RiskMAP
Increasing Resilience Together

No Cell Left Behind: North Dakota Statewide 2D Modeling and Mapping

FEMA

compass
Identify, Interpret, Integrate

Acknowledgements

- **David Sutley, FEMA Region VIII**
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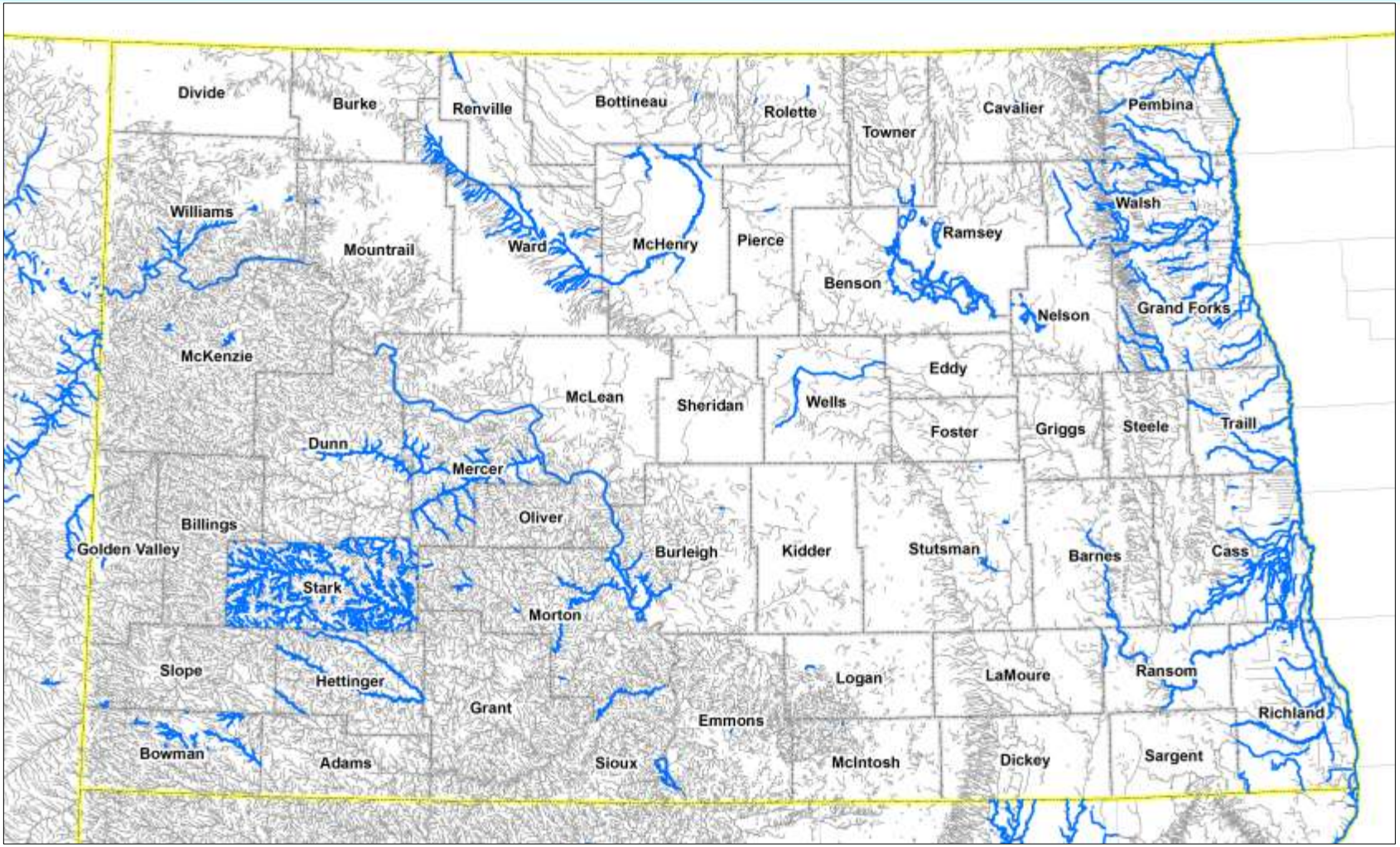
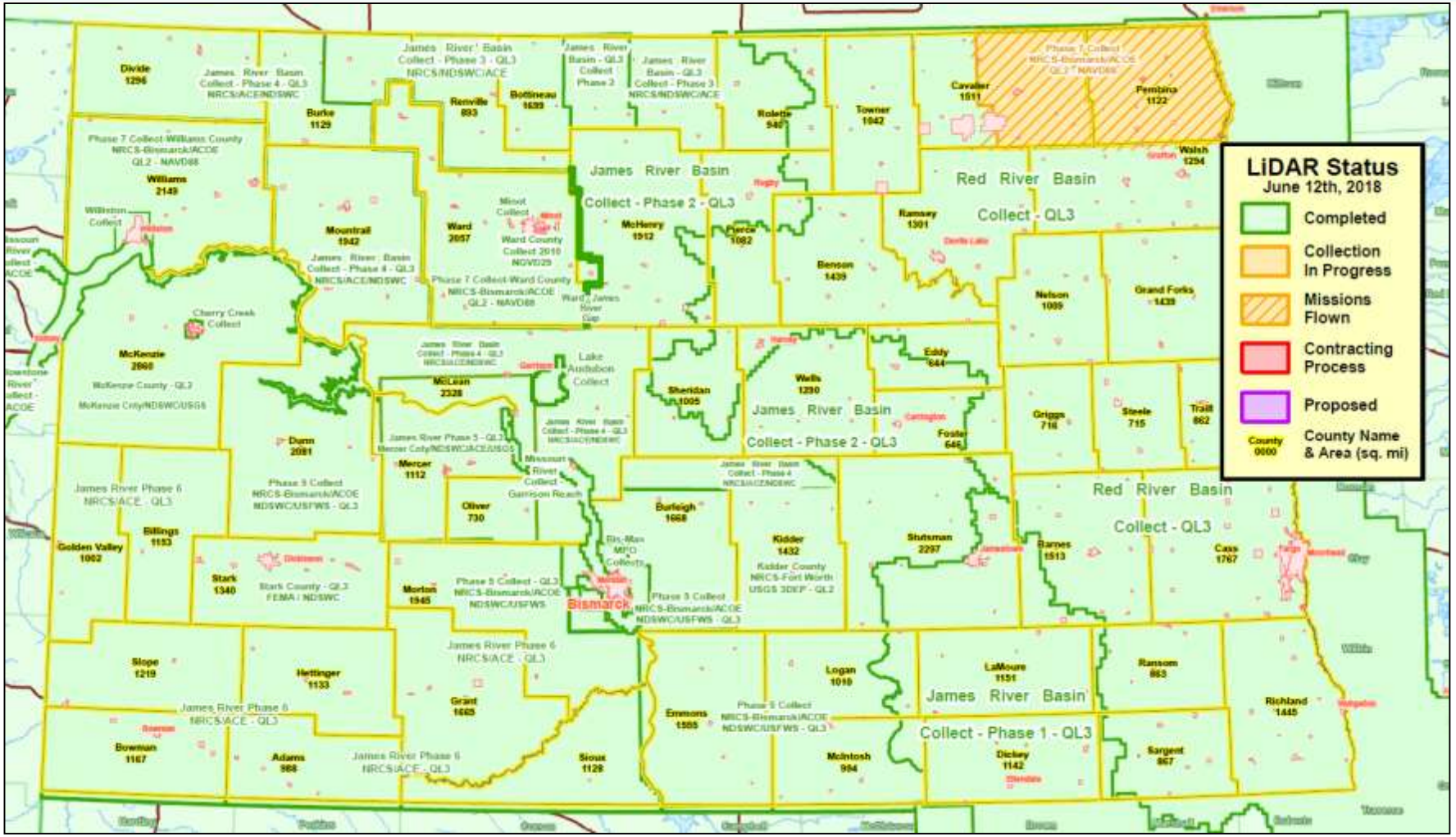
- **Laura Horner, North Dakota State Water Commission**
  - LMHorner@nd.gov
- **Brandon Banks, Compass PTS JV**
  - Brandon.Banks@aecom.com

Largely Unmapped



Statewide LiDAR



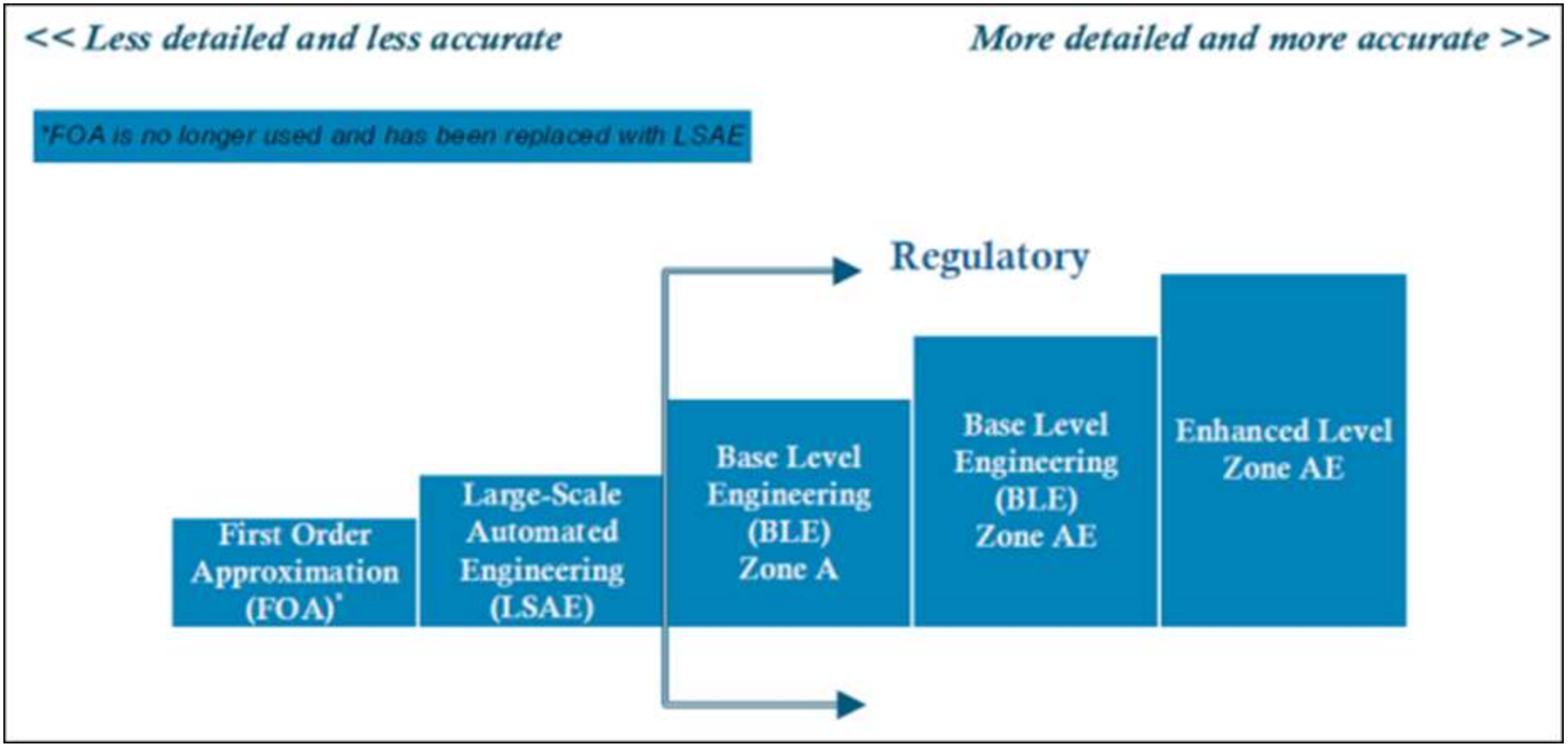
Alignment with Risk MAP Goals

- **Delivering high-quality risk data**
  - Coordinated Needs Management Strategy (CNMS)
  - New, Validated, or Updated Engineering (NVUE)
- **Increasing awareness of flood risk**
  - Percent of local officials aware of flood risk affecting their communities
- **Promoting community mitigation action**
  - Percent of population acting on community planned mitigation strategies
- **Building towards TMAC recommendations**
  - Structure-based risk and flood frequency determination
  - Database driven, digital display environment
- **Reduce risk to lives and property**

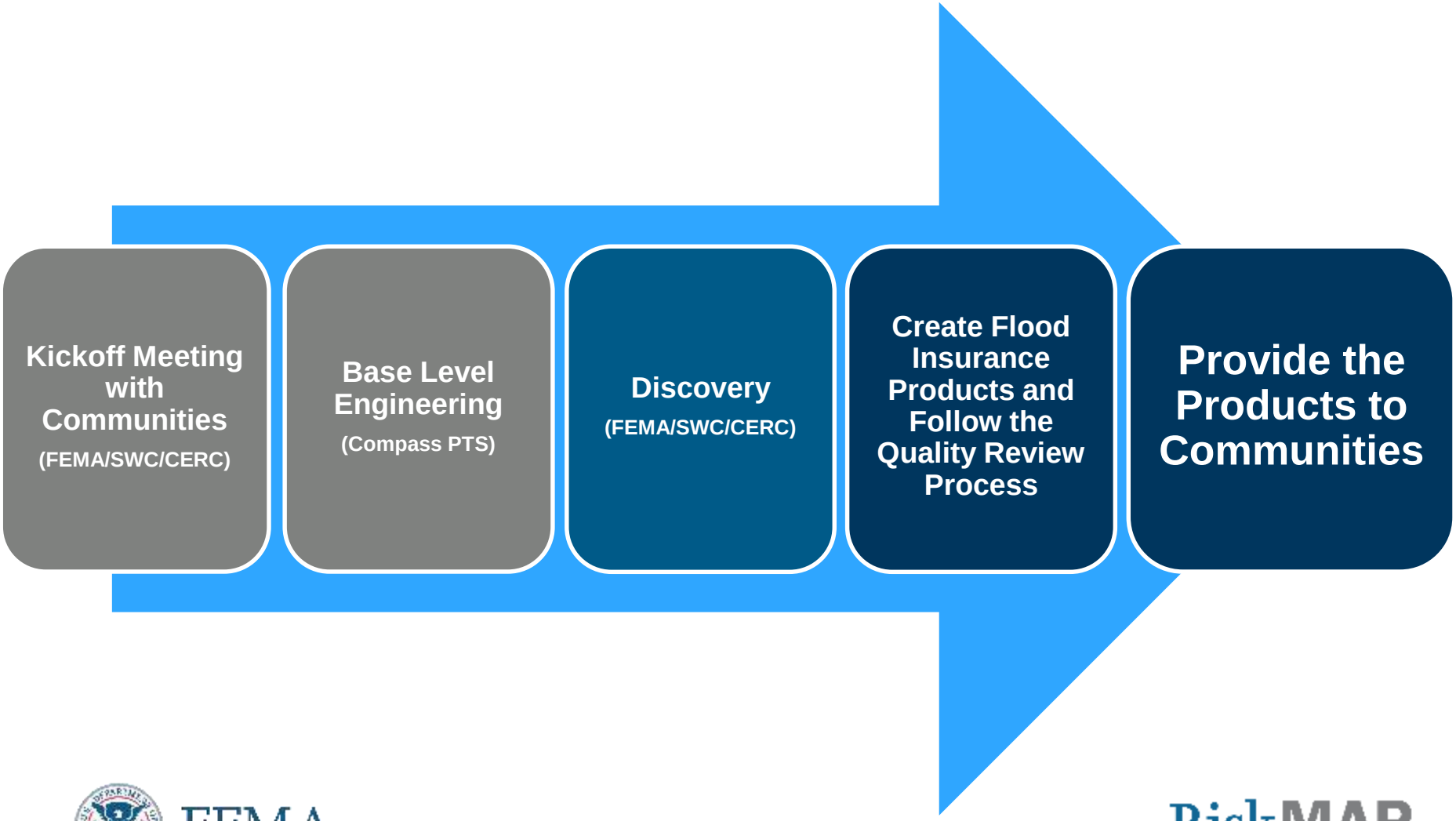
Awareness for Mitigation Action

National Benefit-Cost Ratio Per Peril *BCR numbers in this study have been rounded	Federally Funded	Beyond Code Requirements
Overall Hazard Benefit-Cost Ratio	6:1	4:1
Riverine Flood	7:1	5:1
Hurricane Surge	Too few grants	7:1
Wind	5:1	5:1
Earthquake	3:1	4:1
Wildland-Urban Interface Fire	3:1	4:1

