ARF-021399

March 7, 2018 **SRNS-J2000-2018-00155**

Ms. Marissa Krein
University of South Carolina – Aiken
Gregg - Graniteville Library
471 University Parkway
Aiken, SC 29801

Ms. Fay Verburg
Reese Library Govt. Section
Augusta University
2500 Walton Way
Augusta, Georgia 30904-2200

Mr. Bill Sudduth
Government Information Dept.
Thomas Cooper Library
University of South Carolina
1322 Greene Street
Columbia, South Carolina 29208

Ms. Margaret Ilugbo-Hunter
Asa H. Gordon Library
Savannah State University
2200 Tompkins Road
Savannah, Georgia 31404

READING ROOM FOR REMOVAL SITE EVALUATION REPORT/ENGINEERING EVALUATION/COST ANALYSIS (RSER/EE/CA) FOR C-AREA GROUNDWATER OPERABLE UNIT (U) SRNS-RP-2017-00365, REVISION 1, FEBRUARY 2018, CERCLIS NUMBER 82.

Please make the above document available to the General Public for a minimum of **30** days for **public comment** beginning **March 13, 2018 thru April 11, 2018** after which time it may be discarded.

Please acknowledge receipt of the document by email at Ruth.Douglas@srs.gov.
If you have any questions, please call me at (803) 952-7589, or e-mail me at above address.

Sincerely,

Ruth Douglas
EC & ACP Records
730-4B, Room 135A
Savannah River Site
Aiken, S.C. 29808

Acknowledgment/Date

EC: Janet Griffin
ERD C-Reactor Groundwater
ACP DCC Correspondence File

ADMINISTRATIVE RECORD FILE

READING ROOM FOR THE

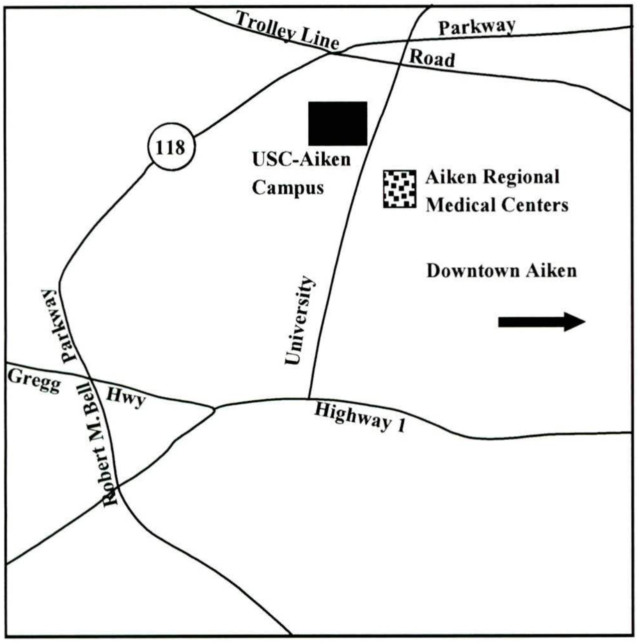
REMOVAL SITE EVALUATION REPORT/ENGINEERING EVALUATION/COST ANALYSIS (RSER/EE/CA) FOR C-AREA GROUNDWATER OPERABLE UNIT (U) SRNS-RP-2017-00365, REVISION 1, FEBRUARY 2018, CERCLIS NUMBER 82

Please make the above document available to the general public for review for a minimum of Thirty (30) days, beginning March 13, 2018 through April 11, 2018 at which time it may be discarded.

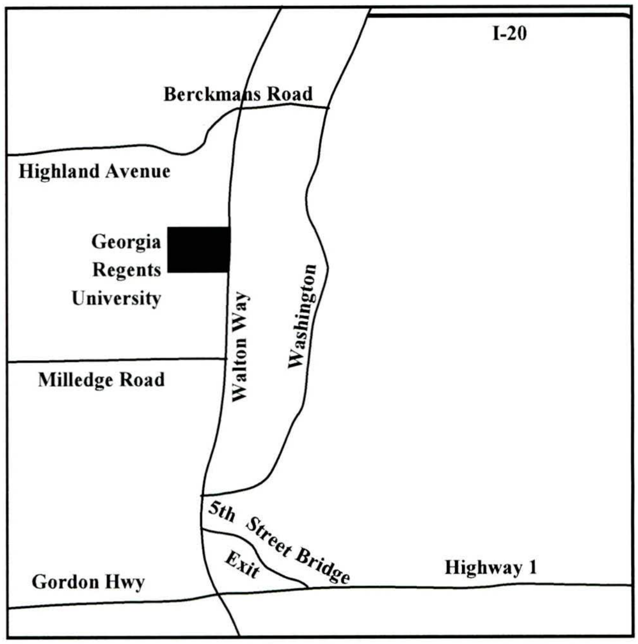
If you have any questions, please contact:

Janet Griffin
Savannah River Nuclear Solutions, LLC
Savannah River Site
Building 730-1B
Aiken, SC 29808
1-(803) 952-8467
e-mail: janet.griffin@srs.gov

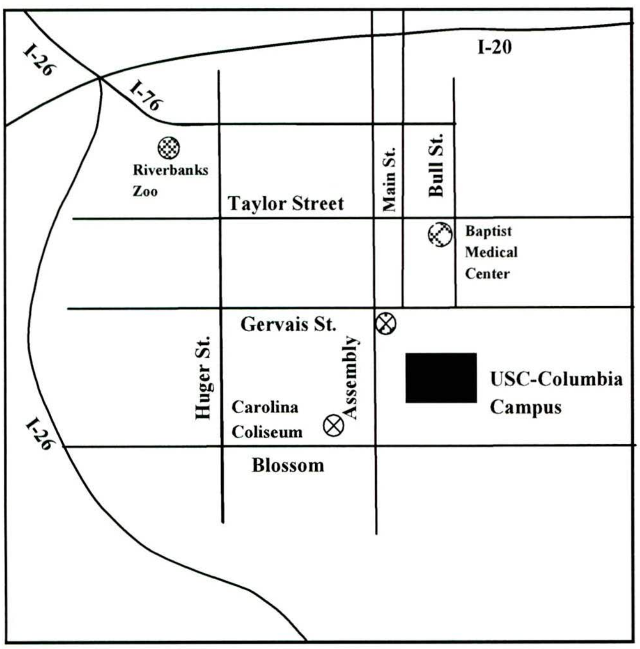
INFORMATION REPOSITORIES



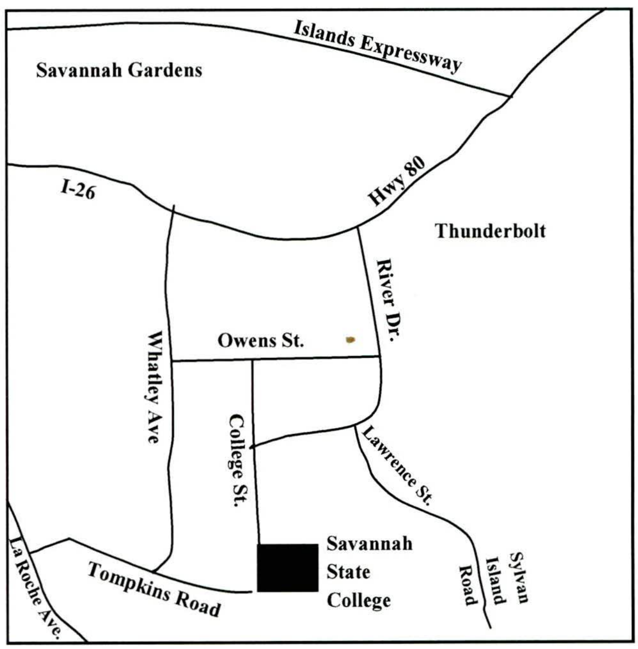
Aiken Information Repository
U.S. Department of Energy
Public Reading Room
USC-Aiken Campus



Augusta Information Repository
Reese Library
Augusta University



Columbia Information Repository
Thomas Cooper Library
University of South Carolina



Savannah Information Repository
Asa H. Gordon Library
Savannah State College

Definitions:

Each entry in this Administrative Record File contains the following information:

ARF/IRF Catalog Number: A unique number assigned to each document or piece of information. This number appears in the upper right hand corner of the document.

Date: The date the document or information was issued.

Document Number: Many of the documents published or produced by SCDHEC, EPA and SRS are assigned unique numbers. If no document number has been assigned, the Catalog Number is used.

Title: The title of the document, or a brief description of the contents.

Author: The person or party responsible for the issuance or writing of the document or information.

Author Affiliation: The organization that the author works for or is affiliated with.

Addressee: In most cases this entry will be blank except if the document is correspondence. The entry in that case will be the organization(s) to which the Addressee is affiliated.

Appx. No. of Pages: The approximate number of pages the document contains.

Classification: The entry will contain one of the two following codes.

> U: The information is unclassified and available to the general public for viewing.
>
> **CP:** The information or document is considered confidential or privileged. The document may contain sensitive information and is not available to the general public. It may be included in an Administrative Record File as it was used to support the decision making, but cannot be made publicly available.

File Type: One of the following codes will be entered in this area:

> **ARF**: This document is included in the Administrative Record File.or Administrative Record for the unit. The document is physically located either in hard copy or on cd and is available to the general public for viewing and/or copying.

ARF-BRO: This document is included in the Administrative Record File or Administrative Record for the unit. The document will not be on cd because it is classified or privileged information, protected by copy-right laws, or is publicly available technical literature not generated for the unit at issue (i.e.; an engineering textbook).

IRF: This document is provided for information only. It is not used in the decision making process for the unit. It is physically located either in hardcopy or on cd and is available to the general public for viewing and/or copying.

IRF-BRO: This document is listed for information only. It was not used in the decision making process for the unit. It will not be microfilmed because it is protected by copyright laws or is publicly available.

Compact Disk (CD) Number: A typical entry is 101. The document associated with that catalog number is located on that cd in pdf format.

Savannah River
NUCLEAR SOLUTIONS℠
FLUOR • NEWPORT NEWS NUCLEAR • HONEYWELL

Removal Site Evaluation Report/Engineering Evaluation/Cost Analysis (RSER/EE/CA) for C-Area Groundwater Operable Unit (U)

CERCLIS Number: 82

SRNS-RP-2017-00365

Revision 1

February 2018

DISCLAIMER

Printed in the United States of America

Prepared for
U.S. Department of Energy
and
Savannah River Nuclear Solutions, LLC
Aiken, South Carolina

EXECUTIVE SUMMARY

The U.S. Department of Energy (USDOE) is proposing to perform a non-time critical (NTC) removal action at the C-Area Groundwater (CAGW) Operable Unit (OU) to address the trichloroethylene (TCE) discharging to an unnamed tributary to Castor Creek above maximum contaminant levels (MCLs). This Removal Site Evaluation Report/Engineering Evaluation/Cost Analysis (RSER/EE/CA) addresses the NTC removal action associated with the CAGW OU and has been developed to combine the reporting requirements of 40 Code of Federal Regulations (CFR) Section 300.410 Removal Site Evaluation and 40 CFR Section 300.415 Removal Action.

The primary source of the TCE groundwater contamination in the CAGW OU is due to releases associated with reactor operations. Characterization from 1998 to 2002 found TCE in the vadose zone soils near the C-Area Reactor Building (105-C) and in the groundwater above its maximum contaminant level (MCL) of 5 micrograms per liter (μg/L). The CAGW OU TCE groundwater plume extends south from the C-Area Reactor Building (105-C) to Castor Creek and an unnamed tributary to Castor Creek. The surface water in the unnamed tributary exceeds the MCL (5 μg/L) for TCE.

The United States Environmental Protection Agency (USEPA), South Carolina Department of Health and Environmental Control (SCDHEC), and USDOE have agreed that the CAGW OU is a candidate for an early action to reduce risk to human health and the environment. The elevated levels of TCE in the groundwater meet the criteria in 40 CFR Section 300.415(b) (2) (i): *Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants.*

The scope of the RSER/EE/CA NTC removal action is to treat the contaminated groundwater in the distal portion of the CAGW OU TCE plume that exceeds the MCL for TCE prior to discharge into the unnamed tributary, thereby reducing TCE concentrations in surface water to below the MCL.

These three removal action alternatives are evaluated in detail in this RSER/EE/CA:

- Alternative 1 – No Action;
- Alternative 2 – Treatment Barrier Using Emulsified Edible Oil; and
- Alternative 3 – In situ Chemical Oxidation Using Sodium Persulfate.

The table below summarizes the results from the alternative evaluation.

