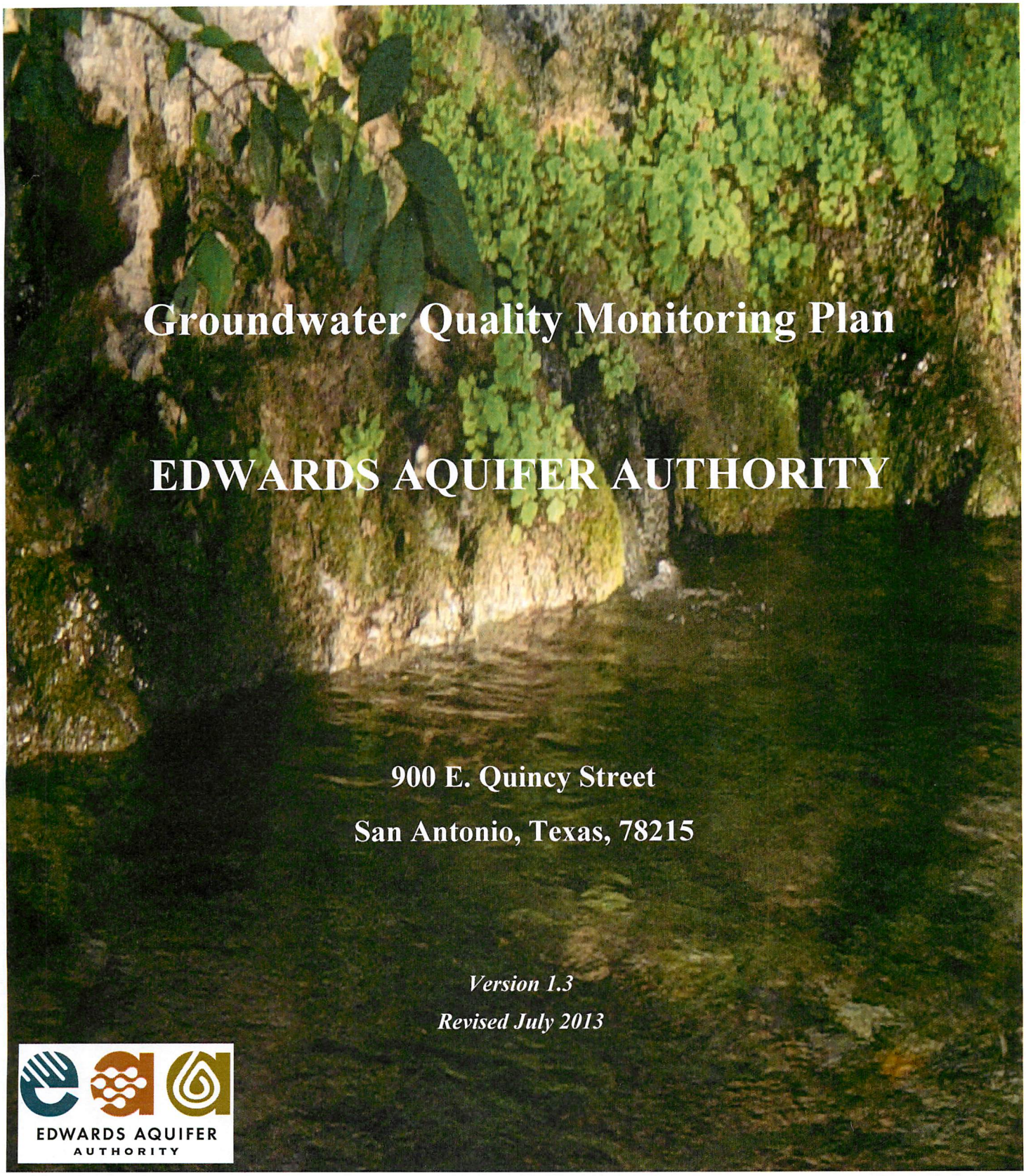

Groundwater Quality Monitoring Plan

EDWARDS AQUIFER AUTHORITY

900 E. Quincy Street

San Antonio, Texas, 78215

Version 1.3

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EDWARDS AQUIFER AUTHORITY

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ACRONYMS AND ABBREVIATIONS

ASTM	American Society of Testing and Materials
bgs	below ground surface
COC	chain of custody
DQO	data quality objective
EAA	Edwards Aquifer Authority
EAHCP	Edwards Aquifer Habitat Conservation Plan
e-line	electronic water level measurement device
GW	groundwater
MSL	mean sea level
NAWQA	national water quality assessment
PPCP	pharmaceutical and personal care products
psi	pounds per square inch
QA	quality assurance
QC	quality control
SOP	standard operating procedure
TWDB	Texas Water Development Board
USGS	United States Geological Survey
U.S. EPA	United States Environmental Protection Agency
VOA	volatile organic analysis
VOC	volatile organic compound

SECTION 1

PURPOSE AND OBJECTIVES

1.1 PURPOSE AND OBJECTIVES OF THE PLAN

Data derived from water quality sampling and analysis provide the primary indicator of the state of water quality in the Edwards Aquifer. These data are also a key component of assessing water quality changes over time. Water quality data also compose the primary source of information for our understanding and monitoring of contaminant loading and migration in the Edwards Aquifer. As such, analytical samples collected for assessing water quality must be collected under a set of standard operating procedures (SOPs), which are outlined in this plan. Included herein are sections on data quality objectives (DQOs), sampling programs, analytical methods, field procedures, and guidelines for plan review.

The purpose of this plan is to provide an SOP document ensuring that useful, consistent, and defensible water quality data are produced by implementation of appropriate procedures and methods when water quality samples are being collected and analyzed. Water quality samples are currently collected under various sampling programs at the Edwards Aquifer Authority (EAA). Data quality requirements vary by program and are discussed in Sections 2 and 3.

Section 2 of this plan provides a description of DQOs in general, as well as DQOs for this program. Section 3 provides detailed information for each of the sampling programs. Section 4 provides a listing of analytical methods used by the EAA, as well as data-flagging requirements, information for sample containers, hold times, and sample preservation. Section 5 outlines field procedures; Section 6 discusses staff training and field audits. Section 7 provides information regarding annual plan review, and Section 8 provides a list of references cited in the document. The appendices (A–G) provide maps of sample locations, a glossary of terms, instrument operation and calibration information, field forms, information on regulatory limits for various compounds, stormwater sample-collection details, and equipment-decontamination procedures.

The purpose of this plan can be achieved by implementation of the objectives listed below and discussed in detail in Sections 2–7 of the plan. Each EAA staff member charged with the responsibility of collecting water quality or other analytical samples is required to be familiar with this plan, along with the objectives and procedures outlined in it. The objectives of this plan are to

- Obtain quality data that are defensible for their intended purpose,

- Analyze field samples in an appropriate and consistent manner such that the results are accurate and repeatable (see calibration procedures in Appendix C),
- Collect samples for laboratory analysis in an appropriate and consistent manner that will ensure accurate and reliable analytical results with a minimal number of anomalous data,
- Select sample sites and time periods that will provide representative water quality data for a range of aquifer conditions, and
- Review the plan annually and revise as needed.

SECTION 2

DATA QUALITY OBJECTIVES

The U.S. Environmental Protection Agency (U.S. EPA) has developed criteria for data quality objectives utilizing a seven-step process that optimizes sample collection and analysis on the basis of data uses, fiscal budget, sample quantity, and other parameters (U.S. EPA, 2000). The process is iterative and may be modified by the planning team to incorporate changes as required:

1. **State the Problem**
   Define the problem, identify the planning team, and examine the budget and schedule.
2. **Identify the Decision**
   State the decision, identify study questions, and define alternative actions.
3. **Identify Inputs to the Decision**
   Identify information needed for the decision, such as information sources, bases for action level, and sampling and analysis methods.
4. **Define the Boundaries of Study**
   Specify sample characteristics, and define spatial/temporal limits and units of decision making.
5. **Develop a Decision Rule**
   Define parameters for decision rules, specify action levels, and develop logic for action.
6. **Specify Tolerable Limits on Decision Errors**
   Set acceptable limits for decision errors relative to consequences (health effects, costs, other impacts).
7. **Optimize the Design for Obtaining Data**
   Select a resource-effective sampling and analysis plan that meets performance criteria.

2.1 U.S. EPA DQO Process as Applied to EAA Analytical Programs

2.1.1 DQO—State the Problem

Collect and analyze groundwater, spring water, and surface water samples that are contained in, issue from, or provide recharge to the Edwards Aquifer. In addition, collect stormwater and sediment samples as needed to satisfy program requirements. Sampling activities are to be conducted such that sufficient funding is held in reserve to collect confirmation samples if needed. In addition, the program must be flexible enough to collect samples in the event of a contingency (spill or other event) that affects or could potentially affect water quality of the Edwards Aquifer. The planning team includes the

Chief Technical Officer (CTO) and supervisory staff of the Aquifer Science Team of the EAA. Budget is proposed by the team and presented for board approval annually. The schedule is annual, with a general goal of collecting a minimum of 80 samples from wells, sampling all major springs (monthly or quarterly, depending on hydrologic conditions), and sampling surface waters twice annually while maintaining a budget reserve sufficient to address other needs (confirmation and contingency sampling).

Under a separate budget, the same team is charged with collecting surface water, stormwater, and sediment samples in support of the Edwards Aquifer Habitat Conservation Plan (EAHCP). Surface water, stormwater, and sediment samples are collected upstream, within, and downstream of Comal and San Marcos springs. Comal Springs has five designated sample locations, whereas San Marcos Springs has seven. Surface water and stormwater samples are to be collected twice annually, whereas sediment samples are collected once annually for the first year (to obtain baseline sediment quality information). Subsequent years may vary depending on results. See *Water Quality Monitoring Program Strategy for Comal Springs and San Marcos Springs in Support of the Edwards Aquifer Habitat Conservation Plan* (EAHCP Workplan).

2.1.2 DQO—Identify the Decision

The decision is to collect the samples as described earlier under the sampling programs and protocols outlined in detail in this document. Study questions are:

- Can the quality of water entering into, residing in, and issuing forth from the Edwards Aquifer be representatively monitored?
- For the allowed budget, how many analytical parameters can be collected?
- What analytical parameters are the most informative with regard to water quality?
- Can a relevant data set that provides historical and current water quality information as relates to the Edwards Aquifer, be developed and maintained?
- Can the data indicate trends in water quality over time?
- Can contingency sampling functionally define contaminant flowpaths and ultimately help in the prevention of public exposure to contaminants in the event of a spill?
- How does the EAA functionally share the information collected with stakeholders and the public?

Alternative actions are to

- Modify the analytical parameter list to accommodate budget constraints,
- Reduce the number of sample points and sample frequency if needed to accommodate budget constraints, and

- Continually review results to assess the need for, and feasibility of, modifying the parameter list such that analytical parameters collected provide the most information for the program, as well as cost-effective information.

2.1.3 DQO—Identify Inputs to the Decision

Sample frequency, sample type, and analytical program are all based on many inputs. The EAA strategic plan dictates minimum sample numbers, for example. Other inputs of importance include findings from karst researchers worldwide regarding the varying nuances of sampling in karst environments (i.e., multiple samples from a single location are generally more valuable than single samples from multiple locations). Assimilating and incorporating information gleaned from EAA sample results annually provide significant inputs to the process as well.

Action levels as defined for this study are not directly comparable to action levels for hazardous waste cleanup. In this program, action levels generally depend on sample type and program: for example, stormwater samples are triggered by specific stormwater events. Action levels may also be related to contingencies. If a contaminant of concern is detected in relation to a contingency, then additional sampling may be triggered. In other cases, an action level may be reached if an anthropogenic compound is detected above a regulatory limit. The resulting action will generally be to utilize additional sampling so as to delineate a possible source if a "contaminant" is the trigger.

Sampling and analysis methods are specific to each sampling program and are designed to provide data on water quality and changes to water quality that may occur over time. Results of each program are reviewed regularly, and changes to the parameters for each program may be made on the basis of these reviews or other needs. All programs are generally analyzed for field parameters (conductivity, dissolved oxygen [DO], turbidity, pH, and temperature) at the time the sample is collected. Other laboratory analytical parameters are then designated on the basis of the program.

2.1.4 DQO—Define Boundaries of the Study

Spatially the study is limited to the Edwards Aquifer Region, which includes contributing area, recharge zone, and artesian zone of the aquifer, as well as contiguous areas that may be pertinent to data collection. Temporal limits are defined by sample program and hydrologic condition. Temporal parameters are described in more detail under sample programs.

2.1.5 DQO—Develop a Decision Rule

Decision rules are defined by multiple factors:

- Strategic plan,
- Board directives,
- Approved budget,

- Data analyses and results,
- Historical data for a particular site, and
- EAHCP requirements.

2.1.6 DQO—Specify Tolerable Limits on Decision Errors

Decision-error limits are dictated by sample program. Whereas all results are considered important, contingency samples have an elevated priority because of the potential to provide a warning to the public in the event water quality is impacted. As such, in the event of a major contingency that requires long-term sampling and analysis, the budget impact would be significant. In some scenarios, additional laboratory funding would be requested from the board to cover these costs. Other sample programs are expected to be well planned and orchestrated such that no budget overruns occur.

The goal of the program in general is to collect a number of samples adequate to monitor the health of the Edwards Aquifer with high confidence that results are representative and accurate. These samples are collected through various sampling programs, as outlined in the next section.

2.1.7 DQO—Optimize the Design for Obtaining Data

The sampling plan as designed provides a resource-effective plan that meets performance criteria through data review, data assessment, and program requirements. The design is optimized by the data needs of each sample program, in which analytical parameters are specific to a program and designed to provide a maximum number of data cost-effectively.

2.2 Additional Inputs for DQO Process

Another definition of DQOs is provided by the Air Force Center for Environmental Excellence (AFCEE) in its *Quality Assurance Project Plan* (QAPP), which states that "DQOs specify the data type, quality, quantity, and uses needed to make decisions and are the basis for designing data collection activities" (AFCEE, 2001). The U.S. EPA and the AFCEE both generally utilize DQOs for hazardous waste clean-up sites, which often represent a threat to public health and the environment. However, sampling programs at the EAA differ in that most samples taken are "clean" and are not used to assess the success of a clean-up action.

Therefore, for the purposes of this plan, DQOs are met by assigning a level of precision and procedural techniques and parameter suites that are appropriate for the sample type and monitoring program. Whereas it is the purpose of this plan for all data produced to be representative and fully defensible, all data do not necessarily need to be analyzed by reference methods in the analytical laboratory utilizing a full suite of QA/QC samples. Most water quality samples collected are intended for monitoring the general status of water quality within the Edwards Aquifer, with one potential exception. In some cases, contingency sampling may be used to assess the impact of an event (i.e., a spill) to the Edwards Aquifer that has the potential for public health implications.

Therefore, DQOs developed for this document are designed to provide data of quality and quantity adequate to reflect the needs of the sample program under which a particular sample is collected. Most analytical data collected are designed to assess

- The presence or absence of anthropogenic compounds in the sample.
- Changes to chemical quality of the sample point when compared with prior data,
- Development of data adequate to establish a record of water quality such that future changes to water quality can be measured,
- Measurement of changes to water quality against changes in hydrologic conditions, and
- In the case of confirmation samples, assessment with a high degree of confidence the presence or absence of a compound of interest.

SECTION 3

SAMPLING PROGRAMS AND OBJECTIVES

Water quality samples are collected under one of the EAA sample programs described in detail in this section. Sample parameters vary with the sample program. For a better understanding of the sampling programs and sample distribution, typical water quality sample locations, see Appendix A, which is a listing of sample type and program. EAHCP sample locations are also provided.

3.1 SAMPLE TYPES AND SAMPLE PROGRAMS

Sample type is simply defined by source and media. The EAA collects samples from wells, springs, surface water, and, at times, groundwater in caves. Samples of soil or sediment may also be collected under some circumstances. As such, sample types are:

- Wells (applies to groundwater samples and includes water collected in caves),
- Springs,
- Surface water,
- Soil or sediment, and
- Stormwater.

Sample programs exist for each sample type, driving the DQO process for a given sample. Each sample program has a defined sample frequency and analytical parameter list. However, the analytical parameter list is always subject to future revision to accommodate changing circumstances. Table 3-1 summarizes current sample types and individual sample programs conducted by the EAA.

Table 3-1. Sample Types and Sample Programs

Sample Type	Sample Program	Sample Frequency	Analytical Parameters
Wells	Passive	Quarterly	FP, GWQP, VOC, TPH, TOC, PAH, metals, bacteria
	NAWQA	Annually	FP, GWQP, VOC, 8081B, 8141A, 8151A, 8082A, TOC, PAH, metals, bacteria
	Routine	Annually	FP, GWQP, VOC, 8081B, 8141A, 8151A, TOC, PAH, metals, bacteria
	TWDB	Annually	FP, GWQP, VOC, 8081B, 8141A, 8151A, TOC, PAH, metals, bacteria
	PPCP	Annual	FP, PPCP (limited to nine wells annually)
	Contingency	As needed	Defined by contingency event
	Confirmation	As needed	Defined by detection needing confirmation
	QA/QC	Per QA needs	Defined by QA program
	EAHCP	Water level dependant	FP, GWQP, TOC, TDS
Springs	Primary	Quarterly (noncritical period) Monthly (critical period)	FP, GWQP, SVOC, VOC, 8081B, 8141A, 8151A, 8082A, TOC, metals, total phosphorous, bacteria, orthophosphate as P
	Secondary	Annually	FP, GWQP, SVOC, VOC, 8081B, 8141A, 8151A, 8082A, TOC, metals, total phosphorous, bacteria
	PPCP	Annually	FP, PPCP (limited to six spring samples annually)
	Contingency	As needed	Defined by contingency event
	Confirmation	As needed	Defined by detection needing confirmation
	QA/QC	Per QA needs	Defined by QA program
Surface water	Primary	Twice annually	FP, GWQP, 8081B, 8141A, 8151A, 8082A, TOC, PAH, metals, total phosphorous, bacteria
	Secondary	Annual	FP, GWQP, 8081B, 8141A, 8151A, 8082A, TOC, PAH, metals, total phosphorous, bacteria
	EAHCP	Twice annually	FP, GWQP, VOC, SVOC, 8081B, 8141A, 8151A, 8082A, TOC, metals, total phosphorous, bacteria, TKN, DOC
	PPCP	Annually	FP, PPCP (limited to two surface water samples annually)
	Contingency	As needed	Defined by contingency event
	Confirmation	As needed	Defined by detection requiring confirmation
	QA/QC	Per QA needs	Defined by QA program
Soil/sediment	EAHCP	Annually	FP, GWQP, VOC, SVOC, 8081B, 8141A, 8151A, 8082A, TOC, metals, total phosphorous
	Contingency	As needed	Defined by contingency event
	Confirmation	As needed	Defined by detection requiring confirmation
	QA/QC	Per QA needs	Defined by QA program
Stormwater	EAHCP	Twice annually	FP, GWQP, VOC, SVOC, 8081B, 8141A, 8151A, 8082A, TOC, metals, total phosphorous, bacteria, TKN
	Confirmation	As needed	Defined by detection requiring confirmation
	QA/QC	Per QA needs	Defined by QA program

FP=field parameter, GWQP=general water quality parameters, SVOC=semivolatile organic compound, VOC=volatile organic compound, TOC=total organic carbon, TKN=total kjeldahl nitrogen, PPCP=personal care and pharmaceutical products., PAH=polynuclear aromatic hydrocarbons, TPH=total petroleum hydrocarbons, DOC=dissolved organic compounds

3.2 SAMPLE PROGRAM DETAIL

The sample types and programs summarized in Table 3-1 comprise the various analytical samples collected and analyzed by the EAA. Specific details of each program are provided in this section.

Sample Programs for Well Sample Types

1. **Passive Sampling Program**
   The passive sampling program is a program to provide continuous monitoring of particular wells (referred to as sentinel wells) through the use of a passive sampling device. The device currently used is the Amplified Geochemical Imaging (AGI), LLC passive diffuse sample module (aka, Gore Module). This device utilizes a sorbent material encased in GoreTex® fabric that is capable of detecting certain analytes for volatile and semivolatile compounds, as well as petroleum hydrocarbon compounds. The Gore Modules are hung at sp ecific intervals continuously in a sentinel well and replaced each month. The module is then shipped to AGI, LLC. for analysis (which is included as part of the module cost). Currently six wells designated as sentinel wells are located in Medina, Bexar, and Hays counties. These wells are sampled via grab sample quarterly. Sample parameter selection for this sample type is generally based on collecting parameters that are also detectable by the Gore Module, plus some additional parameters of value to an understanding of long-term trends in water quality. Sample frequency is also selected to detect temporal changes in water quality at a single sample point.

2. **National Water Quality Assessment (NAWQA) Program**
   The NAWQA wells are a series of thirty wells installed by the USGS for long-term assessment of water quality on a regional and national scale. Ten of these wells (all in the recharge zone of Bexar County) are sampled annually. The sample parameter list is selected on the basis of the NAWQA program and is used to contribute data to that study, as well as to build a historical record of water quality for the EAA data set. Ten out of 30 NAWQA wells are sampled annually, and every well must be sampled within a three-year period.

3. **Routine Water Quality Monitoring**
   Routine water quality samples are collected from a variety of well types (monitoring, domestic, agricultural, industrial, and municipal) to provide a data set for water quality regionwide for different well types. Sample parameters are broad in spectrum and designed to detect the most common anthropogenic compounds, as well as to document changes in concentrations of common cations and anions. These wells are generally sampled annually or less frequently.

4. **Texas Water Development Board (TWDB)**
   Twenty TWDB samples are collected at designated wells using a split-sample technique, such that a sample set is sent to the TWDB contract laboratory (at no cost to the EAA). The remaining sample is sent to the EAA contract laboratory and analyzed for some of the same (TWDB) parameters, as well as additional parameters. This sample type provides a cost-effective tool for evaluation and comparison of analytical results for certain parameters (metals and anions). These wells (or springs, in some cases) are sampled annually under this program for a wide variety of parameters and are also used to assess the health of the system and to establish potential changes or trends in quality.

5. **Pharmaceuticals and Personal Care Products (PPCPs)**
   These parameters detect various compounds found in common personal care products, as well as medications and household items. The primary value in this sample group is the conclusiveness of the data. Because the detection limits are low and the percentage of detections (at low concentrations) to date is high, this sample program appears to provide the most conclusive evidence of anthropogenic impacts on the Edwards Aquifer. The current sample budget allows for nine wells, six springs, and two surface waters to be sampled annually for these parameters. The same locations are sampled each year (with some exceptions) to provide a temporal record of water quality changes associated with the compounds. This program is being evaluated for an increase in sample frequency at some locations.

6. **Contingency Samples**
   Contingency samples are collected only on an as-needed basis to assess potential contamination events related to spills or similar contingencies that have a high potential for affecting water quality in the Edwards Aquifer. Sample parameters and sample frequency are determined on the basis of type of spill (or other contingency), as well as the size of the event. Sample parameters and frequency are decided on by management. EAA staff members are subsequently directed to an appropriate course of action on the basis of assessment of the event by management.

7. **Confirmation Samples**
   Confirmation samples are samples collected in response to an unexpected detection at a site where additional confirmation is needed in order to assess the probability that detection is not a sampling artifact or otherwise false detection. Confirmation detections are method and analyte specific and are taken at the direction of management.

8. **QA/QC Samples**
   QA/QC samples are discussed in detail in Section 3.3.

9. **EAHCP Drought Contingency-Sampling of transect wells and Springs**
   Well samples collected for the EAHCP are collected only when certain springflow criteria are met—specifically, low-flow situations at Comal and San Marcos springs. For Comal Springs, when flows fall below 30 cubic feet per second (cfs), weekly monitoring at three wells is to be conducted for DO, conductivity, pH, and temperature. The next trigger at Comal Springs is 20 cfs, and weekly monitoring is conducted using the same parameters plus nutrients, TDS, and TOC. For San Marcos Springs, the first trigger is 50 cfs, and the second trigger is 30 cfs.

Sample Programs for Spring Sample Types

1. **Primary Springs**
   Primary springs are Comal, Hueco, and San Marcos. They are sampled monthly during critical periods (critical period = a ten-day average when water levels at Bexar, County, index well J-17 of below 660 feet msl, and/or a ten-day average springflow rate at either Comal or San Marcos springs is less than 225 cfs for Comal Springs and less than 96 cfs for San Marcos Springs). During noncritical periods, sampling is generally conducted quarterly. Sample parameters are extensive because the springs represent a composite sample of aquifer water and are directly associated with habitat for threatened and endangered species.

