

Adding 2D Sediment Data and Viewing Results



Stanford Gibson, PhD and Alex Sánchez, PhD



Adding 2D Sediment Data and Viewing Results



Adding 2D Sediment Data

- I. Select Equations
- II. Sediment Boundary Conditions
- III. Define Bed Gradations



Viewing 2D Sediment Results

- I. Add 2D Result Maps
- II. View Time Series
- III. Profile Lines

Adding 2D Sediment Data and Viewing Results



Adding 2D Sediment Data

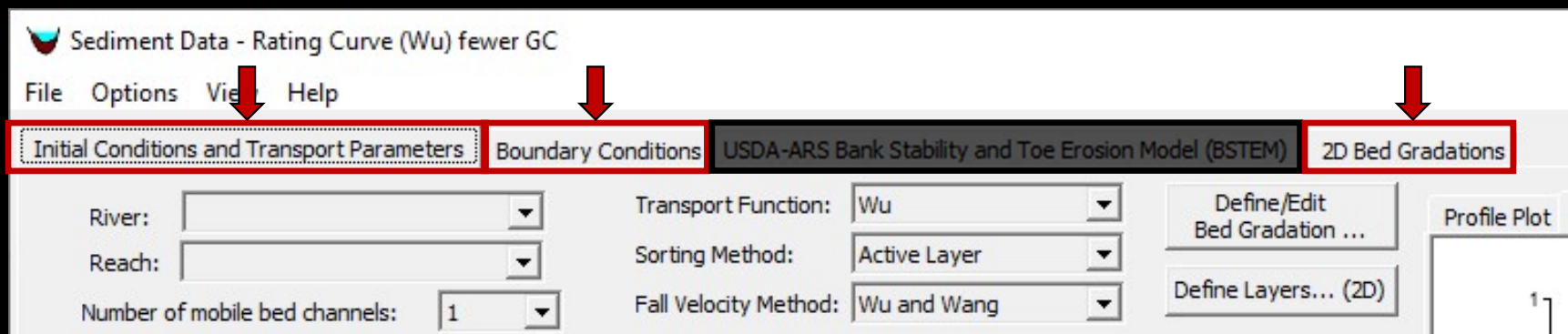
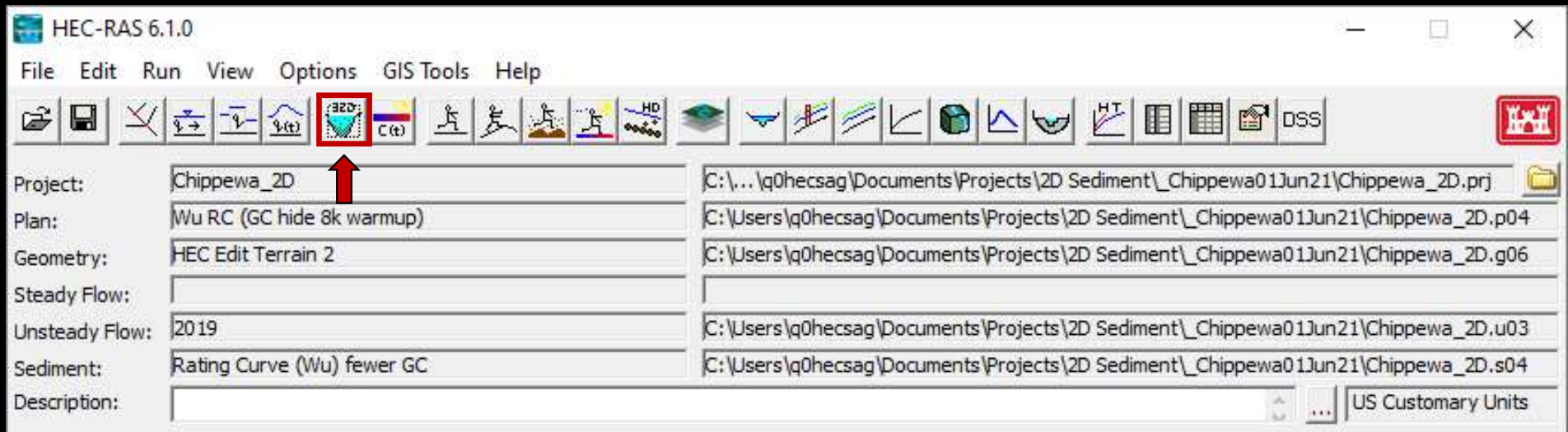
- I. Select Equations
- II. Sediment Boundary Conditions
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Viewing 2D Sediment Results

- I. Add 2D Result Maps
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Adding Sediment Data



Adding 2D Sediment Data and Viewing Results



Adding 2D Sediment Data

I. Select Equations

I. Initial Conditions and Transport Parameters

Sediment Data - Rating Curve (Wu) fewer GC

File Options View Help

Initial Conditions and Transport Parameters | Boundary Conditions | USDA-ARS Bank Stability and Toe Erosion Model (BSTEM) | 2D Bed Gradations

River:	<input type="text"/>	Transport Function:	Wu	Define/Edit Bed Gradation ...	Profile Plot
Reach:	<input type="text"/>	Sorting Method:	Active Layer	Define Layers... (2D)	
Number of mobile bed channels:	1	Fall Velocity Method:	Wu and Wang		1

Initial Conditions and Transport Equations

Sediment Data - Rating Curve (Wu) fewer GC

File Options View Help

Initial Conditions and Transport Parameters | Boundary Conditions | USDA-ARS Bank Stability and Toe Erosion Model (BSTEM) | 2D Bed Gradations

River:

Reach:

Number of mobile bed channels:

Transport Function: Wu

Sorting Method: Active Layer

Fall Velocity Method: Wu and Wang

Define/Edit Bed Gradation ...

Define Layers... (2D)

River	Reach	RS	Invert	Max Depth	Min Elev	Left Sta	Right Sta	Bed Gradation
1								

Profile Plot | Cross Section Plot

Elevation

Station

Use Banks for Movable Bed | Interpolate Gradations

Description : ...

Initial Conditions and Transport Equations

Transport Function:	Wu	Define/Edit Bed Gradation ...
Sorting Method:	Active Layer	Define Layers... (2D)
Fall Velocity Method:	Wu and Wang	

Equations

Gradations
Define Here
Use Later

Initial Conditions and Transport Equations

Transport Function:	Wu
Sorting Method:	Active Layer
Fall Velocity Method:	Wu and Wang

Transport Function

2D sediment can work with any Transport Function
But the Bottom three are 2D-Specific
Use Caution applying 1D Functions in 2D Models
This has little precedent and may be poorly Specified

Ackers-White	▲
Engelund-Hansen	
Laursen (Copeland)	
Meyer Peter Muller	
Toffaletti	
MPM-Toffaletti	
Yang	
Wilcock-Crowe	
Soulsby-van Rijn	
van Rijn	
Wu	▼

Initial Conditions and Transport Equations

Transport Function:	Wu
Sorting Method:	Active Layer
Fall Velocity Method:	Wu and Wang

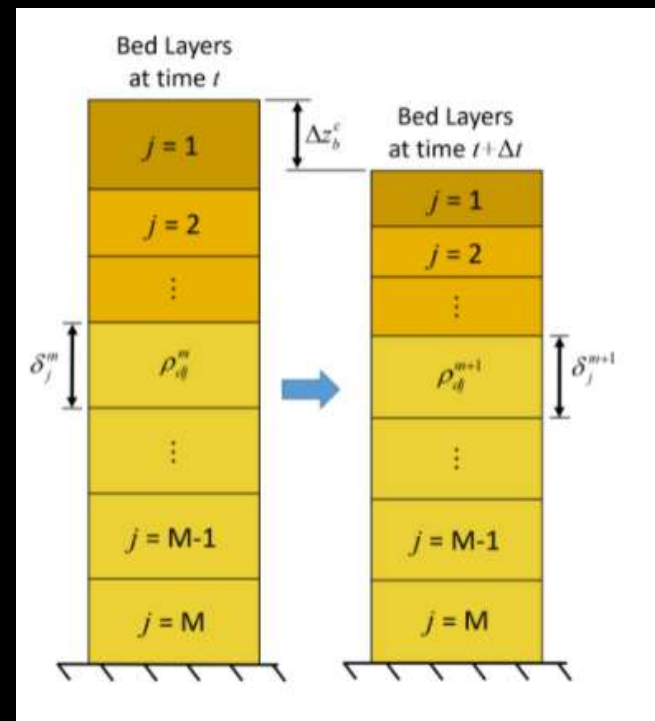
Thomas (Ex5)

Active Layer

Copeland (Ex7)

Sorting/Mixing Method

- Thomas and Copeland are 1D Specific
- It Doesn't Matter What You Choose
- HEC-RAS will Use "Active Layer"
- But the 2D Active Layer \neq 1D Active Layer
- 2D Active Layer Model is Superimposed on a More Sophisticated Multi-layer Stratigraphy



