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New Mexico Environment Department
Surface Water Quality Bureau

Standard Operating Procedure

for

DATA VERIFICATION AND VALIDATION


Approval Signatures



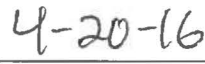
Chuck Dentino
Subject Matter Expert / Field Team Supervisor



Date




Vacant
Quality Assurance Officer




Date

for



Shelly Lemon
Program Manager



Date

1.0 PURPOSE AND SCOPE

The purpose of this document is to describe activities associated with the validation and verification of chemical, physical, and biological data. All data processed and received by the SWQB will be verified and validated according to these procedures. All data not meeting the appropriate QA/QC requirements as identified through the data verification and validation process are assigned appropriate laboratory qualifier or SWQB validation codes. A summary of SLD and the SWQB's qualifier codes are provided in Attachment B-1 and B-2. A summary of Field Quality Control criteria are listed in Attachment B-3.

2.0 RESPONSIBILITIES

Project Coordinator(s) are responsible for ensuring that the data verification and validation process is completed in accordance with the specifications outlined in this document. The verification and validation process should be done by a different person than entered the data into the database. Upon completion of a project, the Project Coordinator(s) will provide a copy of the completed *Data Verification and Validation Worksheets* to the SWQB Quality Assurance (QA) Officer. The Project Coordinator and/or QA Officer will resolve data quality issues. All information pertaining to this process, including the original *Data Verification and Validation Worksheets* will be documented and maintained in the project file.

3.0 BACKGROUND AND PRECAUTIONS

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These procedures are based in part on EPA guidance for environmental data verification and validation (USEPA, 2008). All field and laboratory data will be verified and validated for completeness, correctness and conformance against specified methods, and procedural or contractual requirements. This process establishes the criteria for accepting, rejecting, or qualifying data. The *Data Verification and Validation Worksheets* serve as the summary of results for each type of data verified and validated.

Note: No data should be changed, altered or deleted in any manner through the verification and validation process without proper documentation. Any changes should be indicated with appropriate notations on the worksheet.

4.0 DEFINITIONS

The terms data verification and data validation, as used in this SOP, reflect two separate processes with two separate functions. The fundamental difference between them is embedded in their respective emphases.

Verification: Evaluating the completeness, correctness, and conformance/compliance of a specific data set against method, procedural, or contractual requirements.

Validation: An analyte-and sample-specific process that extends the evaluation of data beyond method, procedural, or contractual compliance (i.e., data verification) to determine the quality of a specific data set.

Data Quality Assessment: A statistical and scientific evaluation of the data set to determine the validity and performance of the data collection design and statistical test, and to determine the adequacy of the data set for its intended use.

Run/Sampling Run – A period of time used to represent and define the most common collecting period or grouping of sampling activities that are indicative of SWQB MASS sampling operations. Typically, most samples are collected during multi-day collection events that depart and return to the office in a given week (M-F). For the purposes of this SOP, the qualification of blanks associated with sample collection during a run is also limited to a single week, which may include single or multi-day collection activities. Also, blanks associated with a run are assumed to collectively represent a grouping of samples whereby the staff, equipment, vehicle, reagents, preservation, and storage remain constant. When multiple single day trips are planned within a given week that maintain constant variables as described above, the single day trips may be considered collectively as a run, provided that the number of blank QC samples collected represents at least 10% of ambient samples collected, preferably at a one blank sample per ten ambient sample frequency to allow for QC blank distribution.

5.0 EQUIPMENT AND TOOLS

None.

6.0 STEP-BY-STEP PROCESS DESCRIPTION

General Guidance for All Data

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The results of the data verification and validation processes should be tracked and documented on the *Data Verification and Validation Worksheets (Attachments A1, 2 & 3)*. These may be completed electronically or in hard copy format. Data verification should be done as soon as possible following the data collection event or receipt of the data. When verifying a subset of data the verifier should indicate data that have been verified to date for tracking purposes. SWQB field forms provide places to note when the data entry has been verified. To reduce database errors this process should be completed as soon after the entry of the data as possible.

The data validation process is typically completed after all data have been received and verified for a particular project or for a specific defined subset of the data such as one sampling run or all of the habitat data; however, to accommodate data requests or to conduct preliminary data analyses, the validation can be performed at any point during the course of the project, but will need to be re-done upon receipt and verification of all additional data. If verifying a subset of data the verifier should indicate data that have been verified to date for tracking purposes.

Supporting Documents that may be needed for the data verification and validation process include:

- Copy of the Sample Design or Field Sampling Plan (sample locations, parameters and frequencies),
- Field forms,
- Sample collection Chain of Custody or equivalent records,
- Analytical Submittal Request Forms,
- Data packages received from lab,
- Equipment/calibration logs.

6.1 CHEMICAL DATA VERIFICATION AND VALIDATION

Chemical data verification should begin as soon as possible. Ideally, step 1 occurs immediately after the data for a sampling event have been entered into the database. Other steps should be done as soon as possible after receipt of a complete set of data from the laboratory. Prior to the verification and validation process, the QA officer will be responsible for verifying that laboratory reported values are consistent with established detection and non-detection reporting protocols. Incorrectly reported or anomalous values are addressed with the lab and corrected prior to database upload and the verification and validation process.

