Hydrography Webinar Series

Session 2
May 21, 2015

U.S. Department of the Interior
U.S. Geological Survey

U.S. GEOLOGICAL SURVEY HYDROGRAPHY WEBINAR SERIES

Hosted by:

Jeff Simley
Al Rea

USGS

Hydrography Webinar Series—Session 2 Agenda:

1. Introduction
2. NHDPlus Flow Computation and Analysis—Al Rea
3. The National Flood Interoperability Experiment (NFIE)—Ed Clark
4. Discussion

USGS

Hydrography Webinar Series—Purposes:

- Share success stories from users who have solved real world problems using hydrographic data
- Provide information on the NHD, WBD and related products
- Provide a forum for users similar to what might be encountered in a conference setting

USGS

Hydrography Webinar Series—Example Topics:

- Hydrology
- Resource Management
- Pollution Control
- Fisheries
- Emergency Management
- Mapping
- Elevation/Hydrography Integration

USGS

NHDPlus Flow Computation and Analysis

Introductory Concepts

by Al Rea

U.S. Department of the Interior
U.S. Geological Survey

Hydrography Webinar Series—Seminar Formats:

- Use cases
- Underlying technology
- “Rapid Fire” sessions
- Collect feedback

USGS

Hydrography Webinar Series—Seminar Information:

- http://nhd.usgs.gov/HydrographySeminarSeries.html
- NHD Newsletter & Mailing list – nhd@usgs.gov
- AWRA and other organization emails
- Contact info from webinar signup

- Expected Interval—every 6-8 weeks
- Questions during webinar—Q&A tab

USGS

NHDPlus V1 and V2 Team:

- Tommy Dewald – EPA Project Manager
- Al Rea, Rich Moore and Craig Johnston – USGS Water, NHDPlus Raster Processing
- Tim Bondelid – Consultant to EPA, Hydrologist
- Cindy McKay – Contractor to EPA, NHDPlus Technical Lead, Database & Software Design

USGS

Overview—Flow computation and analysis:

- NHDPlus Components
  - Surface Water Network
  - NHDPlus Network Attributes
  - Catchments
  - Catchment & Watershed Attributes
  - Points of Interest Linked the Network (gages, forecast points, dams)
- Analysis Example—EROM Flows and Velocities

USGS

NHDPlusV2 Components

Vectors

- NHD Snapshot
- WBD Snapshot
- Hydro-Enforcement Features
- Catchment Polys

Rasters

- NED Snapshot
- Hydro DEM
- FDR/FAC
- Catchments
- More…

Many Attributes

USGS

Value Added Attributes (VAAs) For the Stream Network

Analysis

- Stream Order
- Waterbody Identifier
- Network Identifier
- Level Path Identifier
- Distance to Terminus

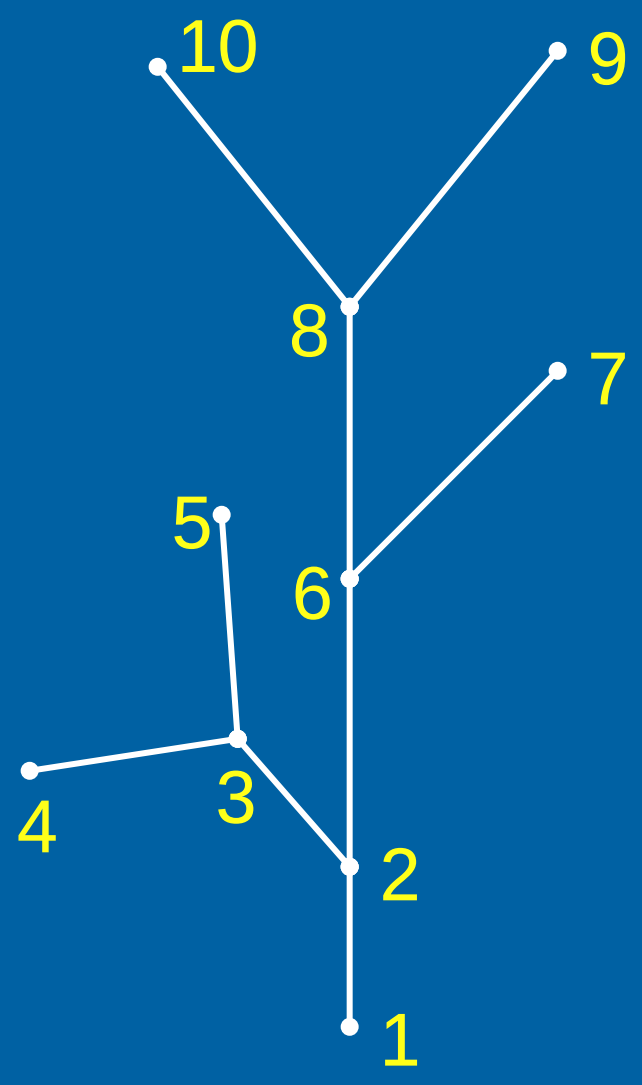
Navigation

- Stream Level
- FromNode/ToNode
- Hydrologic Sequence
- Divergence Main Path
- Start/Terminal Flags
- QA/QC'ed Connectivity Table

USGS

From node/To node

- Nationally unique ID's
- These are conceptual
- No feature class exists



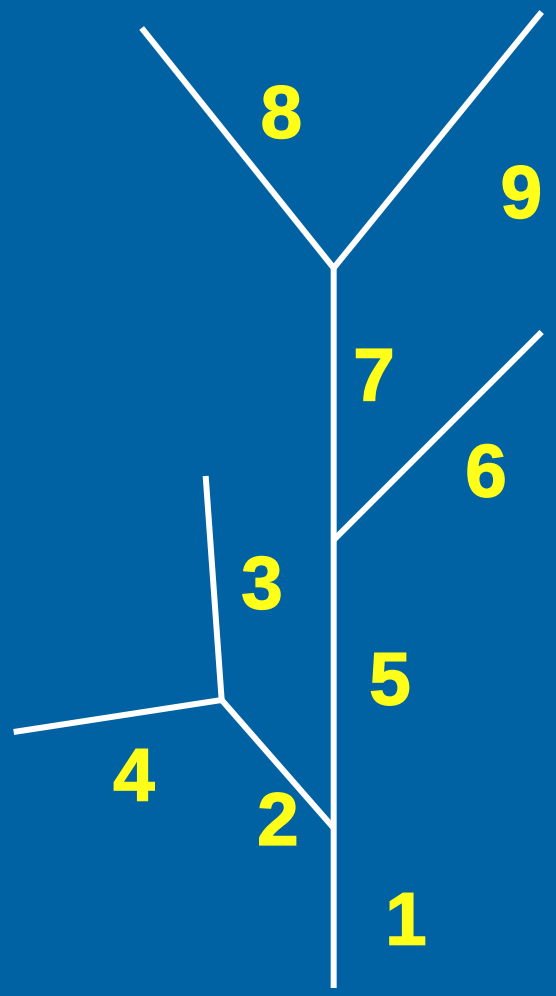
Hydrologic Sequence Number

- Nationally unique sequence number
- All upstream flowlines have higher hydrologic sequence numbers and all downstream flowlines have lower hydrologic sequence numbers.

