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New Mexico Environment Department (NMED) Surface Water Quality Bureau (SWQB)

Standard Operating Procedure (SOP) for

DATA VERIFICATION AND VALIDATION

Approval Signatures

Chuck Dentino
Subject Matter Expert

Date

Miguel Montoya
Quality Assurance Officer

Date

Kristopher Barrios
Program Manager - Monitoring, Assessment and Standards Section

Date

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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, B-2, and B-3. A summary of Field Quality Control criteria are listed in Attachment B-4.

2.0 Personnel Responsibilities

The Program Manager will provide input on the scope and intent of the SOP as it pertains to the program's goals and objectives. The Program Manager coordinates with the Team Supervisor, Project Manager(s), Technical Staff, and the QAO as applicable to ensure quality data is collected, verified, and validated to support program commitments and support protection of the surface waters of New Mexico.

Project Manager(s) are responsible for ensuring that the data verification and validation process is completed in accordance with the specifications outlined in this document. Upon completion of a project, the Project Manager(s) will provide a copy of the completed *Data Verification and Validation Worksheets* to the SWQB Quality Assurance Officer (QAO). The Project Manager will resolve data quality issues in coordination with the Team Supervisor or Quality Assurance Officer. All information pertaining to this process, including the original *Data Verification and Validation Worksheets* will be documented and maintained in the project file.

The Team Supervisor is responsible for ensuring that staff are completing the data verification and validation process in accordance with the specifications as described in this SOP. The Team Supervisor will work with the Project Manager and/or QAO to resolve any data quality issues. The Team Supervisor may also be a Project Manager.

The Quality Assurance Officer (QAO) will work with Project Manager(s) and/or Team Supervisor to resolve quality issues in regard to data verification and validation of data sets. The QAO is involved in the development and revision of this SOP to ensure the SOP meets the requirements of the SWQB's Quality Assurance Project Plan (QAPP). The QAO, along with the Subject Matter Expert (SME) and Program Manager will determine if any revisions to this SOP are needed at a minimum of every two (2) years in accordance with SOP 1.1 for the Creation and Maintenance of SOPs (NMED/SWQB). Pending the review and approval of the document, the QAO will ensure the SOP is accessible through the SWQB's website.

Technical Staff who conduct data verification and validation activities or who supervise those who do must be familiar with this SOP and implement procedures as described in the most up-to-date SOP.

3.0 Background and Precautions

3.1 Background

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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.

3.2 Procedural Precautions

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.

The verification and validation process should be done by a different person other than the person who entered the data into the database.

When applying multiple WQX qualifiers to a sample result, check the qualifier combination against allowable values in WQX. If unsure if a qualifier combination is allowable, contact the Program Manager. When multiple qualifiers describe data condition and the combination is not allowable, apply the qualifier(s) that most restricts data usability.

3.3 Safety Precautions

This SOP has not identified specific precautions in regard to its procedure beyond those found in a typical office environment.

4.0 Definitions

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.

Deployment – use of a sonde or logger at a monitoring location to perform and record measurements of water quality.

Field Sampling Plan (FSP) – A document that provides guidance for all fieldwork by defining in detail the sampling and field data-gathering methods as well as resource requirements for the project.

Long-term Deployment (LTD) – installation of a sonde or data logging device at a monitoring location to perform and record unattended measurements at discrete intervals.

Program Manager – An individual within the SWQB that manages a program such as the Monitoring, Assessment and Standards Section (MASS). The Program Manager may be the same individual as the Subject Matter Expert.

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Project Managers – An individual responsible for a specific project identified in a field sampling plan. This individual, in most cases, holds a different title within the organization. The Program Manager and Project Manager are not synonymous. The Project Manager may be the same individual as the Subject Matter Expert.

RID – is a unique reference ID number for samples submission.

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 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, qualification resulting from 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 frequency of one blank sample per ten ambient samples to allow for adequate QC blank distribution.

Subject Matter Expert (SME) – A person who is familiar with the purpose and procedure for accomplishing a task. The SME may be the same individual as the Program or Project Manager.

Sonde – a device used to measure multiple water quality parameters. Note: the term “sonde” is used interchangeably in this document to describe In-Situ Sondes and Onset HOBO DO, Temperature, and Conductivity Loggers.

Standard Operating Procedure (SOP) – A document that lists the steps that should be completed when performing a task.

Surface Water Quality Bureau (SWQB) – A Bureau under the Water Protection Division of the New Mexico Environment Department. The SWQB's mission is to preserve, protect, and improve New Mexico's surface water quality for present and future generations.

SQUID – Surface Water Quality Information Database: the SWQB database for storing, retrieving and reporting laboratory results, field observations, biologic assemblage data, LTD data, and stream habitat/geomorphic data.

SQUID Administrator – An individual assigned as the SQUID database administrator.

Quality Assurance Officer (QAO) – An individual within the MASS that is responsible for overseeing the development and implementation of all quality assurance procedures and processes within the SWQB including those projects that receive support or funding from the SWQB. The QAO is also responsible for validating and verifying data sets for potential use in assessment of surface waters.

Quality Assurance Project Plan (QAPP) – A formal planning document for environmental data collection activities that describes the data collection procedures and the quality assurance and quality control

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activities that must be implemented to ensure that the results are sufficient and adequate to satisfy the stated performance criteria.

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.

5.0 Equipment and Tools

Implementation of the procedures outlined in this SOP require access to: the SWQB network, Microsoft Word and Excel or equivalent software, completed SWQB field sheets, and the SQUID database.

