Lower Platte River Hydraulic Modeling

HDR Platte River Recovery Implementation Program

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Creighton Omer, PE, CFM

7/16/2024

AGENDA

01

Introduction/Background

Introduction/Background

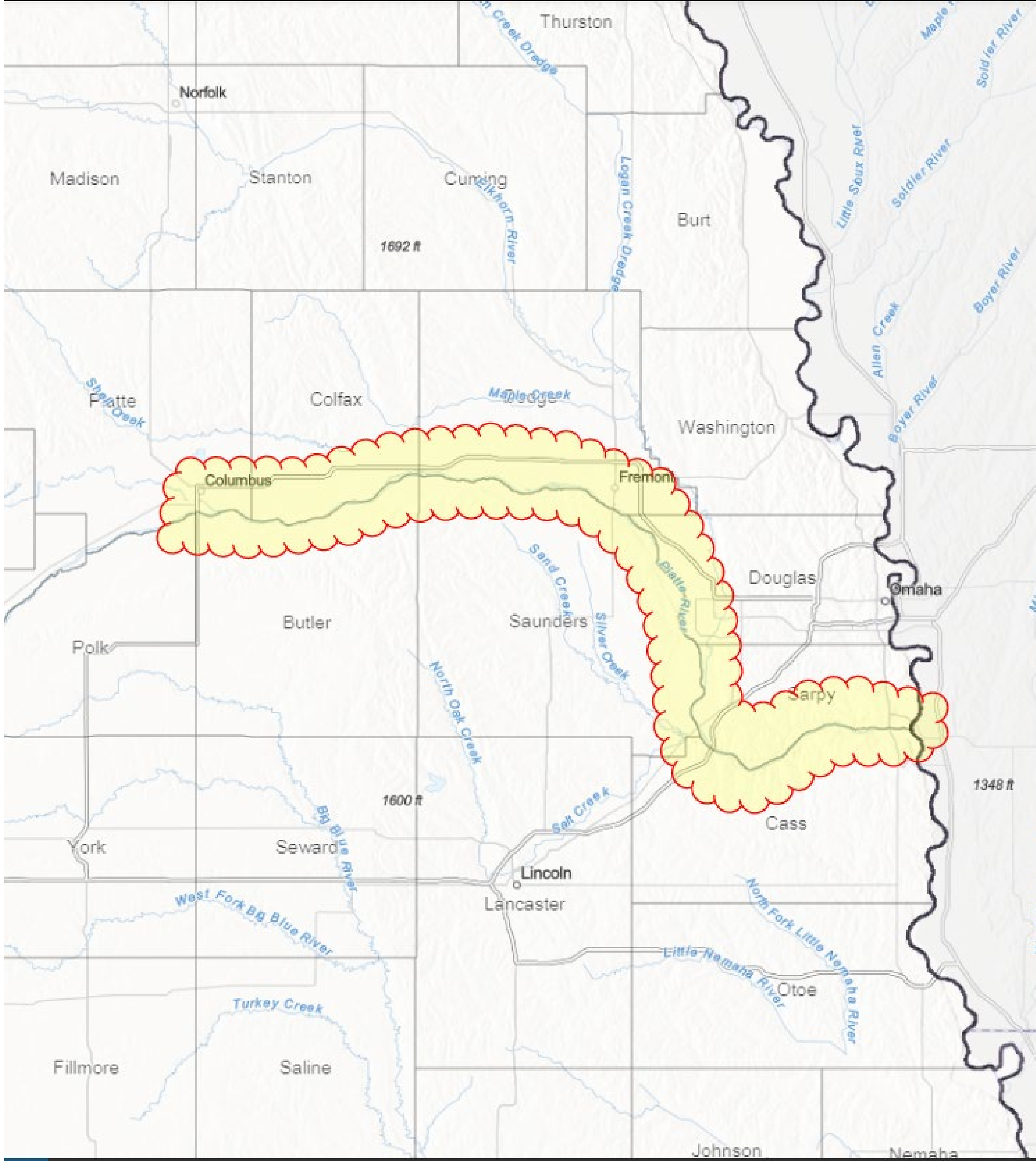
Program Objectives

- Collaboration with UNL to better understand Pallid Sturgeon Habitat
- Understand Spatial Distribution of Habitat
- Develop Hydraulic Model of Lower Platte
- Systematic Evaluation of Depth, Velocity, and Other Metrics

Introduction/Background

Accomplishing Objectives…

- Develop 2D model of Lower Platte River
- Discharges: 500 to 50,000 cfs
- HDR to Collaborate with Program and UNL to:
  - Review Hydrologic & Hydraulic Data
  - Determine Additional Data Needs
  - Develop Solution for Gaps in LiDAR (topobathy) Data
  - Select Modeling Parameters
  - Develop Modeling Scenarios

