Clean Water Act Section 319(h) Nonpoint Source Pollution Control Program

Investigation into Contributions of Nitrate-Nitrogen to Plum Creek, Geronimo Creek and the Underlying Leona Aquifer

TSSWCB Project 13-07
Revision 0

Quality Assurance Project Plan

Texas State Soil and Water Conservation Board

Prepared by

Guadalupe-Blanco River Authority

Effective Period: September 1, 2014 – September 30, 2016
with annual revisions required

Questions concerning this quality assurance project plan should be directed to:

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A1 APPROVAL PAGE

Investigation into Contributions of Nitrate-Nitrogen to Plum Creek, Geronimo Creek and the Underlying Leona Aquifer

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Signature: ___________________________________ Date: _____________________

The GBRA will secure written documentation from each sub-tier project participant (e.g., subcontractors, other units of government, laboratories) stating the organization's awareness of and commitment to requirements contained in this QAPP and any amendments or added appendices of this QAPP. The GBRA will maintain this documentation as part of the project's QA records, and will be available for review. (See sample letter in Appendix 1 of this document.)

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List of Acronyms/Abbreviations

ASR	USGS Analytical Services Request (ASR) form
AWRL	Ambient Water Reporting Limit
BMP	Best Management Practice
CAR	Corrective Action Report
cfs	cubic feet per second
cm	centimeter
COC	Chain of Custody
CR	County Road
CRP	Clean Rivers Program
CWA	Clean Water Act
DO	Dissolved Oxygen
DOC	Demonstration of Capability
DQO	Data Quality Objective
EPA	U.S. Environmental Protection Agency
FA	Filtered acidified
FCC	Filtered, chilled
FNU	Formazin Nephelometric Units
FU	Filtered, unacidified
GBRA	Guadalupe-Blanco River Authority
GCWP	Geronimo and Alligator Creeks Watershed Partnership
GW	Groundwater
H	Hydrogen
L	Liter
LC	Lab code
LCS	Laboratory Control Standard
LOD	Limit of Detection
LOQ	Limit of Quantitation
mg	milligrams
mg/L	milligrams per liter
N	Nitrogen
NA	Not Applicable
NCR	Nonconformance Report
NELAC	National Environmental Laboratory Accreditation Conference
NFM	National Field Manual
NRCS	U.S. Department of Agriculture Natural Resources Conservation Service
NWIS	U.S. Geological Survey National Water Information System database
NWQL	U.S. Geological Survey National Water Quality Laboratory, Denver, CO
O	Oxygen
P	Phosphorus
PCWP	Plum Creek Watershed Partnership
PM	Project Manager
PRE	Precipitation
QA	Quality Assurance
QASM	Quality Assurance System Manual

QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
RL	Reporting Limit
RPD	Relative Percent Difference
RSIL	U.S. Geological Survey Reston Stable Isotope Laboratory, Reston, VA
RU	Raw, unacidified
SA	Sample Amount (reference concentration)
SM	Standard Methods
SOP	Standard Operating Procedure
SPR	Spring
SR	Sample Result
STPO	U.S. Geological Survey South Texas Program Office, San Antonio, TX
SW	Surface water
SWQMIS	Surface Water Quality Monitoring Information System
TCEQ	Texas Commission on Environmental Quality
TSS	Total Suspended Solids
TSSWCB	Texas State Soil and Water Conservation Board
TSWQS	Texas Surface Water Quality Standards
TWQI	Texas Water Quality Inventory
TWRI	USGS Techniques of Water Resources Investigations
TWSC	Texas Water Science Center
USGS	U.S. Geological Survey
WCA	Unfiltered, chilled, acidified
WPP	Watershed Protection Plan
WQMP	Water Quality Management Plan
WW	Wastewater

A3 DISTRIBUTION LIST

Organizations, and individuals within, that will receive copies of the approved QAPP and any subsequent revisions include:

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Name: Tyler B. Coplen, Ph.D.
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Name: Haiping Qi, Ph.D.
Title: QAO, USGS Reston Stable Isotope Laboratory

The GBRA will provide copies of this QAPP and any amendments or appendices of this QAPP to each person on this list and to each sub-tier project participant, e.g., subcontractors, other units of government, laboratories. The GBRA will document distribution of the QAPP and any amendments and appendices, maintain this documentation as part of the project's QA records, and will be available for review.

A4 PROJECT/TASK ORGANIZATION

The following is a list of individuals and organizations participating in the project with their specific roles and responsibilities:

EPA

Henry Brewer, EPA Project Officer

Responsible for managing the project for the EPA. Reviews project progress and reviews and approves QAPP and QAPP amendments.

TSSWCB

Jana Lloyd, TSSWCB PM

Responsible for ensuring that the project delivers data of known quality, quantity, and type on schedule to achieve project objectives. Provides the primary point of contact between the GBRA and the TSSWCB. Tracks and reviews deliverables to ensure that tasks in the workplan are completed as specified in the contract. Responsible for verifying that the QAPP is followed by the GBRA. Notifies the TSSWCB QAO of significant project nonconformances and corrective actions taken as documented in quarterly progress reports from GBRA Project Manager.

Mitch Conine, TSSWCB QAO

Reviews and approves QAPP and any amendments or revisions and ensures distribution of approved/revised QAPPs to TSSWCB participants. Assists the TSSWCB Project Manager on QA-related issues. Coordinates reviews and approvals of QAPPs and amendments or revisions. Conveys QA problems to appropriate TSSWCB management. Monitors implementation of corrective actions. Coordinates and conducts audits.

GBRA

Mike Urrutia, Project Manager/Quality Assurance Officer/Data Manager

Responsible for implementing the monitoring requirements in the contract and the QAPP. Responsible for writing and maintaining records of the QAPP and its distribution, including appendices and amendments. Responsible for maintaining written records of sub-tier commitment to requirements specified in this QAPP. Coordinates project planning activities and work of project partners. Manager is responsible for ensuring that field data are properly reviewed and verified. Prepares the electronic data deliverables for submission to the TCEQ Data Management and Analysis team, and serves as primary contact with the TCEQ Data Management and Analysis team w/r/t data management/data delivery issues. Ensures that the subcontractors are qualified to perform the contracted work. Maintains quality-assured data on GBRA Internet sites. Ensures TSSWCB project manager and/or QAO are notified of deficiencies and nonconformances, and that issues are resolved. Responsible for validating that data collected are acceptable for reporting to the TCEQ SWQMIS.

Lee Gudgell, Water Quality Technician

Responsible for coordinating sampling events, calibrating equipment and making field measurements of flow and field parameters, and assisting the USGS in the collection of water-quality samples. Maintains records of field data collection and observations. Responsible for uploading data to the TCEQ SWQMIS test site for identification data errors prior to the data transmittal to TCEQ Data Management and Analysis Team.

USGS – South Texas Program Office (STPO)

J. Mark Null, Project Manager:

Responsible for managing and directing the South Texas Program Office, including all water-quality collection activities and ensuring that all aspects of the QAPP are understood and followed by Texas Water Science Center (TWSC) personnel. This is accomplished by his direct involvement or through clearly stated delegation of his responsibility to other appropriate personnel in the TWSC. Responsible for ensuring that the project delivers data of known quality and quantity on schedule to achieve project objectives. Tracks and reviews deliverables to ensure that tasks in the work plan are completed as specified. Provides final resolution of any conflicts or disputes related to the project and for reviewing and ensuring all funding, budgeting, accounting, and expenditures associated with the project.

Rebecca Lambert, Field/Data manager:

Responsible for ensuring that USGS project tasks and other requirements in the contract are executed on time and as defined by the grant work plan; assessing the quality of work by participants; submitting accurate and timely deliverables to the GBRA and TSSWCB Project and Program Managers; and coordinating attendance at conference calls, meetings, and related project activities.

Responsible for coordinating and supervising field sampling activities including sample collection of water-quality samples and quality assurance samples. Responsible for ensuring that field personnel have adequate training and a thorough knowledge of standard operating procedures (SOPs) specific to the analysis or task performed and/or supervised. Responsible for ensuring field-related project tasks and other requirements in the contract are executed on time and in accordance with the QA/QC requirements as defined by the contract work plan and in the QAPP. Ensures that USGS field staff follow the TWSC Surface-Water Quality-Assurance Plan (TWSC-QAPP) and the USGS National Field Manual (USGS-NFM) for the collection and analysis of any data associated with the project. The TWSC-QAPP documents the standards, policies, and procedures used in activities related to the collection, processing, storage, analysis, presentation, and publication of hydrologic data.

Responsible for the checking, reviewing, and finalizing of project data sets. The Field/Data manager may, at his/her discretion, delegate that duty to a senior hydrologic technician with final review and approval by the Field Manager/Data Manager. Ensures that this project is producing data of a known quality and that Project Managers and/or QA Specialists are notified of any deficiencies and nonconformance, and that all issues associated with the project are resolved.

Responsible for the transfer of quality-assured water-quality data to the USGS South Texas Program office from the USGS laboratories. Responsible for coordinating with the GBRA project manager and the TSSWCB QAO to resolve QA-related issues including notification of deficiencies and nonconformances. Responsible for validating that data collected are acceptable for reporting in the final report.

Field Staff, Hydrologic Technicians:

The field staff involved in the Plum Creek Isotope Study will consist of teams of two trained hydrologic technicians that will provide the personnel necessary to complete the project tasks. The field staff assigned to the survey will have been trained and have prior experience in collecting water-quality data at other surface-water and groundwater sites in Texas. The field staff will collect hydrologic data following the guidelines outlined in the TWSC-QAPP and the USGS-NFM. Field staff will collect samples to be analyzed for a selected set of inorganic constituents, nutrients, and environmental isotopes.

USGS - National Water Quality Laboratory (NWQL)

Dave Reppert, Acting Laboratory Chief

Responsible for overall performance, administration, overall quality control and quality assurance and reporting analyses performed by the USGS-NWQL. Responsible for the overall supervision of the laboratory that is accomplished by his direct involvement or through clearly stated delegation of his responsibility to other appropriate personnel in the NWQL. The laboratory chief supervises laboratory personnel, equipment purchases, maintenance of the QA manual for laboratory operations, and supervision of the lab safety program. The laboratory chief also ensures that lab personnel are properly trained and that training records are maintained.

Doug Stevenson, QAO

Responsible for coordinating and implementing the laboratory QA program, and for maintaining the laboratory QAPP and monitoring its implementation. Also responsible for identifying, receiving, and maintaining project QA records. The QAO, or their designated representative, notifies the USGS-STPO Field and/or Project Manager of particular circumstances that may adversely affect the quality of data. Coordinates and monitors deficiencies, nonconformances, and corrective action. Coordinates the research and review of technical QA material and data related to water-quality monitoring system design and analytical techniques.

Laboratory Analyst/Technician

Performs laboratory analyses for inorganic constituents, trace elements, and nutrients as listed in Table A7.1. Any laboratory technician (physical science technician or chemist) involved in sample analysis activities is required to have a current demonstration of capability (DOC) on file for any procedure that he/she will be performing. A DOC affirms that the technician is capable of executing the analytical procedure and producing quality sample analysis results. Laboratory technicians also perform sample custodial duties, receipt of samples, and ensure that all chain of custody (COC) requirements are met when samples are received.

USGS – Reston Stable Isotope Laboratory (RSIL)

Tyler Coplen, Director

Responsible for overall performance, administration, overall quality control and quality assurance, and reporting analyses performed by the USGS-RSIL. Responsible for overall supervision of the laboratory that is accomplished by his direct involvement or through clearly stated delegation of his responsibility to other appropriate personnel in the RSIL. The director supervises laboratory personnel, equipment purchases, maintenance of the QA manual for laboratory operations, and supervision of the lab safety program. He also ensures that lab personnel are properly trained and that training records are maintained.

Haiping Qi, QAO

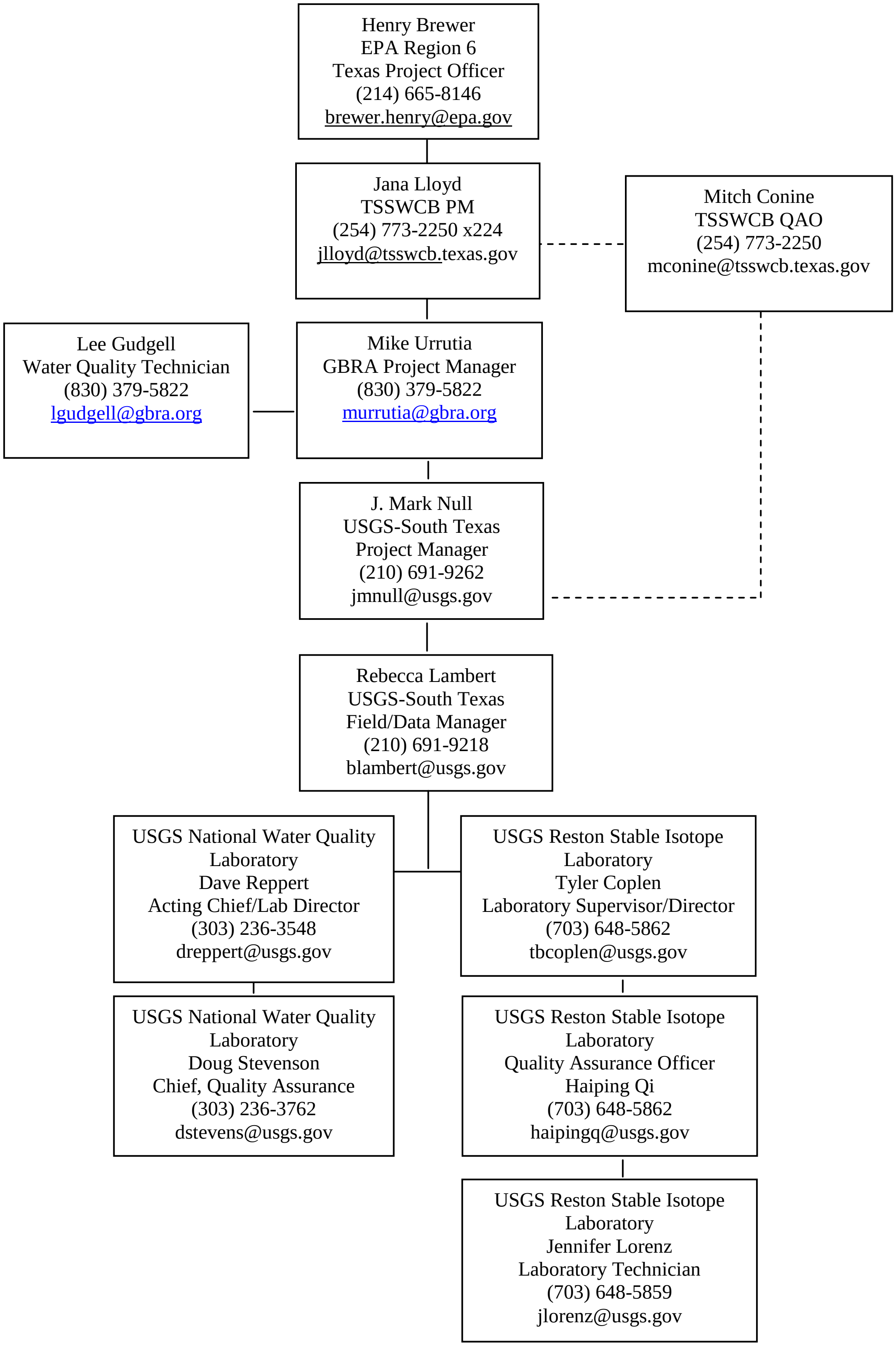
Responsible for the quality assurance of reported analyses performed by the USGS-RSIL. Notifies Field/Data manager of any particular circumstances that may adversely affect the quality of the data. Supervises laboratory, purchasing of equipment, maintain QA manual for laboratory operations, and supervision of lab safety program. Responsible for the coordination and implementation of the laboratory QA program for the USGS-RSIL. Responsible for maintaining the laboratory QAPP and monitoring its implementation. Ensures that lab staff have proper training, training records are maintained, and have a thorough knowledge of the QAPP and related SOPs.

Also responsible for identifying, receiving, and maintaining project QA records. Reviews, validates, and verifies analyses before results are uploaded and transferred to the USGS STPO and the NWIS database. The QAO or their designated representative notifies the USGS-STPO Field and/or Project Manager of any particular circumstances that may adversely affect the quality of data. Coordinates and monitors deficiencies, nonconformances, and corrective action. Coordinates the research and review of technical QA material and data related to water quality monitoring system design and analytical techniques.

Jennifer Lorenz, Lab Analyst/Biologist, USGS-RSIL

Performs sample custodial duties, receipt of samples, and ensures that all chain of custody requirements are met when samples are received. Assists in review, validation, and verification of analytical results before results are uploaded and transferred to the USGS STOP and the NWIS database.

Figure A4.1 Project Organizational Chart* – Lines of Communication



* See Project/Task Organization in this section for a description of each position's responsibilities.

A5 PROBLEM DEFINITION/BACKGROUND

Plum Creek originates in Hays County north of Kyle and runs south through Caldwell County, passing Lockhart and Luling, and eventually joins the San Marcos River at their confluence north of Gonzales County. Plum Creek is 52 miles in length and has a drainage area of 389 mi^2. According to the 2012 Texas Integrated Report and 303(d) List (Texas Commission on Environmental Quality, 2012), all three assessment units of Plum Creek that make up the classified stream segment exhibit nutrient enrichment concerns for ammonia, nitrate+nitrite nitrogen and total phosphorus. The mean concentration of nitrate nitrogen for Assessment Unit (AU) 1810_01 for samples collected from December 2001 through November 2008 is 3.07 milligrams per liter (mg/L), with 25 out of 82 samples exceeding the screening concentration. The mean concentration of nitrate nitrogen for AU 1810_02 is 8.89 mg/L, with 24 out of 27 samples exceeding the screening concentration; and the mean concentration for AU 1810_03 is 9.5 mg/L, with 50 of 82 samples exceeding the screening concentration.

Geronimo Creek and its tributary Alligator Creek are located in Comal and Guadalupe Counties. The almost 70-square-mile watershed lies within the larger Guadalupe River Basin. The headwaters of Alligator Creek begin in southeastern Comal County, just above Interstate 35. The majority of the Alligator Creek watershed lies within the extra-territorial jurisdiction (ETJ) of New Braunfels, while the majority of the Geronimo Creek watershed is almost entirely within the ETJ of Seguin. The majority of Alligator Creek is intermittent with pools during much of the year, until just above its confluence with Geronimo Creek, where it receives spring flow. Geronimo Creek rises approximately one mile east of Clear Springs in northwestern Guadalupe County and runs southeast for 17 miles to its confluence with the Guadalupe River, three miles southeast of Seguin. Geronimo Creek is a perennial stream, receiving flows from Alligator Creek, Baer Creek, an unnamed tributary, and numerous springs along its length. The GBRA has been sampling Geronimo Creek since 1996. The mean concentration for nitrate-nitrogen during that period is 11.0 mg/L, greatly exceeding the assessment screening concentration of 1.95 mg/L and exceeding the EPA drinking water standard of 10.0 mg/L. The only point source of nutrients to the creek is the Geronimo Creek Wastewater Treatment Facility (WWTF) that is owned and operated by the City of Seguin and is within three-quarter mile of the confluence with the Guadalupe River, downstream of the historical monitoring locations. Hence, excess contributions of the nutrient loads are most likely from nonpoint sources. The land use in the area is primarily agricultural. The 44,152-acre watershed is made up of 45.5% cropland, including managed pasture, 31.6% rangeland, 9.8% forest and 11.5% developed land.

TSSWCB and Texas AgriLife Extension Service (Extension) established the Plum Creek Watershed Partnership (PCWP) in April 2006. The PCWP Steering Committee completed the Plum Creek WPP in February 2008 and was accepted by EPA in July 2009. Information about the PCWP, including the WPP, WPP Update, and implementation activities, is available at http://plumcreek.tamu.edu/. Sources of pollutants identified in the Plum Creek WPP include urban storm water runoff, pet waste, failing or inadequate on-site sewage facilities (septic systems), wastewater treatment facilities, livestock, wildlife, invasive species (feral hogs), and oil and gas production. The WPP Update notes that since the completion of the plan and implementation has begun, the watershed has seen significant changes, including severe drought, construction of State Highway 130 and subsequent commercial and residential growth, all of which have altered the land use and management of many areas in the watershed, affecting the implementation of some Best Management Practices (BMPs) (Extension, 2012).

TSSWCB, GBRA and Extension established the Geronimo and Alligator Creeks Watershed Partnership in 2008. The Geronimo Creek Partnership completed the WPP in August 2012 and was accepted by EPA in September 2012. The report states that the chemical quality of the water from wells in the area varies greatly. It goes on to say:

> *"Water from the alluvium and the Leona formation contains elevated nitrates. Nitrate concentrations vary by location within the watershed and by depth of the well. It is not uncommon to have nitrate-nitrogen concentrations at or above the primary drinking water standard of 10 mg/L. Further exploration of the hydraulic connection between these groundwater sources and the water in the creeks may help explain the elevated nitrate-nitrogen levels in the creeks. The draft report goes on to say that while LDC [Load Duration Curve] analysis indicated that nitrate-nitrogen levels exceed the screening criterion across all flow ranges, a review of area water well data in the Texas Water Development Board Groundwater Database revealed evidence of historically elevated nitrate-nitrogen concentrations (2 mg/L to over 40 mg/L) which pre-date the first use of inorganic fertilizers in the late 1940s. For example, one well drilled in the Alligator Creek watershed in 1943 yielded a nitrate concentration of 21.6 mg/L. Water testing data from the same time period for several other wells located in the Leona Formation and in immediately adjacent watersheds showed nitrate-nitrogen concentrations ranging from 10.8 to 21.7 mg/L. These data suggest that "natural", non-anthropogenic sources of nitrate-nitrogen are impacting in-stream levels of this pollutant. More intensive sampling and study would be required to accurately allocate the contribution of nitrates from groundwater. Another important observation is that the loading which might be expected from fertilizer and waste products during runoff conditions is not demonstrated by a noticeable increase in nitrate-nitrogen concentrations in the stream when compared to levels measured during ambient flows. The Steering Committee determined that together, these factors suggest that activities in the watershed are having little impact on in-stream nitrate-nitrogen concentrations."*

Water-quality monitoring is being conducted by GBRA at three sites on Plum Creek through resources dedicated by the TCEQ CRP. Through TSSWCB project 10-07, *Surface Water Quality Monitoring and Additional Data Collection Activities to Support the Implementation of the Plum Creek Watershed Protection Plan*, GBRA is conducting intensive targeted monitoring on tributaries, springs, wastewater effluent, urban storm water runoff, and other main stem in-stream sites. GBRA is conducting water-quality monitoring at one site on Geronimo Creek through resources provided by TCEQ CRP. In addition to the CRP monitoring, GBRA resumed comprehensive water quality monitoring in 2012 in the Geronimo and Alligator Creeks watersheds under TSSWCB project 11-06, *Water Quality Monitoring in the Geronimo Creek Watershed and Facilitation of the Geronimo Creek and Alligator Creeks Watershed Partnership*, and will be used to assess projects identified in the WPP as they are implemented.

