# Final 2D Sediment Modeling Workshop

Over the course of this class, you have developed the tools you need to build and evaluate a sediment transport model. The objective of this workshop is to guide you through the process of building a realistic mobile-bed model to evaluate the relative effect of navigation structures.

**Warning**: The models in this workshop are intended for pedagogical purpose only. They have been simplified and modified to fit into a brief workshop and should not be used for scientific or engineering analysis.

### Part 1: Evaluate and Improve Your Mesh

We have provided you a terrain and mesh. The mesh is adequate for this exercise.<sup>1</sup> But open it and make any edits you would like. You can continue to edit the mesh through the hydraulic analysis, but after you associate the mesh with a second geometry and terrain, it is more difficult to make changes.

#### Part 2: Build a Flow File and Run Hydraulics

- <u>Define a Flow Hydrograph for Your Upstream Boundary Condition</u>. Open the unsteady flow file. Select the Upstream Boundary condition already associated with the geometry. Select the Flow Hydrograph button Flow Hydrograph to define upstream flows.
- Set an EG Slope: Set the EG Slope for distributing flow along BC Line. Set it a little higher than you might expect. Then click the TW check which will drive the boundary condition.
- Select the DSS flow file: The flows for this pool are in the DSS file Pool3\_hourly\_TW\_Release.dss in the Flow Data folder. Select the Read from DSS before simulation radio button and press the Select DSS file and Path button.
   Select DSS file and Path

Flow Hyd	drograph					
2D: Bend Model BCLine: US BC						
Read	from DSS before simulation		Select DSS file and Path			
File:	File: ises\Little Rock 2D Sed\Workshops\Proof of Concept 4 Structure Model\Flow Data\Pool3_hourly_TW_Release.dss					
Path:	/ARKANSAS/LD03/REL.TOT/	/01SEP2010-01SEP2022/1HOUR/OBS	6/			

<sup>&</sup>lt;sup>1</sup> Note: the cell size is probably too large for an engineering analysis. But we developed this mode for workshopappropriate runtimes.

This DSS file only has two "paths." One is a stage, the other is a flow series. Select the fow series **REL.TOT**. Press the **Show Plot** option at the bottom of the editor to view the data.

🔚 2D:	Bend Model BCLine: US BC: F	low							-		$\times$
File Op	otions Utilities										
∧ File	Count: 2 Time Window:	Invalid Time Windo	w								
	Jse FileName d:\Classes\_Little Rock 21							Time Window			•
	d:\Classes\_Little Rock 20	D Sed\Workshops\Pr	oof of Conce	pt 4 Structure Mode	I\FixedBedSe	d.dss	12, 👻				
Genera	l Filter:					Apply					
Last Ap	plied Filter:					Path Co	unt: 2 / 90				
Row #	File Name	Туре	Part A	Part B	Part C	Part D	Part E Part	t F		Data Unit	T VV2
1	Pool3_hourly_TW_Release	RegularTimeSeries	ARKANSAS	LD03	REL.TOT	01SEP2010-01SEP2022	1HOUR OBS	;	INST-VAL	CFS	
2	Pool3_hourly_TW_Release	RegularTimeSeries	ARKANSAS	LD03	TAILWATER	01SEP2010-01SEP2022	1HOUR OBS		INST-VAL	FT-MSL	
Y Show	w Plot										
Selected	I Path:								(	ок с	Cancel

- 4. <u>Set the Downstream Boundary Condition</u>: Choose the field associated with the downstream boundary condition. Select the Rating Curve option. <u>Rating Curve</u> Enter the Rating Curve data from the excel data file provided. (Note: These data came from the steady flow model.)
- 5. Save your flow data. Call it "October 2019."
- 6. <u>Create an Unsteady Plan</u>: Open the Unsteady Analysis (plan) Editor 4. Choose a simulation that isolates one of the modest flow events in fall of 2018 (early WY 2019).

1	<ul> <li>Simulation Time Window</li> </ul>				_
	Starting Date:	08Oct2018	Starting Time:	0000	
	Ending Date:	17Nov2018	Ending Time:	0000	

Choose and appropriate time step and select your hydraulic computational options. Select the **Options**→**Computation Options and Tolerances** menu. Make sure you either initialize or warmup the model, select appropriate hydraulic and turbulence equations and parameters, and set **Solver Cores** to **4 Cores**.

