How Can You Use Streamflow Data in Watershed Management?

Daily streamflow data are particularly useful for watershed science and management applications. Analyzing daily streamflow data can lead to understanding basic hydrologic aspects of the watershed in question.

The United States Geological Survey (USGS) provides streamflow data from thousands of stream gages across the country through their National Water Information System website. Examples of available streamflow data are:

1. **Real-time data**: data, from automated equipment, representing the most current hydrologic conditions. Measurements are commonly recorded at 5-60 minute intervals, depending on the gage type, and transmitted to the National Water Information System database every 1-4 hours.
2. **Daily data**: daily values for each day for the period of record and may represent the daily mean, median, maximum, minimum, and/or other derived value.
3. **Daily, Monthly, or Annual Statistics**: provides streamflow discharge statistics based on the time period specified.
4. **Peak streamflow**: the maximum instantaneous discharge of a stream. It usually occurs at or near the time of maximum stage depending on the individual gage's recording interval.

Other information available for each stream gage is its: position, in latitude and longitude, county, state, hydrologic unit code, drainage area, and elevation. Field measurements of the stream along with water quality sample data may also exist.

Gathering Streamflow Data

The following procedure details how to obtain mean daily streamflow data from a stream gage in order to create a streamflow hydrograph. A streamflow hydrograph is the graphical relationship of streamflow discharge plotted against time.

1. Go to the USGS Real-Time Water Data for the Nation website, http://waterdata.usgs.gov/nwis/rt, and navigate to your particular state.

The USGS Real-Time Water Data website only shows stream gage stations currently in use. Offline stations and their associated data are also available by querying the database.

