

# GIS for Support of Hydrologic and Hydraulic Modeling

Kyle Morgan

Sheng Tan, GISP



WOOD RODGERS



**esri**

Partner Network  
Silver

# H&H Modeling

Using GIS to Solve Fluid Problems

*Presented at CalGIS 2014, first publication by CalGIS/URISA*

A little bit about us...

# Kyle Morgan

GIS Developer

kmorgan@woodrogers.com



@gisdev\_km

- 10 years of experience in GIS, 17 years experience in programming and IT-related disciplines
- GIS related travels include Greenland and Qatar

# Sheng Tan

GIS Manager, GISP

stan@woodrogers.com

- 18 years of experience in GIS

# some quick CVFEED\* statistics

Entire Project Area =  
~9,000 sq miles

Wood Rodgers' extent =  
2,500 sq miles

Of the 2,500 sq miles, 540 sq miles  
of streams are modeled

Over 17 terabytes of project-related  
data

\**Central Valley Floodplain Evaluation and Delineation  
Program*



# Some challenges faced...

- Large amounts of data
- Collaboration with sub-consultants
- Distributed internal work-force over 3 different office locations
- Maintain data quality and versions
- Different modeling platforms

# 1-Dimensional

## *HEC-RAS*

*Possible to do it with GeoRAS, but has it's limitations*

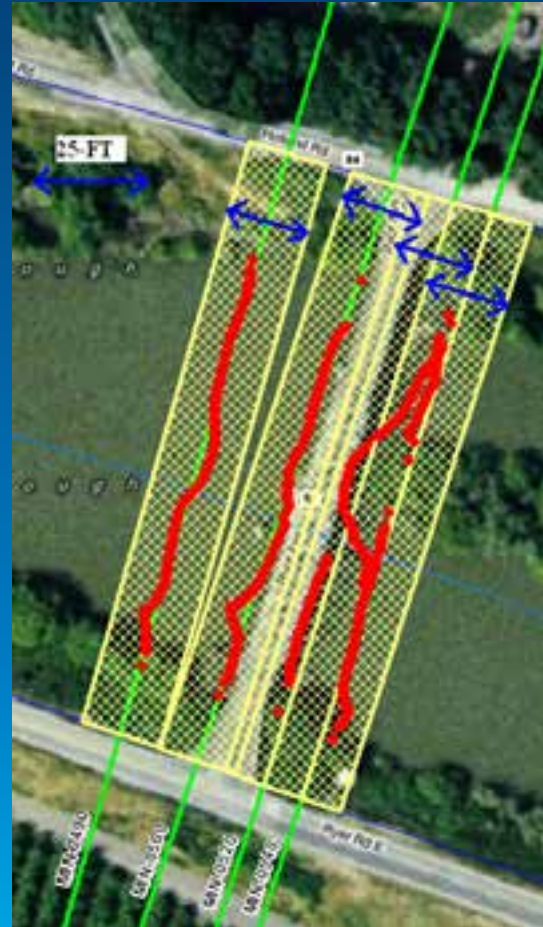
- Blending of multiple data sources for channel bottoms, new bathymetry, existing bathymetry, field survey, etc.
- Large amounts of data (e.g. DEMs)