Sort:

Ascending = downstream to up

Descending = upstream to down



USGS

VAA Navigation By Query

- Four types of traversal
  - Upstream Mainstem
  - Upstream with Tributaries
  - Downstream Mainstem
  - Downstream with Divergences
- Various stopping conditions
- Well suited to large navigations

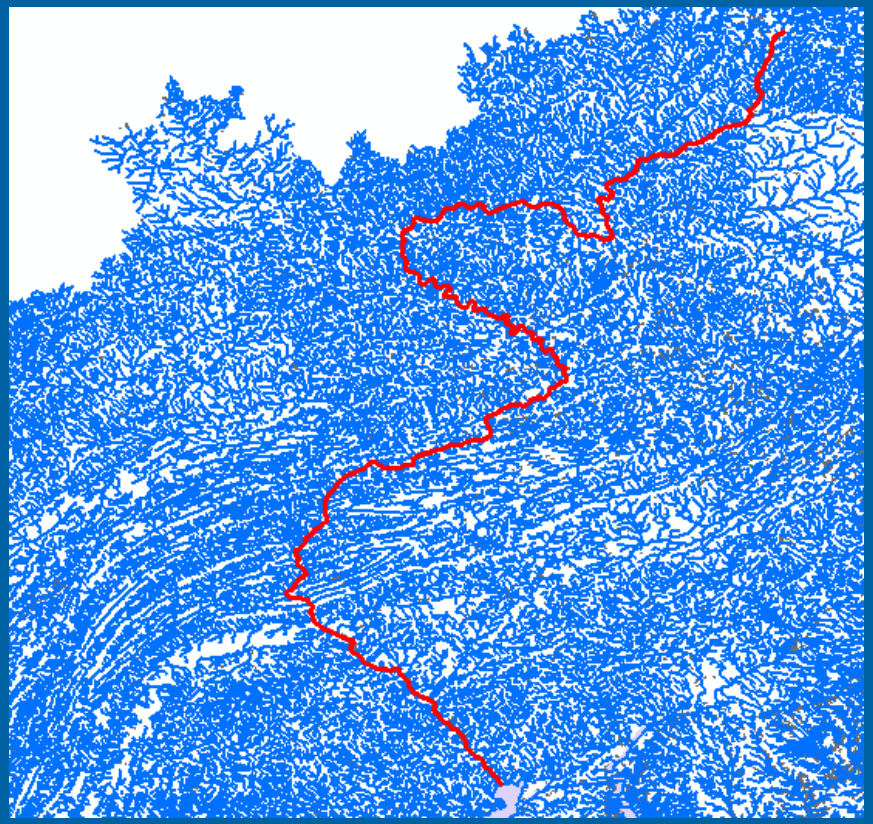
USGS

Navigation by Query Tools

- ArcMap Tools –
  - VAANavToolbarCom.dll &
  - VAANavigatorCom.dll
- Callable Tools –
  - VAANavigatorCom.dll

