SAMPLING AND ANALYSIS PLAN
for
Quarterly Groundwater Monitoring

Prepared for:

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ACRONYMS AND ABBREVIATIONS

AFCEE	Air Force Center for Environmental Excellence
AOC	Area of Concern
BSR	Boerne Stage Road
C	Celsius
chERP	CSSA-customized hybrid environnemental restoration program
CLIN	Contract line item number
CS	Camp Stanley
CSSA	Camp Stanley Storage Activity
DQO	data quality objective
EP	entry point
F	Fahrenheit
FO	Fair Oaks Ranch
GAC	granular activated carbon
HS	Hidden Springs
IDW	investigation-derived waste
JW	Jackson Woods
L/min	liters per minute
LS	Leon Springs Villa
LTMO	long-term monitoring optimization
MS	matrix spike
MSD	matrix spike duplicate
O&M	operations & maintenance
OFR	Old Fredericksburg Road
OW	Oaks Water
PVC	poly vinyl chloride
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RFR	Ralph Fair Road
SAP	Sampling and Analysis Plan
SAWS	San Antonio Water System

ACRONYMS AND ABBREVIATIONS *(continued)*

SLD	Scenic Loop Drive
SWMU	Solid Waste Management Unit
TCEQ	Texas Commission on Environmental Quality
TO2	Task Order 2
USEPA	U.S. Environmental Protection Agency
UV	Ultraviolet
VOCs	volatile organic compounds

1.0 INTRODUCTION

This document is an amendment to the existing Sampling and Analysis Plan (SAP) for quarterly groundwater monitoring **(Volume 1-4: Sampling and Analysis Plan and Quality Assurance Project Plan)** in the Camp Stanley Storage Activity (CSSA) Environmental Encyclopedia. The purpose of this addendum is to identify and address specific sampling and analysis plan items for the Task Order 2 (TO2) field activities and confirm that the activities will be conducted as set out in the original SAP or subsequent addenda.

This addendum to the SAP is prepared in accordance with applicable state regulations. The guidance for sampling techniques was adapted from the Air Force Center for Environmental Excellence (AFCEE) Model Field Sampling Plan. Input and recommendations from the United States Environmental Protection Agency (USEPA), Region 6 and the Texas Commission on Environmental Quality (TCEQ) were also considered and incorporated into the planning documents.

The scope of work for quarterly groundwater monitoring (contract line item number [CLIN] 301 for contract option year 1) under TO2 includes the following:

1. Perform four rounds of groundwater monitoring from selected off-post wells. The estimated number of off-post wells to be sampled is 56, 17, 10, and 63 respectively per quarter in December 2012, March 2013, June 2013, and September 2013. These sample counts do not include quality assurance/quality control (QA/QC) samples.
2. Installation of an additional granular activated carbon (GAC) treatment system, if necessary.
3. Perform operation and maintenance (O&M) at the six (including the new GAC) off-post GAC systems every 3 weeks. Perform two semi-annual carbon exchanges at the existing off-post GAC systems.
4. Perform four rounds of groundwater monitoring from selected on-post wells.
5. Perform three rounds of long-term monitoring optimization (LTMO)-selected zone sampling and 4 rounds of profiling at the four Westbay®-equipped wells (CS-WB01, CS-WB02, CS-WB03, and CS-WB04) located both on- and off-post. The Westbay-equipped wells located at solid waste management unit (SWMU) B-3 (CS-WB05, CS-WB06, CS-WB07, and CS-WB08) are sampled under a separate CLIN and are not covered in this sampling plan.

2.0 GROUNDWATER WELL SAMPLING

On-post wells will be sampled according to the recommendations presented in the TCEQ and USEPA-approved **Three-Tiered Long-Term Monitoring Network Optimization Evaluation (Parsons, 2010)** for drinking water, monitoring or agricultural/livestock wells and the **Data Quality Objectives (DQOs) for the Groundwater Monitoring Program (Parsons, 2009)**. Additionally, off-post private and public drinking water wells will be sampled in accordance with the DQOs.

Table 1 indicates the current number of wells to be sampled and the analytical parameters. **Table 2** indicates the tentative list of wells expected to be sampled on-post based on the approved 2010 LTMO sampling frequency. This table is subject to change depending on rainfall, water table elevation at the time of sampling, well accessibility, and right-of-entry agreements. **Table 3** provides the list of analytes.

Sampling of the wells will be based on AFCEE Handbook procedures with exceptions as appropriate for the hydrogeology at the site. The wells will be purged in accordance with low-flow sampling techniques. QA/QC sampling and analysis will be performed to meet requirements in the CSSA Quality Assurance Project Plan (QAPP). Purged water will be containerized and transported to the SWMU B-3 bioreactor trenches.

Table 1 Estimated Sample Quantities and Analytical Parameters

		Analyses & Method						
		Volatile organic compounds (VOCs)	**Metals**	**Drinking Water Well Metals**	**Trip Blank (per cooler)**	**Matrix Spike (MS) (5%)**	**Matrix Spike Duplicate (MSD) (5%)**	**Field Duplicates (10%)**
Well Type/Total No. Wells		**8260**	**6010**	**6010**	**8260**	**8260**	**8260**	**8260**
December 2012								
Total Wells	112	**8260**	**6010**	**6010**	**8260**	**8260**	**8260**	**8260**
CSSA Wells		48	45	3	4	2	2	5
Westbay Intervals		8	0	0	0	0	0	0
Off-Post Supply Wells		56	0	0	3	3	3	6
March 2013								
Total Wells	22	**8260**	**6010**	**6010**	**8260**	**8260**	**8260**	**8260**
CSSA Wells		5	2	3	1	1	1	1
Westbay Intervals		0	0	0	0	0	0	0
Off-Post Supply Wells		17	0	0	2	1	1	2
June 2013								
Total Wells	61	**8260**	**6010**	**6010**	**8260**	**8260**	**8260**	**8260**
CSSA Wells		14	11	3	2	1	1	1
Westbay Intervals		37	0	0	0	0	0	0
Off-Post Supply Wells		10	0	0	1	1	1	1
September 2013								
Total Wells	105	**8260**	**6010**	**6010**	**8260**	**8260**	**8260**	**8260**
CSSA Wells		34	31	3	3	2	2	2
Westbay Intervals		8	0	0	0	0	0	0
Off-Post Supply Wells		63	0	0	3	3	3	6

Table 2
On-Post Well to be Sampled

Count	Well ID	*Analytes*	*Last Sample Date*	*Dec-12 (snapshot)*	*Mar-13*	*Jun-13*	*Sep-13 (snapshot)*	*Sampling Frequency **
1	CS-MW1-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Sep-12	S	NS	S	S	Semi-annual + 9 month snapshot
2	CS-MW1-BS	VOCs & metals (Cr, Cd, Hg, Pb)	Jun-11	S	NS	NS	NS	Every 18 months
3	CS-MW1-CC	VOCs & metals (Cr, Cd, Hg, Pb)	Jun-11	S	NS	NS	NS	Every 18 months
4	CS-MW2-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Sep-12	S	NS	S	S	Semi-annual + 9 month snapshot
5	CS-MW2-CC	VOCs & metals (Cr, Cd, Hg, Pb)	Jun-11	S	NS	NS	NS	Every 18 months
6	CS-MW3-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Mar-12	S	NS	NS	S	Every 9 months
7	CS-MW4-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Mar-12	S	NS	NS	S	Every 9 months
8	CS-MW5-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Mar-12	S	NS	NS	S	Every 9 months
9	CS-MW6-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Mar-12	S	NS	NS	S	Every 9 months
10	CS-MW6-BS	VOCs & metals (Cr, Cd, Hg, Pb)	Jun-11	S	NS	NS	NS	Every 18 months
11	CS-MW6-CC	VOCs & metals (Cr, Cd, Hg, Pb)	Sep-10	S	NS	NS	NS	Every 18 months
12	CS-MW7-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Mar-12	S	NS	NS	S	Every 9 months
13	CS-MW7-CC	VOCs & metals (Cr, Cd, Hg, Pb)	Sep-10	S	NS	NS	NS	Every 18 months
14	CS-MW8-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Sep-12	S	NS	S	S	Semi-annual + 9 month snapshot
15	CS-MW8-CC	VOCs & metals (Cr, Cd, Hg, Pb)	Jun-11	S	NS	NS	NS	Every 18 months
16	CS-MW9-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Jun-11	S	NS	NS	NS	Every 18 months
17	CS-MW9-BS	VOCs & metals (Cr, Cd, Hg, Pb)	Sep-12	S	NS	NS	S	Every 9 months
18	CS-MW9-CC	VOCs & metals (Cr, Cd, Hg, Pb)	Mar-12	S	NS	NS	S	Every 9 months
19	CS-MW10-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Mar-12	S	NS	S	S	Semi-annual + 9 month snapshot
20	CS-MW10-CC	VOCs & metals (Cr, Cd, Hg, Pb)	Sep-10	S	NS	NS	NS	Every 18 months
21	CS-MW11A-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Sep-12	S	NS	S	S	Semi-annual + 9 month snapshot
22	CS-MW11B-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Sep-10	S	NS	NS	S	Every 9 months
23	CS-MW12-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Mar-12	S	NS	NS	S	Every 9 months
24	CS-MW12-BS	VOCs & metals (Cr, Cd, Hg, Pb)	Jun-11	S	NS	NS	NS	Every 18 months
25	CS-MW12-CC	VOCs & metals (Cr, Cd, Hg, Pb)	Sep-10	S	NS	NS	NS	Every 18 months
26	CS-MW16-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Mar-12	S	NS	NS	S	Every 9 months
27	CS-MW16-CC	VOCs & metals (Cr, Cd, Hg, Pb)	Mar-12	S	NS	NS	S	Every 9 months
28	CW-MW17-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Mar-12	S	NS	NS	S	Every 9 months
29	CS-MW18-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Mar-12	S	NS	NS	S	Every 9 months
30	CS-MW19-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Mar-12	S	NS	NS	S	Every 9 months
31	CS-1	VOCs & metals (As,Ba,Cr,Cu,Cd,Hg,Pb,Zn)	Sep-12	S	S	S	S	Quarterly
32	CS-2	VOCs & metals (Cr, Cd, Hg, Pb)	Mar-12	S	NS	NS	S	Every 9 months
33	CS-4	VOCs & metals (Cr, Cd, Hg, Pb)	Mar-12	S	NS	S	S	Semi-annual + 9 month snapshot
34	CS-9	VOCs & metals (Cr, Cd, Hg, Pb)	Sep-12	S	S	S	S	Quarterly
35	CS-10	VOCs & metals (As,Ba,Cr,Cu,Cd,Hg,Pb,Zn)	Sep-12	S	S	S	S	Quarterly
36	CS-12	VOCs & metals (As,Ba,Cr,Cu,Cd,Hg,Pb,Zn)	Sep-12	S	S	S	S	Quarterly
37	CS-D	VOCs & metals (Cr, Cd, Hg, Pb)	Mar-12	S	NS	S	S	Semi-annual + 9 month snapshot
38	CS-MWG-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Jun-11	S	NS	NS	NS	Every 18 months
39	CS-MWH-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Jun-11	S	NS	NS	NS	Every 18 months
40	CS-I	VOCs & metals (Cr, Cd, Hg, Pb)	Jun-11	S	NS	NS	NS	Every 18 months
41	CS-MW20-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Mar-12	S	NS	NS	S	Every 9 months
42	CS-MW21-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Mar-12	S	NS	NS	S	Every 9 months
43	CS-MW22-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Mar-12	S	NS	NS	S	Every 9 months
44	CS-MW23-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Mar-12	S	NS	NS	S	Every 9 months
45	CS-MW24-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Sep-12	S	NS	S	S	Semi-annual + 9 month snapshot
46	CS-MW25-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Mar-12	S	NS	NS	S	Every 9 months
47	CS-MW35-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Sep-12	S	NS	NS	S	Semi-annual + 9 month snapshot
48	CS-MW36-LGR	VOCs & metals (Cr, Cd, Hg, Pb)	Sep-12	S	S	S	S	Quarterly

