Surface Water Quality Monitoring for Boerne City Lake
Quality Assurance Project Plan

City of Boerne Public Works Department
402 E. Blanco
Boerne, Texas 78006

Effective Period: One year from date of final approval

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

Ryan Bass, Capital Projects Administrator
City of Boerne Public Works
(830) 248-1538
rbass@boerne-tx.gov
The City of Boerne will secure written documentation from additional project participants (e.g., subcontractors, laboratories) stating the organization’s awareness of and commitment to requirements contained in this quality assurance project plan and any amendments or revisions of this plan. The City of Boerne will maintain this documentation as part of the project’s quality assurance records. This documentation will be available for review.
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A3 DISTRIBUTION LIST

The City of Boerne will provide copies of this project plan and any amendments or revisions of this plan to each project participant defined in the list below. The City of Boerne will document receipt of the plan by each participant and maintain this documentation as part of the project’s quality assurance records. This documentation will be available for review.

City of Boerne
402 E. Blanco
Boerne, Texas 78006

Ryan Bass, Quality Assurance Officer
rbass@boerne-tx.gov
(830)-248-1538

San Antonio River Authority
Regional Environmental Laboratory
600 E. Euclid Ave.
San Antonio, Texas 78212

Patricia M. Carvajal, Quality Control Supervisor
San Antonio River Authority
pmcarvajal@sara-tx.org
210-302-3674
A4 PROJECT/TASK ORGANIZATION

City of Boerne

Cheryl Rogers,  
City of Boerne, Project Manager  
Responsible for verifying the QAPP is followed and the project is producing data of known and acceptable quality. Ensures adequate training and supervision of all monitoring and data collection activities. Complies with corrective action requirements.

Ryan Bass  
City of Boerne, Quality Assurance Officer  
Responsible for coordinating development and implementation of the QA program. Responsible for writing and maintaining the QAPP. Responsible for maintaining records of QAPP distribution, including appendices and amendments. Notifies the Project Manager of circumstances which may adversely affect the quality of data. Responsible for validation and verification of all data collected. Coordinates the research and review of technical QA material and data related to water quality monitoring system design and analytical techniques. Conducts laboratory inspections. Develops, facilitates, and conducts monitoring systems audits.

Ryan Bass  
City of Boerne, Data Manager  
Oversees data management and distribution for the study.

Ryan Bass  
City of Boerne, Field Supervisor  
Responsible for supervising all aspects of the sampling and measurement of surface waters and other parameters in the field. Responsible for the acquisition of water samples and field data measurements in a timely manner that meet the quality objectives specified in Section A7 (Table A7.1 and A7.2), as well as the requirements of Sections B1 through B8. Responsible for field scheduling, staffing, and ensuring that staff is appropriately trained as specified in Sections A6 and A8.

Larry Thomas  
City of Boerne, Field Data Collection  
Responsible for acquisition of water samples and field data measurements.
A5 PROBLEM DEFINITION/BACKGROUND

Boerne City Lake (BCL) is the primary surface water impoundment in the Upper Cibolo Creek Watershed and serves as a source of potable water for the City of Boerne. BCL is located on Cibolo Creek northwest of Boerne and has a drainage basin of 19.57 square miles. Covering approximately 188 surface acres the lakes conservation pool stores approximately 4,000 acre-feet of water.

Currently, the BCL watershed is mostly undeveloped with landuse consisting of light ranching and recreational uses. Lake Country Estates is an existing residential development on the southern shore of BCL and is the largest residential development within the BCL watershed. A proposed high density residential development on the southern shore of BCL will direct a portion of its stormwater runoff to the lake.

A6 PROJECT/TASK DESCRIPTION

The BCL Water Quality Monitoring Program will consist of routine monitoring to better understand existing water quality conditions in BCL prior to changes in landuse within the watershed. The City of Boerne will monitor 4 sites monthly. The program will help ensure BCL meets TCEQ Water Quality Standards established for aquatic life use and contact recreation. See Section B1 for monitoring to be conducted under this QAPP.

Water Quality Standards

The Texas Surface Water Quality Standards establish explicit goals for the quality of streams, rivers, lakes and bays throughout the state. The standards were developed to maintain the quality of surface waters in Texas so they support public health, recreational use and protect aquatic life. In short, The Texas Surface Water Quality Standards are rules that:

- Designate the uses, or purposes, for which the state’s water bodies should be suitable

- Establish numerical and narrative goals for water quality throughout the state

- Provide a basis on which TCEQ regulatory programs can establish reasonable methods to implement and attain the state’s goals for water quality

According to The Texas Surface Water Quality Standards (Updated February 7, 2018), Segments 1908 (01-02) are designated for the following uses:

Aquatic Life Use

The standards associated with Aquatic Life Use (ALU) are designed to protect aquatic species. The standards establish optimal conditions for the support of aquatic life and define indicators used to measure whether these conditions are met. Some pollutants or conditions that may violate this standard include low levels of dissolved oxygen, or toxins such as metals or pesticides dissolved in water. Upper Cibolo Creek is listed as maintaining a high ALU.
Contact Recreation
The standard associated with this use measures the level of certain bacteria in water to estimate the relative risk of swimming or other water sports involving direct contact with the water. *E. coli* (EC), and historically fecal coliform bacteria are used to indicate the potential presence of harmful pathogens that come from the fecal matter of warm-blooded animals. It is possible to swim in water that does not meet this standard without becoming ill; however, the probability of becoming ill is higher than it would be if bacteria levels were lower.

Public Water Supply
The City of Boerne utilizes water from Boerne City Lake for a portion of its public water supply. Standards associated with this use indicate whether water from a specific lake or river is suitable for use as a source for a public water supply system. Source water is treated before it is delivered to the tap. A separate set of standards governs treated drinking water.

Texas Surface Water Quality Standards, Numeric Criteria for Upper Cibolo Creek (Segment 1908)

- *E. coli* bacteria: Geometric Mean ≤126 colonies /100mL
- Chloride (Cl$^{-1}$): 50 mg/L
- Sulfate (SO$_4^{2-}$): 100 mg/L
- Total Dissolved Solids: 600 mg/L
- Dissolved Oxygen: 5.0 mg/L
- Temperature: 90°F (32.2°C)
- pH Range (SU): 6.5 - 9 mg/L

Freshwater Stream Nutrient Screening Criteria:

Historically, the State of Texas does not include numerical criteria for nutrients in their surface water quality standards. To monitor nutrient levels in surface waters throughout the state the TCEQ screens phosphorus, nitrate nitrogen, and chlorophyll as a preliminary indication of areas of possible concern. The following numeric values for nutrients are used for screening purposes only. No segment specific nutrient standards exist for Segment 1908.

