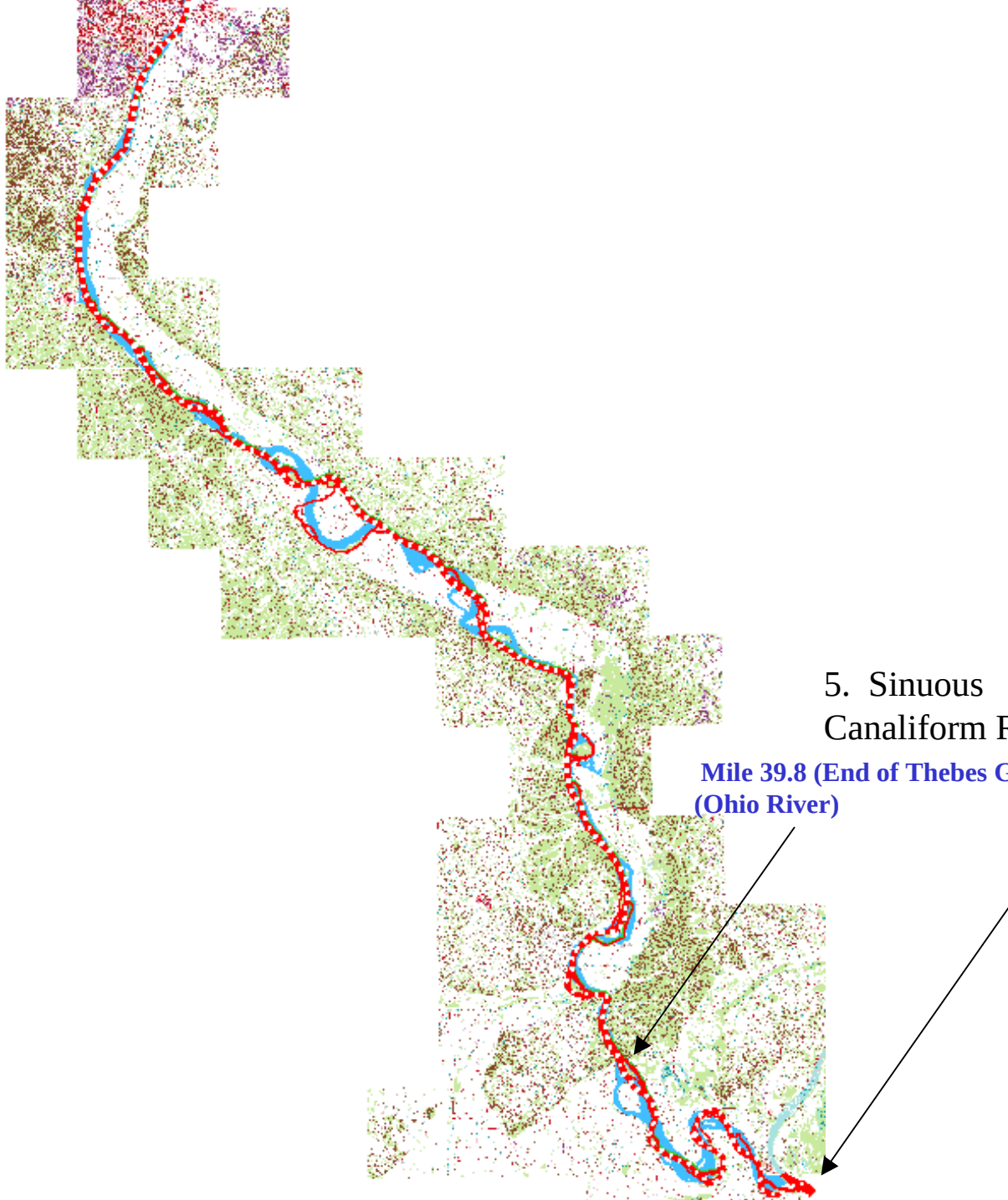

2 Transitional Cutoff Reach
Mile 126 (Little Rock Lng) to Mile 110 (Chester)



3. Braided Canaliform Reach

Mile 110 (Chester) to Mile 91 (Lower End of Wilkinson Island)


4. 2nd Canaliform Reach
Mile 91 (Lower End of Wilkinson Island)
To Mile 39.8 (End of Thebes Gap)



5. Sinuous Canaliform Reach

Mile 39.8 (End of Thebes Gap) to Mile 0 (Ohio River)

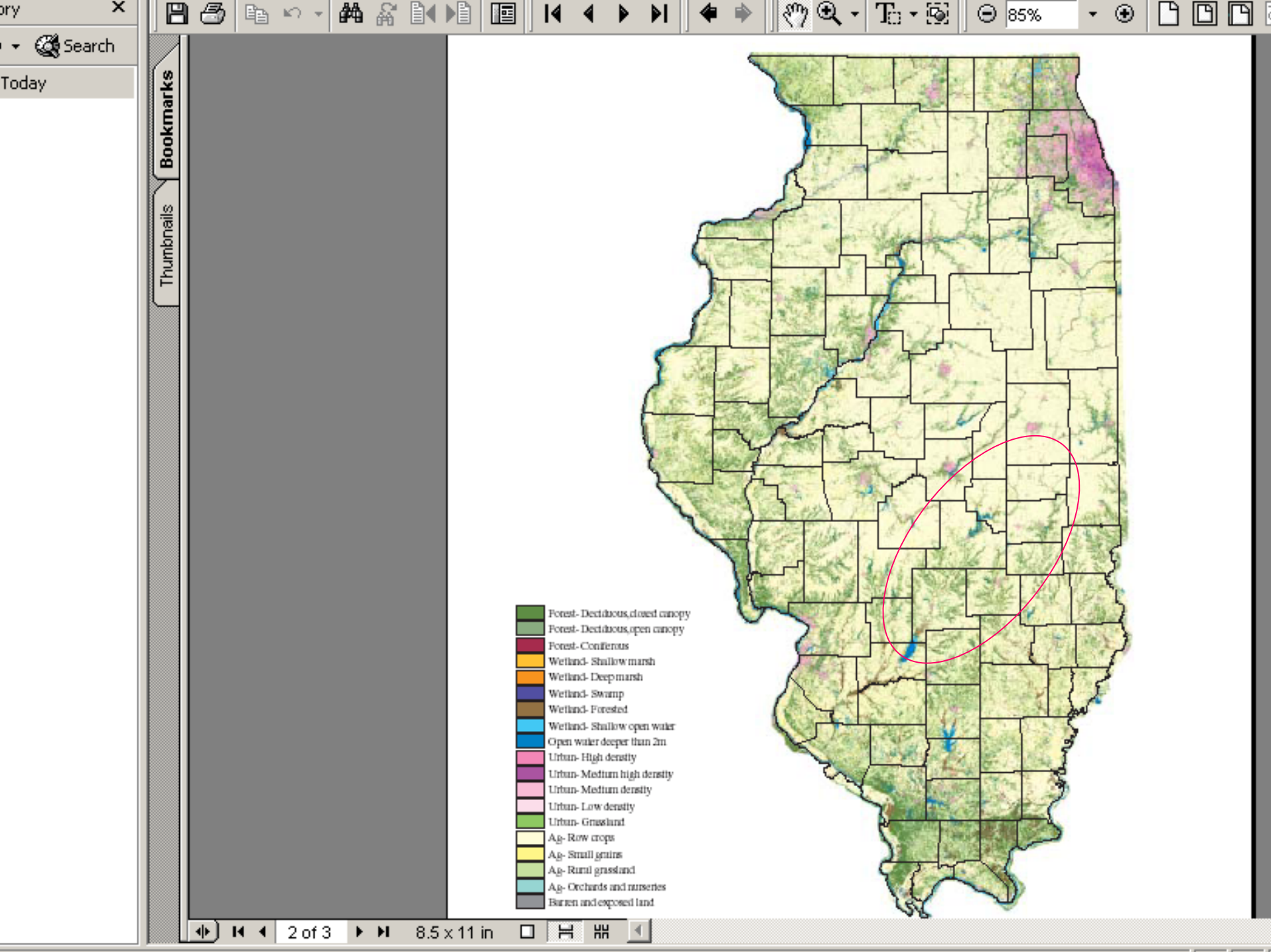
The Westward Migration of European Settlement

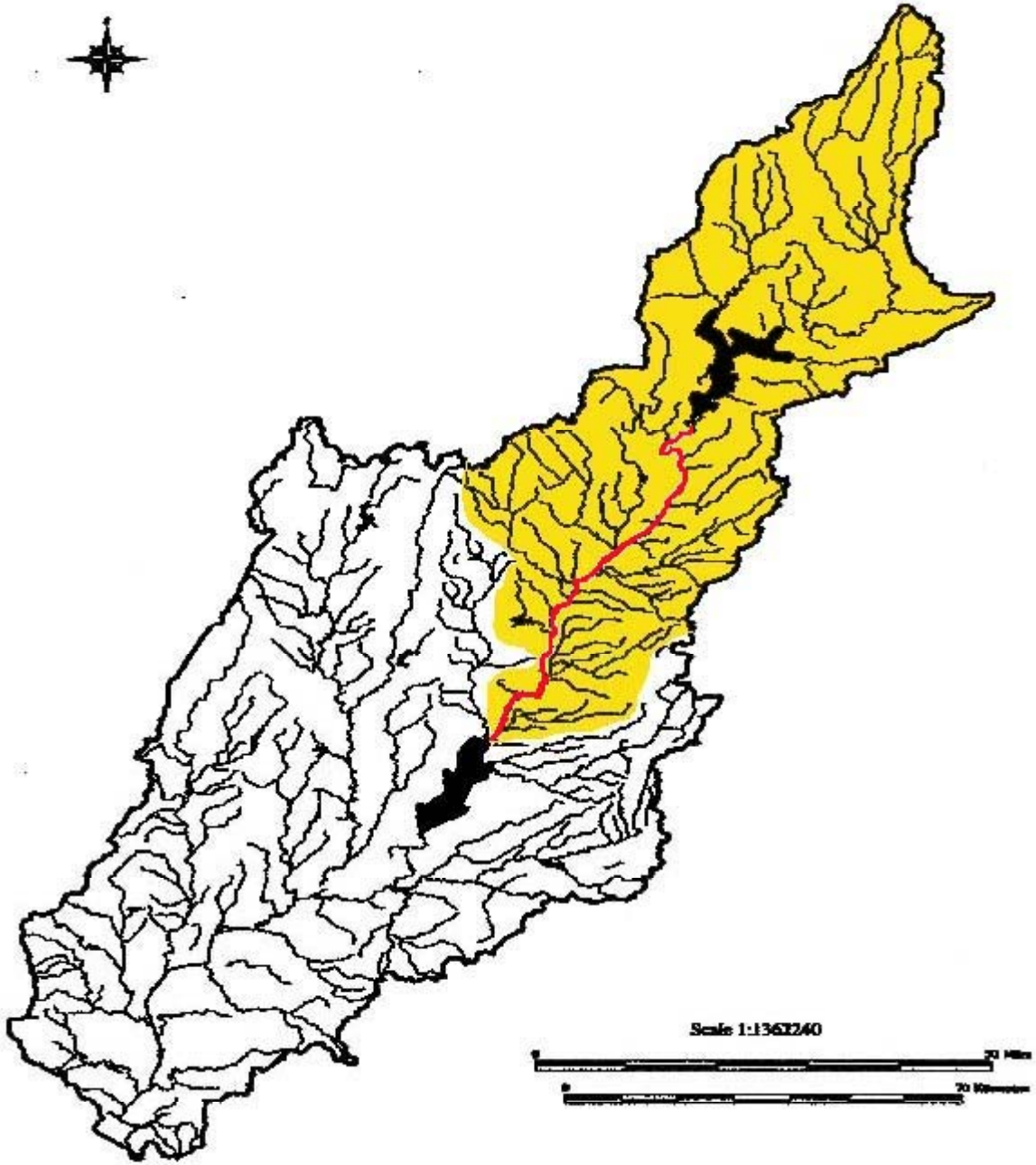
The river was dangerous!

people died in steamboat
nts between 1810 and 1850

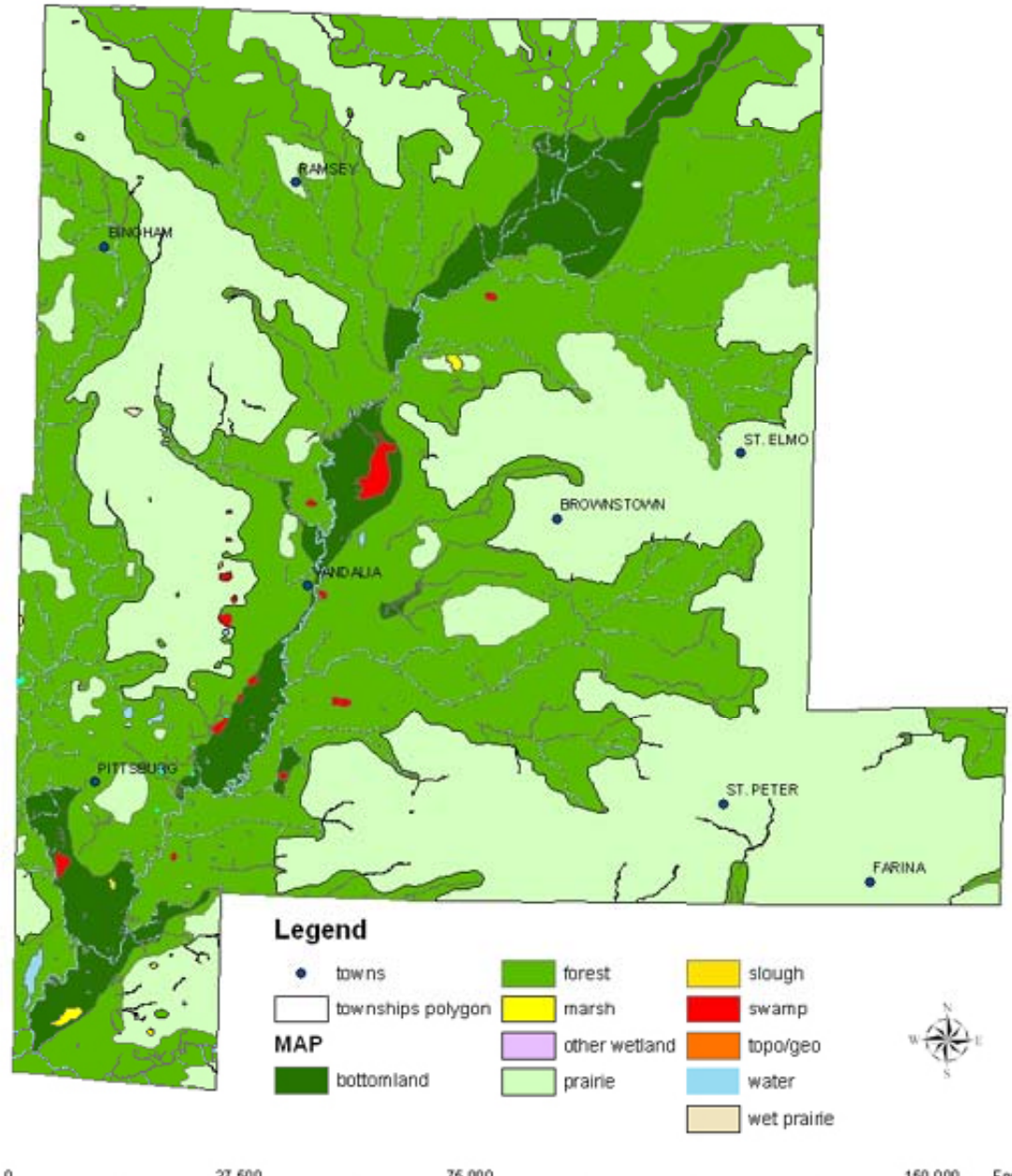
Changes in Land Use in the 1800s and the Transformation of a River

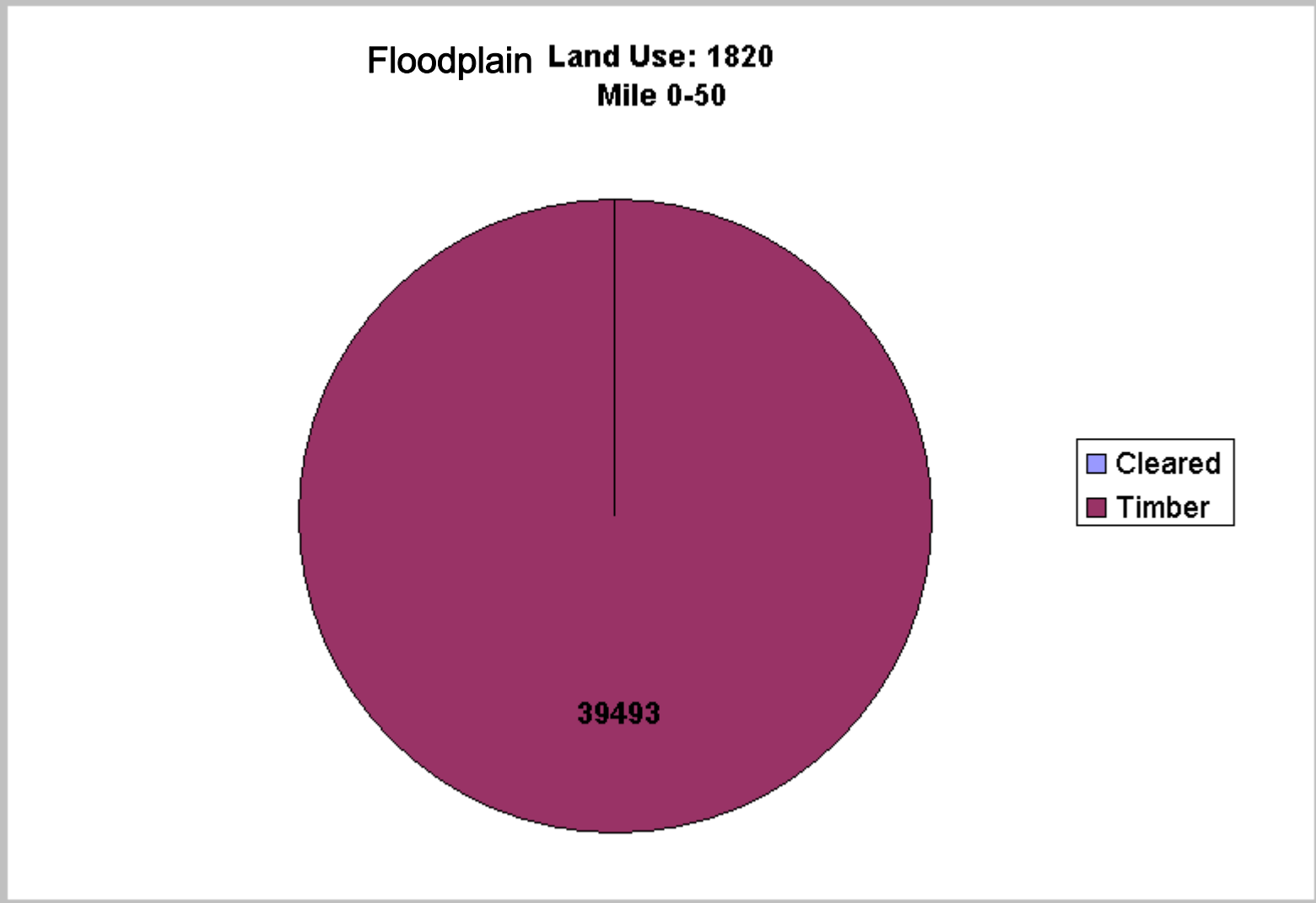
Kaskaskia River, A Test Case

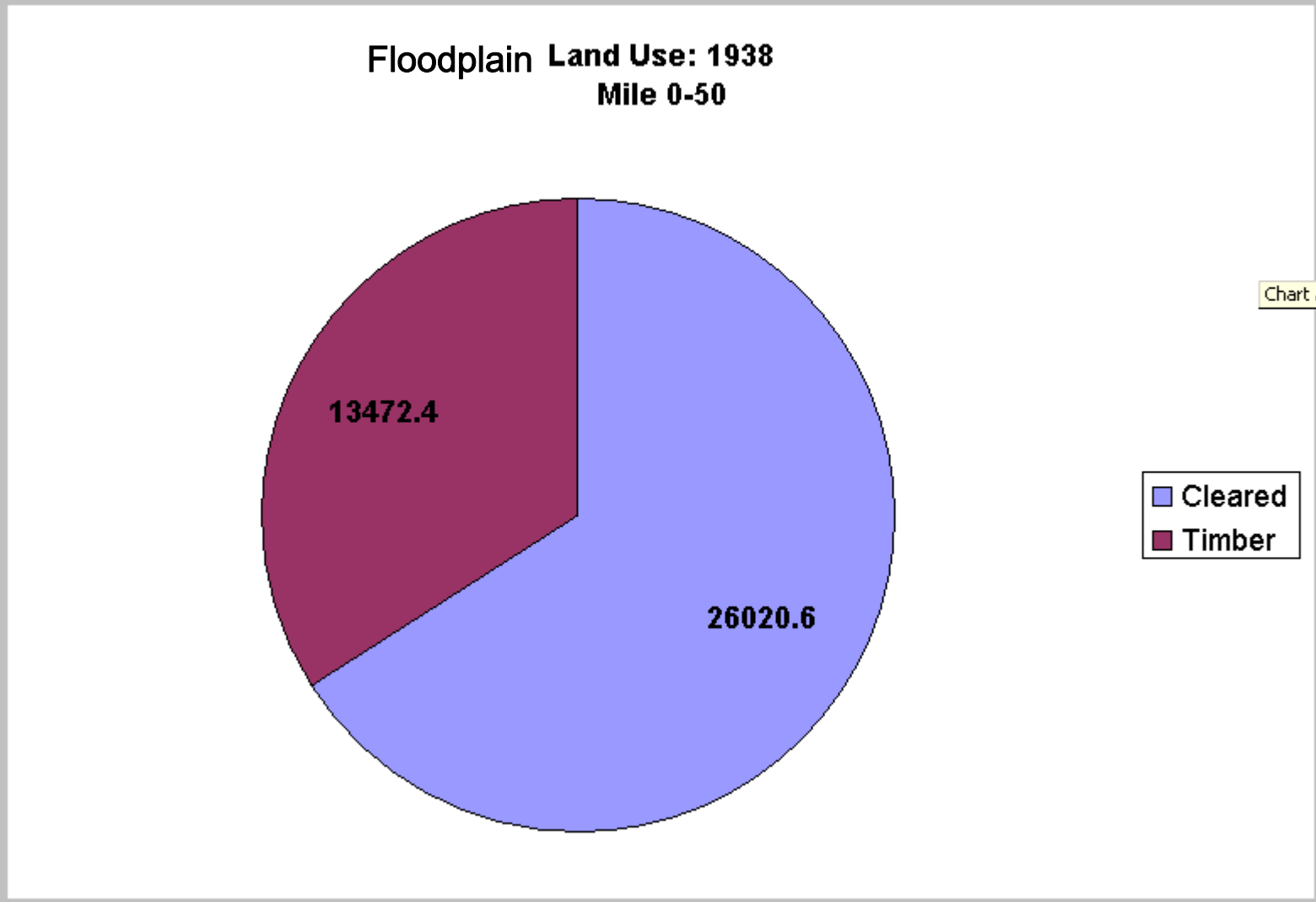

Forest- Deciduous,closed canopy
Forest- Deciduous,open canopy
Forest- Coniferous
Wetland- Shallow marsh
Wetland- Deep marsh
Wetland- Swamp
Wetland- Forested
Wetland- Shallow open water
Open water deeper than 2m
Urban- High density
Urban- Medium high density
Urban- Medium density
Urban- Low density
Urban- Grassland
Ag- Row crops
Ag- Small grains
Ag- Rural grassland
Ag- Orchards and nurseries
Barren and exposed land
Bookmarks
Thumbnails
Search
Today
85%
2 of 3
8.5 x 11 in


Scale 1:1362240

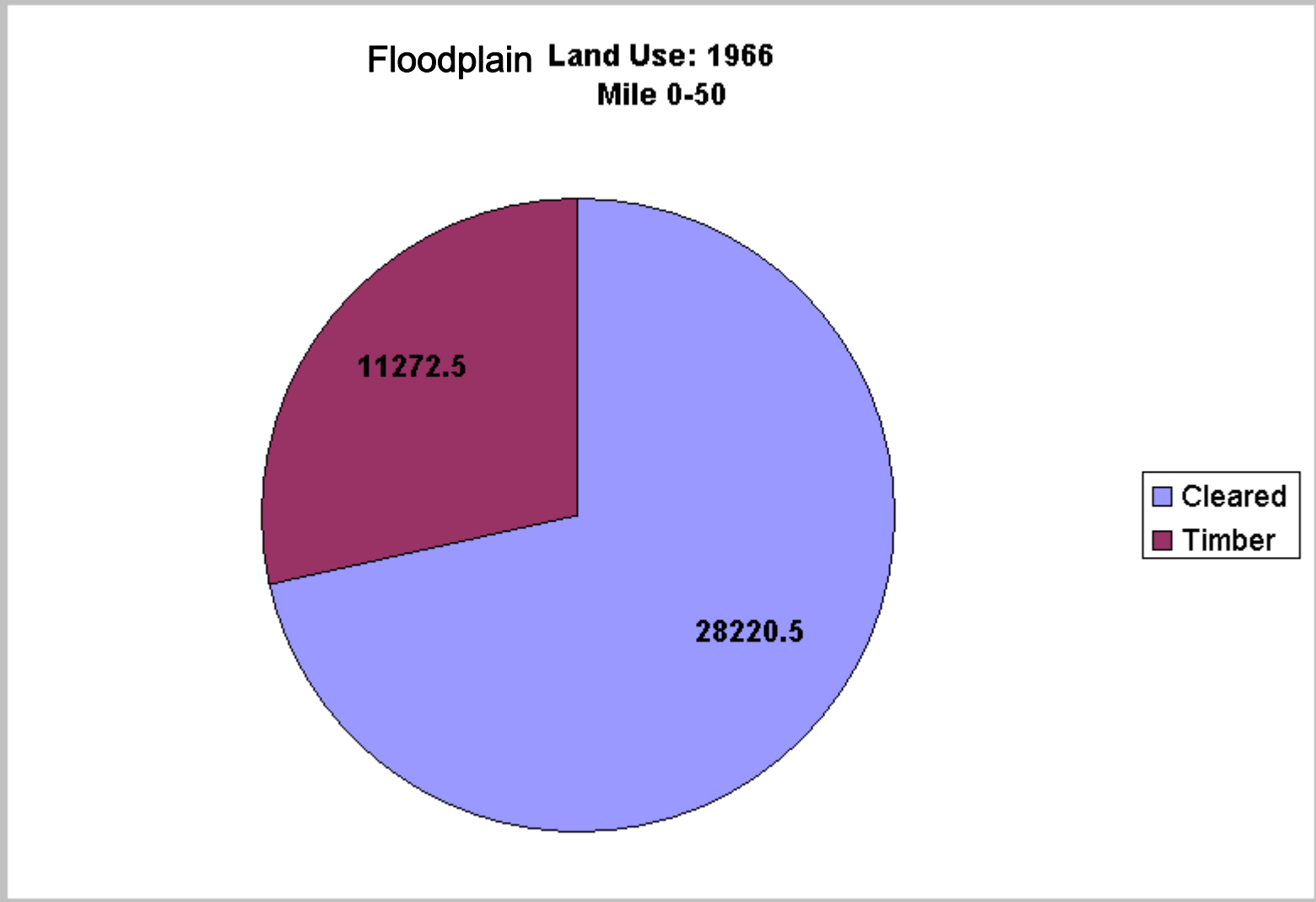
Fayette County Land Cover in the Early 1800's




Floodplain Land Use: 1820
Mile 0-50
39493
Cleared
Timber


Floodplain Land Use: 1938
Mile 0-50
13472.4
26020.6
Chart Area
Cleared
Timber

File Edit View Insert Format Tools Chart Window Help



1966 1998 Sheet5 Riv Length Sheet6 0-50 1820 reach Chart8 Chart9 1998 reach
Microsoft Excel - Kaskaskia River Survey.xls

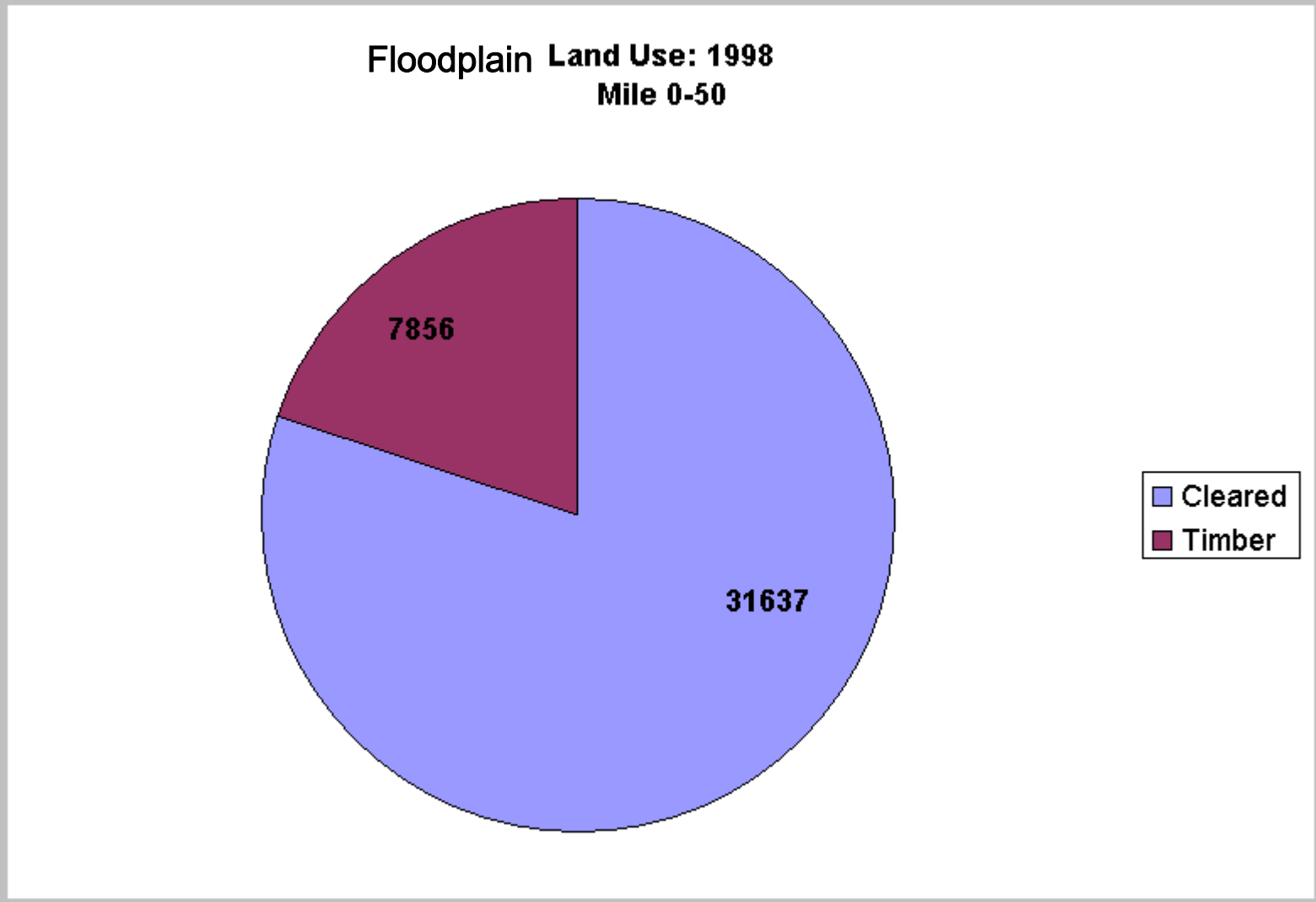
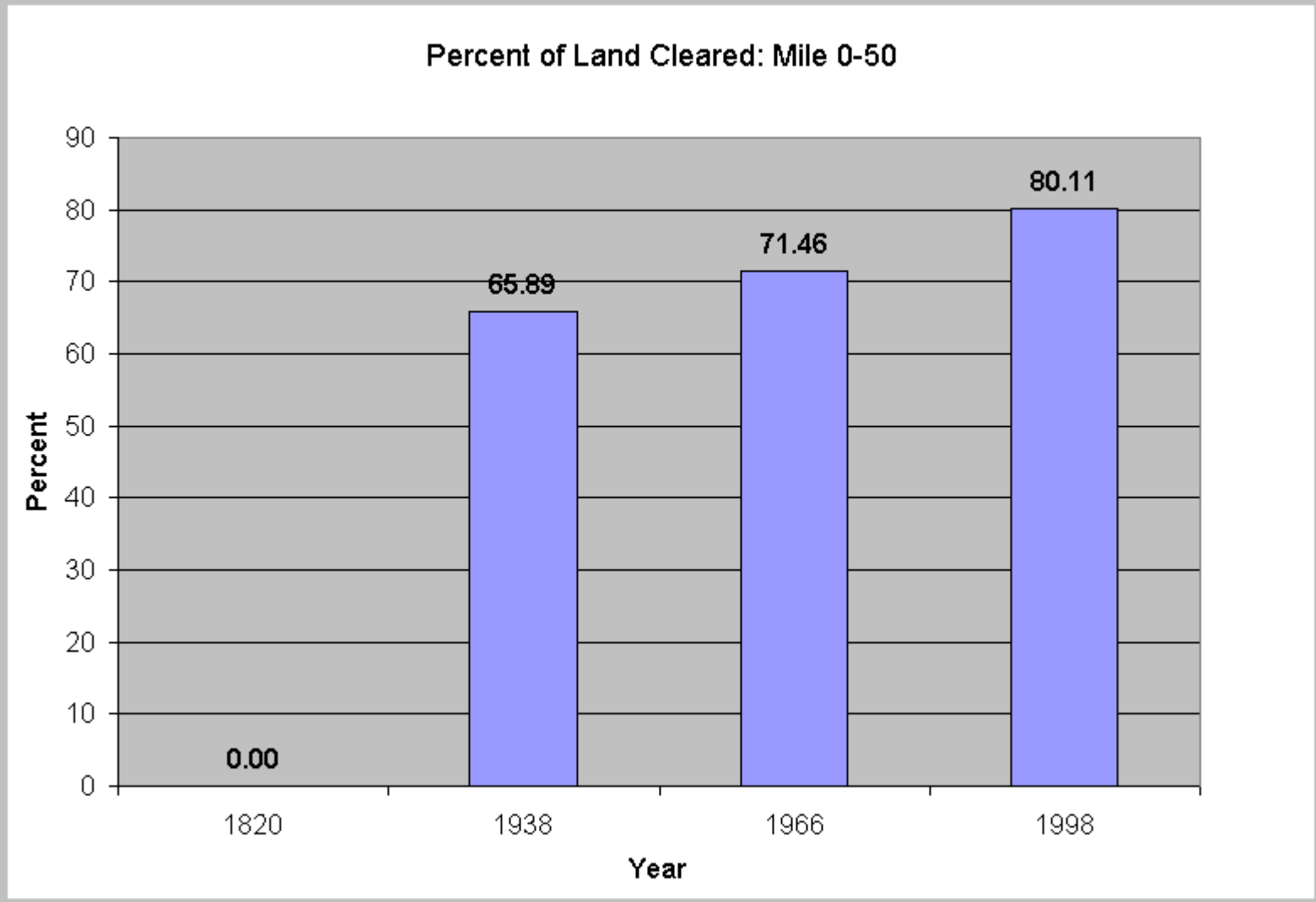
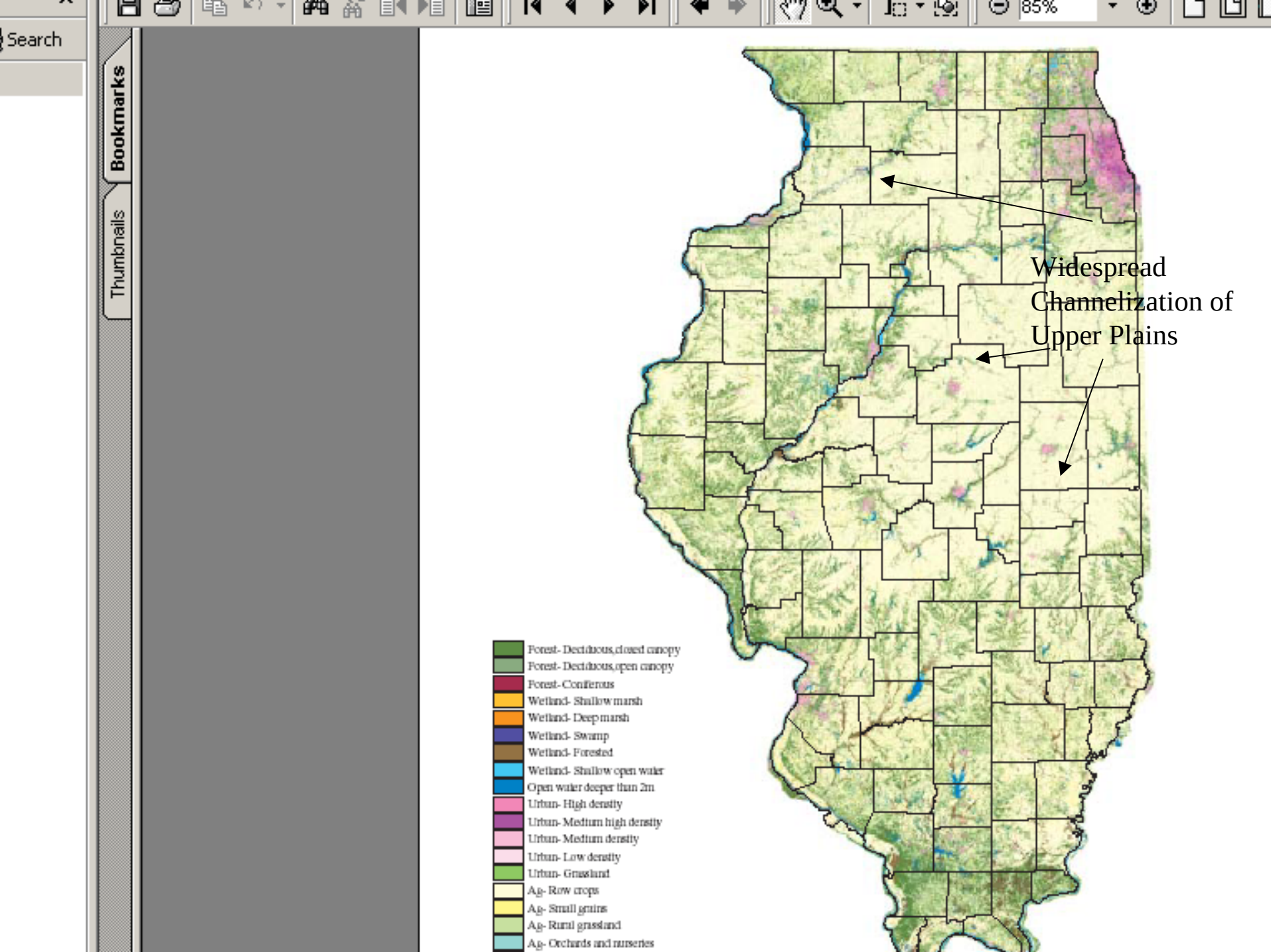

Floodplain Land Use: 1998
Mile 0-50
7856
31637
Cleared
Timber

Chart Area


Percent of Land Cleared: Mile 0-50
Percent
90
80
70
60
50
40
30
20
10
0
0.00
65.89
71.46
80.11
1820
1938
1966
1998
Year


Search
Bookmarks
Thumbnails
85%
Widespread
Channelization of
Upper Plains
Forest- Deciduous,closed canopy
Forest- Deciduous,open canopy
Forest- Coniferous
Wetland- Shallow marsh
Wetland- Deep marsh
Wetland- Swamp
Wetland- Forested
Wetland- Shallow open water
Open water deeper than 2m
Urban- High density
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Ag- Row crops
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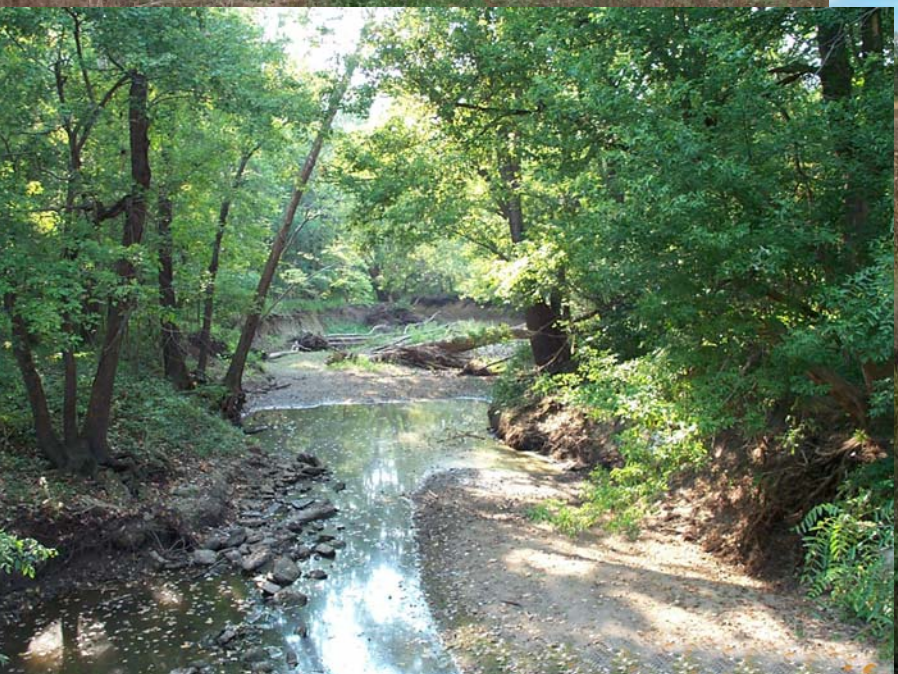


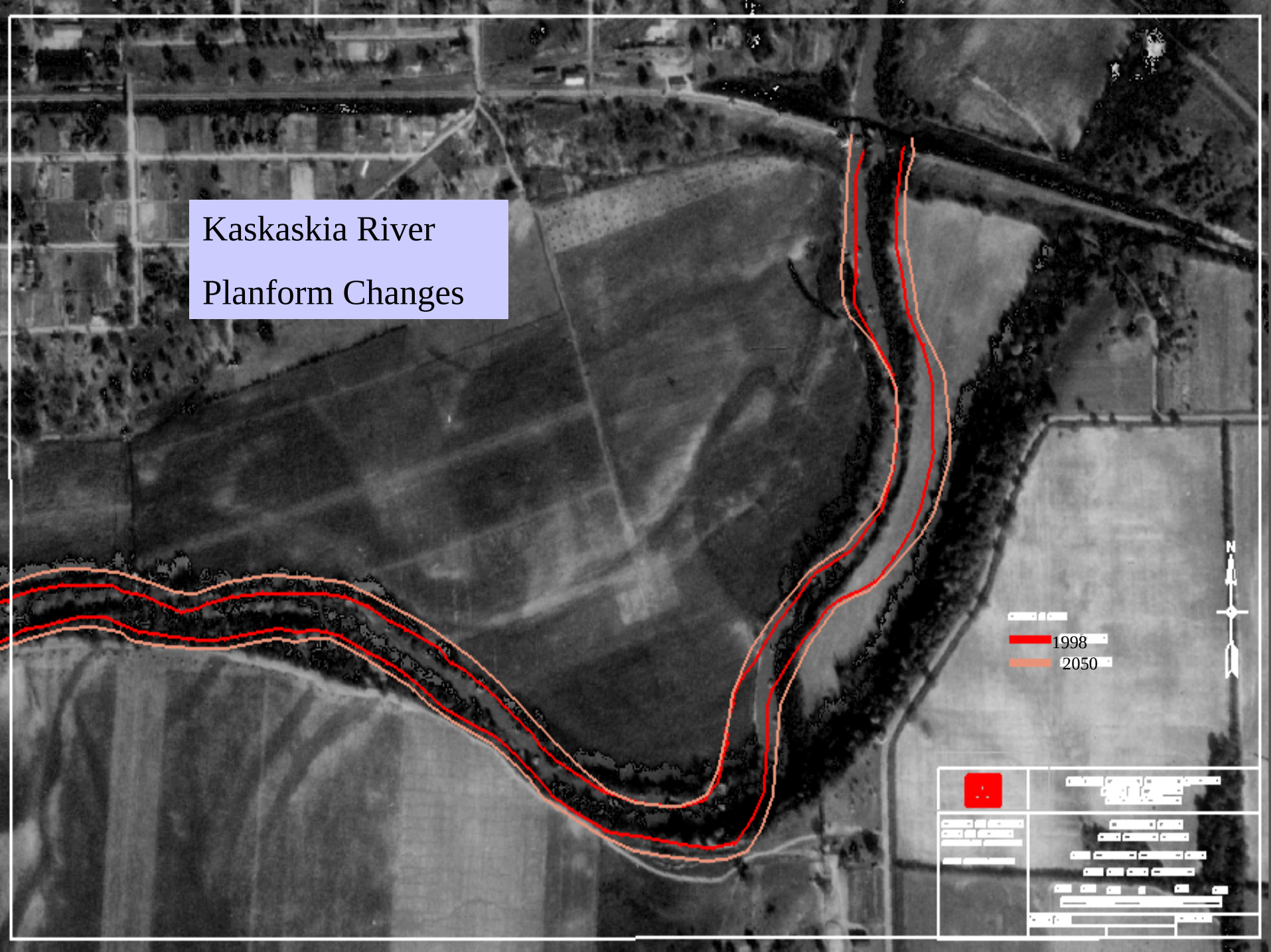
John Johnston:
"The Father of Tile Drainage in the United States"

John Johnston was born in Knockknolling, Dalrys, Dumfrieshire, Scotland, on April 11, 1791. He immigrated to the United States, landing at New York City in April of 1821. The following year he purchased 112 acres of farmland in Seneca County and built a house there, which he called “Viewfields”. Later he added several more parcels to the farm, bringing the total size to 320 acres.

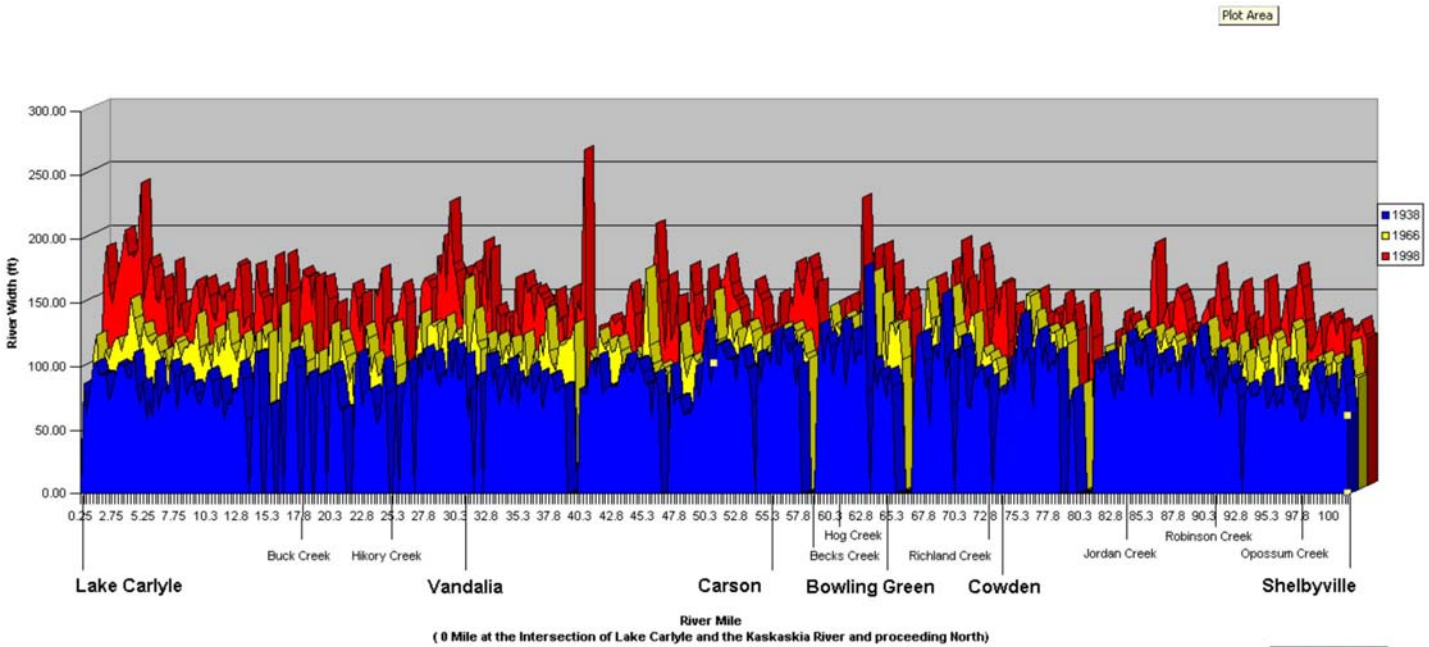
Due to abundant springs in the area, Johnston’s farm retained a great deal of moisture, often imperceptible on the surface, but detrimental to crops. Familiar with the use of tile drainage in Scotland, Johnston knew of its ability to increase the yield of heavy, wet soils. He sent to Scotland for two pattern tiles in 1835, which he took to Benjamin F. Whartenby, a crockmaker, in Waterloo, N.Y. Whartenby made 3,000 tiles that Johnston laid down on his farm in 1838. The process was so successful that by the time he retired from farming he had 72 miles of tile drains on his 320-acre farm. Whartenby continued making tiles, producing 840,000 in 1849, and Waterloo was home to ten tile drainage factories by 1871.

A prolific writer for newspapers and magazines, Johnston promoted tile drainage at every opportunity, even traveling to advise other farmers on the technology. Because of his ceaseless advocacy he became known as “The Father of Tile Drainage” in the United States. Johnston’s son-in-law Robert Swan also adopted the technology for Rose Hill farm, helping to make it the premier farm in the state in 1858. Johnston died November 24, 1880 in his ninetieth year, having changed the course of agriculture in the United States.

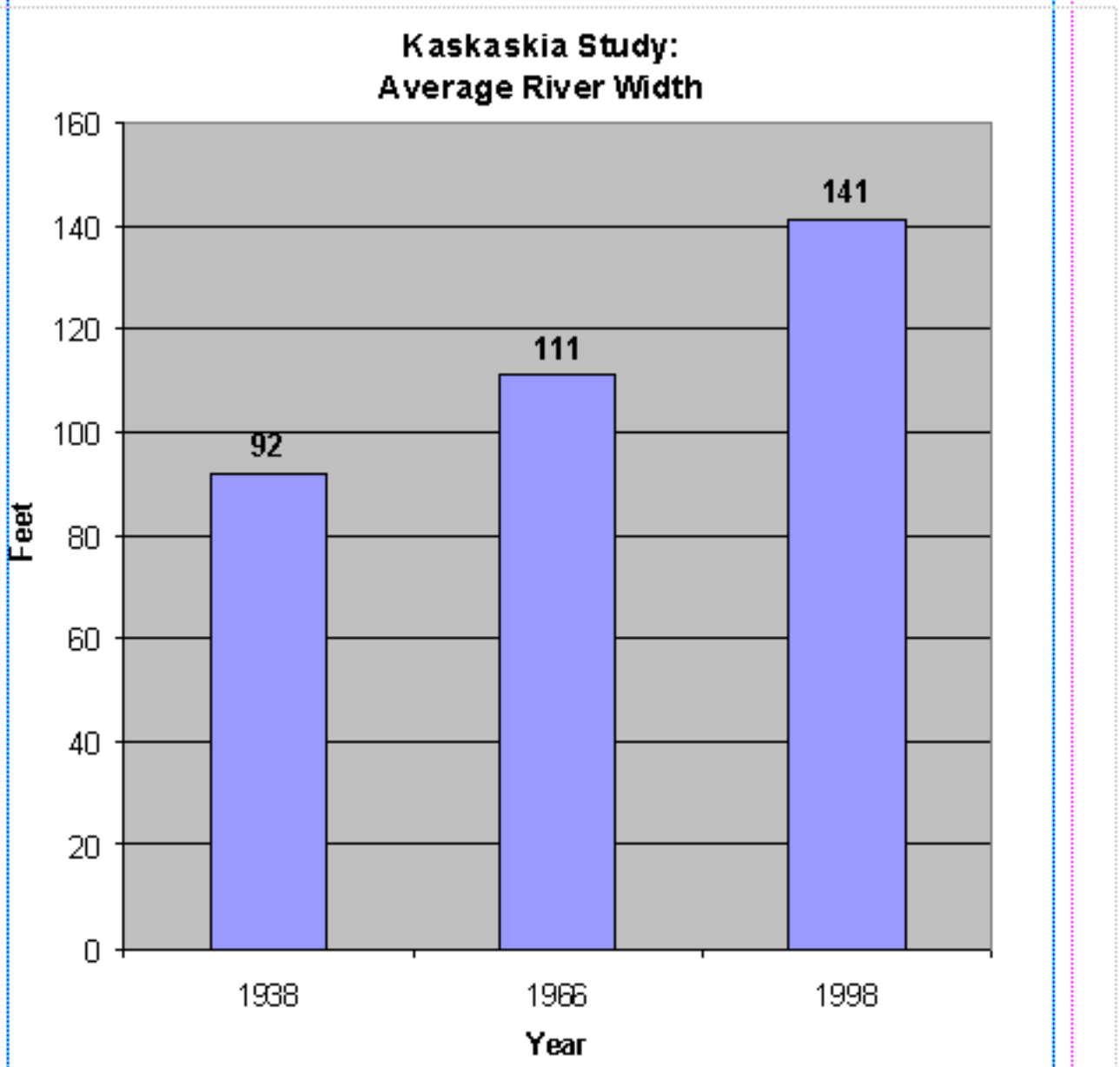
Swamp Being Drained with Tiles, 1914


Kaskaskia River
Planform Changes
1998
2050
N

Kaskaskia Erosion Study:
River Mile vs. River Width



APPLIED RIVER ENGINEERING CENTER



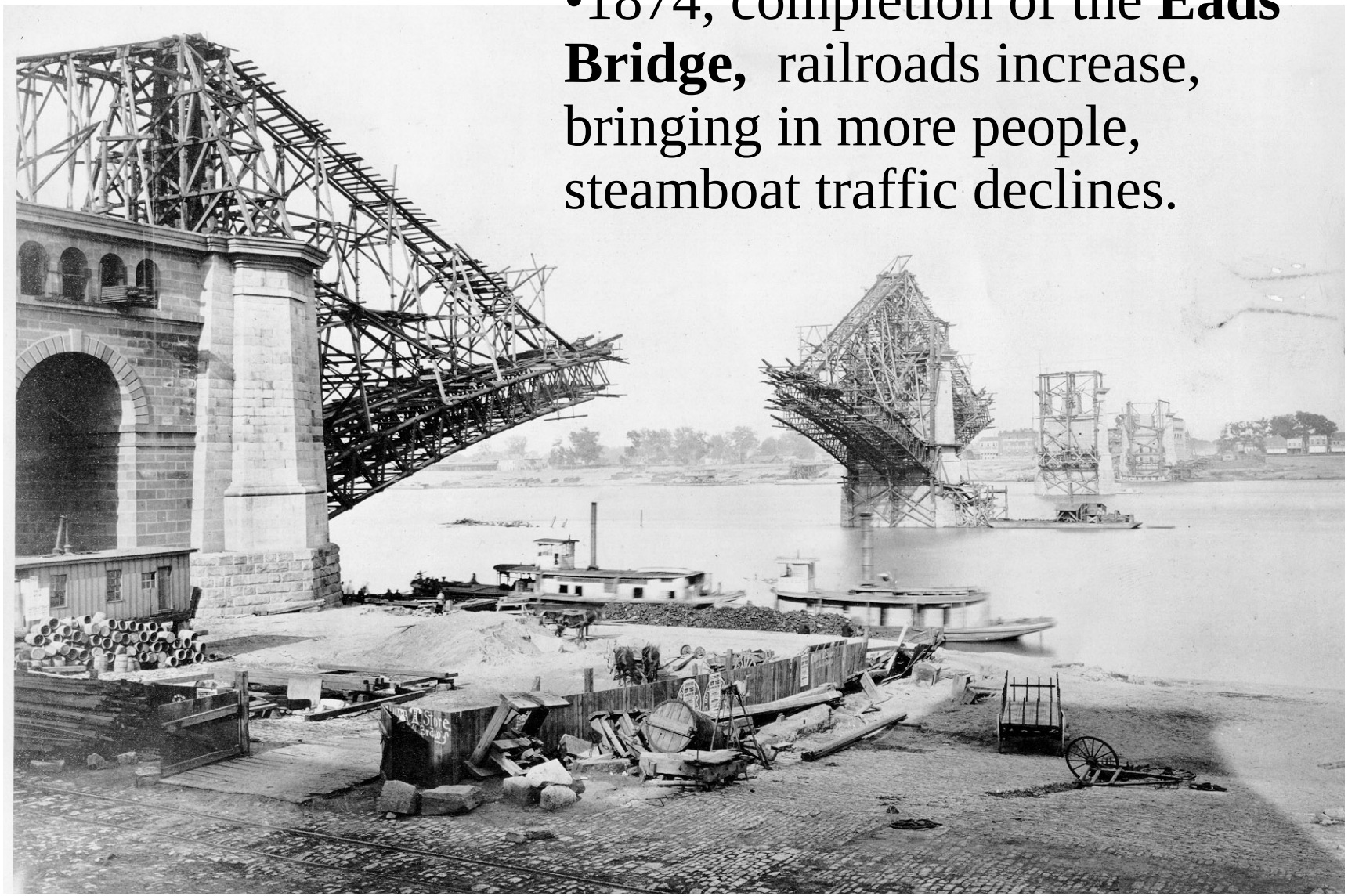
U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

Some Important History that Influenced the Condition of the Mississippi River Today

- 1764, French fur traders from New Orleans found St. Louis, named for Louis IX, the Crusader King of France.
- 1804, Jefferson sends explorers Lewis & Clark from St. Louis to chart the new Louisiana Territory
- 1804 population of St. Louis about 1,000 people, mostly French, Spanish, Indian and both free and slave blacks. City serves as center of the fur trade in America.
- 1817 First Streamboat arrives in St. Louis

- Mid to Late 1800’s, New immigrants descend upon and change the face of St. Louis and the surrounding Mississippi Basin and floodplain region. Joining the French, Spanish, Indians and Africans: Germans,Irish, Poles,and other Europeans

1874

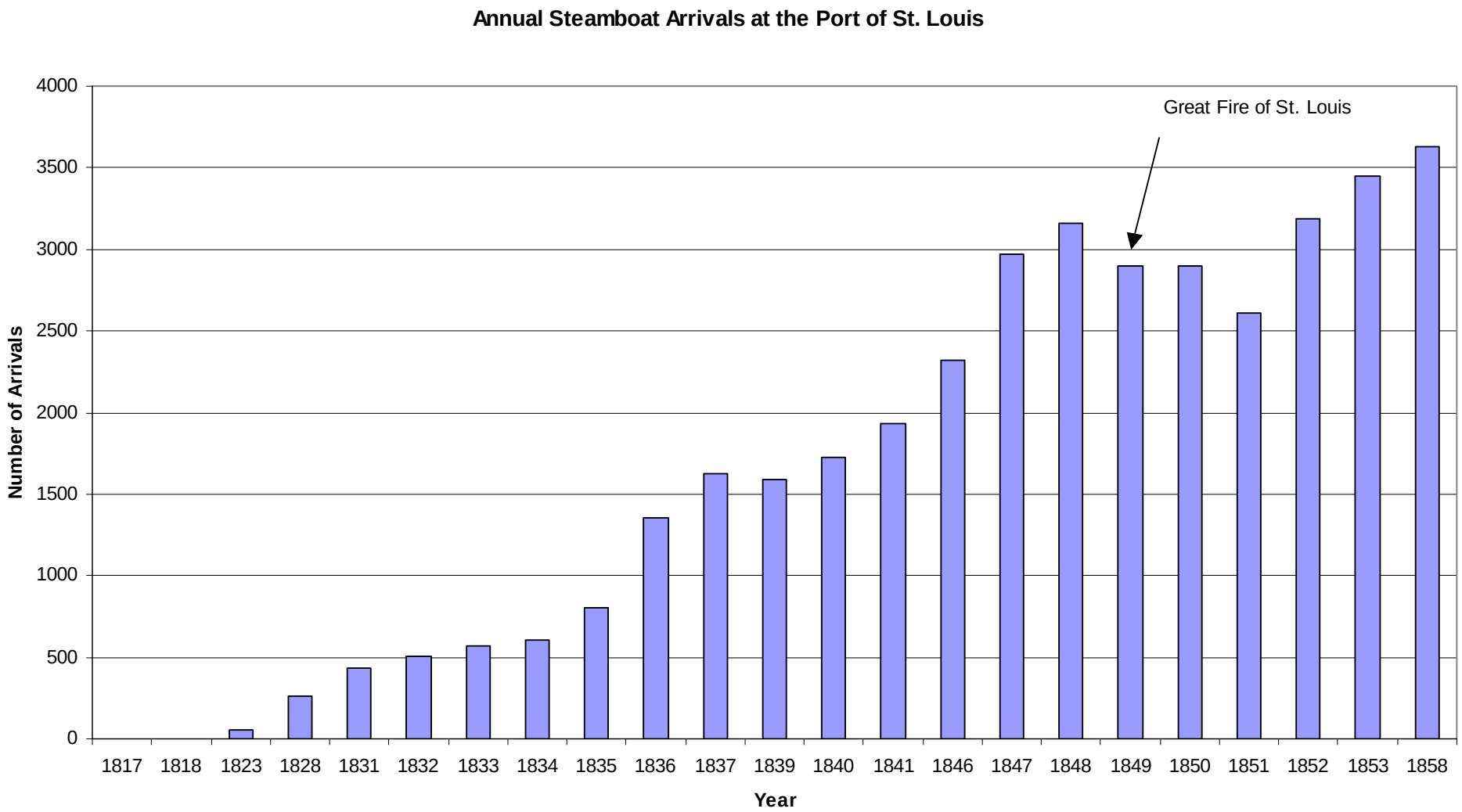


•1874, completion of the **Eads Bridge,** railroads increase, bringing in more people, steamboat traffic declines.

•By late 1880s….The world calls St. Louis, "first in shoes, first in booze (100 breweries), and last in the American League," a reference to the St. Louis Browns baseball club.

•1904, World’s Fair in St. Louis

Trade and Expansion Trends on the Mississippi River at St. Louis



A report written to the Chief of Engineers by Captain O. H. Ernst in 1880 described this river deterioration. Captain Ernst had just finished comparing a recently obtained survey to a prior survey when he wrote the following:

"One of the most important developments of this survey is the evidence which the present position of the shore lines affords, that the stability of the banks has decreased with the settlement of the country and the clearing away of the forests. Weakened banks permit more rapid erosions, give the river greater width, and therefore less depth, and the navigation is injured. The fact that the river has materially widened within the last 60 years is generally acknowledged by those best informed. And if this widening process is still going on it is evident that the navigation is still further deteriorating. An examination of the shore line shows that in every case where cleared fields along a caving bank are interrupted by a patch of wood, the latter projects out into the river. It is easy to believe that the binding quality of the roots, and the protection formed by the fallen trees at the foot of the bank should have this effect. Wooded banks yield finally, of course, but the rate of erosion is so slow that the river has time to build up on the opposite side, and there is no increase of width."

"The facts lead to the belief not only that the navigation has been deteriorating in the past, but that the process is still going on, and will increase in rapidity as further clearings are made, and that, unless energetic measures are adopted to replace the guards established by nature and removed by man, the day will come when the navigability of the river for vessels that now use it will be destroyed."