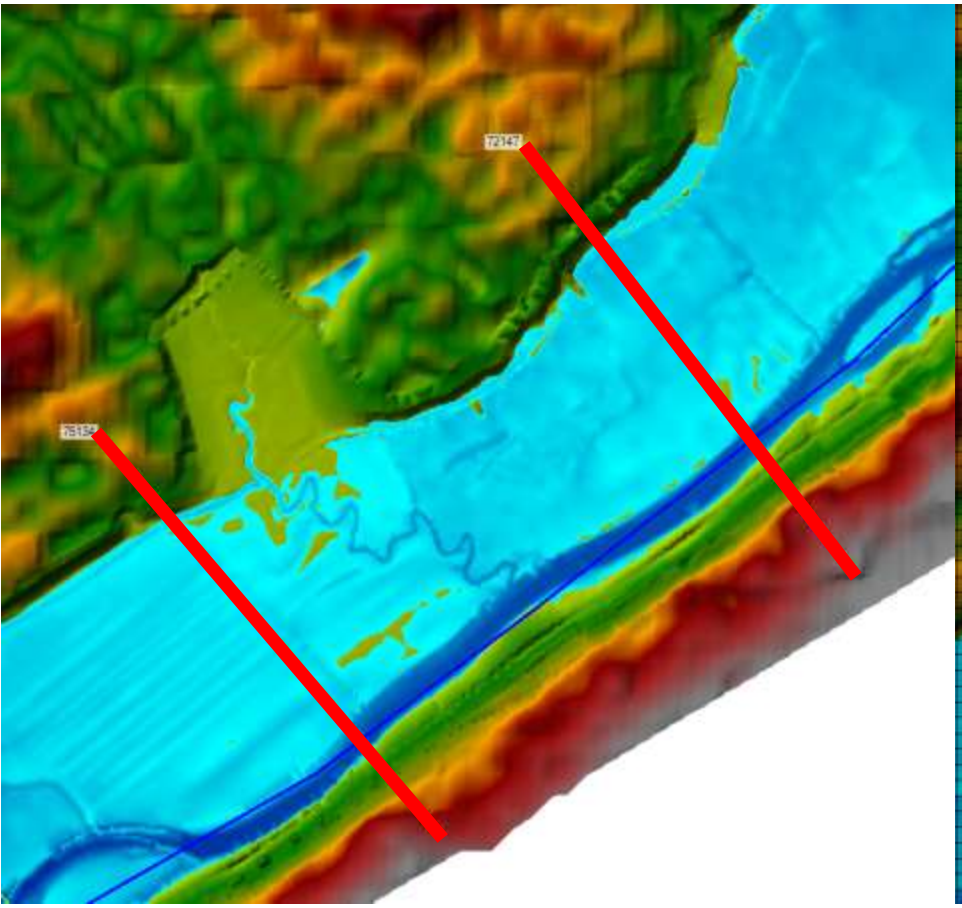
LSAE vs BLE

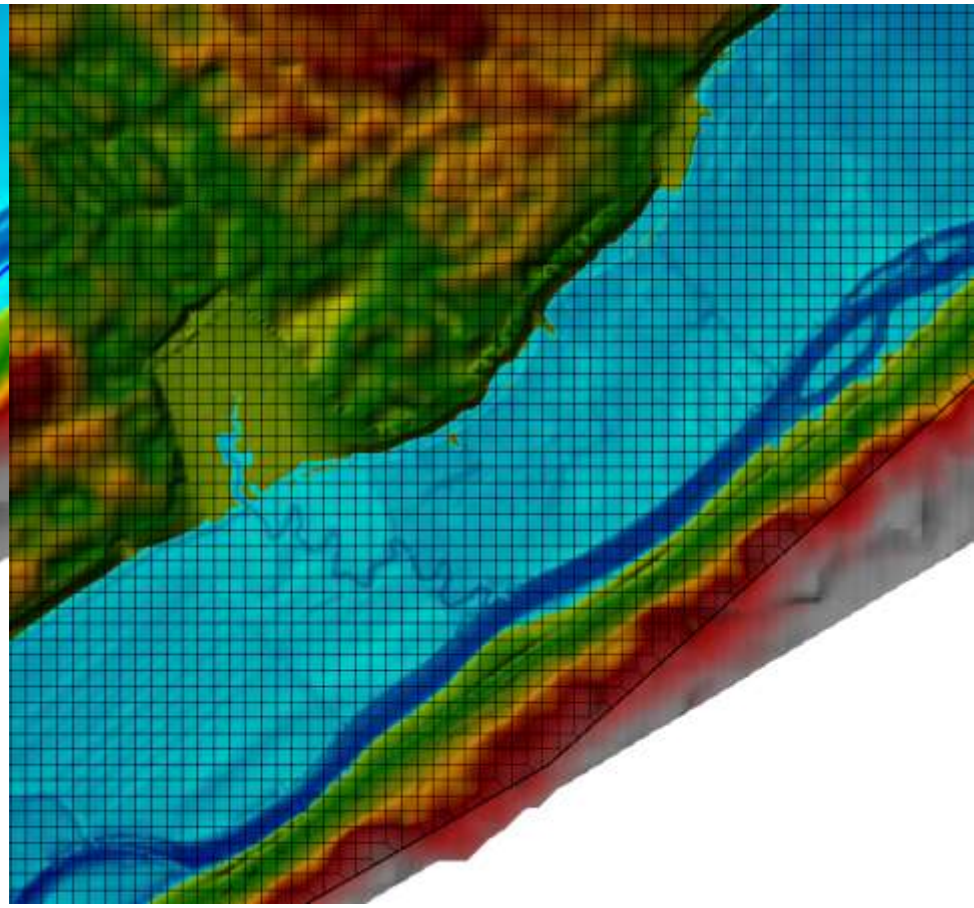

<< Less detailed and less accurate
More detailed and more accurate >>
*FOA is no longer used and has been replaced with LSAE
Regulatory
First Order Approximation (FOA)*
Large-Scale Automated Engineering (LSAE)
Base Level Engineering (BLE) Zone A
Base Level Engineering (BLE) Zone AE
Enhanced Level Zone AE

FEMA Process

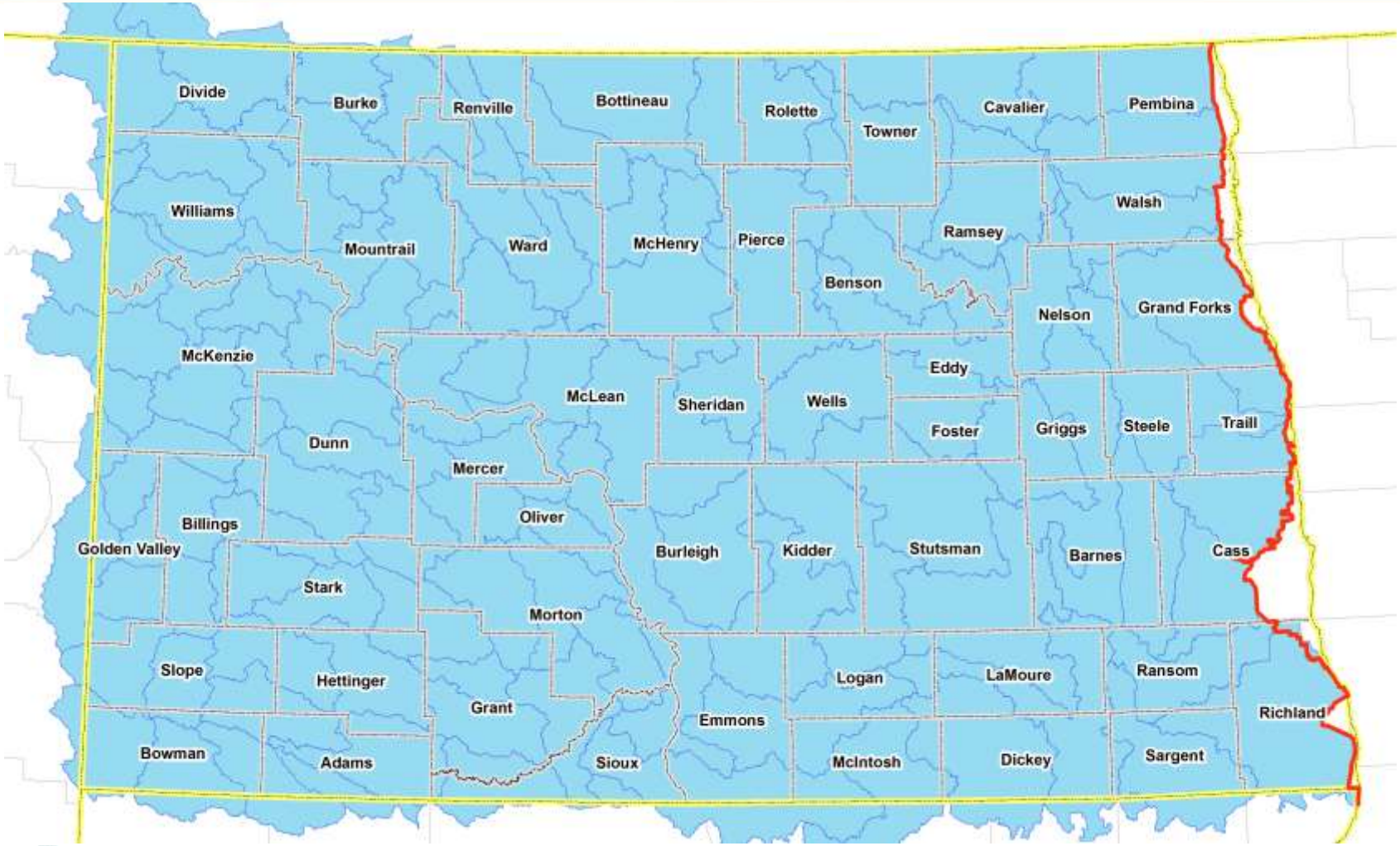


1D or 2D?

