Missouri River Flow Corridor

Boonville, MO to Jefferson City, MO
Pilot Study
2008 modeling summary & path forward

MRFTF – 4 Jan 2011

Flood of 2007:

"Scientists, government officials and environmentalists agree that a two- decade-long project to restore Missouri River habitat helped reduce flooding last month. They just don't know how much."

– Associated Press, June 8, 2007

Flood of 2011:

"Public lands along the Missouri River don't soak up nearly as much floodwater as previously believed." … "They do have some effect on downstream flooding, but in a flood as large and as long-lasting as the one this summer, that effect will be insignificant."

– The Missourian, July 5, 2011

Flood of 2011:

"Farmers John Sam Williamson of McBaine and Wayne Hilgedick of Hartsburg say they've noticed a difference. A high river level on the Boonville gauge doesn't seem to affect the river towns like it did before areas such as Overton Bottoms were set up. Brett Dufur, a bed and breakfast owner in Rocheport, also credited conservation areas for lessened flooding effects."

– The Missourian, July 5, 2011

Outline

- Modeling scope
- Test of concept models
- Existing Conditions vs pre Missouri River Recovery
- Status / Q&A

General Questions…

- Did restorations raise or lower river stages?
- Can we spend habitat funding more wisely in the future?
- Stages at low flows are decreasing, but larger flows are getting higher. Is this concerning?

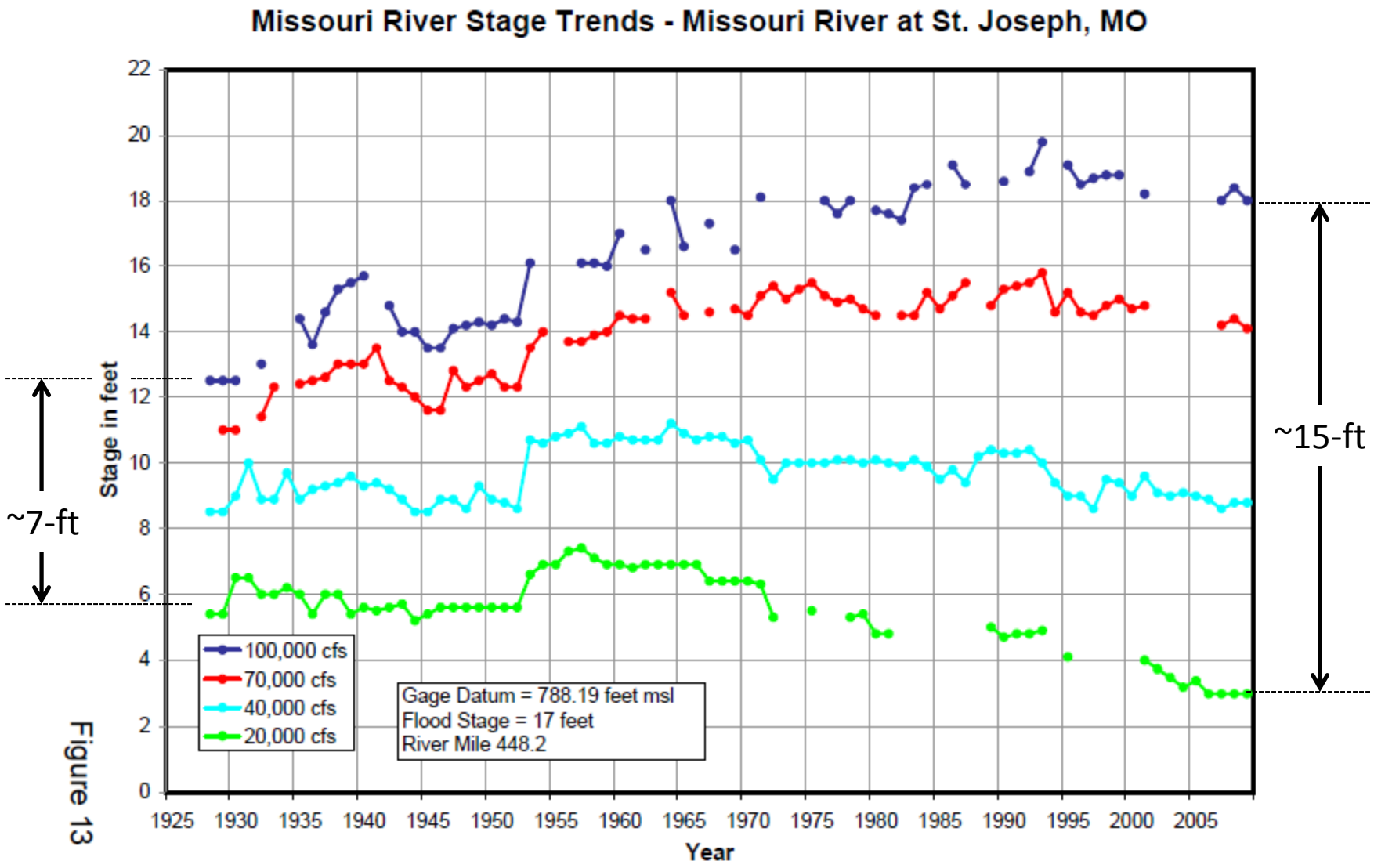

Missouri River Stage Trends - Missouri River at St. Joseph, MO
Stage in feet
Year
100,000 cfs
70,000 cfs
40,000 cfs
20,000 cfs
Gage Datum = 788.19 feet msl
Flood Stage = 17 feet
River Mile 448.2
~7-ft
~15-ft

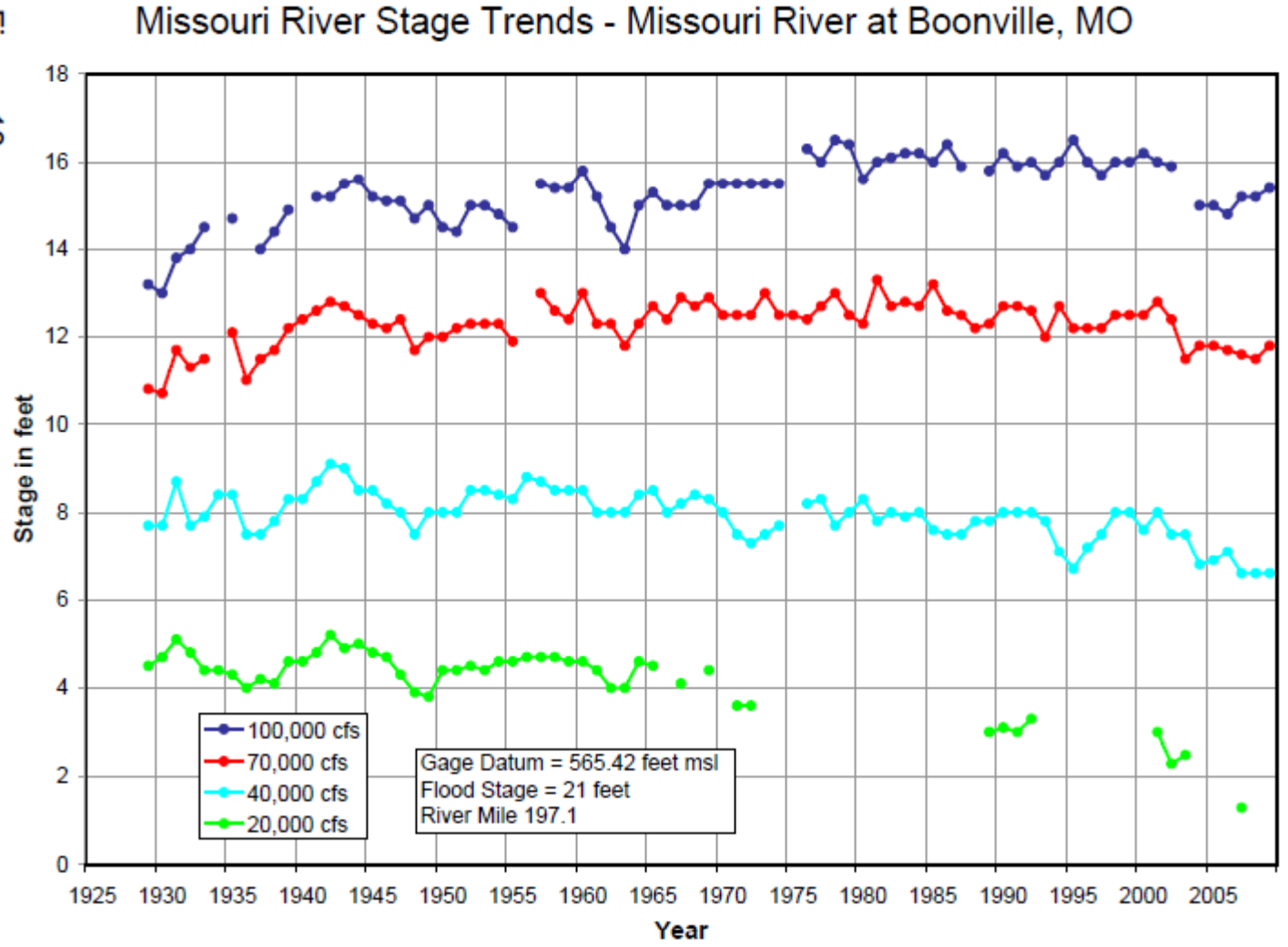
Figure 13

Why Boonville to Jefferson City?

- High amount of public land
- Between two gauging stations
- Segment has aggraded at high flows
- Previous Recovery actions in segment have reportedly lowered flood stages


Public Land and Levees:
Boonville to Jeff Ctiy MO
Map Features:
Levee Centerline
Private Levee Systems
Missouri Department of Conservation
Federal Lands
National Forest
Municipal Area
Missouri River
River Mile
Floodplain
DAVISDALE CA
Bonne Femme Levee District No. 1
New Franklin
Franklin Island
195
200
190
Diana Bend
185
Rocheport Cave
Columbia
Boonville
Howard County Levee District No. 4
Levee District Number 2 of Howard County
Overton Bottoms
Overton North (USFWS)
180
Wooldridge
Levee District No. 1 of Cooper County
Eagle Bluffs
McBaine
McBaine Levee District
175
Lupus
THREE CREEKS CA
Eagle Bluffs
Plowboy Bend
170
Prairie Home
PRAIRIE HOME CA
Plow Boy Bend Levee Dist.
Providence Bend
Bunceton
Mark Twain National Forest
Jamestown
Ashland
165
Hartsburg Levee District, Section 1
Hartsburg Levee District, Section 2
HART CREEK CA
New Bloomfield
160
Marion Bottoms
Hartsburg
Hartsburg Levee District, Section 3
Prison Farm Levee
155
Renz Levee District
SMITH (ROGER V. & VIOLA WACHAL) CA
150
Holts Summit
Cole Junction Levee District
California
Centertown
Capital View Drainage District
BINDER CL
St Martins
145
Jefferson City
140
Location Map:
Miles
0
2
4
8

Figure 18


Missouri River Stage Trends - Missouri River at Boonville, MO
Stage in feet
Year
0
2
4
6
8
10
12
14
16
18
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
100,000 cfs
70,000 cfs
40,000 cfs
20,000 cfs
Gage Datum = 565.42 feet msl
Flood Stage = 21 feet
River Mile 197.1

