

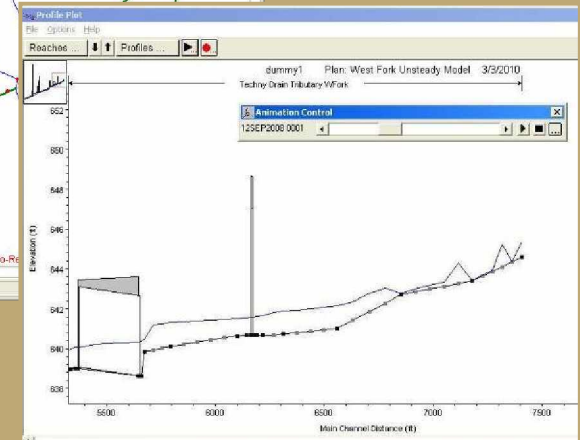
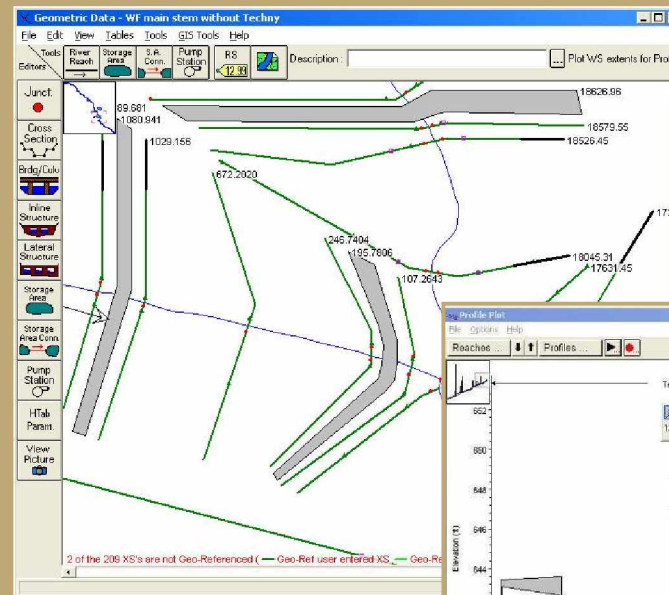


De-Bugging a HEC-RAS Unsteady Flow Model

Geometry Processor			
River:	NBCR West Fork	RS:	17.76965
Reach:	DS S Navy	Node Type:	Cross Section
IB Curve:			
Unsteady Flow Simulation			
Simulation:			
Time:	120.0000	17SEP2008	00:00:00
Iteration:	0		
Writing Profiles:	400		
Post Process			
River:	NBCR West Fork	RS:	26523.93
Reach:	US N Navy	Node Type:	Cross Section
Profile:	12SEP2008 0200		
Simulation:	3/3		

HEC-RAS Finished Computations

Geometry Processor			
River:	NBCR West Fork	RS:	17.76965
Reach:	DS S Navy	Node Type:	Cross Section
IB Curve:			
Unsteady Flow Simulation			
Simulation:			
Time:	120.0000	17SEP2008	00:00:00
Iteration:	0		
Writing Profiles:	3400		
Post Process			
River:	NBCR West Fork	RS:	17.76965
Reach:	DS S Navy	Node Type:	Cross Section
Profile:	16SEP2008 2400		
Simulation:	242/242		

