Regional Sediment Management 2012
BSTEM/HECRAS Integration

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Kansas City District

River Engineering and Restoration Section

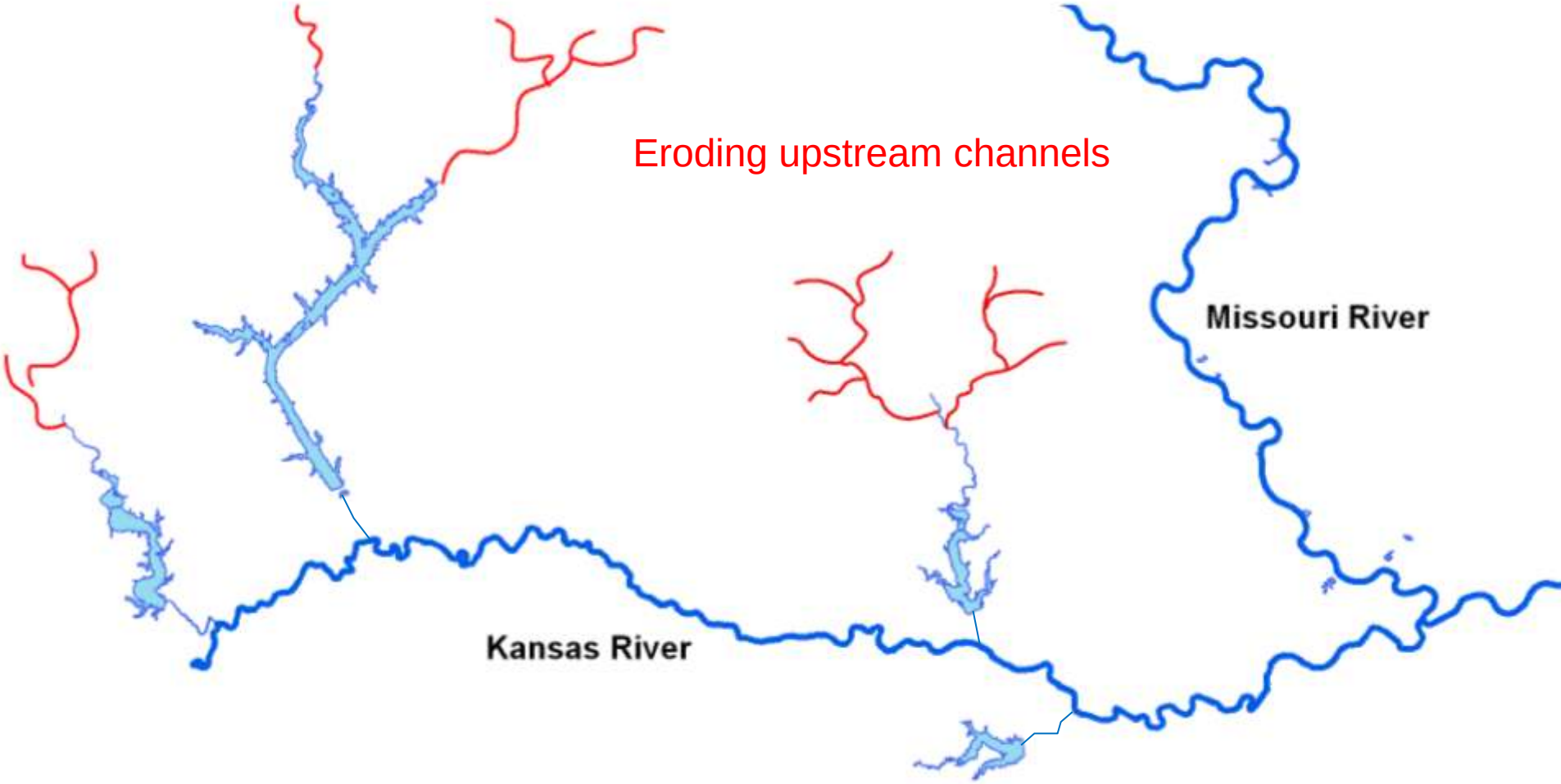
August 2012

•US Army Corps of Engineers
•BUILDING STRONG®

Outline

- Sediment imbalances
- NWK sediment management
- Need for modeling tools
- BSTEM/HEC-RAS

Sediment Imbalances



Sediment Imbalances

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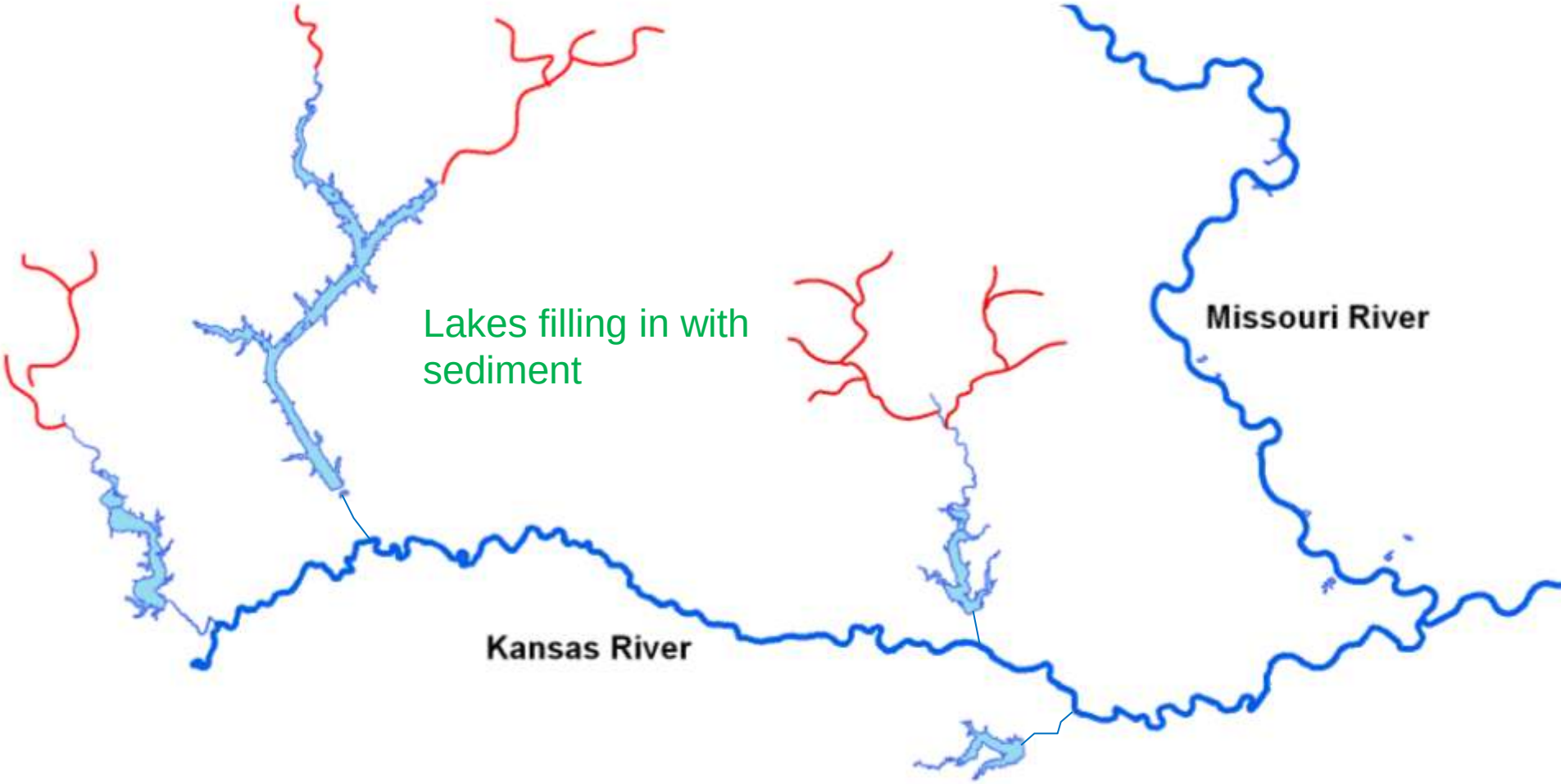