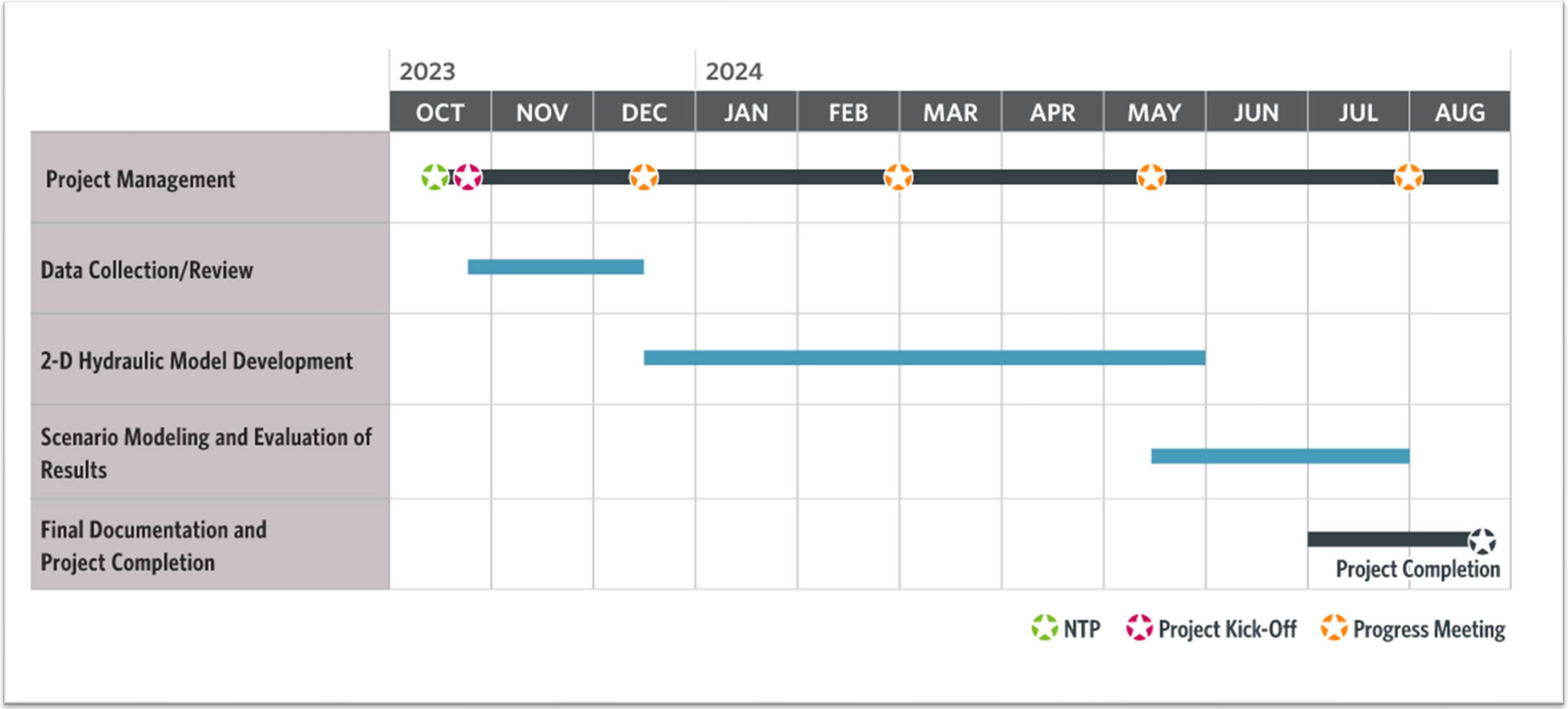


02

Recap from February

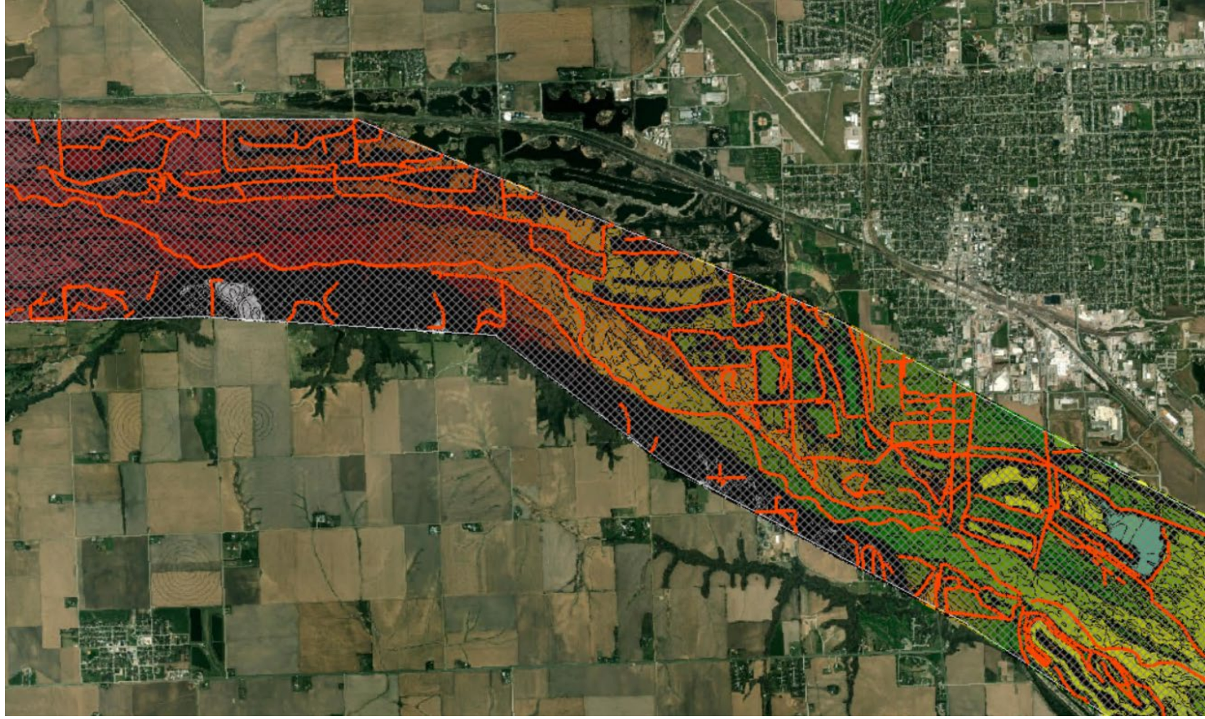
Recap from February

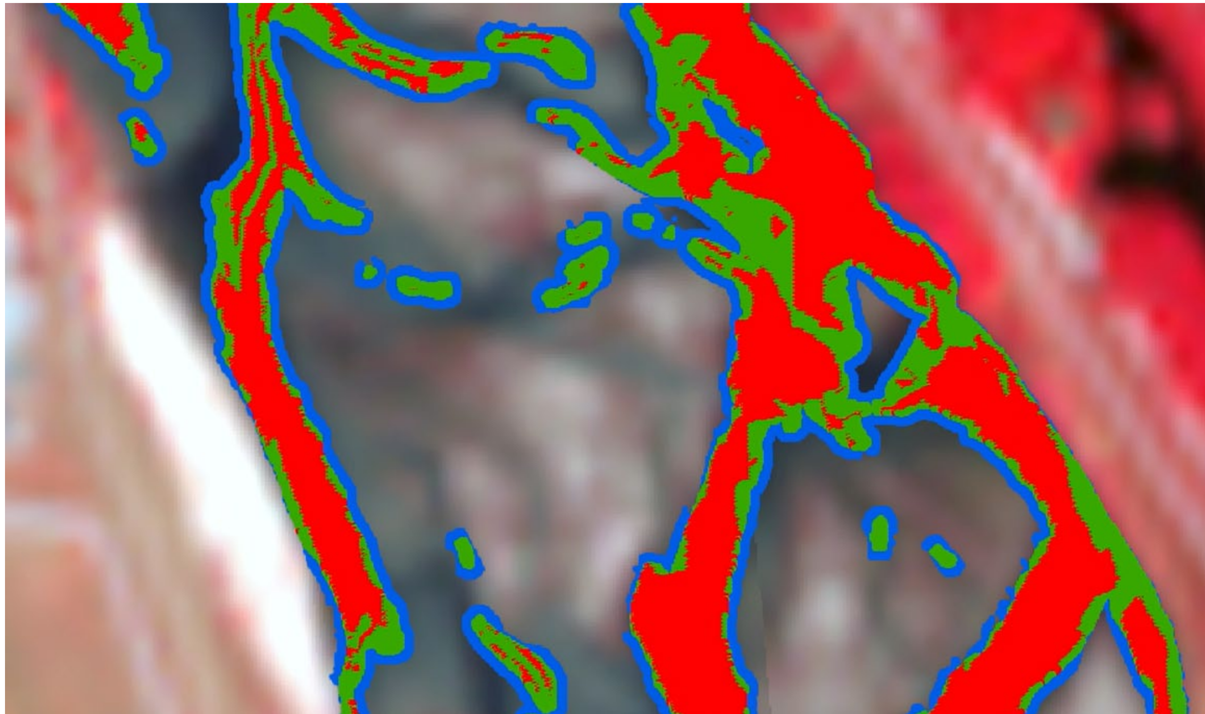
- Scope of Work/Schedule



Recap from February

- Scope of Work/Schedule
- Data Collection
- Model Development
  - Domain, Mesh, Breaklines, Structures, Flow Data, Computational Sensitivity, Mesh
- Bathymetry
  - Shallow vs. Deep
  - Aerial Imagery
  - Python Scripting



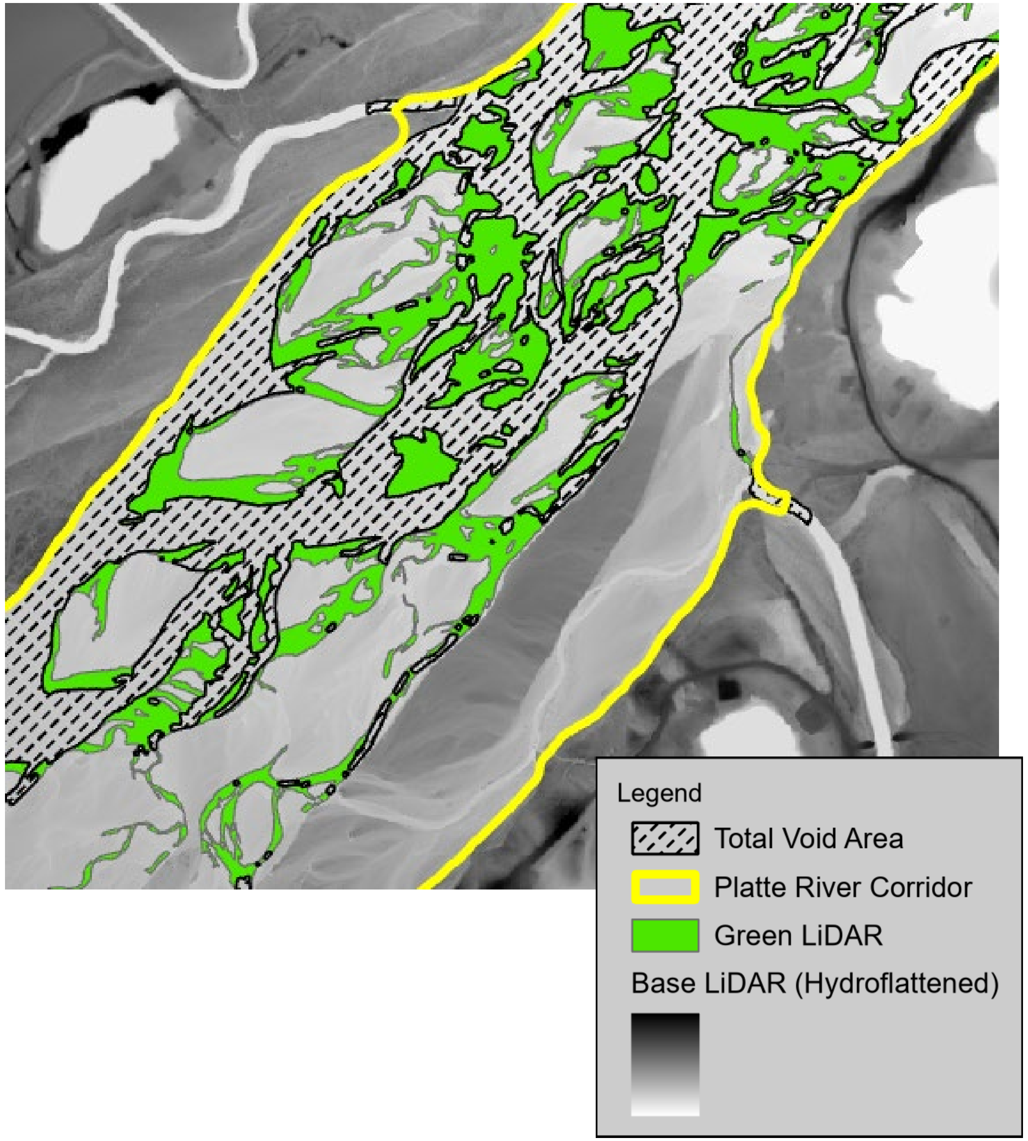


03

Bathymetry Overview

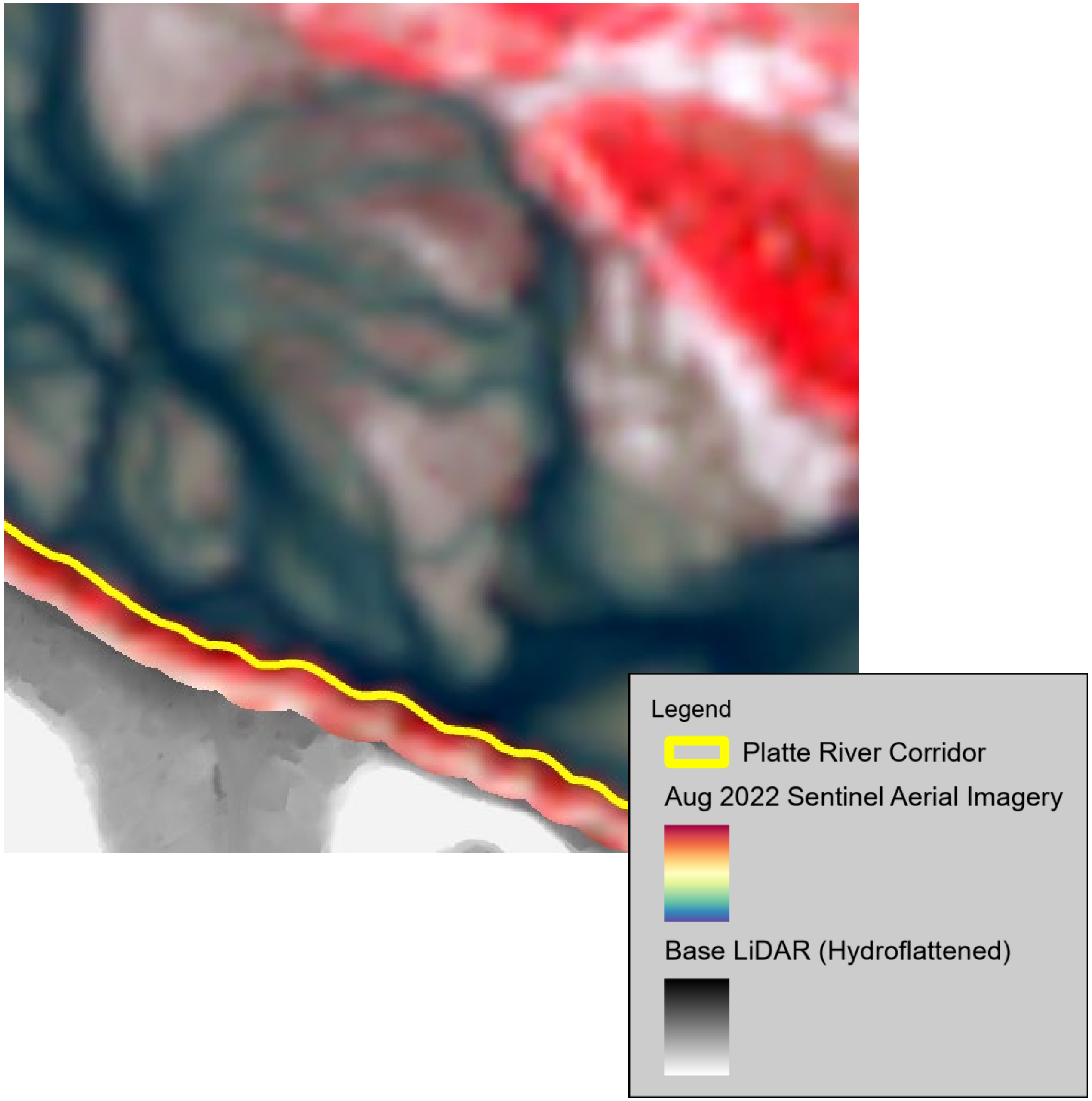
Bathymetry Overview

- River Corridor
- Voids
- Shallow Bathymetry Step 1
- Deep Bathymetry Area Identification
- Shallow Bathymetry Step 2
- Deep Bathymetry Process



Deep Bathymetry Areas

- False color imagery
- Red value
  - 25 to 45, increment of 5
  - 35 to 40, increment of 1
- Evaluation
  - Coverage
  - Avoid excessive overlap
  - Number of polygons
  - Continuity of flow



