

# A decision support tool to estimate unregulated, daily streamflow at ungauged sites in the Connecticut River Basin



Stacey Archfield<sup>1</sup> and Peter Steeves<sup>1</sup>

<sup>1</sup>U.S. Geological Survey, Massachusetts-Rhode Island Water Science Center, Northborough, MA, United States

## A SEAMLESS MULTI-STATE TOOL TO ESTIMATE DAILY STREAMFLOW IN THE CONNECTICUT RIVER BASIN

The Connecticut River basin contains a number of flood-control and hydropower dams; there has been increased attention on how these dams can be managed to support ecological services.

Daily streamflow is needed at ungauged locations as input to reservoir simulation and optimization models as well as to determine ecological-flow needs and ecology-flow alteration relations.

### PROJECT OBJECTIVE

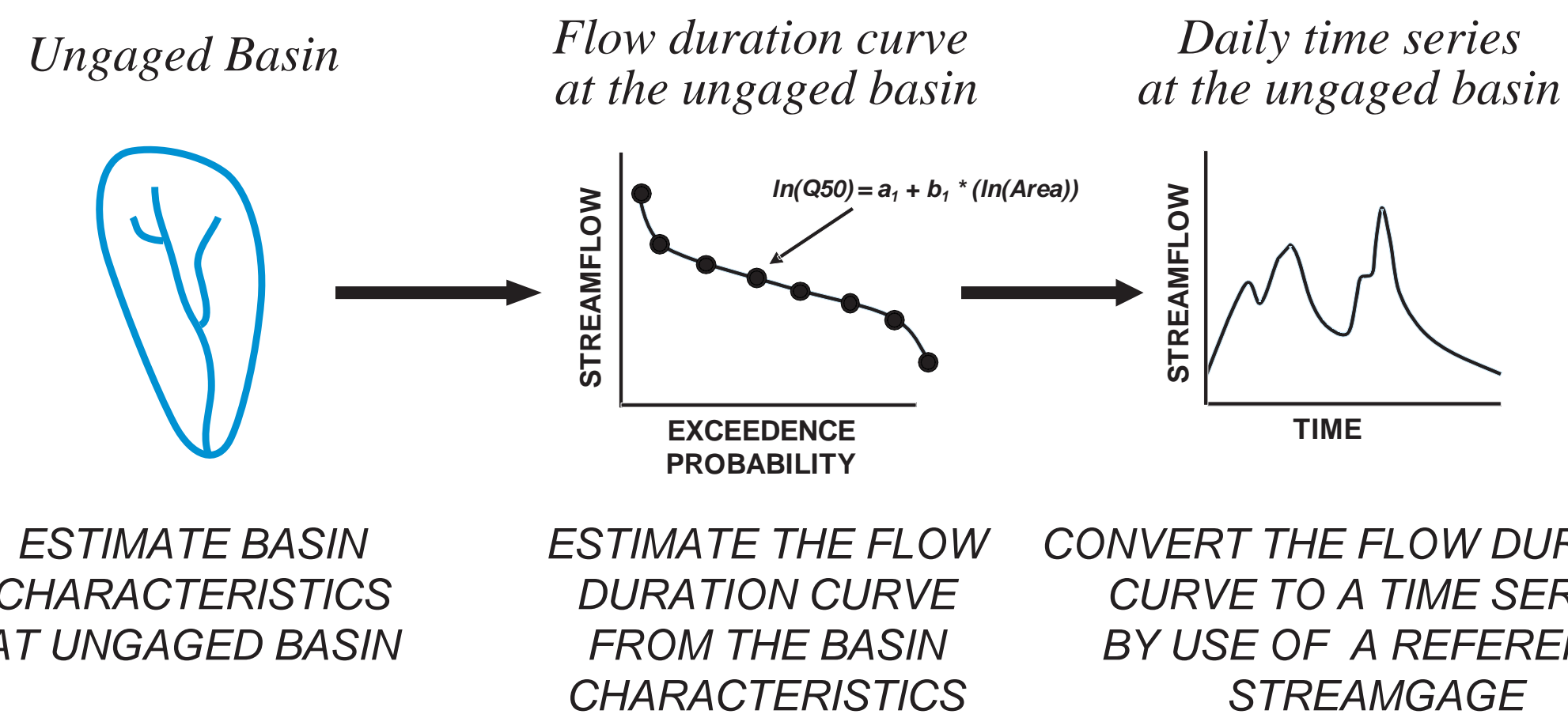
Develop an **easy-to-use, screening-level** tool to estimate continuous unimpacted **streamflow** at ungauged locations in the Connecticut River Basin (excluding the mainstem of the Connecticut River).