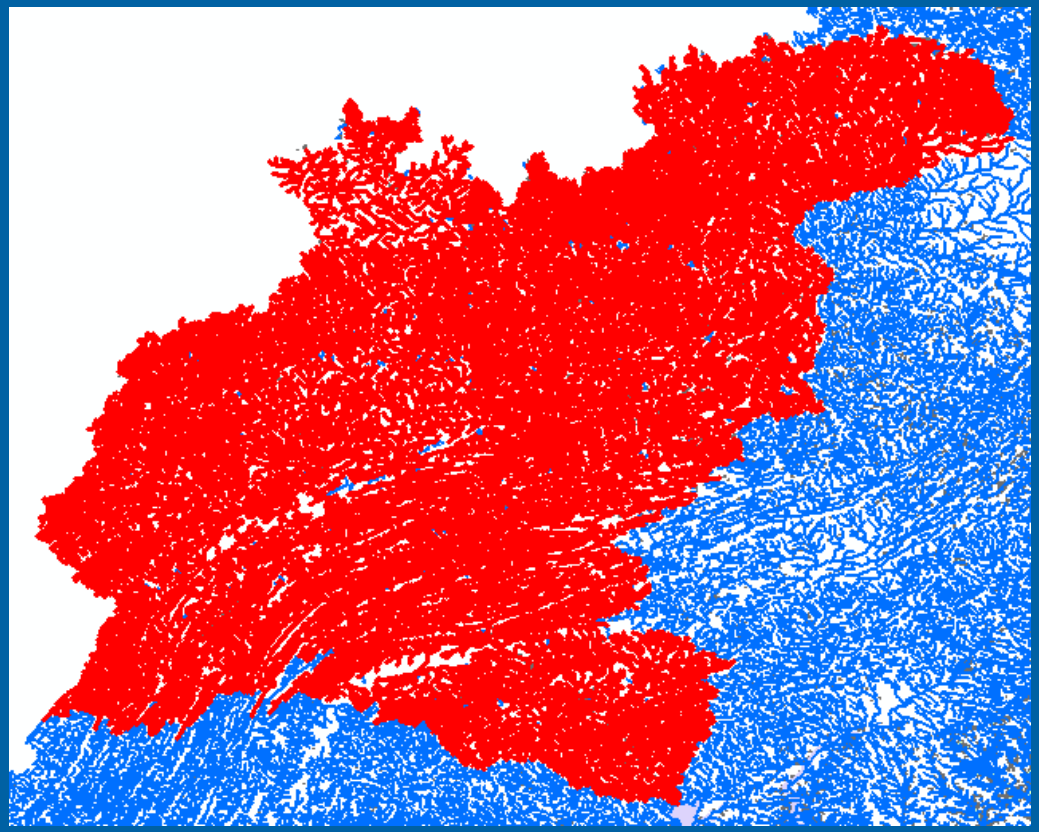
USGS

NHDPlus Concepts: Rapid Navigation of the Linear Surface Water Network



Susquehanna River Main Stem

Susquehanna River Drainage Basin

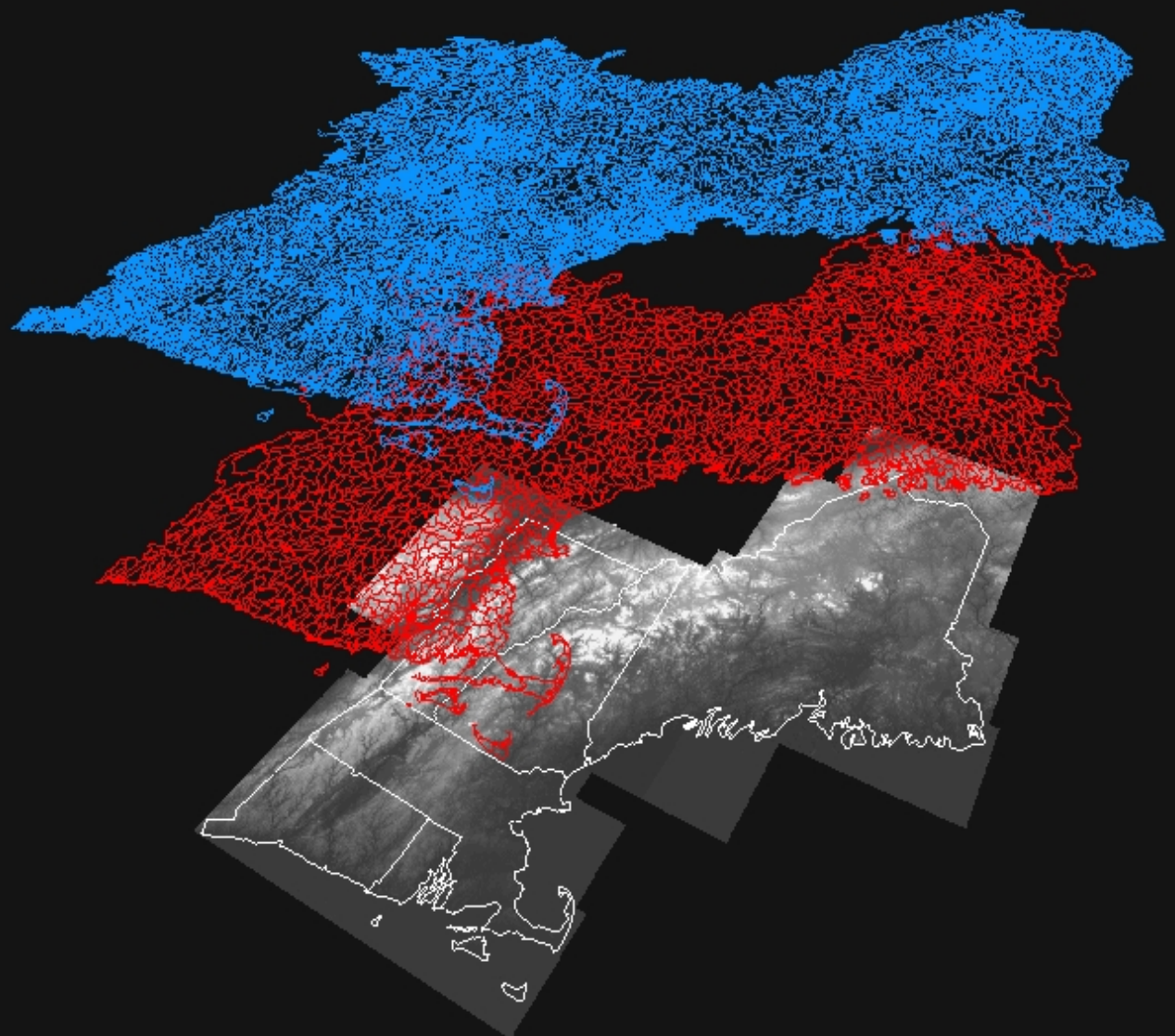


Catchments

- Catchment delineation process developed out of the New England SPARROW project (USGS) and the “Agree” aml (University of Texas)
- Creates a hydrologically-conditioned DEM (HydroDEM) which integrates information from three datasets
- Catchments are generated from this HydroDEM
- Catchments provide linkage between landscape processes and stream network

USGS

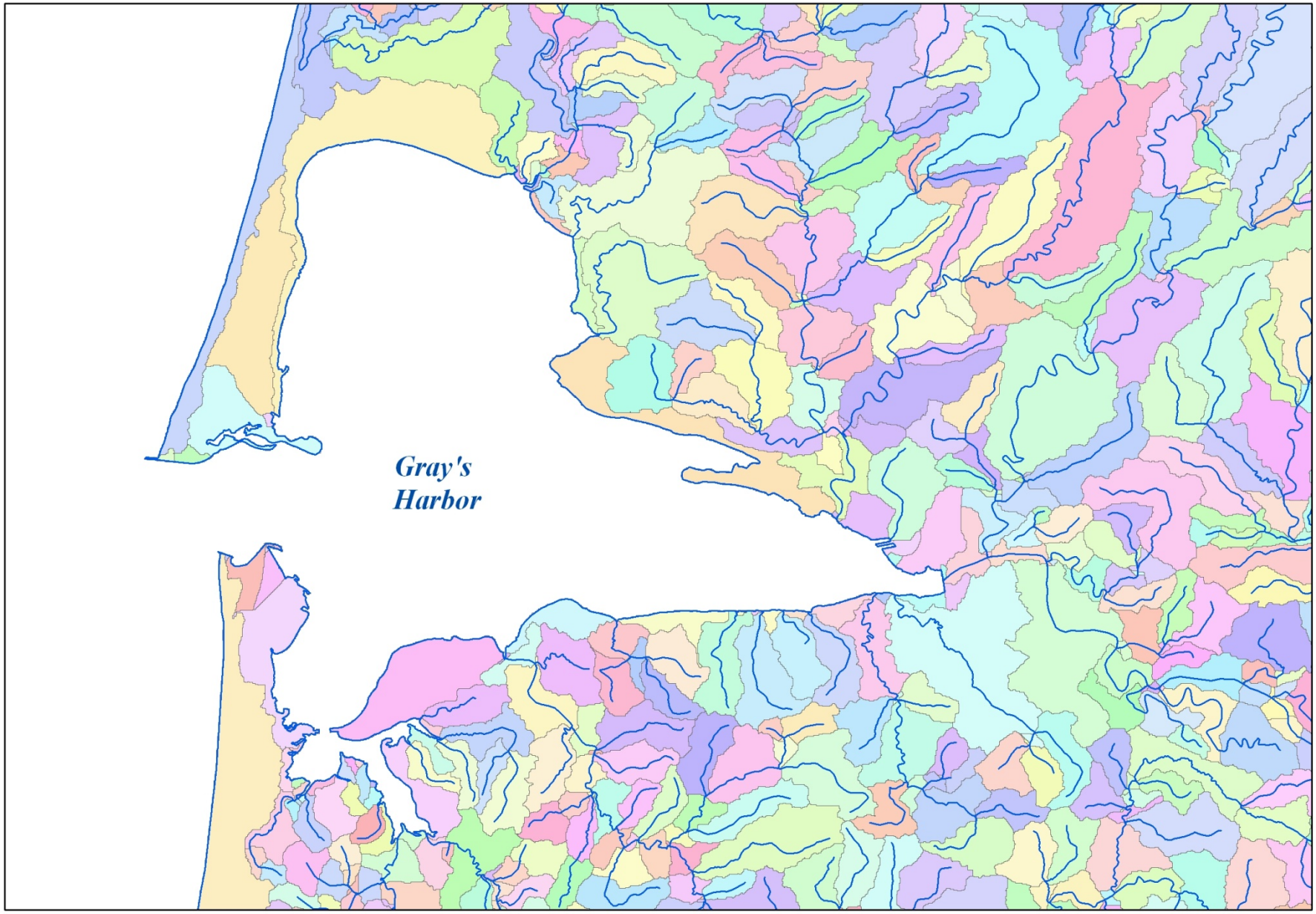
Hydrologically-Conditioned DEM Incorporates:



National Hydrography Dataset (NHD)

Watershed Boundary Dataset (WBD)

National Elevation Dataset (NED)


Gray's
Harbor

Catchment attributes included (incremental and cumulative):

- Climate (mean annual and monthly)
  - Precip
  - Temperature
- Runoff (mean annual and monthly by Wolock and McCabe)
- NLCD 2011 (all categories)
- Mean Latitude (incremental only)

USGS

Example Points/Lines of Interest along the Network:

- Stream Flow Gages (NHDPlus)
- Dams (restricted distribution)
- Water Quality Monitoring Stations, Discharge Permits, WQ Standards, Assessments, Impairments, and TMDLs (EPA)
- Road Crossings
- Habitat
- Others…

