REGIONAL UPDATE: DATA AND MODELING PROGRAM AND MODEL USE

April 2023

LOUISIANA
WATERSHED
INITIATIVE

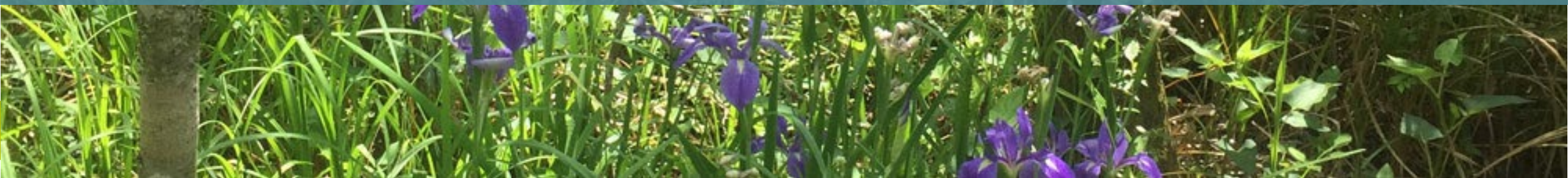
working together for sustainability and resilience

AGENDA

1. General Modeling Program Update(OCD/DOTD)
2. Modeling 101 (HDR)
3. Regional 5 Modeling Update (HDR)
4. Model Use (Henry Consulting)
5. MUSM Development and Access (TWI)
6. Compound Flooding in Coastal Transition Zones (TWI)
7. Consequence Modeling (TWI)

Meeting goal is to gain high level understanding of

- the data and modeling program,
- state model use,
- regional model use,
- and gain an understanding of the scale of proposed modeling



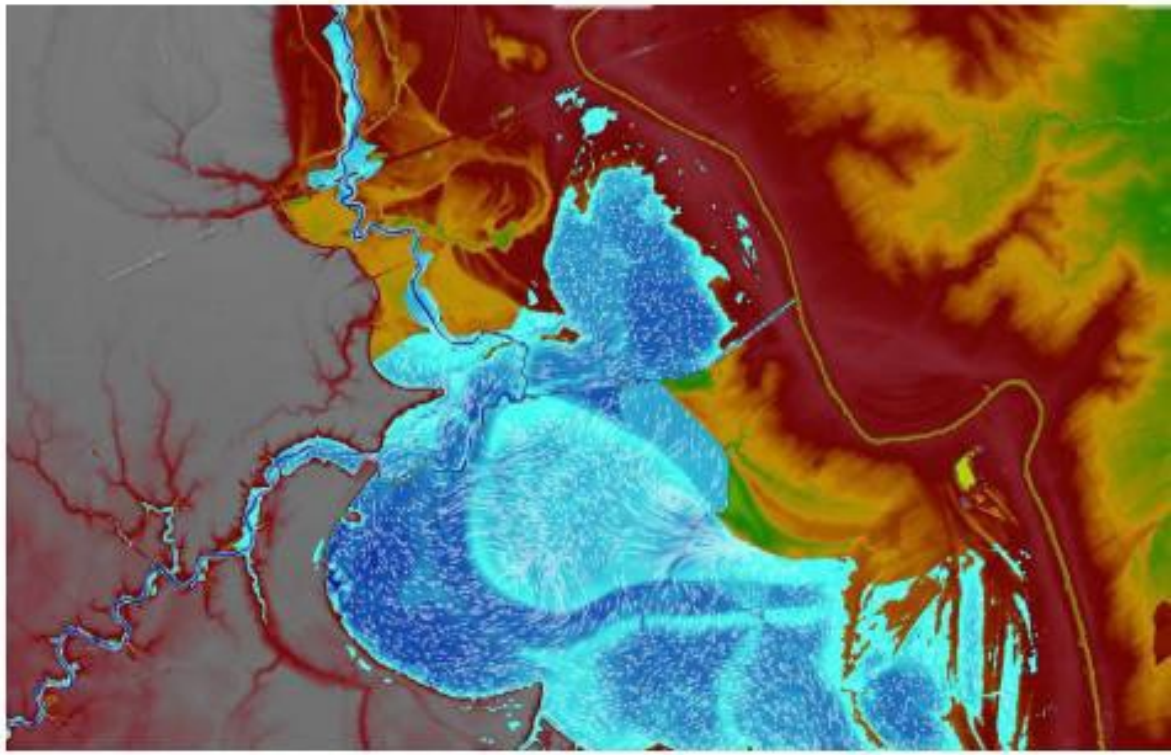
General Modeling Program Update

The program

GOALS AND OBJECTIVES

- **Build**: Collect accurate, timely and consistent data to develop high-quality hydrologic and hydraulic models statewide to support evaluation of flood mitigation plans, policies and projects
- **Sustain:** Ensure program outcomes and tools continue to support flood risk reduction efforts throughout the state long after the CDBG-MIT funds are expended

For additional information, visit watershed.la.gov.



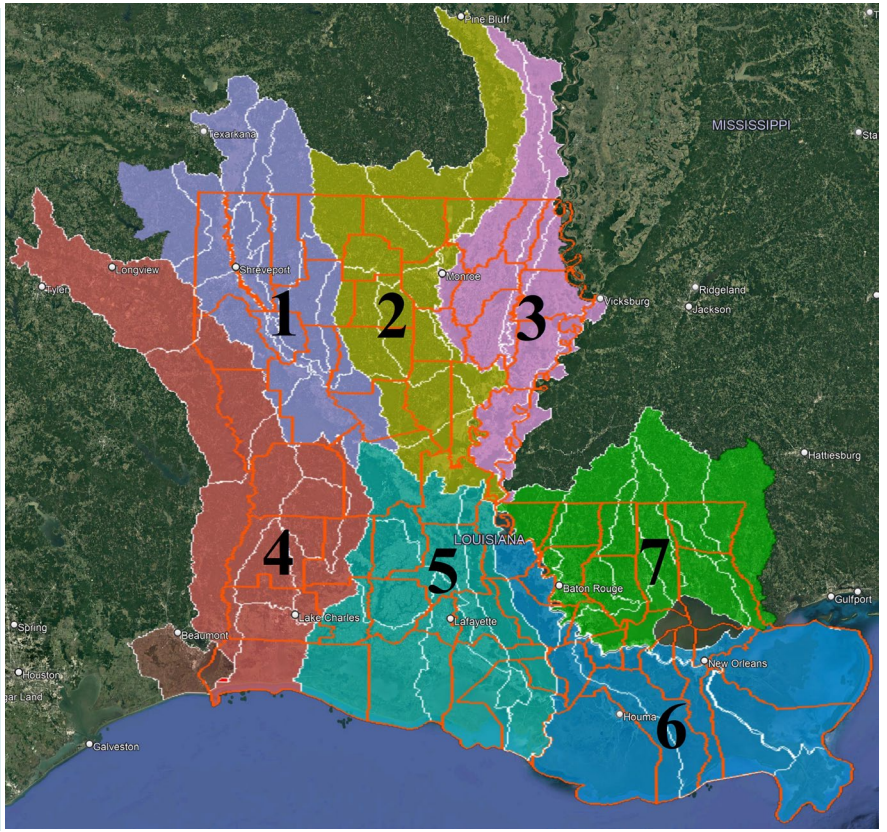
H&H models use software to simulate rainfall runoff processes and predict the rise of water levels and flooding.

Watershed monitoring, mapping and modeling program

- The state is working with engineering experts to develop hydrologic and hydraulic models of major watersheds throughout Louisiana, in consultation with local and regional stakeholders.
- Once complete, the H&H models—as well as outputs, background data and support tools—will form a foundation on which the state can advance its collective assets and holistically manage evaluations of watersheds.
- In addition, the program supports greater regional collaboration around shared water management challenges and an objective, science-based understanding of how projects, policies and other measures will reduce flood risk.

Watershed Monitoring, Modeling and Mapping Program

- Contracting through DOTD for 48 HUCs, seven regions
- Regional modeling is done on the HUC 8 scale
- Main modeling software includes HEC-HMS and HEC-RAS
- Design approaches were aligned with the Guidance on Modeling Methodology issued by LWI,
- Design approach developed for each HUC and reviewed by the Technical Design and Quality Team



Watershed monitoring, mapping and modeling program

- Models are being developed using a wide variety of datasets.
- Outputs from H&H models can be used on their own or combined with datasets to create new special purpose tools.
- H&H modeling is a core requirement to evaluate whether proposed flood risk reduction projects would have positive benefits or adverse effects on neighboring communities.
- Datasets can be used at multiple scales beyond just H&H model construction.

Program Data and Products

- Local climatological data
- Radar rainfall data
- Rain gauges
- Structure inventory
- Critical and essential facilities
- Dams
- Jurisdictional boundary
- Topo and bathymetric survey
- Survey control monumentation
- LiDAR/DEM
- Model Terrain
- Digital SSURGO (soils) database

- Levees
- Municipal stormwater asset inventories
- Parcels/Zoning
- Parks
- Transportation features
- Watershed HUC Basins
- Culturally Significant Areas
- Elected officials
- Economic demographics
- Census data
- Social vulnerability index

- HUC 8 Modeling Design Approaches
- HUC 8 technical deliverables
- Ecological data
- Hydraulic structures
- Louisiana NAIP Imagery
- National Land Cover Database
- Stream and Tidal stations
- Wetlands Inventory

Watershed monitoring, mapping and modeling program

- The outputs of H&H models are nearly as important as the models themselves.
- They can be adapted to create mapping products, precipitation grids, flood depth grids, floodplain extents and other relevant information.
- These datasets will become more useful for developing additional kinds of models and tools with the standardization of a data and model repository.
- When these data are collected and maintained to specific standards, the number of people who can use them for other specialized analyses grows.

Program data and products – H&H models

MODELS

- Regional HUC 8 Hydrologic (HEC-HMS or HEC-RAS Rain on Grid) Models
- Regional HUC 8 Hydraulic (HEC-RAS 1D, 2D) models
- Modeling Report
- Modeling Quick Guide

OUTPUT

- Depth grids, velocity grids and water elevations for historic storm events
- Design storm events
- Future outputs
- Historic and AEP flood boundaries
- Compound flooding events in coastal areas

TOOLS AND FUTURE APPLICATIONS

- Nature based solutions tools*
- Consequence modeling *
- Real-time flood forecasting
- Water quality and low-flow modeling
- Economic models
- Local small-scale modeling
- Engineering design
- Environmental restoration
- State and federal flood hazard programs

Note: items with * are program deliverables. All others are items which could be created with reduced effort using products generated by the program.

Watershed monitoring, mapping and modeling program

- LWI partners are developing a statewide structure inventory, which is a list of all the structures that could be affected by a flood, with information relevant to consequence estimation. This includes location, type of structure, structure value, structure elevation and content value.
- This information (along with H&H modeling results) forms the basic inputs to consequence modeling and can be used by any consequence modeling software, such as LWI tools or products like FEMA Hazus.
- Consequence modeling is used to estimate economic impact and life-loss consequences of flood events.
- Estimates can be used in analysis of the costs and benefits of flood mitigation, in support of grant submissions or to help direct recovery funding.

Data and Modeling Program Stages

Base Regional Model

- Calibrated and validated to historic storms HUC8 Base Regional models (in-progress)

Design Storms

- Base Regional Models run with various design storm scenarios to inform assessment of risk (Design storm pilot in progress)

Other Adaptations

- Consequence modeling (methodology under review)
- Transition Zone (pilot for methodology in progress)
- Mapping of modeling outputs

Regional H&H Modeling

April 2023

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HDR

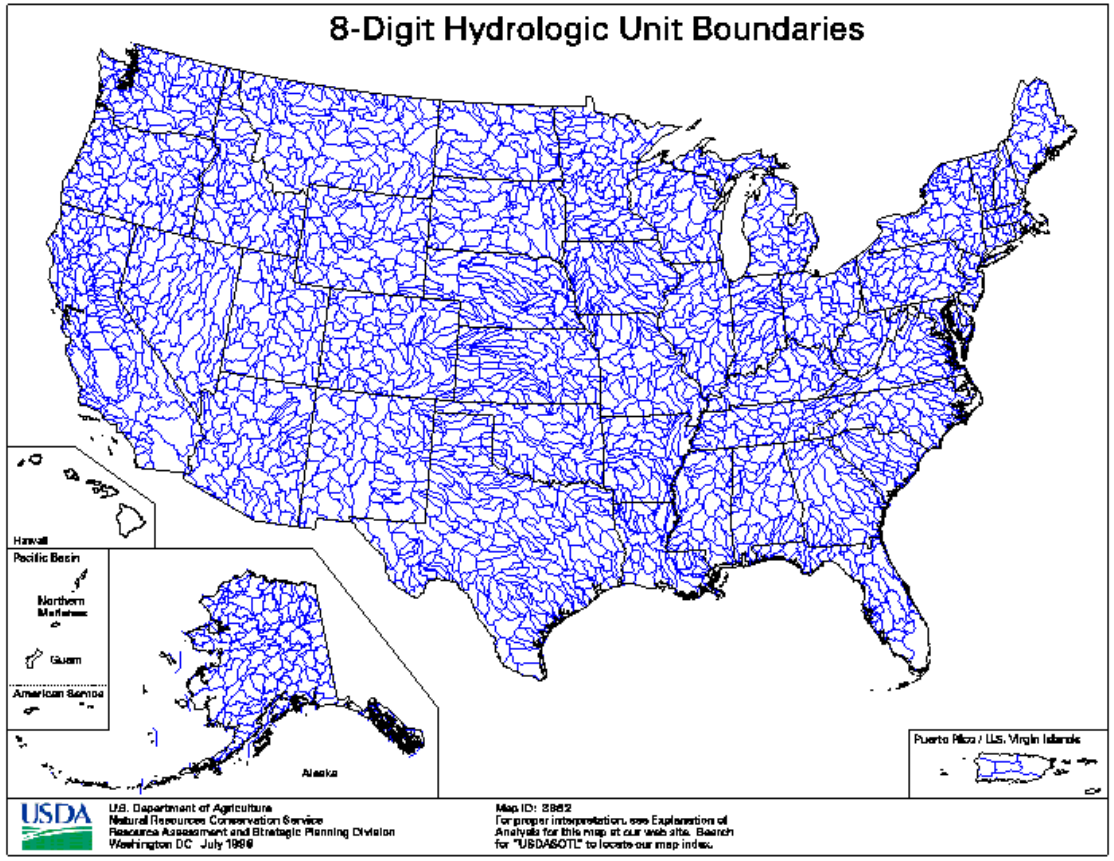
LOUISIANA WATERSHED INITIATIVE

working together for sustainability and resilience

Modeling 101

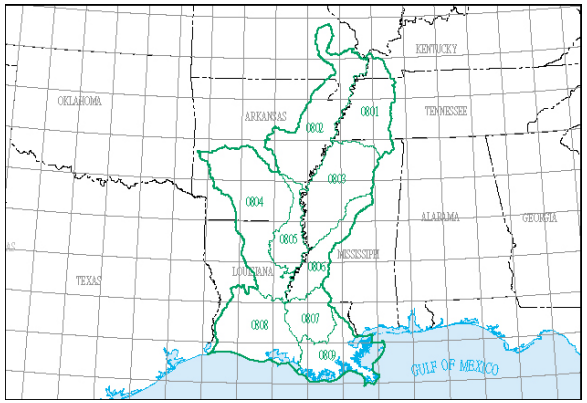
How is a Watershed defined?

- A watershed is defined as the geographic area within the boundary of a drainage divide.
- There are six levels of HUCs:
  - 2-digit (region)
  - 4-digit (subregion)
  - 6-digit (accounting unit)
  - 8-digit (cataloguing unit)
  - 10-digit (watershed)
  - 12-digit (subwatershed)

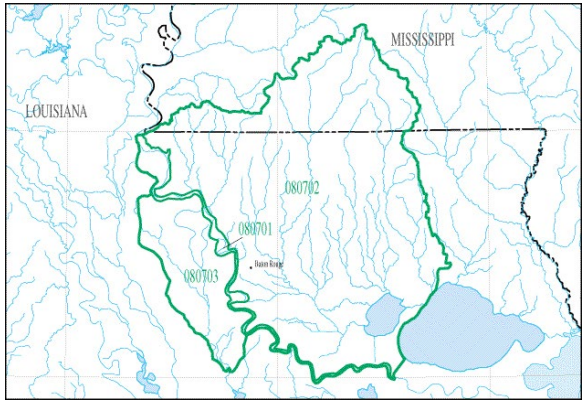


How is a Watershed defined?

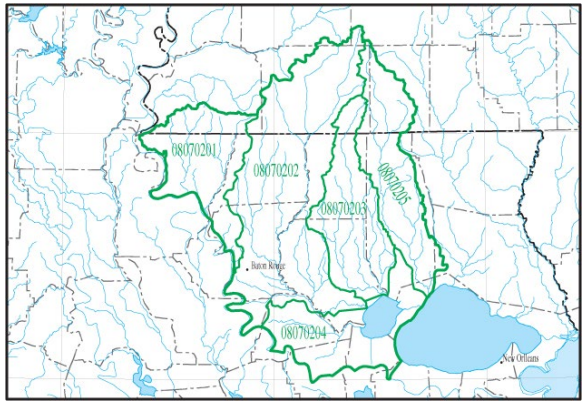
HUC 2 - Region



HUC 4 - Subregion



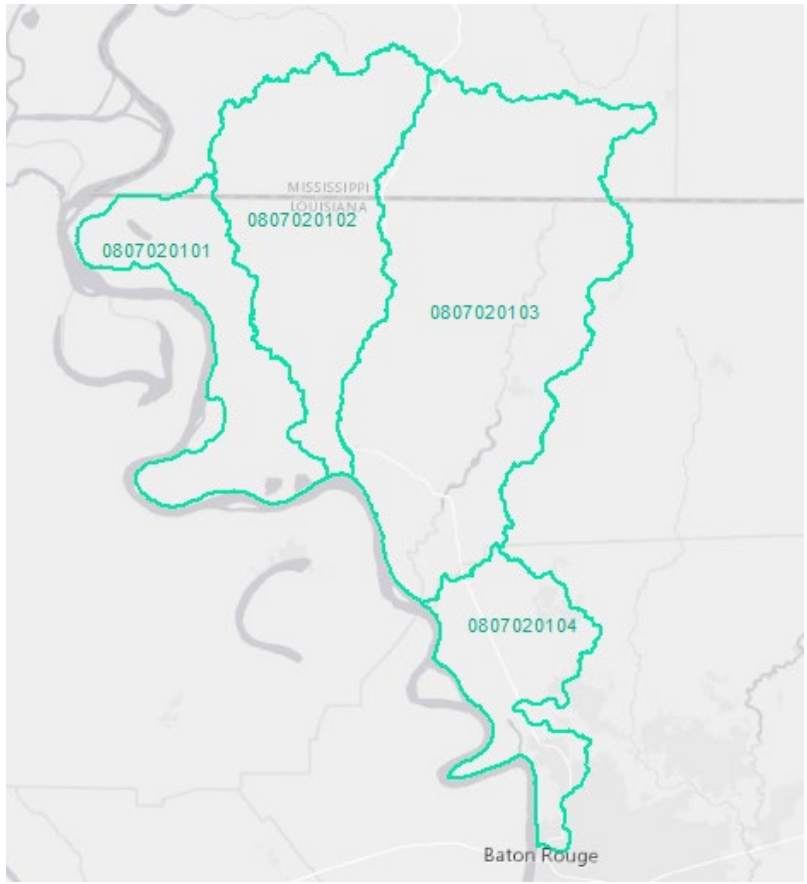
HUC 6 – Accounting unit



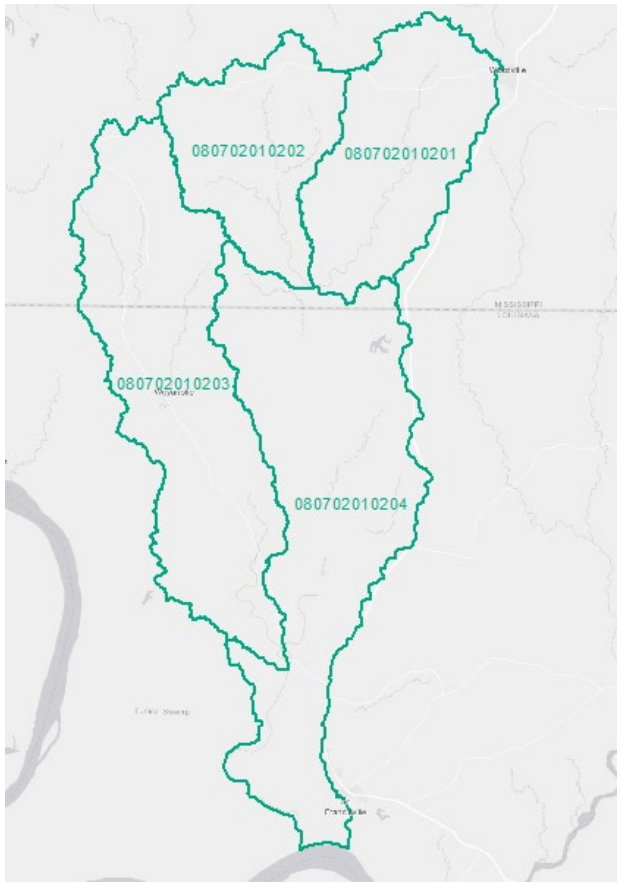
HUC 8 – Cataloguing unit

How is a Watershed defined?

- HUC 8 means a watershed delineated by the U.S. geological survey using a nationwide system based on surface hydrologic features at the 8-digit sub-basin scale (the hydrologic unit code 8).
- The larger the number the smaller the subdivided watershed. IE HUC 12 is smaller than HUC 8.
- HUC 8's range from the smallest being 700 sq. Mi
- HUC 10's range in size from 62 to 390 sq. Mi.
- HUC 12's range in size from 15 to 62 sq. mi.



HUC 10 – Watershed



HUC 12 – Subwatershed

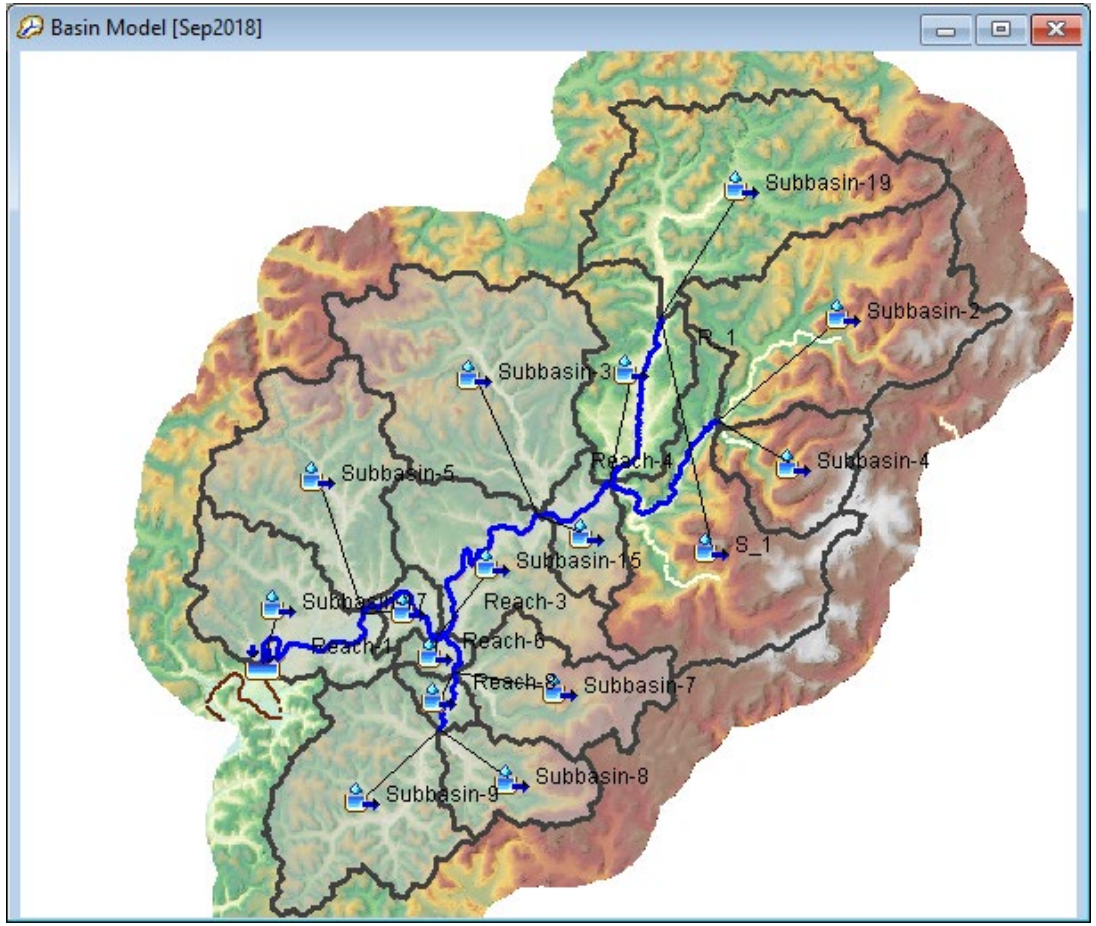
What is a Model?

- A model for the LWI program is a hydrologic or hydraulic computer software that is used to analyze storm (historic and design) scenarios.
- A model is simplification of process to quantifiable variables to forecast expected responses
- Input variables can be:
  - Shape of the channel and overbanks (flat low land, steep mountainous area)
  - the amount of rainfall intensity (inches) and duration (per hour)
  - the roughness of the land cover (heavily wooded, pasture, roadway/urban)
  - the ability of the land to absorb rainfall (dry pasture, impervious parking lot)
- Regional Base Models being developed for LWI are on the HUC 8 Scale.

What is a Model?

Hydrology

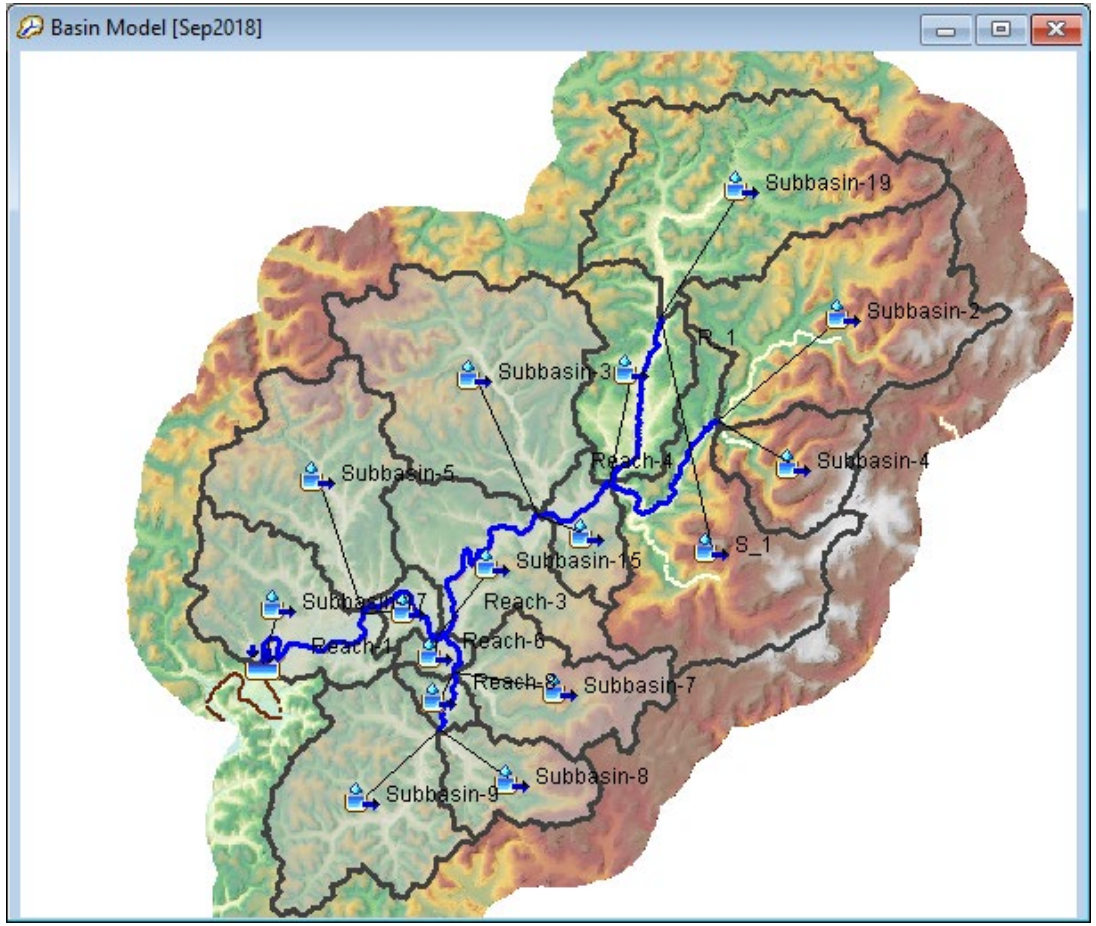
- The branch of science concerned with the properties of the earth's water, and especially its movement in relation to land.
- Hydrologic Models for LWI Data and Modeling Program is HEC-HMS or direct to HEC-RAS 2D through Rain on Grid



What is a Model?

Hydrology

- For the LWI Data and Modeling program, a HEC-HMS or Rain on Grid RAS model is being developed for each HUC 8 in the state.
- The hydrologic models evaluate how the rainfall from design and historic storms travels over the terrain and how quickly and what volume enters each modeled stream also called a reach (see image).

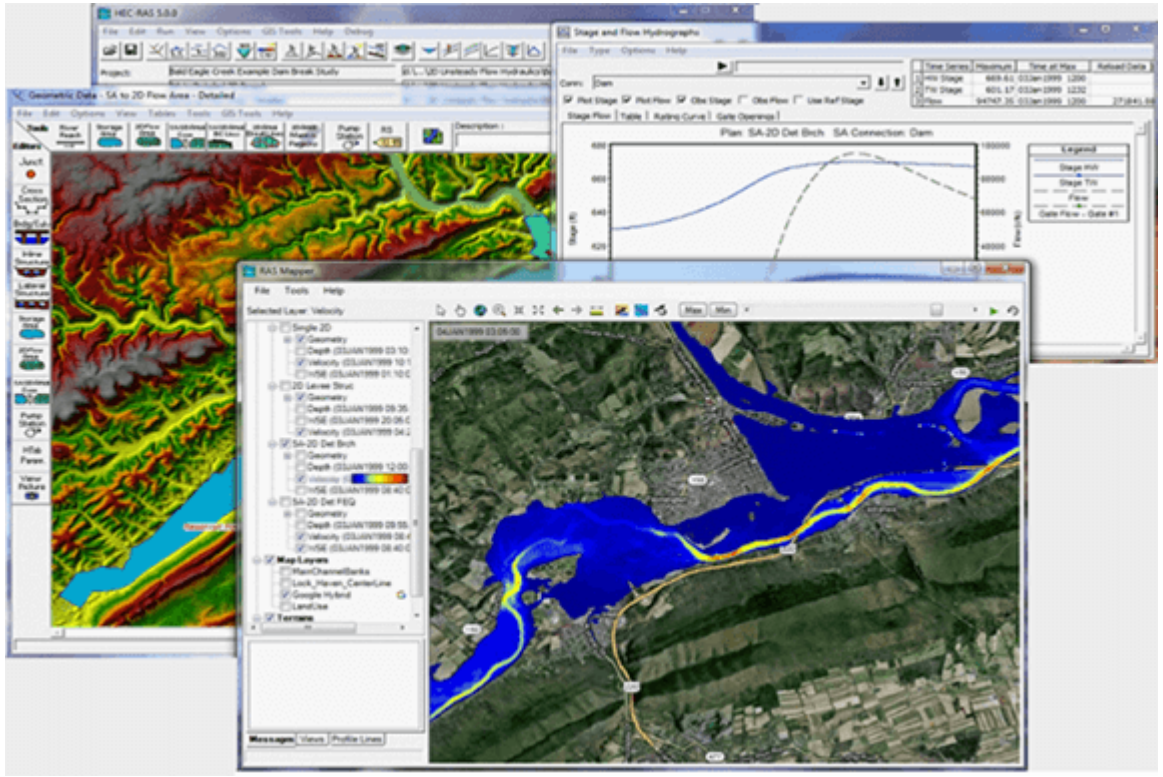


What is a Model?

Hydrology

- Examples of data needed to develop the hydrology include:
  - land use (impervious, vegetated, forested)
  - terrain (LiDAR),
  - Soil type
  - Stream length and general shape
- This allows the modeler to evaluate how the rainfall will interact with the ground surface and interpret how quicky the rainfall may accumulate at any point within the watershed.
- Tree canopy, evapotranspiration, and other transformation and loss parameters
- The timing and volume is then incorporated into the Hydraulic Modeling.

What is a Model?



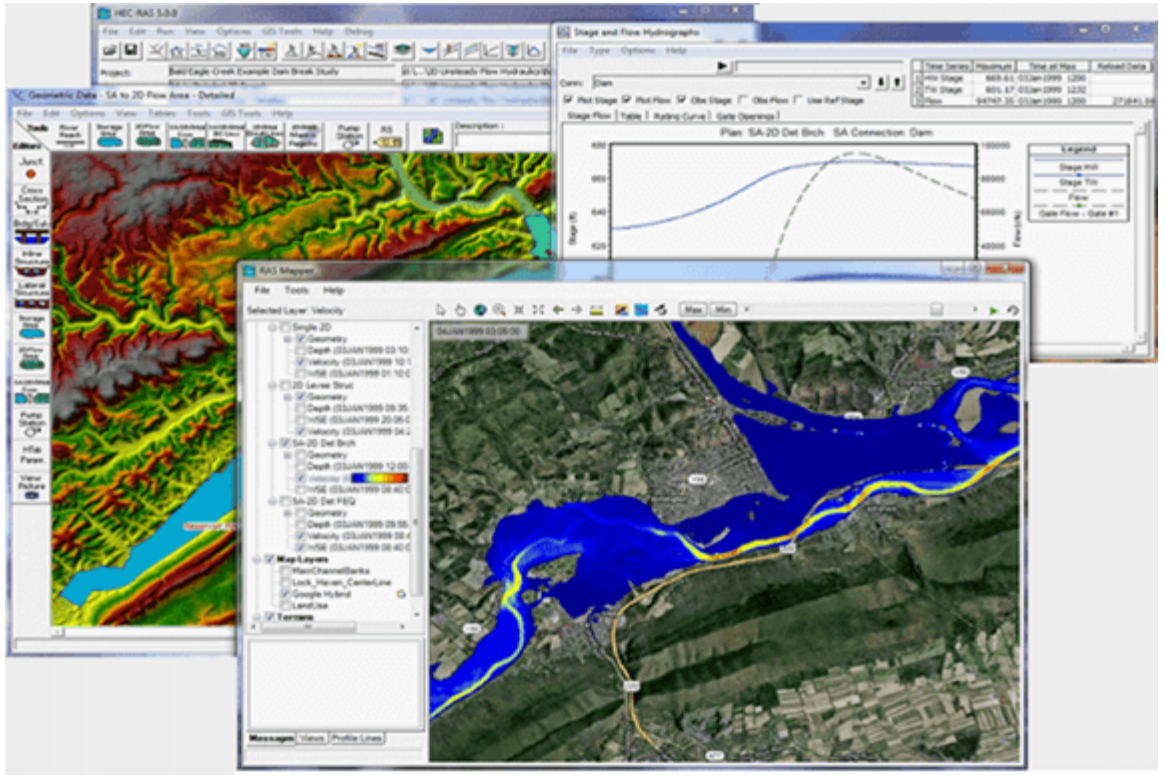
Hydraulics

- the branch of science and technology concerned with the conveyance of liquids through pipes and channels, especially as a source of mechanical force or control.
- Hydraulic Models for LWI Data and Modeling Program
  - HEC-RAS (1D, 2D, and 1D/2D)

What is a Model?

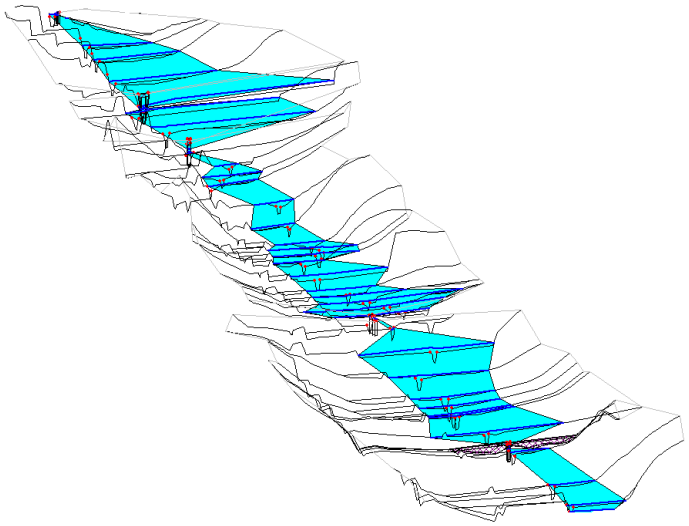
Hydraulics

- For the LWI Data and Modeling program, a RAS model is being developed for each HUC 8 in the state.
- The hydraulic models evaluate how the volume of water from design and historic storms travels through the channels and how those channels filled with water interact over time.

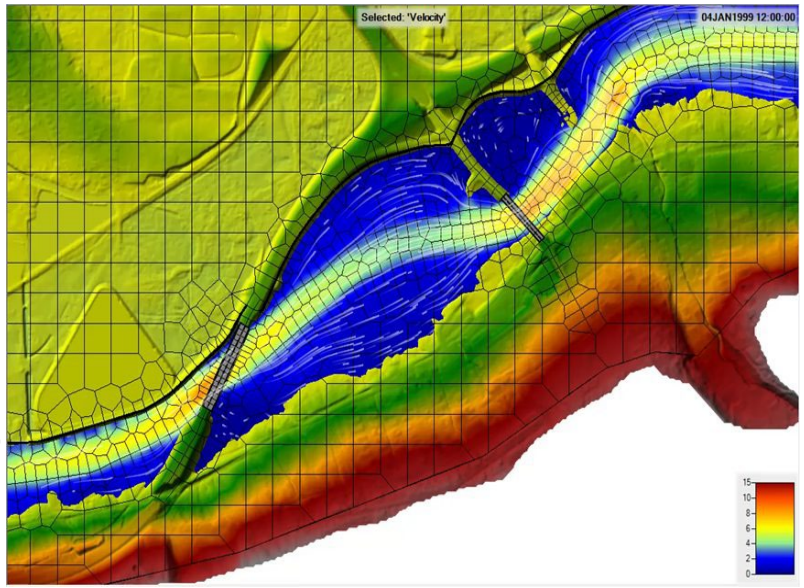


General Modeling Concepts: Hydraulic Models

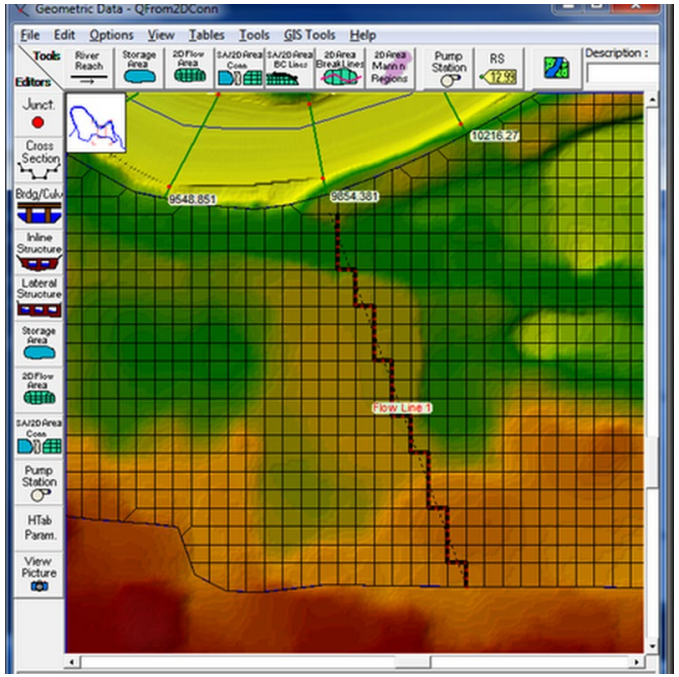
- One-Dimensional
- HEC-RAS



- Two-Dimensional
- HEC-RAS 2D



- One-Dimensional and Two-Dimensional Combined
- HEC-RAS 1D/2D



What is a Model?

