U.S. Geological Survey, New England Water Science Center,

meeting on Monday, February 1, 2016, with the

Town of Acton, Board of Health

regarding

APPLICATION FOR 10-DAY EMERGENCY BEAVER OR MUSKRAT PERMIT

To reduce flooding at the USGS Streamflow Gaging Station

Nashoba Brook near Acton, MA (01097300)

- The USGS Streamflow Network provides streamflow and water-level data for the nation

USGS
science for a changing world

Streamgages–Measuring the Pulse of our Nation's Rivers

What is a Streamgage?

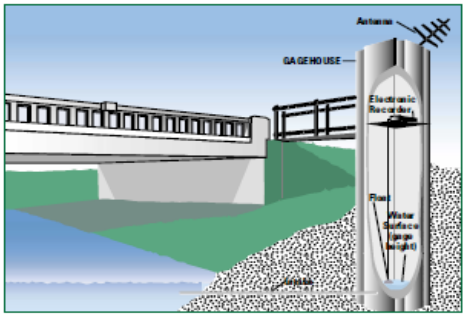
Information on the flow of rivers is a vital national asset that safeguards lives, protects property, and ensures adequate water supplies for the future. The U.S. Geological Survey (USGS) operates a network of about 7,000 streamgages nationwide.

A streamgage is a structure located beside a river that contains a device to measure and record the water level in the river. Generally, these measurements occur automatically every 15 minutes, and at about 5,000 of these streamgages the data are sent via satellite back to a USGS office once every 4 hours, and more frequently in times of flooding. There, USGS computers use a site-specific "rating curve" to convert the water-level (or "gage-height") data into information about the flow of the river (measured in cubic feet per second). To keep the rating curve accurate and up-to-date, USGS hydrologic technicians visit each streamgage about once every 6 weeks to measure the flow directly.

The flow and gage-height data are then made available to users over the Internet (http://water.usgs.gov/nwis/). Users access data for immediate use and in data sets that describe the average conditions, long-term variations, and trends in flow.

Good Planning & Good Decisions Depend on Good Information

Families, communities, and businesses need information about rivers in their areas to help them make good decisions.



- County or city planners need to know what area should be zoned as flood plain so that families and businesses will not build in locations that are vulnerable to floods.
- Families and businesses need warnings of impending floods to help them decide about evacuating and to decide about moving valuables (heirlooms, furniture, cars, boats, appliances) out of harm's way.
- Communities need information to plan for their future water supplies.
- Communities and farmers need information about river conditions to help them develop strategies to help them through a drought.
- State and county highway departments need information so they can design adequate bridges, culverts, and roadways that will function safely during floods.
- Watershed organizations and regulatory agencies need river-flow information (along with water-quality data) to develop cost-effective plans to improve and protect water quality.
- Families planning to canoe, kayak, or fish need information to avoid unsafe river conditions and to preclude costly trips to remote river locations when conditions are not suitable for recreation.

Information at Risk

The streamgaging network is operated as a partnership between the USGS and over 800 Federal, State, tribal, and local agencies. This partnership has great value but has been showing significant instability in recent years. There is widespread agreement among stakeholders that a new shared plan is needed to reverse the loss of streamgages and to provide for a stable and modern system for the future.

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

USGS Information Sheet
April 2001

- Streamflow data for Massachusetts streams is available on-line, in real-time, from the USGS website: http://ma.water.usgs.gov/

USGS science for a changing world

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National Water Information System: Web Interface

USGS Water Resources (District Access)

Data Category: Current Conditions | Geographic Area: Massachusetts | GO

Click for News Bulletins

USGS Current Water Data for Massachusetts

Click to hide state-specific text

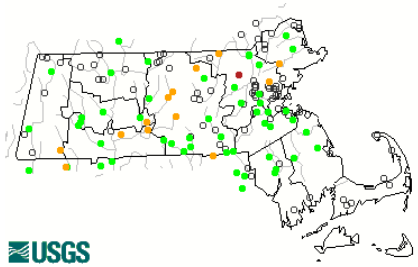
ICE EFFECTS ON STREAMFLOW During winter, ice formation may cause stage and discharge values to appear higher than expected. Ice effects may be minor (occurring only at night and early morning) with baseline flows obvious, or the effects may be major (stage constantly increases over several days or weeks) resulting in greatly erroneous discharge. Streamgages experiencing minor ice conditions will continue to display stage and discharge values to enable users to estimate the approximate base-line stage and discharge. Streamgages experiencing major ice conditions will have the discharge record temporarily disabled to prevent use of erroneous discharge values. The discharge record will resume when it is determined that ice conditions are no longer present. Daily mean discharges during periods of ice effect will be estimated after detailed data analysis.

--- Predefined displays ---
Introduction | go

Daily Streamflow Conditions

Select a site to retrieve data and station information.

Friday, January 29, 2016 16:30ET



USGS

Explanation

- High
- > 90th percentile
- 76th - 90th percentile
- 25th - 75th percentile
- 10th - 24th percentile
- < 10th percentile
- Low
- Not ranked

The colored dots on this map depict streamflow conditions as a percentile, which is computed from the period of record for the current day of the year. Only stations with at least 30 years of record are used.
The **gray circles** indicate other stations that were not ranked in percentiles either because they have fewer than 30 years of record or because they report parameters other than streamflow. Some stations, for example, measure stage only.

Statewide Streamflow Table

Current data typically are recorded at 15- to 60-minute intervals, stored onsite, and then transmitted to USGS offices every 1 to 4 hours, depending on the data relay technique used. Recording and transmission times may be more frequent during critical events. Data from current sites are relayed to USGS offices via satellite, telephone, and/or radio telemetry and are available for viewing within minutes of arrival.

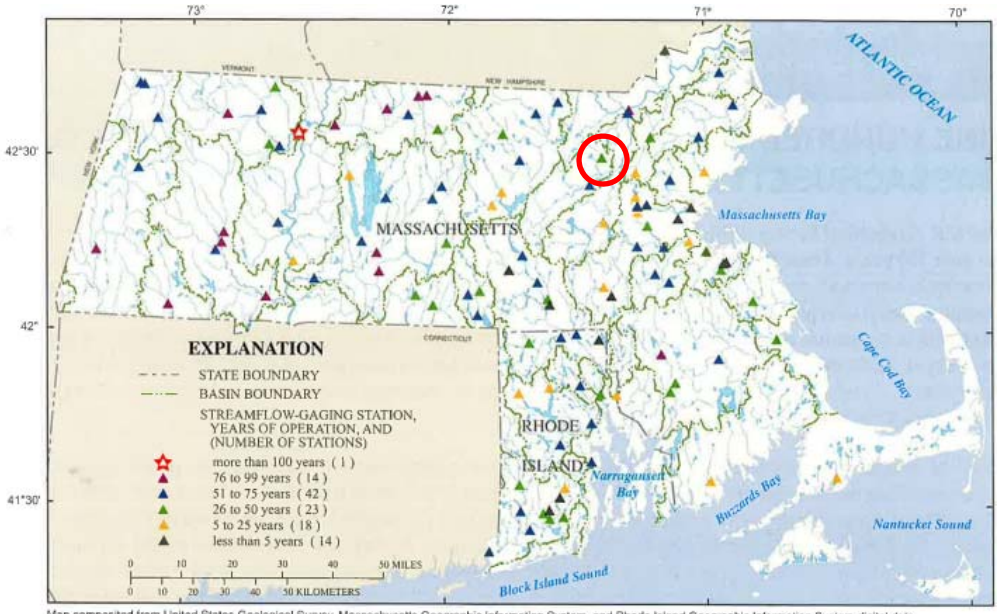
All real-time data are provisional and subject to revision.

Build Current Conditions Table	Show a custom current conditions summary table for one or more stations.
Build Time Series	Show custom graphs or tables for a series of recent data for one or more stations.

