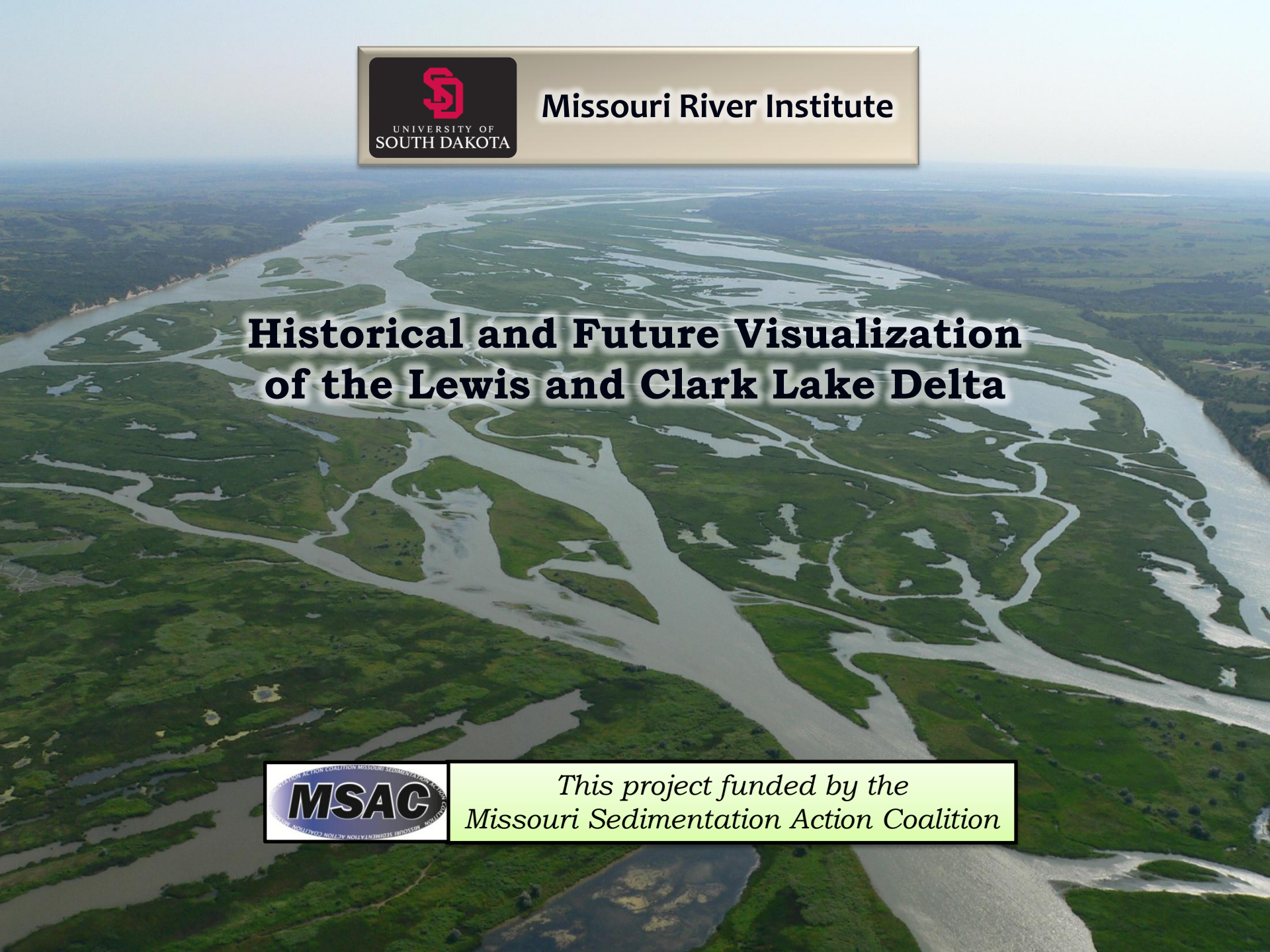


UNIVERSITY OF SOUTH DAKOTA

Missouri River Institute

Historical and Future Visualization of the Lewis and Clark Lake Delta

MSAC

This project funded by the Missouri Sedimentation Action Coalition

Goal of the Project

Review previous reports and data, and conduct new field surveys to provide a visualization of historical and future sediment accumulation in the Lewis and Clark Lake Delta.

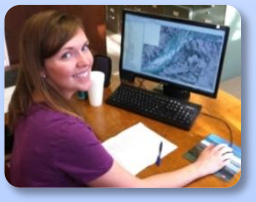
- *How has the delta evolved since Gavins Point Dam was built?*
- *How far will the delta migrate in the future and what will it look like?*
- *Where does the sediment in the delta come from?*

Interdisciplinary Project Team

Dr. Mark Sweeney
Earth Sciences/MRI

Tim Cowman
Missouri River Institute

Dr. Mark Dixon
Biology/MRI



Melissa Campbell
Missouri River Institute

Chris Boever
Biology Grad Student

Nicole Geary
Fine Arts Grad Student

US Army Corps of Engineers®
Omaha District

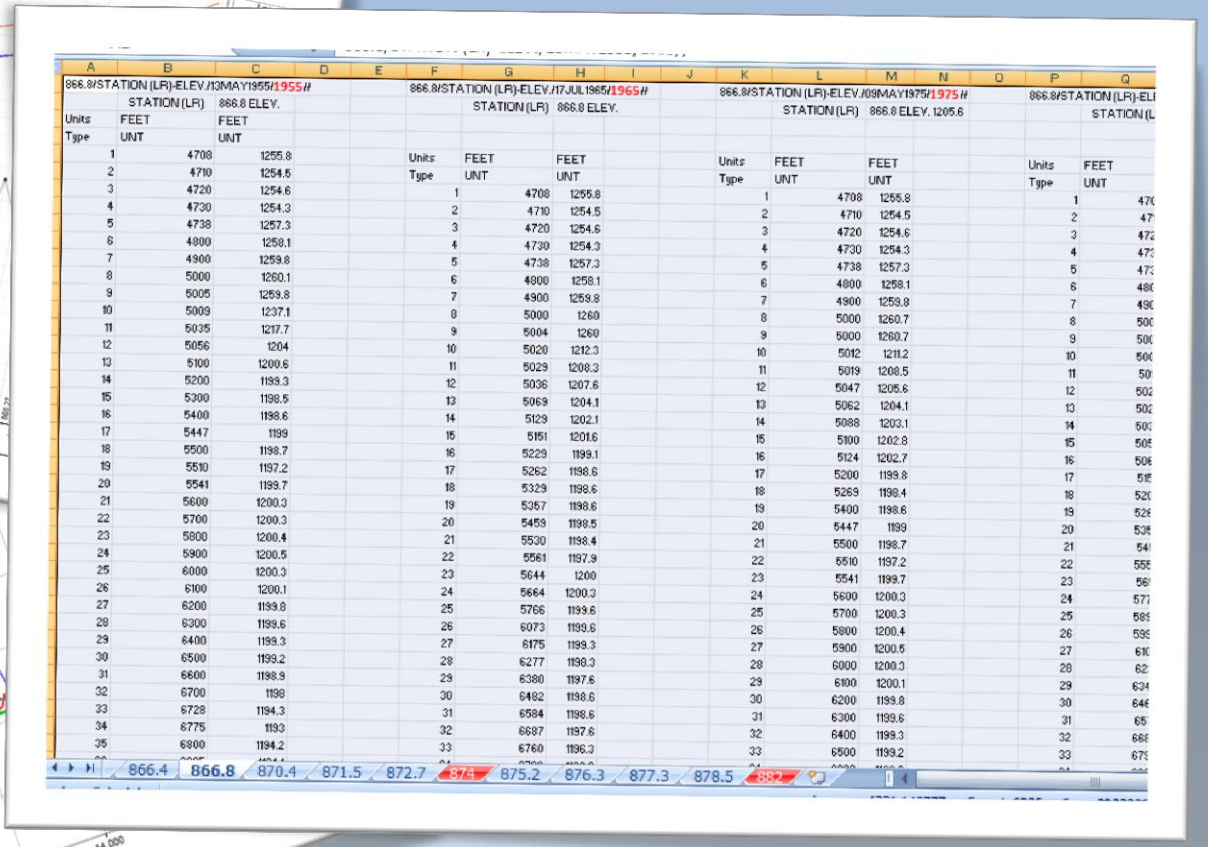
Special thanks to Paul Boyd, U.S. Army Corps of Engineers, for providing river bed profile data.

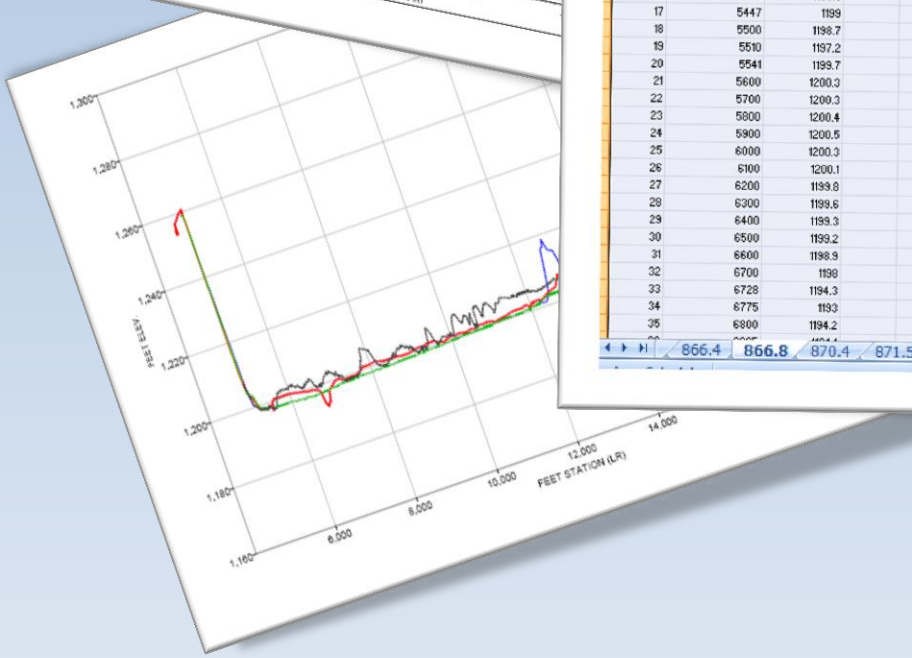
Objective #1

Compile information from previous science and engineering reports

Objective #2

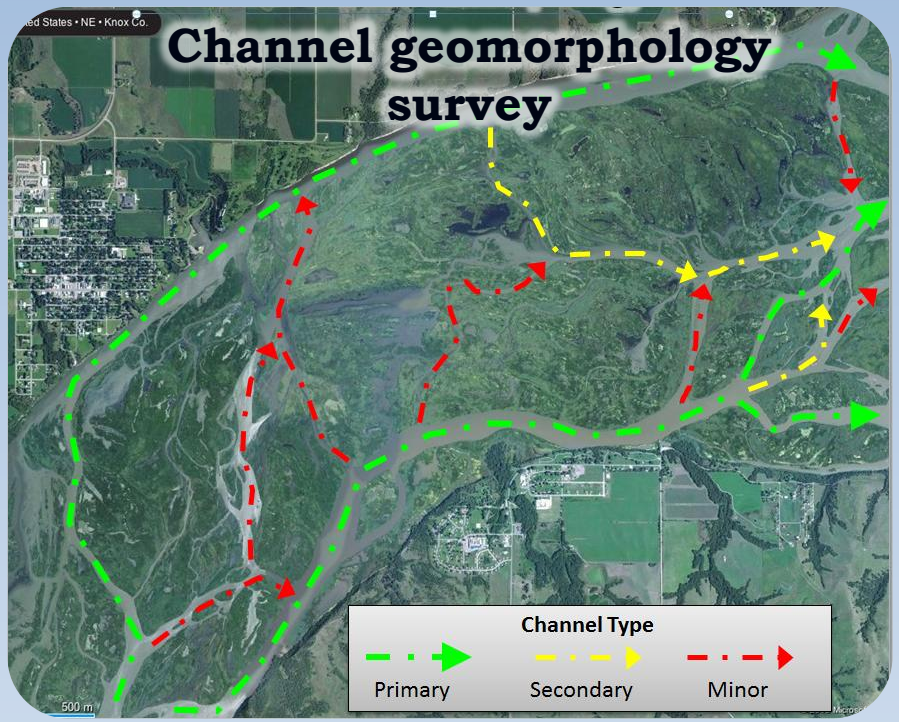
Re-interpret existing charts and create new charts from spreadsheets of raw data