**SIMPLE APPROACH REQUIRING FEW PARAMETERS**

**WEB-BASED WATERSHED DELINEATION TOOL COUPLED WITH MICROSOFT EXCEL**

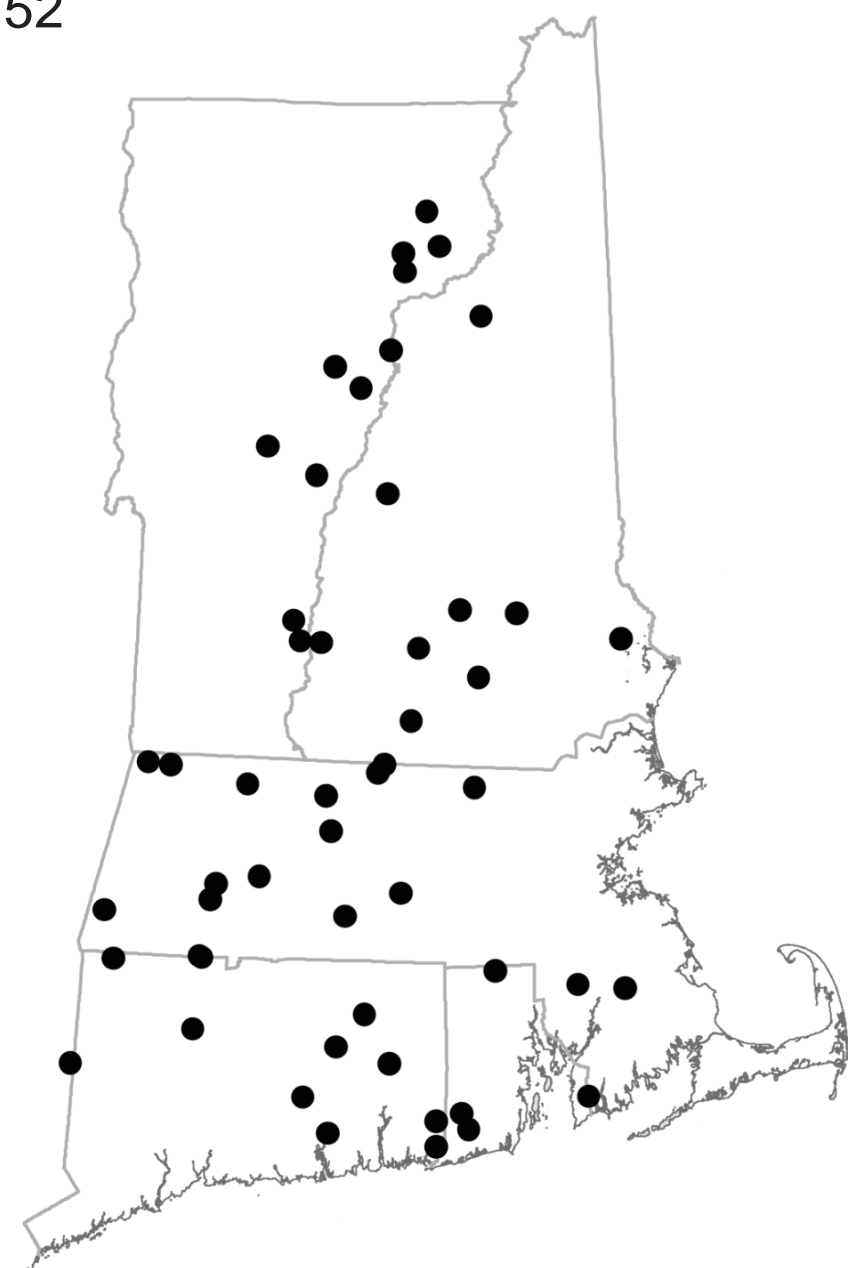
## METHOD TO ESTIMATE DAILY STREAMFLOW AT UNGAUGED LOCATIONS IN THE CONNECTICUT RIVER BASIN

Daily streamflow is estimated for a 44-year period from 1960 through 2004 using a three-step process documented in Archfield *et al.* [2010] and Archfield and Vogel [2010] and calibrated to the Connecticut River Basin.



