An aerial photograph of a wide, winding river, likely the Missouri River, flowing through a vast, dense green forest. The river meanders across the landscape, creating several large loops and curves. The surrounding land is a mix of forest and open fields, with some small structures visible in the distance. The sky is clear and blue.

Lower Missouri River: Flood Risk Data for the Future

Governors Water
Conference 2022

Will Zung, CFM, PMP – Stantec
Anish Pradhananga, PE, CFM - Stantec

Why This Project?



2019 Flood Event, Missouri River

Photo courtesy of USACE – Omaha District

Why This Project?

NASA Goddard Photo and Video
at <https://flickr.com/photos/24662369@N07/404630137>

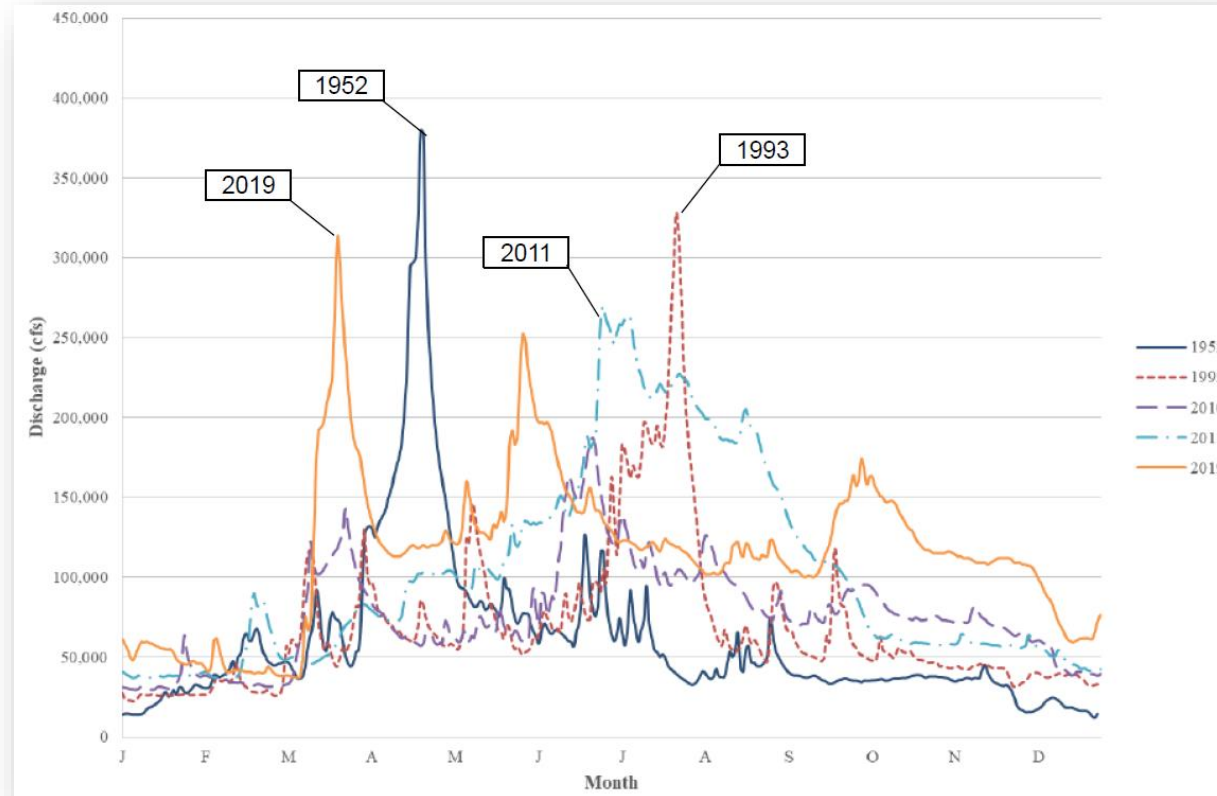


2019 Flood Event, Missouri River

Photos courtesy of USACE – Omaha District

Why This Project

- Several large flood events in recent years.
- Last study was over 19 years ago.



Upper Mississippi River System Flow Frequency Study

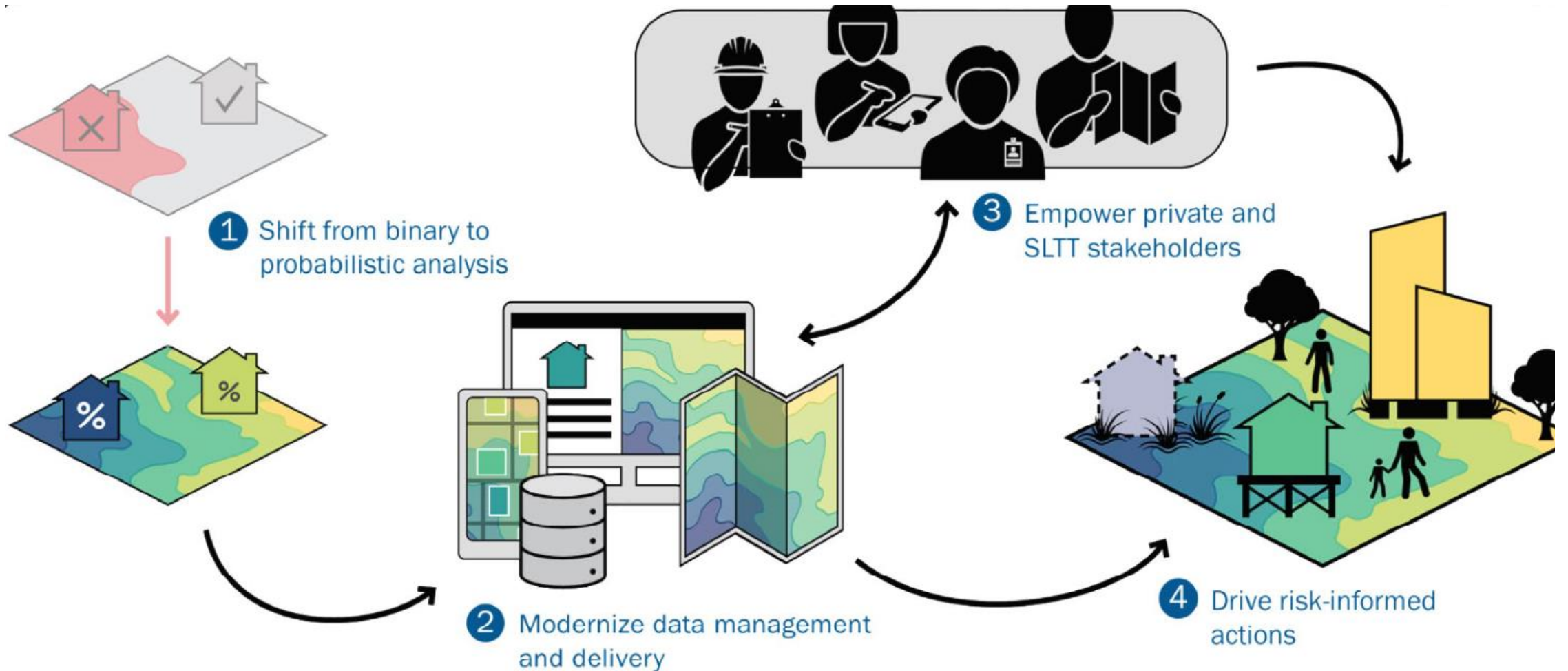
Hydrology and Hydraulics Appendix F Missouri River

U.S. Army Corps of Engineers
Omaha District

November 2003

Why This Project?

Future Flood Risk Data



Why This Project

Purpose

Partnership between FEMA and USACE on creating a technically sound platform for producing future flood risk data of the Missouri River for use in flood risk analysis, communication, mitigation planning, and support the implementation of mitigation actions.

USACE –
Omaha

FEMA
Region 7

USACE –
Kansas City

USGS
(LiDAR;
Gages)

USACE –
St. Louis

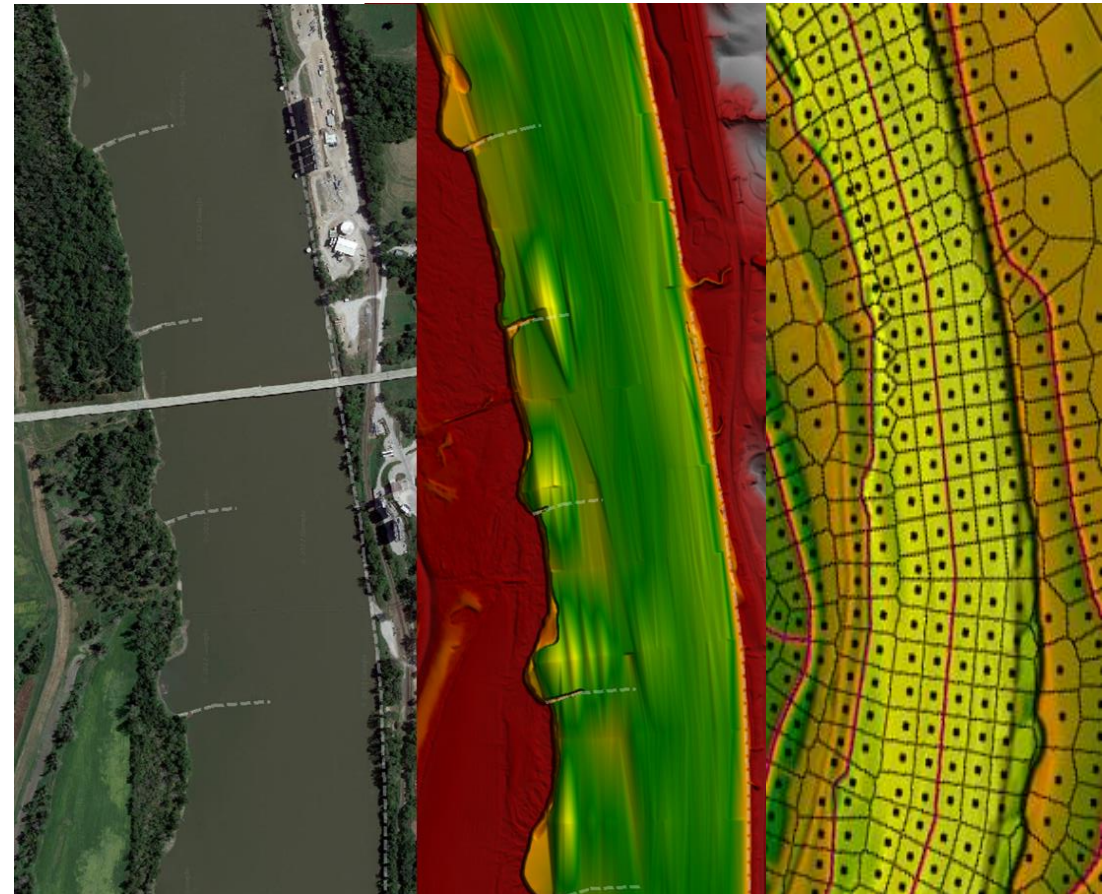
NOAA
(Rainfall)



Why This Project?