- Ammonia Nitrogen (NH$_3$-N): 0.33 milligrams per liter (mg/L)
- Nitrate Nitrogen (NO$_3$-N): 1.95 mg/L
- Ortho Phosphorus (PO$_4$-P): 0.37 mg/L
- Total Phosphorus (TP): 0.69 mg/L
- Chlorophyll-a: 14.1 micrograms per liter (μg/L)
Revisions to the QAPP

Until the work described is completed, this QAPP shall be revised as necessary and reissued annually on the anniversary date, or revised and reissued within 120 days of significant changes, whichever is sooner. The most recently approved QAPPs shall remain in effect until revisions have been fully approved. If the entire QAPP is current, valid, and accurately reflects the project goals and organization’s policy, the annual reissuance may be done by a certification that the plan is current. This can be accomplished by submitting a cover letter stating the status of the QAPP and a copy of new, signed approval pages for the QAPP.

Amendments

Amendments to the QAPP may be necessary to reflect changes in project organization, tasks, schedules, objectives, and methods; address deficiencies and nonconformances; improve operational efficiency; and/or accommodate unique or unanticipated circumstances. Requests for amendments are directed from the City of Boerne Project Manager. The changes are effective immediately upon approval by the City of Boerne Utility Director or their designees.

Amendments to the QAPP and the reasons for the changes will be documented, and revised pages will be forwarded to all persons on the QAPP distribution list by the City of Boerne QAO. Amendments shall be reviewed, approved, and incorporated into a revised QAPP during the annual revision process or within 120 days of the initial approval in cases of significant changes.
### A7 QUALITY OBJECTIVES AND CRITERIA

Data collected as part of BCL Surface Water Quality Monitoring. Data collected for parameters listed in Table A7.1 and A7.2 will not be submitted to TCEQ SWQMIS.

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>UNITS</th>
<th>MATRIX</th>
<th>METHOD</th>
<th>PARAMETER CODE</th>
<th>AWRL</th>
<th>Limit of Quantitation (LOQ)</th>
<th>PRECISION (RPD of LCS/LCSD)</th>
<th>BIAS %Rec. of LCS</th>
<th>LOQ CHECK STANDARD % Rec</th>
<th>LAB</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>S.U.</td>
<td>water</td>
<td>EPA 150.1 and TCEQ SOP, V1</td>
<td>00400</td>
<td>NA³</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Field</td>
</tr>
<tr>
<td>DO</td>
<td>mg/L</td>
<td>water</td>
<td>SM 4500-O G and TCEQ SOP, V1</td>
<td>00300</td>
<td>NA³</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Field</td>
</tr>
<tr>
<td>Specific Conductance</td>
<td>µS/cm</td>
<td>water</td>
<td>EPA 120.1 and TCEQ SOP, V1</td>
<td>00094</td>
<td>NA³</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Field</td>
</tr>
<tr>
<td>Temperature</td>
<td>°C</td>
<td>water</td>
<td>SM 2550 B and TCEQ SOP, V1</td>
<td>00010</td>
<td>NA³</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Field</td>
</tr>
<tr>
<td>Transparency Secchi Disk</td>
<td>meters</td>
<td>water</td>
<td>TCEQ SOP V1</td>
<td>00078</td>
<td>NA³</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Field</td>
</tr>
<tr>
<td>Days since precipitation event</td>
<td>days</td>
<td>NA</td>
<td>TCEQ SOP V1</td>
<td>72053</td>
<td>NA³</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Field</td>
</tr>
<tr>
<td>Flow severity</td>
<td></td>
<td>water</td>
<td>TCEQ SOP V1</td>
<td>01351</td>
<td>NA³</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Field</td>
</tr>
<tr>
<td>Estimated Flow</td>
<td>cfs</td>
<td>NA</td>
<td>TCEQ SOP V1</td>
<td>74069</td>
<td>NA³</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Field</td>
</tr>
<tr>
<td>Water Color</td>
<td></td>
<td>NA</td>
<td>TCEQ SOP V1</td>
<td>89969</td>
<td>NA³</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Field</td>
</tr>
<tr>
<td>Water Odor</td>
<td></td>
<td>NA</td>
<td>TCEQ SOP V1</td>
<td>89971</td>
<td>NA³</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Field</td>
</tr>
<tr>
<td>Present Weather</td>
<td></td>
<td>NA</td>
<td>TCEQ SOP V1</td>
<td>89966</td>
<td>NA³</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Field</td>
</tr>
</tbody>
</table>
Table A7.2 Conventional Parameters for Routine Monitoring

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>UNITS</th>
<th>MATRIX</th>
<th>METHOD</th>
<th>PARAMETER CODE</th>
<th>AWRL</th>
<th>Limit of Quantitation (LOQ)</th>
<th>PRECISION (RPD of LCS/LCSD &amp; Sample/Sample Dup)</th>
<th>BIAS % Rec. of LCS</th>
<th>LOQ CHECK STANDARD % Rec</th>
<th>LAB</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. coli, IDEXX Colilert</td>
<td>MPN/100 mL</td>
<td>water</td>
<td>SM 9223-B</td>
<td>31699</td>
<td>1</td>
<td>1</td>
<td>0.5 (1)</td>
<td>NA</td>
<td>NA</td>
<td>SARA</td>
</tr>
<tr>
<td>E. coli, IDEXX Colilert³</td>
<td>hours</td>
<td>water</td>
<td>NA</td>
<td>31704</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>SARA</td>
</tr>
<tr>
<td>Total Kjeldahl N</td>
<td>mg/L</td>
<td>water</td>
<td>EPA 351.2</td>
<td>006205</td>
<td>0.2</td>
<td>0.2</td>
<td>20</td>
<td>90-100%</td>
<td>70-130%</td>
<td>SARA</td>
</tr>
<tr>
<td>Nitrate-N, total</td>
<td>mg/L</td>
<td>water</td>
<td>EPA 300.0 Rev. 2.1</td>
<td>00625</td>
<td>0.05</td>
<td>0.05</td>
<td>20</td>
<td>90-110</td>
<td>70-130%</td>
<td>SARA</td>
</tr>
<tr>
<td>Total Phosphorus - P</td>
<td>mg/L</td>
<td>water</td>
<td>EPA 365.3</td>
<td>00665</td>
<td>0.06</td>
<td>0.02</td>
<td>20</td>
<td>80-120</td>
<td>70-130%</td>
<td>SARA</td>
</tr>
<tr>
<td>Chlorophyll a</td>
<td>µg/L</td>
<td>water</td>
<td>SM 10200-H²</td>
<td>32211</td>
<td>3</td>
<td>1²</td>
<td>20 (3)</td>
<td>80-120</td>
<td>N/A</td>
<td>SARA</td>
</tr>
<tr>
<td>Phophytin-a</td>
<td>µg/L</td>
<td>water</td>
<td>SM 10200-H²</td>
<td>32218</td>
<td>3</td>
<td>1²</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>SARA</td>
</tr>
</tbody>
</table>