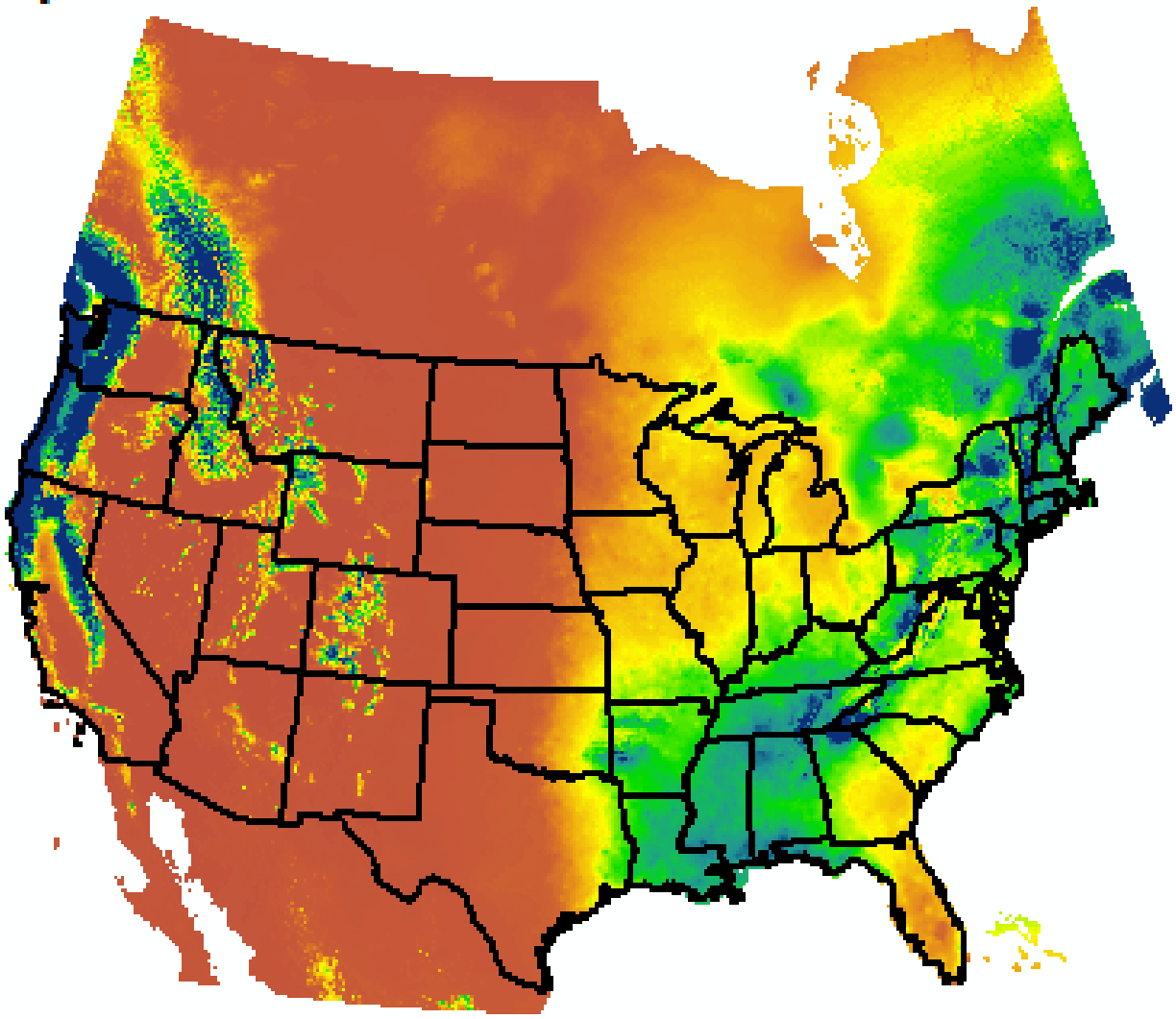
USGS

NHDPlus V02
EROM Flow Estimation Steps

1. Runoff based on water balance model (RO)
2. “Excess ET” component that takes into account excess evapo-transpiration in the stream channel area (EET)
3. A regression of Step 2 flows on Gage flows using Reference gages (RGR)
4. A capability for users to add, remove and transfer flows (PlusFlowAR)
5. Adjustments to observed gage flows
6. A flow QA module to evaluate accuracy of the flow estimates