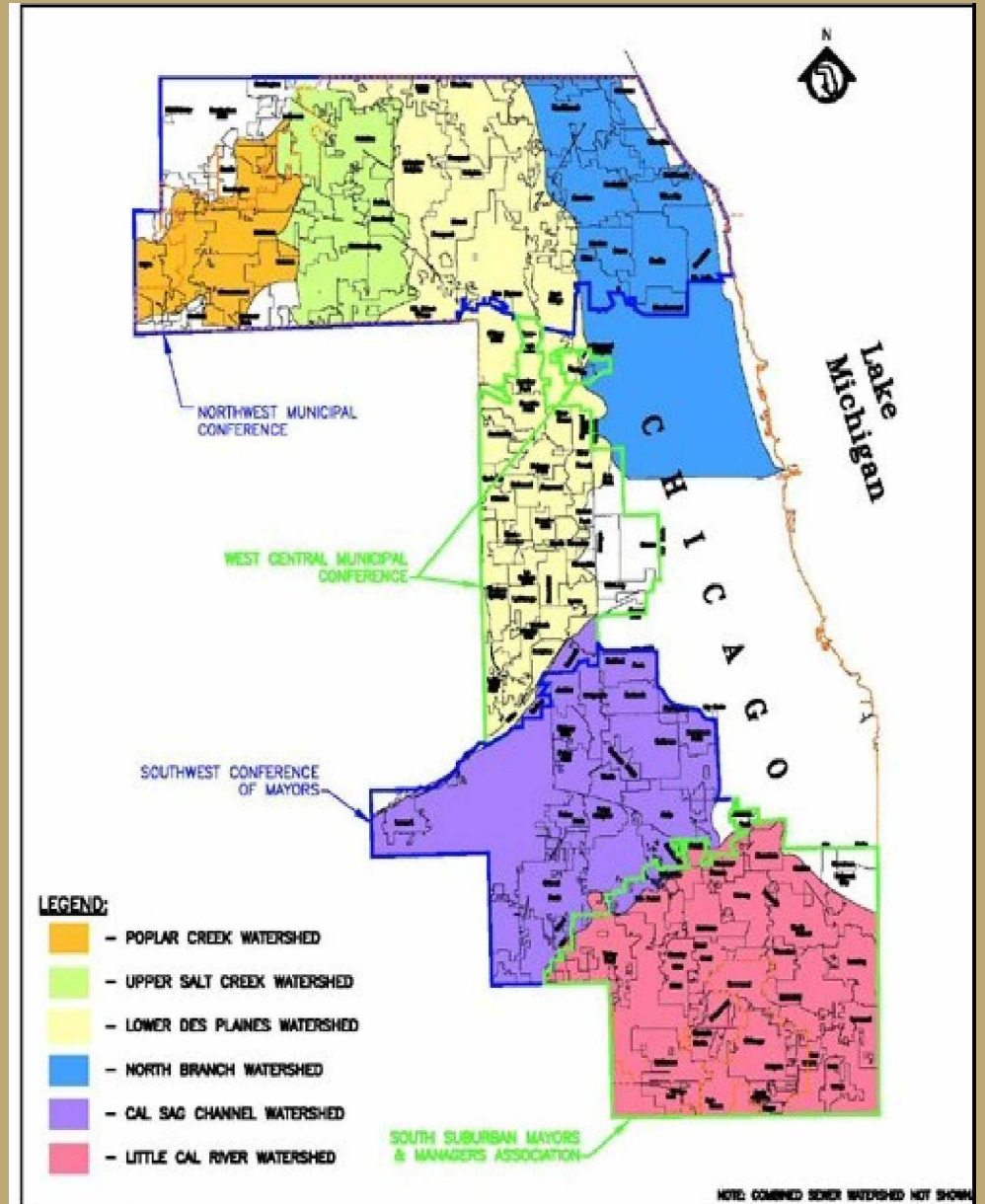


Presented by:
Jennifer Maercklein, P.E., CFM
V3 Companies



Presentation Agenda

- Goals
- Model Errors Before Simulation Begins
- De-bugging Initial Conditions
- De-bugging Runtime Errors
- Resources for Help
- Questions





Presentation Goals

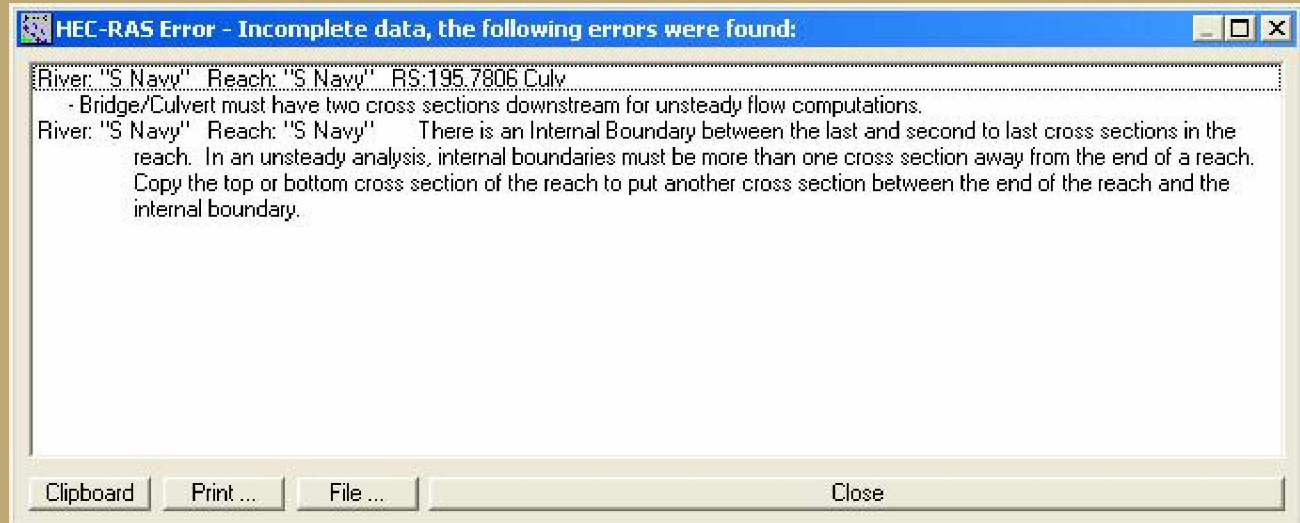
- Tips to get started with de-bugging
 - Useful HEC-RAS tools for debugging
 - Tips to find sources of error
- De-bugging ideas presented here do not represent an exhaustive list of de-bugging techniques
- Presentation Assumptions
 - Familiarity with HEC-RAS
 - Familiarity with Unsteady Flow Modeling



