

Appendix 2. Guidance and Instructions for the Preparation of Data Furnished to the USGS for Review and Publication

Annual Review of Furnished Records

The annual review by USGS personnel of furnished records is designed to ensure that furnished records are collected in accordance with USGS standards. The review also provides a mechanism for identifying opportunities for improvement. During the review and during visits to streamgaging facilities, USGS personnel will identify areas, if any, that need improvement. Cooperators may consult USGS staff as they endeavor to make these improvements. For records provided to the USGS as a condition of a FERC license, the USGS will report unresolved deficiencies to the FERC for follow-up action.

To allow the time necessary for review (and possible corrections) of furnished data prior to publication, all furnished data must be received by the reviewing USGS field office no later than **December 15** for the water year ending September 30. This deadline became effective for the 2006 water year ending September 30, 2006. Records not received by the due date might not be included in the annual data report for that water year.

Technical References, USGS standards for streamgaging

As an aid to those providing furnished records, the California Water Science Center created a website that includes this document and several procedural and technical guidelines for non-USGS hydrographers.

<http://ca.water.usgs.gov/FERC/>

Two interactive courses have also been created and are available on the Internet at the following URLs:

Surface-Water Field Techniques Training Class:

<http://wwwrcamnl.wr.usgs.gov/sws/SWTraining/FlashFandR/Index.html>

Stage-Discharge Relations – Basic Concepts:

<http://wwwrcamnl.wr.usgs.gov/sws/SWTraining/RatingsWeb/Index.html>

Many USGS publications are now available on line and can be retrieved at the following URL: <http://water.usgs.gov/pubs>. A limited number of CD-based classes on wading measurements, cableway measurements, ice measurements, and levels are available. Please contact your local USGS Field office if you are interested in obtaining one of these CDs.

Materials to Be Included for Review of Furnished Record

Materials that should be provided for review include:

- Daily values table for the water year
- Hydrograph of daily discharge values
- List of discharge measurements
- Log of visits
- Copies of discharge measurements
- Primary computation sheets (hourly gage-heights, shifts, datum corrections)
- Copy of any graphic record used for computation
- New rating tables and new rating curves
- Station analysis (explaining how and why ratings were changed, shifts, and datum corrections for the current water year)
- A copy of the latest gaging station levels
- Station description, updated annually as necessary, including:
 - The surveyed elevation of at least three reference marks; and,
 - A revised “Quality Assurance” section containing the information described below.

Questions about what should be included in the review package can be directed to the local USGS Field Office or the FERC coordinator.

Development and Maintenance of Discharge Ratings

Collection and computation of high-quality streamflow data require the development and maintenance of discharge ratings, instrument ratings, or both. Developing and maintaining ratings are among the more challenging aspects of streamgaging. For natural channels, stage-discharge relations (rating curves or tables) are usually defined by discharge measurements (using current-meter or hydroacoustic instrumentation) of sufficient number to define the rating over a sufficient range of discharge, along with applicable changes (shifts) to the rating. Measurements generally are made every 4-8 weeks (depending on the site), and may be required more frequently to document significant changes in channel conditions that will affect the rating. Ratings are then adjusted in accordance with the measurement data. If discharge measurements covering the entire range of stage observed during a period of time indicate that the stage-discharge relation is stable, there is little problem in defining the discharge rating for that period.

In WSP-2175, Measurement and Computation of Streamflow, S.E Rantz states: “At a new station many discharge measurements are needed to define the stage- discharge relation throughout the entire range of stage. Periodic measurements are needed thereafter to either confirm the permanence of the rating or to follow changes (shifts) in the rating. A minimum of 10 discharge measurements per year is recommended, unless it has been demonstrated that the stage-discharge relation is unvarying with time. In that event the frequency of measurements may be reduced. It is of prime importance that the stage-discharge relation be defined for flood conditions and for periods when the rating is subject to shifts as a result of ice formation (see section titled, “Effect of Ice Formation on Discharge Ratings”)

or as a result of the variable channel and control conditions discussed in the section titled, ‘Shifts in the Discharge Rating’. It is essential that the stream-gaging program have sufficient flexibility to provide for the non-routine scheduling of additional measurements of discharge at those times.”

The USGS will make two discharge measurements which will serve as check measurements each year. These measurements are **in addition to, and do not substitute for**, measurements to be made by the operator of the gage. These check measurements represent a key part of the quality assurance process. If there are any questions about the number of discharge measurements to be made by the gage operator at a particular site, guidance should be obtained from the local USGS field office.