2. **Secondary Springs**
   Secondary springs generally produce a smaller volume of springflow and may or may not be located within the San Antonio Segment of the Edwards Aquifer. These springs are Las Moras (Fort Clark Springs), San Pedro, San Antonio, Government Canyon, and other springs that may be designated for infrequent sampling. Las Moras is generally sampled annually, whereas the others are sampled quarterly or annually if flowing. Sample parameters are the same as those for the primary springs, except that sample frequency differs between primary and secondary.

3. **Pharmaceuticals and Personal Care Products (PPCPs)**
   These parameters detect various compounds found in common personal care products, as well as medications and household items. The primary value in this sample group is the conclusiveness of the data. Because the detection limits are low and the percent of detections (at low concentrations) to date are high, this sample program appears to provide the most conclusive evidence of anthropogenic impacts on the aquifer. The current sample budget allows for nine wells, six springs, and two surface waters to be sampled annually for these parameters. The same locations are sampled each year (with some exceptions)

to provide a temporal record of water quality changes associated with the compounds. This program is being evaluated for an increase in sample frequency at some locations.

4. **Contingency Samples**
   Contingency samples are collected only on an as-needed basis to assess potential contamination events related to spills or similar contingencies that have a high potential for affecting water quality in the Edwards Aquifer. Sample parameters and sample frequency are determined on the basis of type of spill (or other contingency), as well as the size of the event. Sample parameters and frequency are decided on by management. EAA staff members are subsequently directed to an appropriate course of action on the basis of assessment of the event by management.

5. **Confirmation Samples**
   Confirmation samples are samples collected in response to an unexpected detection at a site where additional confirmation is needed in order to assess the probability that detection is not a sampling artifact or otherwise false detection. Confirmation detections are method and analyte specific and are taken at the direction of management.

6. **QA/QC Samples**
   QA/QC samples are discussed in detail in Section 3.3.

7. **Drought Contingency-Sampling of transect wells and Springs**

Sample Programs for Surface Water Sample Types

1. **Primary Surface Water**
   Primary surface waters are collected twice annually from eight locations: Nueces River at Laguna, Dry Frio River at Reagan Wells, Frio River at Concan, Sabinal River near Sabinal, Seco Creek at Miller Ranch, Hondo Creek near Tarpley, Medina River at Bandera, and Blanco River at Wimberley. These sample locations have a significant historical sample record and provide information regarding the quality of waters that effectively provide recharge to the Edwards Aquifer. Sample parameter lists are fairly significant, but do not generally include VOCs because of the low probability of detection of these compounds in a surface water environment.

2. **Secondary Surface Water**
   Secondary surface water sites may have varying locations and are generally sampled only annually. They are generally sites of interest because of their ability to provide recharge to the aquifer, or they may be indicators of water

quality from springs issuing forth from the Trinity Aquifer. Sample parameter lists are fairly significant but do not generally include VOCs because of the low probability of detection of these compounds in a surface water environment.

3. **EAHCP Surface Water Samples**
   EAHCP surface water samples are collected at Comal and San Marcos springs; Comal Springs has five sample locations, whereas San Marcos has seven sample locations, which are situated upstream and downstream of the spring orifice locations. Parameters provide a broad spectrum of analyses so that water quality might be better understood in detail at these locations. The parameters list will also be used to study trends in water quality at these locations over time. Sample frequency is twice annually.

4. **Pharmaceuticals and Personal Care Products (PPCPs)**
   These parameters detect various compounds found in common personal care products, as well as medications and household items. The primary value in this sample group is the conclusiveness of the data. Because the detection limits are low and the percent of detections (at low concentrations) to date high, this sample program appears to provide the most conclusive evidence of anthropogenic impacts on the aquifer. The current sampling budget allows for nine wells, six springs, and two surface waters to be sampled annually for these parameters. The same locations are sampled each year (with some exceptions) to provide a temporal record of water quality changes associated with the compounds. This program is being evaluated for an increase in sample frequency at some locations.

5. **Contingency Samples**
   Contingency samples are collected only on an as-needed basis to assess potential contamination events related to spills or similar contingencies that have a high potential for affecting water quality in the Edwards Aquifer. Sample parameters and sample frequency are determined on the basis of type of spill (or other contingency), as well as the size of the event. Sample parameters and frequency are decided on by management. EAA staff members are subsequently directed to an appropriate course of action on the basis of assessment of the event by management.

6. **Confirmation Samples**
   Confirmation samples are samples collected in response to an unexpected detection at a site where additional confirmation is needed in order to assess the probability that detection is not a sampling artifact or otherwise false detection. Confirmation detections are method and analyte specific and are taken at the direction of management.

7. **QA/QC Samples**
   QA/QC samples are discussed in detail in Section 3.3.

Sample Programs for Sediment Sample Types

1. **EAHCP Sediment Samples**
   EAHCP sediment samples will be collected for a broad spectrum of parameters to establish a base-line data set for sediments in and around Comal and San Marcos springs. These sample data are important to an understanding of potential issues with disturbing sediments in these areas.

2. **Contingency Samples**
   Contingency samples are collected only on an as-needed basis to assess potential contamination events related to spills or similar contingencies that have a high potential for affecting water quality in the Edwards Aquifer. Sample parameters and sample frequency are determined on the basis of type of spill (or other contingency), as well as the size of the event. Sample parameters and frequency are decided on by management. EAA staff members are subsequently directed to an appropriate course of action on the basis of assessment of the event by management.

3. **Confirmation Samples**
   Confirmation samples are samples collected in response to an unexpected detection at a site where additional confirmation is needed in order to assess the probability that detection is not a sampling artifact or otherwise false detection. Confirmation detections are method and analyte specific and are taken at the direction of management.

4. **QA/QC Samples**
   QA/QC samples are discussed in detail in Section 3.3

Sample Programs for Stormwater Sample Types

1. **EAHCP Stormwater Samples**
   EAHCP stormwater samples are collected twice annually for a broad spectrum of parameters to establish a base-line data set for stormwater quality in and around Comal and San Marcos springs. Stormwater samples are collected across the hydrograph at three points (rising, peak, and recession) to ascertain changes in water quality associated with storm flow.

2. **Confirmation Samples**
   Confirmation samples are samples collected in response to an unexpected detection at a site where additional confirmation is needed in order to assess the probability that detection is not a sampling artifact or otherwise false detection. Confirmation detections are method and analyte specific and are taken at the direction of management.

3. **QA/QC Samples**
   QA/QC samples are discussed in detail in Section 3.3

3.3 QUALITY CONTROL AND QUALITY ASSURANCE SAMPLES (QA/QC)

So that the data quality process is adhered to, additional samples for QA/QC must be taken and analyzed on occasion so that the quality of the sample collection and analysis process might be assessed. The various types of QA/QC samples applicable to this plan are outlined in the following paragraphs. Approximately ten percent of all samples will be QA/QC samples.

3.3.1 Matrix Spike and Matrix Spike Duplicate

Matrix spike and matrix spike duplicate samples (MS/MSD) are used to assess the effects of the sample matrix on the analytical process. The MS/MSD is a split (or replicate) of a parent sample collected in the field concurrently during the normal sample-collection process. Ideally, one MS/MSD is collected for each media type (soil, water, sludge, etc.) every 20 samples for each analysis being performed. For most sampling, no media changes will be encountered; i.e., most samples will be water. However, should the samples vary significantly in turbidity, collection of a specific MS/MSD for a sample with elevated turbidity may be advisable.

The MS/MSD is spiked and analyzed, and if the spiked analytes are recovered within a method-specific percentage, then matrix effects will be deemed minimal and no matrix data flag will be attached to the results. However, if spike recovery does not fall within the designated percentage, then analytical results will be flagged with an M-flag, indicating that a matrix effect is present. The sample name for MS/MSDs is identical to that of the parent sample, with the MS/MSD attached as a modifier at the end of the sample name. The MS/MSD will also be noted on the chain of custody (COC).

3.3.2 Ambient Blanks

Ambient blanks are taken to assess the possibility of site-specific atmospheric contamination of VOC samples. Ambient blanks are taken only when an area is suspected of having detectable quantities of atmospheric VOCs present (e.g., if VOC samples are being collected near a fueling operation). Ambient blanks are prepared by pouring ASTM

II, reagent-grade water directly into a 40-milliliter (mL), VOA container at the sample site during collection. The VOA is allowed to remain open and exposed to the atmosphere for the duration of the sample-collection process. The water is treated and analyzed as a sample from this point forward, with the designation *AB* on the COC. Ambient blanks are applicable to VOC samples.

3.3.3 Equipment Blanks

Equipment blanks consist of ASTM II, reagent-grade water poured over/through any sampling equipment used for collection of definitive samples. Most sample-collection equipment is disposable; however, in some cases, an equipment blank may be required. Equipment blanks are used to assess the effectiveness of decontamination procedures (for new materials provided to the EAA or from EAA decontamination processes) and are designated as *EB* on the COC. The frequency of collection of equipment blanks will depend on the sampling routine and sampling equipment in use.

3.3.4 Trip Blanks

Trip blanks are applicable only to VOC samples and are prepared and supplied by the contracted analytical laboratory. Trip blanks are to be shipped from the laboratory and maintained along with the VOC samples collected in the field. The purpose of trip blanks is to assess any potential contamination that may be introduced during shipping and sample handling. Trip blanks are designated on the COC as *TB*. Trip blanks are not to be opened in the field.

3.3.5 Duplicate or Replicate Samples

Duplicate and replicate samples are intended to assess the precision or repeatability of the analytical process. Typically one in ten samples should have a duplicate sample collected. The collection frequency of one duplicate per ten samples is generally acceptable. Note, however, that if a confirmation sampling event involves only three wells, then the duplicate (as well as other) QA/QC samples are still required. In other words, duplicates compose 10% of the sample set such that a sample population of ten would contain one duplicate. However, a sample population of 11 would contain two duplicates. The calculated number of duplicates is always rounded to the next whole number. Duplicates will generally be collected only at the 10% level for EAHCP analysis. For other programs, duplicate analysis is covered generally by the application of a TWDB sample set. Exceptions may apply and will be designated by management.

A duplicate sample is a second sample collected at the same location as that of the parent, either simultaneously or immediately following collection of the first sample (AFCEE, 2001). Both samples are collected, stored, and transported identically. A replicate sample, sometimes called a *split sample* is defined as a single sample divided into two samples (AFCEE, 2001). As with a duplicate, collection, storage, and transport of the resulting

samples must be identical. Duplicate and replicate samples each have unique identifiers (see Section 4).

3.3.6 Spike Samples

Spike samples are used as part of EAA's quality control on the contracted laboratory. EAA sampling staff members collect and subsequently spike twelve liters of water at one of the major springs, the spike containing a known percentage of a substance (contaminant). The spiked sample is then submitted to the contracted laboratory for analysis. If the contracted laboratory reports the findings within the specified amount, then EAA has confidence in their data. However, if the contracted laboratory is unable to detect or report the spikes, then EAA will pursue corrective action with the help of laboratory personnel to resolve the discrepancy. The corrective-action process will be initiated by the Hydrogeology Supervisor.

3.3.7 Recording QA/QC Samples in Analytical Workbook

Samples collected for QA/QC or spiked samples are to be recorded in chronological order in the laboratory notebook. The laboratory notebook is to be kept in the EAA Camden Building in the water quality area with the calibration notebook.

SECTION 4

ANALYTICAL METHODS, SAMPLE IDENTIFICATION, AND CUSTODY PROCEDURES

This section will discuss analytical methods applicable to the EAA sampling program, as well as provide a summary of analytical hold times, acceptable sample containers, and preservation techniques. In addition, a discussion of proper identification and sample custody procedures is provided herein.

4.1 ANALYTICAL METHODS

A variety of analytical methods are used in the various water quality and sediment sampling programs. Table 4-1 lists standard analytical reference methods that have possible application to the various programs. Recall, too, that Table 3-1 provides a current listing of analytical methods/parameters for each sample type and program.

Table 4-1. Analytical Reference Methods

Analysis	Method
VOC	SW-8260b
SVOC	SW-8270c
Chlorinated herbicides	SW-8151a
Organophosphorus compounds	SW-8141a
Nonvolatile compounds by HPLC	SW-8321
Organochlorine pesticides	SW-8081b
Polychlorinated biphenyls (PCBs)	SW-8082a
PAH	SW-8310
Determination of triazine pesticides	EPA-619
Organonitrogen pesticides in industrial/municipal wastewater	EPA-633
Oryzalin in industrial/municipal wastewater	EPA-638
TPH	TX-1005
Metals (except mercury)	SW-6010b or SW-6020
Mercury	SW-7470A
Cyanide	SW-9010B

Table 4-1. Analytical Reference Methods (continued)

Analysis	Method
Alkalinity	EPA-310.1
Common anions	SW-9056
Sulfate (SO_4)	EPA 300.0
pH	SW-9040B
Total dissolved solids (TDS)	EPA 160.1
Total suspended solids (TSS)	EPA 160.2
Ortho-phosphate	EPA 365.3
Nitrate/nitrite (both as N)	EPA 353.2
Ammonia (as N)	EPA 350.3
Kjeldahl (as N)	EPA 351.3
Total organic carbon (TOC)	EPA 415.1 or SW-9060
Sulfide	EPA 376.2
Dissolved organic compound	SM 5310C-2000
E-coli most probable number (MPN)	SM9223B-2004
Dissolved orthophosphate lab	EPA 365.3-1978
Ammonia as N-nondistilled	SMA4500 NH3D-1997
Bromide	EPA 300.0-1993
Chloride	EPA 300.0-1993
Nitrate as N	EPA 300.0-1993
Total phosphorous	EPA 365.3-1978
Enterococci	ENTEROLERT
Eshcerichia coli-colilert	SM 9223B 20Ed
Total coliform_colilert	SM 9223B 20Ed
TWDB anions	EPA 300.1
TWDB cations	EPA 200
TWDB nitrate	EPA 353.2
Anti-bacterial agents	1694
Pharmaceuticals	1694
Steroids/hormones	1698

SIM analysis	MS-SIM-GX/MS
Nonylphenols	WS-MS-0010
General water quality parameters (GWQP), general chemistry—(alkalinity, bicarbonate, carbonate, Ca, Mg, Na, K, Cl, SO_4, F, Si, Sr, bromide, nitrate as N, pH, TDS, and TSS)	Methods listed in table

4.2 DATA-FLAGGING CONVENTIONS

Analytical data must be qualified by the EAA-contracted analytical laboratory, which is done summarily by the addition of data flags to the data result. Table 4-2 provides a summary of the data-flagging convention used in this plan (modified from AFCEE, 2001).

Table 4-2. Data Flags

Flag	Description
J	Analyte positively identified. Quantitation is an estimation because the associated numerical value is below the reporting limit (RL).
U or ND	Analyte analyzed for, but not detected. Associated numerical value at or below method detection limit (MDL).
R	Data rejected because of deficiencies in ability to analyze sample and meet QC criteria.
B	Analyte found in associated blank, as well as in sample.
M	Matrix effect present.
T	Tentatively identified compound (using GC/MS).
No flag	Analyte detected at reported concentration.

4.3 SAMPLE CONTAINERS AND HOLD TIMES

Samples sent to the analytical laboratory must be properly containerized, preserved, and analyzed within specified hold times for the method for the data to be of defensible quality. In addition to the requirement for samples to be chilled to 4°C, ±2°, some analytical methods require the sample to be maintained at specific pH values. As such, Table 4-3 lists acceptable container types, preservatives, and hold times for common analytical methods. The table includes all scheduled analyses for the various sampling programs. In the event an analysis is required that is not included in the table, Aquifer Science Team members listed herein (hydrogeology supervisor or hydrologic data coordinator) will communicate with the EAA contracted laboratory regarding appropriate containers, preservatives, and hold times for the methods in question.

Table 4-3. Sample Containers, Preservatives, and Hold Times

Analyte or Method[1]	Container	Preservation	Minimum Sample Volume	Holding Times
Volatile organic compounds (SW8260B)	G, Teflon®-lined septum, T	4°C, HCl to pH <two	3× 40 mL with no head space or (1) 250 mL amber bottle with no head space	14 days (water and soil); seven days if unpreserved by acid
Semivolatile organic compounds (SW8270C)	G, Teflon®-lined cap, T	4°C	1L or 8 ounces/soil	Seven days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Chlorinated herbicides (SW8151a)	G, Teflon®-lined cap, T	4°C	1L or 8 ounces/soil	Seven days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Organophosphorus compounds (SW8141A)	G, Teflon®-lined cap, T	4°C	1L or 8 ounces/soil	Seven days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Organochlorine pesticides (SW8081)	G, Teflon®-lined cap, T	4°C	1L or 8 ounces/soil	Seven days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Polychlorinated biphenyls (SW8082)	G, Teflon®-lined cap, T	4°C	1L or 8 ounces/soil	Seven days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)

Analyte or Method[1]	Container	Preservation	Minimum Sample Volume	Holding Times
Polynuclear aromatic hydrocarbons (SW8310)	G, Teflon®-lined cap, T	4°C	1L or 8 ounces/soil	Seven days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Total petroleum hydrocarbons (TX1005)	G, Teflon®-lined septum, T	4°C, HCl to pH <2	3× 40 mL with no head space or (1) 250 mL amber bottle with no head space	14 days (water); to extraction, and 14 days after extraction
General water quality parameters (alkalinity, bicarbonate, carbonate, Ca, Mg, Na, K, Cl, SO_4, F, Si, Sr, bromide, nitrate (as N), pH, TDS, and TSS)	P, G	4°C	250 mL	28 days
Cyanide	P, B	4°C; NaOH to pH >12	500 mL or four ounces /soil	14 days (water and soil)
Ortho-phosphate (as P)	P, G	4°C	50 mL	48 days
Nitrate (as N) and nitrite (as N)	P, G	4°C	250 mL	48 days
Ammonia (as N)	P, G	4°C	250 mL	28 days
Kjeldahl (as N)	P,G	4°C	250 mL	28 days
Total organic carbon	P,G	4°C, H_2SO_4 to pH <2	250 mL	28 days
Dissolved organic carbon	P,G	4°C, H_2SO_4	400 mL	28 days
Phosphorus	P,G	4°C, H_2SO_4	500 mL	28 days
Alkalinity E310.1	P, G	4°C	50 mL	14 days
Common anions SW9056	P, G	None required	50 mL	28 days for Br^-, F^-, Cl^-, and SO_4^{-2}; 48 hours for NO_3^-, NO_2^-, and PO_4^{-3}
Cyanide, total and amenable to chlorination SW9010A SW9012	P, G, T	4°C; NaOH to pH >12, 0.6 g ascorbic acid	500 mL or four ounces /soil	14 days (water and soil)
Total dissolved solids (TDS) E160.1	P, G	4°C	100 mL	Seven days
Total suspended solids (TSS) E160.2	P, G	4°C	100 mL	Seven days
Biological oxygen demand (BOD), five-day	P, G	4°C	1L	48 hours
Sulfide	P, G	4°C	1L	Seven days

Analyte or Method[1]	Container	Preservation	Minimum Sample Volume	Holding Times
Total inorganic carbon	P, G	4°C	250 mL	28 days
Escherichia coli-colilert	P, G, WP	4°C, dark, sodium thiosulfate, one-inch headspace	100–250 mL	Six + two h (this holding time represents six field hours and two lab hours
Enterococci	P, G, WP	4°C, dark, sodium thiosulfate, one-inch headspace	100–250 mL	Six + two h (this holding time represents six field hours and two lab hours
Total coliform-colilert	P, G, WP	4°C, dark, sodium thiosulfate, one-inch headspace	100–250 mL	Six + two h (this holding time represents six field hours and two lab hours
TWDB anions	P, G	4°C, filtered on site	500 mL	28 days
TWDB cations	P, G	4°C, HNO_3, filtered on site	250 mL	28 days
TWDB nitrate	P, G	4°C, H_2SO_4, filtered on site	500 mL	28 days
1694 Pharmaceuticals (LCMS/MS) Acetaminophen Caffeine Carbamazepine Cotinine DEET Diltiazem Fluoxetine Gemfibrozil Ibuprofen Lincomycin Naproxen Sulfamethoxazole Trimethoprim Tylosin Iopromide	G, Teflon®-lined cap, T	4°C	1L or 8 ounces/soil	Seven days (unpreserved), 14 (days preserved)
1694 Antibacterial (LCMS/MS) Triclobarban Triclosan	G, Teflon®-lined cap, T	4°C	1L or 8 ounces/soil	Seven days (unpreserved), 14 (days preserved)

Analyte or Method[1]	Container	Preservation	Minimum Sample Volume	Holding Times
1698 Steroids/hormones (LCMS/MS) 17a-Estradiol 17a-Ethynyl estradiol 17b-Estradiol Equilenin Estriol Estrone Progesterone Testosterone	G, Teflon®-lined cap, T	4°C, H_2SO_4	1L or 8 ounces/soil	Seven days (unpreserved), 14 (days preserved)
Nonylphenols/ethoxylates/bisphenol-A (GCMS) Bisphenol-A Nonylphenol diethoxylate (tech.) Nonylphenol monoethoxylate (tech.) p-Nonyphenol (tech.) p-tert-octylphenol para-n-nonylphenol	G, Teflon®-lined cap, T	4°C, H_2SO_4	1L or 8 ounces/soil	Seven days (unpreserved), 14 (days preserved)
Selected metals—6020 (Al, Sb, As, Ba, Be, Cd, Cr (total), Cu, Fe, Pb, Mn, Hg, Ni, Se, Ag, Tl, and Zn)	P, G, T	HNO_3 to pH <2, 4°C	500 mL or 8 ounces/soil	180 days (water and soil)
Hg—Cold vapor 7470.7471	P, G	HNO_3 to pH <2, 4°C	250 mL	28 days (14 days if in plastic bottle)
Selected metals—(ICP unless otherwise noted) 6020/7470/7471 (Al, Sb-ICP-MS or GFAA, As, Ba, Be, Cd, Cr (total), Cu, Fe, Pb, Mn, Hg-ICP-MS or CVAA, Ni, Se-ICP-MS or GFAA, Ag, Tl-ICP-MS or GFAA, and Zn)	P, G, T	HNO_3 to pH <2, 4°C	500 mL or 8 ounces/soil	180 days (water and soil)
Hg- ICP-MS or CVAA **7470/7471**	P, G	HNO_3 to pH <2, 4°C	250 mL	28 days (14 days if in plastic bottle)

a. Polyethylene (P); glass (G); brass sleeves in sample barrel, sometimes called California brass (T).
b. No pH adjustment for soil.
c. Preservation with 0.008 percent $Na_2S_2O_3$ only required when residual chlorine present.

4.4 SAMPLE IDENTIFICATION

Each sample must have a unique identifier so that it can be differentiated from other samples. In addition, sample names must meet the required criteria for entry into the data base and subsequent electronic storage and retrieval of the data. Therefore, sample names must conform to the guidelines herein.

4.4.1 Sample Identification, for Non-EAHCP Samples

The primary method for non-EAHCP sample identification will be to use the state well registration number for wells (and springs as applicable) or the site name for surface water samples. When no well number is available for a spring, then an abbreviation for the spring name and orifice will be used. For example,

- The unique identifier, for use on the COC for Comal Springs, Orifice 1 is DX 68-23-301,
- The unique identifier for use on the COC for Comal Springs Orifice 3 (no state well number) is CS3,
- The unique identifier for use on the COC for the Nueces River at Laguna is Nueces@Laguna, and
- For wells that are sampled in more than one location within the borehole, the interval number is attached to the well name. For example, well LR-67-09-101 is regularly sampled at two intervals, so the COC name is LR-67-09-101-1 (interval 1 or upper interval) and LR-67-09-101-4 (interval 4, or the deepest interval).

Note that to the extent possible, custody forms and sample-container labels will be preprinted by the laboratory.

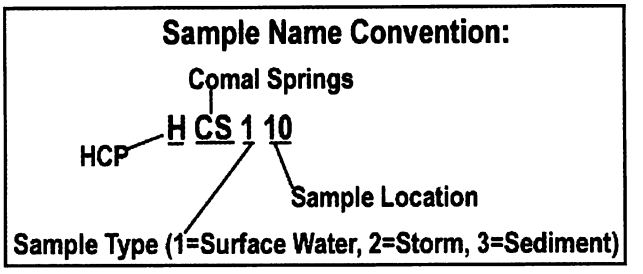
In some cases no well number or other recognized registration number will exist for the sample point. Then documentation for the sample location will require location (latitude/longitude and address if available) and name of well owner. Photographic documentation is also required. The subsequent sample name will be a *pseudo* state well number derived from the well location and owner name. For example,

> The unique identifier for a sample taken from the Mary Smith residence in San Antonio, a private well with no state well registration number and located in Bexar County (abbreviation AY) at state well grid location 68-23-8, would be AY-68-23-8MS.