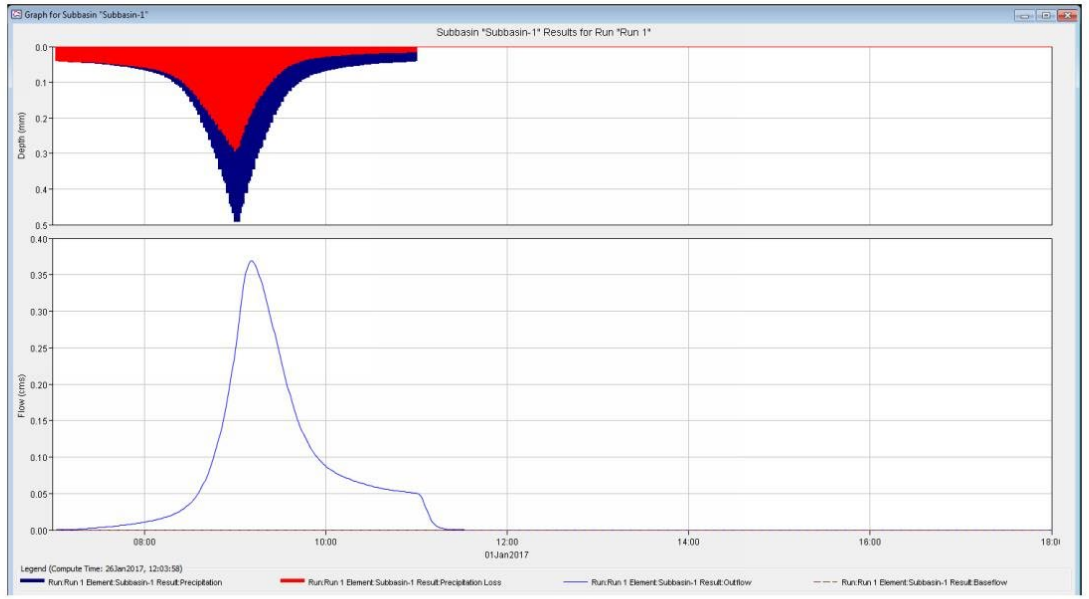
Hydraulics

- Examples of data needed to develop the hydraulic model include:
  - Manning's "n" (land cover coefficient)
  - Terrain (LiDAR)
  - Survey (conventional and bathymetric)
  - Boundary Conditions (from Hydrologic models)
- This allows the modeler to evaluate how the volume of water will interact within the channels and overbank areas.
- The timing and volume of flow as the channels interact is interpreted as results for outputs like water elevations, velocity grids, depth grids, and floodplain extents.

What is a Model Output?

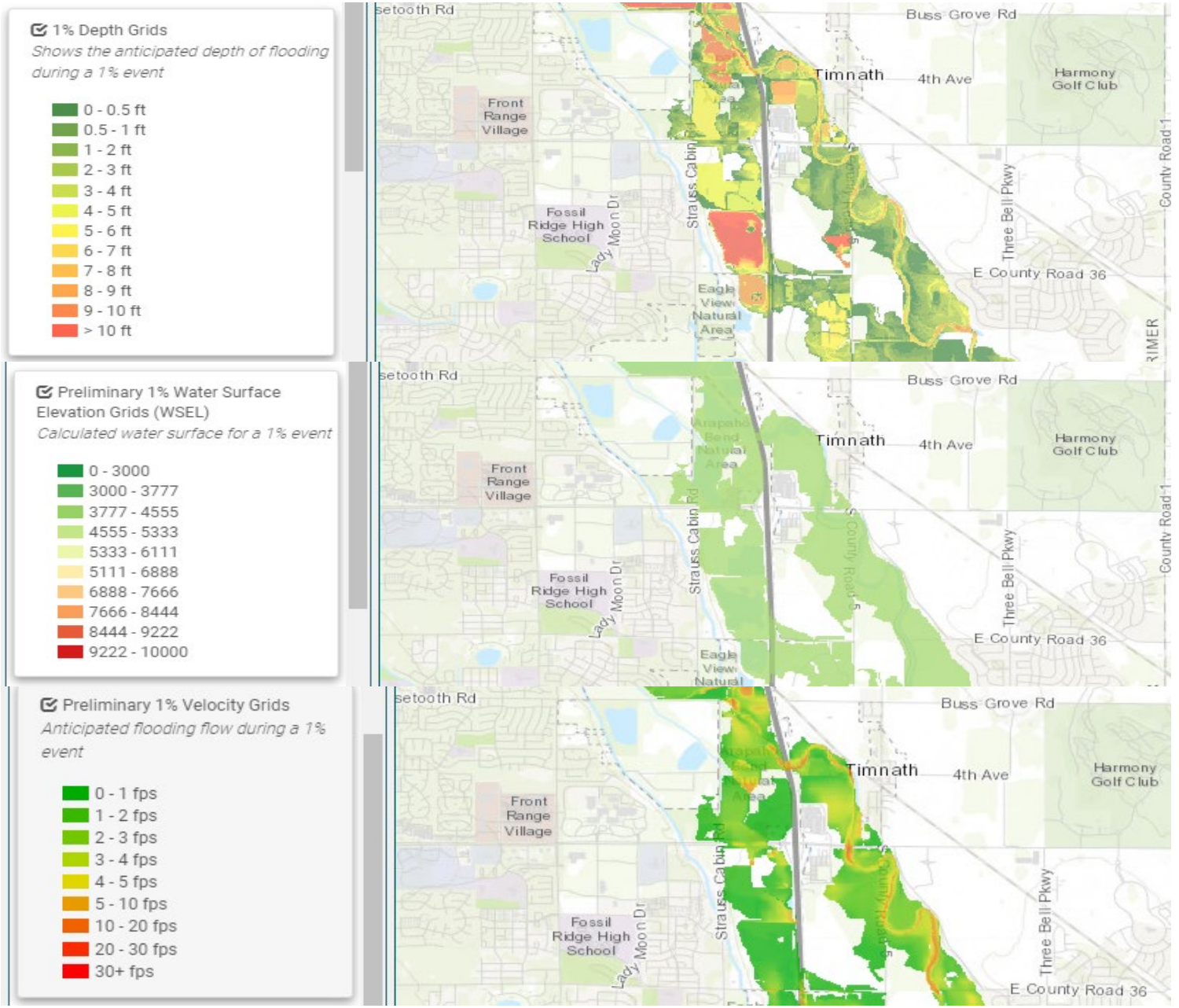
- A model output is the processed results of the data from a model.
- For the LWI Hydrologic models, hydrographs would be a modeling output. (see image)
- Hydrographs for HEC-HMS models inform the boundary conditions in HEC-HMS.

03. HEC HMS (4.1) Result



What is a Model Output?

- For the LWI Hydraulic models, depth grids, velocity grids, water surface elevation grids, and floodplain extents would be examples of modeling outputs.
- These outputs can be used to inform planning and design as stand-alone products.
- In addition, new outputs can be generated by modification in the model for project evaluations.



Region 5 Modeling Update

Schedule

Atchafalaya & Mermentau Headwaters

- H&H Model Calibration/Validation
  - June 9, 2023
- Final Deliverables
  - August 9, 2023

Mermentau

- Hydraulic Model Setup
  - June 9, 2023
- H&H Model Calibration/Validation
  - September 8, 2023
- Final Deliverables
  - November 10, 2023

Bayou Teche & Vermilion

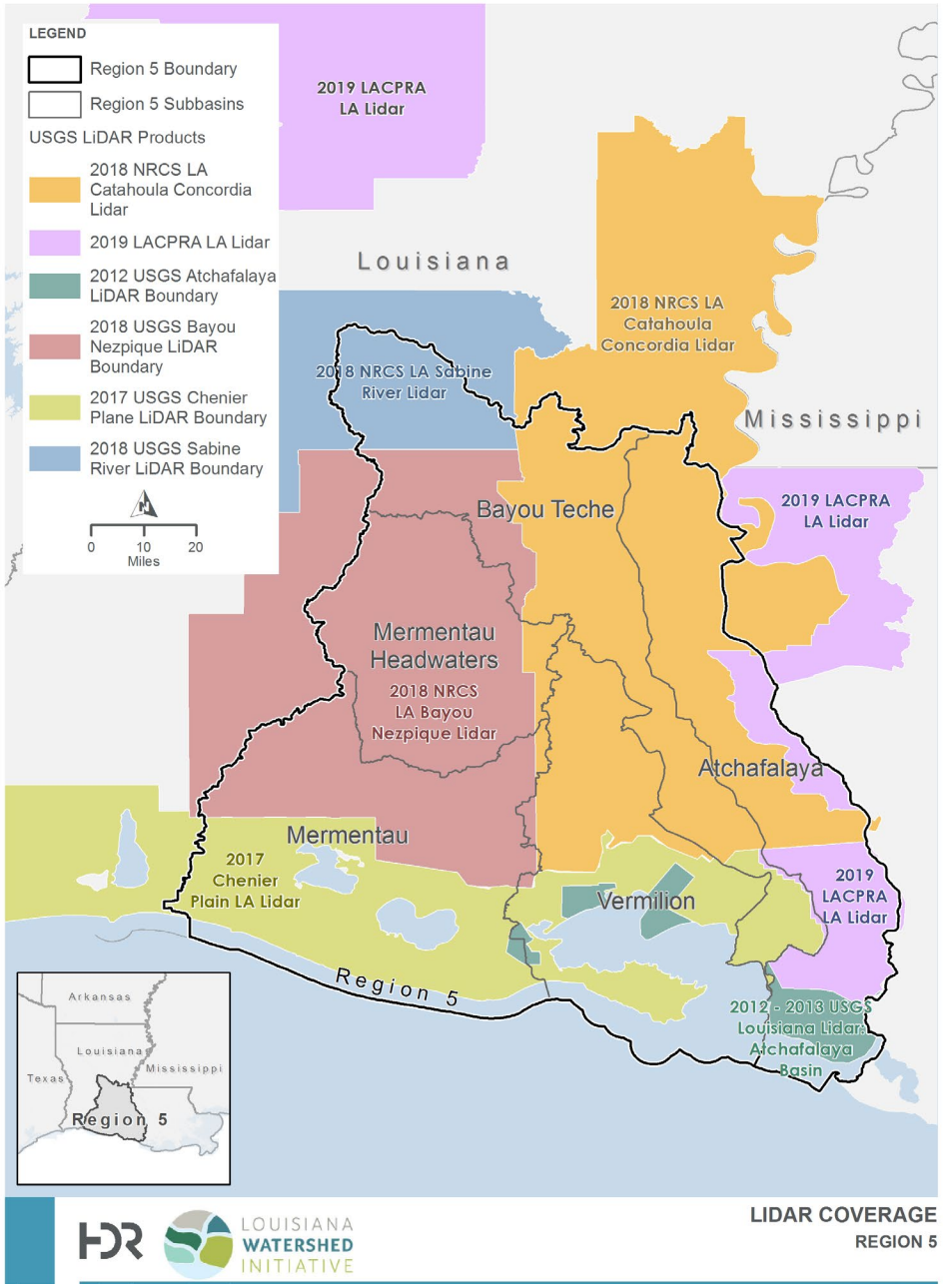
- H&H Model Setup
  - May 26, 2023
- H&H Model Calibration
  - August 31, 2023
- H&H Model Validation
  - October 31, 2023
- Final Deliverables
  - January 31, 2024

Data Collection

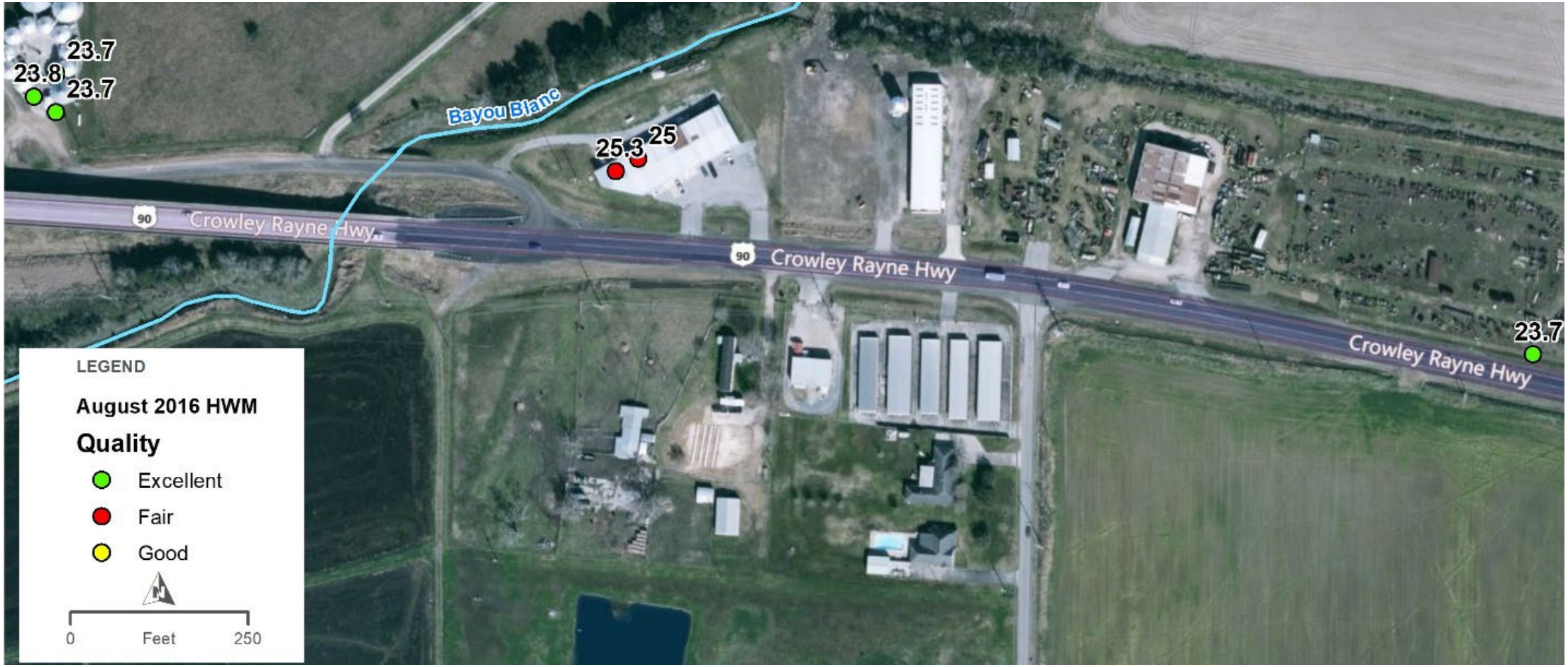
LiDAR for Region 5

- Includes entire region
  - 10 – 20 cm RMSEz
- Processed as region wide DEMs
  - 0.5 – 2 m raster surfaces

LiDAR Dataset Name	Survey Year	3DEP Quality Level
USGS LA Bayou Nezpique Lidar	2018	QL1
USGS LA Chenier Plain Lidar	2017	QL2
USGS LA Sabine River Lidar	2018	QL1
USGS LA Catahoula Concordia	2018	QL1
USGS LACPRA	2019	QL1
USGS Louisiana LiDAR (Atchafalaya Basin)	2012-2013	QL3



High Water Mark Assessment



High Water Mark Assessment

Quality Per Event

Historical Event	Total	Excellent	Good	Fair
Gustav (2008)	63	56	7	0
October 2015	N/A			
August 2016	271	214	37	30
May 2017	N/A			
Barry (2019)	19	14	5	0
Laura (2020)	11	10	0	1
Delta (2020)	N/A			
May 2020	N/A			

Collected Per HUC

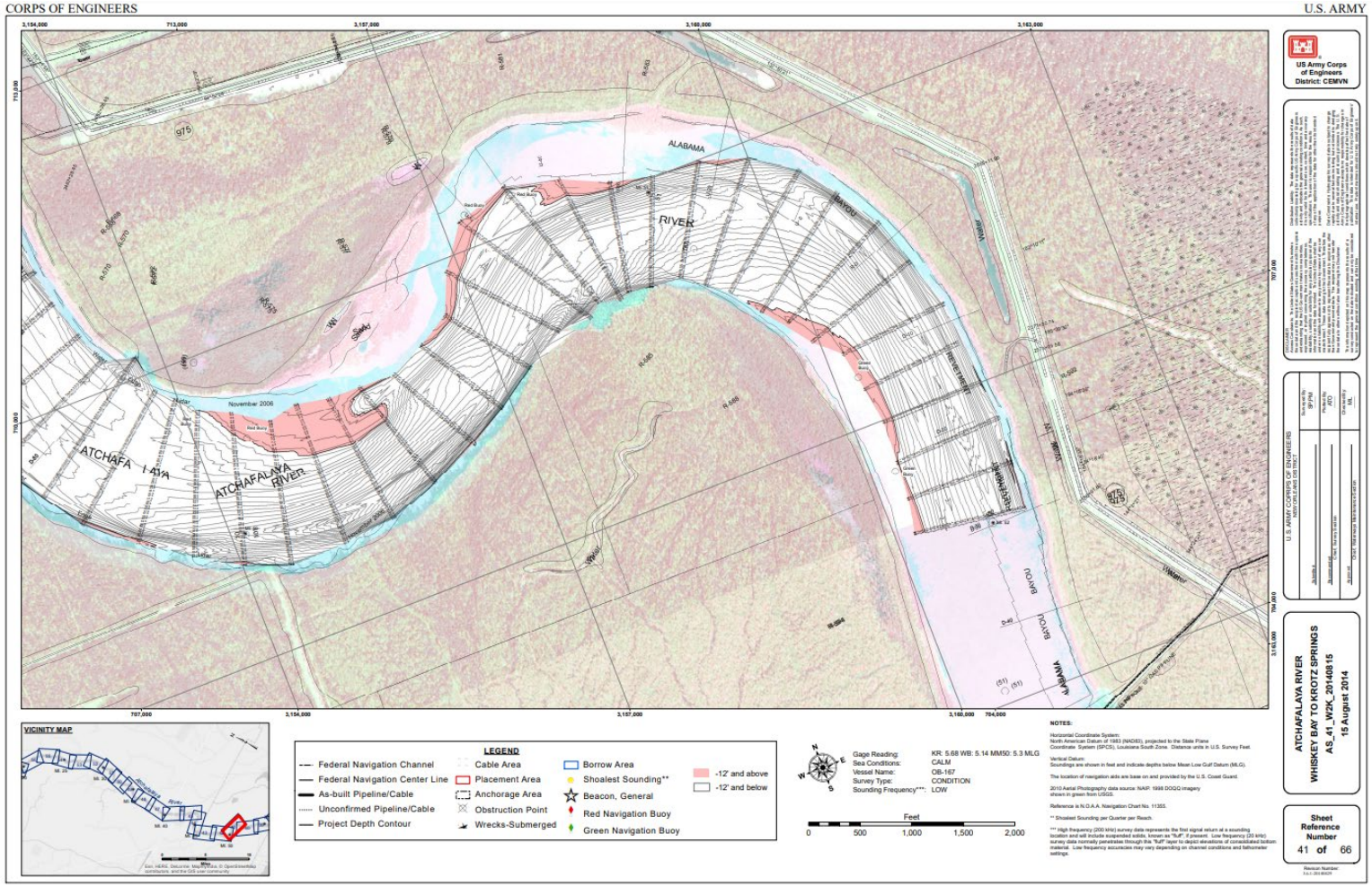
Historical Event	Atchafalaya	Mermentau	Mermentau Headwaters	Bayou Teche	Vermilion
Gustav (2008)	23	14	0	5	21
October 2015	N/A				
August 2016	0	52	96	7	116
May 2017	N/A				
Barry (2019)	0	0	0	2	17
Laura (2020)	0	10	0	0	1
Delta (2020)	N/A				
May 2020	N/A				

- 343/374 classified as “Good” or better
- Obtained from CRPA, Fenstermaker, and USGS
- Collectively reviewed by HDR

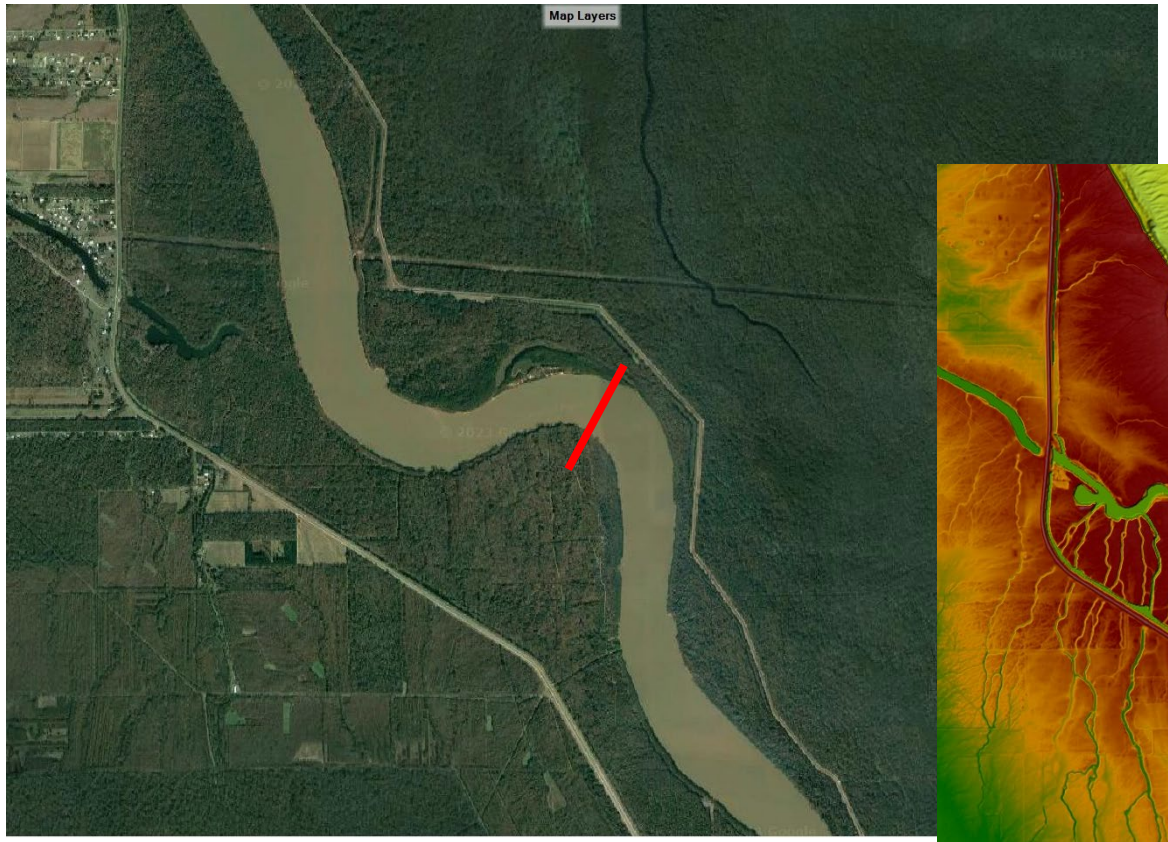
Survey Data

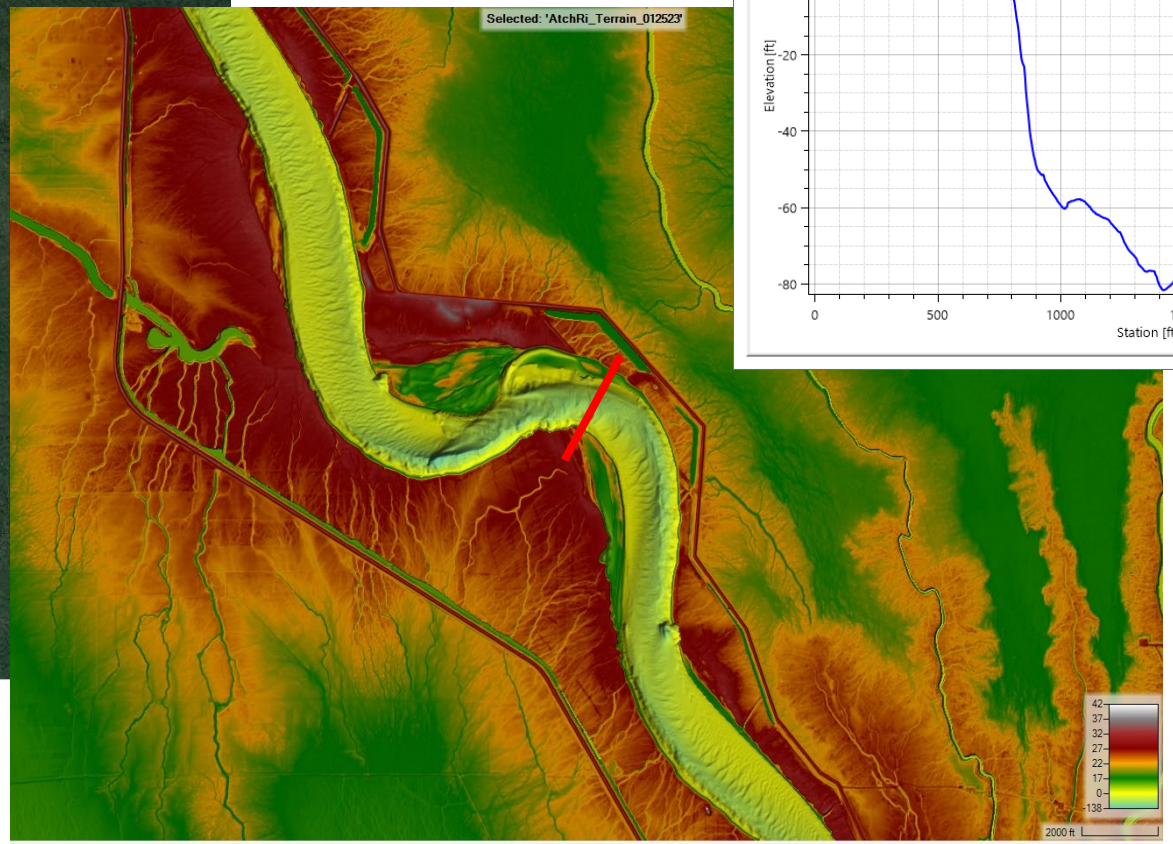
- USACE New Orleans Navigation

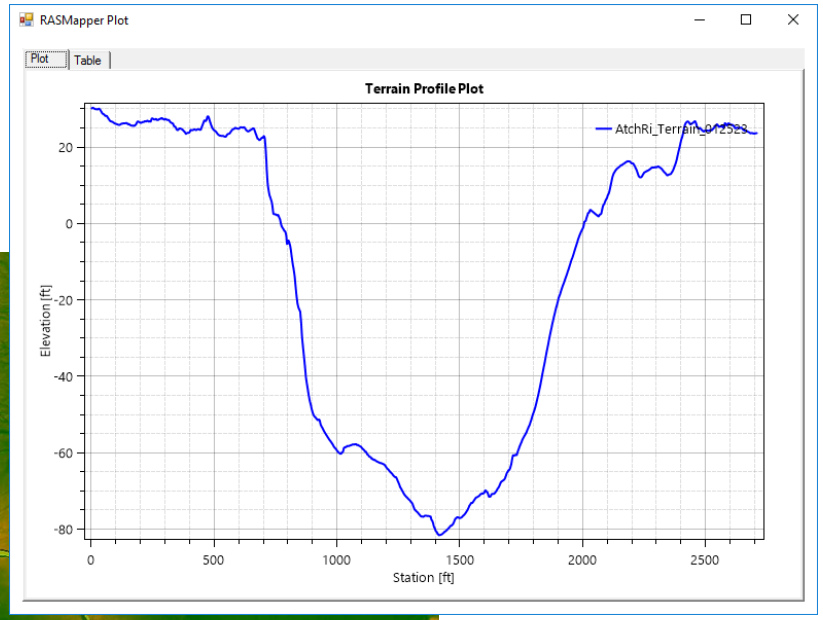
HUC8	Collected Survey Stream Mileage
Atchafalaya	64
Mermentau	103
Mermentau Headwaters	0
Bayou Teche	66
Vermilion	62



Seamless Topo-bathy Surface

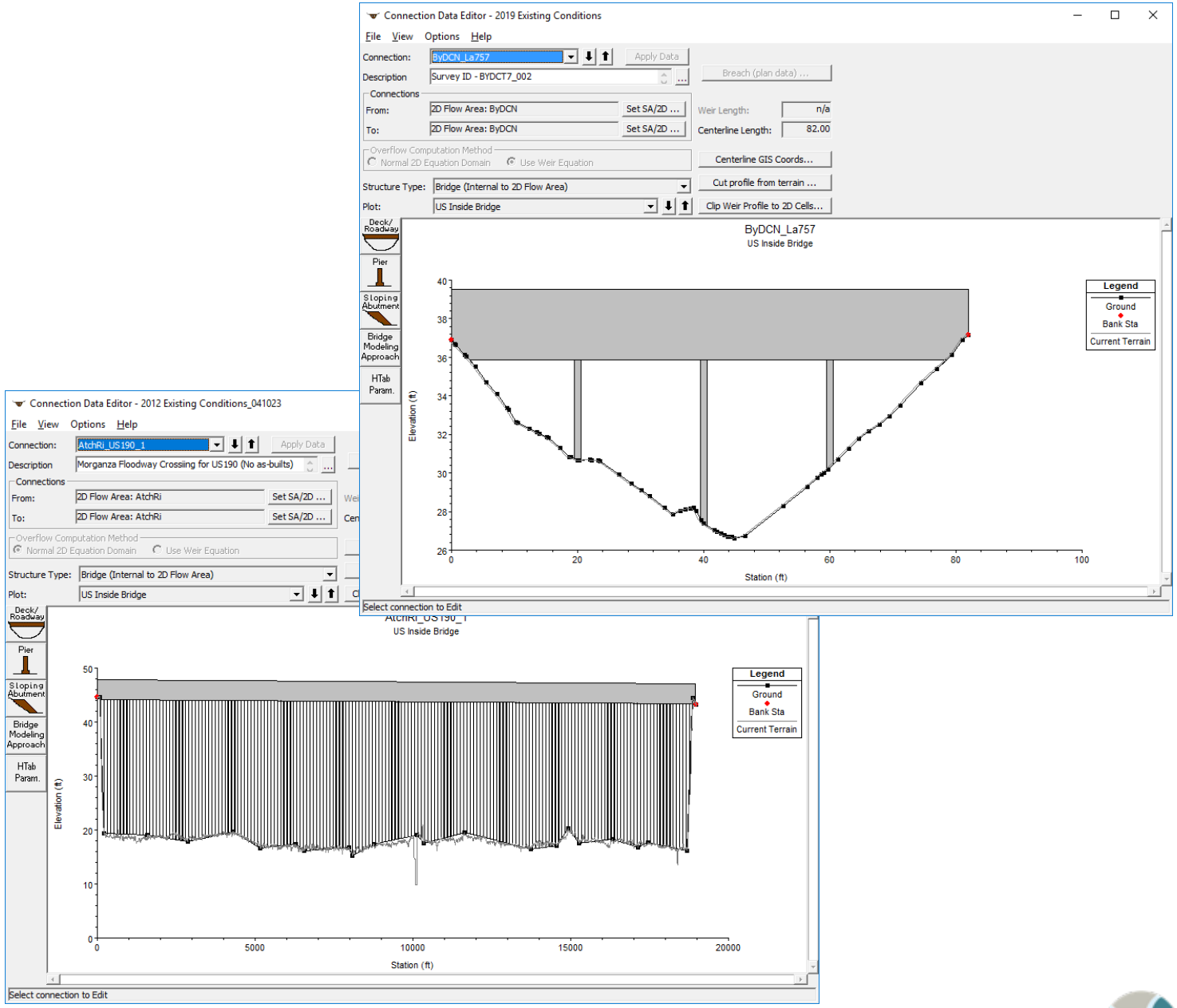




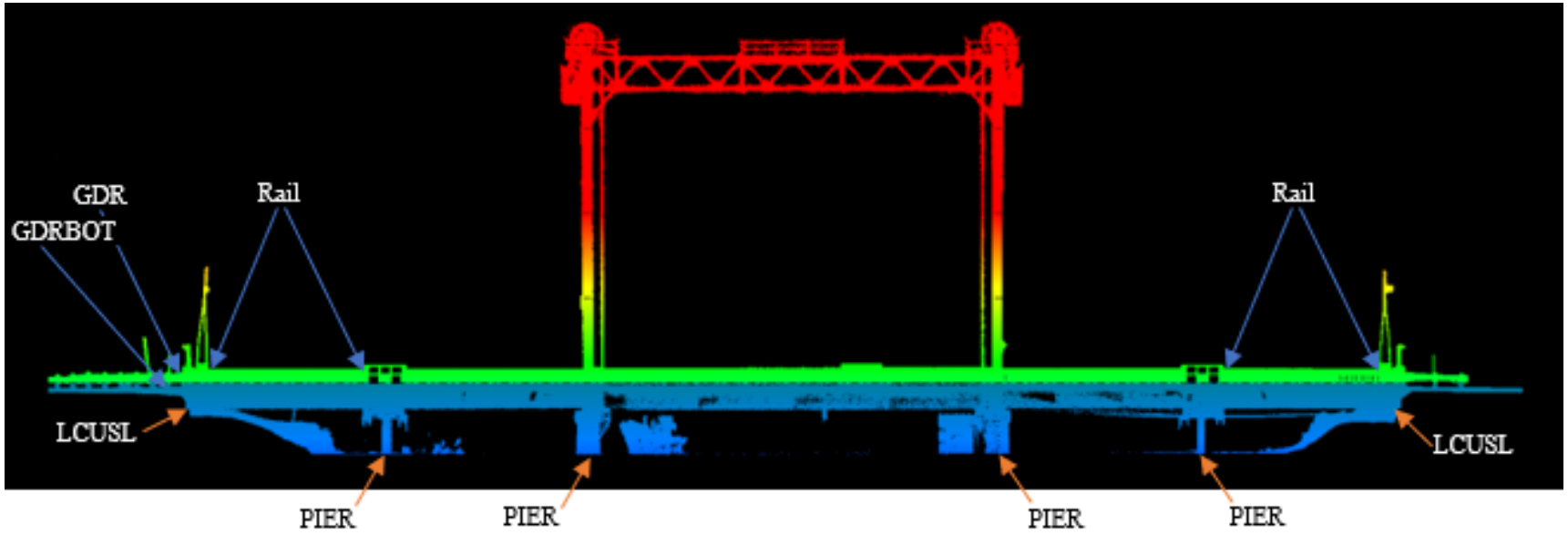


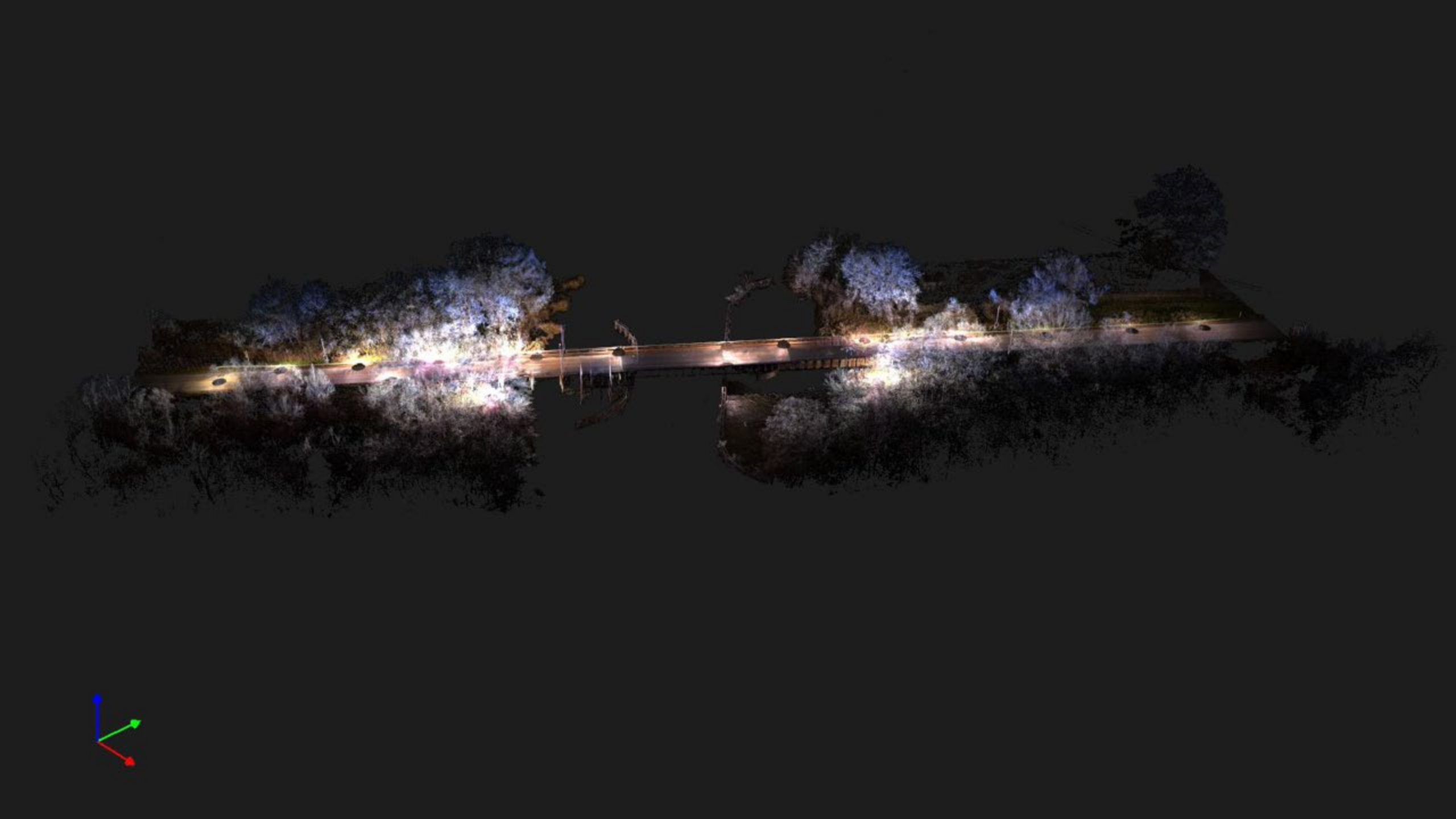
Survey Plan

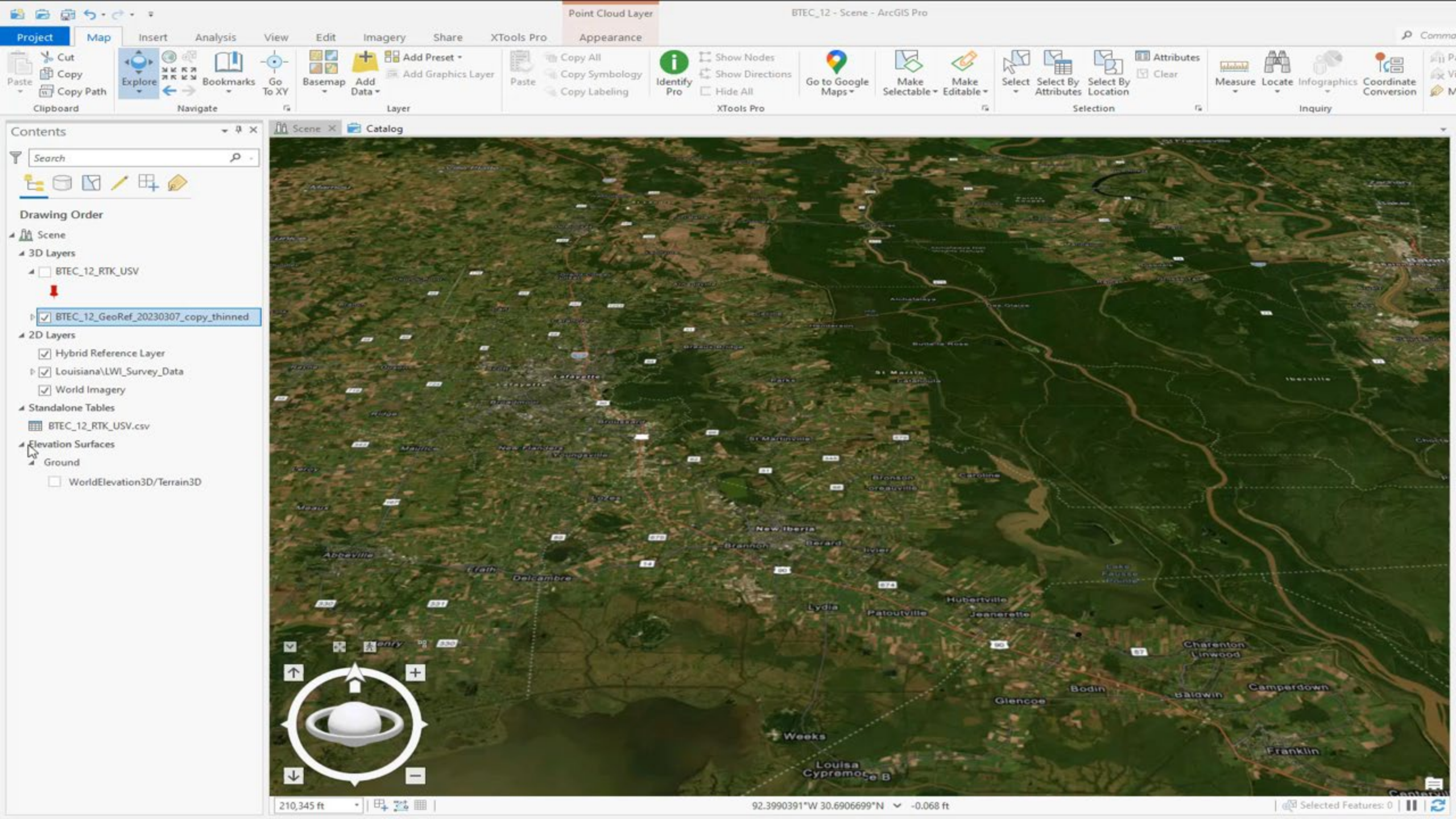
HUC8	Collected Structures
Atchafalaya	33
Mermentau	64
Mermentau Headwaters	194
Bayou Teche	338
Vermilion	602



