

Unit 06: Current System Developments for DSS-WISE 4.0

WEB-BASED FLOOD INUNDATION MODELING WITH DSS-WISE WEB

A SHORT COURSE ON RECENT UPDATES WITH HANDS-ON TRAINING



Developed by

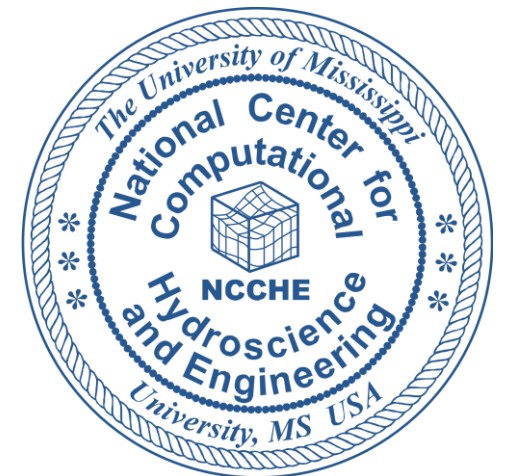
NATIONAL CENTER FOR COMPUTATIONAL
HYDROSCIENCE AND ENGINEERING
THE UNIVERSITY OF MISSISSIPPI

For

FEDERAL EMERGENCY
MANAGEMENT AGENCY



FEMA



Technical Workshop

September 25th, 2025

*Huntington Convention Center of Cleveland
1 St Clair Ave NE, Cleveland, OH 44114*

Agenda

| Time | Topic |
|---------------------|--|
| 8:30 AM – 9:20 AM | Introduction/Overview of DSS-WISE Web |
| 9:20 AM – 9:45 AM | Simulation scenario setup and data entry |
| 9:45 AM – 9:55 AM | SHORT 10 MINUTE BREAK |
| 9:55 AM – 10:20 AM | Understanding simulation outputs |
| 10:20 AM – 11:20 AM | Hands-on exercises using the new system features |
| 11:20 AM – 11:30 AM | SHORT 10 MINUTE BREAK |
| 11:30 AM – 11:45 AM | Tips and Tricks/Advanced Techniques |
| 11:45 AM – 12:15 PM | Current System Developments for DSS-WISE 4.0 (Beta Version Jan. 2026) |
| 12:15 PM – 12:30 PM | Questions / Discussion |

Upcoming Enhancements and Improvements



Simulation & Analysis

- Levee Breach Calculator
- Cascading dam failures
- Culvert flow modeling
- HCOM enhancement



Data Integration & Access

- Improved USGS 3DEP data
- Load past simulation results on Viewer
- User-supplied data overlays
- Inflow hydrographs & USGS gauge integration
- HCOM updated to use 2020 Census Block Data



System & Reporting

- Hybrid cloud compute capability (current/future)
- Improved simulation report maps
- High-priority simulations

Acknowledgements: Funded by ERCD, DHS S&T, and FEMA NDSP inter-agency agreement.

New Interface (Scenario-First Setup)

Users now **choose a scenario type** first (e.g., sunny-day dam breach, cascading failures, levee breach).

The interface then **prompts only the relevant setup elements** for that scenario.

Benefits:

- Guided setup
- Only see inputs needed for the chosen scenario
- workflows tailored to event type

Choose Scenario Guide

Sunny-day dam breach with reservoir Simple setup for sunny-day dam breach events

Sunny-day dam breach hydrograph Dam breach setup without needing to model the reservoir

Wet-day dam breach with inflows Wet-day dam breach with hydrograph inflows

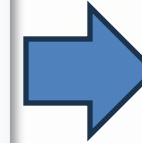
Cascading dam failures Multiple dam breach events with triggers

Levee breach Hydrograph-type release from an embankment

Inflows Only For non-dam related flooding

Advanced / All Options Multi-hazard or advanced analysis presenting all setup options

[Continue](#)



Sunny-day scenario

Pro Mode [Reset](#)

[Dam Search Tool](#)

Reservoir Setup [Add Dam](#) [Configure](#)

Dam 1 [Configure](#) [X](#)

Breach Setup [Configure](#)

▸ Levees Optional [Add](#)

▸ Culverts Optional [Add](#)

▸ Bridges to Remove Optional [Add](#)

▸ Observation Lines Optional [Add](#)

Simulation Parameters [Configure](#)

[Review and Submit](#)

Levee Breach Hydrograph Calculator

BETA DSS-WISE Web System Marcus McGrath

Breach Center Point

Information
Selected levee: Level 1

Trigger Type
Time Depth Elevation

Trigger Time (hr)
0

Breach Type
Physical Hydrograph

Hydrograph Mode
Automatic Manual

- Uses an **Artificial Neural Network (ANN)** to estimate levee breach outflow from **soil properties, embankment geometry, and flood conditions**
- Resulting hydrograph is released downstream of the selected breach location

Event Duration (hr)
 0.5 hours
 1 hour
 3 hours
 6 hours
 12 hours
 24 hours
 48 hours
 72 hours

Levee Height (ft)
30.2

Upstream Slope (H:V)
3

818
Clay Content Fraction
35.4%

Breach Outflow Hydrograph

Discharge (cfs)

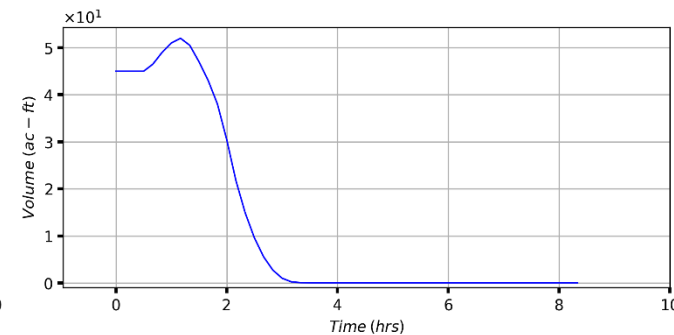
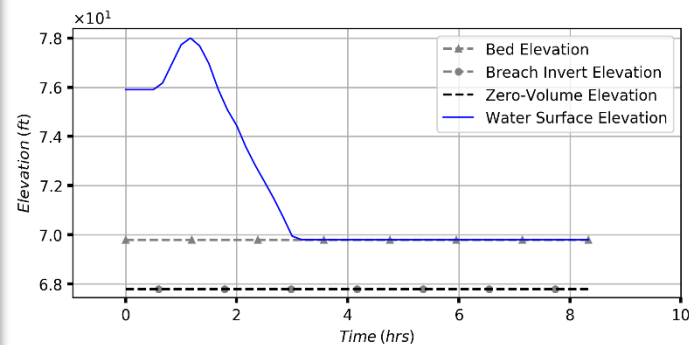
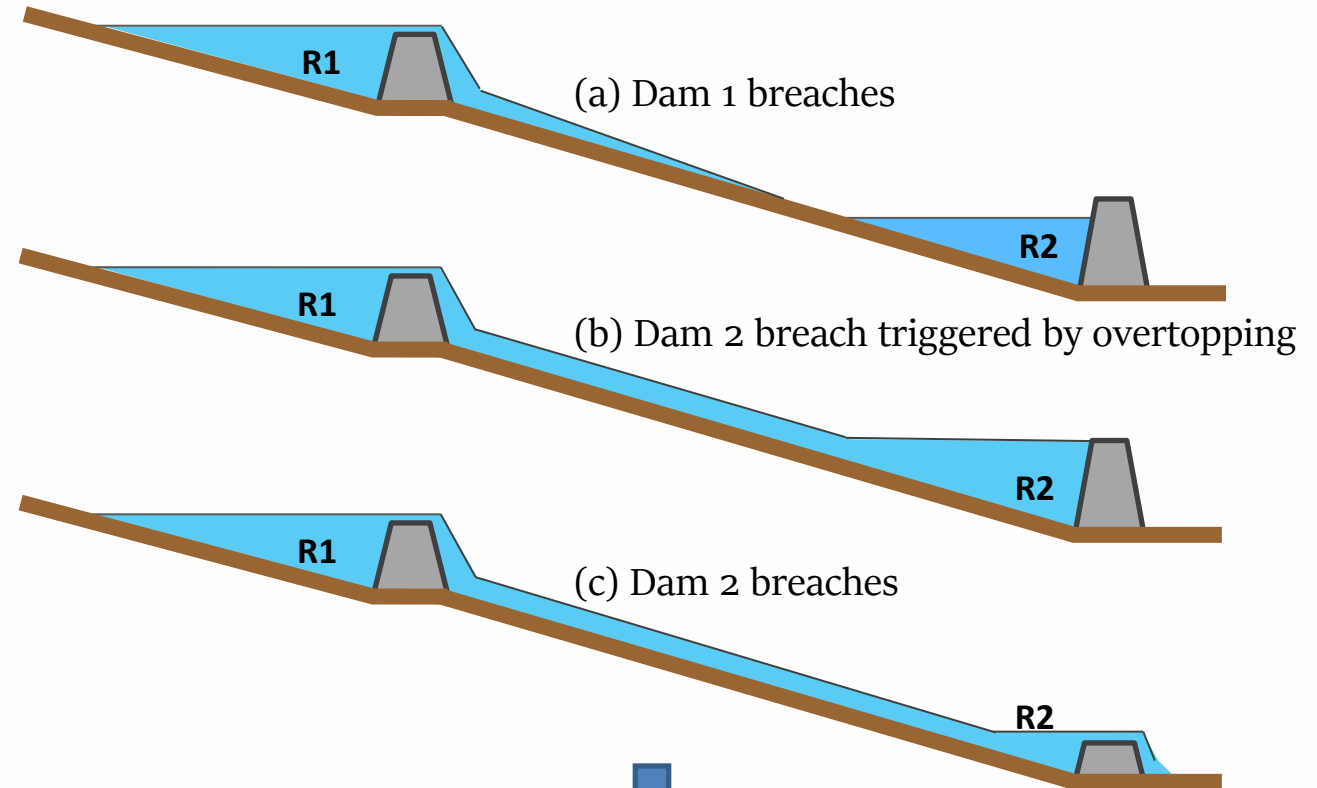
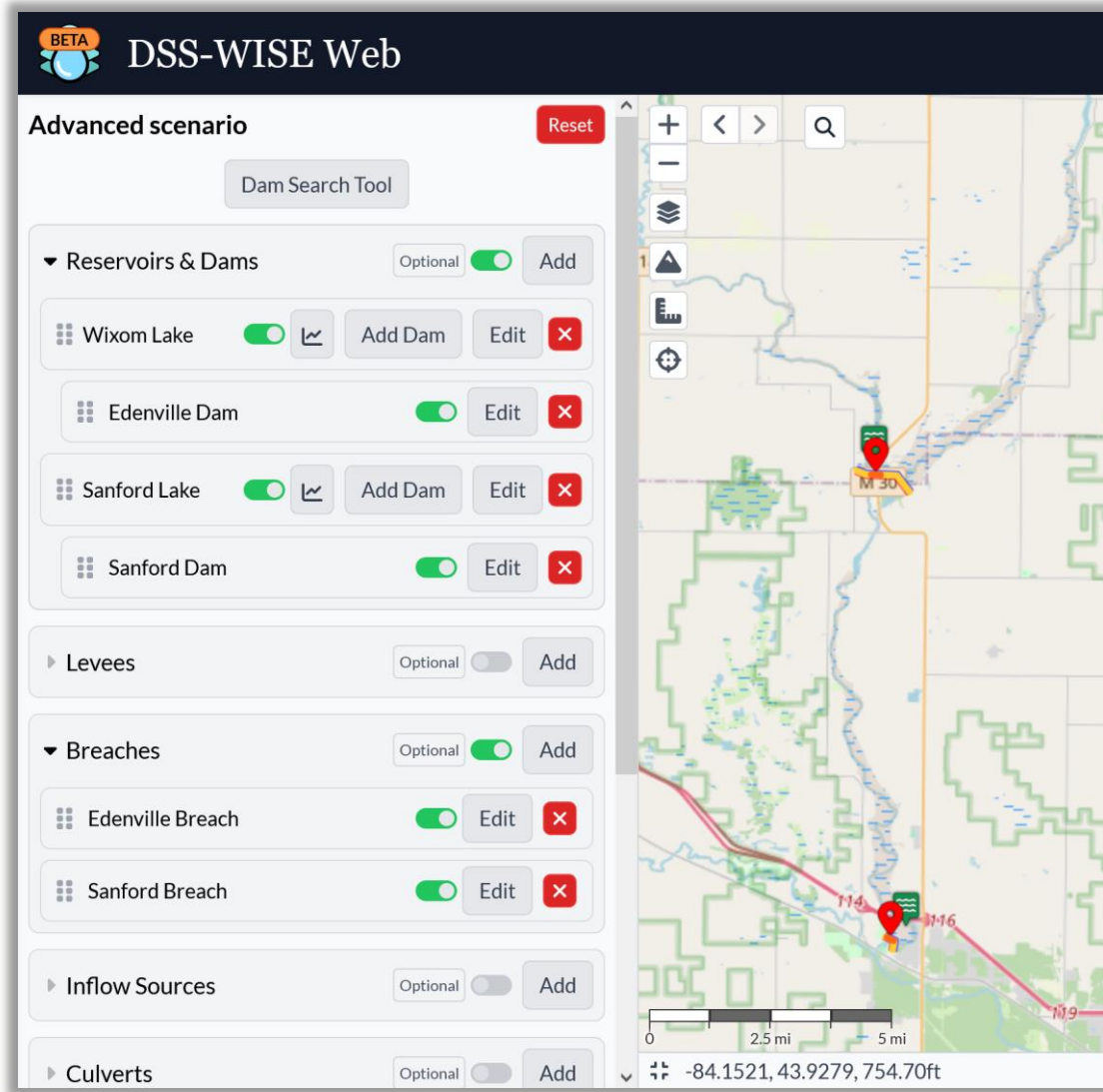
Time (hr)