Goal

Produce a calibrated 2-D HEC-RAS model that can be leveraged as a baseline hydraulic model for future enhancements by FEMA or the USACE to use in Region-wide flood risk data development supporting flood risk reduction activities.

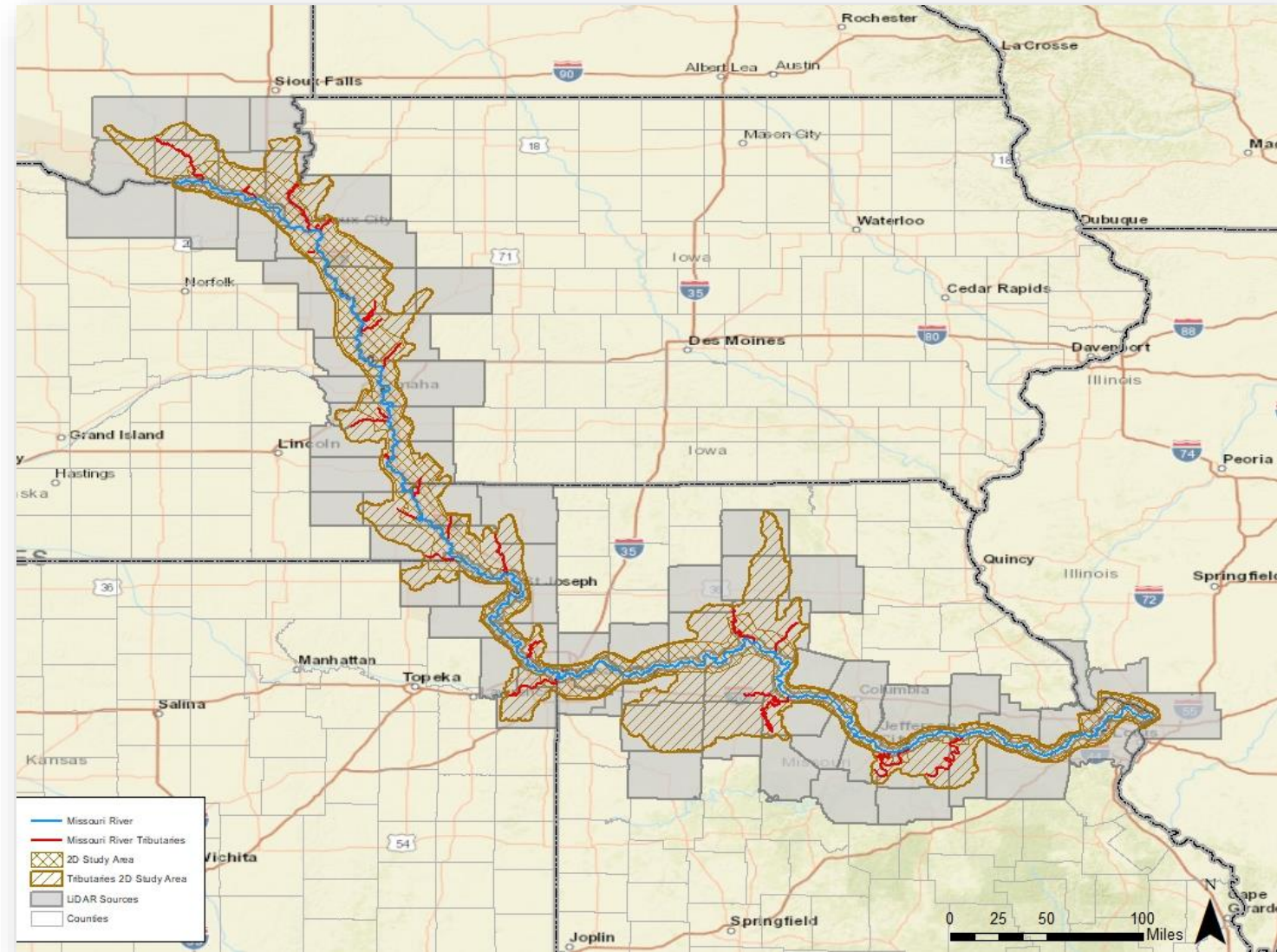


Scope of Work

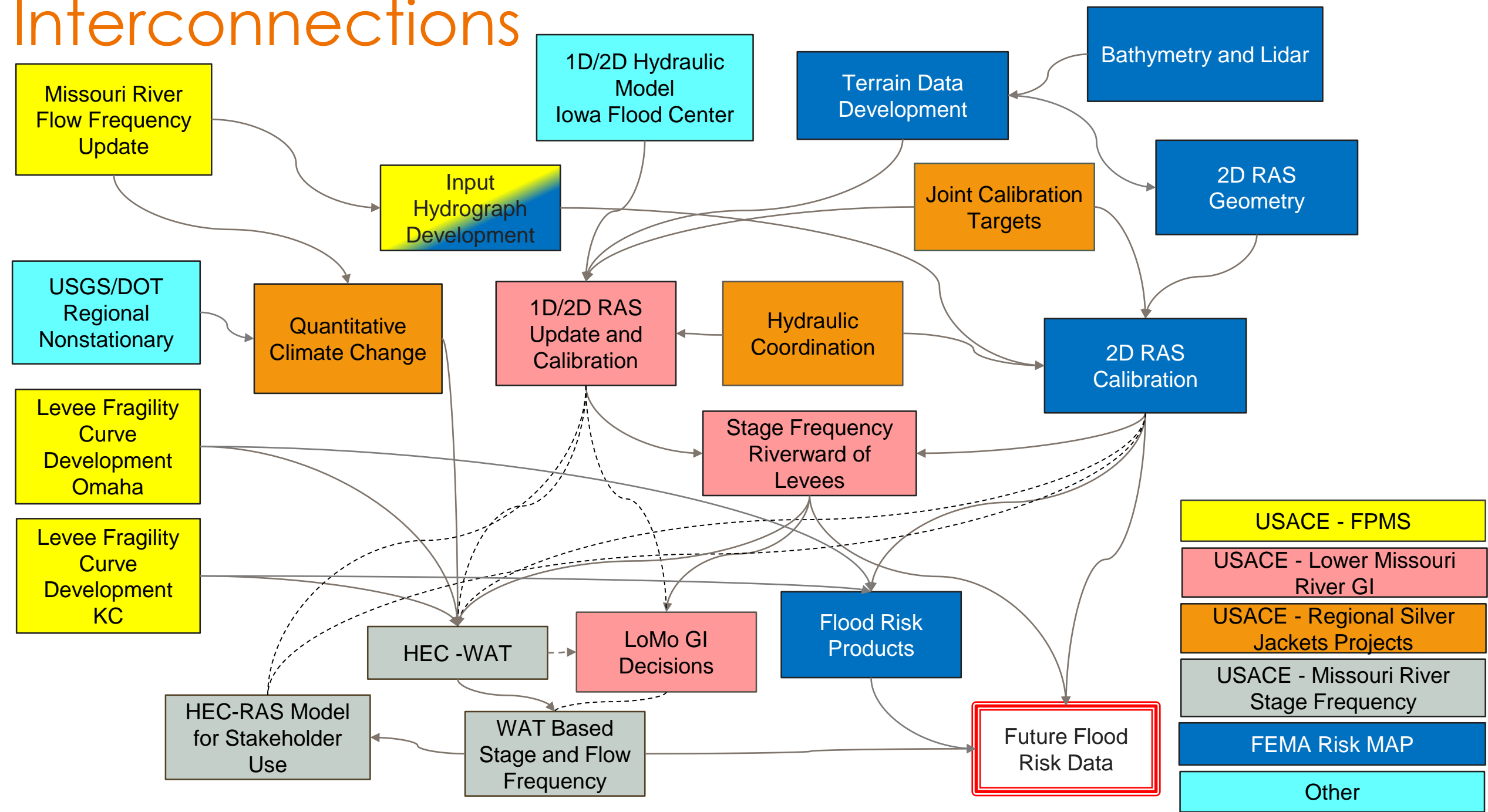


Study Area

- Missouri River from St. Louis to Gavins Point Dam
- 811 river miles
- 27 major tributaries
- 60 bridges
- 358 levee systems
- 7,600 square miles of floodplain
- 52 counties

