

**FINAL**

**QUARTERLY PROGRESS REPORT**

**November 1, 2005 – January 31, 2006**

**(27<sup>th</sup> QUARTER)**



Camp Stanley Storage Activity

Boerne, Texas

EPA ID No. TX2210020739

January 2006

# QUARTERLY PROGRESS REPORT

## NOVEMBER 1, 2005 - JANUARY 31, 2006

### (27<sup>TH</sup> QUARTER)

This 27<sup>th</sup> Quarterly Progress Report for Camp Stanley Storage Activity (CSSA), Texas, U.S. Environmental Protection Agency (EPA) Identification Number TX2210020739, is submitted in accordance with the Administrative Order on Consent (Order) issued to CSSA on May 5, 1999, pursuant to §3008(h) of the Safe Drinking Water Act (SDWA), as amended by Resource Conservation and Recovery Act (RCRA), and further amended by the Hazardous and Solid Waste Act (HSWA) of 1984, 42 U.S.C. §6928(h). This report addresses the project progress from November 1, 2005 - January 31, 2006 (Quarter 27). Subsequent progress reports will continue to be submitted on a quarterly basis.

This report details work completed on tasks associated with the four project phases outlined in the Order. Phase names and task names listed below are taken directly from the Order. Information requested in the Order for each active task is provided in this report. No current information is given for tasks that are not active, however; a summary of the tasks, subtasks and their status have been presented in previous quarterly reports.

#### **Interim Measures**

- Task I: Interim/Stabilization Measures (I/SM) Work Plan (WP)
- Task II: I/SM Implementation
- Task III: Reports

#### **RCRA Facility Investigation**

- Task I: Preliminary Report: Description of Current Conditions (DCC)
- Task II: RCRA Facility Investigation (RFI) WP
- Task III: Facility Investigation
- Task IV: Human Health and Ecological Risk Assessment
- Task V: Investigation Analysis
- Task VI: Treatability Studies
- Task VII: Progress Reports

#### **Corrective Measures Study**

- Task VIII: Identification and Development of Corrective Action Alternatives
- Task IX: Evaluation of Corrective Measures Alternatives
- Task X: Reports

## Corrective Measures Implementation

Task XI: Corrective Measure Implementation (CMI) Program Plan

Task XII: Corrective Measure Design

Task XIII: Corrective Measure Construction

Task XIV: Reports

Details of the evaluation of the percent complete by task are included in **Table 1**. An updated project team chart along with telephone numbers and addresses are included in **Table 2**.

**Attachment 1** shows the locations of groundwater wells referenced in this report. A summary of the status of all identified Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) present at CSSA is provided in **Attachment 2**. **Attachment 3** is a summary of the financial status and the physical percent complete for the various investigations being conducted at CSSA. **Attachment 4** is a technical memorandum for the tracer injection beginning this Quarter.

## **INTERIM/STABILIZATION MEASURES**

I/SMs are being conducted to mitigate a current or potential threat to human health and/or the environment. I/SMs are estimated to represent approximately 30 percent of the actions required by the Order. The I/SMs include I/SM WP (7 percent), I/SM Implementation (70 percent), and Reports (23 percent). Based on information currently available at the end of Quarter 27, the I/SMs are approximately 87 percent complete. No changes have occurred in the status of interim/stabilization measures during this Quarter. If changes occur to the status of any I/SMs during Quarter 28, this section will be updated.

## **CORRECTIVE MEASURES STUDY**

The Corrective Measure Study (CMS) will consist of the identification, screening, and development of alternatives for removal, containment, treatment, and/or other remediation of the contamination identified at CSSA. The CMS will be based on results of the RFI, identified corrective measure technologies, and results of any treatability studies. The CMS is estimated to represent approximately 10 percent of the required actions at CSSA. The CMS includes identification and development of alternatives (15 percent), evaluation of alternatives (60 percent), and reports (25 percent). The CMS has not yet been initiated. When the CMS is initiated, this section will be updated to include the current status.

## **CORRECTIVE MEASURES IMPLEMENTATION**

The purpose of the CMI is to design, construct, operate, maintain, and monitor the performance of corrective measure(s) selected to protect human health and the environment. The CMI consists of a CMI Program Plan, Corrective Measure Design, Corrective Measure Construction, and reports. The CMI is estimated to represent approximately 30 percent of the required actions at CSSA. The CMI includes implementation of the program plan (5 percent), corrective measure design (15 percent), corrective measure construction (70 percent), and reports (10 percent). The CMI has not yet been initiated. When the CMI is initiated, this section will be updated to include the current status.

## **RCRA FACILITY INVESTIGATION**

The RFI phase outlined in the Order covers most of the ongoing activities at CSSA. The remainder of this Quarterly Progress Report consists of discussion concerning the RFI phase.

## **RCRA FACILITY INVESTIGATION**

The RFI is being conducted to characterize the environmental setting of CSSA, define the sources of contamination, define the degree and extent of contamination, identify actual or potential receptors, and assess whether any additional I/SM may be warranted. The RFI is estimated to represent approximately 30 percent of the required actions at CSSA. The RFI includes a Preliminary Report (5 percent), RFI WP (10 percent), Facility Investigation (45 percent), Human Health and Ecological Risk Assessment (15 percent), Investigation Analysis (10 percent), Treatability Studies (10 percent), and Progress Reports (5 percent). As of the end of Quarter 27, the RFI is approximately 71 percent complete.

### **Task I: Preliminary Report: Description of Current Conditions**

#### **Task Description**

This task included preparation of the DCC Report. The DCC Report included information from previous investigations and other relevant data. Information related to the facility background, nature and extent of contamination and pre-investigation evaluation of corrective measure technologies was included in the DCC Report. CSSA's Environmental Encyclopedia was used to meet the DCC Report submittal requirements. The final DCC Report was submitted to the EPA and TCEQ on August 1, 1999. No regulatory comments on the report were received. This task makes up approximately 5 percent of the RFI phase, and is 100 percent complete.

#### **Activities this Quarter**

No activities associated with the DCC were conducted this Quarter.

### **Task II: RFI Work Plan**

#### **Task Description**

The Order requires that the RFI WP task include a Project Management Plan, Data Collection Quality Assurance Plan, Health and Safety Plan (HSP), and a Community Relations Plan (CRP). As previously agreed by EPA, CSSA's Environmental Encyclopedia has been used to fulfill this requirement. The Environmental Encyclopedia includes all information required by the Order. Completion of this task is funded for the planned RFI tasks. The RFI WP task makes up approximately 10 percent of the RFI phase. Estimation of percent complete is difficult due to the continuing need for plan addenda as new projects are being identified. As of the end of Quarter 27, WPs currently under scope are 95 percent complete. The CSSA Environmental Encyclopedia will continue to be updated as WPs for the new task orders are finalized.

#### **Activities this Quarter**

An update to the December 2002 CRP is being prepared. As part of the update, approximately 70 community members were contacted to request an interview regarding CSSA's community relations program. This led to 16 interviews with community members.

A TO0006 draft WP for performance of the Enhanced Anaerobic Bioremediation (EAB) utilizing an injected substrate into the VOC contaminated aquifer underlying SWMU B-3 was submitted to CSSA and AFCEE for review on July 29, 2005, and comments were received on

October 12, 2005. The final revised work plan for the EAB pilot study was approved in January 2006.

Modification 02 to TO0006 was awarded during Quarter 26. Modification 02 includes removal of waste from the SWMU B-3 trenches and the subsequent construction of a bioreactor cell in the excavated trench. The activities planned under Modification 02 were incorporated into revised work plan documents this Quarter which were approved by CSSA in January 2006.

In addition to these work plan approvals, CSSA submitted the underground injection control (UIC) permit for the EAB pilot study to TCEQ on October 17, 2005. TCEQ requested additional information regarding classification of water from CS-MW16-LGR be submitted to enable approval of the application.

### **Task III: Facility Investigation**

#### **Task Description**

An investigation of the facility is being conducted to:

- a) Characterize the environmental setting of the facility;
- b) Define the source(s) of contamination;
- c) Define the nature and extent of contamination; and
- d) Identify actual or potential receptors.

In some cases, multiple investigational phases may be necessary. The investigation results will be used to develop and evaluate alternatives during the CMS. All investigation activities are being conducted in accordance with the RFI WP.

Completion of this task is partially funded for the planned RFI tasks. **Attachment 2** indicates the sites for which investigations have been initiated and site status as well as sites that have been identified, but not yet investigated. The RFI subtask makes up approximately 45 percent of the RFI phase. As of the end of Quarter 27, this task is approximately 63 percent complete.

#### **Activities this Quarter**

The majority of current ongoing environmental activities at CSSA are part of the RFI task. Work on each of these tasks is described in the following paragraphs. The main areas of work this Quarter included groundwater monitoring of on- and off-post and Westbay<sup>®</sup> wells, analytical data verification and validation, closure activities at several SWMUs and AOCs, Building 90/AOC-65 investigations, Soil Vapor Extraction (SVE) system operation and expansion, completion of the second phase of the East Pasture UXO clearance project, National Environmental Policy Act (NEPA) services, SWMU B-3 removal action and bioreactor planning, and various miscellaneous environmental tasks.

#### **Groundwater Monitoring**

There are a total of 45 wells at CSSA that are part of the groundwater monitoring program. Three are drinking water wells, three are former livestock wells, four are Westbay<sup>®</sup> multi-port wells, and 35 are used as monitoring wells. Sampling frequencies for these on-post wells are determined by the long-term monitoring optimization (LTMO) study completed in May 2005, as approved by TCEQ. Based on the LTMO recommendations, on-post wells are sampled

quarterly, semi-annually, or biennially. Off-post wells are not included in the LTMO recommendations and are sampled quarterly under the Data Quality Objectives (DQOs). A map of the well locations sampled is provided on Attachment 1 of this report.

Quarterly groundwater monitoring of on-post, drinking water, and the Westbay<sup>®</sup> wells was not conducted this quarter. Under the provisions of the LTMO study, reductions in sampling frequencies were recommended. The LTMO recommendations were submitted to EPA and TCEQ for review and comment on May 18, 2005. TCEQ issued a letter on November 8, 2005, approving the implementation of the LTMO recommendations on-post only for December 2005. TCEQ issued a letter on December 19, 2005, approving the implementation of the following LTMO recommendations:

- On-post monitoring wells sampling frequency reductions;
- AOC-65 piezometers sampling frequency reductions;
- Westbay<sup>®</sup> well sampling frequency reductions; and
- Construction of 11 additional on-post wells for further delineation.

At the time of the December 2005 groundwater monitoring event, TCEQ had not approved reductions in sampling frequencies for off-post wells. TCEQ raised concerns about reduction in sampling frequency for off-post wells with low VOC levels in a letter dated December 19, 2005. Because of TCEQ concerns, it was determined to continue using the previously approved groundwater monitoring DQOs for the off-post wells and to postpone implementation of the off-post LTMO recommendations. CSSA is currently updating the on-post DQOs to be consistent with the approved on-post LTMO sampling frequencies.

Off-post wells were sampled from December 19 - 23, 2005. Thirty-one private and public off-post drinking water wells were sampled. The locations of these wells are shown on **Attachment 1**. All samples were collected from ports located near the wellhead. Samples were analyzed by Agriculture & Priority Pollutants Laboratories, Inc. (APPL) for the EPA-approved short list of volatile organic compounds (VOCs) from the project DQOs. The VOC short list includes 1,1-dichloroethene (1,1-DCE), bromodichloromethane, bromoform, chloroform, *cis*-1,2-dichloroethene (*cis*-1,2-DCE), dibromochloromethane, dichlorodifluoromethane, methylene chloride, naphthalene, tetrachloroethene (PCE), trichloroethene (TCE), toluene, *trans*-1,2-dichloroethene (*trans*-1,2-DCE), and vinyl chloride. Parsons received preliminary data for these samples on January 12 and 13, 2006. Data validation and verification for these samples were initiated and Parsons' chemists submitted these data packages to AFCEE and Portage Environmental this Quarter.