(1) Criteria applies to E.coli results that are greater than 10 mpn/100ml
(2) Reporting limit. Not a NELAP-defined LOQ
(3) This criterion applies to Chlorophyll duplicates with average concentrations >10µg/L.

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.

Laboratory precision is assessed by comparing replicate analyses of laboratory control samples in the sample matrix (e.g. deionized water, sand, commercially available tissue) or sample/duplicate pairs in the case of bacterial analysis. 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 through A7.2.

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, sand, commercially available tissue) 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 bias are specified in Table A7.1 through A7.2.
**Representativeness**
Site selection, the appropriate sampling regime, the sampling of all pertinent media according to TCEQ SOPs, and use of only approved analytical methods will assure that the measurement data represents the conditions at the site. Routine data collected for water quality assessment are considered to be spatially and temporally representative of routine water quality conditions. Water Quality data are collected on a routine frequency and are separated by approximately even time intervals. At a minimum, samples are collected over at least two seasons (to include inter-seasonal variation) and over two years (to include inter-year variation). Although data may be collected during varying regimes of weather and flow, the data sets will not be biased toward unusual conditions of flow, runoff, or season. The goal for meeting total representation of the water body will be tempered by the potential funding for complete representativeness.

**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(s) that 90% data completion is achieved.

**Comparability**
Confidence in the comparability of routine data sets for this project and for water quality assessments 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 TCEQ 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.

**Limit of Quantitation**

**Ambient Water Reporting Limits (AWRLs)**
The 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 are the program-defined reporting specifications for each analyte and yield data acceptable for the TCEQ’s water quality assessment. A full listing of AWRLs can be found at [http://www.tceq.state.tx.us/compliance/monitoring/crp/qa/index.html](http://www.tceq.state.tx.us/compliance/monitoring/crp/qa/index.html). The limit of quantitation 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 in order to report results:

- The laboratory’s LOQ for each analyte must be at or below 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 analytical batch of Samples analyzed for this project.
**Analytical Quantitation**
To demonstrate the ability to recover at the limit of quantitation, the laboratory will analyze an LOQ check standard for each batch of samples run.

Laboratory Measurement Quality Control Requirements and Acceptability Criteria are provided in Section B5

**A8 SPECIAL TRAINING/CERTIFICATION**

Field Staff will receive training by the City of Boerne QA Officer on the proper methods of collecting, handling and transporting water quality samples. Field Staff will be provided instruction manuals and receive a day of hands-on instruction in the field. Field Staff must successfully demonstrate the ability to properly collect and handle samples before being assigned the duty. Upon completion of training, Field Staff will be signed off as qualified to collect samples by the City of Boerne QA Officer.

Contractors and subcontractors must ensure that laboratories analyzing samples under this QAPP meet the requirements contained in section 5.4.4 of the TNI Standards (concerning Review of Requests, Tenders and Contracts).

**Monitoring Station Position Documentation**

City of Boerne Geographic Information System staff using Trimble Global Positioning System (GPS) equipment may be used as a component of the information required by the City of Boerne to establish monitoring stations at BCL. In lieu of collecting GPS coordinates, positional data may be acquired with a consumer grade GPS and verified with photo interpolation using a certified source, such as Google Earth or Google map. The verified coordinates and map interface can then be used to develop a new station locations.

**A9 DOCUMENTS AND RECORDS**

**Laboratory Test Reports**

Laboratory test reports will be produced by the SARA-REL and emailed to the City of Boerne once sample validation has been completed. The SARA-REL is a NELA accredited laboratory through the TCEQ. Test/data reports from the laboratory document the test results clearly and accurately. Routine data reports are consistent with the TNI standards (Section 5.5.10) and include the information necessary for the interpretation and validation of data. The information provided in an analytical test report whether hard copy or electronic includes the following:

- Title;
- name and address of the laboratory, and the phone number and name of a contact person;
B1 SAMPLING PROCESS DESIGN (EXPERIMENTAL DESIGN)

Routine samples will be collected at the sites listed in Table B1.2 in order to characterize surface water quality conditions in BCL and evaluate long-term impacts of landuse change within the watershed.

See Table B1.2 for sampling process design information and monitoring tables associated with data collected under this QAPP. A Map of the project area is located in Appendix A; a map of the sampling stations is located in Appendix B.
<table>
<thead>
<tr>
<th>Site Description</th>
<th>Station</th>
<th>Submitting Entity</th>
<th>Collecting Entity</th>
<th>Monitoring Type</th>
<th>Conventional Parameters</th>
<th>Bacteria</th>
<th>Flow</th>
<th>Field Parameters</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boerne City Lake at Boerne Water Treatment Facility</td>
<td>BCL1</td>
<td>-</td>
<td>BC</td>
<td>RT</td>
<td>12</td>
<td>12</td>
<td>0</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Boerne City Lake at Bergman Tract east of Lake Country Estates</td>
<td>BCL2</td>
<td>-</td>
<td>BC</td>
<td>RT</td>
<td>12</td>
<td>12</td>
<td>0</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Boerne City Lake at City Park Boat Ramp</td>
<td>BCL3</td>
<td>-</td>
<td>BC</td>
<td>RT</td>
<td>12</td>
<td>12</td>
<td>0</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Upper Cibolo Creek at Sparkling Springs Road</td>
<td>20830</td>
<td>-</td>
<td>BC</td>
<td>RT</td>
<td>12</td>
<td>12</td>
<td>0</td>
<td>12</td>
<td>Flow Observation: Record in field notes if streamflow is passing through the roadway culverts</td>
</tr>
</tbody>
</table>
B2 SAMPLING METHODS