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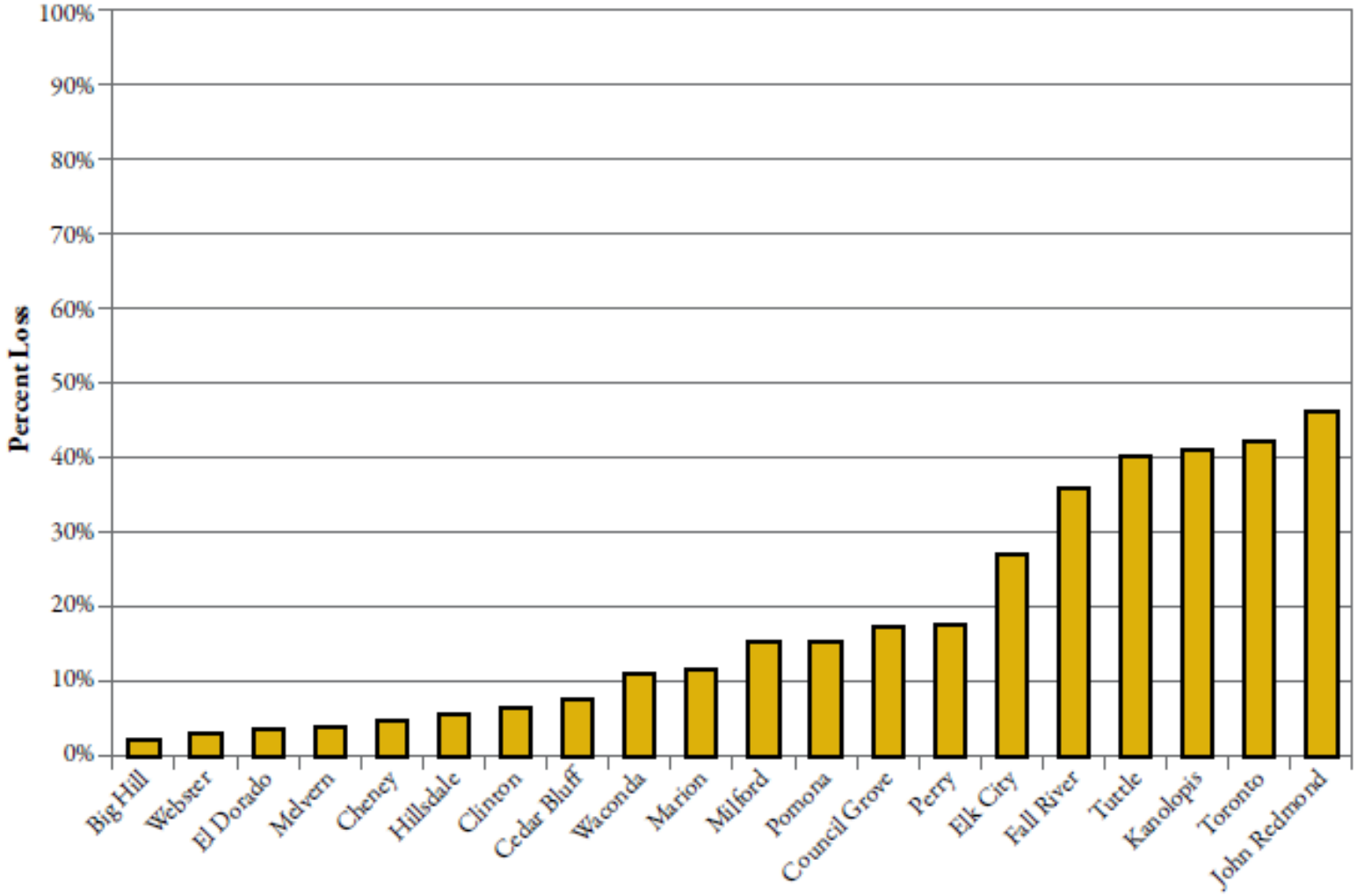
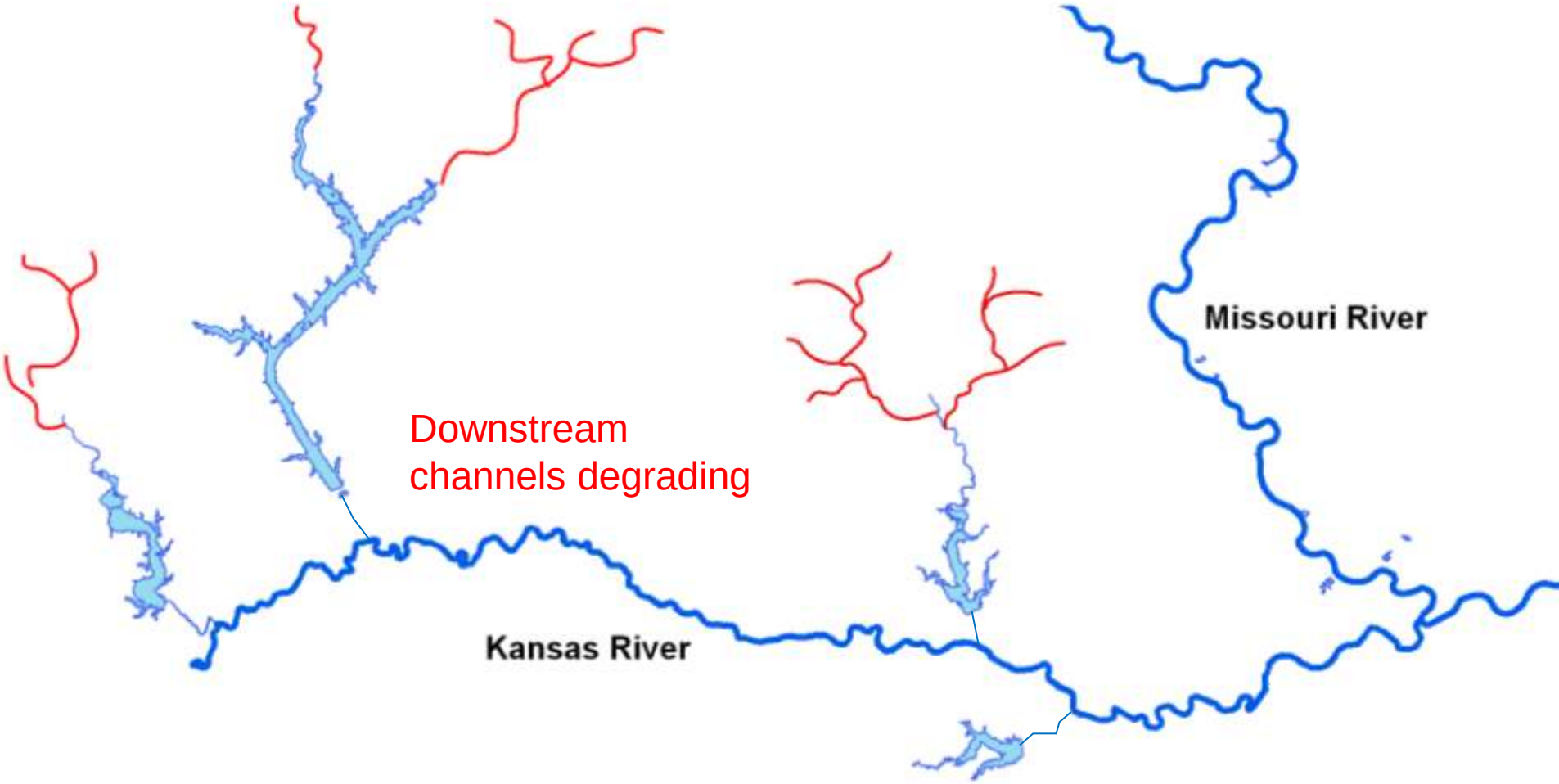
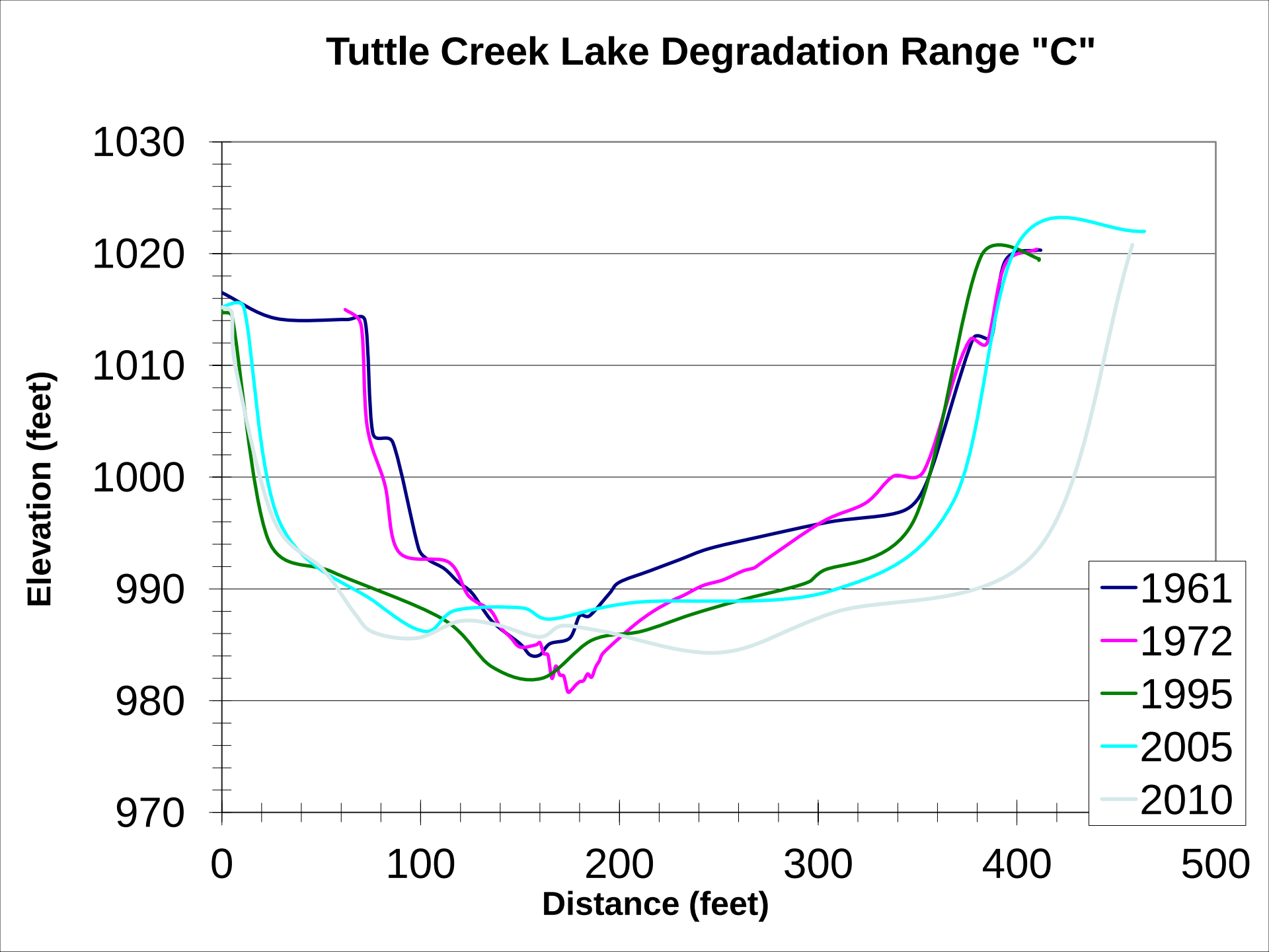