* New LTMO sampling frequency implemented June 2011

S = Sample

NS = No Sample

Table 3 Analytes to be Sampled

On-post Analytes		
VOCs	**Metals**	
1,1 – dichlorethene *cis* – 1,2 – dichloroethene *trans* – 1,2 – dichloroethene tetrachloroethene trichloroethene vinyl chloride	*Monitoring wells:* cadimum chromium mercury lead	*Additional metals for drinking water wells:* arsenic barium copper zinc
Off-post Analytes		
VOCs		
1,1 – dichlorethene *cis* – 1,2 – dichloroethene *trans* – 1,2 – dichloroethene tetrachloroethene trichloroethene vinyl chloride		

2.1 WATER LEVEL MEASUREMENTS

Water level measurements will be obtained from on-post monitoring, agricultural and drinking water wells that provide good access for an electric measuring device. The depth to water will be measured to the nearest 0.01-foot with respect to the surveyed reference point on the top of the casing. If no clear reference point exists, the reading will be obtained from the north side of the well casing as a reference point. Drinking water wells are equipped with gauging tubes for obtaining water levels.

Some on-post wells contain transducers and two weather stations have been installed. The weather stations are located in the SWMU B-3 Bioreactor just inside of the northern fenceline of the inner cantonment, and the other is located at AOC-65 near the southeast corner of the inner cantonment, west of Building 90. Data from all well transducers and weather stations will be downloaded as part of each quarterly event for creation of potentiometric surface maps.

Pressure measurements from each zone of the southern Westbay® Wells will be recorded quarterly. These pressure readings are then converted to water level elevations and can be used in the creation of the potentiometric surface maps. Screening level data is collected quarterly from LTMO selected zones in the 4 southern Westbay® Wells. The 4 northern Westbay® Wells are not sampled as part of this monitoring but are sampled as part of the SWMU B-3 bioreactor monitoring.

2.2 GROUNDWATER SAMPLING METHODS

In general, the overall goal of any groundwater sampling program is to collect representative water samples with little or no alteration in water chemistry caused by the collection process. Analytical data obtained in this manner may be used for a variety of purposes depending on regulatory requirements. CSSA uses low-flow sampling equipment for all the installation's monitoring wells, while drinking water and livestock wells are equipped with either high capacity or solar-powered downhole pumps. Other wells include low-yielding perched aquifer

wells (AOC-65), Westbay® multi-port equipped wells, on- and off-post public drinking water wells, and off-post domestic drinking water wells. There are five types of well sampling that will be routinely carried out over the course of this task order. Each type of well and the appropriate sampling technique is discussed below:

2.2.1 On-post Wells with Dedicated Low-Flow Bladder Pumps

A goal of the CSSA groundwater monitoring program is collection of data that is most representative of conditions at the site. It is generally accepted that static water in the well casing is not representative of the formation water and needs to be purged prior to collection of groundwater samples. However, water in the screened interval may indeed be representative of the formation, depending on well construction and site hydrogeology. CSSA uses a low-flow sampling strategy in many of the on-post monitoring wells. The use of low-flow purging and sampling techniques mitigates sampling-induced turbidity problems. The following discussion and procedures are excerpted from the USEPA guidance entitled *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures* (USEPA, 1995).

Low-flow refers to the velocity with which water enters the pump intake and that is imparted to the formation pore water in the immediate vicinity of the well screen. Flow is minimized to preclude the entertainment of sediment in the water to be collected as a sample. The objective is to pump in a manner that minimizes stress (drawdown) to the system to the extent practical, taking into account established site sampling objectives. Typically flow rates on the order of 0.1-0.5 liters per minute (L/min) are used; however, some extremely porous formations can be successfully sampled at flow rates to one (1) L/min. Isolation of the screened interval water from the overlying stagnant casing water may be accomplished using low-flow minimal drawdown techniques. When the pump intake is located within the screened interval most of the water pumped will be drawn in directly from the formation with little mixing of casing water or disturbance to the sampling zone.

CSSA utilizes a QED Well Wizard™ system for collecting low-flow samples. The sampling device consists of a pressurized nitrogen gas canister, pneumatic controller, gas injection tubing, a bladder pump, a drop pipe with inlet (deeper wells only), and discharge tubing. Prior knowledge of the well construction is necessary to assist in purging. At a minimum, any stagnant water remaining in the pump tubing needs to be purged so that formation-representative groundwater is being collected at the sampling port. A minimum purge volume is defined as the amount of water held in storage within the 3/8-inch discharge tubing. Water may stagnate within the discharge tubing between sampling events since it is held by a check valve located at the pump. **Table 4** lists the current and anticipated low-flow pump systems to be sampled at CSSA. An estimated minimum purge volume to evacuate stagnant water is also included in this table. As additional wells are completed and actual construction information becomes available, the table will be updated.

Well purging is necessary to obtain samples of water from a formation in the screened interval. Rather than using the arbitrary guideline of purging three casing volumes prior to sampling, water quality measurements will be used to establish stabilization time for several parameters (*e.g.*, temperature, pH, and specific conductance) on a well-specific basis. Data on pumping rate, drawdown, and volume required for parameter stabilization can be used as a guide

for conducting subsequent sampling activities. The following recommendations should be considered:

- Use low-flow rates (<0.5 L/min) during both purging and sampling to maintain minimal drawdown in the well;
- Make proper adjustments to stabilize the flow rate as soon as possible;
- Remove a sufficient volume to purge stagnant water from the discharge tubing; and
- Monitor water quality indicators during purging.

In the event a bladder pump fails and can not be repaired by the field crew a bailer grab sample can be collected. Section 2.2.3 outlines the bailer sampling methodology.

Table 4
Low-Flow Pump Installation Data and Minimum Tube Purging Volumes

Well Name	Screen Interval	Pump Depth[3]	Inlet Depth [1]	Minimum Tubing Purge [2]
	(feet btoc)			(gallons)
CS-MW1-LGR	290-315	302	306	0.88
CS-MW1-BS	343-368	305	356	1.01
CS-MW1-CC	397-422	329	410	1.15
CS-MW2-LGR	320-345	329	333	0.95
CS-MW2-CC	428-453	304	440	1.23
CS-MW3-LGR	405-430	377	420	1.18
CS-MW4-LGR	302-327	206	318	0.92
CS-MW5-LGR	423-448	407	438	1.22
CS-MW6-LGR	343-368	314	358	1.02
CS-MW6-BS	400-425	314	415	1.16
CS-MW6-CC	454-479	314	469	1.30
CS-MW7-LGR	325-350	293	340	0.97
CS-MW7-CC	433-458	293	448	1.25
CS-MW8-LGR	335-360	302	350	1.00
CS-MW8-CC	442-467	302	458	1.27
CS-MW9-LGR	299-324	286	314	0.91
CS-MW9-BS	355-380	306	370	1.05
CS-MW9-CC	428-453	306	443	1.23
CS-MW10-LGR	373-398	297	382	1.08
CS-MW10-CC	473-498	296	481	1.33
CS-MW11A-LGR	423-448	345	435	1.21
CS-MW11B-LGR	185-210	196	200	0.61
CS-MW12-LGR	336-361	305	348	0.99
CS-MW12-BS	385-410	305	387	1.09
CS-MW12-CC	443-468	305	455	1.26
CS-2	205-350	339	339	0.97
CS-3	205-328	NA	NA	no pump installed
CS-4	200-252	252	252	0.75
CS-MW16-LGR	198-313	302	302	NA (submersible pump)
CS-MW16-CC	409-434	405 (1.5 hp)	405	NA (submersible pump)
CS-MW17-LGR	370-395	310	383	1.08
CS-MW18-LGR	388-413	329	397	1.12
CS-MW19-LGR	343-368	308	355	1.01
CS-MW20-LGR	308-333	292	320	0.92
CS-MW21-LGR	391-316	276	305	0.88
CS-MW22-LGR	395-420	404	408	1.14
CS-MW23-LGR	375-400	384	388	1.09
CS-MW24-LGR	303-328	311	315	0.91
CS-MW25-LGR	355-380	363	367	1.04
CS-D	205-263	253	253	0.75
CS-I	258-362	344	344	solar powered Grundfos pump
CS-MWH-LGR	315-365	325 (5 hp)	325	NA (submersible pump)
CS-MWG-LGR	28-328	322	322	0.93
CS-MW35-LGR	405-430	395	417	1.17
CS-MW36-LGR	349.8-374.8	358	361.5	1.03

• btoc – Below Top of Casing
• [1] In deeper wells, the Inlet depth varies from pump depth when a drop tube is installed below the pump.
• [2] Minimum purge volume indicates the approximate volume of stagnant groundwater that may be retained within a 3/8" OD discharge tubing (1/4" ID) of a typical QED system at CSSA. Tubing length includes tubing above the pump and drop tube (if applicable). Calculation also includes the 395 mL volume of the teflon bladder. At least this much water requires purging to ensure that fresh groundwater samples are being obtained.
•[3] Pump Depth is measured from top of pump.
• NA - not applicable

Prior to sampling, all sampling devices and monitoring equipment will be calibrated in accordance with manufacturer's recommendations and the SAP **(Volume 1-4: Sampling and Analysis Plan)**. Calibration of the pH meter should be performed with at least two known pH solutions that bracket the expected range.