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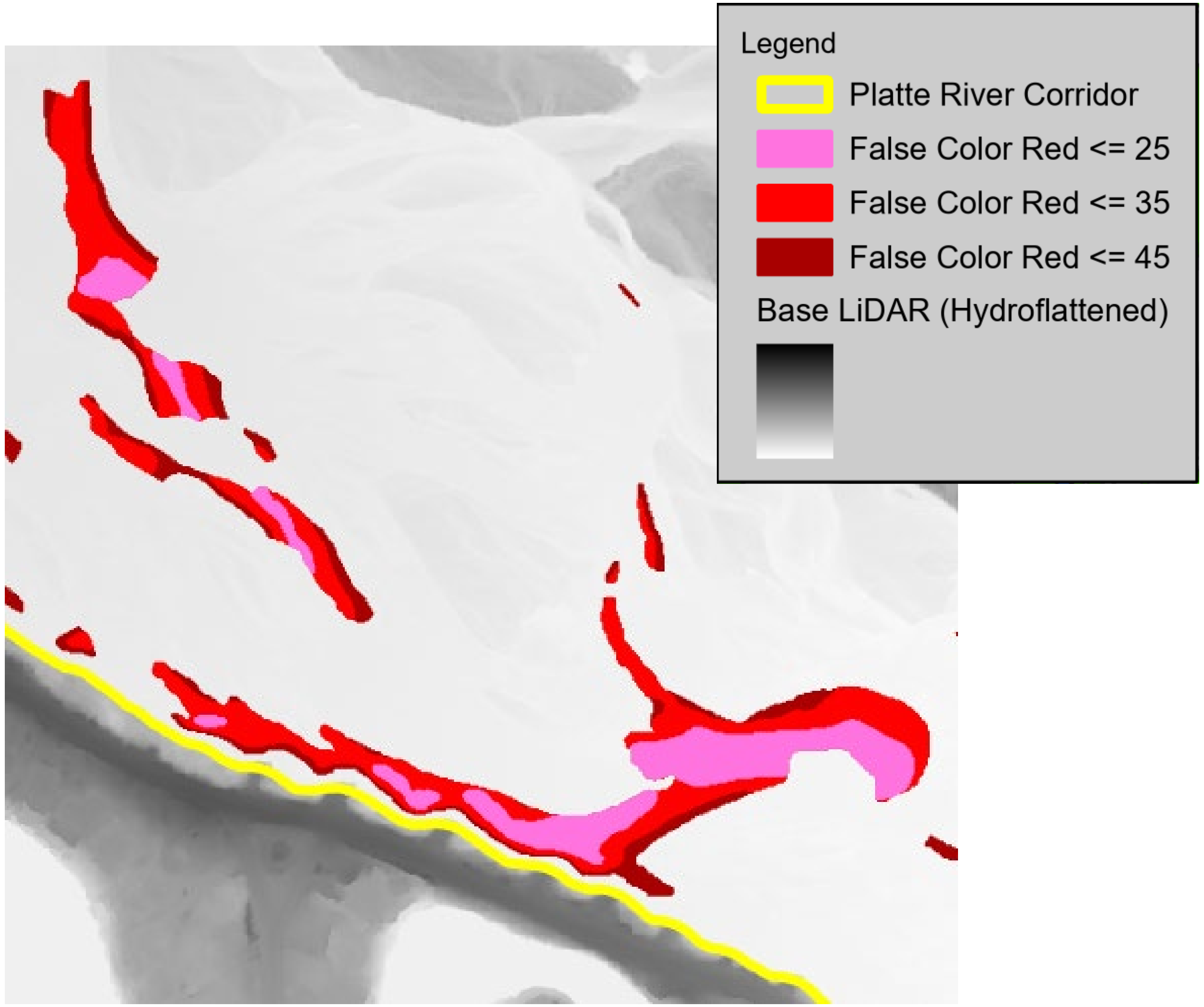

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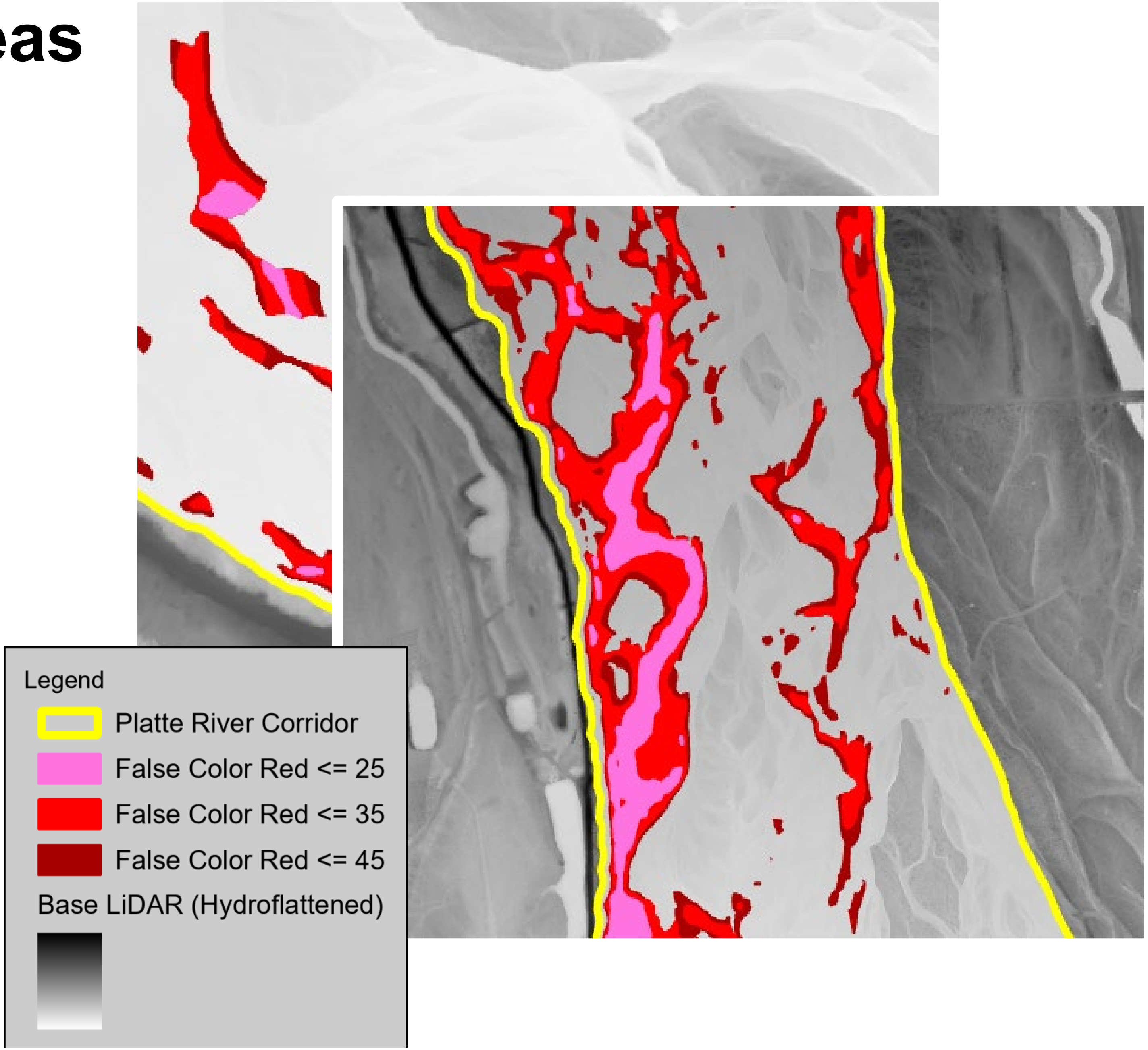
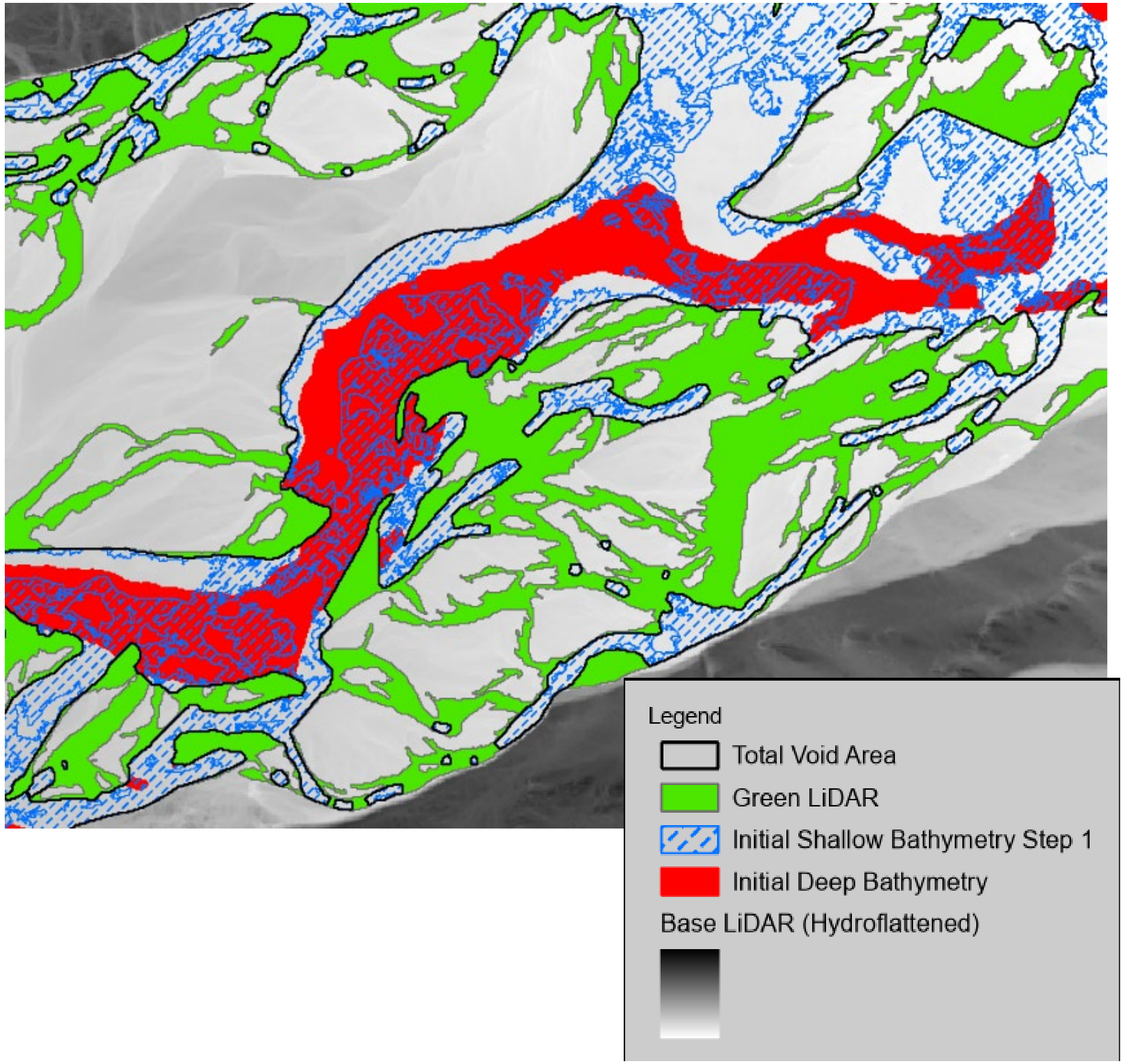