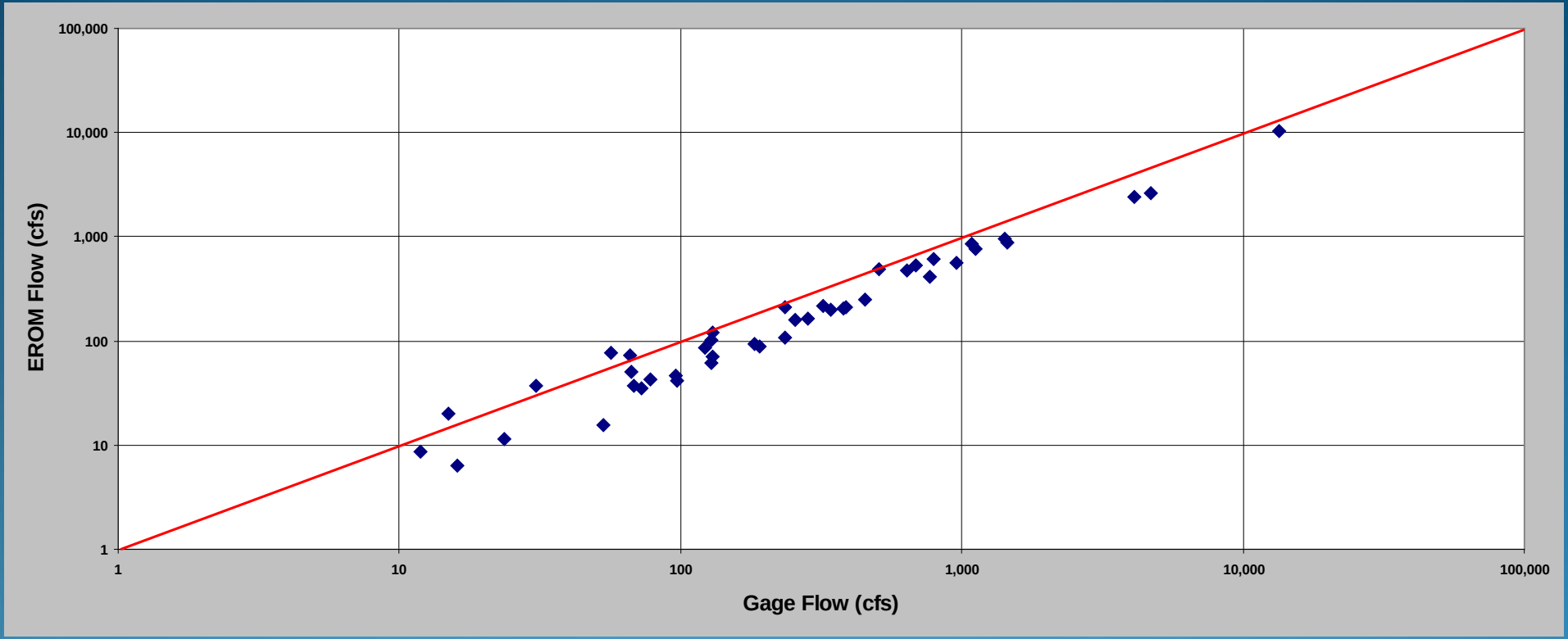
USGS

Step 1: Mean Annual Runoff Grid



U.S.: Wolock and McCabe;
Canada and Mexico: Canadian Forest Service 1971 - 2000

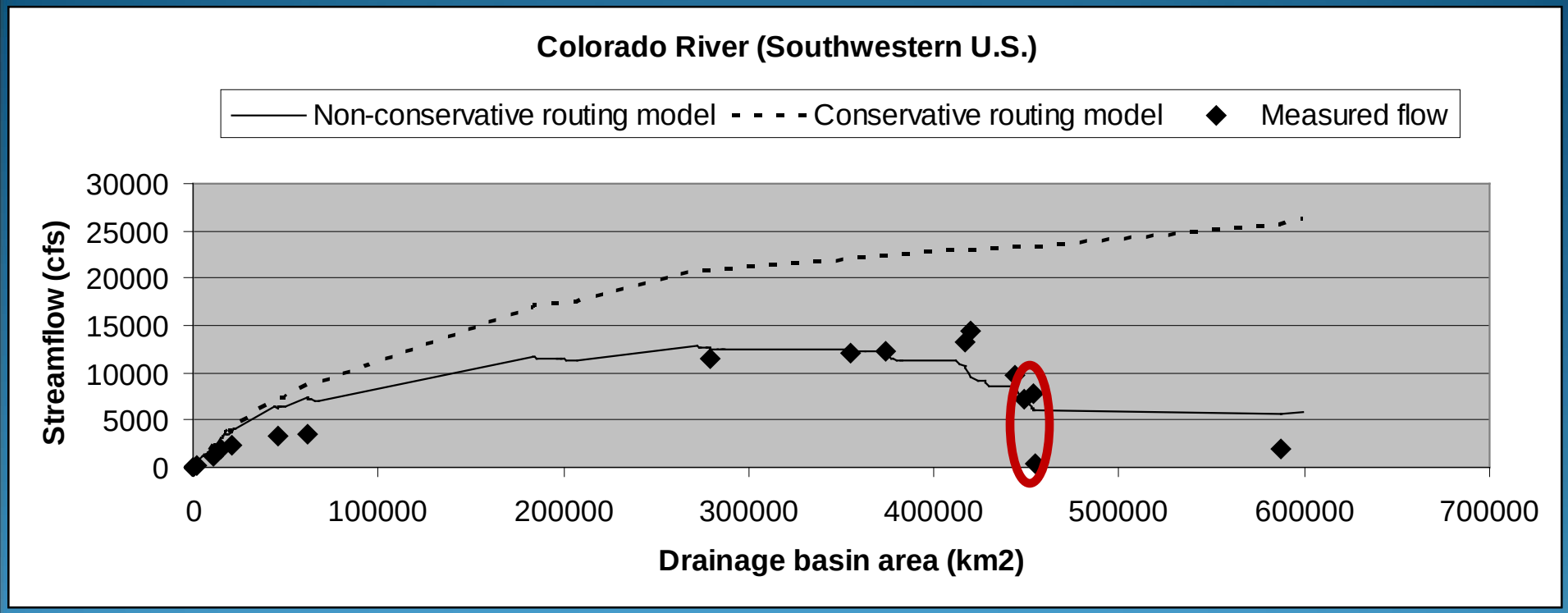
Step 1: Runoff (SR)



QA Statistics

Gage	Runoff		EET		Ref Reg.		PlusFlow		Gage Seq.
Mean	Mean	SEE	Mean	SEE	Mean	SEE	Mean	SEE	SEE
2.36	**2.17**	**58.8**							

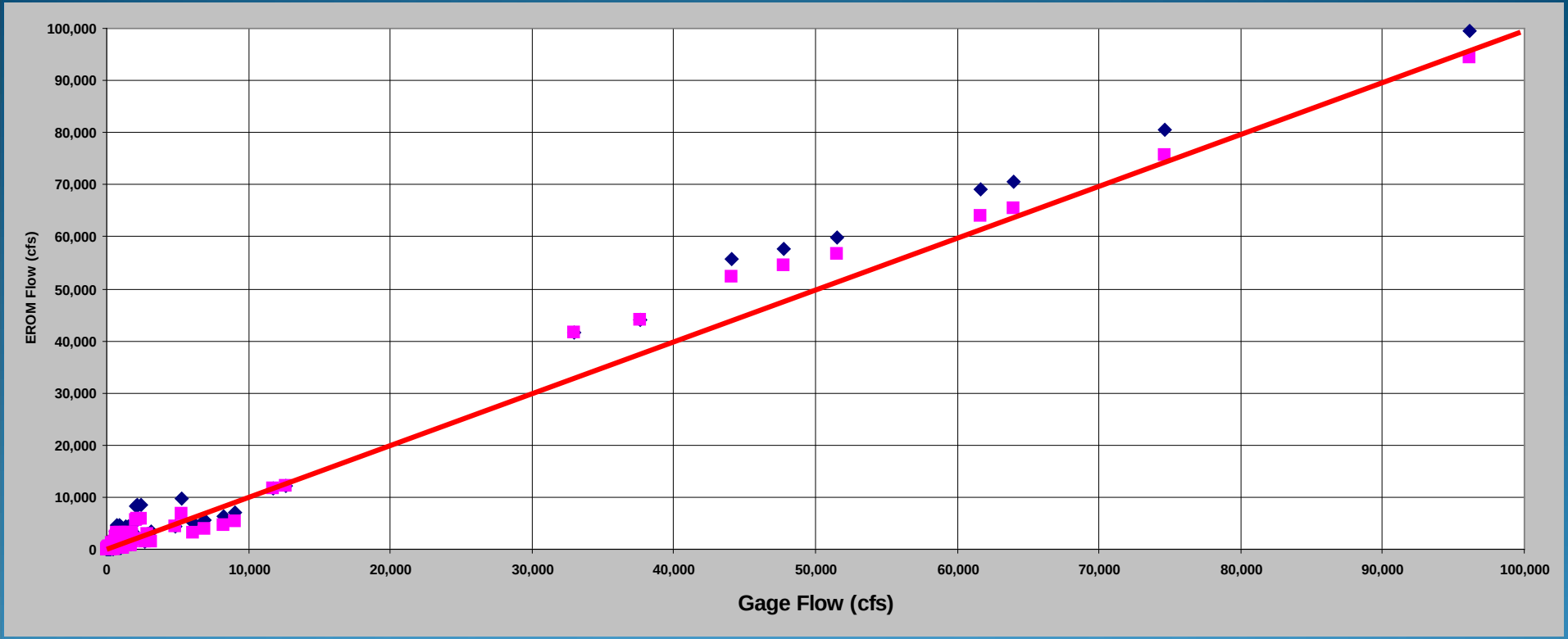
Step 2: Excess Evapotranspiration (EET)



Method developed by Dave Wolock of USGS.

(graphic courtesy of Dave Wolock)