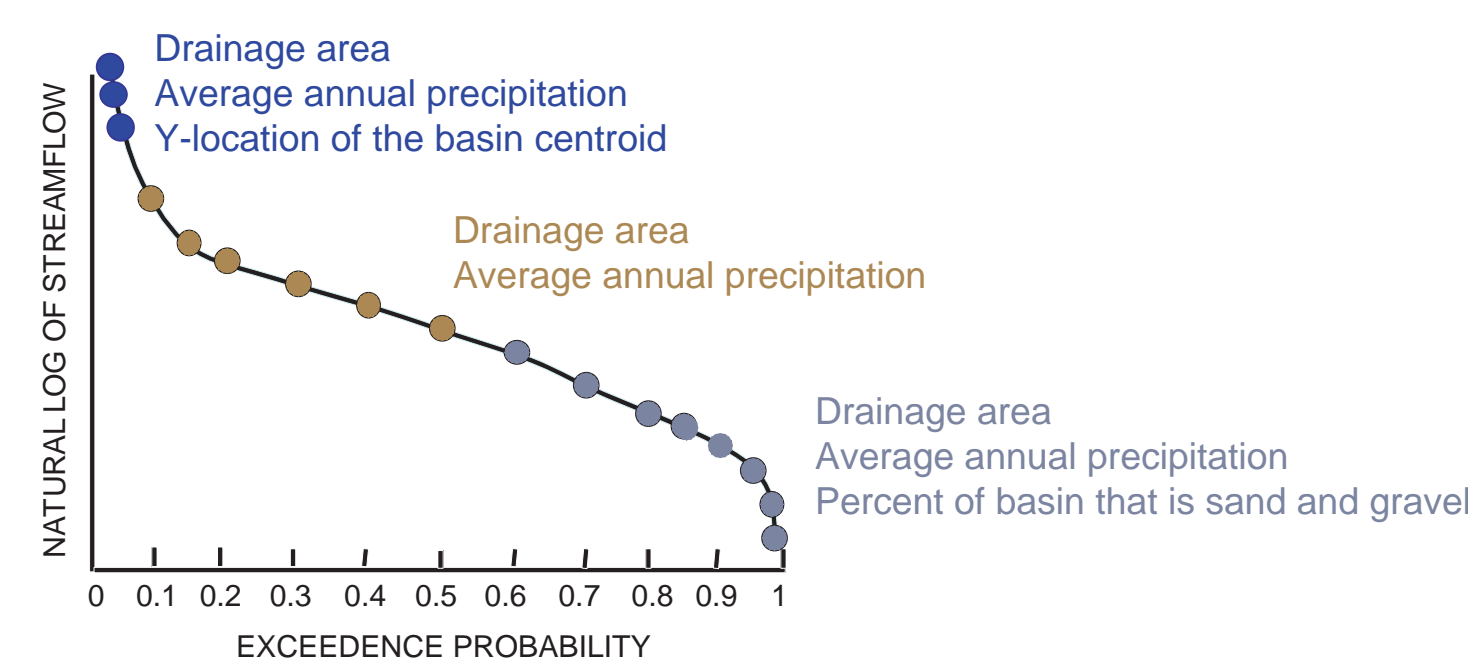
### STUDY STREAMGAGES

N = 52

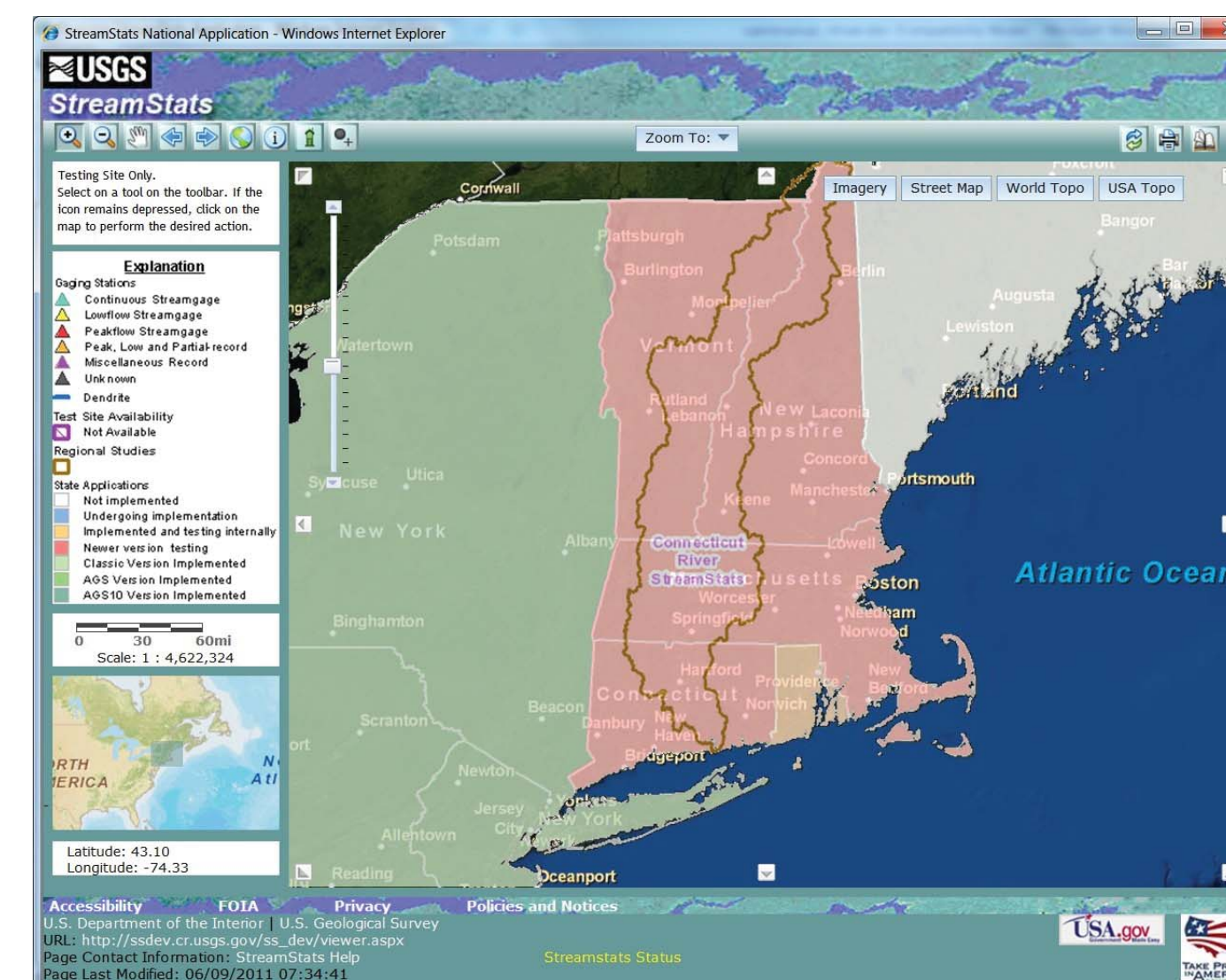


### BASIN CHARACTERISTICS