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Inland Oil Spill Preparedness Program (IOSPP)

USGS StreamStats and Travel Time Application

A web-based map application for estimating plume trajectories and travel times in rivers

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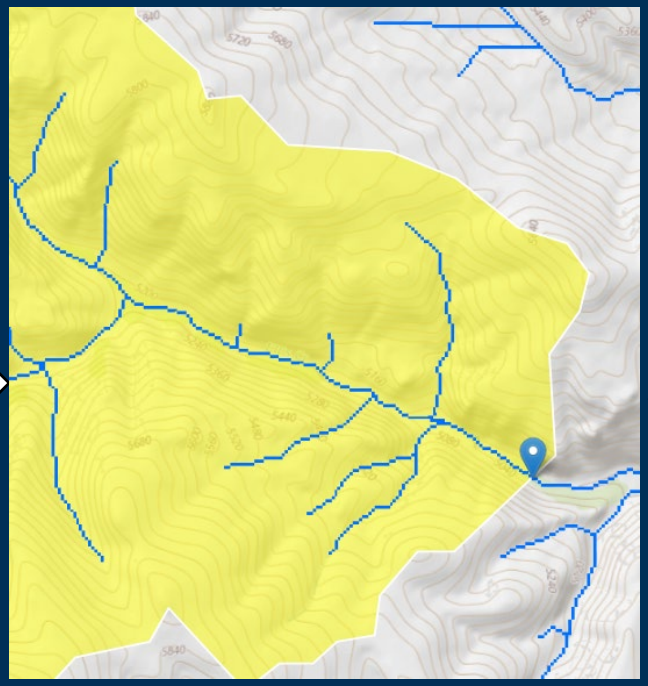
USGS Water Mission Area
StreamStats Development Team
Web Informatics & Mapping

Presentation Overview

- Introduction to StreamStats
- USGS streamgages
- Dye tracer studies
- Jobson's equations for estimating stream velocities and travel times
- Implementation of Jobson's equations in StreamStats with user interface

StreamStats Purpose



Making complex science easily available and useful

StreamStats Overview

- The core functionality of StreamStats is to provide streamflow statistics for gaged and ungaged locations to users
  - Statistics vary from simple mean annual flows to computed flood statistics (i.e. 100 year flood).
  - Statistics for gaged locations are computed using streamflow data
  - Statistics for ungaged locations are estimated using regional regression equations and GIS data

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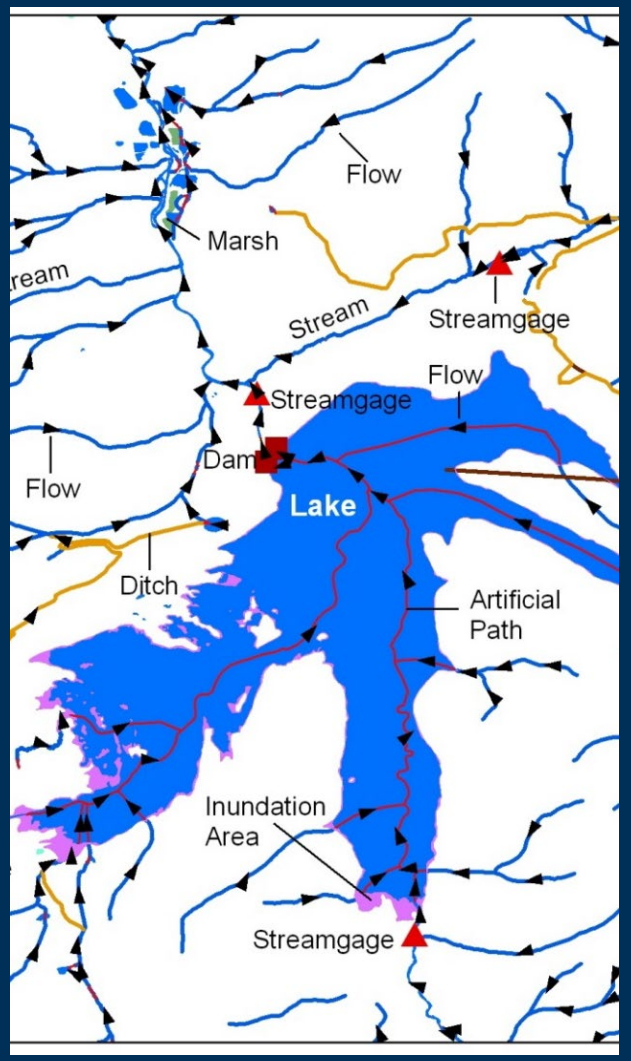
StreamStats Overview