When wells of this type are sampled, proper documentation to include collection location, sample name, sample parameters, date, and time is extremely important and will be recorded in the field log for cross reference to the COC.

4.4.2 Sample Identification, for EAHCP Samples

For samples collected under the EAHCP, sample names are designed to provide additional data regarding sample type. Specifically the sample name will indicate the sample as an EAHCP-related sample, the spring group (Comal or San Marcos), sample type (surface water, stormwater, or sediment), and sample location. In the example below, the sample name refers to an EAHCP sample at Comal Springs, collected for surface water, at location 10. Sample locations are noted on the sample-collection maps for the EAHCP (included in Appendix A with calendar year 2013 non-EAHCP sample locations.



4.4.3 Sample Identification, QA/QC

For QA/QC samples, a modifier is added to the sample name to indicate the QA/QC type, for example, DX-68-23-301 (Comal Spring 1). If an MS/MSD sample were collected, a separate set of samples named DX-68-23-301MS/MSD would be collected. The appropriate modifier for each QA/QC sample is listed in Table 4-4.

Table 4-4. QA/QC Sample Nomenclature

Sample Type	Modifier
Matrix spike/matrix spike duplicate	MS/MSD*
Ambient blank	AB#
Equipment blank	EB#
Trip blank	TB#
Duplicate	FD*
Replicate	FR*

* Requires sample, with same sample name as parent + modifier at end.
\# Numerical suffix to be attached and referenced in laboratory notebook; suffix starts at 1 at beginning of each calendar year. Details for location, etc. included in field notebook documentation.

4.5 SAMPLE CUSTODY

All samples shipped to the analytical laboratory must have proper custody documentation. One person on each sampling team is to have primary responsibility for sample custody (generally the lead sampler). This person will be designated as the *sample custodian* for sample collection. A person has custody of a sample group if samples are (1) in his/her possession, (2) in his/her view after being in his/her possession, (3) placed in a secure area by the sample custodian.

Furthermore, the laboratory COC form is to be filled out completely by the sample custodian in the field. The form must contain all required information for proper sample identification (if not preprinted) and must contain appropriate signatures. In addition, samples must remain in control of the sample custodian. Once collected, samples must be under the supervision of the sample custodian or secured in a manner such that no reasonable chance of unauthorized access to the samples exists. Furthermore, samples shipped by a common courier (i.e., Federal Express), require that the sample custodian note on the COC when the samples were released to the courier and why. The contracted analytical laboratory will sign the COC upon receipt. A breach of sample custody can invalidate the defensibility of the sample set.

4.6 DATA VALIDATION

Analytical data require review in order to be validated prior to publication. The amount of review (or level of review) is a function of the sample type. Field-collected data results are reviewed in the field by the analyst. One of the best ways for the field analyst to assess the acceptability of field data and subsequently validate them is to compare the results with historical data. This comparison, combined with proper equipment calibration, maintenance, and analytical technique, will provide an adequate validation process for field-parameter data. In the event that the analyst finds a discrepancy in the field data, a second analysis for the parameter in question should be performed. If the analyst feels that the data may be inaccurate because of issues with the field analysis, this fact is to be noted on the sample field sheet.

Contract analytical-laboratory data will receive a 100% analyst review at the analytical laboratory prior to posting of analytical results. A subsequent analytical laboratory review by the QA/QC section is required prior to the analytical laboratory's certification of the results. A subsequent 10% review by EAA staff of the analytical data is required upon receipt of the final analytical report. The analytical report will contain numerical analytical results for the laboratory QA/QC samples (i.e., LCS, method blanks, etc.). These laboratory analytical data are to have data flags assigned by the analytical laboratory.

SECTION 5

FIELD PROCEDURES AND SAMPLE COLLECTION

Possibly the most significant part of any successful sample collection is the field procedures and documentation that occur in the field. Field procedures to include sample equipment decontamination; sample-collection procedures for well, spring, surface water, and sediment samples; a listing of potential sources of contamination; and the proper use of field notebooks are included in this section.

5.1 RESPONSIBILITIES

The CTO and hydrogeology supervisor for the data-collection program will ensure that the samples obtained represent the environment being investigated. The hydrologic data coordinator will ensure that all field crews are provided with the necessary information, equipment, and supplies to successfully schedule and complete sampling. The hydrologic data coordinator will also be the primary point of contact between the contract analytical laboratory project manager and the EAA sampling team(s). The hydrologic data coordinator will report sampling deviations to the CTO and hydrogeology supervisor. Sample-collection staff (generally, environmental science technicians) are responsible for being familiar with the instructions provided in this SOP and for collection of samples in accordance with this SOP. For most sample-collection events, a sample team of two people will be utilized. Teams will have a lead sampler (according to experience level) who is directly responsible for adherence to directives of the SOP.

5.2 EQUIPMENT DECONTAMINATION

In order to obtain samples that are reliable and defensible, all (nondisposable) sample-collection equipment must be decontaminated prior to use. When possible, sample collection from a wellhead valve directly to a sample container is best. When this kind of collection is not possible, disposable equipment is preferable.

If neither option is plausible, then nondisposable sample-collection devices (constructed of Teflon® when possible) must be used. Sampling equipment that is exposed directly to sample media (pumps, peristaltic or submersible pump tubing, reusable bailers, or other devices) will be washed in a nonphosphate, laboratory-grade detergent such as Alconox®, followed by a double rinse in potable water. A final rinse of deionized or distilled water will be applied after completion of the initial decontamination process.

Equipment that will not be used immediately must be kept clean by wrapping in aluminum foil or placed inside clean plastic bags. Such storage will prevent

contamination of the equipment prior to use. See Appendix G for additional detail regarding equipment-decontamination procedures.

5.3 SOURCES OF SAMPLE CONTAMINATION

Samples can easily become contaminated during the sample-collection process. It is the responsibility of the sampler to prevent contamination from occurring. A multitude of potential cross-contamination sources are present in the field environment. Because many of the analytical methods used can quantify various analytes in parts per billion or less, even minute sources can potentially contaminate a sample. For example, Table 5-1 summarizes some of the potential sources that can cause a false-positive reading in a sample. These should be considered when samples are collected in the field. Also note that water has a strong affinity for many anthropogenic compounds. Use of good judgment is another aspect of collecting defensible data. Steps should be taken to avoid cross-contamination of samples. If the sampler suspects the possibility of cross-contamination, he/she should note it in the field log for the sample set in question, or the site should be sampled again if necessary.

Table 5-1. Potential Sources of Cross-Contamination

Source	Possible Contaminant
Fuels—generators, work vehicles	BTEX/TPH/VOC/ SVOC
Exhaust fumes—generators, vehicles, heavy roadway traffic, overhead air traffic	BTEX/TPH/VOC/ SVOC
Oil/grease residue on tools, gloves, etc.	TPH/SVOC
Tape	VOC
Insect spray	VOC/SVOC/ pesticides
Insect repellent	SVOC/VOC/ pesticides
Sunscreen	VOC/SVOC/ PPCP
Soil/debris	Bacteriological/ metals/SVOCs
Foods/drinks/medications and other personal care products such as soap, makeup, deodorant, etcetera.	PPCPs

5.4 FIELD NOTEBOOKS

The field notebook is a legal document and should be treated as such. All pertinent site information should be in the notebook, including site name, weather information, site conditions, well condition (if applicable), equipment problems, sample-collection notes such as approximate sample times, and any other information that may be deemed valuable. The names of individuals on the sample team, as well as visitors to the site, should also be recorded in the notebook. All information recorded in the field notebook should follow the format described herein. No blank spaces are to be left on pages. All blank areas should be marked through with a single line and initialed by the author. The top of each page should have the date and sample site. The base of each page should contain the initials of the author. Mistakes are to be crossed out with a single line and initialed. Field notebooks are to be recorded in black ink only.

5.5 SAMPLE COLLECTION

Field personnel must wear clean (disposable) nitrile gloves during the sample-collection process. Generally samples for field water quality parameters are to be collected first, followed by VOC, SVOC, and metals samples. Any required information is to be recorded in the field notebook before, during, and after sampling.

5.5.1 Well Samples

Each well must be gauged and sounded (if possible). The general condition of the well will be noted in the field notebook. After the water level is gauged, the purge volume for the well will be calculated by the following equation,

$$V = H \times F,$$

where V is one well volume, H is the difference between depth of the well and depth to water in feet (i.e., length of water column in well), and F is the number of gallons per foot of water for the well size (Table 5-2).

Table 5-2. Well-Casing Volume in Gallons per Foot

Casing Diameter (in inches)	F (gallons per foot of water in well)
2	0.16
4	0.65
6	1.47
8	2.6
10	4.1
12	5.9
16	10.4

The relationship $F = \pi (D/2)^2 \times 7.48$ gallons/ft^3 can be used to calculate pipe volumes not listed in the table. Note that D = pipe diameter in feet and F = volume per foot.

A well may be sampled upon achieving *one* of the following: a minimum of three well volumes are purged from the well *or* field-parameter readings are stabilized for a minimum of three parameter measurements. Wells that go dry prior to purging the three well volumes, or the field-parameter readings have not stabilized, shall be purged to dryness (except for drinking-water supply or irrigation wells). During purging, water will be monitored for the following field parameters: *temperature, pH, DO, conductivity, and turbidity.*

Stabilization is defined as

- Temperature fluctuations limited to ±1° C,
- pH fluctuations ±0.1 unit,
- DO fluctuations ± 0.3 milligrams per liter (mg/L),
- Conductivity fluctuations ±5%, and
- Turbidity ±10 NTU.

In the event that these parameters do not stabilize (after purging of three well volumes), a maximum of six well volumes will be purged prior to sample collection (if the field parameters stabilize at any point, the well is considered ready to sample, and purging may cease). Once the well has stabilized or the maximum purge volume is reached, and the well has recovered to at least 80% of its initial level, it is ready to sample.

5.5.2 Spring Samples

Springwater samples should be as representative of the actual water issuing forth from the spring as possible and not be "contaminated" by surrounding surface waters. As such, various sample-collection techniques may be necessary. For spring orifices located below surface water, samplers should use a peristaltic pump to collect the springwater sample by placing the intake part of the pump tubing in the spring orifice. This placement allows for filling of sample bottles without introducing surface waters or overflowing the bottles and losing any preservatives inside. This technique is not feasible or necessary for all spring sites but should be utilized as appropriate. When a spring that can be sampled without a pump is being sampled, then a typical grab sample may be collected. In some cases (high flow volume) it may be necessary to collect samples in a clean bottle (such as a clean 1,000-mL amber glass bottle, clean Teflon beaker, or something similar) and the container used to transfer water into subsequent containers. Doing so will prevent the loss of any preservatives that may be in sample bottles. However, the action should be performed with as little agitation to the sample as possible to preserve potential VOCs in the parent sample.

Note: If preservatives in the sample container are diluted or lost because of the collection technique, a new bottle should be used. If a new bottle is unavailable, the lack of preservatives must be communicated to the laboratory to ensure that the sample remains valid by being analyzed within the appropriate hold time.

Current information and observations concerning springflow at the time of sample collection should be entered in the field notebook. For example, approximate springflow volume (can be listed as low, medium, high) is the flow representative of an extreme volume (high or low); observed water quality should be noted (clear, cloudy, or murky), along with other observations deemed appropriate by the lead sampler.

5.5.3 Surface Water Samples

Surface water samples should be collected without disturbing the sediment, if at all possible. The presence of sediment in the sample may bias the results. Samples should be collected from the flowing parts of the stream on the upstream side of the sample collector. Samples are not to be collected from stagnant areas, and they should also be taken from approximately the same location for each sample event. Sample bottles should be filled by collecting the water sample in a clean bottle or by using a peristaltic pump and transferred into the final sample bottle. Caution should be used to prevent overfilling of the sample bottle and diluting any preservatives that may be in the bottle.

Note: If preservatives in the sample container are diluted or lost because of the collection technique, a new bottle should be used. If a new bottle is unavailable, the lack of preservatives must be communicated to the laboratory to ensure that the sample remains valid by being analyzed within the appropriate hold time.

Information regarding the sample point in the stream, streamflow, and water conditions, as well as other information deemed appropriate by the sampler, should be entered into the field notebook at the time of sample collection.

5.5.4 Sediment Samples

Sediment samples are scheduled for collection by the EAHCP sampling program. Furthermore, the possibility exists that EAA staff may be required to collect samples of this type on occasion for other programs. As such, a brief discussion of this type of sample is included herein. Sediment samples may be collected from below the water line, from a dry stream bed, or from any other source in which sediments or soils may collect. The collection technique will depend on conditions. For example, a push tube for collection of sediments below the water surface is generally needed. However, if sediments are being collected from a dry area, then they may be collected using a trowel, hand auger, or push tube of some type. As with all sediment/soil-related samples, VOC samples must be collected in a manner that will minimize the loss of in situ volatiles. As

such, sediment samples for VOC analysis will not be composited or homogenized in the field. Samples for VOC analysis are to be collected first.

In the event that the discreet-interval sediment sampler is used for collection of sediments, the procedure for device operation is as follows:

1. Insert the lower-half of the lead internal rod using a ⅜-inch coupler (first stage) into the internal drive tip. Pull down on the brass ring, push the grooved end of the lead internal rod into the recess, and gently release the brass ring.
2. Insert the internal drive tip and lead internal-rod assembly into the external drive tip.
3. Connect the upper lead internal rod using the ⅜-inch coupler (second stage) to the lower lead internal rod (first stage).
4. Insert a four-ft liner, with the hole in the liner oriented to the top, into the sample tube (the sample tube has a two-inch outside diameter and consists of two parts, a double female lead section and a male × female extension). If the EAA staff chooses to use a two-ft liner instead of a four-ft liner, the process is the same, except that the male × female upper extension is not used.
5. Insert a plastic core catcher (white) in the bottom of the sample tube, with the dome pointing toward the top.
6. Insert the internal drive tip/external drive tip assembly into the sampler tube.
7. Insert the metal core catcher into the top of the main sampler tube, with the dome pointing upward.
8. Install the internal tip chamber to the top of the main sampler tube.
9. Install the top drive head adapter to the top of the internal tip chamber.
10. Install the thread protector cap or internal rod with external drive extensions (if using 1⅛ × 3 ft external extensions with ⅜-inch internal rods, place a ⅜-inch coupler on the top of the internal rods prior to installing the top drive head adapter). Install the thread protector cap at the top of the internal rod prior to connecting the vented drive head (install the correct number of internal/external extensions necessary to lower the sampler to the surface and arrive at the desired sampling point).
11. Install the vented hammer adapter, already attached to the slide hammer.

The field notebook will note details related to the sediment samples; for example, was the sediment dry or below water, how was it collected, was it discolored, at what depth (from the surface) was the sample collected? If sediments are field screened with a photoionization detector (PID), readings from the various intervals will be recorded. Other details will be recorded as deemed appropriate by the sampler.

Also, if a hand trowel is used, it must be constructed of stainless steel, and it must be decontaminated prior to each use. For sites at which multiple samples will be collected, multiple hand trowels may be used, or a single trowel may be used if it is decontaminated in the field (Alconox wash, double rinse in potable water, followed by a DI water rinse).

5.5.5 Stormwater Samples

Stormwater samples are scheduled for collection under the EAHCP program at each spring group, twice annually. Stormwater sample collection offers additional challenges and safety issues, as compared with that of other samples collected under EAA programs. This section provides a general summary of stormwater sampling, additional detail regarding this sample type being provided in Appendix F.

Stormwater samples are scheduled for collection across three points on the storm hydrograph. One sample collected from the initial rise on the hydrograph, a second sample from the peak area of the hydrograph, and a final sample along the recession limb of the graph. In addition, water quality parameters obtained from EAA-installed real-time water quality monitors, flow data from the U.S.G.S. springs gauges, and local weather radar maps will be used to define the behavior of the systems and help guide sample-collection timing. The real-time monitors collect data at 15-minute intervals for conductivity, DO, pH, temperature, and turbidity.

A stormwater event will be dictated by a rainfall event sufficient to cause a significant rise in springflow at either Comal or San Marcos springs. The significant rise in springflow is to be further defined in conjunction with real-time data systems. See Appendix F for details on stormwater sampling procedures.

SECTION 6

ANNUAL REVIEW OF PLAN

6.1 ANNUAL REVIEW OF GROUNDWATER QUALITY PLAN

Data collection described in this plan will be reviewed by May 31 each year. The review will be directed at ensuring that all data collection herein is necessary, properly performed, and properly staffed. Furthermore, the review will ascertain whether the methodologies in use remain appropriate for their intended purpose. The review process will include all sample types and programs, as well as methods used to collect and analyze these samples.

Postreview, modifications will be made, if needed, to accommodate changes to EAA sampling. Changes will be imitated by the management and staff of the EAA Aquifer Science Team.

SECTION 7

CONTINUING EDUCATION CREDITS FOR SAMPLE-COLLECTION PERSONNEL

7.1 CONTINUING EDUCATION

Staff members assigned to sample-collection teams must attain a minimum of 12 hours of continuing education each year. Opportunities for continuing education will be provided either in-house by the EAA, or, in some cases, staff may be sent to an offsite facility to attend a class. One hour of credit is considered to be one classroom or contact hour. Staff may also carry credits over into the following year if more than 12 hours of credit are obtained in a calendar year. It is the responsibility of each staff member to document his/her credit hours annually and submit them to the hydrogeology supervisor by December 1 of each year.

SECTION 8

REFERENCES CITED

AFCEE, 2001, Quality Assurance Project Plan, Version 3.1: Air Force Center for Environmental Excellence, Brooks AFB, Texas.

EAA, 2012, Water Quality Monitoring Program Strategy for Comal Springs and San Marcos Springs in Support of the Edwards Aquifer Habitat Conservation Plan.

SARA, 2013, Watershed Monitoring, San Antonio River Authority.

U.S. EPA, 2000, EPA QA/G-4, Guidance for the Data Quality Objectives Process.

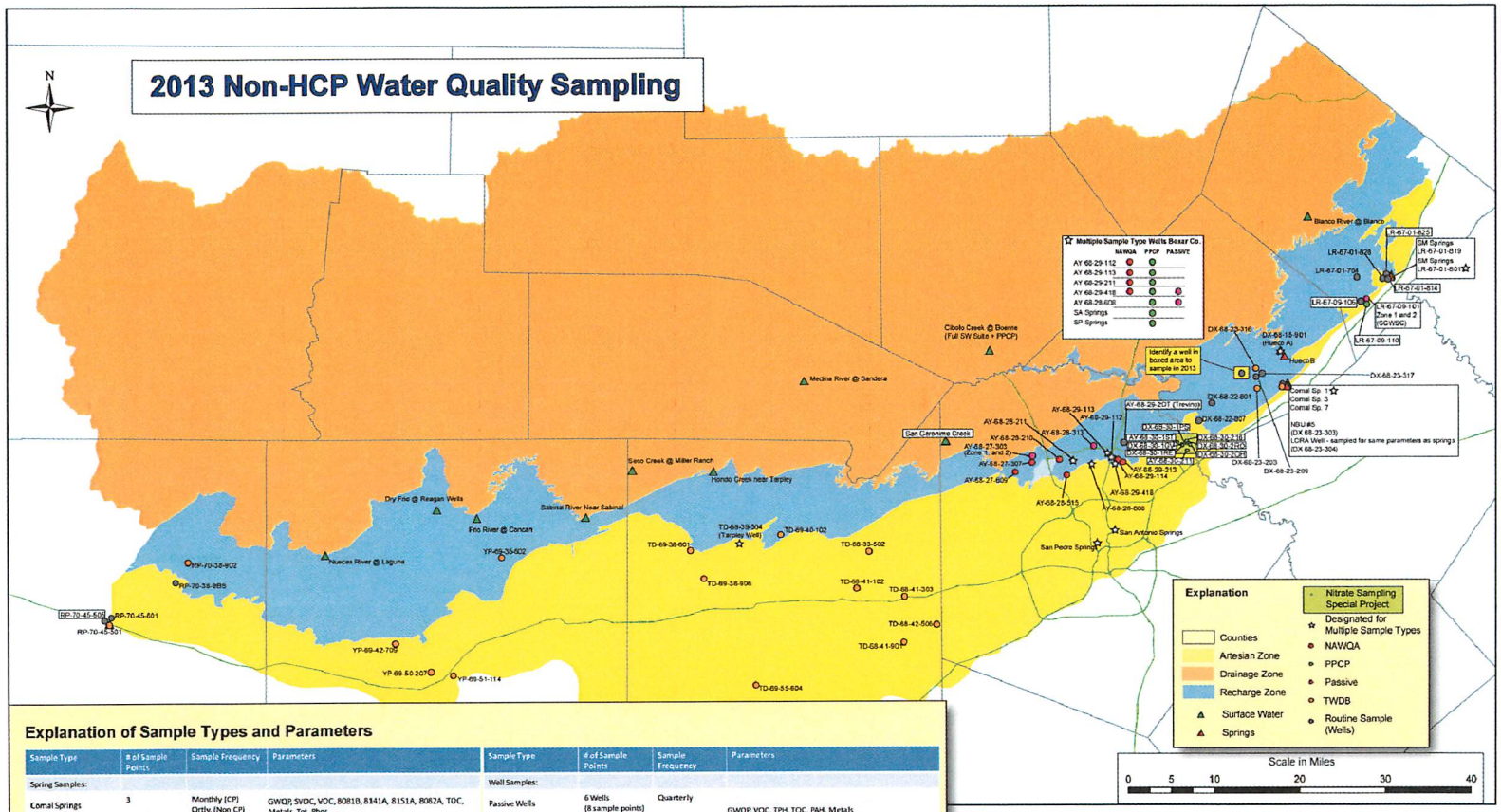
SECTION 9

REFERENCES NOT CITED

Driscoll, F.G., 1995, Groundwater and Wells: St. Paul, Johnson Screens, 1089 p.

Nielsen, D.M., 2006, Environmental Site Characterization and Ground-Water Monitoring: New York, Taylor and Francis, 1318 p.

APPENDIX A—Sample Locations (2013)



Explanation of Sample Types and Parameters

Sample Type	# of Sample Points	Sample Frequency	Parameters
Spring Samples:			
Comal Springs	3	Monthly (CP) Qrtly. (Non CP)	GWQP, SVOC, VOC, 8081B, 8141A, 8151A, 8082A, TOC, Metals, Tot. Phos.
San Marcos Springs	2	Monthly (CP) Qrtly. (Non CP)	GWQP, SVOC, VOC, 8081B, 8141A, 8151A, 8082A, TOC, Metals, Tot. Phos.
Hueco Springs	2	Monthly (CP) Qrtly. (Non CP)	GWQP, SVOC, VOC, 8081B, 8141A, 8151A, 8082A, TOC, Metals, Tot. Phos.
GCSNA Springs	1	Quarterly	GWQP, SVOC, VOC, 8081B, 8141A, 8151A, 8082A, TOC, Metals, Tot. Phos.
Las Moras Springs	1	Annual	GWQP, SVOC, VOC, 8081B, 8141A, 8151A, 8082A, TOC, Metals, Tot. Phos.
San Antonio	1	Quarterly (Flow Dependant)	GWQP, SVOC, VOC, 8081B, 8141A, 8151A, 8082A, TOC, Metals, Tot. Phos.
San Pedro	1	Quarterly (Flow Dependant)	GWQP, SVOC, VOC, 8081B, 8141A, 8151A, 8082A, TOC, Metals, Tot. Phos.

In some cases, San Pedro Springs may be sampled monthly if CP conditions are present and spring is flowing.

Metals Determination Samples will be for comparison of filtered vs un-filtered metals performed on all samples in the TWDB program, such that the TWDB sample is filtered while a secondary sample will be analyzed by EAA as an un-filtered metals sample.

