Introduction to HEC-RAS

Cameron Ackerman, P.E., D.WRE

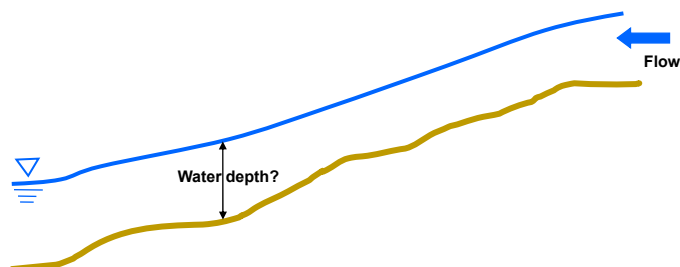USACE, Institute for Water Resources, Hydrologic Engineering Center

1

1

HEC-RAS

- 1D/2D hydraulics program
- Compute water surface profiles from channel geometry and flow
- Steady and Unsteady Flow
- Sediment Transport
- Water Temperature
- Water Quality

Flow

Water depth?

2

2

Type and Scale of Applications

- Types of Studies
  - Initial screening and reconnaissance studies
  - Detailed Investigations and alternative evaluations
  - Design Studies
  - Real-time forecasting
- Spatial Scale of Application
  - Very small urban areas with small drainage systems
  - Moderate-size river systems with natural and constructed channels
  - Large-scale river systems
- Time Scale of Applications
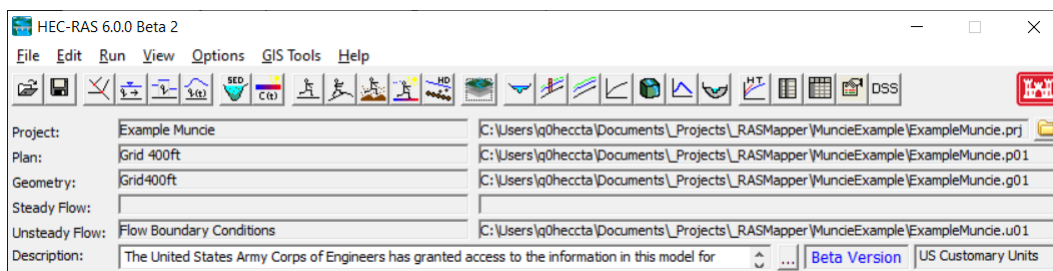 - Peak flow profiles
  - Single event simulations
  - Long term simulations

3

3

HEC-RAS

- HEC-RAS interface helps orchestrate the model development, simulation, and analysis of results.