Field Sampling Procedures

Field sampling will be conducted according to procedures documented in the most recent edition of *TCEQ Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, 2008(RG-415)* and *Volume 2: Methods for Collecting and Analyzing Biological Community and Habitat Data (RG-416)*. Additional aspects outlined in Section B below reflect specific requirements for sampling under the BCL Water Quality Monitoring Program and/or provide additional clarification.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Matrix</th>
<th>Container</th>
<th>Preservation</th>
<th>Sample Volume</th>
<th>Holding Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. coli, IDEXX Colilert</td>
<td>Water</td>
<td>Whirl-pack containing Sodium Thiosulfate</td>
<td>Cool to 0 ≤ 6°C</td>
<td>250 mL</td>
<td>8 hrs¹</td>
</tr>
<tr>
<td>Total phosphorous</td>
<td>Water</td>
<td>Cubitainer</td>
<td>H₂SO₄ to pH &lt;2 Cool to 0 ≤ 6°C</td>
<td>100 mL</td>
<td>28 days</td>
</tr>
<tr>
<td>Total Kjeldahl Nitrogen</td>
<td>Water</td>
<td>Cubitainer</td>
<td>H₂SO₄ to pH &lt;2 Cool to 0 ≤ 6°C</td>
<td>500 mL</td>
<td>28 days</td>
</tr>
<tr>
<td>Nitrate-N, total</td>
<td>Water</td>
<td>Cubitainer</td>
<td>Cool to 0 ≤ 6°C</td>
<td>100 mL</td>
<td>48 hours</td>
</tr>
<tr>
<td>Chlorophyll-a</td>
<td>Water</td>
<td>Amber Plastic</td>
<td>Dark and ice before filtration (within 48 hours) Dark and frozen after filtration (held up to 28 days)</td>
<td>2000 mL³</td>
<td>28 days</td>
</tr>
<tr>
<td>Pheophytin</td>
<td>Water</td>
<td>Amber Plastic</td>
<td>Dark and ice before filtration (within 48 hours) Dark and frozen after filtration (held up to 28 days)</td>
<td>2000 mL³</td>
<td>28 days</td>
</tr>
</tbody>
</table>

¹E.coli samples analyzed by SM 9223-B should always be processed as soon as possible and within 8 hours. When transport conditions necessitate delays in delivery longer than 6 hours, the holding time may be extended and samples must be processed as soon as possible and within 48 hours.

²Chlorophyll-a and Pheophytin are analyzed together, the volume required is a total of 2000 mLs

Sample Containers

Sample containers (cubitainers) are purchased pre-cleaned for conventional parameters and are disposable. Whirl-pak bags are used for bacteriological samples and have 1% sodium thiosulfate tablets added. Amber plastic bottles are used routinely for chlorophyll samples.

Processes to Prevent Contamination

Procedures outlined in the *TCEQ Surface Water Quality Monitoring Procedures* outline the necessary steps to prevent contamination of samples. These include: direct collection into sample containers, when possible; clean sampling techniques for metals; and certified containers for organics.
Documentation of Field Sampling Activities

Field sampling activities are documented on field data sheets as presented in Appendix C. The following will be recorded for all visits:

1. Station ID
2. Sampling Date
3. Location
4. Sampling depth
5. Sampling time
6. Sample collector’s name/signature
7. Values for all field parameters
8. Detailed observational data, including:
   - water appearance
   - weather
   - biological activity
   - unusual odors
   - pertinent observations related to water quality or stream uses (e.g., exceptionally poor water quality conditions/standards not met; stream uses such as swimming, boating, fishing, irrigation pumps, etc.)
   - watershed or instream activities (events impacting water quality, e.g., bridge construction, livestock watering upstream, etc.)
   - specific sample information (number of sediments grabs, type/number of fish in a tissue sample, etc.)
   - missing parameters (i.e., when a scheduled parameter or group of parameters is not collected)
   - potential pollutant source identification (i.e., evidence of wildlife, vegetation, illegal dumping, illicit discharges, etc.)

Recording Data

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

1. Write legibly in indelible ink
2. Changes should be made by crossing out original entries with a single line, entering the changes, and initialing and dating the corrections.
3. Close-out incomplete pages with an initialed and dated diagonal line.
Sampling Method Requirement or Sampling Process Design Deficiencies and Corrective Action

Examples of sampling method requirement or sample design deficiencies include but are not limited to such things as inadequate sample volume due to spillage or container leaks, failure to preserve samples appropriately, contamination of a sample bottle during collection, storage temperature and holding time exceedance, sampling at the wrong site, etc. Any deviations from the QAPP and appropriate sampling procedures may invalidate resulting data and may require corrective action. Corrective action may include for samples to be discarded and re-collected. It is the responsibility of the City of Boerne Project Manager, in consultation with the City of Boerne QAO, to ensure that the actions and resolutions to the problems are documented and that records are maintained in accordance with this QAPP. In addition, these actions and resolutions will be conveyed both verbally and in writing by completion of a corrective action plan (CAP).

The definition of and process for handling deficiencies and corrective actions are defined in Section C1.

B3 SAMPLE HANDLING AND CUSTODY

Sample Labeling
Samples from the field are labeled on the container with a permanent marker. Label information includes:

1. Site identification
2. Date and time of collection
3. Preservative added, if applicable
4. Designation of ‘field-filtered’ (for metals) as applicable
5. Sample type (i.e., analysis(es)) to be performed

Sample Handling

Water quality samples (conventional and bacteriological parameters) are collected according to procedures identified in TCEQ’s SOP, V1 - TCEQ Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue, 2003. The field data sheet is filled out in the field when the sample is collected and the results of field parameters are posted on this sheet. This sheet documents sample collection, flow data collected is also documented with this form or by attachment.