The Final Off- and On-post Quarterly Groundwater Monitoring Reports for June 2005 were submitted to TCEQ on December 29, 2005. The responses to comments for the September Off-post Quarterly Groundwater Monitoring Report were provided to CSSA December 28, 2005, and the September groundwater reports will be made Final this Quarter. Results for the December sampling will be formally reported in the draft December 2005 Quarterly Groundwater Monitoring Report to be submitted to CSSA and AFCEE for review and comments during Quarter 28.

### **Off-Post GAC Systems**

Based on sampling results received in 2001 and 2002 indicating VOC levels above or approaching the maximum contaminant level (MCL), granular activated carbon (GAC) filtration systems were installed at seven off-post wells. In accordance with the CSSA Off-Post Monitoring Program Response Plan dated June 2002, the off-post GAC wellhead treatment systems are maintained by CSSA. Monthly operations and maintenance (O&M) activities for the off-post residential GAC treatment systems were performed this Quarter. Work included inspection and replacement, as needed, of the pre- and post-GAC filters at wells LS-6, LS-7, RFR-10, RFR-11, and OFR-3. Carbon from the LS-6, LS-7, RFR-10, RFR-11, and OFR-3 GAC systems was changed during the week of January 9, 2006. Confirmation samples will be collected in March 2006 to verify the systems are working effectively.

### **On-Post GAC Systems**

Parsons operated and maintained the on-post GAC unit (outfall 002) this Quarter. Parsons prepares a Discharge Monitoring Report (DMR) each month to comply with TPDES permit requirements. From November to December 2005, approximately 149,000 gallons of water containing VOCs were treated by GAC and discharged from Outfall 002. The water treated in November 2005 consisted of well development from CS-WB05, CS-WB06, CS-WB07 and CS-WB08. December 2005 water treated was generated during pumping tests at wells CS-MW16-LGR and CS-MW16-CC.

### **Data Validation and Verification**

Laboratory results from sampling efforts and investigations are validated and verified by Parsons' chemists to ensure results are in compliance with CSSA Quality Assurance Program Plan (QAPP) requirements. Data validation and verification continued during Quarter 27 under CSSA projects TO0006, TO0008 and TO0019.

Parsons received 10 data packages during Quarter 27:

- Three related to TO0006 sampling activities;
- Two related to quarterly groundwater monitoring activities;
- Three related to outfall sampling; and
- Two related to SWMU and AOC closure activities.

The TO0006 sampling and outfall monitoring are verified as screening-level data. The three TO0006 data packages were received from Gulf Coast Analytical Laboratories (GCAL), the TO0019 and TO0008 data packages were received from APPL and the TO0008 data packages for outfall monitoring were received from DHL Analytical, (DHL). Data packages were validated and verified in accordance with specific project DQOs and the CSSA QAPP. Parsons will submit data packages for TO0008 off-post groundwater monitoring this Quarter to AFCEE for review.

### **RCRA Facility Investigations/Closures of SWMUs and AOCs**

A total of 84 SWMUs, AOCs, and Rifle Management Units (RMUs) have been identified at CSSA and investigations have been conducted at 64 of those sites. A summary of the status of each site, including whether the site is recommended for closure or if closure is approved, is provided in **Attachment 2**. To-date, Risk Reduction Standard 1 (RRS1) closure of 35 CSSA

sites has been approved by TCEQ and eight sites were either delisted or granted No Further Action (NFA) status.

TCEQ has requested additional information for the SWMU B-29 closure report. SWMU B-29 closure is pending on the submission and approval of the requested information.

### **Hydrogeologic Conceptual Site Model**

A draft final version of the CSSA Hydrogeologic Conceptual Site Model (CSM) was submitted to AFCEE and CSSA for internal review on May 27, 2005. Comments on the Draft Final CSM were submitted October 24, 2005 and responses to comments were forwarded January 10, 2006. The Final CSM was submitted to EPA and TCEQ on January 31, 2006.

A 72-hour pumping tests was performed on CS-Well 16 CC and CS-Well 16 LGR in December 2005. The depleted carbon in the groundwater treatment unit at Outfall 02 was exchanged on December 7, 2005, prior to beginning the pumping tests. Data evaluation was performed in January 2006 and the results from the pumping tests will be incorporated in a CSM Update to be prepared after installation of six additional monitoring wells in 2006.

### **East Pasture Clearance Project**

Additional UXO removal actions were conducted in the East Pasture during January 2006. Since funds were remaining after the April 2005 removal, a no-cost modification was completed to extend the period of performance (POP) and update the SOW to include additional survey and removal acreages.

Eleven acres were surveyed using an EM and a removal action was performed in two of those surveyed acres. Three-hundred and five anomalies were investigated within the two acres, one of which was found to be UXO. The Fort Sam Explosives and Ordnance Disposal (EOD) team was notified about the UXO item and performed a controlled demolition of the item.

All metal scrap found during the removal action efforts was recycled and other trash items were disposed. A report summarizing all of the East Pasture investigation results will be finalized during Quarter 28.

In addition, four test trenches were excavated at AOC-59, located adjacent to the surveyed area. Visual observation indicated no waste or contamination. Four composite samples were collected for testing. Test results are still under evaluation.

### **NEPA Support and Miscellaneous Environmental Services**

TO0179, NEPA Support and Miscellaneous Environmental Services, was awarded September 2005 (Quarter 26). This task order is setup to handle NEPA requirements associated with various CSSA construction projects, specifically the preparation of Records of Environmental Consideration (RECs). It also encompasses miscellaneous environmental needs (sample collection, coordination or oversight of construction activities, waste characterization, waste disposal, etc.) as they become necessary, per CSSA's request.

During Quarter 27, RECs were completed for the Motor Pool/Car Wash construction project and the Building 96 Generator project.

Miscellaneous environmental services completed under TO0179 during Quarter 27 include waste characterization sampling and construction oversight for the Motor Pool/Car Wash project,

sampling of various containerized waste liquids for characterization and disposal purposes, completing inventories of waste materials, and coordinating with the Defense Reutilization and Marketing Office to recycle various waste materials.

### **SWMU B-3 SVE/Removal Action and Bioreactor/EAB Treatability Testing**

Installation of four Westbay<sup>®</sup> monitoring wells completed with multi-port sampling intervals was initiated on November 7, 2005 and completed by November 14, 2005. CSSA concurred with Parsons' technical basis for the selected monitoring intervals presented in the revised work plan addendum.

The initial round of groundwater samples were collected from CS WB05 monitoring intervals, located between SWMU B-3 and CS-16, on November 21, 2005. The preliminary results are presented in the following table (in micrograms per liter):

<b>WB05 Interval</b>	<b>TCE</b>	<b>PCE</b>	<b>Cis-1,2-DCE</b>	<b>MeCl</b>
LGR3	173	136	207	16.1
LGR4A	120	79.5	230	20.0
LGR4B	362	346	494	30.8
BS01	249	179	355	24.8
CC01	347	345	507	33.4
CC02	329	299	475	44.5

A second round of samples was collected from the Westbay<sup>®</sup> wells on December 27-29, 2005. The third and final pre-injection round of samples was collected January 24-26, 2006. This final round included testing for monitored natural attenuation (MNA) parameters in all sample locations and intervals. The preliminary results from these sampling events were not received this Quarter.

Additionally, soil gas and water from VEW-20, located in the center of SWMU B-3's western trench and completed in the limestone underlying the buried debris, were sampled in November 2005. The results from that sampling indicated only 0.681 parts per billion (ppb) PCE in the soil gas, and 7.5 micrograms per liter ( $\mu\text{g/L}$ ) PCE, 4.94  $\mu\text{g/L}$  TCE, and 9.05  $\mu\text{g/L}$  cis-1,2-DCE in the groundwater sample collected from the well. VEW-20 will be plugged and abandoned before the trench removal action begins.

The blower at the SWMU B-3 SVE system was replaced with a new blower and reconnected for operation. After checking performance, the new blower will remain idle until the SVE system at SWMU B-3 is expanded.

As part of the EAB pilot study, a tracer will be injected into the B3-MW01 well approximately two weeks in advance of the substrate injection to refine estimates of groundwater velocity at the study site. A technical memorandum was submitted to CSSA explaining injection plan and rationale (January 12, 2006). The memorandum gave details of the basis for the tracer study and substrate injections, plus projected flow rates and monitoring frequencies. The tracer

injection is planned for January 30, 2006. The technical memorandum for the injection solutions, volumes, flow rates and monitoring frequencies is presented in Attachment 4.

### **Miscellaneous**

Letters summarizing the results of the September 2005 off-post groundwater monitoring event were mailed to the owners of the off-post wells on December 5, 2005. A draft Fact Sheet 23 summarizing the June 2005 groundwater monitoring results was submitted to CSSA and AFCEE for review during Quarter 26 and the September 2005 Fact Sheet 24 was submitted for review in December 2005. Future fact sheets may be distributed annually.

The CSSA website ([www.stanley.army.mil](http://www.stanley.army.mil)) was updated with documents added to the Environmental Encyclopedia through the end of January 2006. The website includes CSSA's Administrative Record as required under the Order. Parsons continued to update the internal version of the electronic encyclopedia and hard-copy with all final reports through October 2005. Updates made in Quarter 27 included the following:

- Quarterly 27 EPA Progress Report;
- June 2005 On-post Groundwater Monitoring Report;
- June 2005 Off-post Groundwater Monitoring Report;
- September 2005 On-post Groundwater Monitoring Report;
- September 2005 Off-post Groundwater Monitoring Report;
- Well owner letters for September 2005;
- Various meeting minutes; and
- Various tables of contents, site chronologies and indexes.

### **Summary of Contacts**

CSSA received several letters from the TCEQ during Quarter 27. The following correspondence was submitted to and/or received from TCEQ or EPA:

- October 20, 2005 TCEQ approval of the March 2005 On-post Quarterly Groundwater Monitoring Report;
- November 4, 2005 Submittal of the Quarter 26 Progress Report;
- November 8, 2005 TCEQ approval of implementation of the LTMO recommendations for December 2005, on-post only; pending further review;
- December 14, 2005 CSSA request for regulatory ruling from TCEQ on recycling of lead air filters; and
- December 19, 2005 TCEQ approval with modification for implementation of the LTMO recommendations for on-post only.

Copies of all correspondence are included in **Volume 1-7** of the **Environmental Encyclopedia**.

### **Projected Work for the Next Quarter**

## **Fact Sheets**

Fact sheets covering the September and December groundwater monitoring will be finalized and mailed to residents in Quarter 28. Upon completion of the Technology Evaluation Report for AOC-65, a new fact sheet will also be prepared for distribution to the neighborhood covering the topic of investigation and remedial action progress at AOC-65 under TO0058.