- Hydrography data that digitally represents stream features
  - National Hydrography Dataset (NHD)
    - Stream network represented by flowlines
    - Attributes of flow direction, length, name, and many others
  - Watershed Boundary Dataset (WBD)
    - Seamless national framework of drainage boundaries
  - Digital Elevation Model (DEM)
    - Raster (grid) data for elevations used to create flow accumulation and flow direction grids (for delineating basins)



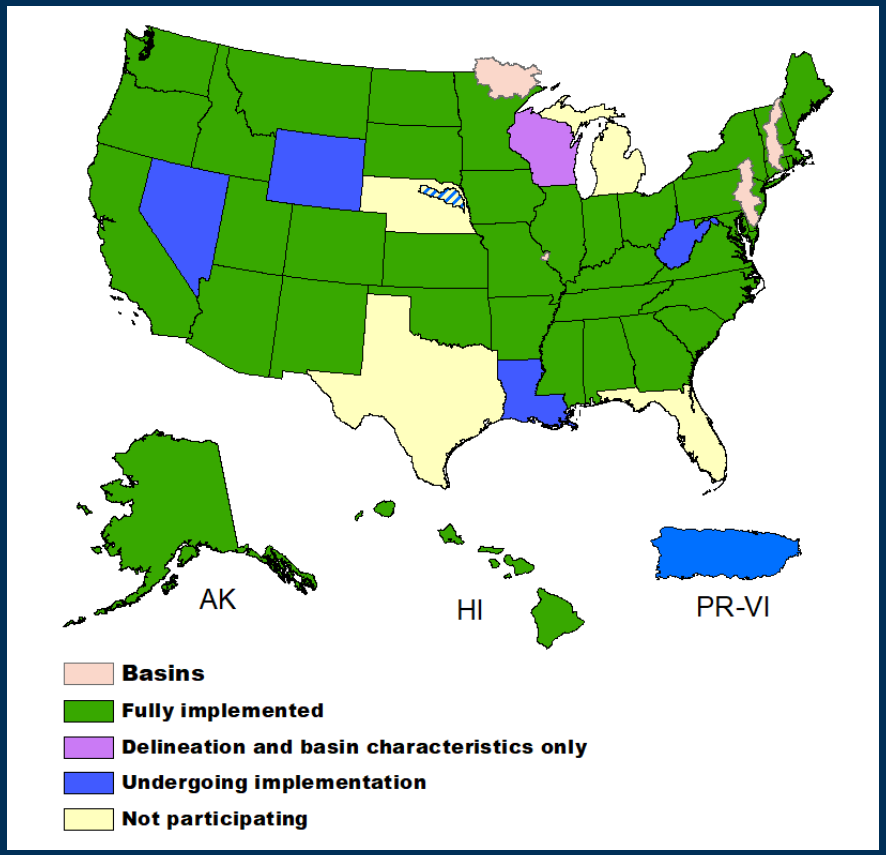
StreamStats Overview

StreamStats is a **national program**, but it is **locally driven**

Every state has its own application with its own tools and priorities; some are more advanced than others based on level of investment and(or) needs.

Examples:
Indiana has interactive maps for estimating peak-flow statistics and bankfull-channel dimensions.

St. Louis Metropolitan area has developed a combined sewer network application within StreamStats



National StreamStats

StreamStats will also be a **national program**, adding **national tools and data**