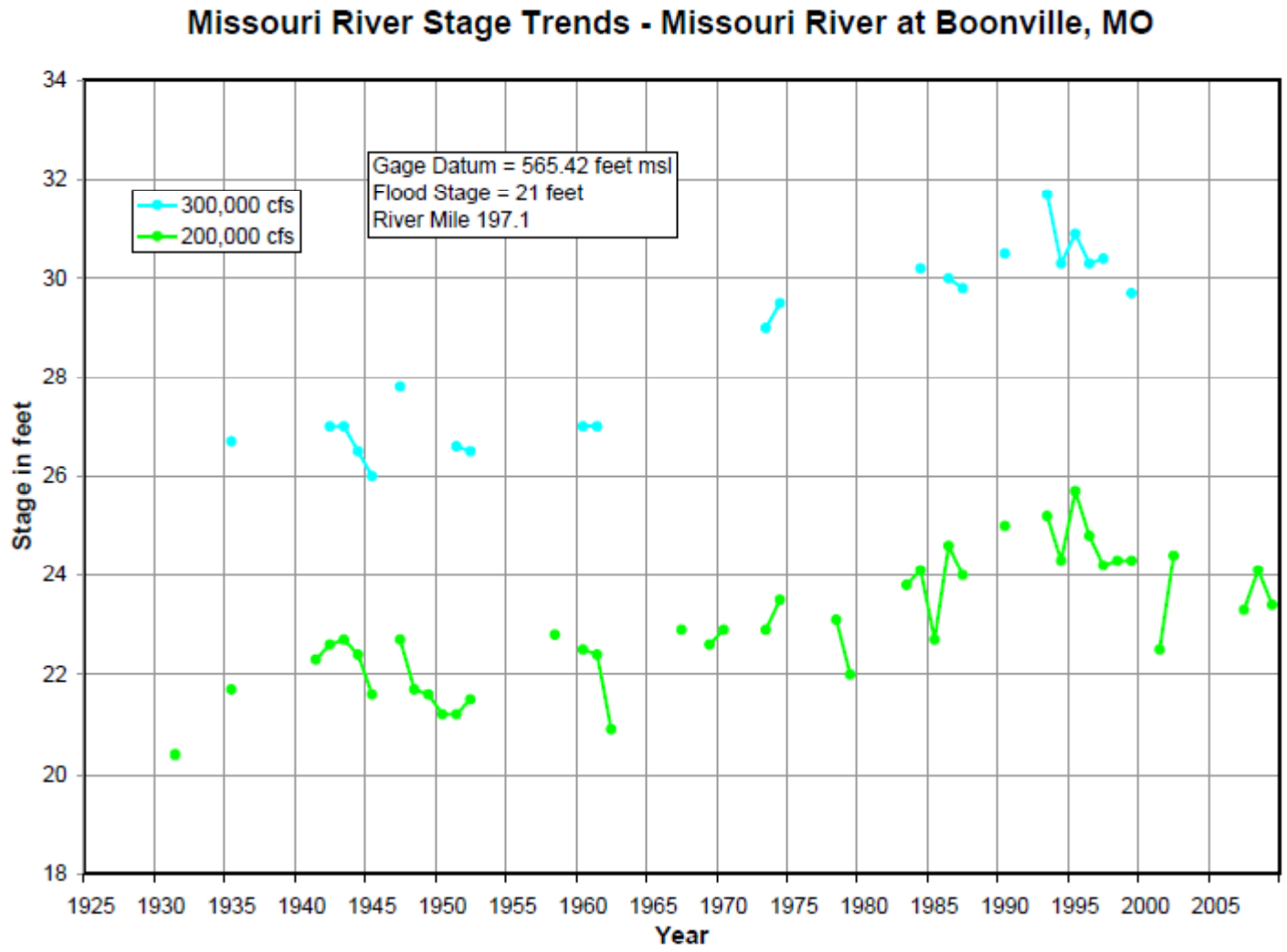

Missouri River Stage Trends - Missouri River at Boonville, MO
Gage Datum = 565.42 feet msl
Flood Stage = 21 feet
River Mile 197.1
300,000 cfs
200,000 cfs
Stage in feet
Year
34
32
30
28
26
24
22
20
18
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005

Figure 19

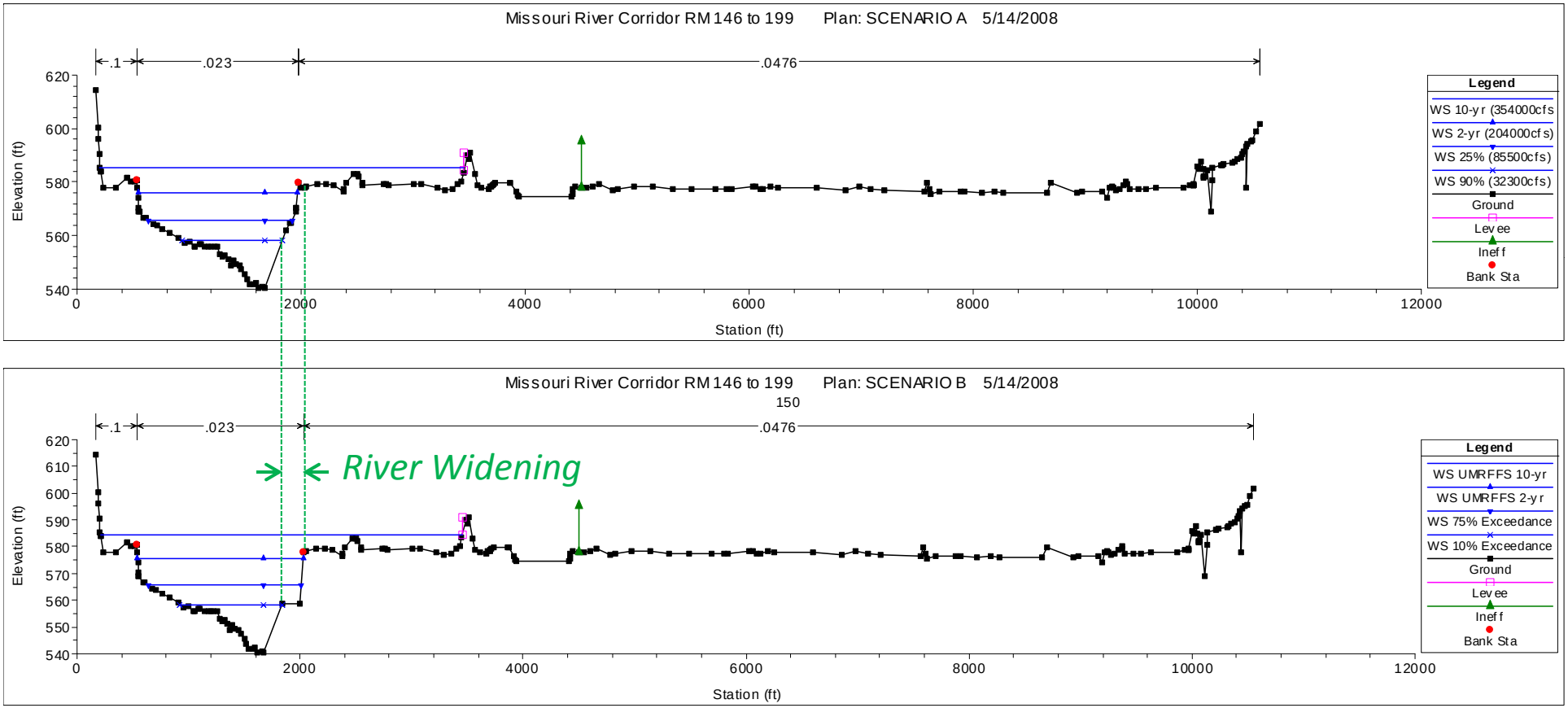
Test of Concept

Do levee setbacks and channel widening change river stages?

Test of Concept Steady-flow Models

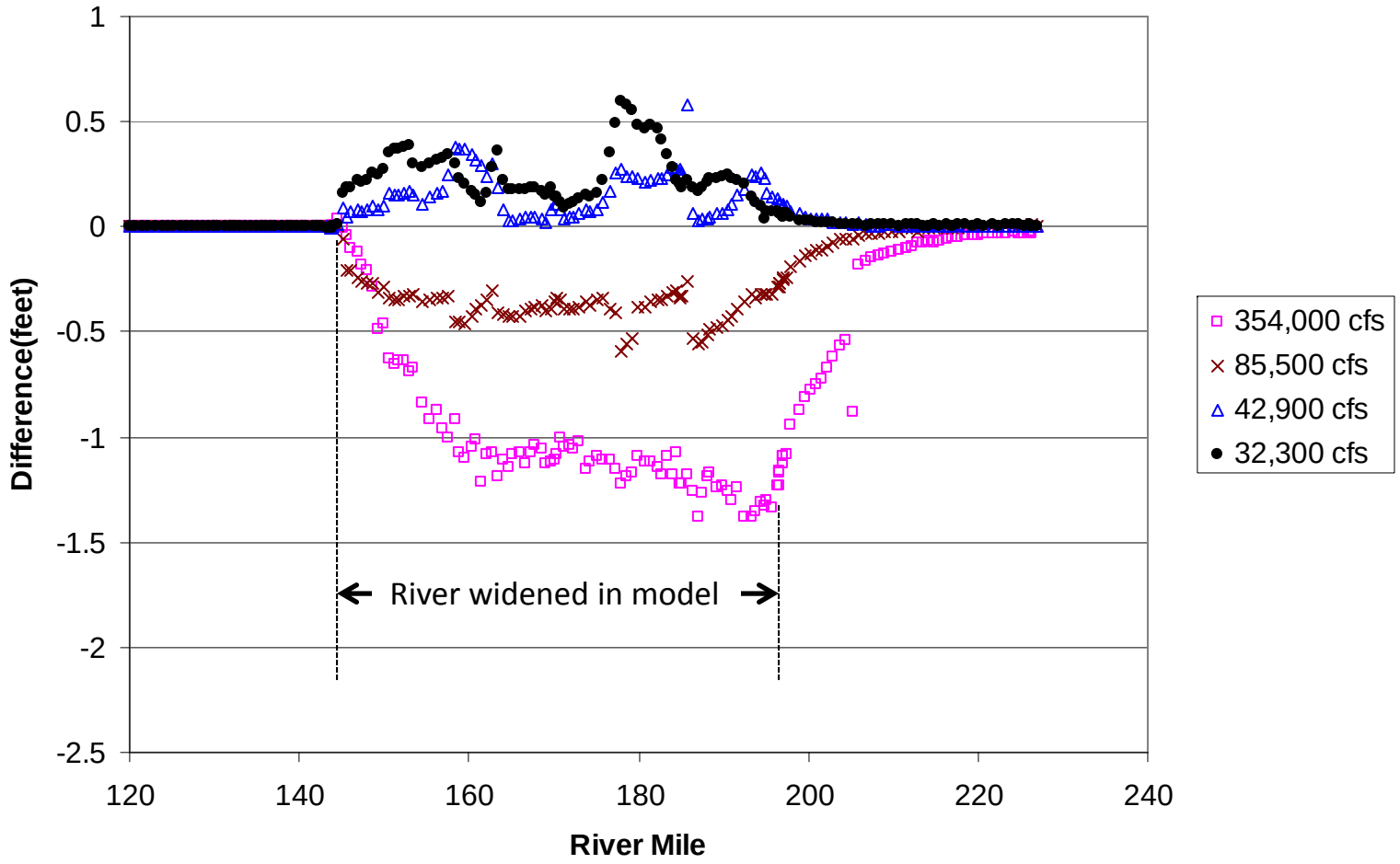
- Scenario A: Pre-recovery model (~1992 conditions)
- Scenario B: River widening - 150 feet
- Scenario C: B + 1,000-feet levee set back
- Scenario D: Levee set back – 1,000 feet
- Scenario E: No levees

