RCRA Facility Investigation Work Plan

Prepared For

Department of the Army
Camp Stanley Storage Activity
Boerne, Texas

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Section 1 - Introduction

Camp Stanley Storage Activity (CSSA) is located in northwestern Bexar County, about 19 miles northwest of downtown San Antonio. The installation consists of 4,004 acres immediately east of Ralph Fair Road, and approximately 0.5 mile east of Interstate Highway 10 (**Figure 1.1**). Camp Bullis borders CSSA completely on the east, and partially on the north and south.

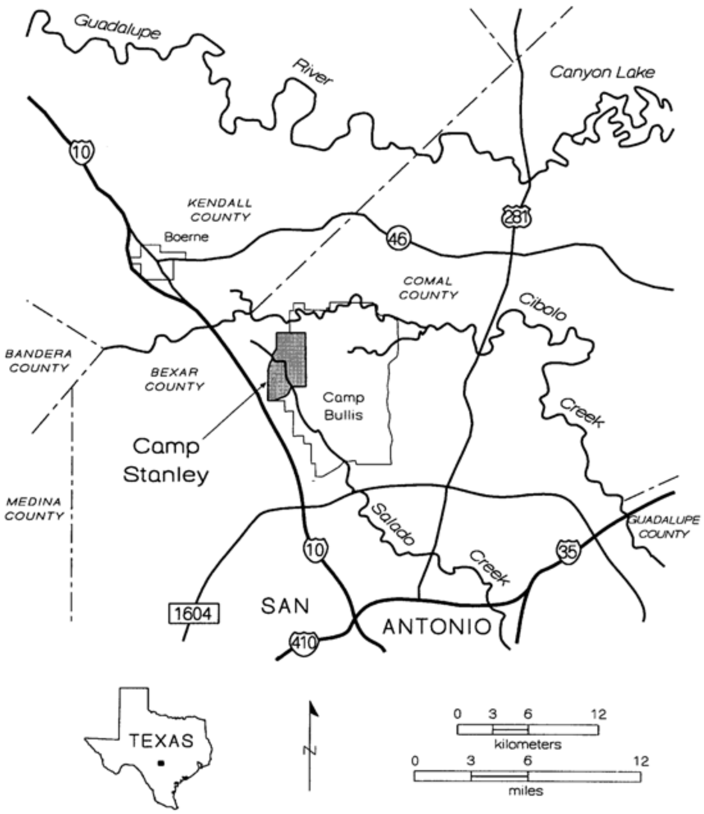

Figure 1.1 – Location of Camp Stanley Storage Activity

The land where CSSA is located was used for ranching and agriculture until the early 1900s. During 1906 and 1907, six tracts of land were purchased by the U.S. Government and designated the Leon Springs Military Reservation. The land included campgrounds and cavalry shelters.

In October 1917, the installation was re-designated Camp Stanley. Extensive construction started during World War I to provide housing for temporary cantonments and support facilities. In 1931, the installation was selected as an ammunition depot, and construction of standard magazines and igloo magazines began in 1938. Land was also used to test, fire, and overhaul ammunition components. As a result of these historic activities, CSSA had a number of historical waste sites, including solid waste management units (SWMUs) and areas of concern (AOCs). Additional information on these waste sites is included in Section 1.1.

The present mission of CSSA is the receipt, storage, issue, and maintenance of ordnance as well as quality assurance testing and maintenance of military weapons and ammunition. Because of its mission, CSSA has been designated a restricted access facility. No changes to the CSSA mission and/or military activities are expected in the future.

1.1 OVERVIEW OF 3008(H) ORDER

On November 19, 1980, CSSA submitted a hazardous waste permit application which identified that, at that time, it treated, stored, or disposed of hazardous wastes at a surface impoundment and a tank. However, an open burn/open detonation (OB/OD) area in CSSA's North Pasture (SWMU B-20) was not included as a hazardous waste management area in the Part A permit application, or in subsequent hazardous waste activity notifications. CSSA had ceased operations at the B-20 site at the time of the Part A application but had resumed demolition activities in 1984 without modifying their permit. From the 1950s or 1960s until 1987 (with a hiatus in activities between 1980-1984 as stated above), CSSA used the B-20 site to treat and dispose of reactive explosives which are classified as hazardous wastes for reactivity (United States Environmental Protection Agency [USEPA] waste number D003). During an inspection in January 1993, USEPA determined that the SWMU B-20 site was a hazardous waste thermal treatment unit and did not have interim status since it was not included in the Part A permit application.

In 1991, two years prior to USEPA's determination on the SWMU B-20 site, routine water well testing by the Texas Department of Health detected the presence of dissolved tetrachloroethene (PCE), trichloroethene (TCE), and *cis*-1,2-dichloroethene (*cis*-1,2-DCE) in a CSSA water supply well (Well 16) above maximum contaminant levels (MCLs) and the well was taken out of service. Subsequent sampling showed volatile organic compound (VOC) contamination levels above MCLs in several other wells. The potential sources of the waste constituents were believed to be the former oxidation pond (SWMU O-1) and Burn Area 3 (later renamed SWMU B-3). Later AOC-65 was also identified as another source of groundwater contamination.

As a result of the groundwater contamination and the findings on the SWMU B-20 site, USEPA issued CSSA an Administrative Order on Consent (the Order) under Section 3008(h) of RCRA on May 5, 1999. The Order requires CSSA to identify, investigate, and prevent the further spread of releases of hazardous wastes and/or hazardous constituents to the environment at and/or from CSSA, and to ensure that corrective action activities are implemented to protect human health and the environment.

CSSA was required to perform the actions included in, and comply with all requests and dates of submittal listed in the Order. The Order requires CSSA to: (1) perform interim/stabilization measures (IM) at the facility to prevent or minimize the further migration of contaminants due to releases of hazardous constituents to the environment, or to mitigate current or potential threats to human health or the environment; (2) perform a RCRA Facility Investigation (RFI) to determine the nature and extent of any release(s) of hazardous waste or hazardous constituents at or from the facility; (3) perform a Corrective Measure Study (CMS) to identify and evaluate alternatives for corrective action(s) to prevent or mitigate any migration of release(s) of hazardous wastes or hazardous constituents at or from the facility, and to collect any other information necessary to support the selection of corrective measures at the facility; and (4) implement the corrective measures [Corrective Measure Implementation (CMI)] selected by the USEPA for the facility.

Due dates associated with the Order include:

- A semi-annual progress report is due on January 10 and July 10 each year.
- An IM Work Plan must be submitted to USEPA within 120 days of the identification of any new current or potential threat to human health and/or the environment. Additionally, USEPA must be notified orally and in writing of the immediacy and magnitude of the potential threat within 5 days of its identification.
- The RFI Report must be submitted to USEPA for review and approval 730 days after USEPA approves the RFI Work Plan. The RFI Work Plan had not yet been formally approved by USEPA; however, investigations have been underway for many years, and with 5 open sites consolidated under the active range fan per USEPA request, 81 of 84 total sites have been closed.
- Within 60 days after the submission of the RFI Report, a Risk Assessment and Investigative Analysis must be submitted to USEPA.
- Within 120 days after the RFI Report is approved by USEPA, a Corrective Measures Study (CMS) Report must be submitted to USEPA.
- Within 120 days of receiving notification of USEPA’s approval of the corrective measure(s), or upon written direction from USEPA, a CMI Program Plan must be submitted.
- Within 5 days of approval or modification by USEPA of any Work Plan(s), work shall commence and the tasks required by the Work Plan(s) implemented in accordance with the standards, specifications and schedule stated in the Work Plan(s).

In addition, USEPA has a goal of having a “remedy-in-place” for all sites by 2020, though this is not specified in the Order. With the Order, USEPA is the lead agency for investigation and remediation of groundwater. The Texas Commission on Environmental Quality (TCEQ) is the lead agency for investigation and closure of waste disposal sites, though USEPA provides input.

1.1.1 Progress Reports

The Order initially required that progress reports be submitted on a quarterly basis. USEPA approved changing the reporting interval from quarterly to semi-annually in 2006. Since that time, progress reports #28 through #43 were submitted on a semiannual basis.

1.1.2 Interim Measures

CSSA performed IM as required by the Order to prevent or minimize the further migration of contaminants due to releases of hazardous constituents to the environment, or to mitigate current or potential threats to human health or the environment. The following IMs have been completed at CSSA:

- **SWMU O-1 IMs and Closure**. The TCEQ approved closure of the land-based portion of SWMU O-1 on December 3, 2001. Remediation of the vadose zone and groundwater beneath SWMU O-1 is being addressed by the SWMU B-3 bioreactor as part of the RFI task.
- **Initial On- and Off-Post Groundwater Sampling**. Periodic sampling of on-post wells was initiated in 1991. Off-post water sampling began in 1995. Quarterly sampling of both on- and off-post wells began in 1999. Scheduled groundwater monitoring continues as part of the RFI task.
- **Off-Post Well Survey**. The initial Off-Post Well Survey Report was issued in August 2001. The survey identified privately- and publicly-owned wells within ¼-mile radius of CSSA. A second Off-Post Well Survey was conducted in November 2010 as an update to the 2001 survey and included wells within a ½-mile radius of CSSA.
- **Soil Pile Disposition Assessment (SPDA) and Implementation**. The SPDA was conducted and an associated report prepared in August 2003 to document the potential disposition of previously sifted soils located at SWMUs B-8, B-20/21, B-24, B-28, and the DD Area. Soil from these areas were either disposed of off-site or treated with phosphate-induced metal stabilization (PIMS).

1.1.3 RCRA Facility Investigation

Since the Order was issued in 1999, CSSA has been aggressively closing sites under State of Texas regulations, with both TCEQ and USEPA oversight. A preliminary RFI Work Plan submitted in 1999 outlined the approach that would be used to aggressively and systematically in investigating and closing sites. Since 1999, CSSA has closed nearly all of its sites with no restrictions on future land use.

1.1.4 Risk Assessment and Investigative Analysis

A Draft Baseline Risk Assessment Report was submitted to USEPA in January 2014. The report will be finalized pending USEPA review.

1.1.5 Corrective Measures Study

A CMS Report will be submitted to present the results of treatability studies at SWMU B-3 and AOC-65, and to identify, screen, and develop alternatives for any remaining remediation or treatment efforts at CSSA.

1.1.6 Corrective Measures Implementation Program Plan

Following CMS approval, a CMI Program Plan will be submitted to document the design, construction, operation, maintenance, and monitoring of all corrective measures in place at CSSA.

1.1.7 Work Plans

Work Plan addenda were submitted prior to the investigation and/or remediation of individual sites and media at CSSA. All Work Plan addenda are available in Volume 1 of the Environmental Encyclopedia.

1.2 WASTE SITES

A total of 84 sites, including 39 SWMUs, 41 AOCs, and five RMUs, have been identified at CSSA since 1993, and investigations have been conducted at a total of 83 of those sites. In 2012, four SWMUs (B-2, B-8, B-20/21, and B-24) were combined with RMU-1 as they are part of the active firing range. This range will be closed in the future when it is no longer active. As of April 2014, 81 sites were closed (see Section 3).

1.2.1 Solid Waste Management Units

A SWMU is broadly defined as any area or structure used to treat, store, or dispose of solid waste. Sites fitting this definition identified during the Environmental Assessment (EA) (Parsons ES, 1993) were labeled as SWMUs. In 1992 and 1993, the SWMUs were identified through historical waste management records (including a list of known waste management areas), site maps, aerial photographs, and interviews with CSSA personnel. Once identified, an attempt was made to locate the sites through a field survey.

A total of 39 SWMUs were identified during the 1993 EA. To date, 33 SWMUs have been closed or delisted and one SWMU, SWMU B-3, remains open (**Table 1.1 and Figure 1.2**). Section 3 details all SWMUs that have been closed or delisted, and Section 4 provides a site summary for each of the two remaining open sites.

1.1.2 Areas of Concern

A total of 42 potential AOCs were identified at CSSA, all of which have been closed or delisted. AOCs are those sites where field investigations and/or historical aerial photograph research indicate a possibility that waste disposal activities or spills may have taken place, as evidenced by disturbed areas, exposed surface debris, or detection of contamination. Section 3 details all closed or delisted AOCs.

1.1.3 Range Management Units

Five RMUs were identified at CSSA (Figure 1.2). RMU-1 is an active rifle range. No investigation or closure activities are planned for this site until it becomes inactive. RMU-2 currently is not in use, and no information was found indicating when it was first identified as a range area. RMUs 3 through 5 were identified on a1953 map as rifle ranges (RMU-3 and RMU-4) and a rocket range (RMU-5).

1.2 GROUNDWATER CONTAMINATION

During a routine screening site visit on August 9, 1991, the Texas Department of Health sampled CSSA water supply wells CS-1, CS-9, CS-10, CS-11, and CS-16. Analytical results revealed that well CS-16 contained 127 micrograms per liter (µg/L) *cis*-1,2-DCE and *trans*-1,2-DCE, 151 µg/L TCE, and 137 µg/L PCE. These concentrations exceeded the drinking water MCLs of 70 µg/L for *cis*-1,2-DCE, 100 µg/L for *trans*-1,2-DCE, 5 µg/L for TCE, and 5 µg/L for PCE. Subsequent sampling on August 23, 1991 confirmed the earlier results and well CS-16 was permanently taken out of service and disconnected from the potable water system.

In 1992, CSSA initiated a groundwater monitoring program. Since that time, numerous groundwater monitoring events have been conducted. More detailed information on the on- and off-post groundwater monitoring programs at CSSA is included in Section 5.

In general, due to the depth of groundwater (greater than 100 feet), the faulted karst nature of the aquifer, the existence of plumes associated with two areas (SWMUs B-3/O-1 and AOC-65), and CSSA's ongoing groundwater monitoring program, investigation of groundwater is not required by the regulating agencies during investigation of each individual SWMU or AOC. CSSA is actively investigating and implementing remediation options for groundwater contamination associated with SWMU B-3/O-1 (Plume 1) and AOC-65 (Plume 2). Treatability studies for remediation of groundwater are described in Section 4 (see Site Summaries for SWMU B-3 and AOC-65).

1.3 CONSIDERATIONS FOR SITE INVESTIGATION AND CLOSURE

The following subsections describe the factors considered in planning and conducting investigations and remediation at CSSA's SWMUs and AOCs.

1.3.1 Endangered Species

There are two federal and state-listed endangered bird species that reside at CSSA during certain times of the year:

- Black-capped vireos (*Vireo atricapillus*) typically reside in Central Texas Hill Country between April and July.
- Golden-cheeked warblers (*Dendroica chrysoparia*) typically reside in Central Texas Hill Country between March and July.

CSSA conducts presence-absence surveys for these birds every two years (odd-numbered years). These surveys identify nesting and preferred habitat areas that should be avoided during the period that these birds are typically present: March to July. If tree removal is required within this habitat at any time, it must be reported to USFWS in accordance with the Programmatic Biological Opinion (PBO) (see Section 2.2.1 for more information).

1.3.2 Archeological and Historical Resources

There are 40 known archeological sites at CSSA, seven of which are potentially eligible for listing in the National Register of Historic Places (NRHP) (Kibler and Gardner 1998; Scott *et al.* 1998; Parsons 2014). Of these sites, 19 are considered historic sites and 21 are considered prehistoric sites. The prehistoric sites were interpreted as open campsites or lithic scatters and historic sites were either classified as pre-military (before 1906) or military (1906-1945). Military components represented World War I training trenches, utilities, and

Table 1.1
Status of Waste Sites at Camp Stanley Storage Activity as of April 2014

	Site Status		
	Closed or Delisted	**Part of Active Range Complex**	**Remediation Currently Underway**
Solid Waste Management Units			
SWMU B-1	✓		
SWMU B-2		✓	
SWMU B-3			✓
SWMU B-4	✓		
SWMU B-5	✓		
SWMU B-6	✓		
SWMU B-7	✓		
SWMU B-8		✓	
SWMU B-9	✓		
SWMU B-10	✓		
SWMU B-11	✓		
SWMU B-12	✓		
SWMU B-13	✓		
SWMU B-14	✓		
SWMU B-15/16	✓		
SWMU B-19	✓		
SWMU B-20/21		✓	
SWMU B-22	✓		
SWMU B-23	✓		
SWMU B-23A	✓		
SWMU B-24		✓	
SWMU B-25	✓		
SWMU B-26	✓		
SWMU B-27	✓		
SWMU B-28	✓		
SWMU B-29	✓		
SWMU B-30	✓		
SWMU B-31	✓		
SWMU B-32	✓		
SWMU B-33	✓		
SWMU B-34	✓[a/]		
SWMU B-71	✓		
Bldg 40	✓		
Bldg 43	✓		
DD	✓		
F-14	✓		
I-1	✓		
O-1	✓		
Coal Bins	✓		
Areas of Concern			
AOC-35	✓		
AOC-36	✓		
AOC-37	✓		
AOC-38	✓		
AOC-39	✓		
AOC-40	✓		

Table 1.1
Status of Waste Sites at Camp Stanley Storage Activity as of April 2014

	Site Status		
	Closed or Delisted	**Part of Active Range Complex**	**Remediation Currently Underway**
AOC-41	✓		
AOC-42	✓		
AOC-43	✓		
AOC-44	✓		
AOC-45			
AOC-46	✓		
AOC-47	✓		
AOC-48	✓		
AOC-49	✓		
AOC-50	✓		
AOC-51	✓		
AOC-52	✓		
AOC-53	✓		
AOC-54	✓		
AOC-55	✓		
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AOC-64	✓		
AOC-65			✓
AOC-66	✓		
AOC-67	✓		
AOC-68	✓		
AOC-69	✓		
AOC-70	✓		
AOC-72	✓		
AOC-73	✓		
AOC-74	✓		
AOC-75	✓		
Range Management Units			
RMU-1		✓	
RMU-2	✓		
RMU-3	✓		
RMU-4	✓		
RMU-5	✓		

[a/] Investigation at this site complete; closure pending as of April 2014.

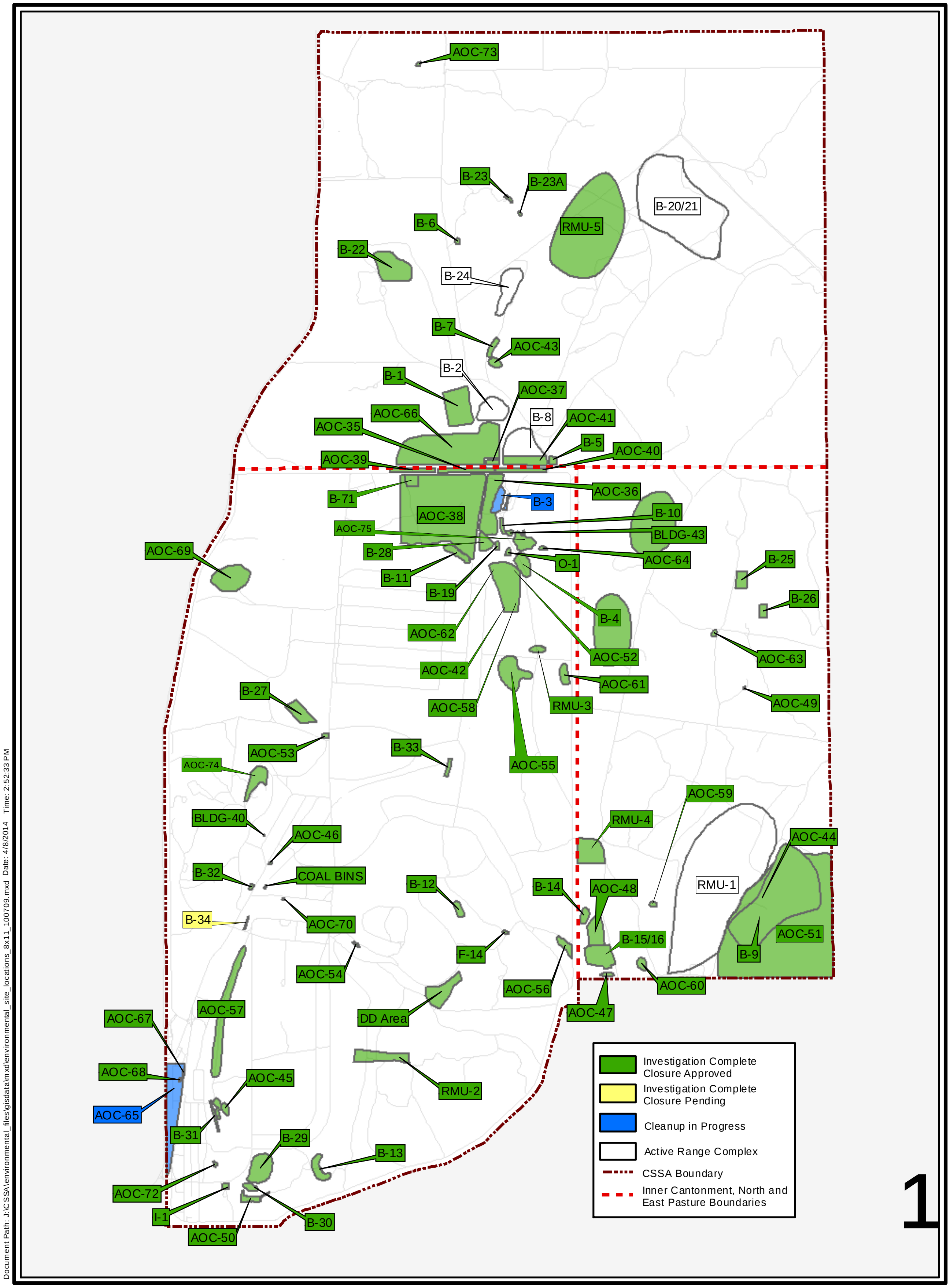

Figure 1.2 - Locations of Remedial Sites at CSSA

infrastructure, facility plans, housing properties, service/support properties, and unidentified property types. The pre-military sites included a 19th Century homestead and 20th-century ranches. If work was necessary in one of CSSA's archeological or historical sites, advance coordination with the Texas Historic Commission was required.

1.3.3 Waste Management

The *RFI and Interim Measures Waste Management Plan* (RFI/IM WMP) (Parsons 2006) establishes specific procedures and requirements for the generation, classification, containerizing and packaging, labeling, transportation, and accumulation of waste associated with planned RFI, treatability study, and remedial actions. The WMP also describes proper recordkeeping and reporting requirements. The RFI/IM WMP was approved by TCEQ on August 28, 2006.

The RFI/IM WMP also specifies the frequency of sample collection for characterization of SWMU and AOC soil. In general, samples must be collected at a frequency of either one sample per 200 cubic yards of soil or one sample per 500 cubic yards of soil depending on contaminant levels in soil from previous investigation results.

CSSA manages soils from SWMUs and AOCs in a number of ways:

1. Offsite disposal at a licensed landfill (typically Covel Gardens Landfill);
2. Reuse on-post at the active East Pasture range berm. Material managed in this way may be either non-hazardous or mixed with phosphate-induced metals stabilization (PIMS) material prior to adding it to the berm such that it is rendered non-hazardous. TCEQ and USEPA initially approved this management method in April 2006, and it has subsequently been used to manage soils from SWMU B-8, SWMU B-24, SWMU B-71, RMU-2, and AOC-64.
3. Reuse on-post in areas other than the East Pasture range berm when contaminant levels are below Texas Risk Reduction Program (TRRP) Tier 1 protective concentration levels (PCLs).

1.3.4 Quality Assurance

In the late 1990s, analytical data for samples collected from several sites were determined to be unusable by USEPA because of the laboratory's inappropriate manual integration practices. The affected data were replaced by the contractor at no cost to the government, and a more stringent and detailed quality assurance program was initiated.

In addition, Section IX of the Administrative Order requires CSSA to follow approved Quality Assurance (QA) and Quality Control (QC) procedures for all sampling and analytical activities. Initially, CSSA adopted the Air Force Center for Environmental Excellence (AFCEE) Quality Assurance Project Plan (QAPP). The *CSSA QAPP* (Parsons 2002a) presents specific policies, organization, functions, and QA/QC requirements for environmental programs at CSSA. The CSSA QAPP was prepared for use by contractors who perform environmental services to ensure the data generated by its subcontract laboratories are scientifically valid and defensible. It establishes the analytical protocols and documentation requirements to ensure samples are collected and analyzed properly, and the data are reviewed and validated in a specified manner; and it provides guidance for using the Data Quality Objective (DQO) process for specific investigations (see Section 2.6 of the *CSSA QAPP Version 1.0*).

