1-D and 2-D Hydraulics Modeling for I-44 Outer Road Bridge over Gasconade River in Laclede County in Missouri

HNTB Presenters:
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Project Background

I-44 Outer Road (Historic Route 66) bridge over the Gasconade River

- Existing bridge is over 94 years old and closed since 2014
- Incident management route
- Access to the river and the recreational activities

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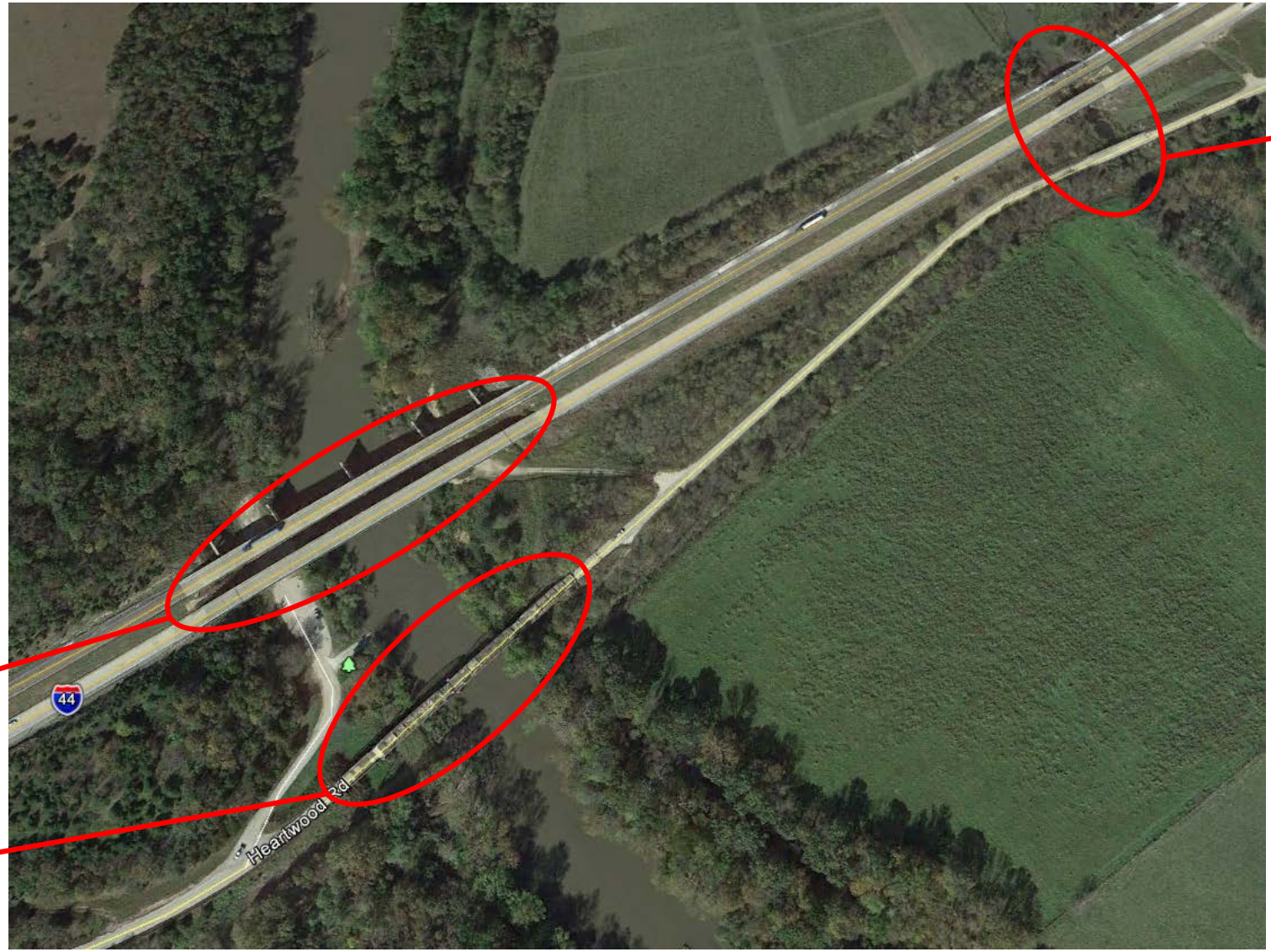
Project Location



Existing Overflow Bridges

Existing I-44 EB/WB Bridges over Gasconade River

Existing I-44 OR Bridge over Gasconade River

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Proposed I-44 OR Bridge

- 6-span continuous steel plate girder
- Special considerations for the East abutment

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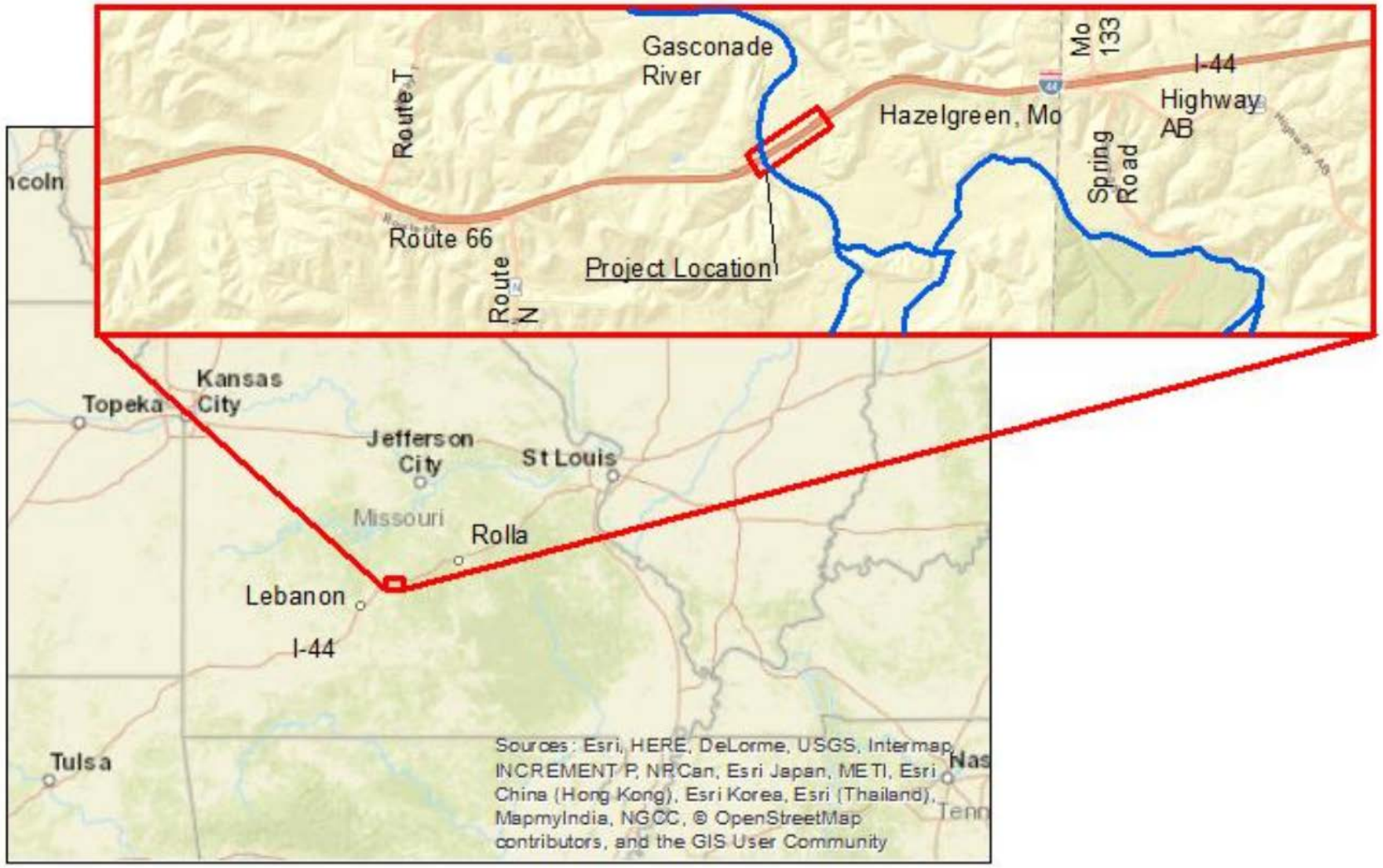