6.0 Step-by-Step Process Description

General Guidance for All Data

The results of the data verification and validation processes should be tracked and documented on the *Data Verification and Validation Worksheets (Attachments A1, A2, A3 & A4)*. 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 has been uploaded and 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 validating a subset of data, the validator should indicate data that have been validated 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,

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- Raw and processed data sets from dataloggers,
- Equipment/calibration logs.

6.1 Chemical Data Verification and Validation

Staff collecting chemical data should begin verification 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 validation process, the QAO 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.

6.1.1 Chemical Data Verification

Step 1. Verify Field Data and Request IDs – Post sampling run

- A. After a sampling run check to confirm that all field forms are all accounted for in the project binder and that they are complete and legible. Use the survey run sampling site list to verify all forms are accounted for.
- B. Next go into the SQUID database to confirm that station name, ID, and sampling date and time entered or uploaded are consistent with the field forms. Use the following procedure in SQUID:
 - Select the Projects tab.
 - Find the project and select View/Add Monitoring Locations.
 - Find your station and click on Sampling Events to find the sampling event that matches the field form. Correct if necessary and re-verify.
- C. After following the steps above select the sampling event that matches your field form and confirm that all field data (field staff, collection equipment, media subdivision, sonde readings and flow condition) on forms are consistent with the database. Use the following procedure in SQUID:
 - Select the Details from the Sampling Event that matches your field form.
 - In the General tab confirm field staff, collection equipment, and media subdivision. Ensure that if a separate aluminum sample was collected this is indicated with a green check mark. Correct if necessary.
 - In the Field Measurements tab confirm sonde readings and flow condition rating. Correct if necessary and re-verify.
- D. Confirm that RIDs are correct and associated with the correct analytical suite and activity type (e.g. routine sample, QA sample, etc.). Use one of the following procedures in SQUID:

Method 1.

- Select Adhoc Report tab in SQUID.
- Select the project.
- Select the date range of the sampling run.
- In the RIDs/QA reporting tab select Samples Pending Results report.

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- Filter the report by the station and confirm RIDs are associated with the correct analytical suite and activity type. Correct if necessary and re-verify.

Method 2.

- Select the Projects tab and select the Project
- Select the Monitoring Location
- Select the Activity for the date to verify
- Confirm RIDs are associated with the correct analytical suite and activity type. Correct if necessary and re-verify.

E. Confirm that lake field data forms are consistent with the database. Use the following procedure in SQUID:

- Select the Projects tab.
- Find the project and select View/Add Monitoring Locations.
- Find your station and click on Sampling Events to find the sampling event that matches the field form.
- Select the LAKE-CHEMICAL activity that matches the field form.
- Select LAKE_DATA results and compare to the field form. Correct if necessary and re-verify.

F. Confirm that lake field data forms are consistent with the database. Use the following procedure in SQUID:

- Select the Adhoc Report tab.
- Select your Project from the list.
- Select Lake Depth Profile Custom Report from the lake reports tab.
- Filter to the Station and Date on the field form.
- Convert depth values to numbers rather than text and filter smallest to largest.
- Compare all sonde readings to the field form. Correct if necessary and re-verify.

Project Managers can correct most errors in the database using the edit function. 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.

Results that have been uploaded to a wrong station cannot be corrected by Project Managers. If these errors exist, send to the Program Manager/SQUID administrator to change correct it through an IT Help Desk Request.

It is not necessary to document transcription errors that are easily corrected in the database. Completion of field data and RID verification is indicated by the verifier's initials and date on each Stream/River or Lake field form. If discrepancies cannot be addressed by the Project Manager, they should be documented in a data report and attached to the *Chemical Data Verification and Validation Worksheet* (Attachment A1) and the Program Manger will be notified to make the necessary corrections.

Using the complete set of field forms, check for verifier's initials on each form. Review unverified forms and make any necessary corrections and notations.

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Step 2. Verify Flow Data - Post sampling run

- A. Confirm that the results of all flow measurements were correctly transcribed from the field sheet to the Stream Flow Sheet and Calculator form (stored in the project file) or that the flow meter output file is complete without data entry errors. Correct if necessary and re-verify.
- B. Confirm that the flow from the Flow Sheet and Calculator form, the flow meter output file, or gage data matches what was entered or uploaded to the database. Once complete, note as verified on the Stream Flow Sheet and Calculator form or a printed flow meter output file. Use the following procedure in SQUID:
 - Select the Projects tab.
 - Find the project and select View/Add Monitoring Locations.
 - Select the monitoring station.
 - Select the details of the flow event and confirm the flow and flow collection method. Correct if necessary and re-verify.

Step 3. Verify Data Deliverables (analytical results received from the lab) – End of season

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:

- Select Adhoc Report tab.
- Select the Project tab and select the project.
- Select the RIDs/QA Report tab and select “samples pending results” report.
- Open the spreadsheet and filter to facilitate verification

Generate “samples with incomplete results” report in database:

- Select Adhoc Report tab.
- Select the Project tab and select the project.
- Select the RIDs/QA Report tab and select “samples with incomplete results” report.
- Open the spreadsheet and filter to facilitate verification

Step 1 of the data verification process includes a check of all RIDs submitted to the laboratory against laboratory data submittals uploaded to the database. 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 QAO 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 *the VV Worksheet*. Upon receipt of any missing results, send new results to QAO or Program Manager 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 can be checked by referring to the analytical submittal request form) or lab error. The purpose of this verification step is to identify

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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. Add any appropriate validation codes to the SWQB qualifier code and WQX qualifier code fields (refer to Attachment B-1 for complete list of SWQB validation codes and equivalent WQX validation codes) and provide to the Project Manager, the Monitoring Team Supervisor, or the Program Manager to upload 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. Add the appropriate WQX qualifiers, if missing, to the WQX qualifier code field. Translators for SLD qualifiers and WQX qualifiers are listed in Attachment B-2.

