

HEC-RAS 2D Sediment Workshop: Initializing a 2D Sediment Model

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Computation Options (2D)



- Initial Conditions
(Warm Up) Time
- Ramp Up Fraction

HEC-RAS Unsteady Computation Options and Tolerances

General | 2D Flow Options | 1D/2D Options | Advanced Time Step Control | 1D Mixed Flow Options

Use Coriolis Effects (only when using the momentum equation)

Number of cores to use in 2D computations: 8 cores

Parameter	(Default)	2D Flow Area
1 Theta (0.6-1.0):	1	1
2 Theta Warmup (0.6-1.0):	1	1
3 Water Surface Tolerance (max=0.2)(ft)	0.01	0.01
4 Volume Tolerance (ft)	0.01	0.01
5 Maximum Iterations	20	20
6 Equation Set	Diffusion Wave	Diffusion Wave
7 Initial Conditions Time (hrs)		24
8 Initial Conditions Ramp Up Fraction (0-1)	0.1	0.1
9 Number of Time Slices (Integer Value)	1	1
10 Eddy Viscosity Transverse Mixing Coefficient		
11 Boundary Condition Volume Check	<input type="checkbox"/>	<input type="checkbox"/>
12 Latitude for Coriolis (-90 to 90)		

OK Cancel Defaults ...

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Viewing "Negative" Time

HEC-RAS Unsteady Computation Options and Tolerances

General | 2D Flow Options | 1D/2D Options | Advanced Time Step Control | 1D Mixed Flow Options | 1D/2D Unsteady Flow Options

1D Unsteady Flow Options

Theta [implicit weighting factor] (0.6-1.0):

Theta for warm up [implicit weighting factor] (0.6-1.0):

Water surface calculation tolerance [max=0.2](ft):

Storage Area elevation tolerance [max=0.2](ft):

Flow calculation tolerance [optional] (cfs):

Max error in water surface solution (Abort Tolerance)(ft):

Maximum number of iterations (0-40):

Maximum iterations without improvement (0-40):

1D/2D Unsteady Flow Options

Number of warm up time steps (0 - 100,000):

Time step during warm up period (hrs):

Minimum time step for time slicing (hrs):

Maximum number of time slices:

Lateral Structure flow stability factor (1.0-3.0):

Inline Structure flow stability factor (1.0-3.0):

Weir flow submergence decay exponent (1.0-3.0):

Gate flow submergence decay exponent (1.0-3.0):

Gravity (ft/s^2):

Wind Forces

Reference Frame:

Drag Formulation:

1D Numerical Solution

Finite Difference (classic HEC-RAS methodology)

Finite Difference Matrix Solver
 Skyline/Gaussian (Default: faster for dendritic systems)
 Pardiso (Optional: may be faster for large interconnected systems)

Finite Volume (Beta)

Number of cores to use with Pardiso solver:

Geometry Preprocessor Options

Family of Rating Curves for Internal Boundaries

Use existing internal boundary tables when possible.

Recompute at all internal boundaries

OK Cancel Defaults ...

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Initial Conditions Points

Little Rock Pool 2 Plan: High Water Marks Final 10/4/2007

Pool2 River channel

Legend

WS 1985 198400

Original

OWS 1985 198400

Sw WS

Main Channel Distance (ft)	Elevation (ft) - Smooth Curve	Elevation (ft) - Jagged Line
0	160	120
50000	170	135
100000	175	140
150000	180	145
200000	185	140

Selected Layer: Initial Condition Points

Selected: 'Initial Con...