I-44 Overtopping

- Flooding history
- 2017 flood video (Thanks to Stacy McMillan, MoDOT)

1-D and 2-D Hydraulics Modeling for I-44 Outer Road Bridge

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Hydrology

- USGS Gauge Data
- Flood Frequency Analysis

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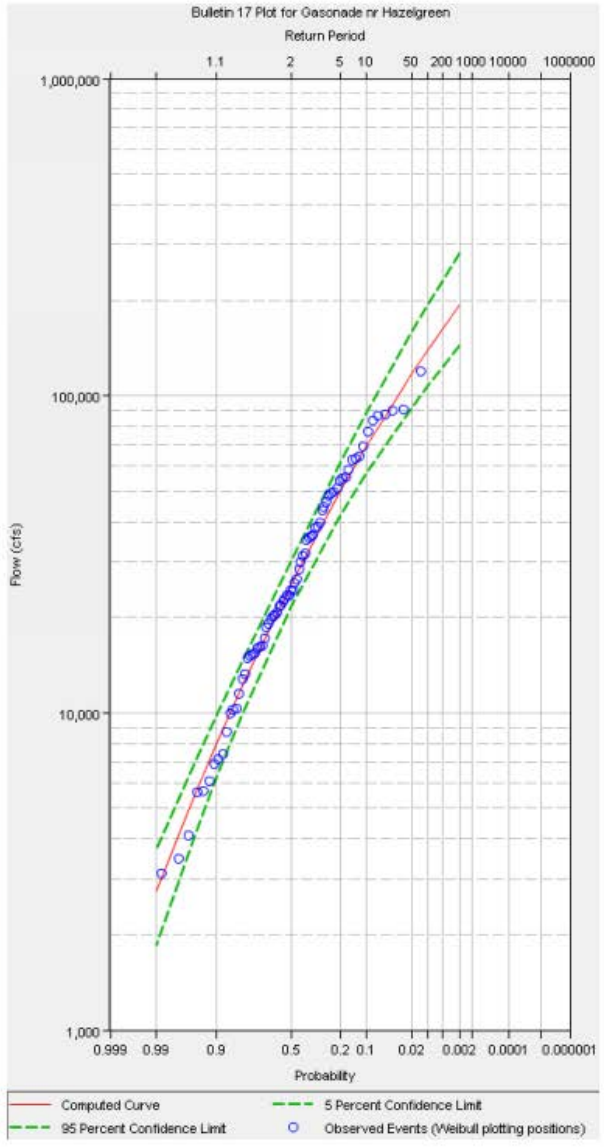
1-D and 2-D Hydraulics Modeling for I-44 Outer Road Bridge

Frequency Curve for: gasconade-Hazelgreen, MO-FLOW-ANNUAL PEAK			
Percent Chance Exceedance	Computed Curve Flow in cfs	Confidence Limits Flow in cfs	
		0.05	0.95
0.2	193838.5	281470.3	144527.6
0.5	162392.5	230066.0	123264.9
1.0	139484.8	193554.7	107468.3
2.0	117388.2	159198.2	91933.3
5.0	89493.8	117255.6	71796.2
10.0	69417.8	88274.1	56824.1
20.0	50189.8	61731.2	41952.4
50.0	25606.1	30220.8	21738.0
80.0	12163.9	14529.8	9916.2
90.0	8005.2	9827.1	6249.1
95.0	5579.3	7059.7	4167.5
99.0	2727.4	3701.4	1848.1

Statistics	
Log Transform: Flow	
Statistic	Value
Mean	4.386
Standard Dev	0.368
Station Skew	-0.396
Regional Skew	-0.300
Weighted Skew	-0.357
Adopted Skew	-0.357

Number of Events	
Event	Number
Historic Events	0
High Outliers	0
Low Outliers	0
Zero Or Missing	0
Systematic Events	73
Historic Period	

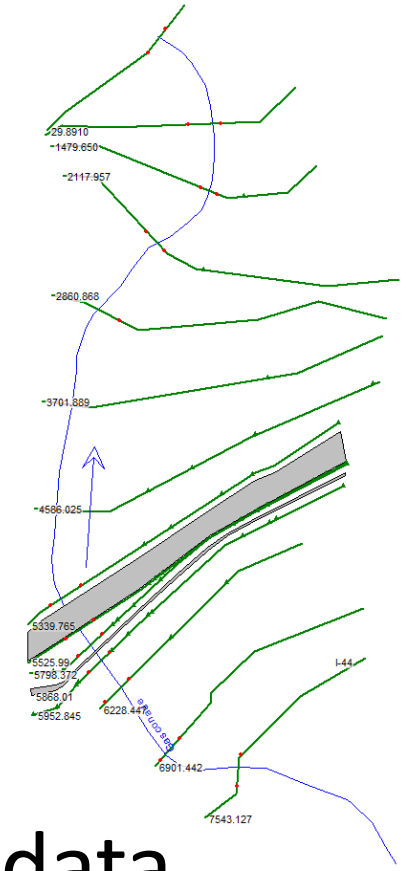


1-D and 2-D Hydraulics Modeling for I-44 Outer Road Bridge

Period	Data Range	# of Peaks	Computed Curve Discharges in cfs			# of Annual Peaks	
			50-Yr	100-Yr	500-Yr	< 15K cfs	> 61K cfs
1	1915 - 1950	24	138,000	168,000	242,000	6	4
2	1915 - 1960	34	120,000	145,000	209,000	9	4
3	1915 - 1970	44	103,000	122,000	167,000	12	4
4	1915 - 1980	53	98,900	117,000	161,000	15	4
5	1915 - 1990	56	102,000	121,000	168,000	16	5
6	1915 - 2010	66	101,000	119,000	162,000	17	6
7	1915 - 2016	72	110,000	130,000	178,000	18	10
8	1915 - 2017	73	117,000	139,000	194,000	18	11

