An Excellent Phase 6 Adventure:

Estimating Upland Erosion
&
Sediment Delivery
(to very small streams)

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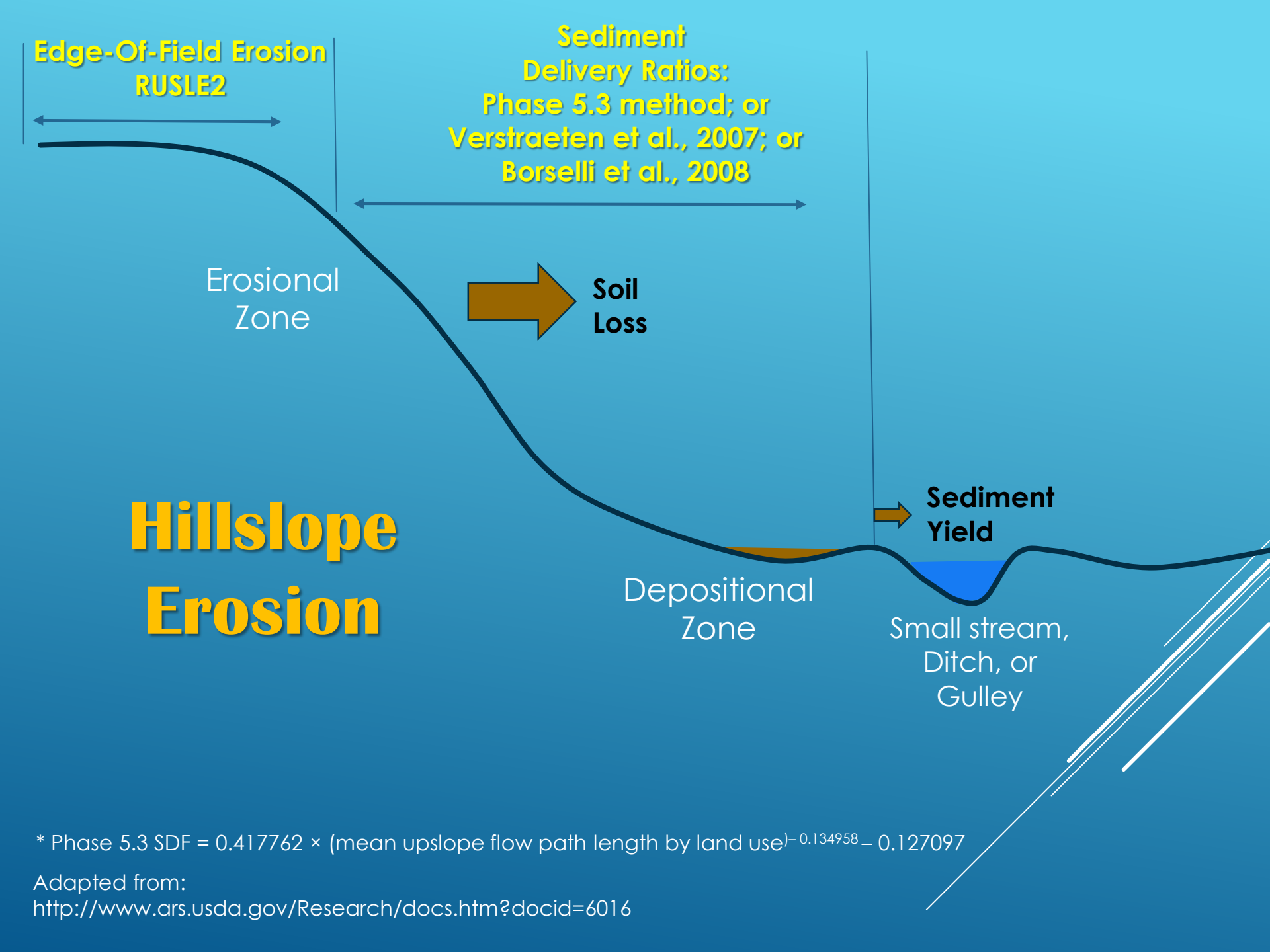
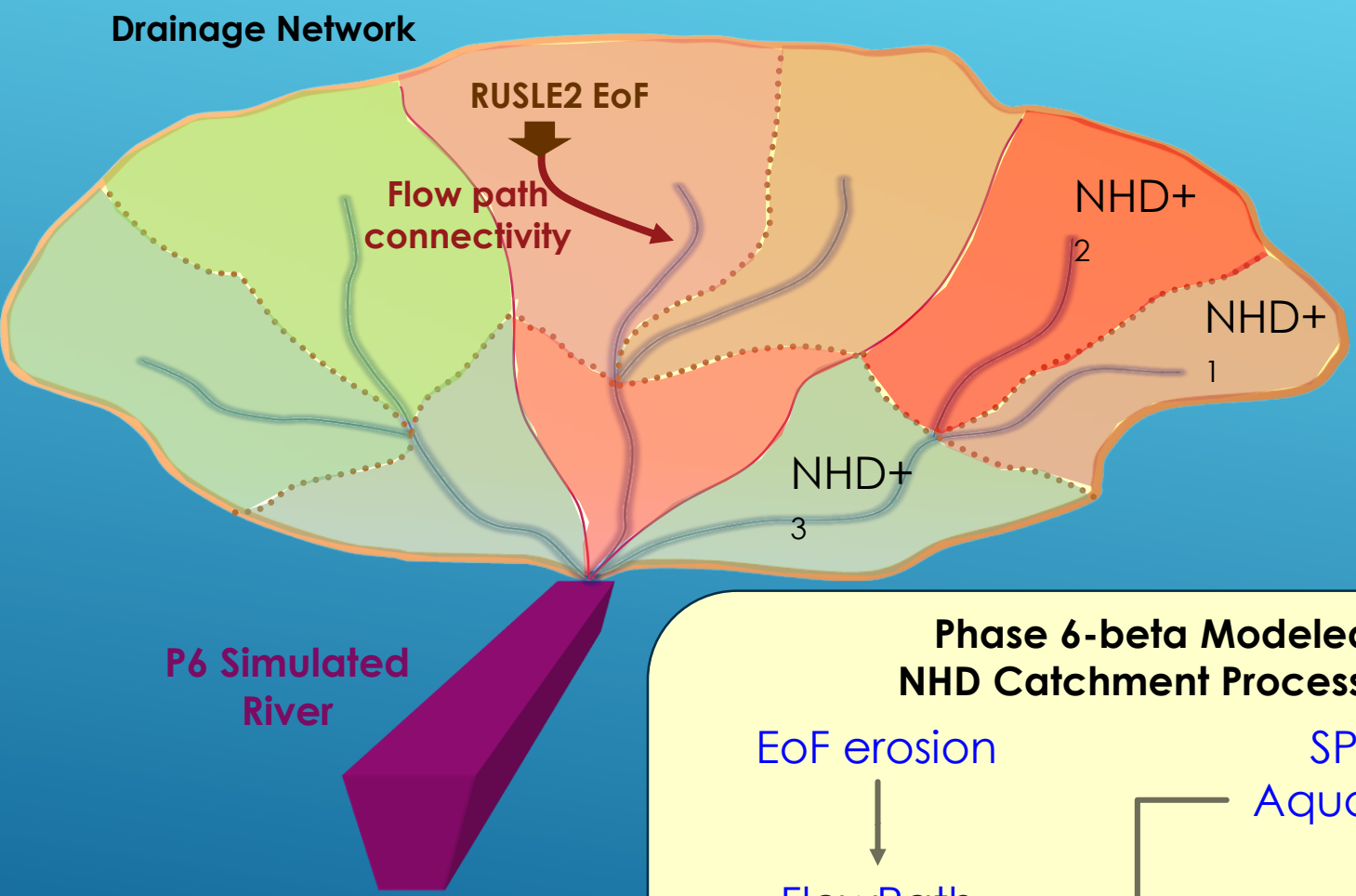


