Sediment Transport Analysis with HEC Tools

Outline

1. **Sediment Transport in HEC-HMS**

2. **Sediment Transport in HEC-HMS**

   i. HD Calculators
   ii. SIAM
   iii. Mobile Bed Modeling

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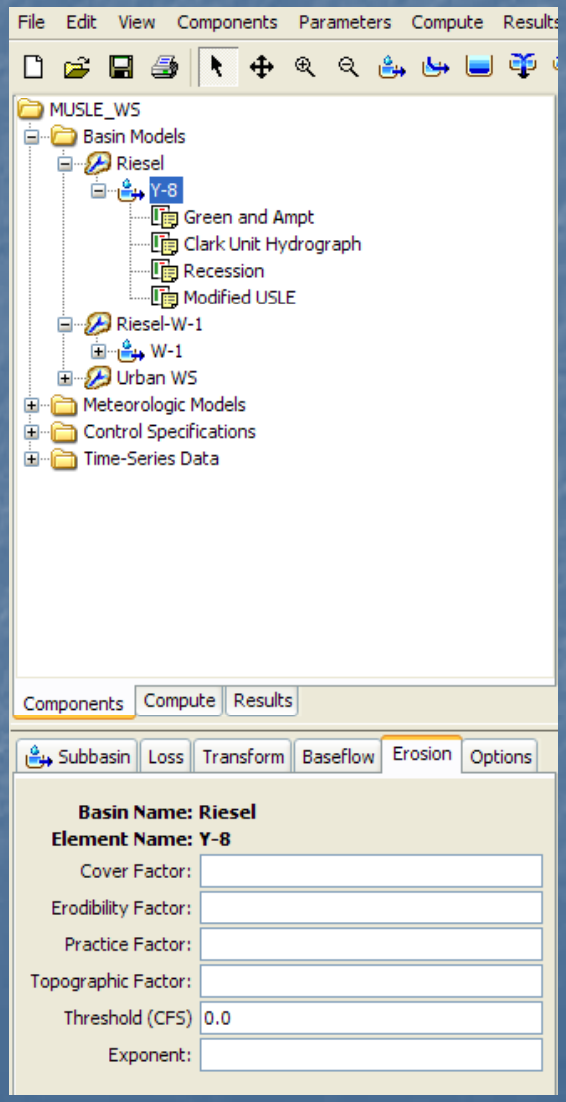
HEC-HMS:
Erosion Methods

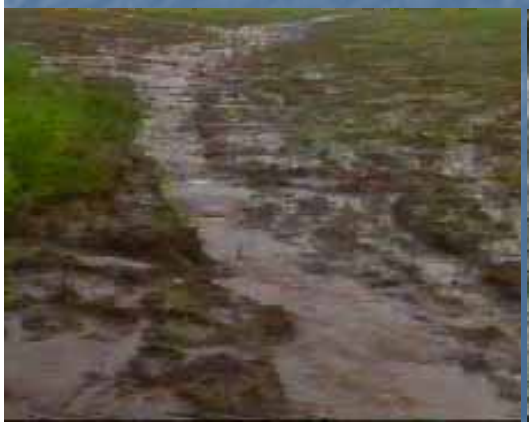
- Computes soil erosion throughout a watershed given precipitation (Energy) and watershed characteristics (Sources).
- Event and continuous simulation for sediment, sediment routing method (WIP) , MUSLE for impervious areas, Build-up & Wash-off (BUWO) for pervious areas, powerful GUI.

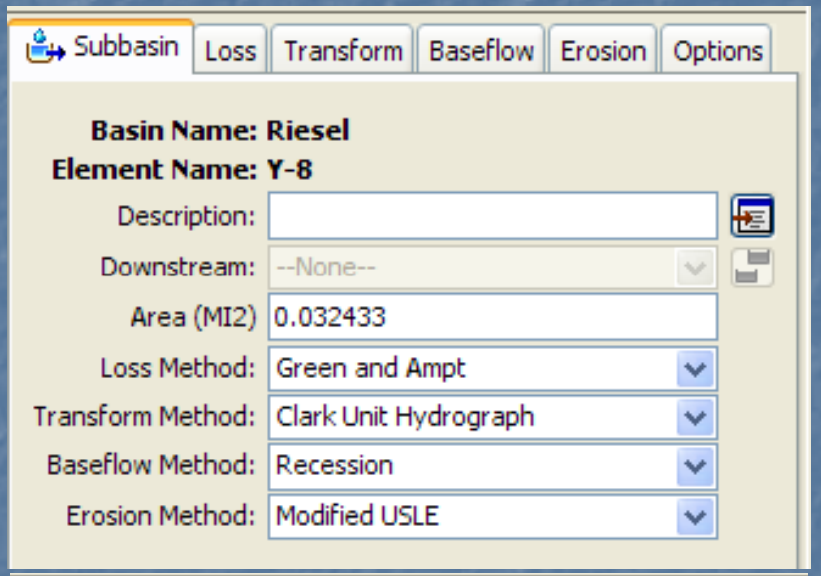


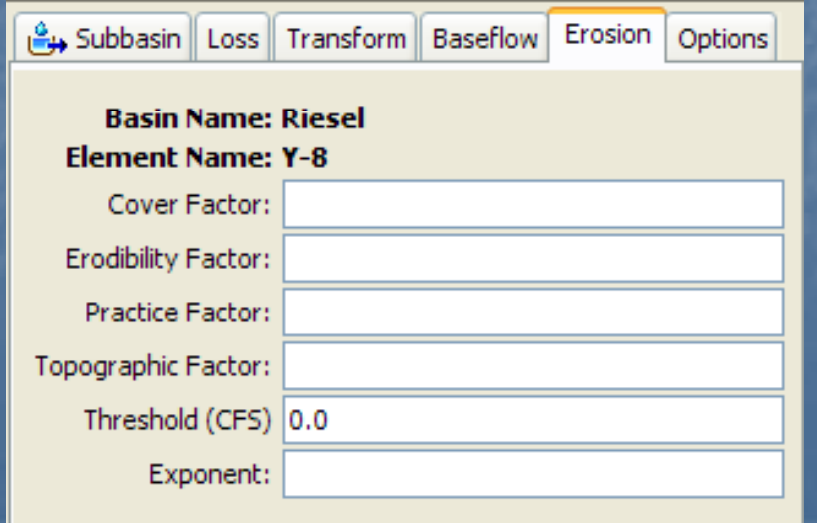
MUSLE

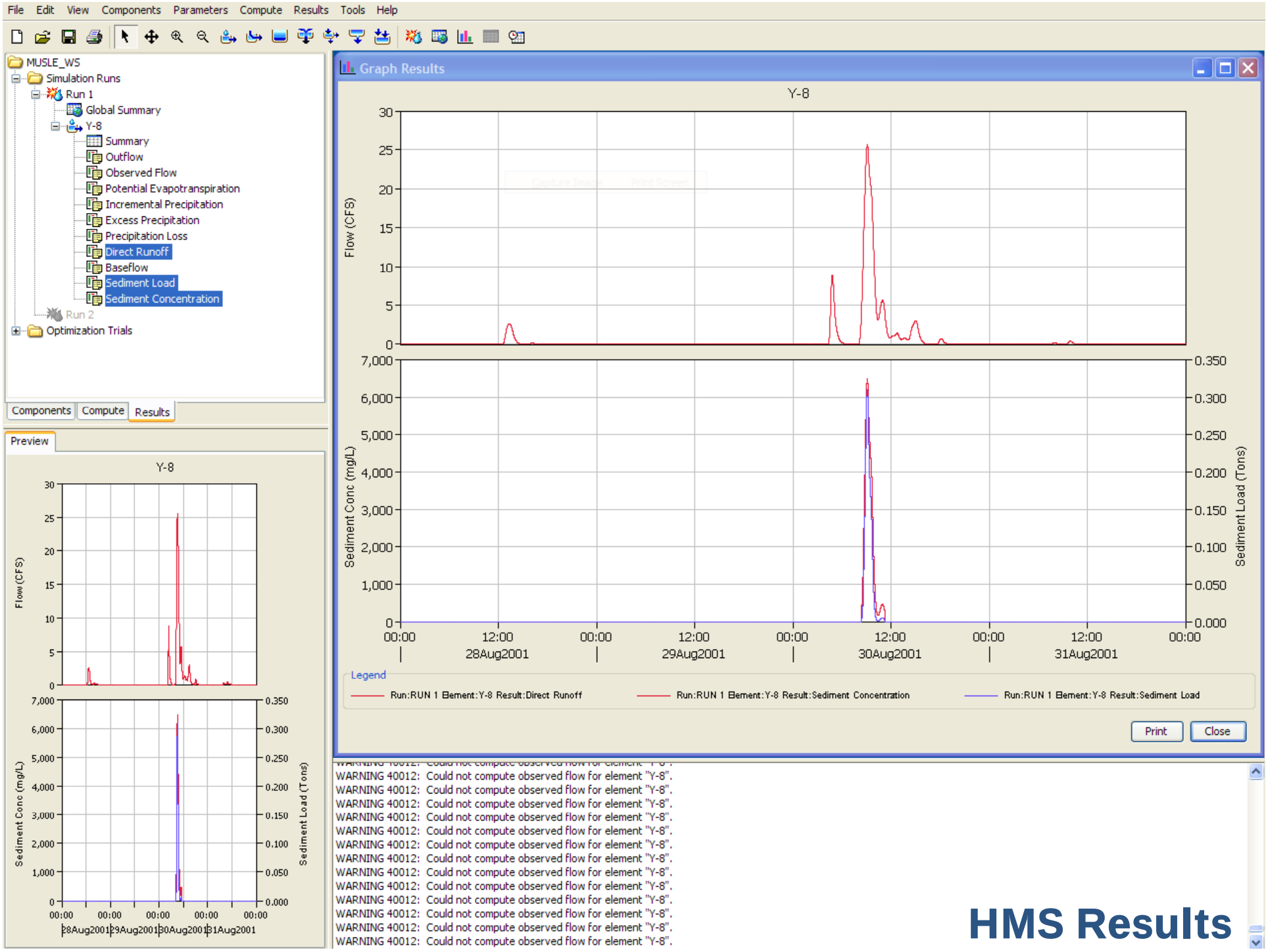
$$Sed = 11.8(Q_{surf} \times q_{peak})^{0.56} \times K \times LS \times C \times P$$