# 1-Dimensional *HEC-RAS*



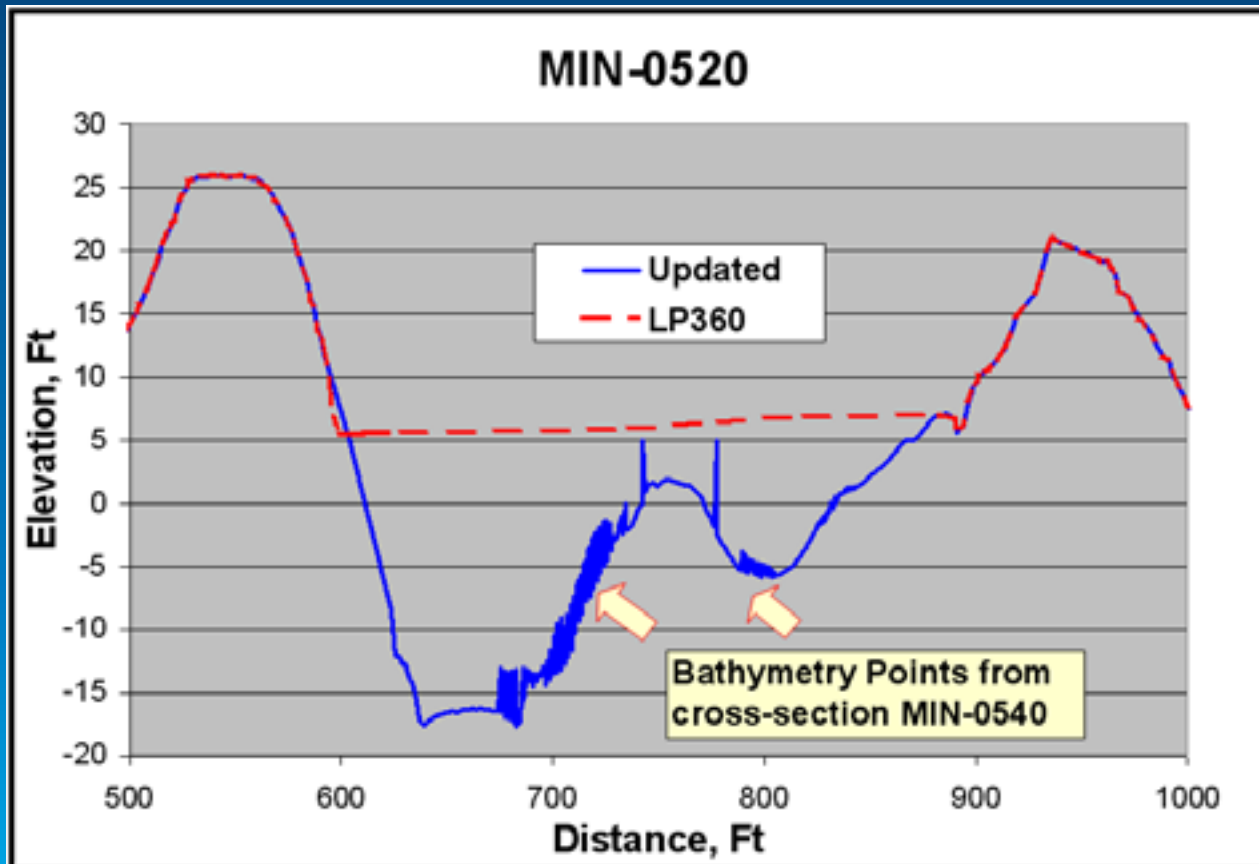


# 1-Dimensional *HEC-RAS*

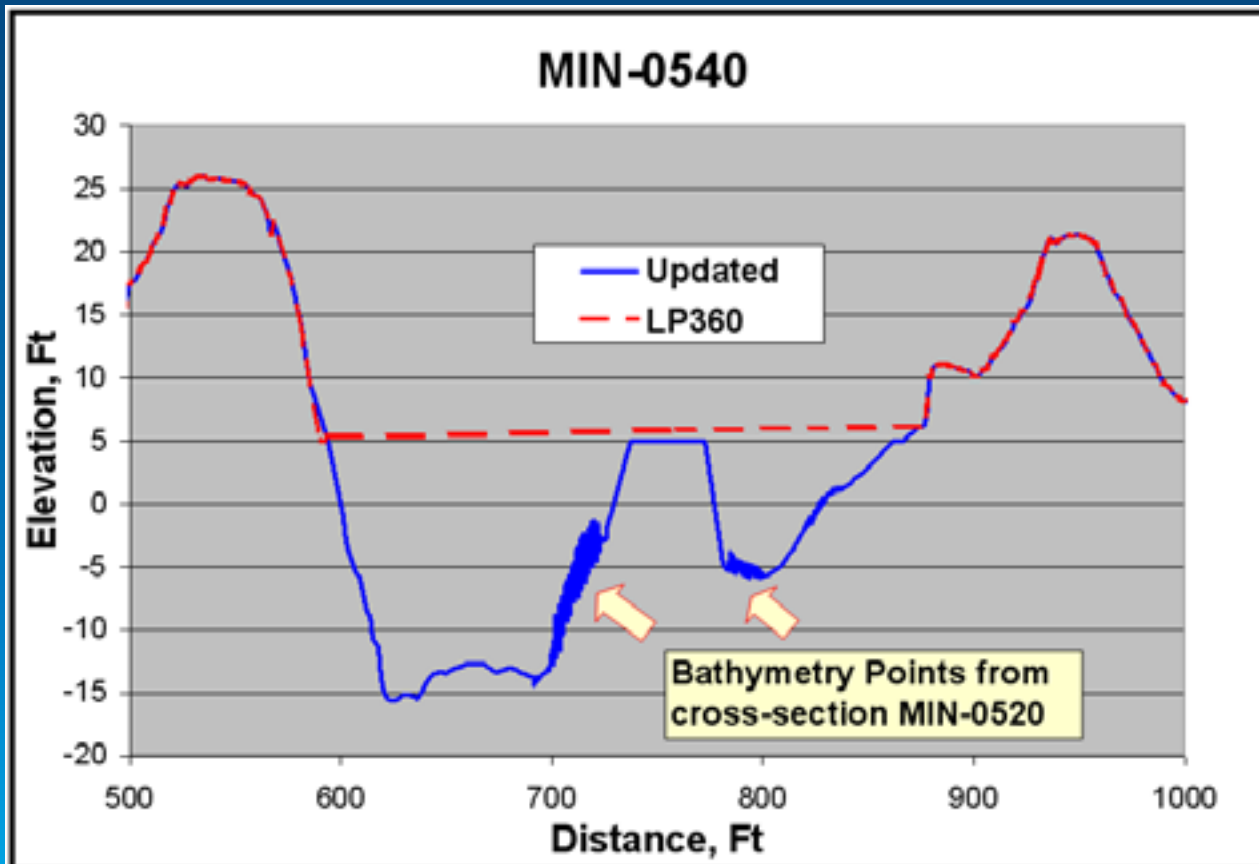




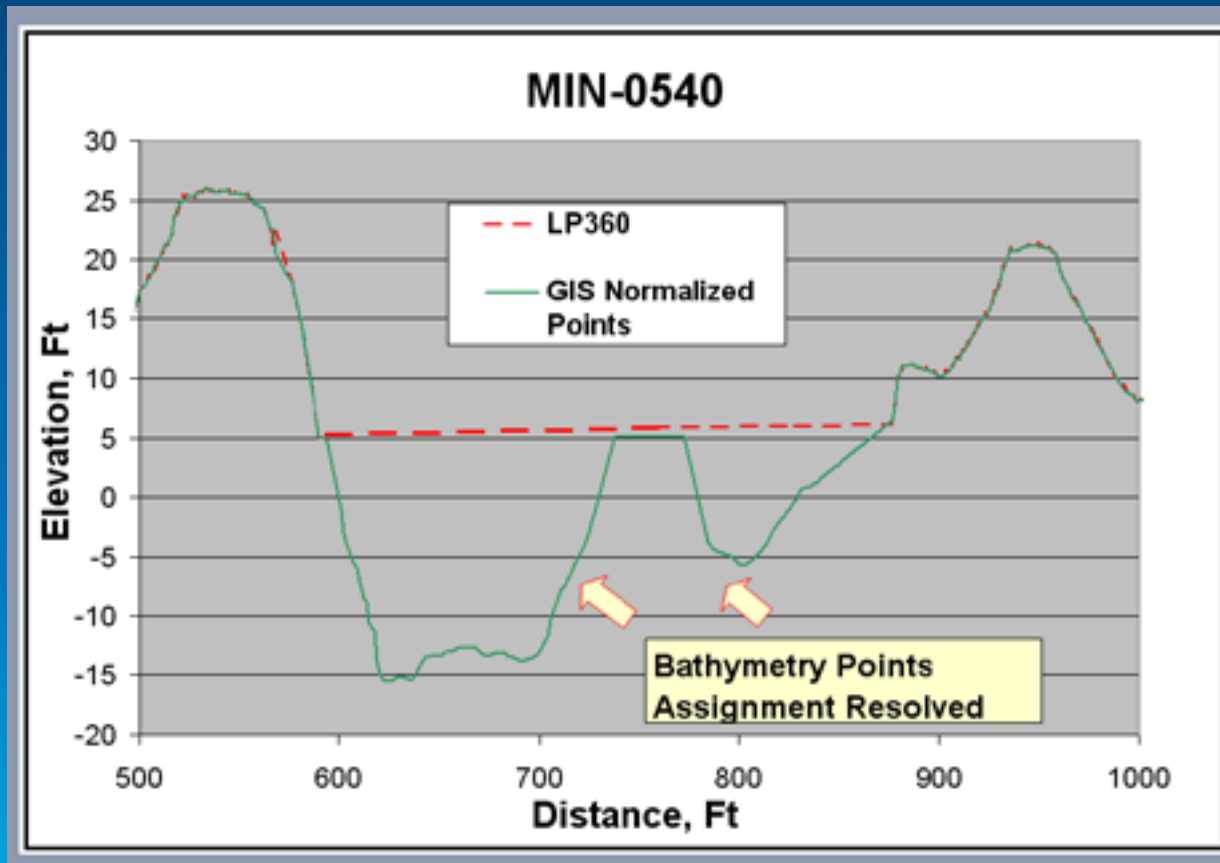
# 1-Dimensional *HEC-RAS*



# 1-Dimensional *HEC-RAS*



# 1-Dimensional *HEC-RAS*



# 1-Dimensional *HEC-RAS*

*Utilizing GIS and Esri's tools instead allowed for...*



A web based solution