The purpose of this QAPP is to clearly delineate GBRA and USGS QA policy, management structure, and procedures that will be used to implement the QA requirements necessary to verify and validate the water-quality data collected for this project. Figure A5.1 and A5.2 are maps of the project watersheds.

Figure A5.1 Plum Creek Watershed and Sampling Locations

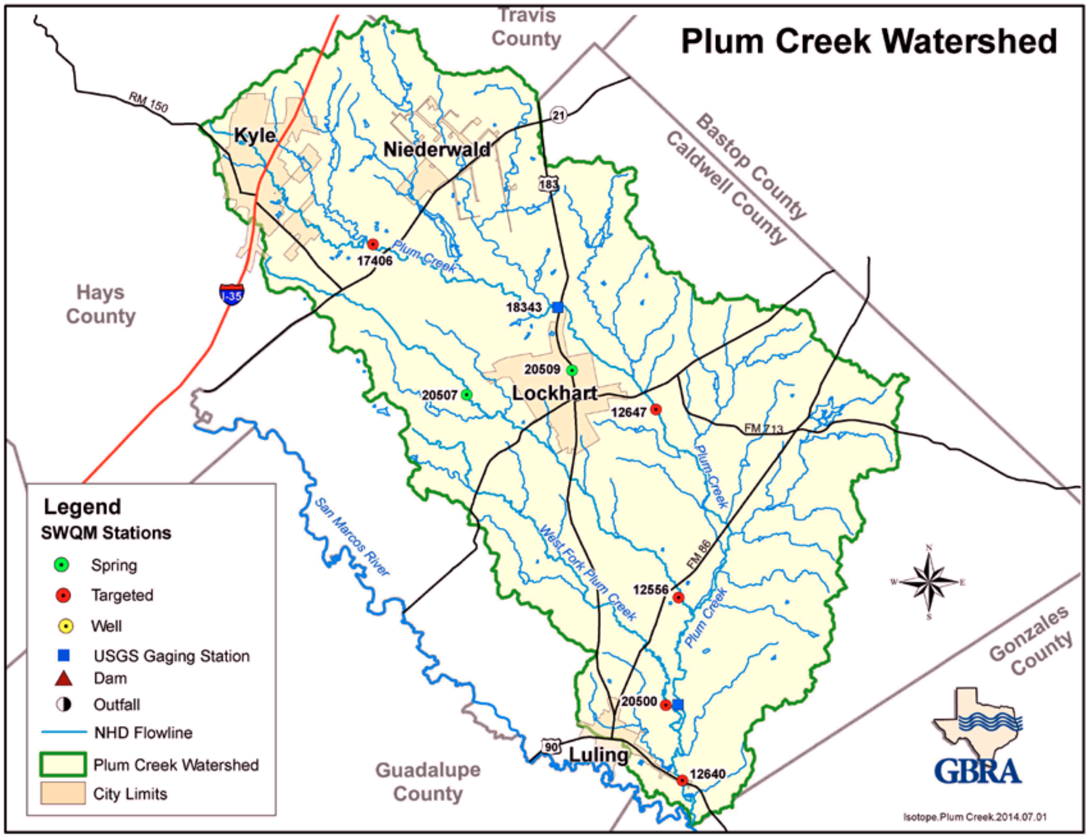
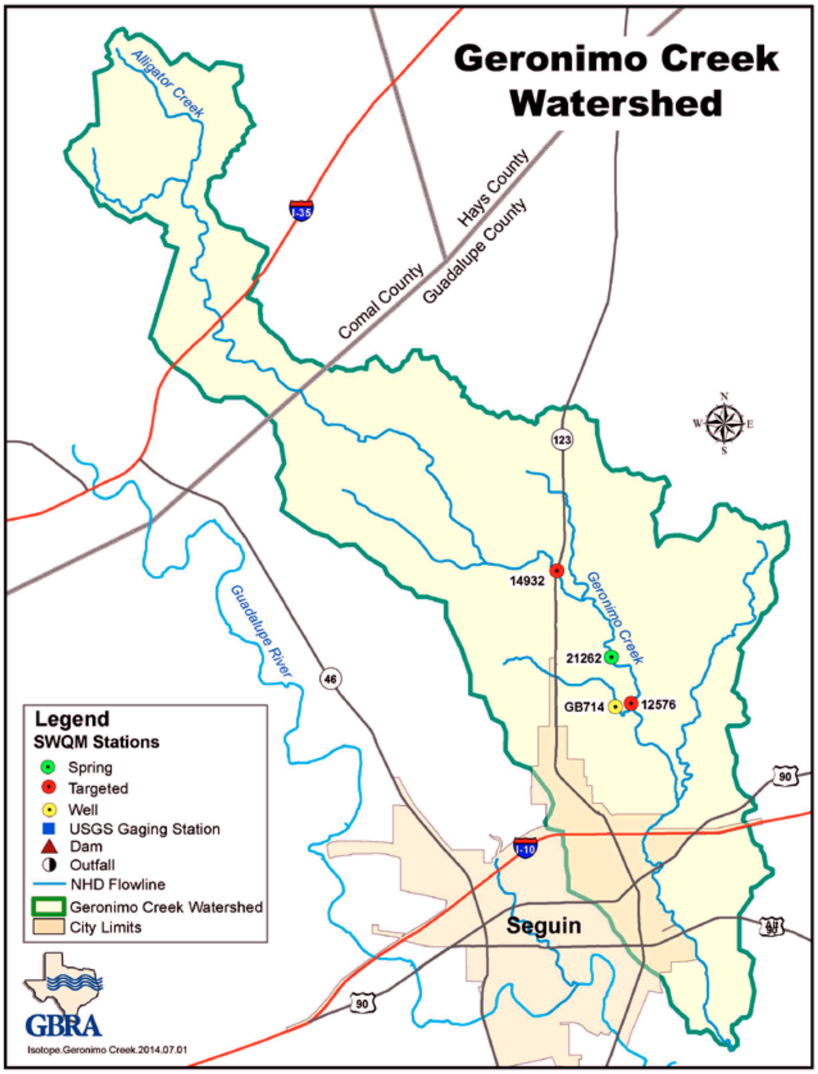


Figure A5.2 Geronimo Creek Watershed and Sampling Locations



A6 PROJECT/TASK DESCRIPTION

Since monitoring of Plum Creek and Geronimo Creek began in the late 1990's, water-quality samples collected from these creeks have shown elevated concentrations of nitrate-nitrogen. Currently (2014), the state stream water-quality standards are not numeric for nutrients, so concentrations exceeding the screening concentration of 1.95 mg/L nitrate-nitrogen have been used to designate a stream as having a concern for nitrate-nitrogen. The possible sources of the nutrient concern are numerous. Plum Creek is effluent-dominated, fed by springs that originate from rocks in the Leona Formation, and known to have elevated concentrations of nitrate-nitrogen. Geronimo Creek also is fed by springs from that same aquifer. Stakeholders in both watersheds have long suspected fertilizer use as the source of the nitrates in the Leona Formation, but elevated concentrations of nitrates have been measured in samples collected from the Leona Aquifer long before commercial inorganic fertilizers came into use. Other possible sources may include septic systems, organic fertilizers, nitrifying plants, and atmospheric deposition.

The TCEQ has begun to develop numeric water quality standards for nitrate-nitrogen. At the end of that process, the standards established by TCEQ and the EPA could move Plum Creek and Geronimo Creek from a designation of "concern for nutrients" to the 303(d) List of impaired waterbodies. The Plum Creek and Geronimo Creek Watershed Partnerships have not waited for "impaired waterbody" status to start working on best management practices (BMPs) that could reduce sources of nitrates. In order to help direct efforts and funding toward the most likely or most influential source(s) of nitrate, this project will look to isotopic signatures of nitrogen and oxygen in the nitrates. The ratios of the isotopes of nitrogen and oxygen in nitrate often can be useful in determining sources of nitrates in groundwater and surface water. Isotopic ratios are expressed as the ratio of the heavier isotope to the lighter isotope relative to a standard in parts per thousand (U.S. Geological Survey, 2011).

A total of 11 sites in the Plum Creek (7) and the Geronimo Creek (4) watersheds will be sampled for field parameters, flow/water level, major ions, selected nutrient species including nitrate-nitrogen, and selected nitrogen, oxygen, and hydrogen isotopes including $^{15}N/^{14}N$ ($\delta^{15}N$) and $^{18}O/^{16}O$ ($\delta^{18}O$) of nitrate and $\delta^{18}O$ and δD of water isotopes approximately quarterly (four times) during the project period. GBRA and USGS will collect surface-water quality samples from five sites in the Plum Creek watershed and from two sites in the Geronimo Creek watershed. If there is insufficient flow at the primary sites to collect the water-quality samples at the time that each synoptic is being conducted, samples will be collected from the alternate sites.

Water-quality samples will be collected over a range in hydrologic conditions (wet and dry conditions). Groundwater-quality samples will be collected from two sites - one site in each watershed. Springflow samples also will be collected from two sites – one site in each watershed. To help characterize possible sources of nitrates to the watersheds, samples of precipitation (rainfall) and wastewater also will be collected to define the end member concentrations of the water chemistry and the isotopes. Up to an additional four (4) precipitation samples and four (4) wastewater samples will be collected during the sampling period for the project. A total of 44 environmental samples will be collected from the surface water, groundwater, and spring sites during the project. Up to eight (8) additional precipitation and wastewater samples will be collected to define the end member concentrations of the water chemistry, and six (6) quality-assurance samples will be collected during the course of the project. The quality-assurance samples will consist of two field blanks (surface water and groundwater) and four split replicate samples. One field blank will be collected each year and a split replicate will be collected each synoptic sampling period.

See Appendix 2 for sampling design and monitoring pertaining to this QAPP.

Table A6.1 QAPP Milestones

TASK	PROJECT MILESTONES	AGENCY	START	END
2.1	Develop QAPP	GBRA and USGS	M1	M9
2.2	Implement, revise and renew QAPP	GBRA and USGS	M9	M36
3.1	Conduct quarterly targeted surface water quality monitoring at 5 sites in Plum Creek watershed	GBRA and USGS	M9	M24
3.2	Conduct quarterly targeted surface water quality monitoring at 2 sites in Geronimo Creek watershed	GBRA and USGS	M9	M24
4.1	Conduct quarterly targeted ground water monitoring on one well site in Plum Creek watershed	GBRA and USGS	M9	M24
4.2	Conduct quarterly targeted ground water monitoring on one well site in Geronimo Creek watershed	GBRA and USGS	M9	M24
5.1	Conduct quarterly targeted spring monitoring at one site in Plum Creek watershed.	GBRA and USGS	M9	M24
5.2	Conduct quarterly targeted spring monitoring at one site in Plum Creek watershed.	GBRA and USGS	M9	M24
6.1	Preparation of interpretive technical report.	USGS	M9	M36
6.2	Upload water quality data to TCEQ SWQMIS quarterly.	GBRA	M9	M36
6.3	Printing and distribution of technical report.	GBRA	M36	M36

A7 QUALITY OBJECTIVES AND CRITERIA FOR DATA QUALITY

Systematic watershed monitoring, is described in the TCEQW SWQM Procedures Manual, vol. 1 as sampling that is planned for a short duration (1 to 2 years) and designed to screen waters that would not normally be included in the routine monitoring program, monitor at sites to check the water quality status, and investigate areas of potential concern.

GBRA and USGS will conduct targeted water-quality monitoring at five surface-water sites, one groundwater site, and one springflow site in the Plum Creek watershed. GBRA and USGS also will conduct approximately quarterly targeted water-quality monitoring at two surface-water sites, one groundwater site, and one springflow site in the Geronimo Creek watershed. The water-quality synoptics will occur approximately quarterly over a 12-month period, for a total of 4 synoptics. Water-quality samples will be collected over a range in hydrologic conditions (wet and dry) during the period. Alternate sites have been identified in the Plum Creek watershed if there is insufficient flow to sample at the primary sites. Additional samples also will be collected from one precipitation site and four wastewater effluent sites in the Plum Creek watershed during the study period.

Sampling is planned to extend over a 12 month period once the QAPP has been approved. Four (4) synoptic samplings will be conducted during the study. Water-quality samples will be collected approximately once a quarter as conditions permit, over a range in hydrologic conditions including baseflow and higher flow after runoff events. "Higher flow conditions" are defined when a rainfall event occurs that is substantial enough to generate runoff. In the Plum Creek watershed, four surface-water quality samples will be collected from each site for a total of 20 samples. The primary sites include the three routine sampling locations in the Clean Rivers Program (17406, 12640, and 12647). The other two sites are routine sites in the TSSWCB CWA Section 319(h) project 10-07, "*Surface Water Quality Monitoring and Additional Data Collection Activities to Support the Implementation of the Plum Creek Watershed Protection Plan*" (12556, 20500).

Four surface-water quality samples will be collected from each of two sites in the Geronimo Creek watershed for a total of eight samples. The sites will be the two historical sampling locations in the Clean Rivers Program (14932 and 12576). If extreme hydrologic conditions exist throughout the first year so that water-quality samples cannot be collected as scheduled because of drought or extended flooding, the USGS will initiate discussions with the GBRA and the TSSWCB to determine whether or not to extend the period of time allowed to collect the needed samples or assess if enough data have been collected to meet the study objectives. Two ground-water quality and two springflow quality samples will be collected, one of each type from each watershed for a total of eight samples each.

Four precipitation samples and four wastewater samples will be collected to characterize the chemical concentrations of potential end-member sources of nitrates to the watersheds. The precipitation samples will be collected using a portable precipitation collector setup that will be deployed at the Lockhart Water Plant prior to a precipitation event. The proposed site for the collection of the precipitation samples is on the grounds of the Lockhart water plant where there is a secured area for the collector to be deployed during an event. The collector will be deployed a distance away from the water plant and away from the influence of trees, etc., but inside the fence to maintain security for the sampler and to help reduce the possibility of contamination from point sources. When the storm event has concluded, the precipitation sample will be put on ice and transported to the USGS office laboratory in San Antonio for processing. By collecting precipitation samples, the quality of atmospheric deposition can be characterized and information provided on one of the inputs to the nitrogen budget in the watershed. The timing of collection of the samples will be based on precipitation events in the watershed and may not coincide with the timing of the collection of the remaining samples. The wastewater samples will be collected from the outfalls of permitted wastewater discharge sites in the Plum Creek watershed. The samples will be collected from the following wastewater treatment plants: 1) City of Kyle, 2) City of Buda, 3) City of Luling, and 4) City of Lockhart no. 2. The four effluent samples will be collected during one of the periods when the other surface-water, groundwater, and spring samples are being collected. The wastewater treatment plants will only be sampled once during the course of the study.

Flow, groundwater levels, and field parameters will be collected by GBRA. The USGS will collect water-quality samples that will be analyzed for select nutrient species, nitrogen isotopes, and major ions. The nutrient and major ion samples will be analyzed at the USGS's National Water Quality Laboratory (NWQL) in Denver, Colorado, and the nitrogen, oxygen, and deuterium isotope samples will be analyzed at the USGS's Reston Stable Isotope Laboratory (RSIL) in Reston, Virginia. Field parameters will include pH, temperature, specific conductance, dissolved oxygen, and turbidity. Conventional parameters will include nutrient species, major ions, and nitrate-nitrogen isotopes ($\delta^{15}N$ nitrogen, $\delta^{18}O$ oxygen, and δD hydrogen). Flow parameters will be collected at surface-water sites by gage, electric, mechanical or Doppler means, and will include severity. Groundwater levels will be made by a tapedown using a steel tape or an electric tape (E-Line).

The measurement performance specifications to support the project objectives for a minimum data set are specified in Table A7.1 and in the text following.

Table A7.1 Measurement Performance Specifications

PARAMETER	UNITS	MATRIX	METHOD	PARA-METER CODE[2]	AWRL[3]	LOQ[4]	LOQ CHECK STD %Rec	PRECISION (RPD of LCS/LCS dup)	BIAS (%Rec. of LCS)	Lab
Field Parameters										
pH	units	water	SM 4500-H^+ B. & TCEQ SOP, V1	00400	NA[1]	NA	NA	NA	NA	Field
DO	mg/L	water	SM 4500-O G. & TCEQ SOP, V1	00300	NA[1]	NA	NA	NA	NA	Field
Conductivity	umhos/cm	water	SM 2510 & TCEQ SOP, V1	00094	NA[1]	NA	NA	NA	NA	Field
Temperature	ºC	water	SM 2550 & TCEQ SOP, V1	00010	NA[1]	NA	NA	NA	NA	Field
Turbidity-Field	FNU	water	USGS TWRI 9-A6.7	63680[2]	NA	NA	NA	NA	NA	Field
Flow	cfs	water	TCEQ SOP, V1	00061	NA[1]	NA	NA	NA	NA	Field
Days since precipitation event	days	other	TCEQ SOP, V1	72053	NA[1]	NA	NA	NA	NA	Field

PARAMETER	UNITS	MATRIX	METHOD	PARA-METER CODE[2]	AWRL[3]	LOQ[4]	LOQ CHECK STD %Rec	PRECISION (RPD of LCS/LCS dup)	BIAS (%Rec. of LCS)	Lab
Flow measurement method	1-gage 2-electric 3-mechanical 4-weir/flume 5-doppler	water	TCEQ SOP, V1	89835	NA[1]	NA	NA	NA	NA	Field
Flow severity	1-no flow 2-low 3-normal 4-flood 5-high 6-dry	water	TCEQ SOP, V1	01351	NA[1]	NA	NA	NA	NA	Field
Flow Estimate	Cubic feet per second (ft^3/s)	water	TCEQ SOP, V1	74069	NA[1]	NA	NA	NA	NA	Field
Depth to water	Ft	water	USGS T&M 1-A1	72019	NA	NA	NA	NA	NA	Field
Conventional and Isotopic Parameters										
pH, unfiltered, lab	units	water	USGS I-2587-89	00403	NA	0.1	NA	NA	NA	NWQL
Specific conductance, unfiltered, lab	µS/cm	water	USGS I-2781-85	00095	NA	5	NA	NA	NA	NWQL
Alkalinity, filtered, field	mg/L	water	USGS TWRI 9-A6.6	39086	20	1	NA	NA	NA	Field
Bicarbonate, filtered, field	mg/L	water	USGS TWRI 9-A6.6	00453	NA	1	NA	NA	NA	Field
Carbonate, filtered, field	mg/L	water	USGS TWRI 9-A6.6	00452	NA	1	NA	NA	NA	Field
Hydroxide, filtered, field	mg/L	water	USGS TWRI 9-A6.6	71834	NA	1	NA	NA	NA	Field
Hardness	mg/L	water	Algorithm	00900	5	NA	NA	20	80-120	NWQL
Dissolved solids, filtered	mg/L	water	USGS I-1750-89	70300	10	20	NA	20	80-120	NWQL
Boron, filtered	µg/L	water	USGS I-1472-95	01020	NA	2	70-130	20	80-120	NWQL
Bromide, filtered	mg/L	water	USGS I-2057-85	71870	NA	0.03	70-130	20	80-120	NWQL
Calcium, filtered	mg/L	water	USGS I-1427-87	00915	NA	0.022	70-130	20	80-120	NWQL
Magnesium, filtered	mg/L	water	USGS I-1427-87	00925	NA	0.011	70-130	20	80-120	NWQL
Potassium, filtered	mg/L	water	USGS 3120	00935	NA	0.03	70-130	20	80-120	NWQL
Sodium, filtered	mg/L	water	USGS I-1427-87	00930	NA	0.06	70-130	20	80-120	NWQL
Silica, filtered	mg/L	water	USGS I-1427-87	00955	NA	0.018	70-130	20	80-120	NWQL
Chloride, filtered	mg/L	water	USGS I-2057-85	00940	5	0.02	70-130	20	80-120	NWQL
Fluoride, filtered	mg/L	water	USGS I-2057-85	00950	NA	0.01	70-130	20	80-120	NWQL
Strontium, filtered	µg/L	water	USGS I-1427-87	01080	NA	0.02	70-130	20	80-120	NWQL
Sulfate, filtered	mg/L	water	USGS I-2057-85	00945	5	0.02	70-130	20	80-120	NWQL
Ammonia, filtered	mg/L	water	USGS I-2525-89, USGS I-2522-90	00608	NA	0.010	70-130	20	80-120	NWQL
Total Kjeldahl Nitrogen (TKN), unfiltered	mg/L	water	USGS I-4515-91	00625	0.2	0.07	70-130	20	80-120	NWQL
Nitrite, filtered	mg/L	water	USGS I-2540-89, USGS I-2542-90,	00613	NA	0.0010	70-130	20	80-120	NWQL

PARAMETER	UNITS	MATRIX	METHOD	PARA-METER CODE[2]	AWRL[3]	LOQ[4]	LOQ CHECK STD %Rec	PRECISION (RPD of LCS/LCS dup)	BIAS (%Rec. of LCS)	Lab
Nitrate + nitrite , filtered	mg/L	water	NWQL I-2548-11	00631	NA	0.01	70-130	20	80-120	NWQL
Phosphorus, filtered	mg/L	water	NWQL I-2650-03	00666	NA	0.010	70-130	20	80-120	NWQL
Orthophosphate, as P, filtered	mg/L	water	USGS I-2606-89, USGS I-2601-90	00671	0.04	0.004	70-130	20	80-120	NWQL
Phosphorus, unfiltered	mg/L	water	USGS I-4650-03	00665	0.06	0.010	70-130	20	80-120	NWQL
$^{15}N/^{14}N$ of NO_3	per mil	water	RSIL LC-2900	82690[2]	NA	NA	NA	NA	NA	RSIL
$^{18}O/^{16}O$ of NO_3	per mil	water	RSIL LC-2900	63041[2]	NA	NA	NA	NA	NA	RSIL
$^{18}O/^{16}O$ of water	per mil	water	RSIL LC-489	82699[2]	NA	NA	NA	NA	NA	RSIL
$^{2}H/^{1}H$ of water	per mil	water	RSIL LC-1574	82082[2]	NA	NA	NA	NA	NA	RSIL

1 Reporting to be consistent with TCEQ SWQM guidance where possible and based on measurement capability.
2 USGS parameter code listed for specific analysis. Not all parameter codes will match TSWQS. Parameter codes that are unique to USGS and not found in the TCEQ parameter code master list will be deleted before uploading to SWQMIS, but will be reported as part of the final report.
3 AWRLs listed for parameters on the TCEQ AWRL master list available at http://www.tceq.texas.gov/waterquality/clean-rivers/qa/index.html.
4 The Limit of Quantification (LOQ) is equivalent to the USGS's Reporting Limit (RL). Values provided for the LOQ are the NWQL RLs for a specific constituent measured using the listed analytical methods.