## **Groundwater Monitoring**

The Draft December 2005 Off-Post Groundwater Monitoring Report will be submitted to CSSA and AFCEE for review in Quarter 28. O&M at the residential GAC filtration systems (LS-6, LS-7, OFR-3, RFR-10, and RFR-11) and public water supply systems (LS-2/LS-3) will be conducted monthly during Quarter 28. The Westbay<sup>®</sup> wells will be profiled and sampled in March 2006

## **SWMU and AOC RFI Closure Reports and Planned Closure Projects**

Closure/characterization work will be continued for SWMUs and AOCs during Quarter 27. All RRS1 closure, delisting, and NFA reports were submitted to TCEQ by May 1, 2005. Responses to TCEQ requests for additional information regarding these reports will be provided as necessary during Quarter 28. All remaining CSSA SWMUs and AOCs that have not achieved closure before the May 1, 2005 deadline will be transitioned to the Texas Risk Reduction Program (TRRP).

## **East Pasture Removal Action Project**

The removal action report for the East Pasture will be finalized and the job will be closed out.

## **SWMU B-3 Removal Action and Bioreactor/EAB Treatability Testing**

Removal actions at SWMU B-3 will be initiated next Quarter.

The EAB pilot study will also continue with tracer test monitoring followed by injection of the substrate tentatively scheduled for early February 2006. Post-injection testing, as described in the EAB work plan, will be performed following the injection of substrate into the formation.

## **Other RFI Subtasks**

The RFI phase as set out in the Order also includes tasks for Human Health and Ecological Risk Assessment, Investigation Analysis, Treatability Studies, and Progress Reports. There are no changes to these subtasks this Quarter. If future activities impact the status of these tasks, they will be included in the report in future Quarters.

**Table 1: Project Task Completion to Date  
 for Open Projects Only  
 (values updated through October 31, 2005)**

Project Number	Description of Task	Relation to Order	Percent Complete
TO0042	TO Management	I/SM/RFI	95%
	Meetings	I/SM/RFI	100%
	Site Survey/WPs	I/SM/RFI	100%
	New Well Installation/Well Upgrade	RFI	100%
	On-Post Groundwater Monitoring	I/SM/RFI	100%
TO0005	TO Management	I/SM/RFI	66%
	Meetings	RFI	20%
	Environmental Encyclopedia Updates	RFI	73%
	LAN Support	NA	100%
	Quarterly Progress Reports	I/SM/RFI	60%
	Publish Encyclopedia Website	I/SM/RFI	30%
TO0008	TO Management	I/SM/RFI	72%
	Meetings	I/SM/RFI	83%
	WPs	I/SM/RFI	88%
	On-Post Groundwater Sampling	I/SM/RFI	75%
	Off-Post Groundwater Sampling	I/SM/RFI	80%
	Analytical Validation, Verification, and ERPIMS	I/SM/RFI	77%
	LAN and GIS Support	I/SM/RFI	35%
	Effluent Re-Use Feasibility Study	NA	0%
	Well Network Optimization Study	RFI	99%
	Installation of Monitoring Wells	RFI	1%
	CSM Update	RFI	1%
TO0019	TO Management	RFI	92%
	Preparation of Plans	RFI	99%
	Field Activities	RFI	95%
	Preparation of Reports	RFI	95%
	Meetings	RFI	90%
TO0017	TO Management	RFI	77%
	Geophysical Prove-Out/Survey	RFI	93%
	Sampling/Transportation and Disposal	RFI	30%
	Anomaly Excavation/Reacquisition	RFI	85%
TO0179	Project Management and Meetings	RFI	16%
	NEPA Support and Permit Acquisition/Tracking	RFI	27%
	Miscellaneous Environmental Services	RFI	13%
TO0011	Project Management	I/SM/RFI	66%
	Meetings	I/SM/RFI	70%
	WPs, Site Survey, & Design	RFI	100%
	SCADA Installation & Commission	RFI	9%
	O&M Manual & Training	RFI	0%
	Site Survey Field Work	RFI	0%
	SCADA Installation Field Work	RFI	0%

<b>Project Number</b>	<b>Description of Task</b>	<b>Relation to Order</b>	<b>Percent Complete</b>
TO0006	Project Management	I/SM/RFI	59%
	Meetings	I/SM/RFI	43%
	WPs & DQOs	RFI	99%
	Outfall Reuse Design & Construct	I/SM/RFI	6%
	B3 Remedial Optimization	RFI	27%
	AST Upgrade	I/SM/RFI	18%
	SVE Expand & O&M	RFI	14%
	SWMU B-3 Monitoring Network	RFI	79%
	Asphalt Removal Action	Other	100%
	SWMU B-3 Removal Action	RFI	1%
	Bioreactor Construction	RFI	12%
	Bioreactor Testing & O&M	RFI	0%
	CS-MW16-CC Pumping Test	RFI	70%
TO0098	Project Management	Other	72%
	TPDES Permit Application	Other	100%
	Storm Water Procedures Manual	Other	95%
	Installation Cultural and Natural Resources Management Plans	Other	93%
	Environmental Noise Management Plan	Other	100%
	Community Relations Plan	RFI	80%
	Air Permit Update	Other	100%
	GIS and LAN Support	Other	18%
	Salado Creek Feasibility Study and Implementation	Other	60%
	EMS Implementation and Training	Other	30%

**Table 2: Project Contact Information**

<b>Name</b>	<b>Organization/Role</b>	<b>Street Address</b>	<b>City, State, Zip</b>	<b>Phone No.</b>	<b>Fax No.</b>	<b>E-mail</b>
Aston, Jeff	CSSA/USACE, Environmental Engineer	c/o Environmental Office, 25800 Ralph Fair Road	Boerne, TX 78015-4800	(210) 698-5208	(210) 295-7386	astonj@envirodept.net
Beal, Christopher	CSSA/Portage Environmental, Geologist and Environmental Assistant	c/o Environmental Office, 25800 Ralph Fair Road	Boerne, TX 78015-4800	(210) 698-5208	(210) 295-7386	bealc@envirodept.net
Brown, Ed	AFCEE/ERC, AFCEE chemist	3300 Sidney Brooks	Brooks City-Base TX 78235-5112	(210) 536-5665	(210) 536-9026	edward.brown@brooks.af.mil
Burdey, Julie	Parsons, Project Mgr. RL74, RL83, TO0019	8000 Centre Park Dr., Suite 200	Austin, TX 78754	(512) 719-6062	(512) 719-6099	julie.burdey@parsons.com
Chang, Tammy	Parsons, Senior Scientist	8000 Centre Park Dr., Suite 200	Austin, TX 78754	(512) 719-6092	(512) 719-6099	tammy.chang@parsons.com
Cobb, Gary	Parsons, Task Mgr for geophysics	8000 Centre Park Dr., Suite 200	Austin, TX 78754	(512) 719-6011	(512) 719-6099	gary.cobb@parsons.com
Fernando, Joe	Portage Environmental, Project Chemist	901 NE Loop 410, Suite 700	San Antonio, TX 78209	(210) 805-7471	(210) 805-7478	jfernando@portageenv.com
Hefner, Rene	AFCEE/ERC, Hydrogeologist	3300 Sidney Brooks	Brooks City-Base TX 78235-5112	(210) 536-4763	(210) 536-9026	rene.hefner@brooks.af.mil
Lynch, John	Parsons, Program Mgr for ENRAC, WERC Contracts	5390 Triangle Parkway, Suite 100	Norcross, GA 30092	(678) 969-2492	(770) 446-4910	John.lynch@parsons.com
Lyssy, Greg	EPA, Project Manager	1445 Ross Avenue (6PD-N)	Dallas, TX 75202-2733	(214) 665-8317	(214) 665-6660	lyssy.gregory@epa.gov
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Name	Organization/Role	Street Address	City, State, Zip	Phone No.	Fax No.	E-mail
	Investigator		78233-4480			
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# **ATTACHMENT 1**

## **ON-POST AND OFF-POST SAMPLED WELLS FIGURE**



## **ATTACHMENT 2**

### **SUMMARY OF STATUS OF EACH SWMU/AOC SITE**

**Attachment 2**

Summary of Solid Waste Management Units  
and Area of Concern Status Table

Unit No.	Description	Investigation Report(s)	Recommendations	Requested Action				Closure Approved by	Closure Type
				RRS1	NFA	Delisting	TRRP		
B-1	Powder and ammo burn area (1954).	RFI/Closure Report July 2002	RRS1 Closure	X				November-02	RRS1
B-2	Small arms ammunition burning area (1954)	Draft RFI Report	Further investigation						
B-3	Landfill area (garbage disposal and burning trash); filled in 1990-91.	RFI Report March 2005	Removal of contaminated soil						
B-4	Classified burn area (documents and trash).	RFI Report June 2002	Removal of waste in trench and confirmation sampling						
B-5	Possible fired small arms ammo brass area. Not located.	RFI/Closure Report July 2002	RRS1 Closure	X				October-02	RRS1
B-6	Possible solid waste disposal area.	RFI/Closure Report July 2002	RRS1 Closure	X				October-02	RRS1
B-7	Possible fired small arms ammunition brass disposal area	RFI/Closure Report July 2002	RRS1 Closure	X				October-02	RRS1
B-8	Fired small arms ammo brass disposal area (piles of fire bricks, ammo shells)	RFI Report December 2003	Remediation of stockpiled and in-situ soils						
B-9	Miscellaneous solid waste (metal and weapons) disposal area.	RFI/Closure Report September 2002	RRS1 Closure	X				March-03	RRS1
B-10	Ammunition disposal area.	RFI/Closure Report May 2003	RRS1 Closure	X				January-04	RRS1
B-11	Miscellaneous solid waste disposal (ammo, scrap metal, const. debris).	RFI Closure Report June 04	RRS1 Closure	X				September-04	RRS1
B-12	Landfill, WPA trash when igloos were being built	RFI Report April-05	RRS1 Closure	X				July-05	RRS1
B-13	Trash dump area.	RFI Report June 2002	Excavation of waste and surface sampling.						
B-14	Possible fired brass area - not located.	Delisting Requested June 1997	Delisting			X			
B-15/16	Landfill (target vehicles, weapons mounts)	RFI Report October 2002	Removal of debris and sampling						
B-19	Solid waste disposal area (metals and weapons).	RFI/Closure Report June 2002	RRS1 Closure	X				September-02	RRS1
B-20	Former OB/OD area	RFI Report July 2002	Remediation of stockpiled and in-situ soils						
B-21	Ammunition disposal areas	Combined with B-20							
B-22	Burn area (artillery shells).	RFI/Closure Report August 2002	RRS1 Closure	X				December-02	RRS1
B-23	Disposal trenches (two green canisters)	RFI Report April 2005	RRS1 Closure	X				July-05	RRS1
B-23A	Disposal Trench (glass ampoules of liquid)	RFI Closure Report September 2004	RRS1 Closure	X				March-05	RRS1