River Widening Geometry



River Mile 184

1992 compared to 150-ft of Widening



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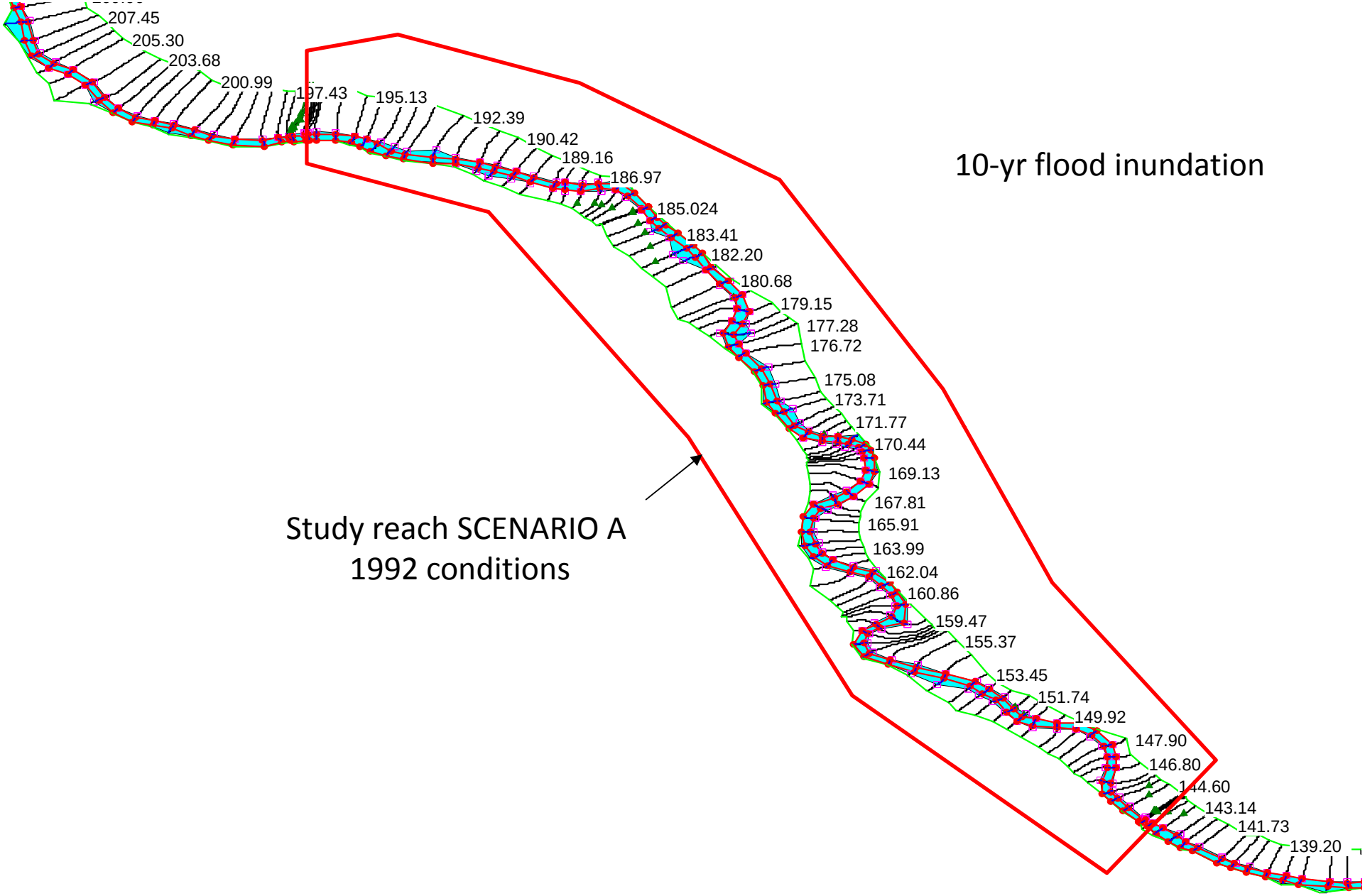
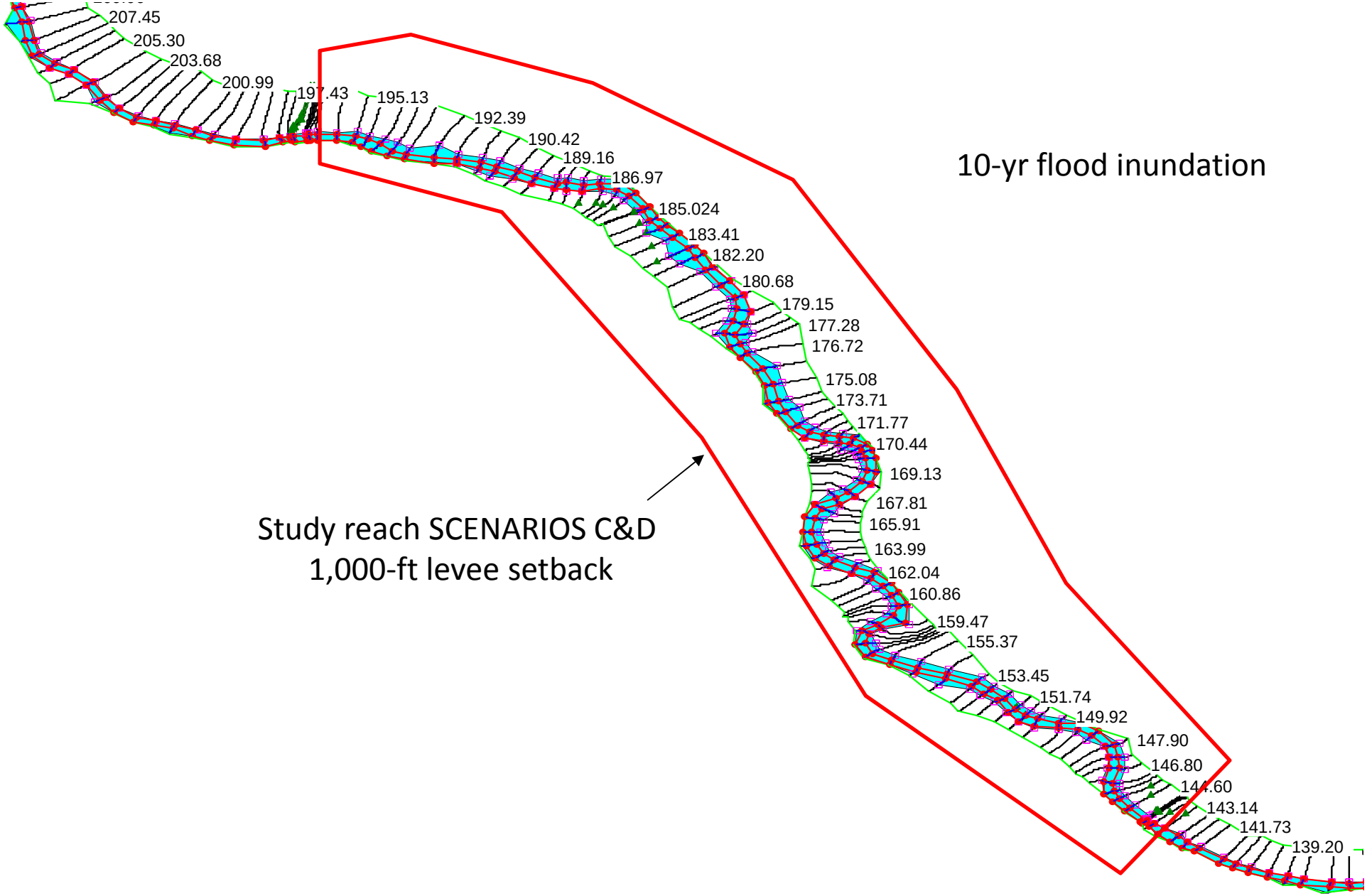

207.45
205.30
203.68
200.99
197.43
195.13
192.39
190.42
189.16
186.97
185.024
183.41
182.20
180.68
179.15
177.28
176.72
175.08
173.71
171.77
170.44
169.13
167.81
165.91
163.99
162.04
160.86
159.47
155.37
153.45
151.74
149.92
147.90
146.80
144.60
143.14
141.73
139.20
10-yr flood inundation
Study reach SCENARIO A
1992 conditions


207.45
205.30
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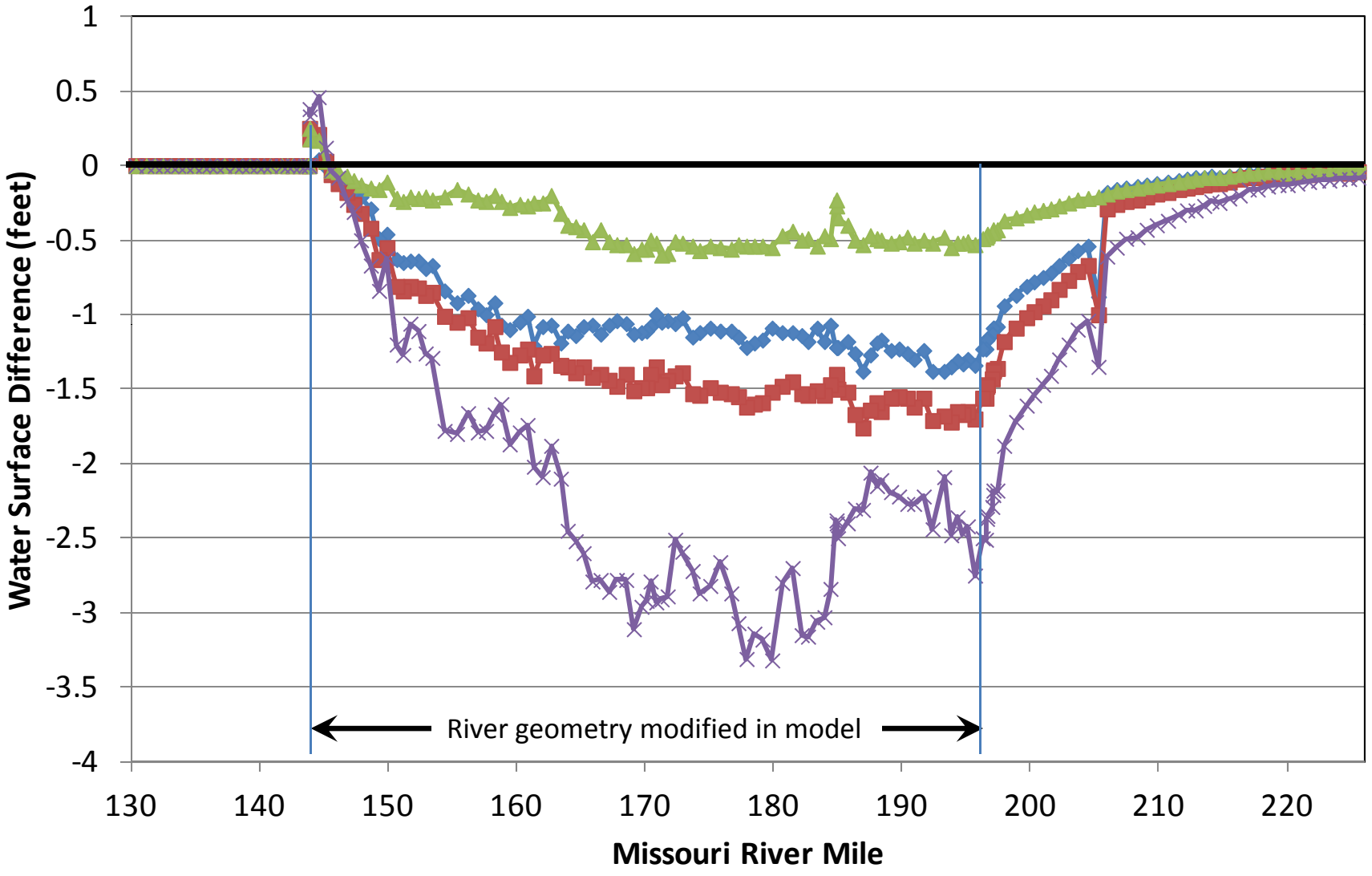
177.28
176.72
175.08
173.71
171.77
170.44
169.13
167.81
165.91
163.99
162.04
160.86
159.47
155.37
153.45
151.74
149.92
147.90
146.80
144.60
143.14
141.73
139.20
10-yr flood inundation
Study reach SCENARIOS C&D
1,000-ft levee setback

10-yr flood Scenarios vs. 1992 Model



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Questions?

Existing Conditions Model

Have completed habitat restoration projects changed river stages?

