***Proposal***

***for***

***Web-based Streamflow Statistics Tool For Georgia***

*Submitted to*

**Georgia Department of Transportation**

**and**

**Georgia Environmental Protection Division**

*Prepared by*

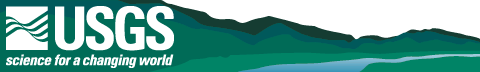
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**Statement of Problem**

Estimates of streamflow statistics are needed for a wide variety of applications, including design of flood- control structures, bridges, culverts; general water-resources planning, management and permitting; flood-plain mapping; and instream flow determinations for pollution and habitat studies.

At gaged sites where sufficient long-term streamflow data have been collected, statistics can be obtained from existing publications or by an analysis of existing data in the USGS National Water Information System database. However, streamflow statistics are often needed at ungaged sites where no observed flow data are available. In this case, watershed (basin) characteristics typically are determined manually using maps or Geographic Information System (GIS) methods, and then the basin characteristics are used as input into regional flow equations that estimate streamflow statistics (Gotvald and others, 2009; Gotvald and Knaak, 2011).

The manual methodologies for determining basin characteristics suffer from several shortcomings. The manual methods are slow and resource intensive. The results may not be reproducible because varying subjective methods often are used. Lastly, the methods often are not feasible for the public and non-hydrologists, because they require training, multiple data sources, and expensive computer software and resources. Without adequate GIS datasets and a sufficient understanding of GIS techniques, basin characteristics could be inaccurate; and without an adequate understanding in statistical techniques, streamflow statistics might be generated incorrectly and without including information about statistical confidence intervals. To provide an easy-to-use tool presenting information on streamflow characteristics and statistics at ungaged sites, the U.S. Geological Survey proposes a cooperative investigation.

**Objective**

The objective of this study is to provide an interactive web-based tool for determining streamflow statistics, such as flood-flow frequency, for any stream location within Georgia for which applicable streamflow regression equations have been published. The web tool will be simple to use, asking only that the user click on a map to identify the stream location of interest. The web tool will be available to all so that the public as well as scientists and managers can quickly obtain basin and streamflow information. It will provide a downloadable set of results that will include a map of the basin of interest, and a statistical summary that includes confidence intervals and an explanation of the results.

**Approach and Scope**

The product of this study will be the Georgia portion of the nationally-developed USGS StreamStats application; development of StreamStats on a national level is supported by the USGS Office of Surface Water. The approach and methodology for this application is outlined on the StreamStats web page: (<http://water.usgs.gov/osw/programs/streamstats.html>). A National prototype application (Figure 1.) is currently (2012) available for 27 states and currently being prepared in 12 other states: (<http://water.usgs.gov/osw/streamstats/ssonline.html>).

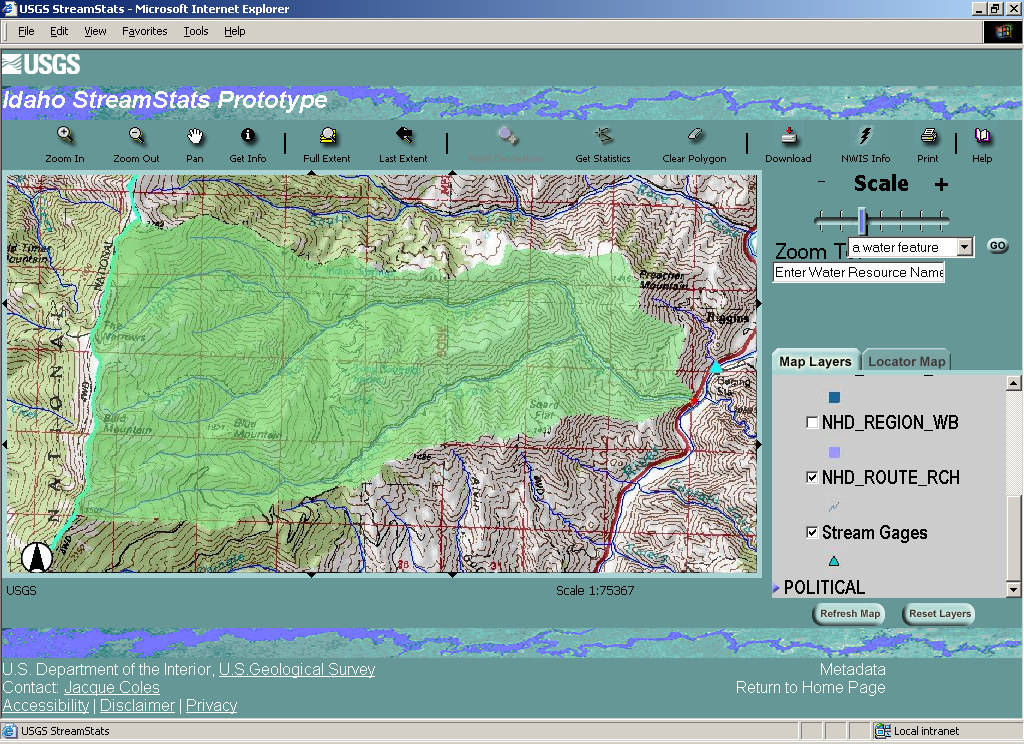
The StreamStats application will provide data for both gaged and ungaged sites. When a user clicks on an existing long-term gaged streamflow site, data are provided for previously published historical streamflow statistics, basin characteristics, and descriptive information about that site. When a user clicks at an ungaged streamflow location, basin characteristics (needed as regression parameters) are first calculated for that location using GIS datasets, and then the regression equations are run to provide estimates of streamflow statistics for the ungaged site. To provide this functionality, several work elements will be completed:

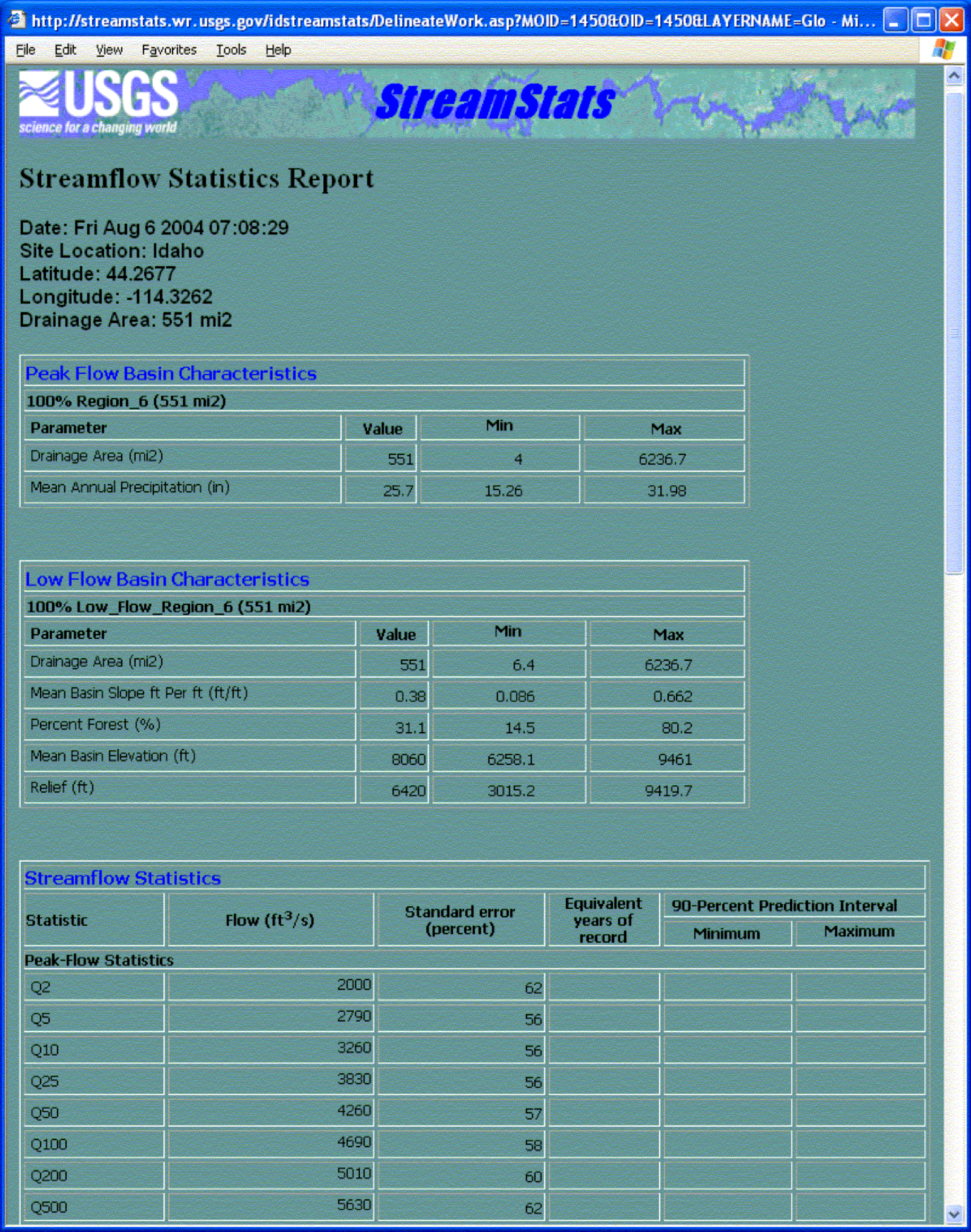
***Compilation of the streamflow statistics database***. A database that enables estimation of streamflow statistics at ungaged sites must be populated. The nationally-developed StreamStats application provides a Microsoft Access database and data-entry tool called StreamStatsDB. This database already is populated with existing regional streamflow regression equations documented in Gotvald and others (2009) and Gotvald and Knaak (2011). Regression relations that have been developed for five regions in Georgia include the 50-, 20-, 10-, 4-, 2-, 1-, 0.5, 0.2-percent annual exceedance probability flood. In addition to regression equations, the StreamStats DB contains information about historical streamflow statistics and basin characteristics for those gaging stations used to develop the streamflow regression equations and for other data-collection stations in Georgia. Much of the existing information is outdated and needs to be updated with information from the recent USGS reports. In addition, descriptive information for the sites needs to be reviewed and corrected or added to where necessary to assure that StreamStats users receive the most current and accurate information possible.