**Attachment 2**

Summary of Solid Waste Management Units  
and Area of Concern Status Table

Unit No.	Description	Investigation Report(s)	Recommendations	Requested Action				Closure Approved by	Closure Type
				RRS1	NFA	Delisting	TRRP		
B-24	Spent ammo/rockets area	RFI Report May 2002	Remediation of stockpiled and in-situ soils						
B-25	Possible disposal trench	RFI Report April 2005	RRS1 Closure	X				July-05	RRS1
B-26	Possible disposal trench	Delisting Report August 2004	Delisting			X		November-04	Delisting
B-27	Sanitary landfill, consisting of 5-6 trenches (6 ft deep, 3 ft wide).	RFI Report July 2002	Removal of waste and confirmation sampling						
B-28	Disposal trenches (molten metal, ammo, ammo parts)	RFI Report April 2002	Remediation of stockpile soils						
B-29	Solid waste disposal area (in old quarry)	RFI Report April 2005	RRS1 closure	X					
B-30	Solid waste disposal area	RFI Report September 2004	RRS1 Closure	X				February-05	RRS1
B-31	Lead shot/sand pipe bedding	RFI/Closure Report July 2002	RRS1 Closure	X				November-02	RRS1
B-32	Lead shot/sand pipe bedding	RFI/Closure Report January 2003	RRS1 Closure	X				November-03	RRS1
B-33	Lead shot/sand pipe bedding	RFI Report September 2004	RRS1 Closure	X				November-04	RRS1
B-34	Maintenance pit floor drain and discharge point	RFI Report August 2002	Delineate contamination, disposal of soil				X		
B-71	Livestock area. Inner cantonment, SW of Well 16.	--	--						
Bldg 40	less-than 90-day accumulation container storage area	RFI/Closure Report September 2003	RRS1 Closure	X				January-04	RRS1
Bldg 43	Inactive makeshift ammo demolition facility	RFI Report April 2005	RRS1 Closure	X				September-05	RRS1
DD	Dud ammunition disposal area	RFI Report January 2005	RRS1 Closure	X				April-05	RRS1
F-14	Hazardous waste storage area (<90-day)	RFI/Closure Report, 1995	RRS1 Closure	X				November-95	RRS1
I-1	Inactive incinerator (built in 1943), currently used for transformer storage	RFI Report February 2003	(Additional work)						
O-1	Waste liquid/sludge oxidation pond (1975)	RFI/Closure Report October 2000	RRS1 Closure	X				April-02	RRS1
Coal Bins	Coal bins (no longer in use)	Delisting Requested January 2003	Delisting			X			
AOC 35	Area immediately around Well 16. Northeast area of inner cantonment.	RFI/Closure Report October 2002	RRS1 Closure	X				February-03	RRS1

**Attachment 2**

Summary of Solid Waste Management Units  
and Area of Concern Status Table

Unit No.	Description	Investigation Report(s)	Recommendations	Requested Action				Closure Approved by	Closure Type
				RRS1	NFA	Delisting	TRRP		
<b>AOC 36</b>	Area between Well 16 and B-3. Possible waste verified not present by magnetometer survey.	RFI/Closure Report April 2002	RRS1 Closure	<b>X</b>				August-02	RRS1
<b>AOC 37</b>	Livestock area. NW of Well 16 and N of Well D.	RFI/Closure Report June 2004	RRS1 Closure	<b>X</b>				January-05	NFA
<b>AOC 38</b>	Livestock area. Inner cantonment, SW of Well 16.	RFI Report September 2004	RRS1 Closure	<b>X</b>				February-05	RRS1
<b>AOC 39</b>	None. Area west of Well 16 between North Outer Rd and cantonment fence.	RFI/Closure Report April 2002	RRS1 Closure	<b>X</b>				September-02	RRS1
<b>AOC 40</b>	None. Area east of Well 16 between North Outer Rd and cantonment fence.	RFI/Closure Report May 2002	RRS1 Closure	<b>X</b>				August-02	RRS1
<b>AOC 41</b>	Gate area east of well 16. North Pasture, north of gate 6.	No Further Action Report April 2005	No Further Action		<b>X</b>			July-05	NFA
<b>AOC 42</b>	None. South of SWMUs B-28 and B-19, west of B-4.	RFI Report October 2002	Excavation and sampling.						
<b>AOC 43</b>	Shallow trench without mounds. Metal, UXO. Located 50 ft south of B-7.	RFI/Closure Report October 2002	RRS1 Closure	<b>X</b>				February-03	RRS1
<b>AOC 44</b>	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	Delisting			<b>X</b>		July-05	Delisting
<b>AOC 45</b>	Flat area with spent and undamaged bullets. Located east of B-31, near bend in road.	--	--						
<b>AOC 46</b>	Bermed area with stockpile of lead shot and sand. Located south of Engineering on east side of Thompkins Road.	RFI/Closure Report April 2005	--	<b>X</b>				July-05	RRS1
<b>AOC 47</b>	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	RRS1 Closure	<b>X</b>				September-02	RRS1
<b>AOC 48</b>	Three N-S trending mounds and a construction debris pile. Located north of B-15/16.	Delisting Report August 2004	Delisting Report			<b>X</b>		November-04	Delisting
<b>AOC 49</b>	Trench (4 x 7 ft) without surficial debris. Located SW of deer stand 41 in central East Pasture.	Delisting Report April 2005	Delisting			<b>X</b>		July-05	Delisting
<b>AOC 50</b>	Area with orange discolored material (most likely nickel penetrate) at ground surface. South of B-30 along gravel road.	RFI/Closure Report January 2005	RRS1 Closure	<b>X</b>				April-05	RRS1
<b>AOC 51</b>	East pasture, east of active range, approximately 25 acres, area around B-9	--	--						
<b>AOC 52</b>	Area west of B-4 towards Salado Creek near trees, two trenches	--	--						
<b>AOC 53</b>	Building foundation near B-27 at Central Road and road to "D" Tank, batteries at rear of slab	RFI/Closure Report April 2005	--	<b>X</b>				July-05	RRS1
<b>AOC 54</b>	Area near gutting pit, east of Welding Shop Building, right side of road batteries were stored in the area	Closure Report July 2004	--	<b>X</b>				November-04	RRS1

**Attachment 2**

Summary of Solid Waste Management Units  
and Area of Concern Status Table

Unit No.	Description	Investigation Report(s)	Recommendations	Requested Action				Closure Approved by	Closure Type
				RRS1	NFA	Delisting	TRRP		
AOC 55	Landfill, south of Tenberg Drive, east of Salado Creek	RFI/Closure Report Feb 04	RRS1 Closure	X					
AOC 56	Landfill, at intersection of Bernard Road and East Outer Road, surface depression on south side of intersection	Closure Report June 04	RRS1 Closure	X				September-04	RRS1
AOC 57	East of Building 98 and KOA Area, cleaning/maintenance activities performed at temporary structures	--	--						
AOC 58	Suspected disposal trench within Inner Cantonment	RFI Report October 2002	Investigate anomaly						
AOC 59	Trench-type anomaly located west Test Pad in the East Pasture	--	--						
AOC 60	Trench located west of tunnel and entrance roadway in the East Pasture.	Delisting Report April 2005	Delisting			X		July-05	Delisting
AOC 61	Suspected landfill	RFI/Closure Report October 2002	RRS1 Closure	X				February-03	RRS1
AOC 62	Located west of monitoring well MW-2 and east of Salado Creek.	--	--						
AOC 63	Area consisting of 3 barrels containing rocks, south of deer stand 41 in the East Pasture.	--	--						
AOC 64	Area east of SWMU B-4; flares observed in the area	--	--						
AOC 65	A concrete pit area that housed a metal vat that contained TCE and PCE.	RFI Report August 2003	Additional investigation, remediation ongoing						
AOC 66	Area north of Well 16 in the outer cantonment.	Closure Report June 04	RRS1 Closure	X				February-05	NFA
AOC 67	Concrete pad near Building 90 housed a vat containing cleaning solvents.	RFI Report August 2002	--						
AOC 68	Area includes metal slag/debris storage area from Wheelabrator operations next to Building 90-2.	--	--						
AOC 69	Located on west side of CSSA.	--	--						
AOC 70	Building used to mix pesticides. Near Building 1.	--	--						
AOC 72	Area containing concrete, possible asbestos. Located east of Building 94, in SW CSSA.	--	--						
AOC 73	Ranch landfill with overgrown trenches. Near Well I1, in northwest corner of CSSA.	--	--						

# **ATTACHMENT 3**

## **OVERALL H ORDER PERCENT COMPLETE**

Task Name	% of Project	% of Phase	% Complete	% of Activity Complete	% of Task Complete
<b>Interim Measures</b>	30%				87.7%
Interim Measures Work Plan		7%	100%	7.0%	
Interim Measures Implementation Reports		70%	83%	57.9%	
		23%	99%	22.7%	
<b>RCRA Facility Investigation</b>	30%				71.2%
Preliminary Report		5%	100%	5%	
RFI Workplan		10%	95%	9%	
Facility Investigation		45%	63%	28%	
Risk Assessment		15%	99%	15%	
Investigation Analysis		10%	84%	8%	
Groundwater Investigation		0%	0%	0%	
Treatability Studies		10%	40%	4%	
Progress Reports		5%	22%	1%	
<b>Corrective Measures Study</b>	10%				0%
Identify and Develop Alternatives		15%	0%	0%	
Evaluate Alternatives		60%	0%	0%	
Reports		25%	0%	0%	
<b>Corrective Measures Implementatio</b>	30%				0%
Implementation Program Plan		5%	0%	0%	
Corrective Measure Design		15%	0%	0%	
Corrective Measure Construction		70%	0%	0%	
Reports		10%	0%	0%	
% of Phase Complete					47.65%

Task Name	% of Phase	% of Task	% Complete	% of Activity Complete	% of Activity Remaining	% of Task Complete	Comments/Status
<b>1 Interim Measures Work Plan</b>	7%					100.0%	
Draft IM Workplan		80%	100%	80%	0%		
Draft Final IM Workplan		15%	100%	15%	0%		
Final IM Workplan		5%	100%	5%	0%		
<b>2 Interim Measures Implementation</b>	70%					82.8%	
Sample 3 Off-Site Wells		1%	100%	1%	0%		
Sample 20 Off-Site Wells (6 events)		6%	100%	6%	0%		(remaining off-post sampling conducted under the RFI task)
2000 Groundwater Monitoring (4 events)		5%	100%	5%	0%		
2001 Groundwater Monitoring (4 events)		5%	100%	5%	0%		
2002 Groundwater Monitoring (4 events)		5%	100%	5%	0%		
2003 Groundwater Monitoring (4 events)		5%	100%	5%	0%		
2004 Groundwater Monitoring (4 events)		5%	100%	5%	0%		
2005 Groundwater Monitoring (4 events)		5%	75%	4%	25%		
2006 Groundwater Monitoring		5%	0%	0%	100%		
Locate and map off-site wells		1%	100%	1%	0%		
O-1 Soil Borings		3%	100%	3%	0%		
O-1 Excavation, Stabilization, Diposal		15%	100%	15%	0%		
Establish Treatment Unit		1%	0%	0%	100%		may or may not be necessary.
Determine appropriate disposition of soil piles		7%	100%	7%	0%		When treatability studies results have been evaluated
Treat/dispose of soil piles		20%	50%	10%	50%		Unfunded CSSA future work.
AOC 50 Excavation and Disposal		3%	100%	3%	0%		Not included as IM in the Order.
AOC 65 Excavation and Disposal		8%	100%	8%	0%		
<b>3 Reports</b>	23%					98.8%	
Quarterly Progress Report 1 (August 1999)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 2 (November 1999)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 3 (February 2000)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 4 (May 2000)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 5 (August 2000)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 6 (November 2000)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 7 (February 2001)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 8 (May 2001)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 9 (August 2001)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 10 (November 2001)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 11 (February 2002)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 12 (May 2002)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 13 (August 2002)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 14 (November 2002)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 15 (February 2003)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 16 (May 2003)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 17 (August 2003)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 18 (November 2003)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 19 (February 2004)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 20 (May 2004)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 21 (August 2004)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 22 (November 2004)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 23 (February 2005)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 24 (May 2005)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 25 (August 2005)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 26 (November 2005)		0.57%	100%	0.57%	0%		
Quarterly Progress Report 27 (February 2006)		0.57%	0%	0.00%	100%		
Quarterly Progress Report 28 (May 2006)		0.57%	0%	0.00%	100%		
Draft O-1 IM Report		25%	100%	25%	0%		
Draft final O-1 IM Report		10%	100%	10%	0%		
Final O-1 IM Report		5%	100%	5%	0%		
Draft Soil Pile IM Report		30%	100%	30%	0%		
Draft Final Soil Pile IM Report		10%	100%	10%	0%		
Final Soil Pile IM Report		4%	100%	4%	0%		
<b>% of Phase Complete</b>						<b>87.65%</b>	

