FINAL

ADDENDUM #2 TO THE SAMPLING AND ANALYSIS PLAN FOR THE FEASIBILITY STUDY/REMEDIAL DESIGN AT THE FORMER CHARLOTTE ARMY MISSILE PLANT (CAMP), MECKLENBURG COUNTY, CHARLOTTE, NORTH CAROLINA

Prepared for

US Army Corps of Engineers®

SAVANNAH DISTRICT

CONTRACT NO. DACA21-95-D-0022
DELIVERY ORDER 0070

January 21, 2005

SAIC®

05-002(WP)(NE)/012505

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Paula Bond, P.G. Project Manager SAIC Engineering of North Carolina, Inc.	1-24-05 Date
C. Allison Bailey, P.G., Technical Manager SAIC Engineering of North Carolina, Inc.	1-24-05 Date

NORTH CAROLINA LICENSED SEAL 1915 GEOLOGIST C. ALLISON BAILEY

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

contributed to the preparation of this document and should not be considered an eligible contractor for its review.

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Prepared for:

U.S. Army Corps of Engineers
Savannah District
Under Contract DACA21-95-D-0022
Delivery Order Number 0070

Prepared by:

SAIC Engineering of North Carolina, Inc.
151 Lafayette Drive
Oak Ridge, Tennessee 37831

January 21, 2005

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INTRODUCTION

This Addendum #2 supplements the Final *Sampling and Analysis Plan (SAP) for the Feasibility Study/Remedial Design at the Former Charlotte Army Missile Plant (CAMP), Mecklenburg County, Charlotte, North Carolina* (SAIC 2001). It presents changes to the SAP and the specific requirements for the performance of the Pilot Study at the Former CAMP Site. The investigation activities will be conducted by Science Applications International Corporation (SAIC) Engineering of North Carolina, Inc., hereafter referred to as SAIC.

Addendum #2 to the SAP for the Former CAMP Site consists of two parts: the Field Sampling Plan (FSP) and the Quality Assurance Project Plan (QAPP) as Appendix A. The Accident Prevention Plan (APP) and Site-Specific Health and Safety Plan (SSHP) have been prepared as a stand-alone document and will be issued under separate cover. The FSP provides guidance and rationale for the Pilot Study by defining the project's purpose, scope, and objectives; environmental setting; data quality objectives (DQOs); description of proposed field activities and chemical testing; and project schedule and milestones. The APP and SSHP document the protocols and procedures to ensure all work activities are performed safely and to prevent potential exposures to physical, chemical, and biological hazards. The QAPP describes the policy, organization, functional activities, and quality assurance/quality control protocols necessary to achieve the project's DQOs.

Addendum #2 has been prepared in accordance with requirements as defined in the U.S. Army Corps of Engineers (USACE) guidance EM-200-1-3 (February 1, 2001). The contents of this Addendum have been prepared by SAIC in accordance with the project scope of work, as modified by subsequent technical direction developed by USACE, Savannah District for Delivery Order No. 0070, under contract DACA21-95-D-0022.

This SAP addendum is structured to present only new information necessary to complete the current field activities. In order to prevent duplication, specific sections of the original SAP (SAIC 2001) will be referenced where applicable.

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ADDENDUM #2 TO THE
FIELD SAMPLING PLAN FOR THE
FORMER CHARLOTTE ARMY MISSILE PLANT (CAMP),
MECKLENBURG COUNTY,
CHARLOTTE, NORTH CAROLINA

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ACRONYMS

bgs	below ground surface
CAMP	Charlotte Army Missile Plant
COD	chemical oxygen demand
DNAPL	dense nonaqueous-phase liquid
DO	dissolved oxygen
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
FS	Feasibility Study
FSP	Field Sampling Plan
gpm	gallons per minute
IDW	investigation-derived waste
M&E	Metcalf and Eddy
NCDENR	North Carolina Department of Environment and Natural Resources
NTU	nephelometric turbidity unit
DO	Dissolved Oxygen
ORP	oxidation-reduction potential
PMP	Project Management Plan
psi	pounds per square inch
PVC	polyvinyl chloride
RD	Remedial Design
RI	Remedial Investigation
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RD	Remedial Design
SAIC	Science Applications International Corporation
SAP	Sampling and Analysis Plan
SVOC	semivolatile organic compound
TAL	target analyte list
TCE	trichloroethene
TCLP	toxicity characteristic leachate procedure
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound

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1.0 PROJECT DESCRIPTION

This document represents Addendum #2 to the Field Sampling Plan (FSP) for the Pilot Study to be performed at the Former Charlotte Army Missile Plant (CAMP) Site by Science Applications International Corporation (SAIC) Engineering of North Carolina, Inc., hereafter referred to as SAIC, which is a wholly owned subsidiary of SAIC. It presents changes to the FSP and the specific requirements for the performance of the Pilot Study at the Former CAMP Site (Figure 1-1).

The Former CAMP is located on Statesville Avenue in Charlotte, Mecklenburg County, North Carolina (Figure 1-2). The site is currently used as an industrial park for several companies. The surrounding area consists of dense industrial/commercial facilities. The Former CAMP is comprised of five former tank sites and two other areas of operation. The individual site boundaries are shown in Figure 1-2.

This FSP addendum provides an overview of the proposed field activities, chemical testing, and procedures to be used in executing the field activities. The environmental summary covers physiography and topography, climatic conditions, geology, soils, bedrock, hydrogeology, surface water hydrology, demographics, ecology, and site history as well as previous investigations for the Former CAMP. The environmental summary is based on and taken from the Phase I Remedial Investigation (RI) and Final Phase II RI for the Former CAMP (Metcalf & Eddy 1998; Metcalf & Eddy 2000). The Project Management Plan, including the primary project organization and responsibilities, is presented in Chapter 2, while the project scope and objectives are found in Chapter 3. Sampling design, procedures, methods, and rationales are discussed in detail in Chapter 4. Sample matrix types, analytical parameters, and analytical methods can also be found in Chapter 4. The remaining chapters summarize requirements for chain-of-custody (COC) documentation, sample packaging and shipment, management of investigation-derived waste (IDW), quality control (QC), project schedule, and instrumentation.

1.1 ENVIRONMENTAL SETTING

Please refer to Section 1.1 of the original FSP (SAIC 2001).

1.2 SITE HISTORY AND CONTAMINANTS AT THE FORMER CAMP

1.2.1 Site History

Please refer to Section 1.2.1 of the original FSP (SAIC 2001).

1.2.2 Previous Investigations

The following discussion includes a summary of those investigations performed by SAIC. A full discussion of the Phase I and Phase II RI's are found in Section 1.2.2 of the original FSP (SAIC 2001).

Investigations at the Former CAMP Site have been conducted since 1990 when site assessments were conducted as part of property real estate transactions. During these early investigations, trichloroethene (TCE) was identified as a primary groundwater contaminant. Beginning in 1996, Metcalf and Eddy, Inc. (M&E) conducted a Phase I RI [M&E 1999] followed by a Phase II RI in 1999 (M&E 2000). The groundwater flow identified during these investigations were divided into three hydrogeologic zones: the shallow, transition, and bedrock. A full description of the hydrogeologic zones found at the CAMP are

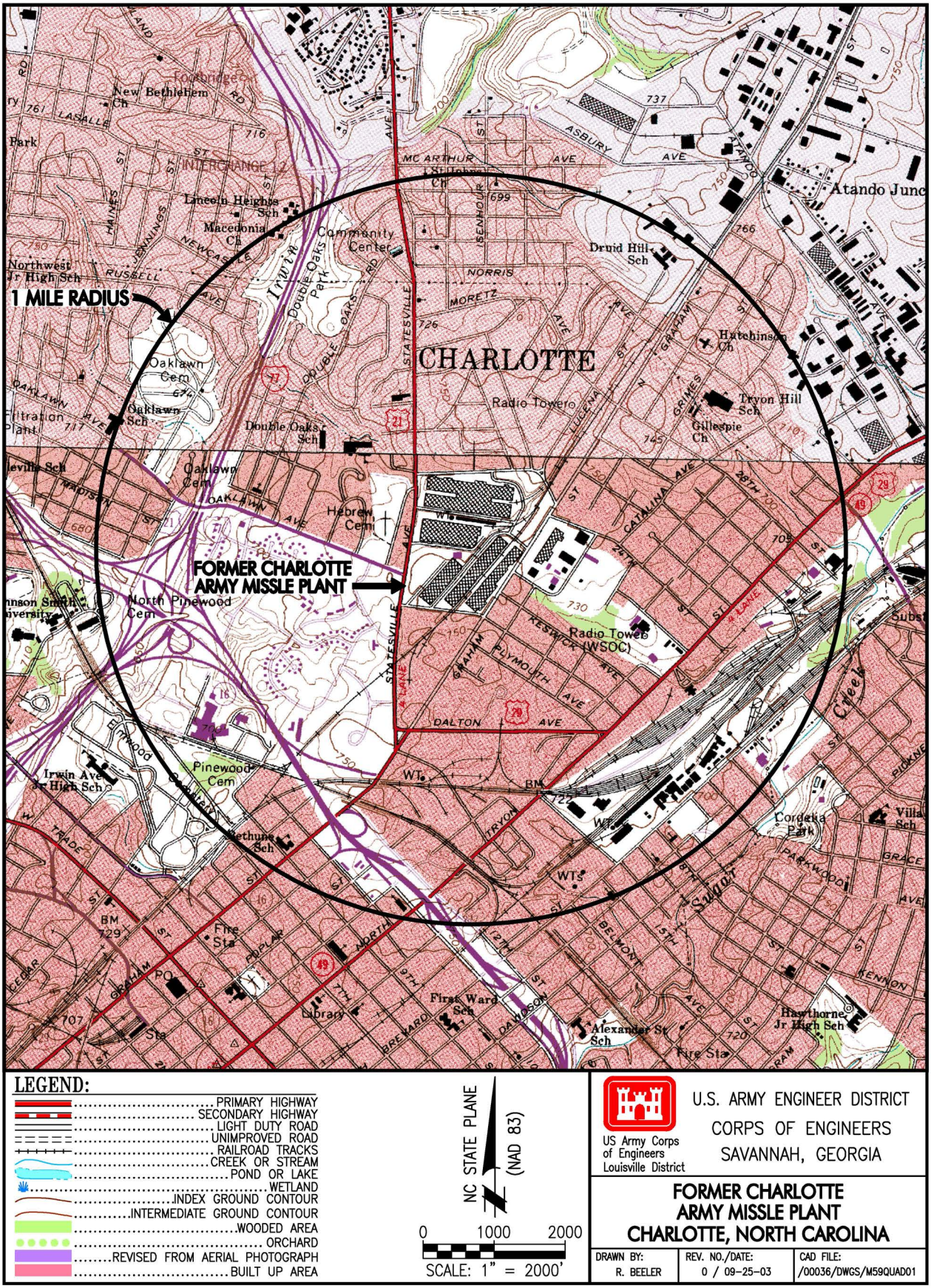

Figure 1-1. Site Location Map

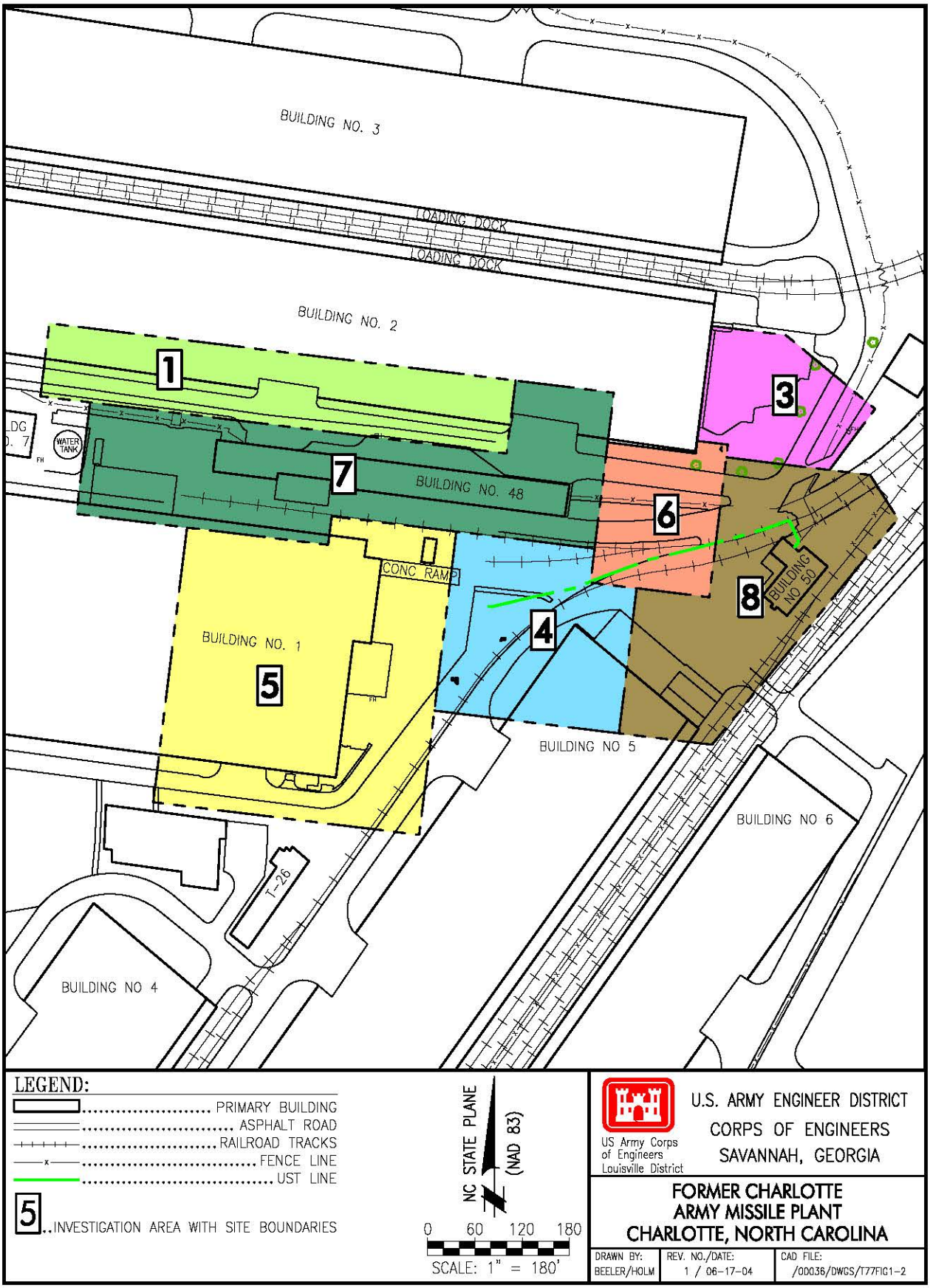

Figure 1-2. Site Location and Individual Site Boundaries

found in the Draft Final Feasibility Study for the Former Charlotte Army Missile Plant, Mecklenburg County, Charlotte, North Carolina (SAIC 2004). The RIs concluded that TCE was the most widespread constituent with the highest concentrations and that the majority of the TCE was detected in the transition zone. While the RI defined the vertical extent of the TCE, the horizontal extent of the TCE plume was not completely identified. The Phase II RI recommended that the TCE plume be further defined prior to implementing the Feasibility Study/Remedial Design (FS/RD).