- 1824 Congressional Authorization For first Federal Work on the Mississippi River, Snagging Operations and Bank Clearing Start
- 1838 Robert E. Lee Dike Work at Bloody Island at St. Louis Harbor
- 1879 Mississippi River Commission Established, Federal Dike Construction Begins

We will return with discussion on Early and Modern day river engineering efforts…

Discuss 1817 condition versus 1880 condition

The GLO and computational map methodology

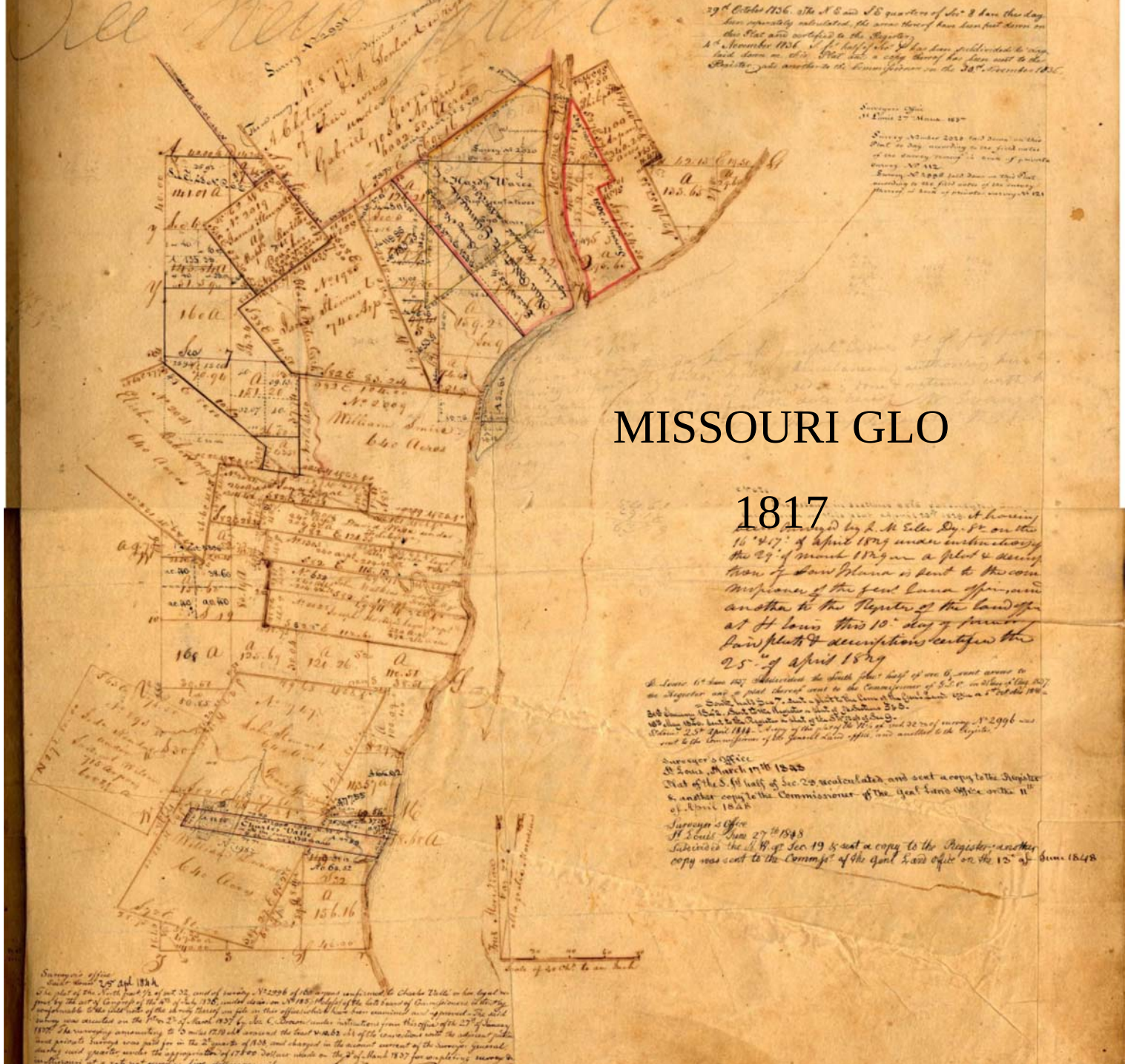
Computational Procedure: Scan and Digitize Historical Maps of Mississippi River into the Computer

Geo-Reference Maps for Physical Comparative Purposes

Government Land Office Surveys

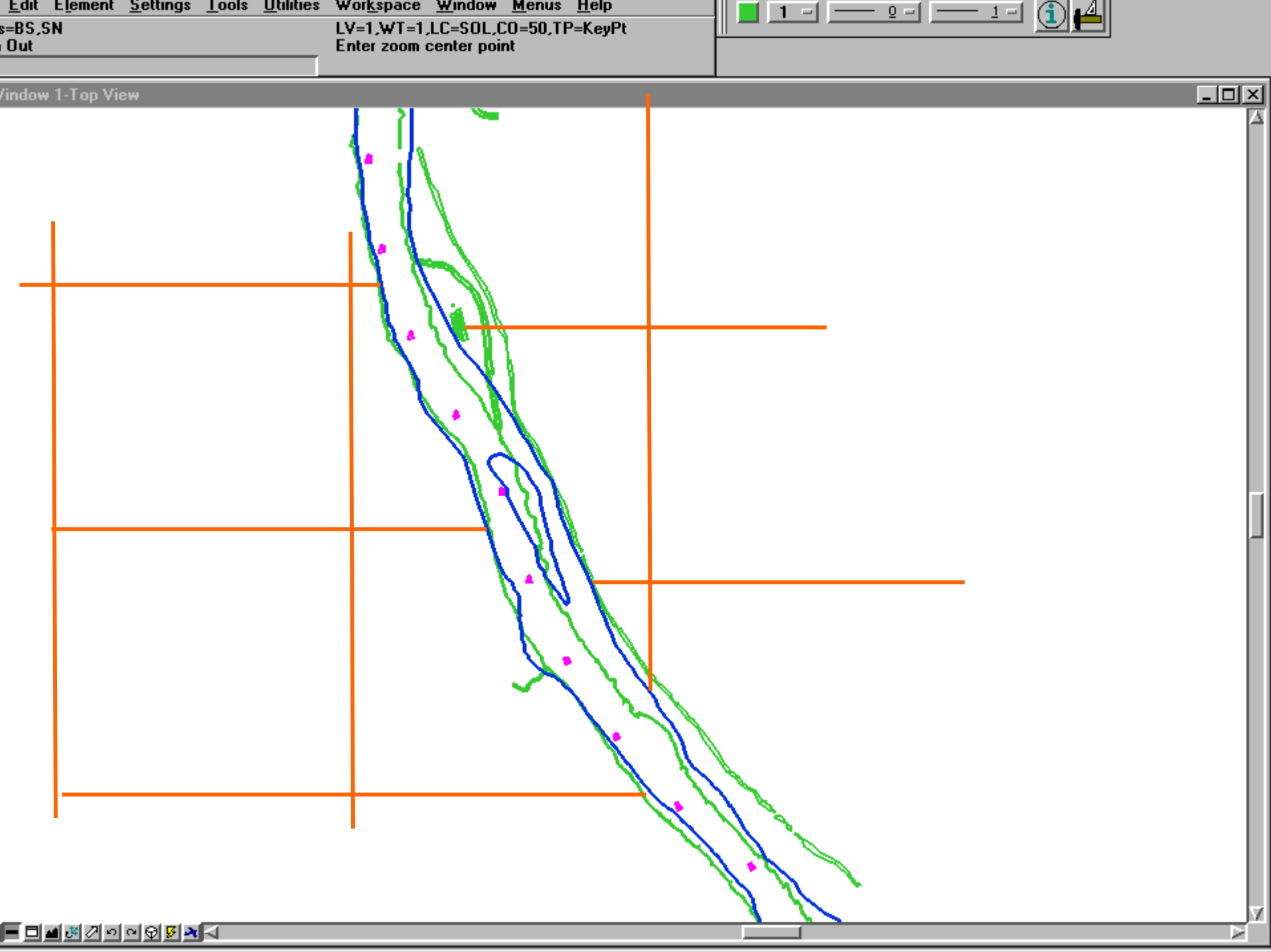
Established for the surveying of government parcels of land, for willing buyers, as a means to pay off federal debt incurred from the War of 1812

Section
Township
ILLINOIS GLO
1821



MISSOURI GLO

1817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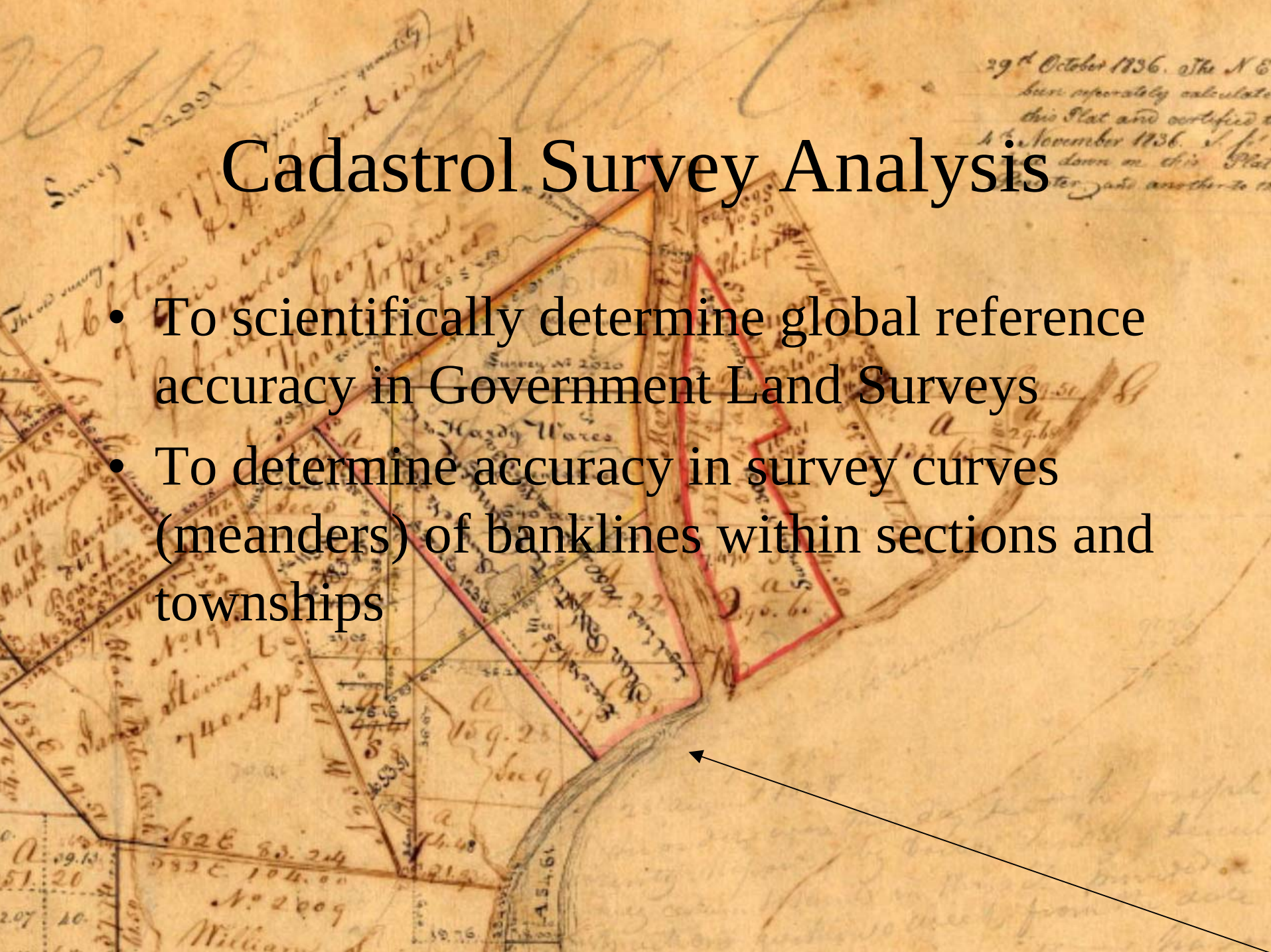
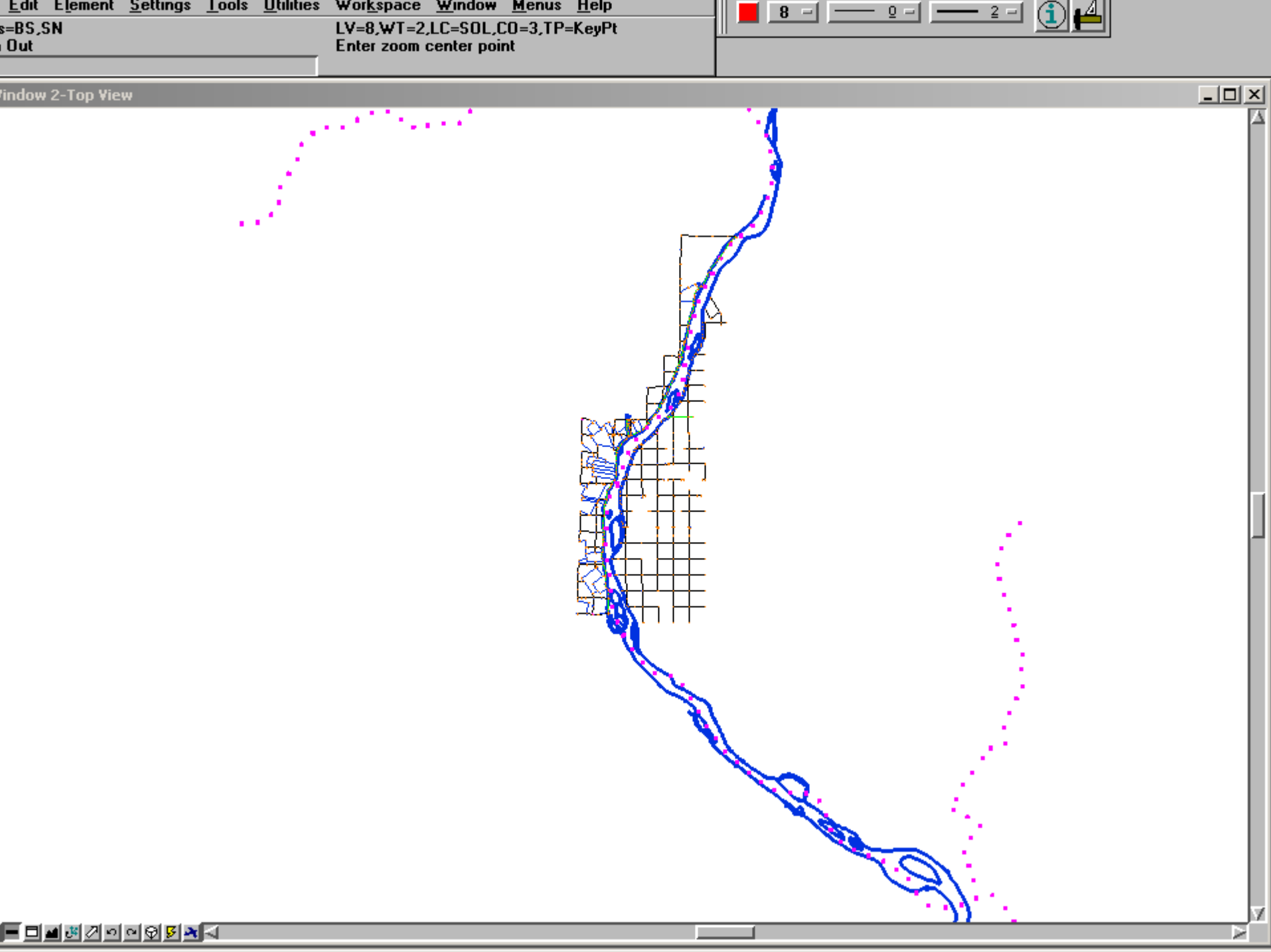
Cadastrol Survey Analysis

- To scientifically determine global reference accuracy in Government Land Surveys
- To determine accuracy in survey curves (meanders) of banklines within sections and townships

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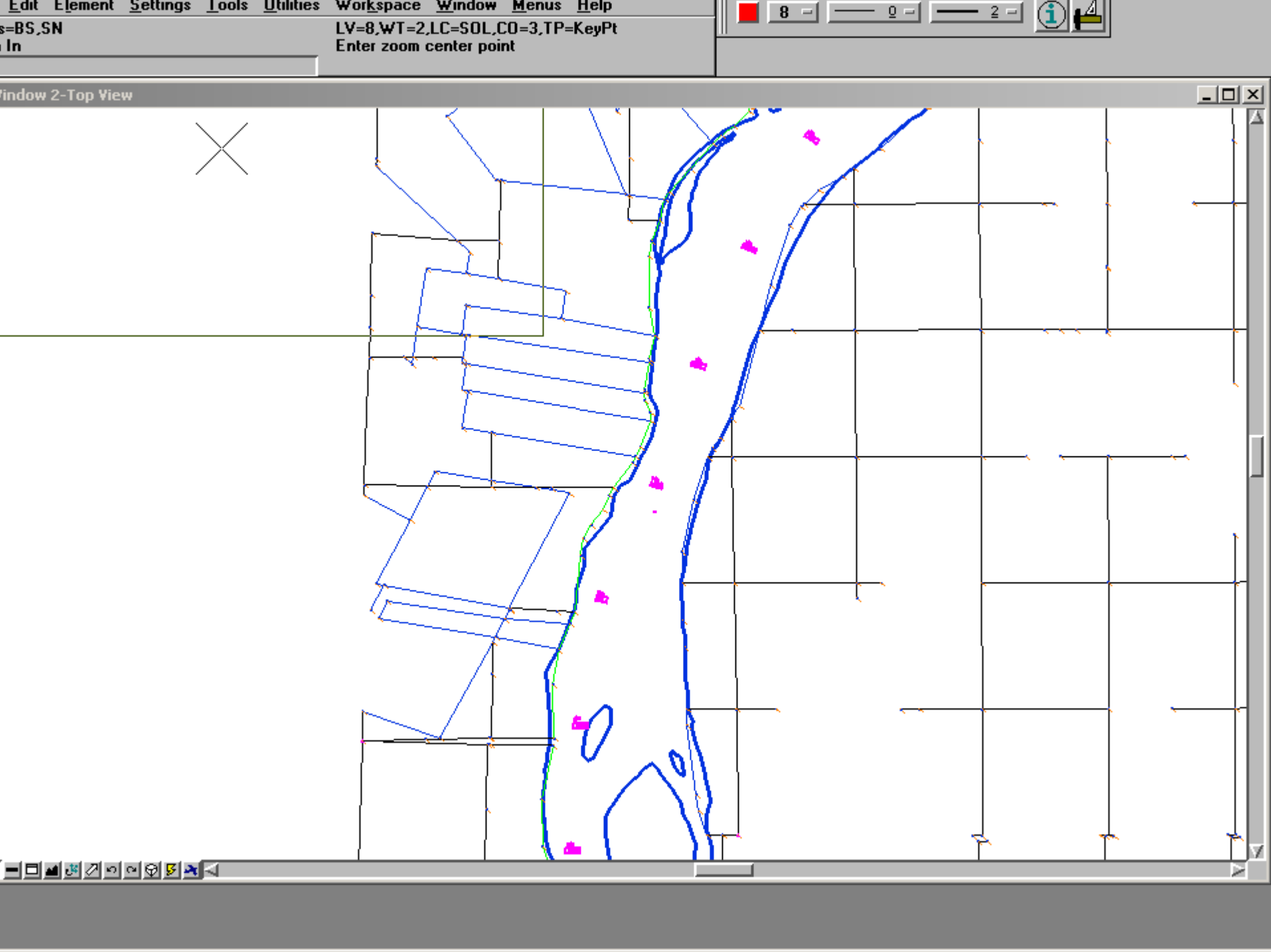
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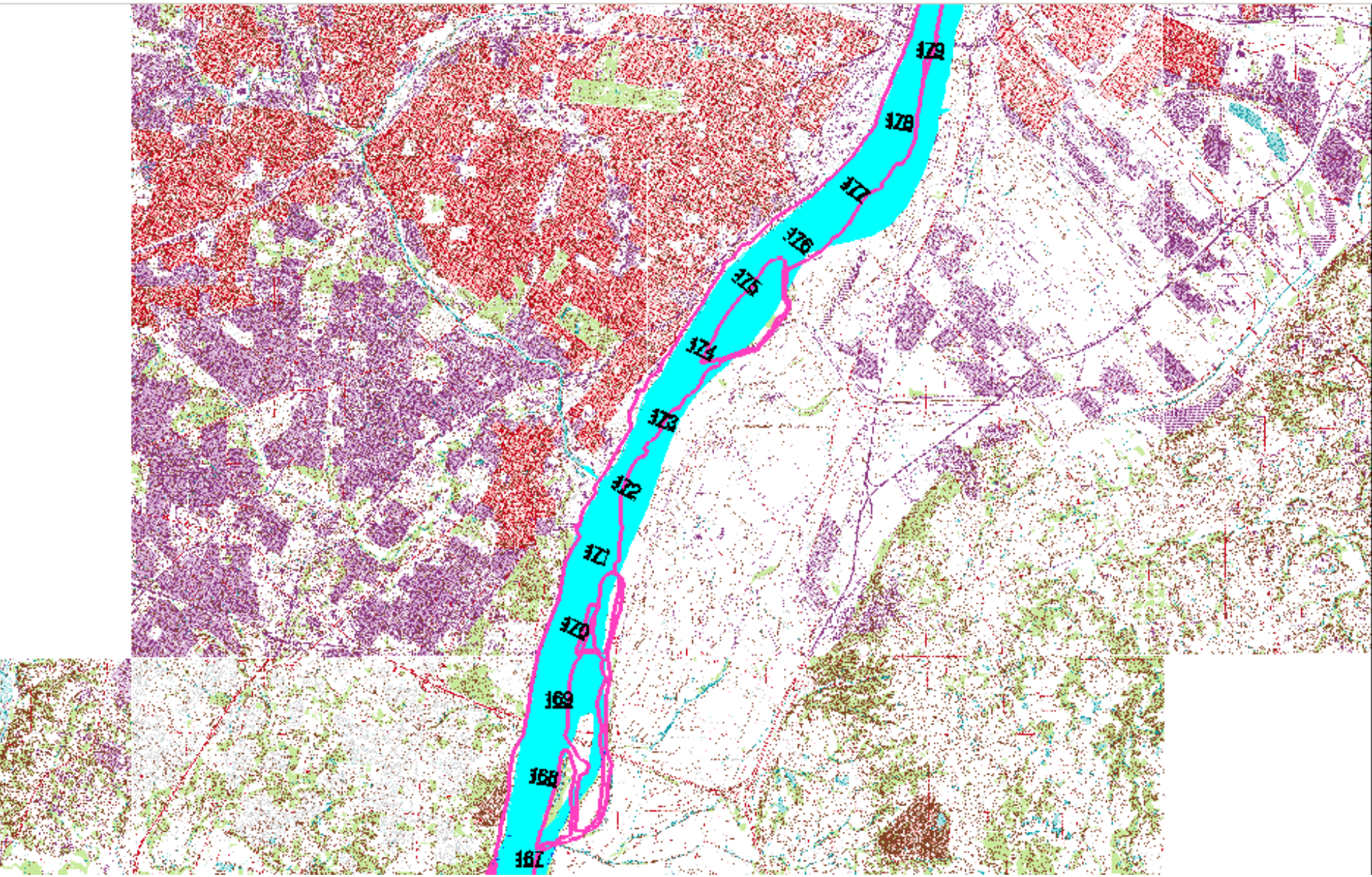
1817 versus 1880 Planform Comparison, St. Louis to Cairo

The Response !!!!!!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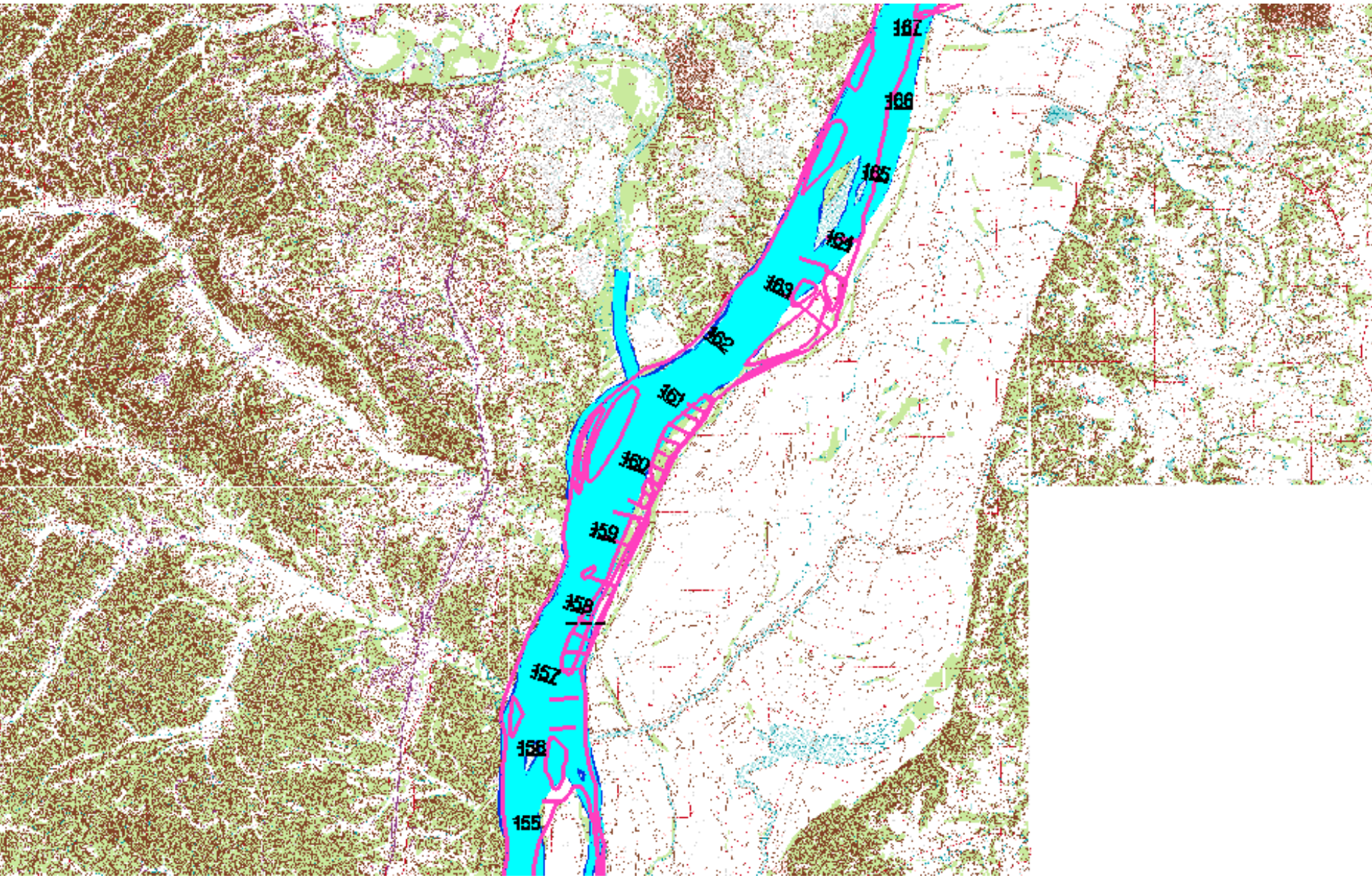
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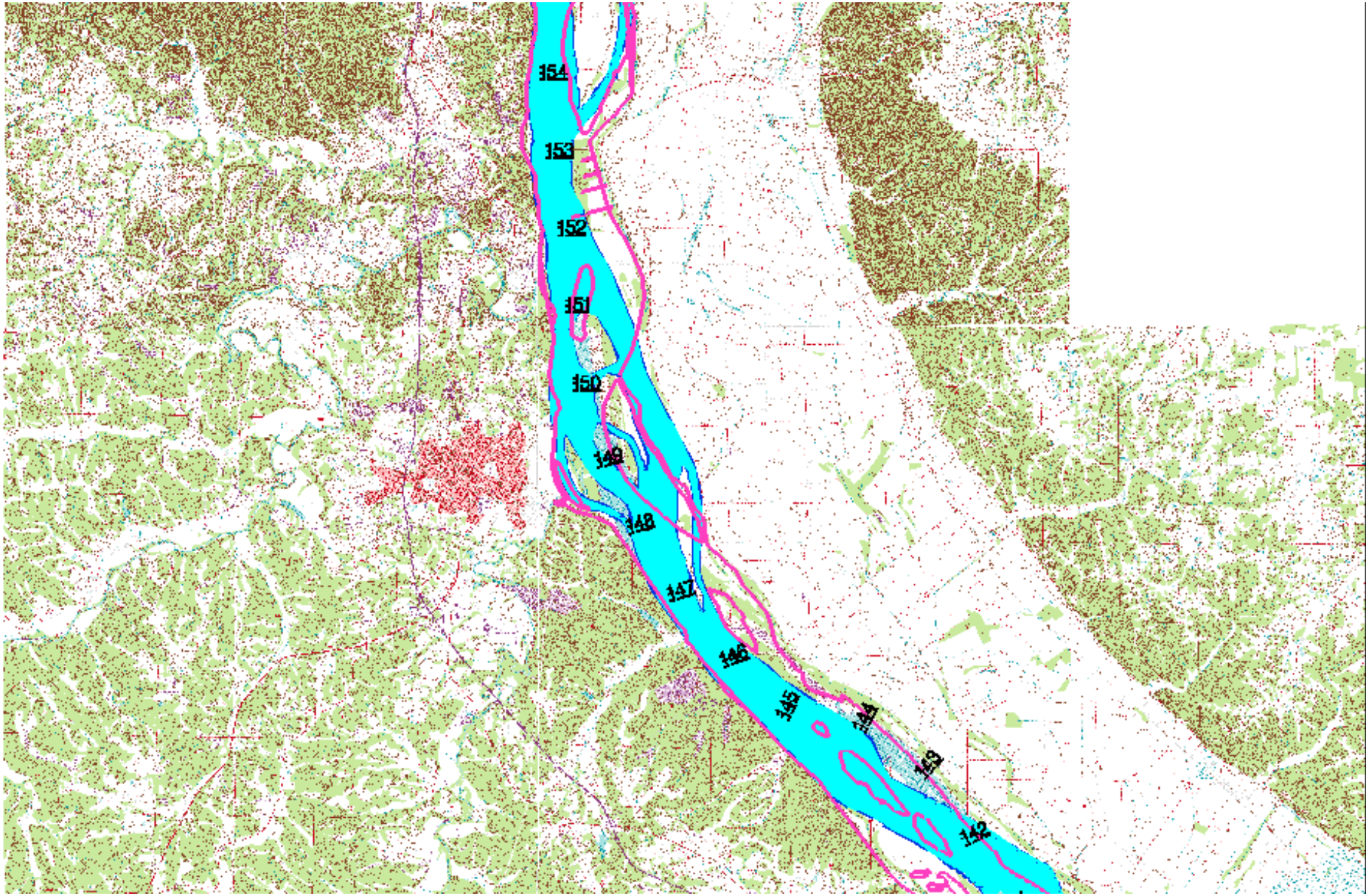
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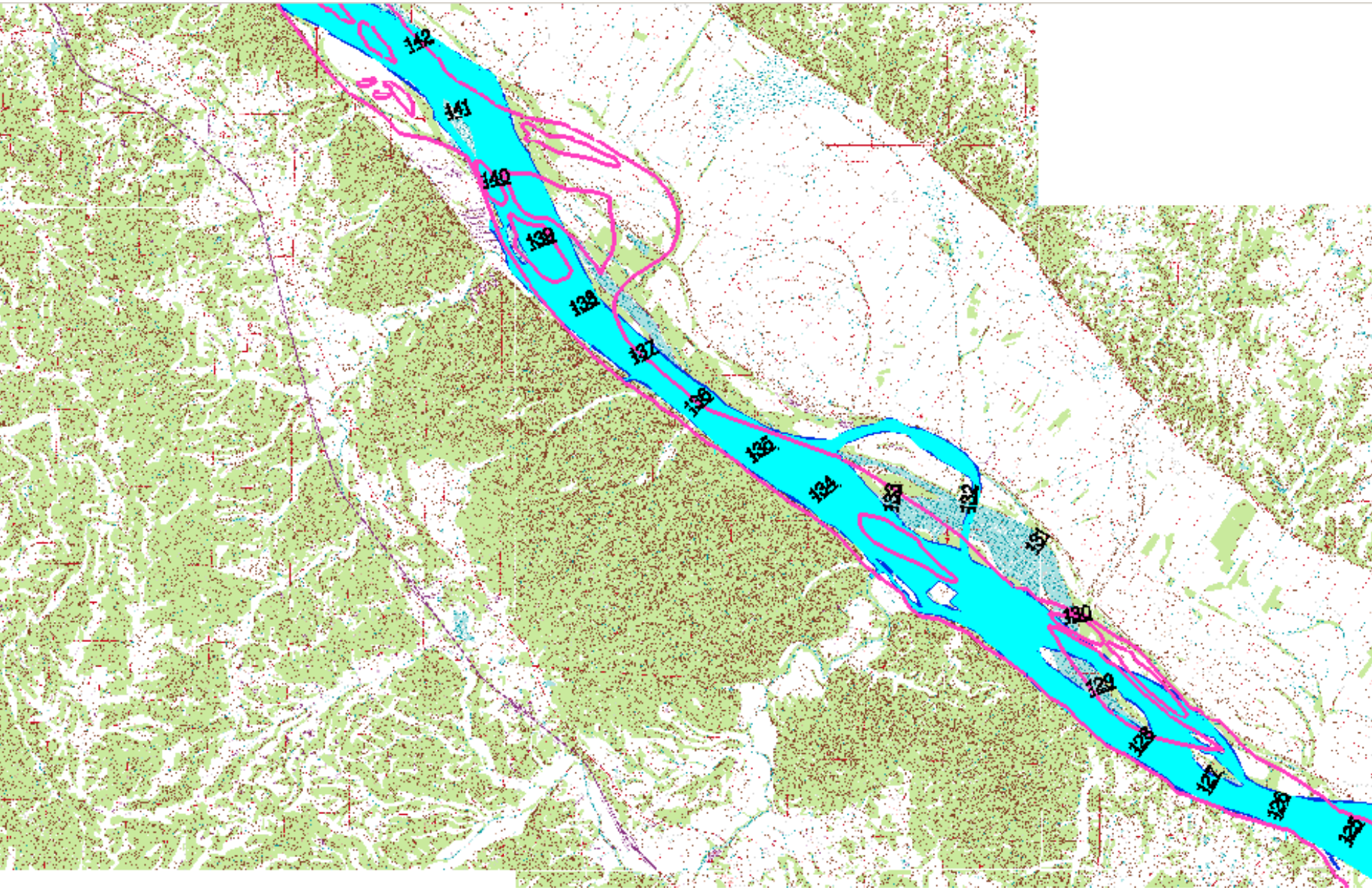
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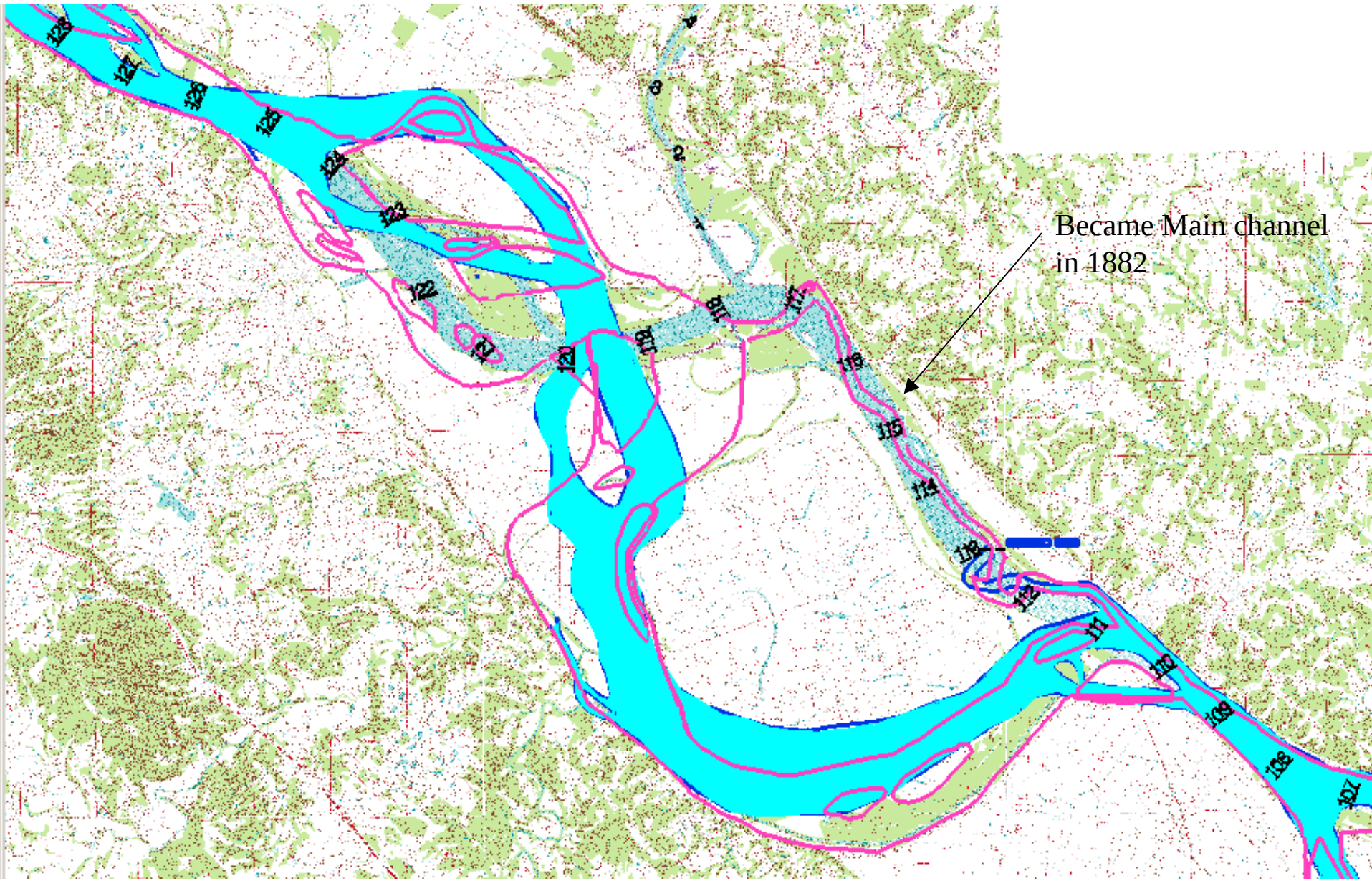
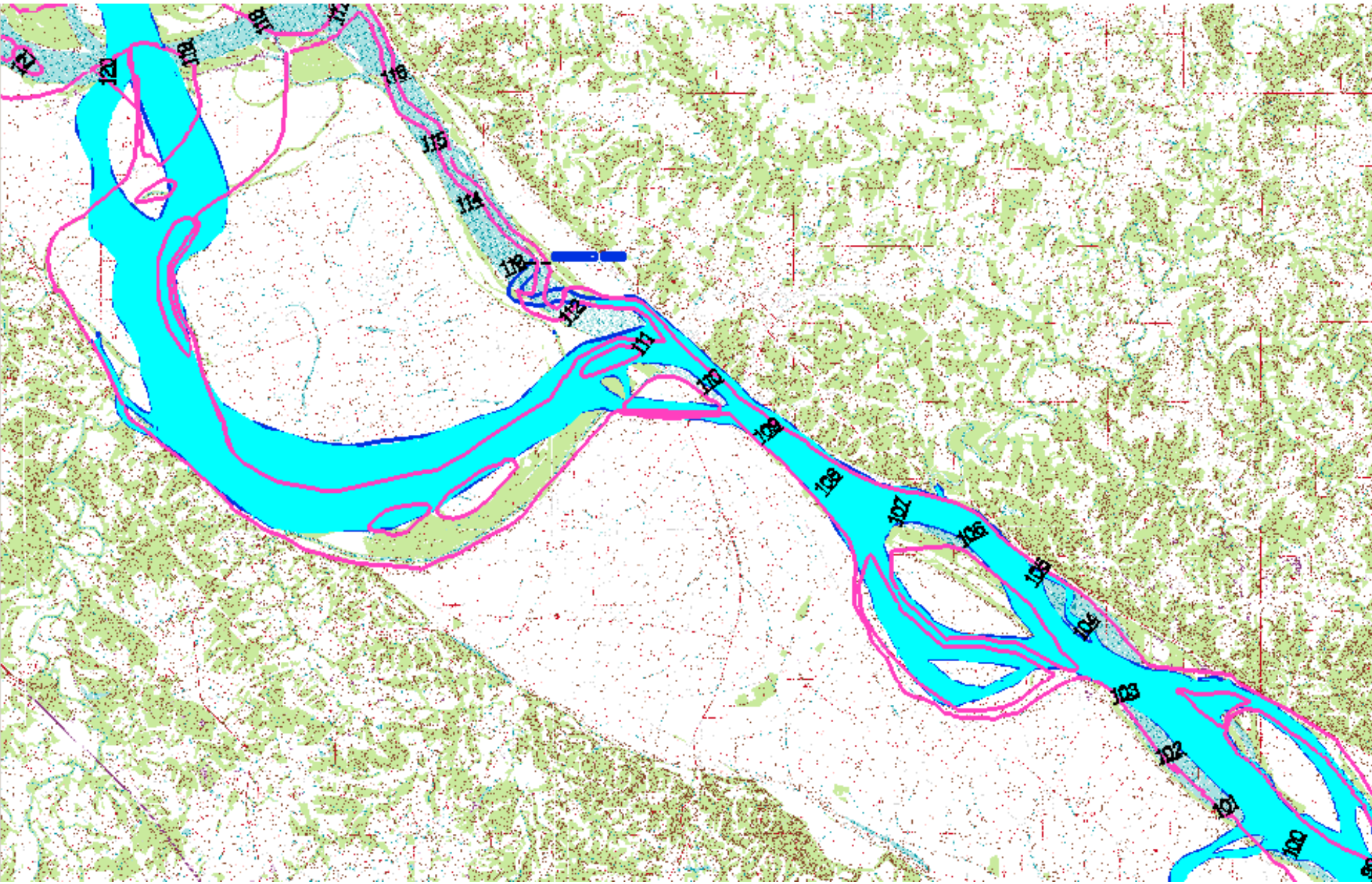

Became Main channel
in 1882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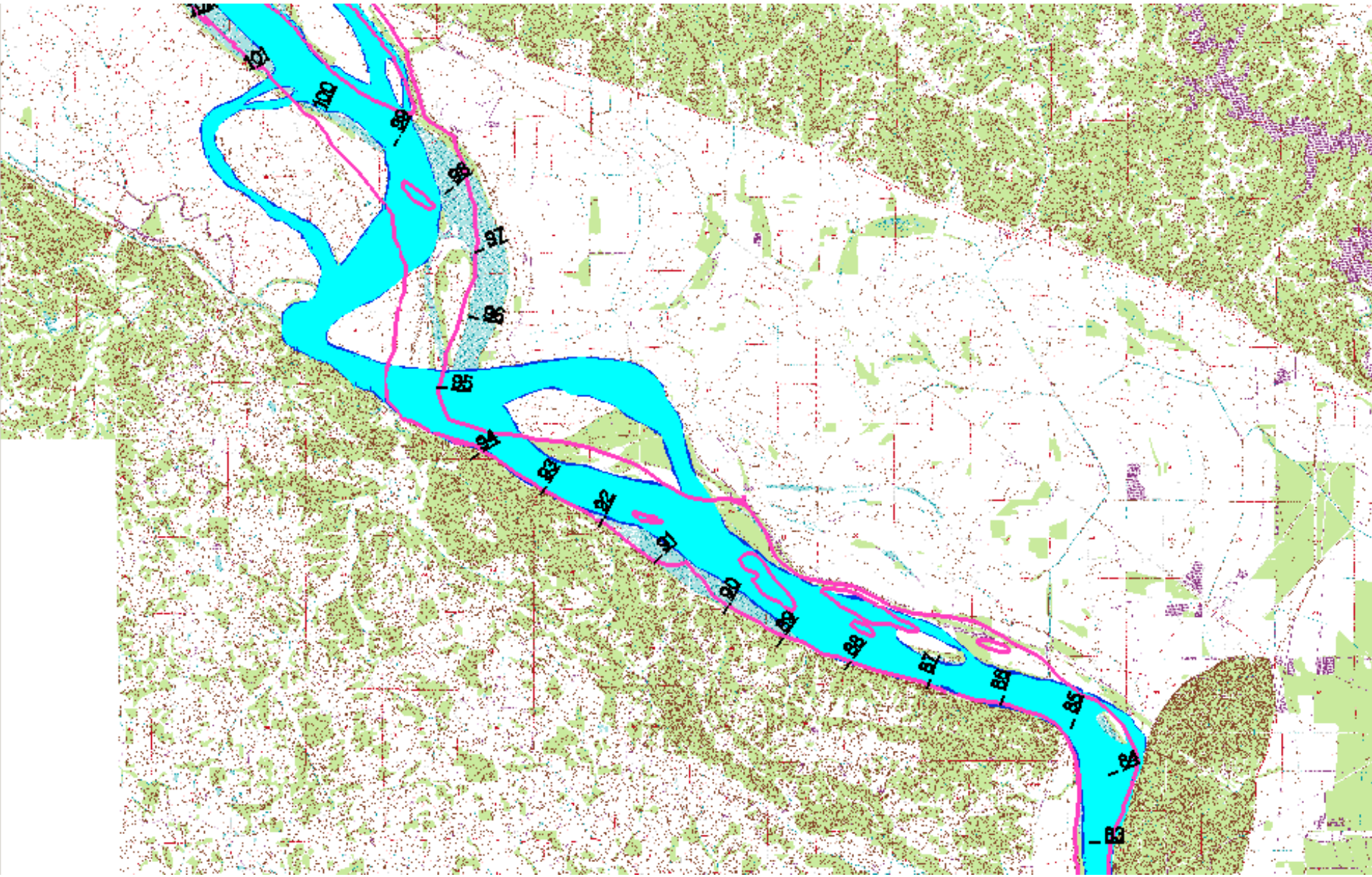
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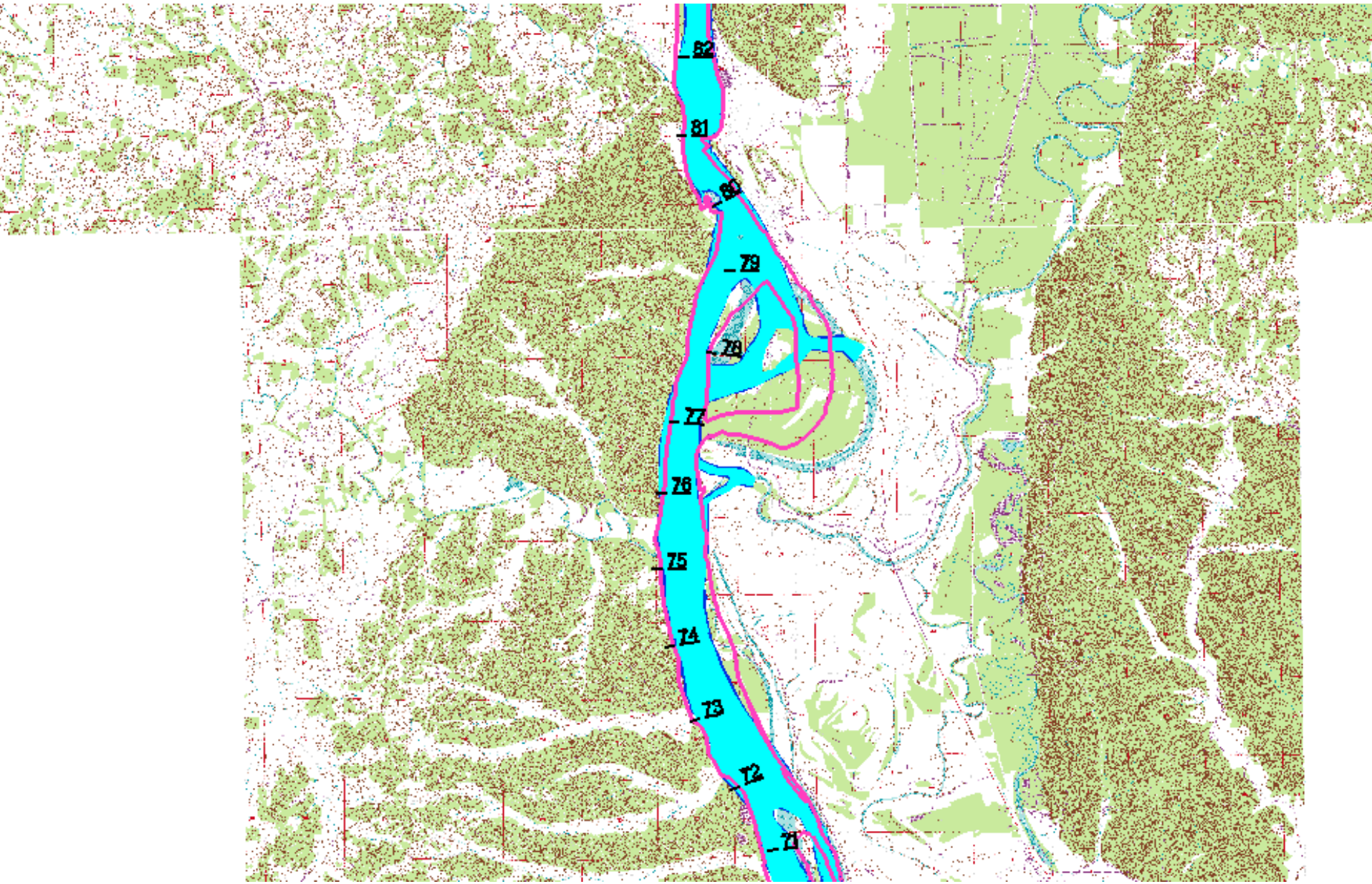
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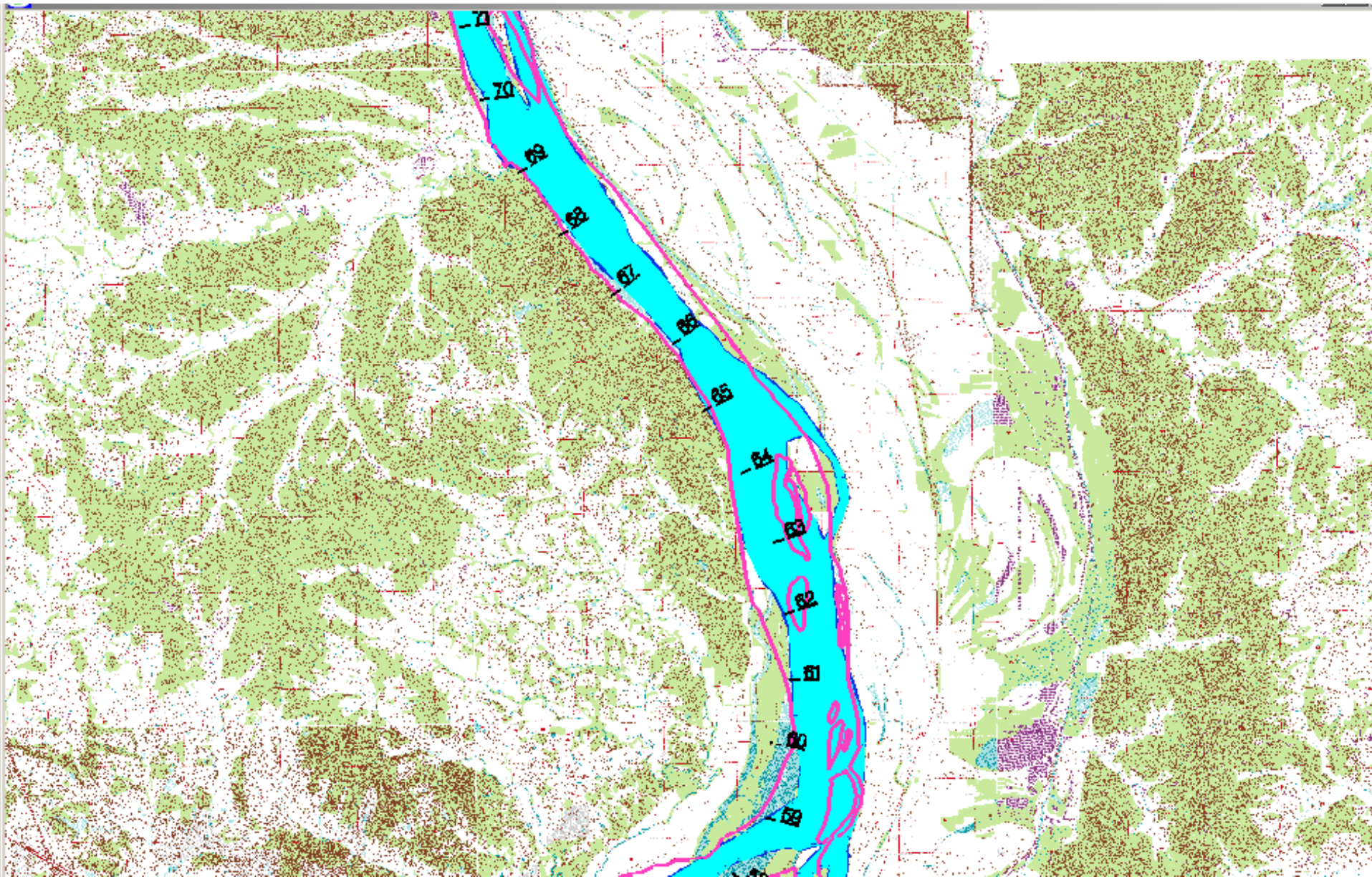
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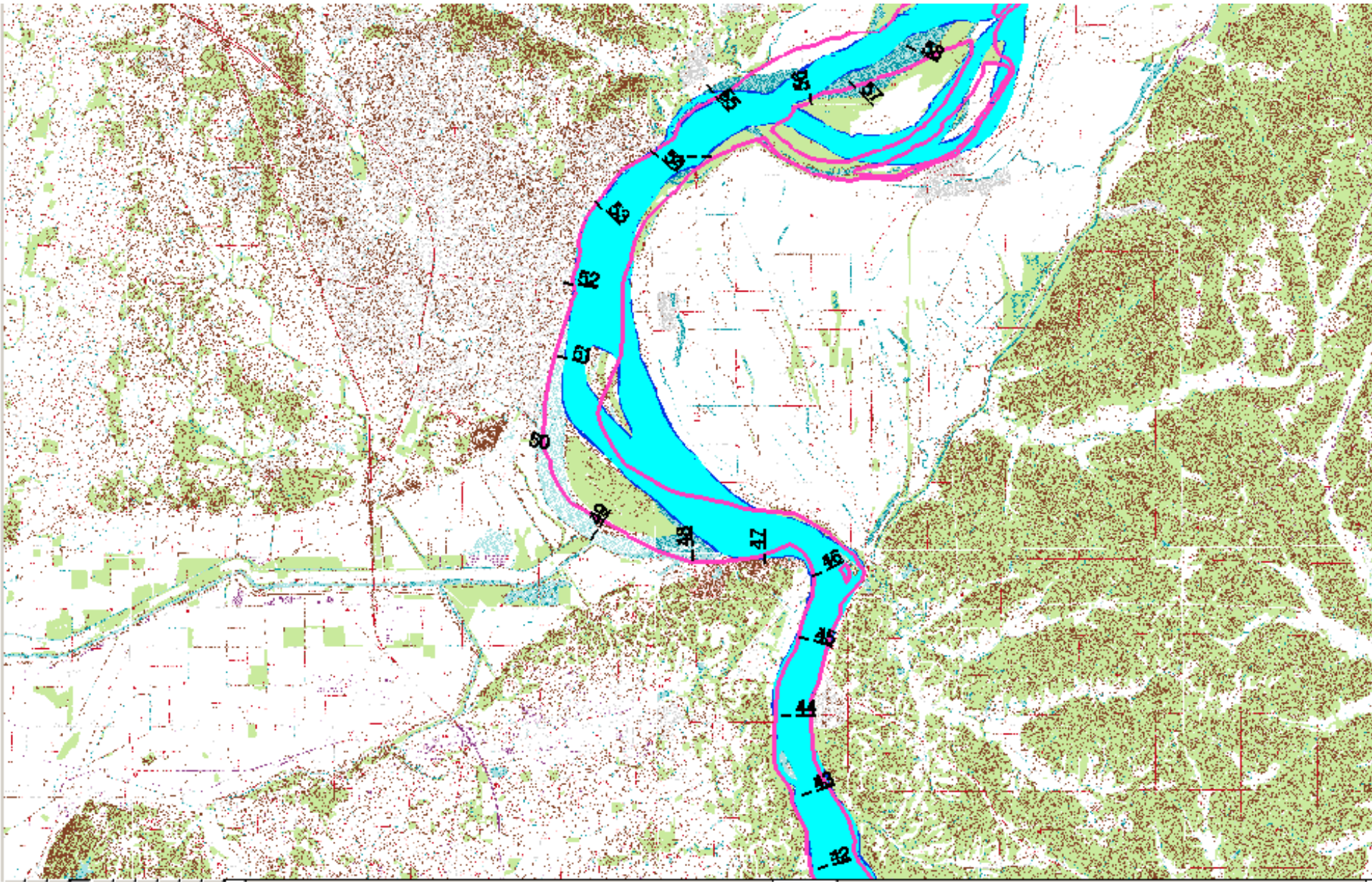
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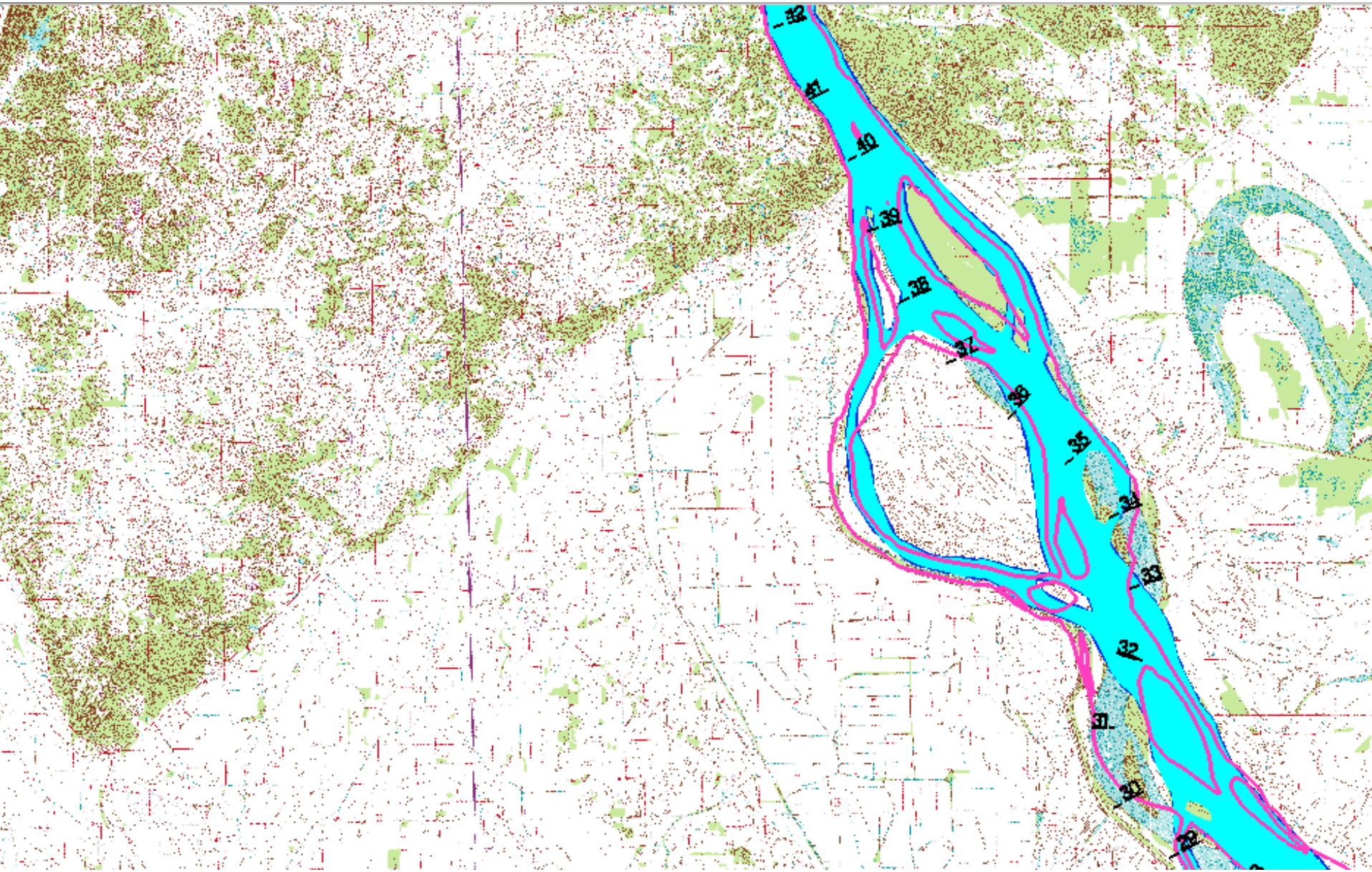
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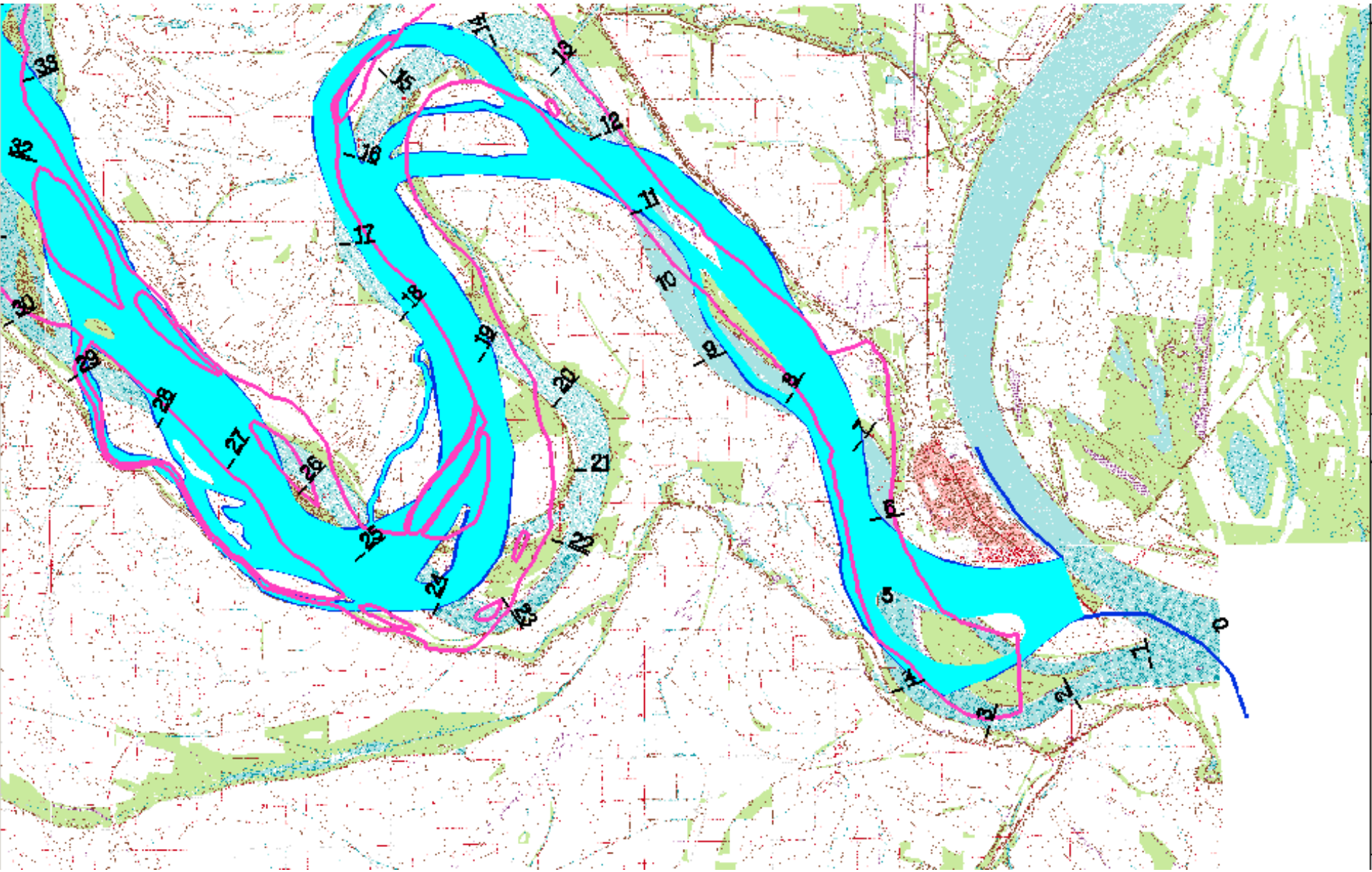
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File Edit View Insert Format Tools Chart Window Help

Average Planform Width

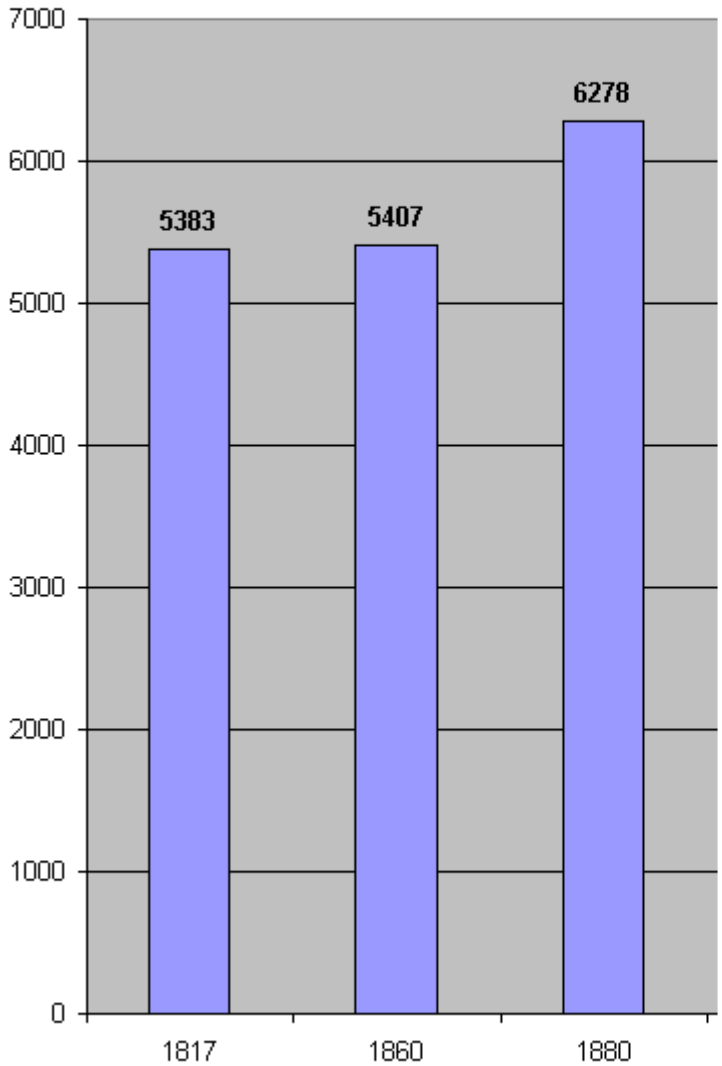
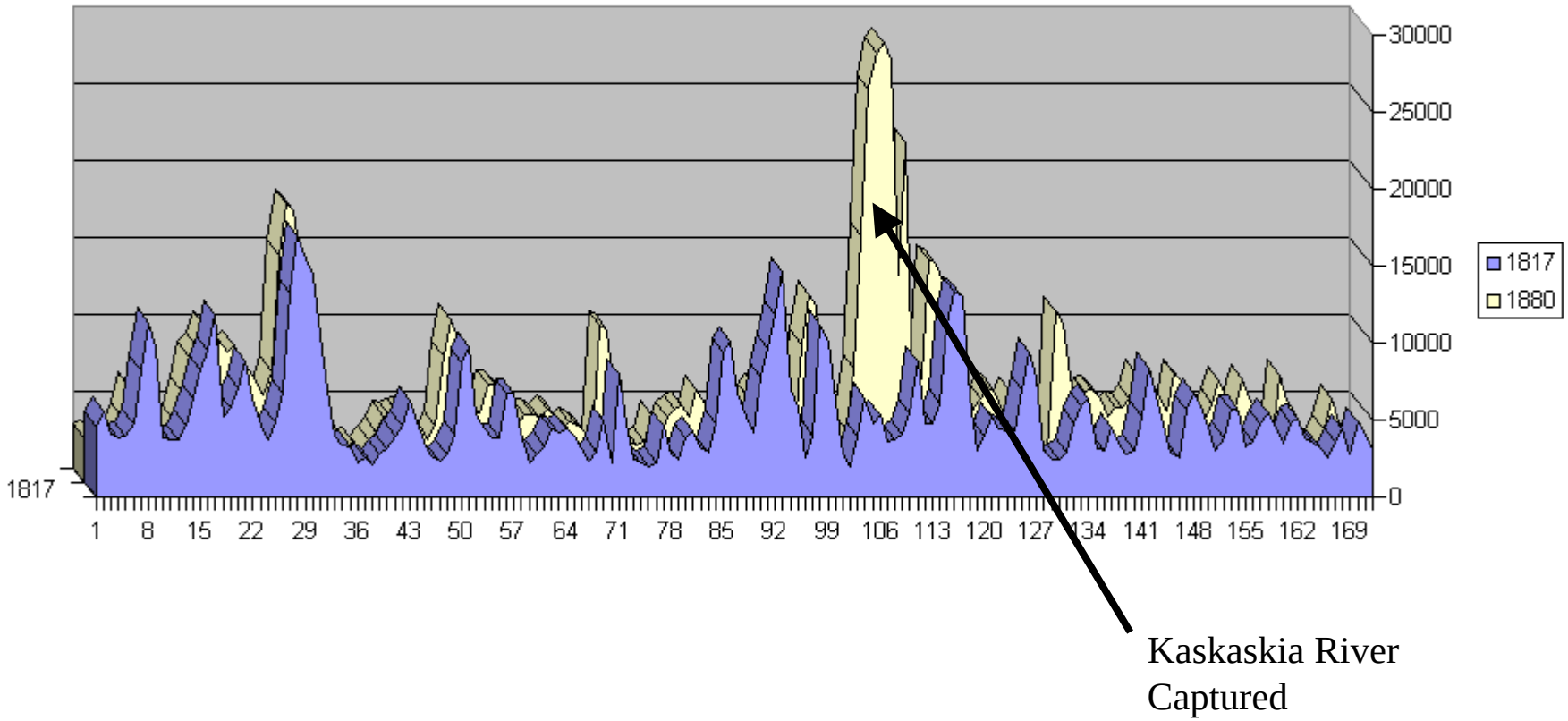