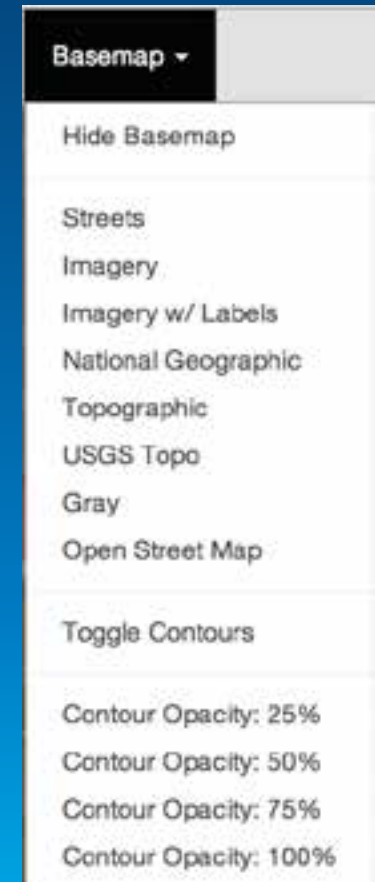
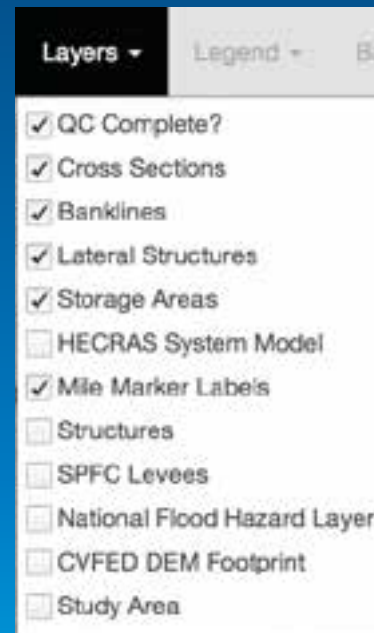
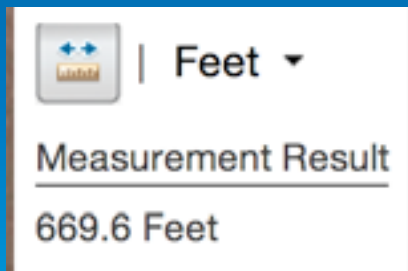
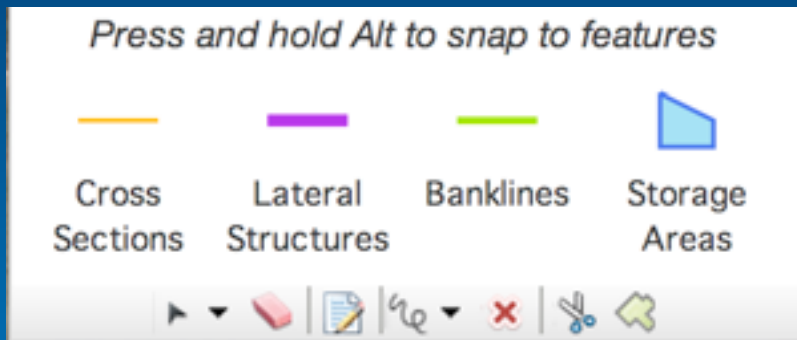
```
Start Time: 04/12/2014 18:32:17 PM
Checking 3D Analyst availability
Setting environment settings
Checking workspace...
  * creating GDB at C:\common\DMR\T034\Workspace.gdb
Processing...
  * GRS
    - exporting from SDE
      * stream centerline
      * banklines
      * cross Sections
    - creating 3D polyline
    - assigning bankline designation
Creating GeoRAS...
  - rivers
  - 2D cross sections
  - 3d cross sections
  - banklines
  - flowpath
  - calculating properties
Creating final output

End Time: 04/12/2014 18:34:46 PM
Processing Time: 2.5 minutes
```

