

# ***StreamStats: The Past, Present, Future, Nuts and Bolts***

## ***Part 1 - StreamStats History, Status and Plans***

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# What is StreamStats?

- A web-service-based application that provides information used by engineers, hydrologists, managers, planners, and others to make informed decisions on water-related activities
- Primary products are basin delineations, basin characteristics, and estimates of streamflow statistics
- Provides information for gaged and user-selected ungaged sites on streams



# StreamStats Home Page

The screenshot shows the StreamStats Home Page in a web browser. The browser's address bar displays <http://water.usgs.gov/osw/streamstats/>. The page header includes the USGS logo and the tagline "science for a changing world". A navigation menu on the left lists various links, including "Home", "News", "Version 3 State Applications", "Beta Version 4 Application", "Version 3 User Instructions", "Beta Version 4 User Instructions", "StreamStats Description", "Un-gaged Site Reports", "Data-Collection Station Reports", "StreamStats Limitations", "USGS Station Statistics", "Troubleshooting", "Definitions", "Version 3 Basin Characteristics", "Version 3 Streamflow Statistics", "Stream Network Navigation", "StreamStats Fact Sheet", "Frequently Asked Questions", "Available Web Services", "Batch Processor", "Talks and Other Info", "Internal Links", "Contact StreamStats Team", and "Current Streamflow Conditions".

The main content area features a green banner with the text "Welcome to StreamStats" and "Best viewed in Internet Explorer 10 or higher with pop-up blocker disabled". Below this, a yellow box contains the following text:

**Beta version 4 has arrived!**

**Beta version 4 is now available for most states on a trial basis, and version 3 remains available.** Beta version 4 provides a single user interface (at <http://streamstatsags.cr.usgs.gov/streamstats/>) for all states that are implemented, rather than separate applications for each state, as in versions 2 and 3, and the user interface is more user friendly than previous versions. Information for user-selected un-gaged sites currently cannot be obtained using beta version 4 for the States of Arkansas, Arizona, Georgia, Iowa, Indiana, Maryland, North Carolina, Oregon, South Carolina, and Tennessee because of unique functionality for those states that is not yet implemented. Users are encouraged to provide comments and report bugs by use of the Help button on the interface, which also provides access to limited beta version 4 documentation. See below for additional information about versions both 3 and 4.

Please contact the StreamStats by email at [support@streamstats.freshdesk.com](mailto:support@streamstats.freshdesk.com) if you have any questions.

**The StreamStats Program**

StreamStats is a Web application that incorporates a Geographic Information System (GIS) to provide users with access to an assortment of analytical tools that are useful for a variety of water-resources planning and management purposes, and for engineering and design purposes. In version 3 as well as beta version 4, StreamStats users can select USGS data-collection station locations shown on a map and obtain previously published information for the stations, including descriptive information, and previously published basin characteristics and streamflow statistics. Currently, StreamStats provides additional tools that allow users to select sites on un-gaged streams and do the following:

- obtain the drainage basin boundary (version 3 and beta version 4),
- compute selected basin characteristics (version 3 and beta version 4),
- estimate selected streamflow statistics using regression equations (version 3 and beta version 4),
- download a shapefile of the drainage-basin boundary, as well as any computed basin characteristics and flow statistics (version 3 and beta version 4),
- edit the delineated basin boundary (beta version 4 only),
- modify the basin characteristics that are used as explanatory variables in the regression equations and get new estimates of streamflow statistics (beta version 4 only),
- print the map (beta version 4 only),
- measure distances between user-selected points on the map (beta version 4 only),
- obtain plots of the elevation profile between user-selected points on the map (beta version 4 only).

The streamflow statistics that StreamStats can provide for data-collection stations and for user-selected un-gaged sites vary among the states that are implemented in StreamStats and among data-collection stations within states. Unless otherwise noted on a state's introductory page, estimates obtained for un-gaged sites assume natural flow conditions at the site.