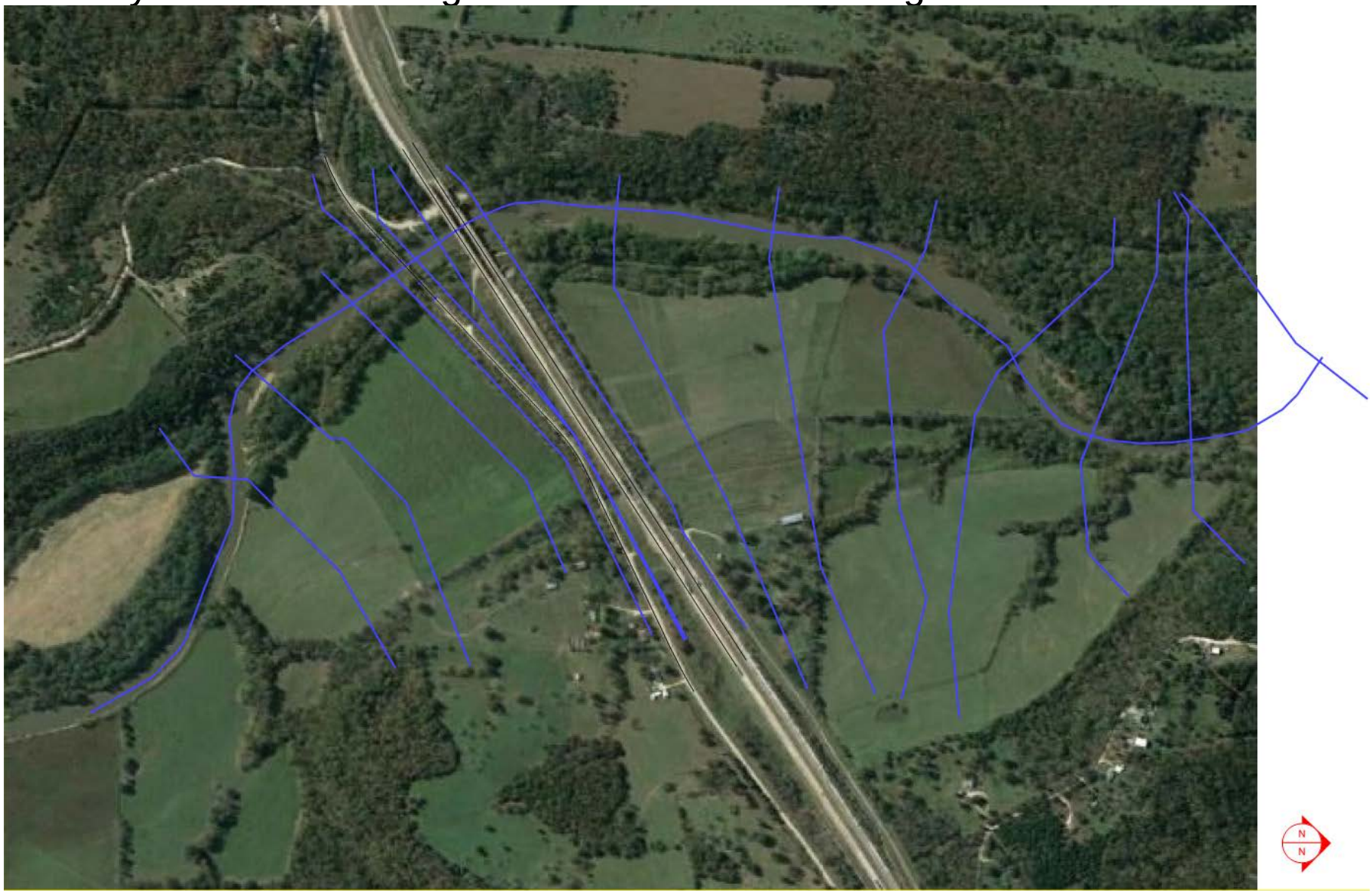
1D HEC-RAS River Analysis

- Cross section layout and data source
- Manning's n-values
- Boundary conditions
- Multiple bridge opening analysis
- Calibration to high water marks and gauge data



1-D and 2-D Hydraulics Modeling for I-44 Outer Road Bridge

HEC-RAS Cross Section Layout



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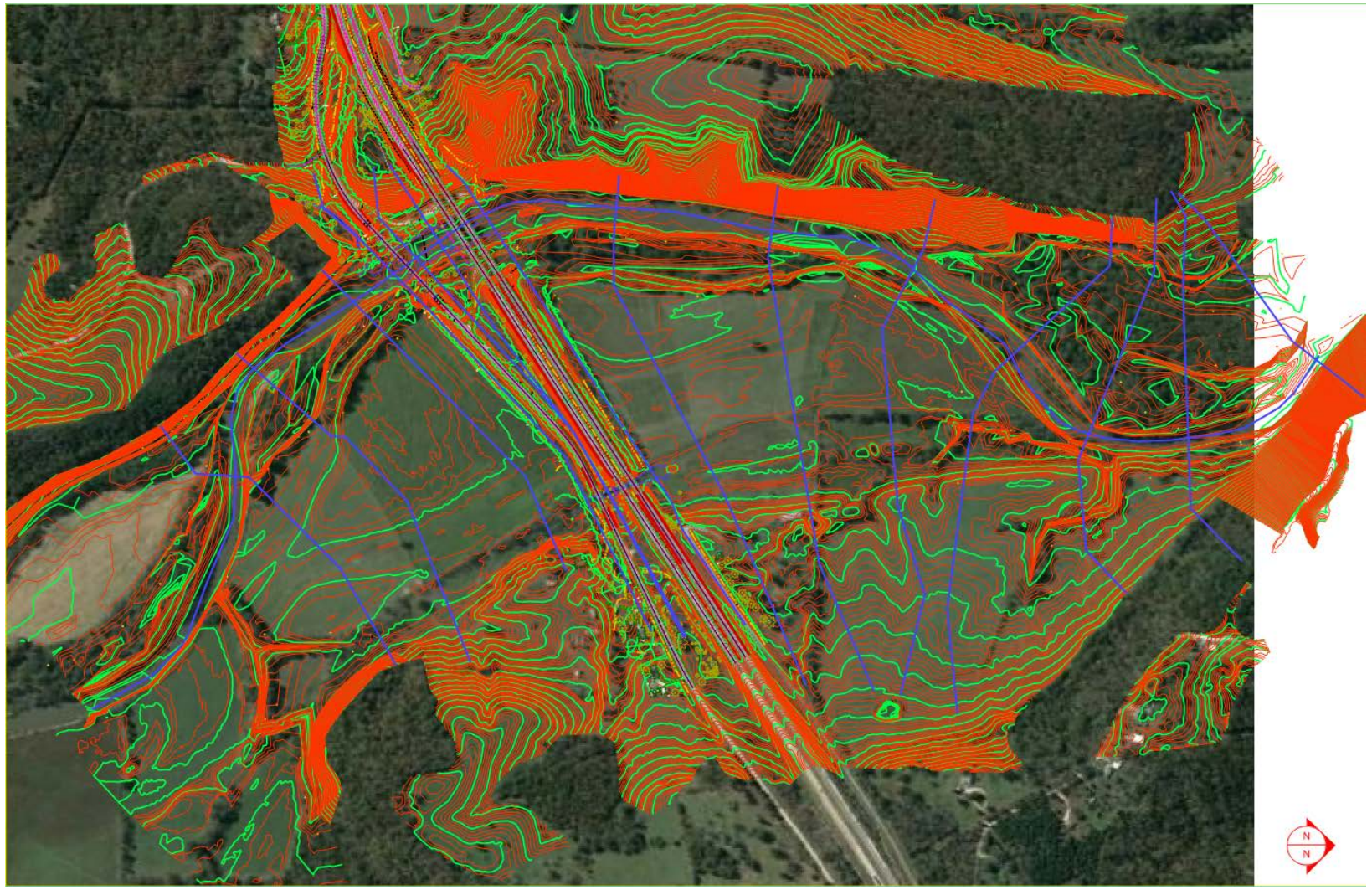

