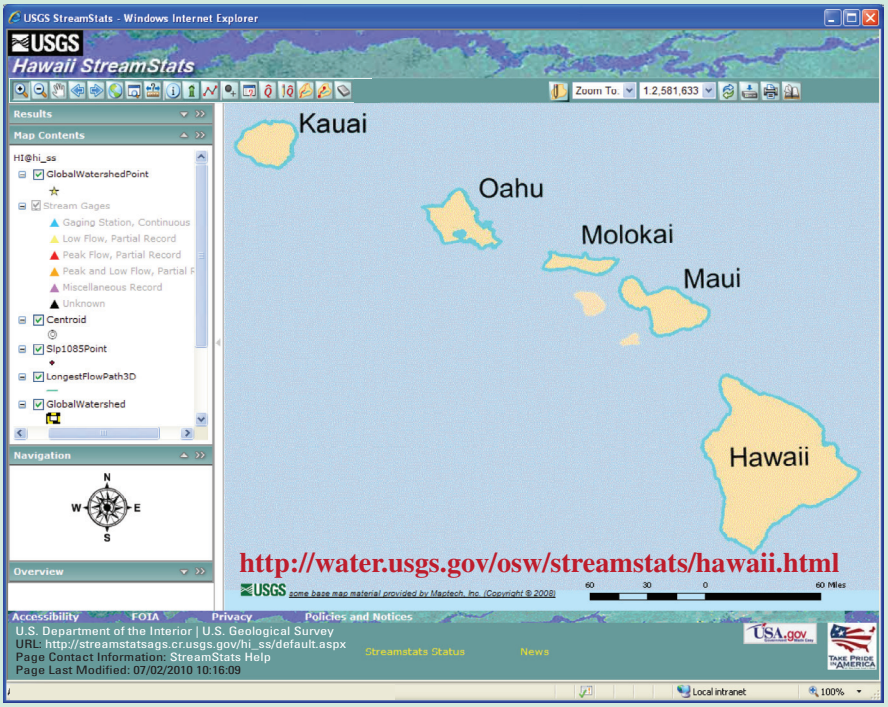
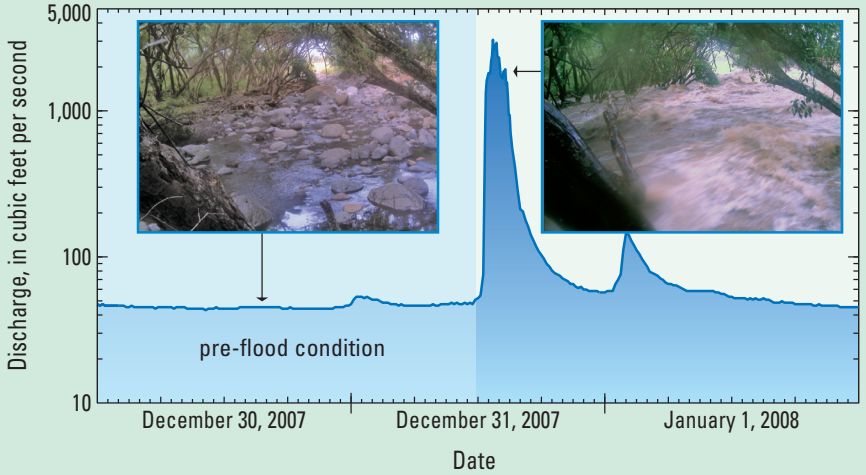
Hawaii StreamStats: A Web Application for Defining Drainage-Basin Characteristics and Estimating Peak-Streamflow Statistics

Reliable estimates of the magnitude and frequency of floods are necessary for the safe and efficient design of roads, bridges, water-conveyance structures, and flood-control projects and for the management of flood plains and flood-prone areas. StreamStats provides a simple, fast, and reproducible method to define drainage-basin characteristics and estimate the frequency and magnitude of peak discharges in Hawaii's streams using recently developed regional regression equations (Oki and others, 2010). StreamStats allows the user to estimate the magnitude of floods for streams where data from stream-gaging stations do not exist. Existing estimates of the magnitude and frequency of peak discharges in Hawaii can be improved with continued operation of existing stream-gaging stations and installation of additional gaging stations for areas where limited stream-gaging data are available.

