Quality Assurance Project Plan for the Continuous Water Quality Monitoring Network Program

Prepared by the
Water Quality Planning Division, Office of Water

TCEQ PG-4
Revised April 2024

Contents

A1. Title Page

Project Title

Quality Assurance Project Plan (QAPP) for the Continuous Water Quality Monitoring Network (CWQMN)

Project Information

Environmental Protection Agency (EPA) Grant No. I –98665312-0, QTRAK No. 24-208

Revision Information

Revision 14. Revised in April 2024.

Effective Date

Effective: April 27, 2024 – April 27, 2026

Organization

Texas Commission on Environmental Quality (TCEQ)

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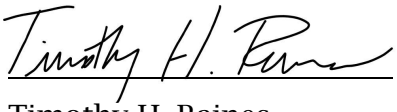

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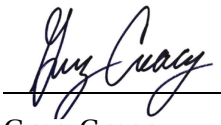

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TCEQ will secure written documentation from each sub-tier project participant (e.g., subcontractors, organizations operating sites, laboratories) stating the organization's commitment to requirements contained in this quality assurance project plan and any amendments. TCEQ will maintain this documentation as part of the project's quality assurance records and will ensure this documentation is available for review. (See Sample Letter in Appendix H of this document.)

A3. Table of Contents, Document Format, and Document Control

CWQMN station data[1] and the current revision[2] of the QAPP are available online.

[1] www.tceq.texas.gov/waterquality/monitoring/swqm_realtime.html
[2] Ibid.

Figures

Tables

Abbreviations

A4. Project Purpose, Problem Definition, and Background

A4.1. Project Purpose and Background

In 2001, the Texas Legislature charged TCEQ to assess the impacts of concentrated animal feeding operations (CAFO) to water quality on the Bosque River in North Central Texas. TCEQ was tasked by executive management and commissioners to develop and deploy a CWQMN built on the existing air monitoring infrastructure. The CWQMN provides near real-time high frequency continuous records of water quality. The vision of these leaders was to provide more timely and comprehensive water quality information at selected high priority locations than is possible with grab sampling or short-term deployment of water quality instrumentation.

TCEQ responded by establishing two CWQMN stations on the North Bosque River and two CWQMN stations on the Leon River. The CWQMN was expanded to include additional stations in various watersheds around the state. The current stations are listed in Tables A4.1 – A4.4. These tables list active stations/projects and are updated during the QAPP annual recertification and biennial revisions. CWQMN stations may be added and/or deactivated throughout the course of the year using CWQMN Project Plans (Section A4.2). These tables are not intended to list the operational status of CWQMN stations.

Some CWQMN stations are part of the Environmental Monitoring Response System (EMRS). At EMRS stations, near real-time measurements are used to screen water quality for water management decisions or potential field investigations. The majority of CWQMN stations are non-EMRS stations and are established to provide near real-time, continuous records of water quality to be used for a variety of purposes. Each CWQMN station is either designated as EMRS or non-EMRS. See Tables A4.1 – A4.4 for project objectives and station measurement parameters for each station designation.

CWQMN stations may be operated by TCEQ staff, local cooperators, or contractors. CWQMN stations operated by TCEQ staff or local cooperators are listed in Tables A4.2 and A4.3. These stations are operated according to the TCEQ Standard Operating Procedures (SOP) found in Section A4.3. TCEQ has contracted with the United States Geological Survey (USGS) to operate the CWQMN stations listed in Tables A4.1 and A4.4. These stations are operated according to the USGS guidelines and procedures found in Section A4.4. The CWQMN program adheres to the quality system detailed in the TCEQ Quality Management Plan (QMP) and the policies described therein.

Station monitoring data[3] are available online.

[3] www.tceq.texas.gov/waterquality/monitoring/swqm_realtime.html

Table A4.1. Objectives and Locations for CWQMN USGS-Operated Non-EMRS Stations

River Basin	Seg. No.	CAMS	USGS Site ID	Station Location	Objectives	Station Parameters
Rio Grande	2307	757	08371500	Rio Grande upstream of the confluence of Rio Conchos near Presidio, Texas	1) Provide comprehensive water quality and stream discharge data at remote locations of the Big Bend Region of Texas. 2) Monitor SC and stream discharge in the basin to provide information about increasing TDS to protect domestic and agricultural water supplies. 3) Provide water quality and stream discharge data to USNPS and USGS to develop managed stream flow program from upstream reservoirs to improve and maintain aquatic stream habitats and water quality. 4) Provide data to the USFWS to support Rio Grande Silvery Minnow reintroduction efforts. 5) Provide data for high flow and low DO related fish kills. 6) Provide data to USNPS on spring flows in the lower canyons. 7) Document SC levels entering Amistad Reservoir. 8) Provide stream discharge data to NOAA and USNWS for flood forecasting. 9) Provide stream discharge data for recreational river use. Data Objectives for CAMS 757 are currently on hold while the station is being relocated. The station will be moved 100 feet downstream to a more stable bank location and combined with a USIBWC stream gauge. The station is scheduled to be relocated and returned to operation in calendar year 2024.	Surface Water Temperature SC[1] DO[1] pH[1] USGS measures discharge in addition to water quality at CAMS 721[1] USGS measures discharge only at CAMS 720[1] USIBWC measures discharge at CAMSs 757, 758, and 759[2]
	2306	758	08374200	Rio Grande downstream of the confluence of Rio Conchos near Presidio, Texas		
		803	08374510	Rio Grande River at Santa Elena Canyon, Big Bend National Park		
		720	08374550	Rio Grande at Castolon, Texas, Big Bend National Park		
		721	08375300	Rio Grande River at Rio Grande Village, Texas, Big Bend National Park		
		759	08377200	Rio Grande at Fosters Ranch upstream of Amistad Reservoir		

River Basin	Seg. No.	CAMS	USGS Site ID	Station Location	Objectives	Station Parameters
Rio Grande	2312	788	08407500	Pecos River near Red Bluff New Mexico. ~8.8 stream miles upstream of the headwaters of Red Bluff Reservoir in Texas	1) Document SC levels entering Texas for the Pecos River Compact Commission.	Surface Water Temperature[1] SC[1] Discharge[3]
Rio Grande	2311	798	08412500	Pecos River near Orla, Texas	1) Provide comprehensive water quality and stream discharge data at locations in the Upper and Lower Pecos River. 2) Monitor SC and stream discharge in the basin to provide information about increasing TDS to protect domestic and agricultural water supplies. 3) Provide data to the US Army Corps of Engineers Pecos River Salinity Assessment Project. 4) Provide SC data to determine the amount of usable water for Pecos River Commission water delivery requirements	Surface Water Temperature[1] SC/TDS[1] DO[1] USGS measures low-range discharge at CAMS 709, 729, 735, and 807[1]
		807	08419000	Pecos River near Pecos, Texas, at FM 3398	5) Provide SC data to TCEQ's Interstate Compact Program for management discussions and negotiations with New Mexico.	USIBWC measures discharge at CAMS 799[2]
		709	08437710	Pecos River at FM 1776 near Coyanosa, Texas	6) Provide TWRI's WPP improved temporal and spatial DO and SC data to identify improvements in water quality for impaired Sections of the Pecos River.	USGS measures discharge at CAMS 785 and 798[3]
		785	08446500	Pecos River near Girvin Texas, upstream of US Hwy 67/385 Pecos River Bridge	7) Provide data to TIAER for various DO modeling-related activities.	
		735	08447000	Pecos River near US Hwy 290 Southeast of Sheffield, Texas	8) Monitor changes in water quality and stream discharge associated with salt cedar eradication.	

River Basin	Seg. No.	CAMS	USGS Site ID	Station Location	Objectives	Station Parameters
Rio Grande	2310	729	08447300	Lower Pecos River near Terrel/Val Verde/Crocket County Lines	9) Characterize water quality conditions that lead to blooms of toxic golden alga. 10) Document SC levels entering Amistad Reservoir.	
		799	08447410	Lower Pecos River at USIBWC discharge monitoring location near Langtry, Texas		
Rio Grande	2310A	764	08447018	Independence Creek at Caroline Springs (T-5) on the Nature Conservancy's Independence Creek Preserve south of Sheffield, Texas	Independence Creek and associated springs provide critical freshwater inputs into the Lower Pecos River. The station was initiated to monitor potential water quality impacts from oil and gas exploration and development in the area. 1) Monitor SC of spring water to detect any changes in water quality. 2) Monitor SC in the basin to provide information about increasing TDS to protect domestic and agricultural water supplies. 3) Monitor SC in the basin to aid Golden alga research efforts	Surface Water Temperature[1] SC/TDS[1]
Rio Grande	2309	809	08449000	Devil's River at Baker's Crossing SH163	The Devils River, a spring-fed stream, is one of the most pristine water bodies in the state of Texas. The station was initiated to monitor potential water quality impacts from oil and gas exploration and development in the watershed. One underground natural gas and one crude oil pipeline now cross the Devils River upstream of the station location. 1) Provide time-varying trends in water quality data to document status and trends to ensure existing conditions are maintained. 2) Monitor SC in the Rio Grande basin to provide information about increasing TDS in the Rio Grande basin.	Surface Water Temperature[1] SC/TDS[1] DO[1] pH[1]

River Basin	Seg. No.	CAMS	USGS Site ID	Station Location	Objectives	Station Parameters
Rio Grande Coastal	2201	730	08470500	Arroyo Colorado Tidal at Rio Hondo FM 106 Bridge	1) Provide vertical profile water quality data to support modeling efforts by TIAER for the impaired portion of the tidal segment and for public education and outreach for the Arroyo Colorado WPP. 2) Provide data to evaluate the effectiveness of BMPs associated with the WPP Collection of vertical profile data is currently on hold at this station due to reconfiguration of the station design. All other water quality parameters (water temperature, DO and SC) are being collected at a fixed depth.	Vertical profile Water Temperature[1] DO[1] SC[1] Gage Height[1]

[1]TCEQ funds USGS water quality and stream discharge monitoring and these stations are under the CWQMN QAPP. Due to frequent dry conditions, DO data is not collected at station 807.

[2]The USIBWC monitors stream discharge, and the stations are not under the CWQMN QAPP.

[3]USGS monitors stream discharge using non-TCEQ funds and these stations are not covered under the CWQMN QAPP.

BMP = Best Management Practice

CAMS = Continuous Ambient Monitoring Station

DO = Dissolved Oxygen

NOAA = National Oceanic and Atmospheric Administration

SC = Specific Conductance

TBD = To Be Determined

TDS = Total Dissolved Solids. TDS is calculated from SC using TCEQ's correction factor of 0.65.

TIAER = Texas Institute for Applied Environmental Research

TWRI = Texas Water Resource Institute

USGS = United States Geological Survey

USFWS = United States Fish and Wildlife Service

USIBWC = United States International Boundary Water Commission

USNWS = United States National Weather Service

USNPS = United States National Park Service

WPP = Watershed Protection Plan

Table A4.2. Objectives and Locations for CWQMN TCEQ Non-EMRS Stations

River Basin	Seg. No.	CAMS	Station Location	Objectives	Station Parameters
NA	NA	808	San Solomon Springs Southern Discharge Canal at Balmorhea State Park in Toyahvale, Texas	San Solomon and the surrounding springs in far West Texas contribute a substantial amount of the region's water quality and quantity and provides habitat for a number of rare and federally listed endangered species. Concerns exist regarding the potential impacts of recent oil and gas discoveries in the Alpine High play on these springs. 1) Provide baseline SC and pH water quality to TPWD.	Canal Water Temperature SC pH Discharge[1]
Neches	0607	749	Pine Island Bayou at Lower Neches Valley Authority Pump Station near U.S Hwy 69	Forecast water quality for LNVA's raw water canal system for municipal, industrial, and agricultural users.	SC/TDS[2] DO pH Turbidity[2] Surface Water Temperature Sample Depth

[1] USGS monitors stream discharge using non-TCEQ funds. Discharge monitoring is not covered under the CWQMN QAPP.

[2] Turbidity and SC data are used on a near real-time basis by the Lower Neches River authority. Turbidity data records are not validated. See Table A4.3.

CAMS = Continuous Ambient Monitoring Station

DO = Dissolved Oxygen

LNVA = Lower Neches Valley Authority

SC = Specific Conductance

TDS = Total Dissolved Solids. TDS is calculated from SC using TCEQ's correction factor of 0.65.

TPWD = Texas Parks and Wildlife Department

Table A4.3. Objectives and Locations for CWQMN TCEQ EMRS Stations

River Basin	Seg. No.	CAMS	Station Location	Objective	Station Parameters
Brazos	NA	804	Tributary of Upper Green Creek near the intersection of CR385 and 382	1) Provide near real-time SC and water depth data for screening and targeting field responses and investigations associated with dairy-related discharges for the North Bosque River EMRS project. 2) Provide near real-time SC data as an indicator to detect major changes in microwatershed water quality during rainfall run-off events.	Located in rainfall-dependent creeks SC Sample Depth Temperature
	1226K	728	Little Duffau Creek near FM1824		
	1255C	726	Scarborough Creek at CR 423		
	1226E	805	Indian Creek just east of U.S. Hwy 281		
	NA	765	Un-named Tributary of Little Duffau Creek near FM 1824		
Neches	0607	749	Pine Island Bayou near U.S. Hwy 69	1) Provide near real-time data to the LNVA for water management decisions. 2) Provide various officials valuable freshwater quality information from potential storm-related saltwater intrusion into Pine Island Bayou.	SC/TDS Turbidity

CAMS = Continuous Ambient Monitoring Station
EMRS = Environmental Monitoring Response System
LNVA = Lower Neches Valley Authority
SC = Specific Conductance
TDS = Total Dissolved Solids. TDS is calculated from SC using TCEQ's correction factor of 0.65.

Table A4.4. Objectives and Locations for CWQMN USGS-Operated Lower Rio Grande EMRS Stations

River Basin	Seg. No.	CAMS	USGS Site ID	Station Location	Objective	Station Parameters
Rio Grande	2302	767	08462500	Rio Grande at Roma, Texas	1) The stations provide SC data to alert TCEQ and interested parties when estimated TDS concentrations exceeds established notification levels. 2) Data can be used to identify and document possible sources of high TDS waters entering the Lower Rio Grande from Mexico or Texas downstream of Falcon Reservoir.	Surface Water Temperature SC/TDS
		796	08465100	Rio Grande downstream of Arroyo Los Olmos		
		791	08467670	Rio Grande ~2.7 miles upstream of the confluence with El Morillo Drain (United Irrigation District)		
		792	08467680	Rio Grande ~2.5 miles downstream of the confluence of El Morillo Drain (Hidalgo County Irrigation District #18)		
		736	08469175	Anzalduas Dam near Pier 7		
		793	08473326	Rio Grande ~5.0 miles downstream of FM 1015 (HC&CC Irrigation District #9)		
		789	08473575	Rio Grande ~3.45 miles upstream of the of the bridge at CR. 409 (Harlingen Irrigation District # 1)		
Colorado	1416	802	08143990	Noyes Canal at Diversion pt nr. Menard, TX	The Menard Irrigation Canal is an uncontrolled diversion of the San Saba River that has been degraded, modified, and rehabilitated throughout its history. In its current state, the actual diversion volume is unknown without a monitoring station. 1) Provides continuous discharge data to help TCEQ manage the water rights in the San Saba River.	Discharge

CAMS = Continuous Ambient Monitoring Station
EMRS = Environmental Monitoring Response System
HC&CCID #9 = Hidalgo and Cameron County Irrigation District #9
SC = Specific Conductance
TDS = Total Dissolved Solids. TDS is calculated from SC using TCEQ's correction factor of 0.65.

A4.2. CWQMN Project Plans

CWQMN Project Plans document the initiation of new stations and the projects associated with them. The stations represented in the Plans and subsequent changes to the project or stations are updated in the CWQMN QAPP during its annual recertification or biennial revision. In addition to updating the QAPP with project changes, changes to projects may also be captured with new Project Plans for project planning purposes. The Project Plans are retained by the TCEQ Austin Headquarters for historical project informational purposes and are available upon request. The Project Plan template can be found in Appendix C.

A4.3. TCEQ CWQMN Standard Operating Procedures

See Tables A4.2 and A4.3 for TCEQ-operated stations following TCEQ procedures. TCEQ CWQMN SOPs are listed below in Table A4.5.

Table A4.5. Active TCEQ CWQMN Standard Operating Procedures

Title	Pages	Revision	Effective Date
Analysis of *In Situ* Dissolved Oxygen, Specific Conductance, pH, Water Temperature, and Sample Depth in Ambient Surface Water Using YSI EXO Multiprobes	31	1	11/1/2021
Analysis of *In Situ* Specific Conductance, Water Temperature, and Sample Depth for the Bosque River Environmental Monitoring Response System Using Aqua TROLL 200 Multiprobes	13	2	3/14/2018
Analysis of In-Situ Turbidity in Ambient Surface Water at Pine Island Bayou for the Environmental Monitoring Response System using YSI EXO Multiprobes	11	0	6/17/2019
Validation of Continuous (non-EMRS) Water Quality Monitoring Data Collected by Multiparameter Sonde	7	6	3/1/2018
Analysis of *In Situ* Specific Conductance, Water Temperature, and pH for the San Solomon Springs Continuous Water Quality Monitoring (CWQM) Site Using Aqua TROLL 500 Multiprobes	13	0	11/1/2021

A4.4. USGS Guidelines and Procedures

USGS has been contracted by TCEQ to collect, validate, and report water quality and stream discharge monitoring from various stations following USGS guidelines and procedures. See Tables A4.1 and A4.4 for USGS-operated stations. USGS procedures and guidelines (and location of documents) are listed below in Table A4.6.

Table A4.6. USGS CWQMN Guidelines and Procedures

Title	Web Link or Provider
Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Station Operation, Record Computation, and Data Reporting TM1D3.	http://pubs.usgs.gov/tm/2006/tm1D3/
USGS/TCEQ – Adaptation of Data Validation and Fouling Correction Procedures for Water-Quality Monitoring Stations on the Upper Rio Grande and Pecos River (May 2013), Revision 4	This QAPP, Appendix G
Discharge Measurements at Gaging Stations: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 3, Chapter A8.	http://pubs.usgs.gov/twri/twri3a8/
User's Manual for Aquarius Time Series.	USGS Oklahoma-Texas Water Science Center
National Field Manual. Techniques of Water-Resources Investigations Book 9	http://water.usgs.gov/owq/FieldManual/
Quality-Assurance Plan for Water Quality Activities in the Texas Water Science Center.	USGS Oklahoma-Texas Water Science Center
Texas Water Science Center Surface-Water Quality-Assurance Plan.	USGS Oklahoma-Texas Water Science Center

A5. Project Task Description

A5.1. Network Description

Continuous surface water quality, sample depth, water level, and stream discharge may be measured automatically (365 days a year) at CWQMN stations located on water bodies of interest. Data from TCEQ operated CWQMN stations are telemetered to TCEQ Headquarters in Austin, Texas. Data from USGS operated CWQMN stations are relayed via satellite to the USGS's National Water Information System (NWIS) database. Data is extracted hourly from the USGS NWIS database and sent to the TCEQ Data Acquisition System (DAS). See TCEQ's website for data, maps, and locations of stations.[4]

Some TCEQ CWQMN projects are funded in whole or in part by federal funds under CWA Sec 106 or other federal grants. Other projects are funded entirely with state and local funds. All CWQMN projects listed in Tables A4.1-A4.4 regardless of funding source(s), are covered under the TCEQ CWQMN QAPP. Independent CWQMN stations are covered under separate quality assurance (QA) systems and are not included under the TCEQ CWQMN QAPP. The CWQMN program adheres to the quality system detailed in the TCEQ QMP and the policies described therein.

This QAPP describes and documents policies, procedures, infrastructure requirements, assessments and response actions, and data management, needed to provide and maintain quality data for the monitoring objectives in Section A4. Table A5.2 lists the activities required to plan, implement, and assess the CWQMN.

During extended extreme circumstances, the practices and procedures detailed in this QAPP may not be possible. Such circumstances may include, but are not limited to, adverse environmental, health, safety, and administrative conditions. Should these or other circumstances arise that would compromise health and human safety, TCEQ or TCEQ cooperators and contractors may be required to deviate from the practices and procedures detailed in this QAPP. TCEQ will notify EPA of the deviation(s) from the QAPP in writing no later than thirty (30) calendar days after the onset of the precipitating circumstances. TCEQ will also notify EPA when the circumstances are resolved and conformance with the QAPP is achieved in writing within thirty (30) calendar days of resolution.

The CWQMN QAPP is updated every two years. The QAPP is reviewed in the interim year as part of the required annual certification process. In accordance with the TCEQ QMP, certification of the review is due to the TCEQ QA Manager and EPA Project Officer no later than thirty (30) days before the QAPP's annual anniversary. During the annual certification process, a list is compiled of new and deactivated stations. This list is included as part of the annual certification document submitted to the TCEQ QA Manager and EPA.