4

4

Modeling in 1D or 2D?
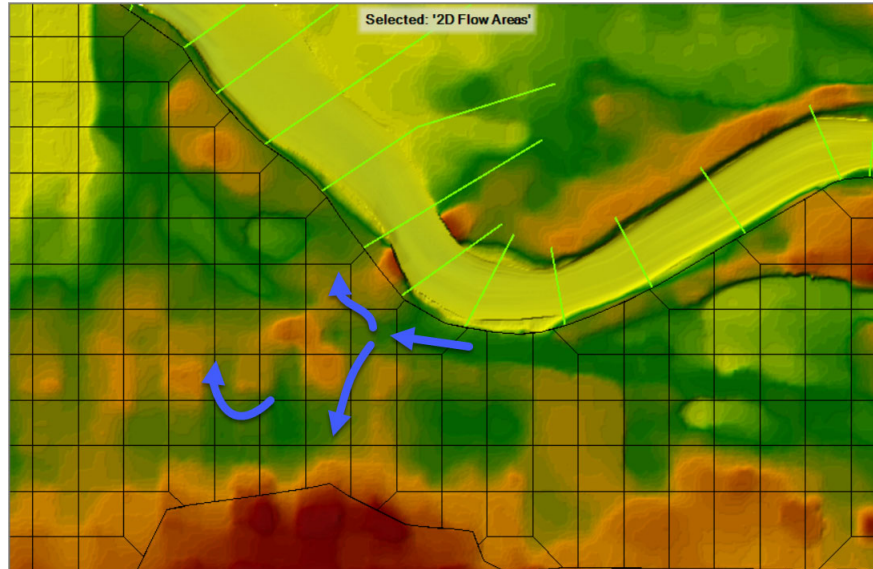
5

Steps in Hydraulic Modeling

- Develop Geometric Data
  - Input survey information
  - Create data using GIS methods
  - Add hydraulic structures
- Enter flow data
  - Steady flow or Unsteady flow
- Perform the computations
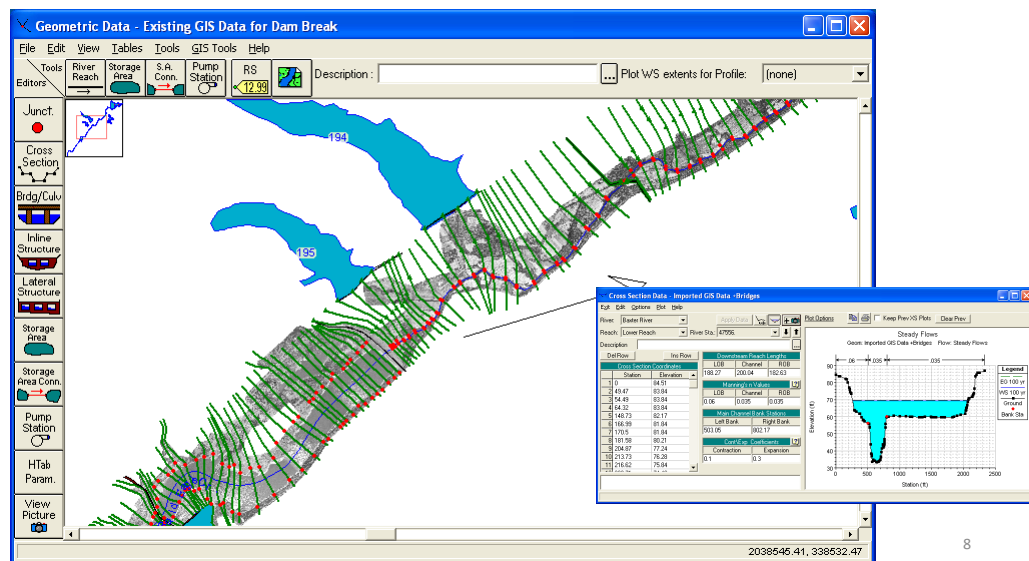- View Results
- Map Results for Analysis
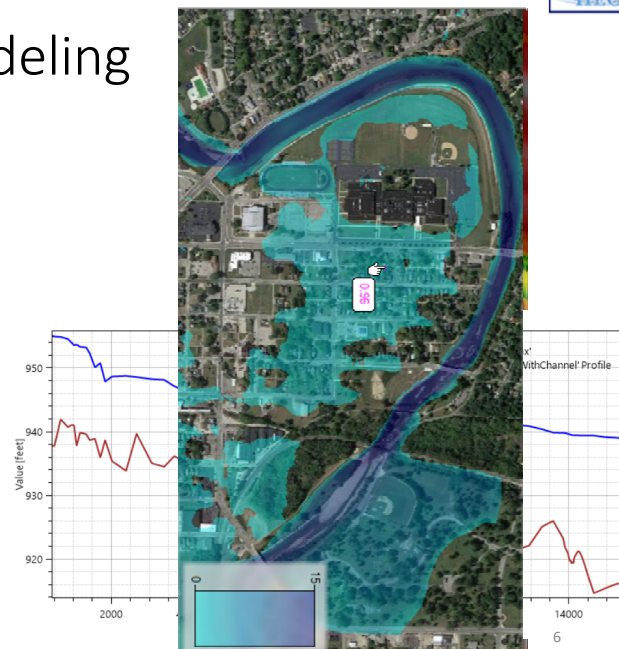
6

Geometric Data

- Cross Sections
- Detailed Bridge Analysis
- Detailed Culvert Analysis (9 shapes)
- Inline Structures (Dams, weirs, drop structure, natural drops)
- Lateral Structures (Levees, diversion, natural lateral overflow)
- Storage Areas (Reservoirs, lakes, ponding areas, interior area inside a levee)
- 2D Flow Areas
- Hydraulic Connections
- Rating Curves
- Pump Stations
- Extensive data import and export

7

7

Geometric Data Editor - Schematic

8

8

4

HEC-RAS Mapper

Cross Sections

- Perpendicular to flow
- Capture flow area
- Main Channel
- Overbanks
- Energy losses from friction and contraction and expansion losses

