

# Rouge River National Wet Weather Demonstration Project

Wayne County, Michigan

## TECHNICAL MEMORANDUM Data Screening, Validation, Reduction, and Reporting

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### Rouge River National Wet Weather Demonstration Project

#### MISSION STATEMENT

The mission of the Rouge River National Wet Weather Demonstration Project is to demonstrate effective solutions to water quality problems facing an urban watershed highly impacted by wet weather and develop potential solutions and implement projects which will lead to the restoration of water quality in the Rouge River. The project will address both conventional and toxic pollutants to:

- provide a safe and healthy recreational river resource for present and future generations;
- re-establish a healthy and diverse ecosystem within the Rouge River Watershed;
- protect downriver water resources such as the Detroit River and Lake Erie; and
- help ensure compliance with federal, state, and local environmental laws which protect human health and the environment.

This will be accomplished through the development, implementation, and financial integration of a technical, social, and institutional frameworks leading to cost efficient and innovative, watershed based solutions to wet weather problems. This watershed-based national demonstration project will provide other municipalities across the nation facing similar problems with guidance and, potentially, effective solutions.

## PREFACE

The Rouge River suffers from pollution from various sources, such as combined sewer overflow (CSO), nonpoint source pollution (NPS), illicit connections to drainage facilities, illegal dumping, surface runoff, sediments and contaminated sites. Many of the continuous point sources of pollution have been eliminated through the issuance and enforcement of National Pollutant Discharge Elimination System (NPDES) permits for municipal and industrial dischargers. However, much work remains in restoring the Rouge River's water quality to an acceptable level for swimming, fishing, picnicking and other recreational activities.

The Rouge River National Wet Weather Demonstration Project (Rouge Project) intends to evaluate each of the various sources of wet and dry weather pollution by examining their financial and institutional impediments. The Rouge Project has been investigating wet weather wasteload allocations and recommending a plan and procedure for watershed-wide pollution control which is implementable in the Rouge and can be readily transferred to similar urban watersheds throughout the country. The Rouge Project has incorporated an effort to organize existing and future data by developing analysis tools to conduct field surveys (i. e. conduct and analyze water quality samples). Also incorporated in that effort is developing and implementing water quality models and designing and testing of structural and nonstructural best management practices (BMPs).

The Rouge River is one of the main sources of pollution in the Great Lakes. The Rouge Watershed expands approximately 427 square miles of southeast Michigan and includes three counties, Wayne, Oakland and Washtenaw, with a population of over 1.5 million residents. In 1985, the Michigan Water Resources Committee created the Rouge River Remedial Action Plan (RAP) to restore the River's greatness; this plan in the foundation for the Rouge Project. The Rouge Project is attacking the problems within the Rouge River by looking beyond treatment and focusing on methods of prevention.

The Rouge Project focuses on a watershed-wide concept. To efficiently manage this effort, the project focuses on four key project elements. They are: *Watershed Management, Nonpoint Source Pollution Control, CSO Construction Coordination* and *Public Involvement/DSS*.

The overall challenges of the Rouge Project are numerous. They are: to meet water quality objectives, both during wet and dry weather, persuade citizens and businesses to eliminate activities that contribute to the river's depravation, overcome financial and institutional barriers that hinder pollution control activities, maintain a watershed-wide approach that unites citizens and public officials in three counties, and bring people back to the river for fishing, swimming, picnicking, golfing, canoeing, boating and walking along the river banks.

The success of the Rouge Project will be determined by bringing people back to the Rouge River and introducing a whole new generation to its wonder. We believe that through the Rouge Project, our collective efforts will begin to set the standards and practices necessary to reach this goal.

The purpose of this document is to summarize procedures that have been established to ensure that

the various types of field and laboratory data collected from the Rouge River Watershed are properly screened, validated, reduced and reported by the Rouge Program Office. The field data will be utilized to establish baseline conditions in the watershed, against which future water quality improvements due to the implementation of watershed management controls can be measured. Therefore, it is extremely important that the data screening procedures are carefully followed to ensure data quality.

## ABSTRACT

This technical memorandum summarizes procedures required to screen, validate, reduce and report environmental measurements and laboratory analytical data collected under the Rouge Project. These procedures are designed to maximize the usability of the data and to establish standard criteria that should be consistently applied to review the environmental data collected under long-term watershed monitoring programs. The procedures pertaining to screening, validation, reduction and reporting are collectively referred to as *data screening procedures*, and are organized according by data type including precipitation data, streamflow data, continuous water quality data and laboratory data. The *precipitation data screening* objective is to identify and correct or reject unreliable or spurious data resulting from instrument problems such as power outages, obstruction of gage by debris, and clock synchronization problems. The data are collected from a network of tipping bucket rain gages at selected locations throughout the watershed. *Stage/flow data screening* seeks to: identify unreliable or spurious data resulting from instrument problems (i.e., power outages, displacement of probes during storm events, incorrect level setting during calibration and timing clock problems), and to ensure that rating curves are properly developed, updated, and applied to estimate stream discharge at various stage levels. These data are collected from a network of flowmeters at selected locations throughout the watershed. The *continuous in-situ water quality data screening* objective is to identify and correct or reject unreliable or spurious data resulting from instrument problems such as sensor damage, power outages, displacement of probes during storm events, incorrect calibration and timing clock problems. These data are collected from a network of multi-parameter water quality sondes at selected locations throughout the watershed. Lastly, *laboratory data screening* will identify preliminary laboratory data that were not generated in accordance with referenced procedures and methods, and to qualify those data in terms of "useable", "useable with qualifiers", or "rejected" (unusable). This is a two-stage process consisting of a data handling check and a data usability review. Careful application of these procedures will facilitate data analyses and prepare the precipitation, stage/flow, continuous in-situ water quality and laboratory data for distribution.

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**1.0 INTRODUCTION.** This technical memorandum summarizes procedures required to screen, validate, reduce, and report environmental measurements and laboratory analytical data collected under the Rouge Project. In general, these procedures are designed to maximize the usability of the data and to establish standard criteria that should be consistently applied to review the environmental data collected under long-term watershed monitoring programs. The criteria and procedures presented herein should also be periodically reviewed and revised as necessary to ensure that they are current and adequate.

In this document, the procedures pertaining to screening, validation, reduction and reporting are collectively referred to as *data screening procedures*. Data directly received from field staff or contract labs are referred to as *raw data*. As a result of the application of the screening procedures described in this document, all raw data will be carefully reviewed and in some cases corrected, modified, or deleted to maximize the usefulness and accuracy of the data. Careful application of these procedures will: 1) facilitate data analysis and 2) prepare the data for distribution.

These screening, reduction and validation procedures will produce *final* data sets that have met all quality control (QC) requirements and are ready for analyses by watershed managers and/or distribution. These procedures represent an extremely important link in the overall quality assurance/quality control (QA/QC) process and should be carefully followed and documented. These procedures will ensure that data are not simply designated with flags or qualifiers during the QC review process, but that these flags or qualifiers are considered as part of the preparation of final data sets.