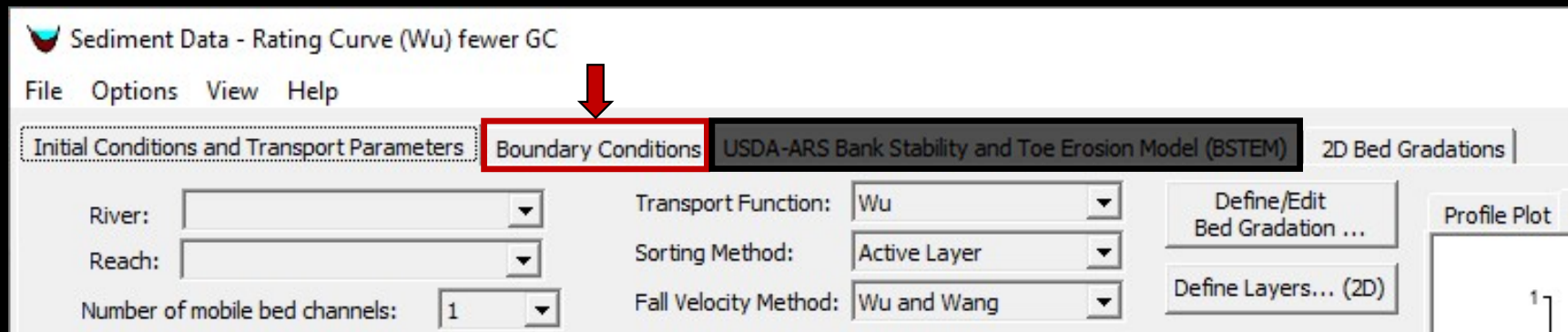
Adding 2D Sediment Data and Viewing Results



Adding 2D Sediment Data

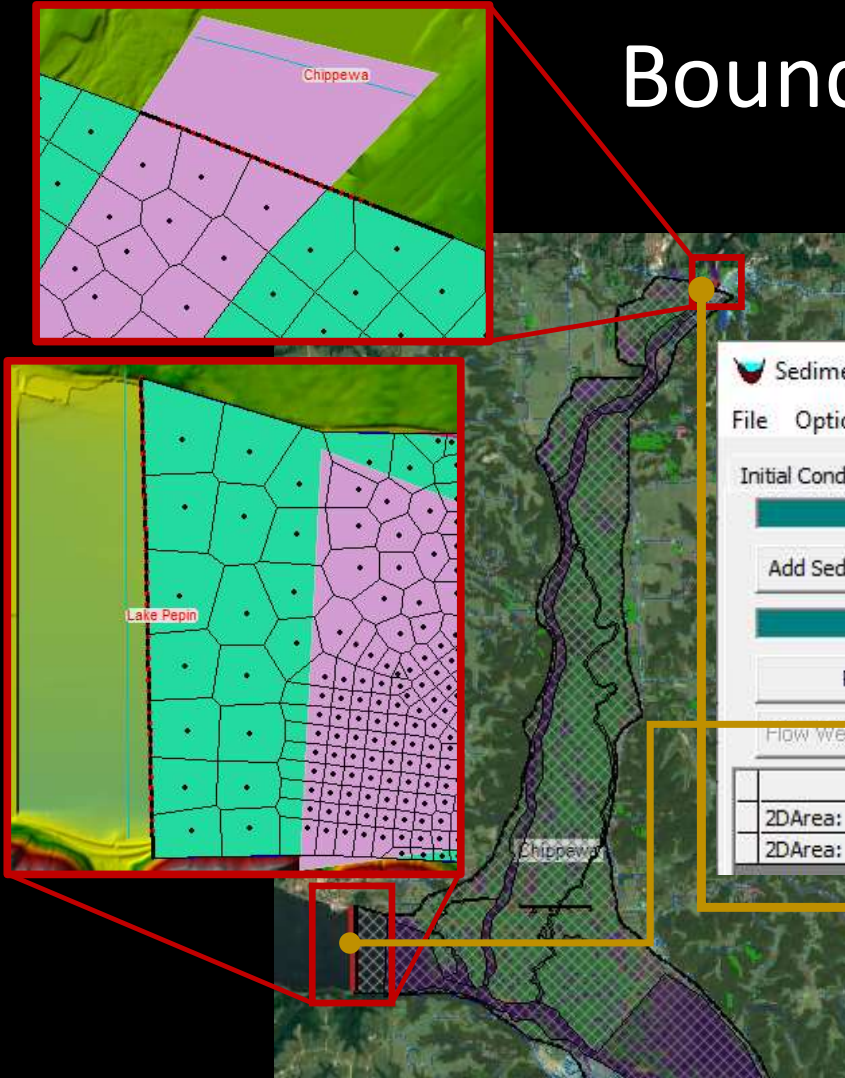
- I. Select Equations
- II. Sediment Boundary Conditions

II. Sediment Boundary Conditions



Boundary Conditions

Define a Sediment Boundary Condition for Each Hydraulic Boundary Condition



Sediment Data - Rating Curve (Wu) fewer GC

File Options View Help

Initial Conditions and Transport Parameters **Boundary Conditions** USDA-ARS Bank Stability and Toe Erosion Model (BSTEM) | 2D Bed

Select Location for Sediment Boundary Condition

Add Sediment Boundary Location(s) Delete Current Row Define Sediment Split at Junction...

Sediment Boundary Condition Types

Rating Curve	Sediment Load Series	Equilibrium Load	Clear Water (no Sediment)
Flow Weighted Sediment Split	Potential Weighted Sediment Split	Q Wtd Sed Split (Threshold)	Sediment Split by Grain Class

2D Area:	BCLine	Lake Pepin	Equilibrium Load
2D Area:	BCLine	Chippewa	Rating Curve

There are Four Sediment Boundary Conditions

1. Rating Curve
2. Time Series
3. Equilibrium
4. Clear Water

Rating Curve

Rating Curve for KansasRiver KansasRiver 143.80

Number of flow-load points: 4 sets

Flow (cfs)	100	1000	5000	25000
Total Load (tons/day)	9	150	1099	8030
Clay	14.5	14.5	14.5	14.5
VFM	1.5	1.5	1.5	1.5
FM	1.5	1.5	1.5	1.5
MM	3.7	3.7	3.7	3.7
CM	3.7	3.7	3.7	3.7
VFS	3.6	3.6	3.6	3.6
FS	10.8	10.8	10.8	10.8
MS	44.4	44.4	44.4	44.4
CS	11.9	11.9	11.9	11.9
VCS	4.3	4.3	4.3	4.3
VFG				
FG				
MG				
CG				
VCG				
SC				

Define Diversion Load Load Concentration Conc<-->Load Plot ... OK Cancel

Both these boundary conditions require grain class fraction estimates

Sediment Time Series

Sediment Load Series

Select/Enter the Data's Starting Time Reference

Use Simulation Time: Date: 01Apr2019 Time: 24:00

Read Load From DSS

Fixed Start Time: Date: Time:

Manual Entry | DSS

Sediment Series					Gradation Rating Curve	
No.	Ordinates	Interpolate Values	Import Dur	Del Row	Ins Row	Number of flow-load points
	Simulation Time	Elapsed Time (hours)	Duration (hours)	Sediment Load (tons)		2 sets
1	01Apr2019 2400					Total Load (tons/day)
2	01Apr2019 2400					Clay (0.002-0.004)
3	01Apr2019 2400					VFM (0.004-0.008)
4	01Apr2019 2400					FM (0.008-0.016)
5	01Apr2019 2400					MM (0.016-0.032)
6	01Apr2019 2400					CM (0.032-0.0625)
7	01Apr2019 2400					VFS (0.0625-0.125)
8	01Apr2019 2400					FS (0.125-0.25)
9	01Apr2019 2400					MS (0.25-0.5)
10	01Apr2019 2400					CS (0.5-1)
11	01Apr2019 2400					VCS (1-2)
12	01Apr2019 2400					VFG (2-4)
13	01Apr2019 2400					FG (4-8)
14	01Apr2019 2400					MG (8-16)
15	01Apr2019 2400					CG (16-32)
16	01Apr2019 2400					VCG (32-64)
17	01Apr2019 2400					SC (64-128)
18	01Apr2019 2400					LC (128-256)
19	01Apr2019 2400					SB (256-512)
20	01Apr2019 2400					MB (512-1024)
21	01Apr2019 2400					LB (1024-2048)
22	01Apr2019 2400					
23	01Apr2019 2400					
24	01Apr2019 2400					
25	01Apr2019 2400					
26	01Apr2019 2400					
27	01Apr2019 2400					

DSS Time Series: Alpha Version
Might be in Version 6.2

OK Cancel

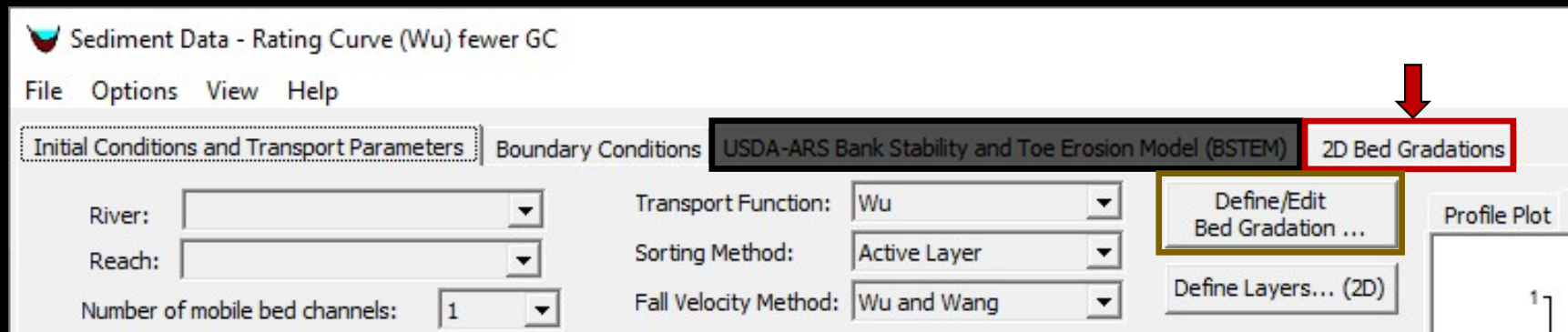
Adding 2D Sediment Data and Viewing Results