Estimated breach width: 899.77 ft

Done

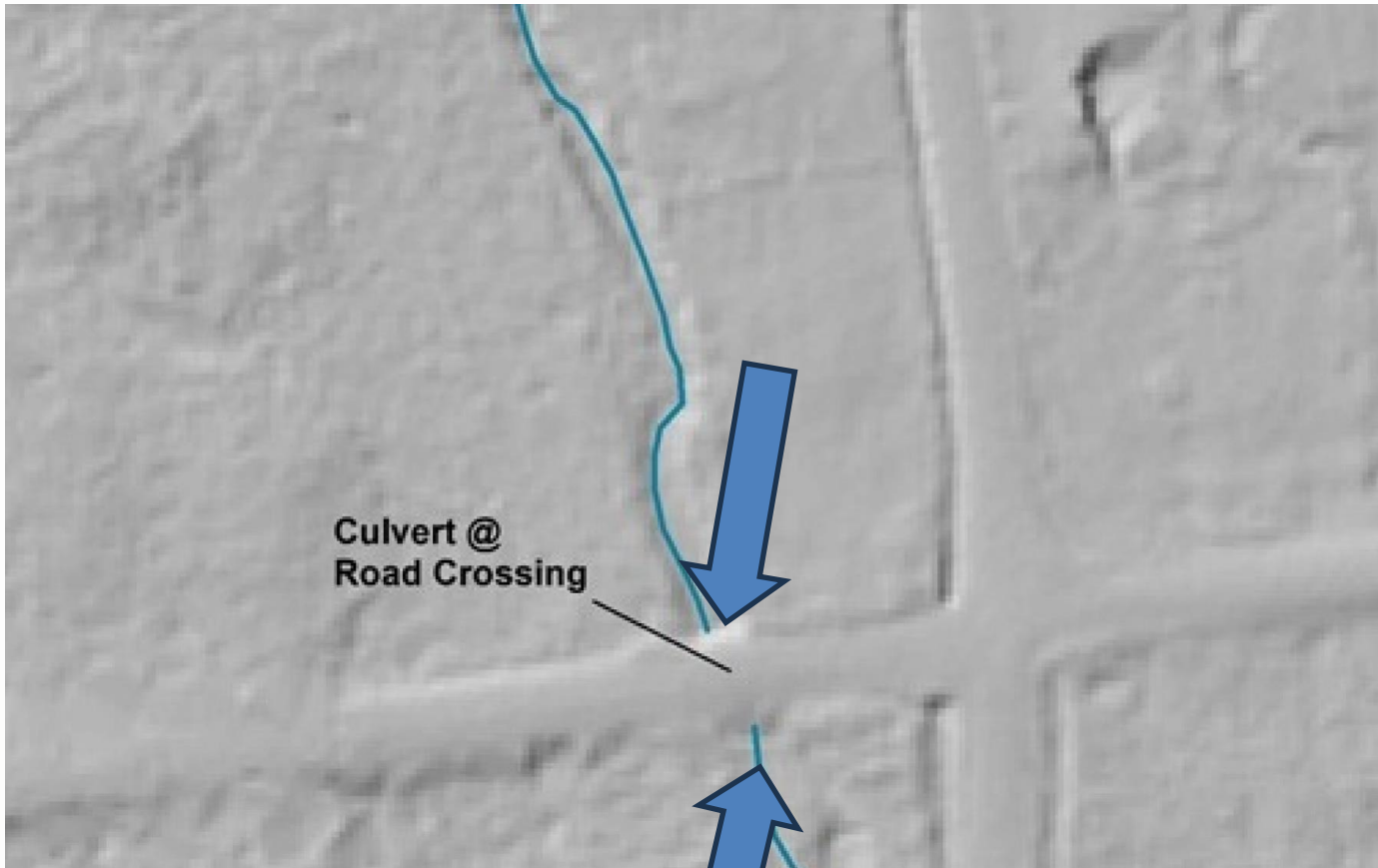
Cascading dam failures

Develop the ability to model cascading dam failures



Modeling flow through culverts

Enhance the way simulations model culverts by using a new method.