Advanced Survey Methods (Drone LiDAR)






Point Cloud Layer
BTEC_12 - Scene - ArcGIS Pro
Project
Map
Insert
Analysis
View
Edit
Imagery
Share
XTools Pro
Appearance
Paste
Cut
Copy
Copy Path
Clipboard
Explore
Bookmarks
Go To XY
Navigate
Basemap
Add Data
Add Preset
Add Graphics Layer
Layer
Paste
Copy All
Copy Symbology
Copy Labeling
Identify Pro
Show Nodes
Show Directions
Hide All
Go to Google Maps
Make Selectable
Make Editable
XTools Pro
Select
Select By Attributes
Select By Location
Attributes
Clear
Selection
Measure
Locate
Infographics
Coordinate Conversion
Inquiry
Contents
Search
Drawing Order
Scene
3D Layers
BTEC_12_RTK_USV
BTEC_12_GeoRef_20230307_copy_thinned
2D Layers
Hybrid Reference Layer
Louisiana\LWI_Survey_Data
World Imagery
Standalone Tables
BTEC_12_RTK_USV.csv
Elevation Surfaces
Ground
WorldElevation3D/Terrain3D
Scene
Catalog
New Iberia
Abbeville
Lydia
Patoutville
Hubertville
Jeanerette
Charenton
Linwood
Bodin
Baldwin
Camperdown
Glencoe
Weeks
Franklin
Louisa
Cypremort Point
210,345 ft
92.3990391°W 30.6906699°N
-0.068 ft
Selected Features: 0

Modeling Approach

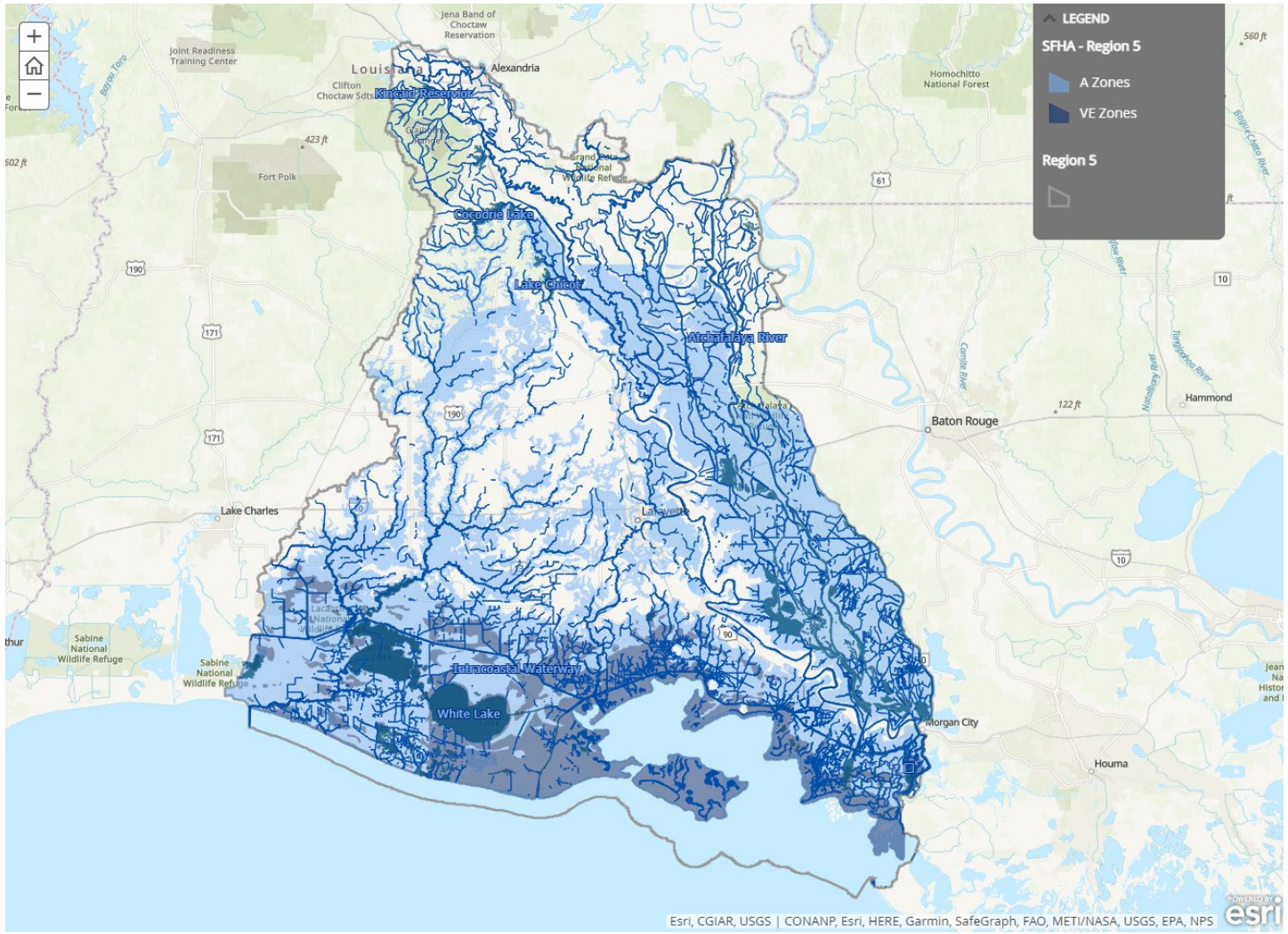
Tiered Modeling Approach

- Risk is a function of:

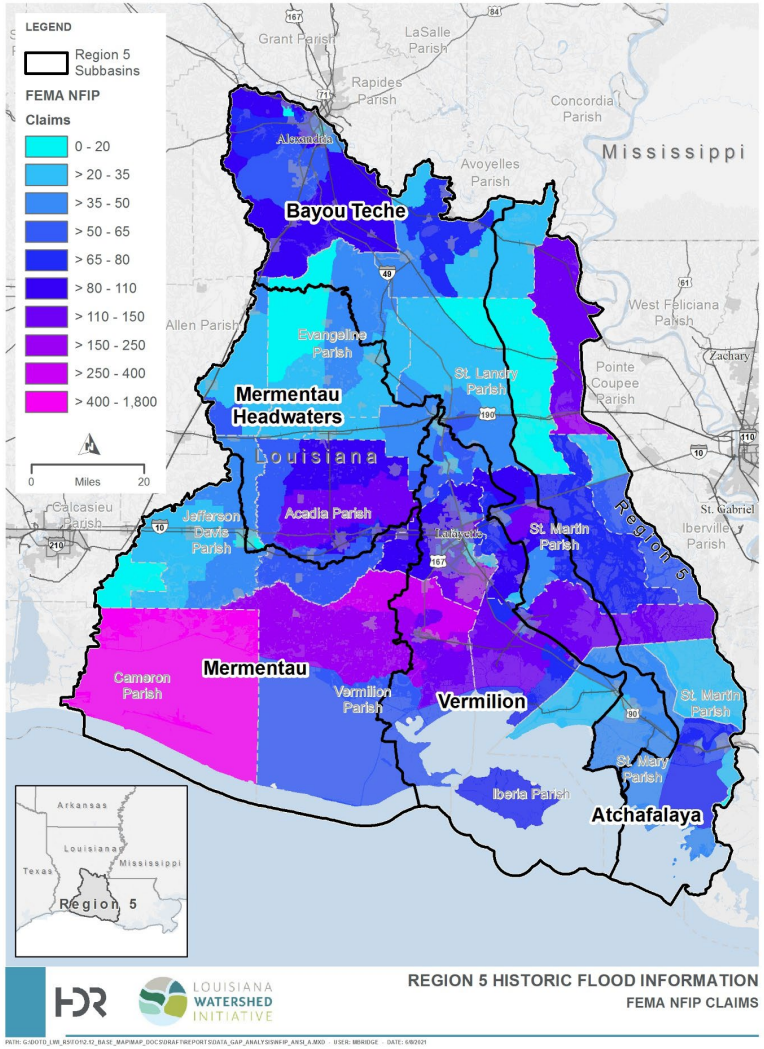
  Probability × Consequences

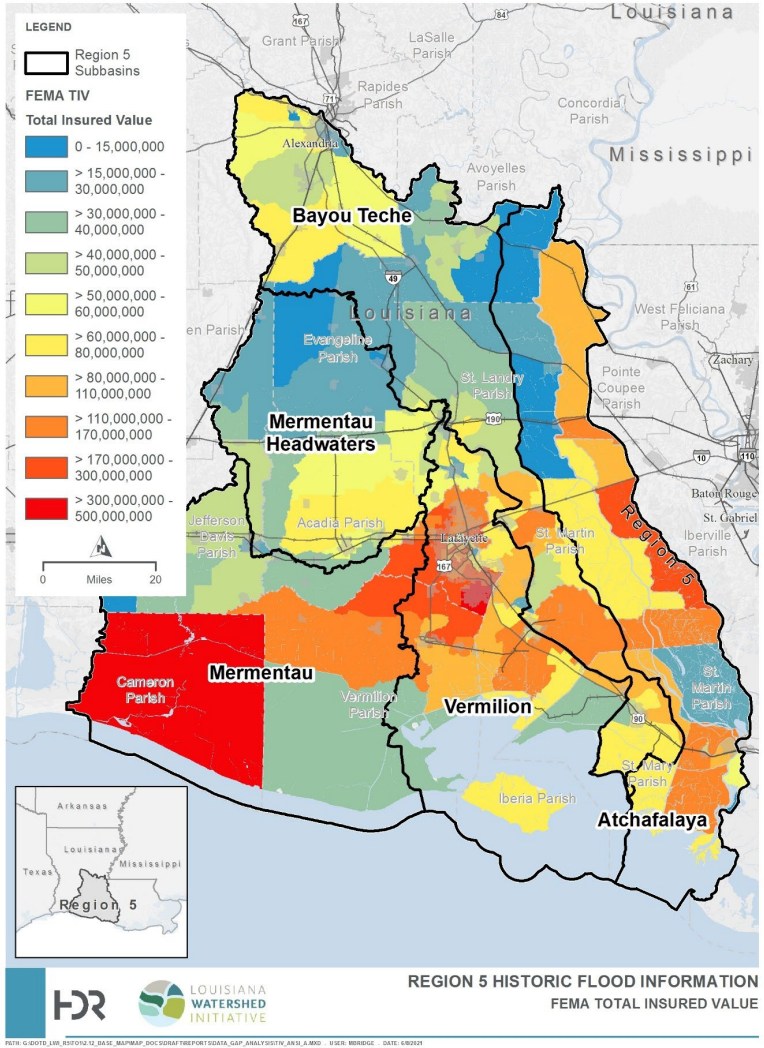
- Risk is non-uniform throughout basin
- Putting money where the risk is
- Scalable solution

Consistent & Replicated Statewide

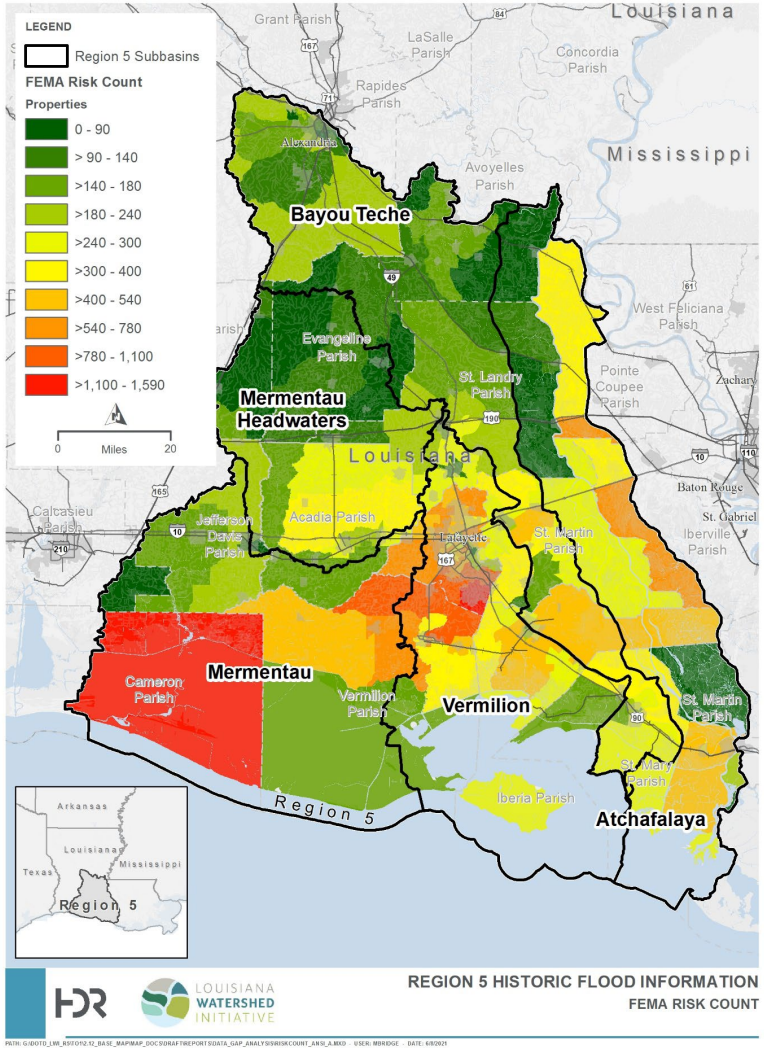


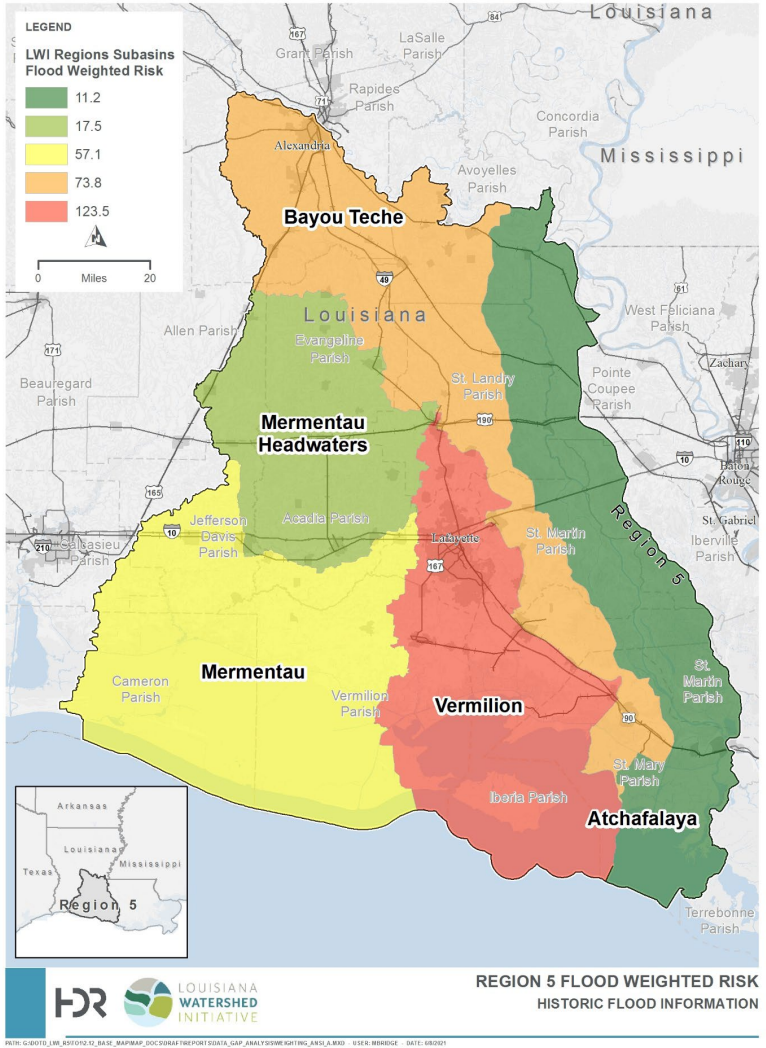
FEMA NFIP Claims & Total Insured Value





FEMA Risk Count and Weighted Flood Risk





Tiered Modeling Approach

High

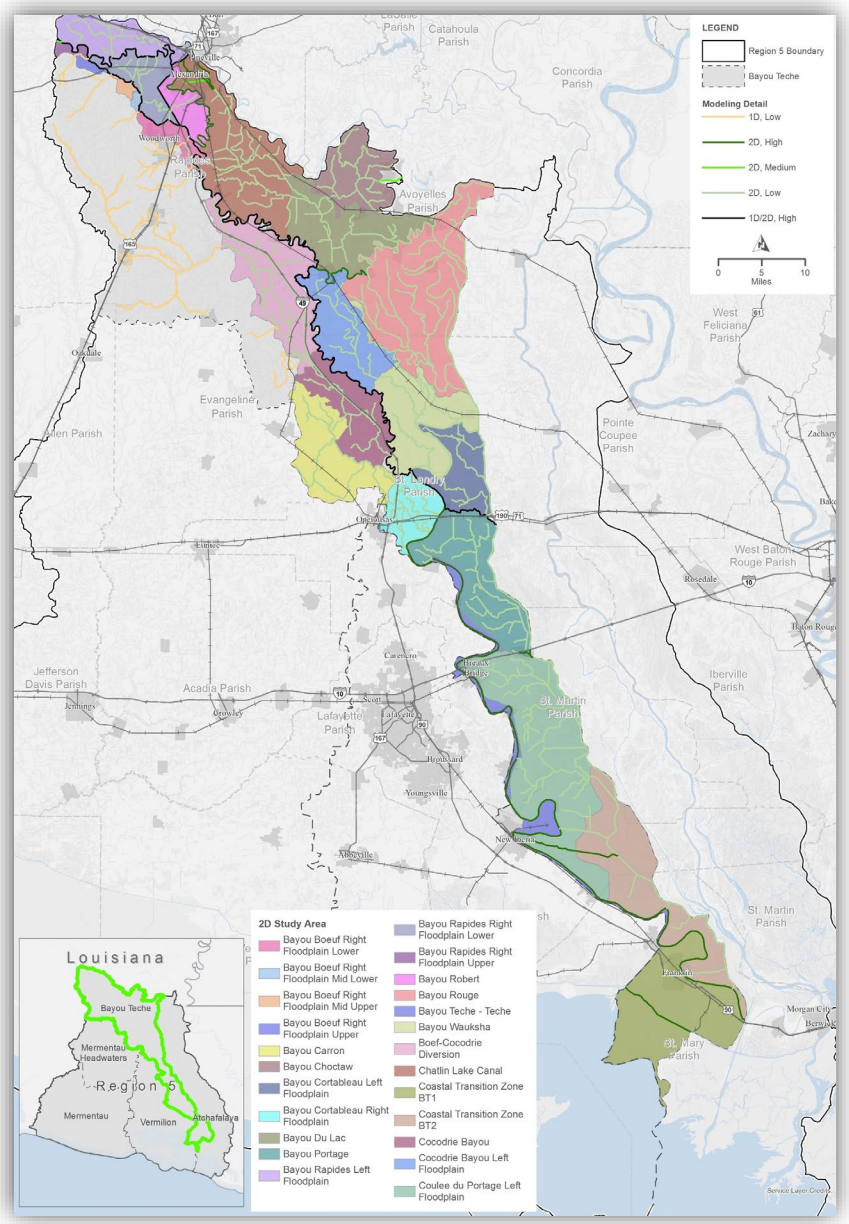
- FEMA Zone AE (Detailed)
- Full Survey
- 20-200 ft Grid

Medium

- FEMA Zone AE (LDS)
- Approximate Survey
- 200-500 ft Grid

Low

- FEMA Zone A
- Limited or No Survey
- 500-1,000 ft Grid



Tiered Modeling Approach

HEC-RAS Spatial Resolution	HEC-RAS Modeling Techniques	General 2D Grid Size (ft)
High	• Channels: LiDAR and supplemented with bathymetry and/or bathymetric assumptions • Structures: Survey and/or available plans for structures	20-200
Medium	• Channels: LiDAR and supplemented with some bathymetric assumptions • Structures: Detailed survey for major hydraulic structures. Minor structures approximated with simple field methods	200-500
Low	• Channels: LiDAR only • Structures: Major hydraulic structures approximated from aerials and topography. Minor structures estimated or not included.	500-1,000

Hydrology

Historic Event Selection

HUC8	Location	Major Flood Stage (ft.)	Moderate Flood Stage (ft.)	Flood Stage (ft.)	Action Stage (ft.)
Mermentau Headwaters	USGS 08012000 Bayou Nezpique near Basile, LA	28	24	22	22
Mermentau Headwaters	USGS 8010000 Bayou Des Cannes near Eunice, LA	21	18	16	14
Mermentau	USGS 08012150 Mermentau River at Mermentau, LA	8	6	4	4
Bayou Teche	USGS 07382500 Bayou Courtableau at Washington, LA	34	30	28	27
Bayou Teche	USGS 07382000 Bayou Cocodrie near Clearwater, LA	23	21	19	17
Vermilion	USGS 07386600 Vermilion River (B. Vermilion) near Carencro, LA	21.5	19.5	17	15
Vermilion	USGS 07386880 Vermilion River at Surrey St. at Lafayette, LA	16	14	10	10
Vermilion	USGS 07386980 Vermilion River at Perry, LA	11	10	9	8
Vermilion	USGS 07387040 Vermilion Bay near Cypremort Point, LA	9	7	4	3
Atchafalaya	USGS 07381490 Atchafalaya River at Simmesport, LA	50	44	40	35
Atchafalaya	USGS 07381515 Atchafalaya River at Butte La Rose, LA	28	25	20	17

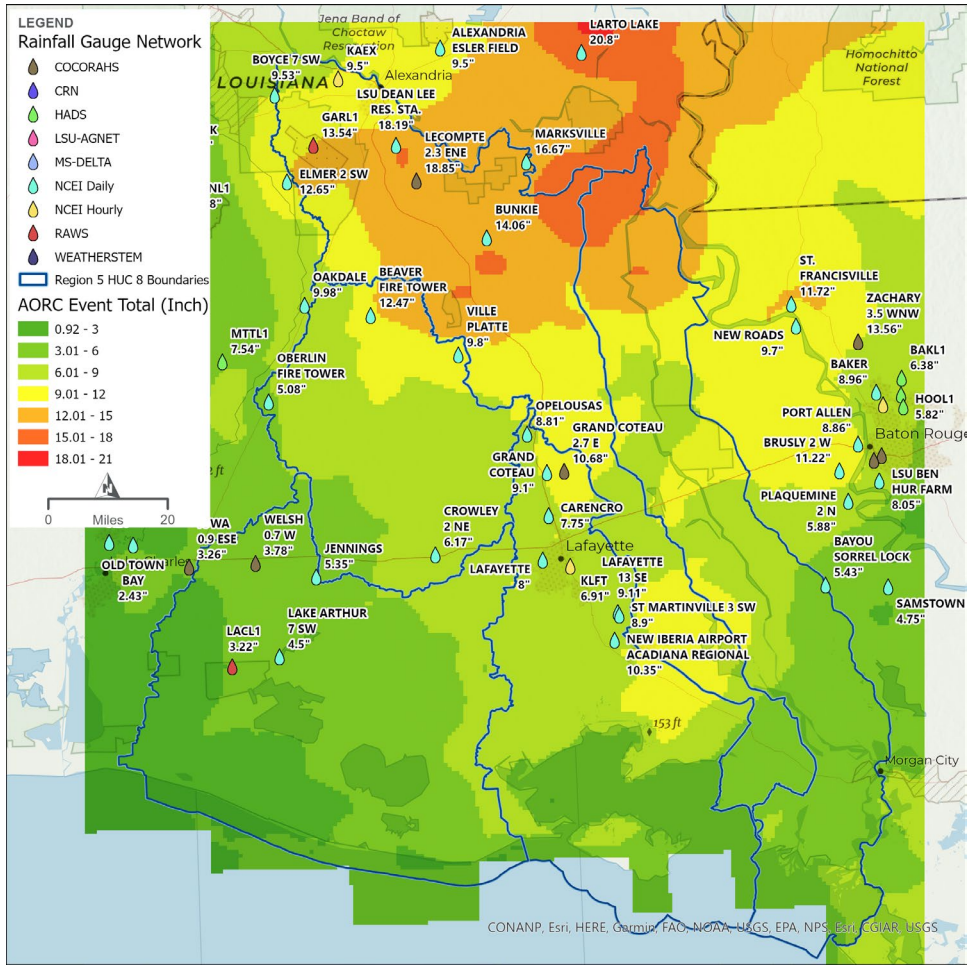
Selected Historical Events for Calibration

- Hydrometeorological Inputs

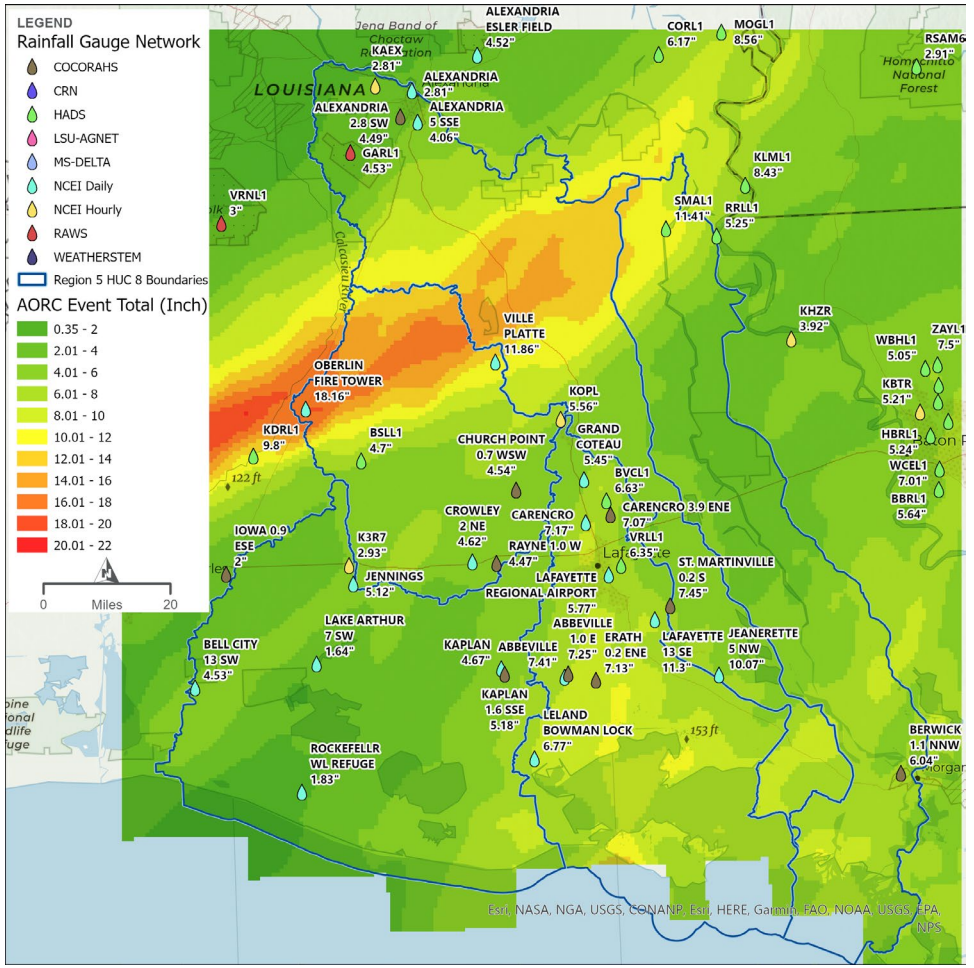
ID	Historical Event	Date Range	Storm type	Storm Duration
1	Gustav (2008)	8/25 – 9/7	Tropical	Short
2	October 2015	10/24 – 11/8	Non-tropical	Multi-Period
3	August 2016	8/12 – 8/22	Non-tropical	Short
4	May 2017	4/29 – 5/5	Non-tropical	Short
5	Barry (2019)	7/11 – 7/19	Tropical	Short
6	Laura (2020)	8/20 – 8/29	Tropical	Short
7	Delta (2020)	10/5 – 10/10	Tropical	Short
8	May 2020	5/5 – 5/19	Non-tropical	Multi-Period