6.1.1 CHEMICAL DATA VERIFICATION

Step 1. Verify Field Data and Request IDs

Check to confirm that all field forms are all accounted for in the project binder and that they are complete and legible. Refer to sampling plan to determine what should have been accomplished to date. Indicate missing and illegible information on the *Chemical Data Verification and Validation Worksheet (Attachment A-1)* and corrective actions taken.

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Confirm that all data (e.g. location, date/time, RIDs and field parameters) on the field forms have been correctly entered into the database. Indicate on field form once the data have been verified. If data have not been entered, complete data entry before continuing verification.

If verifying data after a sampling run, the easiest way is to view through the sampling event information under the project view. Data to be verified can be found under the “*Details View*” at the sampling event level except for RIDs and Analyte Suite, which can be viewed at the activity level for the given sampling event. In addition for Lake Sampling Events, the Lake Depth Profile and the Lake Field Data should be verified either by viewing this data at the “activity” level or running the Lake Depth Profile and Lake Field Data Reports via the Ad Hoc query tool.

The following approach, especially if verifying at the end of the project, can also be used generate a “SLD upload results” report from database:

- Adhoc Report
- Project << >> Monitoring Location
- Select Project whose data is to be verified and validated and Copy
- Select specific station from the project otherwise all will be assumed.
- Select dates of Data Range if needed
- in RIDs/QA Reports select “SLD upload results”
- save file and open in excel
- Use autofilter to sort and arrange data to facilitate verification

Using either approach the following information should be confirmed:

- Sample Location (Station ID)
- Field Staff
- Sample Date and Time
- RIDs (ACT_ID) and associated analytical suite (ANALYTE_SUITE)
- Activity Type (routine sample, QA sample, vertical integrated sample for lakes)
- Media Subdivision (e.g. surface water, municipal waste, etc.)
- Field sampling data - sonde readings, Level 1 Nutrient Screening and flow condition rating
- Any other field notes or comments on field forms

Project Managers can correct most errors in the database using the edit function. Note if the date or time is changed at the sampling event level as this will also need to be changed at the activity level. If the analytical suite in the database is not consistent with that on the field form, check the analytical request submittal forms to identify errors in Request Identification (RID) numbers and/or analytical requests. Once the corrections have been made and/or validation codes added, re-verify these data. The following errors cannot be corrected by Project Managers:

- Sampling Event associated with the wrong station
- RID associated with the wrong Sampling Event
- RID associated with the wrong Analyte Suite

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If these errors exist please note the error and the correct value and send to the MASS Program Manager/SQUID administrator to be changed through an IT Help Desk Request.

Note frequency and type of discrepancies that cannot be addressed by highlighting on data report and attaching those rows with corrections to the *Chemical Data Verification and Validation Worksheet* OR noting on the worksheet. It is not necessary to document transcription errors that are easily corrected in the database. Include any appropriate validation codes (refer to Attachment B-1 for complete list of validation codes) and provide to Program Manager or QA officer to load into the database. Completion of field data and RID verification is indicated by the verifier's initials and date on each field form.

Step 2. Verify Data Deliverables (analytical results received from the lab)

Check to confirm that all data deliverables are complete and that the results consist of the correct analytes. Identify missing or misplaced results. This task should be completed as soon as possible after a complete set of data is received.

Generate the "samples pending results" report from database:

- Adhoc Report
- Project << >> Monitoring Location
- Select appropriate Project and, if needed, Monitoring Location(s)
- Select dates of Data Range if needed
- in RIDs/QA Reports select "samples pending results"
- save file and open in excel
- Use autofilter to sort and arrange data to facilitate verification

Generate "samples with incomplete results" report:

- Adhoc Report
- Project << >> Monitoring Location
- Select appropriate Project and, if needed, Monitoring Location(s)
- Select dates of Data Range if needed
- in RIDs/QA Reports select "samples with incomplete results"
- save file and open in excel
- Use autofilter to sort and arrange data to facilitate verification

Step 1 of the data verification process included a check of all RIDs submitted to the laboratory and therefore it is known in the database what results are expected to be received from the lab. The reports generated in this step will identify RIDs that do not have any associated lab data or have incomplete or incorrect analytes. Note any sample or QA RIDs that are missing data (highlight on report and attach to worksheet OR note on the worksheet). Inform the QA officer of the missing results and work with the data source (lab) to obtain missing results or identify why no results are available for a particular RID. Describe action taken on worksheet. Upon receipt of any missing results, send new results to QA officer for upload to database and verify data according to above procedures.