Task Name	% of Phase	% of Task	% Complete	% of Activity Complete	% of Activity Remaining	% of Task Complete	Comments/Status
<b>Preliminary Report</b>	5%					100.0%	
Draft DCC Report		80%	100%	80%	0%		
Draft Final DCC Report		15%	100%	15%	0%		
Final DCC Report		5%	100%	5%	0%		
<b>RFI Workplan</b>	10%					94.9%	
Draft Community Relations Plan		25%	100%	25%	0%		
Draft Final CRP		5%	100%	5%	0%		
Final CRP		10%	50%	5%	50%		
Draft RFI Workplans		20%	100%	20%	0%		
Draft Final RFI Workplan		5%	100%	5%	0%		
Final RFI Workplans		5%	98%	5%	2%		Will be indefinitely incomplete, until
Draft Closure Plan (TO 0019)		15%	100%	15%	0%		
Final Closure Plan (TO 0019)		5%	100%	5%	0%		
Draft GW Mon Plan (TO 0008)		8%	100%	8%	0%		
Final GW Mon Plan (TO 0008)		2%	100%	2%	0%		
<b>Facility Investigation<sup>1</sup></b>	45%					63.0%	
<b>Small Areas (0-2 acres in size)</b>							
B-3 Investigation/Report		0.36%	80%	0.284%	20%		Final report submitted, additional work required.
B-4 Investigation/Report		0.36%	70%	0.249%	30%		Final report submitted. Additional work required.
B-5 Investigation/Report		0.36%	100%	0.355%	0%		Complete. RRS1 closure approved Oct 02.
B-6 Investigation/Report		0.36%	100%	0.355%	0%		Complete. RRS1 closure approved Oct 02.
B-7 Investigation/Report		0.36%	100%	0.355%	0%		Complete. RRS1 closure approved Oct 02.
B-8 Investigation/Report		0.36%	70%	0.249%	30%		Final report submitted. Additional work required.
B-9 Investigation/Report		0.36%	100%	0.355%	0%		Complete. RRS1 closure approved Mar 03
B-10 Investigation/Report		0.36%	100%	0.355%	0%		Complete. RRS1 closure approved Jan 04
B-11 Investigation/Report		0.36%	100%	0.355%	0%		Complete. RRS1 closure approved Sept 04
B-12 Investigation/Report		0.36%	100%	0.355%	0%		Final report submitted. RRS1 closure approved July 2005
B-13 Investigation/Report		0.36%	70%	0.249%	30%		Final report submitted. Additional work required.
B-15/16 Investigation/Report		0.36%	70%	0.249%	30%		Final report submitted. Additional work required.
B-19 Investigation/Report		0.36%	100%	0.355%	0%		Complete. RRS1 closure approved Sept 02
B-23 Investigation/Report		0.36%	100%	0.355%	0%		Final report submitted. RRS1 closure approved July 2005
B-23A Investigation/Report		0.36%	100%	0.355%	0%		Complete. RRS1 closure approved Mar 05
B-25 Investigation/Report		0.36%	100%	0.355%	0%		Final report submitted. RRS1 closure approved July 2005
B-26 Investigation/Report		0.36%	100%	0.355%	0%		Complete. Delisting approved November 04
B-27 Investigation/Report		0.36%	70%	0.249%	30%		Final report submitted, additional work required
B-28 Investigation/Report		0.36%	70%	0.249%	30%		Final report submitted, additional work required
B-30 Investigation/Report		0.36%	100%	0.355%	0%		Complete. RRS1 closure approved Feb 05
B-31 Investigation/Report		0.36%	100%	0.355%	0%		Complete. RRS1 closure approved Nov 02
B-32 Investigation/Report		0.36%	100%	0.355%	0%		Complete. RRS1 closure approved Nov 03
B-33 Investigation/Report		0.36%	100%	0.355%	0%		Final report submitted, additional work required
B-34 Investigation/Report		0.36%	70%	0.249%	30%		Final report and Addendum report submitted, additional work required
B-71 Investigation/Report		0.36%	0%	0.000%	100%		Not included in any current contract.
BLDG-43 Investigation/Report		0.36%	100%	0.355%	0%		Final report submitted. RRS1 closure approval pending.

Task Name	% of Phase	% of Task	% Complete	% of Activity Complete	% of Activity Remaining	% of Task Complete	Comments/Status
Demo Dud Investigation/Report		0.36%	100%	0.355%	0%		Complete. RRS1 closure approved Apr 05
F-14 Investigation/Report		0.36%	100%	0.355%	0%		Complete, closure approved Nov 95
I-1 Investigation/Report		0.36%	75%	0.266%	25%		Final RFI report submitted. Additional work required.
AOC 35 Investigation/Report		0.36%	100%	0.355%	0%		Complete. RRS1 closure approved Feb 03
AOC 37 Investigation/Report		0.36%	100%	0.355%	0%		Complete. RRS1 closure approved Jan 05
AOC 39 Investigation/Report		0.36%	100%	0.355%	0%		Complete. RRS1 closure approved Sept 02
AOC 40 Investigation/Report		0.36%	100%	0.355%	0%		Complete. RRS1 closure approved Aug 02
AOC 43 Investigation/Report		0.36%	100%	0.355%	0%		Complete. RRS1 closure approved Feb 03
AOC 44 Investigation/Report		0.36%	100%	0.355%	0%		Final delisting report submitted. TCEQ approved July 2005.
AOC 45 Investigation/Report		0.36%	0%	0.000%	100%		
AOC 46 Investigation/Report		0.36%	100%	0.355%	0%		Complete. RRS1 closure approved July 2005
AOC 47 Investigation/Report		0.36%	100%	0.355%	0%		Complete. Closure approved Sep 02
AOC 49 Investigation/Report		0.36%	100%	0.355%	0%		Final delisting report submitted. TCEQ approved July 2005
AOC 50 Investigation/Report		0.36%	100%	0.355%	0%		Complete. Closure approved Apr 05
AOC 52 Investigation/Report		0.36%	0%	0.000%	100%		
AOC 53 Investigation/Report		0.36%	100%	0.355%	0%		Final closure report submitted. TCEQ approved July 2005.
AOC 54 Investigation/Report		0.36%	100%	0.355%	0%		Complete. Closure approved Nov 04
AOC 55 Investigation/Report		0.36%	99%	0.351%	1%		Final closure report submitted. Pending TCEQ approval.
AOC 56 Investigation/Report		0.36%	100%	0.355%	0%		Complete. Closure approved Sept 04
AOC 58 Investigation/Report		0.36%	70%	0.249%	30%		Final RFI report submitted, additional work recommended.
AOC 59 Investigation/Report		0.36%	0%	0.000%	100%		
AOC 60 Investigation/Report		0.36%	100%	0.355%	0%		Final delisting report submitted. TCEQ approved July 2005.
AOC 61 Investigation/Report		0.36%	100%	0.355%	0%		Complete. Closure approved Feb 03
AOC 62 Investigation/Report		0.36%	0%	0.000%	100%		
AOC 63 Investigation/Report		0.36%	0%	0.000%	100%		
AOC 64 Investigation/Report		0.36%	0%	0.000%	100%		Not included in any current contract.
AOC 68 Investigation/Report		0.36%	0%	0.000%	100%		Not included in any current contract.
AOC 69 Investigation/Report		0.36%	0%	0.000%	100%		Not included in any current contract.
AOC 70 Investigation/Report		0.36%	0%	0.000%	100%		Not included in any current contract.
AOC 72 Investigation/Report		0.36%	0%	0.000%	100%		Not included in any current contract.
AOC 73 Investigation/Report		0.36%	0%	0.000%	100%		Not included in any current contract.
<b>Medium Areas (2-10 acres in size)</b>							
B-1 Investigation/Report		1.0%	100%	1.000%	0%		Complete. Closure approved Nov 02
B-2 Investigation/Report		1.0%	70%	0.700%	30%		Final report submitted, additional work recommended
B-22 Investigation/Report		1.0%	100%	1.000%	0%		Complete. Closure approved Dec 02
B-24 Investigation/Report		1.0%	70%	0.700%	30%		Final report submitted, additional work recommended
B-29 Investigation/Report		1.0%	99%	0.990%	1%		Final closure report submitted. RRS1 closure pending TCEQ approval.

Task Name	% of Phase	% of Task	% Complete	% of Activity Complete	% of Activity Remaining	% of Task Complete	Comments/Status
AOC 36 Investigation/Report		1.0%	100%	1.000%	0%		Complete. Closure approved Aug 02
AOC 41 Investigation/Report		1.0%	100%	1.000%	0%		Final NFA Closure Report submitted. TCEQ approved July 2005.
AOC 42 Investigation/Report		1.0%	70%	0.700%	30%		Final report submitted, additional work recommended
AOC 48 Investigation/Report		1.0%	100%	1.000%	0%		Complete. Delisting approved Nov 04
AOC 57 Investigation/Report		1.0%	40%	0.400%	60%		
<b>Large Areas (&gt;10 acres in size)</b>							
B-20/21 Investigation/Report		1.3%	70%	0.931%	30%		Final report submitted, additional work recommended
AOC 38 Investigation/Report		1.3%	100%	1.330%	0%		Final report, additional work
AOC 51 Investigation/Report		1.3%	0%	0.000%	100%		
AOC 66 Investigation/Report		1.3%	100%	1.330%	0%		Complete. NFA Closure approved Feb 05
RMU-1 Investigation/Report		1.3%	0%	0.000%	100%		
RMU-5 Investigation/Report		1.3%	0%	0.000%	100%		
AOC 65 Investigation/Report		1.3%	70%	0.931%	30%		Final report submitted, additional work recommended
AOC 67 Investigation/Report		1.3%	70%	0.931%	30%		Final report submitted, additional work recommended
AOC 68 Investigation/Report		1.3%	0%	0.000%	100%		
AOC 69 Investigation/Report		1.3%	0%	0.000%	100%		
AOC 70 Investigation/Report		1.3%	0%	0.000%	100%		
Coal Bins Investigation/Report		1.3%	95%	1.264%	5%		Site being de-listed as a SWMU
RMU-2 Investigation/Report		1.3%	0%	0.000%	100%		
RMU-3 Investigation/Report		1.3%	0%	0.000%	100%		
RMU-4 Investigation/Report		1.3%	0%	0.000%	100%		
<b>Groundwater Investigation</b>							
Well Installation		5%	80%	4%	20%		Well installations pending under TO 08
Groundwater Monitoring 1999		2.1%	100%	2%	0%		Fieldwork complete and reports submitted to regulators.
Groundwater Monitoring 2000		2.1%	100%	2%	0%		Fieldwork complete and reports submitted to regulators.
Groundwater Monitoring 2001		2.1%	100%	2%	0%		Fieldwork complete and reports submitted to regulators.
Groundwater Monitoring 2002		2.1%	100%	2%	0%		Fieldwork complete and reports submitted to regulators.
Groundwater Monitoring 2003		2.1%	100%	2%	0%		Fieldwork complete and reports submitted to regulators.
Groundwater Monitoring 2004		2.1%	100%	2%	0%		Fieldwork complete and reports submitted to regulators.
Groundwater Monitoring 2005		2.1%	75%	2%	25%		Fieldwork complete to Jun-05, Sep & Dec-05 incomplete.
Groundwater Monitoring 2006		2.1%	0%	0%	100%		incomplete
Groundwater Monitoring 2007		2.1%	0%	0%	100%		incomplete
Groundwater Monitoring 2008		2.1%	0%	0%	100%		incomplete
Groundwater Monitoring 2009		2.1%	0%	0%	100%		incomplete
Conceptual Site Model (CSM)		10.0%	100%	10%	0%		Final submitted May 2005
CSM Update		2.0%	0%	0%	100%		
LTMO 2005 (optimization study)		5%	95%	5%	5%		LTMO recommendations submitted to regulators.
LTMO 2010 (review of optimization)		5%	0%	0%	100%		incomplete
<b>Risk Assessment</b>							
Draft TAD	15%	10%	100%	10%	0%	99%	
Draft Final TAD		4%	100%	4%	0%		
Final TAD		1%	0%	0%	100%		Complete when analytical data is available for full evaluation.
Draft CSM		80%	100%	80%	0%		Complete when report submitted.
Final CSM		5%	100%	5%	0%		Unfunded CSSA future work.
<b>Investigation Analysis</b>							
Collect Background Data	10%	10%	100%	10%	0%	84%	

