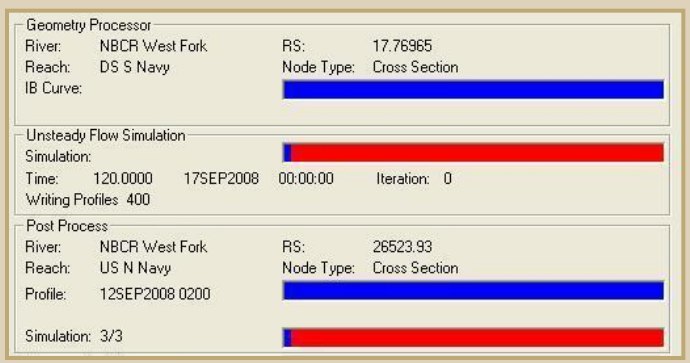
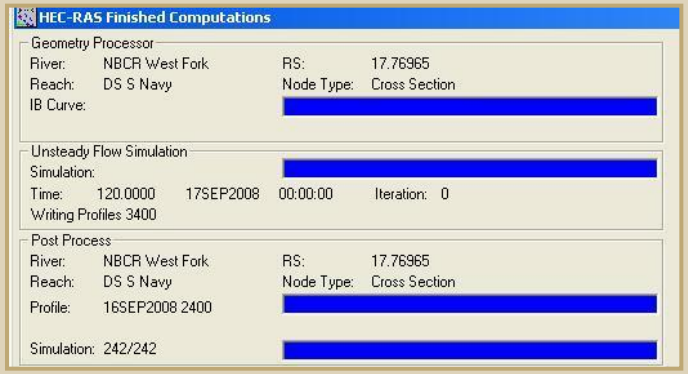
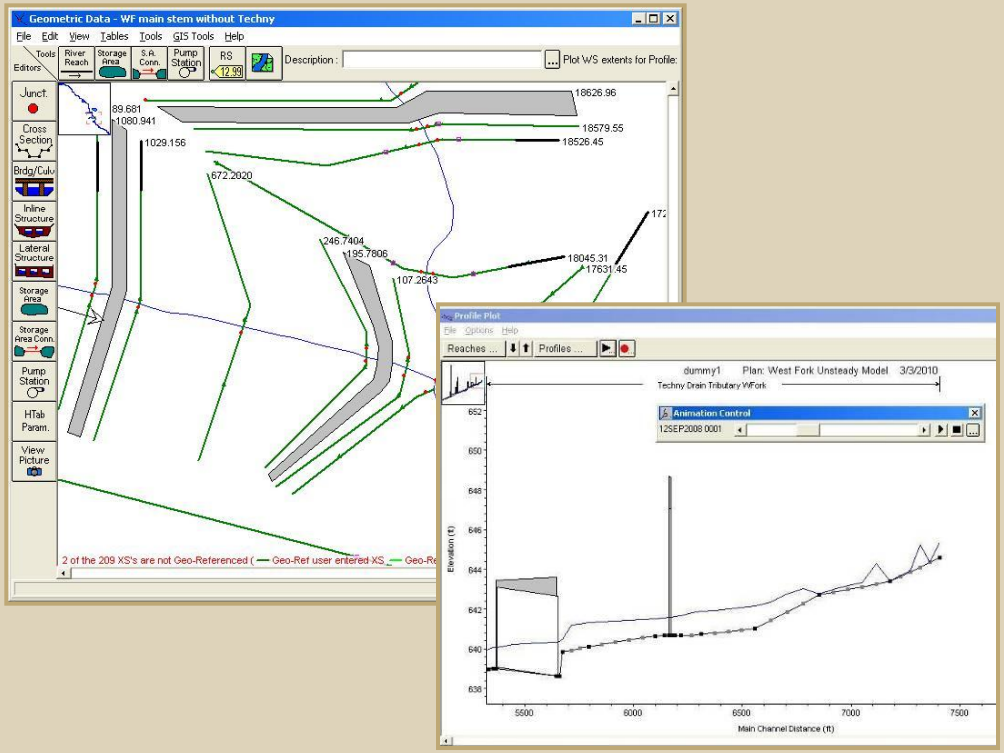
De-Bugging a HEC-RAS Unsteady Flow Model







Presented by:

Jennifer Maercklein, P.E., CFM

V3 Companies

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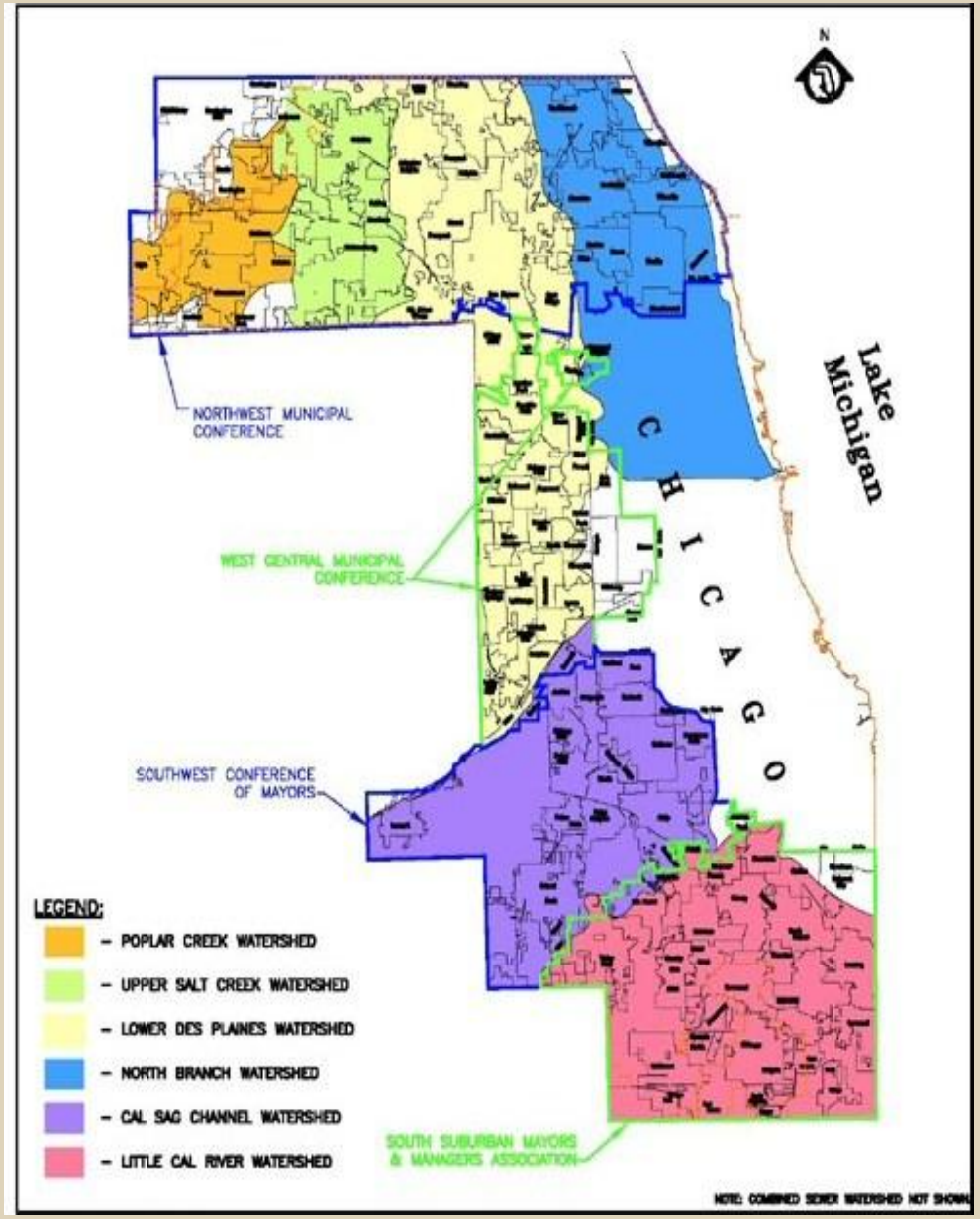
Presentation Agenda