The USEPA recommends that the water level be checked periodically to monitor drawdown in the well as a guide to flow rate adjustment. The goal is minimal drawdown (<0.1 meter or 0.33 feet) during purging. At CSSA, it is unlikely that the dedicated bladder pumps can create such a drawdown in the main karst aquifers (*e.g.*, Lower Glen Rose and Cow Creek. In lower yielding intervals (perched aquifer or Bexar Shale wells) this goal may be difficult to achieve under some circumstances due to geologic heterogeneity within the screened interval, and may require adjustment based on site-specific conditions and experience of the Parsons field team.

Water quality indicator parameters will be continuously monitored during purging. The water quality indicator parameters monitored can include temperature, pH, and conductivity. The last two parameters are often most sensitive. Pumping rate, drawdown, and the time or volume required to obtain stabilization of parameter readings can be used as a future guide to purge the well. Measurements should be taken every 3-5 minutes. Stabilization is achieved after all parameters have stabilized for three successive readings at some volume beyond the minimum purge requirements. Three successive readings should be within ± 1° F (± 0.5° C) for temperature, ± 0.1 for pH, and ± 5% for conductivity.

Samples will be collected upon stabilization of water quality parameters. If an in-line device is used to monitor water quality parameters, it should be disconnected or bypassed during sample collection. Sampling flow rate may remain at established purge rate or may be adjusted slightly to minimize aeration, bubble formation, turbulent filling of sample bottles, or loss of volatiles due to extended residence time in tubing. Typically, flow rates less than 0.5 L/min are appropriate. The flow rate for volatile sampling should approach 0.1 L/min. Generally, volatile (*e.g.*, solvents and fuel constituents) and gas sensitive *(e.g.*, Fe^{2+}, CH_4, H_2S/HS^-, and/or alkalinity) parameters should be sampled first. If filtered (dissolved) samples are needed, filtering will be performed last, and in-line filters should be used. Groundwater samples should be collected directly into this container from the pump tubing.

2.2.2 Westbay® Multi-Port Samplers

LTMO-selected zones in Westbay®-equipped monitoring wells will be sampled in three quarterly events from December 2012 until September 2013. Two Parsons field team members will conduct each groundwater sampling event. Groundwater samples will be collected from discrete intervals using the Westbay® device. Pressure readings will be recorded at selected depth intervals in the Westbay®-equipped wells prior to sampling activities and for all four quarterly events.

The sampling and use of the multi-port monitoring devices require specialized training provided by Westbay®. Parsons' field crew has been trained on the correct usage and procedures for obtaining meaningful data. Requirements for measurement, purging, and sampling were provided by Westbay® at that time.

The four northern Westbay® Wells are not sampled as part of this monitoring but are sampled as part of the SWMU B-3 Bioreactor monitoring.

2.2.3 Deep Wells Sampled by the Bailer Method

Some quarterly groundwater events include deeper, larger diameter wells that may be routinely sampled but are not equipped with any sampling device. Currently, there are no wells scoped for sampling with this design, but the need may eventually arise periodically (*e.g.*, CS-3 is not equipped with a pump). The diameter and depth preclude bailing as a feasible purging alternative. Samples collected from such wells will be obtained by bailer grab samples. The same field methodology for shallow wells will be implemented for collecting deeper samples utilizing a bailer. A single measurement for pH, temperature, and conductivity will be recorded to document the water quality.

2.2.4 On-post Wells Sampled by Electric Submersible Pumps

Water wells available for groundwater monitoring are purged to remove water from the pump column. Currently, these include CS-1, CS-9, CS-10, CS-12, CS-MWH-LGR, and CS-I. Purged groundwater is typically pumped into the distribution system at CS-1, CS-10, and CS-12. CS-9 is inactive, and registered as so with TCEQ. Wells with pumps are purged 15 minutes prior to sampling. Temperature, pH, and conductivity will be taken prior to and during purging. Well purging will be performed until temperature, pH, and conductivity values stabilize. Stabilization is defined for pH as ± 0.1 unit, temperature ± 1°F (±0.5°C), and conductivity as ± 5 %. Successive measurements will be taken at 5-minute intervals. All water quality parameters recorded while purging will be noted in the field logbook. Samples are collected from the water faucet tap located at or near the top of the wellhead.

2.2.5 Off-post Domestic and Public Supply Wells Sampled

Off-post groundwater samples will be collected from select off-post public drinking water and domestic drinking water wells. Nearly all these wells are equipped with a submersible water pump, a bladder-type pressure chamber or booster pump, and possibly a large storage capacity cistern. These wells are purged and sampled with the same criteria as the on-post drinking water wells. Most off-post well locations require a signed access agreement and notification to the well owner before accessing the site.

Most wells with pressure tanks can be operated by opening a faucet to create a pressure drop, thereby engaging the well pump. Cisterns and booster pumps often operate the well pump with some type of level switch (float or pressure), and therefore may require some manipulation to engage the pump. This can be accomplished either by draining water from the cistern to activate the switch, or manually engaging the switch at its location if the well is so equipped. The field sampling team will bring an extra garden hose to directly purge water to an unobtrusive location, if necessary. When possible, public drinking water supply wells will be operated by the owners of the system or their designated representative only. The City of Fair Oaks has instructed Parsons' personnel in proper procedures for sampling the Fair Oaks wells, as described below.

The field sampling team must ensure that the pump is running when the groundwater sample is collected. CSSA has already retrofitted several off-post domestic wells with wellhead sampling ports. All samples must originate at or as near the wellhead as possible prior to other system influences, which include pressure tanks, booster pumps, water softeners, and/or cisterns.

Because of the variability in privately owned drinking water systems, multiple procedures are required to assure that the well pump is running and that a representative groundwater sample is obtained. Instructions for the individual off-post wells sampled to date are included to ensure sample integrity, sampling consistency, and proper entrance and exit from the well owner's property without disrupting the well owner. Future off-post drinking water wells added to the monitoring program will follow similar procedures, as applicable.

2.2.5.1 **The Oaks Water Supply Corp. (OW-HH1, OW-HH2, OW-CS1, OW-CS2, OW-MT2, OW-BARNOWL, OW-DAIRYWELL, OW-HH3)**

1. The wells are located in a gated subdivision. Contact Danny Smith to schedule a sampling time.
2. Mr. Smith will accompany field crew to each well and engage well pumps for sampling.

2.2.5.2 **FO-8**

1. The well is located in a fenced enclosure. The key is kept in CSSA key box, labeled Fair Oaks. Address is on pole next to the well.
2. On the electrical box next to the well make sure the power is on and pump switch is set to "Hand", then push the start button. If the well is on 'Auto' and running, no changes are needed to the electrical box settings. *Note: Make sure all settings are put back as they were when you arrived, after sample is collected.*
3. Purge at wellhead tap **(Appendix A, Figure FO-8)**. Record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
4. Collect sample and return all settings back to original configuration as when the operator arrived.
5. Close and lock all gates.
6. For questions or problems to this accepted procedure regarding the Fair Oaks Ranch Utilities public drinking water wells, contact Mr. Ron Emmons, Fair Oaks Water District, 7286 Dietz Elkhorn Rd, Fair Oaks Ranch, TX 78015, (210) 698-0900.

2.2.5.3 **FO-J1**

1. The well is located behind JW-14's residence. If possible sample FO-J1 in conjunction with JW-14 at the request of the homeowner.
2. After sampling JW-14, walk toward the back of the property and through the gate to the right of the horse barn. Close the gate behind you. The well is located in a fenced area (see photo **Appendix A, Figure FO-J1)**. The Fair Oaks key will be needed to unlock the gate. The key is kept in the CSSA key box.
3. On the electrical box next to the well make sure the power is on and pump switch is set to "Hand", then push the start button. If the well is on 'Auto' and running, no changes are needed to the electrical box settings. *Note: Make sure all settings are put back as they were when you arrived, after sample is collected.*
4. Purge at wellhead tap. Record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
5. Collect sample and return all settings back to original configuration.
6. Close and lock all gates.

7. If the JW-14 homeowner is not available, enter through the gate on the easement at the south end of property. The same Fair Oaks well key is used to unlock the first gate. Go through three gates, closing each gate behind you so that resident's animals do not escape.
8. For questions or problems to this accepted procedure regarding the Fair Oaks Ranch Utilities public drinking water wells, contact Mr. Ron Emmons, Fair Oaks Ranch Utilities, 7286 Dietz Elkhorn Rd, Fair Oaks Ranch, TX 78015, (210) 698-0900.

2.2.5.4 **FO-17**

1. The well is located in a fenced enclosure; key is kept in CSSA key box, labeled Fair Oaks.
2. On the electrical box next to the well **(Appendix A, Figure FO-17)** make sure the power is on and pump switch is set to "Hand", then push the start button. If the well is on 'Auto' and running, no changes are needed to the electrical box settings. *Note: Make sure all settings are put back as they were when you arrived, after sample is collected.*
3. Purge at wellhead tap. Record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
4. Collect sample and make sure wellhead tap is turned off.
5. Return pump settings as they were upon arrival.
6. Close and lock the gate.
7. For questions or problems to this accepted procedure regarding the Fair Oaks Ranch Utilities public drinking water wells, contact Mr. Ron Emmons, Fair Oaks Ranch Utilities, 7286 Dietz Elkhorn Rd, Fair Oaks Ranch, TX 78015, (210) 698-0900.