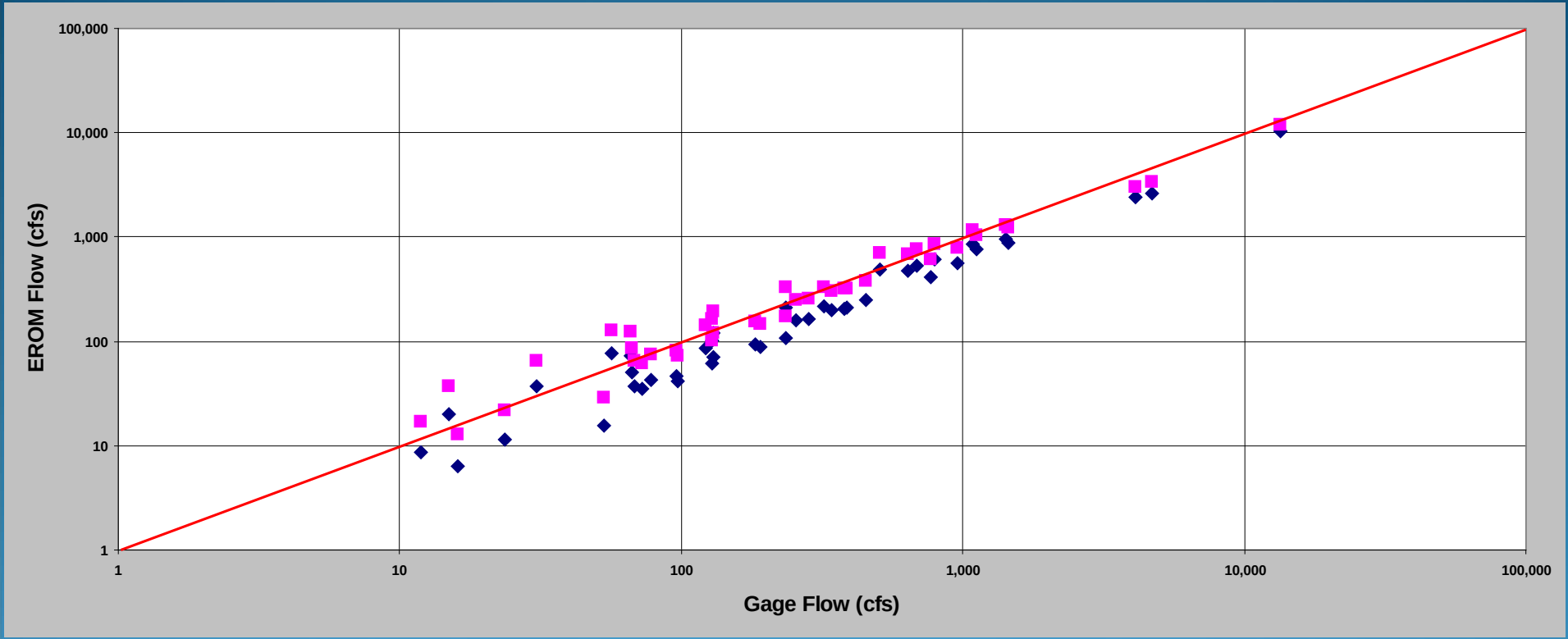
Step 2: EET (10L)



QA Statistics

Gage	Runoff		EET		Ref Reg.		PlusFlow		Gage Seq.
Mean	Mean	SEE	Mean	SEE	Mean	SEE	Mean	SEE	SEE
2.35	**2.46**	**118.7**	**2.30**	**90.6**					

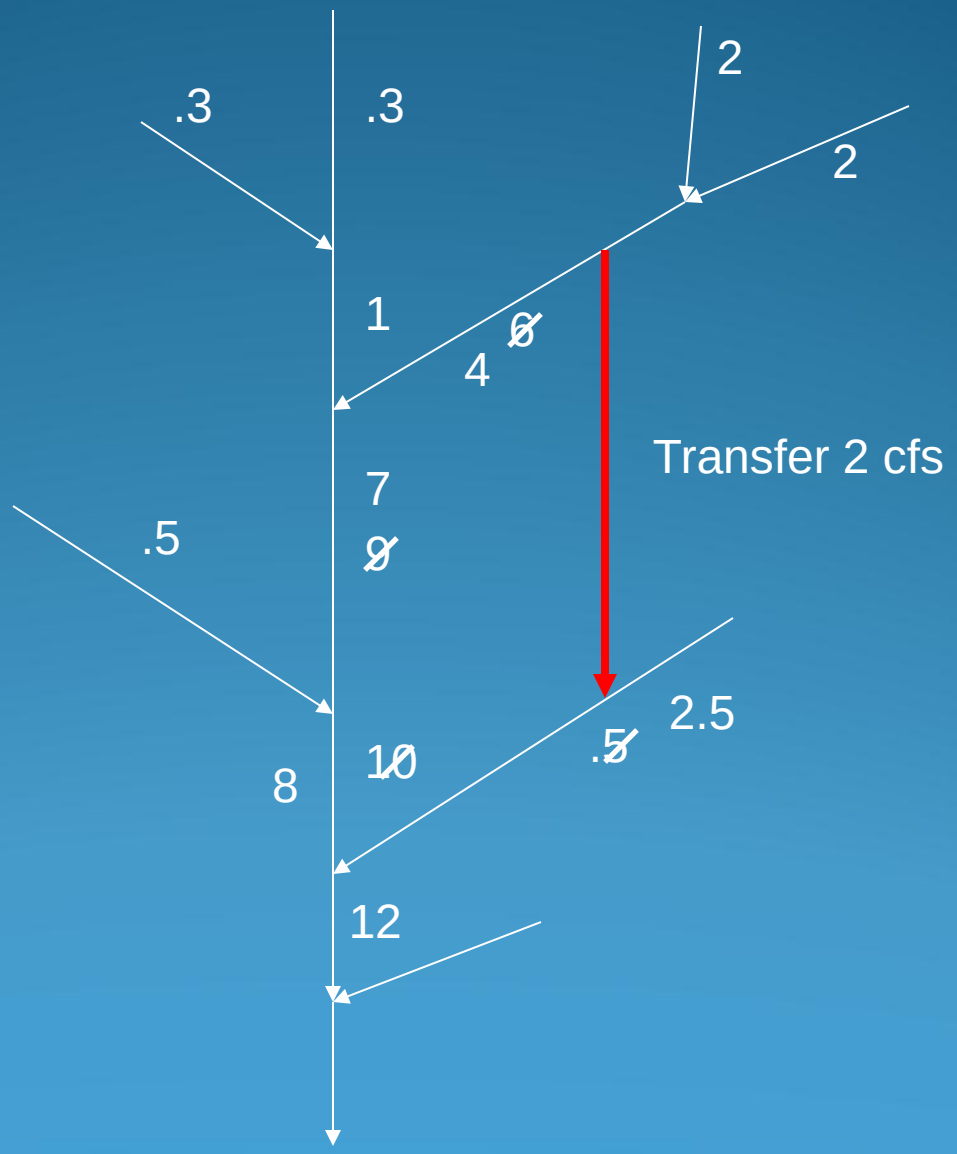
Step 3: Reference Gage Regression (SR)