Shallow Bathymetry Step 2

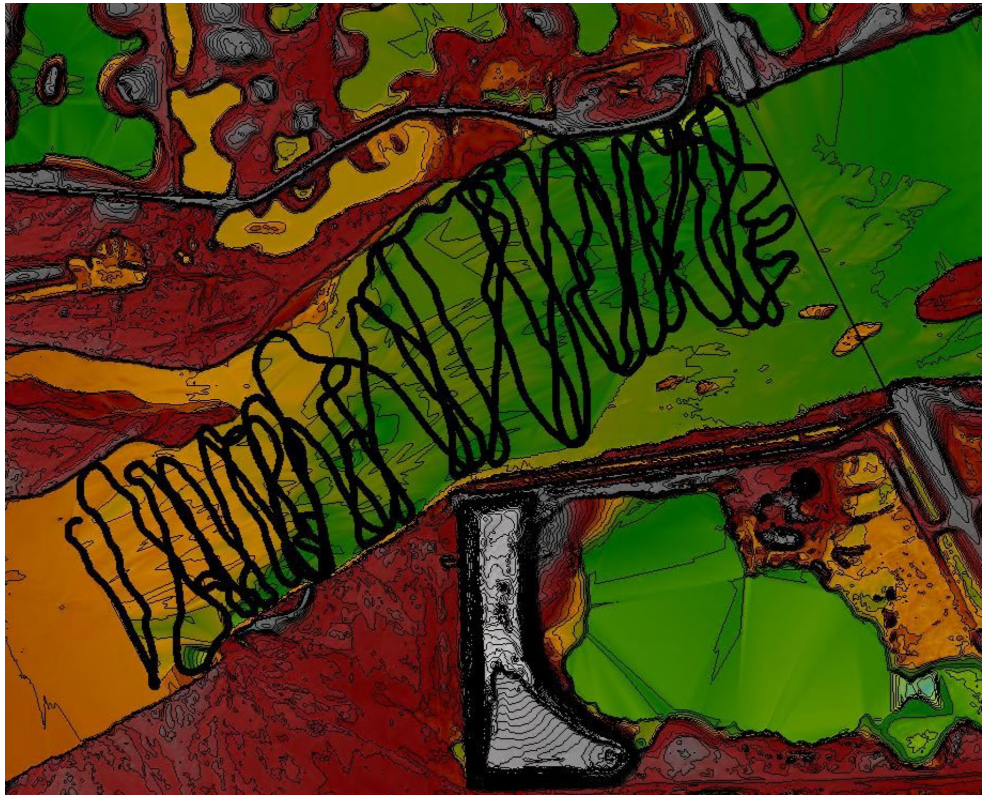
- Address the remaining points
- Supplemental processing of 4 million points
- Similar to Step 1, with values limited to depth range of nearest neighbors



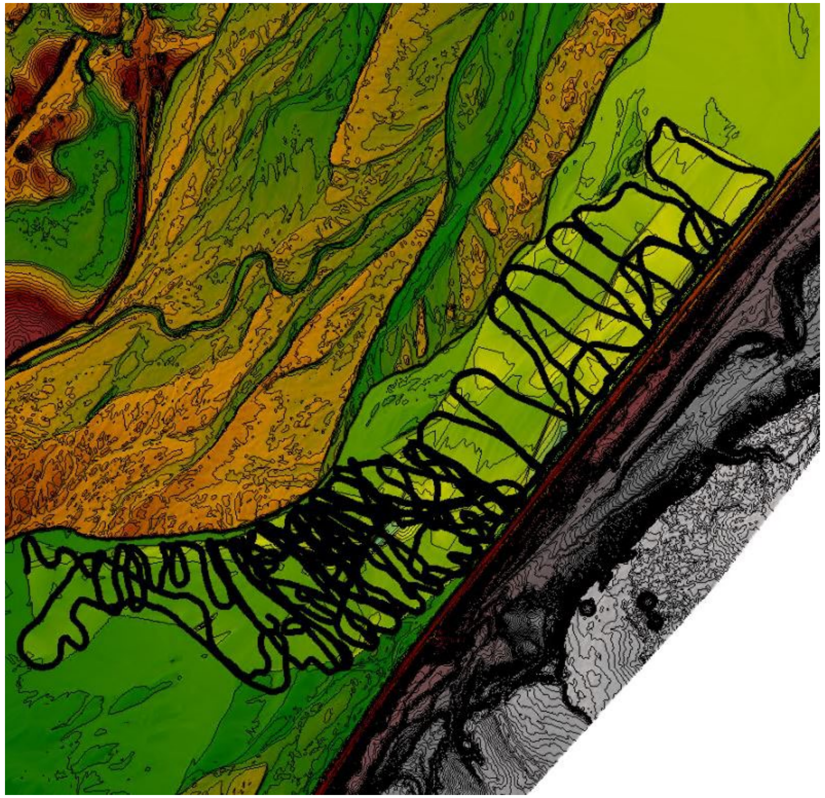
Deep Bathymetry Process

Process Selection

- Width-Depth Relationships



North Bend Vicinity UNL ADCP Data

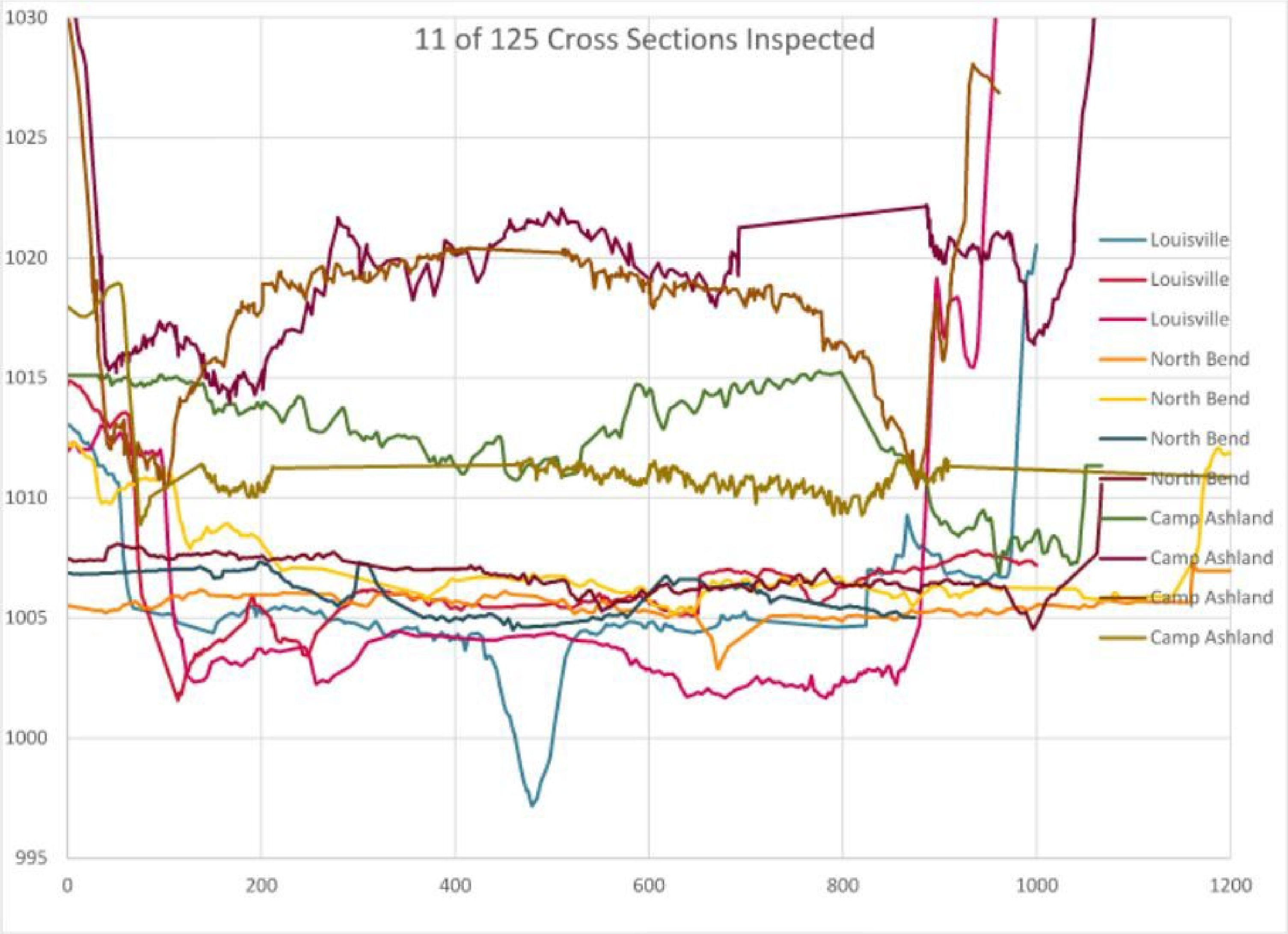


Louisville Vicinity UNL ADCP Data

Deep Bathymetry Process

Process Selection

- Width-Depth Relationships
- Conveyance Approach

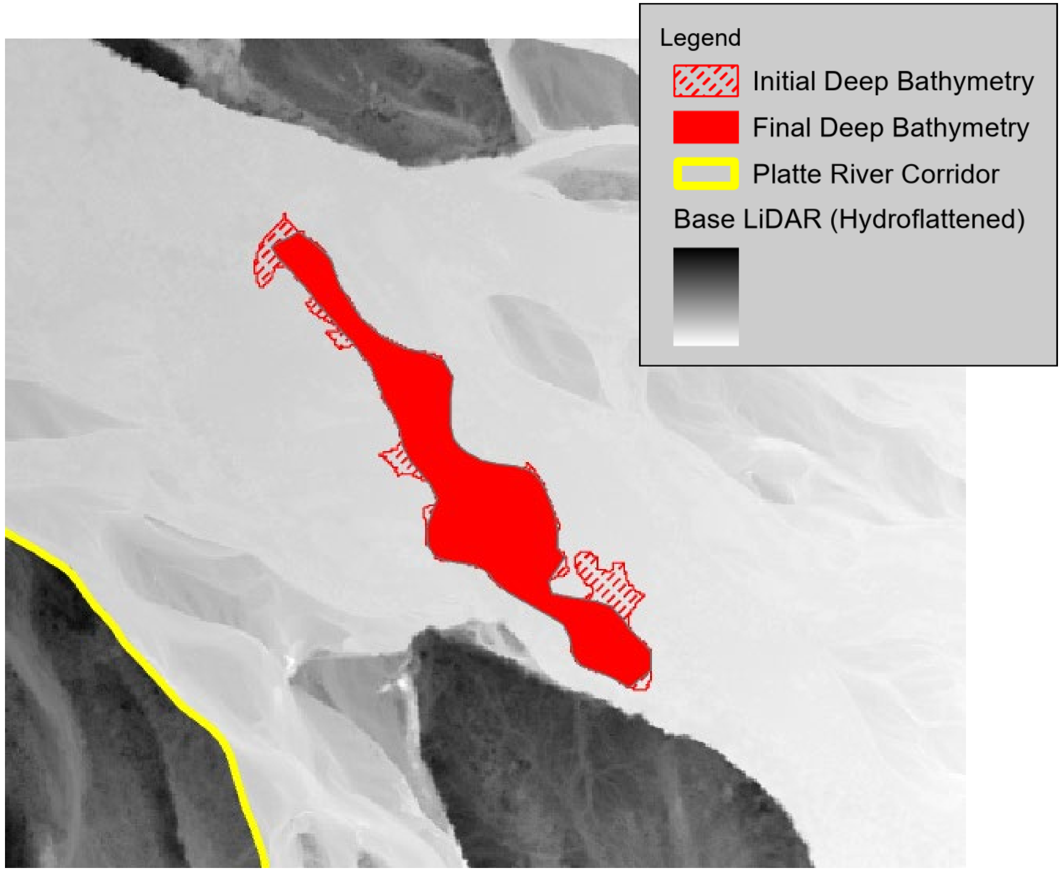


Width-Depth Evaluation Sample Cross Sections

Deep Bathymetry Process

Process Development

- Refine polygons
- Collapse polygons to create channel centerlines
- Refine centerlines
- Assign percentages to primary and secondary channels