TCEQ approved the *CSSA QAPP Version 1.0* on January 16, 2003, and USEPA Region 6 approved the same document on January 31, 2003. Laboratory audits are conducted occasionally by the contractors to ensure that appropriate QA/QC requirements are being followed. In addition to approving the CSSA QAPP, TCEQ approved the laboratory reporting limits (equivalent to practical quantitation limits) for analytes associated with CSSA sites on January 16, 2003.

1.3.5 Metals Concentrations

Soil samples at CSSA are typically analyzed for and compared to background concentrations of up to nine metals: arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, and zinc. These metals were chosen based on known waste disposal records and process knowledge.

A total of 90 samples were collected and analyzed for the nine CSSA metals during the Background Metals Evaluation (Parsons 2002b). The background concentrations were calculated by determining the 95% Upper Tolerance Limit (UTL) of the results. For background soil data, the UTL predicts the upper range of background concentrations from a relatively small data set. Distributional assumptions were tested prior to calculating the UTL to determine if the data fit a normal or lognormal distribution. If the distributional assumption could not be verified, then a non-parametric UTL was used. Background concentrations for the nine CSSA metals in all soil types are shown in **Table 1.2**. TCEQ approved the use of the concentrations calculated in the report on April 23, 2002.

1.4 Regulatory Roles and Criteria

As described above, USEPA is the lead agency for investigation and cleanup of groundwater, and TCEQ is the lead agency for investigation, cleanup, and closure of CSSA's SWMUs, RMUs, and AOCs. Meetings are held periodically with both agencies, including representatives of the local TCEQ office in San Antonio and the state TCEQ office in Austin, to update the regulators on project status and to obtain their input and/or concurrence regarding planned actions. Typically, between two and four meetings per year are held with the regulatory agencies.

Through May 2005, the clean-up or closure strategy for CSSA's SWMUs and AOCs followed TCEQ Risk Reduction Rules (30 Texas Administrative Code [TAC] §335 Subchapter S). As of May 2010, TCEQ has approved Risk Reduction Standard 1 (RRS1) closure of 37 sites, TRRP closure of three sites, de-listing of seven sites, and No Further Action for four sites. Section 3 summarizes the closure activities and status of each of these sites.

Table 1.2 – Soil Background Comparison Concentrations

Metal	Non-Parametric UTL (mg/kg)	95% UTL (mg/kg)
Arsenic	NA	19.6
Barium	NA	300
Cadmium	3.00	NA
Chromium	NA	40.2
Copper	NA	23.2
Lead	NA	84.5
Mercury	0.77	NA
Nickel	NA	35.5
Zinc	NA	73.2

NA = not applicable; mg/kg = milligrams per kilogram. Value for Barium is Texas-specific background concentration.

Current plans are to close remaining open sites (see Section 4) in accordance with TRRP or with a No Further Action determination. TRRP has three tiers of acceptable Protective Concentration Limits (PCLs) which are established levels for constituents in an environmental medium considered safe for human health and the environment. Tier I PCLs are based on conservative default assumptions regarding chemical mobility or exposure risk factors about the contaminant and site conditions. Tiers II and III incorporate increasing amounts of site-specific information to calculate a PCL that is more reflective of actual site conditions. While Tiers II and III provide more accurate representations of site conditions, they are more labor intensive and thus are more expensive. For sites where constituent level concentrations exceed the applicable PCLs, there are two Remedy Standards available to complete the remedial action (Remedy Standards A and B).

Remedy Standard A requires that constituents above the PCL be removed or decontaminated to acceptable levels in all areas. This standard is useful for small sites, sites that are being sold or transferred, and sites near the property boundaries. Remedy Standard B allows consideration of migration of the constituents to a point of exposure not necessarily at the source of the contamination. This standard allows constituents to remain in place at concentrations greater than the PCL with controls, but does not allow the migration of contaminants off-site. More information on TRRP and associated remediation alternatives is included in Section 3.2

Section 2 - Environmental Setting

This section summarizes the physical, geological, and ecological settings of CSSA. A discussion of groundwater use is also included. Additional information on groundwater contamination and monitoring is provided in Section 5.

2.1 PHYSIOGRAPHY

CSSA is characterized by a rolling terrain of hills and valleys in which nearly flat-lying limestone formations have been eroded and dissected by streams draining to the east and southeast. CSSA is located along the southeastern margin of the Edwards Plateau region commonly referred to as the Texas Hill Country. The Texas Hill Country is also known as the Balcones Canyonlands sub-region, a terrain deeply dissected by the erosion of major streams with steep gradients from the plateau to the base of the Balcones Escarpment.

The Balcones Escarpment was formed during the Tertiary period by faulting along the Balcones Fault Zone, a zone of northeast-southwest trending normal faults parallel to the Texas Gulf Coast. Resistive limestone beds crop out as topographic highs, and the differential weathering of alternating beds of hard limestones and dolomites with soft marls and shales of the Glen Rose Limestone form the characteristic stair-step topography of the Balcones Canyonlands. Topographic relief across the CSSA area ranges from about 1,100 to 1,500 ft above sea level.

2.2 ECOSYSTEM AND WILDLIFE

2.2.1 Vegetation

Evergreen woodlands and deciduous forests dominate the Balcones Canyonlands subregion of the Edwards Plateau natural region where CSSA is located. This subregion is also characterized by steep slopes and high-gradient streams. Grasslands are restricted primarily to drainage divides, usually in the context of open woodlands or savannas. Some of the woodlands and a majority of the native grasslands on the Edwards Plateau have been destroyed by historic human settlement of this region. Overall, vegetation at CSSA is similar to that of the region. Past land uses at CSSA resulted in a patchwork of open grassland/disturbed savanna delineated by stands of Ashe juniper-oak (*Juniperus ashei-Quercus sp.*) woodlands.

The vegetation communities at CSSA consist of grasslands, woodlands, and savannas. Each vegetation community can be further divided into seven different community types (**Figure 2.1**). Vegetation community types at CSSA include:

- Juniper-Live Oak Woodlands
- Juniper Woodlands
- Live Oak-Juniper Woodlands
- Juniper Dominant Shrublands
- Live Oak Dominant Shrublands
- Herbaceous Bluestem and Short Grass Prairie
- Mixed Oak Savanna

CSSA regularly mows several areas of the post, primarily in the Inner Cantonment. Although mature Ashe juniper provides a particular desired habitat for an endangered species (golden-cheeked warbler, see Section 2.2.4), it is fast-growing and considered somewhat invasive, particularly in areas where natural fires are suppressed. Occasional prescribed burns are performed to control the Ashe juniper and other vegetation. Any clearing or disturbance of land on-post must be conducted in accordance with the requirements of the PBO issued by USEPA in January 2008. The PBO specifies a programmatic threshold for incidental take of endangered species habitat as a result of CSSA vegetation-clearing activities.

2.2.2 Wetlands

Approximately 4.3 acres of CSSA's over 4,000 acres are considered wetlands. Wetlands field surveys were conducted at CSSA in 1995 and 1996. Based on the survey results, four jurisdictional wetlands totaling 1.1 acres and seven non-jurisdictional wetlands totaling 3.2 acres are present CSSA. The non-jurisdictional wetlands are all man-made impoundments. However, two impoundments are classified as jurisdictional because they intercept flows from defined channels, springs, or seeps. The other jurisdictional wetlands appear to be associated with either springs or seeps.

Approximately 32,250 linear feet of ephemeral stream drainages on CSSA have defined channels and are potentially jurisdictional waters of the U.S. (SAIC 1997a). However, since these streams are ephemeral (run few days per year) and have no direct or indirect ties to permanently-flowing surface waters, it is questionable whether they are truly jurisdictional waters (**Figure 2.2**)

2.2.3 Wildlife

The installation supports a variety of wildlife similar to the surrounding region. Bird surveys conducted at CSSA between mid-March and early June 2005 documented 92 bird species at the installation. Although definitive surveys have not been conducted for other wildlife at CSSA, several game species are known to occur at the installation, including: white-tailed deer (*Odocoileus virginianus*), skunk (*Mephitis mephitis*), wild turkey (*Meleagris gallopavo*), dove (*Zenaida macroura*), duck, quail, rabbits (*Lepus californicus* and *Sylvilagus floridanus*), squirrel (*Sciurus niger*), raccoon (*Procyon lotor*), mountain lion (*Puma concolor*), and coyote (*Canis latrans*). Other species likely to be found at CSSA include opossum (*Didelphis marsupialis*), ring-tailed cat (*Bassariscus astutus*), bobcat (*Lynx rufus*), and a variety of rodent species (SAIC 1997b).

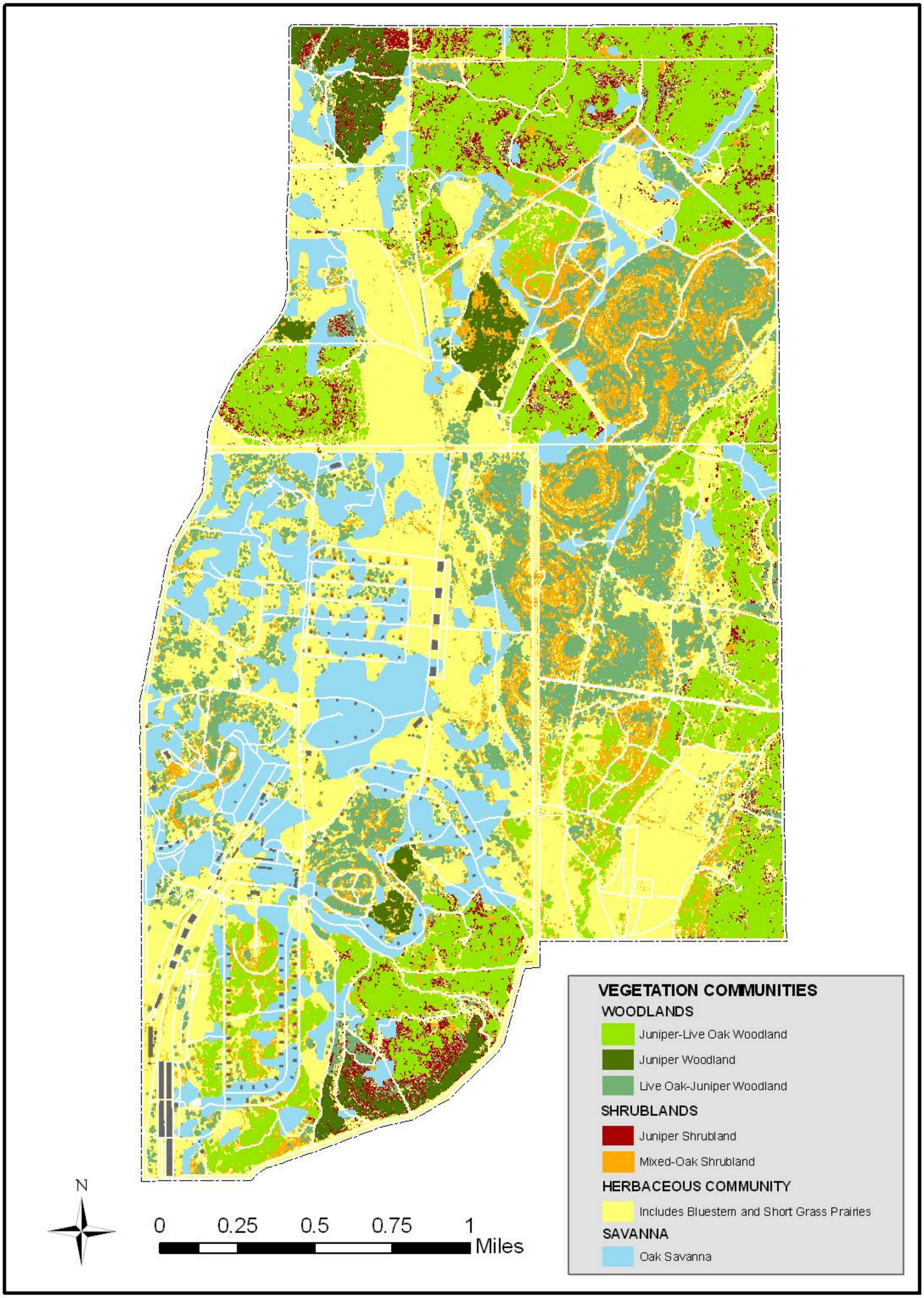

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Figure 2.1 – Vegetation Communities at CSSA

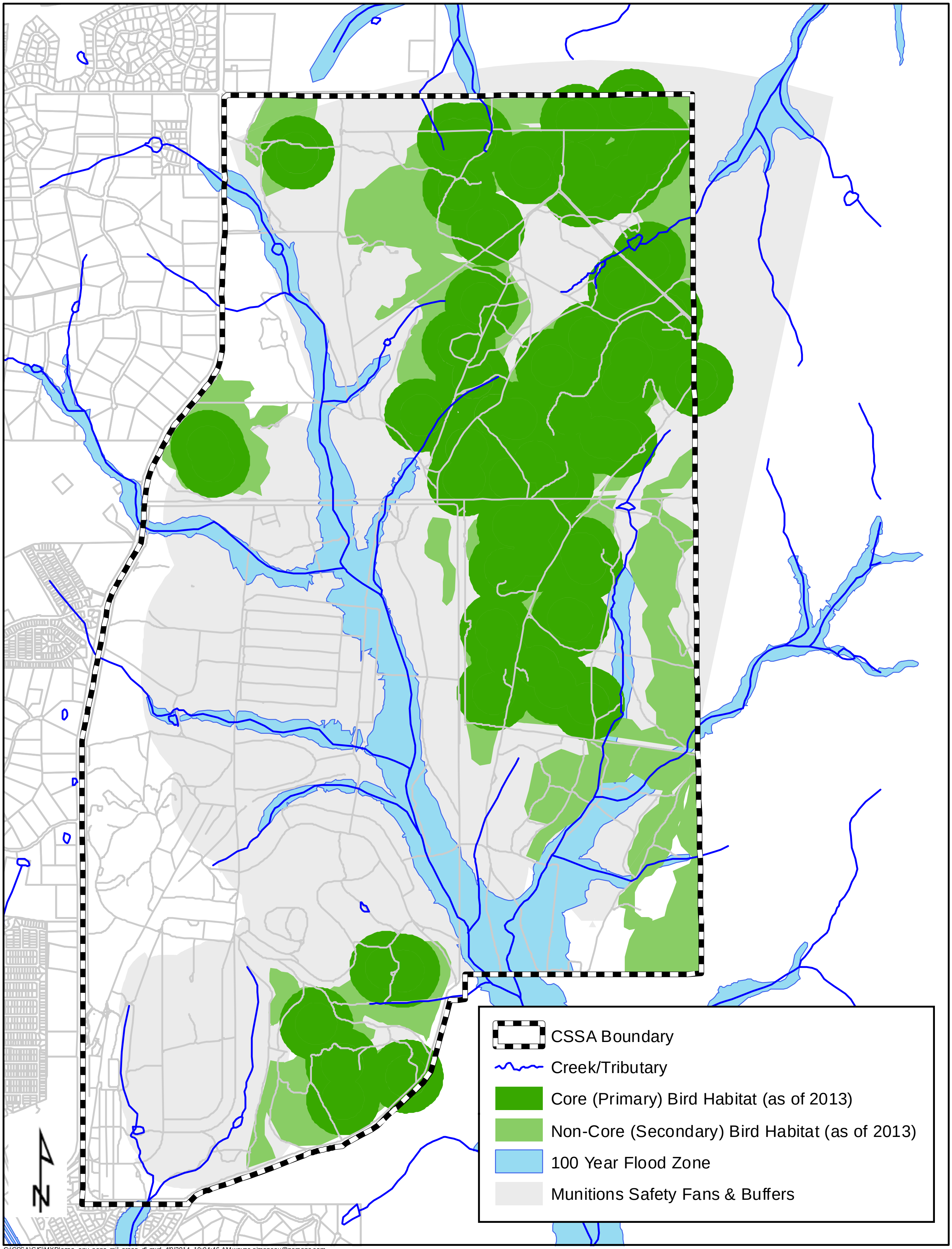

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Figure 2.2 - Environmental Sensitive and Military Safety Areas at CSSA

CSSA has a wildlife management program which includes hunting. The installation maintains a hunting plan, which defines the following goals for the program:

- Maintenance of deer population numbers;
- Improvement of the overall health of the deer herd while allowing for more vegetation diversity;
- Improvement of recreational opportunities for installation employees; and
- To provide excess meat to charitable institutions.

Hunting at CSSA is primarily for native white-tailed deer and exotic axis deer, turkey, dove, and quail. Regulations for hunting white-tailed deer and other game animals at CSSA are consistent with regulations of the State of Texas. Axis deer are not regulated by the State of Texas, but CSSA restricts axis deer hunting to the white-tailed deer season. The entire deer population is confined by 8- to 10-foot security perimeter fence. There are 45 deer stands at the installation that can be moved to different areas, if necessary.

More detailed information on the hunting and wildlife management programs at CSSA can be found in the *Integrated Natural Resource Management Plan* (Parsons 2013a).

2.2.4 Rare Species

There are two federally-listed species present at CSSA: the black-capped vireos (BCVI) (*Vireo atricapillus*) and golden-cheeked warblers (GCWA) (*Dendroica chrysoparia*). The Endangered Species Act (ESA) of 1973 and Army Regulation (AR) 200-3 require the Army to protect animal and plant species that are federally listed as endangered or threatened. The ESA specifically requires agencies not to "jeopardize" the continued existence of any listed species, or to destroy or adversely modify habitat critical to any listed species.

Several surveys were conducted on post for endangered and threatened species. A general habitat evaluation was conducted 1992 and detailed bird surveys were conducted in the spring of 1993 (Stewardship Services 1993). Presence-absence surveys for BCVI and GCWA are conducted in the spring every other year, and past surveys were conducted between April and July in 2005, 2007, 2009, 2011, and 2013. **Figure 2.2** shows primary and secondary bird habitats identified during the 2013 bird survey. In 2013, a total of 36 GCWA and no BCVI were observed at CSSA. This represents is a 27% increase in GCWA from 2011. Although no BCVI detections have occurred at CSSA since the 2005 survey, suitable habitat is found at various locations in the East Pasture, North Pasture, and Inner Cantonment.

None of the caves or karst features on-post are likely to contain state-listed threatened or endangered karst species due to CSSA's probable location outside of the zones where they occur (Veni 2001). However, during a downhole video camera survey of wells at CSSA, an unidentified salamander was observed in well CS-2 (Parsons 1996). This unidentified salamander could have been a Comal blind salamander or another rare troglobitic salamander. The Comal blind salamander is a state-listed species. The Comal blind salamander occurs in two caves on Camp Bullis and one cave on private property just north of CSSA's northern boundary (Veni 2002).

The CSSA *Integrated Natural Resource Management Plan* (Parsons 2013a) provides a summary of federal- and state-listed species with potential to occur in Bexar County, Texas. An analysis of the known distributions, habitat requirements, and habitat present at CSSA suggests that a majority of the state-listed species are not expected to occur at CSSA.

2.3 METEOROLOGY AND CLIMATE

CSSA maintains three on-post weather stations to monitor rainfall, wind speed and direction, relative humidity, and temperature. One is located near AOC-65, one at well MW18, and one near SWMU B-3 (**Figure 2.3**).

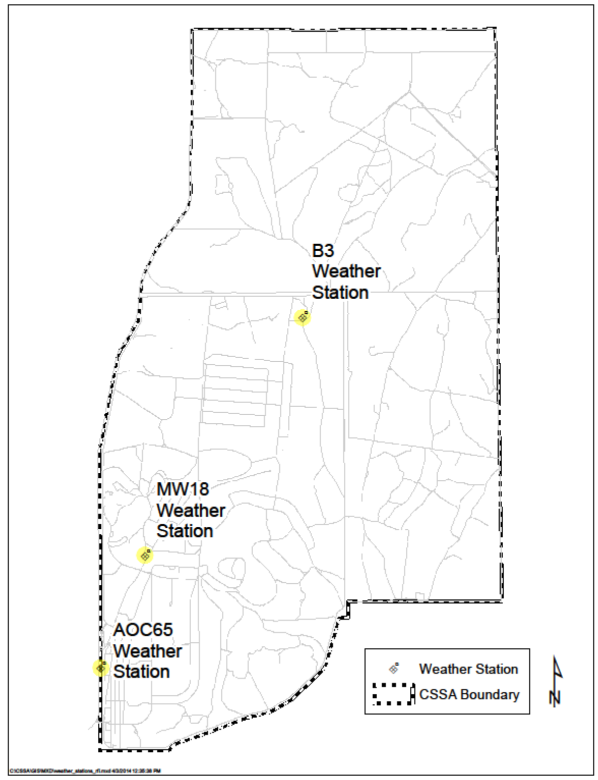


Figure 2.3 – Locations of On-Post Weather Stations

CSSA has a modified subtropical climate, predominantly marine during the summer months and continental during the winter months. The resulting weather is characterized by hot summers with daily temperatures above 90 degrees Fahrenheit (°F) over 80 percent of the time and mild winters with below-freezing temperatures occurring on an average of only about 20 days per year. The average annual temperature is 69°F. The highest average daily maximum temperature is 95°F in July, and the lowest average daily minimum temperature is 39°F in January.

CSSA is situated between a semi-arid region to the west and the coastal area of heavy precipitation to the east. Between the years of 1934 and 1999, the annual rainfall at Boerne averaged 33.66 inches. Precipitation is fairly well distributed throughout the year, with the heaviest amounts occurring in May and September. Approximately 61 percent of the rainfall occurs over the period from April through September and is primarily due to thunderstorms. Damaging hail seldom occurs, but light hail is common with springtime thunderstorms. Since CSSA is only 140 miles from the Gulf of Mexico, tropical storms occasionally affect the post with strong winds and heavy rains. Spring rainfalls are associated with frontal systems while summer rainfalls are associated with thunderstorms and tropical weather. Measurable snowfall occurs only once every 3 or 4 years.

2.4 SOILS

In general, soils at CSSA are thin, dark-colored, gravelly clays and loams derived from the carbonate parent materials limestone and shale bedrock. The soil types are strongly influenced by topography and the underlying limestone. A total of eight soil types occur at CSSA, according to the 1966 USDA soil survey for Bexar County. Past environmental work has been performed to statistically determine background concentrations for inorganics (metals) that naturally occur in CSSA soil. This “Background” study has been accepted by the TCEQ, and has become the basis for SWMU and AOC closure comparison criteria.

2.5 GEOLOGY

The Texas Hill Country is characterized predominantly by limestone bedrock which formed in ancient times when the area was under the ocean, and northeast-southwest trending faults which historically caused displacement between lithologic layers (**Figure 2.3**). Weathering (by water) of limestone results in karst features such as caves, vugs, and “honeycomb.” The faults and karst features strongly influence the movement of groundwater.