User can select upstream and downstream locations for hydraulic connectivity

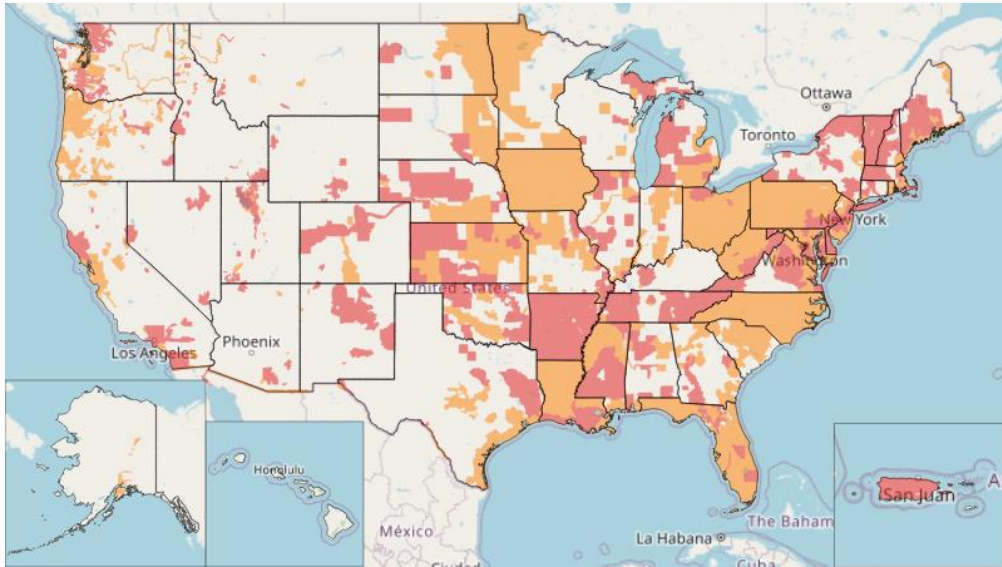


Culvert parameters govern flow between the two sides

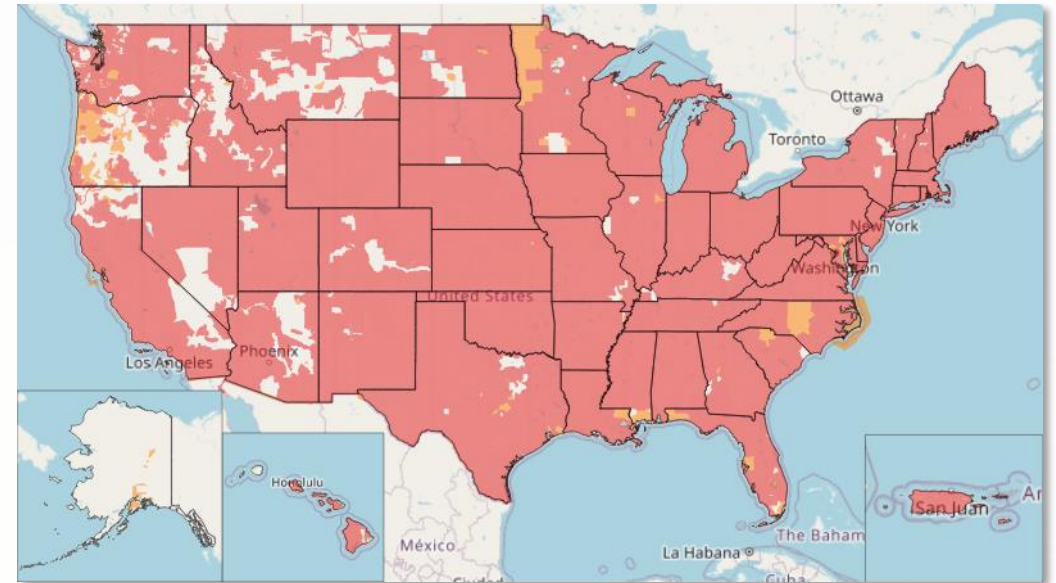
Improved USGS 3DEP Data and Processing

Develop the capability to better utilize the USGS 3D Elevation Program's (3DEP) 1-meter DEM dataset to generate the base level DEMs for simulations on the fly

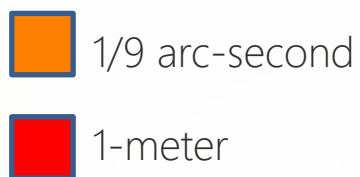
Current high-resolution DEM data



Available high-resolution DEM data



Current 1m data released: **107,973** tiles totaling **26.6+ TB**

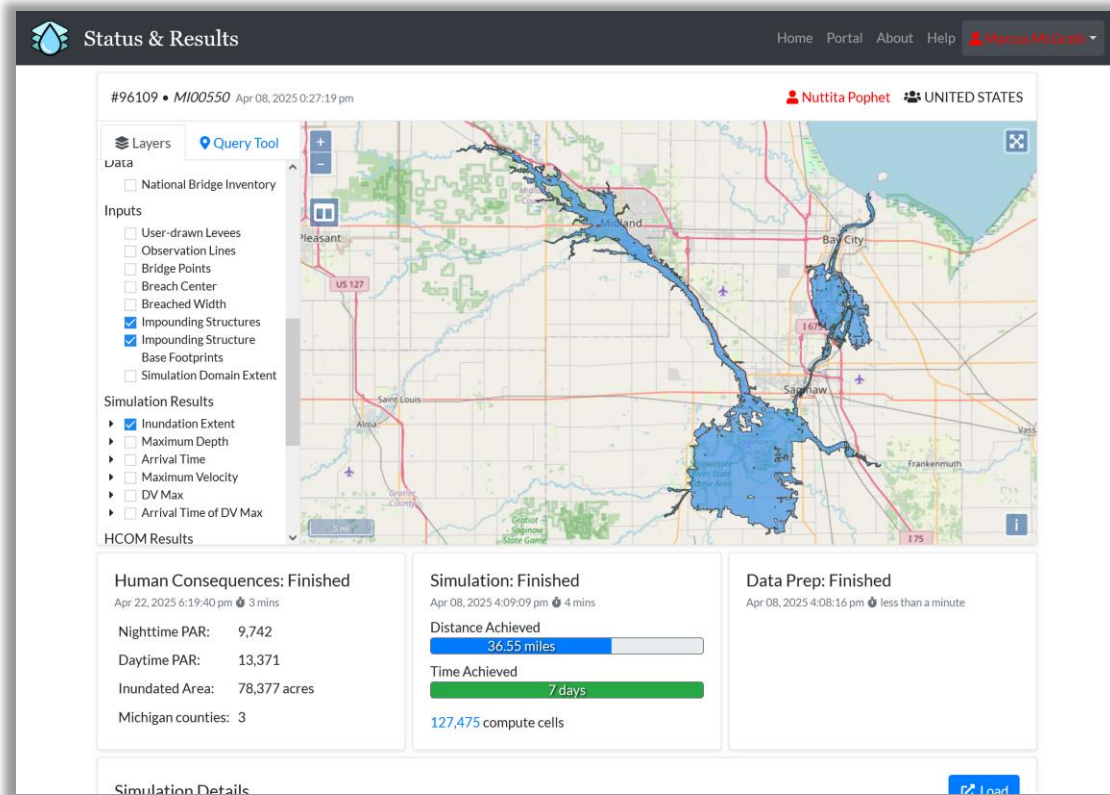


- Newly-added 1-meter USGS 3DEP data will be processed and imported to the system on a frequent basis
- Cloud-native data store to enable hybrid cluster integration and modular decoupling of system components

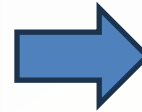
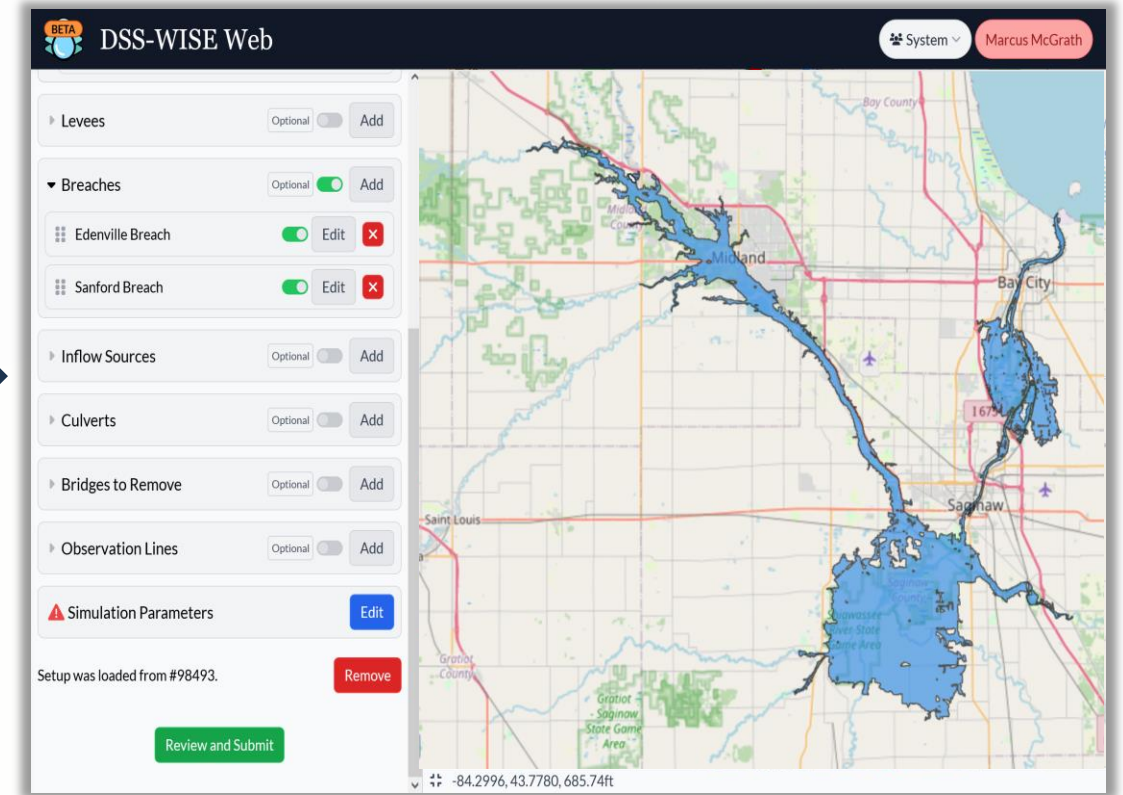
Load past simulation results on Viewer

Develop the ability for a user to load the results of a previous simulation on the Viewer during setup.