Automated model input  
creation

# 1-Dimensional

*HEC-RAS: web based solution*



# 1-Dimensional

*HEC-RAS: automated model input creation*

```
Start Time: 04/12/2014 18:32:17 PM

Checking 3D Analyst availability
Setting environment settings
Checking workspace...
  * creating GDB at C:\common\DWR\T034\Workspace.gdb
Processing...
  * GRS
    - exporting from SDE
      * stream centerline
      * banklines
      * cross Sections
    - creating 3D polyline
    - assigning bankline designation
Creating GeoRAS...
  - rivers
  - 2D cross sections
  - 3d cross sections
  - banklines
  - flowpath
  - calculating properties
Creating final output

End Time: 04/12/2014 18:34:46 PM
Processing Time: 2.5 minutes
```

# 2-Dimensional

## *FLO-2D / TUFLOW*

*2D Modeling requirements differ from 1D Modeling...*

- Flow from HEC-RAS used as input in FLO2D grids
- Breaches from HEC-RAS need to be passed to FLO2D as variables



# 2-Dimensional *FLO-2D* / *TUFLOW*

Utilizing GIS and Esri's tools instead allowed for...



A web-based solution

**WOOD RODGERS**  
ADVANCED INNOVATIVE DESIGN SOLUTIONS

### FLO2D Buildouts

- American River North (ARN)
- American River South (ARS)
- Davis (DAV)
- Natoma Basin (NAT)
- West Sacramento (WES)
- Yuba City (YUB)

**Please Note:**  
By submitting the following form, a queue will be initiated and the FLO2D builds will be automatically e-mailed to the related engineers. Each domain takes about 5 minutes to build out.

