

**THIRD FIVE-YEAR REVIEW REPORT FOR  
SANGAMO WESTON, INC./TWELVEMILE CREEK/LAKE HARTWELL PCB  
CONTAMINATION SUPERFUND SITE  
PICKENS COUNTY, SC**



**Prepared by**

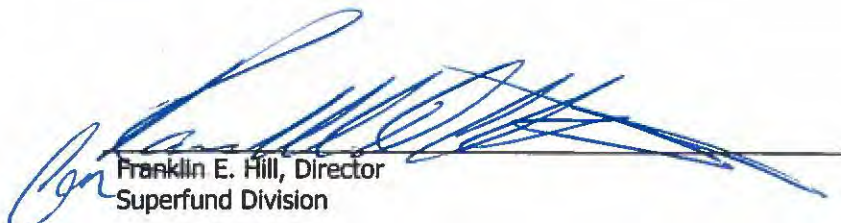
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Franklin E. Hill, Director  
Superfund Division  
U.S. EPA Region 4

3/25/15  
Date

# Executive Summary

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The Region 4 Office of the United States Environmental Protection Agency (USEPA) issued a Record of Decision (ROD) for the Sangamo Weston/Twelvemile Creek/Lake Hartwell Polychlorinated Biphenyl (PCB) Contamination Superfund Site. There are two Operable Units (OUs) for the Sangamo Weston Superfund Site. OU1 includes the land-based source areas, including the Plant Site and six satellite disposal areas and contaminated groundwater associated with the land-based source areas. Four of the satellite sites (Nix, Dodgens, Welborn, and John Trotter) have subsequently been delisted. OU2 is the final action of the two OUs for the site, and addresses the sediment, surface water, and biological migration pathways downstream from the land-based source areas. The ROD for OU2 was issued in June 1994 and monitored natural recovery (MNR) was selected as the remedy for PCB-impacted surficial sediments in approximately 730 acres of the Twelvemile Creek Arm of Lake Hartwell.

The first Five-Year Review (FYR) Reports for OU1 and OU2 were issued in September 2005 and September 2004, respectively. Subsequent FYR Reports for OU1 and OU2 were issued in February 2010. This report is the third FYR Report for the site. The 2014 FYR Report addresses both OUs separately, but under the same cover. The following subsections summarize the work conducted at OU1 and OU2.

## OPERABLE UNIT 1

A substantial amount of work has been conducted during this FYR period, as summarized below for each of the remaining three OU1 sites.

### Breazeale Site

- In 2009, a ROD Amendment (USEPA 2009) was issued to treat groundwater at the Breazeale Site with *in situ* chemical oxidation (ISCO) to further reduce volatile organic compound (VOC) contamination.
- Institutional Controls (IC) have been implemented to restrict land use for OU1.
- Injections and investigations are as follows:
  - ISCO injections were performed at the Breazeale Site in 2009.
  - A source area evaluation using a Membrane-interface Probe was conducted in 2012, which led to the excavation of “hot spots” and further ISCO in late 2012.
  - During November 2012, approximately 561 tons of soil was excavated and backfilled with clean permeable material to create an infiltration gallery.
  - In December 2012, another ISCO injection was completed through the infiltration gallery.

- In early 2013 the National Pollutant Discharge Elimination System (NPDES) permit for Breazeale was rescinded and the wastewater treatment plant (WWTP) and associated wells were abandoned in the last half of 2013 and the beginning of 2014.
- Groundwater monitoring will continue to be conducted annually.
- Additional groundwater investigation in the September 2014 to refine the location of elevated groundwater concentration
- In December 2014, ISCO injections were completed in a number of borings targeted within the elevated groundwater concentration areas.

### **Cross Roads Site**

- Only two chemicals of concern in two wells were detected above Performance Standards.
- Detections were only slightly (less than one order of magnitude) above the 5-µg/L-Performance Standard.
- Groundwater monitoring at the Cross Roads Site will be conducted biennially (every other year) with annual well inspections, beginning in 2015.

### **Plant Site**

- Since startup, over 300 million gallons of groundwater has been recovered and treated, removing approximately 1,988 pounds of VOCs and 27 pounds of PCBs from the environment.
- Groundwater seep collection systems were constructed at Areas 3 and 2 in late 2010.
- In early 2011, the effluent from the WWTP was relocated to the north of Area 3.
- With USEPA approval, recovery wells at Area 3 were shut down in late 2010 and the recovery well at Area D was shut down in 2012.
- The groundwater recovery and treatment system was completely rebuilt to include a new building, new controls, and web-based monitoring during the second half of 2012; the WWTP will continue to be evaluated for potential optimization.
- The concrete basin was cleaned out and converted to an influent storage basin, allowing greater storage capacity and improved system uptime.
- A new stormwater control structure was installed downgradient of Area 5 in 2012 to minimize the amount of sediment in stormwater leaving the site along with a transition zone recovery sump to collect groundwater moving above the bedrock; in addition, the culvert under Sangamo Road was replaced.
- The conceptual site model (CSM) was revised in 2012 and will continue to be revised to help evaluate remedial alternatives for the Plant Site.
- A Supplemental Site Characterization (SSC) was performed for Areas B, D, H, and Former Manufacturing Building (FMB) in 2013 as documented in the SSC Report.
- In 2013, a HydraSleeve comparison study was conducted.
- A new pump building was installed at Area 5 in 2013.

- From results of the SSC of Areas B and D, excavations of “hot spots” were conducted at both areas in late 2013 and early 2014; this eliminated two significant residual areas of contamination and removed approximately 6,284 pounds of PCBs and 715 pounds of tetrachloroethene and trichloroethene combined.
- In 2014, capacity tests were performed and both Area 2 recovery wells and SDMW-4 were re-developed.
- Slug testing was conducted in January 2014.
- In 2014, a geophysical survey of Area 5 was conducted.
- A vapor intrusion screening study was performed in March 2014.
- Vapor intrusion screening and groundwater sampling conducted in late 2014, downgradient of the Former Secure Landfill based on findings from the vapor intrusion study.
- Areas 2, 3, and 5 were updated with new control, monitoring, and alarm systems and new pumps in 2014.

Remedial options for the Plant Site are being further evaluated and a ROD Amendment may be prepared if other remedial options are selected.

### **Protectiveness**

The remedy at OU1 is considered protective of human health and the environment.

### **OPERABLE UNIT 2**

The major components of the OU2 remedy include the following:

- Continuation of the existing fish consumption advisory on Lake Hartwell
- Continued monitoring of aquatic biota and sediment to support continuation and/or justify modifications to the existing advisory
- Regular flushing of sediments trapped in three impoundments on Twelvemile Creek to facilitate burial of contaminated sediments further downstream while mitigating adverse impacts to Lake Hartwell water quality
- Implementation of a public education program to increase awareness about the advisory and methods to prepare/cook fish to reduce the quantity of contaminants consumed

The fish consumption advisory on Lake Hartwell was last modified in 1998 by issuing a joint advisory between Georgia and South Carolina. The current advisory adopts a risk-based approach that issues meal advice to Lake Hartwell anglers based on species harvested and PCB concentration trends in fish tissue. Results of the public education program indicate that users of Lake Hartwell are aware of the fish advisory, and an overwhelming majority of respondents who received public education material reported that it helped them make informed decisions about catching and consuming fish from the lake.

Human health risks are considered minimal for people who eat small to moderate amounts of fish in accordance with the advisory.

The annual aquatic biota and sediment monitoring program has been implemented in the spring of each year since 1994. Three phases of additional investigations were conducted by USEPA's National Risk Management Research Laboratory (NRMRL) and National Exposure Research Laboratory (NERL) to gain a better understanding of natural mechanisms that contribute to the recovery of PCB-contaminated sediments. Data from these investigations indicate that surficial sediment PCB concentrations in the Twelvemile Creek Arm of Lake Hartwell have decreased steadily due to physical processes such as burial, mixing/dispersion, and PCB dechlorination. Sediment age dating indicates that the majority of surficial sediments in the Twelvemile Creek Arm of Lake Hartwell should have reached the 1-milligram-per-kilogram (mg/kg) clean-up goal (adopted in the ROD) between 2007 and 2011. Sediment PCB concentrations in 2008 ranged from non-detect to approximately 3.0 mg/kg. In 2013, sediment PCB concentrations were greater than 1 mg/kg in only 3 of the 21 samples. The concentrations were measured in the lower Twelvemile Creek area. Within the main body of the lake, sediment PCB concentrations were lower than historical levels; PCB values were lower than 1.0 mg/kg. PCB concentrations in the 2013 fish tissue samples indicated substantial decreases compared to the 2005 to 2009 data, and similar levels compared to the 2010 to 2012 data, which were some of the lowest concentrations on record.

PCB concentrations in hybrid bass during 2013 were the lowest (on average lake-wide) on record, and concentrations were below 2.0 mg/kg. The 2013 PCB concentrations in channel catfish were lower than in 2012, with no average concentrations exceeding 1.0 mg/kg compared to one concentration at 1.78 mg/kg in 2012. The majority of largemouth bass sampled from Lake Hartwell were below 2.0 mg/kg. PCB concentrations that exceeded 2.0 mg/kg came from largemouth bass associated with the Twelvemile Creek Arm, at a mean tissue concentration of 3.34 mg/kg, much less than the 2011 and 2012 values, all of which were greater than 8.50 mg/kg.

After several iterations of evaluating effective sediment management plans for the three Twelvemile Creek impoundments, USEPA proposed installing high-flow sluice gates on the downstream side of the Woodside 1 and Woodside 2 impoundments to facilitate downstream transport of sediments to the Twelvemile Creek Arm of Lake Hartwell. However, the Natural Resource Trustees (NRT) and Schlumberger Technology Corporation (STC; potentially responsible party, PRP) reached a technical agreement in principle that involved, among other items, removal of the Woodside 1 and Woodside 2 dams with subsequent stream corridor restoration for an approximately 10,000-foot reach of Twelvemile Creek. USEPA fully supported the dam removal concepts envisioned in the Natural Resource Damage Assessment (NRDA) settlement, as it represented the most permanent solution to ensuring natural sediment transport downstream to the Twelvemile Creek Arm of Lake Hartwell. The NRDA Settlement Consent Decree for OU2 was issued in May 2006. Dam removal activities were ordered to be

expedited and were anticipated to occur during the next 5-year period. An Explanation of Significant Differences (ESD) was issued on September 3, 2009 for OU2 to document a change to the June 1994 ROD. The ESD documents settlement requirements, which include restoration and compensation for alleged injuries to natural resources due to PCB exposure and for alleged lost recreational fishing use due to the fish consumption advisory. Ecological restoration projects included removal of the lower two hydroelectric impoundments on Twelvemile Creek known as Woodside 1 and Woodside 2 and stream corridor restoration. Between March 2010 and September 2011, sediment dredging and the removal of Woodside 1 and Woodside 2 dams were completed as part of stream restoration activities in accordance with the Consent Decree and the ESD.

### **Protectiveness**

The remedy at OU2 is considered protective of human health and the environment.

# Five-Year Review Summary Form

## Five-Year Review Summary Form

SITE IDENTIFICATION		
<b>Site Name:</b> Sangamo Weston/Twelvemile Creek/Lake Hartwell Operable Units (OUs)1 and 2		
<b>USEPA ID:</b> SCD0033544I2		
<b>Region:</b> 4	<b>State:</b> SC	<b>City/County:</b> Pickens/Pickens
SITE STATUS		
<b>NPL Status:</b> Final		
<b>Multiple OUs?</b> Yes	<b>Has the site achieved construction completion?</b> Yes	
REVIEW STATUS		
<b>Lead agency:</b> USEPA If "Other Federal Agency" was selected above, enter Agency name:		
<b>Author name (Federal or State Project Manager):</b> Craig Zeller, P.E.		
<b>Author affiliation:</b> USEPA, Region 4		
<b>Review period:</b> 03/03/14 - 08/31/14		
<b>Date of site inspection:</b> May 7, 2014		
<b>Type of review:</b> Statutory		
<b>Review number:</b> 3		
<b>Triggering action date:</b> 02/10/2010		
<b>Due date (five years after triggering action date):</b> 02/10/2015		



**Five-Year Review Summary Form (continued)**

<b>Issues/Recommendations</b>				
<b>OU(s) without Issues/Recommendations Identified in the Five-Year Review:</b>				
None				
<b>Issues and Recommendations Identified in the Five-Year Review:</b>				
<b>OU(s): 1</b>	<b>Issue Category: Remedy Performance</b>			
	<b>Issue:</b> Although the current groundwater extraction system is protective of human health and environment, it is not going to achieve Maximum Contaminant Levels (MCLs) within a reasonable timeframe.			
	<b>Recommendation:</b> More sustainable alternative remedial technologies will be evaluated and the ROD will be amended.			
<b>OU(s): 2</b>	<b>Issue Category: Operations and Maintenance</b>			
	<b>Issue:</b> Modify aquatic biota and sediment monitoring program to increase efficiency. Remedial actions are now complete at OU2; therefore, monitoring at its current intensity is no longer necessary.			
<b>Affect Current Protectiveness</b>	<b>Affect Future Protectiveness</b>	<b>Implementing Party</b>	<b>Oversight Party</b>	<b>Milestone Date</b>
No	No	PRP	USEPA	OU1: 2019 OU2: 2015

**Five-Year Review Summary Form (continued)**

<b>Protectiveness Statement(s)</b>		
<i>Operable Unit:</i> OU1	<i>Protectiveness Determination:</i> Protective	<i>Addendum Due Date (if applicable):</i> Click here to enter date.
<b>Protectiveness Statement:</b> The remedy at OU1 is considered protective of human health and the environment.		
<i>Operable Unit:</i> OU2	<i>Protectiveness Determination:</i> Short-term Protective	<i>Addendum Due Date (if applicable):</i> Click here to enter date.
<b>Protectiveness Statement:</b> The remedy at OU2 is considered protective of human health and the environment.		
<b>Sitewide Protectiveness Statement (if applicable)</b>		
<i>Protectiveness Determination:</i> Protective	<i>Addendum Due Date (if applicable):</i>	
<b>Protectiveness Statement:</b> At Sangamo Weston/Twelvemile Creek/Lake Hartwell Operable Units (OUs)1 and 2. the remedy is considered protective of human health and the environment.		
<b>Environmental Indicators</b>		
- Current human exposures at the Site are under control. - Current ground water migration is under control.		
<b>Are Necessary Institutional Controls in Place?</b>		
<input checked="" type="checkbox"/> All <input type="checkbox"/> Some <input type="checkbox"/> None		
<b>Has EPA Designated the Site as Sitewide Ready for Anticipated Use?</b>		
<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
<b>Has the Site Been Put into Reuse?</b>		
<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		

# Third Five-Year Review Report

Sangamo Weston, Inc./Twelvemile Creek/  
Lake Hartwell PCB Contamination Superfund Site

## Part 1

*Operable Unit One (OU1), Pickens, Pickens County, South Carolina*

February 2015

# Contents

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1	Introduction .....	1-1
1.1	The Purpose of the Review .....	1-1
1.2	Authority for Conducting the Five-Year Review .....	1-1
1.3	Who Conducted the Five-Year Review.....	1-1
1.4	Other Review Characteristics .....	1-2
2	Site Chronology .....	2-1
3	Background.....	3-1
3.1	Physical Characteristics .....	3-1
3.2	Land and Resource Use .....	3-2
3.3	History of Contamination.....	3-2
3.4	Initial Response .....	3-2
3.5	Basis for Taking Action .....	3-3
4	Remedial Actions .....	4-1
4.1	Remedy Selection.....	4-1
4.2	Remedy Implementation .....	4-2
4.2.1	Soil Remediation .....	4-2
4.2.2	Groundwater Remediation .....	4-3
4.2.3	Groundwater Treatment System Performance Evaluation .....	4-6
4.3	System Operations/O&M/Cost of System Operations .....	4-8
4.4	Implementation of Institutional Controls and Other Measures .....	4-10
4.5	Monitoring Activities.....	4-10
4.6	Opportunities for Optimization.....	4-10
4.7	Early Indicators of Potential Remedy Problems.....	4-10
5	Progress Since Last Five Year Review .....	5-1
5.1	Breazeale Site .....	5-4
5.2	Cross Roads Site .....	5-4
5.3	Plant Site .....	5-4
6	Five-Year Review Process .....	6-1
6.1	Administrative Components .....	6-1
6.2	Community Notification and Involvement.....	6-1
6.3	Document Review .....	6-2

6.4	ARARs Review .....	6-3
6.5	Data Review .....	6-4
6.5.1	Breazeale Site .....	6-5
6.5.2	Cross Roads Site .....	6-6
6.5.3	Plant Site .....	6-6
6.6	Vapor Intrusion Screening Results .....	6-8
6.7	Site Inspection.....	6-8
6.8	Interviews.....	6-9
7	Technical Assessment.....	7-1
7.1	Question A: Is the remedy functioning as intended by the decision documents? .....	7-1
7.2	Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?.....	7-1
7.3	Question C: Has any other information come to light that could call into question the protectiveness of the remedy? .....	7-4
7.4	Technical Assessment Summary .....	7-4
8	Issues .....	8-1
9	Recommendations and Follow-up Actions.....	9-1
9.1	Breazeale Site .....	9-1
9.2	Cross Roads Site .....	9-1
9.3	Plant Site .....	9-1
10	Protectiveness Statement .....	10-1
11	Next Review .....	11-1

**Tables**

1	Chronology of Site Events.....	2-1
2	Groundwater Performance Standards for OU1.....	4-3
3	Annual System Operations/O&M Costs .....	4-10
4	Progress on Recommendations from the 2009 FYR.....	5-2
5	Summary of Groundwater Performance Standard Changes for OU1 .....	6-4
6	Institutional Controls Summary Table .....	6-10
7	Toxicity Changes.....	7-2

## Appendixes

- A Five-Year Review Site Inspection Checklist and Photographs
- B Figures
- C Copy of Community Notification
- D Data Summary Tables
- E Vapor Intrusion Screening and Recommendations Technical Memorandum

# Acronyms and Abbreviations

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AOC	Administrative Order on Consent
ARARs	applicable or relevant and appropriate requirements
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	chemical of concern
CSM	conceptual site model
CWA	Clean Water Act
DCE	dichloroethene
DPT	direct-push technology
ESD	Explanation of Significant Differences
FMB	Former Manufacturing Building
FS	Feasibility Study
FYR	Five-Year Review
gpm	gallons per minute
ICs	Institutional Controls
ISCO	<i>in situ</i> chemical oxidation
MCL	Maximum Contaminant Level
µg/L	microgram per liter
mg/kg	milligrams per kilogram
mg/L	milligram per liter
MIP	Membrane-interface Probe
NCP	National Oil and Hazardous Substances Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRDA	Natural Resource Damage Assessment
NRT	Natural Resource Trustees
O&M	operation and maintenance
OU1	Operable Unit One

OU2	Operable Unit Two
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
ppb	parts per billion
PPE	personal protection equipment
PRP	Potentially Responsible Party
PSVP	Performance Standard Verification Plan
RA	Remedial Action
RAO	Remedial Action Objective
RD	Remedial Design
RI	Remedial Investigation
RI/FS	Remedial Investigation/ Feasibility Study
RMT	RMT, Inc.
ROD	Record of Decision
RPM	Remedial Project Manager
SC DHEC	South Carolina Department of Health and Environmental Control
SDWA	Safe Drinking Water Act
STC	Schlumberger Technology Corporation
SSC	Supplemental Site Characterization
SVE	soil vapor extraction
TBCs	To-Be-Considered criteria
TCE	trichloroethene
TSCA	Toxic Substances Control Act
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UU/UE	Unlimited Use/Unrestricted Exposure
VI	vapor intrusion
VISL	Vapor Intrusion Screening Level
VOC	volatile organic compound
WWTP	wastewater treatment plant





# 1 INTRODUCTION

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## 1.1 THE PURPOSE OF THE REVIEW

The purpose of Five-Year Reviews (FYRs) is to determine whether the remedy at a site is or is expected to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in FYR Reports. In addition, FYR Reports identify issues found during the review and provide recommendations to address them.

## 1.2 AUTHORITY FOR CONDUCTING THE FIVE-YEAR REVIEW

The United States Environmental Protection Agency (USEPA) has prepared this FYR Report pursuant to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121 and the National Oil and Hazardous Substances Contingency Plan (NCP). CERCLA Section 121 states:

*If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with Section 104 or 106, the President shall take or require such action. The President shall report to Congress a list of facilities for which such a review is required, the results of all such reviews, and any action taken as a result of such reviews.*

The USEPA interpreted this requirement further in the NCP. 40 CFR Section 300.430(f)(4)(ii) states:

*If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

## 1.3 WHO CONDUCTED THE FIVE-YEAR REVIEW

USEPA Region 4 has conducted a FYR of the selected remedy for Operable Unit One (OU1) of the Sangamo Weston/Twelvemile Creek/Lake Hartwell PCB Contamination Superfund Site in Pickens County, South Carolina. This review was primarily conducted from March 2014 through August 2014.

A site inspection was completed on May 7, 2014. The site inspection checklist and photolog are presented in Appendix A. This report documents the results of the review.

## **1.4 OTHER REVIEW CHARACTERISTICS**

This is the third statutory FYR for OU1. The triggering action for this review is the previous FYR Report, which was approved on February 10, 2010. The FYR is required statutorily because contamination remains at OU1 at levels that do not allow for Unlimited Use/Unrestricted Exposure (UU/UE).

The third FYR for Operable Unit Two (OU2) was conducted concurrently with the OU1 review and is documented as Part 2, submitted concurrently with this report. Specifically, portions of OU1 that have not been delisted from the National Priorities List (NPL) include the Plant Site, the Breazeale Site, and the Cross Roads Site. These portions of OU1 are discussed in this report. The deleted portions of OU1 (Dodgens [2002], and Welborn, Nix, and Trotter [1998]) have achieved UU/UE and therefore, were not included as part of the FYR process for OU1.

## 2 SITE CHRONOLOGY

Table 1 identifies key site events and relevant dates in the site chronology since 1985. The identified events are illustrative, not comprehensive.

Table 1  
Chronology of Site Events

EVENT	DATE
Discovery and Site Inspection	September 1985
Preliminary Assessment	March 1986
Proposed to NPL	January 1987
Administrative Order on Consent with Schlumberger Technology Corporation (STC) for Performance of Remedial Investigation/Feasibility Study (RI/FS)	June 1987
USEPA Approves RI/FS Work Plan	January 1988
Final Listing on NPL	February 1990
RI/FS Complete	December 1990
OU1 ROD signed	December 1990
OU1 Explanation of Significant Differences (ESD) (first)	September 1991
Remedial Design (RD) Start for Soil	April 1992
RD Start for Groundwater	June 1992
Consent Decree with STC Lodged with Court	December 1992
OU1 Second ESD	June 1993
RD Complete	November 1993
Remedial Action (RA) Start	November 1993
Excavation of Soils at Satellite Disposal Sites	November 1993 – July 1994
RD/RA Completed for Soils	June 1995
Excavation of Soils at Plant Site	July 1995 – May 1997
Thermal Desorption of Soils at Plant Site	December 1995 – May 1997
RD Completed for Groundwater at Breazeale Site	January 1996
RD Completed for Groundwater at Plant Site	January 1997
RD Complete	March 1997
Groundwater System Started at Breazeale Site	June 1997

Table 1  
Chronology of Site Events

EVENT	DATE
Final Inspection for Breazeale Site Groundwater System	September 1997
Final Inspection for Soils Component	November 1997
Pre-Final Inspection for Plant Site Groundwater System	November 1997
Partial Deletion from the NPL	September 1998
Groundwater System Started at Plant Site	November 1998
Final Inspection for Plant Site Groundwater System	March 1999
Partial Deletion of Welborn, Nix, and Trotter areas of OU1	September 1998
Interim RA Report	May 1999
Construction Completion/Preliminary Close-Out Report signed	August 1999
Operation and Maintenance (O&M) of Groundwater Systems at Plant Site and Breazeale Site	Ongoing
Partial Deletion of Dodgens area of OU1	January 2002
Additional Source Characterization on Plant Site near Town Creek	June 2004
Additional Soil and Capacitor Debris Removal at Plant Site	November 2004
Supplemental Groundwater Assessment at Plant Site	March 2005
Supplemental Groundwater Remediation Field Activities at Plant Site	August/September 2005
First FYR Report for OU1	September 2005
Phase 1 Residual Source Investigations Conducted at the Plant Site	March 2007
Phase 2 Residual Source Investigations Conducted at the Plant Site	June 2007
Two <i>In Situ</i> Chemical Oxidation (ISCO) Pilot Studies Conducted at Breazeale Site	2007
Schlumberger Remediation Conducted 3-D Seismic Surveys of Area H and the Former Manufacturing Building Areas at Plant Site	2007
USEPA-approved Modification of Surface Water Sampling Program for Plant Site	December 2007
Soil Vapor Extraction (SVE) Pilot Study at Plant Site	September 2008
Additional Soil and Capacitor Debris Removal at Plant Site	2008
Shut Down Wells in Well Field 2 at Breazeale Site for Development of Site Layout for Chemical Oxidation Program	January 2009
Additional Soil and Capacitor Debris Removal at Plant Site	April 2009
Initial ISCO Injections at Breazeale Site	September 2009
Second FYR Report for OU1	February 2010

Table 1  
Chronology of Site Events

EVENT	DATE
Recovery Wells at Area 3 Shut Down with USEPA Approval	September 2010
Installation of Area 2 Sump Groundwater Seep Collection System	September 2010
Construction of Groundwater Seep Collection System at Area 3	October 2010 to March 2011
Began Operation of Area 3 Seep Collection System and Relocated Outfall of the wastewater treatment plant (WWTP)	March 2011
Installed Stormwater Control Structure and Sump at Area 5	April 2012
Stormwater Control Improvements at Sangamo Road at Plant Site	April 2012
Source Area Evaluation at Breazeale Site with Soil Screening for Volatile Organic Compounds (VOCs) using Membrane-interface Probe (MIP)	July - August 2012
Optimization Improvements to WWTP at Plant Site	July – December 2012
Updated Conceptual Site Model (CSM) for Plant Site	September 2012
Excavation of Hot Spot Soils and Installation of Infiltration Gallery for Further ISCO Treatments at Breazeale Site	November 2012
ISCO Injection at Breazeale Site Infiltration Gallery	December 2012
Recovery Well at Area D Shut Down	2011
Rescinded National Pollutant Discharge Elimination System (NPDES) Permit for Breazeale Site	February 2013
HydraSleeve Comparison Study	March 2013
Area 5, Completed Update Modification to WWTP with New Controls System and Building	May 2013
South Carolina Department of Health and Environmental Control (SC DHEC) Approves Decommissioning Plan for Breazeale Site WWTP	May 2013
Removal of Effluent Discharge Pipe and Diffuser at Wolf Creek and Cap	June 2013
Supplemental Site Characterization for Areas B, D, H, and Former Manufacturing Building (FMB) at Plant Site	March-June 2013
Developed and Cleaned SDMW-4 and Area 2 Recovery Wells and Performed Capacity Tests	October 2013
Excavation of Areas B and H at Plant Site	September 2013 – February 2014
Geophysical Survey of Area 5 at Plant Site	February 2014
Well Abandonment and Final WWTP Decommissioning at Breazeale Site	June 2013 – March 2014
Vapor intrusion screening study	March 2014
OU1 Third ESD to Implement ICs in the ROD	July 2014

Table 1  
Chronology of Site Events

EVENT	DATE
Vapor intrusion testing near Former Secure Landfill	August 2014 – December 2014
Groundwater Investigation and ISCO Injection at Breazeale Site	September 2014 – December 2014
Area H ISCO Injection	November 2014

## 3 BACKGROUND

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### 3.1 PHYSICAL CHARACTERISTICS

Sangamo Weston manufactured capacitors and other related electrical components from 1955 until 1987 when the business was sold. The plant used a variety of dielectric fluids in the manufacturing processes, including fluids that contained PCBs. Waste disposal practices included land burial of off-specification capacitors and wastewater treatment sludge on the 220-acre Plant Site and six satellite disposal areas.

Of the six satellite disposal areas, four were delisted prior to the first FYR. In September 1998, three satellite disposal sites (Nix, Welborn, and John Trotter) and Tract "A" of the Plant Site were delisted from the NPL. There was no groundwater contamination, and soil remediation had been completed at the Nix, Welborn, and John Trotter Sites, which triggered the delisting. In January 2002, the Dodgens Site was also deleted from the NPL. When the RD work plan for groundwater remediation was submitted to USEPA, groundwater quality at the Dodgens Site met Performance Standards.

A remediation system was no longer necessary; therefore, the RD called for groundwater monitoring only for a period of 5 years after October 1994. The first 5-year monitoring period was completed with the January 2000 sampling event. There is no groundwater contamination, and soil remediation has been completed at the Dodgens Site. In November 2001, USEPA pursued a partial delisting for this portion of the OU1. The Dodgens Site was delisted in 2002 and groundwater monitoring is no longer required. The deleted portions of OU1 (Dodgens [2002] and Welborn, Nix, and Trotter [1998]) have achieved UU/UE and therefore, are not discussed extensively in this report. The two remaining satellite disposal areas are within an approximately 3-mile radius of the Plant Site and are referred to as the Cross Roads and Breazeale Sites (see Figure 1 in Appendix B).

At the Plant Site, groundwater flow is toward the north, south, and west, away from the east-west trending ridge that dissects the site. On the north side of the ridge, groundwater flows north to west-northwest toward either of two branches of an unnamed tributary to Twelvemile Creek. Groundwater on the south side of the ridge flows southward where it discharges into Town Creek. Groundwater also discharges into a tributary that begins near the ridge and extends southward to Town Creek (see Figure 2, Appendix B). These creeks and other tributaries that drain the site eventually discharge into Lake Hartwell. Lake Hartwell was created between 1955 and 1963 when Hartwell Dam was constructed by the United States Army Corps of Engineers (USACE) on the upper Savannah River. Lake Hartwell is 56,000 acres in size with a shoreline of 962 miles.



## **3.2 LAND AND RESOURCE USE**

Demographics and land use in Pickens County are variable, with small towns and rural residential development. According to 2010 census data, approximately 119,224 people live in Pickens County. The major community near OU1 is the town of Pickens, which had an estimated population of 3,126 in 2010. Current land use at the satellite disposal areas could be described as vacant parcels. STC donated Tract "A" of the Plant Site to the City of Pickens in June 1999. Tract "A" has been redeveloped as a City of Pickens public recreation complex. The majority of manufacturing infrastructure at the Plant Site was demolished during the clean-up phase. The Plant Site and Breazeale Site remain vacant and ICs have been placed on these parcels, which limits the future land use to industrial purposes. There are currently no residential or industrial activities at the site, and future uses for residential activities are not anticipated at this time.

Groundwater beneath the OU1 sites is not currently used for drinking water and is not anticipated to be used for potable water supply in the future.

## **3.3 HISTORY OF CONTAMINATION**

Between 1955 and 1977, the average quantity of PCBs received and used at the plant ranged from 700,000 to 2 million pounds per year. PCB use was terminated at the plant in 1977, prior to a USEPA ban of its use in January 1978. Waste disposal practices included land burial of off-specification capacitors and wastewater treatment sludge on the Plant Site and six satellite disposal areas. It is generally thought that onsite disposal occurred, as needed, from the mid-1950s until July 1972. The manufacturing process associated with capacitors typically involves the use of chlorinated solvents as degreasing agents. A fish consumption advisory for portions of Lake Hartwell was first instituted in 1976. This advisory has been modified many times and remains in effect. An estimated 3% of the quantities received and used at the plant may have been discarded in Town Creek, resulting in approximately 400,000 lbs of PCBs.

## **3.4 INITIAL RESPONSE**

The Sangamo site was proposed to the NPL in January 1987. On June 18, 1987, Sangamo Weston and USEPA Region 4 signed an Administrative Order on Consent (AOC) that specified actions to assess the presence and extent of waste constituents in soils and groundwater at the Plant Site and the six remote sites resulting from the waste disposal activity. Sangamo Weston developed an RI/FS work plan and supporting plans, which were approved by USEPA in January 1988. The site became final on the NPL in February 1990. The RI/FS was conducted and USEPA issued a ROD in December 1990.

As a result of a merger with Sangamo Weston, the Potentially Responsible Party (PRP) for the Sangamo site is STC of Houston, Texas. The site was divided into two OUs. The land-based source areas, which

included the Plant Site and six satellite disposal areas and contaminated groundwater associated with the land-based source areas, are represented as OU1. STC conducted the OU1 RI/FS pursuant to the terms of a June 1987 AOC. The ROD for OU1 was issued by USEPA in December 1990. STC performed the RD/RA at OU1 pursuant to the terms of an April 1992 Consent Decree with USEPA. Remediation construction objectives outlined in the 1990 ROD were achieved for OU1 at the Sangamo site in August 1999. The first FYR for OU1 was completed in September 2005. OU2, presented in the first FYR, completed in September 2004, is the sediment, surface water, and biological migration pathways downstream from the source areas. The second FYR was completed in February 2009.

### **3.5 BASIS FOR TAKING ACTION**

The contaminated media of concern for OU1 are surface/subsurface soils, groundwater, sediment, and solid waste/sludge. The primary chemical of concern (COC) for the OU1 site is PCBs, although many VOCs were detected in soils and groundwater. The principal human health risk driving the need for a response action was direct contact/incidental ingestion of PCBs in the surface soils. The potential carcinogenic human health risks posed by dermal contact/incidental ingestion of PCBs in surface soils ranged from  $1.2 \times 10^{-5}$  for the Breazeale Site to  $1.3 \times 10^{-3}$  for the Plant Site. While the potential human health risks associated with the future consumption of groundwater were not quantified, PCBs and many VOCs were detected at concentrations that exceeded the Maximum Contaminant Levels (MCLs) and/or risk-based criteria.

Based on recommendations from the first FYR, along with additional investigations performed at both the Breazeale Site and Plant Site, a change in RA was recommended for these portions of OU1. Consistent with the USEPA's ROD process, a ROD Amendment for the Breazeale Site portion of OU1 (USEPA 2009) was prepared and signed by USEPA on September 29, 2009. Additional site investigation work and an injection were performed at the Breazeale Site in late 2014. A remedial alternatives analysis will be conducted in 2014 for the Plant Site and a ROD Amendment may be prepared based on recommendations from further evaluations at the Plant Site.

## 4 REMEDIAL ACTIONS

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### 4.1 REMEDY SELECTION

Remedial action objectives (RAOs) were not explicitly identified for the site in the 1990 ROD; however, general remedial goals were to:

- Excavate, treat, and dispose of PCB-contaminated soils at the Plant Site and satellite sites.
- Restore groundwater to its beneficial use, which at this site is a drinking water aquifer.
- Protect surface water and receptors.

The selected remedy in the December 1990 ROD for OU1 consisted of the following primary components:

- Extraction and treatment of contaminated groundwater at the Dodgens, Breazeale (Figure 3, Appendix B), Cross Roads (Figure 4, Appendix B), and Plant Sites.
- Discharge of treated groundwater to the nearest viable surface water body in accordance with applicable regulations.
- Excavation of contaminated soil with concentrations greater than or equal to 10 milligrams per kilogram (mg/kg) PCBs in non-ravine areas of the Nix and Welborn Sites where erosion was not a concern. Excavation of contaminated soil with concentrations greater than or equal to 1 mg/kg at the Nix and Welborn properties in ravine areas where erosion was a concern.
- Excavation of contaminated soil with concentrations greater than or equal to 10 mg/kg PCBs at the Trotter, Dodgens, Breazeale, and Cross Roads Sites.
- Transportation of excavated soils from the six satellite disposal sites to the Plant Site for staging and treatment.
- Backfilling with 2 feet of clean soil at the six satellite disposal sites where remaining soils were greater than or equal to 1 mg/kg PCBs.
- Excavation of contaminated soil with concentrations greater than or equal to 25 mg/kg PCBs at the Plant Site.
- Treatment of excavated soils from the six satellite disposal sites and the Plant Site to less than or equal to 2 mg/kg PCBs using low temperature thermal desorption.
- Backfilling of treated soils on the Plant Site.

Institution controls were not formally included in the 1990 OU1 ROD as part of the remedy for the site but are currently in place for OU1.

Three ESD documents have been issued by USEPA to document changes to the ROD for OU1. In September 1991, the first ESD identified metals in soils and groundwater in amounts that may exceed acceptable health-based levels. This resulted in a modification to the ROD to include clean-up criteria for metals contamination in groundwater, and to require additional testing and data gathering for metals at the site.

In June 1993, the second ESD for OU1 was issued by USEPA. This ESD presented the results of USEPA's evaluation of metals at the site, concluding that metals contamination of surface soils and groundwater does not pose an unacceptable risk to human health or the environment. Other ROD modifications included updating groundwater remediation criteria and waiving certain applicable requirements identified for the storage of PCB wastes.

In July 2014, a third ESD was issued by USEPA to implement institutional controls.

Remedy effectiveness has been evaluated for both the Plant and Breazeale Sites since the second FYR.

Additional investigations and remedial alternative evaluations are currently being considered for both sites.

## **4.2 REMEDY IMPLEMENTATION**

This section provides a summary of the RAs performed since the previous FYR Report was submitted. The following discussion is organized and presented by soil and groundwater.

### **4.2.1 Soil Remediation**

**Breazeale Site.** In November 2012, approximately 561 tons of soil were excavated from a small 700-square-foot source area at the Breazeale Site to a depth of 13 feet below ground surface (bgs). The excavation was backfilled with approximately 365 tons of clean #57 stone and subsurface polyethylene piping to create an infiltration gallery.

**Plant Site.** Between September 2013 and February 2014, STC excavated and removed soil at Areas B and H using green, sustainable remediation practices. These activities eliminated two previously unknown and significant residual areas of contamination at the facility. Totals of 4,385 and 12,032 in-place cubic yards were excavated from Areas B and H, respectively, comprising a total excavated mass of approximately 28,000 tons. The excavated soil was sorted according to the Toxic Substances Control Act (TSCA) and disposed of as follows:

- Approximately 9,000 tons of rock greater than 2 inches in diameter was screened out to use for backfill.

- 6,992 tons of soil was classified as non-TSCA waste and transported offsite to the Waste Management Palmetto Landfill in Wellford, South Carolina.
- 10,289 tons of TSCA waste was transported offsite to the Waste Management Landfill in Emelle, Alabama.

As a result of this removal action, based on previous soil analytical samples and subsurface modeling, approximately 6,284 pounds of PCBs and 715 pounds of tetrachloroethene (PCE) and trichloroethene (TCE) was calculated to have been removed from Areas B and H combined. A full description of these activities is detailed in the Construction Completion Report (CH2M HILL 2014).

#### 4.2.2 Groundwater Remediation

Active groundwater recovery and treatment has been conducted at the Breazeale and Plant Sites consistent with the 1990 OU1 ROD. Since 1999, formal annual monitoring reports have been submitted for monitoring results at Cross Roads, as well as groundwater monitoring, recovery, and treatment at the Breazeale and Plant Sites.

The Performance Standards for contaminants in groundwater are provided in Table 2:

Table 2  
Groundwater Performance Standards for OU1

CONSTITUENT	PERFORMANCE STANDARD (milligram per liter [mg/L])
Chloroform	0.08
1,1-dichloroethene (1,1-DCE)	0.007
1,2-DCE, total	0.07
PCE	0.005
TCE	0.005
1,1,1-Trichloroethane	0.2
Vinyl Chloride	0.002
Total PCBs	0.0005

**CSM Update.** The purpose of the CSM is to present a representation of surface and subsurface conditions as they exist at the present time. The CSM is an “evergreen” document and evolves as data are collected, gaps addressed, and new insights gained. It was determined that the 2012 CSM figure, although suitable for the original CSM document and Supplemental Site Characterization (SSC), needed greater subsurface detail, expansion to include the Former Secure Landfill, and a rotation of the

perspective for clearer display of the main Plant Site source and groundwater recovery areas. The updated CSM figure (Figure 5, Appendix B) includes the following:

- Structural features and bedrock descriptions from the *Geologic Map of the Pickens Quadrangle* (Garihan et al. 2008)
- Model expansion to incorporate the Former Secure Landfill, the site boundary and receptors such as “Powell Pond,” the Pickens Recreation Center, adjoining properties, and a longer reach of Town Creek
- Topographic contours at 5-foot intervals to better depict site relief
- Inclusion of faults at the FMB and Area H from STC’s seismic profiling (STC 2008)

**Breazeale Site.** In 1997, a groundwater extraction and treatment system, consisting of 2 jet pumps and 11 eductors, was installed to mitigate migration of the dissolved-phase VOCs in groundwater and prevent impacts to Wolf Creek. During the system’s operation, it extracted 116,298,500 gallons of groundwater and removed an estimated 84.4 pounds of chlorinated solvents. The system was deactivated after issuance of the ROD Amendment in September 2009. Since then, the system remained secured but out of service. Therefore, the groundwater extraction and treatment plant and point-source discharge were no longer active.

SC DHEC rescinded Permit No. SC0047198 on February 11, 2013. Closeout operations began and were completed in June 2013. These included removing the diffuser from Wolf Creek along with the ductile iron pipe and concrete sump, capping the 4-inch effluent discharge line at the sump, and plugging and grouting the 4-inch effluent line inside the building.

Between February and March 2014, the remaining equipment inside the building was removed as well as site infrastructure including the jet/eductor system piping, control and electrical cables, well vaults, and the remaining 4-inch capped effluent discharge pipe were excavated back to the WWTP building fence line and removed.

Final inspection and closeout of the WWTP were requested by STC in letters dated April and June 2014, respectively, to SC DHEC, Upstate Environmental Quality Control Region in Greenville. Annual monitoring continues at the Breazeale Site.

To accelerate the groundwater treatment, a full-scale chemical oxidation remedy was implemented in September 2009. Additional chemical oxidant was injected in December 2012, resulting in significant decreases in chlorinated VOC concentrations. In December 2014, an ISCO injection was performed to further decrease the chlorinated VOC concentrations.

**Plant Site.** The groundwater remediation system was started at the Plant Site in November 1998 and has been operated continuously, with minor interruptions for maintenance, since that time. The system

consists of a groundwater extraction and collection system and equipment to treat (remove) PCBs and VOCs. A large 600,000-gallon concrete equalization basin at the WWTP receives groundwater extracted from seeps and recovery wells with electric submersible pumps in Areas 2, 3, 4, 5, and 7. When the water level in the basin exceeds 6 feet deep (210,000 gallons), water is pumped from the basin for further treatment with air stripping and activated carbon. Before treatment, however, a portion of this basin effluent is recycled to a sprayer back into the basin to aerate the water and reduce levels of dissolved iron and manganese. The vapor effluent from the air stripper is de-misted but is not further treated prior to atmospheric discharge. The treated effluent is discharged onsite to a creek bed, where it flows 300 yards to a small pond (approximately 2 acres in size). The pond overflows into a creek bed, which flows another 200 feet before ultimately discharging to Town Creek under NPDES Permit No. SC0046612, which is currently in the renewal process.

Groundwater quality monitoring is conducted annually in March to measure system effectiveness. In March 2013 and as documented in the *Annual Report for the Period March 2012 to March 2013*, a study of groundwater sampling methods was performed to compare the traditional low-flow method to the HydraSleeve no-purge sampling method. Samples were collected by both methods in a subset of the site wells and the analytical results were compared for precision. HydraSleeve analytical results strongly correlated to low-flow sampling results, with log-transformed VOC correlation coefficients in the range of 0.974 to 0.997 (1.000 being ideal). Based on the favorable outcome of the study, HydraSleeve methods were approved for future groundwater sampling at OU1. Active wells in the Plant Site's groundwater extraction network that cannot be sampled by the HydraSleeve method will continue to be sampled from a port in the pump discharge line.

In January 2014, slug testing was completed at 14 monitoring wells at the Plant Site to gain a better understanding of the hydraulic conductivity within the subsurface saturated zones (saprolite, transition zone, and bedrock). The testing concluded that the transition zone exhibited hydraulic conductivity and seepage velocity comparable to those of a silty sand. Saprolite and bedrock wells exhibited slightly higher average hydraulic conductivity than the transition zone. In addition to the slug testing, transducers were deployed in three monitoring wells to monitor long-term groundwater fluctuations.

Since system startup in 1998, the groundwater remediation system has recovered and treated approximately 307 million gallons of groundwater. This has resulted in the removal of approximately 1,988 pounds of chlorinated solvents and 27 pounds of PCBs, primarily Aroclor 1248.

**Cross Roads Site.** Annual monitoring continues at the Cross Roads Site. Remaining concentrations are nearing Performance Standards and monitoring will continue until standards are met. However, since concentrations have been stable to declining, the annual monitoring and reporting frequency will be reduced to biennial, with annual well inspections.

### 4.2.3 Groundwater Treatment System Performance Evaluation

**Breazeale Site.** Injections of ISCO at the Breazeale Site have reduced concentrations of TCE and PCE in a relatively short period of time compared with continued groundwater extraction and treatment. This alternative is protective of human health as it will return the aquifer to its designated use as a drinking water source in a shorter period of time than pump-and-treat. This alternative is also protective of surface water quality as it would meet the surface water criteria for PCE (0.00069 mg/L) and TCE (0.0025 mg/L).