Sample Type	# of Sample Points	Sample Frequency	Parameters
Well Samples:			
Passive Wells	6 Wells (8 sample points)	Quarterly	GWQP, VOC, TPH, TOC, PAH, Metals
NAWQA Wells	1 (per well)	Annual	GWQP, VOC, 8081B, 8141A, 8151A, 8082A, TOC, PAH, Metals
Routine Wells	1 (per well)	Annual	GWQP, VOC, 8081B, 8141A, 8151A, TOC, PAH, Metals
Confirmation Samples	5 (estimated)	As Needed	GWQP, VOC, 8081B, TOC
Nitrate Samples	23	2 X Annually	GWQP, TPH, TOC
Primary Surface Waters*	8	2 X Annually	GWQP, 8081B, 8141A, 8151A, 8082A, TOC, PAH, Metals
Secondary Surface Waters**	2	Annually	GWQP, 8081B, 8141A, 8151A, 8082A, TOC, PAH, Metals
PPCP Samples (Wells, Springs, SW)	17	Annual	Anti-bact., Pharmaceuticals, nonylphenols, steroids/hormones (note: collected w/ additional program)
Contingency	12 (estimated)	As Needed	GWQP, VOC, TPH, TOC, PAH, Kjeldahl, Ammonia
TWDB/Metals Determination	20	Annual	GWQP, VOC, 8081B, 8141A, 8151A, TOC, PAH, Metals (17 wells, 3 springs – Las Moras, Comal, Hueco A)
QA/QC Equip. Blanks	24	As Needed	GWQP, VOC, 8081B, 8141A, 8151A, TOC, PAH, Metals

* Primary Surface Water Sites: Nueces River, Dry Frio River, Frio River, Sabinal, Seco Creek, Hondo Creek, Medina River, Blanco River
** Secondary Surface Water Sites: San Geronimo Creek and Cibolo Creek at Boerne

Notes: PPCP samples are scheduled at these springs: Comal 1, Hueco A, San Antonio, San Marcos Hotel, San Pedro, and GCSNA. PPCP samples are scheduled for these surface water sites: Cibolo Creek at Boerne, and Frio at Concan, and at these wells AY-68-28-211, AY-68-28-608, AY-68-29-112, AY-68-29-113, AY-68-29-418, DX-68-23-316, LR-67-09-101-1, and TD-69-39-504. PPCP samples are scheduled to be collected one time per sample location during the year, in conjuction with one of the other sample programs (see detailed sample collection list for exact requirements at each sample site)

Previous years PPCP sample locations: Comal 1, 2011 and 2012; AY-68-29-112, AY-68-29-113, AY-68-29-418, AY-68-28-608, AY-68-28-211, 2011 and 2012; TD-69-39-504, San Geronimo Creek, Cibolo Creek at Boerne, Hueco A, San Marcos Hotel Spring, and LR-67-09-101-1 all sampled in 2012 only.

In an effort to differentiate metals analyses for filtered vs unfiltered, TWDB wells were chosen as viable locations since the TWDB analyzes many of the same metals as the EAA. Therefore, EAA will submit metals analyses to Test America as non-filtered samples for comparison to the filtered sample collected for and analyzed by the TWDB. This provides a low cost opportunity to conduct this study. This will be conducted for 17 wells and three springs. The TWDB analyses and metals comparison is scheduled for one sample event per TWDB sample site during the year. Some of the selected sites are sampled multiple times under other analytical programs.

This current plan provides for the collection of 90 well samples, from 56 different wells, at various periods over the year. In additon, the plan calls for the collection of QA/QC samples (duplicates, equipment blanks, and trip blanks as needed). Contingency sampling is budgeted for 12 locations, as is confirmation sampling at 5 locations. The budget also allows for approximately $10,000 of additional sampling to be determined in last quarter of the year.

Current document revision date: 2/14/13

Comal Springs HCP Related Sample Points

Analytical Parameter List (HCP)

Surface Water = GWQP, VOC, SVOC, Pesticides, Herbicides, PCBs, Tot. Phos., TOC, DOC, Kjeldahl, Metals
Storm Water = GWQP, VOC, SVOC, Pesticides, Herbicides, PCBs, Tot. Phos., TOC, DOC, Kjeldahl, Metals
Sediment = GWQP, VOC, SVOC, Pesticides, Herbicides, PCBs, Tot. Phos., TOC, DOC, Metals

Notes:
Pesticides = Organochlorine and Organophosphorus;

GWQP = Alkalinity, Bicrbonate, Carbonate, Ca, Mg, Na, K, Chloride, Sulfate, F, Si, Sr, Bromide, Nitrate (as N), pH, TDS, and TSS; as applicable.

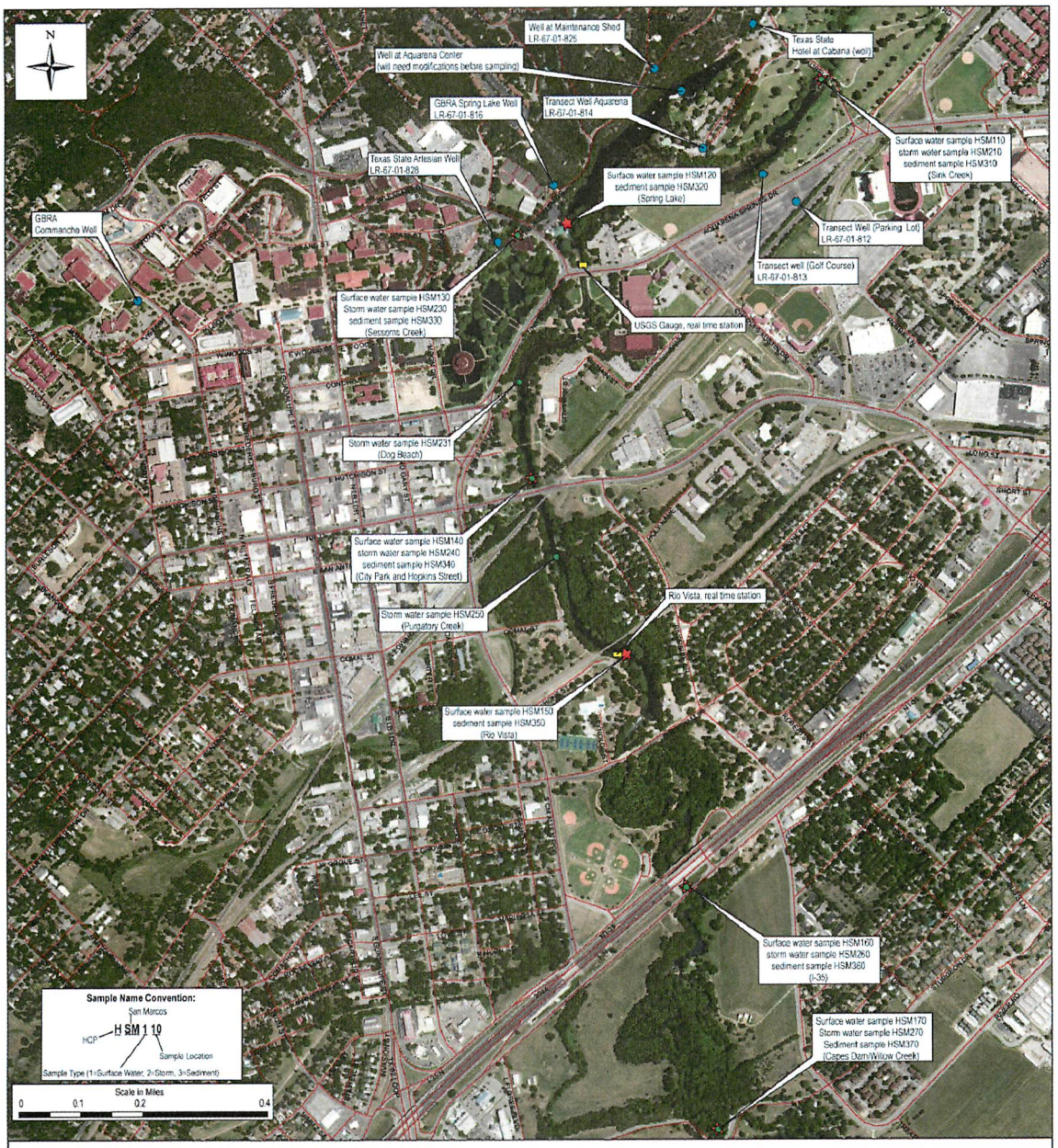
Surface water samples collected twice annually.
Storm water samples collected twice annually.
Sediment samples at designated locations in first sample year.

Explanation

- Surface Water and Sediment Sample Location
- Storm Water Sample Location
- Potential Well Sample Location for Extreme Low Flow Scenarios
- Surface Water, Storm Water and Sediment Sample Location
- Real Time (Continuous) Water Quality Station Location

Prepared by:

EDWARDS AQUIFER AUTHORITY



San Marcos Springs HCP Related Sample Points

Analytical Parameter List (HCP)

Surface Water = GWQP, VOC, SVOC, Pesticides, Herbicides, PCBs, Tot. Phos., TOC, DOC, Kjeldahl, Metals
Storm Water = GWQP, VOC, SVOC, Pesticides, Herbicides, PCBs, Tot. Phos., TOC, DOC, Kjeldahl, Metals
Sediment = GWQP, VOC, SVOC, Pesticides, Herbicides, PCBs, Tot. Phos., TOC, DOC, Metals

Notes:
Pesticides = Organochlorine and Organophosphorus;

GWQP = Alkalinity, Bicrbonate, Carbonate, Ca, Mg, Na, K, Chloride, Sulfate, F, Si, Sr, Bromide, Nitrate (as N), pH, TDS, and TSS; as applicable.

Surface water samples collected twice annually.
Storm water samples collected twice annually.
Sediment samples at designated locations in first sample year.

Explanation

- Surface Water and Sediment Sample Location
- Storm Water Sample Location
- Potential Well Sample Location for Extreme Low Flow Scenarios
- Surface Water, Storm Water and Sediment Sample Location
- Real Time (Continuous) Water Quality Station Location

Prepared by:

EDWARDS AQUIFER AUTHORITY

APPENDIX B—Glossary of Terms

Ambient blank	Sample known not to contain target analytes, which are used to assess airborne contaminants at the site. The ambient blank [AB] is

	opened at the site and exposed to site (ambient) conditions and subsequently treated as an environmental sample thereafter. AB samples are applicable to VOC analysis only.
Anion	Negatively charged ion.
Aquifer	Underground geological formation or group of formations containing water; source of groundwater for wells and springs.
Cation	Positively charged ion.
DOC	Abbreviation for dissolved organic carbon, a broad classification of organic molecules of varied origin and composition within aquatic systems. Organic carbon compounds are a result of decomposition processes from dead organic matter, such as plants.
DQO	Abbreviation for data quality objectives, a process used to develop performance and acceptance criteria or data quality objectives that clarify study objectives, define the appropriate type of data, and specify tolerable levels of data needed to support decisions.
Equipment blank	Sample used to assess the effectiveness of the decontamination process on sampling equipment. The equipment blank is prepared by pouring reagent-grade water over/through sampling equipment and analyzing for parameters of concern (to match the sampling routine applicable to the site).
Field duplicate	Second sample collected simultaneously from the same source as the parent sample, but which is submitted and analyzed as a separate sample. This sample should generally be identified such that the laboratory is unaware that it is a field duplicate.
Field replicate	Sometimes referred to as a *split sample*, a single sample divided into two (or more) samples.
Groundwater	Water found beneath Earth's surface that fills pores between materials, such as sand, soil, or gravel.
Initial rise	Initial surface runoff of a rainstorm. During this phase, water pollution entering storm drains in areas with high proportions of impervious surfaces is typically more concentrated during first flush than it is during the remainder of the storm.

Matrix spike	Sample used to determine the effect of the matrix on a method's recovery efficiency. A known amount of the target analyte is added to a specified amount of matrix sample for which an independent estimate of the target analyte concentration is available. Duplicate samples must be available as well (matrix spike duplicate, or MSD).
MDL	Abbreviation for method detection limit, minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero, as determined from analysis of a sample containing the analyte in a given matrix.
Peak	Maximum instantaneous flow at a specific location resulting from a given storm condition.
PQL	Abbreviation for practical quantitation limit, which is the smallest concentration of the analyte that can be reported with a specific degree of confidence.
Precision	State or quality of being precise; exactness. The ability of a measurement to be consistently reproduced.
Purge	To remove standing water in a well.
Recession	End of runoff event, which is defined as the point in time when the recession limb of the hydrograph is <two% of the peak or is within ten % of the prestorm base flow, whichever is greater.
Recharge zone	Where an aquifer is replenished with water by the downward percolation of precipitation through soil and rock.
Representative	Said of samples collected that are similar to those of groundwater in its in situ condition.
RL	Abbreviation for reporting limit [RL], the smallest concentration of an analyte reported by the laboratory to a customer. The RL is never less than the PQL and is generally twice the MDL.
Spike sample	One of any known concentrations of specific analytes that have been added to minimize change in the matrix of the original

	sample. Every spike sample analyzed should have an associated reference to the spike solution and the volume added.
Spring	Water coming naturally out of the ground.
Surface water	That which forms and remains above ground, such as lakes, ponds, rivers, streams, bays, and oceans.
SVOC	Abbreviation for semivolatile organic compounds, which is a group of chemicals composed primarily of carbon and hydrogen that have a tendency to evaporate (volatilize) into the air from water or soil. Some of the compounds that make up asphalt are examples of SVOCs.
TDS	Abbreviation for total dissolved solids, or the total amount of all inorganic and organic substances, including minerals, salts, metal, cations, or anions that are dispersed within a volume of water.
Temporal	Over a period of time.
TKN	Abbreviation for total kjeldahl nitrogen, which is the total concentration of organic and ammonia nitrogen in wastewater.
TOC	Abbreviation for total organic carbon, which is the gross amount of organic matter found in natural water. Suspended-particulate, colloidal, and dissolved organic matter are part of the TOC measurement. Settable solids consisting of inorganic sediments and some organic particulate are not transferred from the sample by the lab analyst and are not part of the TOC measurement.
Trip blank	Sample known to be free of contamination (for target analytes) that is prepared in the laboratory and treated as an environmental sample after receipt by the sampler. Trip blank [TB] samples are applicable to VOC analysis only.
TSS	Abbreviation for total suspended solids, which are the nonfilterable residue retained on a glass-fiber disk filter mesh measuring 1.2 micrometers after filtration of a sample of water or wastewater.
VOC	Abbreviation for volatile organic compounds, which are often used as solvents in industrial processes and are either known or suspected carcinogens or mutagens. The five most toxic are vinyl

	chloride, tetrachloroethylene, trichloroethylene, 1,2-dichloroethane, and carbon tetrachloride.
Well	Bored, drilled, or driven shaft whose purpose is to reach underground water supplies.

APPENDIX C—Equipment Use and Calibration

DOCUMENTATION PROCEDURES

All equipment maintenance and calibration must be documented in the laboratory notebook kept at the EAA Camden Building. This documentation is an important part of ensuring that data-collection results are "defensible." Calibration details, equipment type, date, calibration statement, and sampler's signature must appear in the book for each day that the equipment is used.

EAA currently uses the YSI 556 MPS field instrument to collect pH, DO, conductivity, and temperature at each sample point. Calibration procedures for this instrument are detailed next.

CALIBRATION PROCEDURES

Calibration Procedures for YSI 556 MPS

Accessing the Calibrate Screen

1. Press the **On/Off** key to display the run screen.
2. Press the **Escape** key to display the main menu screen.
3. Use the arrow keys to highlight the **Calibrate** selection

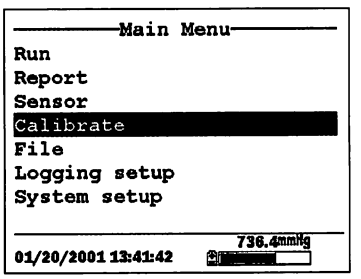


Figure 6.1 Main Menu

4. Press the **Enter** key. The Calibrate screen will be displayed.

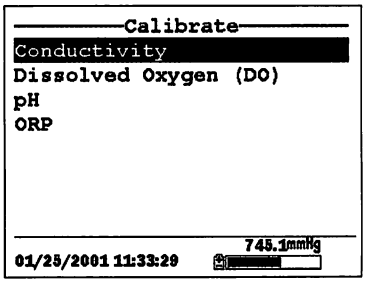


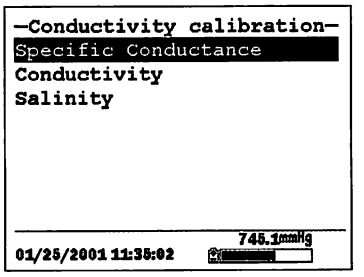
Figure 6.2 Calibrate Screen

Conductivity Calibration

This procedure calibrates specific conductance (recommended), conductivity, and salinity.

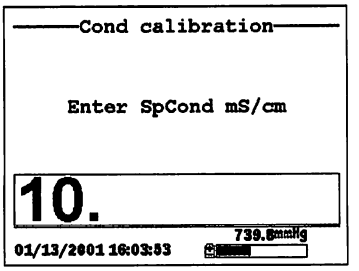
Calibrating any one option automatically calibrates the other two.

1. Go to the Calibrate screen
2. Use the arrow keys to highlight the **Conductivity** selection.
3. Press **Enter**. The Conductivity Calibration Screen is displayed.



Conductivity Calibration Selection Screen

4. Use the arrow keys to highlight the Specific Conductance selection.
5. Press **Enter**. The Conductivity Calibration Entry Screen is displayed.



Conductivity Calibration Selection Screen

6. Place the correct amount of conductivity standard into a clean, dry or pre-rinsed transport/calibration cup.

WARNING: Calibration reagents may be hazardous to health. See information on label.

NOTE: For maximum accuracy, the conductivity standard you choose should be within the same conductivity range as the samples you are preparing to measure. However, we do not recommend using standards less than one mS/cm. For example:

- For freshwater use a one-mS/cm conductivity standard.
- For brackish water use a ten-mS/cm conductivity standard.
- For seawater use a 50-mS/cm conductivity standard.

NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the conductivity sensor with a small amount of standard that can be discarded. Be certain that cross-contamination of solutions be avoided. Make certain that no salt deposits are around the oxygen pr pH/ORP sensors, particularly if standards of low conductivity are being employed.

7. Carefully immerse the sensor end of the probe module into the solution.

8. Gently rotate and/or move the probe module up and down to remove any bubbles from the conductivity cell.

   NOTE: The sensor must be completely immersed past its vent hole. Using the recommended volumes and ensure that the vent hole is covered.

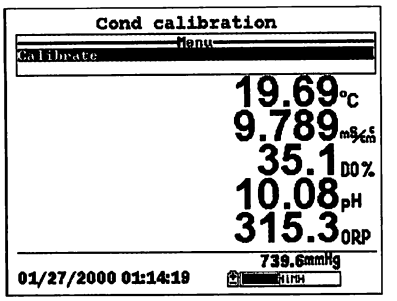
9. Screw the transport/calibration cup onto the threaded end of the probe module and securely tighten.

   NOTE: Do not over tighten because doing so could damage the threaded parts.

10. Use the keypad to enter the calibration value of the standard being used.

    NOTE: Be sure to enter the value in **mS/cm at 25°C**.

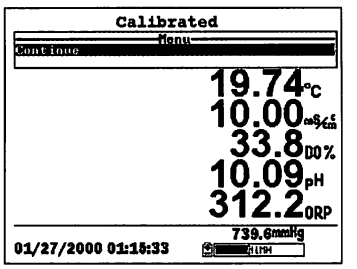
11. Press **Enter**. The Conductivity Calibration Screen is displayed.



Conductivity Calibration Screen

12. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

13. Observe the reading under Specific Conductance. When the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt pressing of **Enter** again to Continue.



Calibrated

14. Press **Enter** to return to the Conductivity Calibrate Selection Screen

15. Press **Escape** to return to the Calibrate menu. See Figure 6.2 Calibrate Screen.

16. Rinse the probe module and sensors in tap or purified water and dry.

Dissolved Oxygen Calibration

This procedure calibrates dissolved oxygen. Calibrating any one option (% or mg/L) automatically calibrates the other.

1. Go to the calibrate screen as described in Section *6.2.1 Accessing the Calibrate Screen.*

   NOTE: The instrument must be on for at least 10 to 15 minutes to polarize the DO sensor before calibrating.

2. Use the arrow keys to highlight the **Dissolved Oxygen** selection. See Figure 6.2 Calibrate Screen.
3. Press **Enter**. The Dissolved Oxygen Calibration Screen is displayed.

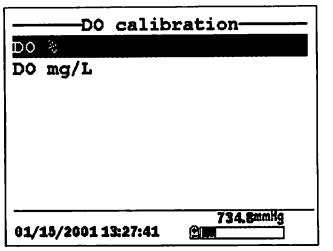


Figure 6.7 DO Calibration Screen

DO Calibration in Percent Saturation

1. Use the arrow keys to highlight the DO% selection.

2. Press **Enter**. The DO Barometric Pressure Entry Screen is displayed.

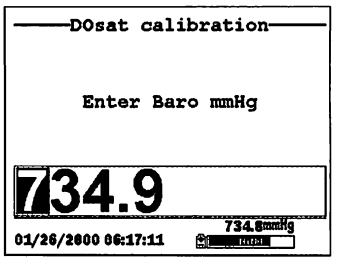


Figure 6.8 DO Barometric Pressure Entry Screen

3. Place approximately 3 mm (⅛ inch) of water in the bottom of the transport/calibration cup.

4. Place the probe module into the transport/calibration cup.

   NOTE: Ensure that the DO and temperature sensors are **not** immersed in the water.

5. Engage only one or two threads of the transport/calibration cup to ensure that the DO sensor is vented to the atmosphere.
6. Use the keypad to enter the current local barometric pressure.

   NOTE: If the unit has the optional barometer, no entry is required.

   NOTE: Barometer readings that appear in meteorological reports are generally corrected to sea level and must be uncorrected before use

7. Press **Enter**. The DO% Saturation Calibration screen is displayed.

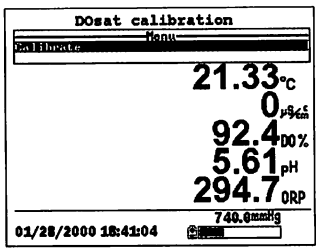


Figure 6.9 DO Sat Calibration Screen

8. Allow approximately ten minutes for the air in the transport/calibration cup to become water saturated and for the temperature to equilibrate before proceeding.

9. Observe the reading under DO %. When the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt pressing of **Enter** again to Continue. See Figure 6.6 Calibrated.

10. Press **Enter** to return to the DO Calibration Screen, See Figure 6.7 DO Calibration Screen.

11. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

12. Rinse the probe module and sensors in tap or purified water and dry.

pH Calibration

1. Go to the Calibrate Screen as described in *Section 6.2.1 Accessing the Calibrate Screen.*

2. Use the arrow keys to highlight the **pH** selection. See Figure 6.2 Calibrate Screen.

3. Press **Enter**. The pH Calibration screen is displayed.

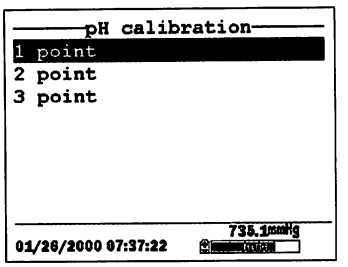


Figure 6.12 pH Calibration Screen

4. Select the **one-point** option only if adjusting a previous calibration. If a two-point or three-point calibration has been performed previously, the calibration can be adjusted by carrying out a one-point calibration. The procedure for this calibration is the same as for a two-point calibration, but the software will prompt a selection of only one pH buffer.

5. Select the **two-point** option to calibrate the pH sensor using only two calibration standards. Use this option if the media being monitored is known to be either basic or acidic. For example, if the pH of a pond is known to vary between 5.5 and seven, a two-point calibration with pH seven and pH four buffers is sufficient. A three-point calibration with an additional pH ten buffer will not increase the accuracy of this measurement because the pH is not within this higher range.

6. Select the **three-point** option to calibrate the pH sensor using three calibration solutions. In this procedure, the pH sensor is calibrated with a pH seven buffer and two additional buffers. The three-point calibration method assures maximum accuracy when the pH of the media to be monitored cannot be anticipated. The procedure for this calibration is the same as for a two-point calibration, but the software will prompt a selection of a third pH buffer.

7. Use the arrow keys to highlight the **two-point** selection.

8. Press **Enter**. The pH Entry Screen is displayed.

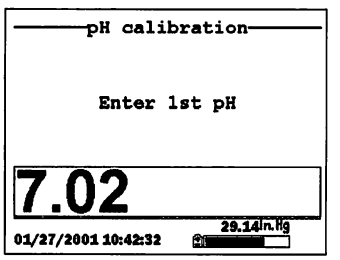


Figure 6.13 pH Entry Screen

9. Place the correct amount (see Table 6.1 Calibration Volumes) of pH buffer into a clean, dry, or prerinsed transport/calibration cup.

NOTE: Always calibrate with buffer seven first, regardless of whether performing a one-, two-, or three-point calibration.

WARNING: Calibration reagents may be hazardous to health. See reagent label for more information.