Tropical Events

Gustav

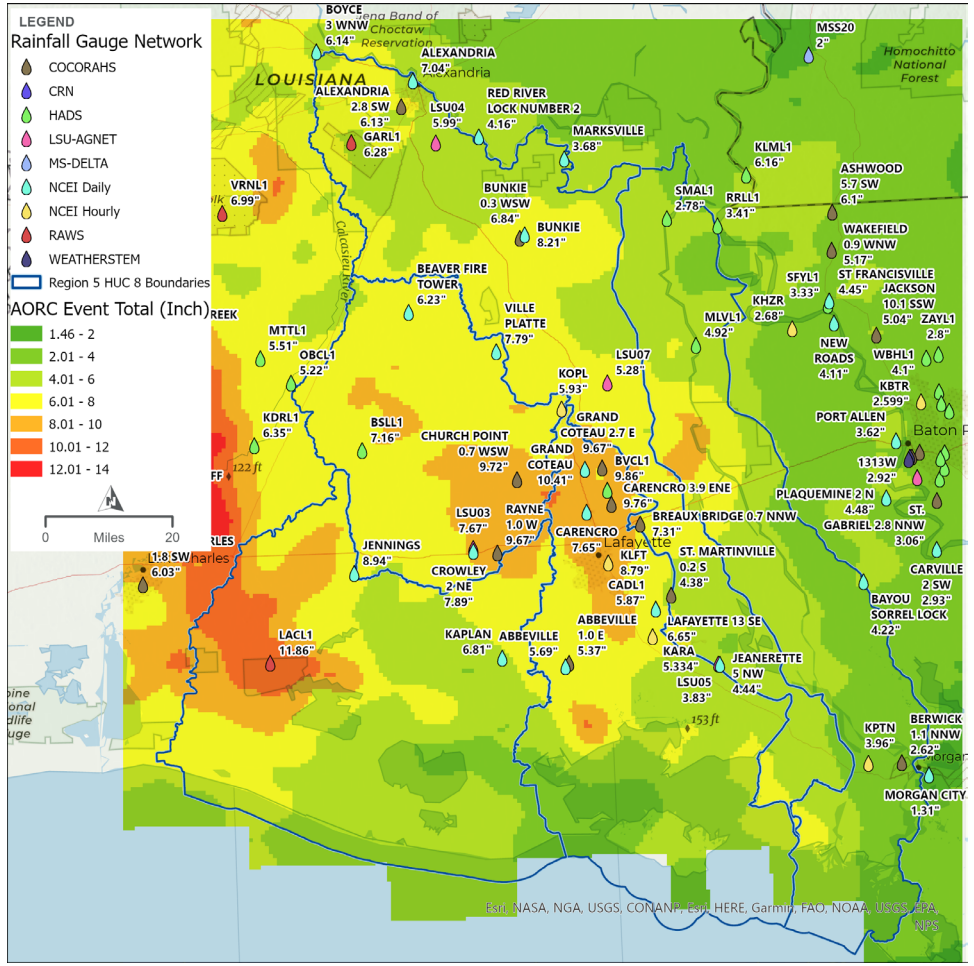


Barry

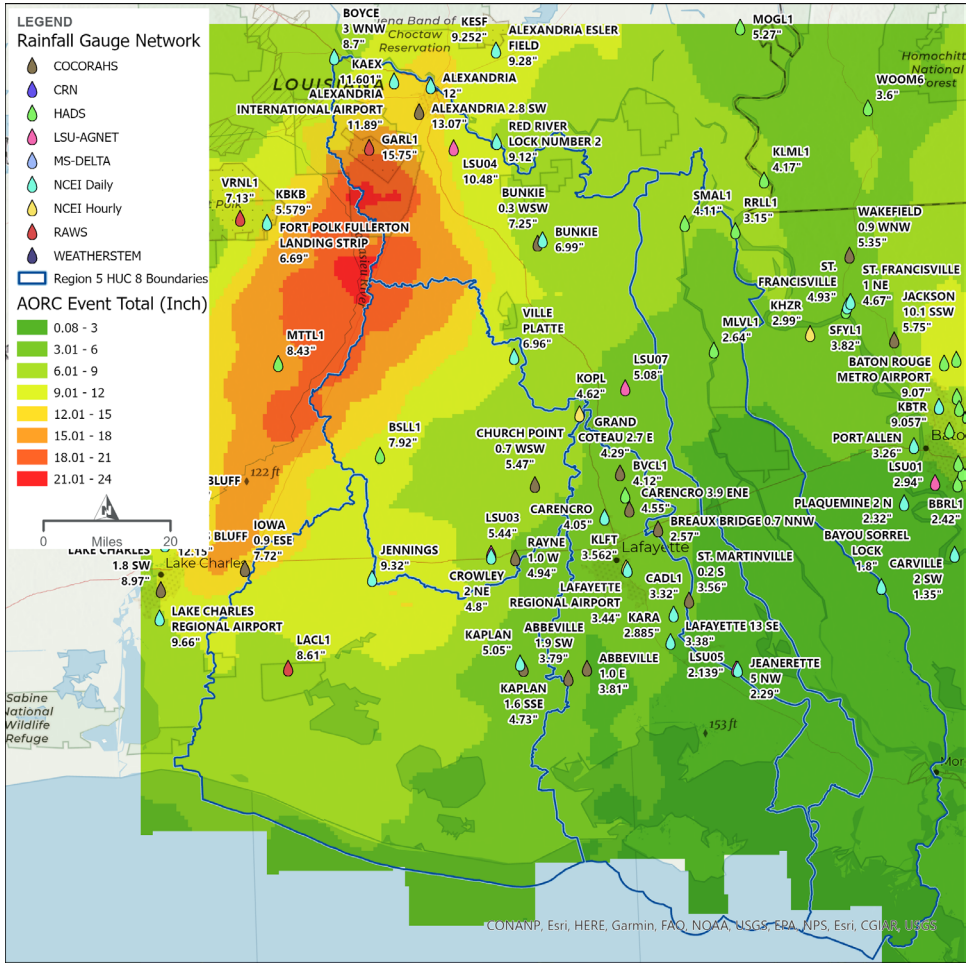


Tropical Events

Laura

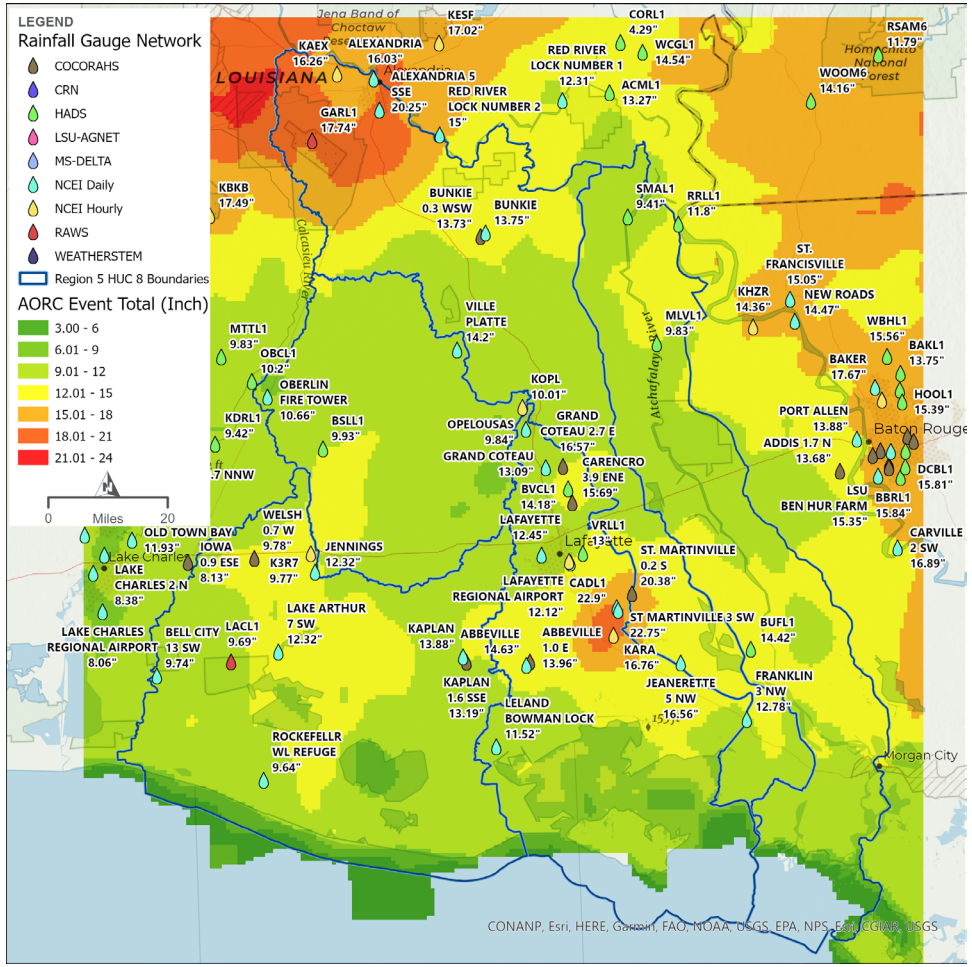


Delta

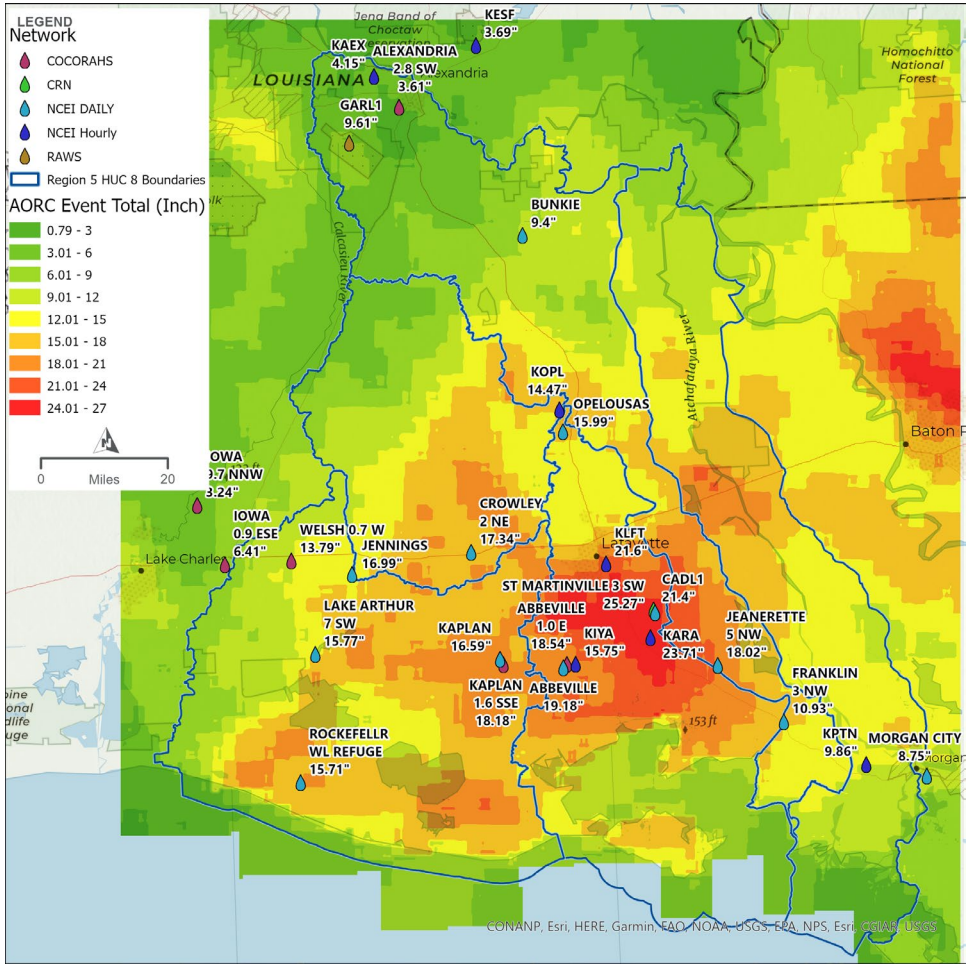


Non-Tropical Events

October 2015

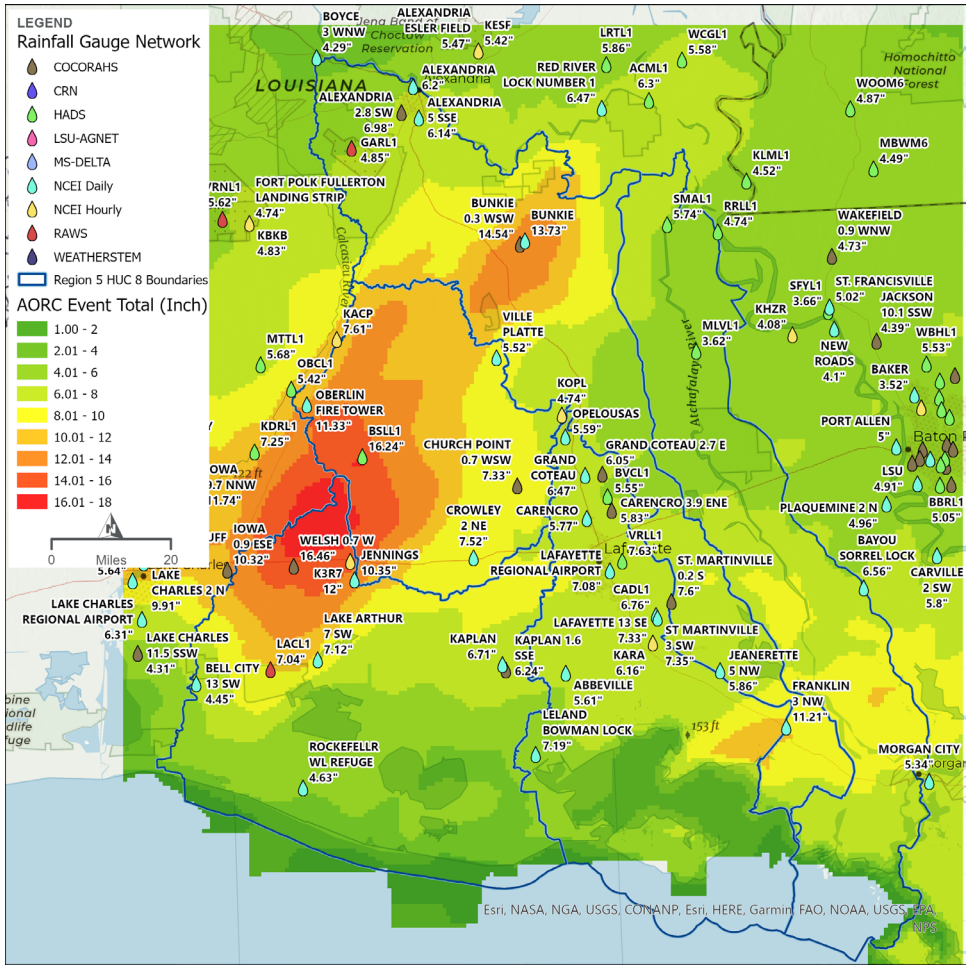


August 2016

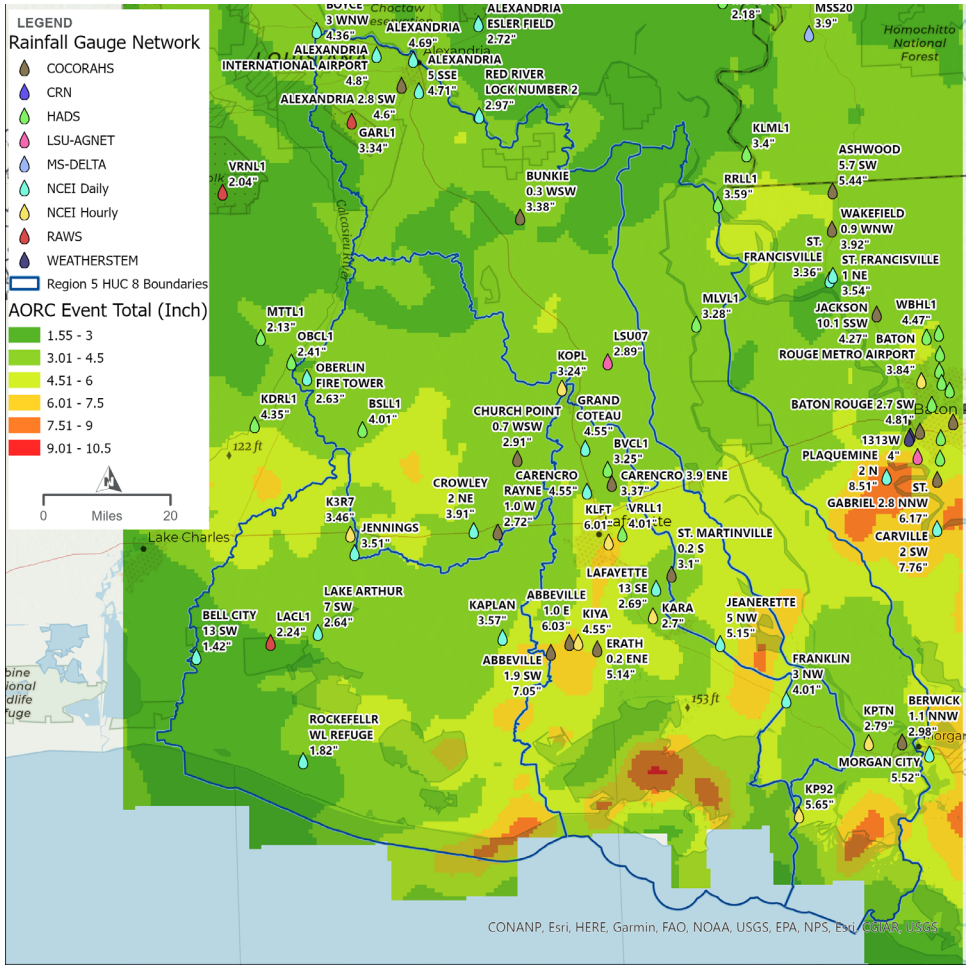


Non-Tropical Events

May 2017



May 2020



Hydrologic Modeling Approach

Standard

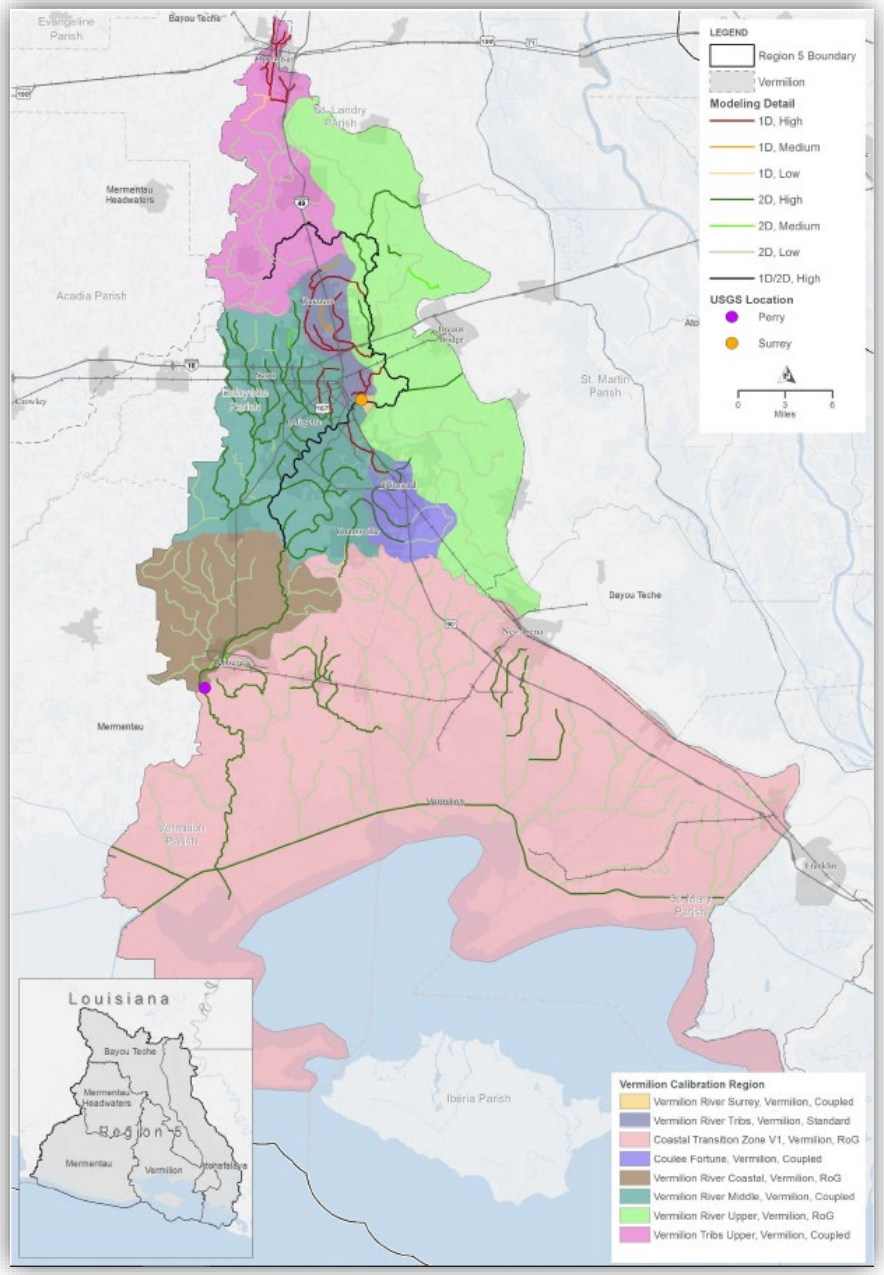
- Subbasin runoff calculations
- Routing through the watershed
- Peak flows at HEC-HMS junctions are extracted

Coupled

- Subbasin runoff calculations
- Subbasin outflows from HEC-HMS are extracted
- Routing through the watershed is done in HEC-RAS

Rain-on-Grid

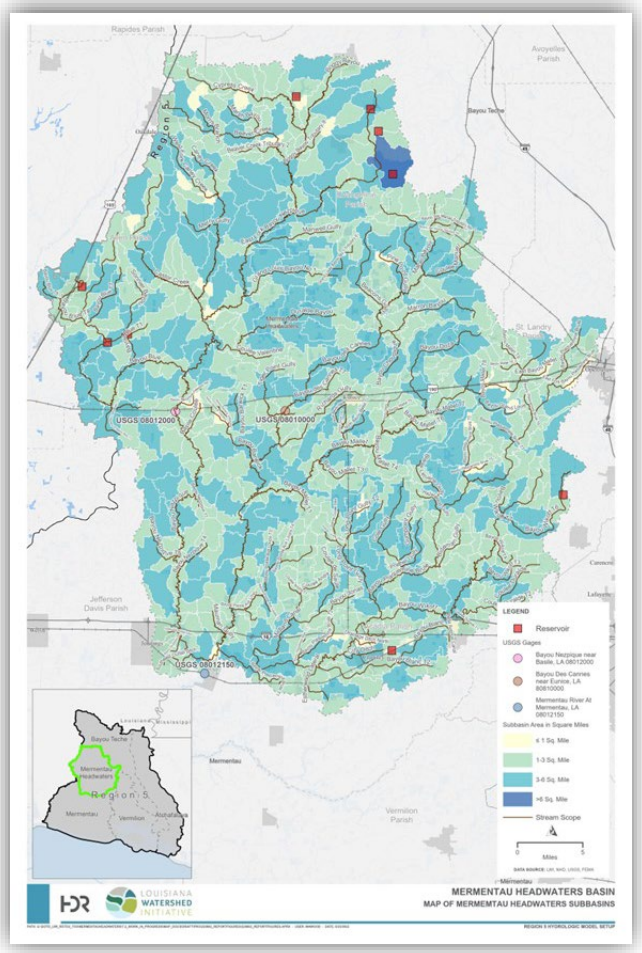
- Rainfall applied directly to the HEC-RAS 2D grid
- Spatial losses, runoff, and routing calculations done in HEC-RAS



Hydrologic Model

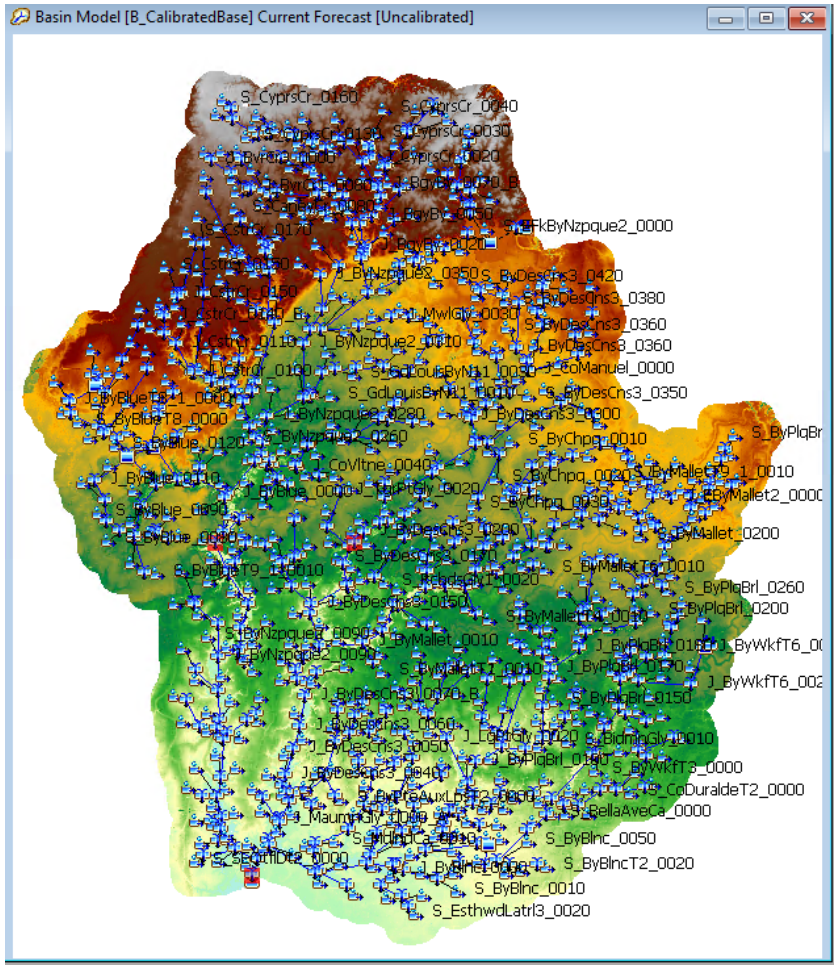
Fine-Scale Subbasin Delineation

- 1 to 5 square miles area



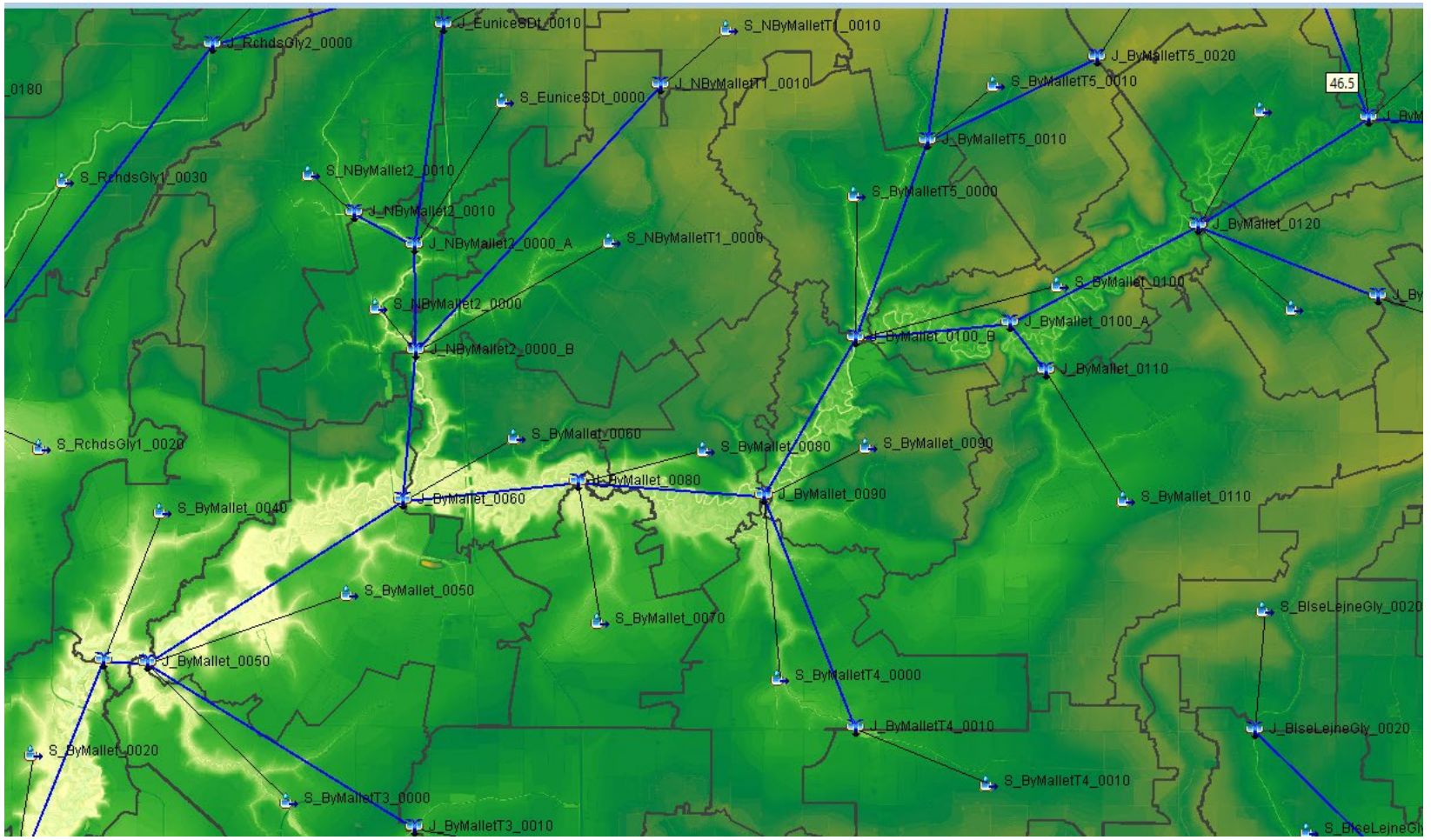
Distributed Hydrologic Model

- HEC-HMS Gridded Model



HEC-HMS Hydrologic Modeling

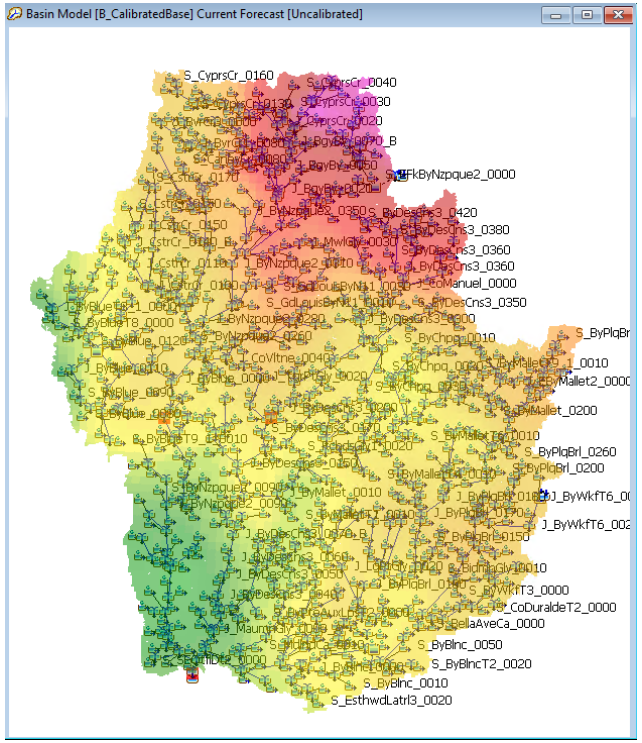
- Infiltration methods
  - Deficit and Constant
- Transform method
  - Mod Clark Unit Hydrograph
- Routing
  - Muskingum-Cunge
- Precipitation
  - Gridded Precipitation



Gridded Input Data

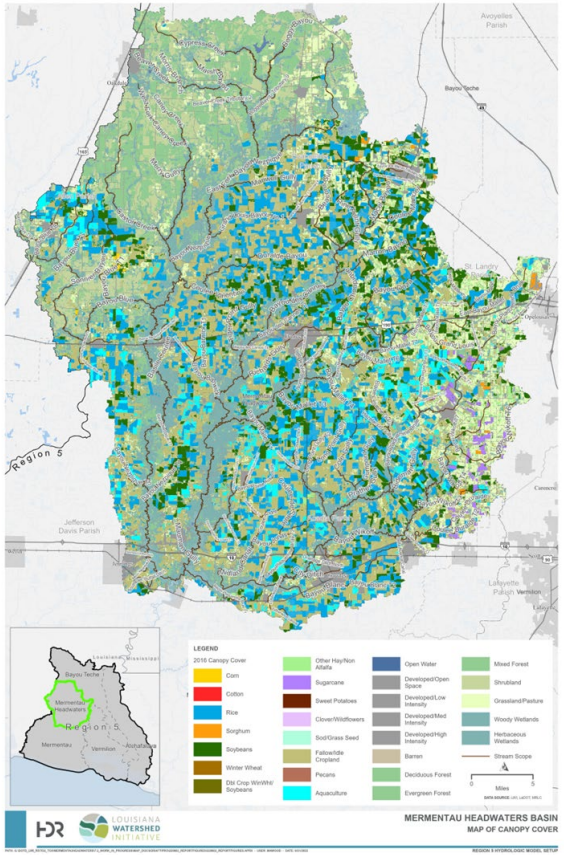
Gridded Precipitation

- AORC QPE Grids



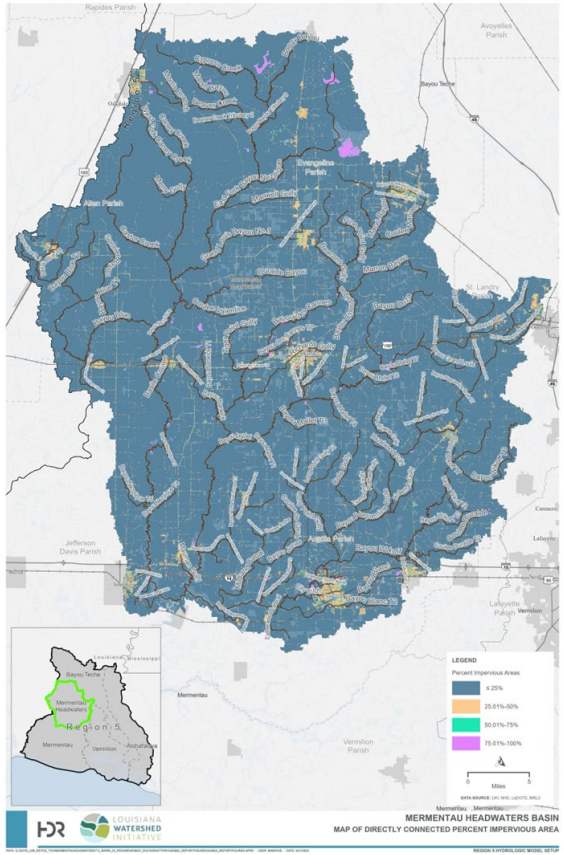
Gridded Canopy

- NASS Vegetation Grids



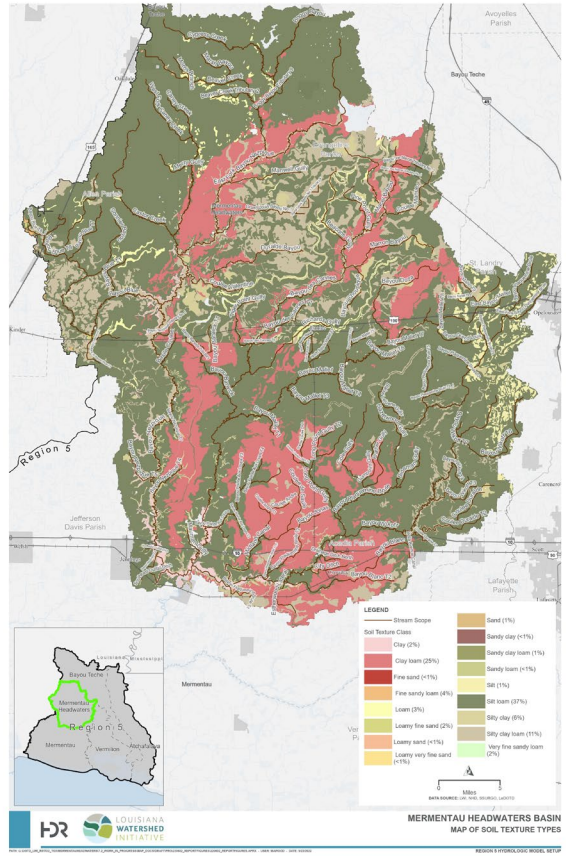
Gridded Impervious Area

- NLCD 2019 and NHD Waterbody



Gridded Soil Texture

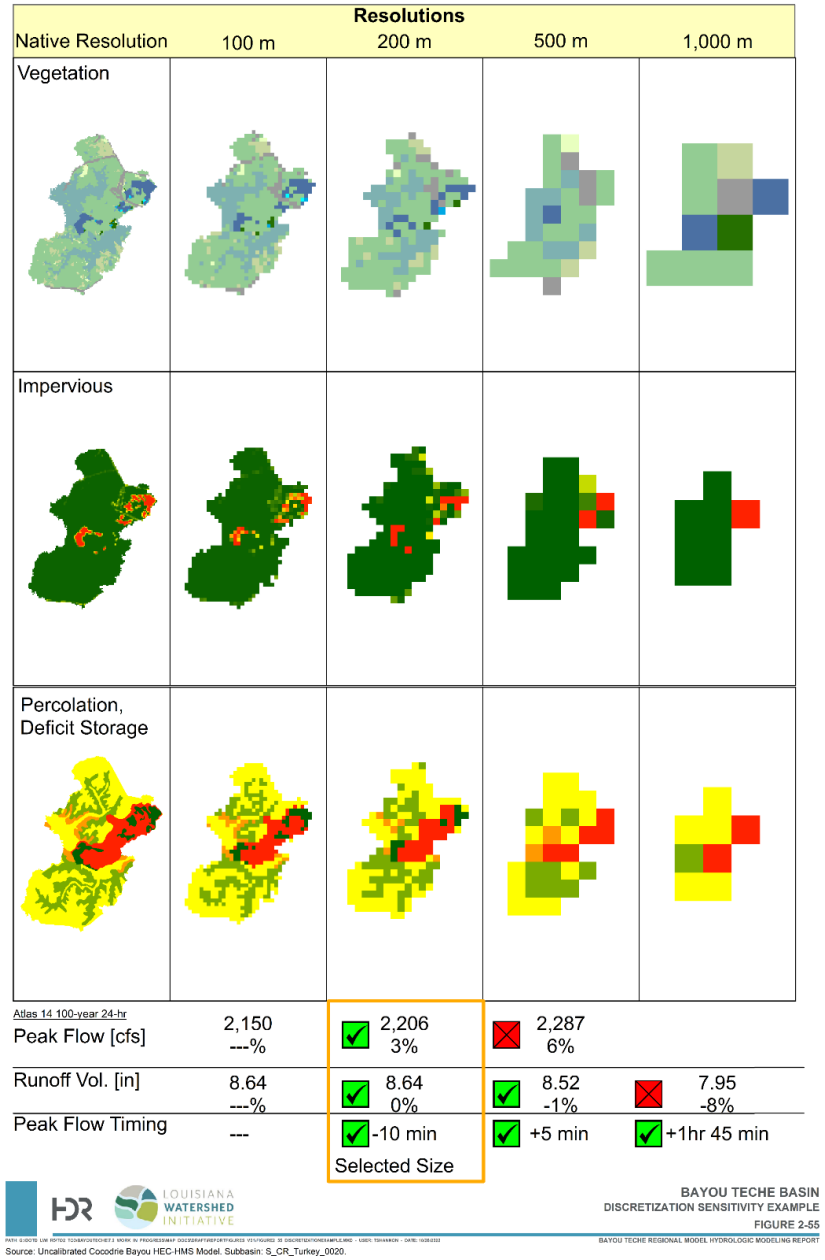
- SSURGO Grids



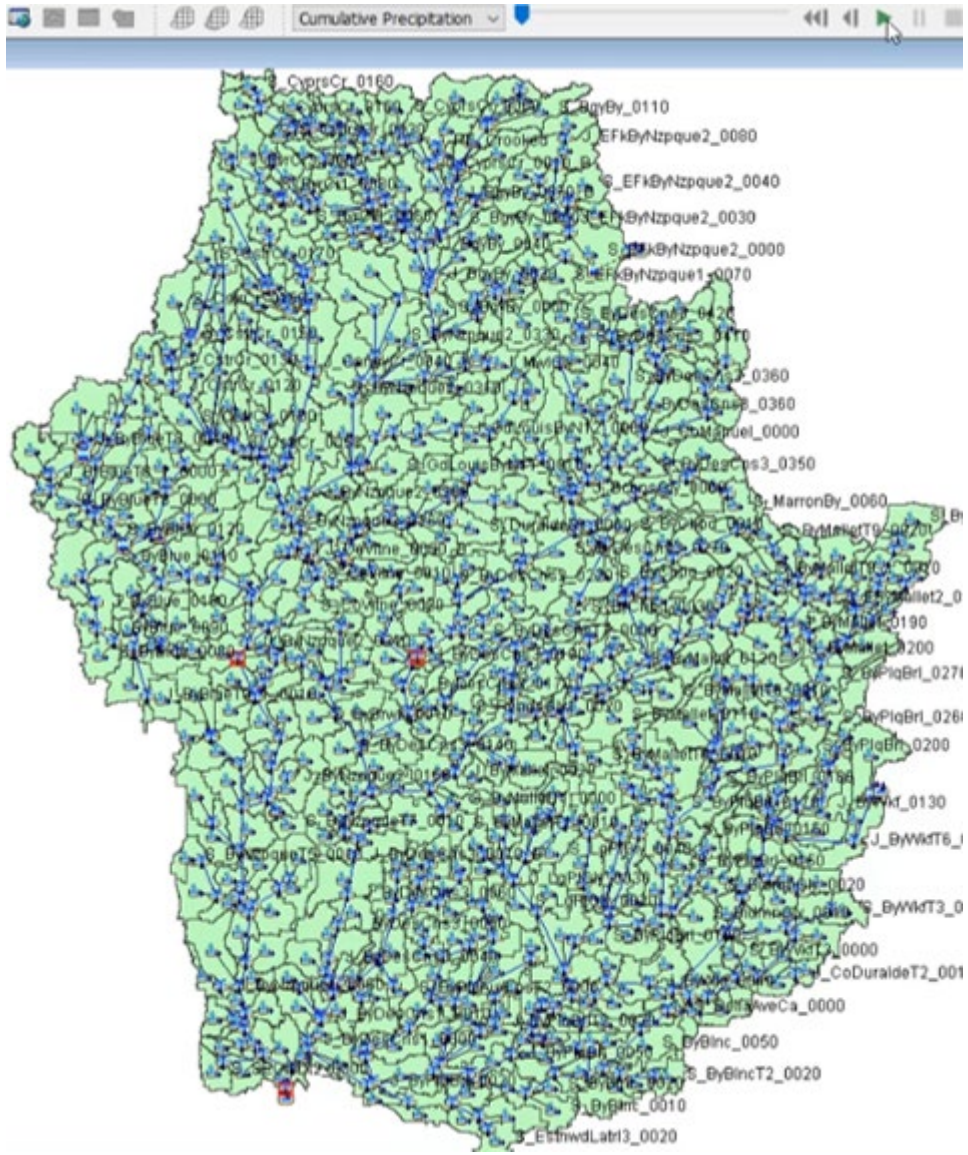
Gridded HMS Sensitivity

- Sensitivity analysis to determine gridded cell size
  - Aggregate native data resolution
- Optimize runtime without sacrificing results

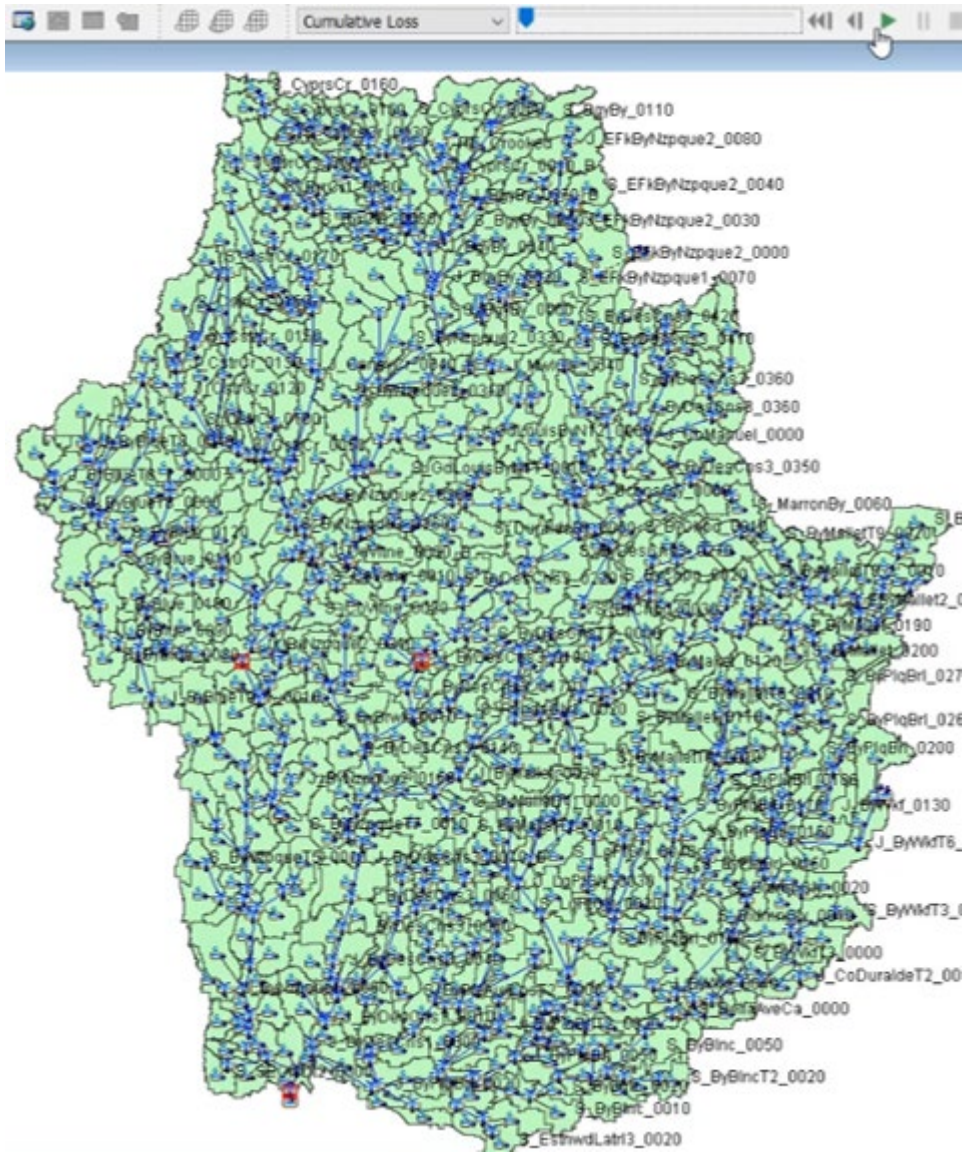
Parameter	Grid Cell Size			
	100-meter	200-meter	500-meter	1,000-meter
Number of Subbasins	1	34	33	10
Modeled Area	0.7	42.4	58.0	23.8
Range of Peak flows Compared to 100-meter	n/a	-3% to 2%	-5% to 3%	-5% to 1%
Range of Runoff Volume Compared to 100-meter	n/a	-3% to 3%	-4% to 5%	-5% to 4%
Range of Peak Flow Timing Compared to 100-meter	n/a	Up to 25 minutes	Up to 1 hour	Up to 1 hour, 15 minutes



