Two-Dimensional Modeling and Design for Resilience and Sustainability

Art Parola, Jeong Park, Clayton Mastin, William Vesely, Jesse Robinson, and Michael Croasdaile
University of Louisville

EcoStream 2018

Ashville, NC

August 16, 2018

UNIVERSITY OF LOUISVILLE
STREAM INSTITUTE

Project Sponsors/Collaborators

USEPA Region 4: Wetland Program Development Grant

State Agencies: KDOW, MD State Highway, MD DNR, MDE, and PA DEP

Kentucky Transportation Cabinet and US Fish and Wildlife Service

US Forest Service, Daniel Boone National Forest

Kentucky Dept. of Fish and Wildlife Resources, In-Lieu Fee Program

US Army Corps of Engineers, Louisville District

Bernheim Arboretum and Research Forest

Lexington-Fayette County Urban Government

Franklin and Marshal College

RES

LandStudies, Inc.

RK&K

Wetland Studies and Solutions, Inc.

Riverine Solutions, LLC

Contractors/Collaborators

Advanced Enterprises, Richmond, Kentucky

Ridgewater, Lexington, Kentucky

EcoGro, Lexington, Kentucky


UN-RESTORED

UN-RESTORED


RESTORED


RESTORED

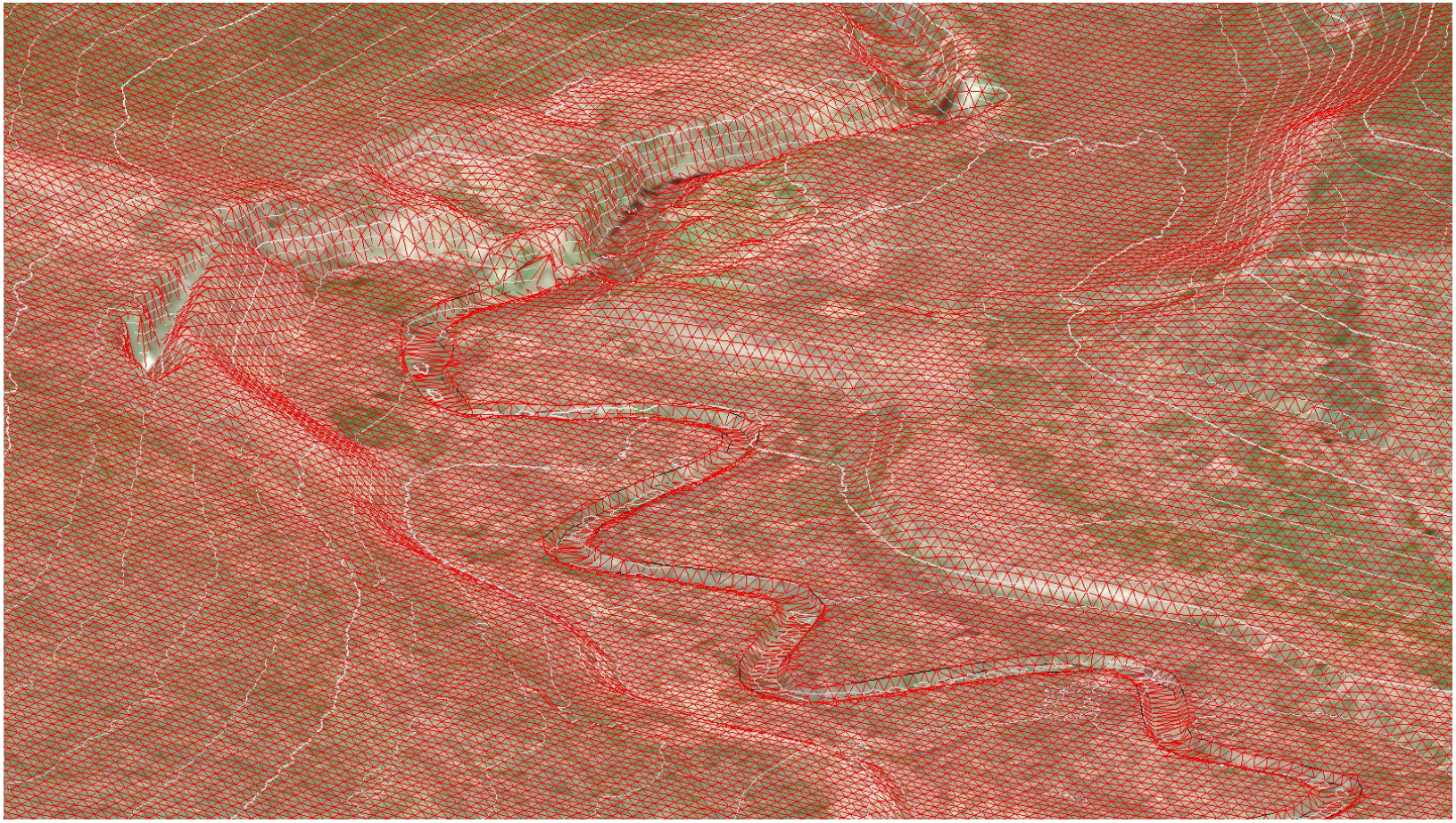

RESTORED

Two Key Element to Resilient and Sustainable Restoration Design:

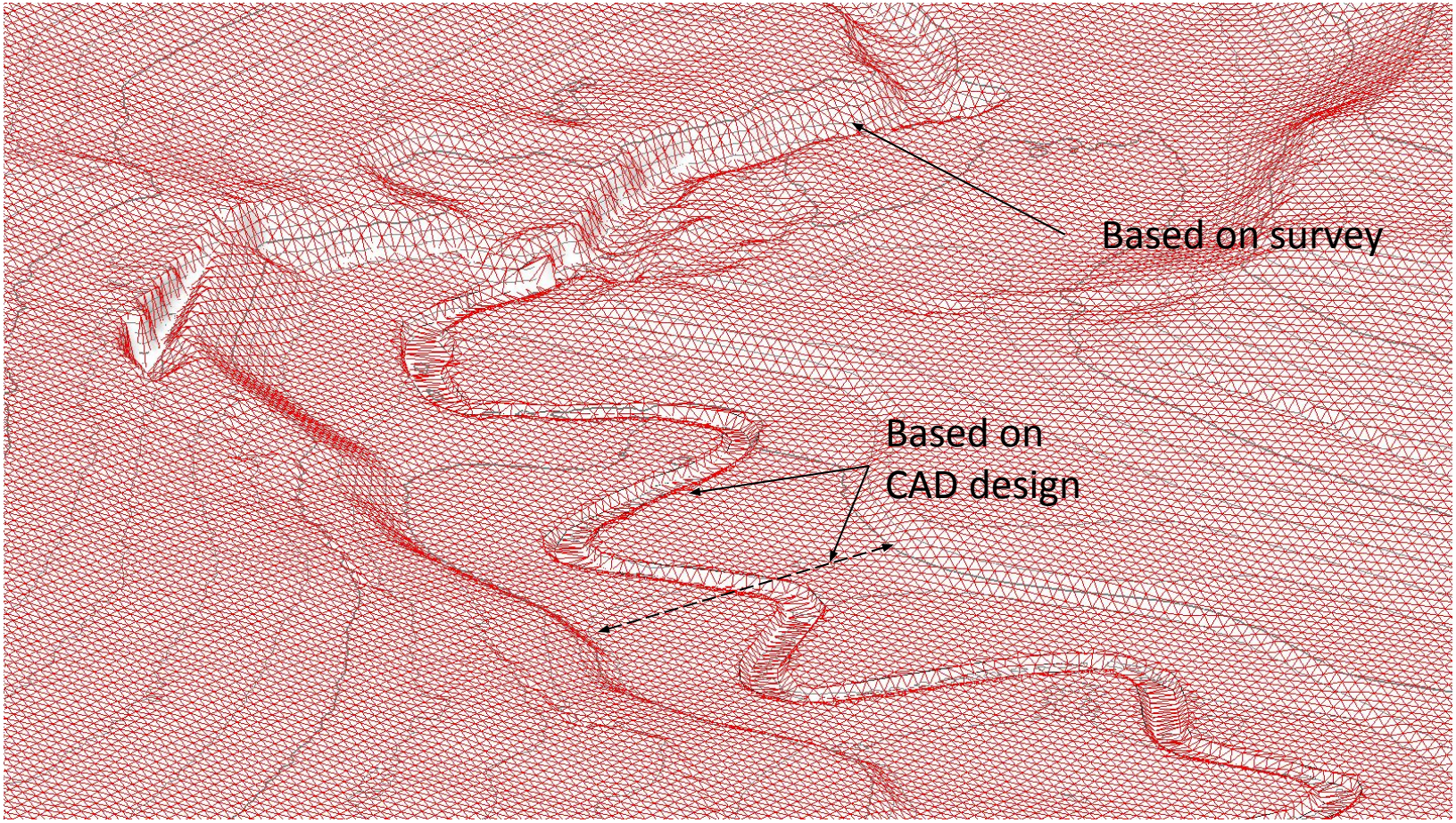
- Reduce flow stress below threshold values
- Increase resistance capacity of controls to withstand flow stresses