NOTE: For maximum accuracy, the pH buffers chosen should be within the same pH range as the water being prepared for sampling.

NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the pH sensor with a small amount of buffer that can be discarded. Be certain to avoid cross-contamination of buffers with other solutions.

10. Carefully immerse the sensor end of the probe module into the solution.

11. Gently rotate and/or move the probe module up and down to remove any bubbles from the pH sensor.

    NOTE: The sensor must be completely immersed. Using the recommended volumes from Table 6.1 Calibration Volumes should ensure that the sensor is covered.

12. Screw the transport/calibration cup onto the threaded end of the probe module and securely tighten.

    NOTE: Do not overtighten because doing so could damage the threaded parts.

13. Use the keypad to enter the calibration value of the buffer being used **at the current temperature**.

    NOTE: pH vs. temperature values are printed on the labels of all YSI pH buffers.

14. Press **Enter**. The pH Calibration Screen is displayed.

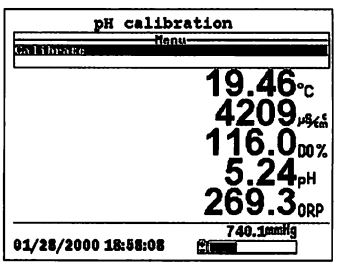


Figure 6.14 pH Calibration Screen

15. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

16. Observe the reading under pH. When the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt **Enter** to be pressed again to continue.

17. Press **Enter** to return to the specified pH Calibration Screen, See Figure 6.13 pH Entry Screen.

18. Rinse the probe module, transport/calibration cup, and sensors in tap or purified water and dry.

19. Repeat steps 6 through 13 using a second pH buffer.

20. Press **Enter** to return to the pH Calibration Screen. See Figure 6.12 pH Calibration Screen.

21. Press **Escape** to return to the Calibrate menu. See Figure 6.2 Calibrate Screen.

22. Rinse the probe module and sensors in tap or purified water and dry.

Return to Factory Settings.

1. Go to the Calibrate screen as described in Section *6.2.1 Accessing the Calibrate Screen.*

2. Use the arrow keys to highlight the **Conductivity** selection. See Figure 6.2 Calibrate Screen.

   NOTE: We will use the Conductivity sensor as an example; however, this process will work for any sensor.

3. Press **Enter.** The Conductivity Calibration Selection Screen is displayed. See Figure 6.3 Conductivity Calibration Selection Screen.

4. Use the arrow keys to highlight the **Specific Conductance** selection.

5. Press **Enter.** The Conductivity Calibration Entry Screen is displayed. See Figure 6.4 Conductivity Calibration Entry Screen.

6. Press and hold the **Enter** key down, and press the **Escape** key.

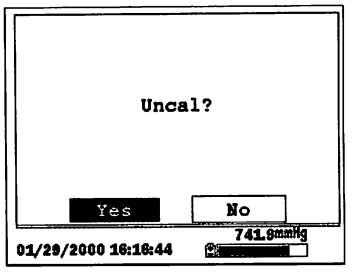


Figure 6.17 ORP Calibration Screen

7. Use the arrow keys to highlight the **YES** selection.

   CAUTION: Pressing **YES** returns a sensor to the factory settings. For example, in the selection to return specific conductance to the factory setting, salinity and conductivity will automatically return to their factory settings.

8. Press **Enter** to return you to the Conductivity Calibrate Selection Screen. See Figure 6.3 Conductivity Calibration Selection Screen. .
9. Press **Escape** to return to the Calibrate menu. See Figure 6.2 Calibrate Screen.

HACH Digital Titrator (for Alkalinity) Primary Method

Titrations are performed using the HACH digital titrator. This instrument provides precise results when properly operated.

Basic Operation

1. Select a sample volume and titration cartridge corresponding to the expected sample concentration.
2. Insert the cartridge into the titrator slide and lock it into place with the plunger. Remove the polyethylene cap from the cartridge and insert a clean delivery tube into the end of the cartridge. (Note: use a straight tube with a hook on the end for hand-held titrations and a 90° tube with a hook at the end for stationary setups.
3. To start the titrant flow, hold the tip of the cartridge upward while turning the delivery knob until the air is expelled and several drops of solution flow from the tip of the delivery tube.
4. Use the counter reset knob (the smaller of the two knobs) to set the digital counter back to zero, then blot any titrant from the delivery tube.
5. Proceed with titration by submerging the tip of the delivery tube into the sample and turning the delivery knob to dispense the titrant. (Note: during the titration process, samples must be continuously stirred either manually or with the magnetic stirrer)

Calculations

HACH titration cartridge solutions are designed to give those numbers used in the titrations (reading from the digital meter) to be actual sample concentration in mg/L, or they are marked with conversion factors. If in the process of sample preparation, the amount of SAMPLE becomes less than 100 mL, the titration number must be multiplied by the divisional factor. For example, if the intended 100-mL sample is reduced to 25 mL (¼ of 100 mL) during the sample-preparation process, then the final result must be multiplied by 4 (25 mL × 4 = 100 mL) to obtain the result.

General Maintenance

1. For long-term storage the delivery tube should be removed, the polyethylene cap reattached, and the cartridge removed from the titrator body. DO NOT attempt to remove the cartridge from the titrator without recapping.
2. After use and removal from the cartridges, rinse the delivery tubes with deionized water to prevent clogging.

The titration process should be checked monthly by titration of a standard solution and recorded in the laboratory notebook. Acceptable results are obtained if the titration is within ±3% of the standard solution.

Alkalinity Determination Using the HACH Digital Titrator
Alkalinity of water is defined by its acid-neutralizing capacity. Once a sample has been collected, geochemical changes can alter the sample's alkalinity. Therefore, alkalinity samples are to be analyzed in the field or immediately upon returning to the EAA laboratory.

Procedure
Sample alkalinity is determined by titration with sulfuric acid to a pH of 4.5 and includes all carbonate, bicarbonate, and hydroxide present within the sample. Values are recorded as mg/L calcium carbonate.

1. Follow the steps outlined in HACH digital titrator usage, with the sulfuric acid cartridge as the active titrant and the 90° delivery tube as a stationary setup.
2. Set up the HACH titrator unit and attach the digital titrator to the rotational holder and clamp securely.
3. The pH and temperature probes should also be connected to the titrastir at the end of the rotational holder. For best results, attempt to have the ends of the delivery tube, pH probe, and temperature probe at the same level.
4. Rinse a 25-mL pipette three times with deionized water and then three times with the sample water to be tested. Pipette 25 mL of this sample into a clean 50-mL beaker. Record this amount on the corresponding field sheet.
5. Place the beaker on the stir plate, put a stir bar in the beaker, and turn on the stirring function.
6. Rotate the titrastir arm toward the sample beaker, submerging the probes and delivery tube. Note: ensure that the titrator counter is reset to zero and the outside of the delivery tube is free of sulfuric acid before submerging.
7. Turn on the pH meter and record the stabilized pH reading of the sample. Record this value on the corresponding field data sheet.
8. Titrate by turning the delivery knob until the pH is reduced to 4.5, which is the endpoint, and the amount of titrant used should be recorded.
9. Calculate the alkalinity by multiplying the amount of titrant used by the dilution factor, and record on the appropriate field data sheet.

Collect a second alkalinity sample every ten samples as a field duplicate, and analyze as outlined above. The field duplicate percent difference should not exceed ±5%, where %D is defined as

$$[(X1 - X2) / X1] \times 100 = \%D \text{ (X1 = original sample, X2 = duplicate sample)}$$

(see next page for additional alkalinity procedures)

Additional Procedures for Alkalinity Analyses, University of Minnesota Methodology (to be incorporated into the EAA methodology)

Good Titration Practices

Aliquot Measurement

- Sample aliquots should be measured with the most accurate method available.
- Rinse the volumetric flask with sample water.
- Never rinse the titration flask with sample water.
- Rinse the titration flask with De-Ionized water between samples and air dry (glass) or shake dry (PMP plastic).
- An electronic balance is preferred over a volumetric flask is preferred over a graduated cylinder.
- A 0.1g scale is comparable to a volumetric flask.
- An electronic balance allows the size of sample aliquots to be varied.
- An electronic balance allows aliquot size to be reduced in high alkalinity samples which reduces titration time.

Titration Equipment

- Digital titrator should be periodically lubricated.
- Titrant cartridges must be kept tightly capped to prevent evaporation.
- Old, partially used titrant cartridges should be replaced.
- Don't try to use every drop of acid in the titrant cartridge - when it gets low start a new cartridge.
- Delivery tubes should be flushed with fresh titrant before use and rinsed after use.
- A magnetic stirrer (battery powered for field use) helps ensure thorough mixing.

Titration Procedures

- All chemical analyses should be replicated.
- Titrations are done in triplicate to allow comparison of results ensuring that reproducible results are obtained.
- Replicates that vary by more than two percent indicate interference or analytic error.
- Real time analysis of the results allows additional titrations and/or a change in procedure to identify the sources of the interference or error.
- Work consistently and quickly to limit degassing and precipitation in your sample bottle.
- Add acid uniformly to each aliquot as if performing the first titration.

Colorimetric

- Bromcresol Green / Methyl Red indicator dyes.
- pH 4.8 to 4.5 buffer solutions.
- Adding acid too quickly and incomplete equilibration will produce irregular results.
- Use buffered indicator solutions to define endpoint.
- Relies on human color interpretation.

Potentiometric

pH Endpoint

- Meter calibration is critical.
- Adding acid too quickly and incomplete equilibration will produce irregular results.
- Must allow for solution equilibration and meter stabilization.
- Uses one data point to determine endpoint.

$\Delta pH/\Delta v$ acid

- Must be done in uniform steps through the endpoint.
- Adding acid too quickly and incomplete equilibration will produce irregular results.
- Organics may shift endpoint.
- Uses two data points to determine endpoint.

Figure 1 shows a typical "S" shaped titration curve. The inflection point represents the true alkalinity of the sample and may not occur at exactly pH 4.5.

Gran Titration

- Uses many data points.
- Must be carried well past the endpoint.
- Requires graphical interpretation or linear regression.
- Adding acid too quickly and incomplete equilibration will produce non-linear trend.
- Presence of organics will produce non-linear trends.
- Least susceptible to operator error or chemical interference but should still be backed up by replicate measurements - replicate may be by colorimetric or potentiometric methods.

To calculate the alkalinity, use the formula $(V_{aliquot} + V_{titrant}) \times 10^{(4.65-pH)}$ to plot an ascending line after the endpoint with apparent alkalinity on the x-axis; $V_{aliquot}$ in ml, $V_{titrant}$ = titrator digits/800 and 4.65 is the assumed endpoint. A linear regression can then be used to calculate an x-intercept. Use only the points well after the endpoint to get the best regression as shown in Figure 2.

Common Interferences

- Highly colored waters
  Organic-rich waters with humic and fulvic acids.
  Often have low pH and correspondingly low alkalinity.

Solutions
  Perform Gran Titration - by extrapolating from points below pH 4.5 a fairly precise determination of alkalinity can be made.

  Add a second packet of indicator dye to intensify green and red colors.

- Chlorinated waters
  Color change at endpoint goes form green to yellow.

Solution: Add 5 drops and 2N Sodium Thiosulfate to scavenge any free chlorine before titrating.

- Clay-rich waters
  Colors of indicators are "off" often tending towards an orange endpoint.
  Commonly associated with poorly developed monitoring wells.

Solution: Filter the sample before titrating.

- Muddy waters
  Suspended sediment may contain carbonates or clays that could react with the acid titrant.
  Thick sediment may mask the color changes.

Solution: Filter the sample, preferably after allowing sediment to settle.

References

Determination of the Equivalent Point in Potentiometric Titrations, 1950, Gunnar Gran, Acta Chemica Scandinavica, pp 559-577.

Determination of the Equivalence Point in Potentionmetric Titrations - Part II, 1952, Gunnar Gran, The Analyst, International Congress on Analytical Chemistry, V. 77, pp 661-671.

Field Guide for Collecting and Processing Stream-Water Samples for the National Water-Quality Assessment Program, Larry R. Shelton, 1994, U.S. Geological Survey Open-File Report 94-455, 42 pp.

Field and Laboratory Methods, 1998, Scott C. Alexander and E.C. Alexander Jr., Hydrogeochemistry Lab, Dept. of Geology & Geophysics, Univ. of Minnesota, 21 pp.

EPA Method 310.1: Alkalinity determination to a colorimetric end-point.

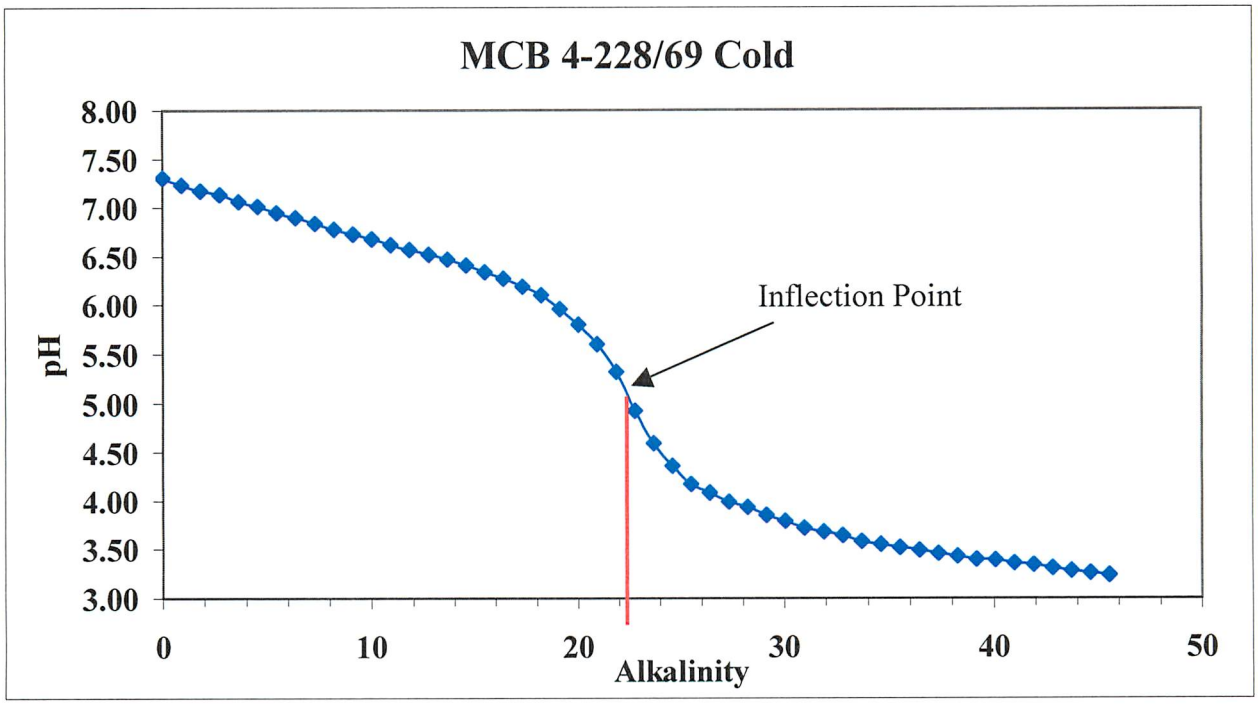


Figure 1. Example of pH titration

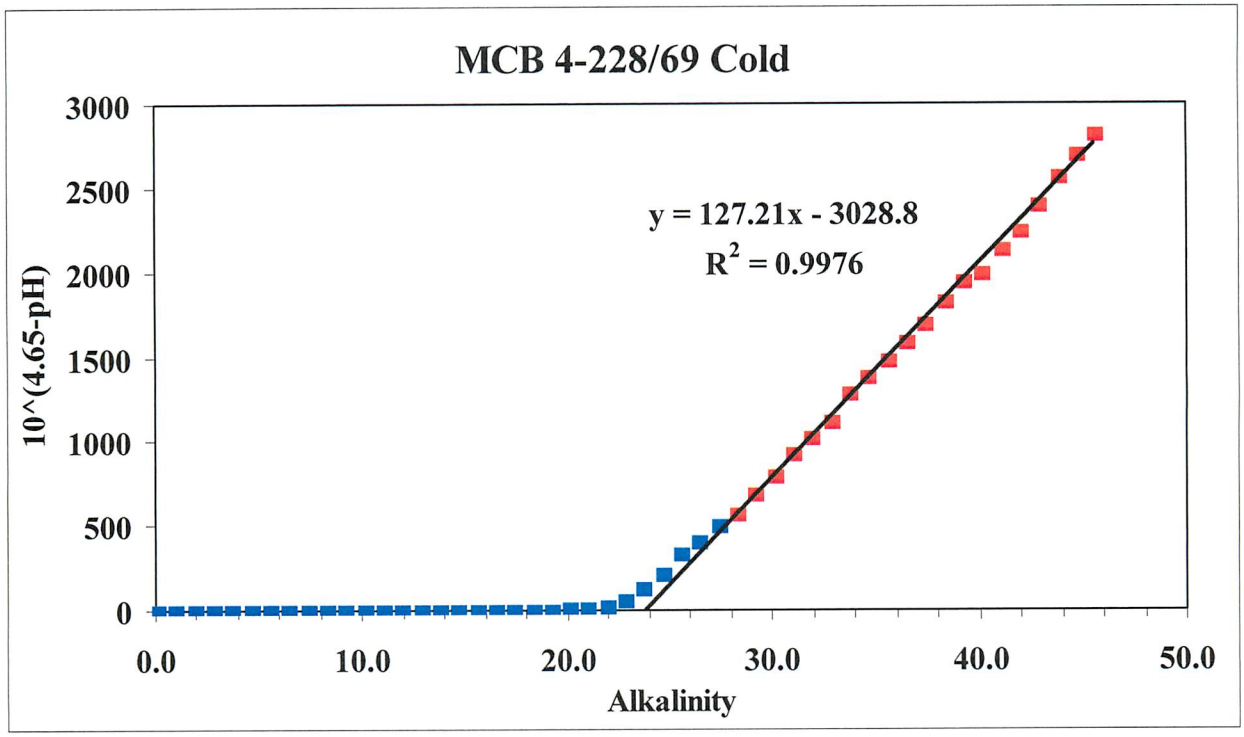


Figure 2. Example of Gran Titration

Use of the DR2800 Portable Spectrophotometer for Alkalinity Measurements (Secondary Method for Alkalinity Determination)

EAA currently uses the DR2800 Portable Spectrophotometer for measuring alkalinity values of samples in the event the Hach Digital Titrator is not available. Measurements are made at the EAA Camden building following the field sample-collection event. All measurements are to be recorded in the alkalinity notebook and on the field sheet. Operation procedures for this instrument are detailed next.

Alkalinity, Total DOC316.53.01257

Colorimetric Method **Method 10239**

25 to 400 mg/L $CaCO_3$ **TNTplus™ 870**

Scope and Application: For drinking water, wastewater and boiler water.

Test preparation

Before the test:

DR 2800 only: Install the light shield in Cell Compartment #2 before performing this test.

Read the safety advice and expiration date on the package.

The recommended sample and reagent temperature is 15–25 °C (59–77 °F).

The recommended reagent storage temperature is 15–25 °C (59–77 °F).

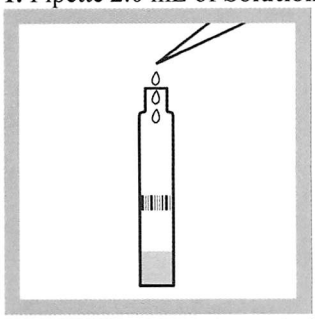
TNTplus™ methods are activated from the Main Menu when the sample vial is inserted into the sample cell holder.

Collect the following items:

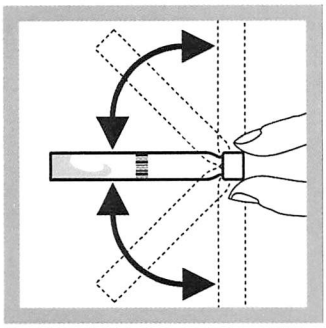
Description	Quantity
Total alkalinity TNT870 vials	variable
Light shield (DR 2800 only)	1
Pipette for 2.0-mL sample	1
Pipette for 0.5-mL sample	1
Pipette tips	variable

TNTplus™ method

1. Pipette 2.0 mL of **Solution A** into test vial.

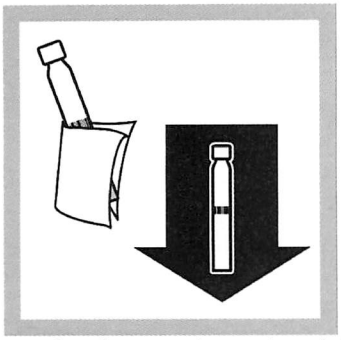


2. Pipette 0.5 mL of sample into vial.



3. Cap and invert vial until contents are well mixed.

4. Wait 5 minutes.



5. After timer expires, wipe vial and insert it into cell holder. Instrument reads barcode, selects method, and make measurement. No instrument zero required.
Results are in mg/L $CaCO_3$.

Interferences

If samples contain particles, remove the particles by filtration through a 0.45-µm filter.

Sample collection, preservation, and storage

- Collect samples in clean plastic or glass bottles. Fill completely and cap tightly.
- Prevent excessive agitation or prolonged exposure to air. Complete the test procedure as soon as possible after collection for best accuracy.
- The sample can be stored for 24 h if cooled to 4 °C (39 °F) or below. Warm to room temperature before the test begins.

Accuracy check

Standard solution method
required for accuracy check:

- Alkalinity Voluette® Ampule Standard Solution, 25,000 mg/L $CaCO_3$ (0.500 N)
- Ampule breaker
- Variable-volume pipette
- Pipette tips
- 100-mL volumetric flask, Class A
- Deionized water

1. Prepare a 250-mg/L $CaCO_3$ standard solution as follows:

a. Pipette 1.0 mL of alkalinity standard solution, 25,000 mg/L as $CaCO_3$, into a clean 1.0-mL volumetric flask.

b. Dilute to the mark with deionized water. Mix well. Prepare this solution daily.

2. Use this solution in place of the sample. Follow the TNTplus™ method test procedure. The result should be within 10% of the expected value.

Summary of method

Carbonates and other buffers react with the reagent in the vial to change the pH. The pH affects the color of the indicator, which is measured photometrically at 615 nm.

Calibration Procedures for Backup Instruments

The following pages contain a discussion of proper use of "backup" instrumentation owned by the EAA, but not in regular use. These instruments may be utilized during a contingency sampling event, or in the case where newer instrumentation is not available due to damage or other issues.

Calibration Procedures for Luminescent Dissolved Oxygen Probe Model LDO10101 with HQ30d Meter

Before calibration:

The probe must have the correct service-life time stamp. Set the date and time in the meter before the probe is attached.

It is not necessary to recalibrate when moving a calibrated probe from one HQd meter to another if the additional meter is configured for the same calibration options.

To view the current calibration, push Select View Probe Data, then select View Current Calibration.

If any two probes are connected, push the **UP** or **DOWN** arrow to change to the single display mode in order to show the Calibrate option.

Calibration notes:

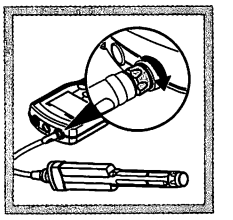
- % saturation or mg/L calibration methods are available in the Modify Current Settings menu.

- Slope value is the comparison between the latest calibration and the factory calibration shown as a percentage.

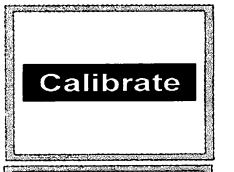
- Calibration is recorded in the probe and the data log. Calibration is also sent to a PC, printer, or flash memory stick if connected.

• Air bubbles under the sensor tip when submerged can cause slow response or error in measurement. If bubbles are present, gently shake the probe until bubbles are removed.

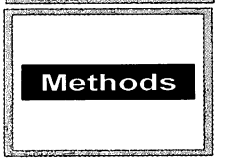
Water-saturated air (100%) calibration procedure:



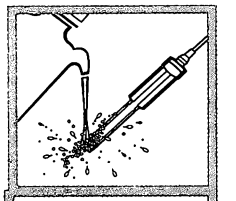
1. Connect the probe to the meter. Ensure that the cable locking nut is securely connected to the meter. Turn on the meter.



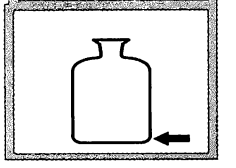
2. Push **Calibrate**.



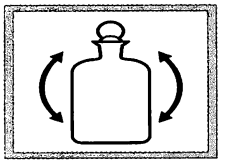
3. Push **Methods**. Select User Cal-100%. Push **OK**.