Supplemental investigations conducted by SAIC in 2001 and 2003 concluded that TCE concentrations in groundwater exceeded the North Carolina (NC) drinking water standard of 2.8 μg/L. The distribution of TCE was then categorized into three hot spot areas (Figure 1-3). Hot Spot No. 1 extends from monitoring well SAIC-10 north to SAIC-18 and contains the majority of TCE mass identified. Monitoring well SAIC-10 is located along the east end of Building 1, and SAIC-18 is located along the south side of Building 2. This hot spot is characterized by concentrations of TCE > 500 μg/L with peaking concentrations of up to 7,500 μg/L. The vertical distribution of TCE > 500 μg/L in this area extends from the shallow groundwater table into the transition zone.

Hot Spot No. 2 is located along the eastern end of Building 2. The identified concentration of TCE appears locally confined and limited to the shallow zone.

Hot Spot No. 3 is located along the northeast corner of Building 1 and is located within the footprint of Hot Spot No. 1. This location is considered independent of Hot Spot No. 1 as the TCE concentration > 500 μg/L was detected within the bedrock zone. With a detected TCE concentration of 5,000 μg/L, this is the only location at the CAMP facility where TCE was identified within a bedrock monitoring well at concentrations exceeding 500 μg/L.

No specific source for the TCE in groundwater has been identified. However, the significant concentrations of documented TCE impact along the eastern end of Building 1 indicate this area is most likely an initial entry location.

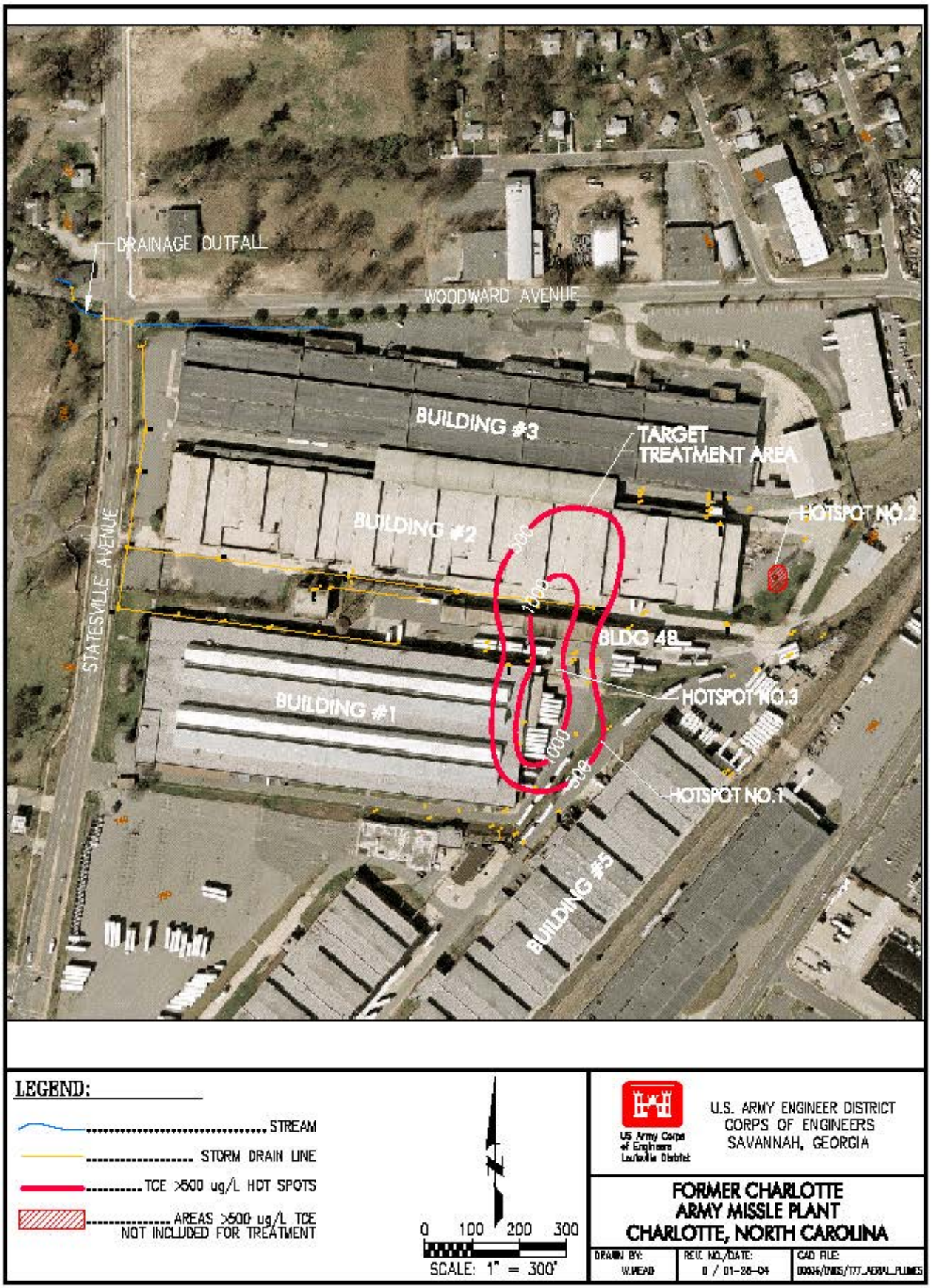

Figure 1-3. TCE Groundwater Hot Spots

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2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

This portion of the FSP Addendum represents the Project Management Plan (PMP) for project activities to be performed by SAIC for the work at the Former CAMP Site. This plan designates the key SAIC and subcontractor personnel who will participate in the project and provides a summary of their responsibilities.

2.1 PROJECT ORGANIZATION

The organizational chart illustrated in Figure 2-1 outlines the management structure that will be used to implement the project. The functional responsibilities of key personnel are described in the following parts of this plan. The assignment of personnel to each project position is based on a combination of (1) experience in the type of work to be performed, (2) experience working with government personnel and procedures, (3) a demonstrated commitment to high quality and timely job performance, and (4) staff availability. The key project personnel have been assigned based upon the minimum education and qualification requirements for each assigned position, as shown in Table 2-1. In the event that personnel identified in Figure 2-1 and Table 2-1 must be replaced after issuance of these documents, SAIC will provide the names and resumes for the replacement individuals to the United States Army Corps of Engineers (USACE), Savannah District Project Manager prior to mobilization for fieldwork.

Table 2-1. Key Assignments and Qualifications for the Pilot Study at the Former CAMP Site

Project Assignment	Minimum Degree Requirements	Minimum Qualifications
Project Manager Paula Bond	B.S., Civil Engineering, Geology, or related field	11+ years of experience in HTRW projects including site investigations and related environmental evaluations/studies
Site Safety and Health Officer Chuck McNulty	B.S., Safety, Engineering, or related field	5 years of experience in HTRW projects including providing health and safety oversight for site investigations, RIs, and related environmental evaluations/studies
Chemical QC Site Representative Chuck McNulty	A.S., Science or Engineering Technology or related field or equivalent fieldwork experience	5 years of experience in HTRW projects including site investigations, RIs, and related environmental evaluations/studies
Laboratory Coordinator Nile Luedtke	B.S., Chemistry	10 years of experience in HTRW projects including laboratory interface for site investigations, RIs, and related environmental evaluations/studies
Field Manager Chuck McNulty	B.S., Civil Engineering, Geology, or related field	5 years of experience in HTRW projects including soil and rock logging and monitoring well installation
Sampling Tech Chuck McNulty Sara Vaughn	A.S., Science or Engineering Technology or related field or equivalent fieldwork experience	2+ years of experience in HTRW projects including soil and groundwater sampling and monitoring well installation
Field Engineer Mark Kidder	B.S., Civil Engineering, Geology, or related field	4+ years of experience in HTRW projects including lead and project engineer in various remedial projects

HTRW = Hazardous, toxic, and radioactive waste.
RI = Remedial Investigation.

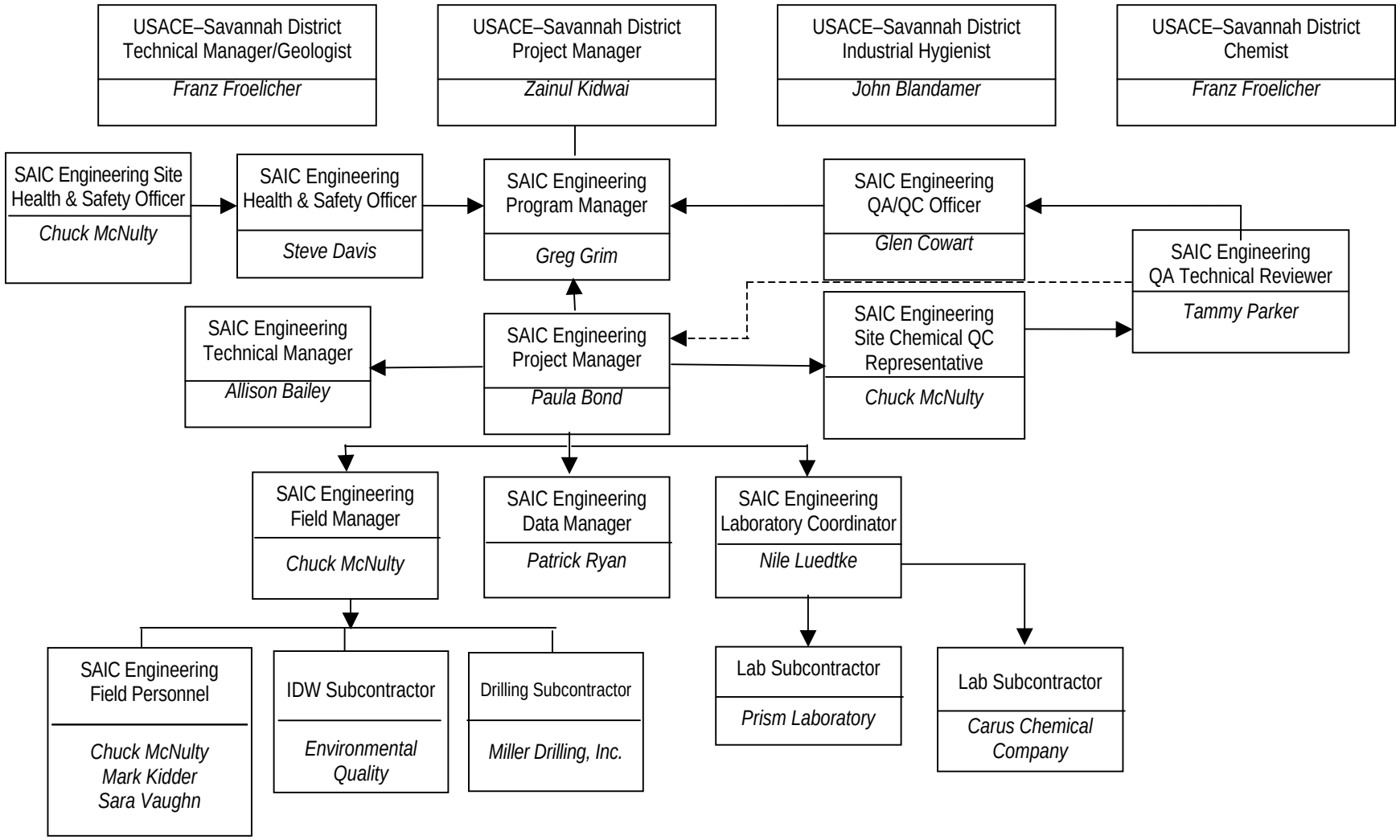

Figure 2-1. Organizational Chart for the Pilot Study at the Former CAMP Site

Identification of additional key personnel associated with the subcontracted laboratory activities for the project and a summary of their responsibilities are presented in Chapter 2.0 of the QAPP. The subcontractors selected by SAIC to support the project and the services to be performed by these companies are presented in Table 2-2 below.

Table 2-2. Summary of Subcontractors and Services

Subcontractors	Services
Miller Drilling Inc.	Monitoring well installation and development
Prism Laboratories, Inc.	Chemical analytical testing for groundwater, soil, and IDW
Carus Chemical Company	Soil Oxidant Demand for Sodium Permanganate
Environmental Quality	Transport and disposal of IDW

2.2 KEY PERSONNEL RESPONSIBILITIES

Please refer to Section 2.2 of the original FSP (SAIC 2001).

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3.0 PROJECT SCOPE AND OBJECTIVES

3.1 SCOPE OF THE FIELD ACTIVITIES

The Pilot Study will be conducted to evaluate the use of chemical oxidation for reducing concentrations of chlorinated compounds as a remedial approach at the Former CAMP Site and to better understand the site-specific aquifer hydraulics. The Pilot Study will focus on a limited area where the highest concentrations of TCE have been detected (SAIC-10 and SAIC-17) (Figures 3-1, 3-2, and 3-3).

Further discussion of the specific field activities to be performed is included in Section 4.0 of this document.

3.2 PROJECT OBJECTIVES

The primary objectives for the Pilot Study are to

- Determine the injection radius of influence of sodium permanganate in the shallow and transition zone;
- Determine the travel distances of sodium permanganate under ambient conditions (i.e., after injection has ceased);
- Determine possible preferential flow paths within each aquifer zone;
- Develop a measure of comparison to apply the results of the Pilot Test across the site during full scale remedial implementation; and
- Determine if TCE concentrations decrease with treatment by sodium permanganate.

A successful pilot study will be defined by meeting the project objectives listed above. Important information to be gained during the pilot test includes the ability to measure and monitor the transport of the sodium permanganate and sodium bromide within the separate zones of the aquifer. Sodium bromide will be injected and monitored to evaluate the hydrologic properties of the shallow zone. This not only includes determining the radius of influence during pumping, but also calculating post injection flow velocities. This information will be paramount in determining if sodium permanganate can be cost effectively distributed through the groundwater contaminant plume during full-scale implementation. The following sections contain the Data Quality Objective (DQO) rationale for the Pilot Study at the Former CAMP.