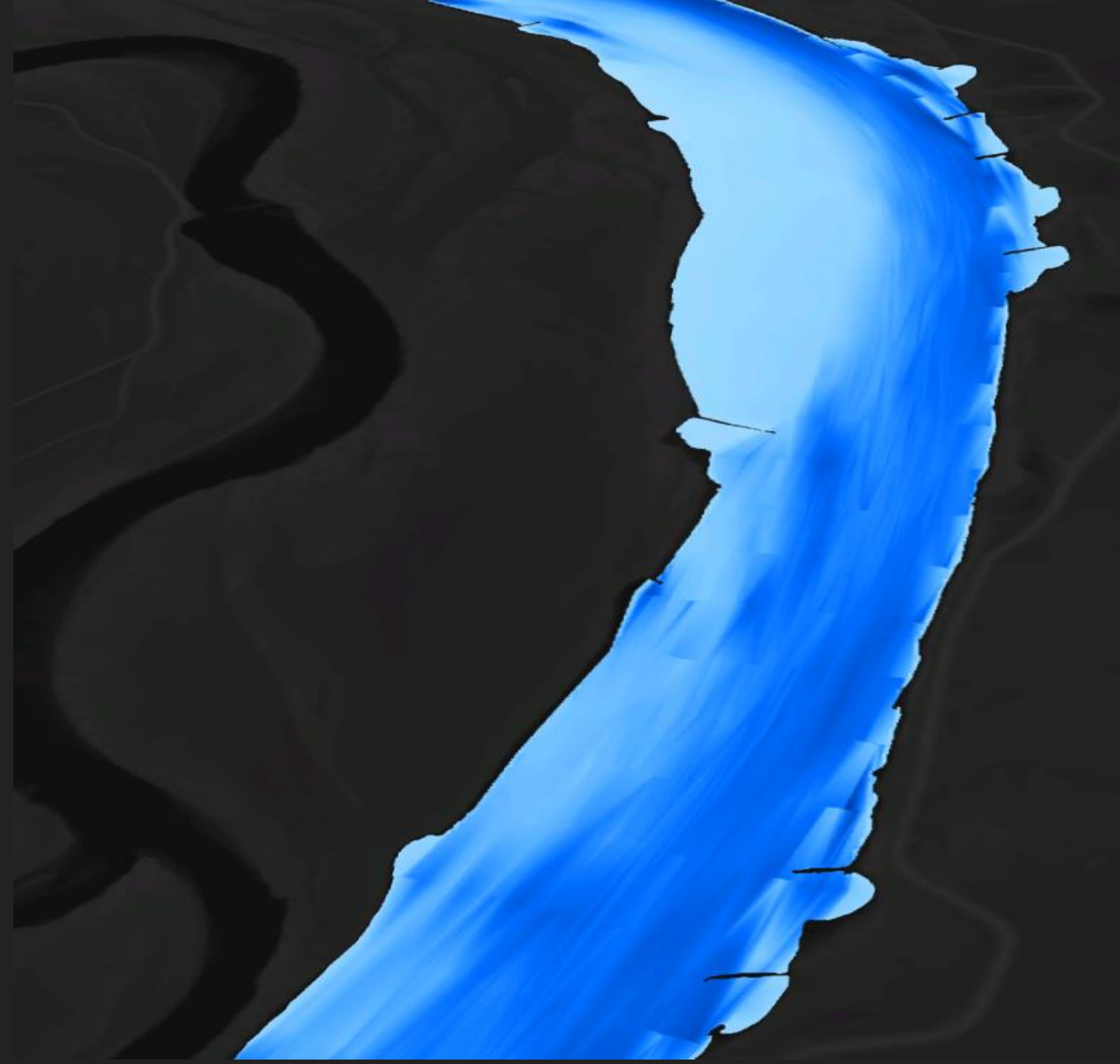


Interconnections



Scope of Work

Terrain Data



Terrain Data

- Mosaic
 - Bathymetry to Corridor
 - Corridor to Countywide
 - Countywide to Model Areas
- Managing large file size