In addition, summary assessments of the overall quality and quantity of data will be produced to provide watershed managers with indicators of the level of certainty or confidence associated with various types of data. Since certain aspects of this process will require professional judgments, the revised data set will be independent of, and in no case will it be overwritten on, the raw data.

**2.0 DATA SCREENING PROCEDURES.** A description of the data screening procedures is presented in this section. Detailed step-by-step procedures that must be followed by staff involved with data management are described in Standard Operating Procedures (SOP). The data screening procedures are organized according to the following general categories of watershed monitoring data: precipitation, streamflow, continuous water quality (field probe) and laboratory analyses. The overall approach for the data screening procedures is derived from *U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, 1994). For each data category, screening procedures are organized to include the following elements:

- *Data Screening Objectives:* Provides a summary of specific objectives for screening each type of data.

- *Data Screening Tools:* A listing of the specific tools or items, including lab reports, review plots, field logs etc., that should be assembled and made available prior to conducting the data screening procedures.
- *Data Review Criteria:* Specific criteria, or threshold conditions that are established to ensure the quality of the data. In some cases, Data Quality Objectives outlined in Field Sampling Plans (FSPs) or the Quality Assurance Project Plan (QAPP) are referenced in the data review.
- *Data Evaluation Procedures:* Step-by-step procedures to be followed for screening each type of data. The evaluation procedures will also address the scheduling of the data screening (i.e., after each event, monthly, quarterly, or annually).
- *Data Validation Procedures:* A list of if-then statements which describe how the data will be treated under various conditions. The procedures include a summary of feedback mechanisms (i.e., corrective actions) to improve data collection techniques or address ongoing problems.
- *Data Reduction Procedures:* A summary of the procedures applied to data to reduce or summarize the data for reporting and analyses. For example, Event Mean Concentrations (EMCs) would be calculated from discrete samples collected during a storm event or 15-minute dissolved oxygen time series data would be converted to a one-hour time series.
- *Data Reporting:* A summary of standard reports or reporting formats that are available for the final/corrected data from the RPO ORACLE database.

The data screening procedures presented in this section represent a key element of the RPO QAPP. Completion of the screening activities described in the SOPs should be documented with sign-off forms indicating who completed the screening, when it was performed, and additional QC review where appropriate. Final data will be released for distribution and analyses only after the data screening is completed.

### **3.0 PRECIPITATION DATA SCREENING.** Precipitation data are collected from a network of tipping bucket rain gages at selected locations throughout the watershed. All of the rain gages contain data recorders which log rainfall amounts at 15-minute intervals. Several of the Wayne County and Oakland County rain gages are telemetered and data can be retrieved by telephone from a remote (office) location. The data from other rain gages

must be periodically downloaded and are collected by field crews using laptop computers during routine equipment servicing and calibration. Field crews periodically maintain the rain gages and retrieve data in digital format.

- 3.1 DATA SCREENING OBJECTIVES.** The precipitation data screening objective is: the identification of unreliable or spurious data resulting from instrument problems such as power outages, obstruction of the gage by debris, and clock synchronization problems. The result of the precipitation data screening procedures will be to either reject spurious data or correct data where appropriate.
- 3.2 DATA SCREENING TOOLS.** Since screening the precipitation data requires careful examination of large time series files, graphical tools are required to facilitate this process. The primary screening tool is a standard report of precipitation data which allow for the comparison of precipitation data collected from several raingage stations. *Figure 3-1* presents an example of a tabular precipitation report which provides a side-by-side comparison of data collected at 15-minute intervals from more than 20 rain gages during a 24-hour period. This type of listing allows for quick visual assessment of timing discrepancies and the identification of localized rainfall events which may be spurious. The use of software applications developed for preparation of these reports is described in Precipitation Data Screening SOP (#RPO/ASI-OFF-0001).
- 3.3 DATA REVIEW CRITERIA.** Wherever possible, standard criteria are used to assess the precipitation data. However, in many cases screening the precipitation data requires application of subjective criteria. In general, data which are obviously spurious are removed from the record. In addition, significant timing shifts resulting from unreliable data logger clocks are identified and a time shift correction factor is estimated.
- 3.4 DATA EVALUATION PROCEDURES.** *Figure 3-2* presents a flowchart of the overall precipitation data screening process. A detailed description of the step-by-step procedures that are applied to the raw/flagged data using the data review items and criteria outlined above to meet the specific objectives (also outlined above) is presented in the Precipitation Data Screening SOP (#RPO/ASI-OFF-0001). In general, the precipitation data screening procedures involve the preparation of standard tabular reports which provide side-by-side comparison of 15-minute precipitation records and daily/event totals.

QA review of these reports includes:

- Flagging of aberrant data based on review criteria and in some cases, subjective judgment;

Date_Time	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21	R22	R27	R28	R29	R30	R31	R32	R33
4/1/2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 12:15:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 12:30:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 12:45:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 1:00:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 1:15:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 1:30:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 1:45:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 3:00:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 3:15:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 3:30:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 3:45:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 4:00:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 4:15:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 4:30:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 4:45:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 5:00:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 5:15:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 5:30:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 5:45:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 6:00:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 6:15:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 6:30:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 6:45:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 7:00:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 7:15:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 7:30:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 7:45:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 8:00:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 8:15:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 8:30:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 8:45:00 AM	0		0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 9:00:00 AM	0		0	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 9:15:00 AM	0		0	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 9:30:00 AM	0		0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 9:45:00 AM	0.01		0.01	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/1/2001 10:00:00 AM	0.01		0.01	0.01	0	0	0	0	0	0	0	0.01	0	0	0	0	0	0	0
4/1/2001 10:15:00 AM	0.01		0.01	0.01	0	0	0	0	0	0.01	0	0	0.01	0	0	0	0	0	0
4/1/2001 10:30:00 AM	0.01		0.02	0.01	0	0	0	0	0	0	0.01	0	0.01	0.01	0	0	0	0	0
4/1/2001 10:45:00 AM	0.01		0.01	0.01	0.01	0	0	0	0	0.01	0.01	0	0.02	0.01	0	0	0	0	0
4/1/2001 11:00:00 AM	0		0.01	0.01	0	0	0	0	0	0.01	0	0	0.01	0.01	0	0	0.01	0	0
4/1/2001 11:15:00 AM	0		0.01	0.01	0.01	0	0	0	0	0.01	0	0.02	0.02	0.01	0.01	0	0	0	0
4/1/2001 11:30:00 AM	0.01		0	0.01	0	0	0	0	0.01	0.01	0	0	0.01	0.02	0.02	0	0.01	0.01	0.01
4/1/2001 11:45:00 AM	0.01		0.01	0.01	0.02	0	0	0.01	0.02	0.01	0.02	0	0	0.01	0.02	0.01	0.01	0.01	0
4/1/2001 12:00:00 PM	0.02		0.01	0	0.01	0	0.01	0.02	0.01	0.01	0.02	0.01	0	0	0.01	0.01	0	0.01	0.02
4/1/2001 12:15:00 PM	0.02		0	0	0.02	0.01	0	0.01	0.02	0.01	0.01	0.01	0.01	0	0.01	0.02	0.02	0.01	0.01
4/1/2001 12:30:00 PM	0.02		0	0	0.01	0.01	0.02	0.01	0	0.02	0	0.01	0	0.01	0	0.01	0.01	0.01	0.01
4/1/2001 12:45:00 PM	0.01		0	0	0	0.01	0.01	0	0.01	0.02	0.02	0.01	0	0	0.01	0.01	0.02	0.01	0.01
4/1/2001 1:00:00 PM	0.01		0	0	0.01	0.01	0.02	0.01	0.01	0.01	0	0.01	0.01	0	0	0	0	0.01	0
4/1/2001 1:15:00 PM	0		0	0	0.01	0.01	0	0	0.01	0.01	0.01	0.02	0	0.01	0.01	0.01	0.01	0	0.01
4/1/2001 1:30:00 PM	0		0	0	0.01	0.01	0.01	0.01	0	0.01	0	0	0	0	0.01	0	0	0.01	0.01
4/1/2001 1:45:00 PM	0		0.01	0	0	0	0	0	0.01	0.01	0	0.01	0	0	0	0.01	0.01	0.01	0
4/1/2001 2:00:00 PM	0.01		0.01	0.01	0.01	0.01	0.01	0.01	0	0	0.01	0.01	0	0	0	0	0	0	0.01
4/1/2001 2:15:00 PM	0		0	0	0	0	0	0	0	0.01	0.01	0.01	0.01	0.01	0	0.01	0.01	0	0