Alternative	Effectiveness	Implementability	Cost
Alternative 1: No Action	Low	Easy	$0
Alternative 2: Treatment Barrier Using Emulsified Edible Oil	High	Easy-Moderate	$1,317,066
Alternative 3: ISCO Using Sodium Persulfate	Moderate	Easy-Moderate	$1,707,034

The preferred action is Alternative 2, Treatment Barrier Using Emulsified Edible Oil for the distal portion of the CAGW OU TCE groundwater plume. A mixture of emulsified edible oil, water and buffer solution would be injected into the groundwater at the areas of highest TCE concentrations in the distal portion of the CAGW OU TCE groundwater plume. The emulsified edible oil would provide a carbon source for the microbes already present within the area that will aid in the biodegradation of the TCE. The emulsified oil also acts to adsorb the TCE as the water flows through the injection zone, thus reducing TCE transport. This alternative will not preclude any additional remediation of the CAGW OU and is expected to be consistent with the expected final remedial actions at the CAGW OU.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS AND ACRONYMS

%	percent
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
C_2HCl_3	trichloroethylene
CAGW	C-Area Groundwater
CAOU	C-Area Operable Unit
CBRP	C-Area Burning/Rubble Pit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Cl^-	chloride ion
cm/yr	centimeters per year
CO_2	carbon dioxide
DCE	dichloroethylene
DPT	direct push technology
EE/CA	Engineering Evaluation/Cost Analysis
ERH	Electrical Resistance Heating
FFA	Federal Facility Agreement
ft	feet
ft^2	square feet
ft^3	cubic feet
ft/yr	feet per year
GA	Gordon Aquifer
GCU	Gordon Confining Unit
H^+	hydrogen ion
in./yr	inches per year
ISCO	in situ chemical oxidation
km	kilometer
km^2	square kilometer
LAZ	Lower Aquifer Zone
LLC	Limited Liability Company
m	meter
m^2	square meters
m^3	cubic meters
m/yr	meters per year
MAZ	Middle Aquifer Zone
MCL	maximum contaminant level
µg/L	micrograms per liter
mi	mile
mi^2	square mile
mrem	millirem or one one-thousandth of a rem. (1,000 mrem = 1 rem)
msl	mean sea level

LIST OF ABBREVIATIONS AND ACRONYMS *(Continued/End)*

$Na_2S_2O_8$	sodium persulfate
$NaHCO_3$	sodium bicarbonate
NaOH	sodium hydroxide
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NTC	non-time critical
OU	operable unit
pCi/mL	picocuries per milliliter
RCRA	Resource Conservation and Recovery Act
rem	roentgen equivalent man, a unit of radiation dose
RFI	RCRA Facility Investigation
RI	Remedial Investigation
RSER	Removal Site Evaluation Report
SCDHEC	South Carolina Department of Health and Environmental Control
SO_4^{-2}	sulfate ion
SRNS	Savannah River Nuclear Solutions, LLC
SRS	Savannah River Site
SVE	Soil Vapor Extraction
TBC	to be considered
TCCZ	Tan Clay Confining Zone
TCE	Trichloroethylene
TZ	Transmissive Zone
USDOE	U.S. Department of Energy
USEPA	U.S. Environmental Protection Agency
UTRA	Upper Three Runs Aquifer
VOC	Volatile Organic Compound
WSRC	Washington Savannah River Company LLC (October 2005-present)
WSRC	Westinghouse Savannah River Company LLC (before October 2005)
yr	year

1.0 INTRODUCTION

The U.S. Department of Energy (USDOE) is proposing to perform a non-time critical (NTC) removal action at the C-Area Groundwater (CAGW) Operable Unit (OU) to address the trichloroethylene (TCE) discharging to an unnamed tributary to Castor Creek above maximum contaminant levels (MCLs). This Removal Site Evaluation Report (RSER)/Engineering Evaluation/Cost Analysis (EE/CA) identifies the objectives of the NTC removal action for the CAGW OU and describes alternatives that address the potential threat from TCE contaminated groundwater and provides a vehicle for public comment in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Section 300.415.

The Savannah River Site (SRS) encompasses 803 square kilometers (km^2) (310 square miles [mi^2]) of land adjacent to the Savannah River, principally in Aiken and Barnwell counties of South Carolina. SRS is located approximately 40-kilometers (km) (25-miles [mi]) southeast of Augusta, Georgia, and 32-km (20-mi) south of Aiken, SC (Figure 1). SRS is owned by USDOE while Savannah River Nuclear Solutions, LLC (SRNS) provides management and operating services. SRS has historically produced tritium, plutonium, and other special nuclear materials for national defense. Chemical and radioactive wastes are by-products of nuclear material production processes. Hazardous substances, as defined by Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), are present in the SRS environment.

The public is encouraged to comment on the alternatives presented in this RSER/EE/CA. Following the public comment period, an Action Memorandum will be prepared by USDOE and added to the SRS Administrative Record, which is accessible by the public. All responses to the public comments will be included in an Action Memorandum.

Copies of this RSER/EE/CA and the Administrative Record for SRS are available at the following locations:

U.S. Department of Energy
Public Reading Room
Gregg Graniteville Library
University of South Carolina-Aiken
471 University Parkway
Aiken, South Carolina 29803 (803) 641–3504

Thomas Cooper Library
Government Information and Maps Department
University of South Carolina
1322 Green Street
Columbia, SC 29208 (803) 777–4841

Hard copies of this RSER/EE/CA are available at the following locations:

Reese Library
Government Information Department
Augusta University
2500 Walton Way
Augusta, GA 30904 (706) 737–1744

Asa H. Gordon Library
Savannah State University
2200 Tompkins Road
Savannah, GA 31404 (912) 358–4324

To submit comments or request a public meeting during the public comment period, contact:

Janet Griffin
Savannah River Nuclear Solutions, LLC
Public Involvement
Savannah River Site
Building 730–1B
Aiken, South Carolina 29808 (803) 952-8467
janet.griffin@srs.gov

2.0 SITE CHARACTERIZATION

2.1 Site Description and Background

The C Area is situated near the center of the SRS (Figure 2). The primary SRS operation facility in C Area was the C-Reactor, which operated between 1955 and 1985. Known sources such as the C-Reactor Seepage Basins (904-66G, -67G, -68G), C-Reactor Area TCE Vadose Zone Source, C-Reactor Purification Area Tritium Source, and non-specified sources associated with reactor operations have resulted in tritium and volatile organic compounds (VOCs) contamination to groundwater.

The CAGW OU is located in the Fourmile Branch watershed and encompasses groundwater beneath C Area, which flows west to Fourmile Branch and south to Castor Creek (Figure 3). VOC contamination in the Twin Lakes area is associated with releases from the C-Area Burning/Rubble

Pit (CBRP) and comingled with the northern tritium plume. However, the CBRP OU TCE plume is being remediated by monitored natural attenuation as part of the final remedy for the CBRP OU, and is not part of the CAGW OU scope. Figure 4 shows the outline of the CBRP OU Boundary (green), and its relationship to the CAGW OU Boundary (brown). Groundwater flow is generally towards the west and southwest from the C-Reactor area. The nature and extent of groundwater contamination within the CAGW OU has been comprehensively investigated using groundwater monitoring wells and direct-push technology (DPT) samples, as documented in 2004 in the Resource Conservation and Recovery Act (RCRA) Facility Investigation/Remedial Investigation (RFI/RI) Report (WSRC 2004b) (Figure 4). The remediation of the CAGW OU is being addressed under CERCLA and its disposition is under consideration. CAGW OU includes a VOC groundwater plume containing primarily TCE with minor quantities of tetrachloroethylene, and a larger tritium groundwater plume.

A *Corrective Measures Study/Feasibility Study Report for the C-Reactor Groundwater Operable Unit (U)* (WSRC 2005) was approved by the South Carolina Department of Health and Environmental Control (SCDHEC) and U.S. Environmental Protection Agency (USEPA) in 2005. An interim action to address TCE in the vadose zone source area was successfully implemented in 2006. A Statement of Basis/Proposed Plan (SRNS 2011), proposing monitored natural attenuation for the CAGW OU, was submitted in April 2011. Agreement on the final remedy could not be reached; however, the Core Team (i.e., representatives from the USDOE, USEPA and SCDHEC) agreed to continue groundwater monitoring and annual reporting for the CAGW OU in support of a future final remedial action. During an interactive scoping process in December 2016 and July 2017, the Core Team identified the distal portion of the CAGW TCE groundwater plume as a candidate for a NTC removal action.

2.2 Previous Action

A single six-phase electrical resistance heating (ERH) array was used to target the C-Reactor Area TCE Vadose Zone Source. The ERH array included six input electrodes with soil vapor extraction (SVE) wells equally spaced around the circumference of a 9.15-meter (m) (30-foot [ft]) diameter circle and a central neutral electrode/SVE well centered on the highest TCE levels in the vadose zone (WSRC 2007). ERH uses the electrical resistance of the soil to heat the soil in situ by passing an electrical current through the soil. The heat vaporizes VOCs in the soil. These vapors are withdrawn by an SVE system, treated and discharged per an air quality control permit (WSRC 2004a). Soil cores collected after the completion of the vadose zone interim action in 2006 and in 2011 verified TCE had been significantly reduced in the vadose zone source area.

2.3 Land Use

The CAGW OU sources are located within an industrial use area, but the distal portion of the plume extends beyond the industrial use boundary. Land use of the entire CAGW OU area will be controlled consistent with the SRS Land Use Control Assurance Plan (WSRC 1999) to prevent use of groundwater or surface water that exceeds MCLs. The Upper Three Runs Aquifer (UTRA), which is the aquifer where the plumes are located, is not currently used as a drinking water source at SRS.

2.4 Environmental Setting

The CAGW OU groundwater plumes originate in C-Area, extend to the south discharging into Castor Creek and extend to the west discharging into Fourmile Branch within the Fourmile Branch watershed (Figure 3). Local relief ranges from 88.5-m (290-ft) mean sea level (msl) in C-Area to 47-m msl (154-ft msl) at the confluence of Fourmile Branch and Castor Creek. Fourmile Branch discharges into the Savannah River floodplain and associated swamps about 10.6-km (6.6-mi) downstream from its confluence with Castor Creek.

The 30 year (yr) average (1983 – 2013) rainfall for SRS is 118.64 centimeters per year (cm/yr) (46.71 inches per year [in./yr]), based on data from the 773-A rain gauge (SRNL 2016a). Recent (2015-2016) annual rainfall totals have been about average (SRNL 2016b). The average groundwater recharge is estimated at 31.75 cm/yr (12.5 in./yr), while the remainder is lost to evapotranspiration or run-off to surface water (WSRC 2000).

The Floridan aquifer system is the aquifer system of concern within the CAGW OU. The Floridan aquifer system is divided into two aquifer units separated by a confining unit. From top to bottom, these three units are known as the UTRA, the Gordon Confining Unit (GCU), and the Gordon Aquifer (GA) (Aadland 1995). In the CAGW OU, contamination is only found in the UTRA. The

UTRA is divided into three aquifer zones. From top to bottom they are known as the Transmissive Zone (TZ), Middle Aquifer Zone (MAZ), and Lower Aquifer Zone (LAZ). The TZ and LAZ are divided by an informal aquitard referred to as the "Tan Clay Confining Zone" (TCCZ), while the MAZ resides as a sandy formation within the TCCZ. Near the C-Reactor Building (105-C), the water table is in the TZ, but it descends into the MAZ near Castor Creek and Fourmile Branch. The hydrostratigraphy is shown on Figure 5, which is a cross section from C Area to Castor Creek in the direction of groundwater flow.

2.5 Nature and Extent of Contamination

The CAGW OU includes a groundwater subunit and a surface water subunit. The Groundwater Subunit consists of two plumes: (a) a southern TCE and tritium plume originating near the Reactor Building (105-C), and extending west to Fourmile Branch and south to Castor Creek, and (b) a northern tritium plume in the vicinity of the Twin Lakes drainage, originating near the Retention Basin for 100-C Containment (904-89G), and extending to Fourmile Branch. By 2016, the northern tritium plume had decayed to below the MCL (20 picocuries per milliliter [pCi/mL]) in all wells, except at well CRP 5C (20.3 pCi/mL). The southern tritium plume exceeds MCLs extending to Castor Creek, but is not the focus of the NTC removal action and will continue to be monitored on an annual basis.

Groundwater was extensively characterized from 1998 to 2002 and documented in the RFI/RI report (WSRC 2004b). The well and DPT locations are shown in Figure 4 with the 2002 TCE plume extent. The potential sources have been investigated as part of the CAOU, with only the C-Reactor Area TCE Vadose Zone Source identified near the C-Reactor Building (105-C) Assembly Area. A narrow portion of the plume extending westward from the C-Reactor Building (105-C) Assembly Area exceeded 1,000 micrograms per liter (µg/L).

The 2016 CAGW OU TCE plume has a small area above 100 µg/L near the C-Area Reactor Building (105-C) in the UAZ of the UTRA, two wells exceeding 50 µg/L at the distal portion of the plume in the MAZ of the UTRA, and low levels of contamination in the middle of the plume (Figure 5 and Figure 6). Overall, The CAGW OU TCE groundwater plume greater than 5 µg/L covers an area of approximately 48.16 hectares (119 acres). The scope of the NTC removal action will address the distal portion of the CAGW OU TCE groundwater plume, which originates near the C-Area Reactor Building (105-C) and extends south to Castor Creek.

In 2017, TCE was above the TCE MCL (5.0 µg/L) in three surface water stations: CCT-03 (15 µg/L), CCT-02 (8.7 µg/L), and CCT-01 (13.0 µg/L). These three stations are located on a small unnamed tributary that discharges to Castor Creek. TCE is above the detection limit in Castor Creek, but has not been detected above MCL (5 µg/L) for TCE in Castor Creek. Detailed characterization of the discharge area of the plume demonstrates that the TCE contamination is limited to the MAZ, which is about 5 m (16 ft) thick in the discharge area. The current 2017 data are included on Figures 7 and 8, which indicate the margins of the TCE plume have shifted slightly towards the east. Groundwater flow between Road 3 and the bluff above the unnamed creek is estimated at 44 meters per year (m/yr) (145 feet per year [ft/yr]) and groundwater flow between the bluff and the unnamed creek is estimated at 321 m/yr (1,000 ft/yr). A study conducted by the South Carolina State University on Castor Creek in 2001 and 2003 identified partial TCE degradation through the detection of a TCE anaerobic breakdown product, cis-1,2-dichloroethylene (cis-1,2 DCE), along the seepline where TCE is entering Castor Creek. In 2017, cis-1,2-DCE was also detected (2.10 µg/L) in the unnamed tributary to Castor Creek, but below the MCL (70 µg/L). Seepline data collected from 2011 to 2016 verify some anaerobic biodegradation for TCE is occurring in the wetlands adjacent to Castor Creek.

3.0 REMOVAL ACTION SCOPE AND OBJECTIVES

The scope of the removal action is to reduce the TCE flux to surface water so that the MCL is no longer exceeded in the unnamed tributary to Castor Creek. This can be achieved through a TCE mass flux reduction of 75%, as the last three tributary sampling events have been less than 20 µg/L and are trending downward. The groundwater within the CAGW OU has been found to be contaminated with TCE exceeding the MCL (5 µg/L), based on upgradient wells CSB020C and CSB 15D. The distal portion of the CAGW OU TCE groundwater plume for this removal action covers an area of approximately 2,733 square meters (m^2) (29,418 square feet [ft^2]) and is located in the MAZ which is approximately 5-m (16-ft) thick in this area with an estimated porosity of 0.25. The TCE groundwater concentrations in this area are expected to exceed

50 μg/L (10 x MCL). The volume of groundwater (25% of total volume) to be treated in the distal portion of the TCE groundwater plume exceeding 50 μg/L is approximately 3,416 cubic meters (m^3) (120,643 cubic feet [ft^3]).