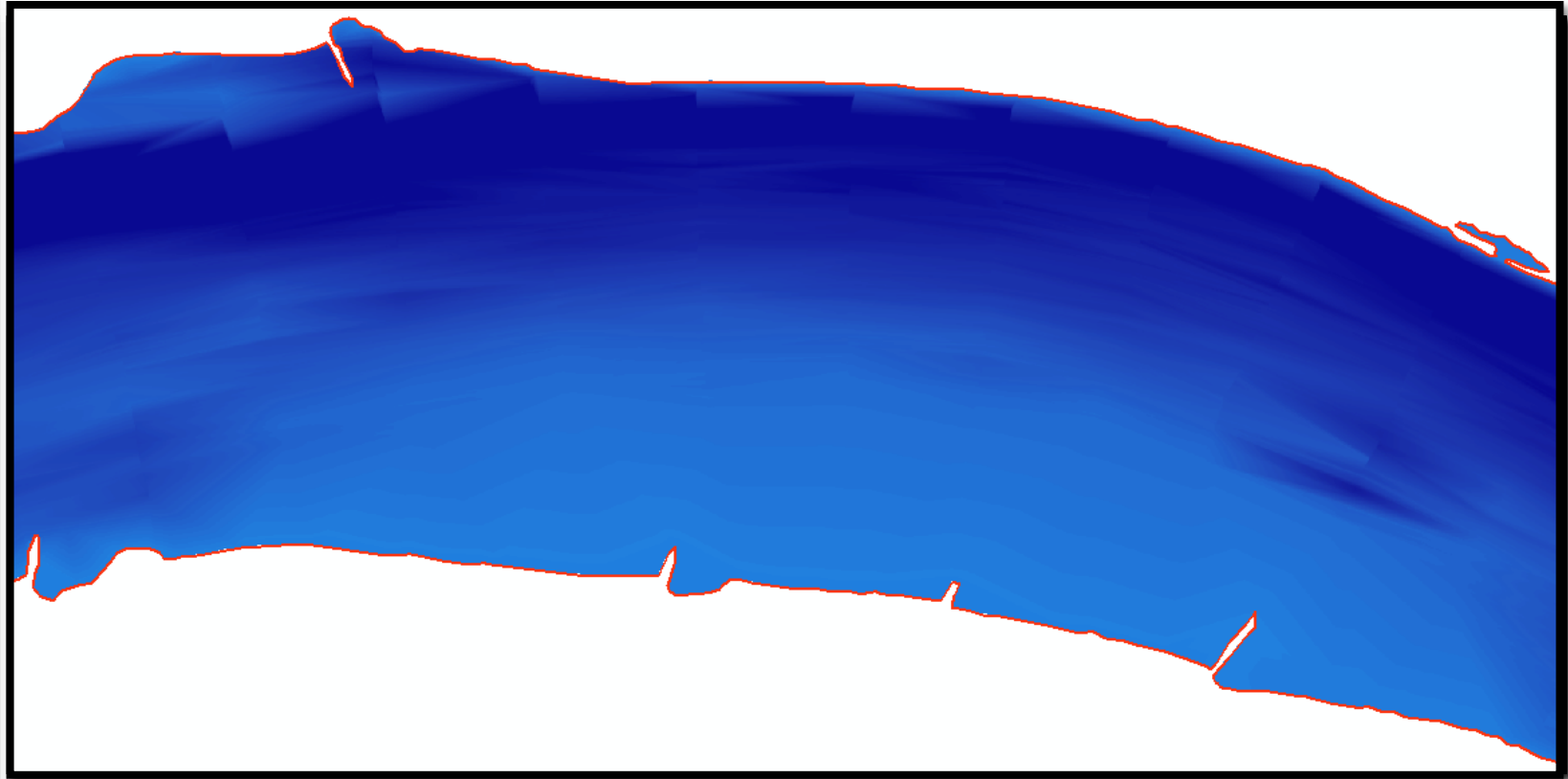


Terrain Data

Technical Guide for Developing Bathymetric
Datasets Using ArcGIS



Lower Missouri River Study
Version 1.0
January 7, 2022



Scope of Work

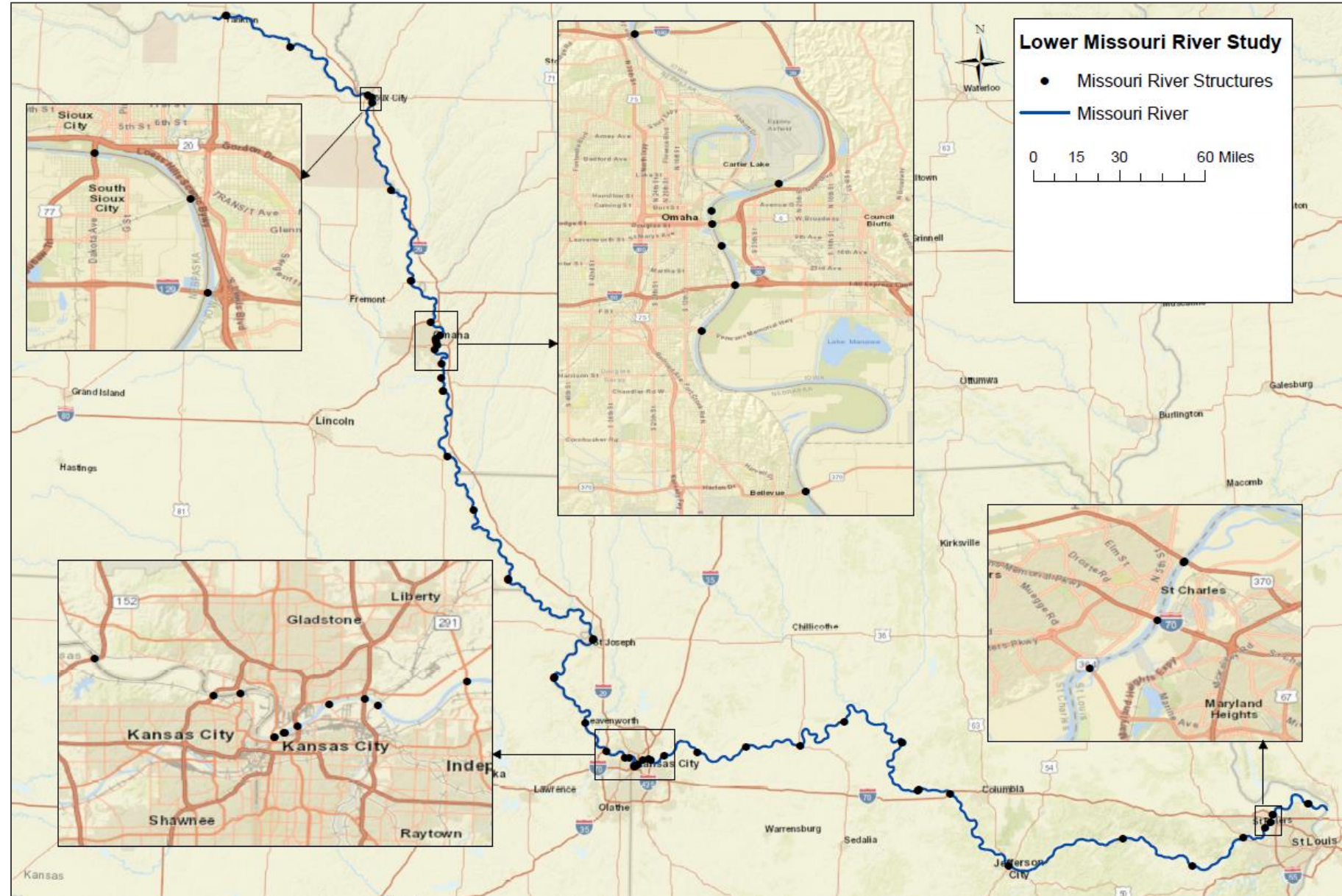
Survey



Survey

Missouri River Structures

- 60 Bridges
 - 50 Roadway
 - 10 Railroad
- As-built data
- Field Survey



Survey

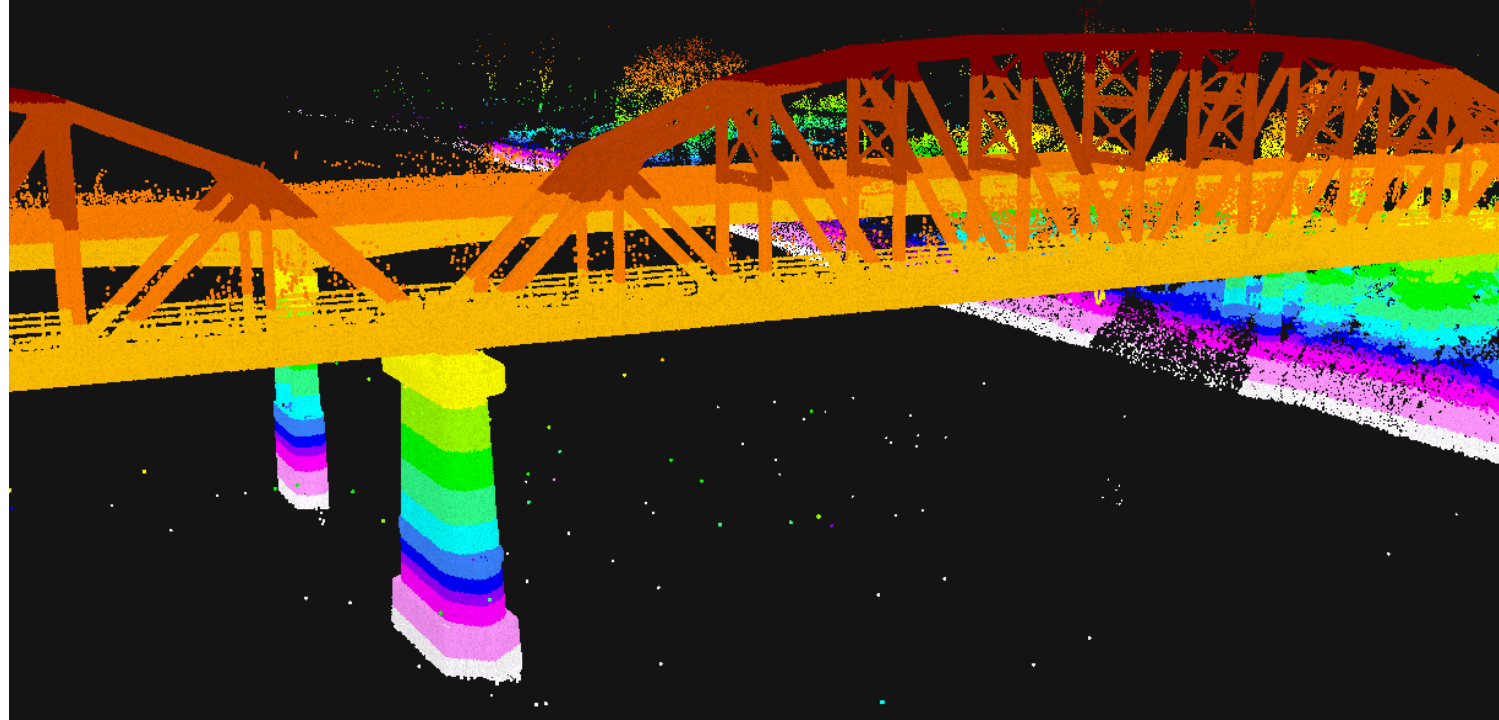
- Roadway bridges
 - As Built data provided by State DOTs
- Railroad Bridges
 - No As Built data provided
 - Accessibility is challenging
 - Solution = Terrestrial LiDAR Survey



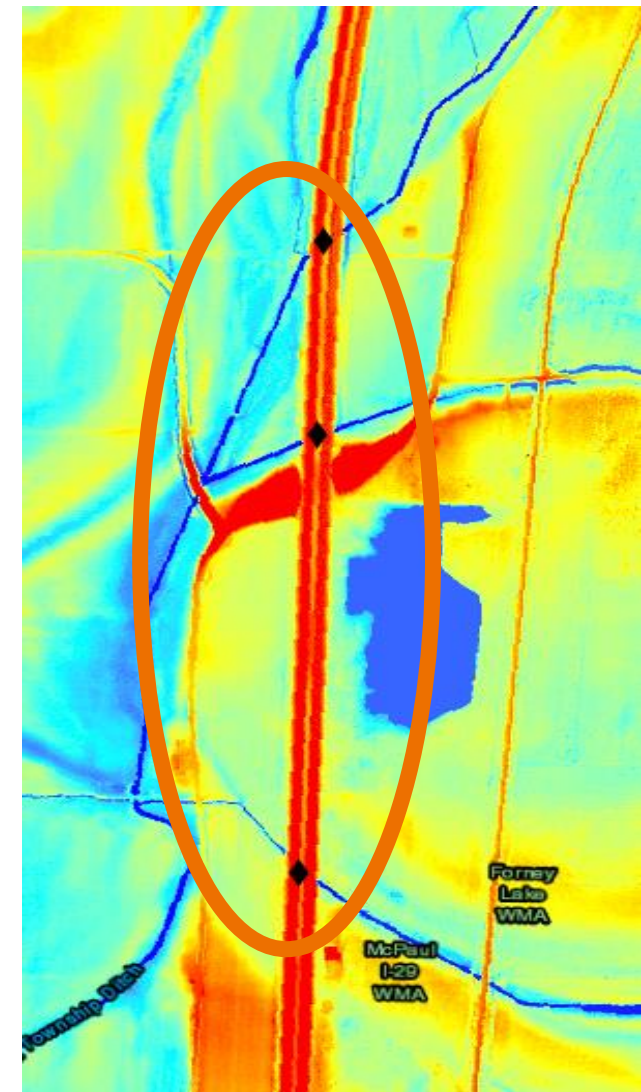
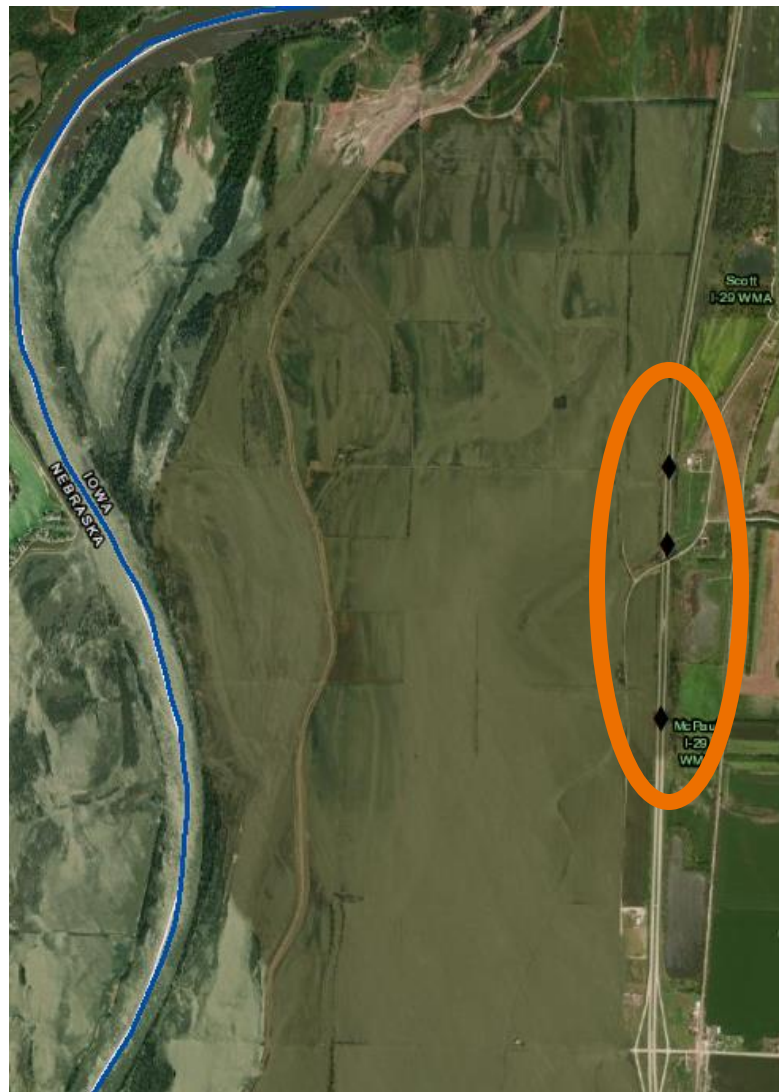
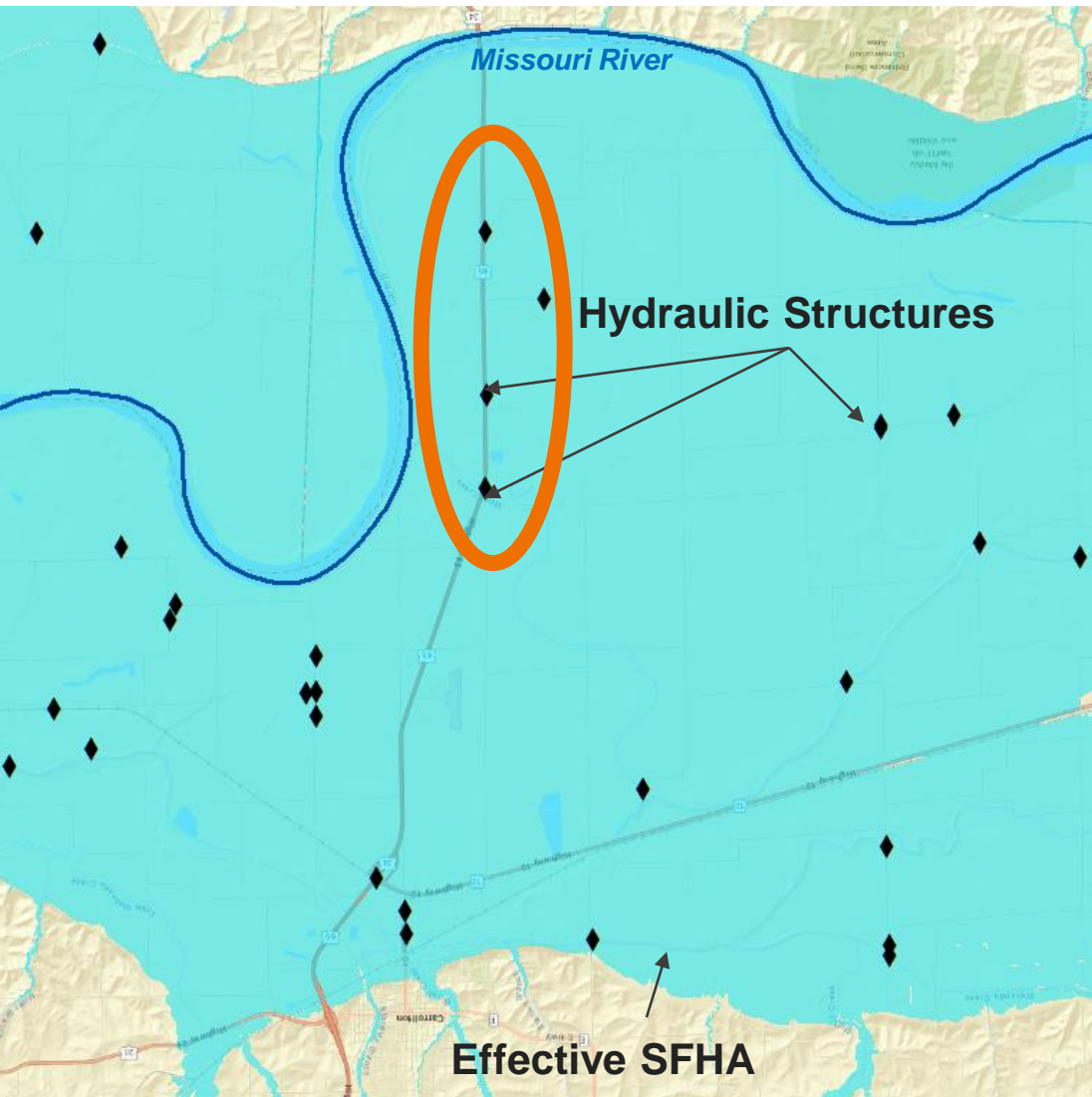
Survey