Hillslope Erosion

* Phase 5.3 SDF = 0.417762 × (mean upslope flow path length by land use)$^{-0.134958}$ – 0.127097

Adapted from:
http://www.ars.usda.gov/Research/docs.htm?docid=6016

Sediment Delivery to Simulated Rivers



Phase 6-beta Modeled NHD Catchment Processes

EoF erosion

↓

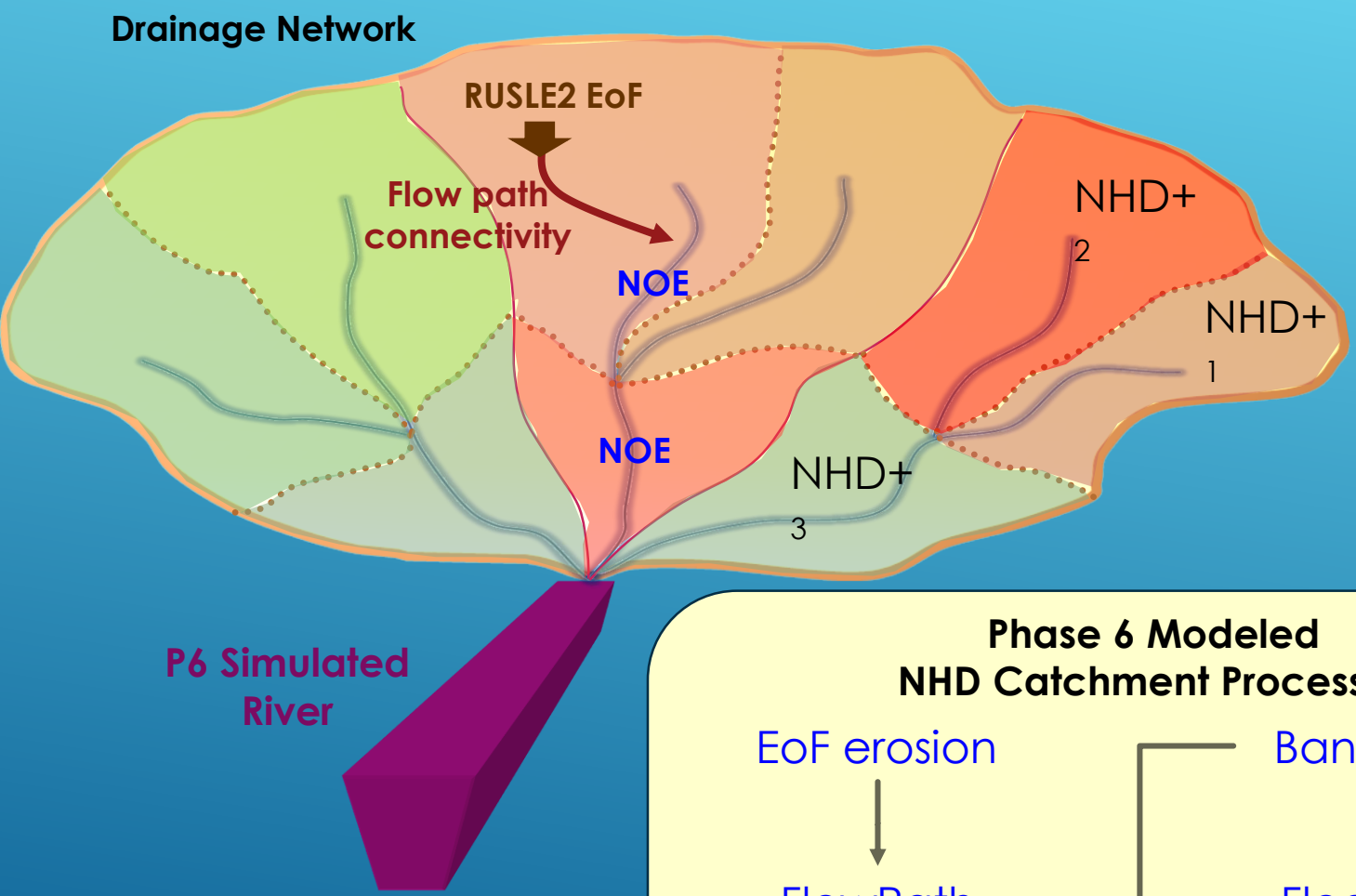
FlowPath connectivity

SPARROW Aquatic Decay Rates

↓

NHD+ Streams

Sediment Delivery to Simulated Rivers



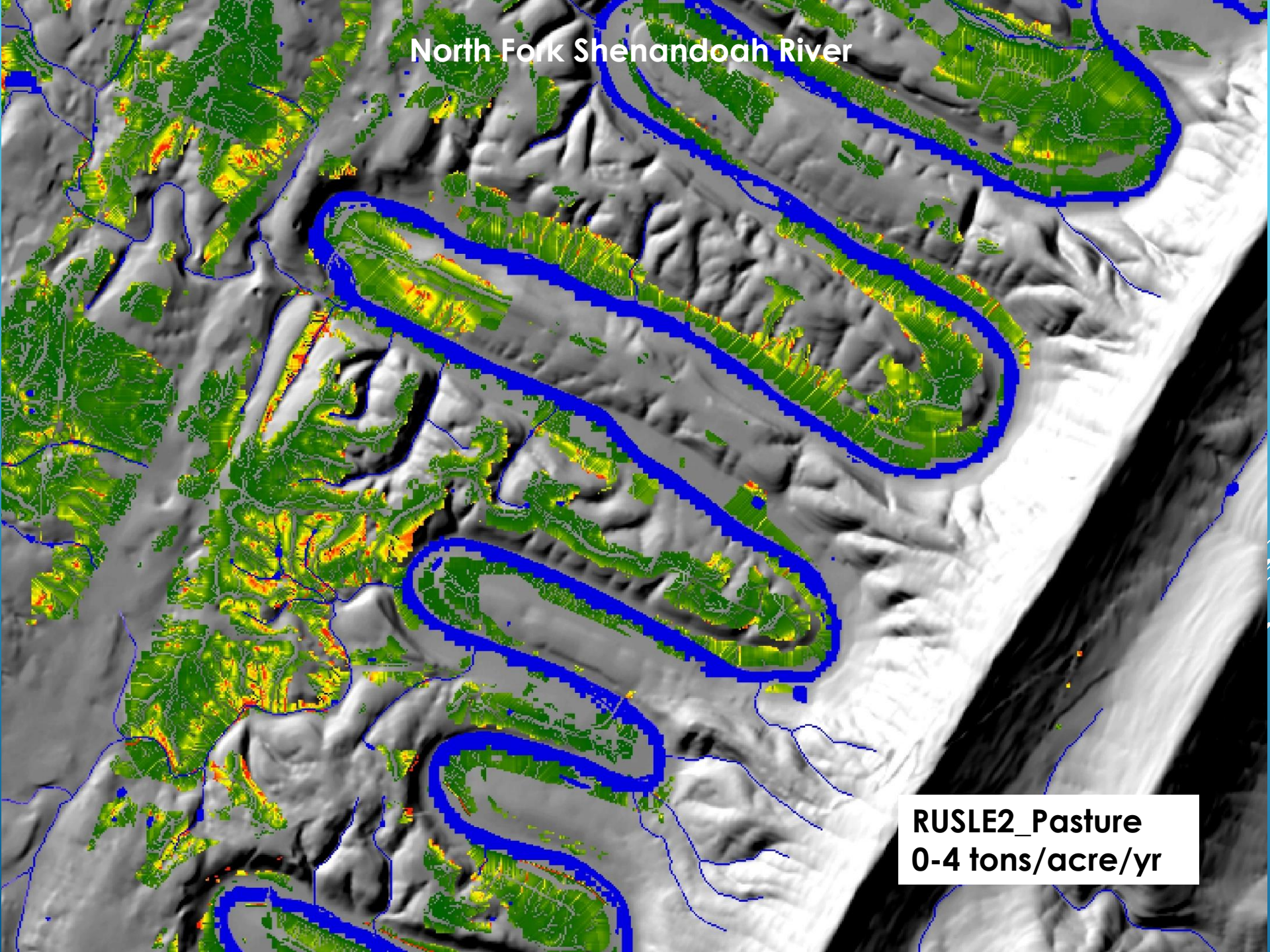
Phase 6 Modeled NHD Catchment Processes