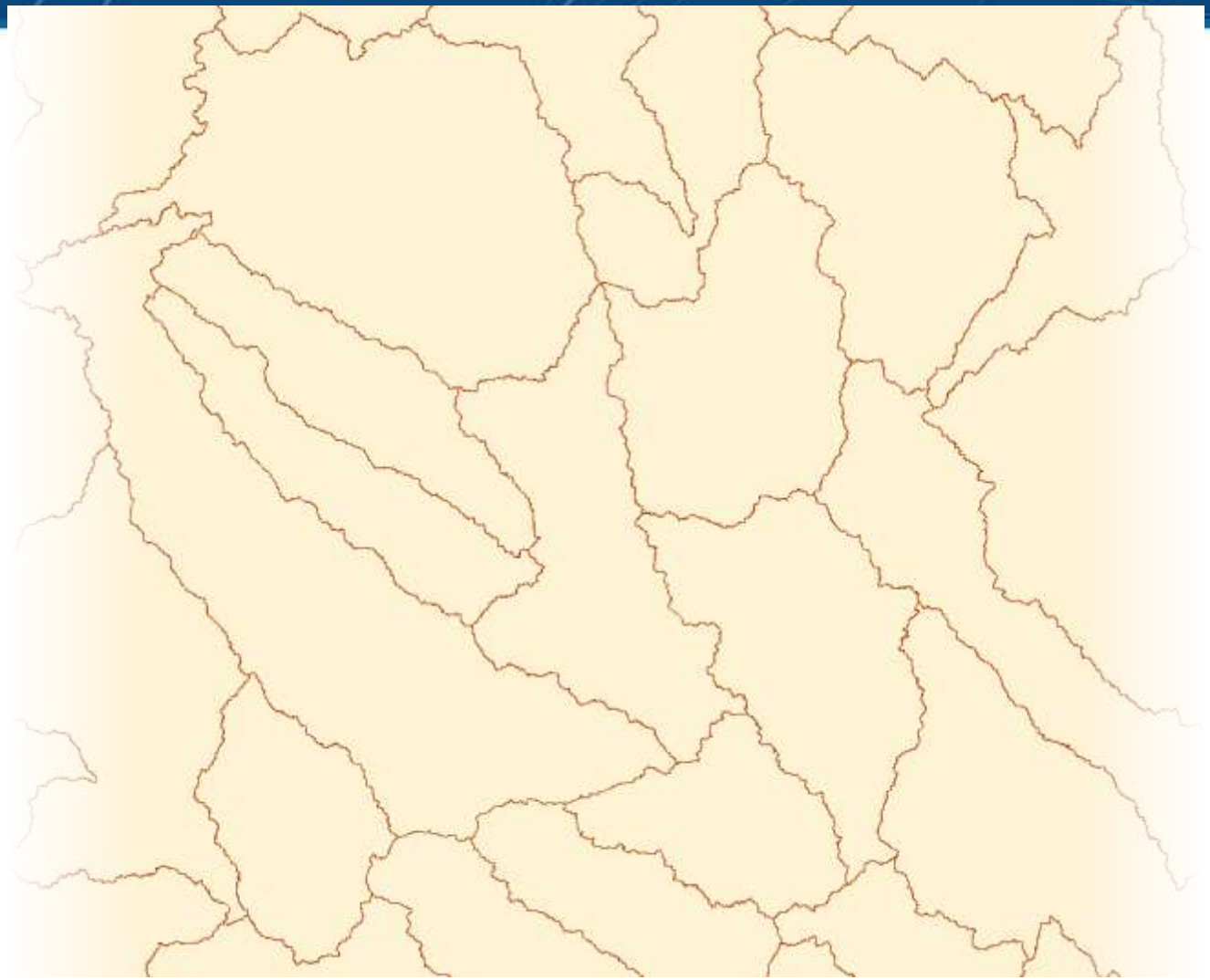




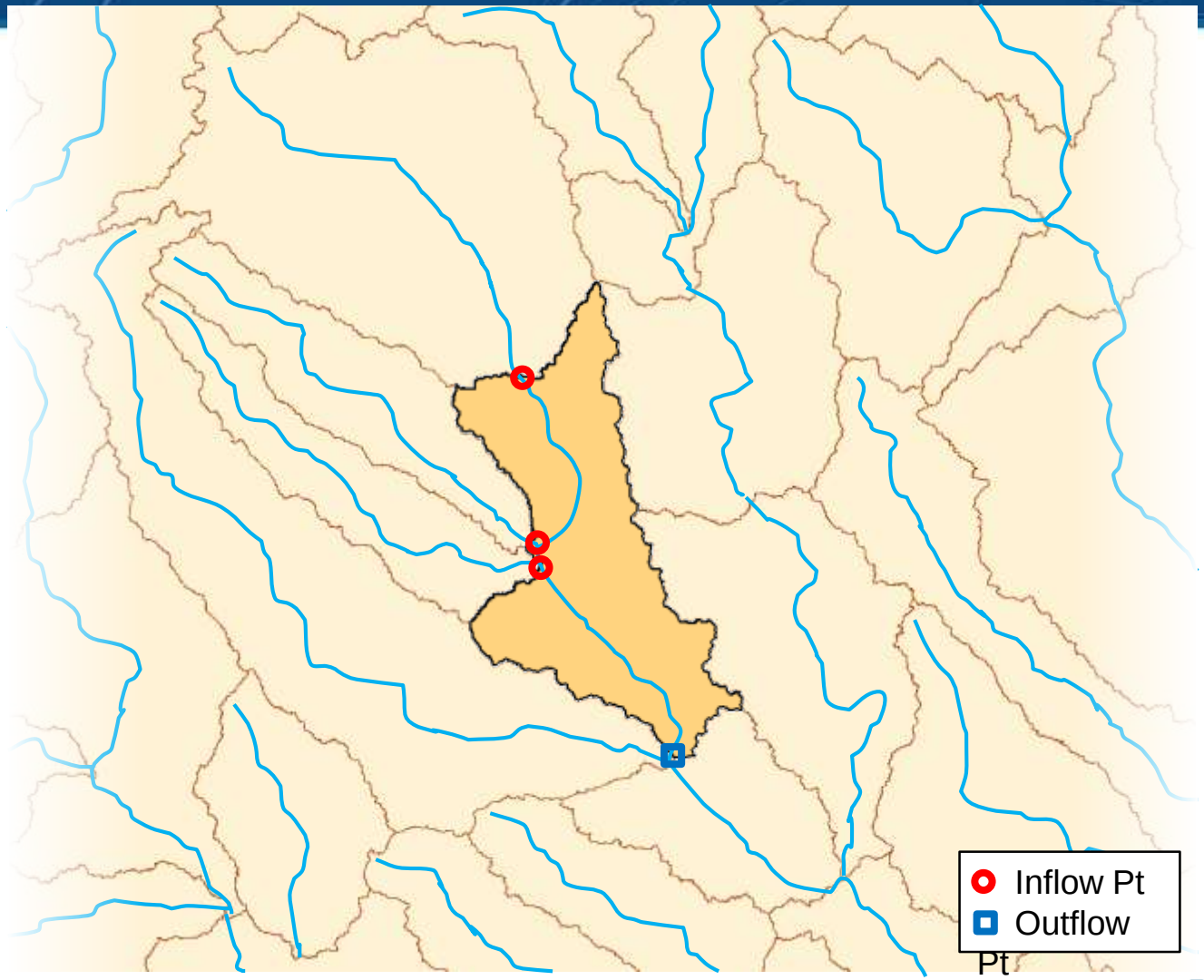
2D Model Areas



Identify Study Area



Identify Study Area



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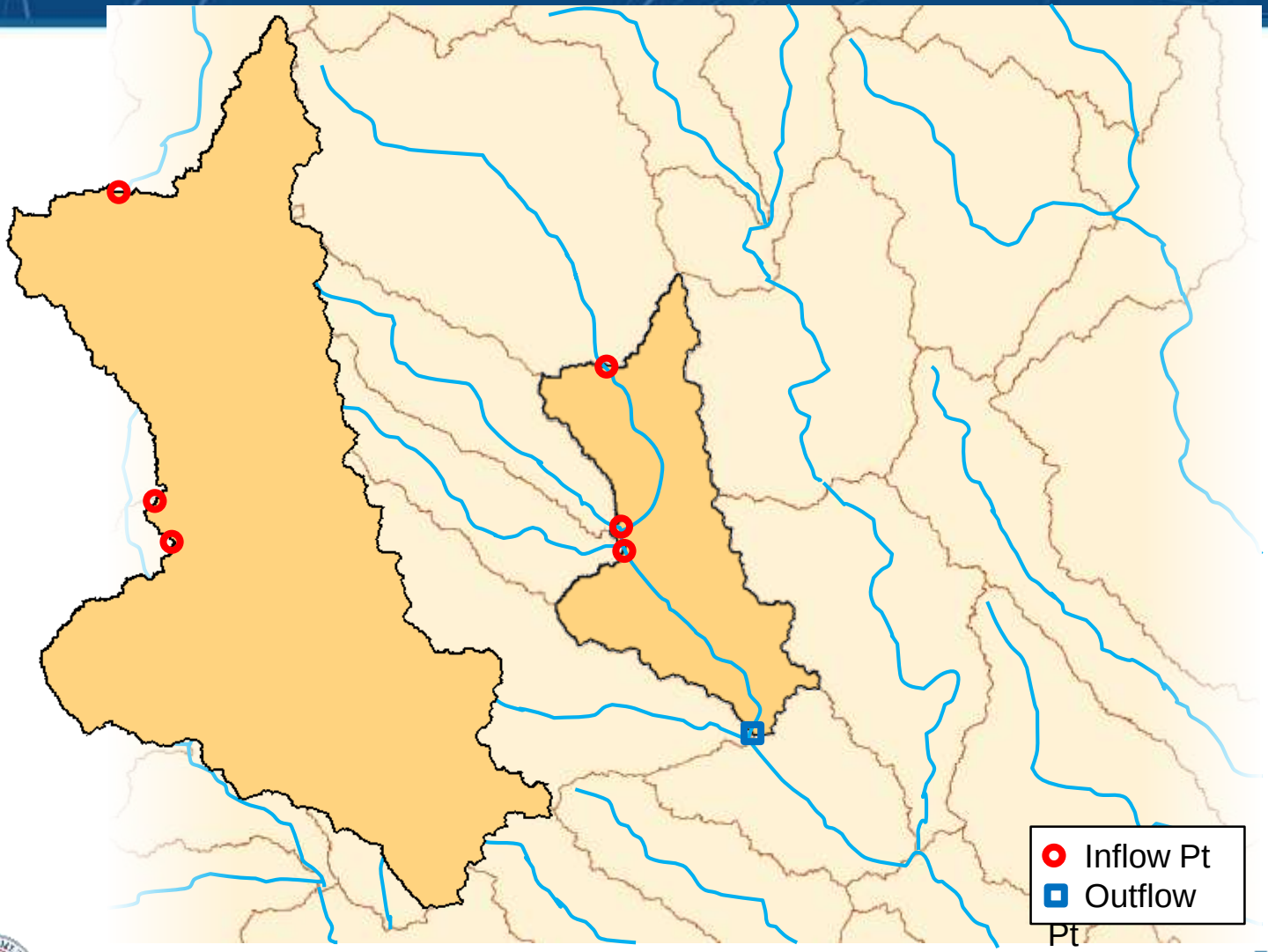
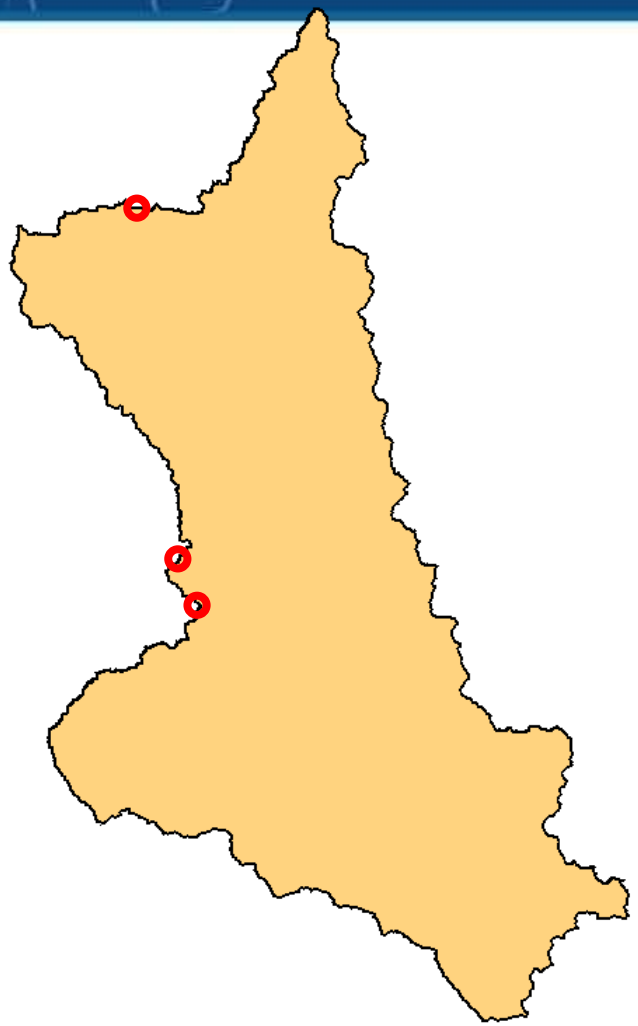
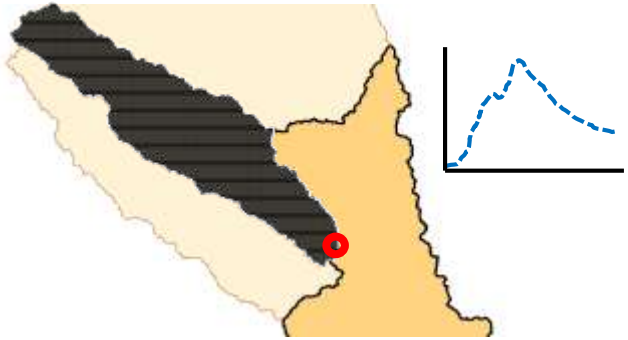


Model Inputs (Hydrology)

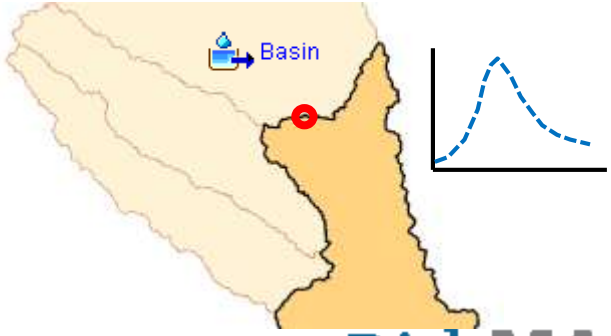


INFLOW HYDROGRAPHS

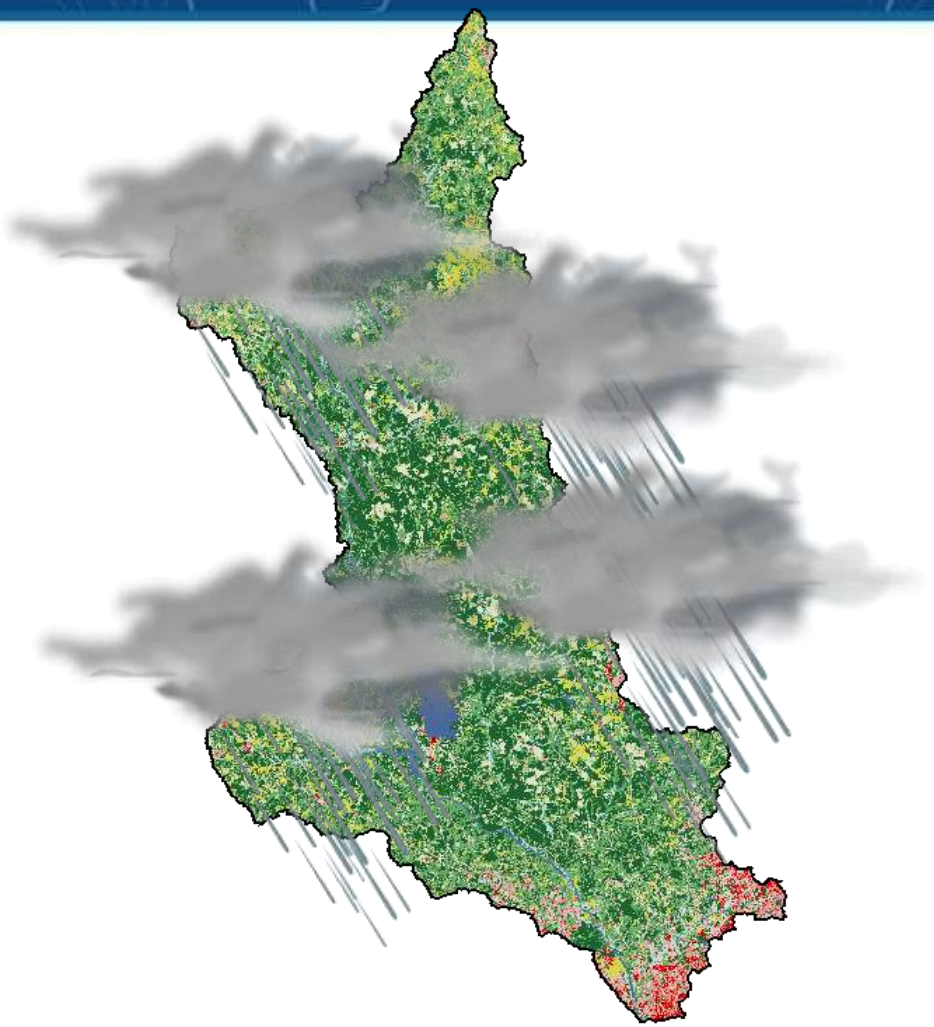
- **Option 1: Use outflow hydrographs from upstream 2D model as inflow**