7. Simulate and Evaluate Hydraulics. Before you add sediment, simulate and evaluate the hydraulics. Make any mesh updates before you add a second geometry that will replicate this mesh. Runtimes should be between 2-4 minutes. If it looks like it is going to run for a long time, re-evaluate some of your simulation parameters.

## Part 3: Add Sediment Data and Run Sediment Model

8. <u>Add Sediment Data and Parameters</u>. Open the sediment file, add sediment data, and set sediment parameters.

#### Leave the Morphological Acceleration Factor = 1 For Now

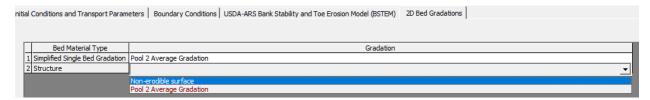
Make sure to update the following:

Bed Gradation	Transport Function
Sediment Boundary Condition	Mixing Algorithm
Bed Mixing Options	Adaptation Coefficient
(e.g. Hiding and Active Layer)	

Check the **Sediment** box in the plan editor, add the sediment file to your plan, and simulate.

Sediment

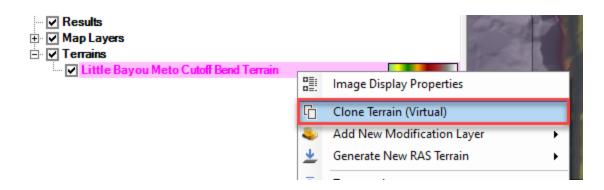
The Sediment Bed Gradation Layer in Mapper does have Structures defined. You can set these to Non-Erodible Surfaces in the **2D Gradation** editor.



## Part 4: Clone and Mod Your Mesh to Remove the Structures

This analysis will be inverted from most study models. Generally, a study team adds proposed structures to a mesh to simulate the results of these structures. But in this case, we have a terrain with structures that we know prevented deposition. In this case comparison requires us to remove the structures from the mesh.

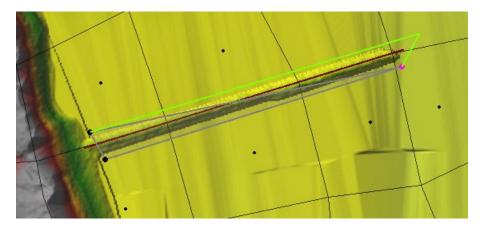
- 9. <u>Clone Your Terrain</u>. Instead of copying the terrain and adding another large file to your dive, RASMapper allows users to "clone" the terrain, which just points to the original terrain and keeps track of modifications.
- 10. <u>Add Sediment Data and Parameters</u>. Open the sediment file, add sediment data, and set sediment parameters.



 Remove Structures from Cloned Terrain: Right click on the cloned terrain and select Add New Modification Layer. Choose Polygon → Multipoint. Give it a name (e.g. Remove Structures).

⊡ 🔽 Terrains		ain	· · · · ·	1.1.1.1
E ✓ Little Bayou Meto Cutoff I		Image Display Properties	Let to	1.1.
	G	Clone Terrain (Virtual)	N.H.T	•
	۵	Add New Modification Layer	Shapes 🕨	$\overline{1} \cdot 1 \cdot 1 \cdot 1$
	<u>+</u>	Generate New RAS Terrain	Lines 🕨	it.t.t.
	ାର୍ଦ୍ଦି।	Zoom to Layer	Polygons 🕨	Multipoint
	6 <del>0</del>	Add Watch to Layer Values		Rectangle
		Remove Laver		Auto Fill No Data Regions
		🚼 Name?	×	
		Provide a name:		
		Remove Structures		
			OK Cancel	

Trace the outline of the structures with the multi-point polygon tool. Double click to finish.



You will use the defaults in the Polygon Mod editor. Give the mod a name (I named the them "Structure 1," "Structure 2", etc from upstream to downstream.

🚟 Polygon Mod Editor	×				
Name:	Structure 2				
Modification Method:	Replace Terrain Value				
Perimeter Profile Mode					
Use Terrain Elevations OR Control Points Override					
C Use Imported Shapefi	ile Z values *				
C Use Constant Elevati	on: 0 ft*				
* Perimeter control p	oints have no effect				
Snapping Tolerance	(ft): 20 ?				
ОК	Cancel Apply				

You will **Use Terrain Elevations** from the perimeter to override the terrain in the polygon, and use the **Replace Terrain Value** Modification Method. Press OK. Your structure should disappear.

**Note:** If your structure does not seem to disappear, you may still have your original terrain visible over top your modified clone. Make sure you turn off the original.

