United States Department of the Interior
U.S. GEOLOGICAL SURVEY
Reston, Virginia 20192

In Reply Refer To:
Mail Stop 415

July 14, 2014

OFFICE OF SURFACE WATER TECHNICAL MEMORANDUM 2014.08

SUBJECT: Policy for the timely correction of time-series data displayed on the NWISWeb

Policy Summary: All USGS Science Centers shall correct time-series stage and discharge data (by applying indicated datum, data, and variable shift corrections, etc.) and enter discharge measurements into NWISWeb within 2 business days of a field measurement if the computed real-time data on NWISWeb do not match the discharge measurement within its rated accuracy. In this case both the discharge measurement and any needed corrections should be entered concurrently. Centers are strongly encouraged to enter all other streamflow measurements (those plotting within the rated accuracy of the current shifted rating) within 7 business days. Special considerations are outlined for (1) ice-affected records; (2) records computed using the index-velocity method; and (3) situations involving emergency conditions or other special needs. Stage and discharge data not corrected per policy shall be removed from public display.

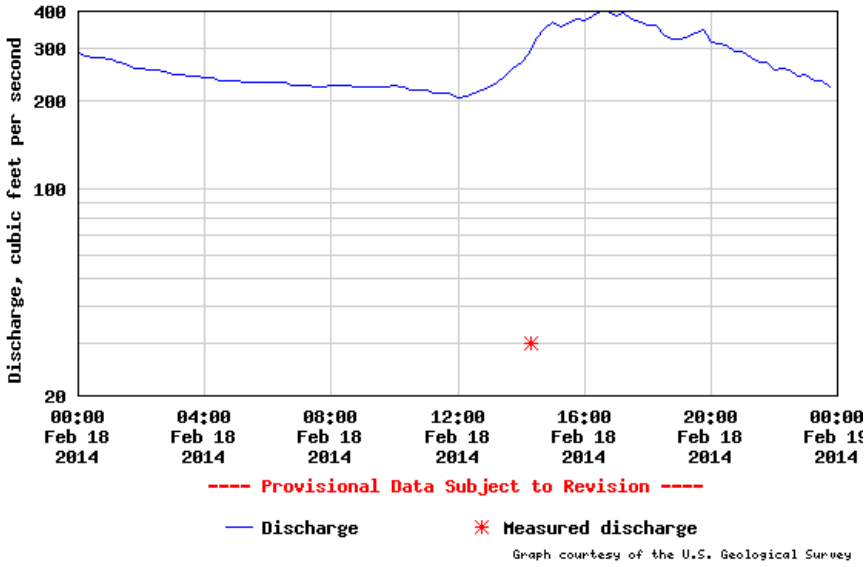
Background: Delivery of USGS stage and discharge data has evolved over several decades to accommodate a variety of user needs. Rigorous quality assurance of approved stage and discharge data makes such data appropriate for the design and analysis of flood protection measures and water-supply infrastructure, as well as for statistical studies such as trend analysis, and low- and high-flow frequency analyses.

Historically, approved daily data was our only product and was published up to 1½ years after collection. While approved data are still our final product, technology has facilitated a tremendous growth in the number of stations providing provisional, near real-time data, both daily and instantaneous. USGS cooperators and the public are continually finding new and innovative uses for these provisional data. Indeed, the role of our provisional data has become prominent in decisions supporting recreation (fishing, rafting, etc.), river operations (power generation, water allocation/diversion/return management, etc.) and flood mitigation (reservoir protocols, flood inundation mapping, etc.). However, applications using data flagged as provisional often are accompanied by an expectation of accuracy equivalent to our approved streamflow data.

While savvy users understand and accept a greater level of uncertainty in exchange for timeliness, erroneous streamflow data are problematic for two reasons. First, inaccurate data can lead public and private users to make decisions that could adversely affect life, property, or business. Second, the display of data known to be erroneous (even if not used to make critical decisions) undermines the credibility of the good data, which comprises the vast majority of what USGS serves. Although provisional data banners clearly warn users about potential errors, we must strive to offer the most accurate information we can at any point in time.

Water Resources Division (WRD) Technical Memorandum 97.17 established policy for the daily review of instantaneous value (IV) data and for making corrections when necessary, but focused primarily on the correction of gross instrument or transmission errors. WRD Technical Memorandum 99.34 established policy for the quality assurance of real-time data served on NWISWeb and required the use of basic thresholds for screening erroneous data from display on NWISWeb. An OSW script (NWISWeb Automated Quality Assurance Report) notifies Centers via email of gross errors at sites where unit value thresholds are exceeded (or have not been properly established). Finally, WRD Policy Memorandum 2010.02 defined the concept of Continuous Records Processing for all water time-series data to ensure all data are quality assured and approved on a sub-water year basis, as soon as possible after all necessary information becomes available.