Figure 3-1: Preliminary Precipitation Data Report

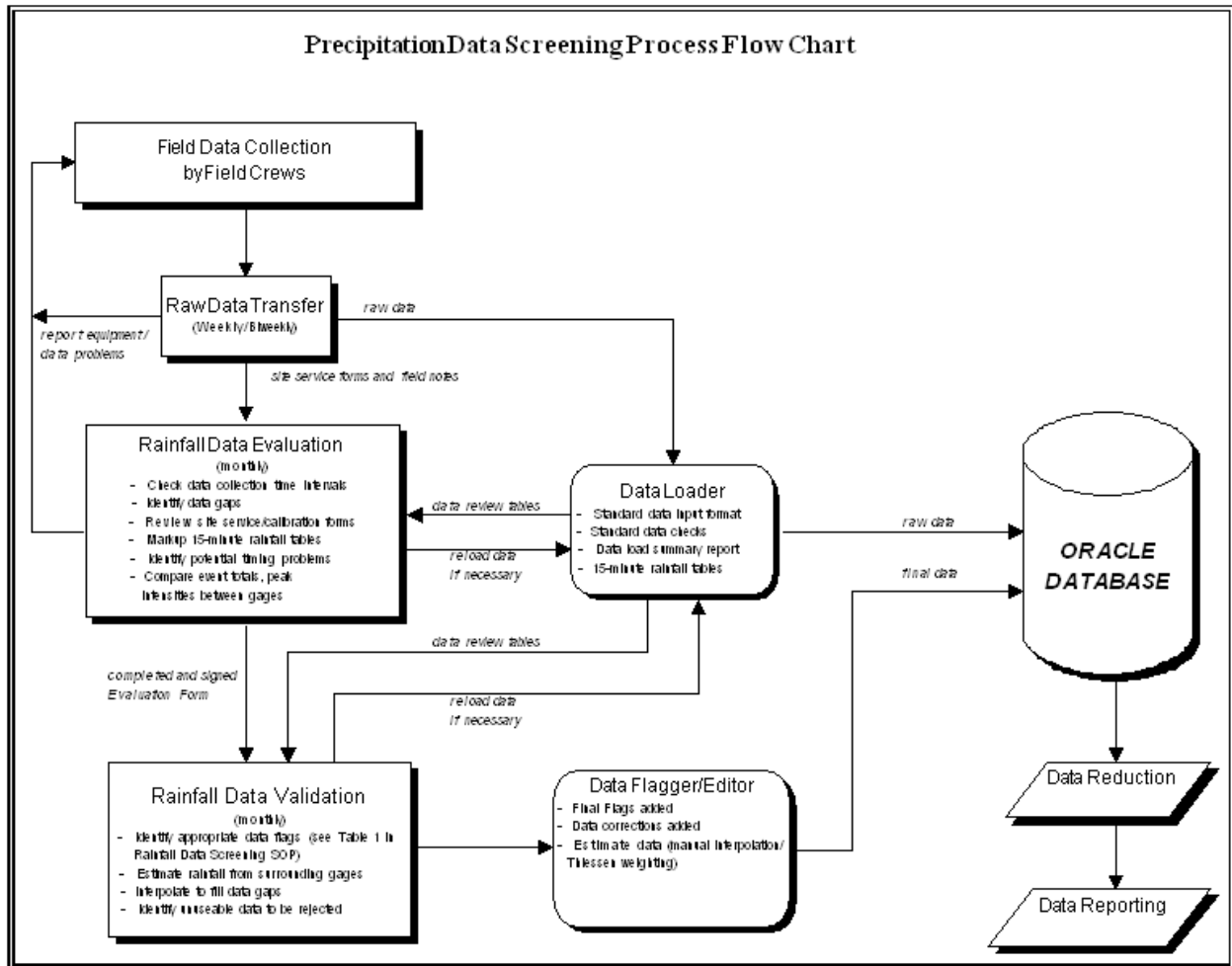


Figure 3-2: Rainfall Data Screening Process Flowchart

- Identification of potential timing shifts; and
- Comparison of event, weekly and monthly totals.

Documentation of the QA review includes:

- Completion of a standard form which provides a checklist and summary evaluation which clearly indicates which precipitation data have been flagged and the appropriate flags to assign to the data; and
- Sign-off to indicate by whom and when the data evaluation was performed.

Field notes are reviewed to identify the source of any observed discrepancies. The results of the data evaluation procedures will be used to identify, and in some cases, recommend actions to be taken in order to validate the precipitation data.

**3.5 DATA VALIDATION PROCEDURES.** Validation will be performed to determine what actions, if any, should be performed to ensure that the recommendations of the data evaluation procedures are implemented. The Precipitation Data Screening SOP (#RPO/ASI-OFF-0001) provides a series of if-then statements that cover various conditions and identify how each condition is handled. In some cases it may be necessary to simply flag the data to signify the results of the data evaluation. The simplest validation cases will occur if: 1) the data evaluation does not identify problems with the data (e.g., data are accepted as is) or; 2) data evaluation recommends rejecting data (e.g., removal of selected data). For example, a previous review of precipitation records found that certain rain gages were inserting the storm event totals from the previous several hours as a 15-minute interval rainfall amount. Since these data were determined to be spurious, simply removing them from the record with proper documentation was considered appropriate. In some cases, precipitation data will be estimated by using data collected from nearby raingage stations and the estimated data will be included in the final data. Standard methods for 'synthesizing' rainfall data (i.e., Thiessen weighting) are documented in the Precipitation Data Screening SOP (#RPO/ASI-OFF-0001). Data Validation should include a sign-off sheet to summarize corrections and indicate by whom and when corrections were made. *Note: This sign-off sheet can be combined with the sign-off sheet for evaluation procedures.*

**3.6.1 DATA REDUCTION PROCEDURES.** Standard data reduction procedures for the precipitation data include conversion of the 15-minute precipitation time series data to hourly and daily totals. Use of software applications to perform these data reduction procedures is presented in *Data Tools for Field Monitoring and Sampling Data*. *Note: This document is currently in the development stage and is not available for reference.*

**4.0 STAGE/FLOW DATA SCREENING.** Stage/flow data are collected from a network of flowmeters at selected locations throughout the watershed. All of the flowmeters contain data recorders which typically log stage or level at 15-minute intervals. Certain flowmeters are configured with an additional probe which provides a measurement of current velocity and allows direct calculation of flow rate. Flowmeters with both level and velocity probes are typically only installed in locations with a relatively small, uniform cross section such as a pipe.