Step 4. Verify Analytical Results for Missing Information or Questionable Results – End of sampling season

Using the SLD upload 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 cases in which no validation codes were reported from lab; sigma is only reported for radionuclide results, etc., but in general most other cells within the SLD uploads report should contain information. Samples below reporting limits should contain measurements or units equal to the SDL and can be confirmed by a Y in the less than field. Samples above the maximum reporting limit (usually only applies to bacterial results) should have a result in the reported value field and a Y in the greater than field. Note any missing information (highlight on report and attach to the *VV Worksheet* OR note on the *VV Worksheet*). Contact QAO and/or data source (lab) to resolve issue and describe action taken on worksheet.

Sort the SLD upload result report spreadsheet by analyte and look for questionable results and extreme outliers. Questionable results must not be changed without written approval and associated documentation from the QAO or Program Manager, although corrections can be made without written approval to metadata (sample detection limits, units, etc.) following consultation with lab and/or QAO, 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 applied to the laboratory qualifier code, SWQB qualifier code, and WQX qualifier code fields to spreadsheet and send to the Project Manager, the Monitoring Team Supervisor, or the Program Manager for upload to the database, specifically identifying what information needs to be added or corrected.

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6.1.2 Chemical Data Validation

Step 5. Validation Sonde Grab Data - End of season

Check the sonde calibration and verification work sheet for the sonde used to collect grab measurements during the sampling run to see any sensors failed post sampling calibration verification. If any sensors fail post sampling calibration verification qualify all data associated with that sensor as rejected (R4) or S2 if the data are deemed usable based on best professional judgment. If data are deemed usable based on best professional judgement, state the reason why in the comments. An example of when the S2 qualifier might be appropriate is if field data values are within the expected range, but the sensor failed the post sampling calibration verification due to an instrument or sensor malfunction, or the calibration verification was performed more than 48 hours after returning from the field. It may be necessary to review other data from the station(s) in the sampling run to determine if values are within the expected range. The Monitoring Team Supervisor, the Project Manager, and the Program Manager can upload qualification codes using the SLD upload results report format.

Add qualifier codes to sonde grab data in SQUID:

- Select the Adhoc Report tap and select the Project
- Select the SLD Upload Results report from the RIDs/QA tab
- Filter for all stations/characteristics that need qualifier codes applied
- Copy these stations/characteristics into new spreadsheet
- In "SWQB_QUALIFIER_CODE" column add appropriate qualifier codes
- In "RES_COMMENTS" column add corresponding comments
- In "SDL" column enter N/A for all rows
- In "ANLMTH_ID" column add appropriate analysis method ID (EPA-approved method) for each row (see SWQB QAPP for IDs)
- In "DILUTION_FACTOR" column enter "1" for all rows, unless this column already contains a dilution factor
- In "ANALYSIS_DATE" column enter same date as "ACT_START_DATE" column for each row. Apply the "m/d/yyyy h:mm" custom format. Delete the .0 at the end of the date.
- In SQUID, navigate to the "Data Management" tab. Select "Imports" from the drop-down menu, then select "SLD Results" from the sub-menu.
- Choose the appropriate file for upload by selecting "choose file," then select "Insert-Update" for Mode and click "upload file."
- Select RES_COMMENTS within the "Comments" field-mapping selection and click "Process SLD Data."
- Ensure there are no errors and select "Import SLD Data."

Step 6. Validate Blank Collections

Confirm that all samples requiring blanks actually had blanks collected. The Monitoring Team Supervisor, the Project Manager, and the Program Manager can upload qualification codes using the SLD upload results report format. Use the following procedure in Squid:

- Select Adhoc Report tap and select the Project.

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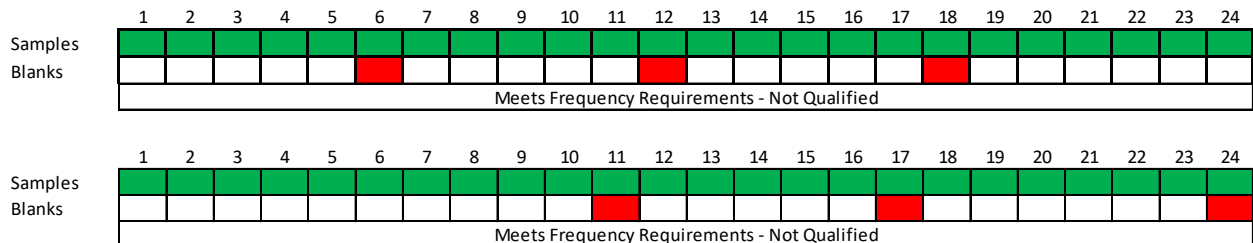
- Select RIDs/QA Report tab.
- Select SLD Upload Results **Note:** If two teams were collecting data in the same project during the same time frame it will be necessary to run a Raw Results Report to be able to filter and identify samples by team. Qualifiers will still need to be applied to the SLD Upload Results.
- Filter samples by an Analyte Suite requiring blanks.
- For ease of determining the collection of blanks select one Characteristic Name (ex. Phosphorus as P).
- Sort by date and ensure that required blanks were collected for the run.
- If blanks were not collected during the sampling run flag all analytes in the analytical suite for the entire sampling run with a SWQB Qualifier Code BN in the SLD Upload Results report.
- Document validation codes that were applied in the Verification and Validation Worksheet.
- Notify a Project Manager, the Monitoring Team Supervisor, or the Program Manager to upload applied validation codes.