Hawaii StreamStats Web Application



Flash Floods in Hawaii



Flow in Hawaiian streams is very flashy and may pose a threat to human lives and property. The amount of discharge in Hawaiian streams commonly changes by a factor of a hundred or more over periods of less than a few hours. The photographs above from Waihee River on the Island of Maui were taken from the same vantage point and show how dramatically conditions can change over short periods of time.

Prepared in cooperation with the State of Hawaii, Department of Transportation.

U.S. Department of the Interior
U.S. Geological Survey

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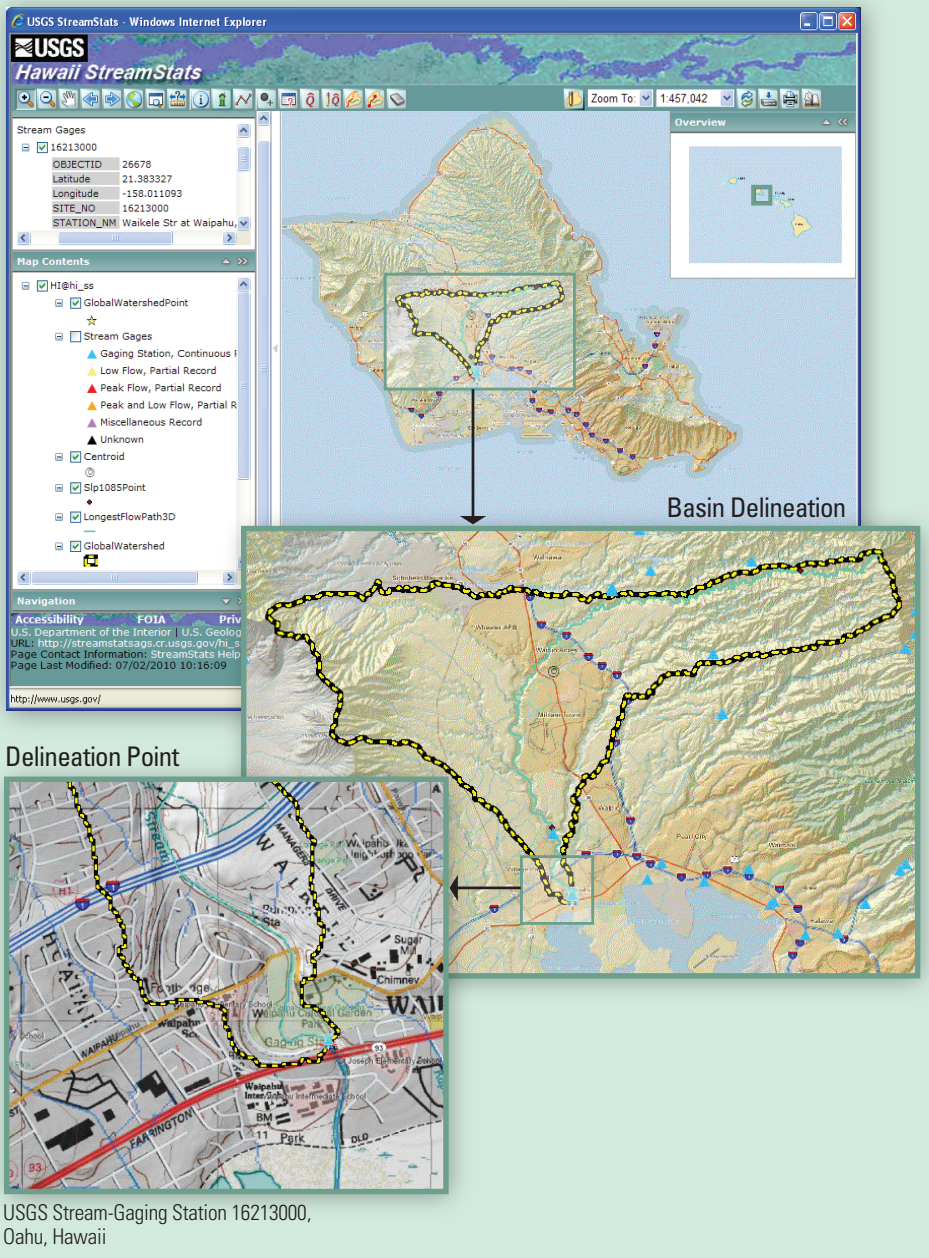
Hawaii StreamStats Basin Delineation