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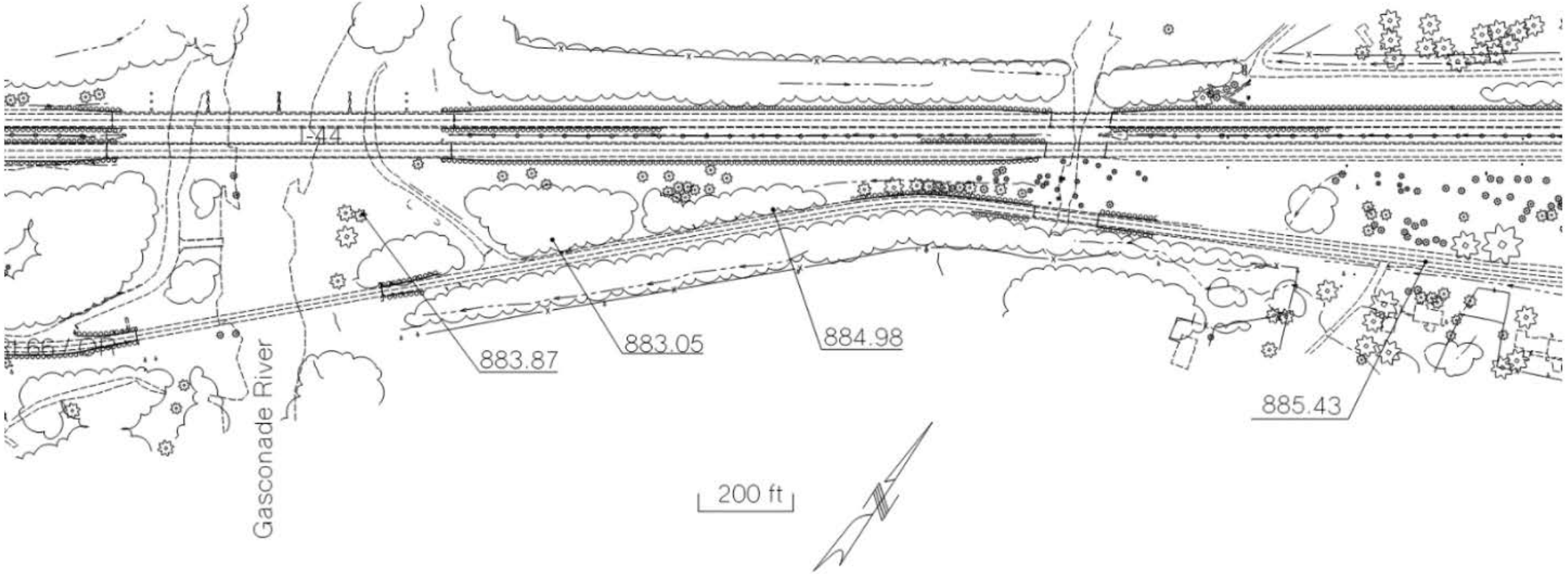

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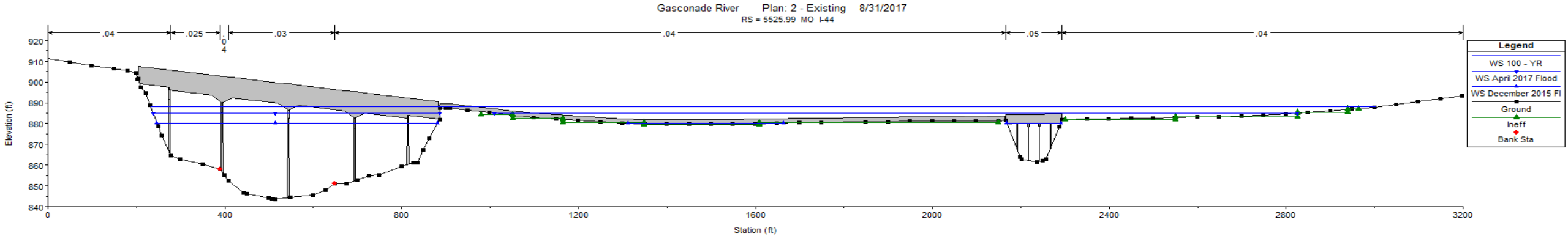