Status & Results Page



DSS-WISE Web Viewer



Results/errors from previous simulations will be visible during setup



Reduces user frustration



Empowers users to extract the most value from their simulation results

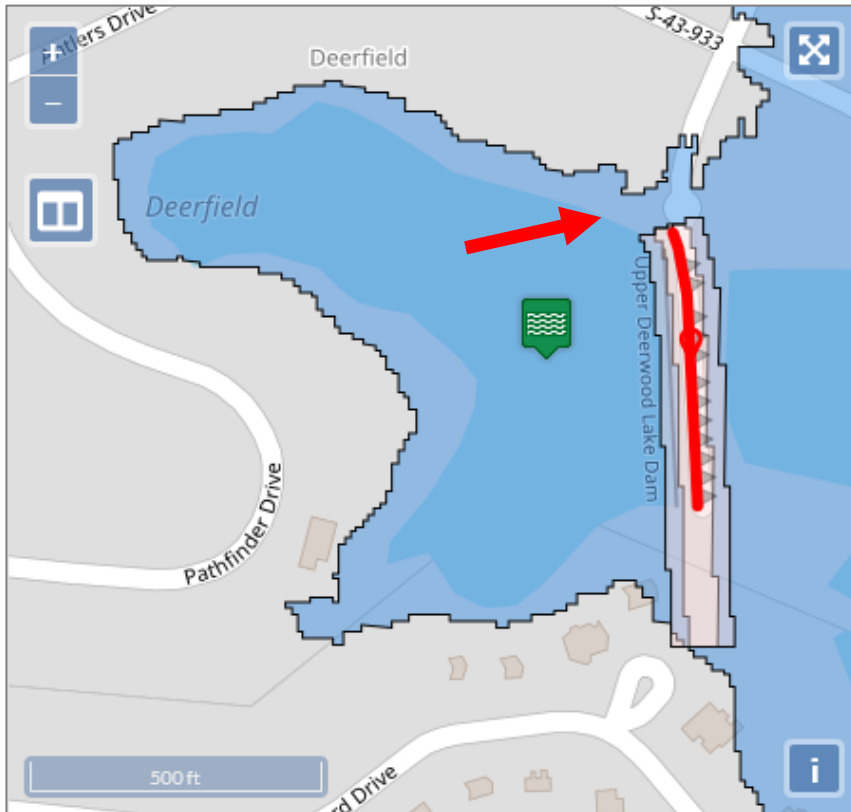


Improves user awareness/understanding of the model

Load past simulation results on Viewer

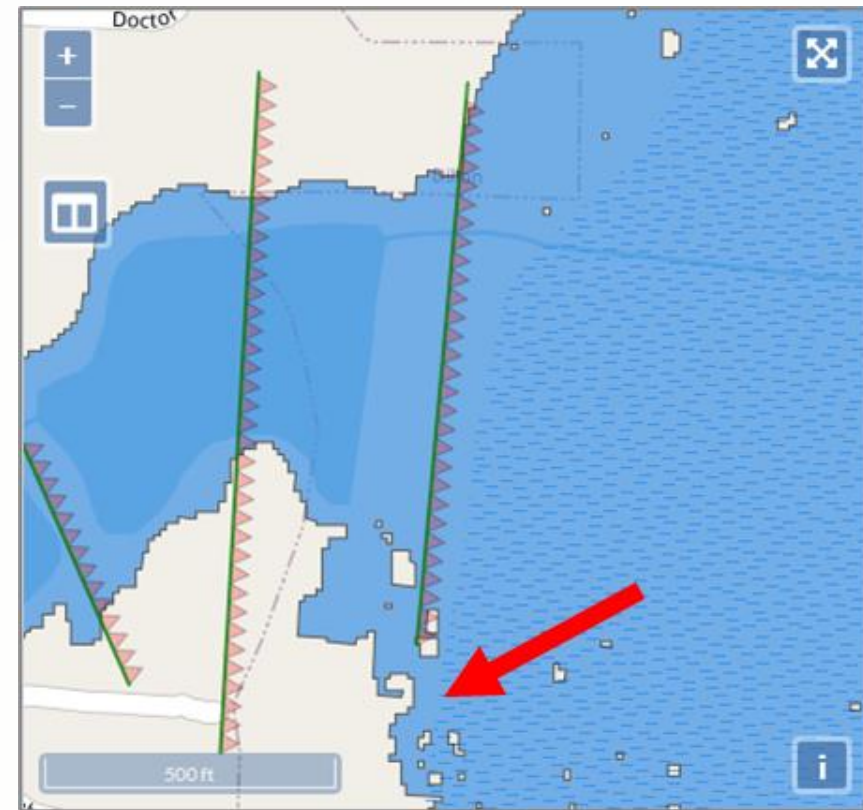
Examples of how previous results guide setup in the Viewer.

Extend the dam to fully contain the reservoir



Flood extent shows where water escapes, guiding dam extension.

Extend the observation line to capture the full flood cross-section

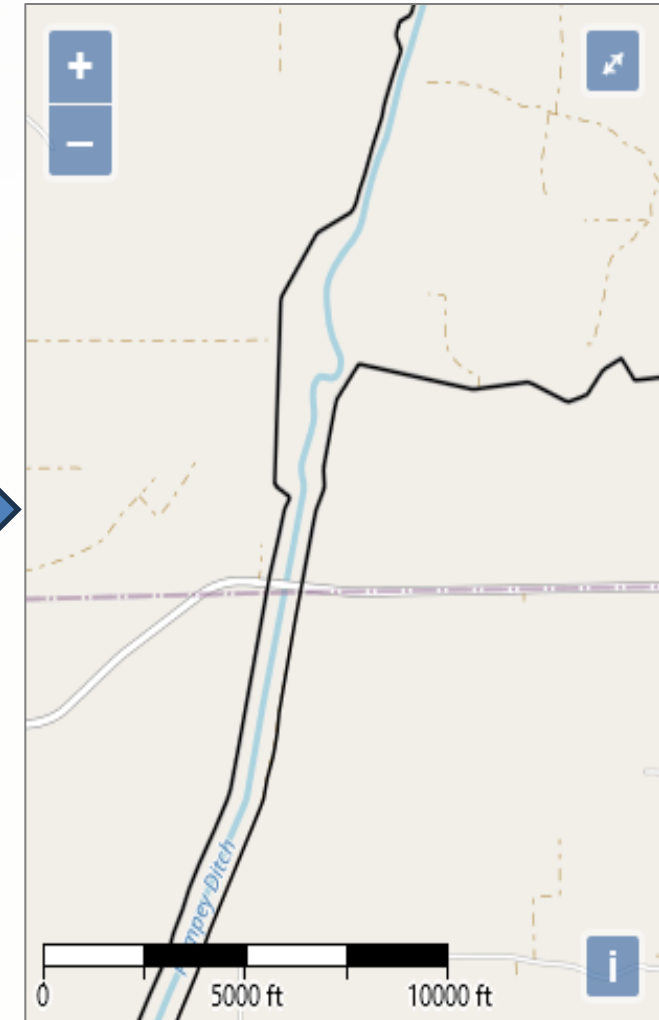
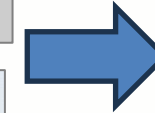
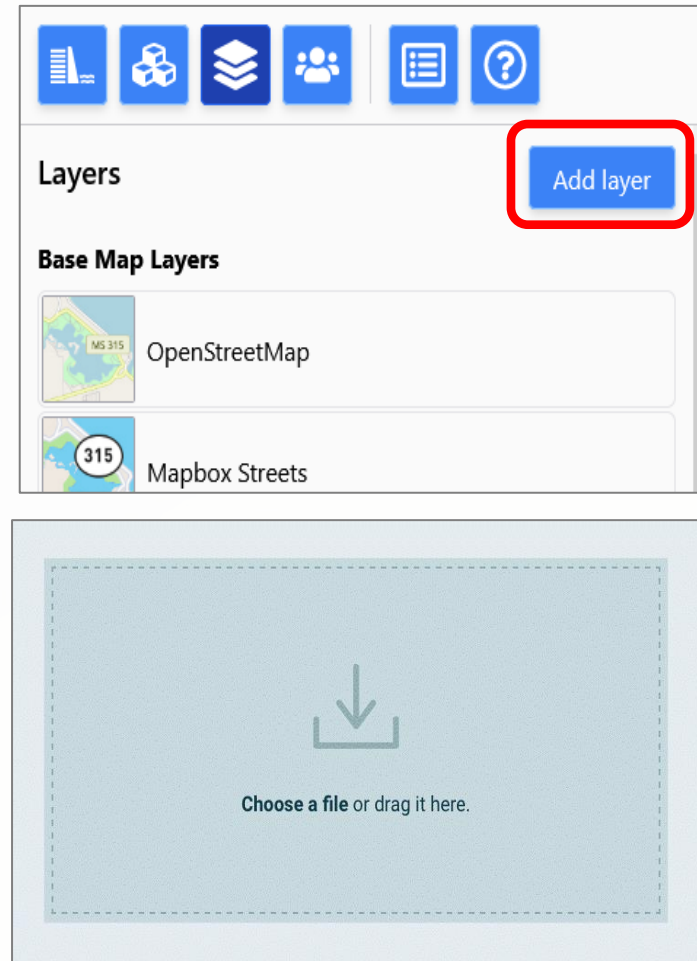


Flood extent highlights where coverage is incomplete, guiding line adjustment.