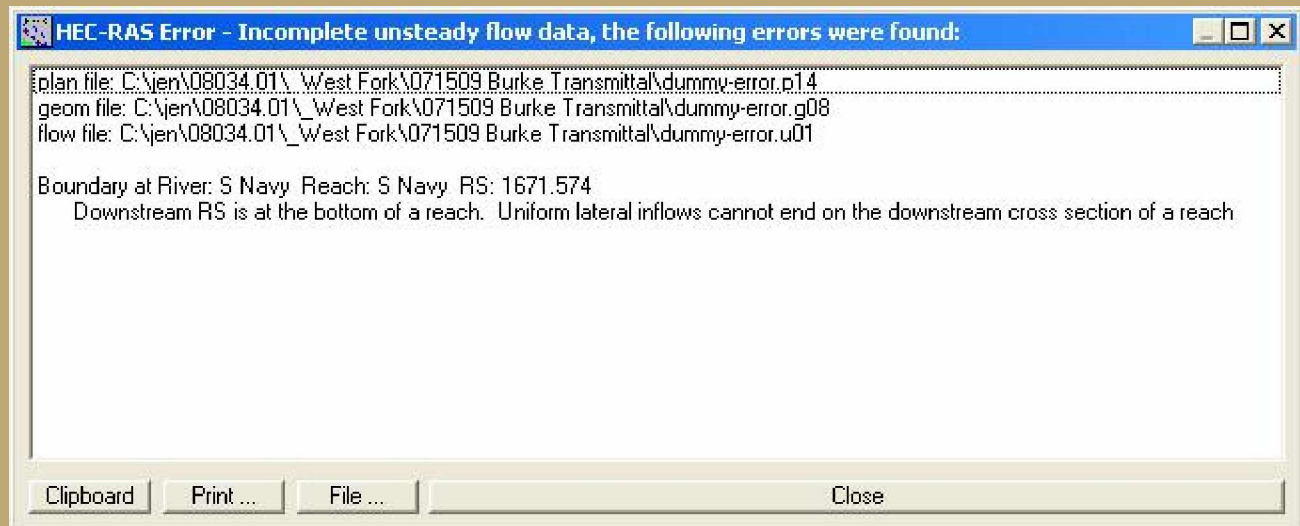
Model Errors Before Simulation Begins

- Model Errors – Before Simulation Begins

- Cross Section Location Errors



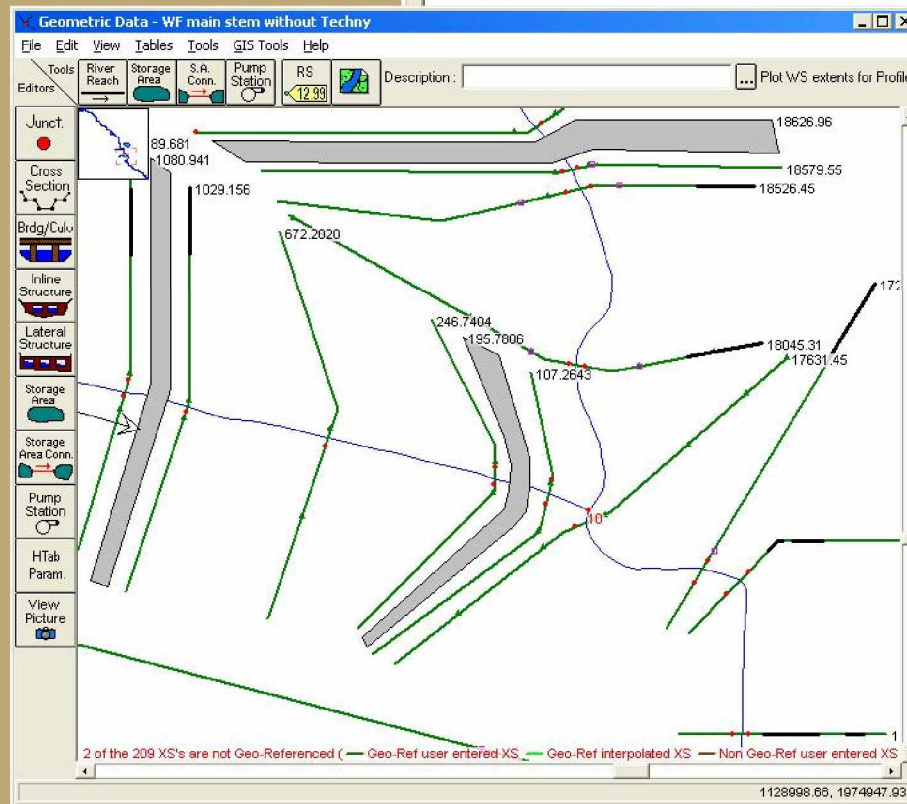
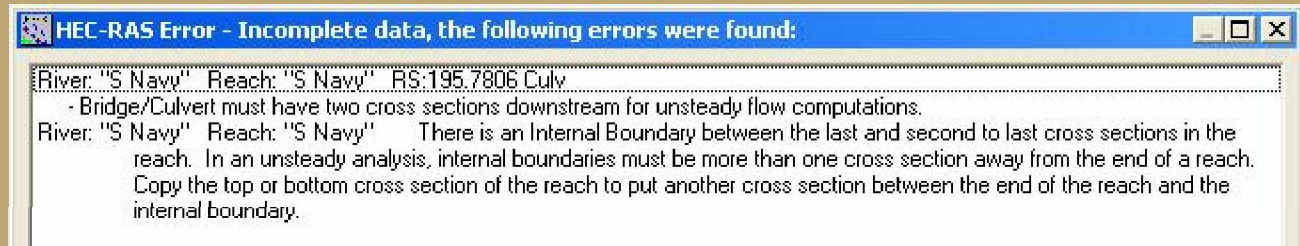
- Unsteady Flow Inflow Errors





Model Errors Before Simulation Begins

- Cross Section Locations



- Two XS d/s of each structure
- Two XS between internal boundary and confluence



Model Errors Before Simulation Begins

- Unsteady Flow Inflow Errors

Unsteady Flow Data - WF HMS Hydrology 062309

File Options Help

Boundary Conditions Initial Conditions Apply Data

Select Location for Boundary Condition

River: S Navy

Reach: S Navy River Sta.: 2228.927 Add a Boundary Condition Location

Boundary Condition Types

Stage Hydrograph	Flow Hydrograph	Stage/Flow Hydr.	Rating Curve
Normal Depth	Lateral Inflow Hydr.	Uniform Lateral Inflow	Groundwater Interflow
T.S. Gate Openings	Elev Controlled Gates	Navigation Dams	IB Stage/Flow