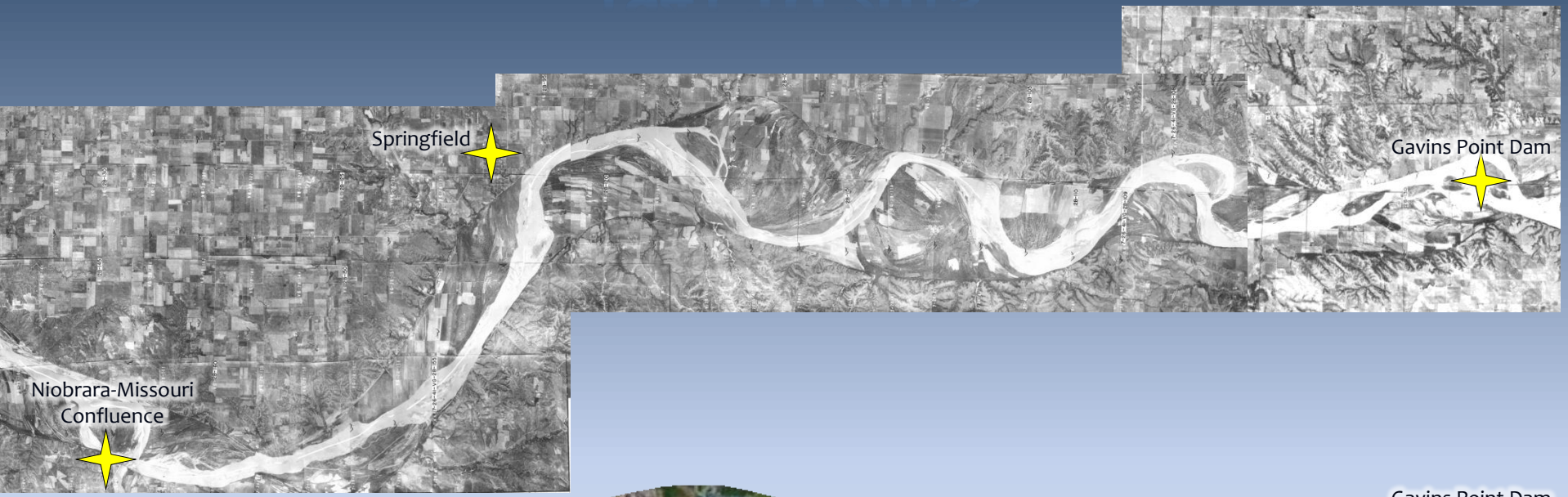


Objective #3

Conduct new field surveys of the delta



DELTA EVOLUTION
1941 TO 2013



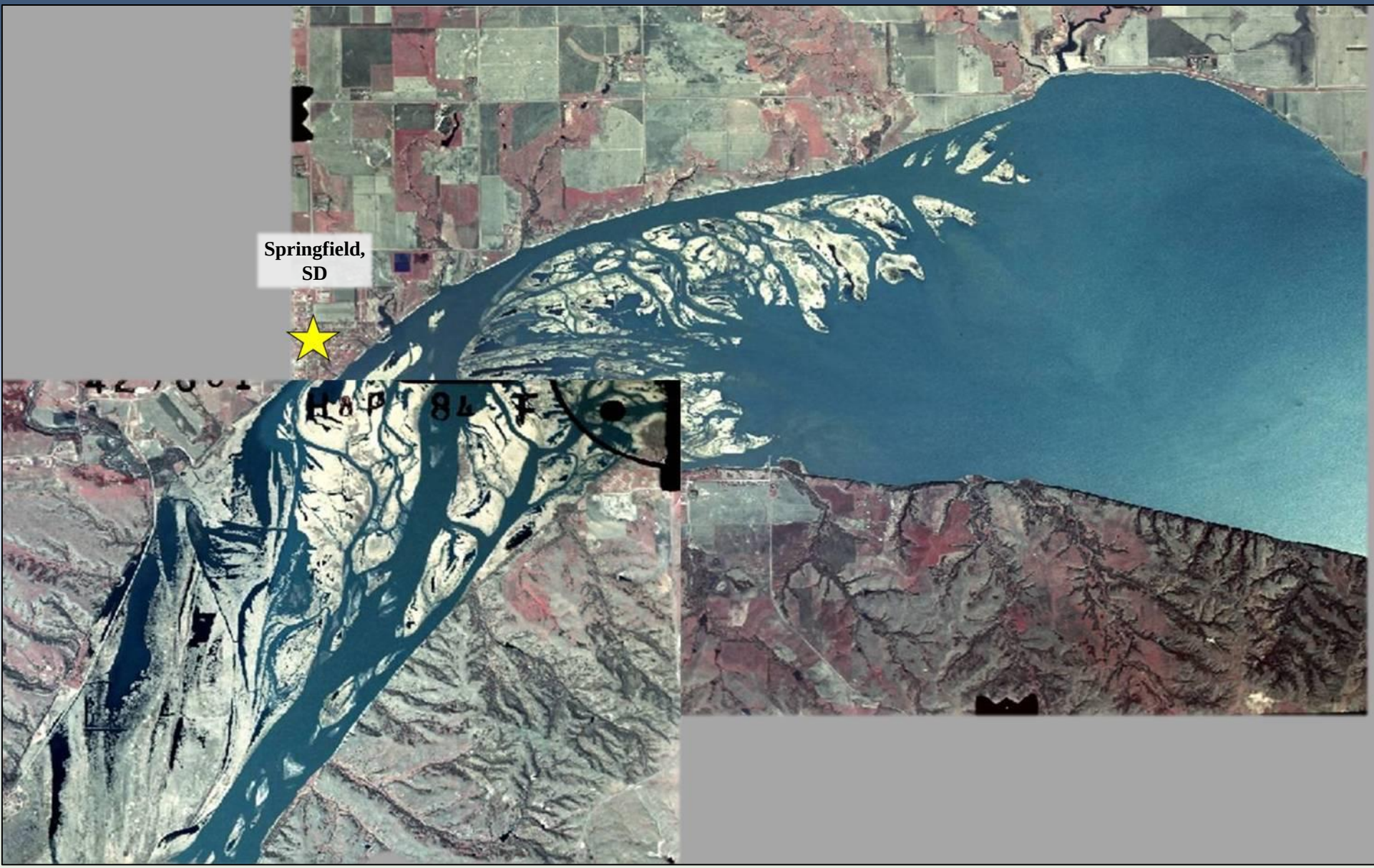
DELTA EVOLUTION: 1941

Gavins Point Dam closed in 1955

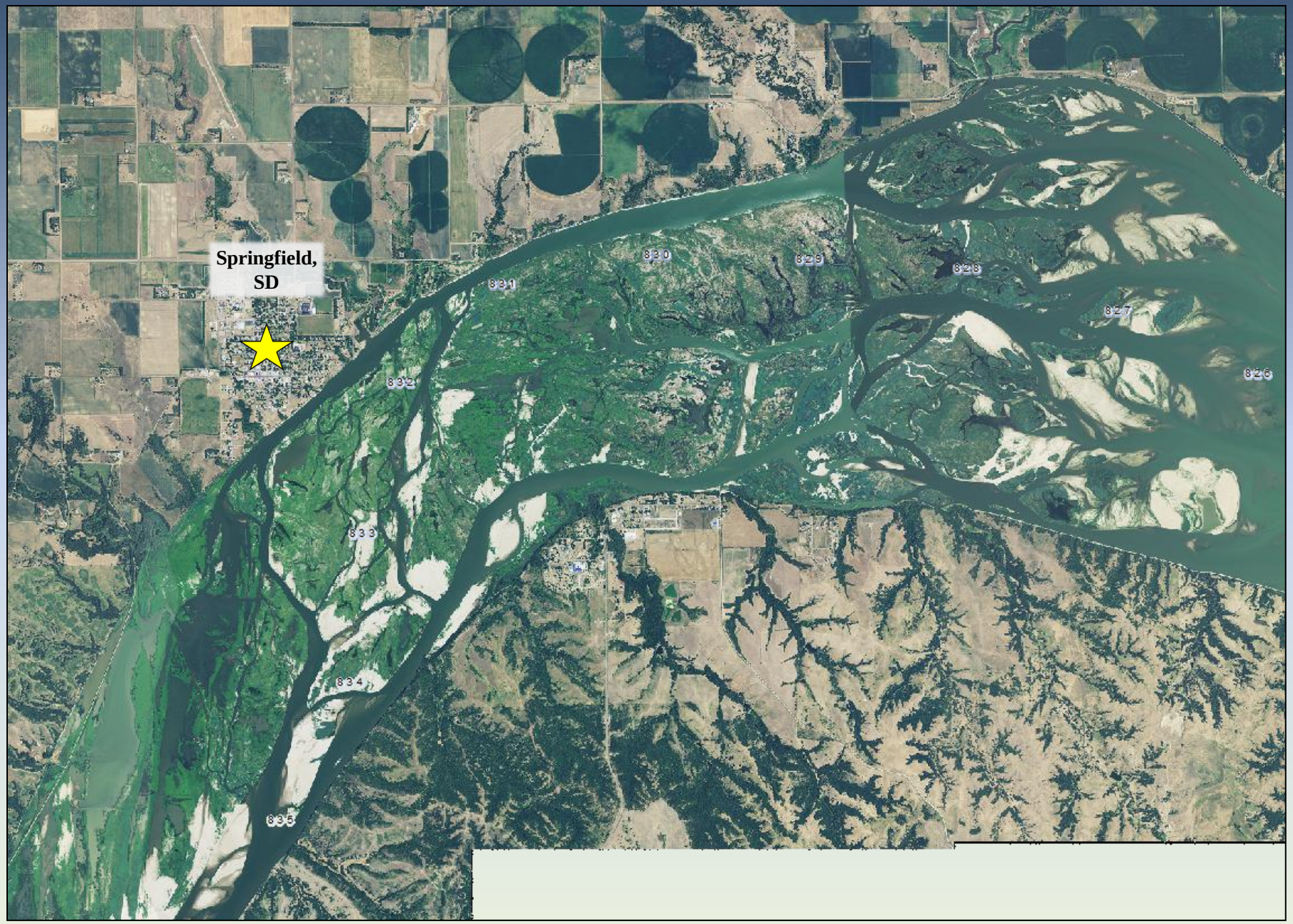
DELTA EVOLUTION: 1964

Gavins Point Dam closed in 1955

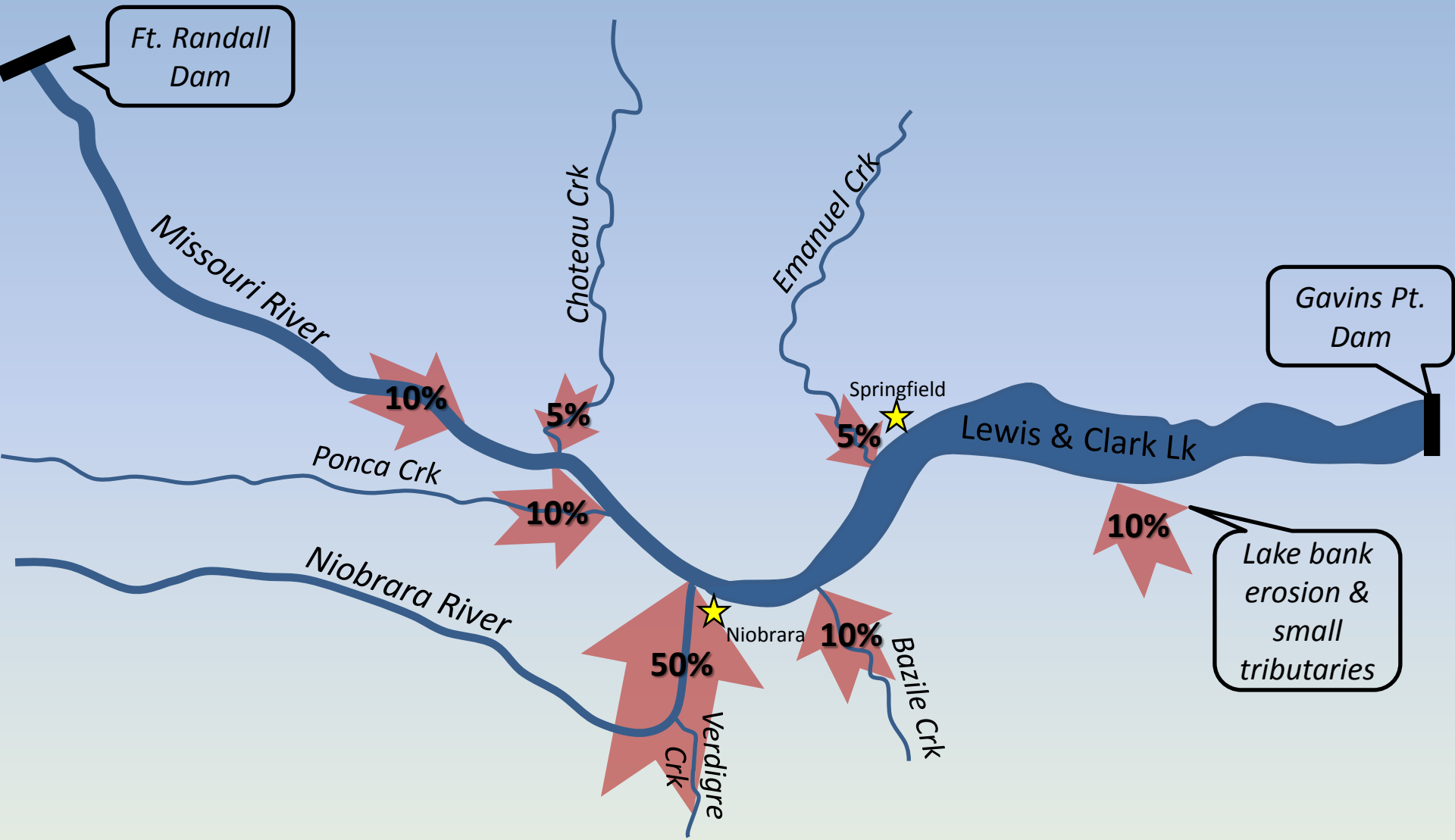
DELTA EVOLUTION: 1984



DELTA EVOLUTION: 2012



Where does the sediment come from?