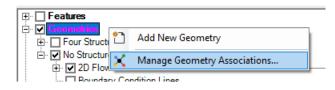


#### Part 5: Copy Geometry File and Associate New Terrain and Layers

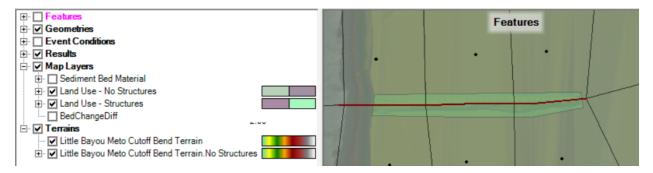
12. <u>Copy Geometry File</u>: To compare the effect of the structures we want to keep the mesh the constant, but switch the terrain and roughness. Right click on the Geometry and choose **Save Geometry As...** Give the new geometry a descriptive name like "No Structures".

Geometries     Four Structures	n=-	
🕀 🗹 2D Flow Areas		RAS Geometry Properties
Boundary Condition     (15 Empty Layers)	0	Edit Geometry
Event Conditions	Q	Validate Geometry
Results	G	Save Geometry As
Map Layers	×	Delete Geometry
Little Bayou Meto Cutoff	6	View Geometry in 3D
🚟 Save Data As		×
Enter a unique Name for the new G	eometry	<i>r</i> .
No Structures		
,		
		OK Cancel

13. <u>Associate Appropriate Layers with New Geometry</u>: Right Click on the Geometries heading and select Mange Geometry Associations to associate the new terrain and appropriate layers with your new geometry.



The project has two **Land Use Layers** including one with and one without structures. We associated a n-value of 0.07 with the structures. So it is important not just to remove the structures but also the n-values in the new project.



Change the Terrain and Manning's n Land Use to the "No Structure" options. The Sediment Bed Material has structures in it, but you can just switch that from Non-Erodible Surface to the gradation in the "No Structure" Model.

Туре	RAS Geometry	Terrain		Manning's n	Infiltrati	% Imperv	Sediment Bed Materia	l Lay
Conneter	Layers	Little Deven Mate Coteff David Terrain		Land Use - Structures	( _1	( <b>v</b>	Sediment Bed Material	
Geometry	Four Structures	Little Bayou Meto Cutoff Bend Terrain Little Bayou Meto Cutoff Bend Terrain.No_Structures	•	(None)	( <u> </u>	( <u>•</u>		-

## Part 6: Create a New Sediment File

14. **Update Structure Bed Gradation:** The only change you should have to make in your sediment file is the structure bed gradation. You could make a new Sediment Bed Material layer in mapper with no structures in it. But you can also just set the bed gradation in the no-structure sediment file to the model gradation (see next figure). Switch this gradation and save the sediment file as a no-structure file.

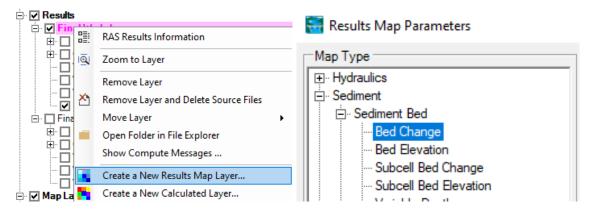
ediment Data - Wu Sediment					_	
Options View Help						
				1		
Conditions and Transport Parame	eters Boundary Conditions	USDA-ARS Bank Stability and Toe Erosion Model (BST	EM) 2D Bed Gradations			
Bed Material Type		Grada	ion			
Bed Material Type		e Grada	ion			
I Simplified Single Bed Gradation	Pool 2 Average Gradation 🔺	Grada	ion			
	Pool 2 Average Gradation 4	Grada	ion			
1 Simplified Single Bed Gradation 2 Structure	-	Grada	ion			
L Simplified Single Bed Gradation Structure	Pool 2 Average Gradation		ion			

## Part 7: Run No-Structure Plan

15. <u>Run No-Structure Plan</u>: You should not have to change the flow file or sediment file. Make a new plan, switch the geometry file, and simulate.

## Part 8: Compare Results With and Without Structures

16. <u>Add Bed Change Results to Both Plan Results</u>: Right Click on each plan result (with and without structures) and select **Create a New Results Map Layer**. Add **Bed Change**.



17. <u>Create a Calculated Map Layer</u>: Sediment models are mostly useful for *relative* results rather than absolute results. The difference in bed change with and without the structures will be much more informative than the absolute change. So you will use the **Raster Calculator** to compare the bed change results (to generate a  $\Delta$  Change map).