- **Option 2: Generate hydrographs from simple HEC-HMS models**

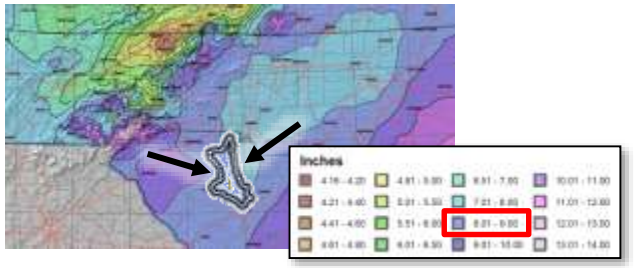


Model Inputs (Hydrology)

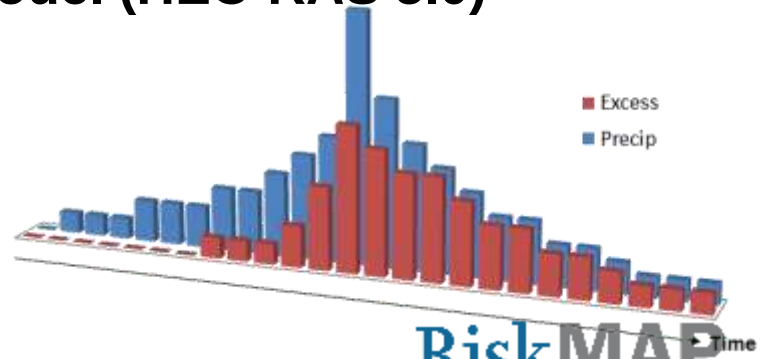


PRECIPITATION (RAIN-on-GRID)

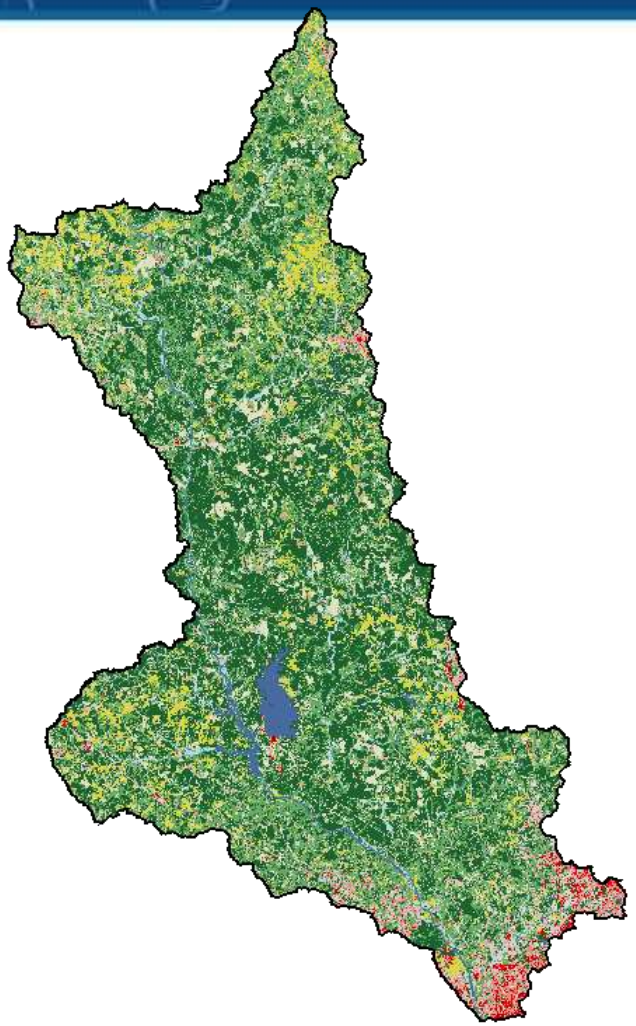
- NOAA Precipitation Frequency Data Server or Atlas 14



- Simple HEC-HMS model developed to determine excess rainfall to apply within the 2D model (HEC-RAS 5.0)



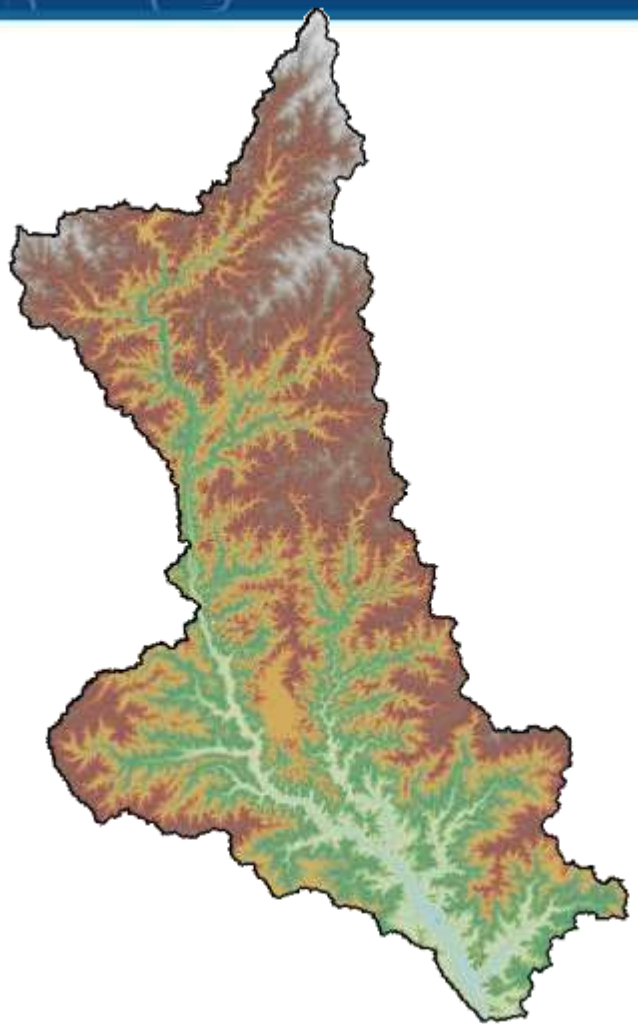
Model Inputs (H&H)



LAND USE & SOILS

- Land Use: National Land Cover Database (2011)
- Soils: NRCS Web Soil Survey
- Used as an input in all HEC-HMS models to support the calculation of Curve Numbers and Lag Times
- Also used within the 2D model to estimate roughness values

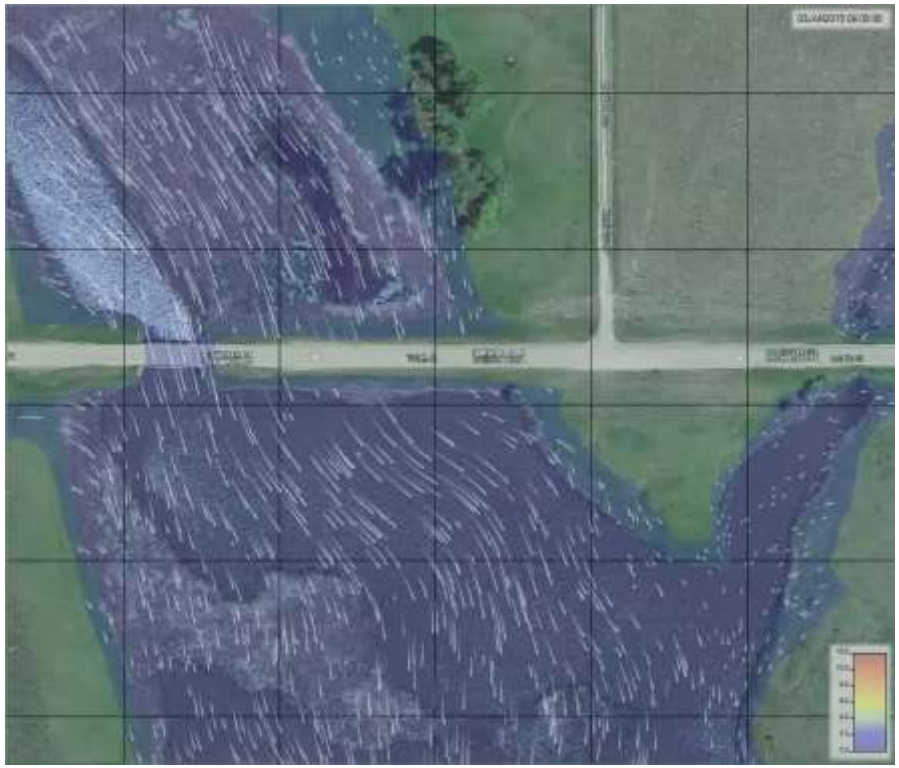
Model Inputs (Hydraulics)

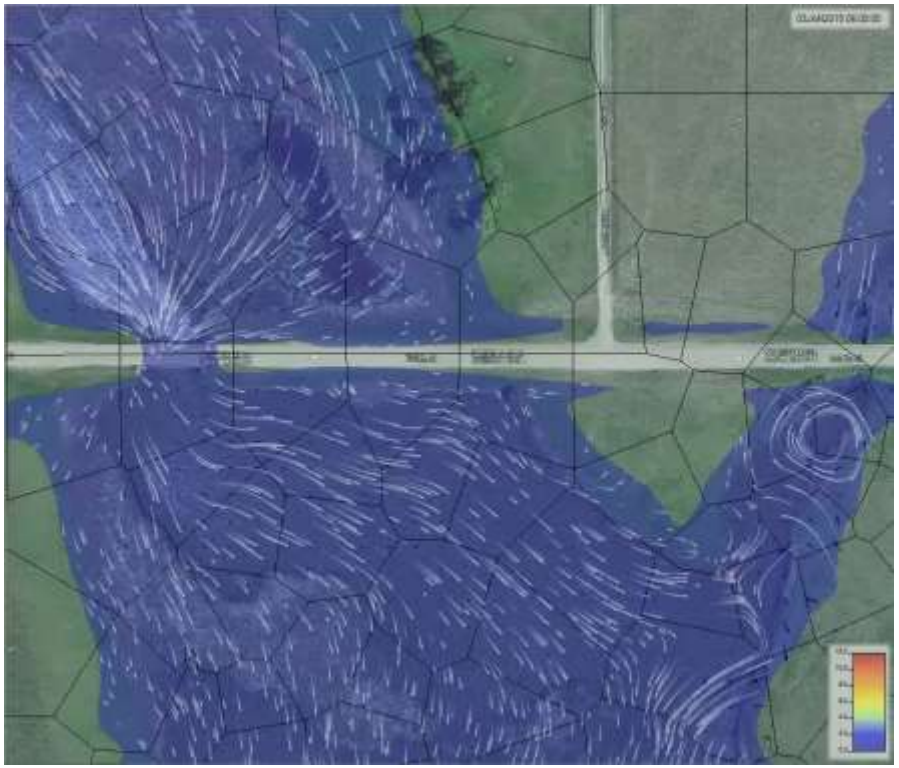


TERRAIN

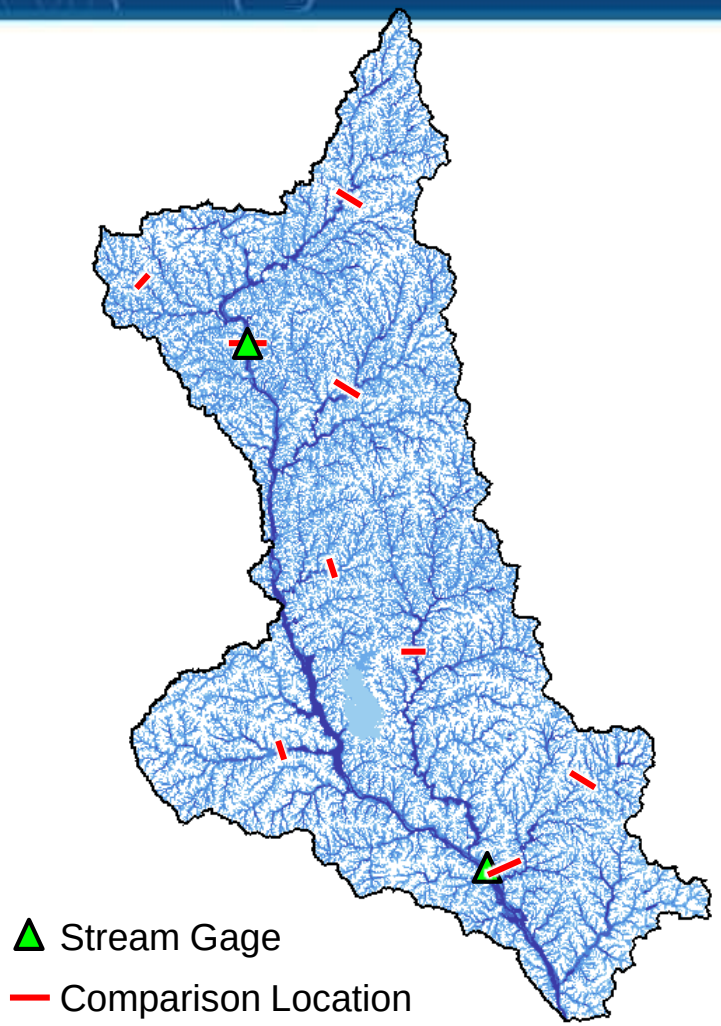
- LiDAR-derived DEM
- DEM assured to meet FEMA SID 43 vertical accuracy standards
- Critical component to carry LSBLE products through regulatory process