USED TO ESTIMATE FLOW DURATION CURVE

21 EQUATIONS

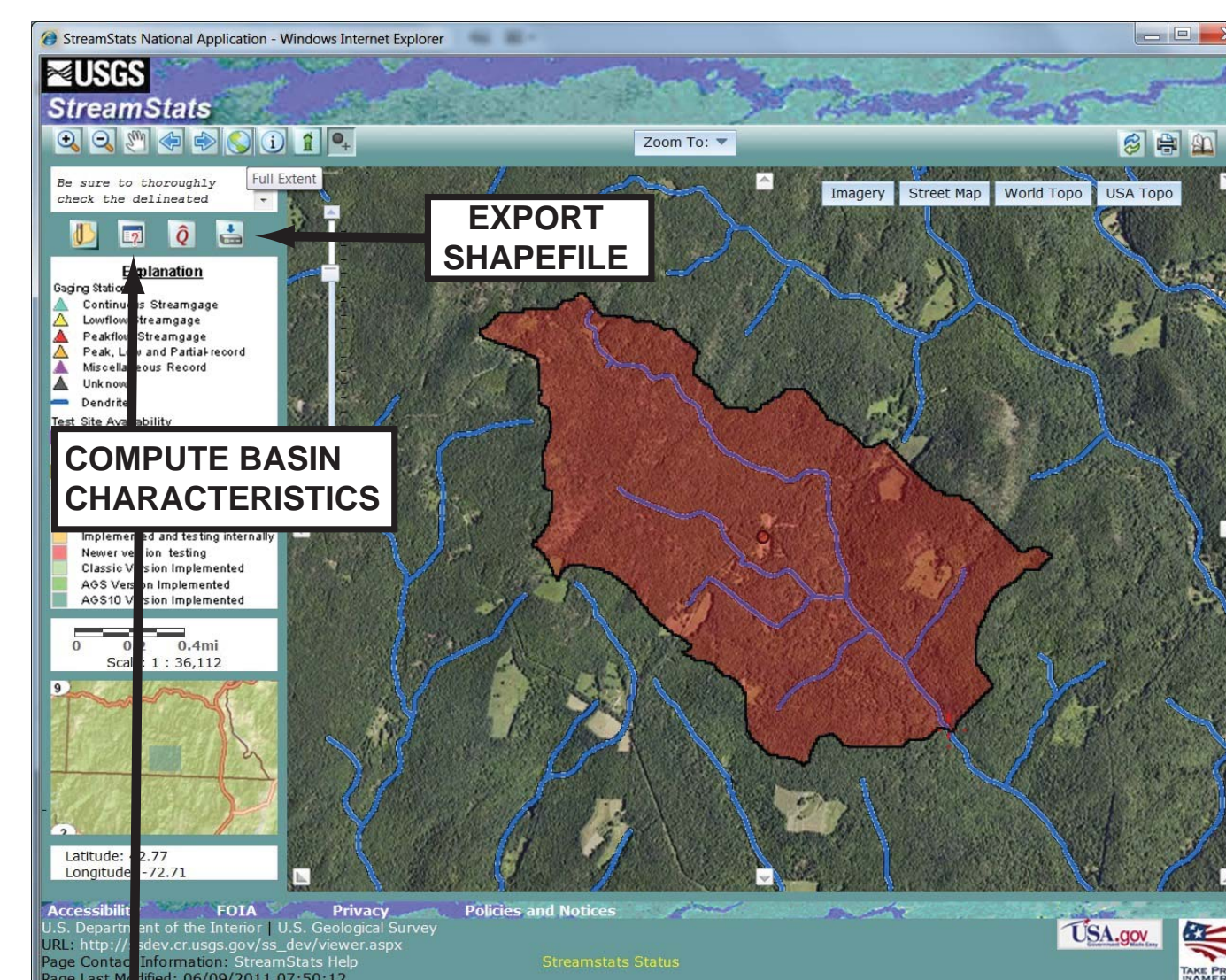
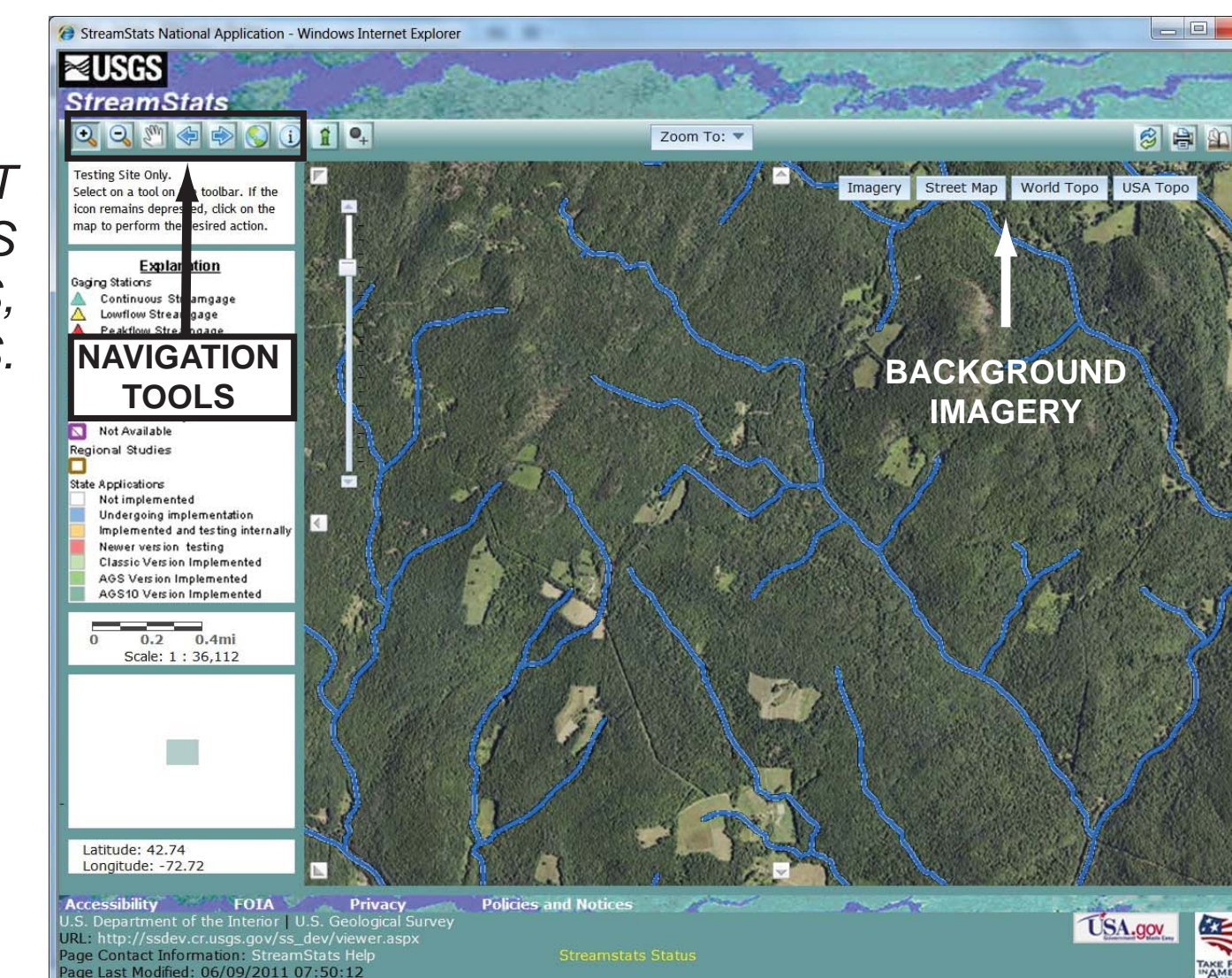