Map Layers

- Manning's n
- Add IC Points
- Cross Sections
- 2D Flow Areas
- Boundary Condition Lines
- Initial Condition Points
- Manning's n
- Event Conditions
- Results
- Reference Regions
- Geometry
- Depth (02MAY2019 06:00:00)
- Velocity (02MAY2019 00:00:00)
- vISE (02MAY2019 00:00:00)
- Cumulative Max Iterations
- 1985 (Q=2000)
- Event Conditions
- Geometry
- Depth (Max)
- Velocity (Max)
- vISE (Max)
- 1985 2000 - IC Points
- Event Conditions
- Geometry
- Depth (Max)
- Velocity (Max)
- vISE (02JAN1985 14:00:00)
- Map Layers
- Google Hybrid
- Manning's_n_asterisk

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Initial Conditions Points

Initial Flow Distribution Method

Restart Filename: C:\Users\j\Documents\Projects\Arkansas\Pool 2.09\Nov.2022\ArkansasR

Prior WS Filename: Profile: [v]

Enter Initial flow distribution (Optional - leave blank to use boundary conditions)

Add RS...

User specified fixed flows (Optional)			
River	Reach	RS	Initial Flow
1			

Initial Elevation of Storage Areas/2D Flow Areas (Optional) Import Min SA Elevation(s)

Keep initial elevations constant during warmup

Storage Area/2D Flow Area	Initial Elevation
1 2D: Pool2	
2 IC Point: 16.9	161.14
3 IC Point: 22.3	161.14
4 IC Point: 22.53	165.6
5 IC Point: 23.45	166.7
6 IC Point: 32.56	174.91
7 IC Point: 35.16	175.78
8 IC Point: 38.19	175.5
9 IC Point: 39.43	176.5

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Initial Conditions Points

RAS Mapper Plot


Water Surface Elevation on 'Main Centerline'

Value [feet]


Station [ft]

Legend:
 - WSE 06JAN1985 14:00:00
 - 20221006_ArkansasRiver_Pool2.Clone Profile

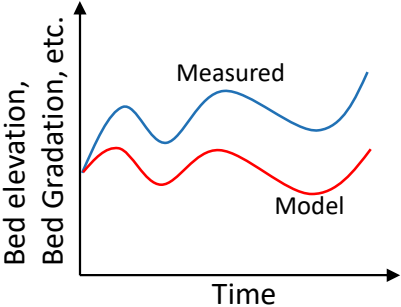
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Initializing 2D Sediment Models




- Model dynamic equilibrium different from real-life dynamic equilibrium
 - Leads rapid changes in the beginning of the simulation
- Initial bed gradation data usually very lacking
- Bathymetry often contains interpolation errors and large bedforms which need to be smoothed out
- Preconditioning
 - Adjusting initial bed gradations and bathymetry to be closer to model dynamic equilibrium
- Hotstart models from Use Simulation Components to precondition input by hotstarting simulations with models




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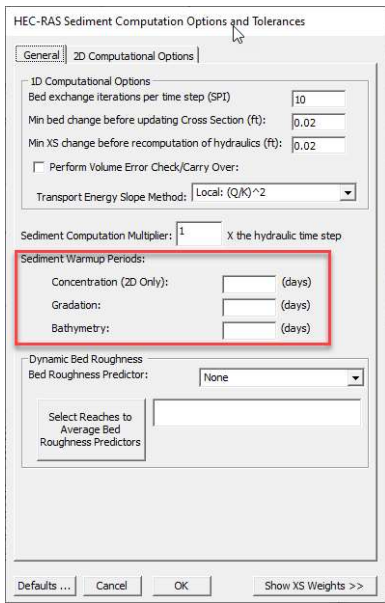
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Sediment Warmup Periods



- Three types of Sediment Warmup Periods
 - Concentration
 - Gradation
 - Bathymetry
- Mostly there for backwards compatibility
- No output during this time period



Time Period	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Initial Conditions				
Concentration Warmup Period				
Gradation Warmup Period				
Bathymetry Warmup Period				

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2D Sediment Initialization from Prior Solution



- Result file specified independently from hydraulic file
- Not Restart file
- Concentrations always initialized with this option

Sediment Output Options

Sediment Output Options

Output Level: 6 [?] [?]