User-supplied data overlays during simulation setup

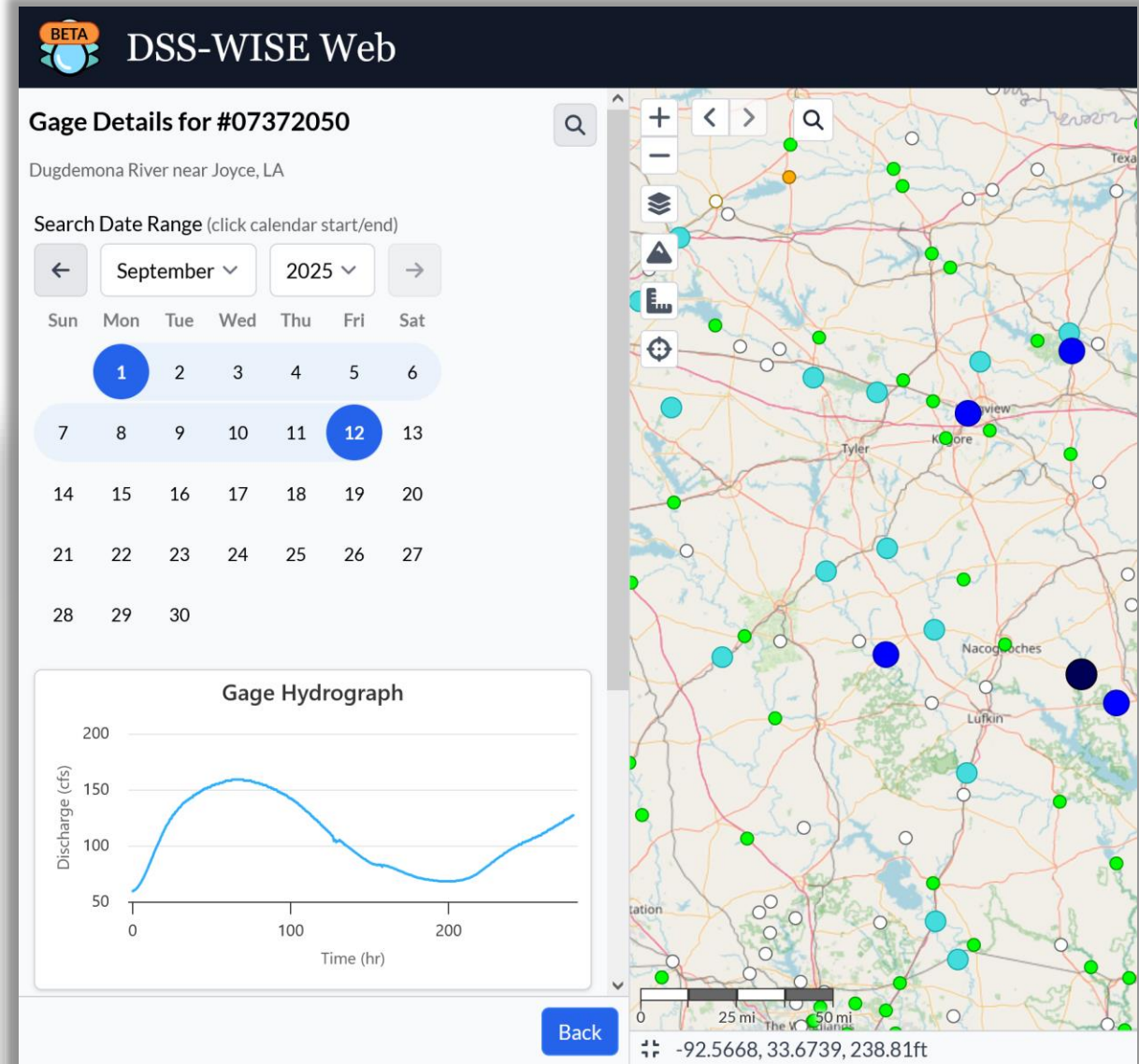
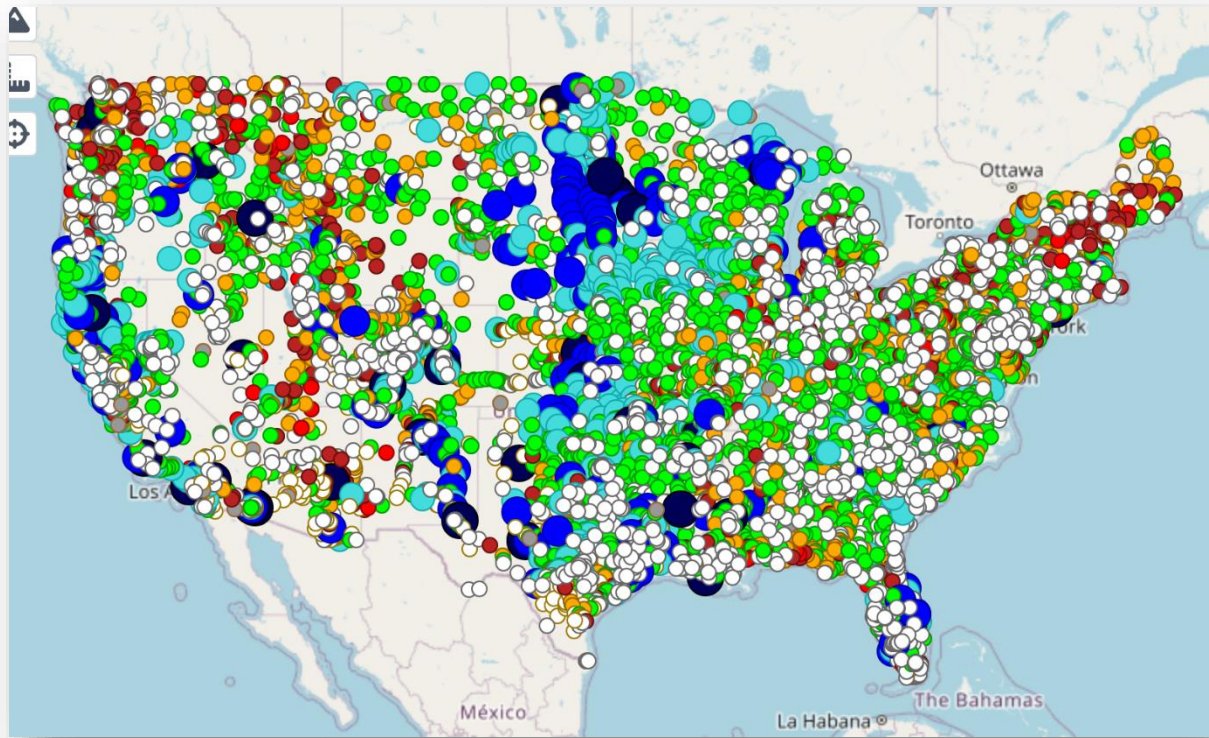
Develop the capability for users to upload their own GIS overlay data onto the Viewer during simulation setup.


- “Bring your own data” approach
- Enhance awareness and understanding



Inflow hydrographs & USGS stream gauge integration

Develop the capability for users to automatically import this USGS stream gage data for use in their simulations instead of having to obtain it manually.



 search for the stream gauge



view and select a window of time for historical discharge data

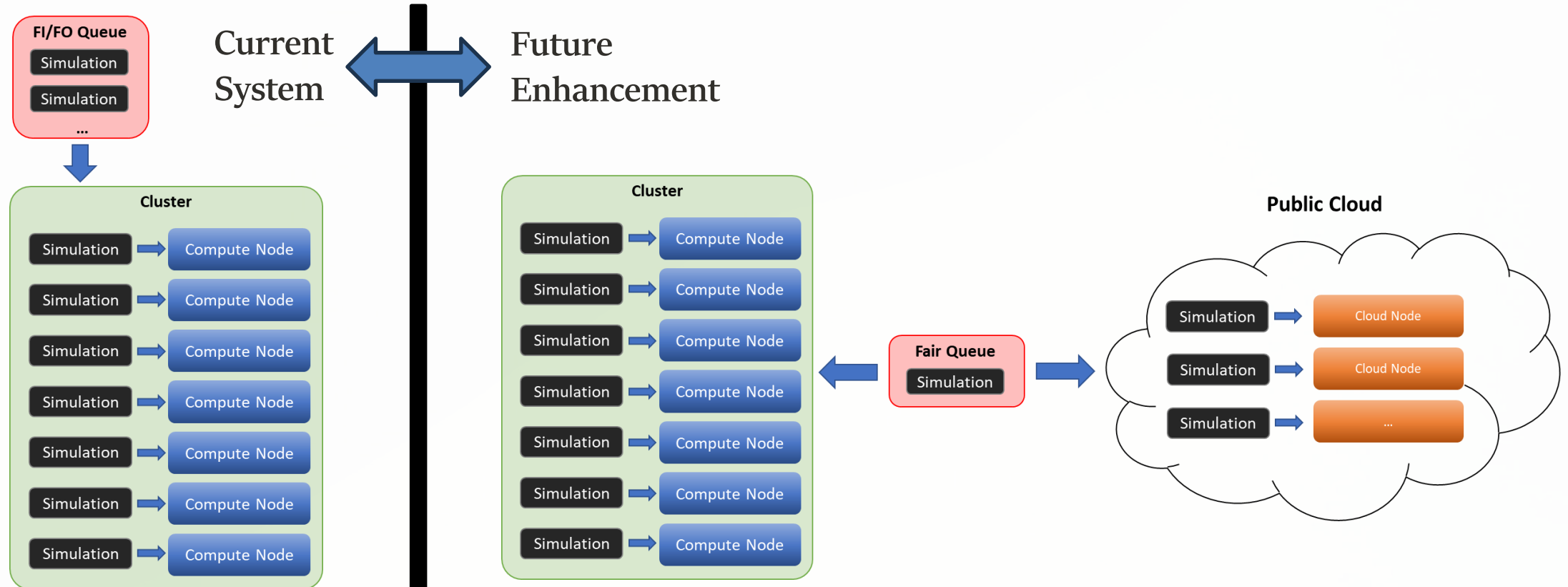


import it as a new inflow hydrograph

Hybrid cloud compute capability

current and future systems

Develop the capability to utilize a hybrid cloud solution for DSS-WISE Web simulations



Currently, simulations wait in a queue until resources become available

- Cloud nodes will be created on-demand to **minimize queue wait time**.
- High-priority simulations are assigned to fastest possible instances.
- **Fair queueing** via dynamic reordering and heuristics

Improvements to maps in simulation report product

Improve map image outputs for PDF report for increased spatial awareness and fidelity.