References for Table A7.1:

American Public Health Association (APHA), American Water Works Association (AWWA), and Water Environment Federation (WEF), "Standard Methods for the Examination of Water and Wastewater," 20th Edition, 1998

American Public Health Association (APHA), American Water Works Association (AWWA), and Water Environment Federation (WEF), 1998, Standard methods for the examination of water and wastewater (20th edition), 3120, p. 3-37 to 3-43. (Method ID: USGS 3120)

Coplen, T.B., Qi, Haiping, Révész, Kinga, Casciotti, Karne, and Hannon, J.E., 2012, Determination of the $\delta^{15}N$ and $\delta^{18}O$ of nitrate in water; RSIL lab code 2900, chap. 17 *of* Stable isotope-ratio methods, sec. C *of* Révész, Kinga, and Coplen, T.B., eds., Methods of the Reston Stable Isotope Laboratory (slightly revised from version 1.0 released in 2007): U.S. Geological Survey Techniques and Methods, book 10, 35 p., available only at http://pubs.usgs.gov/tm/2006/tm10c17/. (Supercedes version 1.0 released in 2007.)

Cunningham, W.L., and Schalk, C.W., 2011, Groundwater technical procedures of the U.S. Geological Survey: U.S. Geological Survey Techniques and Methods 1-A1, 151 p. (Method: USGS T&M 1-A1). Also available online at http://pubs.usgs.gov/tm/1a1.

Fishman, M.J., ed., 1993, Methods of analysis by the U.S. Geological Survey National Water Quality Laboratory – Determination of inorganic and organic constituents in water and fluvial sediments: U.S. Geological Survey Open-File Report 93-125, 217 p. (Method ID: I-1472-87, I-2525-89, I-2522-90, I-2601-90, I-2606-89)

Fishman, M.J., and Friedman, L.C., 1989, Methods for determination of inorganic substances in water and fluvial sediments: U.S. Geological Survey Techniques of Water-Resources Investigations, book 5, chap. A1, 545 p. (Method ID: I-2587-89, I-2781-85, I-1750-89, I-2057-85, I-1630-85)

Patton, C.J., and Kryskalla, J.R., 2003, Methods of analysis by the U.S. Geological Survey National Water Quality Laboratory: Evaluation of alkaline persulfate digestion as an alternative to Kjeldahl digestion for determination of total and dissolved nitrogen and phosphorus in water: Water-Resources Investigations Report 03-4174, 33 p. (Method ID: I-4650-03; I-2650-03)

Patton, C.J., and Kryskalla, J.R., 2011, Colorimetric determination of nitrate plus nitrite in water by enzymatic reduction, automated discrete analyzer methods: U.S. Geological Survey Techniques and Methods, book 5, chap. B8. (Method ID: I-2548-11)

Patton, C.J., and Truitt, E.P., 2000, Methods of analysis by the U.S. Geological Survey National Water Quality Laboratory – Determination of ammonium plu organic nitrogen by a Kjeldahl digestion method and an automated photometric finish that includes digest cleanup by gas diffusion: U.S. Geological Survey Open-File Report 00-170, 31 p. (Method ID: I-4515-91)

Révész, Kinga, and Coplen, T.B., 2008, Determination of the $\delta(^{2}H/^{1}H)$ of water: RSIL lab code 1574, chap. C1 *of* Révész, Kinga, and Coplen, T.B., eds., Methods of the Reston Stable Isotope Laboratory: U.S. Geological Survey Techniques and Methods 10-C1, 27 p.

Révész, Kinga, and Coplen, T.B., 2008, Determination of the $\delta(^{18}O/^{16}O)$ of water: RSIL lab code 489, chap. C2 *of* Révész, Kinga, and Coplen, T.B., eds., Methods of the Reston Stable Isotope Laboratory: U.S. Geological Survey Techniques and Methods 10-C2, 28 p.

Rounds, S.A., 2006, Alkalinity and acid neutralizing capacity (version 3.0), *in* National field manual for the collection of water-quality data, Wilde, F.D. and Radtke, D.B., eds., U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, Chapter A6, Section 6.6, 53 p. (Also available at *http://water.usgs.gov/owq/FieldManual/Chapter6/section6.6/*.)

Struzeski, T.M., DeGiacomo, W.J., and Zayhowski, E.J., 1996, Methods of analysis by the U.S. Geological Survey National Water Quality Laboratory – Determination of dissolved aluminum and boron in water by inductively coupled plasma-atomic emission spectrometry: U.S. Geological Survey Open-File Report 96-149, 17 p. (Method ID: I-1472-95)

TCEQ SOP, V1 - TCEQ SWQM Procedures, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, August 2012 or subsequent editions (RG-415)

United States Environmental Protection Agency (USEPA) "Methods for Chemical Analysis of Water and Wastes," Manual #EPA-600/4-79-020.

U.S. Geological Survey, 2010, Quality Assurance Plan for Groundwater Activities: Available at http://tx.cr.usgs.gov/GWQAP.20120222. Accessed on April 11, 2014. (Method ID: USGS T&M 1-A1).

U.S. Geological Survey, 2012, National Field Manual, Chapter A6. Field Measurements, Section 6.6. Alkalinity and Acid Neutralizing Capacity: U.S. Geological Survey Techniques of Water Resources Investigations (TWRI), Book 9, Chapter A6, Section 6.6. (Method ID: USGS TWRI 9-A6.6).

U.S. Geological Survey, 2012, National Field Manual, Chapter A6. Field Measurements, Section 6.7. Turbidity: U.S. Geological Survey Techniques of Water Resources Investigations (TWRI), Book 9, Chapter A6, Section 6.7. (Method ID: USGS TWRI 9-A6.7).

Ambient Water Reporting Limits (AWRLs)

The Ambient Water Reporting Limit (AWRL) establishes the reporting specification at or below which data for a parameter must be reported to be compared with freshwater screening criteria. The AWRLs specified in Table A7.1 are the program-defined reporting specifications for each analyte and yield data acceptable for TCEQ. Because the project is collecting water-quality data under targeted conditions the data will be submitted to TCEQ, but will not be used in water-quality assessments. The data is being collected to establish the origin of a recognized nutrient concern or degradation of the water body. The Limit of Quantification (LOQ) (formerly known as the reporting limit) is the minimum level, concentration, or quantity of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. The following requirements must be met to report results to the TSSWCB:

- The laboratory's LOQ for each analyte must be at or less than the AWRL as a matter of routine practice
- The laboratory must demonstrate its ability to quantitate at its LOQ for each analyte by running an LOQ check standard for each batch of samples analyzed.

Laboratory Measurement QC Requirements and Acceptability Criteria are provided in Section B5.

Precision

Precision is the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. It is a measure of agreement among replicate measurements of the same property, under prescribed similar conditions, and is an indication of random error.

Field split replicates are used to assess the variability of sample handling, preservation, and storage, as well as the analytical process, and are prepared by splitting samples in the field. Control limits for field split replicates are defined in Section B5.

Laboratory precision is assessed by comparing replicate analyses of laboratory control samples in the sample matrix (e.g. deionized water, sand, commercially available tissue). Precision results are compared against measurement performance specifications and used during evaluation of analytical performance. Program-defined measurement performance specifications for precision are defined in Table A7.1.

Bias

Bias is a statistical measurement of correctness and includes multiple components of systematic error. A measurement is considered unbiased when the value reported does not differ from the true value. Bias is determined through the analysis of laboratory control samples and LOQ check standards prepared with verified and known amounts of all target analytes in the sample matrix (e.g. deionized water) and by calculating percent recovery. Results are compared against measurement performance specifications and used during evaluation of analytical performance. Program-defined measurement performance specifications for LCSs are specified in Table A7.1.

Representativeness

Site selection, the appropriate sampling regime, the sampling of all pertinent media according to USGS SOPs (Appendixes 2-5), and use of only approved analytical methods will assure that the measurement data represents the conditions at the monitoring sites.

Data collection for targeted sampling will be toward both ambient conditions and those conditions that are influenced by storm events. Spring flow will be collected spatially, seasonally and under varying meteorological conditions. Sampling of wells and wastewater treatment plants will be conducted once per quarter, without regard to specific meteorological conditions. Rainfall samples will be collected under varying meteorological conditions. Representativeness will be measured with the completion of sample collection in accordance with the approved QAPP.

Comparability

Confidence in the comparability of targeted data sets for this project is based on the commitment of project staff to use only approved sampling and analysis methods and QA/QC protocols in accordance with quality system requirements and as described in this QAPP and in USGS SOPs. Comparability is also guaranteed by reporting data in standard units, by using accepted rules for rounding figures, and by reporting data in a standard format as specified in Section B10.

Completeness

The completeness of the data is basically a relationship of how much of the data is available for use compared to the total potential data. Ideally, 100% of the data should be available. However, the possibility of unavailable data due to accidents, insufficient sample volume, broken or lost samples, etc. is to be expected. Therefore, it will be a general goal of the project that 90% data completion is achieved.

A8 SPECIAL TRAINING/CERTIFICATION

New GBRA field personnel receive training in proper sampling and field analysis. Before actual sampling or field analysis occurs, they demonstrate to the GBRA QAO (or designee) their ability to properly calibrate field equipment and perform field sampling and analysis procedures. Field personnel training is documented and retained in the personnel file and are available during a monitoring systems audit.

New USGS field personnel receive training in proper water-quality sampling methods described in Appendix 3. Before actual sampling or field analysis occurs, they demonstrate to the QAO (or designee) their ability to properly calibrate field equipment and perform field sampling and analysis procedures. Field personnel training is documented and retained in the personnel file and are available during a monitoring systems audit.

A9 DOCUMENTS AND RECORDS

The documents and records that describe, specify, report, or certify GBRA activities are listed. These reports may or may not be kept in paper form since the reports can be regenerated from the lab database at any time. If kept, the paper form is kept for a minimum of one year and then scanned into the GBRA ITRAX for permanent record.

The GBRA laboratory database is housed on the laboratory computer and is backed up on the network server nightly. A back up copy of the network server files, including ITRAX, is made every Monday and that copy is stored off-site at a protected location. The GBRA network administrator is responsible for the servers and back up generation.

The documents and records that describe, specify, report, or certify USGS activities are listed. These reports may or may not be kept in paper form since the reports can be regenerated from the USGS NWIS database at any time. If kept, the paper form is kept for a minimum of one year and scanned for permanent record (Appendixes 4-5).

Table A9.1 Project Documents and Records

Document/Record	Location	Retention (yrs)	Format
QAPPs, amendments and appendices	TSSWCB/GBRA/USGS	One Year/ Indefinitely	Paper/ Electronic
QAPP distribution documentation	GBRA/USGS	One Year/ Indefinitely	Paper/ Electronic
QAPP commitment letters	GBRA/USGS	One Year/ Indefinitely	Paper/ Electronic
Field notebooks or data sheets	GBRA/USGS	One Year/ Indefinitely	Paper/ Electronic
Field staff training records	GBRA/USGS	One Year/ Indefinitely	Paper/ Electronic
Field equipment calibration/maintenance logs	GBRA/USGS	One Year/ Indefinitely	Paper/ Electronic
COC records	GBRA/USGS	One Year/ Indefinitely	Paper/ Electronic
Field SOPs	GBRA/USGS	One Year/ Indefinitely	Paper/ Electronic
Corrective Action Documentation	GBRA/USGS	One Year/ Indefinitely	Paper/ Electronic

The TSSWCB may elect to take possession of records or receive copies of the records at the conclusion of the specified retention period.

Laboratory Test Reports

Analytical results from the USGS's NWQL and RSIL laboratories will be clearly and accurately documented in the test results reports. The requirements for reporting data and the procedures will be provided and include:

* title of report and unique identifiers on each page
* name and address of the laboratory

* name and address of the client
* clear identification of the sample(s) analyzed
* date and time of sample receipt
* date and time of collection
* sample depth (as applicable)
* identification of method used
* identification of samples that did not meet QA requirements and why (i.e., holding times exceeded)
* sample results
* units of measurement
* sample matrix
* dry weight or wet weight (as applicable)
* project-specific QC results including field split results (as applicable); equipment, trip, and field blank results (as applicable); and LOQ and LOD confirmation (% recovery) (as applicable);
* narrative information on QC failures or deviations from requirements that may affect the quality of results or is necessary for verification and validation of data.

Electronic Data

Selected data will be submitted electronically to TCEQ's Data Management and Analysis Team for upload to SWQMIS. A completed Data Summary (Appendix 6), as described in the most recent version of *TCEQ SWQM Data Management Reference Guide*, will be submitted with each data submittal.

Amendments to the QAPP

Revisions to the QAPP may be necessary to address incorrectly documented information or to reflect changes in project organization, tasks, schedules, objectives, and methods. Requests for amendments will be directed from the GBRA Project Manager to the TSSWCB Project Manager electronically. Amendments are effective immediately upon approval by the GBRA Project Manager, the USGS Project Manager, the GBRA and USGS QAOs, the TSSWCB Project Manager, and the TSSWCB QAO. They will be incorporated into the QAPP by way of attachment and distributed to personnel on the distribution list by the GBRA Project Manager.

B1 SAMPLING PROCESS DESIGN

The sample design is based on the intent of this project as recommended by the USGS and the PCWP Steering Committee. Both Plum Creek and Geronimo Creek exhibit nutrient enrichment concerns for nitrate+nitrite nitrogen. To help direct efforts and funding toward the most likely or most influential source(s) of nitrate, this project will look to isotopic signatures of nitrogen and oxygen in the nitrates. The ratios of the isotopes of nitrogen and oxygen in nitrate often are useful for determining sources of nitrates in groundwater and surface water. Isotopic ratios are expressed as the ratio of the heavier isotope to the lighter isotope relative to a standard in parts per thousand (USGS, 2011).

GBRA and USGS will conduct quarterly targeted surface water quality monitoring at 5 sites in the Plum Creek watershed and at 2 sites in the Geronimo Creek watershed over a range in hydrologic conditions (wet and dry conditions), collecting field, flow and conventional parameter groups. Sites for targeted monitoring were selected to represent spatial, seasonal and meteorological conditions throughout the Plum Creek and Geronimo Creek watersheds and in the Leona Aquifer. Sample collection will occur approximately every quarter and over a range in hydrologic conditions. The surface water will be sampled for major ions, selected nutrient species including nitrate-nitrogen, and ($^{15}N/^{14}N$) and oxygen ($^{18}O/^{16}O$) isotopes four times during the project period.

GBRA and USGS will conduct quarterly targeted groundwater quality monitoring at one well site in the Plum Creek watershed and one well site in the Geronimo Creek watershed, collecting field and conventional parameter groups. The ground water will be sampled for major ions, selected nutrient species including nitrate-nitrogen, and ($^{15}N/^{14}N$) and oxygen ($^{18}O/^{16}O$) isotopes four times during the project period.

GBRA and USGS will conduct quarterly targeted spring quality monitoring at one site in the Plum Creek watershed and one site in the Geronimo Creek watershed, collecting field and conventional parameter groups. The springs will be sampled for major ions, selected nutrient species including nitrate-nitrogen, and ($^{15}N/^{14}N$) and oxygen ($^{18}O/^{16}O$) isotopes four times during the project period. The data will be collected at a location that is in the closest proximity to the headwaters of each spring and with enough depth to collect a representative sample. Care will be given to sample above stream features such as riffles that could influence water quality after the spring emerges from the ground. Flow will be measured manually or estimated at each spring.

A total of 44 environmental samples and six (6) quality-assurance samples will be collected. The quality-assurance samples will consist of 2 field blanks and 4 split replicate samples.

The area has been known to experience scattered showers, i.e., afternoon heat-related showers of short duration that may cause some portions of the watershed to be under wet weather conditions while others are not. Targeted monitoring sites will be visited when the overall watershed is under the specific weather conditions, dry or wet. There may be times, during dry weather conditions, when there is no water in the stream in the subwatersheds. Those visits will be documented but no stream data will be collected. During wet weather conditions, the safety of the sampling crew will not be compromised in case of lightning or flooding. If there is an instance where a sampling site is inaccessible because of weather conditions or flooding, “no sample due to inaccessibility” will be documented in the field notebook.

See Appendix 2 for sampling process design information and monitoring tables associated with data collected under this QAPP.

B2 SAMPLING METHODS

Field Sampling Procedures

Field parameters will be collected by GBRA and measured according to procedures documented in the *TCEQ Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue (RG-415)*, or the most recent version with any interim changes posted to the Surface Water Quality Monitoring Procedures website (http://www.tceq.texas.gov/waterquality/monitoring/swqm_procedures.html). Updates shall be incorporated into program procedures, QAPP, SOPs, etc., within 60 days of any final published version. All following references to "TCEQ Surface Water Quality Monitoring Procedures," "TCEQ Surface Water Quality Monitoring Procedures as amended," "SWQM Procedures," "SWQM Procedures Manual," "*TCEQ Surface Water Quality Monitoring Procedures Volume 1 (RG-415*)," refer to this section and are used interchangeably. USGS check measurements of streamflow discharge measurements will be made using the methods discussed in the USGS's *Discharge Measurements at Gaging Stations* (Appendix 7) (Turnipseed and Sauer, 2010), Additional aspects outlined in Section B below reflect specific requirements for sampling under this project and/or provide additional clarification.

Water-quality field samples and associated water-quality field parameters such as alkalinity will be collected by the USGS according to procedures documented in the *USGS National Field Manual for the Collection of Water-Quality Data Techniques of Water-Resources Investigations Book 9 available online at http://pubs.water.usgs.gov/trwi9A/* (U.S. Geological Survey, variously dated) (Appendix 3), the *USGS's Quality Management Plan for Environmental Projects* (U.S. Geological Survey, 2010) (Appendix 4), and the USGS's *Quality Assurance Plan for Water-Quality Activities in the Texas Water Science Center* (U.S. Geological Survey, 2009) (Appendix 5).

Table B2.1 Sample Storage, Preservation and Handling Requirements

Parameter	Matrix	Container	Preservation*	Sample Volume	Holding Time
pH, lab	Water	Polyethylene bottle	Unfiltered, unacidified	250 or 500 mL	30 days
Specific conductance, lab	Water	Polyethylene bottle (RU)	Unfiltered, unacidified	250 or 500 mL	30 days
Alkalinity, field	Water	Polyethylene bottle (FU)	Filter through 0.45-µm filter; chill; maintain at 4 °C ± 2 °C	250 mL	Process immediately
Total dissolved solids	Water	Polyethylene bottle (FU)	Filter through 0.45-µm filter	250 mL	180 days
Boron	Water	Polyethylene bottle, acid-rinsed (FA)	Filter through 0.45-µm filter; acidify to pH < 2 with 2 mL Ultrex HNO_3 (nitric acid)	125 or 250 mL	180 days
Bromide	Water	Clear polyethylene bottle (FU)	Filter through 0.45-µm filter	250 or 500 mL	180 days
Calcium	Water	Polyethylene bottle, acid-rinsed (FA)	Filter through 0.45-µm filter; acidify to pH < 2 with 2 mL Ultrex HNO_3 (nitric acid)	125 or 250 mL	180 days

Magnesium	Water	Polyethylene bottle, acid-rinsed (FA)	Filter through 0.45-µm filter; acidify to pH < 2 with 2 mL Ultrex HNO_3 (nitric acid)	125 or 250 mL	180 days
Potassium	Water	Polyethylene bottle, acid-rinsed (FA)	Filter through 0.45-µm filter; acidify to pH < 2 with 2 mL Ultrex HNO_3 (nitric acid)	125 or 250 mL	180 days
Sodium	Water	Polyethylene bottle, acid-rinsed (FA)	Filter through 0.45-µm filter; acidify to pH < 2 with 2 mL Ultrex HNO_3 (nitric acid)	125 or 250 mL	180 days
Silica	Water	Polyethylene bottle, acid-rinsed (FA)	Filter through 0.45-µm filter; acidify to pH < 2 with 2 mL Ultrex HNO_3 (nitric acid)	125 or 250 mL	30 days
Chloride	Water	Polyethylene bottle (FU)	Filter through 0.45-µm filter	250 or 500 mL	180 days
Fluoride	Water	Polyethylene bottle (FU)	Filter through 0.45-µm filter	250 or 500 mL	180 days
Sulfate	Water	Polyethylene bottle (FU)	Filter through 0.45-µm filter	250 or 500 mL	180 days
Strontium	Water	Polyethylene bottle, acid-rinsed (FA)	Filter through 0.45-µm filter; acidify to pH < 2 with 2 mL Ultrex HNO_3 (nitric acid)	125 or 250 mL	180 days
Nitrogen, ammonia as N	Water	Brown polyethylene bottle (FCC)	Filter through 0.45-µm filter; chill; maintain at 4 °C ± 2 °C	125 mL	30 days
Nitrogen, ammonia + organic nitrogen	Water	Polyethylene bottle (WCA)	Unfiltered, acidify to pH < 2 with 1 mL 4.5 N sulfuric acid; chill; maintain at 4 °C ± 2 °C	125 mL	30 days
Nitrogen, nitrite	Water	Brown polyethylene bottle (FCC)	Filter through 0.45-µm filter; chill; maintain at 4 °C ± 2 °C	125 mL	30 days
Nitrogen, nitrite + nitrate	Water	Brown polyethylene bottle (FCC)	Filter through 0.45-µm filter; chill; maintain at 4 °C ± 2 °C	125 mL	30 days
Phosphorus, total dissolved	Water	Brown polyethylene bottle (FCC)	Filter through 0.45-µm filter; chill; maintain at 4 °C ± 2 °C	125 mL	30 days
Orthophosphate as P	Water	Brown polyethylene bottle (FCC)	Filter through 0.45-µm filter; chill; maintain at 4 °C ± 2 °C	125 mL	30 days
Phosphorus, total	Water	Polyethylene bottle (WCA)	Unfiltered; acidify to pH < 2 with 1 mL 4.5 N sulfuric acid; chill; maintain at 4 °C ± 2 °C	125 mL	30 days
$^{15}N/^{14}N$ of nitrate	Water	Amber polyethylene bottle with Polyseal cap	Filter first through 0.45-µm filter and then second through a 0.2-µm syringe filter; Add reagent-grade NaOH pellets to achieve a pH greater than 10, but not higher than 11.95.	125 mL	120 days
$^{18}O/^{16}O$ of nitrate	Water	Amber polyethylene bottle with Polyseal cap	Filter first through 0.45-µm filter and then second through a 0.2-µm syringe filter; Add reagent-grade NaOH pellets to achieve a pH greater than 10, but not higher than 11.95.	125 mL	120 days
$^{18}O/^{16}O$ of water	Water	Glass bottle with Polyseal cap	Unfiltered; Fill bottle and cap with Polyseal camp	60 mL	180 days
$^{2}H/^{1}H$ of water	Water	Glass bottle with Polyseal cap	Unfiltered; Fill bottle and cap with Polyseal camp	60 mL	180 days

* Preservation occurs within 15 minutes of sample collection or within 15 minutes of the creation of the composite of rainfall sampling

Sample Containers

Samples are collected in either polyethylene or glass bottles, depending on the analysis type (Table B2.1). Samples are cleaned and prepped following the guidelines listed in the USGS's *National Field Manual* (Appendix 3). Samples analyzed for major ions, nutrients, selected trace elements, $\delta^{15}N$ of nitrate, and $\delta^{18}O$ of nitrate are collected in polyethylene bottles that are cleaned with the following procedure: 1) Containers are rinsed with deionized water in the laboratory, and 2) then triple rinsed with environmental sample water prior to filling the bottle. Capsule filters are rinsed with deionized water in the laboratory and then also rinsed with the environmental sample prior to collecting a filtered sample. Care is taken to ensure that the capsule filter is completely purged of deionized water so that sample results are not diluted. Environmental isotope samples for $\delta^{18}O$ and δD are collected in glass bottles and do not require pre-rinsing. Samples are preserved according to preservation requirements listed in Table B2.1.