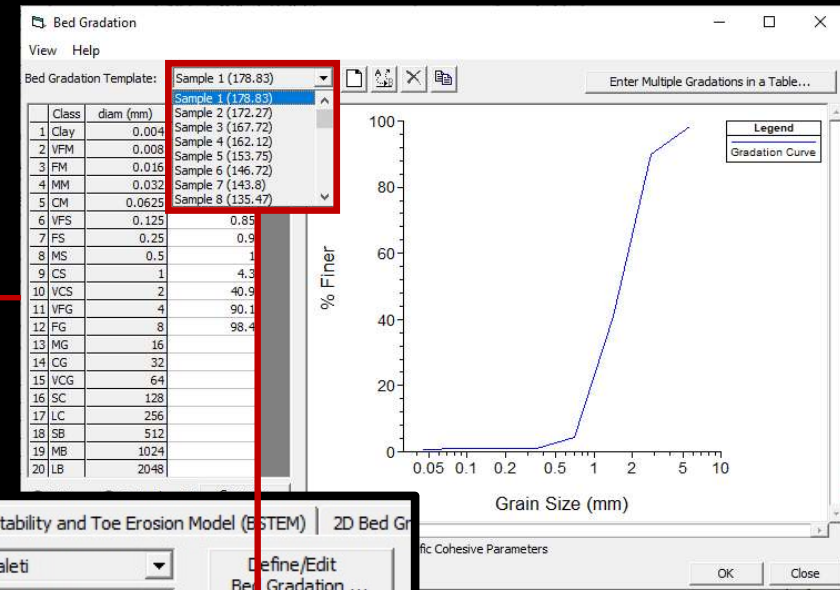
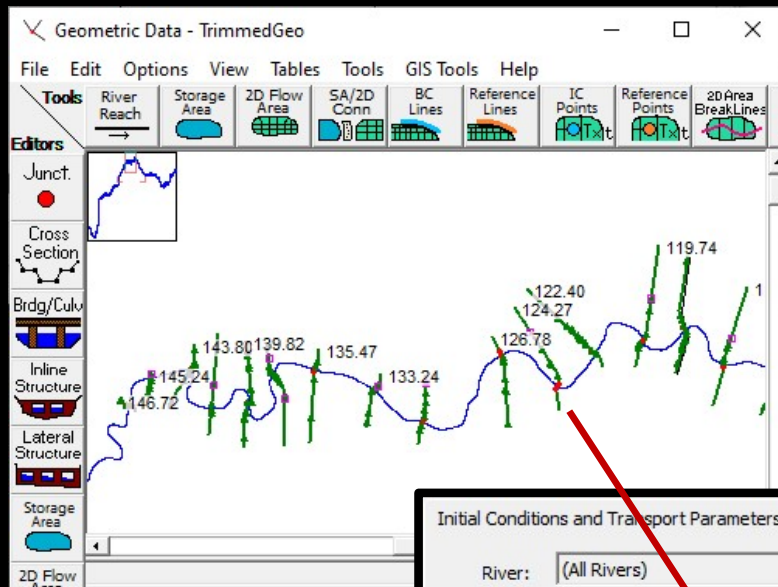
Adding 2D Sediment Data

- I. Select Equations
- II. Sediment Boundary Conditions
- III. Define Bed Gradations

III. 2D Bed Gradations



Defining Bed Gradations (In 1D)



Initial Conditions and Transport Parameters | Boundary Conditions | USDA-ARS Bank Stability and Toe Erosion Model (BSTEM) | 2D Bed Gradation

River: (All Rivers) Transport Function: Toffaletti Define/Edit Bed Gradation ...

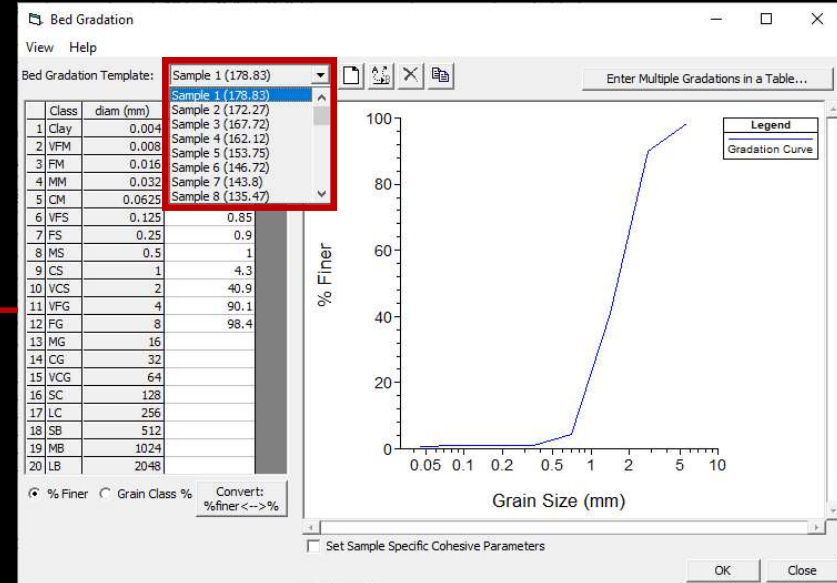
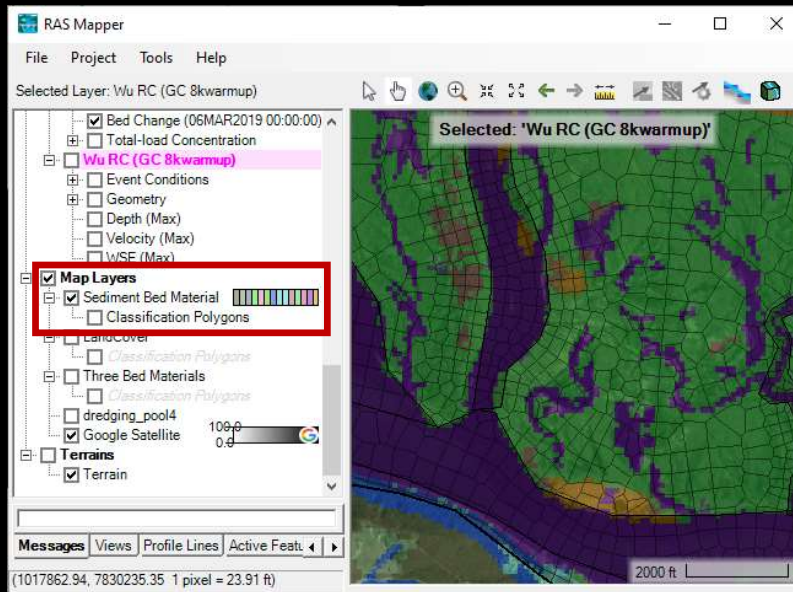
Reach: Sorting Method: Active Layer Define Layers... (2D)

Number of mobile bed channels: 1

Fall Velocity Method: Toffaletti

River	Reach	RS	Invert	Max Depth	Min Elev	Left Sta	Right Sta	Bed Gradation
1	KansasRiver	146.72	988.87	10		1580.37	2041.96	Sample 6 (146.72) mod
2	KansasRiver	145.24	986.04	10		321.92	831.78	Sample 6 (146.72) mod
3	KansasRiver	143.80	976.6	10		4774.85	5564.28	Sample 7 (143.8)
4	KansasRiver	141.84	984.15	10		13284.2	14115.09	Sample 7 (143.8)
5	KansasRiver	139.82	975.08	10		11589.7	12298.48	Sample 7 (143.8)
6	KansasRiver	137.24	974.83	10		5622.53	6370.88	Sample 7 (143.8)
7	KansasRiver	135.47	966.33	10		3592.74	4313.21	Sample 8 (135.47)
8	KansasRiver	133.24	960.82	10		3220.36	3940.02	Sample 8 (135.47)
9	KansasRiver	131.11	957.03	10		8443.46	9106.01	Sample 8 (135.47)
10	KansasRiver	126.78	952.31	10		3242.9	4237.37	Sample 9 (126.78)
11	KansasRiver	124.27	949.6	10		16734.6	17749.62	Sample 9 (126.78)

Defining Bed Gradations (In 2D)



Sediment Data - Rating Curve (Wu) fewer GC

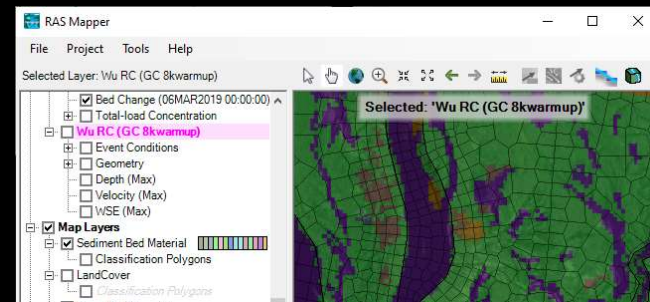
File Options View Help

Initial Conditions and Transport Parameters | Boundary Conditions | USDA-ARS Bank Stability and Toe Erosion Model (BSTEM) | **2D Bed Gradations**