2. In the **Data Category** pull down (Figure 1) in the upper right corner select **Site Information.** Click **GO**.

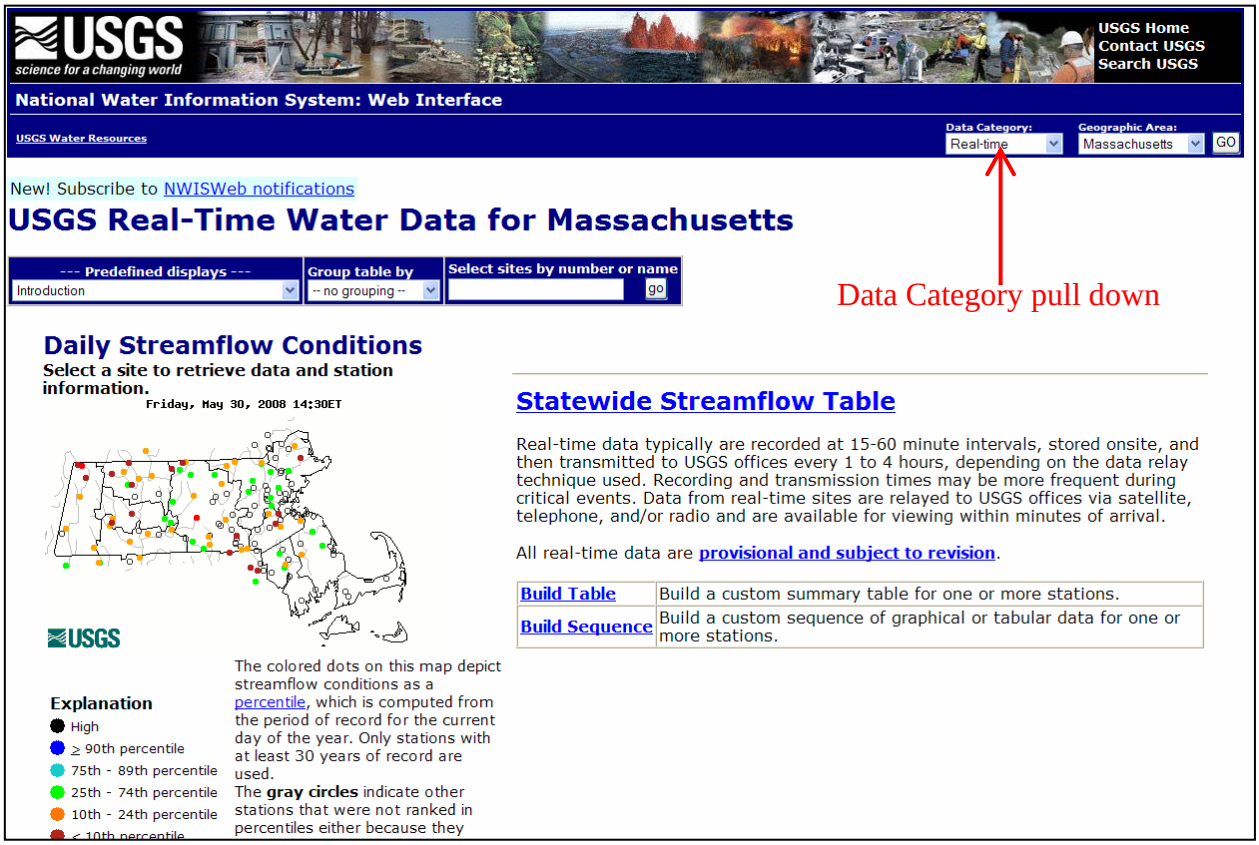


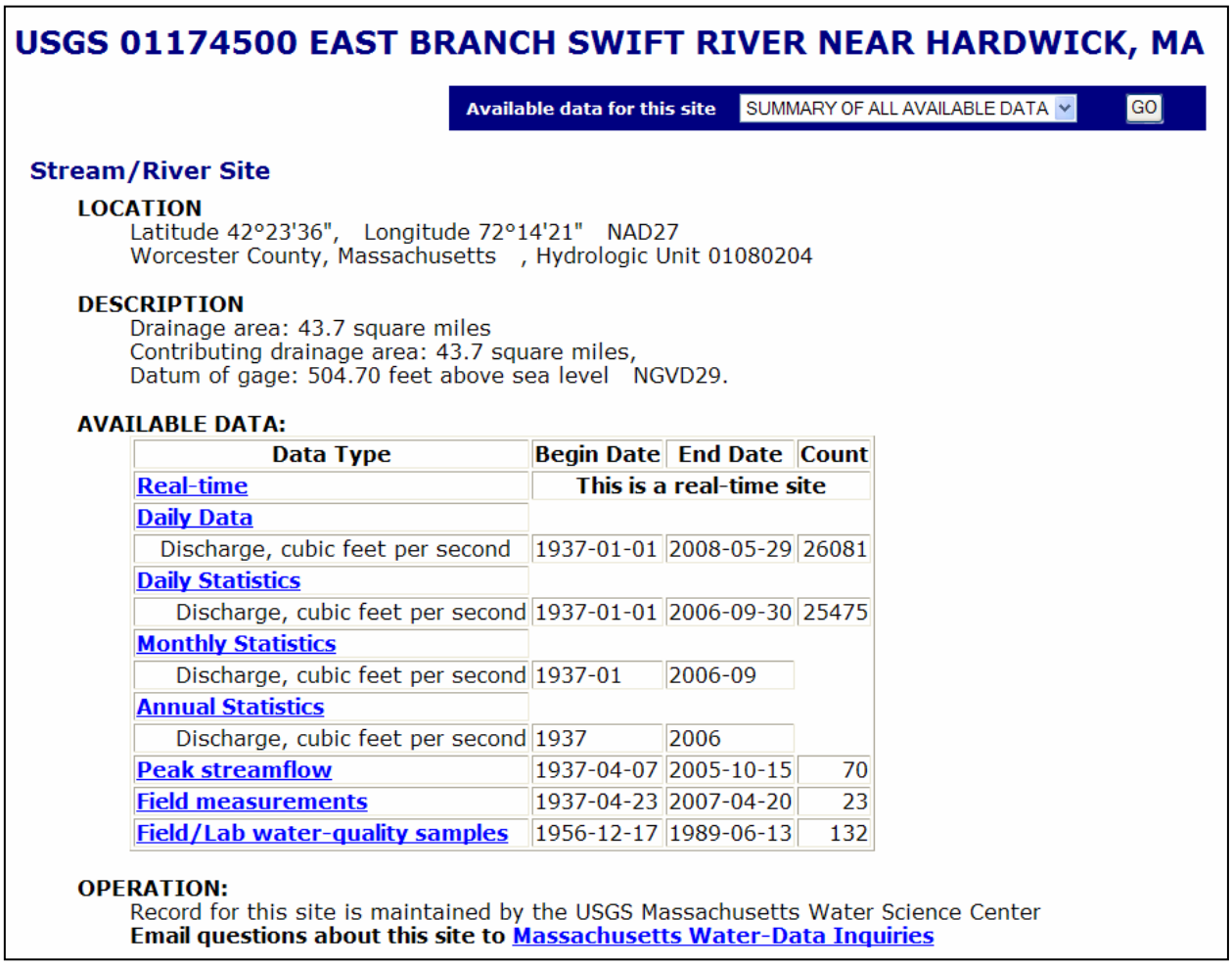
Figure 1. The USGS Real-Time Water Data web interface for Massachusetts.