**PLEASE do not spawn multiple queues.**

Automated build  
environment

# 2-Dimensional

## *FLO-2D: web-based solution*

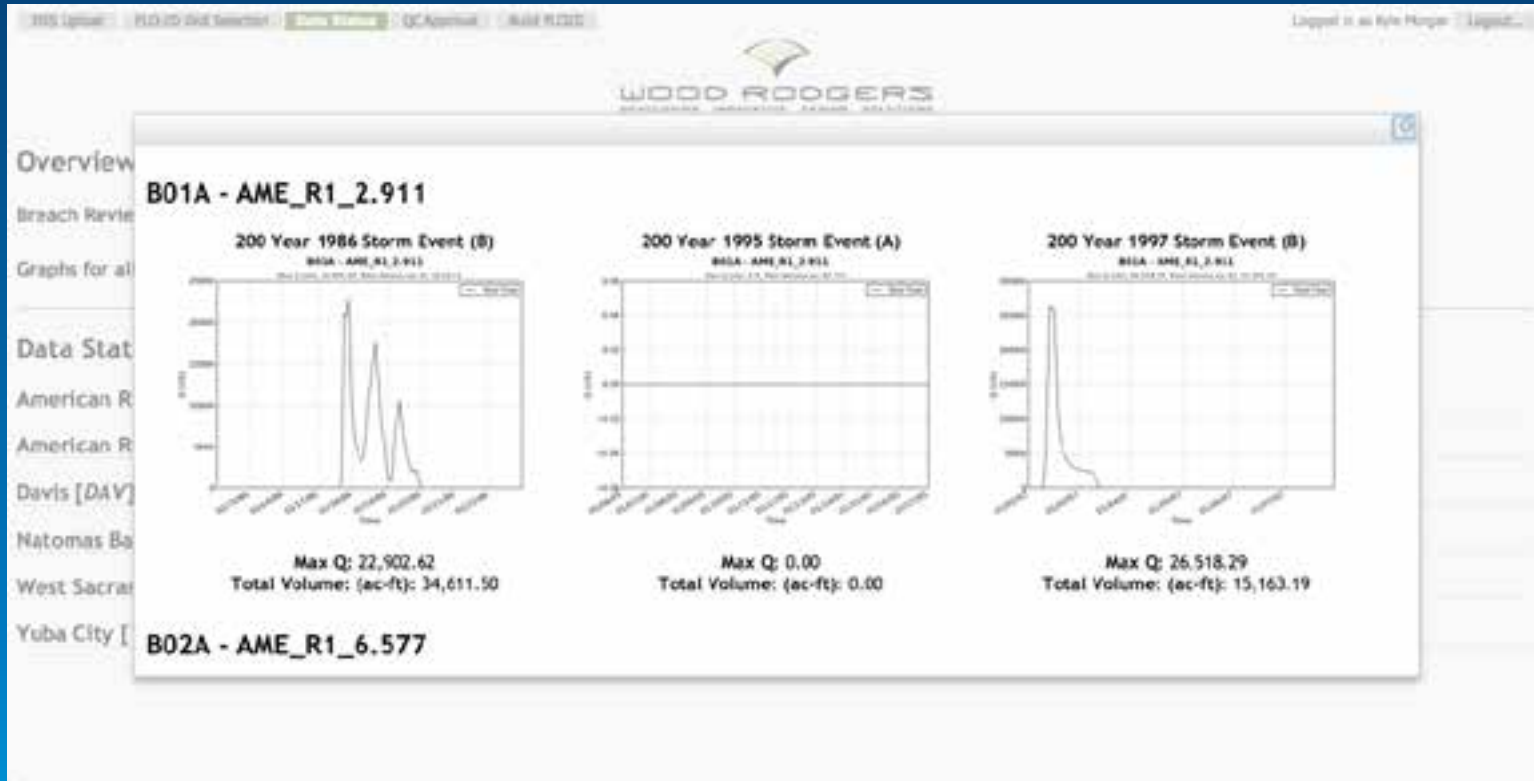


The screenshot shows a web application interface for uploading DSS files. At the top, there is a navigation bar with tabs: "DSS Upload" (highlighted in green), "FLO-2D Grid Selection", "Data Status", "QC Approval", and "Build FLO2D". On the right side of the navigation bar, it says "Logged in as Kyle Morgan" and "Logout...". Below the navigation bar is the Wood Rodgers logo, which includes a stylized umbrella icon and the text "WOOD RODGERS" and "DEVELOPING INNOVATIVE BRIDGE SOLUTIONS". The main heading is "DSS File Upload". Below this heading, there is a "DSS File:" label, a file selection button that says "Choose File" and "No file chosen", and a "Submit" button. Below the file selection area, there is a "Please Note:" section with the text: "Your DSS file name must be in the following format: [3 Letter Study Area Code]\_[Stream Event Code]\_[Breach ID].dss (e.g. ARN\_200\_36A\_BB1A.dss)".

Web-based DSS File upload tool

# 2-Dimensional

## *FLO-2D: web-based solution*



Advanced status reports with graphing

# 2-Dimensional

## *FLO-2D: web-based solution*



Simplified FLO-2D grid selection

# 2-Dimensional *FLO-2D: web-based solution*

The screenshot displays the FLO-2D web-based solution interface. The top navigation bar includes "BOS Upload", "FLO-2D Grid Selection", "Data Status: **QC Approved**", and "Build FLO-2D". The user is logged in as "Kyle Morgan".