Cross Section Layout

2D Area with Breaklines
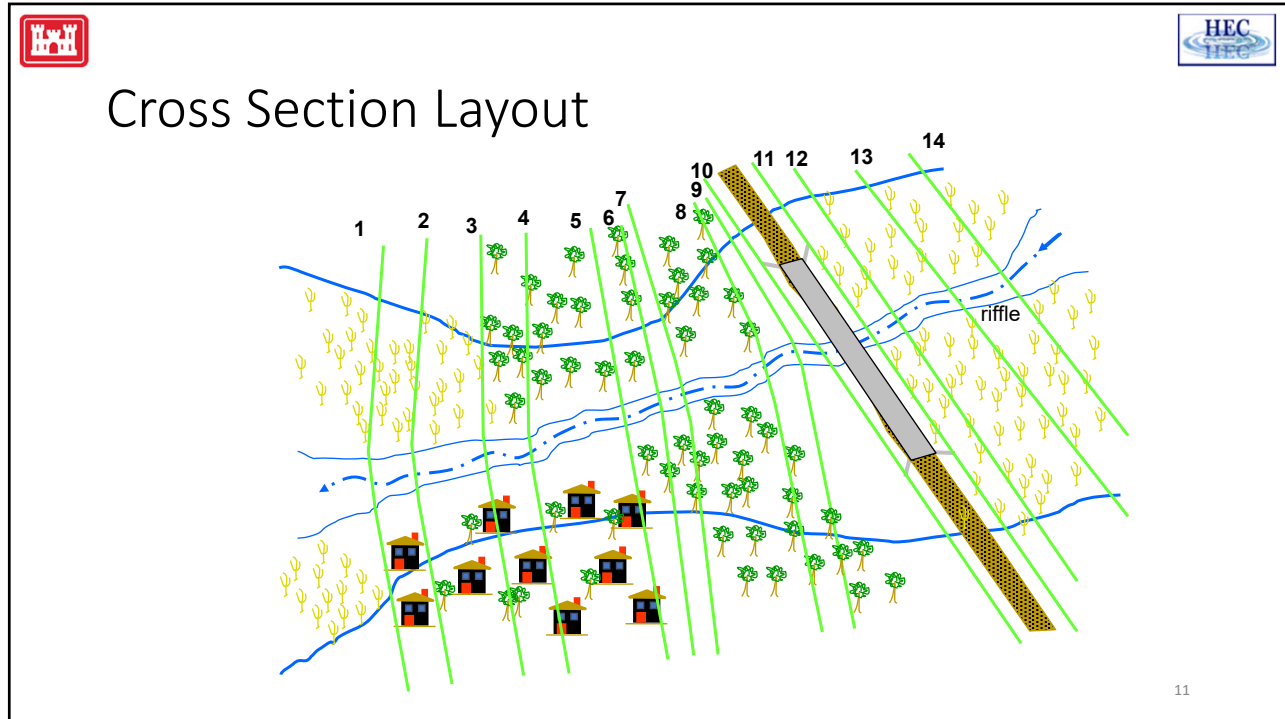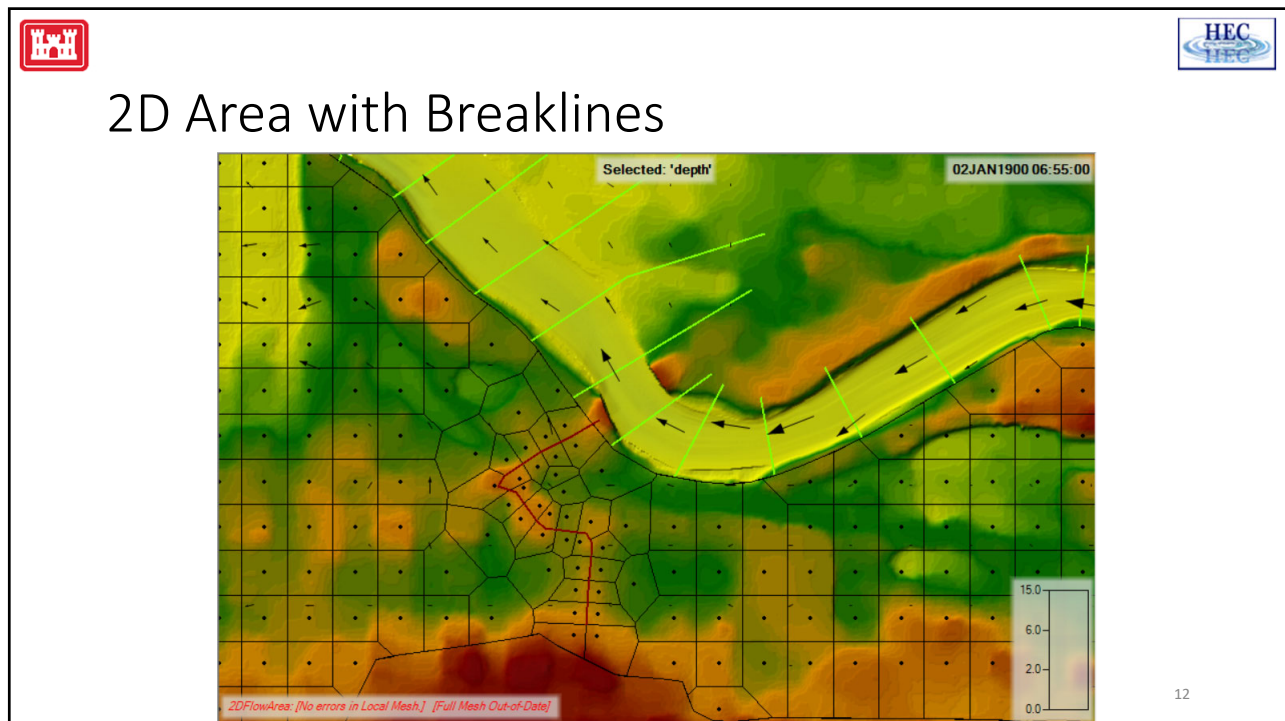
Bridges