3. Click on the **Site information** button.

4. Check any of the boxes under the Site Location, Site Identifier, or Site Attribute headings that best describes a location, name, number, or data type of the stream gage that you are most interested in. Click on the **Submit** button.

5. Depending on your choices you will be asked to narrow your search. Once you have selected a particular stream gage you will arrive at its main information page (Figure 2). Here you will find information on its location, description and what types of data are available and how long a record exists for each record type. Care should be taken in deciding on which streamflow gage to use. It should be based on the number of years of record, proximity to your particular site, and having a comparable land use, of its drainage area, to your watershed.

6. Click on **Daily Statistics** on the stream gage's main information page. The daily statistics page will show the period of approved daily-mean data available from the stream gage (Figure 3). Check the box under the stream gage's heading to enable a table of the mean daily streamflow to be produced. Set the particular dates that you are most interested in. Beginning from October 1st and ending on September 30th is a typical sequence for processing streamflow and other hydrological data. Start with the first available October 1st date and end with the last available September 30th date to maximize the use of the streamflow data. The mean of the daily mean streamflow values is the default table value.



USGS 01174500 EAST BRANCH SWIFT RIVER NEAR HARDWICK, MA

Available data for this site | SUMMARY OF ALL AVAILABLE DATA | GO

Stream/River Site

LOCATION
Latitude 42°23'36", Longitude 72°14'21" NAD27
Worcester County, Massachusetts , Hydrologic Unit 01080204

DESCRIPTION
Drainage area: 43.7 square miles
Contributing drainage area: 43.7 square miles,
Datum of gage: 504.70 feet above sea level NGVD29.

AVAILABLE DATA:

Data Type	Begin Date	End Date	Count
Real-time	This is a real-time site		
Daily Data			
Discharge, cubic feet per second	1937-01-01	2008-05-29	26081
Daily Statistics			
Discharge, cubic feet per second	1937-01-01	2006-09-30	25475
Monthly Statistics			
Discharge, cubic feet per second	1937-01	2006-09	
Annual Statistics			
Discharge, cubic feet per second	1937	2006	
Peak streamflow	1937-04-07	2005-10-15	70
Field measurements	1937-04-23	2007-04-20	23
Field/Lab water-quality samples	1956-12-17	1989-06-13	132

OPERATION:
Record for this site is maintained by the USGS Massachusetts Water Science Center
Email questions about this site to Massachusetts Water-Data Inquiries

Figure 2. USGS 01174500 East Branch Swift River stream gage.

7. Click on **Submit** to view a table of the time sequence. The result is the mean of all the daily mean streamflow values for your particular time interval. The results can be highlighted and copied directly into an Excel spreadsheet for further processing. Once copied into Excel, each value should be in its own cell.