[4] www.tceq.texas.gov/waterquality/monitoring/swqm_realtime.html

Amendments to the QAPP may be necessary to address incorrectly documented information or to reflect changes in project organization, tasks, objectives, methods, and equipment.

Requests for amendments will be directed from the QA Officer to the EPA Project Officer. Amendments are effective immediately upon approval by the Network Coordinator, Program Manager, QA Officer, the QC Officer, the TCEQ QA Manager (or designee), and the EPA Project Officer.

When new stations are added to the network during the year, the program will document project details and requirements in CWQMN Project Plans (Project Plan Shell in Appendix C) using the EPA Environmental Information QAPP Standard (Directive No: CIO 2105-S-02.1) format. The plans will set forth project-specific requirements (or criteria) against which results can be compared and help ensure that project data will be of the type and quality needed for its intended use. Project Plans will refer to the CWQMN QAPP where applicable.

CWQMN Project Plans will be written as addenda to the CWQMN QAPP and will require an abbreviated sign-off by the CWQMN Network Coordinator, various TCEQ managers and staff, CWQMN Program QA Officer, CWQMN QC Officer, Data Management and Analysis, and relevant project participants/cooperators or contractors.

If a new project is substantially different from those described in the QAPP, and if the project is supported with Section 106 monies, TCEQ will send the associated project plan to EPA for comment during project development. Copies of all completed/approved Project Plans will be available to EPA regardless of project funding sources and will remain on file in the central office CWQMN program QA files.

Project Plans may be written and approved throughout the year. Once approved, the plans are available upon request.

Continuous water quality monitoring network stations are operated by station operators who may be:

- Staff from any of TCEQ's 16 regional offices
- Local cooperators
- Contractors working with Central SWQM staff

Table A5.1 lists the station operators and data validators for each CWQMN station.

A5.2. USGS-Generated Data

TCEQ has contracted with USGS to provide stream discharge and water quality measurement data at stations on the Upper Rio Grande, Pecos River, Arroyo Colorado, Devils River, and Lower Rio Grande basins. See Tables A4.1 and A4.4 for USGS station locations and parameters and Section A4.4 for the locations of USGS Guidelines and Procedures. USGS Oklahoma-Texas Water Science Center QAPPs are also listed in Section A4.4.

See the USGS NWIS website for data, maps, site information and location of stations.[5]

Table A5.1. Station Operators and Data Validators

Basin	TCEQ Region	CAMS Number	Station ID	Operator CWQMN Element	Data Validator CWQMN Element	Station Location
Rio Grande	6	803	16274	USGS-Water Quality/Discharge	USGS-Water Quality/Discharge	Big Bend National Park-Santa Elena Canyon
Rio Grande	6	721	18483	USGS-Water Quality/Discharge	USGS-Water Quality/Discharge	Big Bend National Park-Rio Grande Village
Rio Grande	6	720	18482	USGS-Discharge	USGS-Discharge	Big Bend National Park- Rio Grande at Castolon, Texas
Rio Grande	16	799	13420	USGS-Water Quality	USGS-Water Quality	Lower Pecos at IBWC discharge monitoring location near Langtry
Rio Grande	7	788	21010	USGS-Water Quality/Discharge	USGS-Water Quality	Pecos River near Red Bluff New Mexico
Rio Grande	7	785	13257	USGS-Water Quality/Discharge	USGS-Water Quality/Discharge	Pecos River Girvin, Texas
Rio Grande	7	709	13260	USGS-Water Quality/Discharge	USGS-Water Quality/Discharge	FM 1776 near Coyanosa, Texas (Upper Pecos)
Rio Grande	7	729	18801	USGS-Water Quality/Discharge	USGS-Water Quality/Discharge	Pecos River near the Terrel/Val Verde/ Crocket County lines
Rio Grande	16	759	13223	USGS-Water Quality	USGS-Water Quality	Rio Grande at Fosters Ranch upstream of Amistad Reservoir
Rio Grande	16	809	22286	USGS-Water Quality	USGS-Water Quality	Devil's River at Baker's Crossing SH163
Rio Grande	7	798	13265	USGS-Water Quality/Discharge	USGS-Water Quality/Discharge	Pecos River near Orla, Texas
Rio Grande	7	807	21924	USGS-Water Quality/Discharge	USGS-Water Quality/Discharge	Pecos River near Pecos, Texas at FM 3398

[5] waterdata.usgs.gov/nwis

Basin	TCEQ Region	CAMS Number	Station ID	Operator CWQMN Element	Data Validator CWQMN Element	Station Location
Rio Grande	6	757	13230	USGS-Water Quality	USGS-Water Quality	Rio Grande upstream of the confluence of Rio Conchos near Presidio, Texas
Rio Grande	6	758	13229	USGS-Water Quality	USGS-Water Quality	Rio Grande downstream of the confluence of Rio Conchos near Presidio, Texas
Rio Grande	7	735	13249	USGS-Water Quality/Discharge	USGS-Water Quality/Discharge	Pecos River near US Hwy 290 southeast of Sheffield, Texas
Rio Grande Coastal	15	730	13072	USGS-Water Quality	USGS-Water Quality	Arroyo Colorado at FM 106, Rio Hondo, Texas
Rio Grande	7	764	20338	USGS-Water Quality	USGS-Water Quality	Independence Creek at Caroline T-5 Spring, Independence Creek Preserve
Rio Grande	7	808	22194	TPWD Balmorhea State Park-Water Quality	TCEQ/WQPD-Water Quality	San Solomon Springs at Balmorhea State Park
Rio Grande	15	736	13182	USGS-Water Quality	USGS-Water Quality	Rio Grande at Anzalduas Dam near Pier 7
Rio Grande	15	767	20737	USGS-Water Quality	USGS-Water Quality	Rio Grande at Roma, Texas
Rio Grande	15	796	21980	USGS-Water Quality	USGS-Water Quality	Rio Grande downstream of arroyo Los Olmos
Rio Grande	15	789	21977	USGS-Water Quality	USGS-Water Quality	Harlingen Irrigation District #1
Rio Grande	15	791	21101	USGS-Water Quality	USGS-Water Quality	United Irrigation District
Rio Grande	15	792	21012	USGS-Water Quality	USGS-Water Quality	Hidalgo Irrigation District #18
Rio Grande	15	793	21979	USGS-Water Quality	USGS-Water Quality	HC&CC Irrigation District # 9

Basin	TCEQ Region	CAMS Number	Station ID	Operator CWQMN Element	Data Validator CWQMN Element	Station Location
Brazos	4	726	17222	TCEQ Region 4, Stephenville-Water Quality	NV	Scarborough Creek (Upper North Bosque River tributary) at CR 423
Brazos	4	728	20322	TCEQ Region 4, Stephenville-Water Quality	NV	Little Duffau Creek (Upper North Bosque River Tributary) near FM 1824
Brazos	4	765	20323	TCEQ Region 4, Stephenville-Water Quality	NV	Unnamed Tributary of Little Duffau Creek (Bosque River Tributary) near FM 1824
Brazos	4	804	21974	TCEQ Region 4, Stephenville-Water Quality	NV	Tributary of Upper Green Creek near the intersection of CR 385 and 382
Brazos	4	805	17235	TCEQ Region 4, Stephenville-Water Quality	NV	Indian Creek just east of U.S. Hwy 281
Neches	10	749	20471	Lower Neches Valley Authority	TCEQ/WQPD-Water Quality. Turbidity data collected at the station is not validated.	Pine Island Bayou near U.S. Hwy 69
Colorado	8	802	21973	USGS-Discharge	USGS-Discharge	Menard (Noyes) Irrigation Canal near Menard, Texas

CAMS = Continuous Ambient Monitoring Station
HC&CC Irrigation District #9 = Hidalgo and Cameron County Irrigation District #9
NV = Not validated. EMRS project data not validated
TCEQ/WQPD = Texas Commission on Environmental Quality Water Quality Planning Division
TPWD = Texas Parks and Wildlife Department
USGS = United States Geological Survey

Table A5.2. Schedule of Activities

A list of activities required to plan, implement, and assess the CWQMN.

Administrative Activities	Status
Biannual CWQMN QAPP Revision	The biannual CWQMN QAPP revision will be delivered to EPA no later than sixty (60) days prior to the QAPP expiration.
Biannual CWQMN QAPP Review and Certification	Certification of the annual review will be delivered to EPA and the TCEQ QA Manager no later than thirty (30) days prior to the QAPP's annual anniversary.
CWQMN Project Plans	Ongoing, for each new CWQMN Project
CWQMN Data Quality Objectives (measurement performance specifications for multiprobe fouling and drift quality control measurements). When applicable.	Ongoing for new non-EMRS stations
General Activities	**Status**
Arroyo Colorado (CAMS 730) station is not currently producing vertical profile data due to issues with station equipment and design.	Water quality data collection resumed in November 2023. Station reconfiguration to achieve collection of vertical profile measurements is ongoing.
Rio Grande Upstream of Presidio (CAMS 757) is currently inoperable and is not producing any data. The riverbank collapsed at this site and efforts are underway to relocate the station. The station will be moved 100 feet downstream to a more stable bank location and combined with a USIBWC stream gauge.	The station is scheduled to be relocated in calendar year 2024. Funds have been included in the FY24-25 USGS-TCEQ contract to relocate this station.
CWQMN Audits and readiness reviews	Ongoing

A6. Information/Data Quality Objectives and Performance/Acceptance Criteria

CWQMN water quality measurements are used for a variety of purposes. Section A6 describes quality objectives for the various projects.

A6.1. CWQMN Multiprobe Quality Objectives and Criteria

CWQMN Multiprobe Long Term Deployments

CWQMN multiprobe water quality measurement sensors are deployed in various water bodies around the state for extended periods of time. Over deployment periods, the interface between sensors and the environment can become fouled by a variety of organisms, sedimentation, and chemical coatings. Sensor fouling can compromise data quality.

Quality Objectives for CWQMN Stations

TCEQ CWQMN has two types of multiprobe stations, non-EMRS, and EMRS. For non-EMRS stations, data records are validated using multiprobe sensor fouling and electronic drift quality control (QC) measurement results. Generally stated, USGS uses sensor fouling and drift QC measurements to apply prorated data corrections over deployment periods and to determine data quality. TCEQ procedure compares sensor fouling and drift QC measurement results against project specific data quality objectives (DQOs). TCEQ does not use sensor fouling and drift measurements to apply prorated data adjustments over deployment periods.

At EMRS stations, near real-time measurements are used to screen water quality for water management decisions or potential field investigations and QC measurement results are not available to assess the quality of near real-time data.

See Section B4.1 for a summary of TCEQ multiprobe QC procedures, calculations, and limitations. For complete details concerning a project's or station's quality objectives criteria, see TCEQ SOPs. TCEQ SOPs used for projects and stations are cited in this Section.

Quality Objectives for USGS-Operated CWQMN Upper Rio Grande and Pecos River Non-EMRS Stations

Beginning Sept. 1, 2011, TCEQ contracted with USGS to operate, maintain, and validate all CWQMN water quality stations in the Upper Rio Grande, Pecos River, and Arroyo Colorado basins according to: USGS – *Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Station Operation, Record Computation, and Data Reporting TM1D3*.

Due to multiprobe data collection problems at some stations on the Upper Rio Grande and Pecos Rivers, USGS and TCEQ worked collaboratively to interpret and adapt guidelines and standard procedures found in TM1D3. The following procedures are now in use by USGS: USGS/TCEQ – *Adaptation of Data Validation and Fouling Correction Procedures for Water-Quality Monitoring Stations on the Upper Rio Grande and Pecos River* (May 2013), Rev 4. These procedures are in Appendix G of this QAPP.

There are circumstances when data quality cannot be rated because sensor fouling measurements are not available for particular time periods. This data can be reported to TCEQ; however, the quality of this data is not known. See procedures in Appendix G for details.

USGS Data Validation Platform

USGS Automated Data Processing System (ADAPS) data validation platform was replaced in May of 2017 with an Aquatic Informatics platform named Aquarius. The Aquarius platform, while still based on the USGS TM1D3 Guidelines and the Adaptation, does not generate data quality ratings like the previous platform. Instead, Aquarius validates data using the TM1D3 "maximum allowable limits" as acceptance criteria. See Section B7.2 for more information on how this data is validated and delivered to TCEQ.

USGS-Operated Non-EMRS Stations

Table A6.1.1. Quality Objectives for USGS Operated Multiprobe CAMS

Stations 709, 721, 729, 730, 735, 757, 758, 759, 764, 785, 788, 798, 799, 803, 809, and 807

Parameter[1]	**Acceptance Limits (TM1D3 Maximum Allowable Limits)** (Based on combined fouling and calibration drift corrections applied to the record)
Temperature	±2.0 ºC
Specific Conductance	±30%
Dissolved Oxygen	±2.0 mg/l or ±20%, whichever is greater
pH	±2 pH units

[1]See Table A4.1 for a list of water quality parameters measured at each station.

ºC = degrees centigrade

mg/l = milligrams per liter

TCEQ Non-EMRS Stations

Table A6.1.2. Quality Objectives TCEQ Multiprobe CAMS

Stations 749 and 808[1]

Parameter	Fouling and Drift/(CVS) Acceptance Limits (sum and individual fouling and drift acceptance limits)	Temperature Acceptance Limit	SOP
Specific Conductance/ Total Dissolved Solids	±5 RPE	±0.5 ºC[2]	Analysis of *In Situ* Dissolved Oxygen, Specific Conductance, pH, Water Temperature, and Sample Depth in Ambient Surface Water Using Yellow Springs Instrument EXO Multiprobes, Rev. 1[3] Analysis of In Situ Specific Conductance, Water Temperature, and pH for the San Solomon Springs Continuous Water Quality Monitoring (CWQM) Site Using Aqua TROLL 500 Multiprobes[4]
Dissolved Oxygen	±0.5 mg/l		
pH	±0.5 units		
Temperature		±0.5 ºC	
Sample Depth	NA		

[1]CAMS 808 parameters only include specific conductance, pH, and temperature.

[2]If temperature sensor checks do not meet the ±0.5 ºC criterion, the corresponding temperature, DO, SC, and calculated total dissolved solids data are considered invalid.

[3]This SOP is applicable to Station 749.

[4]This SOP is applicable to Station 808.

ºC = degrees centigrade

CVS = calibration verification sample

NA = not applicable, sample depth measurements not assessed for accuracy.

mg/l = milligrams per liter

RPE = Relative percent error

YSI = Yellow Spring Instrument

TCEQ EMRS Stations

North Bosque River Specific Conductance EMRS Project

EMRS data are intended to assist TCEQ Stephenville, Texas staff in targeting field investigations to identify dairy-related discharge sources. Specific conductance, sample depth, and temperature multiprobes are deployed at five rainfall-dependent micro-watersheds locations downgradient of dairy CAFOs. When water quality trigger level(s) are exceeded at a station, an email is automatically sent to TCEQ Stephenville staff and other interested parties. Stephenville staff reviews station data to determine if an

investigation is warranted. Specific conductance, depth, and temperature data records from the stations are not validated.

Table A6.1.3. Quality Objectives TCEQ Multiprobe CAMS

Stations 726, 728, 765, 804, and 805

Parameter	Drift (CVS) Acceptance Limits	Temperature Acceptance Limit	SOP
Specific Conductance	±5 RPE [1]	±0.5 ºC [1]	Analysis of *In Situ* Specific Conductance, Water Temperature, and Sample Depth for the Bosque River Environmental Monitoring Response System Using Aqua TROLL 200 Multiprobes, Rev 2

[1] CVS and temperature check criteria are used as guidelines to ensure measurement equipment is operating within limits.

ºC = degrees centigrade

RPE = relative percent error

Lower Neches Valley Authority EMRS Project

The Lower Neches Valley Authority (LNVA) operates CAMS 749 at Pine Island Bayou. The LNVA uses specific conductance (SC)/total dissolved solids (TDS) and turbidity data on a near real-time basis. The LNVA may divert water from Pine Island Bayou to supply a secondary source of freshwater to various consumers. SC/TDS data provides information from potential storm-related saltwater intrusions into Pine Island Bayou. Turbidity data provides LNVA information about potential water treatment needs of this secondary source of water. Turbidity data records are not validated.

Table A6.1.4. Quality Objectives LNVA Multiprobe CAMS 749

Parameter	Drift (CVS) Acceptance Limits[1]	SOP
Turbidity	± 3 NTU/FNU or 5 RPE[1]	Analysis of In-Situ Turbidity in Ambient Surface Water at Pine Island Bayou for the Environmental Monitoring Response System using YSI EXO Multiprobes, Rev. 0
Total Dissolved Solids	±5 RPE	Analysis of *In Situ* Dissolved Oxygen, Specific Conductance, pH, Water Temperature, and Sample Depth in Ambient Surface Water Using Yellow Springs Instrument EXO Multiprobes, Rev. 1

[1] CVS criteria are used to ensure measurement equipment is operating within limits.

FNU = Formazin Nephelometric Units

NTU = Nephelometric Turbidity Units

RPE = relative percent error

USGS Lower Rio Grande EMRS Stations

Specific conductance and temperature sensor multiprobes are deployed at seven stations downstream from Falcón Reservoir. The stations were designed and deployed to automatically alert TCEQ and interested parties via email when near real-time estimated TDS concentrations exceed established notification levels.

As of Jan. 1, 2021, through a TCEQ contract, USGS began operating, maintaining, and validating station data records according to USGS TM1D3 Procedures. See Section B7.2 for more information on how this data is validated and delivered to TCEQ.

Table A6.1.5. Quality Objectives USGS Operated Multiprobe CAMS

Stations 736, 767, 789, 791, 792, 793, and 796

Parameter	**Acceptance Limits (TM1D3 Maximum Allowable Limits)** (based on combined fouling and calibration drift corrections applied to the record)
Temperature	±2.0 ºC
Specific Conductance/ Total Dissolved Solids	±30%

ºC = degrees centigrade

A6.2. Representativeness

By design, the CWQMN measures water quality in greater temporal detail and resolution than is possible with grab samples or short-term deployments of monitoring instrumentation. This results for a more accurate and precise representation of water quality conditions at each station. See Section B2.1 for information concerning multiprobe deployment and sampling.

A6.3. Comparability

CWQMN water quality measurements are based on *Standard Methods for the Examination of Water and Wastewater*, 20th Edition, 1998, unless otherwise noted. Comparability is also achieved by using SOPs, reporting data in standard units by using accepted rules for significant figures, and by reporting data in standard formats.

As previously discussed in Section A6.1, USGS applies prorated data adjustments to data records based on multiprobe fouling and drift measurements. TCEQ does not adjust data records.

A6.4. Bias

Definitions for bias are provided in Appendix A. Determining and calculating bias for the purposes of this quality assurance project plan is discussed in Section B4.

A6.5. Completeness

A general requirement for data completeness has been set at 75 percent data return. Periods of no flow or dry conditions necessitate shutdown of some instrumentation and these times are not considered in the goal for data completeness. Extreme weather or other natural events, such as bank collapse, station flooding, etcetera, can also cause stations to become inoperable for extended periods of time. These times are not considered in the goal for data completeness. Data completeness is discussed in Section C.