3.2.1 Data Quality Objectives

DQOs are used to identify the data to be collected so that the data are suitable to fulfill the objectives of the project and are obtained in an efficient and cost-effective manner. The DQO process culminates in the reduction of uncertainty associated with decisions related to FS and RD actions. There are three steps to the DQO process:

- identify decision types,
- identify data needs, and
- specify data collection.

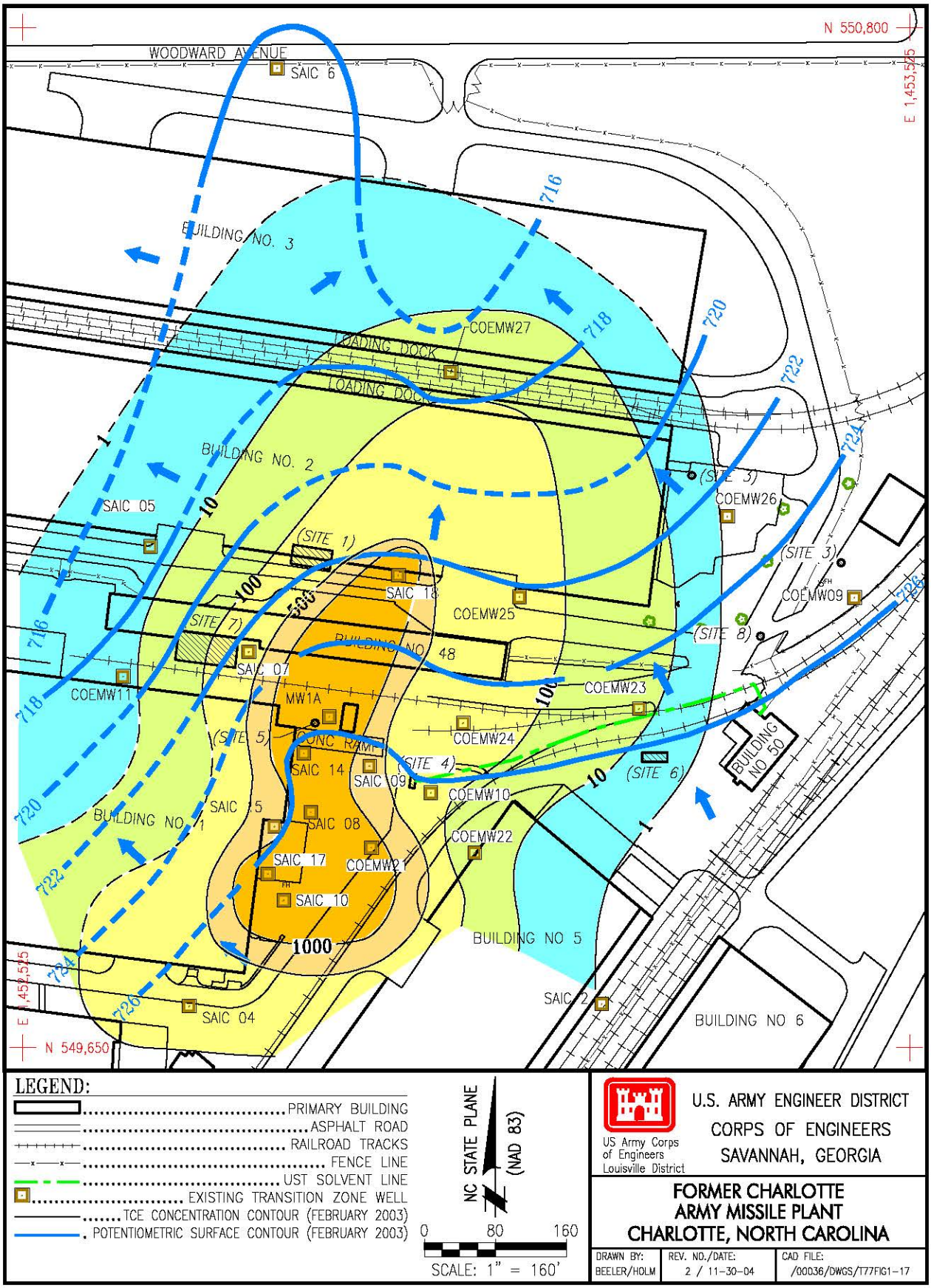

Figure 3-1. TCE Concentrations in the Transition Zone

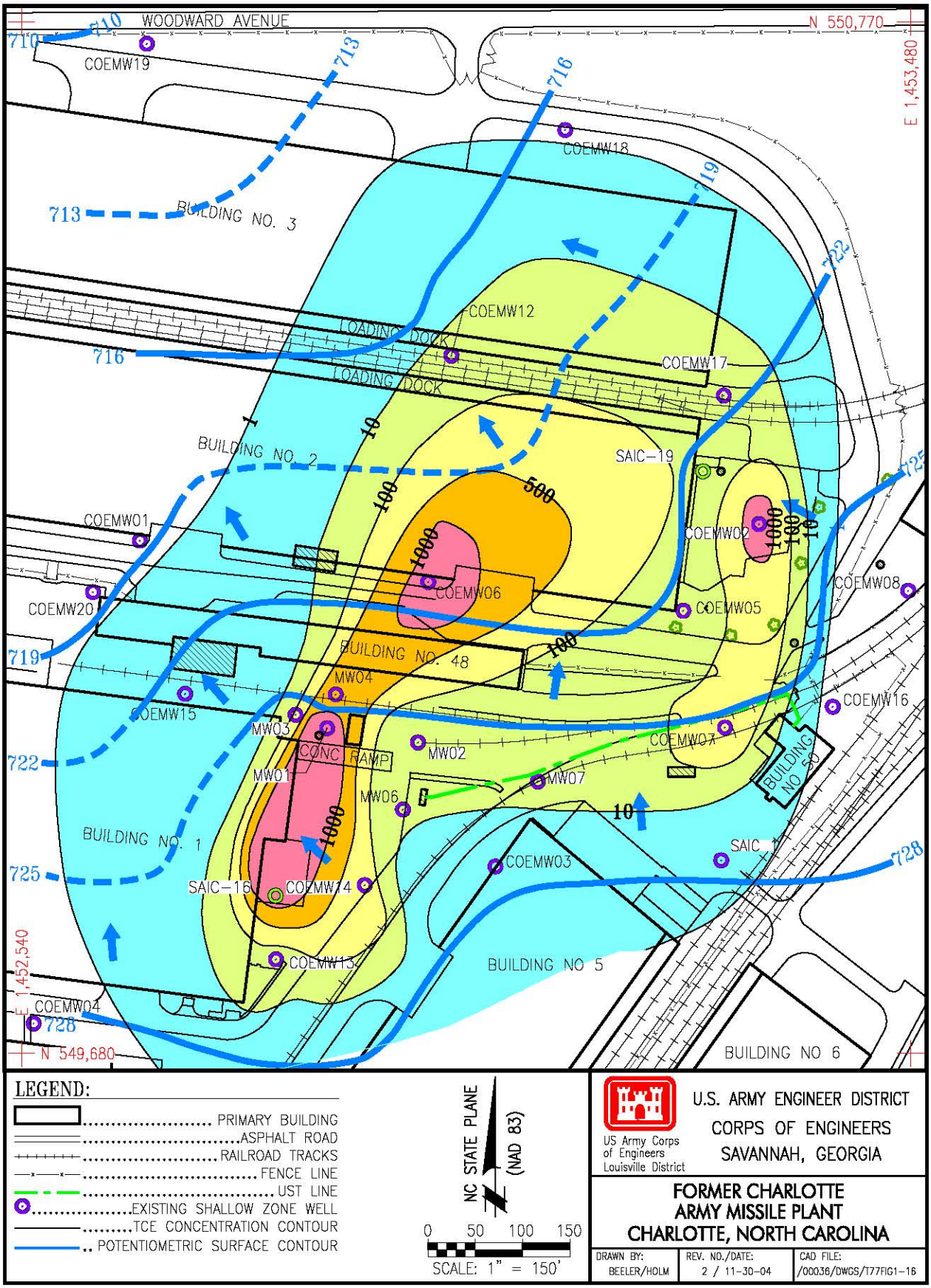

Figure 3-2. TCE Concentrations in the Shallow Zone

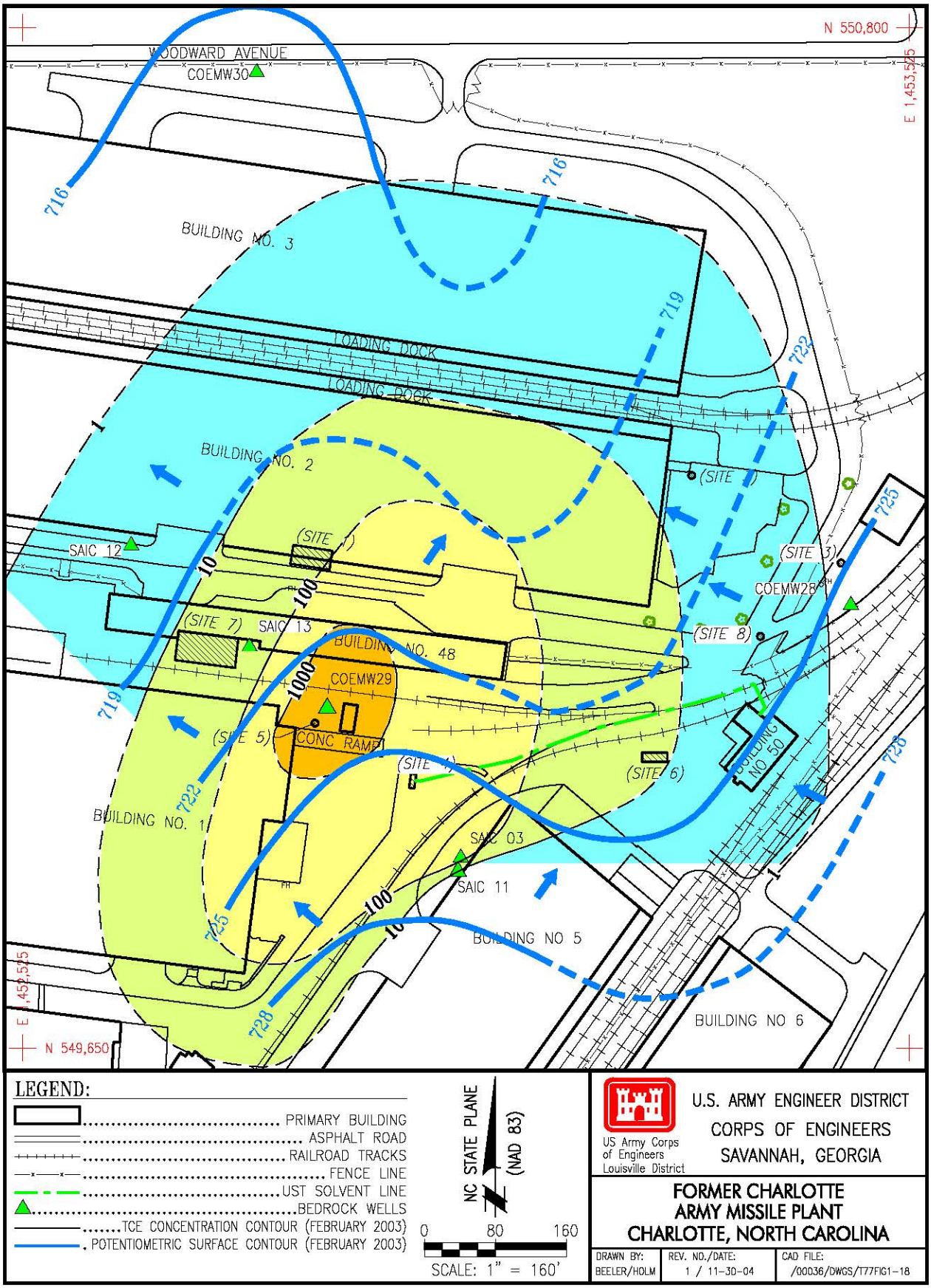

Figure 3-3. TCE Concentrations in the Bedrock Zone

3.2.2 DQO Step 1: Identify Decision Types

The results of the previous investigations indicate that a release above background has occurred at the Former CAMP. The Pilot Study will evaluate the use of sodium permanganate as a remedial option for the TCE contaminant groundwater plume. The primary questions to be answered by the Pilot Study are

- Will the distribution be sufficient to measure and monitor the transport of sodium permanganate?
- Does the observed distribution provide for cost effective full-scale implementation?
- Will the dosing rate and % solution used be adequate to reduce TCE concentrations?
- Will TCE concentrations within the hot spot be reduced to 100 μg/L or less?

3.2.3 DQO Step 2: Identify Data Needs

Data to be collected during the Pilot Study must be sufficient to:

- Determine if TCE concentrations are decreasing;
- Determine that the radius of influence is sufficient to provide a cost effective full-scale implementation.
- Determine the dispersion and flow rate of the sodium permanganate once injection ceases;
- Provide further understanding of the aquifer flow regimes; and
- Be legally defensible under regulatory requirements (reference QAPP Section 3.2)

3.2.4 DQO Step 3: Specify Data Collection

Types and sample locations for the Former CAMP are based on DQOs, USACE-Savannah District recommendations, and identified data needs.

The Pilot Study will be conducted to evaluate the use of sodium permanganate, as a remedial approach, and to better understand the hydraulics at the Former CAMP Site. The Pilot Study will focus on a limited area where the highest concentrations of TCE have been detected. Four new monitoring wells (two in the shallow zone and two in the transition zone) will be installed and used as observation points during the study. During the installation of the new monitoring wells, one saturated soil sample will be collected from each monitoring well boring. The samples will be shipped off-site for batch test analysis of soil oxidant demand. A baseline groundwater sampling event coupled with five performance monitoring events will be performed to monitor and evaluate the contaminant plume during the Pilot Study. Groundwater samples collected during the baseline sampling and performance monitoring events will be analyzed for volatile organic compounds (VOCs), target analyte list (TAL) metals, chemical oxygen demand (COD), and chloride. The data obtained during the sampling event will satisfy the data needs listed under Section 3.2.3 above. Further discussion of the samples to be collected and methods to be used is included in Section 4.0.