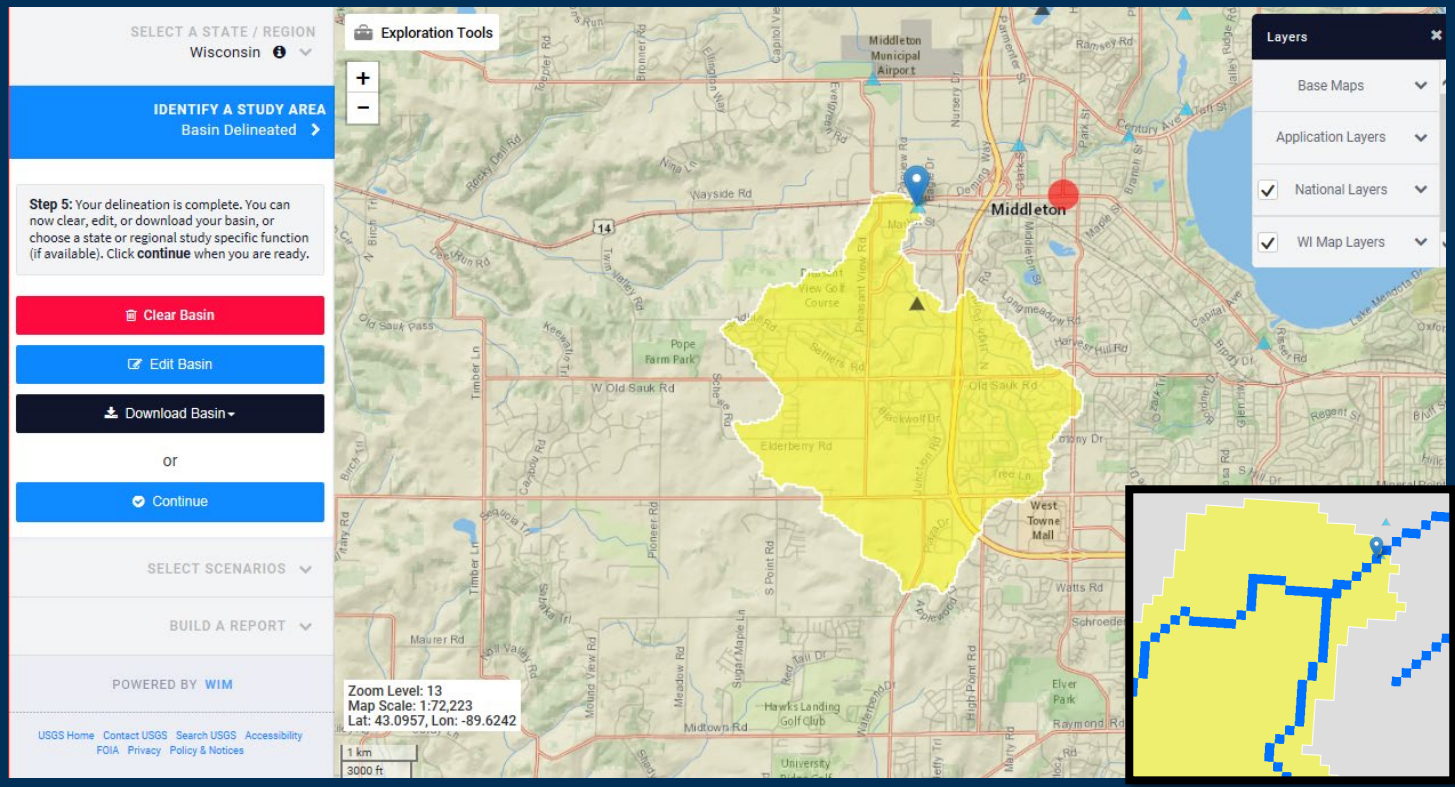
Adding data that is nationally consistent for national models

Adding tools that are developed nationally for consumption and modification at the local level