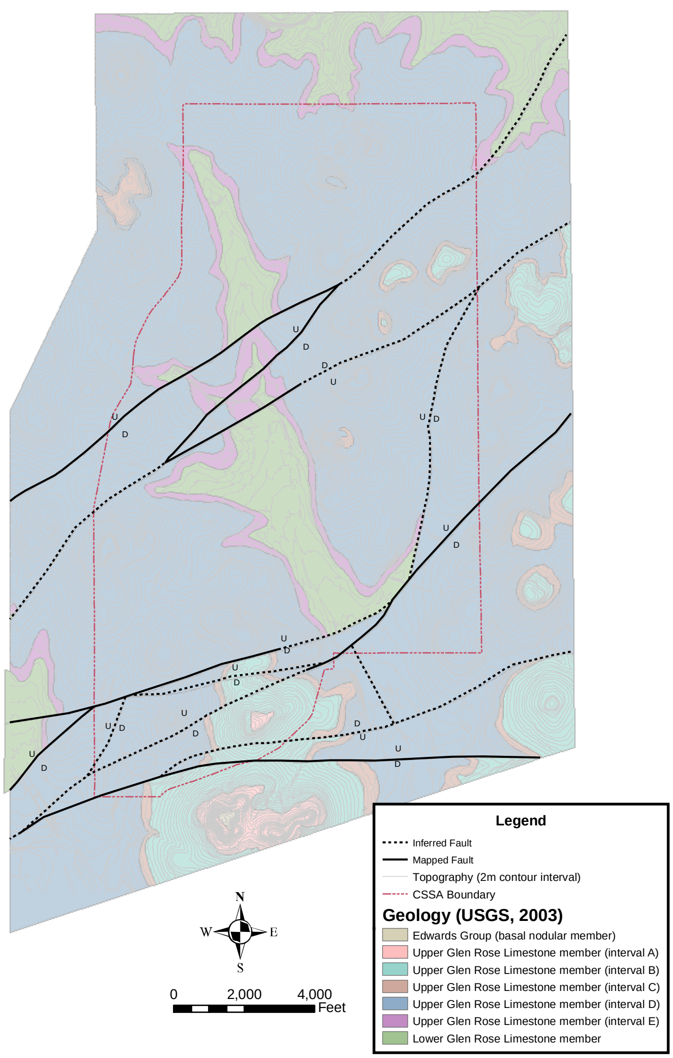


Figure 2.3 - Surface Geology and Fault Zones at CSSA

2.5.1 Stratigraphy

The oldest and deepest known rocks in the area are Paleozoic age (225 to 570 million years ago) schists of the Ouachita structural belt. They underlie the predominant Cretaceous-age carbonate lithology of the Edwards Plateau. **Figure 2.4** summarizes the Cretaceous System stratigraphy at CSSA and the surrounding areas. At CSSA, the near-surface geology and aquifer are composed of Trinity Group carbonate bedrock which includes the Glen Rose and Travis Peak Formations. In particular for CSSA, the units of interest are the Glen Rose Limestone, Bexar Shale, and Cow Creek Limestone that form the Middle Trinity aquifer.

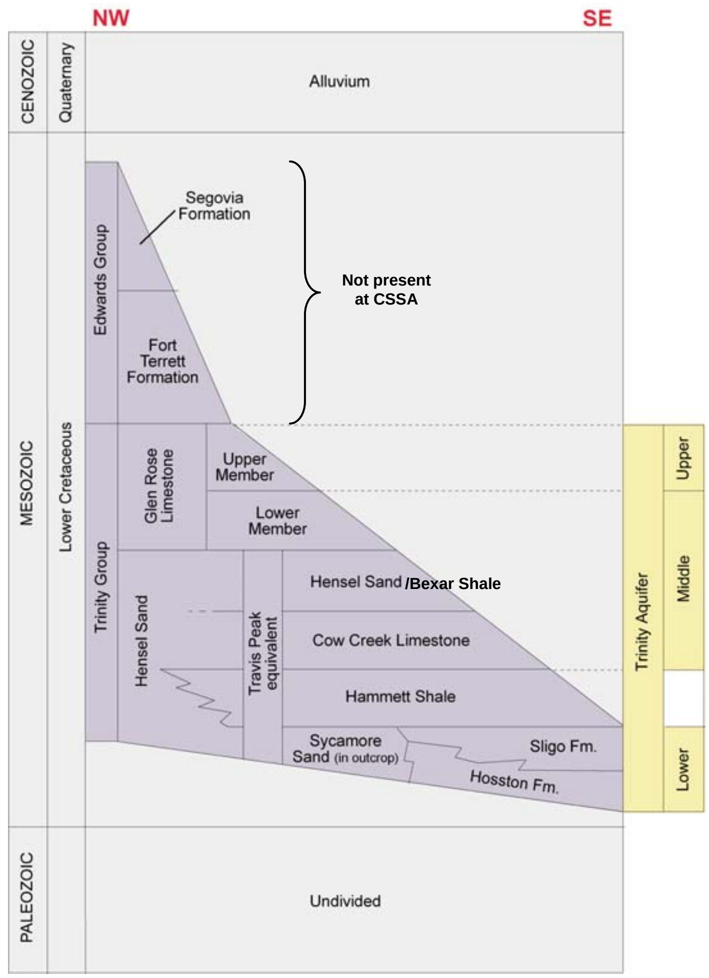


Figure 2.4 - Stratigraphic and Hydrostratigraphic Section of the Hill Country Area

The upper member of the Trinity Group is the Glen Rose Limestone. The Glen Rose represents a thick sequence of shallow water marine shelf deposits. This formation is divided into upper and lower members. At CSSA, the Glen Rose is exposed at the surface and in stream valleys. The Upper Glen Rose (UGR) consists of beds of blue shale, limestone, and marly limestone with occasional gypsum beds (Hammond 1984). Based on well log information, the thickness of the upper member reaches 500 ft in Bexar County. The thickness of this member at CSSA is estimated from well logs to be between 20 and 150 ft. The Lower Glen Rose (LGR), underlying the UGR, consists of a massive fossiliferous limestone, grading upward into thin beds of limestone, marl, and shale (Ashworth 1983).

The lower member, according to area well logs, is approximately 300 ft thick at CSSA.

Underlying the Glen Rose Limestone is the Travis Peak Formation, which attains a maximum thickness of about 940 ft and is divided into five members, in descending order: the Hensell Sand (and Bexar Shale [BS] facies), the Cow Creek (CC) Limestone, the Hammett Shale, the Sligo Limestone, and the Hosston Sand.

The youngest member of the Travis Peak Formation is the Hensell Sand, locally known as the BS. The shale thickness averages 60-80 ft, and is composed of silty dolomite, marl, calcareous shale, and shaley limestone, and thins by interfingering into the Glen Rose Formation. The underlying CC Limestone is a massive fossiliferous, white to gray, shaley to dolomitic limestone that attains a maximum thickness of 90 ft down dip in the area. At CSSA, groundwater is produced from the LGR and CC intervals of the Middle Trinity Aquifer. The stratigraphically oldest rocks (Hammett Shale, Sligo Limestone, and Hosston Sand) comprise the Lower Trinity Aquifer, but are not developed at CSSA.

2.5.2 Structure

The predominant structural geologic features in the area are regional vertical fractures, the regional dip, and the Balcones fault zone (BFZ) escarpment. Regional fractures are the result of faulting in the Cretaceous sediments and in the deeper Paleozoic rocks. The two sets of fracture patterns trend northwest-southeast and northeast-southwest across the region. The regional dip is to the east and southeast at a grade of about 100 ft per mile near the fault zone in Bexar and Comal Counties, decreasing 10-15 ft per mile northwest of CSSA.

The BFZ is a series of high-angle normal faults that generally trend NE and SW. Total displacement in northwest Bexar County is approximately 1,200 ft. The faulting is a result of structural weakness in the underlying Paleozoic rocks and subsidence in the Gulf of Mexico basin to the southeast. The down drop blocks outcrop as progressively younger strata from northwest-southeast across the fault zone. **Figure 2.5** generically diagrams the regional geology and structure based on the groundwater modeling efforts performed by the Texas Water Development Board (TWDB) (Mace, *et al* 2000).

2.6 GROUNDWATER HYDROLOGY

Groundwater occurrence and movement is highly variable due to the complex geologic environment. Three aquifers are present in the area of CSSA: the Upper, Middle, and Lower Trinity aquifers. These divisions are based on hydraulic continuity. The Glen Rose Formation and the Travis Peak Formation are the principle water-bearing units. As is depicted on Figure 2.4, the Upper Member of the Glen Rose Formation composes the Upper Trinity Aquifer, and the Lower Member, a portion of the Middle Trinity Aquifer. The Travis Peak Formation includes a portion of the Middle Trinity Aquifer and the full Lower Trinity Aquifer. Beneath these are metamorphosed Paleozoic rocks, which act as a lower hydrologic barrier. Only the Middle and Upper Trinity aquifers are typically addressed at CSSA.

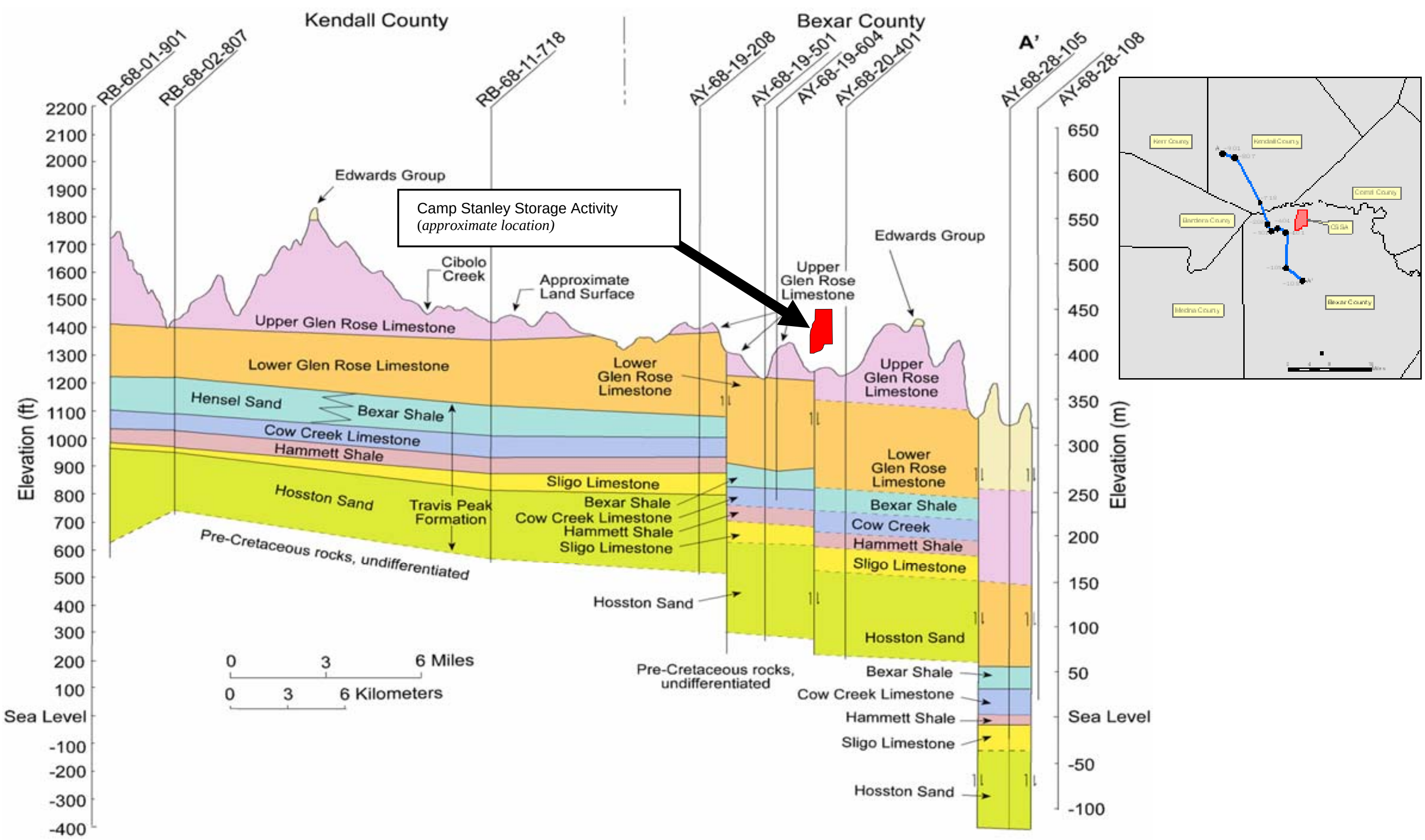


Figure 2.5 - Geologic Cross-Section through the Study Area

2.6.1 Middle Trinity Aquifer

The primary groundwater source at CSSA and surrounding areas is the Middle Trinity aquifer, consisting of the LGR Limestone, the Bexar Shale, and the CC Limestone. The average combined thickness of the aquifer members is approximately 460 feet. In the vicinity of CSSA, the LGR portion of the Middle Trinity aquifer is recharged by direct precipitation on the outcrop and stream flow infiltration. Likewise, over the same area, the Bexar Shale acts as a hydrologic barrier to vertical leakage except where faulted; therefore, most recharge to the CC Limestone comes from overlying updip formations. The bottom of the CC Limestone forms the base of the Middle Trinity aquifer.

Information regarding the subsurface at CSSA was compiled from borehole data, geophysics, and surface mapping to create a conceptual stratigraphic model. Nearly 90 percent of the land surface at CSSA is comprised of the basal section of the UGR limestone, comprising the upper confining layer of the Middle Trinity aquifer. Data indicate that the underlying LGR is typically an average thickness of 320 feet. The Bexar Shale is normally 60 feet in thickness, whereas the underlying CC Limestone unit is typically 75 feet in thickness.

The bulk of the main groundwater body occurs within the basal portion of the LGR and the upper portion of the CC Limestone. The occurrence of groundwater within these units was implicitly related to the massive moldic porosity and karstic features associated with reef-building events and fossiliferous biostromes capable of storing large quantities of water. Occasionally, large volumes of groundwater can also be produced from well-developed reefs above the basal unit, or from significant perched fracture or karstic features. Otherwise, groundwater yields in the UGR and the top 250 feet of the LGR are minimal. Likewise, groundwater production from the BS is negligible.

Based on observation well measurements, regional groundwater flow is generally to the south-southeast (**Figure 2.6**). The LGR typically has a southward gradient that deviates around mounding which occurs at CSSA near the central and northern portions of the facility (CS-MW4-LGR).

Long-term monitoring shows that groundwater response to precipitation events can be swift and dramatic. Depending on the severity of a precipitation event, the groundwater response will occur within several days, or even hours. As an example, The Bexar Shale exhibits the potential for either northward or southward flow, depending on the season. Likewise, the CC Limestone exhibits erratic flow paths, with seasonally radial flow from mounded areas.

CSSA received 4.51 inches of rain in approximately a 24-hour period on October 3-4, 2009. The aquifer had been suffering from a two year drought and the water levels were severely depressed. That one instance of significant rainfall resulted in an aquifer rebound ranging up to 86 feet within one day of the precipitation event. Data obtained from the on-post well clusters indicate that for most of the year, a downward vertical gradient exists within the Middle Trinity aquifer. Differences in drainage rates often leave the head of the Bexar Shale well above the head of the LGR and CC Limestone. The large differences in head suggest that the Bexar Shale reacts locally as a confining barrier between the LGR and CC Limestone.

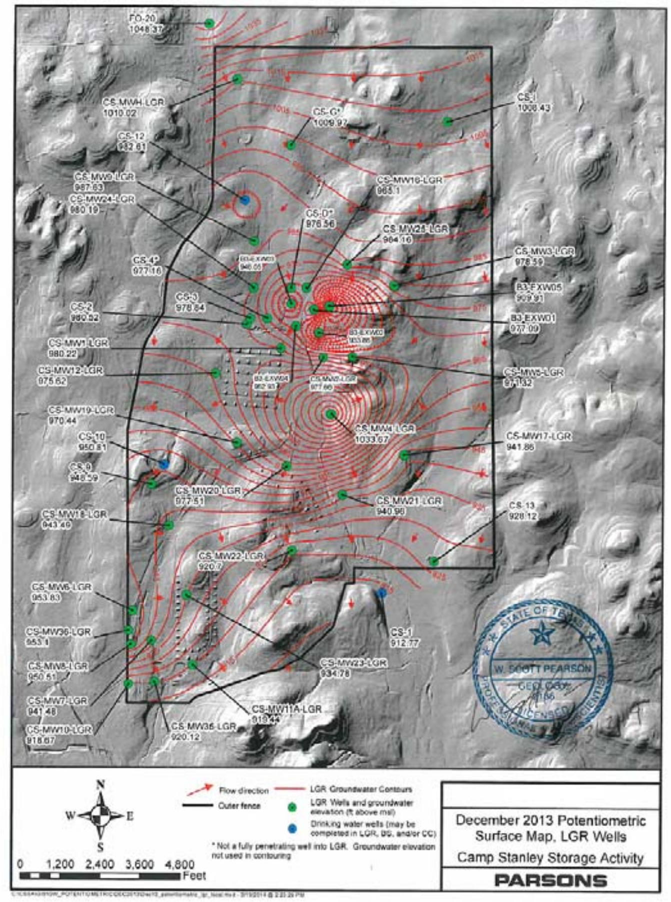


Figure 2.6 - December 2013 Potentiometric Surface Map, LGR Wells

2.6.2 Upper Trinity Aquifer

The Upper Trinity aquifer consists of the UGR Limestone, and is the uppermost water-bearing unit at CSSA. However, because the unit is so thin at CSSA, it normally does not store appreciable quantities of water. Typically it is not used for water supply in the vicinity of CSSA. The primary interest of the UGR at CSSA concerns environmental investigations addressing impacts to the uppermost occurrence of groundwater.

2.6.3 USGS Groundwater Modeling

CSSA contracted with the United States Geological Survey (USGS) to perform geophysical surveys and develop a 3-D geologic model for CSSA and the immediate surrounding area. This geologic model is compatible with groundwater modeling programs that can be used to model Middle Trinity Aquifer ground water present at the facility. The newly-funded work builds upon previous USGS work including surface geologic mapping, aerial electromagnetic (AEM) surveys, and borehole electromagnetic (EM) surveys. The work conducted at CSSA will become the framework for a larger USGS study conducted on the Trinity Aquifer in Northern Bexar County.

The USGS also conducted borehole geophysics in a select number of both on- and off-post wells in order to further define hydrostratigraphic model of the Middle Trinity Aquifer. The borehole logging activities included the standard suite of geophysical methods, advanced video imaging, and nuclear logging tools to aid in the estimation of stratigraphy, porosity, and permeability. The USGS combined this newly-acquired data with existing geologic data from CSSA to build a 3-D visualization model using the EarthVision software similar to **Figure 2.7**. The initial model includes 102 wells, 16 model layers, one major fault line, and six minor faults. The model will visually depict the hydrostratigraphic and structural features of model area and can form the basis for a numerical groundwater flow model.

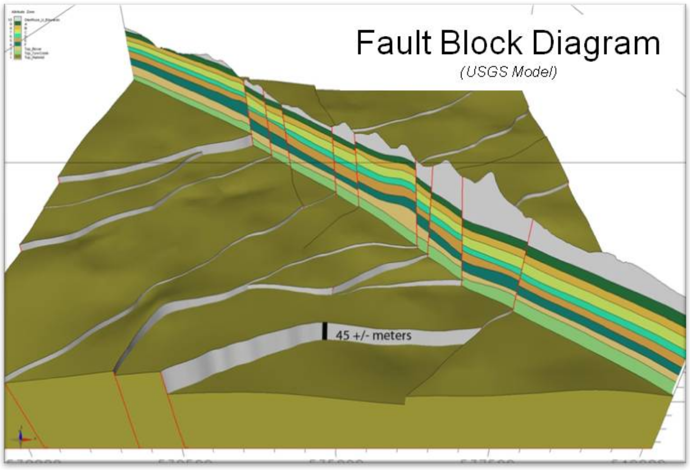


Figure 2.7 – USGS 3-D Model

2.7 GROUNDWATER USE

Both CSSA and the immediate surrounding areas use the Middle Trinity aquifer for a potable water source. This includes CSSA, commercial developments, private landowners, and until recently, several nearby public water systems. As of April 2014, there are four supply wells in use at CSSA (CS-1, CS-9 [for emergency use], CS-10, and CS-10), and approximately 55 private wells within ¼ mile of the post boundary (see Section 5).

Several new housing developments neighboring CSSA are supplied by San Antonio Water System (SAWS). SAWS develops its water primarily from the Edwards aquifer to the southeast. In addition, the neighboring City of Fair Oaks obtains its drinking water from both the Trinity aquifer and Canyon Lake, which the Guadalupe Blanco River Authority (GBRA) extracts and treats at the Western Canyon Water Treatment Plant.

It is estimated that approximately 67 percent of the annual precipitation is expected to be lost to evapotranspiration. Another 29 percent is assumed to be lost to annual surface runoff, while the remaining 4 percent recharges the Middle Trinity aquifer (based on published literature values). Assuming these estimates are valid, CSSA can be expected to consume between 11 percent and 25 percent of its annual rainfall recharge.

2.8 SURFACE WATER HYDROLOGY

The CSSA landscape is hilly with stony soils and high runoff potential. Natural stream channels on CSSA generally have broad floodplains, and portions of CSSA are within the 100-year floodplain. Salado, Leon, and Cibolo Creeks drain surface water from CSSA. Approximately 75 percent of CSSA is in the Salado Creek watershed, 15 percent in the Cibolo Creek watershed, and 10 percent in the Leon Creek watershed (see Figure 2.2). Most of the active-use areas of CSSA are in the Leon Creek watershed. All of these streams are intermittent at CSSA.

Rainfall runoff is conveyed to natural stream flow channels by ditches and sheet flow in the developed areas of CSSA. CSSA has sufficient relief to allow rapid conveyance of runoff from developed areas, and in the undeveloped areas, runoff flows overland to natural channels.

Section 3 - Site Status

As of April 2014, CSSA has closed 81 sites. The first site was closed in 1995, and the most recent closure was approved by TCEQ in November 2013. Cleanup and closures were conducted in accordance with the State of Texas RCRA requirements. Over the course of these site closures, RCRA requirements have changed.

Through May 2005, the clean-up or closure strategy for CSSA's SWMUs and AOCs followed TCEQ's Risk Reduction Rules (30 TAC §335 Subchapter S). After May 2005 the clean-up or closure strategy for these sites fell under the TRRP 30 TAC §350, which became effective May 1, 2000 (discussed below in Section 3.2). All sites that were in the process of being remediated using the Risk Reduction Standard 1 (RRS1) after May 1, 2000 were allowed to complete closure under those criteria until April 30, 2005. **Table 3.1** summarizes the closure status of each site. The location and closure status of each site at CSSA is also shown on Figure 1.1.

Additional considerations and requirements for site closure at CSSA are presented in Section 1.4 of this SMP.

3.1 TEXAS RISK REDUCTION RULES

The Texas Risk Reduction Rules allowed for three different closure standards. RRS1 required that closure and/or remediation concentrations meet background levels or practical quantitation limits if the practical quantitation limit exceeded background. Sites closed under RRS1 have no land use restrictions associated with them, and are considered safe for residential land use. RRS2 and RRS3 used site-specific criteria to determine cleanup levels, and both required that deed restrictions and possibly institutional controls be placed on the property to control future use of the site. All sites at CSSA that were closed under the Risk Reduction Rules, a total of 37 sites, were closed under RRS1.

3.2 TEXAS RISK REDUCTION PROGRAM

The TRRP sets forth a three-tiered method for calculating cleanup levels that are protective of human health and the environment referred to as PCLs. Tier 1 uses a generic non-site-specific list of PCLs which are meant to be conservative (more stringent). Tier 2 and Tier 3 use site-specific, TCEQ, or user models to generate PCLs.

At sites where contaminant of concern (COC) levels are below the Tier 1 PCLs, or where COCs are removed to levels below Tier 1 PCLs, the site may be closed with a simple Release Investigation Report, as described in Section 3.3. At sites where COC levels are above Tier 1 PCLs, an affected property assessment must be completed to identify the nature and delimitate the extent of contamination.

The extent of each environmental media that contains COCs at concentrations greater than the critical (lowest) PCLs are identified and designated as PCL exceedance (PCLE) zones in an Affected Property Assessment Report (APAR).

The rule provides two remediation options to address COCs that exceed PCLs: Remedy Standard A and Remedy Standard B. These rule requirements appear in 30 TAC §§350.31-350.33 and §350.37. In most cases, PCLs determined under Tiers 1, 2, and/or 3 can be used with Remedy Standard A or B.