2D Hydrodynamic Models

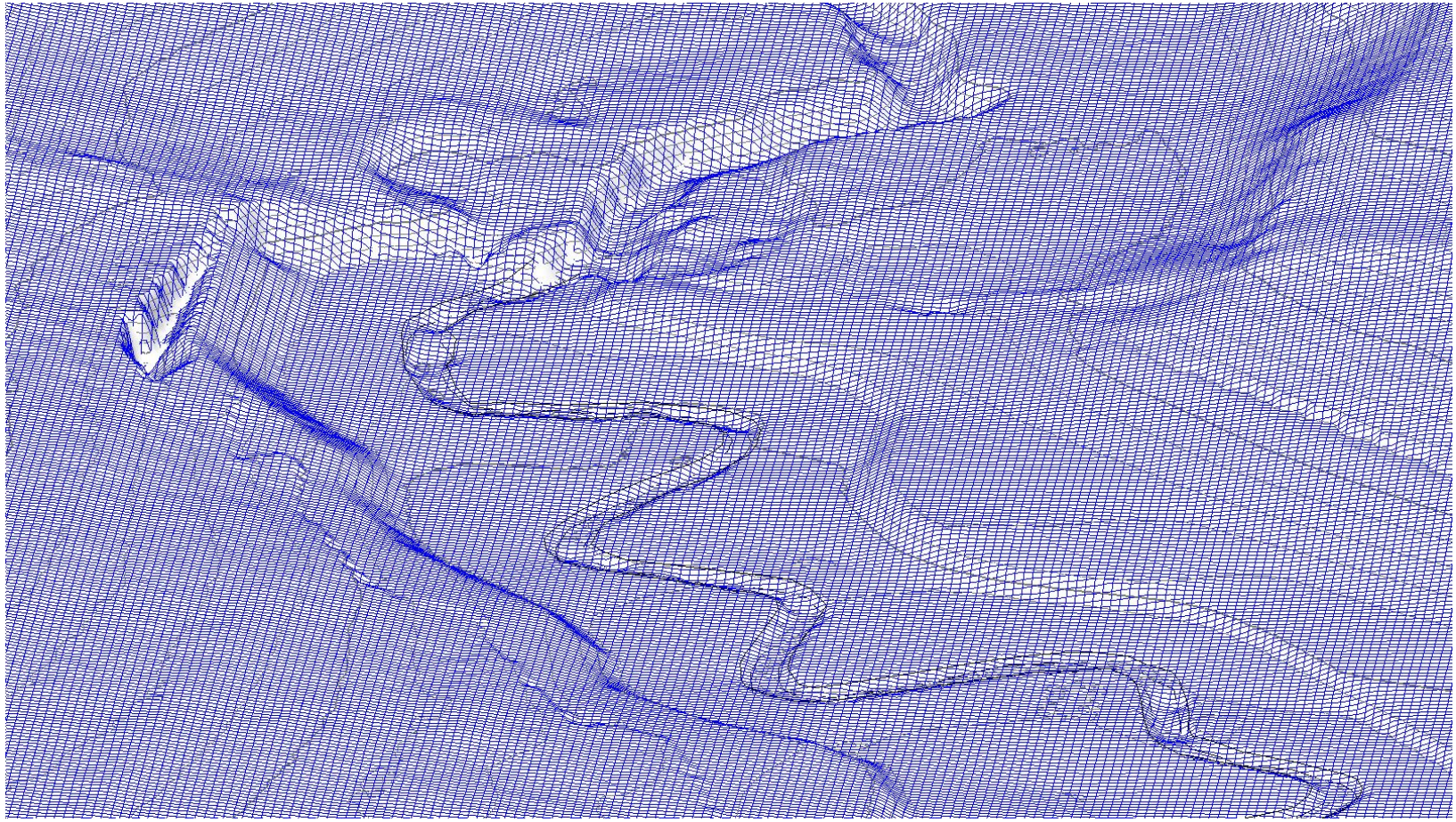
Digital Terrain Model



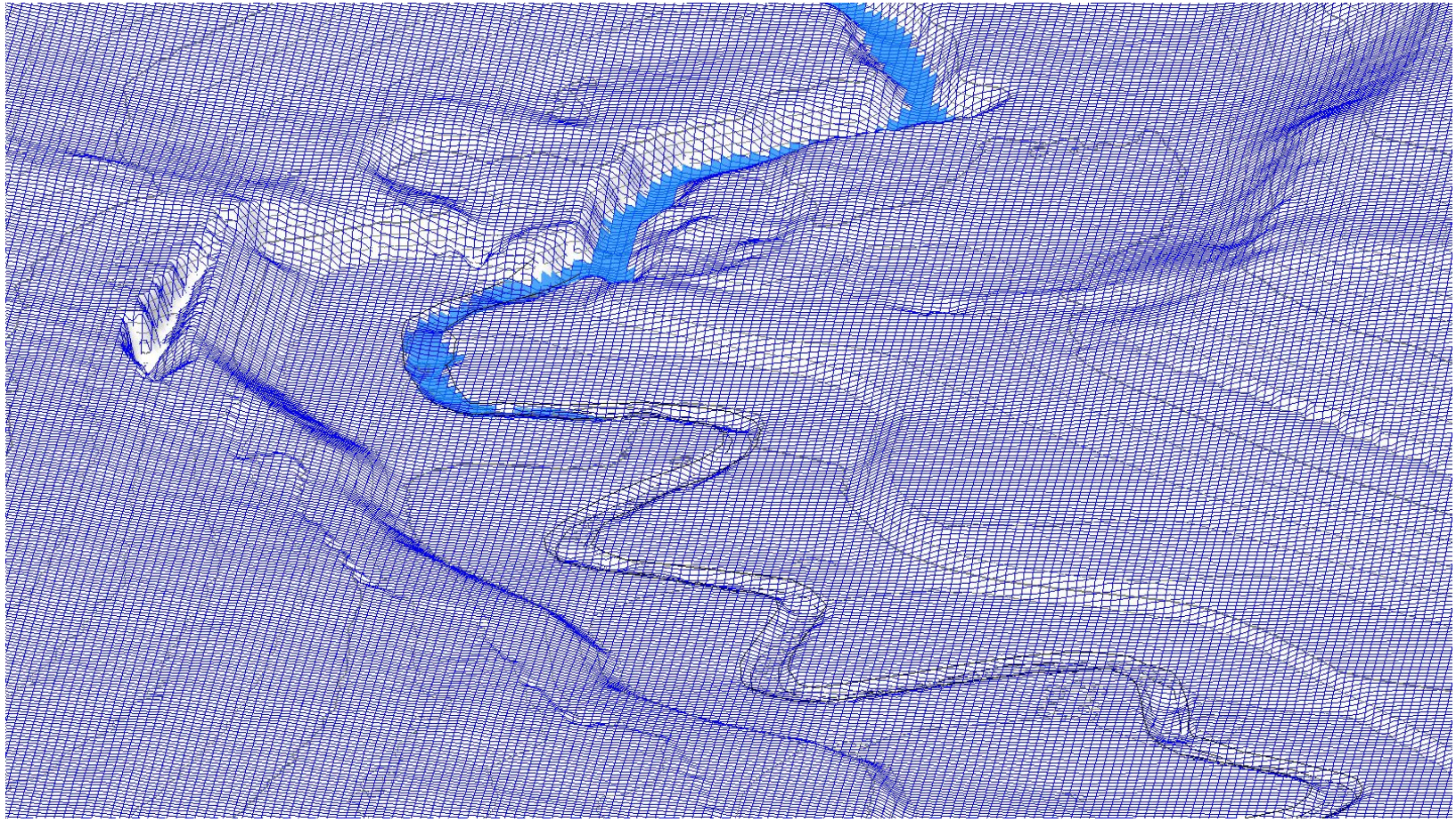