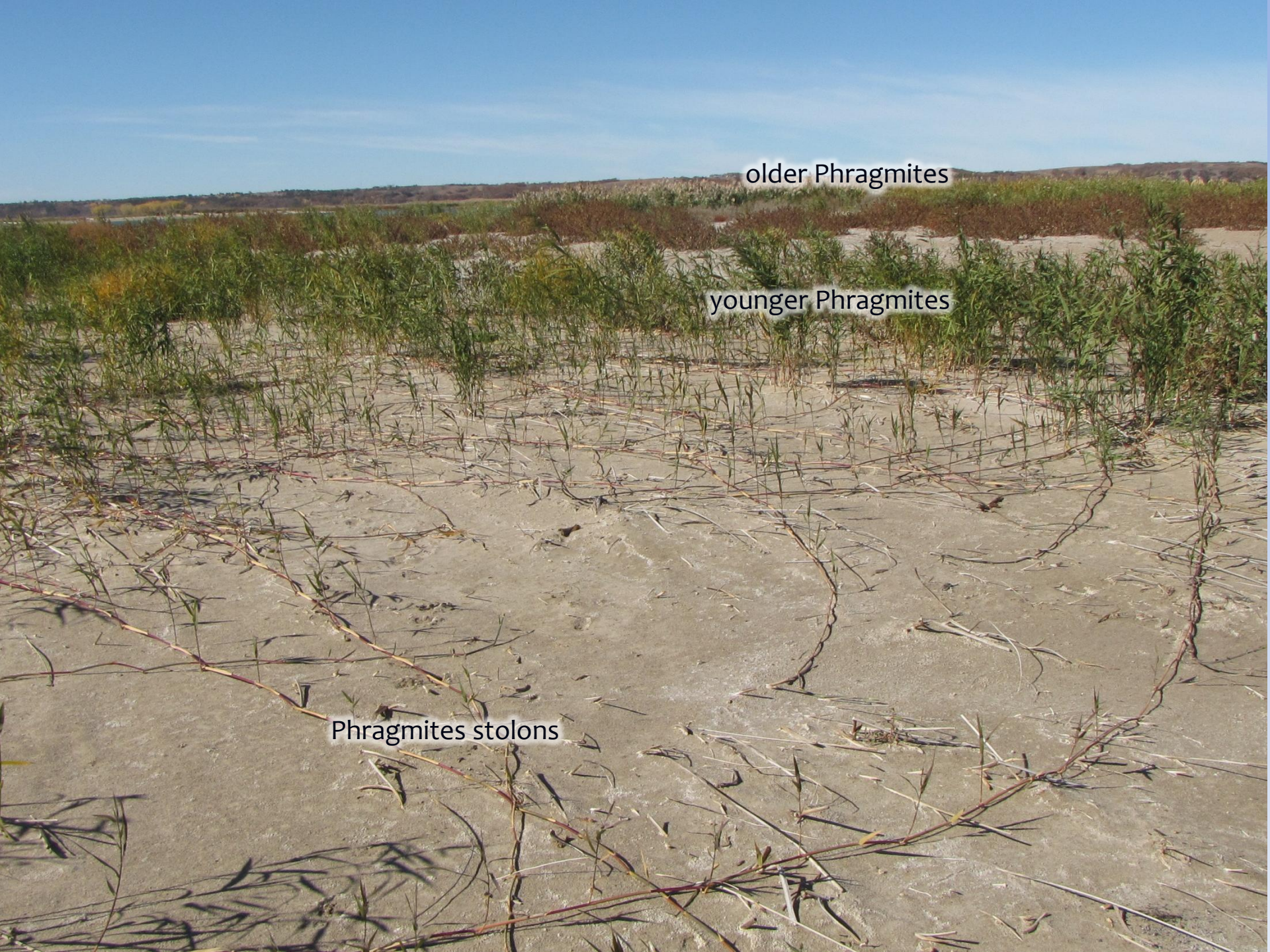


Vegetation and Geomorphology Surveys


Solstice
NORTH WATER

Vegetation Survey


Phragmites

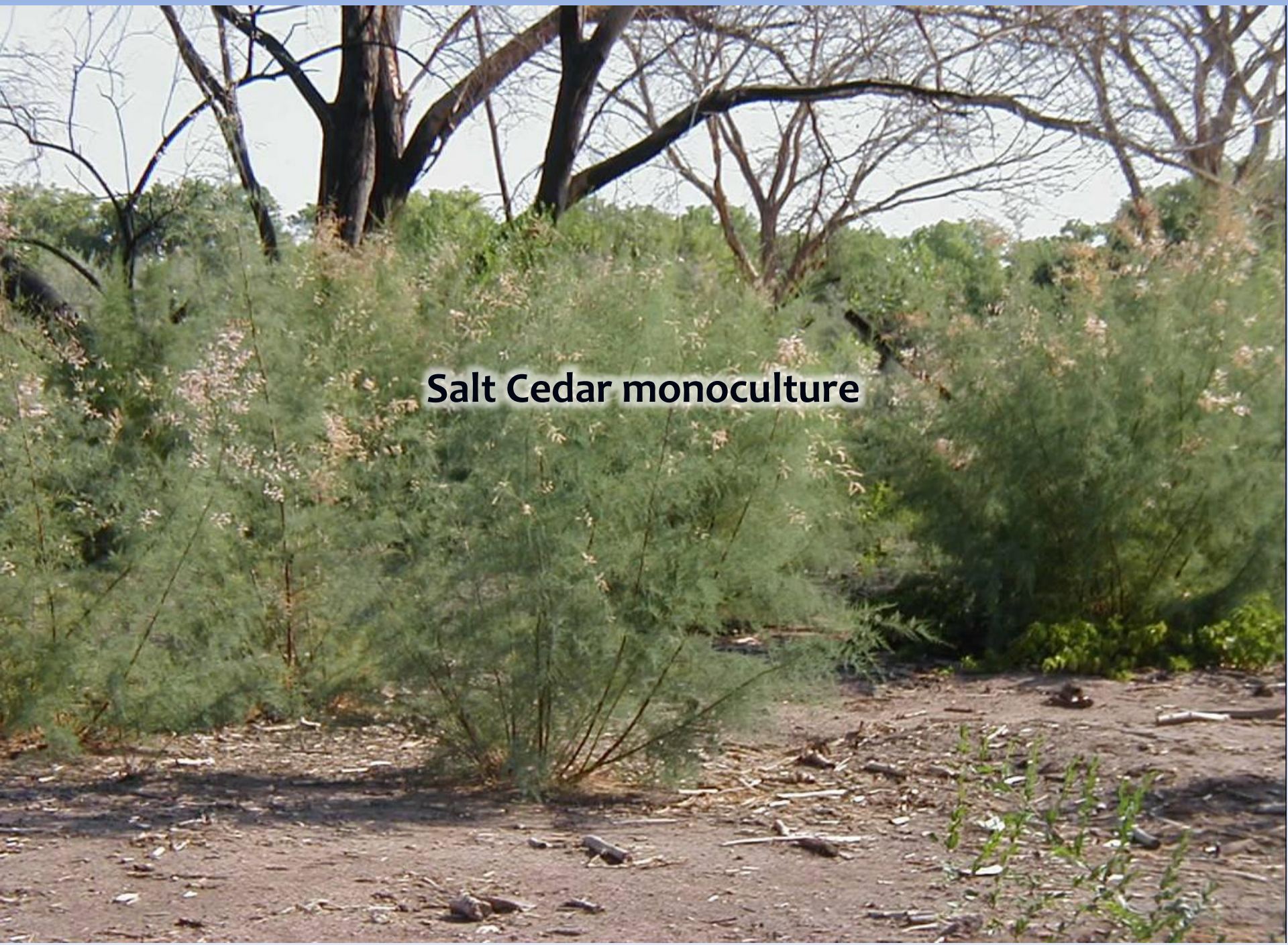

older Phragmites
younger Phragmites
Phragmites stolons


Cattail marsh


Cottonwood
seedling


Small stand of cottonwoods and willows


Salt Cedar


Salt Cedar monoculture


Purple
Loosestrife


Purple Loosestrife monoculture


Bare sand deposits

ABOUT THE DELTA

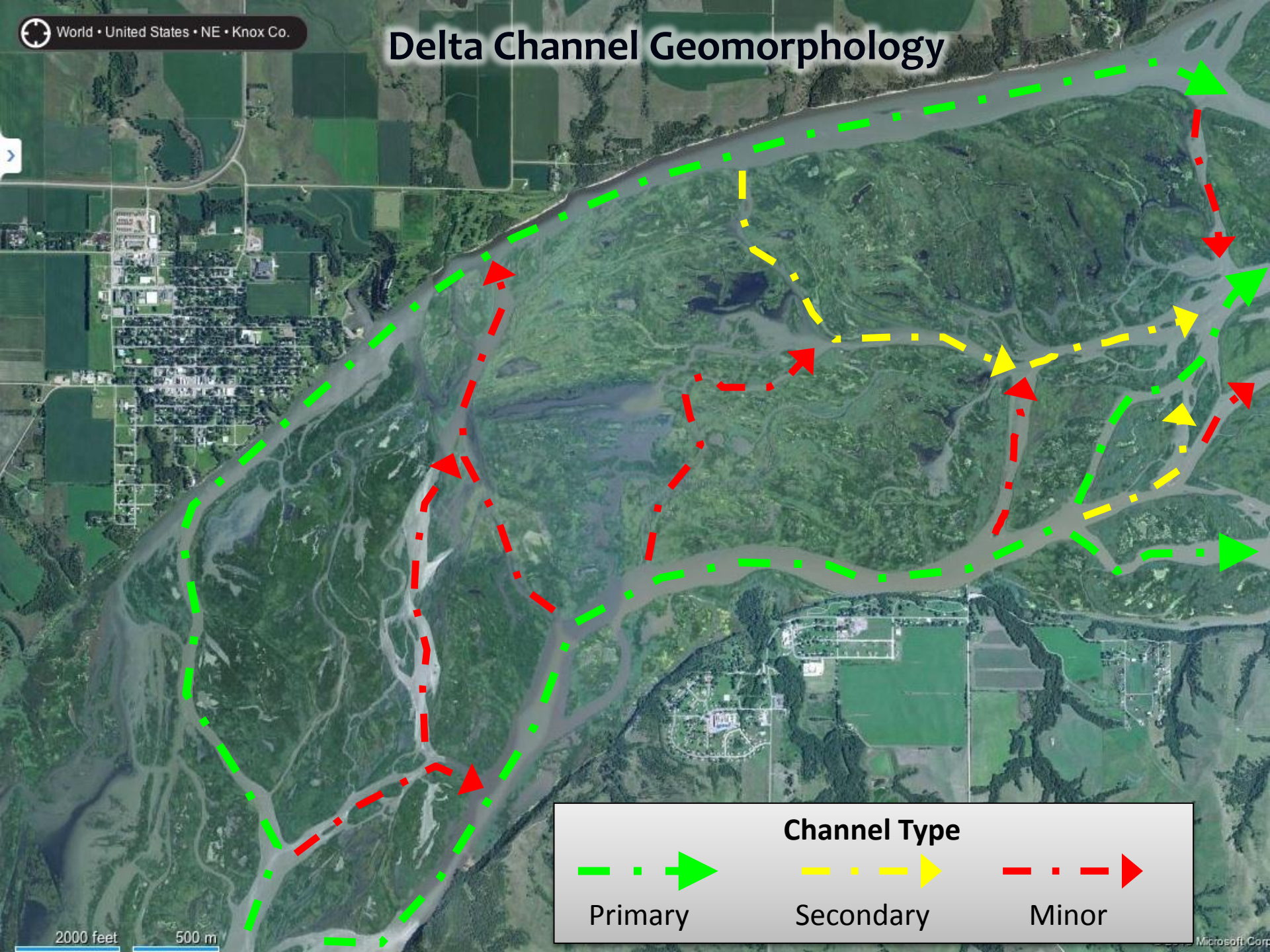
Ecology

- Vegetation cover varies from Phragmites (common reed grass) to cattail marsh to bare sand. Phragmites is the dominant vegetation.
- Phragmites spreads aggressively, can quickly colonize bare sand patches, and crowds out native wetland plants, preventing diversity in the wetlands.
- Several patches of cottonwood and willow trees were observed. These trees cannot tolerate chronically saturated soils and were only present on sandbars built high above the water table.
- A recent animal survey of the delta found a diversity of species similar to what would be expected in other parts of the river, with 79 species of birds, 5 species of frogs/toads, 4 species of turtles, and 1 species of mussel (Kerby and Swanson, 2012).

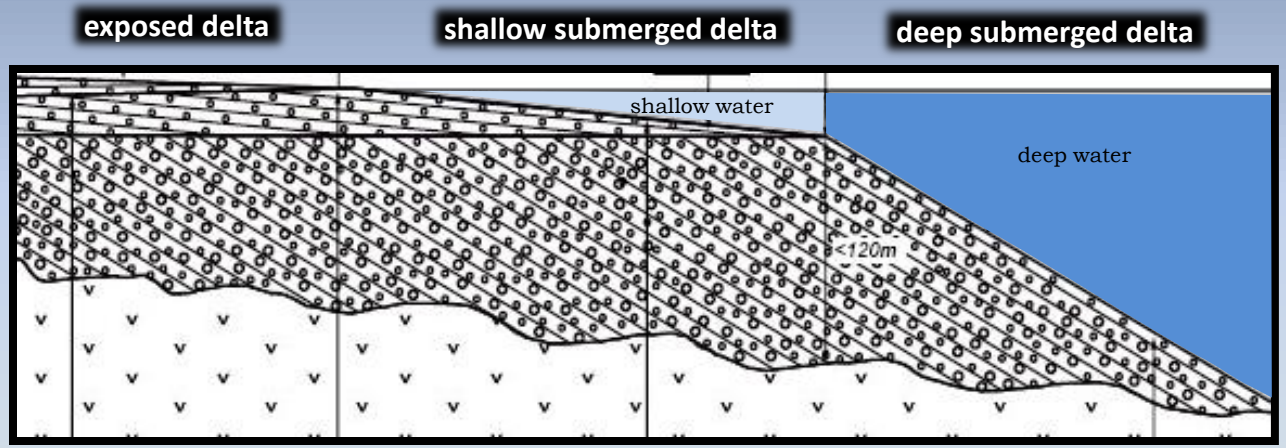
Delta Channel Geomorphology Survey


minor channel


sand dunes
(2011 flood deposits)

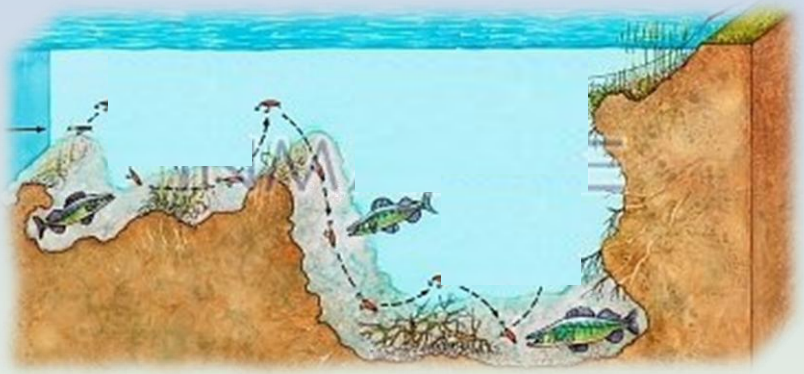

World • United States • NE • Knox Co.
Delta Channel Geomorphology
Channel Type
Primary
Secondary
Minor
2000 feet
500 m
Microsoft Corp