Laser scanning of bridge crossings

- Detailed bridge survey based on overbank laser scans to develop LAS point cloud data
- Does not require access to railroad right-of-way
- Reports more detailed survey information than traditional point survey



Survey



Scope of Work

Hydrology



Hydrology

Missouri River Flow Frequency

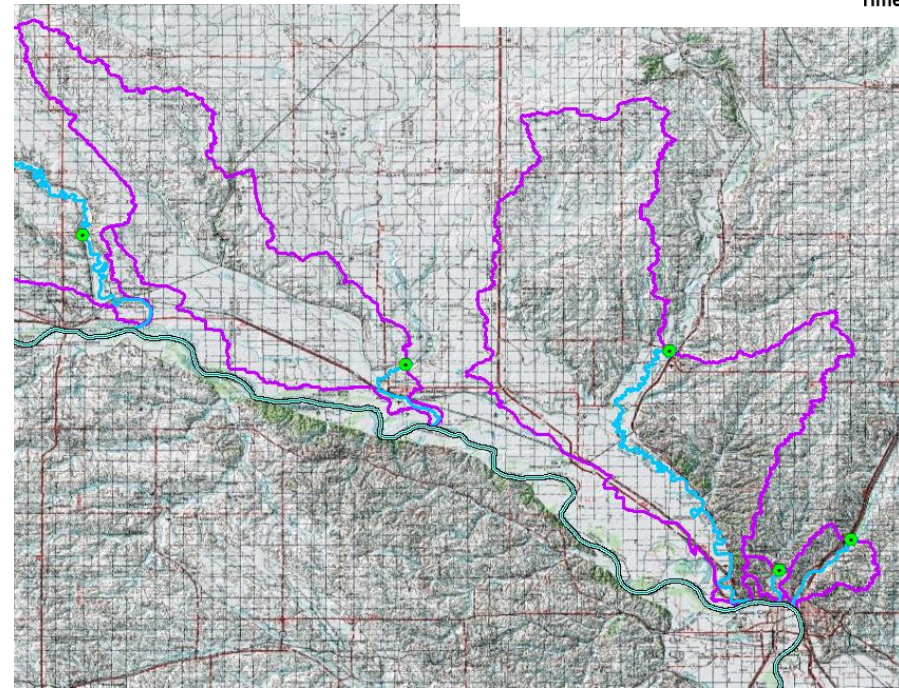
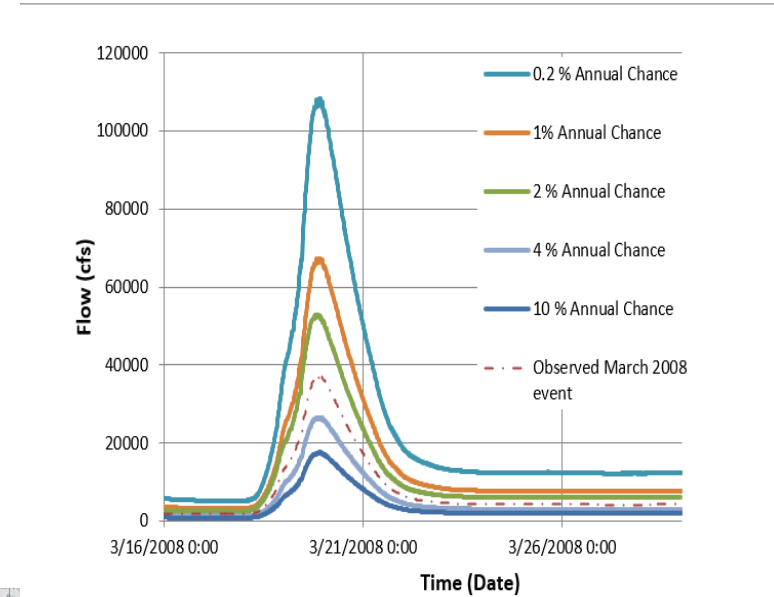
- USACE provide
- 10%, 4%, 2%, 0.2%, 1%, and 1% Plus chance of occurrence within a given year.

Tributaries

- 27 Major Tributaries
 - Omaha – 16 tributaries
 - Kansas City – 11 tributaries

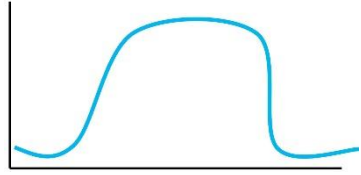
Model Setup

- Hydrograph Scaling
 - Flow frequency
 - Volume-duration frequency
- 2D Hydrodynamic Routing
 - Timing to peak at Missouri River
 - Lateral Inflow

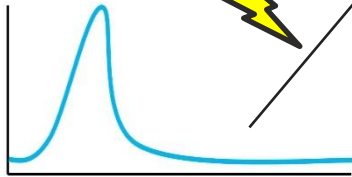


Model Setup – Hydrographs (Peak & Volume)

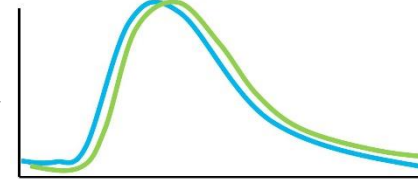
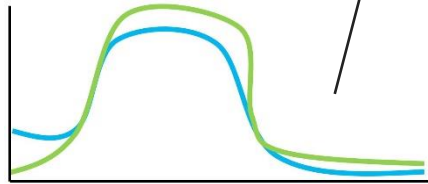
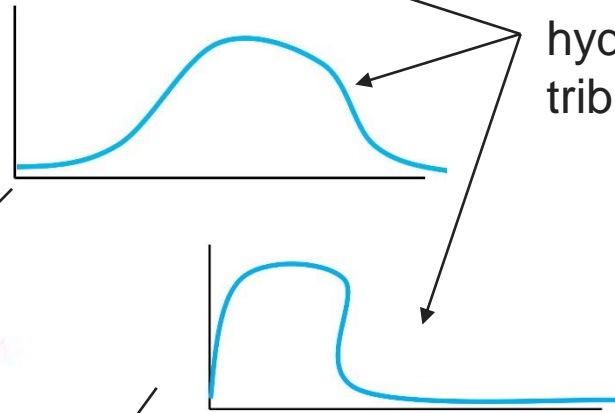
Calibration event
inflow hydrograph
at Gavin's Point