Digital Terrain Model - 3D Surface



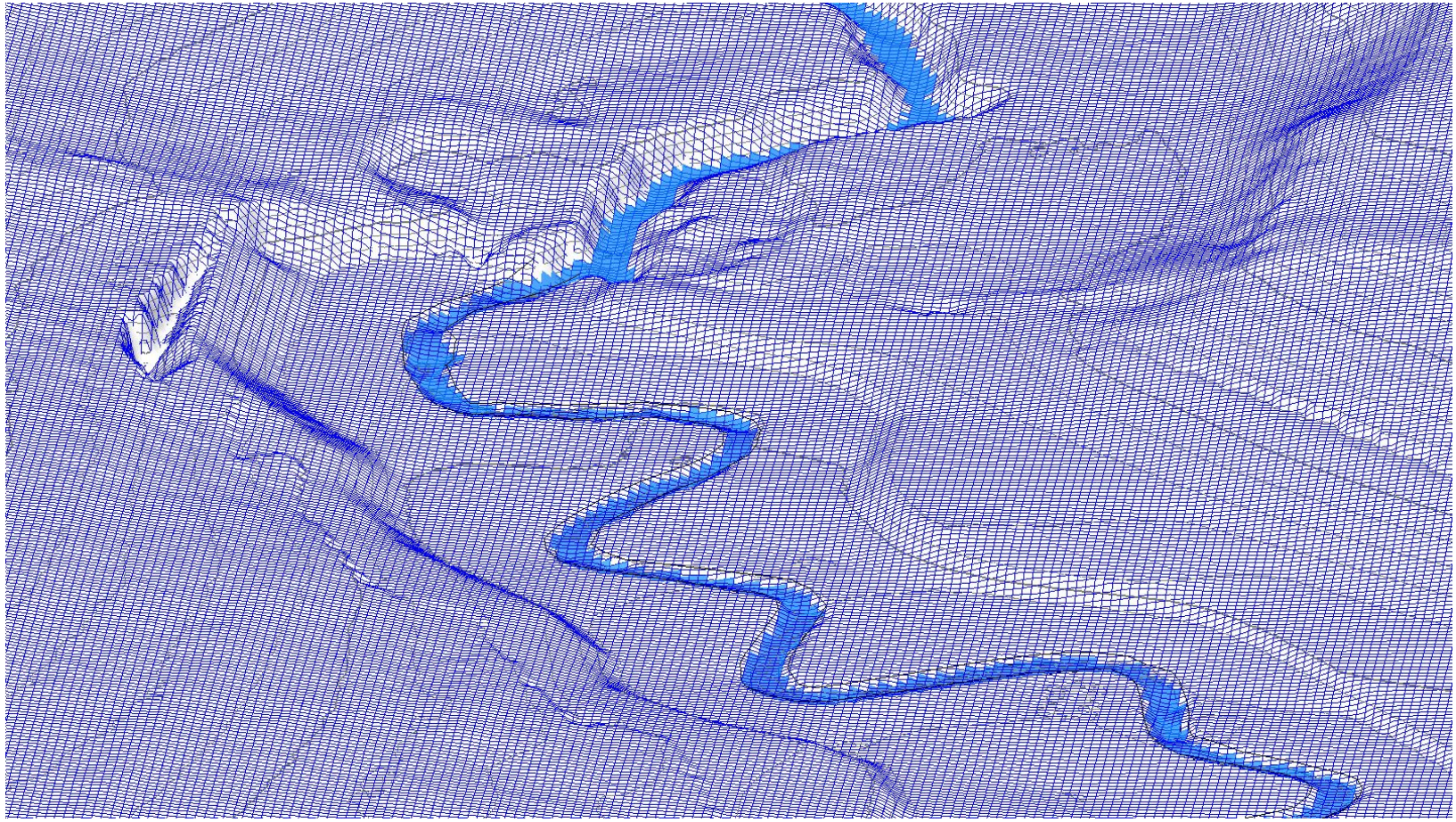
Computational Grid or Mesh



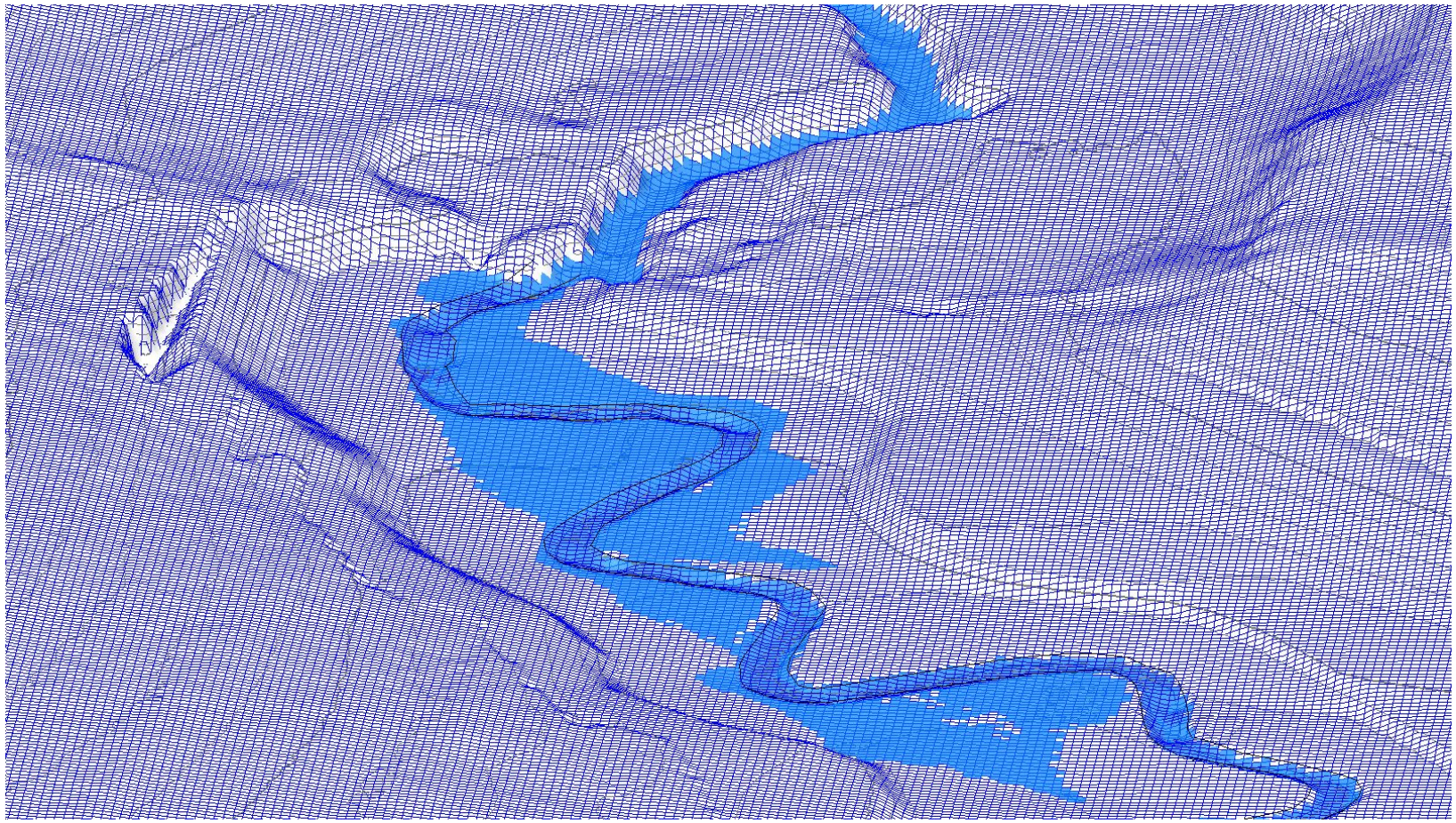