GENERAL DELTA PROFILE

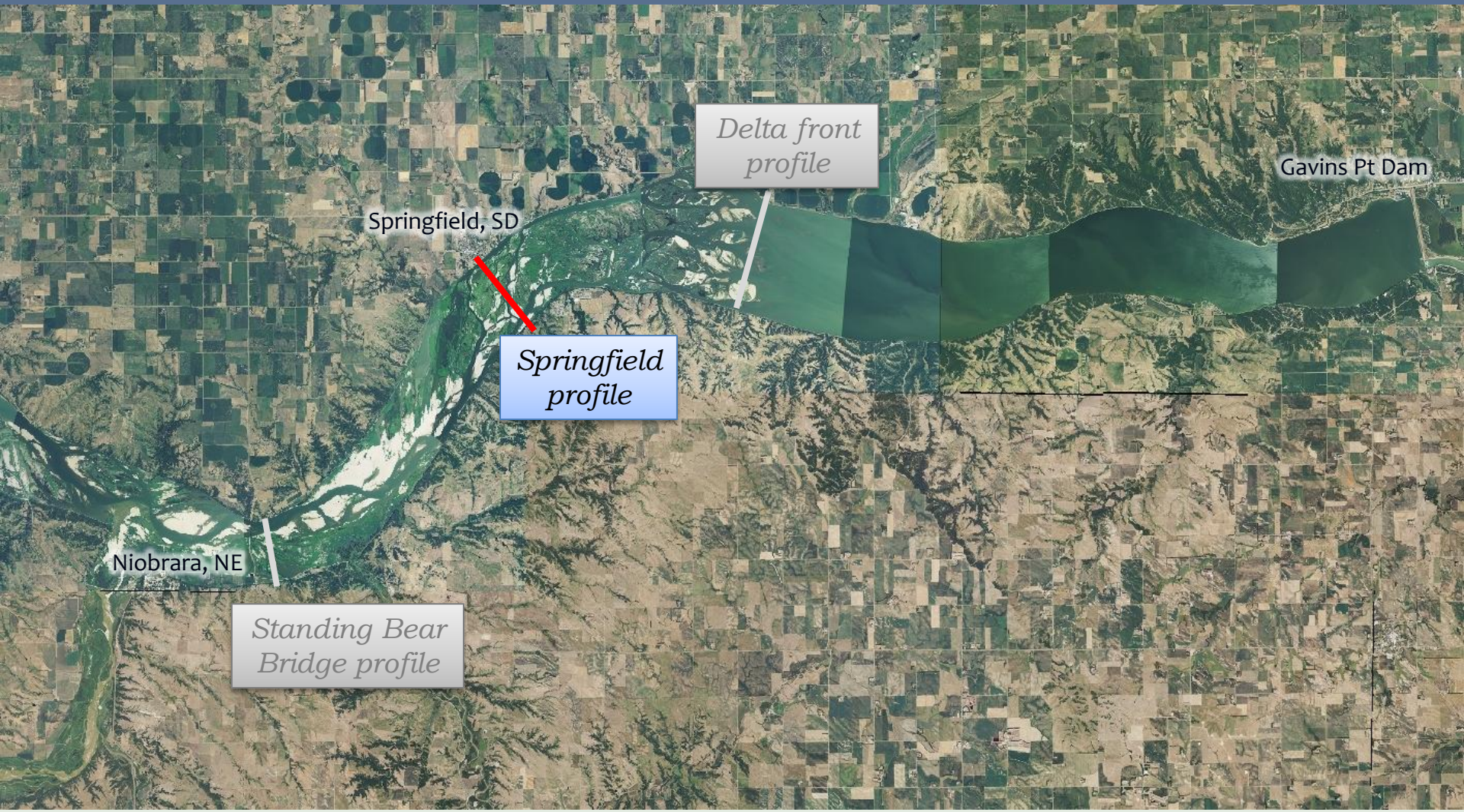


DELTA PROFILES

Profile shows the shape of the river bed

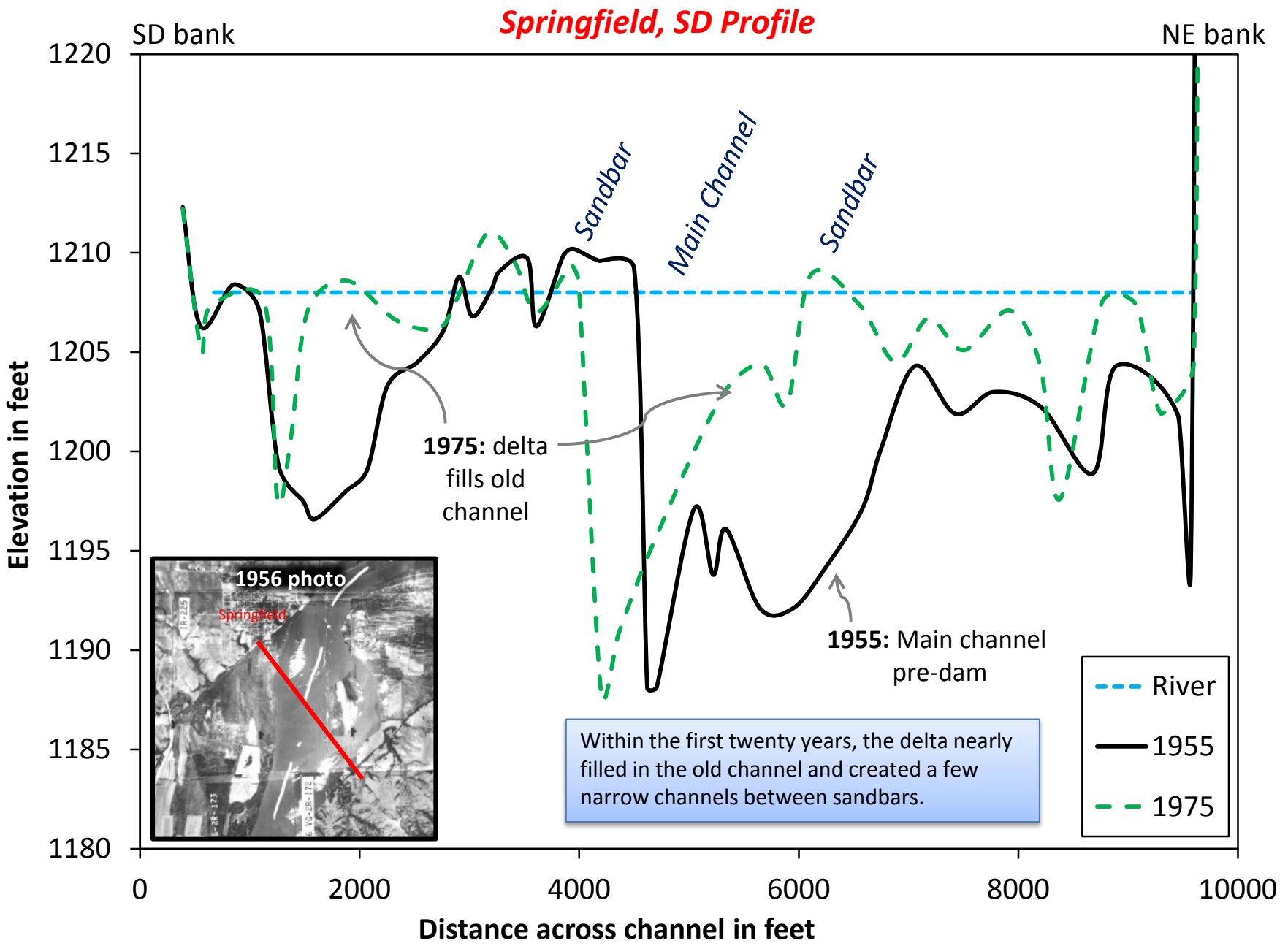


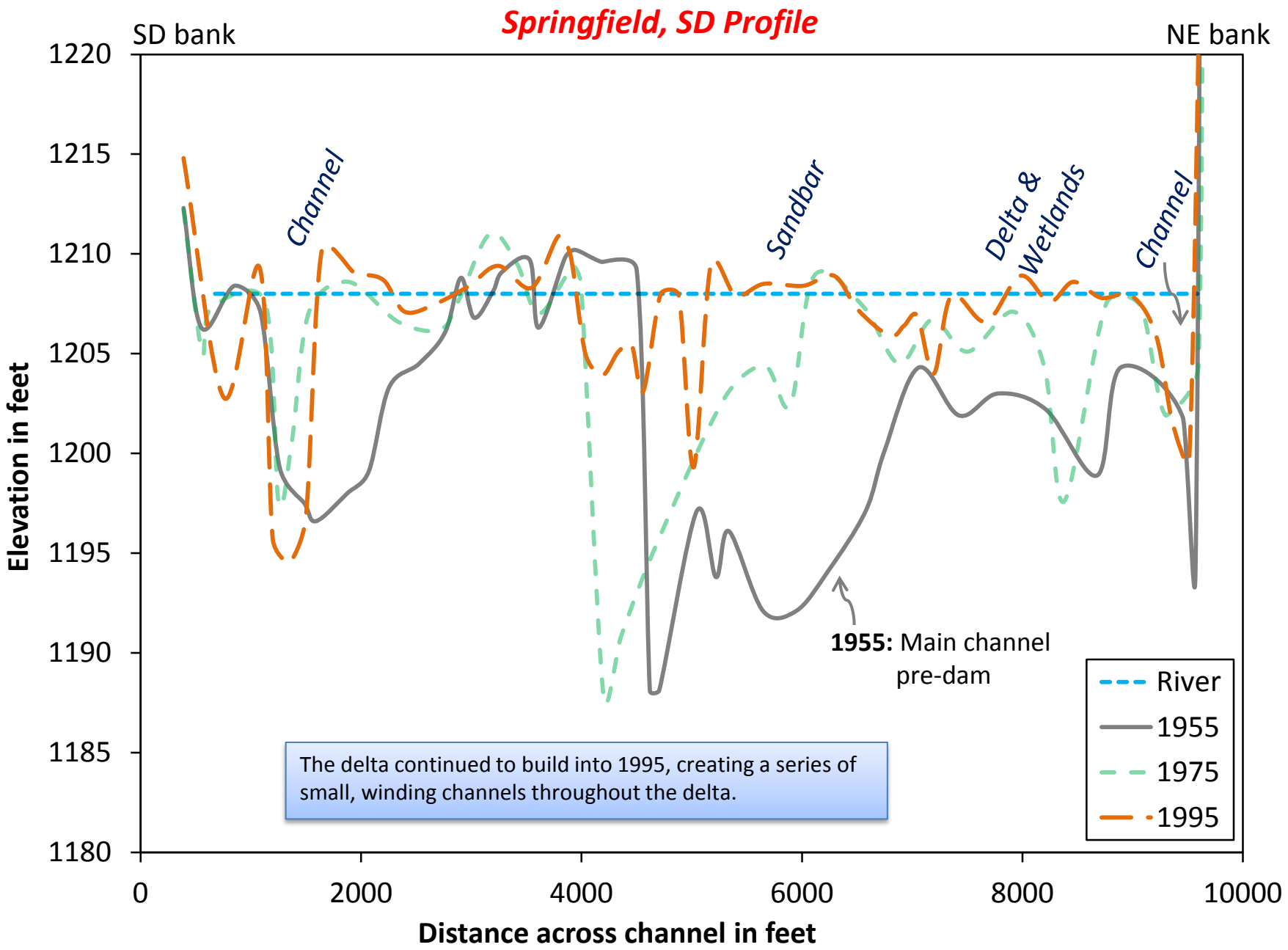
DELTA PROFILES

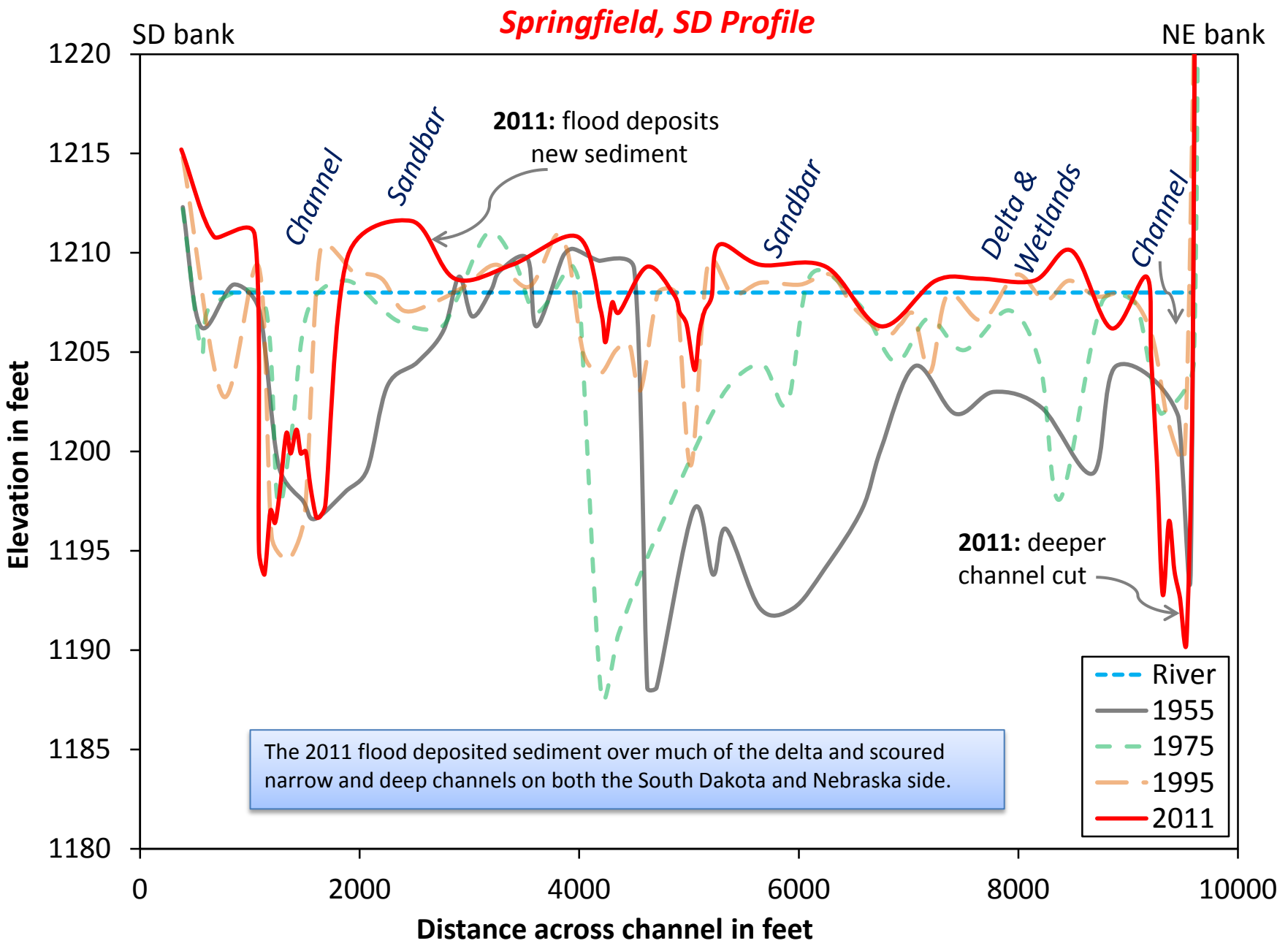


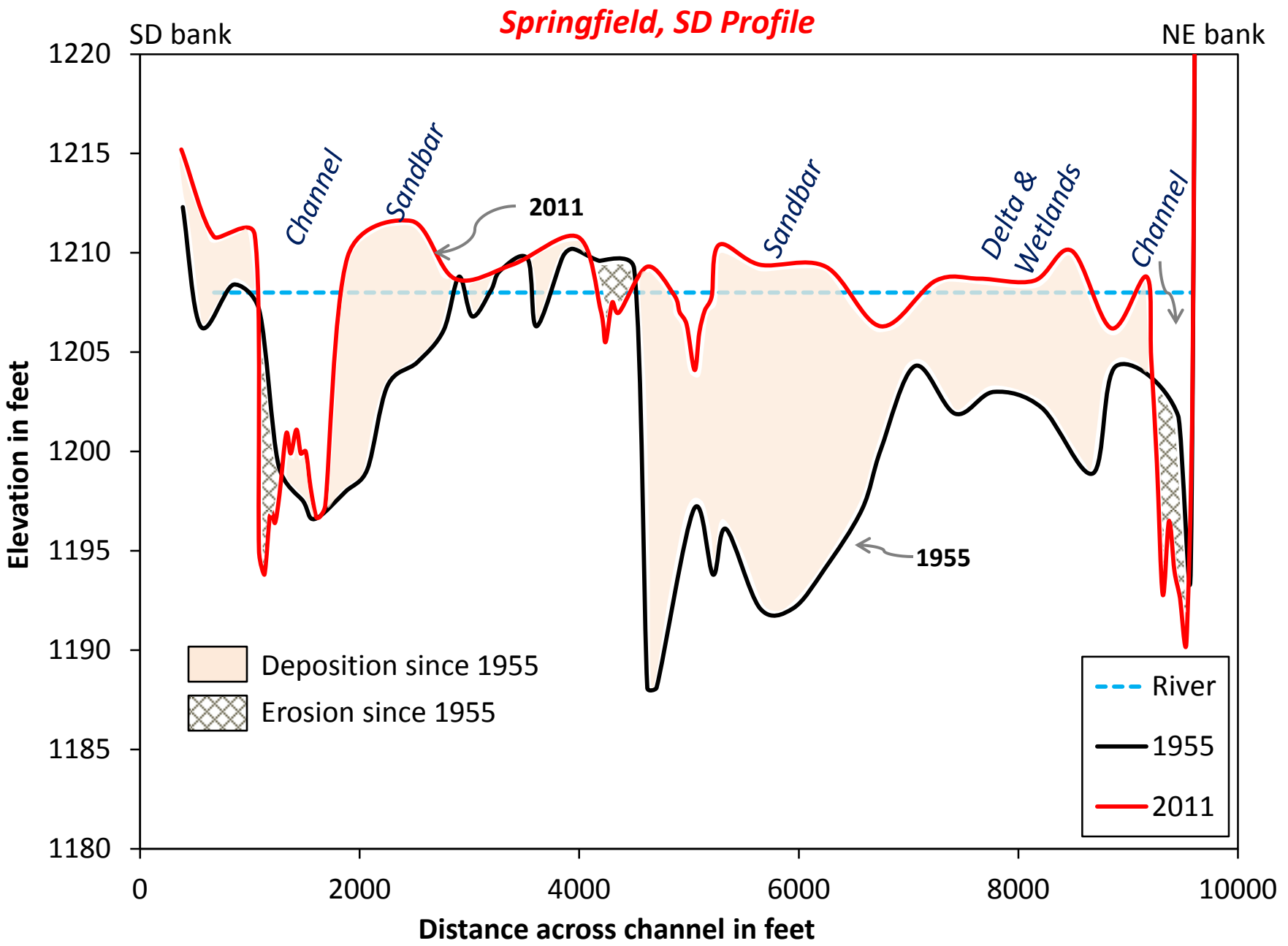
Compiled by the Missouri River Institute, University of South Dakota

River bed profile data courtesy of the U. S. Army Corps of Engineers

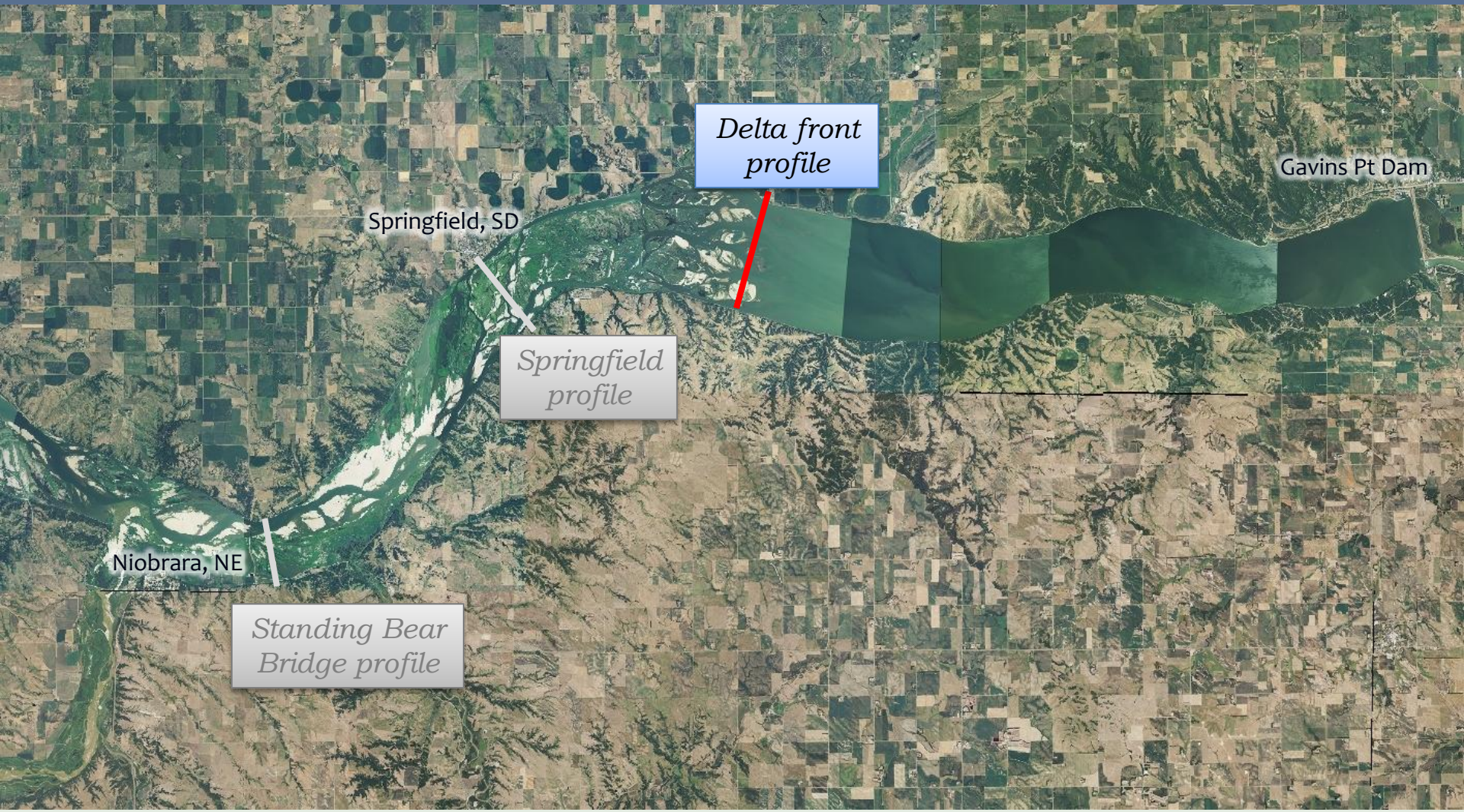

Springfield, SD Profile
SD bank
NE bank
1220
1215
1210
1205
1200
1195
1190
1185
1180
Elevation in feet
0
2000
4000
6000
8000
10000
Distance across channel in feet
Sandbar
Main Channel
Sandbar
1975: delta fills old channel
1955: Main channel pre-dam
1956 photo
Springfield
Within the first twenty years, the delta nearly filled in the old channel and created a few narrow channels between sandbars.
River
1955
1975


Springfield, SD Profile
SD bank
NE bank
Channel
Sandbar
Delta & Wetlands
Channel
1955: Main channel pre-dam
The delta continued to build into 1995, creating a series of small, winding channels throughout the delta.
River
1955
1975
1995
Elevation in feet
Distance across channel in feet
1220
1215
1210
1205
1200
1195
1190
1185
1180
0
2000
4000
6000
8000
10000


Springfield, SD Profile
SD bank
NE bank
Channel
Sandbar
2011: flood deposits new sediment
Sandbar
Delta & Wetlands
Channel
2011: deeper channel cut
The 2011 flood deposited sediment over much of the delta and scoured narrow and deep channels on both the South Dakota and Nebraska side.
River
1955
1975
1995
2011
Elevation in feet
1220
1215
1210
1205
1200
1195
1190
1185
1180
0
2000
4000
6000
8000
10000
Distance across channel in feet


Springfield, SD Profile
SD bank
NE bank
Channel
Sandbar
2011
Sandbar
Delta & Wetlands
Channel
1955
Deposition since 1955
Erosion since 1955
River
1955
2011
Elevation in feet
Distance across channel in feet
1220
1215
1210
1205
1200
1195
1190
1185
1180
0
2000
4000
6000
8000
10000