- The Nashoba Brook gaging station was established in 1963, in response to the need for streamflow data during the 1960's drought-of-record in Massachusetts .

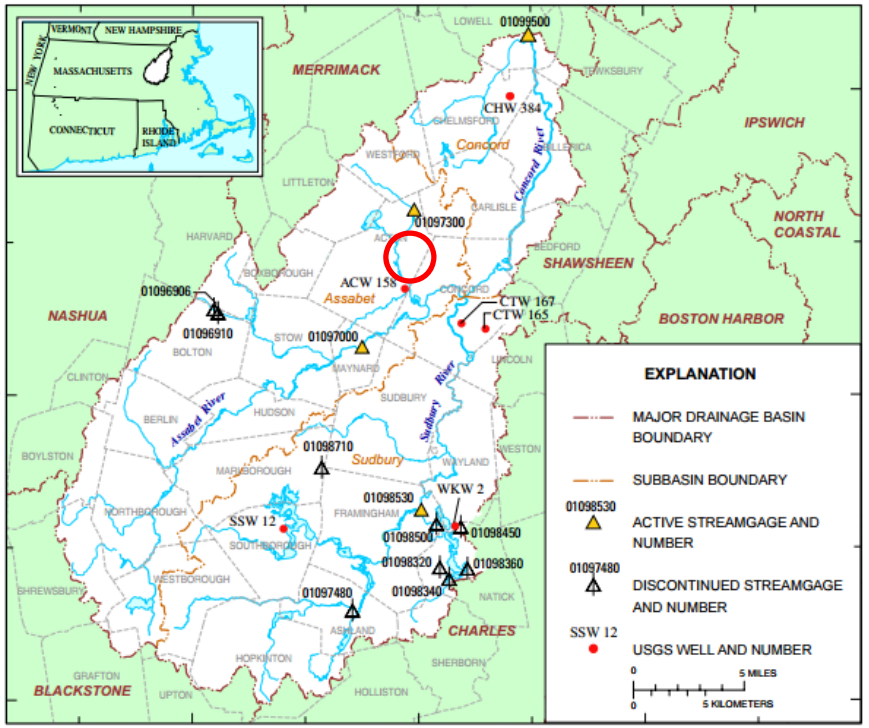
- The Nashoba Brook gage is one of 2 gages in the Assabet River basin.

- The Nashoba Brook gage is valuable because it is one of the few long-term gages (52 yrs) in eastern Massachusetts located on a small stream with relatively-unaltered flow.



Map composited from United States Geological Survey, Massachusetts Geographic Information System, and Rhode Island Geographic Information System digital data, State Plane projection, North American Datum 1983

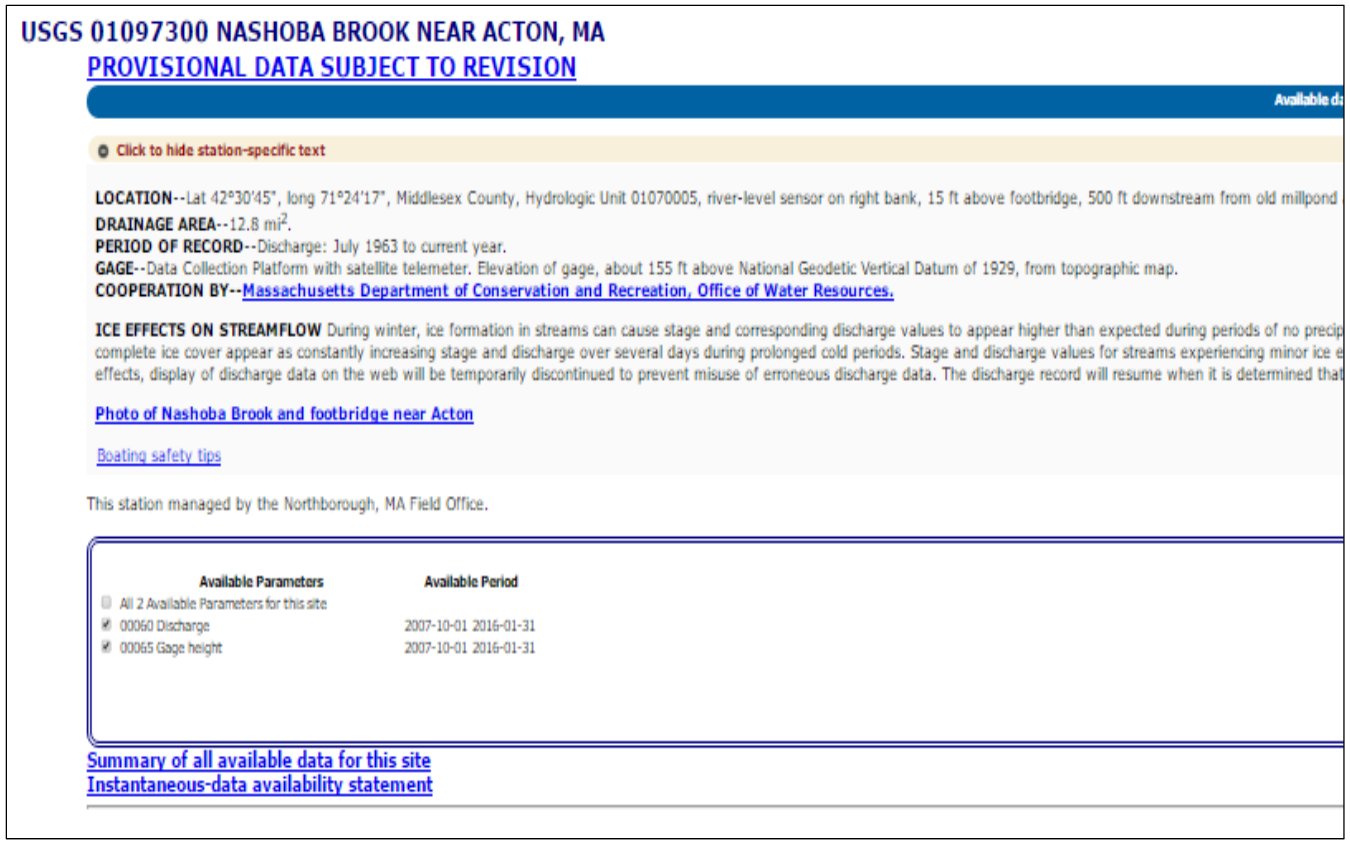
Figure 1. Locations and periods of record for the 112 streamflow-gaging stations currently operating in Massachusetts and Rhode Island.



Base from U.S. Geological Survey digital data, 1:25,000, 1991,

- Funding for the USGS Nashoba Brook gage is provided by a Cooperative Agreement between the Massachusetts Department of Conservation and Recreation (formerly MDEM*) and the USGS

*MDEM funded the construction of the long footbridge over Nashoba Brook



USGS 01097300 NASHOBA BROOK NEAR ACTON, MA

PROVISIONAL DATA SUBJECT TO REVISION

Click to hide station-specific text

LOCATION--Lat 42°30'45", long 71°24'17", Middlesex County, Hydrologic Unit 01070005, river-level sensor on right bank, 15 ft above footbridge, 500 ft downstream from old millpond
DRAINAGE AREA--12.8 mi^2.
PERIOD OF RECORD--Discharge: July 1963 to current year.
GAGE--Data Collection Platform with satellite telemeter. Elevation of gage, about 155 ft above National Geodetic Vertical Datum of 1929, from topographic map.
COOPERATION BY--Massachusetts Department of Conservation and Recreation, Office of Water Resources.