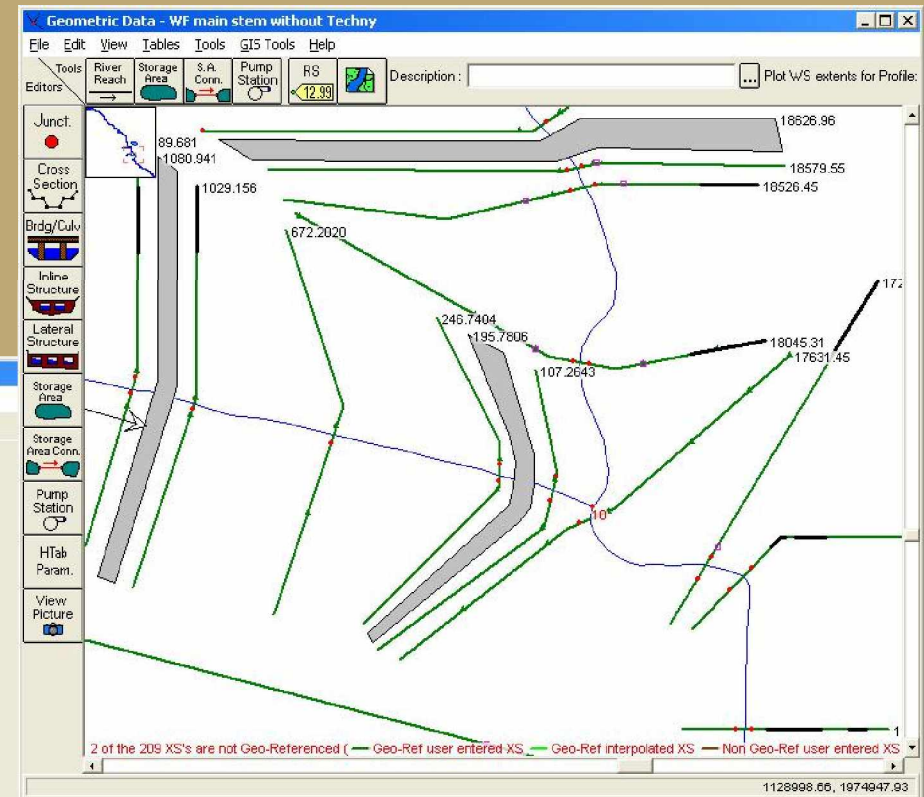
Rules

River	Reach	RS	Boundary Condition Type
1 N Navy Ditch	Upper Reach	2242.068	Flow Hydrograph
2 N Navy Ditch	Upper Reach	1808.803	Uniform Lateral Inflow
3 N Navy Diversion	N Navy Diversion	1056.009	Flow Hydrograph
4 NBCR West Fork	US Techny	50056.06	Flow Hydrograph
5 NBCR West Fork	US Techny	49138.40	Lateral Inflow Hydr.
6 NBCR West Fork	US Techny	47101.55	Uniform Lateral Inflow
7 NBCR West Fork	US Techny	44505.76	Lateral Inflow Hydr.
8 NBCR West Fork	US Techny	44145.32	Uniform Lateral Inflow
9 NBCR West Fork	US Techny	43027.12	Lateral Inflow Hydr.
10 NBCR West Fork	US Techny	42781.46	Uniform Lateral Inflow
11 NBCR West Fork	US Techny	41969.86	Uniform Lateral Inflow
12 NBCR West Fork	US Techny	38343.83	Uniform Lateral Inflow
13 NBCR West Fork	US Techny	36886.14	Uniform Lateral Inflow
14 NBCR West Fork	US Techny	34925.93	Uniform Lateral Inflow
15 NBCR West Fork	US Techny	30891.70	Lateral Inflow Hydr.
16 NBCR West Fork	US Techny	30430.81	Uniform Lateral Inflow
17 NBCR West Fork	US Techny	26777.59	Uniform Lateral Inflow
18 NBCR West Fork	DS S Navy	15654.78	Lateral Inflow Hydr.
19 NBCR West Fork	DS S Navy	15287.88	Uniform Lateral Inflow
20 NBCR West Fork	DS S Navy	10761.58	Lateral Inflow Hydr.
21 NBCR West Fork	DS S Navy	9895.283	Lateral Inflow Hydr.

Storage Area and SA Connections:

Storage Area: Deerfield 2' Add a Boundary Condition Location

Storage Area or SA Connection	Boundary Condition Type
1	



- Uniform Lateral Inflow Can't Span Structures
- Uniform Lateral Inflow Can't End at D/S End of Reach



De-bugging Initial Conditions

- Model crashes at beginning of simulation
- Problem with Initial Conditions
 - Flow too low, reaches go “dry”
 - Flow u/s of confluence \neq flow d/s
 - Supercritical
- Computational Time Step

HEC-RAS Finished Computations

Geometry Processor
River: NBCR West Fork RS: 17.76965
Reach: DS S Navy Node Type: Cross Section
IB Curve:

Unsteady Flow Simulation
Simulation:
Time: 120.0000 17SEP2008 00:00:00 Iteration: 0
Writing Profiles 6400

Post Process
River: NBCR West Fork RS: 17.76965
Reach: DS S Navy Node Type: Cross Section
Profile: 11SEP2008 2400
Simulation: 2/2

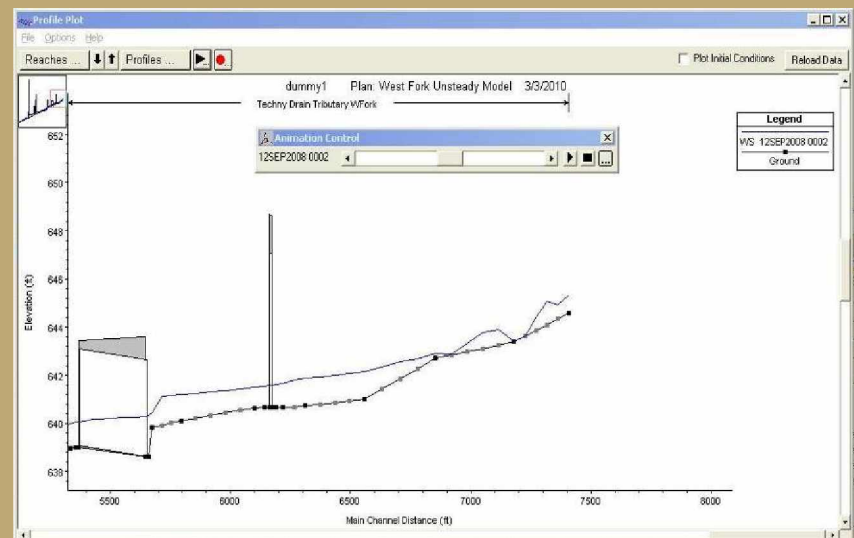
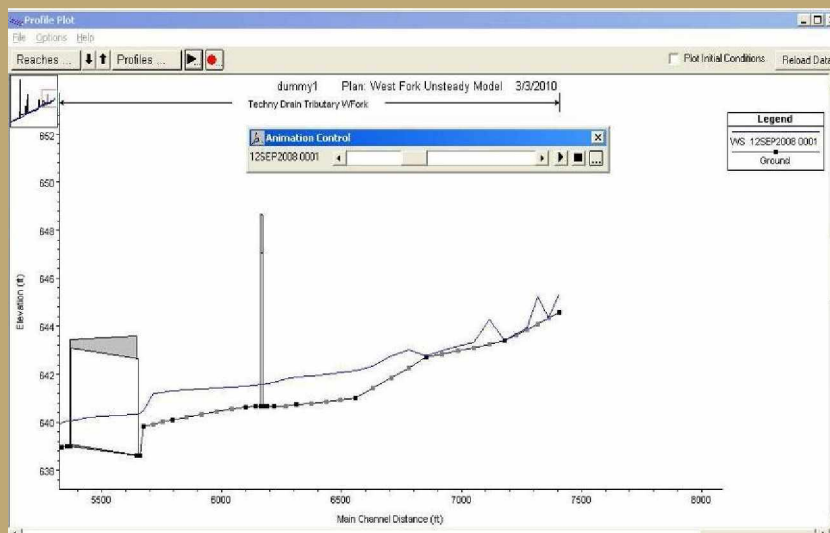
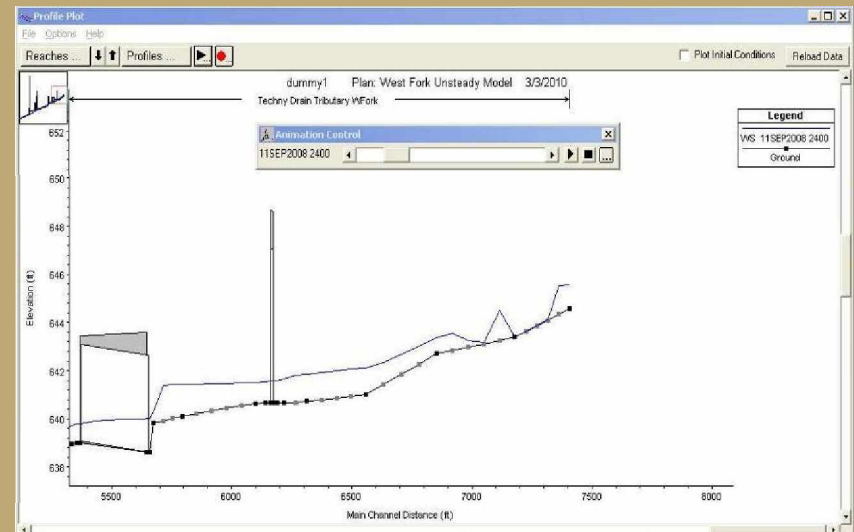
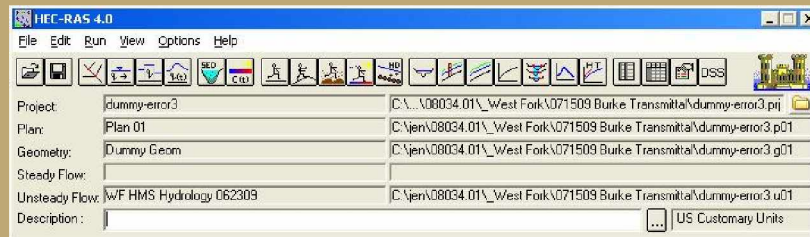
Computation Messages