8. Arrange the data in a column starting with the October 1st value and ending with the Sept 30th value.

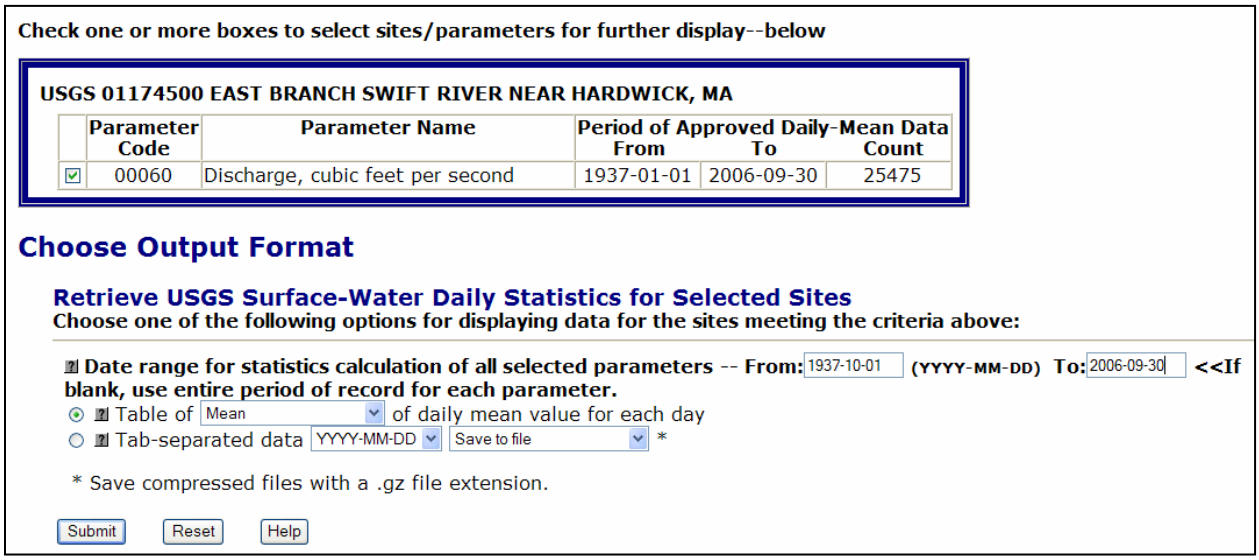


Figure 3. USGS 01174500 East Branch Swift River stream gage Daily Statistics.

9. Converting streamflow data to millimeters per day enables the data to be directly comparable with other data sources, such as precipitation. To convert the streamflow data values of cubic feet per second to millimeters per day involves a conversion. From the streamflow gage's website you will find its drainage area (Figure 2). This number will be used in the conversion. For the east branch Swift River stream gage the drainage area is 43.7 square miles. The conversion is as follows:

A. First convert the drainage area to square feet:

$$43.7 \text{ miles}^2 \times \frac{27{,}878{,}400 \text{ ft}^2}{1 \text{ mile}^2} = 1{,}218{,}286{,}080 \text{ ft}^2$$

B. Convert cubic feet per second to cubic feet per day:

$$\frac{1 \text{ ft}^3}{1 \text{ second}} \times \frac{60 \text{ seconds}}{1 \text{ minute}} \times \frac{60 \text{ minutes}}{1 \text{ hour}} \times \frac{24 \text{ hours}}{1 \text{ day}} = \frac{86{,}400 \text{ ft}^3}{\text{day}}$$

C. Combine above conversions:

$$\frac{\frac{86{,}400 \text{ft}^3}{\text{day}}}{1{,}218{,}286{,}080 \text{ ft}^2} = \frac{0.000070919 \text{ ft}}{\text{day}}$$

$$\frac{0.000070919 \text{ ft}}{\text{day}} \times \frac{12 \text{ in}}{1 \text{ ft}} \times \frac{25.4 \text{ mm}}{1 \text{ in}} = \frac{0.0216 \text{ mm}}{\text{day}}$$

conversion factor for the east branch Swift River stream gage is: $\frac{1 \text{ ft}^3}{\text{second}} = \frac{0.0216 \text{ mm}}{\text{day}}$

10. Multiply the cubic feet per second values, in the Excel spreadsheet, by the conversion factor.

11. Plot the daily mean streamflow in millimeters per day, y axis, by the days of the year, x axis, starting with October 1 (Figure 4).

Figure 4. Mean Daily Streamflow for 69 years for the East Branch Swift River.

The above hydrograph displays the natural cyclical relationship between streamflow and time of year. Due to snowmelt in the Northeast, streamflow is typically at its peak in the spring. In contrast, in the summer due to it being the peak of the growing season, streamflow is at its lowest.

Streamflow data can be used in a variety of watershed management applications: estimating the probability of occurrence of floods, frequency analysis-see Box 4 in the WFMIS User's Guide; sizing reservoirs storage capacities; allocating water supplies; computing total maximum daily load levels (TMDL); understanding timing and magnitude of flows for fish migration and spawning; and determining a stream crossing's hydraulic capacity-see section 5 of the WFMIS User's Guide.

For Further Reading

From the River to You: USGS Real-Time Streamflow Information. pdf
Benefits of USGS Streamgaging Program: Users and Uses of USGS Streamflow Data.pdf

Web Resources

National Streamflow Information Program (NSIP)
http://water.usgs.gov/nsip/reports.html

Water Resources of the United States
http://water.usgs.gov/

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