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

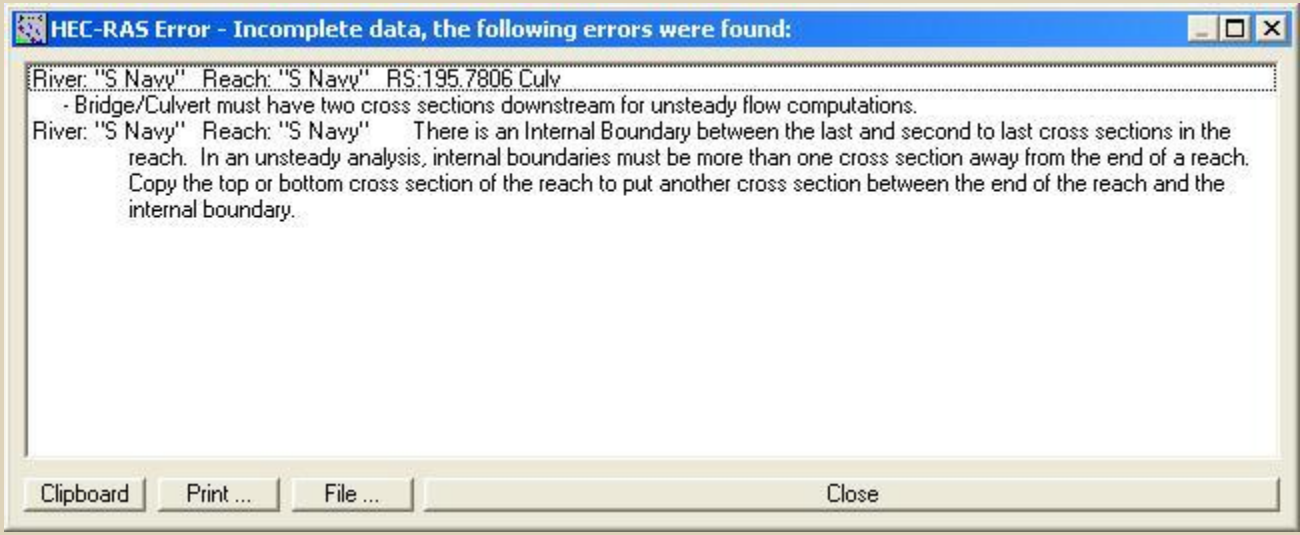


Presentation Goals

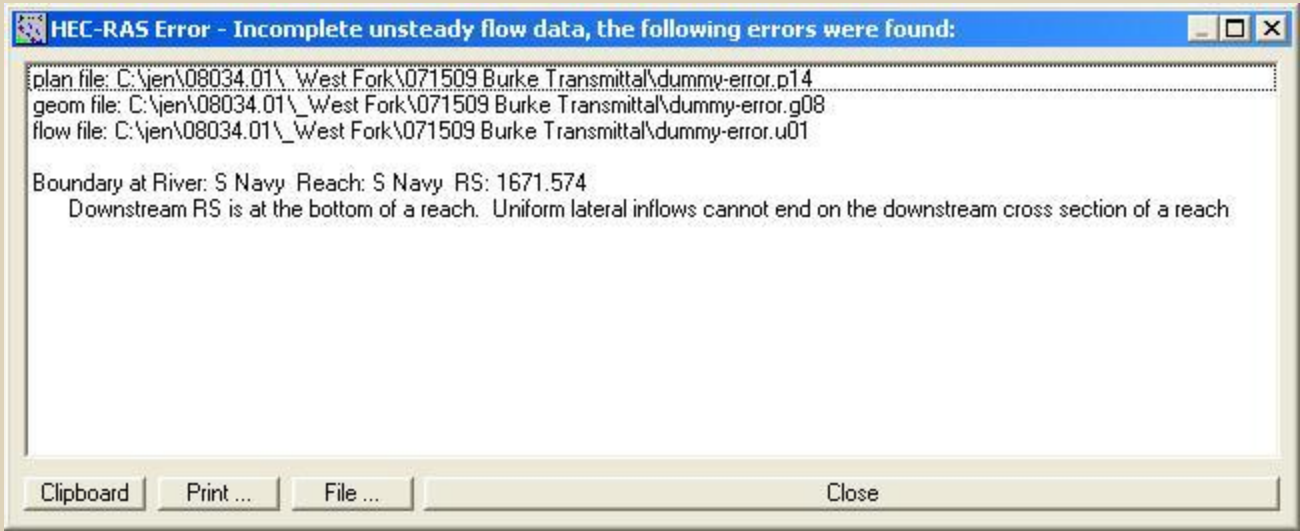
- Tips to get started with de-bugging
  - Useful HEC-RAS tools for debugging
  - Tips to find sources of error
- De-bugging ideas presented here do not represent an exhaustive list of de-bugging techniques
- Presentation Assumptions
  - Familiarity with HEC-RAS
  - Familiarity with Unsteady Flow Modeling