12SEP2008 00:03:15	Techny North	Tributary Techny	486.2416	647.00	0.333
Solution solver went unstable, iteration 12 at 12SEP2008 00:03:30					
	Techny South	Tributary Techny	306.292*	649.84	2.262
Solution solver went unstable, iteration 7 at 12SEP2008 00:03:45					
	Techny South	Tributary Techny	912.5332	651.43	0.343
12SEP2008 00:04:00	Techny South	Tributary Techny	682.35*	651.19	0.161
12SEP2008 00:04:15	Techny South	Tributary Techny	50	645.38	0.253
12SEP2008 00:04:30	Techny South	Tributary Techny	437.7529	648.82	0.085
12SEP2008 00:04:45	Techny South	Tributary Techny	912.5332	650.51	3.673
12SEP2008 00:05:00	Techny South	Tributary Techny	50	645.38	1.263
Solution solver went unstable, iteration 8 at 12SEP2008 00:05:15					
	Techny Drain	Tributary Wfork	6693.42*	641.45	14.284
***** Matrix Solution Failed *****					
Minimum error exceeds allowable tolerance at 12SEP2008 0005					
	Techny Drain	Tributary Wfork	7423.21*		
WARNING!					



De-bugging Initial Conditions

- Initial flow too low, reaches go “dry”
- Animate Profile





De-bugging Initial Conditions

- Keep Reaches “Wet”
 - Check Initial Flows
 - Check Minimum Flows
 - Add Dummy Flow to Emergency/Diversion Channels

Unsteady Flow Data - WF HMS Hydrology 062309

File Options Help

Boundary Conditions Initial Conditions | Apply Data

Initial Flow Distribution Method

☐ Use a Restart File Filename:

☒ Enter Initial flow distribution

Locations of Flow Data Changes

River: Add Multiple...

Reach: River Sta.: Add A Flow Change Location

	River	Reach	RS	Initial Flow
1	N Navy Ditch	Upper Reach	2242.068	2
2	N Navy Diversion	N Navy Diversion	1056.009	0.1
3	NBCR West Fork	US Underwriters	50056.06	5
4	NBCR West Fork	US Techny	44505.76	5
5	NBCR West Fork	DS Techny	30891.70	20
6	NBCR West Fork	US N Navy Div	23552.81	20
7	NBCR West Fork	US S Navy	21471.09	20
8	NBCR West Fork	DS S Navy	17631.45	20
9	S Navy	S Navy	2228.927	2
10	Techny Drain	Tributary Wfork	7468.671	20
11	Techny North	Tributary Techny	3808.565	20
12	Techny South	Tributary Techny	2899.544	20
13	Underwriters	Trib West Fork	1274.258	10

Uniform Lateral Inflow Hydrograph

River: N Navy Ditch Reach: Upper Reach RS: 1808.803

Inflow will be evenly distributed from RS: "1808.803" to RS:

☒ Read from DSS before simulation

File:
Path:

☐ Enter Table Data time interval:

Select/Enter the Data's Starting Time Reference

☒ Use Simulation Time: Date: Time:
☐ Fixed Start Time: Date: Time:

Hydrograph Data

	Date	Simulation Time (hours)	Lateral Inflow (cfs)
1	11Sep2008 2400	00:00	
2	12Sep2008 0100	01:00	
3	12Sep2008 0200	02:00	
4	12Sep2008 0300	03:00	
5	12Sep2008 0400	04:00	
6	12Sep2008 0500	05:00	

Time Step Adjustment Options ("Critical" boundary conditions)

☐ Monitor this hydrograph for adjustments to computational time step

Max Change in Flow (without changing time step):

Min Flow: Multiplier:



De-bugging Initial Conditions

- Flow upstream of confluence not equal to flow downstream of confluence

Unsteady Flow Data - WF HMS Hydrology 062309

File Options Help

Boundary Conditions Initial Conditions | Apply Data

Initial Flow Distribution Method

☐ Use a Restart File Filename:

☒ Enter Initial flow distribution

Locations of Flow Data Changes

River: Add Multiple...