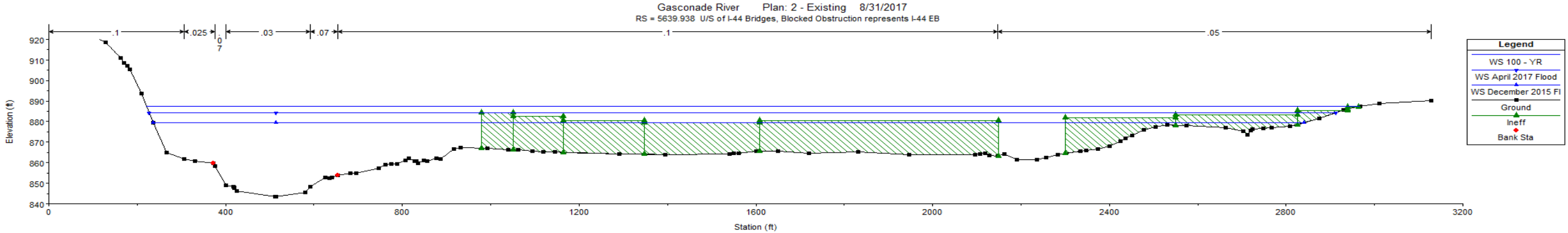

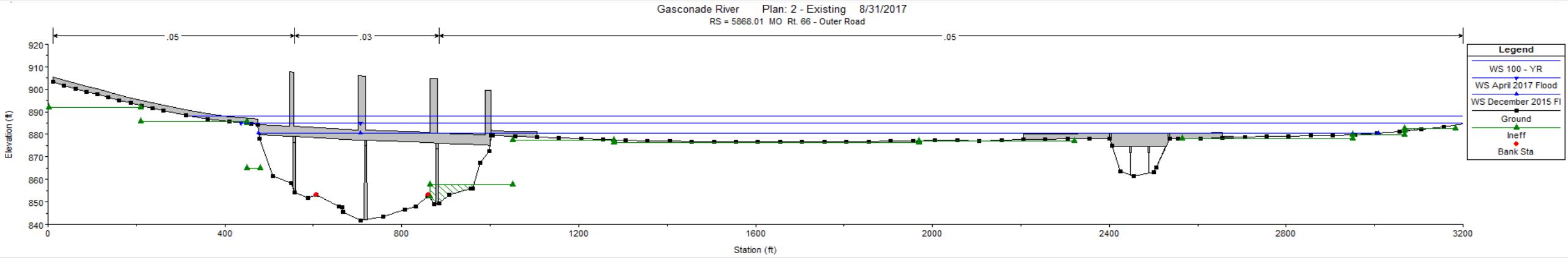

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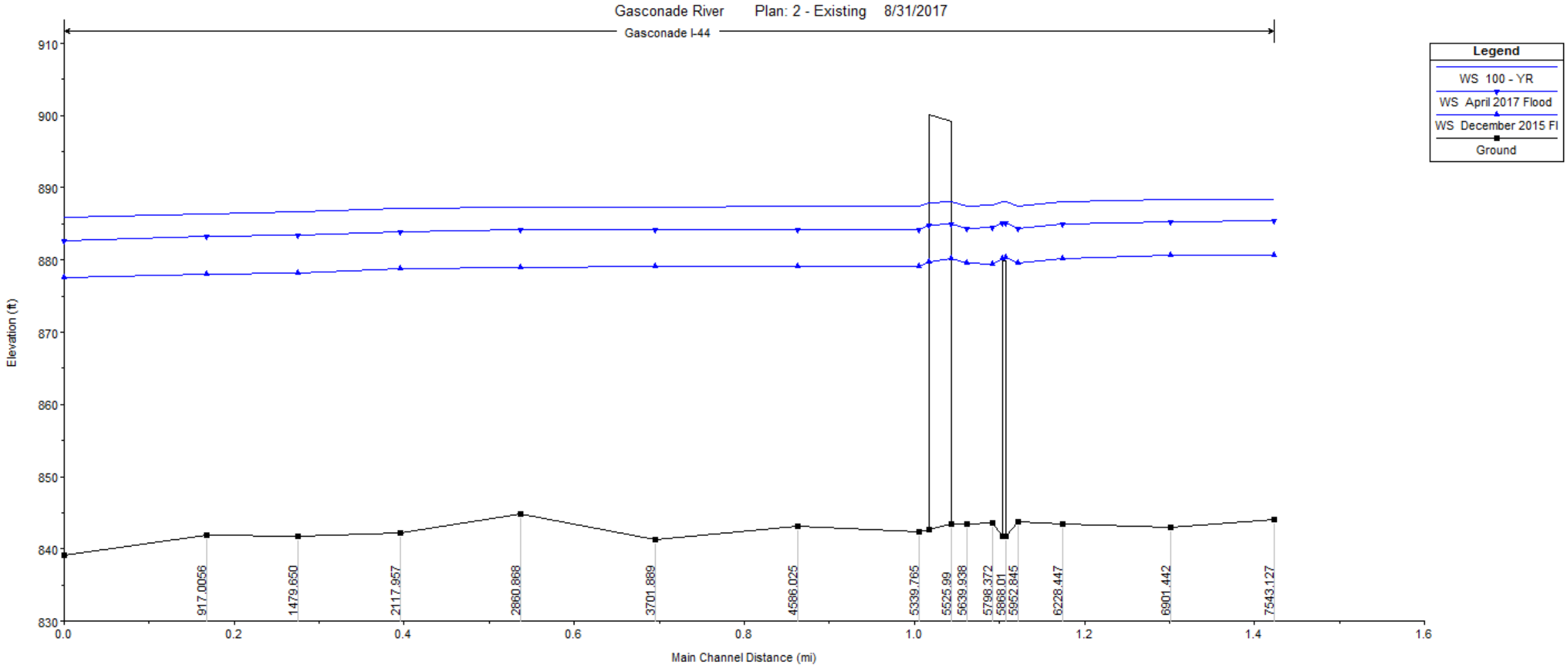
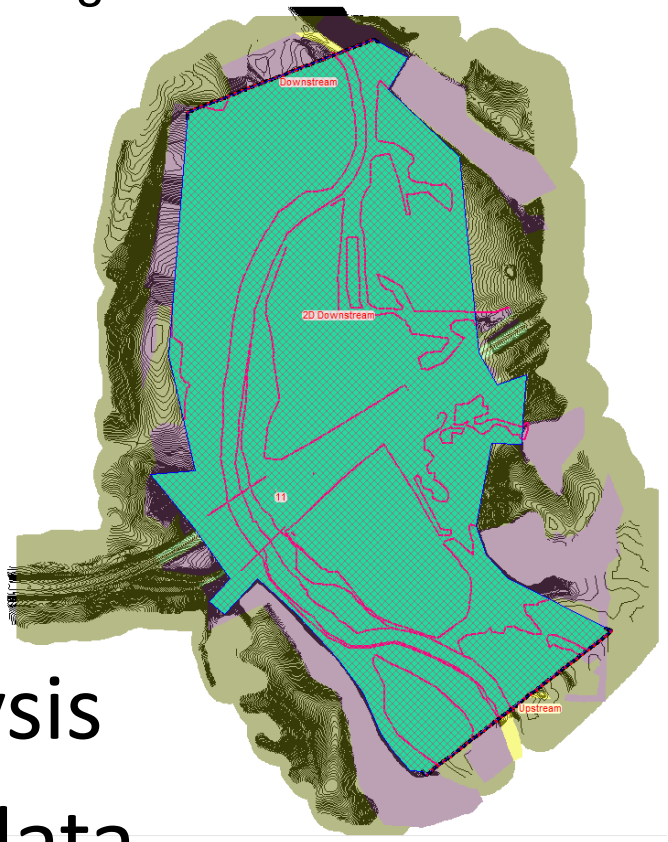


2D HEC-RAS River Analysis

- Topography and grid
- Manning's n-values
- Hydrograph and boundary conditions
- Bridge opening & roadway overflow analysis
- Calibration to high water marks & gauge data
- Comparison to 1D model results