USGS Stream-Gaging Station 16213000, Oahu, Hawaii

Benefits

Hawaii StreamStats can save users considerable time and effort with the automated process that computes reproducible basin characteristics and peak discharges for streams in Hawaii. StreamStats is a simple and effective tool for estimating streamflow statistics and incorporates recent flood-frequency regional regression equations developed for Hawaii (Oki and others, 2010). The Hawaii StreamStats application can be expanded in the future to include regional estimates of low-flow streamflow characteristics as additional equations are developed.

StreamStats

Streamflow statistics, such as the 100-year flood, the mean flow, and the 7-day 10-year low flow, are used by engineers, land managers, biologists, and many others to help guide decisions in their everyday work. StreamStats is a Web-based geographic information system (GIS) application that was created by the U.S. Geological Survey (USGS) in cooperation with Environmental Systems Research Institute, Inc. (ESRI), to provide users with access to an assortment of analytical tools that are useful for water-resources planning and management. StreamStats allows users to easily obtain streamflow statistics, basin characteristics, and descriptive information for USGS data-collection stations and user-selected ungaged sites. This functionality can be accessed through a map-based user interface that appears in the user's Web browser, or individual functions can be requested remotely as Web services by other Web or desktop computer applications (Ries and others, 2008).

StreamStats Hawaii Application

Hawaii StreamStats delineates drainage basins by GIS methods using a USGS 10-meter digital elevation model (DEM). Once the GIS basin boundary is generated, it can then be edited by the user so that any necessary corrections are made to the automated delineation. After the basin boundary is verified, the user can then compute any desired combination of basin characteristics available for the State of Hawaii. The user-selected basin characteristics, which may include drainage area, rainfall characteristics, and land-cover classifications, are displayed in a table. The delineated basin boundary and any basin characteristics that were generated by the user are then available for download in formats suitable for other applications, including GIS.

Estimating Peak-Streamflow Statistics

StreamStats can estimate streamflow statistics for ungaged sites either on the basis of regional regression equations or on the basis of the known flows from nearby stream-gaging stations. Regression equations are developed by statistically relating the streamflow statistics to the basin characteristics for a group of data-collection stations within a region. Estimates of streamflow statistics for

ungaged sites can then be obtained by measuring the basin characteristics for the ungaged site and inserting them into the regression equations (Ries and others, 2008).

Regional regression equations were developed for peak discharges with 2-, 5-, 10-, 25-, 50-, 100-, and 500-year recurrence intervals for unregulated streams (those for which peak discharges are not affected to a large extent by upstream reservoirs, dams, diversions, or other structures) in areas with less than 20 percent combined medium- and high-intensity development on Kauai, Oahu, Molokai, Maui, and Hawaii. Each of the islands was divided into two regions, generally corresponding to a wet region and a dry region. Unique peak-discharge regression equations were developed for each region. The regression equations used in Hawaii StreamStats have standard errors of prediction ranging from 16 to 620 percent, and errors generally are greatest for leeward Molokai (region 5) and southern Hawaii (region 10). For each region, the largest standard error of prediction is associated with regression equations for either the 2- or 500-year peak discharges, which represent the extremes of the recurrence intervals considered. These relatively large errors underscore the need to better understand the processes controlling floods in these areas and the need to collect additional peak-discharge data there. Because the regression equations for some regions contain substantial uncertainty, improved peak-discharge estimates for these regions may be required for proper design of engineering projects that could be affected by floods (Oki and others, 2010).

Limitations and User Warnings

The regression equations developed for the State of Hawaii have a number of limitations:

- Use of a regression equation beyond its limits will produce peak-discharge estimates with unknown error and should therefore be avoided. StreamStats will provide a warning when an extrapolation beyond the limits of the regression equation occurs.
- The regression equations were developed using peak-discharge data from streams that are mainly unregulated (not affected by regulation from upstream dams, reservoirs, diversions, or other structures), and they should not be used to estimate peak discharges in regulated streams.
- Streams in Hawaii commonly flow in natural, unmodified channels in their upper reaches, although some streams may flow through developed areas in their lower reaches. The equations developed for this study may not be reliable for streams with drainage basins in which more than 20 percent of the area is affected by combined medium- and high-intensity developments.
- Hawaii StreamStats users are responsible for (1) checking the accuracy of delineated basins and (2) evaluating whether the errors associated with the predictions are acceptable for the desired application. For regions with limited data, particularly those on the Island of Hawaii, where regions cover large geographic areas that are hydrologically diverse, peak-discharge estimates from the regression equations may not accurately reflect local conditions and should be used with caution.