ICE EFFECTS ON STREAMFLOW During winter, ice formation in streams can cause stage and corresponding discharge values to appear higher than expected during periods of no precip
complete ice cover appear as constantly increasing stage and discharge over several days during prolonged cold periods. Stage and discharge values for streams experiencing minor ice e
effects, display of discharge data on the web will be temporarily discontinued to prevent misuse of erroneous discharge data. The discharge record will resume when it is determined that

Photo of Nashoba Brook and footbridge near Acton

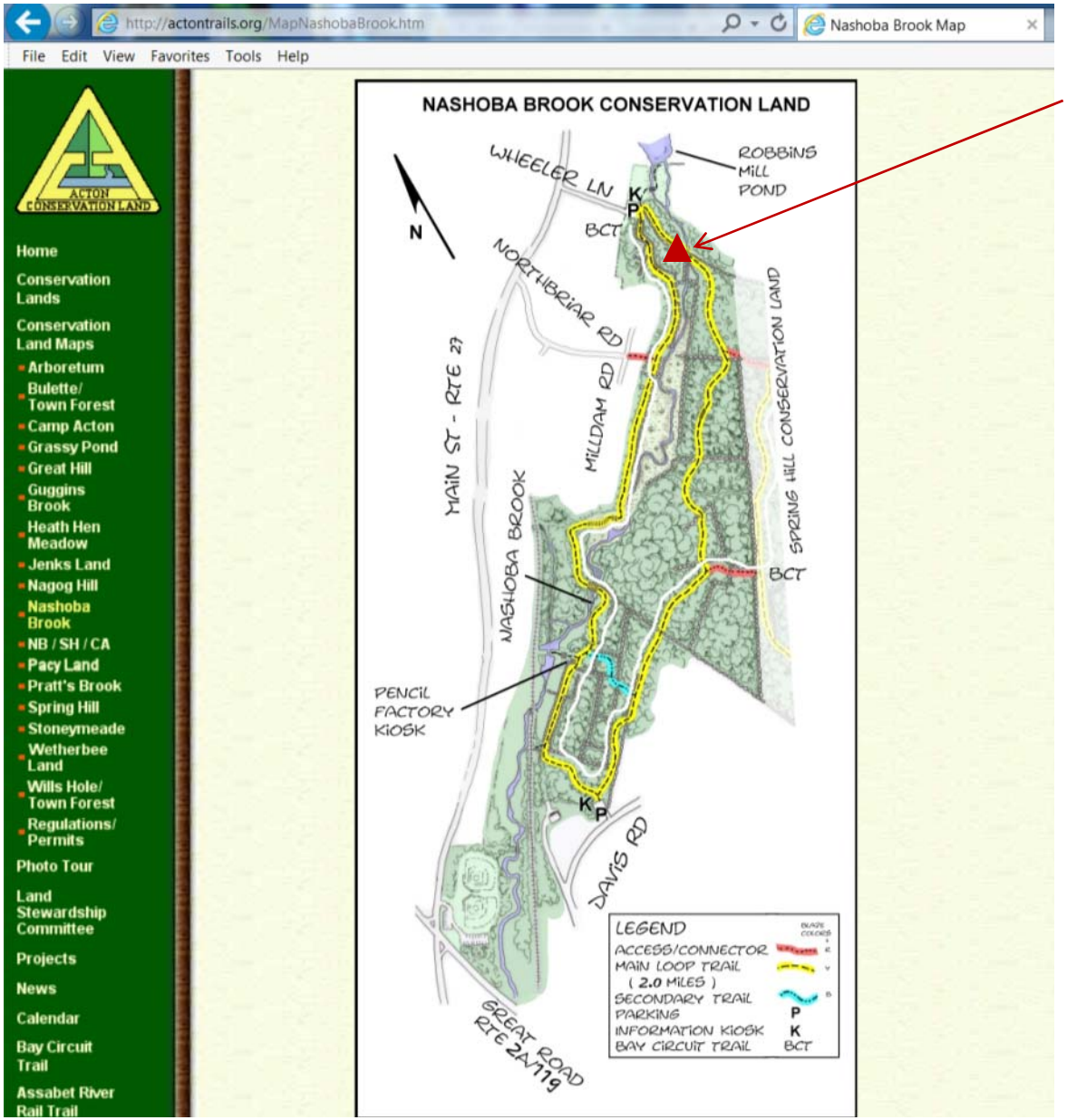
Boating safety tips

This station managed by the Northborough, MA Field Office.

Available Parameters	Available Period
All 2 Available Parameters for this site	
00060 Discharge	2007-10-01 2016-01-31
00065 Gage height	2007-10-01 2016-01-31

Summary of all available data for this site
Instantaneous-data availability statement

- The Nashoba Brook gage is located in the Nashoba Brook Conservation Land, off Wheeler Lane in Acton



Nashoba Brook gage

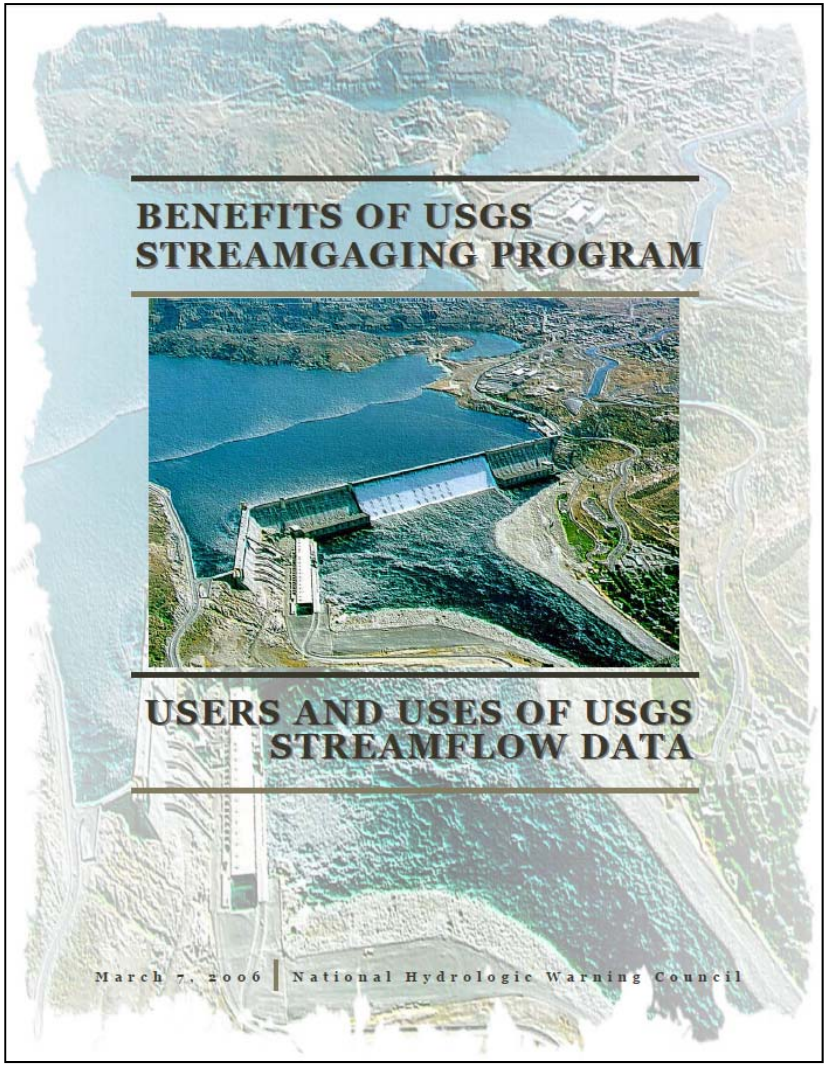
- Prior to 1997, the gage was located downstream on Nashoba Brook.
- The gage was moved upstream to its current location off Wheeler Lane because of frequent flooding by beaver in the large meadow downstream.
- This is the first year since that the gage has been flooded by beaver.