Lateral inflow
from ungaged
streams

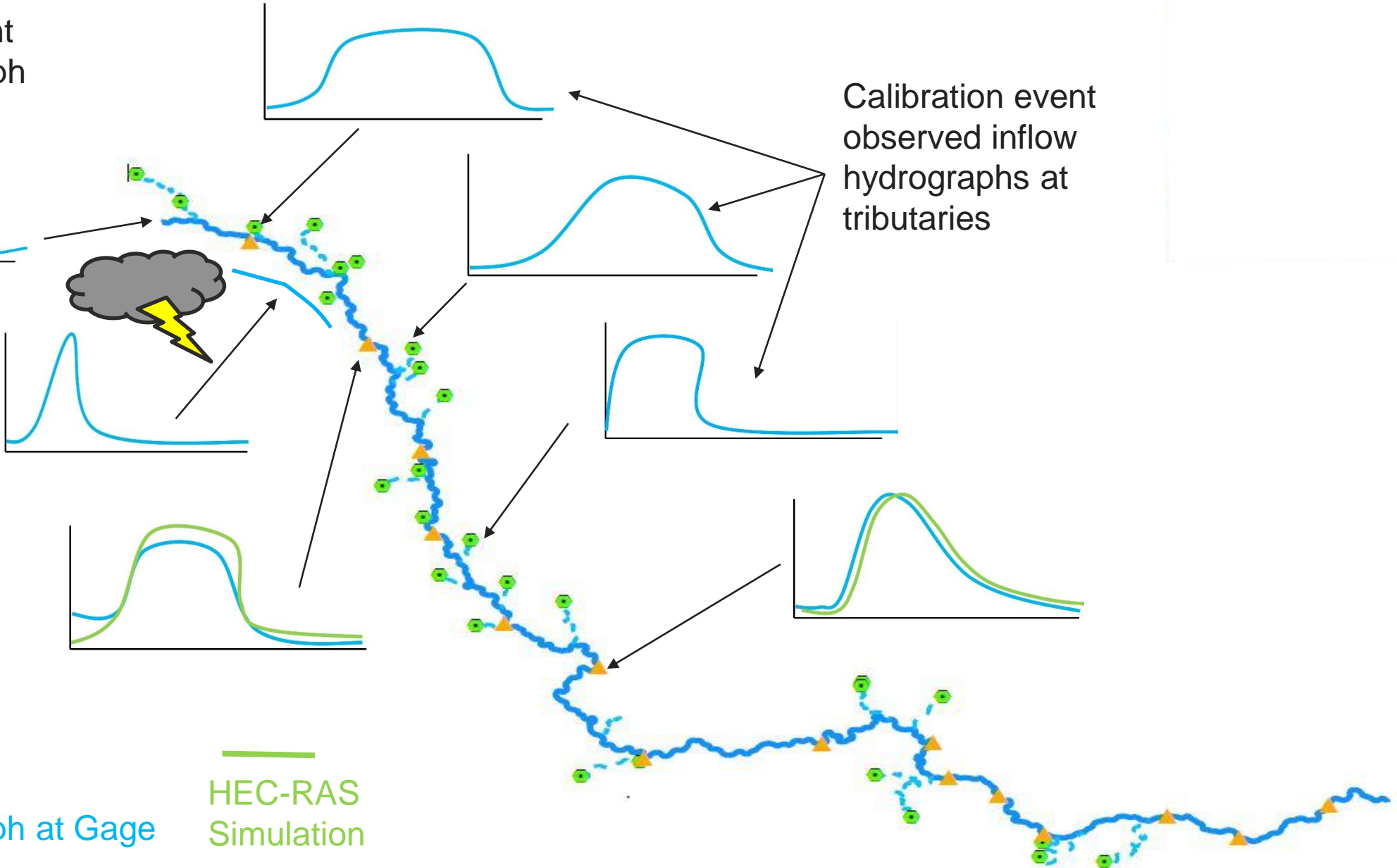


Calibration event
observed inflow
hydrographs at
tributaries



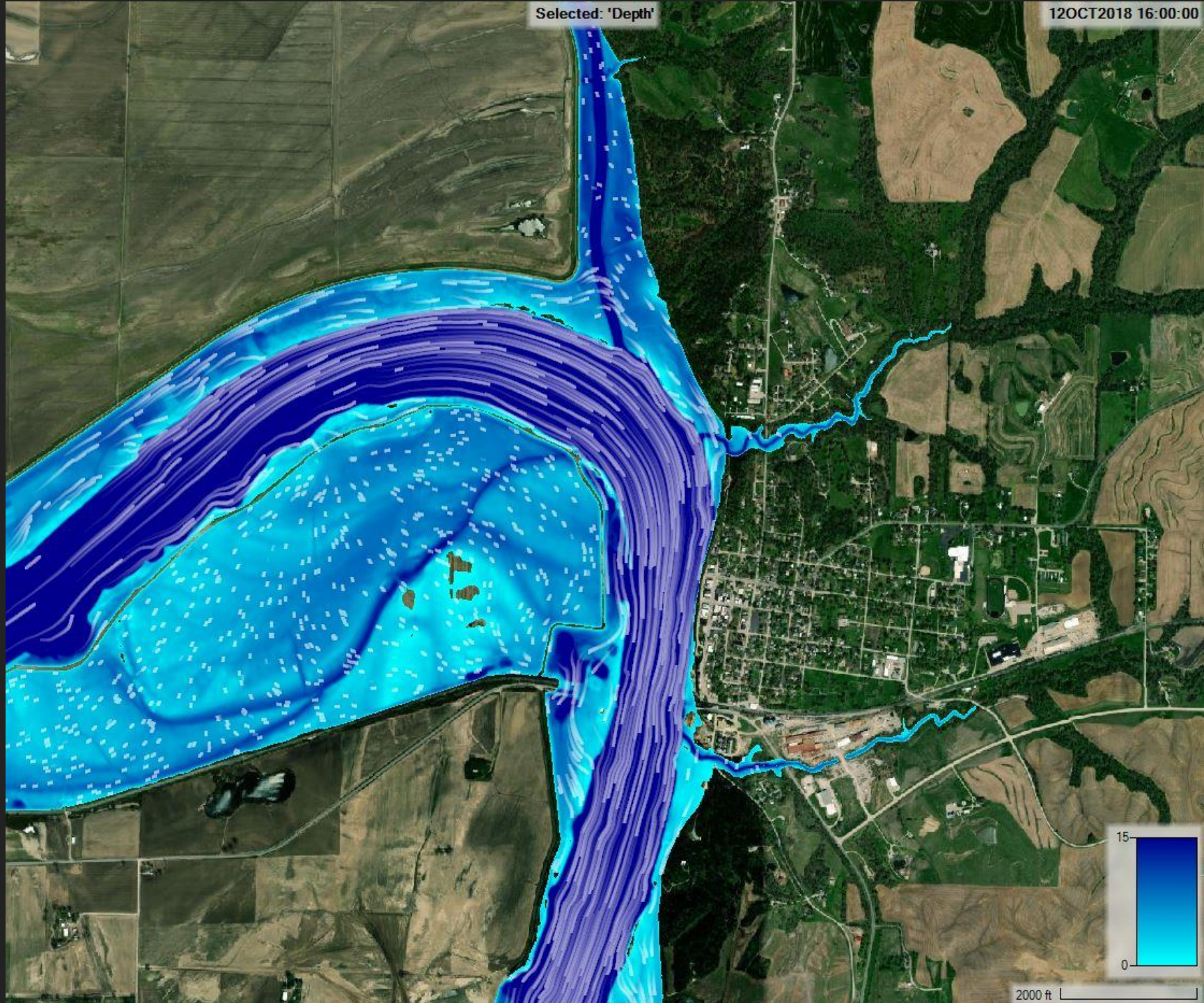
Observed
Hydrograph at Gage

HEC-RAS
Simulation



Selected: 'Depth'

