Desk Instruction for Managing Electronic Stage and Discharge Data from Stream Gage Stations

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REVISION HISTORY

Document No./ Revision No.	Issue Date	Action	Description
SW-DI-10008, R0	3/14/17	New desk instruction	New Desk Instruction for the individual and institutional responsibilities for managing stage and discharge data collected at streamflow gaging stations in the Los Alamos National Laboratory (LANL) surface water programs.

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1. PURPOSE AND SCOPE

This desk instruction (DI) states the individual and institutional responsibilities for managing stage and discharge data collected at streamflow gaging stations in the Los Alamos National Laboratory (LANL) surface water programs. The data described in this DI comprise automatically-recorded water level ("gage height" or "stage") values and manually-measured water flow rate ("discharge") values. Electronic data management processes include: processing the raw data files and reviewing the data for accuracy. This DI integrates the criteria of EP-DIR-QAP-0001, *Quality Assurance Program (QAP) Implementation Plan.*

This DI also describes the process for assigning data qualifier codes to the stage and discharge data, recording code-assignment rationale, adjusting the stage data when appropriate, and updating rating curves for computation of discharge values from stage data. This desk instruction is to be used by project technical personnel familiar with operation of the Sutron data loggers used with the stream gage network and the use of Hydstra and Xconnect applications.

2. BACKGROUND

Measurement, collection, and management of stage data and computed discharge are required by the Memorandum of Understanding (MOU) between the U.S. Department of Energy (DOE) and the Buckman Direct Diversion (BDD) Board for Los Alamos (LA) and Pueblo Canyons, and as part of ongoing environmental surveillance surface water monitoring efforts throughout LANL for the annual site report. The discharge data at E050.1, E060.1, and E099 are used as an early notification system for the BDD Project to make decisions regarding facility operations, including temporarily ceasing diversion of water from the Rio Grande. In addition, the discharge data are used to trigger automated water quality samplers in LA/Pueblo Canyons and at surveillance-specific sites, and to compute the mass flux of sediment and contaminants at specific locations.

3. RESPONSIBLE PERSONNEL

Surface Water Program Electronic Data Management Professional (SW Lead)
Surface Water Program Field Technical Personnel (Field Lead)

4. EQUIPMENT AND TOOLS

The following equipment and tools are necessary for this DI:

- Hydstra Data Management software
- Xconnect Data Management software

5. REFERENCES

Hydstra User Guide- Located under the Help tab when logged into the Hydstra desktop

Xconnect User Guide- Located on the xconnect network drive

EP-SOP-10005, Operation and Maintenance of Gage Stations for Storm Water Projects

6. MANAGING ELECTRONIC STAGE AND DISCHARGE DATA

Stage data are retrieved from gaging stations remotely using radio telemetry and the Xconnect software. If radio communications fail and remote retrieval is temporarily discontinued, stage data can be retrieved manually from each location.

6.2 Manual Retrieval and Upload

6.2.1 Retrieval - Field Lead

[1] **VERIFY** that the station is functioning and **RECORD** the appropriate data on the work order. (Refer to EP-SOP-10005 for gage inspection instructions.)

[A] **IF** the site is not functioning properly, **INVESTIGATE** and **ATTEMPT** to resolve the issue.

[B] **IF** the issue cannot be resolved, **NOTE** on the work order that follow-up maintenance is required.

[C] **IF** the issue can be resolved, **NOTE** what the issues were and what maintenance was performed.

[D] **IF** the station is functioning sufficiently to perform a data download, **DOWNLOAD** the data as instructed in Step [2].

[2] **CONNECT** the appropriate end of the RS232 cable to the matching connector on the data logger. The cable will physically connect to only one connector on the data logger.

[A] **IF** the necessary connector on the data logger is occupied by a cable to telemetry equipment, temporarily **DISCONNECT** the cable during the data download.

[B] **CONNECT** the other end of the RS232 cable to the laptop.

[C] Alternately, **USE** an approved portable drive to retrieve the data.

6.2.1 Retrieval - Field Lead (continued)

[3] **PERFORM** the manual data download by saving the LOG data file to the laptop hard drive.

[A] On the work order, **MARK** the data as retrieved and **RECORD** the LOG data file name, start date, and size (KB).

[B] Once the download is complete, **DISCONNECT** the RS232 cable from the data logger and laptop and **RECONNECT** the telemetry cable (if present) to the data logger.

[C] **VERIFY** that the data logger recording is on, and that the station is operating properly (refer to EP-SOP-10005).