Chart2 Chart1 Planform width MILE 174 MILE 173 MILE 1

Ready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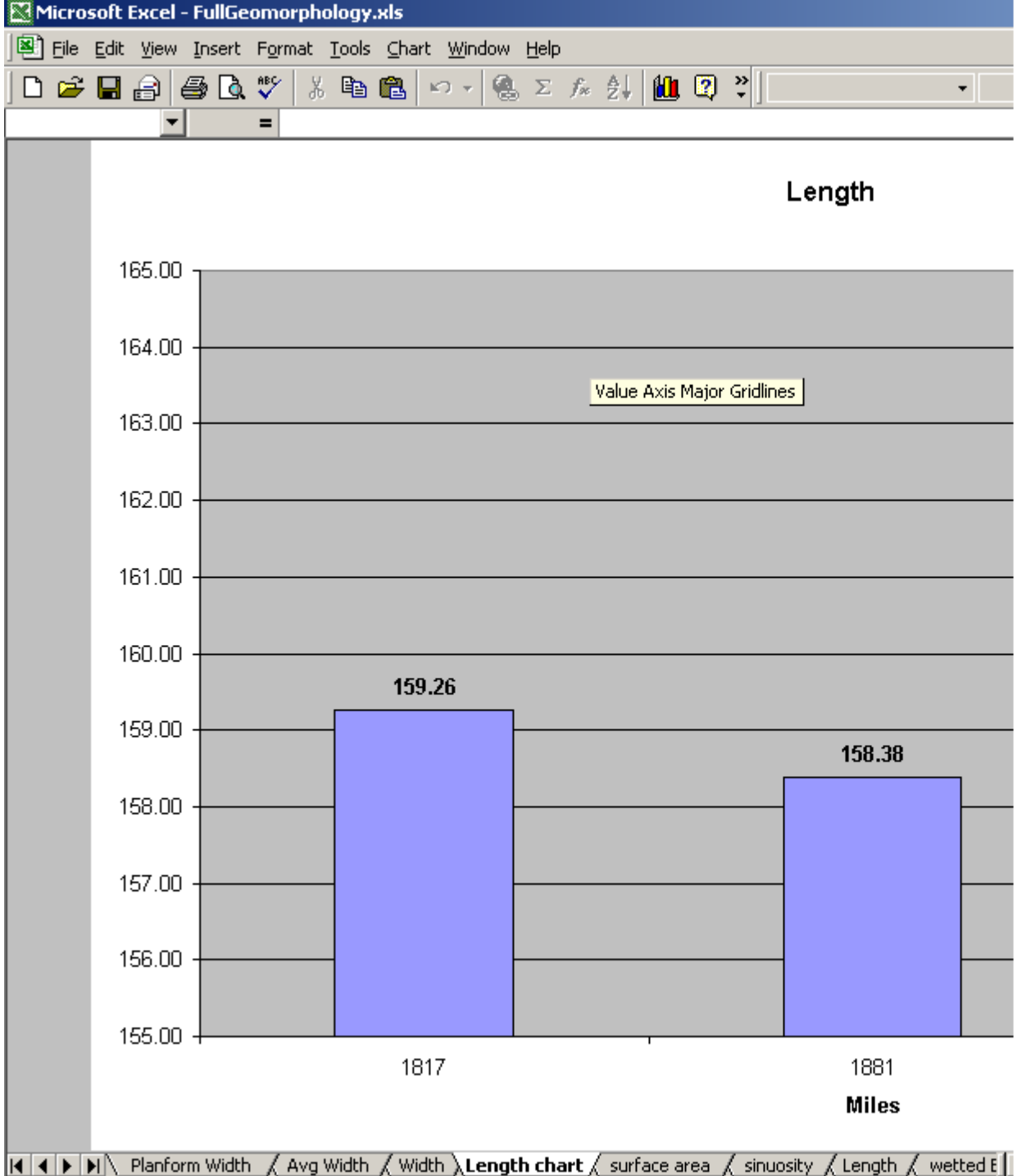
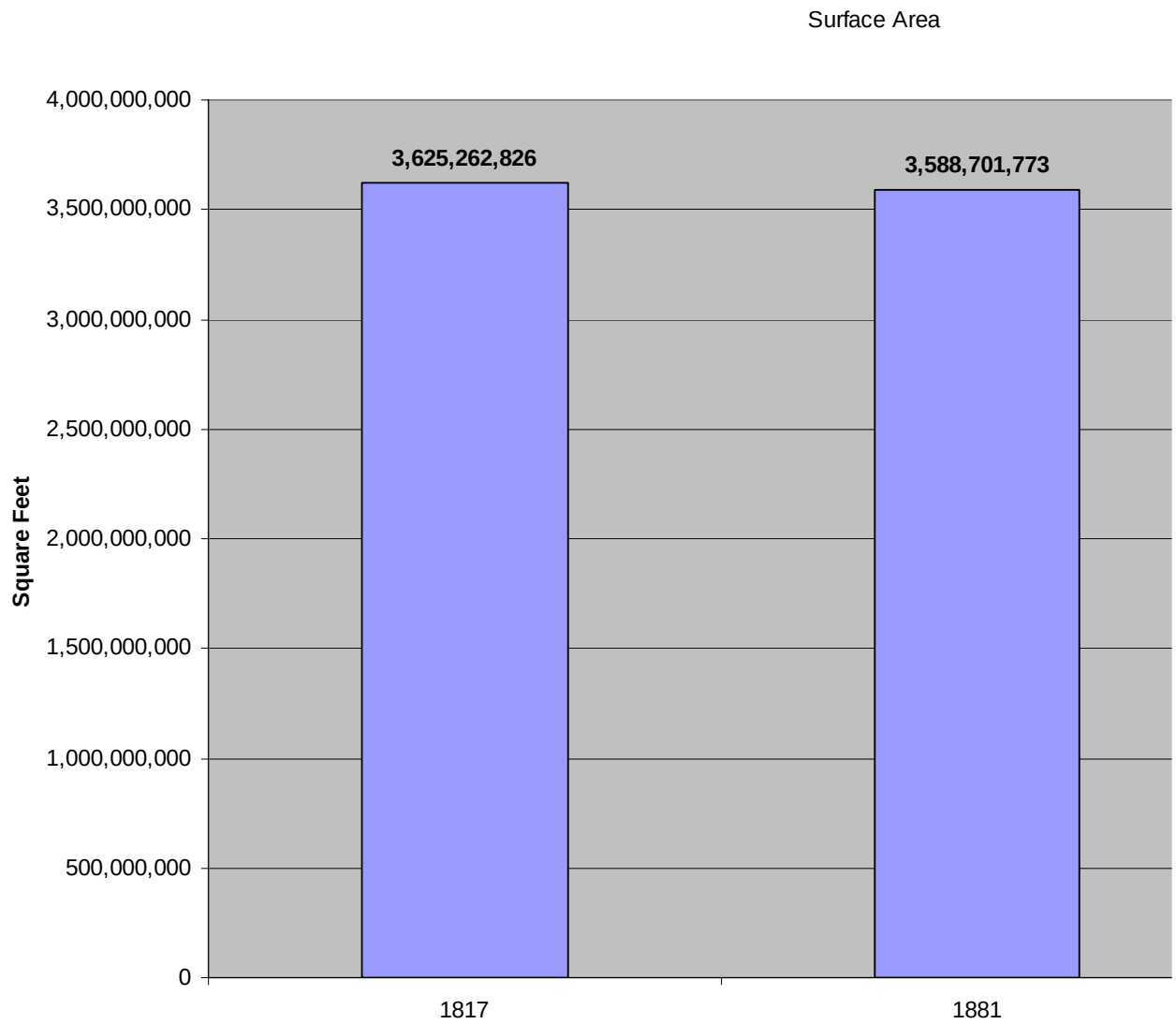
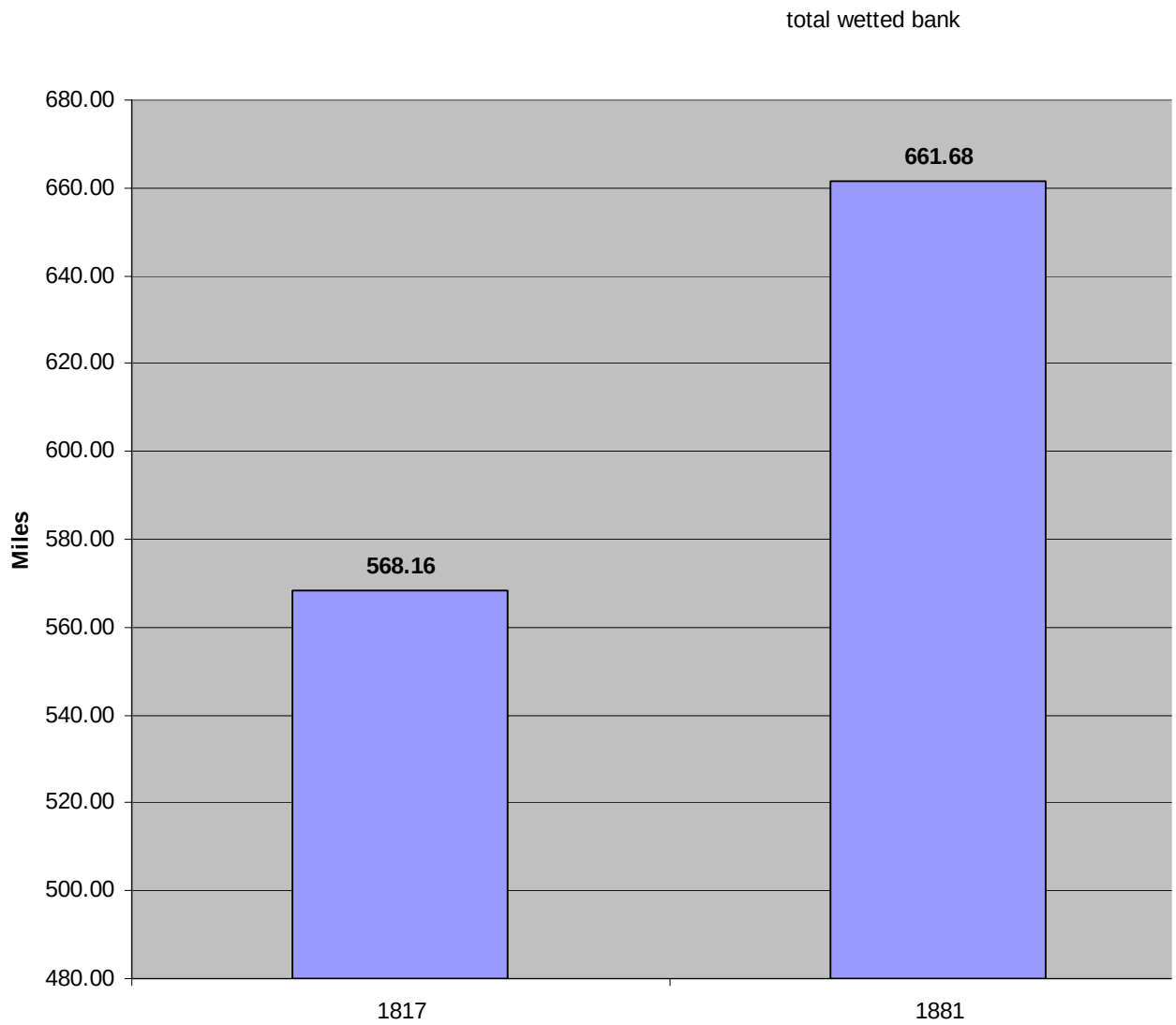
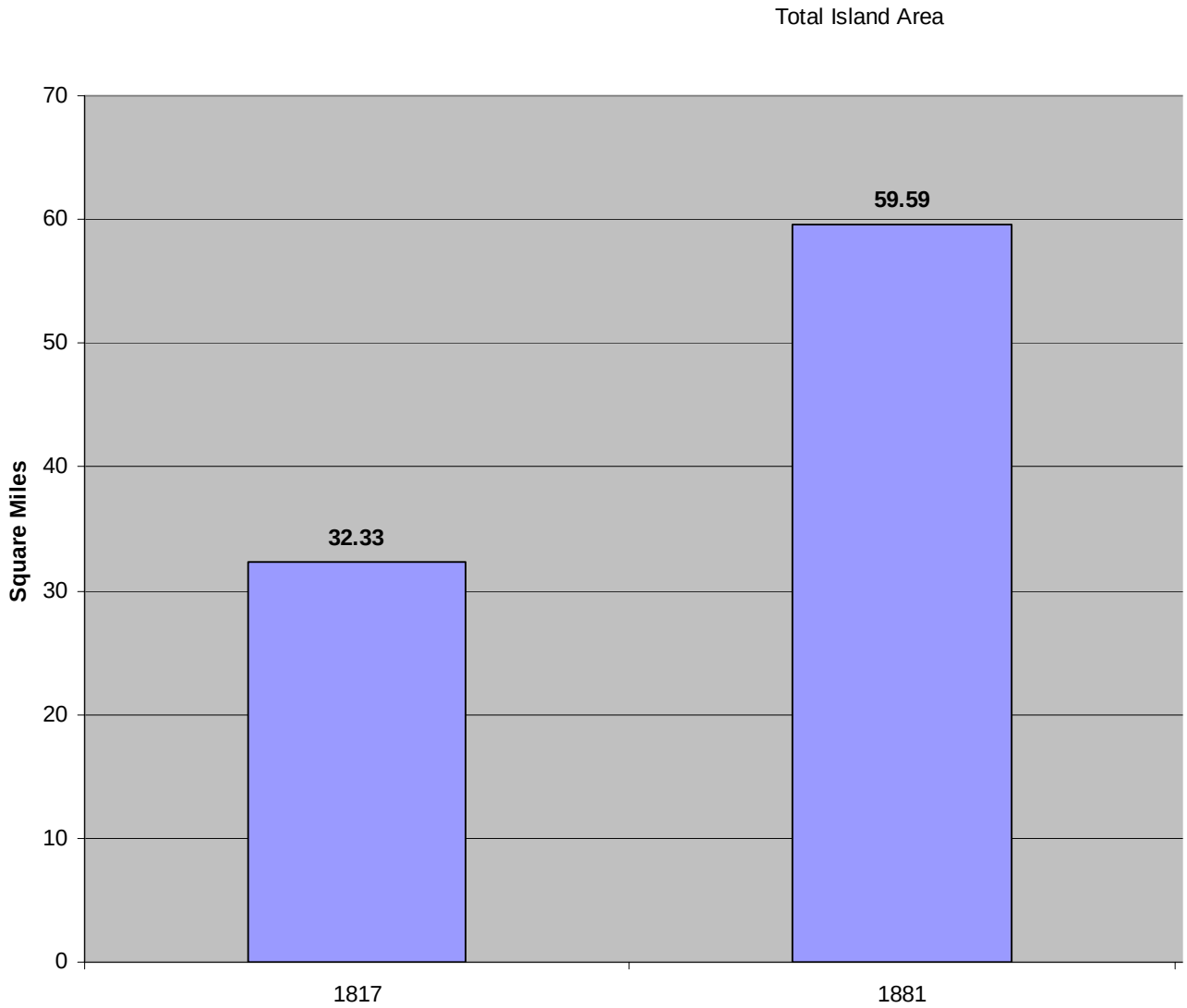
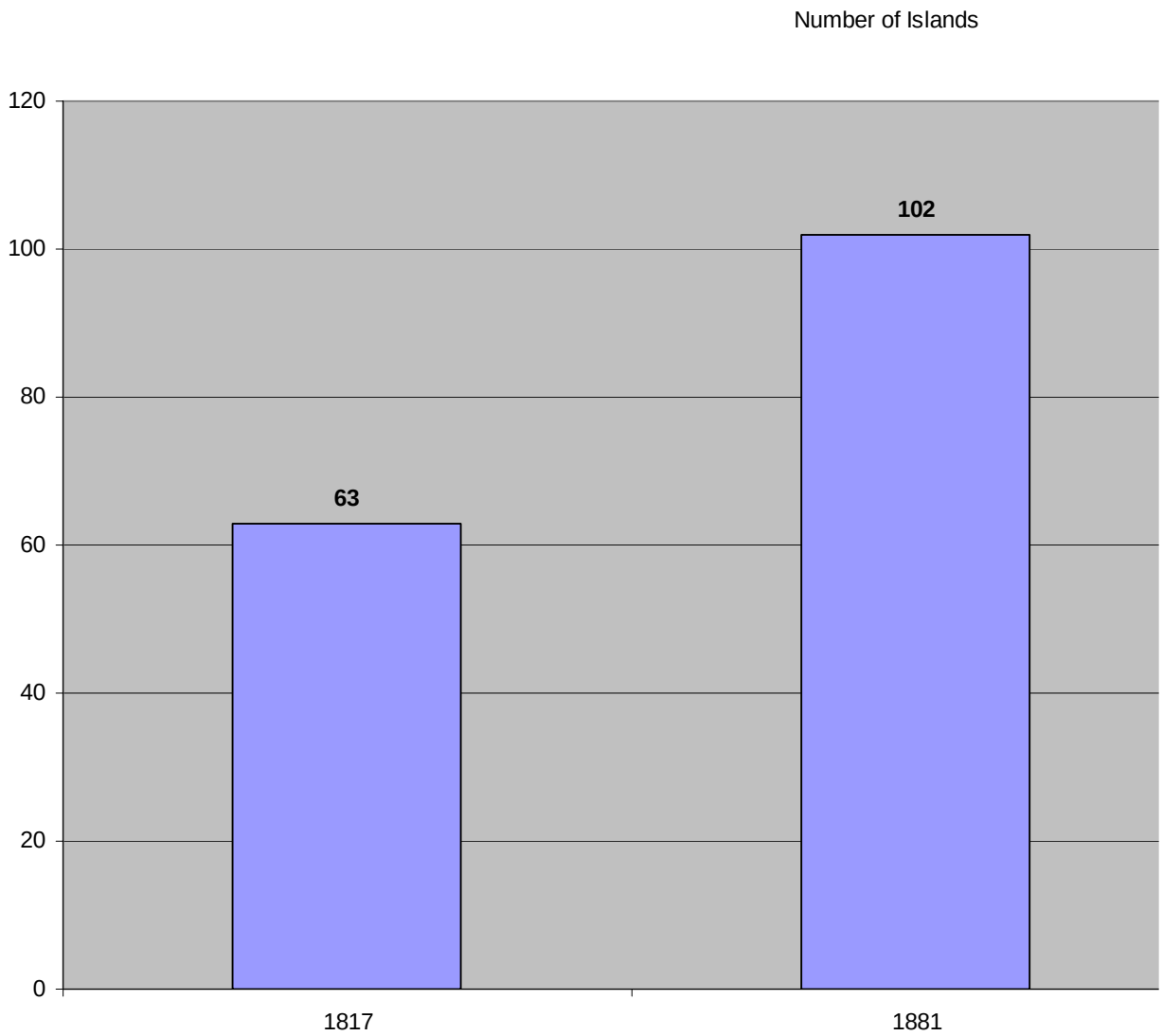
Kaskaskia River
Captured


Microsoft Excel - FullGeomorphology.xls
File Edit View Insert Format Tools Chart Window Help
Length
165.00
164.00
163.00
162.00
161.00
160.00
159.00
158.00
157.00
156.00
155.00
Value Axis Major Gridlines
159.26
158.38
1817
1881
Miles
Planform Width
Avg Width
Width
Length chart
surface area
sinuosity
Length
wetted E


Surface Area
Square Feet
4,000,000,000
3,500,000,000
3,000,000,000
2,500,000,000
2,000,000,000
1,500,000,000
1,000,000,000
500,000,000
0
3,625,262,826
3,588,701,773
1817
1881


total wetted bank
680.00
660.00
640.00
620.00
600.00
580.00
560.00
540.00
520.00
500.00
480.00
Miles
568.16
661.68
1817
1881


Total Island Area
Square Miles
70
60
50
40
30
20
10
0
32.33
59.59
1817
1881


Number of Islands
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20
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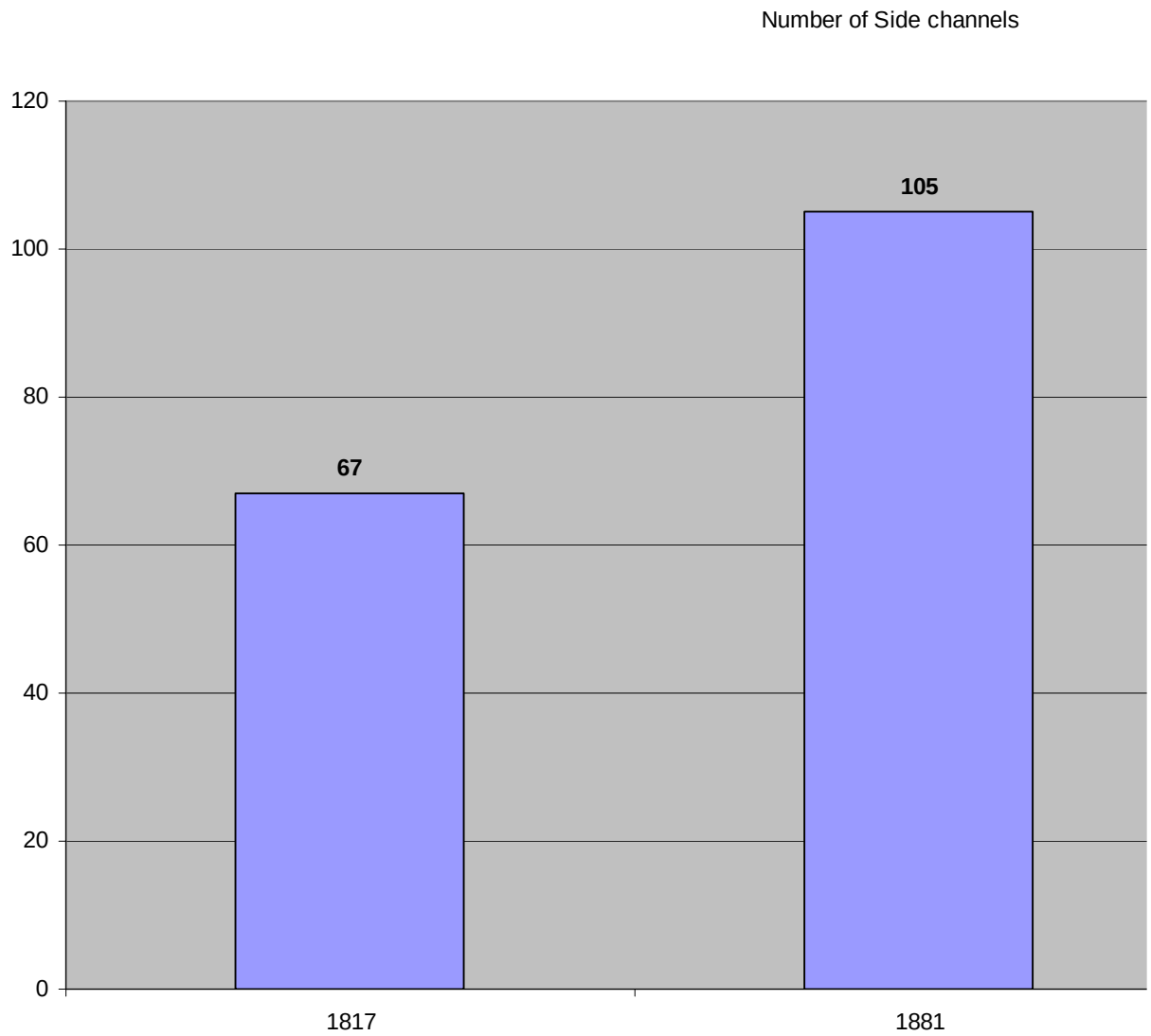
63
102
1817
1881


Number of Side channels
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100
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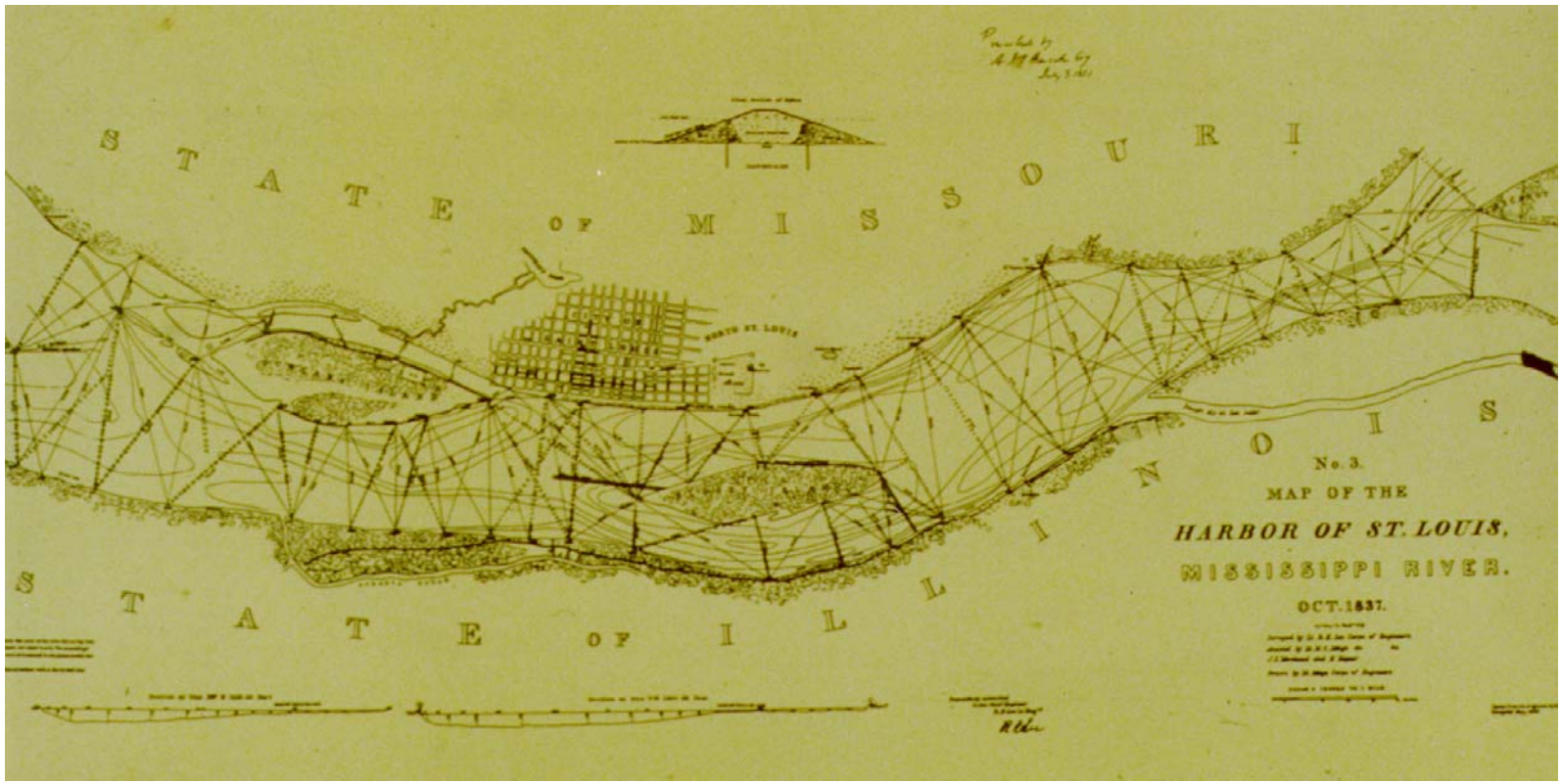
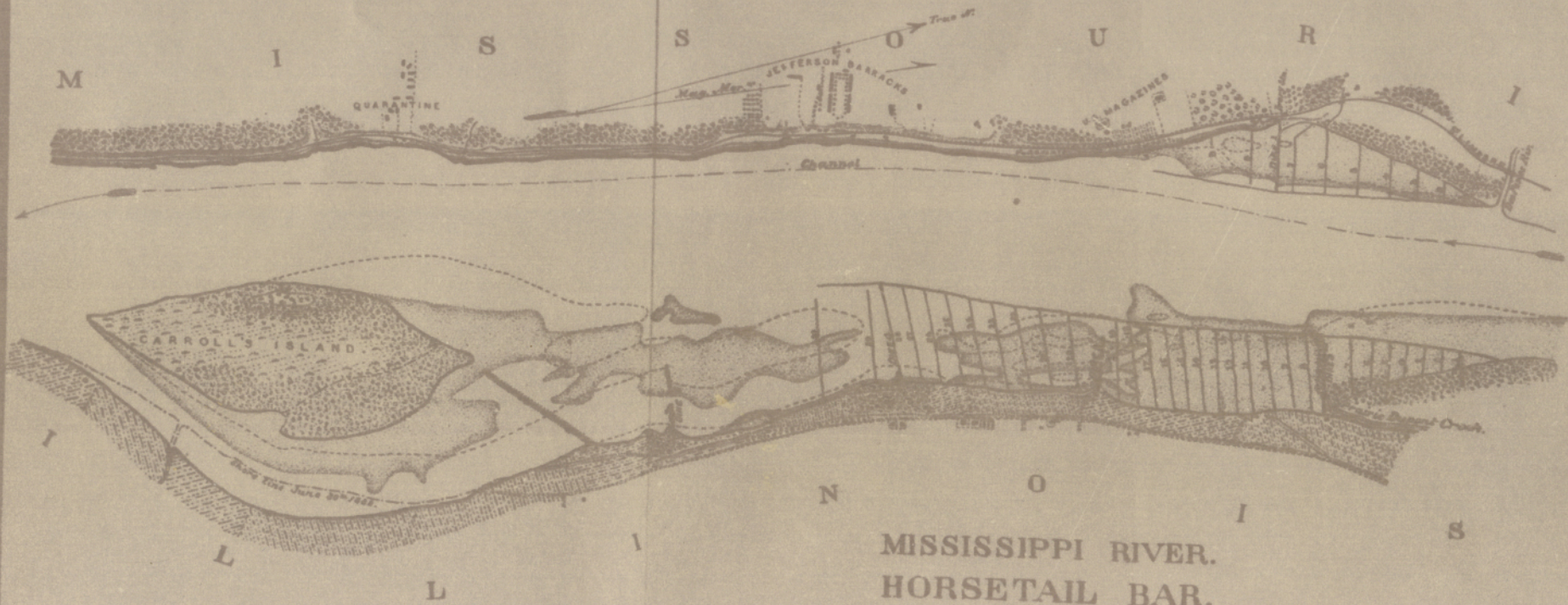
20
0
67
105
1817
1881

1879 Mississippi River Commission Established, Federal Dike Construction Begins


STATE OF MISSOURI
STATE OF ILLINOIS
No. 3.
MAP OF THE
HARBOR OF ST. LOUIS,
MISSISSIPPI RIVER.
OCT. 1837.

Improvement of Mississippi between Illinois and Ohio Rivers. Annual Report of Major O. H. ERNST, Corps of Engineers. 1883.



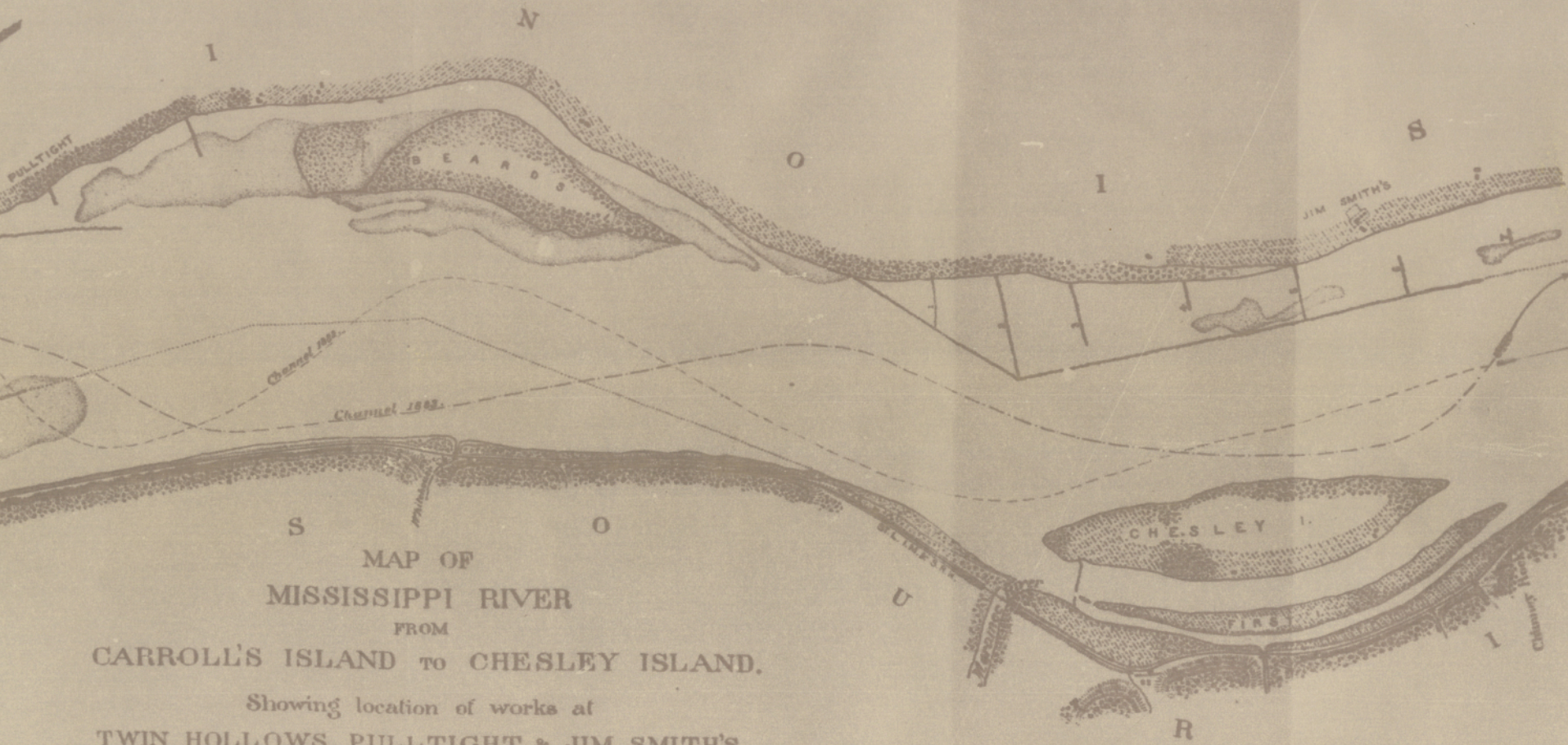
MISSISSIPPI RIVER.
HORSETAIL BAR.

Map showing location of works June 30th 1883.

Bars are shown as they appear at a 11' stage.*
Bars as they appeared at a 11' stage June 30th 1882 represented thus ------

Scale of Feet.

*Standard low water.

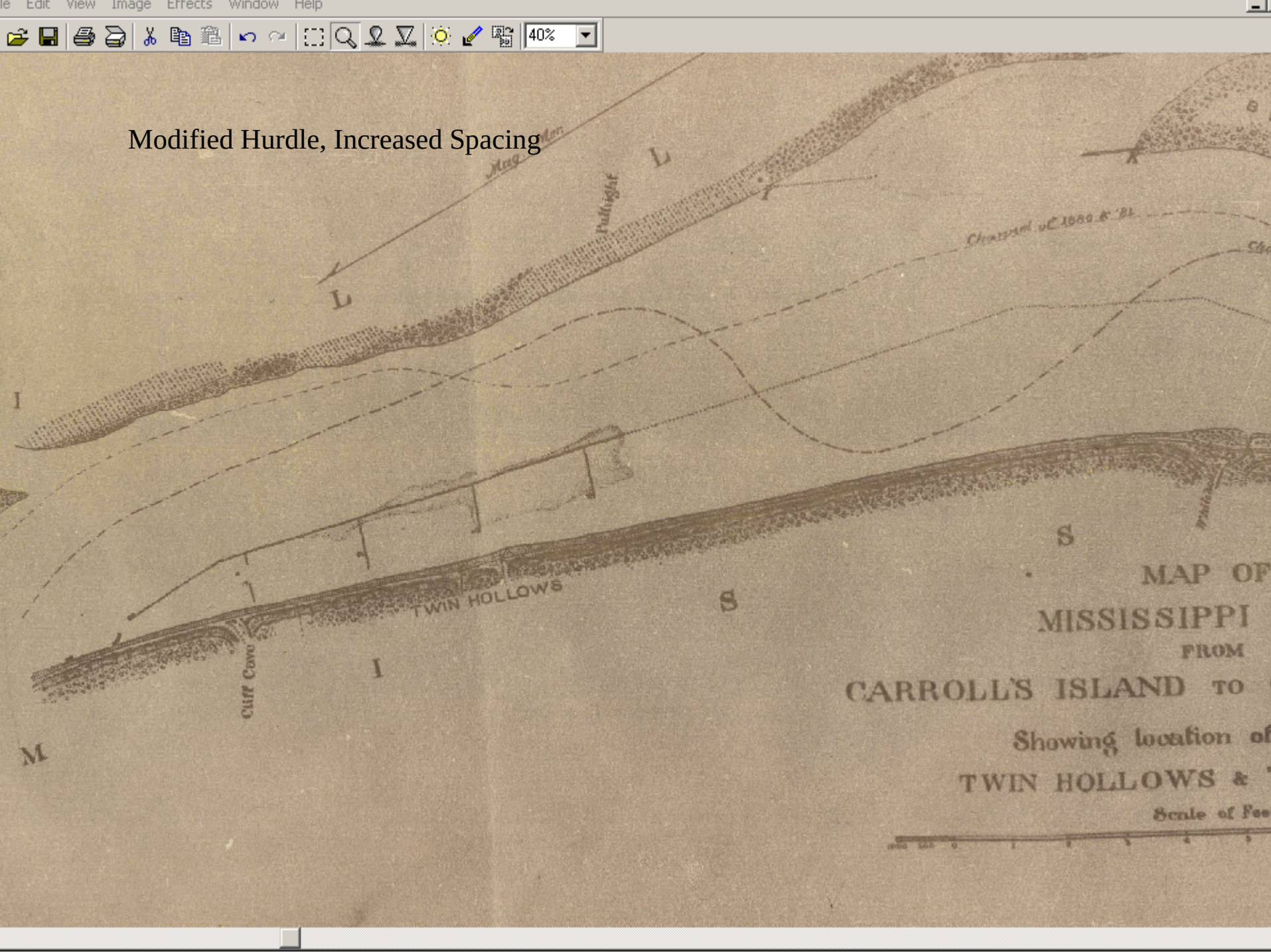


MAP OF MISSISSIPPI RIVER FROM CARROLL'S ISLAND TO CHESLEY ISLAND.

Showing location of works at TWIN HOLLOWS, PULLTIGHT & JIM SMITH'S.

Scale of Feet.

June 30th 1883.


Modified Hurdle, Increased Spacing
TWIN HOLLOWS
Cliff Cave
MAP OF
MISSISSIPPI
FROM
CARROLL'S ISLAND TO
Showing location of
TWIN HOLLOWS &
Scale of Fee

R. B. POTASHNICK - CONT. No. 1365 WOOD RIVER (R)

DIKE 199.4 (R)

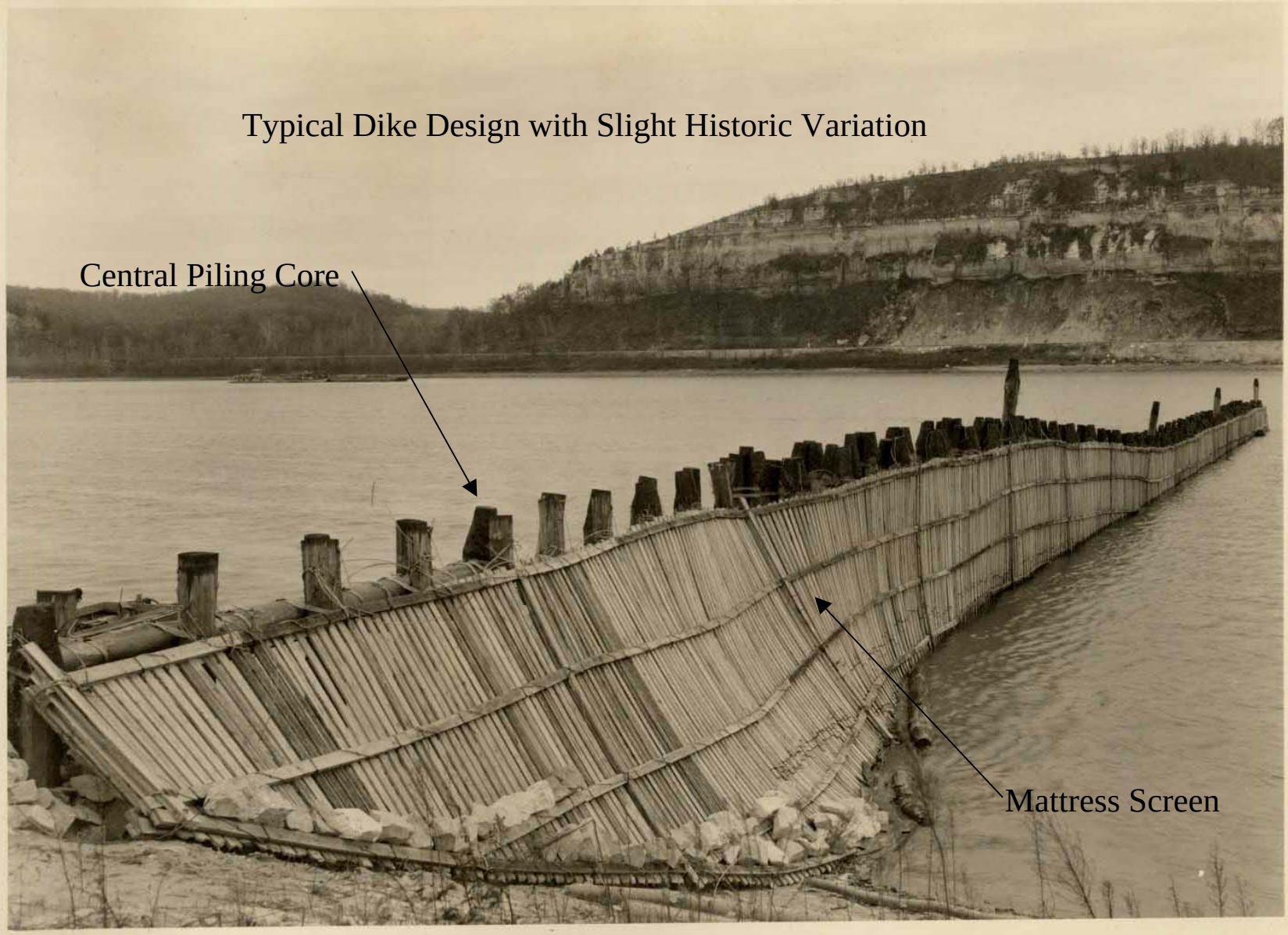
Showing curtain mattress in place on upstream face of piling core. End of pipe line in place, right hand side of picture Oct. 1932.

R. B. POTASHNICK - CONT. No. 1365 WOOD RIVER (R)

DIKE 199.4 (R)

Piling core with sand fill in process of making Oct. 1932

Typical Dike Design with Slight Historic Variation



UPPER MISSISSIPPI RIVER
U. S. ENGINEER OFFICE
ST. LOUIS, MISSOURI

DIKE NO. 146.1-L NEWLY SCREENED
PATTON-TULLY TRANS. CO.
NOVEMBER 28, 1940

DIKES
CONTRACT W-1103-ENG-2946
PHOTO NO. 5778

Officer in Charge.

Details of Hurdles.

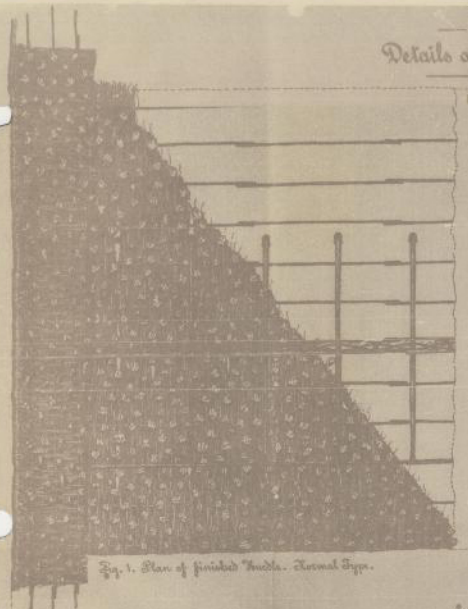


Fig. 1. Plan of finished Hurdle. Normal Type.

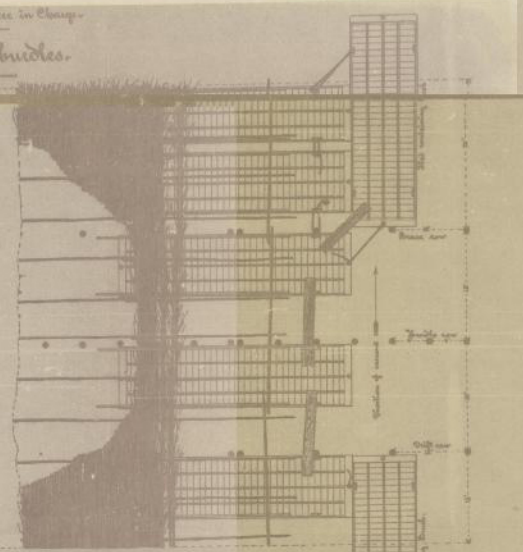


Fig. 3. Plan showing construction of Foundation Mattress.

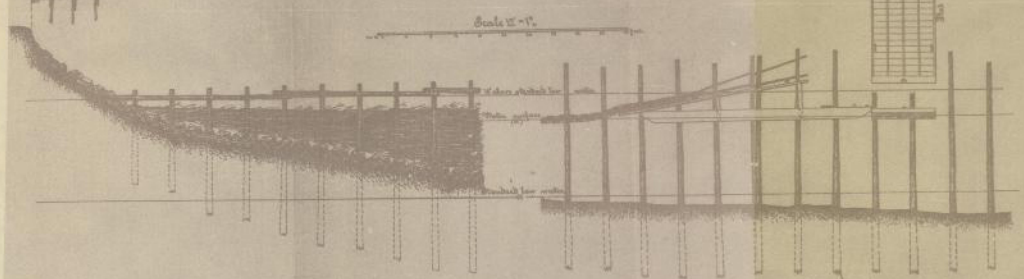


Fig. 2. Upstream side view of finished Hurdle. Normal Type.

Fig. 4. Upstream side view of Foundation Mattress under construction.

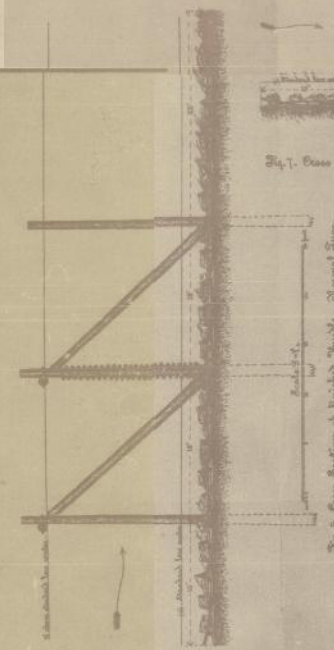


Fig. 5. Cross Section of finished Hurdle. Normal Type.

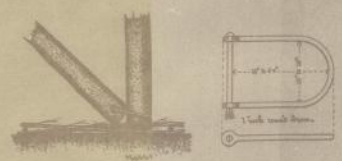


Fig. 8. Clevis fascinating the foot of brace-piles.

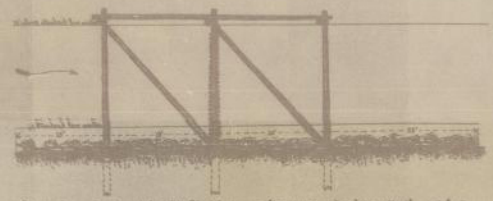


Fig. 7. Cross Section of finished Hurdle in swift current or depths greater than 15 feet.

Fig. 6. Cross Section of Hurdle in depths of from 3' to 6'.

Notes.

The hurdles are built to the surface of the water unless the latter be lower than the plane 14' above standard low water, in which case they are built to the uniform height of 14' above standard low water. Their forms of construction vary somewhat with the depth of water at the 14' standard stage.

Figures 1, 2 and 3 show the normal type.

For depths of 12' or more the distance between the rows of piles is about equal to the depth of water. For example, in a depth of 14', the distance between rows is 18' as shown in drawings, for depths less than 13', the distance is constant and is kept at 15', except next the shore. On the latter case and in other cases of sudden and brief shoaling no change is made in the distance generally employed in that particular hurdle.

For depths of 3' to 6' only two rows of piles are used, as shown in Fig. 6.

For depths of 3' or less, only one row of piles is used.

For depths of 6', or over a dry bar, no piles are used, but the foundation mattress 35' wide is laid upon the bare surface and well ballasted with stone, except when the bar is already protected by a natural growth of willows.

For depths of over 18', or for less depths where the current is very swift, cross stringers are used to brace together the tops of the piles in the three rows as shown in Fig. 7.

The foundation mattress is 35' wide where there are two rows of piles or less. When there are three rows, the width of the mattress depends upon the distance between the rows, it extends 15' above the upstream row, and 25' below the downstream row, making its total width 74' in a depth of 14' as shown in drawings.

Wattling must be placed in horizontal layers. Depressions in the bottom are first filled, and then the wattling is carried up in horizontal courses extending from one end of the hurdle to the other.

When a hurdle crosses a depth of over 15' the wattling will not at first be carried to the tops of the piles. It will be placed to a height about 6' above standard low water, and then be left until the hurdle shall be reinforced by deposits, after which it may be continued up to the full height.

The depth to which piles are driven should as a rule exceed the depth of water.

In most cases the bank near the shore end of a hurdle should be protected for a distance of about 100' above and 100' below the axis of the hurdle, the protection extending to the full height of the graded bank.

The construction of the hurdle should begin at the shore end and progress continuously outward.

U.S. Engineer Office, St. Louis, Mo. March, 1885.

MISSISSIPPI RIVER
Locality - Giboney Isl.-Devils Isl. (47-62)
Contractor - Morrison-Glasscock-Connor Co.
Cont. No. - W-1103-eng.-1920
PAVING BANK
Nov. 16, 1934 (Giboney Island, Ill.) 374

MISSISSIPPI RIVER
Locality - Giboney Isl.-Cape Gir. (47-52)
Contractor - W. P. McGeorge
Cont. No. - W-1103-eng.-1917
DIKE and MATTRESS
Oct. 11, 1934

264

MISSISSIPPI RIVER
Locality - Willard-Grand Tower, Ill.(61-83)
Contractor - Morrison-Glasscock-Connor Co.
Cont. No. - W-1103-eng.- 1921
BUILDING AND SINKING MATTRESS
Oct. 11, 1934

R.B. POTASHNICK - CONT. NO. 1365

WOOD RIVER (R)

DIKE 199.4 (R)

Piling core with sand fill in process of making Oct. 1932

R. B. POTASHNICK - CONT. No. 1365

WOOD RIVER (R)

DIKE 199.4 (R)

Showing curtain mattress in place on upstream face of piling core. End of pipe line in place, right hand side of picture Oct. 1932.

MISSISSIPPI RIVER
Locality - Maple Island Dikes, Mo.
Contractor - Woods Bros. Const. Co.
Cont. No. - W-1103-eng.-1913
DIKE NO. 198.7R - VIEW FROM SHORE END
Nov. 2, 1934 (Solid Dikes) 319

R.B. POTASHNICK - Cont. No. 1365 WOOD RIVER (R)

DIKE 199.4 (R)

Partially completed piling core Oct. 1, 1932.

R.B. POTASHNICK - Cont. 1365 WOOD RIVER (R)

DIKE 199.7(R)

Showing curtain mattress and piling core in place Oct. 1, 1932

PLATE V.

Improvement of Mississippi River between Illinois and Ohio Rivers.

Major H. Ernst,
Corps of Engineers, U.S. Army.
Offices in Charge.

Bank Protection.

Below Missouri River.

U. S. Engineer Office St. Louis, Mo. March 1885.

H. Ernst.

Cross Section of Revetment completed.

Willow Weave Mattress Revetment

Front View.

Plan.

Side View.

Notes.

Mattress to be 32' wide, woven more or less continuous poles 6' apart. Poles to be securely spliced with wire lashings by each stake, the ends of poles overlapping about 6', with three 6' spikes driven through the overlap.

As mattress is built and extended, the mattress is launched and sunk progressively, and its length is unlimited. In great depths and velocities the length should not exceed 200'.

Butt poles 6' apart to be driven upon a line distant 5' horizontally from shore at low water mark. Standard low water is 0' above low water of 1881.

Three days of mattress after sinking should be about 15' outside of line of piles.

To hold it ready for this position poles acting both as spars and ties will extend from each guide pile and be secured to mattress. The upstream end of mattress during construction to be held above water surface by a raft or simply large anchored at right angles to bank.

Stone sufficient to sink mattress and hold it securely in place to be mattress over it. In most cases, one cub. ft. of stone to 10 square feet of mattress is sufficient, at which rate a barge load of 300 cub. yds. of stone should sink 1000 linear feet of mattress.

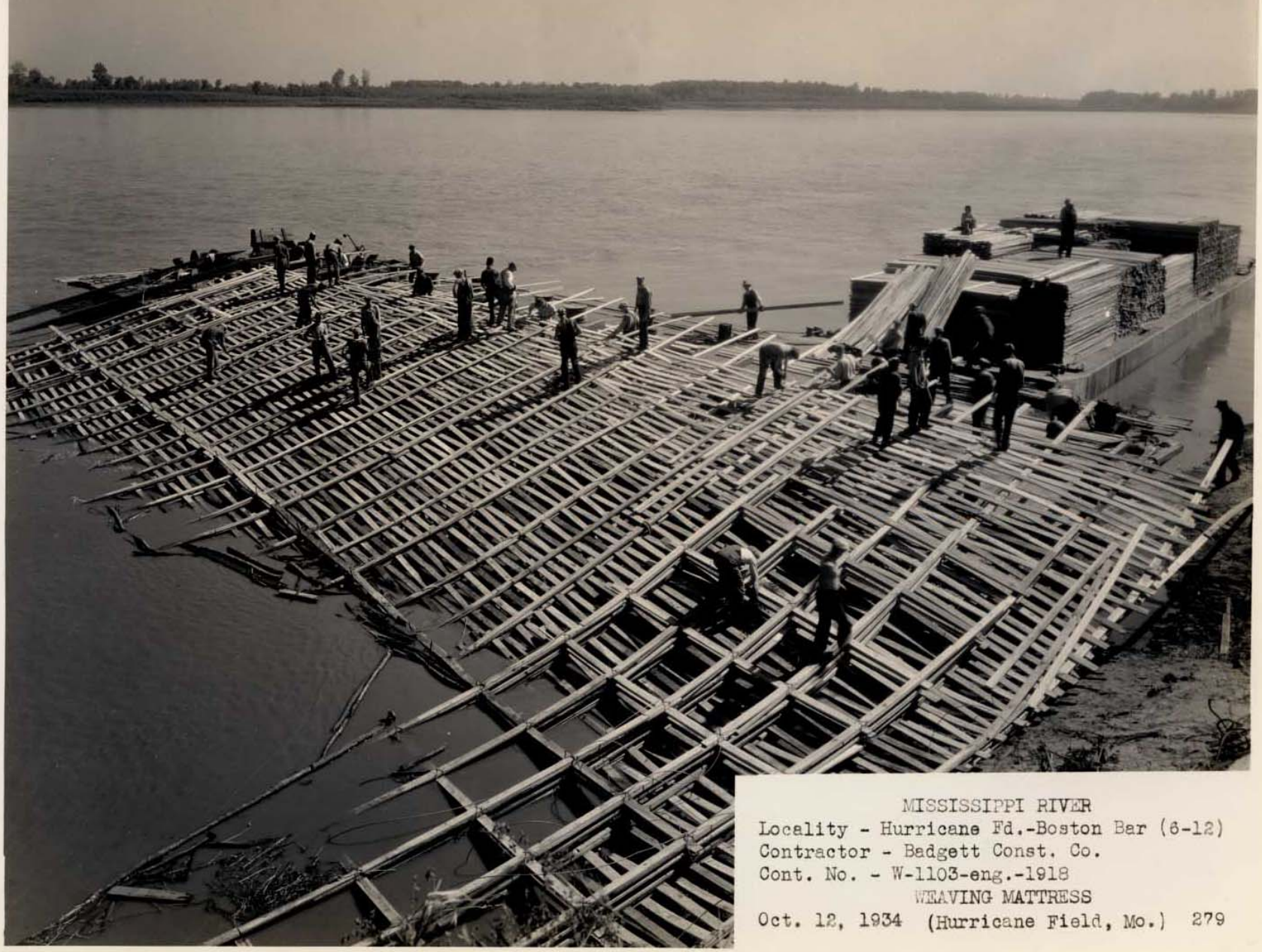
Scattered between inner edge of mattress and water surface to be covered with a liberal supply of stone - say 12" thick.

Bank above water surface to be graded to a slope of 3 by horizontal 1 of, or by natural action of the river, then to be covered to height of 10' above standard low water with a layer of stone 12" thick.

One mattress having been completed and sunk a new one will be begun overlapping the former by about 15'.

Starting at beginning of mattress to be secured by two stringers connecting the ends of the piles as a channel.

MISSISSIPPI RIVER
Locality - Hurricane Fd.-Boston Bar (6-12)
Contractor - Badgett Const. Co.
Cont. No. - W-1103-eng.-1918
WEAVING MATTRESS
Oct. 12, 1934 (Hurricane Field, Mo.) 280



MISSISSIPPI RIVER
Locality - Hurricane Fd.-Boston Bar (6-12)
Contractor - Badgett Const. Co.
Cont. No. - W-1103-eng.-1918
WEAVING MATTRESS
Oct. 12, 1934 (Hurricane Field, Mo.) 279

MISSISSIPPI RIVER
Locality - Giboney Isl.-Cape Gir. (47-52)
Contractor - W. P. McGeorge
Cont. No. - W-1103-eng.-1917
WEAVING DIKE MATTRESS
Oct. 30, 1934 332

MISSISSIPPI RIVER
Locality - Giboney Isl.-Cape Gir. (47-52)
Contractor - W. P. McGeorge
Cont. No. - W-1103-eng.-1917
STONING DIKE MATTRESS
Oct. 30, 1934 331

UPPER MISSISSIPPI RIVER
U. S. ENGINEER OFFICE
ST. LOUIS, MISSOURI

DIKE 148.3-R, NEW CALICO ISLAND,
CORNICE ISLAND
SEPTEMBER 4, 1941

PATTON, TULLY TRANS. CO
CONTRACT NO. W-1103-ENG-2946
PHOTO NO. 6360

MISSISSIPPI RIVER
Locality - Willard-Grand Tower Isl. (61-83)
Contractor - Morrison-Glasscock-Connor Co.
Cont. No. - W-1103-eng.-1921
PAVING BANK
Nov. 16, 1934 (Grand Tower, Ill.) 379

1954…One of the Last …..