Processes to Prevent Contamination

Procedures outlined in the USGS's *National Field Manual* (Appendix 3) and the USGS's *Quality-Assurance Plan for Water-Quality Activities in the Texas Water Science Center* (Appendix 5) document the necessary steps to prevent contamination of the samples. Field blank QC samples (identified in Section B5) are collected to verify that contamination has not occurred.

Documentation of Field Sampling Activities

Field parameters are documented on GBRA field data sheets as presented in Appendix 8 and water-quality sample information are documented on USGS field forms presented in Appendixes 9 and 10. The following will be recorded for all visits:

- Station identification
- Sampling date
- Location
- Sampling depth (if applicable)
- Sampling time
- Sample collector's name/signature
- Values for all field parameters, including flow and flow severity (SW and SPR sites) and depth to water (GW sites).
- Detailed observational data, including:
    - water appearance
    - weather
    - biological activity
    - unusual odors
    - pertinent observations related to water quality or stream uses (i.e., exceptionally poor water quality conditions/standards not met; stream uses such as swimming, boating, fishing, irrigation pumps)

    - watershed or instream activities (i.e., bridge construction, livestock watering upstream)
- missing parameters (i.e., when a scheduled parameter or group of parameters is not collected)

The following appendixes contain descriptions and documentation of GBRA and USGS field and water-quality sample collection and report preparation:

Appendix 2 – Sample Process Design and Monitoring Schedule
Appendix 3 – USGS Protocol for collecting water-quality samples (National Field Manual)
Appendix 4 – USGS Water Discipline Quality Management Plan for Environmental Projects
Appendix 5 – USGS TWSC Quality-Assurance Plan for Water-quality Activities in the Texas Water Science Center
Appendix 6 – Data Summary Report
Appendix 7 – USGS Protocol for Discharge Measurements at Gaging Locations
Appendix 8 – GBRA field data sheet
Appendix 9 – USGS Surface-water quality field form
Appendix 10 – USGS Groundwater-quality field form
Appendix 11 – GBRA Chain of Custody Form
Appendix 12 – USGS Chain of Custody Form for NWQL
Appendix 13 – USGS Chain of Custody Form for RSIL
Appendix 14 – USGS Geospatial Requirements/Use in Reports

Recording Data

For the purposes of this section and subsequent sections, all field and laboratory personnel will follow the basic rules for recording information as documented below:

- Legible writing in indelible ink with no modifications, write-overs or cross-outs;
- Correction of errors with a single line followed by an initial and date;
- Close-out on incomplete pages with an initialed and dated diagonal line.

Deficiencies, Nonconformances, and Corrective Action Related to GBRA Field Sampling Requirements

Deficiencies are defined as unauthorized deviations from procedures documented in the QAPP or other applicable documents. Nonconformances are deficiencies that affect data quantity and/or quality and render the data unacceptable or indeterminate. Deficiencies related to sampling method requirements include, but are not limited to, such things as sample container, volume, and preservation variations, improper/inadequate storage temperature, holding-time exceedances, and sample site adjustments.

Deficiencies are documented in logbooks, field data sheets, etc., by field or laboratory staff and reported to the cognizant field or laboratory supervisor who will in turn notify the GBRA Project Manager/QAO of the potential nonconformance. The GBRA Project Manager/QAO will initiate a Nonconformance Report (NCR) to document the deficiency.

The GBRA Project Manager/QAO (and other affected individuals/organizations), will determine if the deficiency constitutes a nonconformance. If the GBRA Project Manager/QAO determines that the activity or item in question does not affect the data quality and therefore is not a valid nonconformance, the NCR will be completed accordingly and the NCR closed. If a nonconformance does exist, the GBRA Project Manager/QAO, will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by the GBRA Project Manager/QAO by completion of a CAR.

CARs document: root cause(s); impact(s); specific corrective action(s) to address the deficiency; action(s) to prevent recurrence; individual(s) responsible for each action; the timetable for completion of each action; and the means by which completion of each corrective action will be documented. CARs will be included with quarterly progress reports. In addition, significant conditions (i.e., situations which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data) will be reported to the TSSWCB immediately both verbally and in writing.

Deficiencies, Nonconformances and Corrective Action Related to USGS Water Quality Sampling Requirements

Deficiencies are defined as unauthorized deviations from procedures documented in the QAPP or other applicable documents. Nonconformances are deficiencies which affect data quantity and/or quality and render the data unacceptable or indeterminate. Deficiencies related to sampling methods requirements include, but are not limited to, such things as sample container, volume, and preservation variations, improper/inadequate storage temperature, holding-time exceedances, and sample site adjustments.

Deficiencies are documented in logbooks, field data sheets, etc. by field staff and reported to the cognizant field supervisor who will notify the USGS Project Manager/QAO. The USGS Project Manager will notify the GBRA Project Manager of the potential nonconformance. The GBRA Project Manager/QAO will initiate a Nonconformance Report (NCR) to document the deficiency.

The USGS Project Manager, in consultation with the GBRA Project Manager/QAO (and other affected individuals/organizations), will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore is not a valid nonconformance, the NCR will be completed accordingly and the NCR closed. If it is determined a nonconformance does exist, the USGS Project Manager, in consultation with GBRA Project Manager/QAO, will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by the USGS Project Manager by completion of a Corrective Action Report.

Corrective Action Reports (CARs) document: root cause(s); impact(s); specific corrective action(s) to address the deficiency; action(s) to prevent recurrence; individual(s) responsible for each action; the timetable for completion of each action; and the means by which completion of each corrective action will be documented. CARs will be included with quarterly progress reports. In addition, significant conditions (i.e., situations which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data) will be reported to the TSSWCB immediately both verbally and in writing.

B3 SAMPLE HANDLING AND CUSTODY

Sample Tracking

Proper sample handling and custody procedures ensure the custody and integrity of samples beginning at the time of sample collection and continuing through transport, sample receipt, preparation, and analysis.

A sample is in custody if it is in actual physical possession or in a secured area that is restricted to authorized personnel. The USGS COC form is a record that documents the possession of the samples from the time of collection to receipt in the specified laboratory. The following information concerning the sample is recorded on the USGS COC forms for the NWQL and the RSIL (See Appendixes 12 and 13).

- Date and time of collection
- Site identification name and number
- Sampler's name
- Sample matrix
- Sample type
- Number of containers and respective volumes
- Preservative used or if the sample was filtered
- Analyses required
- Custody transfer signatures and dates and time of transfer
- Bill of lading (if applicable)
- Laboratory Schedule(s) to be performed

Sample Labeling

Samples from the field are identified by waterproof labels affixed to the container or marked with an indelible marker. Label information includes:

- Site identification name and number
- Date and time of collection of sample
- Sample type
- Amount and type of preservative added, if applicable
- Designation of "field-filtered" as applicable
- Laboratory Schedule(s) to be performed

Sample Handling

After collection of samples are complete, sample containers are immediately stored on ice in an ice chest prior to shipping to the USGS's National Water Quality Laboratory or the USGS's Reston Stable Isotope Laboratory. Samples will be shipped with appropriate USGS COC forms and Analytical Service Request (ASR) forms. Ice chests will remain in the possession of the USGS field technician, in the locked vehicle, or secured area that is restricted to authorized personnel until shipped to the labs. After receipt at the USGS labs, the samples are stored in the refrigeration unit or given to the analyst for immediate analysis. Only authorized laboratory personnel will handle samples received by each laboratory.

Deficiencies, Nonconformances and Corrective Action Related to Chain of Custody (COC)

Deficiencies are defined as unauthorized deviations from procedures documented in the QAPP or other applicable documents. Nonconformances are deficiencies which affect data quantity and/or quality and render the data unacceptable or indeterminate. Deficiencies related to the USGS COC include, but are not limited to, delays in transfer, resulting in holding time violations; incomplete documentation, including signatures; possible tampering of samples; broken or spilled samples, etc.

Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff and reported to the appropriate field or laboratory supervisor who will notify the USGS Project Manager. The USGS Project Manager will also notify the USGS QAO of the potential nonconformance. The USGS QAO will initiate a NCR to document the deficiency.

The USGS Project Manager, in consultation with USGS QAO, will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore is not a valid nonconformance, the NCR will be completed accordingly and the NCR closed. If it is determined a nonconformance does exist, the USGS Project Manager in consultation with the USGS QAO will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by the USGS QAO by completion of a CAR.

CARs document: root cause(s); impact(s); specific corrective action(s) to address the deficiency; action(s) to prevent recurrence; individual(s) responsible for each action; the timetable for completion of each action; and the means by which completion of each corrective action will be documented. CARs will be included with quarterly progress reports. In addition, significant conditions (i.e., situations which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data) will be reported to the GBRA Project Manager/QAO, who in turn will notify TSSWCB Project Manager immediately both verbally and in writing.

B4 ANALYTICAL METHODS

The analytical methods, associated matrices, and performing laboratories are listed in Table A7.1. The authority for analysis methodologies under this project is derived from the TSWQS (Texas Administrative Code §§307.1 - 307.10) in that data generally are generated for comparison to those standards and/or criteria. The standards state that "Procedures for laboratory analysis must be in accordance with the most recently published edition of the book entitled Standard Methods for the Examination of Water and Wastewater, the TCEQ Texas Surface Water Quality Monitoring Procedures as amended, 40 CFR Part 136, or other reliable procedures acceptable to the commission, and in accordance with Chapter 25 of this title." Laboratories collecting data under this QAPP are compliant with the TNI standards, at a minimum, where applicable (Appendix 4). Copies of laboratory QASMs and SOPs are available for review by the TSSWCB to confirm that methods are compliant with TNI standards, and where applicable (Appendix 4).

Standards Traceability

All standards used in the field and laboratory are traceable to certified reference materials. Standards preparation is fully documented and maintained in a standards log book. Each documentation includes information concerning the standard identification, starting materials, including concentration, amount used and lot number; date prepared, expiration date and preparer's initials/signature. The reagent bottle is labeled in a way that will trace the reagent back to preparation. Table A7.1 lists the methods to be used for field and laboratory analyses.

Deficiencies, Nonconformances and Corrective Action Related to Analytical Methods

Deficiencies are defined as unauthorized deviations from procedures documented in the QAPP or other applicable documents. Nonconformances are deficiencies which affect quantity and/or quality and render the data unacceptable or indeterminate. Deficiencies related to field and laboratory measurement systems include, but are not limited to, instrument malfunctions, blank contamination, QC sample failures, etc.

Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff and reported to the cognizant field or laboratory supervisor who will notify the USGS Project Manager. The USGS Project Manager will notify the USGS QAO of the potential nonconformance. The USGS QAO will initiate a NCR to document the deficiency.

The USGS Project Manager, in consultation with USGS QAO (and other affected individuals/organizations), will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore is not a valid nonconformance, the NCR will be completed accordingly and the NCR closed. If it is determined a nonconformance does exist, the USGS Project Manager, in consultation with the USGS QAO, will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by the USGS QAO by completion of a CAR.

CARs document: root cause(s); impact(s); specific corrective action(s) to address the deficiency; action(s) to prevent recurrence; individual(s) responsible for each action; the timetable for completion of each action; and, the means by which completion of each corrective action will be documented. CARs will be included with quarterly progress reports. In addition, significant conditions (i.e., situations which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data) will be reported to GBRA Project Manager/QAO and the TSSWCB Project Manager immediately both verbally and in writing.

B5 QUALITY CONTROL

Sampling Quality Control Requirements and Acceptability Criteria

The minimum Field QC Requirements are outlined in the TCEQ *SWQM Procedures, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue* (RG-415) and the USGS's *National Field Manual* (Appendix 3) and *Quality Assurance Plan for Water-Quality Activities in the Texas Water Science Center* (Appendix 5). Specific requirements are outlined below. Field QC sample results are submitted separately from the laboratory data report (see Section A9).

<u>Field blanks</u>

USGS field blanks are water samples collected to assess the potential contamination associated with field collection or from field sources such as airborne materials, containers, or preservatives. A field blank is prepared and processed in the field according to the appropriate lab schedule by filling a clean container with inorganic or organic blank water, filtering if needed, and appropriate preservative as required. The frequency requirement for field blanks water samples is specified in Appendix 2 – Sample Process Design and Monitoring Schedule.

The analysis of field blanks should yield values lower than the LOQ. When target analyte concentrations are high, blank values should be lower than 5% of the lowest value of the batch. Field blanks are associated with batches of field samples. In the event of a field blank failure for one or more target analytes, all applicable data associated with the field batch will be qualified as not meeting project QC requirements, and these qualified data will not be reported to the TCEQ SWQMIS. These data include all samples collected on that day during that sample run and should not be confused with the laboratory analytical batch.

<u>Field Split Replicates</u>

A USGS field split replicate is a single sample subdivided by field staff immediately following collection and submitted to the laboratory as two separately identified samples according to procedures specified in the USGS's *National Field Manual* (Appendix 3) (U.S. Geological Survey, variously dated). Split replicate samples are preserved, handled, shipped, and analyzed identically and are used to assess the variability in all of these processes. Field split replicates apply to conventional and isotopic samples only and are collected on an approximately 10% basis, or one per batch, whichever is more frequent. The frequency requirement for field split replicates is specified in Appendix 2 – Sample Process Design and Monitoring Schedule.

The precision of field split replicate results is calculated by RPD using the following equation:

$$RPD = (X_1-X_2)/((X_1+X_2)/2)) * 100\%$$

A 30% RPD criteria will be used to screen field split results as a possible indicator of excessive variability in the sample handling and analytical system. If it is determined that elevated quantities of an analyte (i.e., > RL) were measured and analytical variability can be eliminated as a factor, then variability in field split results will primarily be used as a trigger for discussion with field staff to ensure samples are being handled in the field correctly. Some individual sample results may be invalidated based on the examination of all extenuating information. The information derived from field splits is generally considered to be event specific and would not normally be used to determine the validity of an entire batch; however, some batches of samples may be invalidated depending on the situation. Professional judgment during data validation will be relied upon to interpret the results and take appropriate action. The qualification (i.e., invalidation) of data will be documented on the Data Summary. Deficiencies will be addressed as specified in this section under Deficiencies, Nonconformances, and Correction Action related to QC.

Laboratory Measurement Quality Control Requirements and Acceptability Criteria

Method Specific QC requirements

QC samples, other than those specified later in this section, are run (i.e., sample duplicates, surrogates, internal standards, continuing calibration samples, interference check samples, positive control, negative control, and media blank) as specified in the methods. The requirements for these samples, their acceptance criteria or instructions for establishing criteria, and corrective actions are method-specific.

Detailed laboratory QC requirements and corrective action procedures are contained within the individual laboratory QASMs. The minimum requirements that all participants abide by are stated below.

Limit of Quantitation (LOQ)

The laboratory will analyze a calibration standard (if applicable) at the LOQ on each day the project samples are analyzed. Calibrations including the standard at the LOQ will meet the calibration requirements of the analytical method or corrective action will be implemented.

LOQ Check Standard

An LOQ check standard consists of a sample matrix (e.g., deionized water, sand, commercially available tissue) free from the analytes of interest spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes. It is used to establish intra-laboratory bias to assess the performance of the measurement system at the lower limits of analysis. The LOQ check standard is spiked into the sample matrix at a level less than or near the LOQ for each analyte for each batch of samples that are run.

The LOQ check standard is carried through the complete preparation and analytical process. LOQ check standards are run at a rate of one per analytical batch. A batch is defined as samples that are analyzed together with the same method and personnel, using the same lots of reagents, not to exceed the analysis of 20 environmental samples.

The percent recovery of the LOQ check standard is calculated using the following equation in which %R is percent recovery, SR is the sample result, and SA is the reference concentration for the check standard:

$$\%R = SR/SA * 100$$

Measurement performance specifications are used to determine the acceptability of LOQ Check Standard analyses as specified in Table A7.1.

Laboratory Control Standard (LCS)

A LCS consists of a sample matrix (e.g., deionized water) free from the analytes of interest spiked with verified known amounts of analyte. The LCS is spiked into the sample matrix at a level less than or equal to the mid-point of the calibration curve for each analyte. In cases of test methods with very long lists of analytes, LCSs are prepared with all the target analytes and not just a representative number.

The LCS is carried through the complete preparation and analytical process. The LCS is used to document the bias of the analytical process. LCSs are run at a rate of one per batch. A batch is defined as a set of environmental samples that are prepared and/or analyzed together within the same process using the same lot of reagents.

Results of LCSs are calculated by percent recovery (%R), which is defined as 100 times the measured concentration, divided by the true concentration of the spiked sample.

The following formula is used to calculate percent recovery, where %R is percent recovery; SR is the measured result; and SA is the true result:

$$\%R = SR/SA * 100$$

Performance limits and control charts are used to determine the acceptability of LCS analyses. Project control limits are specified in Table A7.1.

Laboratory Duplicates

A laboratory duplicate is prepared in the laboratory by splitting aliquots of an LCS. Both samples are carried through the entire preparation and analytical process. LCS duplicates are used to assess precision and are performed at a rate of one per batch. A batch is defined as a set of environmental samples that are prepared and/or analyzed together within the same process using the same lot of reagents.

For most parameters, precision is calculated by the RPD of LCS duplicate results as defined by 100 times the difference (range) of each duplicate set, divided by the average value (mean) of the set. For duplicate results, X_1 and X_2, the RPD is calculated from the following equation:

$$RPD = (X_1 - X_2)/\{(X_1 + X_2)/2\} * 100$$

Performance limits and control charts are used to determine the acceptability of duplicate analyses. Project control limits are specified in Table A7.1.

Matrix spike (MS)

Matrix spikes are prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available.

Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Percent recovery of the known concentration of added analyte is used to assess accuracy of the analytical process. The spiking occurs prior to sample preparation and analysis. Spiked samples are routinely prepared and analyzed at a rate of 10% of samples processed, or one per batch whichever is greater. A batch is defined as samples that are analyzed together with the same method and personnel, using the same lots of reagents, not to exceed the analysis of 20 environmental samples. The information from these controls is sample/matrix specific and is not used to determine the validity of the entire batch. The MS is spiked at a level less than or equal to the midpoint of the calibration or analysis range for each analyte. Percent recovery (%R) is defined as 100 times the observed concentration, minus the sample concentration, divided by the true concentration of the spike.

The results from matrix spikes are primarily designed to assess the validity of analytical results in a given matrix and are expressed as percent recovery (%R). The laboratory shall document the calculation for %R. The percent recovery of the matrix spike is calculated using the following equation in which %R is percent recovery, SSR is the observed spiked sample concentration, SR is the sample result, and SA is the reference concentration of the spike added:

$$\%R = (SSR - SR)/SA * 100$$

Measurement performance specifications for matrix spikes are not specified in this document.

The results are compared to the acceptance criteria as published in the mandated test method. Where there are no established criteria, the laboratory shall determine the internal criteria and document the method used to establish the limits. For matrix spike results outside established criteria, corrective action shall be documented or the data reported with appropriate data qualifying codes.

<u>Method blank</u>

A method blank is a sample of matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as the samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses. The method blank is carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination from the analytical process. The analysis of method blanks should yield values less than the LOQ. For very high-level analyses, the blank value should be less than 5% of the lowest value of the batch, or corrective action will be implemented.

Deficiencies, Nonconformances and Corrective Action Related to Quality Control

Deficiencies are defined as unauthorized deviations from procedures documented in the QAPP. Nonconformances are deficiencies which affect data quantity and/or quality and render the data unacceptable or indeterminate. Deficiencies related to QC include but are not limited to field and laboratory QC sample failures.

Deficiencies are documented in logbooks, field data sheets, etc., by field or laboratory staff and reported to the cognizant field or laboratory supervisor who will notify the USGS Project Manager. The USGS Project Manager will notify the USGS QAO of the potential nonconformance. The USGS QAO will initiate a NCR to document the deficiency.

The USGS Project Manager, in consultation with USGS QAO (and other affected individuals/organizations), will determine if the deficiency constitutes a nonconformance. If it is determined the activity or item in question does not affect data quality and therefore is not a valid nonconformance, the NCR will be completed accordingly and the NCR closed. If it is determined a nonconformance does exist, the USGS Project Manager in consultation with the USGS QAO will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by the USGS QAO by completion of a CAR.

CARs document: root cause(s); impact(s); specific corrective action(s) to address the deficiency; action(s) to prevent recurrence; individual(s) responsible for each action; the timetable for completion of each action; and, the means by which completion of each corrective action will be documented. CARs will be included with quarterly progress reports. In addition, significant conditions (i.e., situations which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data) will be reported to GBRA Project Manager/QAO and the TSSWCB Project Manager immediately both verbally and in writing.

B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

All sampling equipment testing and maintenance requirements are detailed in the USGS's *Quality-Assurance Plan for Water-Quality Activities in the Texas Water Science Center* (Appendix 5) (U.S. Geological Survey, 2009). Sampling equipment is inspected and tested upon receipt and is assured appropriate for use. Equipment records are kept on all field equipment and a supply of critical spare parts is maintained.

All laboratory tools, gauges, instrument, and equipment testing and maintenance requirements are contained within laboratory QASM(s).

B7 INSTRUMENT CALIBRATION AND FREQUENCY

Field equipment calibration requirements are contained in the TCEQ *SWQM Procedures, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue* (RG-415). Post-calibration error limits and the disposition resulting from error are adhered to. Data not meeting post-error limit requirements invalidate associated data collected subsequent to the pre-calibration and are not submitted to the TCEQ SWQMIS.

Detailed laboratory calibrations are contained within the QASM(s).

Field equipment calibration methods and requirements for water-quality sampling are contained in the USGS's *Quality-Assurance Plan for Water-Quality Activities in the Texas Water Science Center* (Appendix 5) (U.S. Geological Survey, 2009).

B8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

No special requirements for acceptance are specified for field sampling supplies and consumables. All field supplies and consumables are accepted upon inspection for breaches in shipping integrity.

All new batches of field and laboratory supplies and consumables received by the USGS laboratories are inspected upon receipt for damage, missing parts, expiration date, and storage and handling requirements. Chemicals, reagents, and standards are logged into an inventory database that documents grade, lot number, and manufacturer, dates received, opened, and emptied. All reagents shall meet ACS grade or equivalent where required. Acceptance criteria are detailed in organization's SOPs and described in Appendix 5 (U.S. Geological Survey, 2009).

B9 NON-DIRECT MEASUREMENTS

This QAPP does not include the use of routine data obtained from non-direct measurement sources.