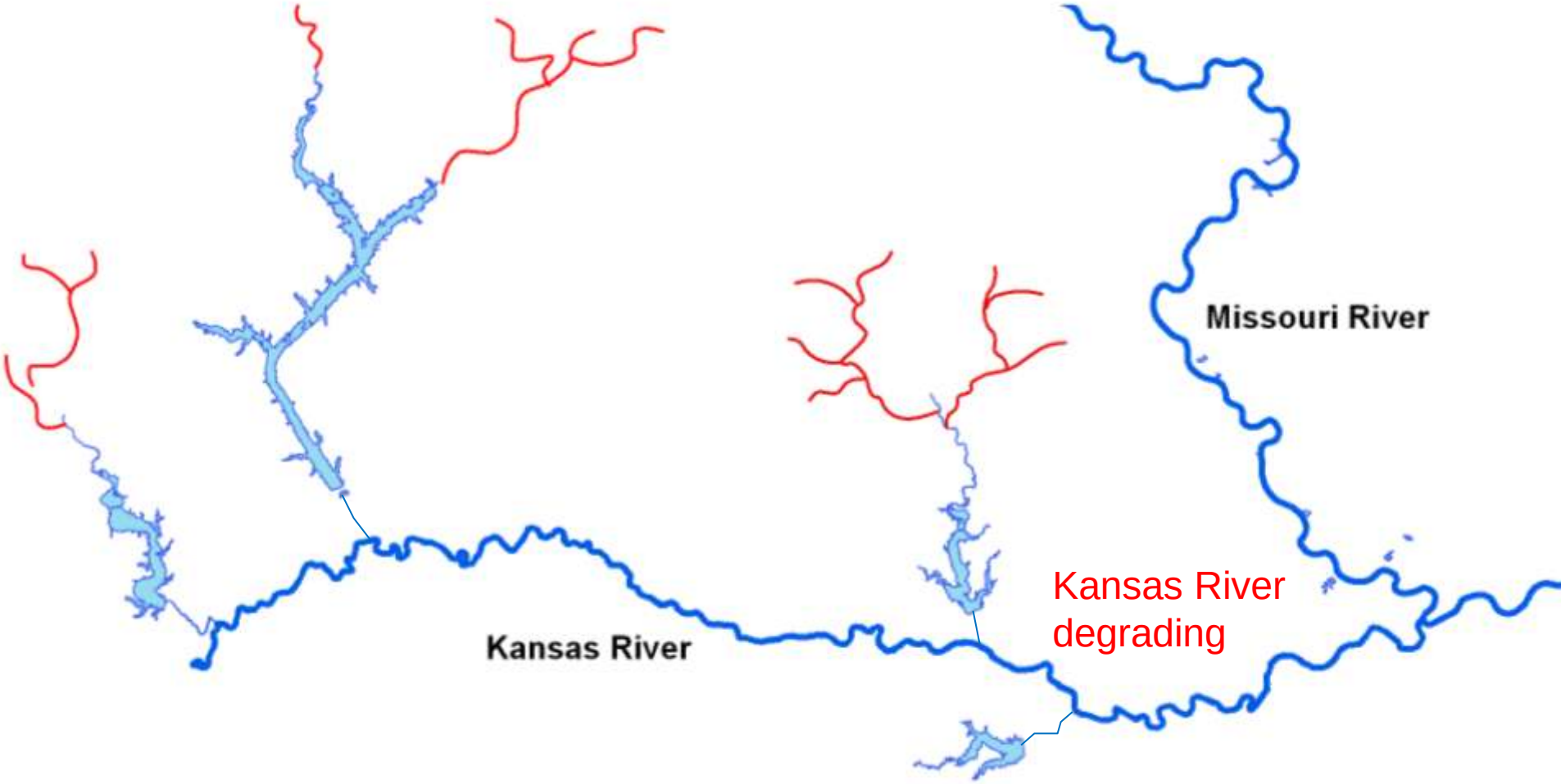
Figure 5. Loss of multipurpose pool water-storage capacity in Kansas federal reservoirs
Data source: KWO (2008)

Sediment Imbalances




Tuttle Creek Lake Degradation Range "C"
Elevation (feet)
1030
1020
1010
1000
990
980
970
0
100
200
300
400
500
Distance (feet)
1961
1972
1995
2005
2010