EoF erosion → FlowPath connectivity

Bank Erosion

Floodplain Deposition

→ Synthetic Streams


North Fork Shenandoah River
RUSLE2_Pasture
0-4 tons/acre/yr

Revised Universal Soil Loss Equation 2

Erosion (tons/acre/yr):

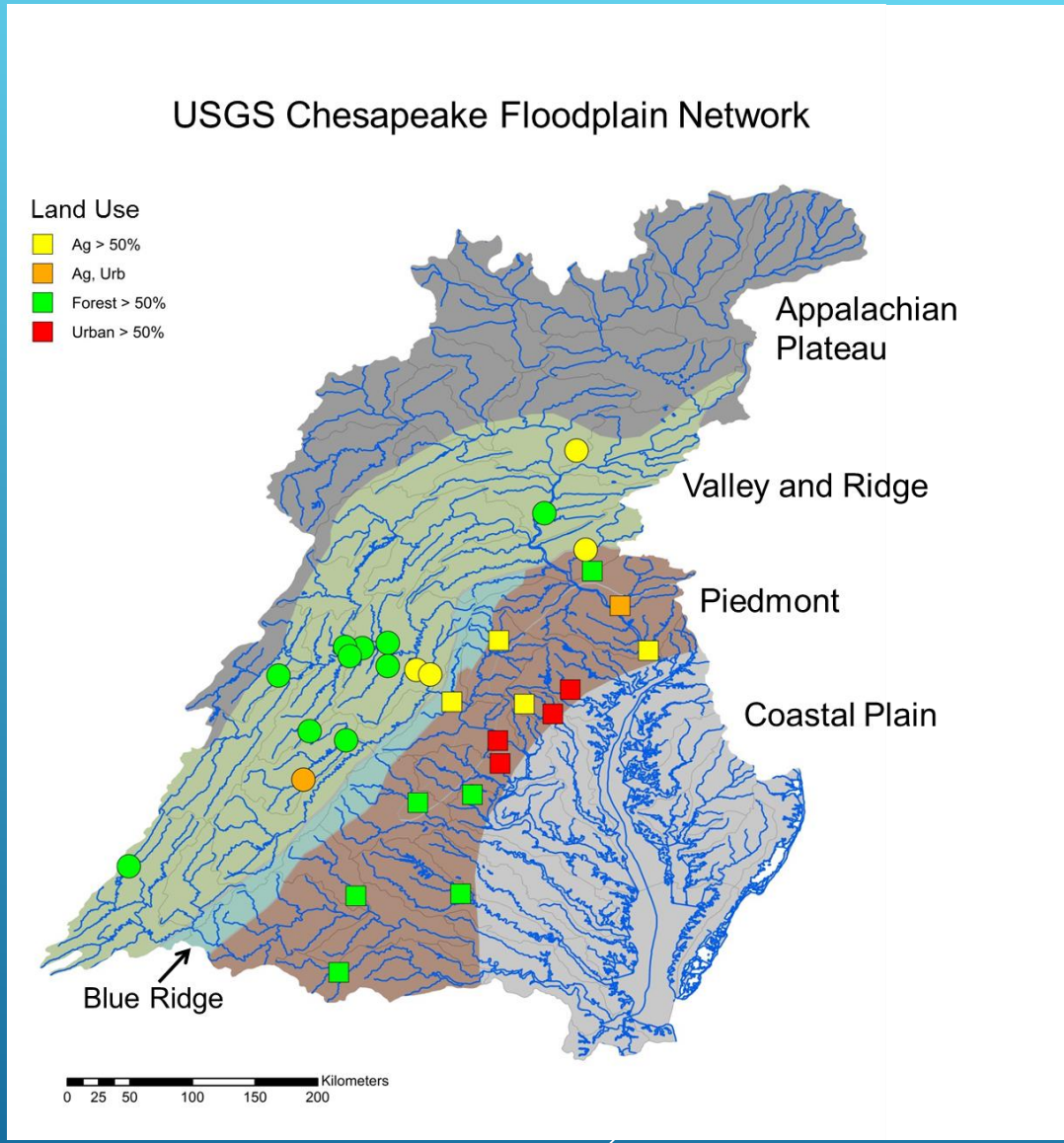
$$r * k * l * s * c * p$$

where,
r = erosivity factor
k = soil erodibility factor,
l = slope length factor,
S = slope steepness factor,
c = cover-management factor, and
p = supporting practices factor (assumed to equal "1" due to lack of data)