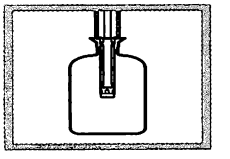
4. Rinse the probe cap with deionized water. Blot dry with a lint-free cloth.



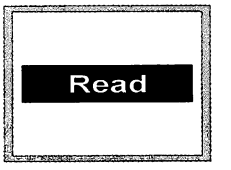
5. Add approximately ¼ inch (6.4 mm) of reagent water to a narrow-neck bottle, such as a BOD bottle.



6. Put a stopper in the bottle and shake the bottle vigorously for approximately 30 seconds to saturate the entrapped air with water. Allow up to 30 minutes for contents to equilibrate to room temperature.



7. Remove the stopper. Carefully dry the probe cap using a nonabrasive cloth. Put the probe in the bottle.



8. Push **Read**. The display shows "Stabilizing" as the probe stabilizes. The display shows the standard value when the reading is stable.

9. Push **Done** to view the calibration summary.

10. Push **Store** to accept the calibration and return the measurement mode. If a rugged probe, install the shroud on the probe.

Calibration Procedures for Conductivity Model 5197500 or 5197503 with sensION ™ 5 (Backup Instrumentation)

Before the test:

Collect samples in clean plastic or glass bottles.

Analyze samples as soon as possible after collection. However, samples may be stored at least 24 h by cooling to 4 °C (39 °F) or below (all storage temperatures have changed to 0 to 6 °C as per the EPA MUR, March 2007). When solutions are measured that are not at reference temperature, the meter automatically adjusts the conductivity value to reference temperature from 20 or 25 °C.

Water samples containing oils, grease, or fats will coat the electrode and affect the accuracy of the readings. If this coating occurs, clean the probe with a strong detergent solution, then thoroughly rinse with deionized water.

Mineral buildup on the probe can be removed with a diluted 1:1 hydrochloric acid solution. Refer to the meter user's manual.

Calibration instructions are given in the operation section of the meter manual. For most accurate results, calibrate before use or check the accuracy of the meter using a known conductivity standard.

Calibrating with a Known Standard

1. Place the probe in a conductivity standard that is in the expected range of the samples. On the meter, choose one of four ranges that corresponds to the sample range. Agitate the probe to dislodge bubbles in the cell. Avoid resting the probe on the bottom or sides of the container.

2. Press **CAL**. Functional keys will appear in the lower-left part of the display. **CAL?** and **1.000 1/cm** will appear in the upper display. If the meter has been calibrated, the last calibration value will appear. The numeric keypad will become active.

3. Press the arrow keys to scroll to the factory-calibration options (1000 µS/cm or 18 mS/cm). To calibrate using one of

these standards, press **ENTER**.

4. If using a standard with a different value, use the number keys to enter the standard conductivity at 25 °C, then press **ENTER**. The meter will automatically correct the calibration measurement to 25 °C using the NaCl-based, non-linear temperature coefficient.

   If the standard has a value of 25 °C in the µS/cm range, enter the value when 1000 µS/cm is displayed. If the standard has a value of 25 °C in the mS/cm range, enter the value when 18 mS/cm is displayed. All four places have a number entered in them. If a number entry error occurs, start over by pressing **SETUP/CE.**

5. When the reading is stable, the calibration is automatically stored, and the instrument returns to reading mode.

Calibration Procedures for Turbidimeter

Note: *for best accuracy, use the same sample cell of four matched sample cells for all measurements during calibration. Always insert the cell so that the orientation mark placed on the cell during the matching procedure is correctly aligned.*

Calibration

1. Rinse a clean sample cell with dilution water several times. Then fill the cell to the line (~15 mL) with dilution water or use StablCal <0.1 NTU standard. *Note: the same dilution water used for preparing the standards must be used in this step.*

2. Insert the sample cell in the cell compartment by aligning the orientation mark on the cell with the mark on the front of the cell compartment. Close the lid, and press **I/O**. *Note: choose signal average mode option (on or off) before pressing CAL— the SIGNAL AVERAGE key in calibration mode.*

3. Press **CAL.** The CAL and S0 icons will be displayed and will flash. The four-digit display will show the value of the S0 standard for the previous calibration. If the blank value were forced to 0.0, the display would be blank (as shown.) Press → for a numerical display.

Hach Company recommends the use of StableCal ® Stabilized Formazin or formazin standards only for the calibration of Hach turbidimeters. Hach Company cannot guarantee the performance of the turbidimeter if calibrated with co-polymer styrene divinlybenzene beads of other suspension. DO NOT calibrate with Gelex® Secondary Standards.

4. Press **READ.** The instrument will count from 60 to 0 (67 to 0 if signal average is on), read the blank, and use it to calculate a correction factor for the 20 NTU standard measurement. If the dilution water is less than or equal to 0.5 NTU, E 1 will appear when the calibration is calculated. The display will automatically increment to the next standard. Remove the sample cell from the cell compartment. *Note: turbidity of the dilution water can be "forced" to zero by pressing → rather than reading the dilution water. The display will show S0 NTU, and the up arrow key must be pressed to continue with the next standard.*

5. The display will show the S1 (with the 1 flashing) and 20 NTU, or the value of the S1 standard for the previous calibration. If the value is incorrect, edit the value by pressing the → key until the number that needs editing flashes. Use the up arrow key to scroll to the correct number. After editing, fill a clean sample cell to the line with well-mixed 20 NTU StablCal Standard of 20 NTU formazin standard. Insert the sample cell compartment by aligning the orientation mark on the cell with the mark on the front of the cell compartment. Close the lid.

6. Press **READ.** The instrument will count from 60 to 0 (67 to 0 if signal average is on), measure the turbidity, and store the value. The display will automatically increment to the next standard. Remove the sample cell from the cell compartment. *Note: for potable water applications with low turbidity values, instrument calibration may be stopped after the 20 NTU StablCal Standard has been read. Pres **CAL** after reading the 20-NTU standard. Instrument calibration is now complete for the range of 0–20 NTU only. The instrument will continue to read turbidity values above 20 NTU. These values were not updated during the 0–20 NTU calibration.*

7. The display will show the S2 (with the 2 flashing) and 100 NTU of the value of the S2 standard for the previous calibration. If the value is incorrect, edit the value by pressing the → key until the number that needs editing flashes. Use the up arrow key to scroll to the correct number. After

editing, fill a clean sample cell to the line with well-mixed 100 NTU StableCal Standard or 100 NTU formazin standard. Insert the sample cell into the cell compartment by aligning the orientation mark on the cell with the mark on the front of the cell compartment. Close the lid.

8. Press **READ.** The instrument will count from 60 to 0 (67 to 0 if signal average is on), measure the turbidity and store the value. Then the display will automatically increment to the next standard. Remove the sample cell from the cell compartment.

9. The display will show the S3 (with 3 flashing) and 800 NTU, or the value of the S3 standard for the previous calibration. If the value is incorrect, edit the value by pressing the → key until the number that needs editing flashes. Use the up arrow key to scroll to the correct number. After editing, fill a clean sample cell to the line with well-mixed 800 NTU formazin standard. Insert the sample cell into the cell compartment by aligning the orientation mark on the cell with the mark on the front of the cell compartment. Close the lid.

10. Press **READ**. The instrument will count from 60 to 0 (67 to 0 if signal average is on), measure the turbidity, and store the value. Then the display will increment back to the S0 display. Remove the sample cell from the cell compartment.

11. Press **CAL** to accept the calibration. The instrument will return to measurement mode automatically. *Note: pressing CAL completes the calculation of the calibration coefficients. If calibration errors occurred during calibration, error messages will appear after CAL is pressed. If E1 or E2 appear, check the standard preparation and review the calibration; repeat the calibration if necessary. If CAL? appears, an error may have occurred during calibration. If CAL? is flashing, the instrument is using the default calibration.*

Notes

- If the **I/O** key is pressed during calibration, the new calibration data are lost, and the old calibration will be used for measurements. Once in calibration mode, only the **READ, I/O,** ↑, and → keys function. Signal averaging and range mode must be selected before the

calibration mode can be entered.

• If **E 1** or **E 2** is displayed, an error occurred during calibration. Check the standard preparation and review the calibration; repeat the calibration if necessary. Press **DIAG** to cancel the error message (**E 1** or **E 2**). To continue without repeating the calibration, press **I/O** twice to restore the previous calibration. If **CAL?** is displayed, an error may have occurred during calibration. The previous calibration may not be restored. Either recalibrate or use the calibration as is.

• To review a calibration, press **CAL** and then ↑ to view the calibration standard values. As long as **READ** is never pressed and **CAL** is not flashing, the calibration will not be updated. Press **CAL** again to return to the measurement mode.

pH Meter Calibration

The pH meter must be calibrated before daily use. The calibration may be accomplished in the laboratory or in the field. In addition to a "preuse" calibration, it is strongly recommended that the meter be checked with a standard buffer solution at least once during the day in order to observe any instrument drift that may have occurred.

Manual Calibration (with two reference solutions)

1. Attach or verify that the pH-indicating electrode and the automatic temperature compensator (ATC) are on the display unit.
2. Remove the rubber filling solution plug (if so equipped) to allow equilibration of the internal solution to the ambient air. Allow approximately five minutes for the equilibration process, and replace the plug.
3. Turn on the unit and select the calibration mode.
4. Rinse both electrodes with deionized water and dry (carefully) any excess water.
5. Rinse the pH electrode in the first pH buffer (reference) solution. After rinsing, immerse the electrode in a container of the first reference solution, and stir to remove bubbles on the electrode.
6. Allow the display to read **READY** and begin flashing. If the pH reading is within the manufacturer's specifications (see equipment manual), press **YES**. If not, press **NO** and repeat the procedure. The first standard will subsequently be locked into the unit's memory.
7. To calibrate the meter to the second pH reference solution, repeat steps 4, 5, and 6 USING the second solution.
8. Remove and rinse probes IN deionized water, and begin sample analysis. Otherwise the meter may be turned off; it will keep calibrating as long as the power source remains intact.

Electrode Care and Maintenance for pH Meters
The pH electrodes discussed above are of the temperature-compensating triode design. These probes are delicate and require careful handling. The probes should not be allowed to freeze and MUST be stored in a vial of the storage solution.

1. Inspect the probe for damage before each use. Verify that probes contain the appropriate levels of filling solution.
2. If filling-solution levels are low, more solution should be added. Use the Hach solution for Hach probes and the Orion solution for Orion probes.
3. If the probe appears sluggish when readings are taken, the filling solution should be drained and refilled with fresh solution.
4. During normal operations, the probe will become fouled with scale deposits and oils. Clean with laboratory-grade soap by soaking the probe in the soap solution and rinsing in deionized water. If fouling is not removed by this procedure, then a 0.1-N solution of HCL or HNO_3 can be used as a soaking media.
5. Probes must be stored in the electrode storage solution or in a 4.0-pH buffer solution. If probes are allowed to dry out, irreversible damage to the probe may occur.

Conductivity Probes

Orion Conductivity/Temperature Meters, Models 122, 126, 128, and 1230
Conductance, refers to the ability of a substance to carry an electrical current. These probes are used to define the physical parameters of conductivity. Conductivity is the algebraic reciprocal of electrical resistance and is expressed in SI units of microSeimens per centimeter. Specific conductance is electrical conductance measured across a one-cm cube of liquid (sample) between opposing faces of two platinum electrodes at 25°C. Conductivity is the same parameter measured at ambient temperature that has not been temperature compensated to 25°C.

Calibration
The conductivity meter must be calibrated in the laboratory or in the field daily. Conductance standards should be chosen to closely reflect the values expected in the sample groups. For example, if historical conductivity values for an area to be sampled range below 1000 µS/cm, the 500-µS/cm solution should be chosen. The meters are designed to provide a nonlinear-function temperature coefficient to correct calculations; however, best results may be obtained when samples are 25°C.

Calibration Steps

1 Select conductivity measurement by turning the meter's conductivity/temperature selector knob from **OFF** to **CONDUCTIVITY** (labeled Δ).
2 Submerge the probe into THE selected conductivity standard (past the open area within the probe), and stir briefly to eliminate any air bubbles.
3 Maintain the probe in solution, wait for the reading to stabilize, and record the final value.
4 No manual adjustment for the meter exists; therefore, the process described herein provides a reference check. If the conductivity reading obtained from steps 1 through 3 is within ±3% of the given standard value, the meter is deemed to be within tolerance limits. If repeated attempts fail to obtain readings within the acceptable range, the meter will require factory service.

Maintenance

1 The meter electrode must be clean for readings to be accurate. Laboratory-grade soap may be used to clean dirt and oil deposits from the meter. For mineral deposits, a 1-M-HCl solution may be used in ten parts deionized water, and ten parts isopropyl alcohol as a soaking agent for their removal.
2 The conductivity probe may be stored dry. After each use, however, the probe should be rinsed in deionized water and blotted dry.
3 The unit will indicate a low battery by flashing **LOBAT** in the upper-left-hand corner of the LCD display. The nine-volt disposable battery should be changed out with the unit **OFF**, to prevent damage.

APPENDIX D—Forms

EDWARDS AQUIFER
AUTHORITY

Water Quality Field Data Sheet

HCP SEDIMENT

Site Information

Station Name:	
Location:	
Owner/Contact: Edwards Aquifer Authority	
Address: 900 East Quincy	
County:	
Point of Collection:	
Date: / / 201	Time:
Ambient Temp.	Collector(s):
Weather:	

Equal-Width-Increment Method

Transect Width:
Number of Verticals:
Flow/Apperance:

Type of Analysis: (circle all that apply)

GWQP	Selct. Met.	8081	8082	8141	8151
TOC	T. Phosphorous	SVOCs	TB	DOC	VOC

Notes

Latitude:	Longitude:

Datum: _____

updated 08/06/13

EDWARDS AQUIFER
AUTHORITY

Water Quality Field Data Sheet

HCP STORM WATER

Site Information

Station Name:	
Location:	
Owner/Contact: Edwards Aquifer Authority	
Address: 900 East Quincy	
County:	
Point of Collection:	
Date: / / 201	Time:
Ambient Temp.	Collector(s):
Weather:	

Field Readings

Time Sampled:
pH:
Temperature:
Conductivity:
Dissolved Oxygen:
Turbidity:

Equal-Width-Increment Method

Transect Width:
Flow/Apperance:

Instrument Calibration

Conductivity Meter #	
Standard	Meter Reading
500	
1000	
10000	
pH Meter #	
Standard	Meter Reading
Buffer 4.0	
Buffer 7.0	
Buffer 10.0	
pH Meter #	
Standard	Meter Reading
DI water in bottle	

Alkalinity

Alkalinity Meter: DR 2800 TNT870

Total Alkalinity

Type of Analysis: (circle all that apply)

GWQP	Selct. Met.	8081	8082	8141	8151
TOC	T. Phosphorous	TKN	E-Coli MPN	DOC	VOC
TB	SVOCs				

Latitude:	Longitude:

Datum: _____

Sampling Conditions

Gage Readings	Time	Level
Before Sampling		
After Sampling		

Hydrologic Event	Hydrologic Condition
Storm	Stable, Low
Drought	Falling
Spill	Stable, High
Regulated Flow	Rising
Routine Sample	Stable, Normal

updated 12/21/12

EDWARDS AQUIFER
AUTHORITY

Water Quality Field Data Sheet

HCP SURFACE WATER

Site Information

Station Name:	
Location:	
Owner/Contact: Edwards Aquifer Authority	
Address: 900 East Quincy	
County:	
Point of Collection:	
Date: / / 201	Time:
Ambient Temp.	Collector(s):
Weather:	

Field Readings

Time Sampled:	
pH:	
Temperature:	
Conductivity:	
Dissolved Oxygen:	
Turbidity:	

Equal-Width-Increment Method

Transect Width:	
Flow/Apperance:	

Instrument Calibration

Conductivity Meter #	
Standard	Meter Reading
500	
1000	
10000	

pH Meter #	
Standard	Meter Reading
Buffer 4.0	
Buffer 7.0	
Buffer 10.0	

pH Meter #	
Standard	Meter Reading
DI water in bottle	

Alkalinity

	mL of Sample	mL of Acid	Total Alk	
Rep.1				Ave. Total Alk.
Rep. 2				
Rep3.				

Type of Analysis: (circle all that apply)

GWQP	Selct. Met.	8081	8082	8141	8151
TOC	T. Phosphorous	TKN	E-Coli MPN	DOC	VOC
TB	SVOCs				

Latitude:	Longitude:

Datum: _____

Sampling Conditions

Gage Readings	Time	Level
Before Sampling		
After Sampling		

Hydrologic Event	Hydrologic Condition
Storm	Stable, Low
Drought	Falling
Spill	Stable, High
Regulated Flow	Rising
Routine Sample	Stable, Normal

updated 12/21/12

EDWARDS AQUIFER
AUTHORITY

Water Quality Field Data Sheet

SPRINGS

Spring Information

State well ID #: NA	
Owner/Contact: New Braunfels Parks & Rec.	
Address:	
Phone Number:	
County: Comal	
Spring Name / #: Comal Springs 7	
Point of Collection: Springs Oriface	
Spring Use: Springs	
Date:	Time:
Weather:	Collector(s):

Field Readings

Time Sampled:	
Turbidity:	

Time	Temp	Cond.	pH	DO

Alkalinity

	mL of Sample	mL of Acid	Total Alk
Rep.1			
Rep. 2			
Rep3.			

Ave. Total Alk.

Type of Analysis: (circle all that apply)

GWQP	Selct. Met.	8081	8082	8141	8151
8260	Trip Blank	SVOC'S	TOC	T. Phosphorous	Ortho-pohsphate as P
E-Coli MPN	TPH	PAH	PPCP		

Latitude:	Longitude:

Datum: _____

Sampling Conditions

Spring Flow	Low	Medium	High
Flow Apperance	Clear	Cloudy	Murky

Instrument Calibration

Conductivity Meter	
Standard	Meter Reading
500	
1000	
pH Meter	
Standard	Meter Reading
Buffer 4.0	
Buffer 7.0	
Buffer 10.0	
DO Meter	
Standard	Meter Reading
DI water in bottle	

updated 12/21/12

EDWARDS AQUIFER
AUTHORITY

Water Quality Field Data Sheet

SURFACE WATER

Site Information

Station Name:	
Location:	
Owner/Contact:	
Address:	
County:	
Point of Collection:	
Date:	Time:
Ambient Temp.	Collector(s):
Weather:	

Field Readings

Time Sampled:
pH:
Temperature:
Conductivity:
Dissolved Oxygen:
Turbidity:

Equal-Width-Increment Method

Transect Width:
Number of Verticals:
Flow/Apperance:

Instrument Calibration

Conductivity Meter #	
Standard	Meter Reading
500	
1000	
10000	
pH Meter #	
Standard	Meter Reading
Buffer 4.0	
Buffer 7.0	
Buffer 10.0	
pH Meter #	
Standard	Meter Reading
DI water in bottle	

Alkalinity

	mL of Sample	mL of Acid	Total Alk	
Rep.1				Ave. Total Alk.
Rep. 2				
Rep3.				

Type of Analysis: (circle all that apply)

GWQP	Selct. Met.	8081	8082	8141	8151
TOC	T. Phosphorous	Ortho-pohsphate as P	E-Coli MPN	TPH	PAH
PPCP					

Latitude:	Longitude:

Datum: _____

Sampling Conditions

Gage Readings	Time	Level
Before Sampling		
After Sampling		

Hydrologic Event	Hydrologic Condition
Storm	Stable, Low
Drought	Falling
Spill	Stable, High
Regulated Flow	Rising
Routine Sample	Stable, Normal

updated 12/21/12

EDWARDS AQUIFER
AUTHORITY

Water Quality Field Data Sheet
GROUNDWATER

Well Information

State well ID #:	
Owner/Contact:	
Address:	
Phone Number:	
County:	
Well Name / #:	
Point of Collection:	
Well Use:	
Weather:	
Date:	Time:
Flow Rate: gpm	Collector(s):
Water Level:	Well Depth:
Casing Dia.:	3 x well volume=

Field Readings

Started Pumping:	
Time Sampled:	
Turbidity:	

Time	Temp	Cond.	pH	Do

Alkalinity

	mL of Sample	mL of Acid	Total Alk
Rep.1			
Rep. 2			
Rep3.			

Ave. Total Alk.

Instrument Calibration

Conductivity Meter #	
Standard	Meter Reading
500	
1000	
10000	

pH Meter #	
Standard	Meter Reading
Buffer 4.0	
Buffer 7.0	
Buffer 10.0	

DO Meter	
Standard	Meter Reading
DI water in bottle	

Latitude:	Longitude:

Datum:

Type of Analysis: (circle all that apply)

GWQP	Selct. Met.	8081	8082	8141	8151
8260	Trip Blank	SVOC'S	TOC	T. Phosphorous	Ortho-pohsphate as P
E-Coli MPN	TPH	PAH	PPCP		

Updated on 12/21/12

FY06

TWDB Water Quality Field Data Sheet

Newly Inventoried Well _____

SWN: _____
County: _____
County Code: _____
Aquifer Code: _____
Aquifer Id: _____

Name: _____
Address: _____
_____
Phone Number: _____
Attention: _____
Well Name or #:

ID Number: _____
Date: _____
Sampler(s): _____

Calibration Verification Readings		
pH	7 =	
	4 or 10 =	
SLP =	7.38 =	
Conductivity	500 =	
	1000 =	
	2000 =	
	5000 =	

CIRCLE EACH SAMPLE FRACTION COLLECTED:

1	2	3	4	5	6	7	8	9	10
500ml filtered Anions/T. Alk. Ice	250 ml filtered Cation (HNO3)	500ml filtered Nitrate Ice + H2SO4							

All acidified samples pH <2.0. (*) If natural pH<7, then add NaOH until pH is >7. If natural pH is≥7, no NaOH required.

Time In: _____
Time Out: _____

Water Level: _____
W.L. remark: _____
M.P. = _____

Pumping time: _____
Sampling Point: _____

Well Use: _____
Lift: _____
Power: _____

FIELD G.P.S. readings
Latitude: ° ' "
Longitude: ° ' "
Datum: _____

Casing Type: _____
Casing Size: _____ "

Sample Time: _____

Filter pressure: hand pump / line / spring

Field Alkalinity Titration:

_____ Start pH _____ End pH
50.0 **mL Sample Size**
_____ mL Acid added for Phenol (> 8.3)
_____ mL Acid added for Total (to pH 4.5)

Items below calculated from: mL acid added x 20 = Alkalinity

Phenol Alkalinity (82244): _____ mg/L
Total Alkalinity (39086): mg/L

Items Below Calculated Later From Results:
Dissolved Solids (mg/L): _____
Hardness (as CaCO3): _____
Balanced:

Water Quality Stabilization Parameters Table (At least 3 readings @ 5 min. intervals)

Time									
pH									
Celsius Temp.									
Conductivity									

Notes:

Data Entered By Sampler Into Database: yes / no

>>> Select a Laboratory <<<
#N/A
#N/A
#N/A
#N/A

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Regulatory Program: ☐DW ☐NPDES ☐RCRA ☐Other:

Client Contact	Project Manager:	Site Contact:	Date:	COC No:
Your Company Name here	Tel/Fax:	Lab Contact:	Carrier:	_____ of _____ COCs
Address	Analysis Turnaround Time			For Lab Use Only:
City/State/Zip	Calendar (C) or Work Days (W) _____			Walk-in Client:
(xxx) xxx-xxxx Phone	TAT if different from Below _____			Lab Sampling:
(xxx) xxx-xxxx FAX	☑ 2 weeks			
Project Name:	☐ 1 week			Job / SDG No.:
Site:	☐ 2 days			
P O #	☐ 1 day			Sampler:

Sample Identification	Sample Date	Sample Time	Sample Type	Matrix	# of Cont.	Filtered Sample (Y / N)	Composite = C / Grab = G																Sample Specific Notes:

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other _____

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐Non-Hazard ☐Flammable ☐Skin Irritant ☐Poison B ☐Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐Return to Client ☐Disposal by Lab ☐Archive for_____ Months

Special Instructions/QC Requirements & Comments:

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4, dated 10/25/2012

SAN ANTONIO RIVER AUTHORITY
Leaders in Watershed Solutions

Regional Environmental Laboratory
CHAIN OF CUSTODY

600 E. Euclid
San Antonio, TX 78212
Phone: (210) 302-3649
FAX (210) 302-3694

Report To: _____ Phone #: _____ Collector's Name: _____

Address: _____ FAX #: _____ Field Comments: _____

City, State, ZIP: _____ E-mail: _____

Rush Analysis(Additional Fees Apply) ☐0-3 days ☐ 4-6 days Report Delivery: ☐Mail ☐Fax ☐E-mail Method of Shipment: ☐Hand Delivered ☐Mailed ☐Ice

Sample # Lab Use Only	Sample Location	1. Collection Method	2. Sample Type	3. Matrix	4. Composite Start Date/Time	Collection Date/Time	5. Container Type	Requested Analyses										6. Type of Preservation	Lab Use ONLY Therm. ID: C01-096 Receipt Temp (°C) Observed/Corrected ___/___ pH <2 Y or N pH Paper: R006-63-6

Relinquished by: _____ Date/Time: _____ Received by: _____ Date/Time: _____

Relinquished by: _____ Date/Time: _____ Received by: _____ Date/Time: _____

Relinquished by: _____ Date/Time: _____ Received by: _____ Date/Time: _____

Relinquished by: _____ Date/Time: _____ Received by: _____ Date/Time: _____

Lab Comments: _____ NA - Not Applicable

1. **Collection Method**: G - Grab C - Composite
2. **Sample Type:** EF – Effluent, IF – Influent, BW – Bottled Water SW – Surfacewater, ST – Stormwater, PW – Private Well, O – Other (Specify in Comments
3. **Matrix:** DW – Drinking Water, NPW – Non-Potable Water, SE – Sediment, SO – Soil, O – Other (Specify in Comments)
4. Composite Samples require Composite Start Date/Time and Collection Date/Time
5. **Container Type:** GC – Gallon Cubitainer, QC Quart Cubitainer, AB – Amber Glass Bottle, CB – Clear Glass Bottle, DS Drinking Water Screwtop, PB-Plastic Bottle, AP-Amber Plastic, WP-Whirl-pak
6. **Type of Preservation :** U – Unpreserved (No Chemical Preservation), S – Sulfuric Acid, H – Hydrochloric Acid, N – Nitric Acid, P – Phosphoric Acid, O – Other (Specify in Comments)

F053_Rev07 Effective Date: 10/1/2012 Page 1 of 1

Environmental Laboratory Services

LCRA ENVIRONMENTAL LABORATORY SERVICES (ELS) CHAIN OF CUSTODY RECORD

NOTE: Relinquishing sample(s) to ELS obligates the submitter to all Standard Terms and Conditions stated on the back of this form.