[4] **USE** a portable drive to transfer the data from the laptop, or **USE** the portable drive containing the gage station data previously obtained.

[A] **TRANSFER** the data files to the current water year folder named *Water Year 20xx Gage Data* located on the Hydstra network drive under SW Log.

6.2.2 Upload - SW Lead

[1] **OPEN** gage data file using Microsoft Excel.

[A] **FORMAT** date and time to match mm/dd/yyyy hh:ii format used by Hydstra.

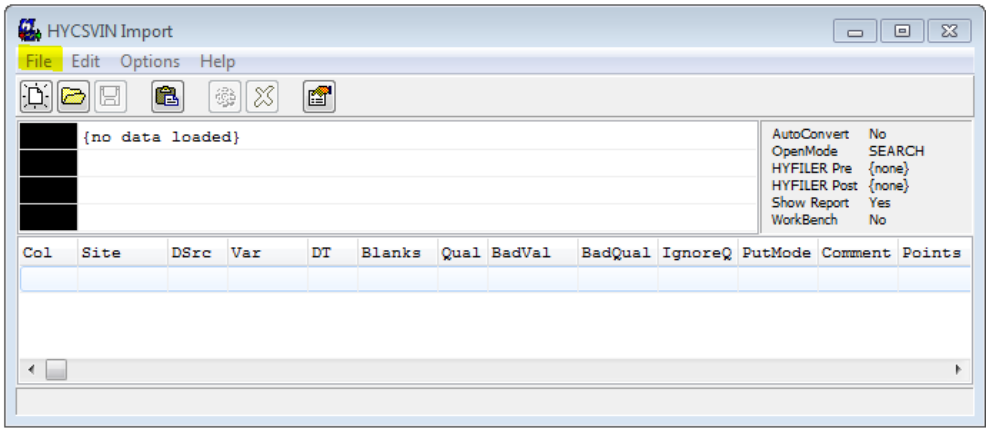
[B] **ISOLATE** individual sensor data into columns.

[C] **RENAME** file with gage station ID and data range of data (e.g., E026_06_22_16-06_29_16).

[2] **OPEN** HYCSVIN in the Hydstra program.

[A] **SELECT** "Open File", then **SELECT** the gage data file.

[B] **SELECT** the "OPEN" button, then **SELECT** "Convert."



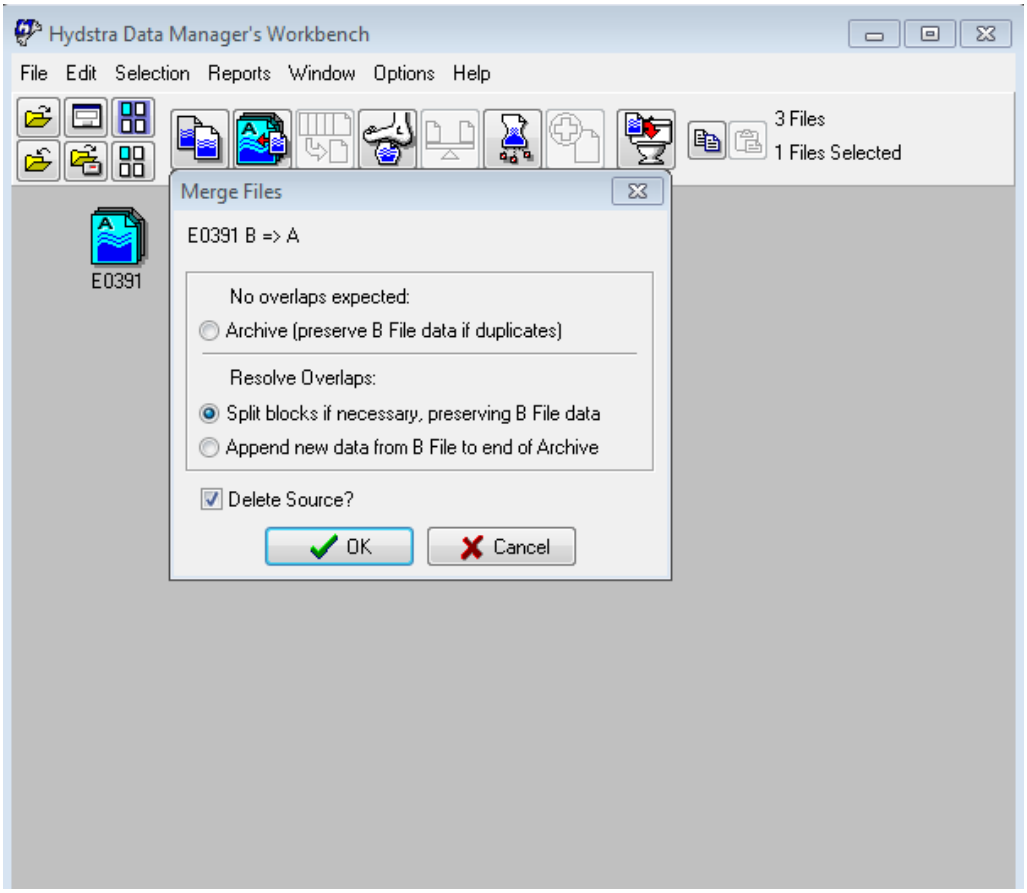
[3] **OPEN** HYDMWB and **SELECT** "Open File."