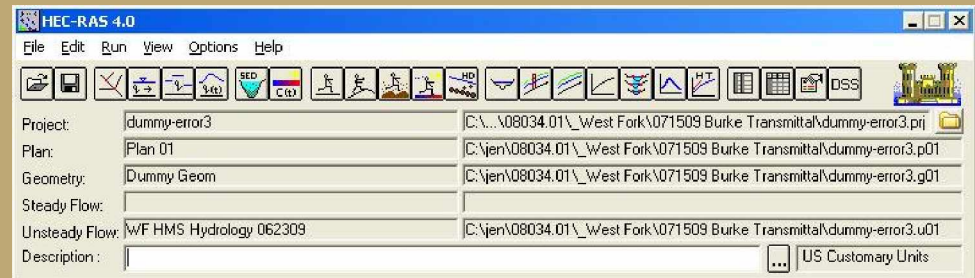
Reach: River Sta.: Add A Flow Change Location

	River	Reach	RS	Initial Flow
1	N Navy Ditch	Upper Reach	2242.068	2
2	N Navy Diversion	N Navy Diversion	1056.009	0.1
3	NBCR West Fork	US Underwriters	50056.06	5
4	NBCR West Fork	US Techny	44505.76	5
5	NBCR West Fork	DS Techny	30891.70	20
6	NBCR West Fork	US N Navy Div	23552.81	20
7	NBCR West Fork	US S Navy	21471.09	20
8	NBCR West Fork	DS S Navy	17631.45	20
9	S Navy	S Navy	2228.927	2
10	Techny Drain	Tributary W'Fork	7468.671	20
11	Techny North	Tributary Techny	3808.565	20
12	Techny South	Tributary Techny	2899.544	20
13	Underwriters	Trib W'West Fork	1274.258	10



De-bugging Initial Conditions

- Supercritical Flow, Model Unable To Converge To Solution
- Review Summary Output Tables



Profile Output Table - Standard Table 1													
File Options Std. Tables User Tables Locations Help													
HEC-RAS Plan: WestForkUnsteady River: Techny Drain Reach: Tributary W/Fork Profile: 12SEP2008 0005													
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude #	Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		
Tributary W/Fork	7468.671	12SEP2008 0005	-8.45	644.590	644.76	645	645	0	-4	2	18	2.37	
Tributary W/Fork	7423.21*	12SEP2008 0005	28.06	644.350	645.60		646	0	1	29	35	0.19	
Tributary W/Fork	7377.75*	12SEP2008 0005	26.67	644.110	645.11		645	0	2	16	27	0.37	
Tributary W/Fork	7332.28*	12SEP2008 0005	-2.91	643.870	643.91	644	966	4430	-144	0	1	180.65	
Tributary W/Fork	7286.82*	12SEP2008 0005	-2.08	643.630	643.65	644	3866	97357	-456	0	0	765.95	
Tributary W/Fork	7241.367	12SEP2008 0005	-0.81	643.390	643.41	644	1846	36848	-278	0	0	467.87	
Tributary W/Fork	7176.16*	12SEP2008 0005	-1.68	643.250	643.48	644	644	1	-5	0	3	2.74	
Tributary W/Fork	7110.95*	12SEP2008 0005	-2.64	643.120	643.14	644	10859	364456	-811	0	0	1361.85	
Tributary W/Fork	7045.75*	12SEP2008 0005	0.57	642.980	643.00	643	1059	15973	164	0	0	274.82	
Tributary W/Fork	6980.54*	12SEP2008 0005	3.95	642.850	643.47		644	0	2	2	8	0.53	
Tributary W/Fork	6915.343	12SEP2008 0005	4.46	642.710	643.57		644	0	1	5	10	0.26	
Tributary W/Fork	6841.37*	12SEP2008 0005	5.63	642.280	643.51		644	0	1	6	10	0.22	
Tributary W/Fork	6767.39*	12SEP2008 0005	4.50	641.850	642.68		643	0	2	2	5	0.56	
Tributary W/Fork	6693.42*	12SEP2008 0005	-5.23	641.430	642.48		643	0	-2	3	6	0.40	
Tributary W/Fork	6619.455	12SEP2008 0005	-8.29	641.000	641.68	642	642	0	-6	1	4	1.94	
Tributary W/Fork	6557.86*	12SEP2008 0005	-0.35	640.930	640.95	641	1421	32297	-224	0	0	376.36	
Tributary W/Fork	6496.26*	12SEP2008 0005	3.22	640.860	642.04		642	0	1	4	7	0.20	
Tributary W/Fork	6434.67*	12SEP2008 0005	2.39	640.800	641.94		642	0	1	4	8	0.16	
Tributary W/Fork	6373.082	12SEP2008 0005	2.36	640.730	641.89		642	0	1	4	10	0.15	
Tributary W/Fork	6326.95*	12SEP2008 0005	2.43	640.690	641.84		642	0	1	4	9	0.18	
Tributary W/Fork	6280.837	12SEP2008 0005	2.52	640.660	641.66		642	0	1	3	10	0.32	



De-bugging Initial Conditions

- Computational Parameters

- May need shorter computational time step to allow HEC-RAS to converge
- May need shorter output time step to enable user to see results at time of failure

Unsteady Flow Analysis

File Options Help

Plan: Plan 01 Short ID: Plan 01

Geometry File: Dummy Geom

Unsteady Flow File: WF HMS Hydrology 062309

Plan Description: Dummy Model

Programs to Run:

- ☒ Geometry Preprocessor
- ☒ Unsteady Flow Simulation
- ☒ Post Processor

Simulation Time Window

Starting Date: 12Sep2008 Starting Time: 0000

Ending Date: 17SEP2008 Ending Time: 0000

Computation Settings

Computation Interval: 15 Secor

Hydrograph Output Interval: 30 Minute

☐ Computation Level Output Detailed Output Interval: 30 Minute

DSS Output Filename: C:\jen\08034.01_West Fork\071509 Burke Transmitt

☐ Mixed Flow Regime (see menu: "Options/Mixed Flow Options ...")