File Edit View Insert Format Tools Chart Window Help

TIME VS. NEW DIKE CONSTRUCTION St. Louis to Cairo

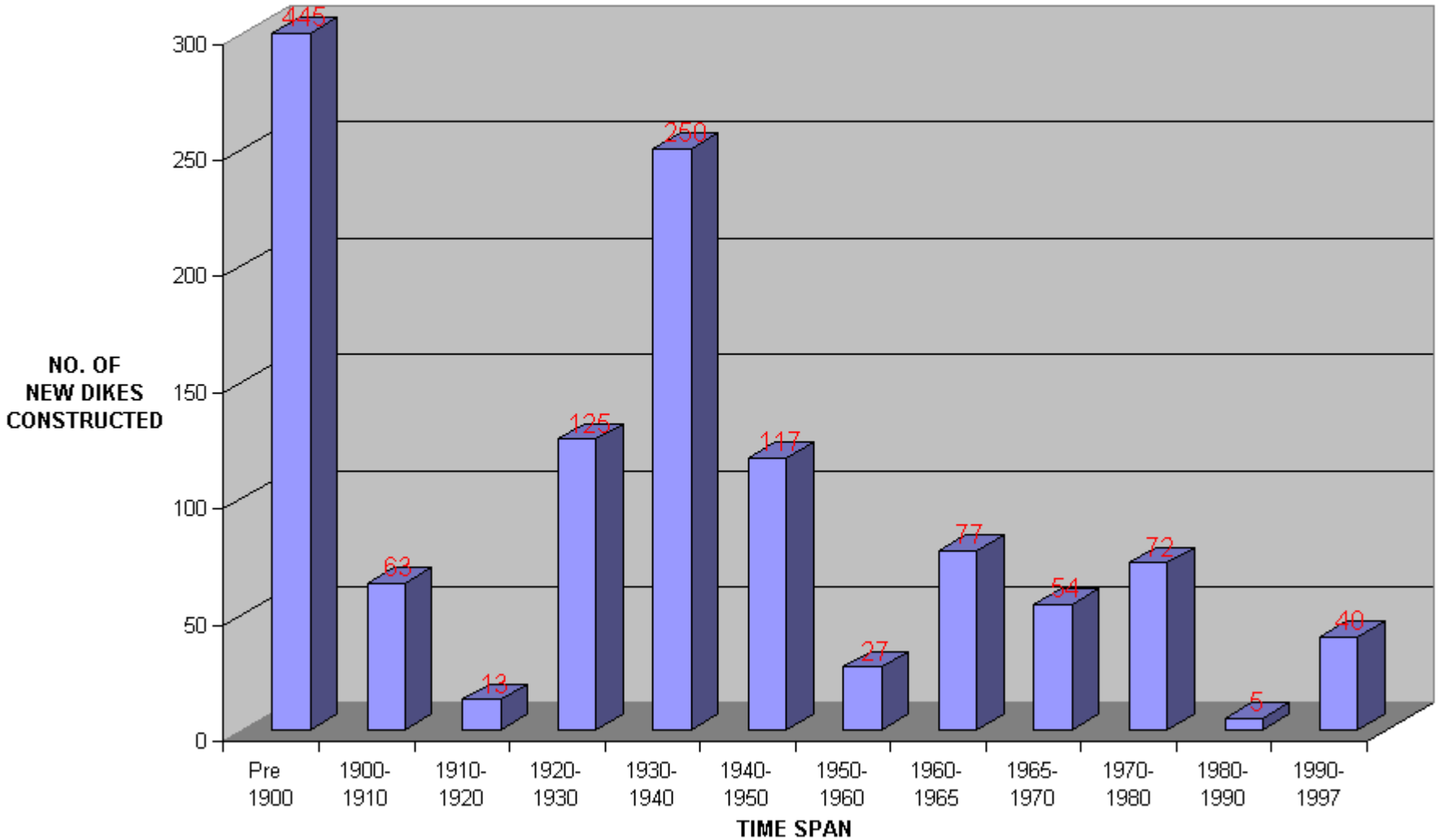


Chart1 Chart2 Chart3 Chart4 Chart5 Chart6 Chart7 Chart8 Sheet1 Sheet2

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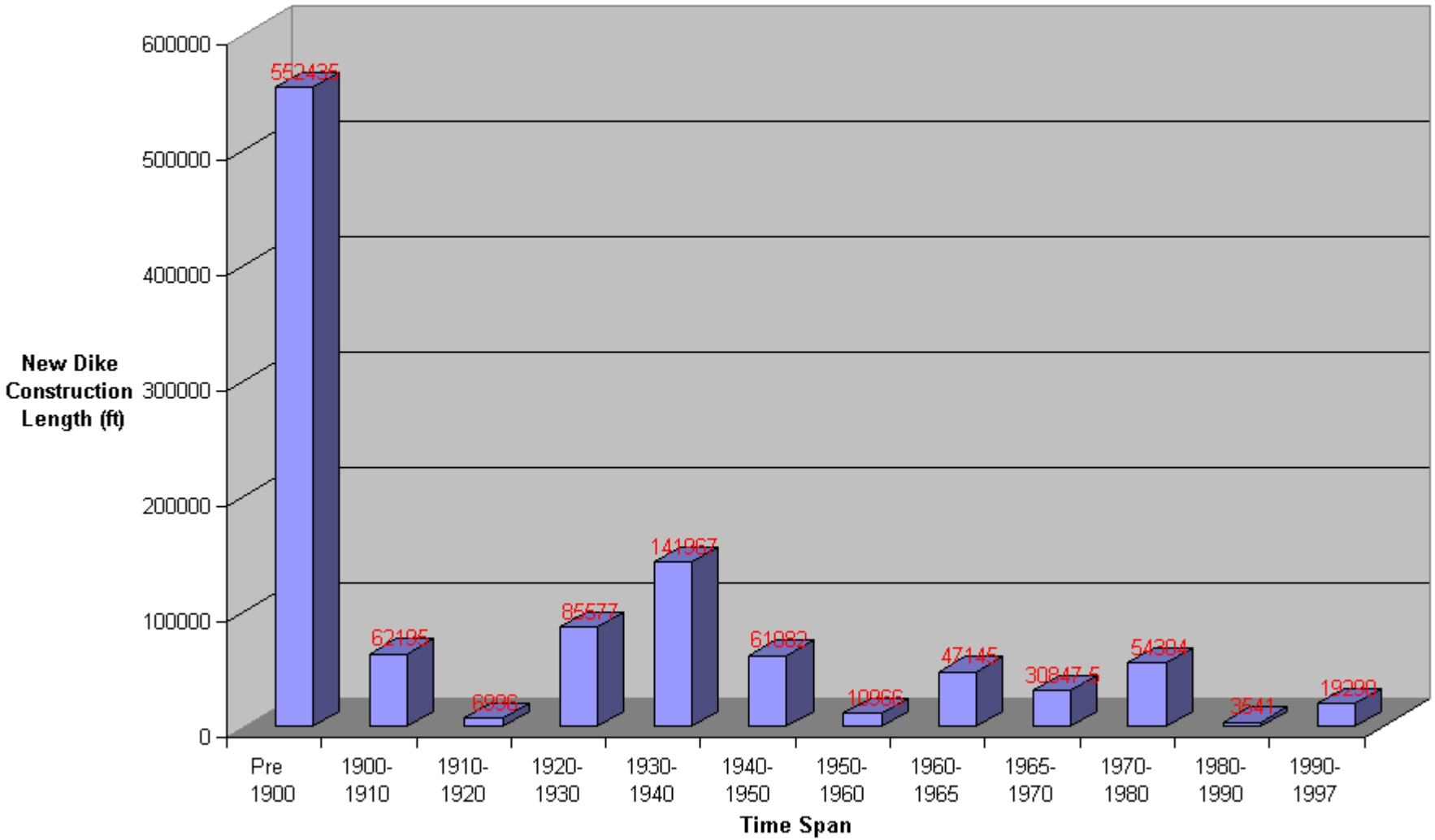
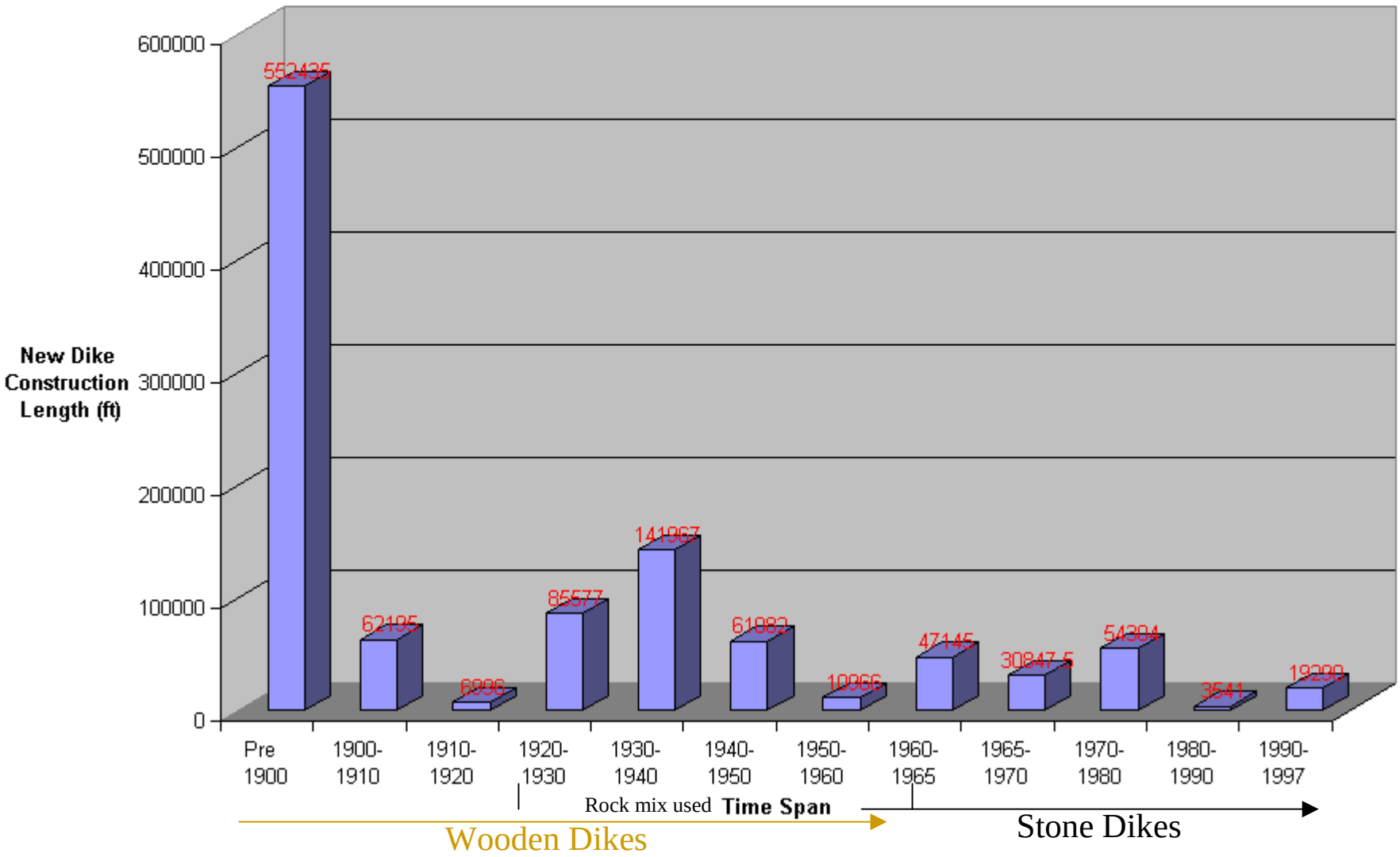


Chart1 | Chart2 | Chart3 | Chart4 | Chart5 | Chart6 | Chart7 | Chart8 | Sheet1 | Sheet2

Microsoft Excel - DECADEvsCONSTRUCTION.xls

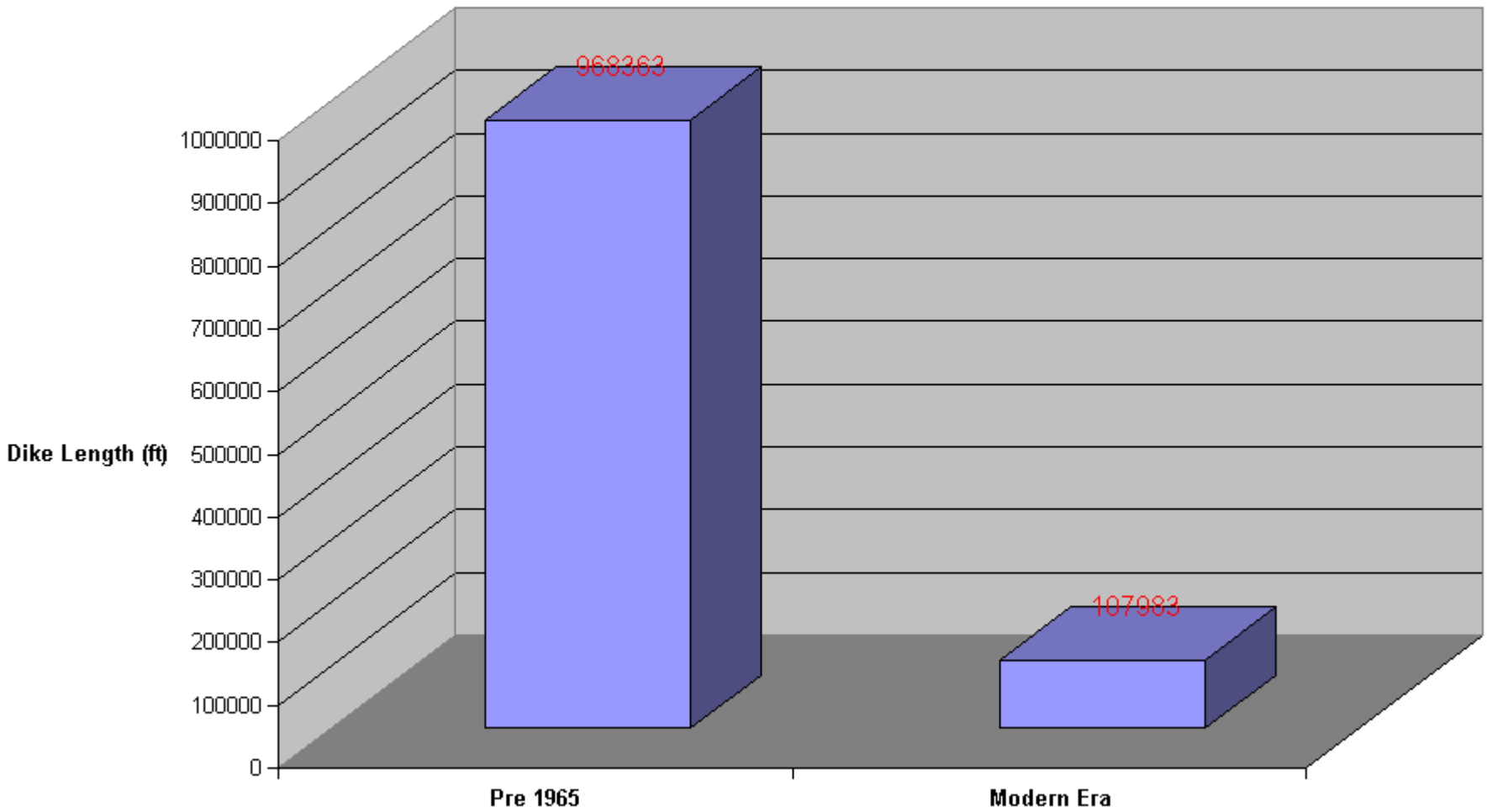
File Edit View Insert Format Tools Chart Window Help

New Dike Length Construction vs. Time St. Louis to Cairo

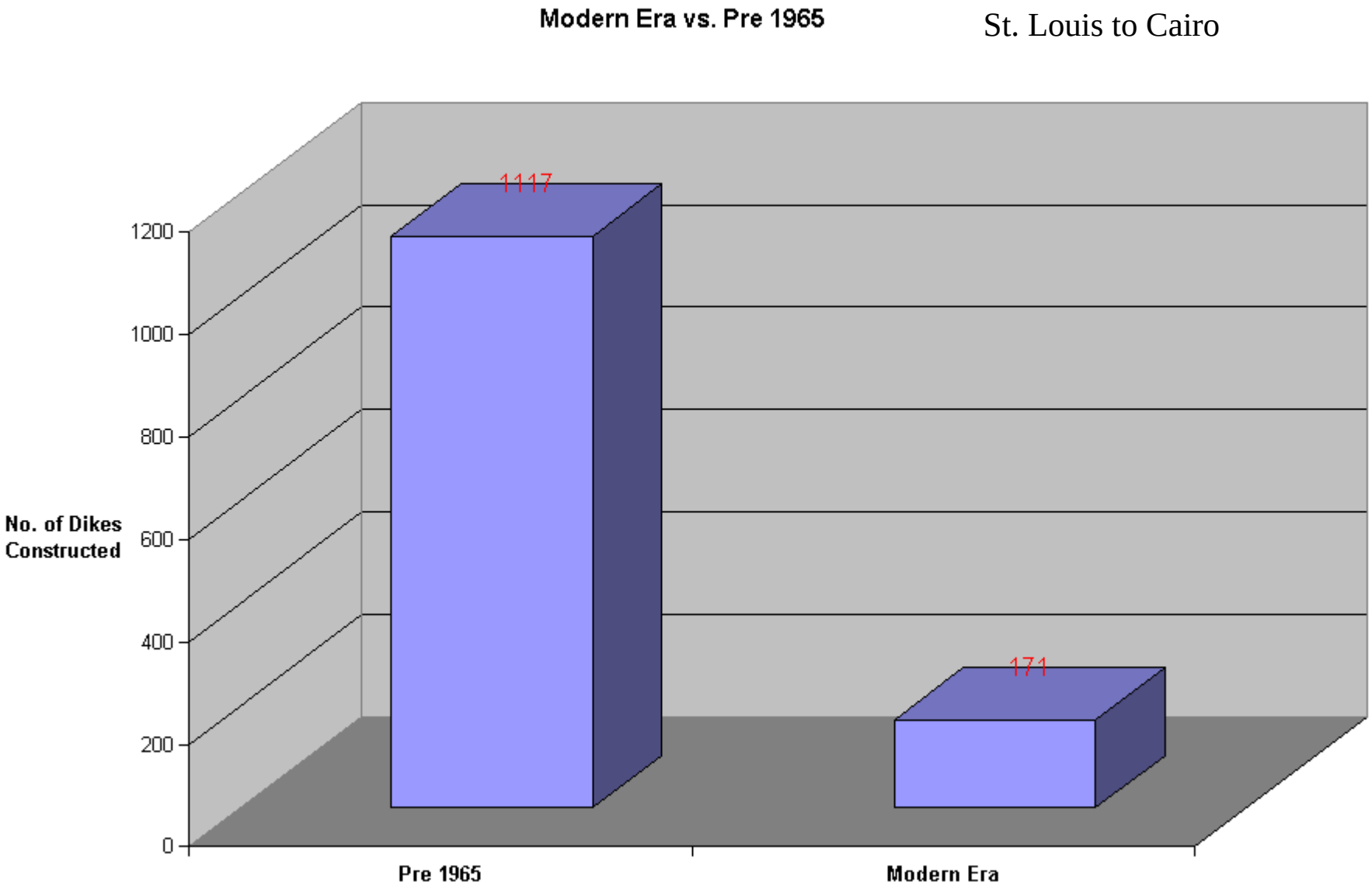


Modern Era vs Pre 1965

St. Louis to Cairo



St. Louis to Cairo



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St. Louis to Cairo

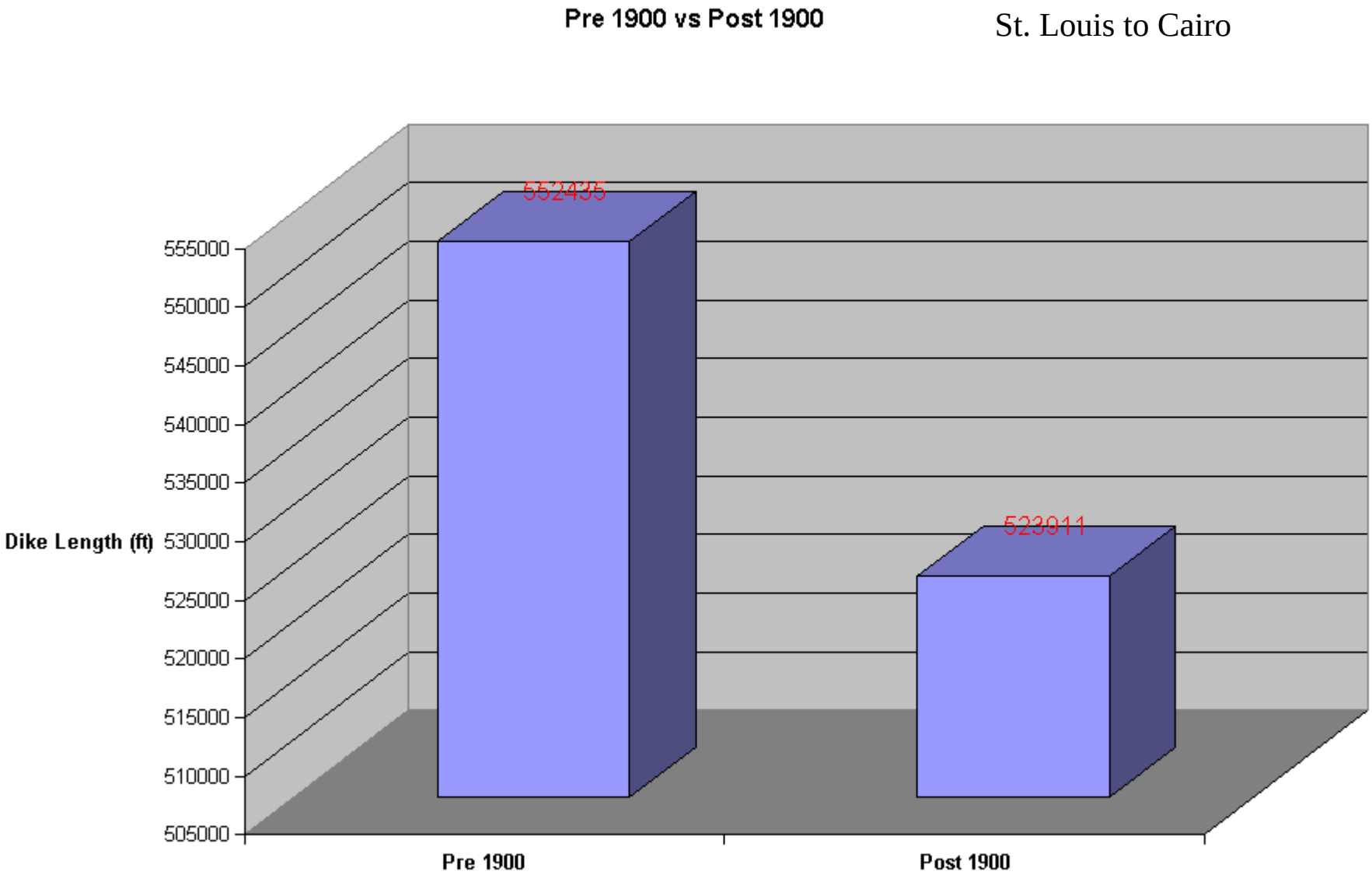
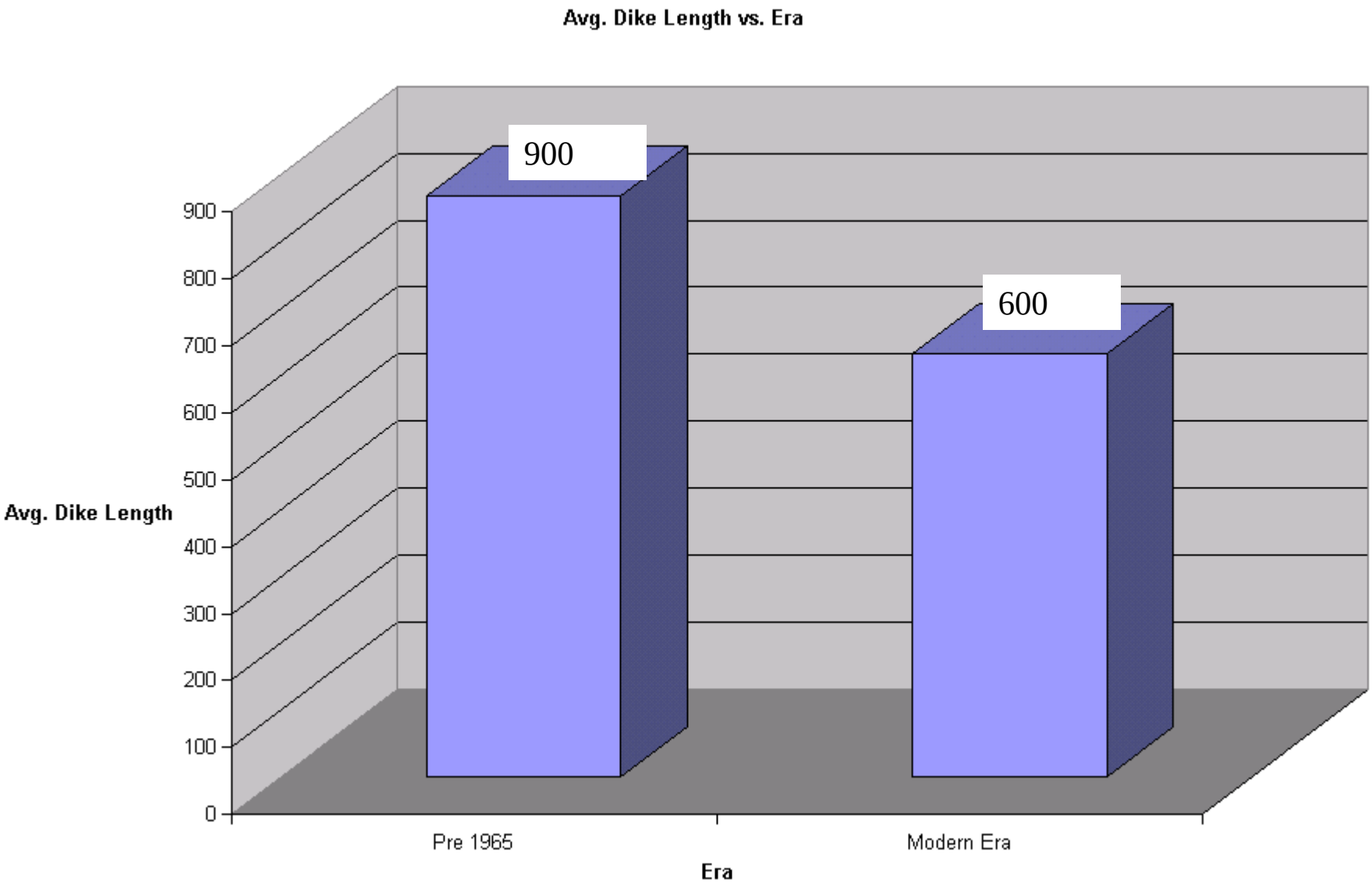
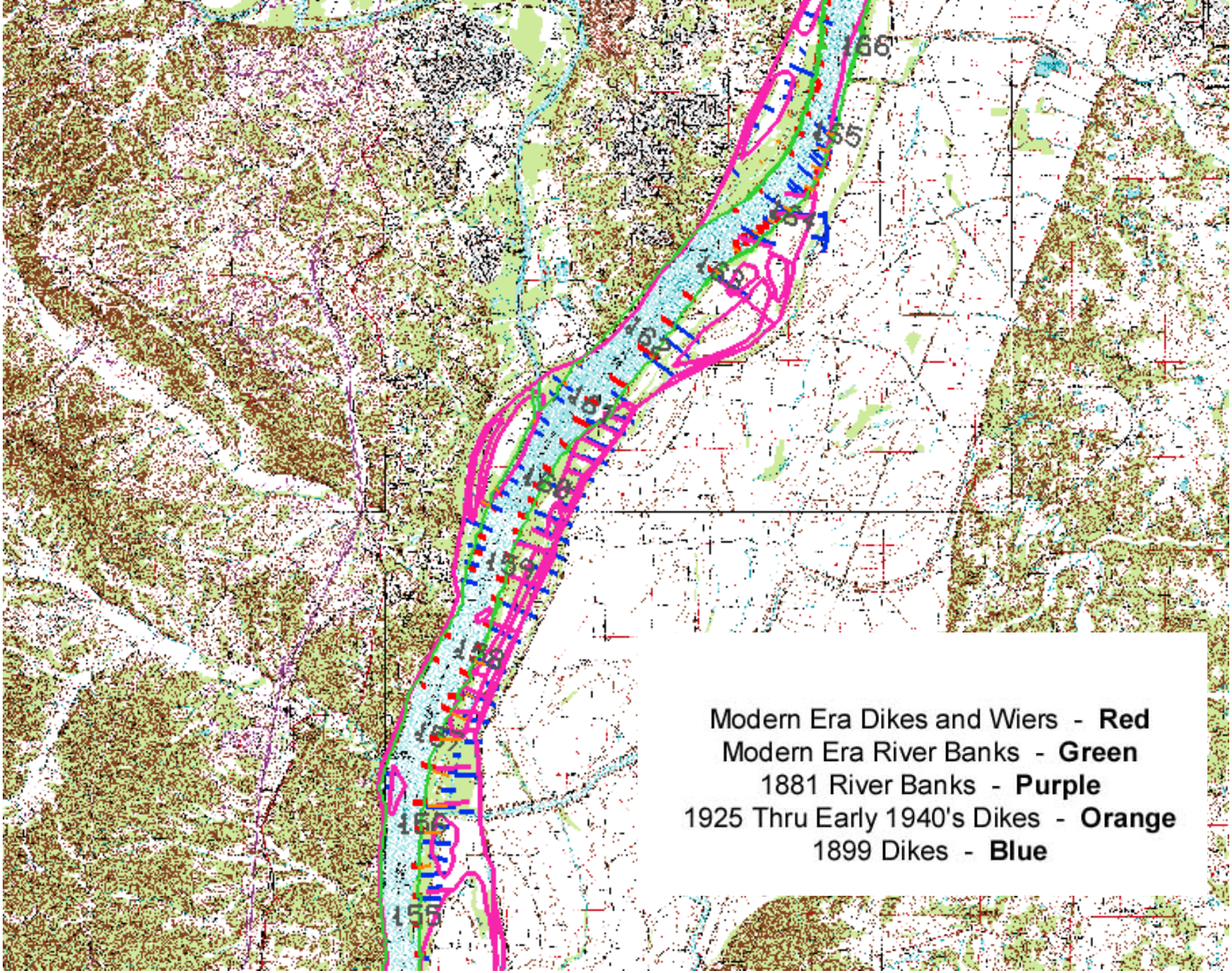
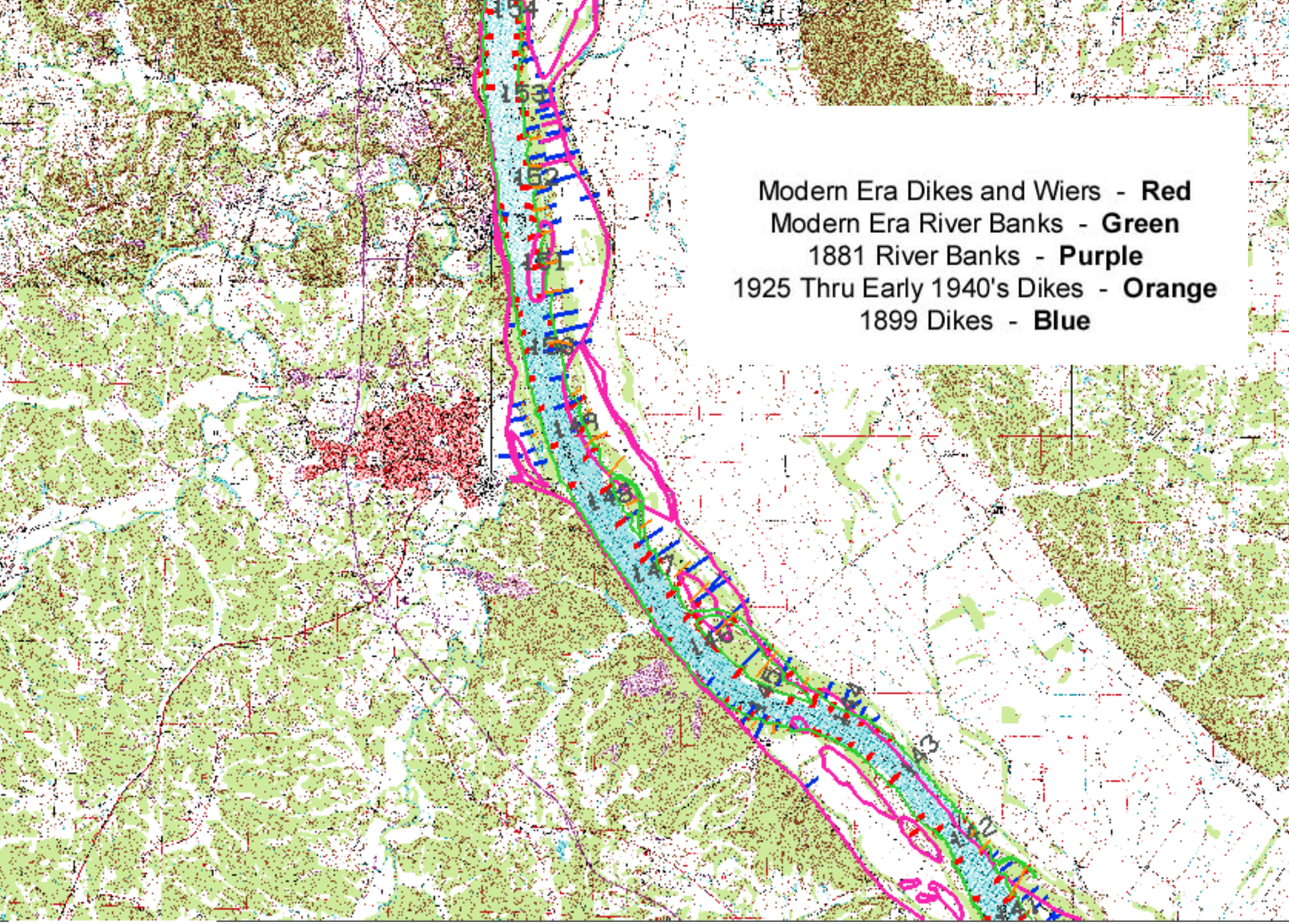


Chart1 Chart2 Chart3 Chart4 Chart5 Chart6 Chart7 Chart8 Sheet1 Sheet2


Avg. Dike Length vs. Era
900
600
900
800
700
600
500
400
300
200
100
0
Avg. Dike Length
Pre 1965
Modern Era
Era


Modern Era Dikes and Wiers - **Red**
Modern Era River Banks - **Green**
1881 River Banks - **Purple**
1925 Thru Early 1940's Dikes - **Orange**
1899 Dikes - **Blue**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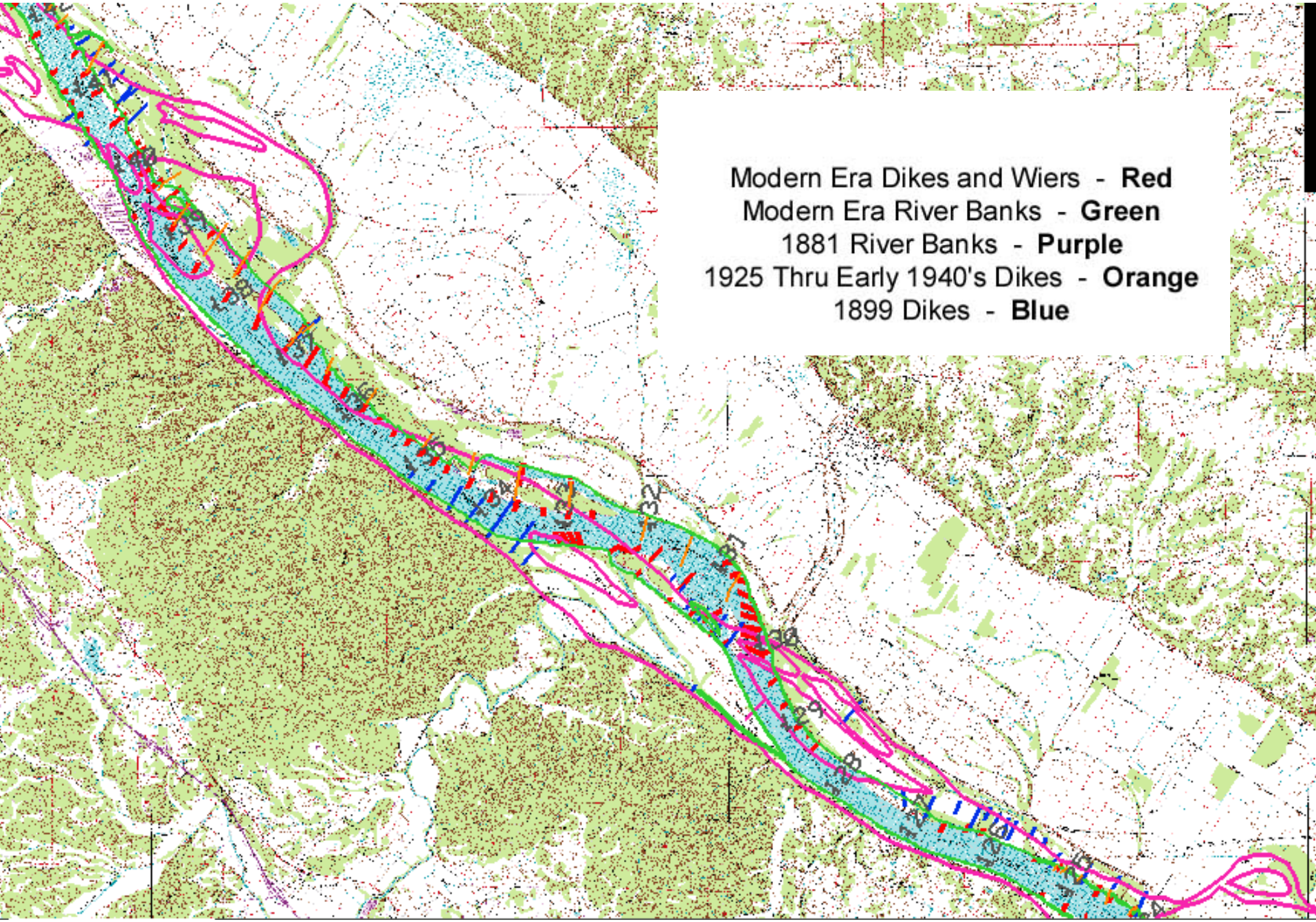
Modern Era River Banks - **Green**
1881 River Banks - **Purple**
1925 Thru Early 1940's Dikes - **Orange**
1899 Dikes - **Blue**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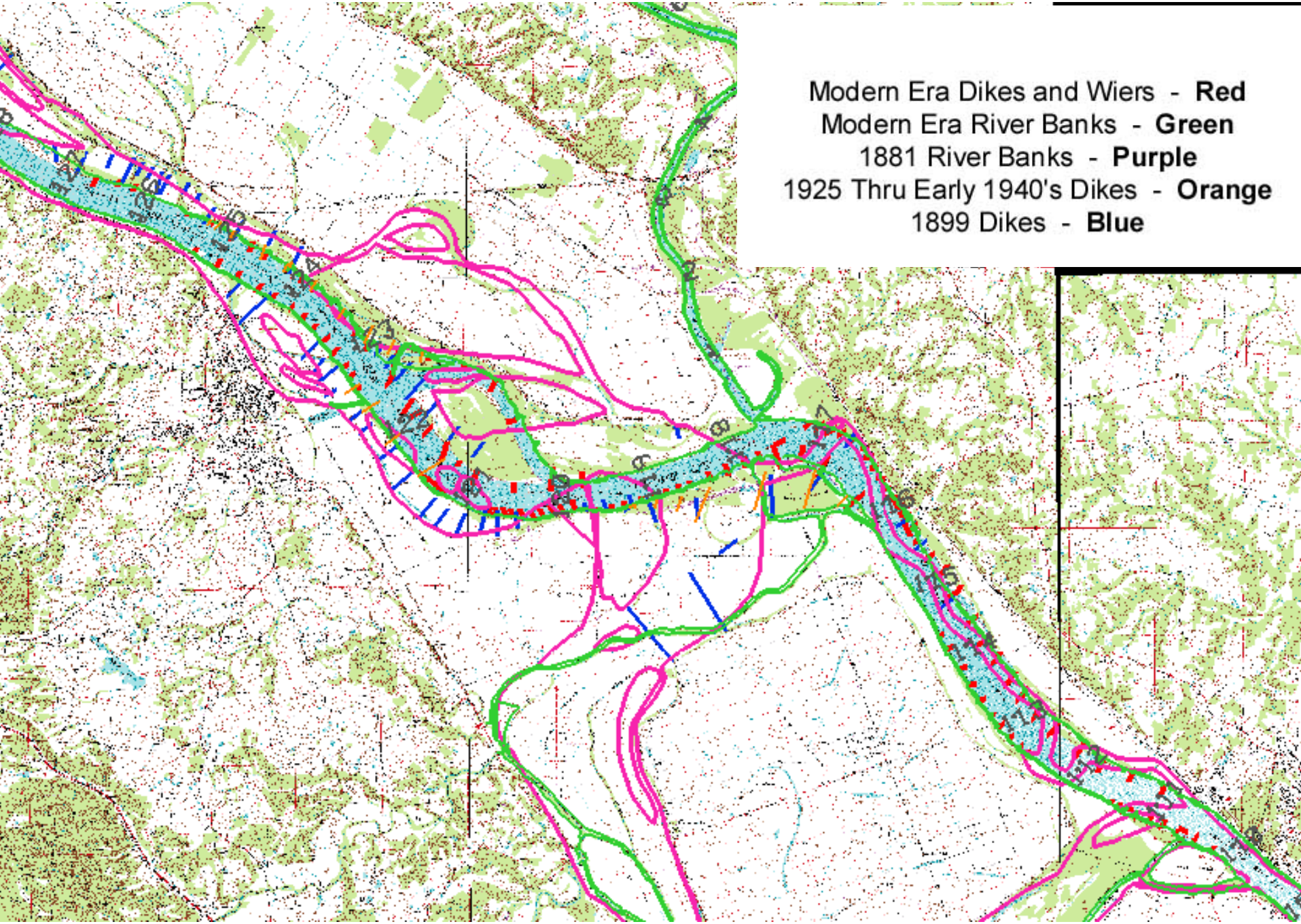
1925 Thru Early 1940's Dikes - **Orange**
1899 Dikes - **Blue**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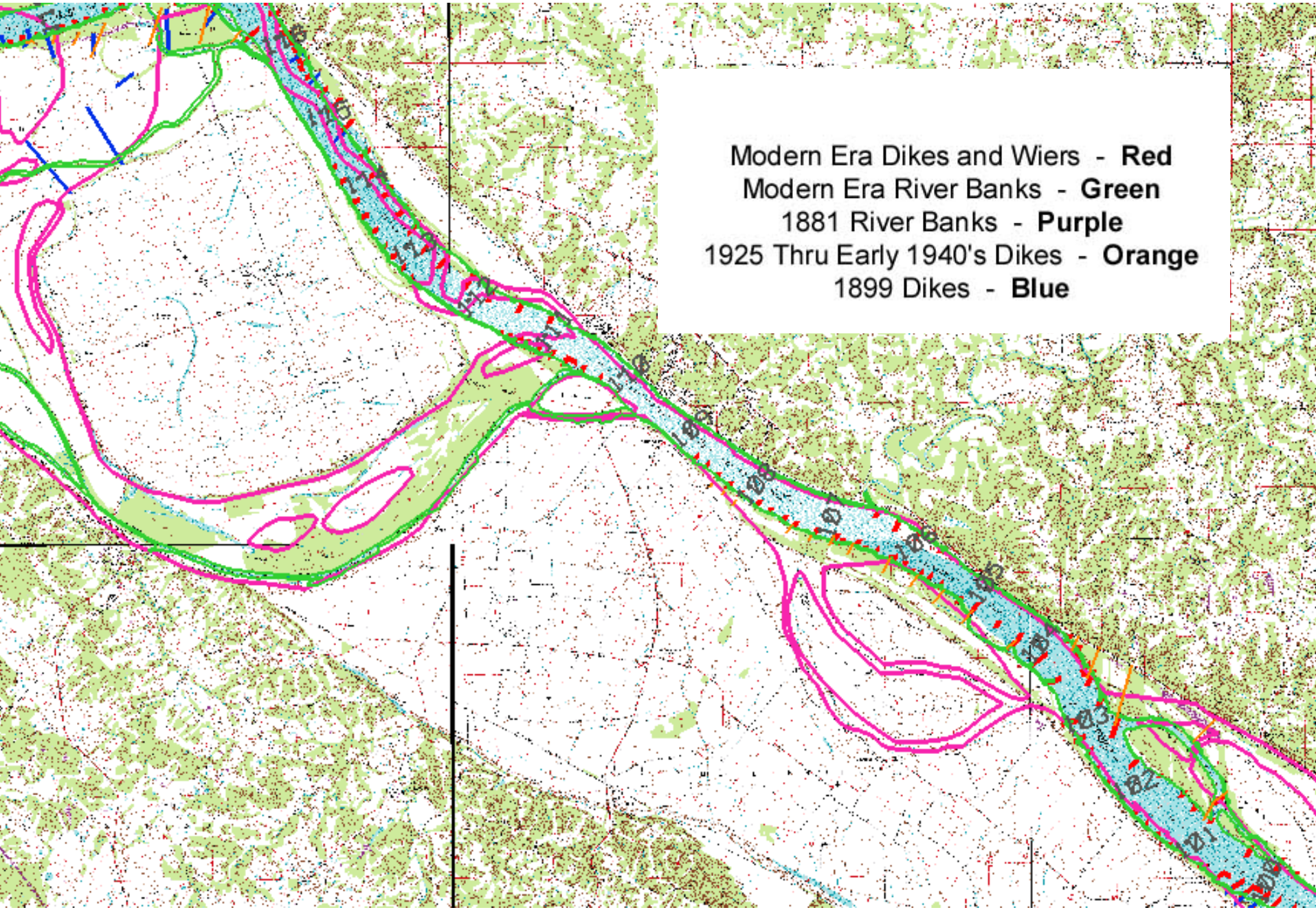
1899 Dikes - **Blue**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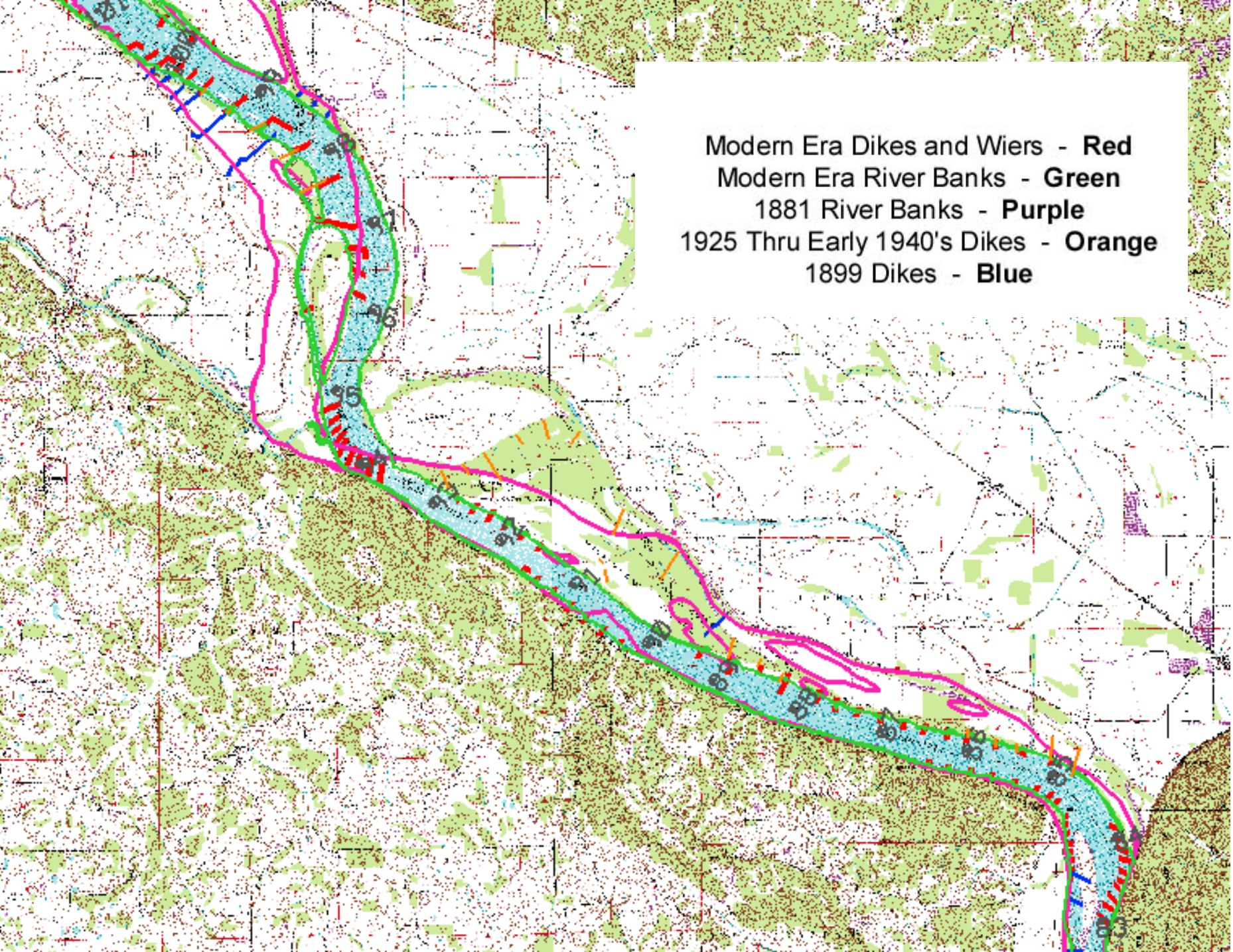
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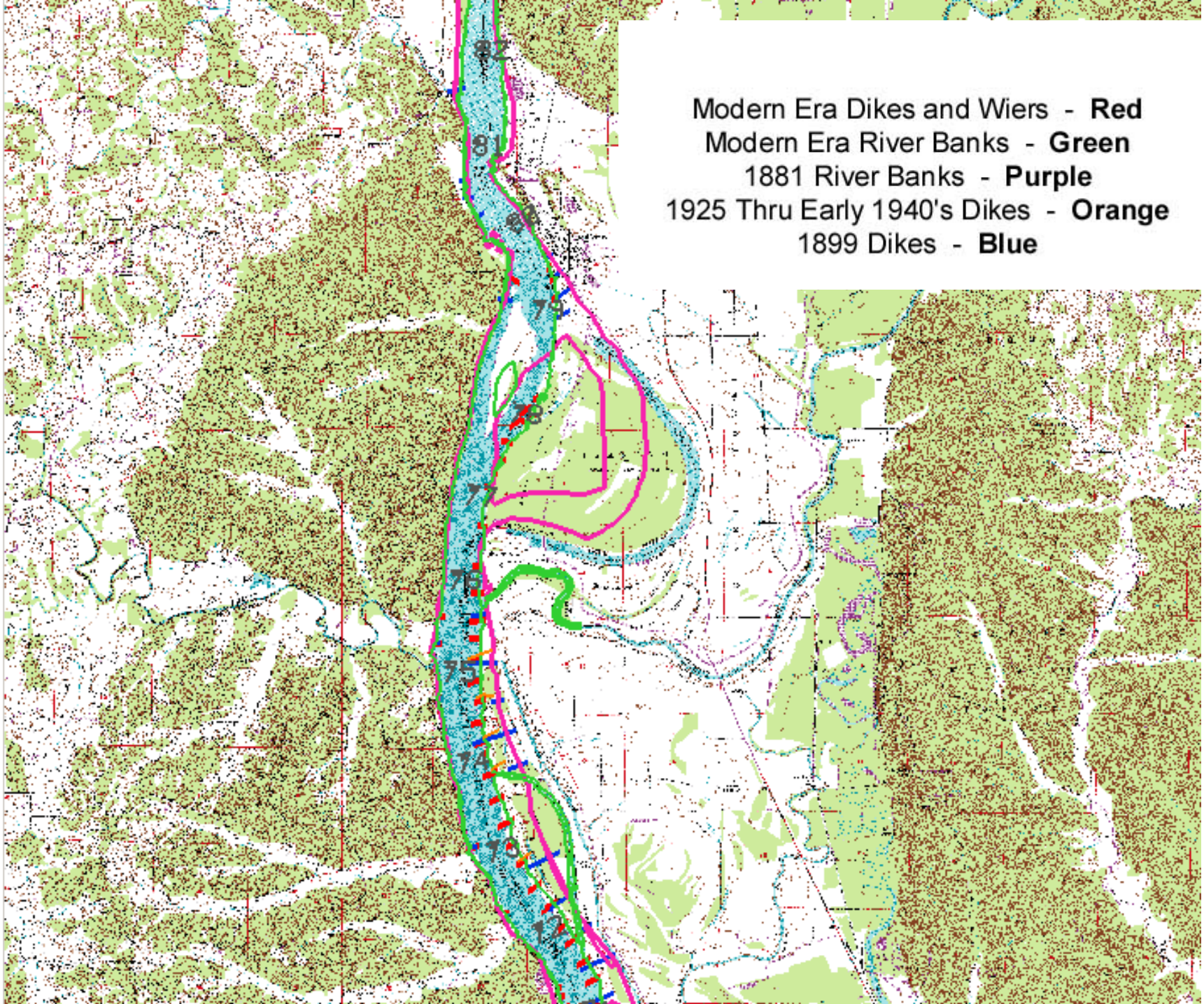
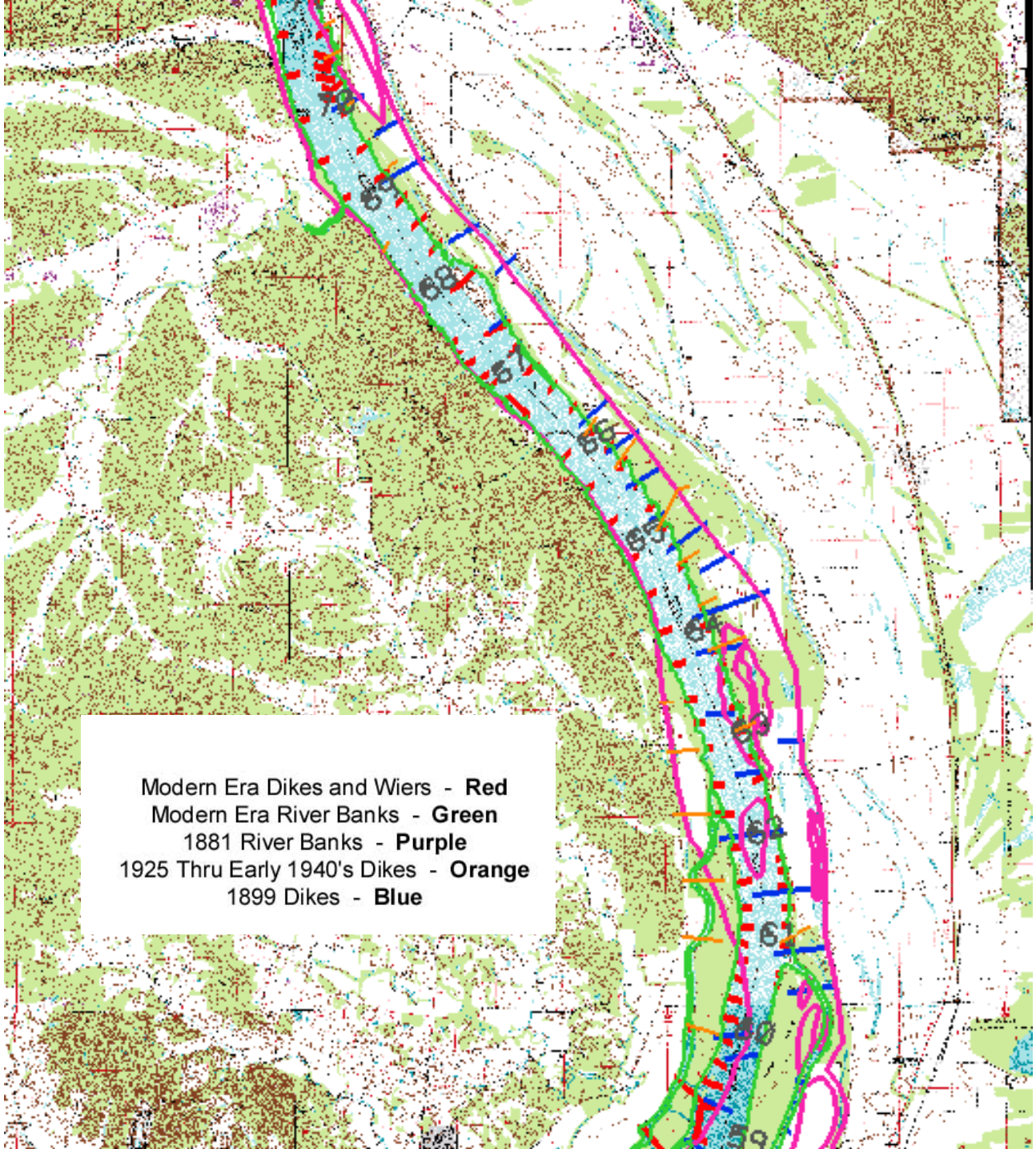

Modern Era Dikes and Wiers - Red
Modern Era River Banks - Green
1881 River Banks - Purple
1925 Thru Early 1940's Dikes - Orange
1899 Dikes - Blue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1925 Thru Early 1940's Dikes - **Orange**
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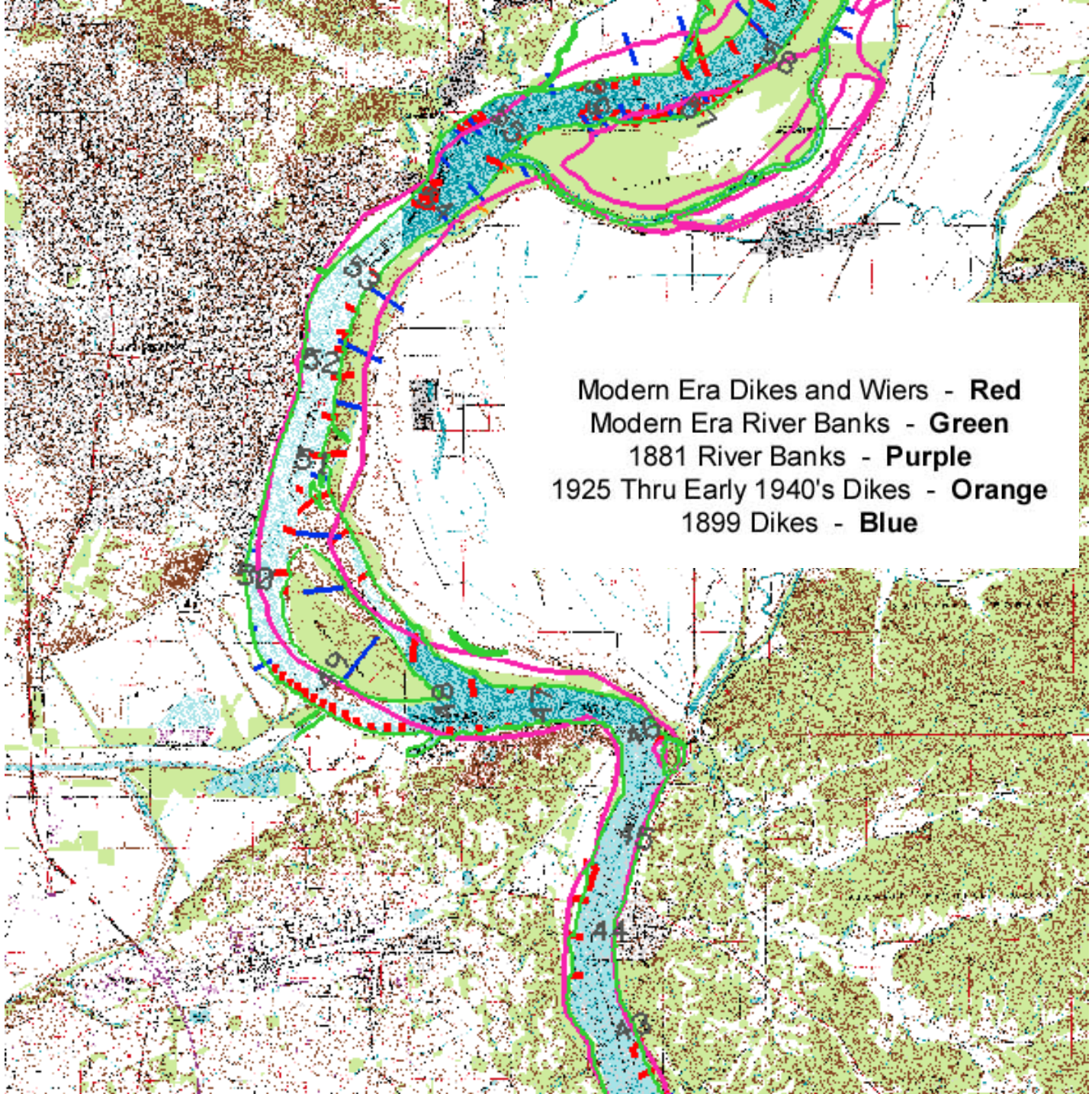
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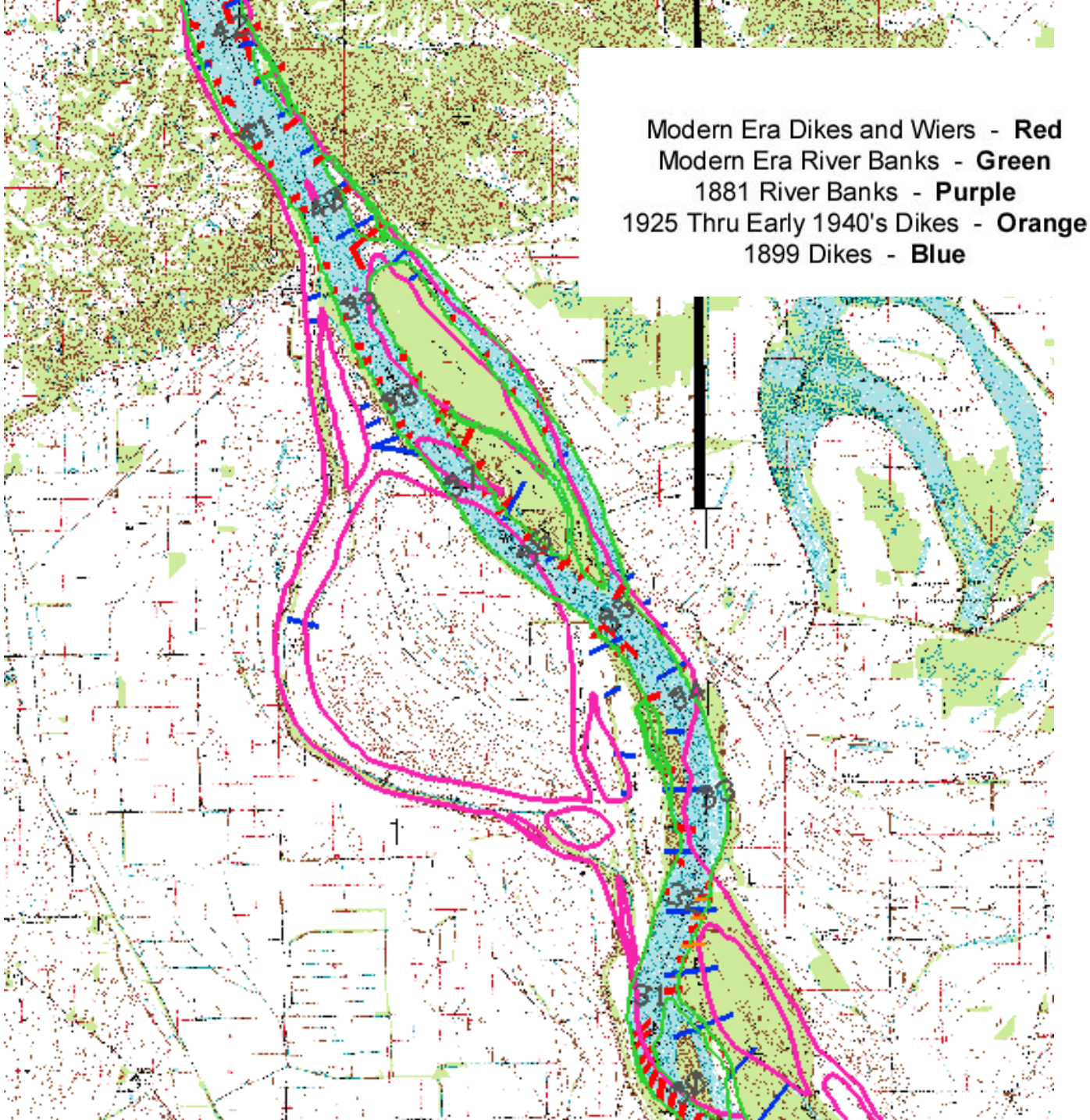
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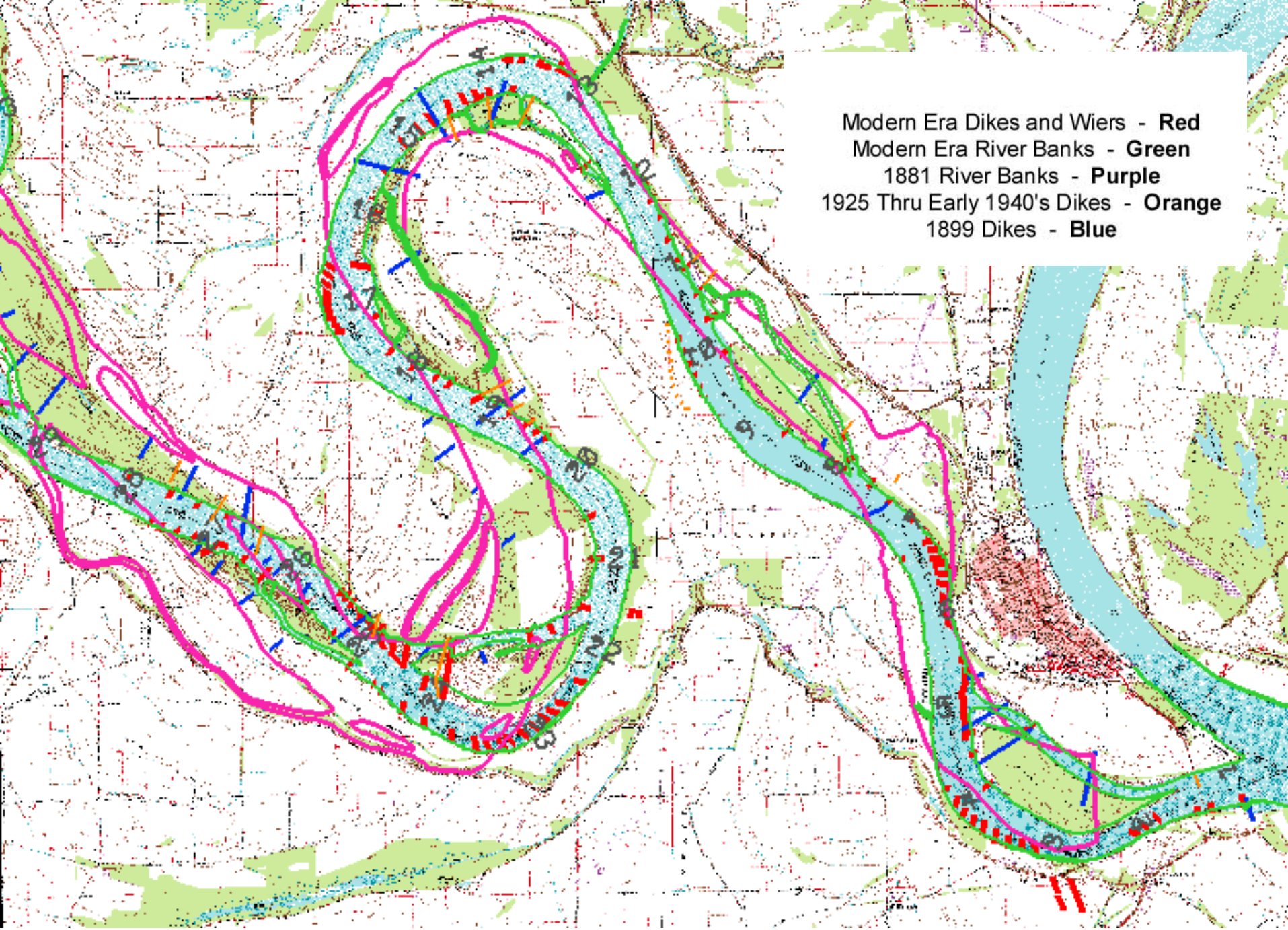
1881 River Banks - **Purple**
1925 Thru Early 1940's Dikes - **Orange**
1899 Dikes - **Blue**


Modern Era Dikes and Wiers - **Red**
Modern Era River Banks - **Green**
1881 River Banks - **Purple**
1925 Thru Early 1940's Dikes - **Orange**
1899 Dikes - **Blue**

Middle Mississippi River

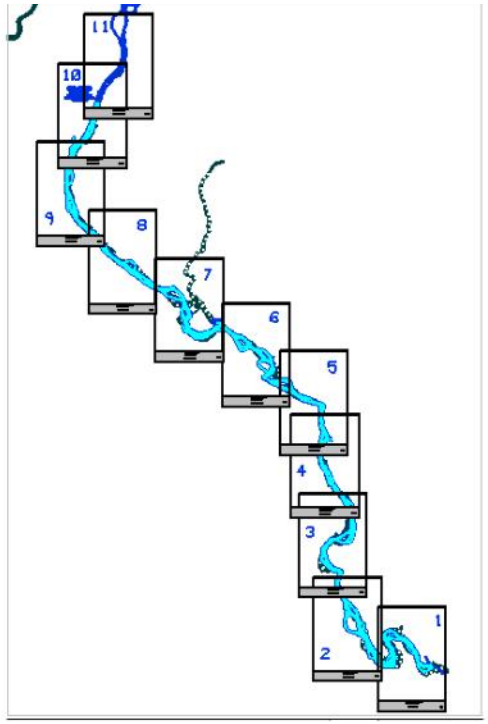
Historical River Morphology

1817 versus 1994 Maps

APPLIED RIVER ENGINEERING CENTER

March 2003

US Army Corps of Engineers
St. Louis District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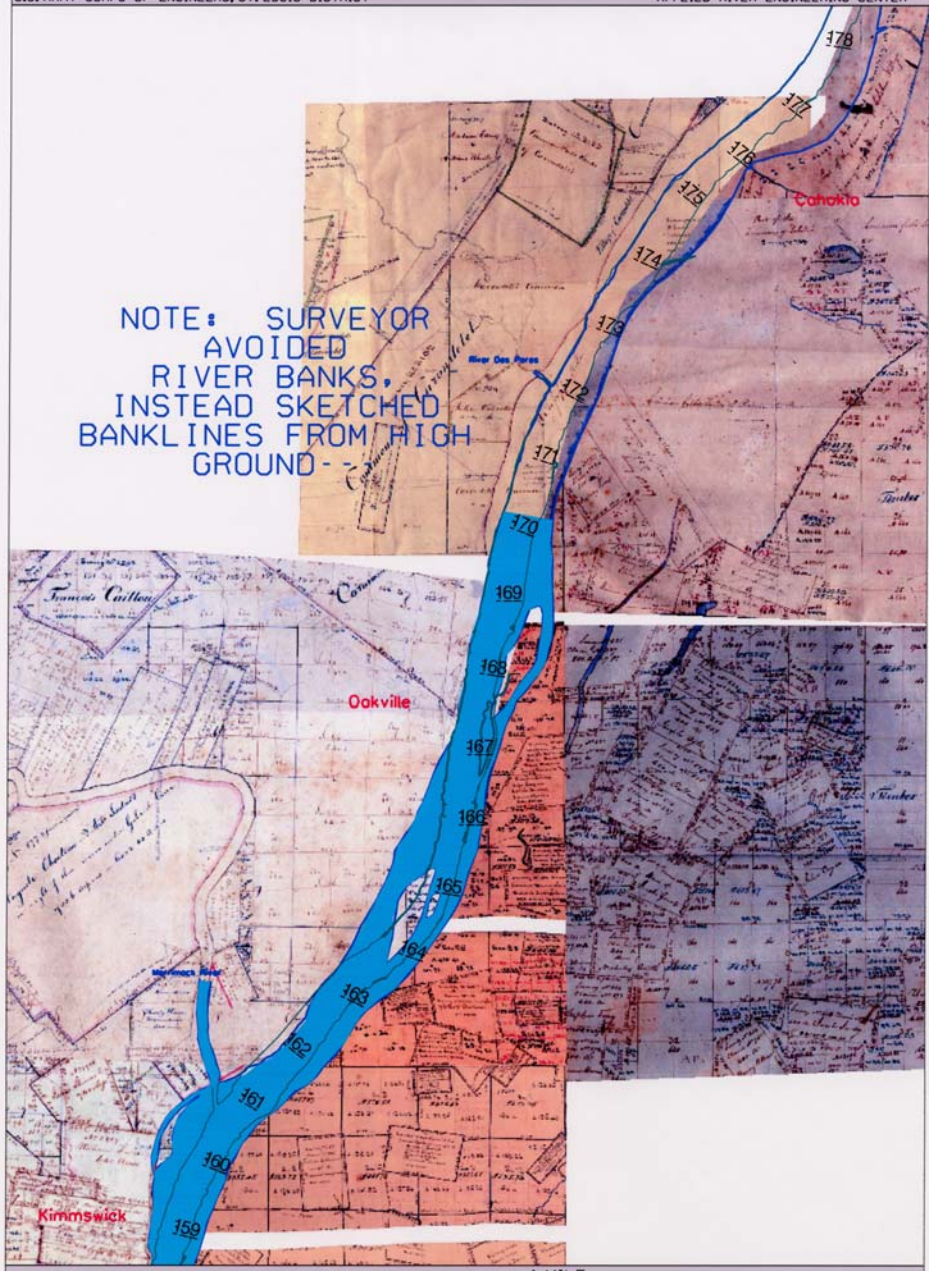
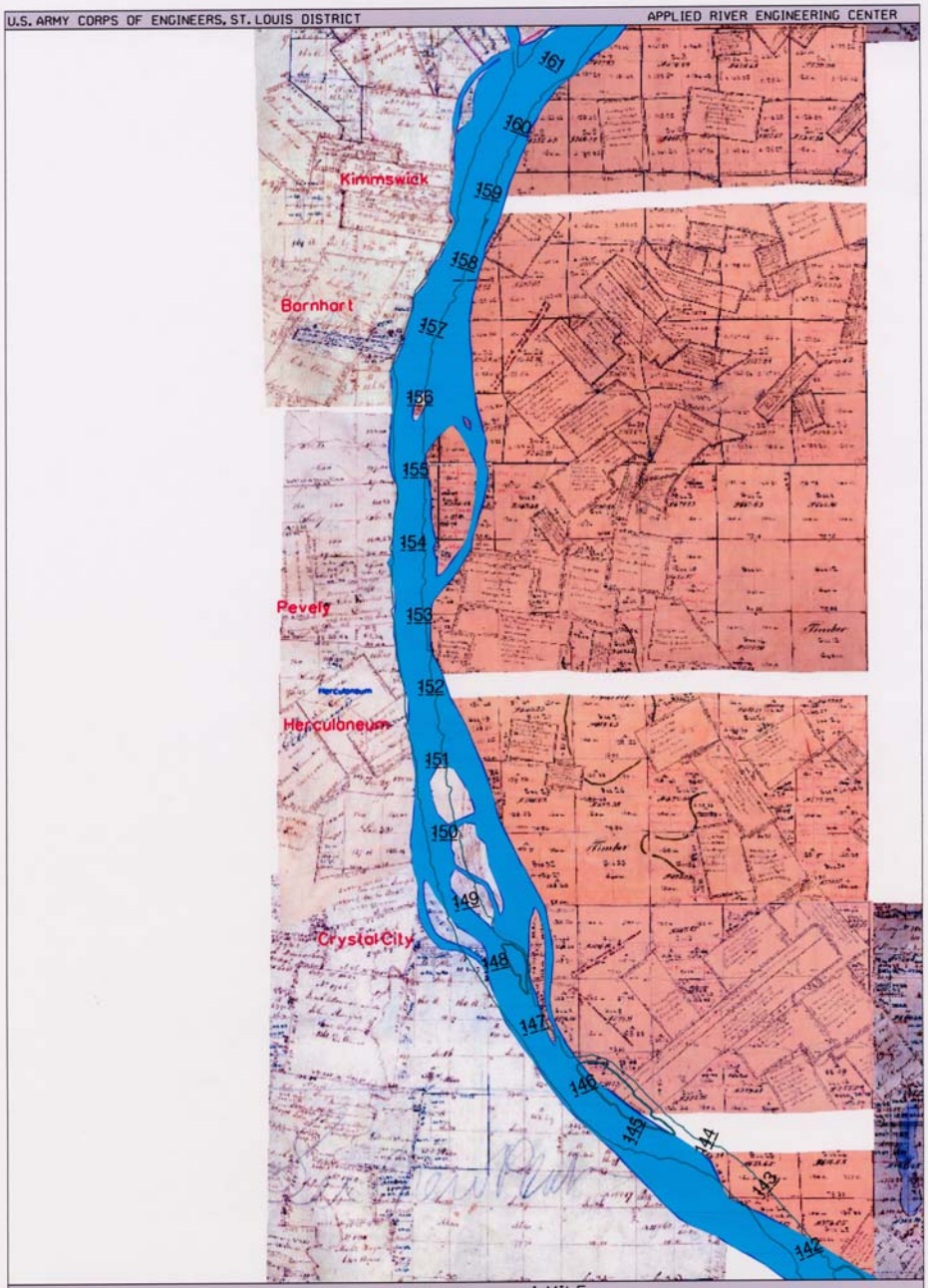
5
4
3
2
1