Task Name	% of Phase	% of Task	% Complete	% of Activity Complete	% of Activity Remaining	% of Task Complete	Comments/Status
Draft Investigation Analysis		85%	82%	70%	18%		Information included in facility investigation reports; percent complete based on overall percent complete of facility investigation tasks.
Final Investigation Analysis		5%	82%	4%	18%		Information included in facility investigation reports; percent complete based on overall percent complete of facility investigation tasks.
<b>Treatability Studies</b>	10%					40%	
Draft Treatability Study Report B-20		15%	100%	15%	0%		
Final Treatability Study Report B-20		5%	100%	5%	0%		
Continued O&M for B-3		10%	50%	5%	50%		Complete when tasks funded for RL74 and RL83 are completed.
AOC-65 Treatability Studies		10%	80%	8%	20%		
Draft Treatability Study & Technology Evaluation Reports		10%	70%	7%	30%		
Final Treatability Study		25%	0%	0%	100%		
Recharge Study		25%	100%	25%	0%		
<b>Progress Reports</b>	5%					22.0%	
Quarter 1 (August 1999)		0.85%	100%	0.85%	0%		
Quarter 2 (November 1999)		0.85%	100%	0.85%	0%		
Quarter 3 (February 2000)		0.85%	100%	0.85%	0%		
Quarter 4 (May 2000)		0.85%	100%	0.85%	0%		
Quarter 5 (August 2000)		0.85%	100%	0.85%	0%		
Quarter 6 (November 2000)		0.85%	100%	0.85%	0%		
Quarter 7 (February 2001)		0.85%	100%	0.85%	0%		
Quarter 8 (May 2001)		0.85%	100%	0.85%	0%		
Quarter 9 (August 2001)		0.85%	100%	0.85%	0%		
Quarter 10 (November 2001)		0.85%	100%	0.85%	0%		
Quarter 11 (February 2002)		0.85%	100%	0.85%	0%		
Quarter 12 (May 2002)		0.85%	100%	0.85%	0%		
Quarter 13 (August 2002)		0.85%	100%	0.85%	0%		
Quarter 14 (November 2002)		0.85%	100%	0.85%	0%		
Quarter 15 (February 2003)		0.85%	100%	0.85%	0%		
Quarter 16 (May 2003)		0.85%	100%	0.85%	0%		
Quarter 17 (August 2003)		0.85%	100%	0.85%	0%		
Quarter 18 (November 2003)		0.85%	100%	0.85%	0%		
Quarter 19 (February 2004)		0.85%	100%	0.85%	0%		
Quarter 20 (May 2004)		0.85%	100%	0.85%	0%		
Quarter 21 (August 2004)		0.85%	100%	0.85%	0%		
Quarter 22 (November 2004)		0.85%	100%	0.85%	0%		
Quarter 23 (February 2005)		0.85%	100%	0.85%	0%		
Quarter 24 (May 2005)		0.85%	100%	0.85%	0%		
Quarter 25 (August 2005)		0.85%	100%	0.85%	0%		
Quarter 26 (November 2005)		0.85%	100%	0.85%	0%		
Quarter 27 (February 2006)		0.85%	0%	0.00%	100%		
Quarter 28 (May 2006)		0.85%	0%	0.00%	100%		
Quarter 29 (August 2006)		0.85%	0%	0.00%	100%		
Quarter 30 (November 2006)		0.85%	0%	0.00%	100%		
Quarter 31 (February 2007)		0.85%	0%	0.00%	100%		
Quarter 32 (May 2007)		0.85%	0%	0.00%	100%		
Quarter 33 (August 2007)		0.85%	0%	0.00%	100%		
Quarter 34 (November 2007)		0.85%	0%	0.00%	100%		
Quarter 35 (February 2008)		0.85%	0%	0.00%	100%		
Quarter 36 (May 2008)		0.85%	0%	0.00%	100%		
Quarter 37 (August 2008)		0.85%	0%	0.00%	100%		
Quarter 38 (November 2008)		0.85%	0%	0.00%	100%		
Quarter 39 (February 2009)		0.85%	0%	0.00%	100%		
Quarter 40 (May 2009)		0.85%	0%	0.00%	100%		
Quarter 41 (August 2009)		0.85%	0%	0.00%	100%		
Quarter 42 (November 2009)		0.85%	0%	0.00%	100%		
<b>(Add'l Quarters - rows hidden)</b>							
% of Phase Complete						71.20%	
<sup>1</sup> Breakdown of percent complete for RFI facility investigations: Field work complete (25%), data validation (20%), boring logs (if applicable)(10%), analytical data tables (10%), figures (10%), draft report (20%), final report (5%). Note: if additional investigations are needed, then the percent complete will need to be adjusted on a site by site basis.							

Task Name	% of Phase	% of Task	% Complete	% of Activity Complete	% of Task Complete
<b>Identify and Develop Alternatives</b>	15%				0.0%
Update DCC Report		35%	0%	0%	
Establish Corrective Action Objectives		30%	0%	0%	
ID, Screen, Develop CM Alternatives		35%	0%	0%	
<b>Evaluate Alternatives</b>	60%				0.0%
Draft Description of CM Alternative		90%	0%	0%	
Final Description of CM Alternative		10%	0%	0%	
???				0%	
<b>Reports</b>	25%				0.0%
Draft CMS Report		75%	0%	0%	
Final CMS Report		5%	0%	0%	
Quarter 1 Progress Report		5%	0%	0%	
Quarter 2 Progress Report		5%	0%	0%	
Quarter 3 Progress Report		5%	0%	0%	
Quarter 4 Progress Report		5%	0%	0%	
???			0%	0%	
% of Phase Complete					0.0%

Task Name	% of Phase	% of Task	% Complete	% of Activity Complete	% of Task Complete
<b>Implementation Program Plan</b>	5%				0.0%
Draft Program Management Plan		40%	0%	0%	
Final Program Management Plan		10%	0%	0%	
Draft Update to CRP		40%	0%	0%	
Final Update to CRP		10%	0%	0%	
<b>Corrective Measure Design</b>	15%				0.0%
Draft CMD Report		90%	0%	0%	
Final CMD Report		10%	0%	0%	
<b>Corrective Measure Construction</b>	70%				0%
Draft Construction QAPP		35%	0%	0%	
Final Construction QAPP		5%	0%	0%	
Implementation of Construction QAPP		60%	0%	0%	
<b>Reports</b>	10%				0%
Progress Report 1		25%	0%	0%	
Progress Report 2		25%	0%	0%	
Progress Report 3		25%	0%	0%	
Progress Report 4		25%	0%	0%	
????					
% of Phase Complete					0.00%

# **ATTACHMENT 4**

## **TECHNICAL MEMORANDUM**

## Draft Technical Memorandum

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**To:** Jeff Aston/Chris Beal CSSA  
**From:** Gary Cobb  
**CC:** file (7442231.04)  
**Date:** January 12, 2006  
**Re:** Groundwater Tracer and Organic Substrate Injection Specifications

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This memorandum has been prepared to present technical decisions related to the tracer and organic substrate composition, mixture volumes, and concentrations for the planned enhanced anaerobic biodegradation (EAB) pilot study at SWMU B-3 at Camp Stanley Storage Activity (CSSA). Additionally, this memo also addresses the monitoring requirements for the tracer test and the substrate injection pilot study. This tracer and substrate information is being submitted for your review and comment.

In September 2005, monitoring well CS-B3-MW01 was installed and this well will be used for the injection of the tracer and the organic substrate. Well CS-B3-MW01 was installed 35 feet southeast of Westbay<sup>®</sup> well CS-WB05 which will serve as the downgradient monitoring point during the pilot study. The location of the injection well with respect to the downgradient monitoring location was based on the assumption that groundwater extraction will occur at nearby well CS-MW16LGR which should create hydraulic gradients that will induce flow from the injection well toward well CS-WB05. Well CS-B3-MW01 was constructed with 4-inch inside diameter (ID) well material and is equipped with a 10-foot-long screen set at 278.5 to 288.5. Injection packer tests performed on the injection zone in the Westbay<sup>®</sup> well CS-WB05 borehole yielded a hydraulic conductivity of 2.7 ft/day ( $9.5 \times 10^{-4}$  cm/sec).

### Pre-injection Tracer Test

Prior to injection of the organic substrate material, a tracer test will be performed to assess groundwater flow velocity within the injection zone at the pilot study area. The tracer test will involve the injection of a conservative tracer at well CS-B3-MW01 and monitoring the tracer concentration over time at downgradient Westbay<sup>®</sup> well CS-WB05. Estimates of groundwater velocity will be used to predict contaminant and substrate migration rates at SWMU B-3 and will be useful in interpreting the geochemical changes observed during monitoring biodegradation reactions during the study. Tracer test results will also be evaluated to estimate the dispersion coefficient of the injection zone. The plans for the tracer test assumes that groundwater extraction will be occurring at well CS-MW16LGR for the duration of the test maintain groundwater gradient to ensure that the tracer will migrate to the downgradient Westbay<sup>®</sup> well.

The conservative tracer used for the pre-injection tracer test will be iodine. An iodine solution will be prepared and injected into the screened portion of well CS-B3\_MW01. The target concentration of the iodine solution in the screened interval is 300 mg/L. For the assumed case of a 4-inch diameter well and a 10 foot screened interval (3.5 gallon capacity), the iodine/water solution will be mixed at an initial concentration of approximately 500 mg/L. Five gallons of this mixture will be evenly distributed across the screened interval of the well where it will undergo approximately a 1.7 to 1 dilution giving resulting in a concentration of approximately 300 mg/L along the well screen. The tracer mixture will be prepared by completely dissolving 2.35 grams of potassium iodide flakes into 5 gallons of distilled water.

The tracer mixture will be added directly into the screened portion of the injection well. Placement of the tracer within the injection well will involve lowering a length of 1-inch ID polyethylene pipe to the bottom of the well. The polyethylene pipe will be weighted at the bottom to facilitate installation into the well and will include perforations along the bottom 2 feet of the pipe to allow the tracer to be transferred into the well. Once the pipe

is lowered into the well, the tracer mixture will be injected into the pipe followed by the addition of another 4 gallons of distilled water. The pipe will then be slowly removed from the well which will result in placement of the tracer mixture within the screened portion of the well.