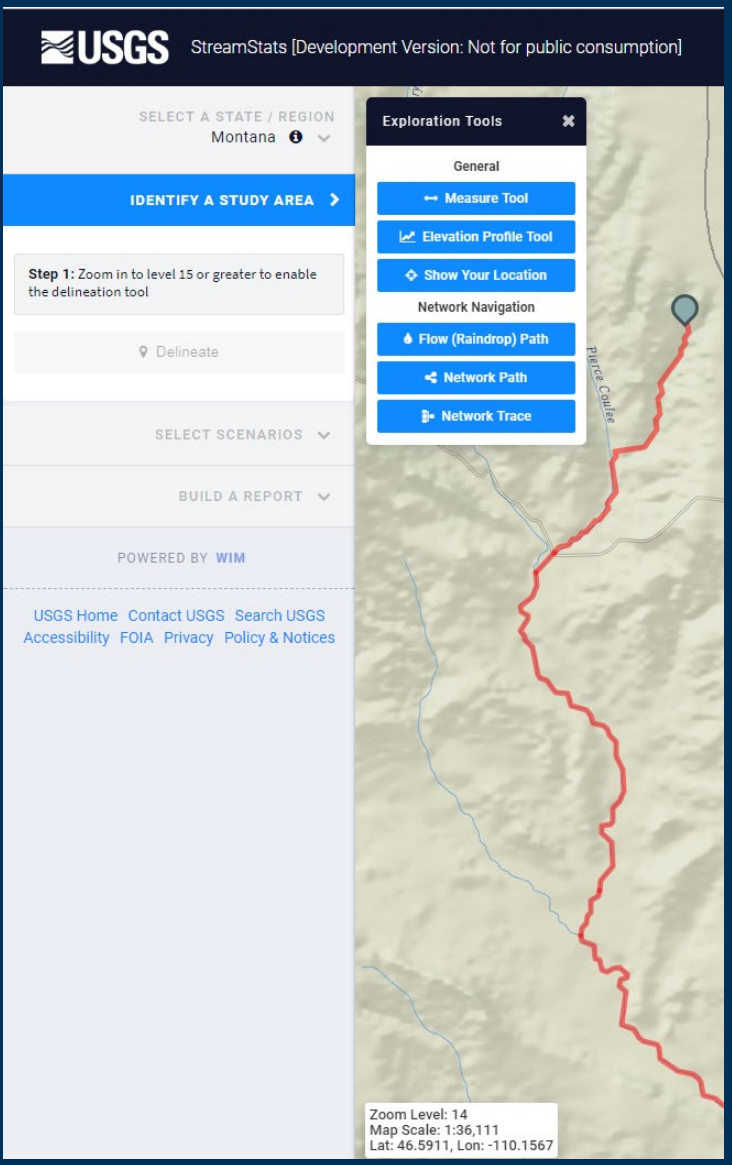
Application will be developed on nationally consistent data (NHDPlus)

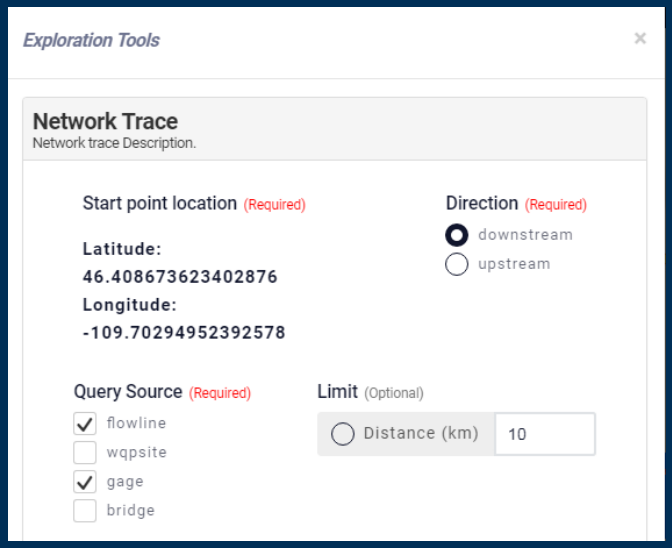
StreamStats User Interface

With a small amount of “reading the directions”, the application is SIMPLE to use – just zoom into your area of interest, select your region, and click on the map. If you’re already familiar with ESRI-based GIS products, this will be even easier.