A7. Distribution List

A7.1. U.S. Environmental Protection Agency

Region 6
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733
Teresita Mendiola, Project Officer

A7.2. TCEQ Austin Headquarters

P.O. Box 13087 Austin, TX 78711-3087

Kelly Mills, Deputy Director, Water Quality Planning Division

Gene Muller, Assistant Deputy Director, Water Quality Planning Division

Sean Smith, Clean Water Act Section 106 Categorical Grants Project Manager, Division Support Section, Water Quality Planning Division

Jason Godeaux, Manager, Monitoring and Assessment Section, Water Quality Planning Division

Sarah Whitley, Team Leader, Water Quality Standards and Clean Rivers Program, Monitoring and Assessment Section, Water Quality Planning Division

Cathy Anderson, Team Leader, Data Management and Analysis Team, Monitoring and Assessment Section, Water Quality Planning Division

Amir Poursamadi, Data Management and Analysis Team, Monitoring and Assessment Section, Water Quality Planning Division

Jacob Cable, Data Management and Analysis Team, Monitoring and Assessment Section, Water Quality Planning Division

Andrew Sullivan, Team Leader, Surface Water Quality Monitoring Team, Monitoring and Assessment Section, Water Quality Planning Division

Ivan Cruickshank, Network Coordinator, Surface Water Quality Monitoring Team, Monitoring and Assessment Section, Water Quality Planning Division

Sarah McCaffrey, CWQMN Quality Control Officer, Surface Water Quality Monitoring Team, Monitoring and Assessment Section, Water Quality Planning Division

Robin Cypher, Surface Water Quality Monitoring Team, Monitoring and Assessment Section, Water Quality Planning Division

Kalista Mitchell, Surface Water Quality Monitoring Team, Monitoring and Assessment Section, Water Quality Planning Division

Laura Ryckman, Surface Water Quality Monitoring Team, Monitoring and Assessment Section, Water Quality Planning Division

Nicole Hughes, Surface Water Quality Monitoring Team, Monitoring and Assessment

Section, Water Quality Planning Division

Terra Lindgren, Surface Water Quality Monitoring Team, Monitoring and Assessment Section, Water Quality Planning Division

Lauren Gray, Surface Water Quality Monitoring Team, Monitoring and Assessment Section, Water Quality Planning Division

Brandy Brooks, Deputy Director, Monitoring Division

D. Jody Koehler, TCEQ Quality Assurance Manager, Laboratory and Quality Assurance Section, Monitoring Division

Jason Natho, CWQMN Quality Assurance Officer, Laboratory and Quality Assurance Section, Monitoring Division

Heather Stewart, Manager, Data Management Section, Monitoring Division

Debbie Odette, Team Leader, Data Collection Team, Data Management Section, Monitoring Division

Stephanie Ma, Manager, Ambient Monitoring Section, Monitoring Division

Steven Cano, Team Leader, Network Support Team, Ambient Monitoring Section, Monitoring Division

Andy Gardner, Deputy Director, Program Support & Environmental Assistance Division

Zachary King, Technical Specialist, Program Support & Environmental Assistance Division

Renae DiGuardi, Team Leader, Field Support Team, Program Support & Environmental Assistance Division

LaTrichia Spikes, Field Support Team, Program Support & Environmental Assistance Division

Alyssa Pantuso, Field Support Team, Program Support & Environmental Assistance Division

A7.3. TCEQ Regional Offices

Central Texas Area, (512) 339-2929
12100 Park 35 Circle
Austin, TX 78753

Mr. Joel Anderson, Area Director

Coastal and East Texas Area, (512) 239-1000
12100 Park 35 Circle
Austin, TX 78753

Mr. David Van Soest, Area Director

Border and Permian Basin Area, (956) 425-6010
1804 W Jefferson Ave
Harlingen, TX 78550

Mr. David A. Ramirez, Area Director

North Central and West Texas Area, (806) 796-7092
5012 50th St, Ste 100
Lubbock, TX 79414

Mr. Randy J. Ammons, Area Director

Dallas/Fort Worth – Region 4, (817) 588-5800
2309 Gravel Dr.
Fort Worth, TX 76118

Mr. Brent Candler, Water Section Manager

Stephenville Special Project Office – Region 4, (254) 965-9200
580 W. Lingleville Rd., Ste D
Stephenville, TX 76401

Mr. Michael Martin, Team Leader
Ms. Christine Whitefield

A7.4. Cooperators

Lower Neches Valley Authority

LNVA-SWB Laboratory
6790 Bigner Road
Beaumont, TX 77708

Mrs. Jeannie Mahan (409) 284-4261
Ms. Brielle Patronella (409) 617-2286
Ms. Bethany Stanton (409) 659-3428
Mr. Brian Fife (409) 659-3428

Texas Parks and Wildlife Department Headquarters

4200 Smith School Rd.
Austin, TX 78744

Mr. Greg Creacy
Mr. Marty Kelly
Mr. Tim Birdsong

Texas Parks and Wildlife Department Balmorhea State Park

9207 TX-17, Toyahvale, Texas 79786

Mr. Torrey Bonham Office: (432) 375-2370, Cell: (432) 249-9908

Texas Parks and Wildlife Department

P.O. Box 1079
Fort Davis, TX 79734

Mr. Adam Jarrett
Mr. Nicolas Havlik Office: (432) 426-3533 ext. 245, Cell: (432) 249-0942

A7.5. Contractors

USGS Oklahoma-Texas Water Science Center –Austin, Texas

1505 Ferguson Lane
Austin, TX 78754

Mr. Timothy H Raines (512) 927-3502
Mr. Gregory Stanton (512) 927-3558
Mr. Michael Canova (512) 927-3536
Ms. Monica Langhorst (512) 927-3532 (Project Primary Contact)

USGS San Angelo Field Office

3745 South Jackson, Suite A
San Angelo, TX 76903

Mr. Darren Garcia (325) 944-4600 x 26

USGS El Paso Field Office

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El Paso, TX 79935

Mr. Eric Suh (915) 227-9801

USGS Corpus Christi Field Office

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Corpus Christi, TX 78412

Mr. Jamie Ingold (210) 213-8914
Mr. Timothy Gonzales (361) 342-2706

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5663 De Zavala Suite 290
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Mr. Vidal Mendoza (210) 422-9742
Mr. Brian Petri (210) 691-9229
Mr. Michael Willis (210) 691-9207
Mr. Alex Lafoon (210) 691-9220

The Texas Commission on Environmental Quality will provide copies of this Quality Assurance Project Plan and any amendments or Appendixes of this plan to each person on this list and to each sub-tier project participant, e.g., subcontractors, organizations operating sites, laboratories. TCEQ will document distribution of the plan and any amendments and Appendixes, maintain this documentation as part of the project's quality assurance records, and will ensure this documentation is available for review.

A8. Project Organization

This QAPP is specific to the activities of the TCEQ. The CWQMN is operated by TCEQ regional staff, cooperators, and contractors. The organization of the CWQMN project is shown in Figure A10.1. The interrelationships and responsibilities of the participants in these projects are listed below:

A8.1. U.S. EPA Region 6

Teresita Mendiola, EPA Project Officer

- Responsible for managing the project on behalf of EPA.
- Reviews and approves the applicable QAPP revisions, QAPP amendments, QAPP annual certification and CWQMN Project Plans.
- Provides EPA-assigned QTRAK# to the CWQMN QC Officer and CWQMN QA Officer.

A8.2. Project Sponsor, Monitoring and Assessment Projects

Kelly Mills, Deputy Director, Water Quality Planning Division, Office of Water

- Sets the preliminary objectives for network projects.
- Allocates adequate resources to ensure completion of the project in compliance with the stated objectives.

A8.3. Project Roles and Responsibilities

Water Quality Planning Division, Office of Water

CWQMN Network Coordinator

Ivan Cruickshank, Monitoring and Assessment Section

- Receives input from CWQMN program managers on the various CWQMN projects.
- Facilitates coordination of the entire CWQMN.
- Coordinates the identification of representative project station(s) with input from interested parties.
- Coordinates and facilitates development of station-specific Data Quality Objectives (DQOs) or Measurement Quality Objectives (MQOs).
- Approves monitoring stations after consultation with TCEQ management, TCEQ staff, and stakeholders.
- Assists program managers for project plan development for new CWQMN projects or stations.
- Responsible for establishing new monitoring stations and integrating stations into the existing monitoring network.

- Coordinates CWQMN deployment schedules with others, as needed.
- Purchases network equipment.
- Manages equipment repair contracts for the network.
- Maintains the Water Quality Planning Division (WQPD) EMRS water listserv accounts.
- Completes Station Initiation Forms, Lease Agreements, Station Access Agreements, and Data Validation Initiation forms for new stations.
- Develops various CWQMN processes to help ensure network goals are achieved.
- Advises network participants about known CWQMN data and/or project limitations.
- Assists QC Officer in developing and revising SOPs.
- Assists QC Officer in conducting audits and implementing corrective actions.
- Provides project planning and prepares comments and project status reports.
- Manages various budgets associated with the EPA grants and state funding.
- Receives and maintains USGS contract assessment records.
- Develops and coordinates contracts and intergovernmental agreements of the CWQMN.
- Coordinates station repairs.
- Assists in station installations and repair.
- Provides WQPD Management updates on CWQMN projects and network stations on an as needed basis.
- Organizes training for station operators.
- Coordinates document reviews.
- Notifies Data Management and Analysis staff when stations are deployed and determine a start date for data validation activities.
- Leads CWQMN Coordination Meetings.
- Monitors and reviews the general operational status of all stations in the lower Rio Grande and emails a daily data review report to interested parties.

CWQMN Program Manager

Andrew Sullivan, Monitoring and Assessment Section

- Develops and communicates objectives for CWQMN projects.
- Communicates to management the status, recommended changes, and goals of CWQMN projects.
- Maintains a thorough knowledge of project work activities, commitments, deliverables, and time frames.
- Develops necessary lines of communication and good working relationships between the lead division staff and personnel of other divisions and organizations participating in the program.
- Approves acceptability of the measurement data process and QA/QC protocols.

- Advises management about objectives, timetables, tasks, and coordination not being met.
- Elevates CWQMN/Monitoring Division (MD) scheduling conflicts and other issues requiring resolution through the appropriate management chain(s) when appropriate.
- Maintains oversight of contracts and intergovernmental agreements of the CWQMN.
- Maintains oversight of various budgets associated with the EPA grants and state funding.
- Monitors the effectiveness of the overall program quality system.
- Participates in the development of station specific DQOs or MQOs.
- Selects SWQM Project Leads for specific CWQMN projects.
- Participates in CWQMN Coordination Meetings.
- Provides feedback to supervisory and administrative personnel as necessary regarding the performance of project leads and managers.

CWQMN QC Officer

Sarah McCaffrey, Monitoring and Assessment Section

- Responsible for CWQMN QAPP revisions, amendments, and annual certifications.
- Provides QC oversight for network activities.
- Assists program managers, network coordinator, and project managers in developing and implementing quality systems.
- Develops various CWQMN processes to help ensure quality objectives are achieved.
- Advises program managers, data users, and network participants about known CWQMN data and/or project limitations.
- Conducts ongoing informal data reviews.
- Reviews and comments on CWQMN Project Plans.
- Researches measurement equipment technical specifications and test equipment if possible.
- Leads developing, coordinating, writing, and revising CWQMN SOPs.
- Investigates network measurement anomalies.
- Participates in the development of DQOs.
- Develops, prepares, conducts, and distributes performance and technical systems/audits/inspections/readiness reviews of CWQMN CAMS.
- Evaluates proposed corrective actions and verifications.
- Concurs with proposed corrective actions and verifications.
- Is responsible for determining if responses to audit findings are acceptable or not.
- Maintains files for Project Plans, performance and technical systems/audits/readiness reviews.
- Trains operators on monitoring equipment and QC procedures.

- Assists grant, program, and project managers in developing and implementing quality systems.
- Assists in station installations and repair.
- Participates in CWQMN Coordination Meetings.
- Assesses the effectiveness of program quality systems and maintains any assessment records.
- Monitors the implementation of corrective actions.
- Consults with the CWQMN QA Officer regarding quality matters, as needed.

Data Management and Analysis Team (WDMA)

- Assigns WDMA Data Validators to the CWQMN program. The WDMA Team Leader is responsible for this task.
- Reviews and verifies TCEQ EMRS CWQMN station data. Validates TCEQ non-EMRS station data.
- Ensures maintenance of records that will demonstrate defensibility of data (Post Deployment Worksheets (PDW) and data validation notes).
- Provides technical support for analyzing and interpreting the data collected from the CWQMN.
- Provides data validation training to interested parties, cooperators, and contractors.
- Provides technical support on statistical evaluation issues that may arise.
- Documents all data management activities.
- Establishes procedures to routinely assess data completeness.
- Participates in the development, approval, implementation, and maintenance of written QA standards (e.g., SOPs, QAPPs) and other guidance documents.
- Participates in CWQMN Coordination Meetings.
- Coordinates the development and maintenance of the Surface Water Quality Monitoring Information System (SWQMIS) for warehousing all CWQMN data.
- Coordinates the development of interfaces between TCEQ DAS and SWQMIS with MD and the Information Resources Division (IRD).

Administrative, Monitoring and Assessment Section

- Processes travel authorization and travel reimbursements for CWQMN activities.

Monitoring Division, Office of Compliance and Enforcement

TCEQ QA Manager

D. Jody Koehler, Monitoring Division

- Responsible for coordinating development and implementation of TCEQ's QA program.
- Provides oversight and guidance for the TCEQ's QA program.
- Responsible for the development and maintenance of the TCEQ QMP.

- Responsible for ensuring program/project QAPPs using federal funding are reviewed and approved to conform to TCEQ and EPA requirements as detailed in the TCEQ QMP.

CWQMN QA Officer

Jason Natho, Monitoring Division

- Provides oversight of all QA activities.
- Participates in the development, approval, implementation, and maintenance of written QA standards (e.g., QMP and QAPPs).
- Participates in the preparation of quality reports (e.g., annual reports).
- Determines conformance with program quality system requirements.
- Recommends to division directors and project managers and through them to deputy directors, that work be stopped to safeguard programmatic objectives, worker safety, public health, or environmental protection.
- Assists grant, program, and project managers in developing and implementing quality systems.
- Receives and maintains assessment records.
- Provides technical expertise and/or consultation on quality services.
- Prepares and forwards an annual QA report memorandum to EPA.
- Participates in data quality assessments.
- Reports on the status of corrective action programs to EPA.
- Identifies positive and adverse trends in program quality systems.
- Serves as quality system representative.
- Participates in CWQMN Coordination Meetings, as needed.

Monitoring Division

- Provides limited support and logistics for monitoring station deployments depending on personnel availability.
- Assists with shipping, tracking, and receiving of CWQMN parts and supplies purchased and inventoried for CWQMN deployments, operations, maintenance, and repair.
- Provides supplemental and/or advanced training to CWQMN Network Coordinator and QC Officer on the basic setup, configuration, and troubleshooting techniques for the appropriate communications and electronic data acquisition equipment based on the standard operating procedure (SOP) and/or manufacturer's operations manual.
- Provides limited advanced technical support of communications and electronic data acquisition equipment for issues that CWQMN operators, CWQMN Network Coordinator, and/or CWQMN QC Officer cannot resolve by following the SOP and/or manufacturer's operations manual.

- Manages the TCEQ DAS contract. Each program area prepares, processes, and provides funds for their specific work orders.
- Provides station registration for CWQMN stations and establishes accounts for CWQMN operators and validators to access Manual Validation.
- Administers the TCEQ DAS, including webpages with water data reports, water data status pages, and other documentation.
- Participates in the revision of the CWQMN QAPP and CWQMN Project Plans.

Primary Data Users

- Assist in the development of DQOs and MQOs.

TCEQ Area and Regional Office Directors, TCEQ Regional Offices Staff, Local Cooperators, and Contractors

- Participate in locating, evaluating, establishing, and documenting locations for monitoring stations.
- Provide overall support for the operation and maintenance of station.
- Operate and maintain monitoring stations and sampling equipment according to current TCEQ QAPPs and SOPs.
- Calibrate measurement instrumentation.
- Perform QC checks on monitoring, sampling equipment according to current TCEQ QAPPs and SOPs.
- Review QC data and ensure quality data is being generated.
- Train operators and cooperators on monitoring equipment and QC procedures.
- Assist auditors with performance evaluations and technical systems audits.
- Participate in the development of SOPs.
- Perform preventative maintenance on monitoring equipment.
- Assist in the development of DQOs or MQOs.

CWQMN External Webpage Maintenance

- The TCEQ DAS is maintained by MD with input from WQPD staff if needed.
- CWQMN webpages and SWQMIS are maintained by WQPD staff.

A9. Project QAM Independence

Quality Assurance Organization

TCEQ uses a semi-decentralized QA program, relying on one organizational unit to coordinate development and implementation of the agency-wide program and certain program quality systems, and relying on offices, divisions, and individual programs to implement other QA programs. The Monitoring Division, within the Office of Compliance and Enforcement (OCE), serves as the QA coordinating division for TCEQ.

TCEQ's QA program is organizationally independent of operational programs and activities within the agency and has sufficient access and authority to coordinate the development and implementation of the agency's quality system. The Monitoring Division QA staff have access to all work areas and sufficient authority and organizational freedom to identify, initiate, and facilitate solutions to quality problems and to verify the implementation of solutions to problems.

Designated lead QA staff are detailed in Appendix D of TCEQ's QMP [6] for each program under TCEQ's quality system. These staff have access to related work areas and sufficient authority and organizational freedom to identify, initiate, recommend, and provide solutions to quality problems and to verify the implementation of solutions to problems.

With delegation from TCEQ's executive management, the TCEQ QA Manager has responsibility for oversight of the agency's QA program and its operations. Issues and questions regarding the agency QA program and its operations may be raised by agency QA staff, agency staff, and agency management to the TCEQ QA Manager.

The TCEQ QA Manager and CWQMN QA Officer are located in TCEQ's Laboratory and Quality Assurance Section within the Monitoring Division of the Office of Compliance and Enforcement, which is a separate office from TCEQ's Office of Water. The TCEQ QA Manager and CWQMN QA Officer are independent from data operations conducted under this QAPP. No individual from CWQMN management may sign this QAPP for the TCEQ QA Manager and CWQMN QA Officer. Additionally, the TCEQ QA Manager and CWQMN QA Officer may not sign for CWQMN management.

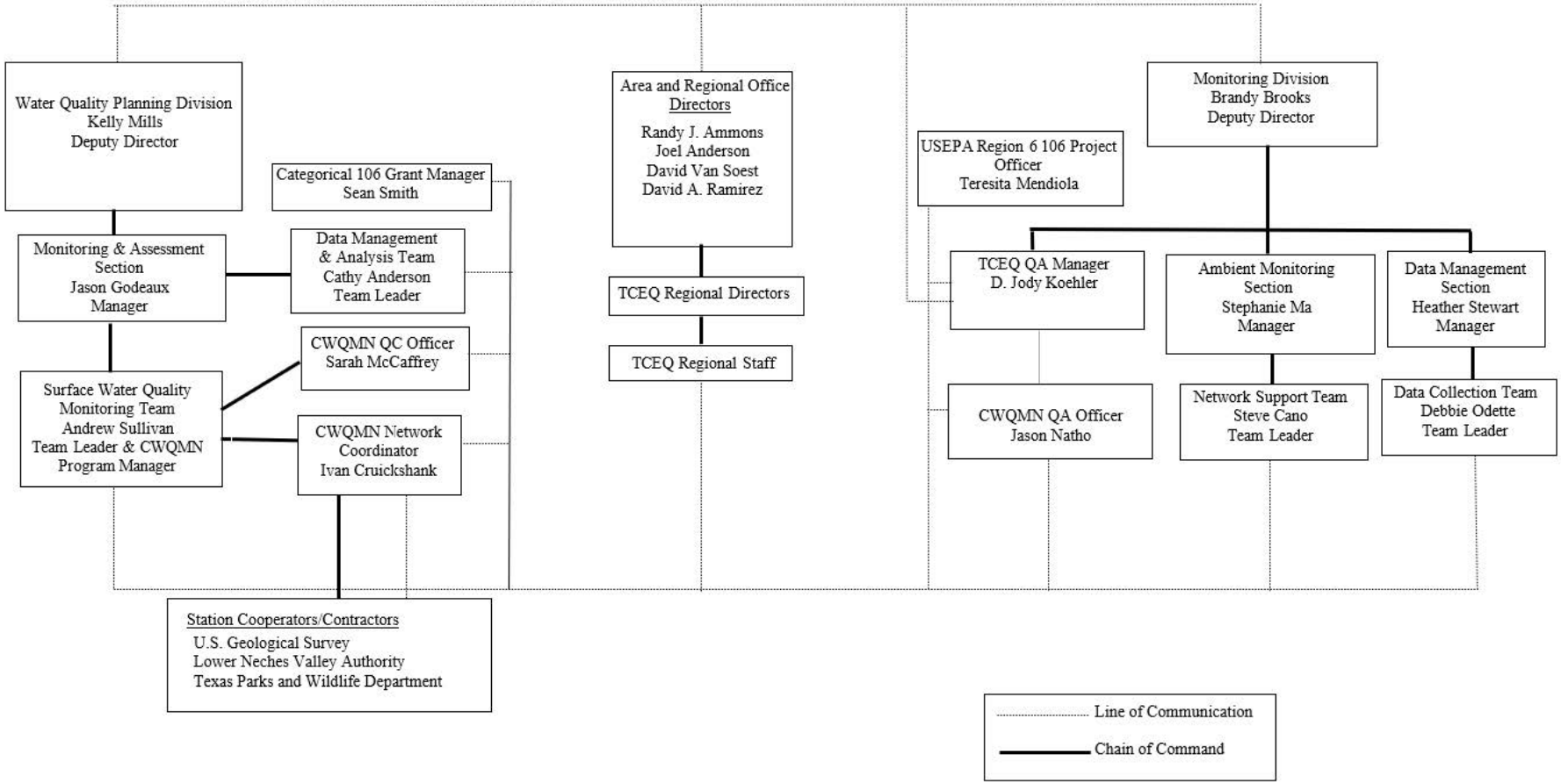
[6] www.tceq.texas.gov/agency/qa/qmp

A10. Project Organizational Chart and Communications

Communication Procedures

The communication procedures used by the CWQMN program are governed by this QAPP and applicable sections of the TCEQ QMP. Project roles and responsibilities, including general personnel interaction and communication, is described in Section A8 of this QAPP. Communication procedures to address process improvements are discussed in Section C1 of this QAPP. Communication procedures to address elevating discrepancies and QAPP nonconformances are detailed in Section C1.1 of this QAPP and in Sections 15d and 16 of the TCEQ QMP.