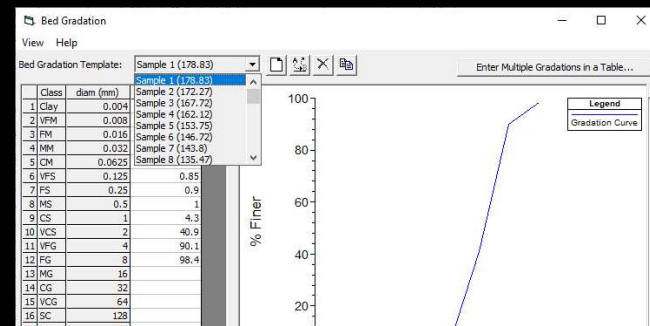
Bed Material Type	Gradation
1 Base Fixed Bed	Non-erodible surface
2 Chippewa River	Chippewa Channel
3 Mississippi	Miss Main Channel
4 Island1	Non-erodible surface
5 Island2	Non-erodible surface

Defining Bed Gradations

1. Define Sediment Material Classification Layers in Mapper



2. Input Bed Gradation Data and Stratigraphy



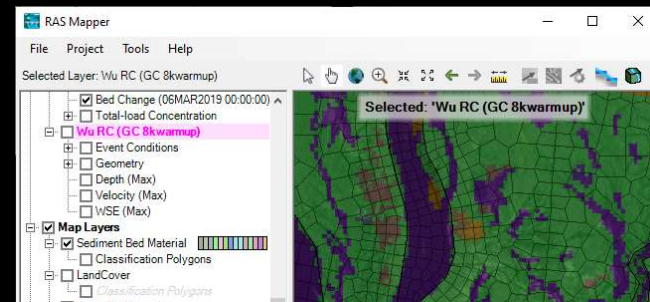
3. Associate Bed Gradation Data with Mapper Layers

The screenshot shows the 'Sediment Data - Rating Curve (Wu) fewer GC' dialog box. It contains a table of bed material types and their associated channels.

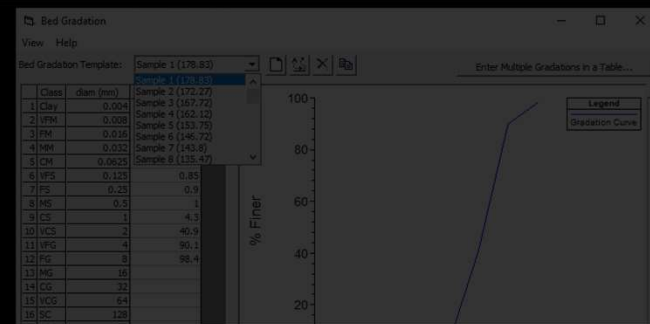
Bed Material Type	
1	Base Fixed Bed Non-erodible surface
2	Chippewa River Chippewa Channel
3	Mississippi Miss Main Channel
4	Island1 Non-erodible surface
5	Island2 Non-erodible surface

Defining Bed Gradations

1. Define Sediment Material Classification Layers in Mapper



2. Input Bed Gradation Data and Stratigraphy



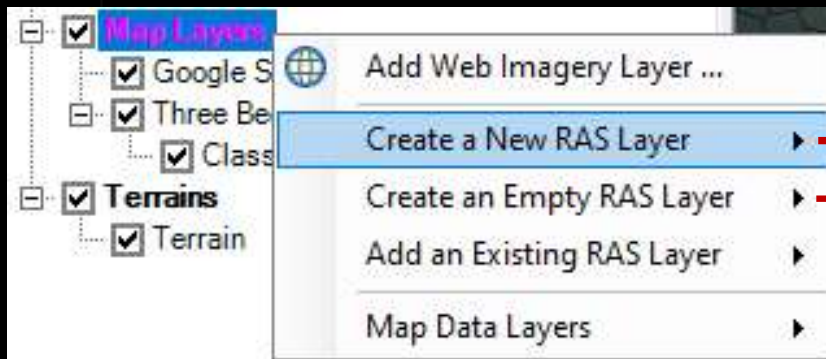
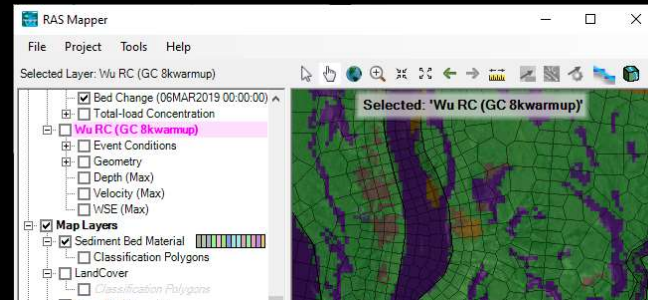
3. Associate Bed Gradation Data with Mapper Layers

The screenshot shows the 'Sediment Data - Rating Curve (Wu) fewer GC' dialog box. The table below lists the bed material types and their associated non-erodible surfaces.

Bed Material Type	
1 Base Fixed Bed	Non-erodible surface
2 Chippewa River	Chippewa Channel
3 Mississippi	Miss Main Channel
4 Island 1	Non-erodible surface
5 Island2	Non-erodible surface

Defining Bed Gradations

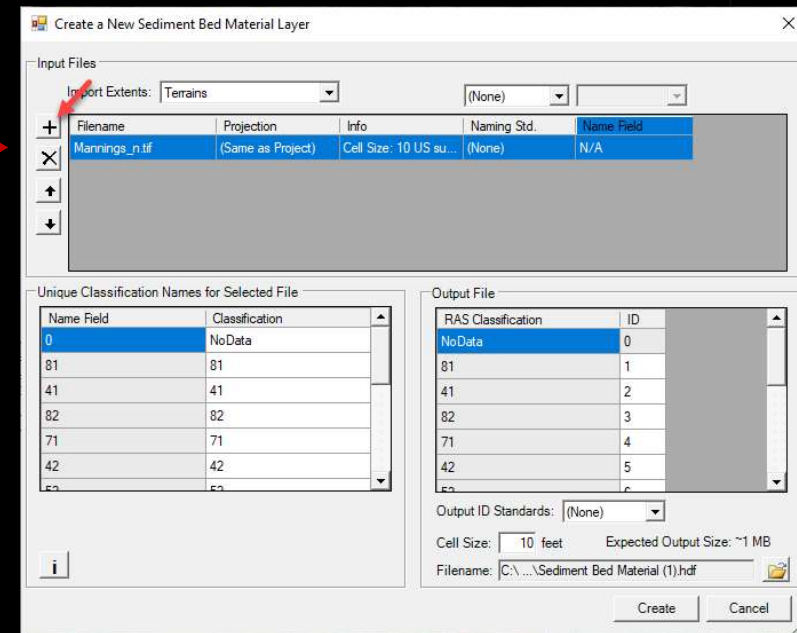
1. Define Sediment Material Classification Layers in Mapper



Add One or More
Shape Files

Identify Bed Material
Name Attribute

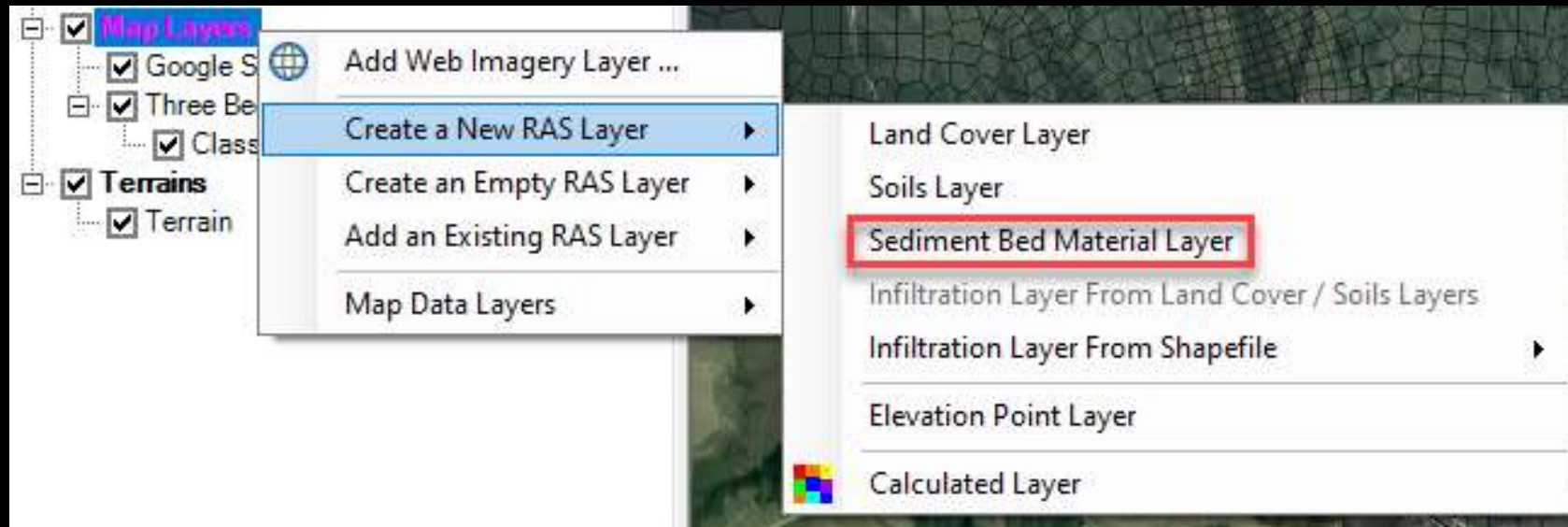
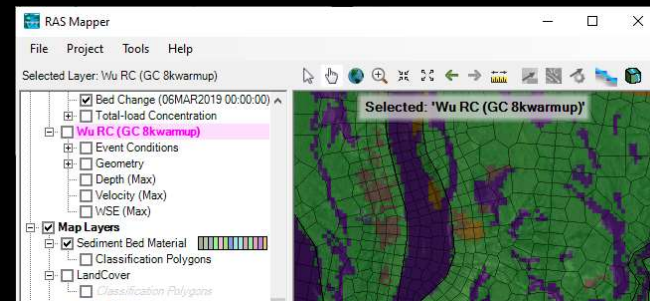
Draw Polygons
and/or Add Later



Create New = Import
Create Empty = Draw

Defining Bed Gradations

1. Define Sediment Material Classification Layers in Mapper



Defining Bed Gradations

Associate Bed Material Layer with...a Geometry!?!