- Sed = Sediment Yield per Event
- Q_{surf} = Surface Runoff Volume
- q_{peak} = Peak Runoff Rate
- K = Soil Erodibility Factor
- LS = Topographic Factor
- C = Cover Factor
- P = Support Practice Factor








File Edit View Components Parameters Compute Results Tools Help
MUSLE_WS
Simulation Runs
Run 1
Global Summary
Y-8
Summary
Outflow
Observed Flow
Potential Evapotranspiration
Incremental Precipitation
Excess Precipitation
Precipitation Loss
Direct Runoff
Baseflow
Sediment Load
Sediment Concentration
Run 2
Optimization Trials
Components
Compute
Results
Preview
Y-8
Flow (CFS)
Sediment Conc (mg/L)
Sediment Load (Tons)
28Aug2001
29Aug2001
30Aug2001
31Aug2001
Graph Results
Y-8
Flow (CFS)
Sediment Conc (mg/L)
Sediment Load (Tons)
Legend
Run:RUN 1 Element:Y-8 Result:Direct Runoff
Run:RUN 1 Element:Y-8 Result:Sediment Concentration
Run:RUN 1 Element:Y-8 Result:Sediment Load
Print
Close
WARNING 40012: Could not compute observed flow for element "Y-8".
HMS Results

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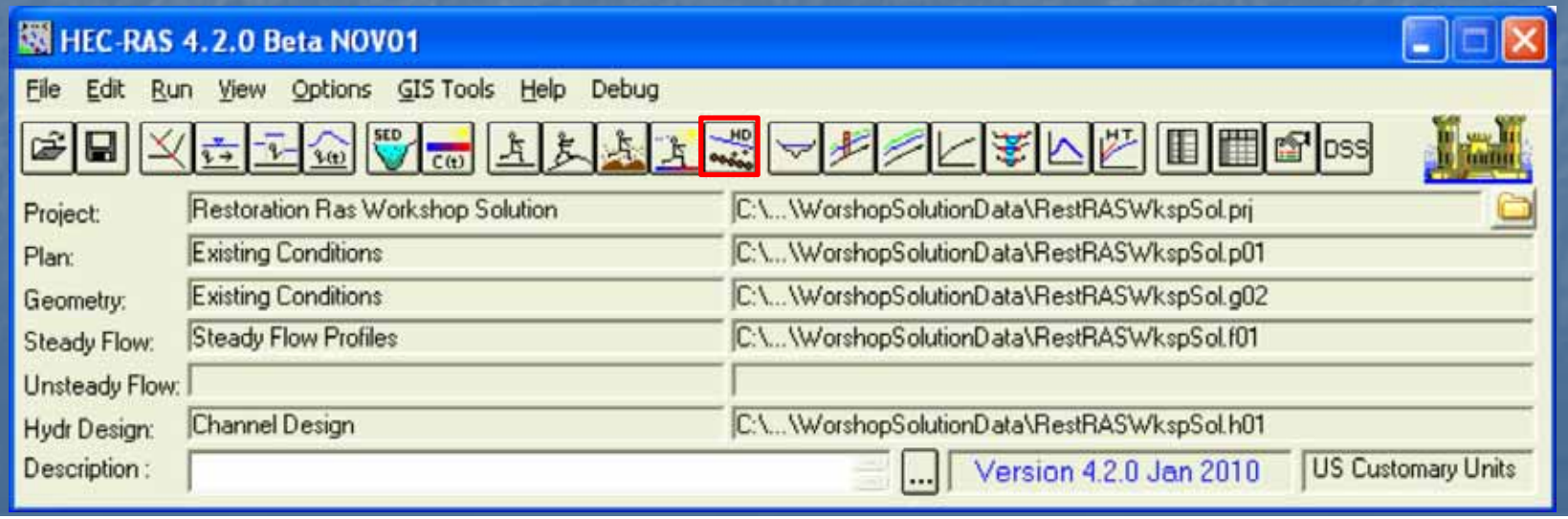