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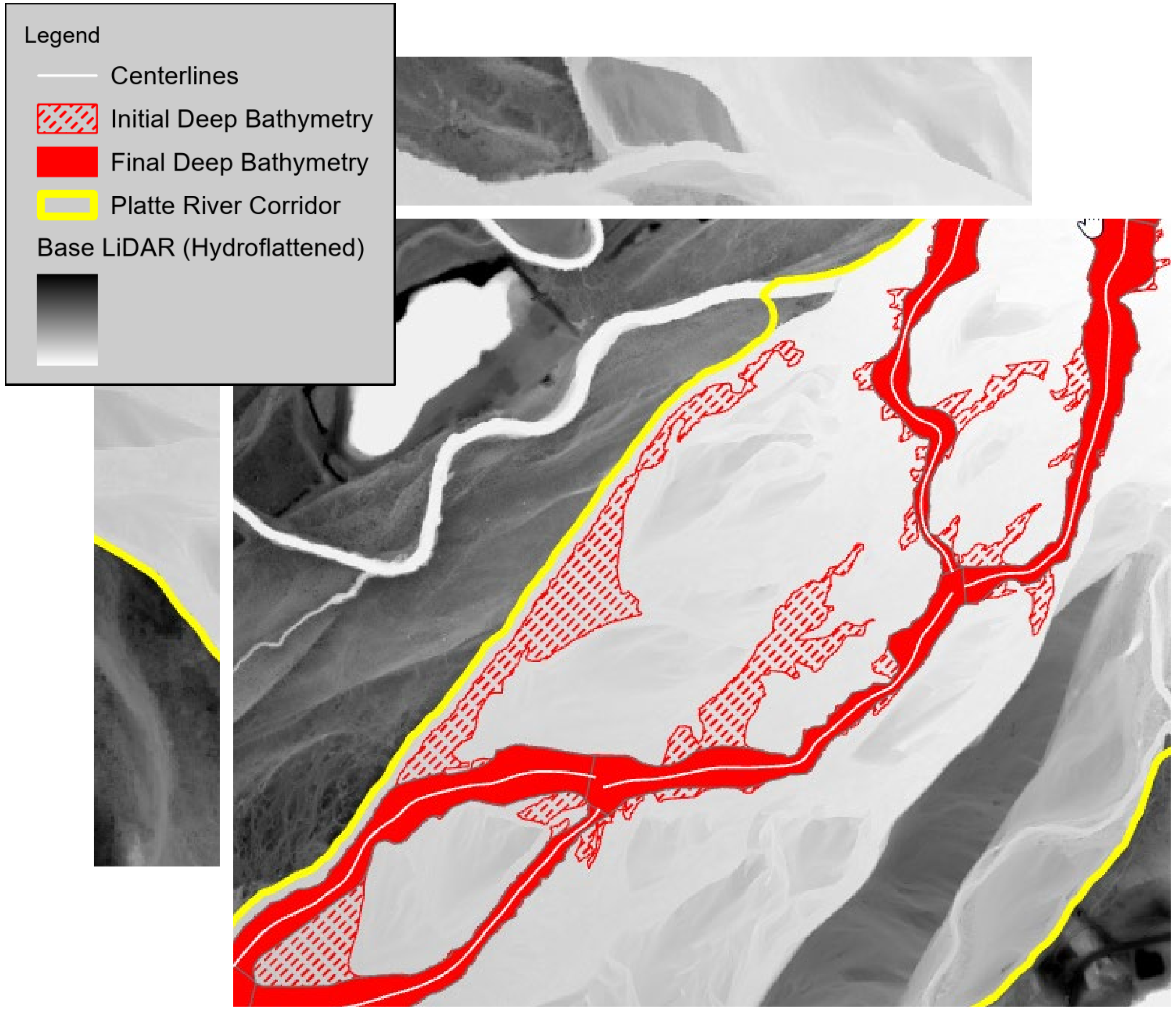
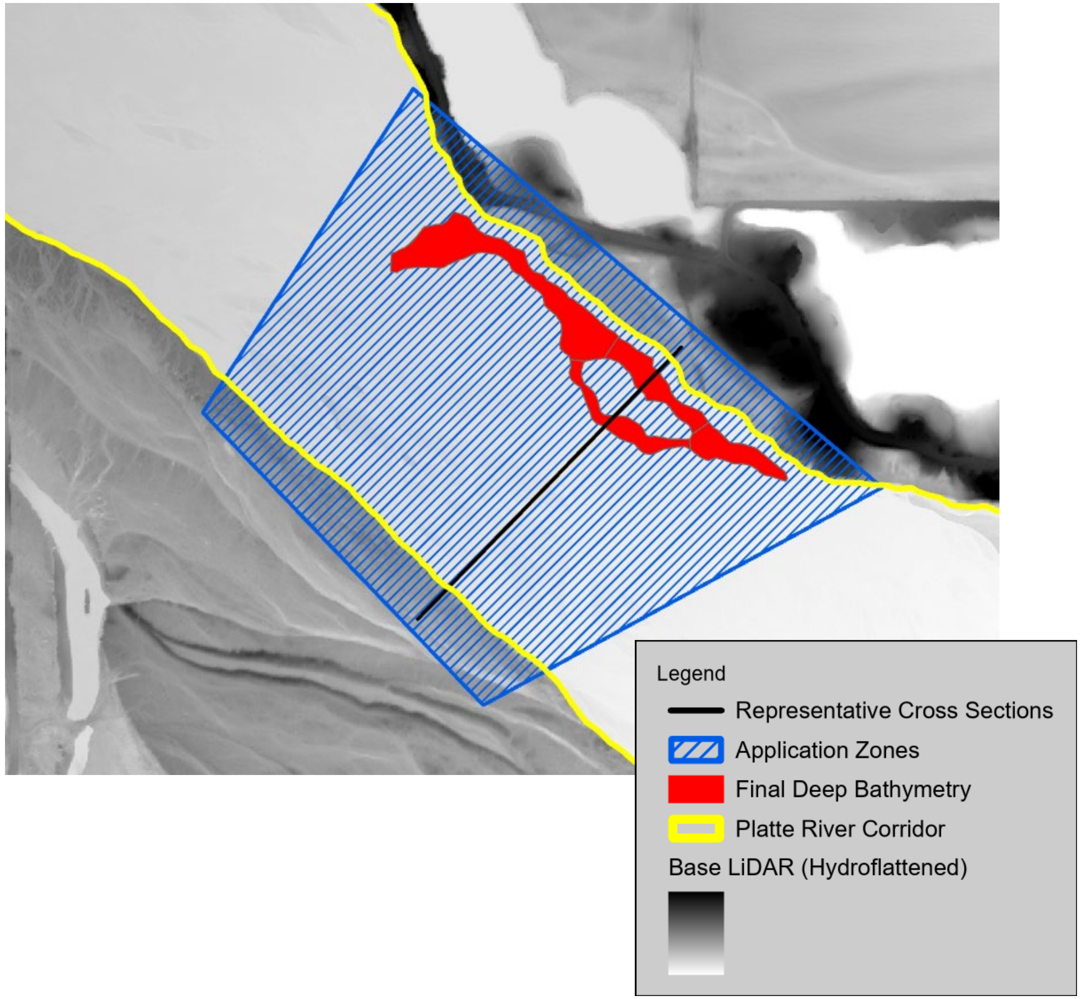


Deep Bathymetry Process

Process Development

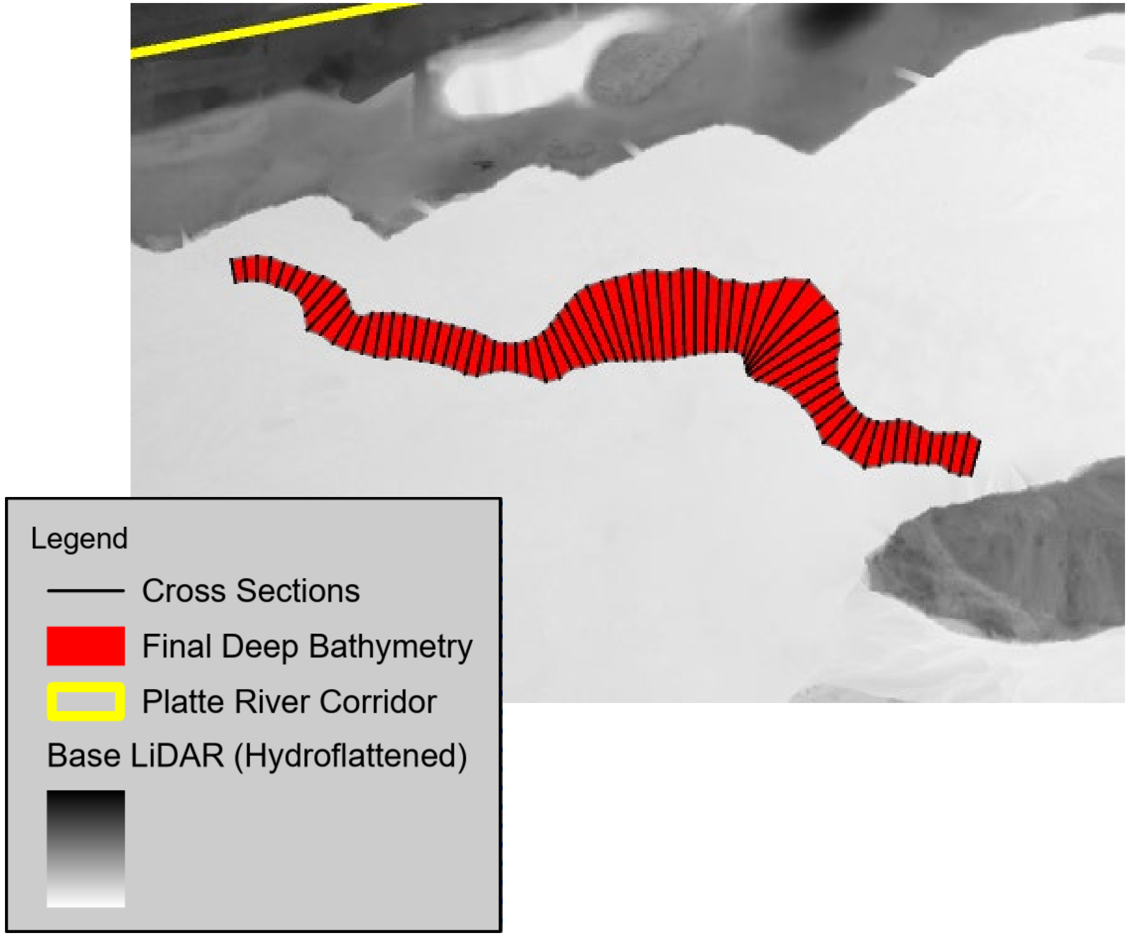
- Create representative cross sections
- Define zones for application
- Identify target flowrates
- Calculate shallow flow
- Calculate deep flow