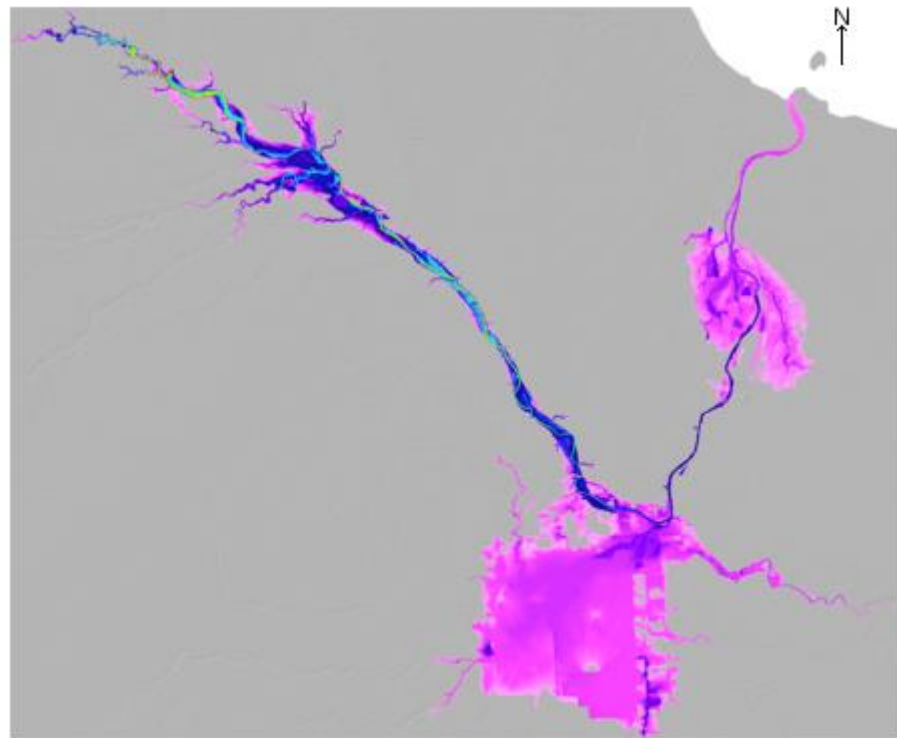
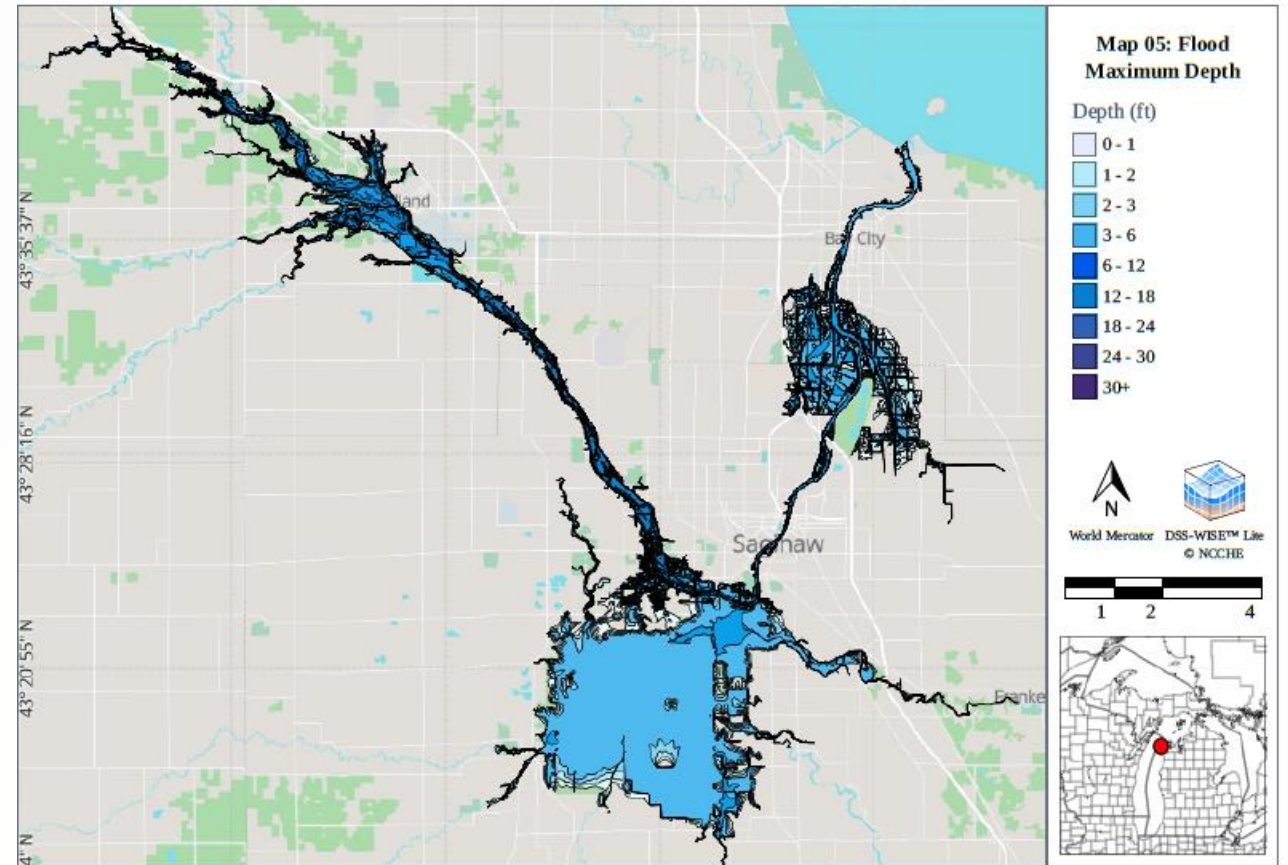


Image Dimensions: N-S: 31,791 miles E-W: 38,686 miles

Figure 5. Maximum Flood Depth Map.



Maximum Flood Depth

Improvements to maps in simulation report product

Improve map image outputs for PDF report for increased spatial awareness and fidelity.

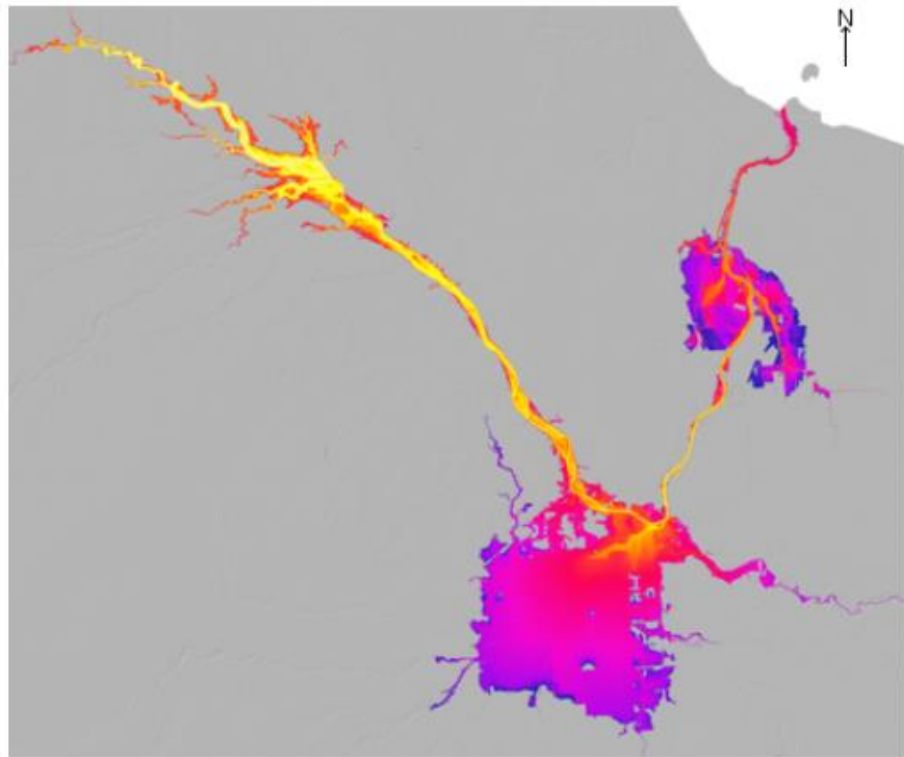
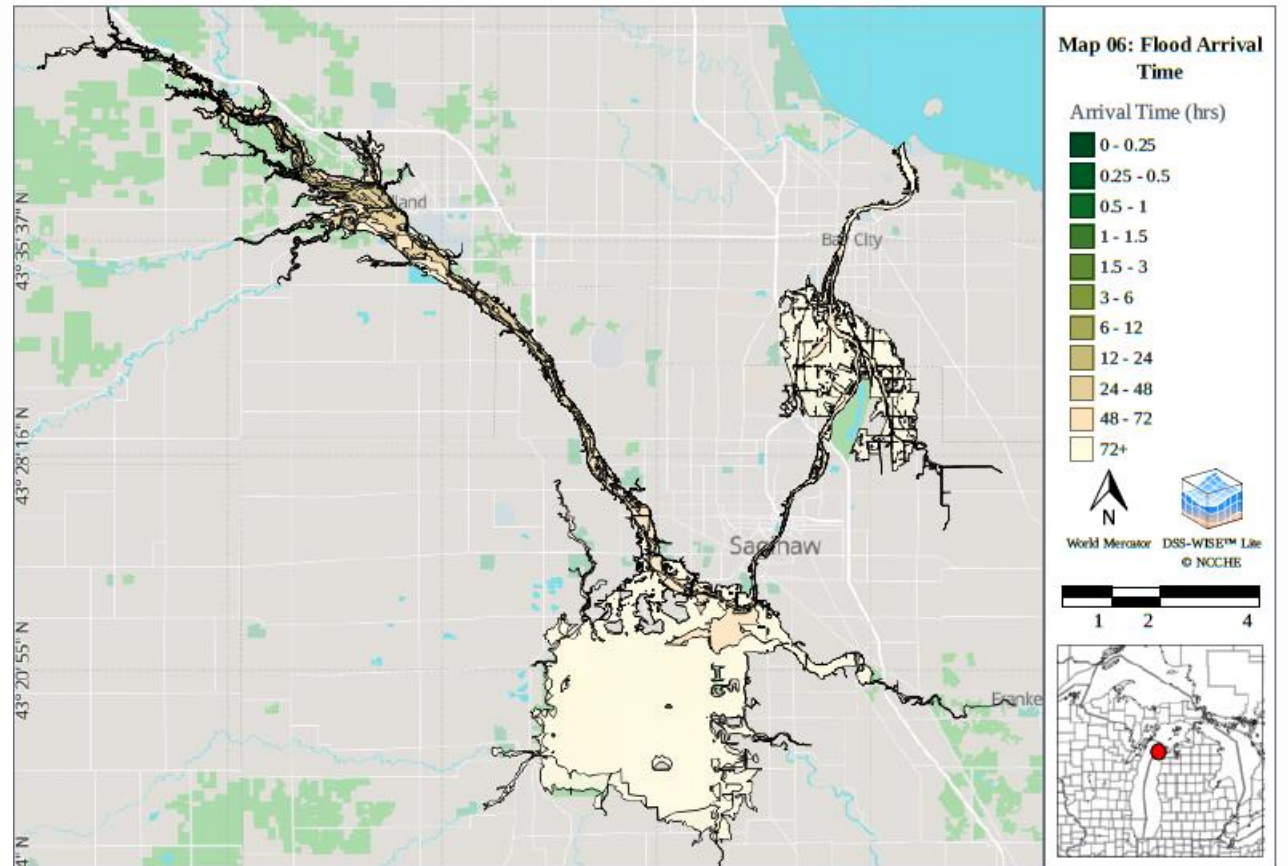


Image Dimensions: N-S: 33.205 miles E-W: 39.619 miles

Figure 6. Flood Arrival Time Map.