## THE CONNECTICUT RIVER UNIMPACTED STREAMFLOW ESTIMATOR VERSION 1.1



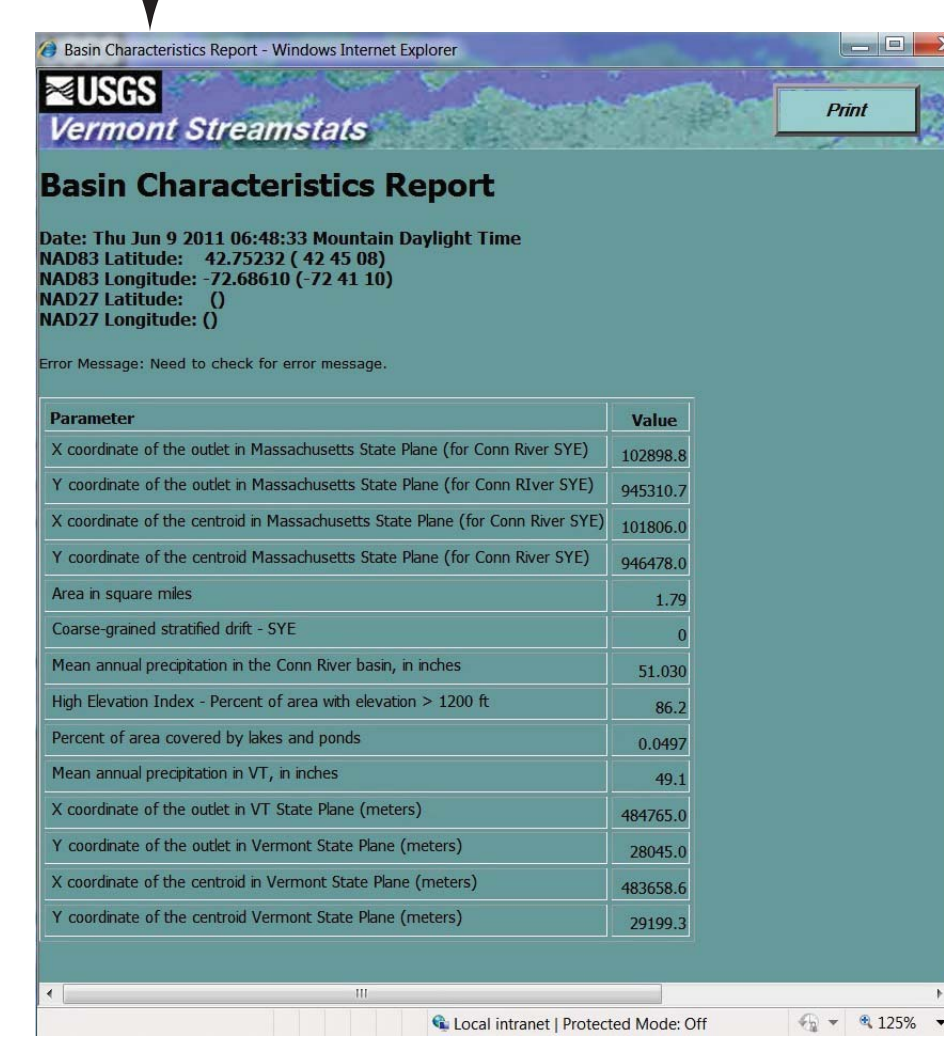
BASIN DELINEATION IS COMPLETED USING THE WEB-BASED U.S. GEOLOGICAL SURVEY STREAMSTATS TOOL

A USER LOCATES THE STREAM OF INTEREST USING THE INTERACTIVE MAP, WHICH INCLUDES SATELLITE IMAGERY, TOPOGRAPHIC MAPS, AND STREET MAPS.

