

# Web Services in the U.S. Geological Survey StreamStats Web Application

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## Abstract

*StreamStats is a U.S. Geological Survey Web-based GIS application developed as a tool for water-resources planning and management, engineering design, and other applications. StreamStats' primary functionality allows users to obtain drainage-basin boundaries, basin characteristics, and streamflow statistics for gaged and ungaged sites. Recently, Web services have been developed that provide the capability to remote users and applications to access comprehensive GIS tools that are available in StreamStats, including delineating drainage-basin boundaries, computing basin characteristics, estimating streamflow statistics for user-selected locations, and determining point features that coincide with a National Hydrography Dataset (NHD) reach address. For the state of Kentucky, a web service also has been developed that provides users the ability to estimate daily time series of drainage-basin average values of daily precipitation and temperature. The use of web services allows the user to take full advantage of the datasets and processes behind the StreamStats application without having to develop and maintain them.*

## 1. Introduction

The U.S. Geological Survey (USGS) has developed a Web-based GIS tool named StreamStats (fig. 1) that provides streamflow statistics, drainage-basin characteristics, and other information for USGS streamgaging stations and for user-selected ungaged sites on streams. When users select the location of a streamgaging station, StreamStats provides previously published information from the StreamStats Database. When users select a site on an ungaged stream, StreamStats will determine the drainage-basin boundary for the site, compute a variety of drainage-basin characteristics, and solve regression equations to

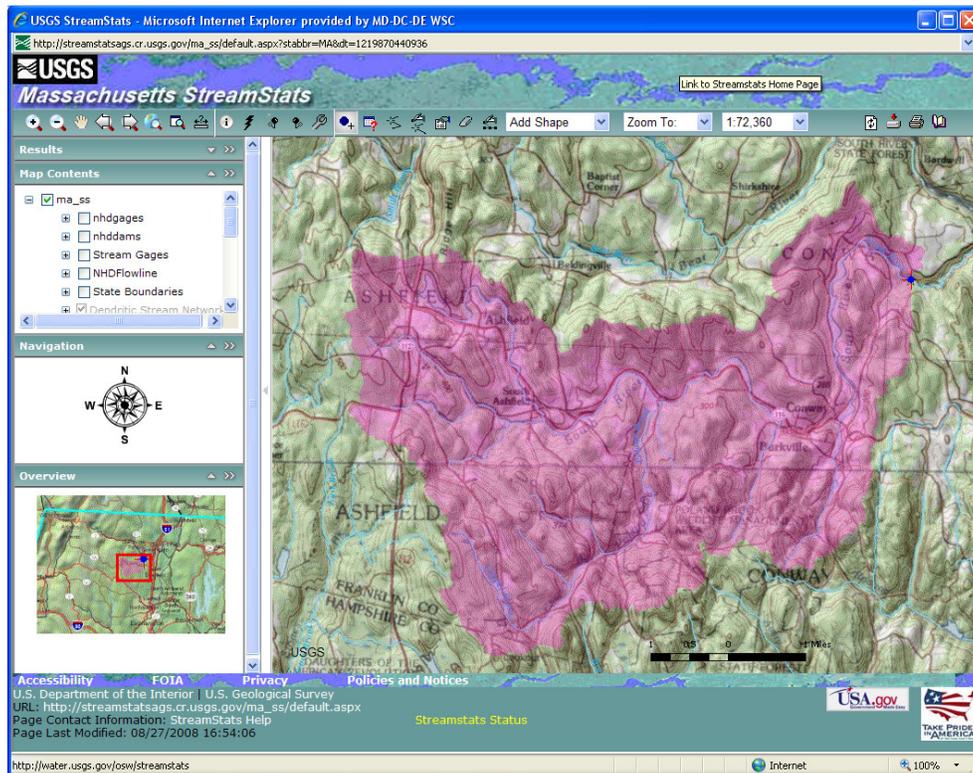
estimate streamflow statistics for the site. This information is needed by engineers, land and water-resource managers, biologists, and many others to help guide decisions in their everyday work. StreamStats was created by the U. S. Geological Survey, in cooperation with Environmental Systems Research Institute, Inc. (ESRI)<sup>1</sup>, and is built on ESRI's ArcHydro Data Model and Tools [1]. StreamStats functionality can be accessed through a map-based user interface that appears in the user's Web browser (fig. 1). The StreamStats home page [2] provides a description of the application, user instruction, access to the separate applications that are available for each state for which StreamStats has been implemented, and several other relevant links. A Fact Sheet by Ries and others [3] describes the functionality in StreamStats.

## 2. Web Services

Several of the StreamStats tools that are available through the StreamStats web application are also available as Web services. This provides remote computer applications the ability to initiate a request to execute StreamStats programs over the Internet. StreamStats will then perform the requested action and deliver a response back to the remote application. The use of web services such as these promotes collaboration among modelers, and allows other modeling efforts to take advantage of work that has been previously done. The StreamStats application and web service represents thousands of hours of work in terms of process building and dataset preparation. The processing power and storage requirements needed for an application of this magnitude could not be easily duplicated by someone who only occasionally needs this information.