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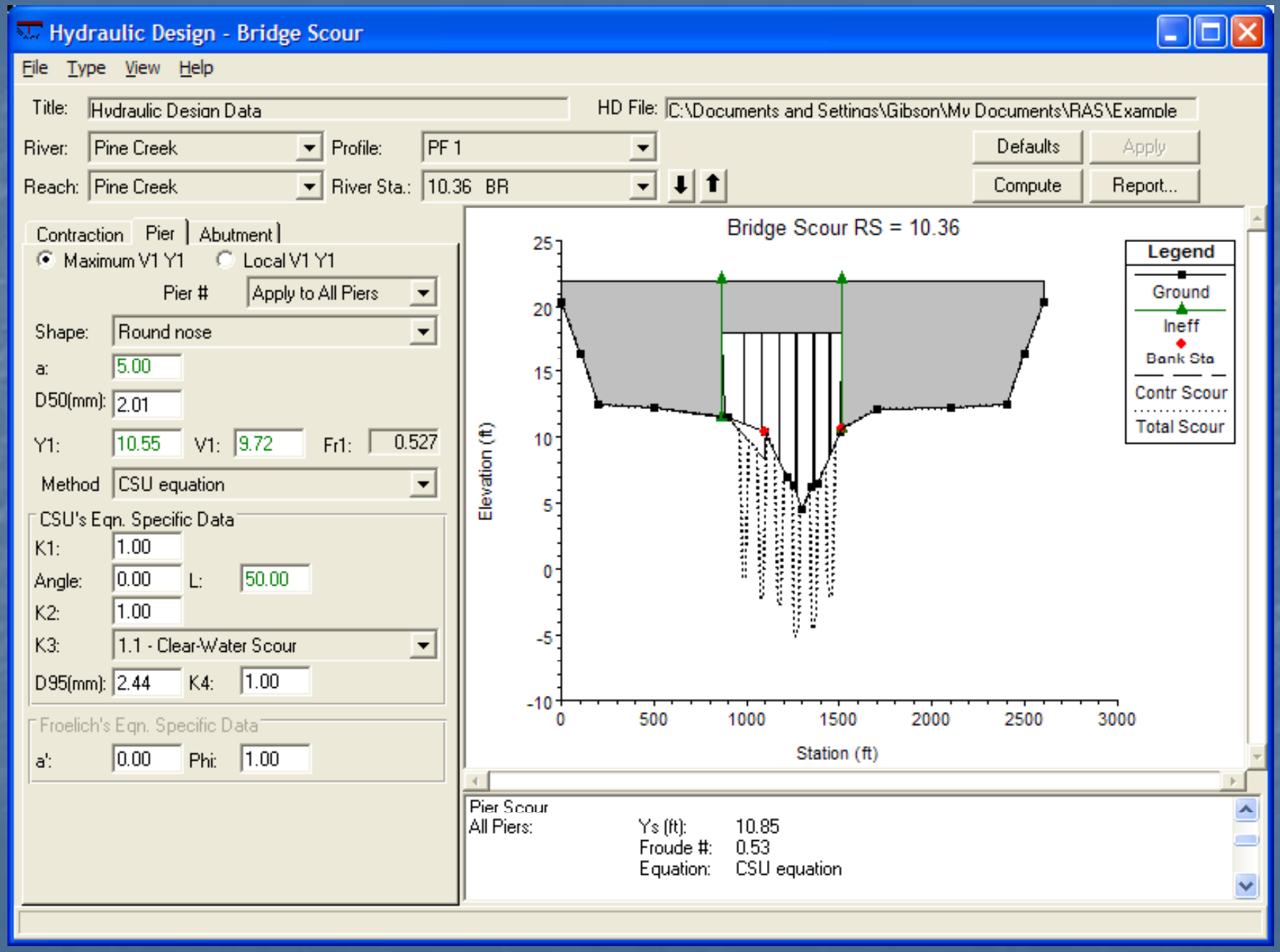
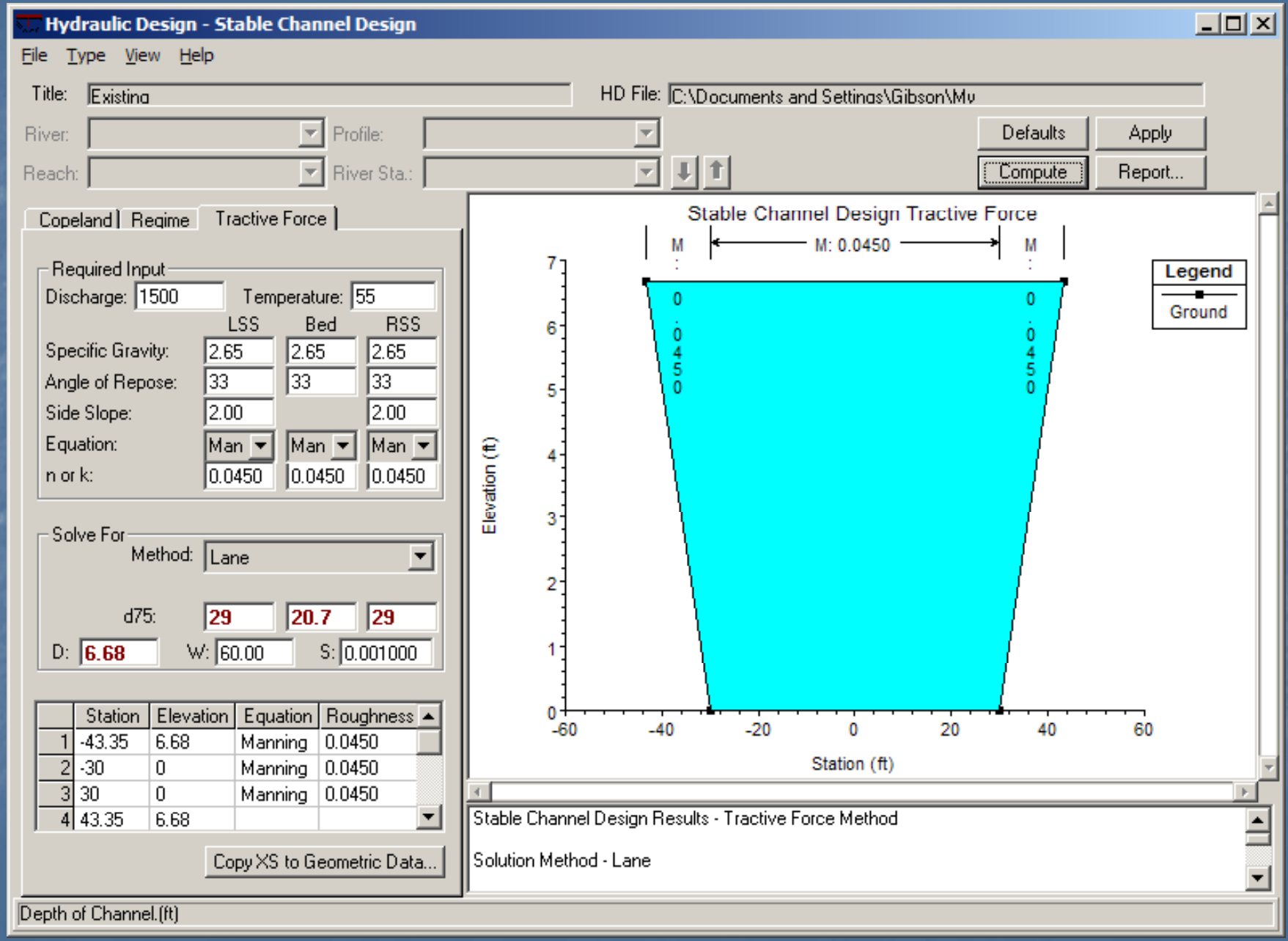
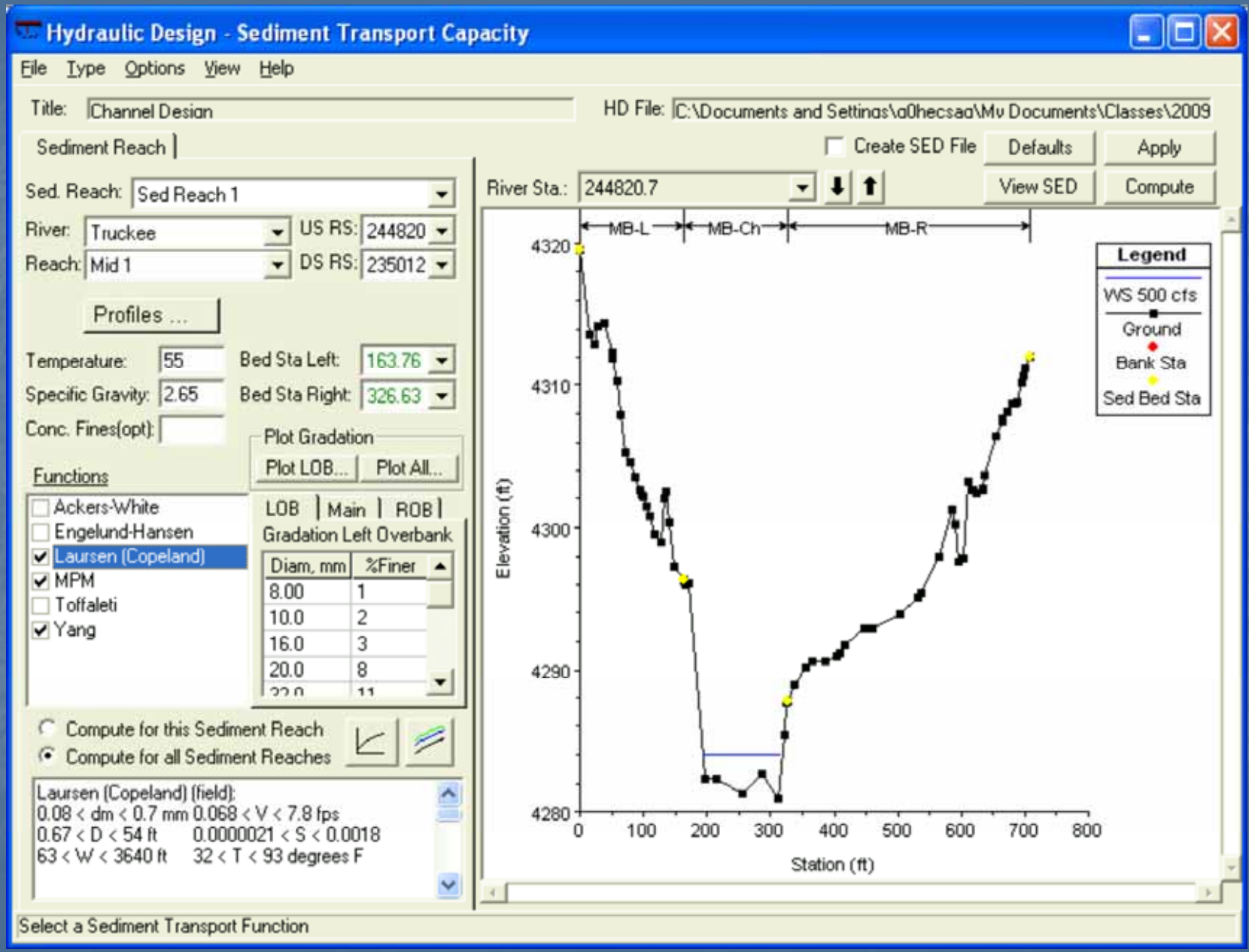
Bridge Scour