Numerically dump water in upstream end – Boundary Conditions



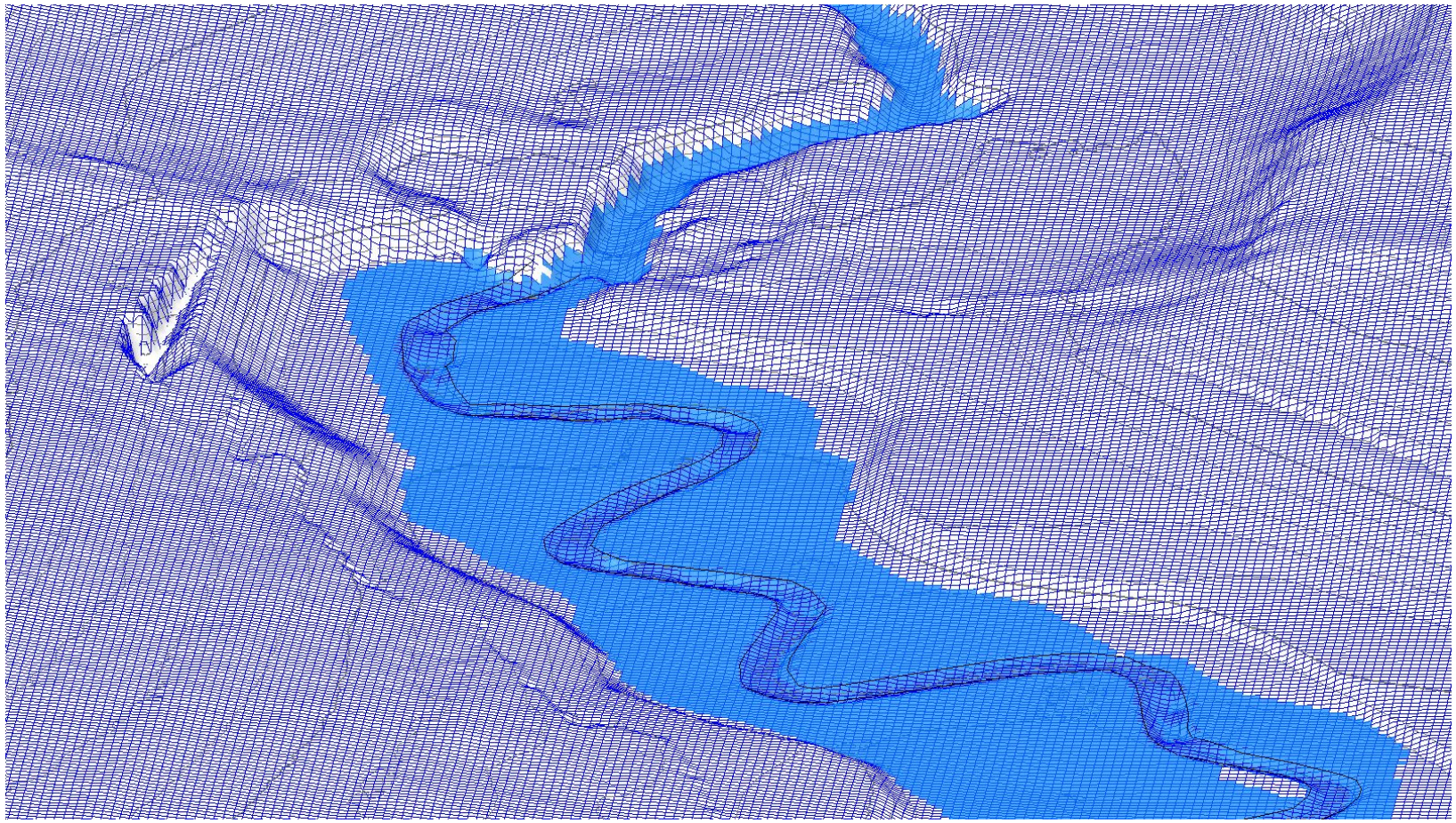
Keep adding water numerically to match flood flow hydrograph