Figure A10.1. Project Organizational Chart



A11. Personnel Training/Certification

Work conducted for this project is covered under a documented quality management system. Personnel conducting work associated with this project are deemed qualified to perform their work through educational credentials, specific job/task training, demonstrations of competency, and internal and external assessments.

TCEQ has contracted with USGS to provide stream discharge and water quality measurement data at stations on the Upper Rio Grande, Pecos River, Arroyo Colorado, Devils River, and Lower Rio Grande basins. See Tables A4.1 and A4.4 for USGS station locations and parameters and Section A4.4 for the locations of USGS Guidelines and Procedures. USGS Oklahoma-Texas Water Science Center QAPPs are also listed in Section A4.4.

Personnel covered by this QAPP may be TCEQ employees, cooperators, or external contractors. Agency organizations and staff and external contractors are bound by the requirements delineated in the TCEQ QMP. TCEQ training records are maintained according to TCEQ agency policy. Contractor training records are maintained by their respective employers and are available for review.

Position descriptions for key personnel detail major responsibilities and qualifications for TCEQ staff and external contractors. The network maintains quality assurance project plans for data collection activities for water quality monitoring, as well as Standard Operating Procedures for the use of monitoring instruments and station operation.

Project “Readiness Reviews” may be conducted when a new contractor begins work or a new station is installed to ensure that personnel are competent to produce data for the network. “Technical Systems Audits” (TSAs) and “Performance Evaluation Audits” (PEAs) are periodically conducted and on an as-needed basis as described in Section C1 and in Table C2.1.

All participants in the network have been successful, ongoing contributors. Work conducted under this revision of the QAPP is similar or identical to the work performed by these participants in the past.

A12. Documents and Records

The CWQMN QAPP, project plans, SOPs, and audit reports are filed and maintained by the SWQM Central Office. Measurement data and other station information can be found on TCEQ's CWQMN webpage. Various SOP worksheet forms and certificate of analysis are filed and maintained by station operators.

Each station operator is expected to maintain records that include sufficient information to reconstruct each final reported measurement from the variables originally gathered in the measurement process. This includes, but is not limited to, information (raw data, electronic files, and/or hard copy printouts) related to measurement instrument calibration, QC checks of sampling or measurement equipment, "as collected" measurement values, an audit trail for any modifications made to the "as collected" measurement values and traceability documentation for reference standards.

Difficulties encountered by TCEQ staff or cooperators during sampling or analyses are documented in operator logs to clearly indicate the affected measurements. Any issues encountered by contractors are documented in the monthly progress reports (MPR). MPRs are described in Section C2.3.

TCEQ has contracted with USGS to provide stream discharge and water quality measurement data at stations on the Upper Rio Grande, Pecos River, Arroyo Colorado, Devils River, and Lower Rio Grande basins. See Tables A4.1 and A4.4 for USGS station locations and parameters and Section A4.4 for the locations of USGS Guidelines and Procedures. USGS Oklahoma-Texas Water Science Center QAPPs are also listed in Section A4.4.

A12.1. Documentation of Procedures and Objectives

1. Published guidance (Code of Federal Regulations).
2. CWQMN Project Plans.
3. Project/instrument specific SOPs.
4. Instrument manufacturer's user manuals.
5. TCEQ QMP, SOPs, and the CWQMN Quality Assurance Project Plan.
6. TCEQ SWQM Procedures, Volume 1.
7. United States Geological Survey: *Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Station Operation, Record Computation, and Data Reporting TM1D3.*
8. USGS/TCEQ: *Adaptation of Data Validation and Fouling Correction Procedures for Water-Quality Monitoring Stations on the Upper Rio Grande and Pecos River* (May 2013), Rev.4.

A12.2. Record Keeping

The documents and records that describe, specify, report, or certify activities are listed in Table A12.1. All documents or records may be retained in either hard copy or electronic form. CWQMN written records are kept for five years. Electronic records are kept indefinitely or for the life of a project. Please see Table A12.1 for type of record and location.

Table A12.1. CWQMN Record Location

Record	Location
QAPPs, amendments and annual certifications	SWQM Central Office
Station Summary Information	TCEQ Website
Project/Instrument-specific SOP worksheet forms	TCEQ Regional offices/Cooperators/Contractors
Certificate of Analysis for pH and Conductivity standards	TCEQ Regional offices/Cooperators
Multiprobe sensor component replacement and multiprobe repairs records for TCEQ non-EMRS stations	TCEQ Regional offices/Cooperators[1]
Calibration records	TCEQ Regional offices/Cooperators/Contractors
TCEQ DAS electronic Operator logs and Validator logs	TCEQ DAS
Validator notes and Validator Worksheet	TCEQ DAS/WDMA Office[2]
Post Deployment Worksheets (Excel Workbooks)	WDMA Office
Monthly Progress Reports	SWQM Central Office
Data completeness reports	SWQM Central Office
CWQMN Project Plans	SWQM Central Office
TCEQ Standard Operating Procedures	SWQM Central Office[3]
Field staff training records	TCEQ Regional offices/Cooperators/Contractors
Technical systems, performance evaluation audits, and readiness reviews	SWQM Central Office

[1]Multiprobe replacement and repair records are kept by TCEQ Regional Office staff and cooperators in the Instrument-specific logbook. Notes regarding replacement and repair may also be kept in the comment section of the PDW.

[2] Validator notes are logged in the DAS and a copy of these notes is kept in the Validator Worksheet. See section D1.3 for more information.

[3]Locations of contractor SOPs are documented in Table A4.6.

WDMA = Water Data Management and Analysis Team

SWQM = Surface Water Quality Monitoring Team

Station summary information for TCEQ operated and co-operated stations is provided on the TCEQ website and includes station location and coordinates, station status (active or deactivated), date of activation, current parameters, historical parameters, and station operator (if station is active). Station summary information for USGS operated CWQMN stations can be found on the USGS NWIS website for that station. The TCEQ website provides links the USGS NWIS webpages for USGS operated CWQMN stations.

A12.3. Data Reporting

CWQMN environmental data, for all stations except the Arroyo Colorado, is stored electronically in the TCEQ DAS. Selected validated CWQMN data may be loaded into the SWQMIS database. See Section B7 and Section D1 for more details.

Vertical profile data from the Arroyo Colorado are not delivered to the TCEQ DAS. Data are stored in the USGS NWIS database and displayed on the USGS NWIS website. See Sections B2.1 and B7.2 for more information.

A12.4. Documentation Control Plan

This section describes the procedure and responsibilities for document control used by the TCEQ CWQMN Project for environmental sample collection and analysis. The current QAPP revision[7] is available on the TCEQ website. It is the responsibility of each CWQMN participant to ensure they are properly following the current QAPP revision. Project Plans are available upon request.

All TCEQ CWQMN SOPs (see Table A4.5) must have a document title, a revision number and an effective date. SOPs are formally reviewed on an as needed basis. SOPs stay in effect until superseded by a later version or the project is completed. It is the responsibility of the CWQMN QC Officer to distribute new and revised SOPs to the applicable TCEQ CWQMN participants. Participants are encouraged to contact the CWQMN QC Officer at swqm@tceq.texas.gov if they are unsure what SOP or SOP Revision is in effect. It is the responsibility of TCEQ CWQMN participants to ensure they are properly following the most current SOP revision.

Standard Operating Procedure Approval Signatures

In addition to TCEQ Monitoring and Assessment managers, TCEQ regional managers may also sign SOPs when their staff perform work under the SOPs. SOPs that are specific to a station/project may also be signed by cooperators who are performing the work. At a minimum the CWQMN QC Officer signs all SOPs.

[7] www.tceq.texas.gov/waterquality/monitoring/swqm_realtime.html

Handwritten Documents

Indelible ink will be used for all hand-written documents. Changes made to hand-written documents must be done by using a single line to strike-out the text. The changes are then initialed and dated.

B1. Identification of Project Environmental Information Operations

B1.1. Network Design/Siting Rationale

The CWQMN measurement stations and parameters are outlined in Tables A4.1 – A4.4.

B1.2. CWQMN Station Proposals

TCEQ continues to improve the CWQMN and accepts suggestions for new CWQMN stations. Interested parties may download the CWQMN Proposal Form[8], complete it and submit it to swqm@tceq.texas.gov. Proposals will be evaluated by a TCEQ panel familiar with the project river basin. TCEQ will consider the data need and expected use, the availability of instruments to monitor the water quality parameter of concern, and the availability of TCEQ and/or in-kind resources for deployment, operation, maintenance, and/or data validation when evaluating project proposals. TCEQ will evaluate each proposal submitted and may, or may not, develop and deploy the proposed project.

United States Geological Survey Stations

TCEQ has contracted with USGS to provide stream discharge and water quality measurement data at stations on the Upper Rio Grande, Pecos River, Arroyo Colorado, Devils River, and Lower Rio Grande basins. See Tables A4.1 and A4.4 for USGS station locations and parameters and Section A4.4 for the locations of USGS Guidelines and Procedures. USGS Oklahoma-Texas Water Science Center QAPPs are also listed in Section A4.4.

[8] www.tceq.texas.gov/waterquality/monitoring/cwqm_project_proposal.html

B2. Methods for Environmental Information Acquisition

Continuous monitoring multiprobe sensors measure water quality *in situ*. Table B2.1 lists equipment, sampling method, and telemetry methods for each CWQMN station. Table B2.2 lists the analytical methods associated with the equipment used and parameters collected.

B2.1. TCEQ Multiprobe Monitoring Methods and Equipment

Discrete multiprobe in-situ water quality and sample depth measurements are logged once every fifteen (15) minutes by a data logger. The data are transmitted via wireless modem to the TCEQ DAS in Austin, Texas, where the data are ingested and archived. Data are then posted to the appropriate TCEQ internet site.

Support equipment is usually installed in a weather-tight aluminum “Traffic Box” containing a data logger, wireless cellular modem, deep cycle battery, and a solar charge controller. Solar panels are installed for battery charging purposes. If wireless cellular service is available at the monitoring station, a wireless modem is used to transmit data to TCEQ. In remote areas, equipment can be installed that will relay data using the Geostationary Operational Environmental Satellite (GOES) system. Table B2.1 describes equipment, sampling method, and telemetry method for specific CWQMN stations.

Station multiprobes are typically deployed at a fixed position in the water column using poly vinyl chloride (PVC) deployment tubes that are attached to support structures. PVC deployment tubes have at least 48 evenly spaced 1-inch diameter holes per linear foot for at least the lower two feet of the deployment tube to allow water to flow across the sensors.

TCEQ Surface Water Quality Procedures, Volume 1, prescribes collecting multiprobe data at a location that is representative of the water body in the centroid of flow and within the mixed surface layer at 0.3 meters of depth. Depending on the monitoring location, it may not be possible to locate deployment tubes in or near the centroid of flow.

Deployment tubes are typically positioned to collect data during low water levels. As a result, data can be collected at depths greater than 0.3 meters during higher water levels. In general, (for nontidal streams) flowing waters remain mixed and unstratified.

When buoys or other floatation devices are used to deploy multiprobes at stations with variable water levels, the optimal depth to collect data is approximately 0.3 meters and within the mixed surface layer.

Bosque River SC EMRS Station Deployment and Sampling

Multiprobes are deployed in dry rainfall-dependent creek channels. During rainfall run-off events, water quality is measured *in-situ.* When no water is present, measurements are collected from dry creek channels.

USGS Operated Multiprobe Stations

In-situ water quality measurements are logged once every fifteen (15) minutes by the data logger. The data are transmitted via wireless modem or GOES telemetry to the USGS National Water Information System (NWIS), and then delivered to the TCEQ DAS in Austin, Texas, where the discrete data are stored. Data are displayed on the external TCEQ webpages and on an external USGS web display (NWISWeb).

Vertical profile data from the Arroyo Colorado are not delivered to the TCEQ DAS. Data are averaged into one-hour averages and displayed on an external USGS web display (NWISWeb). See Section B7.2 for more details.

USGS Stage and Discharge Measurements

For stream discharge, USGS hydrographers develop and maintain a stage to discharge rating. A “Look-up Table” is developed for each station, this table is used to provide discharge values for a given stage measurement. Stream discharge data is periodically uploaded from USGS to the TCEQ DAS.

Stage and water quality measurements are logged once every fifteen (15) minutes by the data logger. The data are then transmitted to the TCEQ DAS in Austin, Texas, where the data are stored. Data are averaged into one-hour averages and displayed on the external TCEQ webpages and on the NWISWeb.

Limitations and Performance Criteria

See Section A6 for performance criteria for the network.

Table B2.1. Monitoring Methods and Equipment

CAMS	Station Location	Measurement Method	Measurement Equipment	Telemetry	Station Parameters
759	Rio Grande at Fosters Ranch upstream of Amistad Reservoir	Multiprobe: *In situ*	*In Situ* Aqua TROLL 500	GOES	Surface Water Temperature
757	Rio Grande upstream of the confluence of Rio Conchos near Presidio, Texas				SC DO
758	Rio Grande downstream of the confluence of Rio Conchos near Presidio, Texas				pH
803	Rio Grande River at Santa Elena Canyon, Big Bend National Park				
721	Rio Grande River at Rio Grande Village, Big Bend National Park	Multiprobe: *In-situ*, swing-pipe installation Bubbler	*In Situ* Aqua TROLL 500 Compact Constant Flow Bubbler		Surface Water Temperature SC DO pH Gage Height, Discharge
720	Rio Grande at Castolon, Texas, Big Bend National Park	Bubbler	Compact Constant Flow Bubbler		Gage Height, Discharge
788	Pecos River near Red Bluff New Mexico	Multiprobe: *In situ*	YSI 6920		Surface Water Temperature SC
798	Pecos River near Orla, Texas	Multiprobe: *In situ*	YSI 6920		Surface Water Temperature
709	Pecos River at FM 1776 near Coyanosa, Texas				SC/TDS DO[1]
785	Pecos River near Girvin upstream of US 67/385	Bubbler	Compact Constant Flow Bubbler		CAMS 709, 729, and 807: Gage Height, Discharge (Low Range)
807	Pecos River near Pecos, Texas, at FM 3398				
729	Pecos River near the Terrel/Val Verde/ Crocket County lines				
799	Lower Pecos at IBWC discharge monitoring location near Langrty, Texas				

CAMS	Station Location	Measurement Method	Measurement Equipment	Telemetry	Station Parameters
735	Pecos River near US Hwy 290 Southeast of Sheffield, Texas	Multiprobe: *In situ* Bubbler	YSI 6920 Compact Constant Flow Bubbler	GOES	Surface Water Temperature SC/TDS DO CAMS 735: Gage Height, Discharge (Low Range)
730	Arroyo Colorado Tidal at Rio Hondo FM 106 Bridge	Multiprobe: *In situ* OTT Vented Pressure Transducer	EXO 3	GOES and Wireless Modem	Vertical Profile Water Temperature DO SC Gage Height
809	Devil's River at Baker's Crossing SH163	Multiprobe: *In situ*	*In Situ* Aqua TROLL 500	GOES	Surface Water Temperature SC/TDS DO pH
767	Rio Grande at Roma, Texas	Multiprobe: *In situ*	*In Situ* Aqua TROLL 500	Wireless Modem	Surface Water Temperature SC/TDS
796	Rio Grande downstream of Arroyo Los Olmos				
789	Rio Grande ~3.45 miles upstream of the of the bridge at County Rd. 409 (Harlingen Irrigation DST #1)			GOES	
791	Rio Grande ~2.7 miles upstream of the confluence with El Morillo Drain (United Irrigation DST)			Wireless Modem	
792	Rio Grande ~2.5 miles downstream of the confluence of El Morillo Drain (Hidalgo County Irrigation DST#18)				
793	Rio Grande ~5.0 miles downstream of FM 1015 (Hidalgo County and Cameron County Irrigation District #9)				
736	Rio Grande (Anzalduas Dam) near Pier 7			GOES	

CAMS	Station Location	Measurement Method	Measurement Equipment	Telemetry	Station Parameters
764	Independence Creek at Caroline Springs (T-5) on the Nature Conservancy's Independence Creek Preserve south of Sheffield, Texas	Multiprobe: *In situ*	YSI 6920	GOES	Surface Water Temperature SC
808	San Solomon Springs southern discharge canal at Balmorhea State Park in Toyahvale, Texas	Multiprobe: *In situ*	In Situ Aqua TROLL 500	Wireless Modem	Surface Water Temperature SC pH
804	Tributary of Upper Green Creek near the intersection of CR385 and 382	Multiprobe: *In situ* *Multiprobes located in dry rainfall-dependent creek channels*	In-Situ Aqua TROLL 200	Wireless Modem	SC Temperature
765	Un-Named Tributary of Little Duffau Creek near FM 1824				
805	Indian Creek just east of U.S. Hwy 281				
728	Little Duffau Creek near FM 1824				
726	Scarborough Creek at CR 423				
749	Pine Island Bayou at Lower Neches Valley Authority Pump Station near U.S. Hwy 69	Multiprobe: *In situ*	YSI EXO 3		Surface Water Temperature SC/TDS DO pH Turbidity Sample Depth
802	Menard (Noyes) Irrigation Canal near Menard, Texas	Bubbler	Compact Constant Flow Bubbler	GOES	Gage Height, Discharge (Low Range)

[1] Due to frequent dry conditions, DO data is not collected at station 807.

CAMS = Continuous Ambient Monitoring Station

DA = design analysis

DO = dissolved oxygen

GOES = Geostationary Operational Environmental Satellite

SC = specific conductance

TDS = Total Dissolved Solids. TDS is calculated from SC using TCEQ's correction factor of 0.65.

USGS = United States Geological survey

YSI = Yellow Springs Instrument

B2.2. Analytical Methods

Water quality measurement methods used by the CWQMN are based on the *Standard Methods for the Examination of Water and Wastewater*, 20th Edition, 1998, unless otherwise noted.

Section A6 summarizes and lists procedures and quality objectives for the various CWQMN projects/CAMSs. CWQMN measurement equipment and analytical methods are listed in Tables B2.2 and B2.3.

Analytical system corrective actions are addressed in Section B2.5 and Section C1 of this quality assurance project plan.

For stations following TCEQ procedures, instrument and project-specific analytical SOPs are used to document procedures necessary to perform the method and to operate a specific instrument.

TCEQ has contracted with USGS to provide stream discharge and water quality measurement data at stations on the Upper Rio Grande, Pecos River, Arroyo Colorado, Devils River, and Lower Rio Grande basins. See Tables A4.1 and A4.4 for USGS station locations and parameters and Section A4.4 for the locations of USGS Guidelines and Procedures. USGS Oklahoma-Texas Water Science Center QAPPs are also listed in Section A4.4.

TCEQ and USGS use water quality measurement methods found in Table B2.2.

Table B2.2. CWQMN Multiprobe Analytical Methods

Parameter	TCEQ DAS Parameter Code	Units	Measurement Equipment	Method
pH	10400	pH/units	YSI 6-Series YSI EXO In-Situ Aqua TROLL 500	Glass electrode, Standard Method 4500-H+B
DO[1,2]	10300	mg/L	YSI 6-Series YSI EXO In-Situ Aqua TROLL 500	Optical (luminescence quenching) ASTM D888-05
SC[4]	10095	µS/cm	YSI 6-Series YSI EXO In-Situ Aqua TROLL 200 In-Situ Aqua TROLL 500	Conductivity cell, Standard Method 2510B
Turbidity[1]	10104	NTU[3]	YSI EXO	Method number ISO 7027
Temperature	10010	ºC	Thermistor	Standard Method 2550 B
Sample Depth	10078	Feet	YSI EXO In-Situ Aqua TROLL 200	Pressure Transducer

Parameter	TCEQ DAS Parameter Code	Units	Measurement Equipment	Method
TDS	10294	mg/L	YSI 6-Series YSI EXO In-Situ Aqua TROLL 200 In-Situ Aqua TROLL 500	Calculated by TCEQ DAS. SC measurements are multiplied by TCEQ's Statewide conversion factor 0.65

[1]Method not based on Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998. U. S

[2]EPA Region 6 has approved Optical DO methods for use in the CWQMN.

[3]TCEQ DAS reports turbidity measurements in NTUs. USGS reports FNU (parameter code 63680) and TCEQ will recode the unit values as NTU (TCEQ DAS parameter code 10104) in order to populate the TCEQ DAS database until an appropriate Surface Water Quality Monitoring Information System (SWQMIS)/EPA Storage and Retrieval Database (STORET) code can be identified.

[4]Modern conductivity sensors utilize auto-ranging sensors.