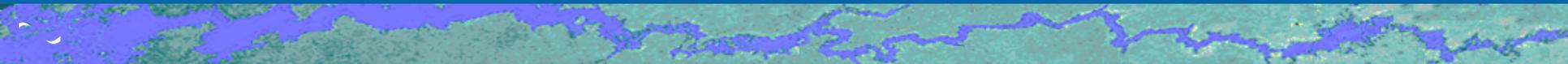
StreamStats generally is implemented separately for each state, with the needed data preparation work accomplished through cooperative agreements with state or other agencies. When states have not been implemented, it is generally because no state or other agency has been willing to enter into a cooperative agreement with the USGS to assist with funding the needed work.

StreamStats applications for individual states are accessed separately in version 3, whereas beta version 4 provides a single national user interface for all state applications. Use the State Applications link at the left to access a web page that shows where StreamStats version 3 is available and where it is being implemented. Users can select an individual state application from the map or the pull-

<http://streamstats.usgs.gov>

# Development Team

- John Guthrie, CO, IT support/programmer
- Tana Haluska, OR, GIS specialist
- Katharine Kolb, NC, GIS specialist
- Jeremy Newson, WiM-ID, programmer
- Kernell Ries, Ofc. of Surface Water-MD, coordinator
- Martyn Smith, WiM-NY, programmer
- Peter Steeves, MA, GIS specialist
- Ryan Thompson, SD, GIS specialist
- Contractors
  - ESRI (GIS programming) and Respec (database programming)



# Ancient History

- Desktop automated process (ONEBASIN) developed in Massachusetts in early 1990's
- Development of web app began in 1997, released in 2001
- Used custom Java\* applet, ArcView, ArcViewIMS
- Addressed the problems of:
  - Making readily available information from numerous old, out of print reports
  - Avoiding large labor costs for manually obtaining basin characteristics needed as input to regression equations for estimating streamflow statistics

# Original Mass. User Interface

The screenshot shows a web browser window titled "USGS Stream Statistics". The interface includes a top navigation bar with radio buttons for "Low Flow Analysis", "Station Lookup", "Identify", "Pan", "Zoom In", and "Zoom Out", along with a scale of "1:2677160" and a "USGS" logo. Below this is a toolbar with buttons for "ZOOM to place", "ADD Layer", "Update", and "Stop".

On the left side, there is a legend panel with two sections:

- USGS Data Collection Stations
  - Continuous gages
  - Peak flow
  - Low & misc. flow
  - Low & peak flow
- MA Towns

The main map area displays a map of Massachusetts with a network of stream lines and numerous colored dots representing data collection stations. A horizontal scrollbar is visible below the legend. At the bottom left, there is a "Legend Tools:" section with buttons for "Up", "Down", and "Delete". The window title bar at the bottom indicates it is an "Unsigned Java Applet Window".

# National Effort

- USGS Office of Surface Water began national effort in 2001 with \$200K budget
- Mass. application not scalable for use nationally
- Initial national development done through CRADA between USGS and ESRI



# StreamStats Version 1

- Based on ArcMap and ArcIMS
- Highly integrated with ArcHydro model and tools
- Could be configured for any state
- Added abilities to edit basin boundaries and download boundaries, basin characteristics, and flow estimates in shapefiles
- Idaho became first State available to public in Jan. 2005



# Version 1 User Interface

The screenshot displays the USGS StreamStats web application interface within a Microsoft Internet Explorer browser window. The page title is "USGS StreamStats - Microsoft Internet Explorer". The main header features the USGS logo and the text "Idaho StreamStats".

A toolbar at the top contains the following icons and labels: ZoomIn, ZoomOut, Pan, GetInfo, FullExtent, LastExtent, EditBasin, FlowStats, BasinChar, ClearBasin, Download, NWIS, Print, and Help. Below the toolbar is a scale bar and a "Zoom To:" dropdown menu set to "water", with a "GO" button and an "Enter Water Resource" input field.

The central map area shows a topographic map of Idaho with a cyan-colored watershed boundary. Major highways are shown in red, and water bodies are shown in blue. A grid pattern is visible in the lower right portion of the map.