At stations configured with stage only flowmeters, the relationship between stage and flow rate is calculated from stage-discharge relationships (i.e., rating curves) developed by the United States Geological Survey (USGS). The data from the flowmeters must be retrieved periodically by field crews using laptop computers during routine equipment servicing and calibration.

**4.1 DATA SCREENING OBJECTIVES.** The stage/flow data screening objectives include: identification of unreliable or spurious data resulting from instrument problems (i.e., power outages, displacement of probes during storm events, incorrect level setting during calibration and timing clock problems), and to ensure that rating curves are properly developed, updated, and applied to estimate stream discharge at various stage levels. Identification of unreliable or spurious data may result in the removal or correction of that data.

**4.2 DATA SCREENING TOOLS.** Since screening the stage/flow data requires careful examination of large time series files, graphical tools are required to facilitate this process. The primary stage/flow data screening tools are standard time series plots of stage/flow data which allow for the comparison of stage/flow data collected at several locations along a tributary. *Figure 4-1* presents an example of a standard time series "stack" plot. This plot format allows a quick visual comparison of the hydrographs from multiple flow gages along a tributary and also includes rain gage data which provide an assessment of rainfall runoff relationships. These stack plots are used to identify timing discrepancies (i.e., runoff vs. rainfall) and to check runoff continuity from upstream to downstream. The use of software applications developed for preparation of these reports is described in the Stage/Flow Data Screening SOP (#RPO/ASI-OFF-0002).

**4.3 DATA REVIEW CRITERIA.** Wherever possible, standard criteria are used to assess the stage/flow data. However, in many cases screening the stage/flow data requires application of subjective criteria. In general, data which are obviously spurious are removed from the record. In addition, significant timing shifts resulting from unreliable data logger clocks are identified and a time shift correction factor is estimated.

RPO Level / Flow — Final QC Review Plots  
 Lower Rouge Sites: US9 US1 L05D  
 09/01/03 to 10/01/03

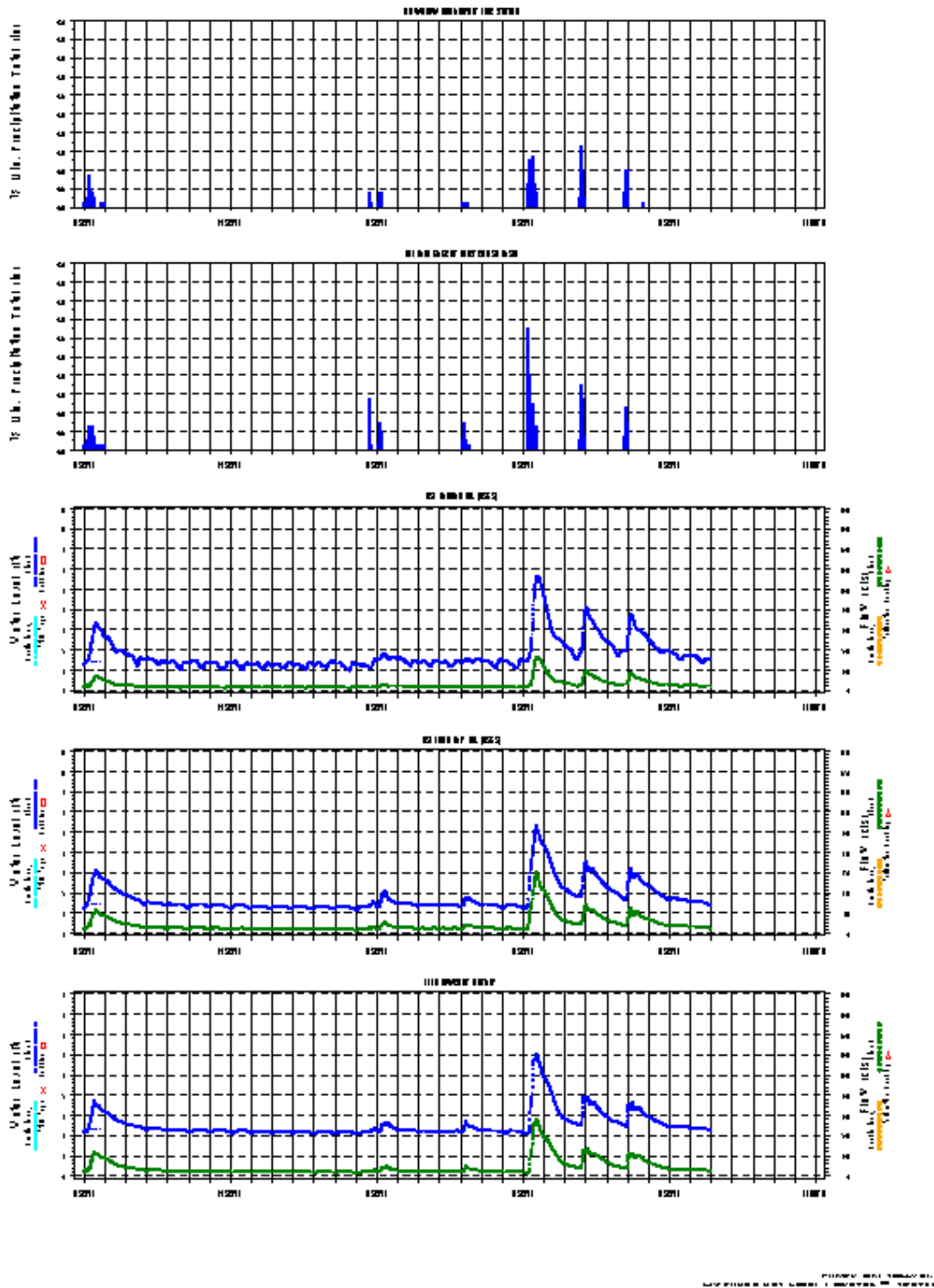


Figure 4-1: RPO Level/Flow - QC Review Plots

**4.4 DATA EVALUATION PROCEDURES.** *Figure 4-2* presents a flowchart of the overall stage/flow data screening process. A detailed description of the step-by-step procedures that are applied to the raw/flagged data using the data review items and criteria outlined above to meet the specific objectives (also outlined above) are presented in Stage/Flow Data Screening SOP (#RPO/ASI-OFF-0002). In general, the stage/flow data screening procedures involve the preparation of "stack" plots which provide visual comparison of hydrographs and rainfall records.