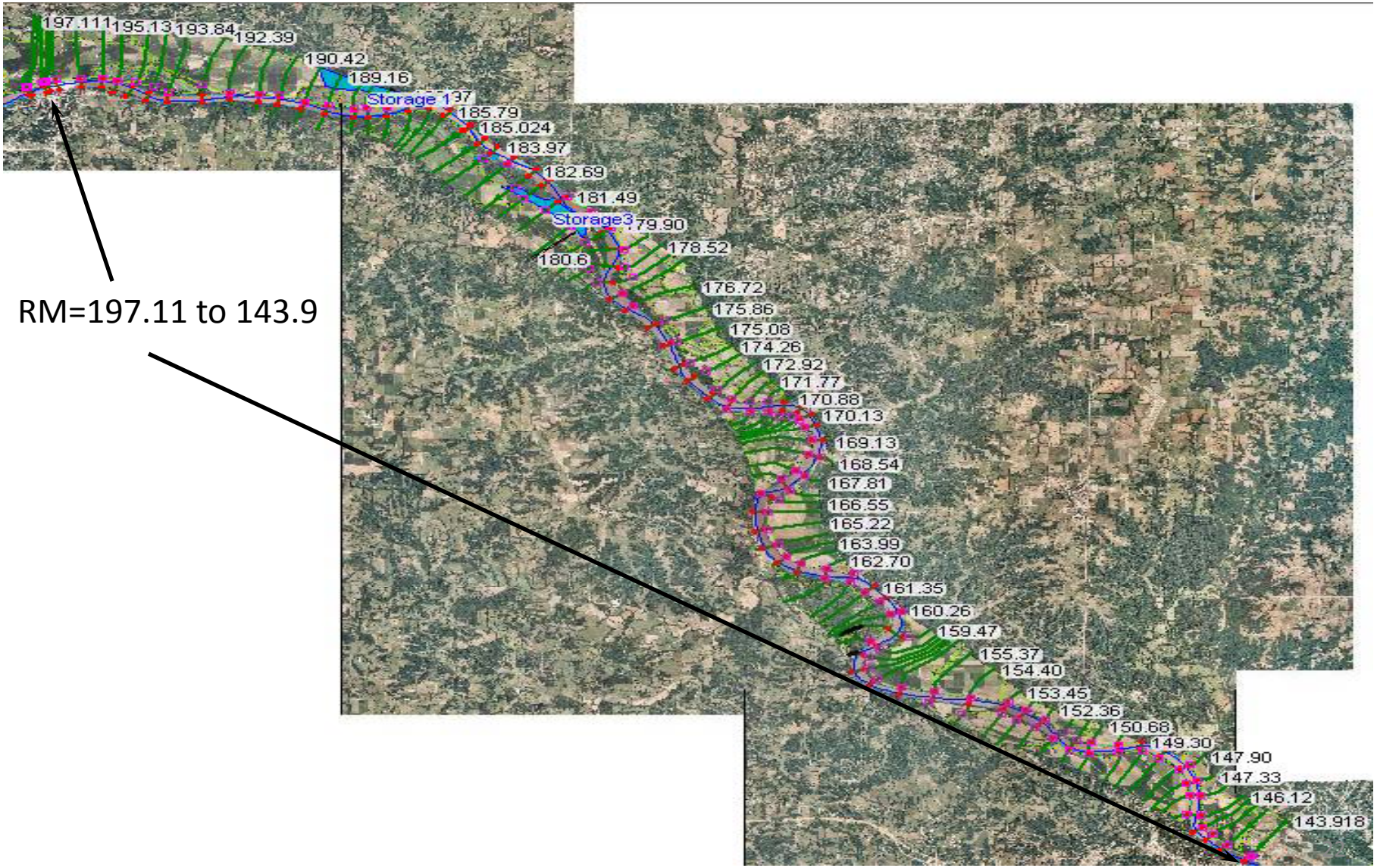
Unsteady Flow Model

- Modeled the 2007 flood event to investigate upstream and downstream effects

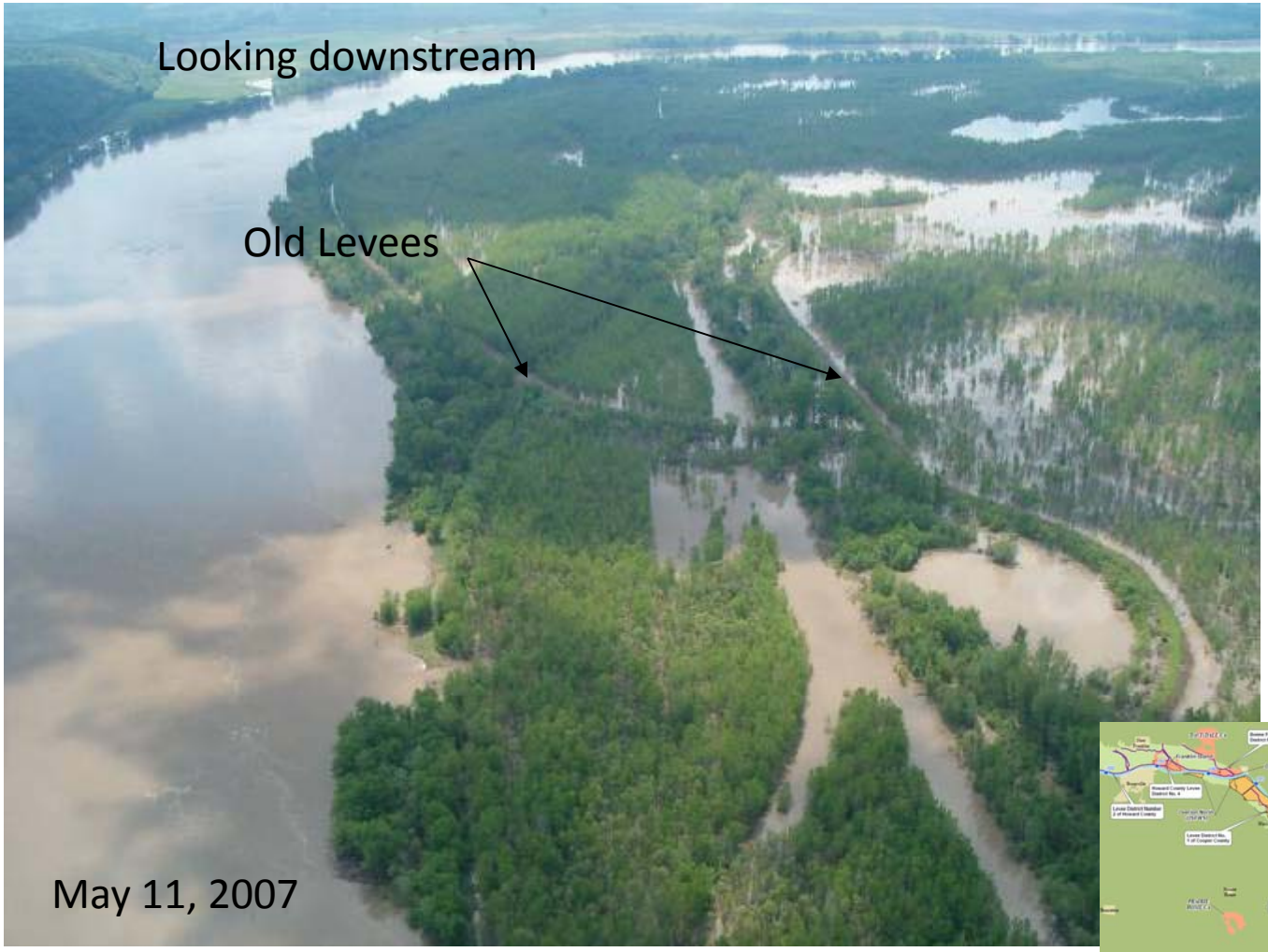
- Calibrated to the “existing conditions” geometry
  - USGS overbank flow measurements at Overton
  - Available high water marks and NWS gages

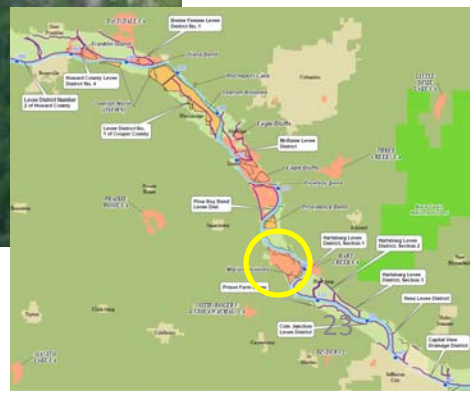
- Re-ran the 2007 flood with the 1992 geometry.

Study Area
Boonville- Jefferson City

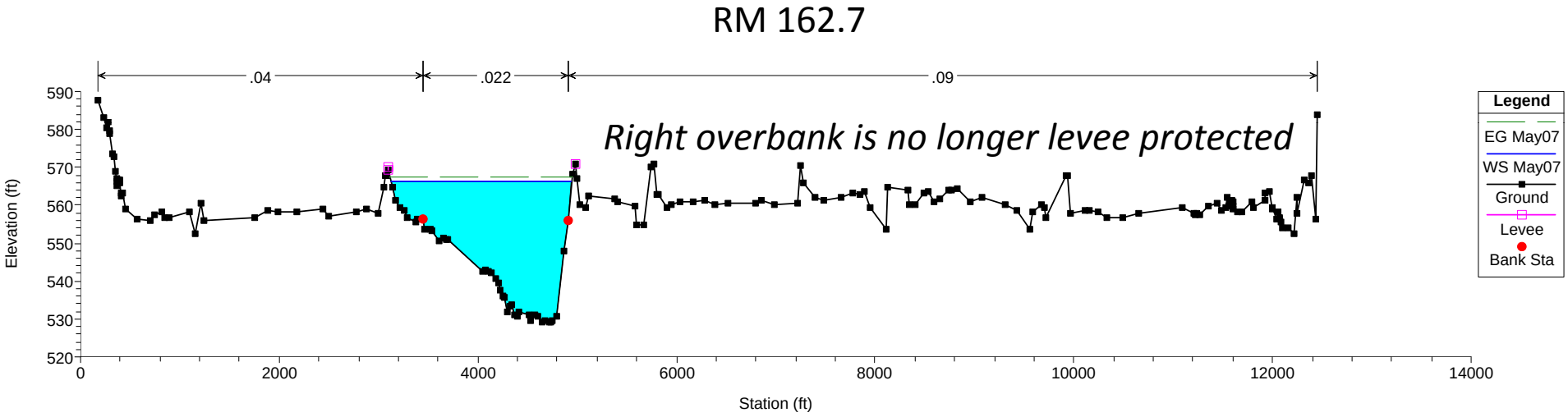


Marion Bottoms



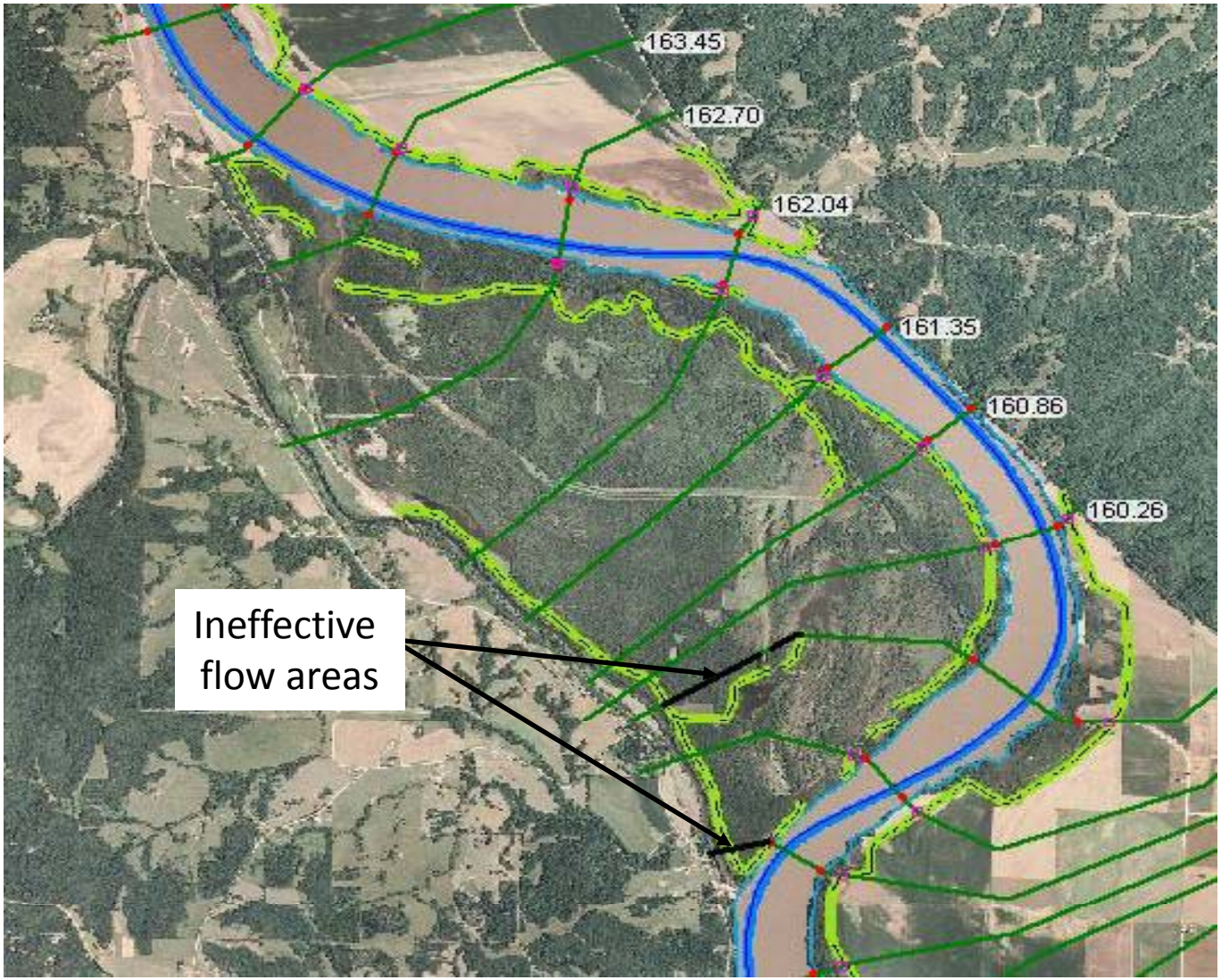


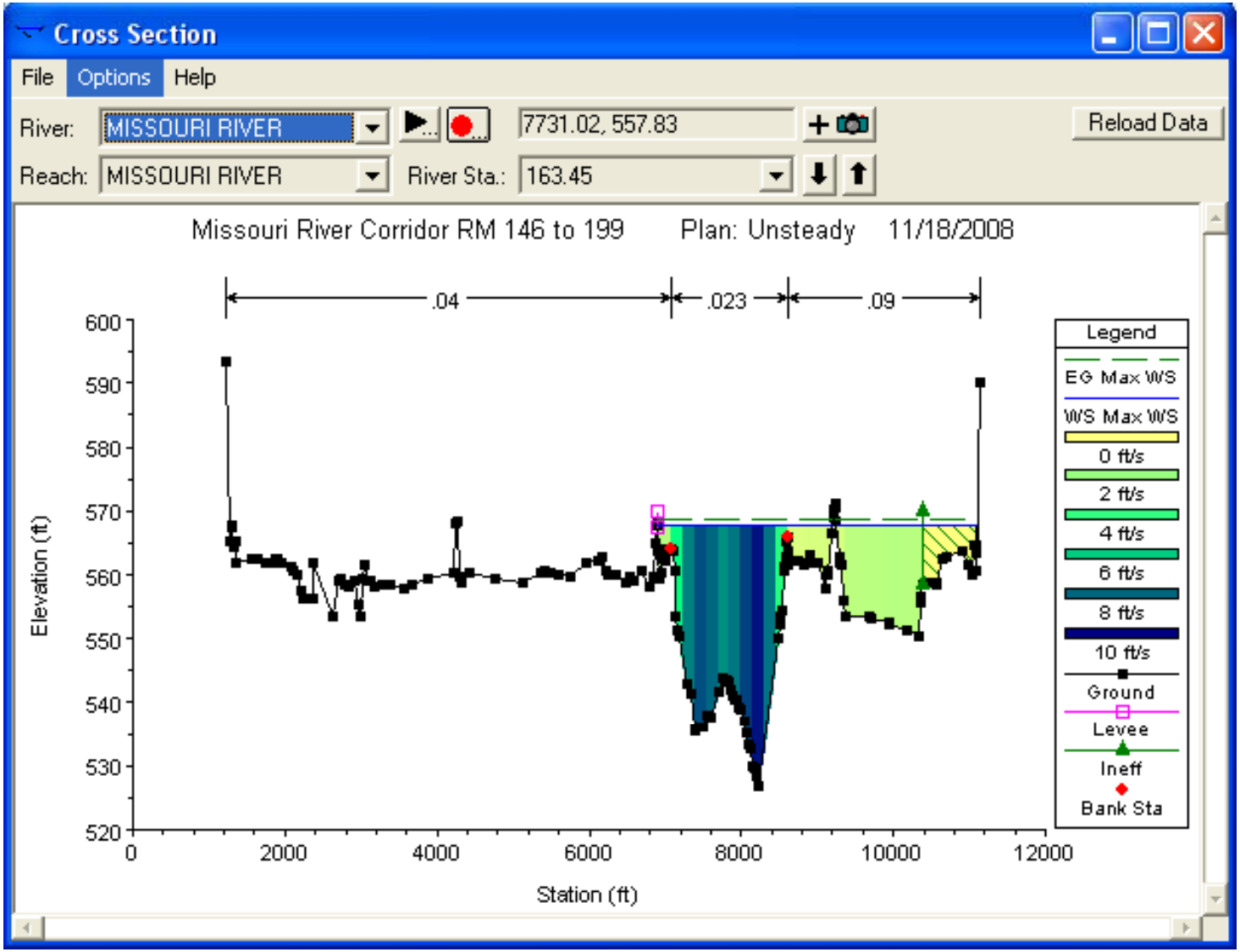
Marion Bottoms (MDC)