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4.0 FIELD ACTIVITIES

A Pilot Study will be conducted to evaluate the use of sodium permanganate, as a remedial approach, and to better understand the hydraulics at the Former CAMP Site. The Pilot Study will focus on a limited area where the highest concentrations of TCE have been detected (Figures 3-1 through 3-3). An injection permit application was submitted to the Underground Injection Control Section of NCDENR for approval. The injection permit was approved and the approval correspondence is included as Appendix B.

The Pilot Study will consist of the following primary tasks

1. Install four new monitoring wells.
2. Execute a potable water injection program.
3. Conduct baseline groundwater sampling.
4. Inject sodium permanganate ($NaMnO_4$) into the transition zone.
5. Inject sodium bromide into the shallow zone.
6. Conduct performance monitoring for a period of 3 months.
7. Perform a civil survey of all newly installed monitoring wells.

4.1 MONITORING WELL INSTALLATION

Four new monitoring wells will be installed and used as observation points during the Pilot Test. Two of the new wells (Figure 4-1) will be installed in the shallow zone and two will be installed in the transition zone. Table 4-1 provides the specific details for each new well.

Table 4-1. Proposed Well Construction Details

Well ID	Well Completion Zone	Casing Material and Diameter	Total Well Depth (ft bgs)	Screened Interval (ft bgs)
SAIC-20	Transition	2-inch PVC	45	35 to 45
SAIC-21	Transition	2-inch PVC	50	40 to 50
SAIC-22	Shallow	2-inch PVC	31	21 to 31
SAIC-23	Shallow	2-inch PVC	31	21 to 31

ft bgs = Feet below ground surface.
PVC = Polyvinyl chloride.

The two transition zone wells will be advanced 5 ft into bedrock to ensure the transition zone is captured by the well screen. Monitoring well installation will be accomplished by rotosonic drilling methods as discussed in Section 4.1.2 of Addendum No. 1 to the FSP dated November 2002 and monitoring well installation and development procedures will be that outlined in Section 4.3.2 of the original FSP (SAIC 2001).

4.1.1 Monitoring Well Placement Rationale

Locations for the four new monitoring wells were selected based on the locations of the proposed injection wells (SAIC-10 for the transition zone and SAIC-16 for the shallow zone). The wells are located approximately seven and 15 ft down gradient of the injection wells (Figure 4-1). It is anticipated that the injection radius of influence will not be greater 10 ft during active injection and travel no more than three feet every 30 days after injection ceases. It is anticipated that the distances of the new observation points would be sufficient to calculate the actual radius of influence and travel times under ambient conditions.

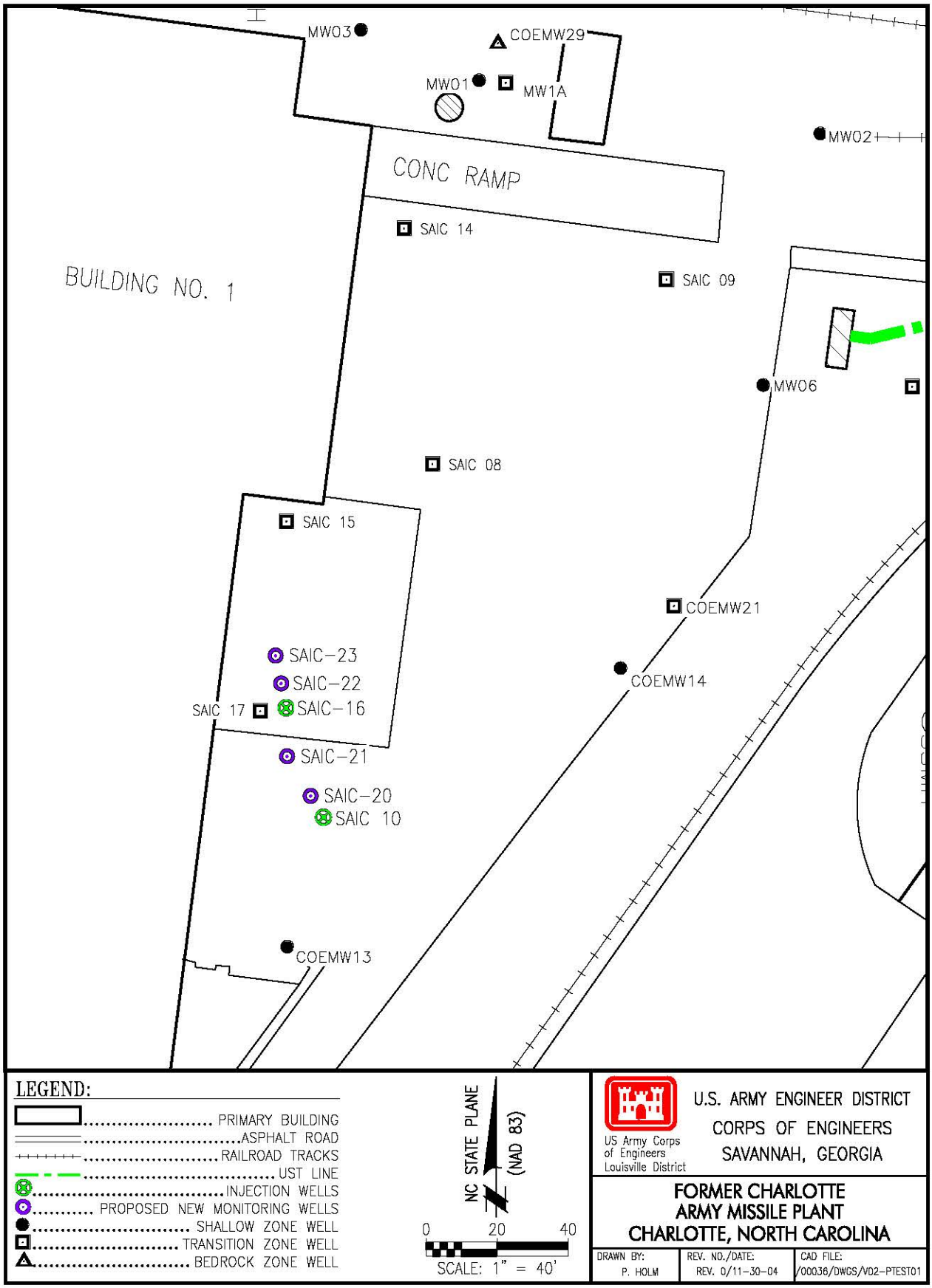

Figure 4-1. Pilot Test Configuration

4.1.2 Soil Sampling During Monitoring Well Installation

During the installation of the new monitoring wells, one saturated soil sample will be collected from each monitoring well boring. The samples will be shipped off-site to the Carus Chemical Company laboratory for batch test analysis of soil oxidant demand. The soil oxidant demand is critical in calculating loading rates for the permanganate injection.

The analysis will consist of measuring the amount of permanganate that will be consumed by the site soils. Each test will be run on three permanganate concentrations for 48 hours. The grab samples will be collected by placing the soil into a 250 mL wide-mouth glass jar with a Teflon® lined lid. The sample container will be packed so as to eliminate the most headspace possible in the container.

4.2 POTABLE WATER INJECTION

4.2.1 Potable Water Injection Rationale

Upon completion of the installation and prior to the $NaMnO_4$ treatment, a potable water injection test will be run in existing shallow (SAIC-16 and COEMW06) and transition (SAIC-10, SAIC-14, SAIC-17, and SAIC-18) monitoring wells (Figure 4-2). This data will be used to further define sustainable injection rates and radius of influences for the pilot test and provide a measure of comparison to apply the results of the pilot study across the contaminant plume during full scale remedial implementation.

4.2.2 Potable Water Injection Procedure

Each well listed above will have approximately 50 gals of potable water injected. Injection rates will start at 0.5 gals per minute (gpm) and step up in 0.25 gpm increments to determine the maximum capacity and injection rate of each well. The potable water will be obtained on-site and pumped into each well using a Grundfos® pump. A rubber gasket fitting will be placed around the collar of the monitoring well to prevent flow from seeping onto the ground.

Where possible due to site access restrictions, the surrounding wells will be monitored for changes in head to evaluate the influence, if any, from the injected water. The monitoring will be accomplished by either placing a pressure transducer in the well or by collecting manual water level measurements. The determination of monitoring method and wells to be observed will be selected once in the field.

4.3 BASELINE GROUNDWATER SAMPLING

4.3.1 Baseline Groundwater Sampling Rationale

Baseline groundwater sampling will occur in five transition zone monitoring wells (SAIC-10, SAIC-15, SAIC-17, SAIC-20, and SAIC-21) and three shallow zone monitoring wells (SAIC-16, SAIC-22, and SAIC-23) as presented in Figure 4-1. Each of wells selected for baseline groundwater sampling are representative of the shallow and transition zones being evaluated. In each zone, a source area or area of high TCE concentrations will be sampled along with at least two down-gradient locations. This configuration will provide sufficient data to determine the radius of influence of the injectate in each aquifer zone.

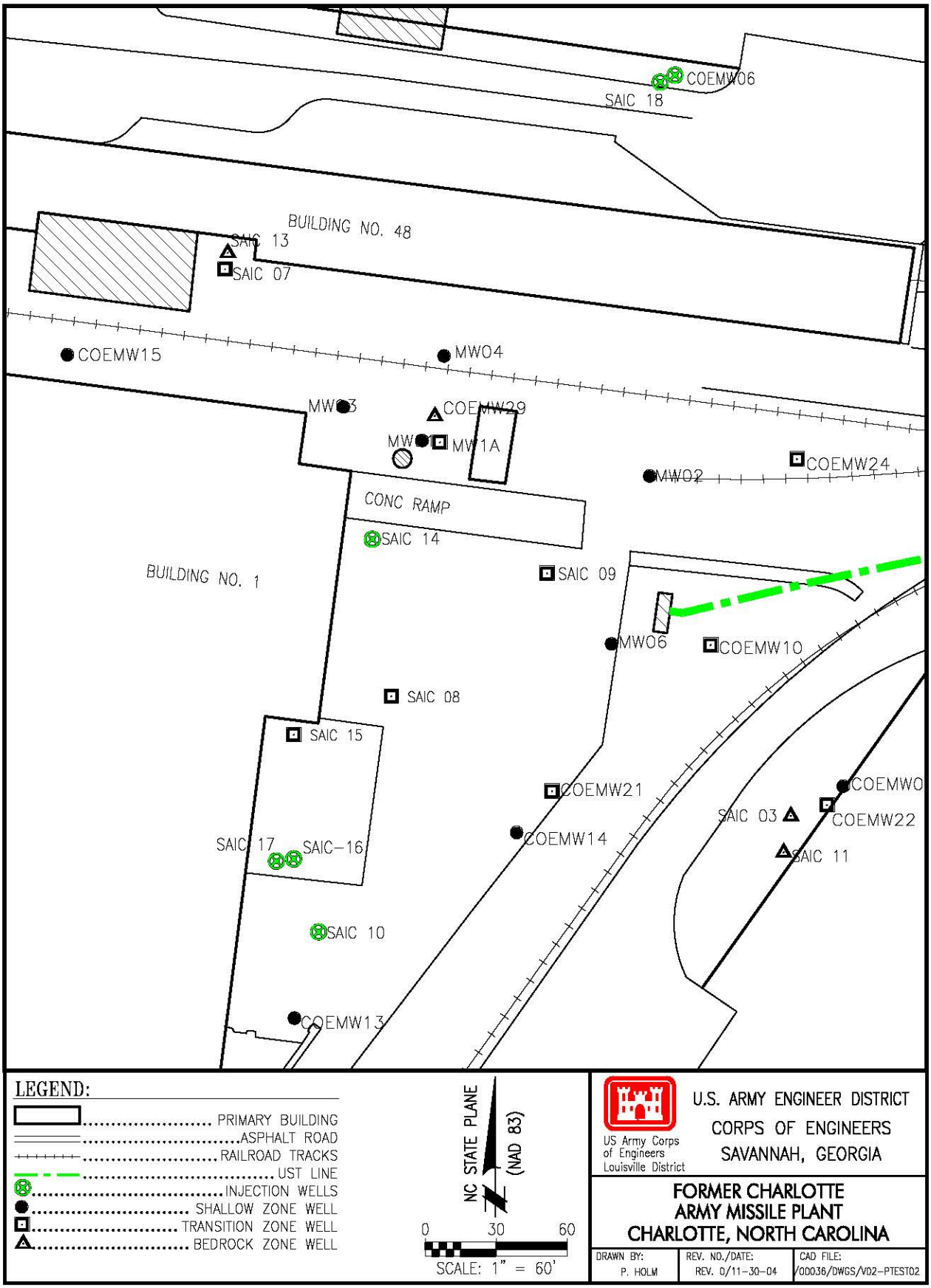

Figure 4-2. Potable Water Injection Configuration

4.3.2 Baseline Groundwater Sampling Procedures

Groundwater samples will be collected using low flow (<100 mL/min) purging techniques to reduce turbidity and decrease the amount of generated IDW. The low flow purging techniques (defined as between 0.1 and 0.5 L/min) will also ensure that representative groundwater samples are being collected. A low flow bladder pump will be used as the purging and sampling method for all wells.

During purging, the water quality parameters of temperature, pH, dissolved oxygen (DO), conductivity, turbidity, and oxidation/reduction potential (ORP) will be measured and observed for stability. Parameter stability will be defined as:

- Temperature ±1°C;
- pH ±0.1 units; and
- Conductivity ±10%
- DO ±10%
- ORP ±10%
- Turbidity <10 nephelometric turbidity units (NTU)

Upon parameter stabilization and the evacuation of at least 2 tubing and pump volumes, each monitoring well will be sampled in accordance with Section 4.3.6 of the original FSP (SAIC 2001).

4.4 SODIUM PERMANGANATE INJECTION

4.4.1 Sodium Permanganate Injection Rationale

Based on an evaluation of remedial alternatives as presented in the *Draft Final Feasibility Study for the Former Charlotte Army Missile Plant* (CAMP), Mecklenburg County, Charlotte, North Carolina (SAIC 2004), sodium permanganate was selected as a preferred remedial alternative. As a preferred remedial alternative, a Pilot Study to determine the effectiveness of sodium permanganate under real site conditions was recommended.

4.4.2 Sodium Permanganate Injection System Controls

The primary injection system components will consist of a mixing and distribution poly tank, a pump, and a control panel.