As part of the normal operation and maintenance of a streamgage, a leveling survey is required every 3 years. For sites that have proven to be particularly stable over the years, the interval between leveling surveys can be extended to 5 years after discussion with and approval by the local USGS FOC. Three Reference Marks (RMs), all staffs, point of zero flow (pzf), and present water surface should be surveyed during the leveling survey. These are minimum quality assurance procedures. Much more may need to be done if unusual events occur.

Ratings Based on Powerplant Records

Discharge ratings developed for well-maintained turbines and penstocks are usually very stable and accurate. However, worn or damaged meters, orifices, valves, and piping or obstructed passages may result in significant rating changes. The planned technique for ensuring the accuracy of turbine and penstocks ratings, and how often the technique is to be used, should be described in the “Quality Assurance” section of the station description. Where possible, such ratings should be checked periodically by independent data such as measurements made using current-meters or portable, clamp-on AVMs (Acoustic Velocity Meters).

Ratings at Sites with Hydraulic Structures and Hydroacoustic Devices

Properly calibrated and maintained weirs, flumes, or gates (hydraulic structures), various hydroacoustic devices including Acoustic Velocity Meters (AVMs), Acoustic Doppler Velocimeters (ADVMS), Acoustic Doppler Current Profilers (ADCPs), and occasionally, dye-dilution techniques, may be used to collect and verify streamflow records. Use of these techniques requires skilled application and periodic verification or recalibration of instruments and ratings. Gage operators who use hydraulic structures or other technologies often do so to reduce the number of measurements required to maintain the discharge rating, or to overcome physical limitations that make discharge measurements impractical. Plans for using these methods should be discussed with the USGS field office that will review the data, and the methods should be described under the “Quality Assurance” section of the station description. The methods used to verify streamflow records will vary depending on gaging conditions.

USGS standards require that the typical stage-discharge relation be checked by periodic discharge measurements (made by the gage operator) to ensure that the relation still is applicable and to provide for adjustment of the rating as needed. Hydraulic structures are often used to improve rating sensitivity and stability. However, while ratings for hydraulic structures are usually more precise than those for natural streams, they introduce other factors that require additional consideration. Theoretical or manufacturer ratings for hydraulic structures should be checked by a minimum of two discharge measurements made by the licensee each year (one each on the high-and low-ends of the rating) or as needed to define shifting conditions. This minimum number (two) of measurements can only be

justified under the ideal conditions for which the structure was designed. The accumulation of debris, aquatic growth on surfaces, degradation or erosion of contact surfaces, changed or unstable approach conditions, expansion and contraction of materials used in the structure, and settling, all can affect the rating and result in inaccurate or biased discharge estimates. These factors necessitate the need for increased monitoring and measurements to verify the applicability of the rating.

Generally, AVM ratings are stable and accurate, but periodically they should be verified by an independent means such as using temporary clamp-on AVM's, current meter measurements, or against independently developed turbine ratings. AVM instrumentation should be monitored for signal strength and inspected for system wear or damage. Plans for quality assuring AVM data should be described in the "Quality Assurance" section of the station description.

Provisions to maintain the applicability of the stage-discharge rating at a hydraulic structure by periodically inspecting and cleaning the structure, repairing and replacing worn or damaged parts, and ensuring correct positioning (through level surveys and adjustment) will be required and should be described in the "Quality Assurance section" of the station description. Changes in stage or hydraulic head following these activities should be recorded and may be used to apply shifts to established ratings.

Other devices or structures in use for measurement of discharge also are subject to change, so any rating developed must be checked periodically just as in the case of a stage-discharge rating. Turbine wear can change head-flow relationships over time. Intake pipes may become coated with mineral deposits, increasing resistance to flow. AVM transducers may fail, resulting in a biased estimate of the velocity profile, and thus, the average velocity. Any of these changes can result in biased discharge estimates. For these reasons, direct measurement of discharge is the preferred method for confirmation of stage-discharge ratings.

Station Description

A station description documents the location and describes the characteristics of a streamgaging station. Beginning with records for water year 2000, records furnished to the USGS were required to be accompanied by a station description that explains how the discharge rating for that system was established, the functional limitations of the rating, how the rating is maintained and its applicability assured, and a section on Quality Assurance. A station description generally should include information specified in the Station Description section previously described in this report for USGS streamflow-gaging stations.