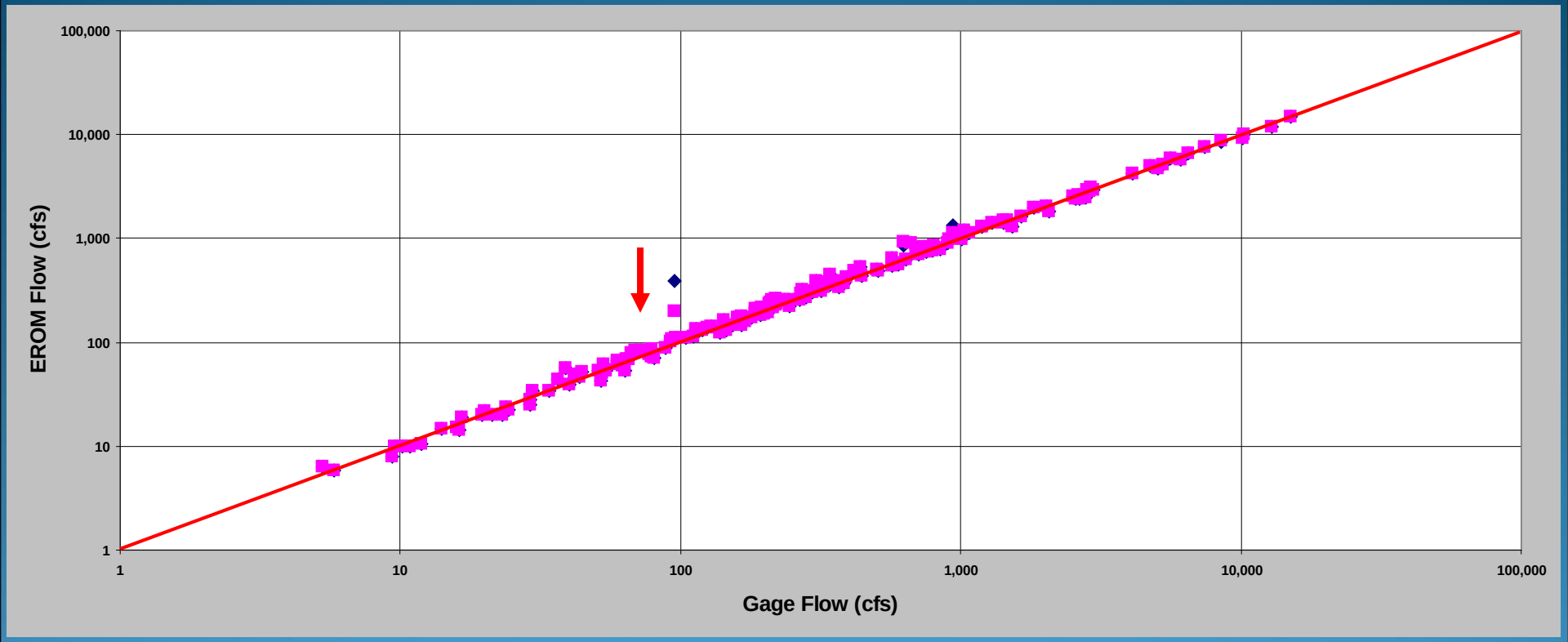
QA Statistics

Gage	Runoff		EET		Ref Reg.		PlusFlow		Gage Seq.
Mean	Mean	SEE	Mean	SEE	Mean	SEE	Mean	SEE	SEE
2.36	2.17	58.8			2.37	32.6			

Step 4: Transfer, Withdraw, Augment Flows (“PlusFlowAR”)



Step 4: “PlusFlowAR” (NE)

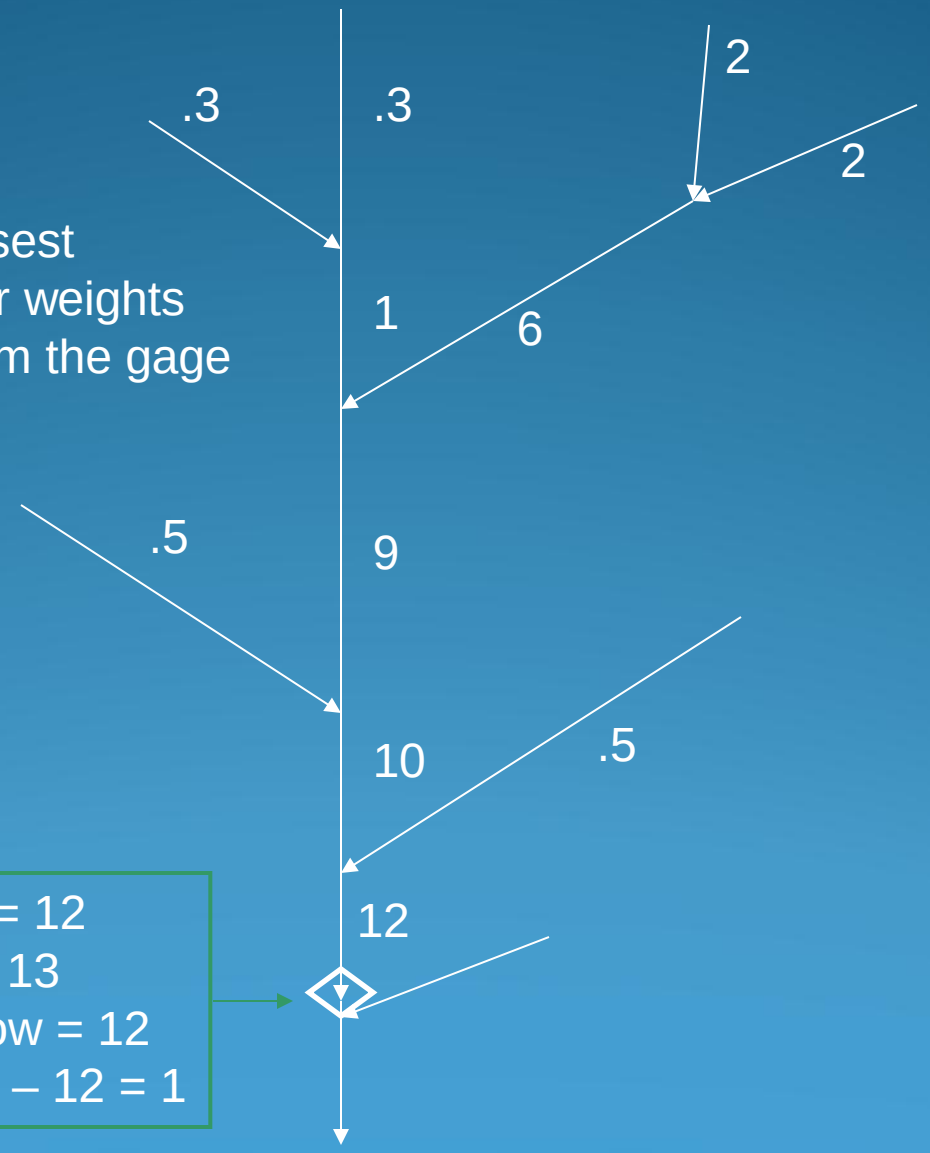


QA Statistics

Gage	Runoff		EET		Ref Reg.		PlusFlow		Gage Seq.
Mean	Mean	SEE	Mean	SEE	Mean	SEE	Mean	SEE	SEE
2.42	2.40	14.9			2.43	14.7	2.43	11.7	