- More complicated way to account for floodplain changes
- Conveyance change
- Energy losses
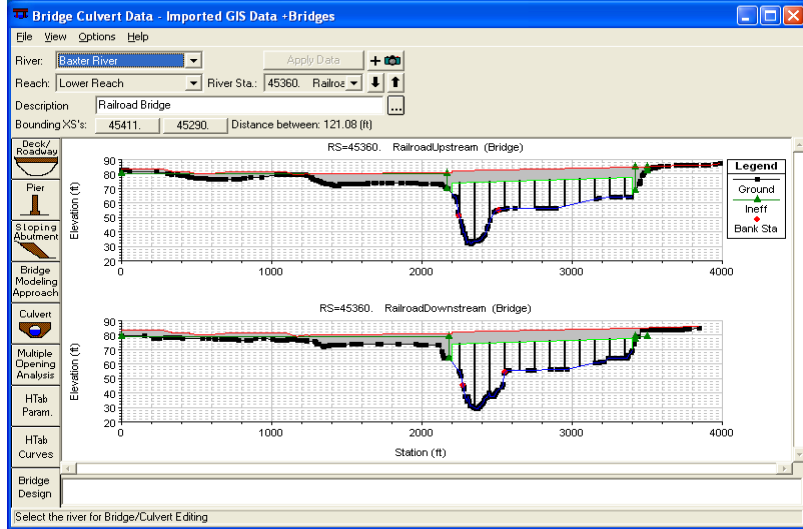
13

Culverts
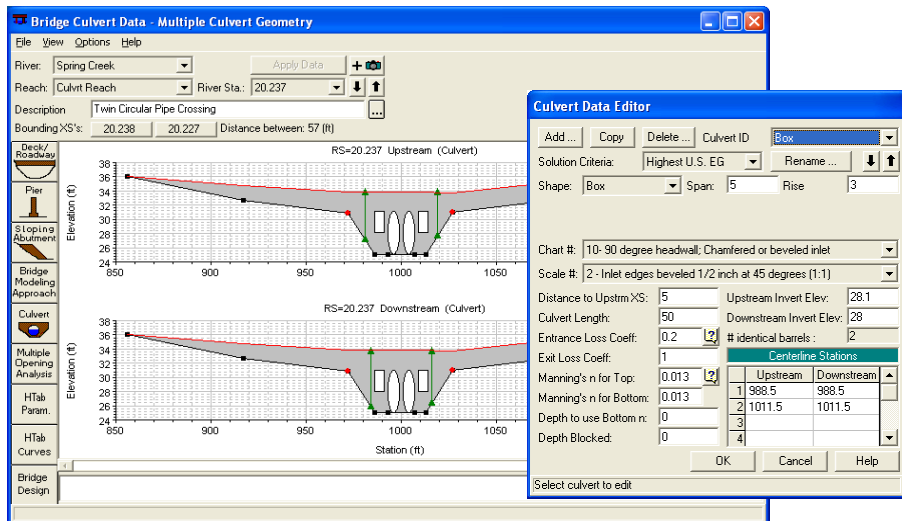
14

Steady vs Unsteady Flow

- Steady = Constant flow

- Unsteady = Flow variation in time

Steady Flow Data Editor

Peak Flows
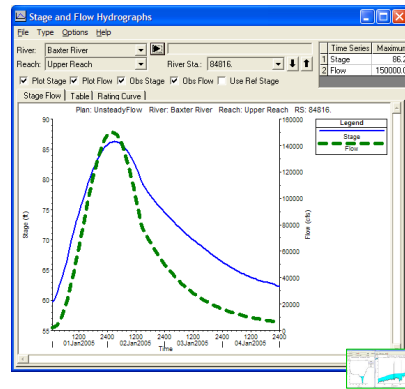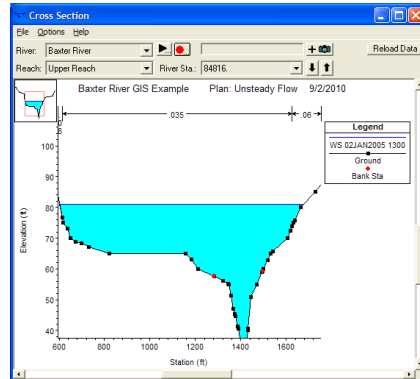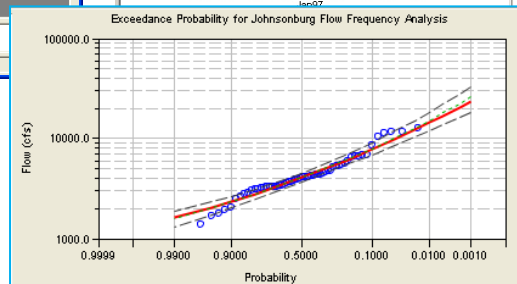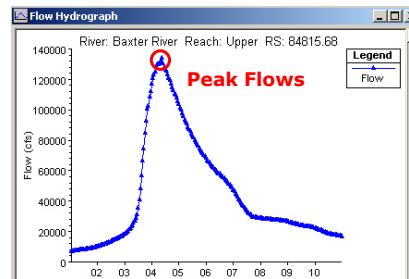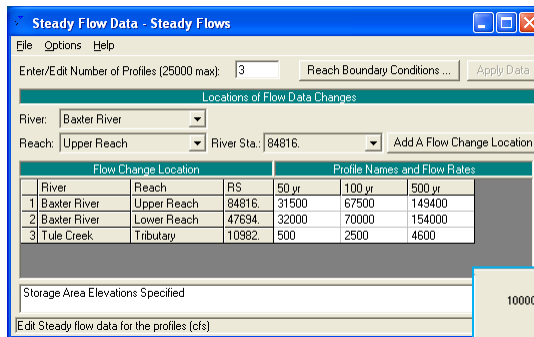
Unsteady Flow Data Editor Boundary Conditions