Step 7. Validate Blank Collection Frequency

Confirm that all samples requiring blanks had blanks collected at the correct frequency. The Monitoring Team Supervisor, the Project Manager, and the Program Manager can upload qualification codes using the SLD upload results report format. Use the following procedure in Squid:

- Select Adhoc Report tap and select the Project.
- Select RIDs/QA Report tab.
- Select SLD Upload Results **Note:** If two teams were collecting data in the same project during the same time frame it will be necessary to run a Raw Results Report to be able to filter and identify samples by team. Qualifiers will still need to be applied to the SLD Upload Results.
- Filter samples by an Analyte Suite requiring blanks.
- For ease of determining the collection of blanks select one Characteristic Name (ex. Phosphorus as P).
- Ensure that required blanks were collected at the correct 10% frequency. Refer to Attachment B-3 – Field Quality Control Summary in the Verification and Validation Worksheet and the example below.
- If blanks were not collected at the correct frequency flag all analytes in the analytical suite for the entire sampling run with a SWQB Qualifier Code A2 in the SLD Upload Results report.
- Document validation codes that were applied in the Verification and Validation Worksheet.
- Notify a Project Manager, the Monitoring Team Supervisor, or the Program Manager to upload applied validation codes.

Figure 1. Examples Blank Frequency Requirements and Qualification



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Samples	[Green cells]																							
Blanks	[White cells]																							
	Does Not Meet 10% Frequency Requirements - Run Qualified A2																							

Step 8. Validate Blank Results – End of sampling season

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

Generate a “Blanks Hits Report” within SQUID to identify analytes detected in blank samples by using the following procedure:

- Select Adhoc Report.
- Select the Project .
- Select the RIDs/QA report tab and select “Blanks Hits Report”.
- Open the spreadsheet and determine if blank samples had analyte detection in a blank sample at a concentration equal to or greater than the SDL. It may be necessary to consult the analytical laboratory to confirm or examine the possible causes of blank contamination.
- If a blank was detected for an analyte use a “SLD upload results” report (see step 7) and locate that sample within the sampling run.
- When blanks demonstrate that contamination has occurred, the Project Manager(s) or Technical Staff must consider on a case-by-case basis if the contamination is significant enough to reject the data and flag as “RB1” (rejected data) or simply flag the data “B1” or “BU” (useable but suspect data). Refer to Table 1 for blank validation. 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.
 - In the case where the contamination values exceed 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 by subtracting blank data values from the reported sample data values to get the corrected reporting values.

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

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II = NPDES Compliance Evaluation and WQS Enforcement Monitoring

Flagging is limited to samples associated with a given run. When multiple blank QC samples are collected (minimum 10% of ambient samples) during a given run, ALL analyte-specific data collected since the last compliant QC sample and all data up to the next compliant QC sample are assigned validation codes for the suite/analyte in which contamination was detected. 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 the analytes of concern. *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 minimum of 10% of sampling locations during the run so that QC blank samples occur during all sampling conditions. The interval between multiple blank collections should be optimized so that each blank represents approximately the same number of samples. This minimizes the risk of qualifying an entire run when compliant and non-compliant blank QC samples are detected, as well as ensures that a variety of sampling conditions are represented through blank collection.* 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.

To assign qualifier codes for blank hits use the following procedure:

- Generate a “SLD Upload Results” report from the database as described above.
- Filter the sample parameter(s) and date(s) which require qualifier codes. Only the specific analytes in which contamination was detected receive qualifier codes; QC blanks themselves do not receive qualifier codes.
- Apply the “m/d/yyyy h:mm” custom format to all dates. Delete the .0 at the end of the date.
- Add comments about the suspect data in the “RES_COMMENTS” column and add the appropriate qualifier codes applied to the SWQB qualifier code and WQX qualifier code fields as shown in Figure 2.
- Send the Excel “SLD Upload Results” file to Project Manager or Monitoring Team Supervisor for upload into the database.
- The Project Manager or QAO 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 Project Manager, the Monitoring Team Supervisor, or the Program Manager. Use the following procedure in SQUID:

- Select the “Data Management” tab
- Select the “Imports” tab and then select “SLD Results”
- Select the file to upload (in the “SLD upload results” format)
- Select the “Insert-Update” mode, and click “Upload File”
- Ensure correct mapping of SQUID columns and Spreadsheet columns. Make changes as necessary. Click “Process SLD Data.” Note: the “Comments” section should be mapped as “RES_COMMENTS” to ensure that the SWQB explanation for assigned qualifier codes is incorporated into the upload.
- A summary of invalid records may 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

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Data,” correct the error in the upload spreadsheet, and repeat the earlier steps. Tip: A frequent cause of upload errors is the date format. If errors occur, check the date format in the upload file and remove any occurrences of “.0”.