Mass or Volume? Mass

Output Increment: Computation Increment

Primary Output Interval (Multiple of Output Increment)
Bed Related Output for 2D: 1

2D Water Column Output Interval (Mult. of Out. Increment)
Only Used For 2D: 1

Cross Section Bed Change Output
Number of Increments Between XS Outputs: 10

Sediment Hotstart

Initialize Data from Sediment Output File

Hotstart Type: Gradation Only

Browse | Sediment: Gradation and Bed Elev | pool2.p04.hdf

Hotstart Date: 02MAY2019 | Hotstart Time: 10000

Write Classic Output (WSE Profile etc. - O file)

Write Legacy Binary Output

Write Sediment DSS Output by Grain Class | Daily Flux

Set RS to Write DSS Sediment Output...

Create Geometry Files from Sediment Results

OK Cancel Defaults ...

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Hotstart/Restart File




Avoid Ramp Up / Warm Up Compute Time!




1. Run initial conditions once
2. Write **Restart File** out
3. Create a new **Unsteady Flow Plan**
4. Select **Use a Restart File**
5. Adjust starting date, and any hydrographs, if needed (if you start model later than previous run).

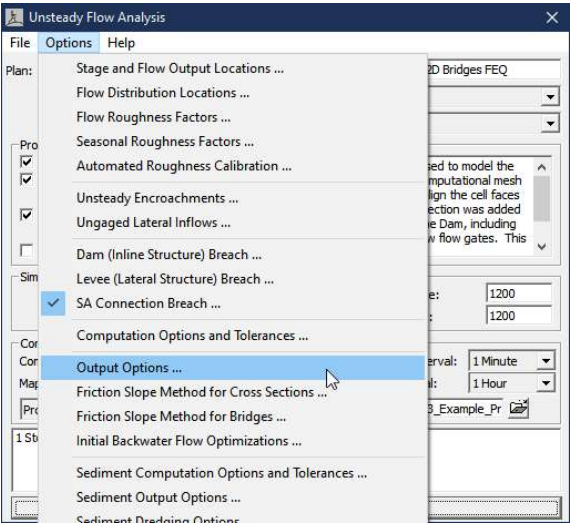
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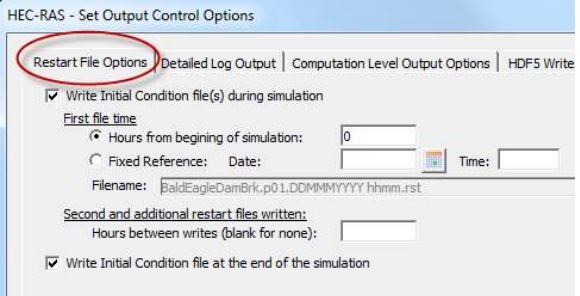
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Write Restart File









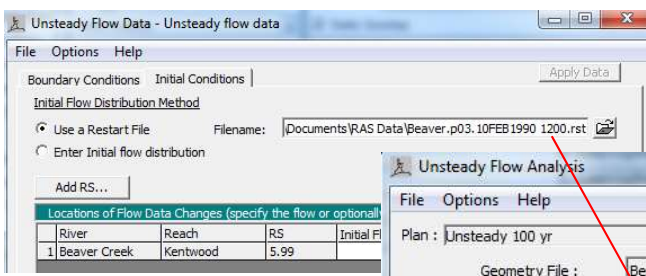
11

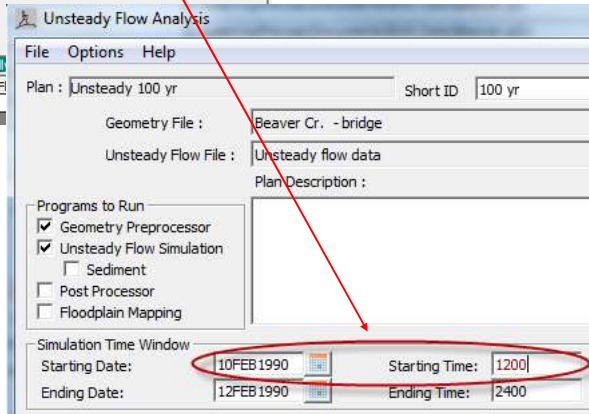
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Select Restart