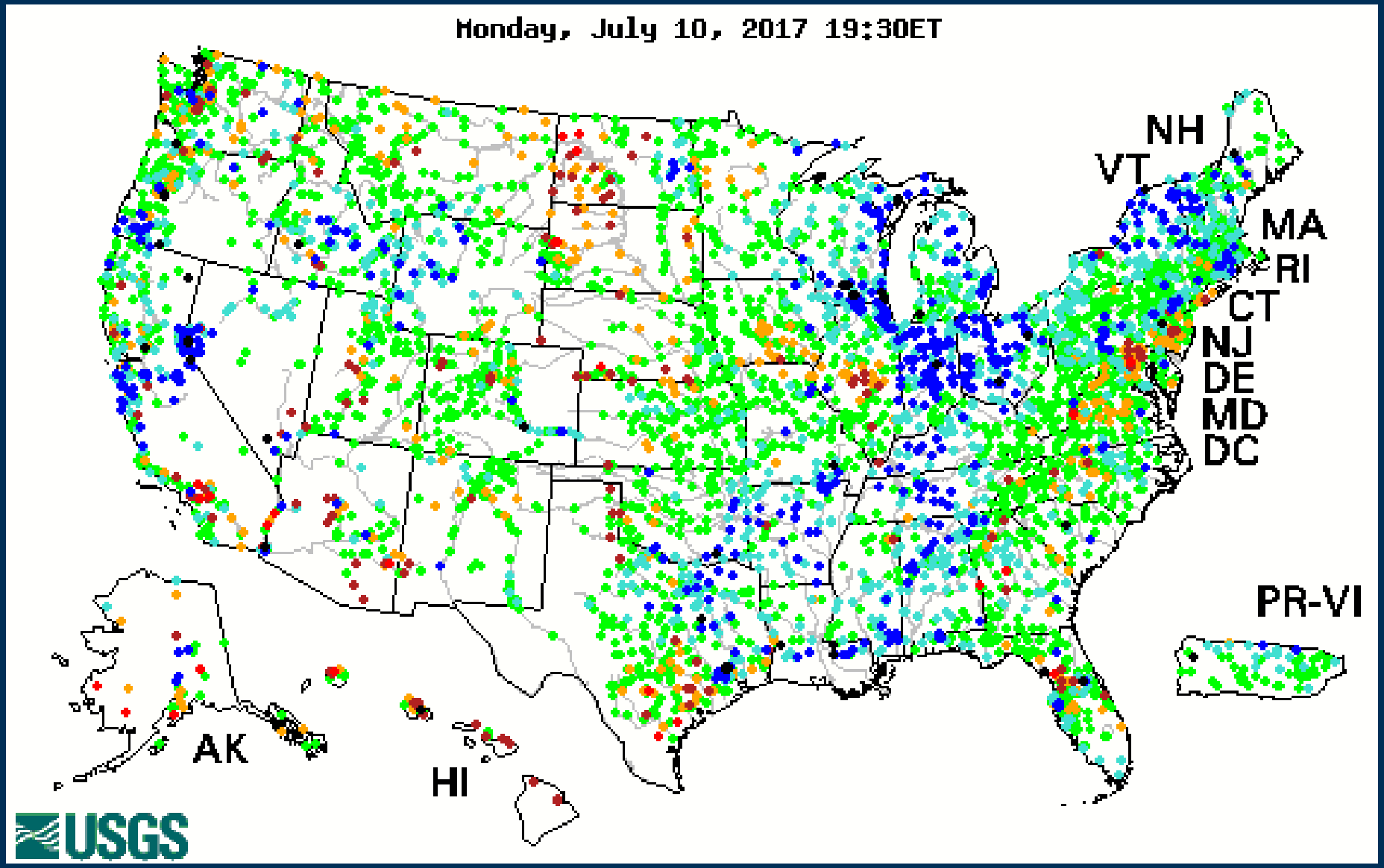


Network Navigation Tools

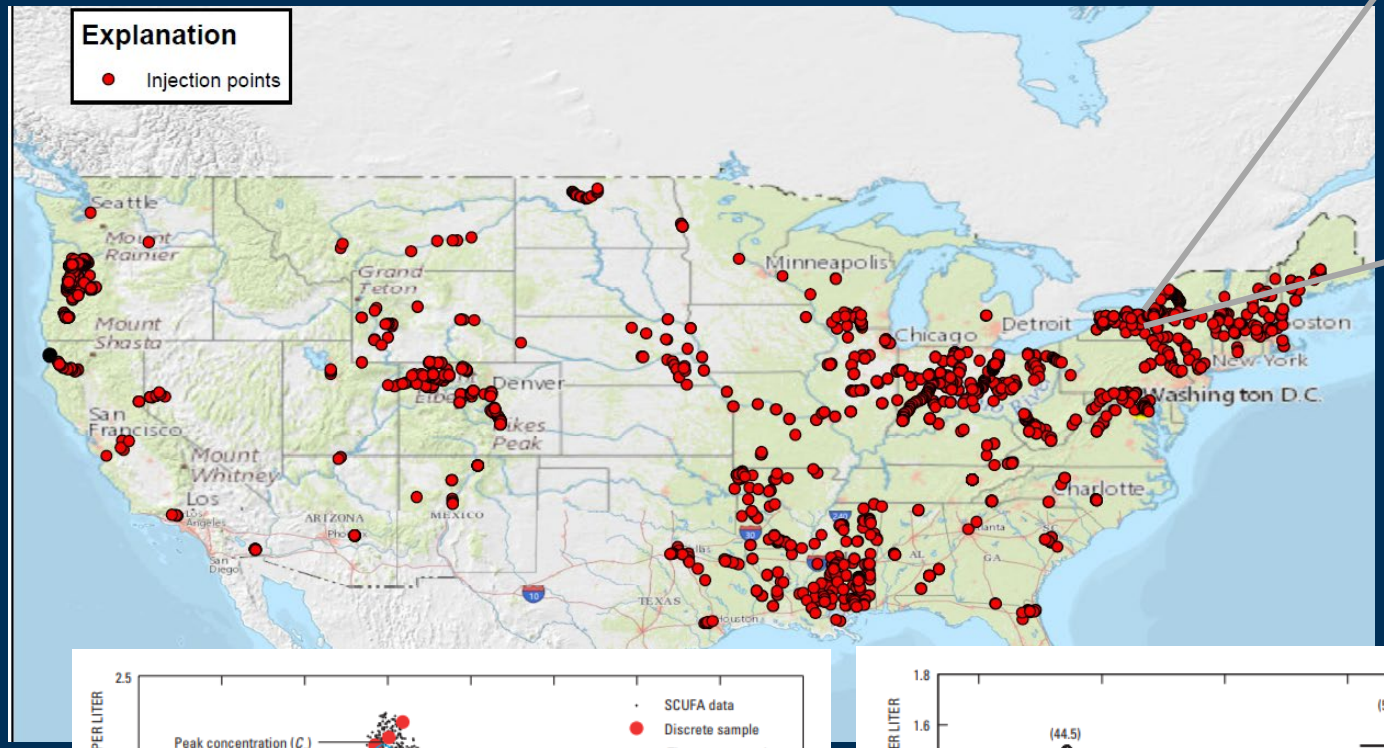


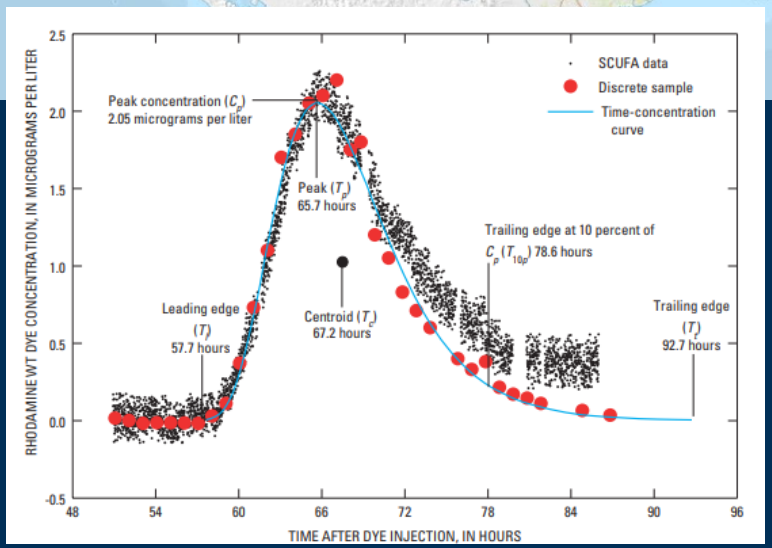


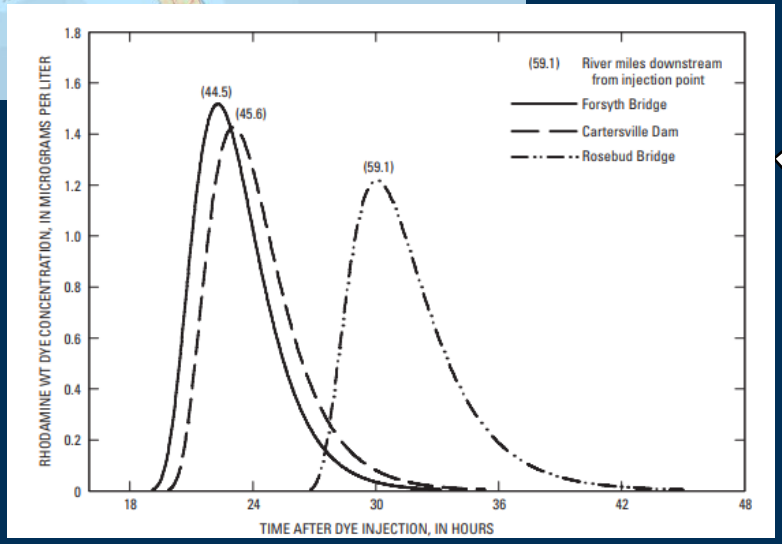
USGS Streamgages



Dye-tracer studies







Travel Time Theory

- Jobson (1996) developed regression equations to estimate travel times and longitudinal dispersion in rivers and streams.

$$V_{pmp} = 0.094 + 0.0143\left(\overline{D}_a\right)^{0.919}\left(\overline{Q}_a\right)^{-0.469} S^{0.159}\frac{Q}{D_a}$$

- Gregory Schwarz (USGS SPARROW Team) is updating Jobson's equations with new data.