- If no invalid records occur, click “Import SLD Data”

Figure 2. Examples of Proper Validation Code Flagging for Blank “Hits”

Sample Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Sample Result (mg/l)	13	<SDL	20	25	30	11	14	40	30	<SDL	39	30	8	12	23	34	17	34	20	21	6	24	4	32
Blank Result (mg/l)							1					<SDL							<SDL					
SWQB Qualifier	RB1	BU	RB1	B1	B1	RB1	RB1	B1	B1	BU	B1													
WQX Qualifier	B	BU	B			B	B			BU														

Sample Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Sample Result (mg/l)	13	<SDL	20	25	30	11	14	40	30	<SDL	39	30	8	12	23	34	17	34	20	21	6	24	4	32
Blank Result (mg/l)							<SDL					1							<SDL					
SWQB Qualifier								B1	B1	BU	B1	B1	RB1	RB1	B1	B1	RB1	B1						
WQX Qualifier										BU			B	B			B							

Sample Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Sample Result (mg/l)	13	<SDL	20	25	30	11	14	40	30	<SDL	39	30	8	12	23	34	17	34	20	21	6	24	4	32
Blank Result (mg/l)							1																	<SDL
SWQB Qualifier	RB1	BU	RB1	B1	B1	RB1	RB1	B1	B1	BU	B1	B1	RB1	RB1	B1	B1	RB1	B1	RB1	B1	RB1	B1	RB1	RB1
WQX Qualifier	B	BU	B			B	B			BU			B	B			B		B		B		B	B

Step 9. Validate Holding Time Violations

An analysis of holding time violations is conducted to identify potential impacts to samples due to hold time violations. Use the following procedure in SQUID:

- Select the “Adhoc Report” tab and select the “Project”
- Select the “RIDs/QA report” tab and select “SLD upload results” report
- Open the spreadsheet and filter to facilitate verification
- Select the “HOLD_TIME_EXCEEDED” column and sort for “Y”

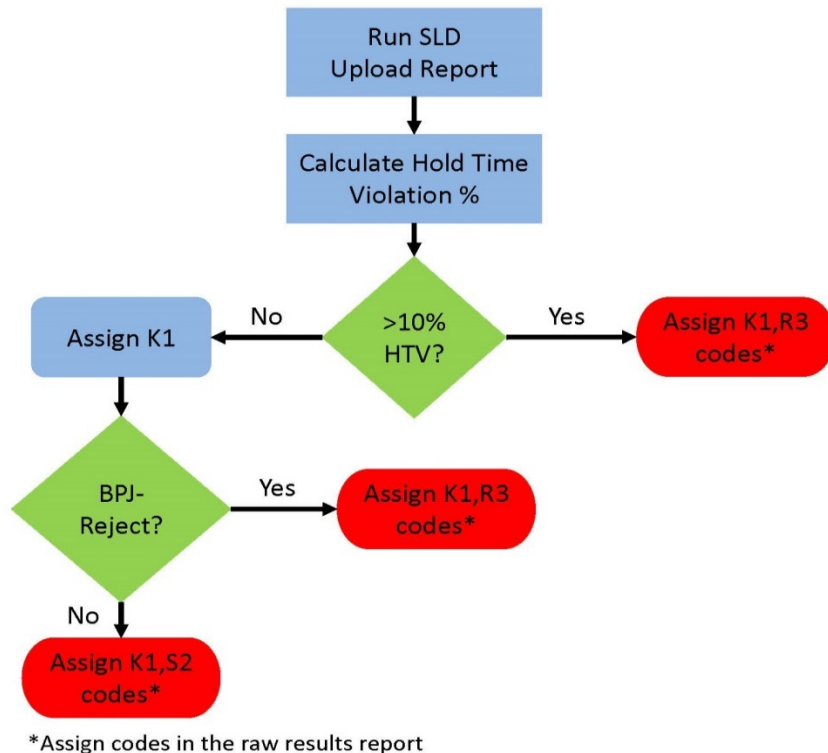
A “Y” result in this column indicates that the holding time was exceeded. The “EXCEEDENCE_PERCENTAGE” column calculates the extent of exceedance. Under the “SWQB_QUALIFIER_CODE” column, the Validator will, using best professional judgment (BPJ), assign a validation code of “K1” and then assign either an “S2” or “R3” to these data to indicate the result is “Suspect but deemed usable” or the result is “Rejected” respectively, due to a hold time violation. Samples where %HTV ≥ 10% will be assigned “R3.” Samples where %HTV < 10% (as indicated in the exceedance percentage column of the report), may be qualified as a usable 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. Coordination with the lab may be required to gain further information about the nature of the hold-time violation. 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

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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 3 below.

Note: This method does not apply to *E. coli* data hold times. The QA and validation and verification process for *E. coli* data is conducted during the upload process, which identifies and qualifies the data before upload. Hold times may be violated by exceeding the amount of time from sample collection to incubation and/or inadequate amount of incubation time. Refer to the SWQB SOP 9.1 Bacteriological Sampling for the procedures for calculating *E. coli* hold times, verifying bacteriological results, and uploading bacteriological sampling data to SQUID.

Figure 3. Holding Time Violation Validation Process



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

- The nature of the analysis. Was the non-compliant sample 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.

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- The sample matrix, and any supporting data. Was there a diluted analysis performed within holding times?

Document in the Verification and Validation Worksheet and save any results, with appropriate validation codes applied to the SWQB qualifier code and WQX qualifier code fields, as an excel "SLD Upload" file. Send the file to the Project Manager, the Monitoring Team Supervisor or the Program Manager for upload into the database and, once completed, verify that these codes have been correctly added.

Step 8. 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:

- Select the "Adhoc Report" tab and select the "Project"
- Select the "RIDs/QA" tab and select the "duplicate samples comparison" tab
- Open the spreadsheet and filter to facilitate verification
- Sort for "Quality Control Sample-Blind Duplicate" or "Quality Control Sample - Field Replicate"
- Calculate the RPD using the 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 parameter-specific 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.