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<sup>1</sup> The use of trade, product, or firm names in this report is for descriptive purposes only and does not imply endorsement by the U.S. Government.



**Figure 1. View of the Massachusetts StreamStats user interface with the drainage basin for a user-selected site shown in magenta.**

The StreamStats web services were first developed and implemented for Kentucky, in cooperation with the Commonwealth of Kentucky. When a user chooses to delineate a drainage-basin boundary, the StreamStats web services are being used in the background by the Kentucky Watershed Modeling Information Portal (KWMIP) [4]. The boundary produced by the StreamStats web service is then displayed in the KWMIP application. An example request for StreamStats basin delineation through KMWIP is shown in figure 2.

In developing this functionality, the StreamStats development team created a web-based web service query builder form that others can use to implement StreamStats web services in their own applications. The query builder form allows users to select (1) the StreamStats function that is needed, such as basin delineation, (2) the state for which it is needed, (3) the output format (simple GML, GeoRSS feed, or ESRI:RecordSet), (4) the input x and y coordinates for the location of interest, and (5) the coordinate system associated with x and y values. Given these inputs, the query builder will build a URL that can be used to send the request to the appropriate StreamStats server; StreamStats will execute the specified function and

return the results, in the specified output format (fig. 3).

Web services are currently available for delineating drainage-basin boundaries from a user-selected point, computing basin characteristics, computing estimates of streamflow statistics using regression equations, and determining the latitude and longitude for a selected site, based on user input of National Hydrography Dataset [5] reach addresses. In addition, intermediate web services have been developed to allow drainage-basin boundary geometry to be supplied to StreamStats so that StreamStats can then compute basin characteristics and streamflow statistics for the basin. These services can be configured for any state in which StreamStats is implemented. In addition, a custom web service has been developed for Kentucky. After users have obtained drainage-basin boundary in KMWIP through the StreamStats web service, KMWIP users can obtain area-averaged estimates of daily mean temperature and daily total precipitation for user-specified time periods.

States where StreamStats has been implemented can be seen in below (fig. 4). Readers who are interested in implementing StreamStats web services in their own applications should contact John Guthrie ([jdguthrie@usgs.gov](mailto:jdguthrie@usgs.gov)) for assistance.

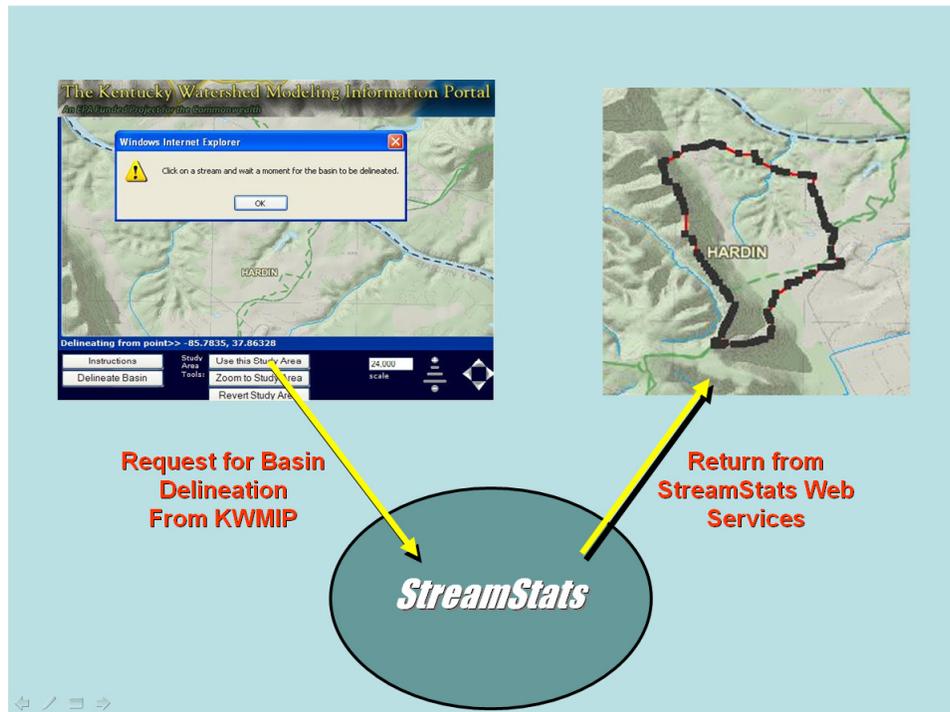


Figure 2. Example of a drainage-area delineation request sent from the Kentucky Watershed Modeling Information Portal (KWMIP) to StreamStats and the resulting delineation shown in the KWMIP user interface.