Sediment Imbalances



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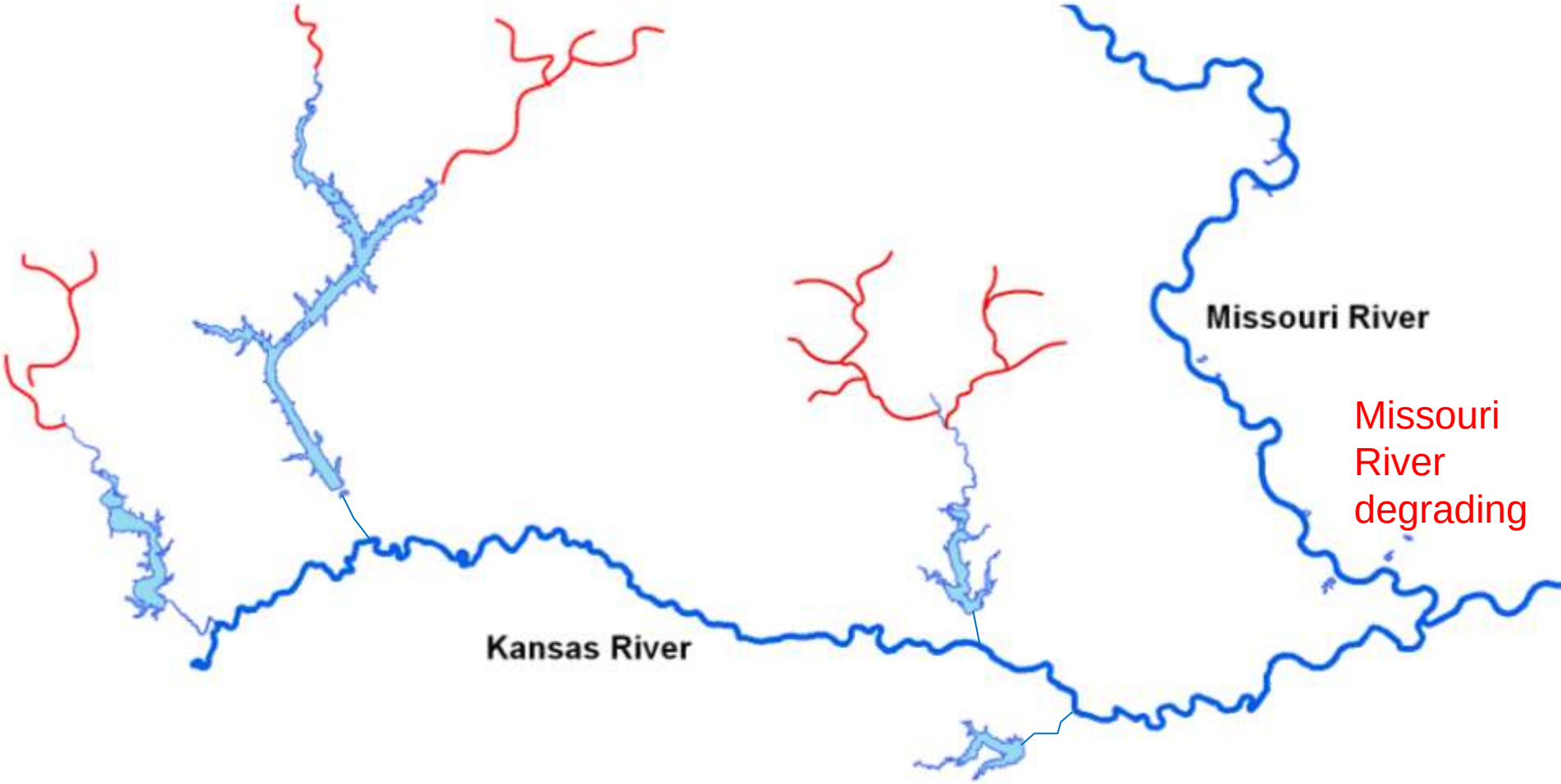

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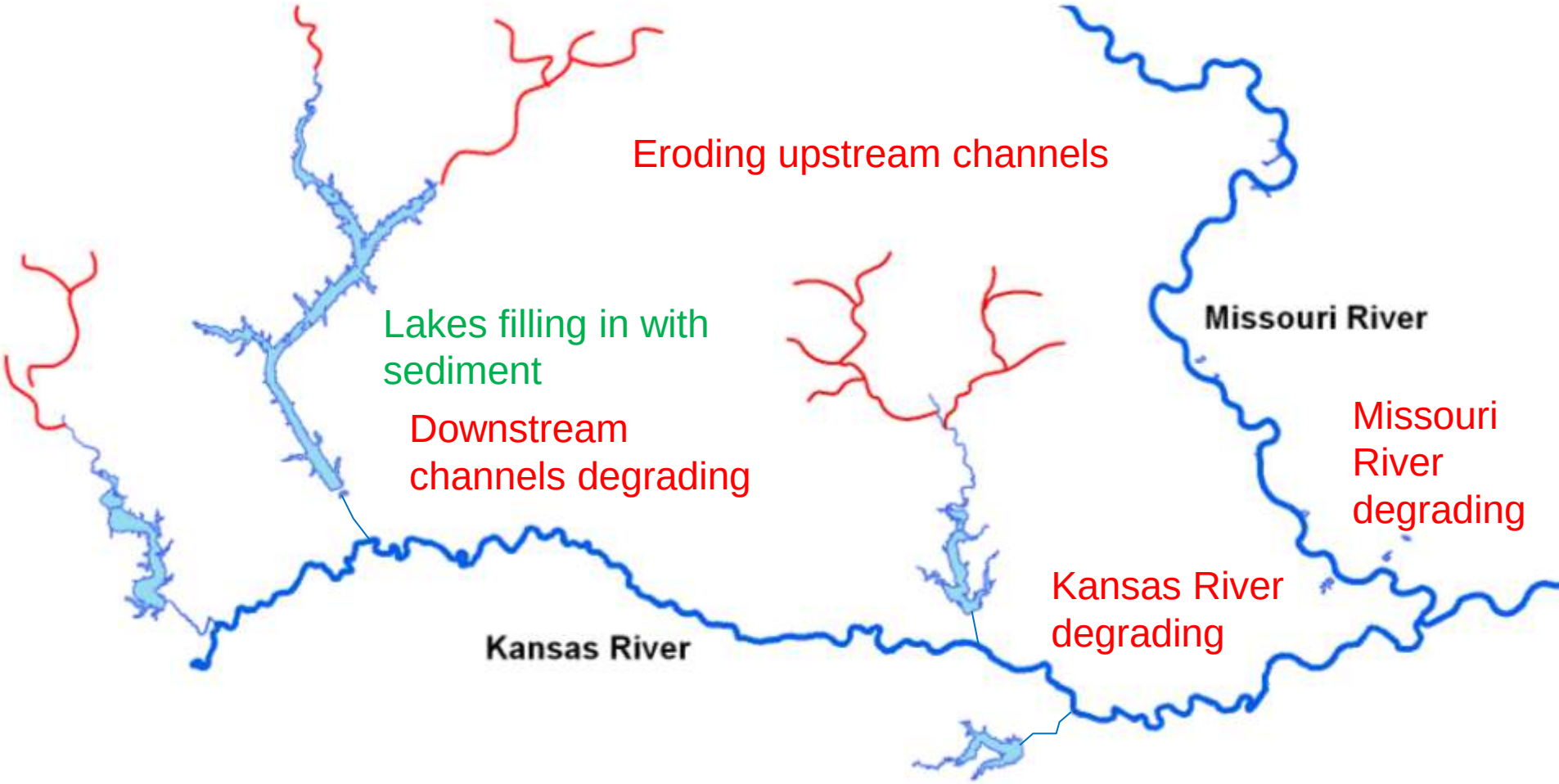
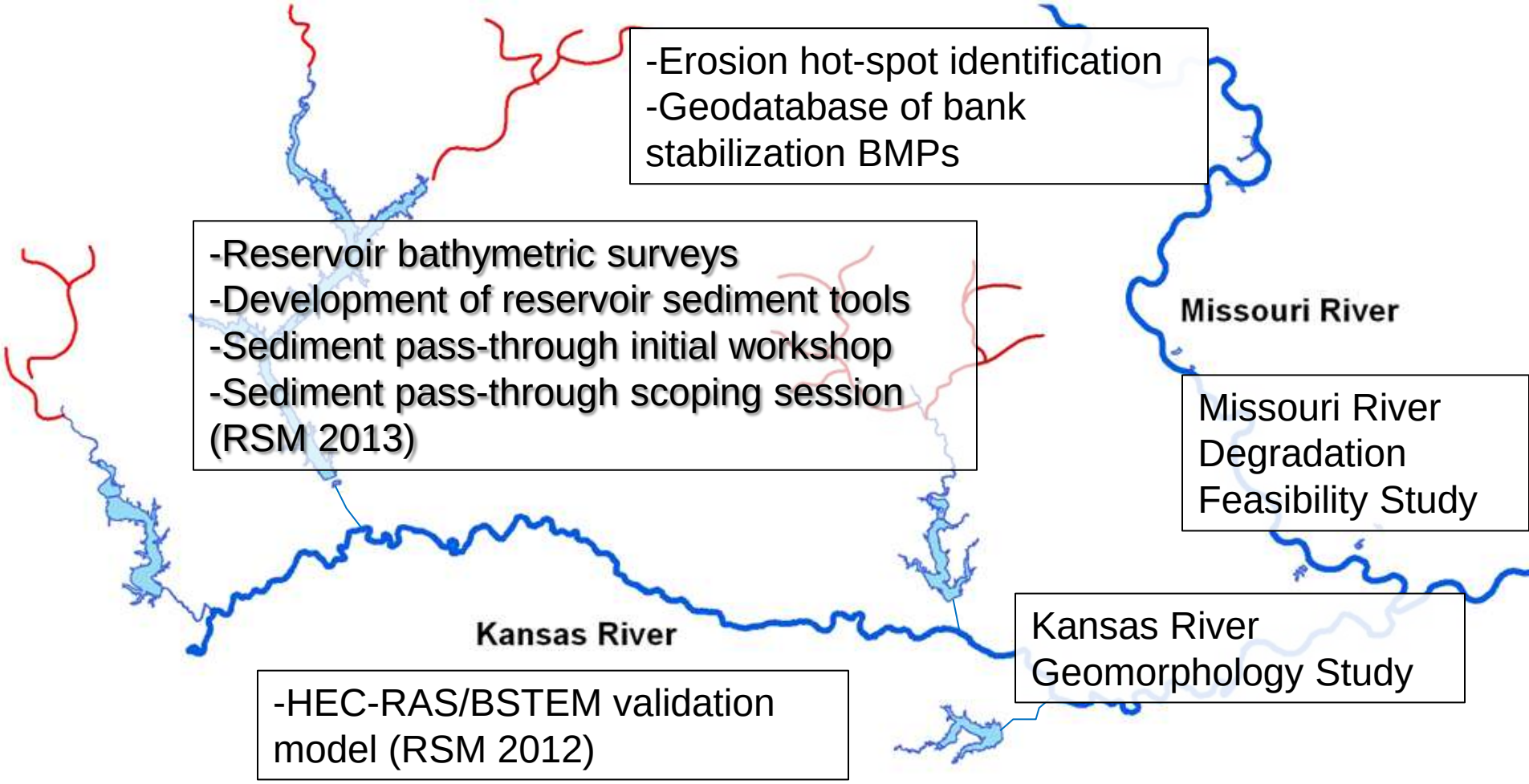