***Development of web site map-base layers***. GIS datasets are needed to provide base cartographic data for the web site map display. Statewide map-base layers will be created for use in StreamStats.

***Development of GIS hydrologic framework.*** The StreamStats application requires information about basin boundaries, land-surface elevations, hydrography, gaging-station locations, and bridge locations. These datasets must be vertically integrated, that is, they must be in spatial agreement. For example, streams (hydrography) in a valley must be precisely located at the lowest elevations in that valley as defined by the land-surface elevation dataset, and the precise location where a stream intersects the basin outlet must be at the lowest-elevation cell in the land-surface elevation dataset for that basin.

A Digital Elevation Model (DEM) with 10-meter grid spacing, obtained from the National Elevation Dataset (<Http://ned.usgs.gov>) will be used in StreamStats for basin-boundary delineations. Assuring that the delineations are of the highest possible accuracy will require processing of the DEM to force the elevation data to agree with quality-assured digital drainage-basin boundaries contained in the Watershed Boundary Dataset (http://nhd.usgs.gov/wbd.html) for basins averaging approximately 35 square miles and digital streams derived from USGS topographic maps that are contained in the high-resolution (1:24,000 scale) National Hydrography Dataset (<http://nhd.usgs.gov>). Some processing of the NHD streams to remove braids and to correct any erroneous flow directions will be needed before it can be used to enforce drainage in the DEM. After drainage enforcement is completed, then flow-direction and flow-accumulation grids needed for basin delineations will be generated from the modified DEM. This modified DEM will be used only for basin delineations. The original, unprocessed DEM will be used to compute any topographically derived basin characteristics, such as mean basin slopes, elevations, and aspects.





***A.***

***B.***

Figure 1. Graphic showing a National StreamStats web site: ***A***. Delineating a basin for the selected site, and ***B***. Displaying streamflow statistics estimated for selected site.

The extension of StreamStats to South Dakota requires three primary tasks:

**Quality Assurance**

The GIS datasets produced as part of this project will be reviewed by using DRG maps as ground-truth information; the target vector-accuracy standard will be 1/25th inch at the 1:24,000 scale. All new datasets will have Federal Geographic Data Committee (FGDC) compliant metadata (Federal Geographic Data Committee, 1994).

Generated basin parameters at existing gages will be checked against historical data in the NWIS (National Water Information System) database, and by independent verification using manual GIS methods. Streamflow statistics produced using the web site will be verified using historical data from existing streamflow gaging stations.

**Relevance and Benefits**

The web tool will contribute to the mission of the U.S. Geological Survey (USGS) by providing basin characteristics, streamflow statistics, and possible hazards data to cooperators and the public. It will provide commonly needed hydrologic information that can quickly be accessed to provide scientifically defensible results in a uniform and non-biased manner. StreamStats is a predictive tool that will initially provide flood-flow frequency information but could later be expanded to include other streamflow information that relate to the health of the stream environment and its biota. This web tool will provide the Georgia Department of Transportation (GDOT) with a reliable method of producing streamflow statistics needed for the design of bridges and culverts. The GIS data developed for StreamStats will be made available in a web clearinghouse so that contractors doing design work for GDOT will each have access to a single, standardized set of GIS data.

**Reports and Deliverables**

The Georgia StreamStats web site will be the primary product of this project. Additional products will be vertically-integrated hydrologic GIS datasets for the study area, including (elevation, hydrography, basin boundaries, and gaging station locations). These datasets will be produced as independent products as the project advances geographically. These datasets will exist within the ArcHydro framework (Maidment, 2002), which will allow for integration and use in a multitude of water-resources projects where basin characteristics as predictive variables need to be linked to a hydrologic flow-network for modeling basin and stream-network processes. A USGS Fact Sheet could be prepared in the future, that discusses the use and features of the Georgia StreamStats web site.