Delta – Cumulative Precipitation



Delta – Cumulative Infiltration Loss

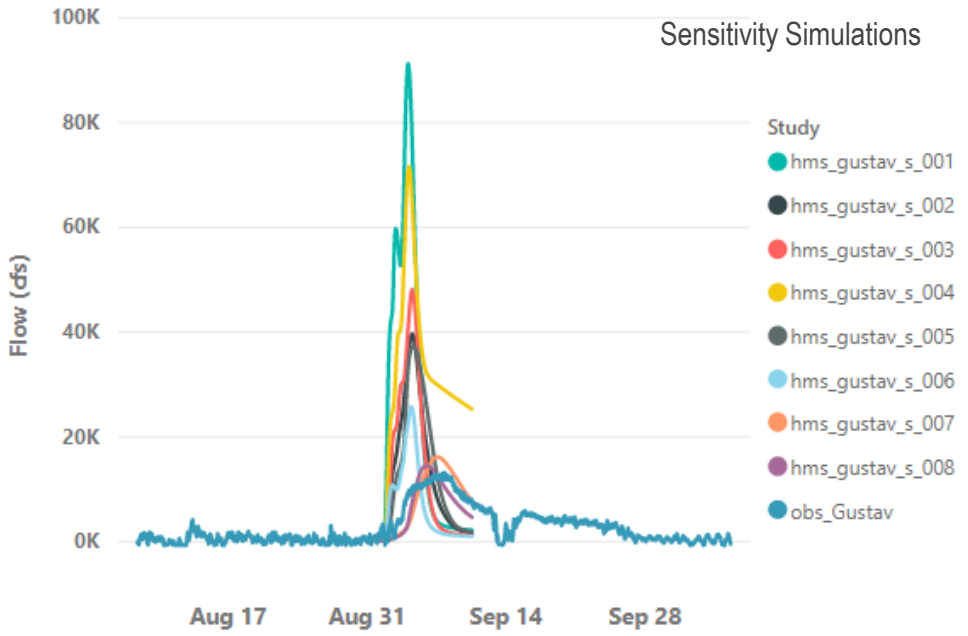


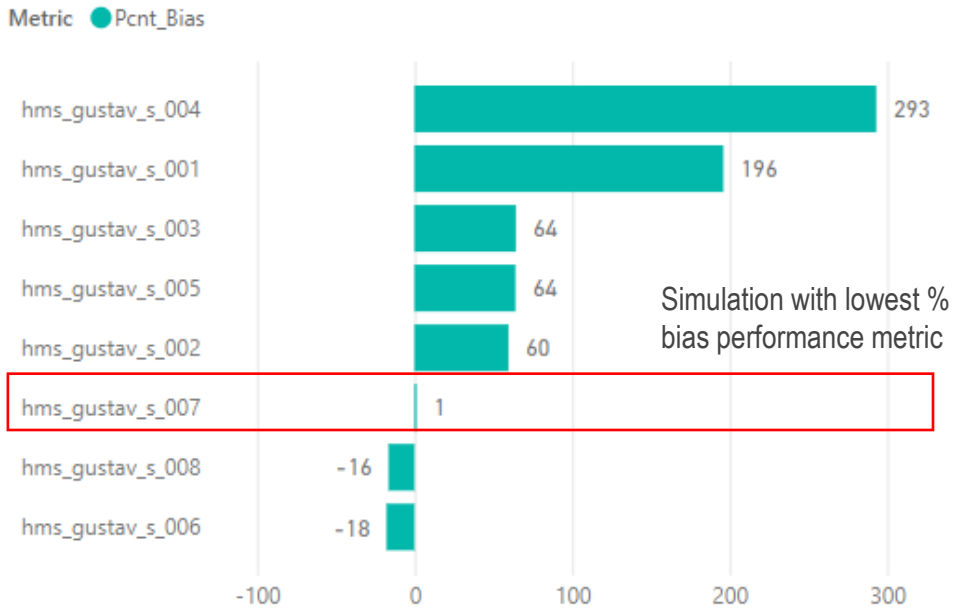
Model Calibration

- **Increase infiltration rate parameters by 20%**

Soil Texture	Uncalibrated Infiltration Rate (inches/hour)	Uncalibrated Initial Deficit (inches)	Uncalibrated Maximum Deficit (inches)
Clay	0.01	0.58	2.88
Clay loam	0.04	0.53	2.64
Fine sand	4.60	1.87	9.36
Fine sandy loam	0.40	1.49	7.44
Loam	0.10	1.49	7.44
Loamy fine sand	1.20	1.63	8.16
Loamy sand	1.20	1.63	8.16
Loamy very fine sand	1.20	1.63	8.16
Muck	0.01	0.58	2.88
Mucky muck	0.01	0.58	2.88
Mucky peat	0.01	0.58	2.88
Peat	0.01	0.58	2.88
Sand	4.60	1.87	9.36
Sandy clay	0.02	0.58	2.88
Sandy clay loam	0.06	0.86	4.32
Sandy loam	0.40	1.49	7.44
Silt	0.04	1.06	5.28
Silt loam	0.30	1.73	8.64
Silty clay	0.02	0.82	4.08
Silty clay loam	0.04	1.06	5.28
Slightly decomposed plant material	0.01	0.58	2.88
Very fine sandy loam	0.40	1.49	7.44
Water	0.001	0.001	0.001

- **Adjust ModClark transform parameters to match observed flow hydrographs**



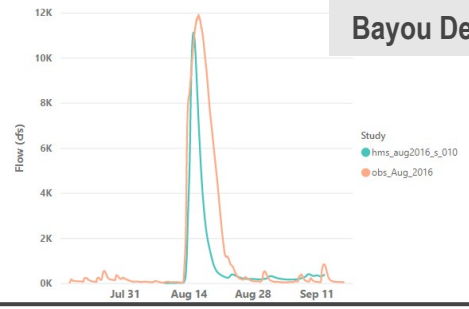


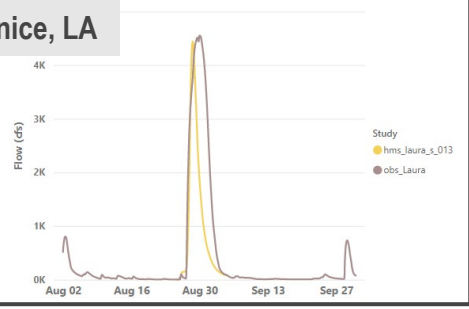
Calibration Results

August 2016 Storm

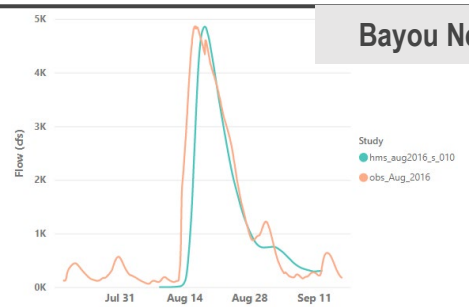
Hurricane Laura, August 2020

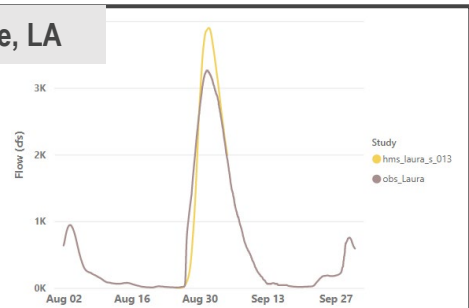
Bayou Des Cannes near Eunice, LA



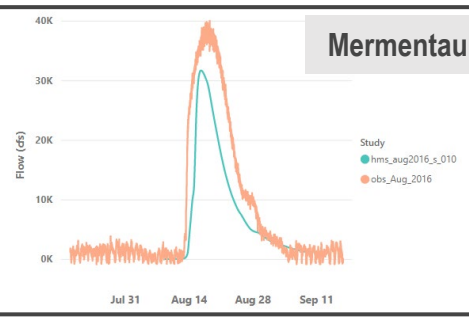


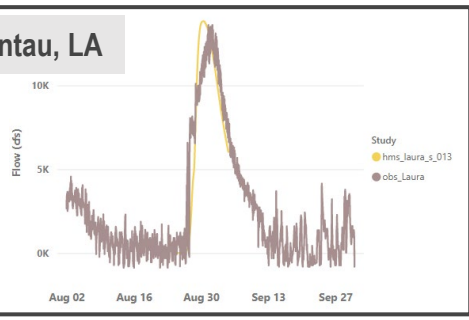
Bayou Nezpique near Basile, LA

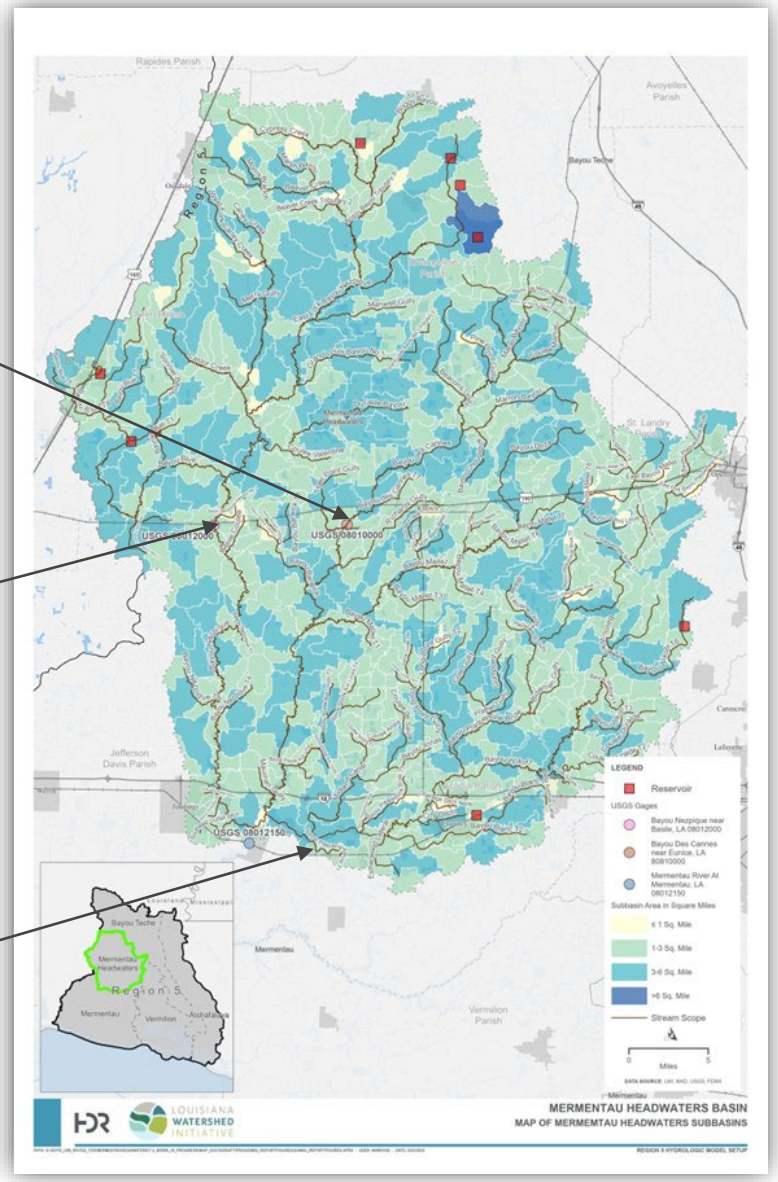




Mermentau River near Mermentau, LA

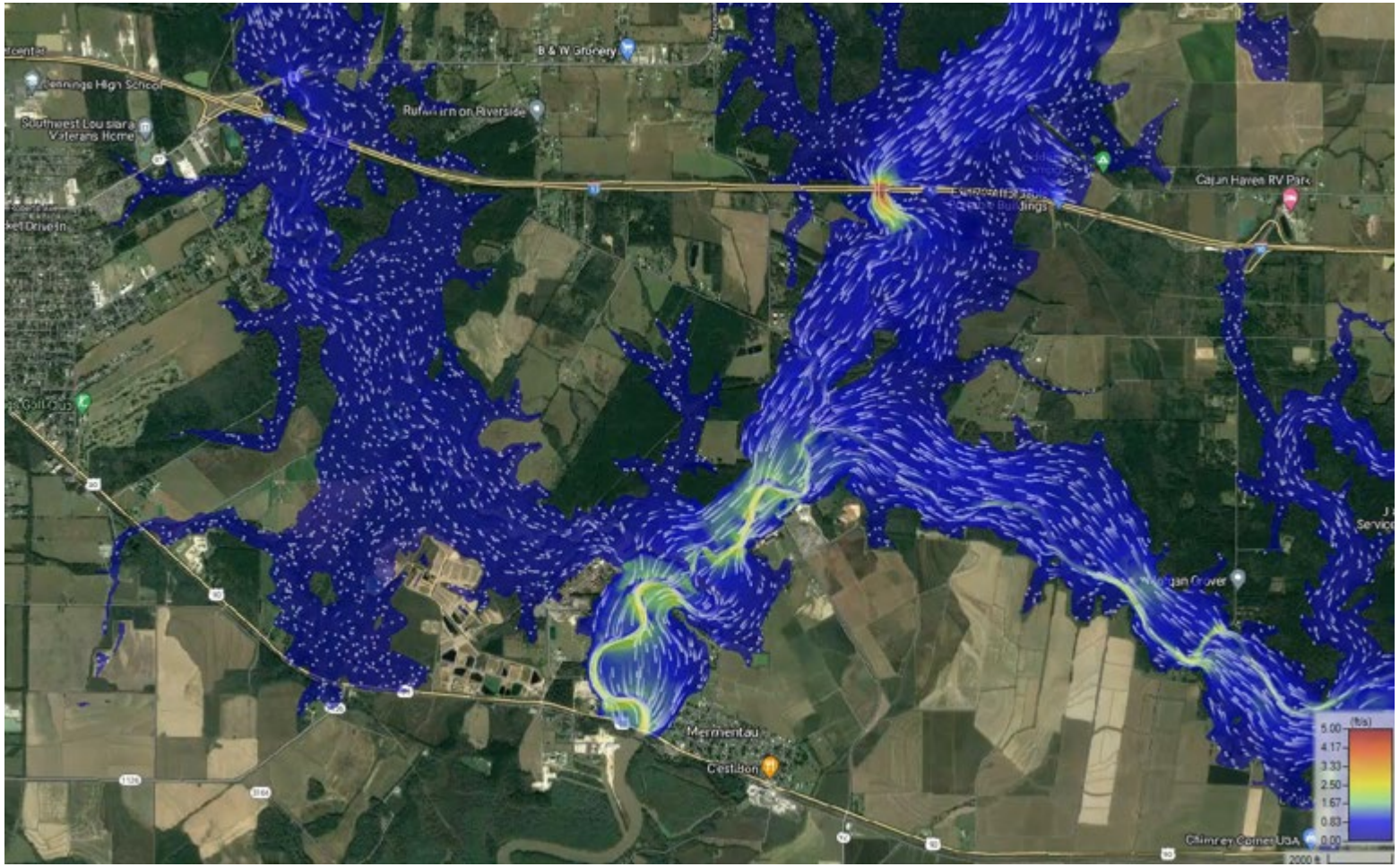






Model Output

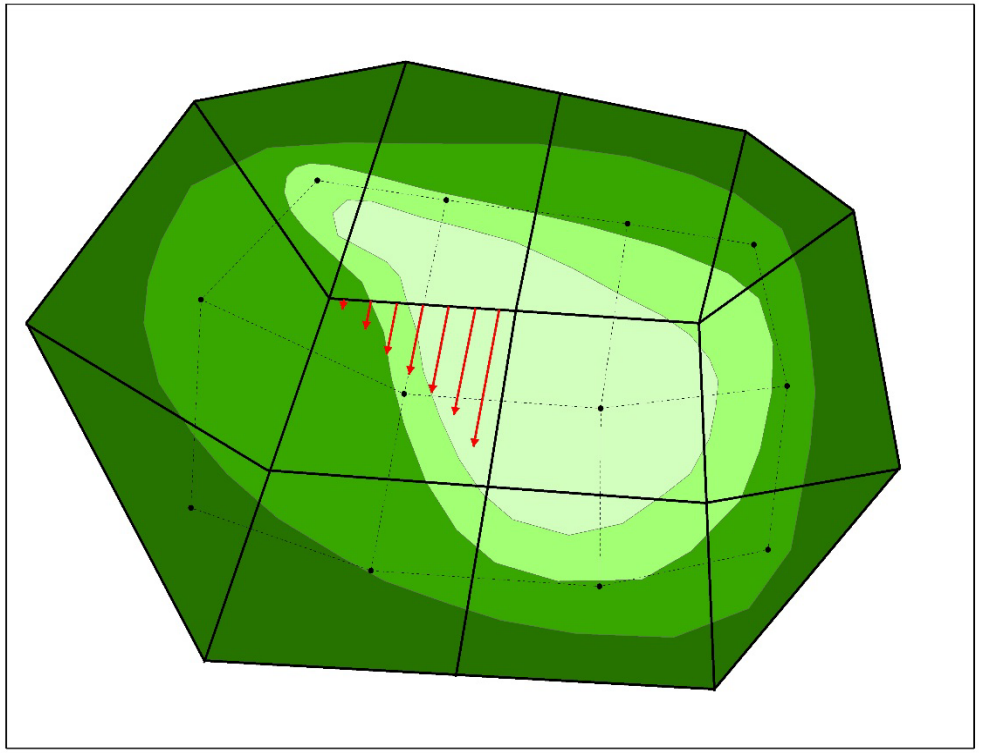
- For HEC-HMS model, the model output includes hydrographs at each subbasin outlet
- The HEC-HMS hydrographs inform the boundary conditions in HEC-RAS model
- For HEC-RAS model, the model output includes depth grids, velocity grids, water surface elevation grids, and floodplain extents



Hydraulics

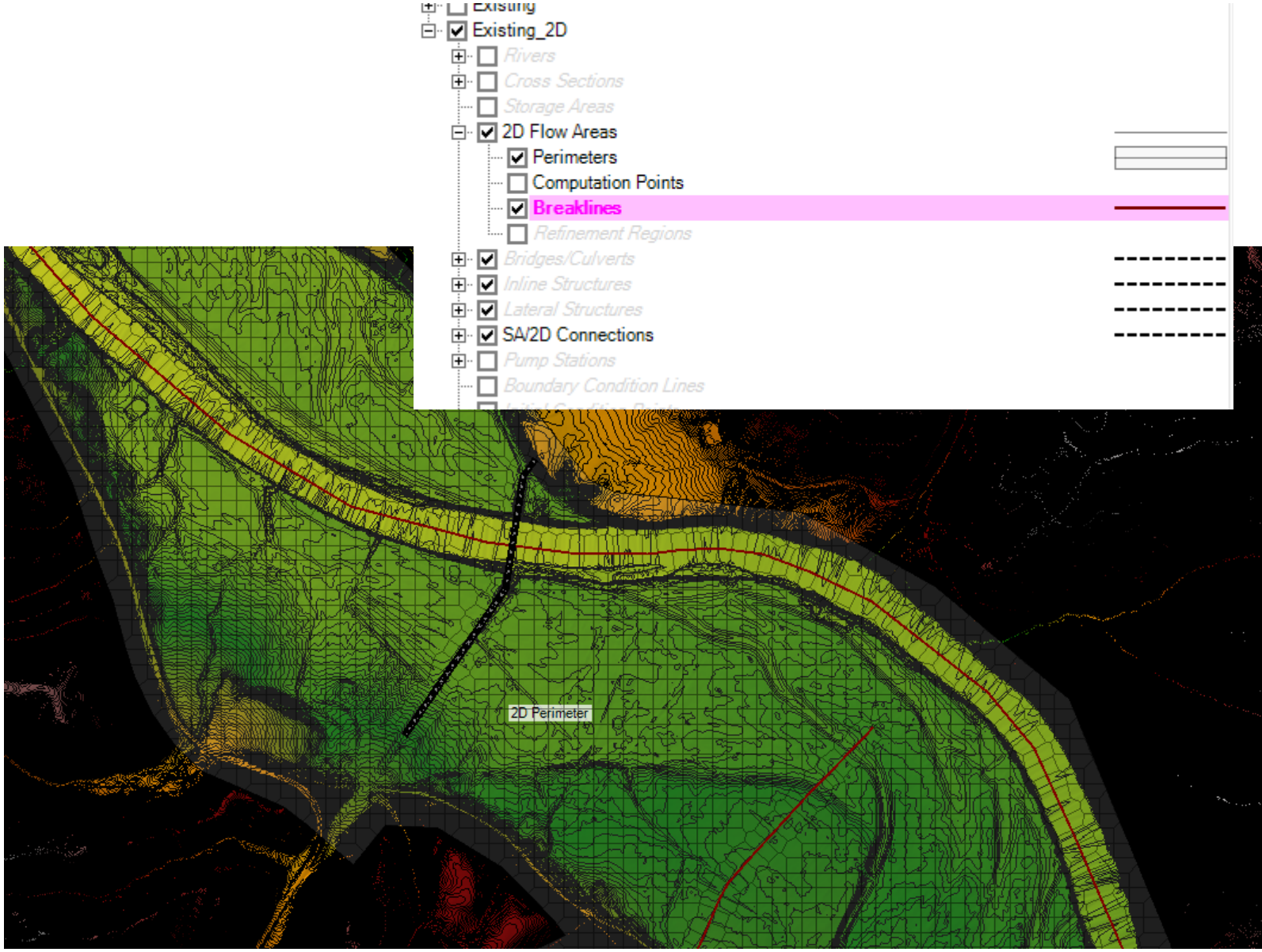
Overview of HEC-RAS v 6.3.1

- Capabilities include
  - 1D unsteady-flow modeling (unchanged from 4.1)
    - Potential to implement 1D finite volume method
  - 2D unsteady-flow modeling
    - Implicit finite volume solution algorithm
    - Full Saint Venant equations
    - Diffusion Wave equations
    - Variable boundary conditions
    - Wind forcing capabilities
  - Combined 1D/2D unsteady flow modeling
    - 1D/2D solutions are coupled at each time step and can iterate back and forth between 1D and 2D



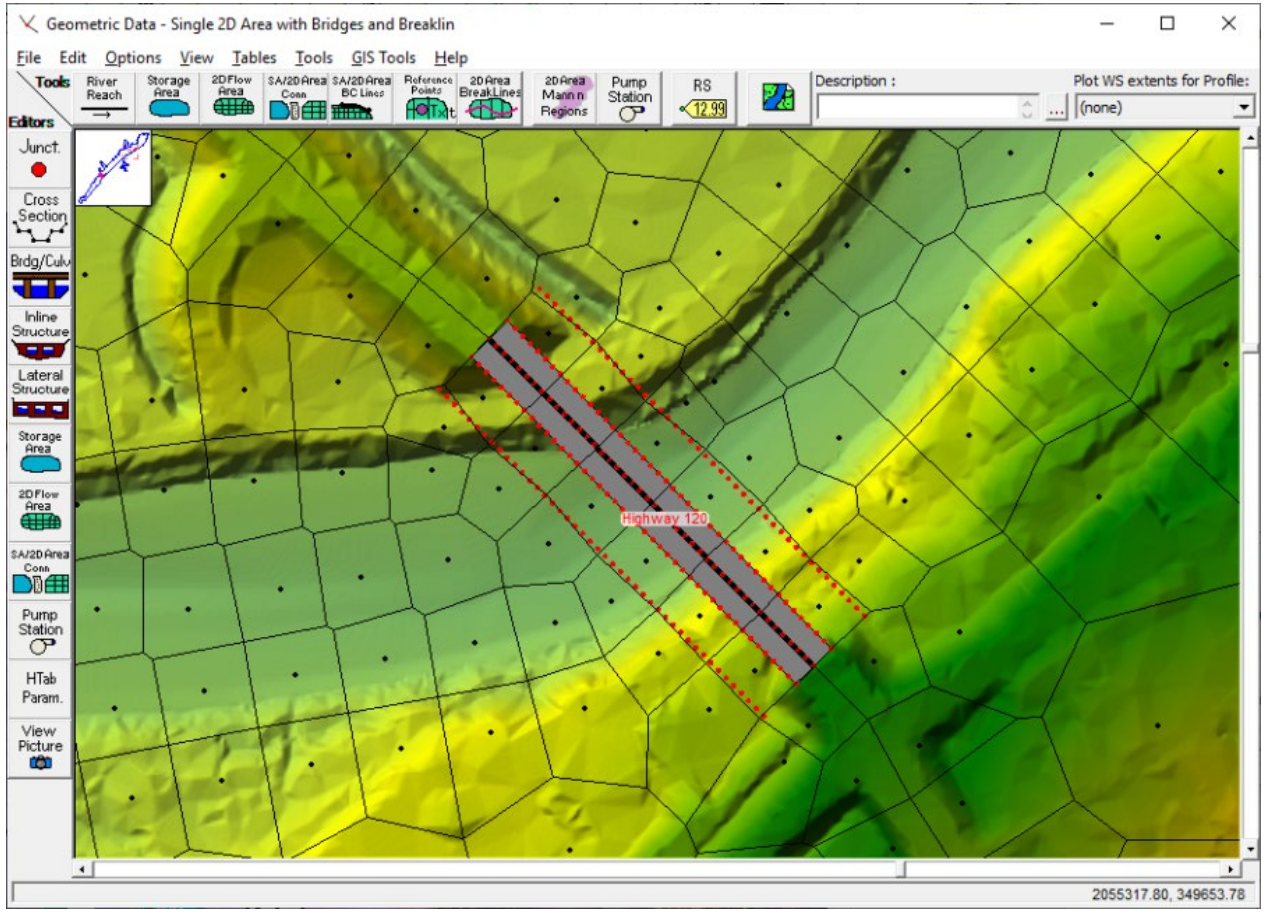
Breaklines

- Breaklines force the mesh to align computational faces along the breakline
- Breaklines placed at locations that:
  - Barrier to flow
  - Controls flow/direction



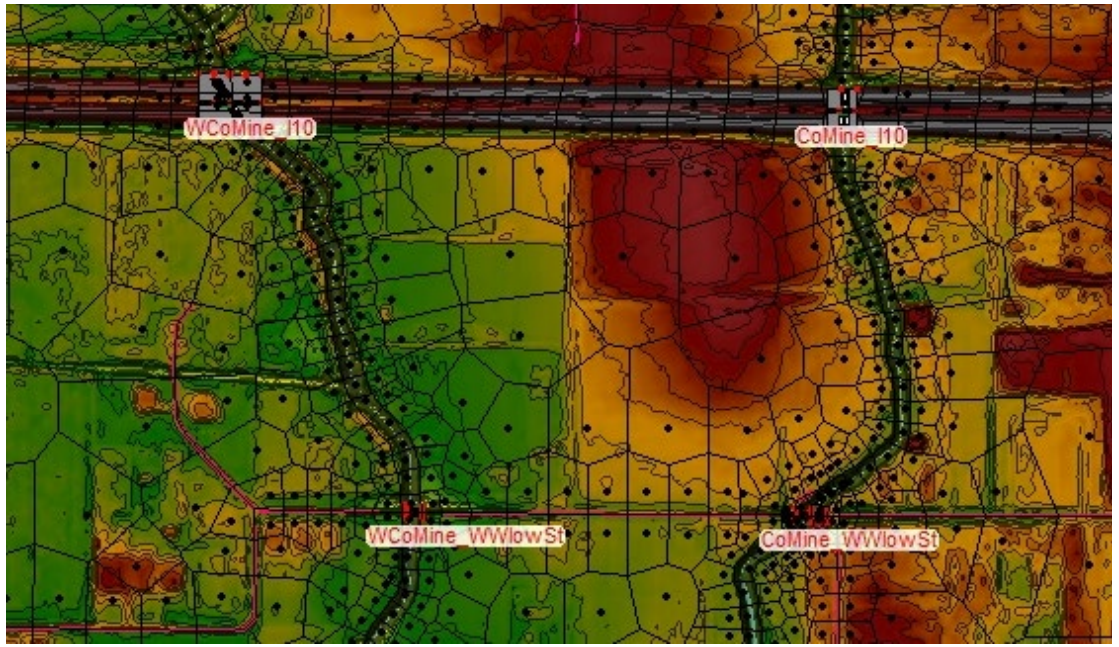
Addition 2D Model Refinements

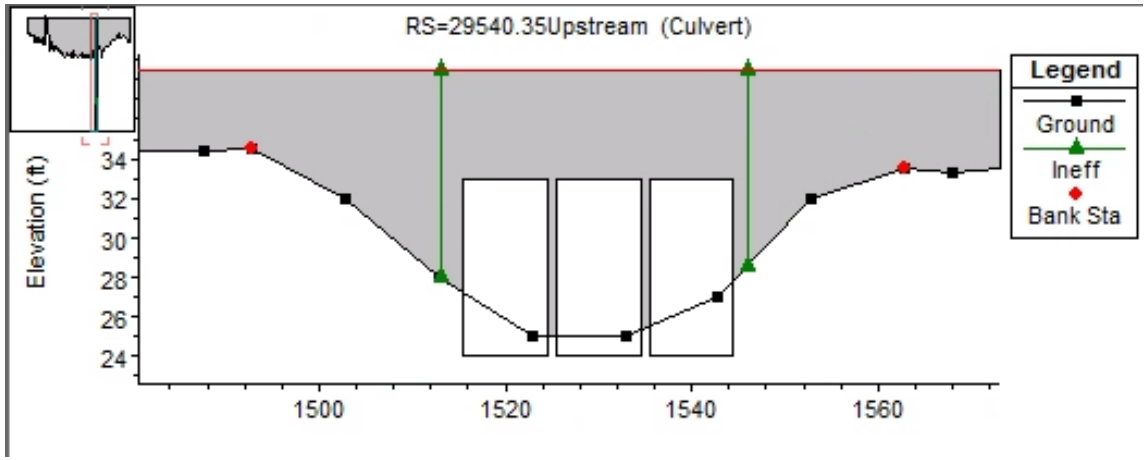
- Mesh refinement regions
- Modeling hydraulic structures inside of 2D flow areas
- Modeling bridges inside of 2D flow areas

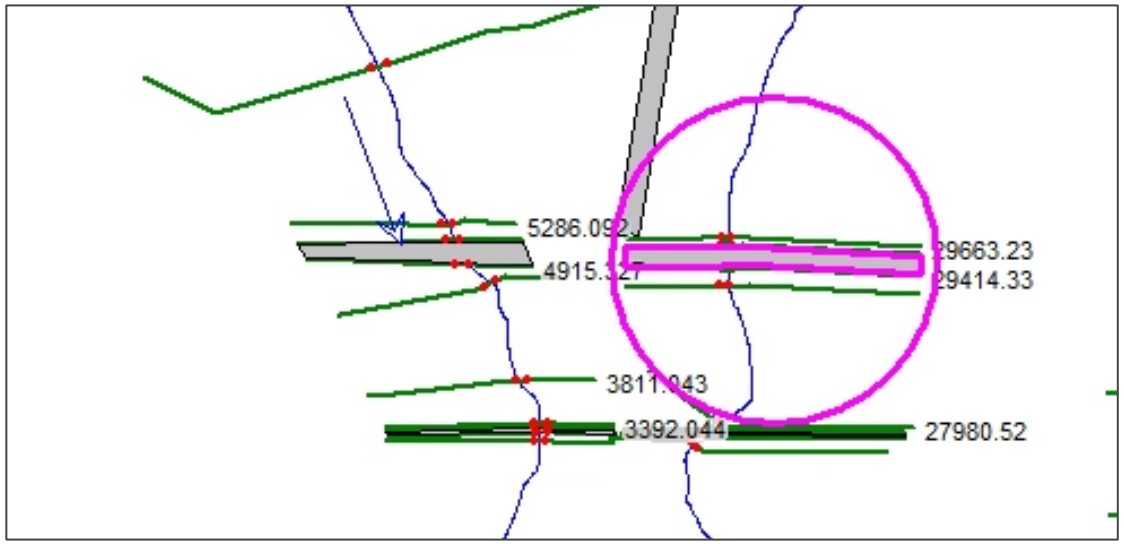


Integration of Existing Models

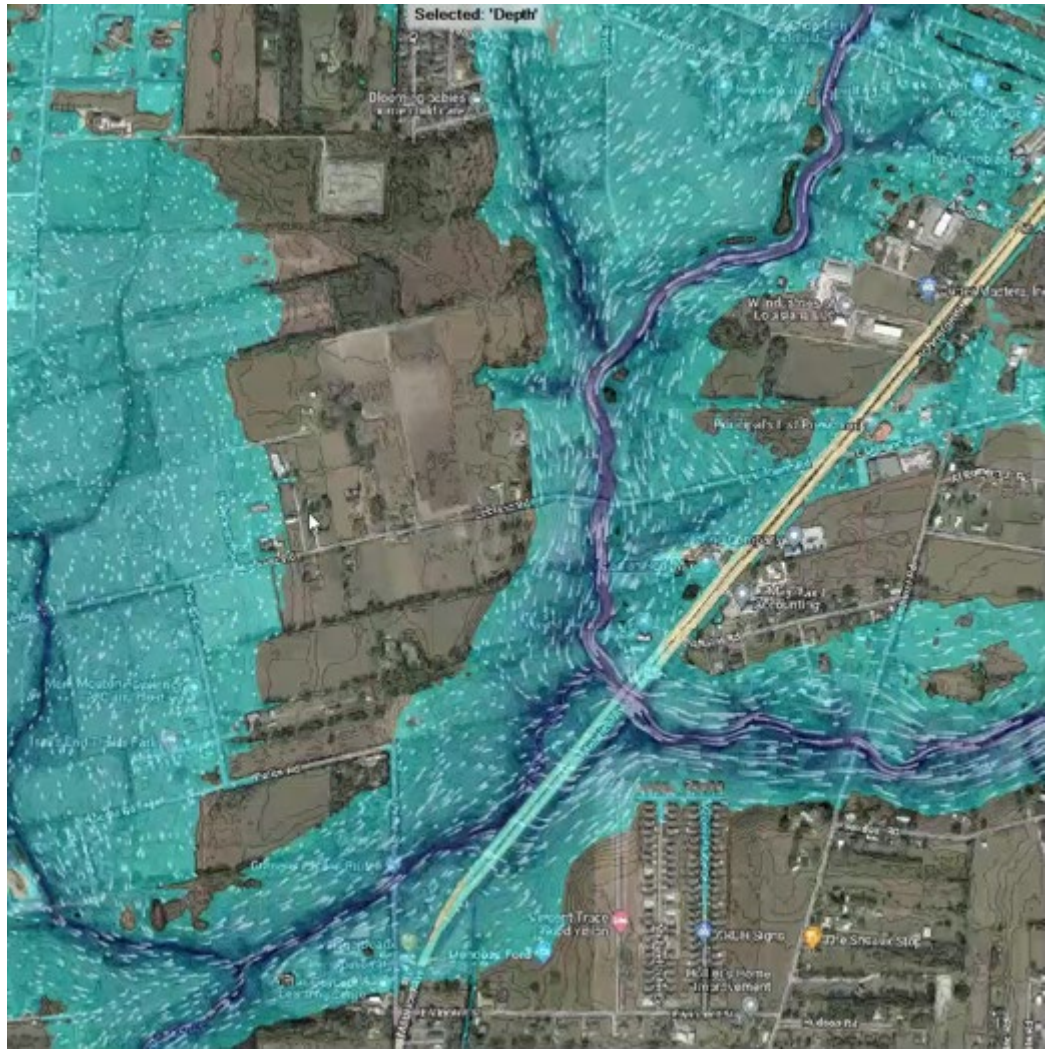
- FEMA Regulatory Models (25+)
- ULL 1D-2D Coupled Research Model
- USACE SLAMM Model
- Various other local models

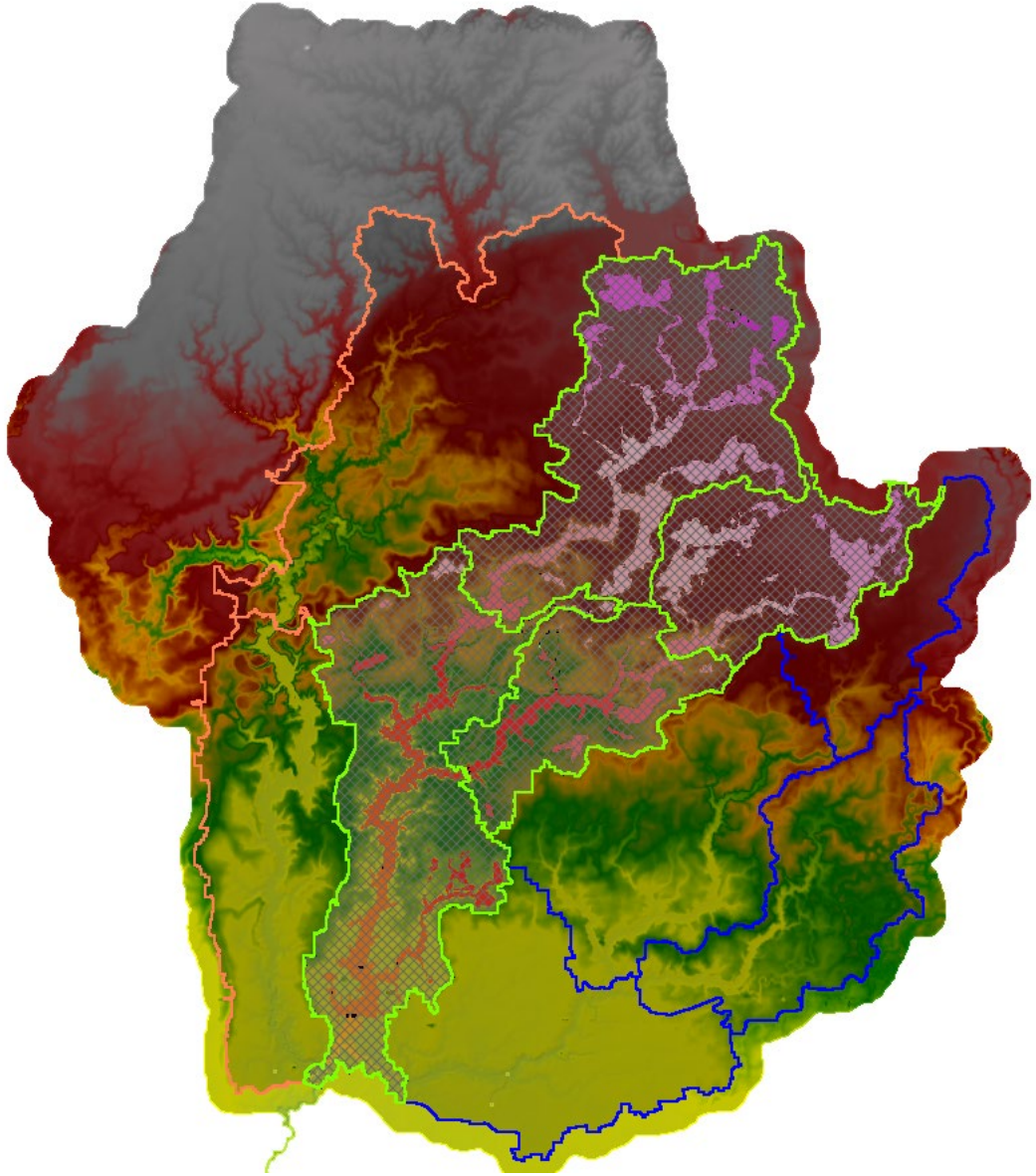




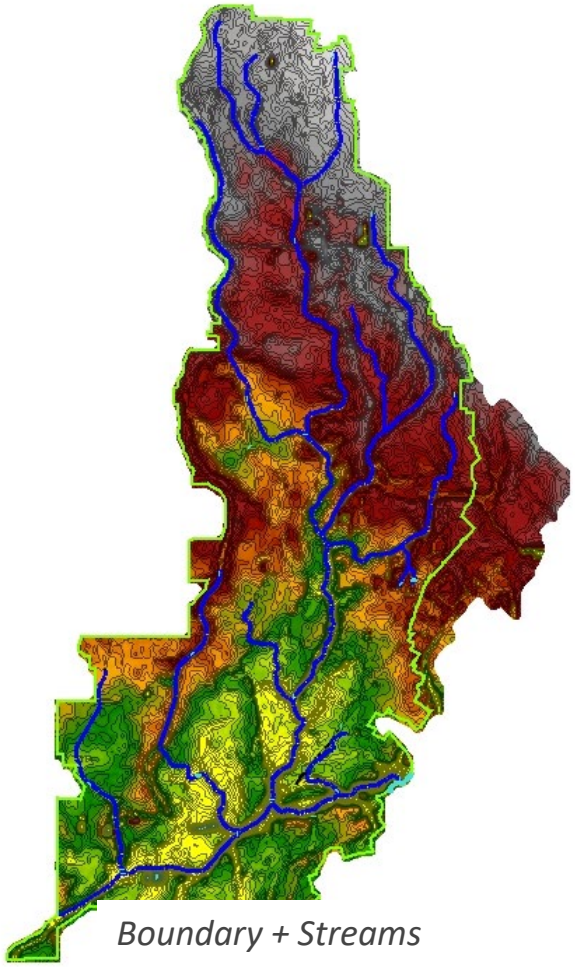


Break-Out Modeling

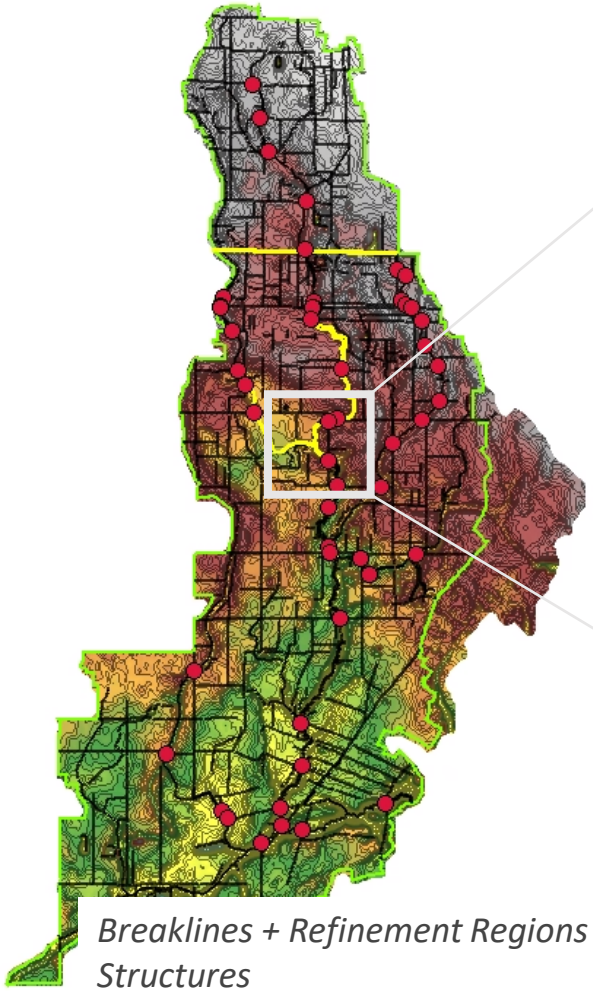




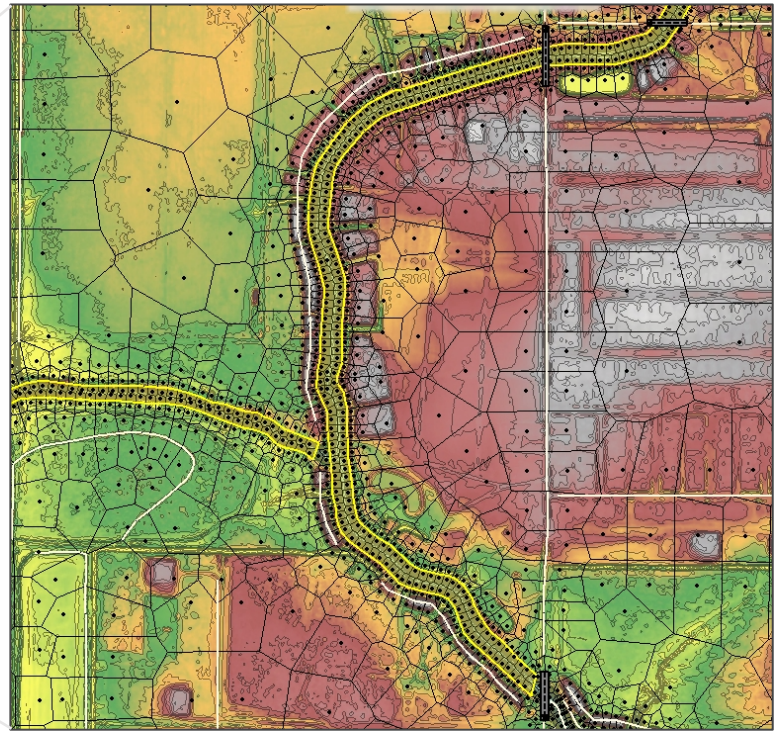
Coulee Ile Des Cannes. ~50k cells, 55 hydraulic structures, 250 miles of breaklines