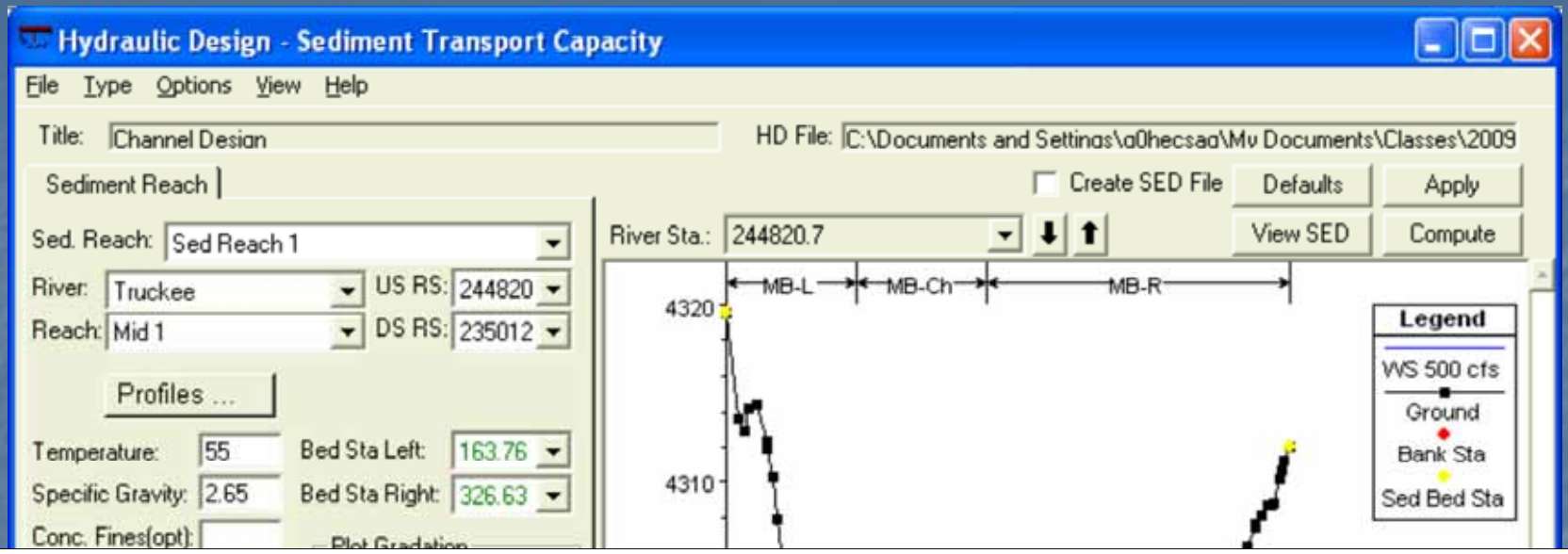
Stable Channel Design

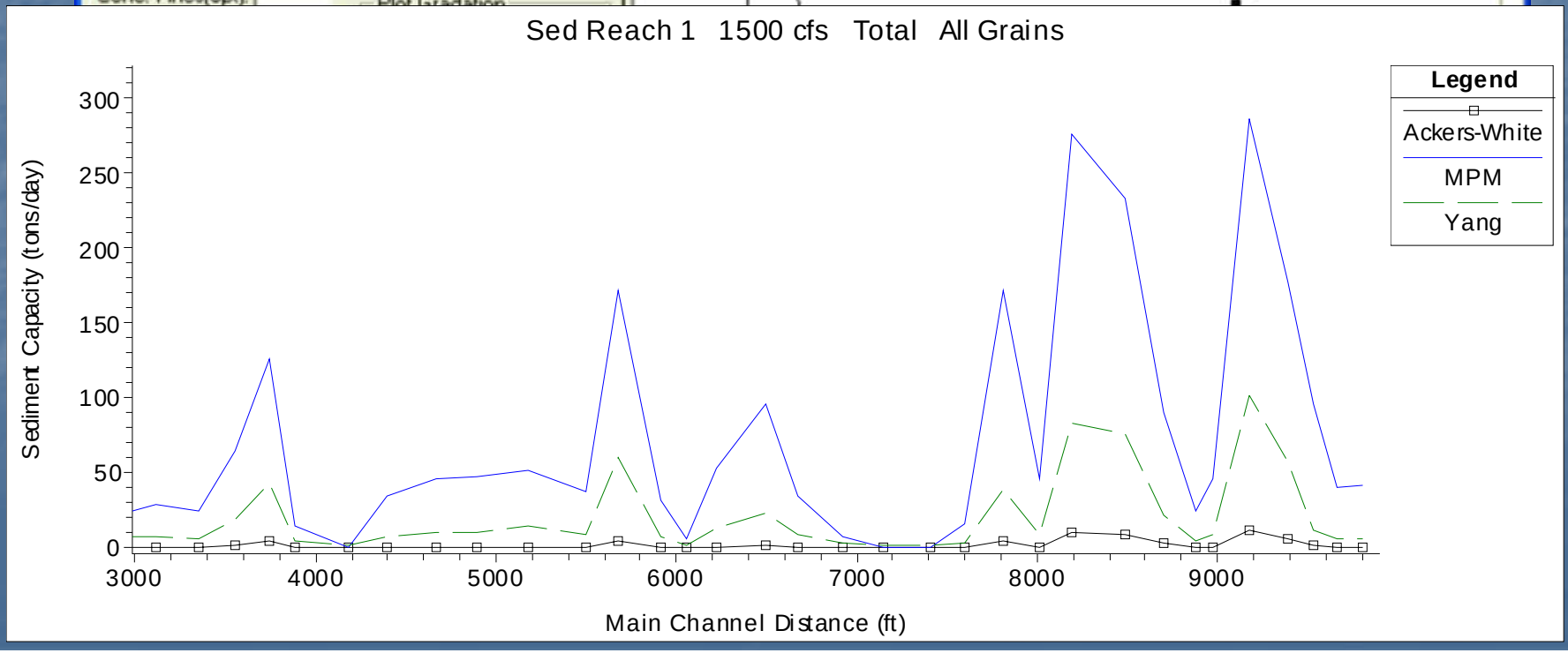


Transport Capacity



Transport Capacity