B10 DATA MANAGEMENT

Data Dictionary

Terminology and field descriptions are included in the November 2014 Data Management Reference Guide, or most recent version. A table outlining the entities that will be used when submitting data under this QAPP is included below for the purpose of verifying which entity codes are included in the QAPP.

Name of Monitoring Entity	**Tag Prefix**	**Submitting Entity**	**Collecting Entity**
Guadalupe-Blanco River Authority	*TX*	*GB*	*GB*
US Geological Survey	*TX*	*GB*	*GS*

GBRA Data Management Process

GBRA field technicians follow protocols to ensure that data collected for this project maintains its integrity and usefulness in determining possible sources of the nitrate-nitrogen in the surface water and ground water in the Plum Creek and Geronimo Creek watersheds. Field data collected at the time of the sampling event is logged on GBRA field data sheets by the GBRA water quality technician, along with notes on sampling conditions. The GBRA field sheet is the responsibility of the GBRA water quality technician and is transported to the GBRA laboratory. The GBRA sample custodian logs the sample in the GBRA Lab Samples Database. Each sample is assigned a separate and distinct sample number. The GBRA field data sheet can be found in Appendix 8.

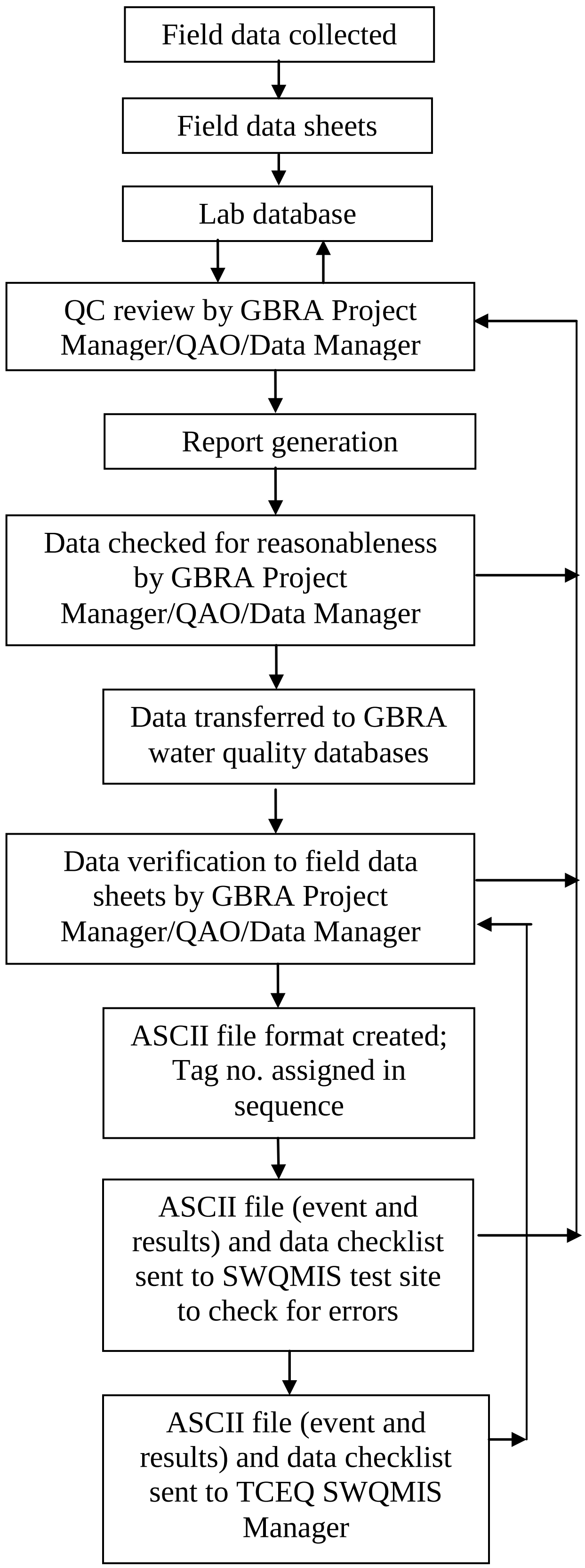
The GBRA Regional Laboratory Director supervises the GBRA Regional laboratory and reviews the report that is generated when all analyses are complete. Again, the report is reviewed to see that all necessary information is included and that the DQOs have been met. When the report is complete, the lab director signs the report. If the GBRA lab director or QAO designee feel there has been an error or finds that information is missing, the report is returned to the water quality technician for review and tracking to correct the error and generate a corrected copy. The GBRA Project Manager/QAO reviews the data for reasonableness and if errors or anomalies are found the report is returned to the water quality technician for review and tracking to correct the error. After review for reasonableness the data is cross-checked to the field data sheets by the GBRA Project Manager/QAO/Data Manager. If at any time errors are identified, the laboratory and water quality databases are corrected.

If errors are identified, the GBRA Project Manager/QAO (and other affected individuals/organizations), will determine if the error constitutes a nonconformance. If it is determined a nonconformance does exist, the GBRA Project Manager/QAO will determine the disposition of the nonconforming activity or item and necessary corrective action(s); results will be documented by the GBRA Project Manager/QAO by completion of a CAR.

CARs document: root cause(s); impact(s); specific corrective action(s) to address the deficiency; action(s) to prevent recurrence; individual(s) responsible for each action; the timetable for completion of each action; and, the means by which completion of each corrective action will be documented. CARs will be included with data summary report that accompanies the data submittal. In addition, significant conditions (i.e., situations which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data) will be reported to the TSSWCB Project Manager immediately both verbally and in writing.

The GBRA Project Manager/QAO/Data Manager is responsible for electronically transmitting the data to the TCEQ Data Management and Analysis Team for upload to SWQMIS. A completed Data Summary, as described in the most recent version of *TCEQ SWQM Data Management Reference Guide*, will be submitted with each data submittal. If errors are found after the TCEQ review, those errors are corrected by the GBRA Project Manager/QAO/Data Manager, logged in a data correction log and all participants are notified.

The following flow diagram outlines the path that data generated by GBRA personnel takes in the field tasks:


Field data collected
Field data sheets
Lab database
QC review by GBRA Project Manager/QAO/Data Manager
Report generation
Data checked for reasonableness by GBRA Project Manager/QAO/Data Manager
Data transferred to GBRA water quality databases
Data verification to field data sheets by GBRA Project Manager/QAO/Data Manager
ASCII file format created; Tag no. assigned in sequence
ASCII file (event and results) and data checklist sent to SWQMIS test site to check for errors
ASCII file (event and results) and data checklist sent to TCEQ SWQMIS Manager

Data Errors and Loss

The GBRA Regional Laboratory Director supervises the GBRA Regional laboratory and reviews the report that is generated when all analyses are complete. The report is reviewed to see that all necessary information is included and that the DQOs have been met. When the report is complete, the lab director signs the report. If the GBRA lab director or QAO designee feel there has been an error or finds that information is missing, the report is returned to the analyst for review and tracking to correct the error and generate a corrected copy. The GBRA Project Manager/QAO reviews the data for reasonableness and if errors or anomalies are found the report is returned to the laboratory director for review and tracking to correct the error. After review for reasonableness the data is cross-checked to the analysis logs by the GBRA Project Manager/QAO. If at any time errors are identified, the laboratory and water quality databases are corrected. The GBRA Project Manager/QAO is responsible for electronically transmitting the data to the TCEQ Data Management and Analysis Team for upload to SWQMIS. A completed Data Summary, as described in the most recent version of *TCEQ SWQM Data Management Reference Guide*, will be submitted with each data submittal. If errors are found after the TCEQ review, those errors are corrected by the GBRA Project Manager/QAO, logged in a data correction log and all participants are notified.

To minimize the potential for data loss, the databases, both lab and server files are backed up nightly and copies of the files are stored off-site weekly. If the laboratory database or network server fails, the backup files can be accessed to restore operation or replace corrupted files.

Record Keeping and Data Storage

After data is collected and recorded on field data sheets by GBRA, the data sheets are filed for review and use later. These files are kept in paper form for a minimum of one year and then scanned into the GBRA ITRAX for permanent record.

The data reports that are generated are reviewed by the GBRA laboratory director and signed. They are then given to the GBRA Project Manager/QAO for verification. If an anomaly or error is found the report is marked and returned to the field technician for review, verification and correction, if necessary. These reports may or may not be kept in paper form since the reports can be regenerated from the lab database at any time. If kept, the paper form is kept for a minimum of one year.

The GBRA laboratory database is housed on the laboratory computer and is backed up on the network server nightly. A back up copy of the network server files is made every Monday and that copy is stored off-site at a protected location. The GBRA network administrator is responsible for the servers and back up generation.

After data is electronically submitted to the TCEQ SWQMIS, the file that has been created is kept on the network server permanently. The network server is backed up nightly.

The GBRA ITRAX is part of the network that is backed up each evening. The GBRA Records Manager is the custodian of these files.

Data Handling, Hardware, and Software Requirements

The laboratory database is housed on a GBRA server and backed up each evening. The laboratory database uses Sequel 2000. The systems are operating in Windows 2010 and any additional software needed for word processing, spreadsheet or presentations uses Microsoft Office 2010.

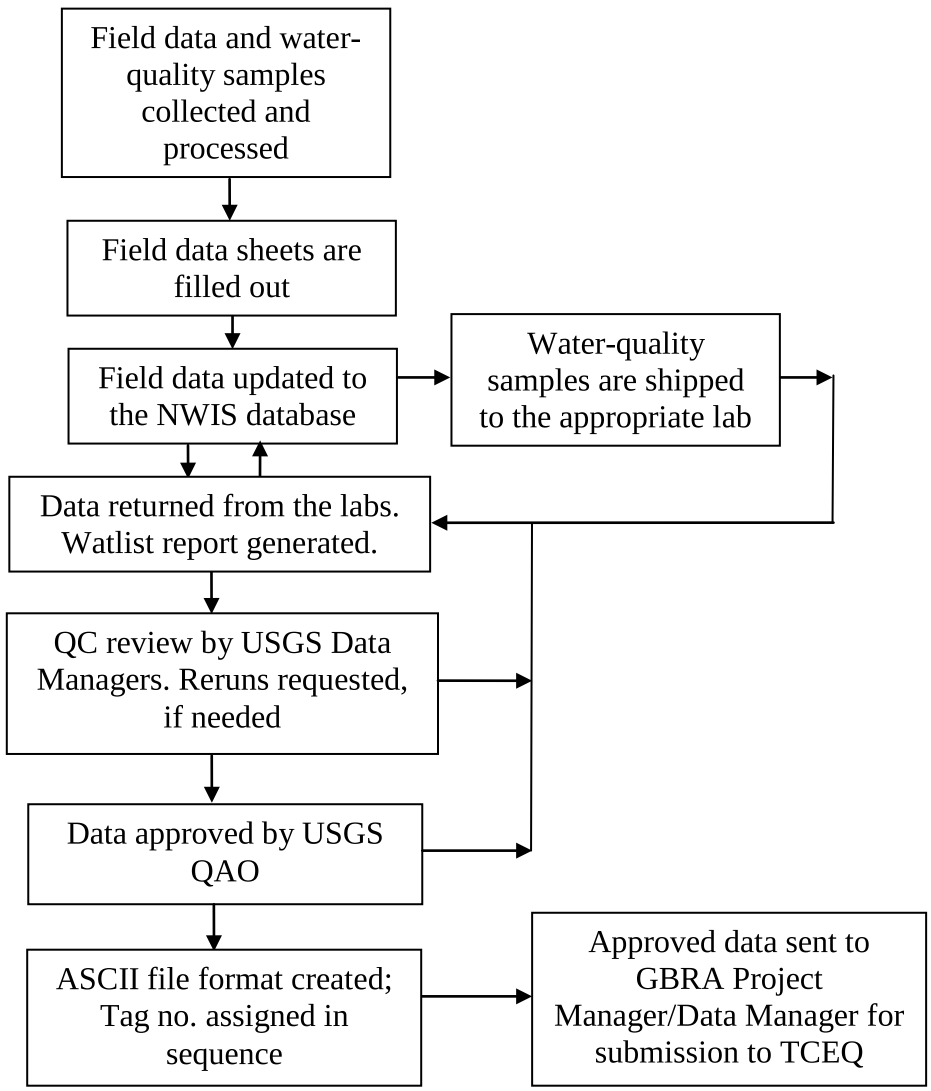
Information Resource Management Requirements

Data will be managed in accordance with the TCEQ *SWQM Data Management Reference Guide*, GIS Policy (TCEQ OPP 8.11), GPS Policy (TCEQ OPP 8.12) and applicable GBRA information resource management policies. The personnel collecting data for this project do not create TCEQ certified locational data using Global Positioning System (GPS) equipment. GPS equipment may be used as a component of the information required by the Station Location (SLOC) request process, but the TCEQ staff is responsible for creating the certified locational data that will ultimately be entered into the TCEQ SWQMIS. Any information developed for this project using a Geographic Information System (GIS) will be used solely to meet deliverable requirements and will not be submitted to the TCEQ as a certified data set.

USGS Data Management Process

USGS field technicians follow protocols to ensure that data collected for this project maintains its integrity and usefulness in determining possible sources of the nitrate-nitrogen in the surface water and ground water in the Plum Creek and Geronimo Creek watersheds. Field data collected at the time of the sampling event is logged onto USGS surface-water quality field forms (Appendix 9) or USGS groundwater-quality field forms (Appendix 10) by USGS water-quality field technicians along with notes on sampling conditions. The USGS field sheets are the responsibility of the USGS water-quality technicians and are transported to the USGS South Texas Program Office. The USGS sample custodian then logs each sample into the USGS's NWIS database. Each water-quality sample is assigned a separate and distinct record number.

The USGS Data Management process is described in Appendix 4, *USGS Quality Management Plan for Environmental Projects* (U.S. Geological Survey, 2010) and Appendix 5, *TWSC Quality-Assurance Plan for Water-quality Activities in Texas* (U.S. Geological Survey, 2009). The flow chart below shows how data is handled by the USGS from sampling to data reporting:



C1 ASSESSMENTS AND RESPONSE ACTIONS

The following table presents the types of assessments and response actions for data collection activities applicable to the QAPP.

Table C1.1 Assessments and Response Requirements

Assessment Activity	Approximate Schedule	Responsible Party	Scope	Response Requirements
Status Monitoring Oversight, etc.	Continuous	GBRA	Monitoring of the project status and records to ensure requirements are being fulfilled	Report to TSSWCB in Quarterly Progress Report
Monitoring Systems Audit of GBRA	Dates to be determined by TSSWCB	TSSWCB	Field sampling, handling and measurement; facility review; and data management as they relate to this project	30 days to respond in writing to the TSSWCB to address corrective actions
Laboratory Inspection	Dates to be determined by TSSWCB	USGS	Analytical and QC procedures employed at the USGS's NWQL and the USGS's RSIL laboratories.	30 days to respond in writing to the TSSWCB to address corrective actions

Corrective Action

The GBRA Project Manager/QAO and USGS Project Manager are responsible for implementing and tracking corrective action resulting from audit findings outlined in the audit report. Records of audit findings and corrective actions are maintained by both the TSSWCB and the GBRA Project Managers. Audit reports and corrective action documentation will be submitted to the TSSWCB with the Quarterly Progress Report.

If audit findings and corrective actions cannot be resolved, then the authority and responsibility for terminating work are specified in the agreements in contracts between participating organizations.

C2 REPORTS TO MANAGEMENT

Reports to GBRA Project Management

Equipment calibration logs for field equipment contain QC information so that this information can be reviewed by the GBRA Project Manager/QAO. After review, if the GBRA Project Manager/QAO finds no anomalies or questionable data, the process of data transmittal to TCEQ begins. Project status, assessments and significant QA issues will be dealt with by the GBRA Project Manager/QAO who will determine whether it will be included in reports to the TSSWCB Project Manager.

Reports to TSSWCB

All reports detailed in this section are contract deliverables and are transferred to the TSSWCB in accordance with contract requirements.

Quarterly Progress Report - Summarizes the GBRA and USGS's activities for each task; reports monitoring status, problems, delays, and corrective actions; and outlines the status of each task's deliverables.

Monitoring Systems Audit Report and Response - Following any audit performed by the GBRA or USGS, a report of findings, recommendations and response is sent to the TSSWCB in the quarterly progress report.

D1 DATA REVIEW, VERIFICATION, AND VALIDATION

For the purposes of this document, the term verification refers to the data review processes used to determine data completeness, correctness, and compliance with technical specifications contained in applicable documents (i.e., QAPPs, SOPs, QASMs, analytical methods). Validation refers to a specific review process that extends the evaluation of a data set beyond method and procedural compliance (i.e., data verification) to determine the quality of a data set specific to its intended use.

All field and laboratory will be reviewed and verified for integrity and continuity, reasonableness, and conformance to project requirements, and then validated against the project objectives and measurement performance specifications which are listed in Section A7. Only those data which are supported by appropriate QC data and meet the measurement performance specifications defined for this project will be considered acceptable, and will be reported to TCEQ SWQMIS.

D2 VERIFICATION AND VALIDATION METHODS

All field and laboratory data will be reviewed, verified and validated to ensure they conform to project specifications and meet the conditions of end use as described in Section A7 of this document.

Data review, verification, and validation will be performed using self-assessments and peer and management review as appropriate to the project task. The data review tasks to be performed by field and laboratory staff are listed in the first two sections of Table D.2, respectively. Potential errors are identified by examination of documentation and by manual examination of corollary or unreasonable data. If a question arises or an error is identified, the manager of the task responsible for generating the data is contacted to resolve the issue. Issues which can be corrected are corrected and documented. If an issue cannot be corrected, the task manager consults with higher level project management to establish the appropriate course of action, or the data associated with the issue are rejected. Field and laboratory reviews, verifications, and validations are documented.

After the field and laboratory data are reviewed, another level of review is performed once the data are combined into a data set. This review step, as specified in Table D2.1, is performed by the GBRA Project Manager/QAO/Data Manager. Data review, verification, and validation tasks to be performed on the data set include, but are not limited to, the confirmation of laboratory and field data review, evaluation of field QC results, additional evaluation of anomalies and outliers, analysis of sampling and analytical gaps, and confirmation that all parameters and sampling sites are included in the QAPP.

Another element of the data validation process is consideration of any findings identified during the monitoring systems audit conducted by the TSSWCB QAO. Any issues requiring corrective action must be addressed, and the potential impact of these issues on previously collected data will be assessed. After the data are reviewed and documented, the GBRA Project Manager/QAO/Data Manager validates that the data meet the DQOs of the project and are suitable for reporting to TCEQ SWQMIS.

If any requirements or specifications of this project are not met, based on any part of the data review, the responsible party should document the nonconforming activities (with a CAR) and submit the information to the GBRA Project Manager/QAO/Data Manager with the data. This information is communicated to the TSSWCB Project Manager by the GBRA Project Manager. The data is not transmitted to TCEQ SWQMIS.

Table D2.1 Data Review Tasks

Field Data Review	Responsibility
Field data reviewed for conformance with data collection, sample handling and COC, analytical and QC requirements	GBRA Field Technicians
Post-calibrations checked to ensure compliance with error limits	GBRA Field Technicians
Field data calculated, reduced, and transcribed correctly	GBRA Project Manager
Field data reviewed for conformance with data collection, and QC requirements	USGS Field Technicians
Post-calibrations checked to ensure compliance with error limits	USGS Field Technicians
Field data calculated, reduced, and transcribed correctly	USGS Project Manager
Laboratory Data Review	**Responsibility**
Laboratory data reviewed for conformance with data collection, sample handling and COC, analytical and QC requirements to include documentation, holding times, sample receipt, sample preparation, sample analysis, project and program QC results, and reporting	USGS QAOs
Laboratory data calculated, reduced, and transcribed correctly	USGS QAOs and USGS Project Manager
LOQs consistent with requirements for AWRLs	USGS QAOs and USGS Project Manager
Analytical data documentation evaluated for consistency, reasonableness and/or improper practices	USGS QAOs and USGS Project Manager
Analytical QC information evaluated to determine impact on individual analyses	USGS QAOs and USGS Project Manager
All laboratory samples analyzed for all parameters	USGS QAOs and USGS Project Manager
Data Set Review	**Responsibility**
The test report has all required information as described in Section A9 of the QAPP	GBRA and USGS Project Managers
Confirmation that field and lab data have been reviewed	GBRA and USGS Project Managers
Data set (to include field and laboratory data) evaluated for reasonableness and if corollary data agree	GBRA and USGS Project Managers
Outliers confirmed and documented	GBRA and USGS Project Managers
Field QC acceptable (e.g., field splits and trip, field and equipment blanks)	GBRA and USGS Field Technicians
Sampling and analytical data gaps checked and documented	GBRA and USGS Project Managers
Verification and validation confirmed. Data meets conditions of end use and are reportable	GBRA and USGS Project Managers

D3 RECONCILIATION WITH USER REQUIREMENTS

Data produced in this project, and data collected by other organizations (i.e., USGS, TCEQ, etc.), will be analyzed and reconciled with project data-quality requirements. Data meeting project requirements will be used in the implementation and adaptive management of the Plum Creek and Geronimo and Alligator Creeks WPPs and will be submitted to TCEQ in SWQMIS for possible use in the development of the biennial Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d).

E1 REFERENCES

Cunningham, W.L., and Schalk, C.W., comps., 2011, Groundwater technical procedures of the U.S. Geological Survey: U.S. Geological Survey Techniques and Methods 1–A1, 151 p. (available only online at http://pubs.usgs.gov/tm/1a1/)

Texas Agri-Life Extension, 2012, Geronimo and Alligator Creeks Watershed Protection Plan: Prepared for the Geronimo and Alligator Creeks Watershed Protection Plan by Ward Ling and Mark McFarland (Texas AgriLife Extension Service), Debbie Magin (Guadlupe-Blanco River Authority), and Loren Warrick and Aaron Wendt (Texas State Soil and Water Conservation Board), 174 p. Accessed April 14, 2014 at http://www.geronimocreek.org/documents/wpp/FinalDraftGACWPP.pdf

Texas Commission on Environmental Quality (TCEQ), 2012, 2012 Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d), variably paged, Accessed on August 28, 2014 at http://www.tceq.texas.gov/waterquality/assessment/waterquality/assessment/12twqi/twqi12.

Turnipseed, D.P., and Sauer, V.B., 2010, Discharge measurements at gaging stations: U.S. Geological Survey Techniques and Methods, Book 3, Chapter A8, 87 p. (Also available at http://pubs.usgs.gov/tm/tm3-a8/)

U.S. Geological Survey, variously dated, National Field Manual for the Collection of Water-Quality Data: Techniques of Water-Resources Investigations, Book 9, Chapters A1-A9, accessed on April 14, 2014 at http://pubs.water.usgs.gov/twri9A

U.S. Geological Survey, 2009, USGS TWSC Quality-Assurance Plan for Water-quality Activities in the Texas Water Science Center, Compiled by Susan Aragon-Long, Stephanie Marr, Mike Canova, Cary Carmen, Kent Becher, and Tim Oden: Accessed at http://tx.cr.usgs.gov/field/plans/MASTER_TWSC_QAP_FINAL.pdf, on April 11, 2014.