2.2.5.5 **FO-22**

1. The well is located in a fenced enclosure **(Appendix A, Figure FO-22)**. The key is kept in CSSA key box, labeled Fair Oaks. Address is on telephone pole next to the well.
2. On the electrical box next to the well make sure the power is on and pump switch is set to "Hand", then push the start button. If the well is on 'Auto' and running no changes are needed to the electrical box settings. *Note: Make sure all settings are put back as they were when you arrived, after sample is collected.*
3. Purge at wellhead tap. Record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
4. Collect sample and return all settings back to original configuration.
5. Close and lock all gates.
6. For questions or problems to this accepted procedure regarding the Fair Oaks Ranch Utilities public drinking water wells, contact Mr. Ron Emmons, Fair Oaks Ranch Utilities, 7286 Dietz Elkhorn Rd, Fair Oaks Ranch, TX 78015, (210) 698-0900.

2.2.5.6 **HS-1, HS-2, & HS-3**

1. These wells are located in a fenced area on top of the hill in Hidden Springs. All wells are in the same gated area.
2. Sampling must be coordinated with David Davila (David.Davila@saws.org) ahead of time. If David is not available contact Jeff Haby, contact information is on the off-post well owner contact information spreadsheet. Meet San Antonio Water System (SAWS)

crew at the gate to Hidden Springs (last gate to the right on Aue Road). SAWS crew has gate code and will escort sampling crew to wells.
3. SAWS crew will turn on well pumps as needed.
4. When well pump is turned on record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
5. Collect sample and notify SAWS crew to turn off well pump and turn on next well pump to be sampled.
6. When sampling is complete, SAWS crew will return well pumps to proper settings and lock the gate.

2.2.5.7 **I10-2**

1. Stop by SA Self Storage office to arrange access, a representative will escort field crew to the well or provide a key and gate code for access. The well is located just inside the farthest gate west, in small metal building, **(Appendix A, Figure I10-2)**.
2. Unlock well house using key provided by well owner.
3. Use the existing fire house to purge the pressure tank and engage the well pump.
4. From the well head record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
5. Collect sample, turn off all water, and return the well house to the condition it was in upon arrival. Return key to SA Self Storage office when finished.

2.2.5.8 **I10-4**

1. Enter the property at the driveway where boulders are blocking it, you can squeeze between them. The well is located to the right of the entrance toward the middle of the lot. Upon entering head back toward the east (right) side of property. The well is surrounded by large rocks to keep equipment from damaging it **(Appendix A, Figure I10-4)**.
2. Use the CSSA on-post key to open the well cap.
3. This well contains no pump and is not in use. Use a bailer to collect the sample from this well. Also, take one pH, temperature, and conductivity reading.
4. Lock well and return everything as it was.

2.2.5.9 **I10-5**

1. Stop by Gentry Research & Development Corp., located in the building to the west of the gas station (suite 101), and let them know you are there to sample the well.
2. Well is located in fenced area to the right of the shopping center **(Appendix A, Figure I10-5)**. Someone from the office will unlock the gate for access to the well.
3. Open drain valve at the bottom of the cistern to engage well pump. Pipe wrench may be needed.
4. After well pump engages purge at wellhead. Record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
5. Collect sample from wellhead tap.

6. Make sure drain valve is closed and wellhead tap is turned off before leaving. Lock the gate behind you.

2.2.5.10 **I10-7**

1. Stop by the sport court office and let them know you are going to sample the well at the back of the property. Follow driveway back and look for the black poly tank, well is in the brown well house, see **Appendix A, Figure I10-7.**
2. Purge holding tank from valve between well house and holding tank, which will engage the well pump.
3. Use a ladder to access lid on top of the poly tank. Water from the wellhead will fill tank from pvc pipe coming into top of poly tank. Record pH, temperature, and conductivity readings from until parameters stabilize, record approximate gallons purged.
4. Collect the sample from this location as well. This is the closest access point from the wellhead.
5. Make sure all water is turned off, lid on poly tank is secured, and valves are closed before leaving.

2.2.5.11 **I10-8**

1. Well is located behind the fence, next to the building closest to the parking lot, notify employees in restaurant before sampling, see **Appendix A, Figure I10-8**.
2. Purge pressure tank from the faucet on the building to the far east end of the property, which will engage the well pump.
3. Purge at wellhead. Record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
4. Collect sample from wellhead tap.
5. Make sure all water is turned off before leaving.

2.2.5.12 **JW-5**

1. Well is located to the left as you pull in the driveway in front of the main house, see **Appendix A, Figure JW-5**.
2. Purge at spigot on the outside of the well equipment house. Engaging the well pump is not necessary until wellhead spigot is installed. This spigot is inline after the holding tank.
3. Record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
4. Collect sample from spigot on the outside of the well equipment house.
5. Make sure all water is turned off before leaving.

2.2.5.13 **JW-6**

1. Must have gate code to enter (see scheduling access column of well owner list or contact well owner for current code).
2. Well is located straight ahead when entering the driveway, behind trees.
3. Turn on water faucet at pressure tank to engage well pump, see **Appendix A, Figure JW-6**.

4. Purge at wellhead. Record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
5. Collect sample from wellhead tap.
6. Make sure all water is turned off before leaving.

2.2.5.14 **JW-7**

1. Well owner must be contacted to arrange access.
2. Well is located behind house, following path to right of house, well is in a well house.
3. Turn on water faucet on the outside of the well house to purge pressure tank, see **Appendix A, Figure JW-7**.
4. Listen for well pump to engage. Record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
5. Collect sample from the tap on outside of well house.
6. Make sure all water is turned off before leaving.

2.2.5.15 **JW-8**

1. Contact well owner for current gate code.
2. Follow the driveway around to the back of the house. The well is located under the 55 gallon drum to the right of the cistern.
3. Watch out for bees and scorpions at wellhead. Remove barrel to gain access to wellhead, see **Appendix A, Figure JW-8**
4. Open valve at the base of the cistern to purge enough water to engage the well pump.
5. Purge at wellhead. Record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
6. Collect sample from wellhead tap.
7. Turn wellhead faucet off, replace barrel over well, and close cistern valve before leaving.

2.2.5.16 **JW-9**

1. Contact well owner to schedule a sampling time. Arrive at gate, reach through the left side of the gate and push the black button in the gray box to open gate. Stand guard to make sure dogs do not escape, close gate behind you during sampling.
2. Well is located on the right hand side of driveway, before you reach the residence **(Appendix A, Figure JW-9)**.
3. Open valve on far side of the cistern to engage well pump.
4. Purge at wellhead. Record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
5. Collect sample from wellhead tap.
6. Make sure all water is turned off and cistern valve is closed before leaving.
7. When leaving stand guard at gate while it closes to make sure dogs do not escape.

2.2.5.17 **JW-13**

1. Contact well owner prior to sampling, he will usually install a combo lock on his gate and provide the code to the field crew for well sampling. Remind him to unlock the well house.
2. Well is located to the left of the driveway across from house in a well house, the well house is new and not seen in this photo.
3. Purge well at spigot on outside of well house to engage well pump.
4. At the wellhead record pH, temperature, and conductivity readings until parameters, stabilize, record approximate gallons purged. Use a bucket to catch water and to keep from getting the well house floor wet.
5. Collect sample from wellhead tap; make sure well pump has not turned off when collecting readings and sample.
6. Turn all water faucets off and close gate behind you when leaving.

2.2.5.18 **JW-14**

1. Contact well owner to schedule a time to sample, well owner will usually leave the gate open that day.
2. Well is located to the right of house when facing it, in small stucco building by the garage **(Appendix A, Figure JW-14)**.
3. Turn on water faucet in front of house in flowerbed to purge pressure tank.
4. Hook up water hose to faucet at wellhead and divert water out of well house while recording parameters (pH, temperature, conductivity, gallons purged).
5. When parameters stabilize, remove hose from wellhead faucet and collect sample directly from wellhead tap. Use a collection container to minimize the amount of water that spills inside the well house. (Note: if pump disengages during sampling wellhead faucet will shut off.)
6. Make sure the water is turned off in flowerbed before leaving.
7. Sample from well FO-J1 should also be collected during this visit at homeowner's request.

2.2.5.19 **JW-15**

1. Contact well owner to schedule access.
2. Well is located behind the house in well house near the cistern, see **Appendix A, Figure JW-15**.
3. Turn on water by the garden to purge cistern until pump engages. Or use a ladder to trip the float switch at the top of the cistern.
4. Purge at wellhead tap. Record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
5. Collect sample from wellhead tap.
6. Make sure all water is turned off before leaving.

2.2.5.20 **JW-26**

1. Contact well owner to schedule access **(Appendix A, Figure JW-26)**. The well is located through the second gate to the left in a well house, look for black cistern.

2. Well owner will usually run sprinklers in advance of sampling to help empty the cistern to engage well pump.
3. Use a ladder to access the top of the black poly tank, this is where the readings and sample will be collected.
4. Record pH, temperature, and conductivity readings until parameters stabilize, and then collect the sample.
5. Return and close lid on the top of the poly tank. Return well house as it was upon arrival and make sure all water is turned off.

2.2.5.21 **JW-27**

1. Well is located to the right of the house when facing it, to gain access enter through gate on Fawn Mountain Road. Contact well owner for access **(Appendix A, Figure JW-27)**.
2. Connect the water hose to avoid flooding the well house. Use well pump key **(Figure Pump Key-1)** to engage well pump.
3. Purge at wellhead tap. Record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
4. Remove water hose and collect sample from wellhead, using a container to minimize water running onto the floor of the well house.
5. Disengage pump and retrieve pump key. Make sure water faucet is turned off. Be sure that all items are left in the condition they were found upon arrival.

2.2.5.22 **JW-28**

1. Contact well owner to schedule access and for current gate code. Stand guard as gate closes to prevent dog from escaping.
2. The well is located in the shed to the left of the driveway, see **Figure JW-28.1**.
3. Turn on water faucet by the house to purge pressure tank.
4. When pump engages use a water hose to purge at wellhead tap **(Figure JW-28.2)** to avoid flooding well house. Record pH, temperature, and conductivity readings until parameters stabilize.
5. Remove water hose and collect sample from wellhead, use a container to catch any overflow.
6. Turn all faucets off and leave everything in the same condition as it was found upon arrival. Keep an eye on the dog when exiting the gate.

2.2.5.23 **JW-29**

1. Contact well owner to schedule access.
2. The well is located to the right of house, just outside of the shed.
3. Turn on water faucet on the way to the well, by the garden, to purge pressure tank, **(Appendix A, Figure JW-29).**
4. Purge at wellhead tap. Listen and feel the ground to ensure well pump has engaged. Record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
5. Collect sample from wellhead.