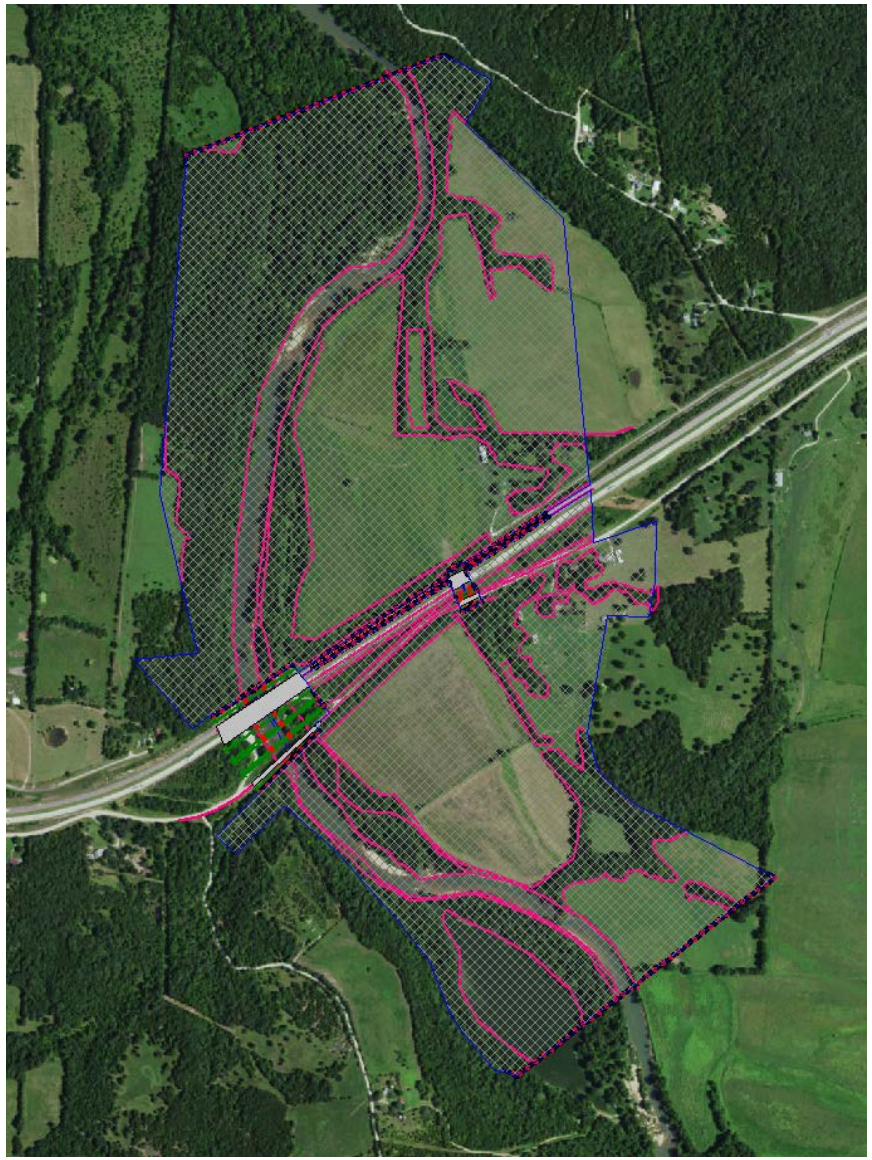


1-D and 2-D Hydraulics Modeling for I-44 Outer Road Bridge

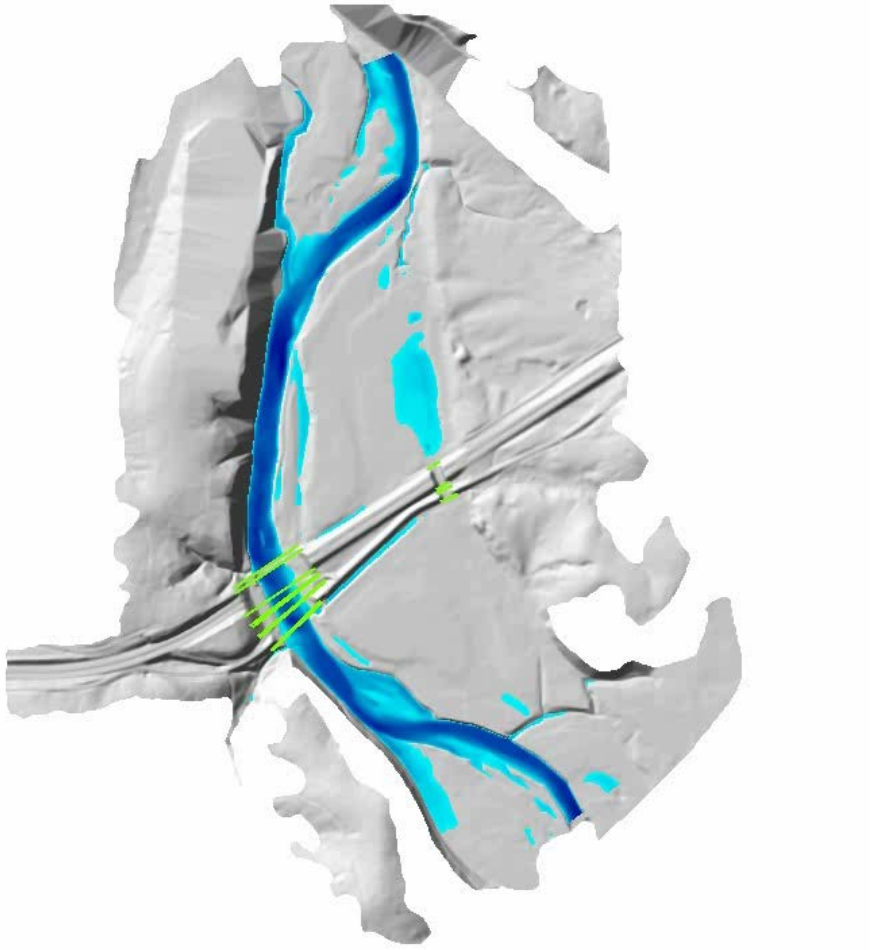
- No Countywide LiDAR
- Ground Survey + Project Photogrammetry
- Data Conversion from GeoPak to GIS

1-D and 2-D Hydraulics Modeling for I-44 Outer Road Bridge

- 2D Grid Extents
- Breaklines
- 1D Bridges



HEC-RAS 2D Animation



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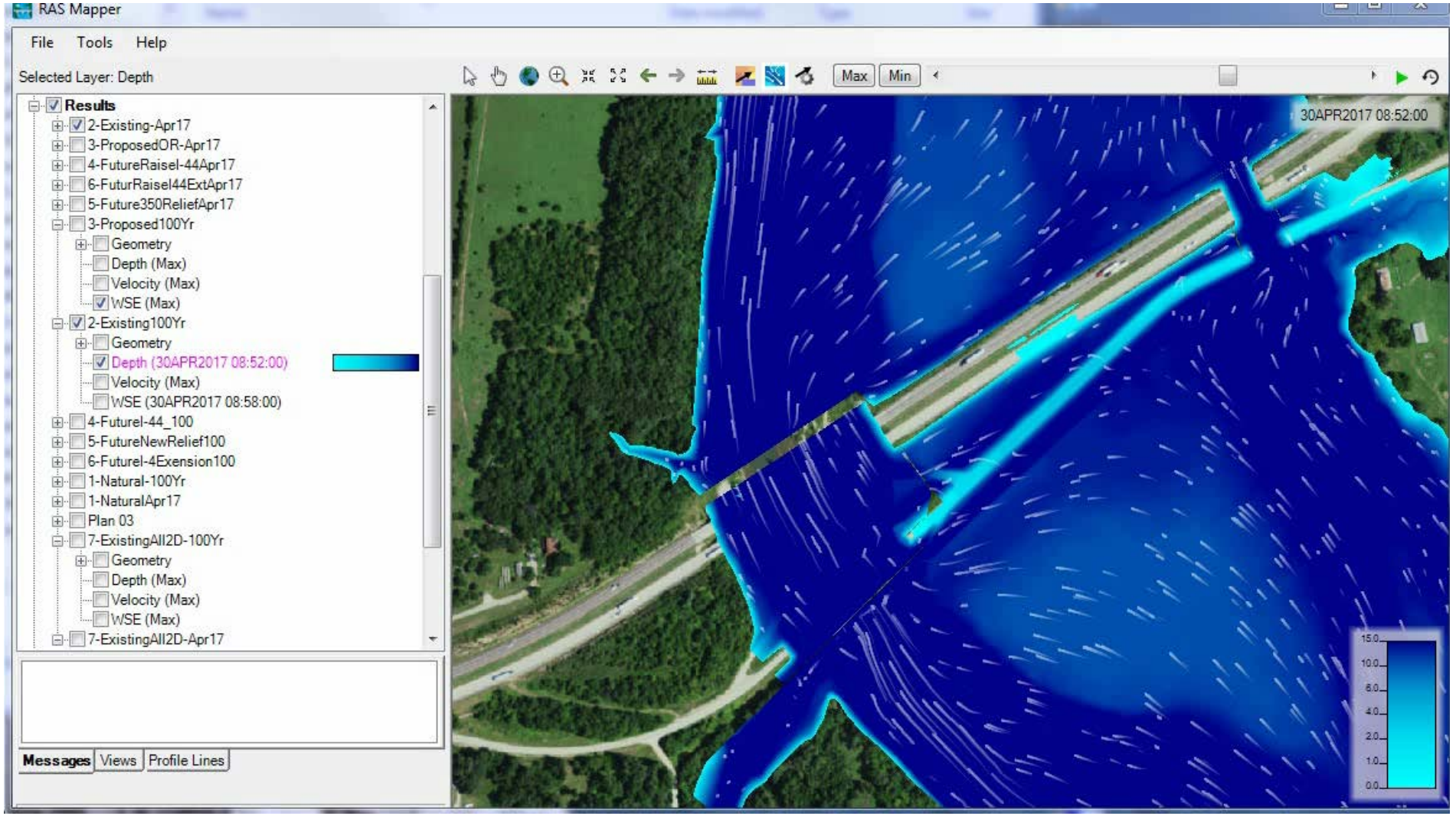