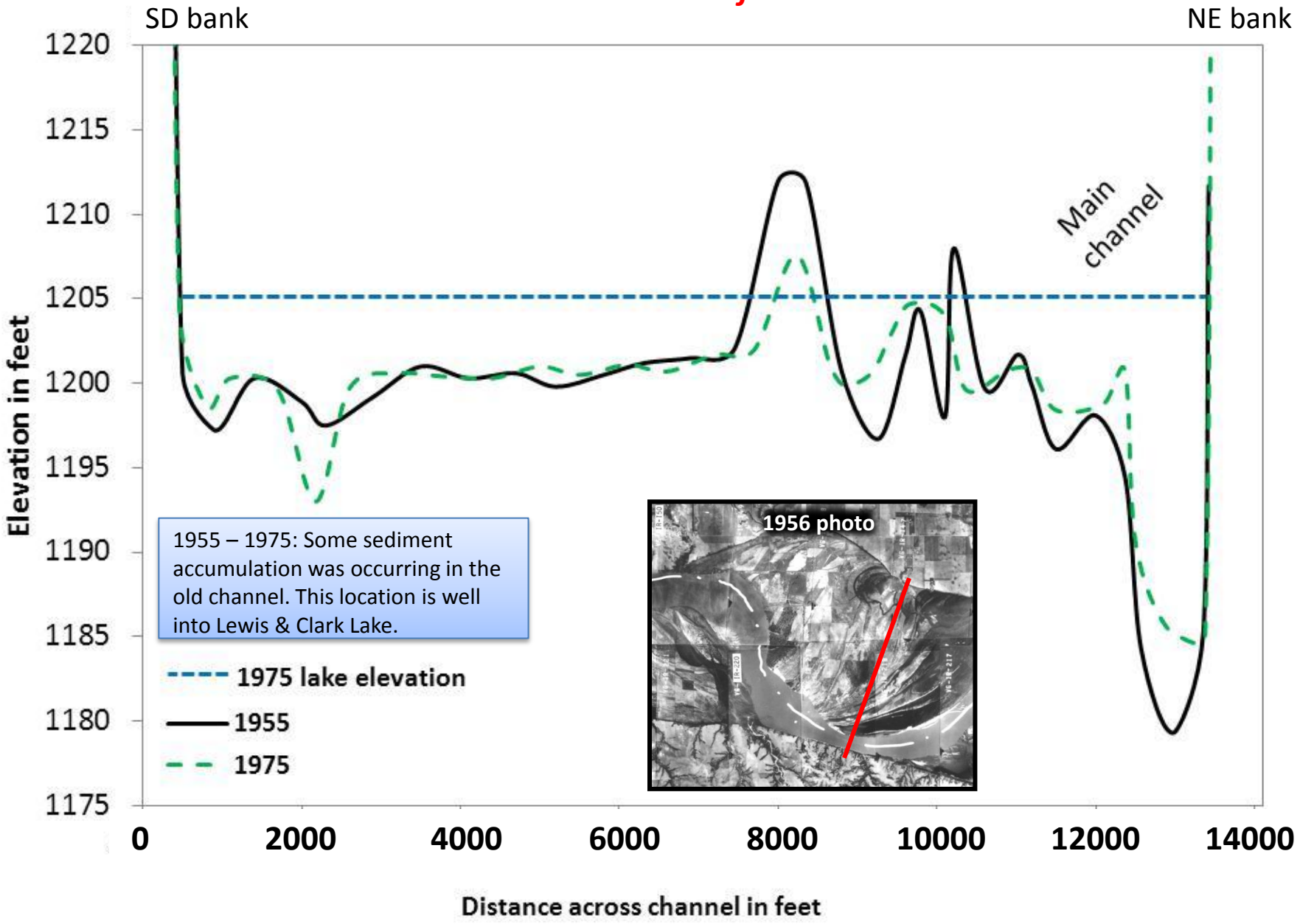
DELTA PROFILES



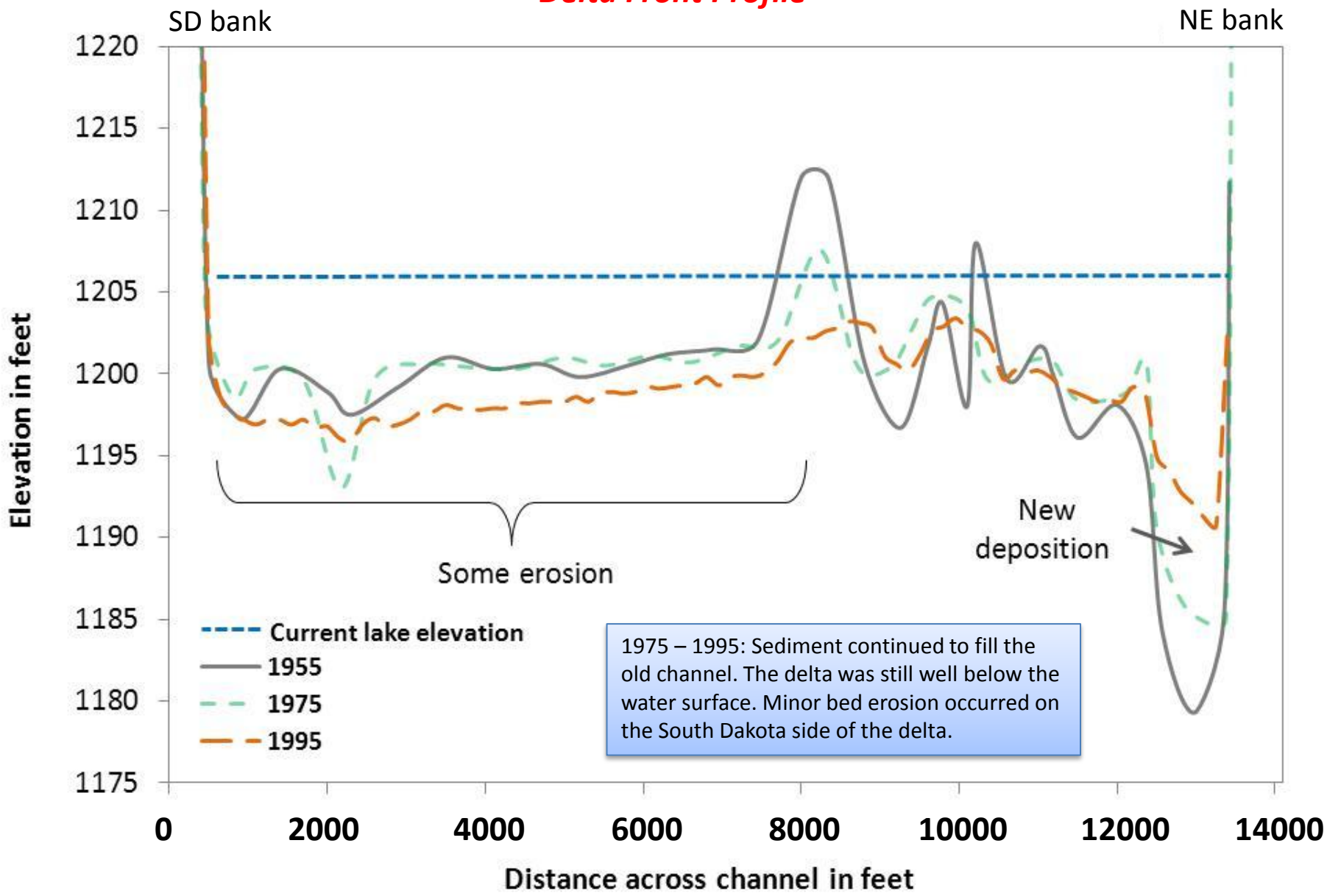
Compiled by the Missouri River Institute, University of South Dakota

River bed profile data courtesy of the U. S. Army Corps of Engineers

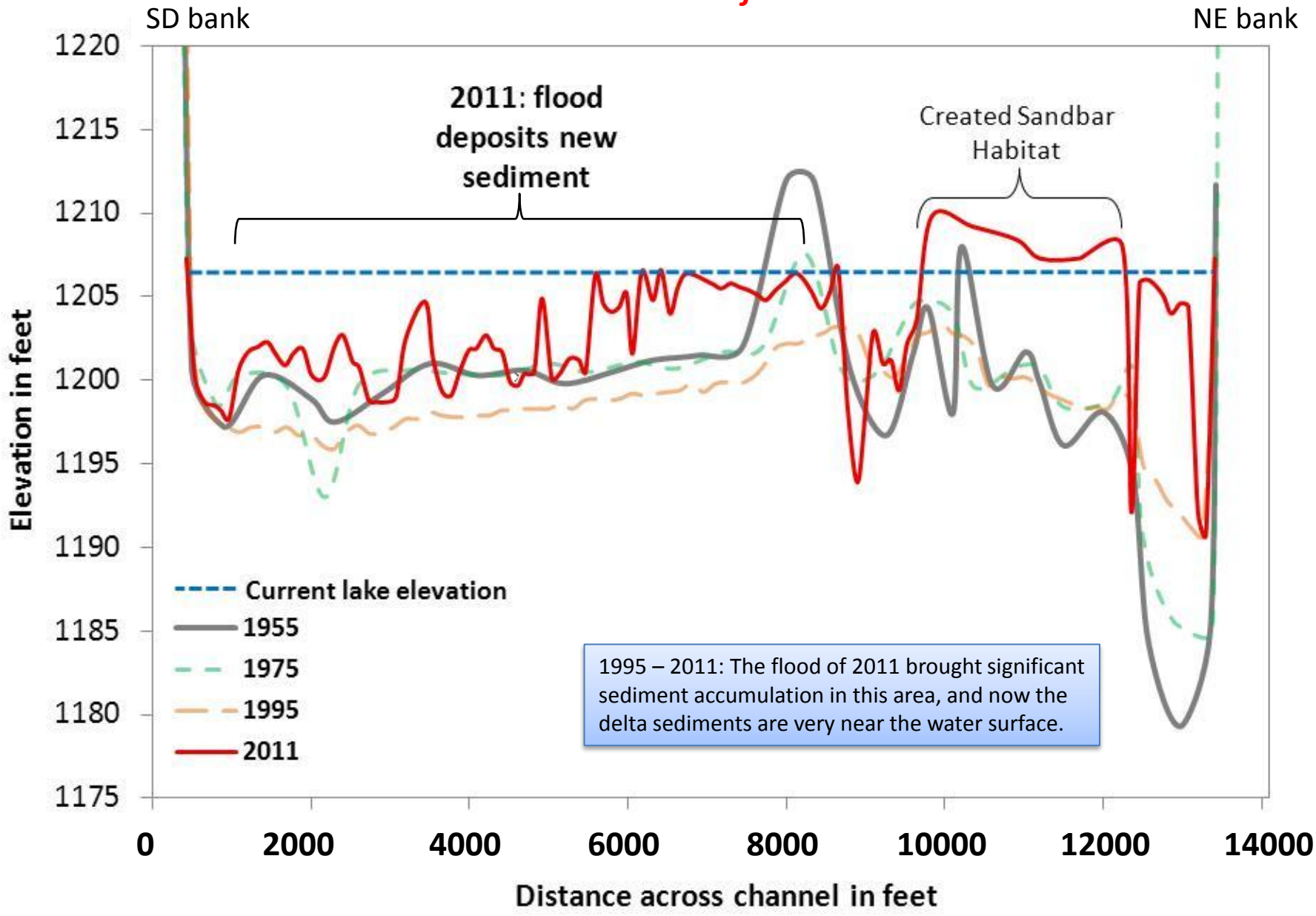
Delta Front Profile

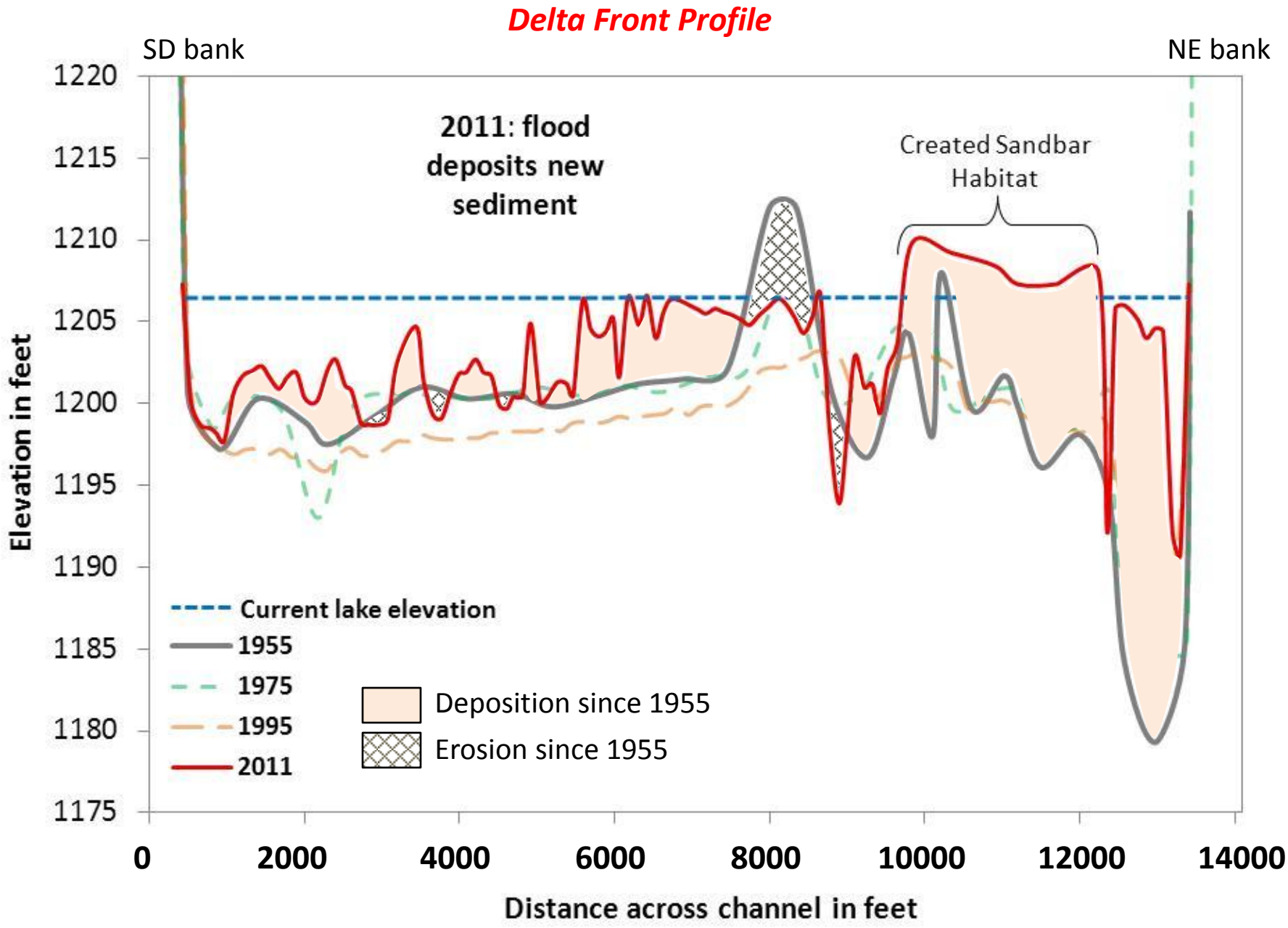


Delta Front Profile



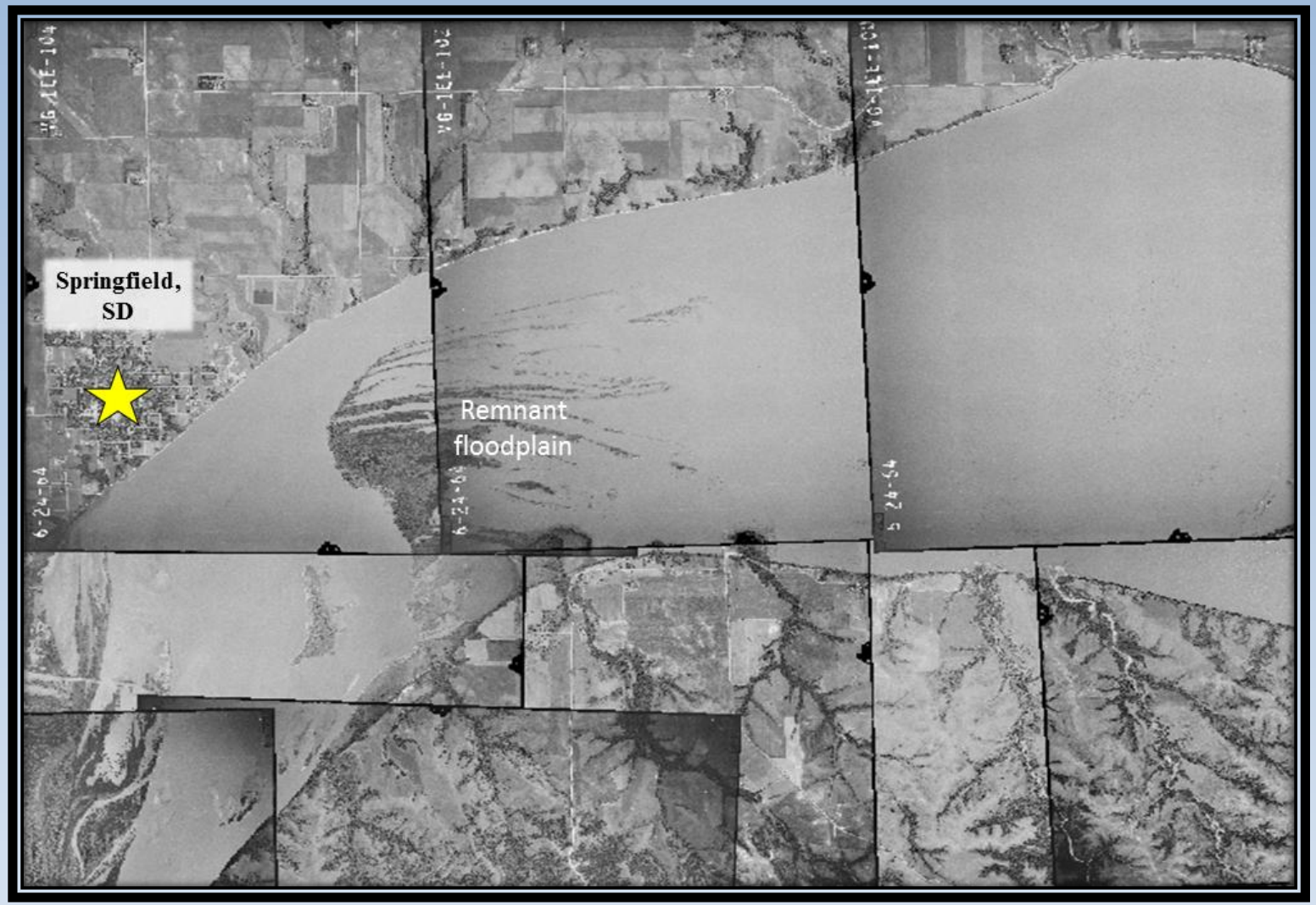
Delta Front Profile



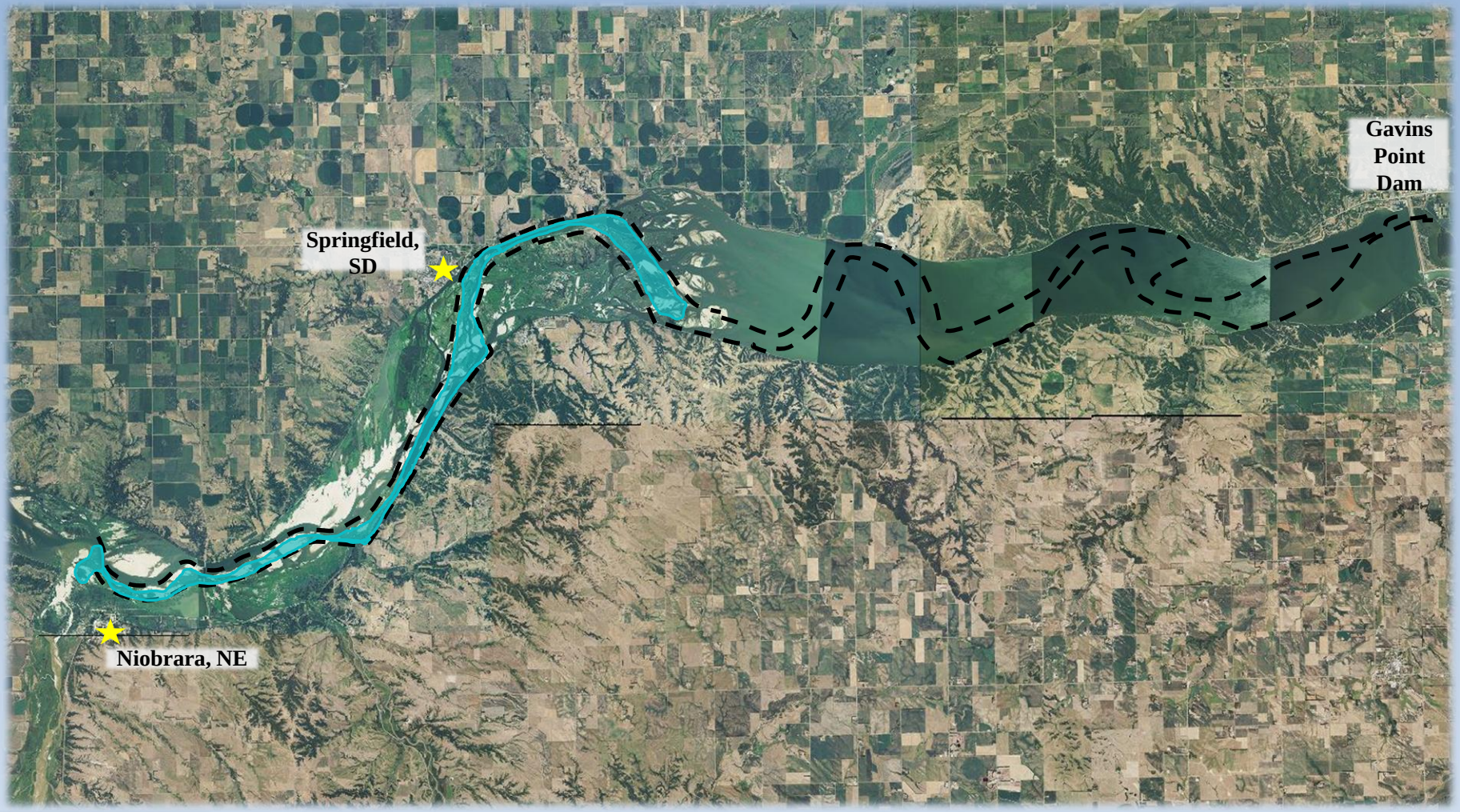

Delta Front Profile
SD bank
NE bank
2011: flood deposits new sediment
Created Sandbar Habitat
Current lake elevation
1955
1975
1995
2011
Deposition since 1955
Erosion since 1955
Elevation in feet
1220
1215
1210
1205
1200
1195
1190
1185
1180
1175
0
2000
4000
6000
8000
10000
12000
14000
Distance across channel in feet