Based on the information available at the time, USEPA and the State of South Carolina believed that the Preferred Alternative would be protective of human health and the environment, would comply with applicable or relevant and appropriate requirements (ARARs), would be cost-effective, and would utilize permanent solutions and alternative treatment technologies to the maximum extent practicable.

In September 2009, STC injected approximately 54,600 gallons of 6 percent potassium permanganate solution into 30 direct-push technology (DPT) borings (RMT 2009). The injections occurred in the central part of the site, inside a quadrilateral area approximately defined by BRMW-04, BRMW-10, BRMW-02, and BRMW-03. In the majority of the borings, 12 injections were made into 1-foot intervals at variable depths so that permanganate was distributed from approximately 18 to 50 feet bgs. At 10 injection locations, the permanganate was distributed from approximately 18 to 40 feet bgs, and at two locations the distribution was from approximately 18 to 29 feet bgs.

In November 2012, STC completed an excavation of hot spot soils and installation of an infiltration gallery for further ISCO treatments. The work was conducted in accordance with the work plan approved by SC DHEC (Geosyntec Consultants 2012) and associated underground injection control permits. During the work, STC excavated approximately 561 tons of VOC-impacted soil and transported the waste offsite for disposal at the Upstate Regional Municipal Solid Waste Landfill in Enoree, Union County, South Carolina. STC backfilled the excavation with approximately 365 tons of clean #57 stone and subsurface piping to create the infiltration gallery.

In December 2012, STC tested the infiltration gallery with about 200 gallons of potable water, and then placed approximately 9,000 gallons of ISCO solution averaging 1.1 percent sodium permanganate into the gallery. The rate of injection (14 gallons per minute [gpm]) was sufficiently slow that minimal groundwater mounding and displacement were measured in downgradient monitoring wells.

The pump-and-treat remedy had a limited effect in most wells, and only the ISCO treatments (beginning in 2009) substantially lowered VOC levels. Many of the wells attained the Performance Standards for TCE and PCE, although some rebound of contaminant levels occurred. Wells further downgradient show residual effects of ISCO treatments, though oxidation-reduction potential measured in BRMW-11 was not high and permanganate was not detected in the groundwater sample. The consistently high VOC



levels in the well suggest an additional ISCO treatment may be needed. Likewise, BRMW-02 showed good response to the 2009 ISCO treatments, but is not yet showing a response to the 2012 treatment through the infiltration gallery. STC monitored the wells in fall 2013 and March 2014 to observe the effects of the 2012 actions. However, three wells (BRMW-02, BRMW-04, and BRMW-11) continued to exceed the Performance Standards. Because BRMW-04 appears to be sidegradient to the infiltration gallery, additional ISCO injections (by DPT) will be performed in late 2014 to treat the plume. Prior to the injection, a site investigation will be performed to delineate the plume in the area of these wells.

A ROD Amendment was finalized in September 2009 for this site. The injection is consistent with Part 5 of the ROD Amendment as follows:

- Use of ISCO in the form of potassium permanganate to reduce the concentrations of PCE and TCE to levels that would be protective of Wolf Creek and accelerate the process to achieve clean-up levels and RAOs for groundwater at the site
- Monitoring of the ISCO treatment process to demonstrate that clean-up levels and RAOs for groundwater at the site have been achieved
- IC in the form of land use and groundwater use restrictions (complete)

**Plant Site.** Recommendations from the second FYR for the Plant Site have been evaluated, implemented, and are ongoing. Between 2012 and 2013, nearly the entire water treatment, controls and conveyance systems were rebuilt, upgraded, and modernized. Since that time, the following observations were made about the groundwater recovery and extraction system:

- The WWTP operated as planned, with occasional downtime due to system repairs, maintenance, and optimization. Because of the increased storage capacity available in the concrete stabilization basin, the recovery wells and pumps were not shut down during these plant down times. Monthly samples were collected to confirm that the effluent quality as required by NPDES permit requirements was achieved. Lastly, a “dashboard” of near-real-time operations data was developed to monitor and assist in making timely decisions regarding system performance and optimization.
- The flow records for the Plant Site WWTP indicate that the system was operated successfully over the past year, showing that the system extracted and treated approximately 27.0 million gallons during the April 2013 to March 2014 reporting period. This exceeds the estimated 20 million gallons reported for the prior 12-month period (CH2M HILL 2013) by 38 percent. This increase is likely due to the site-wide efforts to optimize groundwater recovery that were detailed in the prior annual report (CH2M HILL 2013).
- Since November 1998 (startup), the system has treated 307 million gallons of water and removed approximately 1,988 pounds of VOCs (DCE+TCE+PCE) and 27 pounds of PCBs. As a result of the increased groundwater recovery volume and optimization, approximately 106 pounds of VOCs and 4.4 pounds of PCBs were removed during the April 2013 to March 2014 reporting period, compared to about 59 pounds of VOCs and 1.2 pounds of PCBs reported for the prior year of operations.

The groundwater recovery and treatment system at the Plant site has operated since 1998. From November 1998 through March 2014, approximately 300 millions of gallons of contaminated groundwater have been recovered and treated. This has resulted in the removal of approximately 1,988 pounds of VOCs and 27 pounds of PCBs. In 2013, the groundwater recovery and treatment system appeared to have reached asymptotic levels with only 106 pounds of VOCs and 4.4 pounds of PCBs recovered during 2013. In 2014, optimization efforts were taken that resulted in a slight increase in VOC mass recovery.

During the past 5 years, Schlumberger has made significant progress with respect to optimizing the performance and monitoring of the groundwater recovery and treatment system at the Plant Site. Optimization efforts have included (but are not limited to):

- Removal of unnecessary treatment components and simplifying the treatment train
- Addressing uncertainties in the CSM through additional investigations which led to the discovery of additional source areas
- Removal of 17,246 tons of impacted soils in Areas B and H which were acting as a secondary source of groundwater contamination
- Identifying and implementing remedial alternatives for treating remaining source areas (i.e., ISCO at Area H)
- Evaluation and implementation of passive groundwater sampling techniques (i.e., HydraSleeves)
- Creation of a dashboard system to better track and evaluate operating system data

The results of these optimization efforts and review of historical data indicate that the existing groundwater recovery and treatment system at the Plant site has reached asymptotic levels and is unlikely to achieve MCLs within a reasonable timeframe, as defined by USEPA. Thus, the ROD should be amended to address changes in the technology and to modify the remedial action objectives for the site.

### **4.3 SYSTEM OPERATIONS/O&M/COST OF SYSTEM OPERATIONS**

Long-term O&M activities have been performed at the site since 1997. The primary activities associated with O&M during this reporting period include the following:

- Visual inspection of the Plant, Breazeale, and Cross Roads Sites
- Plant Site and Breazeale Site Groundwater Treatment System O&M (treatment system for Breazeale Site ceased in 2009)
- Periodic mowing
- Inspection of the condition of groundwater monitoring wells at Plant Site, Breazeale Site, and Cross Roads Site
- Environmental Monitoring: Annual monitoring and reporting of groundwater and surface water

Annual O&M costs for the groundwater recovery and treatment systems were estimated at \$1.5 million during the FS and ROD phase. However, annual O&M costs for the existing systems described above for the sites are averaging approximately \$470,000. The major discrepancy in the cost estimate and actual costs incurred relates to what was actually constructed. For example, the ROD required active groundwater recovery/treatment at the Dodgens and Cross Roads Sites, as well as at the Breazeale and Plant Sites. However, active groundwater recovery was not implemented at the Dodgens and Cross Roads Sites, resulting in a lower site-wide annual O&M cost. As presented in the 2009 5-Year Review Report, "In January 2002, the Dodgens Site was delisted from the NPL. When the RD work plan for groundwater remediation was submitted to the USEPA, groundwater quality at the Dodgens site met performance standards. A remediation system was no longer necessary; therefore, the RD called for groundwater monitoring only for a period of 5 years after October 1994. The first 5-year monitoring period was completed with the January 2000 sampling event. There is no groundwater contamination and soil remediation has been completed at the Dodgens site. In November 2001, UESPA pursued a partial delisting for this portion of OU-1. The Dodgens site was delisted in 2002 and groundwater monitoring is no longer required." Groundwater at the Cross Roads Site continues to be monitored annually.

O&M costs include site and treatment system maintenance, sampling and monitoring efforts, and monitoring well maintenance. Annual system operations/O&M costs are summarized in Table 3. Associated costs for OU2 are included in the OU2 FYR Report.

Unanticipated costs include:

- Installed of Area 3 French drain system and relocation of NPDES discharge point - \$496,000 (2010)
- Installed Area 2 sump - \$286,000 (2011/2012)
- Installed stormwater control structure and sump at Area 5 - \$373,000 (2012)
- Rebuilt, upgraded, and modernized water treatment system, controls and conveyance systems - \$522,000 (2012) and \$165,000 (2013)
- Upgraded Areas 2, 3, 4, and 5 - \$55,000 (2012) and \$135,000 (2013)
- Repaired Sangamo Road - \$138,000 (2013)

Table 3  
Annual System Operations/O&M Costs

DATES		TOTAL COST ROUNDED TO NEAREST \$1,000
FROM	TO	
2009	2010	\$792,000
2010	2011	\$386,000

Table 3  
Annual System Operations/O&M Costs

DATES		TOTAL COST ROUNDED TO NEAREST \$1,000
FROM	TO	
2011	2012	\$737,000
2012	2013	\$1,411,000
2013	2014	\$897,000

#### **4.4 IMPLEMENTATION OF INSTITUTIONAL CONTROLS AND OTHER MEASURES**

The Plant Site and Breazeale Site remain vacant and ICs have been placed on these parcels, which limits the future land use to industrial purposes.

#### **4.5 MONITORING ACTIVITIES**

Annual groundwater monitoring has been performed and is continuing at the Breazeale, Plant Site, and Cross Roads locations.

#### **4.6 OPPORTUNITIES FOR OPTIMIZATION**

Optimization of the groundwater recovery system, detailed in the prior annual report has resulted in the system extracting and treating approximately 27.0 million gallons during the April 2013 to March 2014 reporting period. This exceeds the estimated 20 million gallons reported for the prior 12-month period by 38 percent. The weekly evaluation of the groundwater recovery system is conducted to continue to seek optimization opportunities.

Optimization of the monitoring program is conducted as part of the annual monitoring effort to identify and address the well inefficiencies and network gaps.

#### **4.7 EARLY INDICATORS OF POTENTIAL REMEDY PROBLEMS**

Performance monitoring of remedies have not indicated any potential remedy problems.

## 5 PROGRESS SINCE LAST FIVE YEAR REVIEW

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The Protectiveness Statement from the 2009 FYR for OU1 stated the following:

*The remedy at Sangamo OU1 is considered protective in the short term of human health and the environment because groundwater at OU1 and satellite area is not used for potable drinking water. To remain protective in the long term, the remedy at OU1 has been amended to treat groundwater at the Breazeale Site using an ISCO treatment using potassium permanganate to further reduce VOC contamination. A ROD Amendment has been finalized for this modification to the RA at Breazeale. In addition, institutional controls have been implemented to restrict land use for all of OU1 and need to be added to a remedy decision document. Groundwater monitoring at the Cross Roads Site will continue to be conducted annually. The groundwater recovery and treatment system at the Plant Site area will continue to be evaluated for potential optimization. As needed, the site conceptual model will be revised and remedial alternatives will be evaluated at the Plant Site.*

The 2009 FYR included 7 recommendations and indicated that each recommendation would be implemented by STC. Each recommendation and the current status are discussed in Table 4.

STC worked to implement the recommendations from remedy effectiveness evaluations conducted since the second FYR. Residual VOC and PCB source investigations were conducted at the Breazeale and Plant Sites to identify contaminant mass that may be contributing to the need for the long-term pump-and-treat strategy. Two ISCO injection events were performed at the Breazeale Site. In 2009, an ISCO injection was completed using DPT and in 2012, another ISCO injection was completed through a post-excavation infiltration gallery. Results have demonstrated improving groundwater concentrations; another injection was conducted in 2014.

At the Plant Site, the CSM was updated in 2012 followed by an extensive site investigation in 2013. The WWTP was upgraded in 2012 – 2013. The system data are evaluated weekly using a “dashboard” and optimized. STC excavated and removed soil at Areas B and H, which eliminated two previously unknown and significant residual areas of contamination at the facility.

STC is performing a remedial alternatives analysis to address soil and groundwater impacted areas identified in the 2013 SSC report (CH2M HILL 2013). Interim actions and pilot studies may be conducted at both the Breazeale and Plant Sites. The Plant Site activities may support a ROD Amendment.

Table 4  
Progress on Recommendations from the 2009 FYR

2009 FYR SECTION	RECOMMENDATIONS	PARTY RESPONSIBLE	MILESTONE DATE	ACTION TAKEN AND OUTCOME	DATE OF ACTION
9	1990 RODs did not contain ICs. ICs for Plant Site will be included in a ROD Amendment.	STC	2014	Complete.	2014
9	Continue evaluations of remedial options for groundwater treatment at Plant Site to optimize groundwater remediation.	STC	2014	Ongoing. Performing a remedial alternatives analysis to address soil and groundwater impacted areas identified in the 2013 SSC (CH2M HILL 2013). Interim actions and pilot studies may be conducted. The Plant Site activities may support a ROD Amendment. Removed soil at Areas B and H, which eliminated two previously unknown and significant source areas of contamination at the Plant Site.	Ongoing
9.1	Breazeale Site: Full-scale implementation of the ISCO occurred in September 2009 in order to expedite clean-up of groundwater to Performance Standards. Continue groundwater monitoring as described in the Final Design Report for Breazeale Site. (CH2M HILL 2012).	STC	2014	Ongoing. Completed additional ISCO injections in Dec 2012. Focused injections conducted in 2014.	2014
9.2	Cross Roads Site: Groundwater impacts at Cross Roads are limited to one well with concentrations of VOCs slightly above the Performance Standards. Groundwater should continue to be monitored annually and no active remediation is recommended at this time.	STC	2014	Complete.	2014

Table 4  
Progress on Recommendations from the 2009 FYR

2009 FYR SECTION	RECOMMENDATIONS	PARTY RESPONSIBLE	MILESTONE DATE	ACTION TAKEN AND OUTCOME	DATE OF ACTION
9.3	Plant Site: Continue to operate and maintain the full-scale groundwater recovery and treatment system at the Plant Site as recommended in the annual monitoring reports.	STC	2013	<p>Ongoing.</p> <p>Major improvements to the groundwater recovery and treatment system include the following:</p> <ul style="list-style-type: none"> <li>• Stormwater control structure and sump at Area 5 (2012)</li> <li>• Water treatment system controls and conveyance systems rebuild, upgraded, and modernized, building and web-based monitoring (2012 – 2013)</li> <li>• Upgrades to Areas 2, 3, 4, and 5 with new control, monitoring, and alarm systems and new pumps (2012 – 2014)</li> </ul>	2012/2014
9.3	Plant Site: Continue to refine the CSM at the Plant Site.	STC	2012	<p>September 2012 CSM, ongoing.</p> <p>Completed site characterization at Areas B, D, H, and FMB in April 2013.</p> <p>Identified potential secondary source of contamination in Area B, which expanded short-term remedial activities in this area (2013).</p> <p>Optimized monitoring program and identified wells not in use for plugging and abandonment (2013/2014).</p>	2012 - 2014 Ongoing
9.3	Plant Site: Continue to evaluate remedial alternatives for Plant Site	STC	2014	<p>Completed excavation at Areas B and H (2013 - 2014).</p> <p>Evaluation of remedial alternatives is in progress to facilitate potential a ROD Amendment (2014/2015).</p>	2013 - 2014 Ongoing

## **5.1 BREAZEALE SITE**

- September 2009 - ISCO injections made by DPT showed strong reductions in TCE and PCE concentrations in monitoring wells within the central part of the plume.
- 2012 - MIP monitoring indicated a 700-square-foot area of residual contaminated soil (source material).
- November 2012 - Approximately 561 tons of soil were excavated from the source area to a depth of 13 feet bgs. The excavation was backfilled with approximately 365 tons of clean #57 stone and subsurface polyethylene piping to create an infiltration gallery.
- December 2012 - The underground injection control permit was amended and a second ISCO treatment of 9,000 gallons of 1.1 percent sodium permanganate was injected into the new infiltration gallery.
- March 2013 - Groundwater analytical results indicated that groundwater samples from only three wells (BRMW-02, BRMW-04, and BRMW-11) currently exceed the Performance Standards for groundwater.
- May 2013 – Decommission Plan submitted to SC DHEC for the former WWTP, approved May 2013.
- June 2013 – WWTP decommissioning work completed, which included removing the diffuser from Wolf Creek along with the ductile iron pipe and concrete sump, capping the 4-inch effluent discharge line at the sump, and plugging and grouting the 4-inch line effluent line inside the building.
- February 2014 – 33 wells were plugged and abandoned (8 monitoring wells, 16 pilot test wells, and 9 extraction wells).
- February through March 2014 – Site infrastructure removed (jet/eductor system piping, control and electrical cables, well vaults, and the remaining 4-inch capped effluent discharge pipe were excavated back to the WWTP building fence line and removed).
- April 2014 – Site inspection by SC DHEC.
- May 2014 – Follow-up field activities completed for request for final WWTP closeout letter from SC DHEC.
- September 2014—Conducted targeted groundwater sampling effort.
- December 2014—Performed an ISCO injection in targeted locations.

## **5.2 CROSS ROADS SITE**

- Analytical results from annual monitoring results indicated that 2 of 6 Cross Roads wells exceed the Performance Standards for VOCs in March 2014.

## **5.3 PLANT SITE**

Activities performed at the Plant Site during this FYR are as follows:



- Continued operation of the groundwater recovery and extraction system and conducted the annual groundwater monitoring and reporting throughout the past 5 years.
- In April 2012, STC conducted stormwater control system repair and maintenance work in and around the 30-inch concrete stormwater culvert that passes under Sangamo Road adjacent to the site. Significant overgrowth and erosion had undermined the performance of the culvert. In response, STC installed a 54-inch outlet control structure, check dams, sand and geotextile filtration, and rip-rap to control further erosion, effectively manage stormwater runoff, and improve the overall quality of water leaving the site.
- During the Stormwater Control system repair, a 30-inch groundwater collection sump with a sump pump controlled by a float switch was installed below the Stormwater Control system to collect transition zone water at bedrock. The new sump system has been operating since installation, producing an estimated average 6 gpm during dry periods of non-precipitation and up to 20 gpm after storm events.
- In June 2013, in a public/private partnership with the City of Pickens, STC replaced the 48-inch concrete culvert under Sangamo Road and improved the slope stability of the road.
- July - December 2012 - The groundwater extraction and treatment system was re-configured and equipment was optimized to increase groundwater extraction effectiveness and treatment efficiency (discussed below).
- September 2012 - A CSM that described the various components of the subsurface environment, as understood at the present time, was developed based on the numerous historical reports available. The objective of the CSM was to present existing site conditions with the purpose of identifying data gaps and uncertainties and to provide the basis for the SSC.
- March – April 2013 - An SSC was performed to fill data gaps, to further refine the CSM of the nature and extent of contamination, and to gather critical information to aid in the development of a remedial alternatives evaluation. Specific objectives of the SSC included the following:
  - Identify potential secondary sources of contamination (Areas B, D, and FMB).
  - Collect data to support short-term remedial activities in Area H (expanded to Area B).
  - Further refine extent of VOCs and PCBs in groundwater.
  - Refine site geology; focus on transition zone and shallow bedrock.
- In August 2013, a previously unknown 8-inch-diameter steel pipe was discovered in Area 5. It was subsequently capped and a geophysical survey was performed in the area to discover additional buried piping that might be of concern. The findings of the geophysical survey were inconclusive.
- Extraction wells at Area 2 exhibited a decline in performance between 2005 and 2011, so an effort was undertaken in 2013 and 2014 to identify the cause and recommend corrective action. In response to the findings of this study, the following actions were conducted:
  - Rehabilitated two Area 2 wells by acid washing (SPRW-204 and SPRW-205).
  - Replaced three pumps at Area 2.

- Recommended one well (SPRW-202) for abandonment.
- Installed new variable-rate pumps capable of maintaining a constant drawdown in extraction wells SPRW-204, SPRW-205, and SPRW-206.
- Replaced the existing leaking flow meters and pressure gauges associated with extraction wells SPRW-204, SPRW-205, and SPRW-206.
- Replaced the individual pump control panels with a centrally located control panel, including a cellular telemetry system and controls that deactivate the extraction wells in the event of a high water condition at the seep collection system sump, where they discharge.
- Installed a new 3-inch discharge line from Area 2 to outside Surge Tank Building.
- During the period July 2012 through January 2014, the following modifications were made to the WWTP to optimize treatment effectiveness and to increase runtime efficiency:
  - Emptied, cleaned, sampled for disposal, and removed an unneeded neutralization tank and chemical feed tank/pump.
  - Emptied and cleaned the concrete pond adjacent to the WWTP, removed and capped unused pipes and apertures, and patched and sealed holes and cracks to convert overflow basin to an influent holding basin.
  - Removed basin pumps and filter housings and used the existing pipe to plumb Areas 4, 5, and 7 directly to the basin.
  - Installed a primary and redundant second pump at the influent holding basin with controls on a wheeled pump caddy to allow access to the pumps without requiring a crane or entry into the basin.
  - Installed a pump bypass spray aeration bar at the holding basin to allow pumps to operate at maximum efficiency, thereby reducing energy consumption and increasing pump life while providing some pre-treatment aeration.
  - Installed a modified air stripper sump to increase transfer pump runtime.
  - Installed additional air stripper trays to increase treatment efficiency.
  - Installed two new air stripper discharge pumps.
  - Removed 1- and 2-inch process piping and replaced with 3- and 4-inch piping to reduce pressure at the air stripper discharge.

- Installed a new bag filter housing (6 filters) after the air stripper, before the activated carbon unit.
- Constructed and installed a new 6-inch-diameter backwash piping and valve assembly at the carbon filtration vessels to increase efficiency and operator usability.
- Installed ports for pressure indicators and transmitters to monitor backpressure at the carbon filtration vessels.
- Installed four single-filter bag filter housings for backwash water from the carbon filtration vessels; bag filter housings were relocated and reconditioned following removal from the former pond discharge lines.
- Installed two new backwash/discharge pumps and suction piping at the treated effluent holding tank.
- Relocated the treated effluent discharge meter following installation of the discharge pumps.
- Cleaned and repainted the treated effluent holding tank and carbon filtration vessels.
- Constructed and installed a steel mezzanine to access the tops of the air stripper and carbon filtration vessels; new mezzanine will allow operators to inspect and clean air stripper and carbon vessels and replace carbon more safely without using a personnel lift.
- Installed vacuum relief valves along the process piping to allow water to drain from piping and pumps after pumps are deactivated for freeze protection.
- Removed heating cable and insulation.
- Constructed a heated pre-manufactured building around the existing treatment system.
- Modified the main controls system and installed a programmable logic controller and telemetry system.
- Changed out both carbon vessels with a total of 8,400 pounds of new granular activated carbon in January 2014.
- Consolidated various equipment items and concrete debris that had been stockpiled around the site and removed from the site; several small soil stockpiles from previous site activities were sampled and properly disposed of offsite while clean concrete and scrap metal were recycled.

- Removed three out-of-service above-grade brick and concrete structures which had been part of the original plant stormwater system in the area around the WWTP and the area brought to grade.
- Removed, stockpiled, and sampled approximately 15 cubic yards of accumulated sediment from the stormwater control system and disposed of offsite with the excavation soils from Areas B and H.
- Soil excavated and removed at Areas B and H by STC, as discussed in Section 4, between September 2013 and February 2014. These activities eliminated two previously unknown and significant residual areas of contamination at the facility, resulting in removal of approximately 6,284 pounds of PCBs, and 715 pounds of PCE and TCE were calculated to have been removed from Areas B and H combined.

## 6 FIVE-YEAR REVIEW PROCESS

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### 6.1 ADMINISTRATIVE COMPONENTS

The FYR was initiated on April 29, 2014 with the FYR scoping meeting. The FYR team was led by Craig Zeller of USEPA, Region 4, Remedial Project Manager (RPM) for the Sangamo Superfund Site. The team also included staff from the support agency, SC DHEC (Greg Cassidy and Charles Williams), STC (PRP), and CH2M HILL (O&M Manager/Consultant).

The review team established a review schedule that included the following components:

- Community Notification and Involvement
- Document Review
- ARARs Review
- Data Review
- Vapor Intrusion Screening Results
- Site Inspection
- Interviews

### 6.2 COMMUNITY NOTIFICATION AND INVOLVEMENT

The community in Pickens County, South Carolina has been dealing with the legacy of PCBs and capacitor manufacturing for decades. Community involvement associated with this site has ranged from site assessment work in the 1980s, remedy selection and initial implementation for OU1/OU2 in the 1990s, and O&M of long-term RAs in the 2000s. Community interest in USEPA activities at both OU1 and OU2 peaked in 2004, some of which was attributed to negotiation of a Natural Resource Damage Assessment (NRDA) settlement between the Natural Resource Trustees (NRT) and STC.

Citizens continue to show interest in both OU1 and OU2 sites. Community involvement for OU1 during the last 5 years has primarily involved providing updates to the Pickens County Council, so local leaders can keep their constituents informed of current activities at OU1 and OU2.

On July 16, 2014 a public notice was published in the Greenville News and Pickens County Sentinel announcing the commencement of the FYR process for the Sangamo site, providing Craig Zeller's contact information, and inviting community participation. The press notice is shown in Appendix C. No public inquiries were submitted to USEPA as a result of this advertisement.

The FYR Report will be made available to the public once it has been finalized. Copies of this document will be placed in the following designated public repositories:

RM Cooper Library  
Clemson University  
South Palmetto Boulevard  
Clemson, SC 29631

Pickens County Public Library - Easley Branch  
110 West First Avenue  
Easley, SC 29640

Upon completion of the FYR, a public notice will be placed in the Greenville News and Pickens County Sentinel to announce the availability of the final FYR Report in the Site document repositories.

### **6.3 DOCUMENT REVIEW**

The FYR effort for OU1 primarily consisted of review of relevant technical documents that were generated to facilitate the remedy effectiveness evaluation. The documents listed below were reviewed to support preparation of this FYR:

- CH2M HILL, 2012. *Conceptual Site Model, Sangamo Weston Inc./Twelvemile Creek/Lake Hartwell, PCB Contamination Superfund Site, Pickens, South Carolina*. September.
- CH2M HILL, 2013. *Supplemental Site Characterization for the Plant Site (Operable Unit 1), Sangamo Weston, Inc. Pickens County, South Carolina*. September.
- CH2M HILL, 2013. *Summary of Site Work Letter Report (February 2012 – March 2013) Operable Unit One of the Sangamo Weston Breazeale Site*. August.
- CH2M HILL, 2013. *Annual Report for Operable Unit 1, Plant and Cross Roads Sites (Period March 2012 to March 2013) Sangamo Weston, Inc.* September.
- CH2M HILL, 2013. *Annual Report for Operable Unit 1, Breazeale Site (Period February 2012 to March 2013) Sangamo Weston, Inc.* August.
- CH2M HILL, 2013. *Construction Completion Report, Areas B and H Soil Removal Action, Former Sangamo-Weston, Inc., Plant Site, Pickens, South Carolina*. April.
- CH2M HILL, 2013. *Sangamo Weston, Inc./Breazeale NPL Site Wastewater Plant, Request for Final Closeout Letter, Former Permit No. SC0047198, Pickens County, South Carolina*. June.
- CH2M HILL, 2013. *Areas B & H Removal Action Work Plan, Sangamo Weston, Inc. Plant Site, Pickens, South Carolina*. August.
- CH2M HILL, 2013. *Sangamo Weston, Inc./Breazeale NPL Site Wastewater Plant Request for Inspection and Extension to Decommissioning Plan, Former Permit No. SC0047198, Pickens County, South Carolina*. December.

- Fluor Daniel Environmental Services. 1998. *Remedial Action Report and Final Construction Report for OU1 Soils*. January.
- Garihan, J.M., Ranson, W.A., and Clendenin, C.W. 2008. *Geologic Map of the Pickens Quadrangle, Pickens County, South Carolina*. South Carolina Geological Survey.
- Geosyntec Consultants, 2012. *Focused Source Evaluation Report and Excavation Work Plan Letter Report, Former Sangamo Weston, Inc., Plant, Breazeale Area, Pickens, South Carolina*. October.
- RMT, Inc., 1989. *Remedial Investigation Report (RIR) for the Sangamo Plant, Breazeale, Nix, Dodgens, Cross Roads, John Trotter and Welborn Sites, Volumes I and II, Sangamo Weston Inc., Pickens County, South Carolina*. November.
- RMT, Inc., 2009. *Findings of Phase 2 Residual VOC Source Investigation for the Plant Site*. October.
- RMT, Inc., 2009. *Final Design for Full-scale In Situ Chemical Oxidation (ISCO), Sangamo Weston, Inc., OU-1 Breazeale Site, Pickens, South Carolina*. July.
- STC Remediation, 2008. *Recommended Remediation Well Locations at the Sangamo Site, Pickens, South Carolina*. July.
- U. S. Environmental Protection Agency, 1990. *Final ROD for the Sangamo Weston/Twelvemile Creek/Lake Hartwell PCB Contamination Superfund Site, Pickens County, South Carolina (USEPA – Region 4, December 19, 1990)*. December.
- U. S. Environmental Protection Agency, 1991. *Explanation of Significant Differences: Sangamo Weston, INC/Twelvemile Creek/Lake Hartwell PCB Contamination Operable Unit One; Pickens, South Carolina*. September.
- U. S. Environmental Protection Agency, 1993. *Explanation of Significant Differences: Sangamo Weston, INC/Twelvemile Creek/Lake Hartwell PCB Contamination Operable Unit One; Pickens, South Carolina*. June.
- U. S. Environmental Protection Agency, 2009. *Record of Decision (ROD) Amendment, Sangamo Weston, INC/Twelvemile Creek/Lake Hartwell PCB Contamination Operable Unit One; Pickens, Pickens County, South Carolina*. September.
- U. S. Environmental Protection Agency, 2009. *Five-Year Review Report, Sangamo Weston, INC/Twelvemile Creek/Lake Hartwell PCB Contamination Superfund Site; Pickens*. November.

## 6.4 ARARs REVIEW

Section 121 (d)(2)(A) of CERCLA specifies that Superfund RAs must meet federal standards, requirements, criteria, or limitations that are determined to be legally ARARs. ARARs are those standards, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, RA, location, or other circumstance at a CERCLA site. To-Be-Considered criteria (TBCs) are nonpromulgated advisories and guidance that are not legally binding, but should be considered in determining the necessary level of cleanup for protection of human health or the environment. While TBCs do not have the status of ARARs, USEPA's approach to determining if an RA is protective of human health and the environment involves consideration of TBCs

along with ARARs. Chemical-specific ARARs are specific numerical quantity restrictions on individually listed contaminants in specific media. Examples of chemical-specific ARARs include the MCLs specified under the Safe Drinking Water Act (SDWA) as well as the ambient water quality criteria that are enumerated under the Clean Water Act (CWA). Because there are usually numerous contaminants of potential concern for a site, various numerical quantity requirements can be ARARs.

Performance Standards were identified in the 1990 ROD for the groundwater at OU1 and considered for this FYR for continued groundwater treatment and monitoring (Table 5).

Table 5  
Summary of Groundwater Performance Standard Changes for OU1

CONTAMINANTS OF CONCERN	1990 ROD PERFORMANCE STANDARDS (mg/L)	CURRENT PERFORMANCE STANDARDS (mg/L)	PERFORMANCE STANDARDS CHANGED?
Chloroform	0.08	--	Not Analyzed
1,1-DCE	0.007	0.007	No
1,2-DCE, total	0.07	0.07	No
PCE	0.005	0.005	No
TCE	0.005	0.005	No
1,1,1-Trichloroethane	0.2	--	Not Analyzed
Vinyl Chloride	0.002	0.002	No
Total PCBs	0.0005	0.0005	No

A revised groundwater monitoring plan was submitted in the 2012 Annual Report. The request for a revised monitoring plan was part of optimization efforts at the site that focused on streamlining the monitoring well network and reporting of analytes. 1,1,1-TCA and chloroform were not included on the streamlined analyte list as these compounds have not been reported at concentrations exceeding performance standards since 2009 and prior to 1994, respectively. The revised monitoring plan was approved by USEPA and SCDHEC in November 2013.

## 6.5 DATA REVIEW

The data presented in the Annual Monitoring Reports for OU1 were reviewed as part of the FYR. The following section briefly describes the groundwater quality data summary for the Breazeale, Cross Roads, and Plant Sites. Figures 6 and 7 in Appendix B present the Plant Site total VOCs and PCBs in groundwater for March 2014. Breazeale Site March 2014 PCE concentrations in groundwater are presented in Appendix B, Figure 8. Tables 1 through 3 in Appendix D present a summary of the March 2014 analytical results for the Breazeale, Cross Roads, and Plant Sites, respectively.



As presented in the Annual Report (Period March 2012 to March 2013) (CH2M HILL 2013) and approved by USEPA and SC DHEC in November 2013, the following modifications were implemented to the Plant Site monitoring program:

- PCBs will no longer be analyzed at the Former Secure Landfill because of the long history of non-detects for PCBs in groundwater samples from the landfill monitoring wells.
- Monitoring at the Former Secure Landfill will occur on an annual basis because VOC levels in samples are stable (consistent from event to event) and near or below the Performance Standards.
- Annual air sample collection was discontinued.
- 24 wells that are no longer needed for site monitoring were plugged and abandoned.
- HydraSleeve methods were used for 2014 monitoring. They will also be used for future groundwater sampling at OU1 sites. Active wells in the Plant Site's groundwater extraction network will continue to be sampled from a port in the pump discharge line.
- 10 wells at the Plant Site will be rehabilitated in the future, as needed, to allow HydraSleeve sampling.
- PCB analyses were eliminated for 29 wells that have historically had no detections for PCBs.

As presented in the Breazeale Site Annual Report (Period February 2012 to March 2013) (CH2M HILL, 2013) and approved by USEPA and SC DHEC in November 2013, the following modifications were implemented to the monitoring program:

- Reduced the monitoring network by 10 wells, by plugging and abandonment, due to many years with levels of TCE, PCE, and other COCs below the MCL. In addition, 9 extraction wells and 16 wells formerly used for performance monitoring during pilot tests were plugged and abandoned. This work was completed in February 2014.

Beginning with the March 2014 monitoring program, 3 PCBs (1242, 1248, and 1254 using USEPA Method SW8082) and 6 VOCs using USEPA Method SW8260B (1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, PCE, TCE, and vinyl chloride) are now reported as required in the OU1 ROD.

### **6.5.1 Breazeale Site**

The following findings document the groundwater flow and quality conditions observed during the March 2014 sampling event:

- Groundwater flows generally north to south toward Wolf Creek.
- Figure 8 in Appendix B shows PCE concentrations in groundwater. Of the 12 wells sampled at the Breazeale Site, 5 had VOC concentrations above the Performance Standards. The highest PCE concentration was 79 microgram per liter ( $\mu\text{g/L}$ ), detected in well BRMW-11.

- The 2009 ROD amendment (USEPA 2009) established Interim Protective Levels of 40 µg/L for PCE and 150 µg/L for TCE for the protection of Wolf Creek. Only wells BRMW-02, BRMW-04, and BRMW-11 exceeded the PCE Interim Protective Level. BRMW-02 was the only well that exceeded the TCE Interim Protective Level.

### 6.5.2 Cross Roads Site

The following findings document the groundwater flow and quality observed during the March 2014 sampling event:

- Groundwater flows east-southeast toward a drainage feature that extends west to east across the southern part of the site.
- Only two COCs (PCE and TCE) were detected above Performance Standards at the Cross Roads Site, and in only two wells (CRMW-1 and CRMW-3) of the six currently sampled. Those detections were only slightly (less than one order of magnitude) above the 5-µg/L Performance Standard.
- Concentration trends for PCE and TCE for wells CRMW-1, CRMW-2, CRMW-3, and CRMW-3A are generally stable to decreasing.
- PCE and TCE have not been detected in wells CRMW-4 and CRMW-5 since sampling started in 1999.

### 6.5.3 Plant Site

The observations below were made during the March 2014 sampling event at the Plant Site.

Groundwater flow is generally radially outward from the east-west trending ridge where the former release areas are situated. Of the 55 monitoring wells sampled, 15 samples were below the Performance Standards for VOCs analyzed. Figure 6 (Appendix B) shows concentrations of analyzed total VOCs at the Plant Site. For the total VOCs (sum of targeted VOCs), only concentrations above 100 µg/L were plotted with isocontours. Multiple plumes of total VOCs greater than 100 µg/L originating in Source Areas D, H, B, and the FMB are present at the Plant Site and migrating downgradient.

Aroclor 1242 was the only PCB detected and was above the Performance Standard in 4 of the 17 wells analyzed for PCBs. As shown on Figure 7 (Appendix B), only concentrations above the Performance Standard of 0.5 µg/L were plotted with isocontours. Source Areas D and B contained exceedances indicating a plume at Area B migrating toward the southeast.

In the March 2014 surface water samples, TCE was the only analyte detected above its 5-µg/L Performance Standard in sample SW-2 (5.12 µg/L). SW-2 is located in Area 3. No VOC analytes were detected in surface water sample SW-3.

A discussion is presented below by area for the Plant Site.

- **Area 1:** Wells SPMW-5, SPMW-6, and SPMW-9 are located on the property of Ms. Jackie Anderson, north of the ridge area, and had not been sampled since January 2010 due to the lack

of an access agreement. STC recently renewed the access agreement for the property, and monitoring wells SPMW-5, SPMW-6, and SPMW-9 were sampled in March 2014 for the six VOCs listed in the OU1 ROD (1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, PCE, TCE, and vinyl chloride). Concentrations were below detection limits in these wells.

- **Area 2:** Affected groundwater in Area G and Area H flows northward toward the east branch of an unnamed tributary to Twelvemile Creek and passes through Area 2. Affected groundwater in the vicinity of monitoring wells SPMW-10, SPMW-11, and SPMW-12 also passes through Area 2.
  - Except at SPRW-204, VOCs were detected at concentrations above their Performance Standards in samples from recovery wells in Area 2.
  - No PCBs were detected at concentrations above detection limits in these wells, so PCB analysis was discontinued in 2014.
  - Wells SPMW-4 and SPMW-4A are located on Mr. Paul Ray's property downgradient of Area 2. No COCs were detected at concentrations above the Performance Standards in shallow performance monitoring well SPMW-4. TCE and PCE continue to be detected in samples collected from well SPMW-4A at concentrations above the Performance Standards; however, constituent concentrations continue to exhibit a general decreasing trend since January 2008.
- **Area 3:** VOCs were detected in the three recovery wells in Area 3 at concentrations above their respective Performance Standards. No PCBs were detected at concentrations above detection limits in these wells, so as approved by USEPA and SC DHEC, PCB analysis was discontinued in 2014. No VOCs or PCBs were detected at concentrations above the detection limits in downgradient well SPMW-14A.
- **Area 4:** VOCs were detected at concentrations above their respective Performance Standards in recovery well SPRW-401 in this area. PCBs were not detected in this well.
- **Area 5:** VOCs were detected at concentrations above their respective Performance Standards in groundwater from the monitoring wells located in Area 5. PCBs were detected in one monitoring well above the Performance Standard in well SWMW-6.
- **Area 6:** This area was not sampled in March 2014.
- **Area 7:** VOCs were detected at concentrations above their respective Performance Standards in groundwater from both recovery wells. PCBs were detected at a concentration above the Performance Standard in groundwater from monitoring well SWMW-7.
- **Area D:** In six of the seven wells, TCE and PCE were observed in this area at concentrations above their respective Performance Standards.
- **FMB:** Well SPMW-20 exhibited an increase in total VOCs from a concentration of 93.2 µg/L in 2013 (the first time this well was sampled due to its installation date) to 4,039 µg/L. A confirmation sample collected in June 2014 confirmed the high concentrations in this well.

## 6.6 VAPOR INTRUSION SCREENING RESULTS

In order to assess the potential for vapor intrusion (VI) for current and future receptors, a screening evaluation was conducted using the existing groundwater data from the Plant, Breazeale, and Cross Roads Sites for potential VI to surface receptors (Appendix E).

The most recent groundwater concentrations of site COCs were compared to the USEPA Vapor Intrusion Screening Levels (VISLs) for groundwater. The VISLs were calculated using USEPA's VISL calculator, last updated in May 2014. The VISLs were calculated under the residential scenario with a target cancer risk of  $1 \times 10^{-6}$  and hazard quotient of 1 for unrestricted use.

No occupied structures currently stand within 100 feet of a well that exceeded USEPA's VISLs for groundwater. The closest occupied structure to a well where groundwater concentrations exceeded the VISLs is located approximately 150 feet downgradient of the Former Secure Landfill. It is a raised mobile home, located on Reece Mill Road, which has a loose-fitting skirt, which generally allows free air exchange between this space and outdoor air. Vapor is therefore unlikely to accumulate beneath the home at a concentration that would be harmful to human health. To further evaluate the potential for vapor intrusion, exterior soil gas samples were collected in August and September 2014 and a crawlspace and outdoor air sample were collected in September 2014. The results of the evaluation indicate that while PCE and TCE concentrations in exterior soil gas are present above the VISLs for soil gas, these compounds were detected in the crawlspace at levels approximately equal to outdoor ambient air levels and are below USEPA's Regional Screening Levels for indoor air. The current remedy was therefore deemed sufficiently protective of human health.

In December, 2014, a groundwater investigation was conducted in the right-of-way along Reece Mill Road, south of the Former Secure Landfill, and downgradient of existing monitoring well MW-6 and the Reece Mill Road property. Laboratory results from the three tested locations indicated no detection of PCE; TCE; cis-1,2-DCE, trans-1,2-DCE; 1,1-DCE; or vinyl chloride

## 6.7 SITE INSPECTION

The FYR team conducted a site inspection of OU1 on May 7, 2014. The FYR team consisted of Craig Zeller (USEPA Region 4 RPM), Chuck Williams and Greg Cassidy, (support agency, SC DHEC); Vic Cocianni (STC), and Dave Urann/Lillian Furlow/Scott Powell (CH2M HILL – consultants to STC). The status of the OUs since the last FYR Report was discussed during this meeting. The team toured portions of the Breazeale, Cross Roads, and Plant Sites.

Table 6 lists the ICs associated with areas of interest at the site.

## **6.8 INTERVIEWS**

Formal interviews were not conducted as part of this FYR for OU1; however, a meeting was held with the FYR team to discuss the activities and issues at the site since the last FYR along with planned activities for OU1.

Table 6  
Institutional Controls Summary Table

MEDIA	IC NEEDED	IC CALLED FOR IN THE DECISION DOCUMENTS	IMPACTED AREA	INSTITUTIONAL CONTROLS OBJECTIVE <sup>a</sup>	INSTRUMENT IN PLACE	NOTES
<b>BREAZEALE SITE PORTION OF OU1</b>						
Groundwater	Yes	Yes	Breazeale Parcel	Restrict installation of groundwater wells	Yes	This area includes the entire Breazeale Site
<b>PLANT SITE PORTION OF OU1</b>						
Groundwater	Yes	Yes	Plant Site Parcel	Restrict installation of groundwater wells	Yes	This area includes the entire Plant Site

a IC were not required or included as part of the ROD prepared for the site in 1990. The Breazeale Site ROD Amendment (September 2009) included IC. The Plant Site portion of OU1 has a ROD Amendment which will include formal ICs for this portion of OU1.

## 7 TECHNICAL ASSESSMENT

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As recommended by USEPA's Comprehensive Five-Year Guidance (OSWER No. 9355.7-03B-P, June 2001), the framework for the technical assessment of the RA centers around answering the following three key questions.

### **7.1 QUESTION A: IS THE REMEDY FUNCTIONING AS INTENDED BY THE DECISION DOCUMENTS?**

Yes. The remedy continues to operate and function as designed. Progress is being made toward achievement of established groundwater Performance Standards. Recommendations designed to optimize the existing groundwater recovery/treatment system performance have been evaluated and will be implemented at the Plant Site. A ROD Amendment was finalized on September 29, 2009 for the Breazeale Site that included the requirement for ICs (for example, fencing and deed restrictions). Once a remedial alternatives analysis is completed, a ROD Amendment may be required for the Plant Site.

### **7.2 QUESTION B: ARE THE EXPOSURE ASSUMPTIONS, TOXICITY DATA, CLEANUP LEVELS, AND RAOs USED AT THE TIME OF THE REMEDY SELECTION STILL VALID?**

Yes. There have been no significant changes related to contaminant toxicity, and no significant changes in assumptions related to land use that would alter USEPA's current remedy implementation strategy at the OU1 site. With the exception of evaluating the VI pathway, there have been no significant changes in exposures assumptions or risk assessment methods since the remedy selection. VI was not evaluated as part of the 1990 ROD and no occupied buildings above the contaminated groundwater plume exist for the Breazeale, Cross Roads, and Plant Site portions of OU1 and a VI screening was not deemed necessary at that time. However, the VI pathway was screened in March 2014 using groundwater data and it was concluded that groundwater concentrations were below VISLs and therefore the VI pathway was incomplete (Appendix E).