6. Turn all faucets off and leave everything in the same condition as it was found upon arrival.

2.2.5.24 **JW-30**

1. Contact well owner for access and gate code.
2. The well is located behind the house in a well house next to the cistern, see **Figure JW-30**. A ladder is needed to engage well pump without having to empty the cistern.
3. Use the ladder to access the pump switch at the top of the cistern, hold switch down until sampling is complete or purge faucet until well pump engages.
4. Purge at wellhead tap and record pH, temperature, and conductivity reading until parameters stabilize, record approximate gallons used. A water hose will be needed to avoid flooding the well house.
5. Collect sample from wellhead tap and use a container to catch any overflow.
6. Turn all faucets off, make sure pump switch is not stuck down, and leave everything in the same condition as it was found upon arrival.

2.2.5.25 **JW-31**

1. Contact owner for access.
2. The well is located to the left of the house in a small enclosure, next to a concrete cistern **(Appendix A, Figure JW-31)**.
3. Purge at tap off the front of the enclosure. This tap is after the cistern.
4. Use a ladder to access the top of the cistern, gloves will also be needed to remove concrete lid for sample access.
5. Collect water falling in from top of cistern and record pH, temperature, and conductivity readings until parameters stabilize. Collect sample same location.
6. Turn faucet off and leave everything in the same condition as it was found upon arrival.

2.2.5.26 **LS-1**

1. After sampling Hidden Springs wells, SAWS representative will follow you to LS-1 and LS-4 to unlock gates.
2. Well is located in gated area **(Appendix A, Figure LS-1)**.
3. Samples are collected with a bailer from this well.
4. Record one pH, temperature, and conductivity reading and collect sample from bailer.
5. Replace plate on well head and lock gate upon completion.

2.2.5.27 **LS-4**

1. Well is located in gated area next to the Fire Station **(Appendix A, Figure LS-4)**.
2. SAWS representative will unlock gate. Samples are collected with a bailer from this well.
3. Record one pH, temperature, and conductivity reading and collect sample from bailer.
4. Replace plate on well head and lock gate upon completion.

2.2.5.28 **LS-5**

1. The well is located between LS-6 and LS-7 properties, just off the main road. A GAC filtration system was installed on L-5 in October 2011, look for metal GAC shed **(Figure LS-5)**.
2. Temporarily turn off water into GAC unit to change the prefilters prior to sampling:
   a. Turn red valve before the first prefilter to the off position (in the top right portion of the GAC shed).
   b. Use a water hose to divert water out of GAC shed. Open spigot to relieve water pressure.
   c. Use canister tool to unscrew both blue prefilter canisters and change filters if dirty.
   d. Screw filters back on, close spigot and turn red valve back on and check for leaks.
3. Record gallons used from flowmeter at top inside the GAC shed.
4. Engage well pump by purging from a spigot inside the GAC shed, use a water house to divert water outside the GAC shed.
5. Purge at wellhead tap. Record pH, temperature, and conductivity readings until parameters stabilize.
6. Collect pre-GAC sample directly from wellhead.
7. Collect post-GAC sample from the sample port after the two carbon canisters, in the middle portion of the GAC shed next to the UV light.
8. Turn off all water and make sure unit is functioning properly before leaving; check sample ports to make sure water is running through the system.
9. Leave everything as it was upon arrival, except if the GAC system was bypassed or disconnected. Report any tampering with the system or apparent leaks to CSSA Environmental Office and/or Carbonair for repair.

2.2.5.29 **LS-6**

1. Well is located next to cistern, look for metal GAC house.
2. Temporarily turn off water into GAC unit to change the prefilters prior to sampling:
   a. Turn red valve before the first prefilter to the off position (in the top right portion of the GAC shed).
   b. Open any spigot inside the GAC unit to relieve water pressure and divert water outside with a water hose.
   c. Use canister tool to unscrew both blue prefilter canisters and change filters if dirty.
   d. Screw filters back on, close spigot and turn red valve back on and check for leaks.
3. Record gallons used from flowmeter at top inside the GAC unit.
4. In the wellhouse behind the metal GAC shed, locate small gray pump switch box under the electrical box **(Figure Pump Switch-1)**. Use pump key to engage well pump **(Figure Pump Key-1)**. Purge at wellhead to the left of GAC house **(Appendix A, Figure LS-6)**. Record pH, temperature, and conductivity readings until parameters stabilize.
5. Collect pre-GAC sample directly from wellhead.
6. Collect post-GAC sample from the sample port after the two carbon canisters, in the bottom middle portion of GAC shed next to the UV light **(Appendix A, Figure LS-6)**.
7. Turn off well pump and retrieve pump key.

8. Leave everything as it was upon arrival, except if the GAC system was bypassed or disconnected. Report any tampering with the system or apparent leaks to CSSA Environmental Office and/or Carbonair for repair.

2.2.5.30 **LS-7**

1. Well is located on south side of Curres Rd., look for the metal GAC shed **(Appendix A, Figure LS-7)**.
2. Temporarily turn off water into GAC unit to change the prefilters prior to sampling:
   a. Turn red valve before the first prefilter to the off position (in the top right portion of the GAC shed).
   b. Open any spigot inside the GAC unit to relieve water pressure and divert water out of GAC shed with a water hose.
   c. Use canister tool to unscrew both blue prefilter canisters and change filters if dirty.
   d. Screw filters back on, close spigot and turn red valve back on and check for leaks.
3. Record gallons used from flowmeter at top inside the GAC unit.
4. Purge at any tap around the wellhouse or in the GAC shed to engage well pump.
5. Record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
6. Take pre-GAC sample from wellhead tap.
7. Post-GAC sample is collected from sample port next to the UV light, as in LS-6 **(Appendix A, Figure LS-6)**.
8. Turn off all water and leave everything as it was upon arrival, except if the GAC system was bypassed or disconnected. Report any tampering with the system or apparent leaks to CSSA Environmental Office and/or Carbonair for repair.

2.2.5.31 **OFR-1**

1. Well is located behind house, follow road to right at first fork, then to left at second fork, look for black holding tank next to the power pole **(Appendix A, Figure OFR-1)**.
2. Located spigot closest to wellhead.
3. The well owner has installed a pump switch on the electrical box.
4. Turn on pump and record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
5. Collect sample at wellhead tap.
6. Turn off pump switch and leave everything as it was upon arrival.

2.2.5.32 **OFR-3**

1. The wellhead is located to the left of the building behind the gate and the GAC unit is located just outside the gate next to the wellhead, see **Figure OFR-3**.
2. Temporarily turn off water into GAC unit to change the prefilters prior to sampling:
   a. Turn red valve before the first prefilter to the off position (in the top right portion of the GAC shed).
   b. Open any spigot inside the GAC unit to relieve water pressure.
   c. Use canister tool to unscrew both blue prefilter canisters and change filters if dirty.
   d. Screw filters back on, close spigot and turn red valve back on and check for leaks.

3. Record gallons used from flowmeter at top inside the GAC unit.
4. Purge water at spigot inside GAC unit to engage the well pump. Use a water hose to divert water outside of the GAC shed.
5. At wellhead listen and feel for pump to engage or observe temperature reading to ensure well is engaged. Record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
6. Collect sample from wellhead tap. If unable to gain access to the wellhead, the sample can also be collected from the spigot in the top right corner of the GAC unit prior to any GAC filtration.
7. The post-GAC sample is collected from inside the GAC unit. Collect from the bottom sample port next to the UV light as in LS-6 **(Appendix A, Figure LS-6)**.
8. Leave everything as it was upon arrival, except if the GAC system was bypassed or disconnected. Report any tampering with the system or apparent leaks to CSSA Environmental Office and/or Carbonair for repair.

2.2.5.33 **OFR-4**

1. This well can be sampled in conjunction with OFR-1, same well owner.
2. Well is located behind the house, straight ahead when coming up the driveway, look for big black holding tank **(Appendix A, Figure OFR-4)**.
3. Open valve on right side of black holding tank to drain the system and engage well pump.
4. Purge at the wellhead tap. When the pump engages wellhead tap will produce water. Record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
5. Collect sample from wellhead tap.
6. Close valve on black holding tank and leave everything as it was before leaving.

2.2.5.34 **RFR-3**

1. Wells RFR-3, RFR-4, and RFR-5 are all owned by the same family, these wells should be scheduled to be sampled at the same time. Enter property through the first gate, pass 2 houses on the right and take the first right after the homes. Follow road until you see a house on the left.
2. Well is located in storage shed behind the main house, see **Figure RFR-3**.
3. Purge pressure tank from a faucet on the back of the house and use a water hose to purge at faucet by pressure tank. Listen for pump to engage.
4. When pump engages record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
5. Collect sample from tap just off the pressure tank.
6. Turn off all water and leave well house as it was upon arrival.

2.2.5.35 **RFR-4**

1. After leaving RFR-3, follow road back the way you entered toward entrance gate. Take a right and head toward the cow pens. Look for the cistern up behind the cow pens.

2. Locate wellhead next to the cistern, a small gray box is attached just inside the well shed **(Figure Pump Switch-1)**, use pump key **(Figure Pump Key-1)** to engage pump **(Appendix A, Figure RFR-4)**.
3. Record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
4. Collect sample from wellhead tap.
5. Turn off well pump and retrieve pump key.
7. Turn off all water and leave everything as it was upon arrival.

2.2.5.36 **RFR-5**

1. After sampling RFR-4, continue on same road in same direction. Another house is located on the left side of the road. The well is to the right of the house when facing it, underneath well housing, in a doghouse type enclosure **(Appendix A, Figure RFR-5)**.
2. Lift well housing off well. Purge at faucet near the greenhouse to engage well pump.
3. Run a water hose off the wellhead tap to avoid getting insulation wet.
4. When pump engages record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
5. Remove water hose and collect sample from wellhead tap.
6. Turn off all water and replace well housing as it was upon arrival.

2.2.5.37 **RFR-8**

1. Must contact well owner for access, renters currently reside at the property.
2. Well is located to the far left side of property, when facing the residence, underneath a fake wishing well, look for the concrete cistern **(Appendix A, Figure RFR-8)**.
3. Turn on water at any outside faucet to purge the pressure tank.
4. Make sure well pump is engaged, can feel the ground vibrating when the pump is running.
5. Purge at wellhead tap. Record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
6. Collect sample from wellhead.
7. Turn off all water and replace well housing as it was upon arrival.