User-Selected Basin Characteristics

USGS Hawaii StreamStats

Basin Characteristics Report

Date: Fri Jul 2 2010 13:18:58 Mountain Daylight Time
OLD HAWAIIAN DATUM Latitude: 21.3865 (21 23 11)
OLD HAWAIIAN DATUM Longitude: -158.0138 (-158 00 50)
NAD83 Latitude: 21.3833 (21 22 60)
NAD83 Longitude: -158.0111 (-158 00 40)

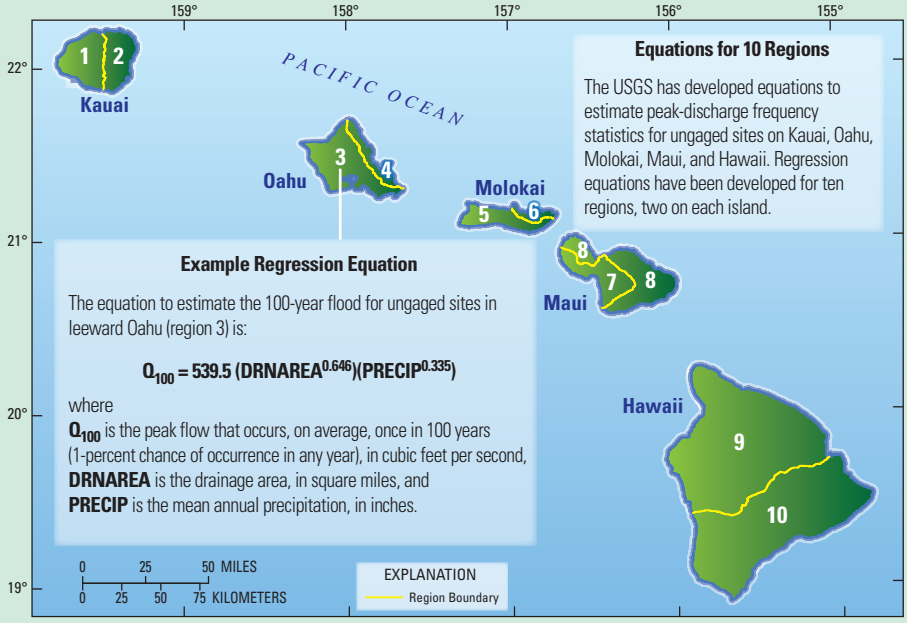
Parameter	Value
Drainage area in square miles	45.1
Perimeter in miles	57.7
Mean Basin Elevation in feet	984
Mean basin slope computed from 10 m DEM, in percent	25.9
Length of associated Longest Flow Path in miles	24.3
Area-weighted mean soil permeability (top 12 inches), in inches per hour (NRCS SSURGO database)	3.25
Mean Annual Precipitation in inches	71.7
60 Minute 2 Year Precipitation in inches	1.9
6 Hour 2 Year Precipitation in inches	3.88
24 Hour 2 Year Precipitation in inches	5.9
48 Hour 2 Year Precipitation in inches	6.96