3.2.1 Remedy Standard A

Remedy Standard A is a cleanup option. A person may initiate or "self-implement" Remedy Standard A without seeking prior approval from the TCEQ. However, a Self Implementation Notice must be sent to TCEQ 10 calendar days before the actual cleanup begins. Remedy Standard A requires the following response objectives be achieved:

- Remove and/or decontaminate PCLE zones:
  - Remove any listed hazardous waste which is contained within a waste management facility component or which is separable from environmental media using simple mechanical removal processes;
  - Remove and/or decontaminate any waste or environmental media which is characteristically hazardous due to ignitability, corrosivity, reactivity, or toxicity characteristic;
  - Remove and/or decontaminate the affected media and non-hazardous waste to achieve COC concentrations below the applicable residential or commercial/industrial critical PCLs;
- Prevent PCLE zones from expanding during the response action;
- Demonstrate that the affected property is protective for ecological receptors; and
- Eliminate the accumulation of vapors originating from COCs in surface or subsurface structures. This response objective also applies to areas of routine construction such as within utility excavations, for example.

3.2.2 Remedy Standard B

Remedy Standard B provides the option to control and manage the COCs instead of cleaning them up. Under Remedy Standard B, the COCs must be controlled and managed such that their extent does not spread in an unauthorized manner and so that no one will be exposed to COCs at a level above the PCL.

If Remedy Standard B is used, then long term monitoring will most likely be required, financial assurance may be required, and institutional controls (deed notices and restrictive covenants) must typically be filed in the county deed records. Remedy Standard B cannot be self-implemented. A Response Action Plan must be submitted to and approved by TCEQ before a person can use Remedy Standard B.

3.3 NO FURTHER ACTION SITE CLOSURE

Sites where TRRP is not applicable can be closed by obtaining a No Further Action (NFA) determination from TCEQ. This process begins by conducting an investigation when there is evidence that there may have been a release, or when there is another voluntary or mandatory reason for investigation (such as commercial real estate transactions, closure of a SWMU, or permanent removal from service of an underground storage tank). As of January 2014, CSSA had closed 29 sites with NFA status.

TRRP is not applicable when the results of the investigation show that:

- COC concentrations are not detected above the MQL or background, whichever is higher;
- There is no other evidence of a release; and
- Response actions were not required to achieve MQLs or background.

If all three of these conditions exist at the site, an RIR may be submitted to TCEQ requesting an NFA decision.

If COC concentrations exceed MQL or background, it is possible to obtain an NFA determination for a site so long as both ecological and human health exposure pathways are evaluated.

If it is determined that the ecological health or water resources (groundwater, surface water/ sediment) at the site are not are threatened or affected, the release is not subject to TRRP. Additionally, if COC concentrations do not exceed human health soil action levels and there is no evidence of other affected or threatened media, the release is not subject to TRRP.

If the concentrations exceed soil action levels for human health protection, the release is subject to TRRP unless it can be shown that COC concentrations in groundwater do not exceed the action levels. Excavation and/or the Synthetic Precipitation Leaching Procedure (SPLP) analysis may be used to either completely remove the affected soils from the property or to determine the COC leachability of the soils. If the final soil confirmation samples and/or SPLP leachate analytical results do not exceed groundwater ingestion pathways, the release will not be subject to TRRP.

In all cases, a report that documents the investigation and provides justification for NFA may be submitted to TCEQ. If the agency concurs with the conclusions, an NFA letter will be issued.

3.4 DELISTING

A total of seven sites at CSSA were closed by delisting them. This option was used for sites where no evidence of waste disposal was found.

3.5 ACTIVE RANGE COMPLEX

In 2012, four SWMUs (SWMU B-2, B-8, B-20/21, and B-24) were combined with RMU-1 as they are part of the active firing range complex. This site will be closed when the range is no longer active.

3.6 OPEN SITES

There are currently two open sites at CSSA that are undergoing remediation – SWMU B-3 and AOC-65. A Site Summary for each open site at CSSA is included at the end of this section. Each Site Summary provides a physical description and history of the site, a site location map, a list of potential or known COCs, the current status of any investigations or treatability studies, and future plans for investigation and closure.

TABLE 3.1
STATUS OF SWMUs, AOCs, AND RMUs at CSSA

Unit No.	Description	Investigation Report(s)	Recommendations	Requested Action				Closure Approved	Closure Type
				RRS1	NFA	Delisting	TRRP		
B-1	Powder and ammo burn area (1954).	RFI/Closure Report July 2002	NA	X				November-02	RRS1
B-2	Small arms ammunition burning area (1954) - North Pasture	RFI/Closure Report June 2002 Closure Report March 2005	Closure once range is inactive						
B-3	Landfill area (garbage disposal and burning trash); filled in 1990-91.	RFI Report March 2005	Bioreactor remediation ongoing						
B-4	Classified burn area (documents and trash).	APAR October 2012	Closure				X	February-13	TRRP
B-5	Possible fired small arms ammo brass area. Not located.	RFI/Closure Report July 2002	NA	X				October-02	RRS1
B-6	Possible solid waste disposal area.	RFI/Closure Report July 2002	NA	X				October-02	RRS1
B-7	Possible fired small arms ammunition brass disposal area	RFI/Closure Report July 2002	NA	X				October-02	RRS1
B-8	Fired small arms ammo brass disposal area (piles of fire bricks, ammo shells) - North Pasture	RFI Report December 2003	Excavate as necessary once range is inactive						
B-9	Miscellaneous solid waste (metal and weapons) disposal area.	RFI/Closure Report September 2002	NA	X				March-03	RRS1
B-10	Ammunition disposal area.	RFI/Closure Report May 2003	NA	X				January-04	RRS1
B-11	Miscellaneous solid waste disposal (ammo, scrap metal, const. debris).	RFI Closure Report June 04	NA	X				September-04	RRS1
B-12	Landfill, WPA trash when igloos were being built	RFI Report April 2005	NA	X				July-05	RRS1
B-13	Trash dump area.	RIR April 2013	Closure		X			July-13	NFA
B-14	*Possible fired brass area - not located.*	Delisting Request November 2007	NA			X		February-08	Delisting
B-15/16	Landfill (target vehicles, weapons mounts)	RIR June 2011	NA		X			September-11	NFA
B-19	Solid waste disposal area (metals and weapons).	RFI/Closure Report June 2002	NA	X				September-02	RRS1
B-20/21	Former OB/OD area & ammunition disposal areas - North Pasture	RFI Report July 2002 Combined with B-20	Closure once range is inactive						
B-22	Burn area (artillery shells).	RFI/Closure Report August 2002	NA	X				December-02	RRS1

TABLE 3.1
STATUS OF SWMUs, AOCs, AND RMUs at CSSA

Unit No.	Description	Investigation Report(s)	Recommendations	Requested Action				Closure Approved	Closure Type
				RRS1	NFA	Delisting	TRRP		
B-23	Disposal trenches (two green canisters)	RFI Report April 2005	NA	X				July-05	RRS1
B-23A	Disposal Trench (glass ampoules of liquid)	RFI Closure Report September 2004	NA	X				March-05	RRS1
B-24	Spent ammo/rockets area - North Pasture	RFI Report May 2002	MC removal once range is inactive						
B-25	Possible disposal trench	RFI Report April 2005	NA	X				July-05	RRS1
B-26	Possible disposal trench	Delisting Report August 2004	NA			X		November-04	Delisting
B-27	Sanitary landfill, consisting of 5-6 trenches (6 ft deep, 3 ft wide).	RFI Report July 2002 RIR September 2011	NA		X			December-11	NFA
B-28	Disposal trenches (molten metal, ammo, ammo parts)	RFI Report April 2002 RIR July 2011	NA		X			November-11	NFA
B-29	Solid waste disposal area (in old quarry)	RFI Report April 2005	NA	X				February-08	RRS1
B-30	Solid waste disposal area	RFI Report September 2004	NA	X				February-05	RRS1
B-31	Lead shot/sand pipe bedding	RFI/Closure Report July 2002	NA	X				November-02	RRS1
B-32	Lead shot/sand pipe bedding	RFI/Closure Report January 2003	NA	X				November-03	RRS1
B-33	Lead shot/sand pipe bedding	RFI Report September 2004	NA	X				November-04	RRS1
B-34	Maintenance pit floor drain and discharge point	RFI Report August 2002	Closure		*X*			*Pending*	*NFA*
B-71	Livestock area. Inner cantonment, SW of Well 16.	APAR	NA				X	October 2011	TRRP
AOC-64	Area east of SWMU B-4; flares observed in the area	APAR	NA				X	October 2011	TRRP
Bldg 40	less-than 90-day accumulation container storage area	RFI/Closure Report September 2003	NA	X				January-04 and January-06	RRS1
Bldg 43	Inactive makeshift ammo demolition facility	RFI Report April 2005	NA	X				August-05	RRS1
DD	Dud ammunition disposal area	RFI Report January 2005	NA	X				April-05	RRS1
F-14	*Hazardous waste storage area (<90-day)*	RFI/Closure Report, 1995	NA	X				November-95	RRS1

TABLE 3.1
STATUS OF SWMUs, AOCs, AND RMUs at CSSA

Unit No.	Description	Investigation Report(s)	Recommendations	Requested Action				Closure Approved	Closure Type
				RRS1	NFA	Delisting	TRRP		
I-1	Inactive incinerator (built in 1943), currently used for transformer storage	RFI Report February 2003	NA				X	November-08	NFA
O-1	Waste liquid/sludge oxidation pond (1975)	RFI/Closure Report October 2000	NA	X				April-02	RRS1
Coal Bins	*Coal bins (no longer in use)*	Delisting Requested January 2003	NA			X		February-08	Delisting
AOC-35	Area immediately around Well 16. Northeast area of inner cantonment.	RFI/Closure Report October 2002	NA	X				February-03	RRS1
AOC-36	Area between Well 16 and B-3. Possible waste verified not present by magnetometer survey.	RFI/Closure Report April 2002	NA	X				August-02	RRS1
AOC-37	Livestock area. NW of Well 16 and N of Well D.	RFI/Closure Report June 2004	NA	X				January-05	NFA
AOC-38	Livestock area. Inner cantonment, SW of Well 16.	RFI Report September 2004	NA	X				February-05	RRS1
AOC-39	None. Area west of Well 16 between North Outer Rd and cantonment fence.	RFI/Closure Report April 2002	NA	X				September-02	RRS1
AOC-40	None. Area east of Well 16 between North Outer Rd and cantonment fence.	RFI/Closure Report May 2002	NA	X				August-02	RRS1
AOC-41	Gate area east of well 16. North Pasture, north of gate 6.	NFA Report April 2005	NA		X			July-05	NFA
AOC-42	None. South of SWMUs B-28 and B-19, west of B-4.	RFI Report October 2002 RIR August 2011	NA		X			December-11	NFA
AOC-43	Shallow trench without mounds. Metal, UXO. Located 50 ft south of B-7.	RFI/Closure Report October 2002	NA	X				February-03	RRS1
AOC-44	Fox holes and trenches south of B-9 along west slope of hill. UXO includes Stokes mortars and 20-lb bombs.	Delisting Report April 2005	NA			X		July-05	Delisting
AOC-45	Flat area with spent and undamaged bullets. Located east of B-31, near bend in road.	RIR July 2011	NA		X			October-11	NFA
AOC-46	Bermed area with stockpile of lead shot and sand. Located south of Engineering on east side of Thompkins Road.	RFI/Closure Report April 2005	NA	X				July-05	RRS1
AOC-47	Area of trenches and mounds (similar to B-15/16). South of B-15/16, in SW area of East Pasture.	RFI/Closure Report June 2002	NA	X				September-02	RRS1
AOC-48	Three N-S trending mounds and a construction debris pile. Located north of B-15/16.	Delisting Report August 2004	NA			X		November-04	Delisting

TABLE 3.1
STATUS OF SWMUs, AOCs, AND RMUs at CSSA

Unit No.	Description	Investigation Report(s)	Recommendations	Requested Action				Closure Approved	Closure Type
				RRS1	NFA	Delisting	TRRP		
AOC-49	Trench (4 x 7 ft) without surficial debris. Located SW of deer stand 41 in central East Pasture.	Delisting Report April 2005	NA			X		July-05	Delisting
AOC-50	Area with orange discolored material (most likely nickel penetrate) at ground surface. South of B-30 along gravel road.	RFI/Closure Report January 2005	NA	X				April-05	RRS1
AOC-51	East pasture, east of active range, approximately 25 acres, area around B-9	RIR July 2012	Closure		X			October-12	NFA
AOC-52	Area west of B-4 towards Salado Creek near trees, two trenches	RIR August 2011	NA		X			December-11	NFA
AOC-53	Building foundation near B-27 at Central Road and road to "D" Tank, batteries at rear of slab	RFI/Closure Report April 2005	NA	X				July-05	RRS1
AOC-54	Area near gutting pit, east of Welding Shop Building, right side of road batteries were stored in the area	Closure Report July 2004	NA	X				November-04	RRS1
AOC-55	Landfill, south of Tenberg Drive, east of Salado Creek	RFI/Closure Report Feb 04	NA	X				June-08	RRS1
AOC-56	Landfill, at intersection of Bernard Road and East Outer Road, surface depression on south side of intersection	Closure Report June 04	NA	X				September-04	RRS1
AOC-57	East of Building 98 and KOA Area, cleaning/maintenance activities performed at temporary structures	RIR May 2011	NA		X			September-11	NFA
AOC-58	Suspected disposal trench within Inner Cantonment	RFI Report October 2002 RIR August 2011	NA		X			December-11	NFA
AOC-59	Trench-type anomaly located west Test Pad in the East Pasture	RIR July 2011	NA		X			October-11	NFA
AOC-60	Trench located west of tunnel and entrance roadway in the East Pasture.	Delisting Report April 2005	NA			X		July-05	Delisting
AOC-61	Suspected landfill	RFI/Closure Report October 2002	NA	X				February-03	RRS1
AOC-62	Located west of monitoring well MW-2 and east of Salado Creek.	RIR August 2011	NA		X			December-11	NFA
AOC-63	Area consisting of 3 barrels containing rocks, south of deer stand 41 in the East Pasture.	APAR October 2008	NA				X	July-09	TRRP
AOC-65	A concrete pit area that housed a metal vat that contained TCE and PCE.	RFI Report August 2003	Additional investigation, ISCO remediation ongoing						

TABLE 3.1
STATUS OF SWMUs, AOCs, AND RMUs at CSSA

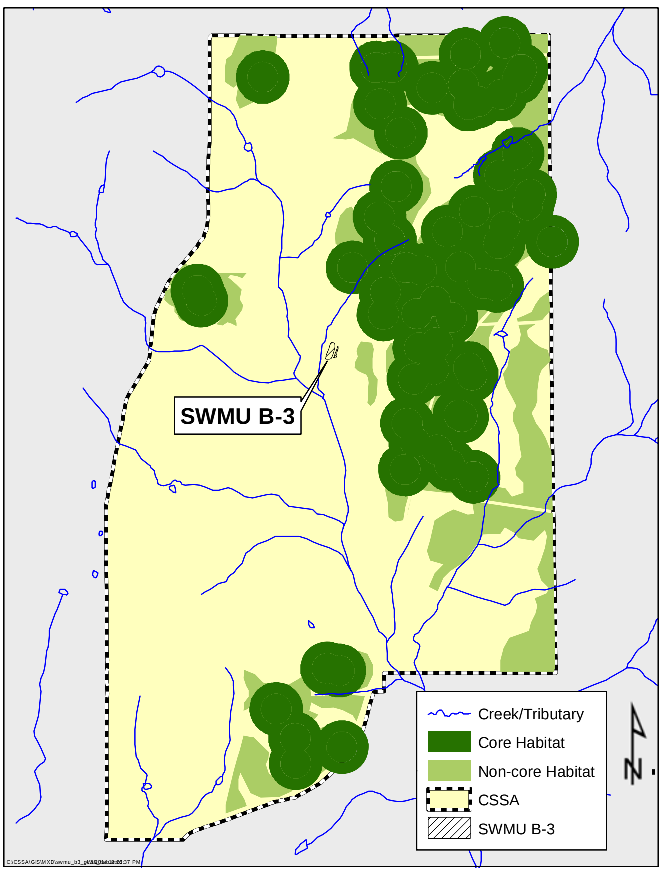
Unit No.	Description	Investigation Report(s)	Recommendations	Requested Action				Closure Approved	Closure Type
				RRS1	NFA	Delisting	TRRP		
AOC-66	Area north of Well 16 in the outer cantonment.	Closure Report June 04	NA	**X**				February-05	NFA
AOC-67	Concrete pad near Building 90 housed a vat containing cleaning solvents.	RIR July 2010	NA		**X**			September-10	NFA
AOC-68	Area includes metal slag/debris storage area from Wheelabrator operations next to Building 90-2.	RIR July 2010	NA		**X**			September-10	NFA
AOC-69	Located on west side of CSSA.	RIR June 2009	NA		**X**			October-09	NFA
AOC-70	Building used to mix pesticides. Near Building 1.	RIR June 2011	NA		**X**			September-11	NFA
AOC-72	Area containing concrete, possible asbestos. Located east of Building 94, in SW CSSA.	RIR March 2012	Closure		**X**			May-12	NFA
AOC-73	Ranch landfill with overgrown trenches. Near Well I1, in northwest corner of CSSA.	RIR September 2008	NA		**X**			January-09	NFA
AOC-74	Area with scattered building debris near Building 605 in the inner cantonment.	RIR February 2012	Closure		**X**			May-12	NFA
AOC-75	Area with high levels of mercury and barium.	RIR July 2013	Closure		**X**			November-13	NFA
RMU-1	Active firing range in the East Pasture	--	Investigation once range is inactive.						
RMU-2	Rifle range located in the inner cantonment.	RIR November 2011	NA		**X**			February-12	NFA
RMU-3	Firing range berm.	RIR May 2013	Closure		**X**			May-13	NFA
RMU-4	Former rifle range in East Pasture.	RIR October 2013	Closure		**X**			February-14	NFA
RMU-5	Former rocket range in North Pasture.	RIR June 2012	Closure		**X**			September-12	NFA

SWMU B-3

Site Status: Remediation in Progress
Dates Used: 1960s -1991
Type of Site: Landfill
Estimated Size: 2.9 acres
Anticipated Waste: Metal debris, solvents, contaminated soil and groundwater
Potential COCs: Metals, VOCs

Site Location and Description

SWMU B-3 is located in the Inner Cantonment Area of CSSA, south of Well CS-16. The site is characterized by north-south oriented dirt roads; a short downhill slope to an intermittent drainage on the west; a gradual uphill slope to the east; limestone outcrop to the east and southwest; and a small depression or "crater" in the north-central area.



Location of SWMU B-3 at CSSA

Site History

SWMU B-3 is a former landfill area, primarily used for garbage disposal and refuse burning, that covers an area of approximately 2.9 acres. The landfill consisted of a series of trench areas oriented north-south that were cut into weathered limestone. Initial site investigations indicated that western-most trenches covered an area about 100 feet wide, 325 feet long, and 19 feet deep, while an eastern trench was encountered that was about 75 feet wide, 250 feet long, and 12 feet deep. Landfill operation was terminated in 1990-1991.

SWMU B-3 View Facing Southeast - 2007

Previous Investigations

A geophysical survey (EM and GPR), a soil gas survey, and soil boring survey were conducted at SWMU B-3 in February 1995. The EM and GPR surveys identified two anomalies related to past waste management activities.

Soil samples were collected from seven soil borings drilled to a depth of 30 feet below ground level in 1995. DCE, PCE, TCE, vinyl chloride, chromium, copper, lead, and nickel were identified in concentrations above background. TCE concentrations in three samples were above the TCEQ risk reduction standards for closure, and chromium, copper, lead, and manganese concentrations also exceeded levels in one sample. Additionally, shallow perched groundwater samples indicated concentrations of *cis*-1,2-DCE, PCE, TCE, and vinyl chloride above the MCL at the soil boring (SB)1 location.

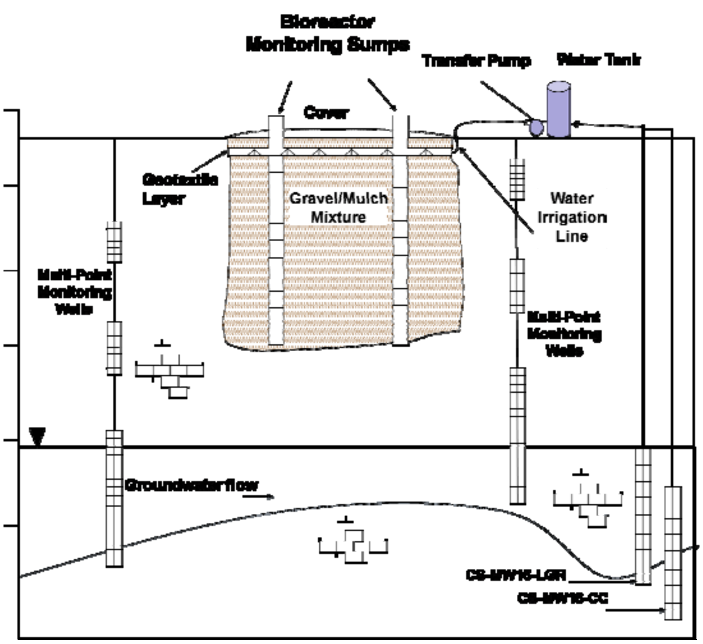
Two soil gas surveys were performed. The first soil gas survey was performed in June 1995, and the second, from November through December 1995. The first survey discovered high concentrations of PCE and TCE with lesser concentrations of *cis*-1,2-DCE associated with the PCE and TCE anomalies. The second, more detailed soil gas survey, provided PCE and DCE results similar to the initial survey, and revealed an additional TCE source area with high *cis*-1,2-DCE concentrations.

A soil vapor extraction (SVE) system was installed at the site and a pilot test conducted from February through March 1996. The SVE system included six vapor extraction wells (VEWs) and six vapor monitoring points (VMPs). Following the pilot test, the SVE system was expanded with the addition of 12 VEWs in January 1999. The SVE system reportedly removed 1,200 lbs VOC through March 2006, and though the technology proved to be an effective means of remediating the vapor-phase contaminants from the fractured bedrock, it was unable to remove sufficient mass to be a viable remediation option at SWMU B-3.

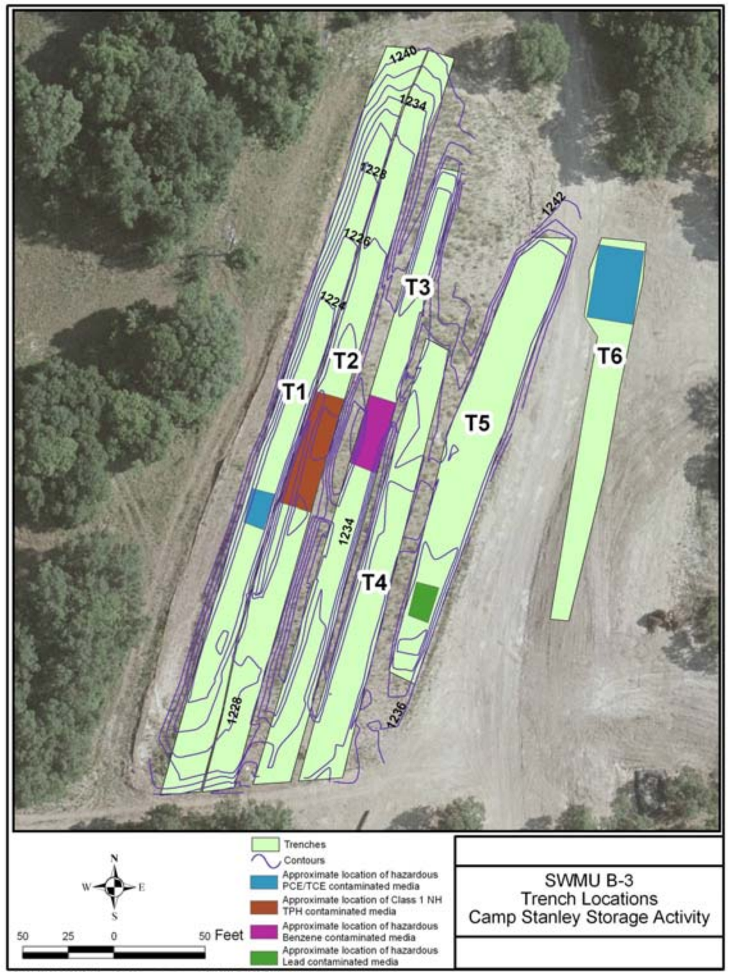
In 2006, approximately 15,000 cubic yards of waste and contaminated media were excavated from six trenches at SWMU B-3 and disposed of off-post. Some of the excavated waste included metal debris and potential MEC. At this time, the SVE system was also removed

Excavated Metal Debris from SWMU B-3

Following the excavation of the trenches, a bioreactor was designed and installed at the site. The trenches were backfilled with deciduous tree mulch and pea-gravel, and water lines with spray nozzles were installed to facilitate uniform water delivery to the trenches. The system was plumbed to Well CC-16, which provides a source of solvent-contaminated water. The solvents are a food source for the bio-organisms which dechlorinate PCE through the following process: PCE→TCE→DCE→vinyl chloride→ethene. Four multi-port monitoring wells (MPMW) were installed surrounding the bioreactor for groundwater monitoring. Three of the MPMWs were installed such that six hydrostratigraphic zones could be sampled and the fourth was installed in nine zones.