On the right side, there is a "Map Layers" panel with two tabs: "Map Layers" and "Locator Map". The "Map Layers" panel is expanded to show the following layers:

- BASE LAYERS**
  - Shaded\_Relief
  - 24K QUAD Boundaries
  - Major Highways
    - Interstate
    - State Highway
    - US Highway
- WATER**
  - Water Bodies
  - Rivers
  - HUCs

At the bottom of the panel are "Refresh Map" and "Reset Layers" buttons.

At the bottom of the map area, the text "USGS" is on the left and "Scale 1:6524373" is on the right. At the very bottom of the page, "U.S. Department of the Interior, U.S. Geological Survey" is on the left and "Metadata" is on the right.

# Version 1 Design Principles

- Separate applications for each state using map projections preferred by the states
- Flexibility in scales of base data (elevation, streams, watershed boundaries) used for delineations
- States could add custom tools
- Statistics provided for streamgages must be published previously and reports must be posted on line



# Funding Model

- The national development team is funded by the National Streamflow Information Program, now GW and SW Information Program
- Water Science Centers are assessed annually to cover IT costs for each implemented state
  - FY16 assessment was \$6,400/state
- Water Science Centers enter into cooperative agreements with other entities (usually state agencies), who provide at least half of the funding needed to implement the states
  - Average cost per state is about \$300,000

# StreamStats Version 2

- Based on ArcGIS Server 9.2
- New user interface with additional zoom functions
- New functionality, including stream network navigation, drainage-area ratio estimates for ungaged sites, and editing of computed basin characteristics to obtain revised regression-equation-based flow estimates
- Batch process, some web services
- Released for MA and UT during Oct. 2008



# Version 2 User Interface

The screenshot displays the USGS Idaho StreamStats web application. The browser address bar shows the URL: [http://streamstatsags.cr.usgs.gov/id\\_ss/default.aspx?stabbr=id&dt=1422144516013](http://streamstatsags.cr.usgs.gov/id_ss/default.aspx?stabbr=id&dt=1422144516013). The page features a top navigation bar with the USGS logo and the title "Idaho StreamStats". Below this is a toolbar with various map navigation and analysis tools, including a "Zoom To" dropdown set to 1:5,000,000. The main content area is a topographic map of Idaho with a cyan-colored watershed boundary overlaid. The map includes labels for major cities like Spokane, Boise, and Idaho Falls, as well as interstate highways. On the left side, there is a "Results" and "Map Contents" panel. The "Map Contents" panel shows a tree view with the following items: 

- ID@id\_ss
  - GlobalWatershedPoint
  - NHDWaterQuality
  - NHDHDam
  - NHDHGage
  - SimilarGages
  - Stream Gages
  - Slp1085Point

Below the map content is a "Navigation" section with a compass rose and an "Overview" section with a small inset map of Idaho. At the bottom of the page, there is a footer with links for "Accessibility", "FOIA", "Privacy", and "Policies and Notices", along with contact information for the U.S. Department of the Interior and U.S. Geological Survey. The footer also includes the "USA.gov" logo and a "Streamstats Status" link.

# StreamStats Version 3

- Originally to be based on ArcGIS Server 9.3
- Began development in 2012, but restarted after release of ArcGIS Server 10.1
- Released July 2015 with additional zoom functions but without network-navigation tools from version 2
- All functionality developed as web services, which are de-coupled from user interface
- Reduced need to keep up with new ESRI releases



# Version 3 User Interface

The screenshot displays the StreamStats web application interface. The browser address bar shows the URL <http://ssdev.cr.usgs.gov/ss3/>. The application title is "StreamStats". The interface includes a toolbar with navigation and tool icons, a "Zoom To:" dropdown, and a sidebar with a "Map Layers" panel. The main map area shows a map of the United States with various layers overlaid, including streamgages, regional studies, availability, state applications, and study area boundaries. The sidebar also includes a scale bar (0 to 1000 miles), coordinates (Latitude: 46.12982, Longitude: -50.04688), and a small inset map. The footer contains links for Accessibility, FOIA, Privacy, and Policies and Notices, along with a copyright notice for USGS.