An evaluation of tracer concentration at the downgradient monitoring point was developed using the 2-dimensional advection dispersion equation (no retardation) for an instantaneous injection into a uniform flow field (Fetter 1993). The predicted iodine concentrations were based on an initial tracer concentration of 300 mg/L in the injection interval, an estimated longitudinal dispersivity of 20.5 ft based on plume geometry, and an estimated groundwater velocity of 0.54 ft/day. The estimated groundwater velocity is based on a measured hydraulic conductivity of 2.7 ft/day from CS-WB05, an assumed porosity of 5%, and an assumed hydraulic gradient of 0.01 ft/ft. To evaluate the possible effects of inaccuracies associated with the estimated gradient, dispersivity and porosity, predictions of iodine concentrations based on groundwater velocities of one half (0.27 ft/day) and twice (1.1 ft/day) the initial estimate were also calculated. The plot of anticipated iodine concentration with time is included in **Figure 1** attached.

From the plot in **Figure 1** it is obvious that the groundwater velocity will significantly affect the maximum or peak concentration detected. At the lowest groundwater velocity (0.27 ft/day) the maximum tracer concentration at CS-WB05 is estimated to be 3.1 mg/L, whereas at the highest velocity (1.1 ft/day) the maximum concentration would be 0.5 mg/L. This decrease in peak concentration with increasing velocity is due to the effects of increased dispersion at higher velocities causing the tracer slug to spread out more and reduces the peak concentration within the slug. Additionally, as shown on the graph the four-fold increase in groundwater velocity (0.27 to 1.1 ft/day) increases the peak arrival time from 27 days to 19 days, or approximately a 30% reduction in arrival time.

Based on the modeling of predicted tracer concentration with time, the monitoring plan for collection and analysis of groundwater samples at the downgradient monitoring point (CS-WB05) can be refined. The sampling frequency implemented should provide time varying concentrations of sufficient distribution to adequately define the arrival of the peak tracer concentration. Therefore, the recommended sampling and analysis for the tracer should begin no later than one week following tracer injection and should be conducted every 3 to 4 days for approximately 5 weeks or until approximately 45 from the injection date. Since the dispersivity for the injection zone is not known and the estimate used for this prediction was estimated from the plume length for the lower section of the Lower Glen Rose formation (known as the LGR(F) hydrostratigraphic zone at CSSA) the actual width of the tracer slug observed during the test may be significantly different than this prediction. Therefore, it is important that the field iodine concentrations be evaluated as the test progress and adjustments to the sampling frequency be made to ensure adequate delineation of the tracer peak's arrival at the downgradient monitoring point.

Groundwater sampling for the tracer test will involve collection and analysis of groundwater samples from downgradient Westbay® CS-WB05 sampling ports. Sample port LGR-04A at CS-WB05 was constructed to monitor groundwater between the depths of 277 to 286 ft, the same hydrostratigraphic interval as the injection well, will be used as the primary monitoring point for the tracer study. Sample intervals ports LGR-03 (197 - 292 ft) and LGR-04B (291 - 342 ft) will also be monitored for the tracer to assess vertical dispersion between the zones. Therefore, the recommended sampling scheme will consist and testing of collection of groundwater samples from the three Westbay port within one week of injection. Following the initial sampling event, samples will be collected from the LGR-04A port at the interval previously established (3 to 4 days). Samples will be collected from the LGR-03 and LGR-04B ports will occur during every other sampling event (every 3 to 8 days) to check for the occurrence of the tracer in these intervals. If the tracer concentration is determined to be increasing in either of the LGR-03 and LGR-04B intervals, the sampling frequency for that interval will be increased to every sampling event to monitor the arrival of the tracer plume. Sampling will continue from each port on either the 3 to 4 or 6 to 8 day schedule after iodine concentrations begin to rise on CS-WB05-LGR-04A until the test is complete. Additionally, during at least one sampling event of the tracer study, groundwater samples will be collected from all Westbay® sampling ports at SWMU B-3 and at CS-MW16-LGR to determine if the iodine tracer is migrating to these locations.

Additionally, the expected tracer concentrations from the predictive modeling can be used to determine the measurement range of the field analytical technique. From the modeling, the maximum tracer concentration predicted is 3.1 mg/L. Applying a factor of safety of 4 to this concentration to allow for errors in estimating modeling input parameters yields an upper detection limit of at least 12.4 mg/L for the field method. For the lower detection limit, assuming that the estimating errors may result in a four-fold error the minimum peak

concentration would then be 0.125 mg/L. The lower detection limit of the field method would need to be no greater than 0.025 mg/L to allow for adequate resolution of a tracer peak with a maximum concentration of 0.125 mg/l.

### **Anaerobic Biodegradation Pilot Test**

Following completion of the tracer test, a pilot test will be performed to assess the effectiveness of using enhanced anaerobic biodegradation to treat the chlorinated aliphatic compounds in the groundwater at SWMU B-3. The pilot test will consist of injecting an organic substrate into the aquifer and then monitoring the geochemical changes in the groundwater to determine if the rate of anaerobic degradation of the contaminants has been increased. Results of the pilot study may be used to determine if anaerobic biodegradation is an effective remedial option at CSSA.

The pilot study activities will include collection and analysis of baseline groundwater samples to establish background groundwater geochemical and microbial conditions prior to injection of the substrate. After the background sampling is complete, an organic substrate consisting of a mixture of a prepared vegetable oil emulsion and lactate mixed with groundwater will be injected into the aquifer. After the substrate has been injected, groundwater samples will be collected to monitor changes in groundwater geochemistry.

### **Baseline Sampling**

Baseline groundwater sampling will be conducted concurrent with the pre-injection tracer test to establish initial groundwater conditions prior to the substrate injection and will be used as the basis for comparison of groundwater chemistry following addition of the substrate. Baseline samples will be conducted from the injection well, from each of the sampling intervals of the four Westbay® wells, and from nearby monitoring wells. A maximum of three baseline sampling events will be performed prior to the substrate injection. The analytical protocols utilized during all pilot test sampling activities are summarized on **Table 1**.

Three baseline sampling events are planned for the pilot study. The purpose of the first two events will be to assess the equilibration of groundwater following installation of the Westbay® wells. The third event will be performed to assess geochemical conditions within the aquifer prior to substrate injection. The first baseline sampling event was performed after the Westbay® wells were installed and samples were analyzed for VOCs and RSK 175. A second sampling event will be performed following completion of the pump test planned for CS-MW15 and will also be analyzed for VOCs and RSK 175. The third sampling event will be performed after completion of the tracer test and will involve analysis for several parameters including VOCs, electron acceptors (DO, nitrate, sulfate, and carbon dioxide), electron donors (total organic carbon), metabolic by-products (ferrous iron, methane, ethane, and ethene), indicator parameters (pH, and ORP), volatile fatty acids, and dissolved metals (arsenic and manganese).

Groundwater samples will be collected from the injection well using low-flow sampling techniques. Collection of groundwater samples from the Westbay® sampling intervals will be performed using the specialized sampling equipment. Sample analytical protocols are listed on **Table 1**. Laboratory analysis of groundwater samples will be performed by Golf Coast Analytical Laboratory (GCAL), 7979 GSRI Ave., Baton Rouge, LA, 70820, (225)769-4900.

### **Substrate Injection**

The substrates used for this will include a vegetable oil emulsion to provide a long-term source of organic carbon for the pilot study, and a faster-acting and more mobile sodium lactate/groundwater mixture. The oil substrate will consist of a micro-emulsion of soybean oil specifically prepared for enhanced biodegradation purposes by RNAS of Brooklyn Center, MN. The sodium lactate will be purchased from JRW Bioremediation, LLC of Lenexa, KS. The pre-mixed oil emulsion will be used due to the limited volume required and the need for a micro-emulsion based on anticipated porosity of the injection zone.\

The pre-mixed oil emulsion product used will consist of approximately 60 percent soybean oil by weight, 10 percent emulsifiers (e.g., polysorbate, mono- and di-glycerides) by weight, and 4 percent sodium lactate by weight. The vendor will prepare the emulsion product prior to shipment to CSSA. This will provide an oil

droplet size less than 1  $\mu\text{m}$  in diameter, which is not practical to produce in the field. The final distribution of vegetable oil after the post-emulsion water push will occupy only a small portion (3.4 percent by volume) of the interstitial void space of the aquifer matrix. This prevents adverse impact to hydraulic conductivity in the reactive zone and allows groundwater to continue to flow through the treatment zone.

Approximately 135 lbs of sodium lactate will be mixed into 1800 gallons of contaminated formation water extracted from either the injection well or well CS-MW16, and this mixture will be injected into the formation to prepare an emulsion mixture and also a post-emulsion water push. The final concentration of lactic acid in the emulsion mixture and water push combined will be approximately 29.3 grams per liter. Additionally, a bromide tracer will be added to the substrate mixture to be used for downgradient detection of the injected mixture. The substrate mixture is summarized in **Table 2**.

Mixing of water with sodium lactate and the vegetable oil emulsion will be performed using a series of air-diaphragm pumps, an in-line mixer, and a central mixing tank. Volumes of water, sodium lactate, and emulsion product will be measured using in-line flow meters to ensure that the proper proportions of fluids are being applied. The final concentrations of lactic acid and oil (plus emulsifiers) relative to the total volume of injected fluid will be 27.8 grams per liter (g/L) and 16.0 g/L, respectively. Total estimated volume of injection mixture will be approximately 1950 gallons.

Substrate will be injected into the formation using the injection well and will be followed by second injection composed primarily of water to flush the substrate mixture from the well and into the formation. The emulsion mixture and post-emulsion water push will be injected directly through the injection well screened interval with the volume of substrate injected into the well metered using in-line flow meters. The target injection rate for the substrate mixtures is 5 gpm and will require approximately 6.5 hours to complete. The post-injection water push will be performed at the maximum rate based on hydraulic properties of the injection interval.