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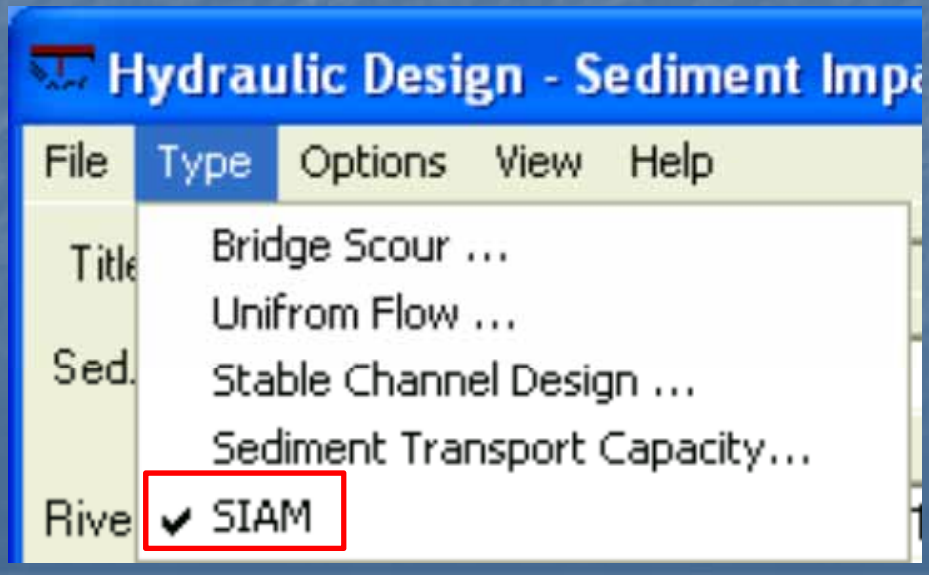
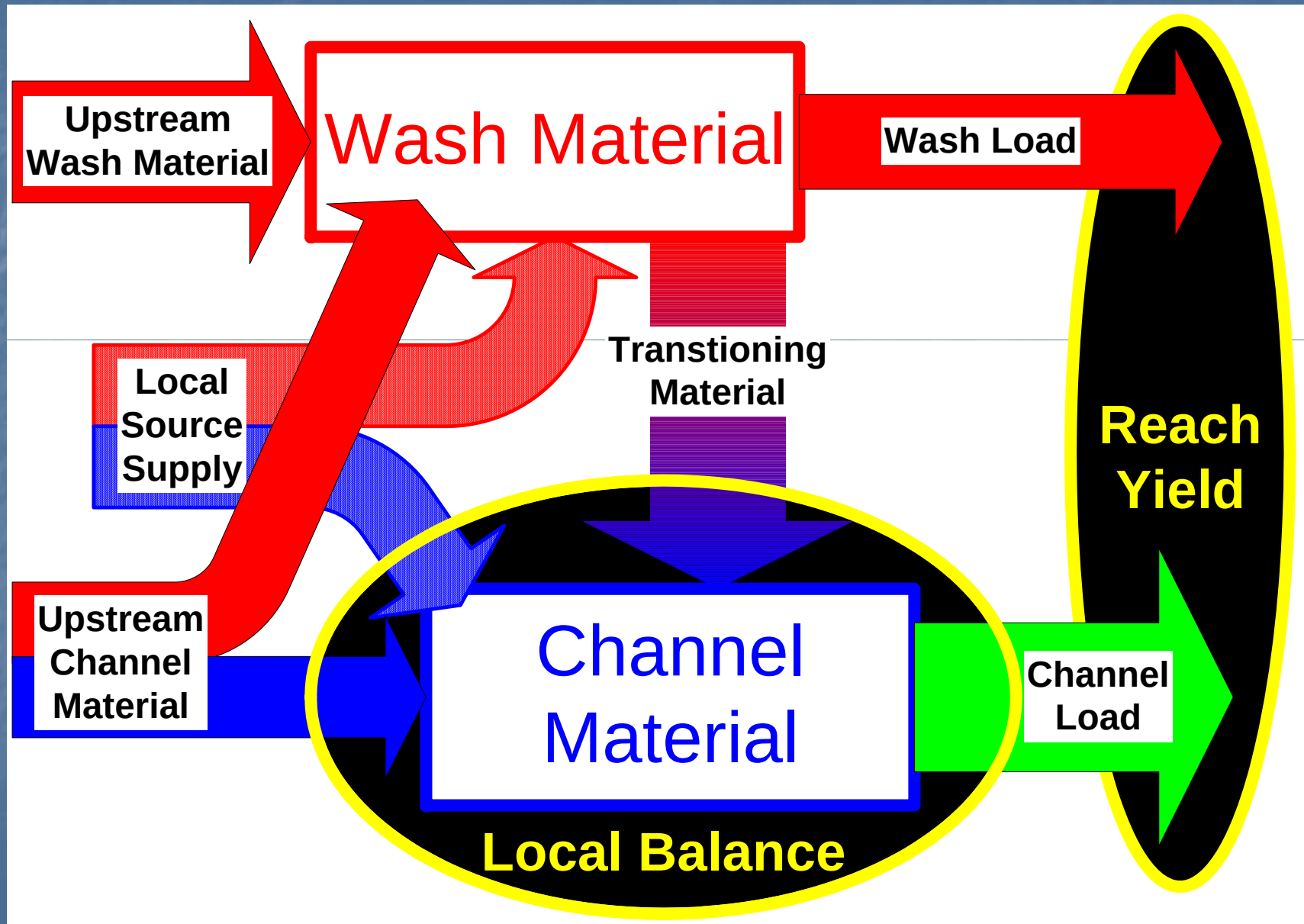
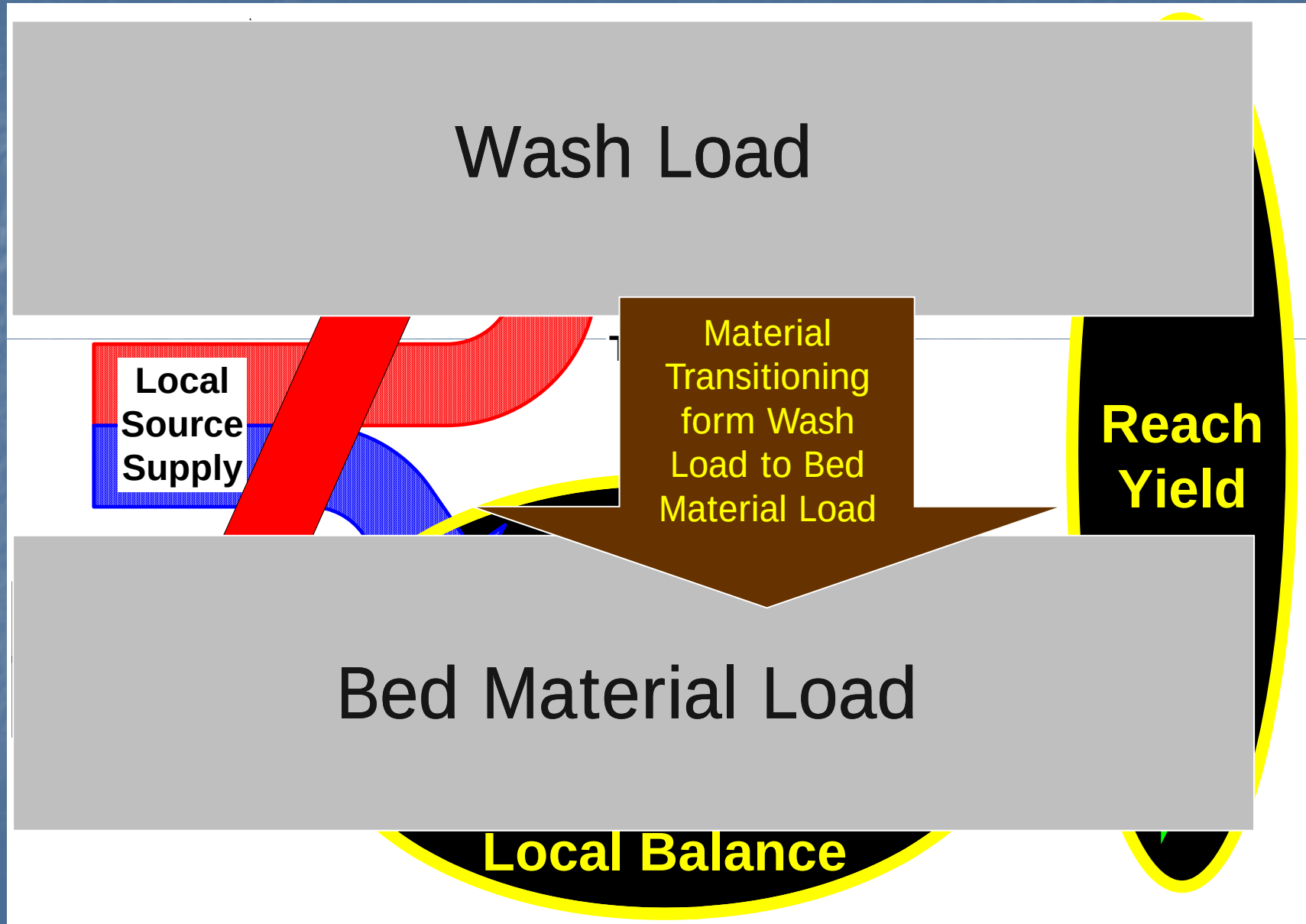