2.2.5.38 **RFR-9**

1. Must contact well owners for access, well owner will contact their renters management company to schedule access.
2. Well is located on the left side of the driveway **(Appendix A, Figure RFR-9)**.
3. Turn on the water outside of the house to purge pressure tank so well pump will engage.
4. Purge at wellhead tap. Record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
5. Collect sample from wellhead.
6. Turn water faucet off at house before leaving.

2.2.5.39 **RFR-10**

1. Well is located near the antenna tower, follow drive way to the right at first fork (onto a gravel road), then to the left before to entering a gated area, up the hill toward the antenna tower then left through the trees toward the black holding tank and metal GAC shed.
2. The well has two GAC units running in parallel. The left side is GAC-B and the right side is GAC-A **(Appendix A, Figure RFR-10).** A pump switch is located in a gray box just to the left of GAC-B's UV light. Note: Pump key not needed to engage well pump.
3. Temporarily turn off water into GAC unit to change the prefilters prior to sampling:
    a. Verify well pump is not running, if it is, make sure switch in GAC house is in the off position then cut power at the telephone pole to the left of the GAC shed.
    b. Turn red valve inline before each system to the off position.
    c. Open a spigot inside the GAC unit to relieve water pressure.
    d. Use canister tool to unscrew both blue and clear prefilter canisters (on both systems) and change filters if dirty.
    e. Also check back-up filters located above prefilters.
    f. Screw filters back on, turn power and red valves back on and check for leaks.
4. Record the gallons used from each flowmeter inside the GAC unit.
5. The pre-GAC sample will be collected from the wellhead located behind the GAC shed.
6. Engage pump by flipping switch on and purge at wellhead tap. Record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
7. Collect pre-GAC sample from wellhead.
8. Two post-GAC samples are collected from sample ports after the second carbon canisters, in the appropriate side of the GAC unit A or B.
9. Make sure unit is functioning properly before leaving; check sample ports to make sure water is running through the system.
10. Leave everything as it was upon arrival, except if the GAC system was bypassed or disconnected. Report any tampering with the system or apparent leaks to CSSA Environmental Office and/or Carbonair for repair.

2.2.5.40 **RFR-11**

1. Well is located in a brick well house behind the main business office. Open the door and watch your head, this is a low doorframe. This GAC unit was installed in the existing well house at the owner's request; there is no metal GAC shed at this location.
2. Temporarily shut off water to change prefilters as in LS-6: **(Appendix A, Figure LS-6)**
    a. Turn red valve before the first prefilter to the off position.
    b. Open any spigot inside the GAC unit to relieve water pressure.
    c. Use the canister tool to unscrew both blue prefilter canisters and change filters if dirty.
    d. Screw filters back on, close spigot and turn red valve back on and check for leaks.
3. Record gallons used from flowmeter just above the wellhead.

4. Purge at faucet immediately outside of well house. Listen for pump to engage. Record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged.
5. Take pre-GAC sample from wellhead.
6. Post-GAC sample is collected from sample port in the corner after it has run through both carbon canisters.
7. Leave everything as it was upon arrival, except if the GAC system was bypassed or disconnected. Report any tampering with the system or apparent leaks to CSSA Environmental Office and/or Carbonair for repair.

2.2.5.41 **RFR-12**

1. Speak with the manager inside the Pico gas station to get the well house key. The well is located behind the gas station, look for the concrete cistern.
2. Enter the gated area, then well house using the key provided by gas station manager.
3. Use a water hose to run purge water out of the well house from sample spigot. To engage well pump use a ladder to access the top of cistern and push down float switch **(Appendix A, Figure RFR-12.1)**.
4. Record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged. Readings are taken from water hose purge water and the sample is collected from the spigot in the corner closest to the well head **(Appendix A, Figure RFR-12.2)**.
5. Release float switch and make sure it is not stuck in the down position.
6. Turn off all water and return the well house to the condition it was in upon arrival.
7. Return key to the Pico gas station manager.

2.2.5.42 **RFR-13**

1. Contact well owner for gate code. Well is located on the right side of the driveway in a well house, look for black holding tank.
2. Purge at spigot in front of the blue pressure tank. Engaging the well pump is not necessary until a wellhead spigot is installed. This spigot is inline after the holding tank.
3. Record pH, temperature, and conductivity readings at the faucet in front of the pressure tank until parameters stabilize, record approximate gallons purged and collect sample **(Appendix A, Figure RFR-13)**.
4. Turn off all water and return the well house to the condition it was in upon arrival.

2.2.5.43 **RFR-14**

1. Well is located to the left of the house down the hill near the garage. Look for old fashion Texaco gas pump covering wellhead.
2. Purge at spigot next to wellhead. Engaging the well pump is not necessary until wellhead spigot is installed. This spigot is inline after the holding tank.
3. Record pH, temperature, and conductivity readings until parameters stabilize, record approximate gallons purged. Collect sample **(Appendix A, Figure RFR-14).**
4. Turn off water and leave well as it was upon arrival.

2.2.5.44 **SLD-01 & SLD-02**

1. Contact Don Jones with the San Antonio Rose Palace to schedule access.
2. Meet Federico at main office, he will escort you to the wells and engage well pumps as needed.
3. Record pH, temperature, and conductivity readings until parameters stabilize then collect sample.
4. Well SLD-02 is the back up well, it is not always possible to get the well to turn on to collect a sample. If Federico can't get well pump to engage, skip the sample for that round. Well SLD-01 is the main well, this sample is representative of the water being delivered for consumption.

2.2.5.45 **BRS-03**

1. Contact well owner to schedule access. The well is located behind the house with a wishing well structure around it **(Figure BSR-03)**.
2. Purge water at house spigot to engage well pump.
3. Record pH, temperature, and conductivity readings until parameters stabilize then collect sample.
4. Turn off all water and return the well house to the condition it was in upon arrival.

2.2.5.46 **BRS-04**

1. Contact well owner to schedule access. Meet with well owner in the office located in the second building on the right. Someone will escort you to the well and turn on faucets in order to engage well pump.
2. The well is located to the right of the church, look for cistern **(Figure BSR-04)**.
3. When the well pump engages record pH, temperature, and conductivity readings until parameters stabilize then collect sample from the spigot on the well head.
4. Turn off all water and return everything as it was upon arrival.

2.3 GROUNDWATER SAMPLE IDENTIFICATION

To keep groundwater sampling information consistent, a naming convention was established as part of the DQOs. Consistent use of a standardized naming convention allows for better database management and ease of use. Nomenclature has been established to distinguish the following data types:

- Wellhead Samples, including on-post monitoring wells and those samples collected as pre-GAC monitoring points (*e.g.*, RFR-10, CS-1, *etc*.);
- Multiple GAC systems serving a single wellhead (*e.g.*, A, B, C, *etc*.);
- GAC system performance monitoring (canisters #1 or #2); and
- Qualifiers to describe special sampling points *(e.g.*, entry point (EP), point-of-use tap)

Table 5 lists valid sample identification codes for wells currently sampled, in addition to the new wells described in this work plan. All sampling locations have a geographic prefix followed by an alphanumeric designator. The following are examples of geographic coding:

- BSR: Boerne Stage Road
- CS: Camp Stanley
- FO: Fair Oaks Ranch
- HS: Hidden Springs
- I10: Interstate Highway 10
- JW: Jackson Woods
- LS: Leon Springs Villa
- OFR: Old Fredericksburg Road
- RFR: Ralph Fair Road
- SLD: Scenic Loop Drive
- OW: Oaks Water

Some off-post well locations are treated with one or more GAC units. The GAC units are designated as unit "A" or unit "B." There is currently only one location with multiple GAC systems (RFR-10). Except for the system at RFR-10, the GAC units consist of two canisters (#1 and #2) that are operated in series, with sampling ports following each canister. Occasionally, samples are collected after individual canisters to evaluate their condition and monitor for contaminant breakthrough. Other infrequently collected samples include EP samples collected at public supply wells, and water samples collected from a point-of-use faucet (tap) such as in a kitchen or washroom.

It is imperative that sampling conventions be applied consistently. For those occasions when a new sampling point does not fit one of the valid sample identifications (*e.g.*, a new GAC system or a newly added well), the field sampling team will contact the project or task manager to assign a new unique sample identifier.

Table 5
Valid Groundwater Sample Identifications
On-post Wells

Well Type	Well Location	Valid Sample Identification
On-Post Quarterly Monitoring Wells	*CS-MW1-LGR*	*CS-MW1-LGR*
	CS-MW1-BS	*CS-MW1-BS*
	CS-MW1-CC	*CS-MW1-CC*
	CS-MW2-LGR	*CS-MW2-LGR*
	CS-MW2-CC	*CS-MW2-CC*
	CS-MW3-LGR	*CS-MW3-LGR*
	CS-MW4-LGR	*CS-MW4-LGR*
	CS-MW5-LGR	*CS-MW5-LGR*
	CS-MW6-LGR	*CS-MW6-LGR*
	CS-MW6-BS	*CS-MW6-BS*
	CS-MW6-CC	*CS-MW6-CC*
	CS-MW7-LGR	*CS-MW7-LGR*
	CS-MW7-CC	*CS-MW7-CC*
	CS-MW8-LGR	*CS-MW8-LGR*
	CS-MW8-CC	*CS-MW8-CC*
	CS-MW9-LGR	*CS-MW9-LGR*
	CS-MW9-BS	*CS-MW9-BS*
	CS-MW9-CC	*CS-MW9-CC*
	CS-MW10-LGR	*CS-MW10-LGR*
	CS-MW10-CC	*CS-MW10-CC*
	CS-MW11A-LGR	*CS-MW11A-LGR*
	CS-MW11B-LGR	*CS-MW11B-LGR*
	CS-MW12-LGR	*CS-MW12-LGR*
	CS-MW12-BS	*CS-MW12-BS*
	CS-MW12-CC	*CS-MW12-CC*
	CS-MW16-LGR	*CS-MW16-LGR*