Scenario A – 1992 Conditions

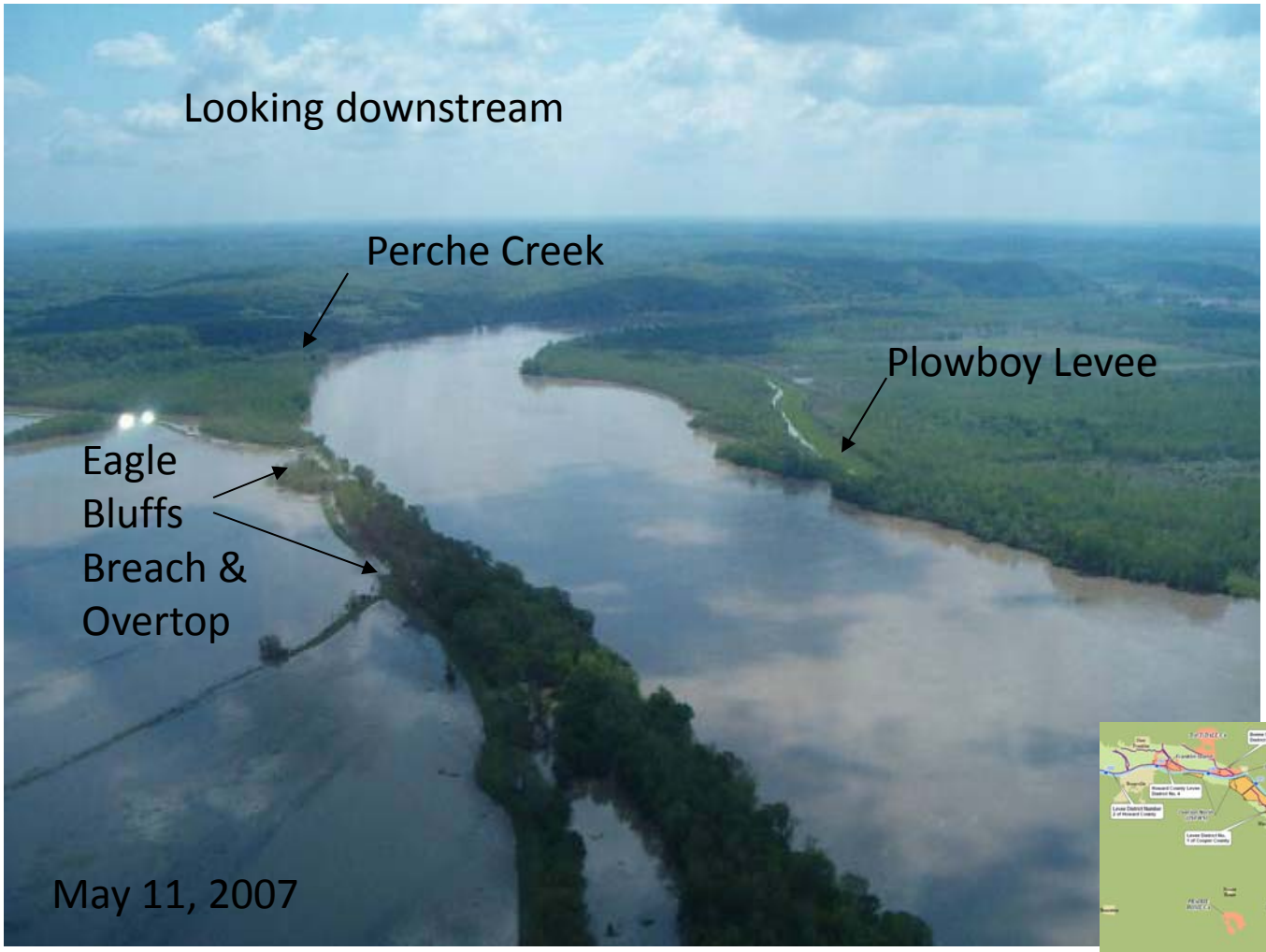
Modeling Broken Levees…




Cross Section
File
Options
Help
River:
MISSOURI RIVER
7731.02, 557.83
Reload Data
Reach:
MISSOURI RIVER
River Sta.:
163.45
Missouri River Corridor RM 146 to 199
Plan: Unsteady
11/18/2008
.04
.023
.09
Elevation (ft)
600
590
580
570
560
550
540
530
520
0
2000
4000
6000
8000
10000
12000
Station (ft)
Legend
EG Max WS
WS Max WS
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Levee
Ineff
Bank Sta