RIVER MILES 159-178

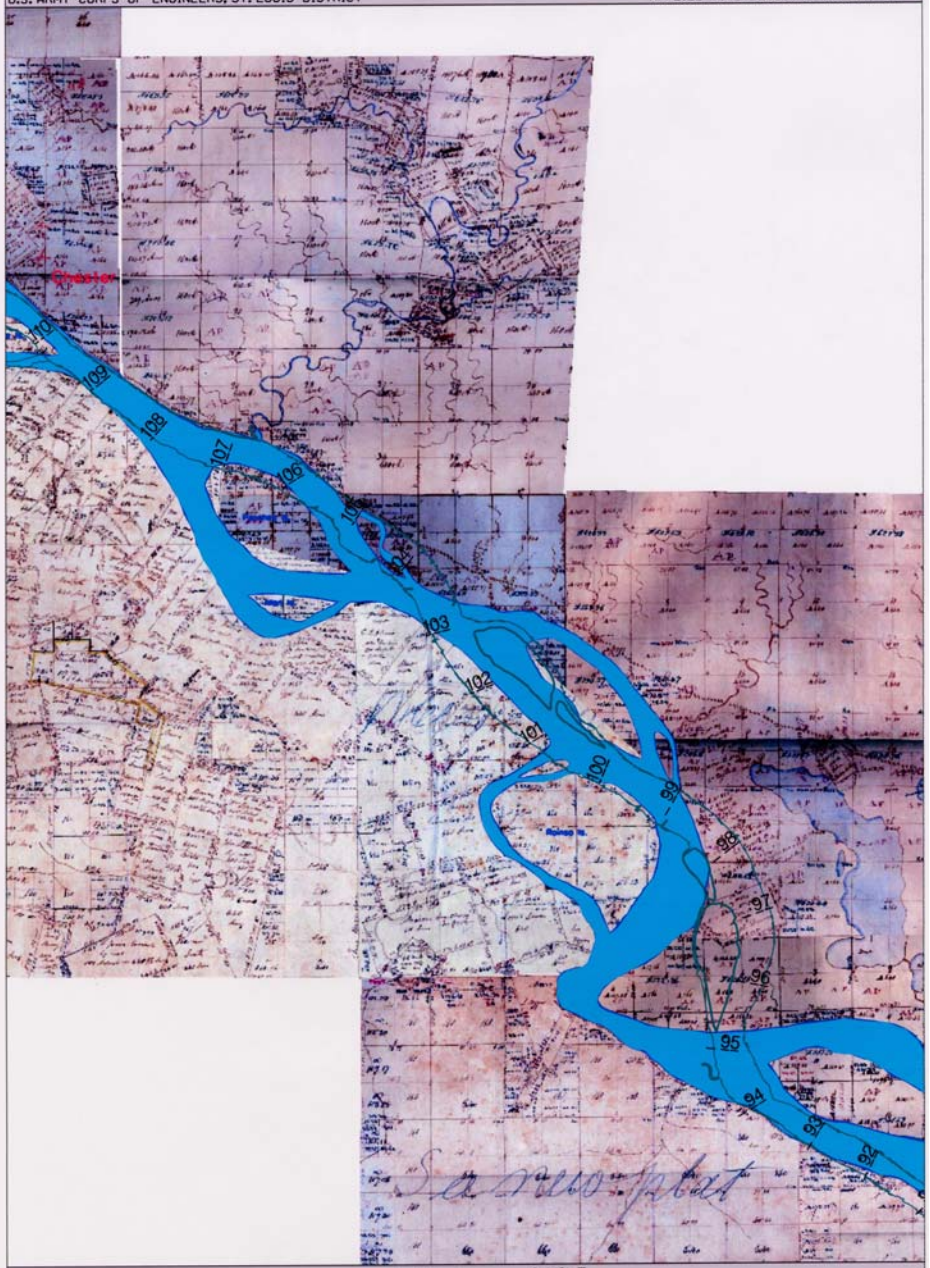


RIVER MILES 142-161

RIVER MILES 125-143

1 1/2 0 1 MILE

RIVER MILES 111-125



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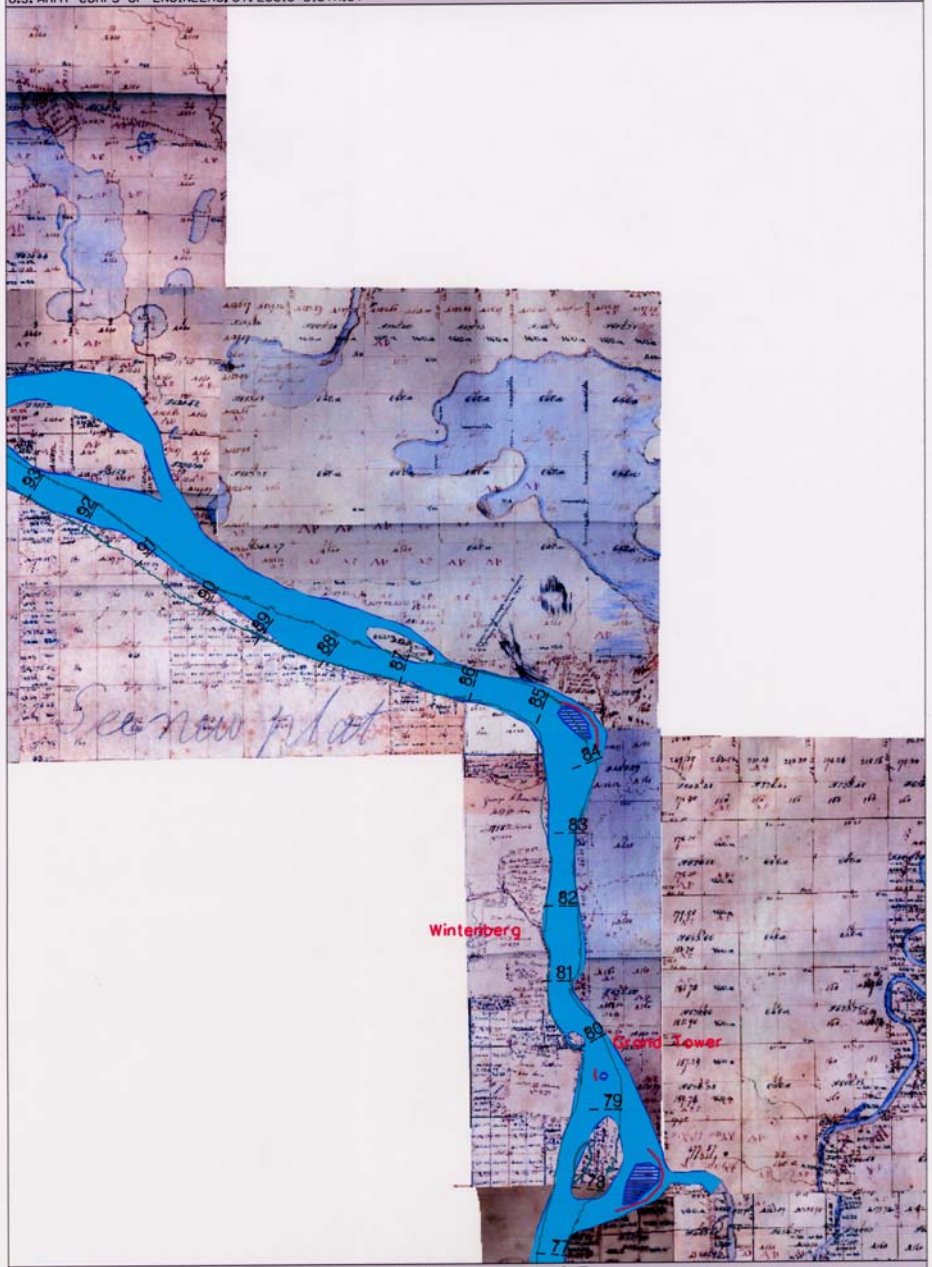

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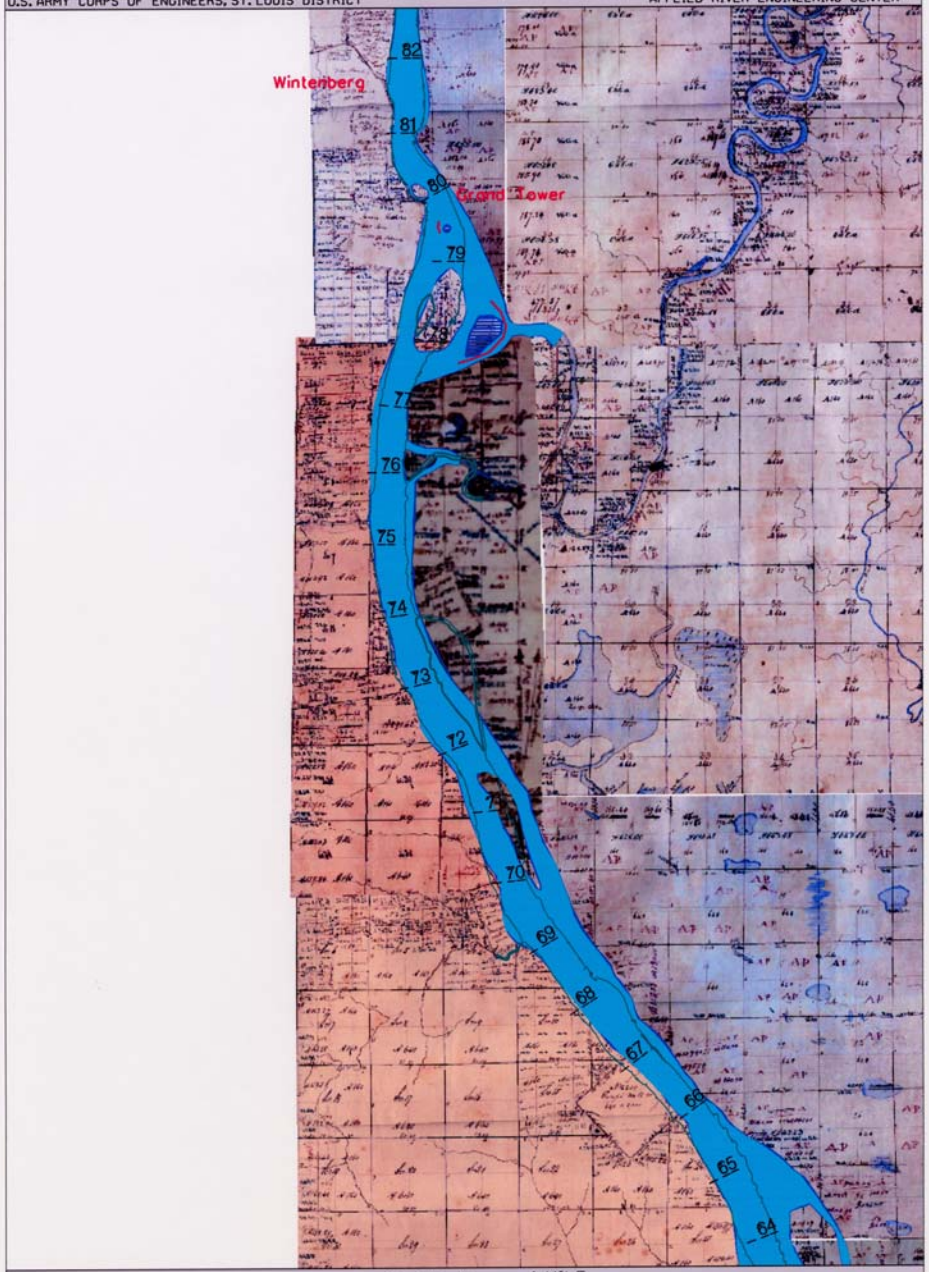
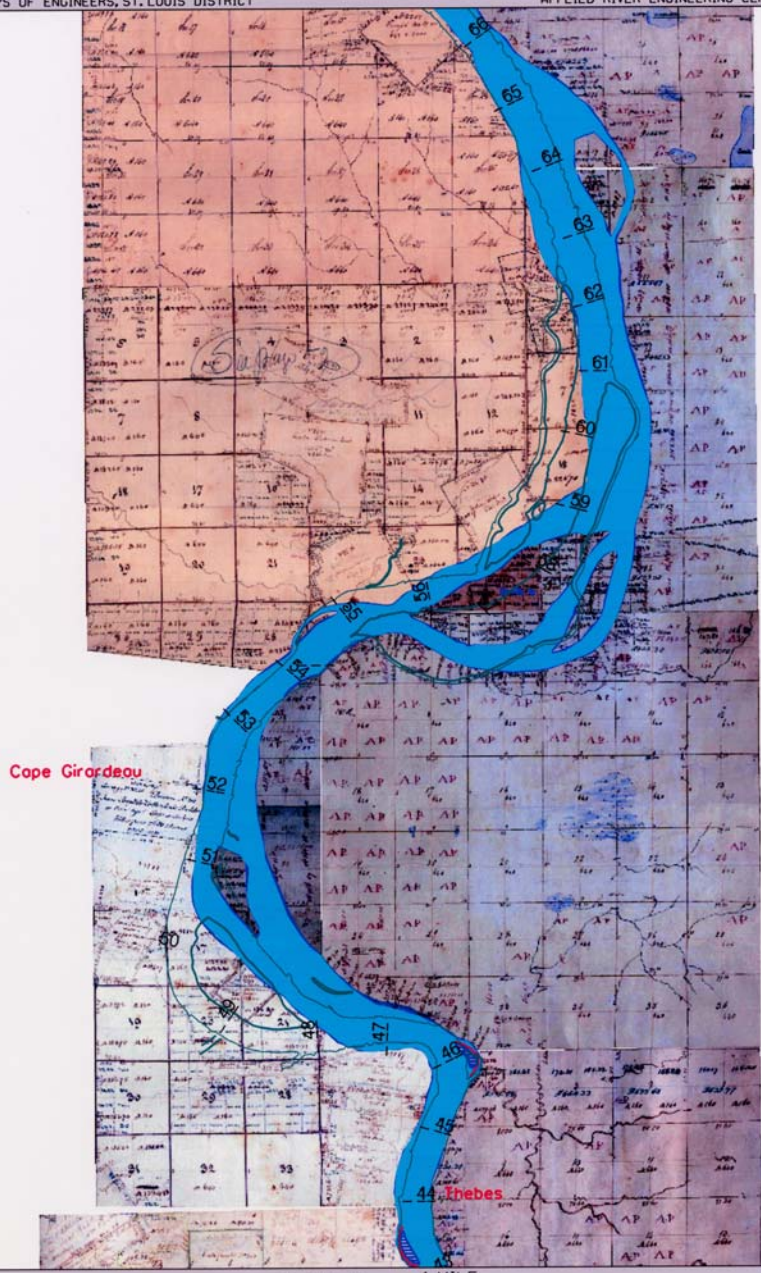
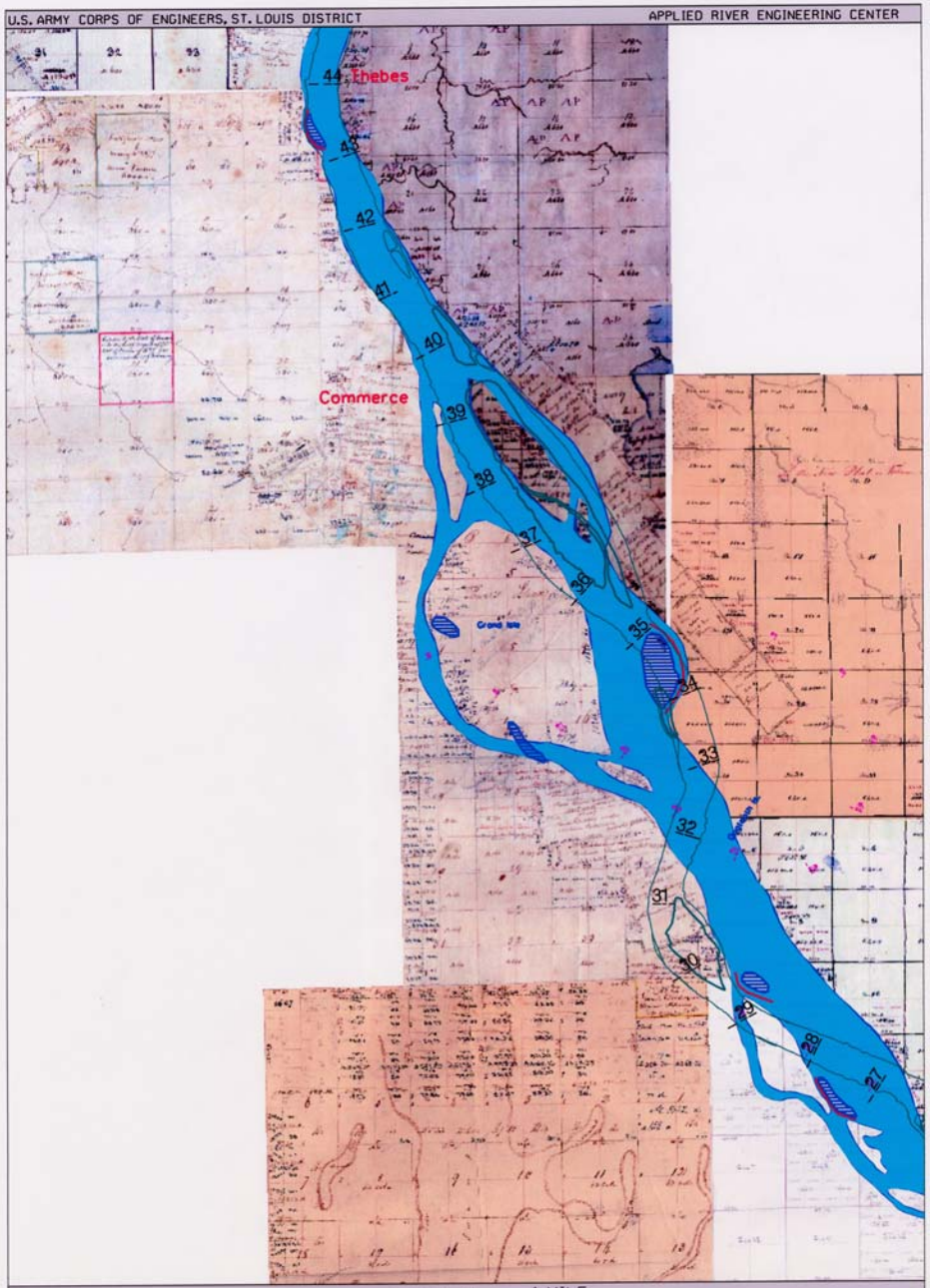
RIVER MILES 77-93



RIVER MILES 64-82



RIVER MILES 44-66



1 1/2 0 1 MILE

RIVER MILES 27-44

1 1/2 0 1 MILE

RIVER MILES 0-26

The Map Planforms Analyzed

- 1817
- 1860
- 1880
- 1899
- 1907
- 1994

File Edit View Insert Format Tools Chart Window Help

Average Planform Width

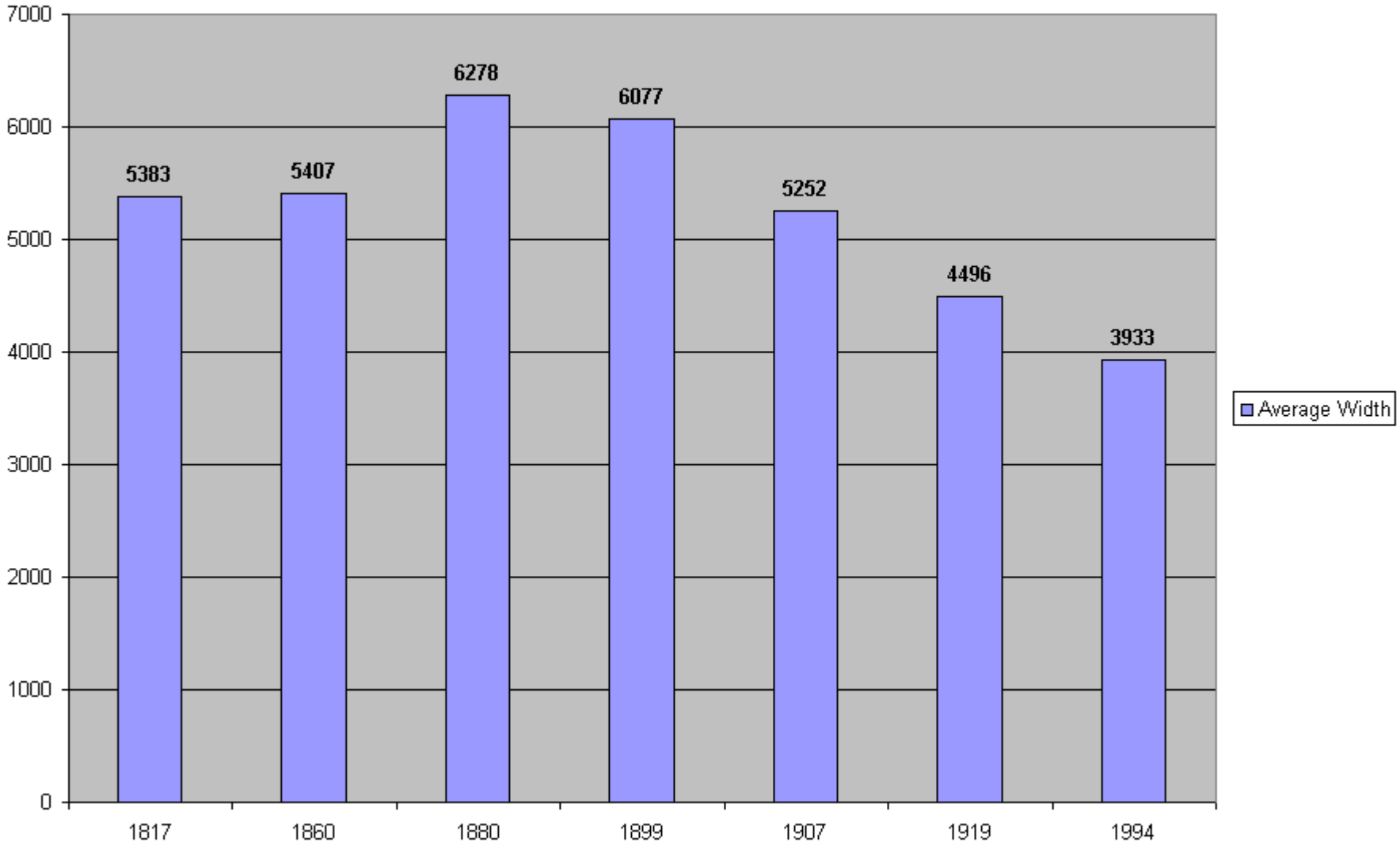


Chart2 Chart1 Planform width MILE 174 MILE 173 MILE 172 MILE 171 MILE 170 Sheet

File Edit View Insert Format Tools Chart Window Help
Arial 10
art Area

Historical Planform Widths, 1817-1994

Mississippi River, Mile 170 to Mile 0

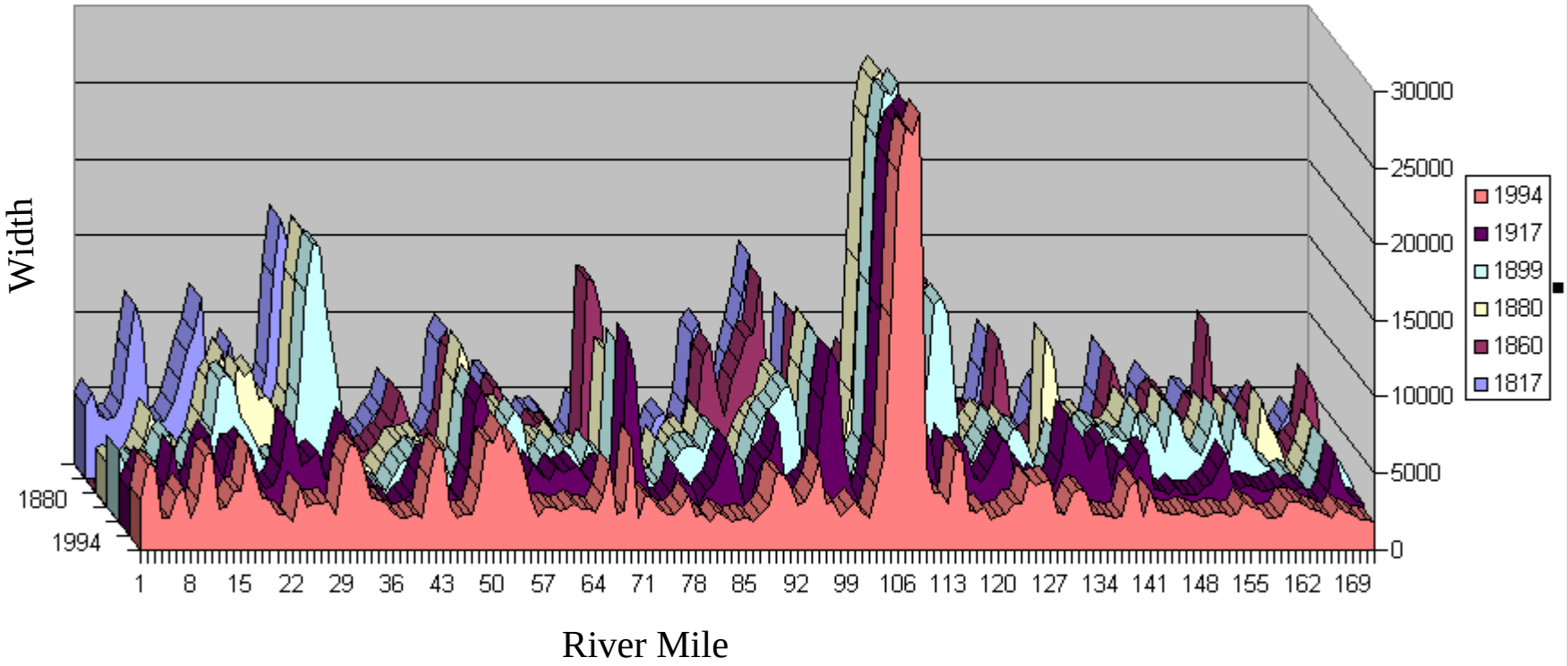
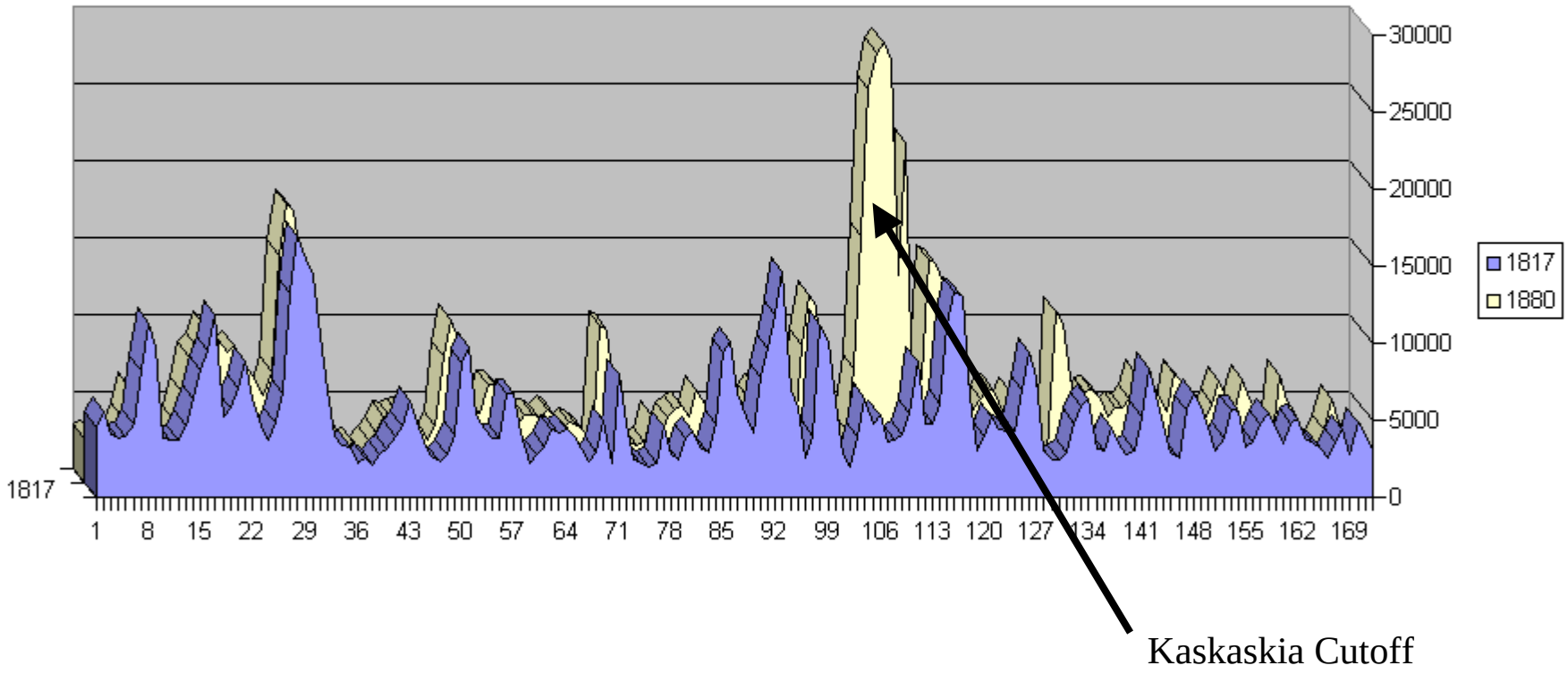
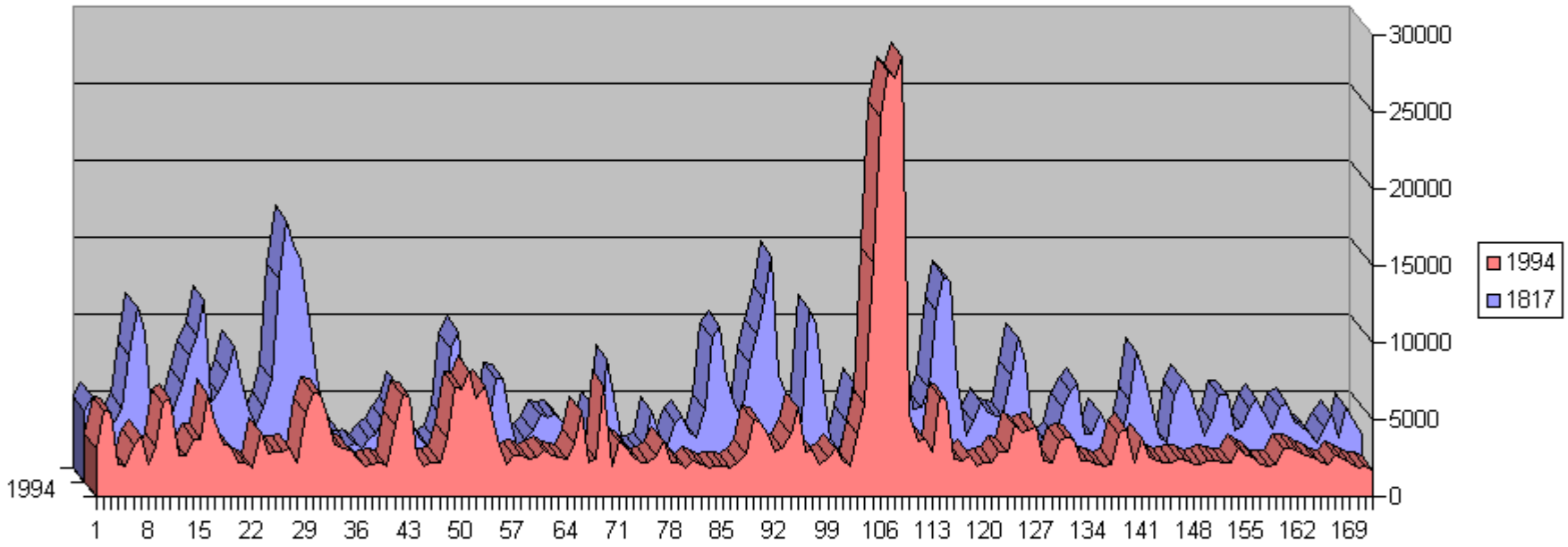


Chart2 Chart1 Sheet1 Sheet2 Sheet3 Sheet4


30000
25000
20000
15000
10000
5000
0
1817
1880
1817
1 8 15 22 29 36 43 50 57 64 71 78 85 92 99 106 113 120 127 134 141 148 155 162 169
Kaskaskia Cutoff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1994
1817
1994
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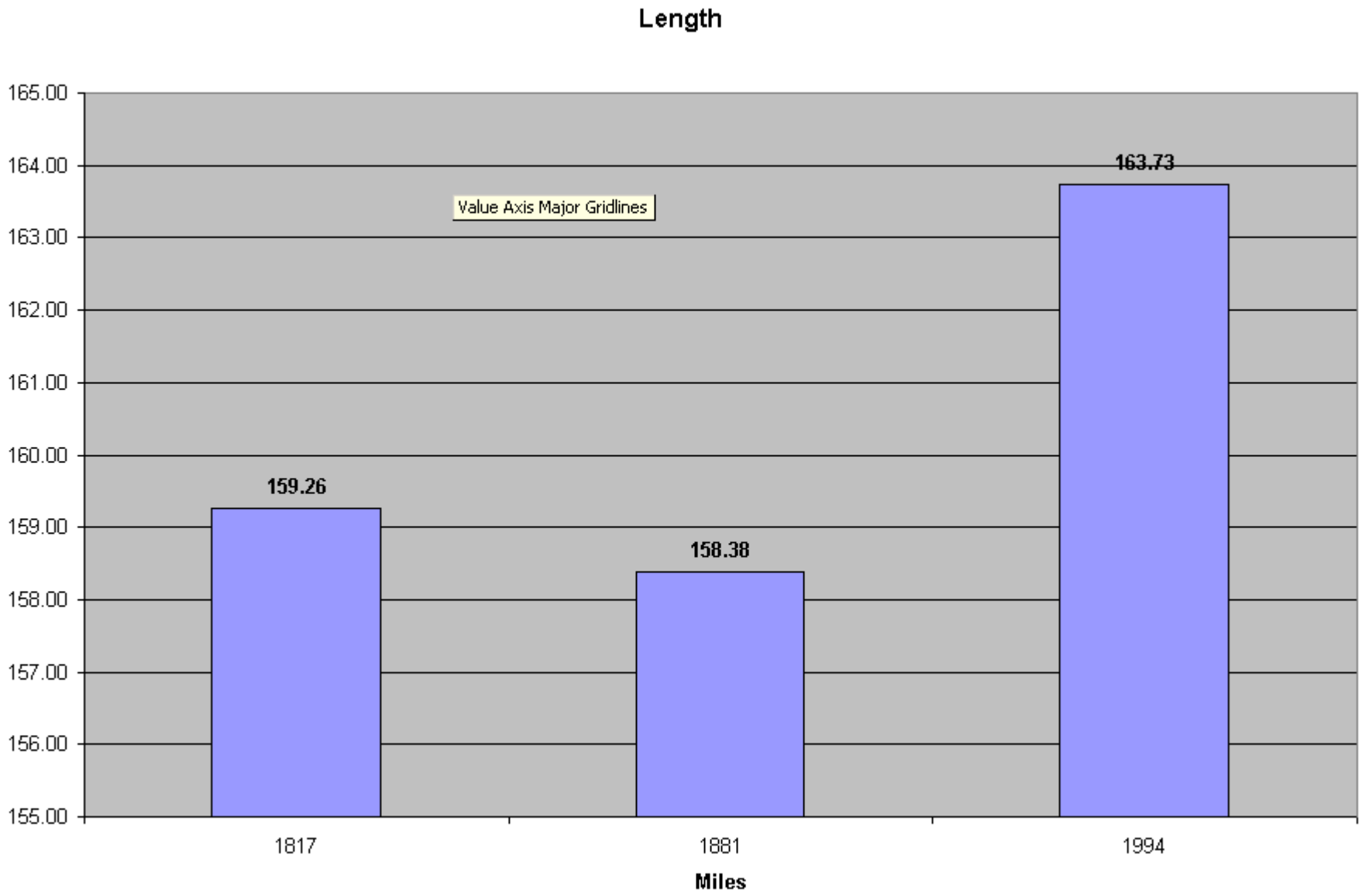
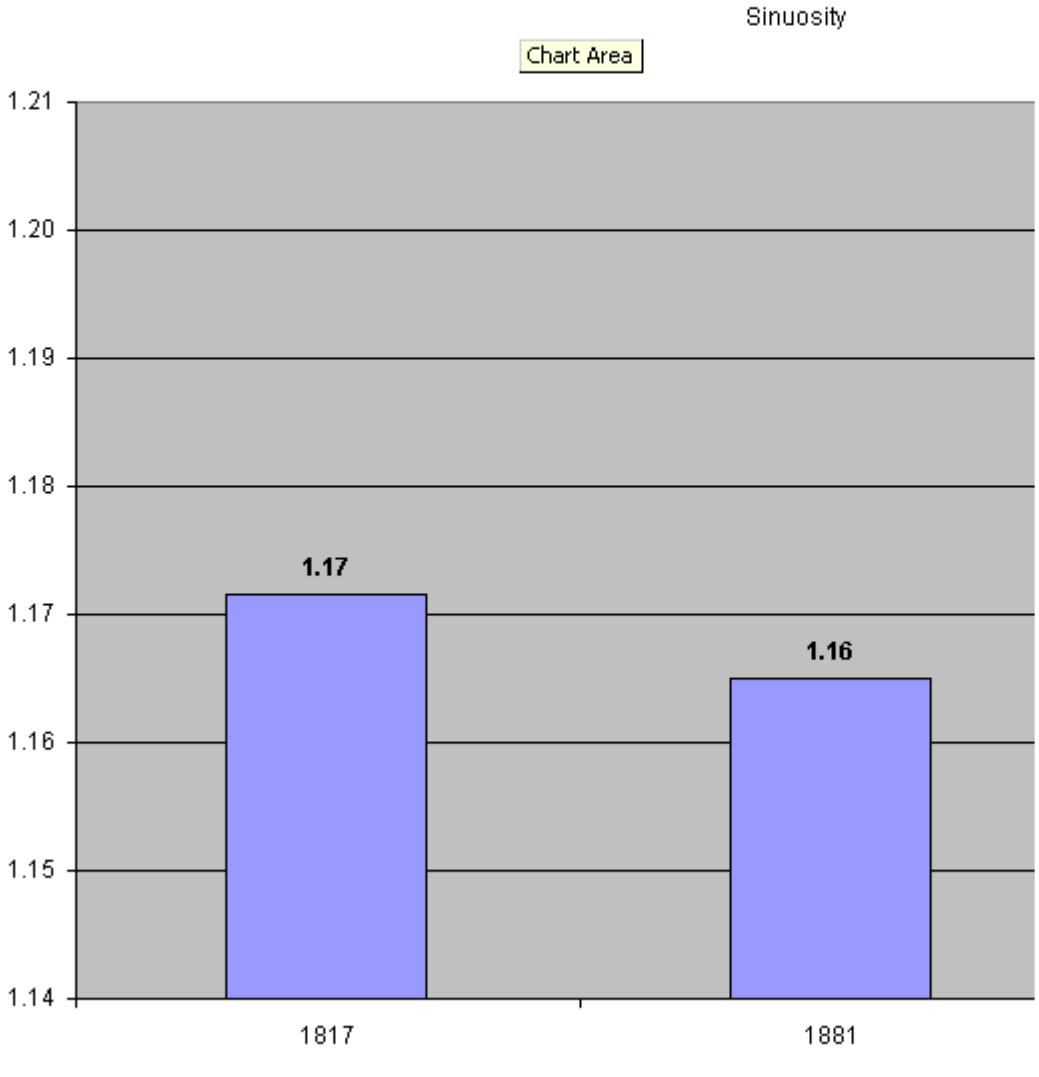
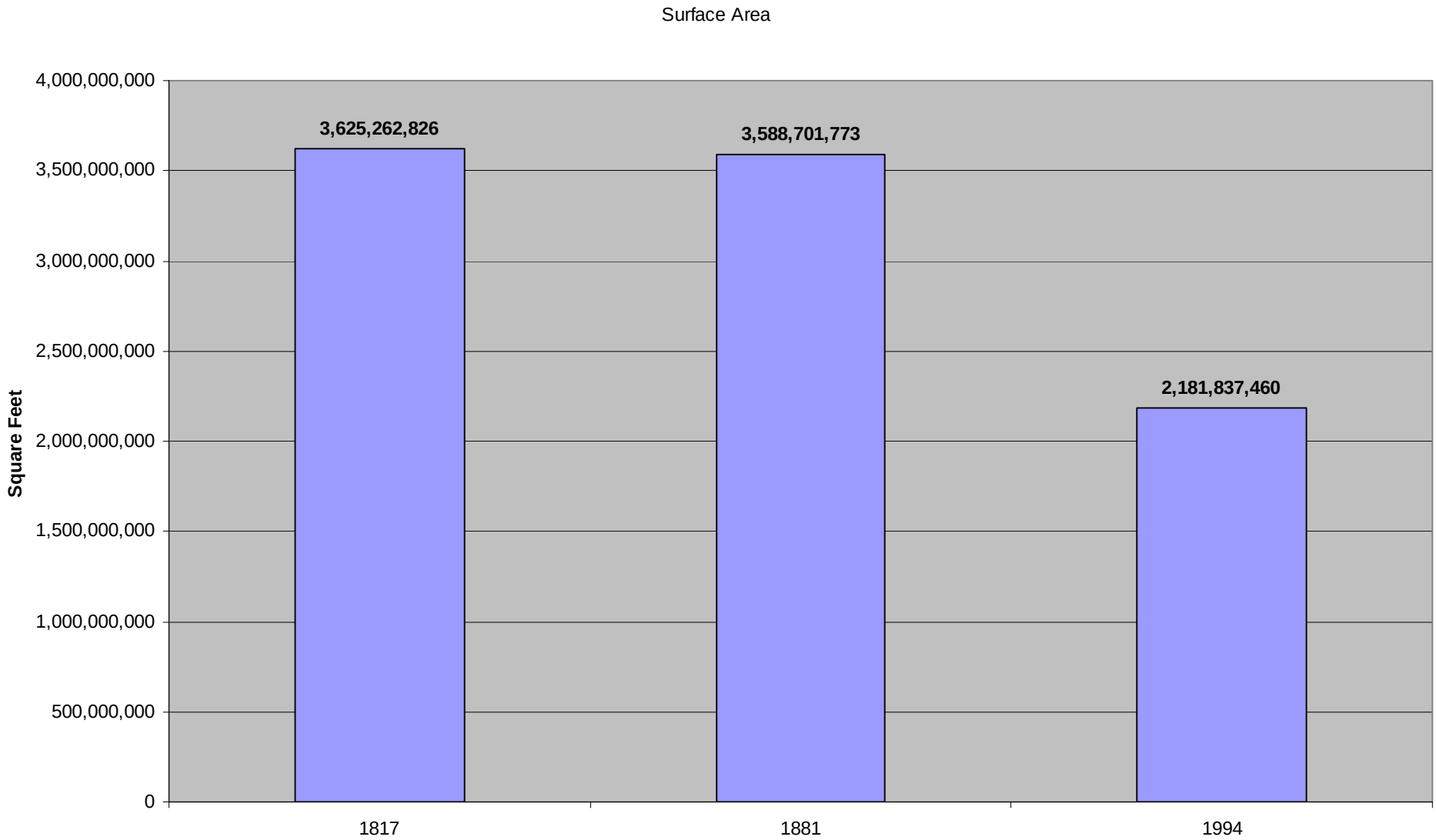

Length
165.00
164.00
163.00
162.00
161.00
160.00
159.00
158.00
157.00
156.00
155.00
Value Axis Major Gridlines
159.26
158.38
163.73
1817
1881
1994
Miles

Microsoft Excel - FullGeomorphology.xls

File Edit View Insert Format Tools Chart Window Help



Planform Width | Avg Width | Width | Length chart | surface area | **sinuosity** | Length | wetted E


Surface Area
Square Feet
4,000,000,000
3,500,000,000
3,000,000,000
2,500,000,000
2,000,000,000
1,500,000,000
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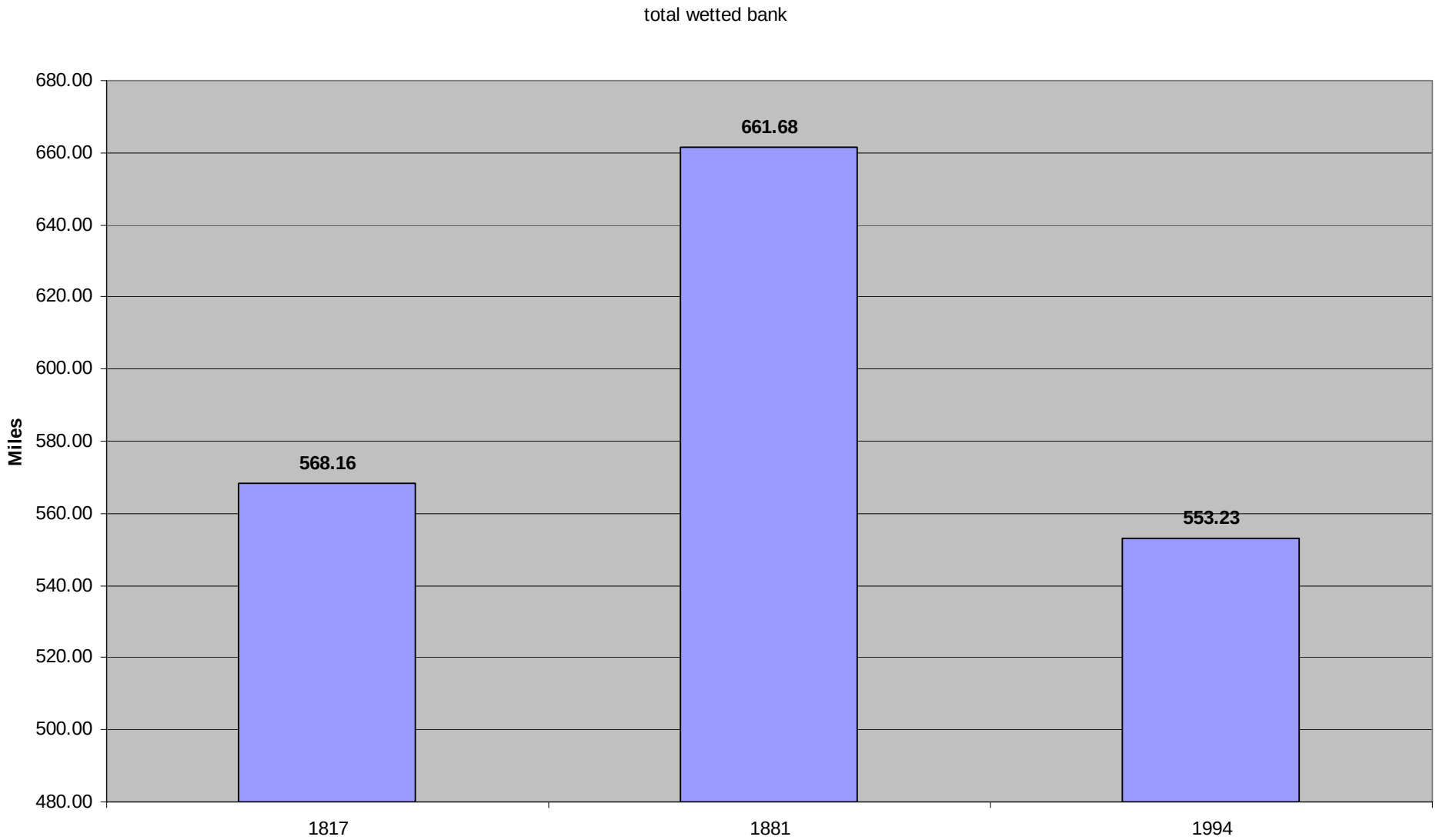
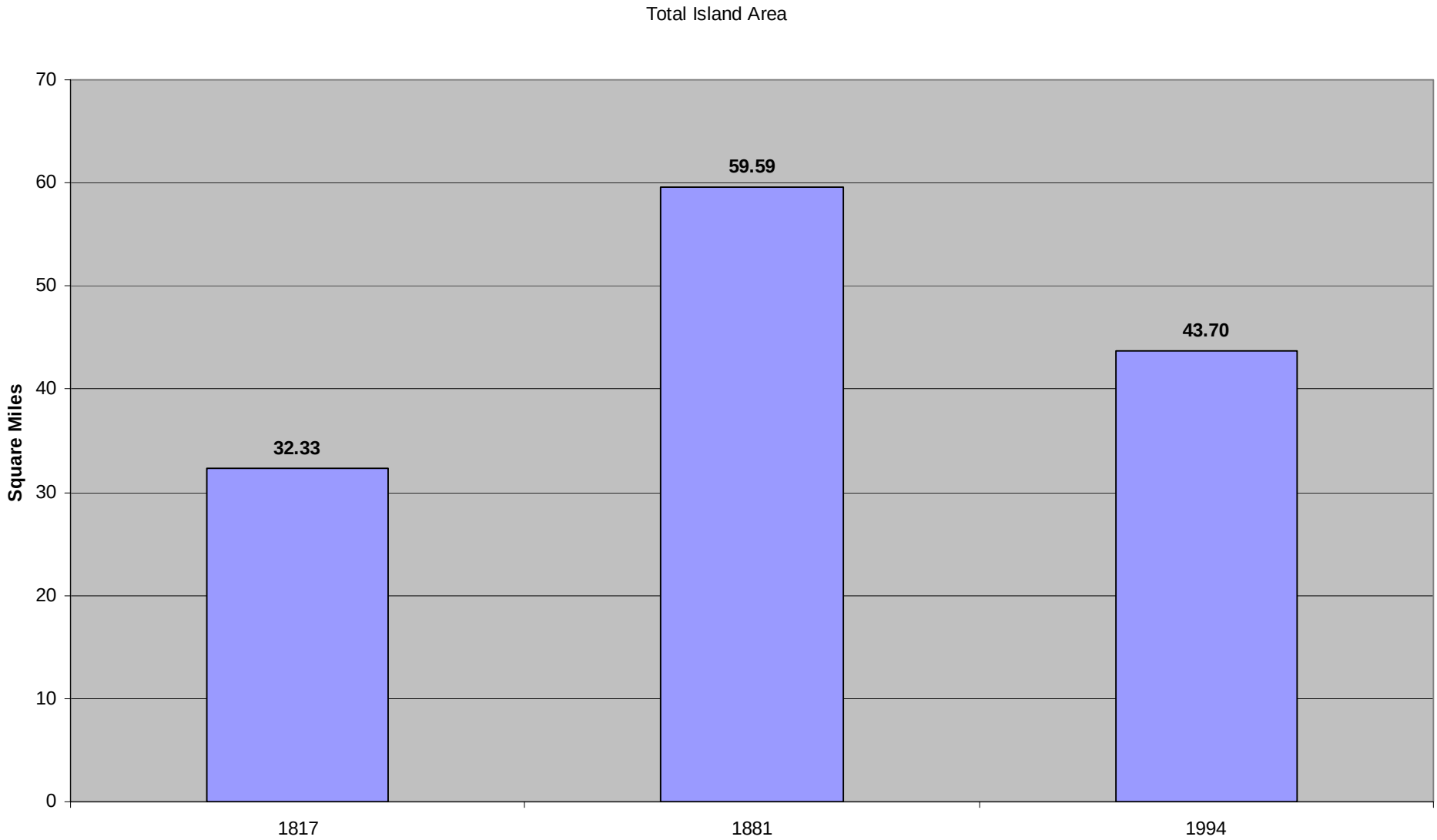
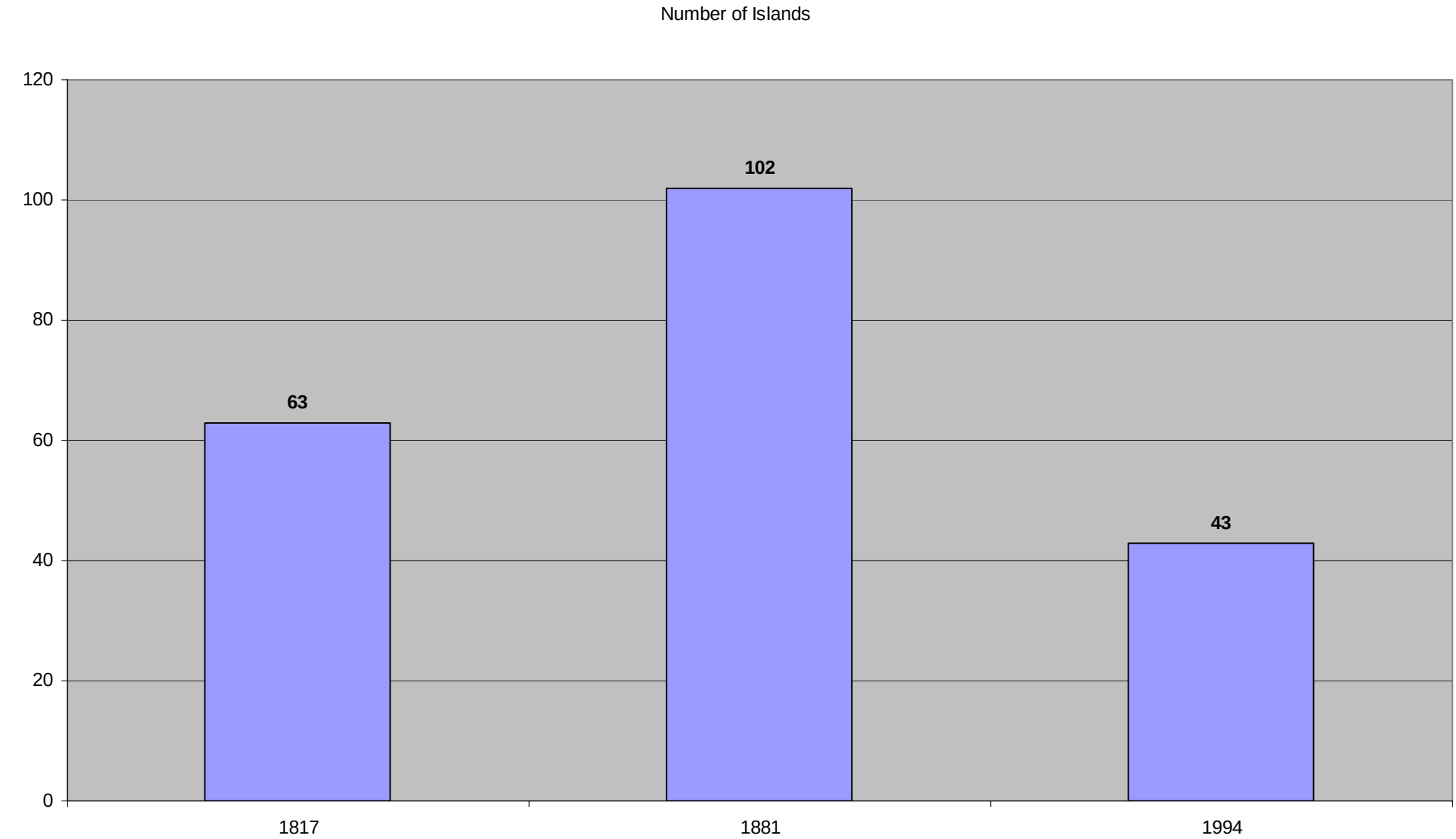
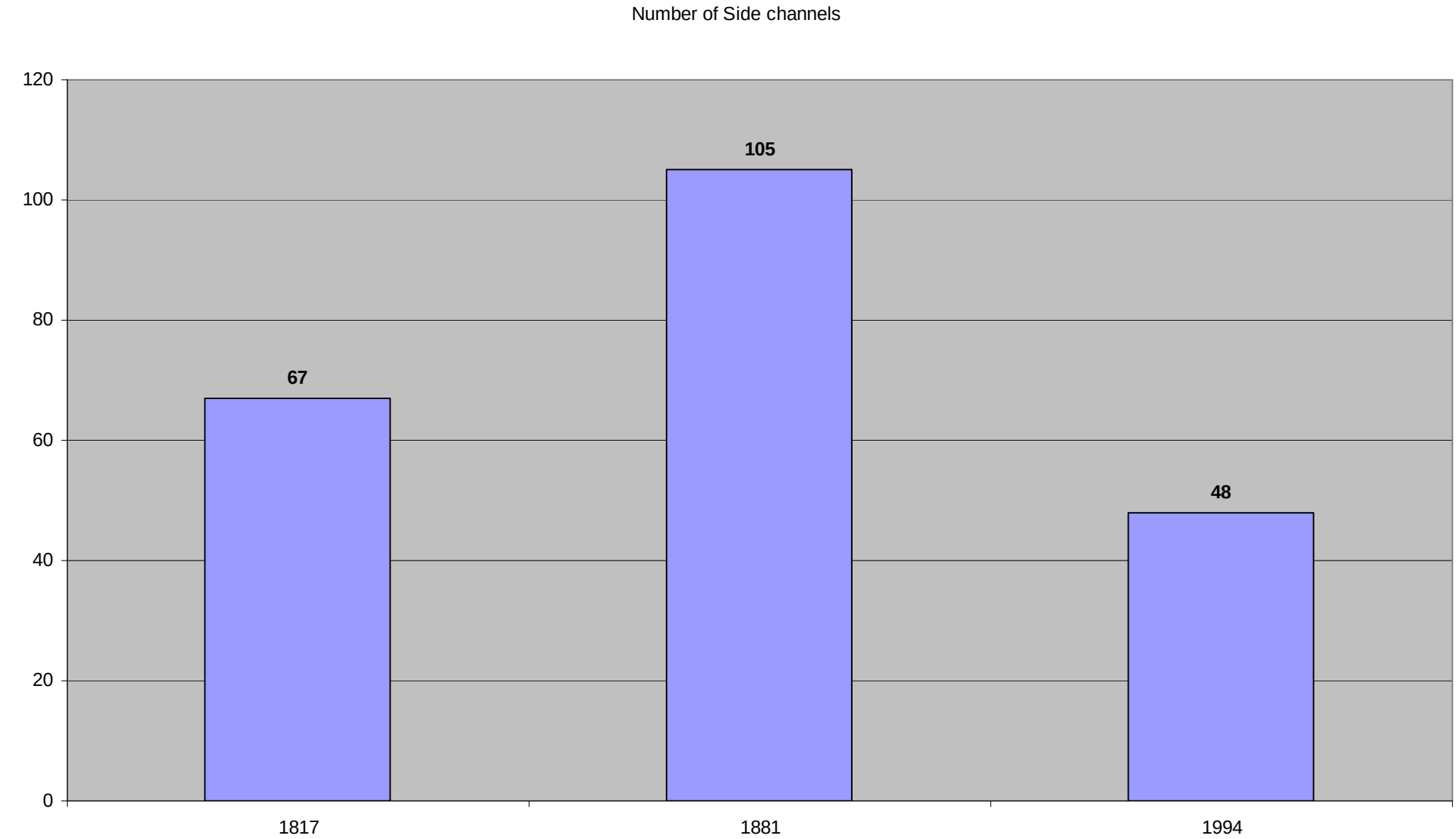
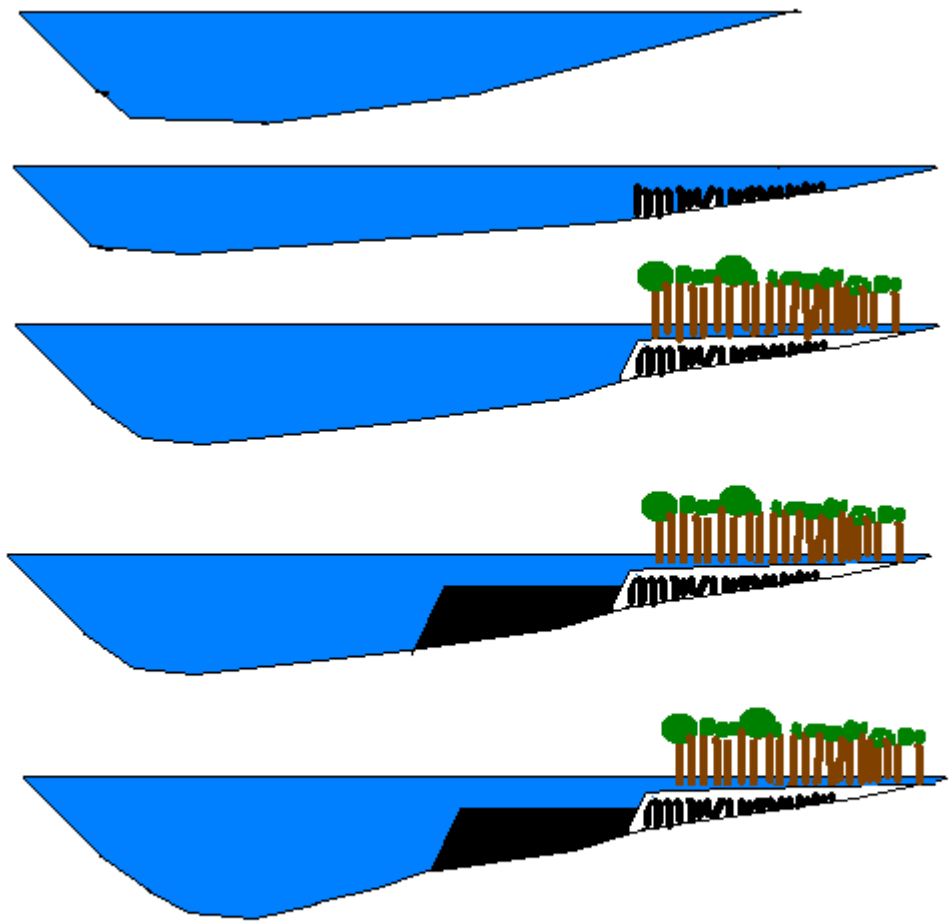
1817
1881
1994


total wetted bank
680.00
660.00
640.00
620.00
600.00
580.00
560.00
540.00
520.00
500.00
480.00
Miles
568.16
661.68
553.23
1817
1881
1994

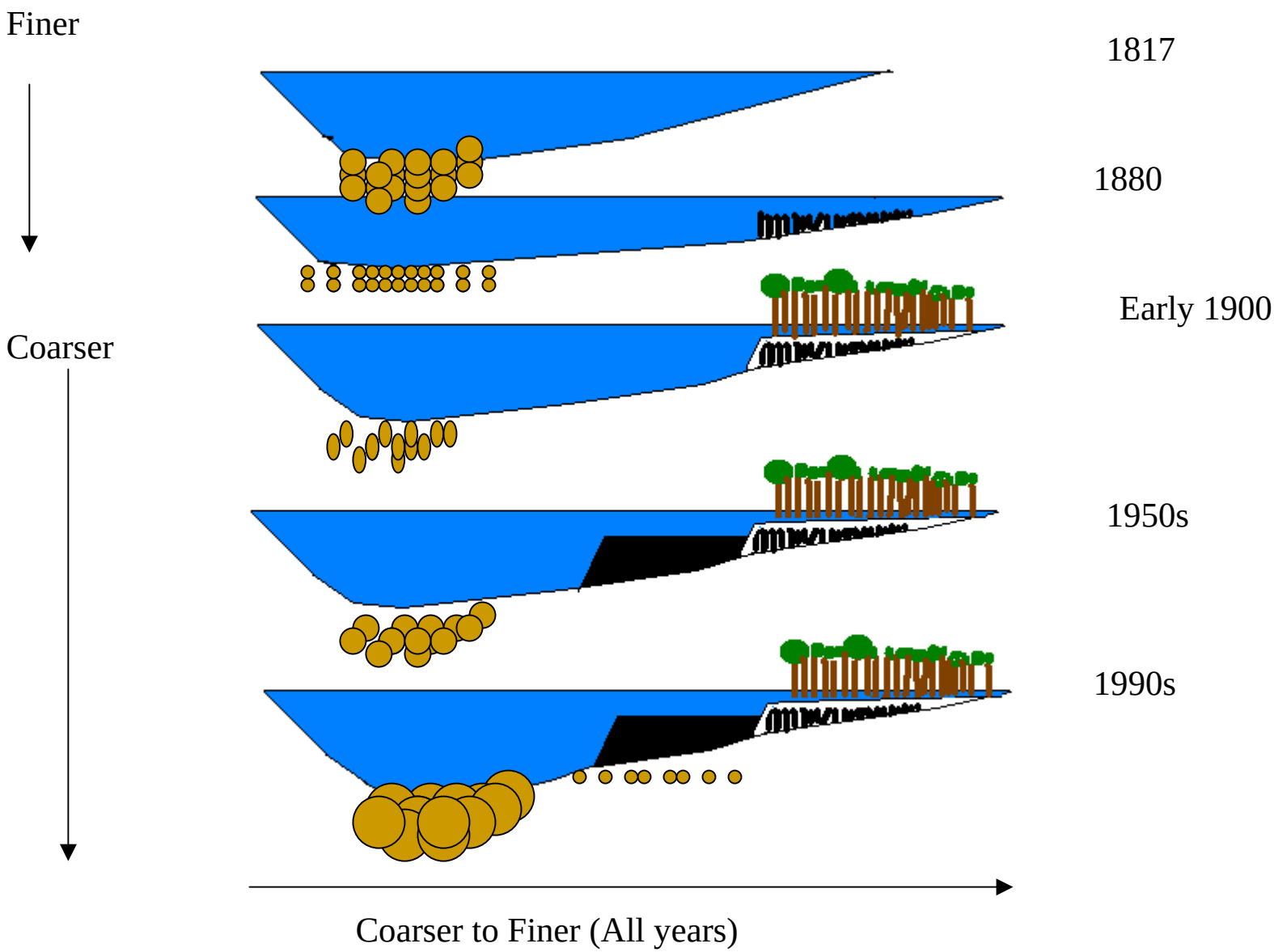

Total Island Area
Square Miles
70
60
50
40
30
20
10
0
32.33
59.59
43.70
1817
1881
1994


Number of Islands
120
100
80
60
40
20
0
63
102
43
1817
1881
1994


Number of Side channels
120
100
80
60
40
20
0
67
105
48
1817
1881
1994



Bed Sediment Gradation Trends



River Biology 101

The inorganic particles, stony material, and organic debris that make up the channel bottom substrate offer footholds for plants and invertebrates, sites for deposition and incubation of eggs, grit for grinding food, drought, and temperature change.