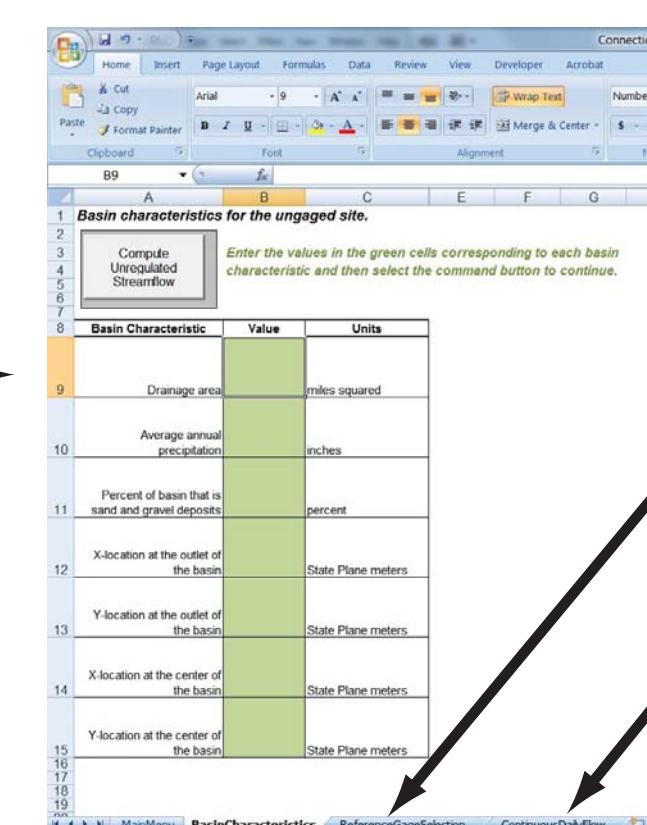


THE WATERSHED DELINEATION TOOL IS USED TO SELECT THE STREAM LOCATION AND GENERATE A CONTRIBUTING BASIN TO THE STREAM LOCATION.

A NEW TOOLBAR APPEARS TO COMPUTE BASIN CHARACTERISTICS AND EXPORT THE DELINEATED BASIN.



A BASIN CHARACTERISTICS REPORT IS GENERATED AND INPUT INTO A SPREADSHEET TOOL, WHICH WILL ESTIMATE THE DAILY STREAMFLOW TIME SERIES.