U.S. Geological Survey, 2014, USGS Water Mission Area Quality Management Plan for Environmental Projects: Prepared for USEPA, Region VI. Accessed October 28, 2014 at http://tx.cr.usgs.gov/QMP14_USGS_final.doc.

Appendix 1 - Example Letter to Document Adherence to the QAPP

TO: (name)
(organization)

FROM: (name)
(organization)

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 GBRA to the TSSWCB Project Manager within 60 days of EPA approval of the QAPP.

Appendix 2 - Sampling Process Design and Monitoring Schedule

Sample Design Rationale

The intent of the sample design of this project is to develop isotopic signatures of nitrate-nitrogen from each sample type (SW, GW, SPR, PRE, WW) to identify the most likely sources of elevated nitrate-nitrogen in Plum Creek and Geronimo Creek watersheds. Under their direction, the TSSWCB and GBRA have been tasked with providing data to characterize water quality conditions in support of the 305(b) assessment, and to identify significant long-term water-quality trends. Achievable water-quality objectives and priorities and the identification of water-quality issues were used to develop the workplan, which are in accord with available resources. As part of the PCWP and GCWP Steering Committee process, the TSSWCB and GBRA coordinate closely with other participants to ensure a comprehensive water monitoring strategy within the watershed.

Site Selection Criteria

This data collection effort involves monitoring targeted water quality sites, using procedures that are consistent with the TCEQ SWQM program, for the purpose of data entry into the SWQMIS database maintained by the TCEQ. To this end, some general guidelines are followed when selecting sampling sites, as basically outlined below, and discussed thoroughly in the TCEQ *SWQM Procedures, Volume 1* (RG-415). Overall consideration is given to accessibility and safety. All monitoring activities have been developed in coordination with the PCWP and GCWP Steering Committees and with the TSSWCB.

1. Stream sites will be selected so that samples can be safely collected from the cross section of flow. If there is not sufficient flow to collect across the cross section, then a grab sample may be collected at the centroid of flow. The centroid is defined as the midpoint of that portion of stream width that contains 50 percent of the total flow. Sites should be selected that best represent the stream segment and not an unusual condition or contaminant source. Backwater areas or eddies should be avoided when selecting a stream site.
2. Because historical water-quality data can be very useful in assessing use attainment or impairment, those historical sites were selected that are on current or past monitoring schedules.
3. Routine monitoring sites were selected to bracket sources of pollution, influence of tributaries, changes in land uses, and hydrological modifications.
4. Sites should be accessible. When possible, stream sites should have a USGS stream flow gage. If not, flow measurements will be made during routine and targeted monitoring visits.

Monitoring Sites

The Monitoring Table for this project is presented on the following pages:

<u>Explanation:</u>

Site type = SW, surface water; GW, groundwater; SPR, spring; QA, quality assurance; PRE, precipitation; WW, wastewater.
Conventional = alkalinity, bicarbonate, carbonate, hydroxide, total dissolved solids, boron, bromide, calcium, magnesium, potassium, sodium, silica, chloride, fluoride, strontium, sulfate, ammonia nitrogen, total Kjeldahl nitrogen, nitrite nitrogen, nitrate nitrogen, nitrite + nitrate nitrogen, orthophosphate, total phosphorus
Isotopic = $\delta^{18}O$ and δD of water, $\delta^{15}N$ and $\delta^{18}O$ of nitrate (NO_3^-)
Flow = flow collected by gage, electric, mechanical or Doppler; includes severity
Field = pH, temperature, specific conductance/conductivity, DO

Sampling Site Locations and Monitoring Regime

This data collection effort involves collecting water-quality samples for a selected set of constituents using procedures that are consistent with USGS standards and protocols. Samples will be collected from the following list of sites. When the synoptics are conducted, if there is not sufficient flow to collect a sample from the primary sites, then one of the alternate sites will be samples. Samples collected at surface water and spring sites will be collected biased for flow and reported with the “BF” as characters one and two of the monitoring code. Because the data is intended to establish the origin of a recognized nutrient concern or degradation of the water body, characters three and four of the monitoring code will be reported as “SI”.

TCEQ Station ID	Site Description	Workplan Task	Site type	Monitoring Code	Con-ventional	Isotopic	Flow	Field
	Plum Creek Watershed							
12556	Clear Fork Plum Creek at Salt Flat Road	3.1	SW	BFSI	4	4	4	4
12640	Plum Creek at CR 135	3.1	SW	BFSI	4	4	4	4
12647	Plum Creek at Old McMahan Road (CR 202)	3.1	SW	BFSI	4	4	4	4
17406	Plum Creek at Plum Creek Road	3.1	SW	BFSI	4	4	4	4
20500	West Fork Plum Creek at Biggs Road (CR 131)	3.1	SW	BFSI	4	4	4	4
12642	Plum Creek at Biggs Road (Plum Creek nr Luling (0817300) (alternate)	3.1	SW	BFSI				
18343	Plum Creek upstream of Hwy 183 (Plum Creek at Lockhart (08172400) (alternate)	3.1	SW	BFSI				
GB001	Water Well – To Be Determined	4.1	GW	NA	4	4	4	4
20507	Clear Fork Springs nr Borchert Rd (67-11-104)	5.1	SPR	BFSI	4	4	4	4
20509	Lockhart Springs (alternate)	5.1	SPR	BFSI				
	Geronimo Creek Watershed							
14932	Geronimo Creek at SH123	3.2	SW	BFSI	4	4	4	4
12576	Geronimo Creek at Haberle Road	3.2	SW	BFSI	4	4	4	4
GB714	Water Well at Laubach Road	4.2	GW	NA	4	4	4	4
21262	Timmermann Springs	5.2	SPR	BFSI	4	4	4	4
	Other							
	Surface-water Field Blank		QA	NA	1	--	--	--
	Groundwater Field Blank		QA	NA	1	--	--	--
	Split Replicates		QA	NA	4	--	--	--
	Precipitation (Rainfall) Samples		PRE	NA	4	4	--	4
	Wastewater Samples		WW	NA	4	4	--	4

Appendix 3 - USGS Protocols for collecting water-quality samples (National Field Manual).

This document can be accessed online at:

http://water.usgs.gov/owq/FieldManual/

Appendix 4 - USGS Water Discipline Quality Management Plan for Environmental Projects.

This document can be accessed online at:

http://tx.cr.usgs.gov/QMP14_USGS_final.doc

Appendix 5 - TWSC Quality-Assurance Plan for Water-Quality Activities in the Texas Water Science Center.

This document can be accessed at:

http://tx.cr.usgs.gov/field/plans/MASTER_TWSC_QAP_FINAL.pdf

Appendix 6 - Data Summary Report

Data Summary

Data Information

Data Source: ____________________

Date Submitted: ____________________

Tag_id Range: ____________________

Date Range: ____________________

Comments

Please explain in the space below any data discrepancies including:

- **Inconsistencies with AWRL specifications;**
- **Failures in sampling methods and/or laboratory procedures that resulted in data that could not be reported to the TSSWCB; and**
- **Other discrepancies.**

-
-
-
-
-
-
-

Data Manager: ____________________

Date: ____________________

Appendix 7 - USGS Protocols for collecting discharge measurements at gaging locations.

This document can be accessed at:

http://pubs.usgs.gov/tm/tm3-a8/

Appendix 8 - GBRA Field Data Sheet

Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program

Field Data Reporting Form

RTAG# | REGION | EMAIL-ID: | COLLECTOR

STATION ID | SEGMENT | SEQUENCE | DATA SOURCE

Station Description ____

GRAB SAMPLE

M M D D Y Y Y Y (DATE) | H H M M (TIME) | X (DEPTH) | M = meters F = feet

COMPOSITE SAMPLE

COMPOSITE CATEGORY : T = TIME S = SPACE (i.e. Depth) B = BOTH F = FLOW WEIGHT

M M D D Y Y Y Y (START DATE) | H H M M (START TIME) | START DEPTH (SURFACE) | M = Meters F = Feet

M M D D Y Y Y Y (END DATE) | H H M M (END TIME) | END DEPTH (DEEPEST) | M = Meters F = Feet

COMPOSITE TYPE : ## = Number of Grabs in Composite CN = Continuous

00010		WATER TEMP (°C only)	72053		DAYS SINCE LAST SIGNIFICANT PRECIPITATION
00400		pH (s.u)	01351		FLOW SEVERITY 1-no flow 2-low
00300		D.O. (mg/L)			3-normal 5-high 4-flood 6-dry
00094		SPECIFIC COND (Φmhos/cm)	00061		INSTANTANEOUS STREAM FLOW (ft³/sec)
00480		SALINITY (ppt, marine only)	89835		FLOW MEASUREMENT METHOD 1- Flow Gage Station 2- Electric 3- Mechanical 4- Weir/Flume 5-Acoustic Doppler
89978		PRIMARY CONTACT, OBSERVED ACTIVITY (# of people observed)			
89979		EVIDENCE OF PRIMARY CONTACT RECREATION (1 = OBSERVED, 0 = NOT OBSERVED)	74069		FLOW ESTIMATE (ft³/sec)
00051		RESERVOIR ACCESS NOT POSSIBLE LEVEL TOO LOW (ENTER 1 IF REPORTING)*	82903		DEPTH OF BOTTOM OF WATER BODY AT SAMPLE SITE (meters)*
00052		RESERVOIR STAGE (feet above mean sea level)*	89864		MAXIMUM POOL WIDTH AT TIME OF STUDY (meters)*
00053		RESERVOIR PERCENT FULL (%)*	89865		MAXIMUM POOL DEPTH AT TIME OF STUDY(meters)
			89869		POOL LENGTH (meters) *
			89870		% POOL COVERAGE IN 500 M REACH (%) *

*Parameters related to data collection in perennial pools; i.e., Flow Severity of 1 and Flow of 0 cfs reported.

Measurement Comments and Field Observations:

____

____

____

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Appendix 9 USGS Surface-Water Quality Field Form

Attach ASR and WatList

U. S. GEOLOGICAL SURVEY SURFACE-WATER QUALITY FIELD NOTES Station No. __________

NWIS Record No. __________

Station No. __________ Station Name __________ Field ID __________

Sample Date __________ Mean Sample Time ______ Time Datum _____ (eg. EST, EDT, UTC) End Date ________ End Time ______

*Sample Medium: WS WSQ OAQ *Sample Type: 9 (regular) 7 (replicate) 2 (blank) 1 (spike) ________

*Sample Purpose (71999): 10 (routine) 15 (NAWQA) 20 (NASQAN) 25 (NMN) 30 (Benchmark) __________

* see last page for additional codes

*Purpose of Site Visit (50280): 1001 (fixed-frequency SW) 1003 (extreme high flow SW) 1004 (extreme low flow SW) 1098 (NAWQA QC) _____

QC Samples Collected? Y N Blank Replicate Spike Other__________

Project No. __________ Project Name__________

Sampling Team __________ Team Lead Signature __________ Date __________

START TIME ________ GAGE HT ______ TIME ________ GHT _____ TIME ________ GHT _____ TIME ________ GHT _____ END TIME ________ GHT ______

FIELD MEASUREMENTS

Property	Parm Code	Method Code http://water.usgs.gov/usgs/owq/Forms/Fieldmeasurement_parametersmethods.doc	Result	Units	Remark Code	Value Qualifier	Null Value Qualifier	NWIS Result-Level Comments
Gage Height	00065			ft				
Discharge, instantaneous	00061			cfs				
Temperature, Air	00020	THM04 (Thermistor) THM05 (Thermometer)		°C				
Temperature, Water	00010	THM01 (Thermistor)		°C				
Specific Conductance	00095	SC001 (Contacting Sensor)		µS/cm				
Dissolved Oxygen	00300	LUMIN (Luminescent) MEMBR (Amperometric) SPC10 (Spectrophotometric)		mg/L				
Barometric Pressure	00025	BAROM (Barometer)		mm Hg				
pH	00400	PROBE (Electrode)		units				
Alkalinity, filtrd, incr. Alkalinity, filtrd, Gran	39086 29802	TT061 (Digital Titrator) TT062 (Buret) TT056 (Digital Titrator) TT057 (Buret)		mg/L				
Carbonate, filtrd, incr. Carbonate, filtrd, Gran	00452 63788	ASM01 (Digital Titrator) ASM02 (Buret) ASM03 (Digital Titrator) ASM04 (Buret)		mg/L				
Bicarbonate, filtrd, incr. Bicarbonate, filtrd, Gran	00453 63786	ASM01 (Digital Titrator) ASM02 (Buret) ASM03 (Digital Titrator) ASM04 (Buret)		mg/L				
Hydroxide, filtrd, incr. Hydroxide, filtrd, Gran	71834 29800	ASM01 (Digital Titrator) ASM02 (Buret) ASM03 (Digital Titrator) ASM04 (Buret)		mg/L				
Turbidity [see attachment for codes and units]								

SAMPLING INFORMATION

Parameter	Pcode	Value	Information		
Sampler Type	84164	*see last page for proper codes— consider type of sampler and material*	Sampler ID:		
Sampling Method	82398	10 EWI; 20 EDI; 30 single vertical; 40 multiple vertical; other __________	**BAG SAMPLER EFFICIENCY TEST**		
Sampler bottle/bag material	84182	Plastic Bag (11) Teflon® Bag(12) Glass Bottle(20) Pastic Bottle (21) Teflon® Bottle (22) other (30)	Test	Duration Sampler Collected Water (seconds)	Sample Volume Collected (milliliters)
Sampler Nozzle material	72219	plastic (2) Teflon® (3) Brass (1)	1		
Sampler Nozzle Diameter	72220	3/16" (3) 1/4" (4) 5/16" (5)	2		
Sampler Transit Rate	50015	feet/second	3		
Velocity to Calculate Isokinetic transit rate	72196	feet/second	Mean	(72217)	(72218)
Depth to Calculate Isokinetic transit rate	72195	feet	Bag Sampler Efficiency (See last page) %		
Splitter Type	84171	*See last page for codes* __________	Splitter ID:		
Hydrologic Condition	N/A	A Not Determined; 4 Stable, low stage; 5 Falling stage; 6 Stable, high stage; 7 Peak stage; 8 Rising stage; 9 Stable, normal stage			
Observations [Codes: 0=none; 1=mild; 2=moderate; 3=serious; 4=extreme]		Oil-grease (01300) ___ Detergent suds (01305) ___ Floating garbage (01320) ___ Floating algae mats (01325) ___ Floating debris (01345) ___ Turbidity (01350) ___ Atm. Odor (01330) ___ Fish kill (01340) ___ Gas Bubbles (01310) ___ Sewage Solids (01335) ___ Floating Vegetation (84178) ___ Ice Cover(01355) ___			

COMPILED BY: __________ **CHECKED BY:** __________ **LOGGED INTO NWIS BY:** __________

Station No. ___________________

SAMPLING CONDITIONS

Stream width (0004): ____________ ft mi Left bank ____________ Right bank ___________ft Ice cover ______% Ave. ice thickness ______ in.

Number of Sampling points (00063): ____

Stations on cross-section (distance from LEFT RIGHT bank)____ ____ ____ ____ _____ ____ ____ _____ ____ ____ ____ ____ ____ ____

Sampling location: wading cableway boat bridge upstream downstream side of bridge _____ ft mi above below gage ___________

Sampling site: pool riffle open channel braided backwater Bottom: bedrock rock cobble gravel sand silt concrete other ___________

Stream color: brown green blue gray clear other _________ Stream mixing: well-mixed stratified poorly-mixed unknown other______

Weather (00041) ________________

wind speed (00035) ______ mph *temperature-* very cold cool warm hot

No. days since last rainfall event (72053) _________

Observations:

Sample Comments (for NWIS; 300 characters max.):

LABORATORY INFORMATION *Sample Set ID* _____

SAMPLES COLLECTED (check all that apply):

Nutrients: ___WCA ___FCC ___FCCVT ___FCA Major cations: ___FA ___RA Major anions: ___FU

Trace elements: ___FA ___RA ___CU Mercury: ___FAM ___RAM ___Wis. Hg Lab Lab pH/SC/ANC: ___RU

Organics: ____GCC filtered __ unfiltered __ ___BGC ___C18 ___ Kansas OGRG Lab _____PEST ____PHARM ____HUN ____HFL

VOC: ______GCV (____ vials) Suspended solids: ___SUSO Turbidity: ___TBY Methylene Blue Active Substances: ___MBAS Color: ___RCB

Carbon: ___TPCN filter1-vol filtered______mL filter2-vol filtered______mL filter3-vol filtered______mL ___DOC ___TOC

Stable isotopes: ___FUS ___RUS Radio-chemicals: ___FUR ___RUR ___SUR ___FAR ___RAR __CUR

___BOD ___COD Chlorophyll: ____ CHL Algae: ____ Invertebrates: ___IQE ___IQL ___IQM ___IRE Fish tissue: ___TBI

Ultraviolet Absorbing Substances: ___UAS

Other:______________ (Lab____________) Other:______________ (Lab____________) Other:______________ (Lab____________)

Other:______________ (Lab____________) Other:______________ (Lab____________) Other:______________ (Lab____________)

Suspended sediment: ____ CONC. S/F SIZE [No. bottles _____]

Microbiology: ____ (Lab__________________) Date shipped: ____________

Date sediment sample shipped: __________ Sediment Lab: ______________________

Comments:

____

Date shipped:____________ Laboratory ____________________ Date shipped______________ Laboratory__________________

Date shipped:____________ Laboratory ____________________ Date shipped______________ Laboratory__________________

****Notify the NWQL in advance if shipping potentially hazardous samples—phone 1-866-ASK-NWQL or email LabLogin@usgs.gov**

Calibrated by:________________________ Location:_____________________ Station No. _________________
Date:________________ Time:____________

METER CALIBRATIONS and FIELD MEASUREMENTS

TEMPERATURE Meter make/model _______________ S/N _____________ Thermistor S/N ___________ Thermometer ID ________

Calibration criteria: ± 0.2 °C for thermistors

Local Meter

Lab Tested against NIST Thermometer/Thermistor? Y N Date: _________________ ±___________ °C

Measurement Location: SINGLE POINT AT ______ ft DEEP STREAMSIDE _____ FT FROM LEFT RIGHT BANK VERTICAL AVG/MEDIAN OF _____ PTS

Field Readings # 1 ______ #2 ______ #3 ______ #4 ______ #5 ______ **MEDIAN**:______ **°C** Method Code _____ Remark ___ ___ Qualifier __

SPECIFIC CONDUCTANCE Meter MAKE/MODEL _________________ S/N _____________ Sensor ID _________________

Sample: CONE SPLITTER CHURN SPLITTER SINGLE POINT AT ______ ft DEEP VERTICAL AVG. OF _______ POINTS

LOCAL METER ID:______________ AUTO TEMP COMPENSATED METER? Y N CORRECTION FACTOR APPLIES? Y N CORRECTION FACTOR:_____

Std Value µS/cm	Std Temp	SC Before Adj.	SC After Adj.	Vendor Lot No.	NWIS Parameter Code (see last page)	NWIS* Lot No.	Expiration Date

Calibration Criteria: ± 5 % for SC ≤100 µS/cm or 3% for SC >100 µS/cm ***NWIS Lot Numbers are available at: http://wwwnwql.cr.usgs.gov/qas.shtml?ConductivityStds_home**

Field readings #1_____ #2_____ #3_____ #4_____ #5 _____ **MEDIAN: ______ µS/cm** Method Code _______ Remark ___ ___ Qualifier ___ ___

DISSOLVED OXYGEN Meter MAKE/MODEL ______________________________ S/N _____________________

Sensor Type: Amperometric Luminescent Spectrophotometer Sensor ID ________________________Local Meter ID_____________

Calibration Method: Air-Saturated Water Water-Saturated Air

Sample: SINGLE POINT AT _______ ft DEEP VERTICAL AVG. OF _____ POINTS BOD BOTTLE OTHER_____________ Stirrer Used? Y N

Calibration Temperature °C	Barometric Pressure mm Hg	DO Table Reading mg/L	Salinity Correc-tion Factor	DO Before Adjustment mg/L	DO After Adjust-ment mg/L

Zero DO Check _________mg/L Adj. to _________ mg/L Date: _____________

Thermister Check? Y N Date_________

Barometer Calibrated? N Y Date: _______________ Time: _______

Phase Degrees/Slope/Gain/Scale Factor (100%)______________(Zero)________

Calibration Criteria: ± 0.2 mg/L **DO saturation ______ %**

Field readings #1______ #2_____ #3_____ #4_____ #5 _____ **MEDIAN: ______ mg/L** Method Code _______ Remark ___ ___ Qualifier ____

pH Meter MAKE/MODEL _________________ S/N _______________ Electrode ID _____________ Type: GEL LIQUID OTHER _______

Sample: FILTERED UNFILTERED CONE CHURN SPLITTER SINGLE POINT AT _______ ft DEEP VERTICAL AVG. OF ____ POINTS

TEMPERATURE CORRECTION FACTORS APPLIED TO BUFFERS? Y N

pH BUFFER	BUFFER TEMP	THEO-RETICAL pH FROM TABLE	pH BEFORE ADJ.	pH AFTER ADJ.	SLOPE	MILLI-VOLTS
pH 7						
pH ___						
CHECK pH ___						

pH Buffer	Vendor Lot No.	NWIS* Lot No.	Expiration Date
pH 7 (99173)			
pH 10 (99171)			
pH 4 (99172)			

Calibration Criteria: ± 0.1 pH units, ± 0.3 if SC <75us/cm ***NWIS Lot Numbers are available at: http://wwwnwql.cr.usgs.gov/qas.shtml?Buffers_home**
Millivolts: pH 7 –10 t0 +10 , pH4 +165 to +195 mV, pH 10 –165 to –195 mV
Slope Acceptance Criteria: 95% to 102%

Field Readings #1________ #2________ #3________ #4________ #5 ________ **MEDIAN: ______ Units** Remark ___ ___ Qualifier ___

Station No. ___________________

TURBIDITY Meter make/model ______________________ S/N __________________ Type: turbidimeter submersible spectrophotometer

Sample: pump discharge line flow-thru chamber single point at _______ ft blw LSD MSL MP Sensor ID _________________

Sample: Collection Time: ________ Measurement Time: ________ Measurement: In-situ/On-site Vehicle Office lab NWQL Other __________

Sample diluted? Y N Vol. of dilution water ________ mL Sample volume ________ mL

	Lot Number or Date Prepared	Expiration Date	Concentration ________ (units)	Calibration Temperature °C	Initial instrument reading	Reading after adjustment
Stock Turbidity Standard						
Zero Standard *(DIW)*						
Standard 1						
Standard 2						
Standard 3						

TURBIDITY VALUE = ***A*** x (***B***+***C***) / ***C***
where:
A= TURBIDITY VALUE IN DILUTED SAMPLE
B= VOLUME OF DILUTION WATER, mL
C= SAMPLE VOLUME, mL