Target Due Date: _____
Work Order No.: _____
COC No.: _____
Page _____ of _____

Results To: _____ (NAME, ADDRESS, CITY, STATE, ZIP) Sampled By: _____
Bill To: _____ (NAME, ADDRESS, CITY, STATE, ZIP) PO No.: _____
Phone No.: _____ Fax No.: _____ Method of Transport: _____ TAT Requested: _____ Working days E-mail: _____
Relinquished By: _____ Date: _____ Time: _____ Received By: _____ Date: _____ Time: _____ Relinquished By: _____ Date: _____ Time: _____

Report Requirements
☐ Hardcopy ☐ E-mail ☐ Fax
☐ EDD (Generic)

Regulatory Requirements
☐ None ☐ NELAP
☐ _____

Received at ELS By: _____ Date: ___ Time: _____
☐ Received on Ice Temp: _____ °C
Login Review: _____ Date: _____

ELS Mgmt. Approval for RUSH: _____
Surcharge for RUSH: _____ %

ELS ID:	SAMPLE DESCRIPTION Custody Seals (circle): Cooler Bottles None	MATRIX	SAMPLE COLLECTION DATE	SAMPLE COLLECTION TIME	CONTAINERS NUMBER	CONTAINERS SIZE	CONTAINERS TYPE	ANALYSIS REQUESTED - Place an "x" in the box below to indicate request.								PRESERVATIVES	pH

Special Instructions: _____
ELS Comments: _____

White - ELS Pink - Customer http://els.lcra.org • 3505 Montopolis • Austin, Texas • 78744-1417 • (512) 356-6022 • Fax (512) 356-6021 • 1-800-776-5272, Ext. 6022 Form 1156 Rev. 7/08

APPENDIX E—Drinking-Water Standards and Chemical Health Effects, from 30 TAC 290, RG-346, and U.S. EPA, July 2002

(Note, regulatory limits change frequently for certain compounds, the data herein are for general comparisons. The reader should utilized the most recent data available online from TCEQ and EPA if sample results exceed regulatory limits)

Parameter, Method, and Units	Maximum Contaminant Levels or Secondary Standards	Potential Health Effects from Ingestion of Water^	Sources of Contaminant in Drinking Water^
Temperature (°C) EPA 170.1	NE	NA	NA
pH measured at 25°C EPA 150.1	>7.0*	NA	NA
Turbidity (NTU)	NE	NA	NA
Dissolved oxygen (DO) (mg/L)	NE	NA	NA
Alkalinity total as $CACO_3$ SM 2320 B (mg/L)	NE	NA	NA
Specific conductance µS/cm	NE	NA	NA
Laboratory		NA	NA
Alkalinity total as $CACO_3$ SM 2320 B	NE	NA	NA
Bicarbonate (HCO_3) SM 2320 B	NE	NA	NA
Fecal coliform (CFU/100 mL)	0 MCLG[1]	NA	NA
Fecal strep (CFU/100 mL)	0 MCLG[1]	NA	NA
E. coli (CFU/100 mL)	0 MCLG[1]	NA	NA
pH measured at 25°C EPA 150.1	>7.0*	NA	NA
Specific conductance µS/cm	NE	NA	NA
Nutrients (mg/L)			
Nitrate-nitrite as N EPA354.1/300.0	10	**Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.**	**Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits**

Parameter, Method, and Units	Maximum Contaminant Levels or Secondary Standards	Potential Health Effects from Ingestion of Water^	Sources of Contaminant in Drinking Water^
Nitrate as N E300	10	Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits
Orthophosphate EPA 365.3	NE	NA	NA
Ammonia as N SM 4500	NE	NA	NA
Phosphorus	NE	NA	NA
Major Ions (mg/L)		NA	NA
Sulfate (SO_4) EPA 300.0	300*	NA	NA
Solids total dissolved (TDS) EPA 160.1	1,000*	NA	NA
Solids total suspended (TSS) EPA 160.2	NE	NA	NA
Bromide (Br) EPA 300.0	NE	NA	NA
Chloride (CI) EPA 300.0	300*	NA	NA
Fluoride (F) EPA 340.2	2.0*	Bone disease (pain and tenderness of the bones); children may get mottled teeth	Water additive that promotes strong teeth, erosion of natural deposits, discharge from fertilizer and aluminum factories
Metals by EPA 200.7 and 200.8 (µg/L)		NA	NA
Aluminum	24,000**	NA	NA
		NA	NA
Antimony	6	Increase in blood cholesterol; decrease in blood sugar	Discharge from petroleum refineries, fire retardants, ceramics, electronics, solder
Arsenic	5	Skin damage or problems with circulatory systems and increased risk of cancer	Erosion of natural deposits; runoff from orchards and glass and electronics production wastes

Parameter, Method, and Units	Maximum Contaminant Levels or Secondary Standards	Potential Health Effects from Ingestion of Water^	Sources of Contaminant in Drinking Water^
Barium	2,000	Increase in blood pressure	Discharge of drilling wastes, discharge from metal refineries, erosion of natural deposits
Beryllium	4	Intestinal lesions	Discharge from metal refineries and coal-burning factories. erosion of natural deposits
Boron	4,900**		
Cadmium	5	Kidney damage	Corrosion of galvanized pipe, erosion of natural deposits, discharge from metal refineries, runoff from waste batteries and paints
Chromium	100	Allergic dermatitis	Discharge from steel and pulp mills, erosion of natural deposits
Cobalt	1,500**	NA	NA
Copper	1,300*	Short-term exposure, gastrointestinal distress; long-term exposure, liver or kidney damage. People with Wilson's disease should consult their personal doctor if the amount of copper in their water exceeds the action level.	Corrosion of household plumbing systems, erosion of natural deposits
Iron	300*	NA	NA
Lead	15	Infants and children: delays in physical or mental development; children could show slight deficits in attention span and learning abilities. Adults: Kidney problems, high blood pressure	Corrosion of household plumbing systems, erosion of natural deposits
Lithium	490**	NA	NA
Manganese	1,100*	NA	NA
Molybdenum	120**	NA	NA
Nickel	490**	NA	NA

Parameter, Method, and Units	Maximum Contaminant Levels or Secondary Standards	Potential Health Effects from Ingestion of Water^	Sources of Contaminant in Drinking Water^
Selenium	50	Hair or fingernail loss, numbness in fingers or toes, circulatory problems	Discharge from petroleum refineries, erosion of natural deposits, discharge from mines
Silver	120*	NA	NA
Strontium	15,000**	NA	NA
Thallium	2	Hair loss; changes in blood; kidney, intestine, or liver problems	Leaching from ore processing sites; discharge from electronics, glass, and drug factories
Uranium	30	NA	NA
Vanadium	1.7**	NA	NA
Zinc	7,300*	NA	NA
		NA	NA
Metals by E200.8 (mg/L)			
Calcium	NE	NA	NA
Magnesium	NE	NA	NA
Potassium	NE	NA	NA
Sodium	NE	NA	NA
Metals by SW-7470A (mg/L)			
Mercury	0.002	Kidney damage	Erosion of natural deposits, discharge from refineries and factories, runoff from landfills and croplands
Total Organic Carbon by E415.1 (mg/L)			
TOC	NE	NA	NA
Herbicides by SW-8141 (µg/L)			
Azinphosmethyl	37**	NA	NA
Bolstar (Sulprofos)	73**	NA	NA
Chlorpyrifos	73**	NA	NA
Coumaphos	170**	NA	NA

Parameter, Method, and Units	Maximum Contaminant Levels or Secondary Standards	Potential Health Effects from Ingestion of Water^	Sources of Contaminant in Drinking Water^
Demeton-O	1.0**	NA	NA
Demeton-S	0.98**	NA	NA
Diazinon	22**	NA	NA
Dichlorvos	3.1**	NA	NA
Dimethoate	4.9**	NA	NA
Disulfoton	0.98**	NA	NA
EPN	0.24**	NA	NA
Ethoprop	2.4**	NA	NA
Famphur	0.73**	NA	NA
Fensulfothion	24**	NA	NA
Fenthion	1.7**	NA	NA
Malathion	490**	NA	NA
Merphos	7.3**	NA	NA
Methyl parathion	6.1**	NA	NA
Mevinphos (Phosdrin)	0.61**	NA	NA
Mononcrotophos	15**	NA	NA
Naled	49**	NA	NA
Parathion	150**	NA	NA
Phorate	4.9**	NA	NA
Ronnel	1,200**	NA	NA
Stirophos (Tetrachlorvinphos)	1,000**	NA	NA
Sulfotepp (Tetraethyl dithiopyrophosphate)	12**	NA	NA
Tokuthion (Prothiofos)	2.4**	NA	NA
Trichloronate	73**	NA	NA
Thionazin	1.7**	NA	NA
Herbicides by SW-8151 (µg/L)			
2,4,5-T	240	NA	NA
2,4,5-TP (Silvex)	50	Liver problems	Residue of banned herbicide

Parameter, Method, and Units	Maximum Contaminant Levels or Secondary Standards	Potential Health Effects from Ingestion of Water^	Sources of Contaminant in Drinking Water^
2,4- D	70	Kidney, liver, or adrenal gland problems	Runoff from herbicide used on row crops
2,4-DB	200	NA	NA
Dalapon	200	Minor kidney changes	Runoff from herbicide used on rights of way
Dicamba	730	NA	NA
Dichoroprop	240	NA	NA
Dinoseb	7	Reproductive difficulties	Runoff from herbicide used on soybeans and vegetables
MCPA	12	NA	NA
MCPP (mecoprop)	24	NA	NA
Pentachlorophenol	1	Liver or kidney problems, increased cancer risk	Discharge from wood-preserving factories
Pesticides by SW-8081 (µg/L)			
4, 4'-DDD	3.8**	NA	NA
4, 4'-DDE	2.7**	NA	NA
4, 4'-DDT	2.7**	NA	NA
Aldrin	0.05**	NA	NA
Alpha-bhc (Alpha-hexachlorocyclohexane)	0.1**	NA	NA
Alpha-chlordane	2.6**	NA	NA
Beta-bhc (Beta-hexachlorocyclohexane)	0.5**	NA	NA
Chlordane	2.0**	Liver or nervous system problems, increased risk of cancer	Residue of banned termiticide
Delta-bhc (Delta-hexachlorocyclohexane)	0.5**	NA	NA
Dieldrin	0.57**	NA	NA
Endosulfan I	49**	NA	NA
Endosulfan II	150**	NA	NA
Endosulfan sulfate	150**	NA	NA
Endrin	2.0**	Liver problems	Residue of banned insecticide

Parameter, Method, and Units	Maximum Contaminant Levels or Secondary Standards	Potential Health Effects from Ingestion of Water^	Sources of Contaminant in Drinking Water^
Endrin aldehyde	7.3**	NA	NA
Endrin ketone	—		
Gamma-bhc (Lindane)	7.3**	NA	NA
Gamma-chlordane	0.2	Liver or kidney problems	Runoff/leaching from insecticide used on cattle, lumber, gardens
	2.6**	NA	NA
Heptachlor epoxide	0.4	Liver damage, increased risk of cancer	Residue of banned termiticide
Methoxychlor	0.2	Liver damage, increased risk of cancer	Breakdown of heptachlor
Toxaphene	40	Reproductive difficulties	Runoff/leaching from insecticide used on fruits, vegetables, alfalfa, livestock
PCBs by SW-8082 (µg/L)	3	Kidney, liver, or thyroid problems; increased risk of cancer	Runoff/leaching from insecticide used on cotton and cattle
Aroclor 1016			
Aroclor 1221	0.5	Skin changes, thymus gland problems, immune deficiencies, reproductive or nervous system difficulties, increased risk of cancer	Runoff from landfills, discharge of waste chemicals
Aroclor 1232	0.5	Skin changes, thymus gland problems, immune deficiencies, reproductive or nervous system difficulties, increased risk of cancer	Runoff from landfills, discharge of waste chemicals
Aroclor 1242	0.5	Skin changes, thymus gland problems, immune deficiencies, reproductive or nervous system difficulties, increased risk of cancer	Runoff from landfills, discharge of waste chemicals
Aroclor 1248	0.5	Skin changes, thymus gland problems, immune deficiencies, reproductive or nervous system difficulties, increased risk of cancer	Runoff from landfills, discharge of waste chemicals

Parameter, Method, and Units	Maximum Contaminant Levels or Secondary Standards	Potential Health Effects from Ingestion of Water^	Sources of Contaminant in Drinking Water^
Aroclor 1254	0.5	Skin changes, thymus gland problems, immune deficiencies, reproductive or nervous system difficulties, increased risk of cancer	Runoff from landfills, discharge of waste chemicals
Aroclor 1260	0.5	Skin changes, thymus gland problems, immune deficiencies, reproductive or nervous system difficulties, increased risk of cancer	Runoff from landfills, discharge of waste chemicals
Aroclor 1262	0.5	Skin changes, thymus gland problems, immune deficiencies, reproductive or nervous system difficulties, increased risk of cancer	Runoff from landfills, discharge of waste chemicals
Aroclor 1268	0.5	Skin changes, thymus gland problems, immune deficiencies, reproductive or nervous system difficulties, increased risk of cancer	Runoff from landfills, discharge of waste chemicals
	0.5	Skin changes, thymus gland problems, immune deficiencies, reproductive or nervous system difficulties, increased risk of cancer	Runoff from landfills, discharge of waste chemicals
SVOCs by SW-8270C (µg/L)			
1,2- dichlorobenzene	600**	NA	NA
1,2,4- trichlorobenzene			
2, 4, 5-trichlorophenol	70**	Changes in adrenal glands	Discharge from textile finishing factories
2, 4, 6-trichlorophenol	2,400**	NA	NA
2, 4-dichlorophenol	24**	NA	NA
2, 4-dimethylphenol	73**	NA	NA

Parameter, Method, and Units	Maximum Contaminant Levels or Secondary Standards	Potential Health Effects from Ingestion of Water^	Sources of Contaminant in Drinking Water^
2, 4-dinitrophenol	490**	NA	NA
2-chlorophenol	49**	NA	NA
2-methylnaphthalene	120**	NA	NA
2-methylphenol (o-cresol)	98**	NA	NA
2-nitroaniline	1,200**	NA	NA
2-nitrophenol	7.3**	NA	NA
3 & 4 methylphenol (m&p cresol)	49**	NA	NA
3-nitroaniline	1,200**	NA	NA
4, 6-dinitro-2-methylphenol	7.3**	NA	NA
4-chloro-3-methylphenol	2.4**	NA	NA
4- chloroaniline	120**	NA	NA
4-nitroaniline	4.6**	NA	NA
4-nitrophenol	46**	NA	NA
Naphthalene	49**	NA	NA
Nitrobenzene	490**	NA	NA
Pentachlorophenol	49**	NA	NA
Phenanthrene	1	NA	NA
Phenol	730**	NA	NA
Pyrene	7,300**	NA	NA
N-nitrosodi-n-propylamine	730**	NA	NA
N-nitrosodiphenylamine	0.13**	NA	NA
Acenaphthene	190**	NA	NA
Acenaphthylene	1,500**	NA	NA
Anthracene	1,500**	NA	NA
Benzo(a)anthracene (1 2-benzanthracene)	7,300**	NA	NA
Benzo(b)fluoranthene	1.3**	NA	NA
Benzo(k)fluoranthene	1.3**	NA	NA
Benzo(ghi)perylene	13**	NA	NA
Benzo(a)pyrene	730**	NA	NA

Parameter, Method, and Units	Maximum Contaminant Levels or Secondary Standards	Potential Health Effects from Ingestion of Water^	Sources of Contaminant in Drinking Water^
Benzyl Alcohol	0.2	Reproductive difficulties, increased risk of cancer	Leaching from linings of water storage tanks and distribution lines
Butyl benzyl phthalate	2,400**	NA	NA
Bis(2-chloroethoxy)methane	480**	NA	NA
Bis(2-chloroethyl)ether	0.83**	NA	NA
Bis(2-ethylhexyl)phthalate	0.83**	NA	NA
4-bromophenyl phenyl ether	6	NA	NA
4-chloroaniline	0.061**	NA	NA
2-chloronaphthalene	4.6**	NA	NA
4-chlorophenyl phenyl ether	2,000**	NA	NA
Chrysene	0.061**	NA	NA
Dibenz(a,h)anthracene	130**	NA	NA
Dibenzofuran	0.2**	NA	NA
3 3-dichlorobenzidine	98**	NA	NA
Diethyl phthalate	2**	NA	NA
Dimethyl phthalate	20,000**	NA	NA
Di-n-butyl phthalate	20,000**	NA	NA
Di-n-octyl phthalate	2,400**	NA	NA
2 4-dinitrotoluene	980**	NA	NA
2 6-dinitrotoluene	1.3**	NA	NA
Fluoranthene	1.3**	NA	NA
Fluorene	980**	NA	NA
Hexachlorobenzene	980**	NA	NA
Hexachlorobutadiene	1**	Liver or kidney problems, reproductive difficulties, increased risk of cancer	Discharge from metal refineries and agricultural chemical factories
Hexachlorocyclopentadiene	12**	NA	NA
Hexachloroethane	50	Kidney or stomach problems	Discharge from chemical factories
Indeno(1,2,3-cd)pyrene	24**	NA	NA

Parameter, Method, and Units	Maximum Contaminant Levels or Secondary Standards	Potential Health Effects from Ingestion of Water^	Sources of Contaminant in Drinking Water^
Isophorone	1.3**	NA	NA
VOCs SW-8260b (µg/L)	960**	NA	NA
1, 1, 1, 2-tetrachloroethane			
1, 1, 1-trichloroethane	35.0**	NA	NA
1, 1, 2, 2-tetrachloroethane	200	Liver, nervous system, or circulatory problems	Discharge from metal degreasing sites and other factories
1, 1, 2-trichloroethane	4.6**		
1, 1-dichloroethane	5	Liver, kidney, or immune system problems	Discharge from industrial chemical factories
1, 1-dichloropropene	4,900**	NA	NA
1, 1-dichloroethene (Vinylidene chloride)	9.1**	NA	NA
1- chlorohexane	7	NA	NA
1-octene	980**	NA	NA
1, 2, 3-trichlorobenzene	NE	NA	NA
1, 2, 3-trichloropropane	73**	NA	NA
1, 2, 4-trichlorobenzene	0.03**	NA	NA
1, 2, 4-trimethylbenzene	72**	NA	NA
1, 2-dibromo-3-chloropropane	1,200**	NA	NA
1, 2-dibromoethane (EDB)	0.2	Reproductive difficulties, increased risk of cancer	Runoff/leaching from soil fumigant used on soybeans, cotton, pineapples, and orchards
1, 2-dichlorobenzene	NE	NA	NA
1, 2-dichloroethane (EDC)	600**	NA	NA
1, 2-dichloropropane	5	Increased risk of cancer	Discharge from industrial chemical factories
1, 3, 5-trimethylbenzene	5	Increased risk of cancer	Discharge from industrial chemical factories
1,3- butadiene	1,200**	NA	NA
1, 3-dichlorobenzene	NE	NA	NA
1, 3-dichloropropane	730**	NA	NA
1, 4-dichlorobenzene	9.1**	NA	NA
1, 4-dioxane	75**	NA	NA

Parameter, Method, and Units	Maximum Contaminant Levels or Secondary Standards	Potential Health Effects from Ingestion of Water^	Sources of Contaminant in Drinking Water^
2, 2-dichloropropane	9.1**	NA	NA
2- chloro-1,3- butadiene	13	NA	NA
2-chlorotoluene	NE	NA	NA
2-hexanone	490**	NA	NA
2-nitropropane	120**	NA	NA
1,3,5- trichlorobenzene	3.4**	NA	NA
3- chloro-1- propene	73**	NA	NA
4-chlorotoluene	NE	NA	NA
4-isopropyltoluene	490**	NA	NA
4-methyl-2-pentanone (MIBK)	2,400**	NA	NA
Acetone	1,950**	NA	NA
Acetonitrile	22,000**	NA	NA
Benzene	780**	NA	NA
Benzyl chloride	5	Anemia, decrease in blood platelets, increased risk of cancer	Discharge from factories, leaching from gas storage tanks and landfills
Bromobenzene	5.4**	NA	NA
Bromochloromethane (chlorobromomethane)	200**	NA	NA
Bromodichloromethane	980**	NA	NA
Bromoform (Tribromomethane)	15**	NA	NA
Bromomethane (methyl bromide)	120**	NA	NA
Carbon disulfide	34**	NA	NA
Carbon tetrachloride	2,400**	NA	NA
Chlorobenzene	5	Liver problems, increased risk of cancer	Discharge from chemical plants and other industrial activities
Chloroethane (ethyl chloride)	100	Liver or kidney problems	Discharge from chemical and agricultural chemical factories
Chloroform	9,800**	NA	NA
Chloromethane (methyl chloride)	240**	NA	NA

Parameter, Method, and Units	Maximum Contaminant Levels or Secondary Standards	Potential Health Effects from Ingestion of Water^	Sources of Contaminant in Drinking Water^
Cis-1, 2-dichloroethene	70**	NA	NA
Cis-1, 3-dichloropropene	70	NA	NA
Cis-1,4- dichloro-2- butene	2.0**	NA	NA
Cyclohexane	NE	NA	NA
Cyclohexanone	120,000**	NA	NA
Dibromochloromethane	120,000**	NA	NA
Dibromomethane	11**	NA	NA
Dichlorodifluoromethane	NE	NA	NA
Ethylbenzene	4,900**	NA	NA
Ethyl acetate	700**	Liver or kidney problems	Discharge from petroleum refineries
Ethyl ether	22,000**	NA	NA
Ethylene oxide	4900**	NA	NA
Ethyl methacrylate	0.89**	NA	NA
Hexane	2,200**	NA	NA
Hexachlorobutadiene	1,500**	NA	NA
Iodomethane	12**	NA	NA
Isobutyl alcohol	34**	NA	NA
Isooctane	7,300**	NA	NA
Isopropylbenzene (cumene)	NE	NA	NA
Methacrylonitrile	700 / 2,400**	NA	NA
Methyl ethyl ketone (2-butanone)	2.4**	NA	NA
Methyl methacrylate	15,000**	NA	NA
Methylene chloride (dichloromethane)	34,000**	NA	NA
Naphthalene	5**	NA	NA
n-Butylbenzene	490**	NA	NA
n-Heptane	1,200**	NA	NA
n-Propylbenzene	1,500**	NA	NA
Pentachloroethane	980**	NA	NA

Parameter, Method, and Units	Maximum Contaminant Levels or Secondary Standards	Potential Health Effects from Ingestion of Water^	Sources of Contaminant in Drinking Water^
Propionitrile	10**	NA	NA
sec-Butylbenzene	9.8**	NA	NA
Styrene	980**	NA	NA
tert-Butylbenzene	100	NA	NA
Tert-butyl methyl ether (mtbe)	980**	NA	NA
Tetrachloroethene	240**	NA	NA
Toluene	5	NA	NA
Trans-1, 2-dichloroethene	1,000	Nervous system, kidney, or liver problems	Discharge from petroleum factories
Trans-1, 3-dichloropropene	100	NA	NA
Trans-1,4- dicloro-2-butene	9.1**	NA	NA
Trichloroethene	NE	NA	NA
Trichlorofluoromethane	5	NA	NA
Vinyl Acetate	7,300**	NA	NA
Vinyl chloride (chloroethene)	24,000**	NA	NA
m-p-xylene	2	Increased risk of cancer	Leaching from PVC pipes, discharge from plastic factories
o-xylene	10,000**	NA	NA
Xylenes, Total	10,000**	NA	NA
	10,000**	Nervous system damage	Discharge from petroleum factories, discharge from chemical factories
Total coliforms (including E. Coli MPN)			
1694 Pharmaceuticals (LCMS/MS)	0	Not a health threat in itself; it is used to indicate whether other potentially harmful bacteria may be present.	Coli forms are naturally present in the environment, as well as feces; fecal coli forms and E. coli only come from human and animal fecal waste.
1694 Pharmaceuticals (LCMS/MS)	NA	NA	NA
1694 Pharmaceuticals (LCMS/MS)	NA	NA	NA
1694 Pharmaceuticals (LCMS/MS)	NA	NA	NA

Parameter, Method, and Units	Maximum Contaminant Levels or Secondary Standards	Potential Health Effects from Ingestion of Water^	Sources of Contaminant in Drinking Water^
Turbidity	NA	NA	NA
	NA	**Turbidity is a measure of the cloudiness of water. It is used to indicate water quality and filtration effectiveness (e.g., whether disease-causing organisms are present). Higher turbidity levels are often associated with higher levels of disease-causing microorganisms such as viruses, parasites, and some bacteria. These organisms can cause symptoms such as nausea, cramps, diarrhea, and associated headaches.**	**Soil runoff**

Maximum contaminant level and secondary standards from 30 TAC 290 Subchapter F.
** Numerical value for risk reduction not an MCL, but provides a measure of desirable concentrations,from RG-346 (www.sos.state.tx.us).
^From EPA 816-F-02-013 July 2002.