NWK Sediment-Related Projects



-Erosion hot-spot identification
-Geodatabase of bank stabilization BMPs

-Reservoir bathymetric surveys
-Development of reservoir sediment tools
-Sediment pass-through initial workshop
-Sediment pass-through scoping session (RSM 2013)

Missouri River Degradation Feasibility Study

Kansas River Geomorphology Study

-HEC-RAS/BSTEM validation model (RSM 2012)

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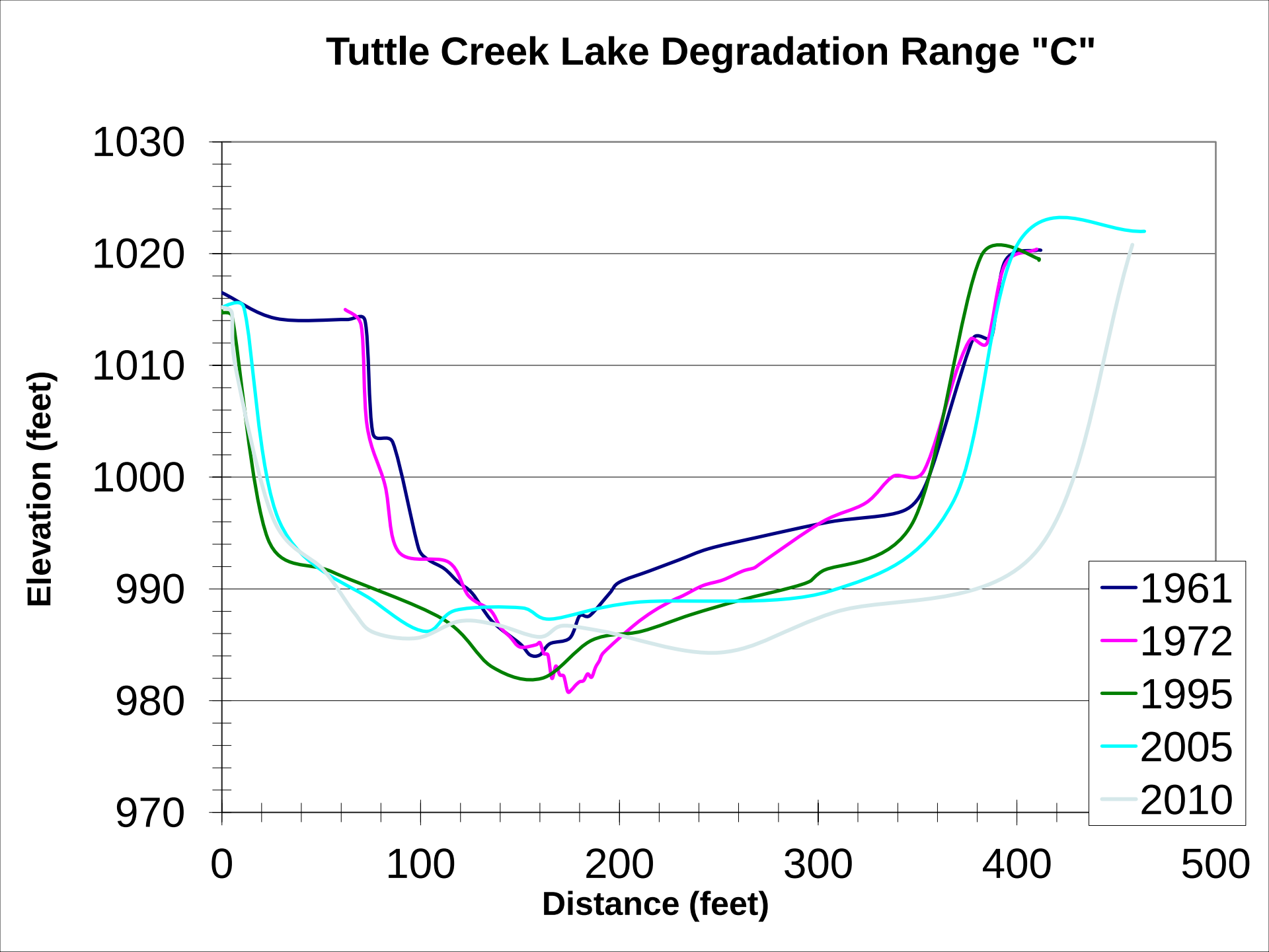
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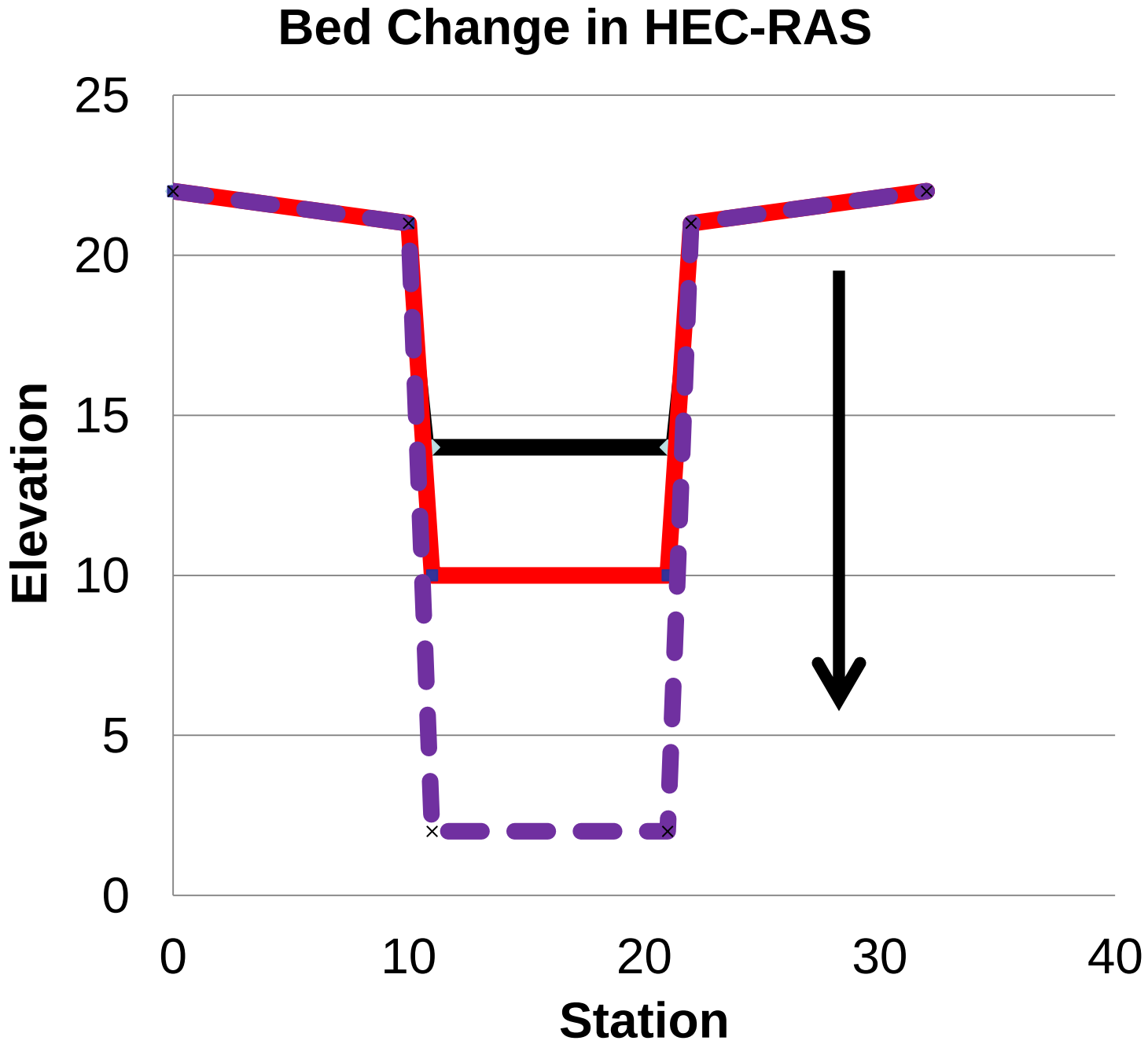