The mixing and distribution poly tank will be a 6,000-gal poly tank equipped with secondary containment. The poly tank will be located on the asphalt slab near proposed injection well SAIC-10. The piping from the poly tank to the pump will be 1-inch, residential-grade, suction hose fitted with worm-gear clamps and quick-disconnect couplers. Piping from the pump to the injection wellhead will be 1-inch, 200 psi working pressure, residential and commercial air and water hose fitted with worm-gear clamps and quick-disconnect couplers. Inlet and outlet control at the poly tank is achieved with two 3-inch butterfly valves (Figure 4-3). The inlet valve will be used during filling operations, and the outlet valve will be used to control the flow of solution to the suction side of the pump. Prior to pump start, the outlet valve will be fully open. This will allow proper priming of the pump and maintain solution supply during operation.

The active injection system for the transition zone will be anchored by a ½-horsepower, 60-Hertz, 115-volt, single-phase Gould's Model 5GB 7-stage Centrifugal Booster Pump capable of the flow and head requirement of 6 gpm at 50 pounds per square inch (psi).

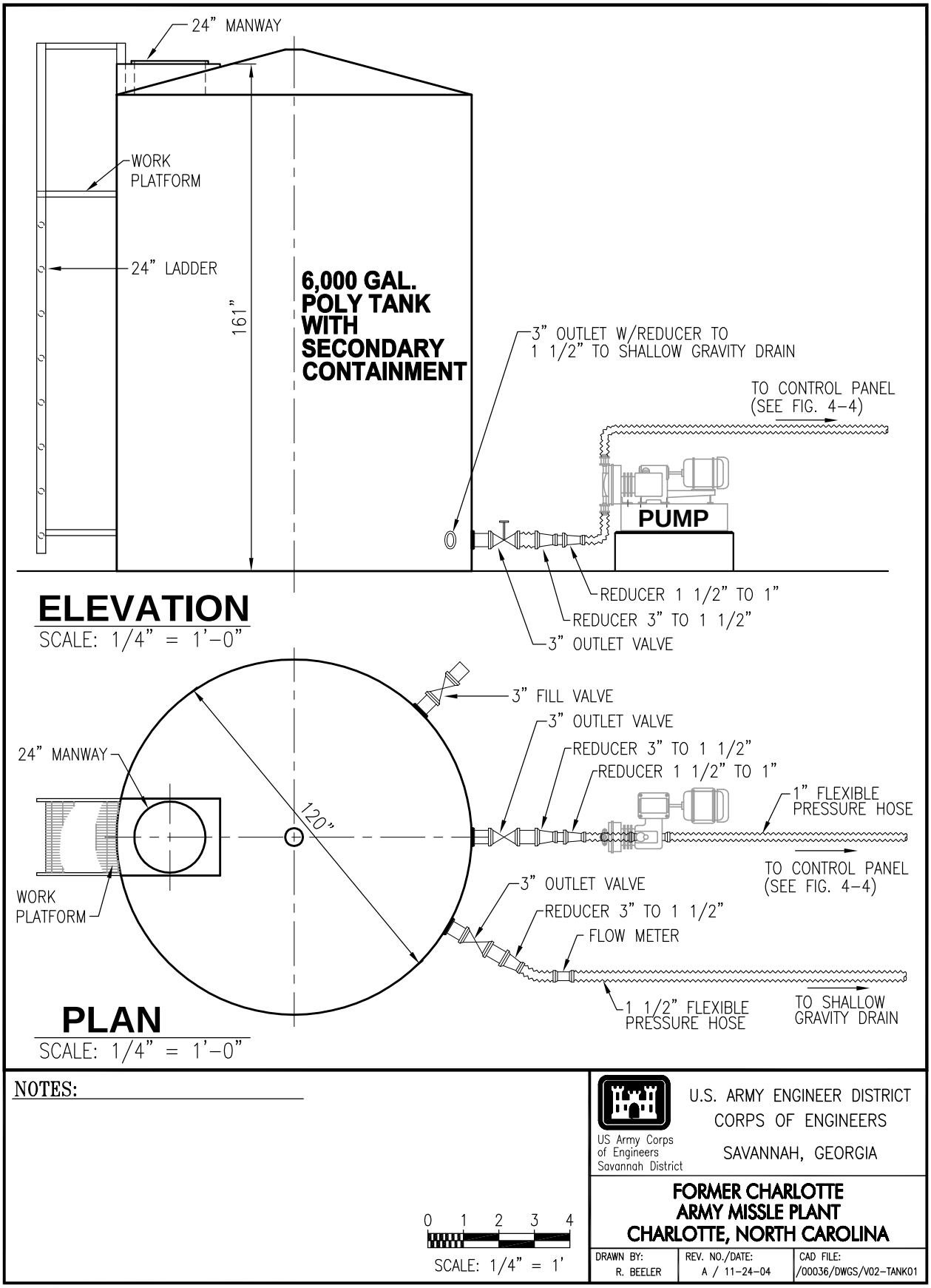

Figure 4-3. Mixing and Distribution Tank and Pump Configuration

The system control panel (Figure 4-4) will be located on the discharge side of the pump. A 1-inch isolation valve will be used to isolate the pump, should it need to be replaced. This isolation valve will be half open at system start to prevent any damage to the flow meters that may be caused by sudden surge. The isolation valve will be slowly opened as the system stabilizes.

As shown in Figure 4-4, a vertical in-line flow meter will be used to monitor $NaMnO_4$ flow to the transition zone well (SAIC-10).

Before the flow meter, there will be a 1-inch butterfly valve used to control the total flow and flow to the well. The butterfly valves at the individual lines will be half open at the system start, and after the system stabilizes the valves will be adjusted, as necessary, to maintain consistent flow to the wells.

System components at the wellhead (Figure 4-5) will include a 1-inch isolation valve, pressure gauge, and well coupling. The isolation valve will remain fully open and only close should any part of the system need to be taken out of service. The pressure gauge will be used to monitor system pressure. A 1.5-inch coupling will be used to hold the flexible hose in place and prevent back surface flow from exiting the injection well (Figure 4-5).

The injection system power requirements will be met through the use of the power outlets within Building No. 1. This will power the pump, lights, tools, and any other miscellaneous equipment needed for the construction, operation, and breakdown of the system.

4.4.3 Sodium Permanganate Injection Procedures

It is anticipated that approximately 2,882 lbs of $NaMnO_4$ will be required to perform the pilot test in the transition zone. Based on the TCE concentrations observed in the transition zone, a 2% solution of $NaMnO_4$ would be effective in reducing the chlorinated compound concentrations. Therefore, up to 16,000 gals of a 2% solution of $NaMnO_4$ will be continuously injected into monitoring well SAIC-10 (Figure 4-1) at an expected rate of up to 4 gpm over the course of 72 hours. The injection pressure will be less than 10 psi.

$NaMnO_4$ will be delivered to the site as a 40% solution in 55-gal steel drums and will require dilution to a 2% solution. The $NaMnO_4$ will be pumped, into the 6,000-gal poly tank using a drum pump. Water for the mixing system will be supplied via a local fire hydrant as necessary. Mixing of the $NaMnO_4$ and water will be achieved by pumping the sodium permanganate (100% water soluble) into the poly tank simultaneously with the water.

Once all system components are assembled and tested, injection of the sodium permanganate into monitoring well SAIC–10 will begin. The flow will start at approximately 0.5 gpm and be increased gradually to the maximum pumping rate that the well can sustain. The injection system will be constantly monitored during injection so as to troubleshoot any system malfunctions immediately. The volumes and rates may be adjusted slightly based on the results of the potable water injection test and the results of the soil oxidant demand test previously discussed.

At the close of the injection phase, all surface controls will be removed from the site during demobilization.

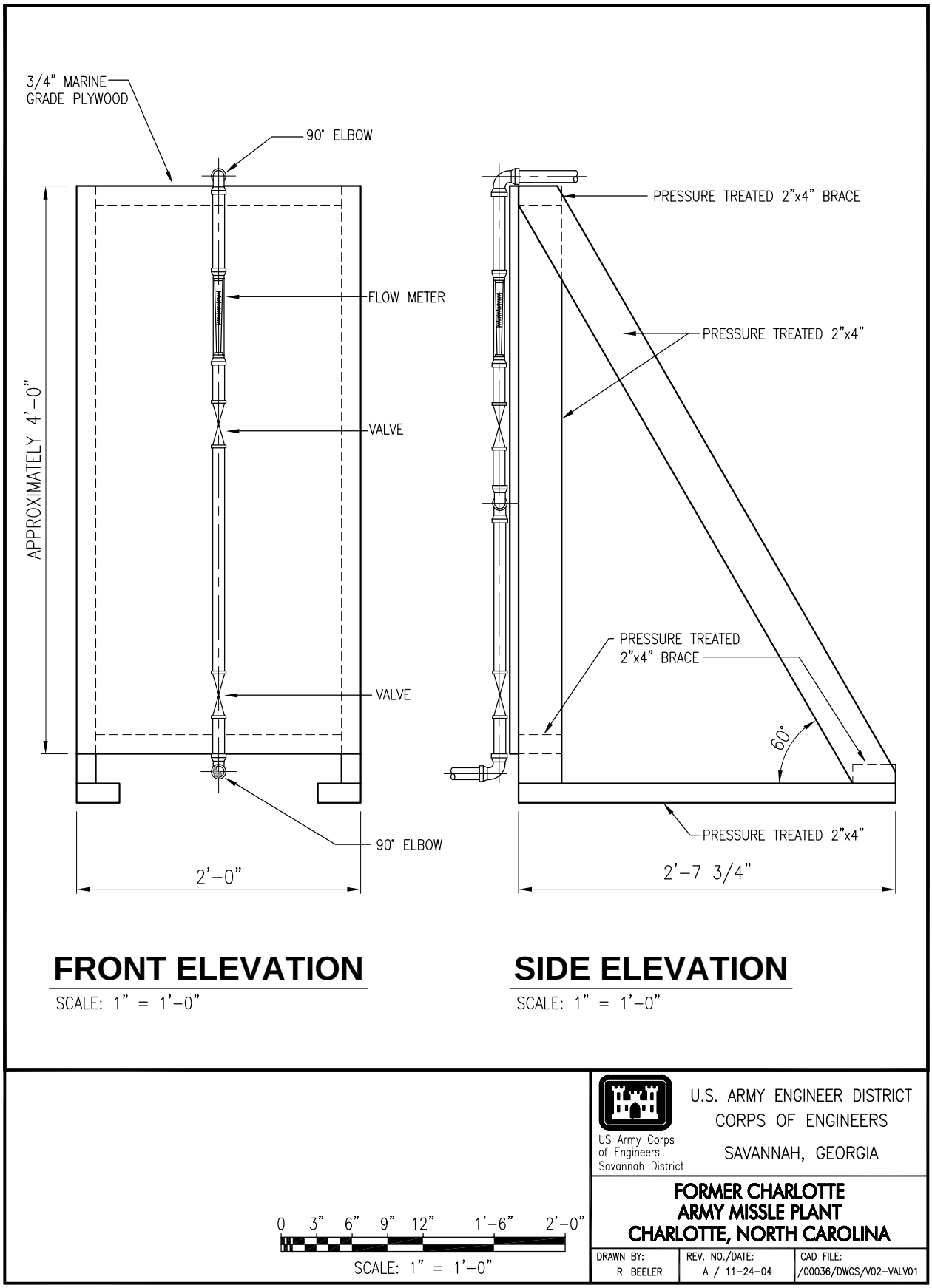

Figure 4-4. Injection System Control Panel

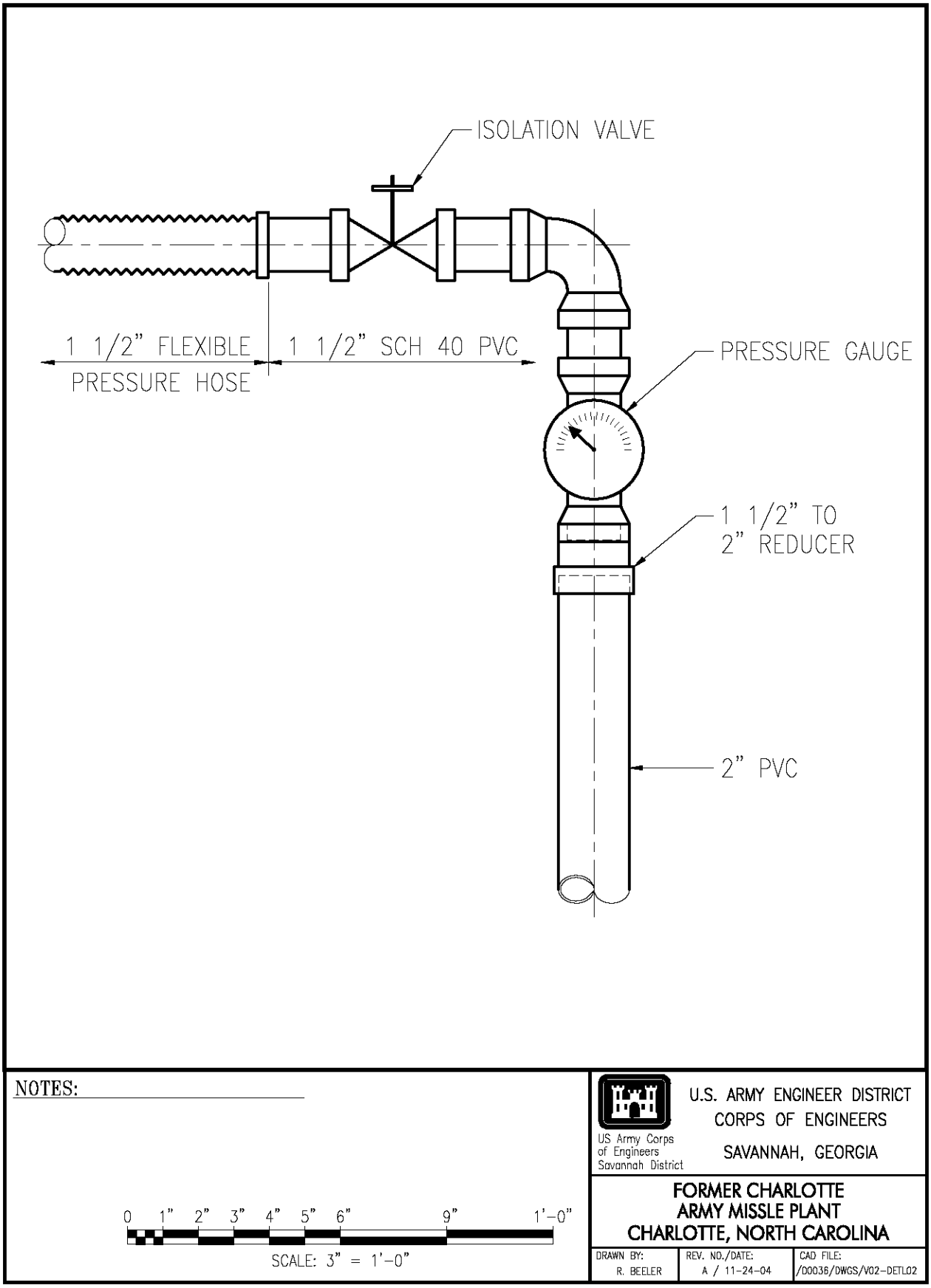

Figure 4-5. Typical Injection Well Head

4.4.4 Sodium Permanganate Performance Monitoring

The performance monitoring events for the sodium permanganate injection will occur at 1, 2, 4, 8, and 12 weeks after injection is complete. During each performance sampling event, a bailer will be dropped into each of the transition zone wells included in the Pilot Study (SAIC-10, SAIC-15, SAIC-17, SAIC-20, and SAIC-21) (Figure 4-1) and observed for the presence of the distinct purple coloring of the permanganate. Groundwater samples will not be collected from a transition well until the permanganate is observed in that well. That is, if the permanganate has not traveled to intercept that well, it is unlikely that the TCE concentrations would have appreciably changed from baseline concentrations. Once the permanganate is observed in a particular well, that well will continue to be sampled during each subsequent performance monitoring event. Chemical analysis for each transition zone monitoring well will consist of VOCs, TAL metals, COD, and chloride.