Presently (2014), no formal policy memo explicitly addresses the timely correction of time-series data, in particular the processing of gage-height data corrections and stage-discharge shifts. As a result, many Centers neglect to make simple corrections, readily defined by actual field measurements, to their data and thus knowingly display inaccurate information to the public for weeks or even months. In the graph below, the flow value of the measured discharge (red asterisk) on February 18, 2014 was about 90% less than the computed instantaneous discharge time series value (blue line). In this example, the instantaneous discharges were already more than 90 days old.



To assist Centers in identifying such sites for timely remediation, OSW Informational and Technical Note 2014.10 (dated February 10, 2014) announced the use of software that examines publicly viewable streamflow data displayed on NWISWeb and distributes a daily report that summarizes potentially erroneous discharge data or discharge data that requires data corrections or shifts. The software evaluates how closely computed IV time series discharge data match up with discrete discharge measurements. Since this software began to be used, the National totals for the number of discharge measurements that differ substantially from the corresponding instantaneous values have declined by nearly 80%. While this result is a significant success, many discrepancies between field measurements and computed discharge are still being displayed to the public. In other cases, valid discharge measurements are being marked as “not used” in order to avoid being flagged by the new screening tool. Further, some Centers have chosen to address periods of potential ice effect with blanket statements on NWISWeb and have not removed discharge time-series values from public display, even after the backwater condition has been confirmed via discharge measurements or control

inspections. In all cases the primary issue is not addressed and *data known to be erroneous are still being delivered to the public.*

Policy: Discharge data known to be in error shall either be corrected or removed from public display. When the instantaneous time series data on NWISWeb do not match the field measurements within the rated accuracy of that measurement, Centers shall enter discharge measurements and apply any needed data corrections or shifts within 2 business days of collecting the field data. This means the computed streamflow data being displayed should be within the uncertainty of the field discharge measurement (where "uncertainty refers to the rated accuracy of the measurement, as justified by documented measurement conditions on field note sheets or in SWAMI). When a measurement is substantially different from the most current shifted stage-discharge rating, the field hydrographers must do one of the following: 1) verify it with a check measurement, 2) validate the measurement by documenting supporting control conditions, or 3) disregard that measurement due to inability to more accurately measure the discharge given the measurement conditions and equipment available (that is, mark the measurement as unused due to documented deficiencies or equipment malfunction coupled with a determination that a better measurement cannot be made under prevailing conditions). Ultimately, the record associated with any discharge measurements deemed to be reliable should be corrected using indicated shifts or data corrections; any time series data more than 2 business days old presented on NWISWeb should agree reasonably with the field data. Additionally, except where warranted as described above, discharge measurements should not be entered into the system and immediately marked as "not used" for the sole purpose of avoiding being flagged by current data screening tools.

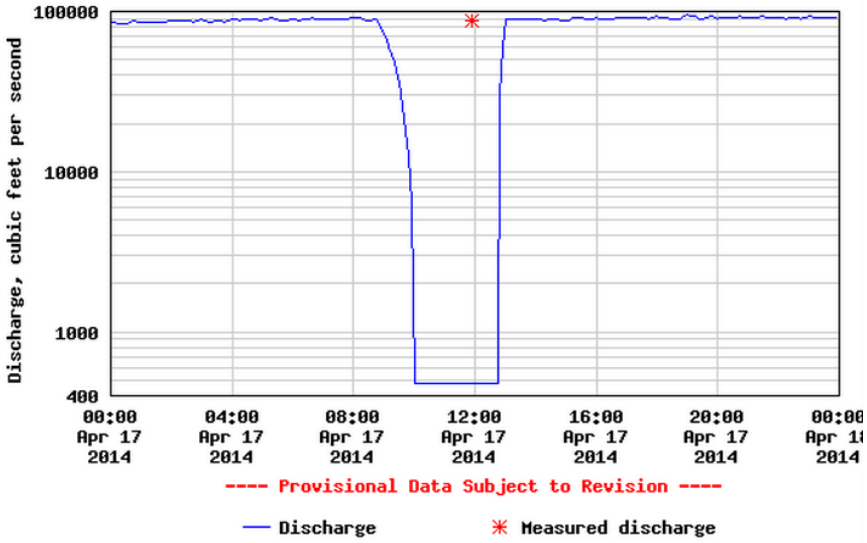
Centers are strongly encouraged to enter other discharge measurements (those that do plot within the rated accuracy of the current or shifted rating) into NWIS no more than 7 business days after they are made. While entering these other measurements in a timely manner will not greatly affect or change our computed data, their timely display does add a substantial measure of confidence and reliability to our data in the eyes of knowledgeable cooperators and other data users. On the other hand, minor corrections and shifts that might become necessary later in the review process will likely make little difference to resource managers or the general public.

In the case of streamflow data, both measurement entry-latency and shift entry-latency are of concern to Centers and both should be given equal priority. As such, the discharge measurement and any needed corrections should be entered concurrently within the timeline outlined in this policy.