2D Mesh Enhancements with Breaklines





Model Verification

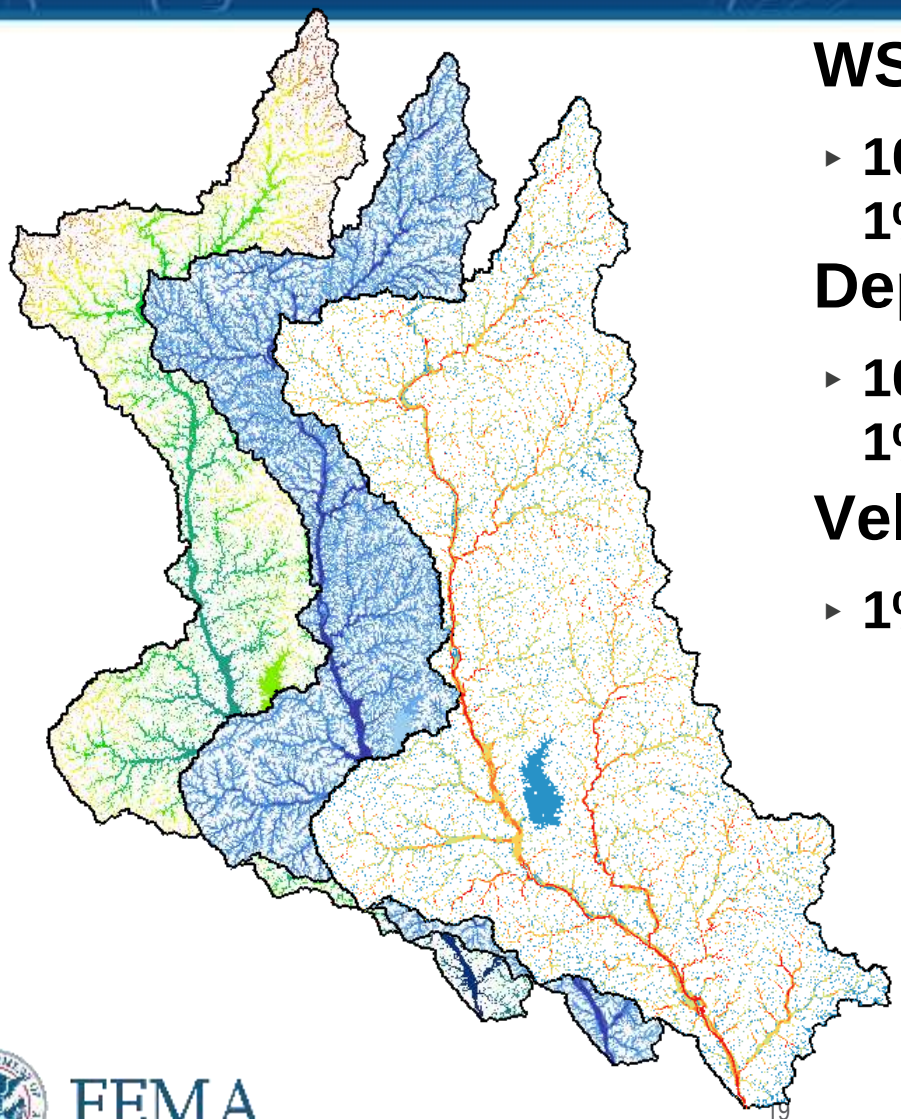


REASONABILITY CHECKS

- **Multiple comparison check locations added to the 2D model (at gages and other representative locations within the study area)**
- **1% annual chance peak discharges, WSELs, and/or flood boundaries from 2D model compared with other available data at these locations (gage analysis, regression equations, effective study*, etc.)**

  *age and level of detail of effective study are taken into consideration when weighing comparisons

Model Outputs



WSEL Grids

- 10%, 4%, 2%, 1%, 0.2%, 1%+, 1%-

Depth Grids

- 10%, 4%, 2%, 1%, 0.2%, 1%+, 1%-

Velocity Grids

- 1% (others as needed)

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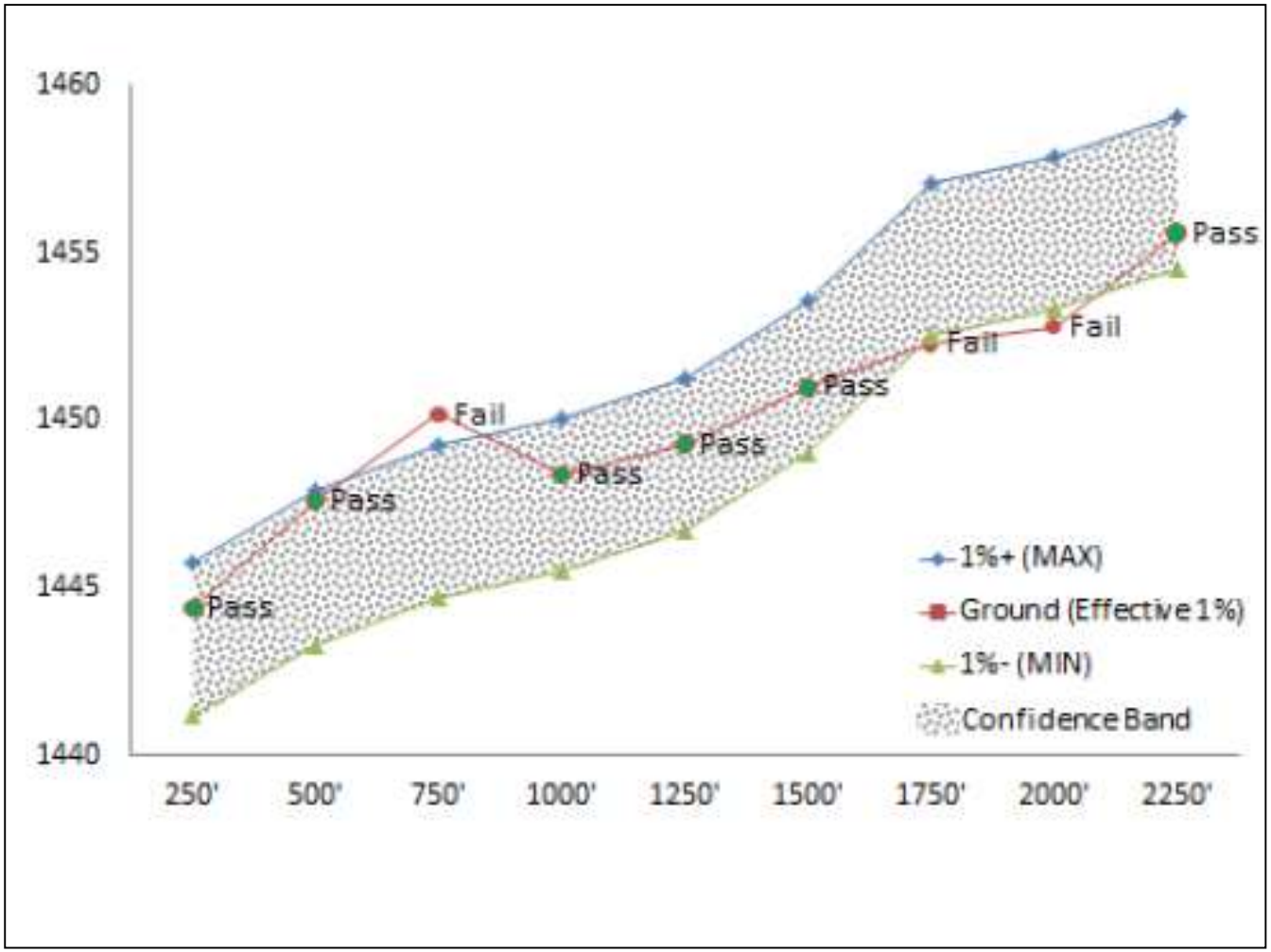
CNMS Zone A Validation

- **A1 – Significant Topography Update Check**
- **A2 – Significant hydrology changes**
- **A3 – Check for significant development**
- **A4 – Studies backed by technical data**
- **A5 – Comparison of LSAE and Effective Zone A**
  - Modified FBS check using 1-percent minus and 1-percent plus error band
  - Stream must have 90% points passing to be Valid in CNMS for next 5 years

A5 Check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250'
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750'
1000'
1250'
1500'
1750'
2000'
2250'
Pass
Fail
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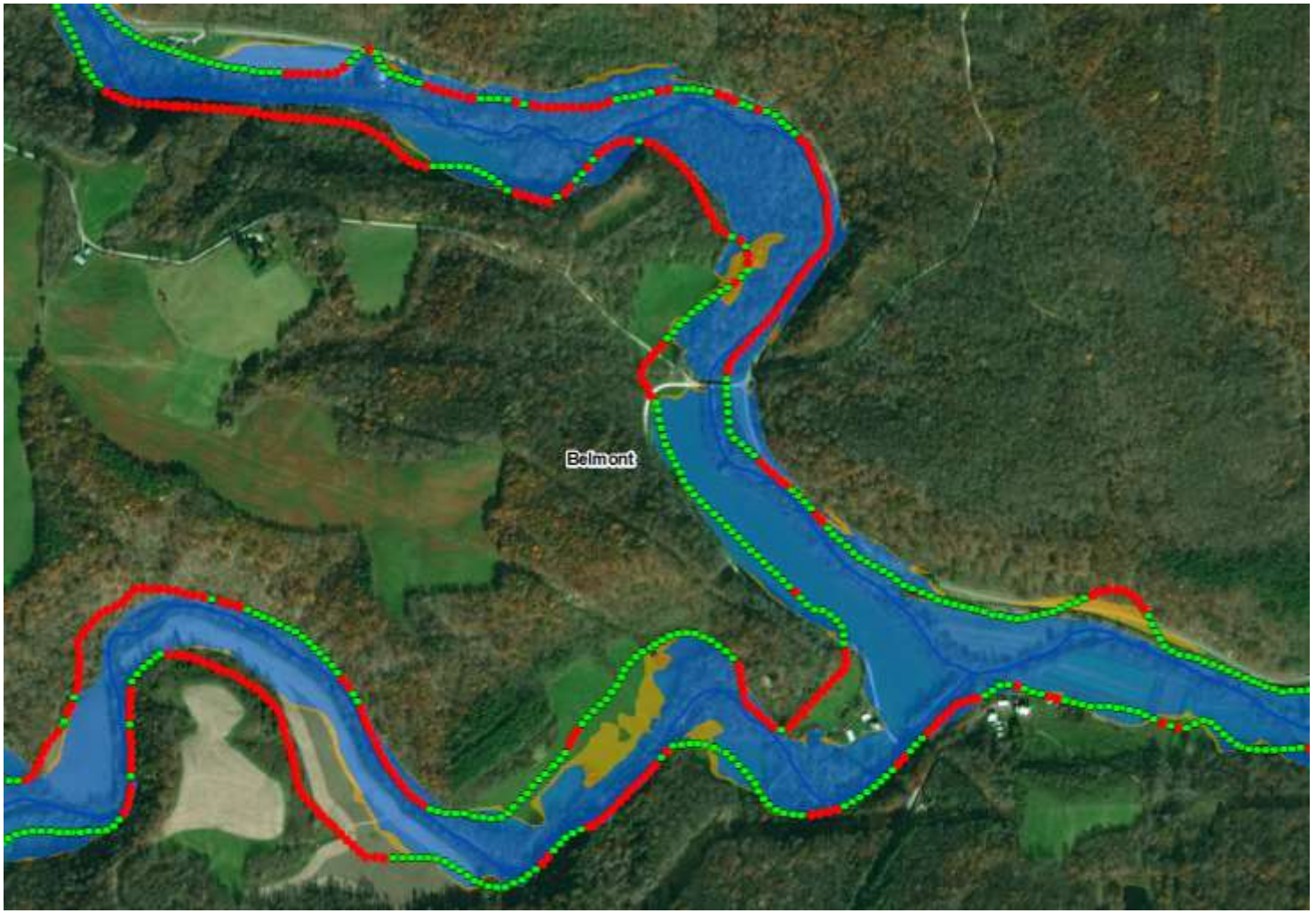
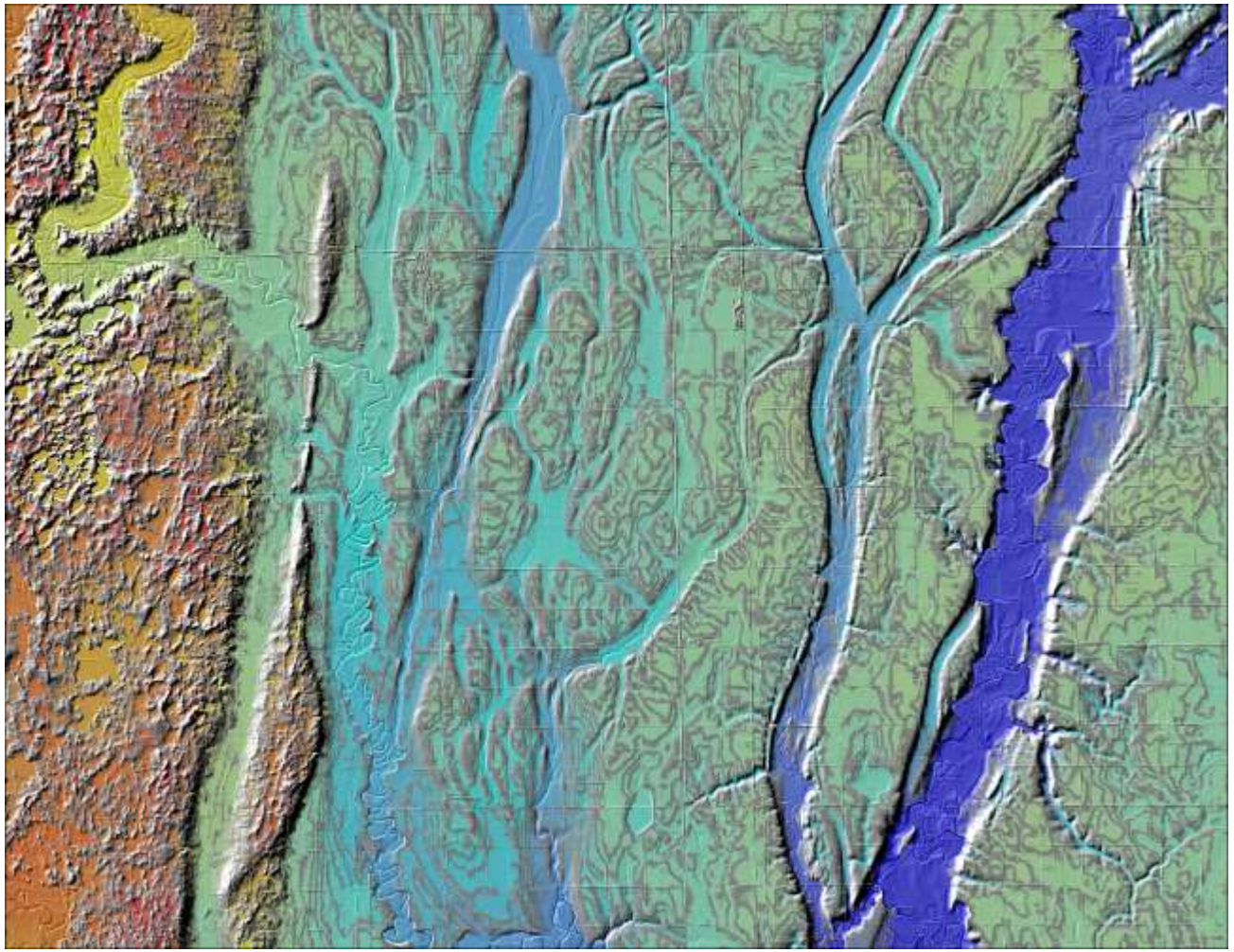
Pass
Pass
Fail
Fail
Pass
1%+ (MAX)
Ground (Effective 1%)
1%- (MIN)
Confidence Band