Table 7  
Toxicity Changes

CONTAMINANT	CARCINOGENIC TOXICITY CHANGES						NON-CARCINOGENIC TOXICITY CHANGES					
	ORAL CANCER SLOPE FACTOR (mg/kg-day) <sup>-1</sup>			INHALATION UNIT RISK (IUR) (µg/m <sup>3</sup> ) <sup>-1</sup>			ORAL REFERENCE DOSE (RfD) (mg/kg-d)			INHALATION REFERENCE CONCENTRATION (RfC) (mg/m <sup>3</sup> )		
	1990 ROD VALUE <sup>a</sup>	CURRENT VALUE <sup>b</sup>	CHANGE	1990 ROD VALUE <sup>a</sup>	CURRENT VALUE <sup>b</sup>	CHANGE	1990 ROD VALUE <sup>a</sup>	CURRENT VALUE <sup>b</sup>	CHANGE	1990 ROD VALUE <sup>a</sup>	CURRENT VALUE <sup>b</sup>	CHANGE
Acetone	ND	ND	None	NA	ND	None	1.0E-02	9.0E-01	Less Stringent	NA	3.1E+01	New
Benzene	2.9E-02	5.5E-02	None	NA	7.8E-06	New	2.3E+00	4.0E-03	More stringent	NA	3.0E-02	New
bis-2-ethylhexyl phthalate	1.4E-02	1.4E-02	None	NA	2.4E-06	New	2.0E-02	2.0E-02	None	NA	ND	None
1,1-DCA	ND	5.7E-03	New	NA	1.6E-06	New	1.2E-01	2.0E-01	Less stringent	NA	ND	None
1,1-DCE	6.0E-01	ND	withdrawn	NA	ND	None	9.0E-03	5.0E-02	Less stringent	NA	2.0E-01	New
cis-1,2-DCE	ND	ND	None	NA	ND	None	NE	2.0E-03	New	NA	ND	New
trans-1,2-DCE	ND	ND	None	NA	ND	None	1.0E-02	2.0E-02	Less stringent	NA	6.0E-02	New
1,4-dioxane	NE	1.0E-01	New	NE	7.7E-06	New	NE	3.0E-02	New	NE	1.1E-01	New
Ethylbenzene	ND	1.1E-02 <sup>c</sup>	New	NA	2.5E-06 <sup>c</sup>	New	1.0E-01	1.0E-01	None	NA	1.0E+00	New
Methylene chloride	7.5E-03	2.0E-03	Less stringent	NA	1.0E-08	New	6.0E-02	6.0E-03	Lower	NA	6.0E-01	New
MEK	ND	ND	None	NA	ND	None	5.0E-02	6.0E-01	Less stringent	NA	5.0E+00	New
MIBK	ND	ND	None	NA	ND	None	5.0E-02	8.0E-02	Less stringent	NA	3.0E+00	New
PCE	5.1E-02	2.1E-03	Less stringent	NA	2.6E-07	New	1.0E-02	6.0E-03	More stringent	NA	4.0E-02	New
Toluene	ND	ND	None	NA	ND	None	3.0E-01	8.0E-02	More stringent	NA	5.0E+00	New
1,1,1-TCA	ND	ND	None	NA	ND	None	9.0E-02	2.0E+00	Less stringent	NA	5.0E+00	New



Table 7  
Toxicity Changes

CONTAMINANT	CARCINOGENIC TOXICITY CHANGES						NON-CARCINOGENIC TOXICITY CHANGES					
	ORAL CANCER SLOPE FACTOR (mg/kg-day) <sup>-1</sup>			INHALATION UNIT RISK (IUR) (µg/m <sup>3</sup> ) <sup>-1</sup>			ORAL REFERENCE DOSE (RfD) (mg/kg-d)			INHALATION REFERENCE CONCENTRATION (RfC) (mg/m <sup>3</sup> )		
	1990 ROD VALUE <sup>a</sup>	CURRENT VALUE <sup>b</sup>	CHANGE	1990 ROD VALUE <sup>a</sup>	CURRENT VALUE <sup>b</sup>	CHANGE	1990 ROD VALUE <sup>a</sup>	CURRENT VALUE <sup>b</sup>	CHANGE	1990 ROD VALUE <sup>a</sup>	CURRENT VALUE <sup>b</sup>	CHANGE
TCE	1.1E-02	4.6E-02	More stringent	NA	4.1E-06	New	7.0E-03	5E-04	More stringent	NA	2.0E-03	New
Vinyl chloride	NE	7.2E-01	New	NE	4.4E-06	New	NE	3.0E-03	New	NE	1.0E-01	New
Xylene	ND	ND	None	ND	ND	None	2.0E+00	2.0E-01	Less stringent	ND	1.0E-01	New

<sup>a</sup> Toxicity values from 1990 ROD.

<sup>b</sup> Values available for comparison from EPA's IRIS (<http://www.epa.gov/IRIS> accessed 11/20/2013) and EPA's May 2013 Regional Screening Level Table ([http://www.epa.gov/reg3hwmd/risk/human/rb-concentration\\_table/Generic\\_Tables/index.htm](http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm)).

New = New value; previously, no toxicity value was available.

ND = Not determined.

NA = The risk assessment did not evaluate inhalation exposure.

NE = The risk assessment did not identify this compound as a COC.

### **7.3 QUESTION C: HAS ANY OTHER INFORMATION COME TO LIGHT THAT COULD CALL INTO QUESTION THE PROTECTIVENESS OF THE REMEDY?**

No.

### **7.4 TECHNICAL ASSESSMENT SUMMARY**

The site document review in combination with the May 2014 site inspection provided the basis for this technical assessment. The Breazeale Site RA has been completed and performance monitoring will continue at this portion of OU1. Ongoing evaluations for options to optimize the remedy at the Plant Site will continue along with annual monitoring.

Biennial monitoring will be performed at the Cross Roads Site beginning in 2015 with annual well inspections until Performance Standards are met.

## 8 ISSUES

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The Plant Site sits on top of bedrock (massive gneiss), and years of subsurface investigations indicate that fractures are few and difficult to predict. Consequently, water yields from recovery wells vary widely across different remediation areas of the Plant Site. Continued refinement of the CSM is being conducted. Recommendations from the first and second FYRs have been considered and implemented. Additional site characterization has been performed and continues to be performed. Information obtained from site characterization activities will be used to enhance the remediation of the groundwater and advance the site toward closure. A ROD Amendment for the Plant Site is anticipated to be issued during the next FYR period.

IC were not required by the ROD.

ISSUE	AFFECTS CURRENT PROTECTIVENESS (Yes or No)	AFFECTS FUTURE PROTECTIVENESS (Yes or No)
Unreasonable timeframe to remediate Plant Site portion of OU1 using pump and treat methods	No	No

## 9 RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Based on the above discussion and findings, the following recommendation is issued for this FYR. STC will be responsible for implementing this recommendation, under the oversight and direction of USEPA and SC DHEC.

ISSUE	RECOMMENDATIONS/ FOLLOW-UP ACTIONS	PARTY RESPONSIBLE	OVERSIGHT AGENCY	MILESTONE DATE	AFFECTS PROTECTIVENESS? (YES OR NO)	
					CURRENT	FUTURE
Unreasonable timeframe to remediate Plant Site portion of OU1 using pump and treat methods	Perform evaluations of remedial options for groundwater treatment at Plant Site to reduce dependence on the pump and treat remedy	STC	USEPA	2019	No	No

### 9.1 BREAZEALE SITE

Groundwater impacts at Breazeale are limited to three wells with concentrations of VOCs slightly above the Interim Protective Level.

- Continue annual groundwater monitoring and conduct additional chemical oxidant injections, as needed.

### 9.2 CROSS ROADS SITE

Groundwater impacts at Cross Roads are limited to two wells with concentrations of VOCs slightly above the Performance Standards.

- Modify groundwater monitoring frequency from annual to biennial, with annual well inspections. No active remediation is recommended at this time.

### 9.3 PLANT SITE

- Continue to operate and maintain the full-scale groundwater recovery and treatment system.
- Evaluate and implement remedial alternatives to reduce the dependence on the current pump and treat remedy, while protecting surface waters and receptors.

## **10 PROTECTIVENESS STATEMENT**

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The remedy at OU1 is considered protective of human health and the environment.

## **11 NEXT REVIEW**

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Pursuant to statutory requirements, the next FYR for this site will be conducted 5 years from the approval date of this document.

# Appendix A Five-Year Review Site Inspection Checklist and Photographs

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## Site Inspection Checklist

<b>III. ON-SITE DOCUMENTS &amp; RECORDS VERIFIED</b> (Check all that apply)			
1.	<b>O&amp;M Documents</b> <input checked="" type="checkbox"/> O&M manual <input checked="" type="checkbox"/> As-built drawings <input checked="" type="checkbox"/> Maintenance logs Remarks Documents were maintained on-site.	<input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date <input checked="" type="checkbox"/> Up to date <input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A <input type="checkbox"/> N/A <input type="checkbox"/> N/A
2.	<b>Site-Specific Health and Safety Plan</b> <input checked="" type="checkbox"/> Contingency plan/emergency response plan Remarks _____	<input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date <input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A <input type="checkbox"/> N/A
3.	<b>O&amp;M and OSHA Training Records</b> Remarks _____	<input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A
4.	<b>Permits and Service Agreements</b> <input type="checkbox"/> Air discharge permit <input checked="" type="checkbox"/> Effluent discharge <input type="checkbox"/> Waste disposal, POTW <input checked="" type="checkbox"/> Other permits _____ NPDES _____ Remarks NPDES permit is currently in the renewal process	<input type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available <input type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A <input type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A <input type="checkbox"/> N/A
5.	<b>Gas Generation Records</b> Remarks _____	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A
6.	<b>Settlement Monument Records</b> Remarks _____	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A
7.	<b>Groundwater Monitoring Records</b> Remarks See O&M Reports (RMT and CH2M HILL)	<input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A
8.	<b>Leachate Extraction Records</b> Remarks _____	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A
9.	<b>Discharge Compliance Records</b> <input type="checkbox"/> Air <input checked="" type="checkbox"/> Water (effluent) Remarks Records available on-site	<input type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A <input type="checkbox"/> N/A
10.	<b>Daily Access/Security Logs</b> Remarks Records available on-site	<input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A

# Site Inspection Checklist

## IV. O&M COSTS

1. **O&M Organization**

<input type="checkbox"/> State in-house	<input type="checkbox"/> Contractor for State
<input type="checkbox"/> PRP in-house	<input checked="" type="checkbox"/> Contractor for PRP
<input type="checkbox"/> Federal Facility in-house	<input type="checkbox"/> Contractor for Federal Facility
<input type="checkbox"/> Other _____	

2. **O&M Cost Records**

Readily available       Up to date

Funding mechanism/agreement in place

Original O&M cost estimate \_\_\_\_\_  Breakdown attached

Total annual cost by year for review period if available

From <u>2009</u>	To <u>2010</u>	\$ <u>792,000</u>	<input type="checkbox"/> Breakdown attached
Date	Date	Total cost	
From <u>2010</u>	To <u>2011</u>	\$ <u>386,000</u>	<input type="checkbox"/> Breakdown attached
Date	Date	Total cost	
From <u>2011</u>	To <u>2012</u>	\$ <u>737,000</u>	<input type="checkbox"/> Breakdown attached
Date	Date	Total cost	
From <u>2012</u>	To <u>2013</u>	\$ <u>1,411,000</u>	<input type="checkbox"/> Breakdown attached
Date	Date	Total cost	
From <u>2013</u>	To <u>2014</u>	\$ <u>897,000</u>	<input type="checkbox"/> Breakdown attached
Date	Date	Total cost	

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: \_\_\_\_\_

Stormwater control system and sump at Area 5 - \$373,000 (2012)

Water treatment system, controls and conveyance systems rebuild, upgraded and modernized - \$522,000 (2012) and \$165,000 (2013)

Upgrades to Areas 2, 3, 4, and 5 - \$55,000 (2012) and \$135,000 (2013)

Sangamo Road repair - \$138,000 (2013)

## V. ACCESS AND INSTITUTIONAL CONTROLS    Applicable    N/A

### A. Fencing

1. **Fencing damaged**       Location shown on site map       Gates secured       N/A

Remarks Site fenced at Breazeale, Cross Roads, and Plant Sites; maintained by O&M contractor

### B. Other Access Restrictions

1. **Signs and other security measures**       Location shown on site map       N/A

Remarks Signage clear of debris blockage, posted on property entrances, including Plant, Breazeale, and Cross Roads Sites.

# Site Inspection Checklist

<b>C. Institutional Controls (ICs)</b>			
1.	<b>Implementation and enforcement</b>		
	Site conditions imply ICs not properly implemented	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No <input type="checkbox"/> N/A
	Site conditions imply ICs not being fully enforced	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No <input type="checkbox"/> N/A
	Type of monitoring ( <i>e.g.</i> , self-reporting, drive by) <u>Self reporting</u>		
	Frequency <u>Annually</u>		
	Responsible party/agency <u>CH2M HILL</u>		
	Contact <u>Lillian Furlow</u>	<u>Project Manager</u>	<u>05/07/2014</u>
	Name	Title	Date    Phone no.
	Reporting is up-to-date	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	Reports are verified by the lead agency	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	Specific requirements in deed or decision documents have been met	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input checked="" type="checkbox"/> N/A
	Violations have been reported	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input checked="" type="checkbox"/> N/A
	Other problems or suggestions: <input type="checkbox"/> Report attached		
	_____		
	_____		
	_____		
2.	<b>Adequacy</b>	<input checked="" type="checkbox"/> ICs are adequate	<input type="checkbox"/> ICs are inadequate <input type="checkbox"/> N/A
	Remarks _____		
	_____		
	_____		
<b>D. General</b>			
1.	<b>Vandalism/trespassing</b>	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> No vandalism evident
	Remarks Trespassing minimized by fencing and full-time O&M operator.		
	_____		
2.	<b>Land use changes on site</b>	<input checked="" type="checkbox"/> N/A	
	Remarks _____		
	_____		
3.	<b>Land use changes off site</b>	<input checked="" type="checkbox"/> N/A	
	Remarks _____		
	_____		
<b>VI. GENERAL SITE CONDITIONS</b>			
<b>A. Roads</b>	<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A	
1.	<b>Roads damaged</b>	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Roads adequate <input type="checkbox"/> N/A
	Remarks _____		
	_____		

## Site Inspection Checklist

<b>B. Other Site Conditions</b>		
Remarks _____ _____ _____ _____ _____		
<b>VII. LANDFILL COVERS</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A		
<b>A. Landfill Surface</b>		
1.	<b>Settlement</b> (Low spots) Areal extent _____ Remarks _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> Settlement not evident Depth _____
2.	<b>Cracks</b> Lengths _____    Widths _____    Depths _____ Remarks _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> Cracking not evident
3.	<b>Erosion</b> Areal extent _____ Remarks _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> Erosion not evident Depth _____
4.	<b>Holes</b> Areal extent _____ Remarks _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> Holes not evident Depth _____
5.	<b>Vegetative Cover</b> <input type="checkbox"/> Grass <input type="checkbox"/> Cover properly established <input type="checkbox"/> No signs of stress <input type="checkbox"/> Trees/Shrubs (indicate size and locations on a diagram) Remarks _____	
6.	<b>Alternative Cover (armored rock, concrete, etc.)</b> <input type="checkbox"/> N/A Remarks _____	
7.	<b>Bulges</b> Areal extent _____ Remarks _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> Bulges not evident Height _____
8.	<b>Wet Areas/Water Damage</b> <input type="checkbox"/> Wet areas <input type="checkbox"/> Location shown on site map    Areal extent _____ <input type="checkbox"/> Ponding <input type="checkbox"/> Location shown on site map    Areal extent _____ <input type="checkbox"/> Seeps <input type="checkbox"/> Location shown on site map    Areal extent _____ <input type="checkbox"/> Soft subgrade <input type="checkbox"/> Location shown on site map    Areal extent _____ Remarks _____	

## Site Inspection Checklist

9.	<b>Slope Instability</b>	<input type="checkbox"/> Slides <input type="checkbox"/> Location shown on site map <input type="checkbox"/> No evidence of slope instability	
	Areal extent _____		
	Remarks _____		
<hr/>			
<b>B. Benches</b> <input type="checkbox"/> Applicable <input type="checkbox"/> N/A			
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)			
<hr/>			
1.	<b>Flows Bypass Bench</b>	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> N/A or okay	
	Remarks _____		
<hr/>			
2.	<b>Bench Breached</b>	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> N/A or okay	
	Remarks _____		
<hr/>			
3.	<b>Bench Overtopped</b>	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> N/A or okay	
	Remarks _____		
<hr/>			
<b>C. Letdown Channels</b> <input type="checkbox"/> Applicable <input type="checkbox"/> N/A			
(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)			
<hr/>			
1.	<b>Settlement</b>	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> No evidence of settlement	
	Areal extent _____                    Depth _____		
	Remarks _____		
<hr/>			
2.	<b>Material Degradation</b>	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> No evidence of degradation	
	Material type _____                    Areal extent _____		
	Remarks _____		
<hr/>			
3.	<b>Erosion</b>	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> No evidence of erosion	
	Areal extent _____                    Depth _____		
	Remarks _____		
<hr/>			

## Site Inspection Checklist

4.	<b>Undercutting</b>	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> No evidence of undercutting
	Areal extent _____	Depth _____	
	Remarks _____		
	_____		
5.	<b>Obstructions</b>	Type _____	<input type="checkbox"/> No obstructions
	<input type="checkbox"/> Location shown on site map	Areal extent _____	
	Size _____		
	Remarks _____		
	_____		
6.	<b>Excessive Vegetative Growth</b>	Type _____	
	<input type="checkbox"/> No evidence of excessive growth		
	<input type="checkbox"/> Vegetation in channels does not obstruct flow		
	<input type="checkbox"/> Location shown on site map	Areal extent _____	
	Remarks _____		
	_____		
<b>D. Cover Penetrations</b> <input type="checkbox"/> Applicable <input type="checkbox"/> N/A			
1.	<b>Gas Vents</b>	<input type="checkbox"/> Active	<input type="checkbox"/> Passive
	<input type="checkbox"/> Properly secured/locked	<input type="checkbox"/> Functioning	<input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition
	<input type="checkbox"/> Evidence of leakage at penetration		<input type="checkbox"/> Needs Maintenance
	<input type="checkbox"/> N/A		
	Remarks _____		
	_____		
2.	<b>Gas Monitoring Probes</b>	<input type="checkbox"/> Functioning	<input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition
	<input type="checkbox"/> Properly secured/locked		<input type="checkbox"/> Needs Maintenance <input type="checkbox"/> N/A
	<input type="checkbox"/> Evidence of leakage at penetration		
	Remarks _____		
	_____		
3.	<b>Monitoring Wells</b> (within surface area of landfill)	<input type="checkbox"/> Functioning	<input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition
	<input type="checkbox"/> Properly secured/locked		<input type="checkbox"/> Needs Maintenance <input type="checkbox"/> N/A
	<input type="checkbox"/> Evidence of leakage at penetration		
	Remarks _____		
	_____		
4.	<b>Leachate Extraction Wells</b>	<input type="checkbox"/> Functioning	<input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition
	<input type="checkbox"/> Properly secured/locked		<input type="checkbox"/> Needs Maintenance <input type="checkbox"/> N/A
	<input type="checkbox"/> Evidence of leakage at penetration		
	Remarks _____		
	_____		
5.	<b>Settlement Monuments</b>	<input type="checkbox"/> Located	<input type="checkbox"/> Routinely surveyed <input type="checkbox"/> N/A
	Remarks _____		
	_____		

## Site Inspection Checklist

<b>E. Gas Collection and Treatment</b>		<input type="checkbox"/> Applicable	<input type="checkbox"/> N/A
1.	<b>Gas Treatment Facilities</b>	<input type="checkbox"/> Flaring	<input type="checkbox"/> Thermal destruction
		<input type="checkbox"/> Good condition	<input type="checkbox"/> Needs Maintenance
	Remarks _____		<input type="checkbox"/> Collection for reuse
_____			
2.	<b>Gas Collection Wells, Manifolds and Piping</b>	<input type="checkbox"/> Good condition	<input type="checkbox"/> Needs Maintenance
	Remarks _____		
_____			
3.	<b>Gas Monitoring Facilities</b> ( <i>e.g.</i> , gas monitoring of adjacent homes or buildings)	<input type="checkbox"/> Good condition	<input type="checkbox"/> Needs Maintenance
	Remarks _____		<input type="checkbox"/> N/A
_____			
<b>F. Cover Drainage Layer</b>		<input type="checkbox"/> Applicable	<input type="checkbox"/> N/A
1.	<b>Outlet Pipes Inspected</b>	<input type="checkbox"/> Functioning	<input type="checkbox"/> N/A
	Remarks _____		
_____			
2.	<b>Outlet Rock Inspected</b>	<input type="checkbox"/> Functioning	<input type="checkbox"/> N/A
	Remarks _____		
_____			
<b>G. Detention/Sedimentation Ponds</b>		<input type="checkbox"/> Applicable	<input type="checkbox"/> N/A
1.	<b>Siltation</b> Areal extent _____ Depth _____		<input type="checkbox"/> N/A
	<input type="checkbox"/> Siltation not evident		
	Remarks _____		
_____			
2.	<b>Erosion</b> Areal extent _____ Depth _____		
	<input type="checkbox"/> Erosion not evident		
	Remarks _____		
_____			
3.	<b>Outlet Works</b>	<input type="checkbox"/> Functioning	<input type="checkbox"/> N/A
	Remarks _____		
_____			
4.	<b>Dam</b>	<input type="checkbox"/> Functioning	<input type="checkbox"/> N/A
	Remarks _____		
_____			



## Site Inspection Checklist

<b>H. Retaining Walls</b> <input type="checkbox"/> Applicable <input type="checkbox"/> N/A	
1.	<b>Deformations</b> <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Deformation not evident Horizontal displacement _____      Vertical displacement _____ Rotational displacement _____ Remarks _____ _____
2.	<b>Degradation</b> <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Degradation not evident Remarks _____ _____
<b>I. Perimeter Ditches/Off-Site Discharge</b> <input type="checkbox"/> Applicable <input type="checkbox"/> N/A	
1.	<b>Siltation</b> <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Siltation not evident Areal extent _____      Depth _____ Remarks _____ _____
2.	<b>Vegetative Growth</b> <input type="checkbox"/> Location shown on site map <input type="checkbox"/> N/A <input type="checkbox"/> Vegetation does not impede flow Areal extent _____      Type _____ Remarks _____ _____
3.	<b>Erosion</b> <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Erosion not evident Areal extent _____      Depth _____ Remarks _____ _____
4.	<b>Discharge Structure</b> <input type="checkbox"/> Functioning <input type="checkbox"/> N/A Remarks _____ _____
<b>VIII. VERTICAL BARRIER WALLS</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A	
1.	<b>Settlement</b> <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Settlement not evident Areal extent _____      Depth _____ Remarks _____ _____
2.	<b>Performance Monitoring</b> Type of monitoring _____ <input type="checkbox"/> Performance not monitored Frequency _____ <input type="checkbox"/> Evidence of breaching Head differential _____ Remarks _____ _____

# Site Inspection Checklist

<b>IX. GROUNDWATER/SURFACE WATER REMEDIES</b> <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A	
<b>A. Groundwater Extraction Wells, Pumps, and Pipelines</b> <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A	
1.	<b>Pumps, Wellhead Plumbing, and Electrical</b> <input checked="" type="checkbox"/> Good condition <input checked="" type="checkbox"/> All required wells properly operating <input type="checkbox"/> Needs Maintenance <input type="checkbox"/> N/A Remarks _____ _____ _____
2.	<b>Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances</b> <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____
3.	<b>Spare Parts and Equipment</b> <input checked="" type="checkbox"/> Readily available <input type="checkbox"/> Good condition <input type="checkbox"/> Requires upgrade <input type="checkbox"/> Needs to be provided Remarks _____ _____
<b>B. Surface Water Collection Structures, Pumps, and Pipelines</b> <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A	
1.	<b>Collection Structures, Pumps, and Electrical</b> <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____
2.	<b>Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances</b> <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____
3.	<b>Spare Parts and Equipment</b> <input checked="" type="checkbox"/> Readily available <input type="checkbox"/> Good condition <input type="checkbox"/> Requires upgrade <input type="checkbox"/> Needs to be provided Remarks _____ _____

## Site Inspection Checklist

<b>C. Treatment System</b>		<input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A
1.	<b>Treatment Train</b> (Check components that apply) <input type="checkbox"/> Metals removal <input type="checkbox"/> Oil/water separation <input type="checkbox"/> Bioremediation <input checked="" type="checkbox"/> Air stripping <input checked="" type="checkbox"/> Carbon adsorbers <input checked="" type="checkbox"/> Filters <u>Bag Filters</u> _____ <input type="checkbox"/> Additive (e.g., chelation agent, flocculent) _____ <input type="checkbox"/> Others _____ <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance <input checked="" type="checkbox"/> Sampling ports properly marked and functional <input checked="" type="checkbox"/> Sampling/maintenance log displayed and up to date <input checked="" type="checkbox"/> Equipment properly identified <input checked="" type="checkbox"/> Quantity of groundwater treated annually <u>See Annual Report</u> <input type="checkbox"/> Quantity of surface water treated annually _____ Remarks <u>Wastewater treatment system at Plant Site is in good condition; Breazeale wastewater treatment system was decommissioned in June 2013.</u>	
2.	<b>Electrical Enclosures and Panels</b> (properly rated and functional) <input type="checkbox"/> N/A <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____	
3.	<b>Tanks, Vaults, Storage Vessels</b> <input type="checkbox"/> N/A <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Proper secondary containment <input type="checkbox"/> Needs Maintenance Remarks _____	
4.	<b>Discharge Structure and Appurtenances</b> <input type="checkbox"/> N/A <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks <u>Rebuilt in 2013</u>	
5.	<b>Treatment Building(s)</b> <input type="checkbox"/> N/A <input checked="" type="checkbox"/> Good condition (esp. roof and doorways) <input type="checkbox"/> Needs repair <input type="checkbox"/> Chemicals and equipment properly stored Remarks <u>Built in 2013</u>	
6.	<b>Monitoring Wells</b> (pump and treatment remedy) <input checked="" type="checkbox"/> Properly secured/locked <input checked="" type="checkbox"/> Functioning <input checked="" type="checkbox"/> Routinely sampled <input checked="" type="checkbox"/> Good condition <input checked="" type="checkbox"/> All required wells located <input type="checkbox"/> Needs Maintenance <input type="checkbox"/> N/A Remarks <u>Cross Roads wells have been secured/locked</u>	
<b>D. Monitoring Data</b>		
1.	Monitoring Data <input checked="" type="checkbox"/> Is routinely submitted on time <input checked="" type="checkbox"/> Is of acceptable quality	
2.	Monitoring data suggests: <input checked="" type="checkbox"/> Groundwater plume is effectively contained <input checked="" type="checkbox"/> Contaminant concentrations are declining	

# Site Inspection Checklist

<b>E. Monitored Natural Attenuation</b>	
1.	<b>Monitoring Wells</b> (natural attenuation remedy) <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input type="checkbox"/> All required wells located <input type="checkbox"/> Needs Maintenance <input type="checkbox"/> N/A Remarks _____ _____
<b>X. OTHER REMEDIES</b>	
If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.	
<b>XI. OVERALL OBSERVATIONS</b>	
<b>A.</b>	<b>Implementation of the Remedy</b>
Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). _____ _____ _____ _____ _____ _____ _____ _____ _____ _____	
<b>B.</b>	<b>Adequacy of O&amp;M</b>

## Site Inspection Checklist

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

**Plant Site:** The system is optimized regularly based upon monitoring data as well as data generated from the dashboard. During 2012-2014, upgrades included the following:

- Rebuilt groundwater recovery and treatment system, including new building
- Automated controls and monitoring
- Optimized SCADA system web based monitoring systems
- Upgraded pumps and filters
- Improved efficiency and operational up-time
- Changing carbon out
- Upgrades to Areas 2, 3, 4, and 5 with new controls, monitoring, and alarm systems and new pumps
- Installed Stormwater containment and sump in Area 5

**Breazeale Site:** SC DHEC's rescinded the NPDES permit in February 2013 and approved the WWTP decommissioning plan in May 2013. Initial WWTP closeout activities were completed in June 2013. In February – March 2014, equipment was removed from the site and 33 wells were plugged and abandoned. A site inspection was performed by SC DHEC on April 22, 2014 and a final WWTP closeout letter was requested on June 20, 2014.

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# Site Inspection Checklist

## C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future.

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## D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

**Plant Site:** The following activities are planned in 2014/2015:

- Area B: remedial alternatives evaluation
- Area D:remedial alternatives evaluation, pilot test
- Area H:ISCO injection
- Former Manufacturing Building: additional investigation, remedial alternatives evaluation
- Area 2:remedial alternatives evaluation, new control systems/pumps, pilot test
- Area 3: remedial alternatives evaluation, groundwater evaluation, pilot test
- Area 5: remedial alternatives evaluation

**Breazeale Site:** Direct push technology injection of potassium permanganate solution has been proposed in 2014 next to 3 wells exceeding Performance Standards.

**All sites will have sustainability review performed in conjunction with remedial alternatives evaluation.**

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# Photographic Log

<b>Client Name:</b> Schlumberger Technology Corporation	<b>Site Location:</b> Operable Unit One (OU1)
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<b>Photo No.</b>	<b>Date</b>
1	5-7-2014

**Description**  
*Plant Site*  
 Wastewater Treatment Plant (WWTP) Building





<b>Photo No.</b>	<b>Date</b>
2	5-7-2014

**Description**  
*Plant Site*  
 WWTP Interior



# Photographic Log

<b>Client Name:</b> Schlumberger Technology Corporation		<b>Site Location:</b> Operable Unit One (OU1)
<b>Photo No.</b> 3	<b>Date</b> 5-7-2014	
<b>Description</b> <i>Plant Site</i> WWTP Equalization Basin		

<b>Photo No.</b> 4	<b>Date</b> 5-7-2014	
<b>Description</b> <i>Plant Site</i> Equalization Basin Aeration System		



# Photographic Log

<b>Client Name:</b> Schlumberger Technology Corporation	<b>Site Location:</b> Operable Unit One (OU1)
--	--

<b>Photo No.</b> 5	<b>Date</b> 5-7-2014	
<b>Description</b> Plant Site Area 5 Sump		

<b>Photo No.</b> 6	<b>Date</b> 5-7-2014	
<b>Description</b> Plant Site Area 5 Pumphouse and Sump		

# Photographic Log

<b>Client Name:</b> Schlumberger Technology Corporation	<b>Site Location:</b> Operable Unit One (OU1)
--	--

<b>Photo No.</b>	<b>Date</b>
7	5-7-2014

**Description**  
*Plant Site*  
 Area 2 – Sump








<b>Photo No.</b>	<b>Date</b>
8	5-7-2014

**Description**  
*Plant Site*  
 Area 2 Groundwater Seep Collection System



# Photographic Log

<b>Client Name:</b>		<b>Site Location:</b>
Schlumberger Technology Corporation		Operable Unit One (OU1)
<b>Photo No.</b>	<b>Date</b>	
9	5-7-2014	
<b>Description</b>		
<i>Plant Site</i> Area H – Post Excavation and Infiltration Gallery		
<b>Description</b>		
<i>Plant Site</i> Area B – Post Excavation, Looking North		
<b>Photo No.</b>	<b>Date</b>	
10	5-7-2014	
<b>Description</b>		
<i>Plant Site</i> Area B – Post Excavation, Looking North		

# Photographic Log

<b>Client Name:</b> Schlumberger Technology Corporation	<b>Site Location:</b> Operable Unit One (OU1)
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<b>Photo No.</b> 11	<b>Date</b> 5-7-2014	
<b>Description</b> <i>Plant Site</i> Area B – Post Excavation, Looking South		

<b>Photo No.</b> 12	<b>Date</b> 5-7-2014	
<b>Description</b> <i>Breazeale Site</i> Entrance Gate		

# Photographic Log

<b>Client Name:</b> Schlumberger Technology Corporation	<b>Site Location:</b> Operable Unit One (OU1)
--	--

<b>Photo No.</b>	<b>Date</b>
13	5-7-2014

**Description**  
*Breazeale Site*  
 Exterior of Decommissioned  
 WWTP Building




<b>Photo No.</b>	<b>Date</b>
14	5-7-2014

**Description**  
*Secure Landfill*  
 Monitoring Well

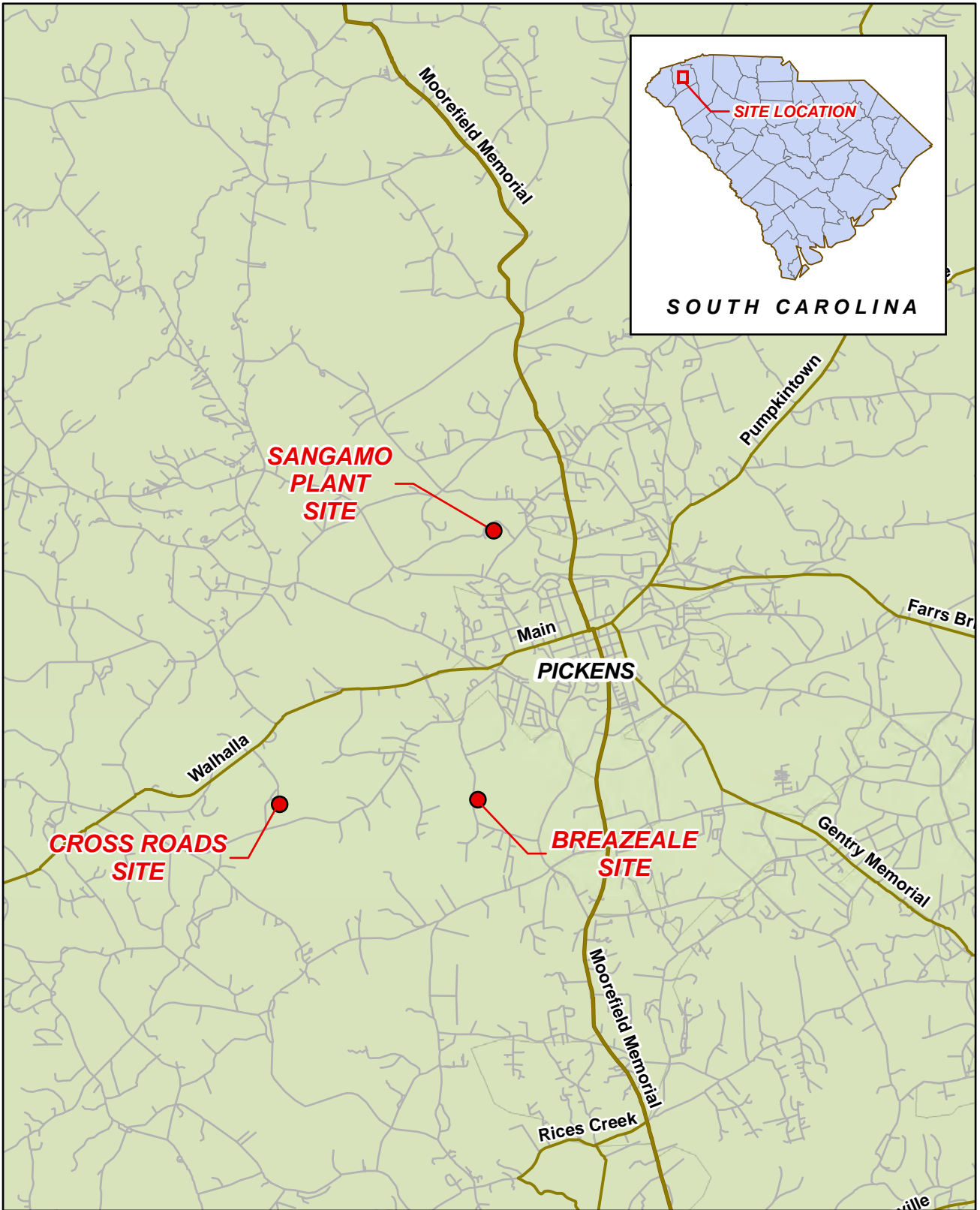


# Photographic Log

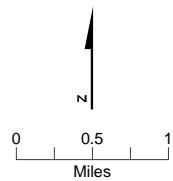
<b>Client Name:</b> Schlumberger Technology Corporation		<b>Site Location:</b> Operable Unit One (OU1)
<b>Photo No.</b> 15	<b>Date</b> 5-7-2014	
<b>Description</b> <i>Cross Roads Site</i> View of Site		

# Appendix B Figures

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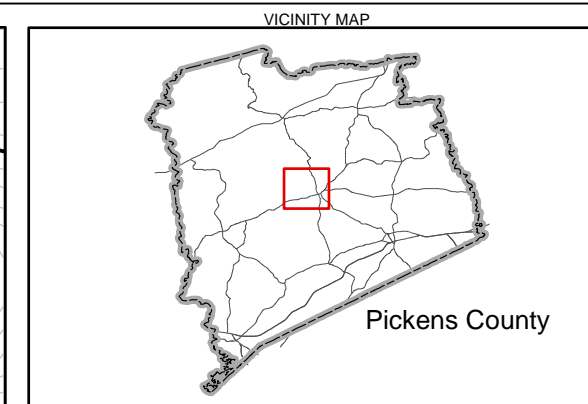
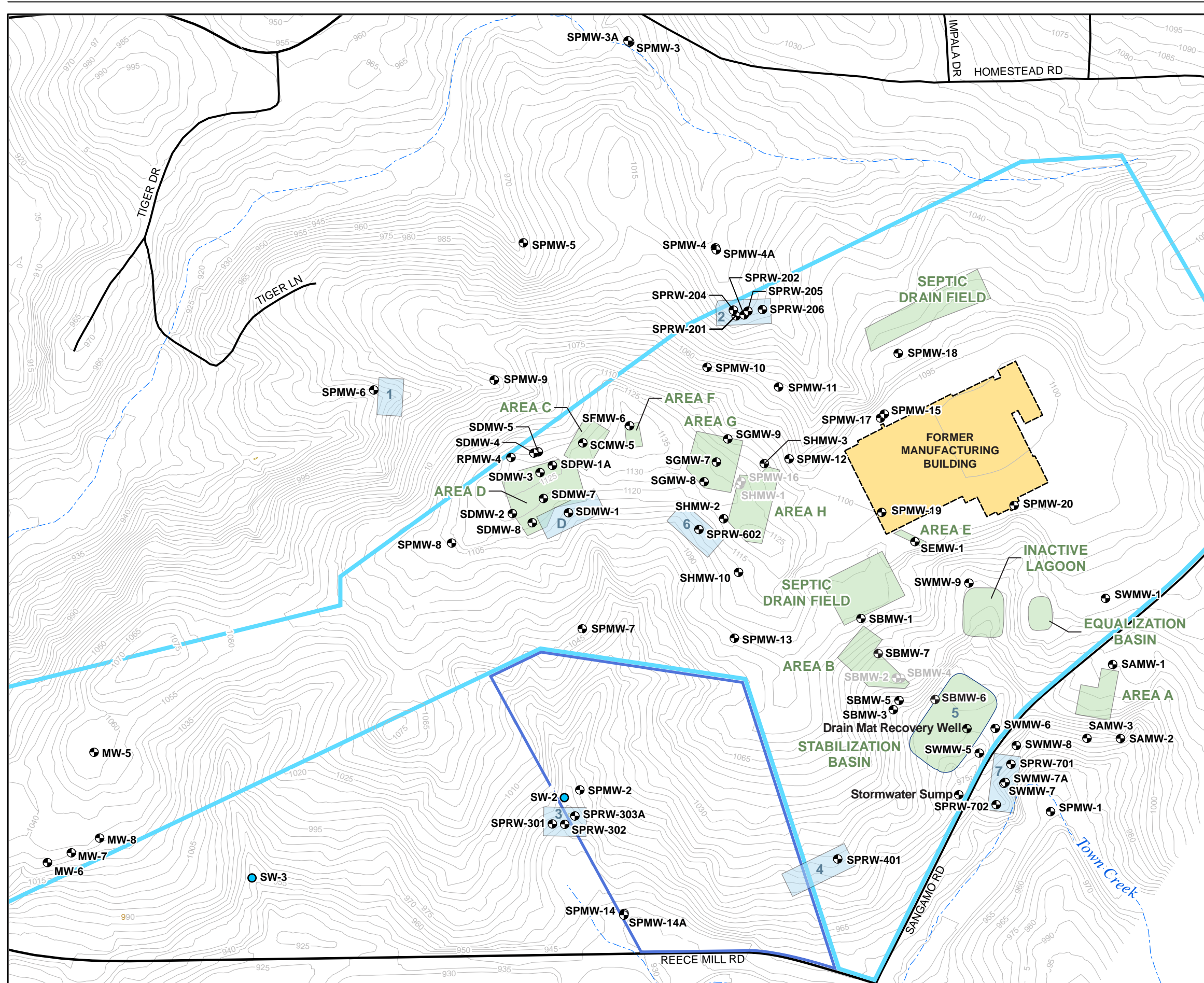


- LEGEND**
- Urban Area
  - U.S. Highway
  - State Highway
  - Road



**FIGURE 1**  
**Location Map**  
**Plant, Breazeale, and Cross Roads Sites**  
**Third Five-Year Review Report**  
*Sangamo Weston Site, Pickens, South Carolina*



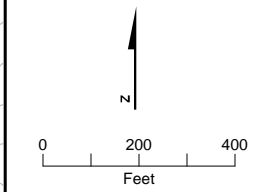


**LEGEND**

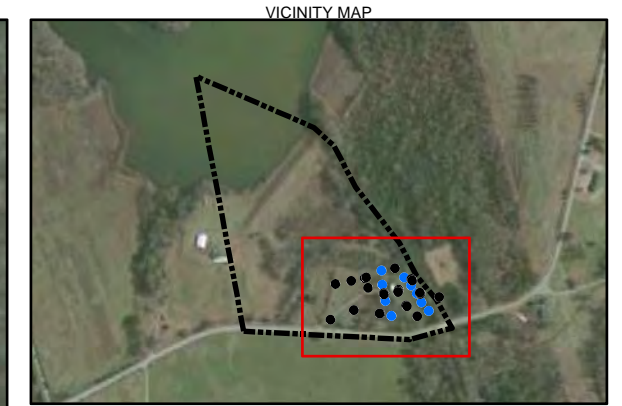
- Monitoring Well
- ⊕ Abandoned Monitoring Well
- Surface Water Sample Location
- 5' Topographic Contour
- - - River or Creek
- Highway or Local Road
- 2 Groundwater Recovery Area and Number
- RI Investigation Area
- Former Manufacturing Building Footprint
- Moore Property Boundary
- Schlumberger Property Boundary

Source Data:

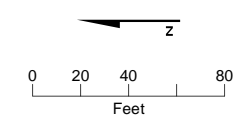
1. River and Creeks: National Hydrography Dataset (NHD), USGS, 1999
2. 5' Topographic Contour: Created using SangamoPlantTIN, Schulmberger



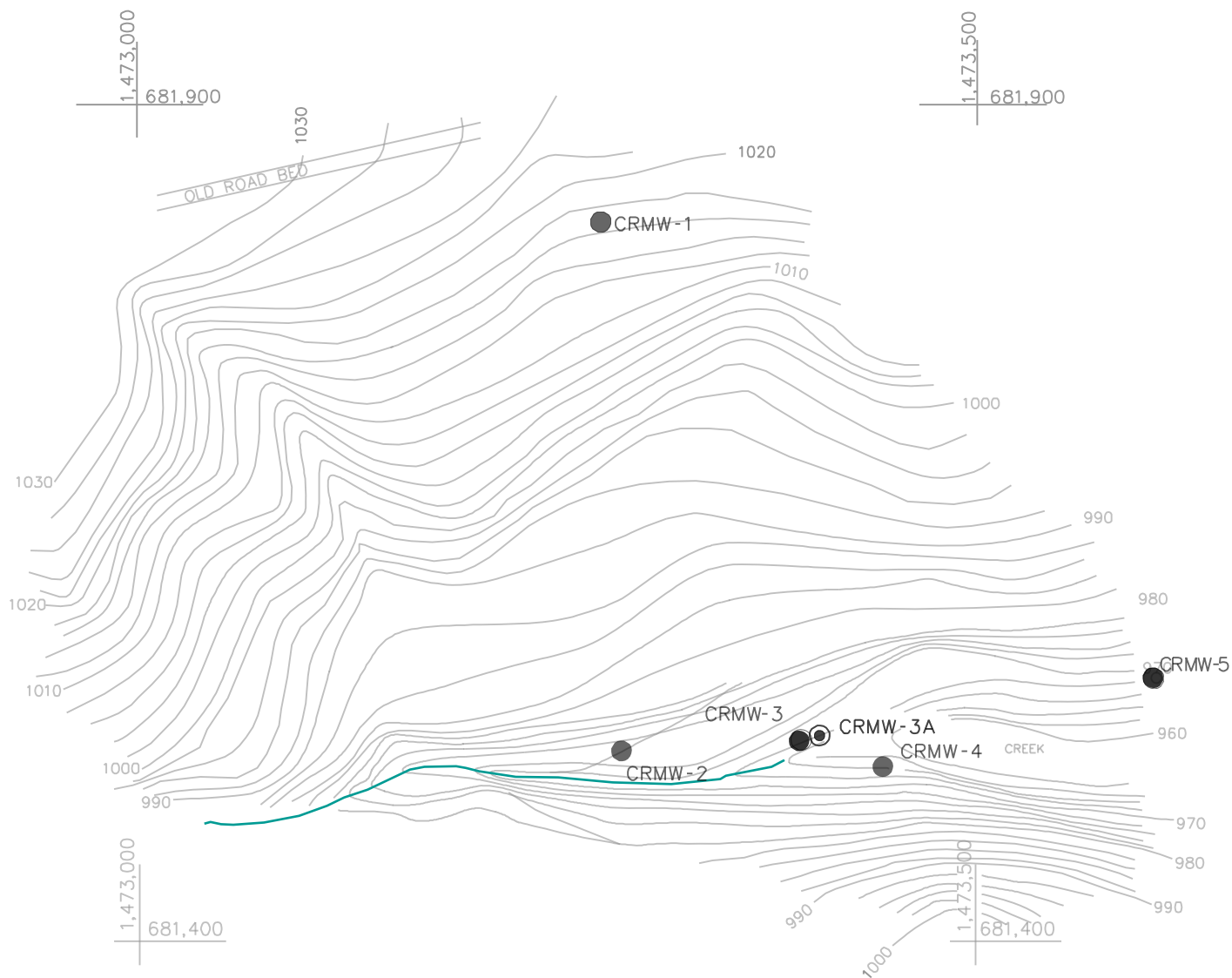
**FIGURE 2**  
**Plant Site Map**  
 Third Five-Year Review Report  
 Sangamo Weston Site, Pickens, South Carolina



- LEGEND**
- Performance Monitoring Well
  - Plugged and Abandoned Well
  - Injection Well
  - Highway or Local Road
  - Legal Boundary
  - Approximate Footprint of Former Soil Excavation Area
  - Wolf Creek



**FIGURE 3**  
**Breazeale Site Map**  
 Third Five-Year Review Report  
 Sangamo Weston Site, Pickens, South Carolina



**LEGEND**

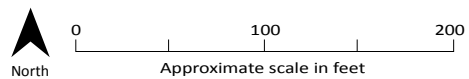
● CRMW-1 Monitoring Well - Shallow

⊙ CRMW-3A Monitoring Well - Deep

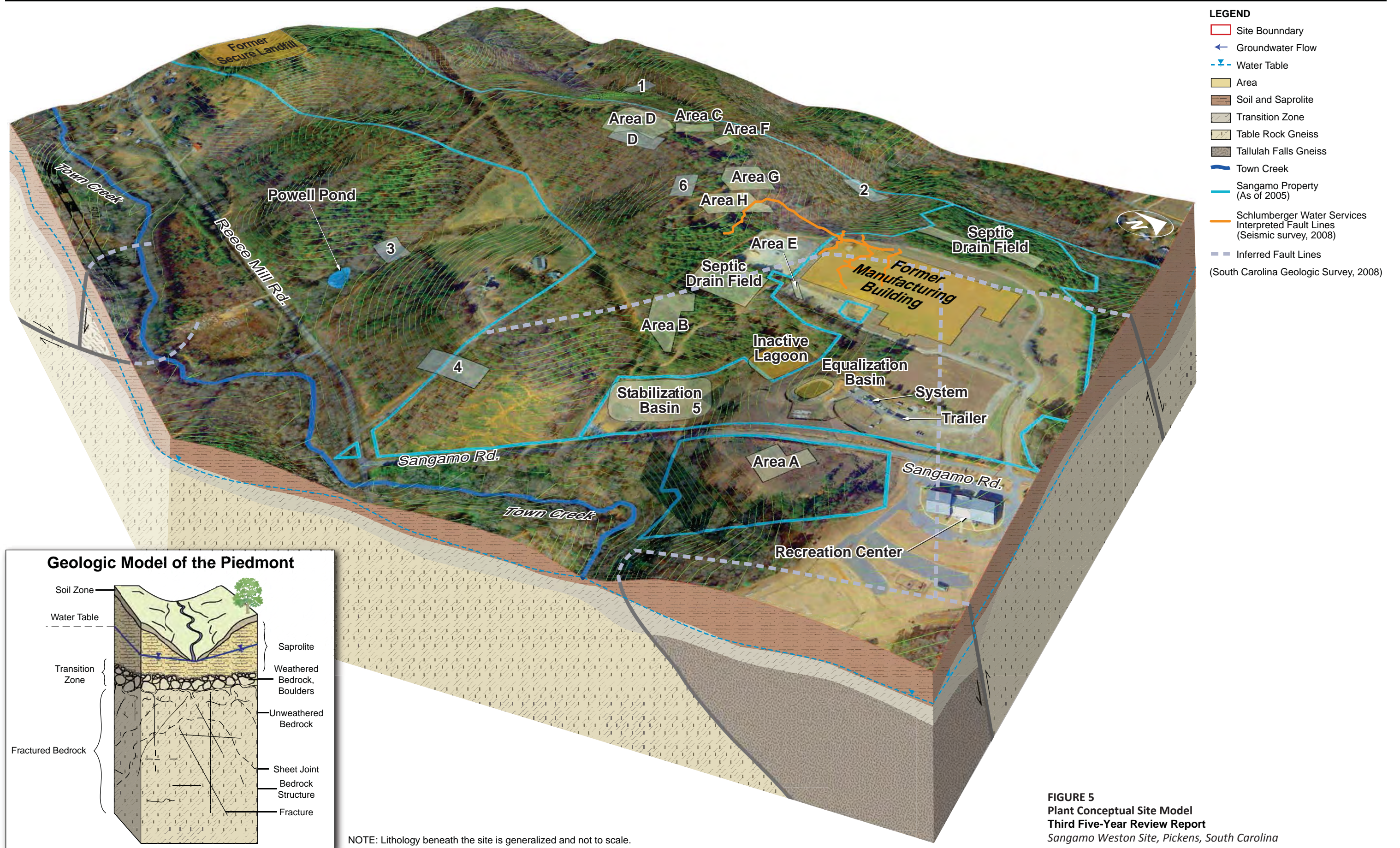
— 990 — Topographic Contours. Elevation in feet above mean sea level. Contour Interval as shown.