Compute




De-bugging Runtime Errors

- De-bugging Runtime Errors
- Identify Source of Model Crashes
 - Note time and location of model crash
 - Find problematic XS and consider HEC-RAS suggestions
- Heed Model Extrapolation Warnings



Geometry Processor

River: NBCR West Fork RS: 17.76965
Reach: DS S Navy Node Type: Cross Section
IB Curve: 

Unsteady Flow Simulation

Simulation: 
Time: 120.0000 17SEP2008 00:00:00 Iteration: 0
Writing Profiles: 400

Post Process

River: NBCR West Fork RS: 26523.93
Reach: US N Navy Node Type: Cross Section
Profile: 12SEP2008 0200 
Simulation: 3/3 

Computation Messages

At River	S Navy	Reach	S Navy	R.S.	195.7806
At River	NBCR West Fork	Reach	DS S Navy	R.S.	15392.18
At River	NBCR West Fork	Reach	DS S Navy	R.S.	12756.26
At River	NBCR West Fork	Reach	DS S Navy	R.S.	11870.73
At River	NBCR West Fork	Reach	DS S Navy	R.S.	11359.11
At River	NBCR West Fork	Reach	DS S Navy	R.S.	6664.061
At River	NBCR West Fork	Reach	DS S Navy	R.S.	4060.731
At River	NBCR West Fork	Reach	DS S Navy	R.S.	2319.75

Finished Unsteady Flow Simulation

Writing Results to DSS
Finished Writing Results to DSS

Reading Data for Post Process
Simulation went unstable at: 12SEP2008 02:15:00
Resetting post process profiles to end at: 12SEP2008 0200

Running Post Processor Version 4.0.0 March 2008

Finished Post Processing

Task	Time
Preprocessing Geometry	0.44 sec
Unsteady Flow Computations	9.02 sec
Writing to DSS	1.45 sec
Post-Processing	2.31 sec
Complete Process	13.27 sec

Computation messages written to: C:\jen\08034.01\dummyforAFSM.p18.comp_msgs.txt

Close



De-bugging Runtime Errors

- Identify Source of Model Crashes
 - Note time and location of model crash

```
**** Matrix Solution Failed ****  
Minimum error exceeds allowable tolerance at 12SEP2008 0214  
NBCR West Fork US N Navy 23529.47
```

- Review detailed output tables
- Find problematic cross section and consider HEC-RAS suggestions
- Often, just need more cross sections

Cross Section Output					
File Type Options Help					
River:	NBCR West Fork	Profile:	12SEP2008 0200		
Reach:	US N Navy	RS:	23529.47	Plan:	ust4 trunc half
Plan: ust4 trunc half NBCR West Fork US N Navy RS: 23529.47 Profile: 12SEP2008 0200					
E.G. Elev (ft)	620.58	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.03	Wt. n-Val.		0.035	
W.S. Elev (ft)	620.55	Reach Len. (ft)	0.50	80.00	82.70
Crit W.S. (ft)		Flow Area (sq ft)		3.38	
E.G. Slope (ft/ft)	0.011402	Area (sq ft)		3.38	
Q Total (cfs)	-4.69	Flow (cfs)		-4.69	
Top Width (ft)	19.91	Top Width (ft)		19.91	
Vel Total (ft/s)	-1.39	Avg. Vel. (ft/s)		-1.39	
Max Chl Dpth (ft)	0.23	Hydr. Depth (ft)		0.17	
Conv. Total (cfs)	44.0	Conv. (cfs)		44.0	
Length Wtd. (ft)	80.00	Wetted Per. (ft)		19.92	
Min Ch El (ft)	620.32	Shear (lb/sq ft)		0.12	
Alpha	1.00	Stream Power (lb/ft s)		-0.17	
Froth Loss (ft)	3.51	Cum Volume (acre-ft)	0.00	0.33	
C & E Loss (ft)		Cum SA (acres)	0.00	1.37	

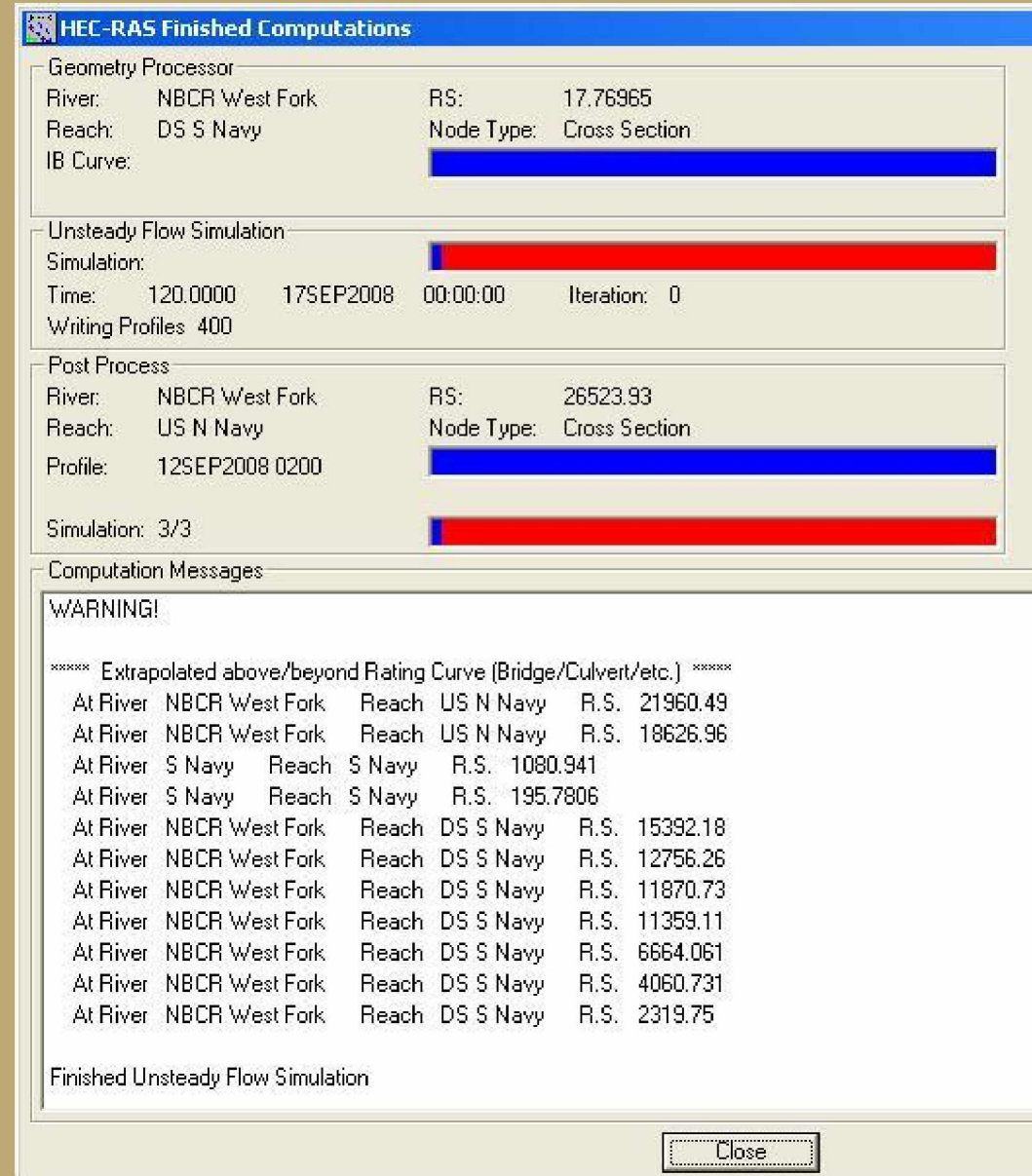
Errors, Warnings and Notes	
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section. This may indicate the need for additional cross sections.