Conceptual Drawing of SWMU B-3 Bioreactor Design



Bioreactor operations at SWMU B-3 were initiated in April 2007, delivering contaminated groundwater extracted from CS-MW16-LGR and CS-MW16-CC to Trench 1. Groundwater samples were collected and analyzed monthly for natural attenuation parameters (e.g. VOC's, hydrogen, etc) to monitor the ongoing treatment of chlorinated compounds in groundwater at SWMU B-3.

Additional shallow monitoring wells were installed in 2010 to monitor bioreactor influence in the areas adjacent to the bioreactor trenches. New extraction wells CS-B3-EXW01 through EXW05 were installed between July 2009 and June 2012 to provide additional groundwater to the bioreactor. In addition to maintaining saturated conditions within the trenches, these wells provide contaminant mass to sustain the bacteria populations that drive the treatment of PCE and TCE in groundwater.

A flood test was conducted from September through October 2009 to evaluate the connectivity of trench 6 to the other trenches and the underlying hydrostratigraphic zones in both the vadose and saturated portions of the aquifer.

A new task order was awarded in September 2009 for continued bioreactor operations and monitoring at SWMU B-3. Nine piezometers were installed in the Upper Glen Rose (UGR-01) Formation around the bioreactor so that bioreactor influence in the vadose zone may be better understood.

In 2013, enhanced anaerobic bioremediation via bioreactor was selected as the final remedy to treat VOC contamination at SWMU B-3. System upgrades including the construction of a semi-permanent building to house the injection controls and holding tanks was completed in 2013. Additionally, the trenches were recharged with fresh mulch and new injection lines were installed.

As of December 2013, more than 90 million gallons of extracted groundwater from wells CS-MW16-LGR, CS-MW16-CC, and extraction wells B3-EXW01 through EXW05 have been applied to the bioreactor. Ethene, a natural attenuation dechlorination end-product, has been observed in trench sumps, and in discrete zones of nearby MPMWs and monitoring wells. Abiotic dechlorination processes have also been identified which has carbon dioxide as an end product.

What's Next?

Results of ongoing treatability studies at the SWMU B-3 bioreactor indicate that it is effective at treating the contaminated water that is pumped into it. Studies are continuing to determine the lateral and vertical extent to which the bioreactor treats underlying contamination lodged in the fractured bedrock and contaminated groundwater. Monitoring and studies also continue to verify that chlorinated compounds are reduced along multiple degradation pathways to the end products carbon dioxide and ethene.

As the bioreactor has been selected as the final remedy for SWMU B-3, and ongoing operations and monitoring activities are expected to continue until the contamination in groundwater is reduced to below MCLs.

Additional Documents

Environmental Assessment, Camp Stanley Storage Activity, Parsons Engineering Science, September 1993.

Groundwater Investigation and Associated Source Characterizations. Prepared for the Department of the Army Camp Stanley Storage Activity, Boerne, Texas and Armstrong Laboratory/OEB, Contract F33615-89-D-4003, Order 067. Parsons Engineering Science, June 1996.

Technical Memorandum on Surface Geophysical Surveys Near Well 16 as Part of Task 5 (Potential Source Characterization), Camp Stanley Storage Activity, Texas, Parsons Engineering Science, May 1995.

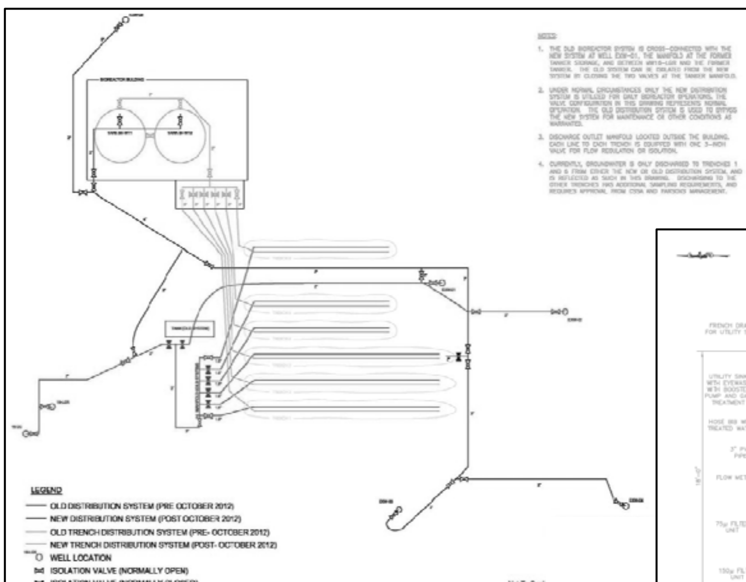
Technical Memorandum on Soil Boring Investigation, Well 16 Source Characterization. *Camp Stanley Storage Activity*, Parsons Engineering Science, June 1995.

Addendum to Technical Memorandum on Soil Boring Investigation, Well 16 Source Characterization. Camp Stanley Storage Activity, Parsons Engineering Science, August 1995.

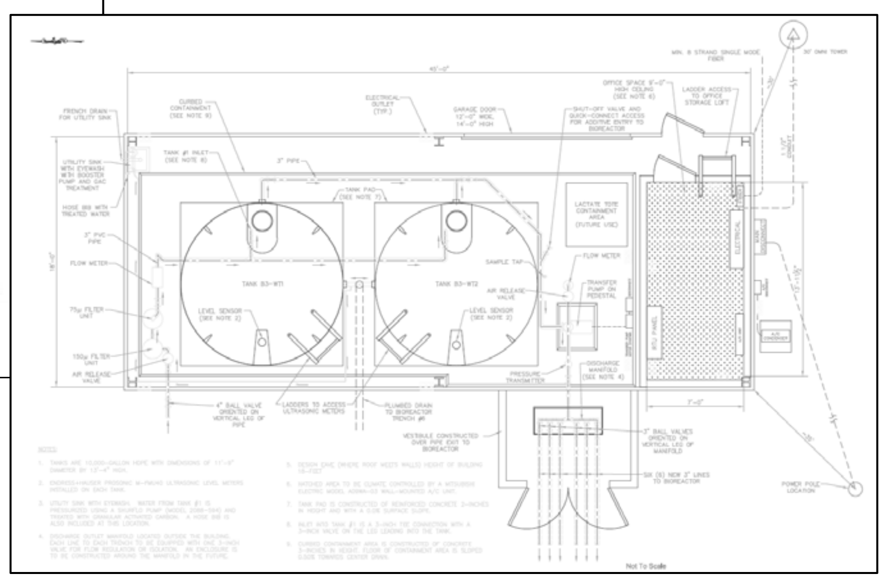
Interim Remedial Action Completion Report, *Camp Stanley Storage Activity*, Parsons, March 2005.

SWMU B-3 Removal Action Report, *Camp Stanley Storage Activity*, Parsons, April 2008.

CSSA B-3 Bioreactor Operations Performance Status Reports (Quarterly 2007-2010, Annually 2011-2013).

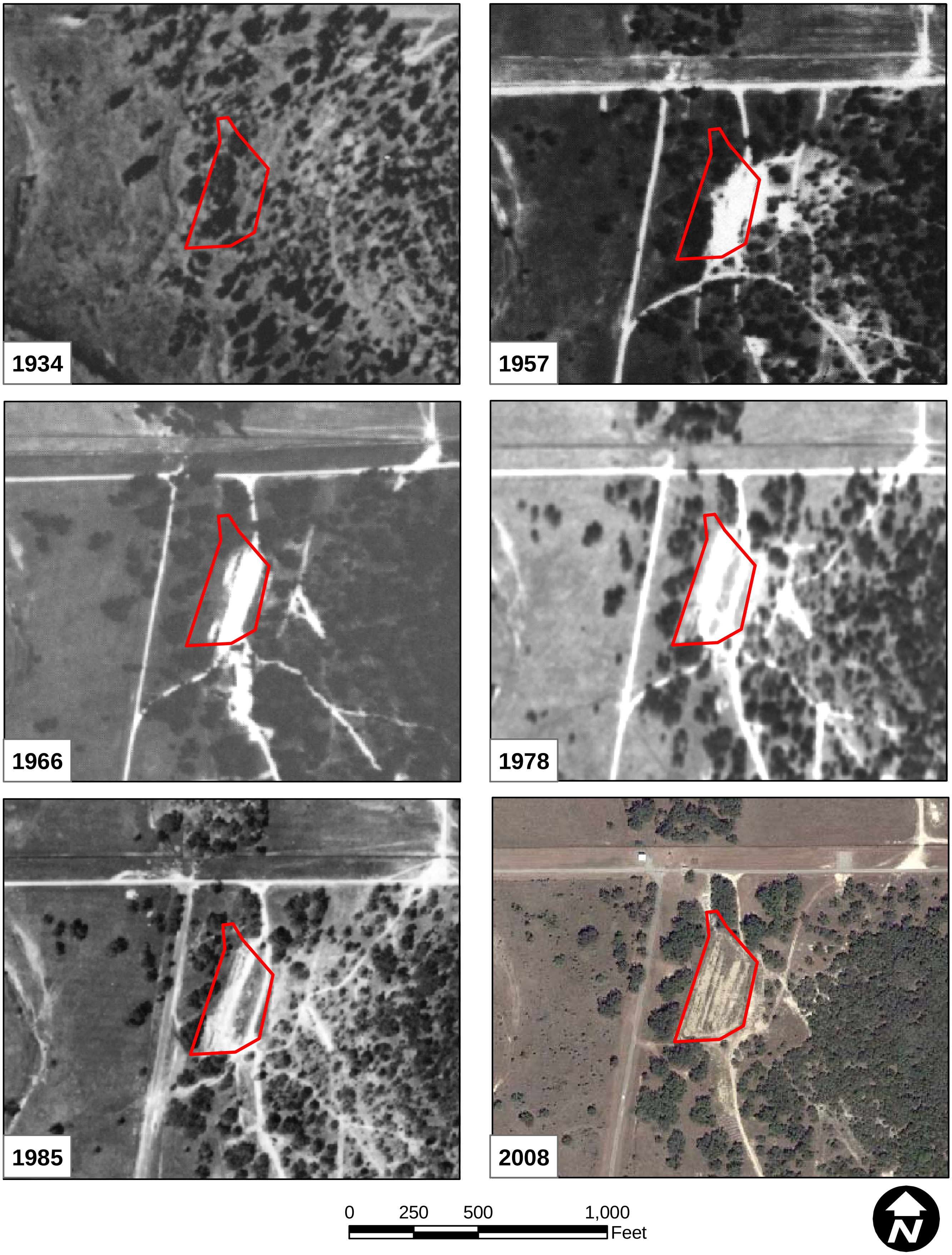


Bioreactor Distribution Configuration



Bioreactor Schematic Design

Aerial Photographs of SWMU B-3

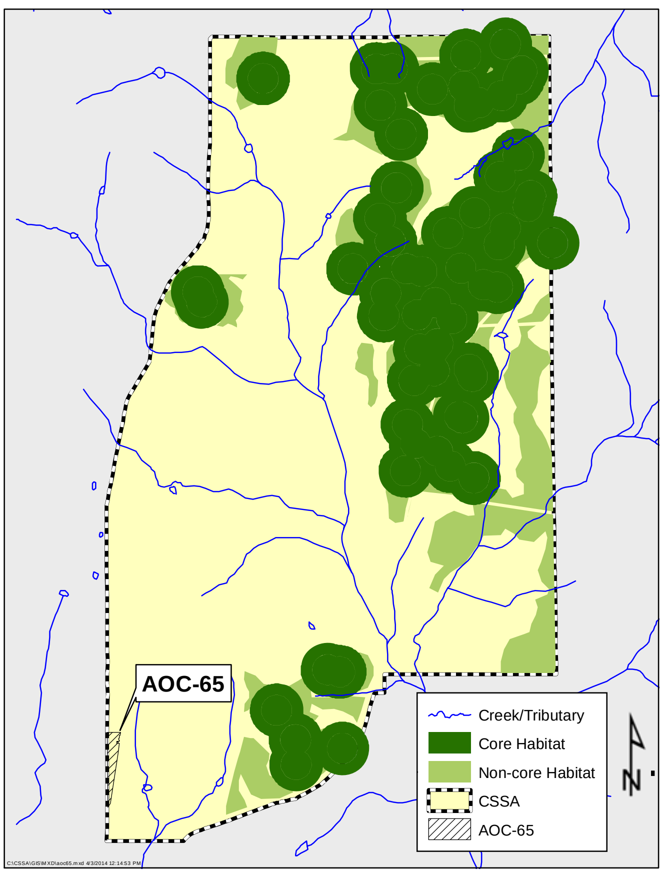


AOC-65

Site Status: Treatability study in progress
Dates Used: 1960s-present
Type of Site: Landfill
Estimated Size: 2.9 acres
Anticipated Waste: Metal debris/leachate, solvents, contaminated soil and groundwater
Potential COCs: Metals, VOCs

Site Location and Description

AOC-65 consists of Building 90 and potential source areas associated with Building 90, which is located along the southwestern side of CSSA. AOC-65 includes two sub-slab, concrete-lined vaults, one on the west side and one in the middle of the interior of Building 90. Building 90 is located approximately 130 feet east of the CSSA western perimeter, approximately 160 feet south of Tompkins Road, which is on-post, and approximately 120 feet from Ralph Fair Road, the nearest off-post road. Building 90 is approximately 580 feet long (north-south) by 80 feet wide (east-west).



Location of AOC-65 at CSSA

Site History

Building 90 was formerly used for weapons cleaning and maintenance. A new armory building currently houses the weapons cleaning and maintenance activities and Building 90 has since been remodeled to accommodate storage activities.

A metal vat was installed in the western vault at Building 90 prior to 1966 and removed in 1995. This vat was used for cleaning ordnance materials with the use of chlorinated liquid solvents, such as PCE and TCE. In 1995, after removal of the former solvent vat, a metal plate was welded over the concrete vault, and PCE and TCE solvents were replaced with a citrus-based cleaner system, which is located on top of the metal plate. Uses of the second vault, located within the middle of the interior of Building 90, are not known.

Building 90 is currently used as a storage facility. AOC-65 also includes the area extending outside Building 90 along the associated building drain lines and ditches. Some of the bedding material for piping leading to Building 90 was recently found to be spent sand from the Building 90 test fire room. AOC-65 was initially limited to the confines of the former solvent vault housed within Building 90; however, recent investigations suggested that the AOC-65 boundaries should be expanded to include other affected areas.

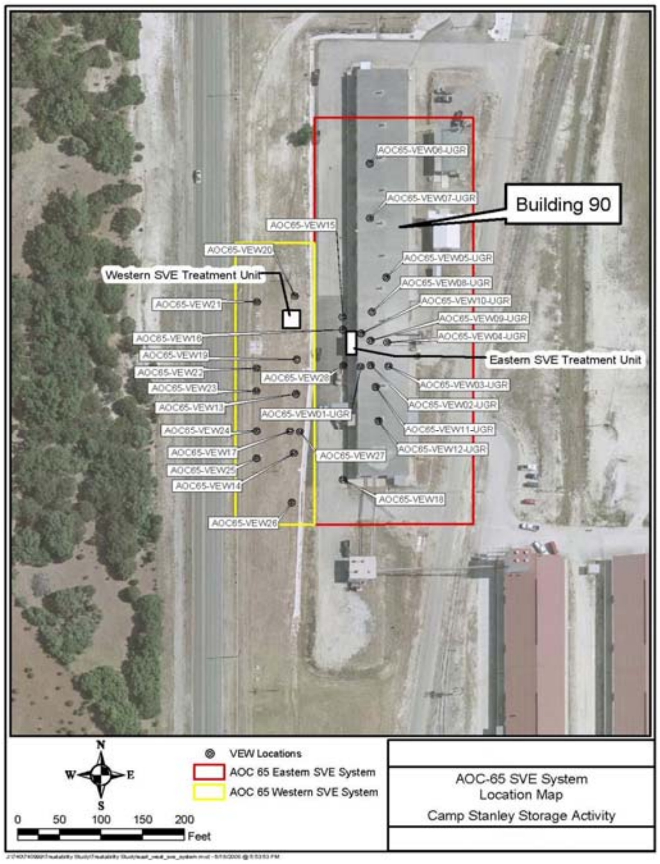
AOC-65 View Facing Southeast – December 2001

Previous Investigations

Solvent releases at AOC-65 resulted in soil and groundwater contamination. Investigations, interim removal actions, and treatability studies have been conducted there, and continue today. The groundwater plume resulting from releases at AOC-65 is referred to as Plume 2. Groundwater monitoring efforts both on- and off-post are described in Section 5. Source characterization of the Building 90 vicinity included a 2001 soil gas survey that involved the collection and analysis of 319 soil gas samples. PCE, TCE, *cis*-1,2- DCE and *trans*-1,2-DCE were detected around and inside Building 90. The detection of DCE indicates that natural degradation of PCE/TCE is occurring in the subsurface.

An RFI report for AOC-65 was completed in September 2002 followed by an interim removal action including excavation of soils underlying the pavement and drainage swale on the west side of the building.

Pilot testing was initiated at AOC-65 to evaluate the effectiveness of SVE for the removal of VOC contamination from the vadose zone. SVE was demonstrated to be an effective method for source removal in surface formations at CSSA during the earlier pilot and treatability study at SWMU B-3. Two SVE systems were installed at AOC-65 in late 2002.



Expansions of the system in 2008 included installation of five shallow (20-foot) and three intermediate-depth (50-foot) VEWs west of the drainage ditch next to Building 90 as well as a deeper two-VEW nested well installed adjacent to the western loading dock of Building 90 to assess the potential for significant mass removal from deeper zones beneath the building, and to investigate the vertical extent under the building and suspected source areas. The system was expanded again in 2010 as part of a steam enhanced extraction treatability study. The 2010 expansion included the installation of five additional VEWs within the paved area between the concrete-lined drainage ditch and building 90, and the installation of two steam injection wells. The steam injection wells were located as close to suspected source areas as possible; one was installed within the concrete-lined vault within Building 90, the other was installed adjacent to the concrete-lined drainage ditch. Although enhanced volatilization of VOCs did occur during the SEE study, condensate accumulation within the steam injection wells rendered this enhancement method ineffective.

Overall results of the SVE and SEE treatability studies indicated the system had reached the point of diminishing returns. The SVE system was taken out of service in 2012, and the above ground equipment (blowers, knockout pots, and associated piping) was removed. VEWs located within Building 90 were plugged and abandoned in anticipation of remodeling efforts. VEWs located outside of building 90 have been repurposed as monitoring wells for current and future treatability studies.

An interim removal action in 2012 included the excavation and removal of contaminated media beneath the concrete lined drainage ditch west of Building 90. Approximately 1,000 CY of material was removed. The material met Class 3 waste characteristics and was reused on-site as construction fill for road maintenance.

The completion of the interim removal action allowed for evaluation of other treatment technologies. Infiltration galleries were installed within the excavation for an *in*-situ chemical oxidation treatability study. This study is ongoing, and to date two injections of activated sodium persulfate totaling approximately 64,000 lbs have been completed. An additional ISCO application is planned for 2014 including the injection of 145,000 lbs of the oxidant, followed by quarterly groundwater monitoring. Additional details regarding the ISCO treatability study are described in the November 2013 *In-Situ Chemical Oxidation Operations and Monitoring Plan*.

What's Next?

Future activities at AOC-65 include the following:

- Perform third round of ISCO injections including the addition of 145,000 lbs of sodium persulfate;
- Continued quarterly monitoring of groundwater to determine efficacy of ISCO;
- Evaluate rebound effects and migration pathways associated with sodium persulfate application.

Additional Documents

In-Situ Chemical Oxidation Operations and Monitoring Plan, Parsons Government Services Group, Austin Texas, November 2013.

Area of Concern-65 Permit By Rule Application for Removal Action, Parsons Infrastructure and Technology Group, Austin, Texas, January 10, 2008.

Draft Area of Concern-65 Assessment Report, Parsons Infrastructure and Technology Group, Austin, Texas, April, 2008.

Final Interim Treatability Test Report, Parsons Infrastructure and Technology Group, Austin, Texas, 2005.

Area of Concern 65 Soil Vapor Extraction Operations & Maintenance Report, Parsons Infrastructure and Technology Group, Austin, Texas, August, 2003.

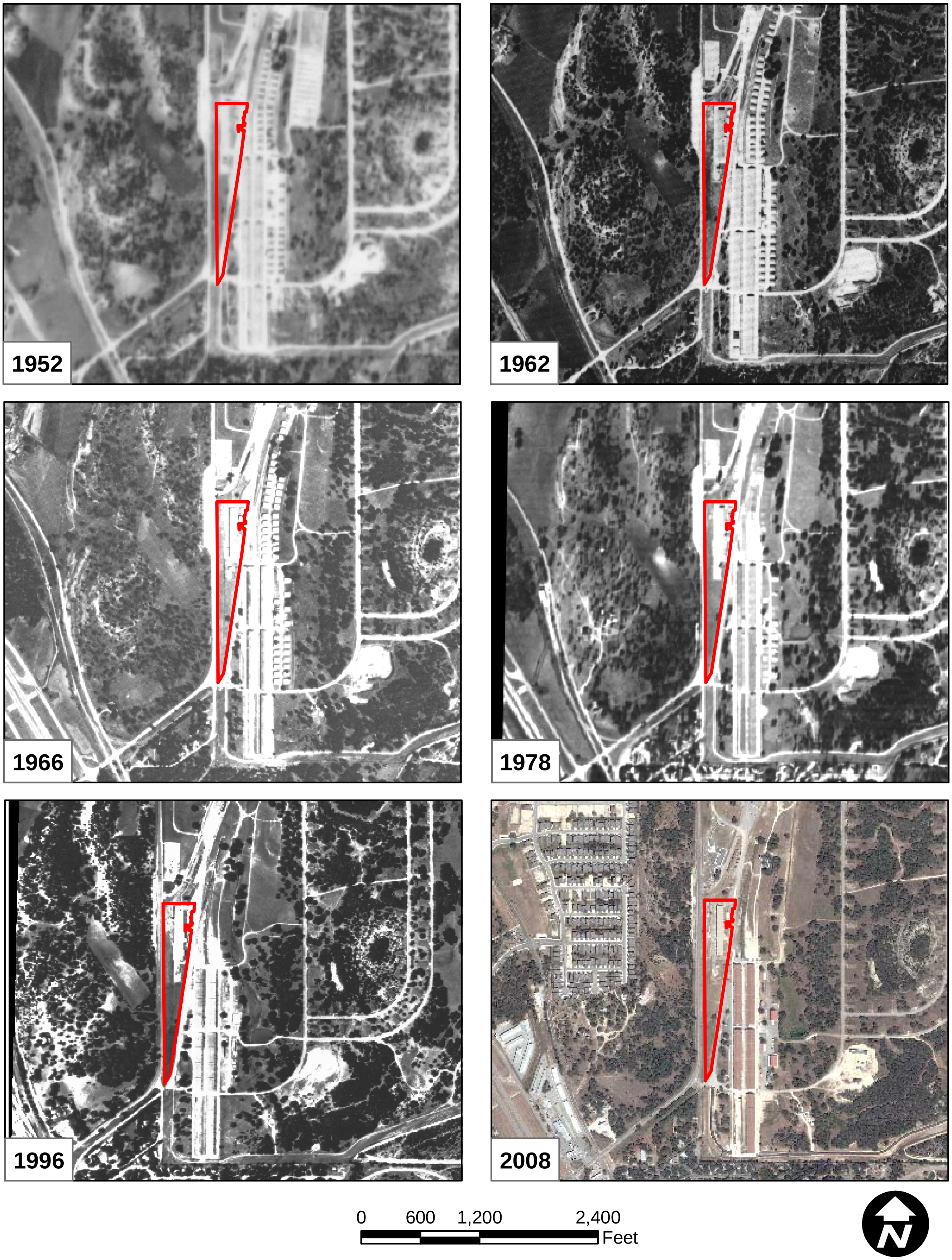
Area of Concern 65 Interim Removal Action, Parsons Infrastructure and Technology Group, Austin, Texas, August, 2003.