QA review of these reports includes:

- Flagging of aberrant data based on review criteria and in some cases, subjective judgment;
- Identification of potential calibration offsets by comparing staff gage readings; and
- Comparison of event, weekly and monthly average flows.

Documentation of the QA review includes:

- Completion of a standard form which provides a checklist and summary evaluation which clearly indicates which stage/flow data have been flagged and the appropriate flags to assign to the data; and
- Sign-off to indicate by whom and when the data evaluation was performed.

Field notes are reviewed to identify the source of any observed discrepancies. The results of the data evaluation procedures will be used to identify, and in some cases, recommend actions to be taken in order to validate the stage/flow data.

**4.5 DATA VALIDATION PROCEDURES.** Validation will be performed to determine what actions, if any, should be performed to ensure that the recommendations of the data evaluation procedures are implemented. Stage/Flow Data Screening SOP (#RPO/ASI-OFF-0002) provides a series of if-then statements that cover various conditions and identify how each condition is handled. In some cases it may be necessary to simply flag the data to signify the results of the data evaluation.

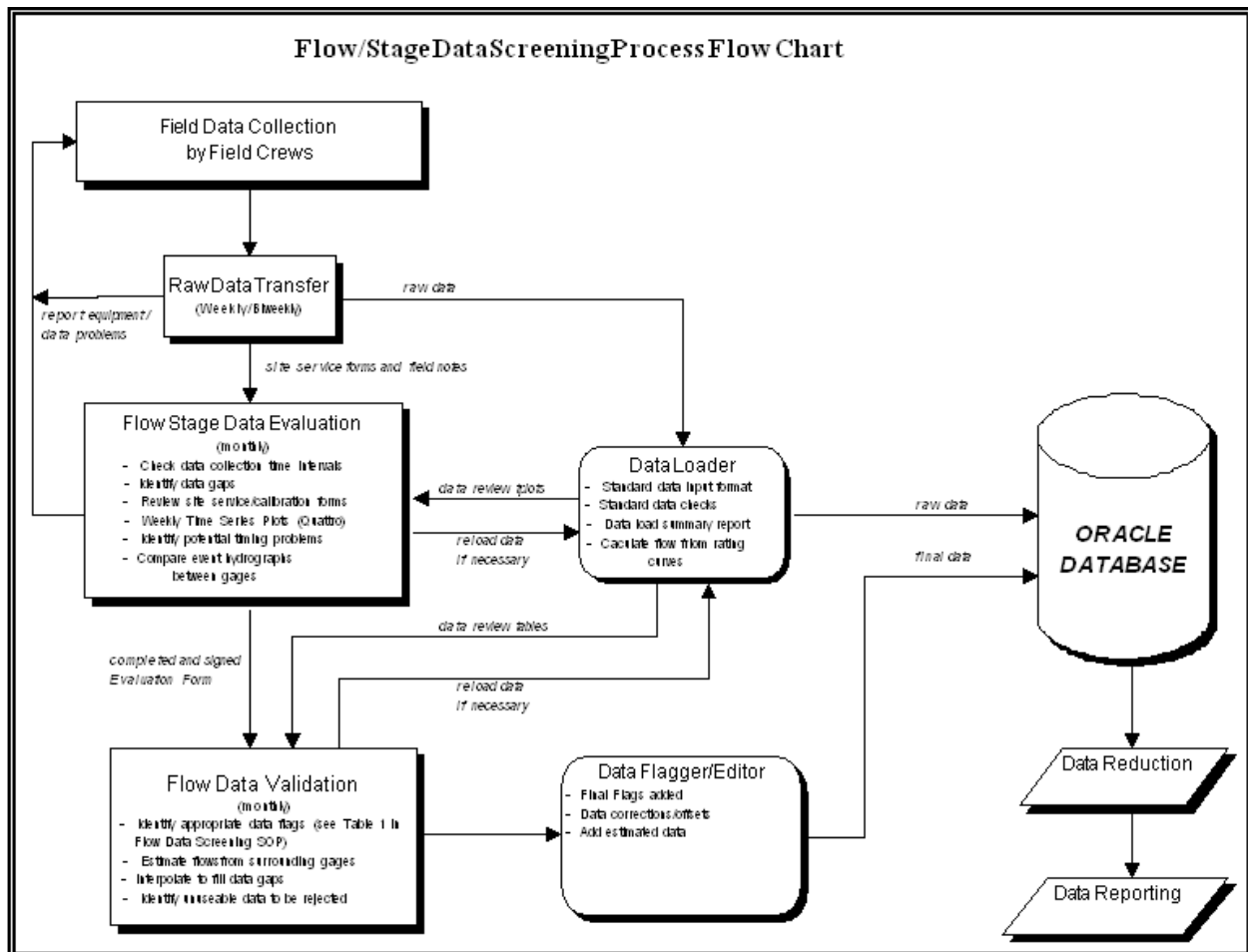


Figure 4-2: Flow/Stage Data Screening Process Flowchart

The simplest validation cases will occur if: 1) the data evaluation does not identify problems with the data (e.g., data are accepted as is) or; 2) data evaluation recommends rejecting data (e.g., removal of selected data). For example, a previous review of stage/flow records found that the flowmeters were improperly correlated to nearby staff gages resulting in a constant offset between level actual and true stage reading. These data were corrected by application of a constant shift factor.

During dry weather, missing stage/flow data can often be estimated by interpolation. Standard methods for reviewing flow data are documented in the Stage/Flow Data Screening SOP (#RPO/ASI-OFF-0002). Data Validation should include a sign-off sheet to summarize corrections and indicate by whom and when the corrections were made.

**4.6 DATA REDUCTION PROCEDURES.** Standard data reduction procedures for the stage/flow data includes conversion of 15-minute stage/flow time series data to hourly and daily totals. Standard procedures are also applied to designate "Wet" versus "Dry" periods to isolate periods of runoff response to rainfall. Use of software applications to perform these data reduction procedures is presented in *Data Tools for Field Monitoring and Sampling Data*. *Note: This document is currently in the development stage and is not available for reference.*

**5.0 CONTINUOUS IN-SITU WATER QUALITY DATA SCREENING.** Continuous in-situ water quality data are collected from a network of multi-parameter water quality sondes at selected locations throughout the watershed. All of the water quality sondes contain data recorders which typically log dissolved oxygen (DO), pH, temperature, and conductivity at 15-minute intervals.

The data from the water quality sondes must be retrieved weekly by field crews using laptop computers during routine equipment servicing and calibration. Since screening the continuous data requires careful examination of large time series files, data screening computer programs and graphical tools are required to facilitate this process.

**5.1 DATA SCREENING OBJECTIVES.** The continuous in situ water quality data screening objective is the identification of unreliable or spurious data resulting from instrument problems such as sensor damage, power outages, displacement of probes during storm events, incorrect calibration, and timing clock problems. The objective of the continuous data screening will be to identify and reject inconsistent data, or correct data when both appropriate and feasible.