The "samples with incomplete results" report will identify results that were entered into the wrong suite or potentially analyzed incorrectly, either due to submittal error (which

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can be checked by referring to the analytical submittal request form) or lab error. The purpose of this verification step is to identify samples that were analyzed or entered incorrectly so that the data can be rejected, corrected, or otherwise flagged to address issues associated with incorrect analysis, primarily varying preservation techniques associated with particular analytical suites. Missing analytes may be the result of changes in the analysis procedures at the laboratory – if this is the case, provide documentation to explain. Note any results that were analyzed correctly but entered in the incorrect analyte suite. Note and flag any samples that were incorrectly analyzed (or highlight on report and attach) on the *Data Verification and Validation Worksheet* for future reference, indicating if it was a submittal request error, correct data associated with the incorrect suite, or lab analysis error. Include any appropriate validation codes (refer to Attachment B-1 for complete list of SWQB validation codes) and provide to QA officer or Program Manager to load into the database.

Review all SLD qualifiers and comments to determine if invalid, questionable, or qualified data has been reported. Refer to Attachment B-2 for a complete list of SLD qualifier codes. Circumstances surrounding the generation of SLD data qualifiers are varied, but generally reflect an anomaly with QC criteria, which may or may not disqualify the use of the data for its intended purpose. These qualifiers are meant to inform the user of inconsistencies that occurred during the course of analysis due to matrix effects, sampler or analyst error, lab accident, or any other uncontrollable situation. These SLD qualifiers are intended to further aid the user in making judgments regarding data quality and use and in some instances, may provide sufficient reason to reject a sample or analyte.

Step 3. Verify Flow Data

Confirm that the results of all flow measurements were correctly transcribed from the field sheet to the flow calculation spreadsheet, then note as verified on the spreadsheet. Confirm that the results of all flow calculations have been entered into the database by comparing the total discharge from the spreadsheet to the flow result on the “raw results” report. There may be two “Flow” results for a given sample event, the measured discharge and the qualitative flow rating. Correct errors in the database (refer to data editing procedures in Step 1 above to correct transcription errors).

Step 4. Verify Analytical Results for Missing Information or Questionable Results

Using the raw results report (step 1), review spreadsheet for missing information (metadata) [can use AutoFilter function to identify blank cells] such as missing results, detection limits or analytical method reference. Some lab results may have blank cells associated with a RID, such as no validation codes reported from lab, sigma is only reported for rads results, etc., but generally most other cells should contain information. Samples below detection limits will not contain measurements or units and can be confirmed by a Y in the less than column (except for E.coli detected above test limits). Only the SLD report will populate the measurement value for samples below detection limits with the SDL value and units. For E.coli samples that were detected above the limits of the test the measurement and unit column will be blank and the less than column will be N whereas there will be a Y in the greater than column. Note any missing information (highlight on report and attach to worksheet OR note on the worksheet).

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Contact QA officer and/or data source (lab) to resolve issue and describe action taken on worksheet.

Sort the spreadsheet by analyte and look for questionable results and extreme outliers. Questionable results must not be changed without written approval and associated documentation, although corrections can be made to metadata (sample detection limits, units, etc.) with approval from lab and/or QA officer as appropriate. However, validation codes can be added as applicable (Attachment B-1). Upon receipt of any missing information, add missing information as well as any validation codes to spreadsheet and send to the NMSQUID administrator and or QA officer for upload to database, specifically identifying what information needs to be added or corrected.

6.1.2 CHEMICAL DATA VALIDATION

Step 5. Validate Blank Results

An analysis of blank results is conducted to identify potential contamination during field processing or transport.

Generate a “blanks with hits” report from database by the following procedure:

- Adhoc Report
- Project << >> Monitoring Location
- Select Project and Monitoring Locations and Copy
- Select dates of Data Range if needed
- in RIDs/QA Reports select “blanks hits report SLD upload results”
- open file in excel, convert the numbers / dates to the correct format, sort and arrange data to facilitate verification, and save file

Examine the results and determine the sampling runs. For chemical parameters that require blanks determine if blanks were collected for that run. If a blank sample was required during a sampling run, but not collected, assign the BN validation code to samples collected without blanks.

Other “RIDs/QA” SQUID reports may be useful for identifying activities that require qualification codes, however, all qualification codes should be reported on the “SLD upload results” report for the purpose of uploading changes.

Examine results and identify samples where chemical parameters were detected in the blanks at a concentration equal to or greater than the SDL. Refer to Table 1 for blank validation codes and discussion in the most recent version of the QAPP. It is usually important and necessary to consult the analytical laboratory to examine the possible causes of blank contamination. When blanks demonstrate that contamination has occurred, the Project Coordinator(s) must consider on a case-by-case basis if the contamination is significant enough to reject the data and flag as “RB1” or simply flag the data “B1” or “BU”. When deciding whether the data need to be rejected, the validator should consider the following:

- If the objective is to detect minute changes in variable concentrations then even small levels of contamination reduce the ability to interpret the data with confidence.

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- In the case where the contamination values approach the real data values, the data collected during the particular sample trip may be invalid.
- If the purpose of the study is to monitor for large variations, then small levels of contamination are not significant. In this case, a correction of the data can be made (subtract blank data values from the sample data values to get the reported value).