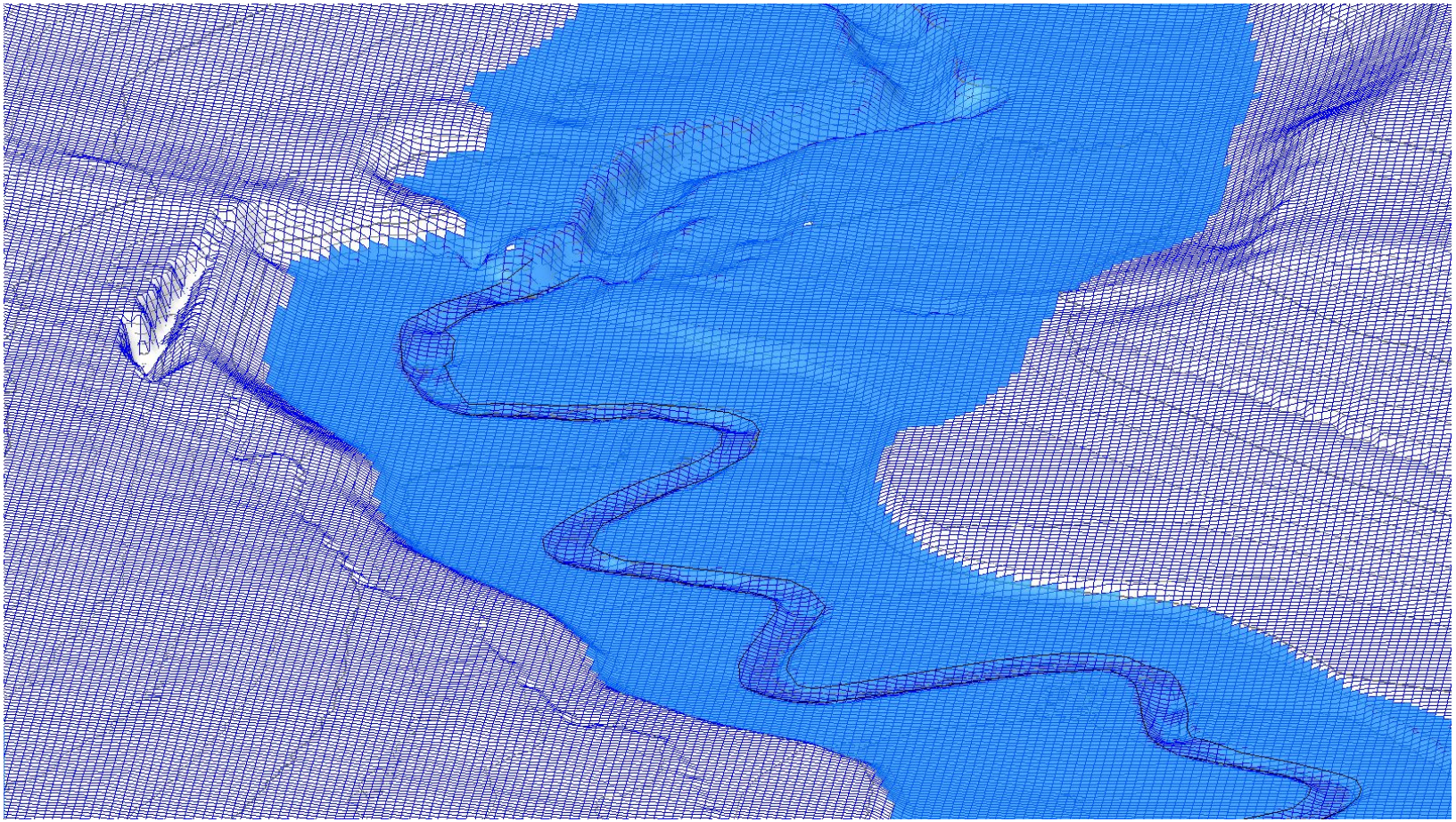
Rising Limb of Hydrograph Flow



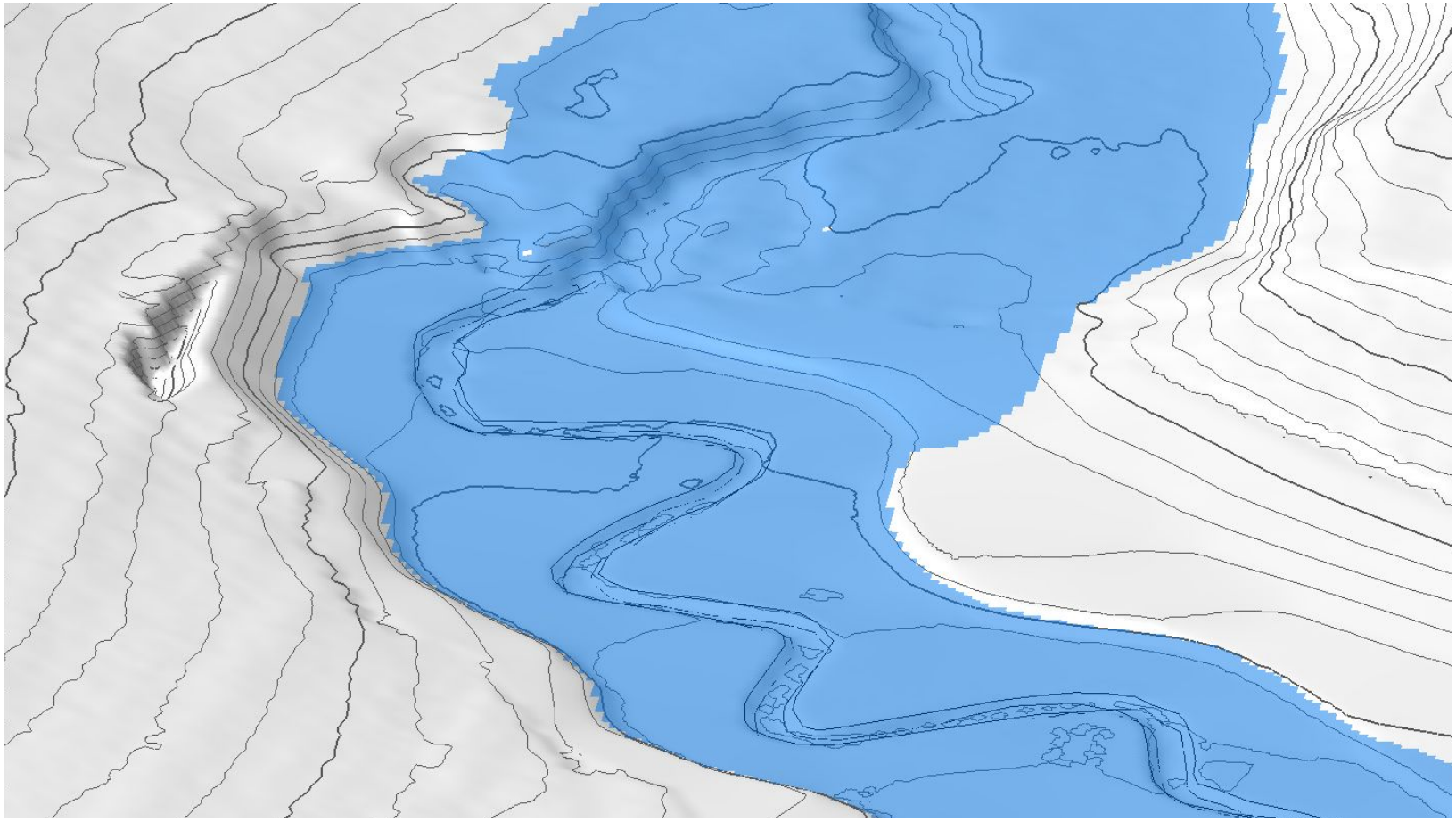
Rising Limb of Hydrograph Flow