Well Type	Well Location	Valid Sample Identification
On-Post Quarterly Monitoring Wells (cont.)	*CS-MW16-CC*	*CS-MW16-CC*
	CS-MW17-LGR	*CS-MW17-LGR*
	CS-MW18-LGR	*CS-MW18-LGR*
	CS-MW19-LGR	*CS-MW19-LGR*
	CS-MW20-LGR	*CS-MW20-LGR*
	CS-MW21-LGR	*CS-MW21-LGR*
	CS-MW22-LGR	*CS-MW22-LGR*
	CS-MW23-LGR	*CS-MW23-LGR*
	CS-MW24-LGR	*CS-MW24-LGR*
	CS-MW25-LGR	*CS-MW25-LGR*
	CS-MW35-LGR	*CS-MW35-LGR*
	CS-MW36-LGR	*CS-MW36-LGR*
	Well 2	*CS-2*
	Well D	*CS-D*
	CS-G-LGR	*CS-MWG-LGR*
	CS-H	*CS-MWH-LGR*
	CS-I	*CS-I*
Westbay®-equipped wells	*CS-WB01-LGR*	*CS-WB01-LGR*
	CS-WB02-LGR	*CS-WB02-LGR*
	CS-WB03-LGR	*CS-WB03-LGR*
	CS-WB04-LGR	*CS-WB04-LGR*
On-post Wells	*Well 1*	*CS-1*
	Well 9	*CS-9*
	Well 10	*CS-10*
	Well 11	*CS-11*
	Well 12	*CS-12*

Valid Groundwater Sample Identifications for Off-post Wells

Well Location	Valid Sample Identification	Remarks
BSR-03	*BSR-03*	*Wellhead sample port*
FO-8	*FO-8*	*Wellhead sample port*
FO-17	*FO-17*	*Wellhead sample port*
FO-22	*FO-22*	*Wellhead sample port*
FO-J1	*FO-J1* *FO-J1 EP*	*Wellhead sample port* *FO-J1 Entry Point to Distribution System*
HS-1	*HS-1*	*Wellhead sample port*
HS-2	*HS-2*	*Wellhead sample port*
HS-3	*HS-3*	*Wellhead sample port*
HS-4	*HS-4*	*Wellhead sample port*
I10-4	*I10-4*	*No pump installed, bailer sample*
I10-5	*I10-5*	*Wellhead sample port*

Well Location	Valid Sample Identification	Remarks
I10-7	*I10-7* *I10-7 NP*	*Wellhead sample port* *Non-purged sample*
I10-8	*I10-8*	*Wellhead sample port*
I10-9	*I10-9*	*Wellhead sample port*
JW-5	*JW-5*	*Wellhead sample port*
JW-6	*JW-6*	*Wellhead sample port*
JW-7	*JW-7*	*Wellhead sample port*
JW-8	*JW-8*	*Wellhead sample port*
JW-9	*JW-9* *JW-9 A2*	*Wellhead sample port* *Post filtration system*
JW-12	*JW-12*	*Wellhead sample port*
JW-13	*JW-13*	*Wellhead sample port*

Table 5 (cont'd)
Valid Sample Identifications
Off-post Wells

Well Location	Valid Sample Identification	Remarks
JW-14	*JW-14* *JW-14 NP*	*Wellhead sample port* *Non purged sample*
JW-15	*JW-15*	*Wellhead sample port*
JW-26	*JW-26*	*Wellhead sample port*
JW-27	*JW-27*	*Wellhead sample port*
JW-28	*JW-28*	*Wellhead sample port*
JW-29	*JW-29*	*Wellhead sample port*
JW-30	*JW-30*	*Wellhead sample port*
JW-31	*JW-31*	*Sample port*
LS-1	*LS-1*	*Bailer sample*
LS-4	*LS-4*	*Bailer Sample*
LS-5	*LS-5* *LS-5-A1* *LS-5-A2* *LS-5-A2-Tap*	*Wellhead sample port* *GAC canister #1 sample port* *GAC canister #2 sample port* *Sample after GAC canister #2 at a point-of-use faucet*
LS-6	*LS-6* *LS-6-A1* *LS-6-A2* *LS-6-A2-Tap*	*Wellhead sample port* *GAC canister #1 sample port* *GAC canister #2 sample port* *Sample after GAC canister #2 at a point-of-use faucet*
LS-7	*LS-7* *LS-7-A1* *LS-7-A2* *LS-7-A2-Tap*	*Wellhead sample port* *GAC canister #1 sample port* *GAC canister #2 sample port* *Sample after GAC canister #2 at a point-of-use faucet*

Well Location	Valid Sample Identification	Remarks
OFR-1	*OFR-1*	*Wellhead sample port*
OFR-3	*OFR-3* *OFR-3-A1* *OFR-3-A2* *OFR-3-A2-Tap*	*Wellhead sample port* *GAC canister #1 sample port* *GAC canister #2 sample port* *Sample after GAC canister #2 at a point-of-use faucet*
OFR-4	*OFR-4*	*Wellhead sample port*
RFR-3	*RFR-3*	*Wellhead sample port*
RFR-4	*RFR-4*	*Wellhead sample port*
RFR-5	*RFR-5*	*Wellhead sample port*
RFR-8	*RFR-8*	*Wellhead sample port*
RFR-9	*RFR-9*	*Wellhead sample port*
RFR-10	*RFR-10* *RFR-10-A1* *RFR-10-A2* *RFR-10-A2-Tap*	*Wellhead sample port* *House: GAC #1 sample port* *House: GAC #2 sample port* *House: Sample after GAC #2 at a point-of-use faucet*
	RFR-10-B1	*Trailer: GAC #1 sample port*
	RFR-10-B2	*Trailer: GAC #2 sample port*
	RFR-10-B2-Tap	*Trailer: Sample after GAC canister #2 at a point-of-use faucet*
RFR-11	*RFR-11* *RFR-11-A1* *RFR-11-A2* *RFR-11-A2-Tap*	*Wellhead sample port* *GAC canister #1 sample port* *GAC canister #2 sample port* *Sample after GAC canister #2 at a point-of-use faucet*
RFR-12	*RFR-12*	*Wellhead sample port*
RFR-13	*RFR-13*	*Wellhead sample port*
RFR-14	*RFR-14*	*Wellhead sample port*
SLD-01	*SLD-01*	*Wellhead sample port*
SLD-02	*SLD-02*	*Wellhead sample port*

2.4 GROUNDWATER SAMPLING PARAMETERS

Sampling frequencies are determined for each well, based on the LTMO and the DQOs and are semiannual, biennial, every nine months or quarterly. Depending on the location and historical results, all wells are sampled for either the CSSA QAPP list of VOC analytes (Full List VOCs), or the reduced list of analytes (short list VOCs shown in Table 3) of compounds historically detected at CSSA. Metals analyses for on-post drinking water wells include arsenic, barium, copper, zinc, lead, cadmium, chromium and mercury. Monitoring wells are sampled for cadmium, chromium, lead, and mercury. In addition, newly installed wells will be sampled for additional metals (nine total) and natural water quality parameters during the first quarterly monitoring event following their installation. All groundwater samples will be analyzed for those parameters and methods listed in **Table 2**.

Currently, all off-post drinking water wells are sampled for the VOCs listed in **Table 3**. The project manager or task manager will prepare a list of sampling parameters for each well prior to each quarterly event. No analyses for inorganics or natural water quality parameters are submitted for laboratory analyses from off-post sampling locations.

2.5 SAMPLE COLLECTION PROCEDURE

Sample labels with well identification, sample date, analysis, sample team initials, and preservatives are generated in the CSSA-customized hybrid environmental restoration program (chERP) prior to sample collection each day. All label information can be printed prior to sampling with the exception of sample time, which will be handwritten in the appropriate space before applying the labels to the containers. As field parameters stabilize during well purging, sampling containers are labeled when the sample is collected. The sample time will be completed on the pre-printed chERP label and the label attached to the container. After sample collection samples will be stored in a cooler on ice for shipment to the laboratory.

3.0 DECONTAMINATION PROCEDURES

All groundwater sampling equipment is dedicated to the well location and does not require decontamination. Bailers used in sampling off-post wells that do not have pumps are disposable and discarded after each sample use. At this time no decontamination is needed for the groundwater sampling task.

4.0 INVESTIGATION-DERIVED WASTE HANDLING

IDW may include purged groundwater and decontamination fluids (water and other fluids). The field sampling team will be responsible for containing and managing produced fluids. The purged water produced from the on-post monitoring wells will be contained and transported to the SWMU B-3 Bioreactor. As long as the Bioreactor is in operation this purge water will be disposed of in the trenches.