- VOCs will be monitored to evaluate the reduction of TCE in the groundwater.
- Metals will be monitored to evaluate potential metals mobilization.
- COD will be measured to evaluate the permanganate consumption of non contaminant constituents in the groundwater.
- Chloride will be measured to evaluate the degradation of TCE.

All transition zone wells will be sampled during the final performance monitoring event in post injection week 12 regardless of the visual detection of the sodium permanganate.

All monitoring well will be sampled in accordance with Section 4.3.2 of this Addendum.

4.5 SODIUM BROMIDE INJECTION PROCEDURES

4.5.1 Sodium Bromide Injection Rationale

In order to evaluate the hydrologic properties of the shallow zone, a sodium bromide solution will be injected and monitored. As the groundwater geochemistry and concentrations of TCE are similar in the shallow and transition zones, it is assumed that if the sodium permanganate reduces TCE concentrations in the transition zone, it will be equally effective at reducing TCE concentrations in the shallow zone. Therefore, the primary goal of the shallow zone injection is to determine the radius of influence of the injectate. This can be accomplished more cost effectively by injecting and monitoring the transport of sodium bromide into the shallow zone. Also, by injecting two separate substances, transport mechanisms of the shallow and transition zone can be more clearly defined, that is, the preferential flow paths in each zone may be more evident if observed without the potential interference uncertainties of using the same injectate in both zones.

4.5.2 Sodium Bromide Injection Controls

Approximately 10 kg of reagent-grade sodium bromide will be delivered to the site in powder form. The sodium bromide will require mixing with approximately 300 gals of water. The sodium bromide and water will be mixed in a 600 gal poly tank. The mixing and distribution poly tank will have a discharge bung near the base of the tank where a 1.5-inch threaded fitting and flow control valve will be located. The discharge hose will be connected to the tank and lead to the well head of monitoring well SAIC-16 as illustrated in Figure 4-5. A horizontal totalizing flow meter will be used in-line for the bromide gravity

feed to shallow monitoring well SAIC-16. The hose will be connected to a fitting on the well. The mixing and distribution poly tank will be placed on the asphalt slab near SAIC-10 for additional height and pressure which will optimize the gravity feed system.

4.5.3 Sodium Bromide Injection Procedure

The flow valve on the poly tank will be slowly opened and the sodium bromide mixture allowed to gravity feed into monitoring well SAIC-16. At maximum flow rates of up to 2 gpm, it is anticipated that the injection could extend continuously for a period up to 1 week. The bromide injection will be conducted concurrently with the permanganate injection and the gravity feed system checked continuously to troubleshoot any system malfunctions. At the completion of the Pilot Test, all materials will be removed from the site during demobilization.

4.5.4 Sodium Bromide Performance Monitoring

In order to monitor the travel times and distances of the bromide solution, a temporary submersible bromide data logger will be placed in monitoring well SAIC-22 (Figure 4-1). The bromide data logger will be downloaded/checked daily during injection to determine when the bromide has reached the well. Once the bromide has been detected in SAIC-22, the probe will be removed and moved down gradient to monitoring well SAIC-23 to monitor further downgradient. This information will be used to calculate the flow velocities in the shallow zone.

The performance monitoring events for the bromide injection will occur at 1, 2, 4, 8, and 12 weeks after injection is complete. During each performance monitoring event, each shallow well (SAIC-16, SAIC-22, and SAIC-23) will be micropurged and sampled for bromide (by EPA Method 320.1) to evaluate and confirm the distribution of the bromide. The bromide data logger will also be downloaded at the beginning of each event to determine if/when the bromide has reached monitoring well SAIC-23. As the sodium bromide solution is not anticipated to affect the TCE concentrations, VOC samples will only be collected from the shallow wells during the baseline sampling event and the week 12 post injection monitoring event. In addition, during the baseline and week 12 post injection monitoring events, additional groundwater analyses will consist of VOCs, TAL metals, COD, and chloride.

All monitoring wells will be purged and sampled in accordance with Section 4.3.2 of this Addendum.

4.6 CIVIL SURVEY

All monitoring wells installed during the Pilot Study will be surveyed by a North Carolina state-registered surveyor to determine their locations and elevations. All survey points shall be referenced both horizontally and vertically. Monitoring well locations will be surveyed off a permanent marker (e.g., manhole cover, fire hydrant, etc.). Elevations shall be recorded for the ground surface, the top of the riser casing, and the well manhole cover. A permanent benchmark will be established near the site and will be tied to the National Geodetic Vertical Datum mean sea level. Monitoring wells will be surveyed to the nearest 0.1 ft horizontally and the nearest 0.01 ft elevation. Positions and coordinates of all permanent points within the control traverse shall be shown on the base map.

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5.0 SAMPLE CHAIN OF CUSTODY/DOCUMENTATION

Please refer to Section 5.0 of the original FSP (SAIC 2001).

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6.0 SAMPLE PACKAGING AND SHIPPING

Please refer to Section 6.0 of the original FSP (SAIC 2001).

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7.0 INVESTIGATION-DERIVED WASTE

During the performance of field investigation activities, IDW will be managed in accordance with Resource Conservation and Recovery Act of 1976 requirements and the EPA's IDW policy. IDW includes all materials generated during performance of an investigation that cannot be effectively reused, recycled, or decontaminated in the field. IDW consists of materials that could potentially pose a risk to human health and the environment (e.g., sampling and decontamination wastes) and materials that pose a risk to human health and the environment (e.g., sanitary solid wastes). The types of IDW expected to be generated during the field activities are: (1) drill cuttings and decontamination sludges; (2) wastewaters, including monitoring well development and purge waters, and decontamination fluids; and (3) noncontaminated compactable and miscellaneous trash.

All soil and drill cuttings generated during the drilling of monitoring wells will be collected and drummed or otherwise contained and segregated by borehole location. Development, decontamination, and purge waste water will be drummed and managed in accordance with Section 7.0 of the original FSP (SAIC 2001). Two composite samples will be collected from the solid IDW to determine the appropriate disposal method. Based on the analytical results, the solids will either be disposed of as nonhazardous, non-regulated, or as hazardous listed waste bearing waste codes D040 and F001. Two liquid IDW samples will be collected from drilling water, purge and decon water, and decontamination pad sludge. The IDW water will be collected as a composite at the same location as the IDW soil. The collected water samples will be analyzed at the end of the Pilot Study period. The disposal method for the IDW water will be determined based on the analytical results. All IDW samples will be analyzed for toxicity characteristic leachate procedure (TCLP) VOCs, semivolatile organic compounds (SVOCs), and metals.

A detailed discussion of the procedures and equipment used for handling IDW is discussed in Chapter 7.0 of the original FSP (SAIC 2001).

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8.0 CONTRACTOR CHEMICAL QUALITY CONTROL PROGRAM

Please refer to Section 8.0 of the original FSP (SAIC 2001).

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9.0 DAILY QUALITY CONTROL REPORTS

Please refer to Section 9.0 of the original FSP (SAIC 2001).

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10.0 CORRECTIVE ACTIONS

Please refer to Section 10.0 of the original FSP (SAIC 2001).

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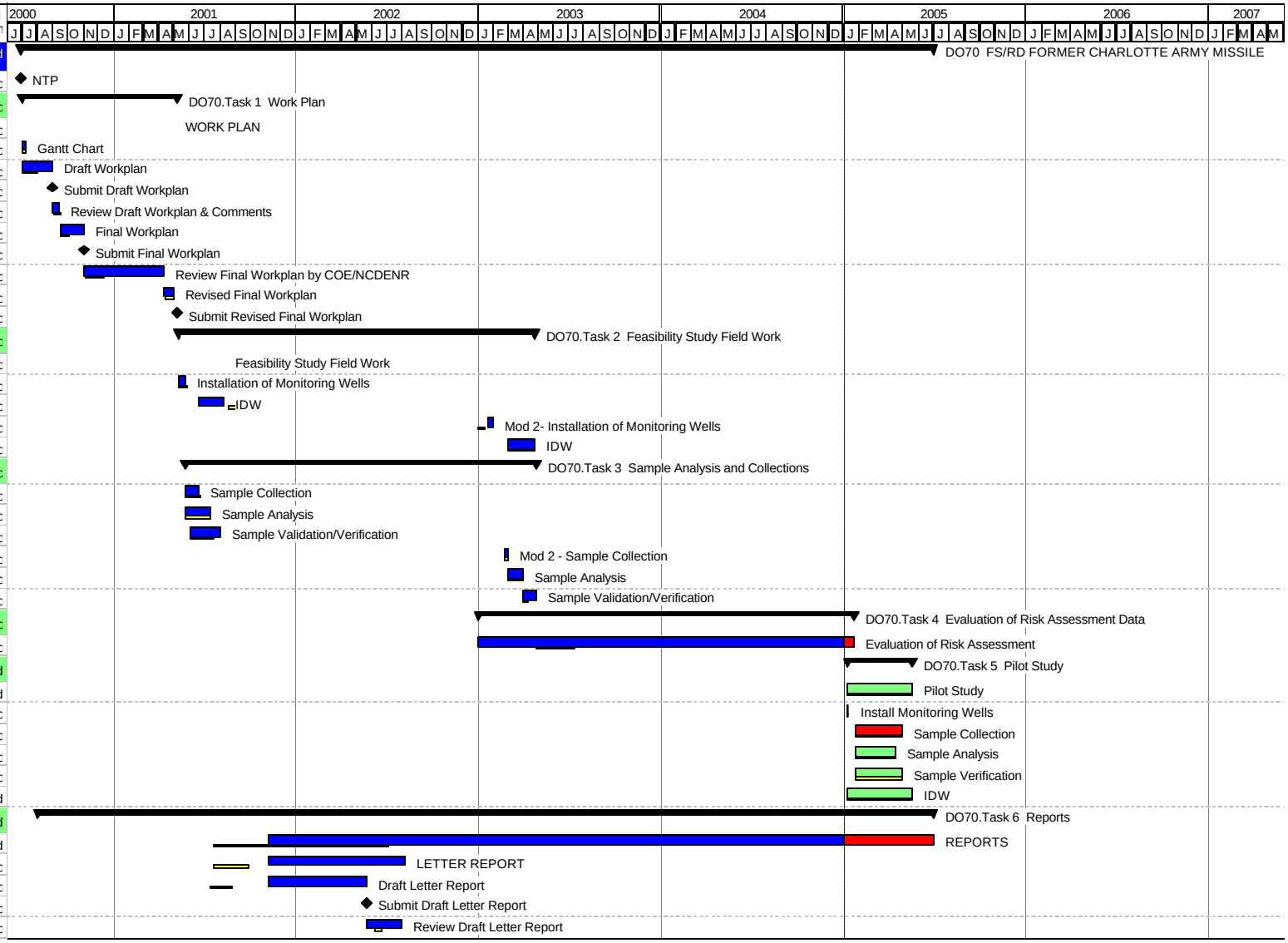
11.0 PROJECT SCHEDULE

The time scale for implementation of the Pilot Study is provided at Figure 11-1.