The main map area shows a grid of cells over a river area. Several cells are highlighted in green, indicating they are selected. The selected grids are:

- 119709 (26.00) - 119710 (26.17)
- 120171 (27.66) - 120172 (27.83)
- 120632 (26.27) - 120633 (27.04)

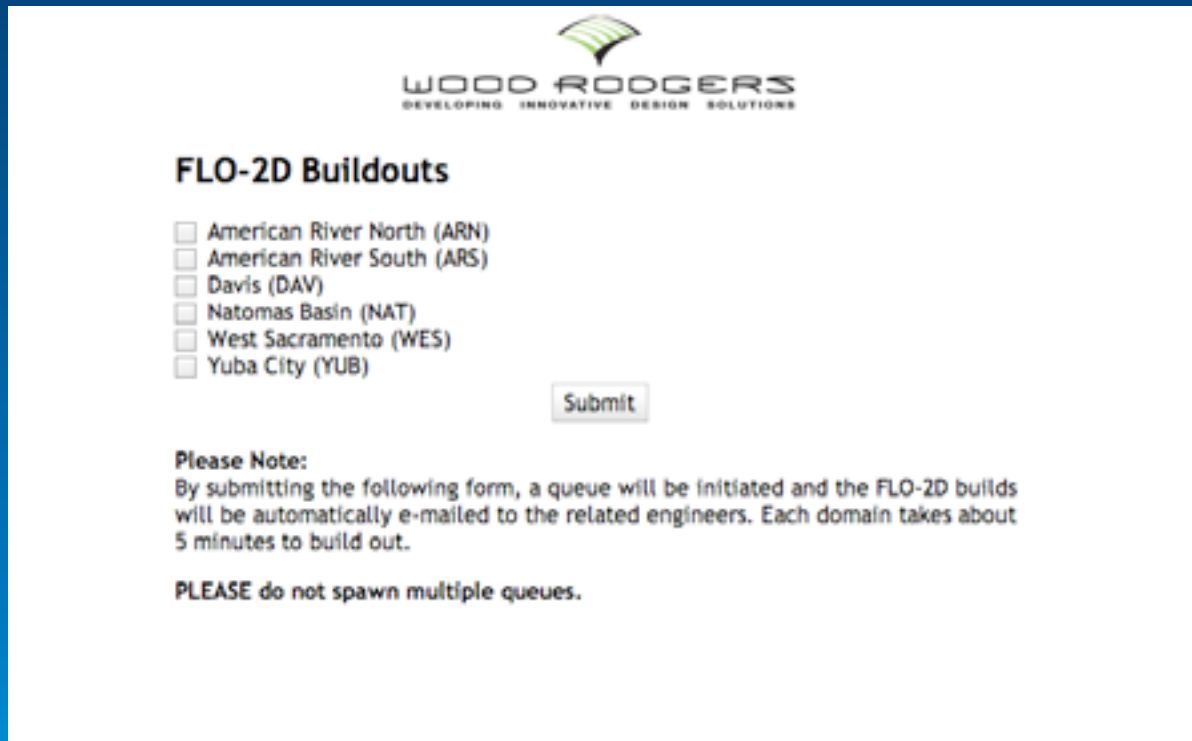
The right-hand panel, titled "Urban Area / Breach Selection", contains the following information:

- Study Area: American River North
- Storm Event: 200 Year 1986 Storm Event (B) [200\_368]
- Lateral Structure: B01A - AME\_R1\_2.9:1 (Y)
- Legend: (Y) - Approved, (N) - Not Approved/Reviewed, (No DSF) - Missing DSF File
- Selected Grids: 6
- Lateral Structure Details:
  - Length: 1,503.94 FT
  - Breach Width: 705.81 FT
  - Avg Top: 44.58 FT
  - Avg Toe: 28.86 FT
  - Trigger Elev: 34.38 FT
- Graph: AME\_R1\_2.9:1 (200 Year 1986 Storm Event (B)) showing a line graph of elevation (FT) vs. distance (FT).
- QC Notes: [Empty text box]

Integrated QC system

# 2-Dimensional

*FLO-2D: automated build environment*



The screenshot shows a web-based form for initiating FLO-2D builds. At the top center is the logo for Wood Rodgers, which includes a stylized green and yellow umbrella-like icon above the text "WOOD RODGERS" and the tagline "DEVELOPING INNOVATIVE DESIGN SOLUTIONS". Below the logo, the section is titled "FLO-2D Buildouts". There is a list of six domains, each with an unchecked checkbox: American River North (ARN), American River South (ARS), Davis (DAV), Natomas Basin (NAT), West Sacramento (WES), and Yuba City (YUB). A "Submit" button is located below the list. A "Please Note:" section follows, explaining that submitting the form initiates a queue and that builds are e-mailed to engineers, with a 5-minute build time per domain. A final instruction reads "PLEASE do not spawn multiple queues."