📻 RA	S Mapper		
File	Project	Тос	ls Help
		Ф	Options
	Features		Create Calculated Layer
	Geometrie		Create Multiple Maps

Select the **Tools→Create Calculated Layer** tool.

18. <u>Define Bed Change Results as Variables</u>: Press the "+" button to add each bed change result as a variable. Select the plan name and **Bed Change** map type. Give them descriptive names that indicate whether they have the structures or not.

RASter C	alculator					$\times$
Script	User Defined		Raster Layer	s	· ·	to Cutoff Bend Te
💶 Create	Raster Layer Definition					×
	Plan	Мар Туре	•	Animation Behavior	Profile	e T
Definition:	Final Workshop	▼ Bed Change	•	Dynamic	•	
Struc = I	Final Workshop   Bed		Name: Struc	]	Add Variable	Close
Creat	e Raster Layer Definitio	n				×
	Plan	Мар Тур	e	Animation Behavio	r Profi	le
Definition	Final Workshop (no S	itrux 💌 Bed Change	-	Dynamic	•	<b>–</b>
NoStru	ic = Final Workshop (i	no Struc)   Bed Change	<b>IIDynamic</b> Name: NoS	ruc	Add Variable	Close

19. <u>Write No Data Statement</u>: The RASter calculator writes a default If loop to handle no data cases. You will add your second result to so it reads like the right hand code below.

If Struc = No Data Then	If Struc = No Data andalso NoStruc = No Data Then
Output = No Data	Output = No Data
Else	Else
Output = <mark>Struc</mark>	Output = <mark>Struc</mark>
End If	End If

20. <u>Write Math Statement</u>: The first statement of the No Data Loop catches the No Data Case (which we should not have because our meshes are identical, but it is still good practice). So we want to difference the results in the second statement.

Output = Struc - NoStruc

No Struc = Final Workshop (no Struc)   Bed Change         Image: Structure - Final Workshop (no Struc)   Bed Change         Image: Structure - Final Workshop (no Struc)   Bed Change         Image: Structure - Final Workshop (no Struc)   Bed Change         Image: Structure - Final Workshop (no Struc)   Bed Change         Image: Structure - Final Workshop (no Struc)   Bed Change         Image: Structure - Final Workshop (no Struc)         Image: St									
	s Bayou Meto Cutoff Bend Te Bayou Meto Cutoff Bend Te								
Raster Output         Folder:       d:\Classes\_Little Rock 2D Sed\Workshops\3.6 Culminating Modeling Workshop\Solution\Calculated Layers         Name:       BedChangeDiff         Create Layer       Close									

Give the result a descriptive Name and press Create Layer.

21. Select a Good Display Color Ramp for Difference Result: Right click on your calculated result and select Image Display Properties and press the Edit Button. Use the Bed Change color ramp, and set symmetrical Max and Min. Then press the Create Ramp Values. I also like to set Alpha of the white 0.00 to 0, so it is transparent. You can also set a narrower band of transparency by adding values.

#### 22. Evaluate Results, Make Adjustments, Rerun.

Select Surface Fill — 🗆 X						][	🚟 Select Surface Fill			_	- 🗆	×		
-Surface Symbol Settings Available Color Ramps: 🔽 RAS Defaults 🔽 User Defined						-Surface Symbol Settings Available Color Ramps: 🔽 RAS Defaults 🔽 User Defined								
Color Ramp:	Bed Change	Color Ramp: Custom												
Surface Symbol														
Max: 2 Use Dataset Min/Max Max: 200 Use Dataset Min/Max														
Min: -2 No. Values: 3 Create Ramp Values							Min: -2.00 No. Values: 5 Create Ramp Values							
✓ Keep user Values with color ramp change						☐ Keep user Values with color ramp change								
Value	Color	Red (0-255)	Green (0-255)	Blue (0-255)	Alpha (0-255)		Value	Color	Red (0-255)	Green (0-255)	Blue (0-255)	Alpha (0-255)		
-2.00		255	0	0	255	Ш	-2.00		255	0	0	255		
0.00		255	255	255	0	Ш	-0.50		255	128	128	255		
2.00		0	0	255	255	Ш	0.00		255	255	255	0		
						Ш	0.50		128	128	255	255		
							2.00		0	0	255	255		
Reverse Colors         Save Color Ramp														
			ОК		Cancel					ОК		Cancel		