Model Errors Before Simulation Begins

- Model Errors – Before Simulation Begins
  - Cross Section Location Errors

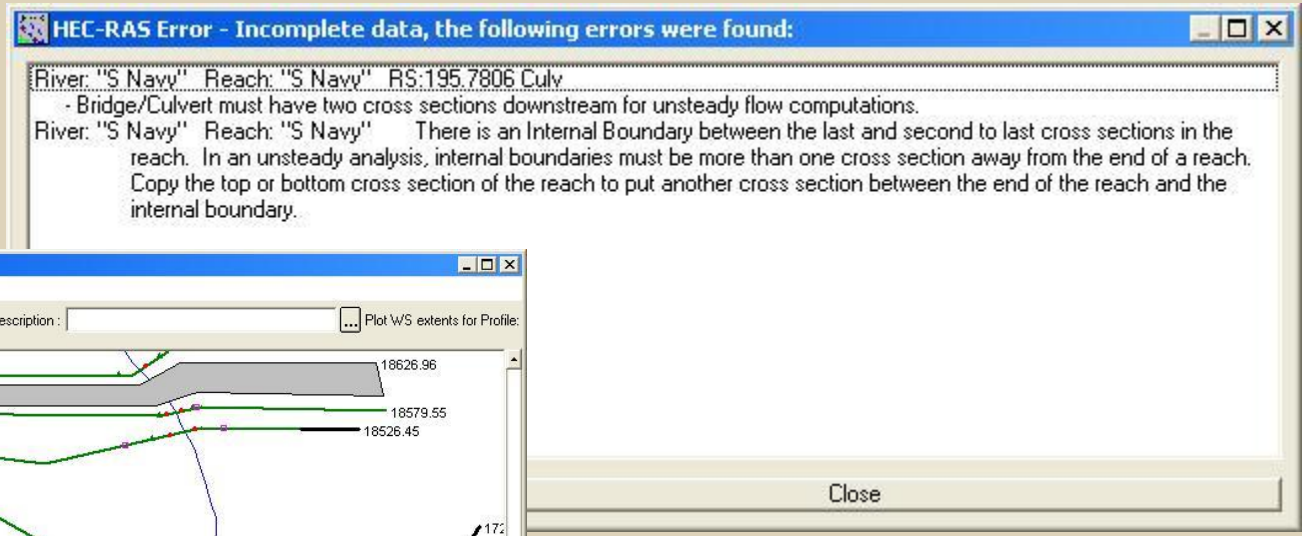


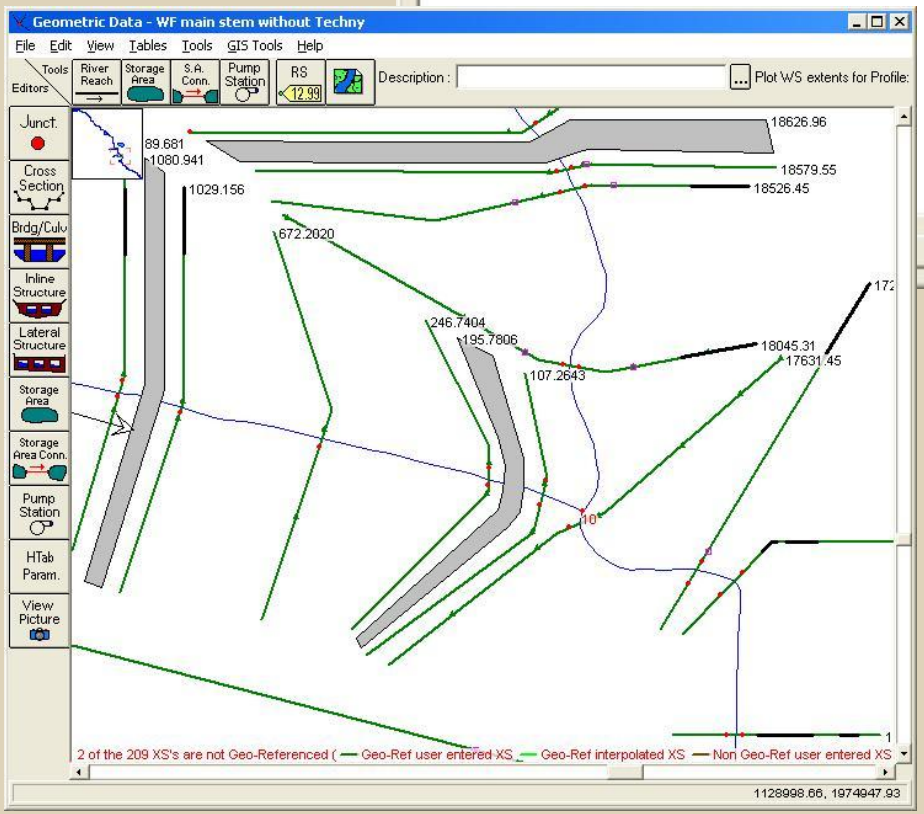
  - Unsteady Flow Inflow Errors



Model Errors Before Simulation Begins

- Cross Section Locations

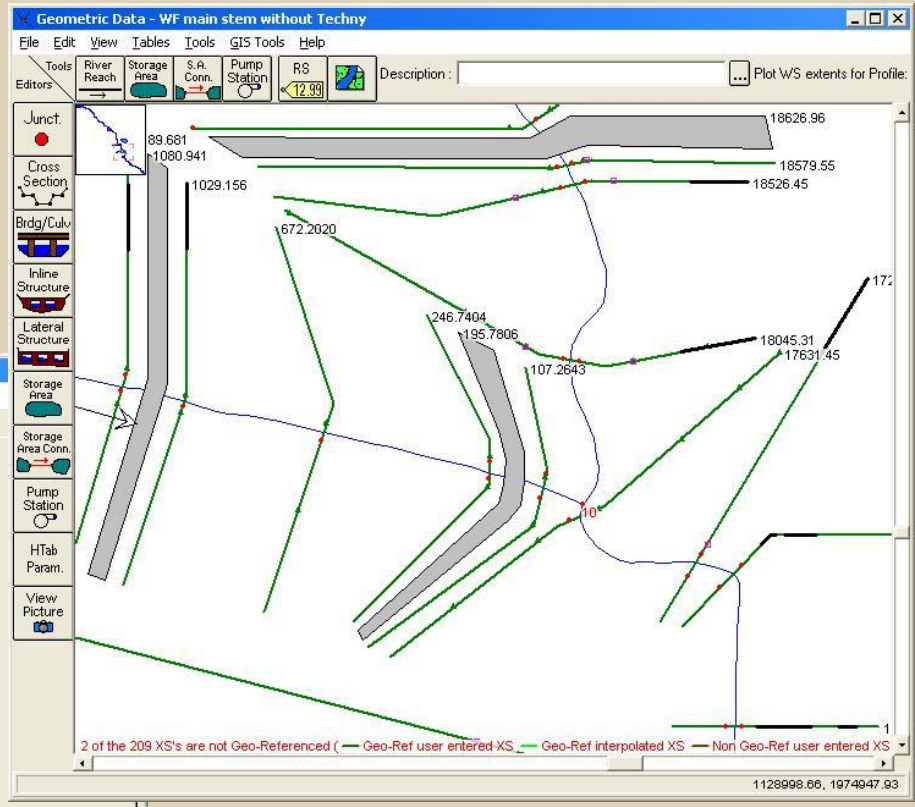


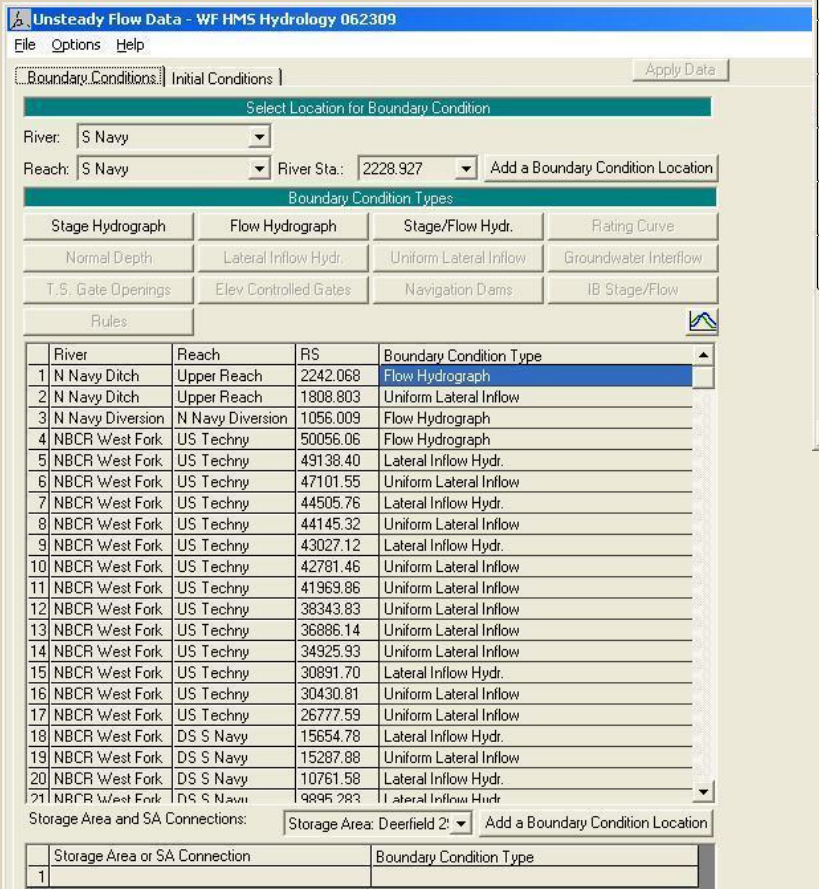


- Two XS d/s of each structure
- Two XS between internal boundary and confluence

Model Errors Before Simulation Begins

- Unsteady Flow Inflow Errors





	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 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