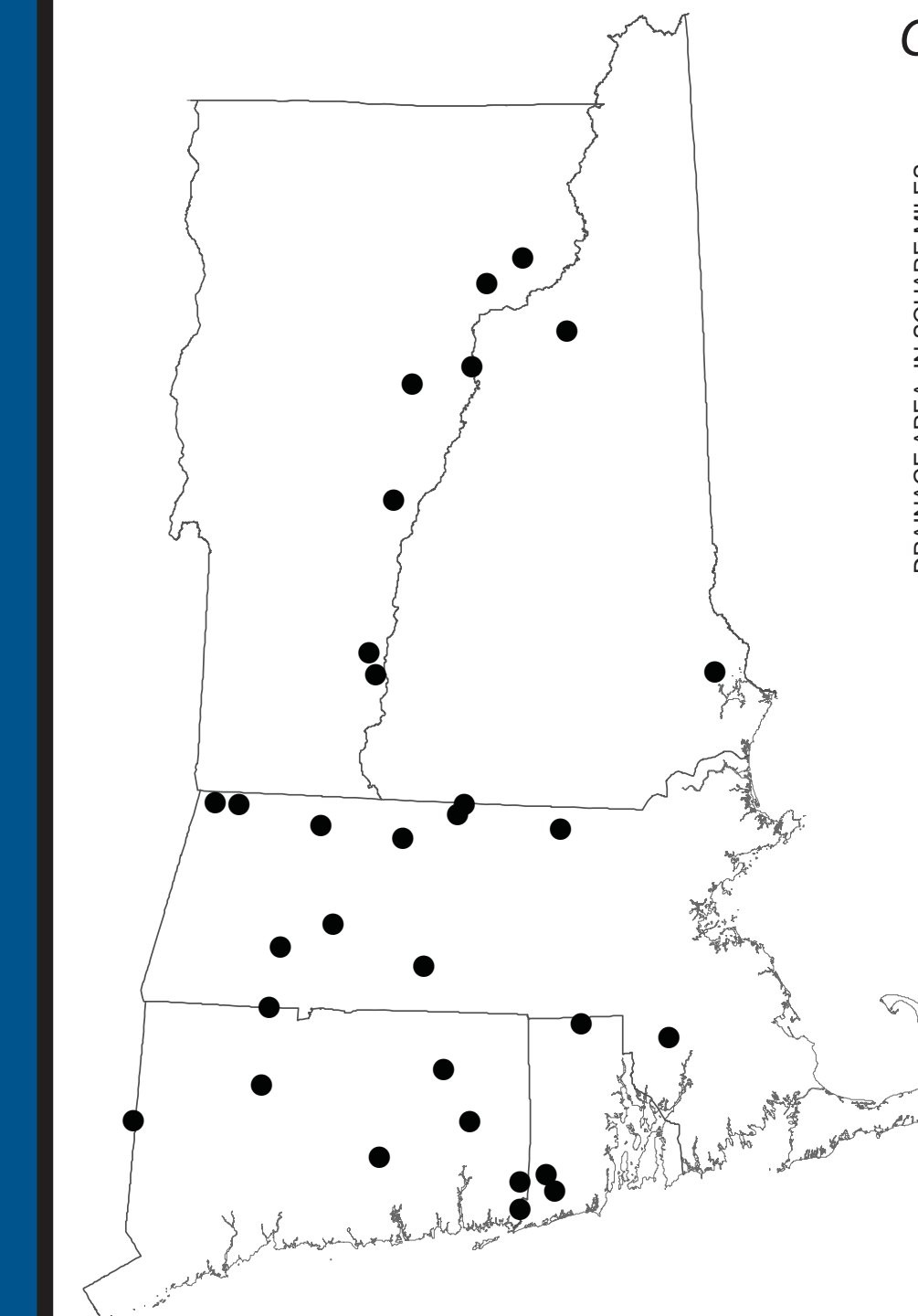


INFORMATION ABOUT THE REFERENCE STREAMGAGE IS SHOWN; USERS HAVE THE OPTION TO SELECT ANOTHER REFERENCE STREAMGAGE

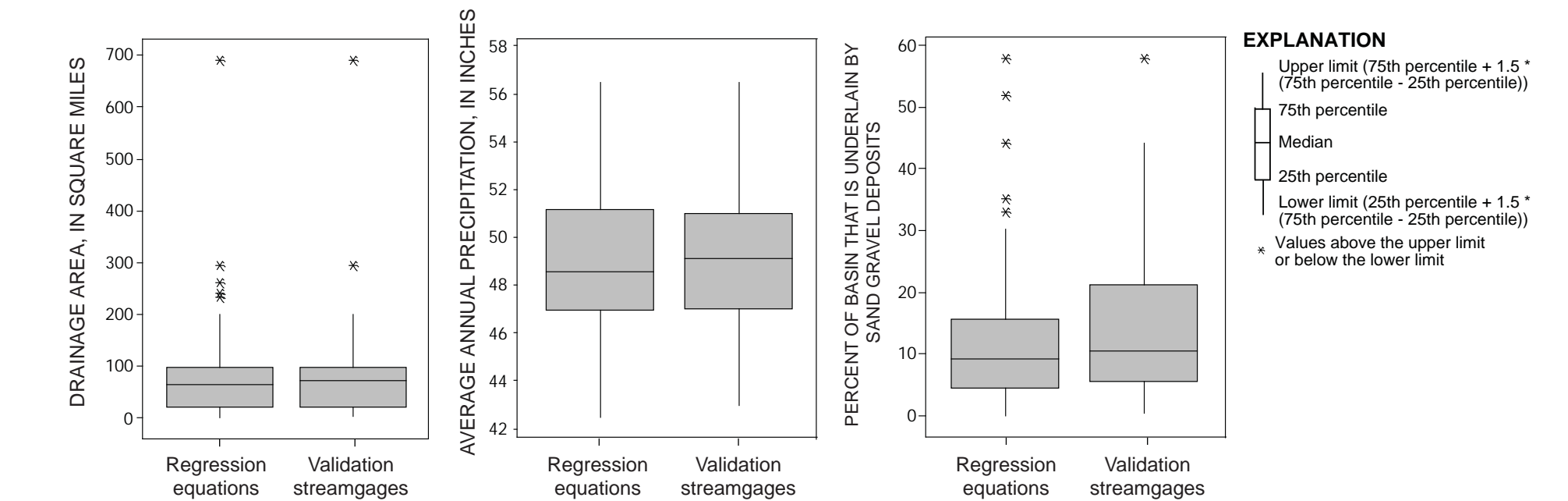
DAILY STREAMFLOW IS PLACED IN A WORKSHEET FOR EASY USE IN GRAPHING OR COPYING TO ANOTHER SOFTWARE PROGRAM FOR ANALYSIS