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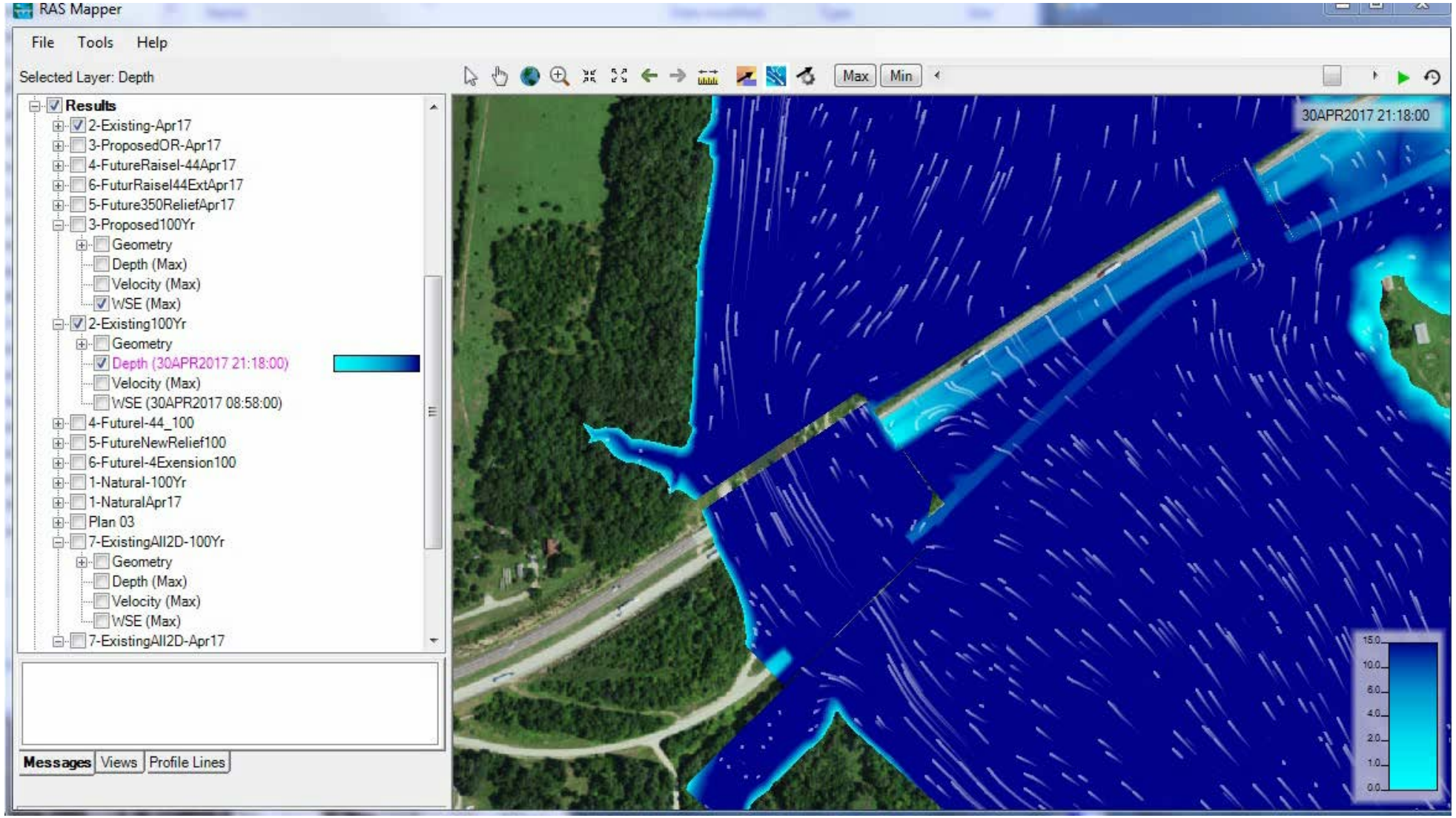

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Overtopping Risk Reduction

New Outer Road bridge configuration alternatives

1. Minimal bridge improvements
2. Additional relief bridges
3. Longer Gasconade River spans

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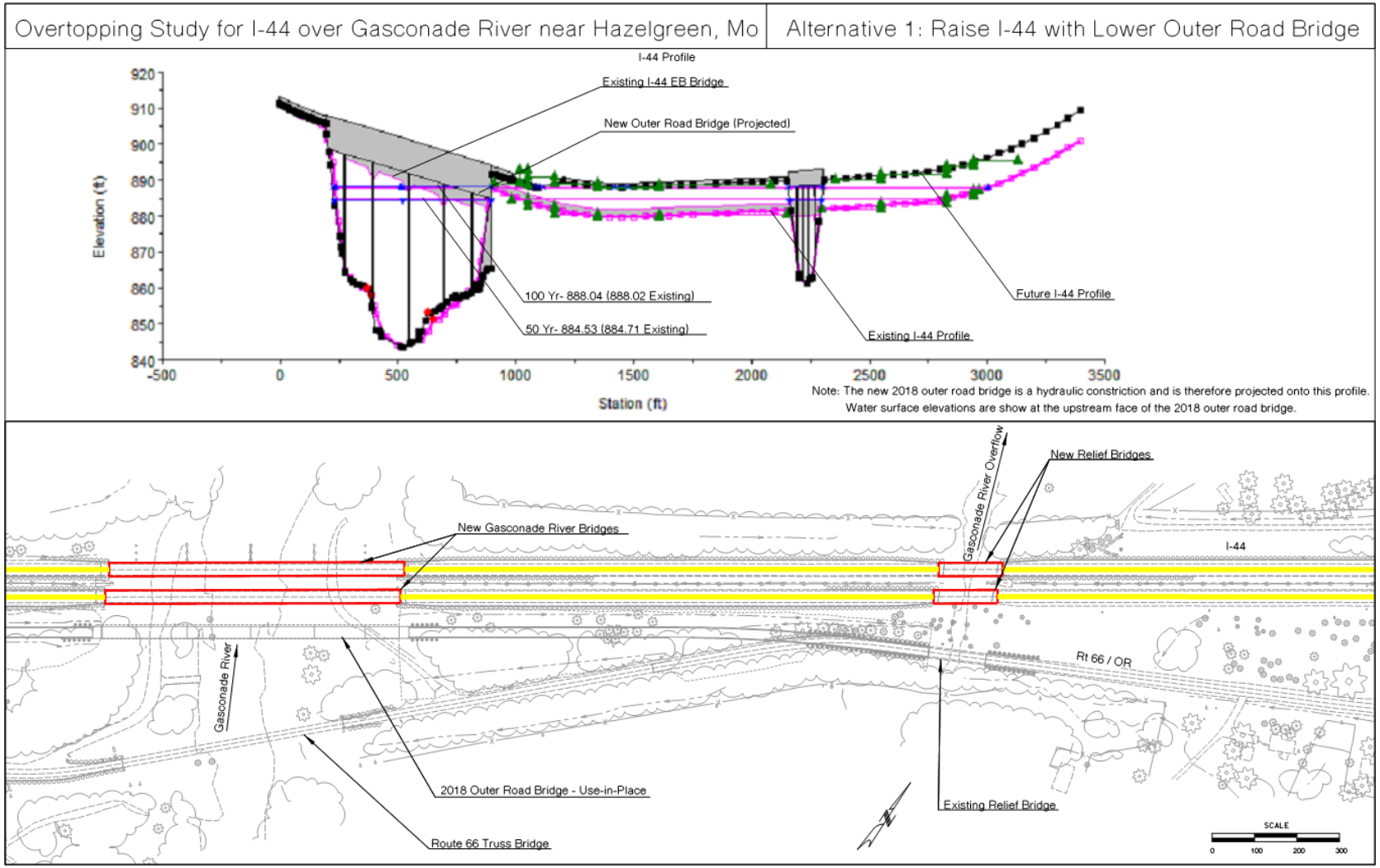