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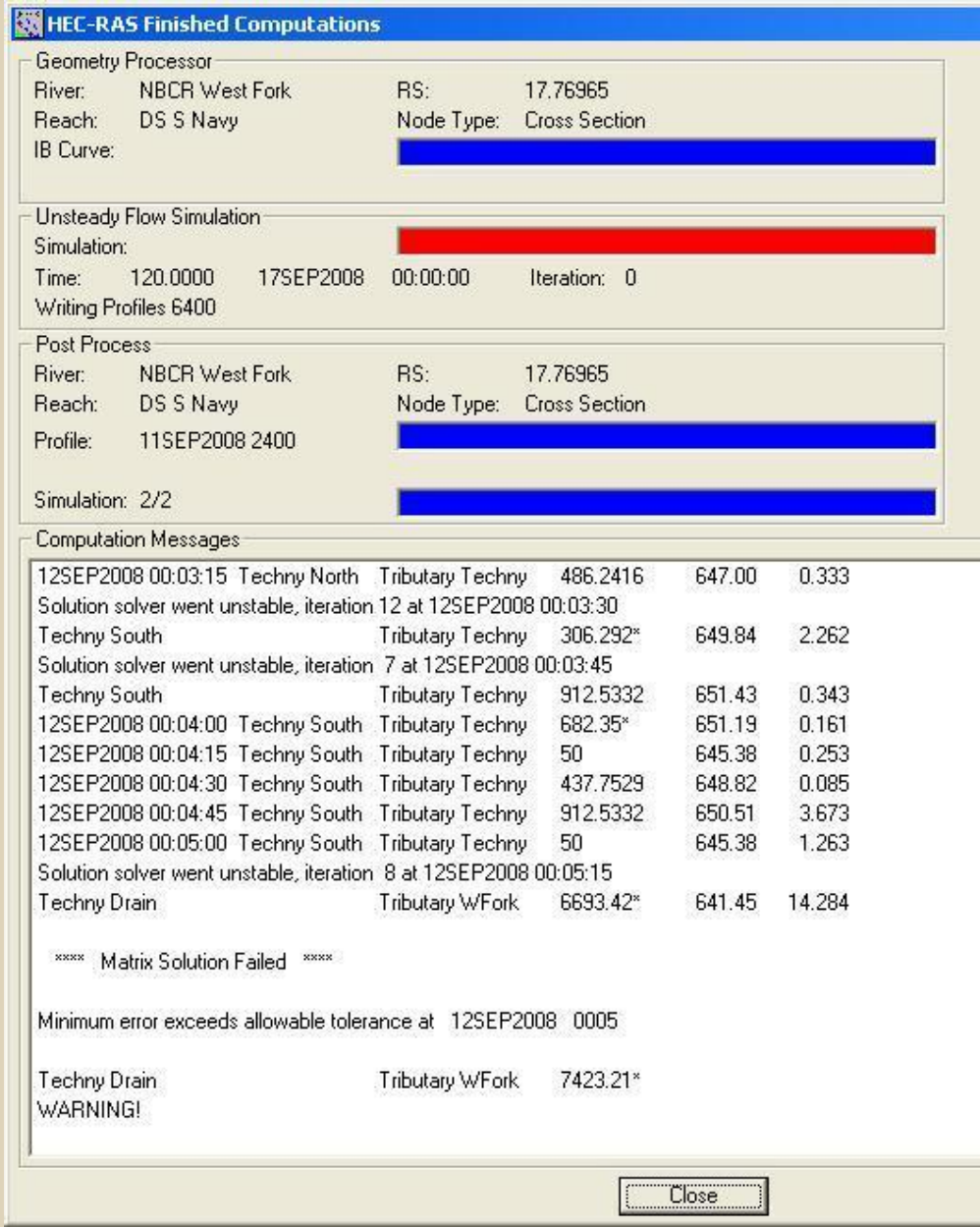
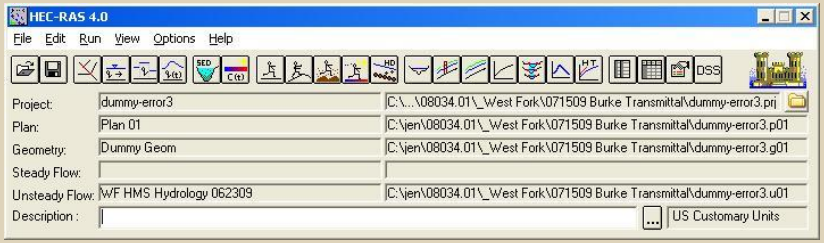
De-bugging Initial Conditions

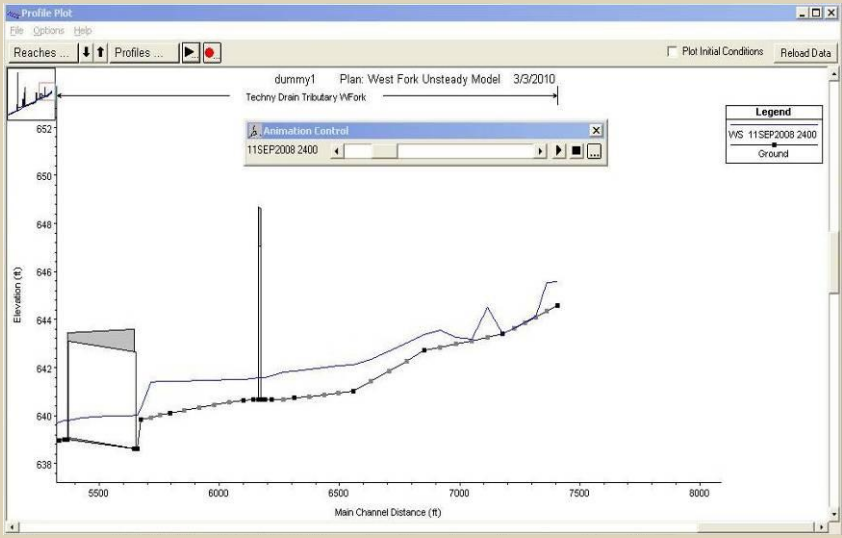
- Model crashes at beginning of simulation
- Problem with Initial Conditions
  - Flow too low, reaches go “dry”
  - Flow u/s of confluence ≠ flow d/s
  - Supercritical
- Computational Time Step