A monitoring plan specific to this removal action will be developed to demonstrate the effectiveness of the NTC removal action.

3.1 Justification for the Proposed Removal Action

USDOE, as lead agency, is mandated to take action to reduce the adverse effects of man-made contamination on human health and the environment. The NCP states that if the lead agency determines a release or potential release poses a threat to public health or welfare or the environment, the lead agency may take any appropriate removal action to abate, prevent, minimize, stabilize, mitigate, or eliminate the release or threat of release. The elevated levels of TCE in the groundwater meet the criteria in 40 CFR Section 300.415(b) (2) (i): *Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants.*

The July 2017 scoping meeting between USEPA, SCDHEC and USDOE identified the distal portion of the CAGW OU TCE groundwater plume (Figure 6) as a candidate for an early action to reduce risk to human health and the environment.

3.2 Removal Action Objectives

The removal action objective to protect human health and the environment is to reduce discharge of groundwater contaminated with TCE above MCLs to surface water so that the MCL (5 μg/L) is no longer exceeded in the unnamed tributary to Castor Creek.

This NTC removal action will reduce TCE concentrations discharging to surface water and support the final remedial action for the CAGW OU. There is no current or projected future use of groundwater or surface water as a drinking water source at the CAGW OU, and site access is currently controlled by SRS facility security and administrative controls. Site specific land use controls are expected to be part of the final remedial action for the CAGW OU.

4.0 Identification of Removal Action Alternatives

The following alternatives for the CAGW OU NTC removal action were examined:

- **Alternative 1 – No Action**: Groundwater at the CAGW OU remain untreated. The No Action alternative is required to be evaluated by the NCP.
- **Alternative 2 – Treatment Barrier Using Emulsified Edible Oil**: This alternative will focus on the distal portion of the TCE plume prior to discharge into the unnamed tributary and/or Castor Creek (Figure 7). Approximately ten DPT injection points will be used to create a treatment barrier in the MAZ with the emulsified edible oil in a transect perpendicular to the groundwater flow from the bluff top to the unnamed tributary to Castor Creek. Prior to final design of the injection layout, additional DPT samples will be collected along two transects as indicated in Figure 7. The location of the oil injection points will be based on the results from these DPT samples, so that the highest concentration portion of the plume is treated prior to discharge to surface water. At the location of the injection wells TCE is present above the MCL only in the MAZ, at an estimated concentration of 50 µg/L. The emulsified edible oil will act as a treatment barrier both by sequestering TCE at the injection point and enhancing the natural ability of the formation to biodegrade TCE between the point of injection and discharge to the unnamed tributary. As an organic contaminant, TCE preferentially partitions into the oil phase from the water phase. Previous data indicate that some natural biodegradation of TCE is occurring in groundwater based on the presence of cis-1,2 DCE, which is an anaerobic breakdown product of TCE. It is expected that the addition of emulsified oil will enhance this process, as the existing microorganisms will use the oil as a food source. However, the emulsified edible oil is not anticipated to migrate far from the injection points and is estimated to enhance TCE biodegradation for 3 to 5 years (USDOD 2010). Optimum pH for bioremediation is between 6 and 8 (USEPA 2016). The groundwater in the MAZ at this location is approximately 5, so a pH buffer will be used to increase the pH to 7 and optimize the reaction rate. The emulsified oil injection points will be spaced approximately 5-m (16-ft) apart. SRS plans to inject approximately 1,000 gallons of emulsified oil, 5 gallons of buffer solution (sodium bicarbonate and sodium hydroxide) and up to 5,000 gallons of water (if needed) per injection point. Groundwater samples will be collected prior to emulsified oil

injection in one upgradient and two downgradient monitoring wells to establish baseline conditions. These wells will be sampled after injection to monitor the effectiveness of the removal action. Following implementation of the removal action, regular monitoring of groundwater and surface water will occur for five years with an annual effectiveness monitoring report presenting the results. The cost of the Treatment Barrier for TCE using emulsified edible oil in groundwater (Alternative 2) is estimated at $1,317,066, including a five year operations and maintenance period.

- **Alternative 3 – In Situ Chemical Oxidation (ISCO) Using Sodium Persulfate**: The ISCO alternative will focus on the distal portion of the TCE plume prior to discharge into the unnamed tributary and/or Castor Creek (Figure 8). Approximately ten polyvinyl chloride injection wells will be installed perpendicular to groundwater flow along a bluff above the unnamed tributary. SRS plans to inject sodium persulfate solution and a buffer solution into each well to oxidize TCE in the groundwater. Prior to final design of the injection layout, additional DPT samples will be collected along two transects as shown in Figure 8. The location of the injection wells will be based on the results from these DPT samples, so that the highest concentration portion of the plume is treated prior to discharge to surface water. Sodium persulfate ($Na_2S_2O_8$) will oxidize TCE (C_2HCl_3) resulting in $2CO_2$, $9H^+$, $3Cl^-$ and $6SO_4^{-2}$ in groundwater. Sodium persulfate will also decompose at a rate of about 1% per day from the native soil oxygen demand in addition to consumption by reaction with TCE (EcoVac 2017) and typically actively degrades VOCs in groundwater for 3 to 4 months (NAVFAC 2010). Maximum TCE degradation occurs at a pH of 7 when compared to groundwater with a pH of 4 and a pH of 9 (Liang 2007). The groundwater in the MAZ at this location is approximately 5, so a pH buffer would be used to increase the pH to 7 and optimize the reaction rate. In addition, since the persulfate reaction produces acid, a buffer solution to balance this pH reduction is also required for this alternative. The sodium persulfate solution is anticipated to flow and spread with the groundwater from the injection points. The sodium persulfate injection wells will be spaced approximately 5-m (16-ft) apart. SRS plans to inject approximately 3,000 gallons of sodium persulfate and 700 gallons of buffer solution (sodium hydroxide) into each well. Two rounds of injections will be performed about six months apart.

Groundwater samples will be collected prior to the sodium persulfate injection to establish baseline conditions at one upgradient and two downgradient monitoring wells, which will be installed to monitor the effectiveness of the removal action. Following implementation of the removal action, regular monitoring of groundwater and surface water will occur for five years with an annual effectiveness monitoring report presenting the results. The cost of ISCO of TCE using sodium persulfate in groundwater (Alternative 3) is estimated at $1,707,034.

5.0 ANALYSIS AND COMPARISION OF REMOVAL ACTION ALTERNATIVES

Three removal action alternatives are presented in this RSER/EE/CA for evaluation. According to the NCP, the No Action Alternative, Alternative 1, must be evaluated as a baseline. Alternative 2, Treatment Barrier Using Emulsified Edible Oil, uses emulsified edible oil to act as a treatment barrier both by sequestering TCE at the injection point and enhancing the natural ability of the formation to biodegrade TCE between the point of injection and discharge to the unnamed tributary. Alternative 3, ISCO Using Sodium Persulfate, involves injection of sodium persulfate into the groundwater to oxidize (destroy) TCE.

Guidance on conducting NTC removal actions under CERCLA recommends that each alternative be reviewed against three broad criteria: effectiveness, implementability, and cost.

Regulatory acceptance and community acceptance are usually not known until after the comment period. However, during the alternative analysis, a judgment as to acceptance may be included based on previous regulatory decisions or on public comment to other related documents. The final impact of these modifying criteria can be assessed only after the public comment period and subsequent responses, if needed, are developed.

5.1 Effectiveness

Alternative 1, No Action, does not meet the effectiveness criteria. Leaving the distal portion of the CAGW OU TCE groundwater plume in place does not reduce the impact of TCE discharge to surface water or reduce the risk of potential contact with contaminated surface water and does not provide overall protection to the environment. This alternative does not contribute to a reduction of toxicity, mobility, or volume through treatment. The No Action Alternative is not effective in either the short-term or the long-term.

Alternative 2, Treatment Barrier Using Emulsified Edible Oil, meets the effectiveness criteria. The injection of emulsified edible oil is effective in two different ways. As an organic contaminant, TCE preferentially partitions into the oil phase from the water phase. Because the oil will tend to sorb to the aquifer sediments, it will not move downgradient towards the unnamed tributary as quickly as groundwater. Thus, as TCE partitions into the oil phase, it is retarded and does not discharge to surface water as quickly. In addition, the oil promotes the process of biodegradation through providing a carbon source for the microbes performing the process. Previous data indicate that some natural biodegradation of TCE is occurring in groundwater based on the presence of cis-1,2 DCE, which is an anaerobic breakdown product of TCE. Therefore, the anaerobic microorganisms responsible for the TCE breakdown are known to be present in the aquifer. Even if cis-1,2 DCE does not further biodegrade, it has a lower toxicity than TCE. The MCL for cis-1,2 DCE is 70 μg/L as compared to the TCE MCL of 5 μg/L. Since the observed TCE concentrations are currently below 70 μg/L, it is expected that any accumulation of cis-1,2 DCE will remain below 70 μg/L.

It is expected that this alternative will be effective in the short term (less than one year), as the groundwater travel time from the treatment zone to the discharge zone at the tributary is expected to be about 3 months. It is also expected to be effective in the long term (3 to 5 years) though not permanent. Based on experience at TNX, the longevity of emulsified edible oil is expected to be 3 to 5 years. Given the fairly low overall TCE in groundwater, it is reasonable to assume that a single injection may prevent future exceedances of the MCL in surface water, as TCE trends have been decreasing since 2012. However, TCE will remain in groundwater above the MCL. SRS safety and health procedures will be followed to ensure there is no exposure to contaminated media or hazardous materials. This alternative does reduce the toxicity, mobility and mass of TCE through treatment using the edible oil.

Alternative 3, ISCO Using Sodium Persulfate, meets the effectiveness criteria. The injection of a chemical oxidizing agent into the groundwater enables a reaction with and destruction of any TCE present. ISCO will rapidly degrade TCE in the groundwater into the following compounds ($2CO_2$, $9H^+$, $3Cl^-$ and $6SO_4^{-2}$). The production of H^+ (acidity) will require addition of a basic buffer to prevent the groundwater acidifying to the extent that naturally occurring metals may be put into solution. Sodium persulfate will also react with natural compounds in the subsurface, which is estimated to consume the sodium persulfate in 3 to 4 months, requiring two injections about 6 months apart. It is expected that this alternative will be effective in the short term (less than one year), as the groundwater travel time from the treatment zone to the discharge zone at the tributary is expected to be about 3 months. However, this alternative may not be effective in the long term (>1 year). Given the fairly low overall TCE in groundwater, it is reasonable to assume that two injections of sodium persulfate will prevent exceedances of the MCL in surface water for about 1 year, but TCE concentrations could rebound in the long term, requiring additional injections. This alternative does reduce the toxicity and mass of TCE through treatment using sodium persulfate.

5.2 Identification of ARARs

In accordance with 40 CFR Section 300.415(j) of the NCP, on-site removal actions conducted under CERCLA of 1980, as amended, are required to attain ARARs to the extent practicable, considering the exigencies of the situation. In determining whether compliance with ARARs is practicable, the lead agency may consider appropriate factors, including "1) the urgency of the situation; and 2) the scope of the removal action." ARARs include only federal and state environmental or facility siting laws/regulations; they do not include occupational safety or worker protection requirements. Compliance with Occupational Safety Health Administration standards is required by 40 CFR Section 300.150. For purposes of ease of identification, the USEPA has created three categories of ARARs: Chemical-, Location- and Action-Specific. Additionally, per 40 CFR Section 300.405(g)(3), other advisories, criteria, or guidance may be considered in determining remedies [i.e., to-be-considered (TBC) category]. USDOE, the lead agency at the

SRS, is expected to comply with ARARs and TBC guidance as set forth in the RSER/EE/CA when conducting this non-time critical removal action.

Applicable requirements, as defined in 40 CFR Section 300.5, means those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, or contaminant, remedial action, location, or other circumstance at a CERCLA site. Relevant and appropriate requirements, as defined in 40 CFR Section 300.5, means those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, or contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at a CERCLA site that their use is well suited to the particular site. Only those state standards that are identified by the state in a timely manner and that are more stringent than federal requirements may be relevant and appropriate.

Under Section 121 of CERCLA, any material remaining on site must reach a level or standard of control equal to that of any other applicable or relevant and appropriate standard or requirement promulgated under any federal or more stringent state environmental statute. The term "promulgated" means that the requirement generally is applicable and legally enforceable. The ARAR concept is pertinent only to onsite actions; offsite actions must comply with all applicable federal and state requirements. A requirement under other environmental laws may be either "applicable" or "relevant and appropriate," but not both. The first step in identifying ARARs is to determine if a requirement is applicable.

ARARs are identified for the CAGW OU NTC removal action in Appendix A. This RSER/EE/CA does not propose to waive any ARARs. The final disposition of the distal portion of the CAGW OU TCE groundwater plume will be addressed under a separate remedial action (i.e., Record of Decision), which will likely include land use controls until MCLs in groundwater are met. Existing SRS administrative controls will be required until the final disposition of the CAGW OU. Completion activities are identified in the Federal Facility Agreement (FFA) (FFA 1993), a legally binding and enforceable tri-party agreement between USDOE and the two regulatory agencies, USEPA and SCDHEC.

Consideration of National Environmental Policy Act (NEPA) Values

This RSER/EE/CA conforms to USDOE policy (i.e., DOE Order 451.1B, "National Environmental Policy Act Compliance Program") to incorporate NEPA values in USDOE CERCLA documents. NEPA values include consideration of socioeconomic, demographic, environmental justice, archaeological, historical, cultural, natural resources, protected species, floodplains, wetlands, and cumulative impacts of the proposed removal action.