Table 1. Blank Validation Codes

| Concentration in Blank | Monitoring Type | |
|---------------------------------------|-----------------|---------|
| | I | II |
| < SDL | No Code | No Code |
| ≥ 5% of Sample Concentration | RB1 | RB1 |
| ≥ SDL and <5% of Sample Concentration | B1 | RB1 |
| ≥ SDL and Sample Concentration <SDL | BU | RB1 |

I = Ambient/Assessment and Effectiveness Monitoring

II = NPDES Compliance Evaluation and WQS Enforcement Monitoring

Flagging is limited to the QC sample/or samples associated with a given run. When multiple blank QC samples are collected (minimum 10% of ambient samples) during a given run, ALL data collected since the last compliant QC sample and all data up to the next compliant QC sample are assigned validation codes. If the non-compliant event is not preceded and followed by a compliant event, within that sampling run, the qualified data range would include the entire sample run. *For this reason, when more than ten samples are anticipated to be collected during a given run, it is best to collect blank QC samples at a continual 1 per 10 frequency during the run so that QC blank sample occur on different days. This minimizes the risk of qualifying an entire run when complaint and non-complaint blank QC samples are taken.* These Blank Validation codes serve to alert the data user that the results are outside Quality Assurance control limits and may require re-sampling or a separate qualitative analysis based on professional judgment.

Method 1631 for mercury (in addition to USEPA Methods 1632, 1636, 1637, 1638, 1639, 1640) requires the collection of field blanks and the rejection of results for regulatory compliance purposes if contamination is demonstrated. If a permit requires the use of this method or similar methods, such results would be qualified “RB1” and considered unusable.

To generate flagging, produce a “SLD upload results” report from the database as described above. Sort the result using autofilter for parameter and dates which require flagging. Add appropriate qualifier code and comments as shown in Figure 1. Send excel file to NMSQUID administrator or QA officer for upload into the database. Program Manager or QA officer should notify the validator once completed. The validator needs to verify that these codes have been correctly added and uploaded.

Uploads to the database should be performed by the Program Manager, QA Officer, or Monitoring Team Supervisor using the following procedure:

- Data Management
- Imports << >> SLD Results

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- Select file to upload (in the “SLD upload results” format)
- Select “Insert-Update” mode, and click “Upload File”
- Ensure correct mapping of SQUID columns and Spreadsheet columns. Make changes as necessary. Click “Process SLD Data”
- A summary of invalid records will display. If invalid records or errors occur, click on the “!” icon of each invalid record to diagnose the error. If invalid records are displayed, click “Discard SLD Data”, correct the error in the upload spreadsheet, and repeat the earlier steps.
- If no invalid records occur, click “Import SLD Data”

Figure 1. Example of proper validation code flagging for blank “hits”