Deep Bathymetry Process

Process Development

- Generate cross sections
- Develop channel geometry
  - Side slope ratio
  - Depth relationships
  - Manning’s n
  - Slope



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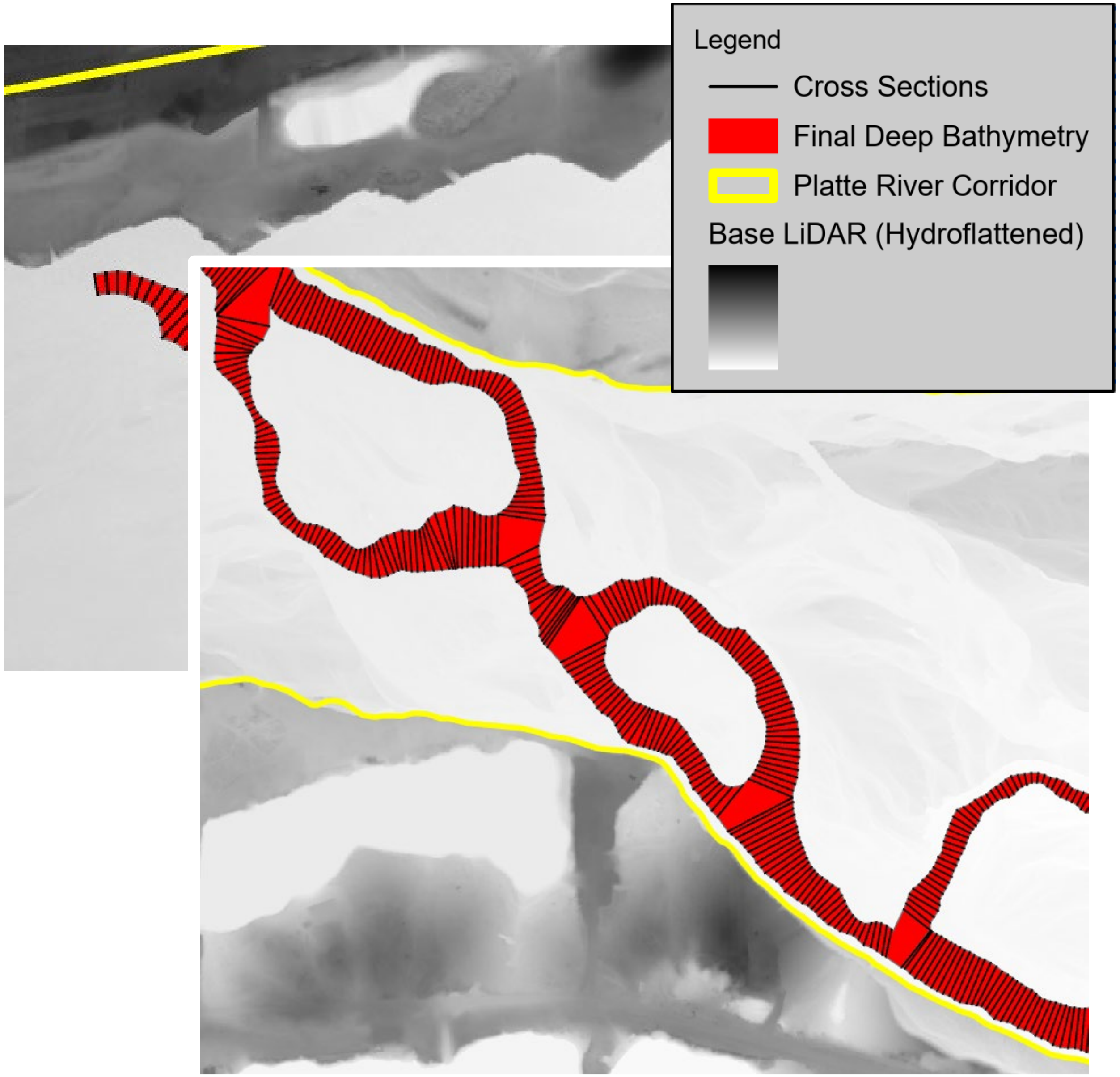

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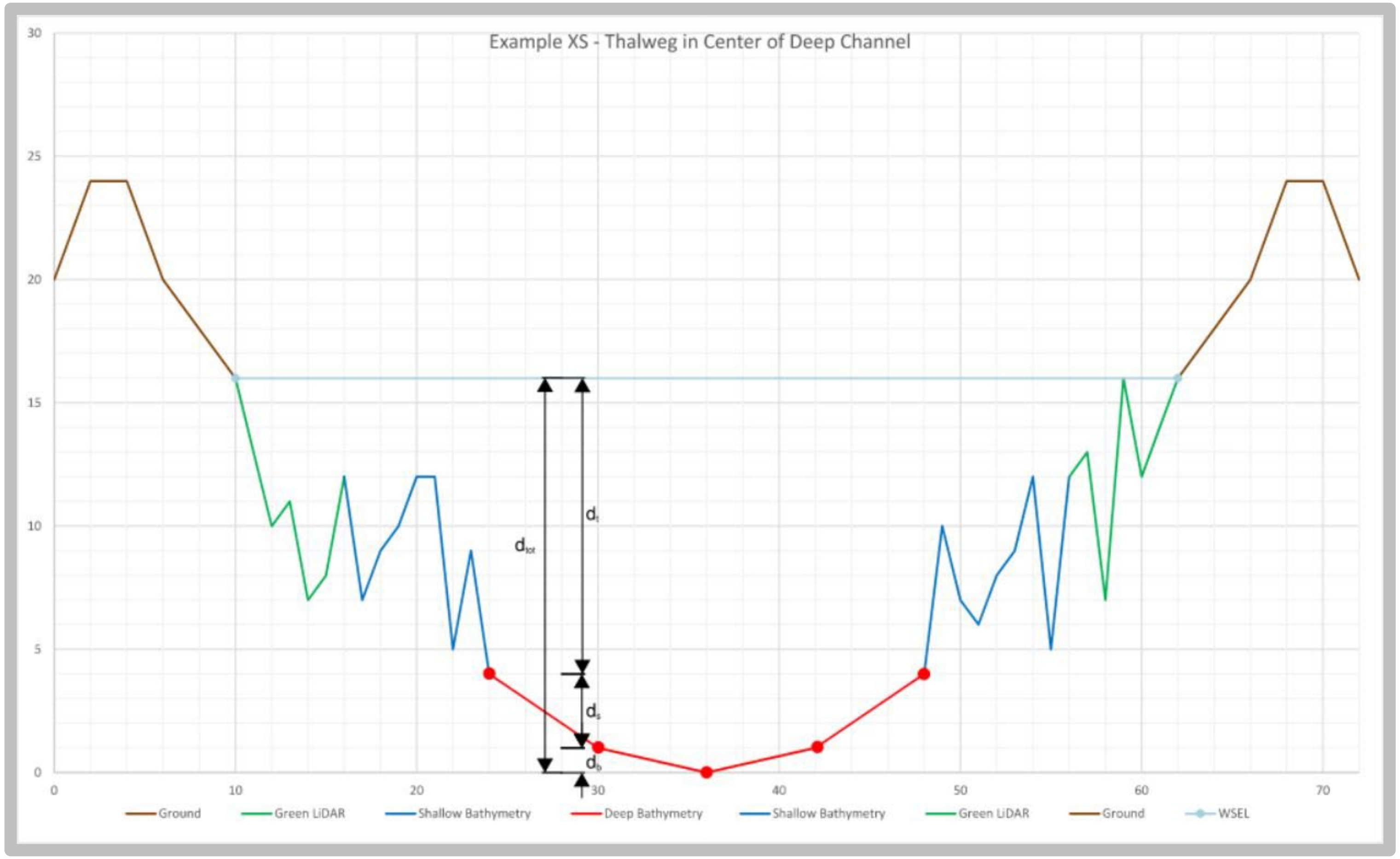
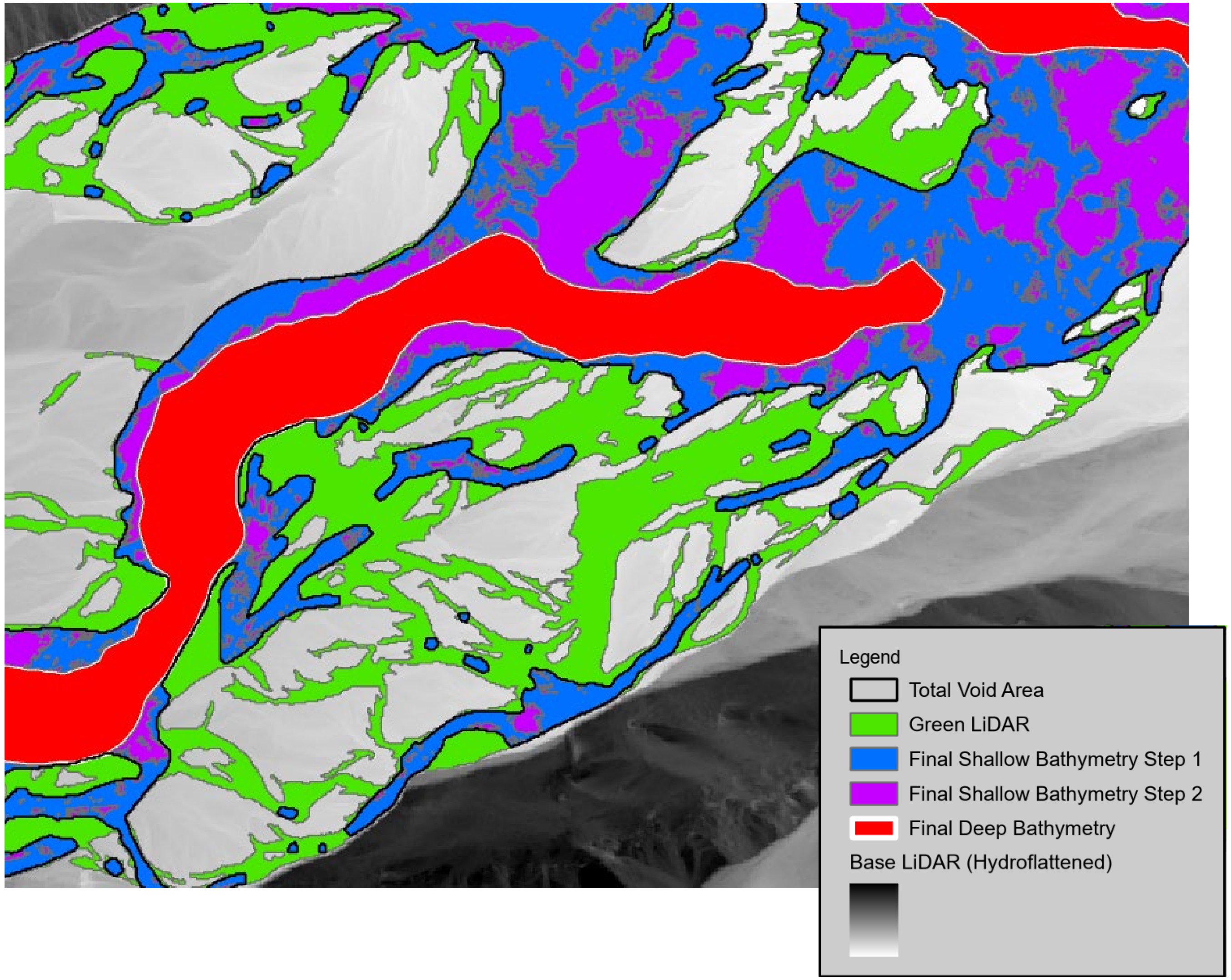