Considerations for proper handling of ice record: Because a measurement of discharge during ice-affected flow is the best representative depiction of the streamflow at a gage at the time it was made, all ice measurements should be shown on NWISWeb as soon as possible, even if rated poor. Only those ice discharge measurements determined to be so inaccurate that they will NOT be used to form the basis for estimating the affected discharge record should be marked as "not used." Time-series discharge data should be masked with an "ice" setting as soon as the record is considered to be affected by ice backwater. This flag should be maintained until the backwater condition no longer exists, at which time the ice mask setting should be turned off. In parts of the country subject to intermittent ice, this may result in many independent ice periods during the winter season. Note that, due to current limitations, it is not possible to show provisional ice estimates of daily values because the masking will prevent the display of the estimates until the data are approved. Removing the masking is not appropriate because it would allow the un-estimated and erroneous instantaneous data to be displayed. Where it is important to display preliminary, estimated data to the public, the estimates must be applied to the instantaneous (IV) data and the ice mask removed from the estimated period.

Considerations for index-velocity record: The index-velocity method (Levesque and Oberg, 2012) is often used to compute discharge records at sites with variable backwater. Discharge records (especially instantaneous values) and discharge measurements at such sites may have a relatively large uncertainty. During periods of very low flow, such as the slack water period of a tidal cycle, substantial differences between the measured flow and IV flow are possible. At some of these sites the uncertainty of the discharge measurements and instantaneous index velocity values may be greater than the difference between the measured and index-velocity-derived discharge values, resulting in the potential for large differences between the measured discharge and IV discharge where neither may be discounted. In such situations, the OSW quality assurance scripts may erroneously identify these data as potential errors, even though they still may be the best data available and should remain publicly available. Only, if the discharge measurements have significant errors that would preclude their use in developing and maintaining the index-velocity rating, should they be marked as "not used". For example, a flow measurement made at an index-velocity site could be marked as "not used" if unusual site conditions (such as high winds coupled with low velocities that are not characteristic of typical conditions) might result in an observation that has undue influence on the rating development (or regression line). If the unit values are thought to be in error, they should be removed from public display on NWISWeb. Information should be added to the banner for these sites that describes and alerts the public to the high uncertainties associated with the data.

It is also possible for erroneous data to be displayed when following the procedure recommended by Levesque and Oberg (2012, p. 82), in which the recording interval of the index velocity meter is reduced during discharge measurements. The recording interval is typically reset to 1-minute during discharge measurements at index-velocity sites in order to more accurately synchronize index velocities with measured mean velocities. When this recommended procedure is followed, the change in recording interval will typically result in a "gap" of transmitted index-velocity values, which may be reported and displayed in NWISWeb erroneously as zero or some other extremely small discharge value (see example, below). Center staff should make sure that these gaps are "filled" in NWIS by loading the 1-minute recording interval data collected during discharge measurements into NWIS. This policy for storing 1-minute index-velocity data is effective immediately.



Considerations for slope station records: There is no need for additional guidance at stations subject to intermittent backwater where discharge is computed using the slope between a base gage and an auxiliary gage (limited fall method).

Considerations during emergency or flood conditions: Most Centers are acutely aware of the fact that during high profile events (local or regional floods, contaminant spills, and so forth) the demand for timely and accurate stage or discharge information increases. The latency associated with our display of corrected data on NWISWeb should commensurately decrease. Under such conditions the timelines for entry of discharge measurements, shifts, and gage height corrections should be compressed and information collected in the field should be called into the servicing offices immediately, as opposed to the "2-business-day" rule mandated by this memo. Cooperator needs may also dictate actions be taken to correct NWISWeb data faster than required by the policies herein.

Related data QA/QC aspects: The use of any automated program that applies shifts does not exempt a Center from visual inspection of real-time hydrographs. Further, implementation of this policy does not assume all corrections made will be final, though in some cases there may be enough information to develop and apply final corrections. In other cases, additional measurements may result in the development of an average shift to be applied later in the records analysis process prior to final approval. In both situations, our current ability to communicate while in the field should easily allow for preliminary shifts and other corrections to be quickly implemented, thus ensuring the data we are providing to the public is timely and consistent with the information we are collecting in the field. Current Continuous Records Processing (CRP) policies are still in effect. But as technology improves our ability to upload measurements, shifts, and data corrections from the field and as CRP concepts, practices, and policies evolve, the basic tenets guiding Center data operations should always ensure that we continue the USGS legacy of providing high-quality hydrologic data to the public in a timely manner.

Questions concerning the policies outlined in this memo may be addressed to Robert Mason (rrmason@usgs.gov).

/signed/

Robert R. Mason, Jr.
Deputy Chief, Office of Surface Water

References Cited

USGS, 2010, "Continuous Records Processing of all Water Time Series Data", Water Resources Division Policy Memorandum 2010.02, USGS, (available online at http://water.usgs.gov/admin/memo/policy/wrdpolicy10.02.html).

USGS, 1997, "Disseminating Real-Time Streamflow Data through the World Wide Web", Water Resources Division Memorandum 97.17, USGS, (available online at http://water.usgs.gov/admin/memo/policy/wrdpolicy97.17.html).

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