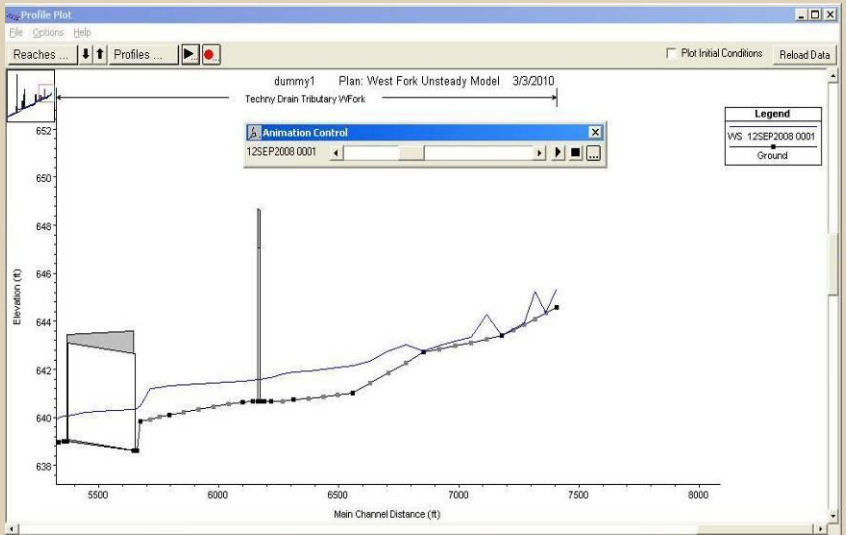


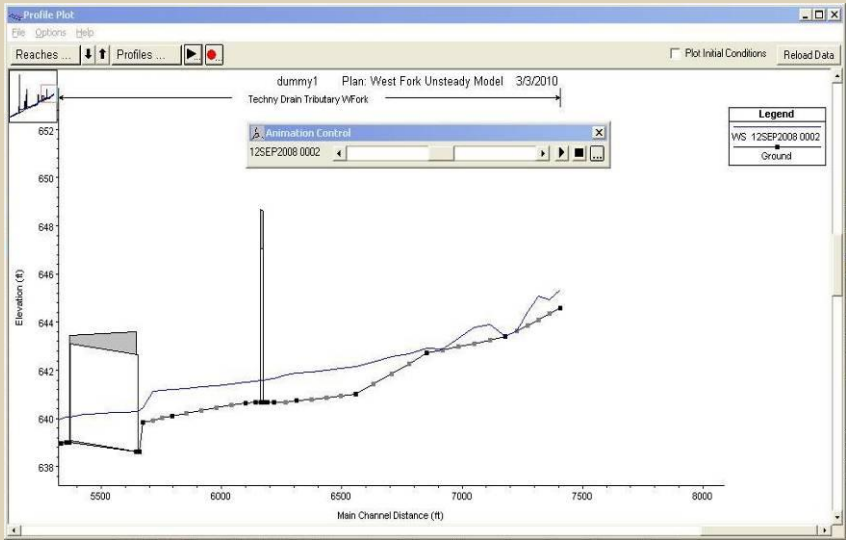
De-bugging Initial Conditions

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









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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: Techny Drain | Add Multiple...

Reach: Tributary WFork | River Sta.: 7468.671 | 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: 338.1133

Read from DSS before simulation | Select DSS file and Path

File: C:\jen\08034.01_West Fork\071509 Burke Transmittal\WestFork_P

Path: //W-WF-NND-1/FLOW/01SEP2008/15MIN/RUN:STORM1_AVGC

Enter Table | Data time interval: 1 Hour

Select/Enter the Data's Starting Time Reference

Use Simulation Time: Date: 12Sep2008 Time: 0000

Fixed Start Time: Date: Time:

No. Ordinates | Interpolate Missing Values | Del Row | Ins Row

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

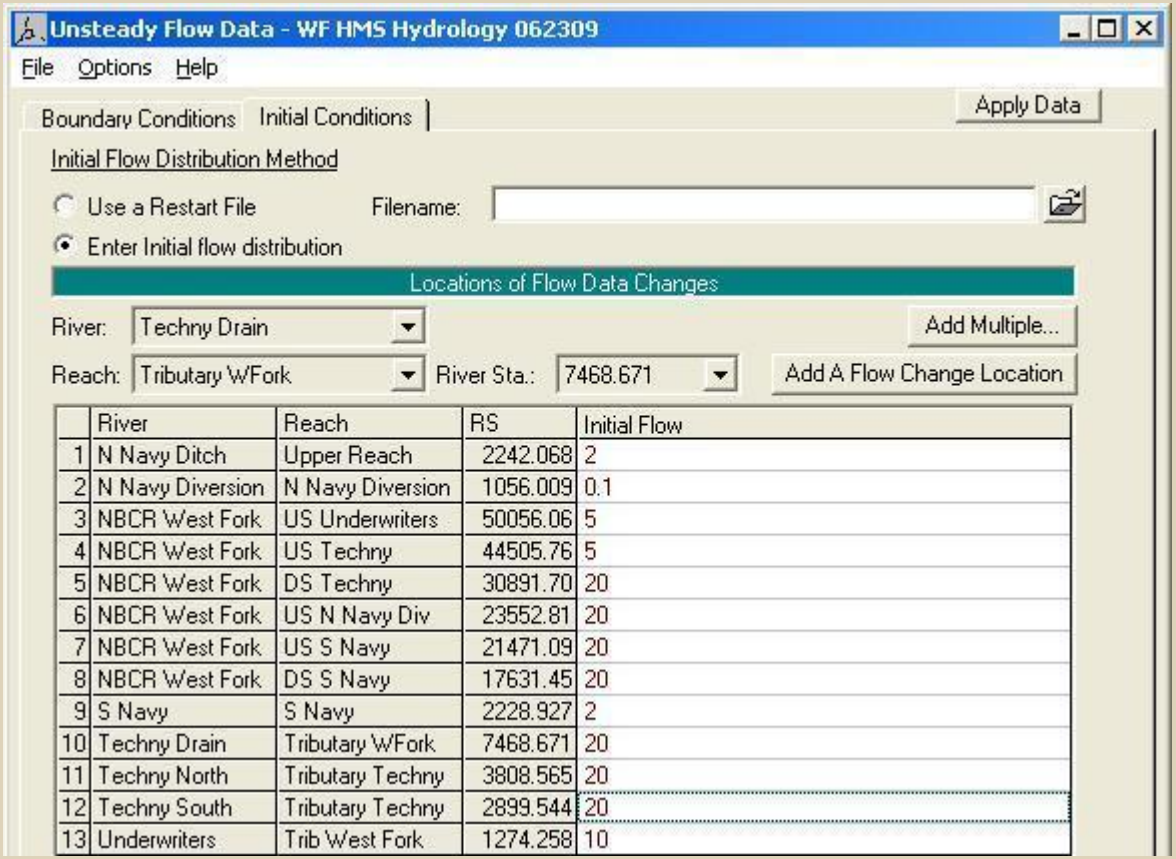
Max Change in Flow (without changing time step):

Min Flow: 2 Multiplier:

Plot Data | OK | Cancel

De-bugging Initial Conditions

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



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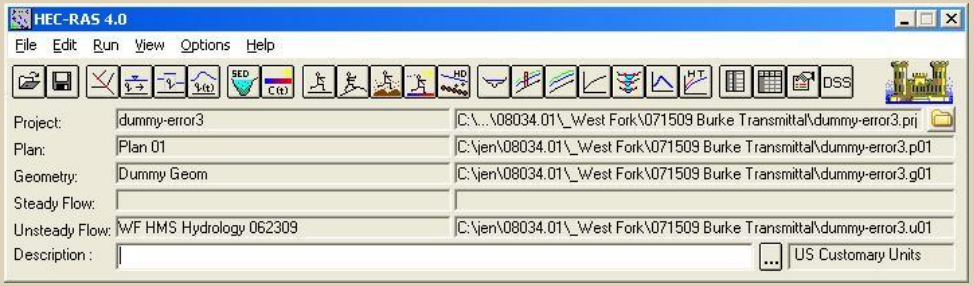
12	Techny South	Tributary Techny	2899.544	20
13	Underwriters	Trib West Fork	1274.258	10

De-bugging Initial Conditions

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



Profile Output Table - Standard Table 1

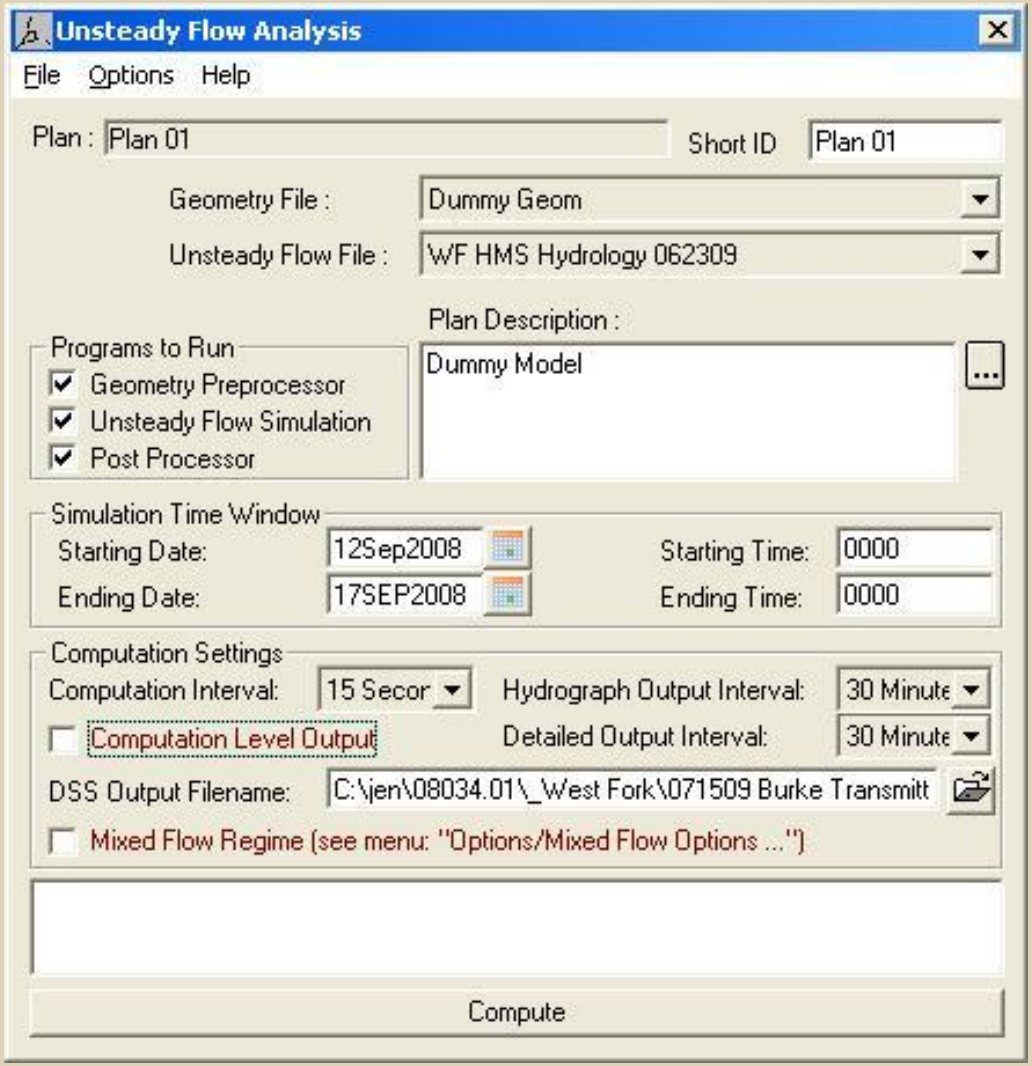
File Options Std. Tables User Tables Locations Help

HEC-RAS Plan: WestForkUnsteady River: Techny Drain Reach: Tributary WFork Profile: 12SEP2008 0005 — Reload Data