Conceptual Cross Section with Symmetrical Deep Channel

Deep Bathymetry Process

Process Implementation

- 148 deep bathymetry polygons
- Create 3D cross section lines
- Generate TIN
- Convert TIN to raster
- Raster integration to create full topobathymetric surface



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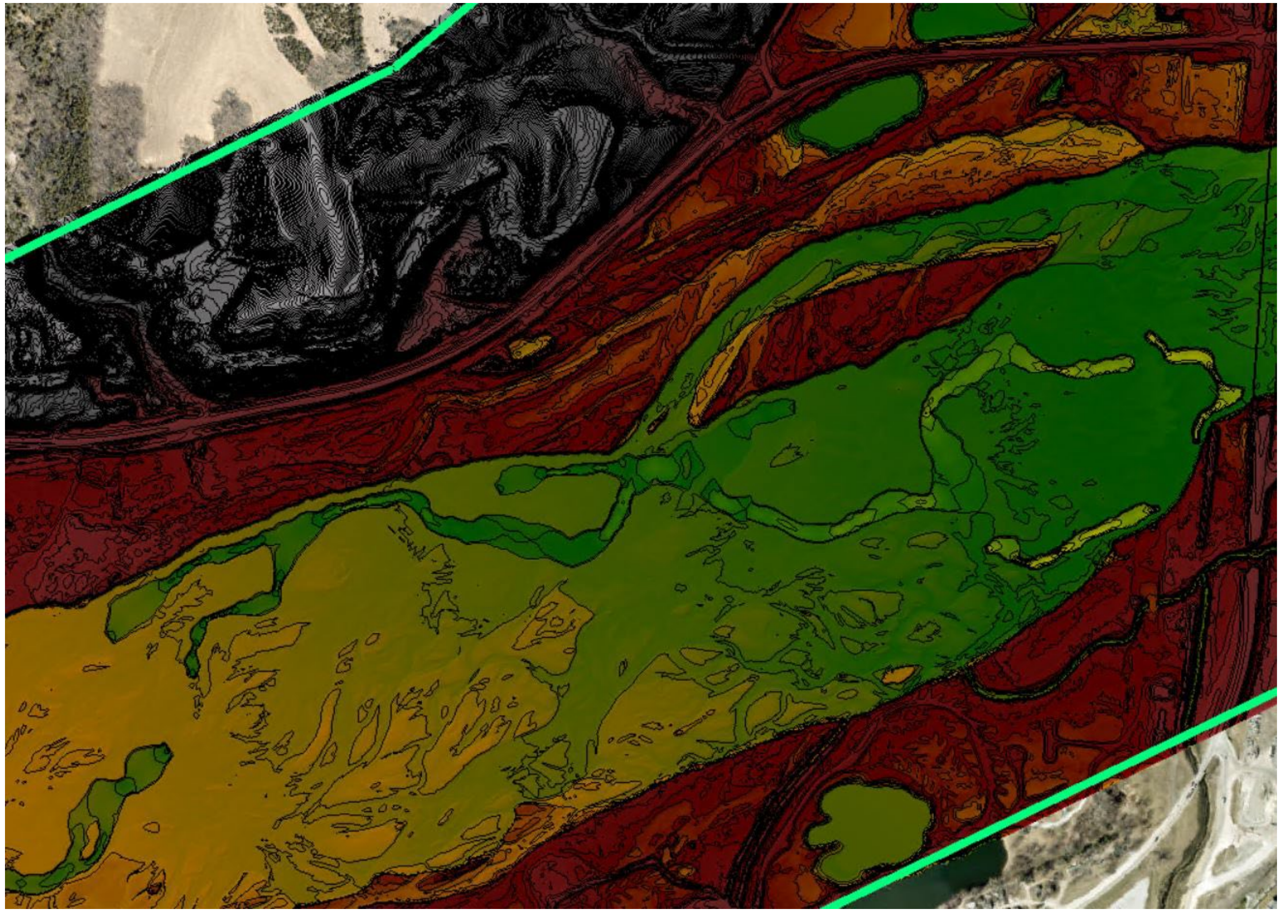


Model Domain with Initial Full Topobathymetric Surface

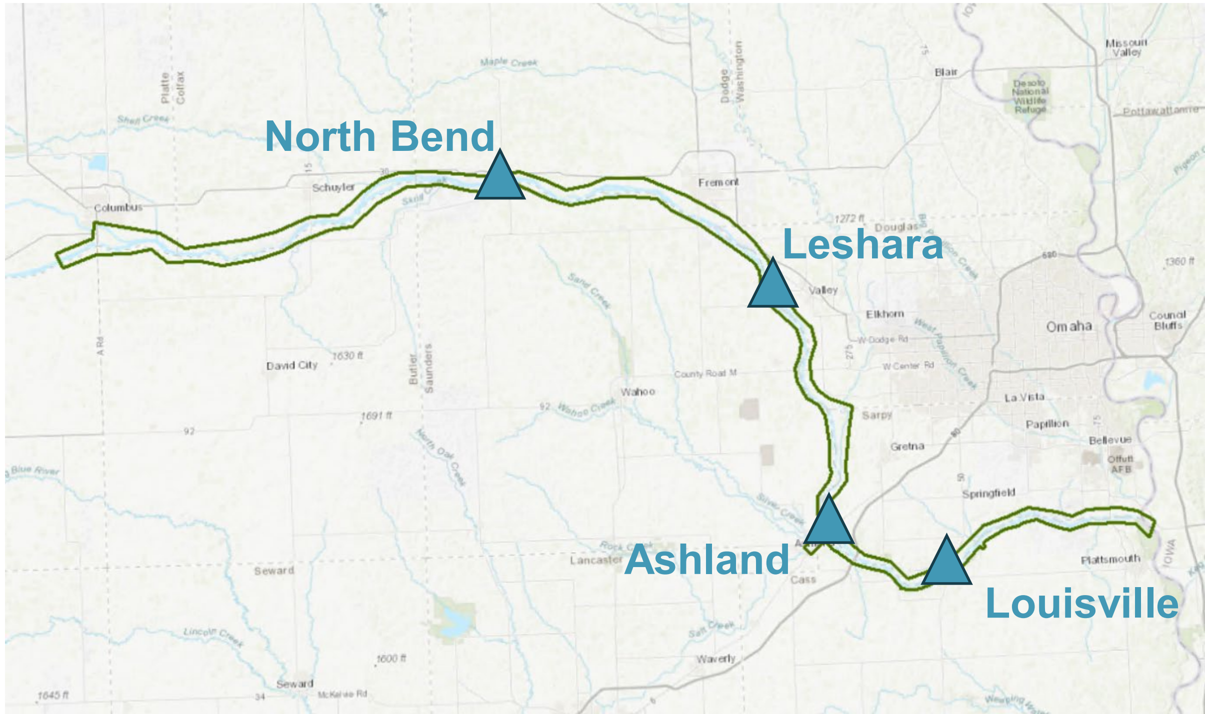
04

Calibration

Calibration

- Bathymetry
- Manning's n values
  - River Corridor
  - Deep Bathymetry
  - Islands
- Calibration Gages
  - North Bend
  - Leshara
  - Ashland
  - Louisville

Candidate Calibration Events	Nominal Flowrate, cfs
Aug. 2022	1,500
Jan. 2023	6,000
May 2023	12,000
Mar. 2023	20,000



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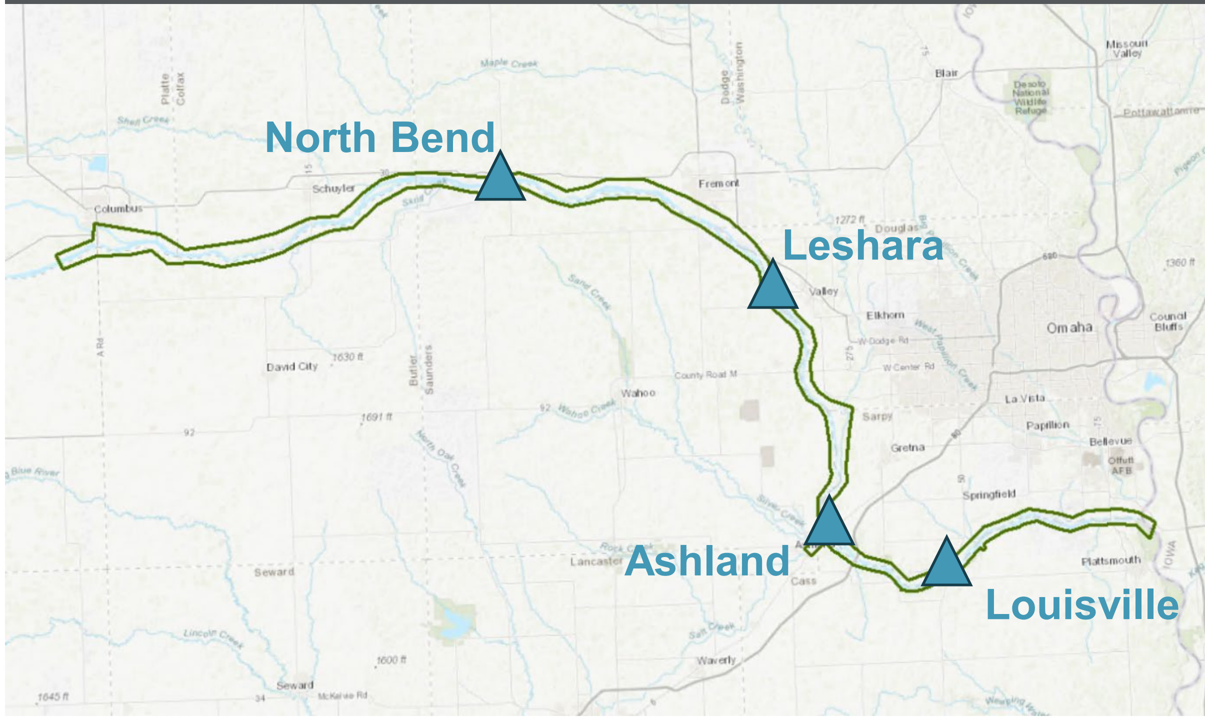
Scenario Runs

Hydraulic Model Scenarios

Scenario	Flowrate, cfs
1	1,000
2	1,500
3	2,000
4	2,500
5	3,000
6	4,000
7	6,500
8	10,000
9	20,000
10	45,000

Note: $Q_{2\text{-year}}$ = 46,000 cfs (Louisville)