— Stream or Creek

— Intermittent Stream

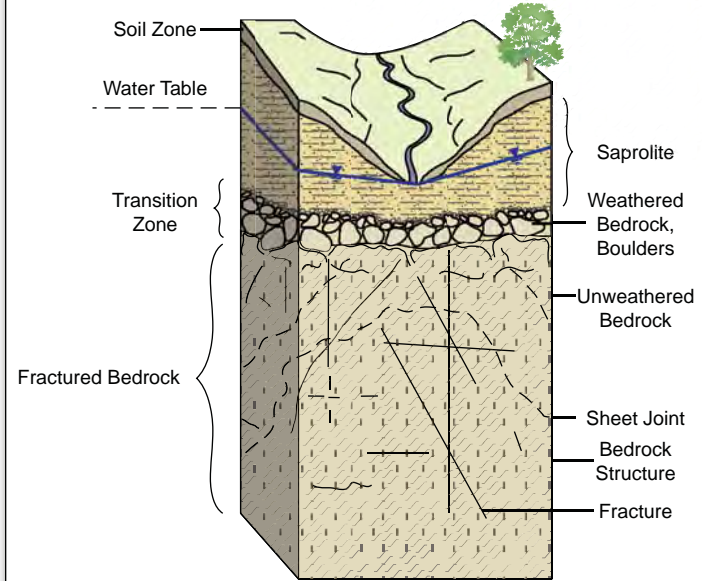


**FIGURE 4**  
**Cross Roads Site Map**  
**Third Five-Year Review Report**  
*Sangamo Weston Site, Pickens, South Carolina*



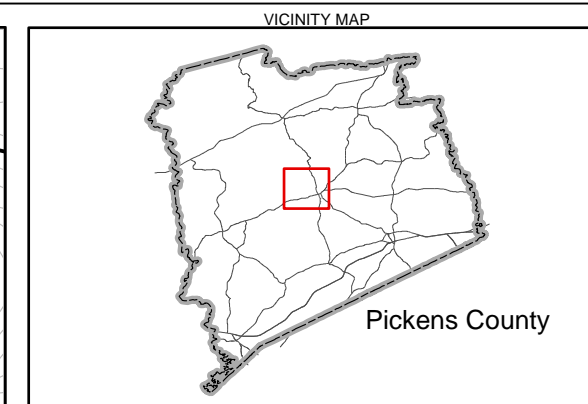
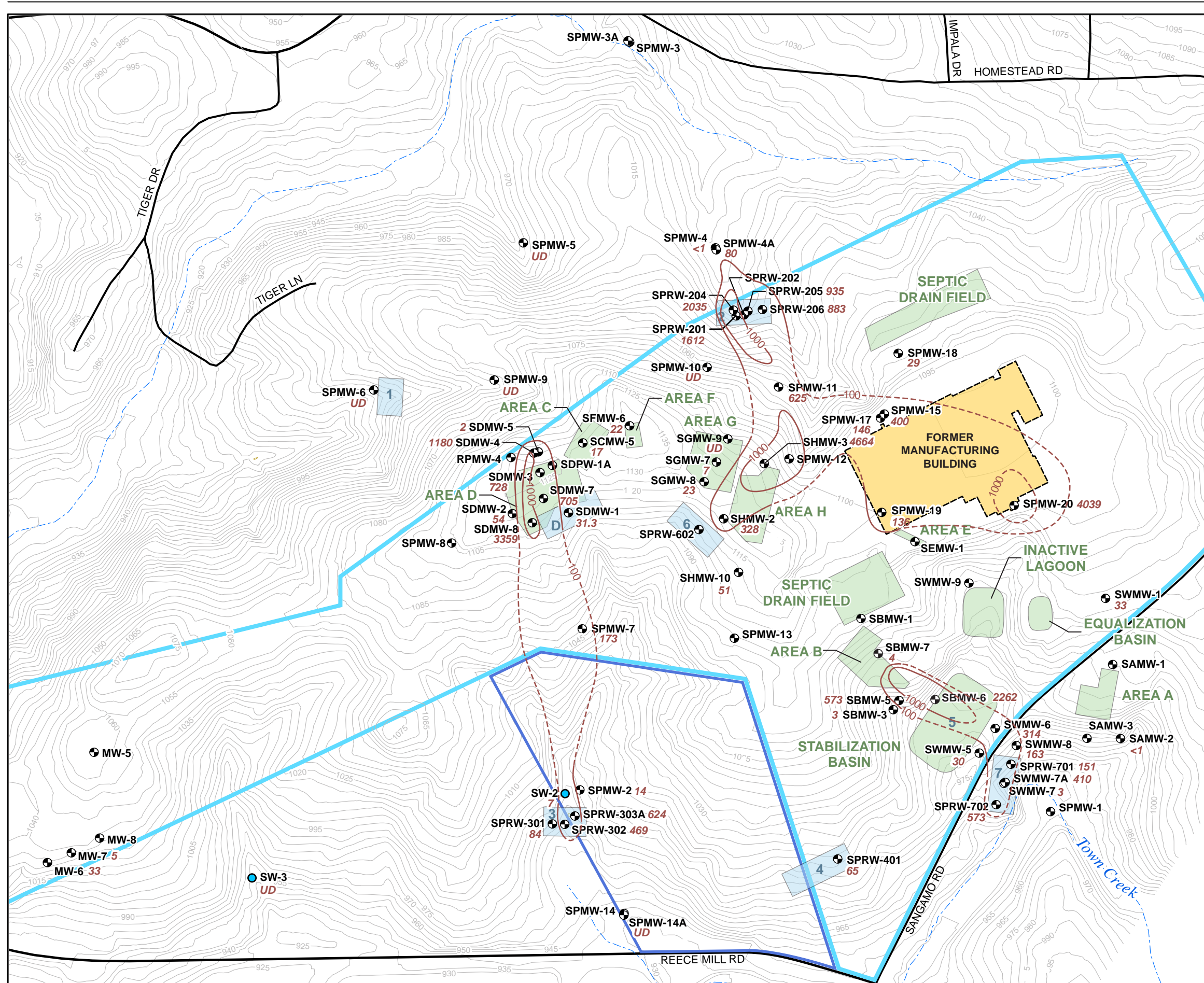
- LEGEND**
- Site Boundary
  - ← Groundwater Flow
  - - - Water Table
  - Area
  - Soil and Saprolite
  - Transition Zone
  - Table Rock Gneiss
  - Tallulah Falls Gneiss
  - Town Creek
  - Sangamo Property (As of 2005)
  - Schlumberger Water Services Interpreted Fault Lines (Seismic survey, 2008)
  - - - Inferred Fault Lines (South Carolina Geologic Survey, 2008)

**Geologic Model of the Piedmont**



NOTE: Lithology beneath the site is generalized and not to scale.

**FIGURE 5**  
**Plant Conceptual Site Model**  
**Third Five-Year Review Report**  
 Sangamo Weston Site, Pickens, South Carolina

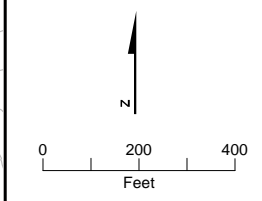


**LEGEND**

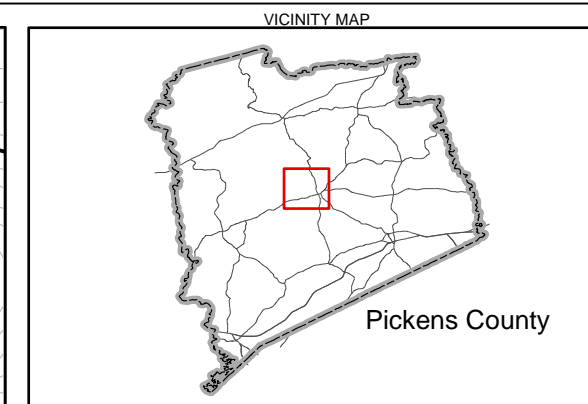
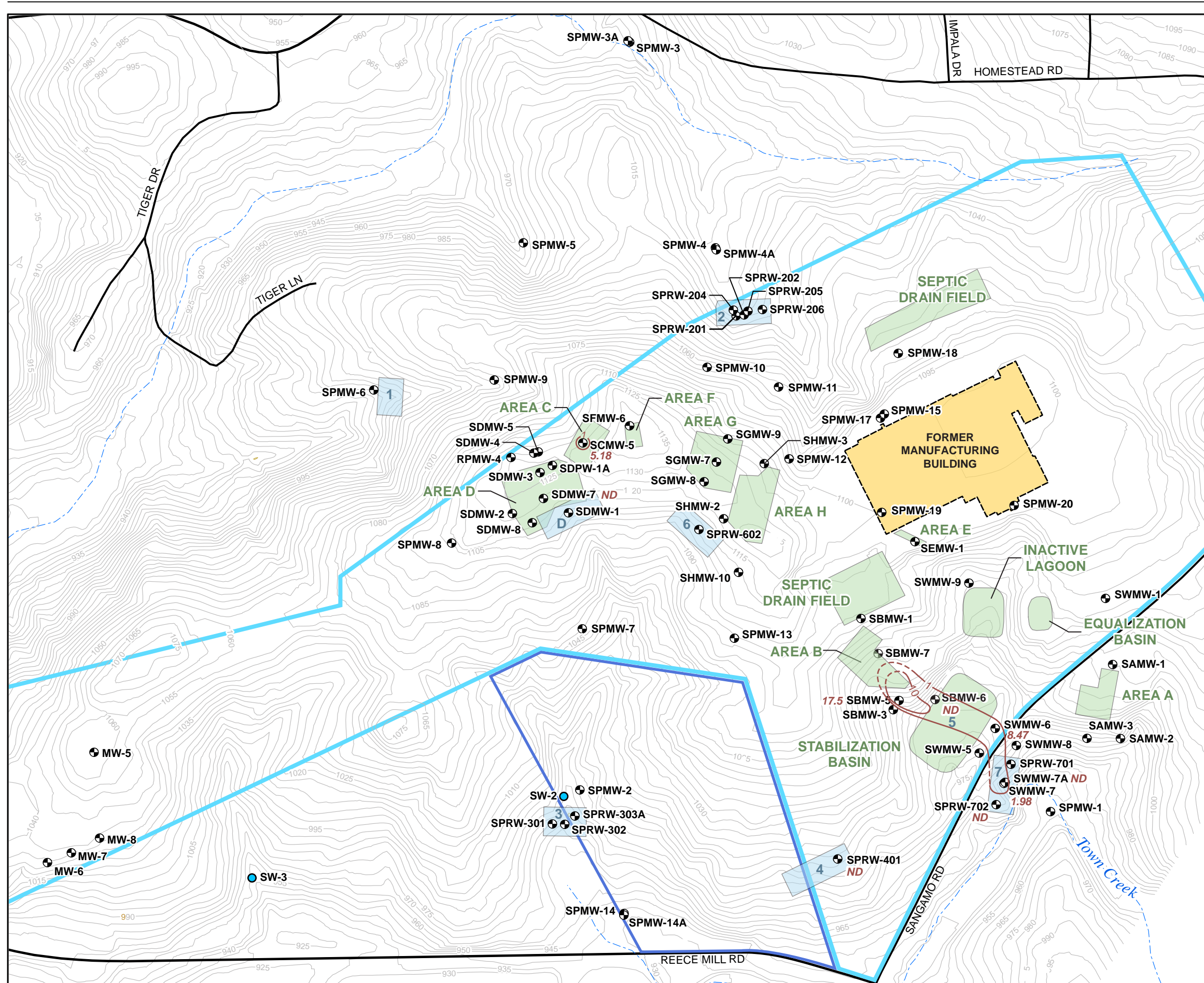
- Monitoring Well
- ⊕ Abandoned Monitoring Well
- Surface Water Sample Location
- 5' Topographic Contour
- River or Creek
- Highway or Local Road
- 2 Groundwater Recovery Area and Number
- RI Investigation Area
- Former Manufacturing Building Footprint
- Moore Property Boundary
- Schlumberger Property Boundary
- Total VOCs in Groundwater (µg/L)  
Dashed Where Inferred
- UD VOCs Not Detected

Source Data:

1. River and Creeks: National Hydrography Dataset (NHD), USGS, 1999
2. 5' Topographic Contour: Created using SangamoPlantTIN, Schulmberger



**FIGURE 6**  
**Plant Site Total VOCs in Groundwater**  
**March 2014**  
**Third Five-Year Review Report**  
**Sangamo Weston Site, Pickens, South Carolina**

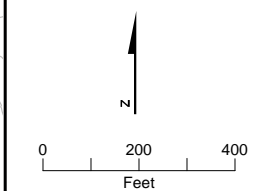


**LEGEND**

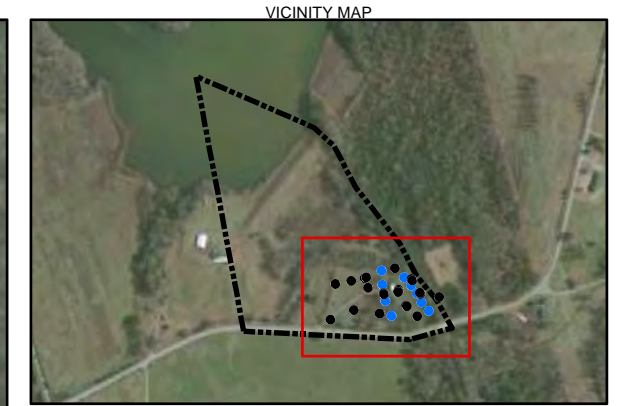
- Monitoring Well
- ⊕ Abandoned Monitoring Well
- Surface Water Sample Location
- 5' Topographic Contour
- River or Creek
- Highway or Local Road
- 2 Groundwater Recovery Area and Number
- RI Investigation Area
- Former Manufacturing Building Footprint
- Moore Property Boundary
- Schlumberger Property Boundary
- PCB-1242 Concentrations in Groundwater ( $\mu\text{g/L}$ )  
Dashed Where Inferred
- J Concentration considered an estimate based on data validation
- ND Not Detected

Source Data:

1. River and Creeks: National Hydrography Dataset (NHD), USGS, 1999
2. 5' Topographic Contour: Created using SangamoPlantTIN, Schulmberger



**FIGURE 7**  
**Plant Site PCB Concentrations in Groundwater**  
**March 2014**  
**Third Five-Year Review Report**  
**Sangamo Weston Site, Pickens, South Carolina**



**LEGEND**

- Performance Monitoring Well
- Plugged and Abandoned Well
- Injection Well
- PCE Isoconcentration Contour- 40 µg/L Interim Protection Level
- Highway or Local Road
- Legal Boundary
- Approximate Footprint of Former Soil Excavation Area
- 9.67 PCE Concentration, µg/L
- NS Not Sampled
- ND Not Detected
- Wolf Creek

0 20 40 80  
Feet

**FIGURE 8**  
**Brezeale Site PCE Concentrations in Groundwater**  
**March 2014**  
**Third Five-Year Review Report**  
*Sangamo Weston Site, Pickens, South Carolina*

# Appendix C

## Copy of Community Notification

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# EDUCATION

## National FFA Scholarship awarded to local student

PICKENS — The National FFA Organization awarded a \$1,000 Tractor Supply — Growing Scholars scholarship to Charlie Dunham of the Pickens County Career & Technology Center.

The scholarship is sponsored by Tractor Supply Company as a special project of the National FFA Foundation. Dunham plans to use the funds to pursue a degree at Tri-County Technical

College. The scholarship is one of 1,786 awarded through the National FFA Organization's scholarship program this year. Currently, 126 sponsors contribute more than \$2.2 million to support scholarships for students.

For 30 years, scholarships have been made available through funding secured by the National FFA Foundation. The funding comes from individuals, businesses and

corporate sponsors to encourage excellence and enable students to pursue their educational goals.

The 2014 scholarship recipients were selected from 6,315 applicants from across the country. Selections were based on the applicant's leadership, academic record, FFA and other school and community activities, supervised agricultural or work experience in agricultural education and future goals.



Gillian Black from the Horticulture Department of the Pickens County Career & Technology Center presents Charlie Dunham with a \$1,000 scholarship from Tractor Supply.

## R.C. Edwards students win at biology contest



A team of R.C. Edwards Middle School students participated in the Biology Merit Exam at Clemson University on April 11. With 198 competitors, Edwards students earned 13 of the 30 awards given in Division I. The winners included: Benjamin Buck, first place; Jennifer Gao and Connor Lehmacher, second place; David Cote, Jack Love, and John Martin, first honorable mention; and Nathaniel Hiott, Rebecca Freeze, Louisa Mai, Hannah Wiggins, Kristopher Luo, Seth Trotter, and Jason Williams, second honorable mention.

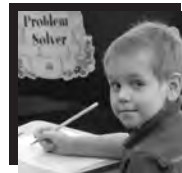
Christian Children Deserve a Christian Education

academics + life experience

A Tabernacle Christian Education



We're committed to fostering our students' success both in and out of the classroom. In addition to a dynamic and challenging academic curriculum, we teach students the value of self-respect, social responsibility and lifelong learning. Our goal is to provide each of our students with a well-rounded education that will inspire achievement in school and in life.



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**Tabernacle Christian School**

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Greenville, SC 29611  
(864) 269-2760  
<http://tbc.sc/school/>

# Reason #124



**No more squinting!**

**You asked ... We listened.** We've redesigned our newspaper with a bigger font and better spacing, modifying the stories to be easier to read. Check out these improvements and more starting the week of July 22, 2014.

**The Dickens Sentinel**

00703226



### The U.S. Environmental Protection Agency, Region 4 Third Five-Year Review Sangamo Weston Superfund Site, Pickens County, South Carolina

The United States Environmental Protection Agency (EPA) Region 4 and the South Carolina Department of Health and Environmental Control (SC DHEC) have initiated the Third Five-Year Review for Operable Unit One (OU1) and Operable Unit Two (OU2) of the Sangamo Weston/Twelve Mile Creek/Lake Hartwell PCB Contamination Superfund Site in Pickens County, South Carolina. Five Year Reviews are conducted to evaluate the protectiveness of cleanup actions taken at Superfund sites.

OU1 of the Sangamo site addressed the land based PCB source areas, including the former Plant site and six satellite disposal areas. Soils impacted by PCBs were excavated from the disposal areas and stockpiled at the Plant Site for treatment. From December 1995 through May 1997, approximately 60,000 tons of soil was treated via thermal desorption and backfilled on the Plant Site. Active groundwater recovery and treatment was initiated at the Plant Site in November 1998. The Plant Site system has recovered more than 400 million gallons of groundwater, and removed an estimated 1,988 pounds of chlorinated solvents and 27 pounds of PCBs. The treatment system was completely refurbished in 2013. In late 2013, an additional 17,000 tons of residual source material was excavated from the Plant site and transported off-site for proper disposal. This supplemental work removed an estimated 6,300 pounds of PCBs and 715 pounds of chlorinated solvents of source material from the subsurface. The Breazeale Site water treatment system recovered an estimated 116 million gallons prior to shut-down in 2009 and decommissioning in 2014.

OU2 of the Sangamo site addressed the sediment, surface water, and biological migration pathways down stream from the land-based source areas. A fish consumption advisory on Lake Hartwell was first issued in 1976, and has been modified many times since to provide meal advice to anglers based on PCB trends in fish tissue. Impacted surface sediments in the Twelve Mile Creek Arm of Lake Hartwell are being addressed by natural burial processes referred to as Monitored Natural Recovery.

EPA and SCDHEC anticipate that the Third Five Year Review for the Sangamo site will be completed by September 2014. Public comments and questions on the Five Year Review process are encouraged. For more information on the Sangamo site, please visit the EPA web page at <http://www.epa.gov/region4/superfund/sites/npl/southcarolina/sangsc.html>; or contact the EPA/SCDHEC project managers below:

Craig Zeller, P.E.  
US EPA Region 4  
Superfund Division  
61 Forsyth Street  
Atlanta, GA 30303  
404.562.8827  
[Zeller.Craig@epa.gov](mailto:Zeller.Craig@epa.gov)

Greg Cassidy  
SCDHEC  
Bureau of Land & Waste Management  
2600 Bull Street  
Columbia, SC 29201  
803.898.0910  
[Cassidga@dhec.sc.gov](mailto:Cassidga@dhec.sc.gov)

# Appendix D

## Data Summary Tables

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TABLE 1

Summary of Breazeale Site Analytical Results, March 2014

Third Five-Year Review Report

Sangamo Weston Site, Pickens, South Carolina

Sample ID	Sample Date	Analyte	Units	Performance Standard MCL <sup>(1)</sup>	Interim Protection Level <sup>(2)</sup>	Station ID	BRMW-01	BRMW-02A	BRMW-02	BRMW-03	BRMW-04A	BRMW-04	BRMW-08	BRMW-09	BRMW-10	BRMW-11	BRMW-12A	BRMW-14
						BRMW-01-GW-HS-031814	BRMW-02A-GW-HS-031814RE	BRMW-02-GW-HS-031814	BRMW-03-GW-HS-031814	BRMW-04A-GW-HS-031814	BRMW-04-GW-HS-031814	BRMW-08-GW-HS-031814	BRMW-09-GW-HS-031814	BRMW-10-GW-HS-031814	BRMW-11-GW-HS-031814	BRMW-12A-GW-HS-031814	BRMW-14-GW-HS-031814	
						3/18/2014	3/18/2014	3/18/2014	3/18/2014	3/18/2014	3/18/2014	3/18/2014	3/18/2014	3/18/2014	3/18/2014	3/18/2014	3/18/2014	3/18/2014
<b>Polychlorinated Biphenyls (PCBs)</b>																		
PCB-1242		µg/L	0.5	--		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
PCB-1248		µg/L	0.5	--		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
PCB-1254		µg/L	0.5	--		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
<b>Volatile Organic Compounds (VOCs)</b>																		
1,1-Dichloroethene		µg/L	7	--		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.874 J	1 U	1 U
cis-1,2-Dichloroethene		µg/L	70	--		1 U	1 U	1.77	1 U	1 U	0.353 J	1 U	1 U	1 U	1 U	572	1 U	1 U
Tetrachloroethene		µg/L	5	40		1 U	0.82 J	57	4.03	9.67	75	1 U	0.201 J	2.67	79	1.05	0.301 J	
trans-1,2-Dichloroethene		µg/L	100	--		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	2.95	1 U	1 U	
Trichloroethene		µg/L	5	150		1 U	0.342 J	177	5.88	1.83	10.1	1 U	1 U	0.989 J	96	0.532 J	1 U	
Vinyl chloride		µg/L	2	--		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

Notes:

**Exceeds Performance Standard (MCL)**

**Bold indicates the analyte was detected**

-- Screening criteria does not exist for analyte

<sup>(1)</sup> Maximum Contaminant Level (MCL) (EPA, November 2012).

<sup>(2)</sup> Levels established for Breazeale Site in the 2009 Record of Decision Amendment (EPA 2009) for the protection of Wolf Creek.

J - Concentration considered an estimate based on data validation.

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ - Not detected; quantitation limit may be inaccurate or imprecise.

µg/L - micrograms per liter

NS - Not sampled

TABLE 2

Summary of Cross Roads Site Analytical Results, March 2014

Third Five-Year Review Report

Sangamo Weston Site, Pickens, South Carolina

Station ID			CRMW-1	CRMW-2	CRMW-3A	CRMW-3	CRMW-4	CRMW-5
Sample ID	Units	Performance Standard MCL <sup>(1)</sup>	CRMW-1-GW-HS-031814	CRMW-2-GW-HS-031814	CRMW-3A-GW-HS-031814	CRMW-3-GW-HS-031814	CRMW-4-GW-HS-031814	CRMW-5-GW-HS-031814
Sample Date			3/18/2014	3/18/2014	3/18/2014	3/18/2014	3/18/2014	3/18/2014
Analyte								
<b>Polychlorinated Biphenyls (PCBs)</b>								
PCB-1242	µg/L	0.5	NS	NS	NS	NS	NS	NS
PCB-1248	µg/L	0.5	NS	NS	NS	NS	NS	NS
PCB-1254	µg/L	0.5	NS	NS	NS	NS	NS	NS
<b>Volatile Organic Compounds (VOCs)</b>								
1,1-Dichloroethene	µg/L	7	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	µg/L	70	1 U	1 U	1 U	0.258 J	1 U	1 U
Tetrachloroethene	µg/L	5	6.94	1.27	0.399 J	5.86 J	1 U	1 U
trans-1,2-Dichloroethene	µg/L	100	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	µg/L	5	5.39	2.7	1 U	11.2	1 U	1 U
Vinyl chloride	µg/L	2	1 U	1 U	1 U	1 U	1 U	1 U

Notes:

**Exceeds Performance Standard (MCL)****Bold indicates the analyte was detected**

-- Screening criteria does not exist for analyte

<sup>(1)</sup> Maximum Contaminant Level (MCL) (EPA, November 2012).

J - Concentration considered an estimate based on data validation.

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ - Not detected; quantitation limit may be inaccurate or imprecise.

µg/L - micrograms per liter

NS - Not sampled

TABLE 3

Summary of Plant Site Analytical Results, March 2014

Third Five-Year Review Report

Sangamo Weston Site, Pickens, South Carolina

Station ID			Secure Landfill		Area A	Area B			Area C	
			MW-6	MW-7	SAMW-2	SBMW-3	SBMW-5	SBMW-6	SBMW-7	SCMW-5
Sample ID	Units	Performance Standard MCL <sup>(1)</sup>	MW-6-GW-HS-031114	MW-7-GW-HS-031114	SAMW-2-GW-HS-031414	SBMW-3-GW-HS-031314RE	SBMW-5-GW-HS-031314	SBMW-6-GW-HS-031314	SBMW-7-GW-HS-031314RE	SCMW-5-GW-HS-031114
Sample Date			3/11/2014	3/11/2014	3/14/2014	3/13/2014	3/13/2014	3/13/2014	3/13/2014	3/11/2014
Analyte										
<b>Polychlorinated Biphenyls (PCBs)</b>										
PCB-1242	µg/L	0.5	NS	NS	NS	NS	17.5	9.43 UJ	NS	5.18
PCB-1248	µg/L	0.5	NS	NS	NS	NS	2.36 U	9.43 UJ	NS	0.469 U
PCB-1254	µg/L	0.5	NS	NS	NS	NS	2.36 U	9.43 UJ	NS	0.469 U
<b>Volatile Organic Compounds (VOCs)</b>										
1,1-Dichloroethene	µg/L	7	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	µg/L	70	1.41	0.623 J	1 U	1 U	11	0.834 J	1 U	1 U
Tetrachloroethene	µg/L	5	1 U	1 U	0.433 J	3.1	538	2,210	3.64	7.89
trans-1,2-Dichloroethene	µg/L	100	0.239 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	µg/L	5	31	4.63	1 U	0.21 J	23.7	50.9	0.388 J	8.62
Vinyl chloride	µg/L	2	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

Notes:

**Exceeds Performance Standard (MCL)****Bold indicates the analyte was detected**

-- Screening criteria does not exist for analyte

<sup>(1)</sup> Maximum Contaminant Level (MCL) (EPA,

J - Concentration considered an estimate based on data validation.

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ - Not detected; quantitation limit may be inaccurate or imprecise.

µg/L - micrograms per liter

NS - Not sampled

TABLE 3

Summary of Plant Site Analytical Results, March 2014

Third Five-Year Review Report

Sangamo Weston Site, Pickens, South Carolina

Station ID			Area D						Area F	Area G			
			SDMW-1	SDMW-2	SDMW-3	SDMW-4	SDMW-5	SDMW-7	SDMW-8	SFMW-6	SGMW-7	SGMW-8	SGMW-9
Sample ID	Units	Performance Standard MCL <sup>(1)</sup>	SDMW-1-GW-HS-031314RE	SDMW-2-GW-HS-031314	SDMW-3-GW-031914	SDMW-4-GW-HS-031314	SDMW-5-GW-HS-031314RE	SDMW-7-GW-HS-031314	SDMW-8-GW-HS-031214	SFMW-6-GW-HS-031314RE	SGMW-7-GW-HS-031314	SGMW-8-GW-HS-031314	SGMW-9-GW-HS-031314
Sample Date			3/13/2014	3/13/2014	3/19/2014	3/13/2014	3/13/2014	3/13/2014	3/12/2014	3/13/2014	3/13/2014	3/13/2014	3/13/2014
Analyte													
<b>Polychlorinated Biphenyls (PCBs)</b>													
PCB-1242	µg/L	0.5	NS	NS	0.472 U	NS	NS	2.36 U	0.485 U	NS	NS	NS	NS
PCB-1248	µg/L	0.5	NS	NS	0.472 U	NS	NS	2.36 U	0.485 U	NS	NS	NS	NS
PCB-1254	µg/L	0.5	NS	NS	0.472 U	NS	NS	2.36 U	0.485 U	NS	NS	NS	NS
<b>Volatile Organic Compounds (VOCs)</b>													
1,1-Dichloroethene	µg/L	7	1 U	1 U	5.6	<b>7</b>	1 U	6.4	<b>25.2</b>	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	µg/L	70	1 U	1 U	3.91	<b>12.8</b>	1 U	61.8	<b>77.4</b>	12.1	1 U	1 U	<b>0.857 J</b>
Tetrachloroethene	µg/L	5	<b>15.1</b>	<b>49.5</b>	<b>263</b>	<b>504</b>	<b>0.344 J</b>	<b>119</b>	<b>796</b>	<b>5.23</b>	<b>3.66</b>	<b>12.5</b>	<b>24.3</b>
trans-1,2-Dichloroethene	µg/L	100	1 U	1 U	1 U	<b>0.288 J</b>	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	µg/L	5	<b>16.2</b>	<b>4.61</b>	<b>455</b>	<b>656</b>	<b>1.44</b>	<b>518</b>	<b>2,460</b>	<b>4.6</b>	<b>3.35</b>	<b>10.3</b>	<b>25.3</b>
Vinyl chloride	µg/L	2	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

Notes:

**Exceeds Performance Standard (MCL)**

**Bold indicates the analyte was detected**

-- Screening criteria does not exist for analyte

<sup>(1)</sup> Maximum Contaminant Level (MCL) (EPA,

J - Concentration considered an estimate based on data validation.

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ - Not detected; quantitation limit may be inaccurate or imprecise.

µg/L - micrograms per liter

NS - Not sampled

TABLE 3

Summary of Plant Site Analytical Results, March 2014

Third Five-Year Review Report

Sangamo Weston Site, Pickens, South Carolina

Station ID			Area H				Area 2				Area 3			Area 4
			SHMW-10	SHMW-2	SHMW-3	SHMW-3	SPRW-201	SPRW-204	SPRW-205	SPRW-206	SPRW-301	SPRW-302	SPRW-303A	SPRW-401
Sample ID	Units	Performance Standard MCL <sup>(1)</sup>	SHMW-10-GW-HS-031214RE	SHMW-2-GW-HS-031214	SHMW-3-GW-HS-031214	SHMW-3-GW-HS-060414	SPRW-201-GW-HS-031214	SPRW-204-GW-HS-031214	SPRW-205-GW-HS-031214	SPRW-206-GW-HS-031214	SPRW-301-GW-031914	SPRW-302-GW-HS-031214	SPRW-303A-GW-HS-031214	SPRW-401-GW-HS-031214
Sample Date			3/12/2014	3/12/2014	3/12/2014	6/4/2014	3/12/2014	3/12/2014	3/12/2014	3/12/2014	3/19/2014	3/12/2014	3/12/2014	3/12/2014
Analyte														
Polychlorinated Biphenyls (PCBs)														
PCB-1242	µg/L	0.5	NS	0.476 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.49 U
PCB-1248	µg/L	0.5	NS	0.476 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.49 U
PCB-1254	µg/L	0.5	NS	0.476 U	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.49 U
Volatile Organic Compounds (VOCs)														
1,1-Dichloroethene	µg/L	7	1 U	1 U	<b>0.857 J</b>	<b>1.3</b>	2.7	<b>1.2</b>	<b>0.348 J</b>	<b>0.436 J</b>	2.55	2.86	4.59	<b>0.673 J</b>
cis-1,2-Dichloroethene	µg/L	70	1 U	<b>21.3</b>	<b>102</b>	<b>260</b>	<b>977</b>	<b>288</b>	<b>122</b>	<b>137</b>	35.6	65	<b>85.5</b>	<b>42.4</b>
Tetrachloroethene	µg/L	5	<b>31</b>	<b>94</b>	<b>1,300</b>	<b>1,730</b>	<b>123</b>	<b>575</b>	<b>402</b>	<b>272</b>	0.996 J	<b>31.9</b>	<b>33.3</b>	<b>9.05</b>
trans-1,2-Dichloroethene	µg/L	100	1 U	1 U	1.17	<b>6.22</b>	1.64	<b>0.67 J</b>	<b>0.954 J</b>	<b>0.627 J</b>	1.34	<b>0.358 J</b>	<b>0.296 J</b>	1 U
Trichloroethene	µg/L	5	<b>18.2</b>	<b>213</b>	<b>3,260</b>	<b>4,180</b>	<b>635</b>	<b>1,170</b>	<b>410</b>	<b>473</b>	<b>42.2</b>	<b>369</b>	<b>500</b>	<b>9.58</b>
Vinyl chloride	µg/L	2	1 U	1 U	<b>0.356 J</b>	<b>0.618 J</b>	<b>2.38</b>	1 U	1 U	1 U	1.56	1 U	1 U	<b>3.61</b>

Notes:

**Exceeds Performance Standard (MCL)**

**Bold indicates the analyte was detected**

-- Screening criteria does not exist for analyte

<sup>(1)</sup> Maximum Contaminant Level (MCL) (EPA,

J - Concentration considered an estimate based on data validation.

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ - Not detected; quantitation limit may be inaccurate or imprecise.

µg/L - micrograms per liter

NS - Not sampled

TABLE 3

Summary of Plant Site Analytical Results, March 2014

Third Five-Year Review Report

Sangamo Weston Site, Pickens, South Carolina

Station ID			Area 5		Area 7		Perimeter Monitoring Wells							
			SWMW-5	SWMW-6	SPRW-701	SPRW-702	SPMW-2	SPMW-4A	SPMW-4	SPMW-5	SPMW-6	SPMW-7	SPMW-9	SPMW-10
Sample ID	Units	Performance Standard MCL <sup>(1)</sup>	SWMW-5-GW-HS-031314RE	SWMW-6-GW-HS-031314	SPRW-701-GW-031414	SPRW-702-GW-031414	SPMW-2-GW-HS-031214	SPMW-4A-GW-HS-031114	SPMW-4-GW-HS-031114	SPMW-5-GW-HS-031114	SPMW-6-GW-HS-031114	SPMW-7-GW-HS-031314	SPMW-9-GW-HS-031114	SPMW-10-GW-031214RE
Sample Date			3/13/2014	3/13/2014	3/14/2014	3/14/2014	3/12/2014	3/11/2014	3/11/2014	3/11/2014	3/11/2014	3/13/2014	3/11/2014	3/12/2014
Analyte														
<b>Polychlorinated Biphenyls (PCBs)</b>														
PCB-1242	µg/L	0.5	0.943 U	<b>8.47</b>	0.474 U	2.37 U	NS	NS	NS	NS	NS	NS	NS	NS
PCB-1248	µg/L	0.5	0.943 U	0.472 U	0.474 U	2.37 U	NS	NS	NS	NS	NS	NS	NS	NS
PCB-1254	µg/L	0.5	0.943 U	0.472 U	0.474 U	2.37 U	NS	NS	NS	NS	NS	NS	NS	NS
<b>Volatile Organic Compounds (VOCs)</b>														
1,1-Dichloroethene	µg/L	7	<b>0.62 J</b>	1 U	1 U	<b>0.367 J</b>	1 U	<b>0.349 J</b>	1 U	1 U	1 U	<b>1.01</b>	1 U	1 U
cis-1,2-Dichloroethene	µg/L	70	<b>7.23</b>	<b>2.12</b>	<b>2.59</b>	<b>12.3</b>	<b>0.626 J</b>	<b>45.4</b>	1 U	1 U	1 U	<b>10.6</b>	1 U	1 U
Tetrachloroethene	µg/L	5	<b>11.9</b>	<b>300</b>	<b>135</b>	<b>512</b>	<b>3.72</b>	<b>9.19</b>	<b>0.152 J</b>	1 U	1 U	<b>33.1</b>	1 U	1 U
trans-1,2-Dichloroethene	µg/L	100	1 U	1 U	<b>0.325 J</b>	<b>0.473 J</b>	1 U	<b>1.06</b>	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	µg/L	5	<b>9.59</b>	<b>12.2</b>	<b>13.2</b>	<b>47.5</b>	<b>9.33</b>	<b>24</b>	1 U	1 U	1 U	<b>125</b>	1 U	1 U
Vinyl chloride	µg/L	2	<b>0.95 J</b>	1 U	1 U	<b>0.369 J</b>	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

Notes:

**Exceeds Performance Standard (MCL)****Bold indicates the analyte was detected**

-- Screening criteria does not exist for analyte

<sup>(1)</sup> Maximum Contaminant Level (MCL) (EPA,

J - Concentration considered an estimate based on data validation.

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ - Not detected; quantitation limit may be inaccurate or imprecise.