THE USGS CHESAPEAKE FLOODPLAIN NETWORK

Goal:
Measure and predict the sediment/N/P balance (sink or source of floodplain + banks)
for entire Chesapeake watershed

Site selection:
- Chesapeake NTN load gages
- 'unmanaged' floodplain land use (forest/scrub/herbaceous; not ag/ pasture/developed)
- Landowner permission
- Range of watershed size and land-use



Courtesy: Greg Noe, USGS

USGS Chesapeake Floodplain Network

Greg Noe, USGS

Fluxes are predictable (and could be extrapolated in GIS)

Net Sediment Flux

P=0.005, R^2=0.44

Step	Beta	R^2 change	P
Constant			0.71
1. Channel depth	0.99	0.19	0.00
2. 1974 land use in production	-0.44	0.10	0.01
3. Channel width x depth	-0.53	0.09	0.07
4. Q99 yield	-0.28	0.07	0.09

Floodplain Sediment Flux

P<0.001, R^2=0.83

Step	Beta	R^2 change	P
Constant			0.00
1. Channel depth	1.36	0.36	0.00
2. Channel width x depth	-0.70	0.11	0.00
3. 1974 land use in production	-0.31	0.06	0.01
4. Reach sinuousity	0.29	0.06	0.02
5. Physiographic Province	1.04	0.05	0.00
6. Rainfall and Runoff R-factor (USLE)	0.75	0.05	0.00
7. Subsurface flow contact time index	-0.41	0.04	0.01
8. Channel width / floodplain width	-0.28	0.04	0.03
9. Median elevation	-0.26	0.03	0.07

Bank Sediment Flux

P<0.001, R^2=0.77

Step	Beta	R^2 change	P
Constant			0.31
1. Floodplain width	-1.62	0.35	0.00
2. Channel width / floodplain width	-0.61	0.23	0.00
3. P application rate	-0.58	0.05	0.00
4. Impervious landcover NLCD 2006/2011	0.45	0.11	0.00
5. Rainfall and Runoff R-factor (USLE)	0.43	0.03	0.00
6. Dam storage in watershed	-0.19	0.01	0.10

Net Nitrogen Flux

P<0.001, R^2=0.89

Step	Beta	R^2 change	P
Constant			0.00
1. Channel depth	1.94	0.25	0.00
2. Channel width x depth	-1.32	0.16	0.00
3. Reach sinuousity	0.56	0.15	0.00
4. Physiographic Province	0.90	0.08	0.00
5. 1974 land use in production	-0.32	0.09	0.00
6. Rainfall and Runoff R-factor (USLE)	0.59	0.08	0.00
7. Dam storage in watershed	-0.29	0.04	0.00
8. Horton overland flow %	-0.23	0.02	0.06
9. Floodplain width / channel width	-0.17	0.02	0.09

Floodplain Nitrogen Flux

P<0.001, R^2=0.92

Step	Beta	R^2 change	P
Constant			0.00
1. Channel depth	1.72	0.26	0.00
2. Channel width x depth	-1.29	0.15	0.00
3. Reach sinuousity	0.50	0.21	0.00
4. Physiographic Province	0.72	0.11	0.00
5. Floodplain width / channel width	0.27	0.07	0.01
6. Rainfall and Runoff R-factor (USLE)	0.56	0.03	0.00
7. SPARROW P yield	0.25	0.02	0.00
8. Soil permeability	0.45	0.04	0.00
9. Dam storage in watershed	-0.18	0.02	0.03
10. SPARROW Sediment load	0.16	0.02	0.07

Bank Nitrogen Flux

P<0.001, R^2=0.79

Step	Beta	R^2 change	P
Constant			0.10
1. P application rate	-0.96	0.25	0.00
2. Floodplain width	-1.45	0.10	0.00
3. Rainfall and Runoff R-factor (USLE)	0.53	0.18	0.00
4. Impervious landcover NLCD 2006/2011	0.60	0.12	0.00
5. Channel width / floodplain width	-0.56	0.06	0.00
6. Q50	0.25	0.03	0.04
7. Dam storage in watershed	-0.20	0.03	0.07