The screenshot shows the RAS Mapper interface. In the 'Features' tree on the left, the 'Geometries' folder is expanded, and a context menu is open with 'Manage Geometry Associations...' highlighted. The 'Manage Layer Associations' dialog box is open, displaying a table with the following data:

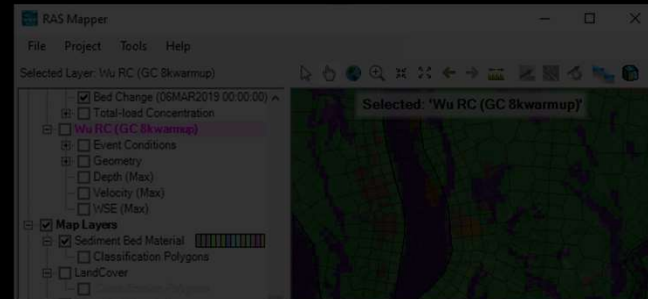
Type	RAS Geometry Layers	Terrain	Manning's n	Infiltration	% Impervious	Sediment Bed Material Layer
Geometry	Geometry New	Terrain	class	(None)	(None)	Three Bed Materials
Results	Wu	Terrain	class	(None)	(None)	Three Bed Materials

The 'Sediment Bed Material Layer' column is expanded, showing 'Three Bed Materials' selected. A 'Close' button is visible at the bottom right of the dialog box.

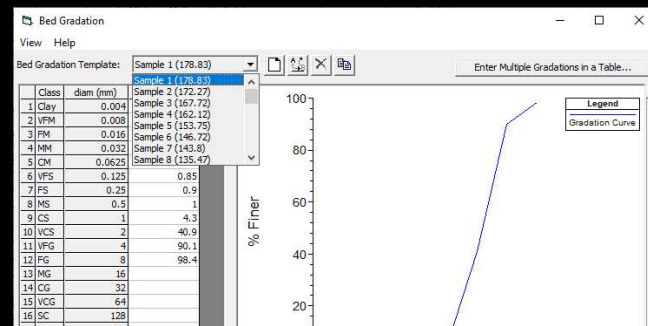
- This is the Most Overlooked Step
- Implications of Associating Bed Materials with Geometry

Defining Bed Gradations

1. Define Sediment Material Classification Layers in Mapper



2. Input Bed Gradation Data and Stratigraphy



3. Associate Bed Gradation Data with Mapper Layers

The screenshot shows the 'Sediment Data - Rating Curve (Wu) fewer GC' dialog box. It contains a table of bed material types and their associated descriptions.

Bed Material Type	Description
1 Base Fixed Bed	Non-erodible surface
2 Chippewa River	Chippewa Channel
3 Mississippi	Miss Main Channel
4 Island1	Non-erodible surface
5 Island2	Non-erodible surface

Input Bed Gradation Data

Sediment Data - Wu

File Options View Help

Initial Conditions and Transport Parameters | Boundary Conditions | USDA-ARS Bank Stability and Toe Erosion Model (BSTEM) | 2D Bed Gradations

River: Transport Function: Wu Profile Plot Cross Section Plot

Reach: Sorting Method: Active Layer Fall Velocity: Bed Gradation

Number of mobile bed channels: 1

River	Reach	RS	Invert	Max Depth	Min Elev
1					

View Help

Bed Gradation Template: Sand

Class	diam (mm)	
1	Clay	0.004
2	VFM	0.008
3	FM	0.016
4	MM	0.032
5	CM	0.0625
6	VFS	0.125
7	FS	0.25
8	MS	0.5
9	CS	1
10	VCS	2
11	VFG	4
12	FG	8
13	MG	16
14	CG	32
15	VCG	64
16	SC	128
17	LC	256
18	SB	512
19	MB	1024
20	LB	2048

Enter Multiple Gradations in a Table...

Legend
Gradation Curve

% Finer Grain Class % Convert: %finer<-->%

Set Sample Specific Cohesive Parameters

OK Close

Use Banks for Movable bed Interpolate Gradations

Define Stratigraphy

Sediment Data - Wu

File Options View Help

Initial Conditions and Transport Parameters | Boundary Conditions | USDA-ARS Bank Stability and Toe Erosion Model (BSTEM) | 2D Bed Gradation

River:

Reach:

Number of mobile bed channels:

	River	Reach	RS	Invert
1				

Define Gradation Layers

Layer Groups: Floodplain Layers

of Layers: 3 Depositional Layer thickness (ft):

	Layer Thickness (ft)	Layer Gradation Template
1	6	Sand
2	8	Chippewa Channel
3	1	Non-erodible surface

Define/Edit Bed Gradation ...

Define Layers... (2D)

Bed Gradation

Defining Stratigraphy

Sediment Data - Sediment Data

File Options View Help

Initial Conditions and Transport Parameters | Boundary Conditions | USDA-ARS Bank Stability and Toe Erosion Model (BSTEM) | 2D Bed Gr

River: Transport Function: Wu

Reach: Sorting Method: Active Layer

Number of mobile bed channels: 1 Fall Velocity Method: Soulsby

Define/Edit Bed Gradation ...

Define Layers... (2D)

	River	Reach	RS	Invert	Max Depth	Min Elev	Left Sta	Right Sta	Bed Gradation
1									

Note: Layers \neq Layers

Define Layers... (2D)

\neq

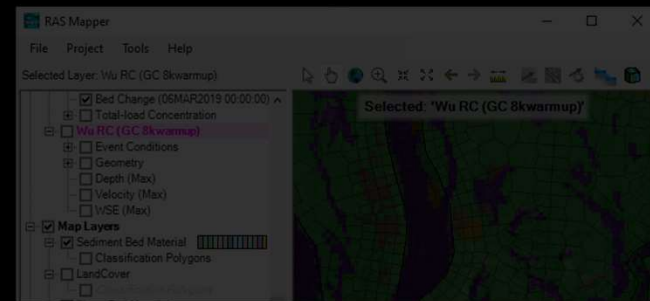
Map Layers

Mannings_n

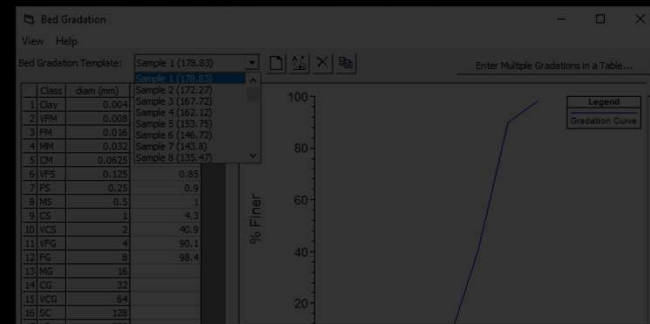
Bed Material

Defining Bed Gradations

1. Define Sediment Material Classification Layers in Mapper



2. Input Bed Gradation Data and Stratigraphy



3. Associate Bed Gradation Data with Mapper Layers

The screenshot shows the 'Sediment Data - Rating Curve (Wu) fewer GC' dialog box. It has a menu bar (File, Options, View, Help) and tabs for 'Initial Conditions and Transport Parameters', 'Boundary Conditions', and 'USDA-ARS Bank S...'. A table below lists bed material types and their associated locations.