µg/L - micrograms per liter

NS - Not sampled



TABLE 3

Summary of Plant Site Analytical Results, March 2014

Third Five-Year Review Report

Sangamo Weston Site, Pickens, South Carolina

Station ID			Perimeter Monitoring Wells									
			SPMW-11	SPMW-12	SPMW-14A	SPMW-15	SPMW-17	SPMW-18	SPMW-19	SPMW-20	SPMW-20	SPMW-20
Sample ID	Units	Performance Standard MCL <sup>(1)</sup>	SPMW-11-GW-HS-031214	SPMW-12-GW-HS-031214	SPMW-14A-GW-HS-031214RE	SPMW-15-GW-HS-031314	SPMW-17-GW-HS-031314	SPMW-18-GW-HS-031214	SPMW-19-GW-HS-031314	SPMW-20-GW-HS-031314	SPMW-20-GW-HS-060414-1	SPMW-20-GW-HS-060414-2
Sample Date			3/12/2014	3/12/2014	3/12/2014	3/13/2014	3/13/2014	3/12/2014	3/13/2014	3/13/2014	6/4/2014	6/4/2014
Analyte												
<b>Polychlorinated Biphenyls (PCBs)</b>												
PCB-1242	µg/L	0.5	NS	0.49 U	0.49 U	NS	NS	0.472 U	NS	NS	NS	NS
PCB-1248	µg/L	0.5	NS	0.49 U	0.49 U	NS	NS	0.472 U	NS	NS	NS	NS
PCB-1254	µg/L	0.5	NS	0.49 U	0.49 U	NS	NS	0.472 U	NS	NS	NS	NS
<b>Volatile Organic Compounds (VOCs)</b>												
1,1-Dichloroethene	µg/L	7	1 U	<b>0.48 J</b>	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	µg/L	70	<b>18.1</b>	<b>166</b>	1 U	<b>53.3</b>	<b>7.05</b>	<b>0.486 J</b>	<b>8.23</b>	<b>0.717 J</b>	<b>0.653 J</b>	<b>0.495 J</b>
Tetrachloroethene	µg/L	5	<b>180</b>	<b>899</b>	1 U	<b>157</b>	<b>61.4</b>	<b>19.6</b>	<b>86</b>	<b>4,010</b>	<b>3,260</b>	<b>4,010</b>
trans-1,2-Dichloroethene	µg/L	100	1 U	<b>9.64</b>	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	µg/L	5	<b>427</b>	<b>1,850</b>	1 U	<b>190</b>	<b>77.1</b>	<b>9.19</b>	<b>41.7</b>	<b>28.6</b>	<b>24.2</b>	<b>23.3</b>
Vinyl chloride	µg/L	2	1 U	<b>0.649 J</b>	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

Notes:

**Exceeds Performance Standard (MCL)****Bold indicates the analyte was detected**

-- Screening criteria does not exist for analyte

<sup>(1)</sup> Maximum Contaminant Level (MCL) (EPA,

J - Concentration considered an estimate based on data validation.

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ - Not detected; quantitation limit may be inaccurate or imprecise.

µg/L - micrograms per liter

NS - Not sampled

TABLE 3

Summary of Plant Site Analytical Results, March 2014

Third Five-Year Review Report

Sangamo Weston Site, Pickens, South Carolina

Station ID			Site-Wide Monitoring Wells					
			SWMW-1	SWMW-5	SWMW-6	SWMW-7A	SWMW-7	SWMW-8
Sample ID	Units	Performance Standard MCL <sup>(1)</sup>	SWMW-1-GW-HS-031414	SWMW-5-GW-HS-031414RE	SWMW-6-GW-HS-031414	SWMW-7A-GW-031414	SWMW-7-GW-031414	SWMW-8-GW-HS-031414
Sample Date			3/14/2014	3/13/2014	3/13/2014	3/14/2014	3/14/2014	3/14/2014
Analyte								
<b>Polychlorinated Biphenyls (PCBs)</b>								
PCB-1242	µg/L	0.5	NS	0.943 U	<b>8.47</b>	2.35 U	<b>1.98</b>	0.469 U
PCB-1248	µg/L	0.5	NS	0.943 U	0.472 U	2.35 U	0.469 U	0.469 U
PCB-1254	µg/L	0.5	NS	0.943 U	0.472 U	2.35 U	0.649 U	0.649 U
<b>Volatile Organic Compounds (VOCs)</b>								
1,1-Dichloroethene	µg/L	7	1 U	<b>0.62 J</b>	1 U	<b>0.331 J</b>	1 U	1 U
cis-1,2-Dichloroethene	µg/L	70	<b>2.4</b>	<b>7.23</b>	<b>2.12</b>	<b>11.7</b>	1 U	<b>1.28</b>
Tetrachloroethene	µg/L	5	<b>22</b>	<b>11.9</b>	<b>300</b>	<b>328</b>	<b>3.24</b>	<b>153</b>
trans-1,2-Dichloroethene	µg/L	100	1 U	1 U	1 U	<b>0.325 J</b>	1 U	1 U
Trichloroethene	µg/L	5	<b>8.74</b>	<b>9.59</b>	<b>12.2</b>	<b>69.4</b>	1 U	<b>9.01</b>
Vinyl chloride	µg/L	2	1 U	<b>0.95 J</b>	1 U	<b>0.7 J</b>	1 U	1 U

Notes:

**Exceeds Performance Standard (MCL)****Bold indicates the analyte was detected**

-- Screening criteria does not exist for analyte

<sup>(1)</sup> Maximum Contaminant Level (MCL) (EPA,

J - Concentration considered an estimate based on data validation.

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ - Not detected; quantitation limit may be inaccurate or imprecise.

µg/L - micrograms per liter

NS - Not sampled

TABLE 4

Summary of Plant Site Surface Water Analytical Results, March 2014

Third Five-Year Review Report

Sangamo Weston Site, Pickens, South Carolina

Station ID			Surface Water	
			SW-2	SW-3
			SW-2-SW-031114	SW-3-SW-031114
<b>Sample ID</b>	<b>Units</b>	<b>Surface Water Quality Standard <sup>(1)</sup></b>		
<b>Sample Date</b>			3/11/2014	3/11/2014
<b>Analyte</b>				
<b>Polychlorinated Biphenyls (PCBs)</b>				
PCB-1242	µg/L	0.000064	NS	NS
PCB-1248	µg/L	0.000064	NS	NS
PCB-1254	µg/L	0.000064	NS	NS
<b>Volatile Organic Compounds (VOCs)</b>				
1,1-Dichloroethene	µg/L	7	1 U	1 U
cis-1,2-Dichloroethene	µg/L	70	<b>0.312 J</b>	1 U
Tetrachloroethene	µg/L	0.69	<b>1.46</b>	1 U
trans-1,2-Dichloroethene	µg/L	100	1 U	1 U
Trichloroethene	µg/L	2.5	<b>5.13</b>	1 U
Vinyl chloride	µg/L	0.025	1 U	1 U

Notes:

**Exceeds Surface Water Quality Standard**

**Bold indicates the analyte was detected**

-- Screening criteria does not exist for analyte

<sup>(1)</sup> SC DHEC Water Quality Numeric Criteria for the Protection of Aquatic Life and Human Health (June 2012)

J - Concentration considered an estimate based on data validation.

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

µg/L - micrograms per liter

NS - Not sampled

Appendix E  
Vapor Intrusion Screening and  
Recommendations Technical Memorandum

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# Vapor Intrusion Screening and Recommendations, Sangamo Weston, Inc., Site Pickens, South Carolina

PREPARED FOR: Vic Cocianni/Schlumberger Technology Corporation

COPY TO: Lillian Furlow/CH2M HILL  
David Urann/CH2M HILL

PREPARED BY: CH2M HILL

DATE: June 25, 2014

## Background and Introduction

Sangamo Weston, Inc. (Sangamo Weston) owned and operated a capacitor manufacturing plant near Pickens, South Carolina. The plant began operation in 1955 and manufactured capacitors and other related electrical components until the business was sold in 1987. Some of the capacitors used a dielectric fluid, which contained polychlorinated biphenyls (PCBs). The use of PCBs was discontinued at the plant in 1977. Additionally, chlorinated solvents appear to have been used, particularly tetrachloroethene (PCE) and trichloroethene (TCE).

The historical activities conducted at the site have resulted in impacts to site groundwater from Volatile Organic Compounds (VOCs). Specifically, the following VOCs are present above the Maximum Contaminant Levels (MCLs): PCE, TCE, and 1,2-Dichloroethylene (DCE). Groundwater remediation activities are ongoing for the site using pump and treat technologies.

Under the right conditions, VOCs can evaporate and move through the soil or shallow groundwater and seep into cracks in basements, foundations, or other openings of a building. Vapor intrusion can be a concern because vapors can migrate into the building and build up to a point where the health of residents or workers in those buildings could be at risk. For this reason, the United States Environmental Protection Agency (US EPA) recommends that vapor intrusion be evaluated anytime groundwater contaminated with volatile chemicals is within 100 feet of buildings.

In order to assess the potential for VI for current and future receptors, CH2M HILL conducted a screening evaluation using the existing groundwater data. This Technical Memorandum (TM) summarizes the results of the evaluation.

The most recent groundwater concentrations of site contaminants of concern (COCs) were compared to the US EPA Vapor Intrusion Screening Levels (VISLs) for groundwater. The VISLs were calculated using US EPA's VISL calculator, last updated in May 2014. The VISLs were calculated under the residential scenario with a target cancer risk (TCR) of  $1 \times 10^{-6}$  and hazard quotient (HQ) of 1 for unrestricted use.

## Breazeale Site

The groundwater analytical results from March 2013 were compared to the VISLs as summarized on Table 1. PCE, TCE and were detected at concentrations above the VISLs. The highest concentrations were detected in monitoring wells BRMW02 and BRMW11. These monitoring wells are centrally located to the site and no occupied structures are located within 100 feet. Additionally, the plume is well delineated in the downgradient direction and impacts would not be expected to extend offsite. Therefore, the VI pathway is not currently complete.

## **Main Plant Site (excluding the Former Secure Landfill)**

The groundwater analytical results from March 2013 were compared to the VISLs as summarized on Table 2. The results are discussed by area below.

### **Onsite Groundwater**

PCE and TCE concentrations exceeded the VISLs throughout the Plant Site. The highest concentrations were detected in groundwater samples collected in Areas 2, B, D and near SPMW-12. No occupied structures are located within 100 feet of any of the monitoring wells. Therefore, the VI pathway is not currently complete.

### **Offsite Groundwater**

Only TCE exceeded the VISL in perimeter monitoring well SPMW04, located north of the site boundary and downgradient of Area 2. TCE also exceeded the VISL in monitoring well SPMW-02 and recovery well SPRW-301, located south of the site boundary and in the vicinity of Area 3. Shallow groundwater impacts appear to be well defined in these areas. No occupied structures are located within 100 feet of these wells. Therefore, the VI pathway is not currently complete.

## **Former Secure Landfill**

The groundwater analytical results from July 2012 were compared to the VISLs as summarized on Table 3. TCE exceeded the VISL in groundwater samples collected from monitoring wells MW06, MW07, and MW08. These monitoring wells are located on the southern boundary of the Former Secure Landfill. There are no occupied structures either onsite or within 100 feet of these monitoring wells. However, the shallow groundwater plume is not fully delineated in the downgradient direction.

The nearest residence is located approximately 150 feet downgradient of the Former Secure Landfill Boundary. This residence is a raised mobile home which has a loose-fitting skirt, allowing free air exchange between this space and ambient air. Therefore, it is unlikely that vapors would accumulate beneath the home to a concentration that would exceed indoor air VISLs.

There is uncertainty, however, in the VI evaluation for a future scenario because no shallow monitoring wells are located downgradient of MW05, MW07, and MW08 to confirm the extent of TCE concentrations exceeding the VISL.

## **Cross Roads Site**

The groundwater analytical results from March 2013 were compared to the VISLs as summarized on Table 4. TCE exceeded the VISL in samples collected from three of the shallow monitoring wells located at the site: CRMW-1, CRMW-2, and CRMW-3. No occupied structures are located within 100 feet of any of these monitoring wells. Additionally, the plume is well delineated in the downgradient direction and impacts would not be expected to extend offsite. Therefore, the VI pathway is not currently complete.

## **Recommendations**

- Collect additional data to reduce uncertainty regarding offsite properties downgradient of the Former Secure Landfill. Efforts are underway to gain access to the property downgradient of the Former Secure Landfill (1160 Reece Mill Road) in order to perform confirmation soil gas sampling on this property.

## **Tables**

Table 1 – Groundwater Analytical Results for Breazeale Site

Table 2 – Groundwater Analytical Results for Main Plant Site

Table 3 – Groundwater Analytical Results for Former Secure Landfill

Table 4 – Groundwater Analytical Results for Cross Roads Site

## **Figures**

Figure 1 – Site Map – Breazeale Site

Figure 2 – Site Map – Main Plant Site

Figure 3 – Site Map - Former Secure Landfill Site

Figure 4 – Site Map – Cross Roads Site

TABLE 1

## Groundwater Analytical Results for Breazeale Site

## Vapor Intrusion Screening and Recommendations

Sangamo Weston Site, Pickens, South Carolina

Parameter	Well>>		BRMW02	BRMW02	BRMW02	BRMW02A	BRMW02A
	US EPA	Sample Type>>	Low flow	Field Duplicate	Hydrasleeve	Low flow	Hydrasleeve
	Groundwater	Sample Date>>	3/25/2013	3/25/2013	3/25/2013	3/19/2013	3/18/2013
	VISL	Unit					
Chloroform	0.00081	mg/L	0.005 U	0.005 U	0.005 U	0.001 U	0.001 U
Tetrachloroethene (PCE)	0.015	mg/L	<b>0.043 =</b>	<b>0.046 =</b>	<b>0.048 =</b>	0.001 =	0.001 U
Trichloroethene (TCE)	0.0012	mg/L	<b>0.187 =</b>	<b>0.204 =</b>	<b>0.209 =</b>	0.001 U	0.001 U
Vinyl chloride	0.00015	mg/L	0.005 U	0.005 U	0.005 U	0.001 U	0.001 U
1,1,1-Trichloroethane	7.4	mg/L	0.005 U	0.005 U	0.005 U	0.001 U	0.001 U
1,1-Dichloroethene (DCE)	0.2	mg/L	0.005 U	0.005 U	0.005 U	0.001 U	0.001 U
cis-1,2-Dichloroethene (DCE)	-	mg/L	0.005 U	0.005 U	0.005 U	0.001 U	0.001 U
trans-1,2-Dichloroethene (DCE)	-	mg/L	0.005 U	0.005 U	0.005 U	0.001 U	0.001 U
Total 1,2-DCE	-	mg/L	ND	ND	ND	ND	ND
Parameter	Well>>		BRMW03	BRMW03A	BRMW03A	BRMW03B	BRMW04
	US EPA	Sample Type>>	Low flow	Low flow	Hydrasleeve	Low flow	Low flow
	Groundwater	Sample Date>>	3/19/2013	3/19/2013	3/19/2013	3/19/2013	3/22/2013
	VISL	Unit					
Chloroform	0.00081	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Tetrachloroethene (PCE)	0.015	mg/L	<b>0.002 =</b>	0.001 U	0.001 U	0.001 U	<b>0.068 J</b>
Trichloroethene (TCE)	0.0012	mg/L	<b>0.003 =</b>	0.001 U	0.001 U	0.001 U	<b>0.009 =</b>
Vinyl chloride	0.00015	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
1,1,1-Trichloroethane	7.4	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
1,1-Dichloroethene (DCE)	0.2	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
cis-1,2-Dichloroethene (DCE)	-	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
trans-1,2-Dichloroethene (DCE)	-	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Total 1,2-DCE	-	mg/L	ND	ND	ND	ND	ND
Parameter	Well>>		BRMW04	BRMW04A	BRMW04A	BRMW05	BRMW05A
	US EPA	Sample Type>>	Field Duplicate	Low flow	Hydrasleeve	Low flow	Low flow
	Groundwater	Sample Date>>	3/22/2013	3/22/2013	3/22/2013	3/22/2013	3/25/2013
	VISL	Unit					
Chloroform	0.00081	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Tetrachloroethene (PCE)	0.015	mg/L	<b>0.039 J</b>	<b>0.008 =</b>	<b>0.009 =</b>	<b>0.003 =</b>	0.001 U
Trichloroethene (TCE)	0.0012	mg/L	<b>0.008 =</b>	<b>0.001 =</b>	<b>0.002 =</b>	<b>0.002 =</b>	0.001 U
Vinyl chloride	0.00015	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
1,1,1-Trichloroethane	7.4	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
1,1-Dichloroethene (DCE)	0.2	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
cis-1,2-Dichloroethene (DCE)	-	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
trans-1,2-Dichloroethene (DCE)	-	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Total 1,2-DCE	-	mg/L	ND	ND	ND	ND	ND



TABLE 1

## Groundwater Analytical Results for Breazeale Site

## Vapor Intrusion Screening and Recommendations

Sangamo Weston Site, Pickens, South Carolina

Parameter	Well>>		BRMW05B	BRMW07	BRMW08	BRMW08A	BRMW08B
	US EPA	Sample Type>>	Low flow	Low flow	Low flow	Low flow	Low flow
	Groundwater	Sample Date>>	3/19/2013	3/21/2013	3/20/2013	3/20/2013	3/22/2013
Parameter	VISL	Unit					
Chloroform	0.00081	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Tetrachloroethene (PCE)	0.015	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Trichloroethene (TCE)	0.0012	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Vinyl chloride	0.00015	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
1,1,1-Trichloroethane	7.4	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
1,1-Dichloroethene (DCE)	0.2	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
cis-1,2-Dichloroethene (DCE)	-	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
trans-1,2-Dichloroethene (DCE)	-	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Total 1,2-DCE	-	mg/L	ND	ND	ND	ND	ND

Parameter	Well>>		BRMW09	BRMW10	BRMW10	BRMW11	BRMW12
	US EPA	Sample Type>>	Low flow	Low flow	Hydrasleeve	Low flow	Low flow
	Groundwater	Sample Date>>	3/22/2013	3/21/2013	3/21/2013	3/25/2013	3/21/2013
Parameter	VISL	Unit					
Chloroform	0.00081	mg/L	0.001 U	0.001 U	0.001 U	0.020 U	0.001 U
Tetrachloroethene (PCE)	0.015	mg/L	0.001 U	0.001 =	0.001 U	0.994 =	0.001 U
Trichloroethene (TCE)	0.0012	mg/L	0.001 U	0.001 U	0.001 U	1.800 =	0.001 U
Vinyl chloride	0.00015	mg/L	0.001 U	0.001 U	0.001 U	0.020 U	0.001 U
1,1,1-Trichloroethane	7.4	mg/L	0.001 U	0.001 U	0.001 U	0.020 U	0.001 U
1,1-Dichloroethene (DCE)	0.2	mg/L	0.001 U	0.001 U	0.001 U	0.020 U	0.001 U
cis-1,2-Dichloroethene (DCE)	-	mg/L	0.001 U	0.001 U	0.001 U	0.235 =	0.001 U
trans-1,2-Dichloroethene (DCE)	-	mg/L	0.001 U	0.001 U	0.001 U	0.020 U	0.001 U
Total 1,2-DCE	-	mg/L	ND	ND	ND	0.235	ND

Parameter	Well>>		BRMW12A	BRMW14	BRMW14	BRMW14A	BRMW15
	US EPA	Sample Type>>	Low flow	Low flow	Hydrasleeve	Low flow	Low flow
	Groundwater	Sample Date>>	3/21/2013	3/21/2013	3/21/2013	3/22/2013	3/21/2013
Parameter	VISL	Unit					
Chloroform	0.00081	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Tetrachloroethene (PCE)	0.015	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.025 =
Trichloroethene (TCE)	0.0012	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 =
Vinyl chloride	0.00015	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
1,1,1-Trichloroethane	7.4	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
1,1-Dichloroethene (DCE)	0.2	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
cis-1,2-Dichloroethene (DCE)	-	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
trans-1,2-Dichloroethene (DCE)	-	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Total 1,2-DCE	-	mg/L	ND	ND	ND	ND	ND

mg/L = milligrams per liter  
U = not detected above indicated lab quantitation limit  
J = estimated result (between laboratory's quantitation limit and reporting limit)  
= - result above lab reporting limit  
ND = not detected  
NA = not analyzed  
**Bold indicates analyte detected**  
Shaded values exceed the VISL  
VISL based on Target Cancer Risk = 1e-6 and HQ = 1 for residential scenario (unrestricted use)

TABLE 2

Groundwater Analytical Results for Main Plant Site  
 Vapor Intrusion Screening and Recommendations  
 Sangamo Weston Site, Pickens, South Carolina

Station ID	Area 2					Area 3			Area 4	Area 6		Area 7		Area A			
	SPRW-201	SPRW-202	SPRW-204	SPRW-205	SPRW-206	SPRW-301	SPRW-302	SPRW-303A	SPRW-401	SPRW-602	SPRW-602	SPRW-701	SPRW-702	SAMW-1	SAMW-3		
Analyte	Units	US EPA Groundwater VISL	3/8/2013	3/8/2013	3/8/2013	3/8/2013	3/11/2013	3/11/2013	3/12/2013	3/13/2013	3/11/2013	3/11/2013	3/13/2013	3/13/2013	3/5/2013	3/4/2013	
<b>Volatile Organic Compounds (VOCs)</b>																	
1,1-Dichloroethene	µg/L	200	50 U	20 U	20 U	20 U	2 U	5 U	5 U	10 U	2 U	20 U	10 U	5 U	10 U	1 U	1 U
cis-1,2-Dichloroethene (DCE)	µg/L	-	<b>2160</b>	<b>1460</b>	<b>169</b>	<b>164</b>	<b>34.8</b>	<b>109</b>	<b>62.6</b>	<b>107</b>	<b>50.8</b>	20 U	<b>13.9</b>	5 U	<b>11.8</b>	1 U	<b>2.4</b>
trans-1,2-Dichloroethene (DCE)	µg/L	-	50 U	20 U	20 U	20 U	2 U	5 U	5 U	10 U	2 U	20 U	10 U	5 U	10 U	1 U	1 U
1,2-DCE, total <sup>(1)</sup>	µg/L	-	<b>2160</b>	<b>1460</b>	<b>169</b>	<b>164</b>	<b>34.8</b>	<b>109</b>	<b>62.6</b>	<b>107</b>	<b>50.8</b>	20 U	<b>13.9</b>	5 U	<b>11.8</b>	1 U	<b>2.4</b>
Tetrachloroethene	µg/L	15	<b>259</b>	<b>231</b>	<b>379</b>	<b>330</b>	<b>108</b>	5 U	<b>22.8</b>	<b>33.2</b>	<b>11.4</b>	<b>451</b>	<b>449</b>	<b>109</b>	<b>378</b>	1 U	<b>1.1</b>
Trichloroethene	µg/L	1.2	<b>1000</b>	<b>794</b>	<b>564</b>	<b>406</b>	<b>119</b>	<b>53.3</b>	<b>312</b>	<b>540</b>	<b>5.8</b>	<b>735</b>	<b>738</b>	<b>7.5</b>	<b>39.7</b>	<b>1.3</b>	1 U
Vinyl chloride	µg/L	0.15	50 U	20 U	20 U	20 U	2 U	5 U	5 U	10 U	2 U	20 U	10 U	5 U	10 U	1 U	1 U

**Notes:**  
**Bold indicates the analyte was detected**  
**Exceeds VISL**

- Screening criteria does not exist for analyte  
 VISL based on Target Cancer Risk = 1e-6 and HQ = 1 for residential scenario (unrestricted use)  
<sup>(1)</sup> Total 1,2-DCE is sum of cis-1,2-DCE and trans-1,2-DCE.  
 J - Concentration considered an estimate based on data validation.  
 U - Compound was analyzed, but was not detected above the reported quantitation limit.  
 µg/L - micrograms per liter

TABLE 2

Groundwater Analytical Results for Main Plant Site  
 Vapor Intrusion Screening and Recommendations  
 Sangamo Weston Site, Pickens, South Carolina

Station ID	Area B		Area C	Area D					Area F	Area G					Area H			
	SBMW-2	SBMW-3	SCMW-5	SDMW-1	SDMW-2	SDMW-3	SDMW-4	SDMW-4	SFMW-6	SGMW-7	SGMW-8	SGMW-8	SGMW-9	SGMW-9	SHMW-10	SHMW-10		
Analyte	Units	US EPA Groundwater VISL	3/14/2013	3/6/2013	3/8/2013	3/8/2013	3/7/2013	3/13/2013	3/14/2013	3/14/2013	3/7/2013	3/7/2013	3/7/2013	3/7/2013	3/11/2013	3/11/2013		
<b>Volatile Organic Compounds (VOCs)</b>																		
1,1-Dichloroethene	µg/L	200	200 U	1 U	1 U	1 U	2 U	50 U	100 U	250 U	1 U	1 U	1 U	1 U	1 U	2 U	1 U	
cis-1,2-Dichloroethene (DCE)	µg/L	-	200 U	1 U	1 U	1 U	2 U	50 U	100 U	250 U	<b>3.3</b>	1 U	1 U	1 U	<b>3.5</b>	<b>3.2</b>	2 U	<b>1.4</b>
trans-1,2-Dichloroethene (DCE)	µg/L	-	200 U	1 U	1 U	1 U	2 U	50 U	100 U	250 U	1 U	1 U	1 U	1 U	1 U	2 U	1 U	
1,2-DCE, total <sup>(1)</sup>	µg/L	-	200 U	1 U	1 U	1 U	2 U	50 U	100 U	250 U	<b>3.3</b>	1 U	1 U	1 U	<b>3.5</b>	<b>3.2</b>	2 U	<b>1.4</b>
Tetrachloroethene	µg/L	15	<b>14500</b>	<b>22.2</b>	<b>1.5</b>	<b>6.1</b>	<b>27.9</b>	<b>416</b>	<b>759 J</b>	<b>1020</b>	<b>5</b>	<b>12.7</b>	<b>5.5</b>	<b>2.7</b>	<b>20.7</b>	<b>23.9</b>	<b>69.1</b>	<b>61</b>
Trichloroethene	µg/L	1.2	<b>271</b>	1 U	<b>2.3</b>	<b>5.1</b>	<b>3.1</b>	<b>1280</b>	<b>2060 J</b>	<b>5090</b>	<b>3.2</b>	<b>9.2</b>	<b>4.3</b>	<b>3.2</b>	<b>25.8</b>	<b>26.3</b>	<b>49.6</b>	<b>52.3</b>
Vinyl chloride	µg/L	0.15	200 U	1 U	1 U	1 U	2 U	50 U	100 U	250 U	1 U	1 U	1 U	1 U	1 U	2 U	1 U	

Insufficient volume for PCBs - Hydrasleeve ripped during retrieval

**Notes:**

**Bold indicates the analyte was detected**

**Exceeds VISL**

- Screening criteria does not exist for analyte

VISL based on Target Cancer Risk = 1e-6 and HQ = 1 for residential scenario (unrestrict)

<sup>(1)</sup> Total 1,2-DCE is sum of cis-1,2-DCE and trans-1,2-DCE.

J - Concentration considered an estimate based on data validation.

U - Compound was analyzed, but was not detected above the reported quantitation limit.

µg/L - micrograms per liter

TABLE 2

Groundwater Analytical Results for Main Plant Site  
 Vapor Intrusion Screening and Recommendations  
 Sangamo Weston Site, Pickens, South Carolina

			Perimeter Monitoring Wells														
Station ID		US EPA Groundwater VISL	SPMW-02	SPMW-04A	SPMW-04A	SPMW-04	SPMW-07	SPMW-10	SPMW-11	SPMW-11	SPMW-12	SPMW-12	SPMW-14	SPMW-15	SPMW-16	SWMW-1	SWMW-5
Analyte	Units		3/12/2013	3/14/2013	3/14/2013	3/14/2013	3/8/2013	3/6/2013	3/6/2013	3/6/2013	3/7/2013	3/7/2013	3/6/2013	3/11/2013	3/11/2013	3/12/2013	3/12/2013
<b>Volatile Organic Compounds (VOCs)</b>																	
1,1-Dichloroethene	µg/L	200	1 U	1 U	1 U	1 U	5 U	1 U	1 U	1 U	100 U	50 U	1 U	5 U	20 U	1 U	1 U
cis-1,2-Dichloroethene (DCE)	µg/L	-	1 U	47.3	46.8	1 U	15.7	1 U	1 U	1 U	119	50 U	1 U	41.9	139	2.4	13
trans-1,2-Dichloroethene (DCE)	µg/L	-	1 U	1 U	1 U	1 U	5 U	1 U	1 U	1 U	100 U	50 U	1 U	5 U	20 U	1 U	1 U
1,2-DCE, total <sup>(1)</sup>	µg/L	-	1 U	47.3	46.8	1 U	15.7	1 U	1 U	1 U	119	50 U	1 U	41.9	139	2.4	13
Tetrachloroethene	µg/L	15	1.5	8	7.6	1 U	25.6	1 U	18.8	16.7	2470	1360	1 U	200	419	7.7	56.3
Trichloroethene	µg/L	1.2	2.3	12.7	12.1	1 U	140	1 U	21	20	3780	2280	1 U	251	692	5	30.1
Vinyl chloride	µg/L	0.15	1 U	1 U	1 U	1 U	5 U	1 U	1 U	1 U	100 U	50 U	1 U	5 U	20 U	1 U	5.6

**Notes:**  
 Bold indicates the analyte was detected  
 Exceeds VISL

- Screening criteria does not exist for analyte  
 VISL based on Target Cancer Risk = 1e-6 and HQ = 1 for residential scenario (unrestrict)  
<sup>(1)</sup> Total 1,2-DCE is sum of cis-1,2-DCE and trans-1,2-DCE.  
 J - Concentration considered an estimate based on data validation.  
 U - Compound was analyzed, but was not detected above the reported quantitation limit.  
 µg/L - micrograms per liter

TABLE 2

Groundwater Analytical Results for Main Plant Site  
 Vapor Intrusion Screening and Recommendations  
 Sangamo Weston Site, Pickens, South Carolina

			Site-Wide Monitoring Wells						
Station ID			SWMW-5	SWMW-6	SWMW-6	SWMW-7	SWMW-7	SWMW-7A	SWMW-8
Analyte	Units	US EPA Groundwater VISL	3/12/2013	3/12/2013	3/12/2013	3/12/2013	3/12/2013	3/13/2013	3/13/2013
<b>Volatile Organic Compounds (VOCs)</b>									
1,1-Dichloroethene	µg/L	200	1 U	5 U	5 U	1 U	1 U	10 U	1 U
cis-1,2-Dichloroethene (DCE)	µg/L	-	<b>10.3</b>	5 U	5 U	1 U	1 U	<b>21.4</b>	1 U
trans-1,2-Dichloroethene (DCE)	µg/L	-	1 U	5 U	5 U	1 U	1 U	10 U	1 U
1,2-DCE, total <sup>(1)</sup>	µg/L	-	<b>10.3</b>	5 U	5 U	1 U	1 U	<b>21.4</b>	1 U
Tetrachloroethene	µg/L	15	<b>38.6</b>	<b>198</b>	<b>183</b>	<b>13</b>	<b>8</b>	<b>546</b>	<b>53.7</b>
Trichloroethene	µg/L	1.2	<b>21.9</b>	<b>6.4</b>	<b>6.1</b>	1 U	1 U	<b>137</b>	<b>1.7</b>
Vinyl chloride	µg/L	0.15	<b>3.5</b>	5 U	5 U	1 U	1 U	10 U	1 U

**Notes:**

**Bold indicates the analyte was detected**

**Exceeds VISL**

- Screening criteria does not exist for analyte

VISL based on Target Cancer Risk = 1e-6 and HQ = 1 for residential scenario (unrestrict)

<sup>(1)</sup> Total 1,2-DCE is sum of cis-1,2-DCE and trans-1,2-DCE.

J - Concentration considered an estimate based on data validation.

U - Compound was analyzed, but was not detected above the reported quantitation limit.

µg/L - micrograms per liter

Insufficient volume for PCBs

TABLE 3

Groundwater Analytical Results for Former Secure Landfill

Vapor Intrusion Screening and Recommendations

Sangamo Weston Site, Pickens, South Carolina

			Former Secure Landfill		
		Station ID	MW06	MW07	MW08
		US EPA Groundwater VISL			
Field Parameter	Units		7/30/2012	7/30/2012	7/30/2012
<b>Volatile Organic Compounds (VOCs)</b>					
1,1-Dichloroethene	µg/L	200	1 U	1 U	1 U
cis-1,2-Dichloroethene (DCE)	µg/L	-	<b>3</b>	1 U	1 U
trans-1,2-Dichloroethene (DCE)	µg/L	-	1 U	1 U	1 U
total 1,2-DCE	µg/L	-	<b>3</b>	1 U	1 U
Tetrachloroethene	µg/L	15	1 U	1 U	1 U
Trichloroethene	µg/L	1.2	<b>68.7</b>	<b>7.8</b>	<b>3.4</b>
Vinyl chloride	µg/L	0.15	1 U	1 U	1 U

**Notes**

**Bold indicates the analyte was detected**

**Exceeds VISL**

- Screening criteria does not exist for analyte

VISL based on Target Cancer Risk = 1e-6 and HQ = 1 for residential scenario (unrestricted use)

TABLE 4

## Groundwater Analytical Results for Cross Roads Site

Vapor Intrusion Screening and Recommendations

Sangamo Weston Site, Pickens, South Carolina

			Cross Roads Site					
Station ID			CRMW-1	CRMW-2	CRMW-3	CRMW-3A	CRMW-4	CRMW-5
Analyte	Units	US EPA Groundwater VISL	3/15/2013	3/15/2013	3/15/2013	3/15/2013	3/15/2013	3/15/2013
<b>Volatile Organic Compounds (VOCs)</b>								
1,1-Dichloroethene	µg/L	200	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene (DCE)	µg/L	-	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene (DCE)	µg/L	-	1 U	1 U	1 U	1 U	1 U	1 U
1,2-DCE, total <sup>(1)</sup>	µg/L	-	1 U	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	µg/L	15	<b>7.1</b>	<b>4</b>	<b>5.1</b>	<b>9.8</b>	1 U	1 U
Trichloroethene	µg/L	1.2	<b>6.2</b>	<b>6.3</b>	<b>8.9</b>	<b>17.8</b>	1 U	1 U
Vinyl chloride	µg/L	0.15	1 U	1 U	1 U	1 U	1 U	1 U

**Notes:****Bold indicates the analyte was detected****Exceeds VISL**

- Screening criteria does not exist for analyte

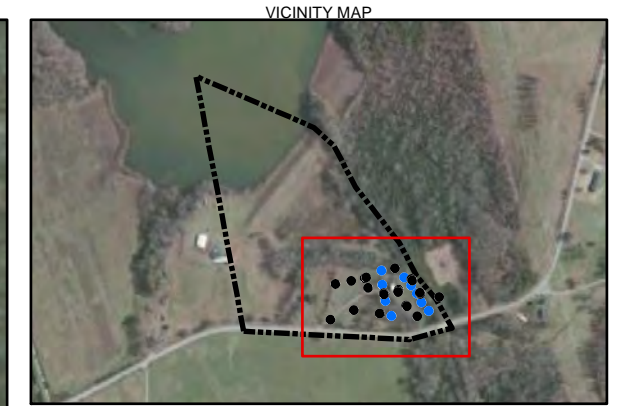
VISL based on Target Cancer Risk = 1e-6 and HQ = 1 for residential scenario (unrestricted use)

<sup>(1)</sup> Total 1,2-DCE is sum of cis-1,2-DCE and trans-1,2-DCE.

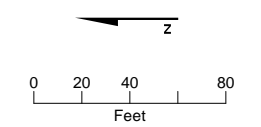
J - Concentration considered an estimate based on data validation.

U - Compound was analyzed, but was not detected above the reported quantitation limit.

µg/L - micrograms per liter

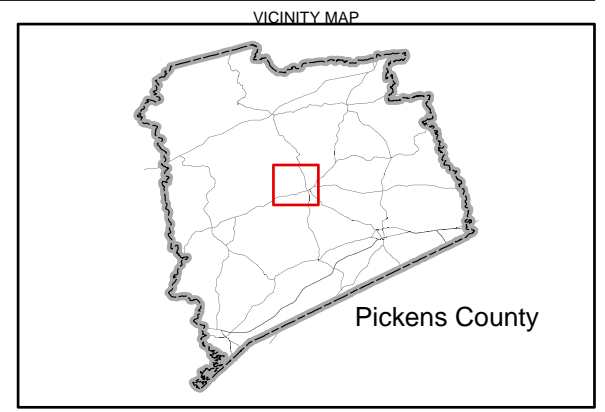
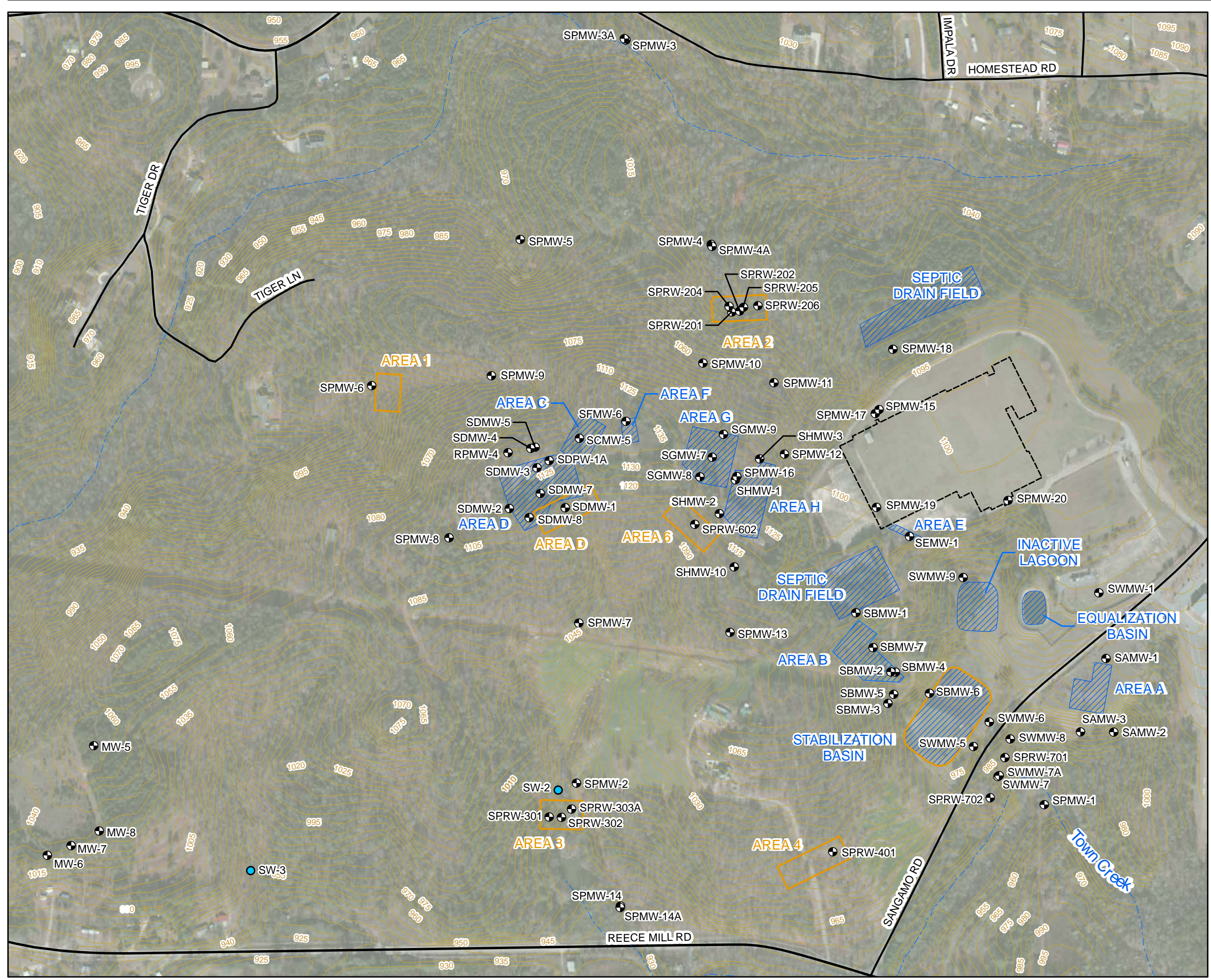


- LEGEND
- Performance Monitoring Wells
  - ⊕ Extraction Well
  - ⊕ Well Exceeding Performance Standard
  - ~ River or Creek
  - Highway or Local Road
  - - - Legal Boundary



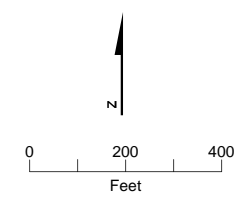
**FIGURE 1**  
**Site Map – Breazeale Site**  
**Vapor Intrusion Screening and**  
**Recommendations**  
 Sangamo Weston Site, Pickens, South Carolina



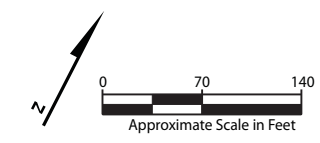


- LEGEND**
- Monitoring Well
  - 5' Topographic Contour
  - River or Creek
  - Highway or Local Road
  - ▭ GW Recovery Area
  - ▨ RI Areas
  - ▭ Former Manufacturing Building Footprint

- Source Data:**
1. River and Creeks: National Hydrography Dataset (NHD), USGS, 1999
  2. 5' Topographic Contour: Created using SangamoPlantTIN, Schulmberger



**FIGURE 2**  
**Site Map**  
**Vapor Intrusion Screening and Recommendations**  
 Sangamo Weston Site, Pickens, South Carolina



**LEGEND**

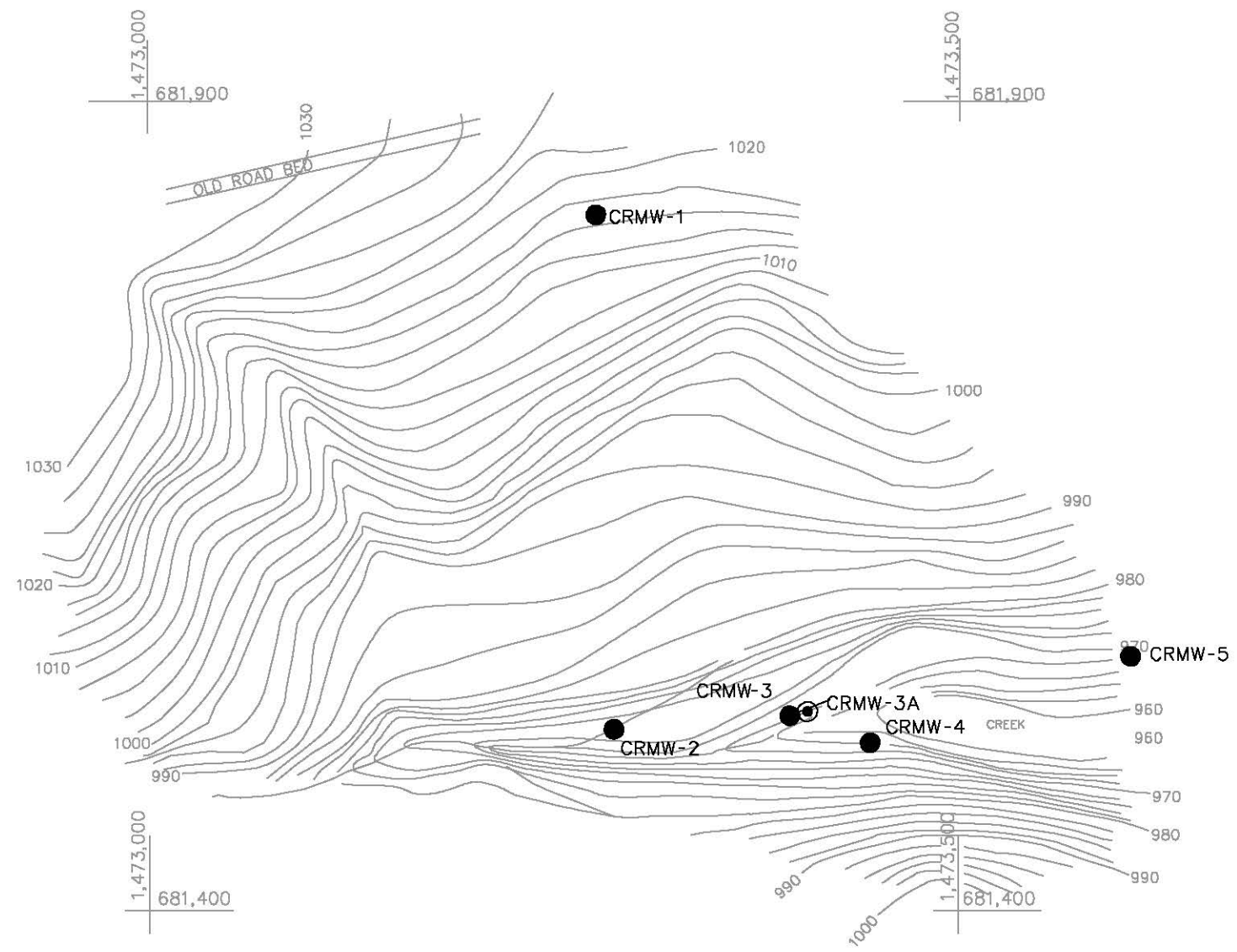


Well

Trichloroethene	68.7
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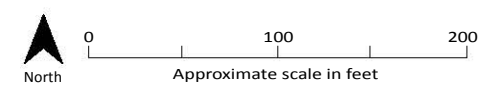
Detected concentrations in micrograms per liter

**FIGURE 3**  
**Site Map – Former Secure Landfill Site**  
**Vapor Intrusion Screening and**  
**Recommendations**  
*Sangamo Weston Site, Pickens, South Carolina*



**LEGEND**

- CRMW-1 MONITORING WELL - SHALLOW
- ⊙ CRMW-3A MONITORING WELL - DEEP
- ~ 990 ~ TOPOGRAPHIC CONTOURS. ELEVATION IN FEET ABOVE MEAN SEA LEVEL. CONTOUR INTERVAL AS SHOWN.
- ~ ~ ~ STREAM OR CREEK
- - - - - INTERMITTENT STREAM
- 1,473,000 / 681,400 STATE PLANE COORDINATE SYSTEM



**FIGURE 4**  
**Site Map – Cross Roads Site**  
**Vapor Intrusion Screening and**  
**Recommendations**  
*Sangamo Weston Site, Pickens, South Carolina*

**THIRD FIVE-YEAR REVIEW REPORT FOR  
SANGAMO WESTON, INC./TWELVEMILE CREEK/LAKE HARTWELL  
PCB CONTAMINATION SUPERFUND SITE  
PICKENS COUNTY, SC**



**Prepared by**

**U.S. Environmental Protection Agency  
Region 4 Superfund Division  
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Atlanta, GA 30303**

-----  
**[Enter Name], Division Director**

-----  
**Date**

# Five-Year Review Report

Sangamo Weston, Inc./Twelvemile Creek/  
Lake Hartwell PCB Contamination Superfund Site

## Part 2

*Operable Unit Two (OU2), Pickens, Pickens County, South Carolina*

February 2015

# Contents

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1	Introduction.....	1-1
1.1	The Purpose of the Review .....	1-1
1.2	Authority for Conducting the Five-Year Review .....	1-1
1.3	Who Conducted the Five-Year Review.....	1-1
1.4	Other Review Characteristics.....	1-2
2	Site Chronology .....	2-1
3	Background.....	3-1
3.1	Physical Characteristics.....	3-1
3.2	Land and Resource Use.....	3-2
3.3	History of Contamination.....	3-3
3.4	Initial Response .....	3-5
3.5	Basis for Taking Action .....	3-5
4	Remedial Actions.....	4-1
4.1	Remedy Selection.....	4-1
4.2	Remedy Implementation .....	4-1
4.2.1	Continuation of the Fish Consumption Advisory .....	4-1
4.2.2	Aquatic Biota and Sediment Monitoring .....	4-2
4.2.3	Sediment Flushing Behind Twelvemile Creek Impoundments .....	4-4
4.2.4	Public Education Program.....	4-6
4.3	System Operations/Operation and Maintenance (O&M).....	4-6
5	Progress Since Last Five-Year Review.....	5-1
5.1	Continuation of the Fish Consumption Advisory .....	5-3
5.2	Aquatic Biota and Sediment Monitoring .....	5-3
5.3	Sediment Flushing and Twelvemile Creek Impoundments.....	5-4
5.4	Public Education Program.....	5-6
6	Five-Year Review Process .....	6-1
6.1	Administrative Components .....	6-1
6.2	Community Notification and Involvement.....	6-1
6.3	Document Review .....	6-2
6.4	Clean-up Goals .....	6-3
6.5	Data Review .....	6-3

6.6	Site Inspection.....	6-5
6.7	Interviews.....	6-5
7	Technical Assessment.....	7-1
7.1	Question A: Is the remedy functioning as intended by the decision documents? .....	7-1
7.2	Question B: Are the exposure assumptions, toxicity data, clean-up levels, and RAOs used at the time of the remedy selection still valid?.....	7-1
7.3	Question C: Has any other information come to light that could call into question the protectiveness of the remedy? .....	7-1
7.4	Technical Assessment Summary .....	7-1
8	Issues .....	8-1
9	Recommendations and Follow-up Actions.....	9-1
10	Protectiveness Statement .....	10-1
11	Next Review.....	11-1

## Tables

1	Chronology of Site Events .....	2-1
2	Annual System Operations/O&M Costs.....	4-6
3	Progress on Recommendations from the 2009 FYR .....	5-2
4	Summary of Clean-up Goals for OU2 .....	6-3
5	Toxicity Changes.....	7-2

## Appendixes

A	Fish Consumption Advisory Monitoring Options
B	Figures
C	Fish Consumption Advisory Sign Inspections
D	Five-Year Review Site Inspection Checklist and Photographs
E	Copy of Community Notification

# 1 INTRODUCTION

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## 1.1 THE PURPOSE OF THE REVIEW

The purpose of Five-Year Reviews (FYRs) is to determine whether the remedy at a site is or is not expected to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in FYR Reports. In addition, FYR Reports identify any issues found during the review and provide recommendations to address them.