17

Steady Flow Hydraulic Computations

- Compute **Plan** comprised of a **Geometry** and **Flow**

18

Viewing Results

- Graphics
  - Cross sections
  - Water surface profiles
  - Generic plots – Any variable in profile
  - Rating Curves
  - XYZ Plot
  - Stage and flow hydrographs
  - Animation – (cross section, profile, 3D plots)
- Tabular Output
  - Pre-defined detailed tables
  - Pre-defined summary tables
  - User-define output tables
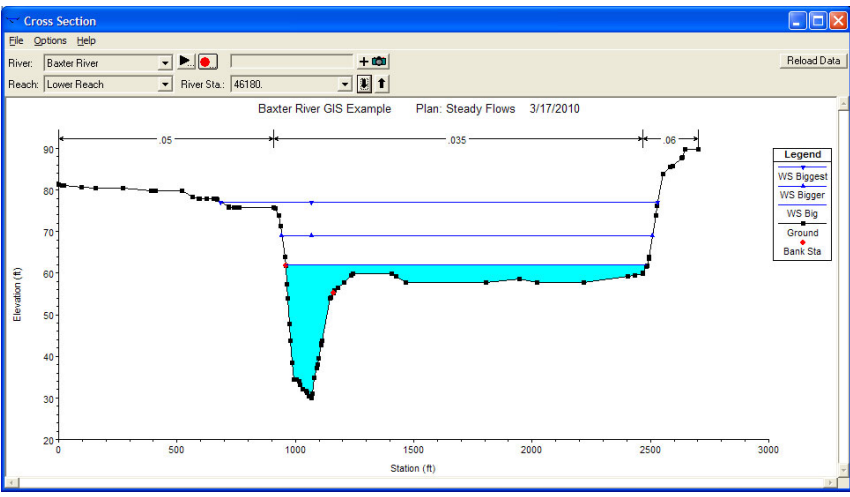
19