Any potential environmental releases resulting from implementation of the preferred alternative (such as a hydraulic fluid leak) would be minimal and limited to the vicinity of the drilling rig at the project site. Work controls will be in place to contain any spills of chemicals used in the proposed action. Given the potential alternatives and distance to the SRS boundary, no impacts beyond the SRS boundary could occur, ensuring that there are no environmental justice concerns associated with the proposed removal action.

The CAGW OU contains no sites of cultural or historical significance. The site of the proposed removal action is located within a managed pine forest by the U.S. Forest Service. The location of the proposed removal action in the distal portion of the CAGW OU TCE groundwater plume is not within any jurisdictional waters of the United States (i.e., wetlands). The proposed removal action will not result in adverse impacts to the wetlands or floodplains. Implementation of the proposed removal action would have a negligible impact on SRS archaeological, cultural, historical, or natural resources.

Six plant and animal species on SRS are afforded protection by the Federal government under the Endangered Species Act of 1973. None of these species has been identified within the small footprint of the proposed removal action; therefore, this action is not anticipated to adversely affect the protected species identified at SRS.

Implementation of this removal action would reduce chlorinated VOC concentrations in the groundwater at the application area. Therefore, the removal action would contribute cumulatively to reducing risk to site workers and the public. Additionally, the expenditure of funds for the proposed closure action would contribute cumulatively to an overall positive economic impact within the Site's region of influence. It would also represent progress toward the completion of the 515 waste units and 15 areas where environmental restoration work is required under the FFA at SRS.

5.3 Implementability

Implementability of each alternative was assessed against the criteria below:

- Technical feasibility with regard to available techniques and demonstrated methods for accomplishing the proposed alternative.
- Administrative feasibility with regard to operations personnel and other resources to complete the alternative's implementation; also the availability of specific equipment and technical specialists.
- Regulatory acceptance of the preferred alternative.
- Community acceptance of the preferred alternative. USDOE–Savannah River will provide for a public comment period, and comments concerning the proposed remedy will be incorporated into the Responsiveness Summary and included with the action memorandum.

Alternative 1, No Action, is the current condition and, therefore, would not require any additional resources to implement.

Alternative 2, Treatment Barrier Using Emulsified Edible Oil, could be implemented without major technical or administrative concerns. Personnel are readily available and technologies for injection of emulsified edible oil are well defined. The extent of road construction into the woods would be minimal (about 300 ft for injection points). The only waste generated by this alternative would be job control solid waste which is expected to be disposed of in the local solid waste landfill. Well installation and the injection of materials uses standard drilling rigs and scientific equipment readily available to SRS. An underground injection control permit will be required and has been granted by SCDHEC for similar SRS activities. Drilling and land clearing activities would comply with regulations to prevent sediment discharges to surface water and runoff.

Alternative 3, In Situ Chemical Oxidation Using Sodium Persulfate, could be implemented without major technical or administrative concerns. Personnel are readily available and technologies for chemical oxidation are well defined. The extent of road construction into the woods would be minimal (about 300 ft for injection points). The only waste generated by this alternative would be job control solid waste which is expected to be disposed of in the local solid waste landfill. Well installation and the injection of materials uses standard drilling rigs and scientific equipment readily available at SRS. Chemicals used for the process would be properly stored to prevent spills at the site. A site-specific safety and health plan would be followed to ensure there is no exposure to hazardous materials. An underground injection control permit would be required and has been granted by SCDHEC for similar SRS activities. Drilling and land clearing activities would comply with regulations to prevent sediment discharges to surface water and runoff.

5.4 Cost

The costs for these alternatives are as follows: $0 for Alternative 1, No Action, approximately $1.317 million for Alternative 2, Treatment Barrier Using Emulsified Edible Oil and approximately $1.707 million for Alternative 3, ISCO Using Sodium Persulfate. Cost estimate details for Alternatives 2 and 3 are provided in Appendix B.

Assumptions that form the basis of the estimated cost for Alternative 2, Treatment Barrier Using Emulsified Edible Oil are presented below.

- There would be ten DPT injection locations that will be installed 5-m (16-ft) apart near Castor Creek. DPT depths are estimated at 10- to 15-m below ground surface (bgs) (34- to 50-ft bgs), and the area needs to be cleared of trees/brush.
- There would only be one injection of emulsified edible oil. Each well will receive 3,785 L (1,000 gallons) of emulsified edible oil, 18,927 L (5,000 gallons) of water and 19 L (5 gallons) of buffer solution ($NaHCO_3$ and NaOH).

- A total of 227,125 L (60,000 gallons) would be injected in the ten DPT locations. At an injection rate of at least 9,463 L (2,500 gallons) per day, injections will take a maximum of 24 days plus 4 days standby.
- Three wells would be installed to monitor groundwater. One upgradient well will have a screen zone approximately 12.2- to 15.2-m bgs (40- to 50-ft bgs) and the two downgradient wells will have screen zones approximately 1.5- to 4.6-m bgs (5- to 15-ft bgs).
- Monitoring of groundwater and surface water will be monthly the first year and semiannual for years 2 to 5 with an annual effectiveness monitoring report all five years.

Assumptions that form the basis of the estimated cost for Alternative 3, ISCO Using Sodium Persulfate are presented below:

- Ten polyvinyl chloride injection wells would be installed 5-m (16-ft) apart near Castor Creek. Well depths are estimated at 12.2- to 15.2-m bgs (40- to 50-ft bgs), and the area needs to be cleared of trees/brush.
- There would be two rounds of injection of sodium persulfate about 6 months apart. Each well would receive 11,356 L (3,000 gallons) sodium persulfate 4% solution and 2,665 L (704 gallons) of 25% sodium hydroxide base solution.
- A total of 151,416 L (40,000 gallons) would be injected in the ten wells. At an injection rate of at least 9,463 L (2,500 gallons) per day, injections will take a maximum of 16 days plus 2 days standby for each round of injections.
- The monitoring approach is the same as for Alternative 2.

5.5 Comparison of Removal Action Alternatives

A comparative analysis of the alternatives is summarized in the table below. Both Alternatives 2 and 3 are moderately easy to implement. Both are similar in cost, with Alternative 2 being about 15% less expensive. Alternative 2 is judged to have high effectiveness, as the longevity of the emulsified oil is likely to prevent the TCE from exceeding MCLs in the tributary to Castor Creek again in the future, whereas the persulfate oxidant has less residence time and is much more likely to be flushed through the system, allowing for TCE rebound. An additional concern using persulfate is the potential for acidification of the aquifer that may result in the dissolution of natural metals into groundwater, which has a short transport distance to surface water. Therefore, Alternative 3 was judged to have moderate effectiveness.

Alternative	Effectiveness	Implementability	Cost
Alternative 1: No Action	Low	Easy	$0
Alternative 2: Treatment Barrier Using Emulsified Edible Oil	High	Easy-Moderate	$1,317,066
Alternative 3: ISCO Using Sodium Persulfate	Moderate	Easy-Moderate	$1,707,034

6.0 PREFERRED REMOVAL ACTION ALTERNATIVE

The preferred action is **Alternative 2, Treatment Barrier Using Emulsified Edible Oil,** which has the greatest effectiveness. A preliminary conceptual design of this alternative is depicted in Figure 7. The emulsified edible oil will act as a treatment barrier both by sequestering TCE at the injection point and enhancing the natural ability of the formation to biodegrade TCE between the point of injection and discharge to the unnamed tributary. The partitioning of the TCE into the emulsified edible oil should relatively quickly reduce the TCE concentrations in surface water due to the short travel time from the treatment zone to surface water. In addition, the expected length of time (3-5 yrs) the emulsified edible oil will be effective means should prevent rebound of TCE concentrations above the MCL.

Alternative 2 will not preclude any additional remediation of the CAGW OU and is consistent with the current and future land use. The waste streams generated as part of the selected alternative will be transported to the appropriate disposal facilities. The contaminated waste anticipated to be generated includes job control waste, personal protective equipment, and miscellaneous items. Prior to the transfer of these wastes to their final disposal facility, SRS will obtain an acceptability determination from the appropriate Regional Off-site Rule Coordinator for disposal of CERCLA waste.

7.0 IMPLEMENTATION SCHEDULE

This RSER/EE/CA will be submitted to USEPA and SCDHEC for review and comment. The RSER/EE/CA will be available for public comment following this review. The removal action schedule is presented below:

Submit Revision 0, RSER/EE/CA for Regulatory Comment	September 29, 2017
Issue RSER/EE/CA for Public Comment	March 13, 2018
Submit Final Action Memorandum and Responsiveness Summary to USEPA and SCDHEC	April 30, 2018
Submit Revision 0, Removal Action Design Plan and Effectiveness Monitoring Plan for Regulatory Comment	August 16, 2018
Removal action start of RSER/EE/CA activity	January 30, 2019
Anticipated completion of RSER/EE/CA activity	March 30, 2019
Submit Revision 0, Removal Action Report[a]	September 28, 2019

a) The annual groundwater report for the CAGW OU will be suspended until the effectiveness monitoring of the removal action is reported.

This page intentionally left blank.

8.0 REFERENCES

Aadland, R.K., J.A. Gellici, and P.A. Thayer, 1995. *Hydrogeologic Framework of West-Central South Carolina*, Report 5, State of South Carolina, Department of Natural Resources, Water Resources Division

EcoVac, 2017. *Treatability Study for In-Situ Remediation of Subsurface Tetrachloroethylene Contamination*, 2017, EcoVac Services, Inc., 105 Weatherstone Drive, Suite 610, Woodstock, Georgia 30188

FFA, 1993. *Federal Facility Agreement for the Savannah River Site,* Administrative Docket No. 89-05-FF (Effective Date: August 16, 1993)

Liang, 2007. *Influence of pH on Persulfate oxidation of TCE at Ambient Temperatures*, Chenju Liang, Zih-Sin Wang, Clifford Bruell, February 2006, Chemosphere 66 (2007), 106-113.

NAVFAC, 2010. *Cost and Performance Report for Persulfate Treatability Studies*, Technical Report, TR-2333-ENV, June 2010, Naval Facilities (NAVFAC) Engineering Command, Engineering Center, Port Hueneme, California 93043-4370

SRNL, 2016a. *Trends in Atmospheric Climate Parameters Measured at SRS 1964-2013*, S. Weinbeck, SRNL-L2200-2016-00100, December 2016, Savannah River National Laboratory, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNL, 2016b. *Meteorological Monthly Monitoring, Savannah River Site*, SRNS-STI-2016-00241, Revision 0, April 2016, Savannah River National Laboratory, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2011. *Statement of Basis / Proposed Plan for the C-Area Groundwater Operable Unit (U)*, SRNS-RP-2011-00207, Revision 0, April 2011, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

USDOD, 2010. *Edible Oil Barriers for Treatment of Chlorinated Solvent and Perchlorate-Contaminated Groundwater*, ESTCP Cost and Performance Report, ER-0221, February 2010, Environmental Security Technology Certification Program, U.S. Department of Defense

USDOE, 2011. *Final Long-Term Management and Storage of Elemental Mercury Environmental Impact Statement*, DOE/EIS-0423, Office of Environmental Compliance, Washington, DC

USEPA, 2016. *Bioremediation*, EPA, Technology Innovation and Field Services Division, December 5, 2016 https://clu-in.org/techfocus/default.focus/sec/Bioremediation/cat/Anaerobic_Bioremediation_(Direct)/

WSRC, 1999. *Land Use Control Assurance Plan for the Savannah River Site*, WSRC-RP-98-4125, Rev. 1.1, August 1999, latest update, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

WSRC, 2000. *Groundwater Flow Model for C-Area Groundwater Operable Unit (U)*, WSRC-RP-2000-4096, Revision 0, November 2000, Westinghouse Savannah River Company LLC, Savannah River Site, Aiken, SC

WSRC, 2004a. *Interim Record of Decision Remedial Alternative Selection for the Remediation of the Trichloroethylene Vadose Zone Source Unit at the C-Reactor Groundwater Operable Unit (U)*, WSRC-RP-2004-4022, Revision 1, June 2004, Westinghouse Savannah River Company LLC, Savannah River Site, Aiken, SC

WSRC, 2004b. *RCRA Facility Investigation/Remedial Investigation Report for the C-Area Reactor Groundwater (CRGW) Operable Unit (U)*, WSRC-RP-2003-4073, Revision 1 (May), Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2005. *Corrective Measures Study/Feasibility Study Report for the C-Reactor Groundwater Operable Unit (U)*, WSRC-RP-2004-4113, Revision 1.1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2007. *Report on the Effectiveness of the TCE Vadose Source Unit at C Reactor Groundwater (VCRGW) OU Interim Remedial Action*, Revision 0, April 2007, Washington Savannah River Company LLC, Savannah River Site, Aiken, SC

9.0 GLOSSARY

Applicable or Relevant and Appropriate Requirement (ARAR): The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) requires compliance with any promulgated standard requirements, criteria, or limitation under Federal and more stringent State environmental laws. Examples include the Clean Water Act, Endangered Species Act, etc.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA): A Federal law, known as Superfund passed in 1980 and reauthorized by the Superfund Amendments and Reauthorization Act (SARA) in 1986. The law authorizes the Federal government to respond directly to releases of hazardous substances that may endanger public health or the environment.

Curie: A unit of radioactivity that represents the amount of radioactivity associated with one gram of radium. To say that a sample of radioactive material exhibits one curie of radioactivity means that the element is disintegrating at the rate of 37 billion times per second.

Emulsified Oil: Small uniform droplets (~ 1 micrometer) of vegetable oil suspended in a water matrix are prepared with a high energy mixer and food-grade nonionic surfactants. Emulsified oil injected into an aquifer results in a low to moderate loss of permeability when compared to neat oil, because the emulsified oil droplets coat the sediment grains in the subsurface rather than filling the pore spaces. Emulsified oil can be used to create a permeable reactive barrier for VOCs.

In Situ Chemical Oxidation: An oxidant (e.g., sodium persulfate) injected or mixed into the subsurface where contaminants are located and will react with the contaminants (e.g. VOCs) resulting in relatively harmless compounds. Oxidants will tend to flow and mix with the groundwater until the oxidant has all reacted with the contaminants and natural soil components (e.g., organic matter).