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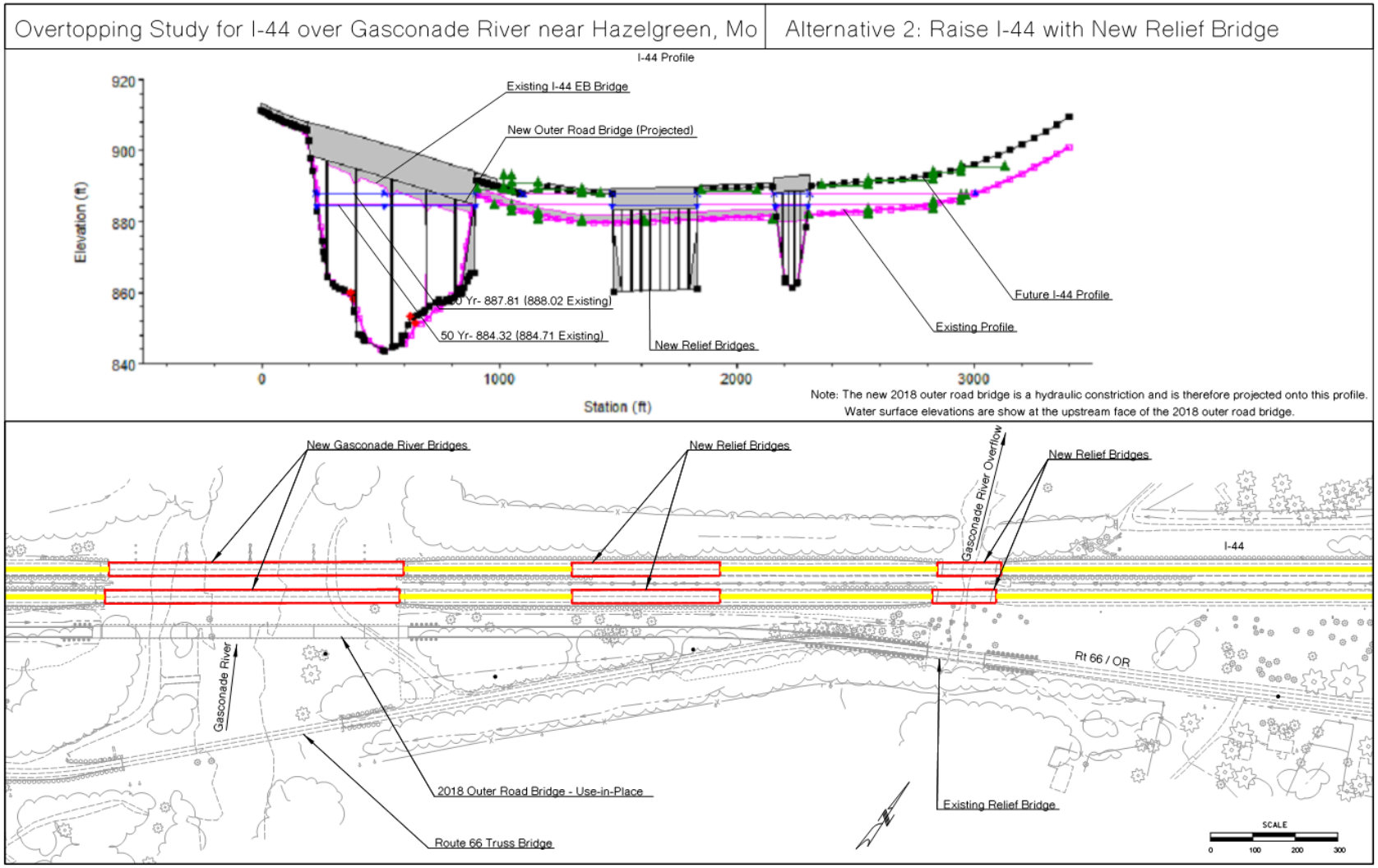

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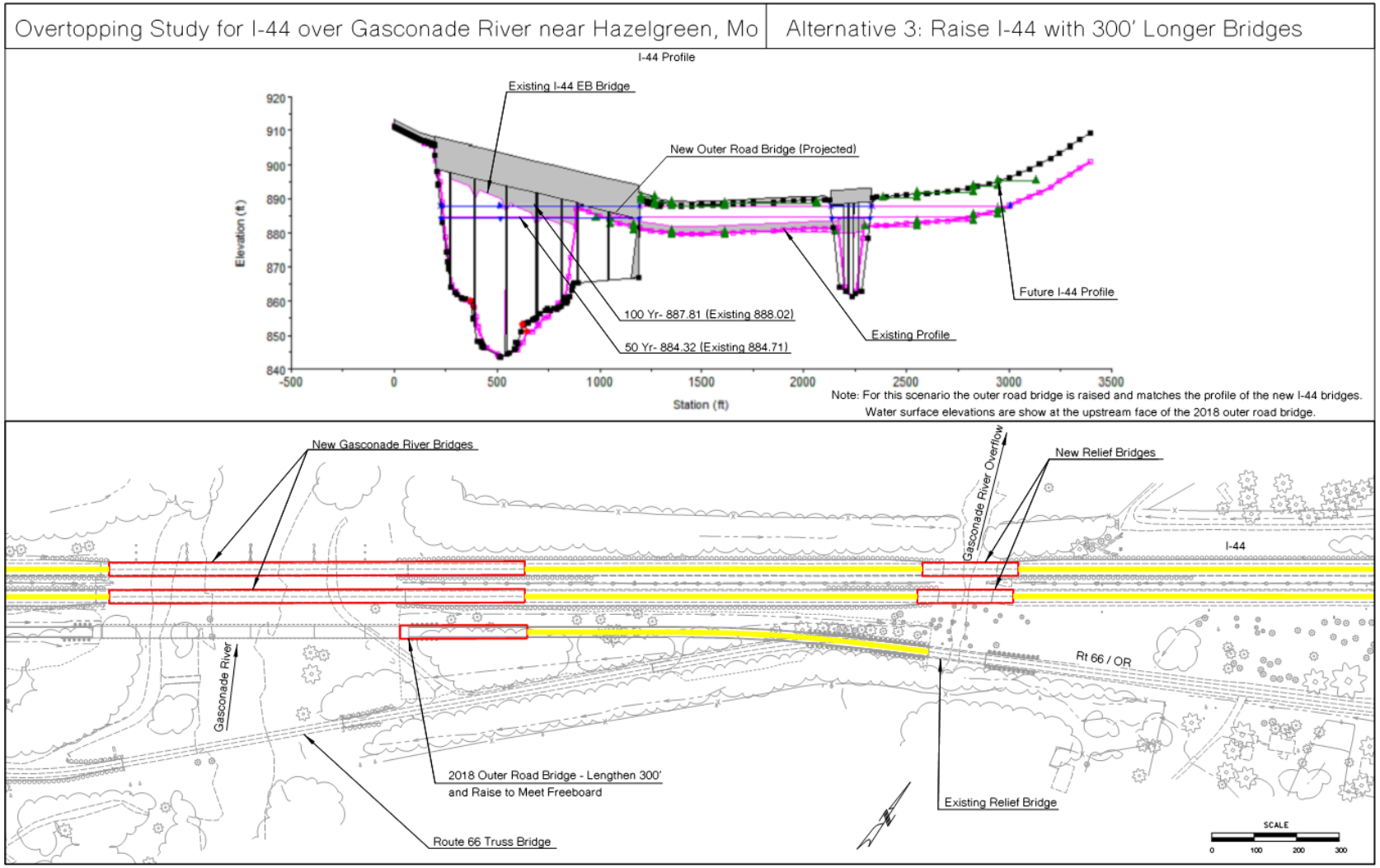

Summary

- Applicability of 2D modeling
- Lessons learned

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