[A] **ENTER** site ID and **SELECT** "Finish."

[B] **OPEN** the B file and **ENSURE** data upload was successful.

[C] **IF** data upload is good, **MERGE** B file with the archive.

6.2.2 Upload - SW Lead (continued)



6.3 Reviewing and Qualifying Stage in Hydstra

SW Lead

[1] Once data are uploaded into Hydstra, **GATHER** all work orders related to the gage station(s) for the dates of the uploaded data.

[A] **EXAMINE** the work orders, making note of any information that may explain departure from "normal" or baseline stage values in the recorded data. This information may include, but is not limited to, the presence of flow or recent flow in ephemeral streams, increased or decreased flow in perennial or intermittent streams, channel silting or scouring, presence of ice or debris, re-calibration of equipment by the field team, equipment malfunction, and/or data not recorded or not retrievable.

6.3 Reviewing and Qualifying Stage in Hydstra (continued)

[2] **VIEW** the plot of stage vs. time in HYDMWB in Hydstra.

[A] **EXAMINE** the data plot for period(s) of potentially erroneous data, such as data gaps, extreme peaks or troughs, peaks or troughs unassociated with a typical "smooth" discharge curve, erratic values, unrealistic rates of increase of decrease, or flat lines at stages other than the usual no-flow stage.

[B] **EXAMINE** the stage record in the context of the work order information, and also vice versa, to form the most complete and accurate assessment of the accuracy of the data record.

[3] A qualifier of "140 – Data not yet validated" is automatically assigned to data when uploaded into Hydstra ©.

[A] **IF** no problems are found and the data looks reasonable (e.g., no extreme peaks or troughs, no flat lines besides zero stage, no other non-natural type patterns, etc.), **CHANGE** data qualifier to "1 – Good continuous records."

[B] **IF** issues are found, **DETERMINE** which one of the following situations (steps 6.3 [4] – [13]) applies to the data, **CHANGE** the qualifier code(s) as instructed, and **RECORD** any relevant notes (e.g., suspected cause(s) of error(s) – if any found, method of addressing/correcting error(s), justification/rationale for assigning the chosen qualifier code):

NOTE *A qualifier in the 1-150 range is considered "good" data, and a qualifier greater than 150 is considered "bad" data. For all intents and purposes, bad data is considered not viable.*

[4] **SMALL DATA GAP** (small number of incorrect or missing measurements due to unknown circumstances, [e.g., an animal walking under the probe, etc.])

- **DETERMINE** if discharge was measured at surrounding stations and if precipitation was measured at surrounding gages.
- **IF** there was no flow or precipitation, **FILL IN** gap with zeros. **NOTE:** in general, a "no flow" scenario can be filled for a longer period of time than a "flow" scenario, depending on the season (e.g., winter precipitation tends to be regional, but summer monsoonal precipitation can be very localized, thus do not assume a "no flow" scenario during the monsoon season without relatively strong supporting evidence).

6.3 Reviewing and Qualifying Stage in Hydstra (continued)

- **IF** there was flow or precipitation, **INTERPOLATE** between the measurements before and after the missing data point(s) and **ASSIGN** this value to the missing data point(s). **NOTE:** this should only be done for one or two missing points (5 or 10 minutes, respectively).
- **CHANGE** data qualifier to "2 – Good quality edited data." **RECORD** the suspected cause of the error (or "unknown"), the method used to correct the error (e.g., interpolation, reference to outside gage measurement), and the justification for considering the estimated values "good quality."