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06

Next Steps

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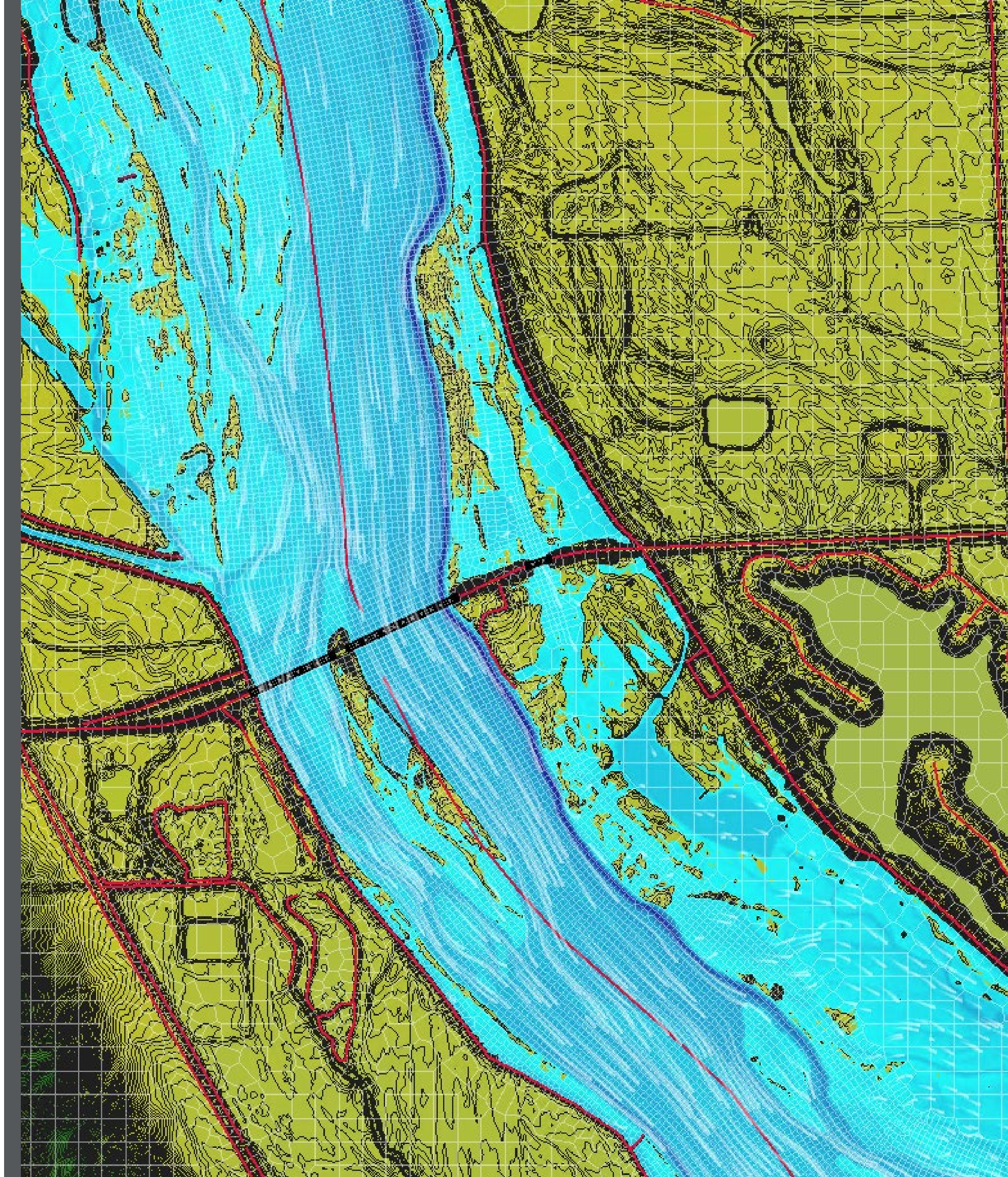
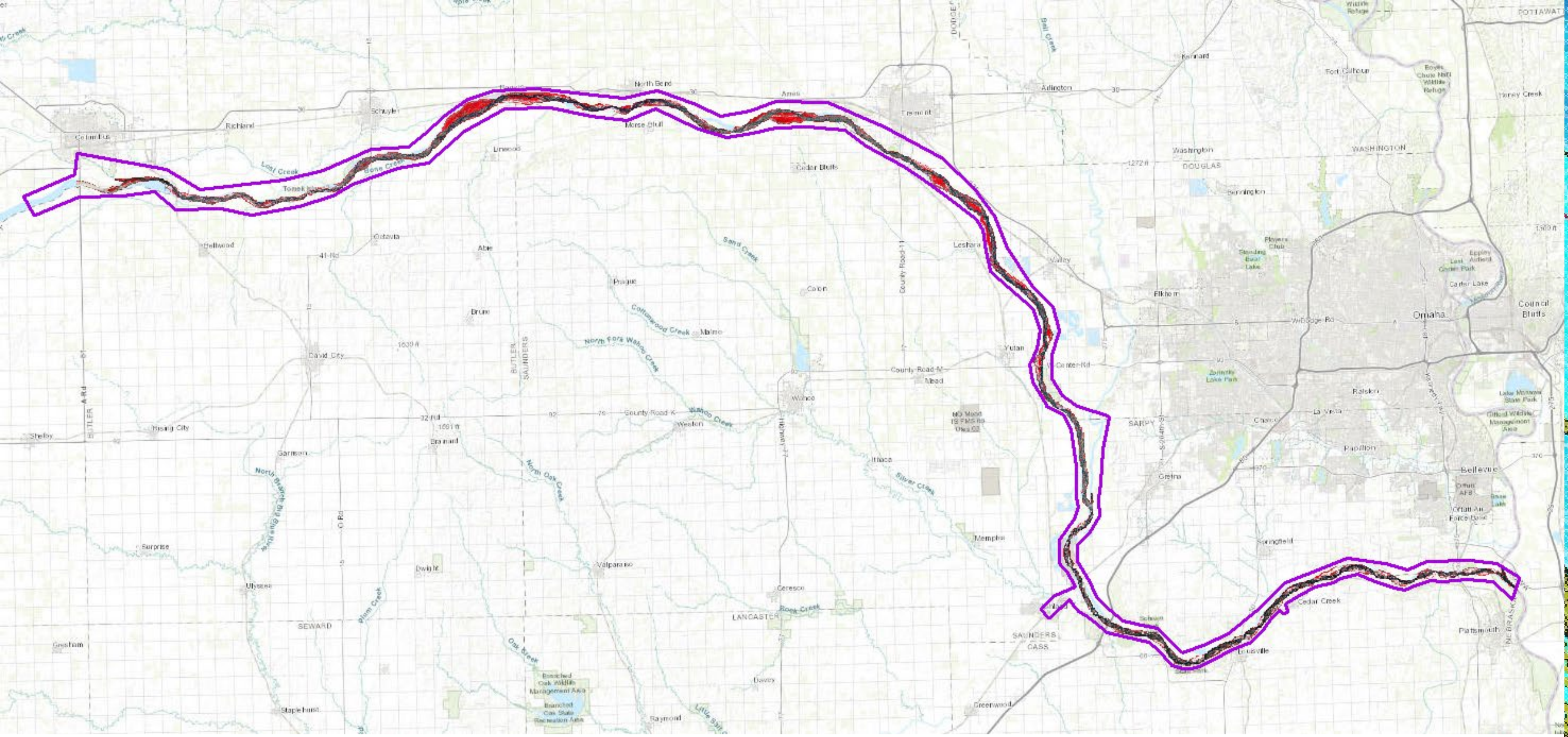
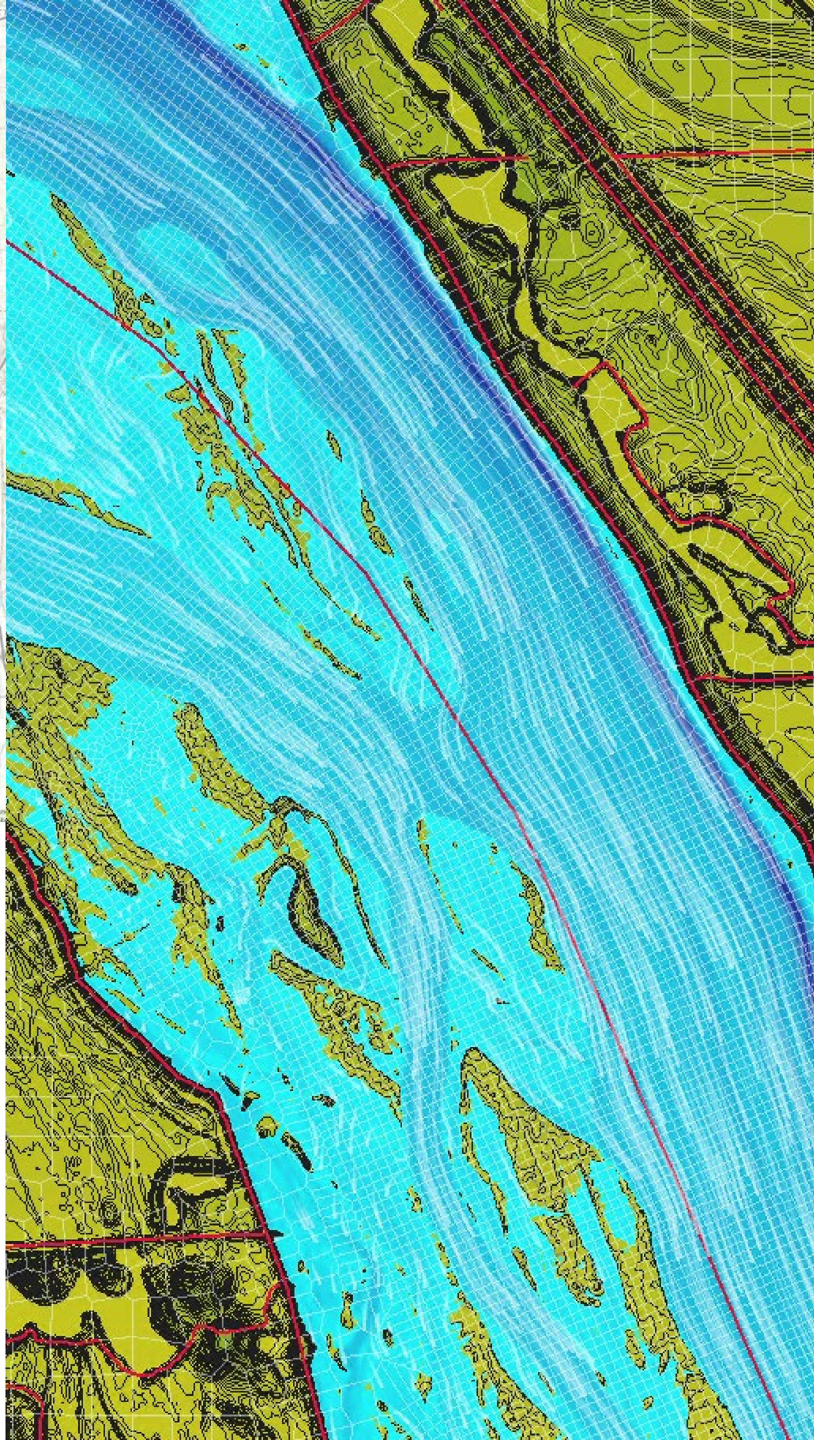
- Draft Report
- Complete Scenario Runs
- Prepare Geodatabase
- Progress Meeting #4
- Finalize Report/Geodatabase







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