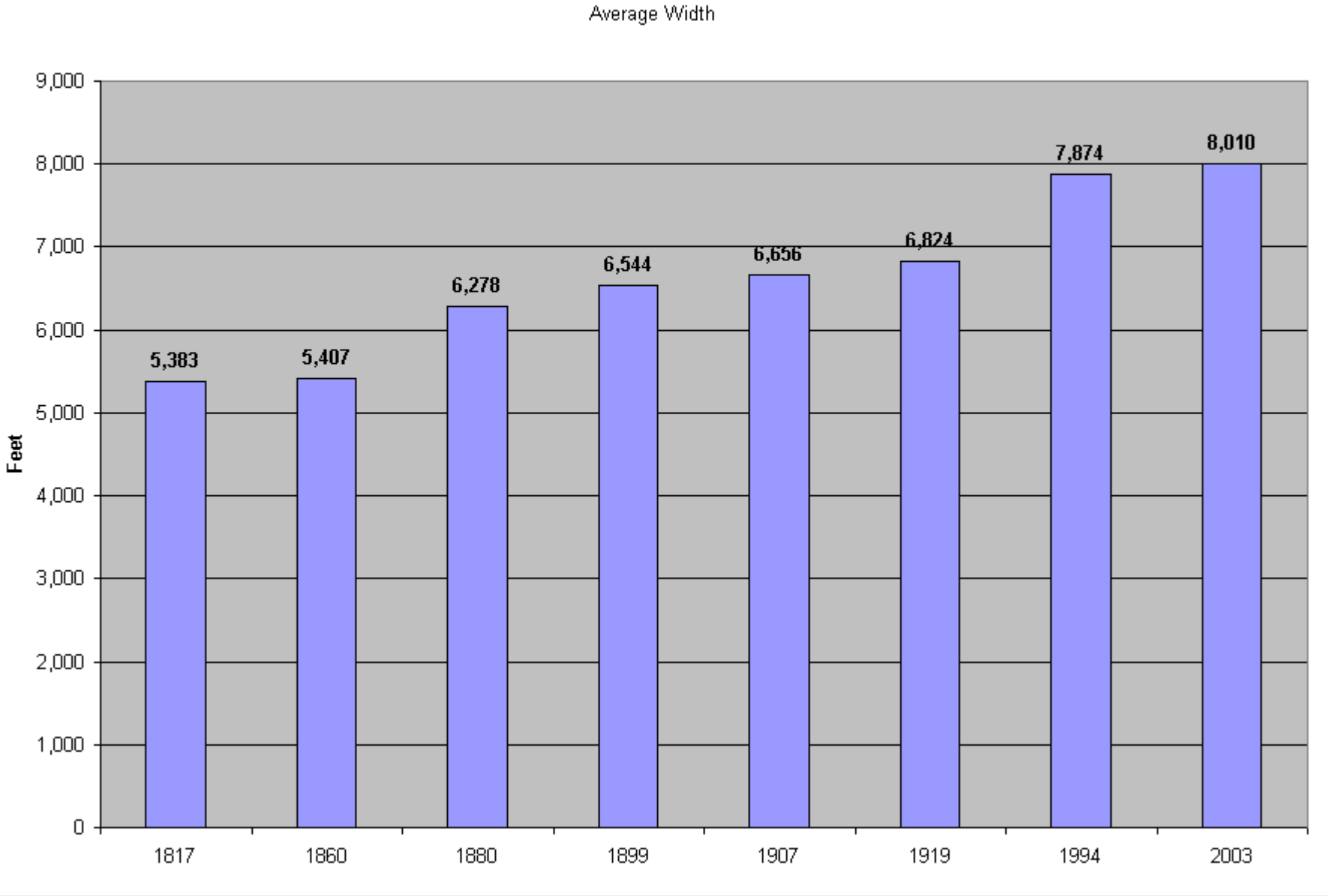
The streambed surface serves as a trap for organic material and the interstitial (spaces between particles within the bed), or hyporheic, area can be one of the primary, so-called faunal reservoirs for re-colonizing reaches following disturbance.

The distribution of sediment sizes along a river is one of the primary physical habitat factors influencing composition of lotic communities. The overall distribution of substrate particles is related to frequency and magnitude of flood events and human activity, which dislodges material from the bed. Within a reach, larger particles are associated with faster currents and smaller particles with slower flows. Bed stability usually decreases as average substrate particle size decreases.

Although all sediment sizes have some habitat value for select species (burrowing invertebrates prefer sandy bottoms, while many filter feeding insects require a stable hard substrate surface), highest productivity and diversity of bethic organisms occurs in riffle habitats of medium cobble (approximately 150 mm diameter) and gravel, and this relationship has been generally found to be true in rehabilitated streams.

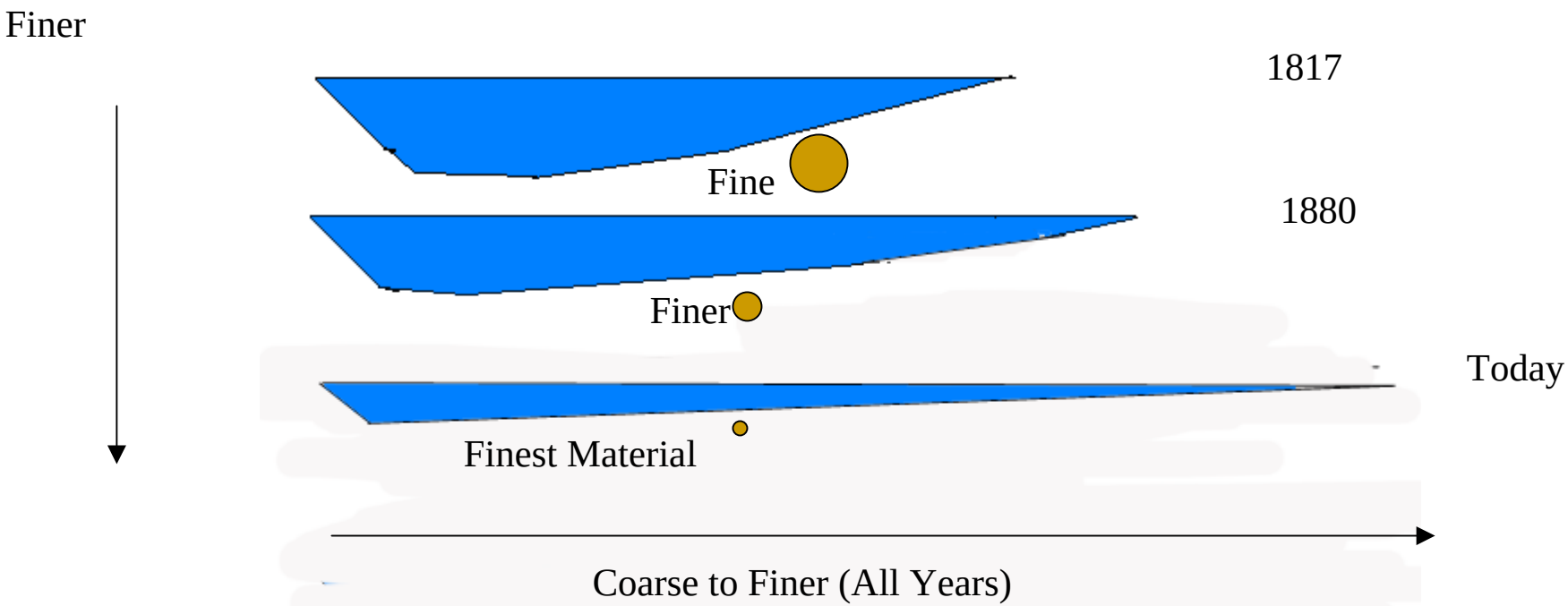
Fine sediments or areas of continually shifting sands reduce macro invertebrate species abundance and richness which in turn may affect species composition. In sand bed rivers, much of the macro invertebrate production used by higher trophic levels occurs on woody debris or rock structure.

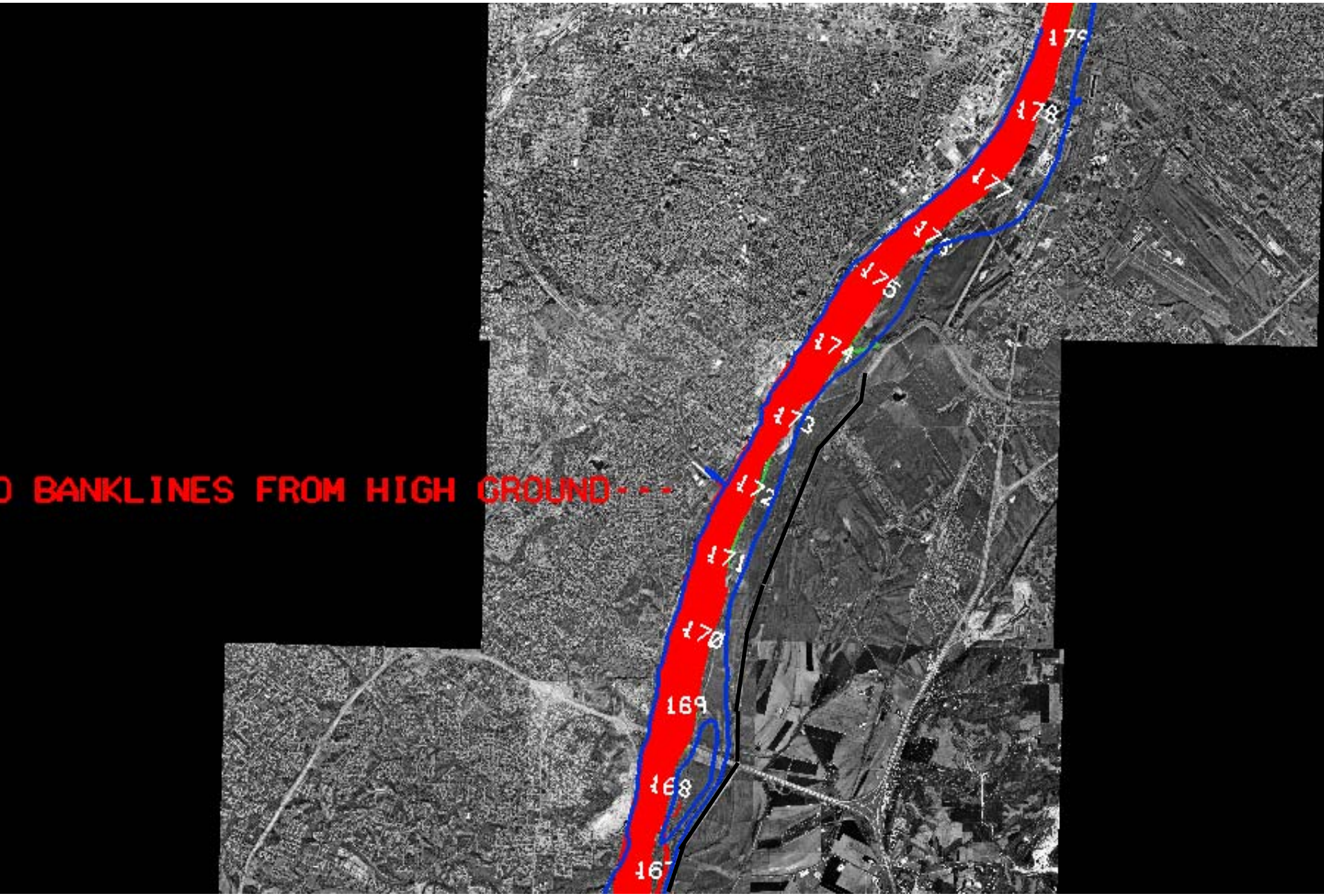
What if we would have done nothing?

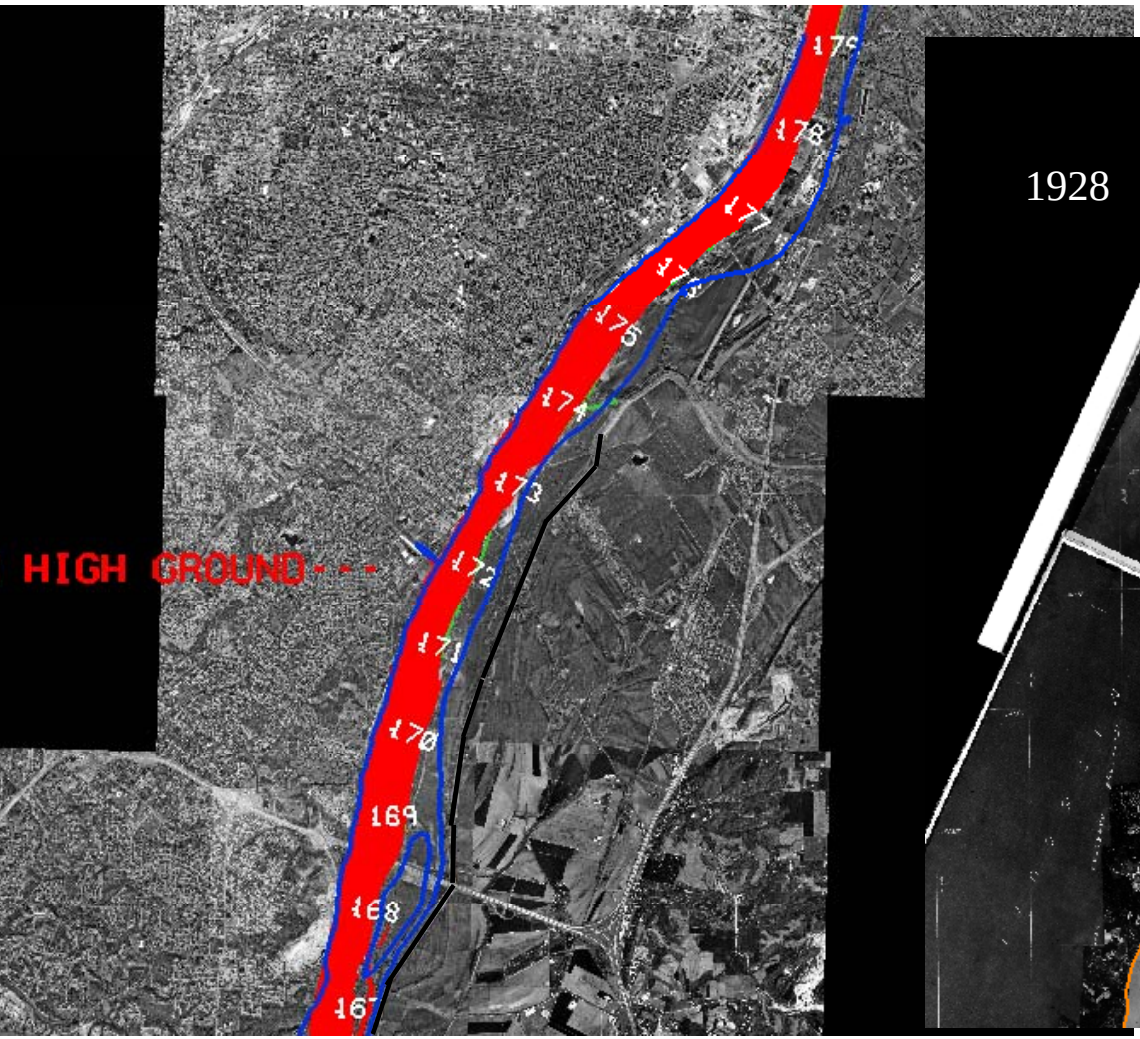


Note: Based upon average widening rate of 14 feet per year…

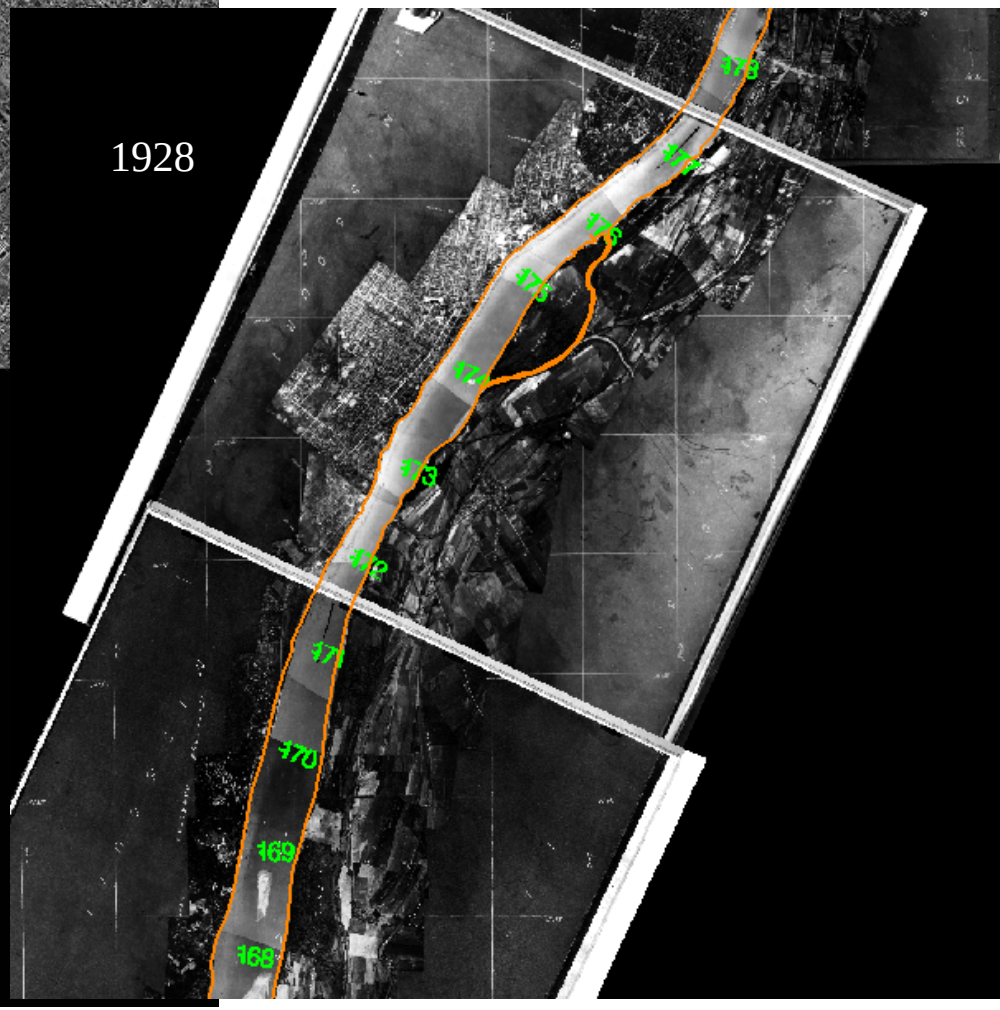
Bed Sediment Gradation Trends, No River Engineering

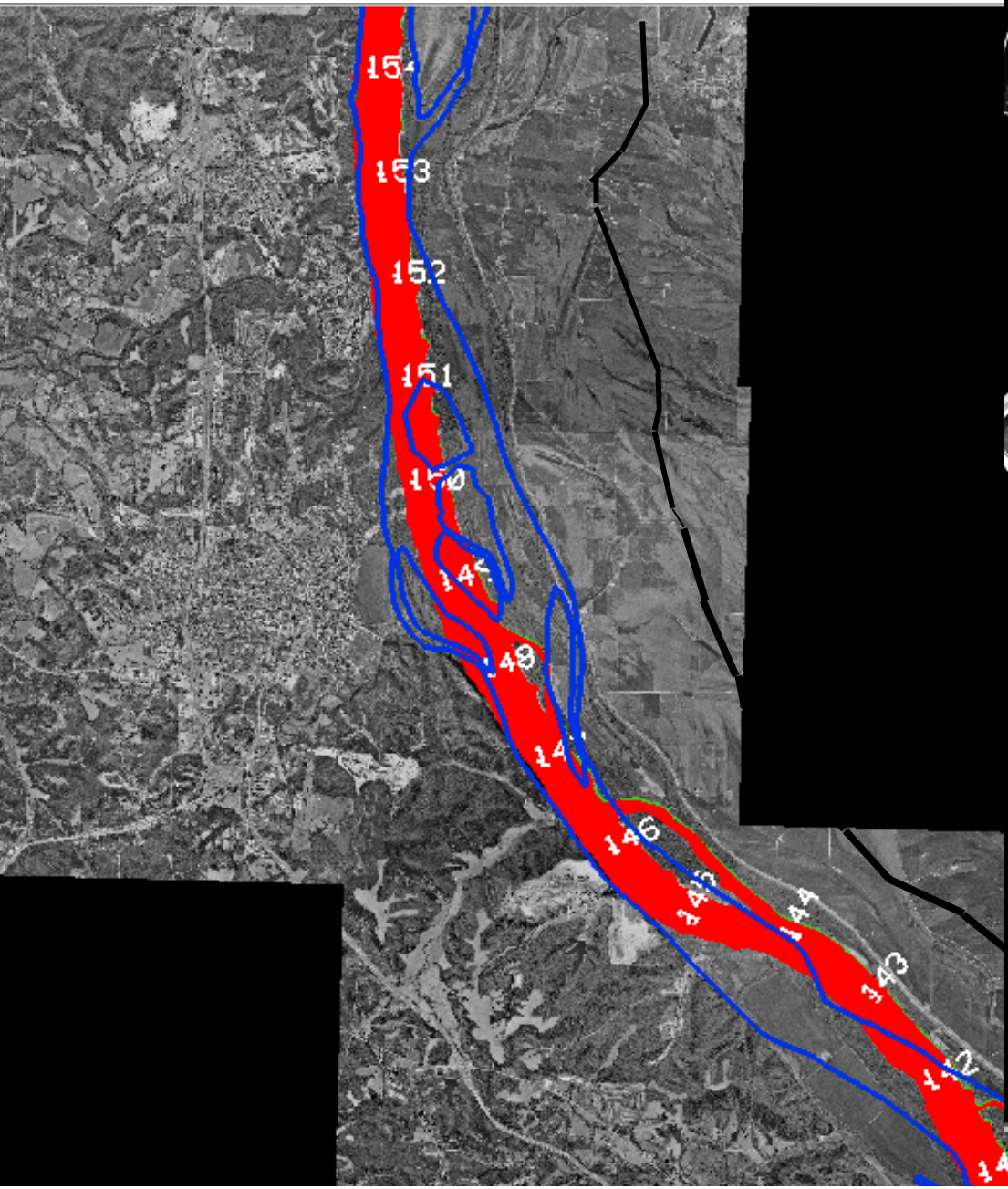


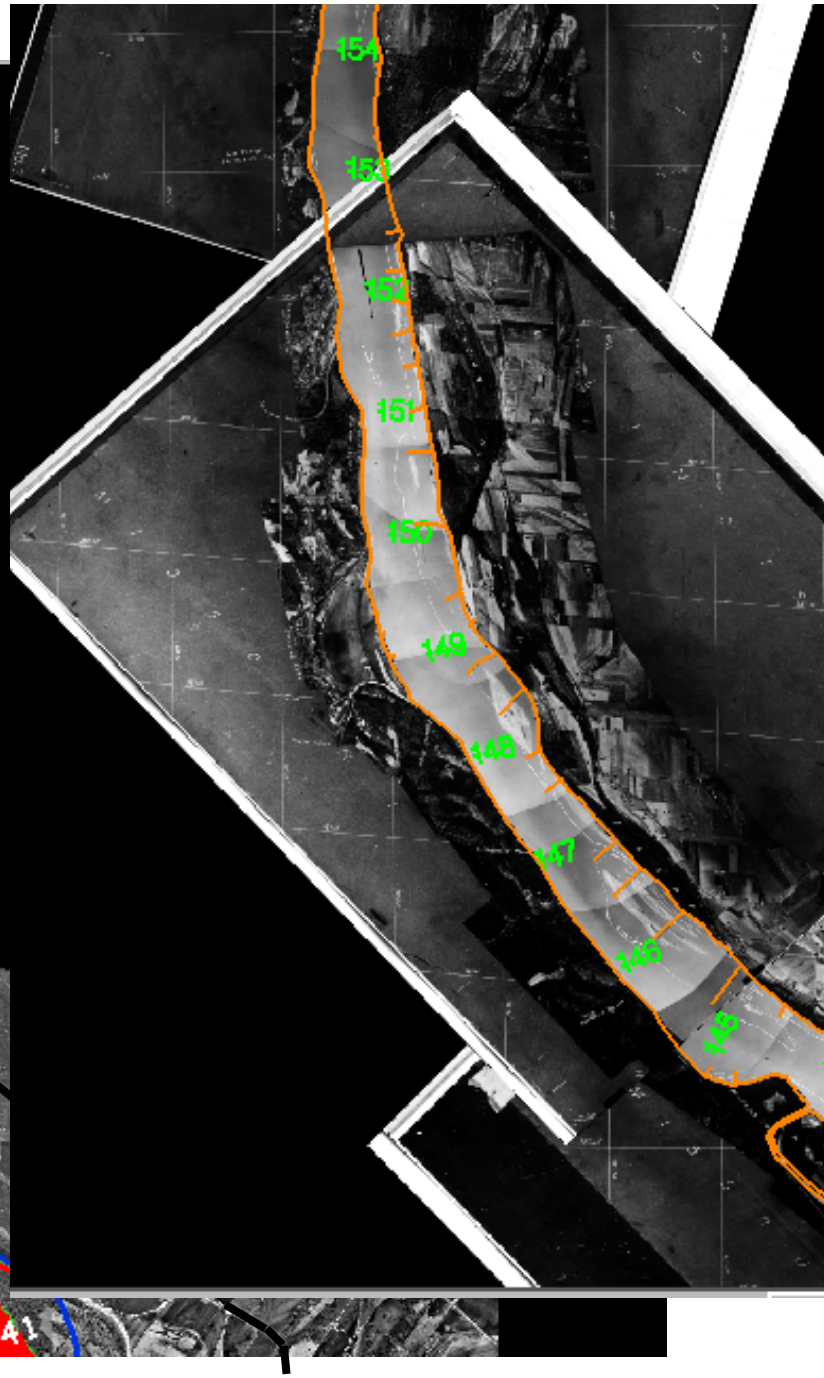

D BANKLINES FROM HIGH GROUND---
179
178
177
175
174
173
172
171
170
169
168

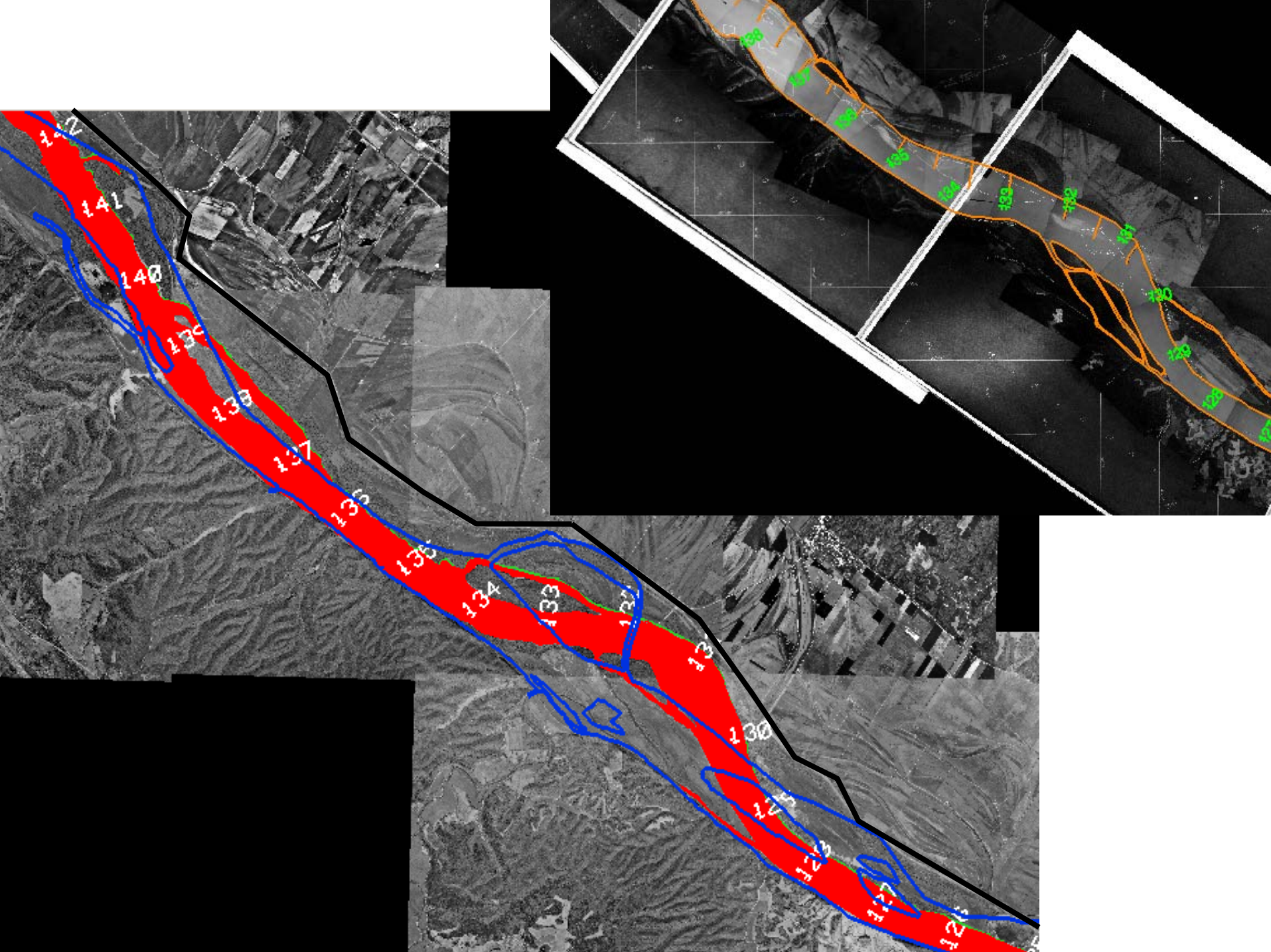

HIGH GROUND---
179
178
177
176
175
174
173
172
171
170
169
168
167

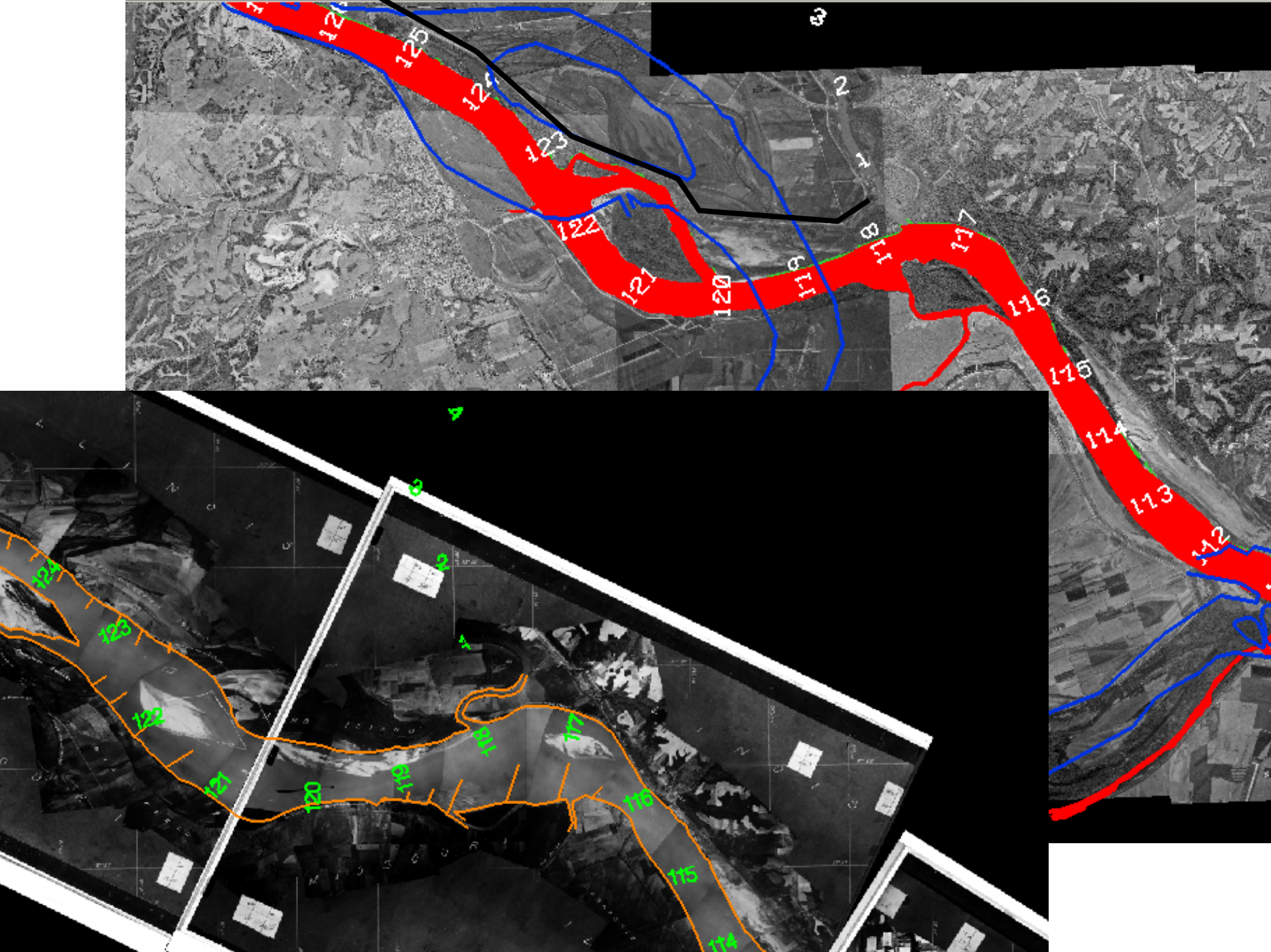
1928

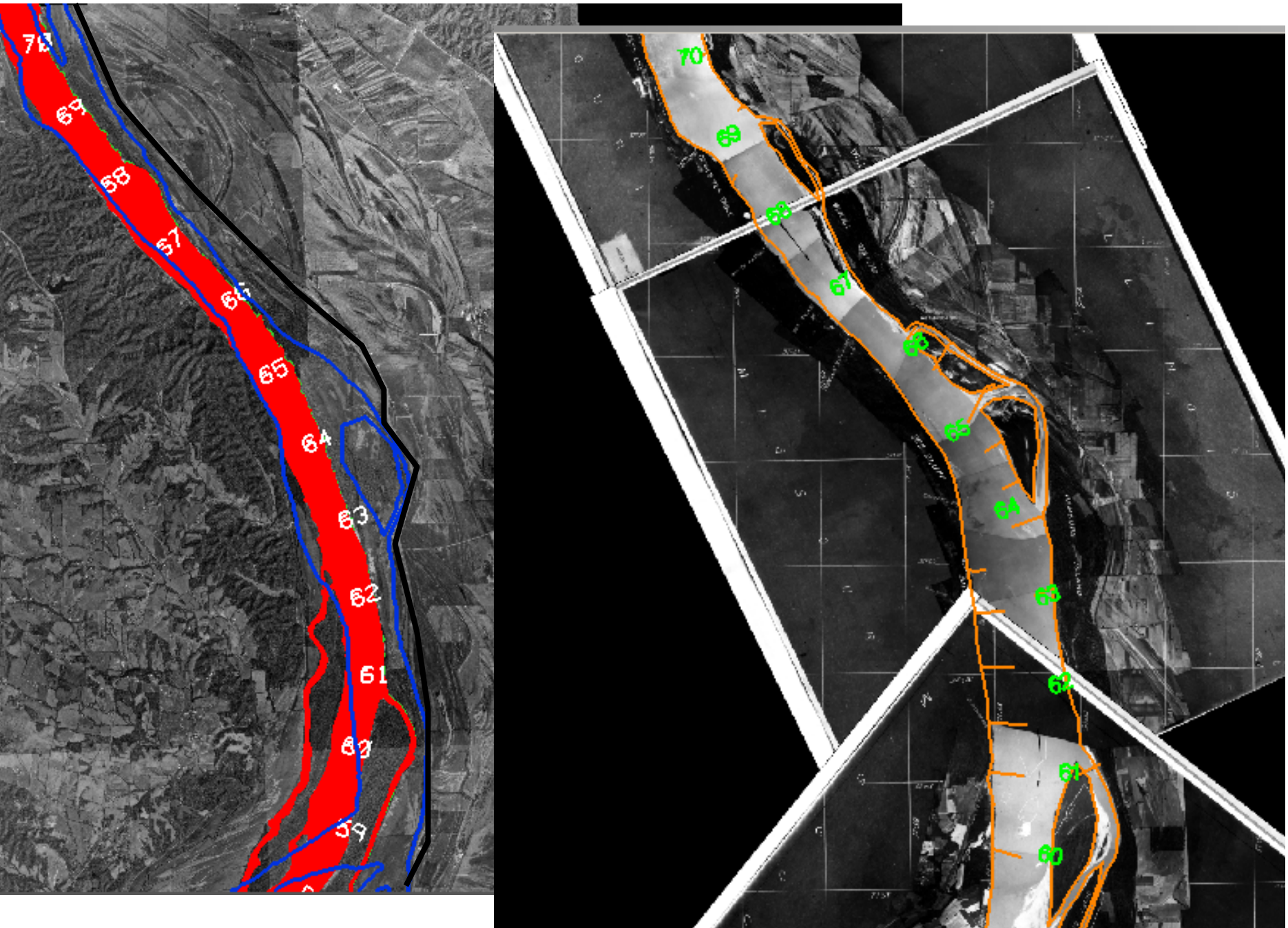

178
177
176
175
174
173
172
171
170
169
168


154
153
152
151
150
149
148
147
146
145
144
143
142
141


154
153
152
151
150
149
148
147
146
145

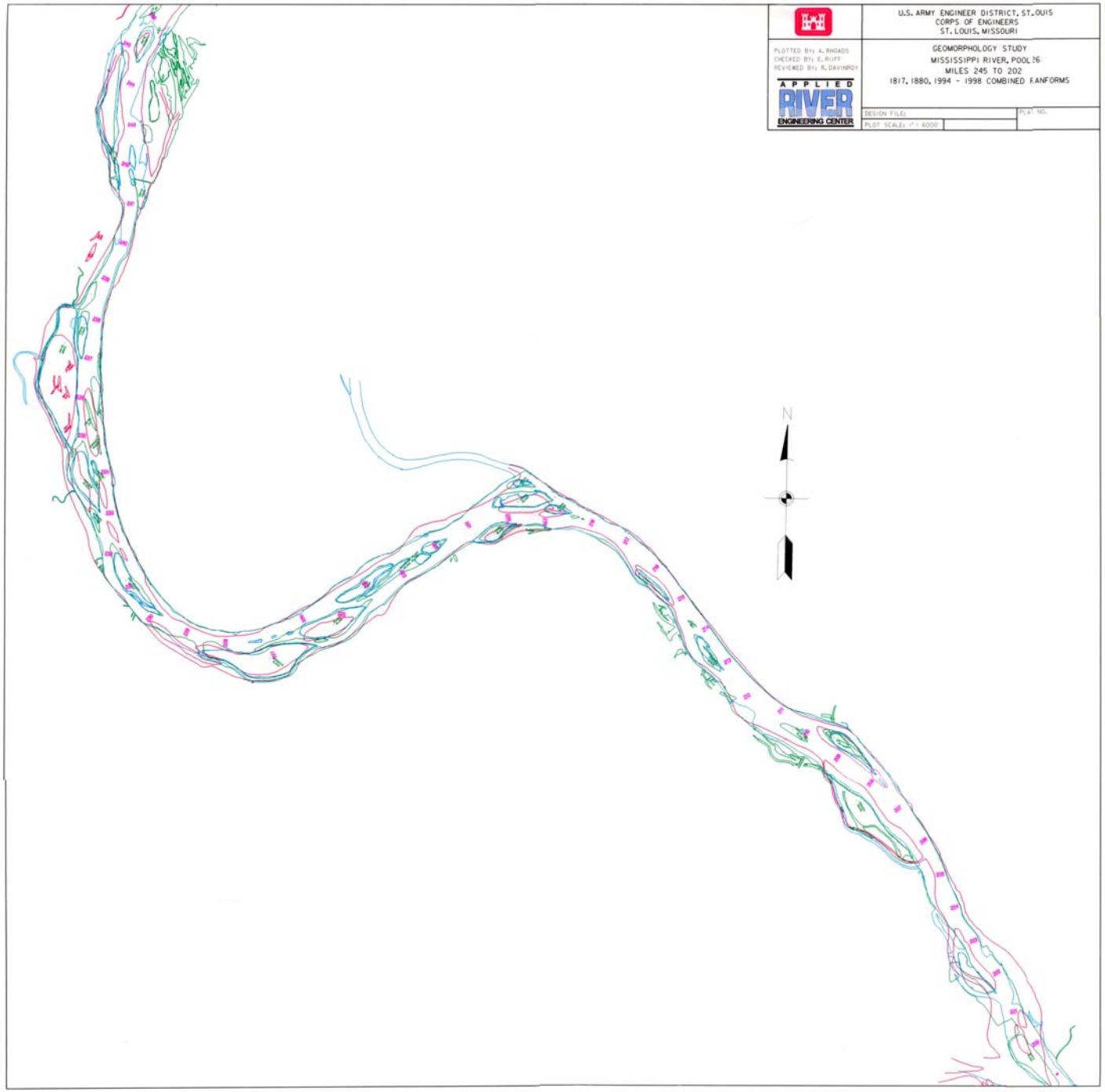

142
141
140
139
138
137
136
135
134
133
132
131
130
129
128

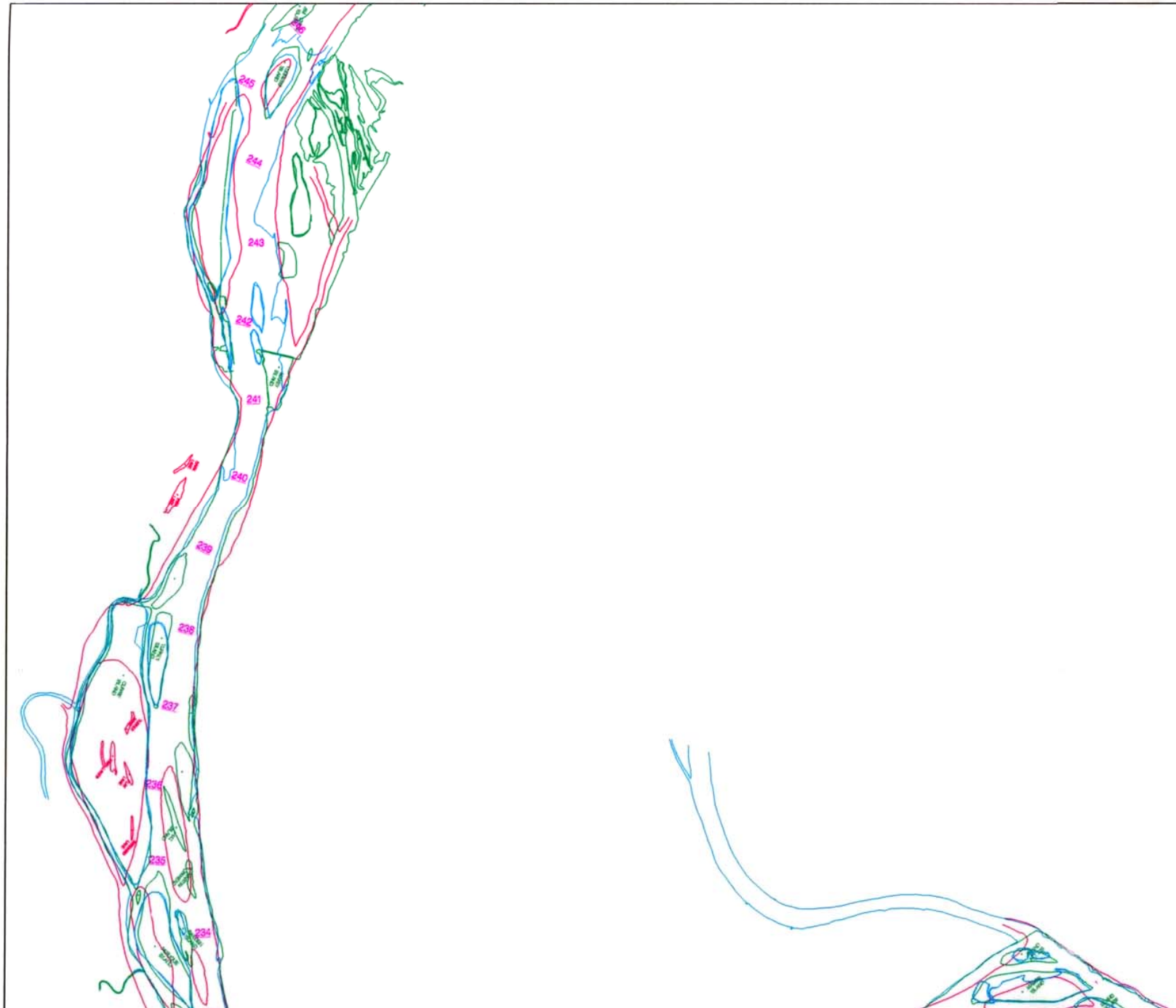

125
124
123
122
121
120
119
118
117
116
115
114
113
112
3
2
1
4

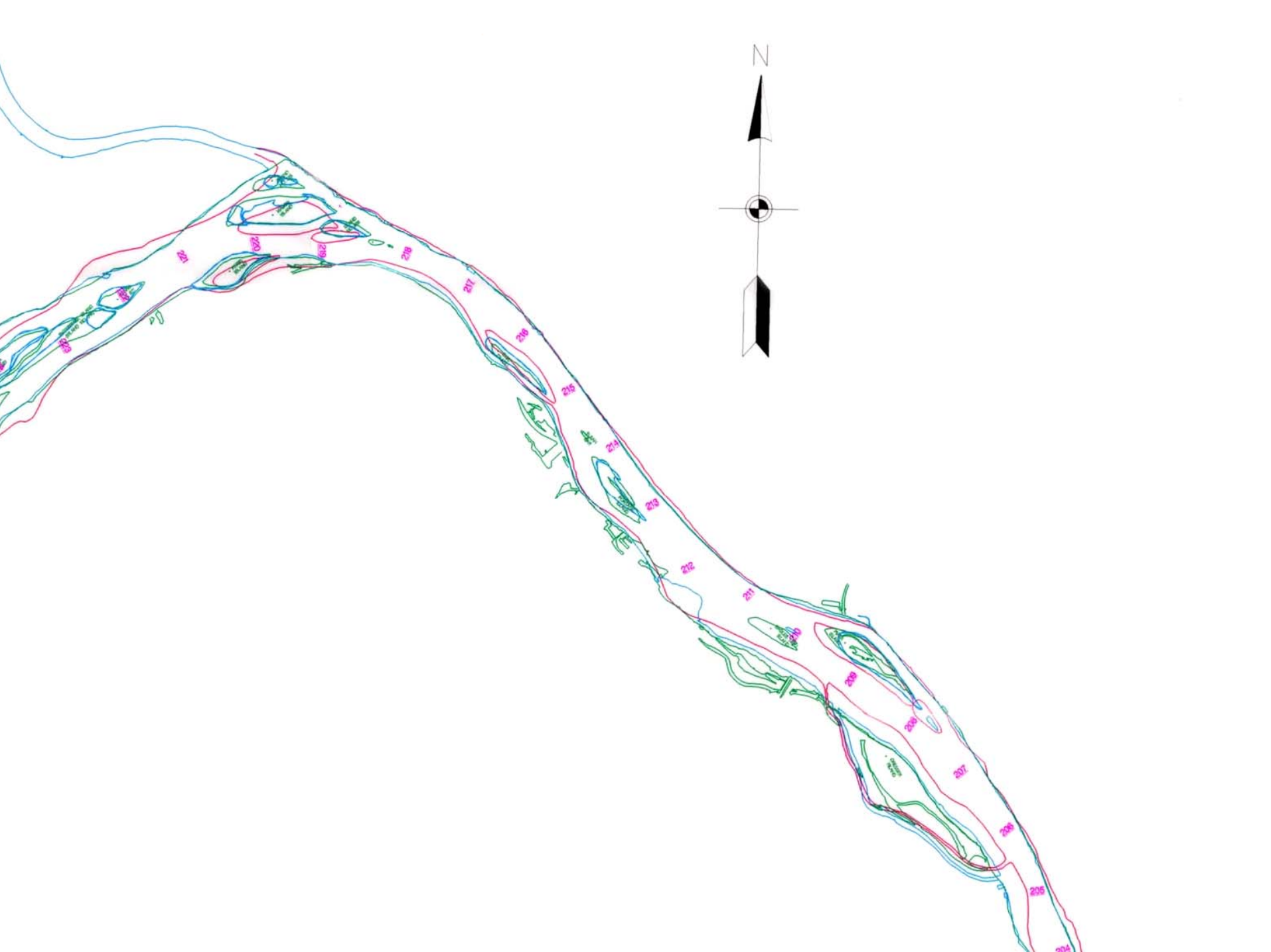

70
69
68
67
66
65
64
63
62
61
60
59

Pool 26

1817, 1880, 1998


U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI
PLOTTED BY: A. RHOADS
CHECKED BY: E. RIFF
REVIEWED BY: R. DAVINROY
APPLIED RIVER ENGINEERING CENTER
GEOMORPHOLOGY STUDY
MISSISSIPPI RIVER, POOL 26
MILES 245 TO 202
1817, 1880, 1994 - 1998 COMBINED FANFORMS
DESIGN FILE:
PLOT SCALE: 1" = 4000'
PLAT NO.
N


245
244
243
242
241
240
239
238
237
236
235
234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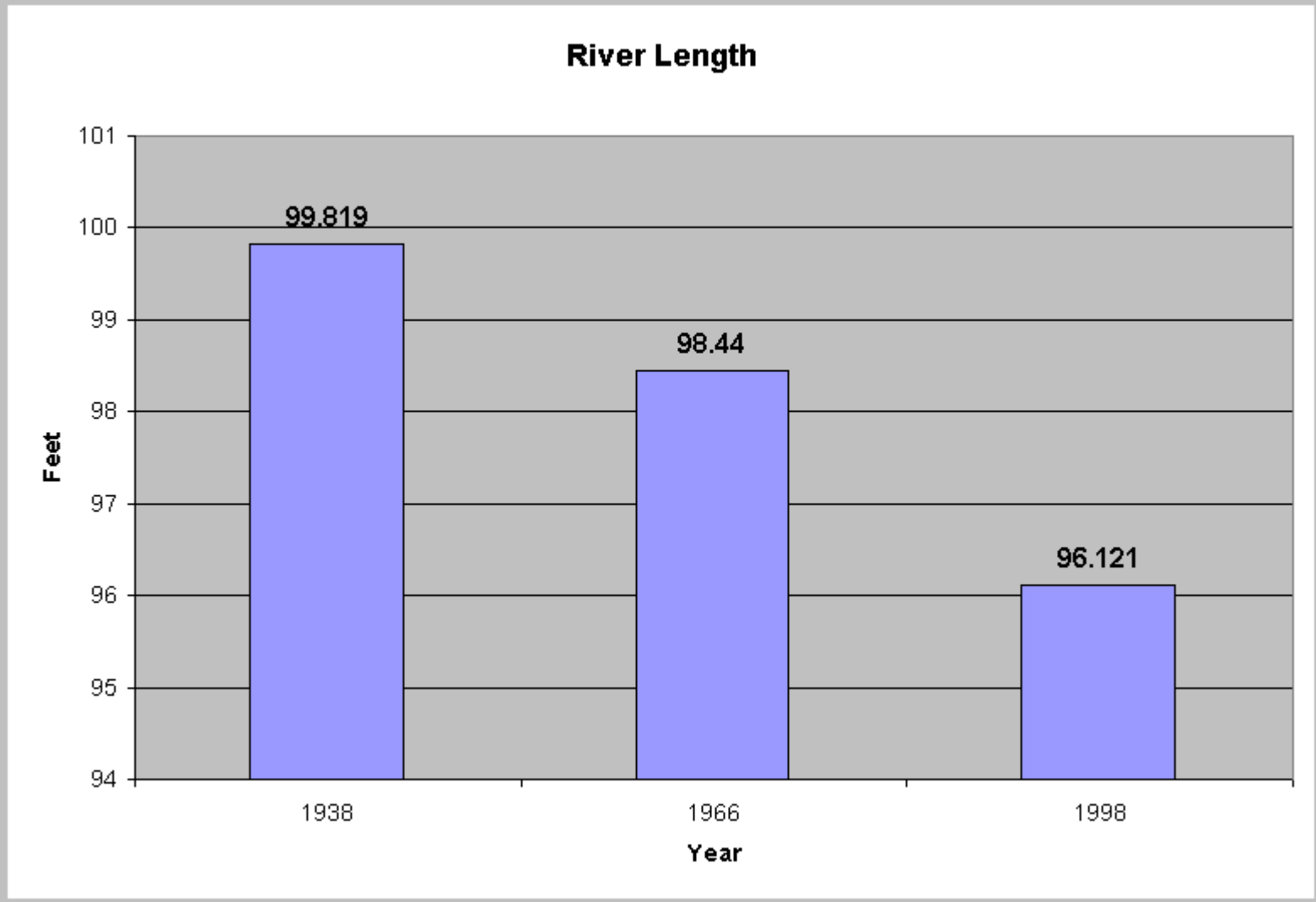
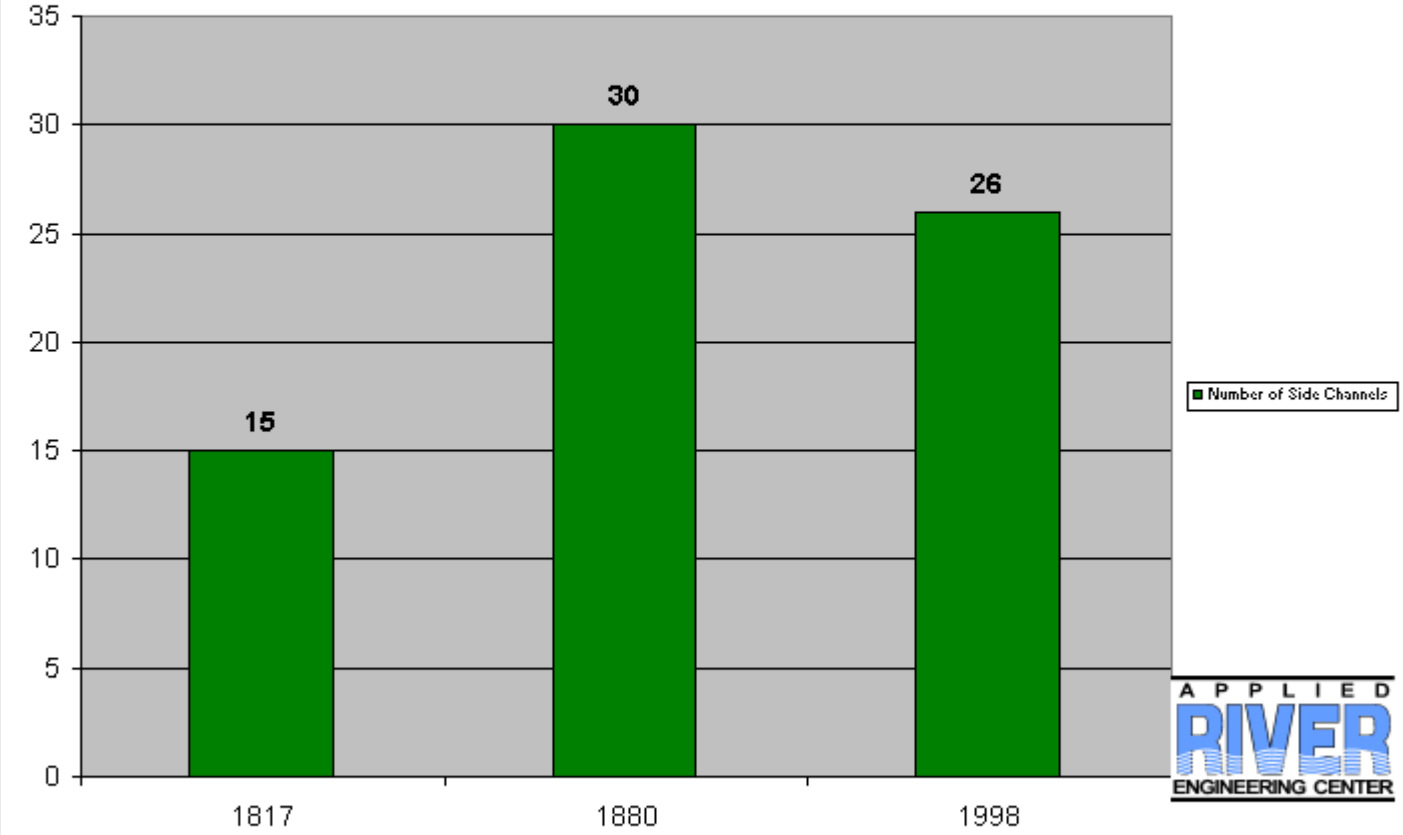

River Length
101
100
99
98
97
96
95
94
Feet
99.819
98.44
96.121
1938
1966
1998
Year

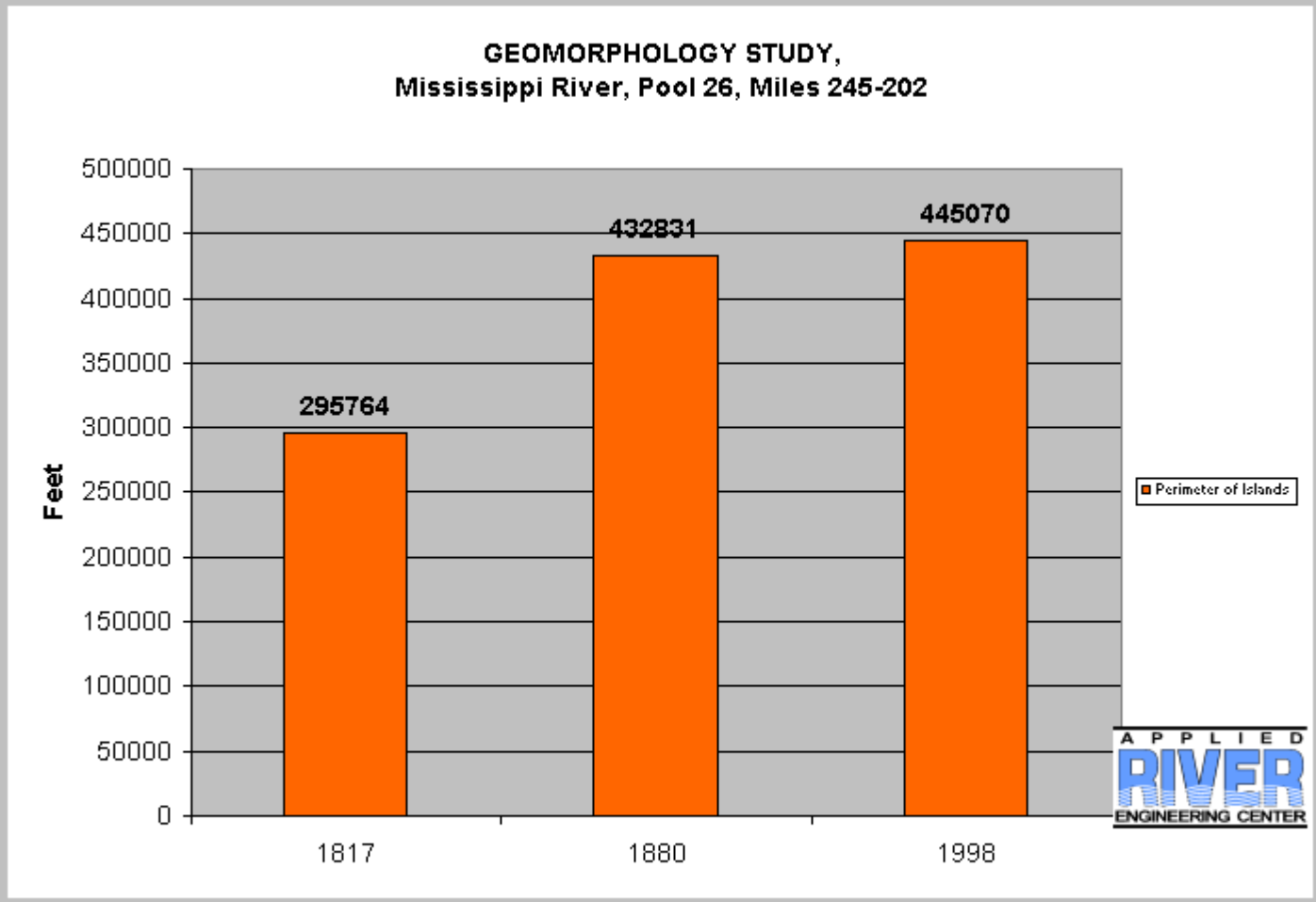
File Edit View Insert Format Tools Chart Window Help

GEOMORPHOLOGY STUDY,
Mississippi River, Pool 26, Miles 245-202



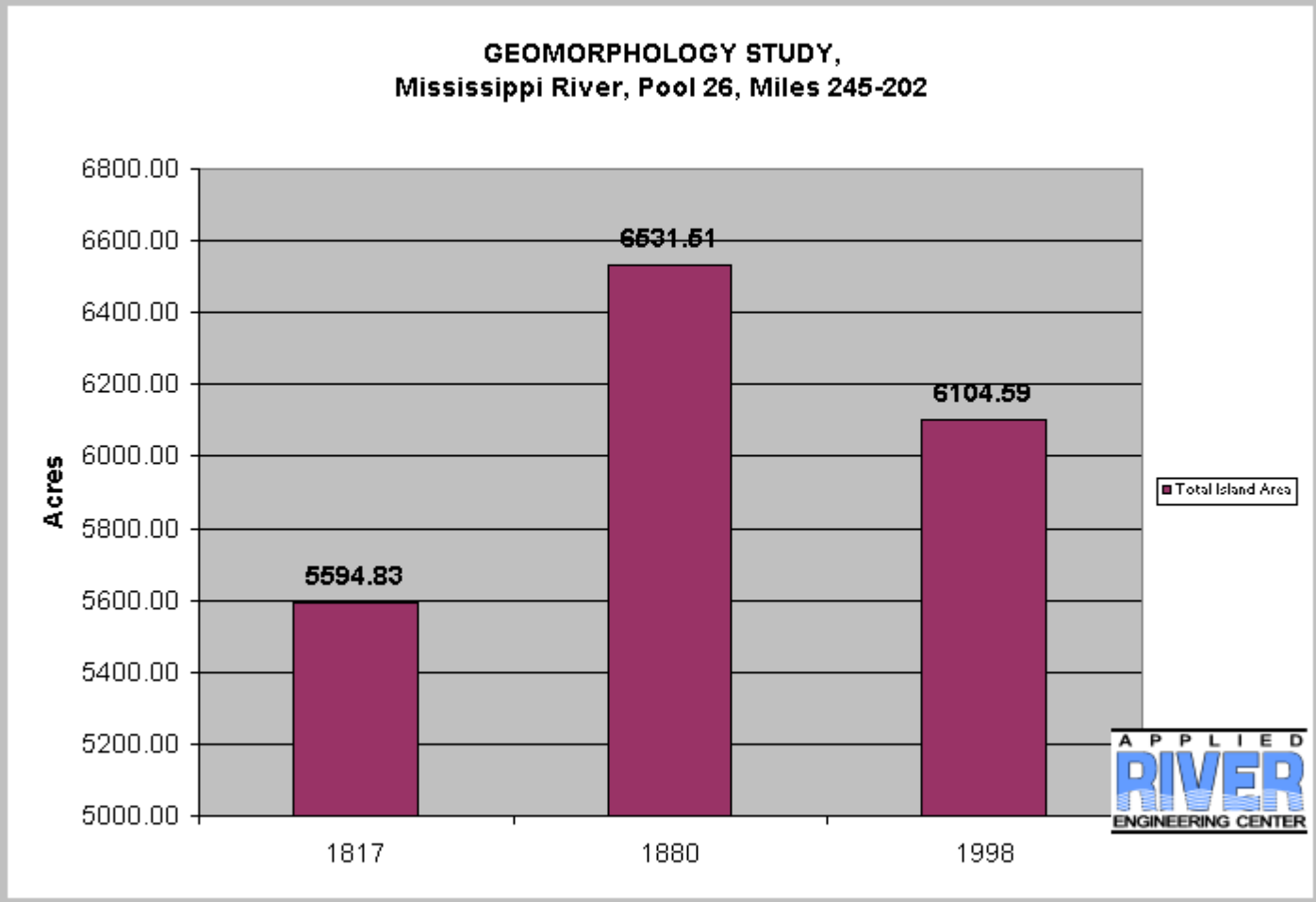
Width graph | Ave Width graph | Acres | perimeter | #islands | side channels | Width | Islands