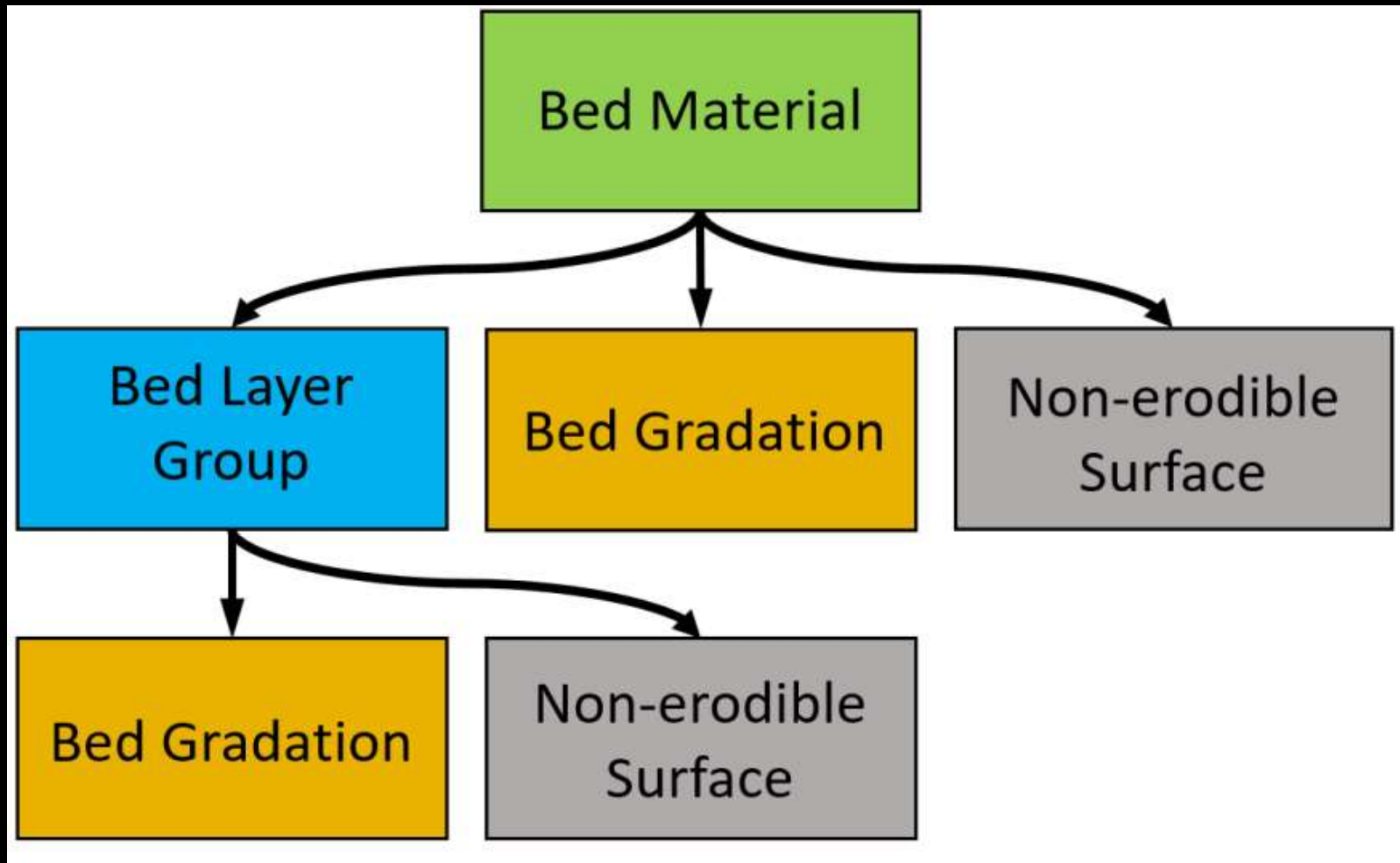
Bed Material Type	
1 Base Fixed Bed	Non-erodible surface
2 Chippewa River	Chippewa Channel
3 Mississippi	Miss Main Channel
4 Island1	Non-erodible surface
5 Island2	Non-erodible surface

Associate Bed Gradation Data with Mapper Layers

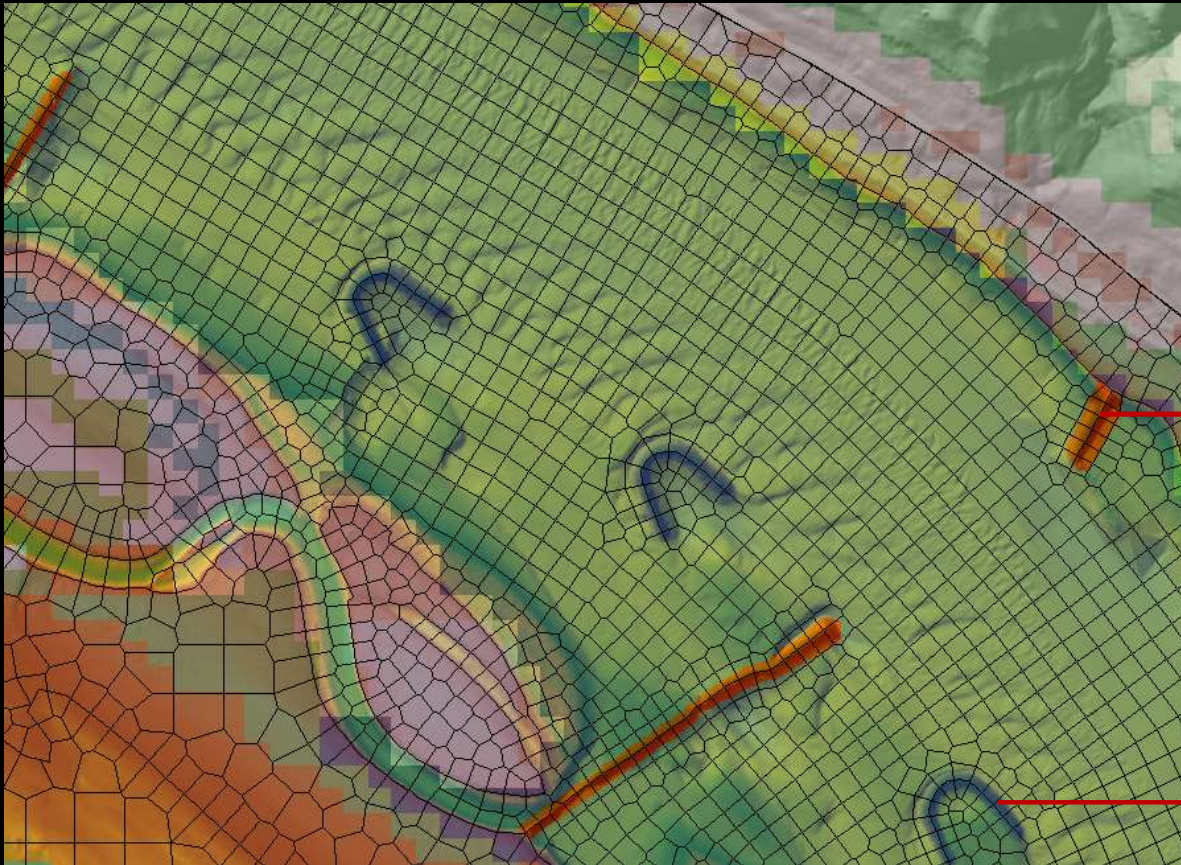
The screenshot shows the 'Sediment Data - Sediment-BedGradation' application window. The menu bar includes 'File', 'Options', 'View', and 'Help'. The main window has a tabbed interface with the following tabs: 'Initial Conditions and Transport Parameters', 'Boundary Conditions', 'USDA-ARS Bank Stability and Toe Erosion Model (BSTEM)', and '2D Bed Gradations (beta)'. The '2D Bed Gradations (beta)' tab is active and contains a table with the following data:

	Bed Material Type	Gradation
1	sand	Sand
2	82	MainChannel
3	71	Gravel Bar
4	42	Non-erodible surface
5	52	Gravel Bar
6	43	Bank Materials
7	21	Floodplain
8	22	Floodplain
9	23	Trib Gradation
10	95	Coarse Thalweg Material
11	90	MainChannel
12	24	Floodplain
13	11	Non-erodible surface
14	31	Coarse Thalweg Material

Below the table, a list of material types is displayed, with 'Non-erodible surface' highlighted in blue. The list includes: Non-erodible surface, Sand, MainChannel, Gravel Bar, Floodplain, Coarse Thalweg Material, Trib Gradation, and Bank Materials.



Non-Erodible Surfaces



Bed Material Type	
1	Bed Materials
	Nonuniform
	Non-erodible surface
	Nonuniform

12	24	Floodplain
13	11	Non-erodible surface
14	31	Coarse Thalweg Material
		Non-erodible surface
		Sand
		MainChannel
		Gravel Bar
		Floodplain
		Coarse Thalweg Material
		Trib Gradation
		Bank Materials

Adding 2D Sediment Data and Viewing Results



Adding 2D Sediment Data

- I. Select Equations
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Viewing 2D Sediment Results

- I. Add 2D Result Maps
- II. View Time Series
- III. Profile Lines

Adding 2D Sediment Data and Viewing Results



Viewing 2D Sediment Results

I. Add 2D Result Maps



The screenshot displays the RAS Mapper software interface. The left-hand side shows a tree view under the 'Results' category, with 'Pulse RC 28Nov2021' selected. A context menu is open over this selection, with the option 'Create a New Results Map Layer...' highlighted in red. The main window shows a 2D sediment map with a color scale ranging from blue (low) to red (high). The map is overlaid on a grid. The top status bar indicates 'Selected: 'Pulse RC 28Nov2021'' and '02JUL1975 00:00:00'. The bottom status bar shows coordinates '(154.2452, 4.0431 1 pixel = 0.3419 m)' and a scale bar for '50 m'.

Adding 2D Sediment Data and Viewing Results



Viewing 2D Sediment Results

I. Add 2D Result Maps



Create a New Results Map Layer...