| ACT_ID | SAMPLE_CHARACTER | MEASURE | UNITS | SDL | PQL | MDL | ML | LESS_THAN | ANL | MTH | DILUTION | ACT_STAR | Lab ID | QUALIFIER | RES | COMMENTS |
|---------|---------------------|---------------|-------|-------|-------|---------|---------|-----------|-------|-----|----------|----------|--------|-----------|-----|--|
| 2430913 | Dissolved Manganese | 0.007 mg/l | | 0.001 | 0.001 | 0.00012 | 0.00038 | FALSE | 200.8 | 1 | 00:00:0 | SLD | RB1 | | | Analyte detected in blank for this sampling run at |
| 2430919 | Dissolved Manganese | 0.009 mg/l | | 0.001 | 0.001 | 0.00012 | 0.00038 | FALSE | 200.8 | 1 | 30:00:0 | SLD | RB1 | | | Analyte detected in blank for this sampling run at |
| 2430909 | Dissolved Manganese | 0.001 mg/l | | 0.001 | 0.001 | 0.00012 | 0.00038 | TRUE | 200.8 | 1 | 00:00:0 | SLD | RB1 | | | Analyte detected in blank for this sampling run at |
| 2430905 | Dissolved Manganese | 0.001 mg/l | | 0.001 | 0.001 | 0.00012 | 0.00038 | TRUE | 200.8 | 1 | 00:00:0 | SLD | RB1 | | | Analyte detected in blank for this sampling run at |
| 2430896 | Dissolved Manganese | 0.001 mg/l | | 0.001 | 0.001 | 0.00012 | 0.00038 | TRUE | 200.8 | 1 | 00:00:0 | SLD | RB1 | | | Analyte detected in blank for this sampling run at |
| 2430900 | Dissolved Manganese | 0.059214 mg/l | | 0.001 | 0.001 | 0.00012 | 0.00038 | FALSE | 200.8 | 1 | 00:00:0 | SLD | RB1 | | | Analyte detected in blank for this sampling run at |
| 2430932 | Dissolved Manganese | 0.011 mg/l | | 0.001 | 0.001 | 0.0001 | 0.00032 | FALSE | 200.8 | 1 | 00:00:0 | SLD | RB1 | | | Analyte detected in blank for this sampling run at |
| 2430923 | Dissolved Manganese | 0.002 mg/l | | 0.001 | 0.001 | 0.0001 | 0.00032 | FALSE | 200.8 | 1 | 30:00:0 | SLD | RB1 | | | Analyte detected in blank for this sampling run at |
| 2430926 | Dissolved Manganese | 0.002 mg/l | | 0.001 | 0.001 | 0.0001 | 0.00032 | FALSE | 200.8 | 1 | 30:00:0 | SLD | RB1 | | | Analyte detected in blank for this sampling run at |
| 2430942 | Dissolved Manganese | 0.021 mg/l | | 0.001 | 0.001 | 0.0001 | 0.00032 | FALSE | 200.8 | 1 | 30:00:0 | SLD | RB1 | | | Analyte detected in blank for this sampling run at |
| 2430936 | Dissolved Manganese | 0.009 mg/l | | 0.001 | 0.001 | 0.0001 | 0.00032 | FALSE | 200.8 | 1 | 30:00:0 | SLD | RB1 | | | Analyte detected in blank for this sampling run at |
| 2430984 | Total Phosphori | 0.008 mg/l | | 0.003 | 0.003 | 0.013 | 0.0132 | FALSE | 365.1 | 1 | 00:00:0 | SLD | RB1 | | | Analyte detected in blank for this sampling run at |
| 2430990 | Total Phosphori | 0.005 mg/l | | 0.003 | 0.003 | 0.013 | 0.0132 | FALSE | 365.1 | 1 | 30:00:0 | SLD | RB1 | | | Analyte detected in blank for this sampling run at |
| 2430968 | Total Phosphori | 0.006 mg/l | | 0.003 | 0.003 | 0.013 | 0.0132 | FALSE | 365.1 | 1 | 00:00:0 | SLD | RB1 | | | Analyte detected in blank for this sampling run at |
| 2430972 | Total Phosphori | 0.003 mg/l | | 0.003 | 0.003 | 0.013 | 0.0132 | FALSE | 365.1 | 1 | 00:00:0 | SLD | RB1 | | | Analyte detected in blank for this sampling run at |
| 2430980 | Total Phosphori | 0.005 mg/l | | 0.003 | 0.003 | 0.013 | 0.0132 | FALSE | 365.1 | 1 | 30:00:0 | SLD | RB1 | | | Analyte detected in blank for this sampling run at |
| 2430977 | Total Phosphori | 0.006 mg/l | | 0.003 | 0.003 | 0.013 | 0.0132 | FALSE | 365.1 | 1 | 00:00:0 | SLD | RB1 | | | Analyte detected in blank for this sampling run at |

Step 6. Validate Holding Time Violations

Generate a “SLD upload results” report. Review spreadsheet using AutoFilter function., specifically the “HOLD_TIME_EXCEEDED” column. A “Y” result in this column indicates that the holding time was exceeded. The “EXCEDENCE_PERCENTAGE” column calculates the extent of exceedance.. Under the “SWQB_QUALIFIER_CODE” column, the Validator will, using best professional judgment (BPJ), assign a validation code of “K1” and then assign either an “S2” or “R3” to these data to indicate the result is “Estimated” or the result is “Rejected” respectively, due to a hold time violation. Samples where %HTV ≥ 10% will be assigned “R3.” Samples where %HTV < 10%, may be qualified as an estimated value (S2) when additional information related to the sample can support not rejecting the data. Further information and consideration about the nature of the particular sample can include the magnitude of the sample result and its relative comparison to other valid data from the same station and evidence that all sample handling, preservation, and collection methods indicate compliance with stated requirements. Knowledge of the segment/station, past results, expected results, and physical in-stream parameters collected coincident to the sample in question can be used to either justify or reject a determination of an estimated value. Document all justifications in brief but concise language within the comment field or other appropriate data attribute section. A summary of the holding time violation validation process is shown in Figure 2 below.

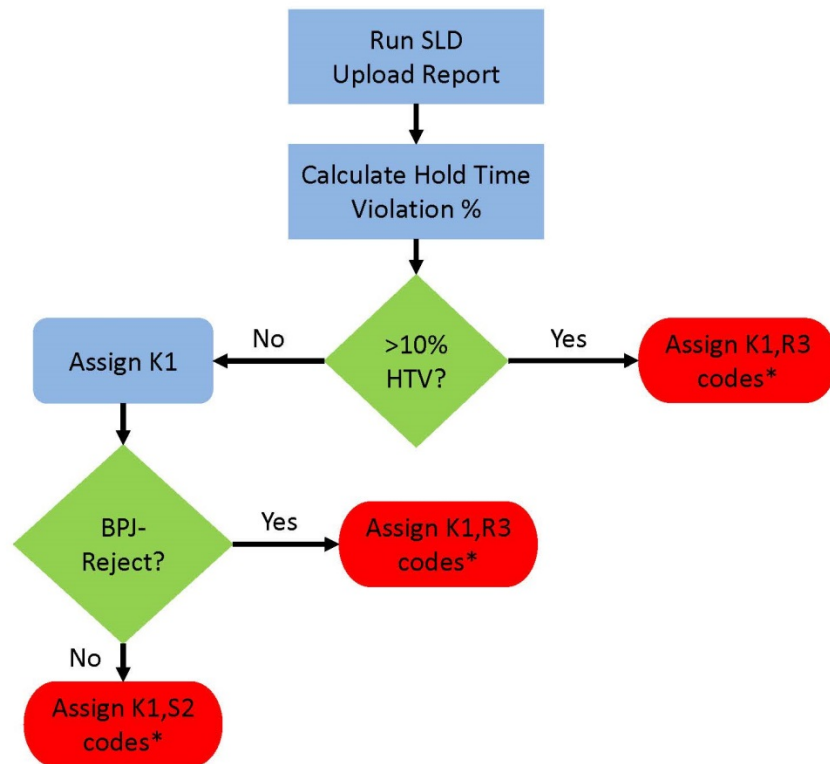
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Additionally, the data validator should evaluate the impact of the holding time non-compliance, taking the following into account:

- the nature of the analysis (Was it a critical parameter in the determination of project objectives?),
- the nature of the analyte (Some analytes such as mercury may be particularly sensitive to holding time violations or sample container issues.)
- the sample matrix, any supporting data (Was there a diluted analysis performed within holding times?), and the purpose and goals of the sampling and analysis program.

Save any results, with appropriate validation codes, as an excel file; send to Program Manager or QA Officer for upload into the database and, once completed, verify that these codes have been correctly added.

Figure 2. Holding Time Violation Validation Process Diagram



*Assign codes in the raw results report

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Step 7. Validate Replicate/Duplicate Results (if applicable)

The evaluation of field replicate/duplicate samples provides information on the environmental variability at a particular location, the sampling technique, sample processing and transport, and laboratory analysis.

The chemical data validation process includes an evaluation of the variability of measurements based on the relative percent difference (RPD) between field replicate and/or duplicate samples.

Relative Percent Difference between results for all replicate and duplicate pairs is calculated using the following equation:

$$\text{Relative Percent Difference} = \left(\frac{|A-B|}{(A+B)/2} \right) \times 100$$

The RPD calculations can be using the following database commands:

- Adhoc Report
- Project << >> Monitoring Location
- Select Project and Monitoring Locations and Copy
- Select dates of Data Range if needed
- in RIDs/QA Reports select “duplicate samples comparison”
- open file in excel, convert the numbers / dates to the correct format, sort, limit data as necessary, and arrange data to facilitate verification, and save file
- sort for Quality Control Sample-Blind Duplicate or Quality Control Sample - Field Replicate
- calculated RPD using formula above

- If both reported values are < 4 times the SDL, the RPD is not applicable and no entry is made.
- If one or both of the reported values are ≥ 4 times the SDL and if the RPD ≥ 20%, then a qualifier (PD1) is entered.

The data validator should evaluate the impact of RPDs ≥ 20%, taking into account the considerations listed in Step 5 above.

When multiple QC samples are collected, ALL data collected since the last compliant QC sample and all data up to the next compliant QC sample are assigned validation codes. If the non-compliant event is not preceded and followed by a compliant event, the qualified data range would include the beginning or end of the sample run. Flagging is limited to the non-compliant analytes and to the sample run in which the non-compliant sample was identified. This validation code will alert the data user that the results are outside control limits and may require re-sampling or a separate, qualitative analysis based on professional judgment.

To generate flagging produce a raw results report from the database as described above. Sort the result using autofilter for parameter and dates which require flagging. Add appropriate qualifier code and comments as shown in Figure 1. Send excel file to

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QA officer or Program Manager for upload into the database and, once completed, verify that these codes have been correctly added.

6.1.3 COMPLETION OF CHEMICAL DATA VERIFICATION AND VALIDATION PROCESS

When ALL Verification and Validation steps have been completed, sign the completed *Chemical Data Verification and Validation Worksheet*.

Notify the Program Manager and QA officer that the verification and validation process has been completed for that particular study. The Program Manager/Database Manager will indicate that this process has been completed for that study and will contact the SQUID administrator to mark the Project as “verified” in the Project level of SQUID. The SQUID administrator will then initiate upload of the data to EPA’s national database via WQX.

Provide a copy of the completed *Chemical Data Verification and Validation Worksheet* with attachments to the Quality Assurance Officer and retain originals in the project binder.

6.2 PHYSICAL/HABITAT DATA VERIFICATION AND VALIDATION

Physical/habitat data verification is to be performed both in the field, following the completion of data entry on field forms, and in the office, as soon as possible following transcription into electronic formats. The person verifying data should be different than the person who enters/transcribes data. Steps 1 and 2 describe the physical/habitat data verification process.

Supporting documents needed for the data verification process:

- Copy of the Sample Design or Field Sampling Plan (sample locations, parameters and frequencies),
- Field forms.