Westbay Study Report, Parsons Infrastructure and Technology Group, Austin, Texas, 2003.

Area of Concern-65 Permit By Rule Application for Removal Action, Parsons Infrastructure and Technology Group, Austin, Texas, August 2002.

Area of Concern-65 RCRA Facility Investigation Report, Parsons Infrastructure and Technology Group, Austin, Texas, September 2002.

Aerial Photographs of AOC-65



Section 4 – Work Plan, Field Sampling Plan, and Quality Assurance Project Plan

This section supplements the original RFI Work Plan submitted in 1999, and describes activities in support of and in compliance with the EPA Administrative Order on Consent, EPA identification number TX2210020739, proceeding under Section 3008(h) of RCRA, as amended, 42 U.S.C. Section 6928(h).

The objectives of the RFI include:

- Identifying possible releases;
- Investigating and preventing the further spread of identified releases of hazardous waste and /or hazardous constituents to the environment at and/or from the facility; and
- Ensuring that corrective actions protect human health and environment.

In addition to this work plan, Sampling and Analysis Plans (SAP) and Health and Safety Plans (HASP) are included in Volume 1-4 and Volume 1-5, respectively, of the CSSA Environmental Encyclopedia. The SAP consists of the Quality Assurance Project Plan (QAPP) and the Field Sampling Plan (FSP). A detailed description of the RFI measures for each SWMU, AOC, and RMU is provided in Volume 1-2 (SWMUs) or Volume 1-3 (AOCs and RMUs).

Table 4.1 includes a list of work plan requirements as specified in the RFI Scope of Work, Section B.2. (Task II) of the Order, and the locations in the encyclopedia where the required information may be found.

Table 4.1 - Location in CSSA Encyclopedia for RFI Work Plan Requirements

Order Citation	RFI Work Plan Requirement	Location in CSSA Encyclopedia
B.2.A	**Project Management Plan (Work Plan)**	
B.2.A	The respondent shall prepare a Project Management Plan, which will include a discussion of the technical approach, schedules, budget, and necessary personnel. The technical approach shall include the rationale for investigation of each media (soil, groundwater, surface water, soil gas, and air) and a description of each area of concern which may have contamination from Facility activities. The technical approach shall address all the requirements set forth in Task III of this Corrective Action Plan. The Project Management Plan shall also document the overall management approach to the RFI.	The technical approach for investigation of each SWMU and AOC at CSSA is provided in **Volume 1-2** and **Volume 1-3**. The anticipated schedule, subject to government budget constraints, and a general description of necessary personnel are provided in the RFI Work Plan addendum, ***Volume 1-1***.
B.2.B	**Data Collection Quality Assurance Plan (Field Sampling Plan)**	
B.2.B.	The Respondent shall prepare a Data Collection Quality Assurance Plan to document all monitoring procedures, including: sampling, field measurements, and sample analysis performed during the investigation to characterize the environmental setting, source, and contamination, so as to ensure that all information, data and resulting decisions are technically sound, statistically valid, and properly documented.	Generally, this information is provided in the existing Field Sampling Plan and the Quality Assurance Project Plan, **Volume 1-4**. Specific locations of the required information are provided below.
B.2.B.1	**Data Collection Strategy**	
B.2.B.1.a	Description for intended uses of data collected, and precision and accuracy for these uses.	Intended use is described in **Section 2.1** of the work plan overview. Precision and accuracy is defined in the **Quality Assurance Project Plan** and Variances. Precision and accuracy are method-specific. *This is an outside link to the AFCEE web site.*
B.2.B.1.b	Description of methods and procedures used to assess the precision, accuracy and completeness of measurement data.	**Quality Assurance Project Plan** Section 4. *This is an outside link to the AFCEE web site.*
B.2.B.1.c	Description of methodologies used to assure the data represent the characteristics of a population, parameter variations at a sampling point, and process conditions or environmental conditions, including environmental conditions at time of sampling, number of sample points, representativeness of selected media and	**Quality Assurance Project Plan** Section 4. *This is an outside link to the AFCEE web site.*

Order Citation	RFI Work Plan Requirement	Location in CSSA Encyclopedia
	analytical parameters.	
B.2.B.1.d	Description of measures taken to assure that the following data sets can be compared to each other: (1) RFI data generated by the Respondent; (2) RFI data generated by parties other than the Respondent; (3) Data previously generated by Respondent or Respondent's agents; and (4) Data previously generated by parties other than the Respondent.	**Quality Assurance Project Plan** Section 1 (QAPP was created to assure that all data sets are comparable, and all contractors and subcontractors adhere to the same procedures); Section 4.2.5, page 4-4 discusses comparability; Sections 8.1 and 8.2, pages 8-1 through 8-7 discusses requirements that must be followed to ensure comparability; and Section 9.1, pages 9-1 through 9-3 discusses evaluation programs, audits and training to ensure these items listed. *This is an outside link to the AFCEE web site.*
B.2.B.1.e	Details relating to the schedule and information to be provided in quality assurance reports. The reports shall include but not be limited to: (1) Periodic assessment of measurement data accuracy, precision and completeness;	**Quality Assurance Project Plan** Section 8. *This is an outside link to the AFCEE web site.*
	(2) Results of performance audits, including corrective actions necessary as a result of audits and re-audits.	**Volume 1-4**, Laboratory Audits.
	(3) Results of system audits.	**Volume 1-4**, Laboratory Audits.
	(4) Significant quality assurance problems and recommended solutions.	Information related to quality assurance problems will be included in the Informal Technical Information Report. In addition, if significant quality assurance problems are found, a follow-up audit may be performed at the laboratory. Laboratory audit reports and follow-up correspondence will be included in **Volume 1-4**, Laboratory Audits.
B.2.B.2.a	Strategy for selecting appropriate sampling locations, depths, etc.	Items B.2.B.2.a-i address data quality objectives (DQOs). DQOs for CSSA were developed using EPA's three-stage process. First, decision types were identified. Data from the RFI will be used to determine if sites are contaminated or if they can be closed. Standards established in the Risk Reduction Rules will be used as comparison criteria. Secondly, data uses and needs were identified. Data uses may include closure, risk assessment, or identification of potential treatment options, as appropriate. Data needs for each site are listed in the RFI Work Plan Addenda for each site. The final step in the DQO process is to design the data collection program. The data

		collection program for each site is included in **Volume 1-2** and **Volume 1-3**. The strategy for selecting appropriate sampling locations and depths at SWMUs and AOCs is site-specific. In general, a minimum of three samples is collected at each site. If there is evidence of buried waste or trenches (through records or geophysical surveys), subsurface soil samples will be collected at a depth approximately two feet deeper than the depth of the waste management unit. Otherwise, only surface soil samples will be collected. Locations are selected based on known data (such as geophysical survey results) or observations (stained soil, exposed waste, etc) made at the site.
B.2.B.2.b	Strategy for determining a statistically sufficient number of samples.	Because each site is relatively small and if contamination exists or not is not known at many sites, statistical sampling strategies are not currently planned.
B.2.B.2.c	Strategy for measuring all necessary ancillary data.	**Volume 1-4** includes strategy and methodology for collecting ancillary data.
B.2.B.2.d	Strategy for determining conditions under which sampling will be conducted.	The strategy for sampling described above will be used at any site identified as a potential waste management unit. Sites can be identified through base records, historic aerial photographs, interviews with former personnel.
B.2.B.2.e	Strategy for determining which media are to be sampled (e.g. ground water, air, soil, sediment, etc.)	Media present at a site, with the exception of air, will generally be sampled. In general, the only media typically present are soil and occasionally shallow groundwater. Surface water occurs very sporadically on the base, typically only after a precipitation event.
B.2.B.2.f	Strategy for determining which parameters are to be measured and where.	All sites will initially be sampled for VOCs, SVOCs, and metals. These methods will detect compounds and contaminants potentially present at the facility based on CSSA's known past and current industrial processes. Some sites where ordnance disposal is suspected will also be sampled for explosives. In general, the potential waste management practices at the site will be considered when determining the appropriate analytical parameters. The analyte list for groundwater has been developed through evaluation of over 8 years of historic data.
B.2.B.2.g	Strategy for selecting the frequency of sampling and length of sampling period.	All sampling currently planned at SWMUs and AOCs will be one-time grab sampling.

		Groundwater monitoring will occur quarterly.
B.2.B.2.h	Strategy for selecting the types of samples (composites or grabs) and number of samples to be collected.	See above **B.2.B.2.a** and **B.2.B.2.g**.
B.2.B.2.i	Strategy for documenting field sampling operations and procedures, including: (1) Documentation of procedures for preparation of reagents or supplies which become an integral part of the sample (e.g., filters and adsorbing agents);	**Section 2.2** of the Field Sampling Plan.
	(2) Procedures and forms for recording the exact location and specific considerations associated with sample acquisition;	Procedures are described in **Volume 1-2** and **Volume 1-3**, behind the site-specific tabs. Standard forms to be used can be found in Volume 1-4**,** Field Sampling Plan, **Appendix A**.
	(3) Documentation of specific sample preservation;	**Quality Assurance Project Plan** Section 5. *This is an outside link to the AFCEE web site.*
	(4) Calibration of field devices;	**Section 3 of Field Sampling Plan**
	(5) Collection of replicate samples;	**Section 2 of Field Sampling Plan**
	(6) Potential interferences present at the Facility;	**Section 1 of Field Sampling Plan**
	(7) Construction materials and techniques associated with monitoring wells and piezometers;	Construction materials and techniques for shallow wells are provided in **Section 1 of Field Sampling Plan**
	(8) Field equipment listing and sample containers;	Field equipment is listed in **Section 3 of Field Sampling Plan**. Sample containers required are listed in **Quality Assurance Project Plan** Section 5. *This is an outside link to the AFCEE web site.*
	(9) Sampling order; and	**Section 2.1.5 of Field Sampling Plan**
	(10) Decontamination procedures.	**Section 1 of Field Sampling Plan**
B.2.B.2.j	Strategy for selection of appropriate sample containers.	**Quality Assurance Project Plan** Section 5. *This is an outside link to the AFCEE web site.*
B.2.B.2.k	Strategy for sample preservation.	**Quality Assurance Project Plan** Section 5. *This is an outside link to the AFCEE web site.*
B.2.B.2.l	Strategy for chain-of-custody, including: (2) Standardized field tracking reporting forms to establish sample custody in the field prior to shipment; and (3) Pre-prepared sample labels containing all	**Quality Assurance Project Plan** Section 5. *This is an outside link to the AFCEE web site.*

	information necessary for effective sample tracking.	
B.2.B.3	**Field Measurements**	
B.2.B.3.a	Strategy for selecting appropriate field measurement locations, depths, etc.	**Field Sampling Plan, Sections 3.1 through 3.5**
B.2.B.3.b	Strategy for providing a statistically sufficient number of field measurements.	**Field Sampling Plan, Sections 3.1 through 3.5**
B.2.B.3.c	Strategy for measuring all necessary ancillary data.	**Field Sampling Plan, Sections 3.1 through 3.5**
B.2.B.3.d	Strategy for determining conditions under which field measurements should be conducted.	**Field Sampling Plan, Sections 3.1 through 3.5**
B.2.B.3.e	Strategy for determining which media are to be addressed by appropriate field measurements (e.g. groundwater, air, soil, sediment, etc.).	**Field Sampling Plan, Sections 3.1 through 3.5**
B.2.B.3.f	Strategy for determining which parameters are to be measured and where.	**Field Sampling Plan, Sections 3.1 through 3.5**
B.2.B.3.g	Strategy for selecting the frequency of field measurement and length of field measurements period.	**Field Sampling Plan, Sections 3.1 through 3.5**
B.2.B.3.h	Strategy for documenting field measurements operations and procedures, including: (1) Procedures and forms for recording raw data, exact location, time and Facility-specific considerations associated with the data acquisition;	**Field Sampling Plan, Section 1.1.5**
	(2) Calibration of field devices;	**Field Sampling Plan, Section 3.6**
	(3) Collection of replicate measurements;	**Field Sampling Plan, Section 4.1**
	(4) Potential interferences present at the facility;	**Field Sampling Plan, Section 1.1.1** discusses site reconnaissance, preparation and restoration procedures. Since a large portion of potential interferences are present when soil boring is taking place, **Section 1.1.4** and **Section 1.1.5** discusses drilling and soil sampling. Evaluation of underground utilities is discussed in **Health and Safety Plan, Section 2.3.2**.
	(5) Construction materials and techniques associated with monitoring wells and piezometers used to collect field data;	**Field Sampling Plan, Section 1**
	(6) Field equipment listing	**Field Sampling Plan, Section 3**

	(7) Order in which field measurements were made; and	**Field Sampling Plan, Sections 3.1 through 3.5**
	(8) Decontamination procedures.	**Field Sampling Plan, Section 1.5**
B.2.B.4	Disposal of waste material contaminated with hazardous constituents in accordance with all State and Federal regulations.	**RL33 Addendum, Addendum 2.**
B.2.B.5.a	Chain-of-custody procedures, including: (1) Identification of a responsible party to act as sample custodian at the laboratory facility authorized to sign for incoming field samples, obtain documents of shipment, and verify the data is entered onto the sample custody records; (2) Provision for a laboratory sample custody log consisting of serially numbered standard lab-tracking report sheets; and (3) Specification of laboratory sample custody procedures for sample handling, storage and disbursement for analysis.	**Field Sampling Plan, Section 2.3** gives and overview of sample custody procedures; **Quality Assurance Project Plan** Sections 5 and 8 (*this is an outside link to the AFCEE web site)* discuss sample custody procedures in more detail.
B.2.B.5.b	Sample storage procedures and holding times.	**Quality Assurance Project Plan** Section 5.1.2 (*this is an outside link to the AFCEE web site)*
B.2.B.5.c	Sample preparation methods.	**Quality Assurance Project Plan** Section 7.1 (*this is an outside link to the AFCEE web site)*
B.2.B.5.d	Analytical procedures, including: (1) Scope and application of procedure;	**Quality Assurance Project Plan** Section 7.2 (*this is an outside link to the AFCEE web site)*
	(2) Sample matrix;	**Quality Assurance Project Plan** Section 7.2 (*this is an outside link to the AFCEE web site)*
	(3) Potential interferences;	**Quality Assurance Project Plan** Section 7.2 (*this is an outside link to the AFCEE web site)*
	(4) Precision and accuracy of the methodology	**Quality Assurance Project Plan** Section 7.2 (*this is an outside link to the AFCEE web site)*
	(5) Method detection limits	**Quality Assurance Project Plan** Section 7.2 (*this is an outside link to the AFCEE web site)*
	(6) Calibration procedures and frequency	**Quality Assurance Project Plan** Section 7.2 (*this is an outside link to the AFCEE web site)*
	(7) Data reduction, validation and reporting	**Quality Assurance Project Plan** Sections 8.1 and 8.2 (*this is an outside link to the AFCEE web site)*
	(8) Internal quality control checks, laboratory performance and systems audits and frequency, to be conducted annually during the life of an	Quality control checks are discussed in **Quality Assurance Project Plan** Section 8.3 (*this is an outside link to the AFCEE web site)*. Laboratory

	analytical services subcontract by Parsons ES or other contractor working for CSSA, including: (i) Method blank(s); (ii) Laboratory control sample(s); (iii) Calibration check sample(s); (iv) Replicate sample(s); (v) Matrix-spiked sample(s); and (vi) "Blind" quality control sample(s).	performance and systems audits and frequency are discussed in **Quality Assurance Project Plan** Sections 9.0 (*this is an outside link to the AFCEE web site).* Method blanks, laboratory control samples, calibration check samples, replicate samples, matrix-spiked samples and "blind" quality control samples are discussed in **Quality Assurance Project Plan** Sections 4.4.1 through 4.4.12 (*this is an outside link to the AFCEE web site).*
	(9) Preventive maintenance procedures and schedules;	**Quality Assurance Project Plan** Section 10.0 (*this is an outside link to the AFCEE web site)*
	(10) Corrective action for laboratory problems; and	**Quality Assurance Project Plan** Section 11.0 (*this is an outside link to the AFCEE web site)*
	(11) Turnaround time.	Turnaround times are addressed in the format of holding times for each analysis and matrix. **Quality Assurance Project Plan** Section 4.1.2 (*this is an outside link to the AFCEE web site),* Table 5.1.2-1, and Section 5.2 all address holding times for different methods, analyses and matrices.
B.2.C	**Data Management Plan**	
B.2.C	The Respondent shall develop and implement a Data Management Plan to Document and track investigation data and results. This plan shall identify and set up data documentation materials and procedures, project file requirements, and project-related progress reporting procedures and documents. The plan shall also provide the format to be used to present the raw data and conclusions of the RFI.	Data generated during the RFI will be submitted to EPA and TCEQ in reports which will be inserted into **Volume 3-1** (SWMUs), **Volume 3-2** (AOCs), and **Volume 5** (Groundwater). The SWMU and AOC investigation reports will include all data and information required by the TCEQ Risk Reduction Rules, as well as information specified to be included in RCRA Facility Investigation Guidance (OSWER Directive 9502.00-6D). All reporting will be in a format compatible with the Environmental Encyclopedia. Where appropriate, updates to the Background Information Report will be made.
		Data from investigation activities are stored in CSSA's GIS, which includes the Tri-Services Spatial Data System (TSSDS, version 1.8) database in Microsoft SQL Server. The TSSDS database was established by the U.S. Army Corps of Engineers for storing environmental and infrastructure information. Project files are stored and maintained by the Austin office of Parsons Engineering Science. Files are generally project specific; however, information pertaining to each site is also

		maintained in a separate set of files. Progress reports will be submitted quarterly, as specified in the order and in the first Quarterly Progress Report (included in **Volume 1-1**). A generalized list of report requirements is provided in **Workplan Overview, Section 2.5**.
B.2.C.1	**Data Record**	
B.2.C.1.a	Unique sample of field measurement code;	**Field Sampling Plan, Section 2.2.1**.
B.2.C.1.b	Sampling or field measurement location and sample or measurement type;	Sampling locations for each SWMU and AOC are provided in **Volume 1-2** and **Volume 1-3**.
B.2.C.1.c	Sampling or field measurement raw data;	**Field Sampling Plan, Section 4.4**
B.2.C.1.d	Laboratory analysis ID number;	**Quality Assurance Project Plan** Section 5.2 (*this is an outside link to the AFCEE web site)*
B.2.C.1.e	Property or component measured; and	**Field Sampling Plan, Section 2.2.1**
B.2.C.1.f	Result of analysis (e.g., concentration).	**Quality Assurance Project Plan** Section 8.0 (*this is an outside link to the AFCEE web site)*
B.2.C.2	**Tabular Displays**	
B.2.C.2.a	Unsorted (raw) data;	Raw data, in addition to AFCEE forms, will be provided by the laboratory to the data validation team. Hard copies of this information will be provided to EPA upon request. This information will not be included in the Encyclopedia.
B.2.C.2.b	Results for each medium, or for each constituent monitored	Summary results for each medium will be provided in the reporting information behind each SWMU or AOC in **Volume 3-1** (SWMUs), **Volume 3-2** (AOCs), and **Volume 5** (Groundwater), after a sampling event or delivery order action. Data related to groundwater chemistry will be provided in **Volume 5**. The summary tables will be set up like this **example**.
B.2.C.2.c	Data reduction for statistical analysis;	Data reduction for statistical analysis, if necessary, will included in the appropriate investigation report, which will be in **Volume 3-1** (SWMUs), **Volume 3-2** (AOCs), and **Volume 5** (Groundwater).
B.2.C.2.d	Sorting of data by potential stratification factors (e.g. location, soil layer, topography); and	Sorting of data by potential stratification factors will be performed for each SWMU or AOC if it is appropriate. If needed for a site, the resulting information will be provided in **Volume 3-1**

		(SWMUs), **Volume 3-2** (AOCs), and **Volume 5** (Groundwater). Sorted data will also be provided in **Volume 5**.
B.2.C.2.e	Summary data.	A summary of data results for each SWMU or AOC will be provided behind the corresponding tab in **Volume 3-1** and **Volume 3-2**. Summary data for groundwater will be provided in **Volume 5.** Data summary will be appropriate after field efforts or delivery order actions.
B.2.C.3	**Graphical Displays** (e.g. bar graphs, line graphs, area or plan maps, isopleth plots, cross-sectional plots or transects, three dimensional graphs, etc.)	
B.2.C.3.a	Sampling locations and sampling grids;	Sampling locations for each SWMU and AOC will be provided in **Volume 3-1** and **Volume 3-2**. Groundwater sampling locations will be provided in **Volume 5**.
B.2.C.3.b	Boundaries of sampling areas, and areas where more sampling is required;	Boundaries for each SWMU and AOC will be provided in **Volume 3-1** and **Volume 3-2**.
B.2.C.3.c	Levels of contamination at each sampling location;	Levels of contamination at each SWMU and AOC sampling point will be provided in **Volume 1-2** and **Volume 1-3**. Groundwater contamination maps will be provided in **Volume 5.**
B.2.C.3.d	Geographical extent of contamination;	Defining the geographical extent of contamination for most CSSA sites may not be applicable (i.e. a trench where metal particles exist and are excavated and removed). Where applicable, site maps showing the extent of contamination may be found behind the corresponding tab in **Volume 3-1** and **Volume 3-2**. Maps showing the extent of groundwater contamination will be provided in **Volume 5**. This information may also be viewed utilizing the CSSA GIS database, which is available through CSSA or Parsons ES.
B.2.C.3.e	Display contamination levels, averages, and maxima;	Contamination levels, where applicable, may be found in site maps behind the corresponding tab in **Volume 3-1** and **Volume 3-2**. Contamination averages and maxima may be derived with information from the data summary tables. This information may also be viewed utilizing the CSSA GIS database.
B.2.C.3.f	Illustrate changes in concentration in relation to distance from the source, time, depth or other parameters;	Changes in contamination concentration levels, where applicable, may be found in site maps behind the corresponding tab in **Volume 1-2** and **Volume 1-3**. This information may also be

		viewed utilizing the CSSA GIS database.
B.2.C.3.g	Indicate features affecting intramedia transport and potential receptors; and	Potential receptors and intramedia transport features may be viewed utilizing the CSSA GIS database.
B.2.C.3.h	Illustrate the structural geology in the area of CSSA, including detailed structural geology of CSSA.	**Soils and Geology, Background Information Report**
B.2.D	**Health and Safety Plan**	
B.2.D.1.a	Health and Safety Plan (HSP) that includes facility description, including availability of roads, water supply, electricity and telephone service.	**Health and Safety Plan, Section 1.2** gives a facility description. The route to the hospital depicts the availability of roads; **Section 3.4.4** states that the field team will have potable water with them, should the base-wide water supply be unavailable, electric service is provided by CSSA or through generators, and Emergency Contacts lists telephone service instructions for CSSA, page 6.
B.2.D.1.b	HSP that describes the known hazards and evaluates the risks associated with each activity conducted, including exposure to contaminants during the implementation of interim measures at CSSA.	**Health and Safety Plan, Section 2.3.**
B.2.D.1.c	HSP that lists key personnel and alternates responsible for site safety, response operations, and protection of public health.	**Health and Safety Plan, Section 1.4**
B.2.D.1.d	HSP that delineates work areas.	**Health and Safety Plan, Section 1.2**
B.2.D.1.e	HSP that describes levels of protection to be worn by personnel in work areas.	**Health and Safety Plan, Section 3.4**
B.2.D.1.f	HSP that establishes procedures to control site access.	**Health and Safety Plan, Section 4.1**
B.2.D.1.g	HSP that describes decontamination procedures for personnel and equipment.	Health and Safety Plan, **Section 3.4.3** and **Section 3.4.4**
B.2.D.1.h	HSP that establishes site emergency procedures.	**Health and Safety Plan, Section 4.7**
B.2.D.1.i	HSP that addresses emergency medical procedures for injuries and toxicological problems.	**Health and Safety Plan, Section 2**
B.2.D.1.j	HSP that describes requirements for an environmental surveillance program.	**Health and Safety Plan, Section 3.2**
B.2.D.1.k	HSP that specifies any routine and special training	**Health and Safety Plan, Section 3.1.**

	required for responders.	
B.2.D.1.l	HSP that establishes procedures for protecting workers from weather-related problems.	Health and Safety Plan, **Section 2.2.1** and **Section 2.2.2**
B.2.D.2.a	HSP shall be consistent with NIOSH Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities (1985).	**Health and Safety Plan, Section 1**
B.2.D.2.b	HSP shall be consistent with EPA Order 1440.1 – Respiratory Protection.	**Health and Safety Plan, Section 1**
B.2.D.2.c	HSP shall be consistent with EPA Order 1440.3 – Health and Safety Requirements for Employees engaged in Field Activities.	**Health and Safety Plan, Section 1**
B.2.D.2.d	HSP shall be consistent with Facility Contingency Plan.	**Health and Safety Plan, Section 1**
B.2.D.2.e	HSP shall be consistent with EPA Standard Operating Safety Guide (1984).	**Health and Safety Plan, Section 1**
B.2.D.2.f	HSP shall be consistent with OSHA regulations, particularly in 29 CFR 1910 and 1926.	**Health and Safety Plan, Section 1**
B.2.D.2.g	HSP shall be consistent with state and local regulations.	**Health and Safety Plan, Section 1**
B.2.D.2.h	HSP shall be consistent with other EPA guidance as provided.	**Health and Safety Plan, Section 1**
B.2.E	**Community Relations Plan**	
B.2.E	Respondent shall prepare a Community Relations Plan which includes description of site background, history of community involvement at the site, community relations strategies, schedule of community relations activities, list of contact, local officials and interested parties.	Please see **Community Relations Plan**

Section 5 - Groundwater Monitoring

This section summarizes the on- and off-post groundwater sampling programs at CSSA, as well as current off-post drinking water treatment for select private wells.