Boundary + Streams

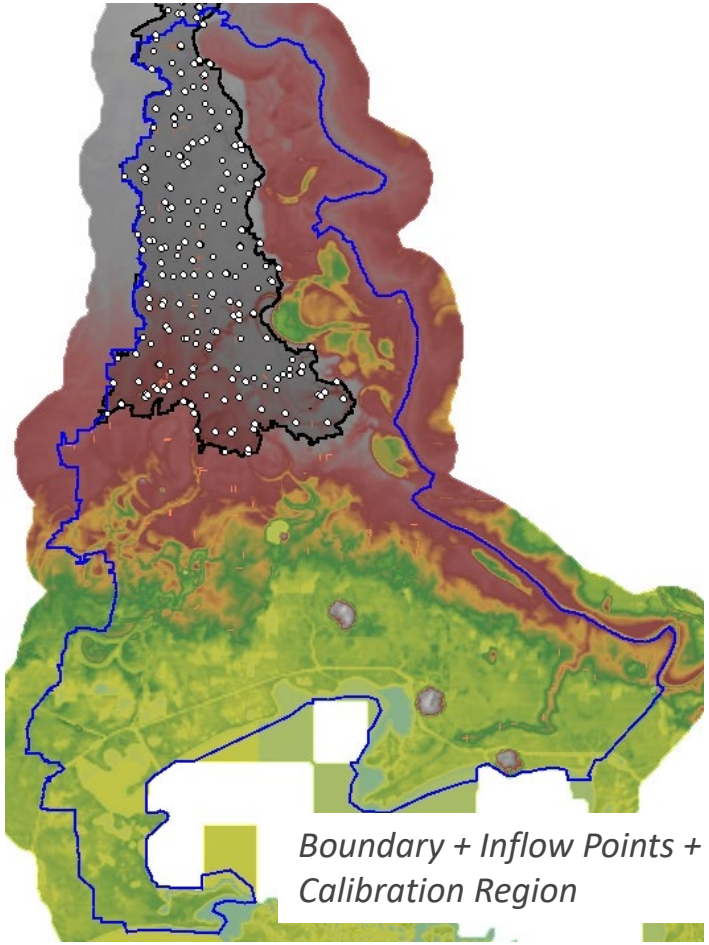


Breaklines + Refinement Regions + Structures

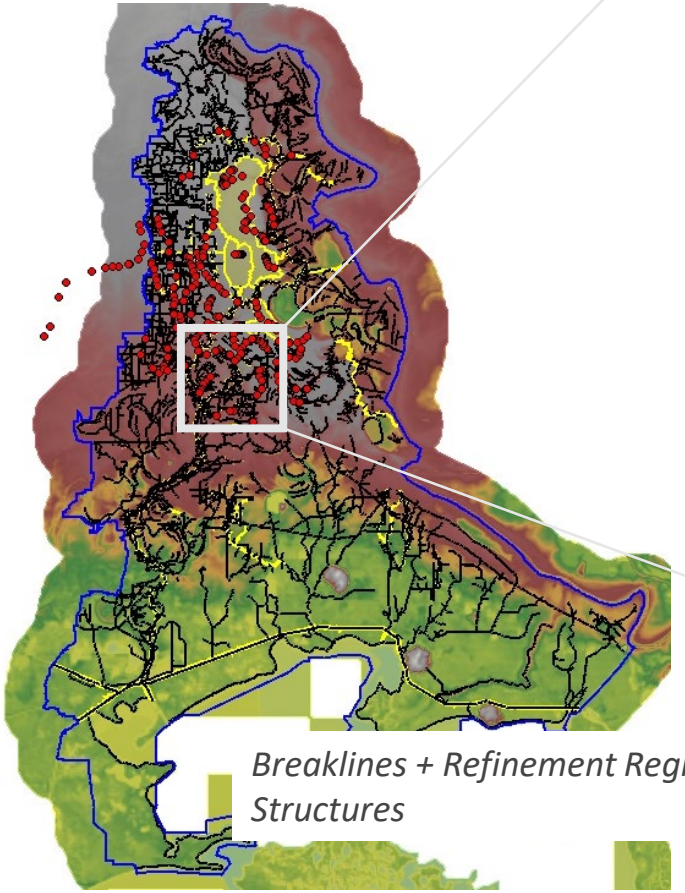


Event Duration: 14 days
Runtime: 2.75 hours
Cores: 8
Equations: SWE (original faster)

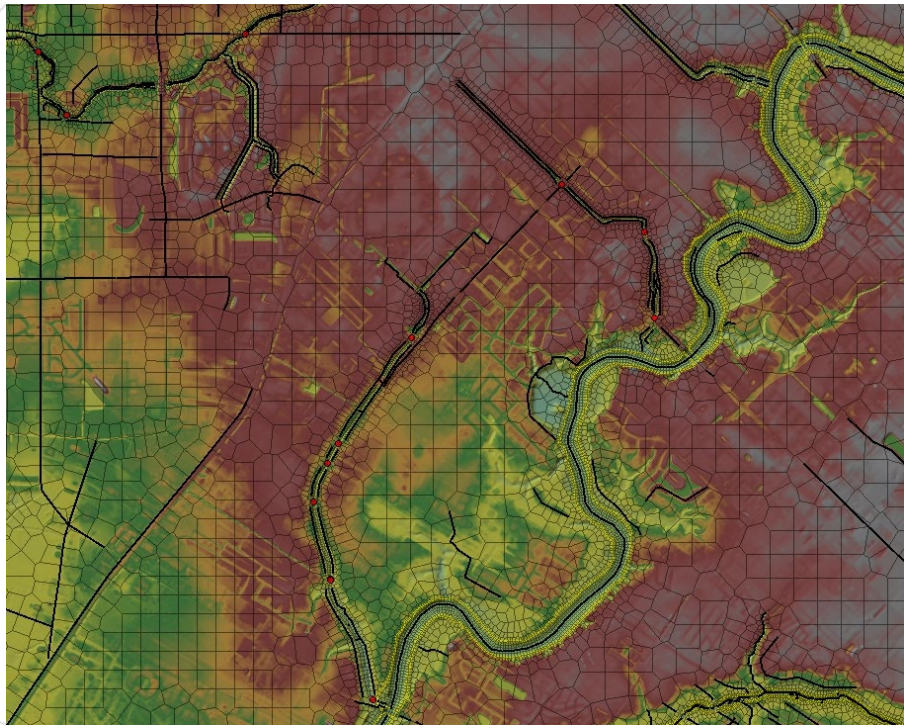
Vermilion River. ~270k cells, 240 hydraulic structures, 2,200 miles of breaklines



Boundary + Inflow Points + Calibration Region

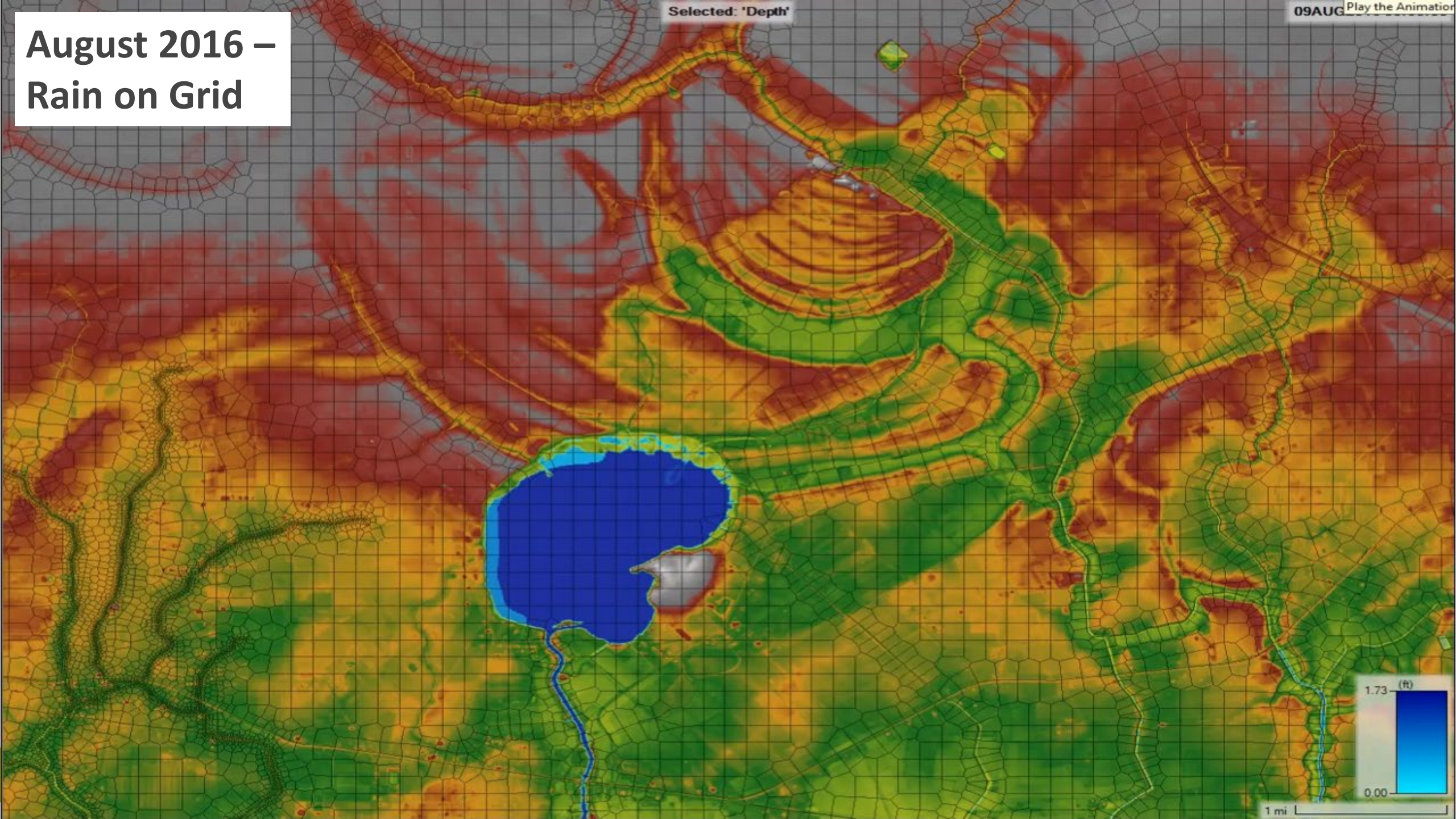


Breaklines + Refinement Regions + Structures

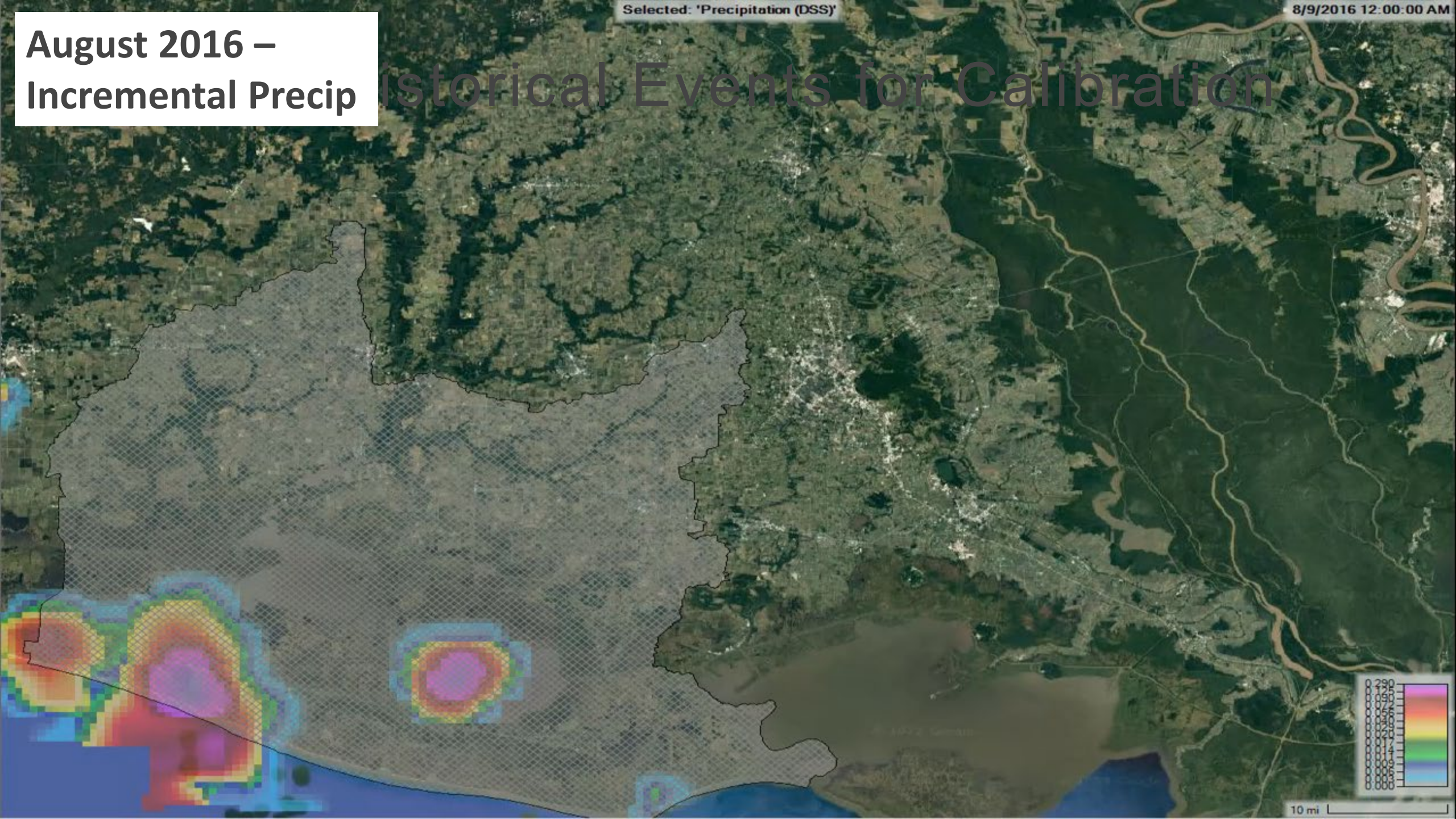


Event Duration: 14 days
Runtime: 8.5 hours (3.5 w/o structures)
Cores: 8
Equations: Diffusion Wave

