Appendix 8 – Example of an Index Velocity Station Analysis

A station analysis is a document that describes the complete analysis of the data collected, procedures used in processing the data, and the logic used in rating analysis and discharge computations (Rantz and others, 1982). This document should be prepared for each year of record (or more frequently for the Continuous Records Process) to provide a basis for review and to serve as a reference in the event that questions arise about the records at some future date. The station analysis should be written concisely and clearly and contain enough information that a hydrographer unfamiliar with the station will be able to reproduce the same discharge record. Two examples of a station analysis for an index velocity streamflow-gaging station are provided in this appendix: one for a non-tidal streamflow-gaging station and one for a tidally affected streamflow-gaging station.

Station Analysis for Non-Tidal Streamflow-Gaging Stations

Station Analysis View

02356000 FLINT RIVER AT BAINBRIDGE, GA

Responsible Office
U.S. Geological Survey
Albany - Field Office
314 Roosevelt Avenue
Albany, GA 31702
(229) 430-8420

Most recent revision: 1/19/2011
Revised by: agotvald

LOCATION.--Lat 30°54'41", long 84°34'48" referenced to North American Datum of 1927, Decatur County, GA, Hydrologic Unit 03130008, on downstream side of bridge on US 27 (Business Route), 0.2 mi downstream from Seaboard Coast Line Railroad bridge, and 29.2 mi upstream from Jim Woodruff Dam, 5.19 mi upstream from confluence with Fourmile Creek, 2.37 mi downstream from confluence with Big Slough Creek, 0.6 mi northwest of Bainbridge, and at mile 29.0.

EQUIPMENT.-- Satellite telemetry data is provided by a Design Analysis H-522+ Data Collection Platform (DCP), which is interfaced with a Vaisala 436BD shaft encoder, a Design Analysis H340 raingage, and a 1.5 MHz SonTek Argonaut SL acoustic Doppler velocity meter (ADVM). The DCP is housed in an aluminum box shelter over a 24 inch spiral aluminum pipe stilling well that is attached to the downstream side of the right center bridge pier. The float indicator is used as the primary reference gage. A wire-weight gage on the downstream side of the bridge serves as the outside gage. The ADVM is attached to a sliding track that is attached to the well braces on the downstream side of the right center bridge pier. The ADVM transducers point toward the left bank.

GAGE HEIGHT RECORD.-- The primary recorder (DCP interfaced with 436BD shaft encoder) furnished a complete gage-height record of stage for the 2010 water year.

VELOCITY RECORD.--The DCP and Sontek ADVM produced a complete record of index velocity for the 2010 water year, except for January 26-29 and February 6-10, when communications between the DCP and the ADVM were lost. The ADVM performs an automated beam check of the transducers approximately every hundred measurements. The automated beam checks are stored in the data logger of the ADVM. Also, manual beam checks are performed during every site visit. Signal strength, y-velocity, and water temperature data measured by the ADVM are transmitted through satellite transmissions via the DCP for quality control/quality assurance (QA/QC) purposes. The beam checks and QA/QC parameters indicated that the ADVM furnished good data for the 2010 water year. An independent water temperature measurement is made during each site visit to ensure that the ADVM is measuring the water temperature accurately. The independent water temperature and ADVM water temperature measurements were within 1 degree Celsius for the 2010 water year.

GAGE HEIGHT CORRECTIONS.--The primary recorder readings were within limits of the float tape indicator (primary reference gage) for the 2010 water year. No gage-height corrections were applied for the 2010 water year.

DATUM CORRECTIONS.—Levels were last run on May 28, 2009. All gages were found reading within allowable limits so no datum corrections were applied for the 2010 water year.

RATING.--The channel is fairly straight for several thousand feet upstream and has a sharp bend about 500 ft downstream. Prior to backwater from Jim Woodruff Reservoir (beginning April 1955) the right bank is subject to overflow at about a stage of 20 feet. The left bank overflows at a stage of approximately 30 feet. The discharge is affected by backwater from Jim Woodruff Reservoir below a stage of 25 feet. Backwater appears to be negligible above a stage of 25 feet. The discharge cannot be computed using a stage-discharge relation due to the backwater affects, so index velocity methods are used to compute the discharge.