National Oil and Hazardous Substances Pollution Contingency Plan (NCP): The federal government's blueprint for responding to both oil spills and hazardous substance releases. The NCP is the result of our country's efforts to develop a national response capability and promote overall coordination among the hierarchy of responders and contingency plans.

Non-Time Critical Removal Action: This is a type of response action recognized by the USEPA as appropriate for addressing hazardous substance threats where a planning horizon of six months or more is appropriate. Under an USEPA/USDOE agreement, USDOE uses a non-time critical removal action approach tailored for decommissioning USDOE facilities. That approach is comprised of: a threat assessment; identification, analysis, and documentation of decommissioning alternatives; opportunities for public participation in the decommissioning decision; and planning and performance of decommissioning activities.

Permeable Reactive Barrier: A reactive material (e.g. emulsified oil) injected or emplaced into an aquifer along a line perpendicular to groundwater flow designed to form a permeable wall that intercepts the flow of a contaminant.

Picocurie (pCi): One one-trillionth (1/1,000,000,000,000) of a curie.

Removal Action: When USDOE identifies a threat of exposure to, or migration of, hazardous substances that poses a risk to health, welfare, or the environment, USDOE is authorized by CERCLA to exercise removal action authority to implement an appropriate response to the risks posed. Activities that may be taken under CERCLA removal action authority include any activity that reduces risks or potential risks in a relatively short time frame and can be identified as appropriate with a relatively limited analysis of alternatives. Removal actions are not limited to immediate action, or action in response to an emergency. (See non-time critical removal action.)

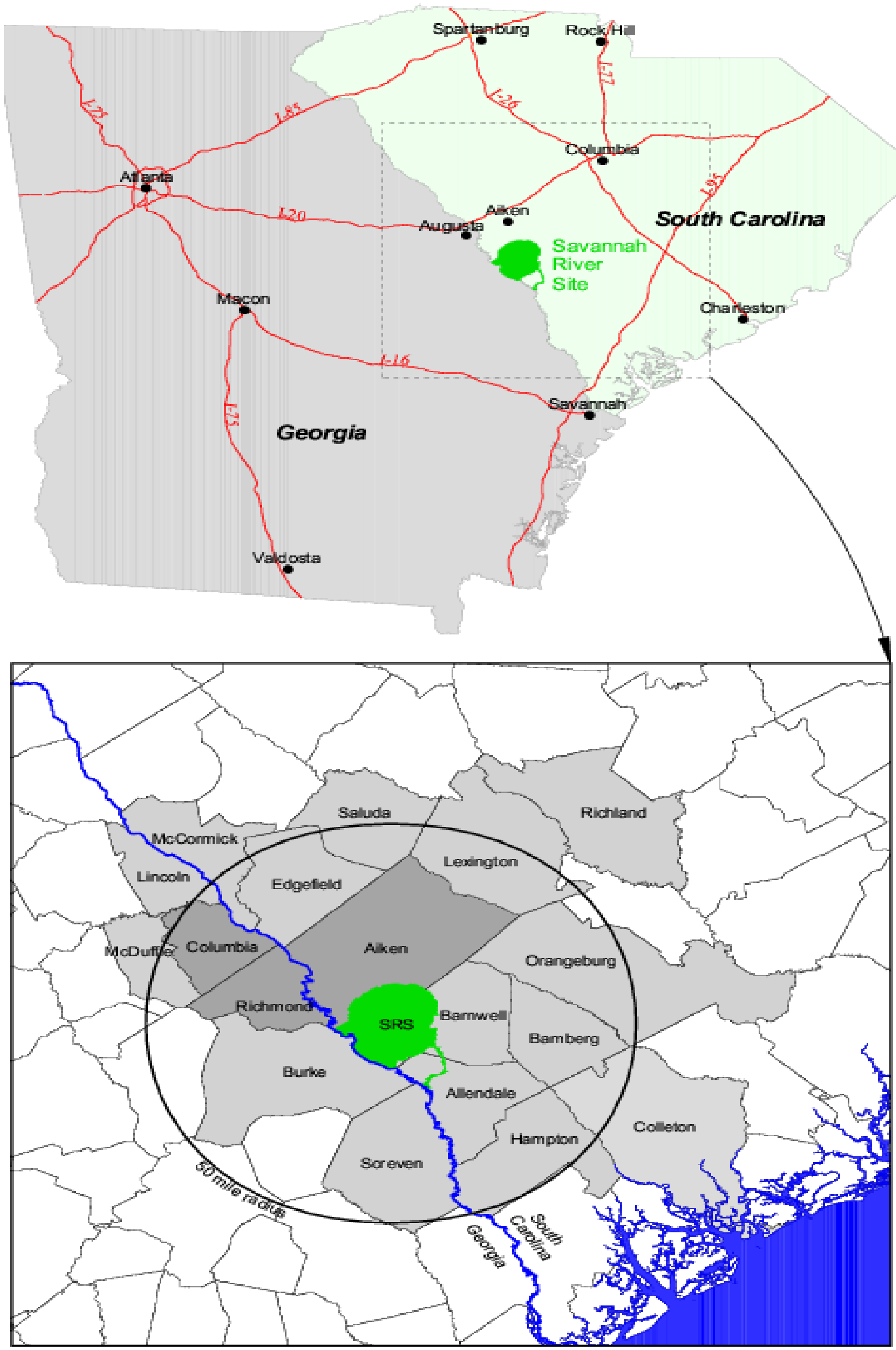


Figure 1. Geographic Proximity of the Savannah River Site

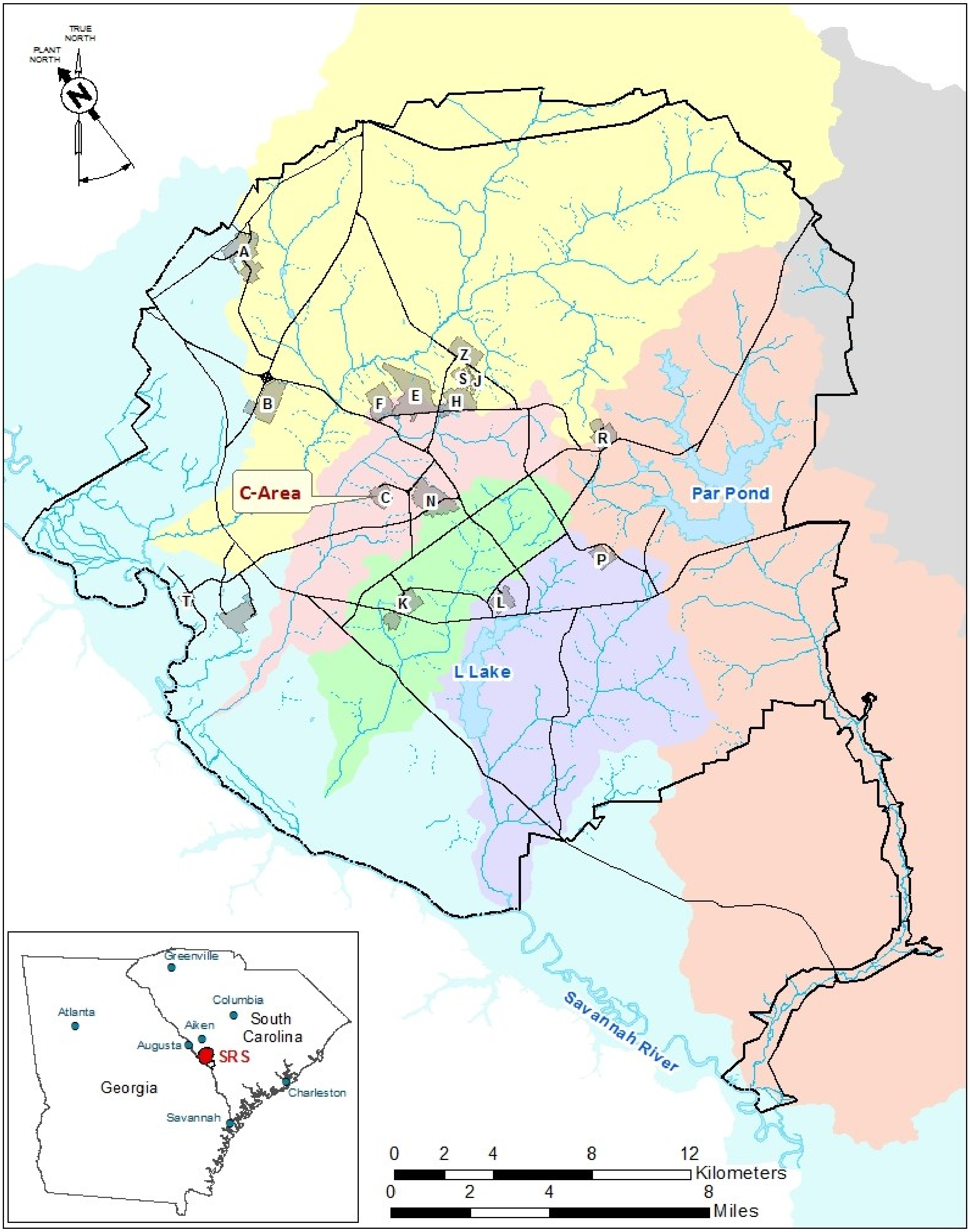


Figure 2. SRS Site Map Showing the Relative Location of C-Area at SRS

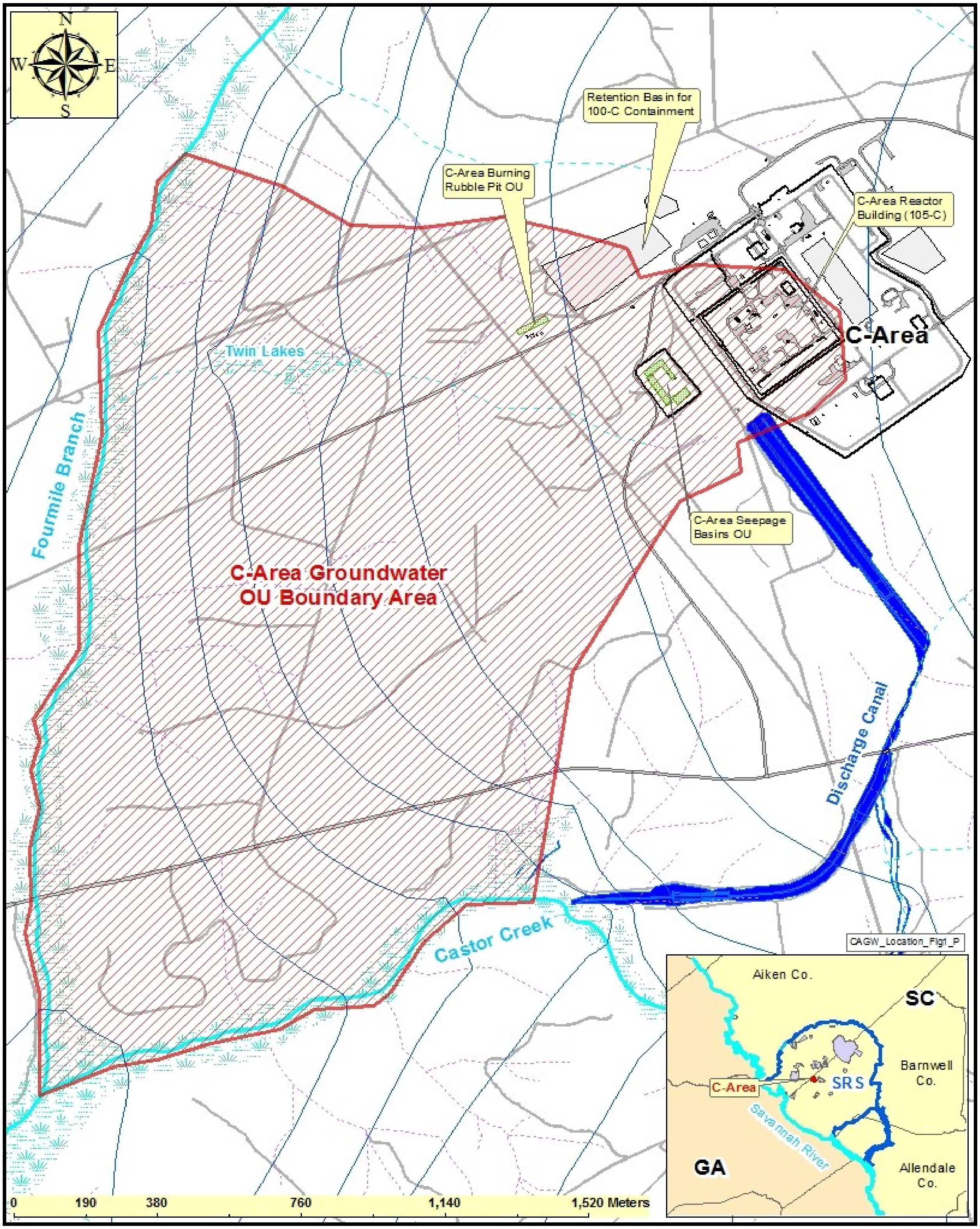


Figure 3. SRS Site Map Showing the CAGW OU Boundary Area

This page intentionally left blank.