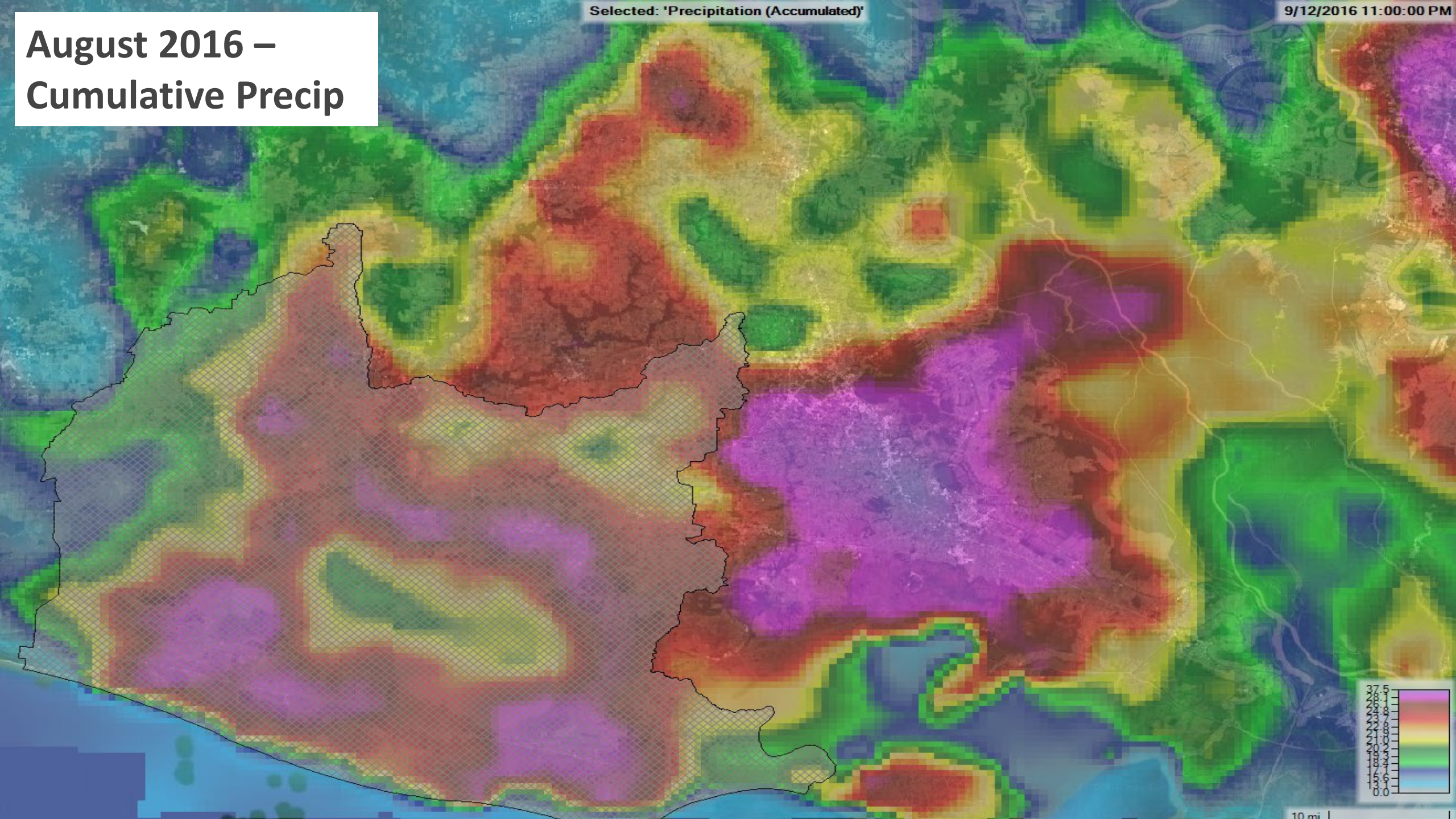
August 2016 – Rain on Grid



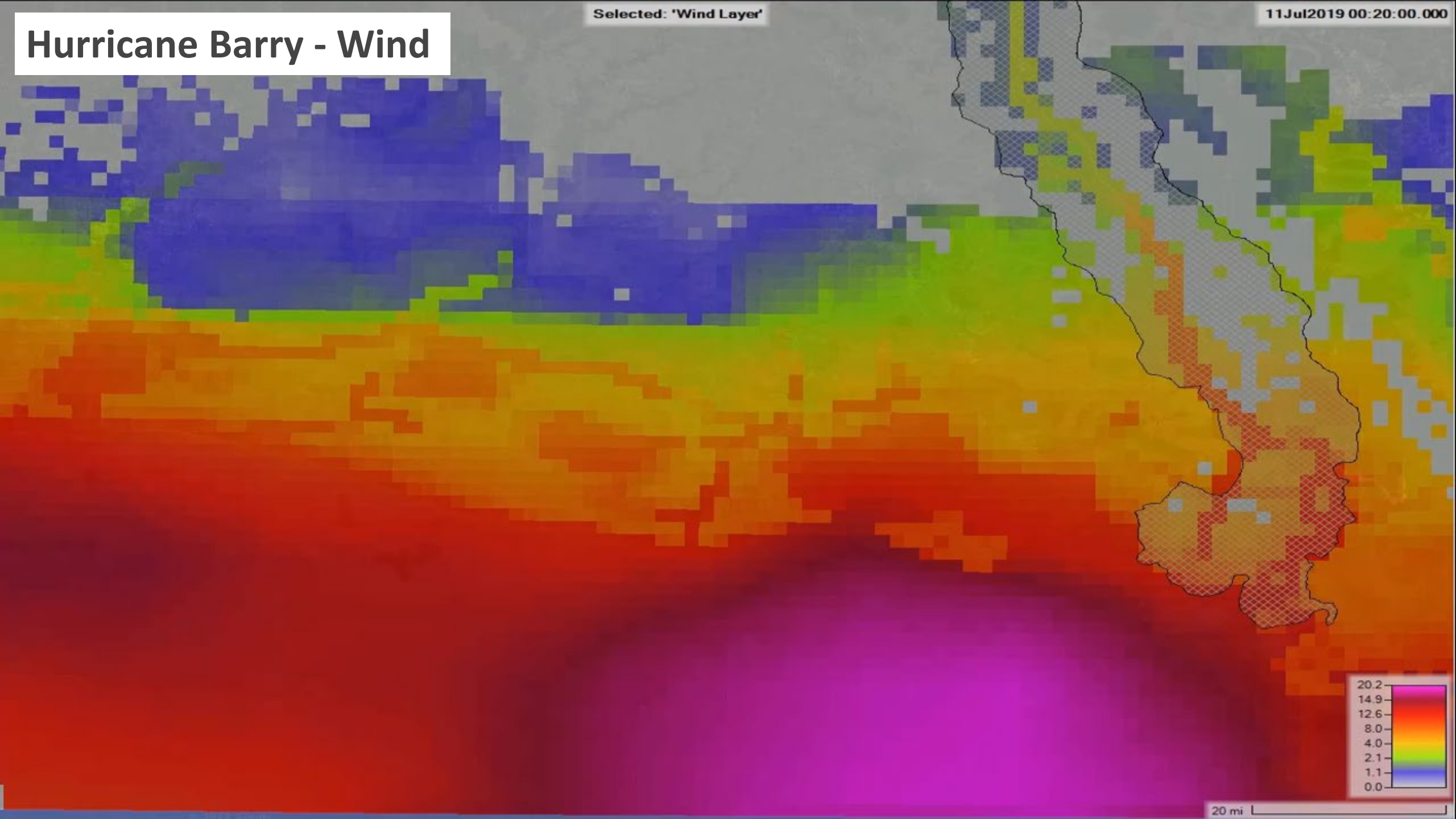
August 2016 – Incremental Precip



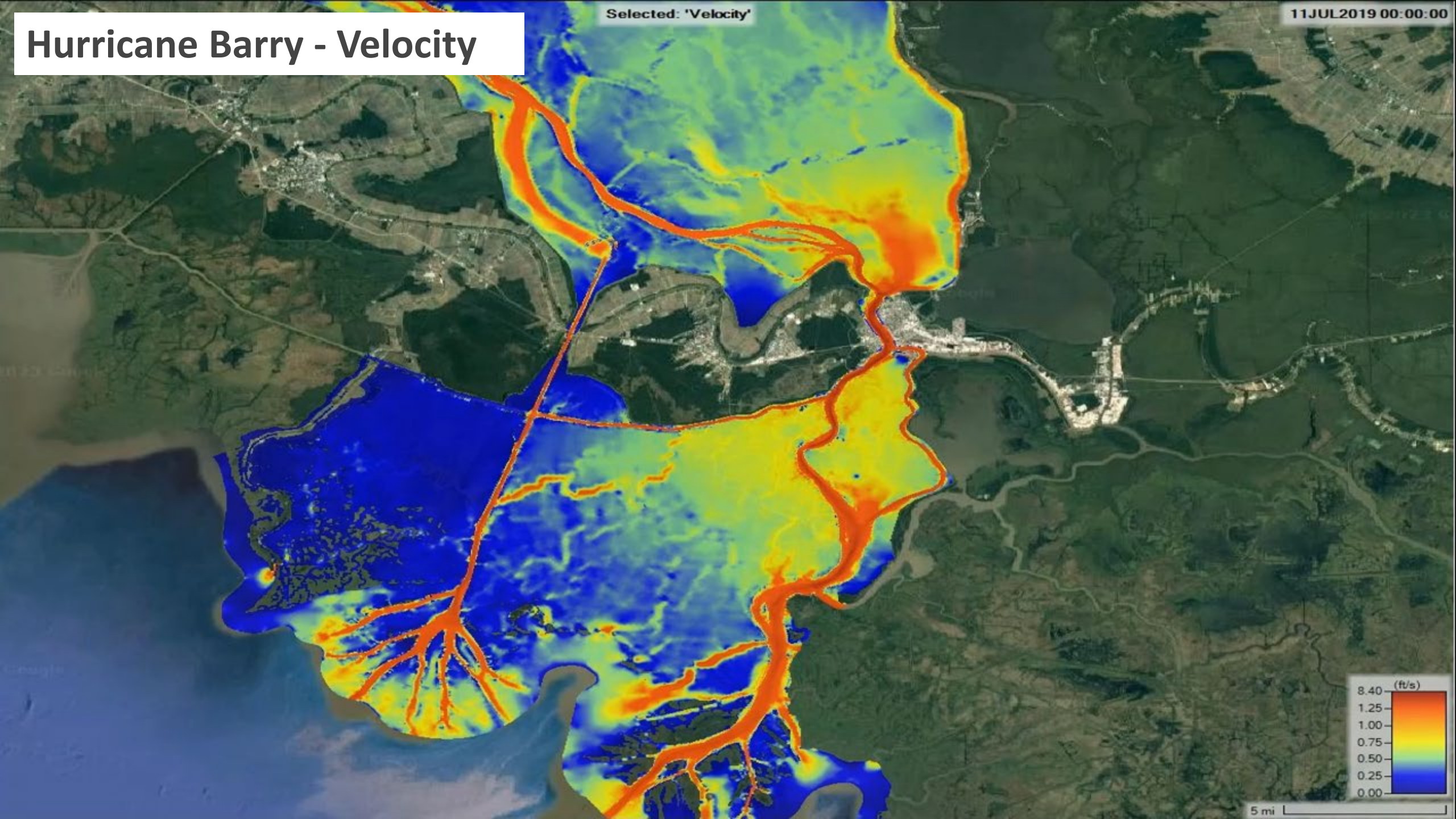
August 2016 – Cumulative Precip



Hurricane Barry - Wind

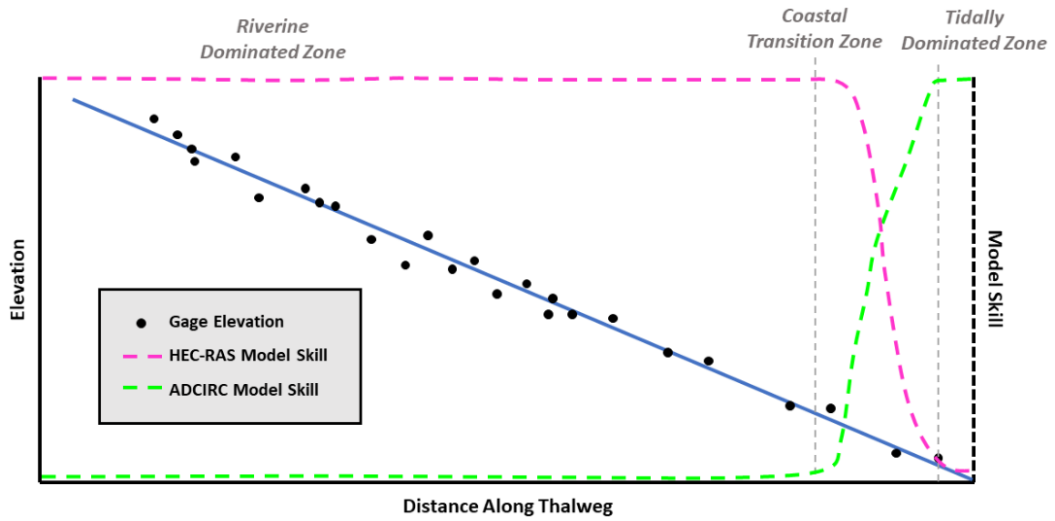


Hurricane Barry - Velocity

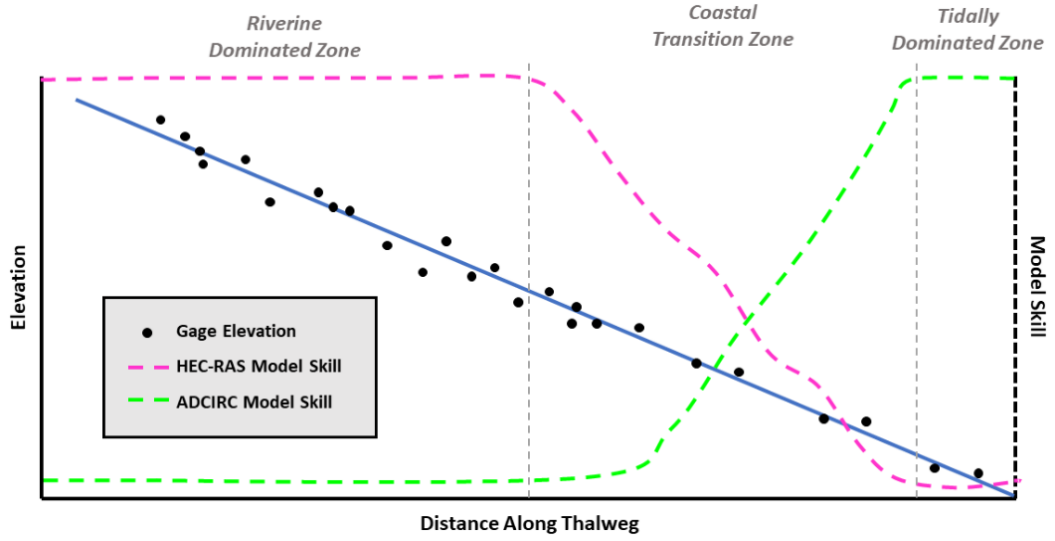


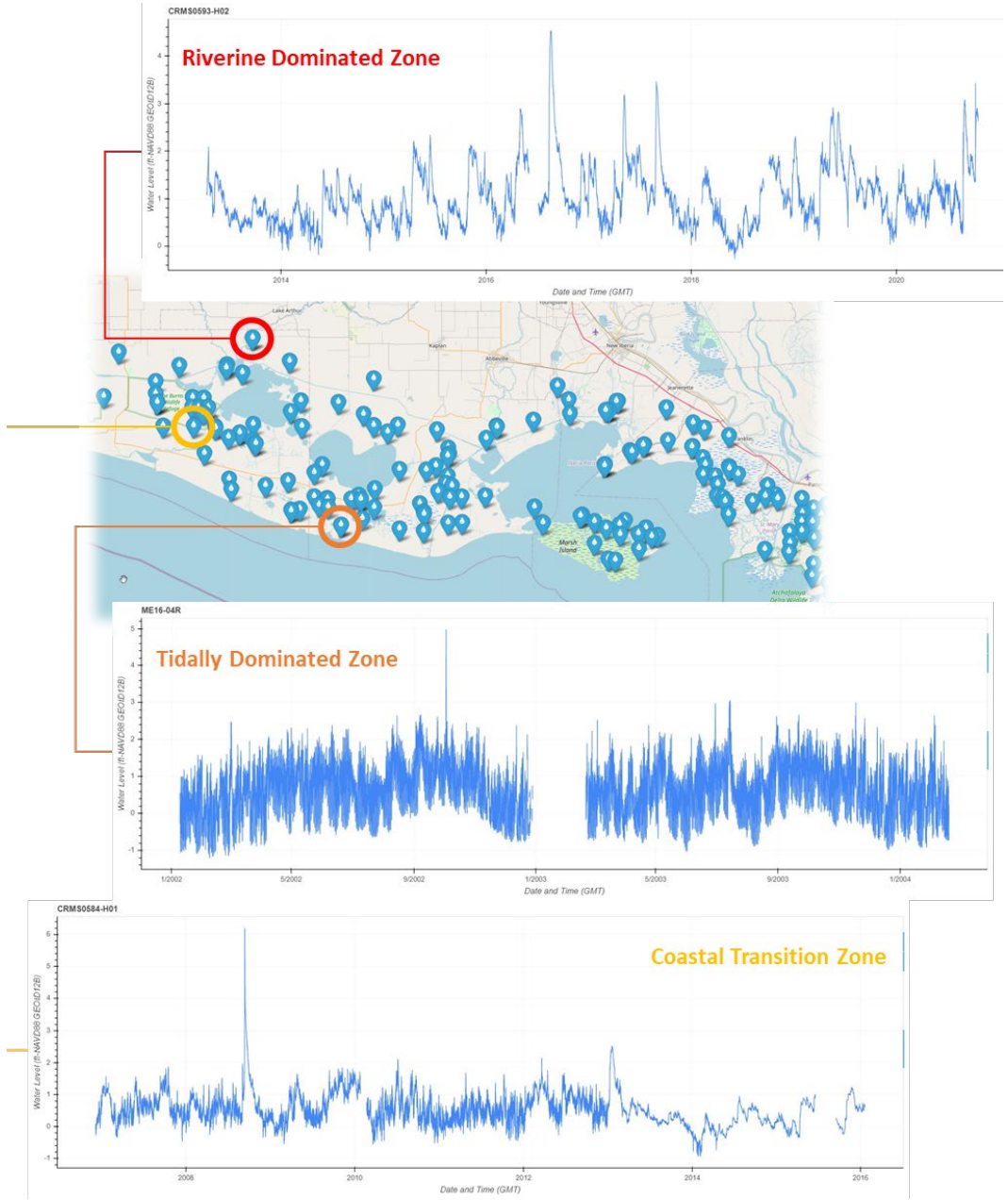
Coastal Transition Zone Modeling

Riverine Dominated Regime



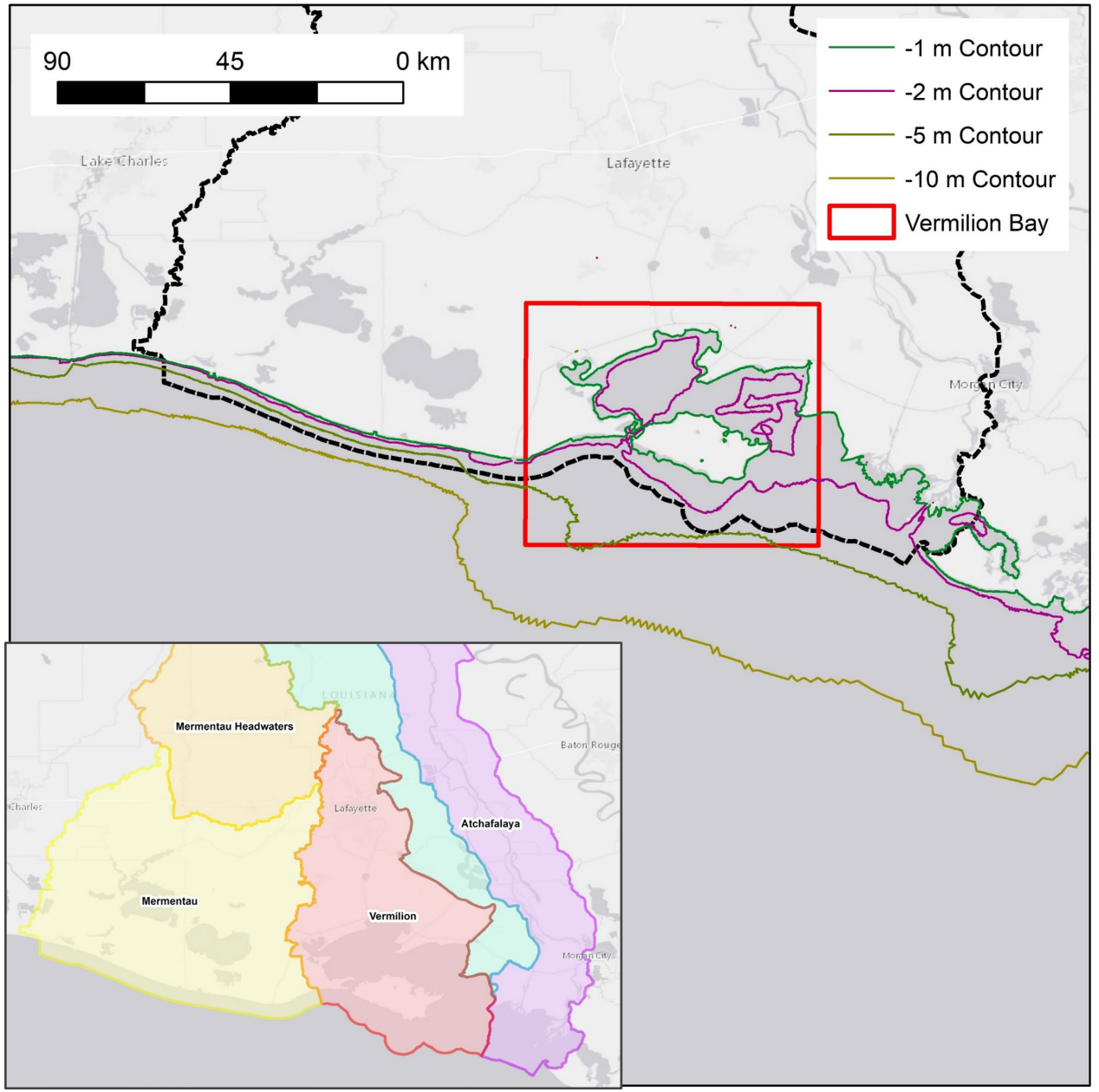
Surge Dominated Regime



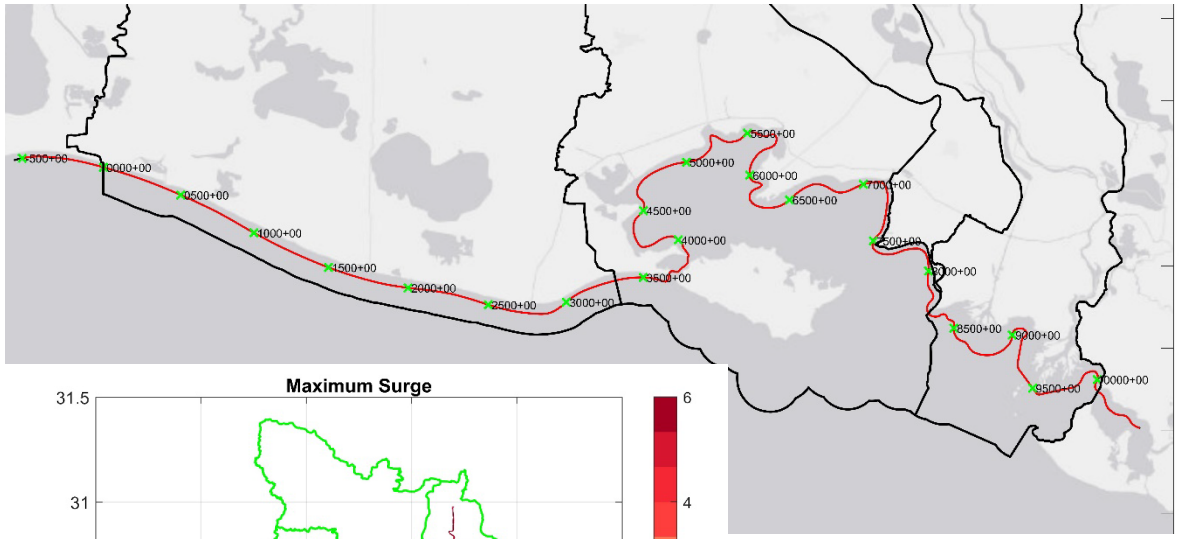


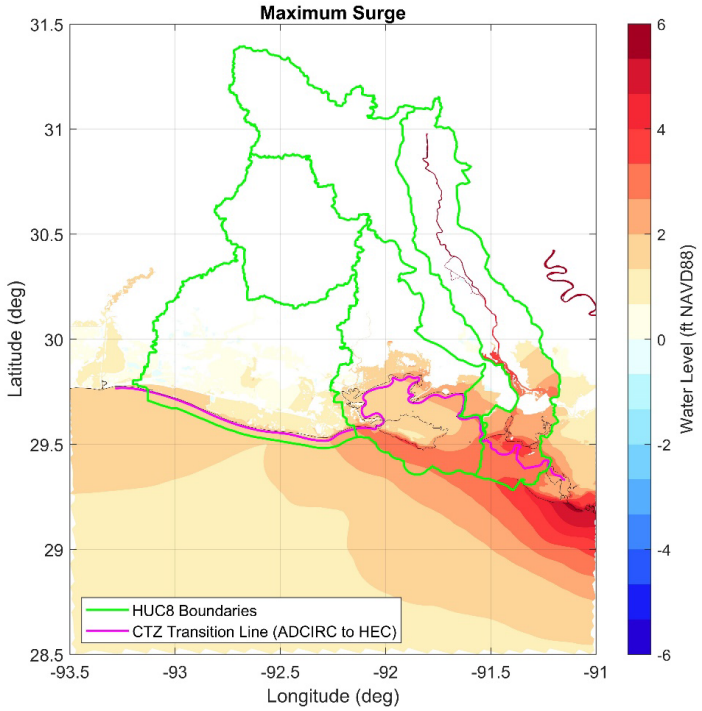
Offshore Bathymetry

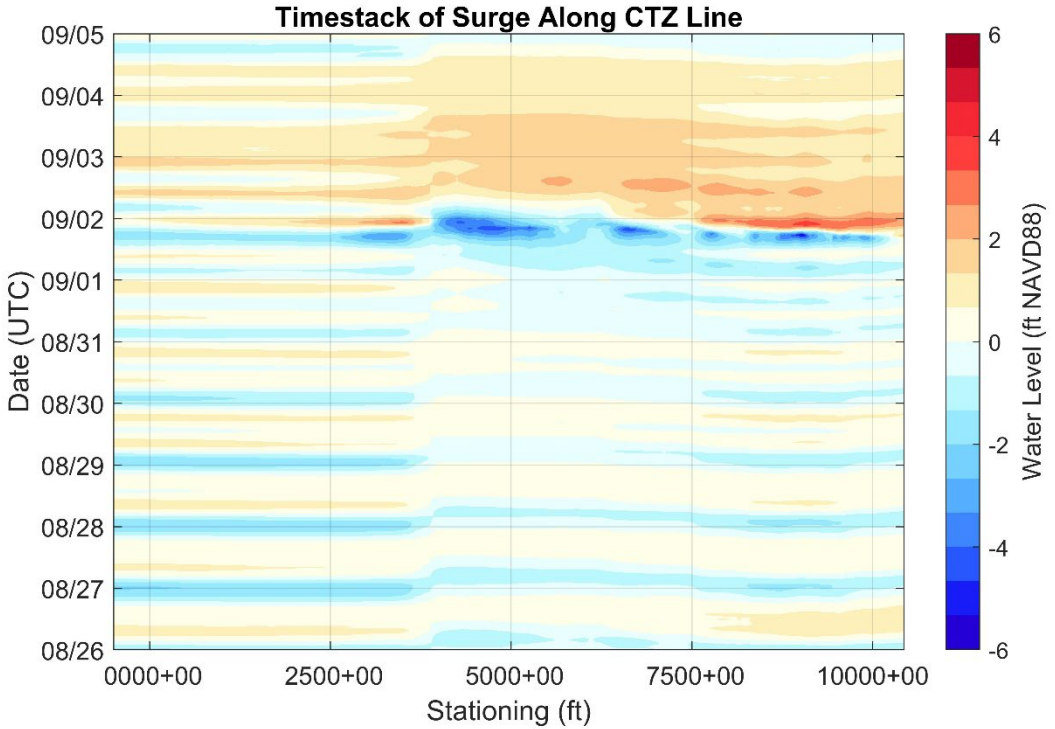
- Use Gustav (2008) as initial assessment.
- Bathymetry contours from ADCIRC+SWAN Mesh.
  - Mermentau – Relatively “Straight and Parallel”
  - Vermillion, Atchafalaya, Bayou Teche – Shallow & Mild Sloped.
- Starting Assumptions:
  - Significant amount of energy breaks offshore of 1-2 m contour.
  - Vegetation and marsh dissipate remaining wave energy.

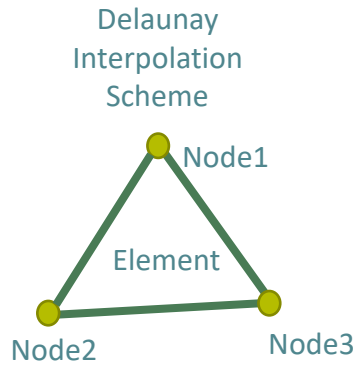


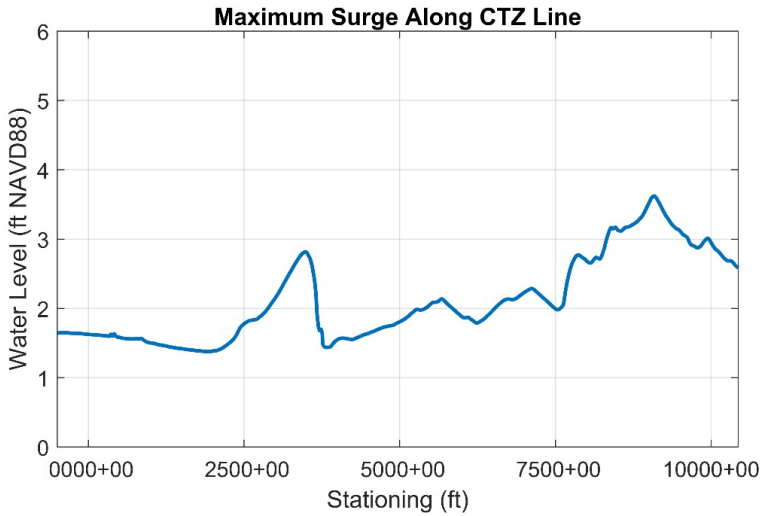
Water Levels



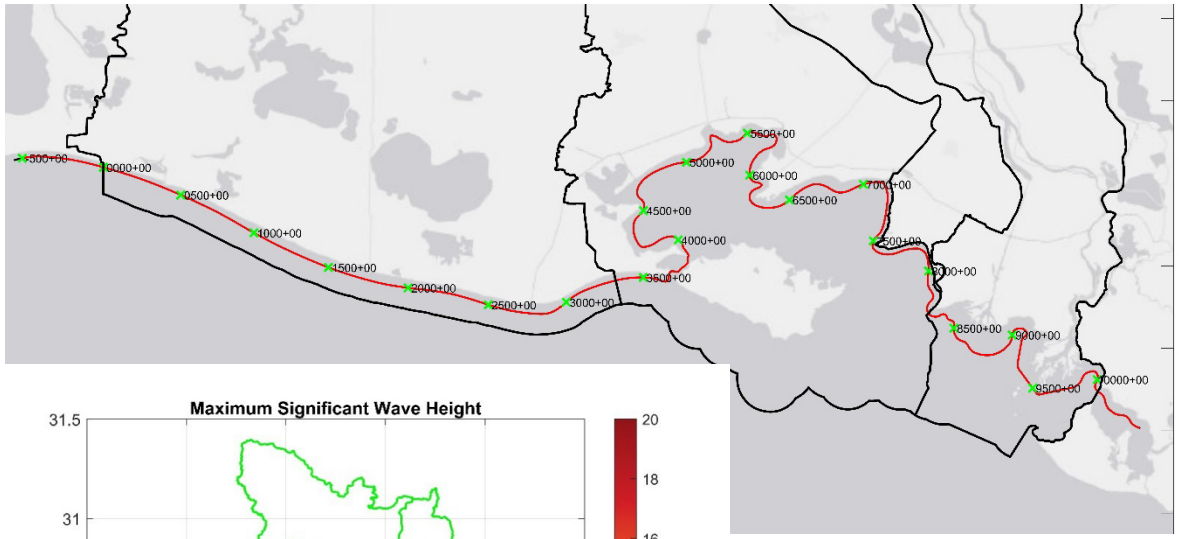








Wave Height


-1500+00
0000+00
0500+00
1000+00
1500+00
2000+00
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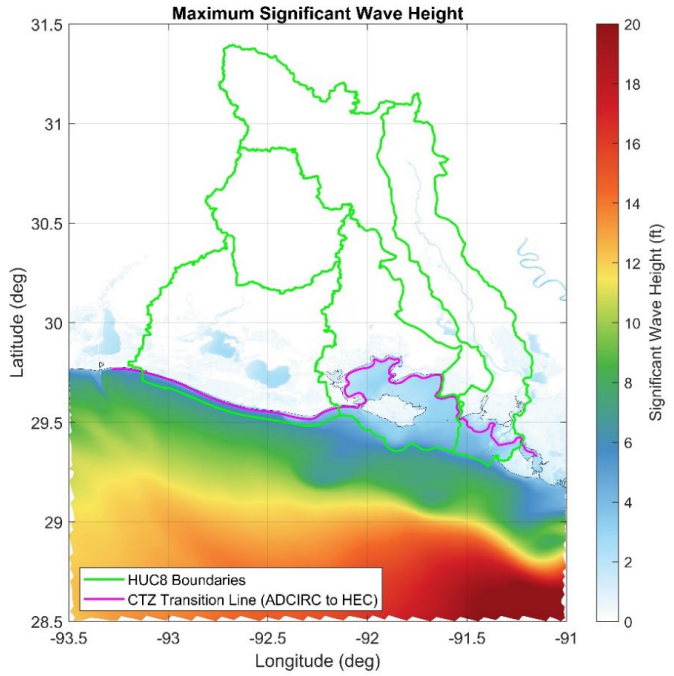
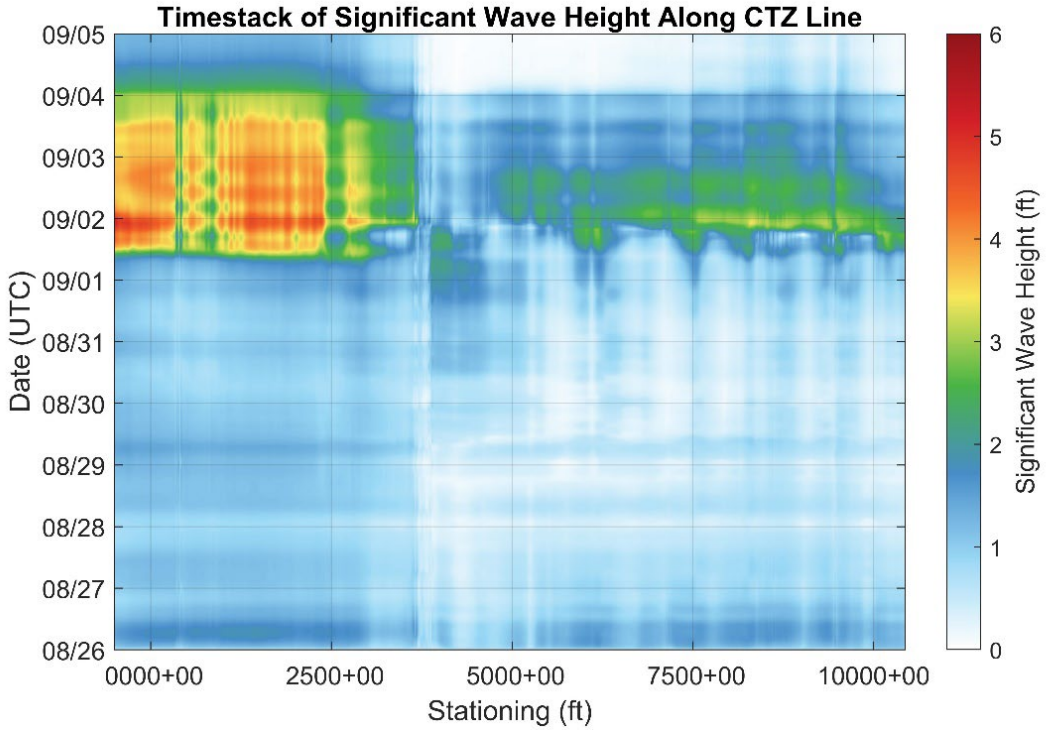
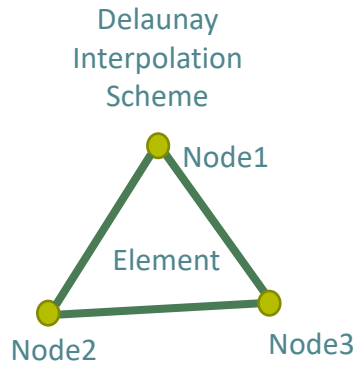
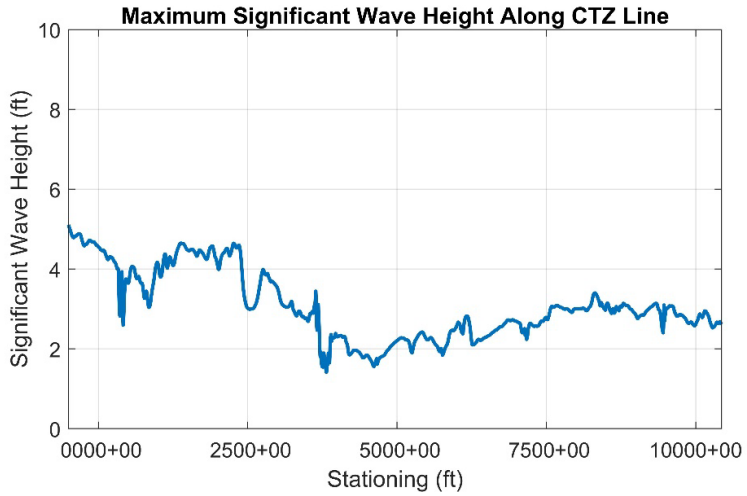
10000+00

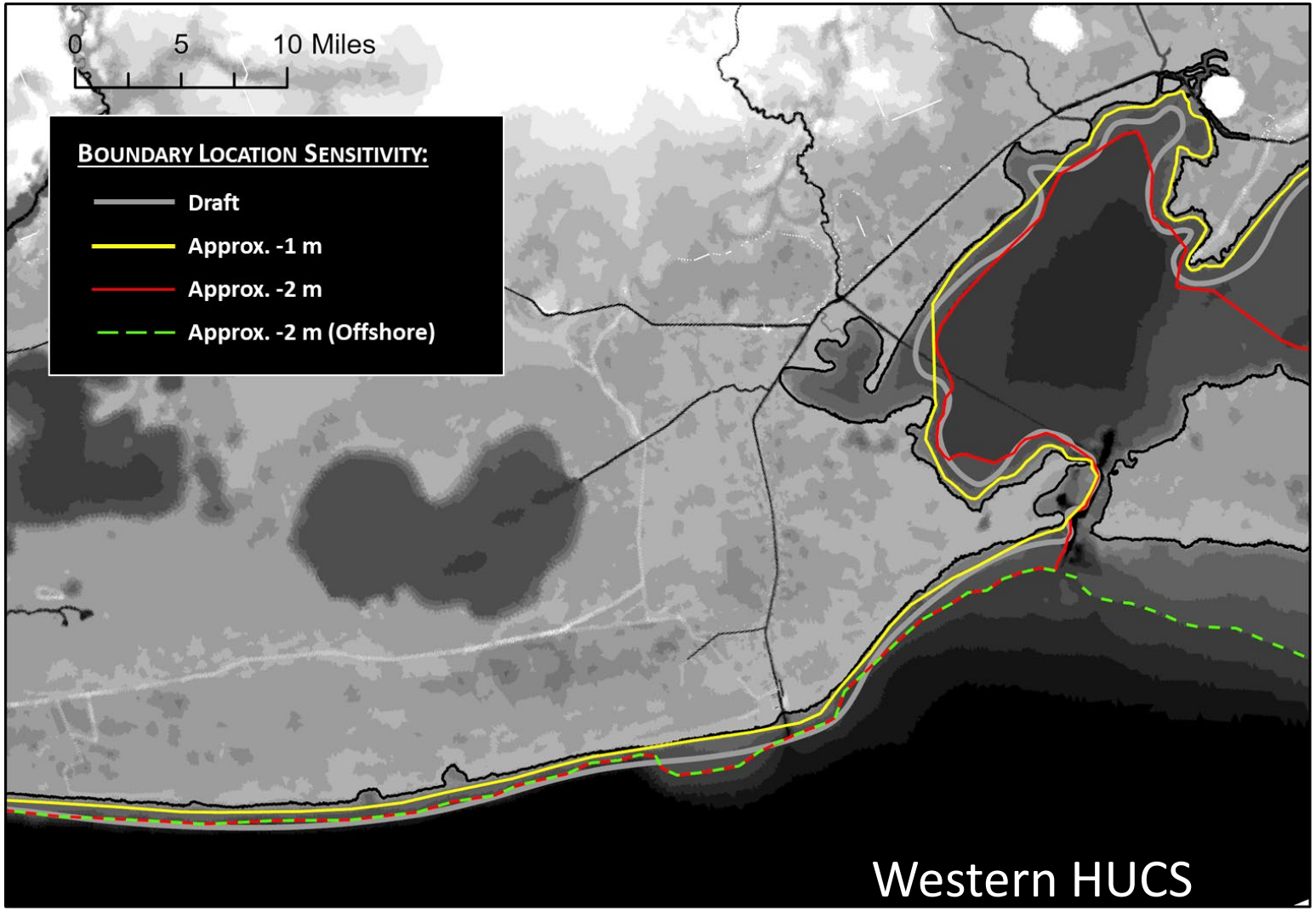

Maximum Significant Wave Height
Latitude (deg)
Longitude (deg)
Significant Wave Height (ft)
HUC8 Boundaries
CTZ Transition Line (ADCIRC to HEC)


Timestack of Significant Wave Height Along CTZ Line
Date (UTC)
Stationing (ft)
Significant Wave Height (ft)

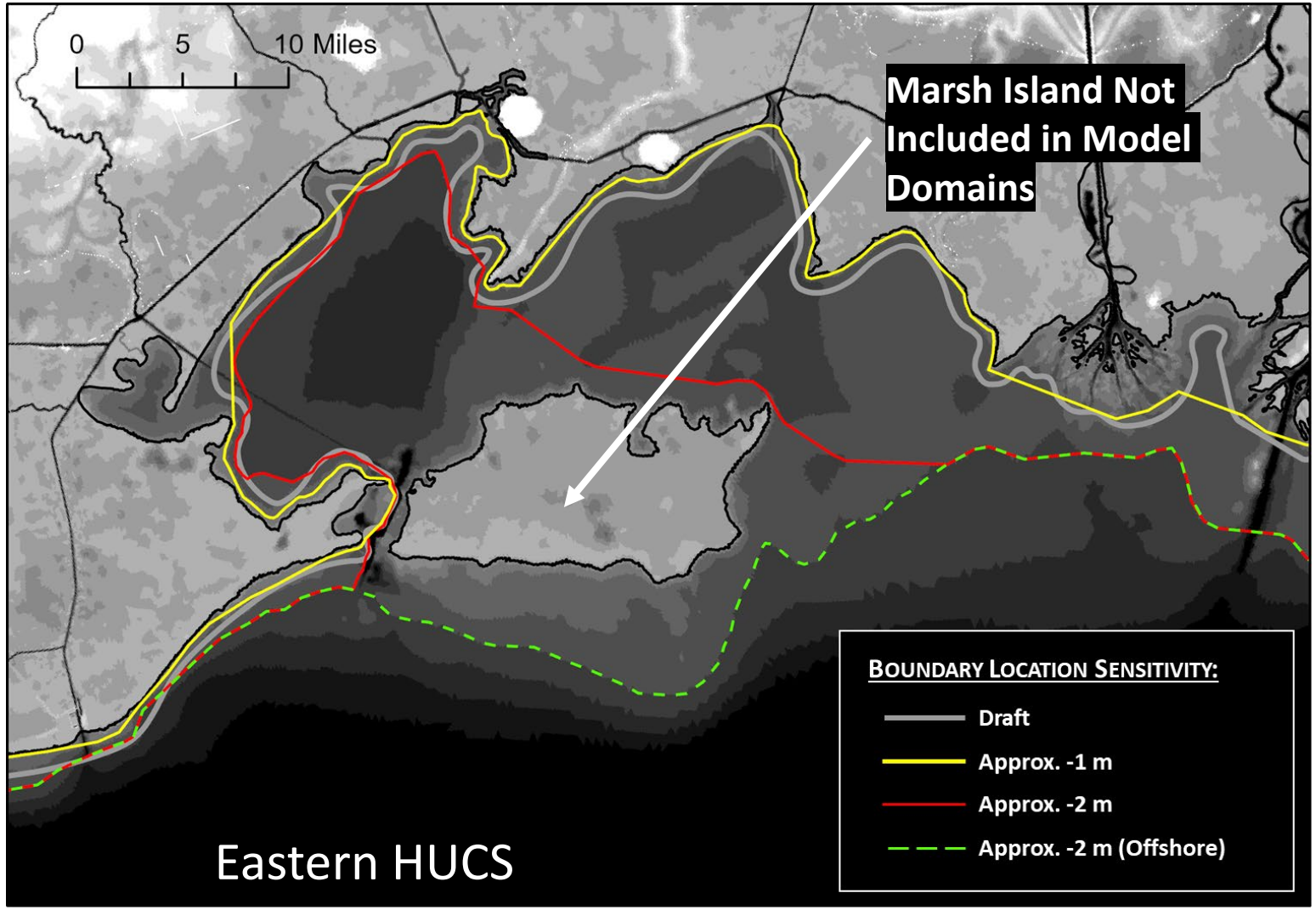

Delaunay
Interpolation
Scheme
Node1
Element
Node2
Node3


Maximum Significant Wave Height Along CTZ Line
Significant Wave Height (ft)
Stationing (ft)

Boundary Sensitivity Locations



Boundary Sensitivity Locations

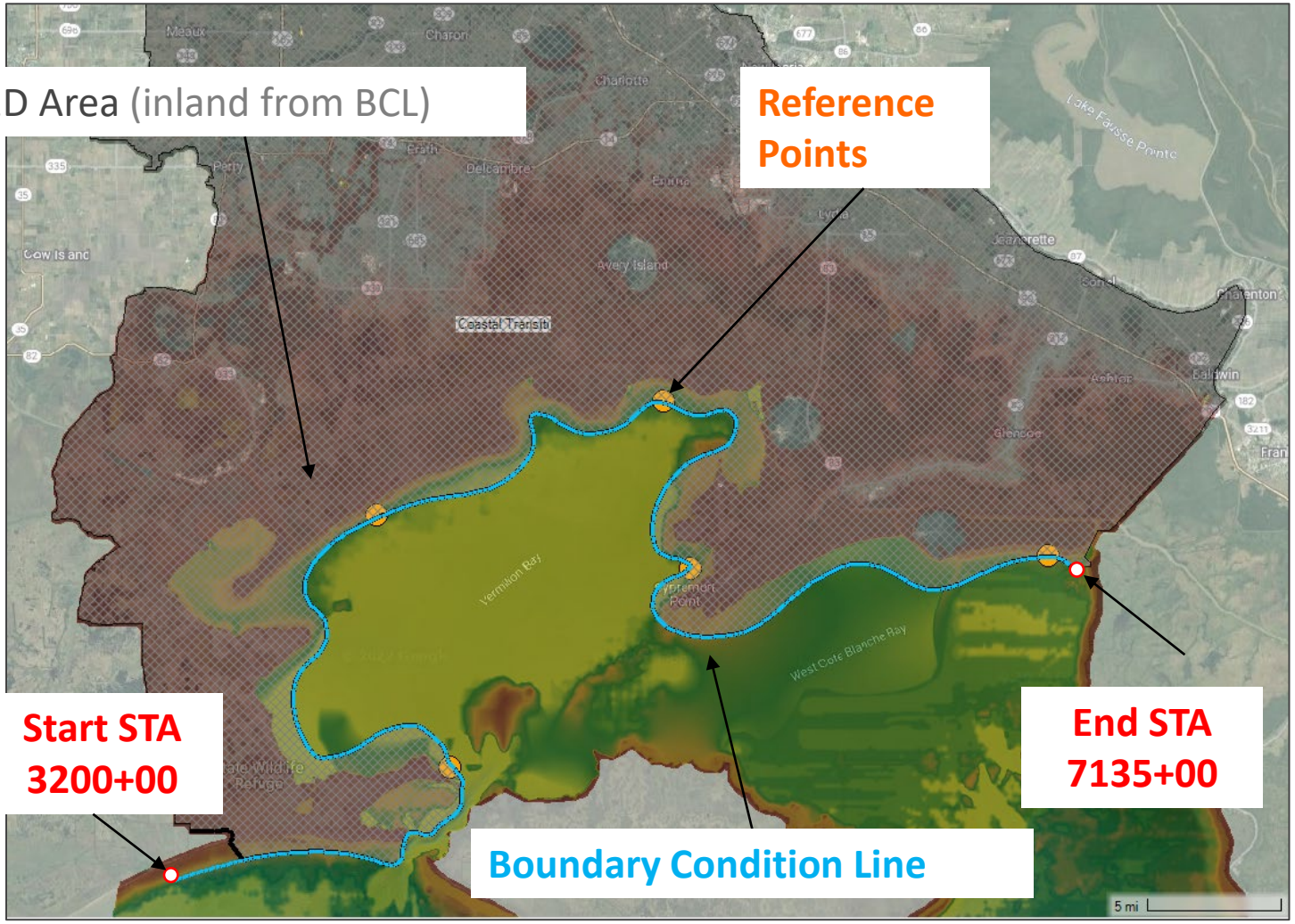


Coastal ADCIRC Modeling

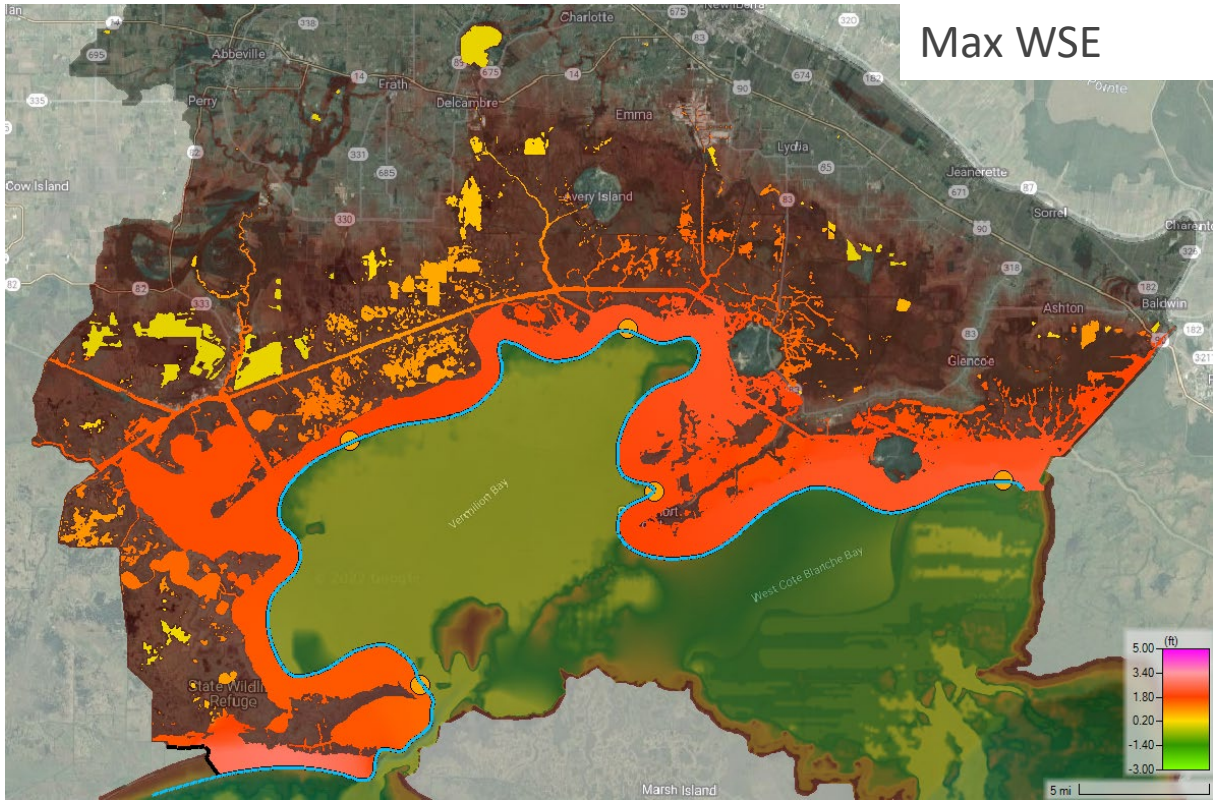
&

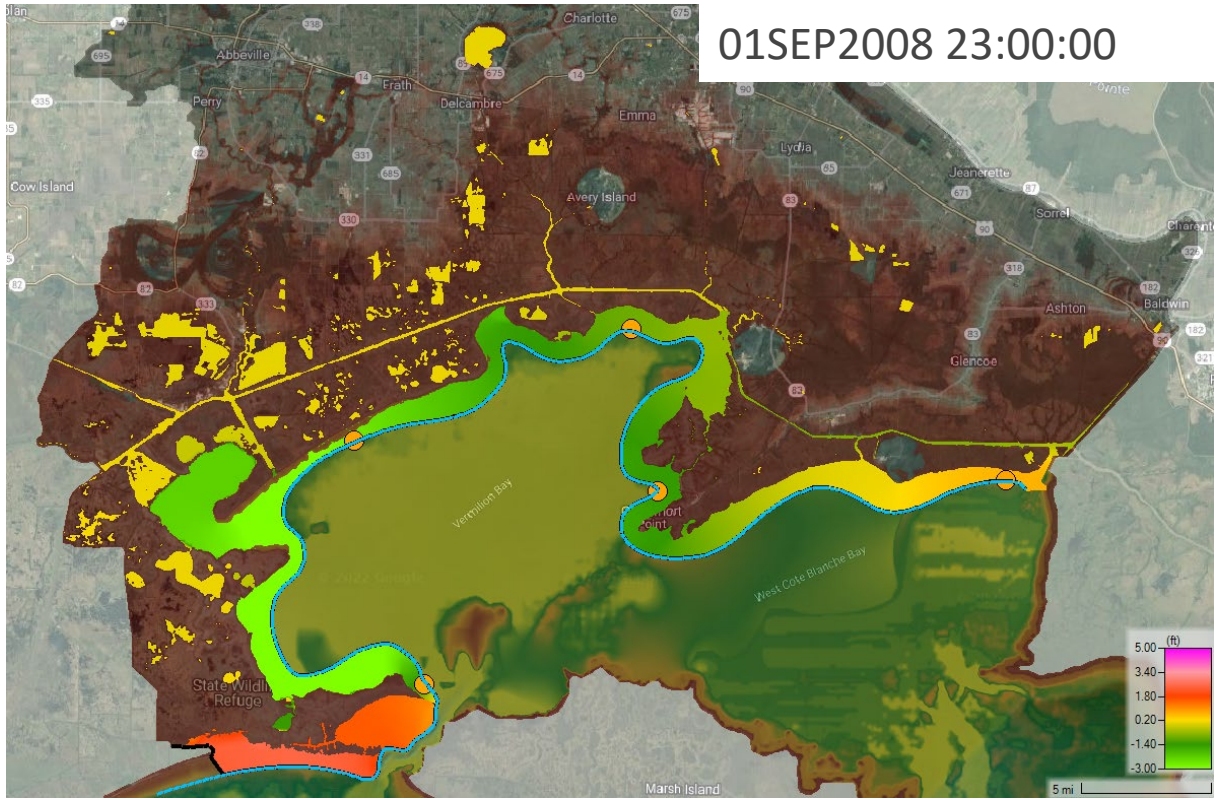
HEC-RAS 2D Integration

Geometry and Data Preparation

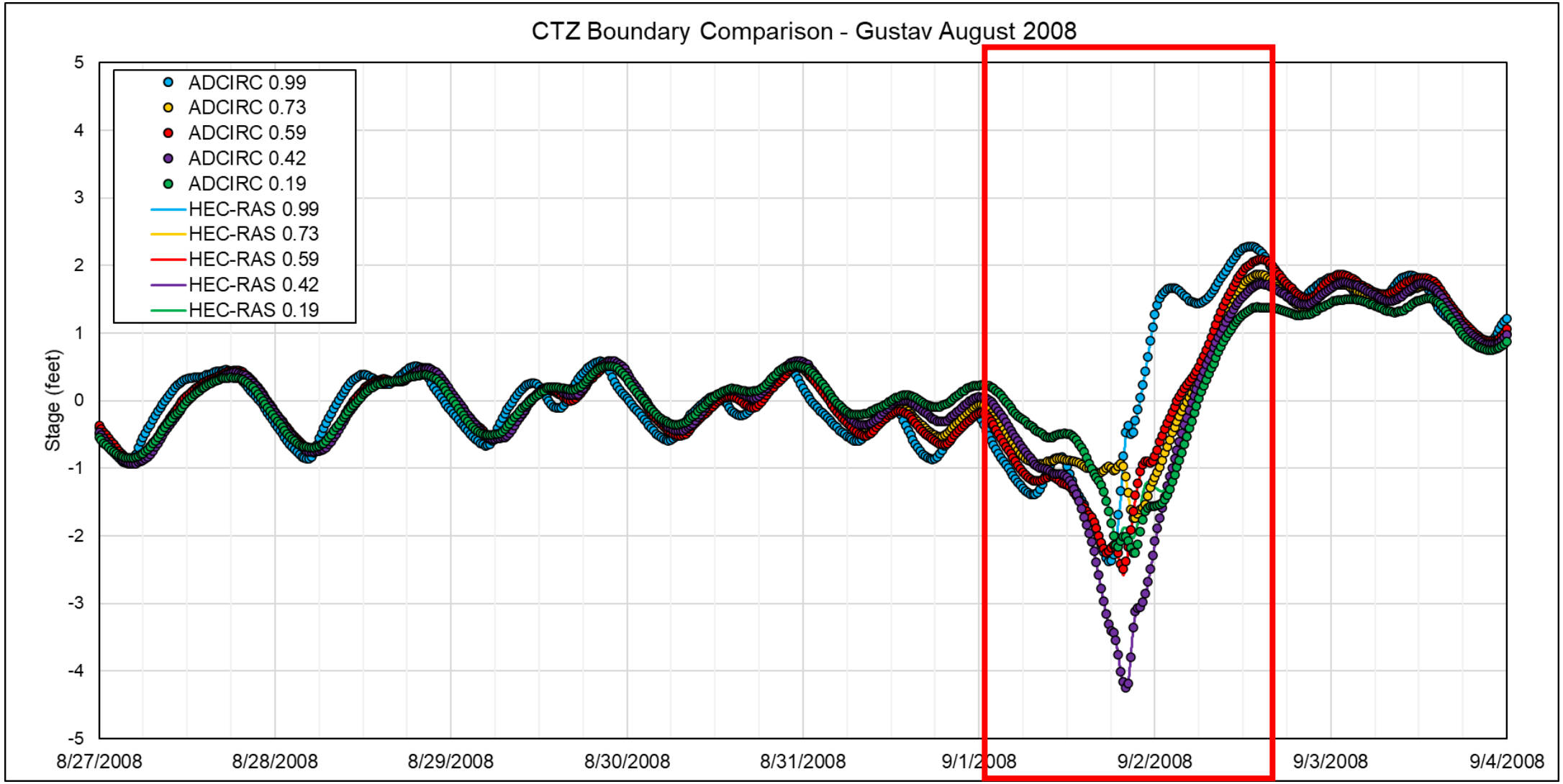


Confirm Application of ADCIRC in HEC-RAS

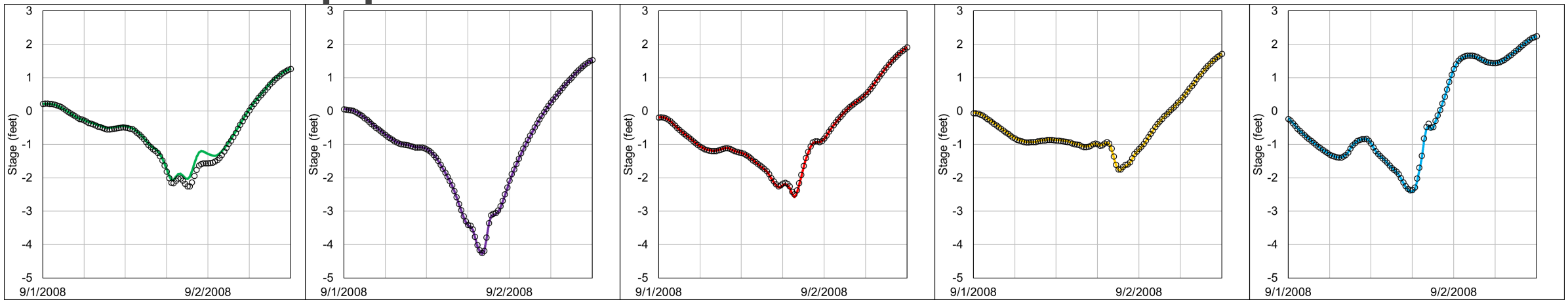


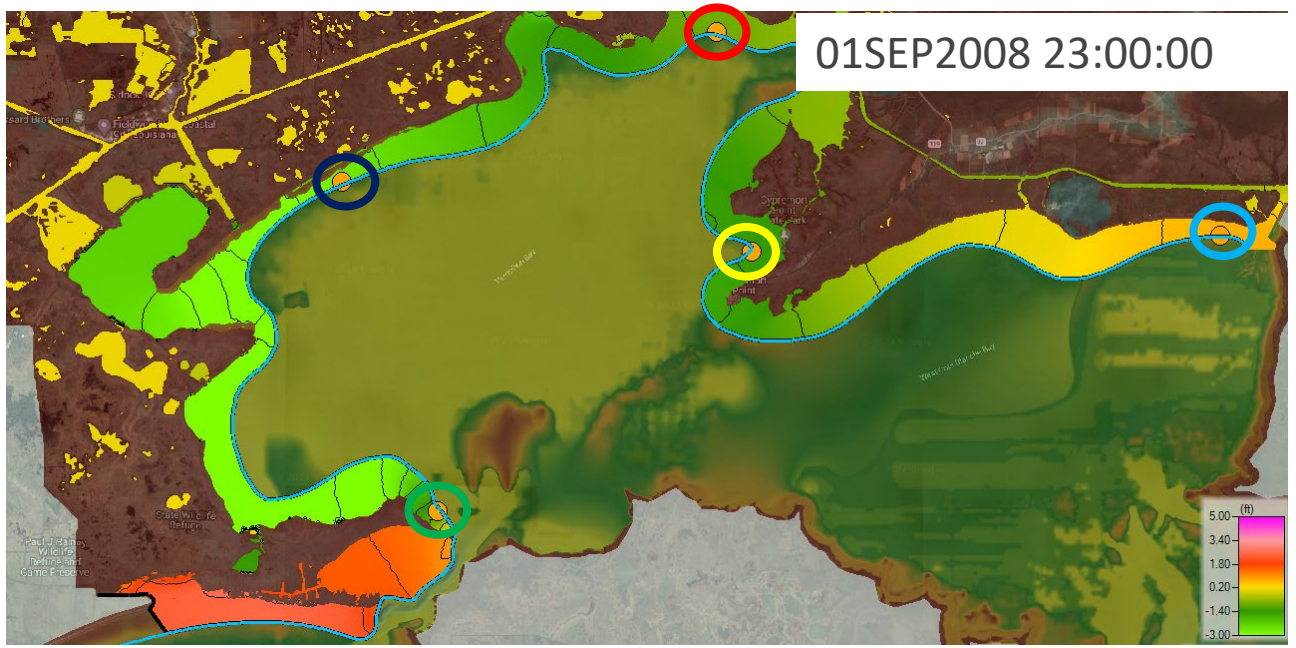


Confirm Application of ADCIRC in HEC-RAS



Confirm Application of ADCIRC in HEC-RAS





Model Use

Presentation to Region 5

April 27, 2023

David Cody

Henry Consulting

LOUISIANA
WATERSHED
INITIATIVE

working together for sustainability and resilience

Model Use: Potential applications

- Planning, risk assessment, mitigation and policy
  - Evaluate flood risk in specific geographies
  - Evaluate likely impact of new developments or public policy changes
    - e.g. the possibility of adverse impact on neighboring jurisdictions

- Design
  - Inform the design of flood mitigation projects or developments
  - Compare alternative project designs

Model Use: Challenge and Plan

- Full model use with HEC-RAS is an extremely demanding and complex effort requiring significant training and practice.
- … but the LWI program has an interest in maximizing the benefit of the models and providing value to a wide variety of users.
- Henry Consulting has a preliminary recommendation: a dual path of model use, based on the audiences.
- The plan is still under development; we are months away from full implementation.
- Plenty of opportunity for RSC and professional input.