[5] **SILTING** (stage measurements increase during a runoff event but do not decrease to pre-event stage) or **SCOURING** (stage measurements increase during an event but decrease to below pre-event stage)

- **ADJUST** rating curve for time period the stilling well and/or channel was silted/scoured using "Ratings Stage Shift Workbench" and applying a "Datum Shift" from the peak of the hydrograph to a point after the hydrograph flattens out (e.g., streamflow stops or returns to baseflow conditions).
- At the peak, the shift will be zero. At the point when streamflow stops or returns to baseflow conditions, the shift will equal the negative stage for silting and positive stage for scouring. **ADD** comments when adding the shift values (e.g., start of silting/scouring, end of silting/scouring).
- **CHANGE** data qualifier to "3 – Silting or scouring."
- **VIEW** discharge (variable 262 in Hydstra) to ensure the data were properly adjusted.
- **NOTE:** If stilling well and/or channel are cleaned/filled, another time shift needs to be added to compensate for this adjustment at the time of cleaning/filling.

[6] **GREATER THAN RATING CURVE MAXIMUM** (stage measurement is above the maximum value in the rating curve)

- **EXAMINE** stage value and rating curve to determine if extrapolation of the rating curve is appropriate (e.g., the stage did not exceed the maximum for the flume or overtop the bank).
- **IF** extrapolation is appropriate, **EXTRAPOLATE** the discharge value for the stage and **ADJUST** the rating curve in the "Ratings Stage Shift Workbench" by adding a point to the maximum end of the rating table.
- **IF** extrapolation is not appropriate, **DETERMINE** how to adjust the rating curve based on field cross-sectional surveys for over-bank flow.
- **CHANGE** data qualifier to "4 – Greater than rating curve maximum."

6.3 Reviewing and Qualifying Stage in Hydstra (continued)

[7] **DATUM SHIFT** (inside and outside stage measurements do not match)

- **IF** the field notes indicate that the inside and outside stage measurements are not the same (due to numerous circumstances, but NOT silting and scouring) and the stage height was adjusted to align the inside with the outside stage, a datum shift is required.
- **ADJUST** rating curve for time period the datum was incorrect using "Ratings Stage Shift Workbench" and applying a "Datum Shift."
- At the beginning of the period, the shift will be zero. At the point just before the stage height was corrected, the shift will equal the inside minus the outside (including the negative/positive sign). At the end of the period, the shift will be zero. **ADD** comments when adding the shift values (e.g., inside and outside stage do not match).
- **CHANGE** data qualifier to "5 – Datum shift."
- **VIEW** discharge (variable 262) to ensure the data were properly adjusted.

[8] **DATA MISSING** (more than a small gap of stage measurements are missing for unknown reasons)

- **CHANGE** data qualifier to "151 – Data Missing."

[9] **ICE** (stage measurements increase during winter but do not decrease or "flat line" at a particular non-zero stage height)

- **CHECK** nearest meteorological tower temperature data to determine if precipitation occurred and if it is feasible for the streamflow to be frozen.
- **CHANGE** data qualifier to "152 – Ice present."

[10] **MAINTENANCE** (stage measurements are not real due to testing and/or maintenance being performed at the station)

- Based on visual inspections while at the station:
- **IF** no flow, **SET** stage height values to zero and **CHANGE** data qualifier to "1 – Good continuous records."
- **IF** flow and outside gage measurements confirm that interpolation will result in an accurate stage record, **INTERPOLATE** the values and **CHANGE** data qualifier to "2 – Good quality edited data."
- **IF** there is flow but there is no noted confirmation of stage during the un-recorded period, **CHANGE** data qualifier to "153 – Testing or maintenance performed."

6.3 Reviewing and Qualifying Stage in Hydstra (continued)

[11] **EQUIPMENT MALFUNCTION** (more than a small gap of stage measurements is missing or not accurate due to equipment malfunction [e.g., data logger, bubbler, probe, battery, etc.])

- Special case: A continuous period with stage values of 0.00 requires further investigation, as 1) recorded stage is rarely exactly 0.00 in natural-channel measurements, and 2) 0.00 is the default stage value which would result from a malfunction-related data logger reset.
- **CHANGE** data qualifier to "154 – Equipment malfunction."

[12] **NON-STANDARD FLOW** (e.g., water line breaks, fire hydrant testing, spills from a building or truck, etc.)

- **CHANGE** data qualifier to "155 – Non-standard flow."

[13] When edits are complete, **SAVE** file(s) and **CLOSE** HYDMWB.