RAS Mapper

File Project Tools Help

Selected Layer: Pulse RC 28Nov2021

Selected: 'Pulse RC 28Nov2021' 02JUL1975 00:00:00

Results Map Parameters

Map Type

- Hydraulics
- Sediment
 - Sediment Bed
 - Active Layer Percentile Diameter
 - Bed Elevation
 - Bed Elevation Rate
 - Bed Change Rate
 - Subcell Bed Elevation
 - Subcell Bed Change
 - Hydraulic Bed Elevation
 - Hydraulic Bed Change
 - Subface Bed Elevation
 - Subface Bed Change
 - Sediment Transport
 - Bed Shear Stress
 - Critical Shear
 - Fraction Suspended
 - Hydraulic Depth
 - Settling Velocity
 - Total Load Capacity

Unsteady Profile

Maximum

Minimum

Profile

- 01JUL1975 00:00:00
- 01JUL1975 01:00:00
- 01JUL1975 02:00:00
- 01JUL1975 03:00:00
- 01JUL1975 04:00:00
- 01JUL1975 05:00:00
- 01JUL1975 06:00:00
- 01JUL1975 07:00:00
- 01JUL1975 08:00:00
- 01JUL1975 09:00:00
- 01JUL1975 10:00:00
- 01JUL1975 11:00:00
- 01JUL1975 12:00:00
- 01JUL1975 13:00:00
- 01JUL1975 14:00:00

Map Output Mode

Generated for Current View (in memory)

Raster (with Associated Terrain)

Point Feature Layer:

Stored (saved to disk)

Raster based on Terrain: 2D 04Apr2020

Point Feature Layer:

Polygon Boundary at Value: 0

Map Type	Layer Name
Bed Change	Bed Change

Map Type: A Map layer will be created for A general map-type for 2D-only datasets.
Map Mode: Map results are generated on-the-fly for the current view.

Add Map Close

Adding 2D Sediment Data and Viewing Results



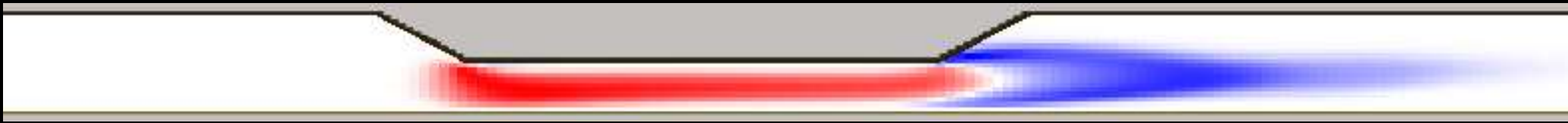
Viewing 2D Sediment Results

I. Add 2D Result Maps

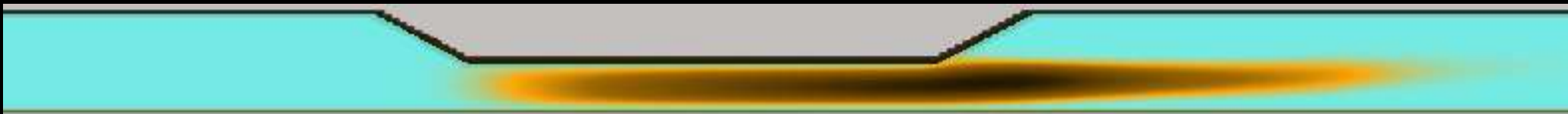


Create a New Results Map Layer...

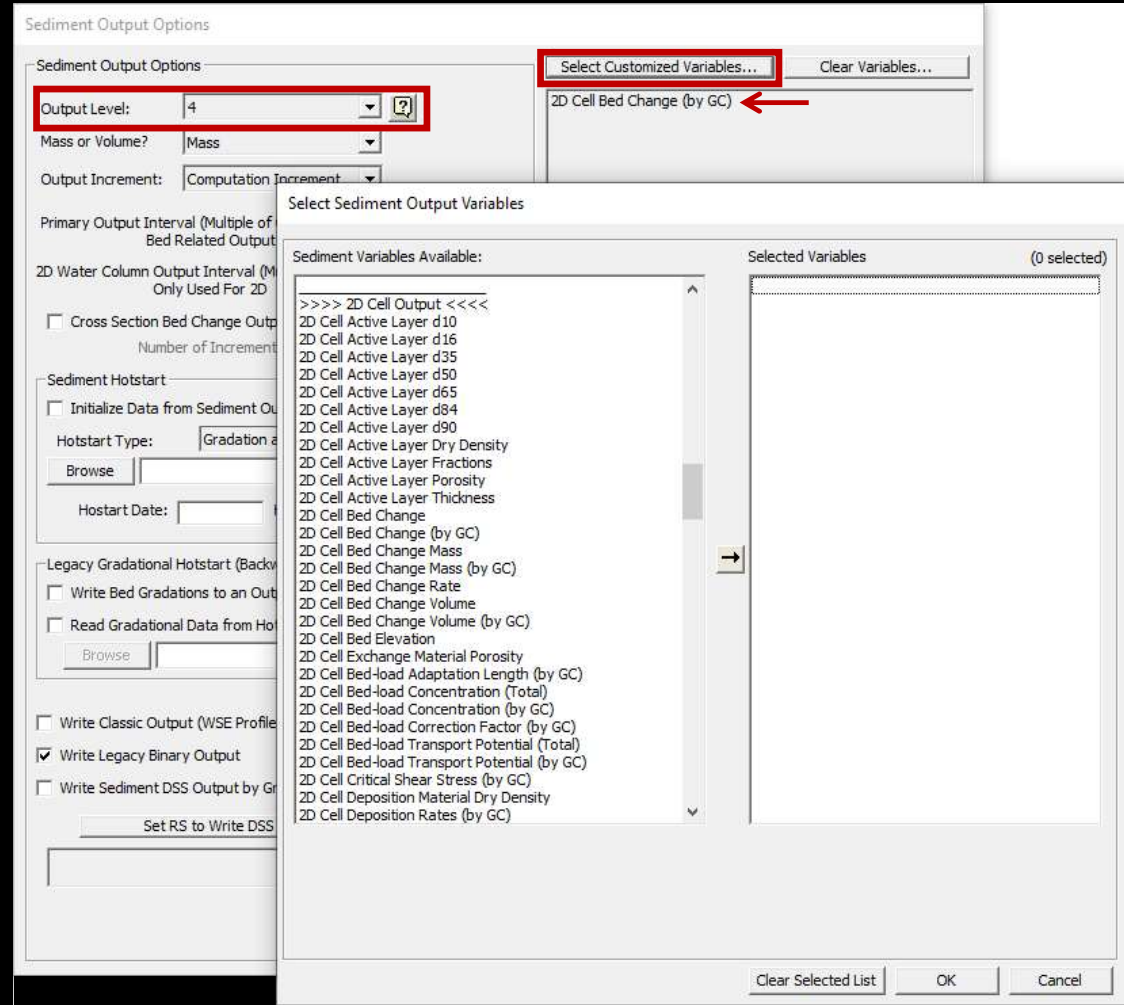
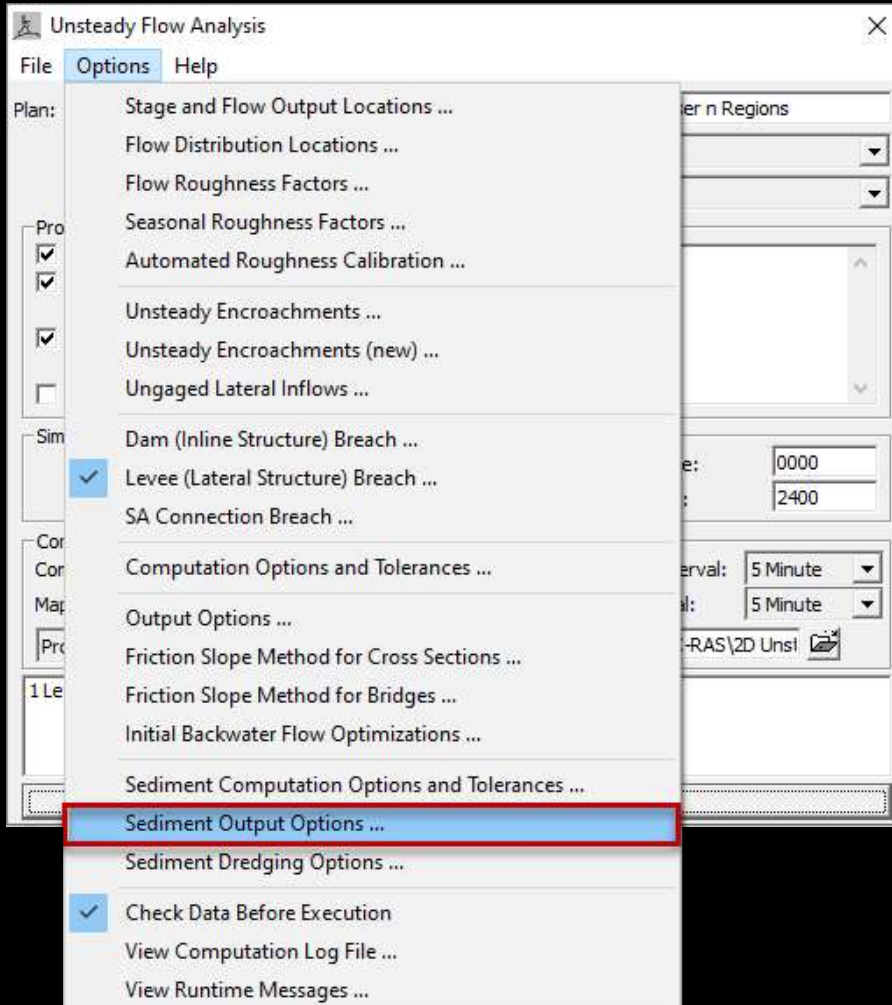
Bed Change



Concentration



What if you want more/different results?