Select Profile



De-bugging Runtime Errors

- Heed Model Extrapolation Warnings
 - Adjust Hydraulic Table (HTab) Parameters
 - Adjust Storage Ratings





Summary

- Start with Good XS Locations, Good Unsteady Flow Input Locations
- Use HEC-RAS Graphical & Tabular Tools
 - Review .txt file to find time & location of error
 - Animate Profile
 - Review Summary Output Tables
 - Review Detailed Output Tables
- Pay Attention to:
 - Initial Flows
 - Supercritical Flow
 - Cross Section Spacing
- Consider HEC-RAS Warnings



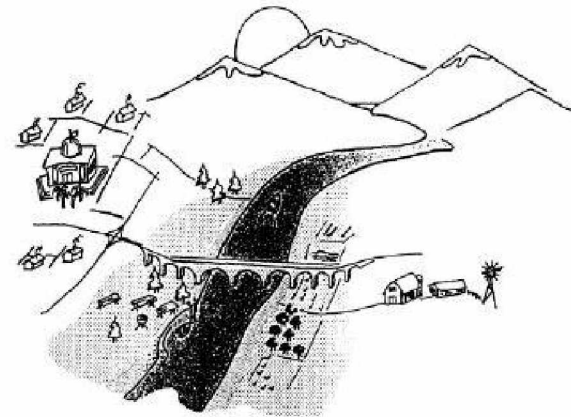
Resources for Help

- Resources for Help
 - HEC-RAS Help
 - ASCE HEC-RAS Unsteady Flow Class and/or Class Manual



**US Army Corps
of Engineers**
Hydrologic Engineering Center

HEC-RAS River Analysis System



User's Manual

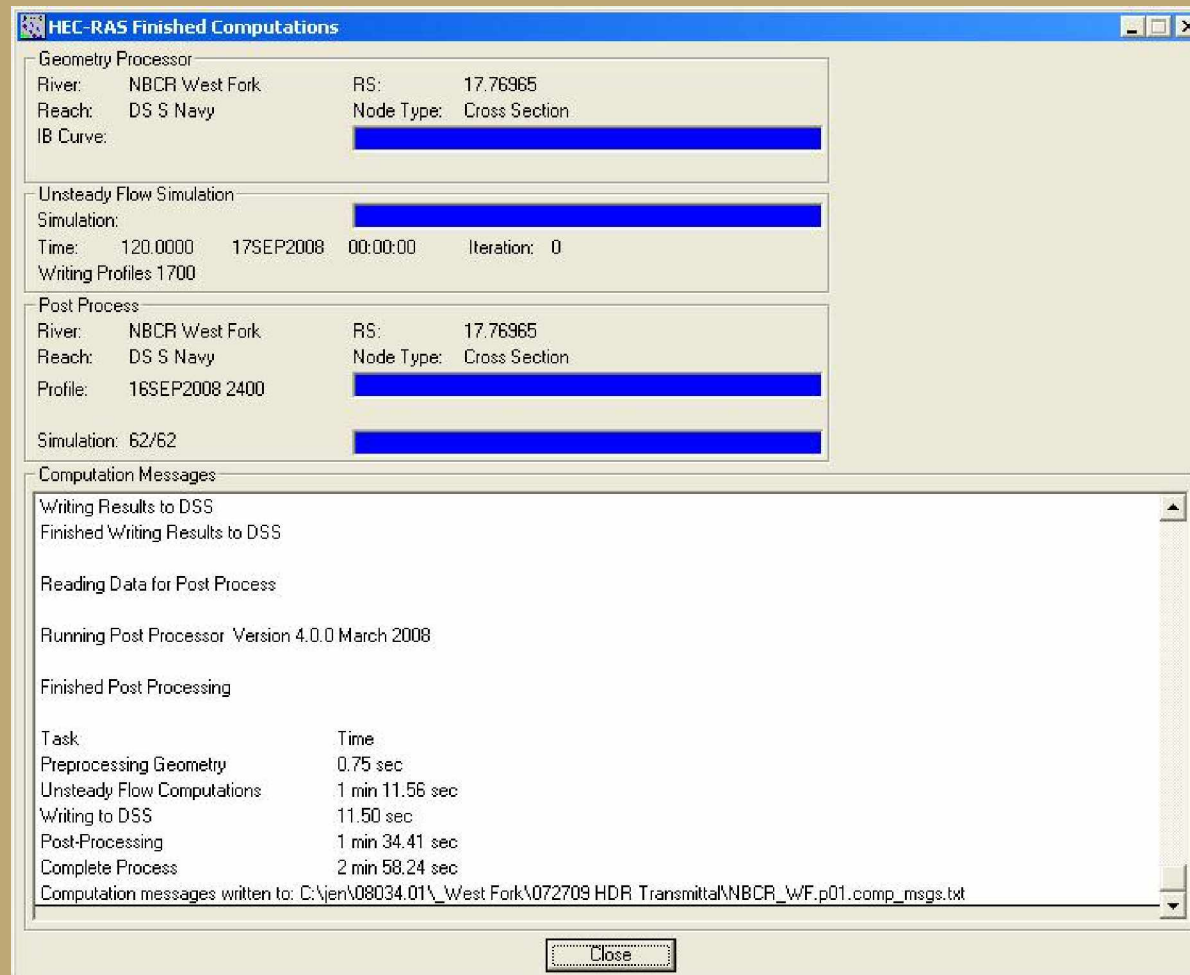
Version 4.0
March 2008

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CPD-68



Model Runs! Success!



Questions?