Stage-Area Rating 2.0 was carried over from the previous water year. The standard cross-section used to develop Stage-Area Rating 2.0 is located at the downstream side of the bridge. The standard cross-section is re-surveyed every year or after major flood events to ensure that no substantial scour or fill occurred at the standard cross-section. The standard-cross section was surveyed on January 13, 2010. The measured area was within 5% of the rated channel area. Stage-Area Rating 2.0 was used for the entire 2010 water year.

Velocity Rating 3.0, which was constructed during the 2007 water year using measurements #364-370, was carried over from the 2009 water year and used for the entire 2010 water year.

RATING SHIFTS.--Six discharge measurements, #377-382, were used in the 2010 shift analysis. The range in stage and mean channel velocity of the measurements and the recorded stage and computed mean channel velocity during the year are as follows:

Range of stage of measurements	Range of recorded stage	Range of measured mean channel velocity	Range of computed mean channel velocity
Max. 21.62 ft	Max. 27.12 ft	Max. 1.27 ft/sec	Max. 3.21 ft/sec
Min. 18.37 ft	Min. 18.28 ft	Min. 0.28 ft/sec	Min. 0.17 ft/sec

Measurements #377-382 plotted within allowable limits of Velocity Rating 3.0 so no shifts were applied during the 2010 water year.

DISCHARGE RECORD.--Discharge was determined using the computed unit value gage-height and velocity data through computer applications of Stage-Area Rating 2.0 and Velocity Rating 3.0. A hydrologic comparison was made using the upstream station Flint River at Riverview Plantation, near Hopeful, GA (02355662). The hydrologic comparison is considered good and was used to estimate the daily discharge on January 26-29 and February 6-10, when the velocity data was missing.

REMARKS (SANAL).--Discharge records good, except for days of estimated discharge, which are poor.

Station Analysis for a Tidally Affected Streamflow-Gaging Station

Station Analysis View

021989773 SAVANNAH RIVER AT USACE DOCK, AT SAVANNAH, GA

Responsible Office
U.S. Geological Survey
Savannah - Field Office
190 Technology Circle Suite 125
Savannah, GA 31407
(912) 966-2689

Most recent revision: 1/19/2011
Revised by: agotvald

LOCATION.--Lat 32°04'51", long 81°04'53" referenced to North American Datum of 1927, Chatham County, GA, Hydrologic Unit 03060109, at the United States Army Corps of Engineers Dock on Hutchinson Island, GA.

EQUIPMENT.--Satellite telemetry data provided by a Design Analysis H-522+ Data Collection Platform (DCP) interfaced with a Design Analysis H-350/355 gas pressure system and a SonTek Argonaut SL acoustic Doppler velocity meter (ADVM). The DCP is housed in an aluminum shelter located on the left upstream corner of the U.S. Army Corps of Engineers' dock. The sonde and attachment cable are encased by PVC pipe that is drilled to allow for the free flow of water at all stages. The ADVM is attached to a sliding track attached to the dock near the gage house. A staff gage is attached to the dock near the gage house. The staff gage serves as the primary reference gage.

GAGE HEIGHT RECORD.--The primary recorder (DCP and H350/H355 pressure system) furnished a complete gage-height record of stage for the 2010 water year.

VELOCITY RECORD.--The DCP and ADVM produced a complete record of index velocity for the 2010 water year, except for November 29 - December 2, March 29 - April 1, and July 27-30, when communications between the DCP and the Sontek SL were lost.

The ADVM performs an automated beam check of the transducers approximately every hundred measurements. The automated beam checks are stored in the data logger of the ADVM. Also, manual beam checks are performed during every site visit. Signal strength, y-velocity, and water temperature data measured by the ADVM are transmitted through satellite transmissions via the DCP for quality control/quality assurance (QA/QC) purposes. The ADVM also logs multi-cell velocity data for 10 cells that subdivide the sample volume. The multi-cell velocity data are used to compute discharge when obstructions are found within the larger sample volume.