- Regression/input variables
- River slope
- River length
- Drainage area
- Mean annual discharge
- Real-time discharge
- Spill Mass

Travel Time Theory

Jobson's Equations estimate the following

- Most Probable Velocity (best predictor)
  - Travel times for leading edge, peak, and trailing edge
  - Peak concentration
- Maximum Probable Velocity (envelope curve)
  - Travel times for leading edge, peak, and trailing edge
  - Peak concentration

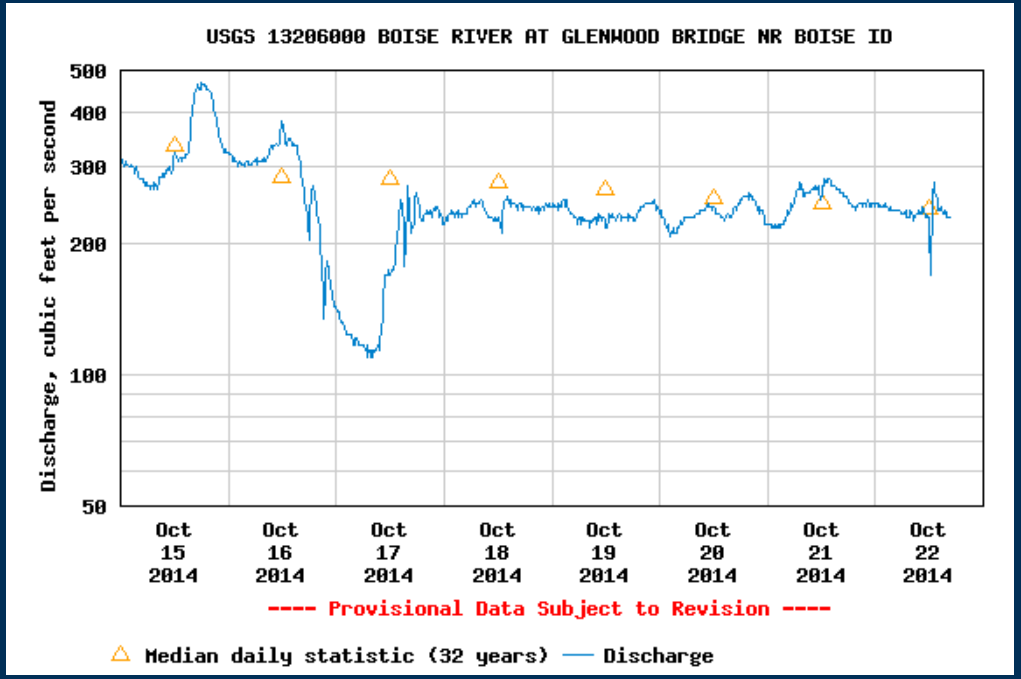
Current limitations of Jobson's equations

- Soluble and conservative contaminants
- Streamflow limitations (low flow to bankfull)
- Steady state flow
- Dams, reservoirs, and lakes
- Karst

These can be addressed over time

Conceptual user inputs

- StreamStats
  - River slope
  - River length
  - Drainage area
  - Mean annual discharge
  - Real-time discharge*
- User
  - Real-time discharge*
  - Spill location
  - Spill mass



Implementation of Travel Time

- Funded by Inland Oil Spill Preparedness Program
  - Phase I: Develop the web services (calculator) for computing travel times using Jobson's Equations and the NHDPlus data
  - Phase II: Develop a user interface for I/O
  - Submerged oil modeling and Kalamazoo spill

Phase I: Web services

- Spill response
- Spill planning
- Streamflow estimation
- DRIFFT[1] database of TOT studies

[1]DRIFTT – Database of Riverine Injected Fluorescent Tracer Travel times

Phase II: User Interface

- Interactive map template
- I/O options based on spill response workflow
- I/O options based on spill planning workflow

Questions?