Net Phosphorus Flux

P<0.001, R^2=0.78

Step	Beta	R^2 change	P
Constant			0.00
1. Channel depth	2.02	0.25	0.00
2. Channel width x depth	-1.23	0.15	0.00
3. Reach sinuousity	0.45	0.09	0.00
4. Horton overland flow %	-0.57	0.10	0.00
5. Physiographic Province	0.52	0.07	0.00
6. Erodability K-factor (USLE)	0.47	0.07	0.01
7. 2011 land use in agriculture	-0.28	0.06	0.02

Floodplain Phosphorus Flux

P<0.001, R^2=0.72

Step	Beta	R^2 change	P
Constant			0.00
1. Channel depth	1.66	0.38	0.00
2. Channel width x depth	-1.58	0.15	0.00
3. Reach sinuousity	0.35	0.08	0.01
4. Q50	0.50	0.07	0.02
5. Soil permeability	0.28	0.06	0.04

Bank Phosphorus flux

P<0.001, R^2=0.61

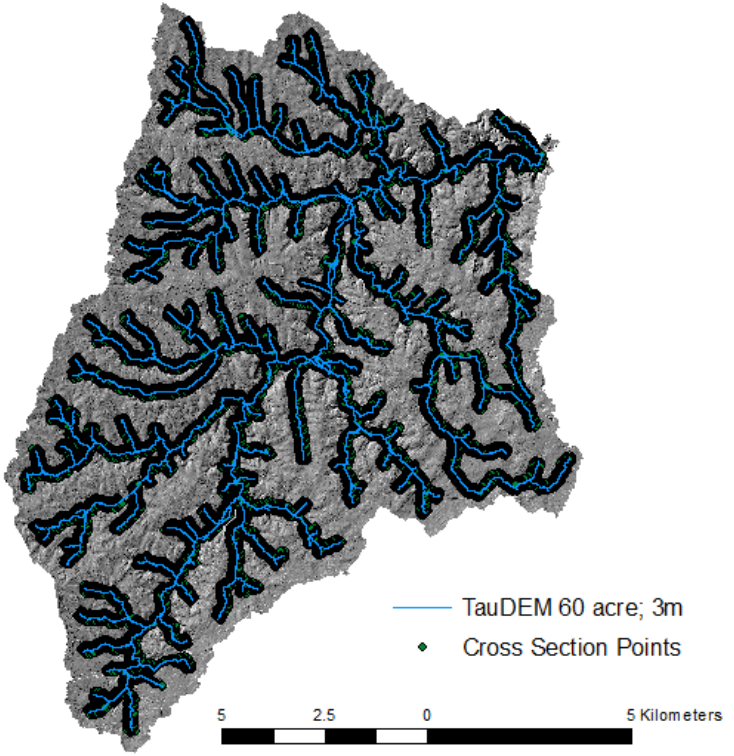
Step	Beta	R^2 change	P
Constant			0.03
1. 1974 land use in production	-0.29	0.38	0.04
2. Floodplain width	-0.58	0.13	0.00
3. Dimensionless median elevation - relief ratio	0.47	0.11	0.00

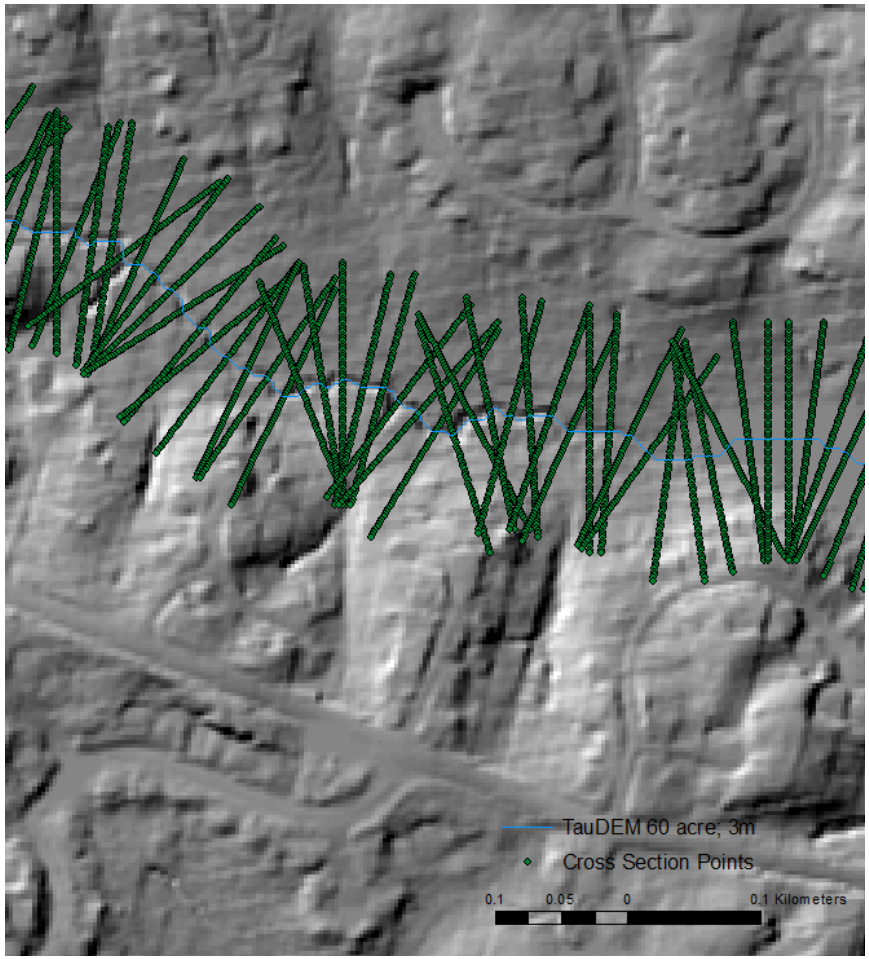
Bank Detection & Floodplain Analysis Tool
(Lamont and Claggett)