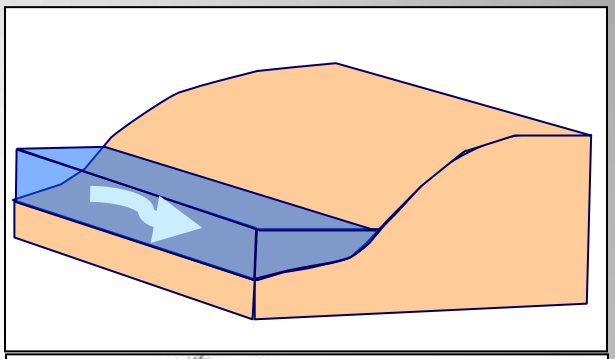
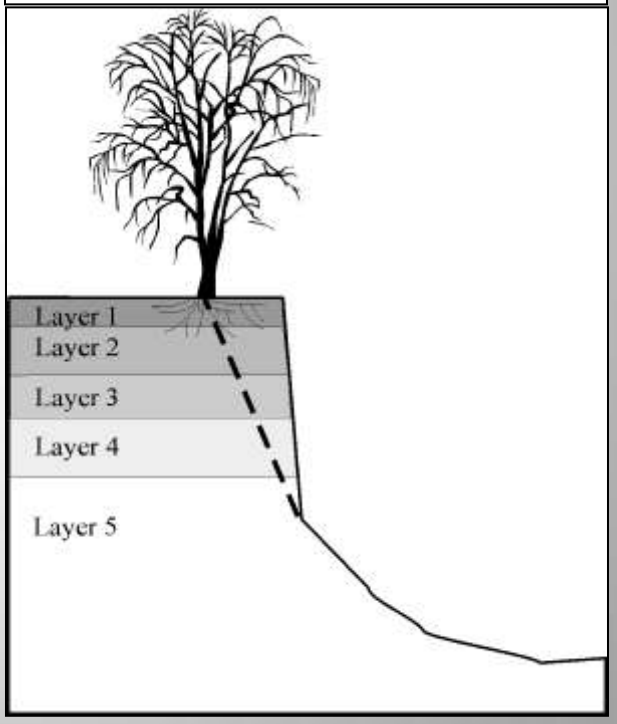

Bed Change in HEC-RAS
25
20
15
10
5
0
Elevation
0
10
20
30
40
Station

USDA- BSTEM

- Bank Stability Toe Erosion Model
- Hydraulic erosion on the toe and slope
- Geotechnical mass failure

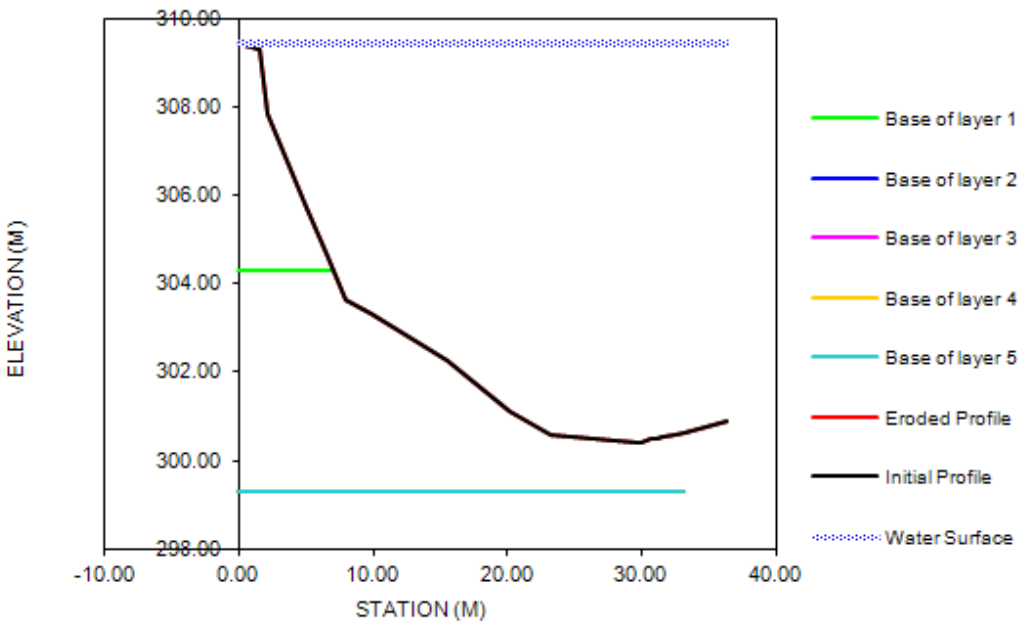




Toe Model Output

Verify the bank material and bank and bank-toe protection information entered in the "Bank Material" and "Bank Vegetation and Protection" worksheets. Once you are satisfied that you have completed all necessary inputs, hit the "Run Toe-Erosion Model" button (Center Right of this page).