**5.2 DATA SCREENING TOOLS.** The primary screening tools for continuous in-situ water quality data are standard time series plots of continuous data which allow for the comparison of continuous data collected at several locations along a tributary and reports of logical tests performed on the data as it is loaded at the office. *Figure 5-1* presents an example of a standard time series "stack" plot which allows for a quick visual comparison

of the water quality responses at each site to stimuli shown on the hydrographs and precipitation data along a tributary. These stack plots are used to visually scan the data for errors or spurious data, and to compare the field verification measurements to the recorded data on the plots. The use of software applications developed for preparation of these reports is described in Continuous In-situ Data Screening SOP (#RPO/CDM-OFF-0002).

**5.3 DATA REVIEW CRITERIA.** Wherever possible, standard criteria are used to assess the continuous water quality data. However, in many cases, screening the continuous water quality data requires application of subjective criteria. In general, data which are obviously spurious due to sensor failure or equipment damage are removed from the record. In addition, data affected by sensor failure or calibration drift are frequently corrected.

**5.4 DATA EVALUATION PROCEDURES.** *Figure 5-2* presents a flowchart of the overall continuous water quality data screening process. A detailed description of the step-by-step procedures that are applied to the raw/flagged data using the data review items and criteria outlined above to meet the specific objectives (also outlined above) is presented in the Continuous In-situ Water Quality Data Screening SOP (#RPO/CDM-OFF-0002). In general, the continuous water quality data screening procedures involve the preparation of "stack" plots which provide visual comparison of continuous water quality data to hydrographs and rainfall records.

QA review of these reports includes:

- Data loading reports;
- Review of logical test results for out of range values, or illogical values;
- Flagging of aberrant data based on review criteria and in some cases, subjective judgment;
- Identification of potential calibration offsets by reviewing "stock" plots and site service sheets; and
- Comparison of event, weekly and monthly average flows.