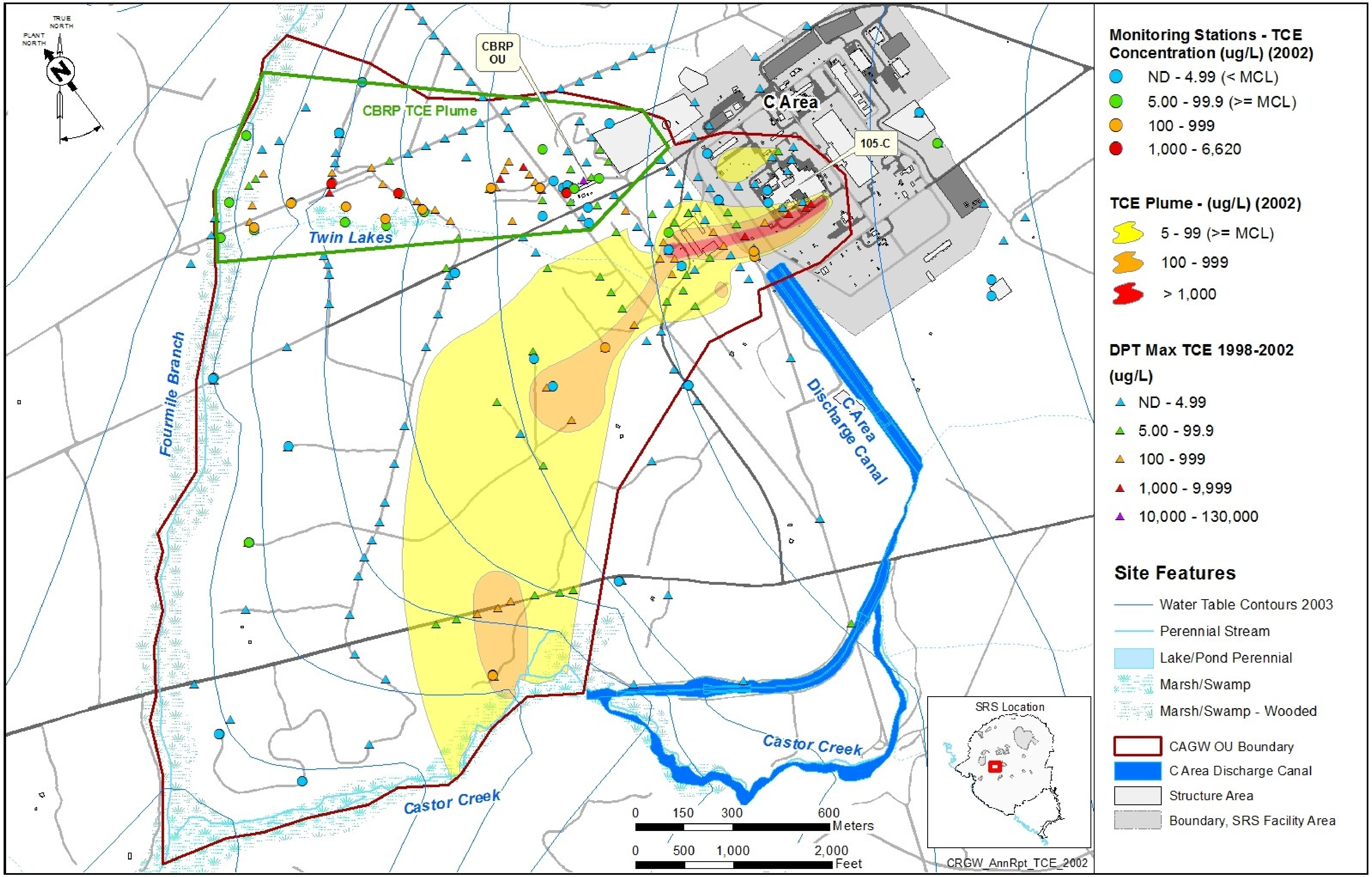


Figure 4. CAGW OU TCE Plume, 1998 to 2002

This page intentionally left blank.

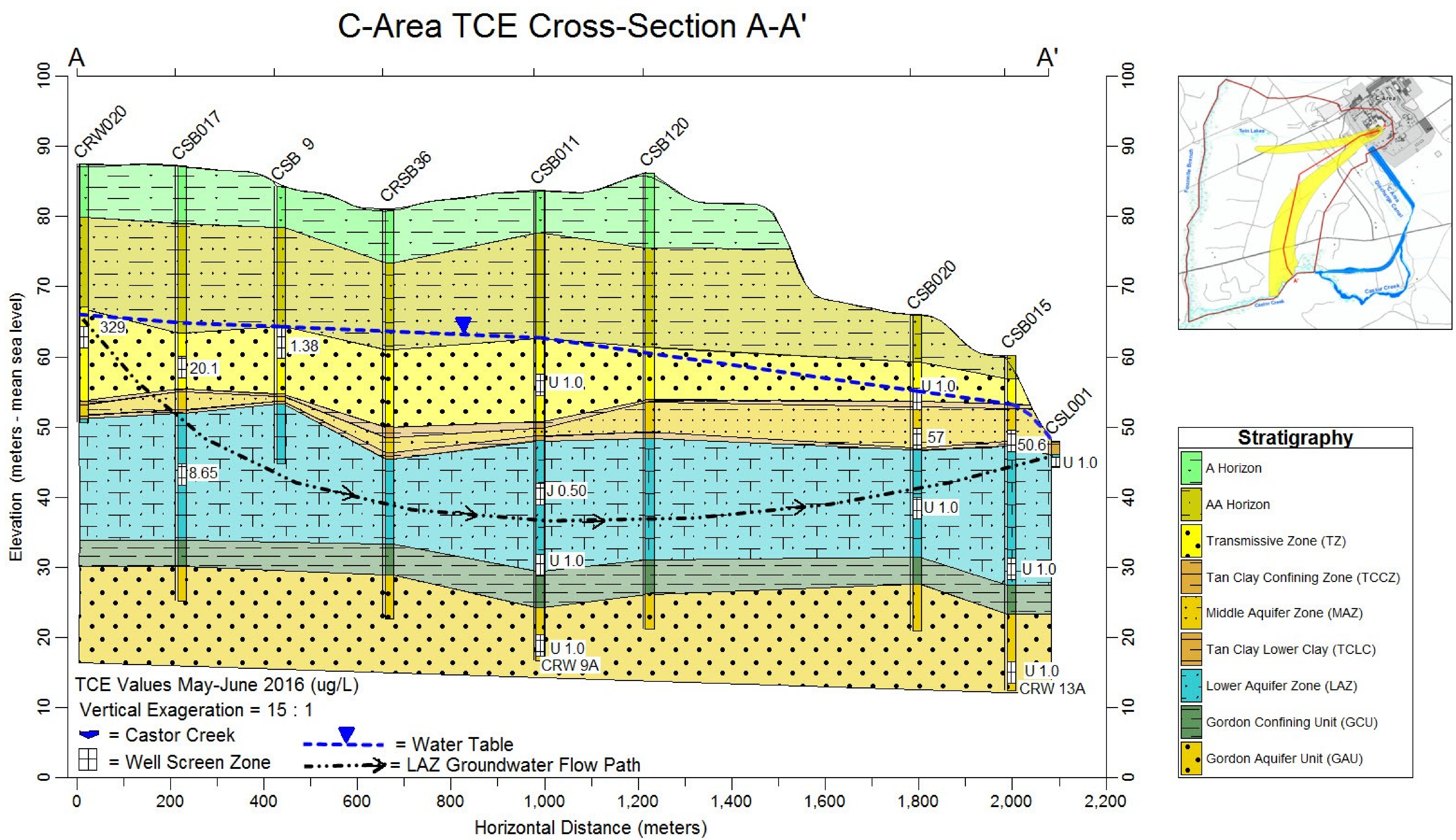


Figure 5. **CAGW OU Cross Section A – A' with 2016 TCE Values (µg/L) at Well Screen Zones**

This page intentionally left blank.

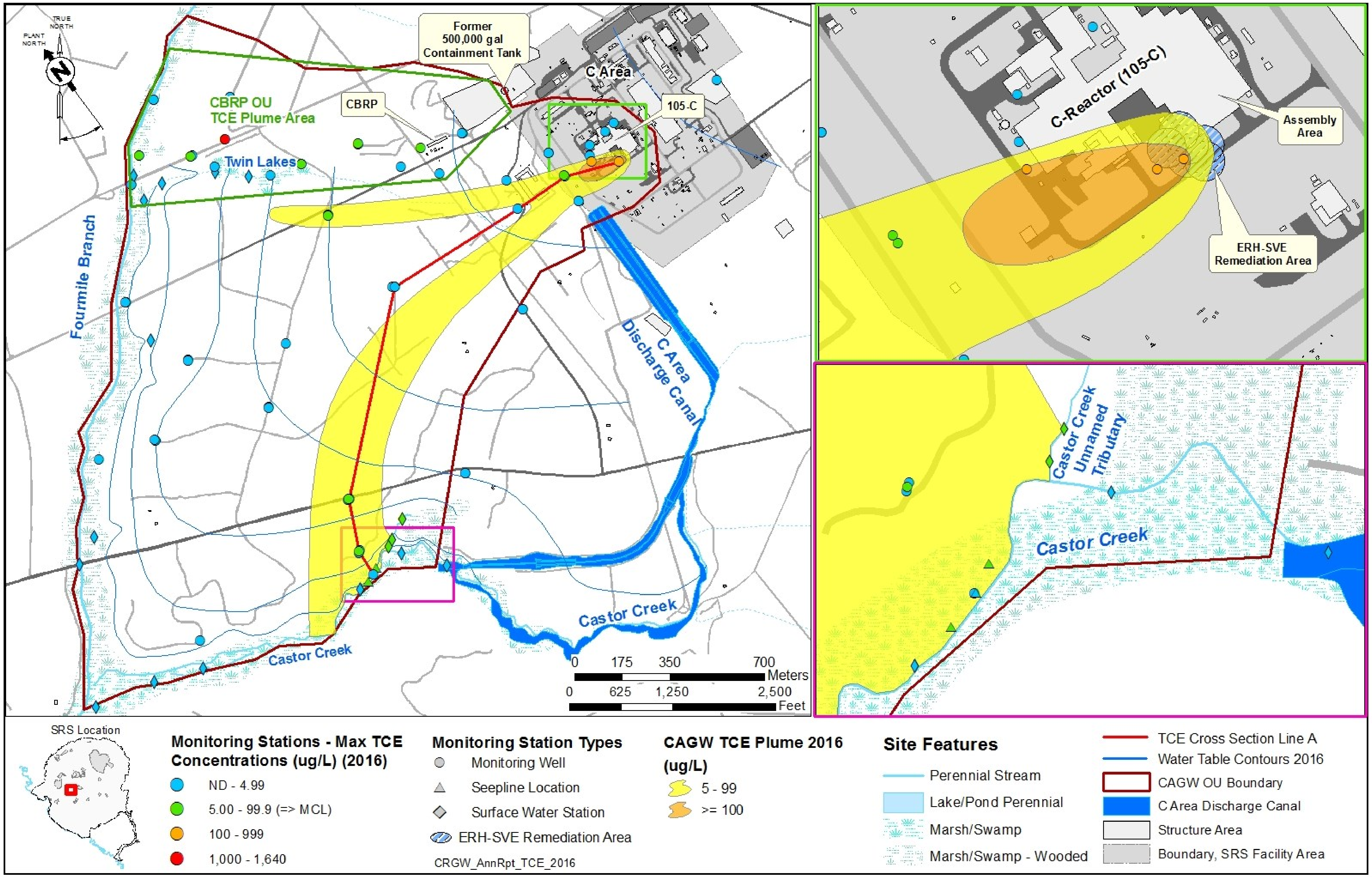


Figure 6. CAGW OU TCE Plume, 2016

This page intentionally left blank.

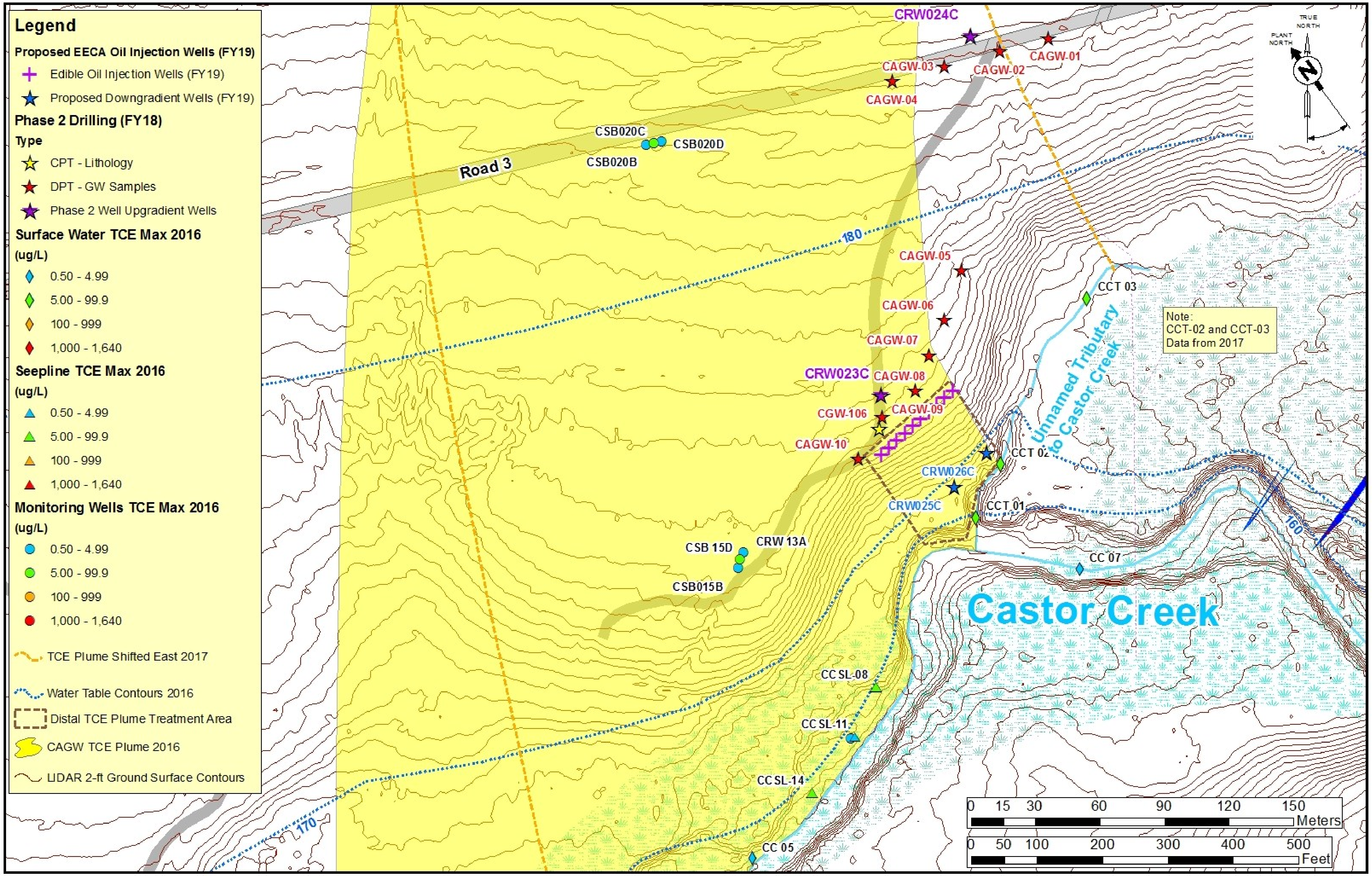


Figure 7. CAGW OU Distal TCE Groundwater Plume with Treatment Barrier

This page intentionally left blank.