- The Nashoba Brook gage records water-level year-around, every 15 minutes

Low flow

High flow

- USGS streamflow data is valuable for many different users



Uses of USGS streamgaging data fall broadly into the following 9 categories:

1. Planning, designing, operating, and maintaining the nation's multipurpose water management systems.
2. Issuing flood warnings to protect lives and reduce property damage.
3. Designing highways and bridges.
4. Mapping floodplains.
5. Monitoring environmental conditions and protecting aquatic habitats.
6. Protecting water quality and regulating pollutant discharges.
7. Managing water rights and transboundary water issues.
8. Education and research.
9. Recreational uses.

Local examples

- Acton's 2009 DEP Water Management Act permit that governs groundwater withdrawals for Acton's public water supply uses the Nashoba Brook gage to set limits for non-essential water use.
- OARS uses the Nashoba Brook gage to assess the health of Nashoba Brook as cold-water fish habitat. See http://www.pars3rivers.org

USGS
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How Does a U.S. Geological Survey Streamgage Work?

Information on the flow of rivers and streams is a vital national asset that safeguards lives, protects property, and ensures adequate water supplies for the future. The U.S. Geological Survey (USGS) operates a network of more than 9,000 streamgages nationwide with more than 500 in Texas.

If you have ever crossed a highway bridge and noticed a metal structure with an antenna by the side of it, you've probably seen a USGS streamgage (fig. 1). A streamgage contains instruments that measure and record the amount of water flowing in the river or stream, or its discharge. Generally, these measurements occur automatically every 15 minutes or more frequently in times of flooding.

Words that have the same meaning used throughout this text:

Stream stage = gage height = water level
Streamflow = discharge = flow
Streamflow station = streamgage = gaging station = gage

Figure 1. Examples of gage structures located at U.S. Geological Survey streamgaging stations.

USGS computers convert the water-level data into information about the flow of the river. The flow and gage-height data are then made available to users over the Internet at *http://water.usgs.gov/nwis/*.

How Streamflow Is Measured

Measuring streamflow in rivers or streams is similar to taking the pulse of blood flow in a human body. It is important to measure streamflow so that scientists and water managers can make informed decisions about a river's or stream's health.

Measuring streamflow generally involves several steps. These include recording continuous water levels, taking discharge measurements in the river or stream, developing a mathematical relation between stage and discharge, and then applying this relation to the continuous stage record to compute streamflow. Because it is not practical for a streamgage to continuously measure streamflow, the gage height of a stream is continuously measured. There is a strong mathematical relation between this height and streamflow and, as a result, a continuous record of streamflow can be calculated from the record of stream stage.

Measuring the relative height of streams is done many times a day through an underwater tube contained in the streamgage (fig. 2). Gas is continually pushed through the tube into the stream. As the depth of water above the tube opening increases, more pressure is required to push the gas through the tube. As the water decreases, less pressure is needed to push the gas out. This level of pressure is used to calculate the height of the water above the tube. These changes in pressure are recorded as changes in height, or stage. Stage data are measured usually every 15 minutes. When intense rainfall and runoff cause the river or stream to rise quickly, the time intervals sometimes are shorter. The time interval can be as short as every 5 minutes. These data are transmitted to a satellite on a preset schedule which is usually every 1 to 4 hours. During high water or other emergency situations, data will be sent to the satellite every 15 minutes to provide more timely data.

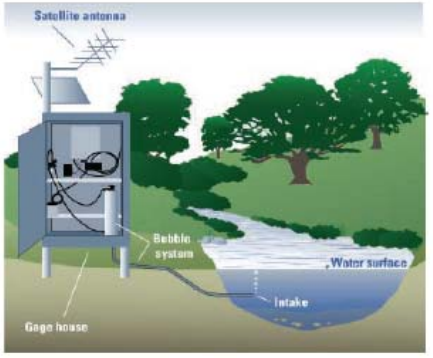

Figure 2. Diagram of a typical streamgage installation with equipment used to measure stream stage (by L.S. Coplin, U.S. Geological Survey).

U.S. Department of the Interior
U.S. Geological Survey
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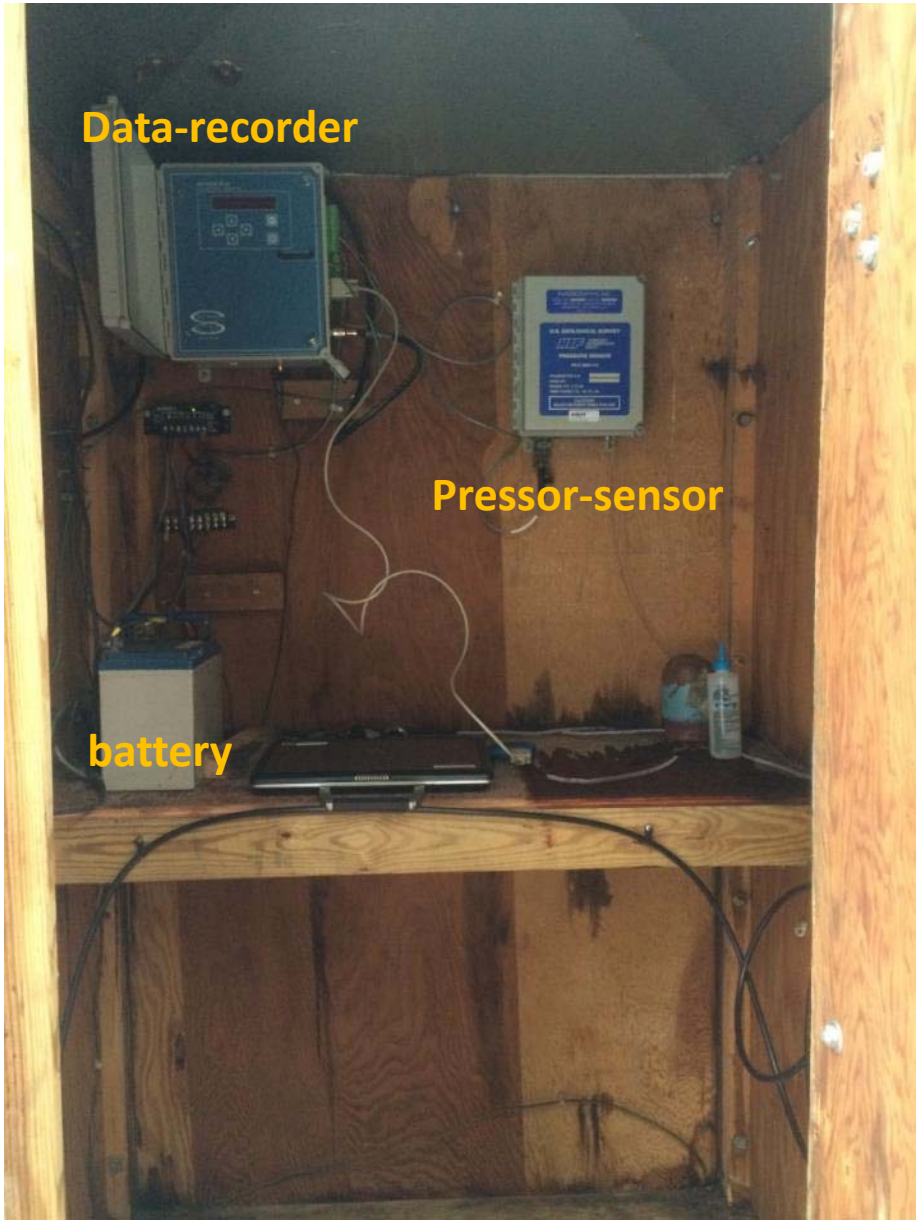
Fact Sheet 2011-3001
January 2011