Model Use Path 1: Technical Audiences

Audiences

- Civil Engineering profession
- Academics
- Technical staff at parishes, municipalities, levee districts, and other water resource districts
- DOTD and other state Departments
- Other governmental agencies: ACE, FEMA, etc.

Skills Required

- HEC-RAS training and experience

Model Use Path 1 (continued): Critical Success Factors

- Invitation and Recruitment
- Training
- Help Desk
- Quality Control
- Trouble reporting
- Model maintenance: upgrades and notifications

Model Use Path 2: non-Technical Audiences

Audiences

- RSCs/Coalitions
- Regional Watershed Coordinators
- Elected officials
- Senior staff at municipalities and parishes
- Industry and professions
- Other stakeholders
- General public

Skills Required

Model Use Path 2 (continued)

Content

- Output from model runs
- Survey data
- Floodplain maps

Model Use Path 2 (continued)
Critical Success Factors

- Thorough assessment of interesting issues
  - Survey is planned
- A robust library at launch
  - A process for adding to library
- Clear explanation of potential uses
- POC for public questions

LWI Program Updates

April 2023

Brett McMann, PE, CFM
The Water Institute

LOUISIANA WATERSHED INITIATIVE

working together for sustainability and resilience

Program questions MUSM seeks to address

- How does the program best position the data and models for future use?
- Where are models stored long term?
- How is storage and access maintained?
- How is check-in of revisions performed?
- How does the LWI balance future statewide needs with a broad spectrum of current regional capability and future needs?

MUSM Development

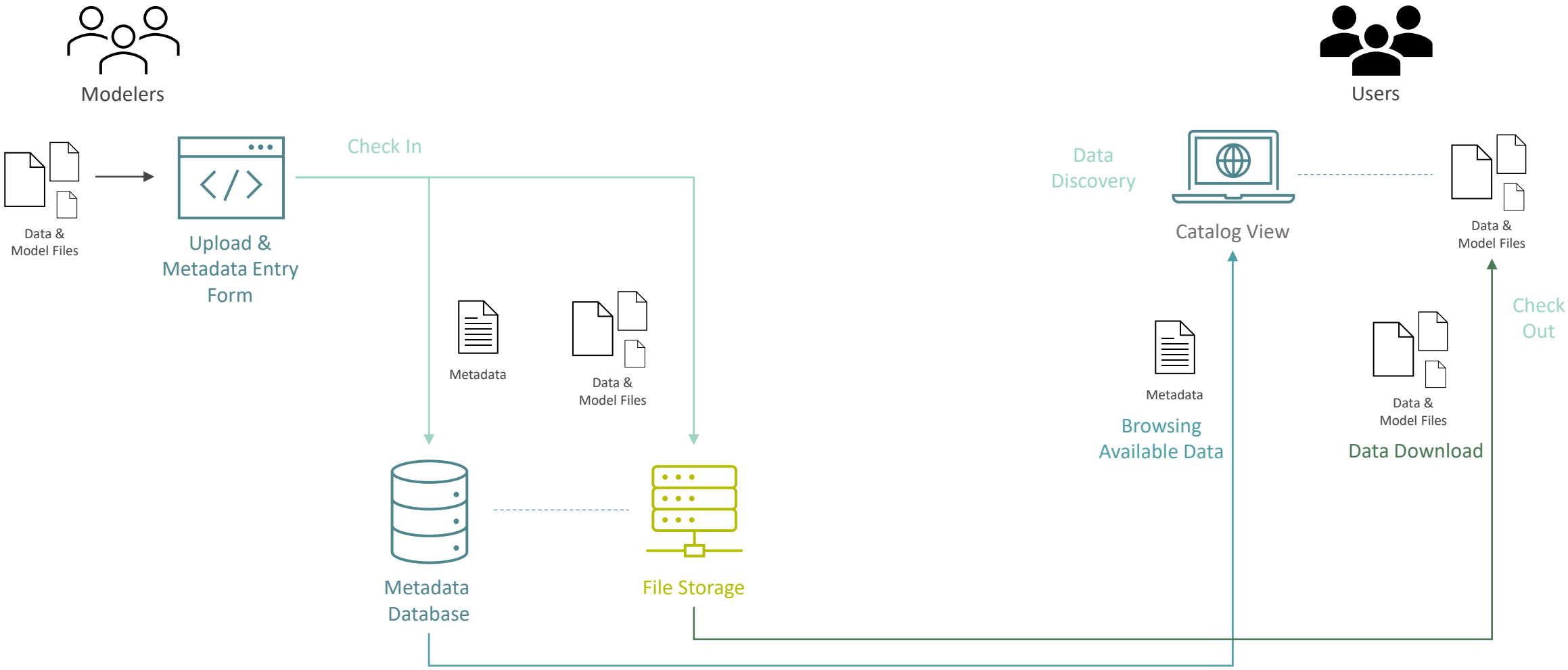
PURPOSE and STATUS

- *Goal:* Achieve sustainable use of LWI models by all LWI stakeholders after model creation
- *Background:* Various strategies considered, Working Group, TDQ recommended a federated approach to the Council. Presented and achieved buy-in to modeling consultants, regional watershed coordinators. Work ongoing to build software system.

What is the system being built?

- Front end: the web interface the public will interact with to query data and models
- Back end: think of a library analogy…we need to create the library shelves and catalogue system to allow searches and data relations across areas, topics, keywords, etc.
  - The ‘card catalog’ metadata standard by which all model developers will catalogue key information (the data describing the data). This standard will also serve as CPRA’s standard; ongoing conversations with federal agencies as well.
  - The ‘library building’ of data storage with high availability and low cost (Amazon Web Services)
  - The ‘library shelves’ with sections/subdirectories of data (survey data, climate data, model input and output data, etc.)

How will users interact with the system?



MUSM: Management responsibilities

The MUSM plan provides the framework to support long-term management of LWI models and data, with recommendations for state, regional, and local use and storage. This involves two main components:

DATA AND MODEL MANAGEMENT

a) Uploading data and/or models to cloud storage

b) Supporting user access and download

c) Updating data/models (new software versions, data maintenance)

Requires funding for labor to support the above activities

SYSTEM AND SOFTWARE MAINTENANCE

a) Maintaining the software platform used to access and store data and models

b) Updating, as necessary, data/model standards for cloud storage

c) Supporting data and model management leads

d) Troubleshooting technical issues

Requires funding for cloud infrastructure and labor to support the above activities

MUSM approach: **Federated**

FEDERATED DATA AND MODEL MANAGEMENT

- Multiples sets of users, across levels of government, can host and maintain models as deemed appropriate based on use cases
- Staff assigned by any user group (e.g., any level of government) to lead model maintenance
- Reliant on user-based technical expertise
- Leveraging standardized approaches to data and model storage across user groups

FEDERATED SOFTWARE AND STANDARDS MANAGEMENT

- Single team to manage software maintenance
- Consistent platform for supporting model use and management across all users in the state across levels of government
- Improving software where funding is available to ensure future user needs are met
- State assumes costs for technical staff and cloud-based storage and access costs (for publicly available models)

Status of MUSM System Development

Schedule for Completion

- Minimum viable product rollout to program's modeling consultants end of 2023
- "Break it" testing from modeling consultants early 2024
- Operationalization, improvements, and debugging remainder of 2024
- Operations and maintenance begin in full in late 2024

Compound Flooding in Coastal Transition Zones

April 2023

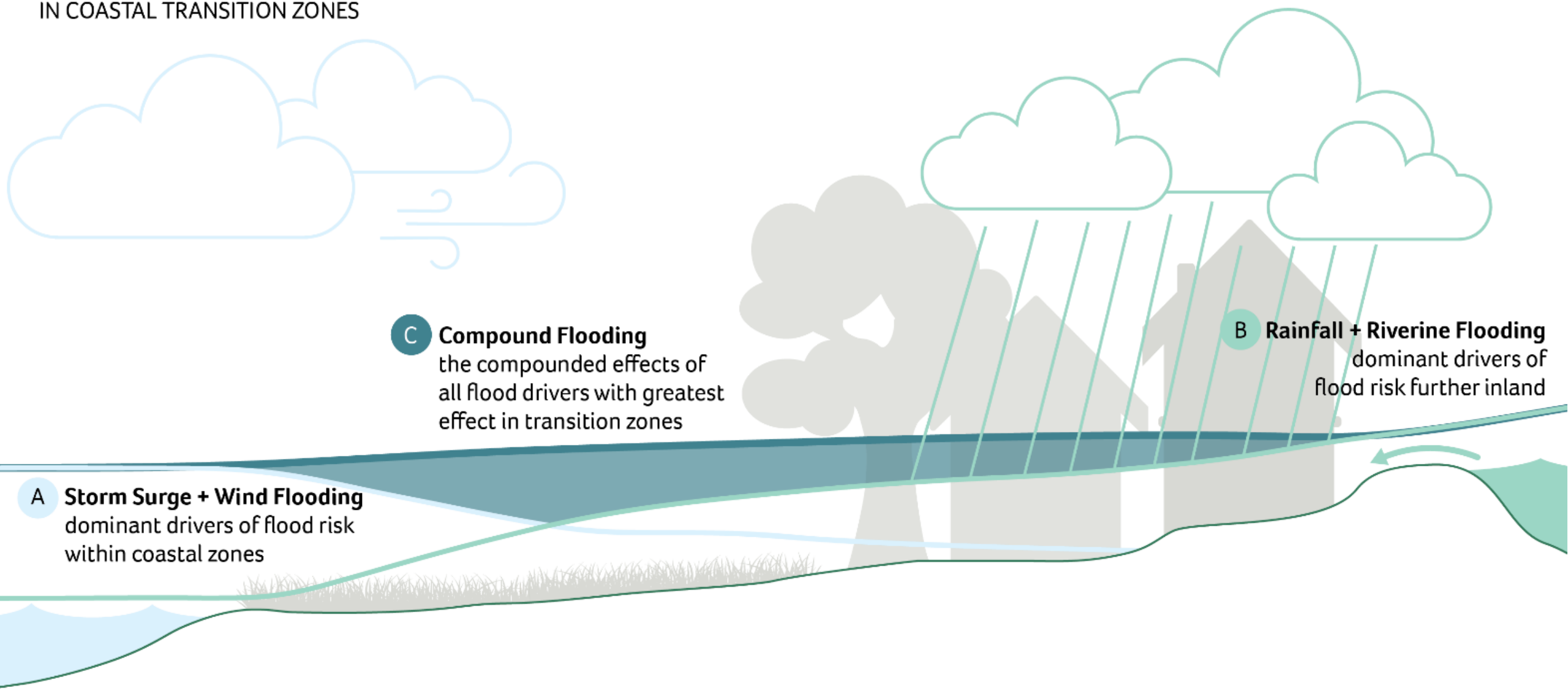
Brett McMann, PE, CFM
The Water Institute

LOUISIANA WATERSHED INITIATIVE

working together for sustainability and resilience

COMPOUND FLOODING

IN COASTAL TRANSITION ZONES



LWI modeling objectives

Primary objectives

- Flood mitigation feasibility studies
- No adverse-impact assessments
- Consequence and risk assessment
- Management of future developments and community growth
- Support evaluation of proposed projects, watershed management strategies and policy development

Added-value objectives

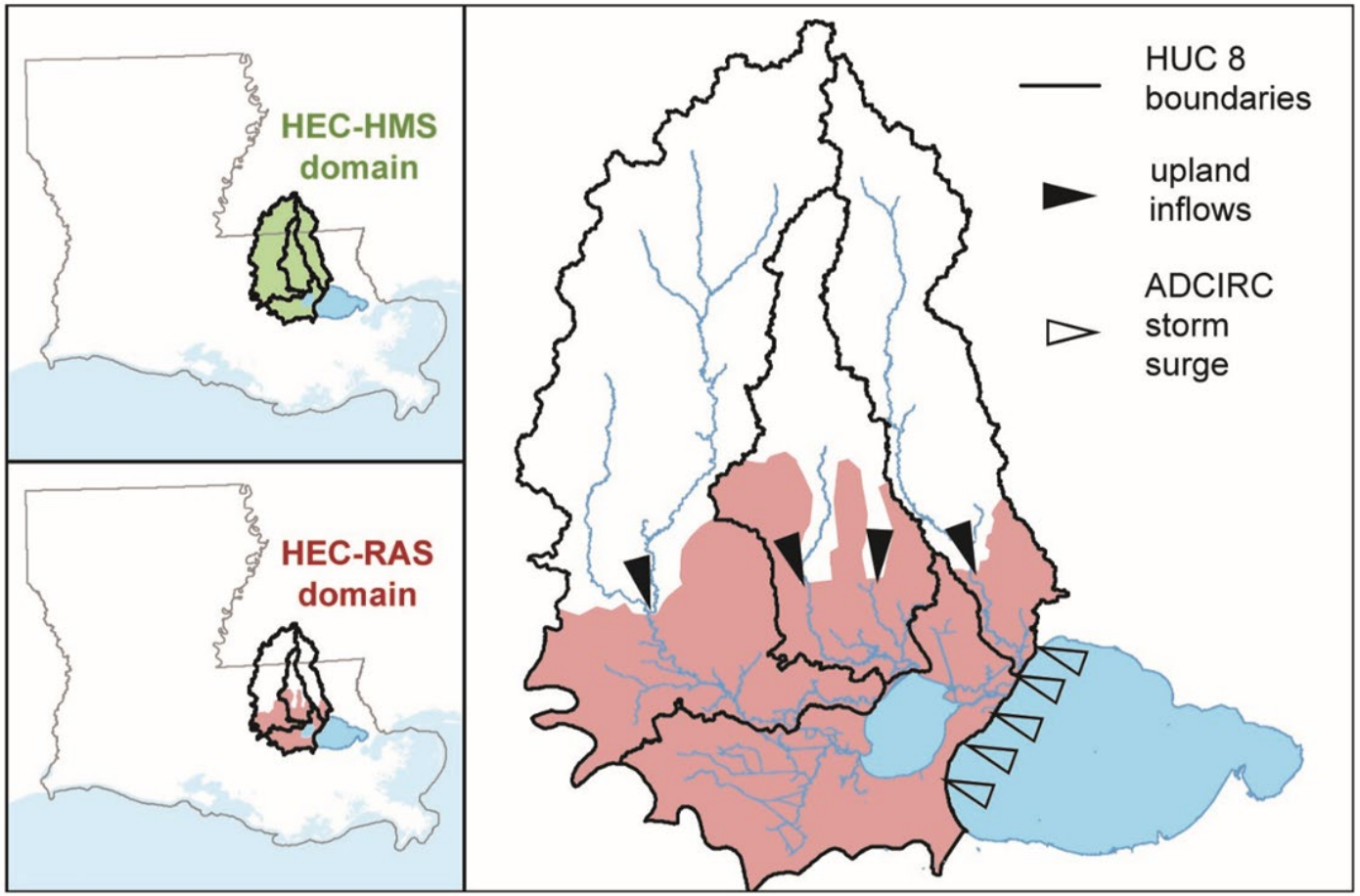
- Inform assessment of habitat suitability and impacts on water quality
- Inform assessment of ecological consequences (e.g., IHA's)
- Support development and update of FEMA flood risk maps
- Support future development of flood forecasting warning systems

Compound Flood Transition Zone Approach

OVERVIEW

- Develop a compound flooding approach in the flood transition zone that aligns with:
  - Coastal flood hazard approaches used by Coastal Restoration and Protection Authority (CPRA), US Army Corps of Engineers (USACE), and Federal Emergency Management Agency (FEMA)
  - LWI numerical model guidance
- Leverage previous/ongoing efforts
  - 2023 Coastal Master Plan (CMP)
  - RESTORE Center of Excellence
  - National Oceanic and Atmospheric Administration (NOAA), USACE, FEMA, and other studies
- Water level annual exceedance probability (AEP) surfaces (e.g., 100-year floodplain or 1% AEP) to support model objectives, especially consequence and risk assessments, as well as supporting management of future developments and community growth

Amite Transition Zone Pilot Study



A NUMERICAL MODEL OF THE TRANSITION ZONE OF THE AMITE RIVER BASIN

TECHNICAL MEMORANDUM: VERSION 3

December 14, 2020

OVERVIEW OF THE COMPOUND FLOOD TRANSITION ZONE PILOT STUDY FOR THE AMITE RIVER BASIN

TECHNICAL MEMORANDUM

August 19, 2021

MODEL CALIBRATION AND VALIDATION

AMITE RIVER BASIN PILOT STUDY TECHNICAL MEMORANDUM

August 19, 2021

PRODUCTION RUN DEVELOPMENT AND SIMULATION

AMITE RIVER BASIN PILOT STUDY TECHNICAL MEMORANDUM

August 19, 2021

RECURRENCE ANALYSIS

AMITE RIVER BASIN PILOT STUDY TECHNICAL MEMORANDUM

August 19, 2021

Consequence Modeling

April 2023

Brett McMann, PE, CFM
The Water Institute

LOUISIANA WATERSHED INITIATIVE

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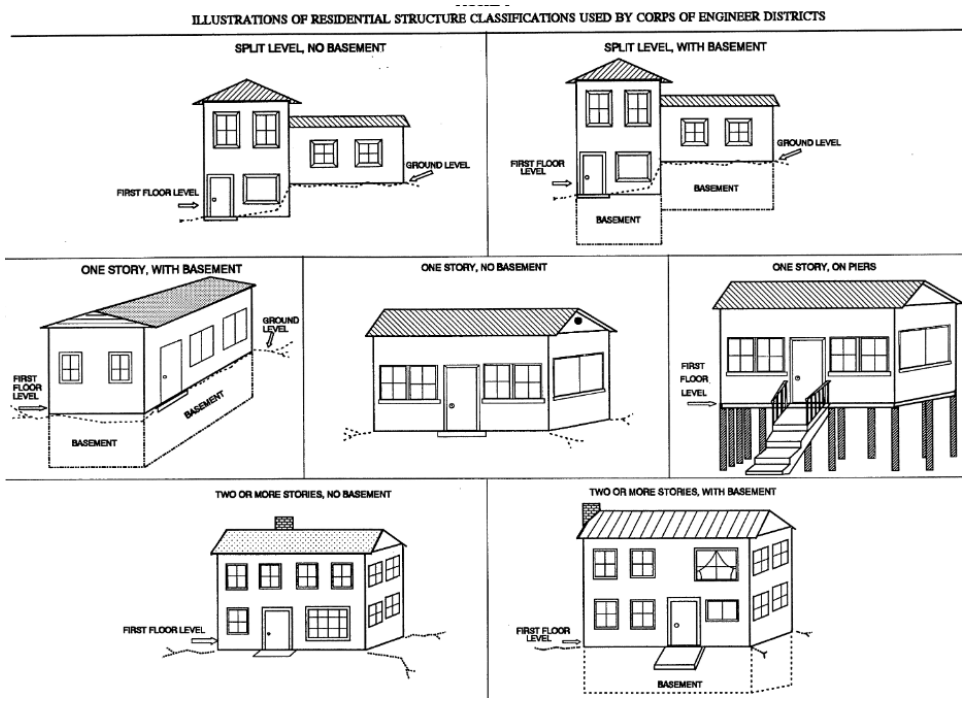
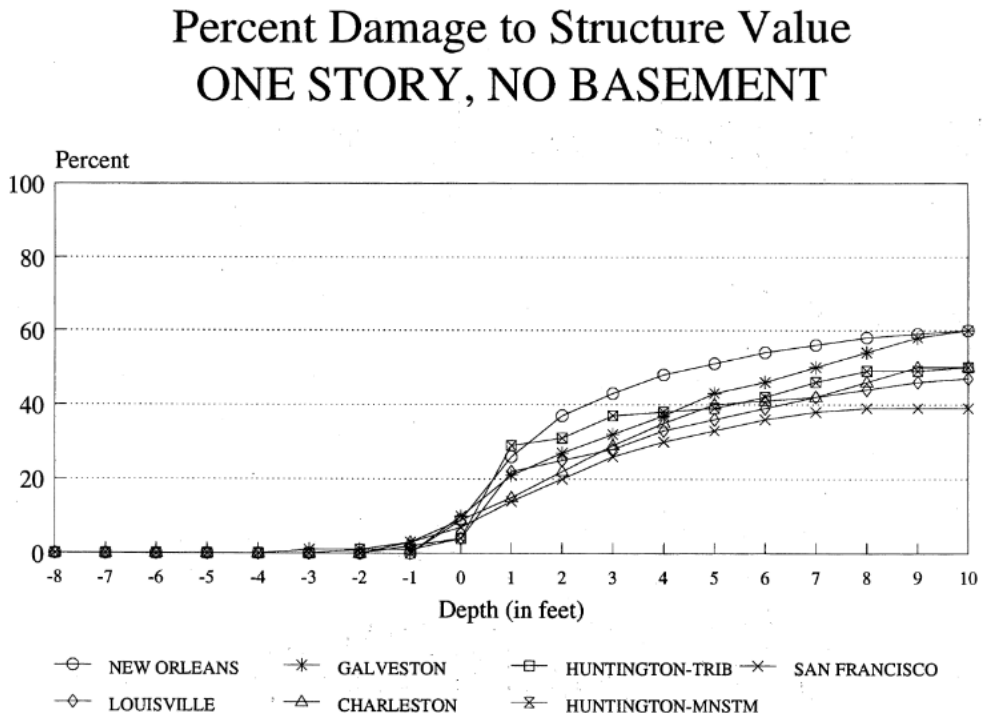
What is Consequences Modeling?

- Relates flood depth and extent predictions to expected direct damage (dollars) to buildings and contents
- Damage dollars most often consider structure and contents damages to residential, commercial, and industrial buildings across many structure types. In some cases, may also consider vehicles, agricultural losses, etc. (LWI focuses on structures only at the present).





What Tools is the LWI Developing and their Status?

- Statewide structure inventory
  - Created by Purdue, based on same methods used for CPRA's Master Plan inventory.
  - Combination of observed data from numerous sources including
    - the US Army Corps of Engineer's National Structure Inventory (NSI);
    - Lightbox parcel data from Homeland Infrastructure Foundation-Level Data (HIFLD);
    - tax assessor data compiled by ATTOM Data Solutions;
    - Microsoft's Building Footprints database; and
    - Building attributes predicted through application of machine learning (ML) to Google Street View (GSV) imagery

Single story	Multi stories	Multi stories	Single story
Garage present	Garage absent	Garage present	Garage absent
Basement absent	Basement absent	Basement absent	Basement absent
Slab foundation	Pier foundation	Slab foundation	Mobile foundation
Residential building	Residential building	Residential building	Mobile building
0.19 m high foundation	0.33 m high foundation	0.45 m high foundation	0.71 high foundation
(a)	(b)	(c)	(d)

What Tools is the LWI Developing and their Status?

- Consequences modeling viewer
- Purpose of the output GUI developed for consequences modeling is to:
  - Display tabular native outputs in graphic and pictorial form
  - Provide future decision support across a variety of events and geographies
  - Explore project evaluation capability/reporting mechanisms
  - Secondary benefits of Q/A on structure inventory

Consequences Viewer

Go Consequences visualization demo
The Water Institute of the Gulf

Storm: Aug2016 | Region: Community Boundary | Name: All

Structure inventory

Structure #526466

Flood 3.7 ft above the first floor
Damage category: Com
Occupancy type: COM8
Height above sea level: 17.16 ft
Structure damage cost: $2599237.63
Content damage cost: $13635124.94
Total damage cost: $16234362.57

Structure #459066

Flood 4.81 ft above the first floor
Damage category: Ind
Occupancy type: IND2
Height above sea level: 0.87 ft
Structure damage cost: $1740537.90
Content damage cost: $5221613.69
Total damage cost: $6962151.59

Structure #17351

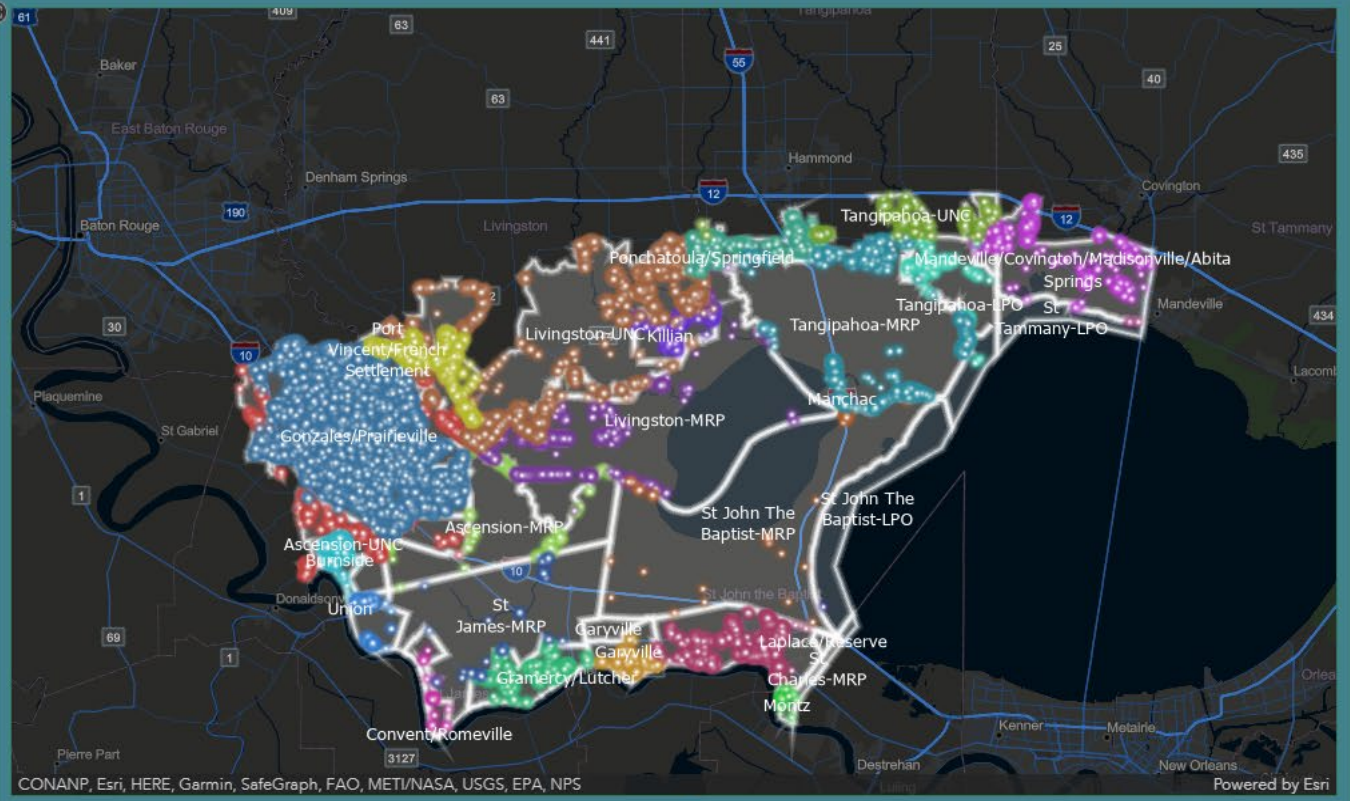
Flood 1.79 ft above the first floor
Damage category: Com
Occupancy type: COM8
Height above sea level: 9.81 ft
Structure damage cost: $895999.38
Content damage cost: $4479996.89
Total damage cost: $5375996.26

Structure #436749

Flood 6.46 ft above the first floor
Damage category: Ind
Occupancy type: IND2
Height above sea level: 2.81 ft
Structure damage cost: $1050214.51
Content damage cost: $3048763.54
Total damage cost: $4098978.06

Structure #159330

The values shown in this application are generated using the Go-consequence library. To get more information about this, please visit the repository code.



Total damage cost

$1.19BN Total

2021 dollar value

Structure damage cost

$763.94MM Total

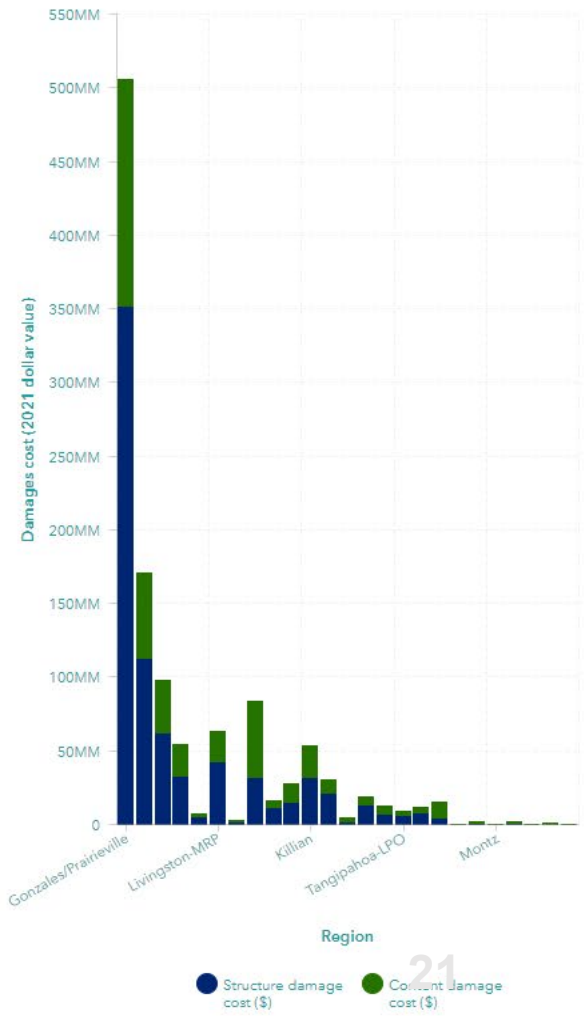
2021 dollar value

Content damage cost

$421.78MM Total

2021 dollar value

Damages cost



Status of Consequence Modeling

Schedule for Completion

- Consequence Modeling Run Output – rolling completion through 2023/2024 as models are completed as H&H models are completed by others
- Statewide Structure Inventory – draft completed in April 2023; pending input into consequence modeling
- Statewide Consequences Modeling Viewer – completion end of 2023

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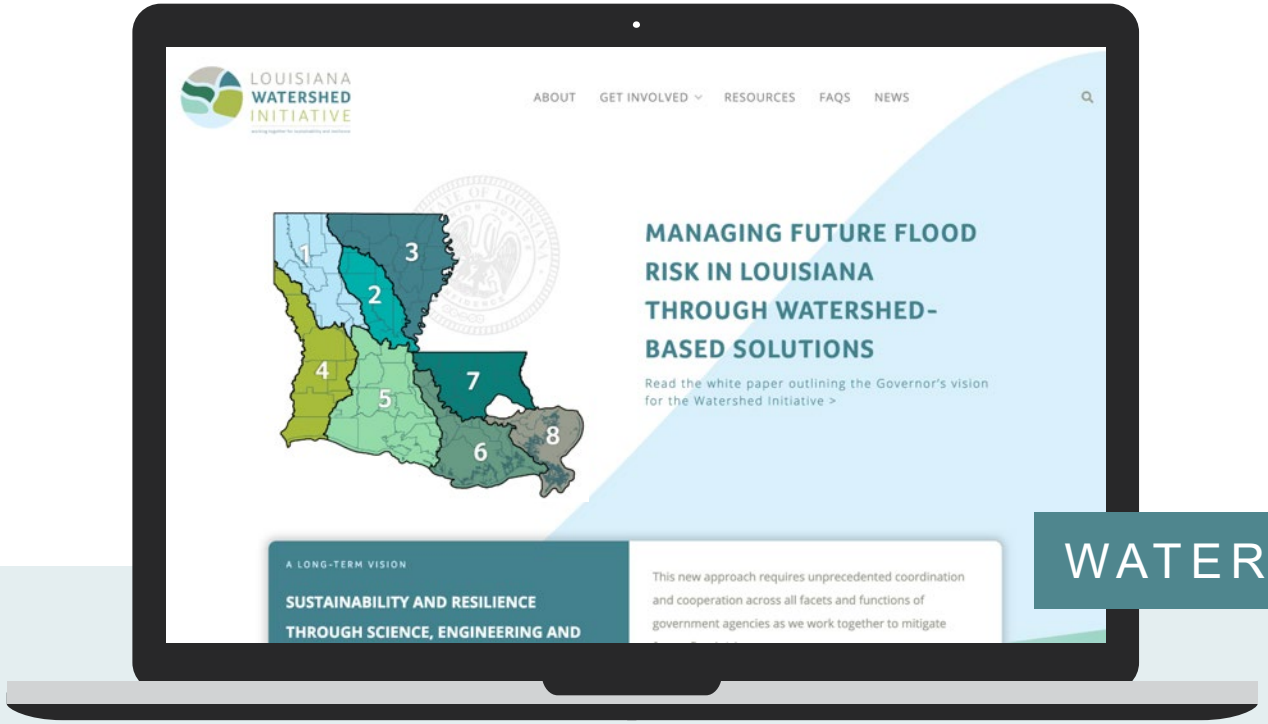
THANK YOU



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Model Use: Next Steps

- Complete the planning
  - Input is encouraged and needed. Please contact:

    David Cody
    Henry Consulting, LLC
    David.Cody@HenryConsulting.com
    (504) 529-9890
- Launch date depends on Model release.
  - Training and Library to follow.

Questions

Questions

- Open Discussion on material today and model use in your community.
- Lead off questions:
    1. What do you see your community using the modeling for?
    2. What questions do you have about modeling?
    3. What questions do you have about data collection?

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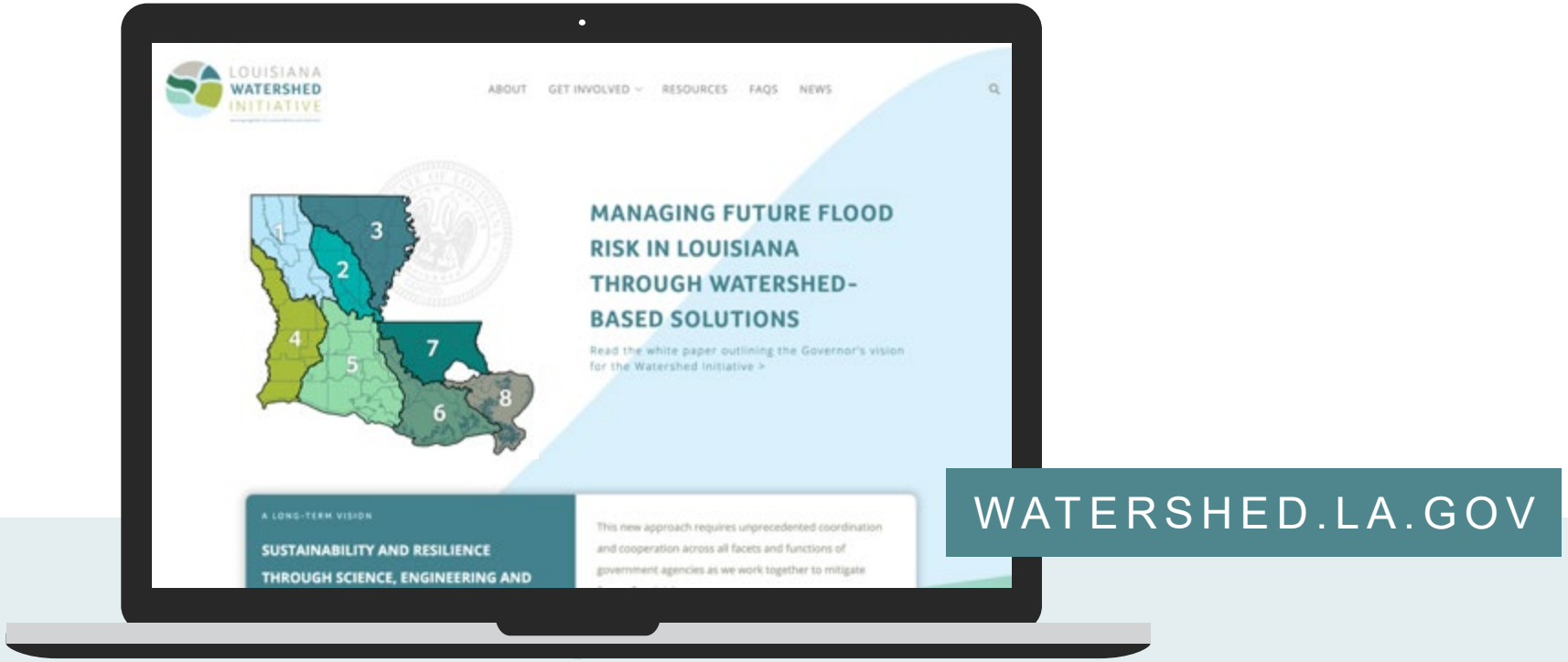

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