**WOOD RODGERS**  
DEVELOPING INNOVATIVE DESIGN SOLUTIONS

### FLO-2D Buildouts

- American River North (ARN)
- American River South (ARS)
- Davis (DAV)
- Natomas Basin (NAT)
- West Sacramento (WES)
- Yuba City (YUB)

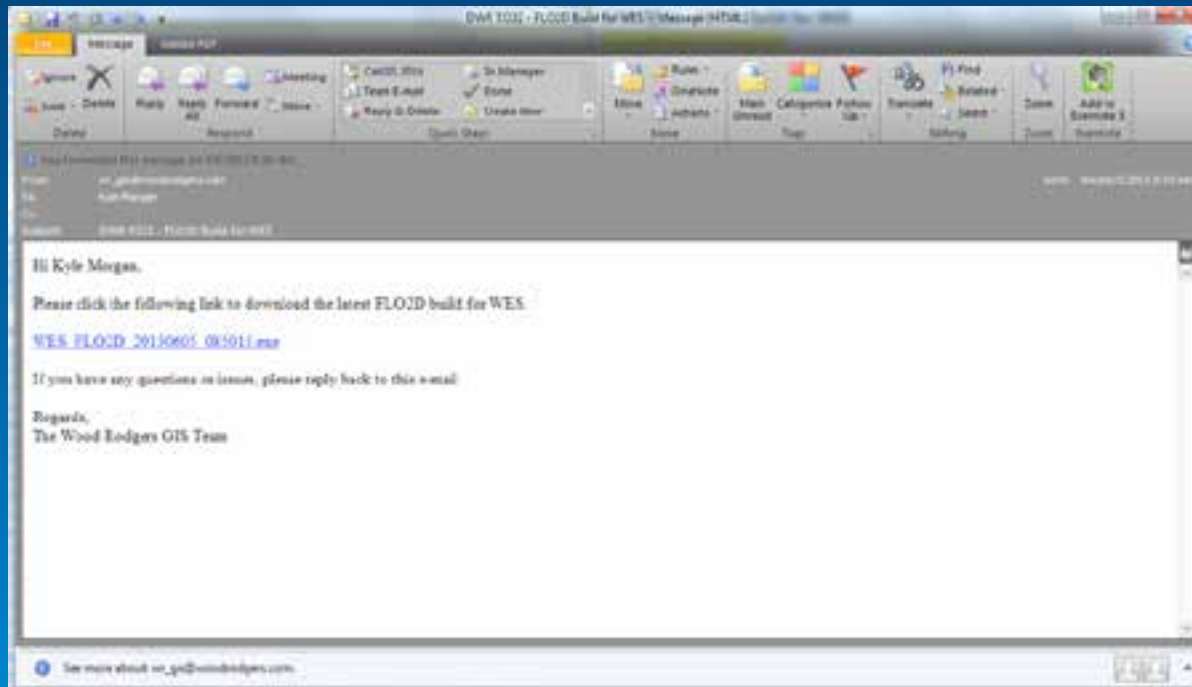
**Please Note:**  
By submitting the following form, a queue will be initiated and the FLO-2D builds will be automatically e-mailed to the related engineers. Each domain takes about 5 minutes to build out.

**PLEASE do not spawn multiple queues.**

Web-based initiator

# 2-Dimensional

*FLO-2D: automated build environment*



Email notifications



# Extra Benefits using GIS

- Model data starts and ends in GIS
- Max floodplain can be determined in GIS
- Data can be converted and used in other software

**Demo time!**

# Conclusion

- GIS can be used through the entire lifecycle of the project
- Requires proper planning
- Brunt of time shifts from middle and end of workflow to beginning
- Less rework and errors due to human element being removed
- Developing simple focused apps improved productivity

Questions?

**Kyle Morgan**

kmorgan@woodrogers.com

**Sheng Tan**

GISP,  
stan@woodrogers.com