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

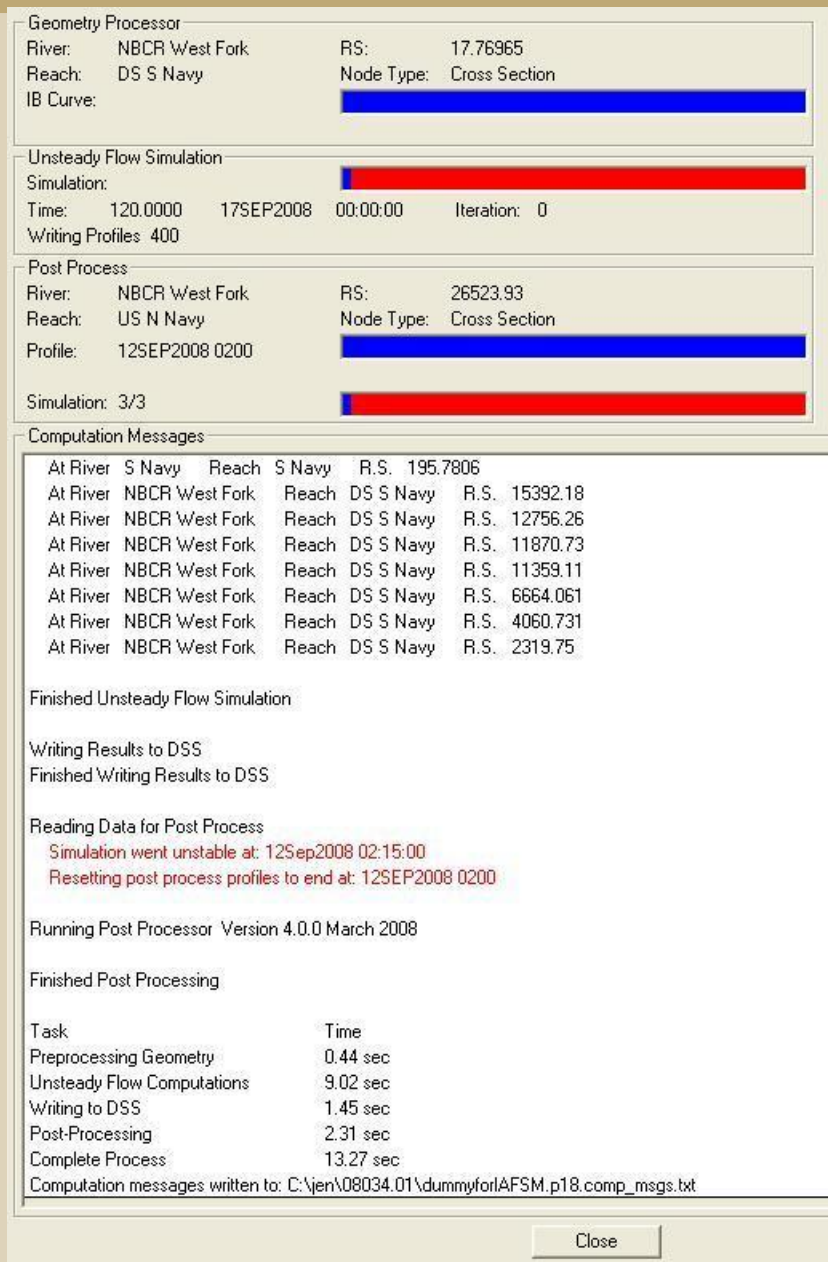
De-bugging Initial Conditions

- 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



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

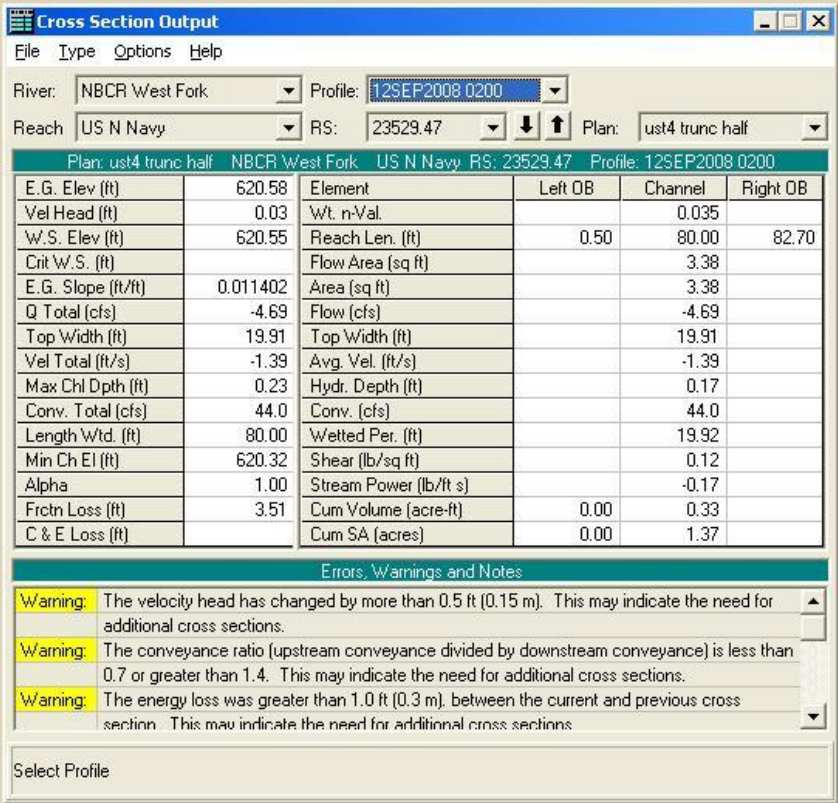


De-bugging Runtime Errors

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

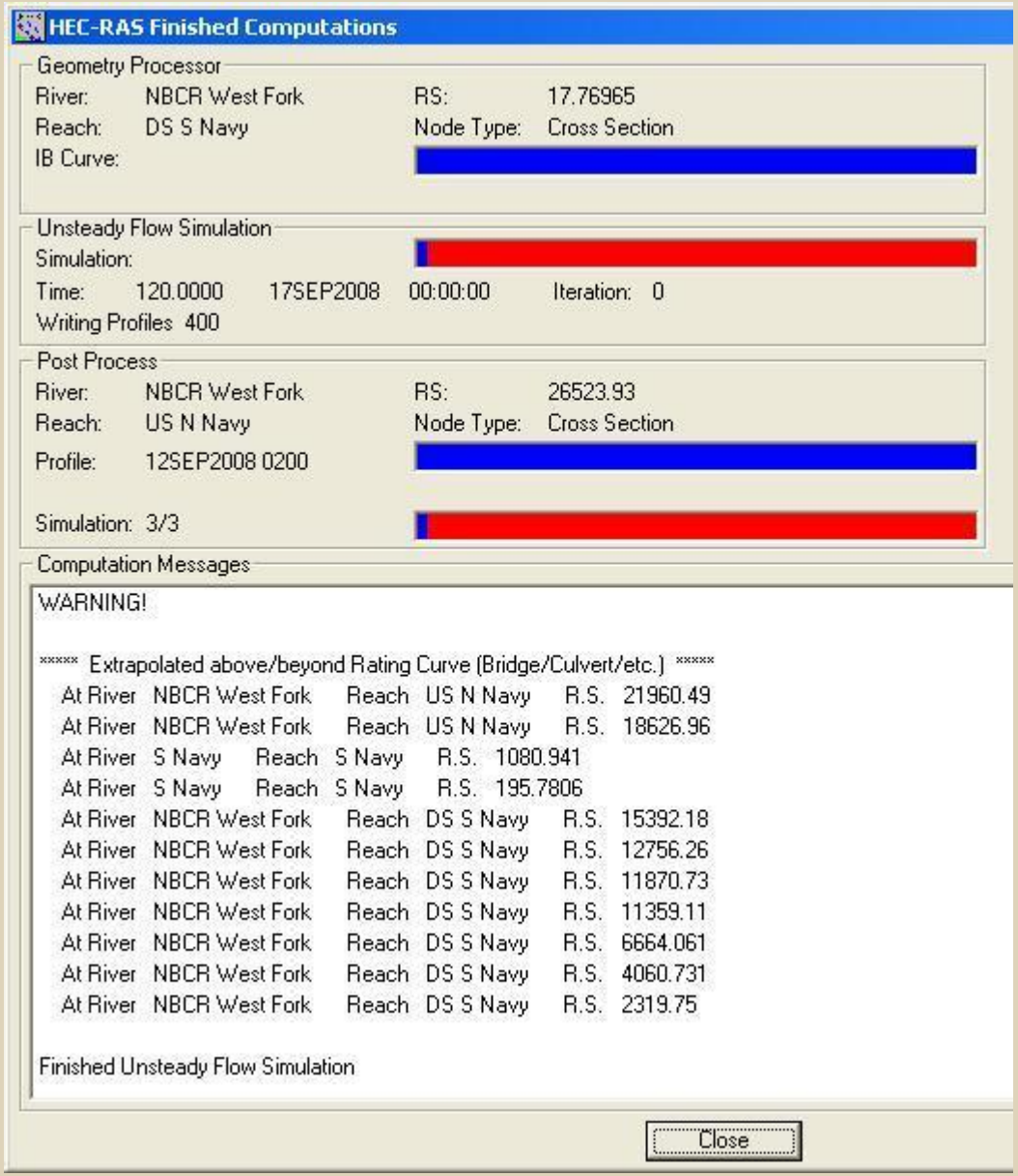
```
   ****   Matrix Solution Failed   ****
Minimum error exceeds allowable tolerance at   12SEP2008   0214
NBCR West Fork          US N Navy              23529.47
```