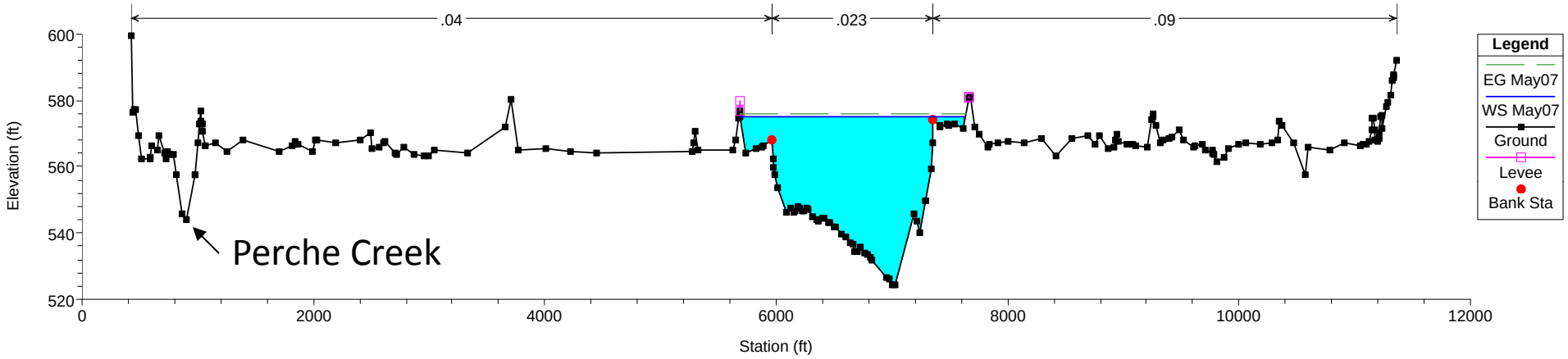
Plowboy / Eagle Bluffs

Plowboy / Eagle Bluffs

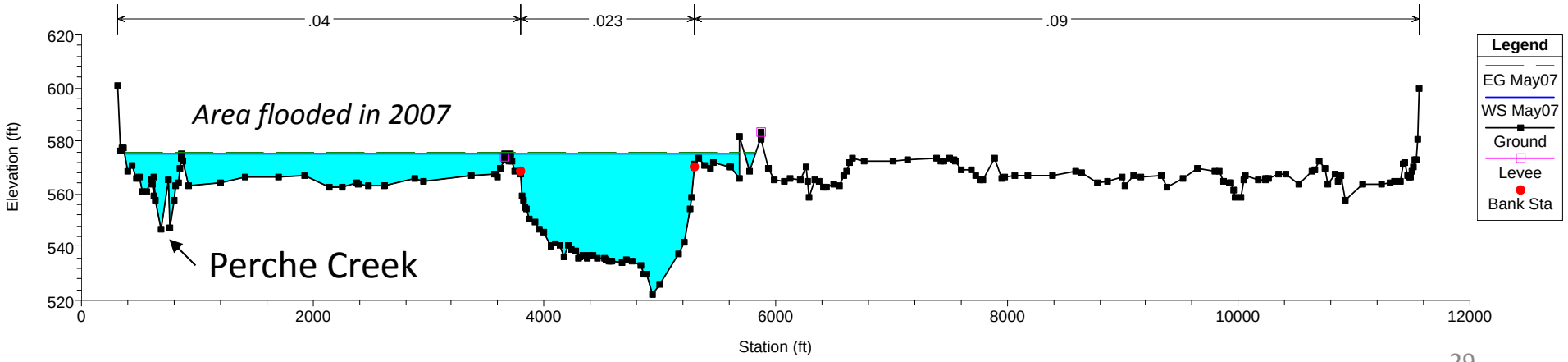


Plowboy / Eagle Bluffs

RM 171.8

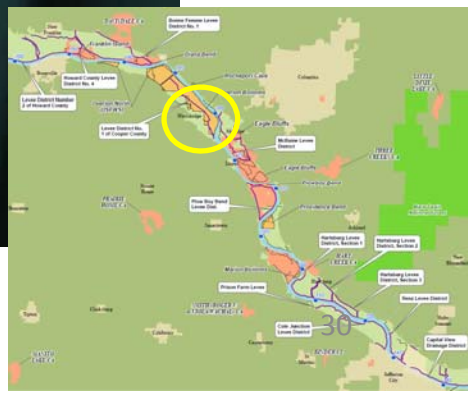


RM 171.3



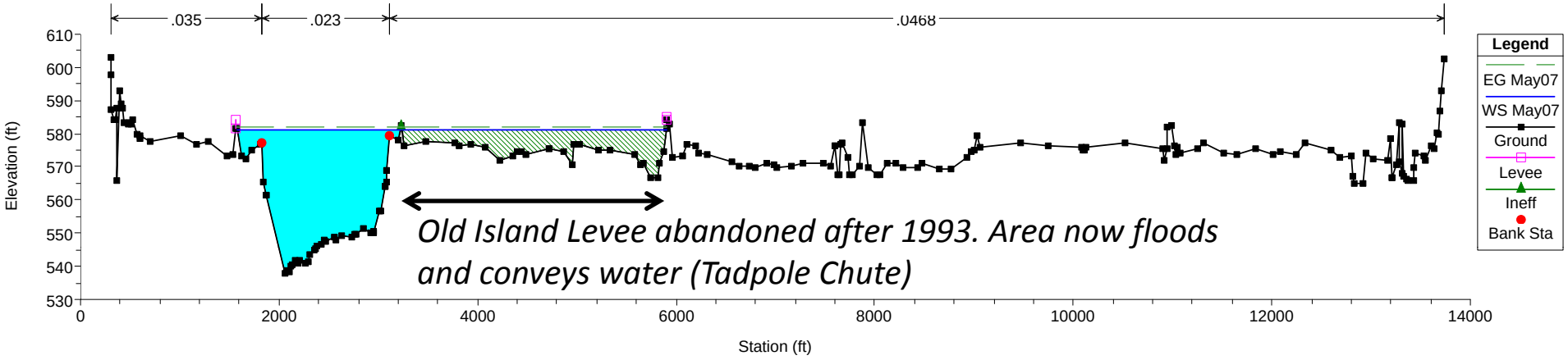
Scenario A – 1992 Conditions

Overton South

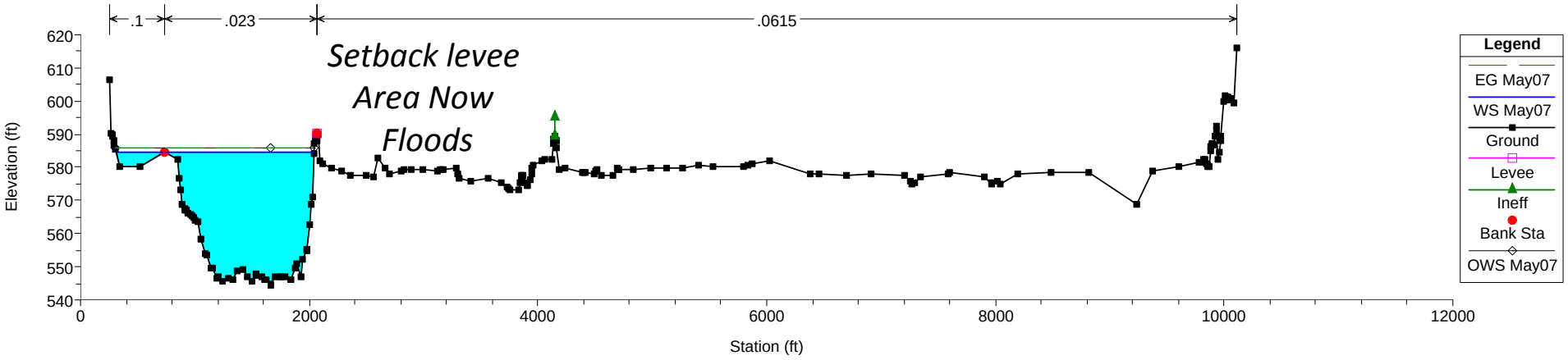


Overton South

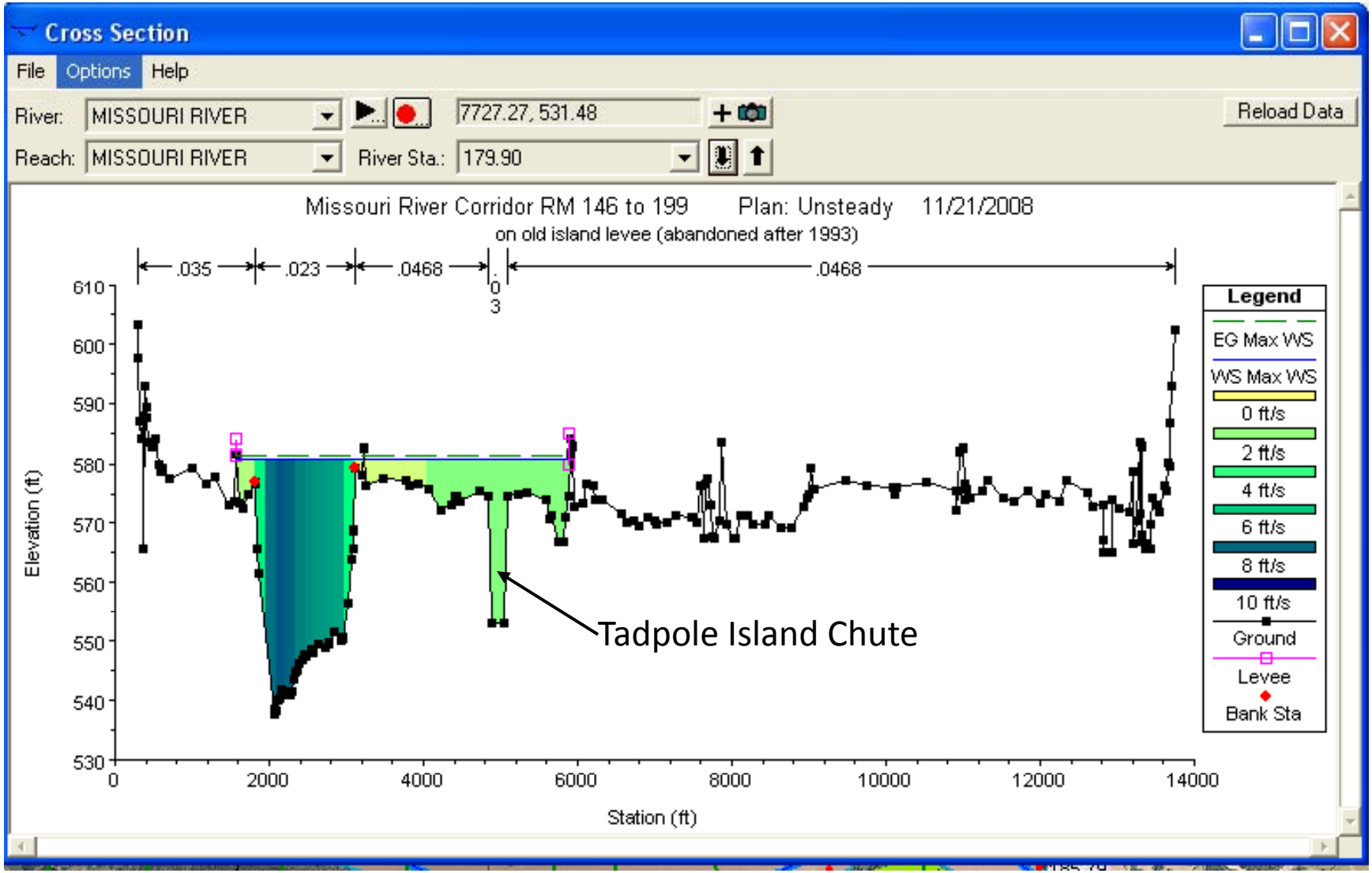
RM 179.9



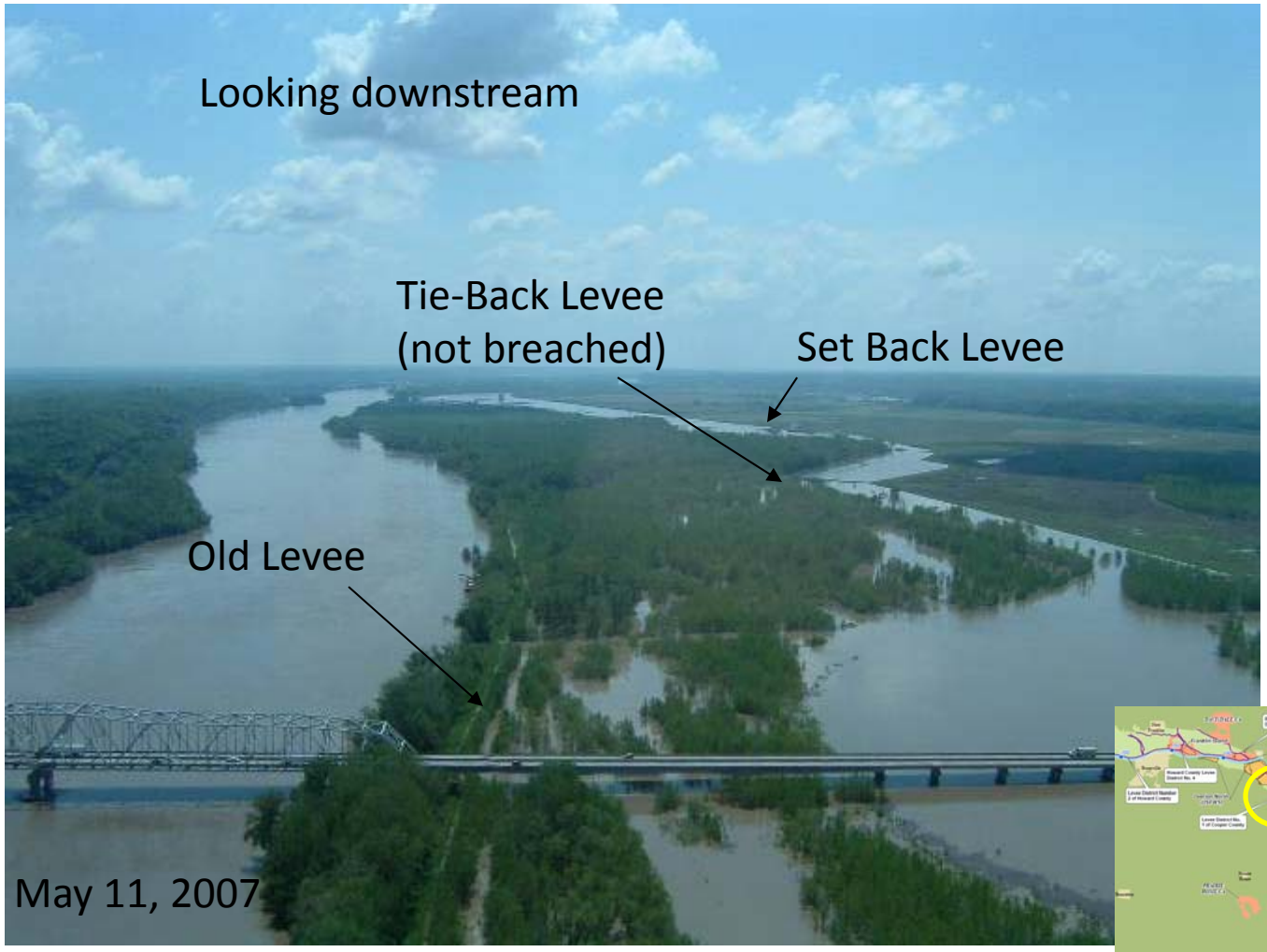
RM 184.5



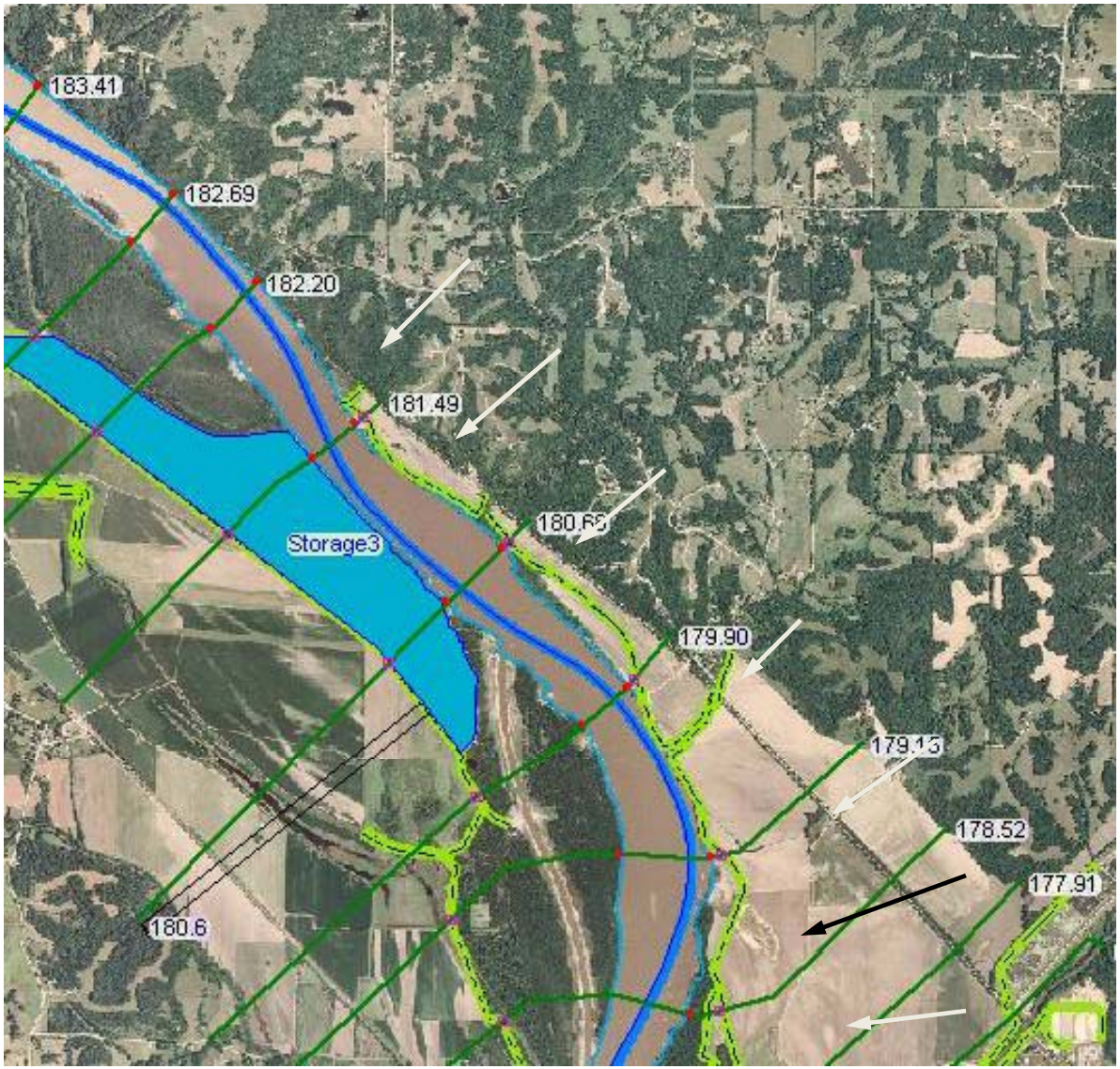
Scenario A – 1992 Conditions


Cross Section
File
Options
Help
River: MISSOURI RIVER
Reach: MISSOURI RIVER
River Sta.: 179.90
7727.27, 531.48
Reload Data
Missouri River Corridor RM 146 to 199 Plan: Unsteady 11/21/2008
on old island levee (abandoned after 1993)
.035
.023
.0468
.03
.0468
Elevation (ft)
610
600
590
580
570
560
550
540
530
0
2000
4000
6000
8000
10000
12000
14000
Station (ft)
Tadpole Island Chute
Legend
EG Max WS
WS Max WS
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Levee
Bank Sta