StreamStats

Select on a tool on the toolbar. If the icon remains depressed, click on the map to perform the desired action.

**Map Layers**

- Streamgages
- Regional Studies
- Availability
- State Applications
- Study Area Bndys
- Base Layers

0 500 1000mi  
Scale: 1 : 54,191,172  
Latitude: 46.12982  
Longitude: -50.04688 SS

USGS The National Map: National Boundaries Dataset, National Elevation Dataset, G...

# StreamStats Beta Version 4

- Began development in 2015, released in beta during March 2016
- Much different, more intuitive, single national user interface
- Restores abilities to edit and download basins, and get elevation profiles
- All functionality initially uses same web services as in version 3
- Ungaged site outputs now include maps
- Improved support utility



# Beta Version 4 User Interface

The screenshot displays the StreamStats 4.0 web application interface. The browser address bar shows the URL `streamstats.sgs.cr.usgs.gov/streamstats/`. The page header includes the USGS logo and the text "StreamStats", along with navigation links for "HELP", "ABOUT", and "REPORT".

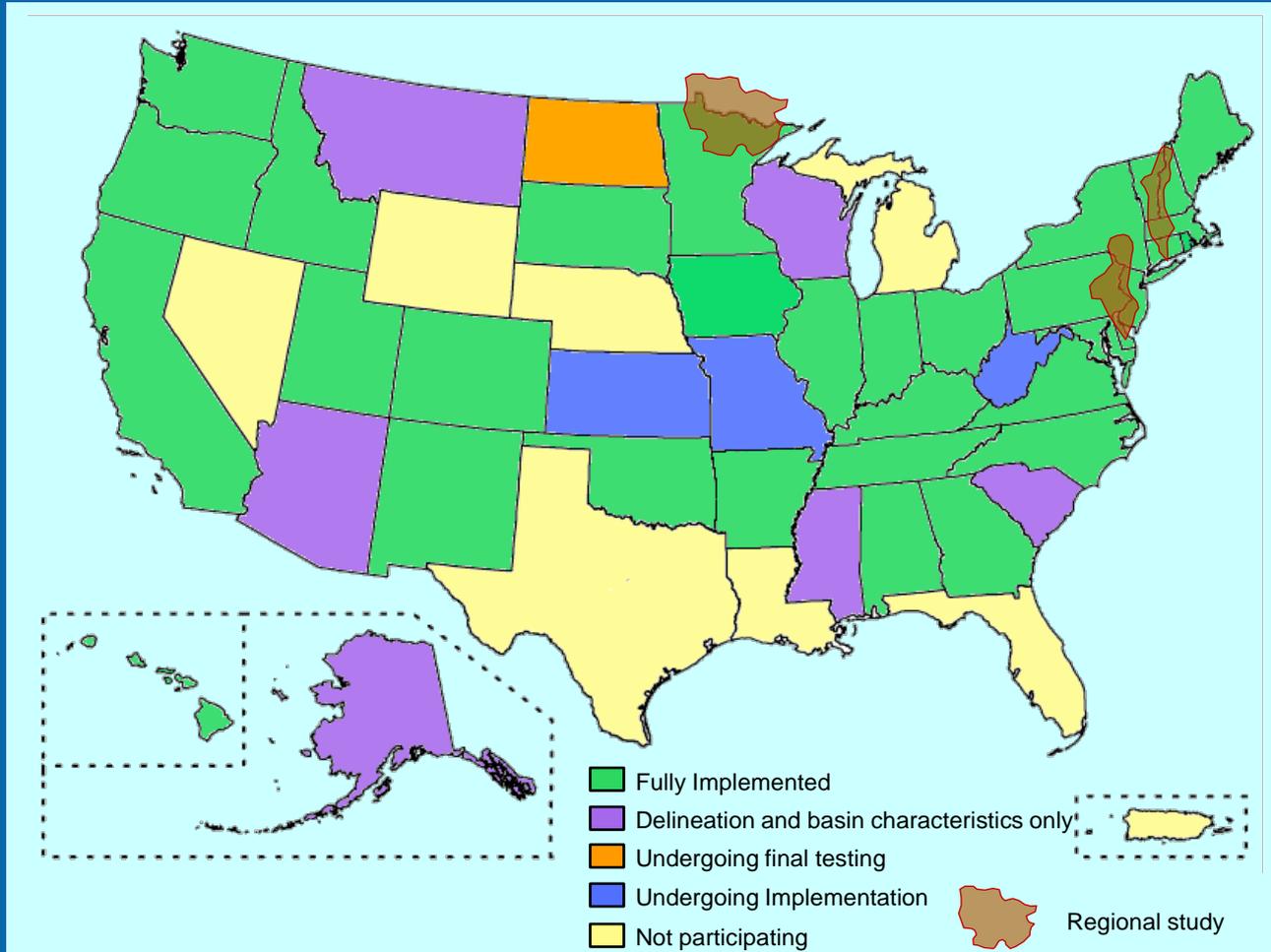
The main interface is divided into a left sidebar and a central map area. The sidebar contains the following sections:

- SELECT A STATE / REGION**: Includes a search box with the text "Use the map or the search tool identify an area of interest", a "Location Search" input field, a green "Go!" button, and a blue circular icon with a question mark.
- IDENTIFY A STUDY AREA**: A dropdown menu.
- SELECT SCENARIOS**: A dropdown menu.
- BUILD A REPORT**: A dropdown menu.
- POWERED BY WIM**: A small logo.

The central map area shows a topographic map of North America. The United States is highlighted with various colored overlays representing different regions or states. Labels for "Canada", "Mexico", "Pacific Ocean", and "Atlantic Ocean" are visible. A zoom control panel in the bottom left corner of the map area displays the following information:

- Zoom Level: 3
- Map Scale: 1:73,957,193
- Lat: 42.6824, Lon: -17.0508

# StreamStats Status - July 2016



- 33 states fully implemented
- 6 states basin characteristics only
- 1 new state in testing
- 3 states in process
- Regional Studies
  - Connecticut River Basin and Delaware River Basins fully implemented
  - Rainy River Basin - basin characteristics only

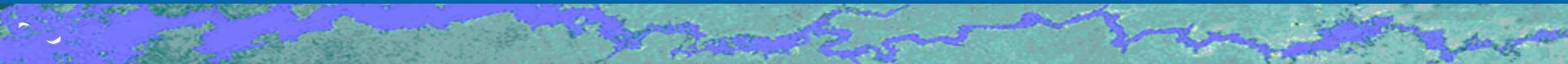
# Done So Far in FY16

- Released beta version 4 on March 26
- Released basin-characteristics-only applications for AK, MS, SC, WI, Delaware River Basin (water use)
- Updates of equations and/or data for GA, ME, OH (water use), OR



# Plans Remaining for FY16

- Release ND and KS
- Major updates of equations and/or data to AK, AR, AZ, IA, IL, MT, NM, OK, WA
- Get network navigation working
- Start implementing StreamStats in the cloud
- Begin serving ~100 non-interpretive flow stats for ~18,500 streamgages, to be updated annually



# Plans for FY17

- Improve version 4 to the point where version 3 can be retired
- Continue updating states with new regression equations and data
- Implement remaining states using NHDPlus version 2 to allow delineations and computation of limited basin characteristics
- Update published statistics for streamgages



# Future Vision

- Use high-resolution NHDPlus datasets currently in development to power delineations nationally
- Compute a standard set of basin characteristics nationally, and custom BCs where needed
- Regression equations based on large basins (such as HUC4s)
- Incorporate estimation methods that consider effects of urbanization and climate change
- Work with others on new functionality, such as estimation methods for small basins and travel time