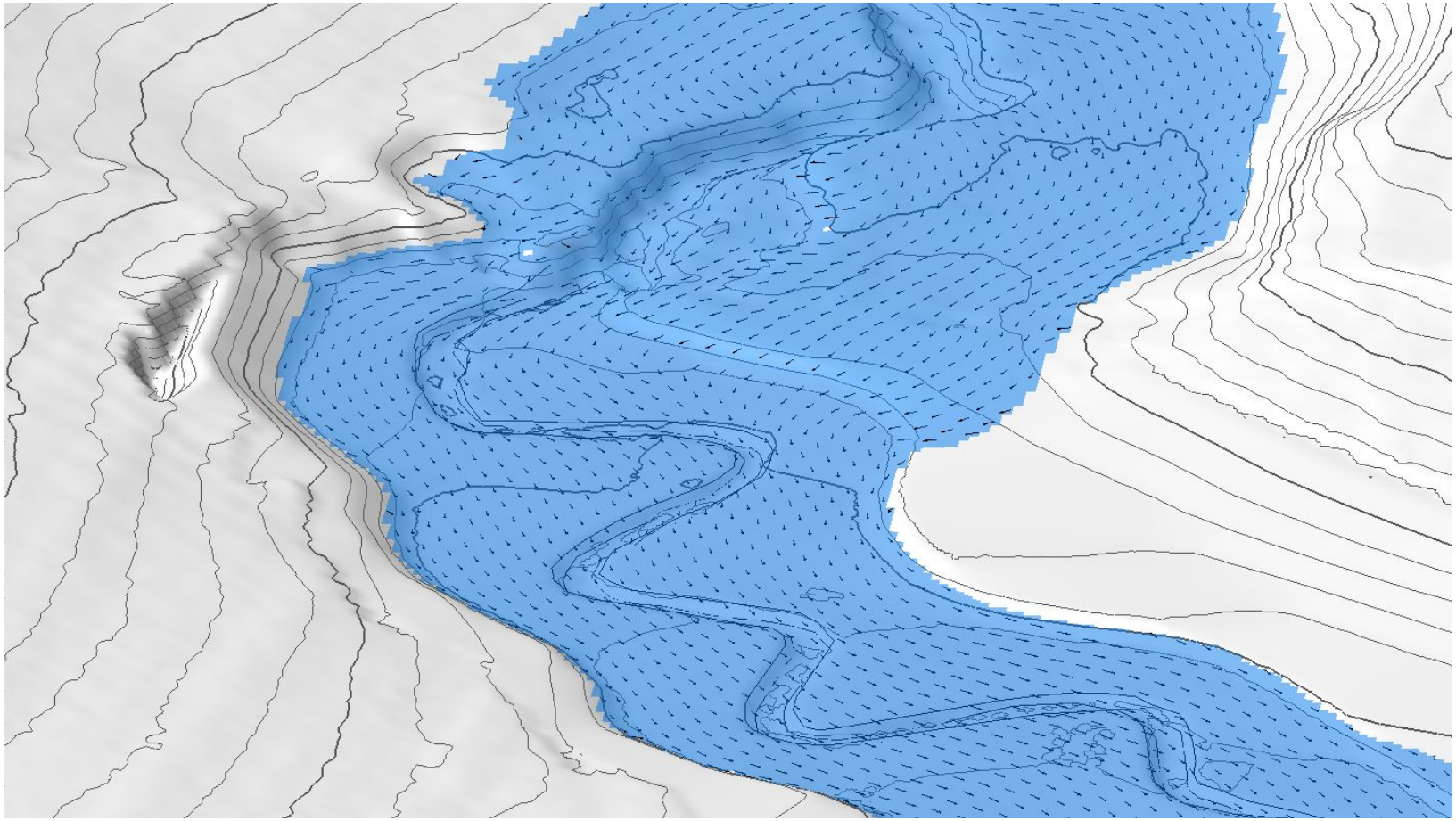
Peak Flow – Usually 100-year Flow



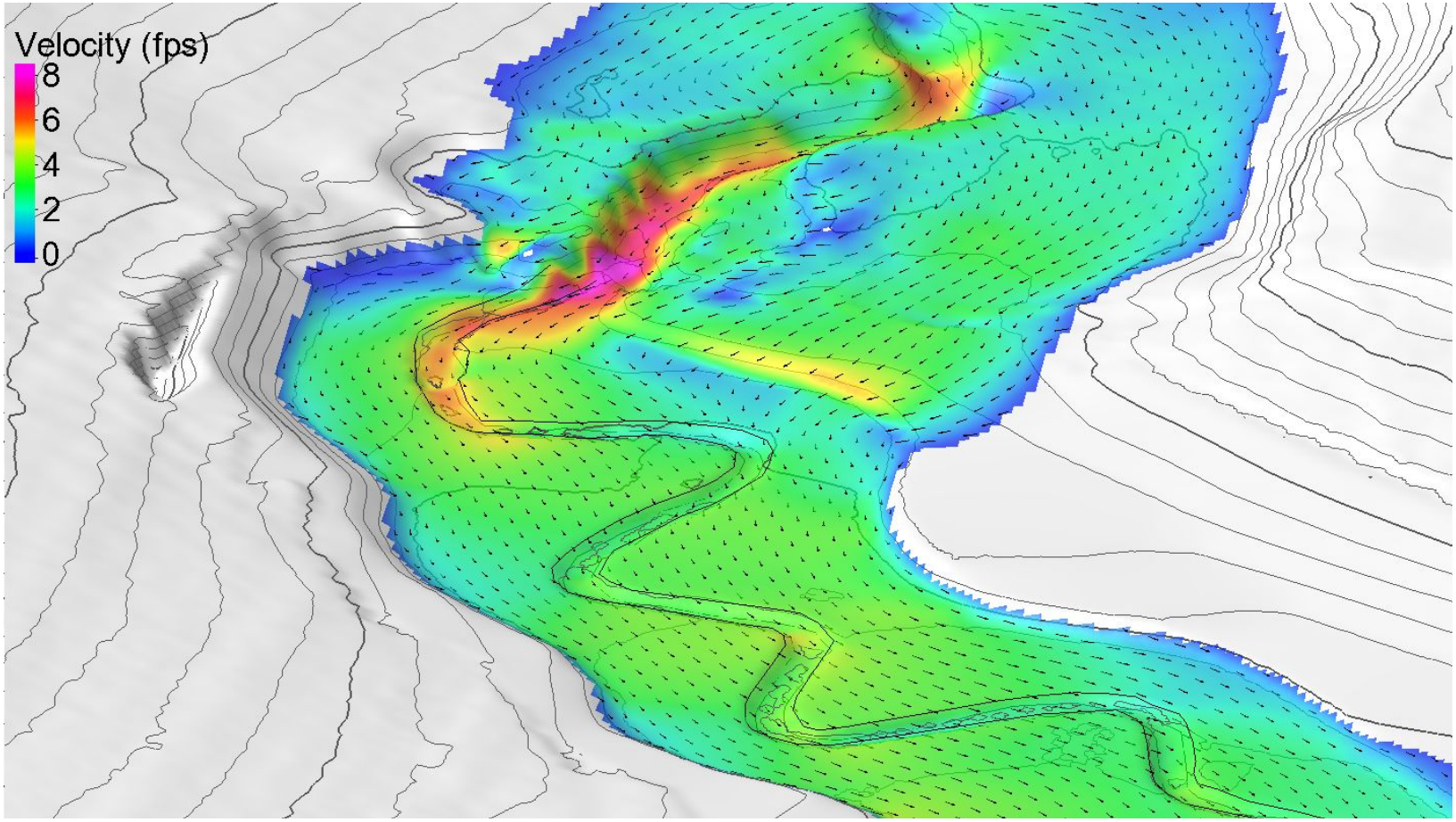
Peak Flow Flood Extent