**Personnel**

A hydrologist (GS-13) experienced in streamflow data compilation and statistical analysis will be required to act as project chief – 240 hours.

A GIS specialist (GS-12) will oversee the creation of GIS elements – 1,200 hours.

**Funding**

The total cost for the proposed project is $200,000, which will be a spread over 2 State fiscal years, which begin on July 1, as shown in table 1.

Table 1. Project funding for State fiscal year.

|  |  |  |  |
| --- | --- | --- | --- |
| Fiscal Year | GDOT | GAEPD | Fiscal Year Total |
| FY 2013 | $30,000 | $70,000 | $100,000 |
| FY 2014 | $30,000 | $70,000 | $100,000 |
| Total | $60,000 | $140,000 | $200,000 |

**Timeline**

A general schedule of major work elements for the proposed project is shown in table 2 by State fiscal year (FY, beginning July 1) and quarter. Work will begin upon receipt of a Joint Funding Agreement.

Table 2. Project schedule for proposed study.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TASK | **FY 2013** | | | | **FY 2014** | | | |
|  | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| Training, Project set up: |  |  |  |  |  |  |  |  |
| Development of streamflow statistics database |  |  |  |  |  |  |  |  |
| Development of web site map-base layers: |  |  |  |  |  |  |  |  |
| Development of GIS hydrologic framework: |  |  |  |  |  |  |  |  |
| Site review and testing: |  |  |  |  |  |  |  |  |

**References**

Federal Geographic Data Committee., 1994., Content standards for digital spatial metadata (June 8 draft). Federal Geographic Data Committee., Washington, D.C.

Gotvald, A.J., Feaster, T.D., and Weaver, J.C., 2009, Magnitude and frequency of rural floods in the southeastern United States, 2006—Volume 1, Georgia: U.S. Geological Survey Scientific Investigations Report 2009–5043, 120 p.

Gotvald, A.J., and Knaak, A.E., 2011, Magnitude and frequency of floods for urban and small rural streams in Georgia, 2008: U.S. Geological Survey Scientific Investigations Report 2011–5042, 39 p.

Maidment, David, ed., 2002, Arc Hydro: GIS for Water Resources: ESRI Press, Redlands, California.

**Safety**

Job hazards for this project include hazards associated with working in an office environment such as typing on computers and staring at computers screens. An additional hazard includes driving to meetings with cooperators as the project work progresses.

|  |  |
| --- | --- |
| **Job Hazard *Analysis* *For New Projects***  • Check the numbered box(s) for all significant safety concerns this project should address. Significant  safety concerns are commonly those that require training, purchase of safety equipment, or specialized   preparation to address potentially hazardous conditions.  • Identify any unlisted safety concerns at bottom of the page.  • Provide details on the back of this page.  Proposal Number\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Project Title (Short)\_\_\_\_GA StreamStats\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Project Chief or Proposal \_Anthony Gotvald\_\_\_\_\_\_\_\_\_\_\_ | |
|  | Safety Concerns |
| 1. | Wading, bridge, boat, or cableway measurements or sampling |
| 2. | Working on ice covered rivers or lakes |
| 3. | Measuring or sampling during floods |
| 4. | Well drilling; borehole logging |
| 5. | Electrical hazards in the work area |
| 6. | Construction |
| 7. | Working in remote areas, communication, office call in procedures |
| 8. | Ergonomics, carpal tunnel syndrome |
| 9. | Field Vehicles appropriate for task?- Safety screens, equipment restraints. |
| 10. | All terrain vehicles, snowmobiles |
| 11. | Helicopter or fixed wing aircraft usage |
| 12. | Site access |
| 13. | Hypothermia or heat stroke |
| 14. | Hantavirus, Lyme Disease, Histoplasmosis, Pfiesteria, Others? |
| 15. | Contaminated water with sanitary, biological, or chemical concerns |
| 16. | Immunizations |
| 17. | Laboratory or mobile laboratory. Chemical hygiene plan. |
| 18. | Hazardous waste disposal |
| 19. | Hazardous waste site operations |
| 20. | Confined space |
| 21. | Radioactivity |
| 22. | Respiratory protection |
| 23. | Scuba Diving |
| 24. | Electrofishing |
| 25. |  |
| 26. |  |
| 27. |  |
| 28. |  |

|  |  |
| --- | --- |
| Box  no. | For each numbered box checked on the previous table, briefly:  A. Describe the safety concern as it relates to this project.  B. Describe how this safety concern will be addressed. Include training, safety  equipment and other actions that will be required.  C. Estimate costs. |
| 8 | Ergonomics, carpal tunnel syndrome is related to repeatative work at a desk and using a computer necessary for completion of the study. Employees will be provided with an ergonomic chair, keyboard, and mouse as requested. Total cost is expected to be less than $500 per employee. |