APPENDIX A

OFF-POST WELL PHOTOGRAPHS

Figure FO-8

Figure FO-J1

Figure FO-17

Figure FO-22

Figure I10-2

Figure I10-4

Figure I10-5

Figure I10-7

Figure I10-8

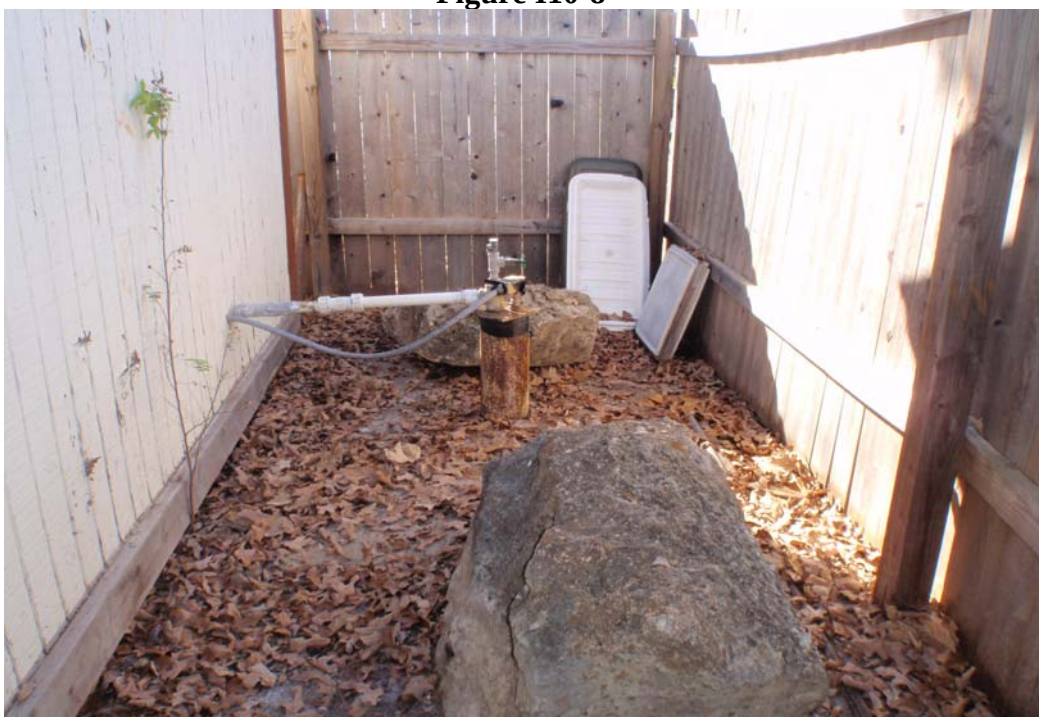

Figure JW-5

Figure JW-6

Figure JW-7

Figure JW-8

Figure JW-9

Figure JW-14

Figure JW-15

Figure JW-26

Figure JW-27

Figure JW-28.1

Figure JW-28.2

Figure JW-29

Figure JW-30

Figure JW-31

Figure LS-1

Figure LS-4

Figure LS-5

Figure LS-6

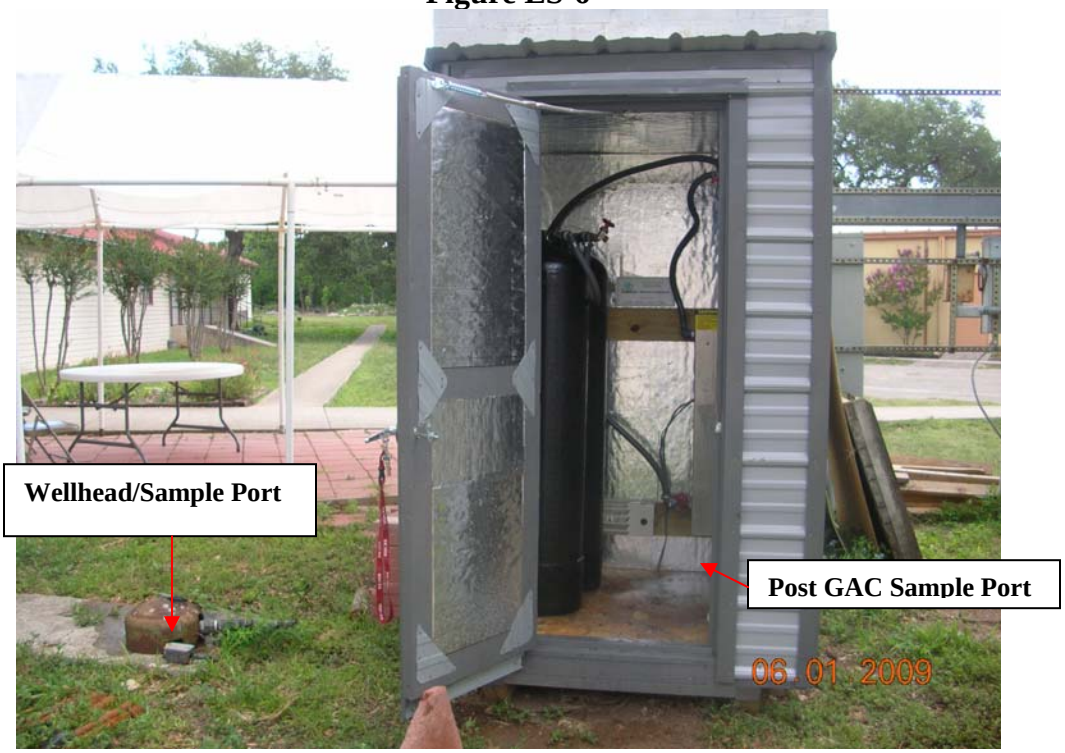

Figure LS-7

Figure OFR-1

Figure OFR-3

Figure OFR-4

Figure Pump Key-1

Figure Pump Switch-1

Figure RFR-3

Figure RFR-4

Figure RFR-5

Figure RFR-8

Figure RFR-9

Figure RFR-10

Figure RFR-11

Figure RFR-12.1

Figure RFR-12.2

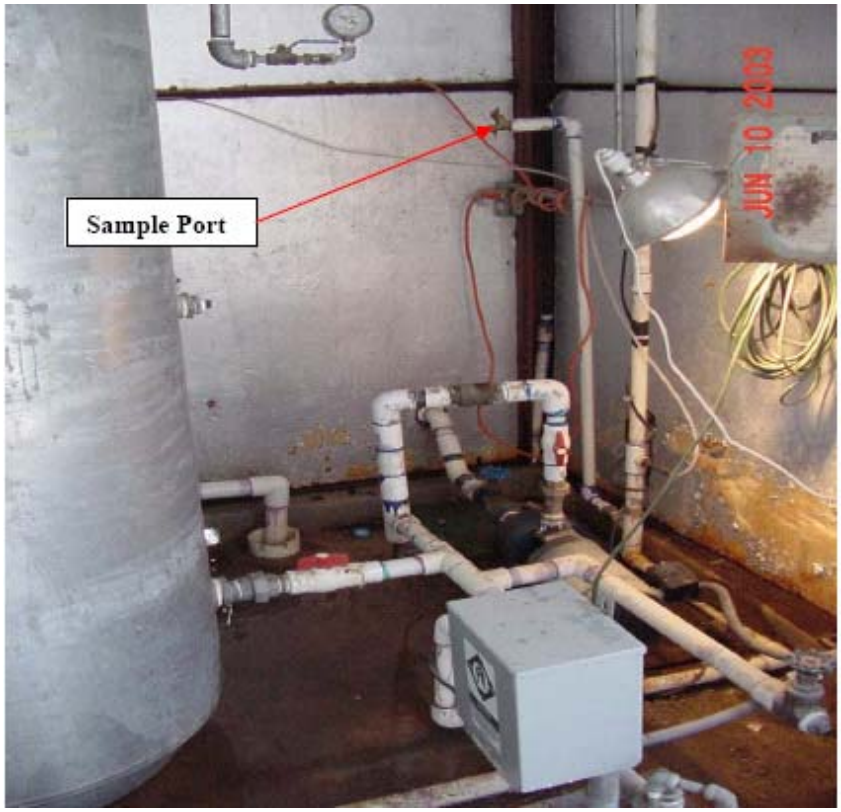

Figure RFR-13

Figure RFR-14

Figure BSR-03

Figure BSR-04

APPENDIX B

OFF-POST WELL SAMPLING LOCATIONS

Appendix B

Far Western Off-Post Ground Water Wells
Camp Stanley Storage Activity

PARSONS

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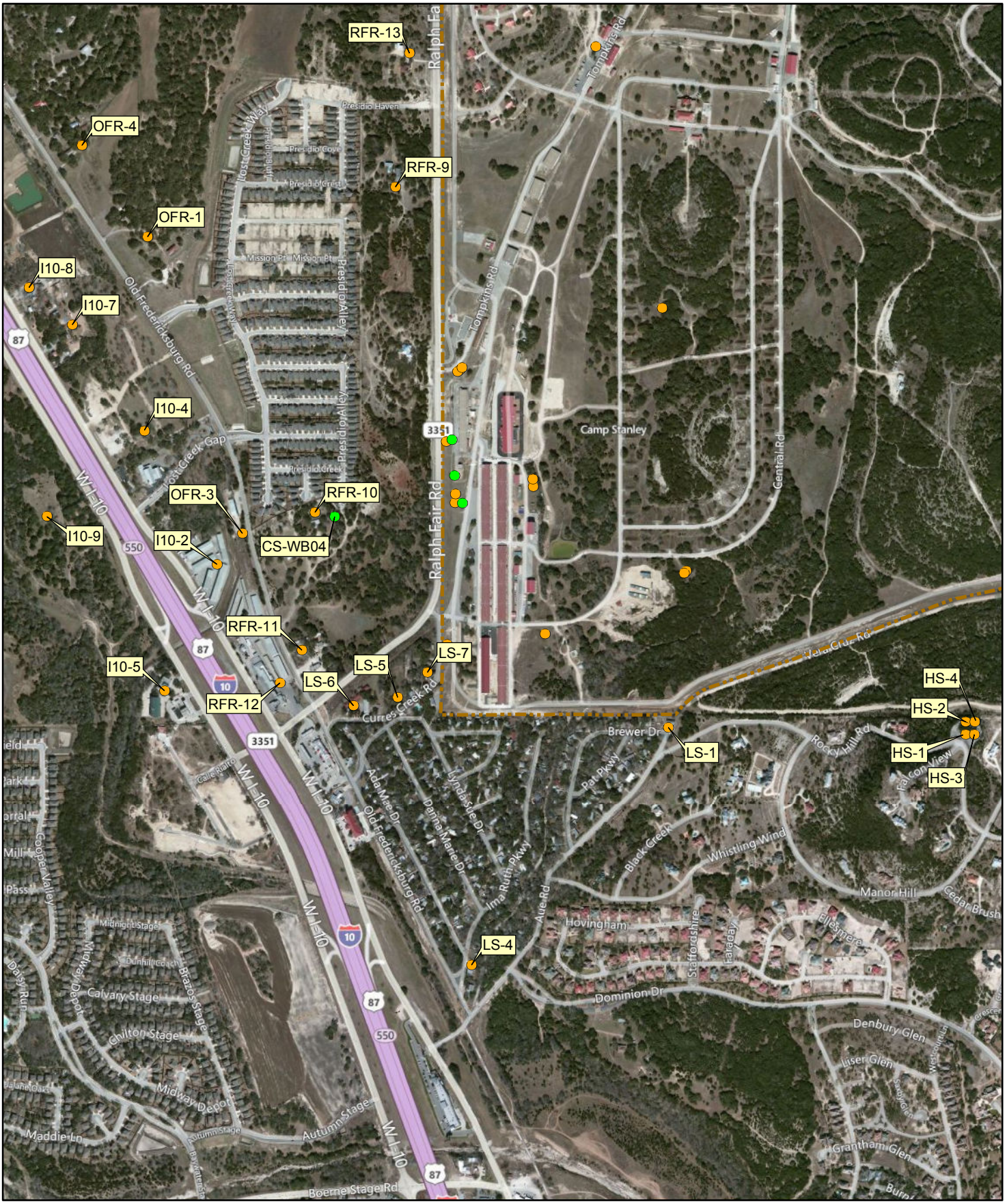

Appendix B

South Western Off-Post Ground Water Wells
Camp Stanley Storage Activity

PARSONS

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Appendix B

Western Off-Post Ground Water Wells
Camp Stanley Storage Activity

PARSONS

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