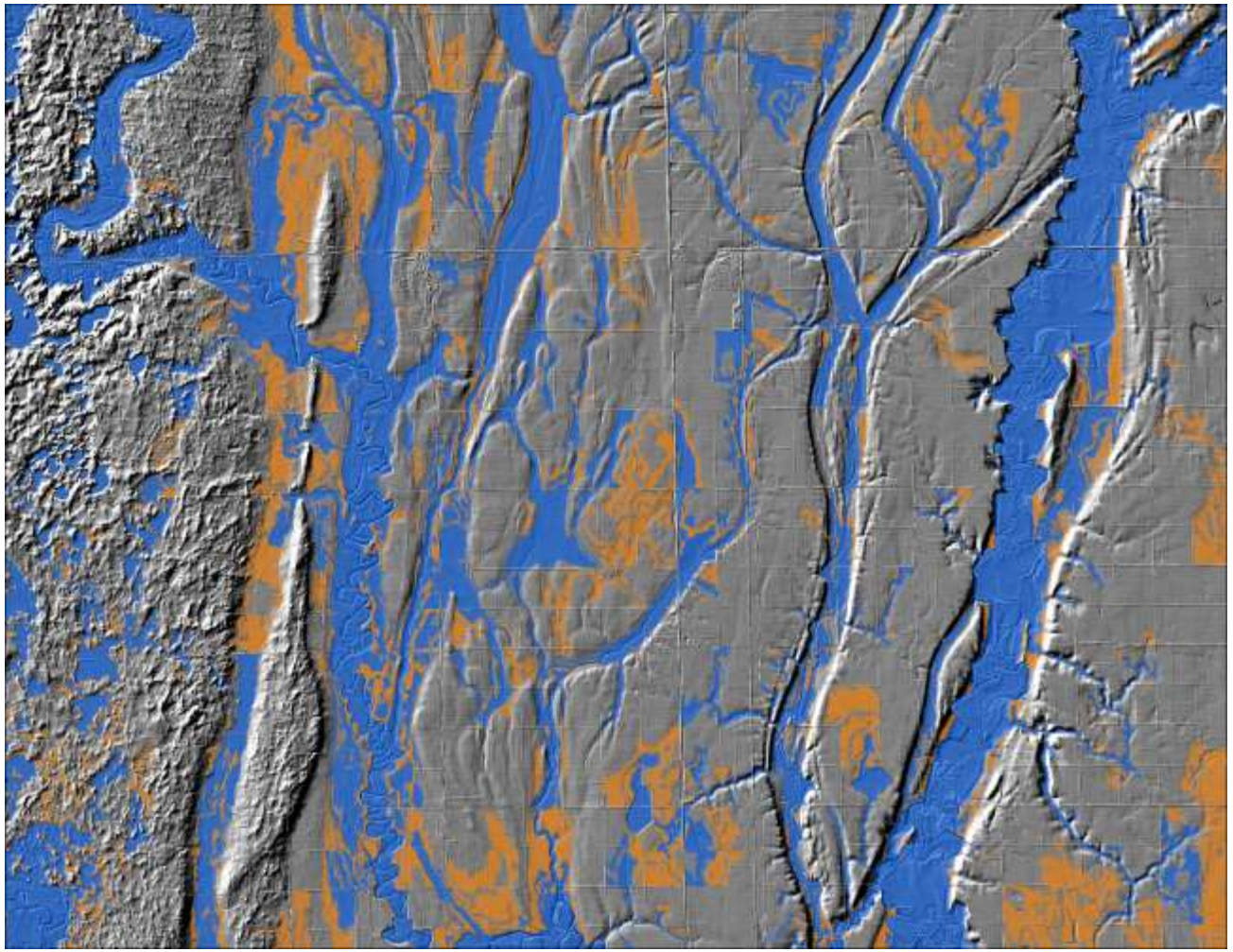
A5 Check



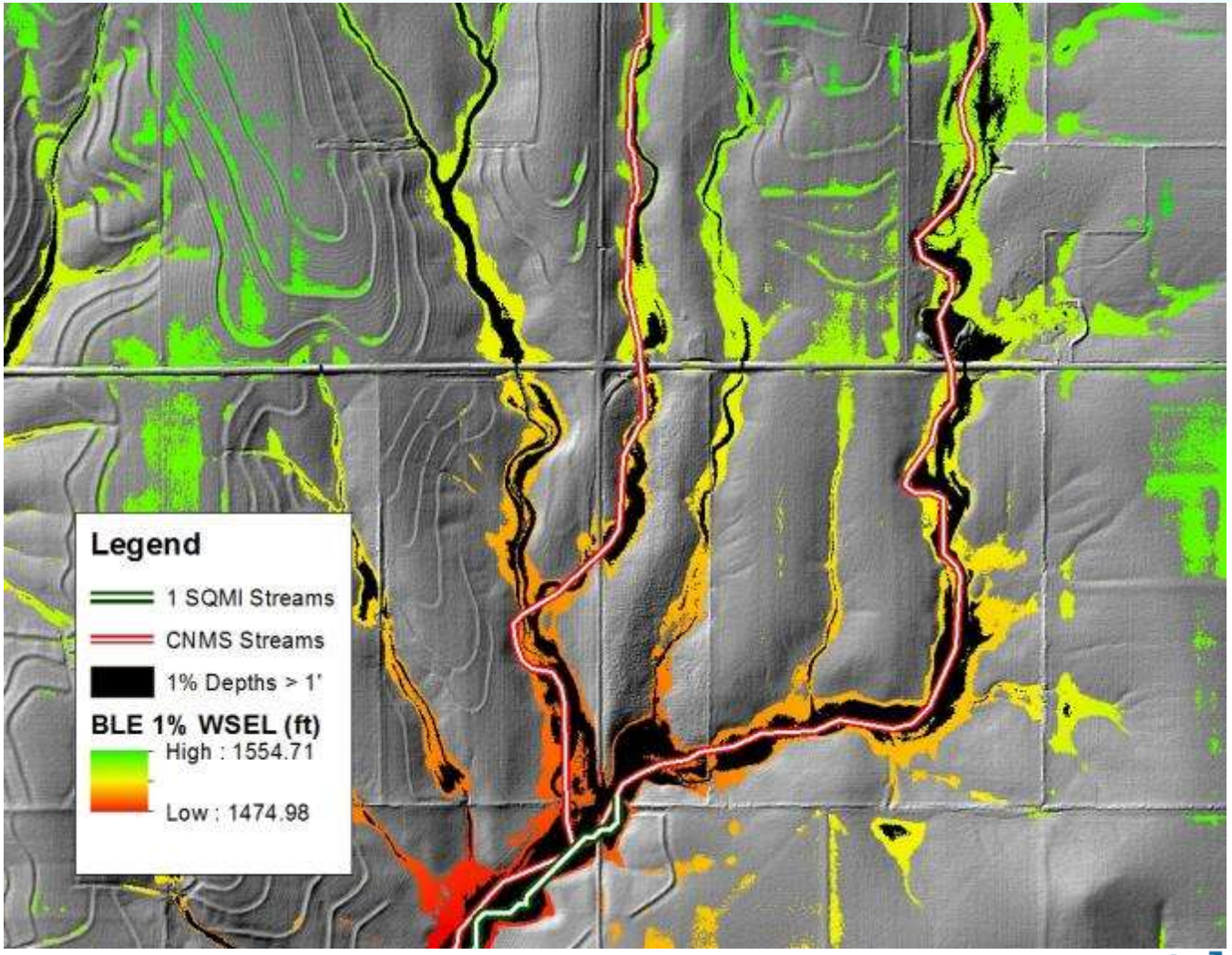
BLE Raw 1%



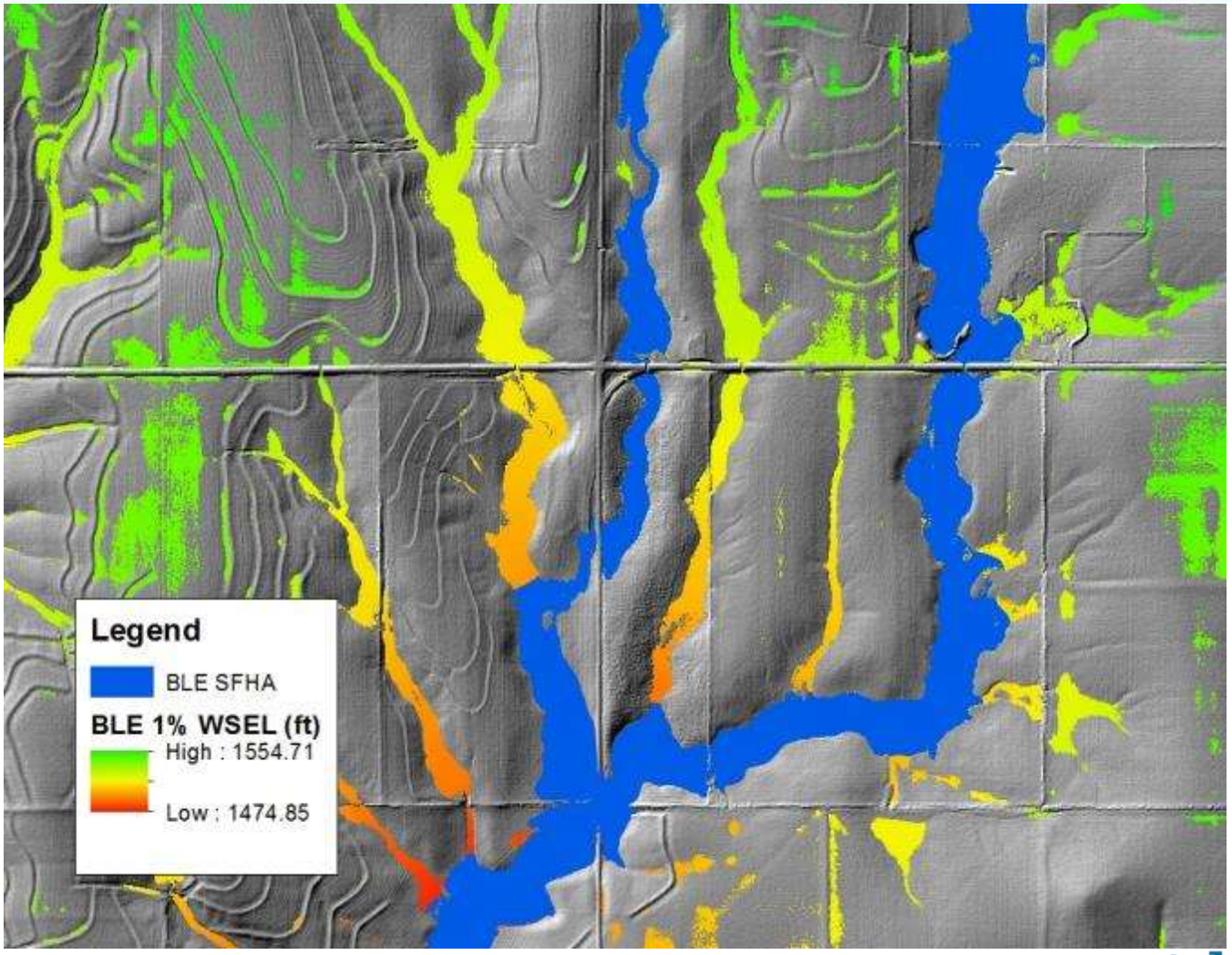
BLE Mapping (1 and 0.2%)