Samples requiring analysis that require acid preservation are collected in containers prepared for acid preserved sample collection prior to departing for the days sample collection. These containers are prepared by dispensing 2 mL of acid in the container at the beginning of the day. The sample container is labeled with a permanent water proof marker directly on the container and placed in an ice chest where they are covered with ice.
The samples are transported to the SARA-REL. Upon arrival at the laboratory, all samples and paperwork are relinquished to the sample custodian. The sample custodian accepts the sample, checking for any abnormalities in the sample (i.e. leakers, missing or torn COC seals, etc.) and notes any abnormalities at log in. The sample custodian also checks and documents the temperature of the samples using an infrared thermometer, and that all acid preserved samples are below 2 S.U. pH. Paperwork is examined for completeness and the sample custodian accepts the sample and documentation by signing the chain of custody (field data sheet) and also posting the date and time of acceptance.

The sample custodian enters the sample information into the laboratory’s information management system and prints out one set of labels. Each sample container brought in, gets a label with a unique identification number. The water quality samples are then either given directly to an analyst, preparing to analyze the sample(s) immediately, or placed in a refrigerator in a secured (access is controlled through the use of programmed access cards) portion of the laboratory.

Laboratory staff run backlog reports to identify samples that need to be analyzed and identify when sample hold time elapses.

**Sample Tracking**

Proper sample handling and custody procedures ensure the custody and integrity of samples beginning at the time of sampling 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 COC form is used to document sample handling during transfer from the field to the laboratory and among City of Boerne staff. The following information concerning the sample is recorded on the COC form (See Appendix F).

1. Date and time of collection
2. Site identification
3. Sample matrix
4. Number of containers
5. Preservative used
6. Was the sample filtered
7. Analyses required
8. Name of collector
9. Custody transfer signatures and dates and time of transfer
10. Bill of lading (*if applicable*)
Sample Tracking Procedure Deficiencies and Corrective Action

All deficiencies associated with chain-of-custody procedures as described in this QAPP are immediately reported to the City of Boerne QAO. These include such items as delays in transfer, resulting in holding time violations; violations of sample preservation requirements; incomplete documentation, including signatures; possible tampering of samples; broken or spilled samples, etc. The City of Boerne Project Manager in consultation with the City of Boerne QAO will determine if the procedural violation may have compromised the validity of the resulting data. Any failures that have reasonable potential to compromise data validity will invalidate data, and the sampling event should be repeated. Corrective Action Plans will be prepared by the City of Boerne QAO and submitted to the City of Boerne Project Manager.

The definition of and process for handling deficiencies, nonconformances, and corrective action are defined in Section C1.

B4 ANALYTICAL METHODS

The analytical methods are listed in Table A7.1 through Table A7.2 of Section A7. Laboratories collecting data under this QAPP are compliant with the NLEAC Institute Laboratory Accreditation Standard.

Copies of laboratory SOPs are retained by the SARA-REL and are available for review by the City of Boerne. Laboratory SOPs are consistent with EPA requirements as specified in the method.

Standards Traceability

All standards used in the field and laboratory are traceable to certified reference materials. Standards and reagent preparation is fully documented and maintained in a standards log book. Each documentation includes information concerning the standard or reagent identification, starting materials, including concentration, amount used and lot number; date prepared, expiration date and preparer’s initials/signature. The bottle is labeled in a way that will trace the standard or reagent back to preparation. Standards or reagents used are documented each day samples are prepared or analyzed.

Analytical Method Deficiencies and Corrective Actions

Deficiencies in field and laboratory measurement systems involve, but are not limited to such things as instrument malfunctions, failures in calibration, blank contamination, quality control samples outside QAPP defined limits, etc. In many cases, the field technician or lab analyst will be able to correct the problem. If the problem is resolvable by the field technician or lab analyst, then they will document the problem on the field data sheet or laboratory record and complete the analysis.
Laboratory Corrective Actions:

If the problem is not resolvable, then it is conveyed to the Quality Assurance Officer, who will make the determination and notify the City of Boerne QAO. The nature and disposition of the problem is reported on the data report which is sent to the City of Boerne QAO.

The definition of and process for handling deficiencies, nonconformances, and corrective action are defined in Section C1.

B5 QUALITY CONTROL

Sampling Quality Control Requirements and Acceptability Criteria

The minimum Field QC Requirements are outlined in the TCEQ Surface Water Quality Monitoring Procedures. Specific requirements are outlined below. Field QC sample results are submitted with the laboratory data report (see Section A9.).

Laboratory Measurement Quality Control Requirements and Acceptability Criteria

Batch – A batch is defined as environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A preparation batch is composed of one to 20 environmental samples of the same NELAP-defined matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours.

An analytical batch is composed of prepared environmental samples (extract, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples.

Method Specific QC requirements – QC samples, other than those specified later this section, are run (e.g., 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 quality assurance manuals (QAMs). 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 calibrations are performed. In addition, an LOQ check standard will be analyzed with each analytical batch. 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 the LOQ for each analyte for each analytical batch of CRP samples 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.

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:

\[
% R = \frac{SR}{SA} \times 100
\]

Measurement performance specifications are used to determine the acceptability of LOQ Check Standard analyses as specified in Table A7.1-A7.2.

Laboratory Control Sample (LCS) - An LCS 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.

The LCS is spiked into the sample matrix at a level less than or near the mid-point of the calibration 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, except in cases of organic analytes with multipeak responses.

The LCS is carried through the complete preparation and analytical process. LCSs are run at a rate of one per preparation batch.

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:

\[
% R = \left( \frac{SR}{SA} \right) \times 100
\]

Measurement performance specifications are used to determine the acceptability of LCS analyses as specified in Table A7.2.
Laboratory Duplicates – A laboratory duplicate is prepared by taking aliquots of a sample from the same container under laboratory conditions and processed and analyzed independently. A laboratory control sample duplicate (LCSD) is prepared in the laboratory by splitting aliquots of an LCS. Both samples are carried through the entire preparation and analytical process. LCSDs are used to assess precision and are performed at a rate of one per preparation batch.