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To generate flagging produce a raw results report from the database as described above. Filter the parameter and dates which require flagging. Add comments and appropriate qualifier codes to the SWQB qualifier code and WQX qualifier code fields. Send the Excel file to the Project Manager, the Monitoring Team Supervisor, or the 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*. Provide a copy of the completed *Chemical Data Verification and Validation Worksheet* with attachments to the QAO and retain originals in the project binder.

6.2 Physical Habitat Data Verification and Validation

Staff are to perform physical/habitat data verification 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 and parameters),
- Field forms.

6.2.1 Physical/Habitat Data Verification

Step 1. Verify Field Data

- A. After a sampling run check to confirm that all field forms are all accounted for in the project binder and that they are complete and legible. Use the survey run sampling site list to verify all forms are accounted for.
- B. Next go into the SQUID database to confirm that station name, ID, and sampling date and time entered or uploaded are consistent with the field forms. Use the following procedure in SQUID:
 - Select the Projects tab.
 - Find the project and select "View/Add Monitoring Locations."
 - Find the station and click on "Sampling Events" to find the sampling event that matches the field form. Correct if necessary and re-verify.
- C. After following the steps above select the sampling event that matches your field form and confirm that all field data on forms are consistent with the database. Use the following procedure in SQUID:
 - Select "Details" from the Sampling Event that matches the field form.
 - Confirm all sampling event metadata within the "Details" tab including comments, flow method, field staff, ecoregion, latitude/longitude, average wetted width, pebble count reach length, thalweg reach length and interval length. Correct if necessary and re-verify.

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Using the complete set of field forms, check for verifier's initials on each form. Review unverified forms and make any necessary corrections and notations.

Step 2. Verify Data Transcription

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

Based on available forms from the 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.

Confirm that pebble count, cross section, thalweg, shade, slope and bankfull/flow field forms are consistent with the database. Use the following procedure in SQUID:

- Select the "Adhoc Report" tab and select the project
- Select the project and then add the station to verify
- In the "Geomorph/Habitat" reporting tab select the "Raw Data Report"
- Confirm data from pebble count, cross section, thalweg, slope, bankfull/flow, and shade field forms are consistent with the database raw results report. Correct if necessary and re-verify. **Note: corrections are made in the .csv file used for upload and require re-upload.**
- 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 procedure.

Step 3. Validate Replicate Results

Physical/habitat data replicates are conducted to identify collector bias and evaluate performance characteristics of the sampling protocol (primarily field sampling precision). Individuals who collect pebble count data must complete a field replicate for the pebble count survey once per field season the same day as the initial pebble count collection event. This validation step is completed to ensure that required replicates have been completed.

Note: Individuals may have completed their replicate in a different survey/project. Multiple projects may need to be reviewed/selected.

Complete the following procedure using hard copy field sheets and SQUID:

- Review all pebble count field sheets and record pebble count observers for the project(s) in the VV worksheet

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- Review field sheets for replicate sampling events and document replicate pebble count completion for all observers in the VV worksheet. To help identify stations with replicates it may be necessary to run the following report in SQUID:
 - Select the “Adhoc Report” tab and select/add the project(s)
 - Select and add all applicable stations
 - In the “Geomorph/Habitat” reporting tab, select the “XLS report standard” report
 - Identify replicate sampling events by station and date.
- For sampling events for which a pebble count observer did not complete a replicate pebble count within the field season (including between all projects), enter “replicate pebble count not completed” in the sampling event comments in SQUID. Document the missing pebble count replicate in the project *Validation and Verification Worksheet*.

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* (Attachment A-2). Provide a copy of the completed *Physical/Habitat Data Verification and Validation Worksheet* with attachments to the QAO and retain originals in the project binder.

6.3 Biological Data Verification and Validation

Biological data verification is to be performed by staff immediately following the completion of data entry on field forms in the office and as soon as possible following receipt of data from contract laboratories. These procedures currently apply to macroinvertebrate, phytoplankton, and fish data. Steps 1 through 3 describe the biological data verification process.

6.3.1 Biological Data Verification

Step 1. Confirm Verification of Field Data

- A. After a sampling run confirm that all field forms are all accounted for in the project binder and that they are complete and legible. Use the survey run sampling site list to verify all forms are accounted for.
- B. Next go into the SQUID database to confirm that station name, ID, and sampling date and time entered or uploaded are consistent with the field forms. Use the following procedure in SQUID:
 - Select the “Projects” tab.
 - Find the project and select “View/Add Monitoring Locations.”
 - Find the station and click on “Sampling Events” to find the sampling event that matches the field form. Correct if necessary and re-verify.
- C. After following the steps above select the sampling event that matches the field form and confirm that all field data (field staff and collection method/equipment) on forms are consistent with the database. Use the following procedure in SQUID:
 - Select the “Details” tab from the Sampling Event that matches your field form.

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- Confirm date, comments, field staff, and collection method/equipment. Correct if necessary and re-verify.

Using the complete set of field forms, check for verifier's initials on each form. Review unverified forms and make any necessary corrections and notations.

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

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. Use the following procedure in SQUID:

Generate the "samples pending results" report from database:

- Select the "Adhoc Report" tab.
- Select the "Project tab" and add the project.
- Select the "RIDs/QA" tab and select the "samples pending results" report.
- Open the spreadsheet and filter to facilitate verification

If during the verification process data is found to be missing, contact the data source (laboratory) to resolve the issue.