Flood Arrival Time

High-priority simulations

Priority ?

High Priority
Schedule ahead of all other simulations
Please reserve for time-sensitive circumstances

Normal Priority
Most simulations fall into this category

Low Priority
Schedule after all other simulations

Develop the ability for privileged users to submit high-priority simulations that run in the cloud on the fastest available compute nodes

- Users will be able to request high-priority status for emergencies without requiring administrator intervention
- Simulation request is then routed to the fastest available cloud compute node

Potential Loss of Life Module

PLL Introduction and Background

The potential loss of life module is a new feature integrated into the Decision Support System for DSS-WISE web platform.

The purpose of this module is to assist dam safety professionals and emergency managers in assessing the human consequences of dam failure scenarios.

The inclusion of PLL extends the capabilities of DSS-WISE by directly estimating the potential loss of human life resulting from a flood event.

Background:

The methodology behind the PLL module is based on the Reclamation Consequence Estimating Methodology, which was developed through analysis of numerous historical dam-break and extreme flooding events.

The RCEM approach recognizes three key factors influencing life loss:

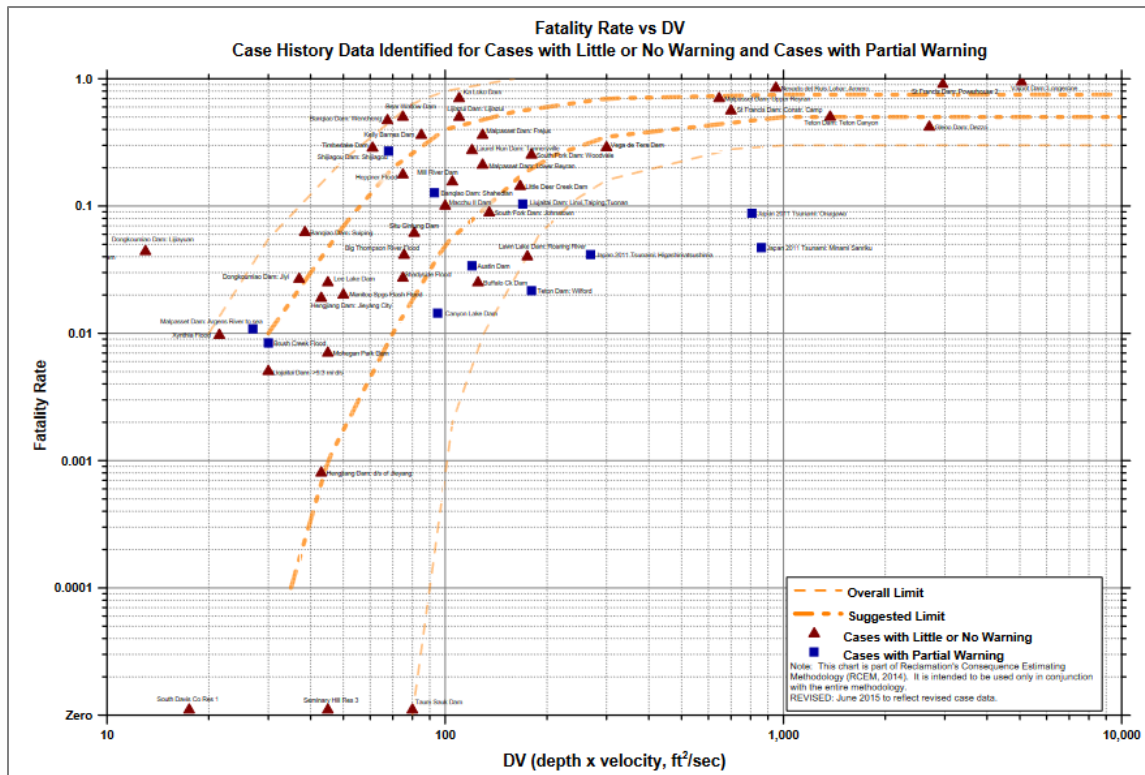
- Flood severity
- Warning time
- Degree of Community understanding

Using these factors RCEM developed two empirical charts for selecting fatality rates:

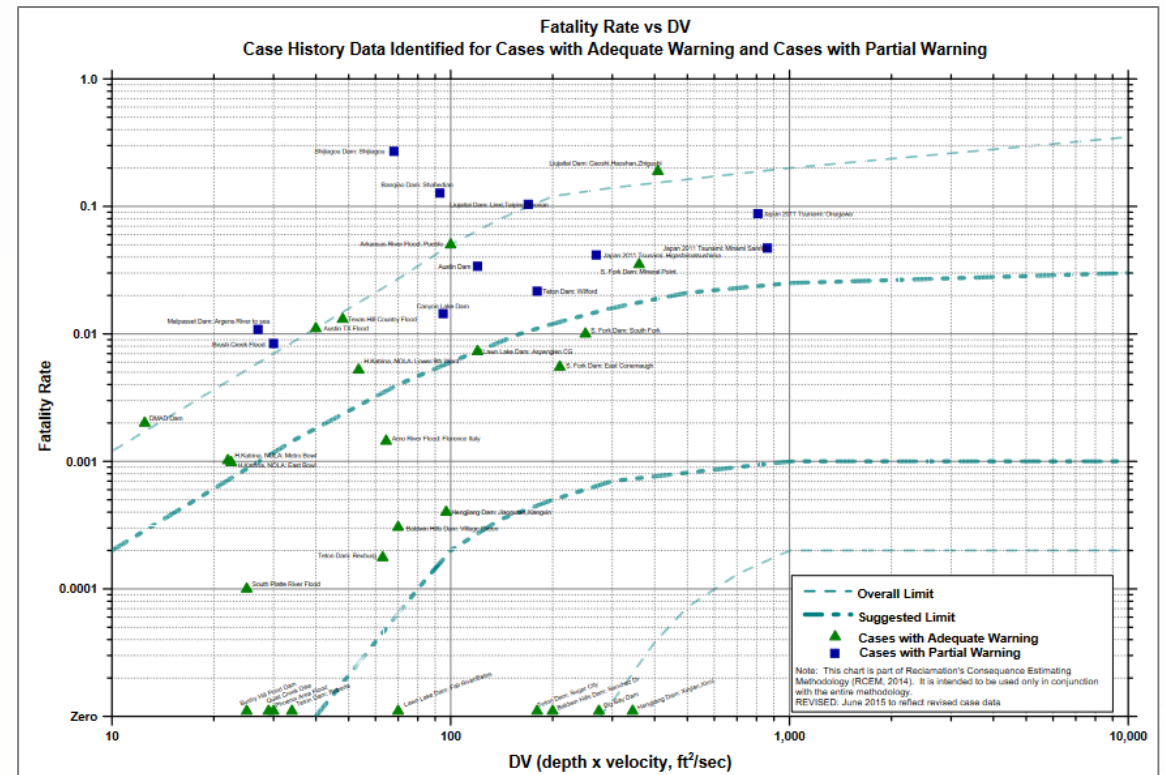
- Fatality Rate versus Depth-Velocity for little to no warning
- Fatality rate versus Depth-Velocity for adequate warning

RCEM Fatality Rate Curves

Fatality Rate vs DV
(Little or No Warning and Partial Warning)



Fatality Rate vs DV
(Adequate Warning and Partial Warning)