°C = degrees centigrade

mg/L = milligrams per liter

µS/cm = micro siemens per centimeter

ASTM = American Society for Testing and Materials

DAS = Data Acquisition System

DO = dissolved oxygen

FNU = Formazin Nephelometric Units

ISO = International Organization for Standardization

NTU = Nephelometric Turbidity Unit

TDS = total dissolved solids

YSI = Yellow Springs Instrument

B2.3. Sample Depth Measurement Methods

YSI multiprobes utilize absolute (unvented) pressure sensors to measure sample depth. Aqua TROLL 200 multiprobes utilize gauged (vented) pressure sensors. Vented sensors correct sample depth measurements for changes in barometric pressure.

Table B2.3. Water Level and Sample Depth Analytical Methods

Instrument/Parameter	TCEQ DAS Parameter Code	Units	Range	Method
(YSI EXO Multiprobes) Sample Depth	10078	Meter	Various	Absolute (unvented) Pressure Transducer
(Aqua TROLL 200)- Sample Depth	10078	Meter	Various	Gauged (vented) Pressure Transducer

B2.4. CWQMN Turbidity Method

Pine Island CAMS 749 turbidity measurement methods are not based on *Standard Methods for the Examination of Water and Wastewater*, 20th Edition, 1998. Currently, the CWQMN utilizes ISO Method 7027 for turbidity. The turbidity data generated by

ISO Method 7027 are not appropriate for regulatory purposes. A variety of measurement techniques can be used to measure turbidity. Data from differing instrumentation and sample matrixes can be highly variable. The only approved EPA method for turbidity is EPA Method 180.1. EPA Method 180.1 utilizes a white or broadband light source. Data produced by Method 180.1 are reported as NTU and is a laboratory method.

ISO Method 7027 turbidity measurements are made using near-infrared (780 – 900 nanometers) or monochrome light source with single-detector nephelometry at a 90-degree angle making it compliant with ISO Method 7027. Formazin Nephelometric Units (FNU) are the designated measurement units for data collected using this ISO method. The CWQMN uses NTUs to report turbidity data collected by the ISO Method 7027 until the appropriate SWQMIS/Parameter code can be identified. All CWQMN turbidity data stored in TCEQ DAS is coded as NTU. When the appropriate parameter code is identified, the parameter code will be updated for all CWQMN turbidity data.

B2.5. Sampling/Measurement System Corrective Action

Corrective action measures in the CWQMN will be taken to ensure the DQOs are attained. The station operator is responsible for monitoring the performance of the measurement and support equipment and identifying problems or potential problems.

It is expected that any individual in the CWQMN who discovers a problem will initiate corrective action appropriate to the situation. Corrective action is accomplished at the lowest level and shall be documented in the TCEQ DAS operator log for TCEQ operated stations and in the MPRs for USGS operated stations. The QC Officer and Network Coordinator must be notified of any proposed corrective action that can affect data quality and/or CWQMN protocols. When problems are identified that cannot be resolved by the station operator, the station operator notifies the Network Coordinator. The Network Coordinator is responsible for coordination with appropriate personnel to resolve the problems.

The Network Coordinator and the CWQMN QC officer are responsible for coordinating the necessary supply and parts shipments to the station operator. When necessary, personnel from MD travel to a particular station to repair or replace support equipment that cannot be repaired or replaced by the station operators. Monitoring equipment that cannot be repaired by TCEQ staff is sent back to the manufacturer if within the equipment's warranty period; if not, the equipment is sent to a qualified vendor for repair. If monitoring equipment cannot be repaired or if it is not economical to repair a piece of equipment, it may be surplused.

Some CWQMN stations are in or near flood plains. Consequently, various CWQMN stations have the potential to be damaged or destroyed by flood waters during severe floods. Potential flooding is a consideration in the station development process. Additionally, multiprobes, sampling and/or support equipment are located in stream beds and are subject to frequent flooding. These components are secured to the

stream banks and have proved capable of surviving a given flood. However, it is accepted that the support systems and components will need periodic replacement and repair.

B2.6. Existing Information

Continuous water quality and flow data are obtained from USGS gauge station 08181800 (San Antonio River near Elmendorf, Texas). This data is collected by USGS in cooperation with San Antonio Water System and CPS Energy. These data are permanently stored in the USGS NWIS database and are also hosted by TCEQ in the DAS. Data inclusion in the TCEQ DAS was originally requested by the TCEQ Region 13 San Antonio Office to be used to monitor ambient conditions on the Upper San Antonio River (Segment 1911). The data for USGS gauge station 08181800 (San Antonio River near Elmendorf, Texas) is logged in the TCEQ DAS under CAMS 715. Data is transferred to the DAS from NWIS on an hourly basis with an automated script. This data is then sent to a file transfer protocol (FTP) site where it is received by TCEQ and ingested into the DAS database. The parameters logged in the DAS for CAMS 715 include: water temperature, flow rate, gage height, specific conductance, dissolved oxygen, and pH. Data collected with USGS guidelines and procedures under the USGS quality management system meet the quality requirements of this project.

B3. Integrity of Environmental Information

See Section B7 for electronic managing of CWQMN data. Water quality is measured *in situ* with multiprobe instrumentation.

B4. Quality Control (QC)

Quality control includes technical activities that measure the attributes and performance of the sampling and analysis process against defined standards to verify that they meet the needs of the project. Data quality is measured, assessed, and controlled according to procedures and criteria in TCEQ instrument/project-specific SOPs. Audits can also be used to assess data quality.

Project/station-defined quality objectives are specified in Section A6.

TCEQ has contracted with USGS to provide stream discharge and water quality measurement data at stations on the Upper Rio Grande, Pecos River, Arroyo Colorado, Devils River, and Lower Rio Grande basins. The USGS TM1D3 describes QC measures used at USGS operated CWQMN stations including sensor fouling corrections, calibration drift corrections, maximum allowable limits for sensors, National Institute of Standards and Technology (NIST) thermometer checks for temperature sensors, and other correction measures. See Tables A4.1 and A4.4 for USGS station locations and parameters. See Section A4.4 for the locations of USGS Guidelines, Procedures, and USGS Oklahoma-Texas Water Science Center QAPPs.

B4.1. TCEQ-Operated Station Multiprobe QC

Section B4.1 is intended to summarize TCEQ CWQMN QC activities. For complete details, see TCEQ SOPs.

TCEQ-operated stations include EMRS and non-EMRS stations. Data from EMRS stations are used on a near-real time basis to screen water quality for a variety of purposes. Non-EMRS station data records are validated using results from QC measurements. See Table B4.1.1 for CAMS designations and TCEQ SOPs followed at each station.

Table B4.1.1. TCEQ-Operated CAMS Designations and SOPs

CAMS	Station Designation	Multiprobe Instrument	SOP
749	Non-EMRS	YSI EXO	Analysis of *In Situ* Dissolved Oxygen, Specific Conductance, pH, Water Temperature, and Sample Depth in Ambient Surface Water Using Yellow Springs Instrument EXO Multiprobes, Rev.1
808	Non-EMRS	Aqua TROLL 500	Analysis of In Situ Specific Conductance, Water Temperature, and pH for the San Solomon Springs Continuous Water Quality Monitoring (CWQM) Site Using Aqua TROLL 500 Multiprobes, Rev.0
726, 728, 765, 804, 805	EMRS	Aqua TROLL 200	TCEQ – Analysis of In-Situ Specific Conductance, Water Temperature, and Sample Depth for the Bosque River Environmental Monitoring Response System Using Aqua TROLL 200 Multiprobes, Rev.2

CAMS	Station Designation	Multiprobe Instrument	SOP
749	EMRS	YSI EXO	Analysis of *In-Situ* Turbidity in Ambient Surface Water at Pine Island Bayou for the Environmental Monitoring Response System using YSI EXO Multiprobes, Rev.0

CAMS = Continuous Ambient Monitoring Station
EMRS = Environmental Monitoring Response system
YSI = Yellow Springs Instrument

Non-EMRS Multiprobe Quality Control

Quality control measurements consists of measuring sensor fouling and calibration drift. Temperature sensors are checked with NIST-traceable thermistors at the conclusion of deployments. Sensor fouling is measured using USGS-based procedures. Fouling measurements are estimates of environmental effects on sensor performance. Results from these QC checks are used to validate station data records over the course of the multiprobe deployment periods.

Multiprobe Sensor Fouling and Drift

The USGS-based fouling measurement procedures are designed to measure the potential combined effects of various forms of sensor and deployment tube fouling on sensor performance. The procedure measures and compares the responses of uncleaned and cleaned sensors and deployment tubes in the water body at the conclusion of deployment periods. Sensor drift is also measured at the conclusion of deployments using standards.

Total Error Multiprobe Fouling and Drift

The sum (Total Error) and individual fouling and drift measurements are compared against project quality objectives.

1. Total error (*T)* for DO, pH, and conductivity is expressed as the sum of fouling (*F*) and calibration drift (C_d).

$$T = F + C_d$$

Where:

F = fouling; and

C_d= calibration drift.

2. Change in water quality (C_w) during the fouling measurement procedure (for DO, pH, SC, and temperature) is determined by the field meter.

$$C_w = F_i - F_f$$

Where:

F_i = field meter response initial; and

F_f = field meter response final.

As part of the fouling measurement procedure, an additional multiprobe/field meter is deployed at the same location as the deployed multiprobe. Field meter measurements are made at the beginning and at the conclusion of the procedure. Field meter measurements are used to correct fouling measurements for any changes in water quality that have occurred during the fouling measurement procedure.

Fouling measurement procedures are intended for use in situations when water quality conditions are not considered rapidly changing or fluctuating. USGS defines (*TM1D3*) rapidly changing for DO, EC, pH and temperature as follows: "*Rapid change is relative to the length of time needed to service the monitor and generally is defined as a change that exceeds the [USGS] calibration criteria within 5 minutes."* If changes in water quality exceed criteria found in Table B4.1.2 for a given parameter(s), the fouling measurement is not considered valid and the corresponding data are invalidated. This is general criteria and station-specific change in water quality criteria can be developed.

Table B4.1.2. USGS Change in Water Quality Criteria

Parameter	USGS Criteria
SC	±5 µS/cm or 3% use greatest value
DO	±0.3 mg/l
pH	±0.2 pH units

3. Multiprobe conductivity sensor fouling (*F*) is evaluated by using Relative Percent Error (RPE) to compare not cleaned and cleaned conductivity sensor responses:

$$F = \left(\frac{\left(S_i - S_f\right) - \left(F_i - F_f\right)}{S_f} \right) 100$$

Where:

S_i = sensor response initial (not cleaned);

S_f = sensor response final (cleaned);

F_i = field meter response initial; and

F_f = field meter response final.

4. Multiprobe, DO (mg/l), pH (SU), and temperature (ºC) sensor fouling (*F*) is evaluated by using Absolute Error (AE) to compare not cleaned and cleaned sensor responses:

$$F = \left(S_i - S_f\right) - \left(F_i - F_f\right)$$

Where:

S_i = sensor response initial (not cleaned);

S_f = sensor response final (cleaned);

F_i = field meter response initial; and

F_f = field meter response final.

Temperature sensor fouling measurements are collected for informational purposes. Temperature sensors are not typically affected by fouling unless an extreme fouling event has occurred that has plugged sensors and deployment tubes with sediment. When this occurs, all collected data (DO, SC, pH, and Temperature) are invalidated back to the last service event.

Sensor Calibration Drift

Multiprobe sensor calibrations are assessed at the conclusion of deployment periods using Calibration Verification Samples (CVS). The CVS is prepared from the same standard used to generate the initial calibration curve.

5. Multiprobe conductivity sensor calibration drift (C_d) is evaluated using RPE:

$$C_d = \frac{(S_r - S_v)}{S_v}(100)$$

Where:

S_r= sensor response; and

S_v = specific conductance KCl standard value.

6. DO and pH calibration drift (C_d) is evaluated using AE:

$$C_d = (S_r - S_v)$$

Where:

S_r = DO or pH sensor response; and

S_v = DO mg/l theoretical value; pH buffer standard value

Known Multiprobe Fouling Measurement Limitations

- Fluctuating water quality or unstable sensors can cause fouling measurement errors. When performing the procedure, multiprobe sensor measurements must not be fluctuating due to changes in water quality or sensor instability. Measurement stability criteria have not been developed.
- In some streams, scouring events can clean sensor interfaces and deployment tubes prior to performing the fouling measurement procedure; this can result in the measurement not being representative of the entire deployment period.

- At some locations (and/or times of year) there is not enough stream flow to disperse biological and/or sediment debris clouds that can result from deployment tube cleaning activities. The debris can cause changes in water quality that are not representative of stream conditions and can skew Sensor Response Final (S_f) and Field Meter Final (F_f) measurements. Debris clouds can also cause water quality measurements to fluctuate. Consequently, during low or no stream flow, station operators at some stations are allowing significant amounts of time to elapse for debris clouds to disperse before S_f and F_f measurements are recorded. Due to extended time allowed, changes in water quality can exceed Table B4.1.2 criteria as measured by the field meter.
- Fouling measurement procedures compare the responses of uncleaned and cleaned sensors in the water body. The effectiveness of sensor cleaning activities is not assessed quantitatively.

EMRS Quality Control

EMRS multiprobe data are used on a near real-time basis. Data records for these stations are not validated. For high quality data, sensors and deployment tubes must be kept free of fouling through multiprobe and deployment tube cleanings.

Bosque River (CAMS 726, 728, 765, 804, and 805) and Pine Island (CAMS 749)

Multiprobe exchanges occur at a minimum of once a month. Quality Control consists of monthly SC sensor calibrations, measuring sensor calibration drift, and checking temperature sensors. These checks are conducted to ensure the multiprobes are operating within limits.

Multiprobe Temperature Checks for TCEQ-Operated Stations

After every deployment period (EMRS and non-EMRS stations), multiprobe temperature sensors are checked in the laboratory against NIST-traceable thermistors. The criterion for this check is ±0.50 ºC. For non-EMRS stations, when a multiprobe fails this check, temperature, DO, and SC data collected during the deployment are invalidated. Calculated TDS concentrations are also invalidated.

Multiprobe Deployment Tube Cleaning

A variety of organisms and sediment can foul multiprobe deployment tubes. Deployment tube fouling can compromise data quality. Every multiprobe deployment tube in the network must be cleaned with a chimney brush as part of every routine service event. Bosque River EMRS stations do not utilize deployment tubes. Multiprobes are secured to stream beds by various means.

Multiprobe Anti-Fouling Measures

Multiprobes can be equipped with various anti-fouling measures. Anti-fouling measures can improve data quality and increase deployment periods. USGS-based fouling measurement procedures can be useful in evaluating the various anti-fouling measures. YSI EXO 2, YSI EXO 3, and Aqua TROLL 500 multiprobes are equipped with a central wiper that brushes sensors prior to each measurement. Wiper brushes must be cleaned or replaced prior to each deployment period.

Multiprobe Sample Depth Measurements

CWQMN sample depth measurements are used qualitatively. Data from these measurements are not assessed for accuracy.

Station Monitoring

Every business day, all CWQMN station operators must monitor and screen water quality measurements, sample depth measurements, and station communications for anomalies. If problems are identified, a station visit may be needed to correct any problems.

B4.2. Corrective Action Related to QC

Any deviation from the procedures documented in the SOP should be documented in the operators log by the station operator. The log entry should contain a description of the exception, the cause (if possible), the affected data, and the impact on the data record. Any deviations which have an impact on data quality will be communicated to the WDMA data validator, the CWQMN QC Officer and the CWQMN Network Coordinator. Any affected data will be qualified by a data validator accordingly.

Note: A failing QC sample can be followed by a single replicate analysis to determine if there is a systematic problem. If the replicate analysis meets all acceptance criteria, then the system may be deemed as providing acceptable data. Conducting multiple analyses, however, to obtain a single passing QC sample when no corrective action as a result of an assignable cause or instrument maintenance is performed is not acceptable. If either the original QC sample or its rerun passes, then the failing QC analysis is considered an anomaly, and its results are not used for data assessment. Best professional judgment is needed at times to determine if the QC sample is representative of ambient measurements. QC sample anomalies should be documented.

B5. Instrument/Equipment Calibration, Testing, Inspection and Maintenance

Instruments and equipment for specific projects included in the *CWQMN QAPP* may be funded by any combination of federal funds (Clean Water Act Sec 106 or other federal grants) and/or nonfederal funds (state and local funds).

Multiprobe maintenance activities are documented in equipment dedicated logbooks or electronically in the comment section of the Post Deployment Excel Worksheets. This requirement only applies to TCEQ non-EMRS stations. Records must include multiprobe repair information, sensor component replacements, and the dates of these activities.

Other helpful information can include symptoms, troubleshooting effort descriptions, results, and follow-up observations. Records can aid future troubleshooting. TCEQ maintenance documents are based on manufacturers' recommendations.

TCEQ has contracted with USGS to provide stream discharge and water quality measurement data at stations on the Upper Rio Grande, Pecos River, Arroyo Colorado, Devils River, and Lower Rio Grande basins. Multiprobe maintenance activities are documented according to USGS guidelines and procedures. See Tables A4.1 and A4.4 for USGS station locations and parameters. See Section A4.4 for the locations of USGS Guidelines, Procedures, and USGS Oklahoma-Texas Water Science Center QAPPs.

B5.1. Multiprobes

Manufacturers user manuals are used as guidance for maintenance activities.

Multiprobe Optical DO Membranes (YSI)

The manufacturer recommends replacing optical DO membranes on an annual basis. Among the reasons for replacing membranes provided by the manufacturer is degradation of the luminescence dye in the sensing element due to photo-bleaching and membrane age. According to the manufacturer, as the membranes age, they lose accuracy at the low-end first. The low-end was defined as less than 1.0 mg/l.

Optical DO calibration adjustments are automatically tracked through changes in sensor gain. The manufacturer recommends DO calibrations be rejected and the sensor not be used to collect data when a calibration causes the gain to exceed acceptance criteria. When a sensor exceeds gain criteria, the problem can be associated with membrane or other sensor components.

Optical DO membranes are coated with a black material to keep ambient light from causing sensor measurement interferences. In abrasive stream environments, DO wiper pads can trap abrasive particles and damage membrane coatings. If coatings are scratched off by more than 25%, the membrane must be replaced.

The current TCEQ policy is to routinely replace optical DO membranes every twelve months. The date the membrane is installed on the DO sensor is considered the

starting date for the twelve-month replacement frequency. After DO membrane installations, DO membrane calibration code certificates must be retained by station operators so they are readily available for TSA assessments to ensure coefficients matching the membranes certificates were programmed to project DO sensors. See the TCEQ *Analysis of In Situ Dissolved Oxygen, Specific Conductance, pH, Water Temperature, and Sample Depth in Ambient Surface Water Using YSI EXO Multiprobes* SOP for membrane replacement and documentation instructions.

B5.2. Standards

Calibration and CVSs shall be NIST traceable standards. All CWQMN multiprobe conductivity and pH standards must have a Certificate of Analysis (COA) that contains traceability and accuracy statements. Expired standards cannot be used.

Pine Island Bayou CAMS 749 Formazin Turbidity Standards

Turbidity sensors are calibrated using Hach Formazin standards and reagent grade water. Class A pipettes are used to dilute a 4000 NTU Formazin standard.

B5.3. Instrument Calibrations

Before multiprobe deployments, calibration standards are analyzed to establish instrument response. Concentrations or constituents are calculated using single point and multipoint calibration responses.

Single point or multipoint calibrations are performed whenever any of the following apply:

1. The instrument response has drifted so that the CVSs or other quality control checks do not meet established acceptance criteria.
2. Instrumentation is calibrated at routine frequencies.
3. Prior to *in situ* field deployment.

For instruments used at TCEQ operated stations, instrument calibrations will be performed in accordance with program SOPs found in Table A4.5. Calibration results will be recorded in equipment dedicated logbooks. Printable calibration forms are included in the SOPs.

B5.4. Multiprobe Temperature Sensor Checks

After every deployment period, network multiprobe temperature thermistors are checked against NIST-traceable digital thermistors; TCEQ employs single point checks using tap water in a temperature-controlled environment.

TCEQ station operators and cooperators have been issued NIST-traceable digital thermistors. These thermistors must be recertified/calibrated every two years. The stated accuracy of these thermistors is ± 0.05 ˚C. Since the checks are not conducted in

a circulated vessel of water, there can be an additional 0.05 ˚C approximate error with the method.

On an annual basis, USGS station operators use NIST-traceable thermistors to check multiprobe thermistors in a circulated water bath.

B5.5. USGS Instrument Calibration and Frequency

TCEQ has contracted with USGS to provide stream discharge and water quality measurement data at stations on the Upper Rio Grande, Pecos River, Arroyo Colorado, Devils River, and Lower Rio Grande basins. Instruments used at USGS operated stations are calibrated and calibration efforts are documented according to USGS guidelines and procedures. See Tables A4.1 and A4.4 for USGS station locations and parameters. See Section A4.4 for the locations of USGS Guidelines, Procedures, and USGS Oklahoma-Texas Water Science Center QAPPs.