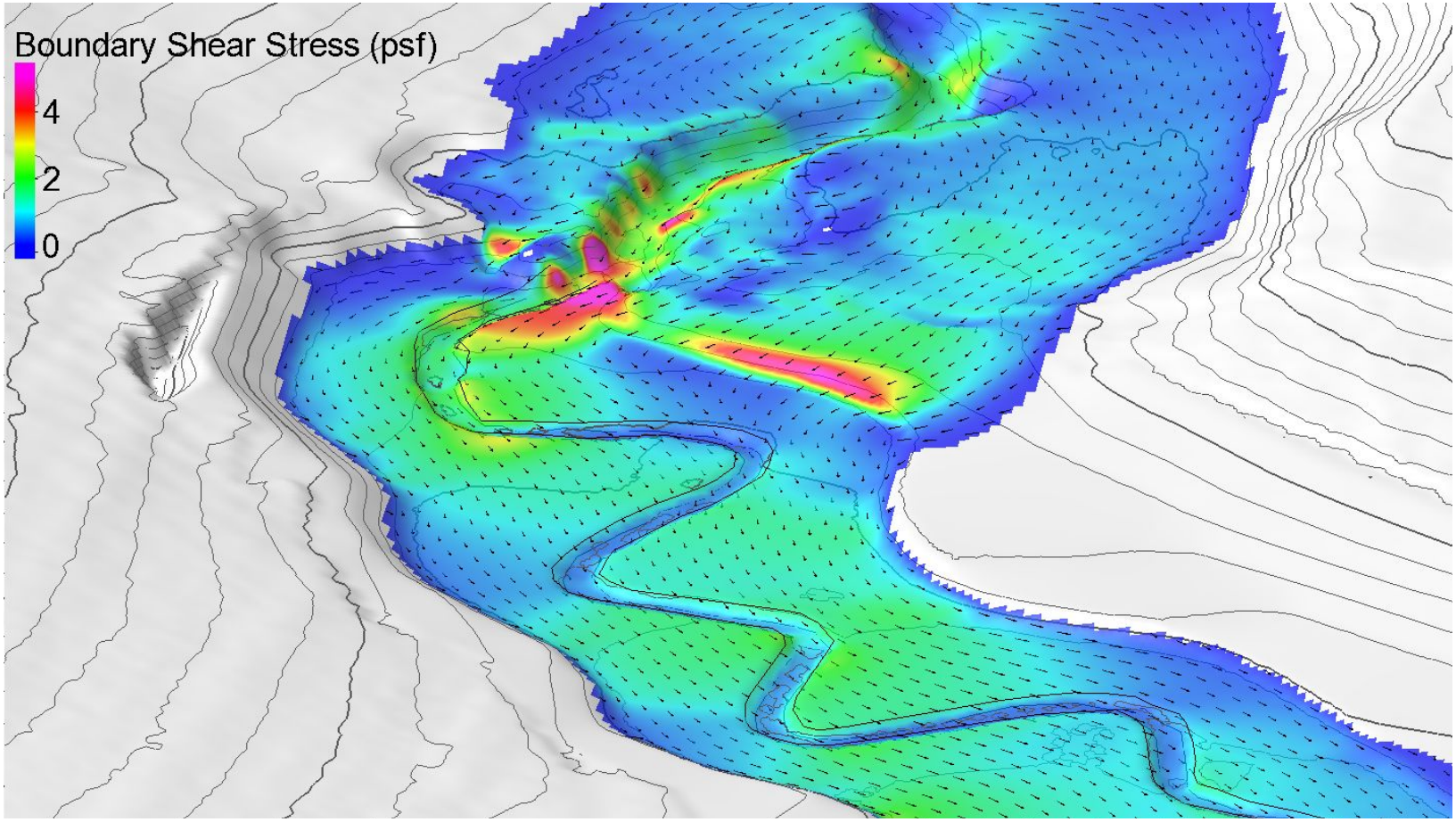
Flow Direction – Velocity Vector



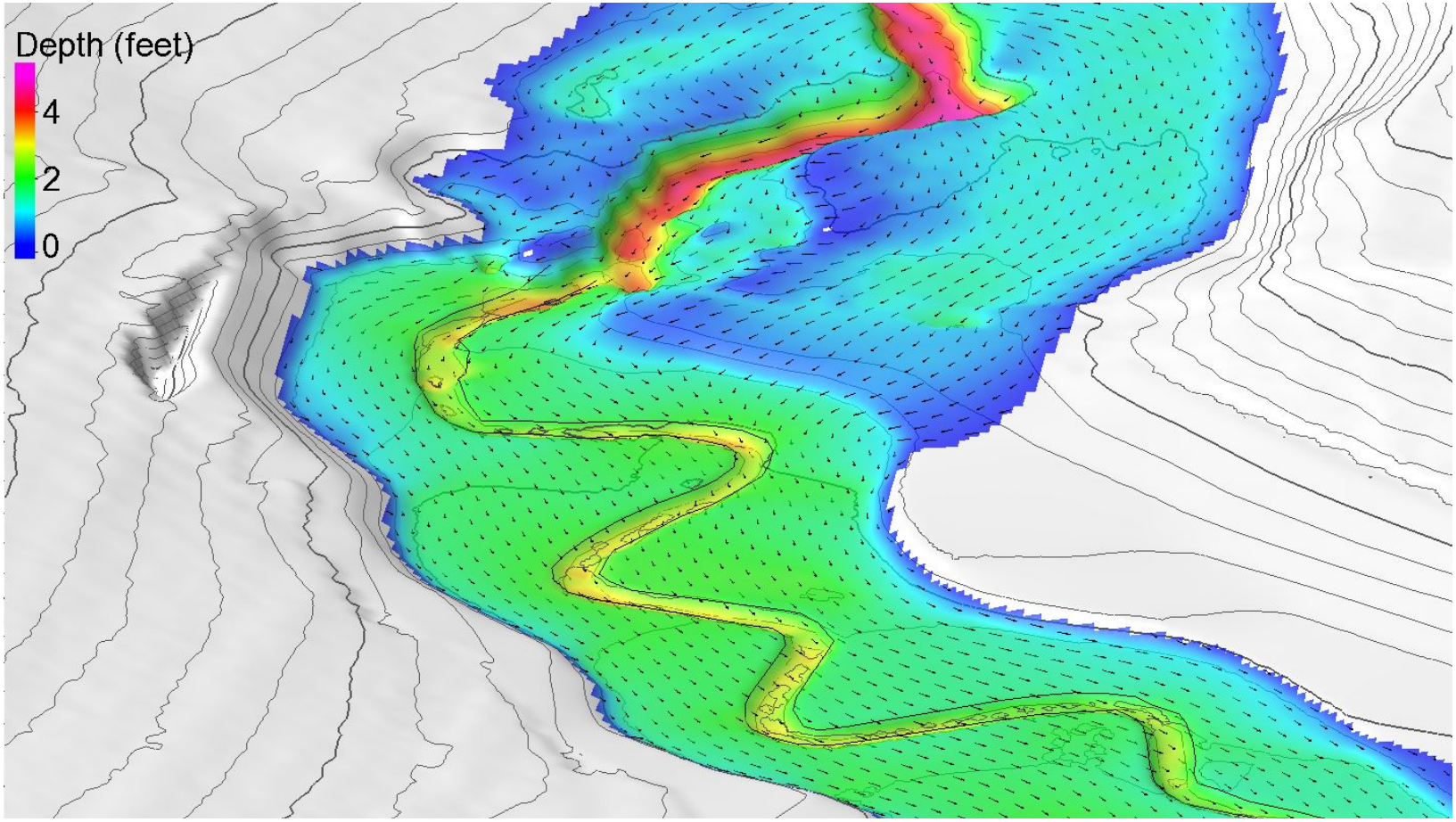
Flow Velocity in Feet Per Second (fps)