5.1 CONTAMINANT OCCURRENCE AND DISTRIBUTION

Solvent contamination (PCE, TCE, *cis*-1,2-DCE) was first detected in water supply well CS-16 at CSSA in 1991 above the regulatory MCLs. Between 1992 and 1999, CSSA undertook a series of investigations to identify potential source areas for the groundwater contamination, which identified SWMUs B-3 and O-1, and AOC-65 as likely candidates. Starting in 1996, the first of nearly 120 monitoring wells were installed, and well installation continued through May 2013 (**Figure 5.1**). Twelve additional former and active water supply and agricultural wells complete the on-post monitoring network of 131 wells.

Off-post contamination was first identified by CSSA in December 1999 at a private well adjacent to the facility. Since that time, solvent contamination has been detected above laboratory method detection limits (MDLs) in 30 off-post private and public water supply wells.

Contamination from past disposal activities resulted in multiple groundwater units, referred to as Plume 1 (SWMUs B-3 and O-1) and Plume 2 (AOC-65) as shown on **Figure 5.2**. Contamination is most widespread within the LGR water-bearing unit. Locally, the Bexar Shale serves as a confining unit between the water-bearing LGR and CC Limestone. Faults of the BFZ structurally influence and re-direct the groundwater flowpaths. Environmental studies demonstrate that most of the contamination resides within the LGR.

Plume 1 has advectively migrated southward towards Camp Bullis, and west-southwest toward CSSA well fields (CS-9 and CS-10) and several off-post public and private wells. VOC concentrations over 400 µg/L are present in Middle Trinity aquifer wells near the source area. However, contaminant concentrations are below 1 µg/L over most of the Plume 1 area. In contrast, little to no contamination within the Bexar Shale and CC Limestone has been consistently identified within Plume 1 except in association with former open borehole completions. Trace concentrations associated with Plume 1 have been detected at off-post locations.

Contamination at Plume 2 originated at AOC-65, and spread southward and westward from the post. The greatest concentrations of solvents are reported at the near subsurface adjacent to the source area. Deeper in the subsurface, concentrations in excess of 100 µg/L have been reported in perched intervals above the main aquifer body in the LGR. However, multi-port well sampling has shown that once the main aquifer body is penetrated, the concentrations are diluted to trace levels. Off-post, concentrations in excess of MCLs have been detected in private and public wells with open borehole completions. Only sporadic, trace concentrations of solvents have been detected in Bexar Shale and CC Limestone wells within Plume 2.

The style of well completion can affect the concentration detected at a location. At CSSA, monitoring wells were purposely designed to case off contamination present within upper strata in an effort to reduce cross-contamination between water-bearing units. This style of well completion typically results in a groundwater sample from the main portion of the aquifer that has little to no contamination present. In contrast, most off-post wells are designed to maximize yield from all portions of the aquifer, resulting in co-mingling of stratified groundwater with varying degrees of contamination as seen in Plume 2. Within an open wellbore, the net effect is that perched waters with high concentrations of solvents are contaminating relatively pristine groundwater held within the main body of the aquifer.

5.2 GROUNDWATER MONITORING

Groundwater has been monitored on post since VOC contamination was detected in supply well CS-16 in 1991. At the time of discovery, well CS-16 was condemned and environmental investigations ensued to determine the source of the contamination. Initial groundwater monitoring occurred at existing water supply wells and abandoned agricultural wells. Beginning in 1996, a series of monitoring wells was installed to delineate the plume.

By 1999, detections of VOCs were detected in privately-owned wells off post. A survey was conducted and records obtained to identify all the privately-owned wells within ¼-mile of the post. This survey was updated in 2010 to include all wells within ½-mile of the post. Off-post consumers whose wells approached or exceeded safe drinking water levels were provided wellhead treatment systems to remove the contamination.

The COCs at CSSA are based on historically-detected analytes (since the inception of the groundwater monitoring program in 1991) and process knowledge. Analytes detected above regulatory standards in soil and groundwater at CSSA are limited to a short list of chlorinated VOCs and metals. Of the analytes detected at CSSA, only a handful of organic and inorganic compounds exceed the appropriate Action Level (AL) or MCL as given in **Table 5.1**.

Table 5.1 - Contaminants Detected in Groundwater above MCLs or ALs, 1992-2014

VOCs	Metals
PCE	Cadmium
TCE	Chromium
cis-1,2-DCE	Copper
trans-1,2-DCE	Lead
	Mercury

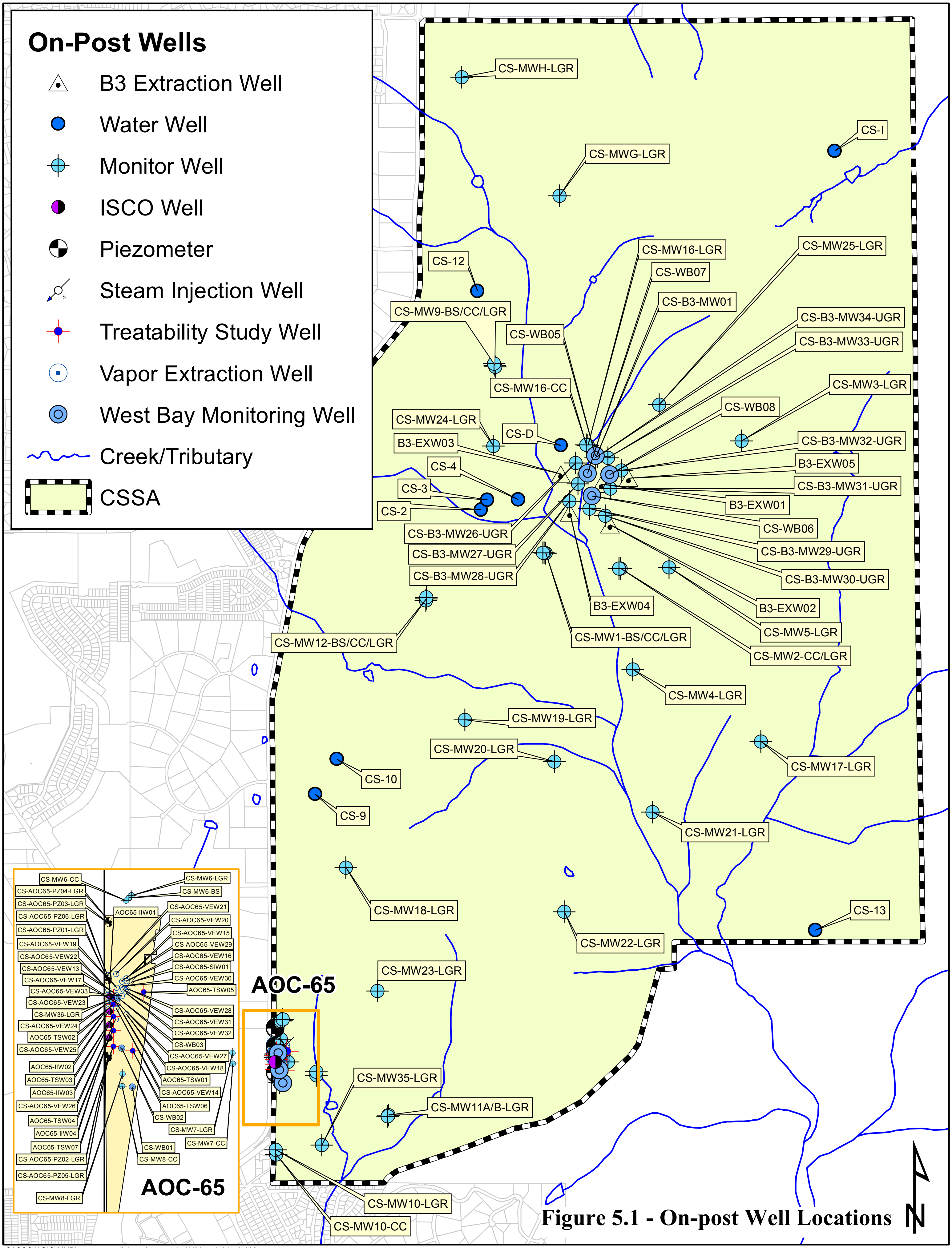


Figure 5.1 - On-post Well Locations

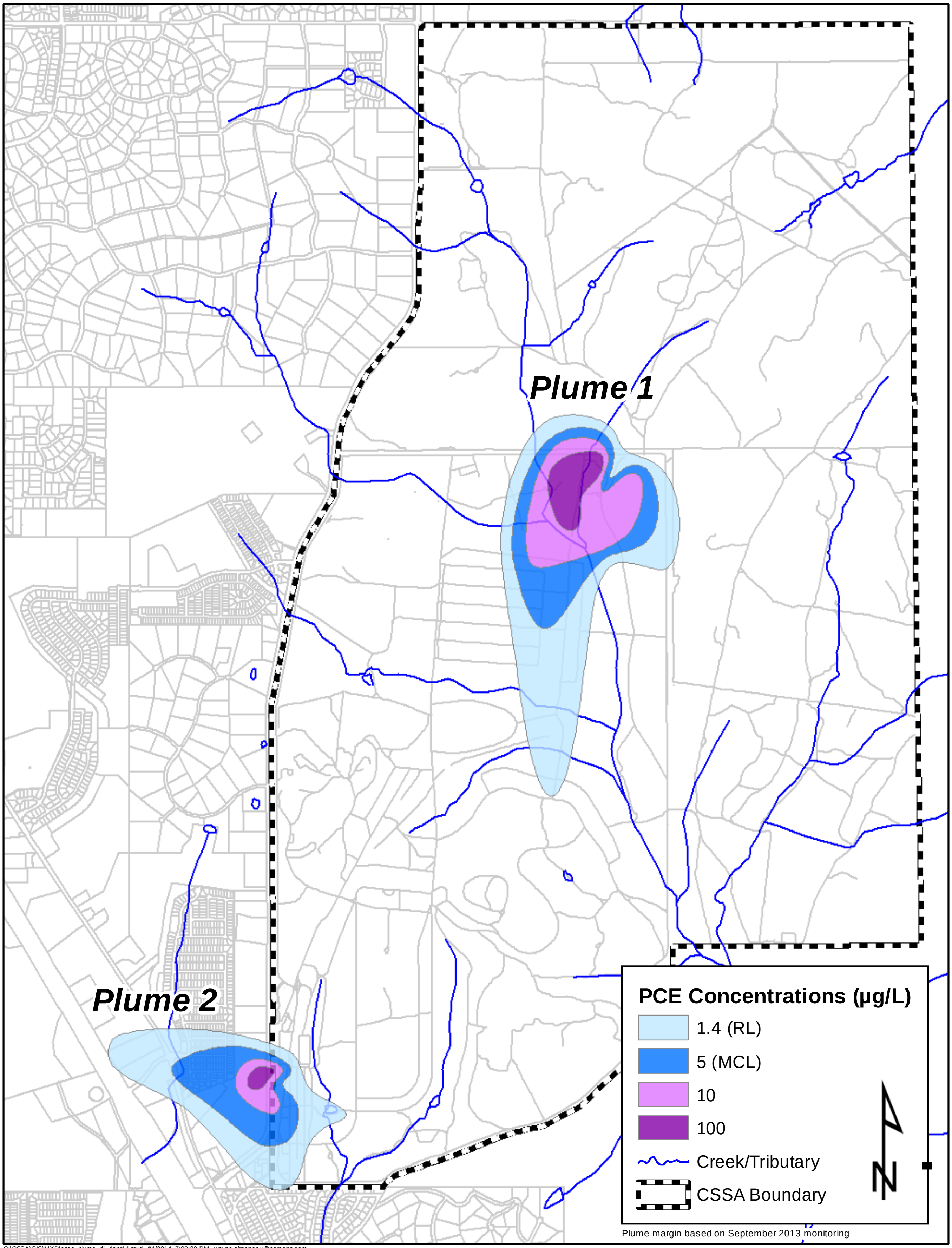


Figure 5.2 - Plume Location Map

As part of the environmental investigations, routine groundwater monitoring events are performed (usually quarterly) to monitor the progression and concentration of the plume. In 2004, a statistical approach referred to as Long-Term Monitoring Optimization (LTMO) was performed to assess the value of the quarterly sampling program, and was used to statistically verify that less-frequent sampling could be performed in the generally static portions of the plume. The LTMO was also used to identify areas where there were data gaps. After a 5-year review, the LTMO process at CSSA was evaluated and further refined in 2010. The LTMO will be re-evaluated and further refined in 2014 with five additional years of data to identify appropriate changes to sampling frequency, and to identify potential data gaps (see Section 5.3).

5.2.1 On-Post

Between 1992 and 2013, 39 conventional monitoring wells were drilled on-post to address various issues regarding the distribution and occurrence of contamination in the subsurface. This includes 26 LGR wells, 4 BS wells, and 9 CC wells (see Section 2 for geologic descriptions of these units). The monitoring wells are equipped with dedicated bladder pumps for obtaining analytical samples using low flow (minimal drawdown) sampling techniques. Until 2005, these wells were generally sampled on a quarterly basis. Since 2005, most of these wells are sampled on a semi-annual, annual, or biennial frequency based on the results of the LTMO.

Twelve wells that mostly pre-date the monitoring wells are sampled as part of the monitoring program. These include current (4) and former (2) CSSA potable supply wells and former (6) agricultural wells. These wells are sampled using dedicated electric submersible pumps or bladder pumps installed into the wells, or occasionally using bailers. All potable supply wells are monitored on a quarterly basis to ensure that threats from contamination are not developing. Former supply and agricultural wells have mostly been reduced to a semi-annual or annual sampling frequency.

A total of eight Westbay multi-port wells have been installed as part of the monitoring program. Four wells (WB01 through WB04) are used to monitor Plume 2 in the SW quadrant of the post. WB05 through WB08 are installed at the SWMU B-3 source area for Plume 1, and are exclusively used to support the Bioreactor remediation activities. The wells are unique such that they can monitor multiple zones within a single borehole. As shown on **Figure 5.3**, each zone within a Westbay well contains a packer (1), a measurement port (2), and a pumping port (3). At CSSA, for example, WB04 monitors 17 discrete zones throughout the Middle Trinity aquifer. The Plume 2 multi-port wells (WB01 through WB04) are generally monitored on a semi-annual frequency, but several non-impacted zones (BS and CC) are on a biennial schedule. The Plume 1 multi-port wells (WB05 through WB08) are sampled quarterly in association with Bioreactor activities.

Figure 5.3 - Westbay Well

An additional 72 wells used for remedial activities have been installed in, and around the two plume source areas at SWMU B-3 and AOC-65. These wells are generally shallower than those in the formal groundwater program that monitors the Middle Trinity aquifer, and include groundwater and vapor extraction wells, substrate injection wells, and performance monitoring points. The monitoring of those wells are also specific to the goals and schedules of their respective treatment systems.

5.2.2 Off-Post

Most off-post wells are private residential wells serving single homes. A few wells also provided potable water to commercial properties near the intersection of IH-10 and Ralph Fair Road. Lastly, potable water wells serve as public supply sources to the Fair Oaks (4) development west-northwest of CSSA, Scenic Oaks (8) to the west, and the Hidden Spring Estates (3) community along the south fenceline of CSSA.

The off-post wells were first identified during the Offsite Well Survey conducted in 1999. Following that identification effort, off-post contamination was first discovered in December 1999 in LS-7, adjacent to the southwest CSSA fenceline. Right-of-entry permits were obtained to sample other nearby wells. To date, more than 73 off-post wells have been sampled for VOC contamination. More than 30 wells have had detections of VOCs in their groundwater, and seven wells consistently exceed the MCLs for either PCE or TCE contamination. **Figure 5.4** (next page) shows wells that have been either positively or tentatively identified as locations during the off-post surveys, and shows which of those wells that have been previously or are currently sampled.

In general, the off-post wells are open borehole wells that fully penetrate the Middle Trinity aquifer to provide water to the well owner. The normal practice by local well installers was to use a minimal amount of surface casing to keep drilling costs down and maximize the amount of water available to enter the borehole. However, this style of well completion is thought to increase the risk of contamination in a well because significant contaminant concentrations may occur in perched groundwater above the main aquifer body. Minimally-cased wells may allow for the co-mingling of contaminated perched groundwater with otherwise clean groundwater within the primary production intervals of the well.

Routine off-post groundwater sampling began in 2001 and will continue into the foreseeable future. A set of Data Quality Objectives (DQOs), shown in **Figure 5.5**, were established in 2002 (updated in 2006) that provided the basis for frequency of sampling and remedial actions taken, if any.

After each groundwater sampling event, CSSA notifies the wellowners of their specific results from the sampling event. More information on the CSSA public relations program is described in Section 6.

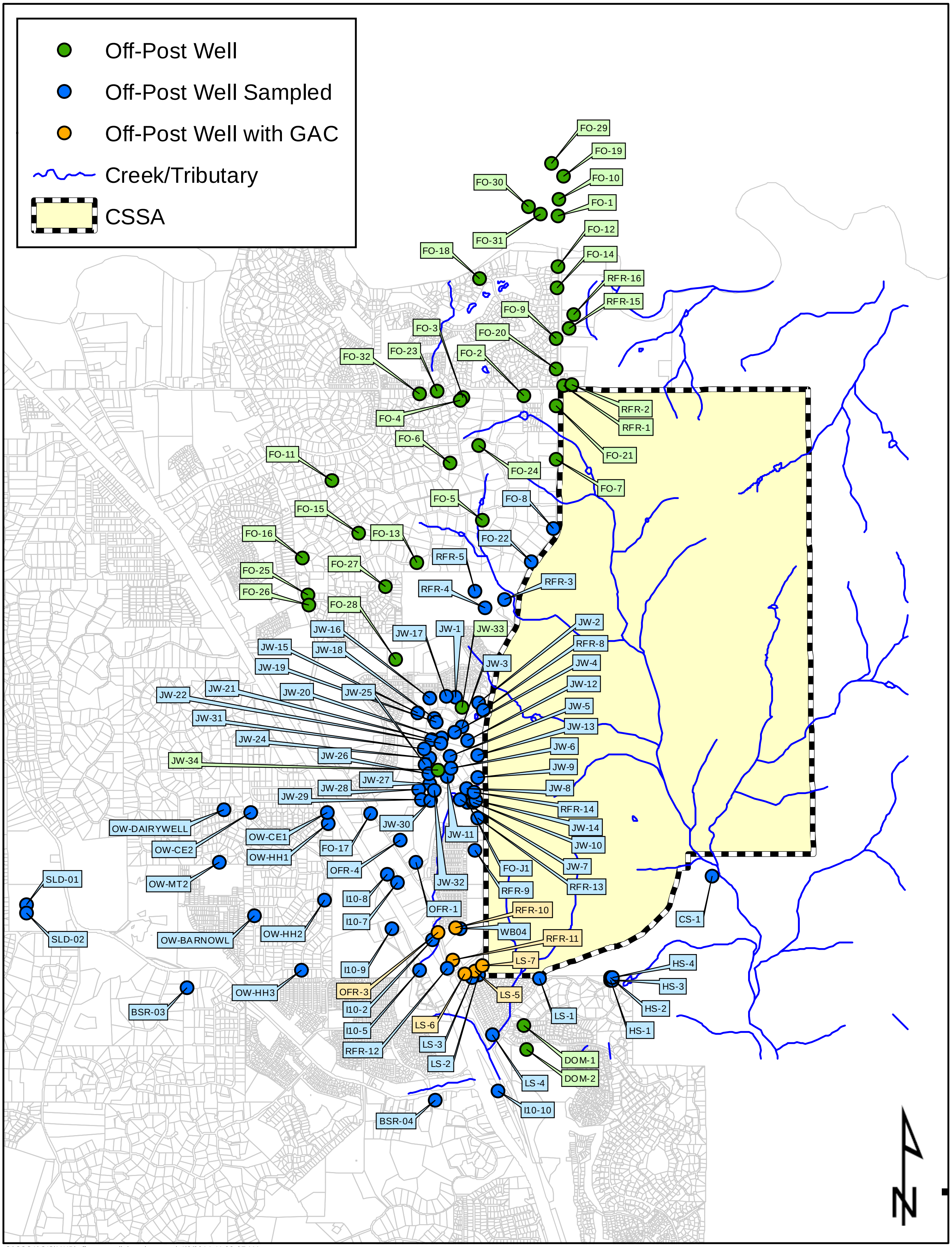


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Figure 5.4 - Off-Post Well Locations

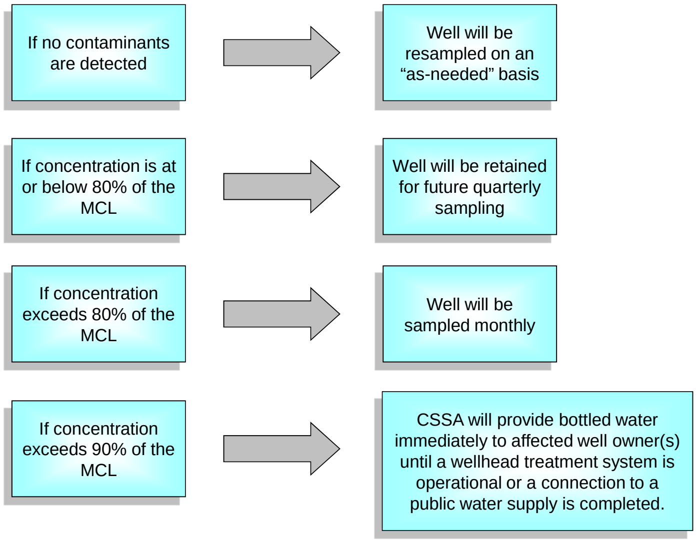

Figure 5.5 - Rationale for Off-post Sampling Frequency and Treatment

5.3 LONG-TERM MONITORING OPTIMIZATION

In 2004, Parsons performed an LTMO initiative to evaluate CSSA's quarterly groundwater sampling program. The evaluation was designed to determine the appropriate frequency of sampling on a qualitative and quantitative basis and also to identify data gaps. The 139 sampling points at CSSA were evaluated using qualitative hydrogeologic information, temporal statistical techniques, and spatial statistics. As each tier of the evaluation was performed, monitoring points that provide relatively greater amounts of information regarding the occurrence and distribution of COCs in groundwater were identified, and were distinguished from those monitoring points that provide relatively lesser amounts of information. The results of the evaluations were combined to generate a refined monitoring program that could potentially provide information sufficient to address the primary objectives of monitoring, at reduced cost. Monitoring wells not retained in the refined monitoring network could be removed from the monitoring program with relatively little loss of information.