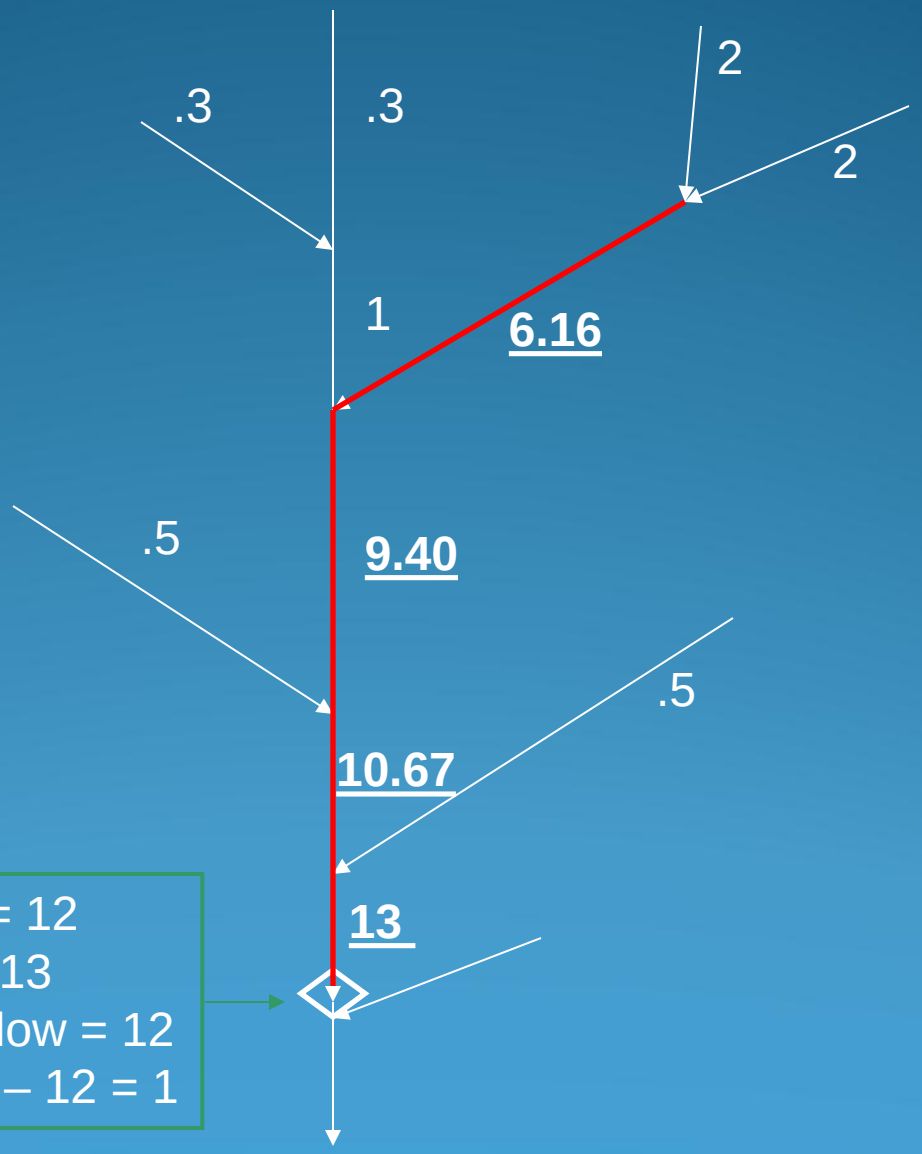
Step 5: Gage Adjustment

Flowline adjustments closest to the gage will get higher weights than Flowlines farther from the gage



Gage DA = 12
Gage Q = 13
EROM Flow = 12
QAdj = 13 – 12 = 1

Gage Adjustment: Re-Accumulated Flows



Gage DA = 12
Gage Q = 13
Flowline Flow = 12
QAdj = 13 – 12 = 1

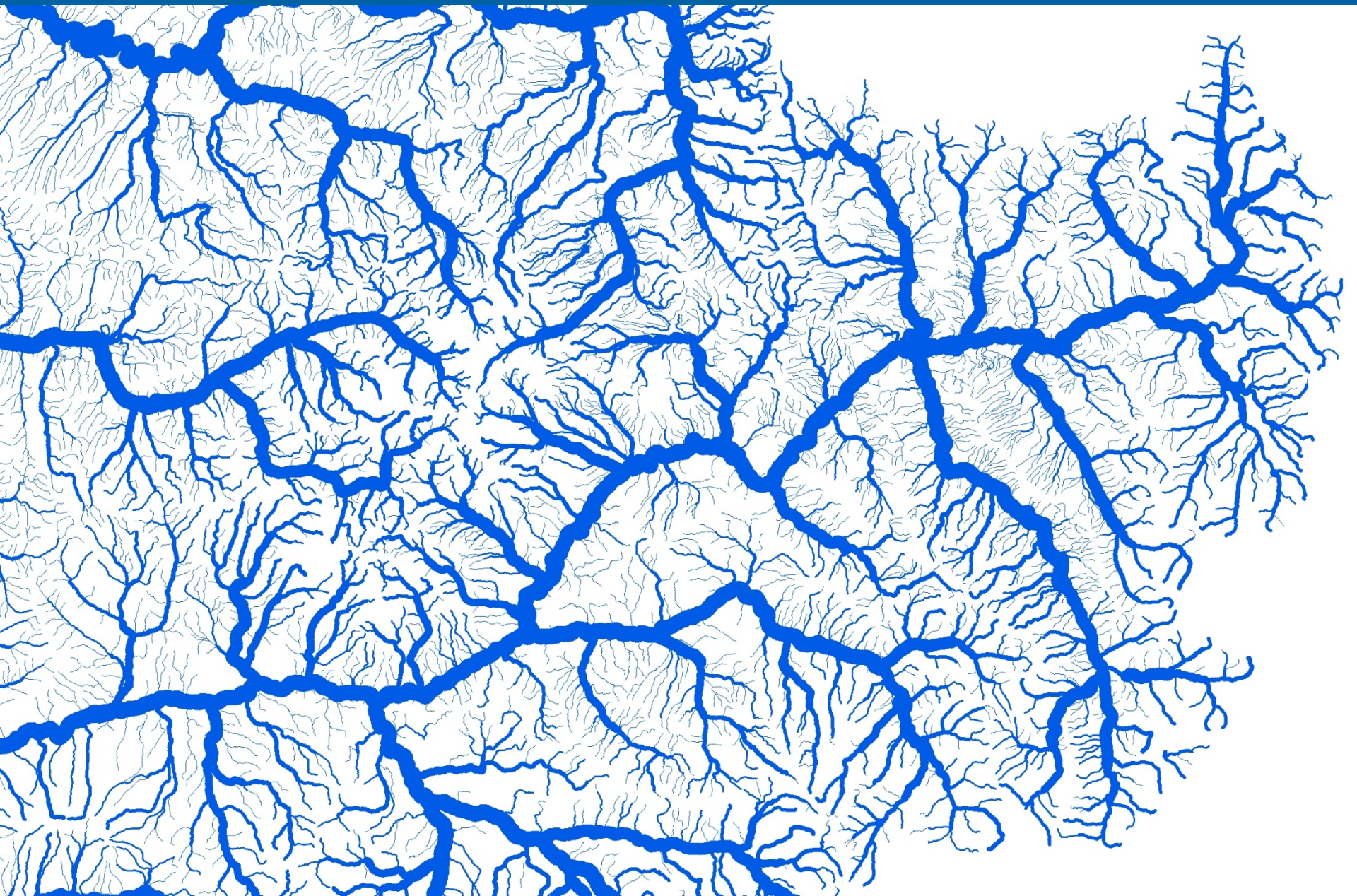
Gage Adjustment QA:

- Randomly remove 20% of the gages from the gage adjustment
  - Called “Gage Sequestration”
- Provides a ballpark estimate of how well the final, gage-adjusted flows match gage flows

QA Statistics

Gage	Runoff		EET		Ref Reg.		PlusFlow		Gage Seq.
Mean	Mean	SEE	Mean	SEE	Mean	SEE	Mean	SEE	SEE
		58.8				32.6			23.0

Streams symbolized using EROM flows:



Teaser…

- USGS and the NHDPlus team have begun work on High Resolution NHDPlus based on HiRes NHD and 10-m NED/3DEP
- … but that’s a topic for another day…

USGS

Hydrography Webinar Series—Session 2 Agenda:

1. Introduction
2. NHDPlus Flow Computation and Analysis—Al Rea
3. The National Flood Interoperability Experiment (NFIE)—Ed Clark
4. Discussion

USGS

NFIE PRESENTATION …

U.S. GEOLOGICAL SURVEY HYDROGRAPHY WEBINAR SERIES

SESSION 3

JULY 30, 2015

USGS

USGS Hydrography Webinar Series

Closing

Poll

Recording and Presentations

http://nhd.usgs.gov/HydrographySeminarSeries.html

USGS