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



De-bugging Runtime Errors

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

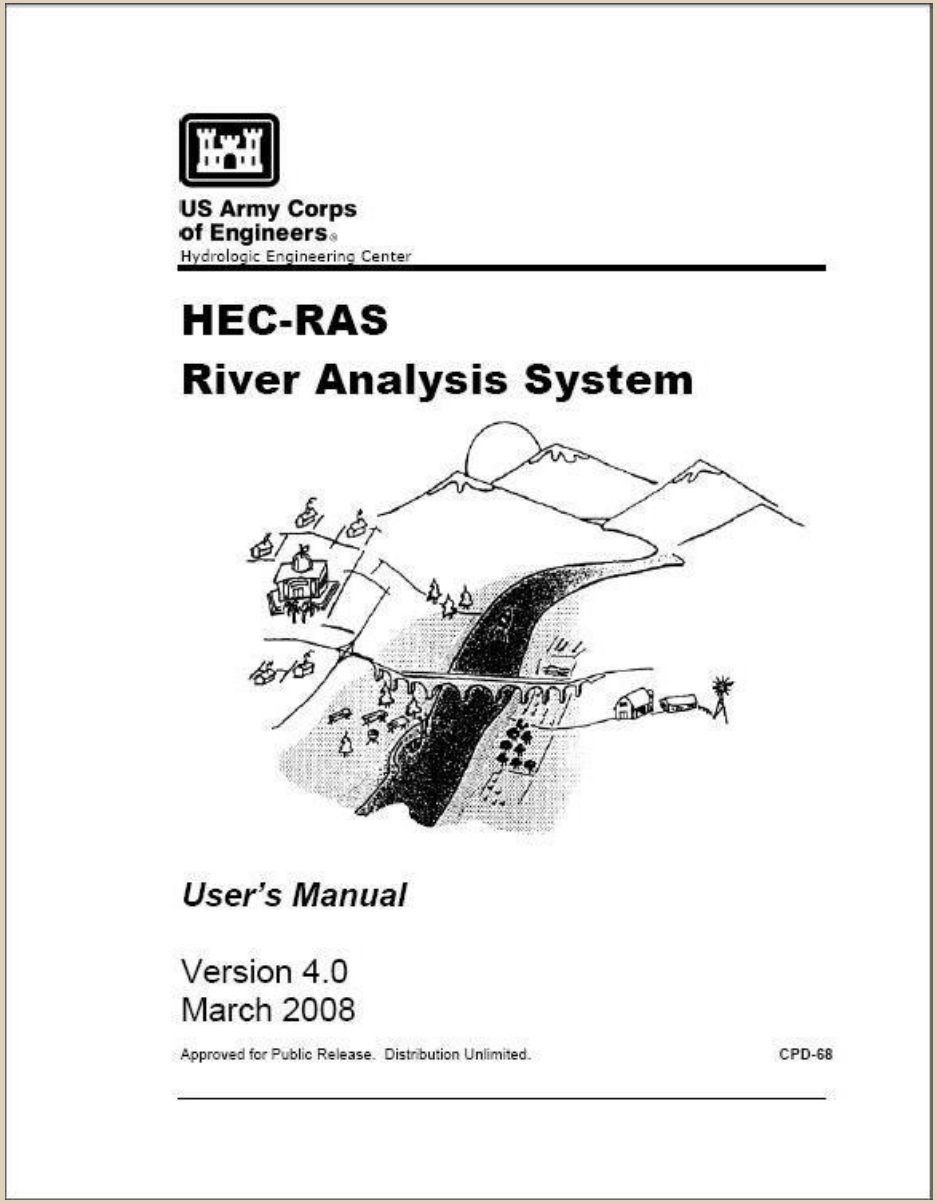


Summary

- 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

Approved for Public Release. Distribution Unlimited. CPD-68

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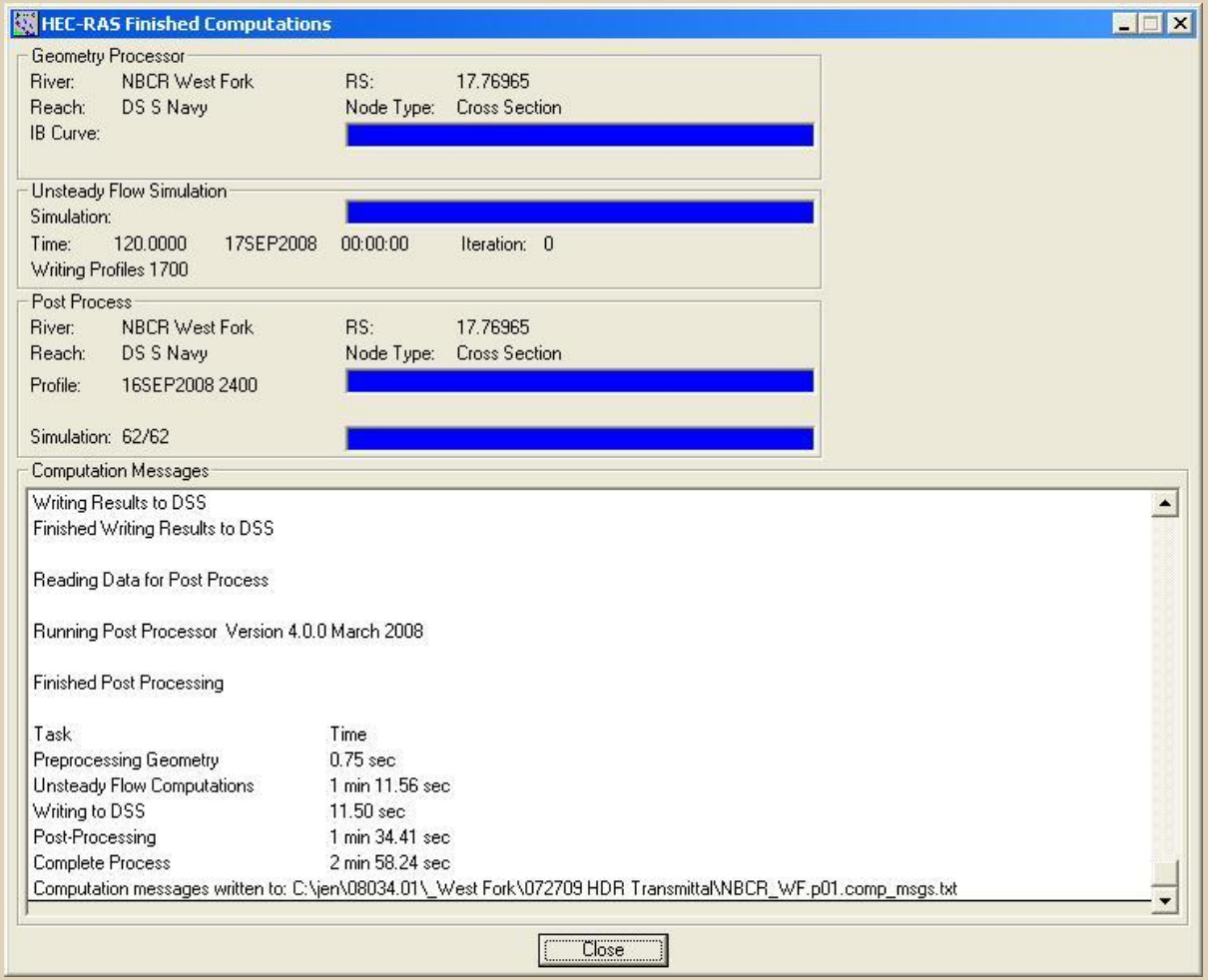
Model Runs! Success!



Questions?