Steps to calculate streamflow at a streamgage

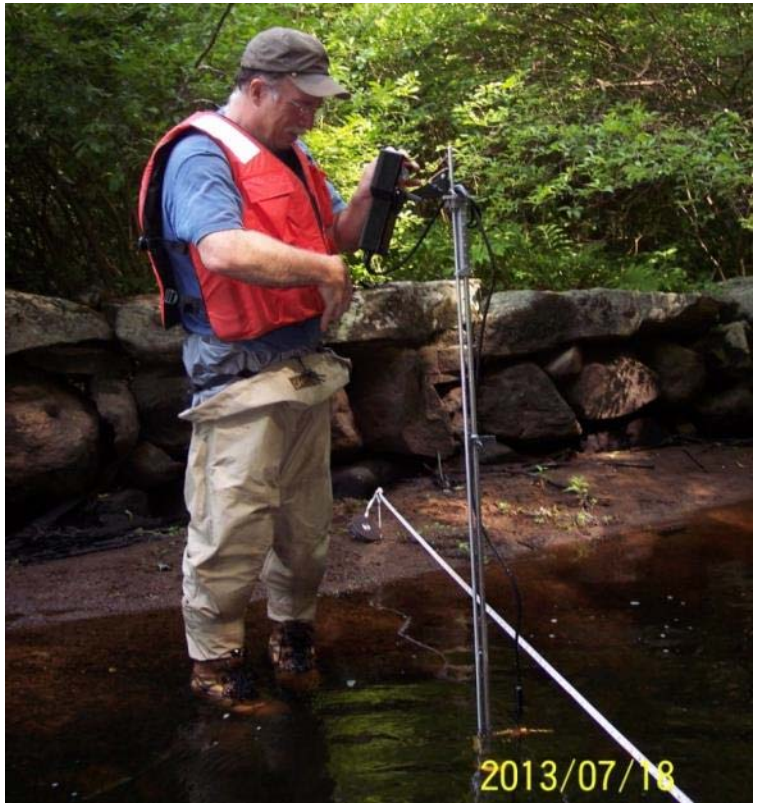
1. Identify a gage pool with a control section.
2. Establish a reference staff-gage in the gage pool.
3. Install a stage sensor in the gage pool, calibrated to read the water-level at the staff-gage, and record water-level data every 15 minutes.
4. Make discharge measurements at different water-levels and flow rates.
5. Develop a stage-discharge relation (rating curve and table).
6. Use rating curve to compute discharge for each 0.01 ft of stage.

- Nashoba Brook gage: control section and equipment in the brook

Nashoba Brook gage: Gagehouse, stage sensor, data recorder and satellite transmitter



- Discharge measurements are made in Nashoba Brook at different discharges (low, medium, high flows), and used to develop rating curves



Example discharge measurement:

01097300 Nashoba Brook, Measurement 451, 2015-06-09

(wading measurement 451 with acoustic flow meter; results shown below)

Discharge Measurement Summary

Date Generated: Thu Jan 28 2016

File Information

File Name	01097300.WAD
Start Date and Time	2015/06/09 11:22:11

Site Details

Site Name	01097300
Operator(s)	CRB

System Information

Sensor Type	FlowTracker
Serial #	P1800
CPU Firmware Version	3.9
Software Ver	2.30
Mounting Correction	0.0%

Units (English Units)

Distance	ft
Velocity	ft/s
Area	ft^2
Discharge	cfs

Discharge Uncertainty

Category	ISO	Stats
Accuracy	1.0%	1.0%
Depth	0.2%	4.3%
Velocity	0.5%	2.4%
Width	0.1%	0.1%
Method	1.5%	-
# Stations	1.5%	-
Overall	**2.4%**	**5.0%**

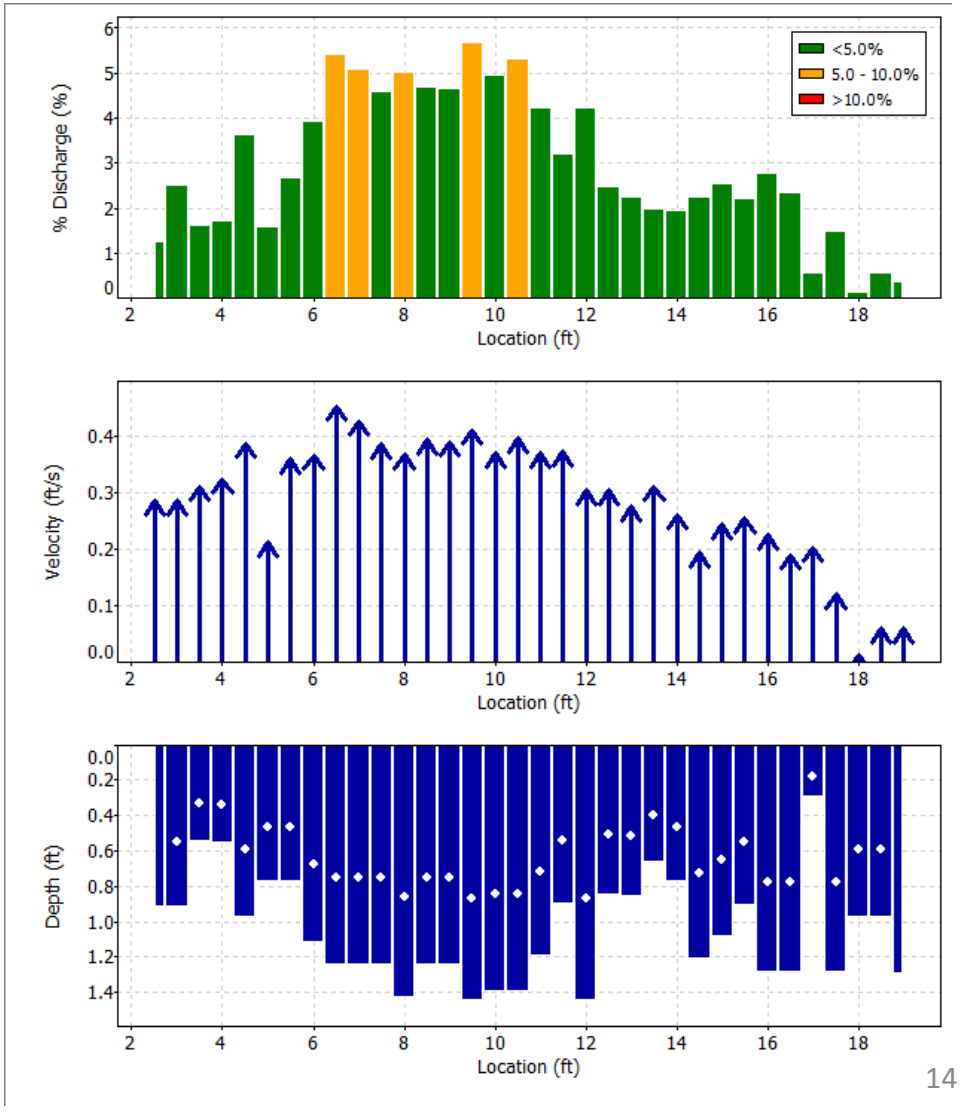
Summary

Averaging Int.	40	# Stations	34
Start Edge	REW	Total Width	16.500
Mean SNR	20.6 dB	Total Area	17.390
Mean Temp	65.70 °F	Mean Depth	1.054
Disch. Equation	Mid-Section	Mean Velocity	0.2914
		Total Discharge	**5.2411**