In the CSSA qualitative evaluation, few wells were recommended for exclusion from the monitoring network, while many were recommended for reduced sampling frequency. Thus, the temporal and spatial statistical evaluation results were primarily used to confirm or adjust qualitative monitoring frequency recommendations. The justification for these modifications fall into the following general categories:

- Temporal and/or spatial statistical results confirm the sampling frequency recommendations from the qualitative evaluation.
- Decrease sampling frequency due to statistical results.
- Qualitative factor overrides statistical recommendations.
- Increase sampling frequency due to statistical recommendations.

The results of the qualitative hydrogeologic and spatial analyses were also used to suggest locations for possible future monitoring wells. As a result, six new wells were drilled in 2007 to address spatial data gaps identified during the LTMO.

For the on-post and off-post wells, the LTMO results indicated that a refined monitoring program consisting of 88 wells sampled less frequently (33 wells sampled biennially, 28 sampled annually, 16 semi-sampled annually, and 7 sampled quarterly) would be adequate to address the primary objectives of monitoring.

Implementing all of these recommendations for optimizing the monitoring program at CSSA would have reduced the number of on- and off-post well-sampling events per year by approximately 57 percent and the WB sampling events per year by approximately 88 percent. The US EPA approved the recommendations of the LTMO in 2005. The TCEQ approved the frequency reduction of on-post sampling (57 percent), but did not approve the reduction of sampling at off-post wells. The TCEQ requested that the current DQOs be retained for off-post sampling.

The same LTMO process was implemented in 2010 to evaluate the success of the LTMO implementation, suggest improvements, and identify additional programmatic cost savings, if any. An additional 5 years of data (2004-2009) was evaluated with the historical trends to assess the qualitative and quantitative impacts of the LTMO process. The most significant outcome was that all wells would be sampled during a single event to create a "snapshot" event to accurately depict the geometry and concentration of the plumes. This aspect of the plume management had been lost during the original LTMO implementation.

Another significant change was that annual and biennial sampling frequencies were reduced to 9-month and 18-month scheduling. This frequency change allowed samples to be collected over varying seasons and hydrologic seasons, rather than just one season (e.g. December only). This change was made to capture seasonal fluctuations associated with the change in recharge and contaminant flushing that occurs in the subsurface.

Finally, additional reductions in both on-post and off-post sampling were proposed. Implementing these recommendations would reduce on- and off-post sampling events by 24 percent and 28 percent, respectively. Likewise the reduction of Westbay sampling would result in a 19 percent decrease in sampling events. Overall, the recommendations of the 2010 LTMO update will reduce the CSSA groundwater monitoring frequency by 24 percent.

The updated LTMO was approved by the USEPA and the TCEQ in March 2011. In addition, both regulatory agencies approved the LTMO implementation at off-post well locations. The revised LTMO approach was implemented starting in June 2011.

5.4 GAC UNITS

Because of the off-post VOC contamination in excess of the MCLs, CSSA elected to install seven point-of-use granular activated carbon (GAC) treatment systems at six affected well locations (Figure 5.5). Well locations that routinely exceed the MCL for PCE and/or TCE and are used for consumption include:

- Three private residences (LS-5, LS-7 and RFR-10 [2 GAC units]);
- Two businesses (OFR-3 and RFR-11); and
- One church (LS-6).

These wells are all located southwest of CSSA, within the extent of Plume 2. Prior to 2008, two public supply wells (LS-2 and LS-3) for the Leon Springs Villas were also treated by a centralized hi-capacity GAC unit. However, this Public Water Supply (PWS) system no longer derives its groundwater from the Middle Trinity aquifer, and therefore the system was dismantled. This method of groundwater treatment employs activated carbon to remove organic contaminants from the groundwater. In general, contaminated groundwater produced from the well is pumped through two carbon vessels, each containing 90 pounds of granular activated carbon. The carbon vessels are placed in "series" in ensure all VOCs are removed. The treatment systems also include 5-micron cartridge filters to remove sediment and ultraviolet light treatment to destroy microbial contaminants. The entire system is self-contained within a "doghouse" at each well location (**Figure 5.6**). There are multiple configurations of treatment dependent upon the well and water supply equipment that each well owner operates. Figure 5.6 shows the GAC system configuration for well RFR-10.

Regular maintenance is performed both by Parsons and the carbon vendor (Carbonair, Inc.). The GAC units are wholly operated and maintained by CSSA without cost or burden to the well owner. A Parsons representative inspects each GAC filtration system every 3 weeks to change pre-filters and/or troubleshoot problems occurring with the systems. The carbon vessels are changed by Carbonair every 6 months. Semi-annual post-GAC confirmation samples are collected from all wells equipped with GAC filtration systems. The samples confirm that the GAC filtration systems are working effectively and that VOCs are reduced to concentrations below the applicable drinking water MCLs. To date, no COCs have been detected above reporting limits in the post-GAC samples. The annual cost to maintain the seven GAC units is approximately $30,000.

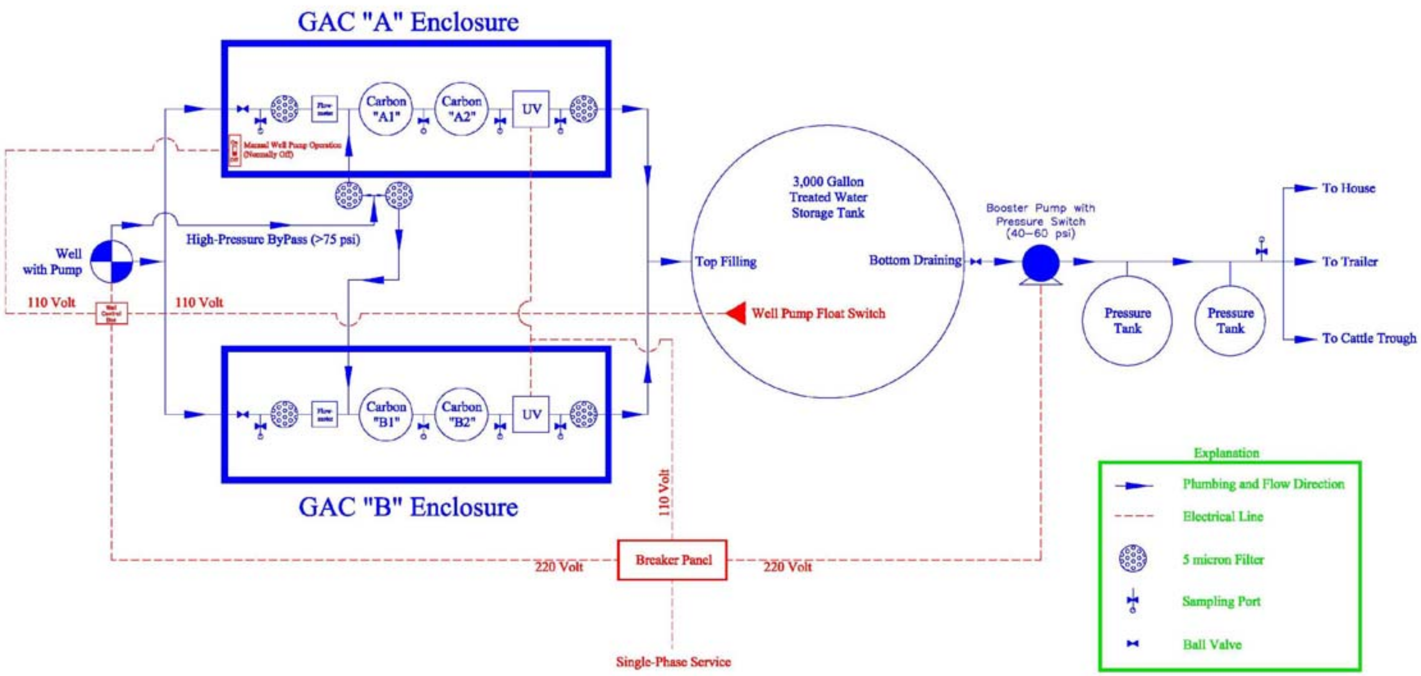

Figure 5.6 – Example of GAC System Operational Schematic and Residential GAC Unit Housing (Well RFR-10)

Section 6 - Public Relations

6.0 INTRODUCTION

A number of methods are used to provide information to the public regarding CSSA's environmental program. This section summarizes the following ways CSSA maintains good public relations and keeps the community informed:

- Community Relations Plan
- Administrative Record (Environmental Encyclopedia and CSSA website)
- Public Meetings
- Fact Sheets
- Off-post Monitoring
- Off-post Water Treatment

6.1 COMMUNITY RELATIONS PLAN

The Community Relations Plan (CRP) is a formal plan which documents past community relations activities and plans activities for the future. It focuses on environmental work being conducted under RCRA, and is a requirement under the May 5, 1999, §3008(h) Administrative Order on Consent issued by the USEPA (see Section 1). The initial CRP was completed in August 1999, and outlined the process of community involvement, availability of the document, and public comment opportunities to be conducted throughout the investigation and remediation processes. The CRP was then updated in 2002 and 2006 with recommendations for additional community outreach activities.

Updates are made to the CRP in response to community feedback. Interviews of local residents were held to gauge the effectiveness of the current plan and to determine if the public had suggestions to improve communication and dissemination of information. These interview discussions with state and local officials, community leaders, area residents/landowners, and interested citizens identied public information needs as well as the most effective method for disseminating this information. As part of CSSA's community relations efforts, 13 people were interviewed prior to the development of the original CRP in 1999, 16 people were interviewed prior to the 2002 update, and 15 people were interviewed prior to the 2006 update.

The CRP is currently undergoing a revision in 2014. The August 1999 CRP, and the December 2002 and May 2006 updates are available in the Environmental Encyclopedia under Volume 1-6, Other Plans and Approaches.

6.2 ADMINISTRATIVE RECORD/ENVIRONMENTAL ENCYCLOPEDIA

CSSA maintains an Administrative Record for its environmental program (named the Environmental Encyclopedia) at the main branch of the San Antonio Public Library, 600 Soledad Plaza, San Antonio, TX 78206. A hard copy of the administrative record is also maintained at the CSSA Environmental Office. Electronic copies have been available to the public on the CSSA website (www.stanley.army.mil) since 2000 (**Figure 6.1**). The Environmental Encyclopedia contains copies of all plans and reports submitted to regulators, meeting minutes from technical progress meetings, and key correspondence between CSSA and the regulatory agencies.

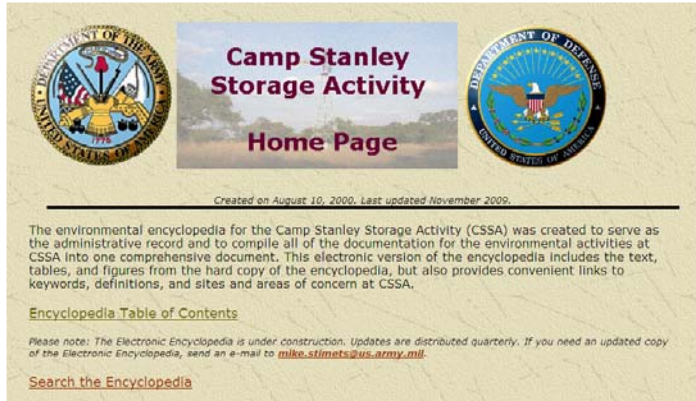

Figure 6.1 - Camp Stanley Environmental Encyclopedia Website

6.3 PUBLIC MEETINGS

6.3.1 Past Public Meetings (2001-2009)

CSSA held public meetings in 2001 and 2002. Approximately 120 people attended the public meetings hosted in October 2001, and less than 25 people attended the October 2002 meetings. The low public turnout for the meetings in 2002 suggested that community concerns were being effectively addressed by the proactive approach CSSA has taken to address off-post environmental concerns. Additional information on those public meetings can be found in the August 1999 CRP and the December 2002 CRP update.

Per USEPA's request, public meetings were held again on December 5 and 7, 2006, and November 17 and 19, 2009. Approximately 22 people attended the 2006 meetings and 8 people attended the 2009 meetings, including nearby homeowners, local public officials, regulatory representatives, and local media personnel.

6.3.2 Recent Public Meeting (2014)

The most recent public meeting was held on January 16, 2014 at the Leon Springs Baptist Church. Approximately two weeks prior to the meeting, invitation postcards were sent to stakeholders and 2,015 landowners within one-mile of the Plume 2 and/or CSSA boundary. Landowners were identified using Bexar County Appraisal District records. A public notice was published in the San Antonio Express-News (English), Conexion (Spanish), and the Boerne Star (English) newspapers.

A total of ten nearby residents and three local officials attended the 2014 meeting. Representatives from USEPA and TCEQ, as well as the Fort Sam Houston Public Affairs Officer, Phil Reidinger, were available to discuss issues specific to concerns raised by those in attendance.

The 2014 meeting was conducted in an open house format, with five laptop stations playing continually-looped PowerPoint presentations. Parsons personnel were available at each station to discuss the site and answer questions. The presentation topics included: 1) CSSA History and Mission; 2) Restoration Efforts; 3) Groundwater Compliance, 4) SWMU B-3 Treatment Technologies, and 5) AOC-65 Treatment Technologies (**Figure 6.2**). Several attendees had questions or concerns that were discussed with CSSA representatives at each meeting.

Figure 6.2 - 2014 Public Meeting

6.4 FACT SHEETS

To inform the public, an initial newsletter and various fact sheets were distributed to residents in the area of CSSA in December 1999 (**Figure 6.3**). This initial mailing was intended to gauge public interest in CSSA's environmental program and create a mailing list. A Congressional Fact Sheet was generated in July 2001 in response to public concern over the newly-discovered environmental issues at CSSA. Early Fact Sheets mailed in 2001 supplied general information about CSSA, the environmental program, and specific information regarding the contamination plume in the central region of CSSA.

To continue to inform the public, various Fact Sheets have been distributed from 2002 to present providing the results of groundwater monitoring, and specific items of interest such as clean-up activities at specific sites.

All Fact Sheets published to date, shown in **Table 6.1**, are available in the Environmental Encyclopedia and the Camp Stanley website under *Volume 1-6*, *Other Plans and Approaches*. Additional Fact Sheets will be prepared and distributed to present the results of future sampling events and/or clean-up activities at CSSA.

6.5 OFF-POST MONITORING

USEPA requires that CSSA monitor off-post public and private drinking water wells as part of its environmental program. As of April 2010, off-post monitoring is conducted on a quarterly basis. The changes in monitoring frequency recommended in the 2005 Long-Term Monitoring Optimizaiton (LTMO) study were not accepted by TCEQ for off-post wells. However, the LTMO study is currently being updated with five additional years of monitoring data, and TCEQ will be requested to approve the updated document's recommendations.

Camp Stanley Storage Activity
Groundwater Contamination – 2008 Sampling

FACT SHEET

No. 28 – Annual Fact Sheet for 2008

The purpose of this Fact Sheet is to provide an overview of the quarterly groundwater sampling conducted in 2008. Results for all groundwater sampling events are available in the Camp Stanley Storage Activity Environmental Encyclopedia located at the downtown San Antonio Public Library, 600 Soledad Street, on the 2nd floor behind the Reference Desk in the Government Documentation Section, or on the internet at www.stanley.army.mil.

On-post Groundwater Monitoring Plan

On-post groundwater monitoring has been conducted since 1991 as part of the Camp Stanley Storage Activity (CSSA) environmental program. The wells sampled include drinking water, monitoring, and agriculture/livestock wells. Sampling frequencies for the on-post wells are determined by the long-term monitoring optimization (LTMO) study completed in May 2005, as approved by U.S. Environmental Protection Agency (USEPA) and Texas Commission on Environmental Quality (TCEQ). Based on the LTMO recommendations, on-post wells are sampled semi-annually, every nine months, or biennially. Currently, CSSA samples for metals (*e.g.* chromium, cadmium, mercury, and lead) and for volatile organic compounds (VOC). VOCs are substances such as paint thinners, dry cleaning solvents, and some constituents of petroleum fuels (*e.g.* gasoline and natural gas). VOCs are sometimes accidentally released into the environment, where they can contaminate the soil and groundwater. The CSSA Groundwater Monitoring Program Data Quality Objectives (DQO) that provides a description of the ongoing groundwater monitoring program and sampling frequencies is available in the Environmental Encyclopedia.

Off-post Groundwater Monitoring Plan

CSSA describes its off-post groundwater monitoring plan in its *Off-Post Monitoring Program and Response Plan*, July 2001 (Plan). The goals of this Plan are to confirm that off-post drinking water meets USEPA and TCEQ safe drinking water standards, determine where VOC contamination has migrated and, respond according to the Plan if contaminant levels in those wells exceed standards. As part of the Plan, 43 off-post wells were sampled in 2008.

Off-post water wells are selected for sampling based on CSSA's Plan to ensure protection of drinking water and to provide information for the environmental program. Factors considered in deciding if a well is sampled include where the well is located, how close it is to areas where VOCs have been detected, whether the well owner grants access for sampling, and results of previous sampling at the well.

CSSA takes action if VOC contamination is detected in off-post wells at concentrations greater than 90 percent of the USEPA maximum contaminant level (MCL) (greater than 4.5 parts per billion (ppb) for tetrachloroethene (PCE) and trichloroethene (TCE)). If this occurs, CSSA's actions include supplying bottled water to the affected residents within 24 hours of the detection and resampling the well for confirmation. If additional sampling confirms previous test results, CSSA will either install a granular activated carbon (GAC) filter to remove contaminants from the water, or provide the well owner with an alternate water supply for as long as contaminant levels in the well exceed standards. Over the history of off-post sampling, six off-post water wells have been fitted with GAC filtration systems: LS-7 (August 2001), LS-6 (August 2001), RFR-10 (two units, October 2001), RFR-11 (October 2001), LS-2/LS-3 (April 2002), and OFR-3 (April 2002).

In August 2007, San Antonio Water Systems (SAWS) began supplying water to residents of the Leon Springs Villas Subdivision and use of the former drinking water supply wells (LS-1, LS-2, LS-3, LS-4) was discontinued. Based on these changes, GAC filtration service for LS-2/LS-3 has been discontinued.

2008 Groundwater Sampling Results

The locations of all on- and off-post wells sampled in 2008 are shown on Figure 1 (Page 4). According to the USEPA, concentrations below 5.0 ppb for PCE and TCE meet safe drinking water standards. Table 1 (Page 3) presents groundwater data for PCE and TCE from all four 2008 sampling events (March, June, September, December). Three wells, OFR-3, RFR-10 and I10-4, exceeded the MCL for PCE. Three wells (LS-6, LS-7 and RFR-11) had PCE and/or TCE detections at concentrations above the MCL (5.0 ppb) in the past. Wells OFR-3, RFR-10, RFR-11, LS-6 and LS-7 have been equipped with GAC filtration systems, and samples of water collected after going through the filtration for these wells are non-detect. Well I10-4 is not currently being used as a drinking water well and is not equipped with a GAC filtration system. In all other wells tested, VOC detections were below the applicable MCLs for drinking water for PCE and TCE, specifically.

CSSA will continue to sample both on- and off-post groundwater wells at the frequencies recommended in the LTMO and DQOs. CSSA will continue to coordinate this groundwater monitoring program with the regulatory agencies and other potentially affected parties, including the USEPA, TCEQ, Fort Sam Houston, City of Fair Oaks, Fair Oaks Water Utilities, San Antonio Water Systems, Bexar County Commissioners' office, State Representatives' offices, local, state, and federal elected officials, private well owners, and others.

Post-GAC Sampling Results

Because of the previously detected presence of VOCs, five off-post wells in the area are currently equipped with GAC filters. In March and September 2008 analyses of the post-GAC water samples confirmed that no VOCs were present above the applicable MCLs, and that the GAC units were working properly. Maintenance

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Figure 6.3 - Example Fact Sheet

As described in Section 5.5, CSSA has sampled a total of 51 privately-owned wells since 1999. Prior to sampling a private well, CSSA obtains a right-of-entry agreement from the landowner. Parsons coordinates sampling events with each well owner in advance. The *Off-Post Monitoring Program and Response Plan* guides the selection of off-post wells for sampling; however, exceptions are made based on contaminant migration trends, well owner concerns, and other factors.

Letters summarizing and explaining sampling results are sent to individual off-post well owners after the sampling results are verified. In addition, a report presenting analytical results for each event is located in the Environmental Encyclopedia, *Volume 5-1*, *Groundwater*. A summary of the off-post monitoring program is provided in Section 2 of this SMP.

6.6 OFF-POST WATER TREATMENT

CSSA has installed GAC filtration systems (see Figure 5.5) at five off-post well locations to remove VOCs from drinking water (see Section 5.4 for more information). Operation and maintenance of the GAC treatment systems are performed by CSSA on a monthly basis and every 6 months by Carbonair, the supplier of the activated carbon filtration systems and replacement filters. Residents with GAC units are informed when their unit is due for and has received routine maintenance. New GAC buildings were installed at four locations in 2009.

Table 6.1 - CSSA Fact Sheets (2001-2013)

No.	Title	No.	Title
-	Environmental Program - Congressional Fact Sheet	18	Groundwater Contamination - March 2004 Sampling
1	Environmental Program	19	Groundwater Contamination - June 2004 Sampling
2	Soil and Groundwater Contamination	20	Groundwater Contamination - September 2004 Sampling
3	Groundwater Contamination - Plume 1	21	Groundwater Contamination - December 2004 Sampling
4	Groundwater Contamination - Plume 2	22	Groundwater Contamination - March 2005 Sampling
5	Groundwater Contamination - September 2001 Sampling	23	Groundwater Contamination - June 2005 Sampling
6	Groundwater Contamination - December 2001 Sampling	24	Groundwater Contamination - September 2005 Sampling
7	Groundwater Contamination - March 2002 Sampling	25	Groundwater Contamination - December 2005 Sampling
8	Groundwater Contamination - June 2002 Sampling	26	Clean-up Activities at SWMU B-3 - March 2006
9	Environmental Program Information - August 2002	26	Groundwater Contamination - 2006 Sampling
10	Cleanup Activities at SWMU B-3 and AOC-65 - October 2002	27	Groundwater Contamination - 2007 Sampling
11	Groundwater Contamination - Chloroform - December 2002	28	Groundwater Contamination - 2008 Sampling
12	Groundwater Contamination - September 2002 Sampling	29	Overview and History - 2009
13	Groundwater Contamination - December 2002 Sampling	30	Groundwater Contamination - 2009 Sampling
14	Groundwater Contamination - March 2003 Sampling	31	Groundwater Contamination - 2010 Sampling
15	Groundwater Contamination - June 2003 Sampling	32	Groundwater Contamination - 2011 Sampling
16	Groundwater Contamination - September 2003 Sampling	33	Groundwater Contamination - 2012 Sampling
17	Groundwater Contamination - December 2003 Sampling	34	Groundwater Contamination - 2013 Sampling

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