References Cited

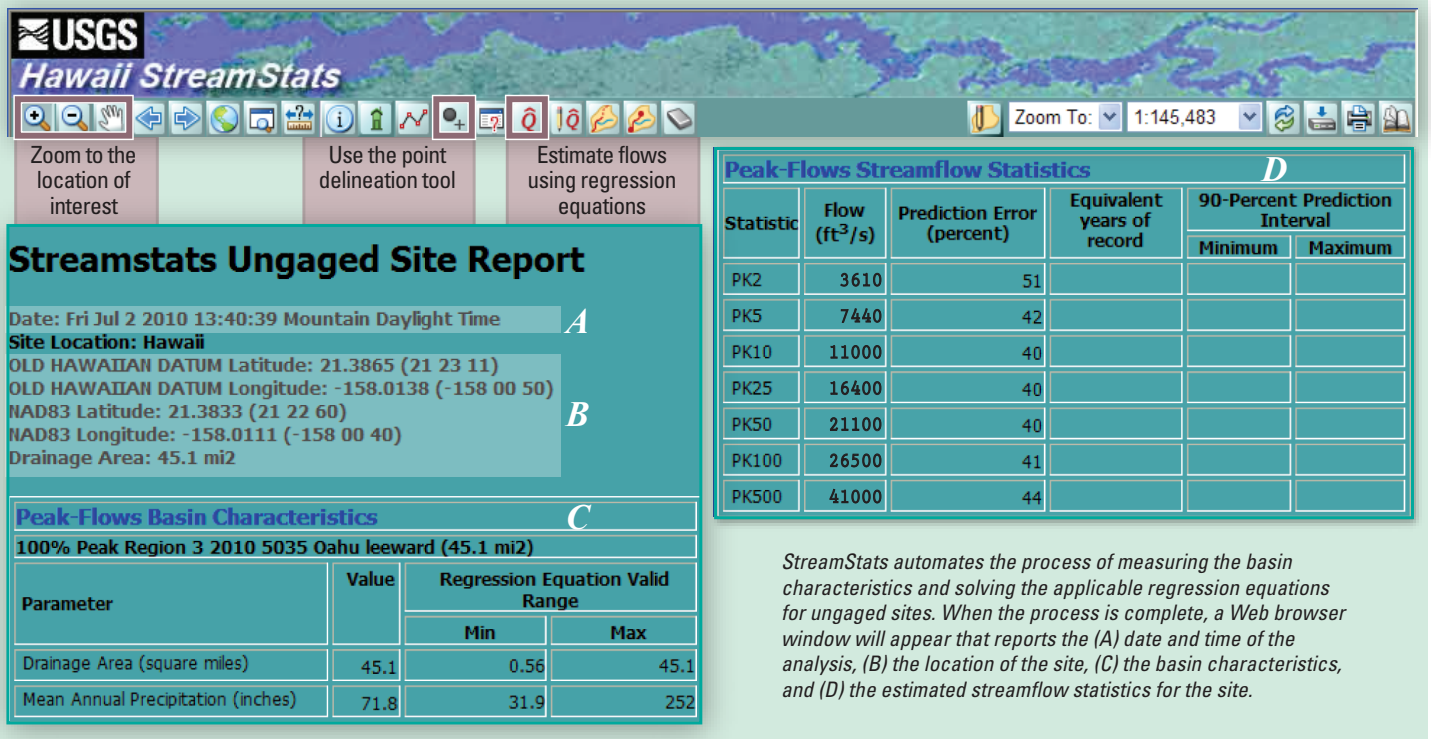
Ries, K.G., III, Guthrie, J.D., Rea, A.H., Steeves, P.A., and Stewart, D.W., 2008, StreamStats; a water resources web application: U.S. Geological Survey Fact Sheet 2008–3067, 6 p. [http://pubs.usgs.gov/fs/2008/3067/].

Oki, D.S., Rosa, S.N., and Yeung, C.W., 2010, Flood-frequency estimates for streams on Kaua‘i, O‘ahu, Moloka‘i, Maui, and Hawai‘i, State of Hawai‘i: U.S. Geological Survey Scientific Investigations Report 2010–5035, 42 p. [http://pubs.usgs.gov/sir/2010/5035].

Hawaii Regression Equation Regions



Streamflow Statistics Report



StreamStats automates the process of measuring the basin characteristics and solving the applicable regression equations for ungaged sites. When the process is complete, a Web browser window will appear that reports the (A) date and time of the analysis, (B) the location of the site, (C) the basin characteristics, and (D) the estimated streamflow statistics for the site.

Additional information on StreamStats:

The USGS StreamStats homepage: http://water.usgs.gov/osw/streamstats/

The StreamStats Description page: http://water.usgs.gov/osw/streamstats/ssinfo.html

The User Instructions-Version 2 page: http://water.usgs.gov/osw/streamstats/instructions1.html

The StreamStats Limitations page: http://water.usgs.gov/osw/streamstats/disclaimer.html

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This Fact Sheet and any updates to it are available online at
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