Calibration Criteria:
$\leq$ 100 Turbidity units ± 0.5 turbidity units or ± 5% of the measured Value, whichever Is greater
> 100 Turbidity units ± 10%

Field Readings #1 _________ #2 _________ #3 _________ #4 _________ #5 _________

MEDIAN _______ **Parameter Code** ________ FNU NTU NTRU FNMU FNRU FAU FBU AU METHOD CODE __________ Remark ___ ___ Qualifier ___ __

CROSS SECTION NOTES Barometric pressure = ________ mm Hg

Station	ft from left bank (00009) or ft from right bank (72103)	Time	Gage ht ft (00065)	Depth to Bottom at this station ft (81093)	Depth of measure -ment ft (00003)	Temp °C (00010) ____ THM01	SC µS/cm (00095) ____ SC001	DO mg/L (00300) ____ (Method Code)	DO sat %	pH units (00400) ____ PROBE	Turbidity ______ (______) ____ (Method Code)	Chl A Units (______)	NWIS Record No.
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													
21													
22													
23													
24													

NOTES:

ALKALINITY/ANC

BEGINNING H_2O TEMP. ________ °C
Specific Conductance__________μS/cm

pH	ΔpH	VOL ACID DC OR mL	ΔVOL ACID DC OR mL	ΔpH / ΔVOL ACID

End H_2O temp. ________ °C
Specific Conductance__________μS/cm

FIRST TITRATION

DATE ____________ INITIALS ____________
BEGIN TIME____________ END TIME____________
ALKALINITY/ANC ____________ mg/L* AS $CaCO_3$
BICARBONATE ______________mg/L* AS HCO_3^-
CARBONATE ______________mg/L* AS CO_3^{2-}
HYDROXIDE ______________mg/L* AS OH^-
ACID: 1.6N 0.16N 0.01639N OTHER:______
ACID LOT NO. ________EXPIRATION DATE ________
CORRECTION FACTOR: 1.01 ________
ACID DELIVERY: DIGITAL COUNTER BURET
SAMPLE VOLUME: _______mL FILTERED UNFILTERED
METHOD: INFLECTION POINT GRAN
STIRRING METHOD: MAGNETIC MANUAL

BEGINNING H_2O TEMP. ________ °C
Specific Conductance__________μS/cm

pH	ΔpH	VOL ACID DC OR mL	ΔVOL ACID DC OR mL	ΔpH / ΔVOL ACID

End H_2O temp. ________ °C
Specific Conductance__________μS/cm

SECOND TITRATION

DATE ____________ INITIALS ____________
BEGIN TIME____________ END TIME____________
ALKALINITY/ANC ____________ mg/L* AS $CaCO_3$
BICARBONATE ______________mg/L* AS HCO_3^-
CARBONATE ______________mg/L* AS CO_3^{2-}
HYDROXIDE ______________mg/L* AS OH^-
ACID: 1.6N 0.16N 0.01639N OTHER:______
ACID LOT NO. ________EXPIRATION DATE ________
CORRECTION FACTOR: 1.01 ________
ACID DELIVERY: DIGITAL COUNTER BURET
SAMPLE VOLUME: _______mL FILTERED UNFILTERED
METHOD: INFLECTION POINT GRAN
STIRRING METHOD: MAGNETIC MANUAL

Go to the Alkalinity Calculator for a complete listing of reporting rules, parameter codes, method codes, etc:
http://or.water.usgs.gov/alk

Alkalinity/ANC pH Meter Calibration		
Meter make/model:	S/N	
Calibration Location:		
Electrode No.		
Electrode type GEL LIQUID		
	pH 7	pH ____
BUFFER TEMPERATURE		
THEORETICAL FROM TABLE		
pH BEFORE ADJUSTMENT		
pH AFTER ADJUSTMENT		
SLOPE		
MILLIVOLTS		
MANUFACTURER LOT NUMBER		
NWIS LOT NUMBER		

Field titration by:______________

Checked by:____________

Station No. ___________________

QUALITY-CONTROL INFORMATION

PRESERVATIVE, BLANK WATER and SPIKE NWIS LOT NUMBERS

NWIS lot numbers are available at: http://wwwnwql.cr.usgs.gov/qas.shtml?nfssqa_certificates

Description	Parameter Code	Expiration Date	Manufacturer Lot Number	NWIS Lot Number
4.5N H_2SO_4 (NUTRIENTS AND DOC)	99156			
7.5N-7.7N HNO_3 (METALS&CATIONS)	99159			
6N HCl (Mercury)	99158			
1:1 HCl (VOC)	99157			
18N H_2SO_4 (COD and Phenol)	99155			
Inorganic Blank Water	99201			
Organic Blank Water	99203			
VOC/Organic Blank Water	99205			
Spike	99104			

FILTER LOT NUMBERS

Filter descriptions with parameter codes require NWIS LOT NUMBERS available at http://wwwnwql.cr.usgs.gov/qas.shtml?filters_home

Filter Type	Pore Size (microns)	Manufacturer's Lot Number	Parameter Code	NWIS Lot Numer
Capsule	0.45		99206	
Disc	0.45		99206	
142 mm GFF (organics)	0.70			
Syringe (organics)	0.70		99207	
25 mm GFF (organic carbon)	0.70			
142 mm membrane (inorganics)	0.45			

QC SAMPLES

Sample Type	NWIS Record No.	Sample Type	NWIS Record No.	Sample Type	NWIS Record No.
Equip Blank _____	_____________	Sequential _____	_____________	Trip Blank _________	_____________
Field Blank _____	_____________	Spike _____	_____________	Other ___________	_____________
Split _____	_____________	Concurrent _____	_____________	Other ___________	_____________

NWQL Schedules/lab codes (QC Samples) __________ __________ __________ __________ __________ __________

COMMENTS:____

(Circle appropriate selections)

99100 Blank-solution type
10 Inorganic grade (distilled/deionized)
40 Pesticide grade (OK for organics and organic carbon)
50 Volatile-organic grade (OK for VOCs, organics, and organic carbon)
200 Other

99101 Source of blank water
10 NWQL
40 NIST
55 Wisconsin Mercury Lab
140 EMD Chemicals
150 Ricca Chemical Company
200 Other

99105 Replicate-sample type
10 Concurrent
20 Sequential
30 Split
40 Split-Concurrent
50 Split-Sequential
200 Other

99102 Blank-sample type
1 Source Solution
30 Trip
40 Sampler
50 Splitter
80 Equipment (done in non-field environment)
90 Ambient
100 Field
200 Other

99111 QC sample associated with this environmental sample
1 No associated QA data
10 Blank
30 Replicate Sample
40 Spike sample
110 Cross-section information stored
100 More than one type of QA sample
200 Other

99106 Spike-sample type
10 Field
20 Lab

99107 Spike-solution source
10 NWQL

99108 Spike-solution volume, mL _______________

99112 Purpose, Topical QC data
1 Routine QC (non-topical)
10 Topical for high bias (contamination)
20 Topical for low bias (recovery)
100 Topical for variability (field equip)
110 Topical for variability (field collection)
120 Topical for variability (field personnel)
130 Topical for variability (field processing)
140 Topical for variability (shipping&handling)
200 Topical for variability (lab)
900 Other topical QC purpose

A complete list of fixed-value codes can be found online at:
http://wwwnwis.er.usgs.gov/currentdocs/index.html

REFERENCE LIST FOR CODES USED ON THIS FORM

The complete list of fixed-value codes can be found online at: http://wwwnwis.er.usgs.gov/currentdocs/index.html

Sample Medium Codes
WS Surface water
WSQ Quality-control sample (Replicate, Spike)
OAQ Blank

Value Qualifiers
e see field comment
f sample field preparation problem
k counts outside the acceptable range

Null-value Qualifiers
e required equipment not functional or available
f sample discarded; improper filter used
o insufficient amount of sample
p sample discarded; improper preservation
q sample discarded; holding time exceeded
r sample ruined in preparation

Sample Type Code
9 Regular
7 Replicate
2 Blank
1 Spike
3 Reference
B Other QA
H Composite

71999 Sample Purpose
10 Routine
15 NAWQA
20 NASQAN
25 National Monitoring Network
30 Benchmark
40 SW Network
60 Lowflow Network
70 Highflow Network
110 Seepage Study
180 Cross-Section Variation

Time Datum Codes

Time Zone	Std Time Code	UTC Offset (hours)	Daylight Time Code	UTC Offset (hours)
Hawaii-Aleutian	HST	-10	HDT	-9
Alaska	AKST	-9	AKDT	-8
Pacific	PST	-8	PDT	-7
Mountain	MST	-7	MDT	-6
Central	CST	-6	CDT	-5
Eastern	EST	-5	EDT	-4
Atlantic	AST	-4	ADT	-3

82398 Sampling Method
10 Equal Width Increment (EWI)
15 Multiple Verticals, non-isokinetic, equal widths and transit rate
20 Equal Discharge Increment (EDI)
25 Timed Sampling Interval
30 Single Vertical
40 Multiple Verticals
50 Point Sample
55 Composite, multi-point samples
70 Grab Sample (Dip)
8030 Grab Sample At Water-Supply Tap

Bag Sampler Intake Efficiency (IE)

$$IE = K \times \frac{(V/T)}{Vs}$$

IE=Intake Efficiency
T=Mean Duration Sampler Collected Water (P72217)
V=Mean Sample Volume Collected (P72218)
Vs=Mean Stream Velocity (P72196)
K = 0.1841 for 3/16" nozzle
K = 0.1036 for 1/4" nozzle
K = 0.0663 for 5/16" nozzle

84164 Sampler Type
100 Van Dorn Sampler
110 Sewage Sampler
125 Kemmerer Bottle
3044 US DH-81
3045 US DH-81 With Teflon Cap And Nozzle
3047 Sampler, Frame-Type, Plastic Bottle W/Reynolds Oven Bag
3048 Sampler, Frame-Type, Teflon Bottle
3049 Sampler, Frame-Type, Plastic Bottle
3050 Sampler, Frame-Type, Plastic Bottle W/Teflon Collapsible Bag
3051 US DH-95 Teflon Bottle
3052 US DH-95 Plastic Bottle
3053 US D-95 Teflon Bottle
3054 US D-95 Plastic Bottle
3055 US D-96 Bag Sampler
3057 US D-99 Bag Sampler
3058 US DH-2 Bag Sampler
3060 Weighted-Bottle Sampler
3061 US WBH-96 Weighted-Bottle Sampler
3070 Grab Sample
3071 Open-Mouth Bottle
3080 VOC Hand Sampler
4010 Thief Sampler
4115 Sampler, point, automatic
8000 None
8010 Other

NWIS Lot Number Parameter Codes* for Conductance Standards

Parameter Code	Standard Value µS/cm, KCl
99160	50
99161	100
99162	250
99163	500
99164	750
99165	1000
99166	2500
99167	5000
99168	10,000
99169	25,000
99170	50,000

50280 Purpose of Site Visit
1001 Fixed frequency, surface-water
1002 Storm hydrograph, surface-water
1003 Extreme high flow, surface-water
1004 Extreme low flow, surface-water
1005 Diurnal, surface-water
1006 Synoptic, surface-water
1098 NAWQA surface-water quality control
1099 Other, surface-water
3001 Occurrence Survey, bed sediment or tissue
3002 Spatial Distribution Survey, bed sediment or tissue
3003 Synoptic Study, bed sediment or tissue
3098 Bed-sediment or tissue quality control
3099 Other, bed sediment or tissue

Dissolved Oxygen
AZIDE Azide-modified Winkler
INDIGO Spectrophotometer, indigo carmine
INDKT Field Kit, indigo carmine, visual
LUMIN Luminscence sensor
MEMB2 Amperometric, Membrane (DODEC)
MEMBR Amperometric, Membrane electrode
RHODA Field Kit, Rhodazine-D, visual
SPC10 Spectrophotometer, Rhodazine-D
WINKL Winkler titration

84171 Splitter type, field, code
10 Churn splitter, plastic, 8 liter, cooler-type spigot
20 Churn splitter, plastic, 14 liter, cooler-type spigot
30 Churn splitter, plastic, 8 liter, cubitainer-type spigot
40 Churn splitter, plastic, 14 liter, cubitainer-type spigot
50 Churn splitter, fluoropolymer, 8 liter (future development)
60 Churn splitter, fluoropolymer, 14 liter, US SS-1
70 Cone splitter, plastic
80 Cone splitter, fluoropolymer
90 Sieve, wet
100 Sieve, dry
110 Riffle splitter (Jones)
200 Other

Parameter and method codes for field measurements: http://water.usgs.gov/usgs/owq/Forms.html

***NWIS Lot numbers and Certificates of Analysis: http://wwwnwql.cr.usgs.gov/qas.shtml?nfssqa_certificates**

National Field Manual: http://water.usgs.gov/owq/FieldManual/

Alkalinity Calculator, Alkalinity/ANC parameter and method codes: http://or.water.usgs.gov/alk/reporting.html

Appendix 10 USGS Groundwater Quality Field Form

Attach ASR and WatList

USGS science for a changing world

U. S. GEOLOGICAL SURVEY GROUNDWATER QUALITY FIELD NOTES

NWIS RECORD NO ______________

Station No.__________________________ Station Name _____________________________ Field ID ______________

Sample Date ________________________ Mean Sample Time (watch) ____________ Time Datum _______ (eg. EST, EDT, UTC)

Sample Medium _____ Sample Type _____ Sample Purpose (71999) _____ Purpose of Site Visit (50280) _____ QC Samples Collected? Y N

Project No. ________________________________ Project Name____

Sampling Team ______________________________ Team Lead Signature ______________________ Date _________

FIELD MEASUREMENTS

Property	Parm Code	Method Code	Result	Units	Re-mark Code	Value Quali-fier	Null Value Qual-ifier	NWIS Result-Level Comments
Water Level (see p. 8 for codes and units)								
Flow Rate	00059			gal/min				
Sampling Depth	00003			ft				
Depth to top of sampling interval	72015			ft blw lsd				
Depth to bottom of sam-pling interval	72016			ft blw lsd				
Temperature, Air	00020	THM04 (Thermistor) THM05 (Thermometer)		°C				
Temperature, Water	00010	THM01 (Thermistor) THM02 (Thermometer)		°C				
Specific Conductance	00095	SC001 (Contacting Sensor)		µS/cm				
Dissolved Oxygen	00300	SPC1 (Spectrophotometer) LUMIN (Luminescent MEMBR (Amperometric)		mg/L				
Barometric Pressure	00025	BAROM (Barometer)		mm Hg				
pH	00400	PROBE (Electrode)		units				
ANC, unfiltered, incr. ANC, unfiltered, Gran	00419 29813	TT065 (Digital counter) TT066 (Buret) TT058 (Digital counter) TT059 (Buret)		mg/L				
Alkalinity, filtrd., incr. Alkalinity, filtrd., Gran	39086 29802	TT061 (Digital counter) TT062 (Buret) TT058 (Digital counter) TT059 (Buret)		mg/L				
Carbonate, filtrd., incr Carbonate, filtrd., Gran	00452 63788	ASM01(Digital counter) ASM02(Buret) ASM03(Digital counter) ASM04(Buret)		mg/L				
Bicarbonate, filtrd., incr. Bicarbonate, filtrd., Gran	00453 63786	ASM01(Digital counter) ASM02(Buret) ASM03(Digital counter) ASM04(Buret)		mg/L				
Hydroxide, filtrd., incr. Hydroxide, filtrd., Gran	71834 29800	ASM01(Digital counter) ASM02(Buret) ASM03(Digital counter) ASM04(Buret)		mg/L				
Turbidity [see attachment for codes]								
Redox potential (Eh)	63002			mvolts				
Hydrogen sulfide odor detected?	71875	SNIF1 (sniff test, acidified sample) SNIF2 (sniff test, non-acidified sample)	#	Yes No	M detect U non-detect			Sample acidified beforehand? yes no
Hydrogen sulfide, unfiltered, measured	99119	ISE01 (electrode) KIT01 (Chemetrics) KIT02 (Hach)		mg/L				

SAMPLING INFORMATION

Parameter	Pcode	Value	Information
Sampling Condition*	72006		Sampler/Pump Type (make/model): ______________________
Sampling Method*	82398		Pump/Sampler ID: ________________ Sampler Material: stainless steel pvc teflon other ______________
Sampler Type*	84164		Tubing Material: teflon plastic tygon copper other______________
*see p. 8 for values			Filter type(s): capsule disc 142mm 25mm GFF membrane

COMPILED BY: ________________ CHECKED BY: ________________ LOGGED INTO NWIS BY: ________________

Date________________ Date________________ Date ________________

FIELD ID ____________________ Station No. ____________________

Aquifer name ____________________ Depth pump set at: ____________ft blw lsd msl mp

Sampling point description ____________________

GW Color: *brown gray blue green yellow other* ____________________

GW Clarity: *clear turbid muddy other* ____________________ *Foaming: Yes No*

*Sand Present: Yes No If yes, color of sand: Black Brown Tan Yellow Gray Other*____________

GW Odor: Yes No *describe* ____________________

Sample in contact with: atmosphere oxygen nitrogen other ______

Weather: ***sky-*** clear partly cloudy cloudy ***precipitation-*** none light medium heavy snow sleet rain mist ________

wind- calm light breeze gusty windy est. wind speed __________ mph ***temperature-*** very cold cool warm hot

Observations:

Sample Comments (for NWIS; 300 characters max.):

LABORATORY INFORMATION *Sample Set ID* _____

SAMPLES COLLECTED:

Nutrients: ___WCA ___FCC ___FCA Major cations: ___FA ___RA Major anions: ___FU Trace elements: ___FA ___RA

Mercury: ___FAM ___RAM ___Wis. Hg Lab Lab pH/SC/ANC: ___RU

VOC: ______GCV (____ vials) Suspended solids: ___SUSO Turbidity: ___TBY Methylene Blue Active Substances: ___MBAS Color: ___RCB

Carbon: ___DOC ___TOC

Radon: ___RURCV (Radon sample collection time:______) Stable isotopes: ___FUS ___RUS

Radiochemicals: ___FUR ___RUR ___SUR ____FAR ___RAR ___BOD ___COD

Other:______________ (Lab______________) Other:______________ (Lab_____________) Other:______________ (Lab___________)

Other:______________ (Lab______________) Other:______________ (Lab_____________) Other:______________ (Lab___________)

Microbiology: ____________________ (Lab ____________________)

Comments:
____

Date shipped:____________ Laboratory ____________________ Date shipped______________ Laboratory__________________

Date shipped:____________ Laboratory ____________________ Date shipped______________ Laboratory__________________

****Notify the NWQL in advance of shipment of potentially hazardous samples—phone 1-866-ASK-NWQL or email LabLogin@usgs.gov**

Comments:

GROUNDWATER LEVEL NOTES

Station No.______________________________ Field ID _______________
Station Name ____
Project No. _______________ Project Name________________________
Measurement made by: ______________________________________
Signature ___________________________________ Date ____________

WELL___ SPRING___ MONITOR___ SUPPLY___ OTHER_____________________________
SUPPLY WELL PRIMARY USE: DOMESTIC__ PUBLIC SUPPLY__ IRRIGATION __ OTHER___________
Casing Material: ____________________ **Altitiude (land surface) ________ ft abv MSL(C16*)**
Measuring Point: ______ ft abv blw LSD(C323*) MSL(C325*)
Well Depth _______ ft abv blw LSD MSL MP
Casing/Well diameter (in)_______
Screened interval (ft): Top_________ Bottom __________ft abv blw LSD MSL MP
Sampling condition (72006) pumping (8) flowing (4) static (n/a)
[see QWDATA User Manual for additional fixed-value codes]
Water Level: ______________ ft blw LSD (72019) ft blw MP (61055)
ft abv MSL (NGVD 29) (62610) ft abv MSL (NAVD 88) (62611)
Comments/Notes(C267) (256 character limit):

Depth to Water and Well Depth	1ST	2ND	3RD (optional)
Time			
Hold (for DTW)			
◻- Cut			
= DTW from MP (electric tape reading)			
– Measuring point (MP)			
= DTW from LSD			
Hold (for well depth)			
+ Length of tape leader			
= Well depth below MP			
– MP			
= Well depth below LSD			

WATER-LEVEL DATA FOR GWSI

DATE WATER LEVEL MEASURED (C235) __ __ - __ __ - __ __ __ __ (Month Day Year) TIME (C709) __ __ __ __

TIME DATUM RELIABILITY CODE (C269): E (estimated) K (known) T (transfered)

TIME DATUM CODE (C402) __ __ __ __ __ __

WATER LEVEL (C237/241*/242) __ __ __ __.__ __

EQUIPMENT IDENTIFIER (C249) (26 character limit).
__ __

WATER LEVEL TYPE CODE (C243): L (below land surface) M (below meas. pt.) S (sea level)

WATER LEVEL DATUM (C245) (Mandatory if WL type=S): NGVD 29 (National Geodetic Vertical Datum 0f) NAVD 88 (North American Vertical Datum 0f 1988) | | | | | | | | | | (Other (See GWSI manual for codes))

MP SEQUENCE NO. (C248) __ __ __ (Mandatory if WL type=M)

SITE STATUS FOR WATER LEVEL (C238):

A	B	C	D	E	F	G	H	I	J	M	N	O	P	R	S	T	V	W	X	Z
atmos. pressure	tide stage	ice	dry	recently flowing	flowing	nearby flowing	nearby recently	injector site	injector site	aquifer contact	measure-ment	obstruct-tion	pumping	recently pumped	nearby pumping	nearby recently	foreign sub-	well des-	affected by surface	other

METHOD OF WATER-LEVEL MEASUREMENT(C239):

A	B	C	D	E	F	G	H	L	M	N	O	P	R	S	T	V	Z
airline	analog	calibrated airline	differential gps	esti-mated	trans-ducer	pressure gage	calibrated pres. gage	geophysi-cal logs	manometer	non-rec. gage	observed	acoustic pulse	reported	steel tape	electric tape	calibrated elec. tape	other

WATER LEVEL ACCURACY (C276):

0	1	2	9
foot	tenth	hun-dreth	not to nearest foot

SOURCE OF WATER-LEVEL DATA (C244):

A	D	G	L	M	O	R	S	Z
other gov't	driller's log	geo-logist	geophysi-cal logs	memory	owner	other reported	reporting agency	other

PERSON MAKING MEASUREMENT (C246) (WATER-LEVEL PARTY) | | | | | | |

MEASURING AGENCY (C247) (SOURCE) | | | | | |

RECORD READY FOR WEB (C858):

Y	C	P	L
checked; ready for web display	not checked; no web display	proprietary; no web display	local use only; no web display

*Measuring Point Altitude (C325) or
Measuring Point Height (C323) and Station Altitude (C16)
Are Required for Water Level (C241)

WELL PURGE LOG FIELD ID ____________________

Allowable Drawdown: _________ *ft* **Purge method:** STANDARD LOW-FLOW OTHER ____________________________