For most parameters, precision is calculated by the relative percent difference (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:

$$RPD = \frac{\left| X_1 - X_2 \right|}{\left| \left( X_1 - X_2 \right)/2 \right|} \times 100$$

A bacteriological duplicate is considered to be a special type of laboratory duplicate and applies when bacteriological samples are run in the field as well as in the lab. Bacteriological duplicate analyses are performed on samples from the sample bottle on a 10% basis. Results of bacteriological duplicates are evaluated by calculating the logarithm of each result and determining the range of each pair.

Measurement performance specifications are used to determine the acceptability of duplicate analyses as specified in Table A7.2. The specifications for bacteriological duplicates in Table A7.2 apply to samples with concentrations $> 10$ MPN/100mL.

$$| \log A - \log B | = \log \text{Range}$$

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 once per preparation batch whichever is greater. The information from these controls is sample/matrix specific and is not used to determine the validity of the entire batch. To the extent possible, matrix spikes prepared and analyzed over the course of the project should be performed on samples from different sites. 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:

$$%R = \frac{(SSR - SR)}{SA} \times 100$$

Measurement performance specifications for matrix spikes are not specified in this document. Matrix spike criteria are method specific and acceptance criteria are stated in the applicable Standard Operating Procedures.

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.

**Method blank** – 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 blanks are performed at a rate of once per preparation batch. 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. Samples associated with a contaminated blank shall be evaluated as to the best corrective action for the samples (e.g. reprocessing or data qualifying codes). In all cases the corrective action must be documented.

The method blank shall be analyzed at a minimum of once per preparation batch. In those instances for which no separate preparation method is used (example: volatiles in water) the batch shall be defined as environmental 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.

**Quality Control or Acceptability Requirement Deficiencies and Corrective Actions**

Sampling QC excursions are evaluated by the City of Boerne Project Manager, in consultation with the City of Boerne QAO. In that differences in sample results are used to assess the entire sampling process, including environmental variability, the arbitrary rejection of results based on pre-determined limits is not practical. Therefore, the professional judgment of the City of Boerne Project Manager and QAO will be relied upon in evaluating results. Rejecting sample results based on wide
variability is a possibility. Field blanks for trace elements and trace organics are scrutinized very closely. Field blank values exceeding the acceptability criteria may automatically invalidate the sample, especially in cases where high blank values may be indicative of contamination which may be causal in putting a value above the standard. Notations of field split excursions and blank contamination are noted in the quarterly report and the final QC Report. Equipment blanks for metals analysis are also scrutinized very closely.

Laboratory measurement quality control failures are evaluated by the laboratory staff. The disposition of such failures and the nature and disposition of the problem is reported to the City of Boerne QAO. The Laboratory QAO will discuss with the City of Boerne QAO.

The definition of and process for handling deficiencies and nonconformances, and corrective action are defined in Section C1.

**B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE**

All in-stream sampling equipment testing and maintenance requirements are detailed in the *TCEQ Surface Water Quality Monitoring Procedures, Volume 1*. Equipment records are kept on all field equipment and a supply of critical spare parts is maintained by the City of Boerne Field Supervisor.

All laboratory tools, gauges, instrument, and equipment testing and maintenance requirements are contained within laboratory QAM(s) and Technical SOP’s. Testing and maintenance records are maintained and are available for inspection by the TCEQ. Instruments requiring daily or in-use testing may include, but are not limited to, water baths, ovens, autoclaves, incubators, refrigerators, and laboratory pure water. Critical spare parts for essential equipment are maintained to prevent downtime. Maintenance records are available for inspection by the TCEQ.

**B7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY**

Field equipment calibration requirements are contained in the *TCEQ Surface Water Quality Monitoring Procedures*. 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.

Detailed laboratory calibrations are contained within the SOP(s). The laboratory SOP’s identifies all tools, gauges, instruments and other sampling, measuring and test equipment used for data collection activities affecting quality that must be controlled and, at specified periods, calibrated to maintain bias within specified limits. Calibration records are maintained, are traceable to the instrument, and are available for inspection by the TCEQ. Equipment requiring periodic calibrations includes, but is not limited to, thermometers, pH meters, balances, incubators, turbidity meters and analytical instruments.
B8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Inspection and acceptance of supplies and consumables is done by the analyst/technician ordering the supplies. SARA-REL has found that the best person to determine if the supplies are acceptable for use in the laboratory or field is the individual responsible for the analysis. Sample Containers will be provided by SARA-REL.

B9 NON-DIRECT MEASUREMENTS

Data collected directly under this QAPP will not be submitted to the SWQMIS database. Sampling conducted by the TCEQ, USGS, and Texas Clean Rivers Program partners, and Texas Watch quality assured volunteer monitors is not covered under this QAPP and will not be reported to TCEQ by the City of Boerne.

B10 DATA MANAGEMENT

Personnel
Section A4 lists responsibilities and lines of communication for data management personnel.

Field personnel may consist of staff in the Public Works Department of the City of Boerne. Any personnel that assist in collection of field samples will receive training to verify competency (Refer to A8).

Data Management Process

Field Data:

- Field measurements and observations will be recorded on loose-leaf field data sheets by project field staff.

- Individual field data sheets will be used at each sampling station.

- Field data will be entered into Excel spreadsheets by project staff and reviewed by the City of Boerne QAO. Data will be stored on the City of Boerne Data Manager’s desktop computer and the City of Boerne’s secure on-site server, which is operated and maintained by the City of Boerne Information Technology Department.

Laboratory Data:

- Laboratory results will be submitted electronically (via PDF report) to the City of Boerne Data Manager. Lab results will be stored on the City of Boerne Data Manager’s desktop computer and the City of Boerne’s secure on-site server.
Archives/Data Retention
Complete original data sets are archived electronically and retained on-site by the City of Boerne.

Data Verification/Validation
The control mechanisms for detecting and correcting errors and for preventing loss of data during data reduction, data reporting, and data entry are contained in Sections D1, D2, and D3.

Forms and Checklists
See Appendix C for the Field Data Sheets.

Data Dictionary
Terminology and field descriptions are included in the SWQM DMRG (January 2010 or most recent version). For the purposes of verifying which entity codes are included in this QAPP, a table outlining the entities that will be used when submitting data under this QAPP is included below.