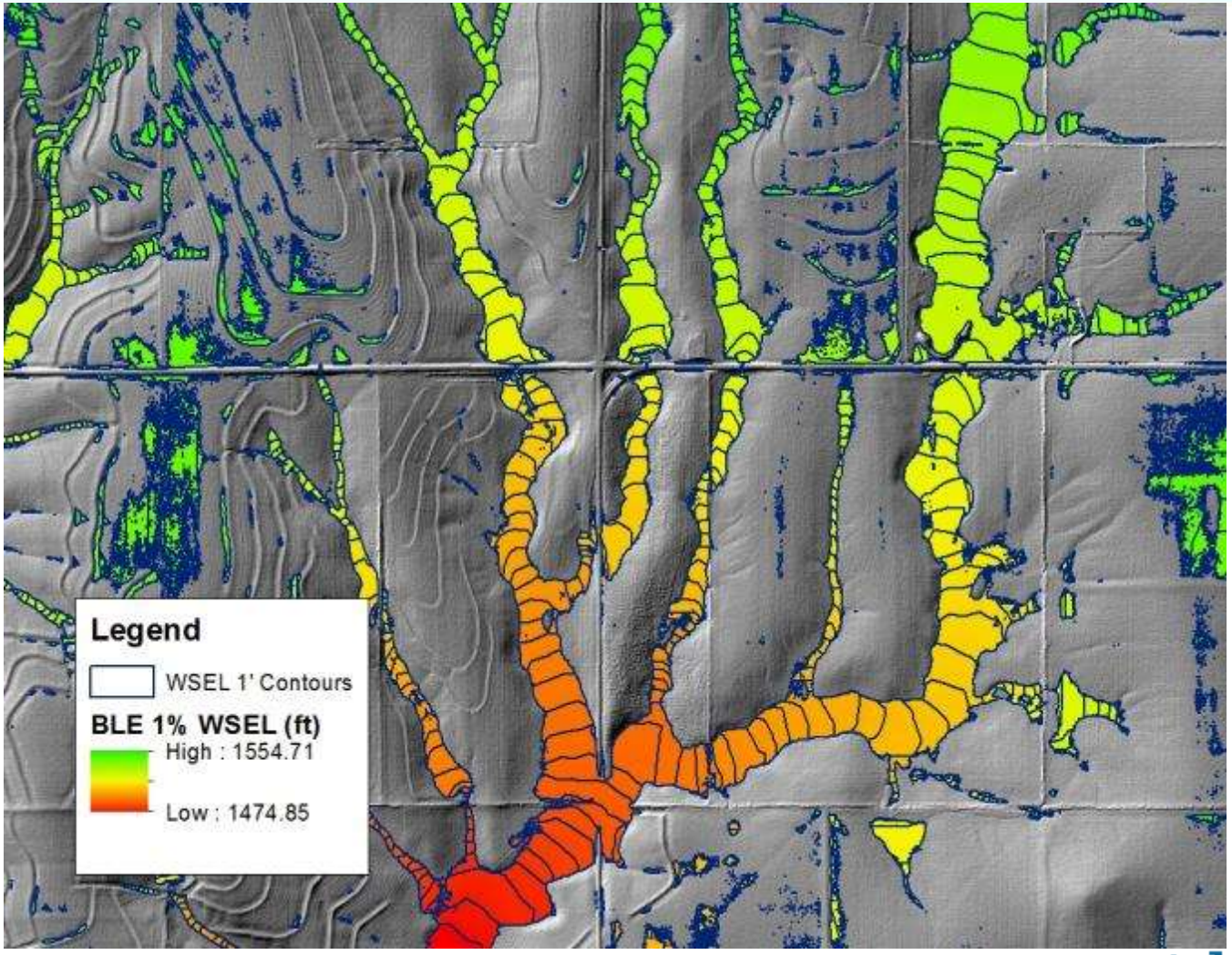
Mapping SFHA



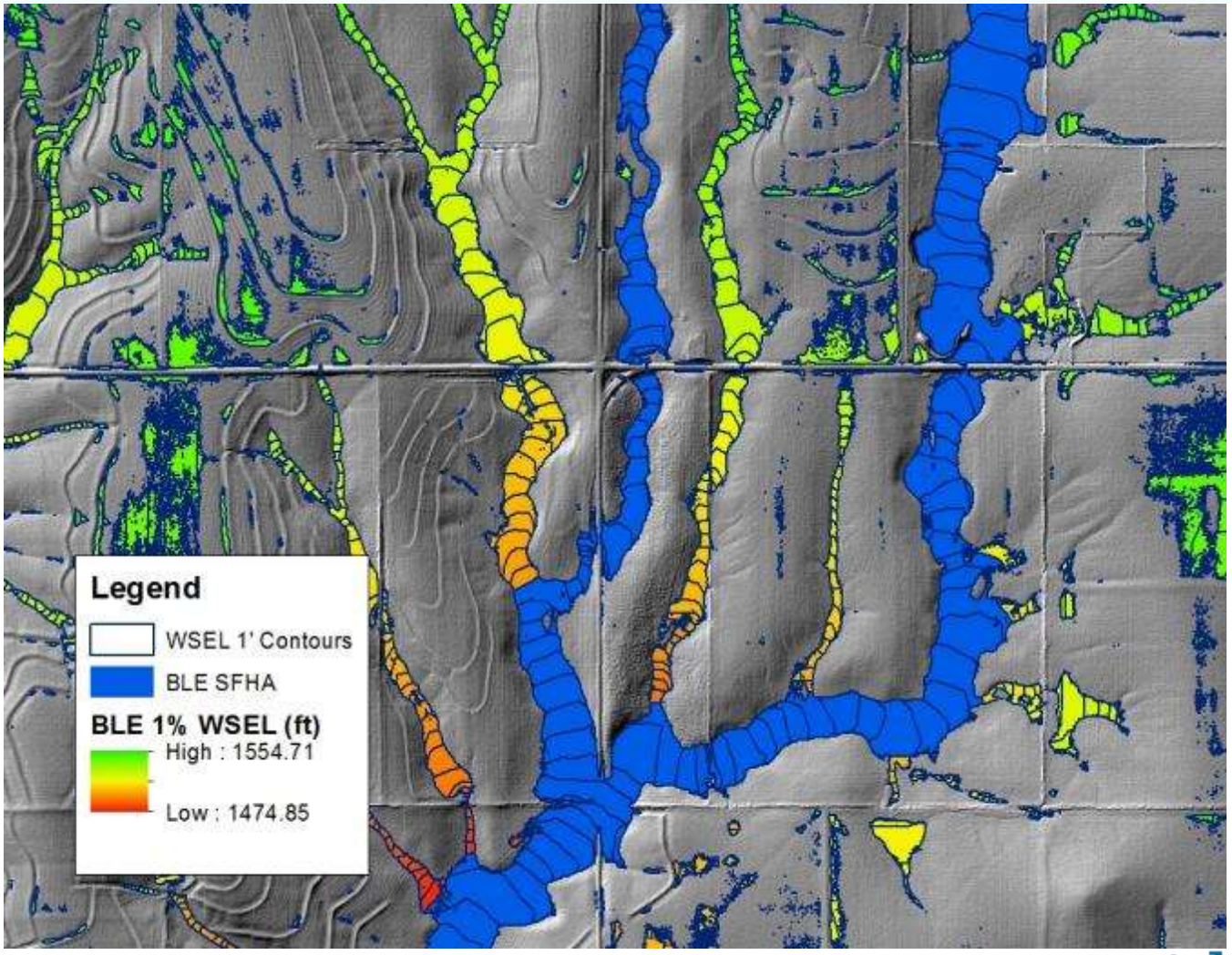
Mapping SFHA

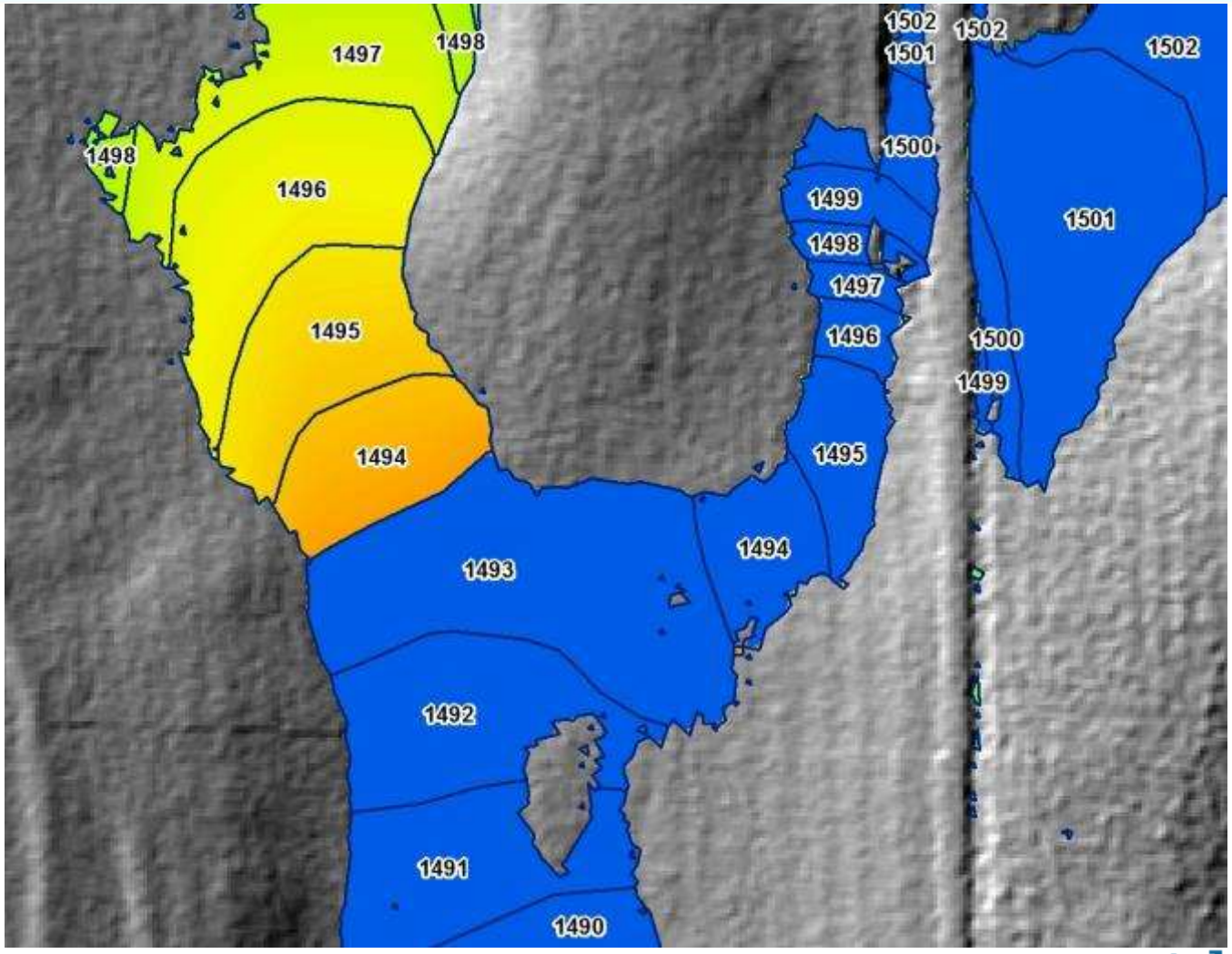


Mapping SFHA



Mapping SFHA

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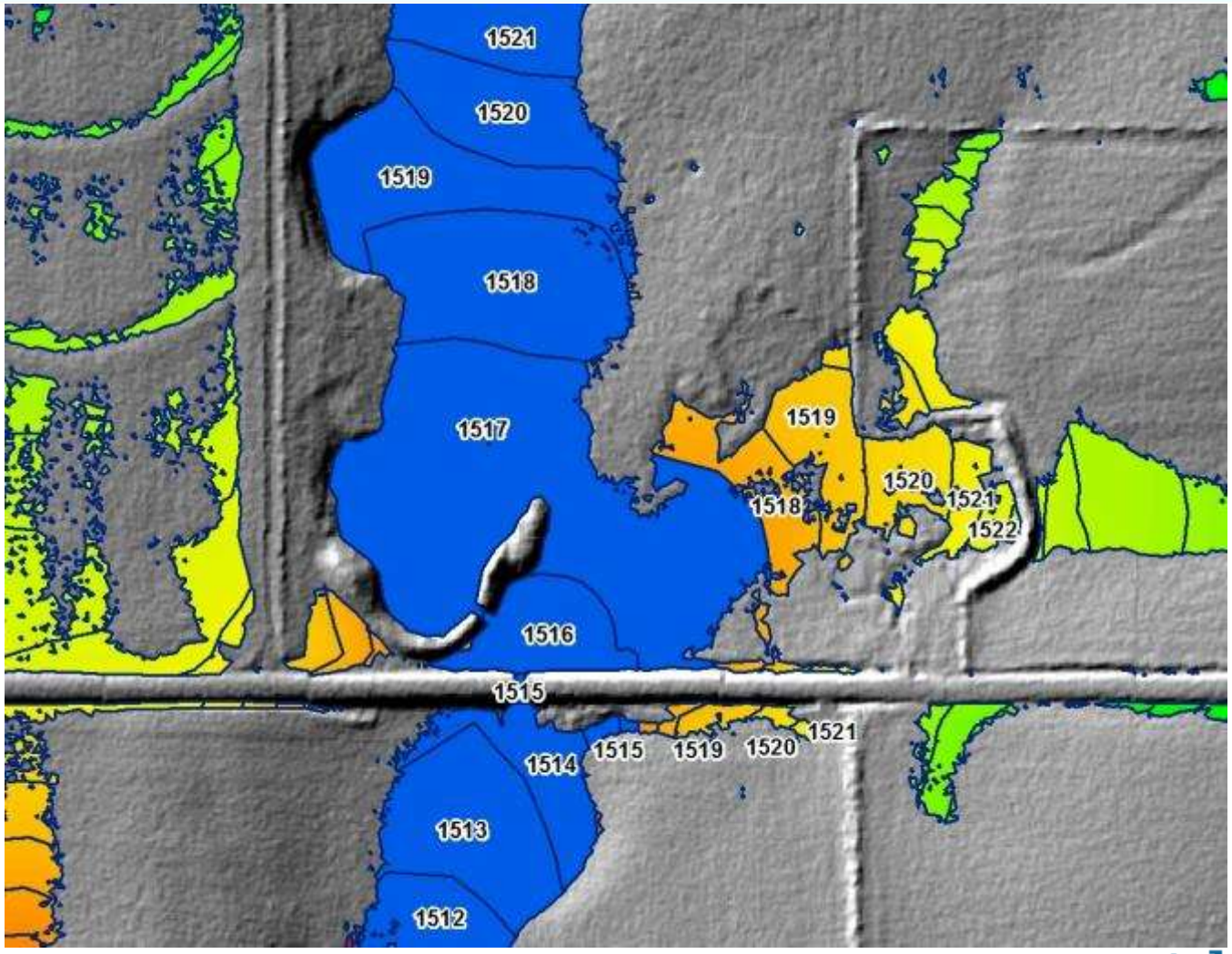
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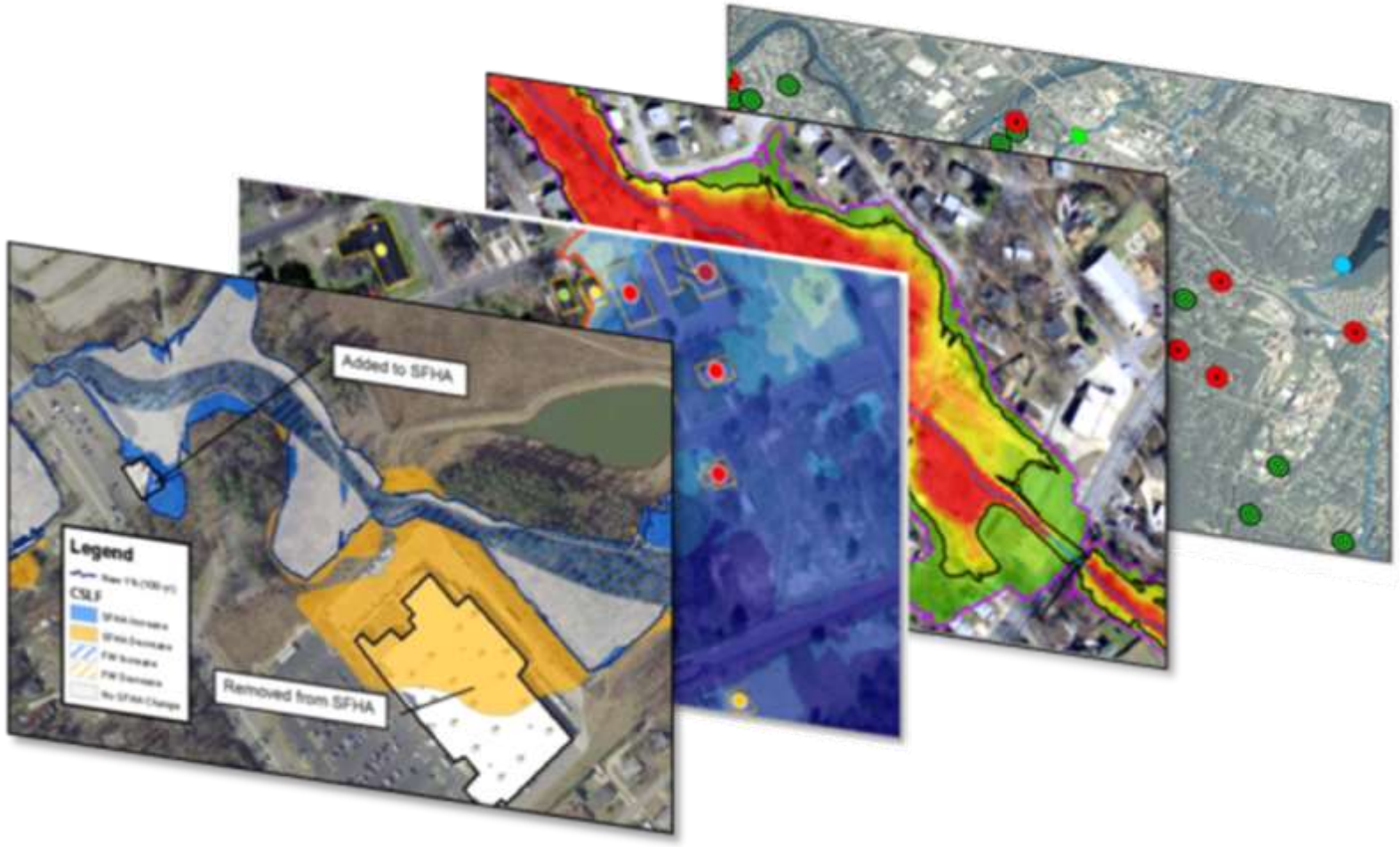
BLE Products