6.2.1 PHYSICAL/HABITAT DATA VERIFICATION

Step 1. Confirm Verification of Field Data

Following the completion of data collection at a sampling location and prior to leaving a site, all forms are to be checked for completeness and for obvious errors or anomalies. Corrections are indicated by striking through the incorrect information with a single line and adding the correct information with a notation as to why the correction was made. Completion of field verification is indicated by the verifier’s initials and date on each form.

Using the complete set of field forms, check for verifier’s initials on each form. Identify any forms that were not verified on the *Physical/Habitat Data Verification/Validation Worksheet (Attachment A-2)*. Have the data verifier review and make any necessary corrections and notations. Indicate on form that verification was performed in office and not at sampling location.

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Indicate forms that were not verified in the field or remain missing on the *Physical/Habitat Data Verification and Validation Worksheet*.

Step 2. Verify Data Transcription

Physical/habitat data is housed in NMSQUID. Prior to upload to the database, physical/habitat data are entered into electronic spreadsheets.

Based on available forms from previous step, confirm that all data have been entered into the database. If data have not been entered, then complete data entry. The person verifying data should be different than the person who enters data.

Compare data collection information (sample location, date, time, etc.), raw data and field notes on field forms to data in database/spreadsheet for consistency to identify data entry errors. Note frequency and type of discrepancies and any resulting corrections on *Physical/Habitat Data Verification and Validation Worksheet*, correct errors in the database and re-verify. Completion of data transcription verification is indicated by the verifier's initials and date on each field form.

6.2.2 Physical/Habitat Data Validation

The data validation process is typically performed after all data have been received and verified for a particular project; however, to accommodate data requests or to conduct preliminary data analyses, the validation can be performed on a subset of data at any point during the course of the project, but will need to be re-done upon receipt and verification of all additional data. Step 3 describes the physical/habitat data validation procedures.

Step 3. Validate Replicate Results

An analysis of physical/habitat data replicate results is conducted to identify collector bias and evaluate performance characteristics of sampling protocols (primarily field sampling precision), stream types and the monitoring program. If a replicate was not conducted during the survey assign the H1 validation code to the comments of all the sediment sampling events within the survey.

The RPD calculations can be using the following database commands:

- Adhoc Report
- Project << >> Monitoring Location
- Select Project and Monitoring Location of replicate and Copy
- Select dates of Data Range if need
- in Geomorph/Habitat select "XLS report standard"
- open file in excel, convert the numbers / dates to the correct format,
- calculated RPD using formula below

Calculate the Relative Percent Difference between all replicate pairs using the following equation:

$$\text{Relative Percent Difference} = \left(\frac{|A-B|}{|A+B|/2} \right) \times 100$$

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If the RPD is $\geq 15\%$, then the associated data are flagged (currently this means adding the H1 validation code and noting the RPD value in the comment field at the sample event level) and examined further to identify potential sources of differences and determine appropriate corrective actions. Note which procedure generated flagged data, pebble count, cross section, thalweg, or shade. The results of this analysis and any findings and corrective actions should be documented in the Field Sampling Plan.

Coefficient of Variation and Confidence Interval calculations will be incorporated into these validation procedures once a larger dataset of duplicate/replicate samples is obtained. These values, including RPD, can be used for evaluating the difference between and among samples.

6.2.3 COMPLETION OF PHYSICAL/HABITAT DATA VERIFICATION AND VALIDATION

When ALL Verification and Validation steps have been completed, sign the completed *Physical Data Verification and Validation Worksheet*. Provide a copy of the completed *Physical/Habitat Data Verification and Validation Worksheet* with attachments to the Quality Assurance Officer and retain originals in the project binder.

6.3 BIOLOGICAL DATA VERIFICATION AND VALIDATION

Biological data verification is to be performed both in the field, immediately following the completion of data entry on field forms, and in the office, as soon as possible following receipt of data from contract laboratories. These procedures currently apply to macroinvertebrate, periphyton/phytoplankton, and fish data. Steps 1 through 4 describe the biological data verification process.

Supporting Documents needed for the data verification process:

- Copy of the Sample Design or Field Sampling Plan (sample locations, parameters and frequencies),
- Field forms and notebooks.

6.3.1 BIOLOGICAL DATA VERIFICATION

Step 1. Confirm Verification of Field Data

Following the completion of data collection at a sampling location and prior to leaving a site all forms are checked for completeness and for obvious errors or anomalies. Corrections are indicated by striking through the incorrect information with a single line and adding the correct information with a notation as to why the correction was made. Completion of field verification is indicated by the verifier's initials and date on each form.

Using the complete set of field forms, check for verifier's initials on each form. Identify any forms that were not verified on the *Biological Data Verification/Validation Worksheet (Attachment A-3)*. Have the data verifier review unverified forms and make any necessary corrections and notations. Indicate on form that verification was performed in office and not at sampling location.

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Indicate forms that were not verified or remain missing on the *Biological Data Verification and Validation Worksheet*.

Step 2. Verify Completeness of Data Deliverables (taxonomic results from laboratory)

Check to confirm that all information from field forms related to biological sampling efforts have been entered into NMSQUID. Refer to sampling plan to determine what should have been accomplished to date.