<table>
<thead>
<tr>
<th>Name of Monitoring Entity</th>
<th>Tag Prefix</th>
<th>Submitting Entity</th>
<th>Collecting Entity</th>
</tr>
</thead>
<tbody>
<tr>
<td>City of Boerne</td>
<td>BC</td>
<td>No TCEQ Submittals</td>
<td>BC</td>
</tr>
</tbody>
</table>

Data Handling
Data are processed using the Microsoft Excel suite of tools and applications. Data integrity is maintained by of peer review for data entry processes. The administrative assistant will enter the results into the worksheets; the project QAO will then review these entries for accuracy.

Hardware and Software Requirements
Hardware configurations are sufficient to run Microsoft Excel under the Windows operating system.

Information Resource Management Requirements
City of Boerne information technology (IT) policy is contained in IT SOPs which are available for review at City of Boerne offices.

Quality Assurance/Control
See Section D of this QAPP
C1 ASSESSMENTS AND RESPONSE ACTIONS

Table C1.1 Assessments and Response Requirements

<table>
<thead>
<tr>
<th>Assessment Activity</th>
<th>Approximate Schedule</th>
<th>Responsible Party</th>
<th>Scope</th>
<th>Response Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status Monitoring Oversight, etc.</td>
<td>Continuous</td>
<td>City of Boerne Project Manager</td>
<td>Monitoring of the project status and records to ensure requirements are being fulfilled.</td>
<td>None</td>
</tr>
<tr>
<td>Laboratory Inspection</td>
<td>Every 2 Years</td>
<td>TCEQ</td>
<td>Analytical and quality control procedures employed at the laboratory and the contract laboratory</td>
<td>30 days to respond to TCEQ Assessment Report</td>
</tr>
</tbody>
</table>

Corrective Action Process for Deficiencies

Deficiencies are any deviation from the QAPP, SWQM Procedures Manual, SOPs, or Data Management Reference Guide. Deficiencies may invalidate resulting data and may require corrective action. Corrective action may include for samples to be discarded and re-collected. Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff. It is the responsibility of the City of Boerne Project Manager, in consultation with the City of Boerne QAO, to ensure that the actions and resolutions to the problems are documented and that records are maintained in accordance with this QAPP. In addition, these actions and resolutions will be conveyed to the COB Project Manager both verbally and in writing by completion of a corrective action plan (CAP).

Corrective Action

CAPs should:

- Identify the problem, nonconformity, or undesirable situation
- Identify immediate remedial actions if possible
- Identify the underlying cause(s) of the problem
- Identify whether the problem is likely to recur, or occur in other areas
- Evaluate the need for Corrective Action
- Use problem-solving techniques to verify causes, determine solution, and develop an action plan
- Identify personnel responsible for action
- Establish timelines and provide a schedule
- Document the corrective action
Status of CAPs will be documented on the Corrective Action Status Table (See Appendix E.) 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 City of Boerne Project Manager immediately.

The City of Boerne Project Manager is responsible for implementing and tracking corrective actions. Corrective action plans will be documented on the Corrective Action Plan Form (See Appendix F). Records of audit findings and corrective actions are maintained by both the City of Boerne QAO.

C2 REPORTS TO MANAGEMENT

Laboratory Data Reports

Laboratory data reports contain the results of all specified QC measures listed in Section B5, including but not limited to laboratory duplicates and method blanks. This information is reviewed by the San Antonio River Authority QAO and compared to the pre-specified acceptance criteria to determine acceptability of data before forwarding to the City of Boerne Project Manager.

D1 DATA REVIEW, VERIFICATION, AND VALIDATION

For the purposes of this document, data verification is a systematic process for evaluating performance and compliance of a set of data to ascertain its completeness, correctness, and consistency using the methods and criteria defined in the QAPP. Validation means those processes taken independently of the data-generation processes to evaluate the technical usability of the verified data with respect to the planned objectives or intention of the project. Additionally, validation can provide a level of overall confidence in the reporting of the data based on the methods used.

All data obtained from field and laboratory measurements will be reviewed and verified for conformance to project requirements, and then validated against the data quality objectives which are listed in Section A7. Only those data which are supported by appropriate quality control data and meet the measurement performance specification defined for this project will be considered acceptable.

The procedures for verification and validation of data are described in Section D2, below. The City of Boerne Field Supervisor is responsible for ensuring that field data are properly reviewed and verified for integrity. The Laboratory Supervisor is responsible for ensuring that laboratory data are scientifically valid, defensible, of acceptable precision and bias, and reviewed for integrity. The City of Boerne Data Manager will be responsible for ensuring that all data are properly reviewed and verified, and submitted in the required format to the project database.
D2 VERIFICATION AND VALIDATION METHODS

All data will be verified to ensure they are representative of the samples analyzed and locations where measurements were made, and that the data and associated quality control data conform to project specifications. The staff and management of the respective field, laboratory, and data management tasks are responsible for the integrity, validation and verification of the data each task generates or handles throughout each process. The field and laboratory tasks ensure the verification of raw data, electronically generated data, and data on chain-of-custody forms and hard copy output from instruments.

Verification, validation and integrity review of data will be performed using self-assessments and peer review, as appropriate to the project task, followed by technical review by the manager of the task. The data to be verified (listed in table 2.1) are evaluated against project performance specifications (Section A7) and are checked for errors, especially errors in transcription, calculations, and data input. 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 electronically or by initialing and dating the associated paperwork. If an issue cannot be corrected, the task manager consults with the higher level project management to establish the appropriate course of action.

The City of Boerne Project Manager and QAO are each responsible for validating that the verified data are scientifically valid, defensible, of known precision, bias, integrity, meet the data quality objectives of the project. One element of the validation process involves evaluating the data again for anomalies. Any suspected errors or anomalous data must be addressed by the manager of the task associated with the data, before data validation can be completed.
Appendix A. Area Location Map
Figure A1.1 Area Location – Upper Cibolo Creek Watershed
Appendix B. Detailed Site Location Map
Figure B1.1 Sampling Station Locations
Appendix C. Field Data Reporting Form
City of Boerne  
Field Data Sheet

Sample No.(s): 
Tag Id: ________________ Matrix: □ NPW □ QC

Station Id: ___________________ Station Location: ____________________

Program Code: □ CRP □ (Please Specify)
Sample Type: □ RT □ SS (Specify in Comments) □
Collection Method: □ Grab Instrument #: ____________________

Submitting Entity: SA □ Collecting Entity: CB □
Collection Date: 
Collection Time: ________________ End Depth: 
Collector(s) Signature(s): 