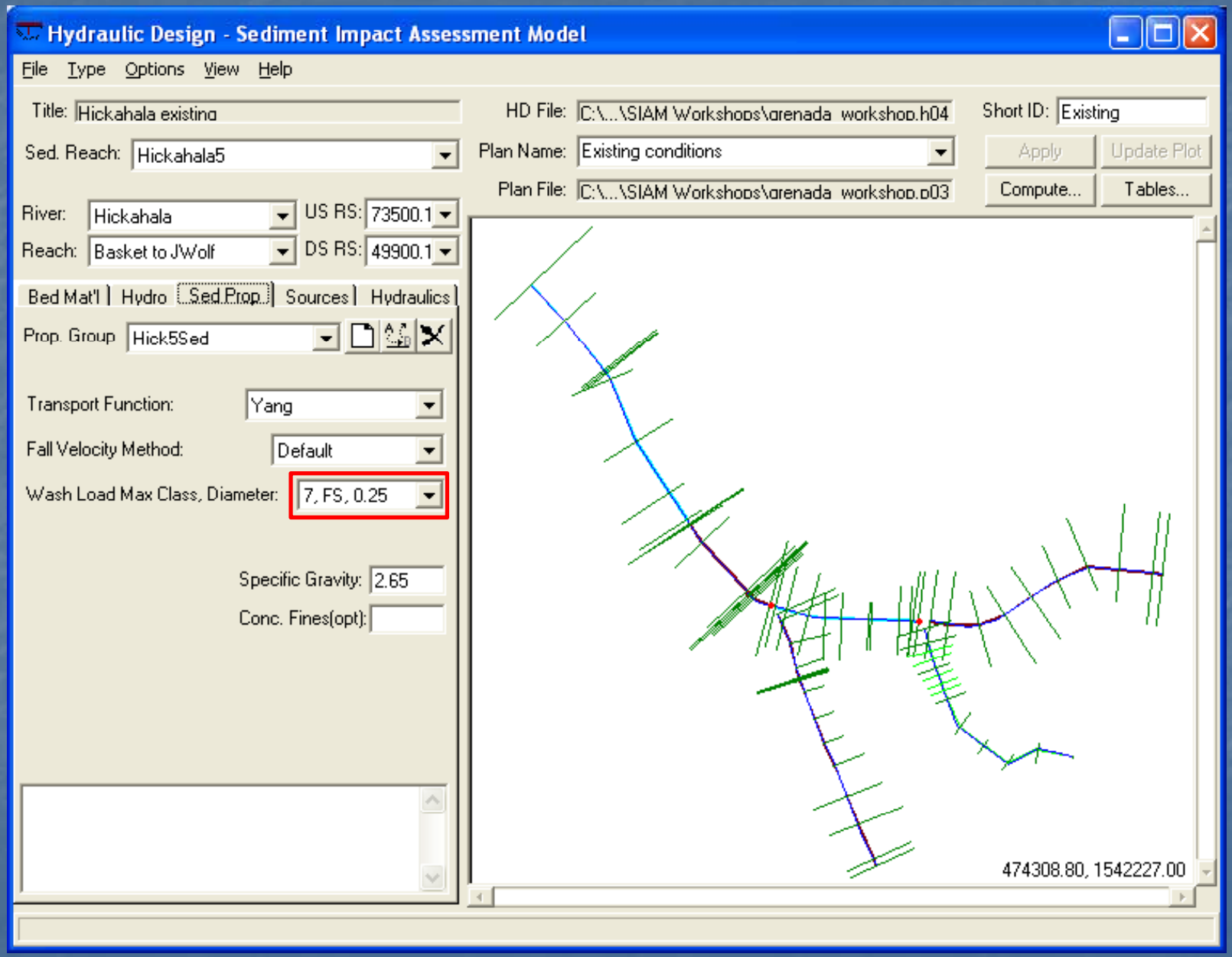
SIAM Sediment Accounting Process



SIAM Sediment Accounting Process



Wash Load Threshold

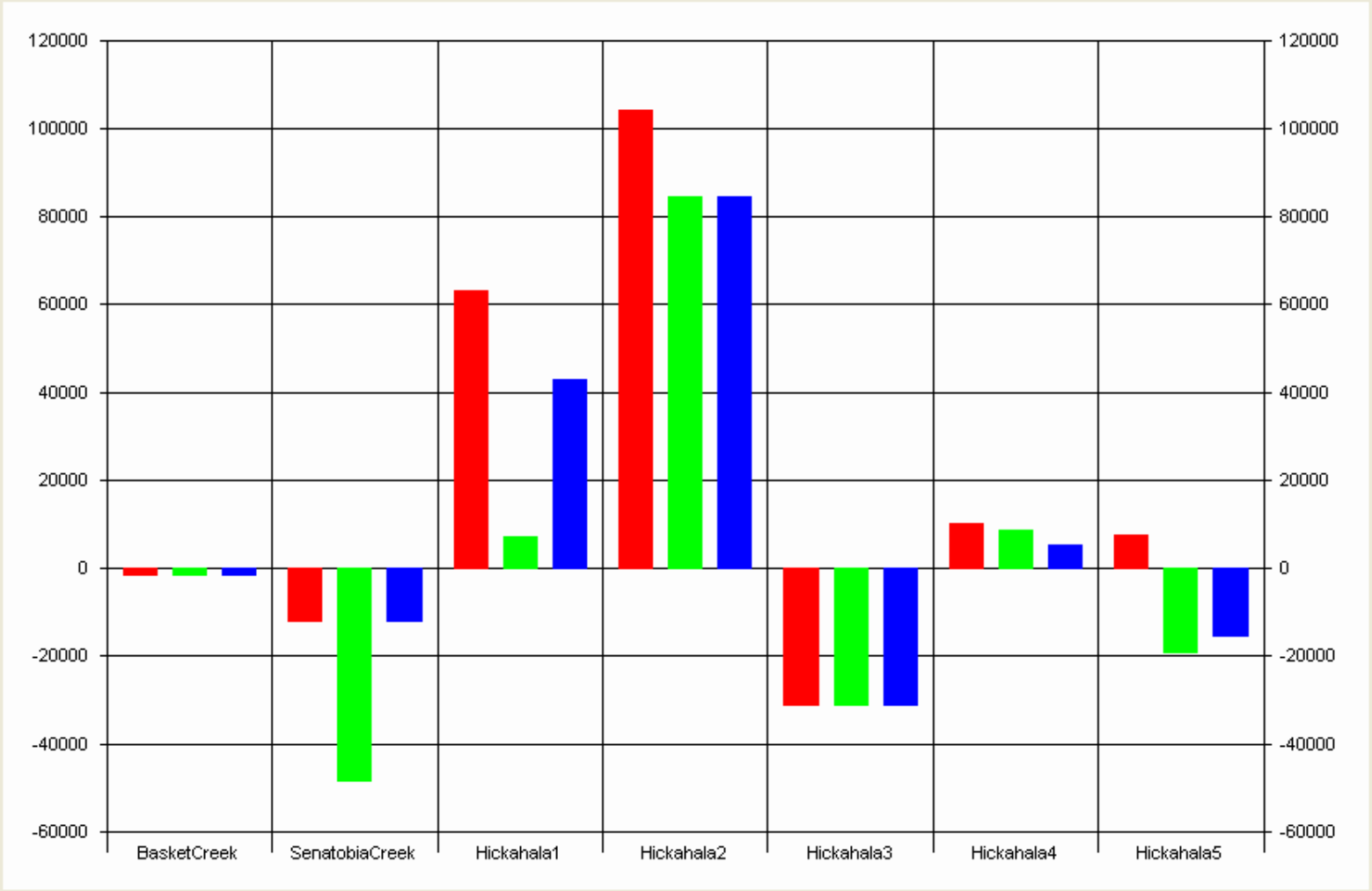


Total Bed Material Budget - Grenada Workshop

File Type

HD File ... Reaches ... Aggradation/Degradation (tons/year)

Table Plot



Close

SIAM Limitations:

-Sediment budget, not a coupled model.

-Only as good as estimated sediment loads. (Data intensive).

-No Computational Feedback.

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-Sediment budget, not a coupled model.

-Only as good as estimated sediment loads. (Data intensive).

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-SIAM is not a cheaper, easier alternative to sediment modeling, it is an excellent sediment budget tool that can help isolate the best alternatives to model.