All multiprobes are calibrated in a temperature-controlled environment before deployment in the field, in accordance with the procedures found in the USGS TM1D3.

B6. Inspection/Acceptance of Supplies and Services

TCEQ procures, stores, and dispenses various spare parts, equipment, consumable items, and other items for CWQMN TCEQ staff and cooperators.

TCEQ has contracted with USGS to provide stream discharge and water quality measurement data at stations on the Upper Rio Grande, Pecos River, Arroyo Colorado, Devils River, and Lower Rio Grande basins. USGS is responsible for the purchase, procurement, storage and maintenance of equipment and consumable items needed to maintain and operate these stations. See Tables A4.1 and A4.4 for USGS station locations and parameters. See Section A4.4 for the locations of USGS Guidelines, Procedures, and USGS Oklahoma-Texas Water Science Center QAPPs.

B6.1. Equipment and Spare Parts

The CWQMN Network Coordinator purchases and distributes equipment and spare parts for TCEQ stations. Consumable items such as optical DO membranes and pH sensors/cartridges, are purchased and distributed on an annual basis and as needed throughout the year. The Network Coordinator manages contracts for a vendor to repair equipment and recertify CWQMN NIST-traceable thermometers. A supply of critical items including station electronic components, multiprobes, and cables is maintained for immediate distribution. Equipment failures occurring within warranty periods are sent back to the various manufacturers for repair.

B6.2. Standards

For stations operated by TCEQ staff, SC and pH standards are purchased through the state contract system or through inter-agency contracts. For TCEQ stations that are operated by cooperators, the cooperator is typically responsible for purchasing standards.

B7. Environmental Information Management

B7.1. TCEQ Stations

Discrete water quality and sample depth measurements are logged by a data logger every fifteen (15) minutes. Near real-time data from the data loggers are automatically sent to TCEQ Headquarters' (Austin, Texas) DAS communications server via wireless telemetry. Wireless telemetry data are secured from tampering or corruption over the carrier line through an unlisted telephone number, pass code protection, and error checking protocol.

The TCEQ DAS processing program checks the data for correct date, time, sampling station number, and proper formatting of raw data fields. For water quality parameters, the DAS then calculates and stores hourly averages as engineering units.

The station operator and data validator check the operational status of the station every business day via the TCEQ website. If communication problems are detected, the station operator and/or the data validator alerts the Network Coordinator and QC Officer to initiate corrective action and coordinate with other staff as necessary. To resolve problems a station service visit may be needed.

B7.2. USGS Stations

Discrete water quality and gage height measurements from the Upper Rio Grande, Pecos River, Arroyo Colorado, Devil's River, and Lower Rio Grande stations are logged by data loggers every fifteen (15) minutes. Once every hour, near real-time data from the data loggers are relayed to the USGS NWIS database. Data are either transmitted via wireless modem or with GOES telemetry. USGS uses an automated water quality data ingest system that retrieves, formats, and scans incoming data for errors.

USGS Provisional and Approved Data Submissions to TCEQ

Two data sets are routinely delivered to TCEQ. The two data sets are "provisional" and "approved."

Near-real time provisional station data are sent to TCEQ DAS using an automated script that extracts data hourly from the USGS NWIS data base, formats it and sends the data to a file transfer protocol (FTP) site where it is received by TCEQ and ingested into the DAS database.

Site visit, instrument drift, multiprobe fouling, and calibration information are recorded in the Site Visit Mobile for Aquarius field software. The recorded field information is uploaded to the Aquarius time-series database where an Auto Correction Loader (ACL) is used to compute, view, and apply multiprobe fouling and drift corrections to the data. The data is then validated by comparing the corrected data against the raw data. If the corrected values differ from the raw recorded values

by more than the maximum allowable limits (see Table A6.1.1), then those data are invalidated. The data is then screened by the USGS site hydrographer and may be invalidated based on hydrographer knowledge of the site. Additionally, for stations in the Upper Rio Grande and Pecos Rivers, data may be invalidated for periods of time when the sonde was believed to be silted in by sediment (see Appendix G). The remaining data that passes all validation checks are flagged "approved." Throughout this process, data are transferred to USGS' National Water Information System database (NWISWeb) in near real-time.

After data approval, an R script is used to retrieve the data from NWISWeb water services. The data are formatted to meet SWQMIS database input requirements for each unique combination of site and parameter code. The approved data are delivered electronically via email, FTP, or some other medium to TCEQ.

Approved data for each state fiscal year quarter is delivered to TCEQ no later than the last day of the subsequent state fiscal year quarter. USGS reviews data on an ongoing basis. If problems with data are identified as part of this review, USGS may resubmit data to TCEQ.

TCEQ's public webpages provide links to USGS NWIS station data for the Upper Rio Grande, Pecos, Arroyo Colorado, Devil's River and Lower Rio Grande stations. The TCEQ DAS cannot ingest profiler data, so data from the Arroyo Colorado vertical profiler station (CAMS 730) is only available via the web from the USGS NWIS data base.

B7.3. SWQMIS Database

A data loader has been developed to load validated CWQMN data into the SWQMIS database for long term storage and management. Only data collected and validated under an EPA or TCEQ approved QAPP will be stored in SWQMIS. These data may be requested from the Water Data Management and Analysis (WDMA) team.

Calculated parameters such as total dissolved solids are not stored in the SWQMIS database, nor are water level and sample depth parameters.

See Table B7.1 for a complete list of CWQMN parameters that will be stored in SWQMIS and a crosswalk of parameters codes from TCEQ DAS to SWQMIS.

Table B7.1. Surface Water Quality Monitoring Information System Parameters

Parameter	TCEQ DAS Parameter Code	SWQMIS Parameter Code	Units
Temperature	10010	00010	ºC
Specific Conductance	10095	00094	µS/cm
Dissolved Oxygen	10300	00300	mg/L
pH	10400	00400	pH units

Units

mg/L = milligrams/Liter
µS/cm = micro Siemens / centimeter
°C = Degrees Centigrade

B7.4. Data Users

Data stored in the TCEQ DAS may be provided to internal users (TCEQ data analyst, etc.) by email, on a flash drive, or through TCEQ webpage reports. Other internal customers have read-only access. Public requests for CWQMN data, as well as TCEQ DAS data, are made through the WDMA team. Unvalidated data may be released to the public with disclaimers regarding the validity of the data.

B7.5. Data Reporting

Data collected in the CWQMN are internally hosted on the TCEQ DAS. Internal and external reports and summaries are compiled from data hosted on this server.

Data collected with multiprobes every fifteen (15) minutes are reported in the SWQM Daily Report in the fifteen (15) minute increment of their collection. Internal summary reports are available for all CWQMN data. Hourly data summary reports for all stations[9] are available on TCEQ webpages.

[9] www.tceq.texas.gov/waterquality/monitoring/swqm_realtime.html

C1. Assessments and Response Actions

The CWQMN Program advocates and encourages a "continuous improvement" philosophy in personnel development and work processes. Each employee is responsible for implementing and evaluating the effectiveness of quality improvement activities with which they are involved. Fostering a "no-fault" attitude to encourage the identification of opportunities for improvement so they can be brought to the forefront and addressed accordingly is recognized to be a critical factor in a continuous improvement environment. Review of process performance is done on a continuous basis. This section addresses the assessment and response actions for the CWQMN.

TCEQ has contracted with USGS to provide stream discharge and water quality measurement data at stations on the Upper Rio Grande, Pecos River, Arroyo Colorado, Devils River, and Lower Rio Grande basins. See Tables A4.1 and A4.4 for USGS station locations and parameters and Section A4.4 for the locations of USGS Guidelines and Procedures. USGS Oklahoma-Texas Water Science Center QAPPs are also listed in Section A4.4.

These documents contain information about USGS stage and discharge assessments and response actions. TCEQ does not currently have staff with required expertise to conduct assessments of stage and discharge monitoring related activities.

Based upon audit reports, the Network Coordinator, QA Officer, and QC Officer will work collaboratively on recommendations to the appropriate Manager(s) to stop work if necessary, to safeguard programmatic objectives, worker safety, public health, or environmental protection.

C1.1. CWQMN Participant-Initiated Corrective Action

A deficiency is an unauthorized deviation from the acceptable procedures or practices outlined in this QAPP, program SOPs or other applicable documents. Relevant program documents are listed in Table A4.5, Table A4.6 and Section A12.1.

Deficiencies can be identified by a variety of activities such as internal and external audits, management reviews, and staff observations. Deficiencies in the CWQMN program are often discovered during the following processes:

- Daily review of station data and station operational status performed by station operators, the CWQMN Coordinator and WDMA staff
- Data validation performed by USGS staff and WDMA staff
- Station service events performed by station operators
- Instrument calibration performed by station operators
- QC checks performed by station operators

- Review of Data Completeness Reports by the CWQMN Coordinator and CWQMN QC Officer
- Review of Monthly Progress Reports by the CWQMN Coordinator
- TSAs, PEAs or Readiness Reviews performed by the CWQMN QC Officer

It is expected that any individual in the CWQMN who discovers a problem or deficiency will initiate corrective action appropriate to the situation. Issues encountered during station service events, instrument calibration and QC checks that can be resolved by the station operator will be documented in the TCEQ DAS operator log or MPR, as appropriate. See Sections B2.5, B4.2 and C2.3 for details. The QC Officer and Network Coordinator must be notified of any proposed corrective action that can affect data quality and/or CWQMN protocols. When problems are identified that cannot be resolved by the station operator, the station operator notifies the Network Coordinator. The Network Coordinator is responsible for coordination with appropriate personnel to resolve the problems. Any deviations which have an impact on data quality will be communicated to the WDMA data validator. Any deficiencies determined to be significant conditions will be reported to the CWQMN QA Officer and a Corrective Action Plan (CAP) will be prepared.

Deficiencies discovered by USGS staff or WDMA staff during data validation will be reported to the CWQMN Network Coordinator. See Sections C2.2 and D1.2 for details. Issues detected during daily review of the station data and station operational status will first be communicated to the station operator who may be able to resolve the issue with a station service visit (see Section B7.1). If the problem persists, the station operator and/or the data validator alerts the Network Coordinator and QC Officer to initiate corrective action and coordinate with other staff as necessary.

Deficiencies identified by the CWQMN Coordinator or QC Officer during review of Data Completeness Reports or Monthly Progress Reports will be reported to the station operator and other appropriate personnel. Corrective action will be initiated by the QC Officer in coordination with the Network Coordinator and station operator.

Deficiencies discovered during TSAs, PEAs or Readiness Reviews performed by the CWQMN QC Officer will be addressed as discussed below in Sections C1.2 and C1.3.

C1.2. CWQMN Assessments

The following types of assessments are conducted under the CWQMN Program:

- Readiness reviews
- Monitoring station TSAs and PEAs
- Annual station multiprobe data completeness assessments for all stations

The program has a goal of conducting a total of two assessments each fiscal year (readiness reviews and/or monitoring station TSAs and PEAs).

Readiness Reviews

Station readiness reviews may be conducted at the beginning of a new project or when a new contractor begins work to ensure a project is a functioning correctly. Readiness reviews may also be conducted after a major change to an existing project.

Monitoring Station TSAs and PEAs

TCEQ staff conducts monitoring station TSAs/PEAs and readiness reviews for CWQMN water quality monitoring related activities.

Monitoring station TSAs/PEAs focus on project objectives, station operations, and measurement systems.

TSAs include a thorough systematic, on-site qualitative audit of station operation, equipment, training, personnel, documentation, sampling and measurement systems, QC procedures, and safety of a system. TSAs focus on conformance to procedures, if available.

PEA procedures test the ability of measurement systems to obtain acceptable results. Audit results are compared against applicable quality control acceptance criteria. Audit results are documented on forms and spreadsheets.

To help communicate the structure and approach of an upcoming audit, the auditor notifies the auditee and details the scope, participating auditors, and the expected schedule. The auditors and participants review and discuss preliminary results during a conference immediately following the conclusion of the audit. The auditor prepares a detailed audit report for each monitoring station audit.

Each audit report is individually numbered, dated, and identifies the auditor, auditee, and nonconformity (findings and observations). The audit report may suggest recommended corrective action to findings.

Data Completeness Assessments

The CWQMN has a general data completeness requirement of 75 percent data return. Data completeness is defined as data meeting QC performance criteria described in Sections A5 and B2.

Stations in the CWQMN may be located in intermittent streams. Suspension of water monitoring can occur in times of drought.

TCEQ Data completeness is calculated as follows for stream stations:

$$\% \text{ Completeness} = \frac{\text{Number of valid measurements during stream flow} * 100}{\text{Total possible measurements} - \text{Total possible measurements during no stream flow}}$$

USGS Data Completeness Reports

Quarterly, USGS provides TCEQ data completeness reports for TCEQ/USGS contract stations. The general data completeness requirement for USGS contract stations is 75 percent data return meeting quality objectives in Table A6.1.1.

USGS calculates an overall percent data return by first calculating the data return for each parameter at each station. These percentages are then averaged to give an overall percent data return for USGS operated stations.

TCEQ Data Completeness Reports

Data completeness reports for TCEQ-operated stations are submitted by Data Management and Analysis on an annual basis (end of the FY).

C1.3. Monitoring Station Audit Response Requirements

If an audit report contains negative findings, a written response to the findings is required within thirty (30) days of the issuance of the audit report. Written responses are used to track and verify the proposed corrective action initiated by the finding.

Audit report findings and observations can be categorized as program or project. Program findings/observations are typically associated with SOP/QC procedures, measurement systems, multiprobe deployments, or are process related. Project findings are typically associated with the station operator not following procedures. It is the responsibility of the Network Coordinator to respond to program findings. Responses to Project findings are the responsibility of the station operators or their management.

It is the responsibility of the CWQMN QC Officer in consultation with the CWQMN QA Officer to determine if responses to audit findings are acceptable or not. If a finding or proposed corrective action is disputed and cannot be readily resolved, the recommendation is pushed to successively higher management levels for resolution. The Network Coordinator is responsible for managing this process. Corrective actions can be verified during subsequent inspections.

Audit Finding Response Requirements

Written audit responses are required within thirty (30) days of the issuance of the audit report to address negative findings. The response to finding must describe:

1. The root cause of the finding (nonconformance).
2. The nature and extent of the finding's impact on data quality.
3. The specific corrective actions taken or planned to address the finding.
4. Actions taken or planned to prevent recurrence, and personnel responsible.
5. The timetable for completing each action.
6. The means to be used to document and verify completion and effectiveness of each action, and personnel responsible for documentation and verification.

The Network Coordinator is responsible for executing TCEQ corrective actions when findings are program related. The TCEQ station operator's management is responsible for executing TCEQ corrective actions when findings are project related.

For stations operated by a contractor, the Network Coordinator is responsible for applying applicable contractual authority to resolve corrective actions.

The Network Coordinator is responsible for documenting and verifying completion of all corrective actions.

Audit findings will remain open until an acceptable response has been received for negative findings. Audit finding responses may be submitted via email to the CWQMN QC Officer.

C2. Oversight and Reports to Management

Reports are distributed according to the TCEQ *Quality Management Plan.*

C2.1. Audit Reports

Final reports are submitted to the auditee and the various TCEQ managers who support the CWQMN, team leaders, Categorical 106 Grant Project Manager, and to the QA Officer. Audit reports and audit responses are available upon request.

C2.2. USGS Water Quality and Discharge Data

USGS must notify TCEQ CWQMN Network Coordinator in writing if any USGS collected data has been subsequently identified by USGS and/or TCEQ as not meeting USGS/TCEQ quality objectives or criteria.

Reports to TCEQ Project Management

USGS will provide TCEQ with a report providing the following information when any USGS validated data does not meet quality objectives or criteria:

- Specific data not meeting quality objectives or criteria.
- The quality objective or criteria not met.
- An explanation of impact to data.
- Corrective action

C2.3. USGS Monthly Progress Reports

USGS submits monthly progress reports to the CWQMN Network Coordinator for all USGS-operated stations. These reports document activities from the first day of the subject month to the last day of the subject month and are due on the 15th of the subsequent month. Each monthly report details each station service event, fouling and drift measurements, issues encountered and the resolution of issues.

Table C2.1. Reports to Management and Actions Taken

Report Title	Frequency	Originator	Recipient	Actions To be Taken
Monitoring station TSA and PEA or readiness reviews	A goal of a total of two assessments each fiscal year	CWQMN QC Officer	CWQMN Network Coordinator TCEQ Regional Manager[1] CWQMN Program Manager Station Operator/Cooperator CWQMN QA Officer Categorical 106 Grant Project Manager Monitoring and Assessment Section Manager WDMA Team Leader	1) Contact the station operator to determine probable cause for any findings 2) Determine corrective action 3) Notify QA/QC Officers, Categorical 106 Grant Project Manager, and Project Management if DQOs and/or MQOs are not met.
Data Completeness Reports (TCEQ Operated Stations)	Annual (end of fiscal year)	WDMA Data Validator	CWQMN Network Coordinator CWQMN Program Manager Station Operator/Cooperator CWQMN QA Officer CWQMN QC Officer Categorical 106 Grant Project Manager WDMA Team Leader	
Data Completeness Reports (Contractor Operated Stations)	Quarterly	Contractor	CWQMN Network Coordinator CWQMN Program Manager Station Operator/Cooperator CWQMN QA Officer CWQMN QC Officer Categorical 106 Grant Project Manager	
Annual QA Report	Annual	CWQMN QC Officer	CWQMN Network Coordinator TCEQ QA Manager CWQMN QA Officer CWQMN Program Manager	The TCEQ QA Manager analyzes all agency QA reports and provides a summary memorandum to the TCEQ Executive Director and the EPA Region 6 QA Manager
106 Grant Progress Reports and CWQMN Site Updates	Biannual	CWQMN Network Coordinator	Categorical 106 Grant Project Manager	NA

[1]The TCEQ Regional Manager is only notified if the station is operated by TCEQ regional staff.

CWQMN = Continuous Water Quality Monitoring Network

DQO = Data Quality Objective

EPA = U.S. Environmental Protection Agency

MQO = Monitoring Quality Objective

NA = Not Applicable

PEA = Performance Evaluation Audit

QA = Quality Assurance
QC = Quality Control
TCEQ = Texas Commission on Environmental Quality
TSA = Technical Systems Audit
WDMA = Water Data Management and Analysis Team

D1. Environmental Information Review

TCEQ WQPD staff and contractors review and validate water quality data generated by the CWQMN. See Table A5.1 for CWQMN data validators.

D1.1. USGS Operated Stations

TCEQ has contracted with USGS to provide stream discharge and water quality measurement data at stations on the Upper Rio Grande, Pecos River, Arroyo Colorado, Devils River, and Lower Rio Grande basins. See Tables A4.1 and A4.4 for USGS station locations and parameters and Section A4.4 for the locations of USGS Guidelines and Procedures. USGS Oklahoma-Texas Water Science Center QAPPs are also listed in Section A4.4.

For the Upper Rio Grande and Pecos River stations, USGS is validating and processing data according to procedures found in Appendix G: *Adaptation of Data Validation and Fouling Correction Procedures for Water-Quality Monitoring Stations on the Upper Rio Grande and Pecos River* (May 2013), Rev. 4 and the USGS TM1D3.

For the Arroyo Colorado and Lower Rio Grande stations, USGS is validating and processing data according to procedures found in the USGS TM1D3. See Section B7.2 for more information on how data is validated and delivered to TCEQ.

D1.2. Data Reviews and Validation for Stations Following TCEQ Procedures

The WQPD Data Management and Analysis Team is responsible for assigning data validation flags in the TCEQ DAS database. For a complete list of Data Validation flags, see Table D1.2. TCEQ data is validated based on data reviews and by comparing applicable QC sample results against project/CAMS quality objectives found in Section A6.

TCEQ Data Reviews

For each CAMS, data are reviewed by station operators, electronically by the TCEQ DAS, and manually by the data validators. See Table D1.1 for TCEQ data reviews.

Table D1.1. TCEQ Data Reviews

Data Reviews	Responsibility
The station operator documents any problems identified during a station visit in TCEQ DAS operator logs that detail any anomalies and affected data (see Appendix F for operator log content). Data validators may qualify data based on this information.	Station Operators
Every business day, station operators, SWQM staff and WDMA staff monitor and screen water quality measurements, sample depth measurements, and station communications for anomalies. Data validators may qualify data based on this information.	Station Operators and Assigned WDMA Data Validator
The TCEQ DAS automatically flags data when values exceed station-specific predefined ranges. Limit Exceeded (LIM) – Flags are automatically assigned to any data that fall above or below station-specific predefined ranges. Data are automatically flagged Lost Data (LST) when data is not retrieved by the data logger because of power outages, equipment malfunction, etc.	TCEQ DAS
On a monthly basis, data validators perform data review using the TCEQ DAS interface to graphically display the data. Data are reviewed for integrity, continuity, and reasonableness. Any data deemed questionable by the data validator due to inexplicable extreme values, data dropouts, flatlined data, etc. may be qualified Ambient Quality Invalidated (AQI).	Assigned WDMA Data Validator

During data validator data reviews, certain issues or questions may arise about particular data point(s); in these cases, the data validator will refer to the operator logs. If no logs exist, or the log does not identify a source for the questionable data, the validator contacts the station operator via phone or email to try to resolve any issues and verify affected data. Additionally, data validators may use multiprobe

sample depth, water level, and discharge measurement data as a source of additional information for data qualifying decisions.