- **Terrain**
- **Engineering**
  - HMS Models
  - RAS Models
- **Geospatial**
  - WSEL Grids (10, 4, 2, 1-, 1, 1+, 0.2%)
  - Depth Grids (10, 4, 2, 1-, 1, 1+, 0.2%)
  - Velocity Grid (1% [others as necessary])
  - S_Fld_Haz_Ar (1% Zone A and 0.2% Shaded X)
  - S_CSLF_Ar
  - CNMS Validation Points

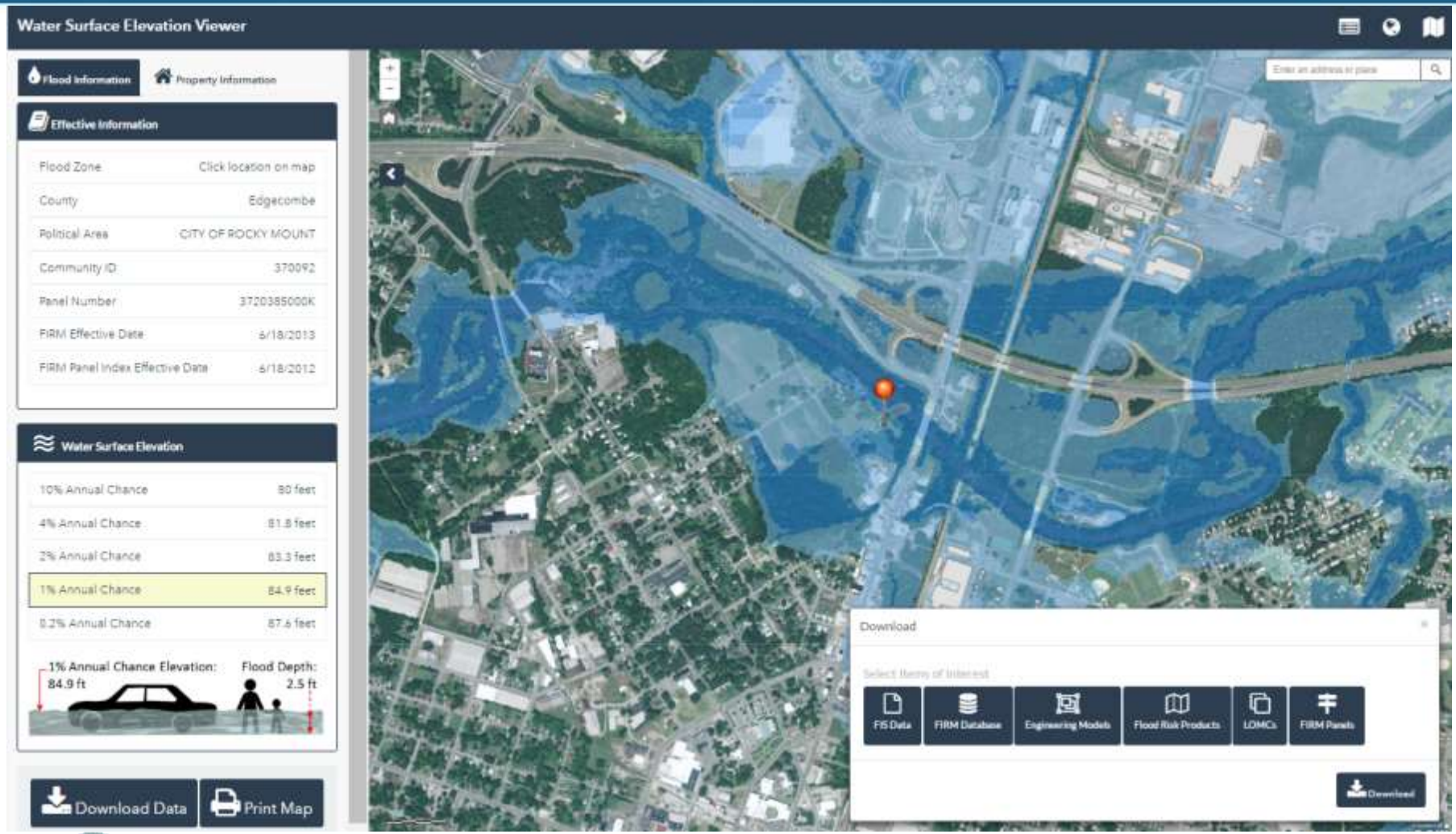
Cost-Effective Flood Risk Database Buildup Opportunity



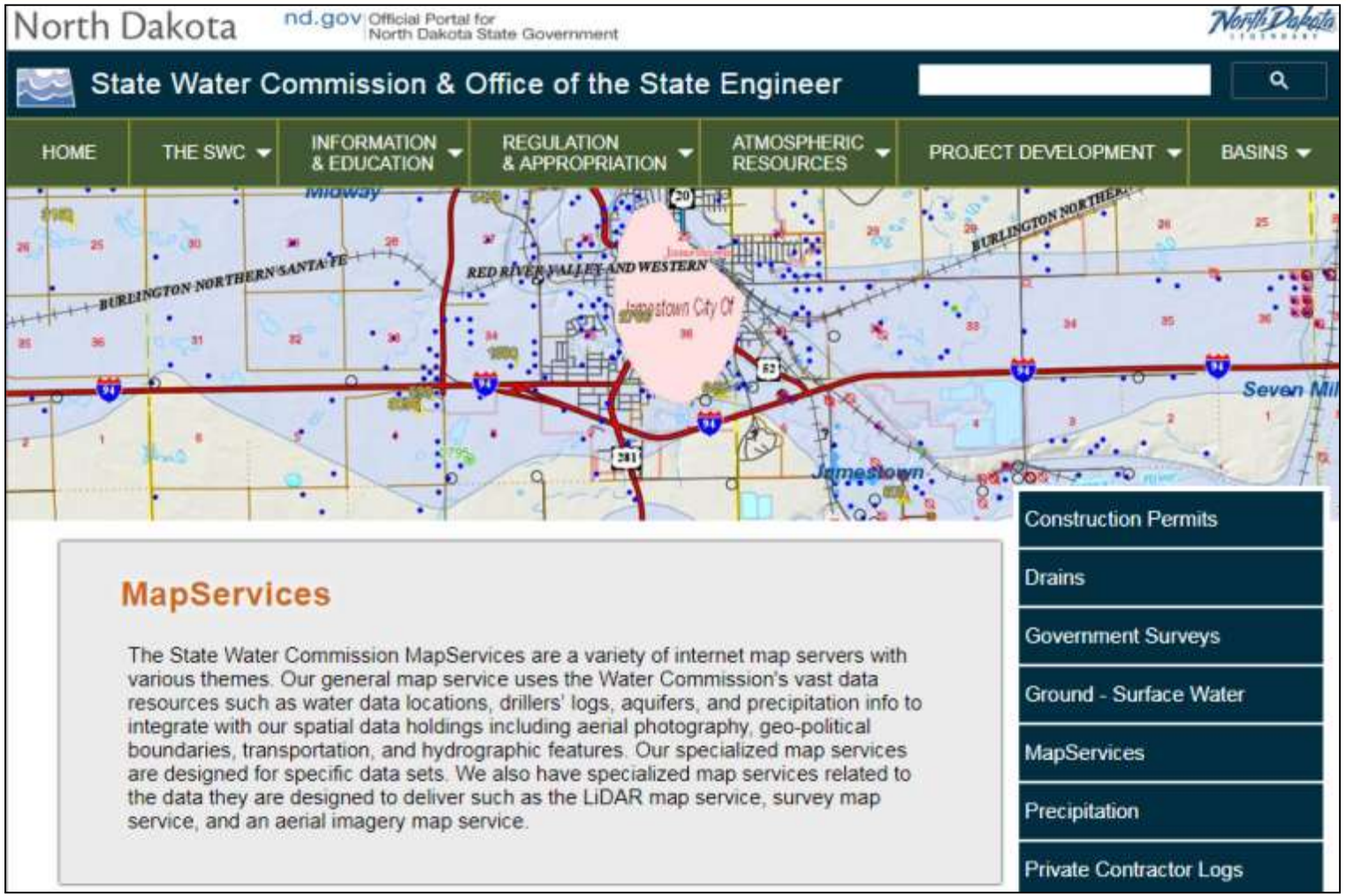
Multi-Frequency Spatial Assessment

Flood Risk Assessment

Data Dissemination



Data Dissemination



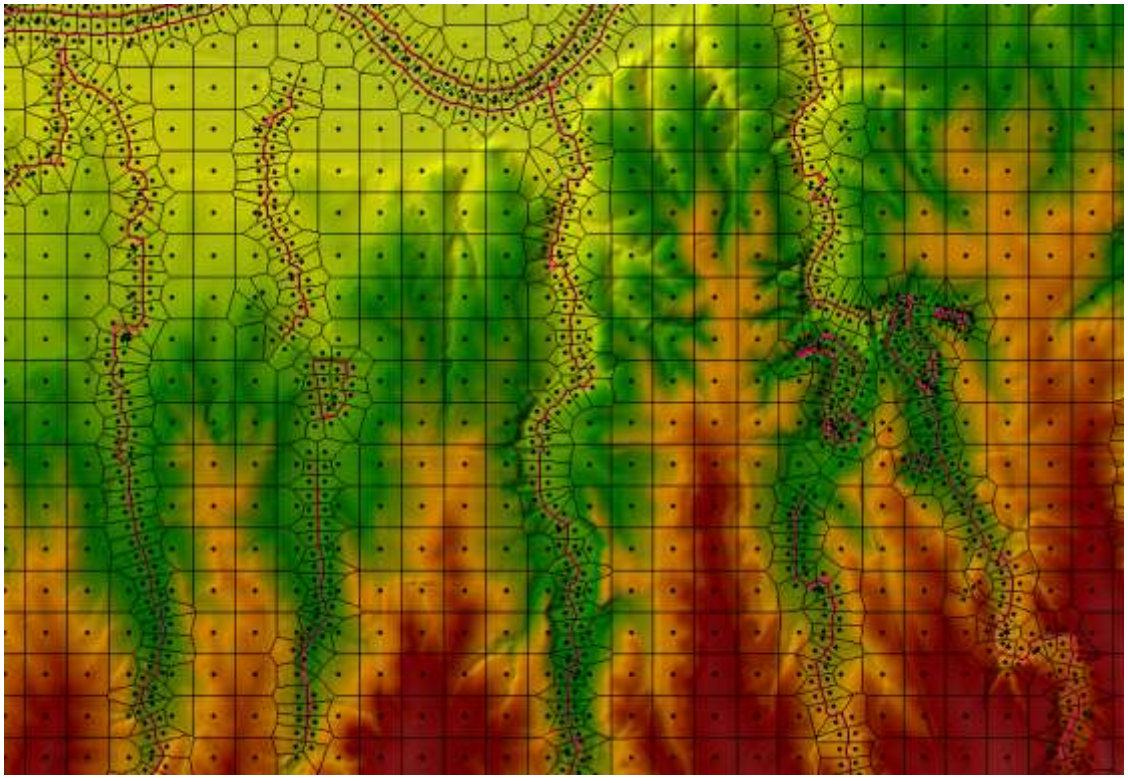
Other uses of 2d LSBLE Best Available Information

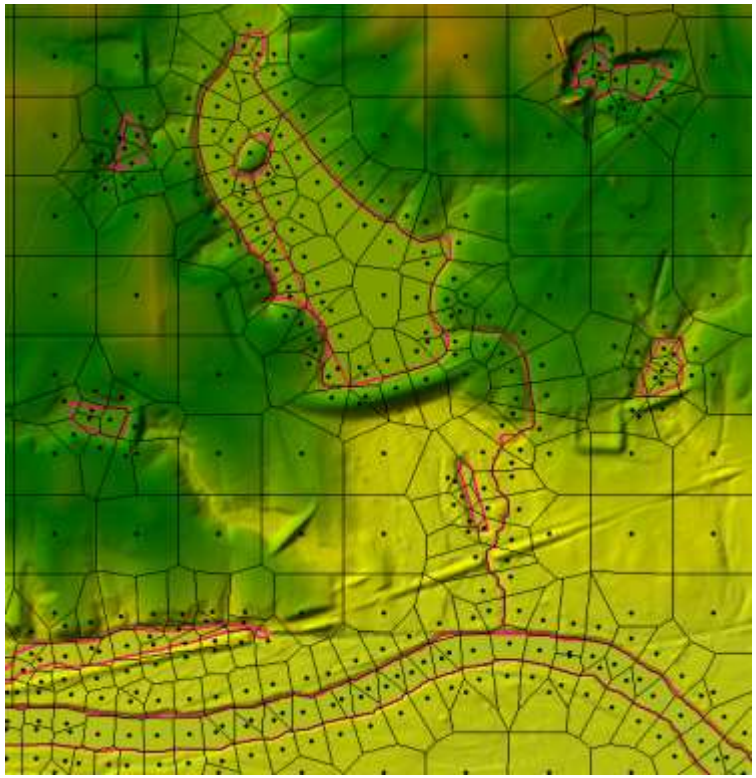
- LOMC Processing
- State/Local Mitigation Plans
- Emergency Response
- Evacuation Planning
- Critical Facilities in or near flood hazard area
- Residential/Commercial Development Planning
- Hazard Mitigation Grant Program

ND Statewide 2D BLE Key Takeaways

- **Large Scale BLE completed in two years**
  - Massive coordination effort with Region, NDSWC, PTS, CERC
- **Outreach Process Successful**
  - Kickoff to inform communities of modeling approach and schedule
  - Discovery to roll out results of BLE
- **Best Available Data for unmapped and non-deployed areas**
- **Awareness of flood risk for non-participating communities**
- **Watershed Approach provides flood risk awareness outside of SFHA**
- **BLE basis for follow on work**
  - Flood Risk Products
  - Freeboard grids, scenario-based, near real time modeling
  - Zone AE enhancements

Scalable to AE





NO CELL LEFT BEHIND!

Questions