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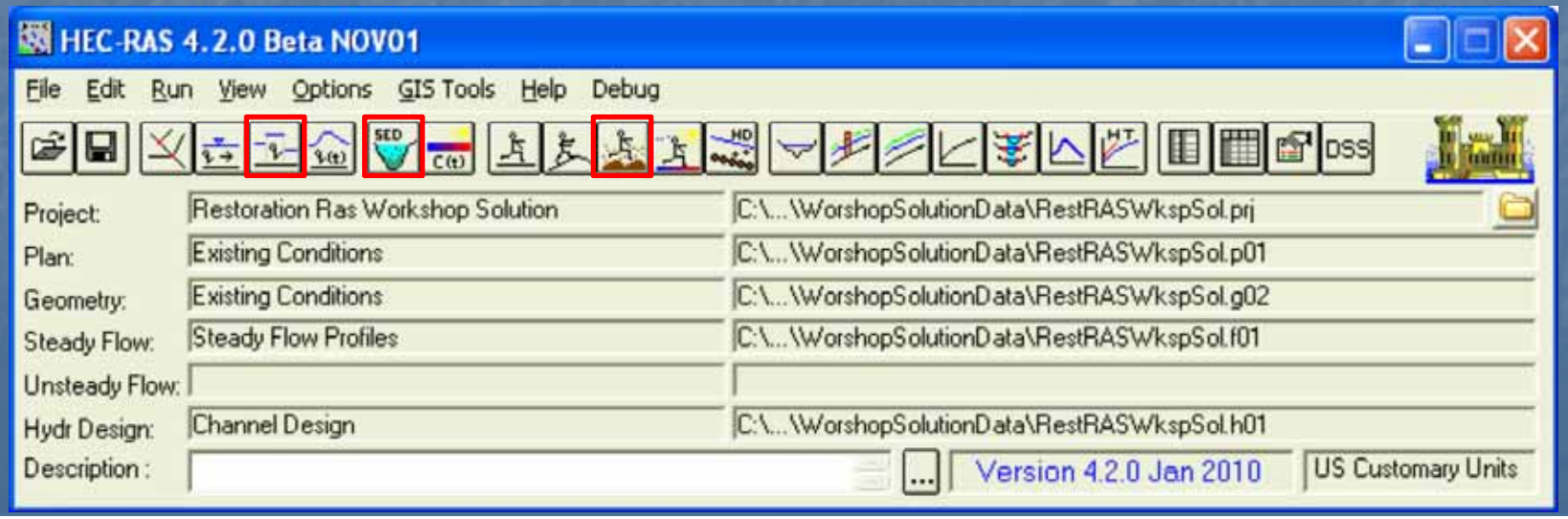
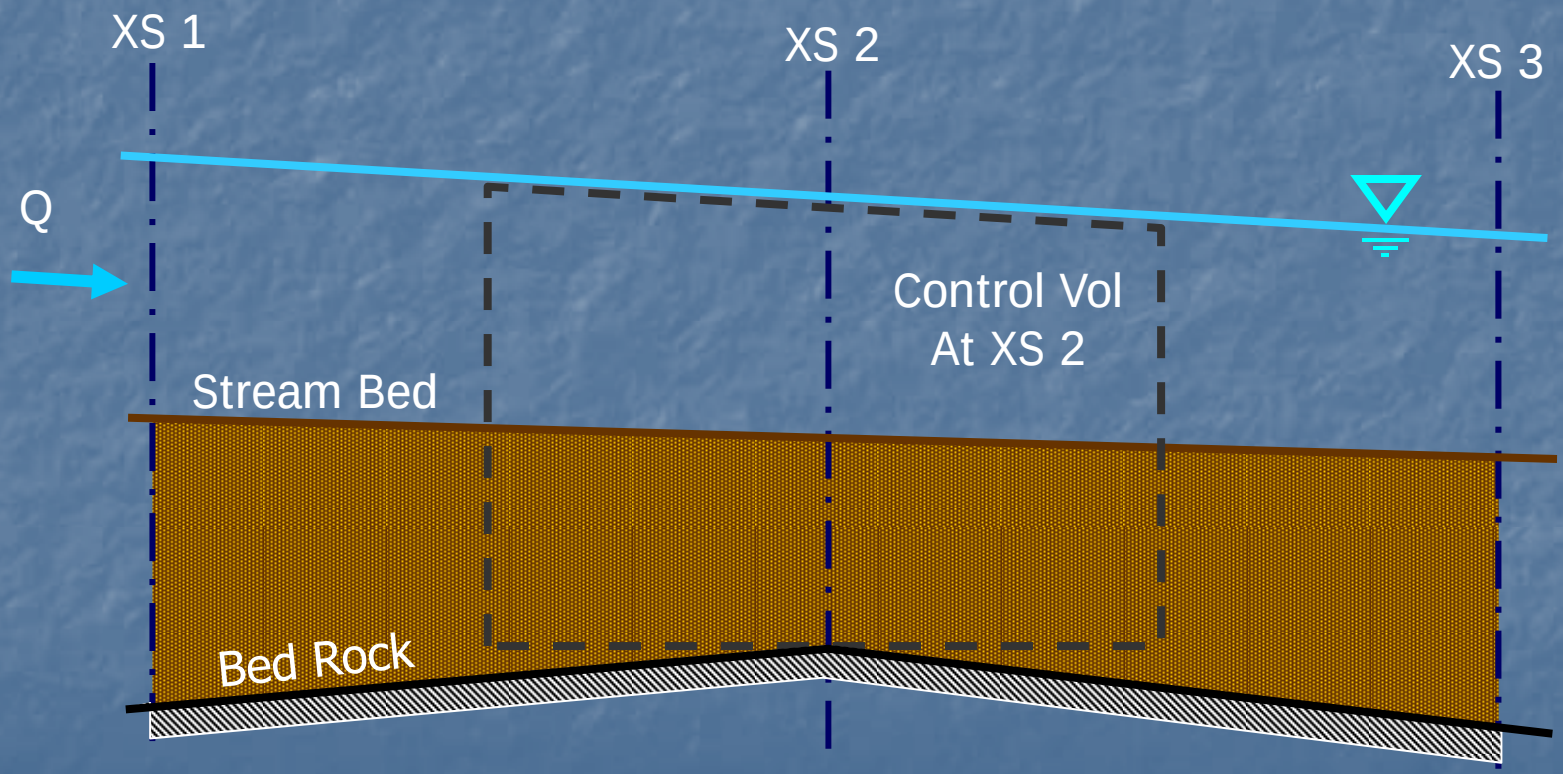
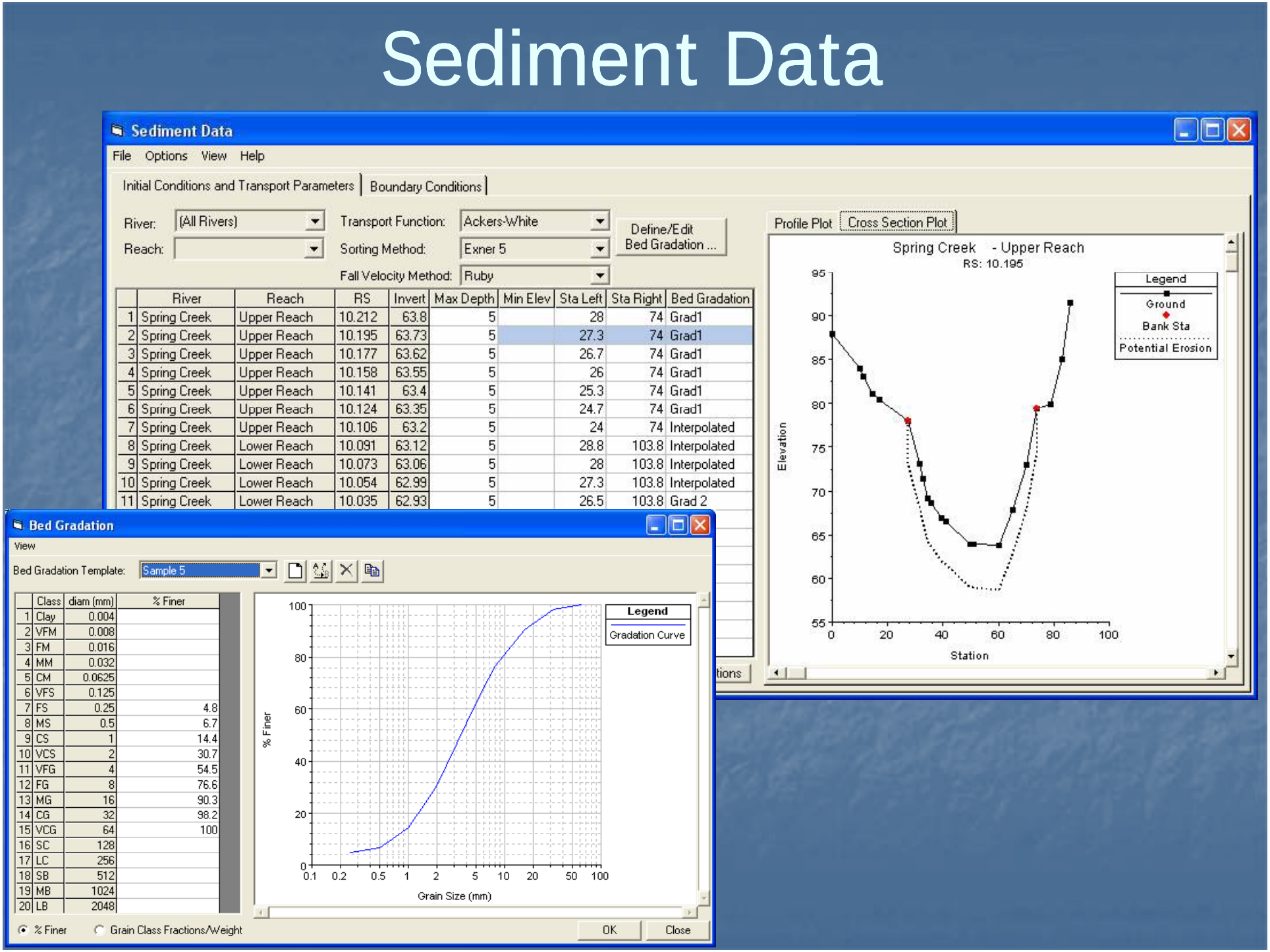


Sediment Continuity: Exner Equation

$$(1-\lambda_p)B\frac{\partial \eta}{\partial t} = -\frac{\partial Q_s}{\partial x}$$