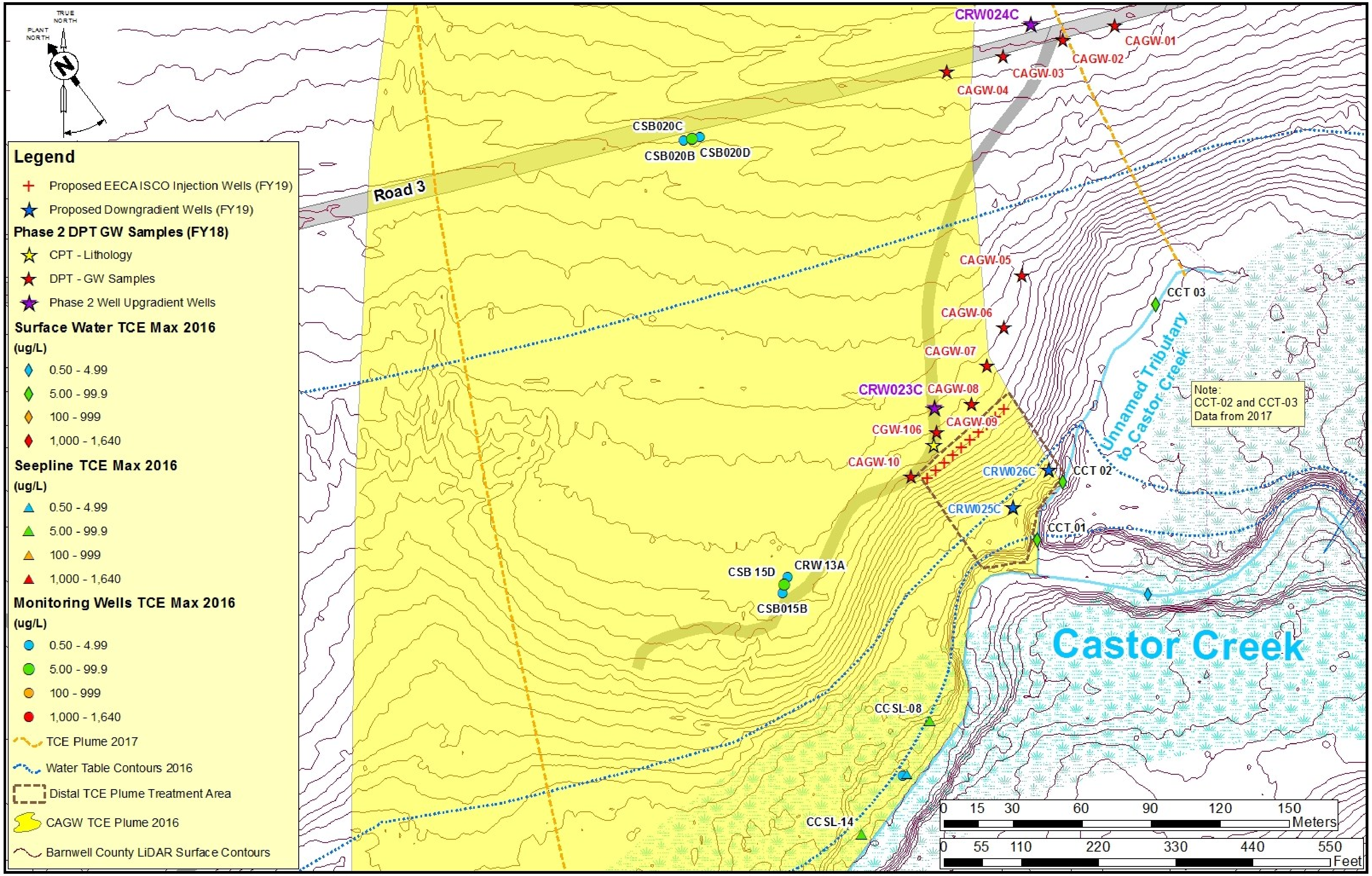


Figure 8. CAGW OU Distal TCE Groundwater Plume ISCO Treatment Area

This page intentionally left blank.

APPENDIX A: Potential ARARs

Table A-1. Potential ARARs and TBC Criteria for the CAGW OU

Action	Requirements	Prerequisite	Citation	Alt-2	Alt-3
Action Specific ARARs					
Underground Injection Well Installation, Operation, and Abandonment					
Monitoring of Class V underground injection wells	Monitoring requirements shall, at a minimum, specify: Monitoring of the nature of injected fluids with metering and daily recording of injected and produced fluid volumes as appropriate; Monitoring of injection pressure and either flow rate or volume semimonthly, or metering and daily recording of injected and produce fluid, volumes as appropriate; Demonstration of mechanical integrity at least once every five years during the life of the well; Monitoring of the fluid level in the injection zone semimonthly, where appropriate and monitoring of the parameters chosen to measure water quality in the monitoring wells semimonthly	Monitoring into the injection zone of ground waters of the State of South Carolina - **applicable**	SCDHEC R.61-87.14(G)(3)	✓	✓
Operation and maintenance of Class V underground injection wells	Shall at all times properly operate and maintain all facilities and systems of treatment and controls which are installed or used.	Operation of well for underground injection of any fluids into the subsurface or ground waters of the State of South Carolina – **applicable**	SCDHEC R.61-87.13(X)	✓	✓
	Shall report malfunction of injection system which may cause fluid migration into or between underground sources of drinking water; shall immediately stop injection upon determination that the injection system has malfunctioned and could cause fluid migration into or between underground sources of drinking water; shall not restart the injection system until the malfunction has been corrected.		SCDHEC R.61-87.13(EE)	✓	✓
Closure of Class V underground injections wells	Wells must be closed in a manner that complies with the prohibition of fluid movement in 40 CFR 144.82(a)(l). Also, any soil, gravel, sludge, liquids, or other materials removed from or adjacent to the well must be disposed or otherwise managed in accordance with substantive applicable Federal, State, and local regulations and requirements.	Closure of Class V wells [as defined in 40 CFR 144.6(e)] – **applicable**	40 CFR 144.82(b)	✓	✓

Table A-1. Potential ARARs and TBC Criteria for the CAGW OU *(Continued)*

Action	Requirements	Prerequisite	Citation	Alt-2	Alt-3
Action Specific ARAR					
Monitoring Well Installation, Operation, and Abandonment					
Installation or Abandonment of Permanent and Temporary Monitoring Wells	All monitoring wells shall be drilled, constructed, maintained, operated, and/or abandoned to ensure that underground sources of drinking water are not contaminated. Abandonment of permanent conventionally installed monitoring wells shall be by forced injection of grout or pouring through a tremie pipe starting at the bottom of the well and proceeding to the surface in one continuous operation. The well shall be filled with either with neat cement, bentonite-cement, or 20% high solids sodium bentonite grout, from the bottom of the well to the land surface.	Construction of permanent and temporary monitoring wells (including non-standard installation, as defined in R.61-71B(2)) – Removal and abandonment of wells - **applicable**	SC R.61-71H.1(b) SC R.61-71H.2(e)	✓	✓
Transportation of Samples (i.e. Solid Waste, Soils and Wastewaters)	Samples are not subject to any requirements of 40 CFR Parts 261 through 268 or 270 when: • The sample is being transported to a laboratory for the purpose of testing; or • The sample is being transported back to the sample collector after testing. In order to qualify for the exemption in paragraphs (d)(1)(i) and (ii), a sample collector shipping samples to a laboratory must: • Comply with U.S. DOT, U.S. Postal Service, or any other applicable shipping requirements • Assure that the information provided in (1) thru (5) of this section accompanies the sample. • Package the sample so that it does not leak, spill, or vaporize from its packaging.	Water samples for purpose of conducting testing to determine its characteristics or composition will occur as part of the groundwater monitoring program - **applicable**	40 CFR 261.4(d)(1)(i)-(iii) SC R.61-79 261.4*(d)* (1) 40 CFR 261.4(d)(2)(i) 40 CFR 261.4(d)(2)(i)(A)and (B) SC R.61-79 261.4*(d)* (2)(i)(A) and (B)	✓	✓

Table A-1. Potential ARARs and TBC Criteria for the CAGW OU *(Continued)*

Action	Requirements	Prerequisite	Citation	Alt-2	Alt-3
Chemical Specific ARAR					
Organic contaminants in the groundwater	MCLs established the highest level of a contaminant that is allowed in drinking water. • Trichloroethylene (TCE) = 0.005 mg/L (5 µg/L)	The state of South Carolina classifies all groundwater as potential sources of drinking water and mandates that groundwater meet MCLs established by the SDWA– **applicable**	40 CFR 141.61 Maximum contaminant levels for organic contaminants SCDHEC R.61.58, Section 5 (N) Maximum Contaminant Levels for Volatile Synthetic Organic Chemicals	✓	✓
	• Cis-1,2-dichlroethylene = 70 µg/L NOTE: compound is a degradation product of TCE	Same as above – **reasonable and appropriate**	Same as above	✓	✓
Groundwater seep into Water of the State	Establishes South Carolina official classified water uses for all waters of the State, general rules and specific numeric and narrative criteria for protecting classified and existing water uses • Trichloroethylene (TCE) = 0.005 mg/L (5 µg/L)	This regulation classifies all surface water and groundwater in the state for protecting classified water uses. - **applicable**	SC R. 61-68 Water Classification and Standards SC R. 61-68 Section G.10.c Appendix		✓
	• Cis-1,2-dichlroethylene = 70 µg/L NOTE: compound is a degradation product of TCE	Same as above – **reasonable and appropriate**	Same as above	✓	✓
	• Priority Pollutants 1-13 (SC R. 61-68 Section G.10.c Appendix) **NOTE** – These priority pollutants are the list of metals that could leach to the surface stream from the groundwater plume as a result of lowering the pH in the groundwater plume due to persulfate injection. These metals would need to be monitored in the event Alternative 3 is selected.	Same as above - applicable	Same as above		✓

Table A-1. Potential ARARs and TBC Criteria for the CAGW OU *(Continued/End)*

Action	Requirements	Prerequisite	Citation	Alt-2	Alt-3
Location Specific ARAR					
Discharge of groundwater during well drilling operations	Discharges to the ground must not impact or reach waters of the state.	Discharges of water to the ground that will not reach surface waters – **TBC**	SRS No Discharge Permit #ND0072125	✓	✓
Protection of Migratory Birds	No person may take, possess, import, export, transport, sell, purchaser, barter or offer for sale, purchase or barter, any migratory bird, or the parts, nests, or eggs of such bird except as under the terms of a valid permit.	Migratory bird populations may be present in the vicinity – **applicable**	16 *USC* 703-704 – Migratory Bird Treaty Act	✓	✓

Alt = Alternative
ARAR = applicable or relevant and appropriate requirement
CFR = *Code of Federal Regulations*
DOT = U.S. Department of Transportation
EPA = U.S. Environmental Protection Agency
SCDHEC = South Carolina Department of Health and Environmental Control
SDWA = Safe Drinking water Act

APPENDIX B: Cost Estimates

Detailed Cost Analysis for Alternative 2 – Treatment Barrier Using Emulsified Edible Oil