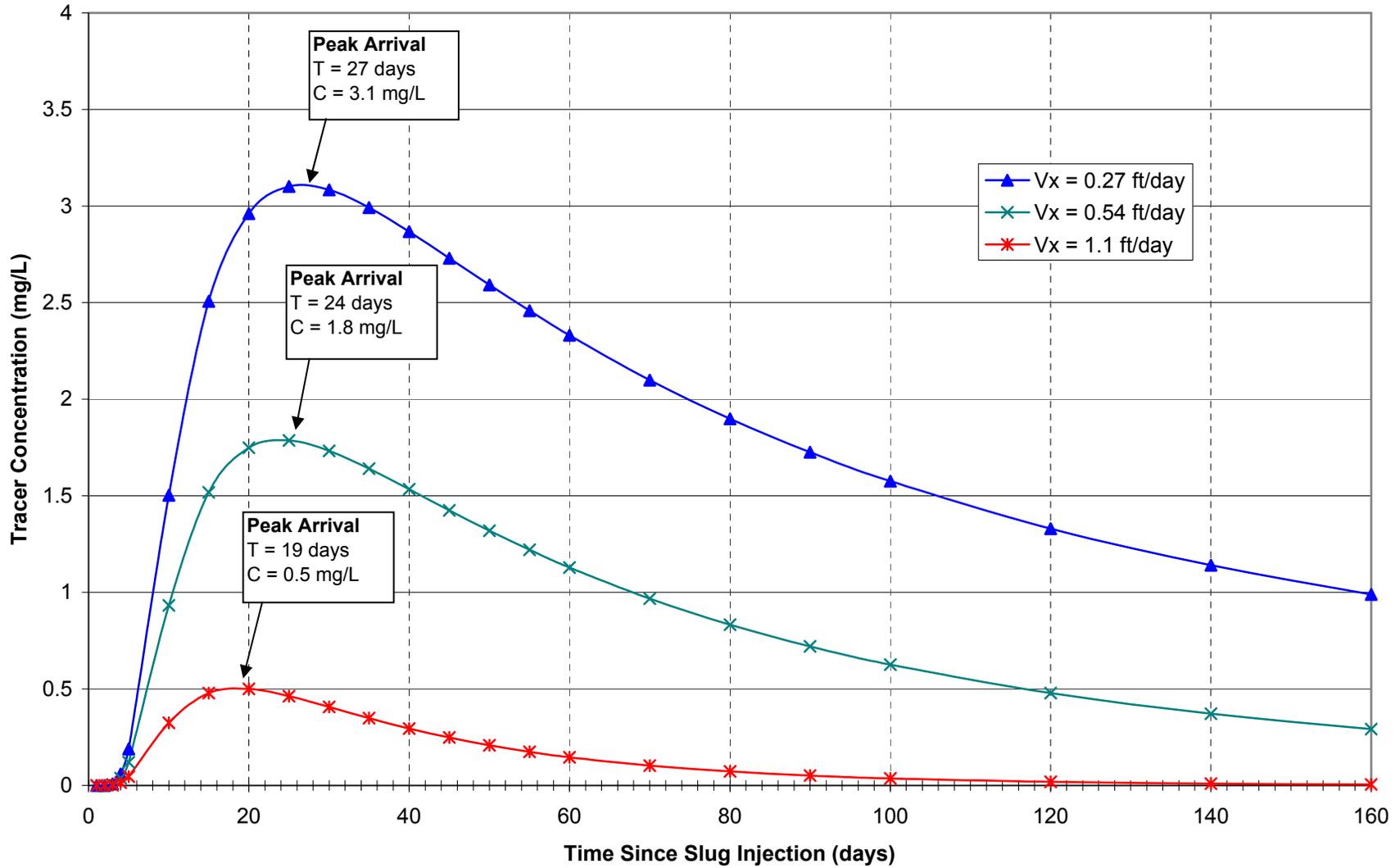
System pressures will be monitored and flow rate adjustments made as needed to avoid excessive pressure which could constitute a health and safety hazard or fracture the aquifer matrix. Water, sodium lactate, and the pre-mixed emulsion will be metered into the injection system upstream of the inline mixer at a rate appropriate to produce an oil-in-water emulsion consisting of approximately 7.0 percent vegetable oil and 0.6 percent sodium lactate by weight.

### **Process Monitoring Groundwater Sampling**

Groundwater samples will be collected from the injection well (CS-B3-MW01) and at downgradient Westbay® sample ports CS-WB05-LGR-03, CS-WB05-LGR-04A and CS-WB05-LGR-04B approximately 1, 2, 4, 6, and 9 months following injection of the substrate to monitor the progress of the degradation process. Groundwater samples will be collected from downgradient wells CS-MW16-LGR and CS-MW16-CC and from the remaining ports at Westbay® CS-WB05 (CS-WB05-LGR-BS-01, CS-WB05-CC-01, and CS-WB05-CC-02) approximately 4, 6 and 9 months after substrate injection. Additionally, groundwater samples will be collected from all sample ports in Westbay® wells CS-WB06, CS-WB07, and CS-WB08 approximately 9 months after injection. Sampling from the injection well will utilize low-flow sampling techniques. **Table 3** summarizes the process monitoring to be performed during the pilot study.

Groundwater samples collected from the monitoring wells during the pilot study will be analyzed for VOCs, electron acceptors (DO, nitrate, sulfate, and carbon dioxide), electron donors (total organic carbon), metabolic by-products (ferrous iron, methane, ethane, and ethene), indicator parameters (pH, and ORP), volatile fatty acids, and dissolved metals (arsenic and manganese). As indicated in Table 3, many of the groundwater chemical parameters will be measured onsite by field personnel. Some of the measurements will be made with direct-reading meters, while others will be made using a Hach® or CHEMetrics® portable colorimeter or titration kit in accordance with manufacturer-specified procedures. Procedures for the field analysis of samples are described in the Work Plan for Enhanced Anaerobic Biodegradation Pilot Study (Parsons, 2005).

**Figure 1**  
**Predicted Tracer Concentration at CS-WB05 Well With Time**



**TABLE 1**  
**SUMMARY OF BASELINE MONITORING ACTIVITIES**  
**AREA B-3 ENHANCED MNA TREATABILITY STUDY**  
**CAMP STANLEY, TEXAS**

Location Identifier	Groundwater Analyses											
	VOCs <sup>a/</sup> (SW8260B)	Methane, Ethane, Ethene	Nitrate + Nitrite (E353.3)	Sulfate (E300.1)	Chloride (E300.1)	Bromide (E320.1)	Total Organic Carbon (SW9060M)	Volatile Fatty Acids Microbial Insights	Phospholipid Fatty Acids Microbial Insights	Dissolved Metals (SW6010B) <sup>b/</sup>	Well Head Analyses <sup>c/</sup>	Mobile Lab Analyses <sup>d/</sup>
<b>Sampling Following Well Installation</b>												
CS-B3-MW01	1	1										
CS-WB05, CS-WB06, CS-WB07, & CS-WB08*	12	12										
<b>Sampling Following Pump Test</b>												
CS-B3-MW01	1	1										
CS-WB05, CS-WB06, CS-WB07, & CS-WB08*	12	12										
<b>Sampling Following Tracer Test &amp; Prior to Substrate Injection</b>												
CS-B3-MW01	1	1	1	1	1	1	1	1	1	1	1	1
CS-WB05, CS-WB06, CS-WB07, & CS-WB08*	12	12	12	12	12	12	12	12	12	12	12	12
CS-MW16-LGR, CS-MW16-CC, CS-D, CS-2, CS-MW1-LGR, CS-MW2-LGR, CS-MW3- LGR, CS-MW5-LGR, & CS-MW9-LGR	9	9	9	9	9	9	9	9	9	9	9	9
<b>SUBTOTALS</b>	48	48	22	22	22	22	22	22	22	22	22	22

<sup>a/</sup> Volatile organic compounds (VOCs) to include aromatic and chlorinated aliphatic hydrocarbons.

<sup>b/</sup> Dissolved metals analyses include manganese, arsenic, and selenium.

<sup>c/</sup> Well head analyses include dissolved oxygen, oxidation-reduction potential, pH, temperature, and conductivity.

<sup>d/</sup> Mobile lab analyses include carbon dioxide, alkalinity, ferrous iron, hydrogen sulfide, and manganese.

<sup>e/</sup> Estimated Westbay ports containing groundwater during sampling events.

**TABLE 2**  
**SUBSTRATE INJECTION SCENARIO**  
**AREA B-3 ENHANCED MNA TREATABILITY STUDY**  
**CAMP STANLEY, TEXAS**

Injection Point		Emulsion Injection Mixture						Post-Emulsion Push			Total Volume		Injection Interval (feet)	Estimated Effective Porosity (percent)	Radius of Influence (feet)	Injection Time at 5 gpm (hours)
Well ID	Injection Interval (feet)	Product Volume (gallons)	Vegetable Oil Component		WillClear		Makeup Water (gallons)	WillClear		Makeup Water (gallons)	Substrate (pounds)	Water/Substrate (gallons)				
			(gallons)	(pounds)	(gallons)	(pounds)		(gallons)	(gallons)				(pounds)			
CS-B3-MW01	278-288	150	150	693	100	135	1800	50	266	900	1,094	3,000	10	5%	16.0	10.0

**SUBSTRATE CONCENTRATIONS**

<b>Final Percent Substrate by Weight:</b>	<b>4.9%</b>	<b>Final Lactic Acid Concentration:</b>	<b>16.0</b>	<b>grams/liter</b>	<b>Percent Oil by Volume in Emulsion:</b>	<b>7.7%</b>
<b>Final Percent Water by Weight:</b>	<b>95.1%</b>	<b>Final Oil Concentration:</b>	<b>27.8</b>	<b>grams/liter</b>	<b>Final Residual Percent Oil by Volume:</b>	<b>5.0%</b>

**NOTES: Sodium Lactate Product**

1. Assumes WillClear sodium lactate product is 60 percent sodium lactate by weight.
2. Molecular weight of sodium lactate (CH<sub>3</sub>-CHOH-COONa) = 112.06.
3. Molecular weight of lactic Acid (C<sub>6</sub>H<sub>6</sub>O<sub>3</sub>) = 90.08 .
4. Specific gravity of WillClear Product = 1.323 @ 20 degrees Celsius.
5. Weight of WillClear Product = 11.0 pounds per gallon.
6. Pounds per gallon of lactic acid in product = 1.323 x 8.33 lb/gal H<sub>2</sub>O x 0.60 x (90.08/112.06) = 5.31 lb/gal.

**NOTES: Vegetable Oil Emulsion Product**

1. Assumes emulsion product is 100 percent soybean oil by weight.
2. Soybean oil is 7.8 pounds per gallon.

**NOTES: Conservative Tracer (Bromide)**

1. Assume sodium bromide will be used to produce soluble bromide for conservative tracer.
2. Desired bromide concentration in substrate mixture is 500 mg/L.

**TABLE 3**  
**SUMMARY OF PROCESS MONITORING ACTIVITIES**  
**AREA B-3 ENHANCED MNA TREATABILITY STUDY**  
**CAMP STANLEY, TEXAS**

Location Identifier	Sampling Events (mo)	Groundwater Analyses											
		VOCs <sup>a/</sup> (SW8260B)	Methane, Ethane, Ethene	Nitrate + Nitrite (E353.3)	Sulfate (E300.1)	Chloride (E300.1)	Bromide (E320.1)	Total Organic Carbon (SW9060M)	Volatile Fatty Acids Microbial Insights	Phospholipid Fatty Acids Microbial Insights	Dissolved Metals (SW6010B) <sup>b/</sup>	Well Head Analyses <sup>c/</sup>	Mobile Lab Analyses <sup>d/</sup>
CS-B3-MW01	1,2,4,6,9	5	5	5	5	5	5	5	5	5	5	5	5
CS-WB05-LGR-04A, -LGR-03, & -LGR-04B	1,2,4,6,9	15	15	15	15	15	15	15	15	15	15	15	15
CS-MW16-LGR & -CC	4,6,9	6	6	6	6	6	6	6	6	6	6	6	6
CS-WB05-BS-01, -CC-0, & 1-CC-02	4,6,9	9	9	9	9	9	9	9	9	9	9	9	9
CS-WB06-LGR-03 & -LGR-04	9	2	2	2	2	2	2	2	2	2	2	2	2
CS-WB07-LGR-03 & -LGR-04	9	2	2	2	2	2	2	2	2	2	2	2	2
CS-WB08-LGR-03 & LGR-04	9	2	2	2	2	2	2	2	2	2	2	2	2
<b>SUBTOTALS</b>		41	41	41	41	41	41	41	41	41	41	41	41

<sup>a/</sup> Volatile organic compounds (VOCs) to include aromatic and chlorinated aliphatic hydrocarbons.

<sup>b/</sup> Dissolved metals analyses include manganese, arsenic, and selenium.

<sup>c/</sup> Well head analyses include dissolved oxygen, oxidation-reduction potential, pH, temperature, and conductivity.

<sup>d/</sup> Mobile lab analyses include carbon dioxide, alkalinity, ferrous iron, hydrogen sulfide, and manganese.

<sup>e/</sup> Estimated Westbay ports containing groundwater during sampling events.