19

Cross Section Plot

20

20

Velocity Distribution

21

![icon] Profile Plot

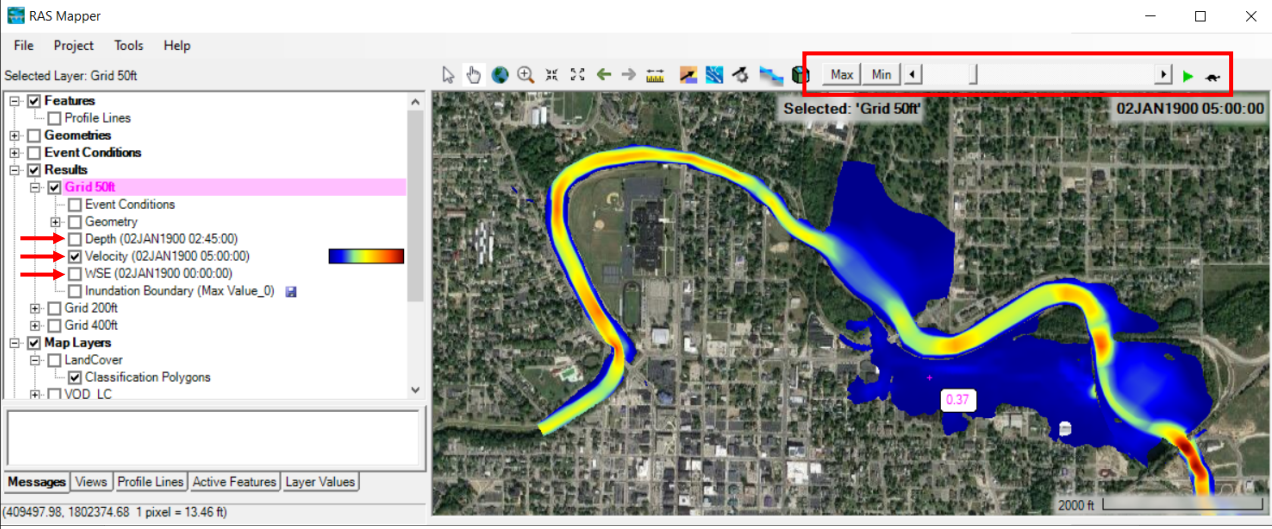22

XYZ Plot

23

3D Visualization