TCEQ Non-EMRS Multiprobe Data Validation Using QC Sample Results

For each project/CAMS, Section A6.1 lists quality objectives used to accept or reject project data. Compliance with quality objectives in Section A6.1 is based on QC sample results.

CAMS: 749 and 808

Data validations for these stations are based on the following QC results:

1. Calibration Verification Sample (calibration drift) results
2. Sensor/deployment tube fouling measurement results
3. Change in water body measurement results
4. Laboratory multiprobe temperature check results

After each multiprobe deployment period, station operators enter fouling, CVS, and temperature check measurement results into the Post Deployment Worksheet (PDW) Excel spreadsheets. The PDW calculates results for these checks. See Section B4.1 for calculations.

Spreadsheet Pass/Fail fields include the following:

1. The sum (total error) of fouling and CVS results
2. Individual fouling and CVS results
3. Change in water body results
4. Temperature check results

If any of these fields indicate “Fail” for a given parameter(s), the corresponding data (including TDS calculated from SC) back to the last passing multiprobe exchange are invalidated using the Ambient Quality Invalidated flag (AQI).

Multiprobe temperature checks are done at the conclusion of deployment periods. If the check fails, the ±0.5 º Celsius criterion, the corresponding temperature, DO, SC, and calculated TDS data are invalidated (flagged as AQI) back to the last passing multiprobe exchange.

TCEQ Bosque EMRS Multiprobe Stations

(CAMS: 726, 728, 765, 804, and 805)

Data records for the Bosque EMRS stations are not validated; CVS and temperature check criteria are used as guidelines to ensure measurement equipment are operating within limits. TCEQ uses data from these stations to provide timely run-off specific conductance data for screening and targeting field responses and investigations.

Lower Neches Valley Authority Turbidity CAMS 749

The LNVA uses turbidity data on a near real-time basis for water management decisions.

TCEQ Lower Rio Grande EMRS Project

(CAMS: 736, 767, 789, 791, 792, 793, and 796) Data Review Reports

Every business day, WQPD staff remotely monitors and reviews the general operational status of all stations in the Lower Rio Grande and emails a daily data review report to interested parties. The report contains the following information:

- Stations online
- Measurement values
- Stations reporting data
- Reasonableness of the data
- Data concerns
- Other comments

D1.3. Data Verification and Validation Methods for Stations Following TCEQ Procedures

Data Validation Notes and Audits

After validating any data, and for the TCEQ DAS to consider the data as validated, the data validator must enter validator notes in the DAS. These notes document and explain any data qualifications made, other than valid (VAL flag), and why the qualification was made. In addition, validators also keep an electronic copy of a Validator Worksheet containing the same information. Data validators keep these worksheets on file and make them available for audits upon request.

Data Tracking

End data users can access validated data via TCEQ's webpages. Actual measurement values (or averages of these) are shown for data that has been qualified as valid, while the validation flag is shown for data that were qualified as invalid. For stations where data is validated, all data is manually verified, no matter the qualifier assigned by the system. For a list of validation flags and their definitions, see Table D1.2. After data is reviewed and validated by the data validator, it is flagged as such in the TCEQ DAS.

Table D1.2. Data Validation Flags (Qualifiers)

Flag	Definition
AQI	Ambient Quality Invalid – Flag manually assigned when data point deemed invalid by the data validator.
PMA*	Preventive Maintenance – Flag manually assigned when station operator is performing maintenance on analytical equipment.
VAL	Valid – Flag automatically assigned to any data that does not fall above or below predefined limits. Valid – Flag manually assigned to any data that was previously automatically assigned a Limit Exceeded (LIM) flag that was later deemed valid by the data validator.
LIM	Limit Exceeded – Flag automatically assigned to any data that fall above or below a predefined range.
LST	Lost Data – Flag automatically assigned when data is not retrievable by the data logger because of power outages, equipment malfunction, etc.

*All data within one hour after any PMA flag is qualified as invalid (AQI). This 1-hour time-period allows the multiprobe to equilibrate/stabilize to ambient water quality conditions before data may be considered valid.

D2. Useability Determination

Problems with potential limitations of the data are handled at three different levels:

1. At the time of audit of the monitoring stations or by the station operators, who have prime responsibility for routine calibrations, maintenance, and analysis of quality control samples.
2. Data validators who review verify and validate station data.
3. By users of the data.

Issues are reconciled at the lowest level and at the earliest time possible. The mechanisms for communication between the producers and the users of the data are telephone, e-mail, and the operator's log.

The auditors, validators, station operators, project leads, Network Coordinator, QC Officer, and managers are empowered to review and question any part of the measurement process and may initiate data reviews and corrective actions to bring the process back into compliance.

Appendix A. Definitions

Accuracy

A data quality indicator. The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations.

Audit (Quality)

A systematic and independent examination and evaluation to determine whether quality activities and related results comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve specified objectives.

Bias

The systematic or persistent distortion of a measurement process that causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value).

Calibration Standard (CS)

Definition – A mixture prepared from the primary standard mixture or stock standard mixture and, when appropriate, containing the internal standards and surrogates.

Application – Used to calibrate the instrument response with respect to analyte concentration.

Calibration Verification Sample (CVS)

Definition – An analytical standard analyzed during a batch to ensure acceptable instrument calibration.

Application – Used to verify analytical system calibration.

Comparability

A measure of the confidence with which one data set can be compared to another.

Completeness

A measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct, normal conditions.

Data Quality Objectives (DQOs)

Established quantitative measurements (with associated precision and bias or acceptable uncertainty) that must be obtained from the environmental data operations to demonstrate that the desired and expected result has been achieved.

Deficiency

An unauthorized deviation from acceptable procedures or practices, or a defect in an item.

Matrix

Substance being tested.

Precision

A measure of agreement among individual measurements of the same property, usually under prescribed similar conditions, expressed generally in terms of the standard deviation.

Quality

The sum of features and properties/characteristics of a process, item, or service that bears on its ability to meet the stated needs and expectations of the user.

Quality Assurance (QA)

An integrated system of activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the customer.

Quality Assurance Project Plan (QAPP)

A formal document describing in comprehensive detail the necessary QA, QC, and other technical activities that must be implemented to ensure that the results of the work performed will satisfy the stated performance criteria.

Quality Control (QC)

The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality

Quality Management Plan (QMP)

A formal document or manual, usually prepared once for an organization that describes the quality system in terms of the organizational structure, functional responsibilities of management and staff, lines of authority, and required interfaces for those planning, implementing, and assessing all activities conducted.

Representativeness

A measure of the degree to which data accurately and precisely represent a characteristic of a population, parameter, variations at a sampling point, a process condition, or an environmental condition.

Sample Depth

Depth of multiprobe in the water column (TCEQ).

Standard Operating Procedure (SOP)

A written document that details the method of an operation, analysis, or action whose techniques and procedures are thoroughly prescribed and that is accepted as the method for performing certain routine or repetitive tasks.

Water Level (also known as stage)

Height of water in the stream above a reference point. (USGS)

Appendix B. Abbreviations

A

ADAPS	Automated Data Processing System
AE	Absolute Error
AQI	Ambient Quality Invalid
ASTM	American Society for Testing and Materials

B

BMP	Best Management Practices

C

CAFO	Concentrated Animal Feeding Operation
CAMS	Continuous Ambient Monitoring Station
CAP	Corrective Action Plan
CFEP	Comms Front End Processor
CFR	Code of Federal Regulations
cfs	cubic feet per second
COA	Certificate of Analysis
COMMS	Communications
CRP	Clean Rivers Program
CVS	Calibration Verification Sample
CWA	Clean Water Act
CWQMN	Continuous Water Quality Monitoring Network

D

DAS	Data Acquisition System
DI	De-ionized water
DO	Dissolved Oxygen
DQO	Data Quality Objective

E

EC	Electrical Conductance (Reported as Specific Conductance)
EMRS	Environmental Monitoring Response System
EPA	United States Environmental Protection Agency

F

FNU	Formazin Nephelometric Units
FTP	File Transfer Protocol
ft/s	Feet per Second
FY	Fiscal Year

G

GOES	Geostationary Operational Environmental Satellite

H

HC&CC	Hidalgo and Cameron County Irrigation District

I

IRD	Information Resources Division
ISO	International Organization for Standards

K

KCl	Potassium Chloride

L

LIM	Limit Exceeded
LNVA	Lower Neches Valley Authority
LRG	Lower Rio Grande
LST	Lost Data

M

MA	Monitoring and Assessment Section
MD	Monitoring Division
mg/L	milligram per liter
MOA	Memorandum of Agreement
MPR	Monthly Progress Report
MQO	Measurement Quality Objective

N

NA	Not Applicable
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NTU	Nephelometric Turbidity Units
USNWS	United States National Weather Service
NV	EMRS project data not validated
NWIS	USGS's National Water Information database

P

PC	Personal Computer
PDW	Post Deployment Worksheet
PEA	Performance Evaluation Audit
PMA	preventative maintenance
PVC	Polyvinyl Chloride

Q

QA	Quality Assurance
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QC	Quality Control
QMP	Quality Management Plan

R

RPE	Relative Percent Error

S

SAS	Statistical Analysis Software
SC	Specific Conductance
SOP	Standard Operating Procedure
STORET	Storage and Retrieval
SWQM	Surface Water Quality Monitoring Team
SWQMIS	Surface Water Quality Monitoring Information System

T

T	Temperature
TBD	To Be Determined
TCEQ	Texas Commission on Environmental Quality
TDS	Total Dissolved Solids
TIAER	Texas Institute of Applied Environmental Research
TMDL	Total Maximum Daily Load
TPWD	Texas Parks and Wildlife Department
TSA	Technical System Audit
TSWQS	Texas Surface Water Quality Standards
TWRI	Texas Water Resource Institute

U

µS/cm	micro siemens per centimeter
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USIBWC	United States International Boundary Water Commission
USNWS	United States National Weather Service
USNPS	United States National Park Service

W

WDMA	Water Data Management and Analysis
WPP	Watershed Protection Plan
WQPD	Water Quality Planning Division

Y

YSI Yellow Springs Instrument

Appendix C. Project Plan Template

A1. Title Page

Texas Commission on Environmental Quality
Continuous Water Quality Monitoring Network

Project Plan

(Project Name)

(Note To User: *This* form *provides some of the text to be used in the project plan. Instructions are provided in italics and should be deleted during completion of the form.*)

A2. Approval Pages

Ivan Cruickshank CWQMN Network Coordinator, TCEQ SWQM	Date
Andrew Sullivan SWQM Program Manager, TCEQ SWQM	Date
Jason Godeaux Section Manager, TCEQ Monitoring and Assessment Section	Date
Jason Natho CWQMN Quality Assurance Officer	Date
Name Project Lead, TCEQ SWQM Program	Date
Sarah McCaffrey CWQMN Quality Control Officer, TCEQ SWQM	Date
Cathy Anderson Team Leader Data Management and Analysis Section	Date
Other Project Participants	Date

This plan documents specific details for new continuous water quality projects. Critical project-specific details for new CWQMN stations are not covered in the CWQMN QAPP. Please see the CWQMN QAPP for other network details.

A3. Table of Contents, Document Format and Document Control

Figures

Insert list of figures.

Tables

Insert list of tables.

List of Abbreviations

Insert list here.

A4. Project Purpose, Problem Definition, and Background

State the specific problem to be solved or decision to be made, or the outcome to be achieved. Include enough background information to provide a historical perspective and scientific perspective.

The discussion should include enough information (i.e., history, regulatory context, and previous work) to understand the project objective.

A5. Project Task Description

Summarize the work to be performed and the schedule for implementation as well as monitoring station geographic location(s) and TCEQ segment numbers.

In some CWQMN projects, project/task descriptions are laid out in detail in contractual/ subcontractual work plans. If the work plan addresses the following information in detail, then the contractual/subcontractual work plan may be attached and referenced.

A6. Information/Data Quality Objectives and Performance/Acceptance Criteria

The measurement performance specifications to support the project objectives are specified in *Table(s) A6.1 – x.*

Add tables as needed. Reference applicable CWQMN analytical SOPs if available.

Methods used are based on *Standard Methods for the Examination of Water and Wastewater*, 20th Edition, 1998 unless otherwise noted.

Table A6.1. Quality Objectives: TCEQ Multiprobe CAMS

Parameter	Fouling and Drift/(CVS) Acceptance Limits[1]	Temperature Acceptance Limit	Instrument/SOP
Specific Conductance/ Total Dissolved Solids	±5%	±0.5 º C*	*Add instrument and applicable SOP*
Dissolved Oxygen	±0.5 mg/l		
pH	±0.5 units		
Temperature		±0.5 º C	
Sample Depth	NA		

[1] Sum and individual fouling and drift acceptance limits

*If temperature sensor checks do not meet the ±0.5 º C criterion, the corresponding temperature, DO, SC, and calculated total dissolved solids data are considered invalid

CVS = calibration verification sample

NA = not applicable, sample depth measurements not assessed for accuracy

ºC = degrees centigrade

mg/l = milligrams per liter

A6.1. Ambient Water Reporting Limits (AWRLs)

As described in Section A6 of the CWQMN QAPP. (*If applicable)*

A6.2. Precision

As described in Section A6 of the CWQMN QAPP. (*If applicable.)*

A6.3. Bias

As described in Section A6 of the CWQMN QAPP. (*If applicable.)*

A6.4. Representativeness

As described in Section A6 of the CWQMN QAPP. (*If applicable.)*

A6.5. Comparability

As described in Section A6 of the CWQMN QAPP. (*If applicable.)*

A6.6. Completeness

As described in Section A6 of the CWQMN QAPP. (*If applicable.)*

A7. Distribution List

Project Plan distribution will include any new project personnel and applicable TCEQ staff members in the distribution list from the most recent QAPP revision or certification.

A8. Project Organization

This section is intended to identify individuals and organizations that will be responsible for developing and/or supporting new CWQMN projects. For a list of additional project/task and responsibilities please refer to section A4 of the CWQMN QAPP.

The Project Lead is responsible for the development of the Project Plan.

TCEQ CWQMN Coordinator

Ivan Cruickshank

TCEQ SWQM Project Lead

Name

X. Develop Project Plan

Station Operator

Name and Agency

X. Station Operation and Maintenance

(Name and Agency)

X. Data Validation

Project Participant

Name and Agency

Contractor

Name

A9. Project QAM Independence

As described in Section A9 of the CWQMN QAPP. *(If applicable.)*

A10. Project Organization Chart and Communications

Provide a project organization chart which shows the lines of authority to include the reporting relationships and the lines of communication between all parties involved in the project.

A11. Personnel Training/Certification

Indicate who will train station operators, and how.

Discuss training schedule for station operators, data validators, or other needed project training.

Provide any other training requirements.

A12. Documents and Records

As described in sections A12 of the CWQMN QAPP. (*If applicable)*

B1. Identification of Project Environmental Information Operations

B1.1. Station Selection Criteria

Describe the rationale for selecting monitoring station(s).

B1.2. Monitoring Station Design

Describe how monitoring equipment will be configured (including measurement frequencies) to collect data that will answer project objectives.

List specific monitoring and support equipment: measurement equipment, data logger, telemetry, modems, trailer, traffic box, etc.

Detail station developmental needs; pad, electricity, fence, phone, special items, etc. Discuss station development schedule.

Indicate who will be responsible for station operation and maintenance.

B2. Methods for Environmental Information Acquisition

As described in sections B2 of the CWQMN QAPP. (*If applicable.)*

B2.1. Multiprobe Monitoring Methods and Equipment

Include a table which lists the station location, multiprobe equipment, telemetry method and station parameters.

B2.2. Analytical Methods

Water quality measurement methods used by the CWQMN are based on the Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998, unless otherwise noted.

Include a table which lists the parameters to be collected, the units, the measurement equipment used, and the methods associated with that equipment and parameters.

Analytical methods and analytical SOPs are listed in Section A6.

B2.3. Sampling and Measurement System Corrective Action

As described in section B2.5 of the CWQMN QAPP.

B2.4. Existing Information

There are no indirect measurements used in this project. *(If applicable.)*

B3. Integrity of Environmental Information

As described in Section B3 of the CWQMN QAPP. (*If applicable.)*

B4. Quality Control

As described in Section B4 of the CWQMN QAPP. (*If applicable.*) Analytical method SOPs are listed in Section A6 detailing Quality Control (QC) procedures. *If SOPs are not available describe QC program for project.*

B4.1. Corrective Action Related to Quality Control

As described in Section B4 of the CWQMN QAPP. (*If applicable.)*

B5. Instruments/Equipment Calibration, Testing, Inspection, and Maintenance

As described in CWQMN QAPP. *(If applicable.)*

List the equipment and/or systems needing periodic maintenance, testing, or inspection, and the schedule for such.

List all applicable equipment maintenance SOPs or equipment manuals.

Describe instrument calibration and frequency of calibration.

B6. Inspection/Acceptance of Supplies and Services

As described in CWQMN QAPP. *(If applicable.)*

Describe how spare parts, standards and reagents will be obtained by station operators.

B7. Environmental Information Management

As described in CWQMN QAPP. *(If applicable.)*

Indicate who will manage project data, and how, including communication, telemetry, data processing, and depository. State who is performing data analysis (and how) and what action will be taken with data results.

C1. Assessments and Response Actions

As described in CWQMN QAPP. (If applicable)

C1.1. Corrective Action

As described in Section C1 of the CWQMN QAPP. *(If applicable)*

C2. Oversight and Reports to Management

As described in Section C2 of the CWQMN QAPP.

C2.1. Reports to TCEQ Project Management

As described in Section C2 of the CWQMN QAPP.

D1. Environmental Information Review

As described in Section D1 of the CWQMN QAPP.

List the TCEQ data validation SOPs that will be used.

Indicate who will be responsible for validating station data, and if the person(s) will require training.

Indicate how data will be reviewed and verified.

D2. Useability Determination

As described in Section D2 of the CWQMN QAPP.

Appendix D. References

Current Revision of the Texas Commission on Environmental Quality, *Quality Management Plan (QMP[10])*

United States Geological Survey – Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Station Operation, Record Computation, and Data Reporting TM1D3[11]

United States Geological Survey – *Turbidity 6.7, Version 2.1* (9/2005)[12]

United States Environmental Protection Agency, *Quality Assurance Project Plan Standard (CIO 2105-S-02.1[13])*, July 2023

Standard Methods for the Examination of Water and Wastewater. American Public Health Association, Washington, DC, 20th edition, 1998.

Guidance for the Data Quality Objectives Process, Appendix D, Glossary of Quality Assurance Terms. United States Environmental Protection Agency, Quality Assurance Management Staff QA/G-4, Washington, DC, 1994.

American National Standard Institute [ANSI]/American Society for Quality Control [ASQC] Z1, Standard E4-19.

Surface Water Quality Monitoring Procedures, Volume1: Physical and Chemical Monitoring Methods, October 2008, RG-415[14]

[10] www.tceq.texas.gov/agency/qa/qmp
[11] pubs.usgs.gov/tm/2006/tm1D3/
[12] pubs.usgs.gov/twri/twri9a6/twri9a67/twri9a_Section6.7_v2.1.pdf
[13] www.epa.gov/system/files/documents/2024-04/quality_assurance_project_plan_standard.pdf
[14] www.tceq.texas.gov/publications/rg/rg-415

Appendix E. Instructions for Using the Sutron Xpert Data Logger for Station Service Visits

Enter Data Logger Password

- Touch screen with stylus pen to illuminate data logger screen.
- A Select Type of Access screen will appear with Retrieval Access and Set up Access buttons.
- Touch "**Setup Access**" button.
- A screen with "Select User" will appear with AQUA in the selection box.
- Touch "**OK**" button.
- A screen with "Enter Password" will appear.
- In password entry box, type in the password letters "AQUA" using the touch screen.
- Touch "**OK**" button.
- The **Tab** menu screen will appear with the **Main** tab selected.