Check to confirm that all data have been delivered from the laboratory and correctly loaded into the database (use the Benthic Taxon Report, Fish Ecology Report and/or Periphyton/Phytoplankton report). This task should be completed as soon as possible after a batch of data are received.

Indicate missing information on the *Biological Data Verification and Validation Worksheet*. Contact laboratory to resolve issue and indicate action taken.

Step 3: Verify Laboratory Results for Missing or Questionable Information

Review data for missing information or questionable results. Note any missing or questionable information (can highlight on report and attach to worksheet OR note on the worksheet). Contact data source (lab) to resolve issue and describe action taken on worksheet. Questionable results must not be changed without written approval and associated documentation. Upon receipt of any missing information, add missing information to database or spreadsheet and re-verify.

Step 4. Verify Data Transcription

Based on available forms and results received from laboratory from previous step, confirm that all data have been entered into the database. If data have not been entered, then complete data entry. The person verifying data should be different than the person who enters/transcribes data.

Compare data collection information (sample location, date, time, etc.), raw data and field notes on field forms to data in database/spreadsheet for consistency to identify transcription errors. Note frequency and type of discrepancies and any resulting corrections on *Biological Data Verification and Validation Worksheet* and correct errors in the database and re-verify. Completion of data transcription verification is indicated by the verifier's initials and date on each field form.

6.3.2 BIOLOGICAL DATA VALIDATION

The data validation process is typically performed after all data have been received and verified for a particular project. To accommodate data requests or to conduct preliminary data analyses, the validation can be performed on a subset of data at any point during the course of the project, but will need to be re-done upon receipt and verification of all additional data. Step 5 describes the biological data validation procedures.

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Step 5. Validate Reported Quality Control Results

A review of benthic macroinvertebrate data quality control results is conducted to identify any reported sample sorter or taxonomic identification bias.

Confirm that the Macroinvertebrate sample sorter or taxonomic identification bias items detailed in Field Quality Control Summary (Attachment B-3) have been met. If they are not met, follow the corrective actions as outlined in the current version of the QAPP.

Once the data verification and validation process has been completed for the entire study (note: if the worksheet is for a subset of the data from a study, be sure ALL the data for the entire study is included before final completion of the data verification and validation process), provide copies of ALL *Data Verification and Validation Worksheets* and attachments associated with the study to the Quality Assurance Officer and retain originals in the project binder.

6.4 LONG TERM DEPLOYMENT (LTD) DATA

Step 1. Confirm all LTD data has been uploaded

This can be done by generating a LTD report for the survey, and matching the sampling events with the FSP/Field Sheets for each deployment

Step 2. Confirm all LTD data has been reviewed, truncated to deployment, corrected and qualified as necessary, and summary statistics generated.

Access the LTD csv file for each deployment event.

- i. The csv file is found by clicking the details icon at the long term deployment event: Projects » Monitoring Locations » Sampling Events
- ii. Under the “General” tab, click on the blue box with the xxxx.csv filename. This opens the LTD dataset that was uploaded.

Confirm filename on csv file matches station.

Confirm the dates, sonde model and number, and coordinates match the field sheet.

Confirm dataset is truncated to the deployment and retrieval times found on the deployment field sheet.

Confirm probe calibration and verification were within calibration criteria or qualified as necessary.

Confirm drift and/or offset corrections were applied as necessary.

Open the “Field Measurement” tab on the LTD Sampling Event details window to view the LTD metadata: Projects » Monitoring Locations » Sampling Events » Long Term Deployment “details” icon » “Field Measurements” tab.

Confirm metadata (summary statistics) on the .csv file matches the data entered into SQUID. Check for any summary values that seem out of the ordinary, and check for associated comments. If you discover missing, incorrect, or extraordinary values existing without comments, consult the project manager.

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Correct any errors, re-upload or re-enter data if necessary with the help of the project manager.

Step 3. Date and initial the top right corner of deployment field sheet "VV, Initials, Date"

7.0 RELATED FORMS AND TABLES

Attachment A-1 Chemical Data Verification and Validation Worksheet
Attachment A-2 Physical/Habitat Data Verification and Validation Worksheet
Attachment A-3 Biological Data Verification and Validation Worksheet
Attachment B-1 SWQB Validation Codes
Attachment B-2 SLD Data Qualifiers
Attachment B-3 Field Quality Control Summary

8.0 REVISION HISTORY

03/15/2016 – Added confirmation of drift correction for LTD datasets and reformatted to SOP 1.1.

05/29/2015 – Language added to clarify hold time and blank detection qualifications, updated staff responsibility descriptions, and added a definition of sample run.

12/12/14 – Minor updates and language clarification.

11/20/13 – Updated to include changes in personnel, database, and the addition of V&V steps for long term deployment data.

9.0 REFERENCES

USEPA, 2008. *Guidance on Environmental Data Verification and Data Validation*. EPA/QA-G8. EPA/240/R-02/004. Office of Environmental Information, Washington, DC. November.