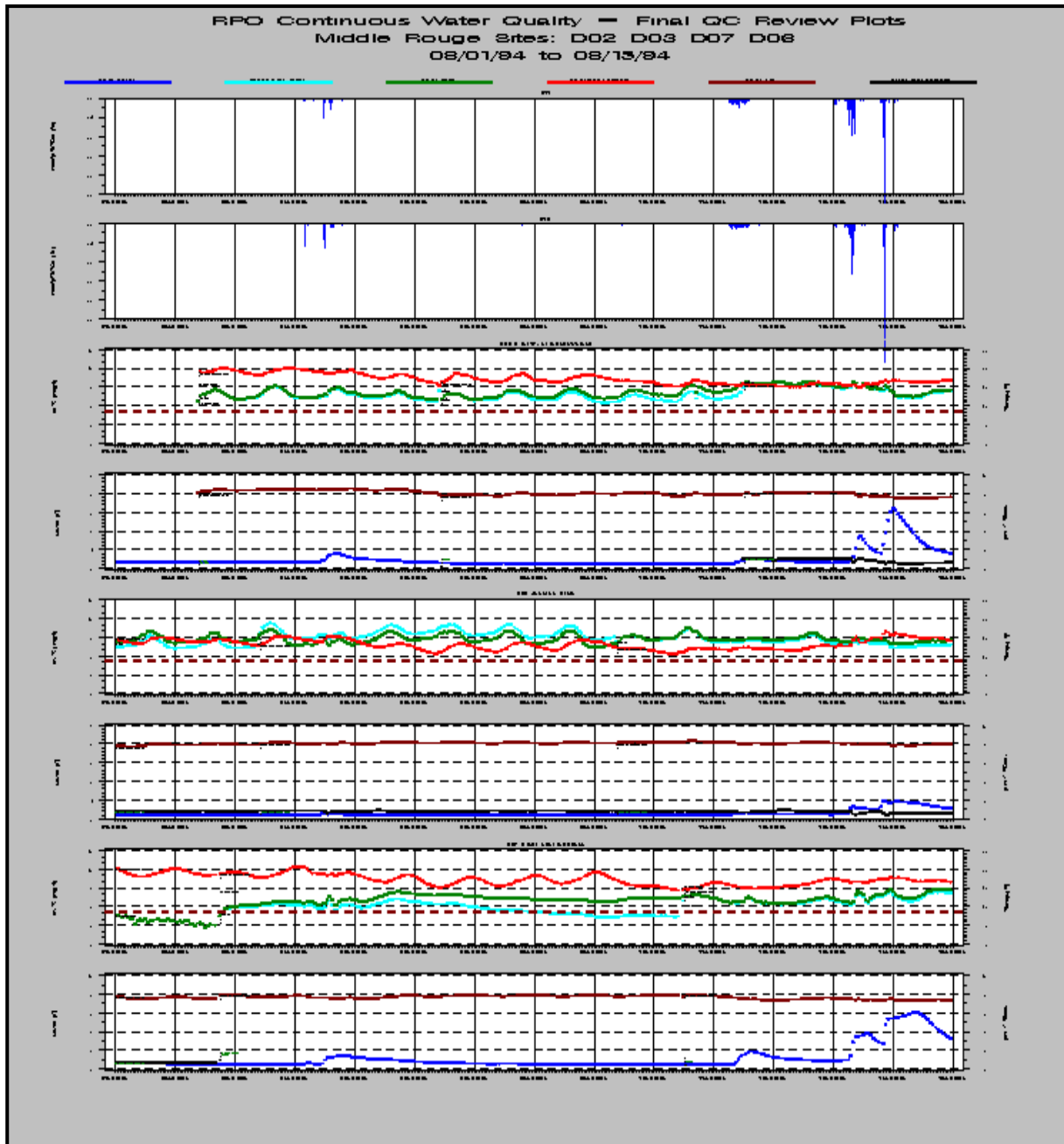


Figure 5-1: RPO Continuous Water Quality - QC Review Plots

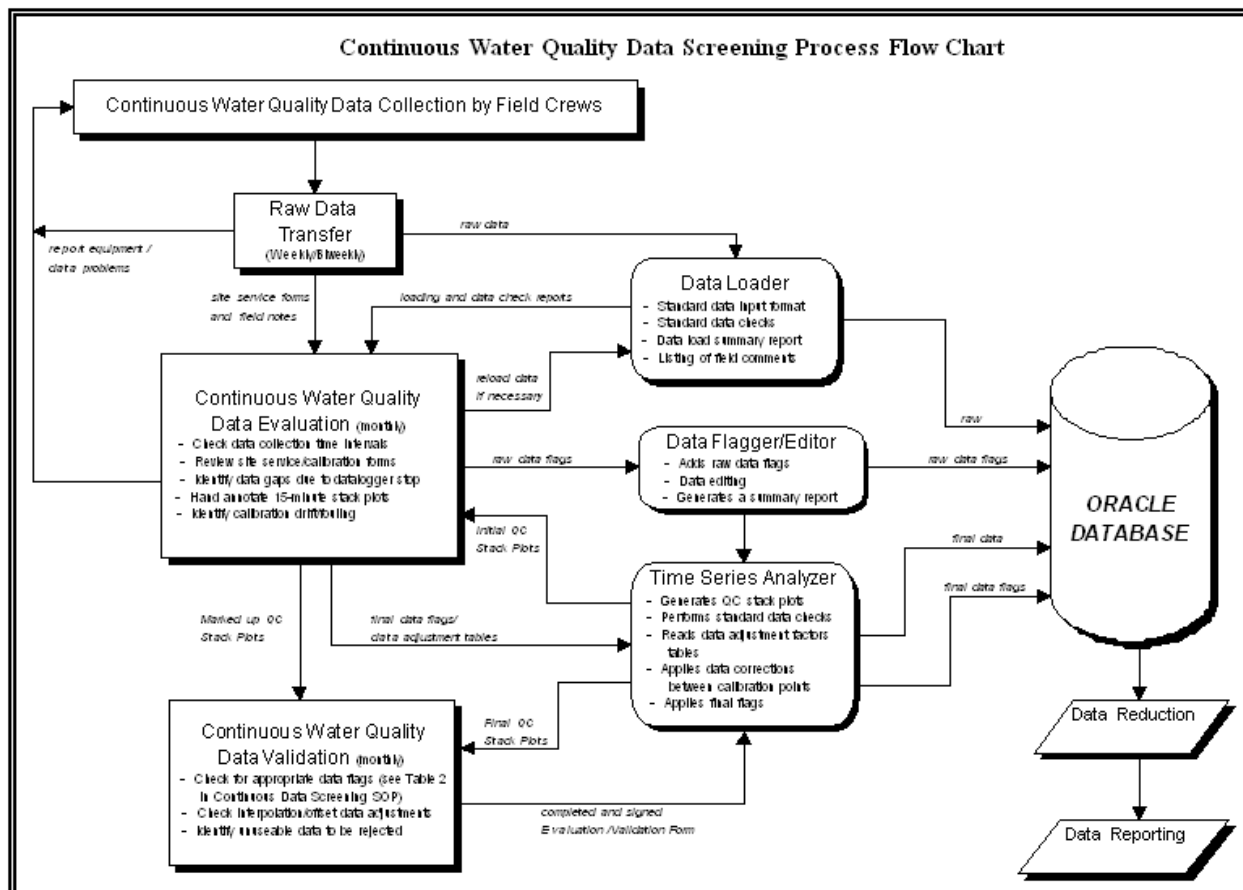


Figure 5-2: Continuous Water Quality Data Screening Process Flowchart

Documentation of the QA review includes:

- Completion of standard form which provides a checklist and summary of the evaluation which clearly indicates the parameter, site, and time range of the data that have been flagged and appropriate flags to assign to the data; and
- Sign-off to indicate by whom and when the data evaluation was performed.

Field notes are reviewed to identify the source of any observed discrepancies. The result of the data evaluation procedures will be used to identify and in some cases, recommend actions to be taken in order to validate the continuous data.

**5.5 DATA VALIDATION PROCEDURES.** Validation will be performed to determine what actions, if any, should be performed to ensure that the recommendations of the data evaluation procedures are implemented. Continuous In-situ Water Quality Data Screening SOP (#RPO/CDM-OFF-0002) provides a series of if-then statements that cover various conditions and identify how each condition is handled. In some cases, it may be necessary to simply flag the data to signify the results of the data evaluation.

The simplest validation cases will occur if: 1) the data evaluation does not identify problems with the data (e.g., data are accepted as is) or; 2) data evaluation recommends rejecting data (e.g., removal of selected data). Previous review of continuous records have found that the water quality sondes were improperly calibrated due to field conditions or tainted standard solutions, resulting in a constant offset between the measured reading and true parameter values. These data were corrected by application of a constant shift factor which was documented on the calibration sheets. Data Validation should include a sign-off sheet to summarize corrections and indicate by whom and when corrections were made.

**5.6 DATA REDUCTION PROCEDURES.** Standard data reduction procedures for the continuous water quality data include the conversion of 15-minute continuous time series data to hourly averages. Standard procedures are also applied to designate "Wet" versus "Dry" periods to isolate periods of runoff response to rainfall. Use of software applications to perform these data reduction procedures is presented in *Data Tools for Field Monitoring and Sampling Data*. *Note: This document is currently in the development process and is not available for reference.*

## **6.0 LABORATORY DATA SCREENING.**

**6.1 DATA SCREENING OBJECTIVES.** The objective of the laboratory data screening process is to identify preliminary laboratory data that were not generated in accordance with referenced procedures and methods, and to qualify those data in terms of "useable", "useable with qualifiers", or "rejected" (unusable). The screened data are then input to a data set that is consistent with the quality assurance policies and protocols of the RPO.

The laboratory data screening is a two-stage process consisting of a data handling check and a data usability review. The data handling check is primarily a documentation review to verify that chain of custody was maintained, that sample identification was consistent, and that any deviations from the project planning documents are noted in the field logbooks and are identified for consideration during the data usability review.

The objective of the data usability review is to evaluate the analytical data and determine if the analyses were performed as specified in the referenced methods.

**6.2 DATA SCREENING TOOLS.** The data screening procedures will be performed using the following documentation for each sample:

- Field logbooks and chain-of-custody forms are used to perform the data handling check.
- Data summary files from the production analytical lab are used for reviewing the sample identifiers as part of the data handling check, for verifying holding times, and for evaluating the field QC sample results as part of the data usability review.
- Split sample data comparison tables are used to evaluate split sample results from the production analytical lab and the QC laboratory as part of the data usability review.
- The laboratory QC package, including results of method blanks, laboratory control samples, laboratory duplicates, and matrix spike samples, are used for the data usability review.
- Data Check Reports are used to identify sample results that are inconsistent or that may be analytical outliers with respect to the rest of the dataset as part of the data usability review.

**6.3 DATA REVIEW CRITERIA.** This section identifies the evaluation criteria for the data screening process. Laboratory data are first checked to ensure that samples are properly handled and that all documentation is complete. Following the data handling check, a data usability review is conducted to determine compliance with QC criteria.

**6.3.1 Data Handling Review Criteria.** The data handling check verifies that all sample documentation is consistent and complete. Chain-of-custody forms are compared to both the field logbooks and the laboratory data summary file to verify the accuracy of all sample identification numbers from the time of sample collection to sample reporting by the laboratory, and to ensure that all samples submitted for analysis have a value reported for all requested parameters.

**6.3.2 Data Usability Review Criteria.** The data usability review is a multi-step process. Individual QC criteria are reviewed for each QC sample batch. After all of the criteria have been evaluated, each sample result is examined to determine the cumulative effect on the data usability of qualifiers added during the review process. The complete data usability review process is presented in the Laboratory Data Screening SOP (#RPO/CDM-OFF-0003). The data usability review criteria address:

- Holding Times
- Laboratory Control Samples
- Laboratory Matrix Spike Samples
- Field Blanks
- Blind Standards
- Logical Tests
- Laboratory Method Blanks
- Laboratory Duplicate Samples
- Trip Blanks
- Field Duplicates
- Field Splits
- Range Checks

The SOP describes the usability criteria associated with each of these.