APPENDIX F—Stormwater-Sampling Detail

Stormwater-Sampling Program for Comal and San Marcos Springs in Support of the Edwards Aquifer Habitat Conservation Plan

PURPOSE

The purpose of this technical procedure is to describe the methodology for collecting grab samples from stormwater runoff in surface waters at Comal and San Marcos springs. Sample frequency is twice annually, with samples collected across three points on the hydrograph. The EAA samples storm waters at Comal Springs at the following five locations (see Appendix A for map):

1. Upper Springs (near Blieders Creek),
2. New Channel—(below confluence with Dry Comal Creek),
3. Upper Old Channel—(at Elizabeth Street),
4. Lower Old Channel—(above Hinman Island), and
5. Comal River—(above confluence with Guadalupe River).

The EAA samples stormwaters at San Marcos Springs at the following seven locations (see Appendix A for map):

1. Sink Creek, upstream of Spring Lake,
2. Sessoms Creek,
3. Dog Beach Outflow,
4. Hopkins Street Outflow,
5. Purgatory Creek (above San Marcos River),
6. I-35 Reach, and
7. Willow Creek (above San Marcos River).

SCOPE

This procedure applies to all EAA personnel and subcontractors who sample storm water.

DEFINITIONS

1. Stormwater runoff as stated by the US EPA, "is generated when precipitation from rain and snowmelt events flows over land or impervious surfaces and does not percolate into the ground" (US EPA Stormwater Program, epa.gov).
2. Rivers are sources of water that flow on top of the ground in volume.
3. Sample intervals (for the EAHCP stormwater sampling program) are defined as:
    a. Initial rise, or rising limb of the hydrograph;
    b. Peak area of hydrograph; and
    c. Recession limb of the hydrograph.

GENERAL

Weather permitting, EAA will sample two stormwater events per year to evaluate stormwater quality from urban landscapes that discharge to Comal and San Marcos springs.

STORM-EVENT SELECTION CRITERIA

According to the *Water Quality Monitoring Program Strategy for Comal Springs and San Marcos Springs in Support of the Edwards Aquifer Habitat Conservation Plan*, (EAHCP Workplan "a storm water sampling event will be triggered when a local rainfall event causes a significant increase in spring flow at the historic Comal Springs gauging station and the San Marcos Springs gauging station." Furthermore, data collected from real-time instrumentation for surface water quality will be used to further refine the type of stormwater event(s) to be sampled. Real-time data are collected for the following parameters at 15-minute intervals from the stations shown on Comal and San Marcos springs EAHCP maps (Appendix A):

- Conductivity,
- DO,
- pH,
- Temperature, and
- Turbidity.

EAA field staff will monitor incoming storms by radar to determine whether the storm will produce one-half inch or more of localized precipitation and determine whether the storm is safe for stormwater sampling. Because of the nature of storms, stormwater sampling may be canceled as a result of false starts, safety issues, or if a new storm interrupts the stormwater sampling. Aquifer Science Management will make the final determination regarding go/no go for stormwater sampling.

Minimum Antecedent Dry Period Requirements

The following is a guideline to determine whether watersheds have returned to "normal" flow conditions. Each watershed will be evaluated separately because one watershed may return to "normal" flow conditions faster and technically be ready for another stormwater sampling event before another watershed, as noted below:

- One day wait if the previous rain event was limited to light rain/drizzle, producing only a surface wetting and no runoff
- Three days wait if the previous rain event did not produce enough rainfall to result in a measurable increase in discharge at the sample location(s)

- Minimum of five days wait if preceded by a rainfall of at least one-half inch at a sample location. The antecedent dry period may be longer if the sample location(s) are still being impacted by runoff from a previous rain event (SARA, 2013).

Canceling a Stormwater-Sampling Event

- A stormwater-sampling event may be canceled because of excessive lightning, hail, high winds, or flooding. If a storm does become severe during a stormwater-sampling event, the event will be postponed, cancelled, or suspended under some circumstances.
- A stormwater sampling event may be suspended because of a new rain event. For example, if samples are collected during the 10% of baseline flow conditions and another storm event interrupts this sampling event, then sampling will be suspended. The second storm will represent a new stormwater event.

RESPONSIBILITIES

CTO and Hydrogeologist Supervisor—Aquifer Science

The CTO and hydrogeologist supervisor—aquifer science will determine which parameters need to be sampled and will ensure that the samples obtained represent the environment being investigated. Sampling parameters are listed in the EAHCP workplan.

Hydrologic Data Coordinator

The hydrologic data coordinator will schedule sampling events and ensure that all field crews are provided with the information and equipment necessary to successfully complete scheduled sampling (i.e., location ID and selected analyses). Furthermore, the coordinator will organize and interface with local entities as needed to ensure that all notifications are in place for each river/spring complex as needed.

Environmental Science Technicians

Environmental science technicians will generally be responsible for collection of samples. Other individuals may also be asked to participate in sample-collection activities. However, each sample team of two people will have a lead sampler who reports back to the hydrogeologist supervisor—aquifer science. Reports will include

problems and issues in the field, inability to sample because of unforeseen or changing circumstances, and any deviations from the sample-collection plan and protocols.

PROCEDURE

Supplies and Equipment

Major Equipment Items

- Sample dipper
- Peristaltic pump with inert sample tubing
- 500- or 1,000-mL Teflon™ beakers affixed to telescoping rods
- Two gallon buckets for field-parameter readings

Equipment Support Items

- Trash bags
- Gloves (nitrile)
- Kim wipes/towels
- Rope
- Garden wagon

Sampling Supplies

- Sample bottles
- COC forms
- Sample labels
- Bailer (for filtration)
- 0.45-micron filter
- Ice chest
- Ice for sample preservation
- Ziplock bags
- Field sheet
- Pen and waterproof permanent marker

Monitoring Equipment

- pH and temperature meter
- Specific conductance meter
- Dissolved-oxygen meter
- Turbidity meter

Health and Safety Items

- First-aid kit and emergency eye-wash kit
- Fire extinguisher
- Mobile phone
- Helmet with head lamp
- Hand sanitizer
- Mud boots
- Raincoat
- Life vests with reflective markings
- Throw rope
- Computer access to real-time flow, water quality, and weather data

Field Equipment Decontamination

Proper decontamination between sites is essential to the avoidance of introducing contaminants from the sampling equipment. Before sampling, all hoses, buckets, water quality probes, and other sampling equipment should be decontaminated at EAA before fieldwork. Procedures specified in the EAA's *Field Sampling Plan* should be followed for decontamination of field equipment.

Instrument Usage and Measurement of Water Quality Parameters

Before going into the field, the environmental science technician should verify that all field instruments are operating properly. Calibration will be done on pH, specific conductivity, dissolved oxygen, and turbidity meters, and calibration information should be recorded in the calibration log book.

Purging

No purging is required for stormwater runoff to be sampled in the Comal and San Marcos rivers.

Sample Collection

According to the EAHCP work plan, "three water quality samples will be collected from each surface water sampling location during the sampling event. Sample times will be spaced to reflect changes in the stream hydrograph." The first sample will be during the initial rise in the hydrograph. The second sample will be collected near the peak of flow. The final sample will be collected along the recession limb of the storm hydrograph. In some circumstances, additional samples may be collected during the storm event such

that sample groups may be subsequently compared to hydrograph data and the most representative samples groups sent for analyses. Following is the sampling procedure:

At EAA Offices

- EAA field staff will monitor local weather forecasts and Doppler radars to determine whether an incoming storm meets the criteria for a stormwater sampling event.
- If the incoming storm DOES NOT meet the criteria, no action will be taken.
- If the incoming storm DOES meet the criteria, EAA field staff will monitor weather conditions, estimate a time of arrival of the incoming storm, and determine whether weather conditions are safe for stormwater sampling (CTO or hydrogeologist supervisor will make the final go/no go decision).
- EAA field staff will notify the contracted laboratories for the possibility of samples.
- Labels for the sample bottles will be filled out.
- Aquifer Science CTO or Hydrogeologist supervisor will make the final determination regarding go/no-go with regard to the storm event.

In the Field

- Field personnel must wear clean (disposable) nitrile gloves during the sample-collection process.
- Sample water will be collected in a two-gallon bucket for parameter readings, and sample water will be collected in a 500- or 1000-mL Teflon™ beaker attached to telescoping rods, or, if needed, a peristaltic pump with inert tubing will be used.
- Meter(s) will be inserted into a two-gallon bucket and measurements recorded on a field sheet, or, if a peristaltic pump is being used, a flow chamber will be used.
- Samples will be collected using beakers or a peristaltic pump.
    - Herbicides and pesticides
    - General water quality parameters
    - Selected metals
    - Turbidity
    - Bacteria (E-coli most probable number)
    - Total phosphorous
    - Total organic carbon
    - Dissolved organic carbon
    - Total kjeldahl nitrogen
    - All containers will be filled almost full, except for alkalinity and VOCs
    - Alkalinity

        - A bailer attached with a filter will be used or a filter will be attached onto tubing from the peristaltic pump
        - Alkalinity must have no head space.
    - Selected metals
        - A bailer attached with a filter will be used or a filter will be attached onto tubing from the peristaltic pump
    - VOC
        - The VOC sample vial will be completely filled so that the water forms a convex meniscus at the top and then capped so that no air space exists in the vial. The vial must be turned over and tapped to check for bubbles in the vial, which indicate trapped air. If bubbles are observed, the vial should be discarded and another sample collected.
    - Any required information will be recorded on the field sheet before, during, and after sampling. Parameter readings will be measured in a two-gallon bucket and recorded on field sheets.
- Preservatives (if any) will be placed in the bottles by EAA-contracted laboratories.
- After the samples have been collected, they will be immediately placed in an ice-filled cooler.
- Prior to departure from the field, field documentation, including the COC form, will be completed, and all EAA field employees will clean their hands with hand sanitizer.
- Field notebooks will be used to record basic information for each event, such as magnitude of storm, issues related to sample collection, weather conditions, time of day samples were collected, and other information deemed pertinent by the lead sampler and/or coordinator.

The second sample will be collected near the peak of flow and will follow the same procedure as that of the initial rise on the hydrograph sample. The third sample will be collected along the recession limb of the hydrograph and will follow the same procedure as that of the other two sampling events. Again, the possibility exists that additional sample may be collected during the event with the most representative three sample groups being submitted for analyses (based on comparison with the appropriate stream hydrograph).

Contracted Laboratories

EAA field staff will drop off samples at EAA-contracted laboratories or have samples picked up at the EAA offices. Samples will be analyzed within proper holding times.

Equipment Blanks

Equipment blanks consist of ASTM II, reagent-grade water poured over/through any sampling equipment used for collection of definitive samples. Most sample-collection equipment is disposable; however, in some cases, an equipment blank may be required. Equipment blanks are used to assess the effectiveness of decontamination procedures (for new materials provided to the EAA or from EAA's decontamination processes) and are designated as *EB* on the COC. The frequency of collection of equipment blanks will depend on the sampling routine and sampling equipment in use. Collection of equipment blanks will be designated prior to sample-collection events.

Trip Blanks

Trip blanks are used to assess potential volatile organic contamination during sample custody in the field and shipment to the receiving laboratory. Trip blanks are submitted with characteristic samples to the laboratory to verify that volatile organic contamination has not occurred from outside influences during sample handling to transport (such as absorption through the septa.)

Trip blanks consist of two 40-mL vials filled with ASTM Type II reagent-grade water prepared by the contracted laboratory. Trip blanks will remain unopened until they are received at the contracted laboratory.

Sample Identification, Handling, and Documentation

Samples will be identified, handled, and recorded as described in the preceding sections of this document.

Records

Field sheets and COCs will be kept in a bound field log book. The following will be recorded using waterproof ink on these sheets and in the field notebook:

- Names of sampling personnel
- Weather conditions
- Project name
- Date and time of sampling
- Analyses to be performed by EAA-contracted laboratory
- Equipment-calibration information
- Field-parameter measurements
- Irregularities, problems, or delays

APPENDIX G—Equipment-Decontamination Procedures

Decontamination

Proper decontamination of all equipment used in the sample-collection process is essential to obtaining quality, representative samples. Improperly decontaminated equipment is capable of causing cross-contamination between sample sites, resulting in samples that are not representative of in situ site conditions. The objective of this appendix is to provide a set of decontamination procedures applicable to various EAA equipment and sampling programs.

Whereas many different protocols exist for decontamination, ASTM Standard D 5088 is perhaps the most commonly referenced protocol. The methods outlined here are tailored to EAA sampling environments and programs.

Basic Decontamination Procedure—Groundwater, Surface Water, and Spring Sampling Equipment

When possible, equipment that comes into contact with sample media will be single-use (disposable) equipment or dedicated equipment. Having such equipment helps reduce the possibility of cross-contamination of samples. However, for many sample types, such dedicated equipment may not be possible. As such, a listing of equipment that may be used to collect a water sample (groundwater, surface water, or spring) would include

- Grundfos submersible pump and associated pump tubing
- Peristaltic pump tubing
- Sample dippers
- Surface water churn

Other equipment that *may* come into direct contact with sample media of concern includes

- Water level measurement devices (steel tape and e-lines)
- Field-parameter probes
- Downhole geophysical equipment

Equipment that will have direct contact with any sample media will be decontaminated prior to use for sample collection or prior to introduction into the well, surface water site, or spring vent, as applicable.

Grundfos Submersible Pumps

Decontamination will be accomplished as follows for submersible well pumps. Sampler will wear new, disposable, nitrile (or equivalent) gloves to perform the decontamination.

Materials needed:

- Submersible pump, pump controller, and pump tubing
- 33-gallon trashcan (dedicated for decon use only)
- Alconox® or laboratory-grade soap
- DI water
- Large plastic bags or foil
- Plastic sheeting
- Clean scrub brush(es)

The designated trashcan will be rinsed with fresh, potable water and subsequently filled with potable water and laboratory-grade soap (per soap label directions).

When the container is approximately 80% full, the pump will be lowered, with heat shield attached, into the trashcan. The pump should be suspended at least six inches off the bottom of the trashcan. The pump will then be activated and allowed to discharge outside of the trashcan for at least 30 seconds. After the initial discharge, pump tubing will be directed into the trashcan such that the decontamination mixture is recirculated through the pump and tubing. The pump should run/recirculate a minimum of ten pump-tubing volumes (about 40 gallons) through the system. This process should take about 15 to 20 minutes.

Note: in the event that the pump or tubing has sediment or other foreign matter on it, a step will be added. A clean scrub brush will be used to remove any sediment or other foreign matter from the equipment manually prior to the circulation process.

Next, the decontamination mixture will be allowed to pump out of the trashcan into the sink (the pump should not be allowed to run dry or cavitate). The pump and tubing will be placed on a clean surface (plastic sheet) and the trashcan rinsed in clean water. The pump will be rinsed and placed back into the trashcan. The pump is to be allowed to discharge outside of the trashcan until the soapy water is evacuated from the tubing. The discharge tubing will then be placed back into the trashcan and more clean water added if needed. The freshwater will be recirculated through the pump and into the trashcan for a minimum of ten volumes (about 40 gallons). Once circulation is complete, the pump will be allowed to discharge outside the trashcan until nearly empty (again, the pump should not be allowed to run dry or cavitate). Next, a final rinse of DI water will be provided on the pump and tubing, an adequate volume being used to ensure that the pump and tubing are well rinsed.

Upon completion of the decontamination procedure, the pump will be sealed in a clean plastic bag, and the end of the pump tubing will be sealed in its own clean plastic bag. A

rubber band can be used to affix the bags around the apparatus. Pump and hose assembly are to be stored indoors when not in use, away from any sources of cross-contamination.

Tubing Decontamination for Peristaltic Pumps:
Decontamination should be accomplished as follows for peristaltic pump tubing. Sampler will wear new, disposable, nitrile (or equivalent) gloves to perform the decontamination.

Materials needed:

- Four five- or seven-gallon plastic buckets (for decon use only)
- Alconox® or laboratory-grade soap
- DI water
- Large plastic bags that can be sealed (large zip-top bags)
- Plastic sheeting
- Clean scrub brush(s)

The designated buckets will be rinsed in fresh, potable water. The first bucket will be subsequently filled with potable water and laboratory-grade soap (per soap label directions). The next two buckets will be filled with clean tap water. All three decontamination buckets are to be placed on top of a clean sheet of plastic sufficiently long to provide a clean surface on which all decontamination can take place. Decon buckets are to be placed in order on the sheet, with the soap bucket first, followed by the two rinse buckets. Decontamination should proceed such that each step is always followed in order from most contaminated to least contaminated (i.e., from prewash if needed, to soap–water mixture, to first rinse bucket, to second rinse bucket, to final DI water rinse).

Any excess foreign material will be removed from the tubing, first by wiping or scrubbing with soap and water mixture (if needed). The suction side of the tubing will be lowered into the soap–water bucket. The pump will be activated and allowed to discharge outside of the bucket until the soap–water mixture has initially purged the tubing. After the initial discharge, the pump tubing will be directed into the bucket such that the decontamination mixture is recirculated through the tubing. The pump will be allowed to run a minimum of ten pump-tubing volumes through the system (or about eight to ten gallons).

Next, the suction end of the tubing will be placed into the first rinse bucket and the pump allowed to discharge into the soap bucket until the soapy water is evacuated from the tubing. The discharge side of the tubing will then be placed back into the first rinse bucket. The freshwater will be allowed to recirculate through the pump and into the first rinse bucket for a minimum of ten volumes (or about eight to ten gallons). Once circulation is complete, the process will be repeated using the second rinse bucket. Final rinse is to be accomplished by pumping/recirculating DI water through the tubing for a minimum of ten volumes, using the third rinse bucket filled with DI water. Next, a final

rinse of DI water will be provided on the outside of the tubing using an adequate volume to ensure that the tubing is well rinsed. This final rinse will complete the decontamination process.

Upon completion of the decontamination procedure, the tubing will be allowed to dry and the tubing seal placed in a plastic bag to prevent exposure to cross-contamination. Bagged tubing is to be stored indoors when not in use away from any sources of cross-contamination.

Note: peristaltic tubing for EAHCP samples is dedicated tubing and is to be stored in *labeled* bags. The bag label will have the name of the sample point written on the outside of it. EAHCP-related tubing is not to be used for any other applications.

Decontamination of Other Equipment Used in Collection of Water or Soil Samples
Decontamination will be accomplished as follows for other equipment that will come into direct contact with sample media (dippers, churns, sample probes—if placed into sample media, water level measurement devices, soil sampling devices, or trowels). Sampler will wear new, disposable, nitrile (or equivalent) gloves to perform the decontamination.

Materials needed:

- Sample-collection device (dipper, churn, etc.) or field meter (applies only to that part of the probe exposed to sample media) or water level measurement device
- Three five- or seven-gallon plastic buckets (for decon use only)
- Alconox® or laboratory-grade soap
- DI water
- Large plastic bags or foil
- Plastic sheeting
- Clean scrub brush

Designated buckets will be rinsed in fresh, potable water. The first bucket will be subsequently filled with potable water and laboratory-grade soap (per soap label directions). The remaining two buckets will be filled with clean tap water. All three decontamination buckets are to be placed on top of a clean sheet of plastic sufficiently long to provide a clean surface on which all decontamination will take place. Decon buckets are to be placed in order on the sheet, with the soap bucket first, followed by the two rinse buckets. Decontamination will proceed such that each step is always followed in order from most contaminated to least contaminated (i.e., from prewash if needed, to soap–water mixture, to first rinse bucket, to second rinse bucket, to final DI water rinse).

Any excess sediment or foreign matter will be removed from the device by gentle scrubbing and rinsing with water prior to placement into the soap–water mixture. The

sampling device will be placed into the soap–water mixture and gently scrubbed (all surfaces that will come into contact with sample media must be cleaned).

Note: the surface water churn may not fit in the bucket(s), as such the churn may be cleaned in the 33-gallon trashcan, or it may be cleaned by some of the soap–water mixture being poured into the churn. The churn will be cleaned with the soap–water mixture; double rinsed in clean, potable water; and provided a final rinse in DI water.

Upon completion of the soap–water wash, each device being decontaminated must be double rinsed (i.e., buckets two and three) in clean, potable water, followed by a final rinse in DI water. Upon completion of decontamination, equipment will be allowed to dry and stored such that it is not exposed to potential contaminants. Equipment should be stored in plastic bags or wrapped in foil to further insulate it from potential contamination.

Note: decontamination buckets are to be monitored when used for multiple items to ensure that the soap–water mixture does not become spent or ineffective. They are to be replaced as needed. Also, rinse water should be replaced regularly when it appears to have a significant accumulation of soap.

Special Decontamination Procedures
Downhole or soil-sampling equipment may be decontaminated generally by one of the applicable processes outlined above. However, in rare cases, a tool or device that is not disposable may be exposed to hydrocarbon residue or, in rarer cases, high concentrations of heavy metals may occur. In such a scenario, the tool may (at the discretion of management) require a more elaborate decontamination procedure.

Exposure to Hydrocarbons
In the event that a tool is exposed to free-product hydrocarbons, an additional step in the decontamination process may be required that will involve spraying the tool with pesticide-grade methanol or hexane prior to the final DI water rinse. Use of solvents in this case serves to remove any hydrocarbon residual from the tool.

Exposure to Heavy Metals
In the event that a tool or device is exposed to heavy metals, and the sample media are being analyzed for these same metals, another step in the decontamination process may be required. In this case, the tool may require a spray rinse with dilute (10%) hydrochloric or nitric acid prior to DI water rinse. Use of acid in this situation will act to remove residual metals from the tool.

Note: use of solvents or acids is only to be pursued if directed by management. Use of these products can be hazardous and can also present issues regarding disposal of the waste products themselves. Use of the products may also damage sampling equipment in

some cases. In the vast majority of cases, the standard washing and rinsing procedures described herein are adequate for proper decontamination of sampling equipment. Analysis of equipment blanks will be pursued when needed so that the decontamination process might be assessed. It is the responsibility of the sampler to notify management if a tool is suspected of any unusual exposure