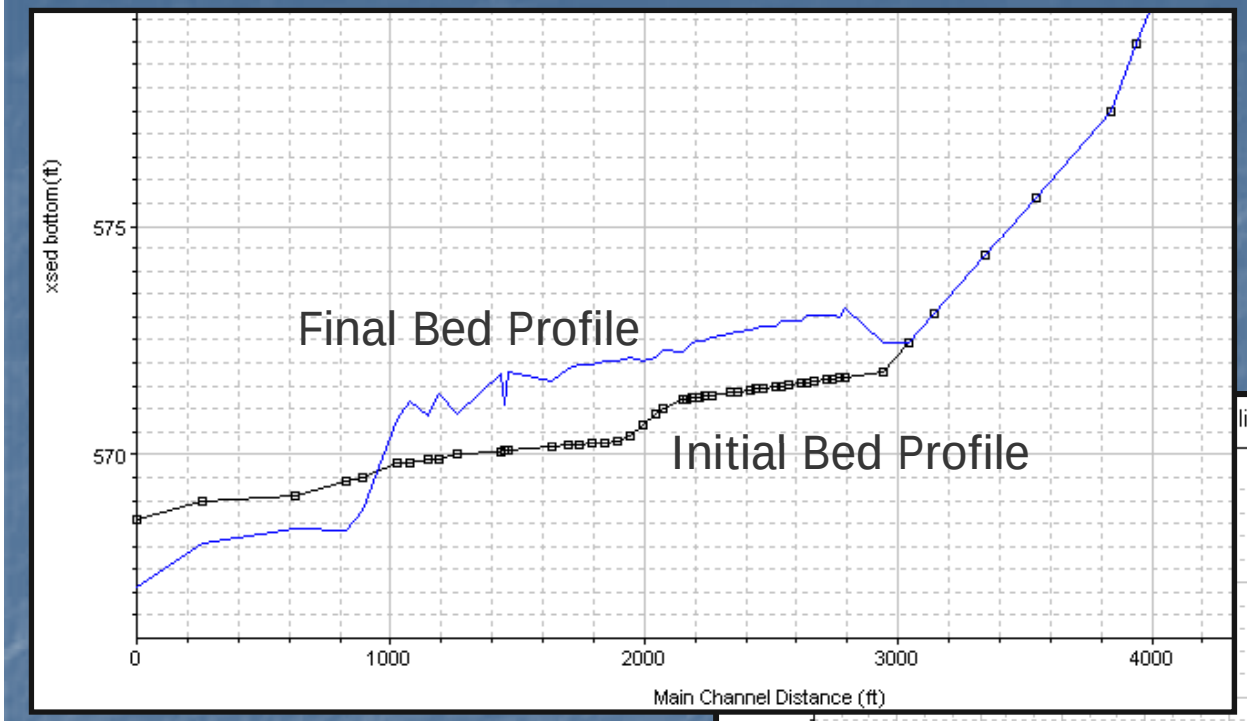
Sediment Data

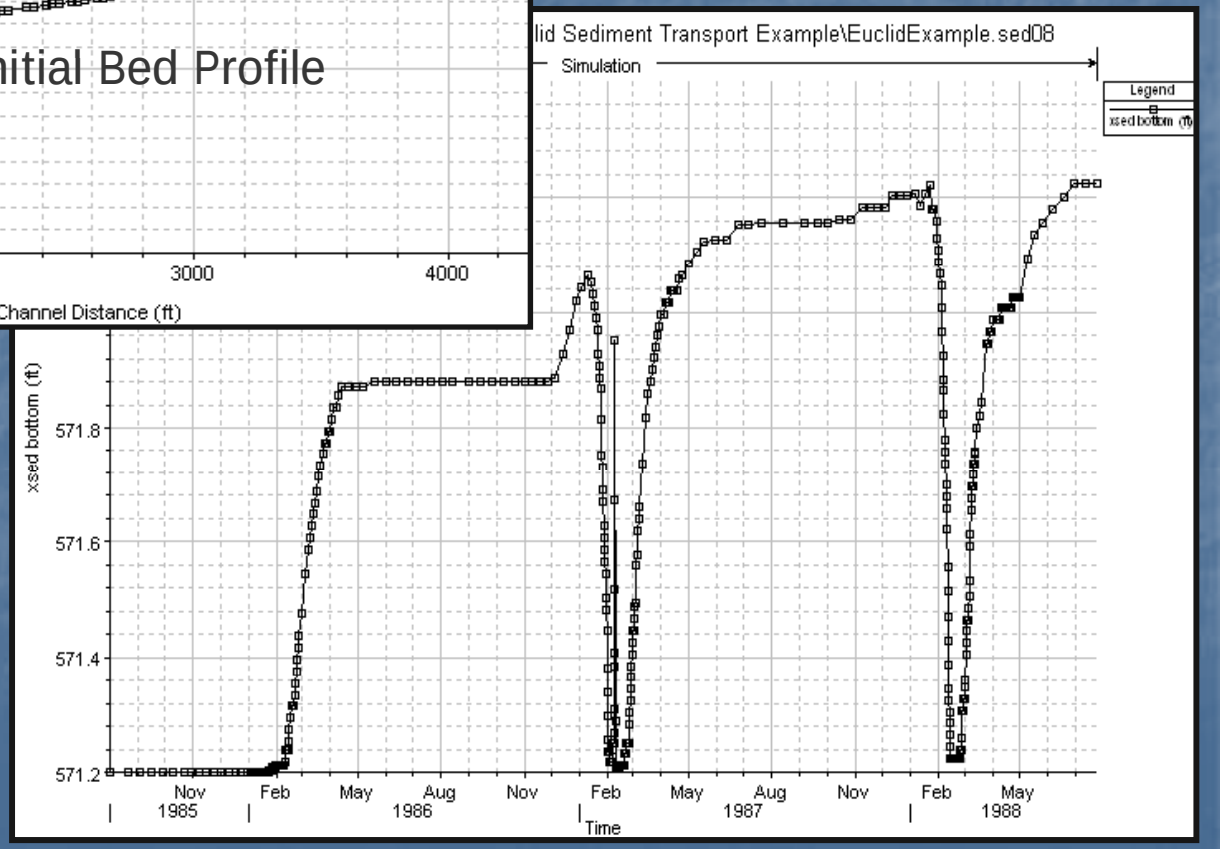


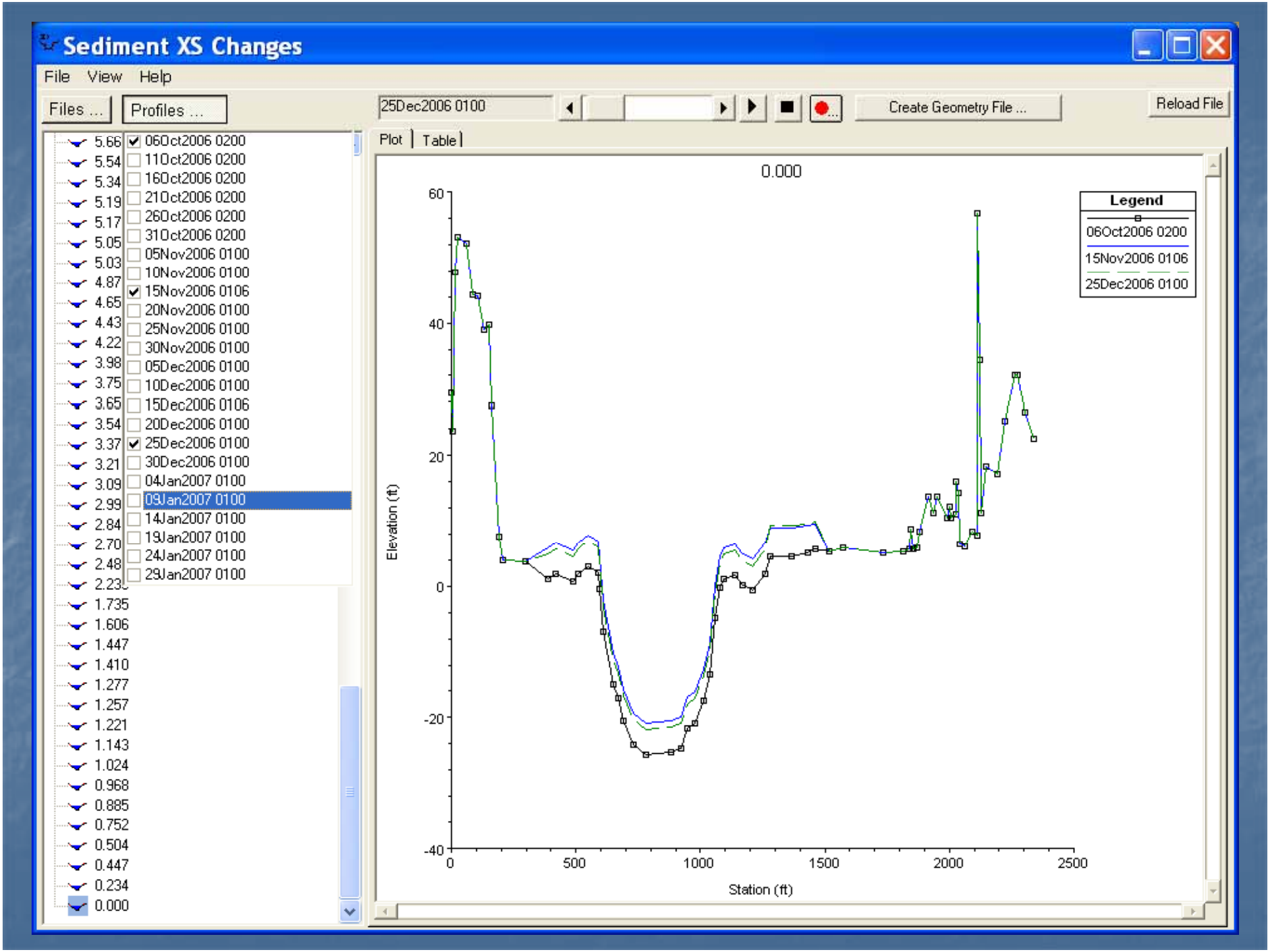
	River	Reach	RS	Invert	Max Depth	Min Elev	Sta Left	Sta Right	Bed Gradation
1	Spring Creek	Upper Reach	10.212	63.8	5		28	74	Grad1
2	Spring Creek	Upper Reach	10.195	63.73	5		27.3	74	Grad1
3	Spring Creek	Upper Reach	10.177	63.62	5		26.7	74	Grad1
4	Spring Creek	Upper Reach	10.158	63.55	5		26	74	Grad1
5	Spring Creek	Upper Reach	10.141	63.4	5		25.3	74	Grad1
6	Spring Creek	Upper Reach	10.124	63.35	5		24.7	74	Grad1
7	Spring Creek	Upper Reach	10.106	63.2	5		24	74	Interpolated
8	Spring Creek	Lower Reach	10.091	63.12	5		28.8	103.8	Interpolated
9	Spring Creek	Lower Reach	10.073	63.06	5		28	103.8	Interpolated
10	Spring Creek	Lower Reach	10.054	62.99	5		27.3	103.8	Interpolated
11	Spring Creek	Lower Reach	10.035	62.93	5		26.5	103.8	Grad 2

	Class	diam (mm)	% Finer
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	4.8
8	MS	0.5	6.7
9	CS	1	14.4
10	VCS	2	30.7
11	VFG	4	54.5
12	FG	8	76.6
13	MG	16	90.3
14	CG	32	98.2
15	VCG	64	100
16	SC	128	
17	LC	256	
18	SB	512	
19	MB	1024	
20	LB	2048	

Sediment Output






Sediment XS Changes
File View Help
Files ...
Profiles ...
25Dec2006 0100
Create Geometry File ...
Reload File
Plot
Table
0.000
Legend
06Oct2006 0200
15Nov2006 0106
25Dec2006 0100
Elevation (ft)
Station (ft)
60
40
20
0
-20
-40
0
500
1000
1500
2000
2500
5.66
5.54
5.34
5.19
5.17
5.05
5.03
4.87
4.65
4.43
4.22
3.98
3.75
3.65
3.54
3.37
3.21
3.09
2.99
2.84
2.70
2.48
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1.257
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1.143
1.024
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09Jan2007 0100
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24Jan2007 0100
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Prospect Training:

Sediment Transport with HEC-RAS

January 10-14: Spaces Available