START TIME:______________________**END TIME**_________________

Time	Water Level blw MP LSD ft	Draw-down ft	Well Yield gpm	Pumping Rate gpm	Water Temp °C	S C µs/cm	pH units	Dis-solved oxygen % sat	Turbidity ____ ____	________ ________	Comments [clarity, etc.]
											MEDIAN VALUES
											QUIESCENT pH
											FINAL FIELD MEASURE-

Well Volume (gal) = $V = 0.0408\ HD^2$ or **Well Volume =** $H \times F$

where:
- V is volume of water in the well, in gallons
- H is height of water column, in feet
- D is inside Diameter of well, in inches
- F is casing Volume Factor, in gallons per foot (see table)

H = Well depth - Static water level = __________ feet

Diameter, inside (D) = ___________ inches

1 well volume (V) = ___________ gallons

Parameter	Stability Criteria* (for more information see NFM Table 6.0-1)
pH	± 0.1 units (± 0.05 units if instrument display 2 or more digits to the right of the decimal) ± 0.3 if SC <~75µS/cm
Temperature (T)	± 0.2° C (thermistor)
Specific Conductivity (SC)	± 5%, of SC < 100 µS/cm ± 3%, for SC > 100 µS/cm
Dissolved Oxygen (DO)	± 0.2 mg/L
Turbidity (TU)	± 10%, for TU< 100: ambient TU is < 5 or most ground-water systems (visible TU > 5)

*allowable variation among 5 or more sequential field-measurement values

Purge Volume = $(n)(V)$ = ___________ **gallons [Actual =**__________ **gal]**

where:
- n is number of well volumes to be removed during purging
- V is volume of water in the well, in gallons

Q = estimated pumping rate = _______ gallons per minute

Approximate purge time = (purge volume)/Q = ________ minutes

	VOLUME FACTORS												
DIAMETER (in.)	1.0	1.5	2.0	3.0	4.0	4.5	5.0	6.0	8.0	10.0	12.0	24.0	36.0
CASING VOL. FACTOR (F)	0.04	0.09	0.16	0.37	0.65	0.83	1.02	1.47	2.61	4.08	5.88	23.5	52.9

Screened/Open Interval: TOP _________.____ ft blw LSD MSL

Bottom _________.____ ft blw LSD MSL

Depth to Top of Sampling Interval _______.____ft blw LSD MSL

Depth to Bottom of Sampling Interval _______.____ ft blw LSD MSL

Depth to set pump from MP (all units in feet except where noted) :	
Distance to top of screen from LSD	
+ MP (- if MP below LS)	
– (7 to 10 x diameter (inches) of the well) [convert to feet]	
= Depth to pump intake from MP	
Depth to pump from LSD (all units in feet) :	
– MP	
= Depth pump set from LSD MSL	

Notes/Calculations:

Calibrated by:__________________________ Location:________________________ Station No. __________________
Date:__________________ Time:______________

METER CALIBRATIONS and FIELD MEASUREMENTS

TEMPERATURE Meter make/model ________________ S/N ______________ Thermistor S/N ____________ Thermometer ID ________

Calibration criteria: ± 0.2 °C for thermistors

Local Meter

Lab Tested against NIST Thermometer/Thermistor? Y N Date: __________________ ±____________ °C

Measurement Location: SINGLE POINT AT _______ ft DEEP STREAMSIDE _____ FT FROM LEFT RIGHT BANK VERTICAL AVG/MEDIAN OF _____ PTS

Field Readings # 1 ______ #2 ______ #3 ______ #4 ______ #5 ______ **MEDIAN**:_______ **ºC** Method Code ______ Remark ___ ___ Qualifier __

SPECIFIC CONDUCTANCE Meter MAKE/MODEL __________________ S/N ______________ Sensor ID __________________

Sample: CONE SPLITTER CHURN SPLITTER SINGLE POINT AT ______ ft DEEP VERTICAL AVG. OF _______ POINTS

LOCAL METER ID:_______________ AUTO TEMP COMPENSATED METER? Y N CORRECTION FACTOR APPLIES? Y N CORRECTION FACTOR:______

Std Value µS/cm	Std Temp	SC Before Adj.	SC After Adj.	Vendor Lot No.	NWIS Parameter Code (see last page)	NWIS* Lot No.	Expiration Date

Calibration Criteria: ± 5 % for SC ≤100 µS/cm or 3% for SC >100 µS/cm ***NWIS Lot Numbers are available at: http://wwwnwql.cr.usgs.gov/qas.shtml?ConductivityStds_home**

Field readings #1_____ #2_____ #3_____ #4_____ #5 _____ **MEDIAN: _______ µS/cm** Method Code _______ Remark ___ ___ Qualifier ___ ___

DISSOLVED OXYGEN Meter MAKE/MODEL _________________________________ S/N _______________________

Sensor Type: Amperometric Luminescent Spectrophotometer Sensor ID ___________________________Local Meter ID______________

Calibration Method: Air-Saturated Water Water-Saturated Air

Sample: SINGLE POINT AT _______ ft DEEP VERTICAL AVG. OF _____ POINTS BOD BOTTLE OTHER______________ Stirrer Used? Y N

Calibration Temperature °C	Barometric Pressure mm Hg	DO Table Reading mg/L	Salinity Correction Factor	DO Before Adjustment mg/L	DO After Adjustment mg/L

Zero DO Check __________mg/L Adj. to __________ mg/L Date: ______________

Thermister Check? Y N Date__________

Barometer Calibrated? N Y Date: ________________ Time: _______

Phase Degrees/Slope/Gain/Scale Factor (100%)_______________(Zero)_________

Calibration Criteria: ± 0.2 mg/L **DO saturation _______ %**

Field readings #1______ #2_____ #3_____ #4_____ #5 _____ **MEDIAN: _______ mg/L** Method Code _______ Remark ___ ___ Qualifier ____

pH Meter MAKE/MODEL ___________________ S/N ________________ Electrode ID ______________ Type: GEL LIQUID OTHER ________

Sample: FILTERED UNFILTERED CONE CHURN SPLITTER SINGLE POINT AT _______ ft DEEP VERTICAL AVG. OF ____ POINTS

TEMPERATURE CORRECTION FACTORS APPLIED TO BUFFERS**? Y N**

pH BUFFER	BUFFER TEMP	THEORETICAL pH FROM TABLE	pH BEFORE ADJ.	pH AFTER ADJ.	SLOPE	MILLIVOLTS
pH 7						
pH ___						
CHECK pH ___						

pH Buffer	Vendor Lot No.	NWIS* Lot No.	Expiration Date
pH 7 (99173)			
pH 10 (99171)			
pH 4 (99172)			

Calibration Criteria: ± 0.1 pH units, ± 0.3 if SC <75us/cm ***NWIS Lot Numbers are available at: http://wwwnwql.cr.usgs.gov/qas.shtml?Buffers_home**
Millivolts: pH 7 –10 to +10 , pH4 +165 to +195 mV, pH 10 –165 to –195 mV
Slope Acceptance Criteria: 95% to 102%

Field Readings #1_________ #2_________ #3_________ #4_________ #5 _________ **MEDIAN: _______ Units** Remark ___ ___ Qualifier ___

FIELD ID ___________________

TURBIDITY Meter make/model ____________________ S/N _________________ Type: turbidimeter submersible spectrophotometer

Sample: pump discharge line flow-thru chamber single point at _______ ft blw LSD MSL MP Sensor ID ________________

Sample: Collection Time: ________ Measurement Time: ________ Measurement: In-situ/On-site Vehicle Office lab NWQL Other __________

Sample diluted? Y N Vol. of dilution water ________ mL Sample volume ________ mL

	Lot Number or Date Prepared	Expiration Date	Concentration ______ (units)	Calibration Temperature °C	Initial instrument reading	Reading after adjustment
Stock Turbidity Standard						
Zero Standard *(DIW)*						
Standard 1						
Standard 2						
Standard 3						

TURBIDITY VALUE = ***A*** x (***B***+***C***) / ***C***
where:
A= TURBIDITY VALUE IN DILUTED SAMPLE
B= VOLUME OF DILUTION WATER, mL
C= SAMPLE VOLUME, mL

Calibration Criteria:

≤ 100 Turbidity units	± 0.5 turbidity units or ± 5% of the measured Value, whichever Is greater
> 100 Turbidity units	± 10%

Field Readings #1 _________ #2 _________ #3 _________ #4 _________ #5 _________

MEDIAN _______ **Parameter Code** ________ FNU NTU NTRU FNMU FNRU FAU FBU AU METHOD CODE __________ Remark ___ ___ Qualifier ___ __

QUALITY-CONTROL INFORMATION

PRESERVATIVE, BLANK WATER and SPIKE NWIS LOT NUMBERS

NWIS lot numbers are available at: http://wwwnwql.cr.usgs.gov/qas.shtml?nfssqa_certificates

Description	Parameter Code	ExpirationDate	Manufacturer Lot Number	NWIS Lot Number
4.5N H_2SO_4 (NUTRIENTS AND DOC)	99156			
7.5N-7.7N HNO_3(METALS&CATIONS)	99159			
6N HCl (Mercury)	99158			
1:1 HCl (VOC)	99157			
18N H_2SO_4 (COD and Phenol)	99155			
Inorganic Blank Water	99201			
Organic Blank Water	99203			
VOC/Organic Blank Water	99205			
Spike	99104			

Filter Lot Numbers

Filter descriptions with parameter codes require NWIS LOT NUMBERS available at http://wwwnwql.cr.usgs.gov/qas.shtml?filters_home

Filter Type	Pore Size (microns)	Parameter Code	Manufacturer's Lot Number	NWIS Lot Number
Capsule	0.45	**99206**		
Disc	0.45	**99206**		
142 mm GFF (organics)	0.70			
Syringe (organics)	0.70	**99207**		
25 mm GFF (organic carbon)	0.70			
142 mm membrane (inorganics)	0.45			

QC SAMPLES

Sample Type	NWIS Record No.	Sample Type	NWIS Record No.	Sample Type	NWIS Record No.
Equip Blank _____	_____________	Sequential _____	_____________	Trip Blank ________	_____________
Field Blank _____	_____________	Spike _____	_____________	Other ___________	_____________
Split _____	_____________	Concurrent _____	_____________	Other ___________	_____________

NWQL Schedules/lab codes (QC Samples) __________ _________ _________ _________ _________ _________

ALKALINITY/ANC

BEGINNING H_2O TEMP. ________ °C
Specific Conductance__________µS/cm

pH	ΔpH	VOL ACID DC OR mL	ΔVOL ACID DC OR mL	ΔpH / ΔVOL ACID

End H_2O temp. ________ °C
Specific Conductance__________µS/cm

FIRST TITRATION

DATE ____________ INITIALS ____________
BEGIN TIME__________ END TIME__________
ALKALINITY/ANC ____________ mg/L AS $CaCO_3$
BICARBONATE ______________mg/L AS HCO_3^-
CARBONATE ________________mg/L AS CO_3^{2-}
HYDROXIDE ________________mg/L AS OH^-
ACID: 1.6N 0.16N 0.01639N OTHER:______
ACID LOT NO. ________EXPIRATION DATE ________
CORRECTION FACTOR: 1.00 1.01
ACID DELIVERY: DIGITAL COUNTER BURET
SAMPLE VOLUME: _______mL FILTERED UNFILTERED
METHOD: INFLECTION POINT GRAN

BEGINNING H_2O TEMP. ________ °C
Specific Conductance__________µS/cm

pH	ΔpH	VOL ACID DC OR mL	ΔVOL ACID DC OR mL	ΔpH / ΔVOL ACID

End H_2O temp. ________ °C
Specific Conductance__________µS/cm

SECOND TITRATION

DATE ____________ INITIALS ____________
BEGIN TIME__________ END TIME__________
ALKALINITY/ANC ____________ mg/L AS $CaCO_3$
BICARBONATE ______________mg/L AS HCO_3^-
CARBONATE ________________mg/L AS CO_3^{2-}
HYDROXIDE ________________mg/L AS OH^-
ACID: 1.6N 0.16N 0.01639N OTHER:______
ACID LOT NO. ________EXPIRATION DATE ________
CORRECTION FACTOR: 1.00 1.01
ACID DELIVERY: DIGITAL COUNTER BURET
SAMPLE VOLUME: _______mL FILTERED UNFILTERED
METHOD: INFLECTION POINT GRAN

Use the Alkalinity Calculator at: **http://or.water.usgs.gov/alk** or PCFF

Alkalinity/ANC pH Meter Calibration		
Meter make/model:	S/N	
Calibration Location:		
Electrode No.		
Electrode type GEL LIQUID		
	pH 7	pH ___
BUFFER TEMPERATURE		
THEORETICAL FROM TABLE		
pH BEFORE ADJUSTMENT		
pH AFTER ADJUSTMENT		
SLOPE		
MILLIVOLTS		
MANUFACTURER LOT NUMBER		
NWIS LOT NUMBER		

Field titration by:______________

Checked by:____________

REFERENCE LIST FOR CODES USED ON THIS FORM

Sample Medium Codes
WG Regular Ground water
WGQ Quality-control sample (Replicate or Spike)
OAQ Blank

The complete list of fixed-value codes can be found online at: http://nwis.usgs.gov/nwisdocs4_10/qw/QW-AppxB.pdf

Value Qualifiers
e see field comment
f sample field preparation problem
k counts outside the acceptable range

71999 Sample purpose
10 Routine
15 NAWQA
50 GW Network
110 Seepage Study
120 Irrigation Effects
130 Recharge
140 Injection

Sample Type Code
9 Regular
7 Replicate
2 Blank
1 Spike
3 Reference
B Other QA
H Composite

Time Datum Codes

Time Zone	Std Time Code	UTC Offset (hours)	Daylight Time Code	UTC Offset (hours)
Hawaii-Aleutian	HST	-10	HDT	-9
Alaska	AKST	-9	AKDT	-8
Pacific	PST	-8	PDT	-7
Mountain	MST	-7	MDT	-6
Central	CST	-6	CDT	-5
Eastern	EST	-5	EDT	-4
Atlantic	AST	-4	ADT	-3

Null-value Qualifiers
e required equipment not functional or available
f sample discarded; improper filter used
o insufficient amount of sample
p sample discarded; improper preservation
q sample discarded; holding time exceeded
r sample ruined in preparation

50280 Purpose of site visit
2001 Primary (primary samples should not exist for a site for more than one date per HIP, and the primary sampling date generally has the highest number of NAWQA analytes)
2002 Supplemental (to fill in missing schedules not sampled or lost)
2003 Temporal characterization (for previously sampled schedules; includes LIP and seasonal samples)
2004 Resample (to verify questionable concentrations in primary sample)
2098 Ground-water quality control
2099 Other (ground-water related samples with medium code other than "6", such as soil samples or core material)

82398 Sampling method
4010 Thief sampler
4020 Open-top bailer
4025 Double-valve bailer
4030 Suction pump
4040 Submersible pump
4045 Submersible multiple impeller (turbine) pump
4050 Squeeze pump
4060 Gas reciprocating pump
4070 Gas lift
4080 Peristaltic pump
4090 Jet pump
4100 Flowing well
4110 Resin trap collector
8010 Other

84164 Sampler type
4010 Thief Sampler
4020 Open-top Bailer
4025 Double-valve Bailer
4030 Suction Pump
4035 Submersible Centrifugal Pump
4040 Submersible Positive-pressure Pump
4041 Submersible Helical Rotor Pump
4045 Submersible Gear Pump
4050 Bladder Pump
4060 Gas Reciprocating Pump
4070 Gas Lift
4075 Submersible Piston Pump
4080 Peristaltic Pump
4090 Jet pump
4095 Line-Shaft Turbine Pump
4100 Flowing Well
8010 Other

72006 Sampling Condition
0.01 The site was dry (no water level is recorded)
0.02 The site had been flowing recently
0.03 The site was flowing, head could not be measured
0.04 A nearby site that taps the Aquifer was flowing
0.05 Nearby site tapping same Aquifer had been flowing recently
0.06 Injector site
0.07 Injector site monitor
0.08 Measurement discontinued
0.09 Obstruction encountered in well above water surface
0.10 The site was being pumped
0.11 The site had been pumped recently
0.12 Nearby site tapping the same Aquifer was being pumped
0.13 Nearby site tapping the Same Aquifer was pumped recently
0.14 Foreign substance present on the surface of the water
0.16 Water level affected by stage in nearby site
0.17 Other conditions affecting the measured water level
2 Undesignated
4 Flowing
6 Flowing on gas lift
8 Pumping
10 Open hole
18 Producing
19 Circulating
22 Lifting
23 Flowing to Pit
24 Water Flooding
25 Jetting
30 Seeping
31 Nearby well pumping
32 Nearby well taking water
33 Well taking water

71875 Hydrogen Sulfide Odor
Value
none entered (null)

Remark Code
M detect
U non-detect

Method Code
U un-acidified sample
V acidified sample

00003 Sampling depth, ft
78890 Sampling depth, ft blw msl
00059 Flow rate, instantaneous, gallons per minute
72004 Pump or flow period prior to sampling, minutes

Water Level
61055 Water level, depth below measuring point, feet
62610 Ground-water level above NGVD 1929, feet
62611 Ground-water level above NAVD 1988, feet
72019 Depth to water level, feet below land surface

NWIS Lot Number Parameter Codes* for Conductance Standards

Parameter Code	Standard Value µS/cm, KCl
99160	50
99161	100
99162	250
99163	500
99164	750
99165	1000
99166	2500
99167	5000
99168	10,000
99169	25,000
99170	50,000

Dissolved Oxygen

AZIDE	Azide-modified Winkler	INDIGO	Sepctrophotometer, indigo carmine
INDKT	Field Kit, ndigo carmine, visual	LUMIN	Luminscence sensor
MEMB2	Amperometric, Membrane (DODEC)	MEMBR	Ampermetric, Membrand electrode
RHODA	Field Kit, Rhodazine-D, visual	SPC10	Spectrophotometer, Rhodazine-D

Parameter and method codes for field measurements: http://water.usgs.gov/usgs/owq/Forms.html

***NWIS Lot numbers and Certificates of Analysis:** http://wwwnwql.cr.usgs.gov/qas.shtml?nfssqa_certificates

National Field Manual: http://water.usgs.gov/owq/FieldManual/

Alkalinity Calculator, Alkalinity/ANC parameter and method codes: http://or.water.usgs.gov/alk/reporting.html

Appendix 11 GBRA Chain of Custody Form

GBRA
REGIONAL LABORATORY

Chain of Custody

Guadalupe-Blanco River Authority Regional Laboratory

933 E. Court Street, Seguin, Texas 78155
830-379-5822 • Fax 830-379-7478

NELAP ACCREDITED TNI LABORATORY

Customer Information

Customer Acct. #__________

Name: __________ Phone: __________

Address: __________ Fax: __________

__________ E-mail: __________

Sample Collected By: __________ (Signature) __________ (Printed Name)

Residual Chlorine (Total/Free) Results __________

Thermometer No.__________

pH Paper GBRA reagent no. __________

Temp C	Date Collected	Time Collected	Matrix WW=Wastewater DW=Drinking Water SW=Surface Water S=Soils/Sludge O=Other	Sx Vol. P=Plastic G=Glass	Sample Name/Description	TCEQ ID Number	Grab/ Comp.	Analysis Requested	GBRA Sample ID	Bottle ID No.	pH	GBRA# Preservation

Delivered By: __________ Date/Time __________ Received By: __________ Date/Time: __________

Delivered By: __________ Date/Time __________ Received By: __________ Date/Time: __________

**Special Notes/Ship To: __________

Ice:__________ (Y or N) Number of Containers:__________ Condition of Container(s): (intact)__________

RL-042-0101/2010 (QASM App. c) GBRA Doc. 3019-C Rev 14 Eff: 7/30/2010 by JT

Appendix 12 USGS Chain of Custody Form for NWQL

NWQL CHAIN OF CUSTODY RECORD

US Geological Survey, WRD, phone Contact: Ext:

NOTE: USE BLACK INK ONLY TO FILL IN THIS FORM	Analytical Schedules:
Project name:	
Sample Identification Number:	
Sampler's Name:	

Sample number (Field ID)	Date sampled (DDMMYY)	Time sampled (HHMM)	Lab ID (lab use only)	Sample matrix, (W, water; S, soil)	Number of containers	ASR Form Enclosed

CHAIN-OF-CUSTODY RECORD			
Relinquished by (signature)	Date (DDMMYY)	Time (HHMM)	Received by (signature)
Additional comments:			

SHIPPING DETAILS	
Seal number:	Delivered to shipper by:
Method of shipment:	Airbill number:
LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Lab:	Cooler seal intact upon receipt Yes___ No___ Conditions of contents: Contents temp. (°C) on delivery:
Received for laboratory by: Carrier Sign: NWQL Sign	
Date: Time:	Laboratory Project Number:

Appendix 13 USGS Chain of Custody Form for RSIL

Attachment 1 –External Chain of Custody Form for Controlled Substances

CONTROLLED SUBSTANCE CHAIN OF CUSTODY RECORD

US Geological Survey Customer (Agency) Name :____________ Phone Number:____________ Ext: ________

NOTE: **USE BLACK OR BLUE INK ONLY TO FILL IN THIS FORM**
Sampler's Agency:
Sampler's Name:

Sample number (Field ID)	Date sampled (DDMMYY)	Time sampled (HHMM)	Lab ID (lab use only)	Controlled Substance Schedule	Number of containers

CHAIN-OF-CUSTODY RECORD			
Relinquished by (signature)	Date (DDMMYY)	Time (HHMM)	Received by (signature)
Additional comments:			

SHIPPING DETAILS	
Seal number:	Delivered to shipper by:
Method of shipment:	Airbill number:
LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
Lab:	Cooler seals intact upon receipt Yes____ No____ Conditions of contents: Contents temp. (°C) on delivery:
Received for laboratory by: Carrier Sign: RSIL Sign Date: Time:	Laboratory Project Number:

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RSIL SOP: 1809; General Procedure
SOP Title: Reston Stable Isotope Laboratory Chain of Custody SOP for Controlled Substances
Effective Date: 3/24/2010
Approved by and date of approval: Tyler B. Coplen 3/24/2010

Appendix 14 - USGS geospatial requirements/use in reports

The final USGS report summarizing the results of the investigation will include geospatial data available from various sources that may be used for cartographic purposes. These sources include local, regional, state, and federal organizations. Maps, figures, and metadata developed for the report will follow the guidelines established by the Federal Geographic Data Committee (FGDC). These guidelines are available at http://fgdc.gov/. The geospatial data used in the report may include, but are not limited to, land use, precipitation, soil type, ecoregion, geology, TCEQ monitoring locations, TCEQ permitted outfall, GBRA monitoring locations, USGS gaging locations, city/county/state boundaries, stream hydrology, locations of wells, springs, reservoirs and lakes, roads, watershed boundaries, river basins, railroads, and recreational areas. This data may be obtained from the USGS, Texas Natural Resources Information System (TNRIS), the Texas Water Development Board (TWDB), or other agencies. The TNRIS data is available at http://www.tnris.org/get-data and the TWDB data is available at http://www.twdb.state.tx.us/mapping/gisdata.asp.