Historical Sediment Accumulation

A closer look



1955 to 1965

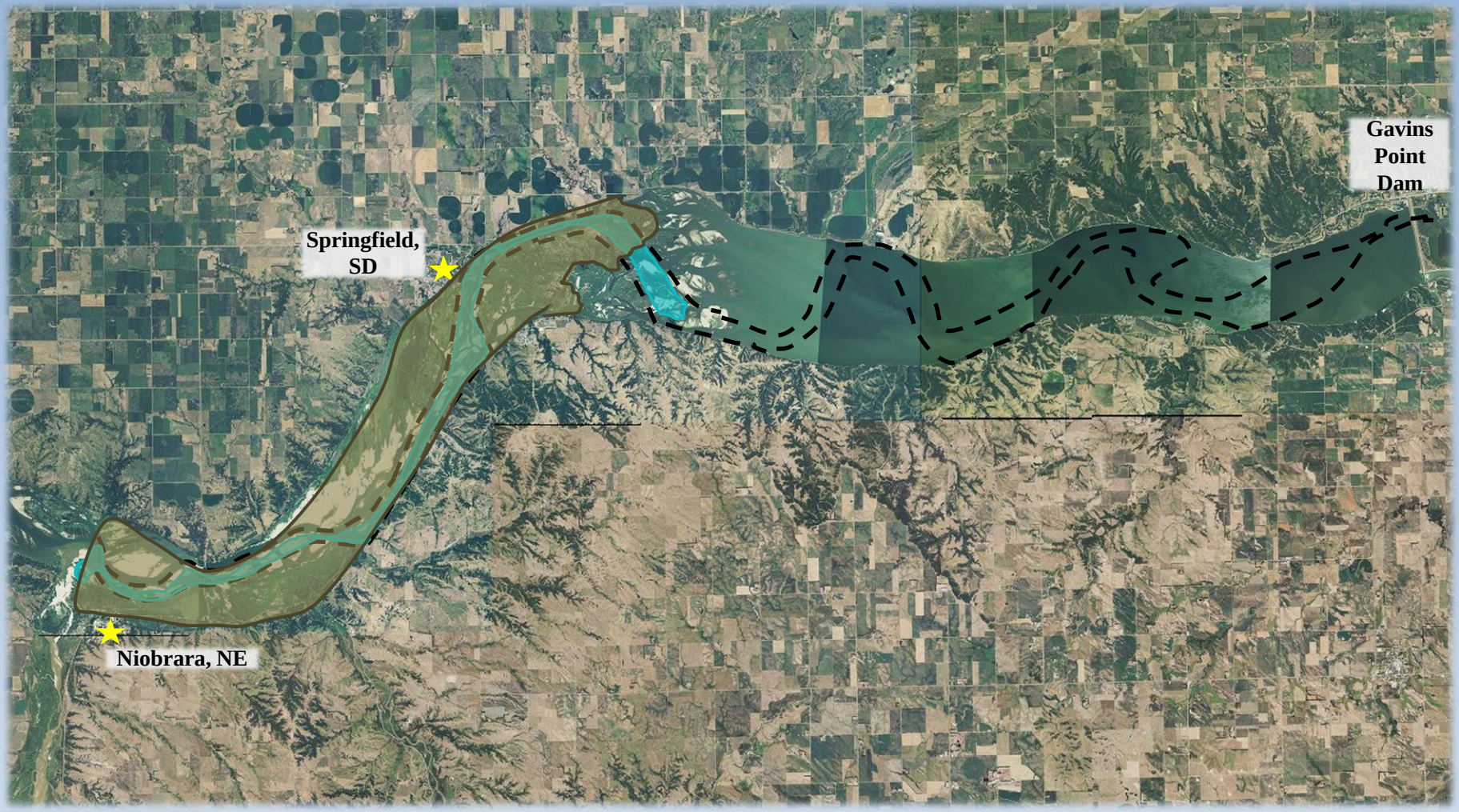


1941 river channel

1955 - 1965 channel fill

Delta formation began after closure of Gavins Point Dam in 1955. Although a delta was not visible, cross section data between 1955 and 1965 show sediment accumulating in the old channel from the mouth of the Niobrara River to 5 miles downstream of Springfield, SD.

1970s



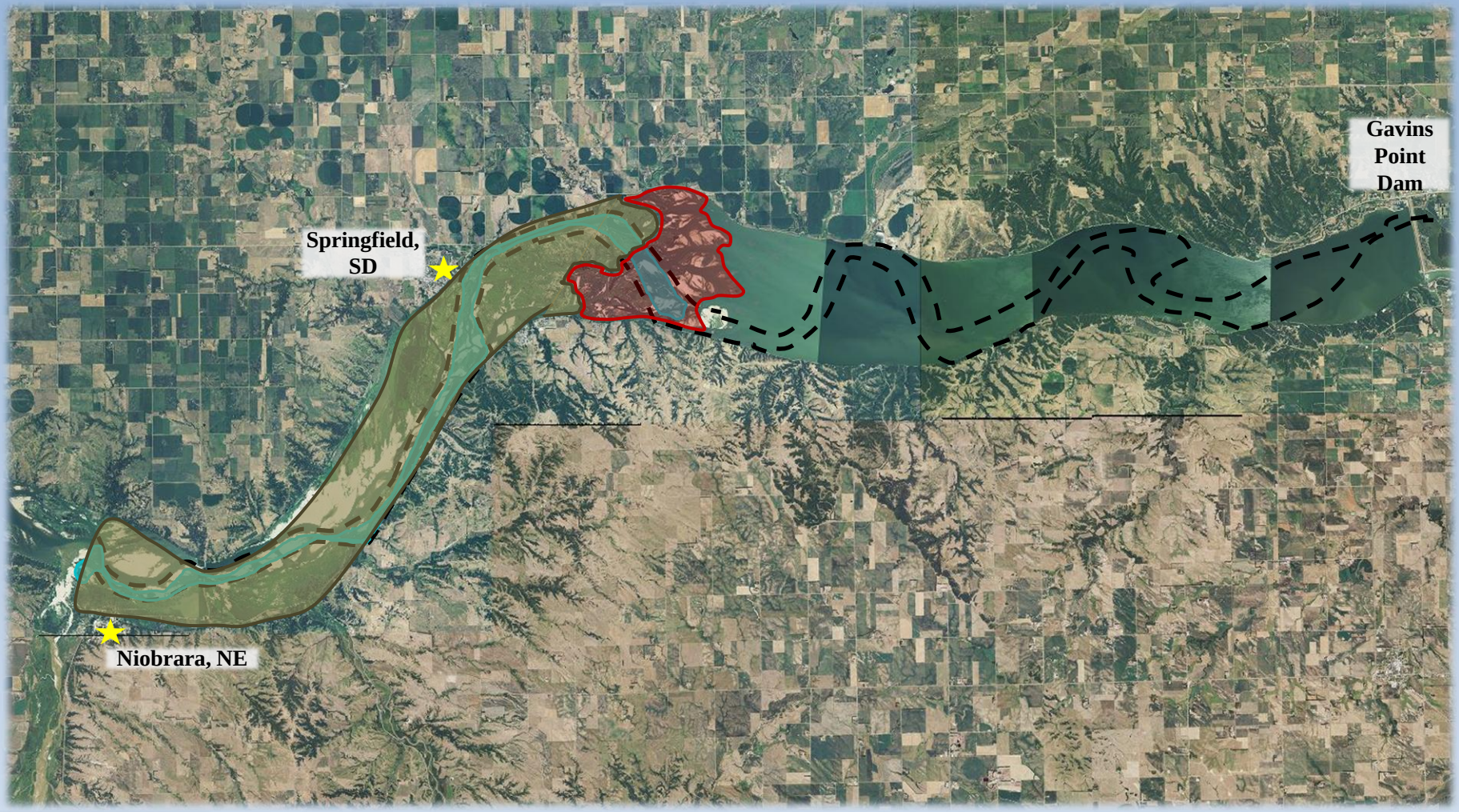
1941 river channel

1970s

1955 - 1965 channel fill

The delta became visible in the 1970s. Enough sediment accumulation had occurred to bring the delta above the water surface in an area extending from the mouth of the Niobrara River to roughly 4 miles downstream of Springfield, SD.

1980s to present



1941 river channel

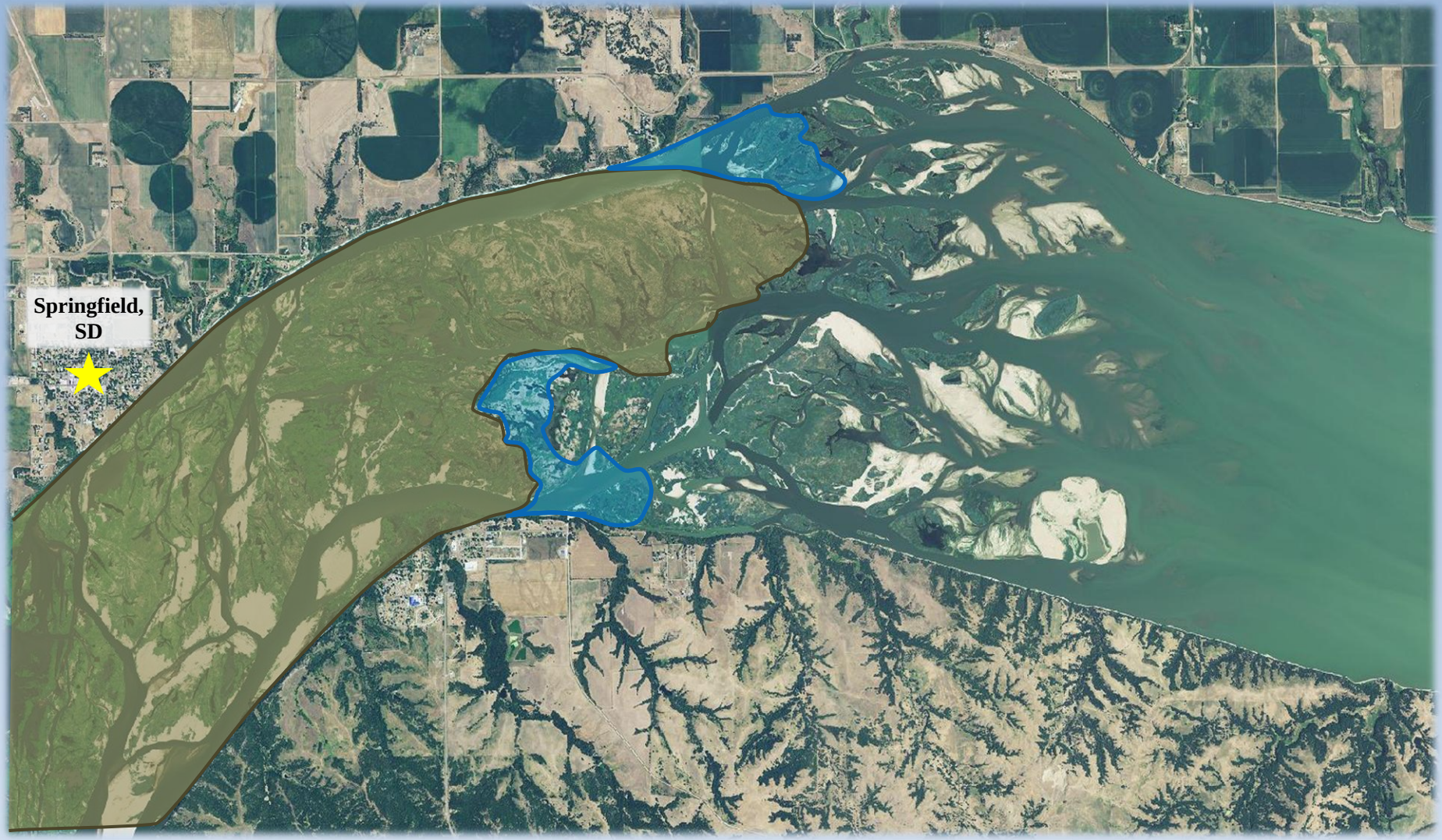
1970s

1955 - 1965 channel fill

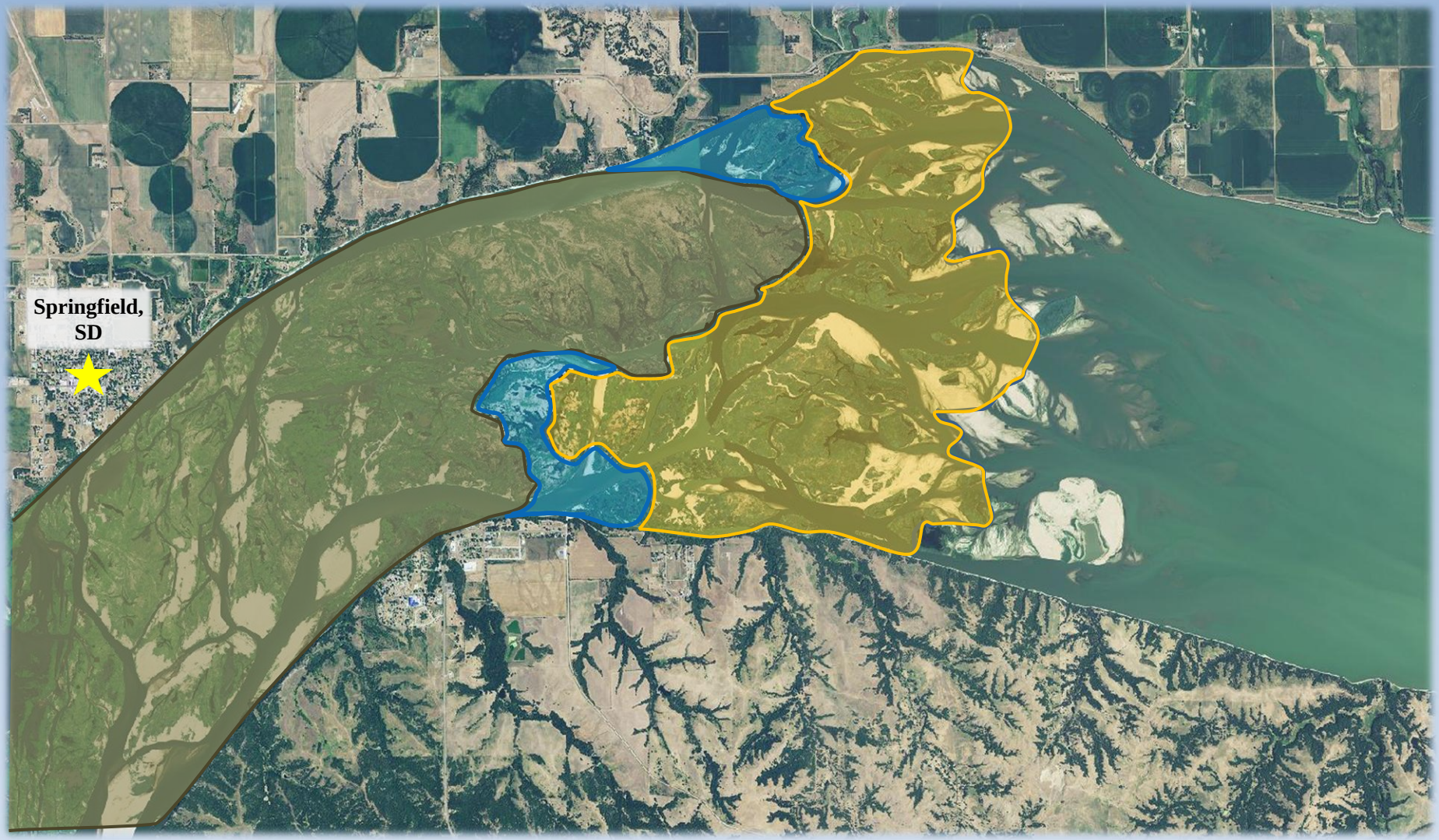
1980s - present

Delta growth has slowed since the 1980s. This is likely the result of the delta entering a wider section and deeper waters of Lewis and Clark Lake.