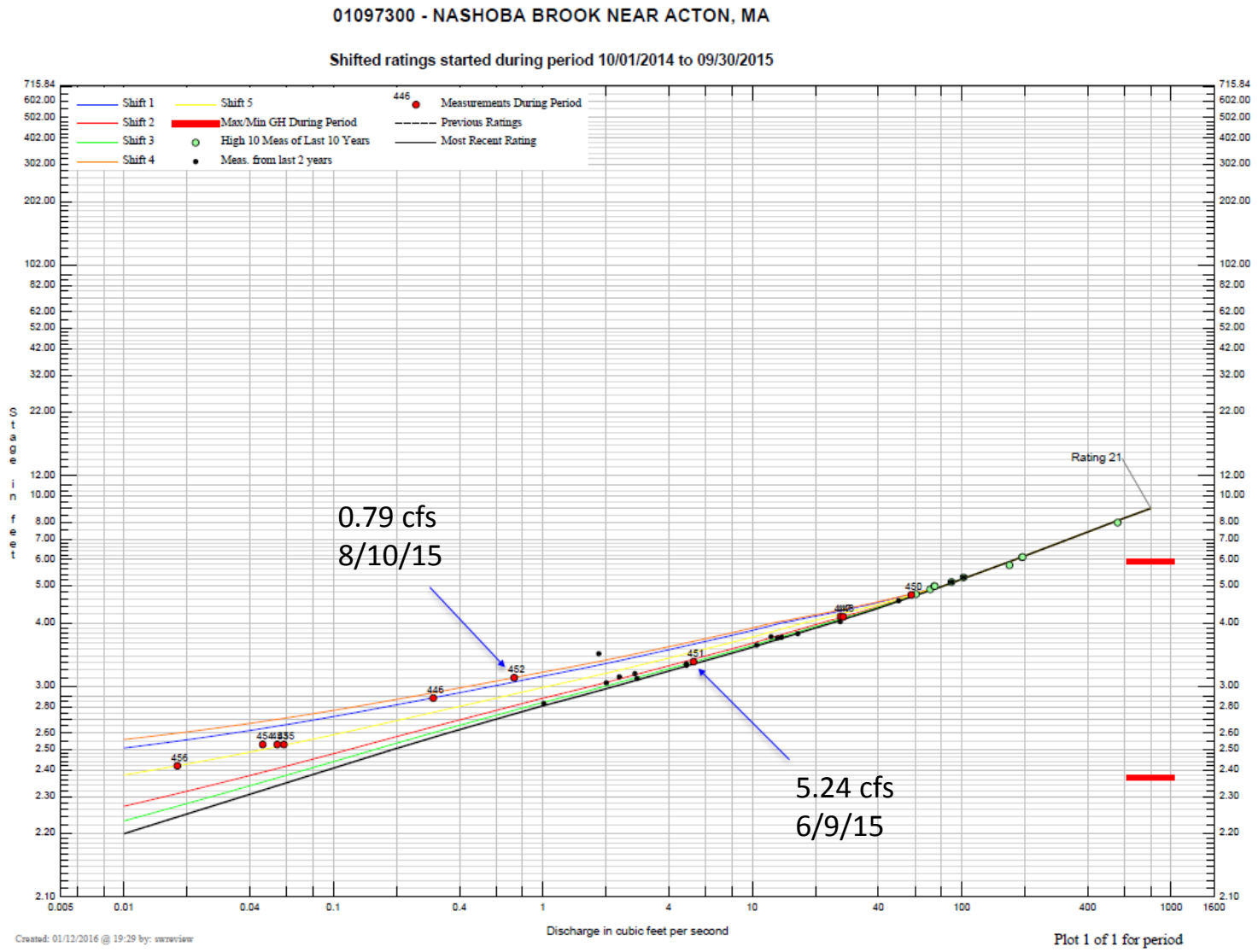
Measurement Results

St	Clock	Loc	Method	Depth	%Dep	MeasD	Vel	CorrFact	MeanV	Area	Flow	%Q
0	11:22	2.50	None	0.920	0.0	0.0	0.0000	1.00	0.2861	0.230	0.0658	1.3
1	11:22	3.00	0.6	0.920	0.6	0.368	0.2861	1.00	0.2861	0.460	0.1316	2.5
2	11:23	3.50	0.6	0.550	0.6	0.220	0.3117	1.00	0.3117	0.275	0.0857	1.6
3	11:25	4.00	0.6	0.560	0.6	0.224	0.3245	1.00	0.3245	0.280	0.0909	1.7
4	11:26	4.50	0.6	0.980	0.6	0.392	0.3878	1.00	0.3878	0.490	0.1900	3.6
5	11:27	5.00	0.6	0.780	0.6	0.312	0.2126	1.00	0.2126	0.390	0.0829	1.6
6	11:28	5.50	0.6	0.780	0.6	0.312	0.3596	1.00	0.3596	0.390	0.1402	2.7
7	11:29	6.00	0.6	1.120	0.6	0.448	0.3671	1.00	0.3671	0.560	0.2056	3.9
8	11:30	6.50	0.6	1.250	0.6	0.500	0.4531	1.00	0.4531	0.625	0.2832	5.4
9	11:31	7.00	0.6	1.250	0.6	0.500	0.4272	1.00	0.4272	0.625	0.2670	5.1
10	11:32	7.50	0.6	1.250	0.6	0.500	0.3862	1.00	0.3862	0.625	0.2413	4.6
11	11:33	8.00	0.6	1.430	0.6	0.572	0.3684	1.00	0.3684	0.715	0.2635	5.0
12	11:34	8.50	0.6	1.250	0.6	0.500	0.3947	1.00	0.3947	0.625	0.2467	4.7
13	11:35	9.00	0.6	1.250	0.6	0.500	0.3901	1.00	0.3901	0.625	0.2438	4.7
14	11:36	9.50	0.6	1.450	0.6	0.580	0.4111	1.00	0.4111	0.725	0.2981	5.7
15	11:37	10.00	0.6	1.400	0.6	0.560	0.3704	1.00	0.3704	0.700	0.2593	4.9
16	11:38	10.50	0.6	1.400	0.6	0.560	0.3970	1.00	0.3970	0.700	0.2779	5.3
17	11:39	11.00	0.6	1.200	0.6	0.480	0.3704	1.00	0.3704	0.600	0.2223	4.2
18	11:40	11.50	0.6	0.900	0.6	0.360	0.3727	1.00	0.3727	0.450	0.1677	3.2
19	11:41	12.00	0.6	1.450	0.6	0.580	0.3048	1.00	0.3048	0.725	0.2210	4.2
20	11:42	12.50	0.6	0.850	0.6	0.340	0.3048	1.00	0.3048	0.425	0.1295	2.5
21	11:43	13.00	0.6	0.860	0.6	0.344	0.2756	1.00	0.2756	0.430	0.1185	2.3
22	11:44	13.50	0.6	0.670	0.6	0.268	0.3120	1.00	0.3120	0.335	0.1045	2.0
23	11:45	14.00	0.6	0.780	0.6	0.312	0.2612	1.00	0.2612	0.390	0.1018	1.9
24	11:47	14.50	0.6	1.210	0.6	0.484	0.1949	1.00	0.1949	0.605	0.1179	2.2
25	11:48	15.00	0.6	1.090	0.6	0.436	0.2451	1.00	0.2451	0.545	0.1336	2.5
26	11:49	15.50	0.6	0.910	0.6	0.364	0.2556	1.00	0.2556	0.455	0.1163	2.2
27	11:50	16.00	0.6	1.290	0.6	0.516	0.2260	1.00	0.2260	0.645	0.1458	2.8
28	*11:51*	*16.50*	*0.6*	*1.290*	*0.6*	*0.516*	*0.1909*	*1.00*	*0.1909*	*0.645*	*0.1232*	*2.3*
29	*11:52*	*17.00*	*0.6*	*0.300*	*0.6*	*0.120*	*0.2044*	*1.00*	*0.2044*	*0.150*	*0.0306*	*0.6*
30	*11:53*	*17.50*	*0.6*	*1.290*	*0.6*	*0.516*	*0.1214*	*1.00*	*0.1214*	*0.645*	*0.0783*	*1.5*
31	11:54	18.00	0.6	0.980	0.6	0.392	0.0154	1.00	0.0154	0.490	0.0076	0.1
32	*11:55*	*18.50*	*0.6*	*0.980*	*0.6*	*0.392*	*0.0604*	*1.00*	*0.0604*	*0.490*	*0.0296*	*0.6*
33	11:55	19.00	None	1.300	0.0	0.0	0.0000	1.00	0.0604	0.325	0.0196	0.4

Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

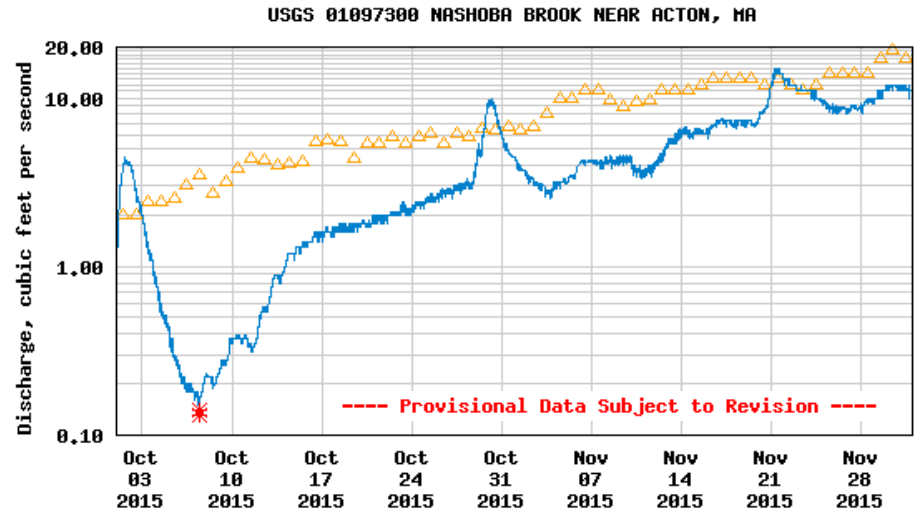


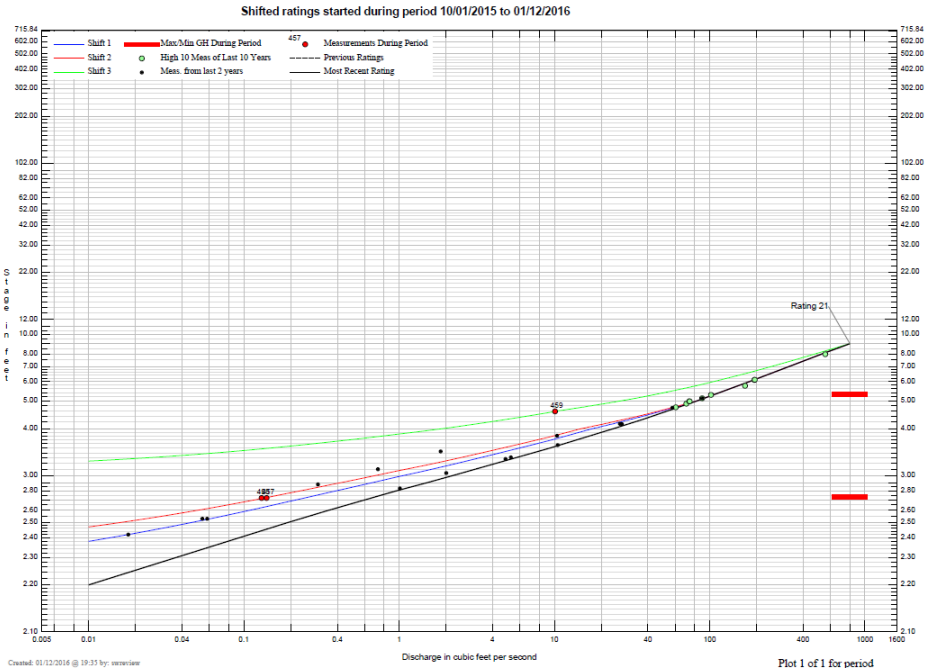
01097300, Stage-Discharge Rating Curve Showing Measurements 451 and 452

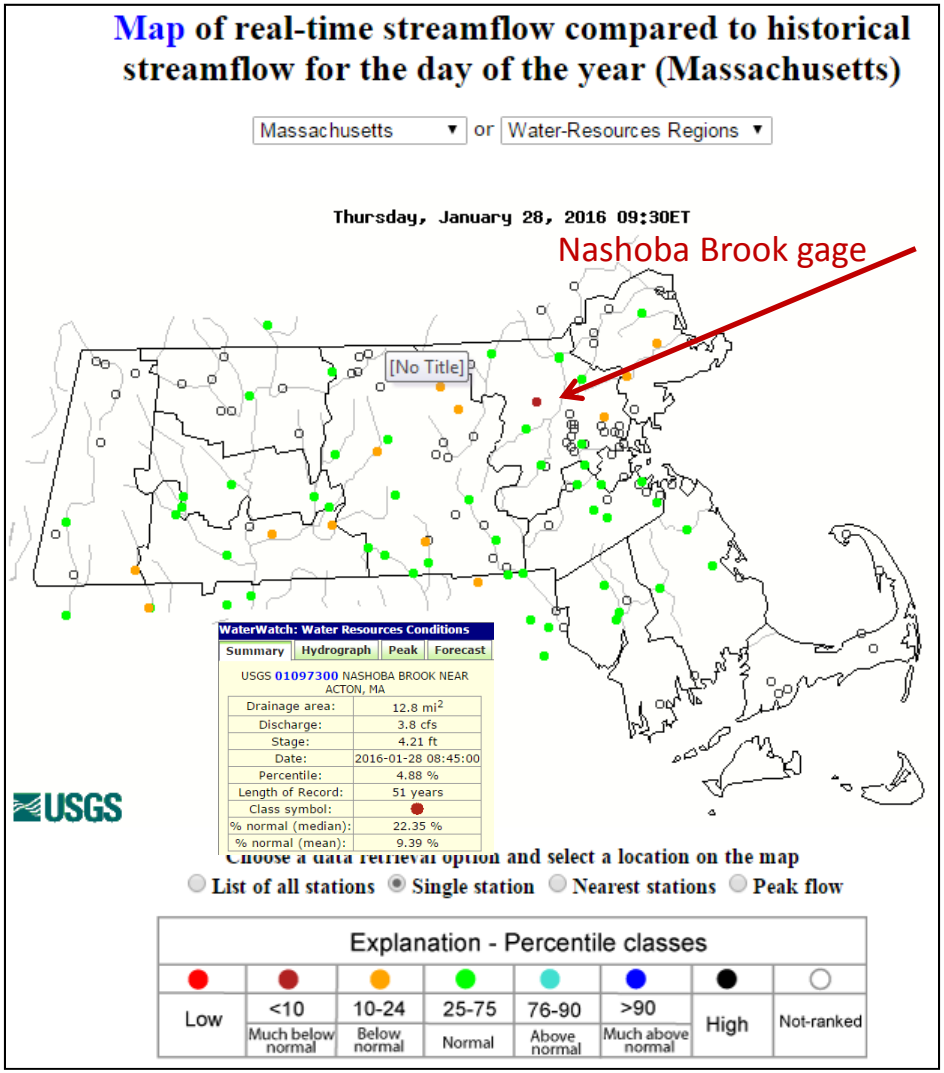


The Nashoba Brook gage currently has backwater from a downstream beaver dam, (photos taken 12/8/2015