CAGW OU Alternative 2 - Treatment Barrier Using Emulsified Edible Oil						
SRS CAGW OU - Distal TCE Groundwater Plume						
		Item	**Quantity**	**Units**	**Unit Cost**	**Total Cost**
Direct Capital Costs						
	Clearing & Grubbing					
		Tree Cutting, Grubbing Stumps, and Grinding Debris	0.5	ac	$10,000	$5,000
	Access Roads					
		Access Roads	300	lf	$15	$4,500
		Stormwater Management	300	lf	$25	$7,500
	EOS	Edible Oil Emulsion				
		EOS Oil	10,000	gal	$10	$100,000
		AquaBuff Solution	50	gal	$10	$500
		Water (Central Shops)	50,000	gal	$0	$0
		Labor Inject Edible Oil 10 DPT locations	1	ea	$128,600	$128,600
	Drilling	RotoSonic Drilling - GW Wells	3	ea	$2,487	$7,461
		DPT Drilling - Inj Wells	10	ea	$4,665	$46,650
	Lab Testing	3 WAC Suite Samples	3	ea	$6,800	$20,400
		Groundwater Analyses	7	ea	$500	$3,500
		Subtotal - Direct Capital Cost*				$324,111
		Site Preparation/Site Restoration*	5%	of subtotal direct capital		$16,206
		Total Direct Capital Cost		(sum of * items)		**$340,317**
Indirect Capital Costs						
	Engineering Support		40%	of direct capital		$136,127
	Project/Construction Management		40%	of direct capital		$136,127
	Health & Safety		5%	of direct capital		$17,016
	Overhead		30%	of direct capital		$102,095
	Contingency		20%	of direct capital		$68,063
		Total Indirect Capital Cost				**$459,427**
		Total Estimated Capital Cost				**$799,744**
Direct O&M Costs (5 yrs; Years 2019 - 2024)						
	Groundwater Monitoring Costs		1	year O&M		*Years 2019 - 2020*
		Well Sampling (yr 1)	12	monthly	$6,500	$78,000
		Annual Reporting Costs (yr 1)	1	yr	$30,000	$30,000
		Subtotal - Annual Costs				$108,000
		Present Worth Annual Costs (-0.3% Real Discount Rate)				$108,325
	Groundwater Monitoring Costs		1	year O&M		*Years 2020 - 2021*
		Well Sampling (yr 2)	2	semi-annual	$6,500	$13,000
		Annual Reporting Costs (yr 2)	1	yr	$20,000	$20,000
		Subtotal - Annual Costs				$33,000
		Present Worth Annual Costs (-0.03% Discount Rate)				$33,199
	Groundwater Monitoring Costs		1	year O&M		*Years 2021 - 2022*
		Well Sampling (yr 3)	2	semi-annual	$6,500	$13,000
		Annual Reporting Costs (yr 3)	1	yr	$20,000	$20,000
		Subtotal - Annual Costs				$33,000
		Present Worth Annual Costs (-0.3% Discount Rate)				$33,398
	Groundwater Monitoring Costs		2	years O&M		*Years 2022 - 2024*
		Well Sampling (yrs 4 - 5)	2	semi-annual	$6,500	$13,000
		Annual Reporting Costs (yrs 4 - 5)	1	yr	$20,000	$20,000
		Subtotal - Annual Costs				$33,000
		Present Worth Annual Costs (-0.3% Discount Rate)				$66,898
	Report		1	time in 5 yrs		
		RAR / IPCR	1	ea	$30,000	$30,000
		Subtotal - Five Year O&M Costs				$30,000
		Present Worth Five Year Costs				$30,454
		Total Present Worth Direct O&M Cost				**$272,275**
Indirect O&M Costs						
	Project/Admin Management		30%	of direct O&M		$81,682
	Health & Safety		10%	of direct O&M		$27,227
	Overhead		30%	of direct O&M		$81,682
	Contingency		20%	of direct O&M		$54,455
		Total Present Worth Indirect O&M Cost				**$245,047**
		Total Estimated Present Worth O&M Cost				**$517,322**
		TOTAL ESTIMATED COST				**$1,317,066**

APPENDIX B: Cost Estimates *(Continued/End)*

Detailed Cost Analysis for Alternative 3 – ISCO Using Sodium Persulfate

CAGW OU Alternative 3: In Sito Chemical Oxidation (ISCO) Using Sodium Persulfate						
SRS CAGW OU - Distal TCE Groundwater Plume						
Item			**Quantity**	**Units**	**Unit Cost**	**Total Cost**
Direct Capital Costs						
	Clearing & Grubbing					
		Tree Cutting, Grubbing Stumps, and Grinding Debris	0.5	ac	$10,000	$5,000
	Access Roads					
		Access Roads	300	lf	$15	$4,500
		Stormwater Management	300	lf	$25	$7,500
	ISCO					
		Sodium Persulfate & Sodium Hydroxide	1	lump sum	$59,505	$59,505
		Labor: 2 Rounds of CPT Injections @ 10 wells, 4,000 gallons/well	2	ea	$81,600	$163,200
	Drilling					
		Drilling - Groundwater Wells	13	ea	$13,180	$171,342
		Drilling - Coring	1	ea	$5,935	$5,935
	Lab Testing					
		GeoTech	1	ea	$2,209	$2,209
		Baseline Groundwater Samples @ 13 wells + 4 surface water stations	17	ea	$6,800	$115,600
		Subtotal - Direct Capital Cost*				$534,791
		Mobilization/Demobilization*	5%	of subtotal direct capital		$26,740
		Total Direct Capital Cost		(sum of * items)		**$561,530**
Indirect Capital Costs						
	Engineering & Design		25%	of direct capital		$140,383
	Project/Construction Management		25%	of direct capital		$140,383
	Health & Safety		5%	of direct capital		$28,077
	Overhead		30%	of direct capital		$168,459
	Contingency		20%	of direct capital		$112,306
		Total Indirect Capital Cost				**$589,607**
		Total Estimated Capital Cost				**$1,151,137**
Direct O&M Costs (5 yrs; Years 2019 - 2024)						
	Groundwater Monitoring Costs		1	year O&M		*Years 2019 - 2020*
		Well Sampling (yr 1)	12	monthly	$6,500	$78,000
		Annual Reporting Costs (yr 1)	1	yr	$30,000	$30,000
		Subtotal - Annual Costs				$108,000
		Present Worth Annual Costs (-0.3% Real Discount Rate)				$108,325
	Groundwater Monitoring Costs		1	year O&M		*Years 2020 - 2021*
		Well Sampling (yr 2)	2	semi-annual	$6,500	$13,000
		Annual Reporting Costs (yr 2)	1	yr	$20,000	$20,000
		Subtotal - Annual Costs				$33,000
		Present Worth Annual Costs (-0.3% Discount Rate)				$33,199
	Groundwater Monitoring Costs		1	year O&M		*Years 2021 - 2022*
		Well Sampling (yr 3)	2	semi-annual	$6,500	$13,000
		Annual Reporting Costs (yr 3)	1	yr	$20,000	$20,000
		Subtotal - Annual Costs				$33,000
		Present Worth Annual Costs (-0.3% Discount Rate)				$33,398
	Groundwater Monitoring Costs		2	years O&M		*Years 2022 - 2024*
		Well Sampling (yrs 4 - 5)	2	semi-annual	$6,500	$13,000
		Annual Reporting Costs (yrs 5)	1	yr	$20,000	$20,000
		Subtotal - Annual Costs				$33,000
		Present Worth Annual Costs (-0.3% Discount Rate)				$66,898
	Report		1	time in 5 yrs		
		RAR / IPCR	1	ea	$50,000	$50,000
		Subtotal - Five Year O&M Costs				$50,000
		Present Worth Five Year Costs				$50,757
		Total Present Worth Direct O&M Cost				**$292,578**
Indirect O&M Costs						
	Project/Admin Management		30%	of direct O&M		$87,773
	Health & Safety		10%	of direct O&M		$29,258
	Overhead		30%	of direct O&M		$87,773
	Contingency		20%	of direct O&M		$58,516
		Total Present Worth Indirect O&M Cost				**$263,320**
		Total Estimated Present Worth O&M Cost				**$555,897**
		TOTAL ESTIMATED COST				**$1,707,034**

Appendix B Notes:
1) Present worth used real discount rate from OMB Circular No. A-94, "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs".

ATTACHED

FOR

ACKNOWLEDGEMENT

OF

RECEIPT

ONLY

SR 224 (Rev 1-26-2011)

Express Mail/Overnight Delivery Service Request

This form must accompany material to the mailroom.

To	Date
Mail Room Personnel	3/7/2018

United Parcel Service (UPS)

Service Required (Check One)

◉ AM Next Morning Before 10:30 ○ Next Day ○ 2nd Business Day

Sender's Name (Print)	Address2	Phone No. 2	Activity Code
Ruth Douglas	730-4B Rm 135	803-952-7589	05DEBPMDRR

Destination Information

Name/Company	Address		
Ms. Margaret Ilugbo-Hunter Asa H. Gordon Library Savannah State University	2200 Tompkins Road		
Phone No.	**City**	**State**	**Zip**
912-358-4325	Savannah	GA	31404

I certify that overnight delivery of:

SRS Administrative Record File (ARF)

READING ROOM FOR REMOVAL SITE EVALUATION REPORT/ENGINEERING EVALUATION/COST ANALYSIS (RSER/EE/CA) FOR C-AREA GROUNDWATER OPERABLE UNIT (U) SRNS-RP-2017-00365, REVISION 1, FEBRUARY 2018, CERCLIS NUMBER 82.

SRNS-J2000-2018-00155

JMLIGHT
8035575456
SAVANNAH RIVER NUCLEAR SOLUTIO
BLDG 731-1N RM 113
AIKEN SC 29808

0.7 LBS LTR 1 OF 1

SHIP TO:
MS. MARGARET ILUGBO-HUNTER
9123584325
ASA H. GORDON LIBRARY
SAVANNAH STATE UNIVERSITY
2200 TOMPKINS ROAD
SAVANNAH GA 31404-5235

GA 314 0-04

UPS NEXT DAY AIR EARLY 1+

TRACKING #: 1Z A5E 795 15 9301 1288

BILLING: P/P

Reference # 1: 05DEBPMDRR

CS 20.0.32. WNTNV50 97.0A 01/2018

SR 224 (Rev 1-26-2011)

Express Mail/Overnight Delivery Service Request

This form must accompany material to the mailroom.

To	Date
Mail Room Personnel	3/7/2018

United Parcel Service (UPS)

Service Required (Check One)

◉ AM Next Morning Before 10:30 ○ Next Day ○ 2nd Business Day

Sender's Name (Print)	Address2	Phone No. 2	Activity Code
Ruth Douglas	703-4B Rm 135	803-952-7589	05DEBPMDRR

Destination Information

Name/Company	Address
Mr. Bill Sudduth Government Information Dept. Thomas Cooper Library University of South Carolina	1322 Greene Street

Phone No.	City	State	Zip
803- 777-5699	Columbia	SC	29208

I certify that overnight delivery of:

SRS Administrative Record File (ARF)

READING ROOM FOR REMOVAL SITE EVALUATION REPORT/ENGINEERING EVALUATION/COST ANALYSIS (RSER/EE/CA) FOR C-AREA

UPS CampusShip

Page 1 of 1

JMLIGHT
8035575456
SAVANNAH RIVER NUCLEAR SOLUTIO
BLDG 731-1N RM 113
AIKEN SC 29808

0.6 LBS LTR 1 OF 1

SHIP TO:
MR. BILL SUDDUTH
8037775699
UNIVERSITY OF SOUTH CAROLINA
THOMAS COOPER LIBRARY
GOVERNMENT INFORMATION DEPT.
1322 GREENE STREET
COLUMBIA SC 29208-4002

SC 292 9-01

UPS NEXT DAY AIR EARLY 1+

TRACKING #: 1Z A5E 795 15 9111 3494

BILLING: P/P

Reference # 1: 05DEBPMDRR

CS 20.0.32. WNTNV50 97.0A 01/2018

Recreate UPS form for DCC use - dsj 2-15-2011

SR 224 (Rev 1-26-2011)

Express Mail/Overnight Delivery Service Request

This form must accompany material to the mailroom.

To	Date
Mail Room Personnel	3/7/2018

United Parcel Service (UPS)

Service Required (Check One)

◉ AM Next Morning Before 10:30 ○ Next Day ○ 2nd Business Day

Sender's Name (Print)	Address2	Phone No. 2	Activity Code
Ruth Douglas	703-4B Rm 135	803-952-7589	05DEBPMDRR

Destination Information

Name/Company	Address
Ms. Marissa Krein Gregg-Graniteville Library University of South Carolina Aiken	471 University Parkway

Phone No.	City	State	Zip
803-641-3261	Aiken	SC	29803

I certify that overnight delivery of:

SRS Administrative Record File (ARF)

READING ROOM FOR REMOVAL SITE EVALUATION REPORT/ENGINEERING EVALUATION/COST ANALYSIS (RSER/EE/CA) FOR C-AREA GROUNDWATER OPERABLE UNIT (U) SRNS-RP-2017-00365, REVISION 1, FEBRUARY 2018, CERCLIS NUMBER 82.

SRNS-12000-2018-00155

UPS CampusShip

Page 1 of 1

JMLIGHT
8035575456
SAVANNAH RIVER NUCLEAR SOLUTIO
BLDG 731-1N RM 113
AIKEN SC 29808

0.6 LBS LTR 1 OF 1

SHIP TO:
MS. MARISSA KREIN
8036413261
UNIVERSITY OF SOUTH CAROLINA-AIKEN
GREGG-GRANITEVILLE LIBRARY
471 UNIVERSITY PARKWAY
AIKEN SC 29801-6389

SC 298 0-01

UPS NEXT DAY AIR EARLY 1+

TRACKING #: 1Z A5E 795 15 9989 2003

BILLING: P/P

Reference # 1: 05DEBPMDRR

CS 20.0.32. WNTNV50 97.0A 01/2018

SR 224 (Rev 1-26-2011)

Express Mail/Overnight Delivery Service Request

This form must accompany material to the mailroom.

To	Date
Mail Room Personnel	3/7/2018

United Parcel Service (UPS)

Service Required (Check One)

(●) AM Next Morning Before 10:30 ( ) Next Day ( ) 2nd Business Day

Sender's Name (Print)	Address2	Phone No. 2	Activitv Code
Ruth Douglas	703-4B Rm 135	803-952-7589	05DEBPMDRR

Destination Information

Name/Company	Address		
Ms. Fay Verberg Govt. Information Coordinator Augusta University, Reese Library Govt. Section	2500 Walton Way		
Phone No.	**City**	**State**	**Zip**
706-737-1744	Augusta	GA	30904

I certify that overnight delivery of:

SRS Administrative Record File (ARF)

READING ROOM FOR REMOVAL SITE EVALUATION REPORT/ENGINEERING EVALUATION/COST ANALYSIS (RSER/EE/CA) FOR C-AREA GROUNDWATER OPERABLE UNIT (U) SRNS-RP-2017-00365, REVISION 1, FEBRUARY 2018, CERCLIS NUMBER 82.

SRNS-J2000-2018-00155

UPS CampusShip

JMLIGHT
8035575456
SAVANNAH RIVER NUCLEAR SOLUTIO
BLDG 731-1N RM 113
AIKEN SC 29808

1.0 LBS LTR 1 OF 1

SHIP TO:
MS. FAY VERBERG
7067371744
GOVT. INFORMATION COORDINATOR
REESE LIBRARY GOVT. SECTION
AUGUSTA UNIVERSITY,
2500 WALTON WAY
AUGUSTA GA 30904-4562

GA 309 0-01

UPS NEXT DAY AIR EARLY 1+

TRACKING #: 1Z A5E 795 15 9277 9309

BILLING: P/P

Reference # 1: 05DEBPMDRR

CS 20.0.32. WNTNV50 97.0A 01/2018