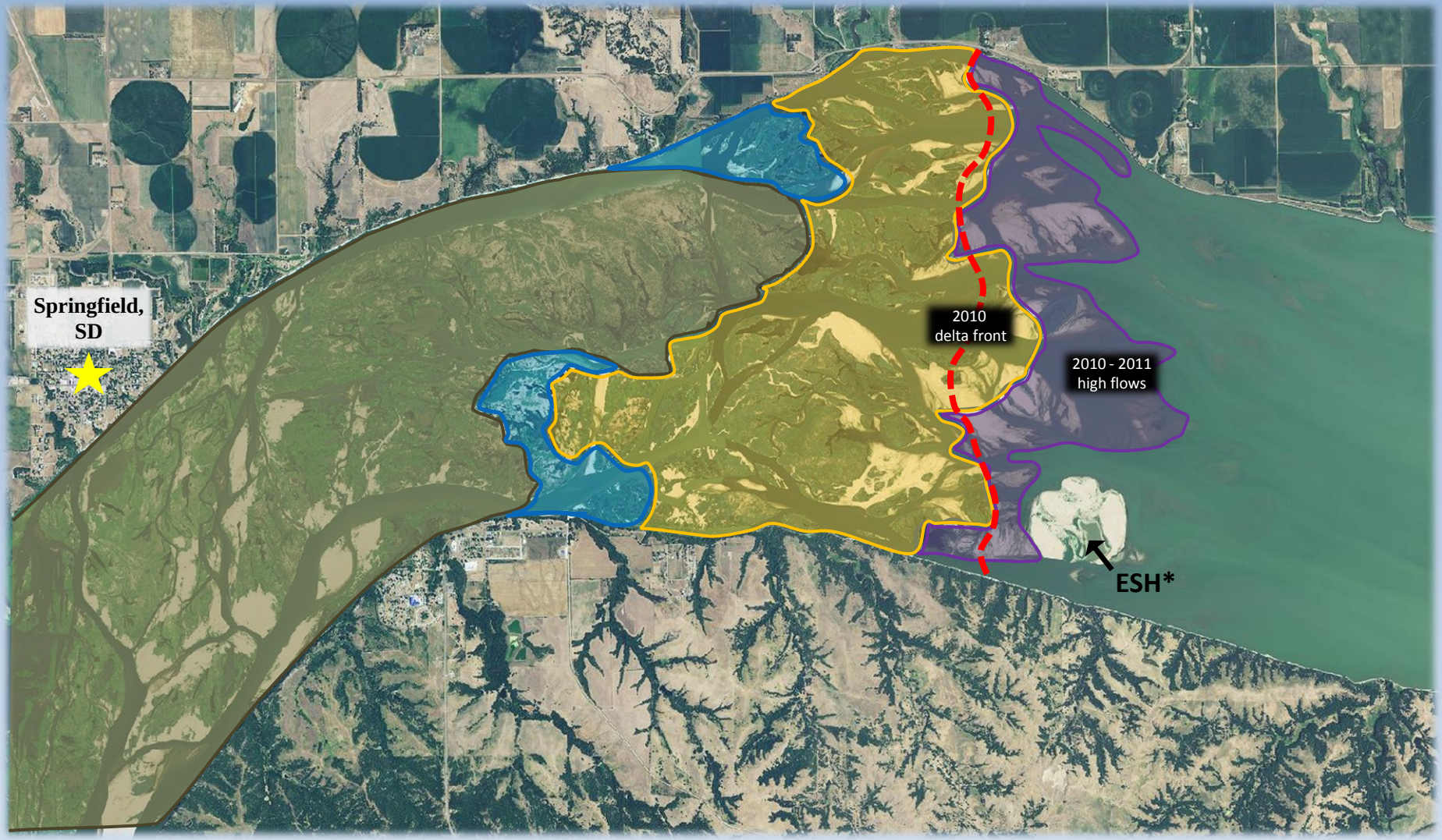
1980s detail



1990s detail



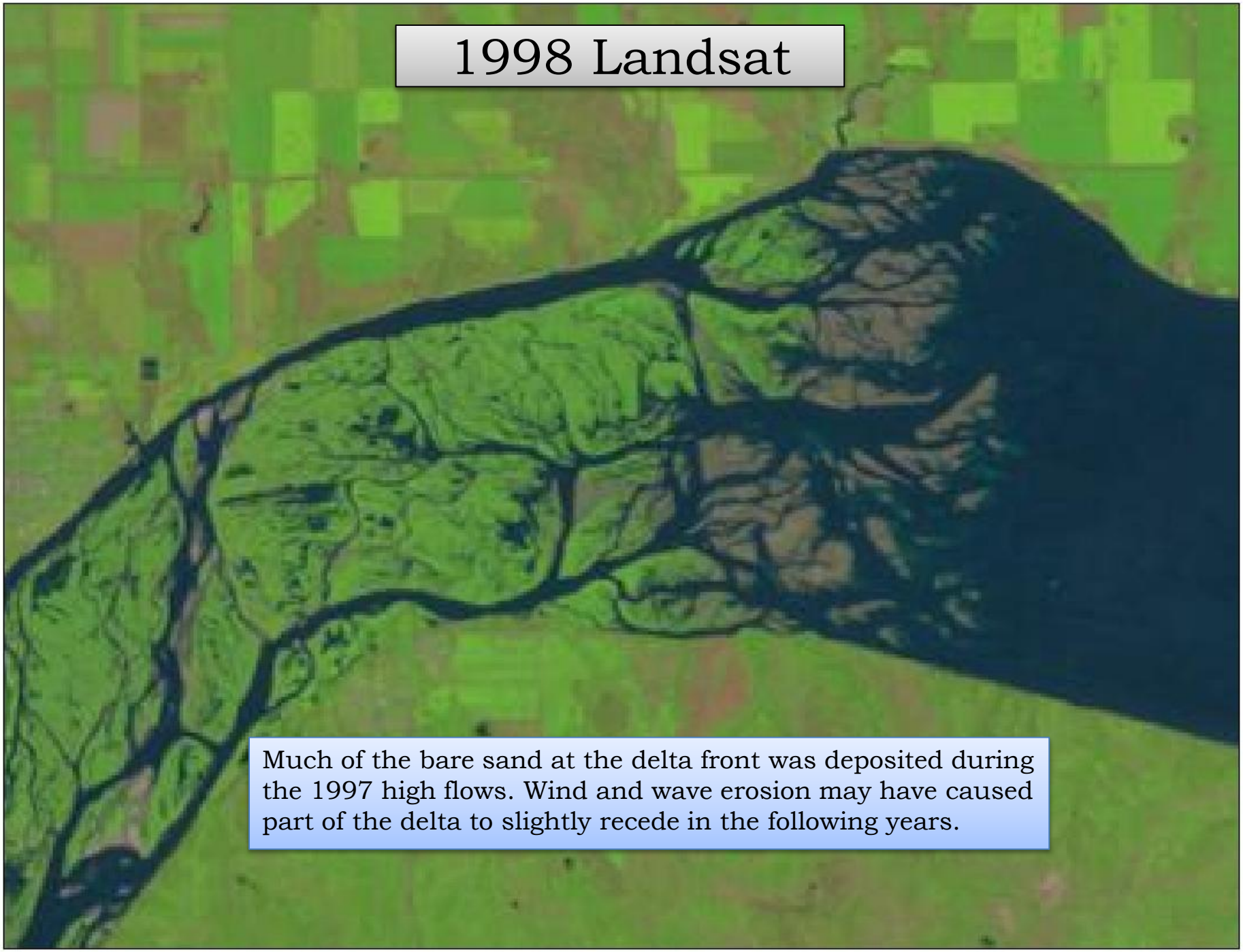
2000s detail



***ESH**: Emergent Sandbar Habitat created by the U.S. Army Corps of Engineers to provide habitat to endangered and threatened species.


1996 Landsat
clouds

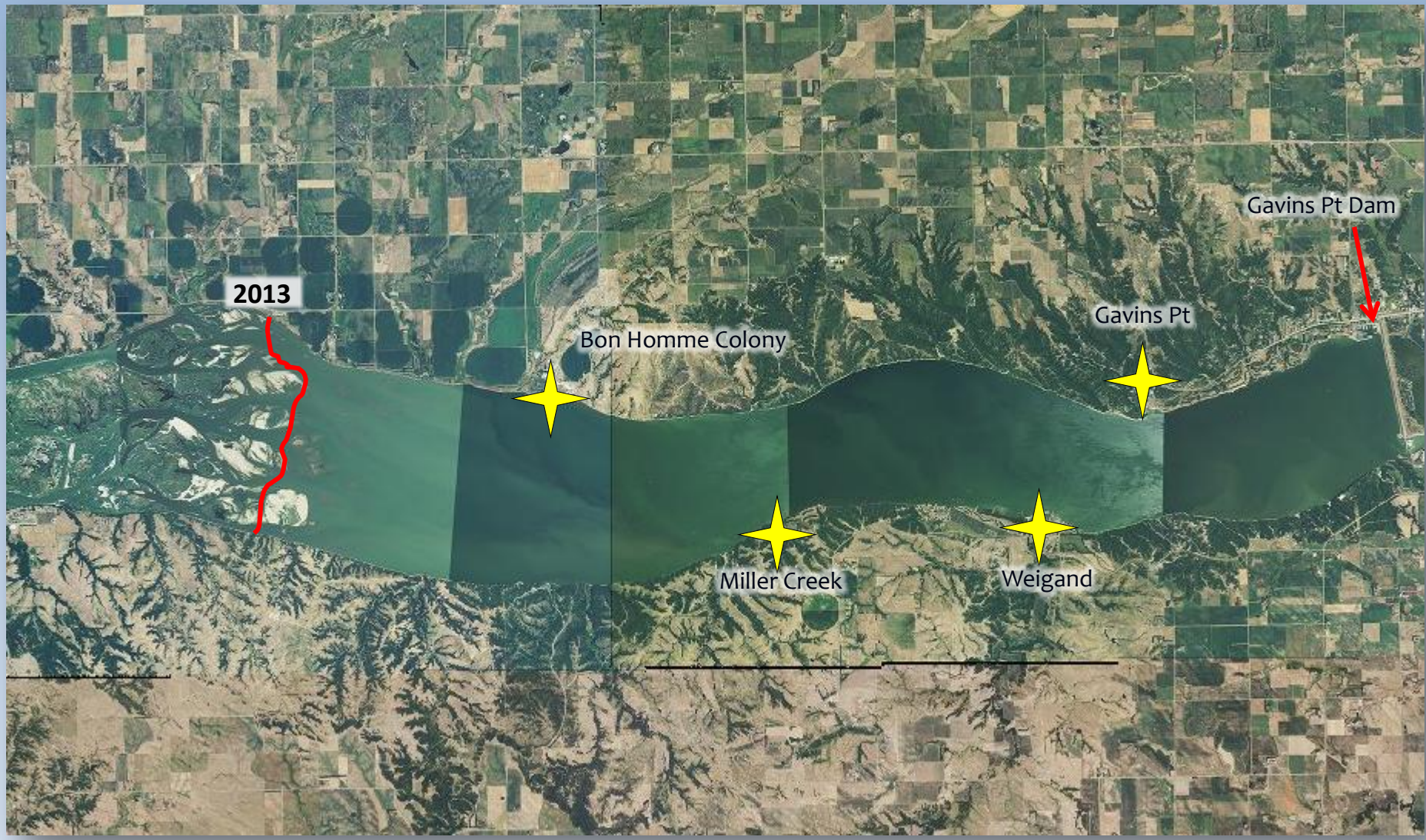
1998 Landsat



Much of the bare sand at the delta front was deposited during the 1997 high flows. Wind and wave erosion may have caused part of the delta to slightly recede in the following years.