File Edit View Insert Format Tools Chart Window Help



Width graph | Ave Width graph | Acres | perimeter | #islands | side channels | Width | Islands

File Edit View Insert Format Tools Chart Window Help



Width graph | Ave Width graph | Acres | perimeter | #islands | side channels | Width | Islands

Edit View Insert Format Tools Table Window Help
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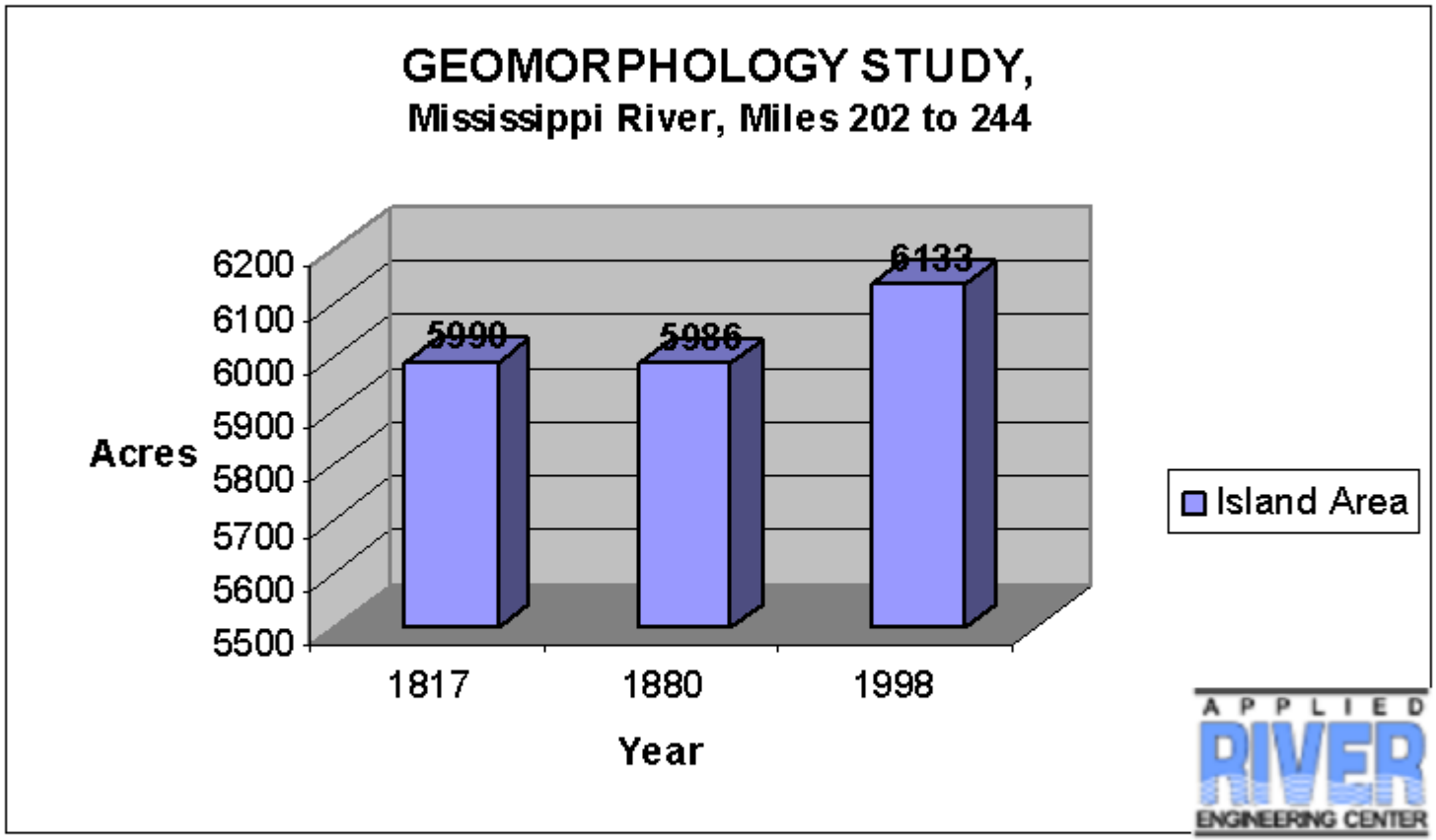

2 Sec 1 2/2 At 2.1" Ln 7 Col 2 REC TRK EXT OVR

Edit View Insert Format Tools Table Window Help
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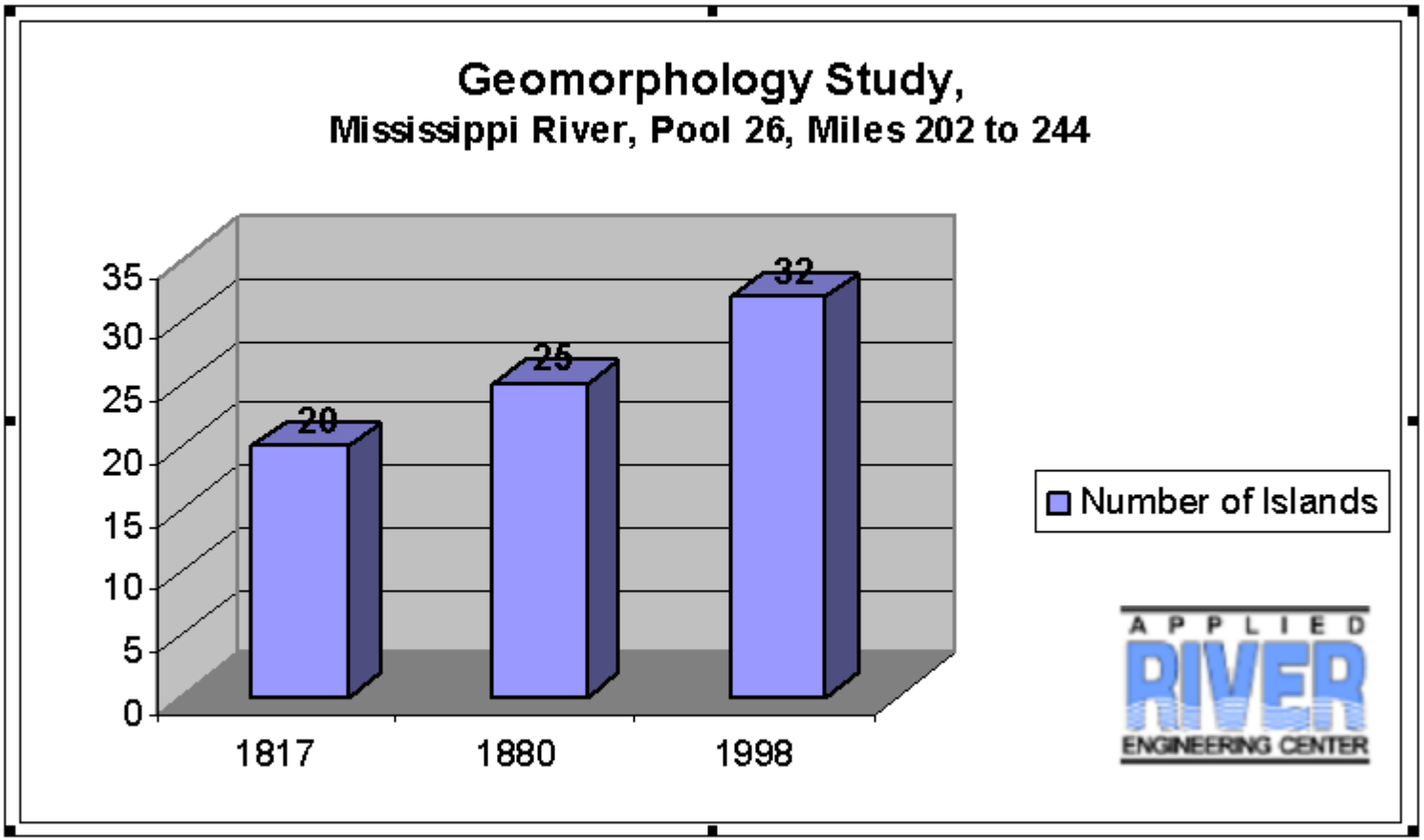

e-click to Edit Microsoft Excel Chart

Edit View Insert Format Tools Table Window Help
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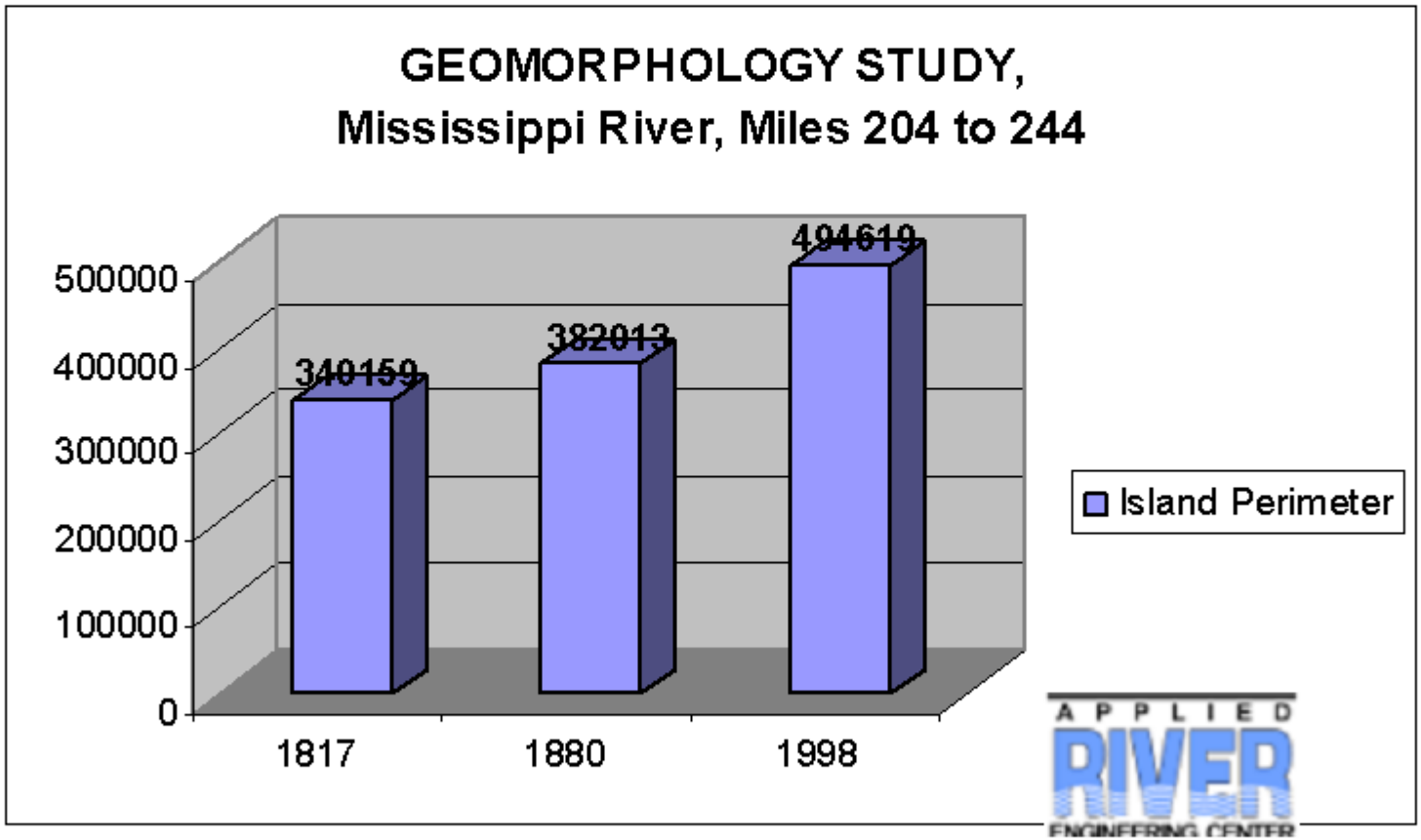
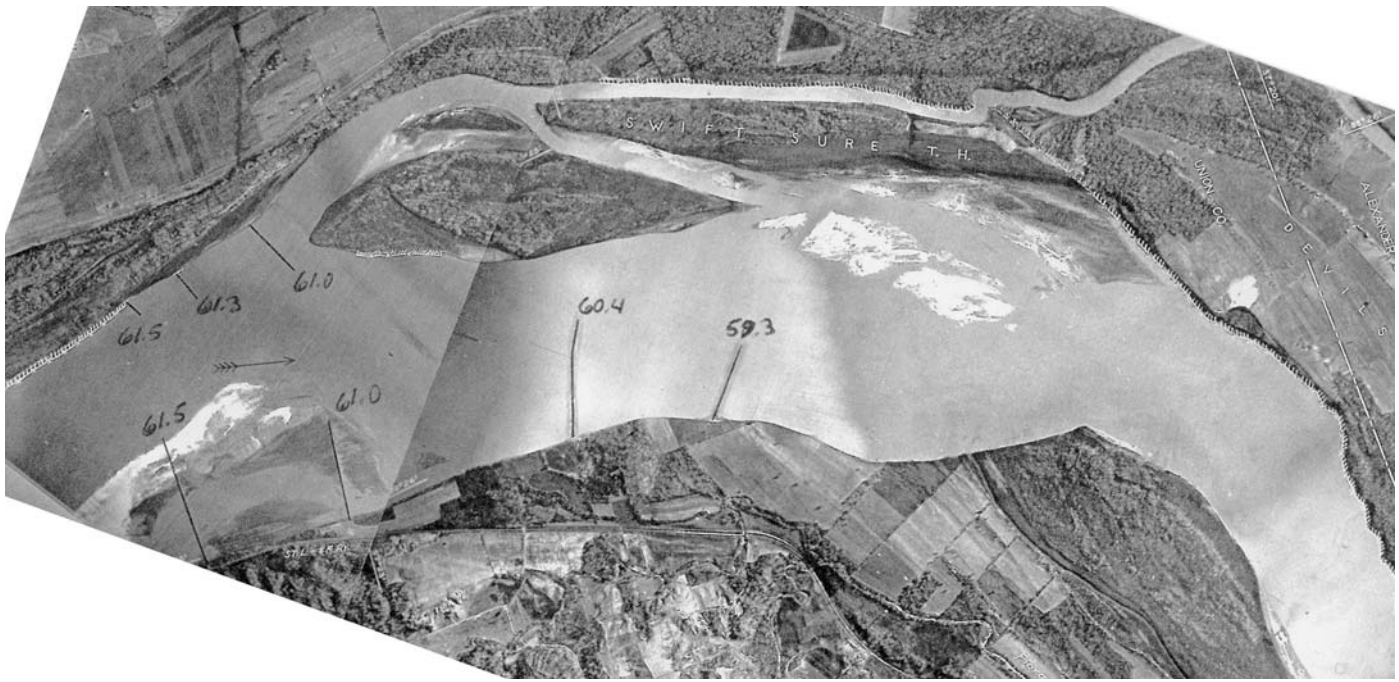


Sec 1 3/3 At 4" Ln 2 Col 1 REC TRK EXT OVR

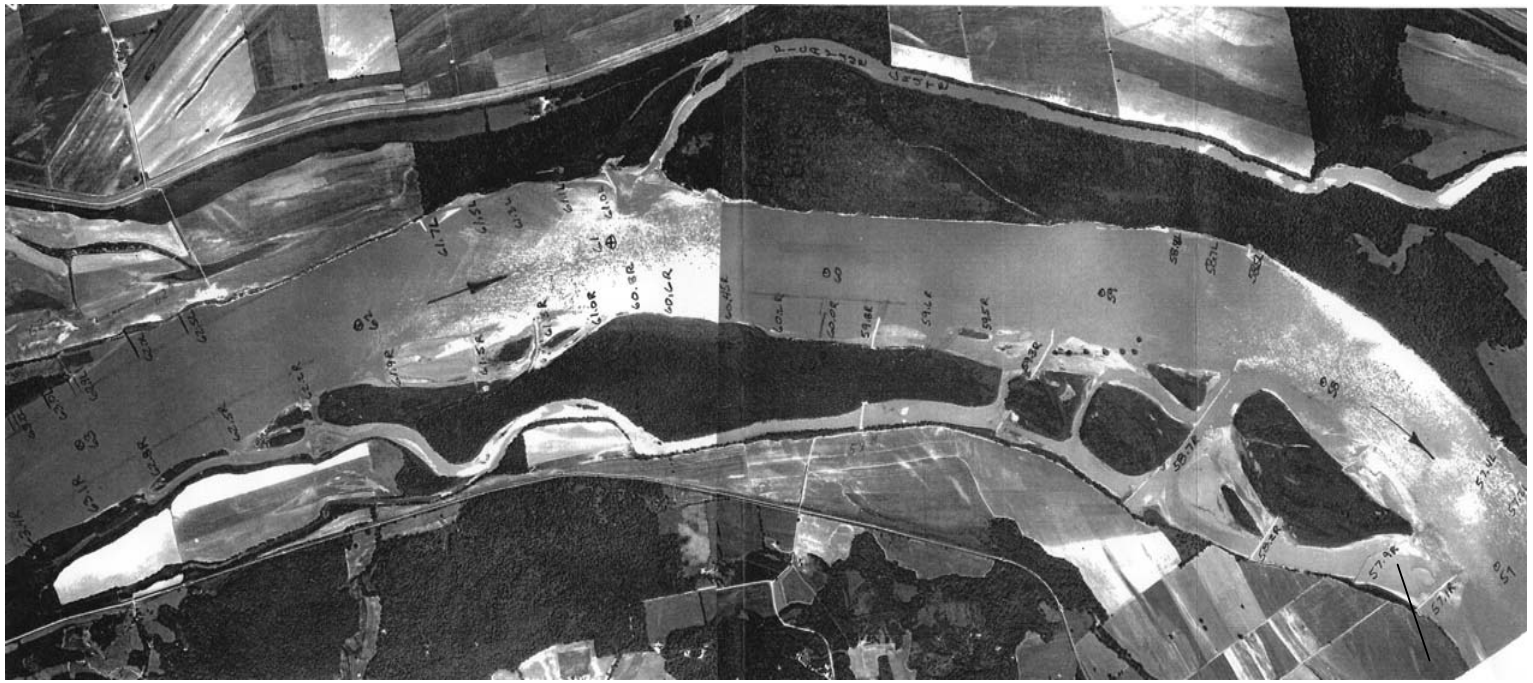
Story of the Formation of the Side channels in Middle Miss River…..

The majority of Side Channels today were formed between the 1930s to 1960,s

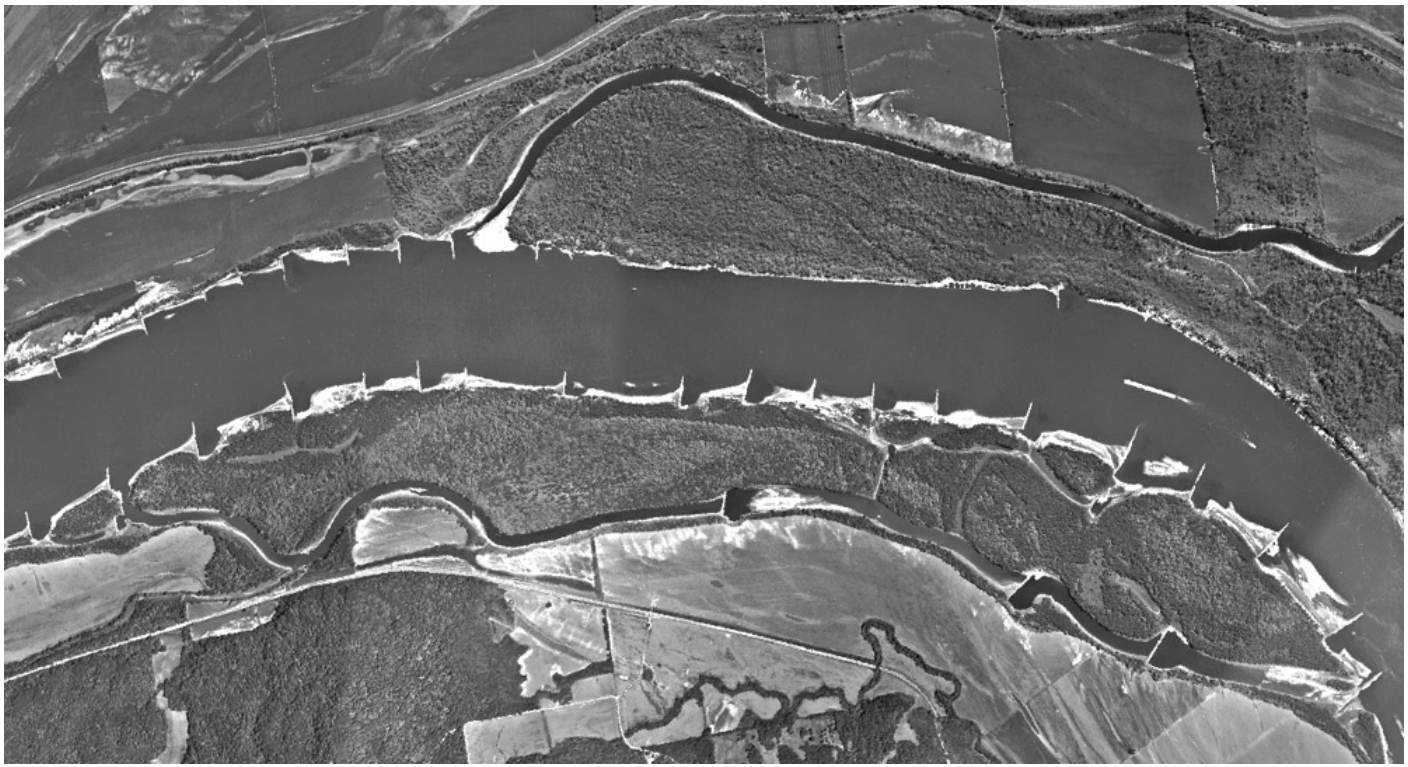


1932

1935

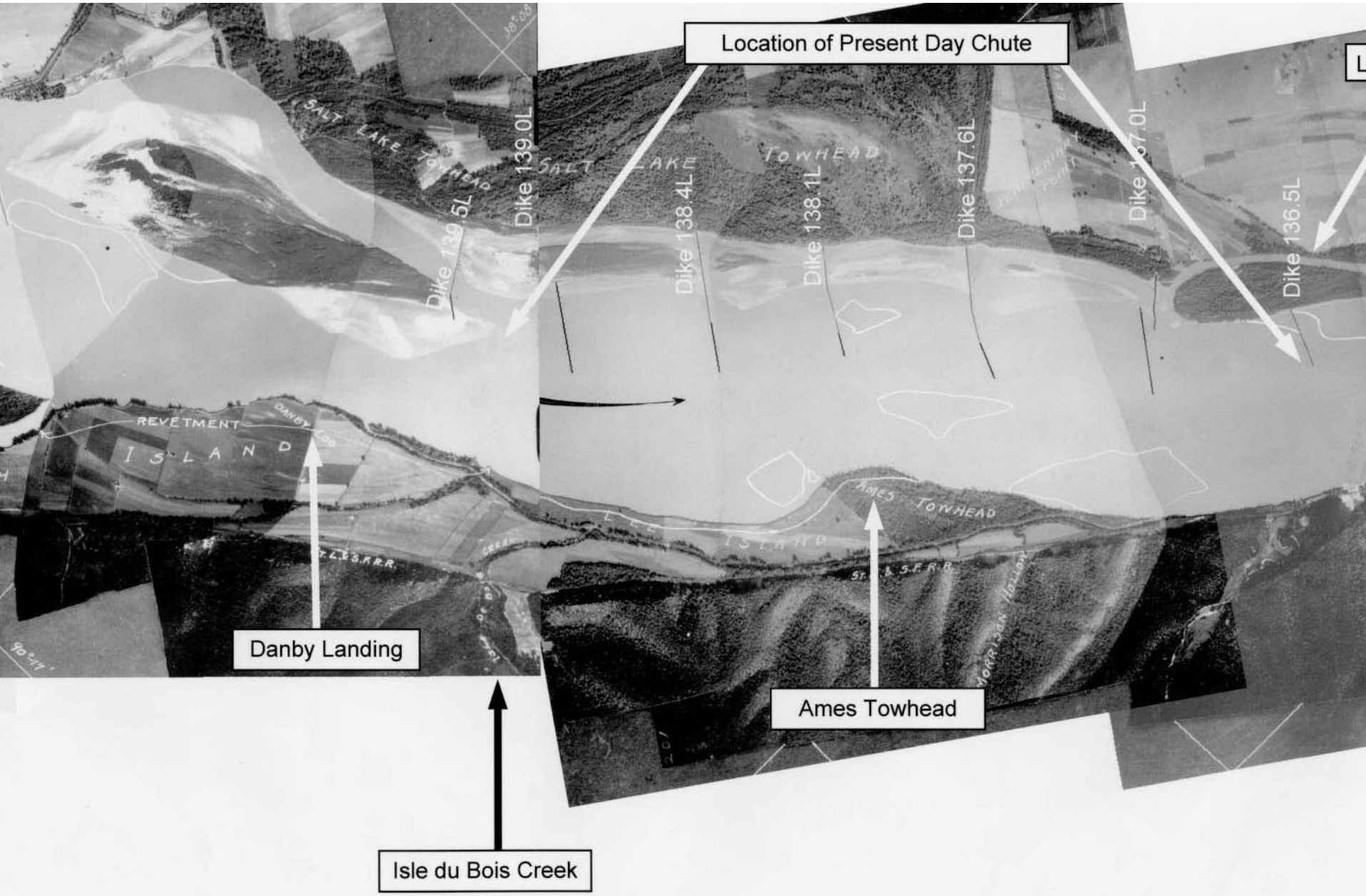


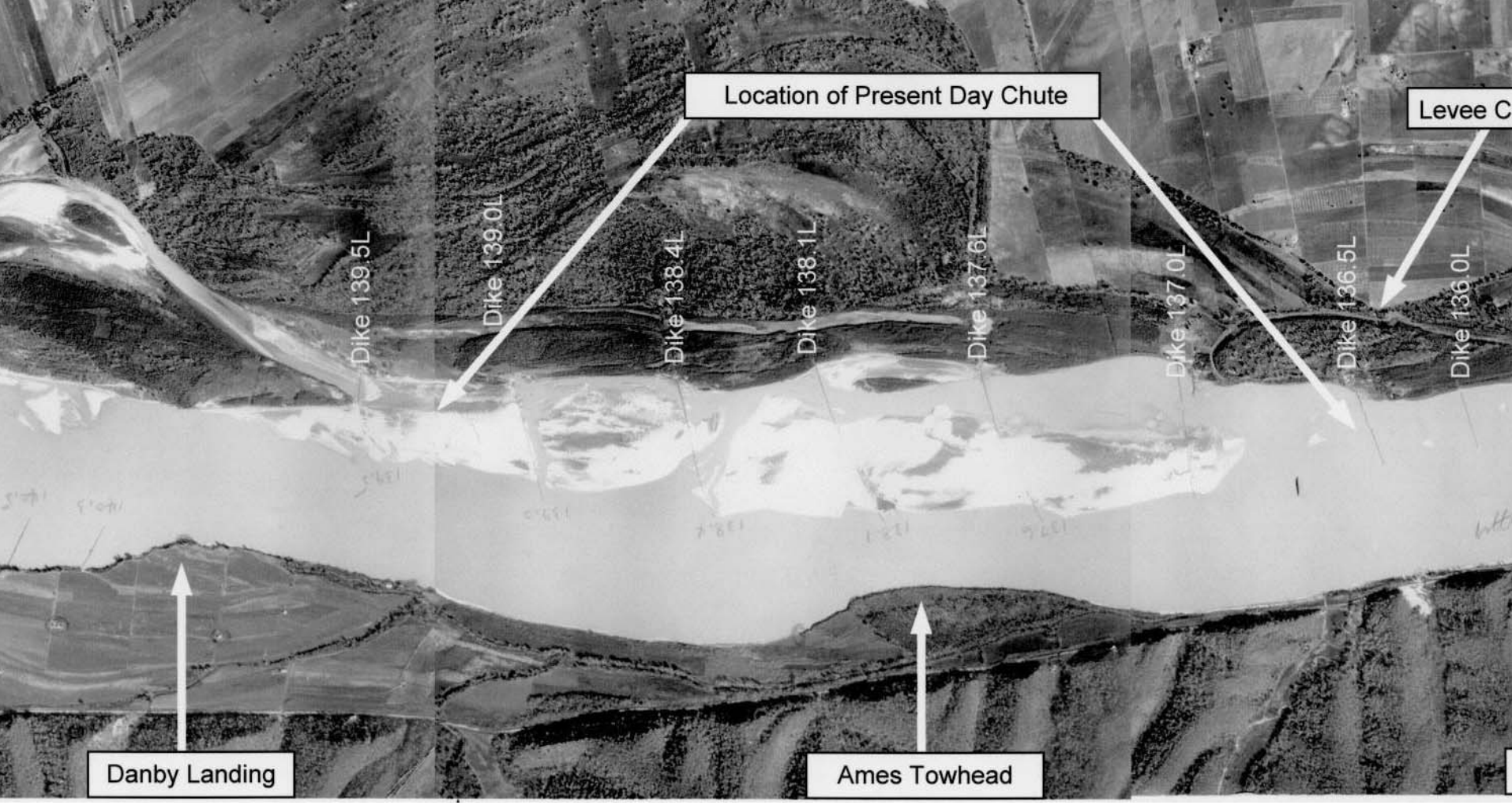
1965



1994

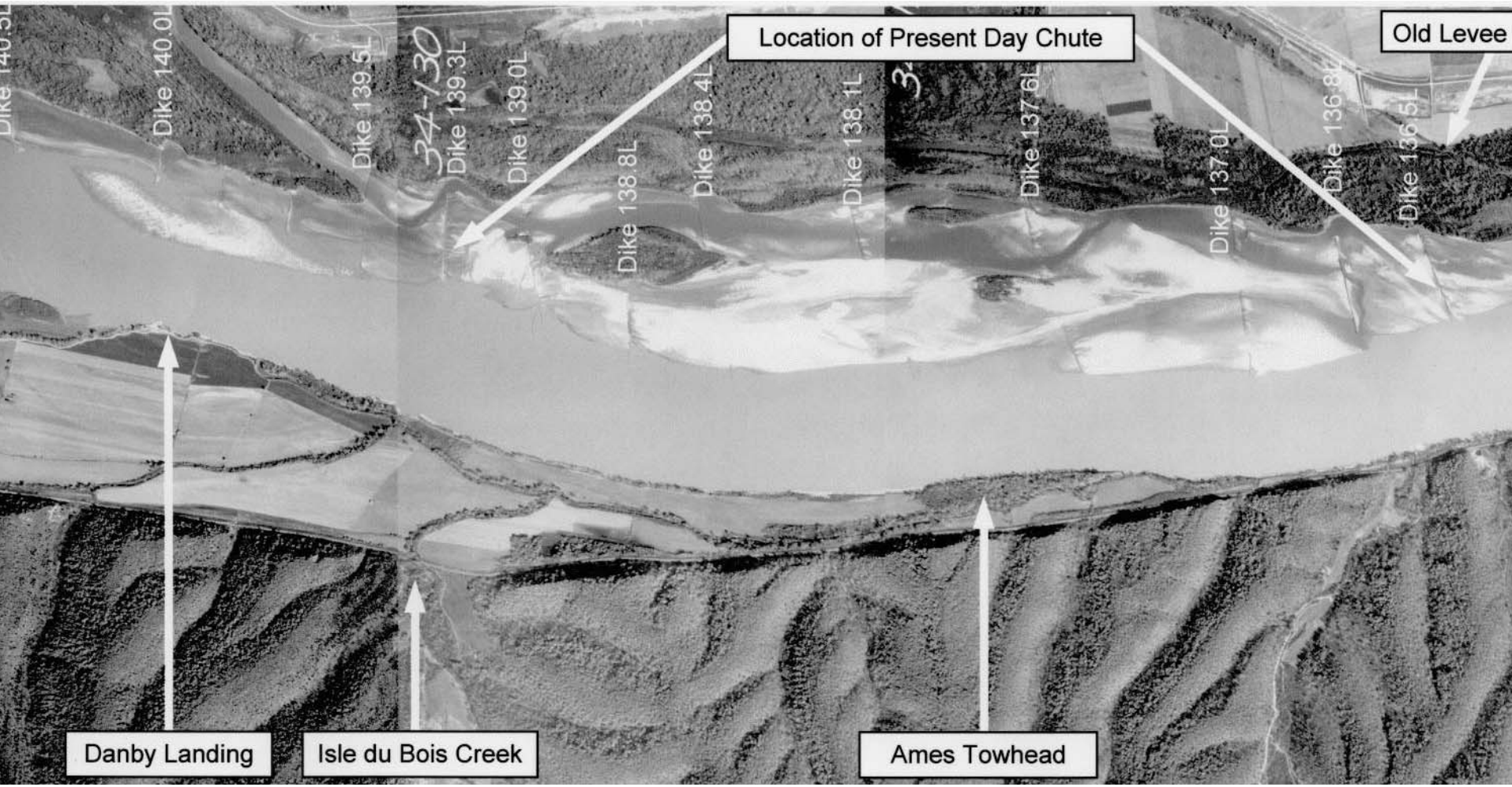
1928


Location of Present Day Chute
Dike 139.0L
Dike 138.4L
Dike 138.1L
Dike 137.6L
Dike 137.0L
Dike 136.5L
SALT LAKE TOWHEAD
REVETMENT
DANBY
ISLAND
AMES TOWHEAD
Danby Landing
Ames Towhead
Isle du Bois Creek


Location of Present Day Chute
Levee C
Dike 139.5L
Dike 139.0L
Dike 138.4L
Dike 138.1L
Dike 137.6L
Dike 137.0L
Dike 136.5L
Dike 136.0L
Danby Landing
Ames Towhead

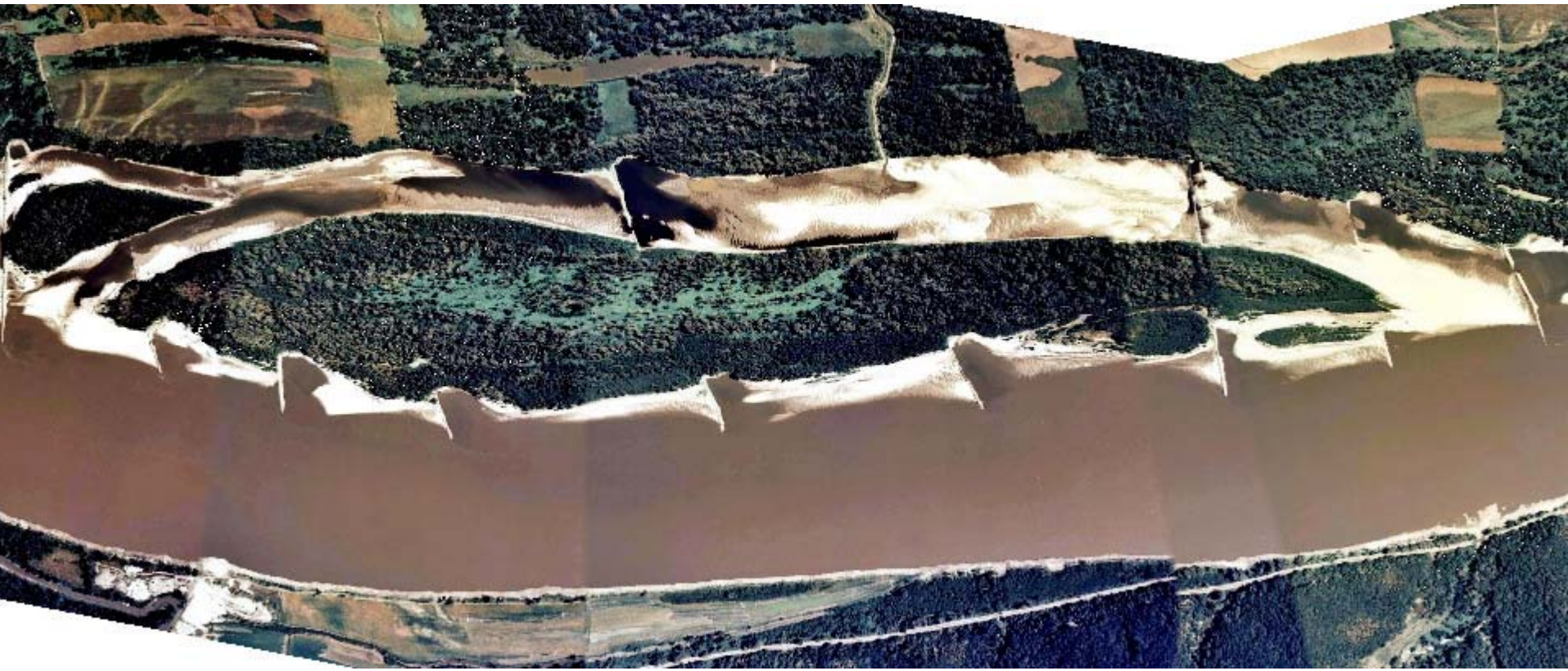
1935

1948


Location of Present Day Chute
Old Levee
Dike 140.0L
Dike 139.5L
34-130
Dike 139.3L
Dike 139.0L
Dike 138.8L
Dike 138.4L
Dike 138.1L
Dike 137.6L
Dike 137.0L
Dike 136.8L
Dike 136.5L
Danby Landing
Isle du Bois Creek
Ames Towhead

Location of Present Day Chute
1976
Dike 140.5L
Dike 140.1L
Dike 140.0L
Dike 139.5L
Dike 139.3L
Dike 139.0L
Dike 138.8L
Dike 138.4L
Dike 138.1L
Dike 137.6L
Dike 137.0L
Dike 136.8L
Danby Landing
Isle du Bois Creek
Ames Towhead

1998



Dike 138.4L
Dike 138.1L
Dike 137
Dike 136.5L
REVETMENT
ISLAND
AMES TOWHEAD

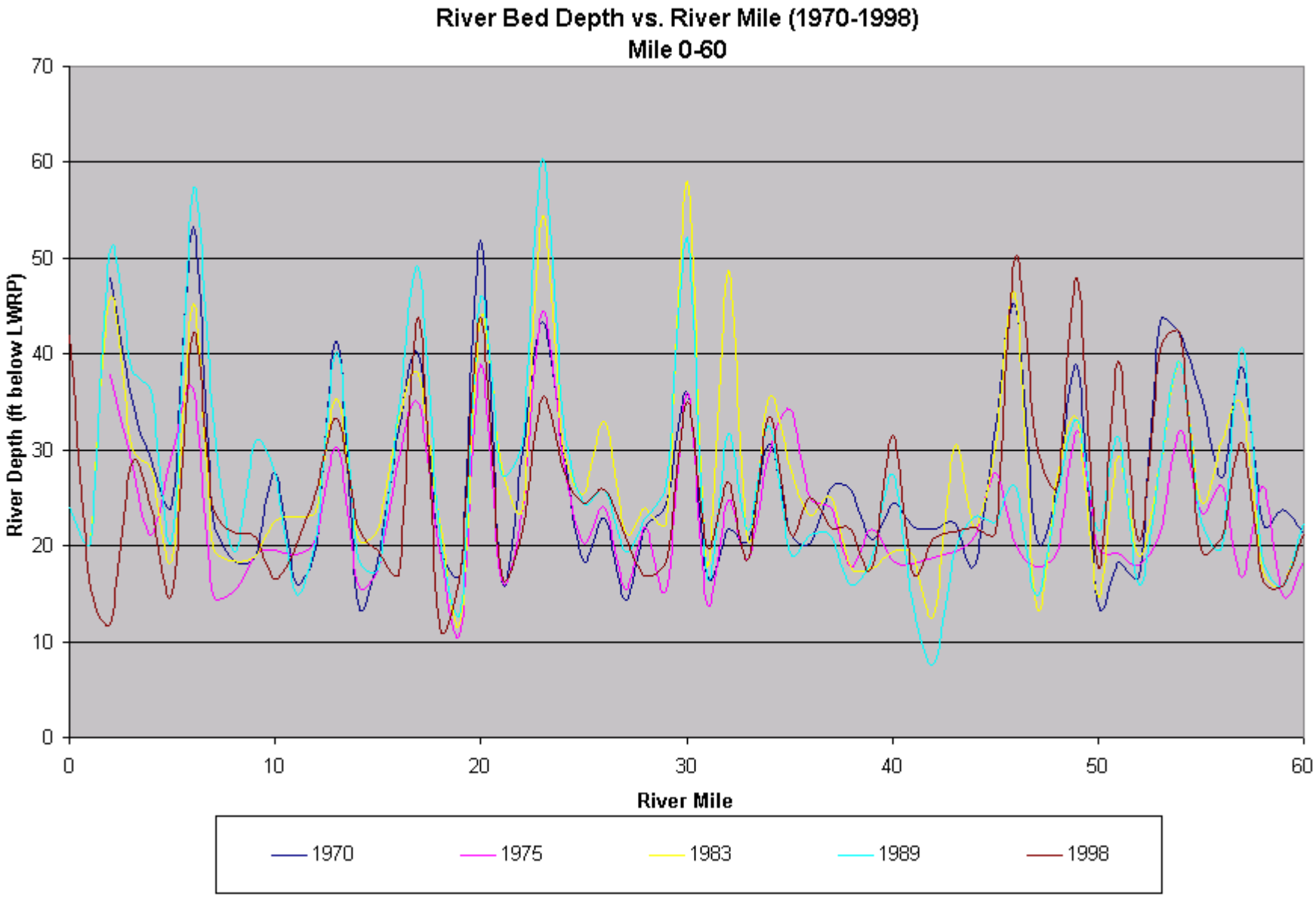
Myth, Multiple channels on a canaliform have an even flow distribution

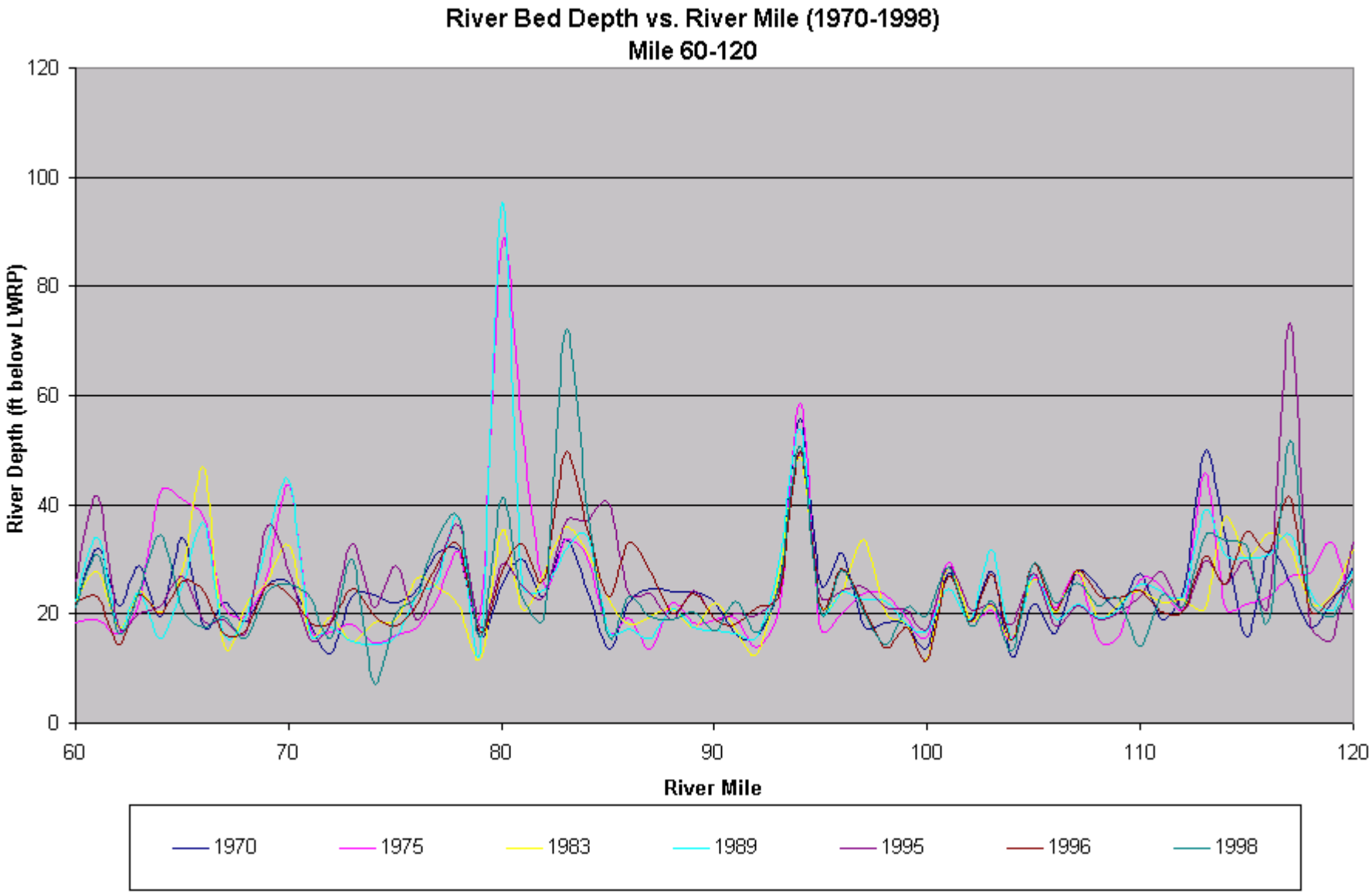
Fact, One channel will always be deep, one will always be shallow

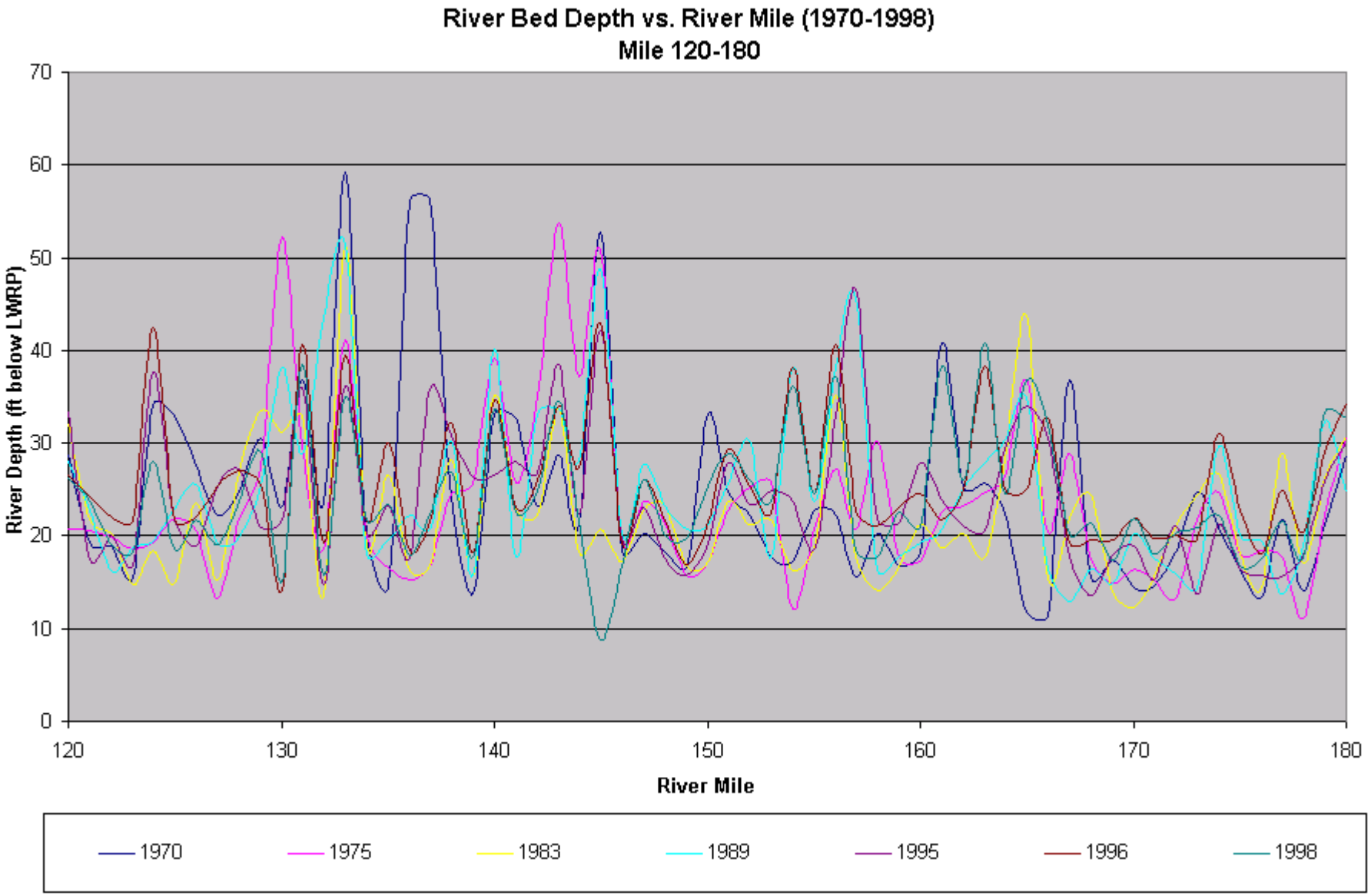
A virgin river

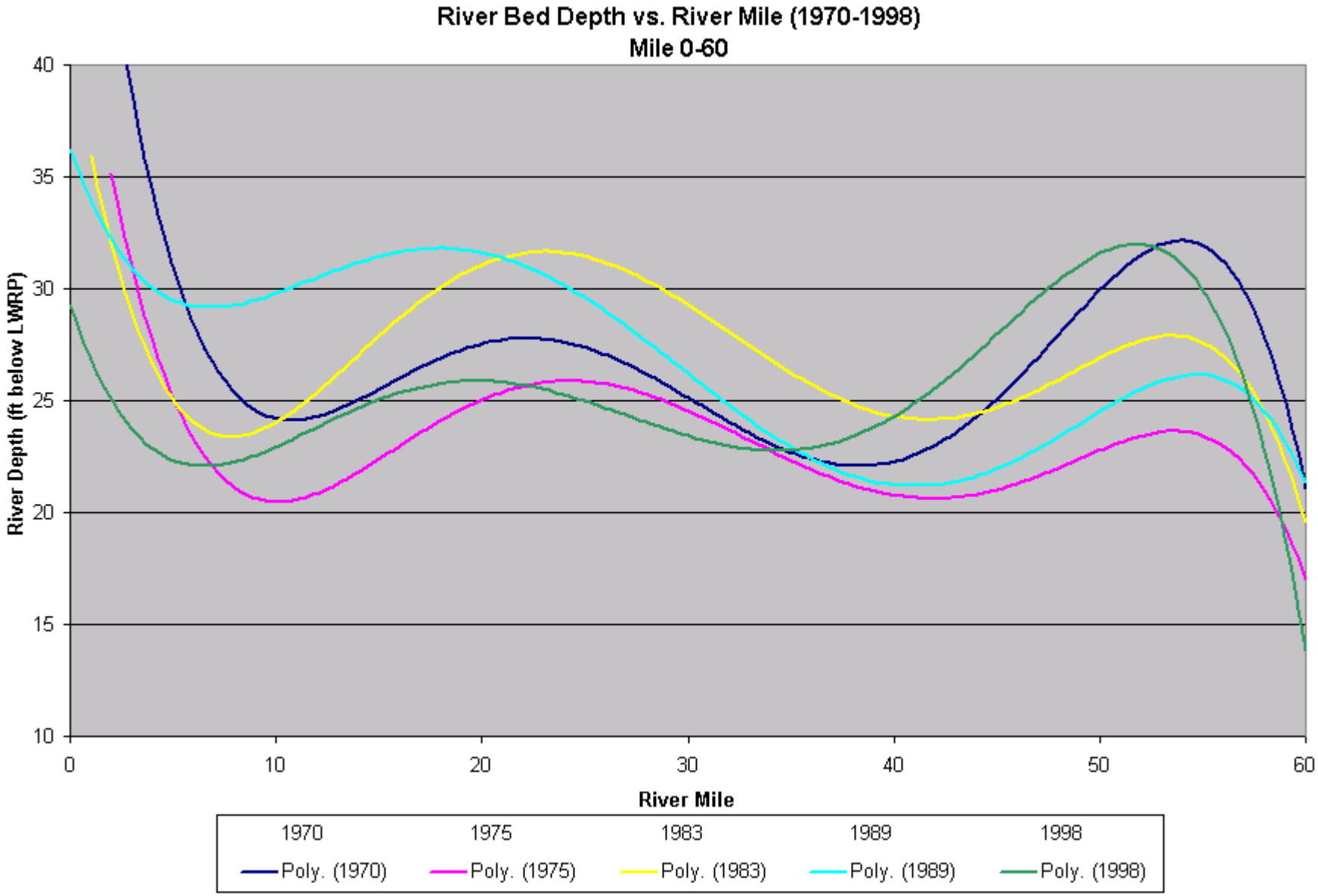
DEEP
SHALLOW
SHALLOW

Long Straight
Stretch


River Bed Depth vs. River Mile (1970-1998)
Mile 0-60
River Depth (ft below LWRP)
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
River Mile
1970
1975
1983
1989
1998

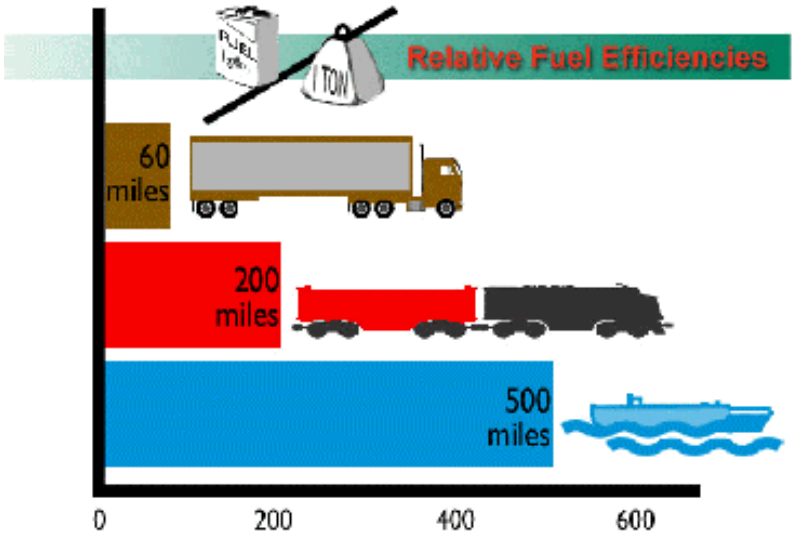

River Bed Depth vs. River Mile (1970-1998)
Mile 60-120
River Depth (ft below LWRP)
120
100
80
60
40
20
0
60
70
80
90
100
110
120
River Mile
1970
1975
1983
1989
1995
1996
1998


River Bed Depth vs. River Mile (1970-1998)
Mile 120-180
River Depth (ft below LWRP)
70
60
50
40
30
20
10
0
120
130
140
150
160
170
180
River Mile
1970
1975
1983
1989
1995
1996
1998


River Bed Depth vs. River Mile (1970-1998)
Mile 0-60
River Depth (ft below LWRP)
40
35
30
25
20
15
10
0
10
20
30
40
50
60
River Mile
1970
1975
1983
1989
1998
Poly. (1970)
Poly. (1975)
Poly. (1983)
Poly. (1989)
Poly. (1998)

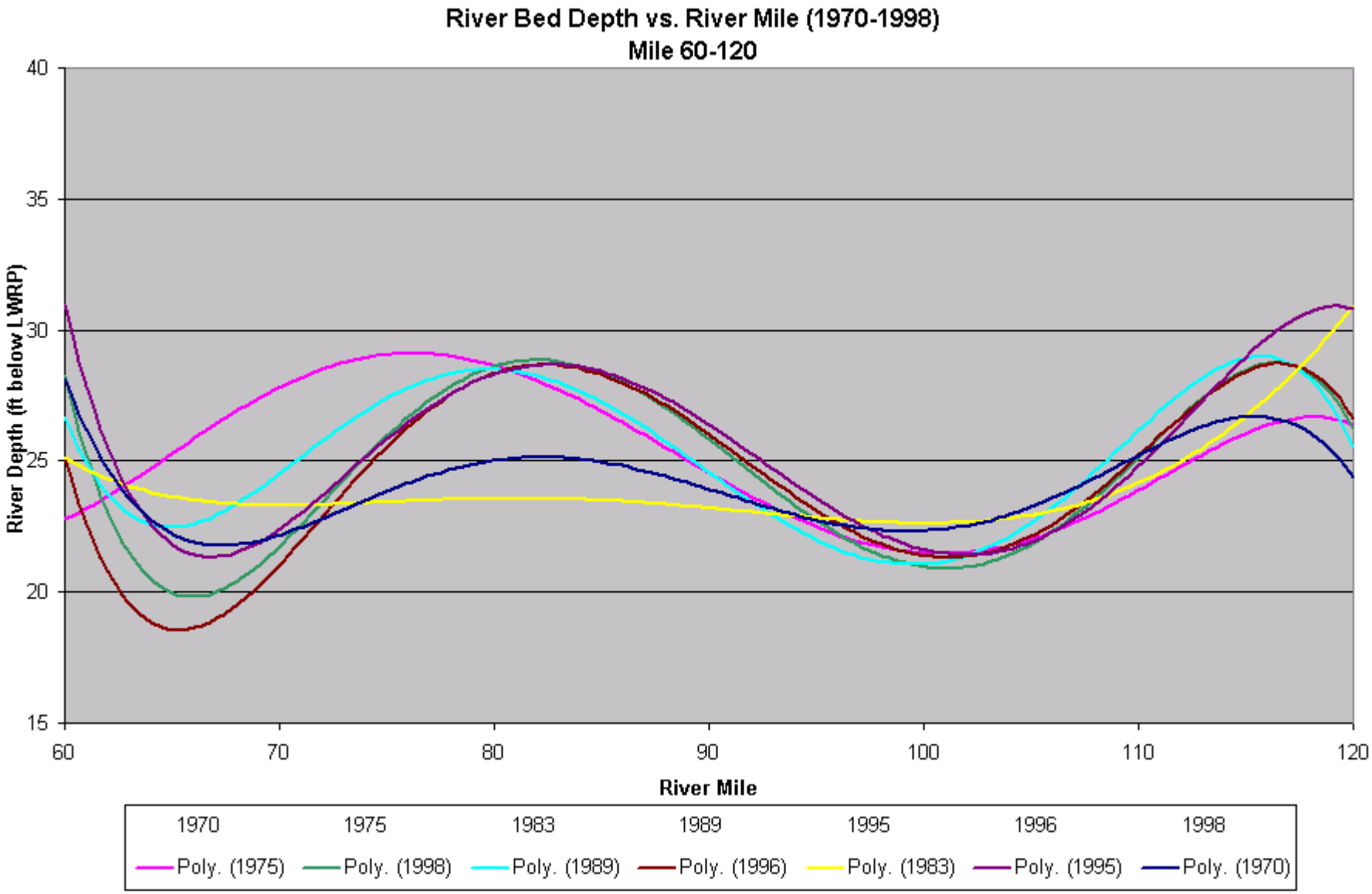
Impacts, an Ecosystem Prospective

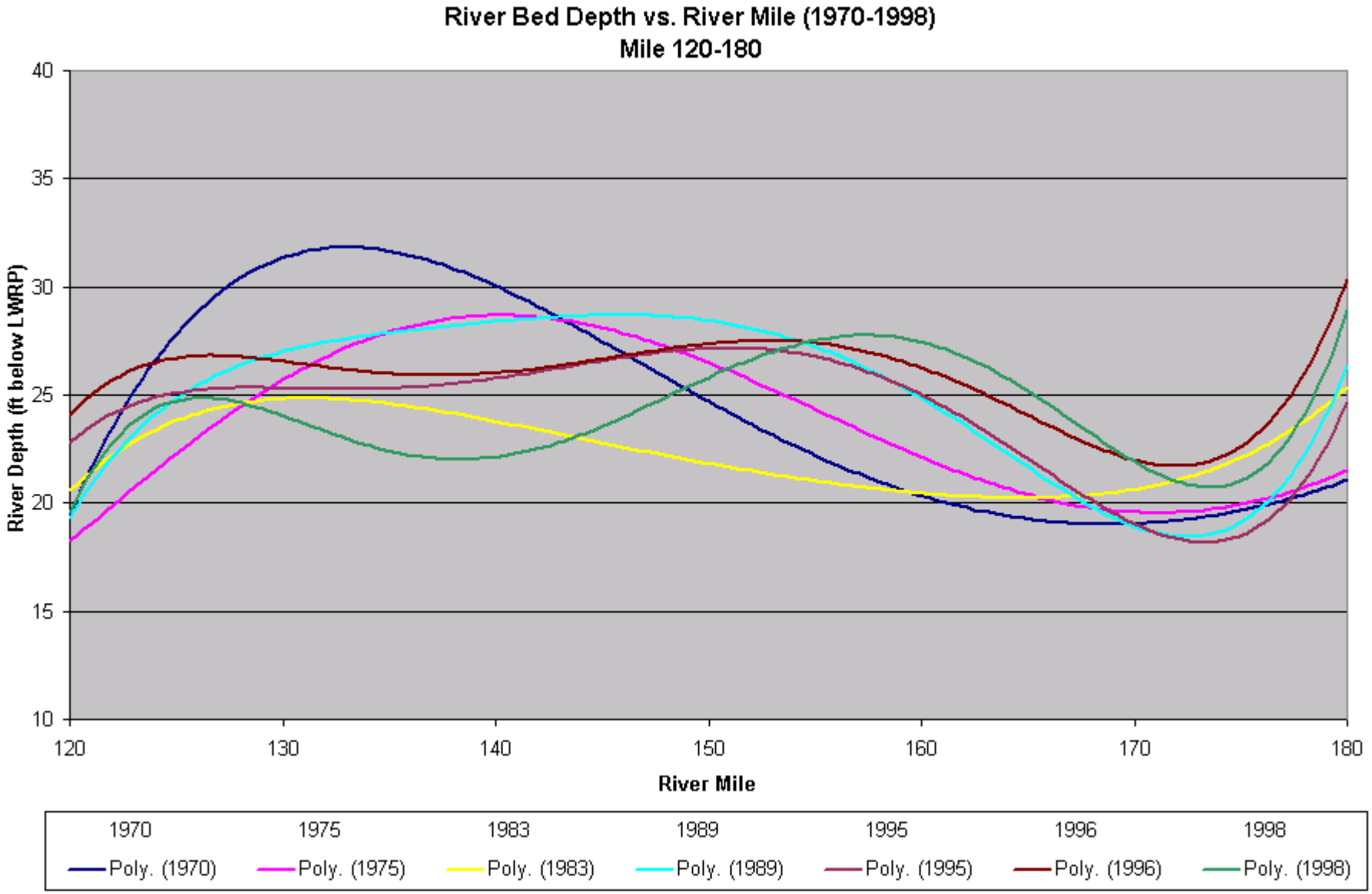
Fossil Fuel Burning



Below LD 27

1 Tow = 4.5 Unit Trains = 1800 trucks


River Bed Depth vs. River Mile (1970-1998)
Mile 60-120
River Depth (ft below LWRP)
40
35
30
25
20
15
60
70
80
90
100
110
120
River Mile
1970
1975
1983
1989
1995
1996
1998
Poly. (1975)
Poly. (1998)
Poly. (1989)
Poly. (1996)
Poly. (1983)
Poly. (1995)
Poly. (1970)


River Bed Depth vs. River Mile (1970-1998)
Mile 120-180
River Depth (ft below LWRP)
40
35
30
25
20
15
10
120
130
140
150
160
170
180
River Mile
1970
1975
1983
1989
1995
1996
1998
Poly. (1970)
Poly. (1975)
Poly. (1983)
Poly. (1989)
Poly. (1995)
Poly. (1996)
Poly. (1998)

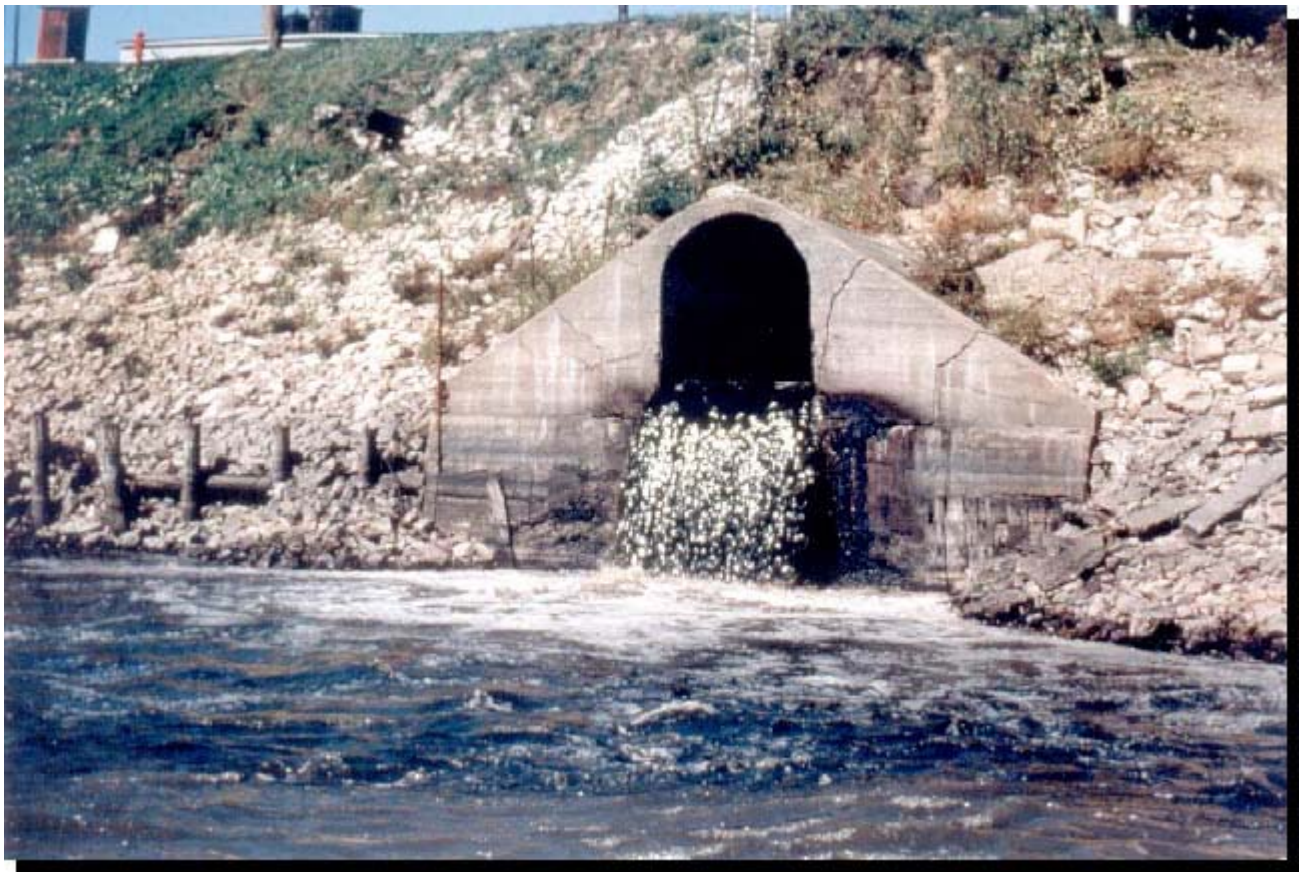
The Road to Restoration

A Major Focus needs to be directed at the source problem: Land Use Conservation

So far, billions have been invested

The Future, Opportunities for Environmental Restoration, Enhancement

St. Louis Direct Sewer Discharge



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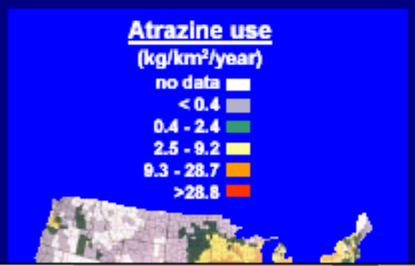
Go Links
ssissippi River Search FTD.COM Flowers Sign In My Yahoo! Godiva Chocolates Yahoo! Games Yahoo! Mail
135%

Controlled re-introduction of the sediment and nutrient-laden waters of the Mississippi River is the best large-scale tool for coastal restoration. However, concern remains over the River's water quality and the potential for adverse impacts such as fish kills.