Boundary Shear Stress in Pounds per Square Foot (psf)



Flow Depth in Feet



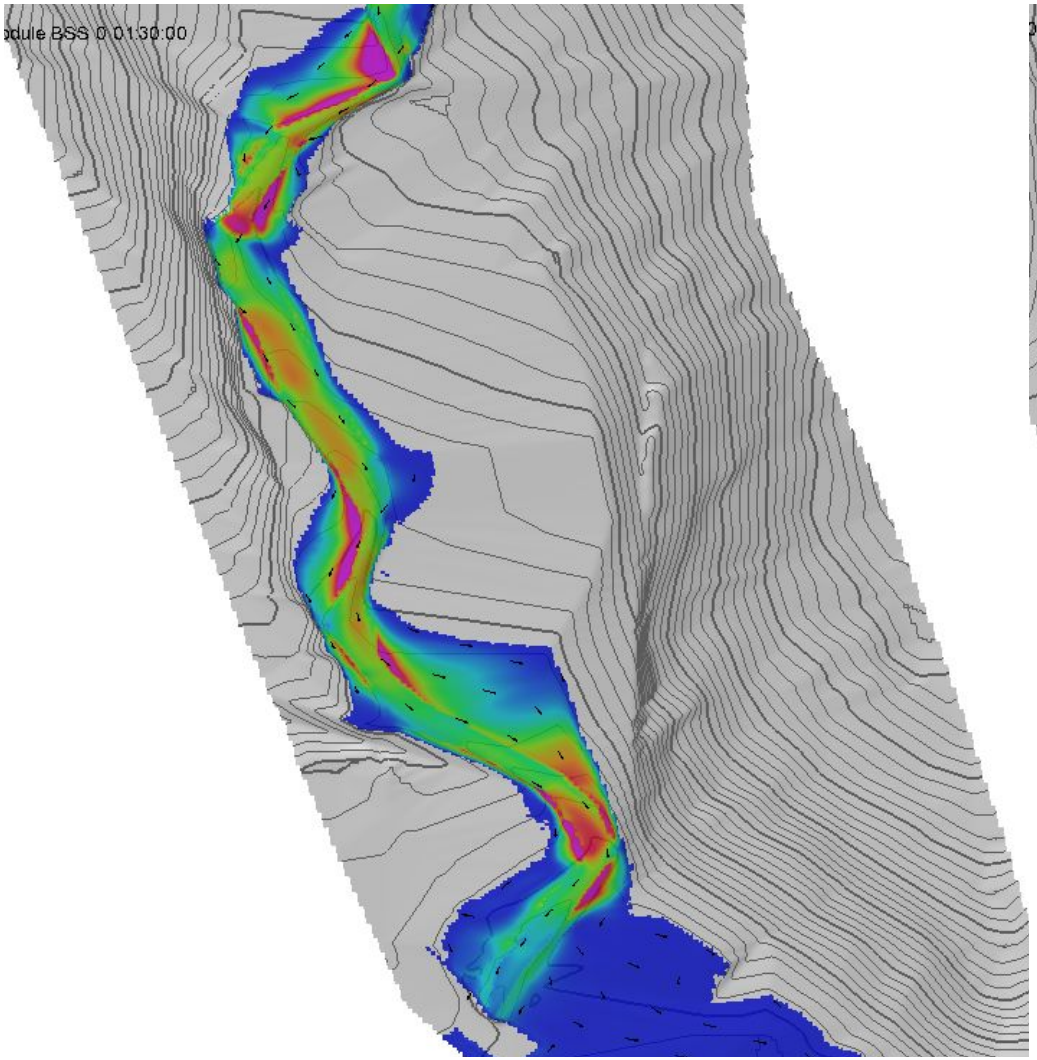
Vulnerabilities

Restoration Site Owner: RES
Imagery and Analysis: Riverine Solutions, LLC

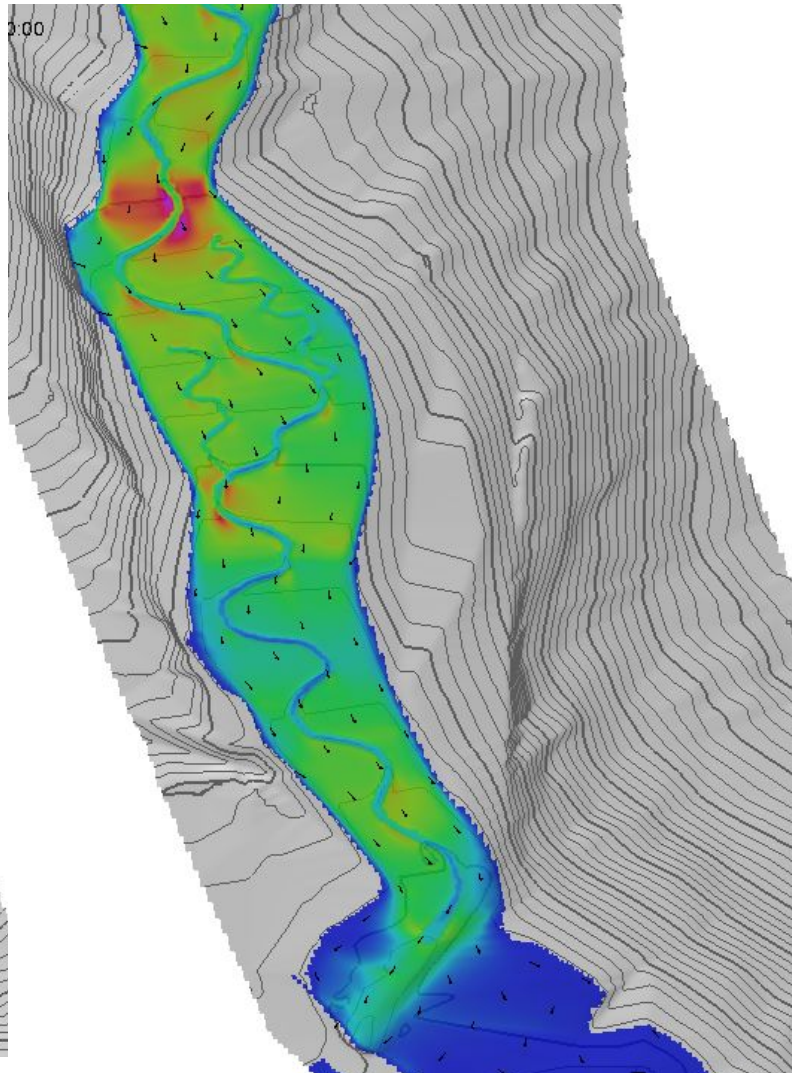
Infrastructure

Restoration Design with 2D Models

Pre-Restoration



Restoration Draft Design




UN-RESTORED

UNT Sinking Creek

UNT Sinking Creek

Excavation Area Required for Floodplain and Channel Stability

Stable Epifaunal Substrate

Long-Term Sustainability