Tool Parameters (default values established for lower and higher-order streams)

- Spacing between cross sections (m)
- Channel cross section linear fit length (m)
- Channel cross section length (m)
- Point spacing along cross sections (m)
- Bank detection slope break ratio
- Bank detection slope break between points (%)
- Channel slope break vertical increment (cm)
- Valley cross section length (m)
- Valley cross section linear fit length (m)
- Floodplain parameter: Search radius (m)
- Floodplain parameter: Height threshold (m)

Methods – Cross Sections



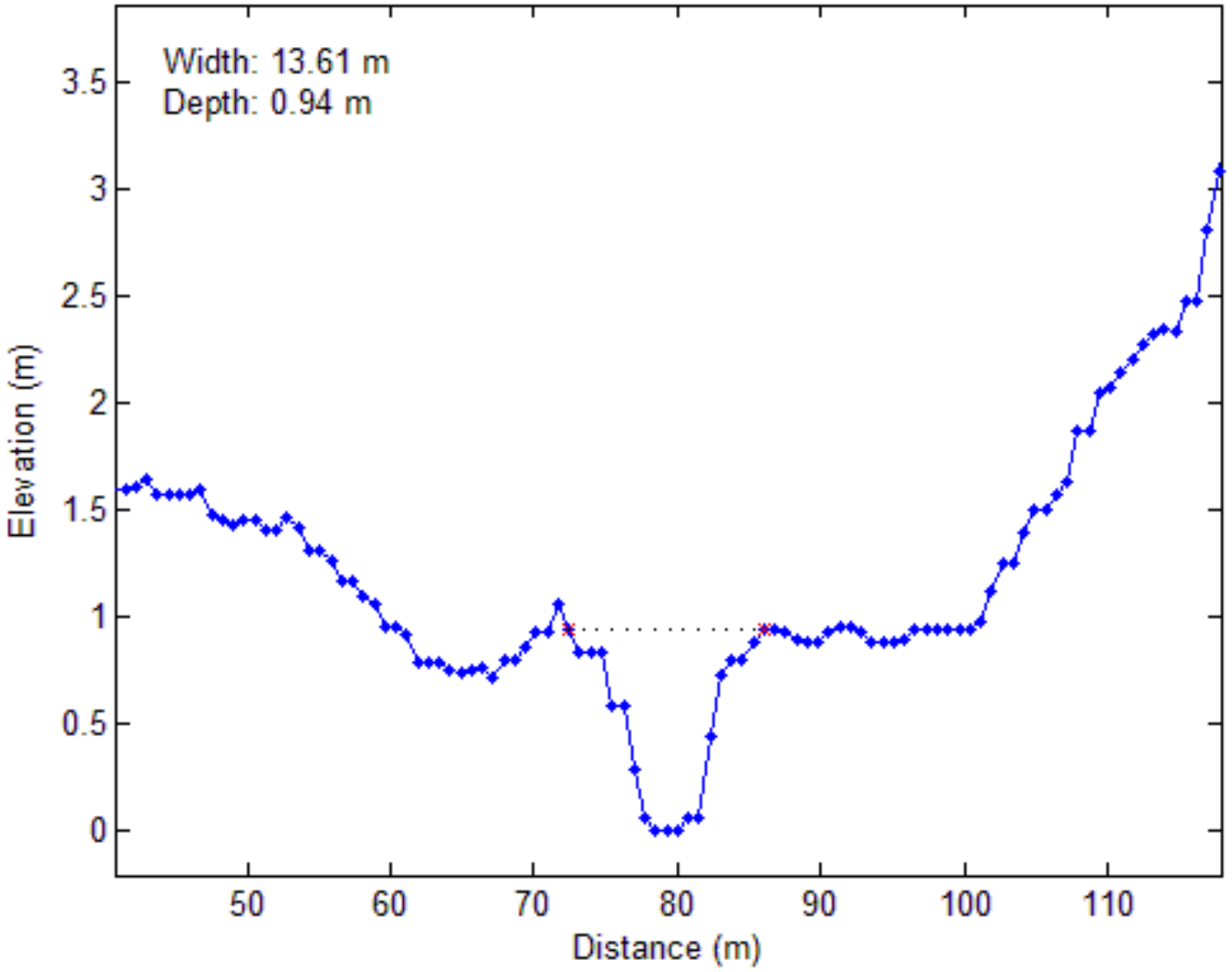


Can vary:

- Linear fit length, spacing, width, point spacing
- Width limited to catchment boundary

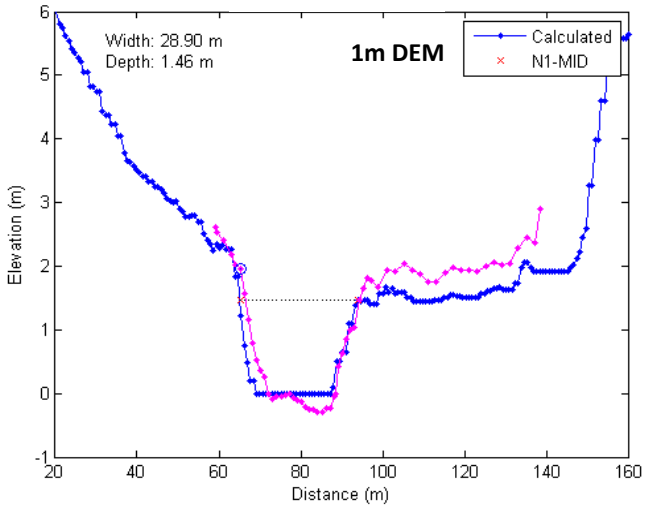
Methods – Cross Sections

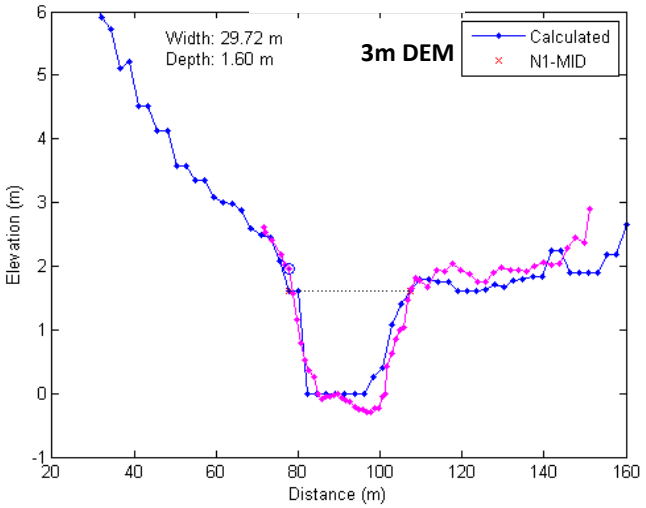
Bank locations based on slope breaks

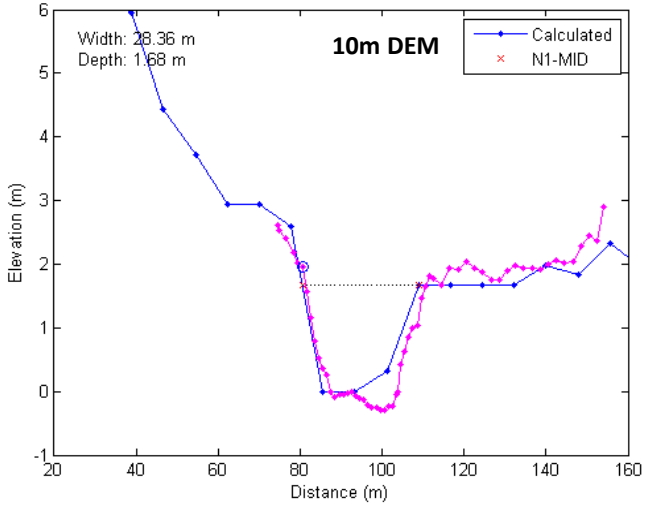


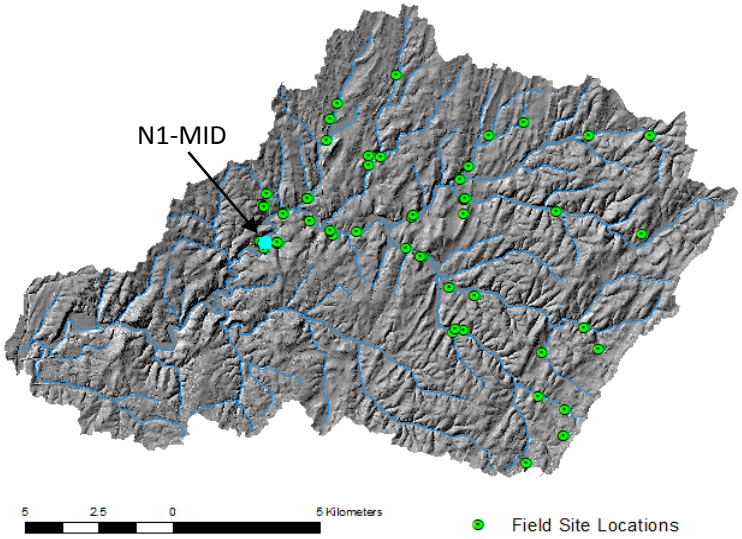
Results – Bank Locations

Results – Field Comparisons









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