	Bank Material					Bank Toe Material
	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	
Material	Erodible cohesive	Coarse sand	Coarse sand	Own data	Own data	Own data
Critical shear stress (Pa)	0.10	0.50	0.50	Own data	Own data	Own data
Erodibility Coefficient (cm^3/Ns)	0.316	0.141	0.141	Own data	Own data	Own data



Run Toe-Erosion Model

Account for:

Stream Curvature ☐

Effective stress acting on each grain ☐

Average applied boundary shear stress		Pa
Maximum Lateral Retreat	0.000	cm
Eroded Area - Bank	0.000	m^2
Eroded Area - Bank Toe	0.000	m^2
Eroded Area - Bed	0.000	m^2
Eroded Area - Total	0.000	m^2

Export New (Eroded) Profile into Model

Toe Model Output

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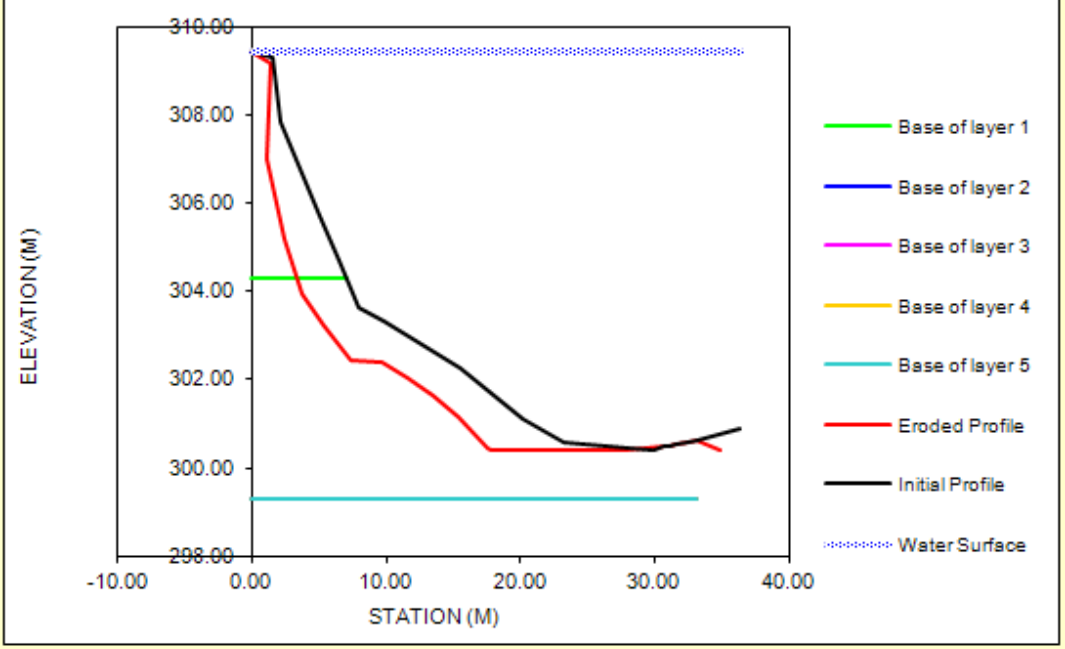


Run Toe-Erosion Model

Account for:

Stream Curvature ☐

Effective stress acting on each grain ☐

Average applied boundary shear stress	596.730	Pa
Maximum Lateral Retreat	244.240	cm
Eroded Area - Bank	29.801	m^2
Eroded Area - Bank Toe	0.063	m^2
Eroded Area - Bed	0.563	m^2
Eroded Area - Total	30.426	m^2

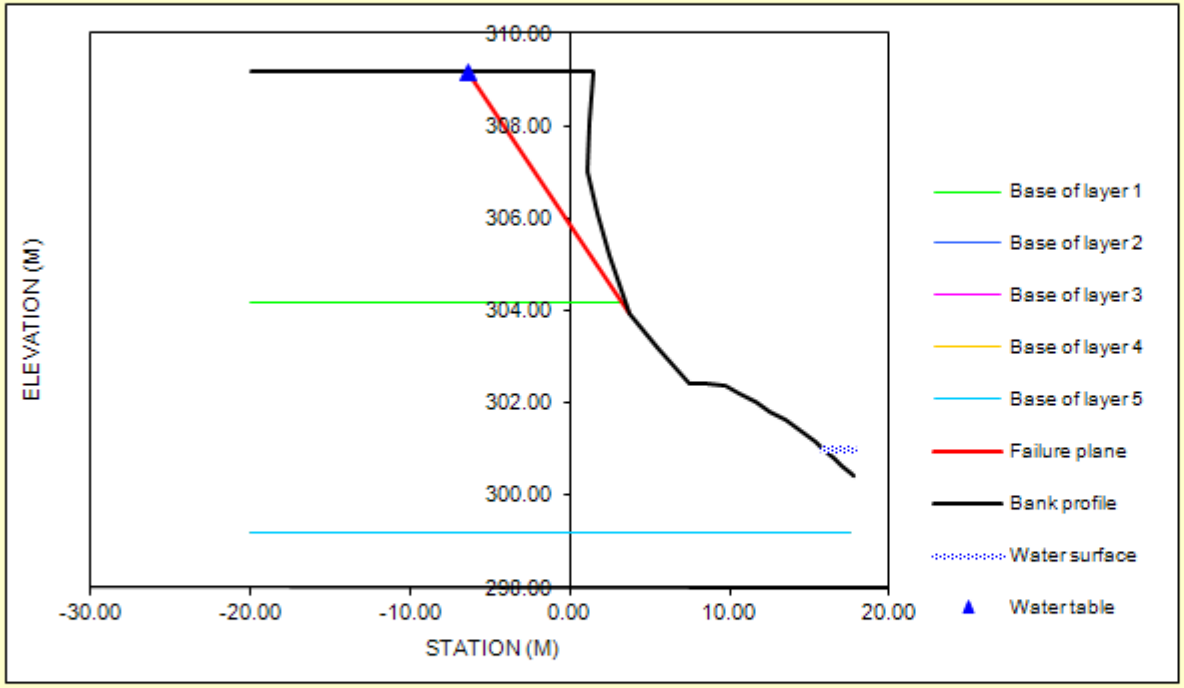
Export New (Eroded) Profile into Model

Bank model output

Verify the bank material and bank and bank-toe protection information entered in the "Bank Material" and "Bank Vegetation and Protection" worksheets. Once you are satisfied that you have completed all necessary inputs, hit the "Run Bank-Stability Model" button.