The beam checks and QA/QC parameters indicated that the ADVM furnished good data for the entire water year, except for the period of January 13 to March 29. There was considerable beam separation (more than 10 counts) observed in both the automated and manual beam checks during this period. The malfunctioning 1.5MHz unit was replaced with a 500 kHz unit on March 30, 2009. A lower frequency unit was used in order to increase the cell end of the sample volume.

An independent water temperature measurement is made during each site visit to ensure that the ADVM is measuring the water temperature accurately. The independent water temperature and ADVM water temperature measurements were within 1 degree Celsius for the entire water year. Lastly, the velocity is affected by tides, and the average salinity over the tide cycle is approximately 8 ppt. This value is entered in the SL configuration for speed of sound adjustment.

GAGE HEIGHT CORRECTIONS.--The primary recorder readings were within limits of the staff gage (primary reference gage) for the 2010 water year. No gage-height corrections were applied for the 2010 water year.

DATUM CORRECTIONS.--Levels were run on August 17, 2010. The gages were found reading within allowable limits so no datum corrections were applied for the 2010 water year.

RATING.--The channel is fairly straight for several thousand feet upstream and has a slight bend about 950 ft downstream. Flow reversal occur on a daily basis due to the effects of tides.

Stage-Area Rating 1.0 was carried over from the previous water year. The standard cross-section used to develop Stage-Area Rating 1.0 is located 50 feet upstream of the gage. The standard cross-section is re-surveyed every year to ensure that no substantial scour or fill occurred at the standard cross-section. The standard-cross section was last surveyed on May 19, 2010. The measured area was within 5% of the rated channel area. Stage-Area Rating 1.0 was used for the entire 2010 water year.

Velocity Rating 1.0, which was developed during the 2007 water year using measurements #1-77 made over a tide cycle on May 30, 2007, was carried over from the 2009 water year and remained in effect until March 30, 2010, when the 1.5MHZ SL was replaced with a 500 kHz ADVM due to transducer malfunction. Velocity Rating 2.0 was developed using measurements #91-130 made over a tide cycle on April 1, 2010. Velocity Rating 2.0 was put into effect on March 30, 2010 when the 500 MHz SL was installed. Velocity Rating 2.0 was used for the remainder of the 2010 water year.

RATING SHIFTS.--Forty-six discharge measurements, #86-132, were used in the 2010 shift analysis. The range in stage and mean channel velocity of the measurements and the recorded stage and computed mean channel velocity during the year are as follows:

Range of stage of measurements	Range of recorded stage	Range of measured mean channel velocity	Range of computed mean channel velocity
Max. 5.29 ft	Max. 6.09 ft	Max. 2.96 ft/sec	Max. 3.74 ft/sec
Min. -4.00 ft	Min. -7.26 ft	Min. -1.87 ft/sec	Min. -3.38 ft/sec

Measurements #86-90, which were made on December 7, plotted within limits of Velocity Rating 1.0. Measurement #90, which was made on March 16, plotted -27.4 percent from Velocity Rating 1.0 and indicated that the index velocities were biased low due the beam separation observed from January 13 to March 29. The velocity data was deleted during this period thus no shifts were applied to Velocity Rating 1.0 for the 2010 water year. A 500KHz was installed on March 30 and measurements #91-130 were made over a tide cycle on April 1 in order to develop a rating for the new 500 kHz unit. Velocity Rating 2.0 was constructed using measurements #91-130. Check measurements #131 made on August 17, 2010 and #132 made on November 19, 2010 plotted within allowable limits of Velocity Rating 2.0 so no shifts were applied to Velocity Rating 2.0 for the 2010 water year.

DISCHARGE RECORD.--Discharge was computed using stage and velocity unit-values along with Stage-Area Rating 1.0 and Velocity Ratings 1.0 and 2.0. A hydrologic comparison was made with the upstream site Savannah River at Georgia Highway 25, at Port Wentworth, GA (02198920) and the downstream site Savannah River at Fort Pulaski, GA (02198980). The hydrologic comparisons are considered good.

REMARKS (SANAL).--Discharge records are fair.

Reference

Rantz, S.E., and others, 1982, Measurement and computation of streamflow—Volume 2. Computation of discharge: U.S. Geological Survey Water-Supply Paper 2175, 284 p.