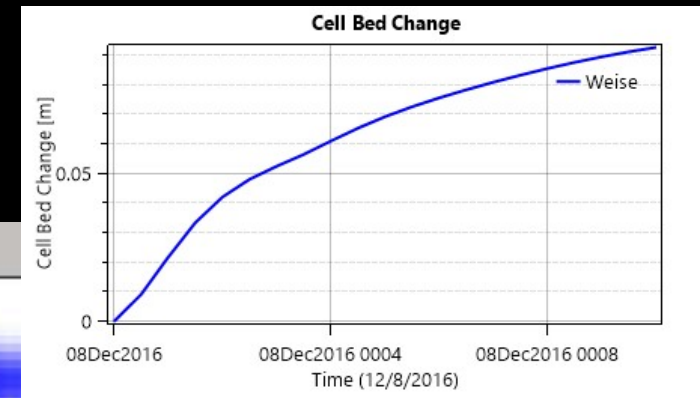


Adding 2D Sediment Data and Viewing Results



Viewing 2D Sediment Results

- I. Add 2D Result Maps
- II. View Time Series



WSE [No Enabled Maps with Profiles]
Velocity [No Enabled Maps with Profiles]
Depth [No Enabled Maps with Profiles]
Courant (Velocity/Length) [No Enabled Maps with Profiles]
Cell Bed Change

All Enabled Results
Plot Time Series
Plot Property Table

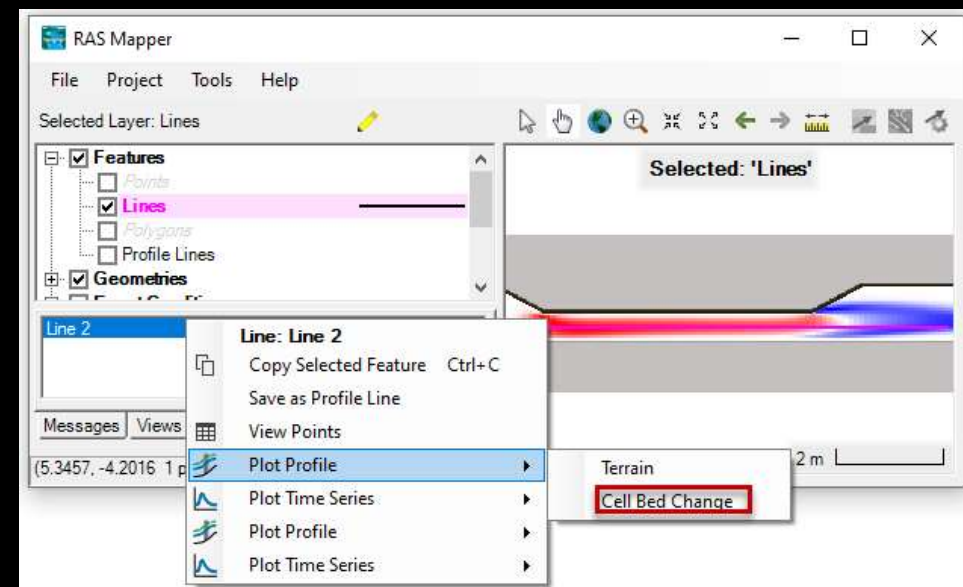
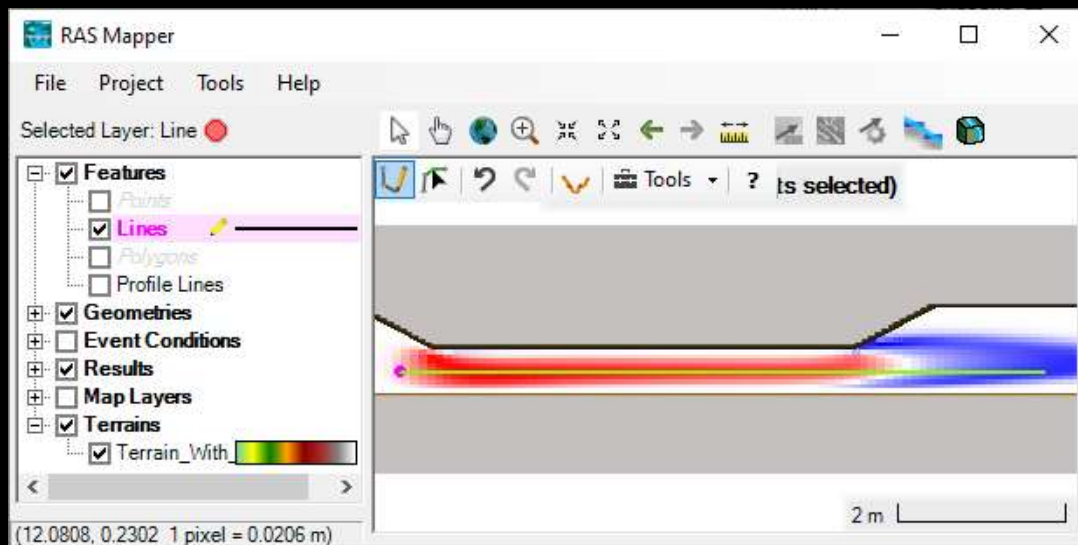
Right Click on Result Map

Adding 2D Sediment Data and Viewing Results



Viewing 2D Sediment Results

- I. Add 2D Result Maps
- II. View Time Series
- III. Profile Lines

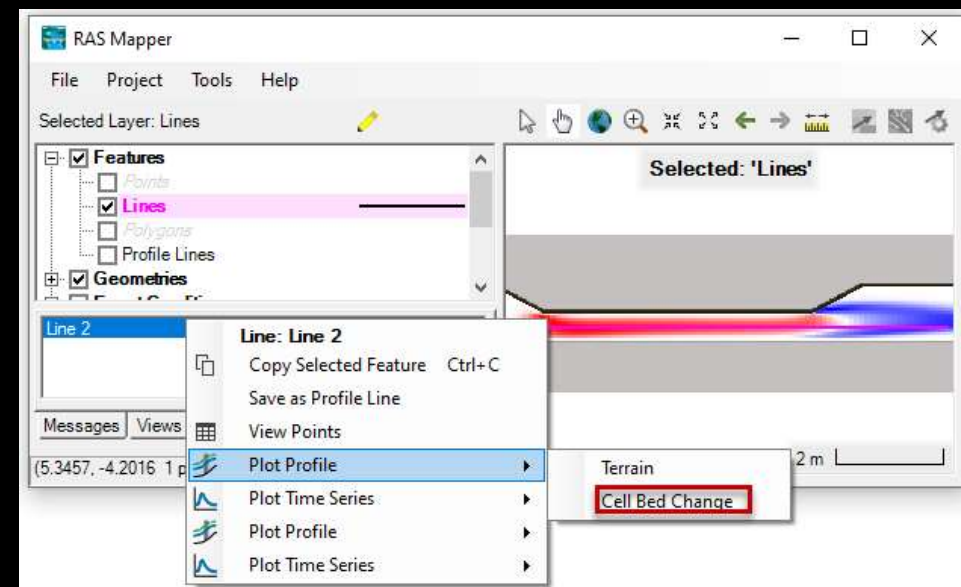
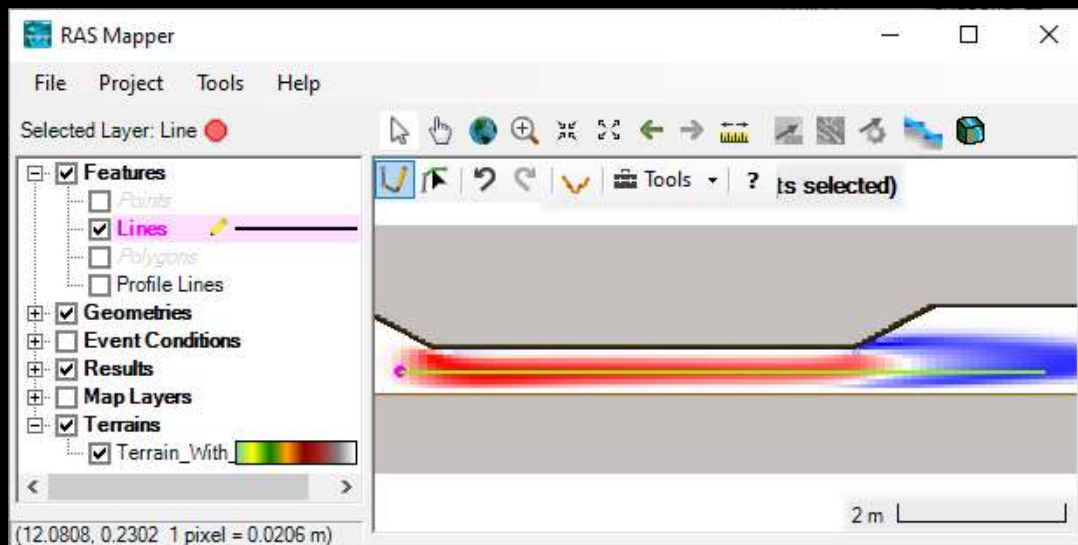


Adding 2D Sediment Data and Viewing Results



Viewing 2D Sediment Results

- I. Add 2D Result Maps
- II. View Time Series
- III. Profile Lines



Adding 2D Sediment Data and Viewing Results



Viewing 2D Sediment Results

- I. Add 2D Result Maps
- II. View Time Series
- III. Profile Lines