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Boundary Condition Starting Times



Flow Hydrograph

River: Bald Eagle Reach: Loc Hav RS: 138154.4

Read from DSS before simulation

File:
Path:

Enter Table Data time in

Select/Enter the Data's Starting Time Reference

Use Simulation Time: Date: 10FEB1990 Time: 1200

Fixed Start Time: Date: Time:

No. Ordinates Interpolate Missing Values Del Row Ins Row

Hydrograph Data		
	Date	Flow (cfs)
	Simulation Time (hours)	
1	10Feb1990 1200	1075.53
2	10Feb1990 1300	1301.64
3	10Feb1990 1400	1676.94
4	10Feb1990 1500	2199.12
5	10Feb1990 1600	2864.95
6	10Feb1990 1700	3670.34
7	10Feb1990 1800	4610.32
8	10Feb1990 1900	5679.08
9	10Feb1990 2000	6870.05

Time Step Adjustment Options ("Critical" boundary conditions)

In Flow: this hydrograph for adjustments to computational time step

Max. Change in Flow (without changing time step):

Min Flow: Multiplier:

Flow Hydrograph

River: Bald Eagle Reach: Loc Hav RS: 138154.4

Read from DSS before simulation

File:
Path:

Enter Table Data time in

Select/Enter the Data's Starting Time Reference

Use Simulation Time: Date: 10FEB1990 Time: 1200

Fixed Start Time: Date: 01Jan1990 Time: 0000

No. Ordinates Interpolate Missing Values Del Row Ins Row

Hydrograph Data		
	Date	Flow (cfs)
	Simulation Time (hours)	
1	31Dec1989 2400	1075.53
2	01Jan1990 0100	1301.64
3	01Jan1990 0200	1676.94
4	01Jan1990 0300	2199.12
5	01Jan1990 0400	2864.95
6	01Jan1990 0500	3670.34
7	01Jan1990 0600	4610.32
8	01Jan1990 0700	5679.08
9	01Jan1990 0800	6870.05

Time Step Adjustment Options ("Critical" boundary conditions)

In Flow: this hydrograph for adjustments to computational time step

Max. Change in Flow (without changing time step):

Min Flow: Multiplier:

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Restart File Notes



- Geometry must be the same
- Can switch model parameters such as governing equations, calibration parameters, etc.
- Can change the time step
- Can change the output interval
- Can change flow and plan data
- All state variables are overwritten (good or bad thing)

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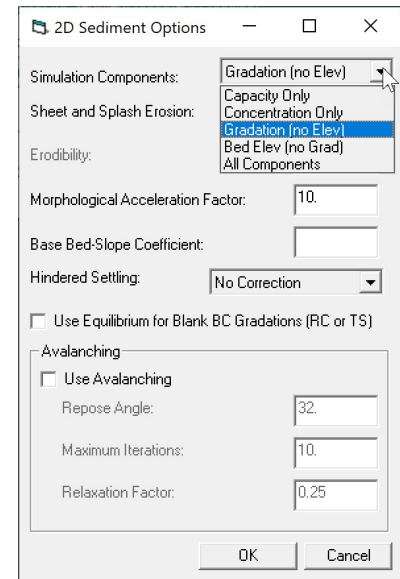
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Simulation Components and Restarts/Hotstarts



- Not possible to choose what variables are overwritten when using Restart/Hotstart files
- Use Simulation Components to control what variables are allowed to modify
- Typically used to precondition bed gradations while the bathymetry is user specified
- Ideally would want to precondition bathymetry in certain places while enforcing the bathymetry in other places, but this is difficult
- Best to fix bathymetry issues as much as possible and not rely on preconditioning of bathymetry



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Thank You!

HEC-RAS Website:

<https://www.hec.usace.army.mil/software/hec-ras/>

Online Documentation:

<https://www.hec.usace.army.mil/confluence/rasdocs>



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