Concerns regarding Mississippi River pollution first emerged after World War II as significant impacts to water quality began to accrue from an increasing human population, persistent use of agricultural chemicals, and an expanding industrial river complex. By the mid 1960s, scientists had documented serious water quality impacts from a variety of pollutants. Harmful environmental effects included mortality and population declines in both fish and wildlife resources. With increased public concern, federal water quality regulatory actions were approved in the late 1960s and early 1970s. The establishment of the U.S. Environmental Protection Agency (EPA), passage of the Clean Water Act (CWA), and the formation of state environmental improvement agencies resulted in nationwide water pollution control regulations and pollutant reduction targets.

STATUS OF RIVER WATER QUALITY

After 25 years of the CWA and other water quality improvement efforts, surface waters nationwide (including the Mississippi River) are significantly cleaner. Recent Louisiana State University studies in the Mississippi River show healthy fish populations, including important recreational and commercial species such as bass, catfish, buffalo, and shad. In a recent Louisiana Department of Environmental Quality (DEQ) tissue analyses, fish from the Mississippi River were analyzed for over 100 toxic chemicals, most which (95%) were undetected. Samples with detectable toxins were at relatively low concentrations, falling below the U.S. Food and Drug Administrations (FDA) standard for edible fish. In addition to DEQ, ongoing Mississippi River water quality monitoring efforts are conducted by the federal Department of the Interior - U.S. Geological Survey (USGS).

2 of 4 8.5 x 11 in
Internet
AutoShapes
Slide 42 of 133 Default Design

An indicator of health or non-health?

The Big River Region includes the Missouri and Mississippi rivers. Many kinds of fish are characteristic of the channels of these streams, but crayfish occur only as small local populations or stray individuals. A four- inch shrimp (Macrobrachium ohione) was formerly abundant in the Mississippi River, but disappeared about 30 years ago.

Measures For Restoration, Potentials and Limitations

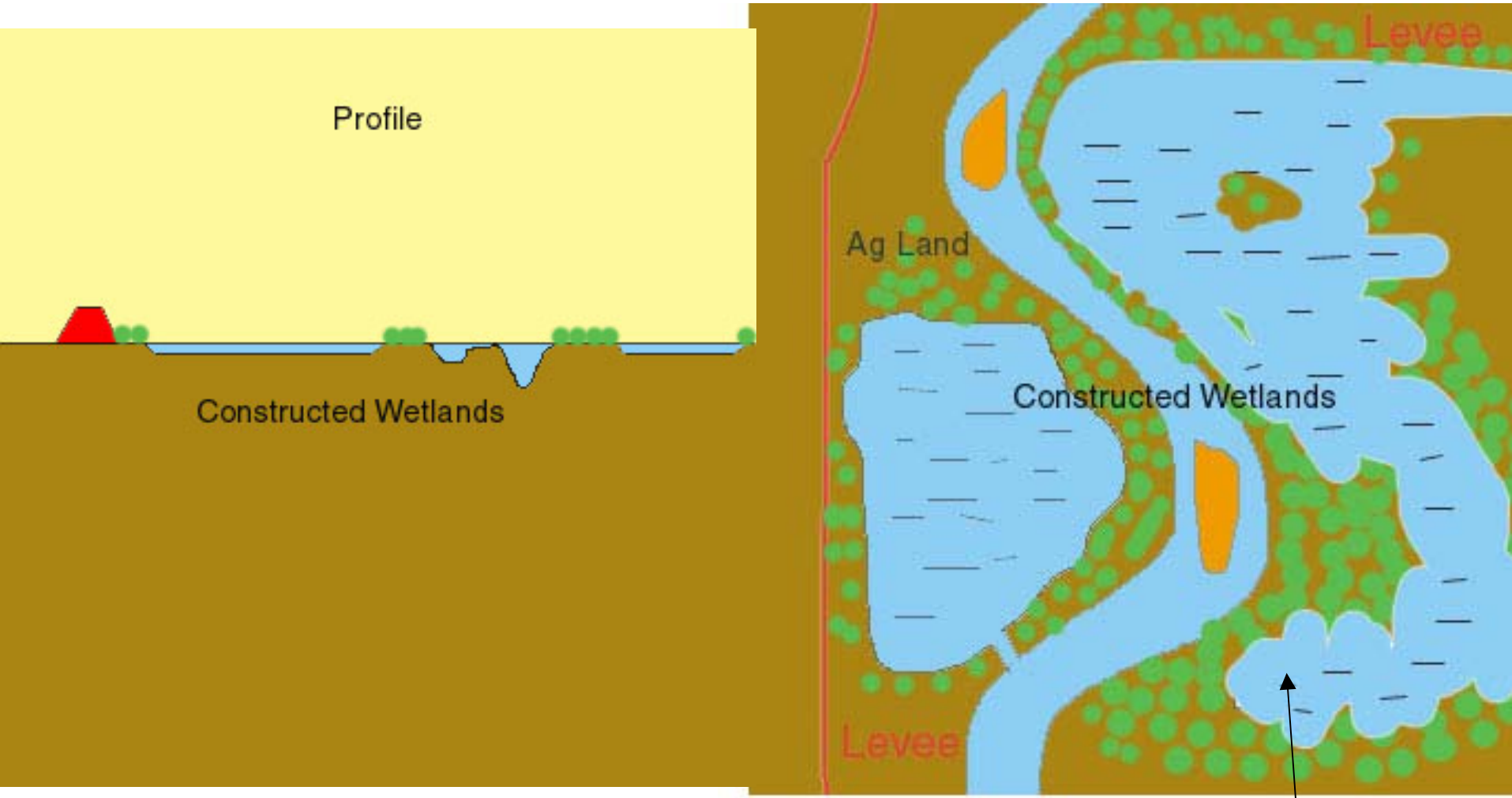
1. 40 square miles of riparian corridor for creation of new pockets, interconnected side channels, and backwaters.
2. Enhancement and preservation of existing side channels
3. Creation of New Islands and Side Channels Within Engineering Contraction Zone

AMERICAN LAND CONSERVANCY

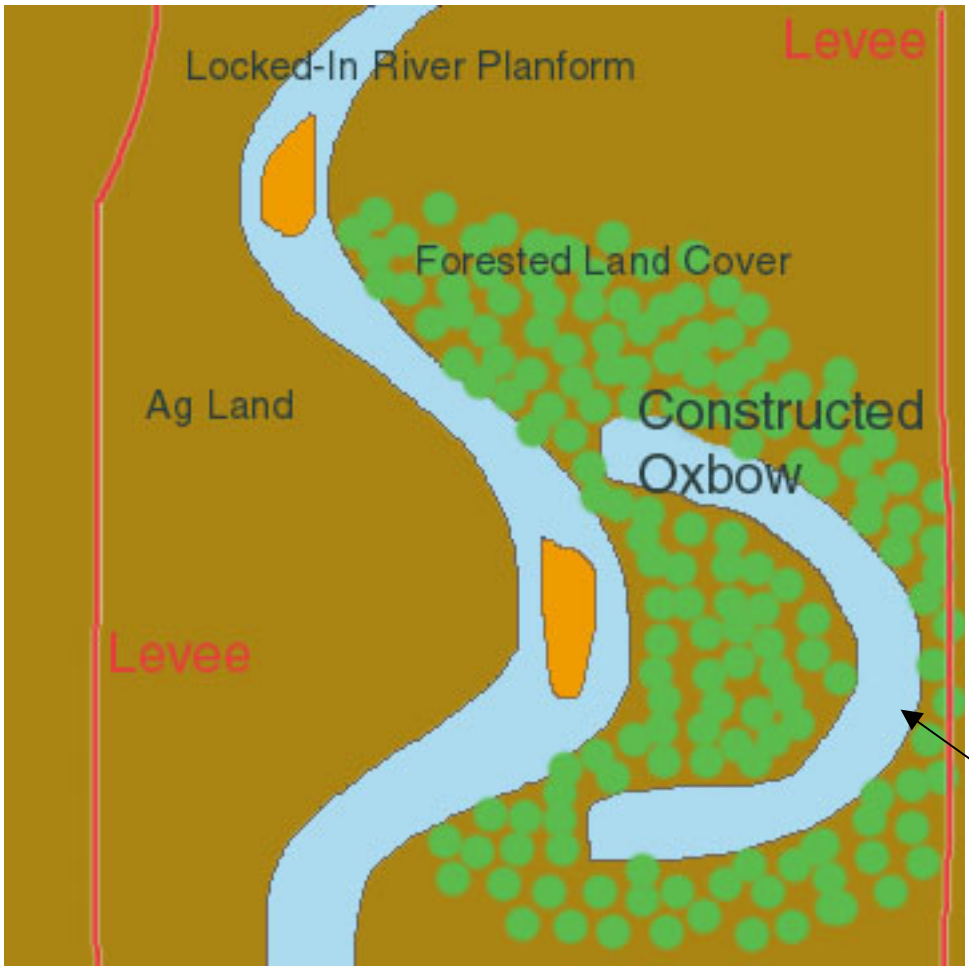
Borrow Area

Riparian Corridor , St. Louis to Cairo +48,819 acres, .. 76.28 square miles!!

Europeans are jealous!!!!



USDA Sediment Reduction Will Help

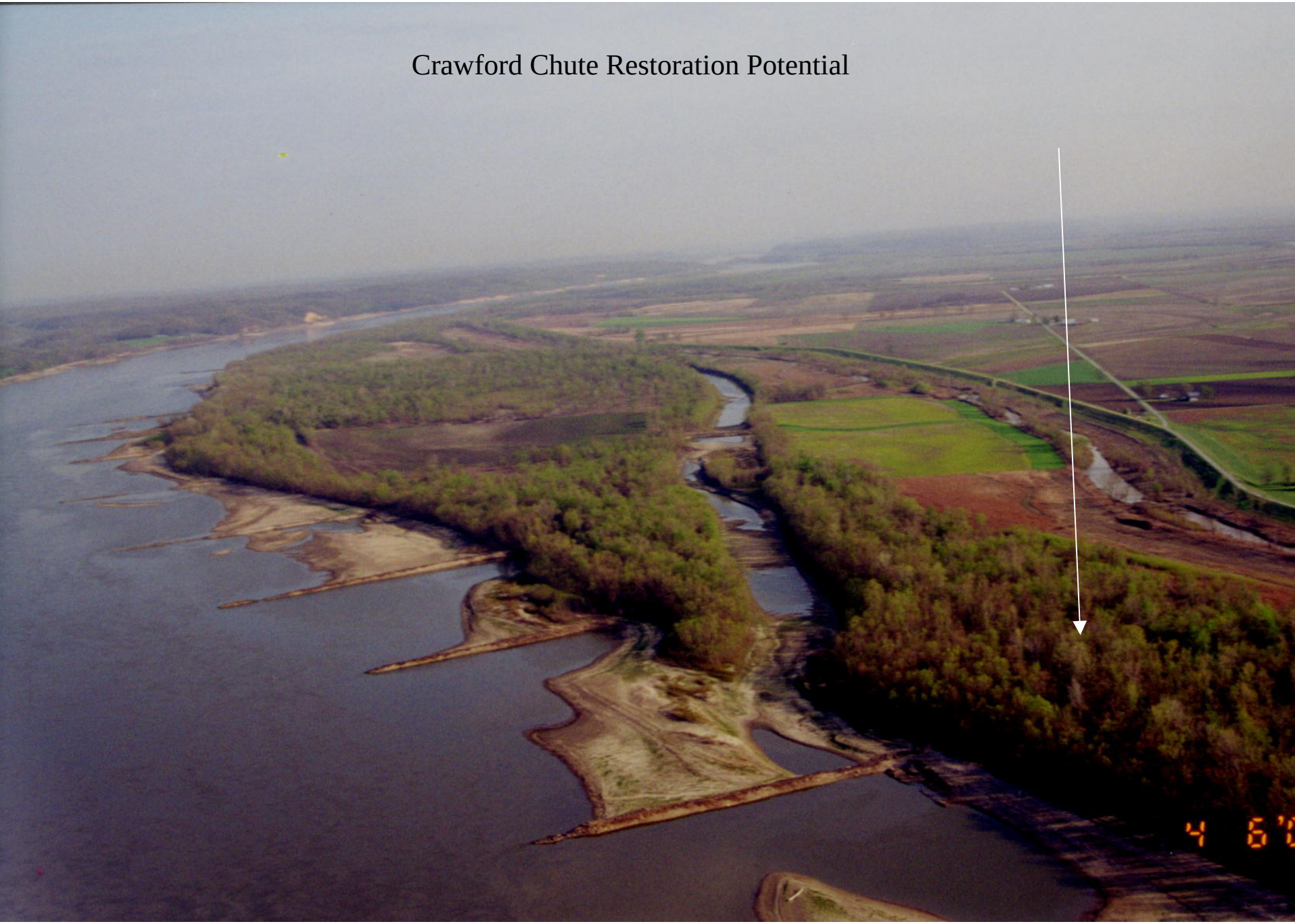


USDA Sediment Reduction Will Help

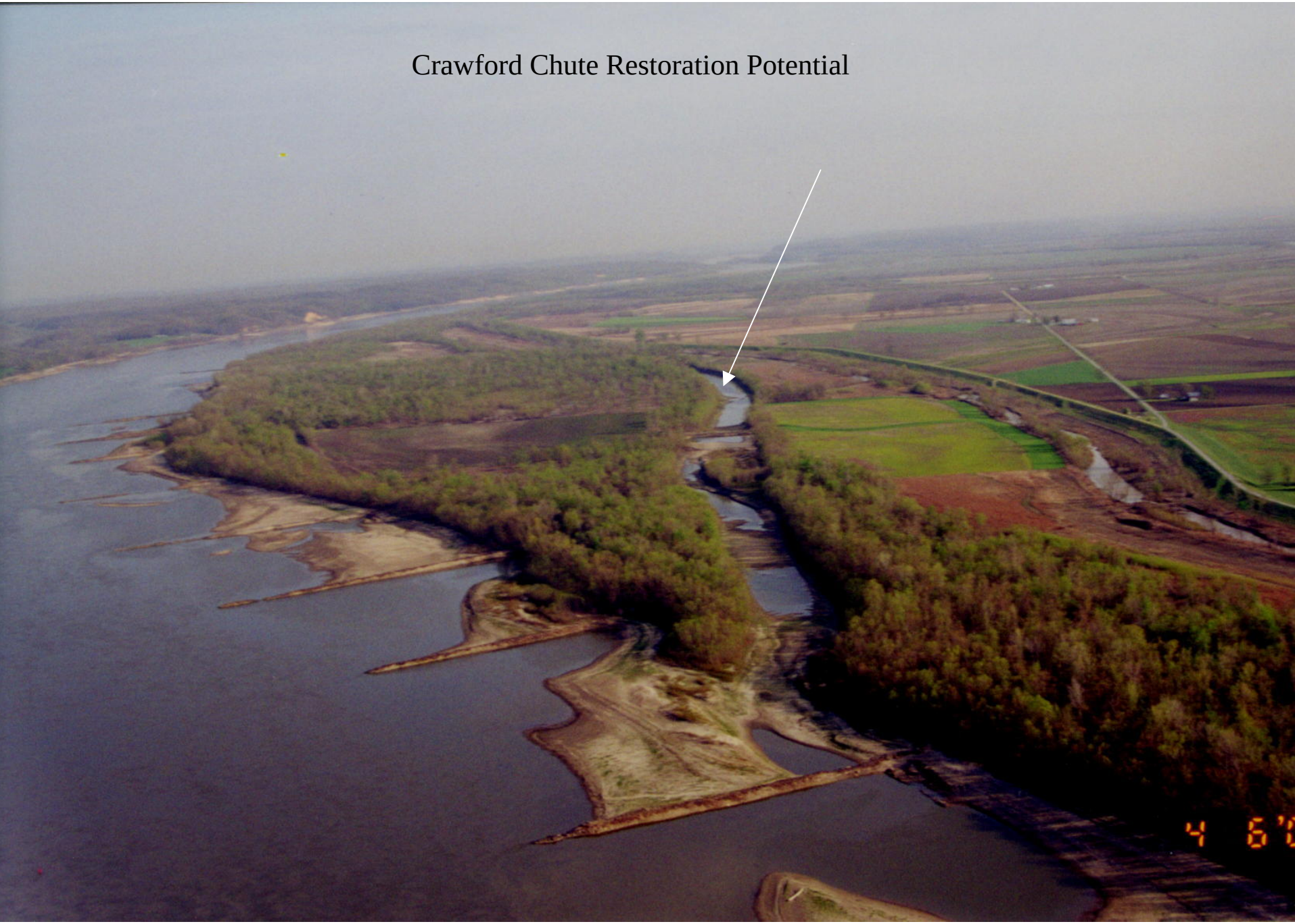
Crawford Chute Restoration Potential Mile 74 to 71

Crawford Chute Restoration Potential

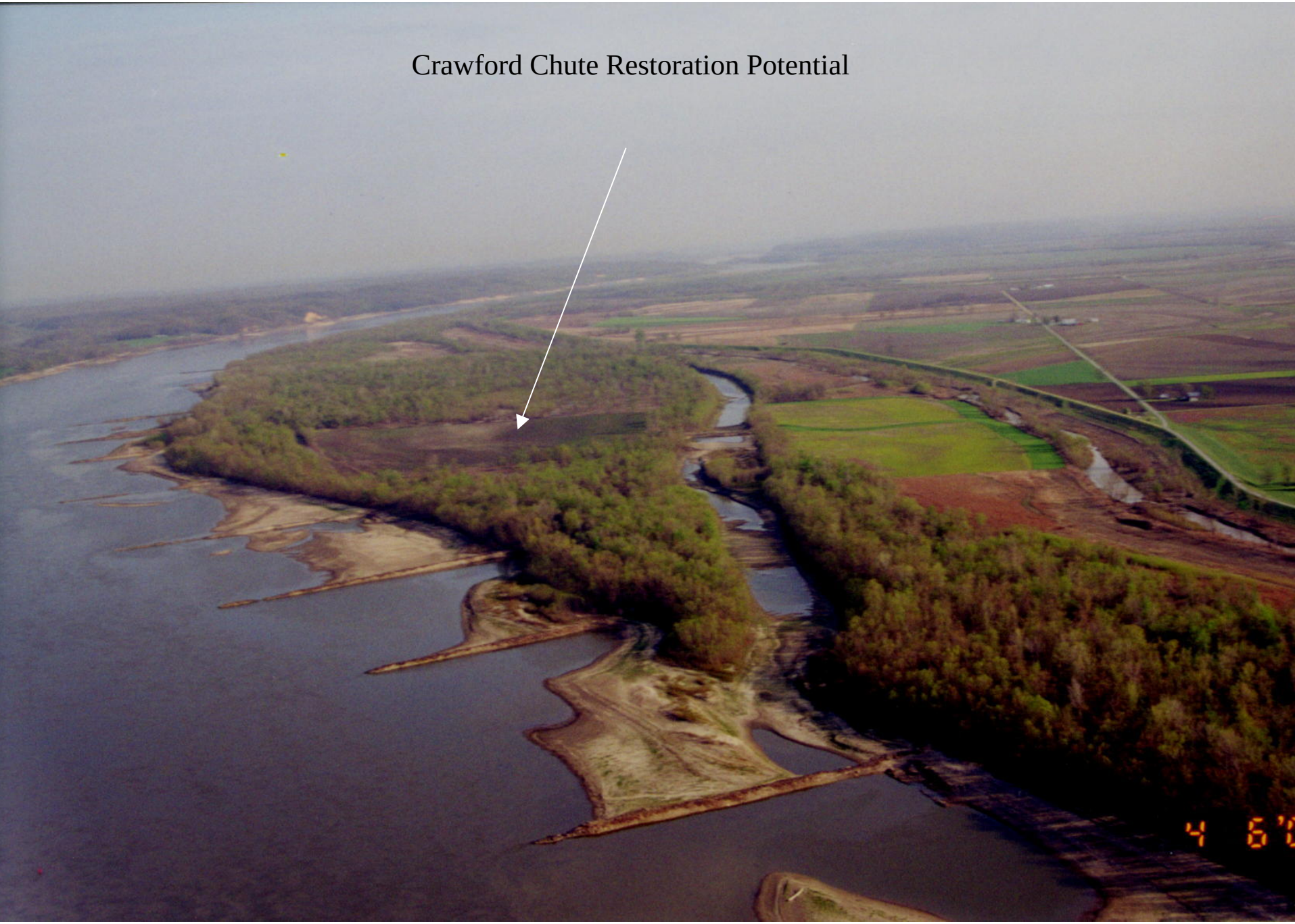
Crawford Chute Restoration Potential



Crawford Chute Restoration Potential



Crawford Chute Restoration Potential

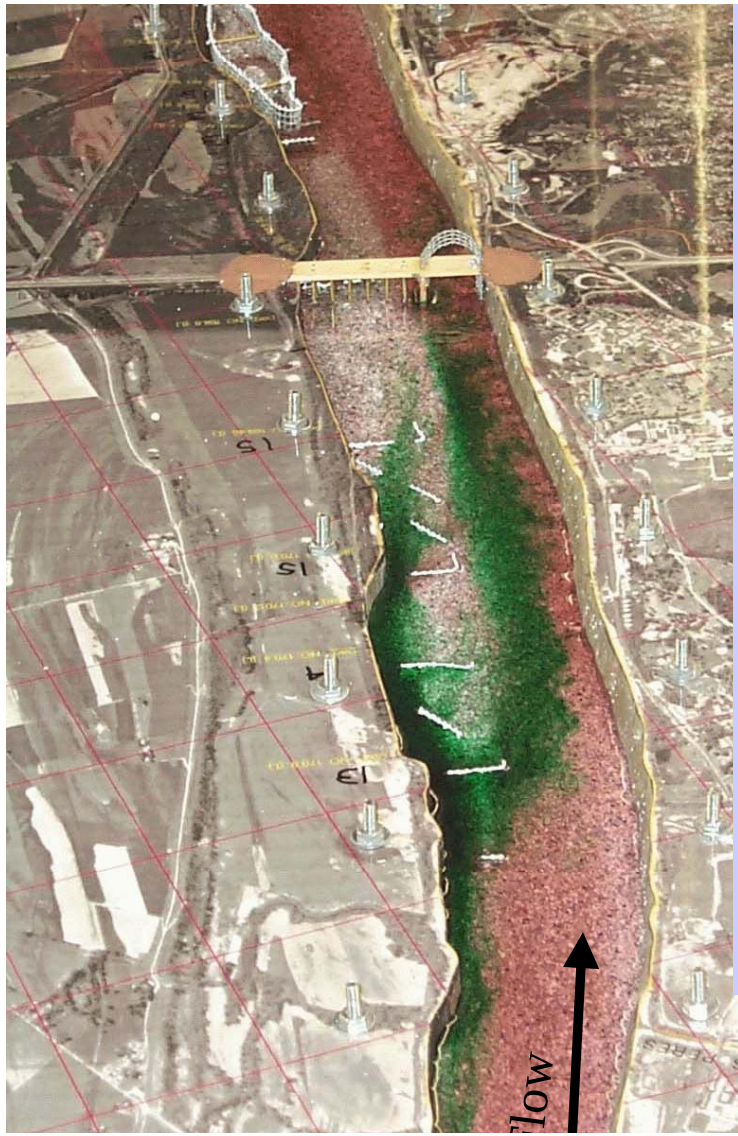


Crawford Chute Restoration Potential

Crawford Chute Restoration Potential

DIKE NO. 154.6(L)
DIKE NO. 154.4(L)

RED SHADE FOU
BATCH NO 013416



Created Side Channel is 1.5 miles long!!

Depths of channel in upper one third of channel between +-2 and –24 feet LWRP (Will be deepest side channel in Middle Mississippi River) !!!!!

Island top near +10 LWRP, may need seeding to accelerate vegetation (if desired)

Island will be totally isolated from bankline near 99% of time!!!!!

Two islands created, 120 acres total

5 additional vane dikes required

Removal of portion of existing dikes (rootless dikes)

All dikes raised to +17 LWRP

Some existing notches filled

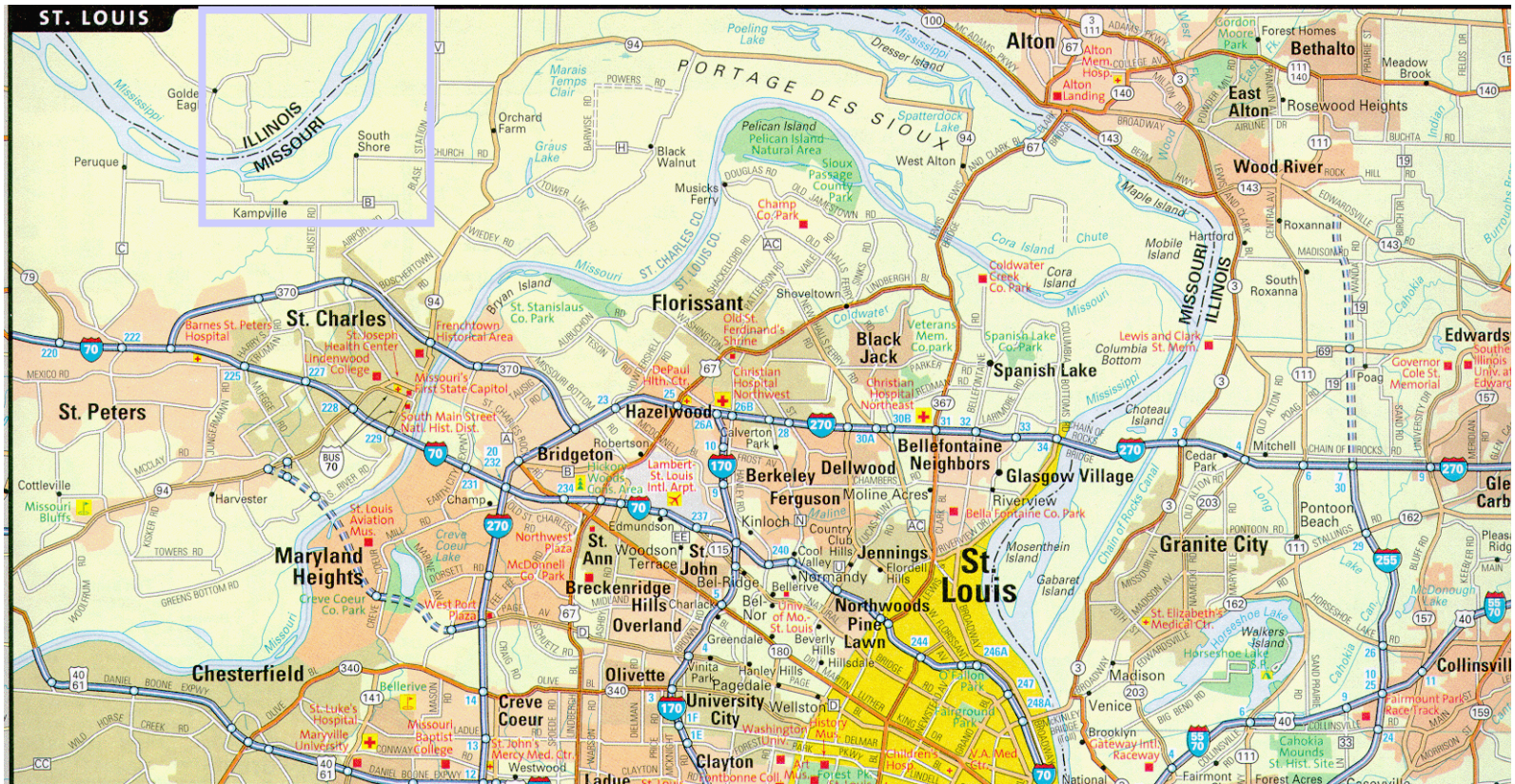
Bankline must be protected

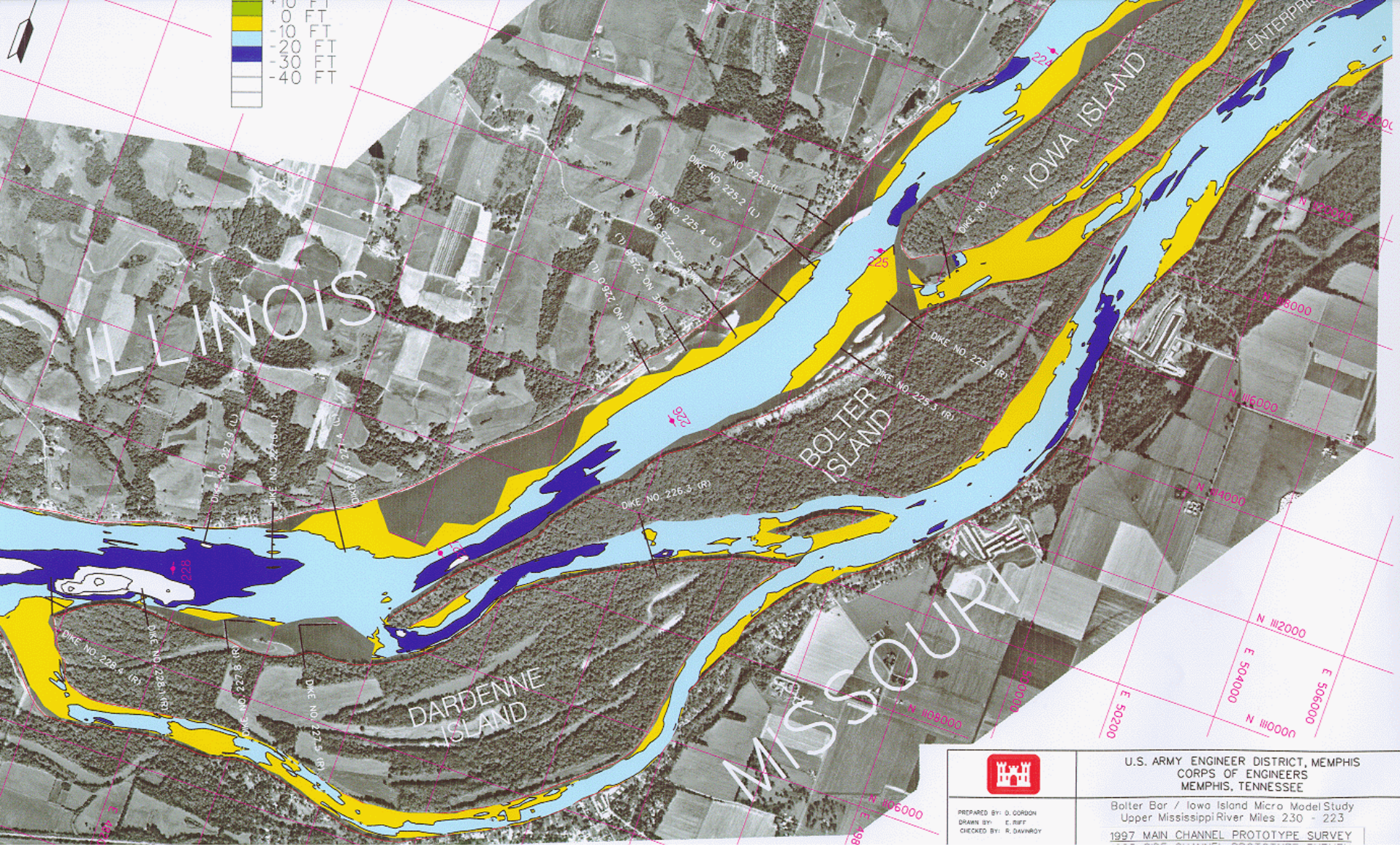
Navigation Channel is Improved, Possible Reduction in Dredging

US Army Corps of Engineers
St. Louis District

APPLIED RIVER ENGINEERING CENTER

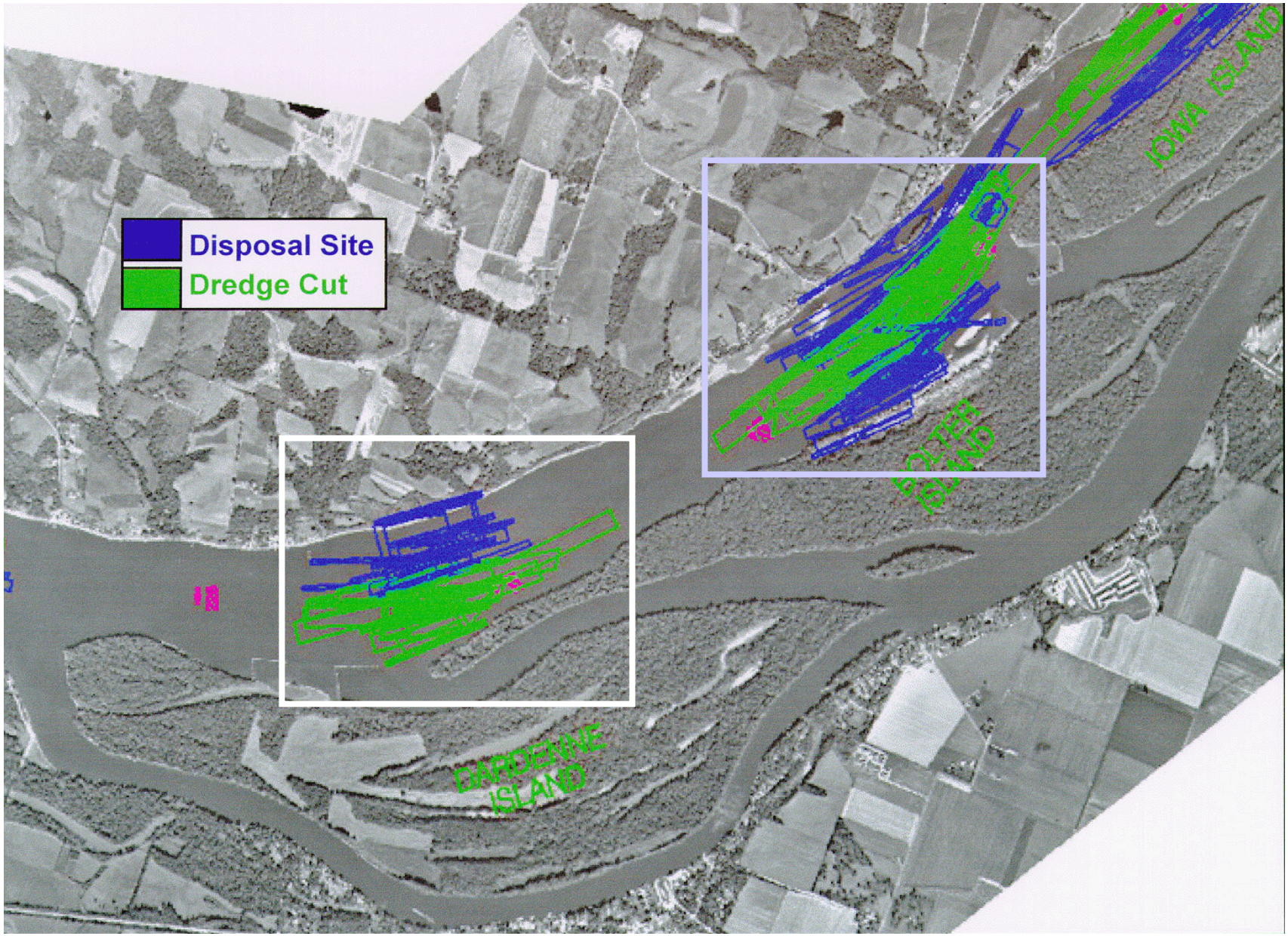
Bolters Bar Micro Model Study, Mississippi River Miles 232.5 to 222.0

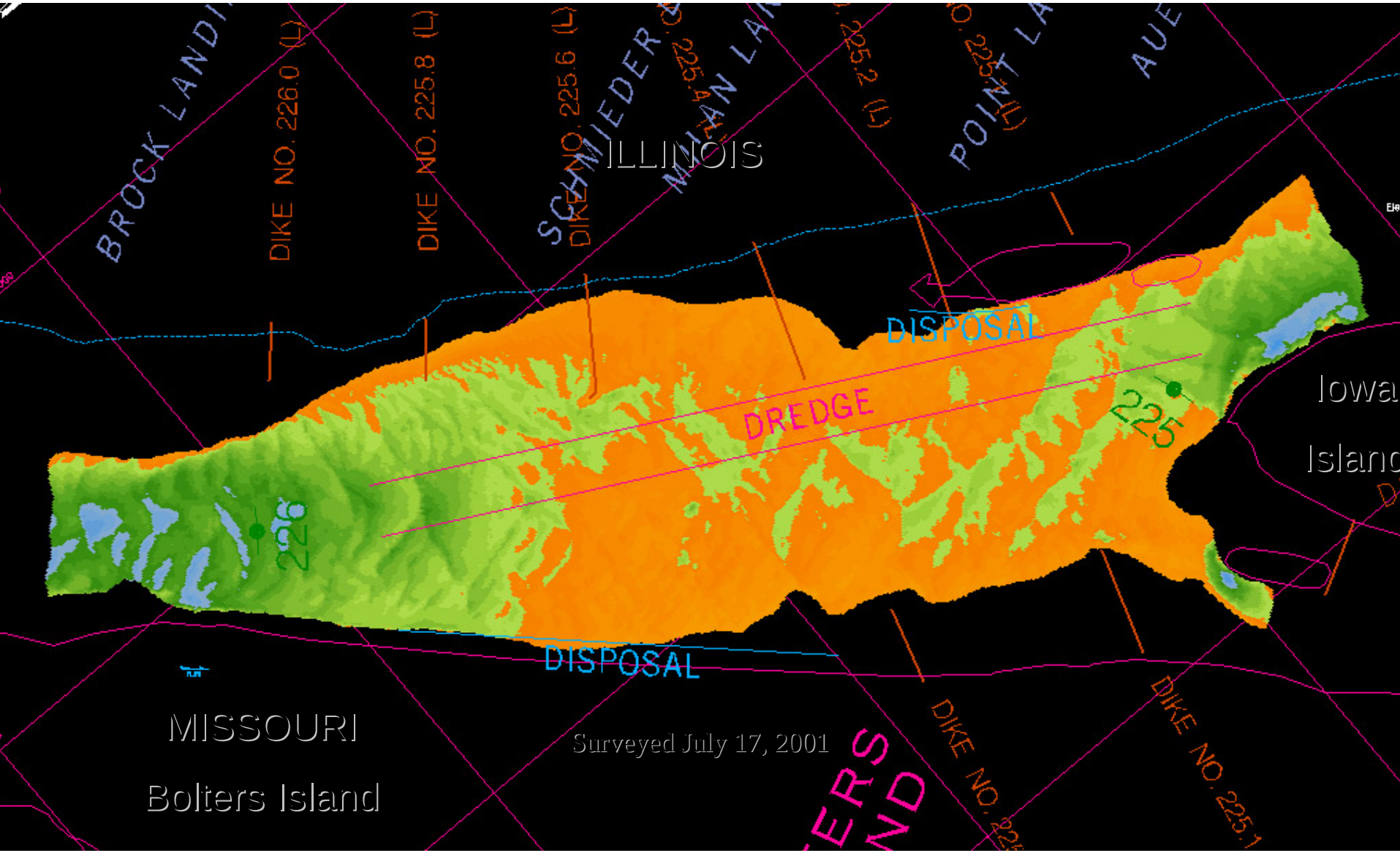




1997 & 98 Prototype Survey

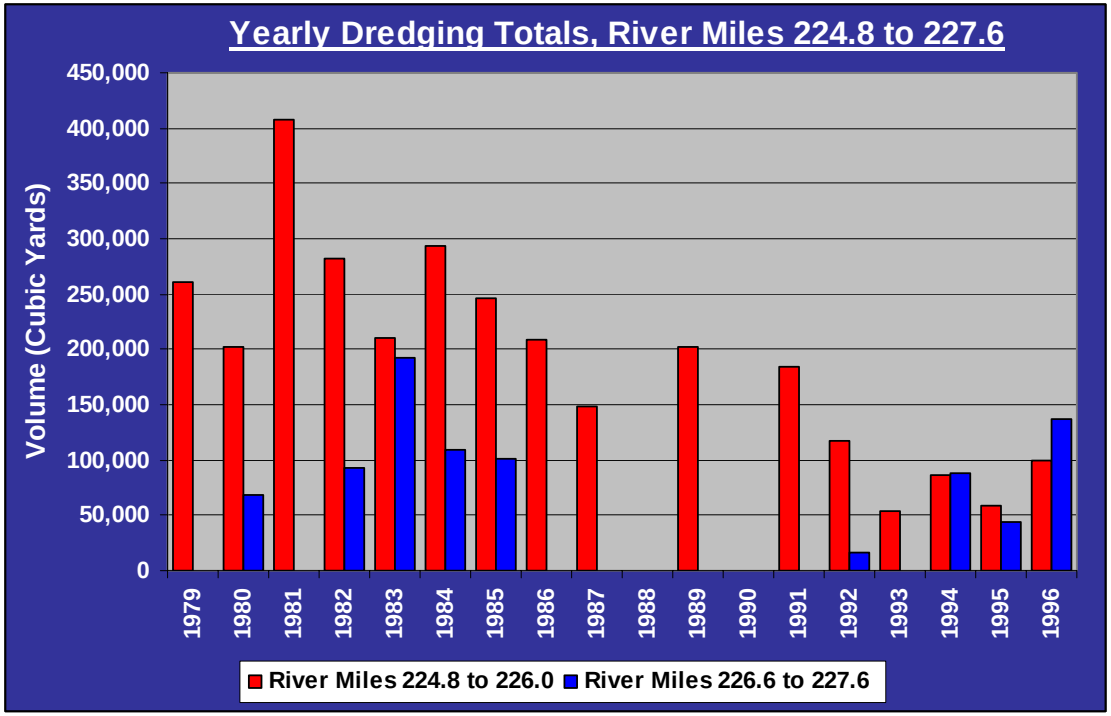
Dredge Cuts and Disposal Sites, 1979 to 1996





Greens and Blues are Depths Below –10 feet

Oranges are Depths Above –10 feet

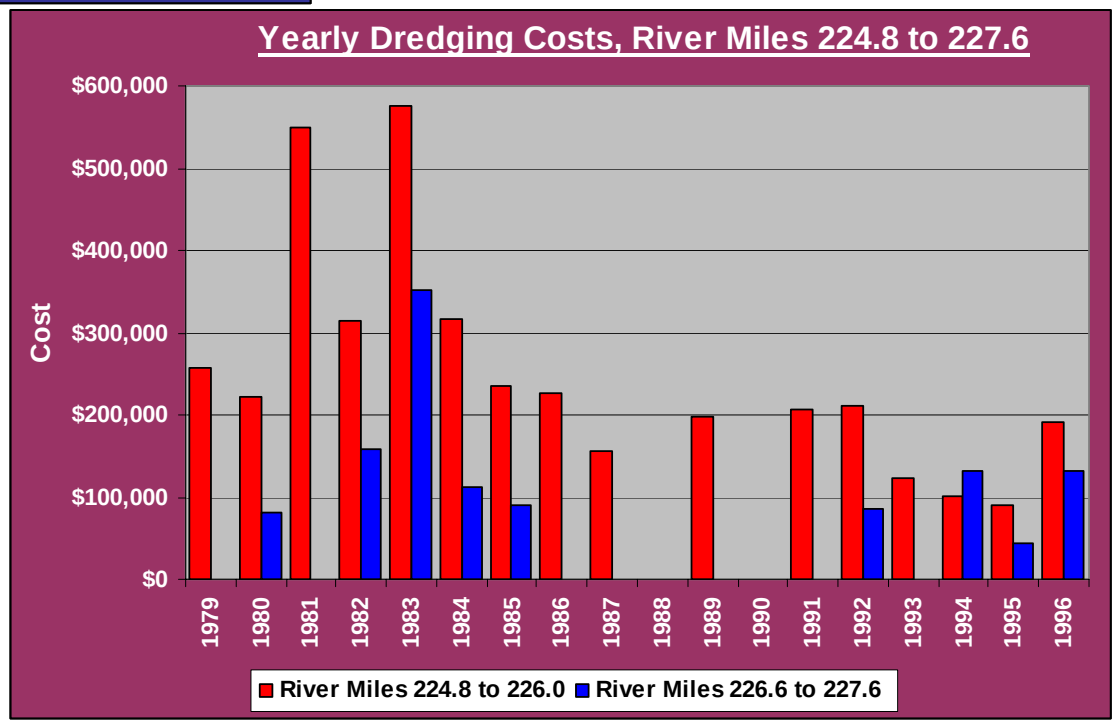


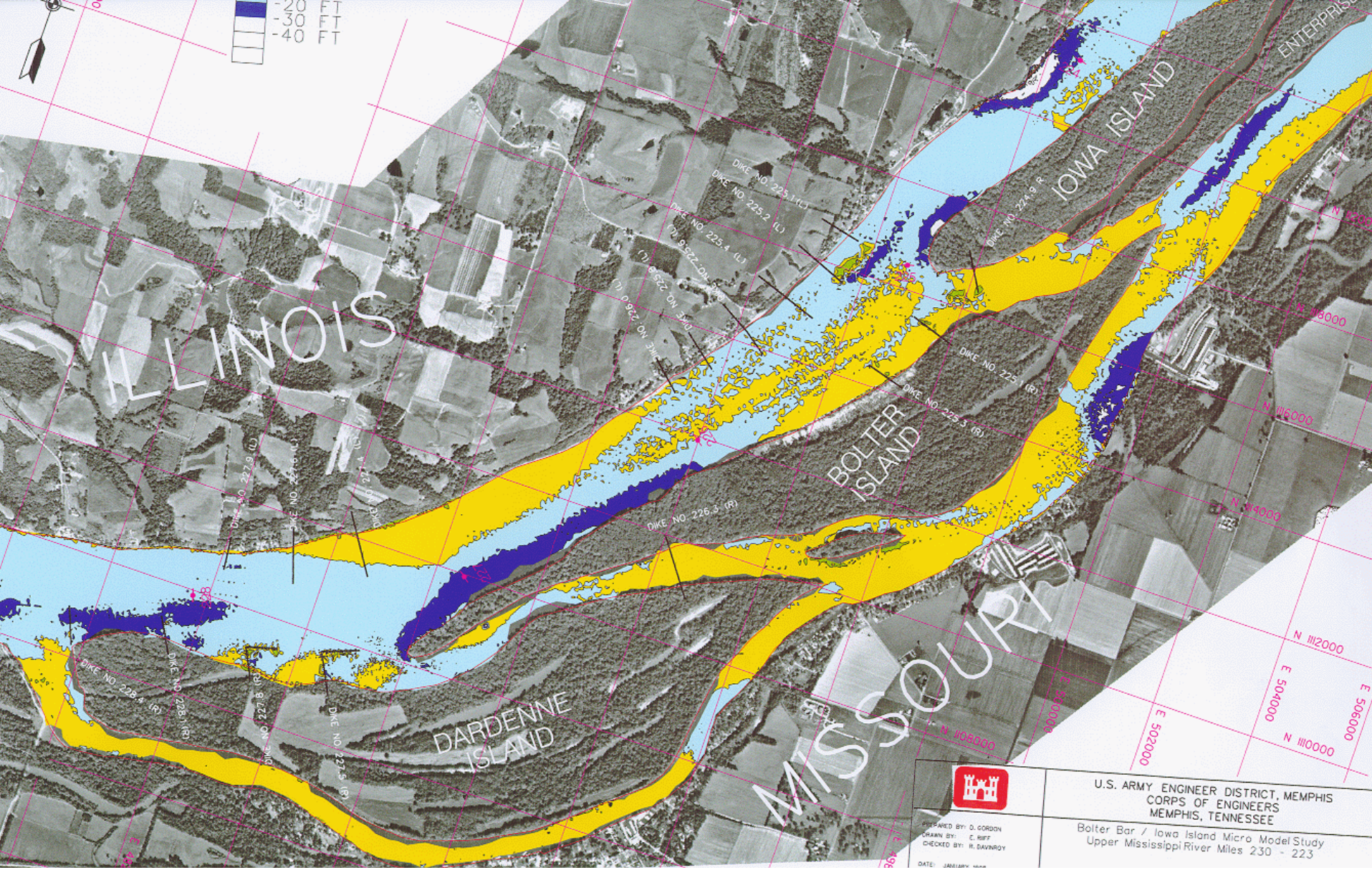
18 Year Total:

3.9 Million Cubic Yards

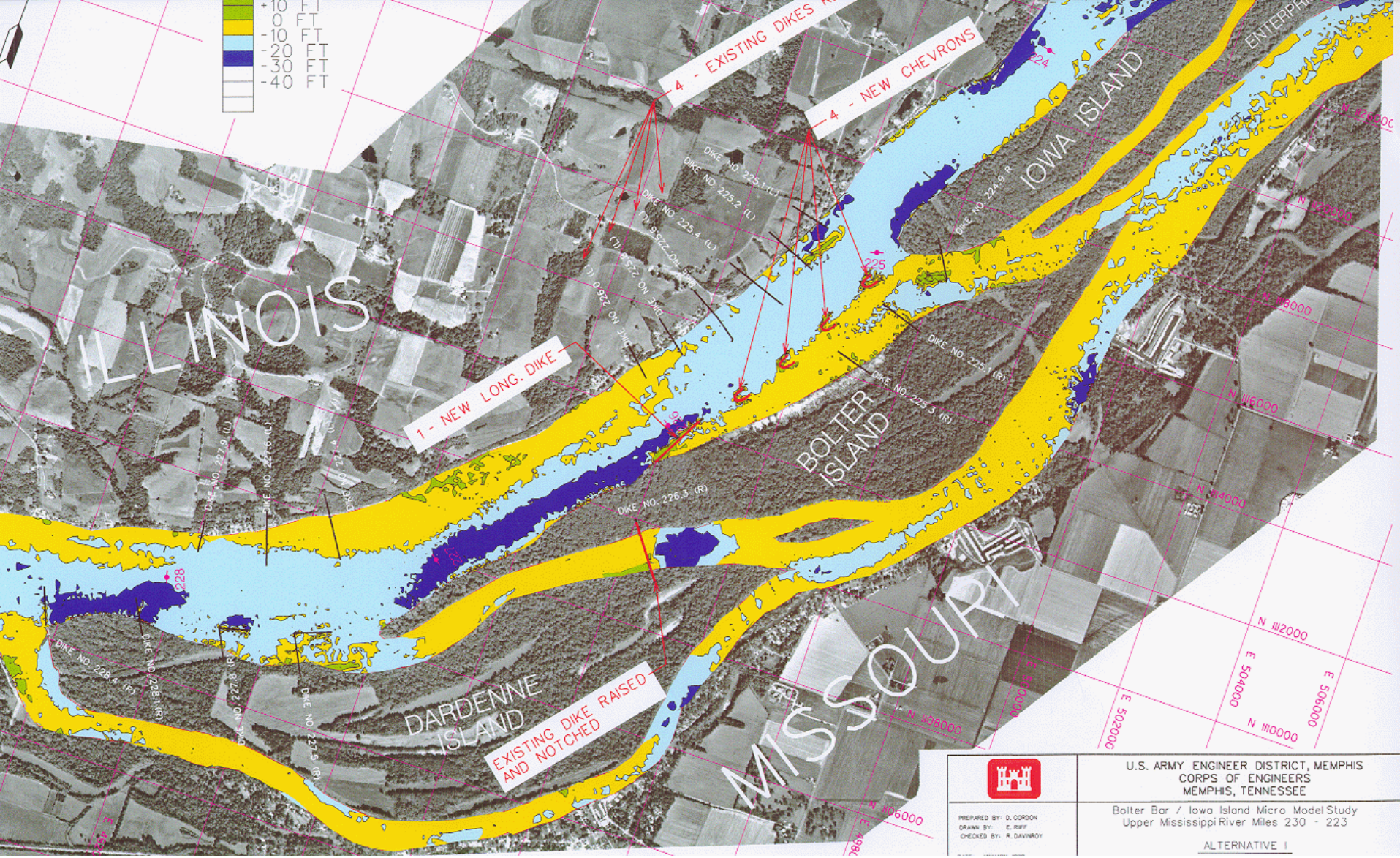
$5.2 Million

Over 75% Between Miles 225 and 226

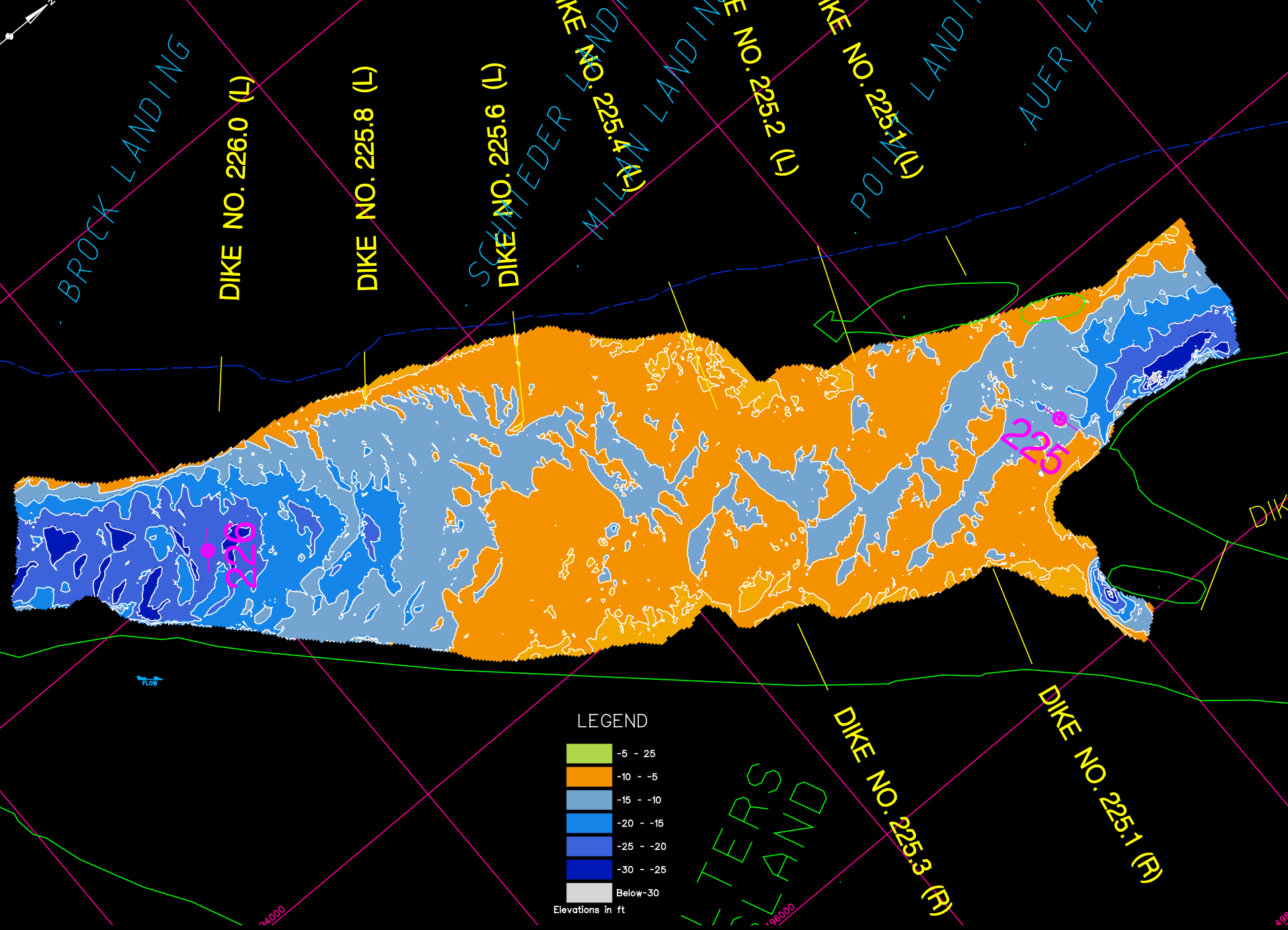




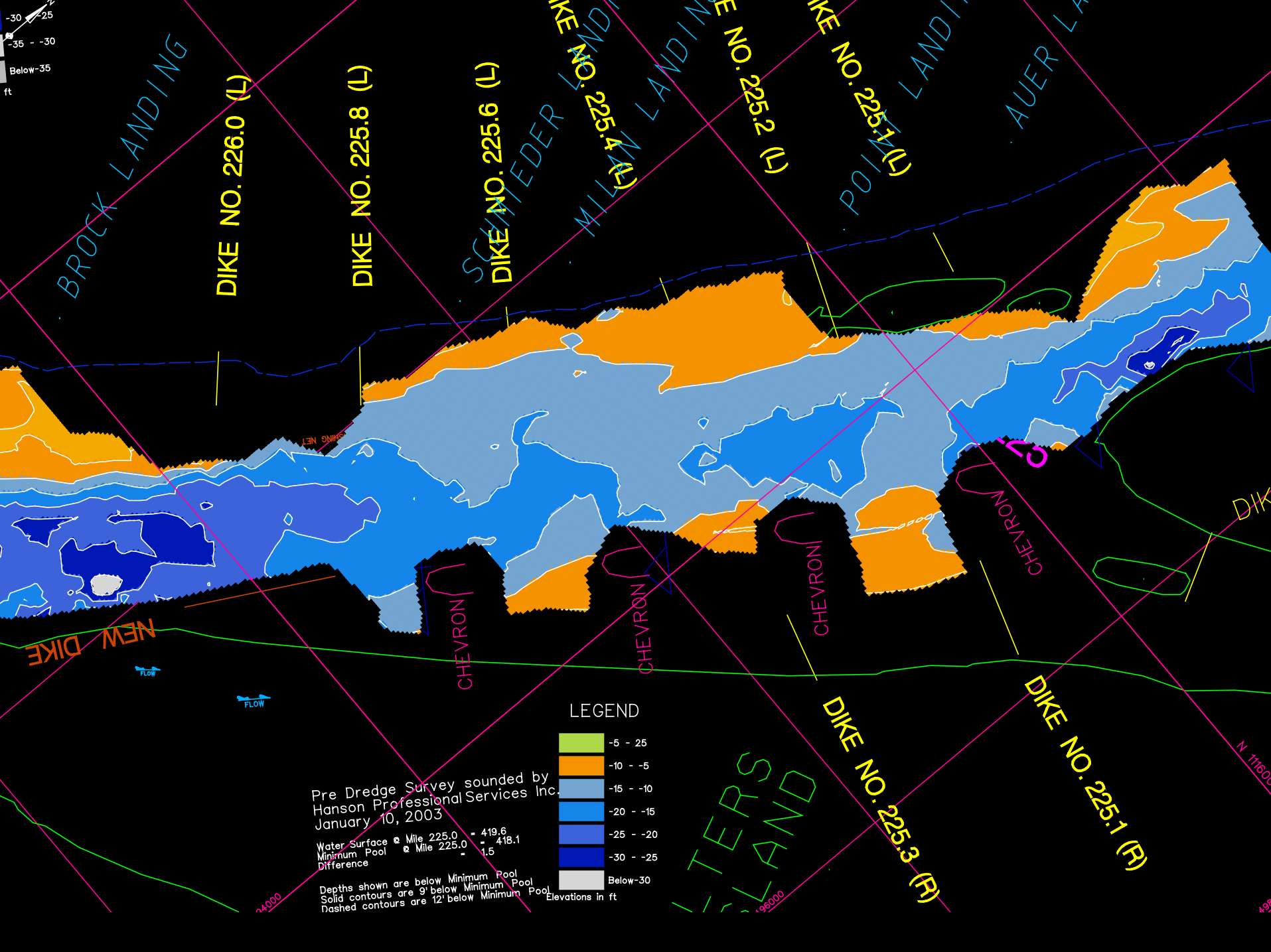
Micro Model Base Test


+10 FT
0 FT
-10 FT
-20 FT
-30 FT
-40 FT
4 - EXISTING DIKES
4 - NEW CHEVRONS
1 - NEW LONG DIKE
EXISTING DIKE RAISED AND NOTCHED
ILLINOIS
IOWA ISLAND
BOLTER ISLAND
DARDENNE ISLAND
MISSOURI
U.S. ARMY ENGINEER DISTRICT, MEMPHIS
CORPS OF ENGINEERS
MEMPHIS, TENNESSEE
Bolter Bar / Iowa Island Micro Model Study
Upper Mississippi River Miles 230 - 223
ALTERNATIVE I

Solution



BROCK LANDING
DIKE NO. 226.0 (L)
DIKE NO. 225.8 (L)
DIKE NO. 225.6 (L)
SCHNIEDER LANDING
MILAN LANDING
DIKE NO. 225.4 (L)
DIKE NO. 225.2 (L)
DIKE NO. 225.1 (L)
POINT LANDING
AUER LA
226
225
DIKE NO. 225.3 (R)
DIKE NO. 225.1 (R)
FLOW
LEGEND
-5 - 25
-10 - -5
-15 - -10
-20 - -15
-25 - -20
-30 - -25
Below-30
Elevations in ft


-30 - -25
-35 - -30
Below-35
ft
BROCK LANDING
DIKE NO. 226.0 (L)
DIKE NO. 225.8 (L)
DIKE NO. 225.6 (L)
DIKE NO. 225.4 (L)
DIKE NO. 225.2 (L)
DIKE NO. 225.1 (L)
POINT LANDING
AUER LA
CHEVRON
CHEVRON
CHEVRON
NEW DIKE
FLOW
FLOW
DIKE NO. 225.3 (R)
DIKE NO. 225.1 (R)
LEGEND
-5 - 25
-10 - -5
-15 - -10
-20 - -15
-25 - -20
-30 - -25
Below-30
Elevations in ft
Pre Dredge Survey sounded by
Hanson Professional Services Inc.
January 10, 2003
Water Surface @ Mile 225.0 = 419.6
Minimum Pool @ Mile 225.0 = 418.1
Difference = 1.5
Depths shown are below Minimum Pool
Solid contours are 9' below Minimum Pool
Dashed contours are 12' below Minimum Pool
N 116000
N 496000

8 14'01

Dredging Versus river Engineering Structures

Impacts of Dredging…destroys two habitats, not just one…dredge cut area and dredge disposal area

Effects natural sediment distribution and sorting of river to artificial, homogeneous sorting……instantaneous disruption of habitat, increases turbidity in other wise clear condition,,,effects habitat downstream of dredge cut and dredge disposal

Are Oils Spills Bad? Should we allow them to happen?

River Restoration Considerations

Although all sediment sizes have some habitat value for select species (burrowing invertebrates prefer sandy bottoms, while many filter feeding insects require a stable hard substrate surface), highest productivity and diversity of bethic organisms occurs in riffle habitats of medium cobble (approximately 150 mm diameter) and gravel, and this relationship has been generally found to be true in rehabilitated streams.

Fine sediments or areas of continually shifting sands reduce macro invertebrate species abundance and richness which in turn may affect species composition. In sand bed rivers (such as the Middle Mississippi River), much of the macro invertebrate production used by higher trophic levels occurs on woody debris or rock structure.

Robinson (1973)
Missouri Department of Conservation

- Procedure:
  - Evaluated the use of rock dikes and revetment in the Missouri River as habitat for fish and macroinvertebrates.
- Conclusions:
  - Fishes were present behind the dikes and may use them as feeding, nesting and rearing areas
  - Invertebrates collected in the study area were found in the stomachs of carp and river carpsuckers, implying that these fish were feeding in the area

Holzer (1979)
Wisconsin Department of Natural Resources

- Procedure:
  - Sampled fish with an electroshocker at dikes, riprap and sand areas to document their value as fishery habitat.
- Conclusions:
  - Rock riprap is an important fish habitat in the upper Mississippi River, serving as a nursery area for desired gamefish such as smallmouth bass, walleye, sauger, crappie, and bluegill
  - Dikes provide feeding areas for larger fish with access to deep water sheltered from current

Burress, Krieger, and Pennington(1982) U.S Army Engineer Waterways Experiment Station

- Procedure:
  - Compared the relative values for fish and macroinvertebrates of nine habitats along the unchannelized portion of the Missouri in North Dakota
    - 6 bank stabilization structures (earth core dike, hard points, revetments, spur dikes, L-head dikes)
    - 3 locations unaltered by structures (two widely separated areas of natural bank and a chute behind two small islands)
  - Performed stomach analysis on carnivorous fish

Burress, Krieger, and Pennington(1982)

- Conclusions:
  - Current-swept rocks of dikes, revetments and hard points support more kinds and far greater numbers of macroinvertebrates per unit area than the stream substrate
  - Dike fields had the most diverse fish community of all habitats sampled
  - Natural banks and revetted banks had similar fish species diversity and abundance
  - Stomach analysis performed on carnivorous fish revealed that the large and diverse assemblage of macroinvertebrates consumed by fish was similar to the assemblages associated with dike fields and revetted banks

Wright (1982)
U.S. Army Engineer Waterways Experiment Station

- Procedure:
  - Twelve major aquatice habitats were identified and mapped.
  - Samples of benthic macroinvertebrates were taken from nine habitat types
- Conclusions:
  - Dikes were determined to serve as effective collectors of main channel drift (organisms) and contained and abundance of lentic- and lotic- adapted taxa
  - Dike structures were the most productive habitat sampled for benthic macroinvertebrates
  - Dike fields were found to have the most diverse fish community, based on adult fish sampling

Hesse and Newcomb (1982) North American Journal of Fisheries Management

- Procedure:
  - Obtained estimates of fish abundance in the channelized Missouri River during two winters
  - Used electrofishing to sample around dikes
- Conclusions:
  - Considered dikes as the “best” habitat.
  - Found varying densities for similar species in the two sections of the river 16 miles apart

Pennington, Baker, and Bond (1983) U.S. Army Engineer Waterways Experiment Station

- Procedure:
  - Quantitatively described fish species diversity, abundance, and distribution in four habitats in the lower Mississippi River
    - Dike fields, revetted banks, natural banks, and an abandoned river channel
- Conclusions:
  - Greatest number of species was captured in the dike field habitat followed in order by abandoned channel, revetted banks, and natural banks

Mathis, Bingham, and Sanders (1982) U.S. Army Engineer Waterways Experiment Station

- Procedure:
  - Obtained basic data on spatial distribution patterns of aquatic macroinvertebrate populations over dike structures
  - Macroinvertebrates were sampled by implanting rock-filled rectangular wire baskets into the dike structures
- Conclusions:
  - Dike studied was inhabited by a diverse and productive macroinvertebrate assemblage, and they attributed the potential habitat value of stone dike structures to increased habitat (substrate) diversity as well as to habitat stability

The End!!!!!!