Start	Finish	Remaining Duration
DO70 FS/RD F...	30-Jun-05	178d
30-Jun-00 A		0c
DO70.Task 1 ...	07-May-01 A	0c
01-Jul-00 A	02-May-01 A	0c
01-Jul-00 A	09-Jul-00 A	0c
01-Jul-00 A	30-Aug-00 A	0c
31-Aug-00 A		0c
01-Sep-00 A	14-Sep-00 A	0c
16-Sep-00 A	01-Nov-00 A	0c
02-Nov-00 A		0c
03-Nov-00 A	11-Apr-01 A	0c
13-Apr-01 A	01-May-01 A	0c
07-May-01 A		0c
DO70.Task 2 ...	24-Apr-03 A	0c
09-May-01 A	09-Aug-01 A	0c
09-May-01 A	23-May-01 A	0c
22-Jun-01 A	09-Aug-01 A	0c
20-Jan-03 A	30-Jan-03 A	0c
01-Mar-03 A	24-Apr-03 A	0c
DO70.Task 3 ...	25-Apr-03 A	0c
25-May-01 A	21-Jun-01 A	0c
25-May-01 A	13-Jul-01 A	0c
04-Jun-01 A	31-Jul-01 A	0c
24-Feb-03 A	28-Feb-03 A	0c
01-Mar-03 A	30-Mar-03 A	0c
31-Mar-03 A	25-Apr-03 A	0c
DO70.Task 4 ...	21-Jan-05	21c
02-Jan-03 A	21-Jan-05	21c
DO70.Task 5 ...	18-May-05	127d
10-Jan-05	18-May-05	129d
10-Jan-05	10-Jan-05	1c
24-Jan-05	29-Apr-05	96c
24-Jan-05	15-Apr-05	82c
24-Jan-05	29-Apr-05	96c
10-Jan-05	18-May-05	129d
DO70.Task 6 ...	30-Jun-05	178d
09-Nov-01 A	30-Jun-05	181d
09-Nov-01 A	08-Aug-02 A	0c
09-Nov-01 A	22-May-02 A	0c
	22-May-02 A	0c
23-May-02 A	30-Jul-02 A	0c



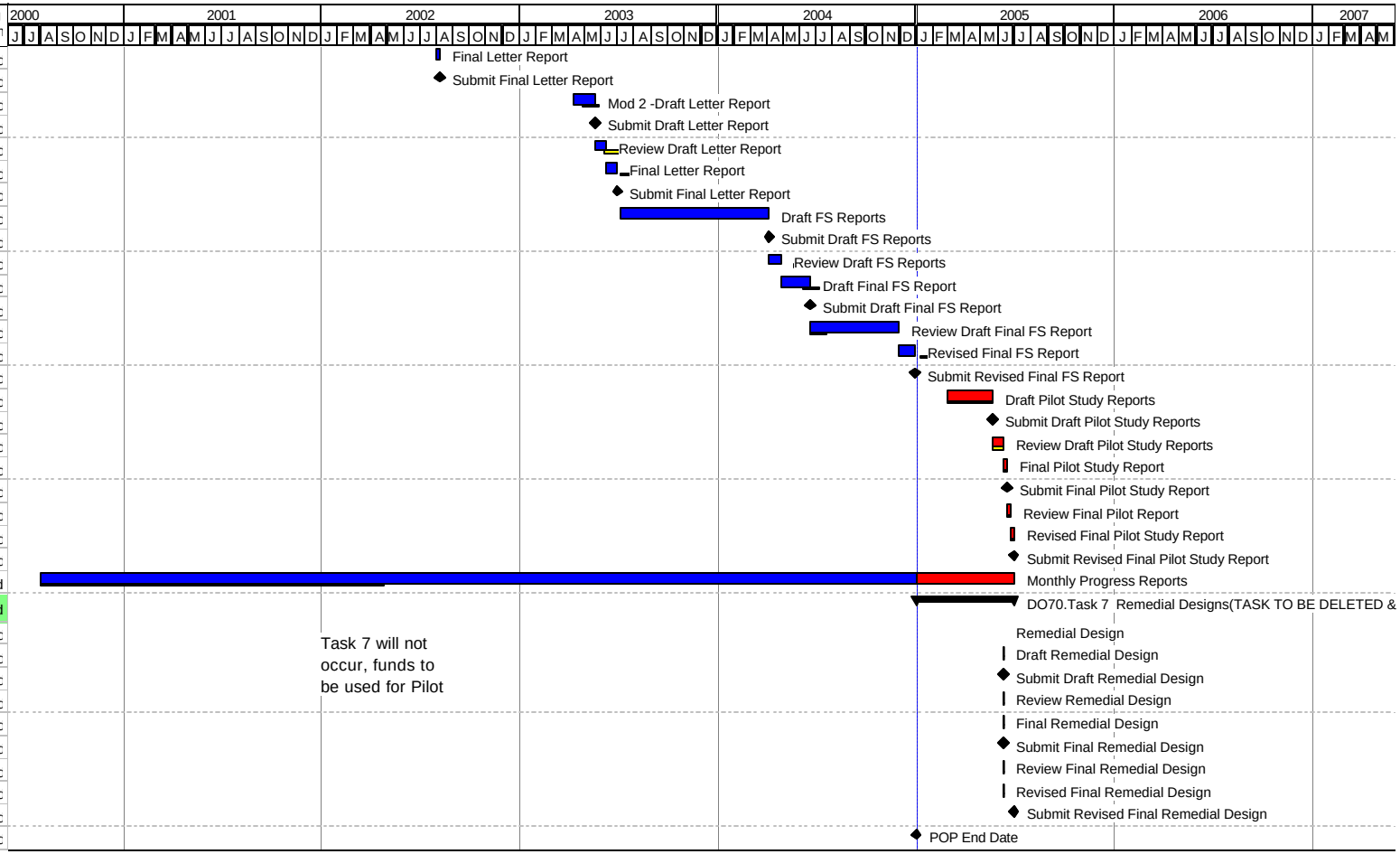
Primary Baseline
Critical Remaining Work
Actual Work
Milestone
Remaining Work
Summary

Start Date: 30-Jun-00
End Date: 30-Jun-05
Data Date: 01-Jan-05
Run Date: 06-Jan-05

FS/RD Former Charolotte Army Missile Plant, Charlotte, NC
DO 70

Figure 11-1. Schedule for the Former CAMP Site

Start	Finish	Remaining Duration
31-Jul-02 A	08-Aug-02 A	0c
	08-Aug-02 A	0c
10-Apr-03 A	20-May-03 A	0c
	20-May-03 A	0c
21-May-03 A	08-Jun-03 A	0c
09-Jun-03 A	30-Jun-03 A	0c
	30-Jun-03 A	0c
08-Jul-03 A	05-Apr-04 A	0c
	05-Apr-04 A	0c
06-Apr-04 A	29-Apr-04 A	0c
30-Apr-04 A	18-Jun-04 A	0c
	18-Jun-04 A	0c
19-Jun-04 A	30-Nov-04 A	0c
30-Nov-04 A	31-Dec-04 A	0c
	31-Dec-04 A	0c
27-Feb-05	20-May-05	83c
	20-May-05	0c
21-May-05	10-Jun-05	21c
10-Jun-05	17-Jun-05	8c
	17-Jun-05	0c
17-Jun-05	24-Jun-05	8c
24-Jun-05	30-Jun-05	7c
	30-Jun-05	0c
03-Aug-00 A	30-Jun-05	181d
DO70.Task 7 ...	30-Jun-05	178d
10-Jun-05	10-Jun-05	0c
10-Jun-05	10-Jun-05	0c
	10-Jun-05	0c
10-Jun-05	10-Jun-05	0c
10-Jun-05	10-Jun-05	0c
	10-Jun-05	0c
10-Jun-05	10-Jun-05	0c
10-Jun-05	10-Jun-05	0c
	30-Jun-05	0c
	01-Jan-05*	0c



Start Date: 30-Jun-00
End Date: 30-Jun-05
Data Date: 01-Jan-05
Run Date: 06-Jan-05

FS/RD Former Charolotte Army Missile Plant, Charlotte, NC
DO 70

Figure 11-1. Schedule for the Former CAMP Site (continued)

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12.0 REFERENCES

Metcalf and Eddy, Inc. 1999. *Final Phase I Remedial Investigation Report for the Former Charlotte Army Missile Plant, Mecklenburg County, Charlotte, North Carolina*, prepared by Metcalf & Eddie Inc., April.

Metcalf and Eddy, Inc. 2000. *Final Phase II Remedial Investigation Report for the Former Charlotte Army Missile Plant, Mecklenburg County, Charlotte, North Carolina*, prepared by Metcalf & Eddie Inc., October.

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SAIC (Science Applications International Corporation) 2003. Addendum #1 To The Sampling and Analysis Plan for the Feasibility Study/Remedial Design (FS/RD) at the Former Charlotte Army Missile Plant, Mecklenburg County, Charlotte, North Carolina, January

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APPENDIX A

ADDENDUM #2 TO THE QUALITY ASSURANCE PROJECT PLAN

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ADDENDUM #2 TO THE QUALITY ASSURANCE PROJECT PLAN FOR THE FEASIBILITY STUDY/REMEDIAL DESIGN AT THE FORMER CHARLOTTE ARMY MISSILE PLANT (CAMP), MECKLENBURG COUNTY, CHARLOTTE, NORTH CAROLINA

January 21, 2005

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ACRONYMS

CAMP	Charlotte Army Missile Plant
CAS	chemical abstract number
COC	chain of custody
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
FSP	Field Sampling Plan
GC/MS	gas chromatography/mass spectrometry
GW	groundwater
MCL	maximum contaminant level
MS	matrix spike
MSD	matrix spike duplicate
NAD	Naval Ammunition Depot
NC	North Carolina
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
Prism	Prism Laboratories, Inc.
RPD	relative percent difference
SAIC	Science Applications International Corporation
SAP	Sampling and Analysis Plan
VOCs	volatile organic compounds
USACE	U.S. Army Corps of Engineers

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A.1 PROJECT DESCRIPTION

This portion of the Sampling and Analysis Plan (SAP) addendum presents the Quality Assurance Project Plan (QAPP) for the activities to be performed at the Former Charlotte Army Missile Plant (CAMP) Site, Charlotte, North Carolina. This QAPP addendum supplements the QAPP presented in the *Sampling and Analysis Plan for the Feasibility Stud/Remedial Design at the Former Charlotte Army Missile Plant, Mecklenburg County, Charlotte, North Carolina* (SAIC 2001). It only presents changes to the QAPP as they relate to the Pilot Study at the Former CAMP Site. The U.S. Army Corps of Engineers (USACE) and the U.S. Environmental Protection Agency (EPA) require that all environmental monitoring and measurement efforts mandated or supported by these organizations participate in a centrally managed quality assurance (QA) program. Any party generating data for this project has the responsibility of implementing minimum procedures to ensure that the precision, accuracy, completeness, and representativeness of its data are known and documented. To ensure that these responsibilities are uniformly met, each party must adhere to the QAPP.

This QAPP presents the organization, objectives, functional activities, and specific QA and quality control (QC) activities associated with the Pilot Study at the Former CAMP Site. Also presented are details regarding data quality objectives (DQOs) for the activities. The specific protocols that will be followed for sampling, sample handling and storage, preservation procedures for samples collected in the field, chain of custody (COC), field and sample documentation, sample packaging and shipping, and laboratory analytical procedures for all media sampled and laboratory analysis are presented in the original project QAPP (SAIC 2001).

The Field Sampling Plan (FSP) portion of the SAP contains the project description, background information, sampling design, procedures, methods, and rationales. Table A-1 of this QAAP presents a summary of the sample matrix types, analytical parameters, and analytical methods to be used during the pilot study.

A.2 PROJECT ORGANIZATION AND RESPONSIBILITIES

The primary project organizational structure and responsibilities for the Pilot Study are discussed in Chapter 2.0 of the FSP. The analytical laboratory for the general chemical analysis is Prism Laboratories Inc., (Prism), which has not changed from the last revision of the QAPP (SAIC 2002). The laboratory organization and responsibilities are included in Addendum No. 1 of the QAPP (SAIC 20002).

Four soil samples will be collected during the drilling operations and submitted to Carus Chemical Company for analysis of soil oxidant demand. The results of this analysis will be used to determine the loading rates for the sodium permanganate.

A.3 DATA QUALITY OBJECTIVES

The overall project objective is to develop and implement procedures for field sampling, COC, laboratory analysis, and reporting that will provide results to be used in site evaluation and assessment and that are technically sound and legally defensible. Specific procedures for sampling, COC, laboratory instrument

Table A-1. Summary of Sampling and Analytical Requirements for the Pilot Study

Samples			QC Samples			Sample Total		
Parameter	**Analytical Method**	**No. Primary Samples**	**No. Duplicates**	**No. Rinsates**	**No. Trip Blanks**	**No. Samples per Event**	**Total No. Events**	**Total No. Samples**
Baseline								
COD	EPA 410.4	8	1	n/a	n/a	9	1	9
VOCs	SW-846 8260B/5030	8	1	1	3	13	1	13
TAL Metals	6010B	8	1	1	n/a	10	1	10
Field Parameters[a]	Field Measurement	8	n/a	n/a	n/a	8	1	8
Chloride	Hach Test Kit	8	n/a	n/a	n/a	8	1	8
Post Injection Weeks 1, 2, 4, and 8								
COD	EPA 410.4	5	1	n/a	n/a	6	4	24
VOCs	SW-846 8260B/5030	5	1	1	3	10	4	40
Bromide	EPA 320.1	3	1	n/a	n/a	4	4	16
Field Parameters[a]	Field Measurement	4	n/a	n/a	n/a	4	4	16
Chloride	Hach Test Kit	5	n/a	n/a	n/a	5	4	20
Post Injection Week 12								
COD	EPA 410.4	8	1	n/a	n/a	9	1	9
VOCs	SW-846 8260B/5030	8	1	1	3	13	1	13
Bromide	EPA 320.1	3	1	1	n/a	5	1	5
TAL Metals	6010B	7	1	1	n/a	9	1	9
Field Parameters[a]	Field Measurement	8	n/a	n/a	n/a	8	1	8
Chloride	Hach Test Kit	8	n/a	n/a	n/a	8	1	8
TCLP VOCs	SW-846 8260B	5	n/a	n/a	n/a	5	1	5
TCLP SVOCs	SW-846 8260B	5	n/a	n/a	n/a	5	1	5
TCLP Metals	SW-846 8260B	5	n/a	n/a	n/a	5	1	5

[a]Field measurements include pH, temperature, dissolved oxygen, turbidity, specific conductance, and oxidation-reduction potential.
COD = Chemical oxygen demand.
EPA = U.S. Environmental Protection Agency.
QC = Quality control.
SVOC = Semivolatile organic compound.
TAL = Target Analyte List.
VOC = Volatile organic compound.

calibration, laboratory analysis, reporting of data, internal QC, audits, preventive maintenance of field equipment, and corrective action are described in the original project QAPP (SAIC 2001) and remain valid. The purpose of this section is to address the specific objectives for the Pilot Study sampling activities for data accuracy, precision, completeness, representativeness, and comparability.

DQOs are qualitative and quantitative statements that specify the quality of data required to support decisions made during investigation activities and are based on the end uses of the data being collected.

A.3.1 PROJECT OBJECTIVES

The Pilot Study will be conducted to evaluate the use of in-situ chemical oxidation (i.e., sodium permanganate) as a remedial approach at the Former CAMP Site and evaluate the hydraulic properties of the surficial aquifer. The Pilot Study will consist of an injection of sodium permanganate into the transition zone and sodium bromide into the shallow zone followed by 12 weeks of performance monitoring.

The objectives of the Pilot Study include the following:

1. Collect groundwater samples from the new and existing monitoring wells within the Pilot Study focus area prior to injection to establish baseline conditions.

2. Inject sodium permanganate into existing transition zone monitoring well SAIC-10.

3. Inject Sodium Bromide into the Existing Shallow Monitoring Well SAIC-16.

4. Perform monitoring activities over a 12-week period to evaluate the distribution of the bromide and sodium permanganate. Groundwater samples will be collected from monitoring wells within the Pilot Study focus area at weeks 1, 2, 4, 8, and 12 for a total of five monitoring events.

A.3.2 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

An analytical DQO summary for this supplemental investigation is presented in Table A-2. All QC parameters stated in the specific EPA SW-846 methods (EPA 1997) [i.e., percent recoveries] will be adhered to for each chemical listed. Laboratories are required to comply with all methods as written; recommendations are considered to be requirements.