## 1.2 AUTHORITY FOR CONDUCTING THE FIVE-YEAR REVIEW

The United States Environmental Protection Agency (USEPA) has prepared this FYR Report pursuant to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121 and the National Oil and Hazardous Substances Contingency Plan (NCP). CERCLA Section 121 states:

*If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with Section 104 or 106, the President shall take or require such action. The President shall report to Congress a list of facilities for which such a review is required, the results of all such reviews, and any action taken as a result of such reviews.*

The Agency interpreted this requirement further in the NCP. 40 CFR Section 300.430(f)(4)(ii) states:

*If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

## 1.3 WHO CONDUCTED THE FIVE-YEAR REVIEW

USEPA Region 4 has conducted an FYR of the MNR (Monitored Natural Recovery) remedy with Institutional Controls (IC) for Sangamo Operable Unit 2 (OU2) in Pickens County, South Carolina. This review was conducted from March 2014 through August 2014. A site inspection was completed on May 7, 2014. This report documents the results of the review.



## **1.4 OTHER REVIEW CHARACTERISTICS**

This is the third statutory FYR for OU2. The triggering action for this review is the previous FYR Report, which was approved on February 10, 2010. The FYR is required statutorily because polychlorinated biphenyl (PCB) contamination remains in sediments and aquatic biota that does not allow for unlimited use and unrestricted exposure.

The third FYR for OU1 was conducted concurrently with the OU2 review and is documented in Part 1, submitted concurrently with this report.

## 2 SITE CHRONOLOGY

---

Table 1 identifies key site events and relevant dates in the site chronology since 1985. The identified events are illustrative, not comprehensive.

Table 1  
Chronology of Site Events

EVENT	DATE
Discovery and Site Inspection	September 1985
Preliminary Assessment	March 1986
Proposed to National Priorities List (NPL)	January 1987
Final Listing on NPL	February 1990
Remedial Investigation/Feasibility Study (RI/FS) Special Notice to Schlumberger (STC)	April 1990
Fund-Lead RI/FS	September 1990 to April 1994
OU2 Record of Decision (ROD)	June 1994
Trash-rack Rakes Installed at Woodside 1/Woodside 2 Impoundments to Facilitate Downstream Passage of Sediments	June 1994
Annual Monitoring of Aquatic Biota/Sediments	April/May since 1995
Trash-rack Rakes Not Performing as Expected	September 1997
Initial Sediment Management Alternative Evaluation for Twelvemile Creek Impoundments	September 1997 to March 1998
Public Education Program and Issuance of a Joint, Risk-based Fish Consumption Advisory by States of South Carolina and Georgia	July 1998
Initial Sediment Dredging at Woodside 1/Woodside 2 Impoundments	October 1998
Remedial Design Complete/Remedial Action (RA) Begins	October 1998
Second Sediment Dredging at Woodside 1/Woodside 2 Impoundments	July 1999
Preliminary Close-Out Report	August 1999
Data Collection for Sediment Transport Modeling	December 1999
High Flow Sluice Gate Installation Evaluation	January 2000
Sediment Transport Modeling and Second Sediment Management Alternative Evaluation for Twelvemile Creek Impoundments Completed	April 2000
Public Education Telephone Interviews Completed	July 2000
Third Sediment Dredging at Woodside 1/Woodside 2 Impoundments	January 2001

Table 1  
Chronology of Site Events

EVENT	DATE
Phase 1 MNR Investigation Report Completed by USEPA – Office of Research and Development (ORD)	September 2001
Fourth (and last to date) Sediment Dredging at Woodside 1/Woodside 2 Impoundments	February 2002
Final Phase 2 MNR Investigation Report Completed by USEPA – ORD	June 2002
Interim RA Report	September 2002
Second Data Collection Effort for Sediment Transport Modeling	November 2002
Sediment Transport Modeling and Morphology Evaluation to Evaluate In-stream Impacts from Dam Removal	April 2003
Draft Phase 3 MNR Investigation Report Completed by USEPA – ORD	April 2003
Final Health Consultation Regarding Lake Hartwell Fish Consumption	July 2004
First FYR Report for OU2	September 2004
Natural Resource Trustees (NRT) and STC Negotiations and Settlement concerning Natural Resource Damage Assessment (NRDA)	2004
Fish Advisory Signs Installed	April 2009
Expedited Order for Dam Removal	2009
Explanation of Significant Differences (ESD) issued by USEPA	September 2009
Second FYR Report for OU2	February 2010
Sediment Dredging within Reach above Woodside 1 and Impoundment Completed and Woodside 1 Dam Demolished	February 2011
Sediment Dredging within Reach above Woodside 2 Impoundment Completed and Woodside 2 Dam Demolished - Construction Complete	August 2011
Monuments Installed at Woodside 1 and 2 Locations Documenting Historic Dams	January 2012
Stormwater Control Improvements at Sangamo Road at Plant Site to Reduce Sediment Erosion and Promote Vegetative Restoration with Live Stakes	April 2012
Completed Supplemental Remedial Investigation (SRI) to Evaluate Residual PCB Concentrations at Twelvemile Creek	October 2011 – May 2012
Human Health Risk Assessment (HHRA) Completed for Twelvemile Creek	September 2012
Stream Restoration Including Structural Stabilization and Vegetative Restoration	November 2012

Table 1  
Chronology of Site Events

EVENT	DATE
Visual Assessment Following Near-Bankfull Flows	January 2013
Second Quarter Bank Stabilization Structural Monitoring Assessment	March 2013
First Semiannual Vegetation Assessment	April 2013
Third Quarter Bank Stabilization Structural Monitoring Assessment	June 2013
Final Bank Stabilization Structural Monitoring Assessment	August 2013
Visual Assessment Following Bankfull Flows	August 2013
Second Semiannual Vegetation Assessment	November 2013
Supplemental Planting	March 2014
Camp Creek Repair	March 2014
Third Semiannual Vegetation Assessment	May 2014
Final Order approving Motion to Terminate the Consent Decree	January 2015

## 3 BACKGROUND

---

This section provides a brief site background and description of the site characteristics.

### 3.1 PHYSICAL CHARACTERISTICS

The Sangamo OU2 site is located in Pickens County, South Carolina. The Sangamo OU2 site comprises the sediment, surface water, and biological migration routes downstream from the Sangamo Weston Plant and satellite disposal areas that have site-related PCB contamination. The Sangamo Weston Plant and satellite disposal areas constitute OU1 of the site. Lake Hartwell was constructed by the Savannah District United States Army Corps of Engineers (USACE) between 1955 and 1963 by damming the Savannah, Seneca, and Tugaloo Rivers. The 56,000-acre Hartwell Reservoir is located on the Georgia-South Carolina border. The OU2 study area includes approximately 40 stream miles of Twelvemile Creek and its tributaries, the Twelvemile Creek Arm of Lake Hartwell, and portions of the Keowee and Seneca River Arms of Lake Hartwell down to the Route 37 (Rt. 37) bridge just south of Clemson, South Carolina (Appendix B). The primary focus of OU2 is centered on this area; however, samples were collected throughout Lake Hartwell during the OU2 investigations, including that portion of the reservoir between Rt. 37 and Hartwell Dam.

The Twelvemile Creek watershed has an area of 140 square miles and includes first-, second-, third- and fourth-order streams. The tributaries to Twelvemile Creek are predominantly first- and second-order streams. Twelvemile Creek is a third-order stream above the mouth of Town Creek; below this point, Twelvemile Creek is a fourth-order stream. Twelvemile Creek is the longest stream segment in the watershed and flows southward for approximately 24 miles until reaching the headwaters of Lake Hartwell. Within this 24-mile reach, approximately 80 tributaries flow into Twelvemile Creek. The bulk of the stream flow is derived from runoff. Sediment in the creek is composed primarily of sand and has a low total organic carbon content throughout the majority of the streambed.

Surface water in the Twelvemile Creek basin is currently utilized for drinking water supply, fishing, and industrial uses. Twelvemile Creek is classified as a Class B stream according to South Carolina Regulations (Regulation 61-68, Water Classifications and Standards). Under the regulations, Class B waters are defined as being suitable for secondary-contact recreation (fishing, boating, wading) and drinking water supply (assuming conventional treatment methods are used) as well as both agricultural and industrial uses.

There were originally three impoundments, of masonry construction, on the lower section of Twelvemile Creek; however, the two lower impoundments were removed in 2011. The lowermost impoundment (Woodside 2) was the largest of the three and was built in 1905. The middle

impoundment (Woodside 1) was located in the community of Catechee and was rebuilt in 1937 after it failed in 1934. Both Woodside 1 and Woodside 2 dams were removed in 2011. The third, or uppermost, impoundment was built in 1926 and is the smallest of the three. This upper impoundment remains in place and was formerly used by the Easley-Central Water District as a water supply reservoir for Pickens County.

Lake Hartwell is an impoundment with a drainage basin 2,088 square miles. Lake Hartwell is managed by the USACE for flood control and electric power generation, both of which are affected by the storage capacity of the reservoir, which is 2,550,000 acre-feet of water (equivalent to 830 billion gallons). Since its construction, the reservoir has become one of the major recreational lakes in the Southeast. Current management practices therefore consider recreational benefits as well as flood control and power generation. The lake is drawn down in the fall in anticipation of the increased rainfall that the area usually receives during the winter and spring.

Lake Hartwell is a Class A surface water (South Carolina regulations) suitable for primary-contact recreation (swimming, waterskiing), secondary-contact recreation (fishing, boating, wading), drinking water supply, and agricultural/industrial uses. The lake currently receives a significant level of point and nonpoint source discharges. National Pollutant Discharge Elimination System (NPDES) permitted discharges include industrial facilities, electric power generating stations, and various sewage treatment plants. The reservoir continues to be a source of potable water for a number of communities, and these discharges have not had an appreciable impact on water quality in the lake.

### **3.2 LAND AND RESOURCE USE**

Demographics and land use in the Lake Hartwell area are variable, with small towns and rural residential development in the Twelvemile Creek watershed giving way to larger towns and more concentrated development in the areas surrounding Lake Hartwell. According to 2010 census data, approximately 119,224 people live in Pickens County. The major community in the upper portion of the Twelvemile Creek watershed is the town of Pickens, which had an estimated population of 3,126 in 2010. The town of Clemson, with an estimated 2010 population of 13,905, is the only large community directly on the shoreline of the lake.

Outside of the small towns and communities, the majority of the Twelvemile Creek watershed (and Pickens County in general) is undeveloped. Most of the acreage bordering Twelvemile Creek and its tributaries is either forested or cleared for agricultural purposes. The entire Hartwell project, both land and water usage, is managed by the USACE Savannah District.

Development along the shoreline of Lake Hartwell is at least partially controlled through the USACE Lakeshore Management Plan. Surface water supplies the bulk of potable water utilized by the residents of Pickens County and surrounding areas.

### 3.3 HISTORY OF CONTAMINATION

**Sangamo Site.** Sangamo Weston manufactured electrolytic mica and power factor capacitors at the Pickens plant from 1955 to 1987. The plant used a variety of dielectric fluids in the manufacturing processes, including fluids that contained PCBs. Between 1955 and 1977, the average quantity of PCBs received and used at the plant ranged from 700,000 to 2,000,000 pounds per year. PCB use was terminated at the plant in 1977, prior to a USEPA ban on its use in January 1978. Waste disposal practices included land burial of off-specifications capacitors and wastewater treatment sludge on the Plant Site and six satellite disposal areas. It is generally thought that onsite disposal occurred, as needed, from the mid-1950s until July 1972. Interviews with former plant employees have indicated that beginning in the early 1970s, liquid PCB wastes were containerized and shipped back to the supplier, Monsanto Corp., for disposal by incineration (RMT 1989). However, there are no written records to confirm that this occurred. Additionally, the manufacturing process associated with capacitors typically involves the use of chlorinated solvents as degreasing agents.

Numerous streams and tributaries drain the Plant Site and satellite disposal areas, eventually discharging into Lake Hartwell. Lake Hartwell was created between 1955 and 1963 when Hartwell Dam was constructed by the USACE on the upper Savannah River. At the normal pool level of 660 feet above mean sea level, Lake Hartwell is 56,003 acres in size with a shoreline of 962 miles. A fish consumption advisory for portions of Lake Hartwell was first instituted in 1976. This advisory has been modified many times and remains in effect.

The Sangamo site was proposed to the NPL in January 1987 and became Final on the NPL in February 1990. The site was divided into two OUs. OU1 addressed the land-based source areas, which included the Plant Site and six satellite disposal areas and contaminated groundwater associated with the land-based source areas. OU2 addressed the sediment, surface water, and biological migration pathways downstream from the source areas.

As a result of a merger with Sangamo Weston in 1989, the responsible party for the Sangamo site is STC, whose U.S. headquarters is in Houston, Texas. STC performed the RA at OU1 pursuant to the terms of a Consent Decree with USEPA. USEPA issued a Special Notice Letter to STC in April 1990 which offered the company the opportunity to conduct an enforcement-lead RI/FS for OU2. STC declined this offer, and USEPA conducted a fund-lead RI/FS for OU2 from September 1990 through April 1994.

**PCB-Impacts to Twelvemile Creek and Lake Hartwell.** A comprehensive discussion and presentation of the RI/FS findings and conclusions can be found in the RI/FS documents and the June 1994 ROD. In general, approximately 730 acres of sediments in the Twelvemile Creek Arm of Lake Hartwell had PCB concentrations greater than the selected clean-up goal of 1 milligram per kilogram (mg/kg). The Twelvemile Creek Arm of Lake Hartwell is generally described as the reach between the Highway 227 Bridge (Maw Bridge) and the Highway 123 Bridge near Clemson. Within the Twelvemile Creek

watershed, minor levels of PCB contamination have persisted in Town Creek near the Sangamo discharge point, and in sediments trapped behind the three small dams on Twelvemile Creek (see discussion in Section 4). The two lower dams, Woodside 1 and Woodside 2, were removed in 2011. The Twelvemile Creek Arm of Lake Hartwell is considered to be a relatively low energy environment, and net depositional. PCB distribution in surface sediments could be described as low-level and wide-spread, without distinct hotspots. Average PCB concentrations in surficial sediments (0 to 6 inches) of the focused study area were generally in the 1- to 10-mg/kg range.

Vertical sediment cores indicated that PCB concentrations increased with depth, and the maximum detections generally occurred 30 centimeters (cm) to 50 cm below the surface water/sediment interface. Historically, the maximum PCB detection was 153 mg/kg, although the maximum detected during the RI was 61 mg/kg. RI results indicated that PCB concentrations in sediments had declined significantly from the mid-20<sup>th</sup> century due to burial and dispersion processes. These conclusions were supported by sediment transport modeling that predicted net sediment accumulations ranging from 5 to 15 centimeters per year (cm/yr) in the portions of the Twelvemile Creek Arm of Lake Hartwell that historically had the highest levels of PCBs.

In the biological investigations conducted during the RI/FS phase, PCBs were detected in all levels of the food web, including drift net samples, *Corbicula* (fresh water clams), smaller forage fish, and migratory/non-migratory game fish. The biological investigation also supported conclusions regarding the sediment component that (1) the Sangamo Plant Site is the primary source of PCB contamination in Twelvemile Creek, and (2) the contribution of PCB input to the Twelvemile Creek watershed from the satellite disposal areas is negligible. Fish in Lake Hartwell were often found to contain PCBs at levels higher than the Food and Drug Administration (FDA) tolerance level of 2 mg/kg.

The need for future response actions at OU2 was largely driven by human health risks associated with the consumption of PCB-contaminated fish. From an ecological risk perspective, the biological investigations documented the presence of PCB contamination in all levels of the aquatic food web. Habitat degradation from development may also result in adverse impacts at the population and community levels. The health of fish in Lake Hartwell did not appear to be affected at the population level for fish that had PCB concentrations around 5 mg/kg (average concentrations in fish at the time the ROD was issued). However, there was historical evidence indicating that as concentrations increased to greater than 20 mg/kg, fish health could be affected.

**Community Involvement.** Community involvement continued during the third FYR timeframe and was focused on the OU2 portion of the site, particularly on the activities associated with the Woodside 1 and 2 dam removals, dredging activities, sampling, and stream restoration.



### **3.4 INITIAL RESPONSE**

In 1987, an Administrative Order on Consent with STC was signed for performance of an RI/FS. In 1992, a Consent Decree with STC was lodged in court. In 1993, the State entered into a Consent Order with the owners of two small hydroelectric impoundments to develop a more effective sediment management plan. In 2004, negotiations between NRT and STC took place over a NRDA settlement. The NRDA Settlement Consent Decree for OU2 was issued in May 2006.

### **3.5 BASIS FOR TAKING ACTION**

The contaminated medium of concern for the OU2 portion of the site is sediment. The primary chemical of concern (COC) is PCBs. Potential threats at the site include human health risks associated with the consumption of PCB-contaminated fish.

## 4 REMEDIAL ACTIONS

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### 4.1 REMEDY SELECTION

Based upon the findings of the RI and associated Baseline Risk Assessment (human health/ecological), USEPA developed Remedial Action Objectives (RAOs) to support the identification, development, and screening of remedial alternatives. These RAOs were:

- Mitigate continued migration of PCB-contaminated sediments into Lake Hartwell by eliminating releases of PCBs into Twelvemile Creek.
- Control or eliminate the downstream migration of PCB-contaminated sediment within the Twelvemile Creek Arm of Lake Hartwell.
- Limit, to the extent feasible, the transfer of PCBs from sediment to biota.
- Prevent or minimize exposure to fish with PCB contamination above target risk (or FDA) levels.

Protection of human health is considered the primary driver for developing and evaluating RA alternatives. The major components of the remedy selected in the 1994 ROD for OU2 include the following:

- Continuation of the existing fish consumption advisory on Lake Hartwell
- Continuation of monitoring of aquatic biota and sediment to support continuation or justify modifications to the existing advisory
- Regular flushing of sediments trapped behind the three impoundments on Twelvemile Creek to facilitate burial of contaminated sediments further downstream while mitigating adverse impacts to Lake Hartwell water quality
- Implementation of a public education program to increase awareness about the advisory and methods to prepare/cook fish to reduce the quantity of contaminants consumed

### 4.2 REMEDY IMPLEMENTATION

This section provides a summary of the activities conducted since the Consent Decree was signed. The summary is presented by each of the major remedy components.

#### 4.2.1 Continuation of the Fish Consumption Advisory

A fish consumption advisory, warning the public against eating fish from the Seneca River Arm of Lake Hartwell north of State Highway 24 and Twelvemile Creek, was originally issued by SC DHEC in 1976. This advisory has been modified many times and remains in effect. Signs warning against eating fish from these reaches have been posted at the majority of the public boat launch and recreation areas in

South Carolina since 1987. The current advisory adopts a risk-based approach that issues meal frequency advice to Lake Hartwell anglers based on species harvested and PCB concentration trends in fish tissue. The Lake Hartwell PCB fish advisory for South Carolina and Georgia is posted at <http://www.scdhec.gov/FoodSafety/FishConsumptionAdvisories/AdvisoryMap/hartwell/>.

Major points of the advisory are summarized in the following table.

ARM OF LAKE HARTWELL	KINDS OF FISH	CONSUMPTION ADVICE <sup>a</sup>
South Carolina – Seneca River Arm	ALL FISH	DO NOT EAT ANY
South Carolina – Twelvemile Creek	ALL FISH	DO NOT EAT ANY
South Carolina – Remaining Waters of Lake Hartwell	Hybrid and Striped Bass	DO NOT EAT ANY
South Carolina – Remaining Waters of Lake Hartwell	Channel Catfish and Largemouth Bass	One meal per month
Georgia – Tugaloo Arm	Hybrid Bass/Striped Bass	DO NOT EAT ANY over 16 inches
	Channel Catfish over 16 inches, Hybrid/Striped Bass 12 to 16 inches, Largemouth Bass over 16 inches	One meal per month
	Largemouth Bass less than 16 inches, Black Crappie Hybrid/Striped Bass less than 12 inches, Channel Catfish less than 16 inches	One meal per week

<sup>a</sup> meal is a half-pound (8-ounce) serving of fish.

#### 4.2.2 Aquatic Biota and Sediment Monitoring

Annual monitoring of sediments and aquatic biota has been conducted by STC, pursuant to USEPA-approved work plans, in the spring of each year since the ROD was issued in June 1994. This effort includes: (1) sediment sampling at 21 locations in Twelvemile Creek, the Twelvemile Creek Arm of Lake Hartwell, and portions of Lake Hartwell proper; (2) fish tissue analyses at six stations in Lake Hartwell for largemouth bass, catfish, and hybrid bass, (3) fish tissue analyses on forage fish species at three locations in Lake Hartwell, and four 28-day caged *Corbicula* analyses at 7 stations in Twelvemile Creek. Additionally, USEPA's NRMRL and NERL conducted three phases of research on Lake Hartwell to gain a better understanding of natural mechanisms that contribute to the recovery of PCB-contaminated sediments. The goal of these investigations was to develop and evaluate physical, chemical, and

biological tools and approaches for measuring the short- and long-term performance of MNR. The scope of the three phases of investigation is briefly summarized below.

***Phase 1 (USEPA/Battelle report dated September 25, 2001)***

- Collection of 10 sediment cores at transects that coincide with annual monitoring stations and sediment modeling efforts
- Age dated sediment cores using lead-210 and cesium-137 techniques to determine sediment accumulation rates (cm/yr) and sedimentation rates (in grams per square centimeter per year)
- Detailed PCB congener analyses to identify vertical/lateral congener profiles and trends
- Evaluation of PCB compositional changes in historically deposited sediments
- Comparison of age dating results with sediment deposition rates predicted by the modeling

***Phase 2 (USEPA/Battelle report dated June 30, 2002)***

- Collection of 8 sediment cores at 3 transects previously studied in Phase 1
- Collection of 21 surface sediment and 9 high volume surface water samples within the Twelvemile Creek watershed and near the former Sangamo Plant Site
- Sediment age dating using lead-210 and cesium-137 techniques
- PCB congener analysis to identify historical PCB depositional patterns, PCB weathering patterns (such as dechlorination), and PCB end member analysis (for example, fingerprint patterns)

***Phase 3 (Draft USEPA/Battelle report dated April 2003)***

- Development of a fully integrated ecological model to assess the ongoing impact of PCB-contaminated sediments on the benthic and aquatic environments
- Tests conducted at three stations: two within the Twelvemile Creek Arm of Lake Hartwell and one at a background station
- PCB surface sediment and surface water sampling/analysis
- Biota collection analysis, which included native fish collection, Hester Dendy trap deployment for macroinvertebrate sampling, fathead minnow cage deployment, *Corbicula* cage deployment, and phytoplankton collection
- Deployment of semi-permeable membrane devices to simulate uptake by fish lipids
- Volatilization studies to measure diffusion from the lake surface
- Deployment of PCB gas flux chambers to measure gas evolution from the sediment surface

- Evaluation of effective transport of the water through the sediments using a network of piezometer wells

The results of 19 years of annual monitoring and 3 phases of USEPA-NRMRL/NERL investigations are too voluminous to present in detail in this FYR Report (see the reports listed above and in Section 6 of this FYR Report for a more detailed account of the findings and conclusions). The following text provides a brief overview of the results.

In general, PCB sediment concentrations have decreased steadily as the deeper, more impacted sediments are covered by physical sedimentation processes typical of man-made, freshwater reservoir ecosystems. Surficial sediment data in April 2008 in the Twelvemile Creek Arms of Lake Hartwell indicate an approximately 10- to 50-fold reduction in PCB concentrations compared to historical data. PCB concentrations in surficial sediments of the Twelvemile Creek Arm of Lake Hartwell were reported in the 1- to 4-mg/kg range during the most recent sampling events, which occurred in April 2013. PCB concentrations exceeded 2.0 mg/kg in only 2 of the 21 samples in 2013 and were greater than 1.0 mg/kg at only 1 other location. Surficial sediments in the upper Twelvemile Creek Arm of Lake Hartwell (stations SD-000 to SD-006 2 in Appendix B), in area impacted by previous hydraulic dredging and flushing events, have PCB concentrations below the 1-mg/kg clean-up goal selected in the ROD. Sediment age dating results and statistical analysis using the 95 percent confidence interval were used to predict the sedimentation rate and time required to achieve the 1-mg/kg clean-up goal. This analysis, which was performed in 2003, predicted that the majority of the surficial sediments in the Twelvemile Creek Arm of Lake Hartwell would achieve the 1-mg/kg clean-up goal between 2007 and 2011.

Annual monitoring results for largemouth bass, channel catfish, and hybrid bass appear to indicate that PCB tissue concentrations have responded measurably to the decreased surface sediment trends. PCB concentrations in hybrid bass during 2013 were the lowest (on average lake-wide) on record and all concentrations were below 2.0 mg/kg. The 2013 PCB concentrations in channel catfish were lower than in 2012, with no average concentrations exceeding 1.0 mg/kg compared to one concentration at 1.78 mg/kg in 2012. PCB concentrations in largemouth bass were below 2.0 mg/kg in five of the six sampling locations. The PCB concentrations that exceeded 2.0 mg/kg came from largemouth bass associated with the Twelvemile Creek Arm (SV-107, as shown in Appendix B), at a mean tissue concentration of 3.34 mg/kg, much less than the 2011 and 2012 values, all of which were greater than 8.50 mg/kg.

#### **4.2.3 Sediment Flushing Behind Twelvemile Creek Impoundments**

Of the four remedy components specified in the June 1994 ROD, ensuring regular, downstream passage of sediments trapped behind the three impoundments on Twelvemile Creek proved to be the most challenging. The primary goal of the OU2 remedy is to use the natural sedimentation processes of Twelvemile Creek to deliver sediment to the Twelvemile Creek Arm of Lake Hartwell, thus providing a

clean sediment cap on top of PCB-impacted sediments to prevent further re-suspension and transport of sediments throughout the creek and lake ecosystem. Until 2011, a significant quantity of the sediment bed load transported via the upper reach of Twelvemile Creek was trapped behind the three impoundments. However, in 2011, two of the three impoundments were removed, allowing approximately 7,600 feet of the creek to return to its natural free-flowing state. Over 400,000 cubic yards (cy) of sediment from behind these dams was dredged and placed in a dedicated sediment management unit (SMU) constructed consistent with South Carolina Regulation 61-107.19 for a Class III Landfill design.

One potential result of these aggressive remediation activities was the temporary suspension of sediment and release downstream to the Twelvemile Arm of Lake Hartwell, which could have extended into the 2012 and 2013 monitoring years. These actions may have resulted in a temporary increase in PCB concentrations over the 2011 levels, which were the lowest levels on record.

The first, or uppermost dam, still remains and is owned by the Easley-Central Water District, which uses the head pool for raw water storage. The Easley-Central dam is equipped with high flow sluice gates, which allows Easley-Central to control when they flush sediments and the quantity of material they flush per event. Easley-Central sluices sediments approximately quarterly, and their flushing schedule meets the requirements specified in the ROD.

The second and third dams on Twelvemile Creek, Woodside 1 and Woodside 2, respectively, were removed in 2011. Woodside 1 and Woodside 2 were small hydroelectric impoundments owned and operated by Consolidated Hydro Southeast. Woodside 1 and Woodside 2 were reported to produce a combined electrical output of 2.5 million kilowatts/year, and both dams were equipped with low flow sluice gates. Historically, sediment was flushed downstream via sluice gates when sediment accumulations began to interfere with power generation. Sediment flushing events during low flow periods in 1984 and 1995 were documented to have adverse impacts on water quality and stream habitat, and in some instances resulted in fish kills.

USEPA fully supported the dam removal concept envisioned in the NRDA settlement as it represented the most permanent solution to ensuring natural sediment transport downstream to the Twelvemile Creek Arm of Lake Hartwell. USEPA continued to monitor the progress of the NRDA settlement and in September 2009 issued an ESD to the 1994 ROD that allowed for dam removal and stream corridor restoration to move forward. Between March 2010 and August 2011, the following actions were completed as part of stream restoration in accordance with the Consent Decree and the ESD: (1) sediment dredging (approximately 410,000 cy of sediment were removed and relocated to the SMU and over 500,000,000 gallons of water were treated) and (2) the removal of Woodside 1 and Woodside 2 dams.

#### 4.2.4 Public Education Program

The Public Education Program was initiated in 1998 to increase awareness of the fish consumption advisory among users of Lake Hartwell and to assist them in making informed decisions regarding consumption of fish harvested from the lake. Approximately 20,000 copies of a brochure were printed and distributed in July 1998 to an estimated 8,000 dock permit holders on Lake Hartwell, an estimated 1,400 members of the Lake Hartwell Association, approximately 100 retail outlets in 6 counties that border the lake and sell fishing licenses, the USACE Lake Hartwell Visitor Center, South Carolina and Georgia Welcome Centers on Interstate 1-85, Lake Hartwell campgrounds and day use areas, local Chambers of Commerce, and miscellaneous personnel involved with State regulatory agencies.

The exposure from fish consumption appears to be minimal and health effects are unlikely for people who eat small to moderate amounts of fish. Fish consumption advisory signs were posted along the shores of Lake Hartwell at boat ramps and known fishing areas accessed by the public in 2009.

Information regarding PCB-related fish consumption and cleaning can be found at the following link: <http://www.scdhec.gov/FoodSafety/FishConsumptionAdvisories/AdvisoryMap/hartwell/>

#### 4.3 SYSTEM OPERATIONS/OPERATION AND MAINTENANCE (O&M)

The primary activities associated with O&M include the following:

- Maintenance of the fish advisory and periodic inspection of advisory signs
- Annual monitoring of sediments and aquatic biota
- SMU mowing and oversight
- SMU quarterly inspection and reporting

Annual system operations/O&M costs for OU2 are included in Table 2. Associated costs for OU1 are included in the OU1 FYR Report.

Table 2  
Annual System Operations/O&M Costs

DATES		TOTAL COST ROUNDED TO NEAREST \$1,000
FROM	TO	
2009	2010	\$279,000
2010	2011	\$233,000
2011	2012	\$257,000
2012	2013	\$285,000
2013	2014	\$265,000

In March 2014, 70 of approximately 80 fish advisory signs surrounding Lake Hartwell were inspected. Nine boat landings were closed for the off season in March 2014 and were not accessible. It was recommended that 10 of the signs be replaced. Signs at these locations will be inspected at a later date. Further details of the inspection are presented in Appendix C.



## 5 PROGRESS SINCE LAST FIVE-YEAR REVIEW

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The Protectiveness Statement from the 2009 FYR for OU2 stated the following:

*The MNR with ICs remedy for OU2 is considered protective of human health and the environment while long-term monitoring of aquatic biota and sediments continues in the future.*

*The remedy at OU2 currently protects human health and the environment because it is considered adequately protective of human health and the environment while long-term monitoring of aquatic biota and sediments continues in the future. Remedial technologies for accelerating clean-up at the Plant Site portion of OU1 areas will be implemented in the near future for the Plant Site. Since operation and maintenance of these systems will be optimized to meet established performance standards, this site is considered adequately protective of human health and the environment. However, in order for the remedy to be protective in the long-term, the following actions need to be taken:*

- *Dam removal and stream restoration at OU2.*
- *Evaluation of remedial technologies for accelerating clean-up at Plant Site portion of OU1 to evaluate the potential for a groundwater to surface water exposure pathway.*

The 2009 FYR Report included five recommendations. Each recommendation and the current status are discussed in Table 3.

Table 3  
Progress on Recommendations from the 2009 FYR

2009 FYR SECTION	RECOMMENDATIONS	PARTY RESPONSIBLE	MILESTONE DATE	ACTION TAKEN AND OUTCOME	DATE OF ACTION
9.1	SC DHEC to continue to administer the existing fish consumption advisory, and implement modifications as warranted by the annual aquatic biota and sediment monitoring program.	SC DHEC	N/A	Advisory remains in effect on Lake Hartwell. Approximately 80 fish advisory signs were posted at USACE lake access points in both Georgia and South Carolina for OU2 in 2009.	Ongoing
9.2	Continue the annual aquatic biota and sediment monitoring program specified by the 1994 ROD. Modifications to annual monitoring program as recommended by USEPA-NRMRL/NERL were implemented during the 2004 sampling event.	STC	N/A	Conducted annual monitoring of sediments and aquatic biota pursuant to approved work plans since 1994. Review criteria and recommend modifications beginning in 2015.	Monitoring annually since 1994 ROD. Modifications to sampling program in 2004.
9.3	Support the NRDA settlement Consent Decree regarding dam demolition and Twelvemile Creek stream corridor restoration as requested by the Department of Justice and the NRT and documented in the September 3, 2009 ESD to the 1994 ROD.	STC	N/A	Completed sediment dredging, removal of Woodside 1 and Woodside 2 dams, and stream corridor restoration.	2011 and 2012
9.4	Continue to evaluate the potential groundwater to surface water pathway at the Plant Site and Town Creek discharge point and assure follow-up investigations will be implemented as appropriate.	STC	N/A	2012 – Installed stormwater control system and developed Conceptual Site Model (CSM) that described the various components of the subsurface environment, as understood at the present time, based on the numerous historical reports available. March through April 2013 – Performed a Supplemental Site Characterization (SSC) to fill data gaps and to further refine the CSM of the nature and extent of contamination.	2012 and ongoing
9.5	Inspect and maintain fish advisory signs installed in April 2009.	STC	N/A	Inspected March 2014; repair is ongoing	Ongoing

This section provides a summary of the RAs performed since the last FYR Report.

The MNR with ICs remedy for OU2 is considered protective of human health and the environment while long-term monitoring of aquatic biota and sediments continues in the future.

The following discussion is organized and presented by the four major components of the selected MNR with ICs remedy for Sangamo OU2.

## **5.1 CONTINUATION OF THE FISH CONSUMPTION ADVISORY**

The fish consumption advisory remains in effect on Lake Hartwell. Approximately 80 fish advisory signs were posted at USACE lake access points in both Georgia and South Carolina for OU2 in April 2009. Photographs of the advisory signs are included in the photologs in Appendixes C and D.

## **5.2 AQUATIC BIOTA AND SEDIMENT MONITORING**

Annual monitoring of sediments and aquatic biota has been conducted by STC, pursuant to USEPA-approved work plans, in the spring of each year since the ROD was issued in June 1994. This effort includes: (1) sediment sampling in Twelvemile Creek, the Twelvemile Creek Arm of Lake Hartwell, and portions of Lake Hartwell proper; (2) fish tissue analyses in Lake Hartwell for largemouth bass, catfish, and hybrid bass, (3) fish tissue analyses on forage fish species in Lake Hartwell, and (4) 28-day caged *Corbicula* analyses in Town and Twelvemile Creeks.

Pursuant to findings described above for the USEPA-NRMRL/NERL three-phase evaluations, USEPA recommended modifications to the annual aquatic biota and sediment monitoring program that is conducted by STC. These modifications reflect the advances in the technical community's understanding of PCB science since the annual monitoring program was first formulated in 1994.

The 2013 monitoring period included the additional sampling and analysis recommended by USEPA. Additional sampling included:

- The analysis of fish for lipid concentration in addition to Aroclor PCBs
- The collection of four composite samples for all three forage fish species at the three stations where forage fish are collected instead of the single composite sample comprised of 10 fish at each location
- The sampling and analysis of *Corbicula* from 6 additional locations for a total of 12 locations.

The additional sampling in 2013 was agreed to in response to the evaluation of the large-scale sampling modifications of 2004.

In response to questions posed to USEPA from the public regarding residual PCB concentrations and residual risk in the dam removal project reach of Twelvemile Creek, an SRI was performed between October 2011 and May 2012 (CH2M HILL 2012). The SRI included soil and sediment sampling within the project reach, an approximately 1.5-mile stretch of Twelvemile Creek from 1,500 feet upstream of former Woodside 1 Dam to approximately 700 feet downstream of former Woodside 2 Dam (Appendix B).

The sediment data collected during the SRI sampling were used to conduct an HHRA for the project reach. Incremental samples were collected from exposed sediment (at a depth interval of 0 to 6 inches) at four areas of interest (AOIs), and discrete submerged sediment samples were collected from a depth interval of 0 to 6 inches in Twelvemile Creek within the project reach. The incremental samples were collected from four AOIs (Ball's Beach, Boy Scout Beach, Woodside 1 Sandbar, and Cateechee Beach) (Appendix B), which were selected based on their potential for sediment accumulation and for recreational use. Six exposed sediment samples (from the four AOIs) and 14 submerged sediment samples were included in the HHRA. Aroclor 1248, Aroclor 1254, and total PCBs were identified as chemicals of potential concern in sediment but were not retained as COCs in the HHRA. The HHRA showed that the estimated excess lifetime cancer risks (ELCRs) were lower than the USEPA's acceptable risk range of  $1 \times 10^{-6}$  to  $1 \times 10^{-4}$  and the noncancer hazard indexes (HIs) were less than the USEPA's target HI of 1.

The SRI sediment data demonstrate that potential human health risks from residual PCB concentrations are within USEPA acceptable levels within the portion of the project reach of Twelvemile Creek that was investigated. Potential exposures were quantified for current and future kayakers, boaters, waders, and sunbathers. Evaluation of these potential exposures showed that both cancer risk and noncancer hazard estimates were at least 25 times lower than the levels considered acceptable by USEPA (CH2M HILL 2012).

### **5.3 SEDIMENT FLUSHING AND TWELVEMILE CREEK IMPOUNDMENTS**

Between March 2010 and September 2011, sediment dredging and the removal of Woodside 1 and Woodside 2 dams were completed as part of stream restoration activities within the project reach in accordance with the Consent Decree and the ESD. The project reach includes the upstream and downstream limits of the sediment removal, dam removal, and restoration activities and includes approximately 1.5 miles of Twelvemile Creek. The project reach begins approximately 1,500 feet upstream of Woodside Dam 1 and extends approximately 700 feet downstream of Woodside 2 Dam (Appendix B). The overall design goals of the project included:

- Using natural channel design to re-establish the free-flowing channel through the dam removal section

- Re-establishing aquatic habitat of a free-flowing stream (including re-exposure of coarse substrates)
- Providing for bank stabilization and tributary stability where landowner has granted access
- Enhancing fish passage
- Re-establishing native vegetation where appropriate
- Improving recreational opportunities

Prior to demolition of the dams, sediment was removed from within the impoundments to the extent practicable. The primary method of sediment removal was hydraulic dredging, which allowed for the direct delivery of dredge material to the SMU for dewatering and disposal, as a slurry via a pipeline. This method eliminated the need for additional vessels, additional handling, and excessive truck traffic in the local communities. Hydraulic dredging was performed using two 10-inch cutterhead dredges with booster pumps.

In cases where conditions indicated that hydraulic dredging was not feasible, such as when large amounts of debris were encountered, mechanical dredging was performed in select portions of the impoundments. During mechanical dredging, excavators equipped with standard excavation buckets were used to remove impounded sediment to bedrock from the creek. This method was utilized during carefully controlled water conditions to limit impacts of the work activities on turbidity. Additionally, best practices were used with this method to minimize the volume of water removed with the sediment. Mechanically dredged sediment was loaded into trucks and transported to the SMU for dewatering and disposal. Approximately 410,000 cy of sediment was removed and relocated to the SMU and over 500,000,000 gallons of water was treated. After the dredging was completed, dredging verification surveys were performed and remaining sediment thicknesses were measured to document the post-dredge conditions.

The removal of Woodside 1 Dam was performed in February and March 2011 and the removal of Woodside 2 Dam began in July 2011 and was completed in September 2011. Demolition of the dams was performed using an excavator equipped with a hydraulic hammer, which broke the masonry walls down in approximately 10-foot deep by 35-foot wide increments across the width of the dams. Demolition debris from the dam removal was loaded into trucks and transported to the SMU for disposal. Turbidity curtains were installed downstream of the dam locations to limit downstream impacts due to dam removal, and turbidity monitoring was performed multiple times per day.

Beginning in April 2012, after the creek channel had returned to its natural configuration following the dam removal, and once the creek had significant flows, stream corridor restoration continued. Stream flow at the locations was directed toward the creek banks, requiring engineered solutions to divert flow away from the banks and to stabilize the eroding bank slopes. Significant natural vegetation had been

filling in along many segments of the creek, but select locations along the creek banks were chosen for augmentation. Over 3,500 live stake species of silky willow, elderberry, and silky dogwood trees were planted (in accordance with the approved plan) along a total of approximately 5,300 feet of bank within and 400 linear feet above the project reach, at 1 foot above the normal (base flow) water surface.

#### **5.4 PUBLIC EDUCATION PROGRAM**

The Public Education Program was implemented to increase awareness of the fish consumption advisory for Lake Hartwell. In 2009, fish consumption advisory signs were posted at approximately 80 locations along the shores of Lake Hartwell at boat ramps and known fishing areas accessed by the public. Additional information regarding fish consumption advisories can be found at the following link: <http://www.scdhec.gov/FoodSafety/FishConsumptionAdvisories/AdvisoryMap/hartwell/>

## **6 FIVE-YEAR REVIEW PROCESS**

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### **6.1 ADMINISTRATIVE COMPONENTS**

The FYR was initiated on April 29, 2014 with the FYR scoping meeting. The FYR team was led by Craig Zeller of USEPA, Region 4, Remedial Project Manager (RPM) for the Sangamo Superfund Site. The team also included staff from the support agency, SC DHEC (Greg Cassidy and Charles Williams), STC (PRP), and CH2M HILL (O&M Manager/Consultant).