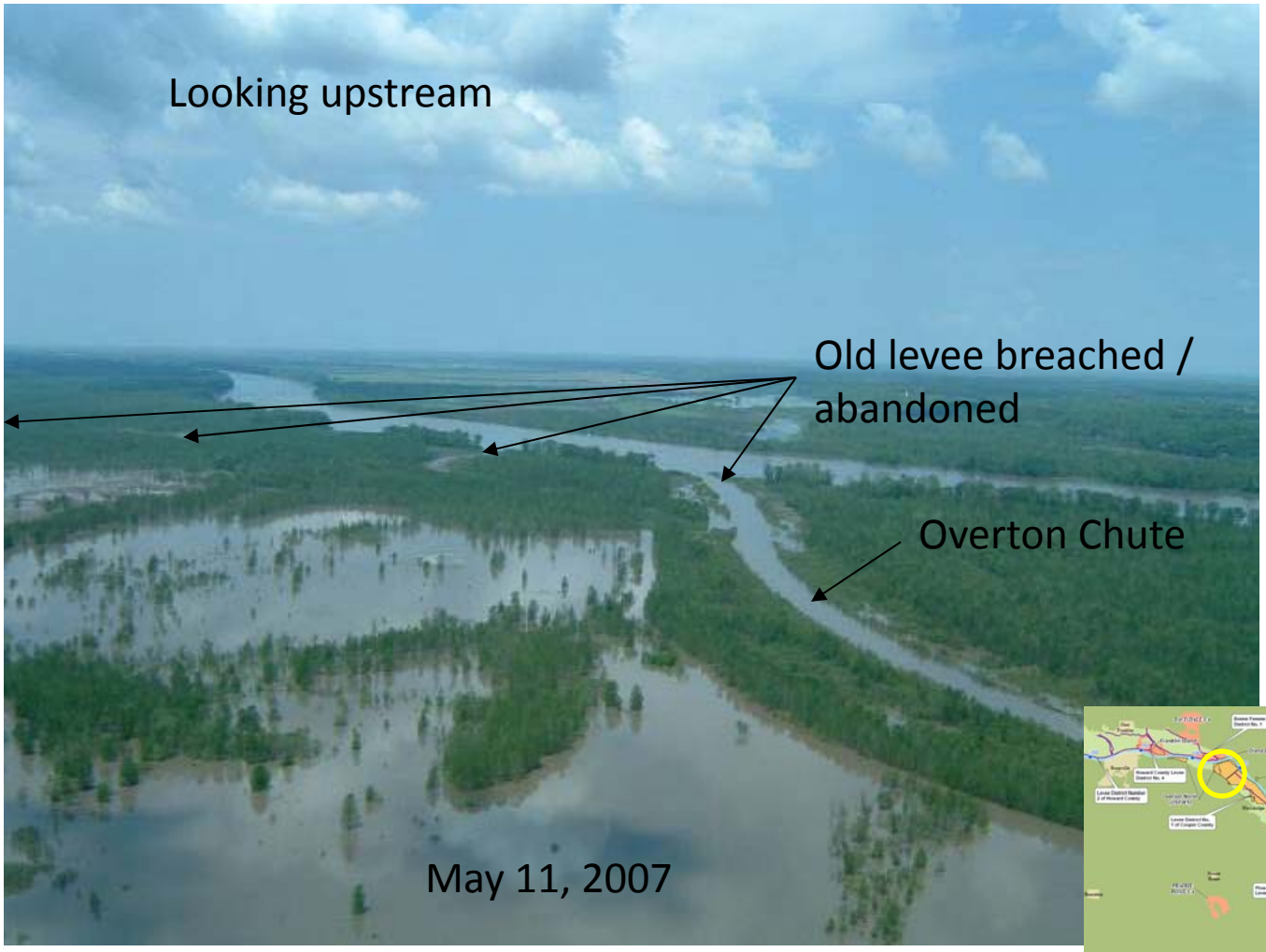
Overton South

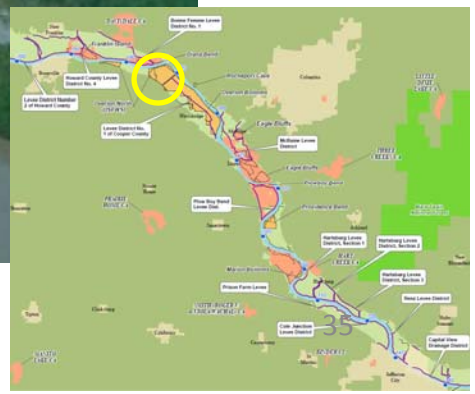


Levee set back storage area

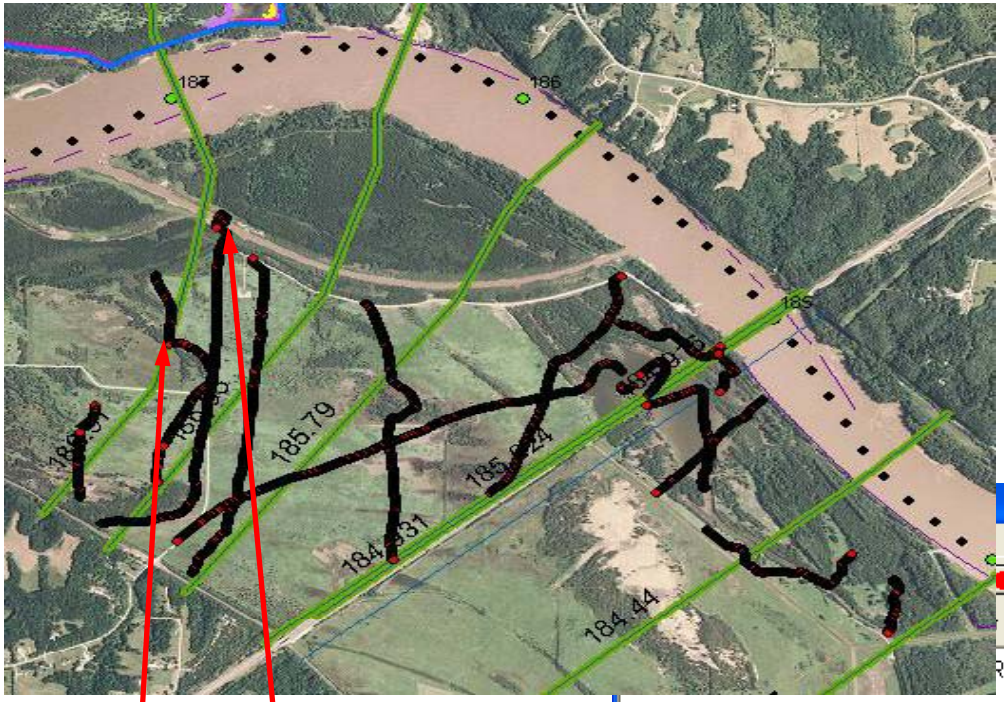


Overton North



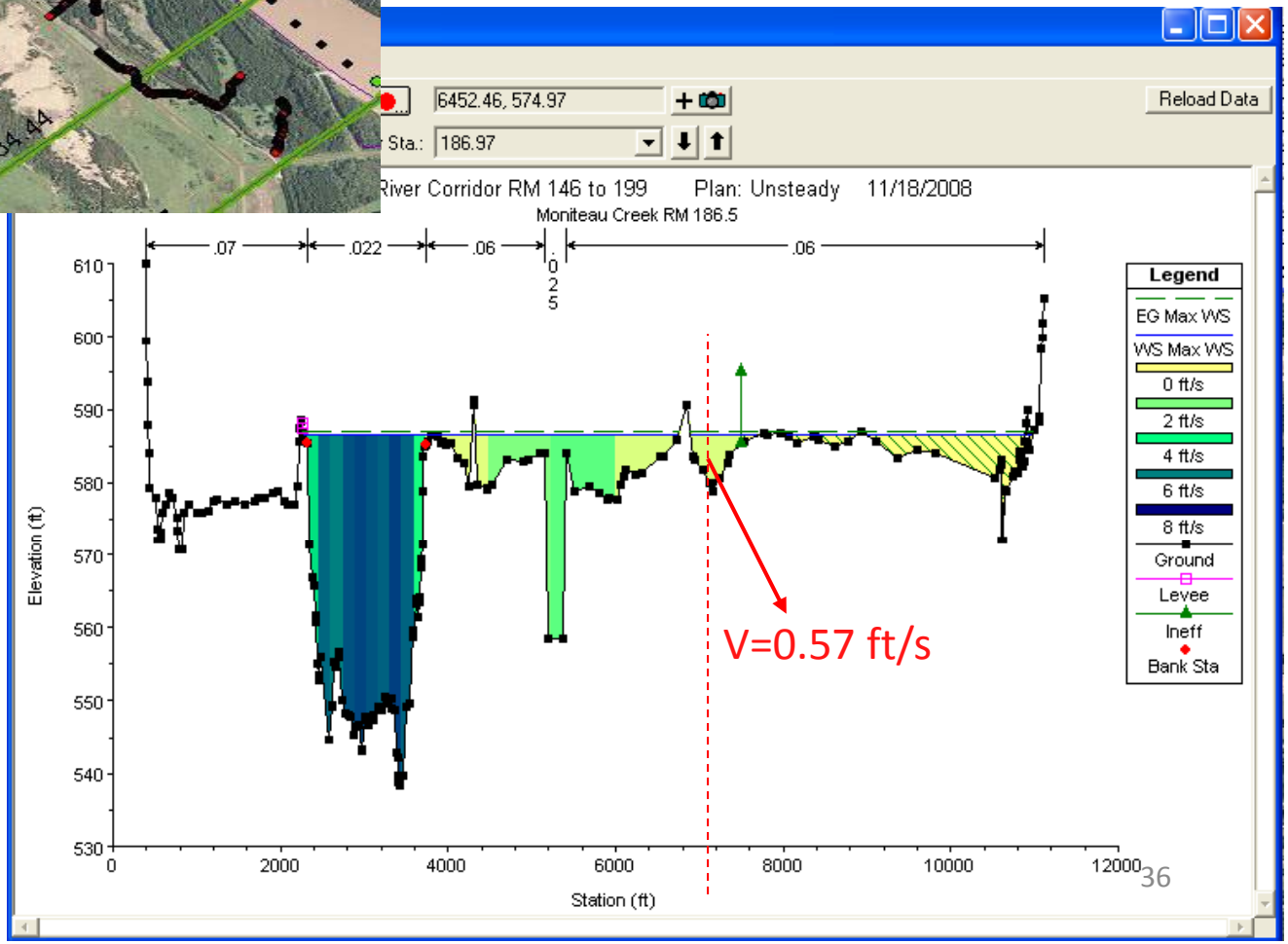


Velocity Calibration using USGS ADCP data from June 2007

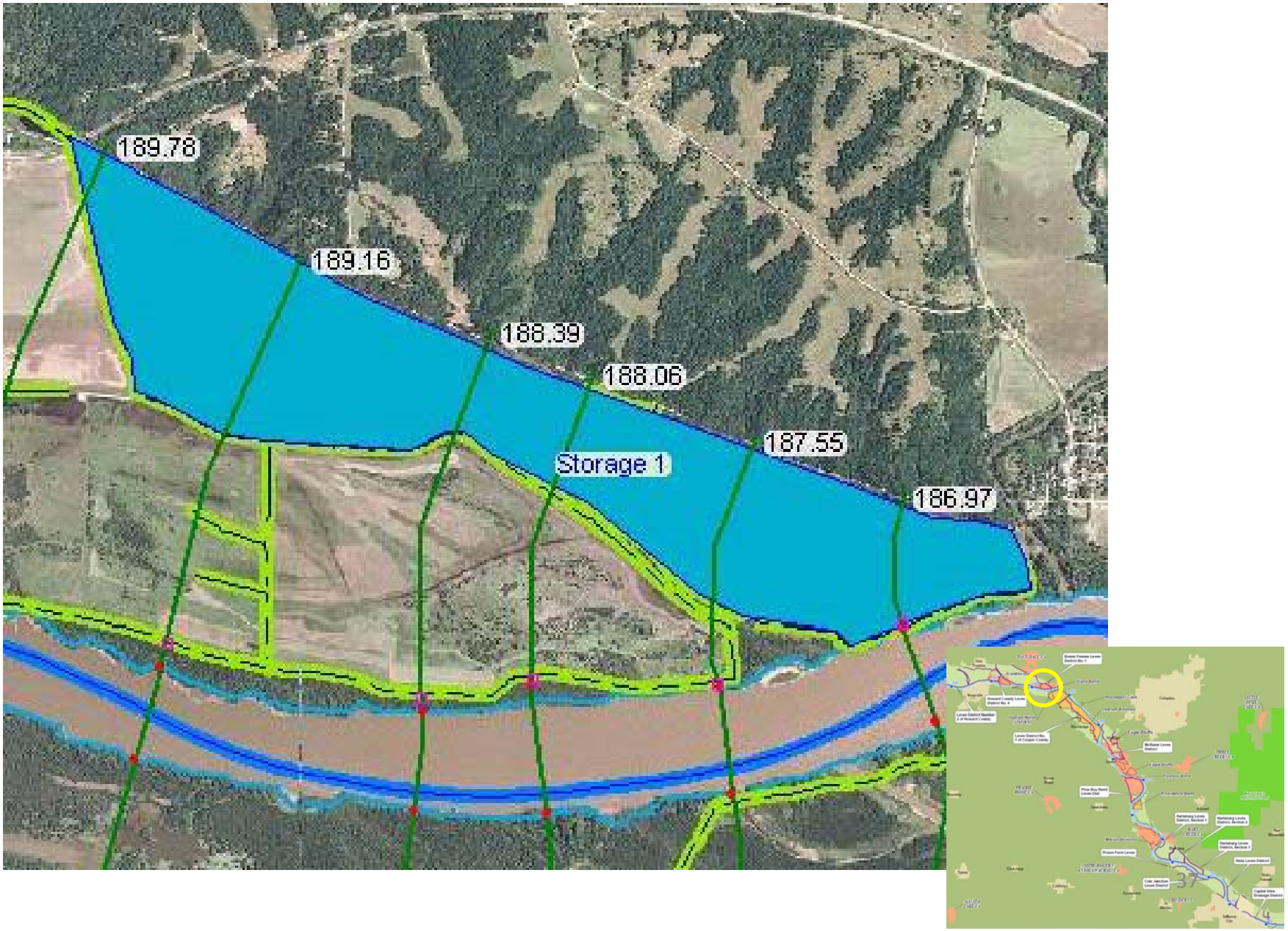


Chute flow measured

V=0.68 ft/s

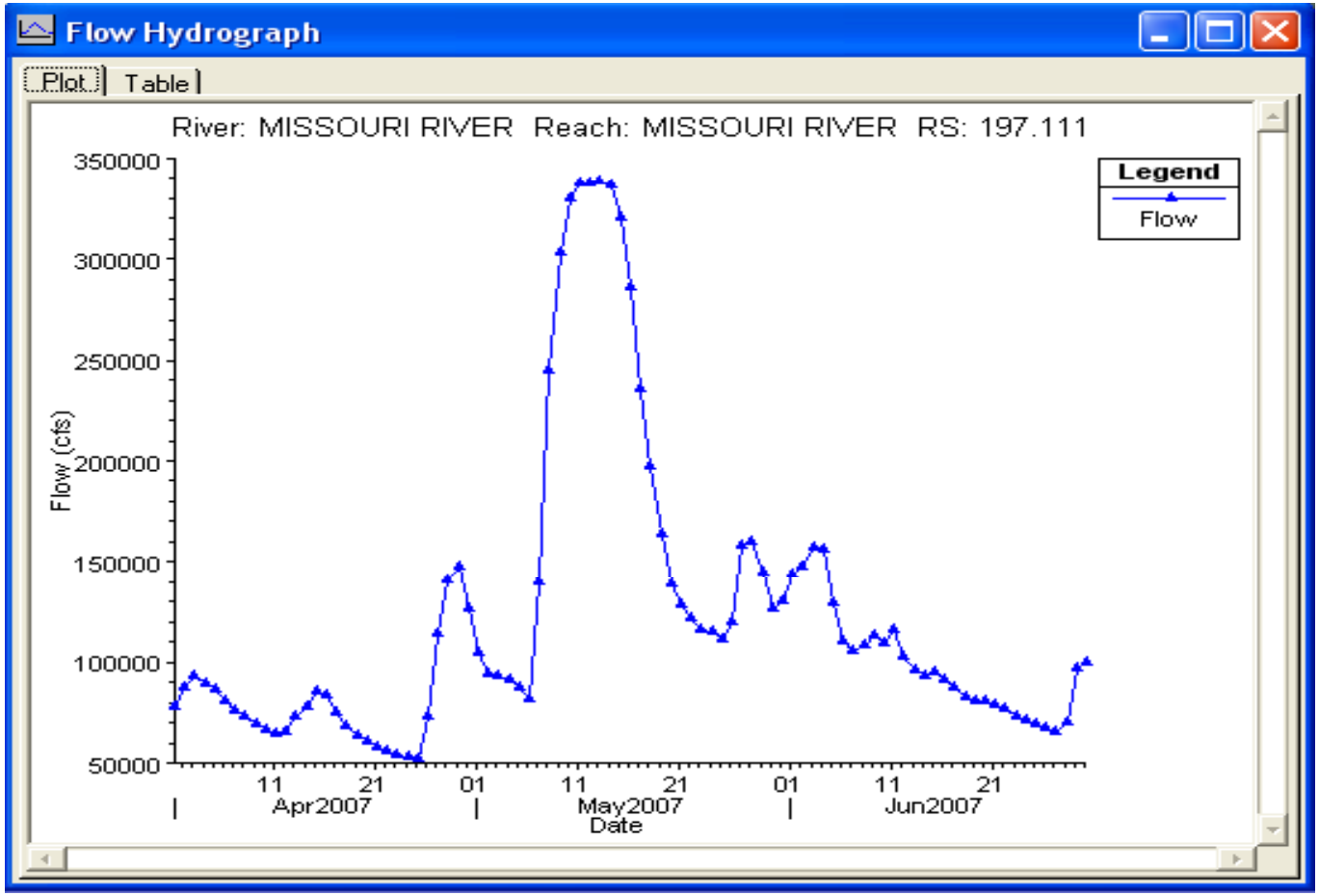


Diana Bend - Storage Area 1



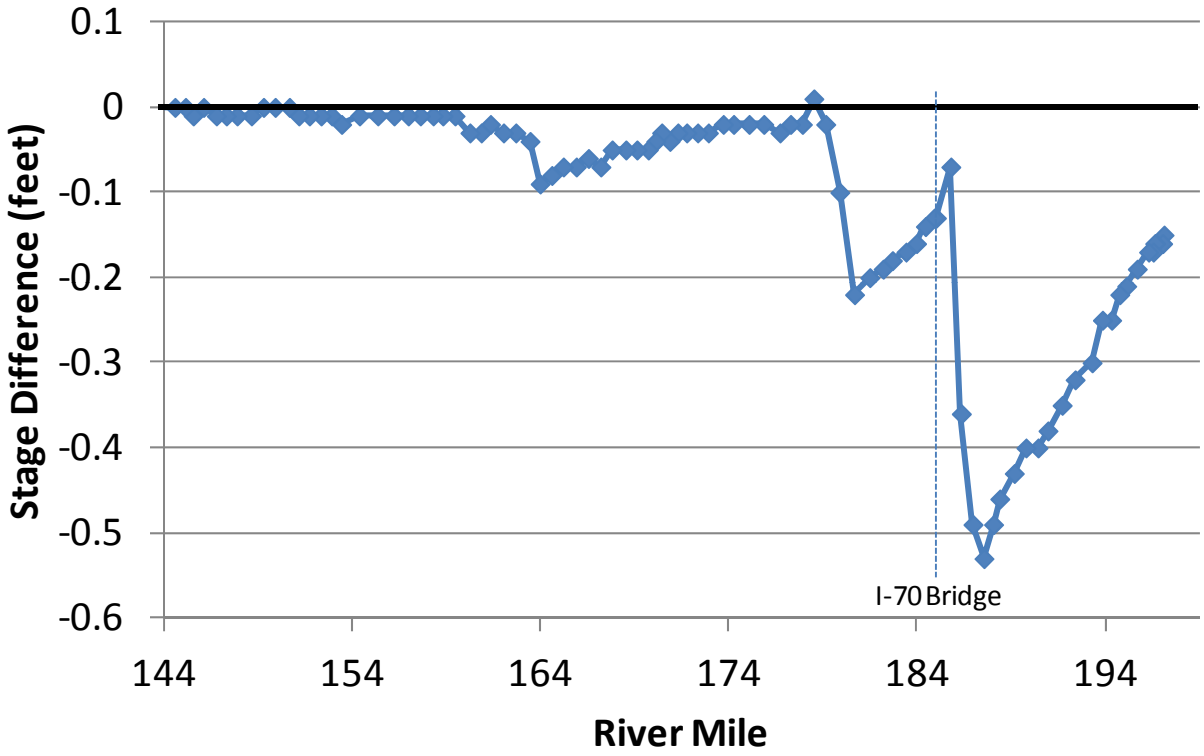
Unsteady Flow File

- Simplified Boundary Conditions to Test the Concept
  - Flow Hydrograph at Boonville
  - Stage Hydrograph at Jefferson City



Existing Condition Results

River Mile	Discharge difference (cfs)
197.1	0
196.6	0
-	-
-	-
144.6	-269
143.9	-269



Computed as Existing Conditions minus 1992
(negative values reflect decreases due to habitat sites)

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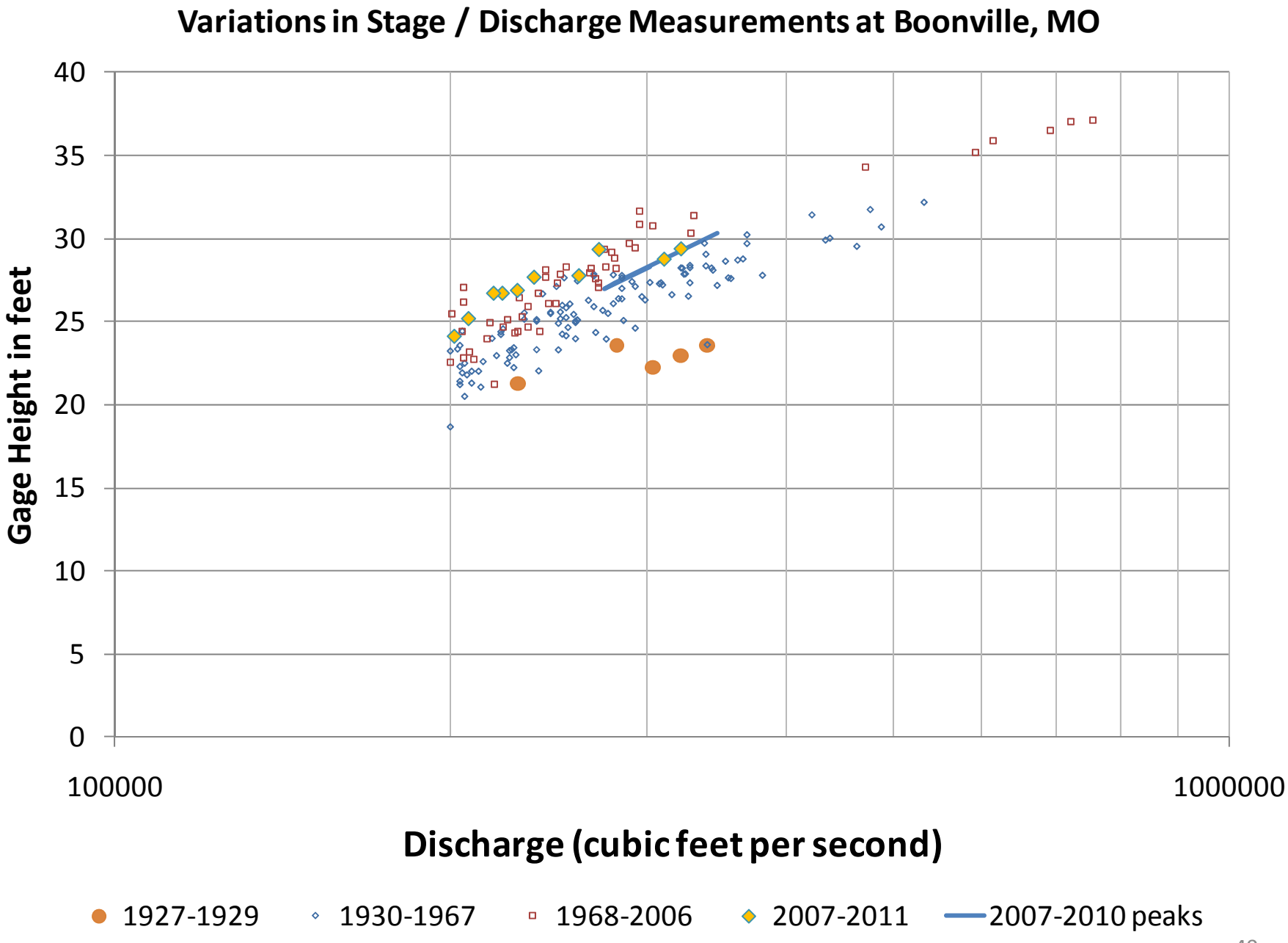
Variations in Stage / Discharge Measurements at Boonville, MO
Gage Height in feet
40
35
30
25
20
15
10
5
0
100000
1000000
Discharge (cubic feet per second)
1927-1929
1930-1967
1968-2006
2007-2011
2007-2010 peaks

The Models Show…

- River widening and levee setbacks can reduce river stages during small floods
- For the 2007 flood:
  - Downstream flow attenuation due to completed habitat projects was minor
  - Stage reductions less than 1-foot occurred at and upstream of completed habitat projects due to the added flow conveyance
- Results vary depending on amount of flow, type of action, etc.

Next Steps

- Consider / model reach-level habitat designs
  - Boonville to Jeff City
  - St Joe, Missouri to Omaha, Nebraska?
  - Waverly, Missouri Reach???
- Modeling objectives / public engagement strategy
- Consider future land cover and geometry changes

Questions?