**6.4 DATA EVALUATION PROCEDURES.** *Figure 6-1* presents a flowchart of the overall laboratory data screening procedures. A detailed step-by-step description of the laboratory data evaluation procedures is presented in the Laboratory Data Screening SOP (#RPO/CDM-OFF-0003).

**6.4.1 Data Handling Evaluation.** As a result of the data handling check, the laboratory data summary file is modified or corrected as necessary prior to initiation of the data usability review. All other pertinent information discovered during the data handling check (missing samples, improper collection techniques, etc.) is documented and submitted with the data to the data usability review team.

**6.4.2 Data Usability Evaluation.** The data evaluation procedures are similar for all analytes. Guidance for assigning final data flags at the conclusion of the review process is presented in the Laboratory Data Screening SOP(#RPO/CDM-OFF-0003). Prior to initiating the data usability evaluation, all of the applicable documentation must be compiled and the appropriate electronic reports generated. One *Data Usability Review Report* will be produced for each analyte per QC batch per laboratory.

**6.5 DATA VALIDATION PROCEDURES.** Laboratory data usability actions are undertaken to assess the suitability of the data for its intended use. The laboratory data usability review will require RPO technical staff to assess the data to determine if excess variability has been introduced through improper sampling techniques or laboratory

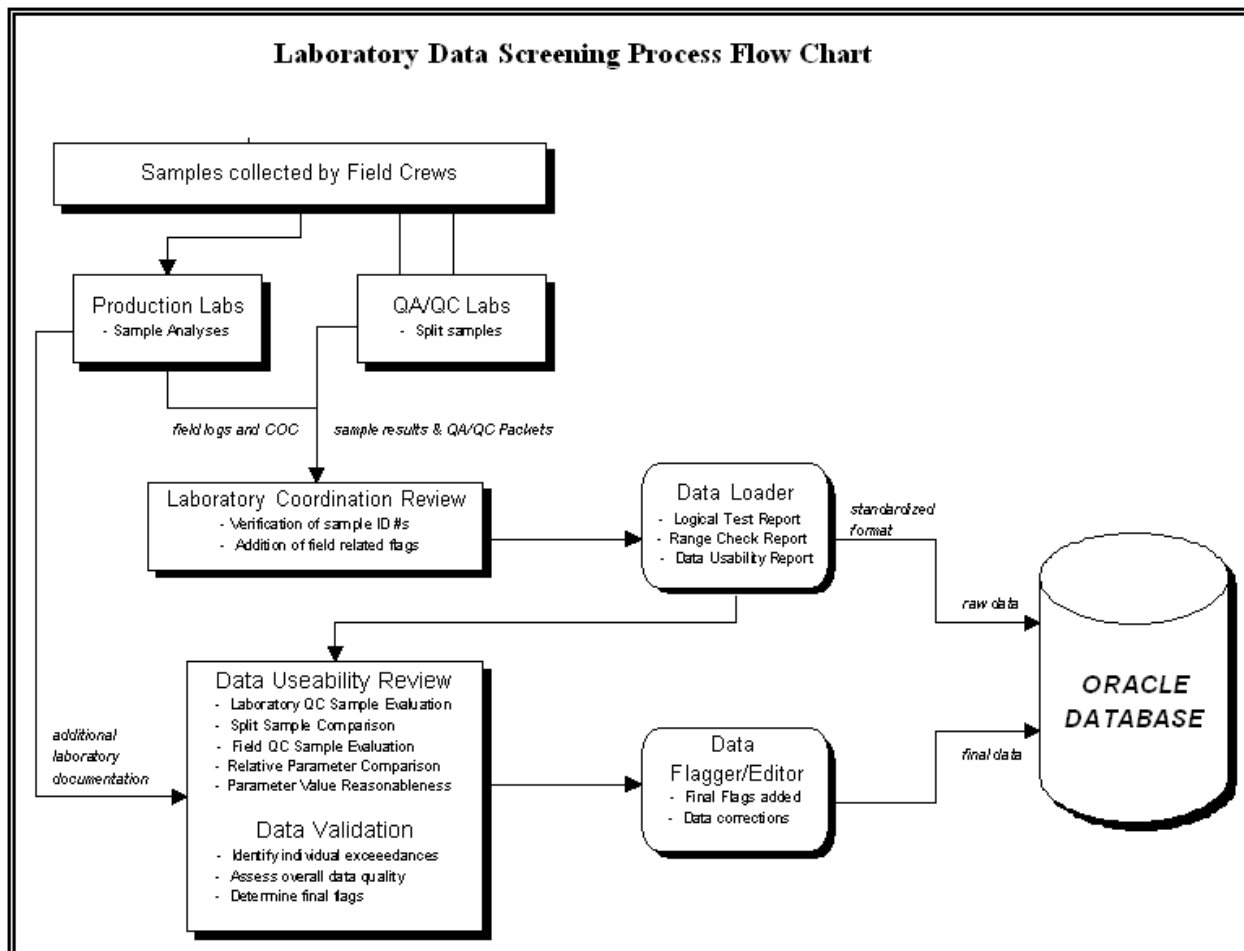


Figure 6-1: Laboratory Data Screening Process Flowchart

methods. Laboratory data usability will result in application of flags to indicate whether data should be rejected or qualified by assessing adherence to data quality objectives, relative to precision, accuracy, representativeness, completeness, and comparability (i.e., PARCC) parameters.

**6.6 DATA REDUCTION PROCEDURES.** Standard data reduction procedures for the laboratory data include the calculation of Event Mean Concentrations (EMC) for samples collected during wet weather events. An EMC is defined as a flow-weighted composite sample or can be estimated by mathematically compositing a series of discrete samples. Use of software applications to perform these data reductions is presented in *Data Tools for Field Monitoring and Sampling Data*. *Note: This document is currently in the development stage and is not available for reference.*

The laboratory data are reduced into "wet weather" and "dry weather" periods based on analyses of flow and rainfall records. Assignment of WET/DRY flags is presented in the Flow Data Screening SOP (*RPO/ASI-OFF-0002*). Additional standard data reduction procedures will be developed as this SOP is revised.

**6.7 DATA REPORTING.** Data reporting refers to standard data reports (tables) that can be generated from database queries. In general, data reports include tabular listings of the data for a selected period from a single station, multiple stations, and formats that facilitate export of the continuous data to spreadsheets and other software.

**APPENDIX A**  
**ABBREVIATIONS**

## ABBREVIATIONS

BMP	Best Management Practice
CSO	Combined Sewer Overflow
DL	Detection Limit
DO	Dissolved Oxygen
EMC	Event Mean Concentration
EPA	Environmental Protection Agency
FSP	Field Sampling Plan
LCS	Laboratory Control Samples
MS	Matrix Spike
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source Pollution
NWS	National Weather Service
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QC	Quality Control
RAP	Remedial Action Plan
RPD	Relative Percent Difference
RPO	Wayne County Rouge Program Office
SOP	Standard Operating Procedure
USGS	United States Geological Survey
VOA	Volatile Organic Analytes