Bank Material Properties

Layer 1	Layer 2	Layer 3	Layer 4	Layer 5
Silt	Rounded Sand	Rounded Sand	Own Data	Own Data



Water table depth (m) below bank top

Use water table

Input own pore pressures (kPa)

Own Pore Pressures	kPa	Pore Pressure From Water Table
	Layer 1	24.52
	Layer 2	73.55
	Layer 3	98.07
	Layer 4	98.07
	Layer 5	98.07

Factor of Safety

0.34 Unstable

Run Bank-Stability Model

HEC-RAS

Water Surface Profiles

Bed elevation changes

BSTEM

Toe/slope erosion

Geotechnical bank failure

HEC-RAS 4.2

HEC-RAS

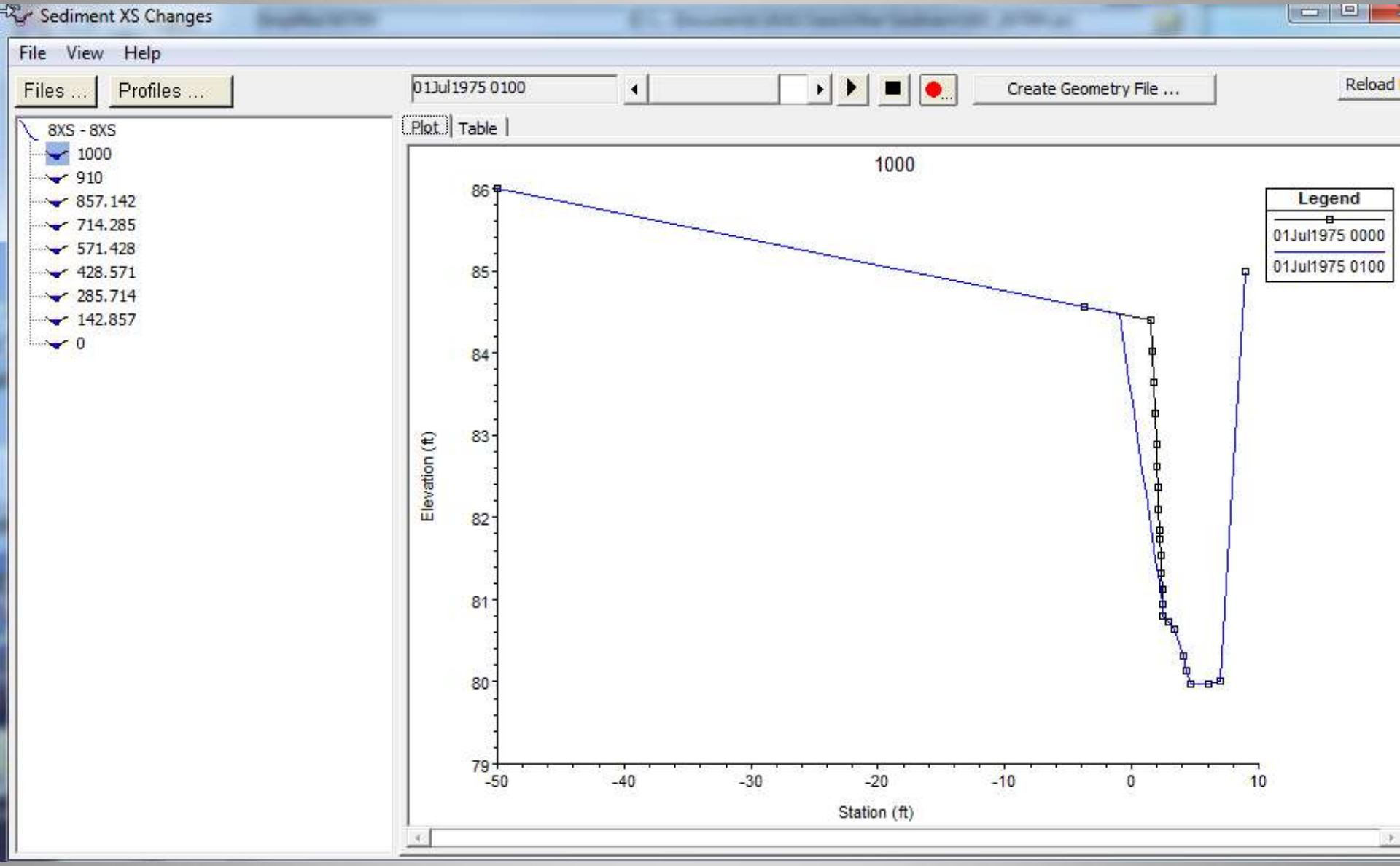
Water Surface Profiles

Bed elevation changes

BSTEM

Toe/slope erosion

Geotechnical bank failure


Sediment XS Changes
File
View
Help
Files ...
Profiles ...
01Jul1975 0100
Create Geometry File ...
Reload
8XS - 8XS
1000
910
857.142
714.285
571.428
428.571
285.714
142.857
0
Plot
Table
1000
Legend
01Jul1975 0000
01Jul1975 0100
Elevation (ft)
Station (ft)
86
85
84
83
82
81
80
79
-50
-40
-30
-20
-10
0
10

RSM FY 2012

- $95k from RSM
  - $50k to HEC
  - $25k to BSTEM Developers
  - $7k to Kansas City District
  - $6.5 to St Paul District
  - $6.5 to Rock Island

RSM FY12 IPR
District, RSM Activity Title

District PDT Members

- John Shelley (River Engineering, RSM Manager)
- Zach White (Kansas City- Former RSM Manager)
- Christy Ostrander (Planning, Section 204 PM)
- Colleen Roberts (River Engineering)

Stakeholders and Partners

- Chris Gnau (Kansas Water Office)

Leveraging/Collaborative Opportunities

funding, data, tools, models, etc
with Other Projects, Programs, Partners, etc

- HEC (Funding from Australia project)
- Section 204 ($50k+)
- St Paul District
- Rock Island District

Milestones/Deliverables

- Integrated HEC-RAS/BSTEM model
- Kansas River (Big Blue River) validation model

RSM FY12 IPR
District, RSM Activity Title

Approach

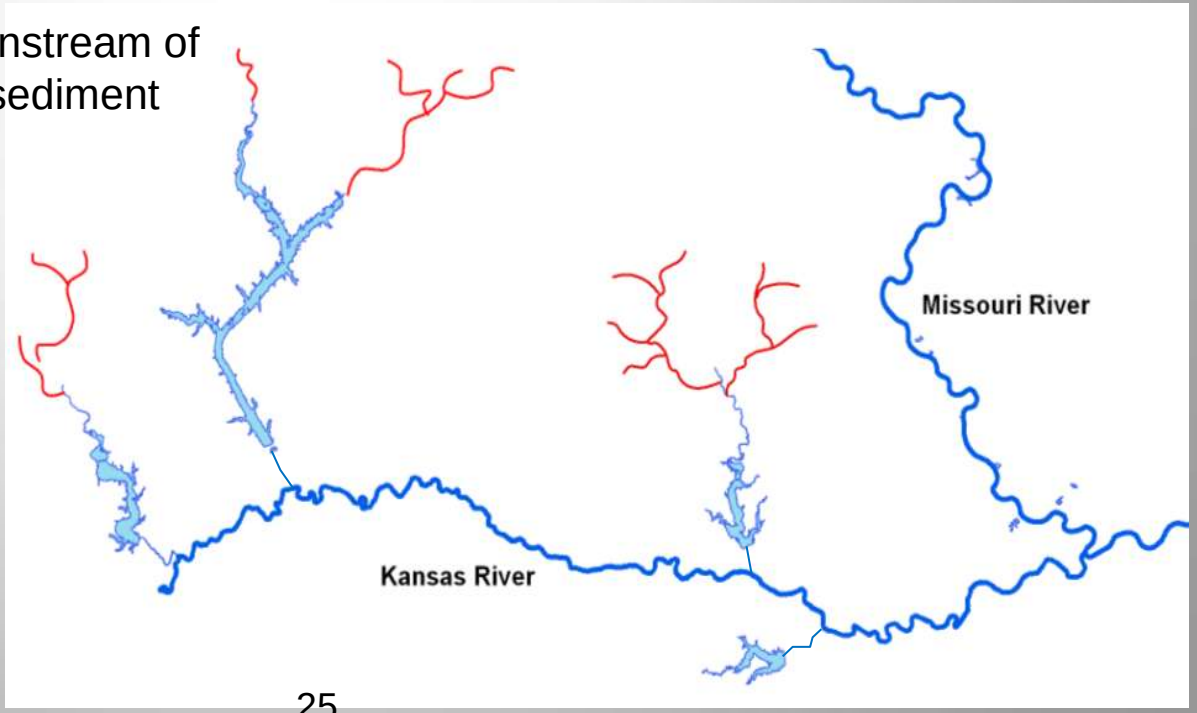
- Incorporate USDA bank erosion software into the popular USACE river modeling software HEC-RAS.
- Develop a demonstration model validating the combined software.

Models, Tools, Databases, etc Used

- HEC-RAS
- BSTEM

Benefits to O&M, FRM, Environmental

- Model sediment erosion of upstream channels
- Model response of channels downstream of dams to increases/decreases in sediment supply



Questions?