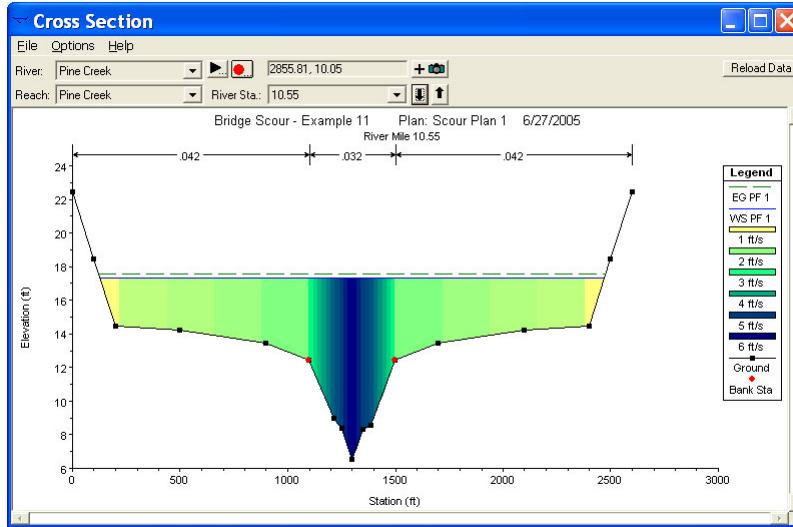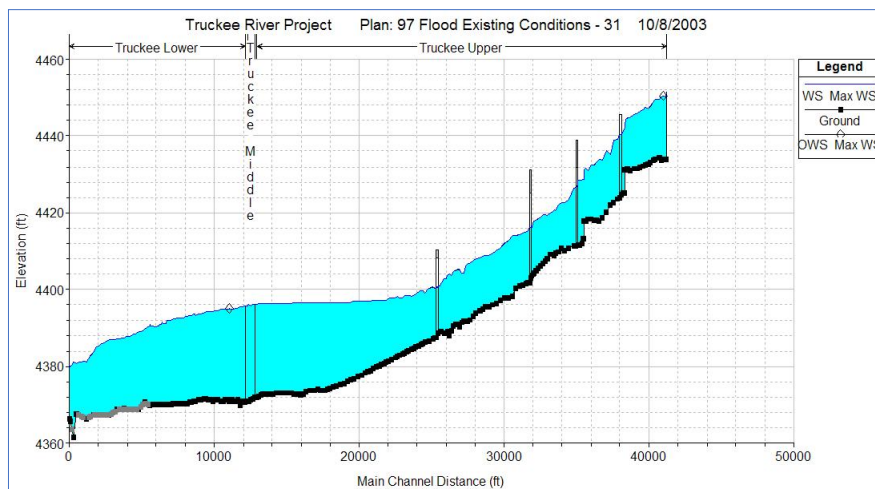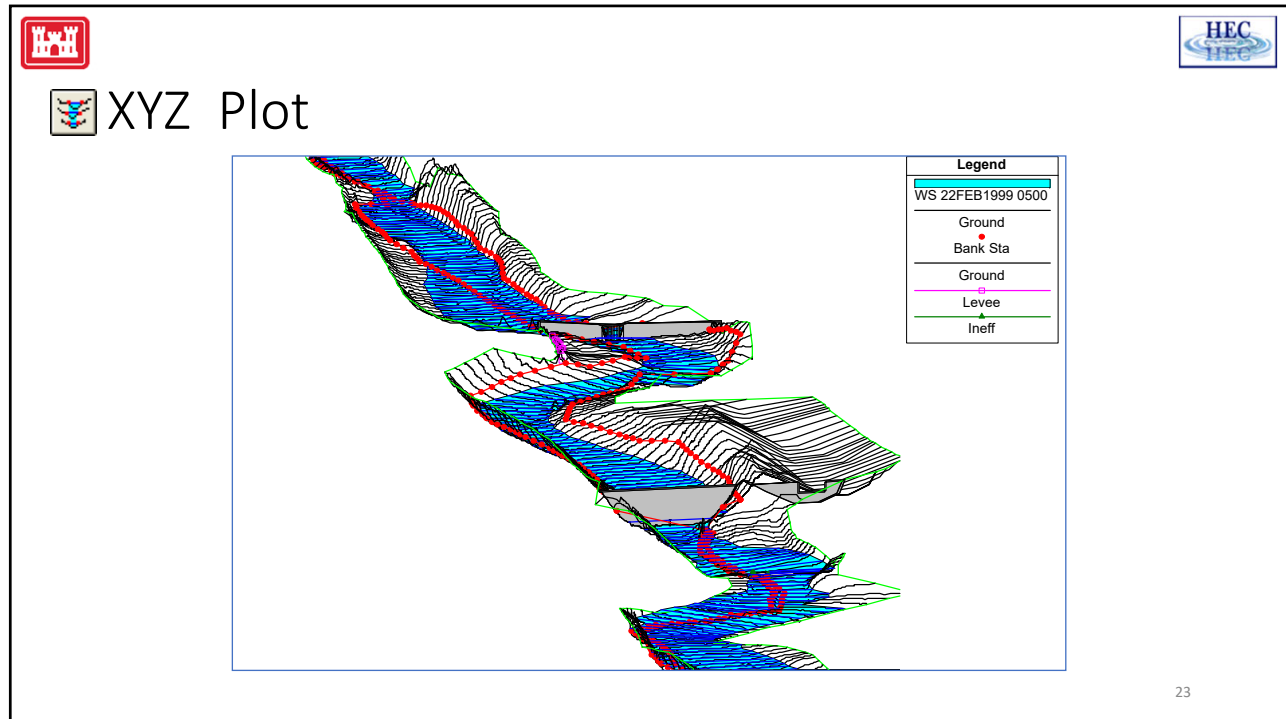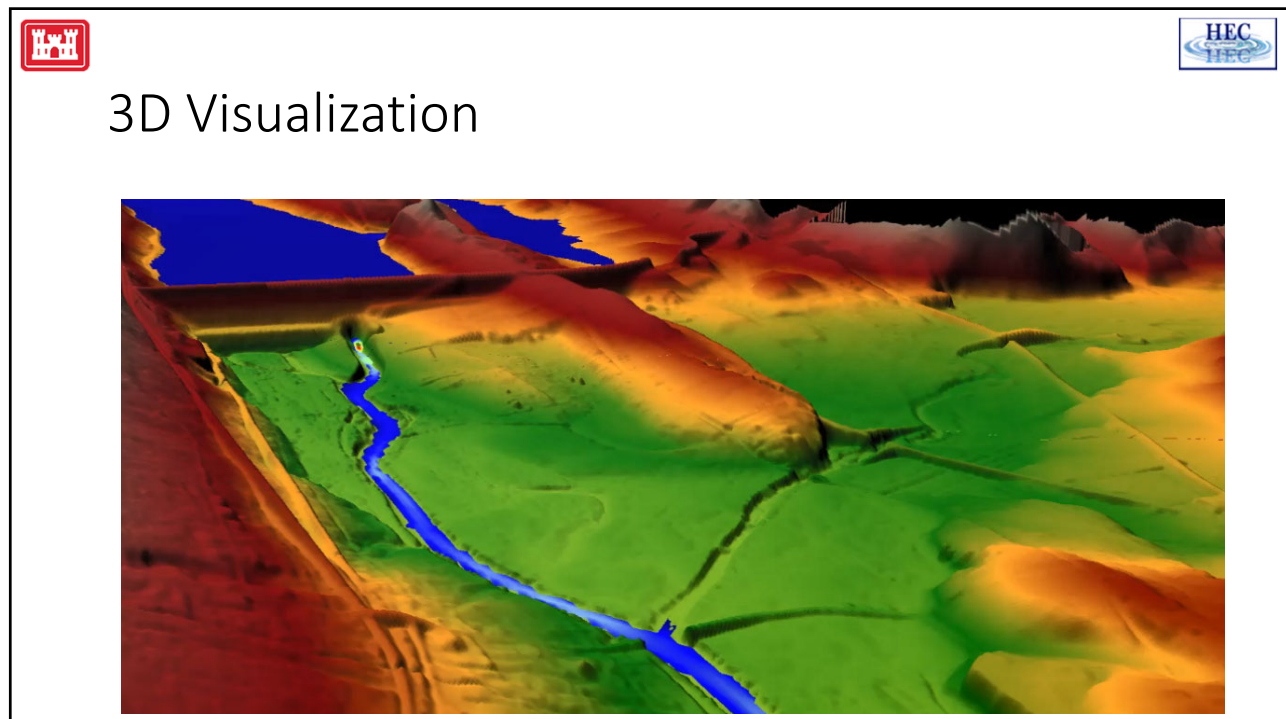
24