The FYR team established a review schedule that included the following components:

- Community Notification and Involvement
- Document Review
- Clean-up Goals
- Data Review
- Site Inspection
- Interviews

### **6.2 COMMUNITY NOTIFICATION AND INVOLVEMENT**

On July 16 2014, a public notice was published in the Greenville News and Pickens County Sentinel announcing the commencement of the FYR process for the Sangamo site, providing Craig Zeller's contact information, and inviting community participation. The press notice is available in Appendix E. No inquiries were submitted to USEPA as a result of this advertisement.

Community interest in OU2 work was high during removal of the Woodside 1 and 2 dams in 2011-2012. Craig Zeller, EPA RPM, met with Pickens County Council members numerous times to explain the dam removal process and to present the scope and results of the Supplemental Remedial Investigation (SRI) on 12 Mile Creek. Specifically, meetings here held with Council members and the general public on October 13, 2011; December 1, 2011; March 19, 2012; April 16, 2012; May 21, 2012; and April 11, 2013. Moreover, representatives of Pickens County Council were also allowed to provide input into the SRI scope of work; and to conduct oversight of the actual field work and data collection.

The FYR Report will be made available to the public once it has been finalized. Copies of this document will be placed in the following designated public repositories:

RM Cooper Library  
Clemson University  
South Palmetto Boulevard  
Clemson, SC 29631

Pickens County Public Library - Easley Branch  
110 West First Avenue  
Easley, SC 29640

### **6.3 DOCUMENT REVIEW**

The FYR effort for Sangamo OU2 primarily consisted of reviewing technical documents that were generated to facilitate the remedy effectiveness evaluation. The documents listed below were reviewed to support preparation of this FYR Report and are incorporated to this report as references.

- ARCADIS, 2012. *Sangamo Weston/Twelvemile Creek/Lake Hartwell PCB Contamination Superfund Site –Twelvemile Creek Restoration. Preliminary As-Built and Final Report.* February.
- CH2M HILL, 2012. *Conceptual Site Model, Sangamo Weston, Inc./Twelvemile Creek/Lake Hartwell PCB Contamination Superfund Site, Pickens, South Carolina.* DRAFT September.
- CH2M HILL, 2012. *Supplemental RI Report, Operable Unit 2 of the Sangamo Weston, Inc./Twelvemile Creek/Lake Hartwell Superfund Site, Pickens County, South Carolina.* September.
- CH2M HILL, 2012. *Draft Uniform Federal Policy Quality Assurance Project Plan (UFP QAPP), Site-specific Plans for Operable Unit 2 of the Twelvemile Creek Site, Supplemental Remedial Investigation, Pickens County, South Carolina.* January.
- CH2M HILL, 2012. *Restoration Plan, Twelvemile Creek Restoration, Pickens County, South Carolina.* November.
- CH2M HILL, 2013. *Letter Report to South Carolina Department of Health and Environmental Control: Construction Permit Number 19570-IW.* March.
- RMT, Inc., 1989. *Remedial Investigation Report (RIR) for the Sangamo Plant, Breazeale, Nix, Dodgens, Cross Roads, John Trotter and Welborn Sites, Volumes I and II, Sangamo Weston Inc., Pickens County, South Carolina.* November.
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## 6.4 CLEAN-UP GOALS

Clean-up goals for OU2 were established by USEPA in the ROD for PCBs in sediment and fish tissue (see Table 4).

Table 4  
Summary of Clean-up Goals for OU2

CONTAMINANTS OF CONCERN	1994 ROD PERFORMANCE STANDARDS (mg/kg)	CURRENT CLEAN-UP GOALS (mg/kg)	CHANGES
Sediment	1	1	No
Fish Tissue	2	2	No

## 6.5 DATA REVIEW

The annual reports present the detailed results of the sediment and biological monitoring for OU2. The 2013 Fish and Sediment Study in the list above includes an evaluation of trends. A brief summary of the trends for each medium is presented below.

- **Sediment.** Continued decrease (from 1995) of residual PCBs in the sediments of the free-flowing stream portion of Twelvemile Creek, upstream of Lake Hartwell.
  - PCB concentrations were greater than 2.0 mg/kg in 2 of the 21 samples in 2013 and exceeded 1.0 mg/kg at 1 location. All these concentrations were measured in the lower Twelvemile Creek area.

- Within the main body of the lake, sediment PCB concentrations were lower than historical levels, with all PCB values lower than 1.0 mg/kg. The most recent data suggest that sediment concentrations have stabilized and are likely decreasing after the dam removals.
- **Corbicula.** Measurable declines in *Corbicula* PCB concentrations at Sangamo discharge point.
  - 2013 PCB concentrations were recorded in 8 of the 10 monitoring site samples. PCBs were not detected above 1.0 mg/kg in any of the *Corbicula* samples in 2013.
  - Percent lipid has been measured as a component of the *Corbicula* analysis since 2004. The lipid normalized PCB concentrations indicate that 2013 values were generally lower than those from the 2012 survey.
- **Fish.** The last 14 years of fish tissue data identify local and lake-wide changes that indicate substantial PCB reduction. The 2013 samples indicated substantial decreases compared to the 2005 to 2009 data, yet were similar to the 2010 to 2012 data, which were among the lowest on record.
  - Lake-wide mean PCB tissue concentrations in hybrid bass and largemouth bass have been below 2.0 mg/kg since 2009.
  - PCB tissue concentrations in forage fish species (bluegill, gizzard shad, and threadfin shad) indicate decreasing concentrations with increasing distance from Twelvemile Creek.
    - PCB concentrations in bluegill and threadfin shad were lower than in the last several years.
    - The average PCB concentration in gizzard shad was substantially lower than levels in previous years and below the 2.0-mg/kg FDA tolerance level for the first time on record.
  - The 2013 average concentration of PCBs in hybrid bass did not exceed the 2.0-mg/kg FDA tolerance level in any of the six stations, as compared to one in 2012, none in 2011, five in 2009, and four in 2008.
  - PCB concentrations in the tissues of largemouth bass and channel catfish consistently show a spatial pattern of decreasing concentrations downstream of Twelvemile Creek.
    - Both largemouth bass and channel catfish tissue concentrations have decreased at all stations from the elevated values of the early to mid-1990s.
    - For channel catfish, average PCB concentrations were below 2.0 mg/kg for all sample locations and did not exceed 1.0 mg/kg at any stations.

Although this report discusses observations of apparent “trends” in various data sets, and makes observational comparisons of differences from one year’s samples to the next, such inferences about apparent trends are not conclusive because the data have not been subjected to formal statistical analysis. While the first 5 years of the monitoring indicate some highs and lows in the data, the last 14 years identify local and lake-wide changes that indicate substantial PCB reduction.

## **6.6 SITE INSPECTION**

The FYR team conducted a site inspection of OU2 on May 7, 2014. The FYR team consisted of Craig Zeller (USEPA Region 4 RPM), Chuck Williams and Greg Cassidy (support agency, SC DHEC); Vic Cocianni (STC), and Dave Urann/Lillian Furlow/Scott Powell (CH2M HILL – consultants to STC). The status of the OUs since the last FYR Report was discussed during this meeting. The team toured portions of Twelvemile Creek and inspected the locations of the two former Woodside 1 and 2 dams.

In March 2014, 70 of approximately 80 fish advisory signs surrounding Lake Hartwell were inspected. Nine boat landings were closed for the off season and were not accessible. It was recommended that 10 of the signs be replaced. Signs at these locations will be inspected at a later date. Further details of the inspection are presented in Appendix C.

## **6.7 INTERVIEWS**

Formal interviews were not conducted as part of this FYR for OU2; however, a meeting was held with the FYR team to discuss the activities and issues at the site since the last FYR along with planned activities for OU2.

## 7 TECHNICAL ASSESSMENT

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As recommended by USEPA's Comprehensive Five-Year Guidance (OSWER No. 9355.7-03B-P, June 2001), the framework for the technical assessment of the RA centers around answering the following three key questions.

### **7.1 QUESTION A: IS THE REMEDY FUNCTIONING AS INTENDED BY THE DECISION DOCUMENTS?**

Yes. The dam removal and stream corridor restoration continues to allow natural sediment transport processes to occur in the stream, facilitating burial of contaminated sediments downstream.

### **7.2 QUESTION B: ARE THE EXPOSURE ASSUMPTIONS, TOXICITY DATA, CLEAN-UP LEVELS, AND RAOs USED AT THE TIME OF THE REMEDY SELECTION STILL VALID?**

Yes. There have been no significant changes in contaminant toxicity (see the table below), or assumptions related to exposure pathways, land uses, or risk assessment methods that would alter USEPA's current remedy implementation strategy at the OU2 site.

The Food and Gill Exchange of Toxic Substances (FGETS) bioaccumulation model predicted that fish tissue concentrations in the Twelvemile Creek Arm of Lake Hartwell would decline in response to decreasing water column and surface sediment PCB concentrations. FGETS predicted that largemouth bass concentrations in the Twelvemile Creek Arm of Lake Hartwell would fall below the 2-mg/kg FDA tolerance level in the 2003 to 2005 timeframe.

PCB concentrations in the 2013 fish tissue samples indicated a decreasing trend compared to the 2005 to 2009 data, and were similar to the 2010 to 2012 data, which included some of the lowest concentrations on record. It is anticipated that the dam removal and stream restoration will aid in the continued decline of trends over time. Tissue concentrations seem to have a longer decline lag time.

Table 5  
Toxicity Changes

Contaminant	Carcinogenic toxicity changes						Non-carcinogenic toxicity changes					
	Oral Cancer Slope Factor (mg/kg-day) <sup>-1</sup>			Inhalation Unit Risk (IUR) (µg/m <sup>3</sup> ) <sup>-1</sup>			Oral Reference Dose (RfD) (mg/kg-d)			Inhalation Reference Concentration (RfC) (mg/m <sup>3</sup> )		
	1990 ROD Value <sup>a</sup>	Current Value <sup>b</sup>	Change	1990 ROD Value <sup>a</sup>	Current Value <sup>b</sup>	Change	1990 ROD Value <sup>a</sup>	Current Value <sup>b</sup>	Change	1990 ROD Value <sup>a</sup>	Current Value <sup>b</sup>	Change
Acetone	ND	ND	None	NA	ND	None	1.0E-02	9.0E-01	Less Stringent	NA	3.1E+01	New
Benzene	2.9E-02	5.5E-02	None	NA	7.8E-06	New	2.3E+00	4.0E-03	More stringent	NA	3.0E-02	New
bis-2-ethylhexyl phthalate	1.4E-02	1.4E-02	None	NA	2.4E-06	New	2.0E-02	2.0E-02	None	NA	ND	None
1,1-DCA	ND	5.7E-03	New	NA	1.6E-06	New	1.2E-01	2.0E-01	Less stringent	NA	ND	None
1,1-DCE	6.0E-01	ND	withdrawn	NA	ND	None	9.0E-03	5.0E-02	Less stringent	NA	2.0E-01	New
cis-1,2-DCE	ND	ND	None	NA	ND	None	NE	2.0E-03	New	NA	ND	New
trans-1,2-DCE	ND	ND	None	NA	ND	None	1.0E-02	2.0E-02	Less stringent	NA	6.0E-02	New
1,4-dioxane	NE	1.0E-01	New	NE	7.7E-06	New	NE	3.0E-02	New	NE	1.1E-01	New
Ethylbenzene	ND	1.1E-02 <sup>c</sup>	New	NA	2.5E-06 <sup>c</sup>	New	1.0E-01	1.0E-01	None	NA	1.0E+00	New
Methylene chloride	7.5E-03	2.0E-03	Less stringent	NA	1.0E-08	New	6.0E-02	6.0E-03	Lower	NA	6.0E-01	New
MEK	ND	ND	None	NA	ND	None	5.0E-02	6.0E-01	Less stringent	NA	5.0E+00	New
MIBK	ND	ND	None	NA	ND	None	5.0E-02	8.0E-02	Less stringent	NA	3.0E+00	New
PCE	5.1E-02	2.1E-03	Less stringent	NA	2.6E-07	New	1.0E-02	6.0E-03	More stringent	NA	4.0E-02	New
Toluene	ND	ND	None	NA	ND	None	3.0E-01	8.0E-02	More stringent	NA	5.0E+00	New
1,1,1-TCA	ND	ND	None	NA	ND	None	9.0E-02	2.0E+00	Less stringent	NA	5.0E+00	New
TCE	1.1E-02	4.6E-02	More stringent	NA	4.1E-06	New	7.0E-03	5E-04	More stringent	NA	2.0E-03	New
Vinyl chloride	NE	7.2E-01	New	NE	4.4E-06	New	NE	3.0E-03	New	NE	1.0E-01	New
Xylene	ND	ND	None	ND	ND	None	2.0E+00	2.0E-01	Less stringent	ND	1.0E-01	New

**Notes:**

a. Toxicity values from 1990 ROD.

b. Values available for comparison from EPA's IRIS (<http://www.epa.gov/IRIS> accessed 11/20/2013) and EPA's May 2013 Regional Screening Level Table ([http://www.epa.gov/reg3hwmd/risk/human/rb-concentration\\_table/Generic\\_Tables/index.htm](http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm)).

New = New value; previously, no toxicity value was available; ND = Not determined.

NA = The risk assessment did not evaluate inhalation exposure.; NE = The risk assessment did not identify this compound as a COC.

### **7.3 QUESTION C: HAS ANY OTHER INFORMATION COME TO LIGHT THAT COULD CALL INTO QUESTION THE PROTECTIVENESS OF THE REMEDY?**

No.

### **7.4 TECHNICAL ASSESSMENT SUMMARY**

The site documents review, in combination with the site visit and team meeting, provided the basis for this technical assessment. Performance monitoring will continue and ICs (fish advisory) will remain in effect until fish tissue clean-up criteria for PCBs are met.

## **8 ISSUES**

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## 9 RECOMMENDATIONS AND FOLLOW-UP ACTIONS

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Based on the above discussion and findings, the following recommendations are issued for this FYR:

1. Continue to administer the existing fish consumption advisory.
2. Continue to inspect and maintain fish advisory signs.
3. Reduce the frequency of sediment and aquatic biota monitoring from annual to biennially.
4. Review and consider further modification of the annual sediment and aquatic biota monitoring program over the next 5 year cycle to include reduction of the total number of stations. Per the ROD, PCB levels have been monitored in sediment and aquatic biota (*Corbicula* and fish) for 20 years.



## **10 PROTECTIVENESS STATEMENT**

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The remedy at OU2 is considered protective of human health and the environment.

## **11 NEXT REVIEW**

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Pursuant to statutory requirements, the next FYR for this site will be conducted 5 years from the approval date of this document.

# Appendix A

## Fish Consumption Advisory Monitoring Options

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# Lake Hartwell Aquatic Biota Monitoring Proposal

PREPARED FOR Vic Cocianni/Schlumberger Technology Corporation

PREPARED BY: CH2M HILL

DATE: May 30, 2014

## Background

The Sangamo Weston/Twelvemile Creek/Lake Hartwell PCB Contamination Superfund Site in Pickens County, South Carolina was placed on the National Priorities List in 1990. The site consists of two operable units. Operable Unit One (OU1) addresses the land-based source areas for polychlorinated biphenyls (PCBs) and includes the Sangamo Weston Plant and six satellite disposal areas. Operable Unit Two (OU2) addresses the sediment, surface water, and biological migration pathways downstream from the source areas. U.S. Environmental Protection Agency (USEPA) Region IV's 1994 Final Record of Decision (ROD, USEPA, 1994) for OU2 identified consumption of PCB-contaminated fish harvested from Lake Hartwell as the primary pathway for human exposure to PCBs. A fish consumption advisory has been in place for Lake Hartwell since 1976, and the 1994 Final ROD called for continued monitoring of aquatic biota and sediment to support continuance of, or justify modifications to, this existing advisory. Annual monitoring of PCBs in sediment and aquatic biota has been conducted since 1995. This monitoring currently includes a comprehensive game and forage fish study, which involves tissue sampling similar to that done as part of the annual monitoring by the South Carolina Department of Health and Environmental Control (SCDHEC), and an Asian clam (*Corbicula fluminea*) bioaccumulation study. Sediment sampling also occurs in Lake Hartwell and in the Twelvemile Creek watershed. These monitoring efforts were modified in 2004 to include additional sampling and analysis of *Corbicula* and fish tissues.

Remediation of OU1 was completed in 1997 and remediation of OU2 was completed in 2012. In 2011, two small decommissioned power dams were removed from Twelvemile Creek, which allowed approximately 7,600 feet of the creek to return to its natural free flowing state. Sediment from behind these dams was dredged and placed in a dedicated Sediment Management Unit constructed consistent with South Carolina Regulation 61-107.19 for a Class III Landfill. In 2012, maintenance on a stormwater control system was conducted at the former Sangamo Weston Plant Site to control sediment erosion.

## Purpose

The purpose of this technical memorandum is to propose changes to the monitoring of PCBs in sediment and aquatic biota that has been conducted over the past 20 years at OU2 since 1995. The current level of monitoring (in terms of type, number, location, frequency, and density of samples) was initially justified by the need to characterize the nature and extent of PCB contamination, in order to design of remedial actions at OU2. In addition, research done at Lake Hartwell has contributed substantially over the years to our scientific understanding of the transport, fate, and bioaccumulation of PCBs in freshwater aquatic ecosystems and food webs (Brenner et al., 2004; Magar et al., 2005a; Magar et al., 2005b; Rashleigh et al., 2009; Schubauer et al., 2012; Sivey and Lee, 2007; Walters et al., 2008; Walters et al., 2010). But with remedial actions now complete at OU1 and OU2, monitoring at its current intensity is no longer necessary, nor do we believe it is necessary to continue to collect monitoring data for research purposes unrelated to compliance with the 1994 Final ROD. Now is thus an appropriate time to propose modifying the monitoring program to more efficiently fulfill its original goal, as described in the 1994 Final ROD (USEPA, 1994), of informing decisions regarding continuance or modification of the existing fish consumption advisory for Lake Hartwell.

## Monitoring Program

### Sediment

Sediment samples are presently being collected at 21 locations: 5 in Lake Hartwell, including 1 background station (**Figure 1**), and 16 in the Twelvemile Creek watershed (**Figure 2**). A number of these locations are tightly clustered spatially and there are no longer substantial differences in PCB concentration between many stations. In addition, many are now consistently below the 1.0-milligram per kilogram (mg/kg) cleanup criterion established in the 1994 Final ROD. We therefore propose retaining only 10 sediment sampling locations in the Twelvemile Creek watershed, 7 of which would be paired with clam sampling stations. It has been suggested that the five sediment stations in Lake Hartwell be retained because they provide data that are useful for informing decisions about placement of docks and other near-shore in-water structures. They are nonetheless being proposed for elimination because: (1) samples taken at depth in the center of the lake are unlikely to be representative of near-shore conditions and (2) the usual practice is for those desiring permits to build docks or other near-shore structures to perform their own sediment sampling and analysis activities. Because PCBs exhibit a long half-life in sediment, significant year-over-year changes in PCB sediment concentrations are not expected. We are therefore proposing to reduce the frequency of sediment sampling from yearly to every 2 years.

### Clams (*Corbicula*)

Given a renewed focus on fish consumption advisories, the primary justification for continued use of *Corbicula* is as a surrogate for fish in those portions of the Twelvemile Creek watershed that do not typically contain fish or where fish are hard to collect. *Corbicula* samples are presently being collected at 13 locations in the Twelvemile Creek watershed (**Figure 3**). As with the sediment locations, a number of *Corbicula* locations are tightly clustered spatially and most indicate similarly low PCB concentrations in tissues. We therefore propose to retain eight *Corbicula* sampling locations in the Twelvemile Creek watershed to serve as surrogates for fish and to monitor the consequences of the recent remedial actions at OU2. Because metabolism and elimination of PCBs by clams is slow to non-existent, significant year-over-year changes in PCB concentrations in clam tissue are not expected. We are therefore proposing to reduce the frequency of clam sampling from yearly to every 2 years.

### Fish

Game and forage fish samples are presently being collected at five locations in Lake Hartwell and at one background location. We propose reducing the number of fish sampling locations to three: one in Twelvemile Arm, one in Lake Hartwell, and at a background location (**Figure 4**). In addition, because the final cleanup goal is based on human consumption of game fish, we propose to limit fish sampling to only those species and sizes typically consumed by humans. We also propose that the sampling program include line-caught game fish for greater consistency with a sport/recreational fishing scenario. Because metabolism and elimination of PCBs by fish is, as with clams, slow to non-existent, significant year-over-year changes in PCB concentrations in fish tissue are not expected. We are therefore proposing to reduce the frequency of fish sampling from yearly to every 2 years. Synchronizing the sediment, clam, and fish sampling would simplify the logistics and lessen the expense of the monitoring program.

### Reporting

At present, the annual monitoring program report runs to several hundred pages, including text and tables, but does not concisely address the goals stated in the 1994 Final ROD. We propose that the main body of the report focus on answering three key questions: (1) How is OU2 progressing toward the cleanup goal of 2 mg/kg total PCBs in game fish tissue (or their clam surrogates)?, (2) How is OU2 progressing relative to the total PCB background level in game fish (i.e., Station SV-641)?, and (3) Is there a need to continue, or make modifications to, the existing fish consumption advisory for Lake Hartwell? Given the recalcitrance of PCBs to metabolize in, or be eliminated from, fish, achievement of the cleanup goal over the long-term is likely linked to turn-over in the lake's game fish populations. Statistical methods would be used to interpret results and identify trends and rates of change to help answer these three questions. Emphasis would be placed on the use of graphs and tables, as opposed to text, to summarize and convey results.

## Summary

Proposed changes to the current sediment and aquatic biota monitoring program are summarized in the table below. Samples are currently taken annually; the proposed frequency is every 2 years.

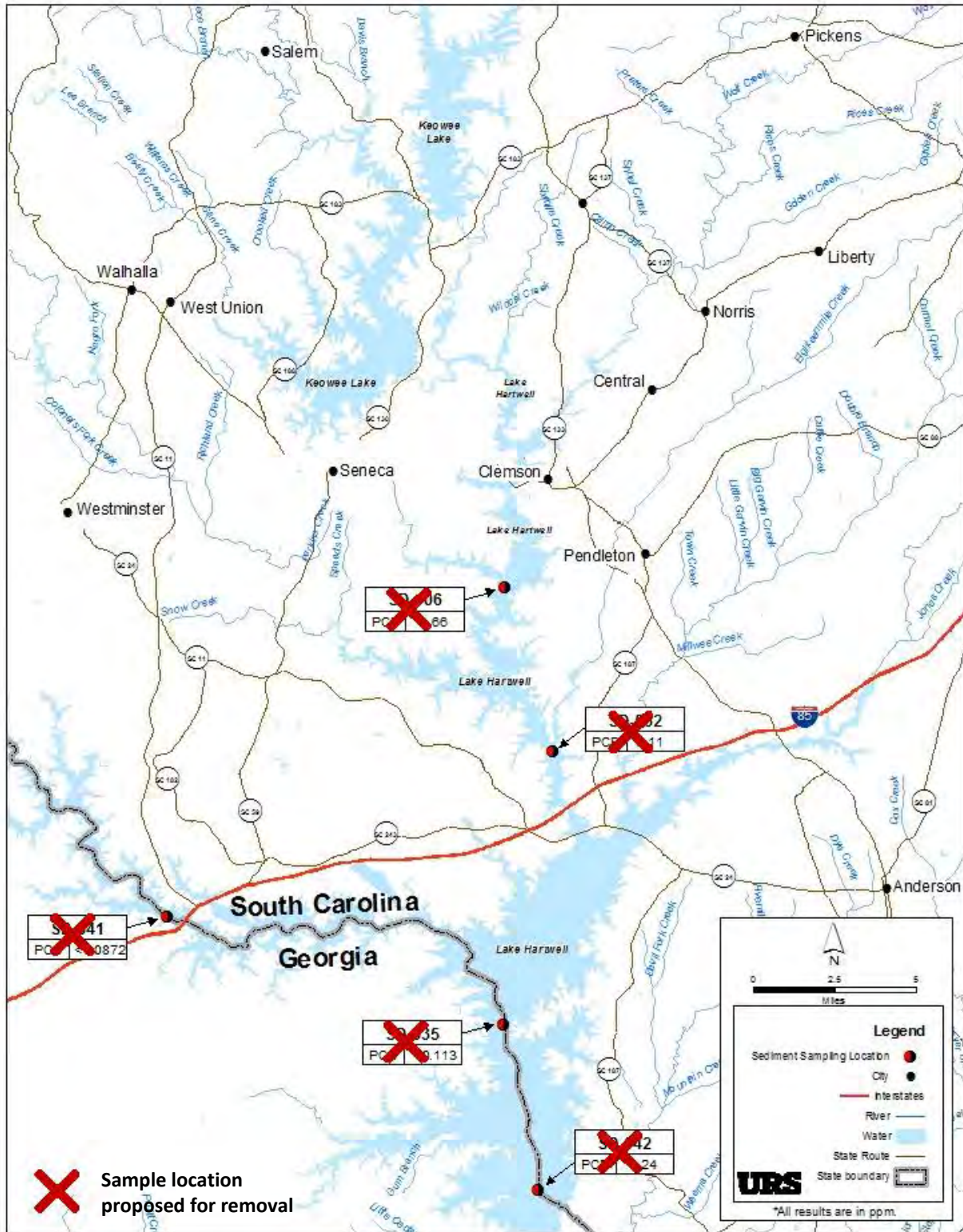
Station	Current	Proposed	Note
<b>SEDIMENT</b>			
SD-106	●	--	
SD-532	●	--	
SD-535	●	--	
SD-641	●	---	
SD-642	●	--	
SD-000	●	●	paired with C-000; sediment background
SD-001	●	●	paired with C-001
SD-002	●	●	paired with C-003
SD-003	●	--	
SD-004	●	●	paired with C-005
SD-005	●	●	no clam station
SD-006	●	--	
SD-007	●	●	paired with C-007
SD-008	●	--	PCBs <1 mg/kg since 2000, except 2006
SD-009	●	●	paired with C-009; second highest PCB conc.
SD-010	●	--	no clam station
SD-011	●	●	no clam station; highest PCB conc. in 2013
SD-012	●	●	paired with C-011 & SV-107
SD-013	●	--	
SD-014	●	●	no clam station
SD-015	●	--	
<b>Totals</b>	<b>21</b>	<b>10</b>	
<b>CLAMS</b>			
C-000	●	●	clam background; paired with SD-000
C-001	●	●	paired with SD-001
C-003	●	●	paired with SD-002
C-004	●	--	
C-005	●	●	paired with SD-004
C-006	●	--	
C-007	●	●	paired with SD-007
C-008	●	--	
C-008.5	●	--	
C-009	●	●	paired with SD-009
C-010	●	●	temporary to confirm trend
C-011	●	●	paired with SD-012 & SV-107
Keowee River	●	--	
<b>Totals</b>	<b>13</b>	<b>8</b>	
<b>FISH</b>			
SV-106	●	--	
SV-107	●	●	paired with SD-012 & C-011
SV-532	●	●	
SV-535	●	--	
SV-641	●	●	fish background
SV-642	●	--	
<b>Totals</b>	<b>6</b>	<b>3</b>	

-- = Station eliminated    ● = Station retained

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Figure 1 Sediment Sampling Locations - 2013  
Lake Hartwell

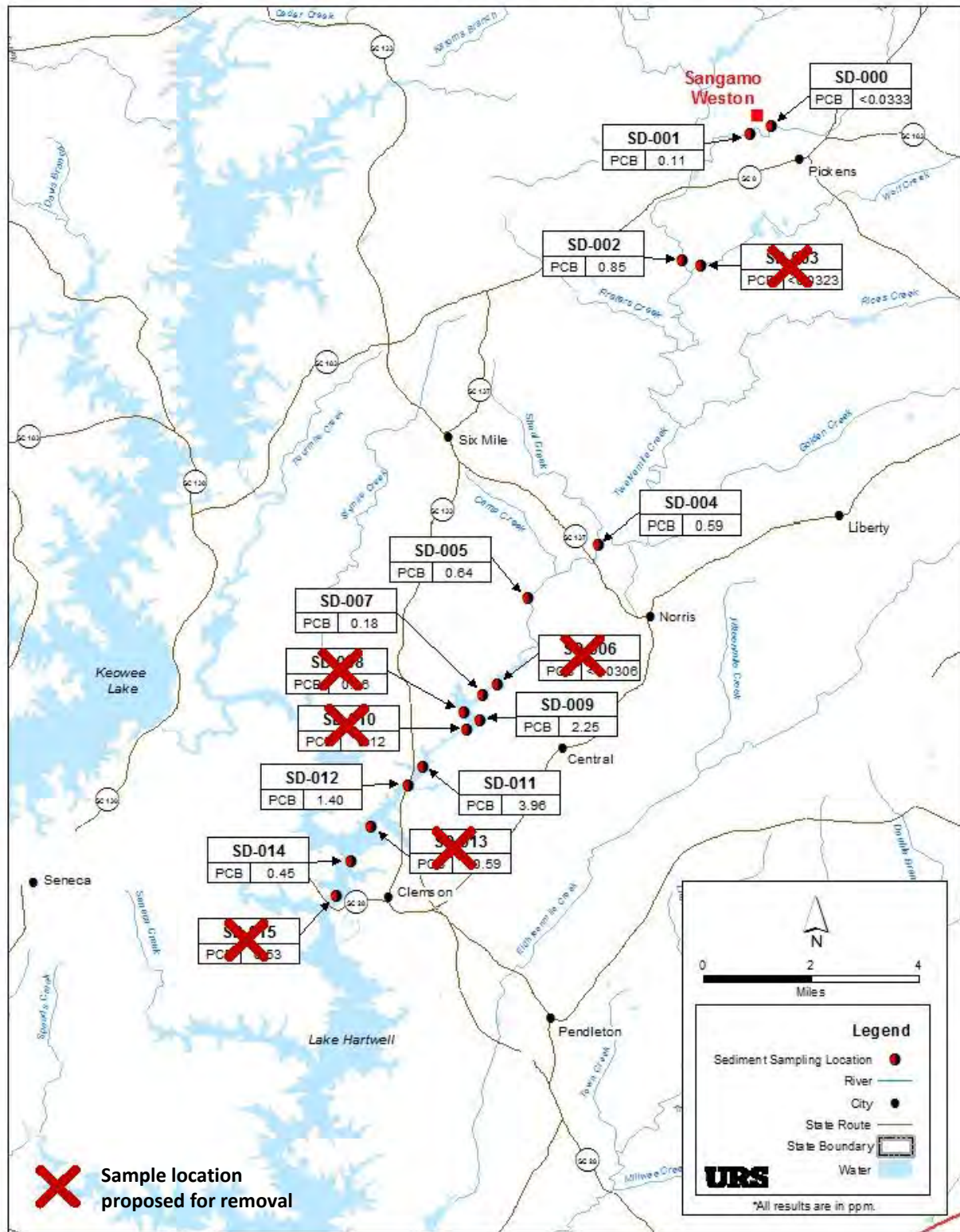


file: G:\Schlumberger\lake\_hartwell\_sediment\enables\2012\fig1-sediment-sampling.mxd



Figure 2

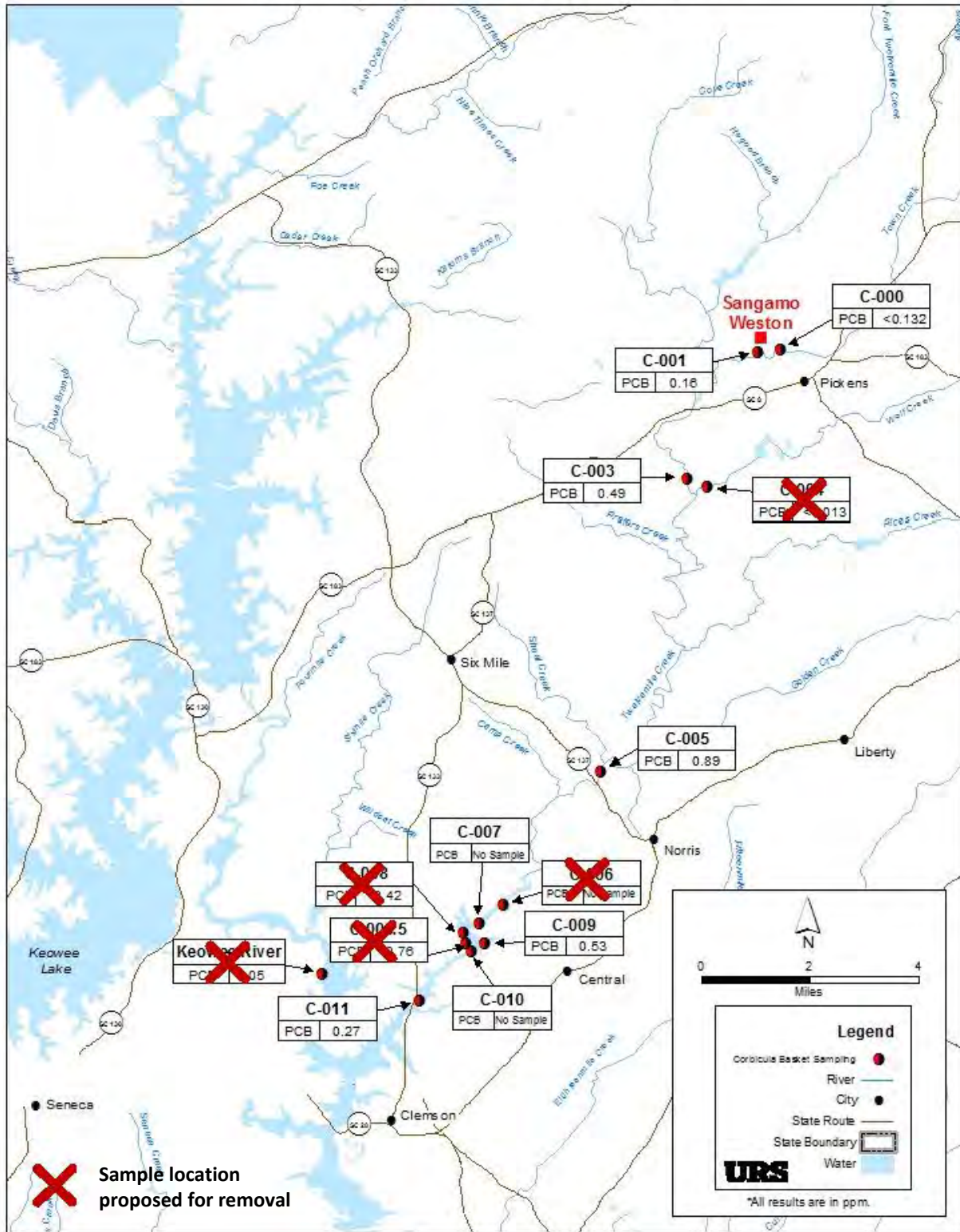
### Sediment Sampling Locations - 2013 Twelvemile Creek Watershed



File: G:\Schlumberger\lake\_hartwell\_aquatic\enables\2012\fig2-sediment-sampling.mxd

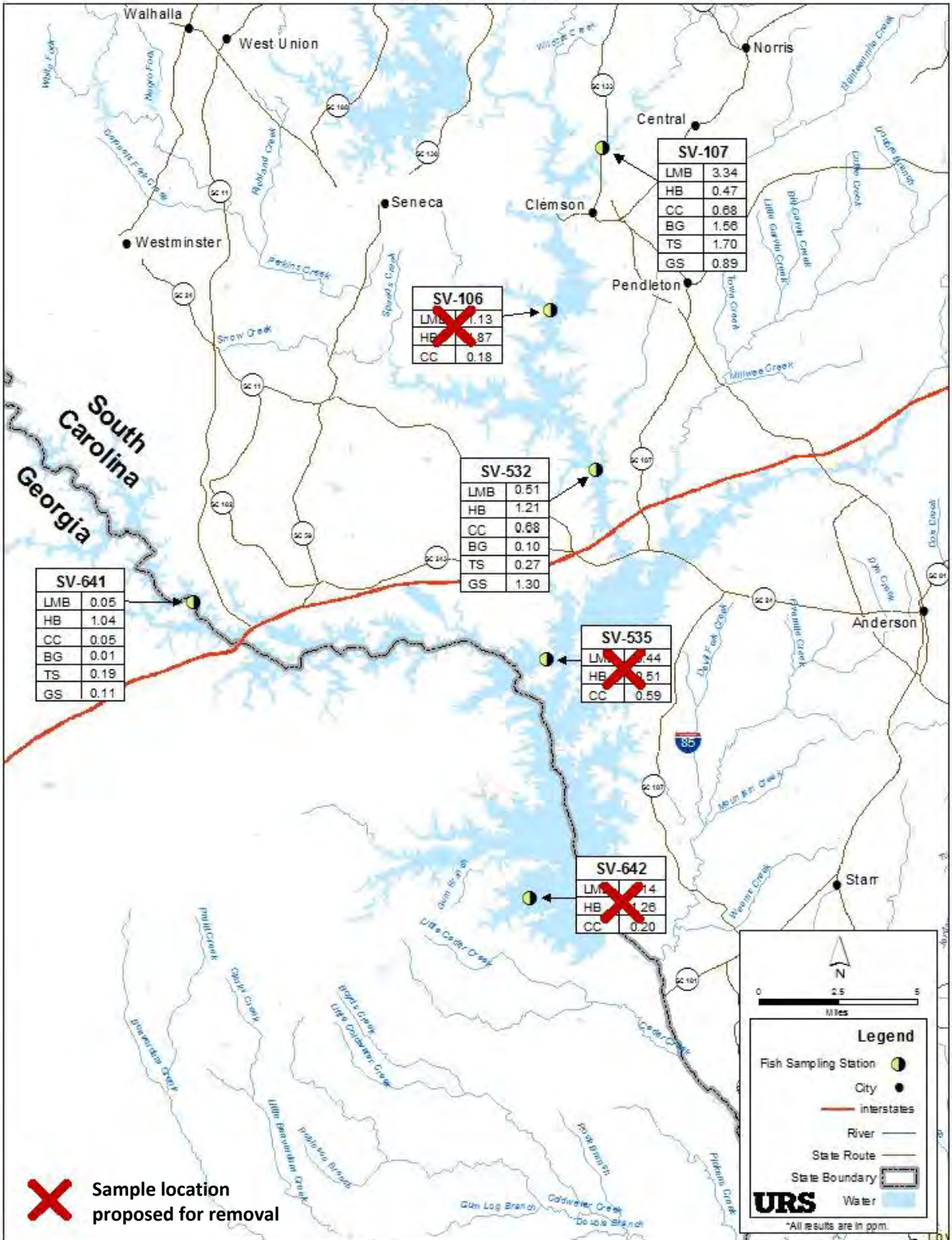
Figure 3

### Corbicula Sample Locations - 2013 Twelvemile Creek and Twelvemile Arm



file:///C:/Users/bjergan/OneDrive/Desktop/2012/fig3-corbicula-sampling.mxd

Figure 4  
Fish Sampling Stations - 2013  
Lake Hartwell



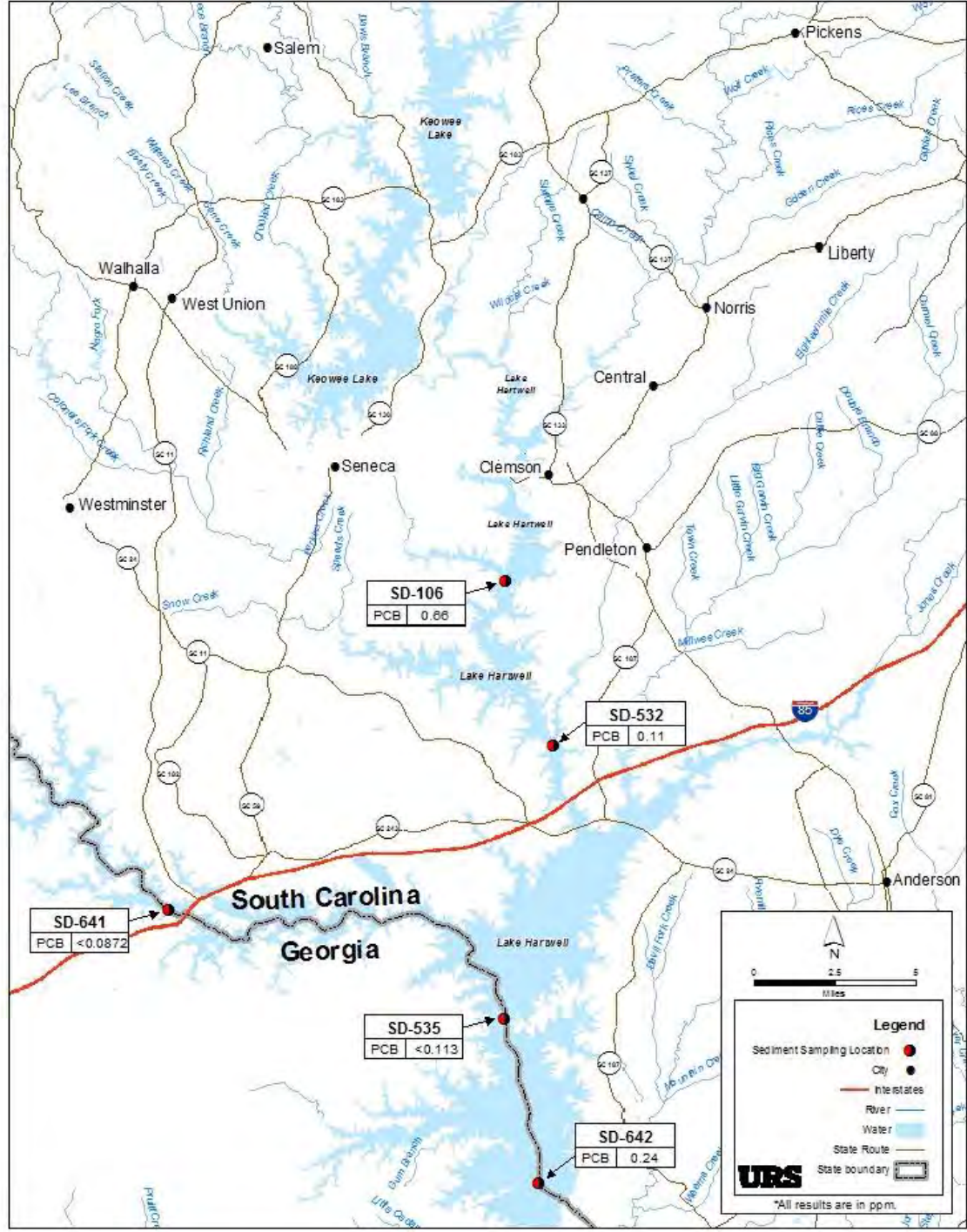
**X** Sample location proposed for removal

# Appendix B

## Figures

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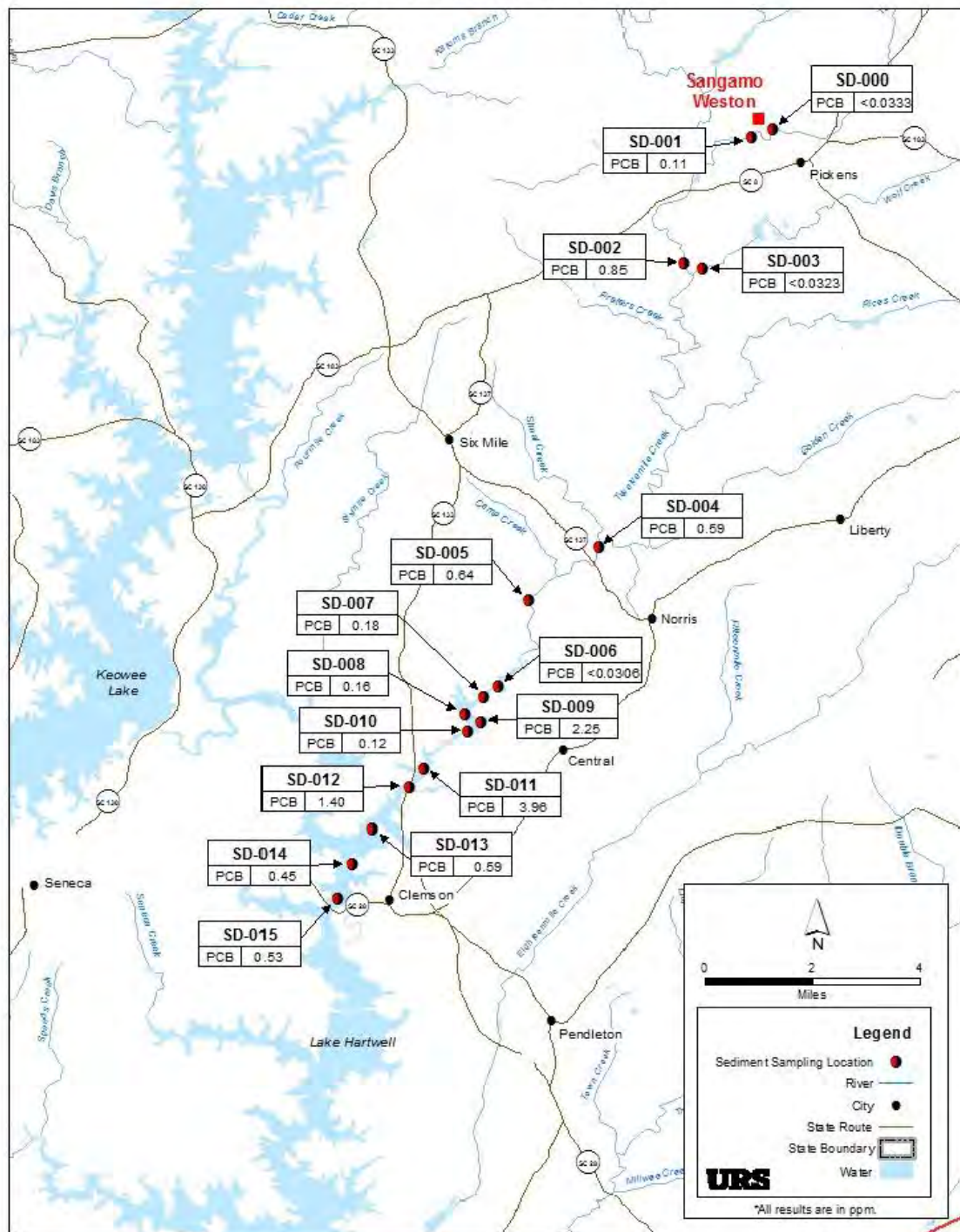
Figure 1 Sediment Sampling Locations - 2013  
Lake Hartwell