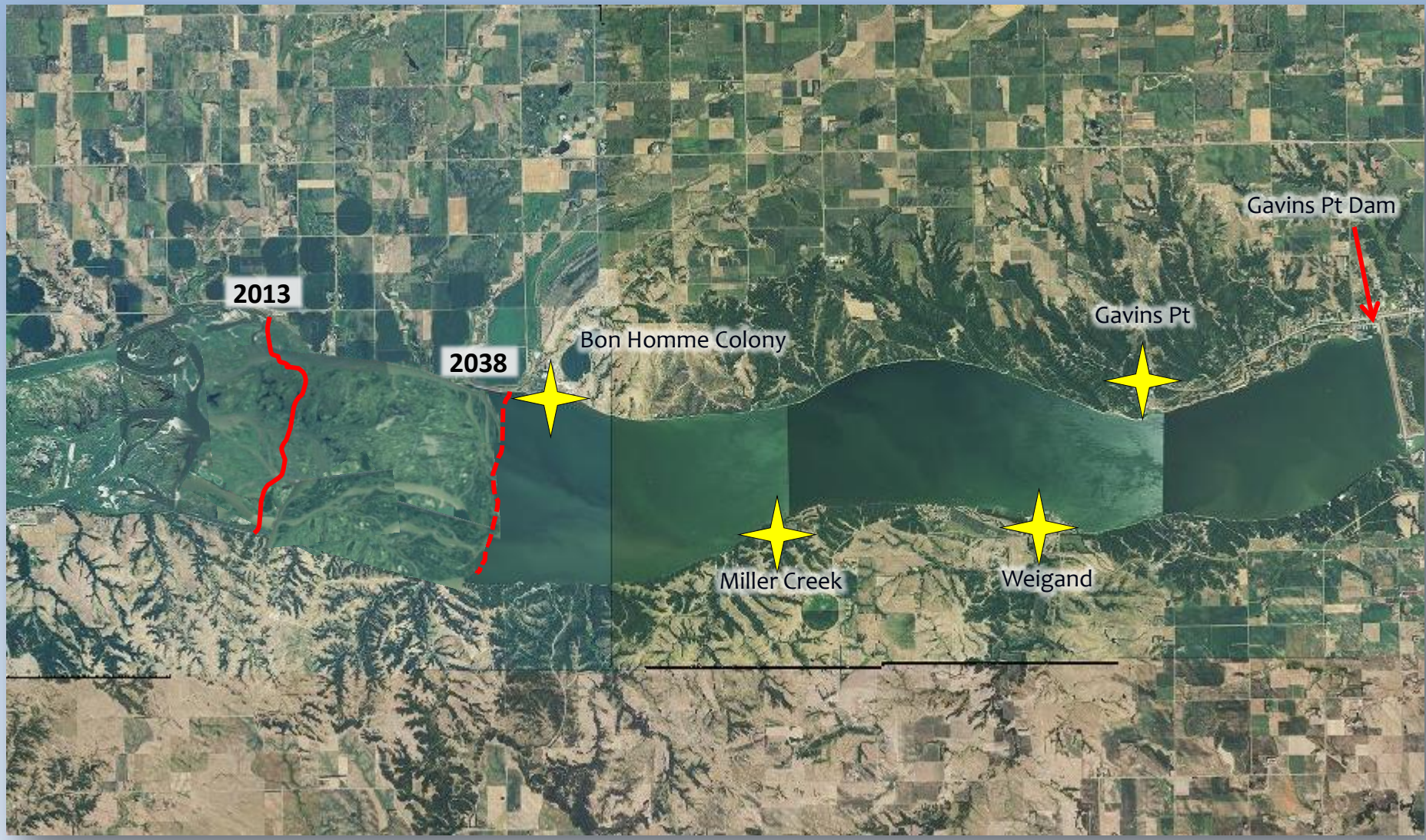
Future Sediment Accumulation

Present Delta Front

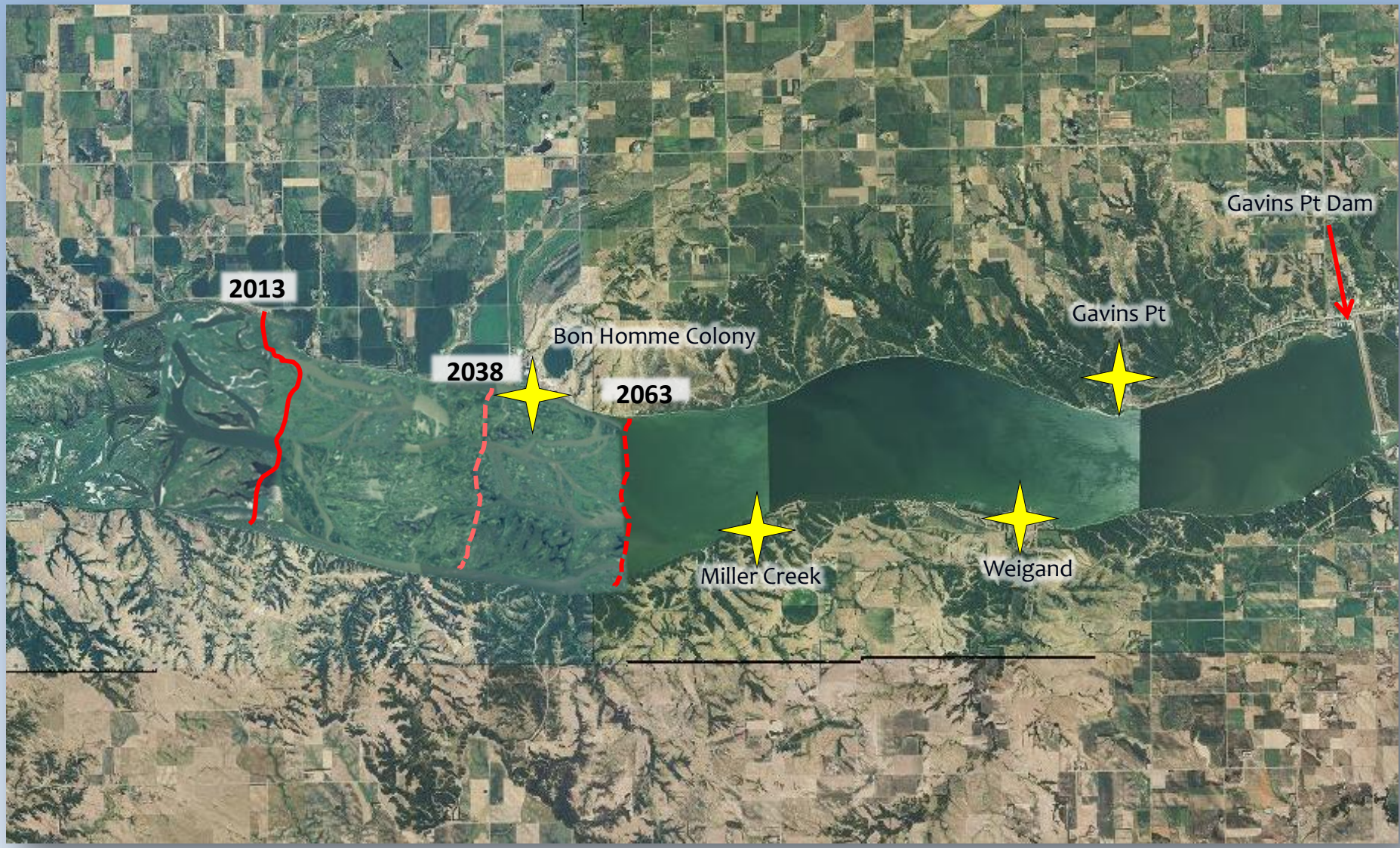


Present
Delta Front

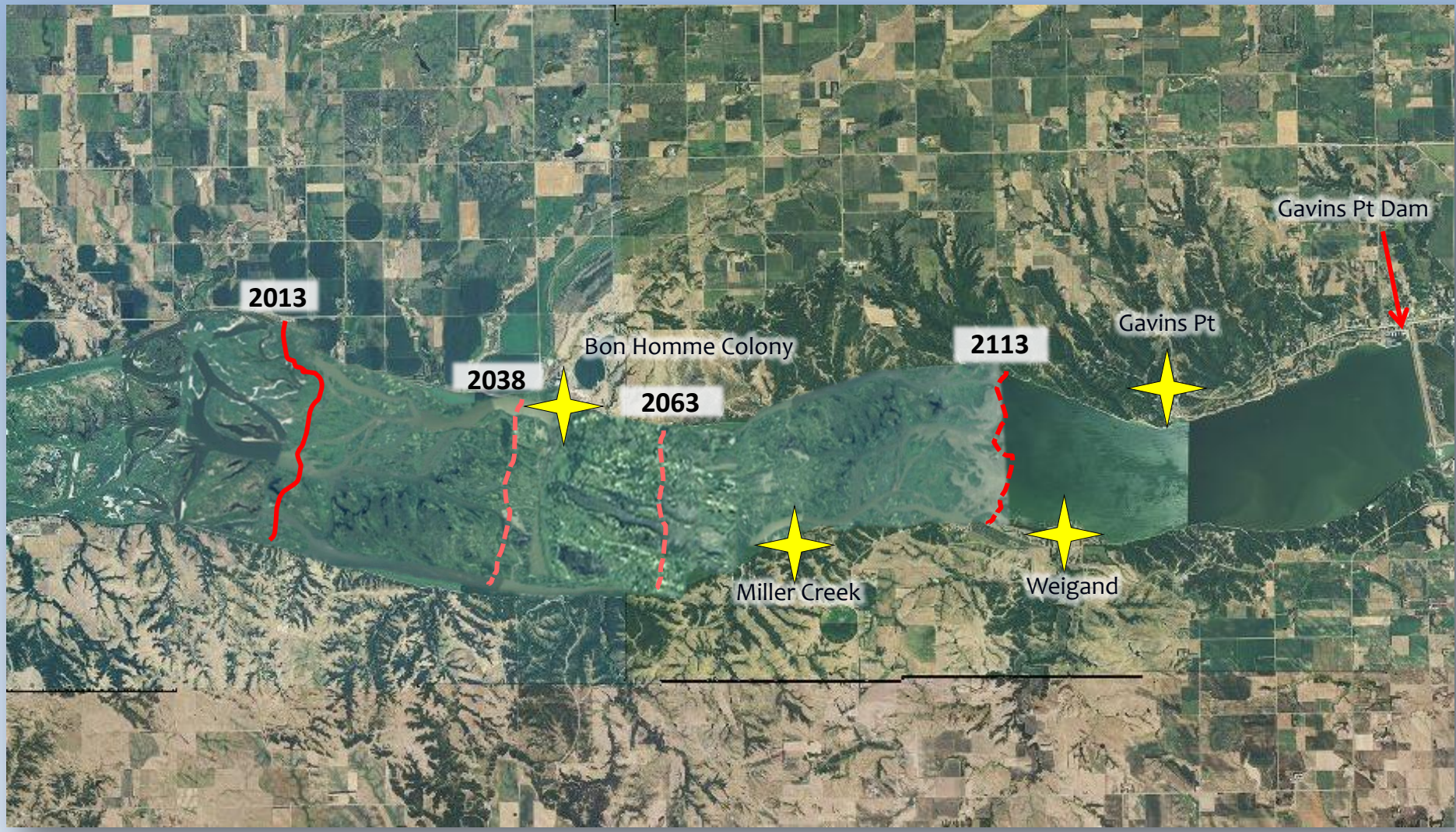
25 Years From Present



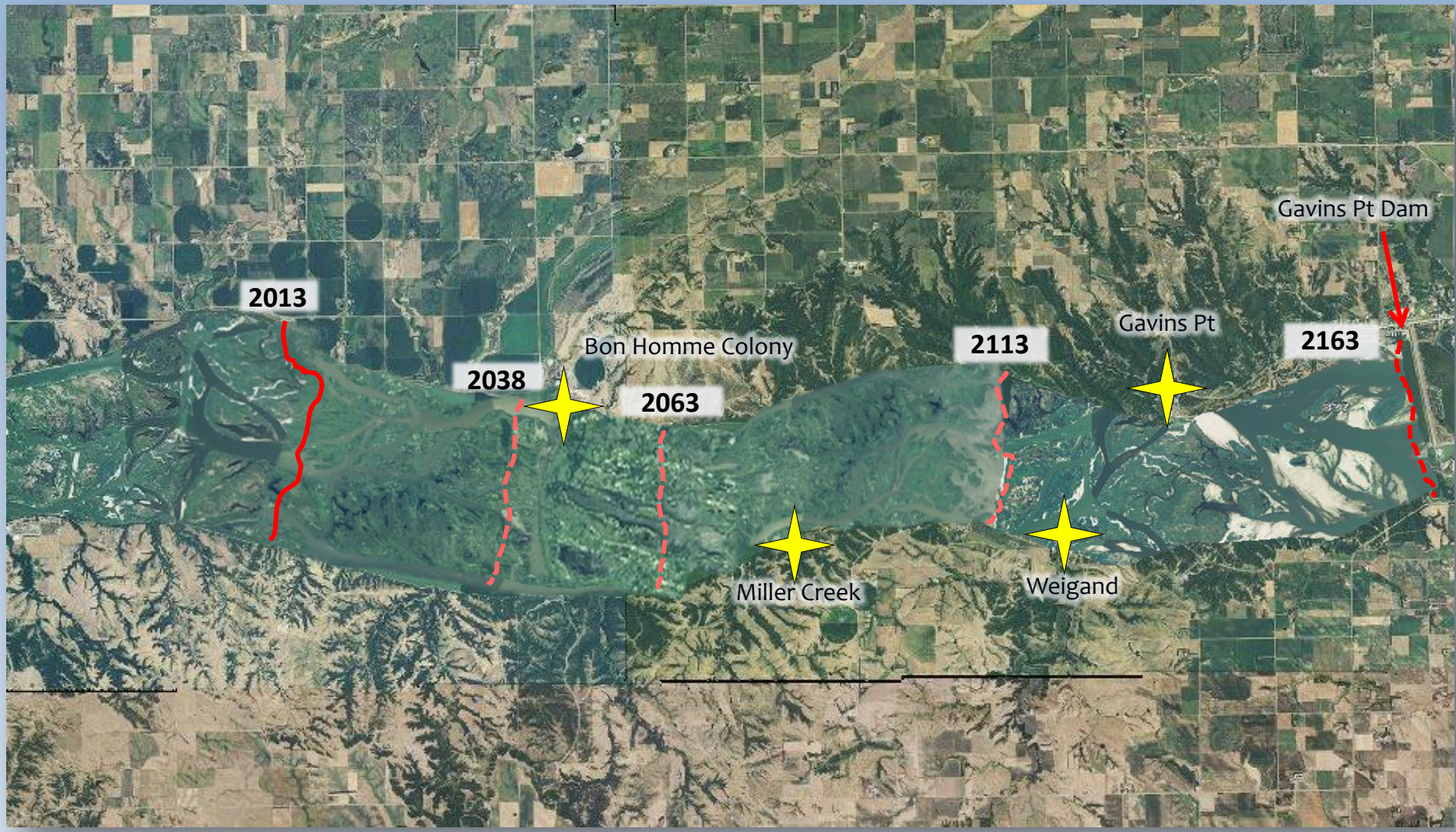
50 Years From Present



100 Years From Present



150 Years From Present



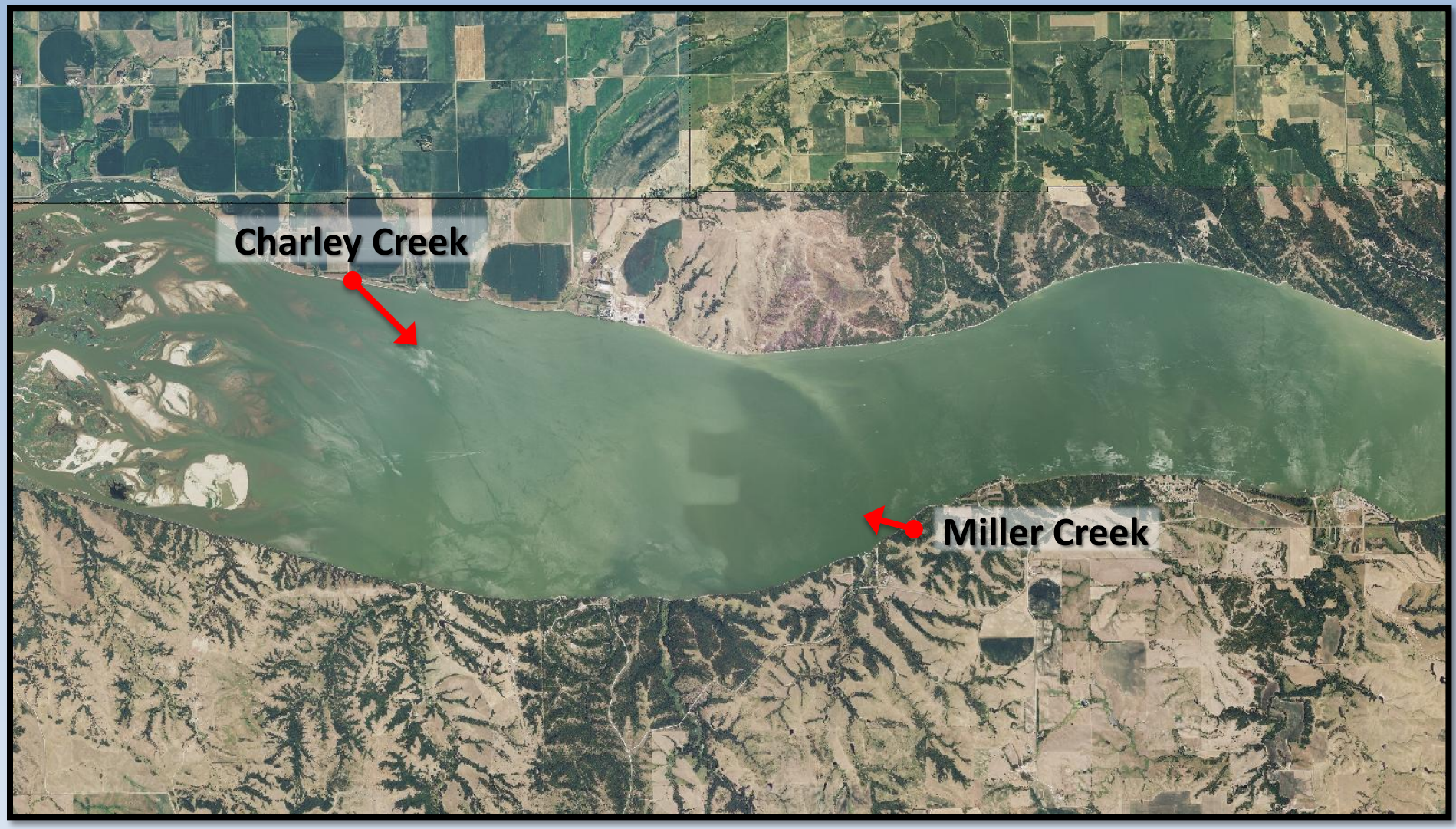
Present Delta Front

Future Delta Front

Artist's Rendering of the Delta

25, 50 and 100 Years in the Future

Location Index



Charley Creek Vantage Point
(looking downstream)

Charley Creek 2013

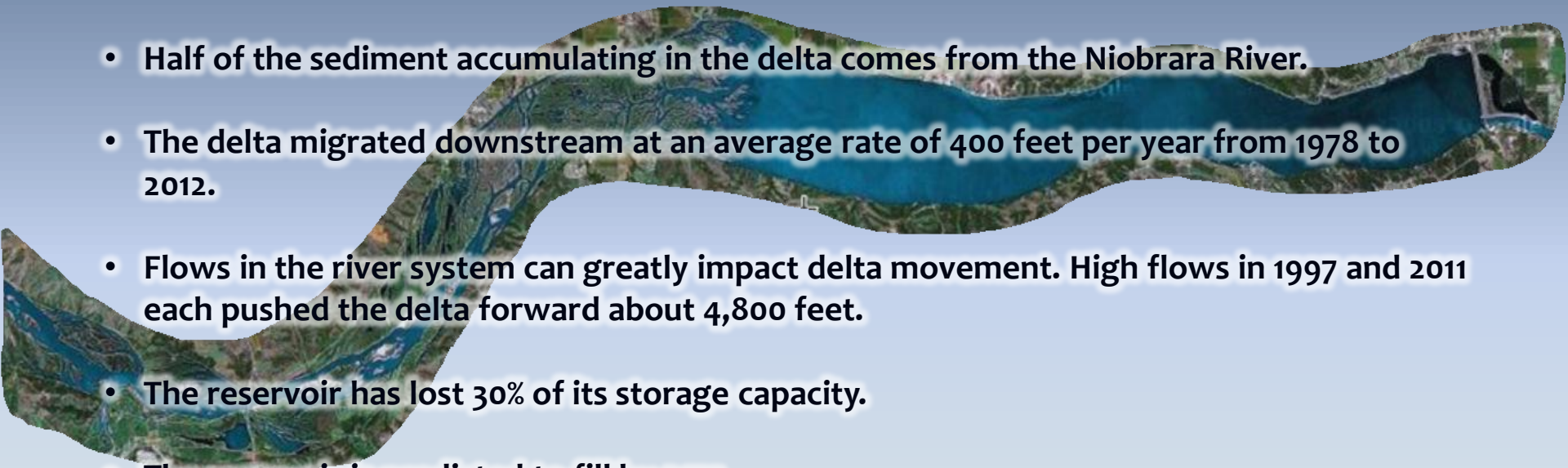
Charley Creek 2038

Charley Creek 2063

Charley Creek 2113

ABOUT THE DELTA

Hydrology / Geomorphology



- Closure of Gavins Point Dam in 1955 reduced the river's ability to carry sediment downstream.
- Half of the sediment accumulating in the delta comes from the Niobrara River.
- The delta migrated downstream at an average rate of 400 feet per year from 1978 to 2012.
- Flows in the river system can greatly impact delta movement. High flows in 1997 and 2011 each pushed the delta forward about 4,800 feet.
- The reservoir has lost 30% of its storage capacity.
- The reservoir is predicted to fill by 2175.
- Sediment management can extend the life of Lewis and Clark Lake and the benefits provided by the dam and reservoir.
- Ground water levels are expected to increase an average of 7 feet in the delta area in the next 50 years, impacting infrastructure and property.

REDUCING SEDIMENTATION

- Regional sediment management along the lower Niobrara River

  (WEST Consultants, 2010)

- Move existing and new sediment to below Gavins Point Dam

  (Coker et al., 2009)

- Lewis and Clark Watershed Project

  Best management practices to reduce sediment, nutrients, and other nonpoint source contaminants.

  (Randall RC&D, 2009)

Niobrara - Missouri River Confluence