Place the Sonde in "P" Code

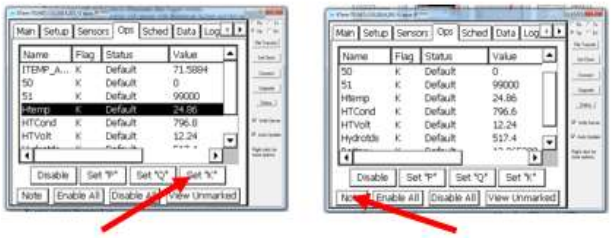
- From the **Main Menu** screen tab, touch "**Ops**" tab.
- Highlight the first sonde measurement parameter by touching it with the stylus.
- Touch "**Set P**" button.
- Repeat for each sonde measurement parameter until they all say "P" instead of "K."

Enter Opening Operator Log

- From the "**Ops**" screen tab, touch "**Note**" button from the choices at the bottom.
- Enter an operator log using the touch screen including technicians' initials and task(s) to be performed. Do not use special characters.
- Select "**OK**" from the top right.
- Review the operator log, correct if necessary, select "**OK**" button at the bottom right.

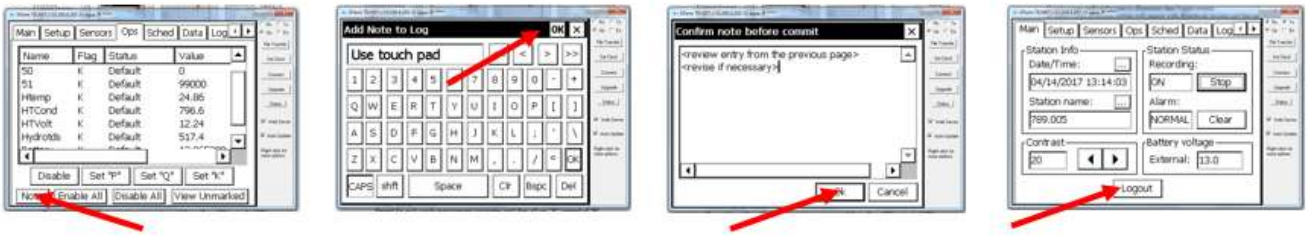
When Station Service is Complete, Return Parameters to "K" Code

- From the "**Ops**" tab, highlight the first sonde measurement parameter by touching it with the stylus.
- Touch "**Set K**" button.
- Repeat for each sonde measurement parameter until they all say "K" instead of "P."



Enter Closing Operator Log

- From the "**Ops**" screen tab, touch "**Note**" button from the choices at the bottom.
- Enter an operator log using the touch screen including technicians' initials and task(s) performed. Do not use special characters.
- Select "**OK**" from the top right.
- Review the operator log, correct if necessary, and select "**OK**" button at the bottom right.
- Select the "**Main Menu**" tab at the top left, and make sure it says "Recording ON."
- Touch "**Log Out**" **button**.



Additional Data Logger Operations

Make an Instantaneous Measurement with the Sonde

- Select "**Sensors**" tab screen from the top.
- Select "**Measure All**" button.
- If an LDM is present, highlight one instrument by touching it with the stylus and select "**Measure**" button.
- An hourglass symbol will appear, and after a minute or so, the sonde values will appear in the programmed order.

View the Last Logged Data

- Select **"Ops"** tab from the top. The values will update every fifteen (15) minutes.

Verify the Data is Being Collected

- Select **"Ops"** tab from the top.
- Select "**View Unmarked**" at the lower right.
- Under [SSP.LOG] there should generally be only one data record and it should be on 00:00, 00:15, 00:30, or 00:45. There may be multiple unmarked records if the station has been offline for more than fifteen (15) minutes.
- Under [OPERATOR.LOG] there should be no logs unless you have entered a log since the last DAS polling at 00:00, 00:15, 00:30, or 00:45 minutes or if the station has been offline for more than fifteen (15) minutes.
- Select **"OK" or "Cancel"** buttons to go back to the **"Ops"** tab screen.

Adjust Screen Contrast

- The SUTRON XPert starts with the contrast at a fixed value which may include several readable contrast settings, fully bright, or fully dark. With the latter two, you can bring the screen content into a visible range with two hidden buttons on the login screen. When the screen is either fully bright or fully dark, touch the screen in the upper right corner to darken the contrast or touch the lower right corner to lighten the contrast. Wait at least 2 seconds between each tap to give the display a chance to adjust to the new contrast setting. You can also tweak the contrast with these buttons anytime the login screen is displayed. Once logged in, adjust the contrast from the "**Main**" tab using the Contrast dialog box by touching the ◄ or ► buttons to decrease or increase the contrast.

Appendix F. Multiprobe Operator Log Entry and Excel Post Deployment Worksheets (Revision 2)

For TCEQ stations, Operator Logs are required for non-EMRS and EMRS CWQMN stations. Station Operator Logs are entered electronically into the TCEQ DAS via the station's Sutron Data Logger after routine and nonroutine station service visits. See instructions in Appendix E for how to enter Operator Logs using the Sutron data logger.

USGS is not required to enter Station Operator Logs for USGS-operated CWQMN stations.

TCEQ Operator Log Content Instructions

TCEQ Non-EMRS and EMRS Stations

At a minimum, routine Operator Logs must list the following information:

1. Initials
2. Conducted routine station service
3. Any applicable field observations: water conditions, meteorological conditions, drought, flood etc.

When applicable, Station Operator Log entries must contain the following:

1. Name, date, and time
2. Any problems with data collection that can affect data quality
3. Change in operating procedures, data collection circumstances, or measurement equipment
4. Station equipment/communication problems and any troubleshooting activities
5. Station either being taken offline or being brought online
6. Nonroutine station service events
7. Date and time (or exact time frames) of the event must be included in Operator Logs

TCEQ Post Deployment Worksheets

For TCEQ non-EMRS stations, station operators must enter multiprobe QC results into TCEQ's Post Deployment Excel Worksheets (PDW) and email the worksheets to the applicable data validator and QC Officer. These Excel spreadsheets document fouling, drift, and multiprobe exchanges at TCEQ non-EMRS stations.

For TCEQ non-EMRS stations after each routine station visit, station operators enter the following information into Post Deployment Worksheets (PDW):

1. CAMS Number and Location
2. Operator
3. Date
4. Service Start/Stop time
5. Multiprobe, SN/asset number, Model, pH sensor type
6. Multiprobe Retrieval Date
7. Multiprobe Deployment Data
8. Field Meter SN/asset number
9. Field Meter pH millivolt (mV) responses to standards 7.00 and 10.00 pH. PDW calculates pH mV slope.
10. Field meter conductivity cell constant after calibration
11. Flow at Deployment Tube
12. Severity of Debris cloud
13. Multiprobe Fouling and Drift Measurements
14. Measurement depth (Pine Island Bayou only)
15. Observed Sensor Fouling
16. Multiprobe NIST temperature Check

The PDW calculates results for fouling and drift and compares these results to project DQO's. After each station service event, the station operator emails the PDW to their WDMA data validator who uses it to validate project data.

PDW workbooks for each station and calendar year are labeled using the following naming convention (PDW_CAMSXXX_CalendarYear). When a new calendar year starts, begin a new workbook. Tabs within the workbook contain individual PDWs and are labeled with the month, day, and year station service occurred.

The following naming convention examples need to be used for each Post Deployment workbook and the tabs within it.

Workbook Naming Convention Example:
PDW_CAMS787_2011

Workbook Tab Naming Convention Example:
March 13, 2011

The WDMA data validator will store the Post Deployment Workbook on their team's electronic folder for CWQMN documents.

Optional Photos of multiprobes and Sensors

It is preferred that photos be taken during each station visit of the multiprobe and its sensors. The purpose of the photos is to photo-document fouling conditions of the probe and other pertinent areas at the CAMS. These optional photos will be emailed to the station's data validator along with the required PDW.

Appendix G. Adaptation of Data Validation and Fouling Correction Procedures for Water-Quality Monitoring Stations on the Upper Rio Grande and Pecos River

Effective Date

May 2013 (rev. 0), Modified March 2024 (rev.4).

Purpose and Scope

This appendix is an adaptation and interpretation of guidelines and standard procedures for continuous water-quality monitors published by USGS in "Station operation, record computation, and data reporting: U.S. Geological Survey (USGS) Techniques and Methods 1–D3 (TM1D3)" for the application of fouling corrections and validating data when water-quality monitors are silted in by sediment, when monitors are partially silted in, when monitor fouling conditions change over time, and when fouling is caused by aquatic insect activity. These procedures are for USGS-operated TCEQ CWQMN stations on the Upper Rio Grande. These procedures will also be applied to similar monitor fouling situations that can occur at USGS-operated TCEQ Pecos River Stations.

Since Sept. 1, 2011, USGS began operating TCEQ Upper Rio Grande and Pecos River stations per TM1D3 guidelines and procedures. The procedures in this appendix apply to all data collected at these stations beginning on that date.

As data are validated and processed, these procedures may be modified as needed. If significant changes to procedures are required, USGS will contact TCEQ for concurrence/approval. USGS will track and update procedures within this SOP when changes are made. When changes are made, USGS will provide TCEQ updated procedures. The section in this appendix titled "SOP Revision Tracking" is used to track changes to the SOP.

Background

Water-quality monitoring measurement sensors at USGS-operated Continuous Ambient Monitoring Stations (CAMS) 757 (upstream Rio Conchos), Station 720 (Castolon), and 721 (Rio Grande Village) in the Upper Rio Grande can be fouled and plugged by sediment due to sudden stream discharge pulses, existing degraded monitoring equipment deployment locations, deployment location stream dynamics, and less than ideal deployment designs. Additionally, monitor fouling conditions can change over

time during and after periods of dynamic stream discharge. At CAMS 758 (downstream Rio Conchos), conductivity sensor cells are prone to fouling by aquatic insect activity.

Water-quality monitors on the Upper Pecos may also become silted as a result of rainfall run-off events, low base stream flows, and due to deployment tubes being deployed at angles (not vertically). Due to periods of low base flows and abundant sediment at Upper Pecos stations, USGS is using a trash pump to modify stream channels/deployments at several CAMS stations.

In February 2013, TCEQ, USGS Texas Water Science Center, and the National Water Quality Monitoring Council Methods Board developed the following working draft procedures and limitations associated with them to address water-quality monitor fouling.

Procedural Summary

1.1. Water-quality monitor data collected when sensors/deployment tubes are silted in / isolated from the stream are invalidated and not reported to TCEQ. Data collected prior to the onset of a monitor silting in event can be reported to TCEQ. These data are not corrected using fouling measurement results and can be corrected for drift measurement results. These data are not assigned TM1D3 data ratings.

1.2. Data collected during changing or transient monitor fouling conditions are invalidated and not reported to TCEQ back to the onset of the initial event. Data collected prior to the onset of changing fouling conditions can be reported to TCEQ. These data are not corrected using fouling measurement results and can be corrected for drift measurement results. These data are not assigned TM1D3 data ratings.

1.3. When it is determined monitor sensors/deployment tubes are not completely silted in, pH and temperature fouling measurement results are used to validate data as described in Section 1.14.1.

1.4. When conductivity sensor cells are fouled by sediment at stations in the Upper Rio Grande, fouling measurement results are generally not used for data validation decisions.

1.5. Conductivity sensors can be significantly impacted by aquatic insect activity; affected data are invalidated and not reported to TCEQ.

1.6. Water-quality monitor sensor drift measurement results are applied to data records according to TM1D3 procedures.

1.7. Water-quality monitor temperature sensor fouling is calculated using the USGS TM1D3 pH and DO calculation method instead of the monitor-to-monitor comparison method (field monitor before cleaning minus deployed monitor dirty).

Limitations

1.8. No data quality fouling measurements are available for data reported prior to monitor silting in/isolation events and when data are reported prior to changing fouling conditions.

It is possible alternative methods may be developed to statistically characterize data quality prior to silting in events by comparing historical fouling measurement results against distinct stream flow regimes. Data for CAMS 721 was compiled and it was decided there were not enough data points to proceed. If USGS's time and budget allow, it may be ideal at a later date to determine if this approach is feasible.

1.9. When water-quality monitors are not found silted in/isolated during station service events and linear prorated fouling measurement corrections are applied to the data, computation errors will occur if fouling occurred at nonlinear rates. These errors are limited to acceptance criteria listed in 1.14.1.

1.10. Sensor/deployment tube fouling can range from minimal to completely silt in/isolated from the stream. Individual sensor sedimentation can be dependent on the particular deployment, orientation of sensors in the deployment tube, stream sedimentation event type, stream flow etc.

1.11. Numeric data acceptance criteria for aquatic insect activity are not available. Best professional judgment is used by the hydrographer to accept data and apply fouling measurement computations to data affected by insect activity.

Field Procedures

1.12. Documenting Water-Quality Monitor Fouling Status and Station Operation

1.12.1. During station service events, the hydrographer will complete a set of detailed field notes describing the fouling status of the sensors. Pictures will be taken of the monitors and the sensor water interfaces. Field notes will document occurrences when the monitor is found buried in stream sediments and isolated from the stream.

1.12.2. When monitors are found silted in, the hydrographer will conduct station field service according to TM1D3 procedures.

1.12.3. When an event causes the monitor to become silted in, the Texas Water Science Center will service the station as soon as possible to minimize the loss of data.

Data Validation and Processing

Stage and discharge measurements collected by USGS or other entities may be used in this procedure. Station Analysis Notes will be used to document data validation and processing decision logic and data processing outcomes.

1.13. Monitors Silted in/Isolated from the stream

1.13.1. When field observations determine monitors are silted in/isolated from the stream data are invalidated/not reported back to a conservative point prior to the fouling event. When the fouling event occurred is determined by using stream stage/discharge and/or optical DO measurements. Typically, during a severe fouling event, optical DO measurements will rapidly decline and stay near zero mg/l. The rapid decline of DO measurements usually corresponds to a stream discharge pulse. However, at CAMS 757, the monitor can become suddenly silted in/isolated from the stream due to decreasing stream stage/discharge; the monitor's deployment tube is located at an incised pocket of the stream bank. Decreases in stream stage/discharge can cause sediment to deposit in this pocket. Stream bank collapses at this station can also cause the monitor to become suddenly silted in/isolated from the stream.

1.13.2. If the onset of fouling is determined, sensor drift corrections are applied as appropriate, no fouling corrections (zero correction) are applied to the data collected prior to the initial fouling/discharge event and no TM1D3 data ratings are applied to these data.

1.13.3. When it cannot be determined when the initial fouling event occurred, all data back to the last service event are invalidated.

1.13.4. Fouling measurement results collected while the monitors are silted in/isolated from the stream are considered invalid.

1.14. Monitor Partially Silted in

1.14.1. When field observations determine monitors are not completely silted in/isolated from the stream and DO measurement response does not go to zero, pH and temperature fouling measurement results are used to validate data. When pH fouling measurement results are greater than ±0.50 pH units and/or temperature fouling measurements are greater than ±0.50 °C, all monitor parameters (DO, pH, T, SC) are invalidated back to the last service event unless the onset of fouling can be determined.

1.14.2. If the initial onset of fouling is determined, sensor drift corrections are applied as appropriate, no fouling corrections (zero corrections) are applied to the data collected prior to the initial fouling/discharge event and no TM1D3 data ratings are applied to these data.

1.15. Changing Monitor Fouling Conditions

1.15.1. When the monitor experiences changing fouling conditions, all data are invalidated back to the initial fouling/discharge event. Fouling measurements collected during changing fouling conditions are considered invalid.

1.15.2. If the initial onset of fouling is determined, sensor drift corrections are applied as appropriate, no fouling corrections (zero correction) are applied to the data collected prior to the initial fouling/discharge event and no TM1D3 data ratings are applied to these data.

1.15.3. If it cannot be determined when the initial fouling event occurred, all data back to the last service event are invalidated.

1.16. Conductivity Sensor Insect Fouling

1.16.1. Data collected during periods of insect activity that causes major spikes will be deleted. Noisy data points and minor spikes will not be deleted. Periods of erratic data will be deleted. The period prior to insect activity will not be deleted. Professional judgment will be used to determine what constitutes major or minor spikes and erratic data.

SOP Revision Tracking

This Section is used to track changes made to this SOP.

1. Revision 1 change (December 2013). Section 6.1.1 updated to include station-specific (CAMS 757) circumstances that can cause the monitor to become suddenly silted in / isolated from the stream.

   Section 6.1.1 Revision: *At CAMS 757 the monitor can become suddenly silted in/isolated from the stream due to decreasing stream discharge/stage heights; stream flow decreases causing sediment to deposit. The monitor's deployment tube is*

located at an incised pocket of the stream bank. Stream bank collapses at this station can also cause the monitor to become suddenly silted in/isolated from the stream.

In Section 6.1.1, the sentence below was modified to include "or" after "and" since stage/discharge measurements may not be usable as a collaborative piece of information to determine when the monitor became silted in. Rapidly declining DO measurements can be used to determine when the monitor was silted in.

*When the fouling event occurred is determined by using stream stage/discharge and/**or** optical DO measurements*

2. Revision 2 change (Jan. 31, 2020). Section 1.0 updated.

   The USGS data validation system has recently been replaced with an Aquatic Informatics program named Aquarius. The Aquarius-base system, while still based on the USGS TM1D3 Guidelines and the Adaptation, does not generate data quality ratings. TCEQ and USGS will develop an alternate approach to describe data quality and will submit that approach as an amendment to this QAPP during FY2020. Monitoring stations affected by the change are CAMSs 709, 721, 729, 730, 735, 757, 758, 759, 764, 785, 788, 798, 799, 803, and 807.

   The following passage from 1.0 was removed. Excluding extreme events, a minimum of seventy-five percent (75%) of the scheduled data will be collected and validated, meeting at least the USGS "fair" data criteria as outlined in TM1D3

3. Revision 3 change (Feb. 23, 2022). This appendix was reformatted, and the sections are no longer numbered. The paragraphs listed under the Procedural Summary section now begin with 1.1 and proceed numerical from there through the Data Validation and Processing section. Paragraph numbering starts over at 1 in the SOP Revision Tracking section.

   Purpose and Scope section Revision: Removed sentence "*Section 7.0 is used to track changes to the SOP*" and replaced with sentence, "*The section in this appendix titled "SOP Revision Tracking" is used to track changes to the SOP."*

   Procedural Summary paragraph 1.3 (previously 3.3) Revision: *"…are used to validate data as described in Section 1.14.1."*

   Limitations paragraph 1.9 (previously 4.2) Revision: *"…limited to acceptance criteria listed in 1.14.1."*

   Purpose and Scope section updated. Alternative approach to data quality ratings was finalized in February 2020. See Appendix H for more details.

   Purpose and Scope section Revision: *USGS developed a TCEQ script for Aquarius that validates data using TM1D3 "Fair" data rating as acceptance criteria. See Appendix H for details concerning the process USGS developed to validate and deliver data to TCEQ.*

   Background section updated for clarity. The procedures in this appendix were developed and finalized in 2013.

   Background section Revision: *In February 2013, TCEQ, USGS Texas Water Science Center, and the National Water Quality Monitoring Council Methods Board developed*

the following working draft procedures and limitations associated with them to address water-quality monitor fouling.

4. Revision 4 change (March 12, 2024). The "Purpose and Scope" and "Background" sections of the SOP were revised to reflect current conditions and procedures.

   The following passage from the "Purpose and Scope" subsection was removed because it is no longer applicable:

   > USGS data validation system has recently been replaced with an Aquatic Informatics program named Aquarius. The Aquarius-base system, while still based on the USGS TM1D3 Guidelines and the Adaptation, does not generate data quality ratings. USGS developed a TCEQ script for Aquarius that validates data using TM1D3 "Fair" data rating as acceptance criteria. See Appendix H for details concerning the process USGS developed to validate and deliver data to TCEQ.

   The following passage from the "Background" subsection was removed because it is no longer applicable:

   > USGS is re-locating and re-designing monitoring equipment deployments at CAMS 757, 720, and 721. Monitors will be suspended vertically using swing-pipes. These improvements are expected to reduce sensor fouling/plugging. To immediately alleviate monitor fouling and fouling conditions changing over time at the existing CAMS 720 station, USGS has moved CAMS 720 from a gravel bar to an area closer to the stream bank. USGS is periodically modifying the stream channel/deployment at CAMS 757 with compressed water (trash pump) to aid sample collection. Data collection is further complicated due to the ephemeral nature of the stream at this location.

Appendix H. Example Letter to Document Adherence to the QAPP

TO: (name)
(organization)

FROM: (name)
(organization)

Subject: RE: Commitments to requirements contained in Continuous Water Quality Monitoring Network (CWQMN) Quality Assurance Project Plan (QAPP) Revision 13

Please sign and return this form by (date) to:

(address)

I acknowledge receipt of the referenced document(s). I understand the document(s) describe quality assurance, quality control, data management and reporting, and other technical activities that must be implemented to ensure the results of work performed will satisfy stated performance criteria.

_____ _____

Signature Date

Copies of the signed forms should be sent by the Operator/Cooperator to the TCEQ CWQMN Network Coordinator within 60 days of TCEQ approval of the QAPP.