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 the data source (lab) to resolve an issue and describe action taken on *Biological Data Verification and Validation Worksheet* (Attachment A-3). Questionable results must not be changed without written approval and associated documentation. Upon receipt of any missing information, add missing information to the database or spreadsheet and re-verify.

Indicate missing information and action taken on the *Biological Data Verification and Validation Worksheet* (Attachment A-3)

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 4 describes the biological data validation procedures.

Step 4. Validate Reported Quality Control Results

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A review of benthic macroinvertebrate data quality control results is conducted to identify any reported sample sorter or taxonomic identification bias. A confirmation of fish species can be provided by the Southwest Museum of Biology if specimens are submitted.

Step 5. Validate Hold Times

An analysis of holding time violations is conducted to identify potential impacts to samples due to hold time violations. Follow Step 9 in the 6.1 Chemical Data Verification and Validation section of this SOP. Document violations in the Verification and Validation Worksheet. Add comments and appropriate qualifier codes to the SWQB qualifier code and WQX qualifier code columns in the SLD Upload Results report and send the Excel file to the Project Manager, the Monitoring Team Supervisor, or the Program Manager for upload into the database. Once completed, verify that these codes have been correctly added.

Once the data verification and validation process has been completed for the entire study, sign the completed *Biological Data Verification and Validation Worksheets* (Attachment A-3). Provide a copy of the completed *Biological Data Verification and Validation Worksheets* and attachments associated with the study to the QAO and retain originals in the project binder. 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.

6.4 Long-term Deployment (LTD) Data

LTD data verification is to be performed by staff 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 LTD data verification process.

Step 1. Confirm all LTD data files have been archived and data has been uploaded

Confirm there is a raw data file in the appropriate archive folder for each deployment/retrieval field sheet. Confirm that raw data files that have more than one segment due to interim segments (i.e. part A and part B) are both archived in the raw data file folder and that the archive file name on the field sheet matches the file in the archive folder. Check that all field forms are complete and match station and study metadata in the database including but not limited to filename, deployment and retrieval dates, and sampling events. Use the following procedure in SQUID:

- Select the "Projects" tab and select "View/Add Monitoring Locations" for the project
- Find the station and select the "Sampling Events"
- Select the "Details" tab for the sampling event
- Confirm that the station name/ID and logger number/type, and logger data start and end dates in the database match the field form.
- Confirm that station name/ID and logger number/type from the database and field form match the archived data file.

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Step 2. Confirm all LTD data has been reviewed, truncated to logger start and stop dates and times, qualified as necessary, and summary statistics generated. See the SWQB SOP 6.4 Datalogger and Upload for details.

Access the LTD .xlsx file for each deployment event. Use the following procedure in SQUID:

- Select the “Projects” tab and select the Project
- Find the station and select “Sampling Events”
- Select the “Details” tab for the Long-term Deployment sampling event (ensuring the correct LTD sampling event is selected, by date, as more than one can occur per station).
- Under the “General” tab, click on the blue box containing the .xlsx file located next to “Logger Data.” This downloads the LTD dataset file that was uploaded.
- Open the file and confirm that the datafile uploaded to SQUID is associated with the proper station.
- Confirm metadata from the “General” tab, including the data logger model and number, data logger type, and coordinates match the field sheet.
- Confirm the dataset is truncated to the logger start and end times for the sampling event listed in SQUID.
- Open the “Field Measurement” tab on the LTD Sampling Event “Details” window to view the LTD summary statistics.
- Confirm metadata (summary statistics) on the .xlsx 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. Correct any errors, re-upload or re-enter data if necessary, with the help of the project manager.

Step 3. Validate LTD Activity Quality

Calibration verification/validation and drift correction of long-term deployment data occurs as logger data is being uploaded to the SQUID database. Refer to the SWQB SOP 6.4 Datalogger and Upload for instructions for applying parameter-specific qualifier codes. If a parameter is within “In-Calibration Range” during the post deployment calibration verification, no LTD parameter drift correction or rejection qualifier is added to the upload spread sheet except when data are suspect due to environmental conditions not related to sensor performance. If a parameter post deployment check exceeds the “In-Calibration Range” but is within the “Linear Interpolation Range” drift-corrected LTD parameter qualifiers are added to the “Qualifier” column in the LTD Data Management Spreadsheet and drift calculations are applied to the parameter in the dataset. If a parameter’s post deployment check exceeds the “Linear Interpolation Range,” rejected parameter qualifiers are added to the “Qualifier” column in the LTD Data Management Spreadsheet and that data is excluded from any calculations. Additionally, parameter data may be rejected and qualified as such even if the logger/sonde was within in-calibration limits. These parameter specific rejections are applied due to burial, exposure, or anomalous or suspect data (see SWQB SOP 6.4) and the reason for the rejected data must be noted in the comments column of the uploaded .xlsx file. **All LTD data that receives a LTD parameter qualifier (indicating drift correction or rejection) during upload will be documented in the LTD Data Validation and Verification Worksheet (Attachment A-4).** Review the post-deployment calibration check or

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deployment field sheet to see if any sensors failed or required drift-corrections and confirm that validation occurred during upload by reviewing the .xlsx file and the LTD Data Management Spreadsheet for that deployment located in the archives (see Step 2). Note that the LTD Data Management Spreadsheet will contain a qualifier, comment, and drift corrected data if a correction was applied, and it may be necessary to review the raw data file in comparison to ensure that the correction was in fact applied to the dataset. Review the “charts” section of the LTD Data Management Spreadsheet to view rejected temperature data and to visually inspect logger data for anomalous (outliers, buried, or exposed) data to ensure these values were rejected. If multiple parameters were corrected or rejected, all applicable parameter qualifier codes must be listed in the “Qualifier” column of the uploaded file, and the comments must address the nature of each of these parameter qualifier codes. Finally, ensure that the appropriate “Assessability” code was applied to the LTD upload file (refer to the SWQB SOP 6.4 and the NMED/SWQB CALM for details regarding assessability qualifier codes and how to apply them to datasets).