<table>
<thead>
<tr>
<th># of Containers/Container Type</th>
<th>Type of Field Preservation</th>
<th>Requested Analysis</th>
<th>pH &lt;2 (Y or N)²</th>
</tr>
</thead>
<tbody>
<tr>
<td>GC - Gallon Container</td>
<td>Ice □ H₂SO₄ □ HNO₃ □ Filtered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>QC - Quart Container</td>
<td>Ice □ H₂SO₄ □ HNO₃ □ Filtered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LW - Large Whirlpak</td>
<td>Ice □ H₂SO₄ □ HNO₃ □ Filtered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AP – Amber Plastic Bottle</td>
<td>Ice □ H₂SO₄ □ HNO₃ □ Filtered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>Ice □ H₂SO₄ □ HNO₃ □ Filtered</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) Observed/Corrected temperature (ID: C01-096)  ² pH Paper R15-3Bb  3 Field Parameters □ Flow □ Sample Temperature (°C): ______/_____

Associated Required Data: □ Nektom □ Benthic □ Habitat □ 24Hr DO □ Metals □ Other (Specify in Comments)

### FIELD PARAMETERS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Code</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissolved Oxygen</td>
<td>00300</td>
<td>mg/L</td>
</tr>
<tr>
<td>Temperature</td>
<td>00010</td>
<td>°C</td>
</tr>
<tr>
<td>pH</td>
<td>00400</td>
<td>S.U.</td>
</tr>
<tr>
<td>CL₂</td>
<td>50060</td>
<td>mg/L</td>
</tr>
<tr>
<td>Conductivity (temperature compensating value to 25 °C)</td>
<td>00094</td>
<td>μS/cm</td>
</tr>
<tr>
<td>Secchi Depth</td>
<td>00078</td>
<td>m</td>
</tr>
<tr>
<td>Days Since Last Precipitation</td>
<td>72053</td>
<td>days</td>
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</table>

### FIELD OBSERVATIONS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Code</th>
<th>Depth Sensor reset to 0.00 (prior to collecting first sample of the day):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Severity</td>
<td>01351</td>
<td>□ 1 – No Flow □ 2 – Low □ 3 – Normal □ 4 – Flood □ 5 – Dry</td>
</tr>
<tr>
<td>Water Color</td>
<td>89969</td>
<td>□ 1 – Brown □ 2 – Reddish □ 3 – Green □ 4 – Black □ 5 – Other (Specify in Comments)</td>
</tr>
<tr>
<td>Water Odor</td>
<td>89971</td>
<td>□ 1 – Sewage □ 2 – City / Chemical □ 3 – H₂S □ 4 – Musky □ 5 – Fishy □ 6 – Other (Specify in Comments)</td>
</tr>
<tr>
<td>Present Weather</td>
<td>89966</td>
<td>□ 1 – Clear □ 2 – Partly Cloudy □ 3 – Cloudy □ 4 – Rain</td>
</tr>
<tr>
<td>Contact Recreation Observations</td>
<td>SA699</td>
<td>□ 1 – Primary, Observed □ 2 – Secondary Observed □ 3 – Non-contact Observed □ 4 – Primary, Evidence □ 5 – Secondary, Evidence</td>
</tr>
<tr>
<td># of People Observed</td>
<td>89978</td>
<td>Evidence of Primary Contact Recreation 89979 □ Observed (1) □ Not observed (0)</td>
</tr>
</tbody>
</table>
## Chain of Custody

<table>
<thead>
<tr>
<th>Field Comments:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Relinquished By:</th>
<th>Date:</th>
<th>Time:</th>
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<tbody>
<tr>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Received By:</th>
<th>Date:</th>
<th>Time:</th>
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<tbody>
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</table>

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<th>Relinquished By:</th>
<th>Date:</th>
<th>Time:</th>
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<tr>
<th>Received By:</th>
<th>Date:</th>
<th>Time:</th>
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<table>
<thead>
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<th>Sample Comments:</th>
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## Stream Discharge Measurement

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<th>Measurement Method [89835]:</th>
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<tbody>
<tr>
<td>1 - Gage</td>
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<thead>
<tr>
<th>Total Discharge (Q) cfs [00061]:</th>
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</table>

<table>
<thead>
<tr>
<th>Estimated Flow [74069]:</th>
</tr>
</thead>
</table>

## Labels

- $Field, $Flow
- Additional Label if applicable
Appendix D. Chain-of-Custody Form
Appendix E: Corrective Action Status Table
## Appendix I - Corrective Action Status Table

<table>
<thead>
<tr>
<th>Corrective Action #</th>
<th>Date Issued</th>
<th>Description of Deficiency</th>
<th>Action Taken</th>
<th>Date Closed</th>
</tr>
</thead>
<tbody>
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</table>
Appendix F: Corrective Action Plan Form
### Corrective Action Plan Form

<table>
<thead>
<tr>
<th>Issued by: ___________________</th>
<th>Date Issued: ___________________</th>
<th>Report No: ___________________</th>
</tr>
</thead>
</table>

#### Description of deficiency

#### Root Cause of deficiency

#### Programmatic Impact of deficiency

#### Does the seriousness of the deficiency require immediate reporting to the TCEQ? If so, when was it?

#### Corrective Action to address the deficiency and prevent its recurrence

#### Proposed Completion Date for Each Action

#### Individual(s) Responsible for Each Action

#### Method of Verification

#### Date Corrective Action Plan Closed?
Appendix G: Example Letter to Document Adherence to the QAPP

Example Letter to Document Adherence to the QAPP

TO: (name)  
(organization)

FROM: Ryan Bass  
Capital Projects Administrator  
City of Boerne  
402 E. Blanco  
Boerne, TX 78006

RE: Boerne City Lake Water Quality Monitoring Program

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

Ryan Bass  
Capital Projects Administrator  
City of Boerne  
402 E. Blanco  
Boerne, TX 78006

I acknowledge receipt of the “QAPP Title, Revision Date”. 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.

My signature on this document signifies that I have read and approved the document contents pertaining to my program. Furthermore, I will ensure that all staff members participating in Clean Rivers Program activities will be required to familiarize themselves with the document contents and adhere to them as well.

_________________________________________  
Signature  

_________________________________________  
Date