## HOW WELL DOES THE TOOL ESTIMATE DAILY STREAMFLOW?

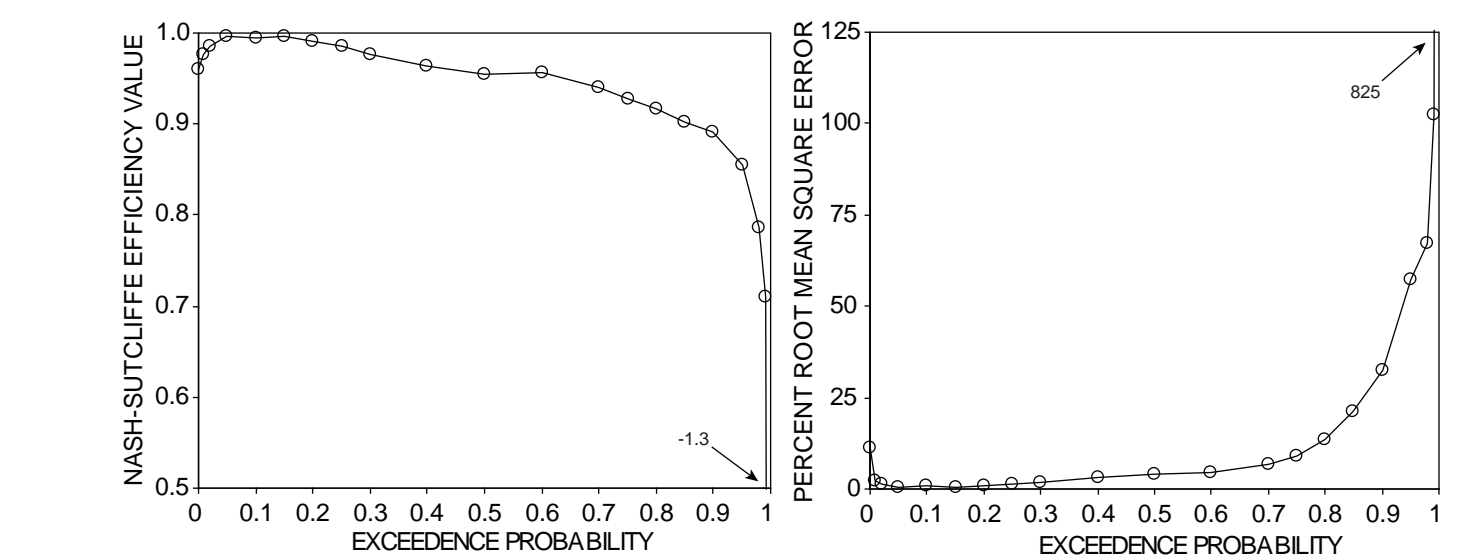
### Validation Streamgages



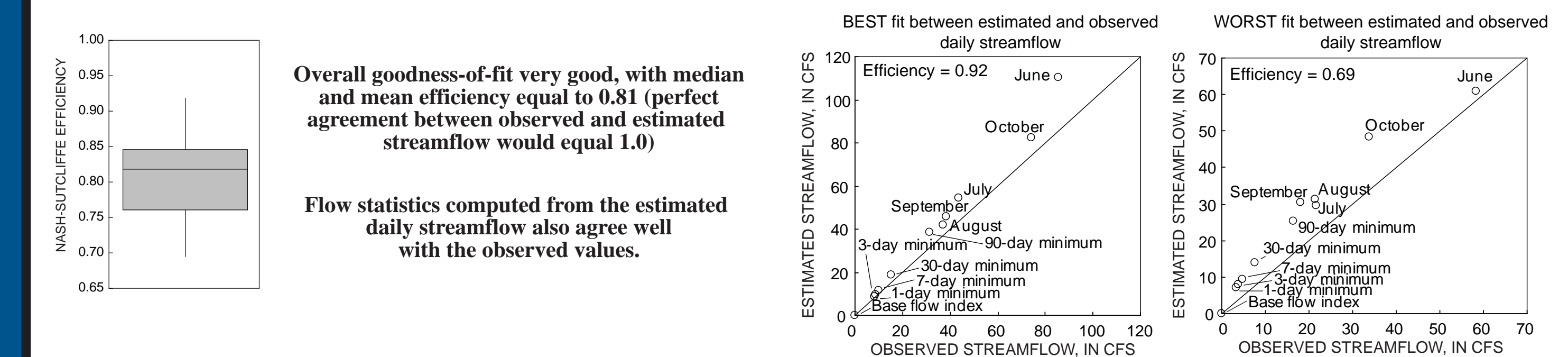
THE VALIDATION STREAMGAGES COVER THE RANGE OF CHARACTERISTICS USED TO DEVELOP THE REGRESSION EQUATIONS.



GOODNESS-OF-FIT WITH RESPECT TO THE FLOW DURATION CURVE



GOODNESS-OF-FIT WITH RESPECT TO DAILY STREAMFLOW AND FLOW STATISTICS



Overall goodness-of-fit very good, with median and mean efficiency equal to 0.81 (perfect agreement between observed and estimated streamflow would equal 1.0)

Flow statistics computed from the estimated daily streamflow also agree well with the observed values.

## DELIVERABLES AND TIMELINE

The software tool will be freely available for download from the U.S. Geological Survey website with an accompanying user's manual. The software tool is currently in beta testing.

A journal article is in preparation to document the methods, results and software tool.

Draft of the journal article and release of the software tool is planned for August 2011.

## REFERENCES

Archfield, S. A., and Vogel, R. M., 2010, Map correlation method: Selection of a reference streamgauge to estimate daily streamflow at ungauged basins, *Water Resources Research*, 46, W10513, doi:10.1029/2009WR008481.

Archfield, S.A., Vogel, R., Steeves, P.A., Brandt, S.L., Weiskel, P.K., and Arabedian S.P., 2010, The Massachusetts Sustainable-Yield Estimator: A decision-support tool to assess water availability at ungauged sites in Massachusetts, U.S. Geological Survey Scientific Investigations Report 009-5227, 41 p., plus CD-ROM.

## ACKNOWLEDGEMENTS

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