12OCT2018 16:00:00



Scope of Work

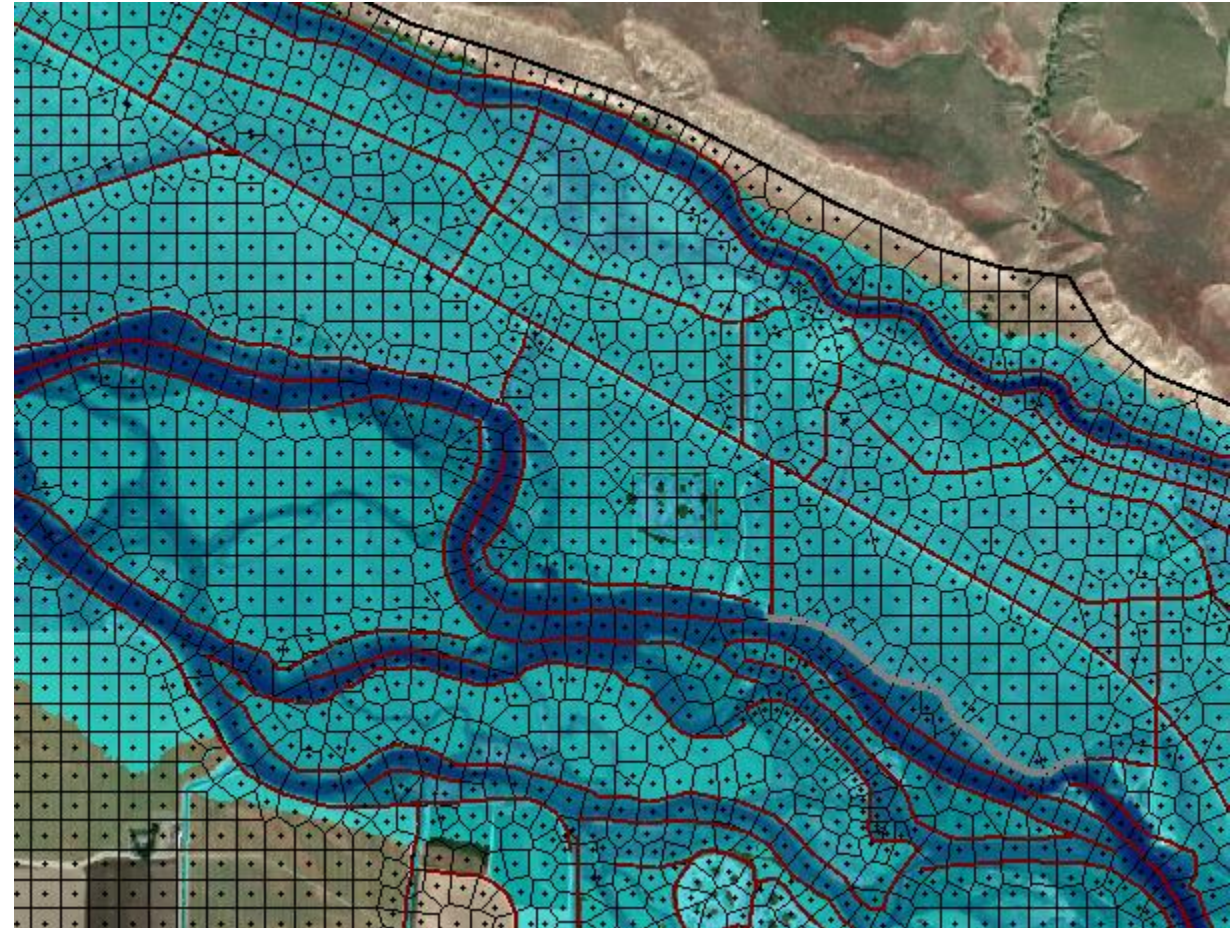
Hydraulics



2000 ft

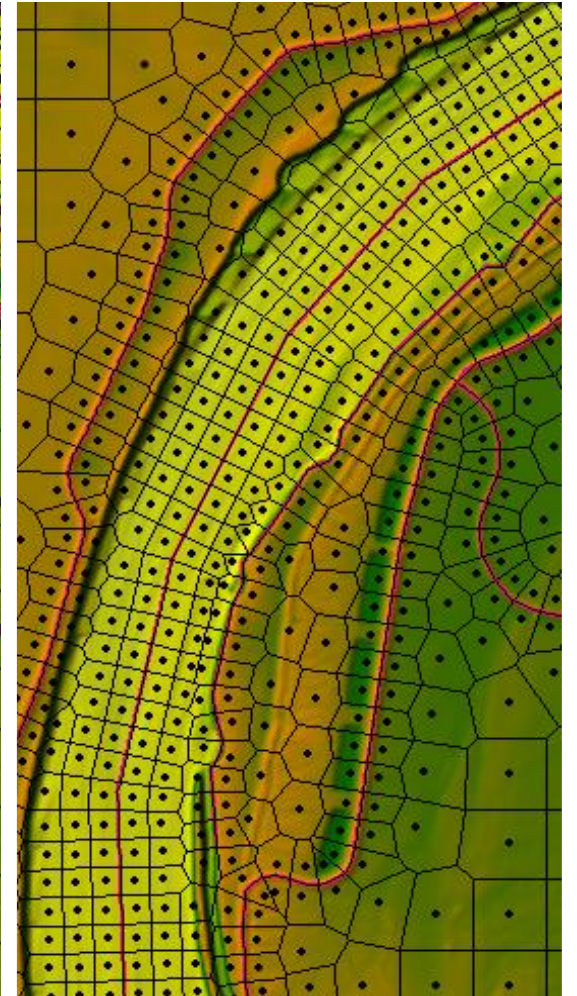
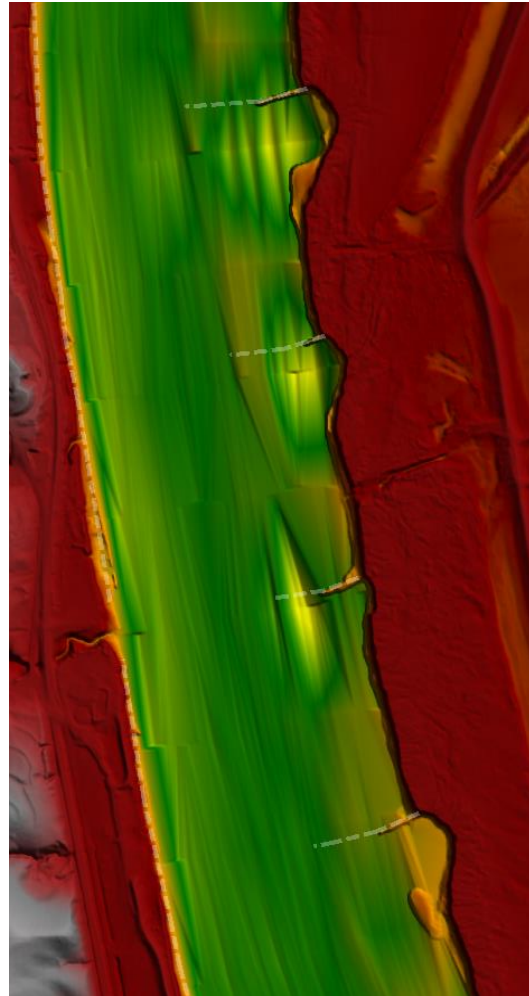
Hydraulics

- HEC-RAS 2D hydrodynamic routing
- Enhanced Geometry
 - All bridges across main channel
 - Hydraulically significant bridges/culverts in overbanks
 - Levee systems
 - Prominent topographic features breaklines
 - Breaklines within stream corridor
 - Refined 2D mesh where necessary
 - Manning's roughness adjusted to capture stream channels



Hydraulics

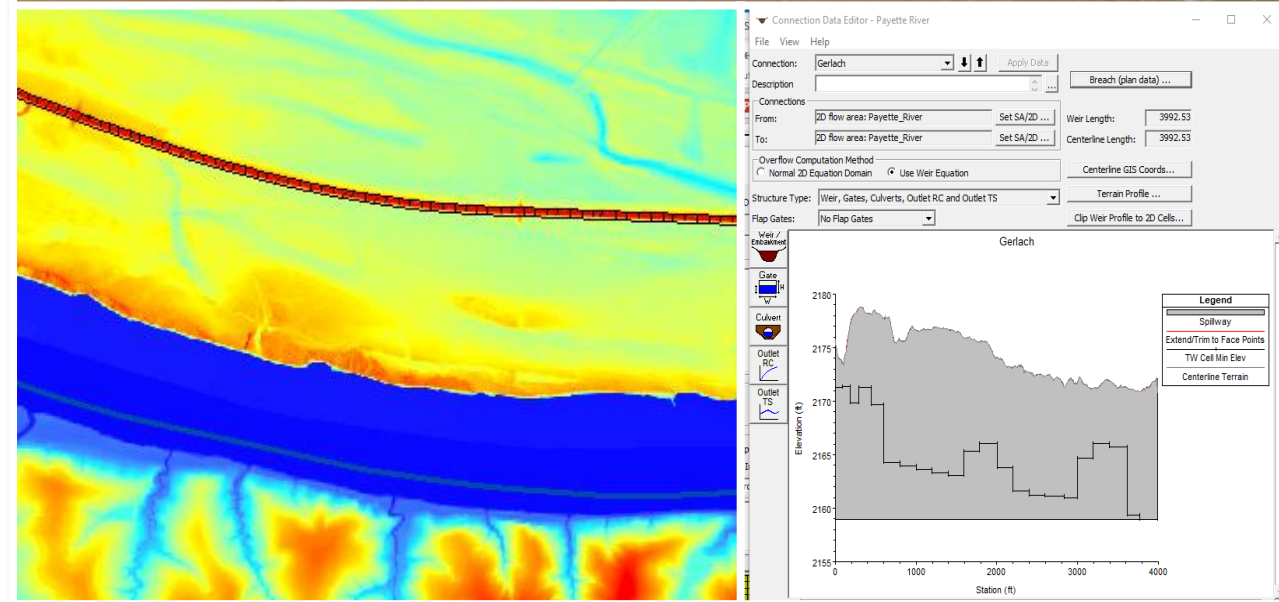
Hydraulic Significance of Dikes and Revetments in Channel



Hydraulics

Levees

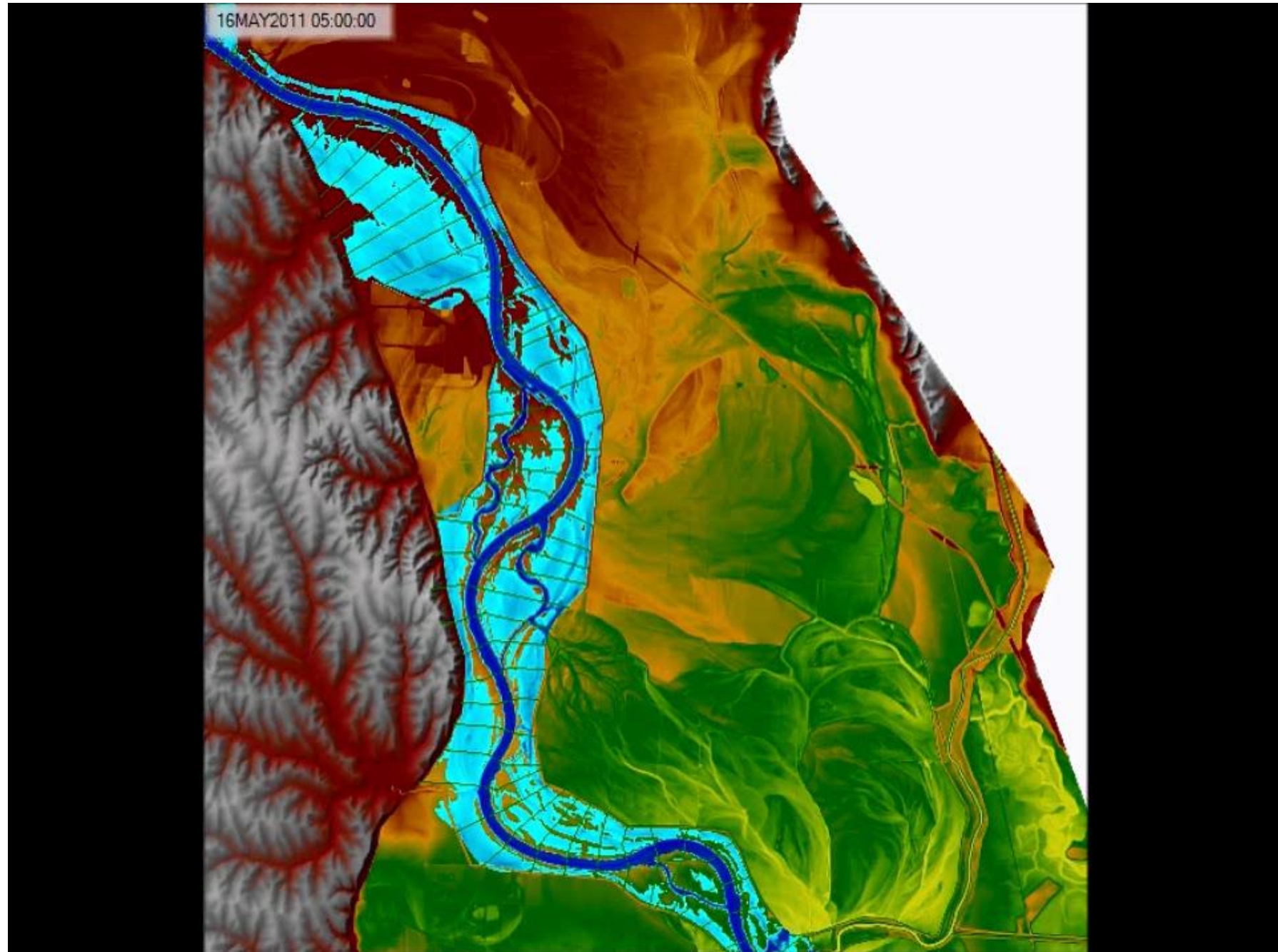
- Levee crest elevation profile
 - Elevation from NLD (USACE portfolio)
 - LiDAR extraction (non-USACE)
- Levees modeled using “with levee” approach
- 2D connector allow future modeling of levee failure scenarios without model geometry modification
- Levee overtopping flood frequency determined from model results



Hydraulics

Example

Simulation of a levee breach near Hamburg, Iowa from the 2011 flood.