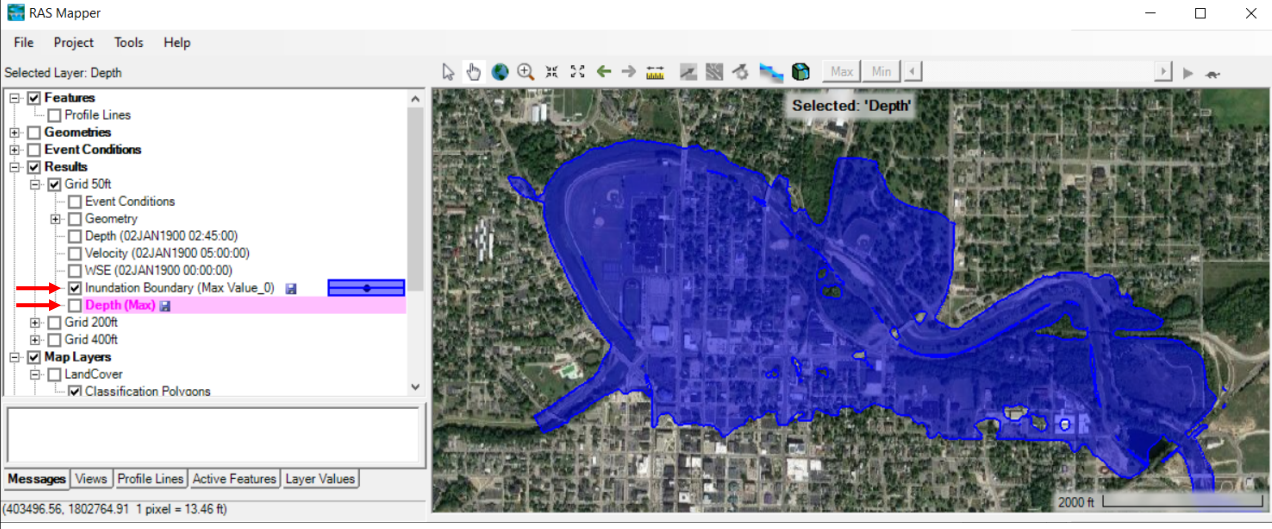## ▦ Summary Tabular Output

25

RAS Mapper

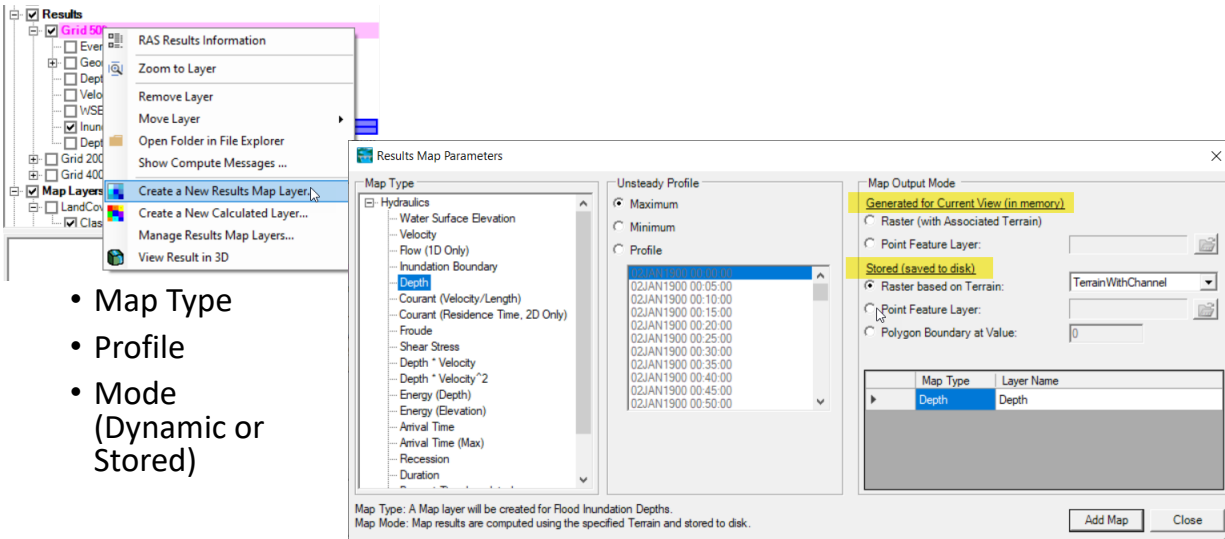26

Results Maps: Dynamic Maps

27

Results Maps: Stored Maps
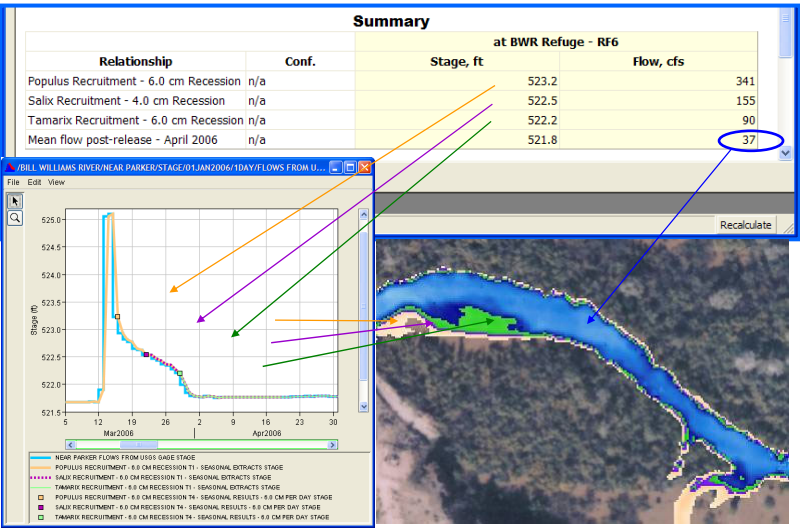

28

Results Maps

- Map Type
- Profile
- Mode (Dynamic or Stored)

29

Mapping for Habitat Suitability

15

Questions?

31

31