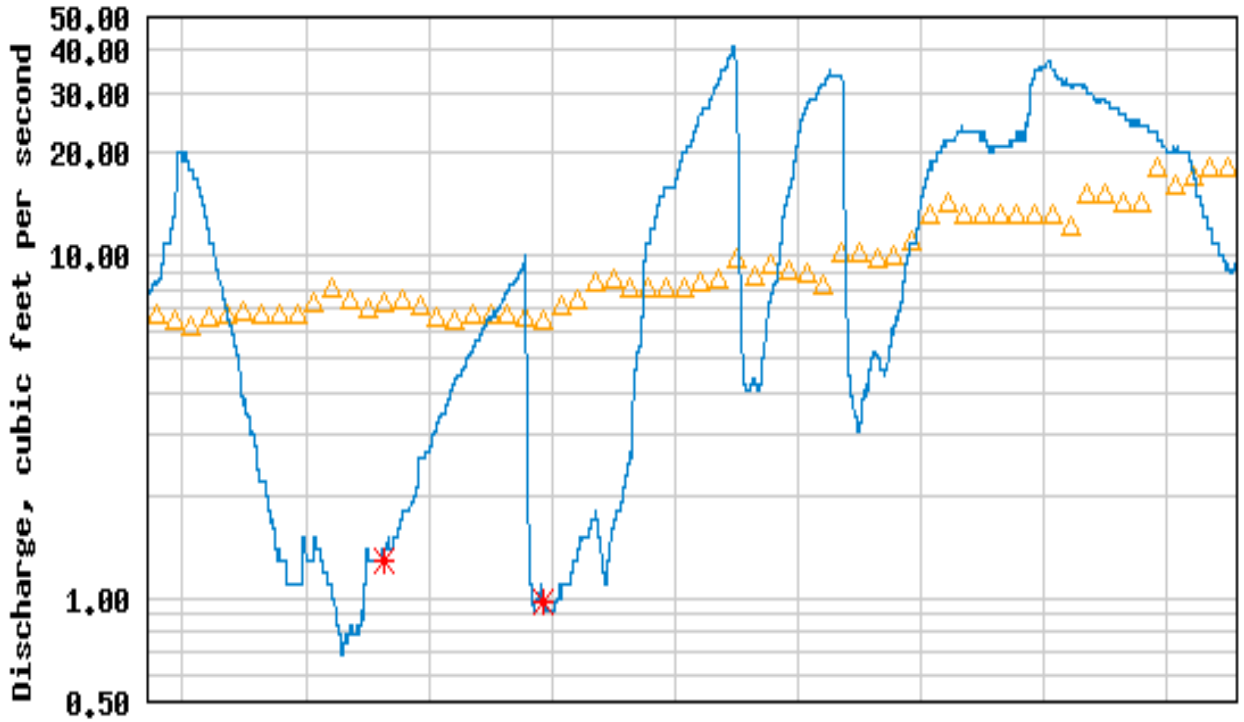
- The backwater behind the beaver dam raises the water-level at the gage and causes inaccurate flow data at the gage.







- If you just remove the beaver dam, the beaver will build quickly rebuild it.



- Beaver deceiver pipes can help, but the dam must be removed or it will alter moderate and high flows at the gage.
- If necessary, the USGS is willing to try installing a beaver-deceiver pipe at the dam location to try to discourage beaver from building dams at the site in the future.

- The USGS is also willing to install educational material on the Nashoba Brook gage to help educate the public on the importance of the Nashoba Brook gage and of the USGS streamflow gaging network.

The beaver lodge on Nashoba Brook is small and likely houses a small colony of beaver.

The beaver dam is also relatively small, however, if it is built up slightly higher it will tie into downed trees and potentially flood the trail.

- There are many beaver in the Nashoba Brook system – such as in the upstream millpond

- Tom Maguire, MDEP Wetlands Program beaver-related flooding coordinator, worked with the State to develop the BOH Guidance, and said that USGS gages fall under the public utilities in section (e).

The Commonwealth of Massachusetts
Executive Office of Health and Human Services
Department of Public Health
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Guidance for Boards of Health Implementing M.G.L. c.131, s.80A
Threats from Beaver and Muskrat-Related Activities

Summary of the Law

The Massachusetts Legislature recently amended M.G.L. c.131, s.80A, with the passage of "An Act Relative to Foothold Traps and Certain Other Devices." This new law became effective on July 21, 2000, and was intended to make it easier for applicants to alleviate threats caused by beaver and muskrat-related flooding.

Any person may apply to the Board of Health (Board) for an emergency permit to immediately alleviate a threat to human health and safety from beaver or muskrat-related activity. The law includes a list of activities, set forth below, that may constitute a threat to human health and safety. The activities in this list are intended to be suggestions about what could constitute a threat, but the determination of whether an activity poses a threat is left to the judgment of the local health officials. If local health officials determine that there is not a threat to public health or safety, this does not mean that the person seeking assistance is without options. With appropriate permits, they can still install water flow devices, breach dams, or trap, under different conditions, which are outlined within the last three paragraphs of MGL c. 131, s. 80A. The person can also appeal the Board's decision to the Massachusetts Department of Public Health (MDPH) or the Division of Fisheries and Wildlife (DF&W) (see page 11).

A threat to human health and safety may include:

(a) beaver or muskrat occupancy of a public water supply;

(b) beaver or muskrat-caused flooding of drinking water wells, well fields or water pumping stations;

(c) beaver or muskrat-caused flooding of sewage beds, septic systems or sewage pumping stations;

(d) beaver or muskrat-caused flooding of a public or private way, driveway, railway or airport runway or taxi-way;

(e) beaver or muskrat-caused flooding of electrical or gas generation plants or transmission or distribution structures or facilities, telephone or other communications facilities or other public utilities;

(f) beaver or muskrat-caused flooding affecting the public use of hospitals, emergency clinics, nursing homes, homes for the elderly or fire stations;

(g) beaver or muskrat-caused flooding affecting hazardous waste sites or facilities, incineration or resource recovery plants or other structures or facilities whereby flooding may result in the release or escape of hazardous or noxious materials or substances;

(h) the gnawing, chewing, entering, or damage to electrical or gas generation, transmission or distribution equipment, cables, alarm systems or facilities by any beaver or muskrat;

(i) beaver or muskrat-caused flooding or structural instability on property owned by the applicant if such animal problem poses an imminent threat of substantial property damage or income loss, which shall be limited to: (1) flooding of residential, commercial, industrial or commercial buildings or facilities; (2)

regulation); 2) breaching of dams, dikes, bogs or berms, subject to determinations and conditions of Conservation Commissions; or 3) use of any non-lethal management or water-flow devices, subject to determinations and conditions of Conservation Commissions (see Sample Permits in Appendix I).

If the applicant has been unable to solve the problem within the 10-day emergency permit period, the applicant, in conjunction with the Board of Health, shall subsequently apply to the DF&W for a 30-day extension permit. While awaiting approval from the DF&W for the 30-day extension permit, the applicant may apply to the Board for two additional ten-day emergency permits (see page 9 for guidance on extension permits).

Beaver and muskrat-related problems that are determined not to constitute threats to public health and safety under this new law may still be addressed. DF&W staff, private contractors, and non-governmental organizations specializing in this work, can assist individuals with dam breaching, installation of water control devices, and trapping subject to any necessary permit. Under M.G.L. c. 131, s. 80A, permits to use a Conibear trap can be issued by DF&W if box or cage traps and alternative methods like water control devices have been tried unsuccessfully for 15 days.

Making Public Health/Safety Determinations

The Board of Health must make a determination as to whether the applicant has a "threat to human health and safety". The intent of the legislation was to provide a quick remedy to flooding caused by beaver or muskrat. In the law, the permit is termed an "emergency permit". Such terminology is meant to imply that the permit is short lived (i.e., ten days) and will be issued quickly. The term "emergency" is NOT meant to imply that the applicant has a public health or safety emergency. The "emergency permit" is issued by the Board of Health to solve a "public health or safety threat". As defined under Chapter 131, Section 80A "A threat to human health or safety may include, but shall not be limited to:" the nine items listed in the law under sub-headings (a) through (i). Although this may become a simple determination once Boards of health become experienced with

- USGS has met with Acton Conservation Commission (Tom Tidman and Bettina Abe) to discuss the flooding, and would work closely with them during the trapping and beaver dam removal.

Questions ?