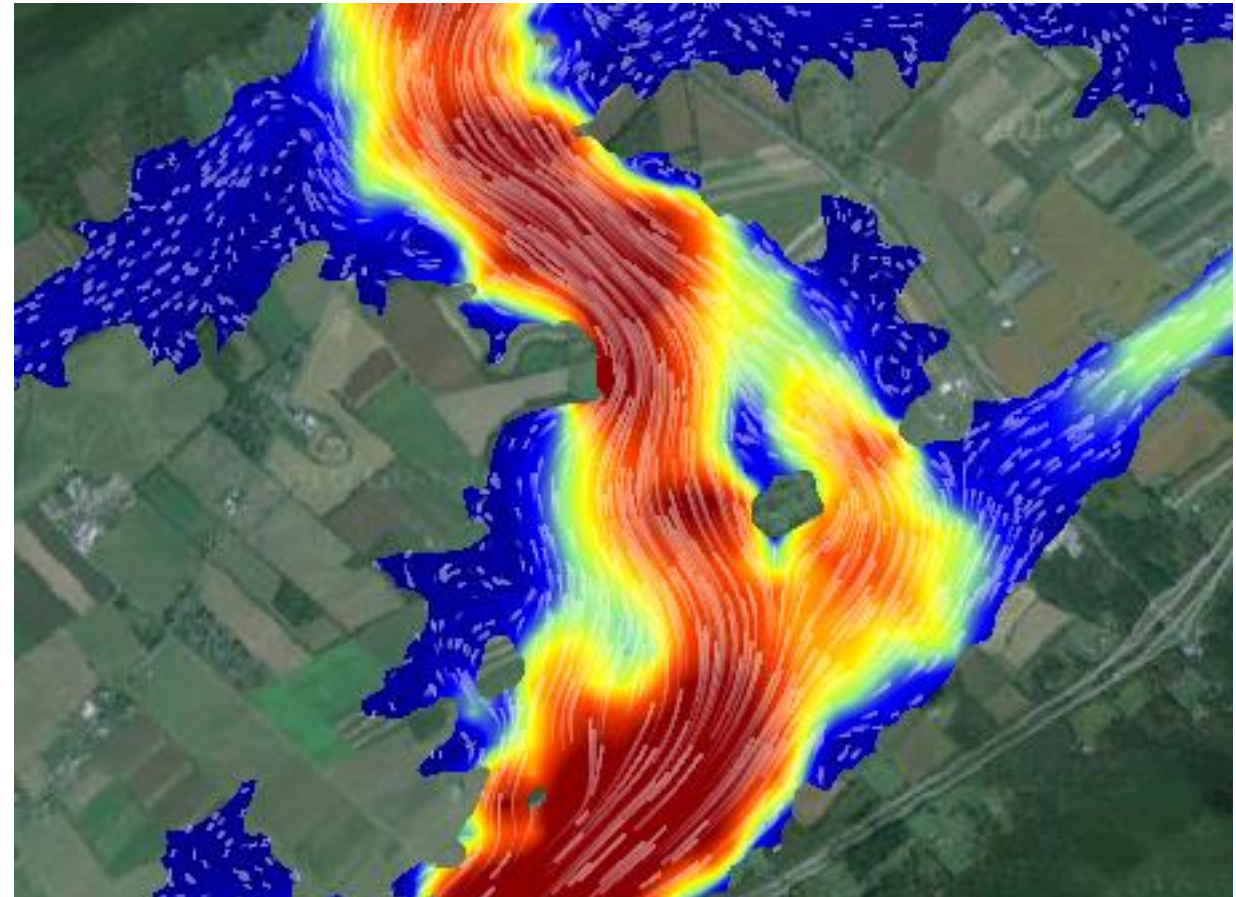


Scope of Work

Flood Risk Products and Communication




Flood Risk Products

- Grids for a range of flood events
 - Water surface elevations
 - Depth of Water
 - Velocity
- Changes in floodplain mapping
 - Compared to UMRSFSS
- Levee overtopping flood frequency



Communicate with Partners

Lower Missouri

A Story Map   

Project Overview **Community Engagement and Mitigation Support** Terrain Field Survey Hydrology Hydraulics Flood Risk Products

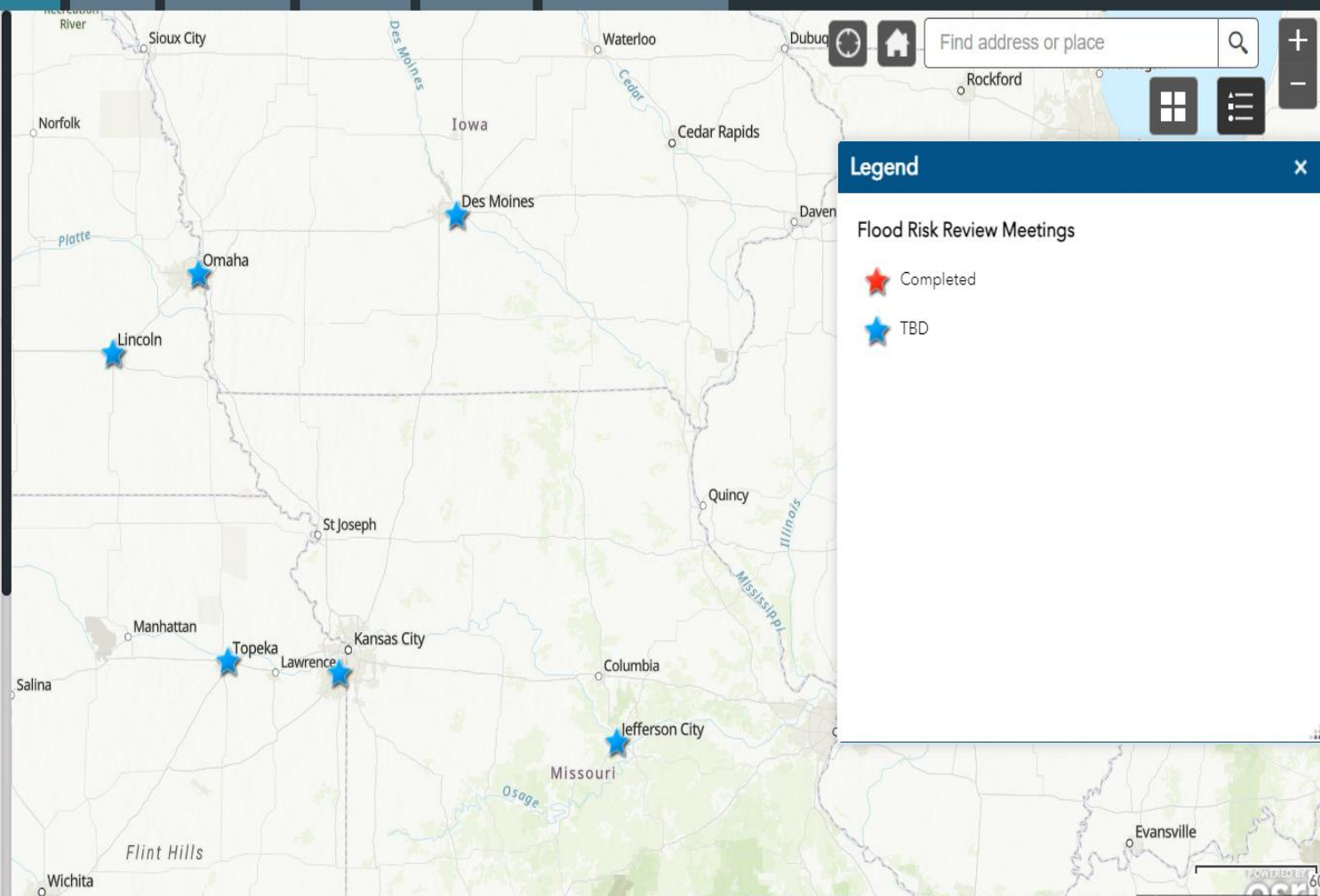
Community Engagement and Mitigation Support

Community Engagement and Mitigation activities include technical efforts designed to help build risk awareness and understanding at the local level, to increase a community's ability to communicate risk at the local level, support local efforts to reduce natural hazard risk within a community or watershed area (e.g. complete mitigation actions), and to keep communities and other stakeholders engaged throughout the Risk MAP process.

Meeting & Process Support



Support the technical aspects of community engagement and outreach strategies: participate in meetings, provide technical data to support decision making processes; provide support for discussions regarding increased regulatory product adoption and acceptance, and mitigation throughout the Risk MAP project lifecycle. Meeting activities include technical support for the planning, presenting technical components as needed, and completing any associated follow up.

- Flood Risk Review Meeting** - Activities include technical support for planning, presenting, and facilitating discussions of data inputs and engineering models used for flood studies with community officials. In addition, draft work maps showing initial study results will be presented during the meeting. The meeting may also include review of



Legend

Flood Risk Review Meetings

-  Completed
-  TBD

Missouri DNR, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS, © 2017 Esri. All rights reserved. -97.43241, 27.1 Degrees



We do what is right.

We approach every project as a partnership because our work creates a lasting impact on communities.