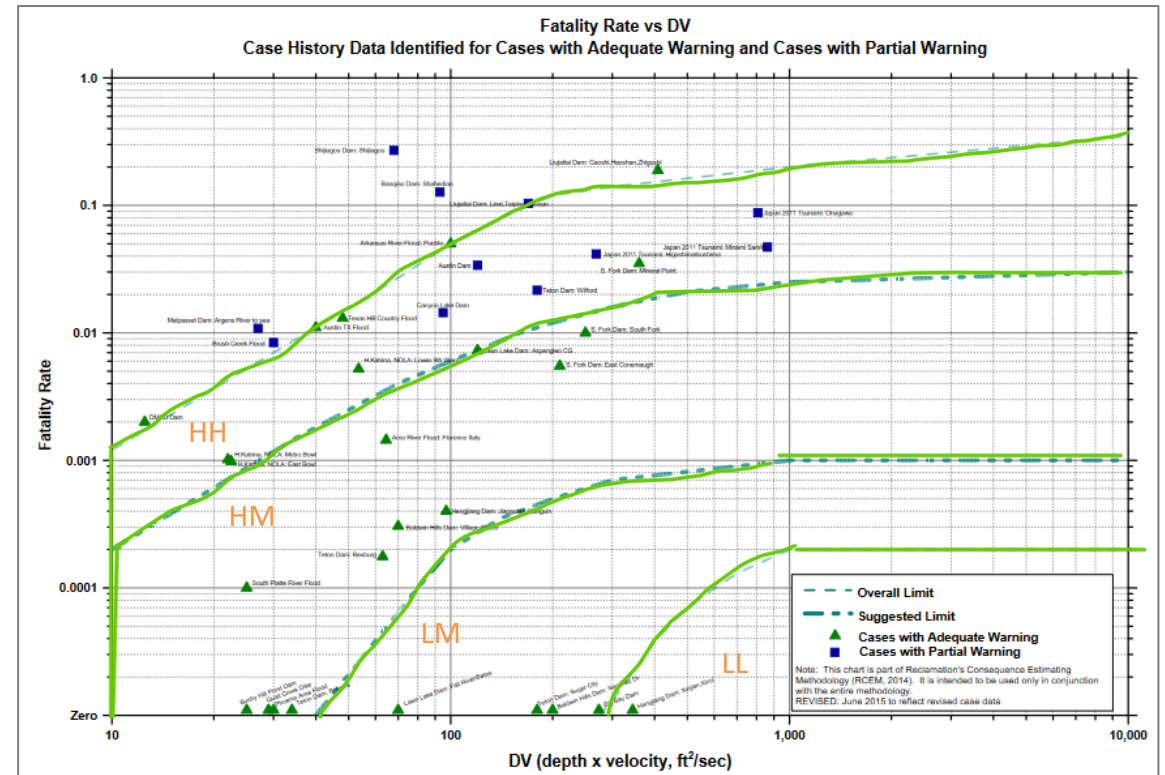
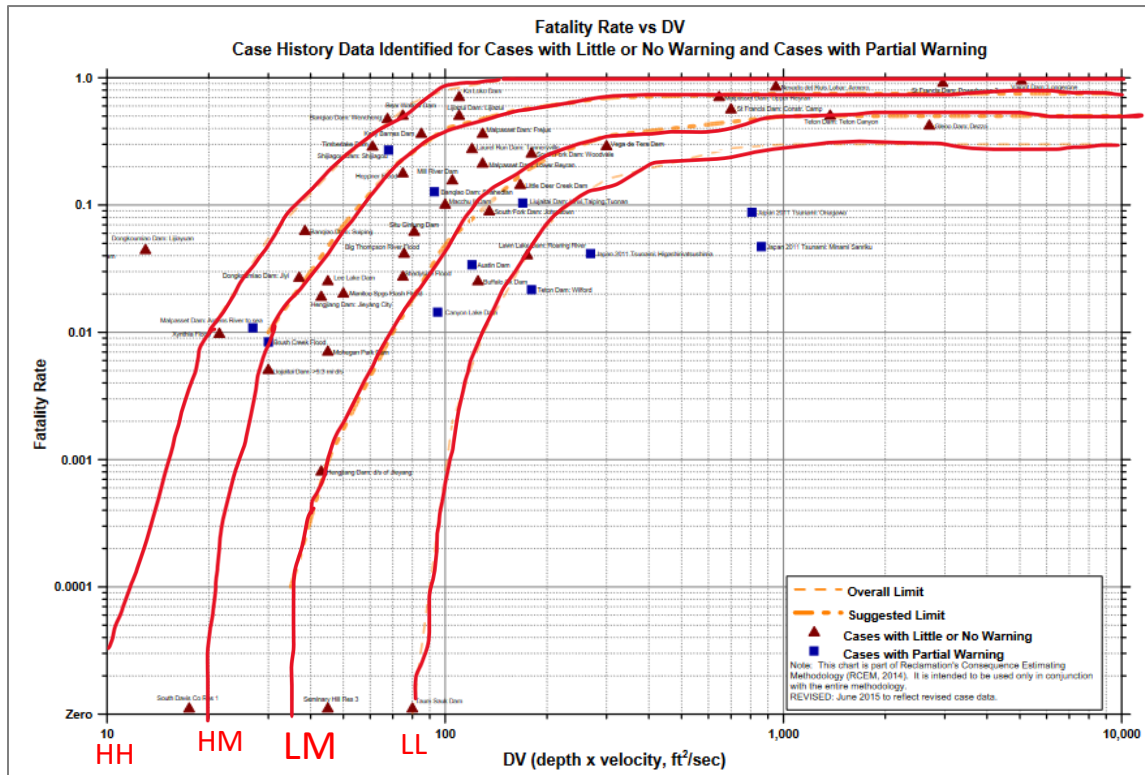
- USBR (2015) methodology
- Users will receive a range of estimated fatality rate and potential Loss of Life (LOL) information for a variety of severity and warning times

PLL Methodology

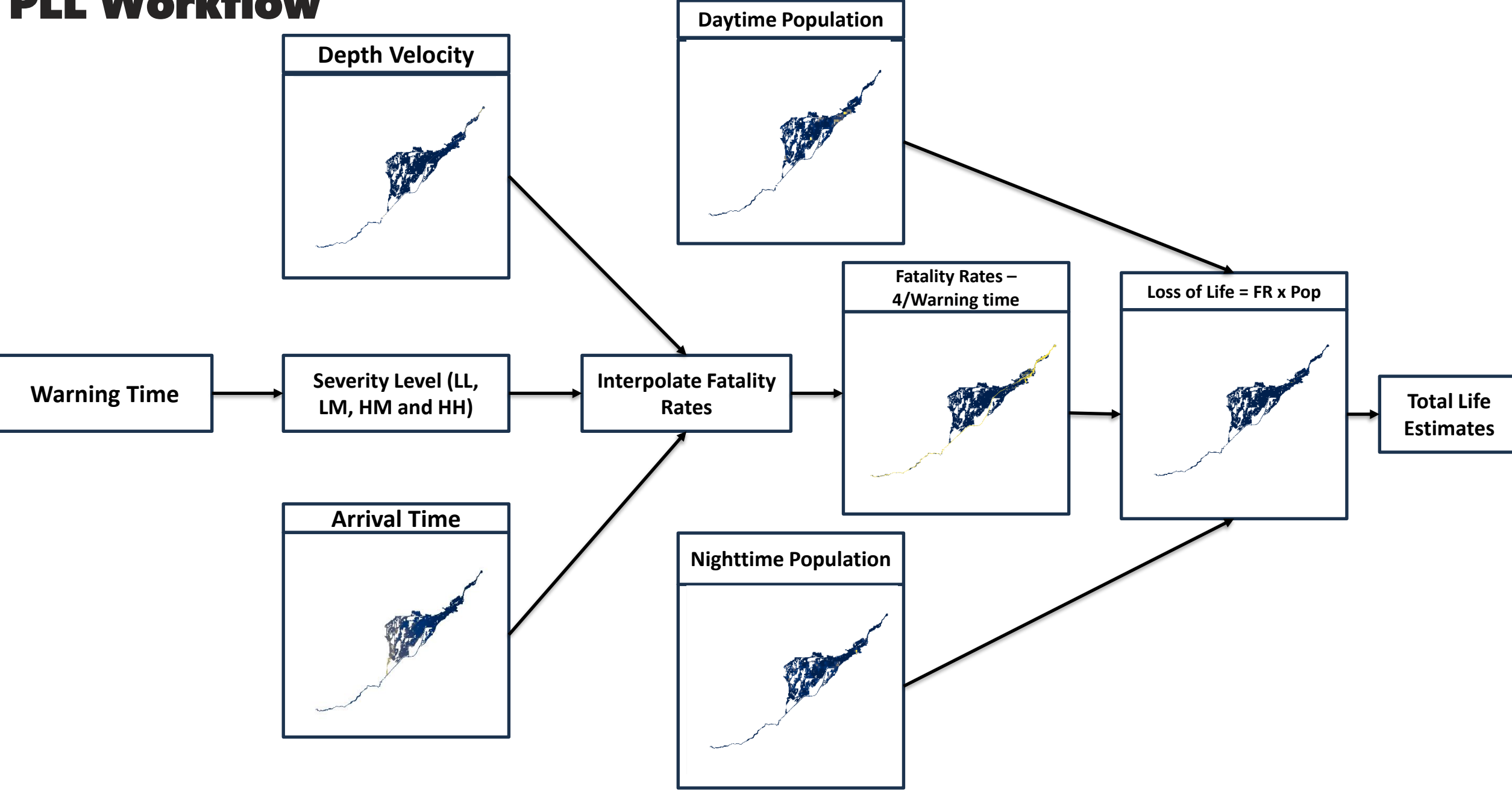
In our implementation, the fatality rate boundaries identified in the RCEM were refined into four severity ranges:

- Low-Low (LL) severity, Low-Medium (LM) severity, High-Medium (HM) severity, High-High (HH) severity

For each of these ranges, depth-velocity thresholds were determined, and corresponding fatality rate curves were defined separately for both Little to no Warning and Adequate Warning cases.



PLL Workflow



PLL Analysis Outputs

The output to the user is a comprehensive set of loss of life estimates for the given flood scenario. The results are provided in a tabular and report formats, enabling dam safety officials and emergency planners to quickly review the sensitivity of loss of life estimates.

Example: PLL estimates for warning time = 15 mins

| | A | B | C | D | E |
|----|---|---|-----------|-----------|-----------|
| 1 | PLL Estimates for Warning time = 15 mins | | | | |
| 2 | | | | | |
| 3 | Flood Time | Daytime severity total estimates | | | |
| 4 | (Hrs) | LL | LM | HM | HH |
| 5 | 0.25 | 591 | 634 | 727 | 845 |
| 6 | 0.50 | 680 | 731 | 855 | 1002 |
| 7 | 0.75 | 769 | 828 | 983 | 1159 |
| 8 | 1.00 | 858 | 925 | 1111 | 1316 |
| 9 | 2.00 | 947 | 1022 | 1239 | 1473 |
| 10 | 3.00 | 1036 | 1119 | 1367 | 1630 |
| 11 | 4.00 | 1125 | 1216 | 1495 | 1787 |
| 12 | 6.00 | 1214 | 1313 | 1623 | 1944 |
| 13 | 12.00 | 1303 | 1410 | 1751 | 2101 |
| 14 | 18.00 | 1392 | 1507 | 1879 | 2258 |
| 15 | | | | | |
| 16 | Flood Time | Nighttime severity total estimates | | | |
| 17 | (Hrs) | LL | LM | HM | HH |
| 18 | 0.25 | 150 | 203 | 278 | 359 |
| 19 | 0.50 | 182 | 267 | 311 | 410 |
| 20 | 0.75 | 214 | 331 | 344 | 461 |
| 21 | 1.00 | 246 | 395 | 377 | 512 |
| 22 | 2.00 | 278 | 459 | 410 | 563 |
| 23 | 3.00 | 310 | 523 | 443 | 614 |
| 24 | 4.00 | 342 | 587 | 476 | 665 |
| 25 | 6.00 | 374 | 651 | 509 | 716 |
| 26 | 12.00 | 406 | 715 | 542 | 767 |
| 27 | 18.00 | 438 | 779 | 575 | 818 |