In accordance with the new EPA guidance (EPA 1993), which now supersedes all other documents in this discipline, the previously used analytical Levels I through V have been changed. These levels are now divided into two categories: (1) screening data with definitive confirmation (replaces Levels I and II), and (2) definitive data (replaces Levels III, IV, and V). Definitive data represent data generated under laboratory conditions using EPA-approved procedures. Data of this type, both qualitative and quantitative, are used for determination of source, extent, or characterization and to support evaluation of remedial technologies.

Table A-2. DQO Summary for the Pilot Study at the Former CAMP Site

Data Use	Sample Type	Analytical Method	Precision (RPD)[a]		Accuracy Laboratory (MS)	Completeness
			Field Dups	Lab Dups		
Screening	Discrete	FID/PID volatile organics	NA	NA	± 0.1 ppm	95%
Determination of basic water characteristics	Discrete	EPA-120.1 conductivity	<10 RPD	NA	± 0.1 µmhos/cm	95%
		EPA-150.1 pH	<10 RPD	NA	± 0.1 s.u.	95%
		EPA-170.1 temperature	<10 RPD	NA	± 0.1ºC	95%
		Turbidity meter	<10 RPD	NA	NA	95%
		Redox potential	<10 RPD	NA	NA	95%
		Dissolved oxygen EPA-360.1	<10 RPD	NA	± 0.1 ppm	95%
Confirmation of contamination extent	Discrete	SW-8260B/5030 Volatile organics	<30 RPD	<20 RPD	70–130% recovery	90%
		SW-6010B/6020/7000 Series TAL metals	<30 RPD	<20 RPD	75–125% recovery	90%
		Chloride	<30 RPD	<20 RPD	75–125% recovery	90%
		Bromide	<30 RPD	<20 RPD	75-125% recovery	90%
		COD	<30 RPD	<20 RPD	75–125% recovery	90%
IDW	Composite	All analytes	<30 RPD	<20 RPD	50–150% recovery	90%

[a]Relative percent differences at values within five times the quantitation level comparison are acceptable if values are plus or minus two times the quantitation level.
Anions = Alkalinity, chloride, sulfate.
COD = Chemical oxygen demand.
FID = Flame ionization detector.
IDW = Investigation-derived waste.
MS = Matrix spike.
NA = Not applicable.
PID = Photoionization detector.
Redox = Oxidation-reduction potential.
RPD = Relative percent difference.
TAL = Target Analyte List.

General analytical objectives for this work are as listed below:

- To analyze samples using well-defined methods that will provide confident detection limits that are accurate enough to determine the presence or absence of target analytes.
- To define precision and accuracy goals for data to provide defensible data.
- To specify QA/QC procedures for both field and laboratory methodology to meet the USACE guidance document requirements.

A.3.2.1 Level of Quality Control Effort

It is anticipated that the Pilot Study activities will produce groundwater and investigation-derived waste samples for analyses. Additional samples will be collected to complete field QC duplicate, and field blank sample analyses. Specific numbers of samples are shown on Table A-1. Tables 3, 4, and 5 of Addendum No. 1 to the original QAPP provide the project quantitation and action levels for the target analytes of the pilot study. However, Tables 3 and 4 of Addendum No. 1 to the original QAPP have been revised to include updated action levels for several constituents. Tables 3 and 4 are included as Attachment A. The only analyte not previously included in the original QAPP nor Addendum No. 1 to the QAPP is bromide. Therefore, Table A-3 provides the project quantitation and action levels for bromide. Sampling procedures are discussed in detail in Chapter 4 of the FSP addendum. The Pilot Study activities have not affected the remaining sections of the QAPP that include analytical procedures, sample custody and holding times, calibration procedures and frequency, QC checks, calculation of data quality indicators, corrective actions, data reduction, validation, and reporting, preventive maintenance procedures, performance and system audits, and QA reports. These sections are discussed in detail in the original project QAPP (SAIC 2001).

Table A-3. Project Quantitation and Action Levels for Bromide in Water Using EPA Methods 300

Compound	CAS Registration Number	Practical Quantitation Level (PQL) (mg/L)	Federal SDWA MCL[a] (mg/L)	NC GW Standards[b] (mg/L)
Bromide	7647-15-6	0.1	N/A	N/A

[a]U.S. Environmental Protection Agency Safe Drinking Water Act (SDWA) maximum contaminant level (MCL).
[b]North Carolina (NC) Groundwater (GW) Standards, Subchapter 2L (Title 15A, Section: 0200).

A.3.2.2 Accuracy, Precision, and Sensitivity of Analysis

Please refer to Section 3.2.2 of Addendum No. 1 to the QAPP (SAIC 2002).

A.3.2.3 Completeness, Representativeness, and Comparability

Please refer to Section 3.2.3 of Addendum No. 1 to the QAPP (SAIC 2002).

A.4 SAMPLING LOCATIONS AND PROCEDURES

All sampling procedures are fully discussed in Section 4.0 of the original QAPP (SAIC 2001). Locations to be sampled during the pilot study are fully discussed in Section 4.0 of the FSP.

A.5 SAMPLE CUSTODY AND HOLDING TIMES

A discussion of sample custody and holding times are presented in Section 5.0 of the original QAPP.

A.6 ANALYTICAL PROCEDURES

A discussion of all analytical procedures are presented in Section 6.0 of the original QAPP

A.7 CALIBRATION PROCEDURES AND FREQUENCY

A discussion of all calibration procedures and frequency are presented in Section 7.0 of the original QAPP.

A.8 INTERNAL QUALITY CONTROL CHECKS

A discussion of all internal quality control checks are presented in Section 8.0 of the original QAPP.

A.9 CALCULATION OF DATA QUALITY INDICATORS

A discussion of calculations of data quality indicators is presented in Section 9.0 of the original QAPP.

A.10 CORRECTIVE ACTIONS

A discussion of corrective actions is presented in Section 10.0 of the original QAPP.

A.11 DATA REDUCTION, VALIDATION, AND REPORTING

A discussion of data reduction, validation, and reporting is presented in Section 11.0 of the original QAPP.

A.12 PREVENTIVE MAINTENANCE PROCEDURES

A discussion of preventive maintenance procedures is presented in Section 12.0 of the original QAPP.

A.13 PERFORMANCE AND SYSTEM AUDITS

A discussion of performance and system audits is presented in Section 13.0 of the original QAPP.

A.14 QUALITY ASSURANCE REPORTS TO MANAGEMENT

A discussion of quality assurance reports to management is presented in Section 14.0 of the original QAPP.

A.15 REFERENCES

EPA (U.S. Environmental Protection Agency) 1993. *Data Quality Objectives Process*, EPA-540-R-93-071, September.

EPA 1997. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, 3rd edition, Revision 1, Update 2.

SAIC (Science Applications International Corporation) 2001. *Sampling and Analysis Plan for the Feasibility Study/Remedial Design at the Former Charlotte Army Missile Plant (CAMP), Mecklenburg County, Charlotte, North Carolina*.

SAIC 2002. *Addendum No. 1 to the Sampling and Analysis Plan for the Feasibility Study/Remedial Design at the Former Charlotte Army Missile Plant (CAMP), Mecklenburg County, Charlotte, North Carolina*.

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ATTACHMENT A

REVISED TABLES 3 AND 4 OF ADDENDUM NO. 1 TO THE QAPP

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Table 3. Project Quantitation and Action Levels for Volatile Organic Compounds in Soil and Water Using SW-846 Methods 8260B/5030 and 8260B/5035 (GC/MS)

Compound	CAS Registration Number	Practical Quantitation Level (PQL) Water (µg/L)	Federal SDWA MCL[a] (µg/L)	NC GW Standards[b] (µg/L)	PQL Soil[c] (µg/kg)
1,1,1-Trichloroethane	71-55-6	1	200	200	5
1,1,2,2-Tetrachloroethane	79-34-5	1	--	--	5
1,1,2-Trichloroethane	79-00-5	1	5	--	5
1,1-Dichloroethane	75-35-3	1	--	700	5
1,1-Dichloroethene	75-34-4	1	7	7	5
1,2-Dibromoethane	106-93-4	1	--	--	5
1,2-Dichloroethane	107-06-2	1	5	0.38	5
1,2-Dichloroethene (total)	540-59-0	1	--	--	5
1,2-Dichloropropane	78-87-5	1	5	0.56	5
2-Butanone	78-93-3	10	--	--	20
2-Hexanone	591-78-6	10	--	--	20
4-Methyl-2-pentanone	108-10-1	10	--	--	20
Acetone	67-64-17	10	--	700	20
Benzene	71-43-2	1	5	1	5
Bromochloromethane	74-97-5	1	--	--	5
Bromodichloromethane	75-27-4	1	--	0.56	5
Bromoform	75-25-2	1	--	0.19	5
Bromomethane	74-83-9	1	--	--	5
Carbon disulfide	75-15-0	1	--	700	5
Carbon tetrachloride	56-23-5	1	5	0.3	5
Chlorobenzene	108-90-7	1	100	50	5
Chloroethane	75-00-3	1	--	2,800	5
Chloroform	67-66-3	1	--	0.19	5
Chloromethane	74-87-3	1	--	2.6	5
Cis-1,3-Dichloropropene	10061-01-5	1	--	--	5
Dibromochloromethane	124-48-1	1	--	--	5
Ethylbenzene	100-41-4	1	700	29	5
Methylene chloride	75-09-2	1	--	5	5
Styrene	100-42-5	1	100	100	5
Tetrachloroethene	127-18-4	1	5	0.7	5
Toluene	108-88-3	1	1,000	10000	5
Trans-1,3-Dichloropropene	10061-02-6	1	--	--	5
Trichloroethene	79-01-6	1	5	2.8	5
Vinyl chloride	75-01-4	1	2	0.015	5
Xylenes (total)	1330-2-7	2	10,000	530	10

[a]U.S. Environmental Protection Agency Safe Drinking Water Act (SDWA) maximum contaminant level (MCL).
[b]North Carolina (NC) Groundwater (GW) Standards, Subchapter 2L (Title 15A, Section: 0200).
[c]Action levels for volatile organic compounds (VOCs) detected in soil and sediment samples will be determined during the preparation of the Feasibility Study report.
Note: Specific quantitation limits are highly matrix dependent; project reporting levels listed here are goals and may not always be achievable. Due to the high inaccuracy and imprecision of values observed between the laboratory method detection levels and these project reporting levels, values estimated below these reporting levels will not be reported.
CAS = Chemical Abstracts Service.
GC = Gas chromatography.
MS = Mass spectrometry.
PQL = Practical Quantitation Level.

Table 4. Project Quantitation and Action Levels for Metals in Soils and Waters Using SW-846 Methods 6010B, 6020, or 7000 Series

Compound	CAS Registration Number	Practical Quantitation Level (PQL) Water (µg/L)	Federal SDWA MCL[a] (µg/L)	NC GW Standards[b] (µg/L)	PQL Soil[c] (mg/kg)
Aluminum	7429-90-5	100	50[d]		10
Antimony	7440-36-0	5	6		0.5
Arsenic	7440-38-2	5	10	10	0.5
Barium	7440-39-3	10	2,000	2,000	1
Beryllium	7440-41-7	1	4		0.1
Cadmium	7440-43-9	1	5	5	0.1
Calcium	7440-70-2	100			10
Chromium	7440-47-3	5	100	50	0.5
Cobalt	7440-48-4	5			0.5
Copper	7440-50-8	5	1,300[d]	1,000	0.5
Iron	7439-89-6	100	300	300	10
Lead	7439-92-1	3	15	15	0.3
Magnesium	7439-95-4	100			10
Manganese	7439-96-5	10	50[d]	50	1
Mercury	7439-97-6	0.2	2	1.1	0.1
Nickel	7440-02-0	10	100	100	1
Potassium	7440-09-7	200			20
Selenium	7782-49-2	5		50	0.5
Silver	7440-22-4	5	100[d]	18	0.5
Sodium	7440-22-4	200			20
Thallium	7440-28-0	2	2		0.2
Vanadium	7440-62-2	10			1
Zinc	7440-66-6	10	5,000[d]	2,100	1

[a]U.S. Environmental Protection Agency Safe Drinking Water Act (SDWA) maximum contaminant level (MCL).
[b]North Carolina (NC) Groundwater (GW) Standards, Subchapter 2L (Title 15A, Section: 0200).
[c]Action levels for metals detected in soil and sediment samples will be determined during the preparation of the Feasibility Study report.
[d]U.S. Environmental Protection Agency SDWA MCL Secondary Standard.
Note: Specific quantitation limits are highly matrix dependent; project reporting levels listed here are goals and may not always be achievable. Due to the high inaccuracy and imprecision of values observed between the laboratory method detection levels and these project reporting levels, values estimated below these reporting levels will not be reported.
CAS = Chemical Abstracts Service.
PQL = Practical Quantitation Level.

APPENDIX B

INJECTION PERMIT APPROVAL

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Michael F. Easley, Governor

William G. Ross Jr., Secretary
North Carolina Department of Environment and Natural Resources

Alan W. Klimek, P.E. Director
Division of Water Quality

December 9, 2004

Zainul Kidwai
United States Army Corps of Engineers-Savannah District
100 West Oglethorpe Avenue
Savannah, GA 31401

RE: Former Charlotte Army Missile Plant (CAMP)

Dear Mr. Kidwai:

The Underground Injection Control Group of the Aquifer Protection Section of the Division of Water Quality has reviewed the permit application for injection of Sodium Permanganate, received on December 2, 2004. The proposed injection project as presented in the work plan meets relevant state regulatory requirements (15A NCAC 2C.0200) for construction and operation of injection wells, provided that one shallow zone monitoring well and one transition zone monitoring well are sampled for RCRA metals prior to and after injection. Monitoring well SAIC-20, in the transition zone, and SAIC-22, in the shallow zone, are to be sampled for Arsenic, Barium, Chromium, Cadmium, Lead, Mercury, Silver, and Selenium prior to injection and again eight weeks after injection.

Due to the site's coverage under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the state's administrative permitting requirements have been waived for this project. A technical report summarizing the project and including monitoring data should be submitted to the UIC Program upon completion of the injection project.

If you have any questions regarding this letter or the UIC Program, please call me at (919) 715-6182.

Sincerely,

Evan O. Kane, P.G.
Underground Injection Control Program Manager

cc: Art Shacter, Division of Waste Management
Aquifer Protection Section – Mooresville Regional Office
~~cc: UIC file~~

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