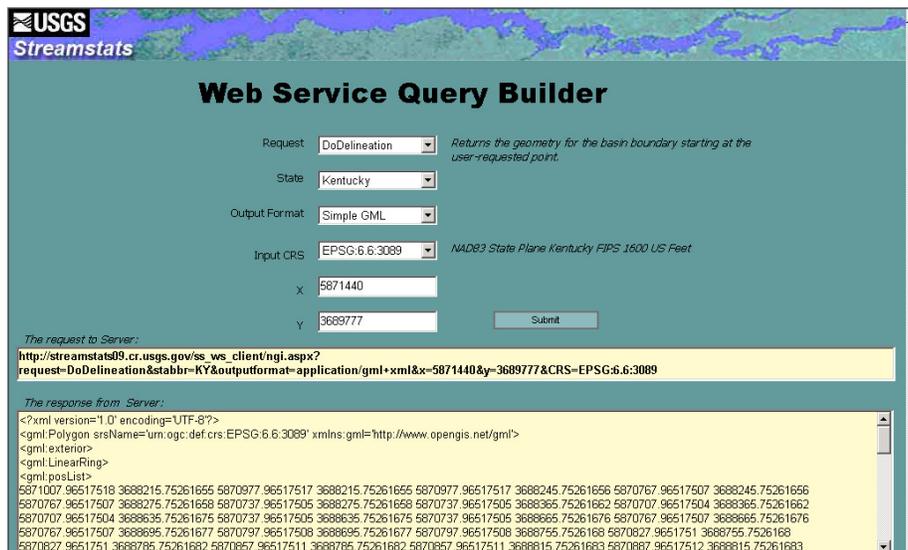
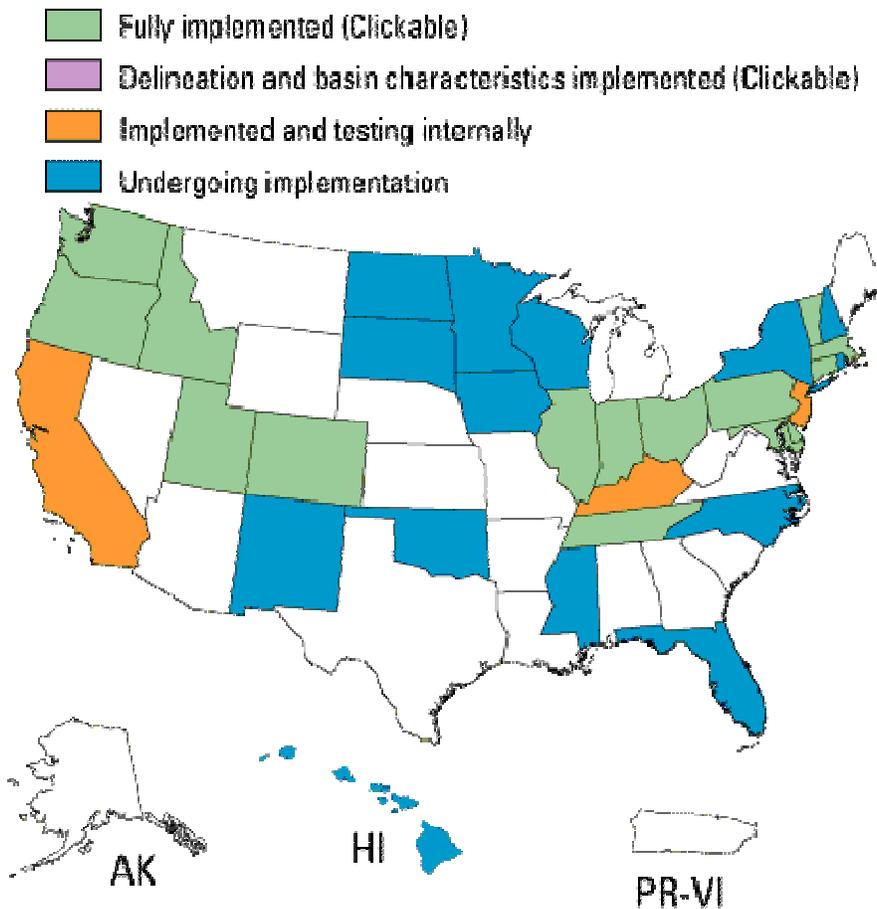


Figure 3. View of the StreamStats web service query builder form.



## References

- [1] Environmental Systems Research Institute, Inc. (ESRI) ArcHydro Data Model and Tools, <http://support.esri.com/index.cfm?fa=downloads.dataModels.filteredGateway&dmid=15>.
- [2] StreamStats <http://streamstats.usgs.gov>
- [3] Ries III, K.G., Guthrie, J.D., Rea, A.H., Steeves, P.A., and Stewart, D.W., in press, *StreamStats: A water resources Web application*: U.S. Geological Survey Fact Sheet 2008-3067, 6 p.
- [4] Kentucky Watershed Modeling Information Portal (KWMIP) <http://technology.ky.gov/gis/kwmip/>
- [5] National Hydrography Dataset (NHD) <http://nhd.usgs.gov>