Table 2. Calibration Verification In-Calibration Ranges

Parameter	Standard	Standard Value	In-Calibration Range	Linear Interpolation Range (Max Allowable Limits)
Temperature, °C	NIST Traceable Thermometer	Ambient Temperature	± 0.5 °C	± 2 °C
Conductivity µS/cm	Standard Solution	1413, 8974, 10000	± 5%	± 30%
Dissolved Oxygen, %	Water-Saturated Air	100%	±5%	± 30%
pH, SU	Buffer Solution	4, 7, 10	± 0.2 su	± 1 su
Turbidity, NTU	DI Water	0	± 1 NTU	± 10 NTU
	Standard Solution	100	± 5 NTU	± 30 NTU
		1000	± 50 NTU	± 300 NTU

Table 3. LTD Parameter Qualifier Codes

Parameter	Corrected Qualifier (LTD only)	Rejected Qualifier
Temperature, °C	CT	RT
Conductivity, µS/cm	CSC	RSC
Dissolved Oxygen, %	C%	R%
Dissolved Oxygen, mg/L	CDO	RDO
pH	CPH	RPH
Turbidity, NTU	CY	RY

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7.0 Data and Records Management

Data housed on individual computers either awaiting calculations, Verification and Validation, or upload are backed up to the network server on a weekly basis at a minimum. The original Verification and Validation Worksheet(s) will be maintained in the survey project binder and electronic versions are maintained within the network server. Copies of the signed *Data Verification and Validation Worksheet (Chemical, Physical/Habitat, and Biological)* with attachments are provided to the QAO for filing.

Verified and Validated data are stored in the NMED/SWQB SQUID database, which is maintained by the Office of Information Technology.

8.0 Quality Control and Quality Assurance

The SWQB controls the quality of verification and validation procedures by using standardized methods that are documented in this SOP. All personnel who perform verification and validation on data must be familiar with these protocols, sign the acknowledgment form associated with this specific SOP and implement procedures as they are defined in this SOP. In addition to standardized methods, proper training of SWQB personnel represents a critical aspect of meeting the data quality objectives in order to fulfill the goals of the SWQB's QAPP (NMED/SWQB 2018).

Data verification should be done as soon as possible following the data collection event or receipt of the data. The person verifying data should be different than the person who enters/transcribes data. The data validation process is typically performed after all data have been received and verified for a particular project. If, at any time, the QAO determines this process is not being adhered to, the QAO has the authority to cease activities specific to this SOP with prior support and approval by the SWQB Bureau Chief and Program Manager, until such a time that the issue can be resolved.

9.0 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 A-4 LTD Data Verification and Validation Worksheet
Attachment B-1 SWQB Validation Codes
Attachment B-2 SLD Data Qualifiers
Attachment B-3 Field Quality Control Summary
Attachment B-4 SLD Detection Flags

10.0 Revision History

- Revision 1. November 20, 2013. Updated to include changes in personnel, database, and the addition of V&V steps for long-term deployment data.
Jody Kougioulis, QAO; Jeff Scarano, Program Manager MASS
 - December 12, 2014. Minor updates and language clarification.
Jody Kougioulis, QAO; James Hogan, Program Manager MASS

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- May 29, 2015. Language added to clarify hold time and blank detection qualifications, updated staff responsibility descriptions, and added a definition of sample run. Jody Kougioulis, QAO; James Hogan, Program Manager MASS
- March 15, 2016. Added confirmation of drift correction for LTD dataset and reformatted to SOP 1.1. Vacant, QAO; Charles Dentino, SME; Shelly Lemon, Program Manager MASS
- Revision 2. May 28, 2020. Major revisions occurred throughout the SOP. The Data and Records Management and Quality Control and Quality Assurance Sections were added to conform with SOP 1.1. Added verification steps for lakes. Added validation steps for sonde grab data. Added validation tracking table for LTD datasets. Clarified verification and validation process for *E. coli* relating to hold times. Updated validation process for pebble count replicates. Updated qualifier codes. Attachments A1-A4 and B1-B4 updated to reflect current procedure. Miguel Montoya QAO; SME Charles Dentino; Kristopher Barrios Program Manager

11.0 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.

New Mexico Environment Department / Surface Water Quality Bureau (NMED/SWQB). State of Mexico Surface Water Quality Bureau Standard Operating Procedure. Available at: <https://www.env.nm.gov/surface-water-quality/sop/>

New Mexico Environment Department / Surface Water Quality Bureau (NMED/SWQB). 2018. Quality Assurance Project Plan for Water Quality Management Programs. Available at: <https://www.env.nm.gov/surface-water-quality/protocols-and-planning>

New Mexico Environment Department / Surface Water Quality Bureau (NMED/SWQB). 2019. Comprehensive Assessment and listing Methodology (CALM). Available at: <https://www.env.nm.gov/surface-water-quality/calm/>