File: G:\Schumberger\lake\_hartwell\_sediment\_analysis\2012\fig1-sediment-sampling.mxd

Figure 2

### Sediment Sampling Locations - 2013 Twelvemile Creek Watershed



**Figure 3.1. PCB Levels in Sediment Samples (1995-2013),  
Lake Hartwell OU2 Fish and Sediment Study, SD-000 to SD-004**

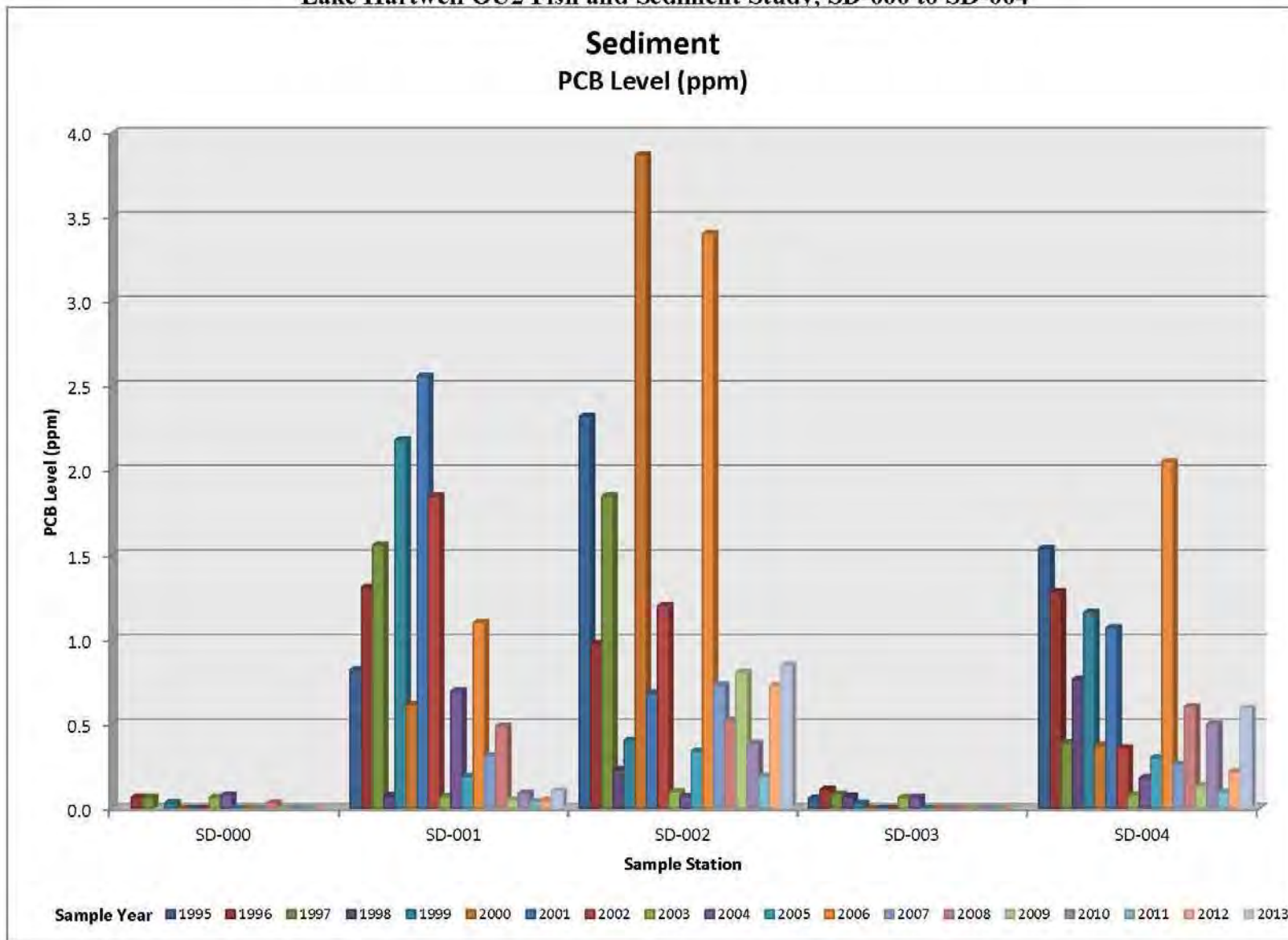
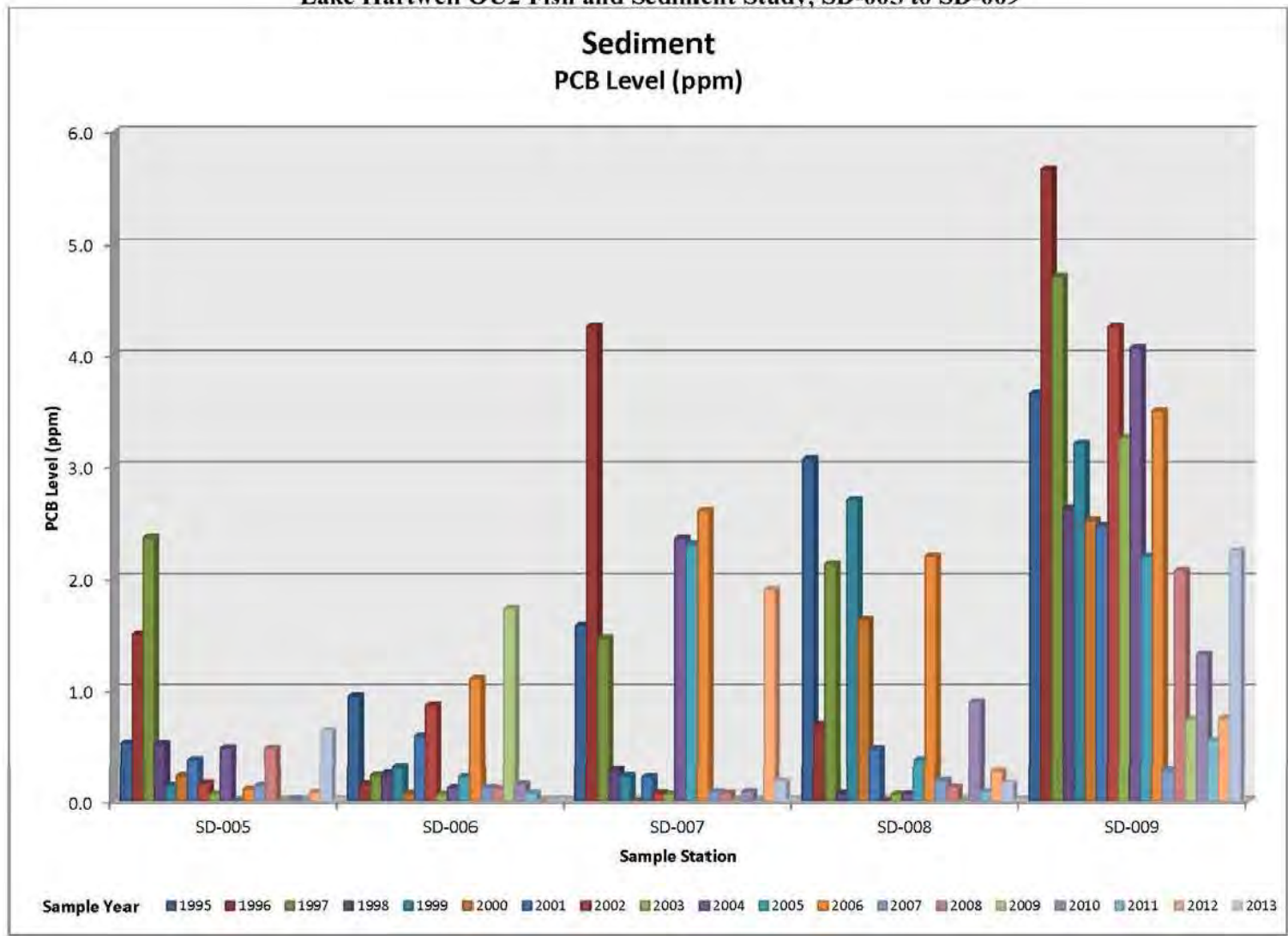
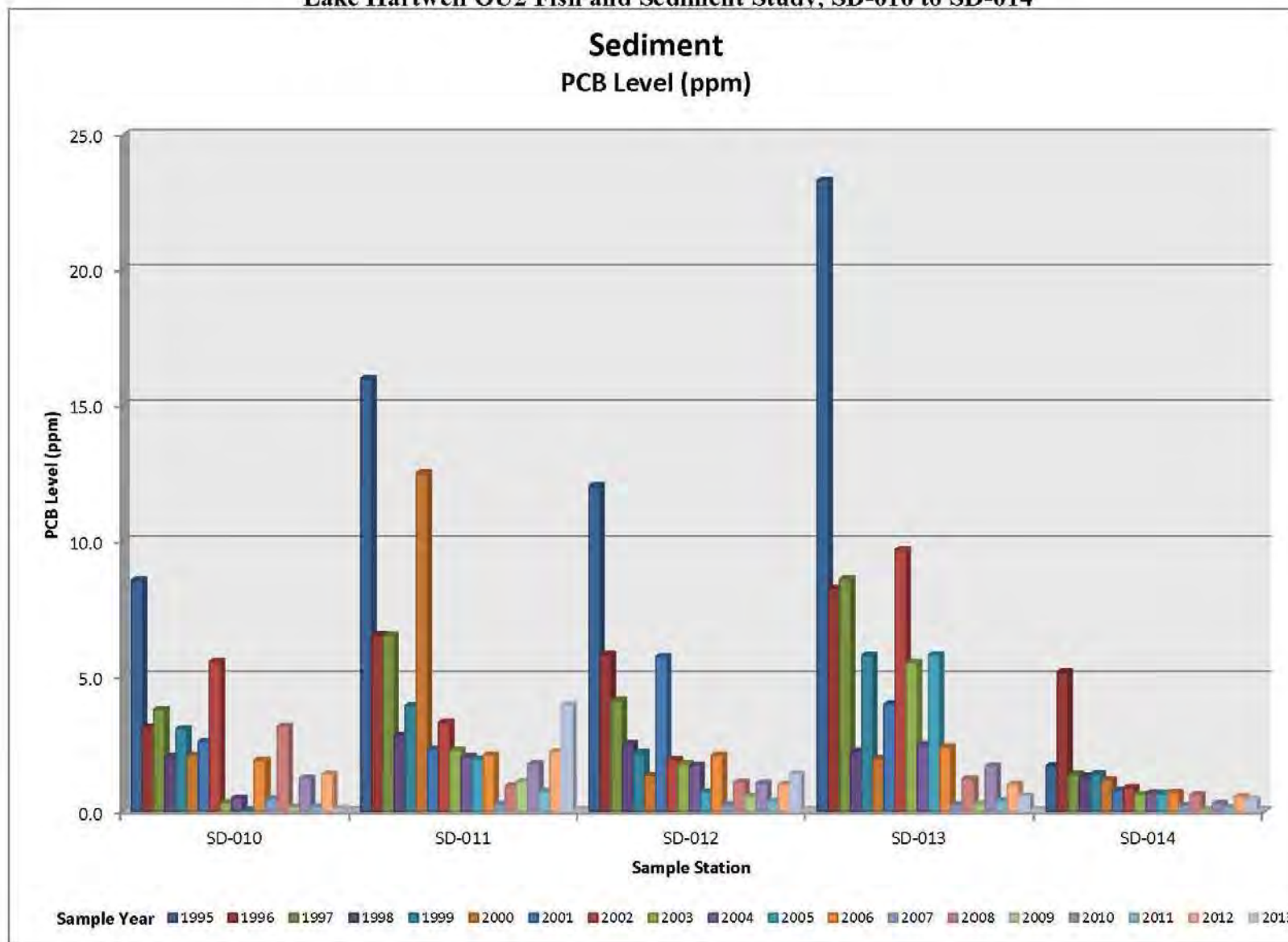


Figure 3.2. PCB Levels in Sediment Samples (1995-2013),  
Lake Hartwell OU2 Fish and Sediment Study, SD-005 to SD-009

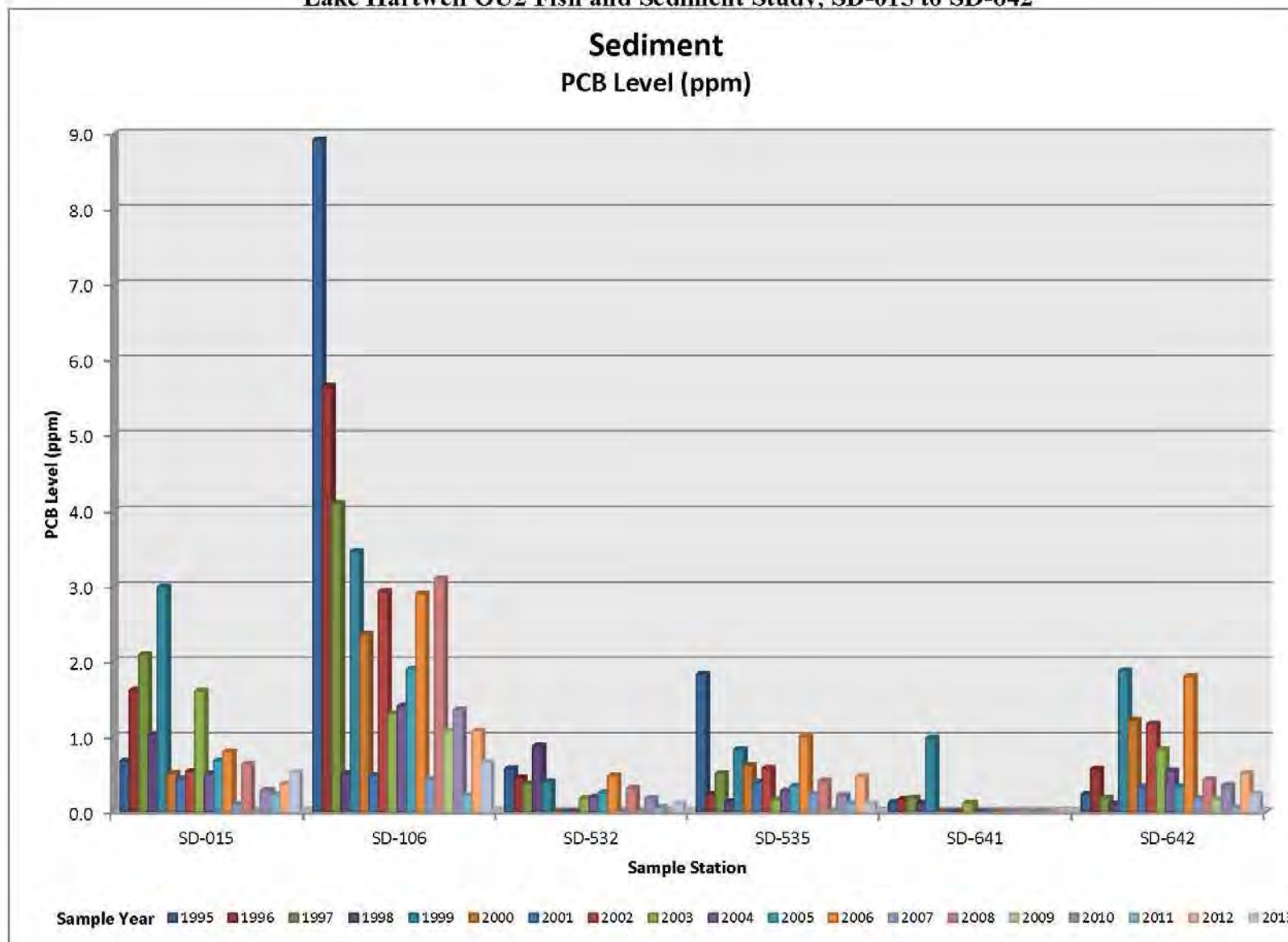




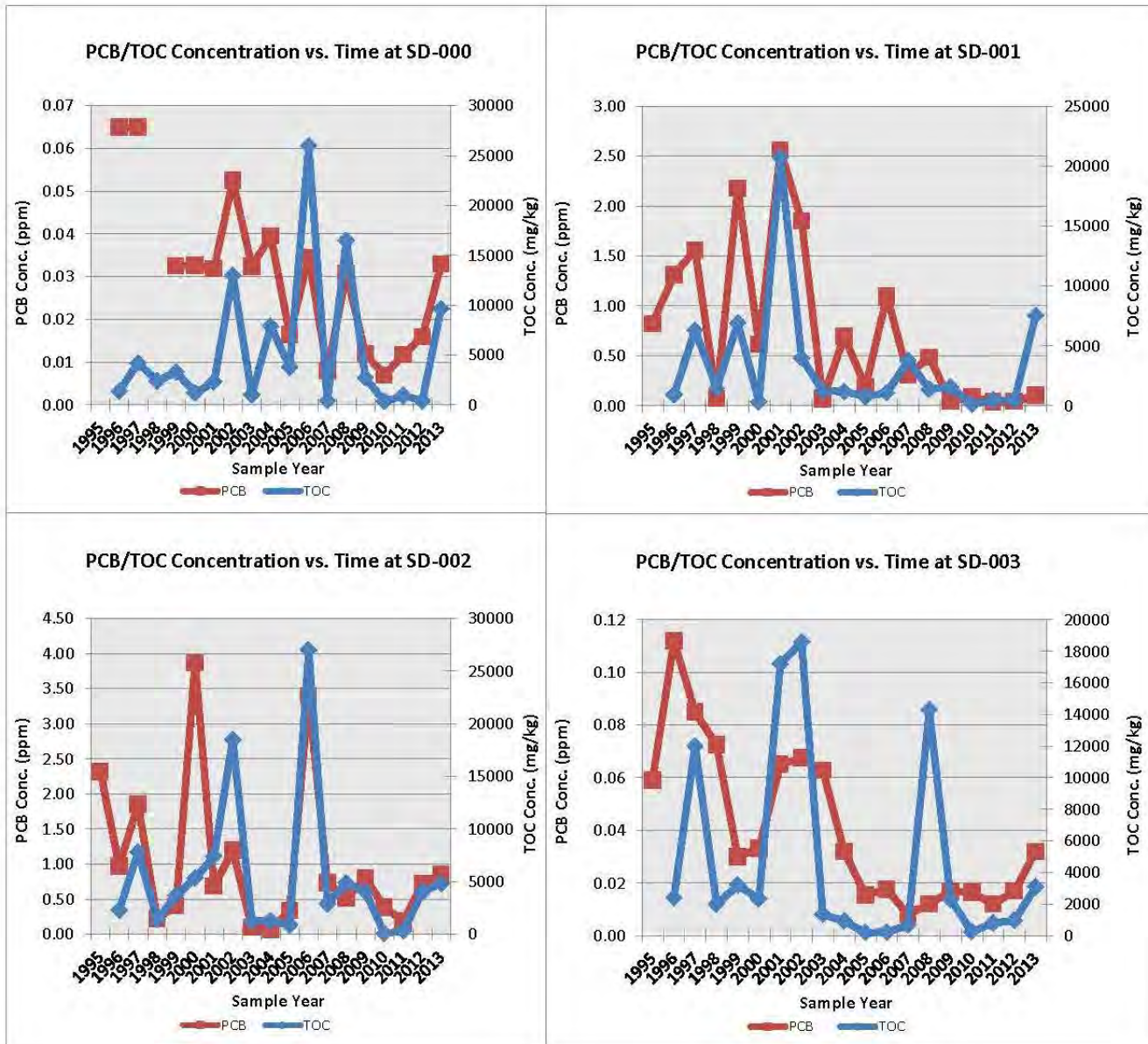
**Figure 3.3. PCB Levels in Sediment Samples (1995-2013),  
Lake Hartwell OU2 Fish and Sediment Study, SD-010 to SD-014**



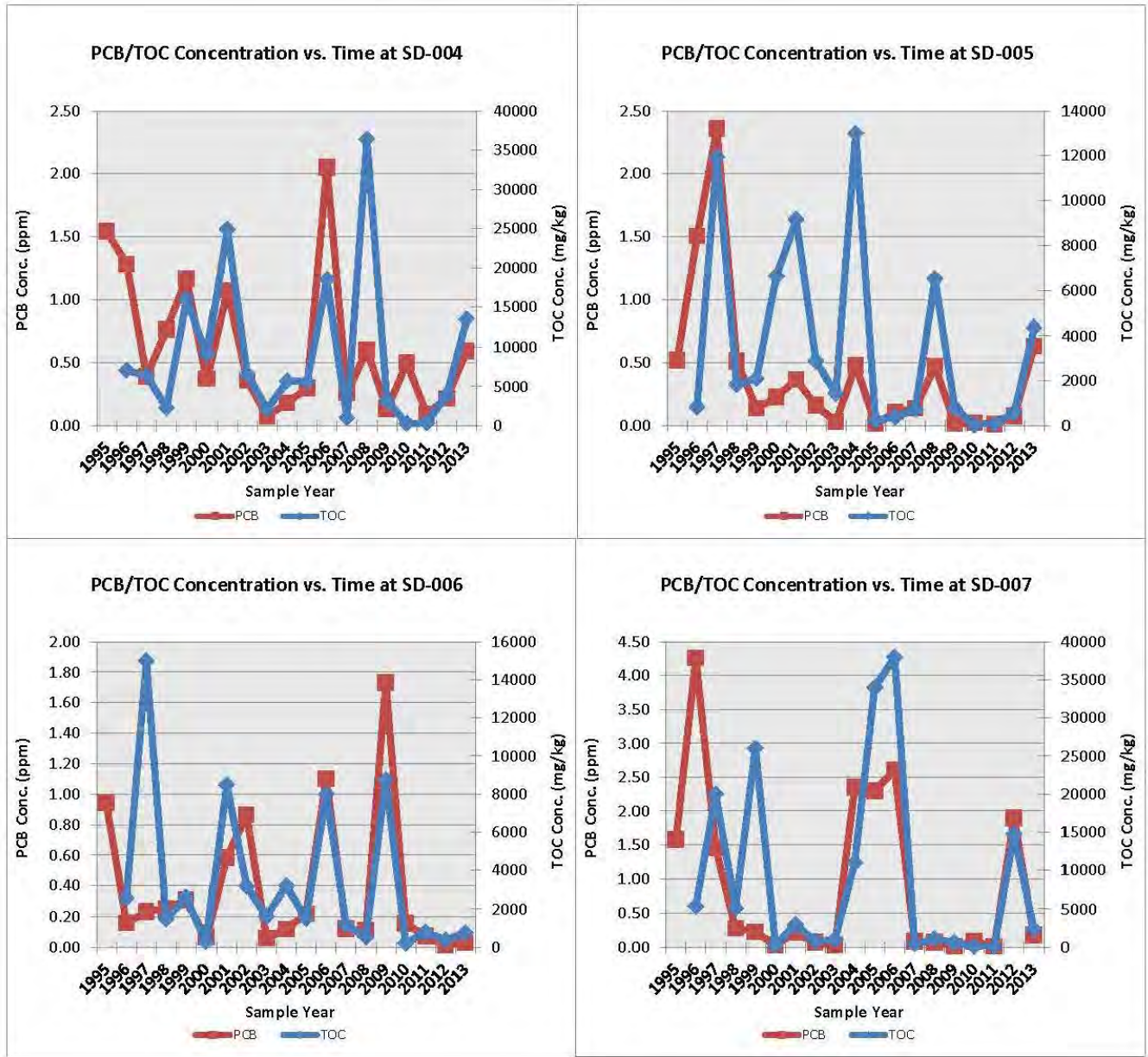
**Figure 3.4. PCB Levels in Sediment Samples (1995-2013),  
Lake Hartwell OU2 Fish and Sediment Study, SD-015 to SD-642**



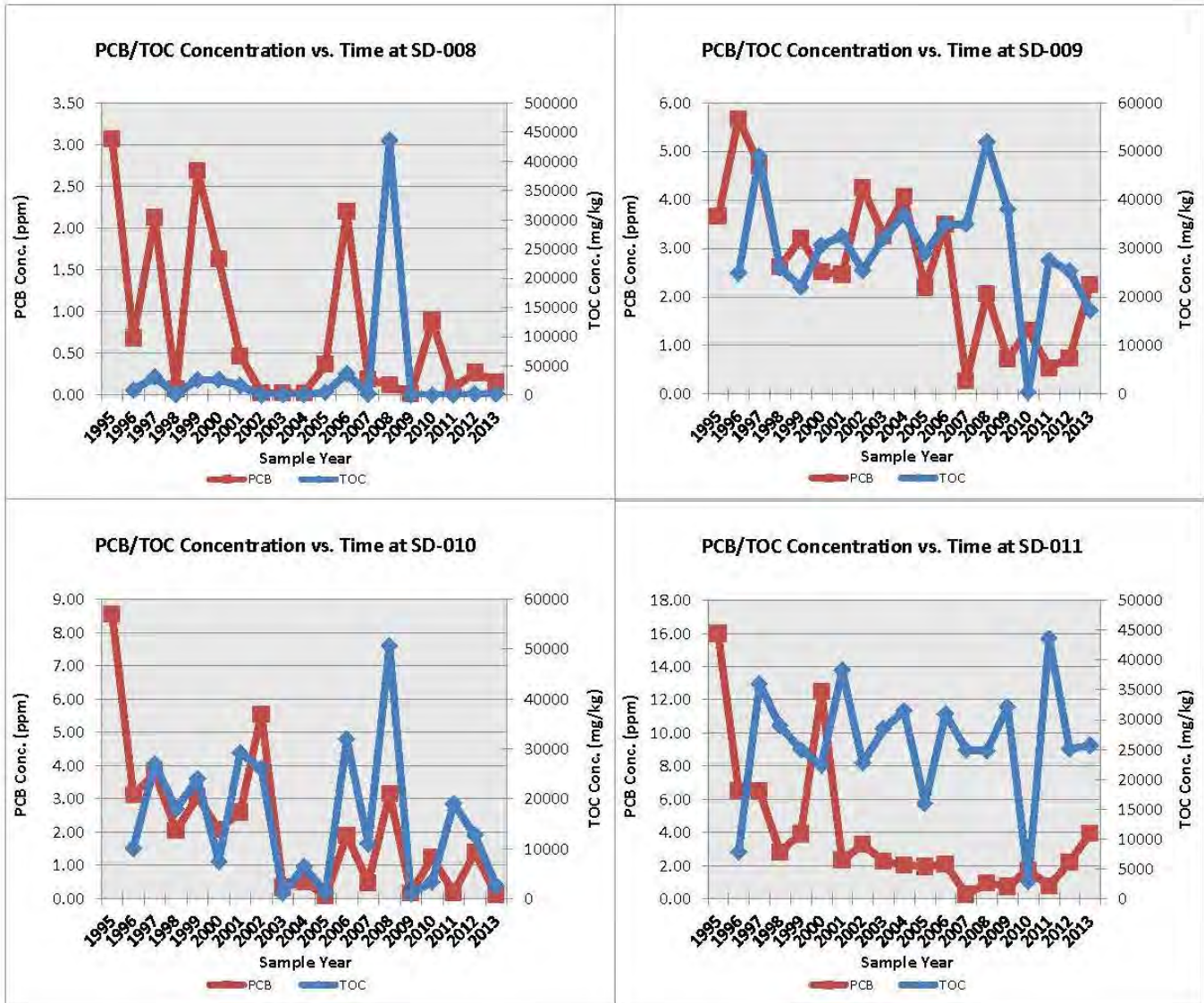
**Figure 3.5. PCB/TOC Concentration by Sample Year SD-000 to SD-003  
Lake Hartwell OU2 Fish Study (1995-2013)**



**Figure 3.6. PCB/TOC Concentration by Sample Year SD-004 to SD-007  
Lake Hartwell OU2 Fish Study (1995-2013)**



**Figure 3.7. PCB/TOC Concentration by Sample Year SD-008 to SD-011  
Lake Hartwell OU2 Fish Study (1995-2013)**



**Figure 3.8. PCB/TOC Concentration by Sample Year SD-012 to SD-015  
Lake Hartwell OU2 Fish Study (1995-2013)**

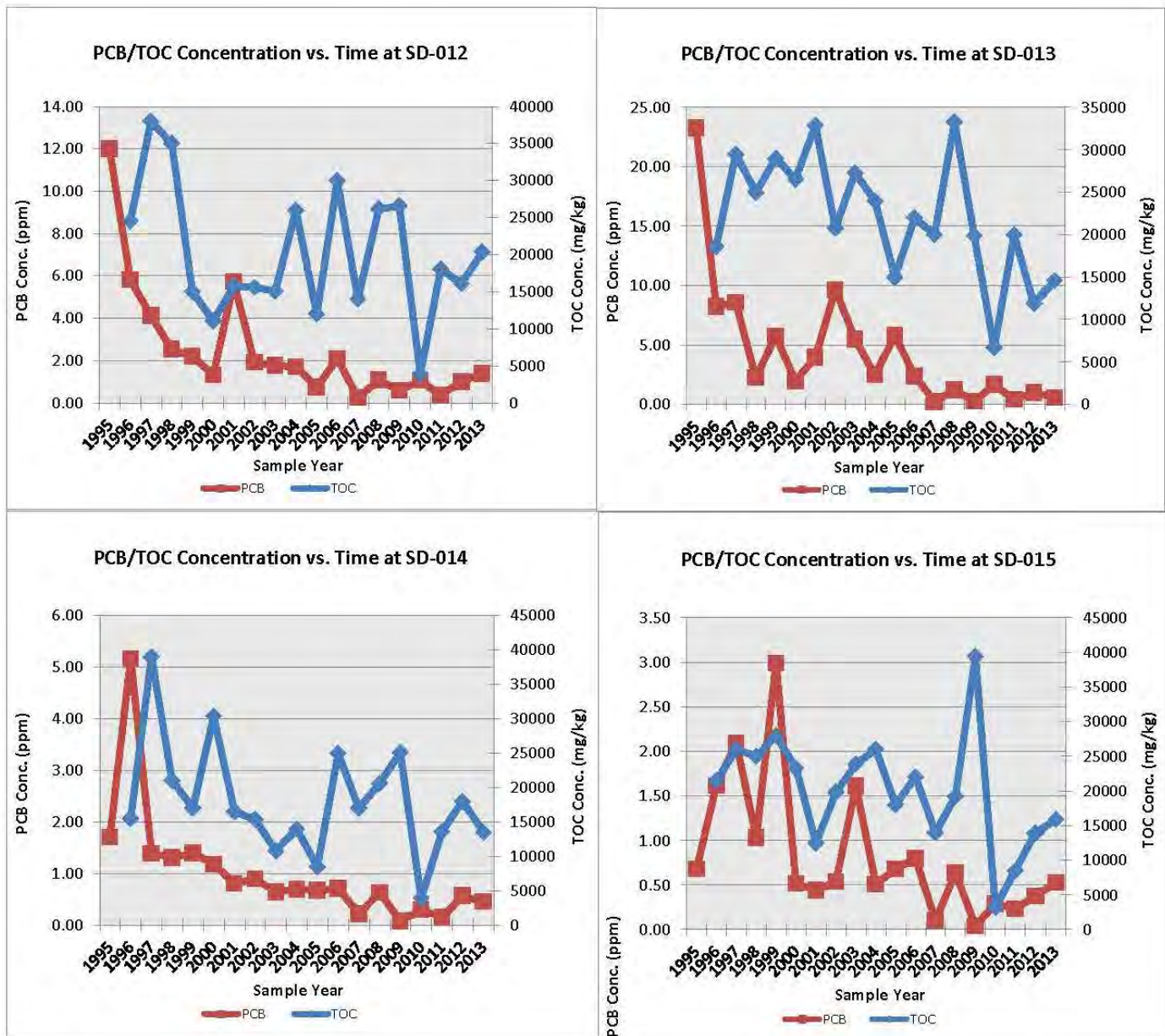


Figure 3.9. PCB/TOC Concentration by Sample Year SD-106, SD-532, SD-535, SD-642  
Lake Hartwell OU2 Fish Study (1995-2013)

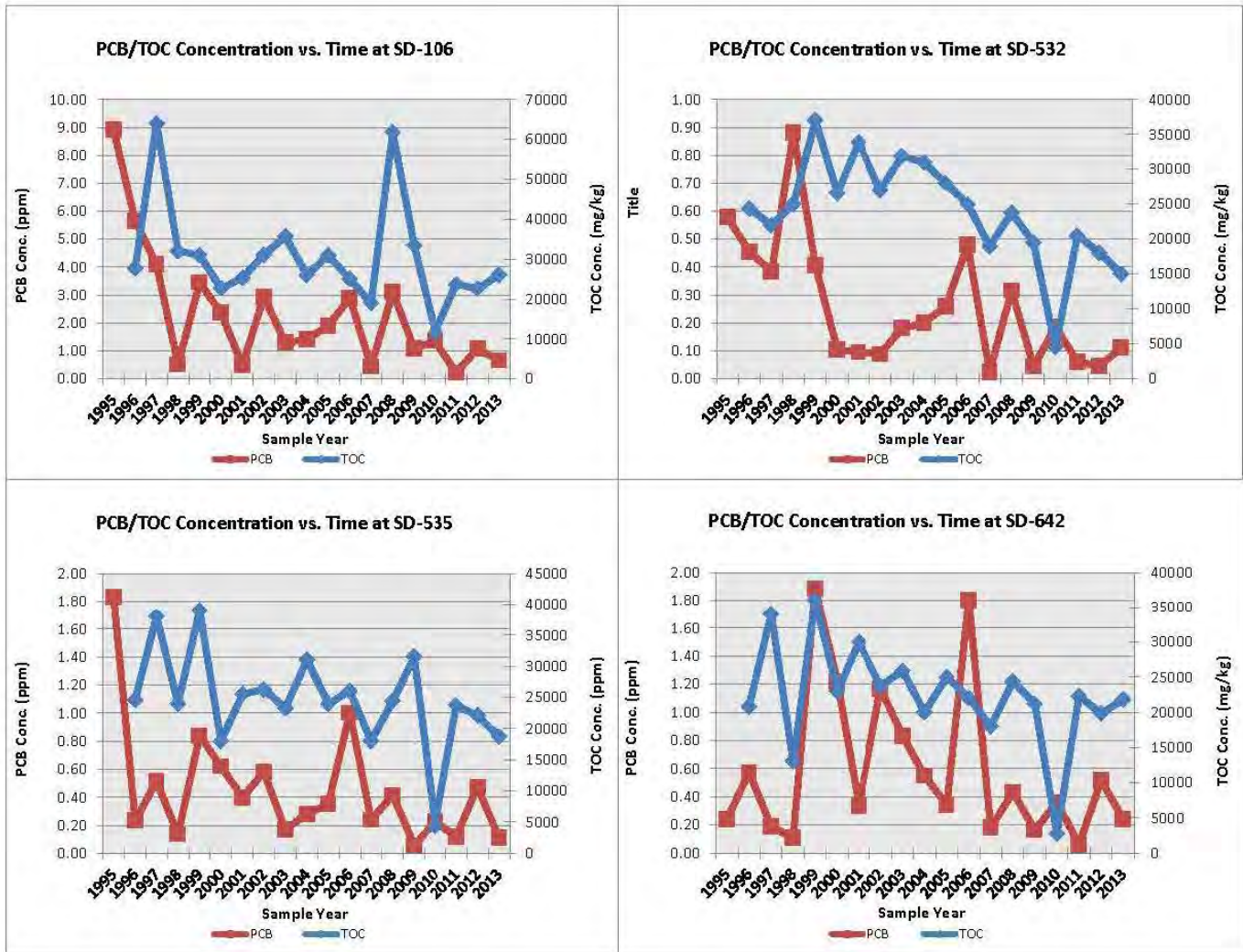
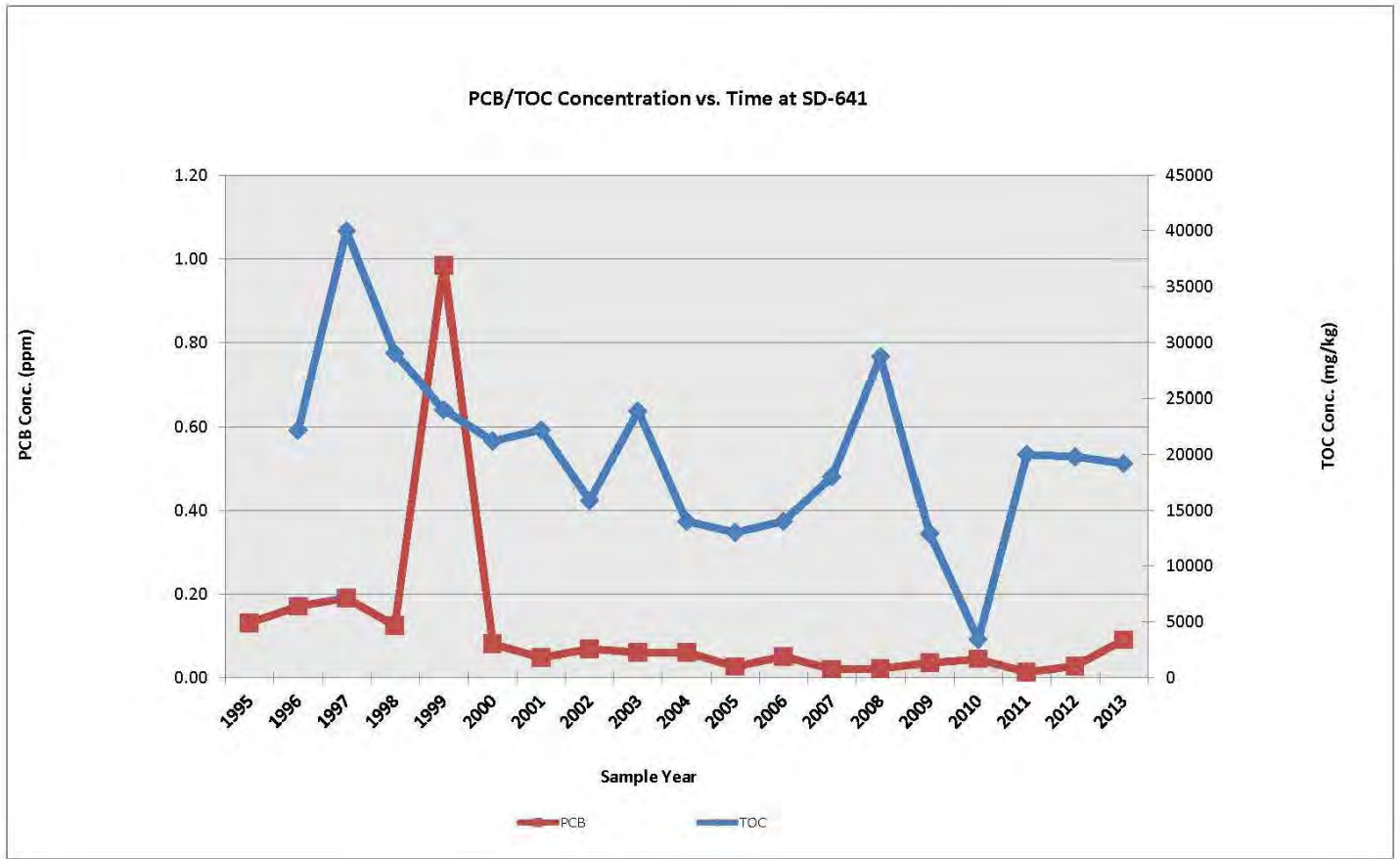


Figure 3.10. PCB/TOC Concentration by Sample Year SD-641  
Lake Hartwell OU2 Fish Study (1995-2013)





**Figure 4.1. TOC Levels in Sediment Samples  
Lake Hartwell OU2 Fish and Sediment Study (1996-2013), SD-000 to SD-004**

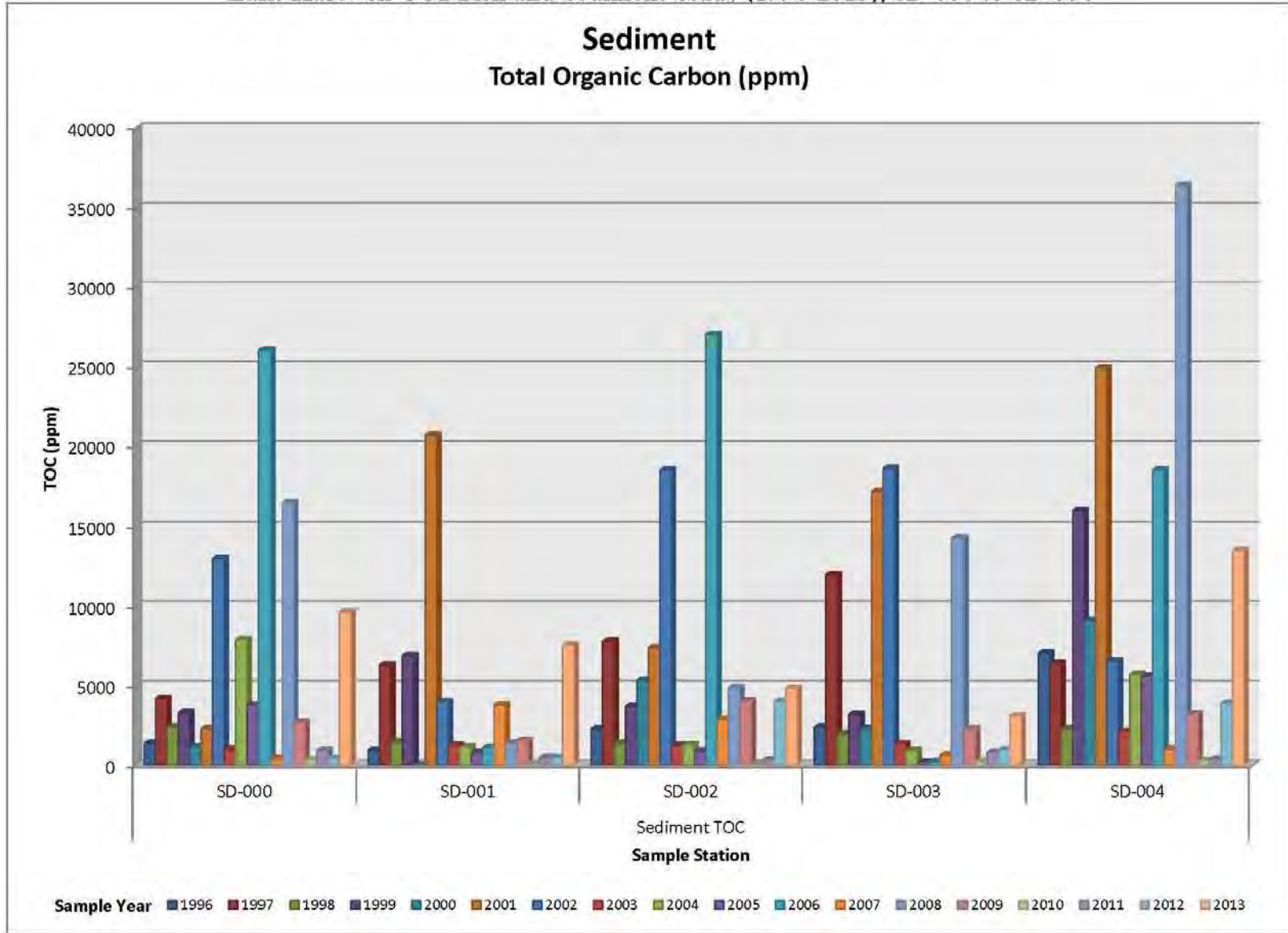
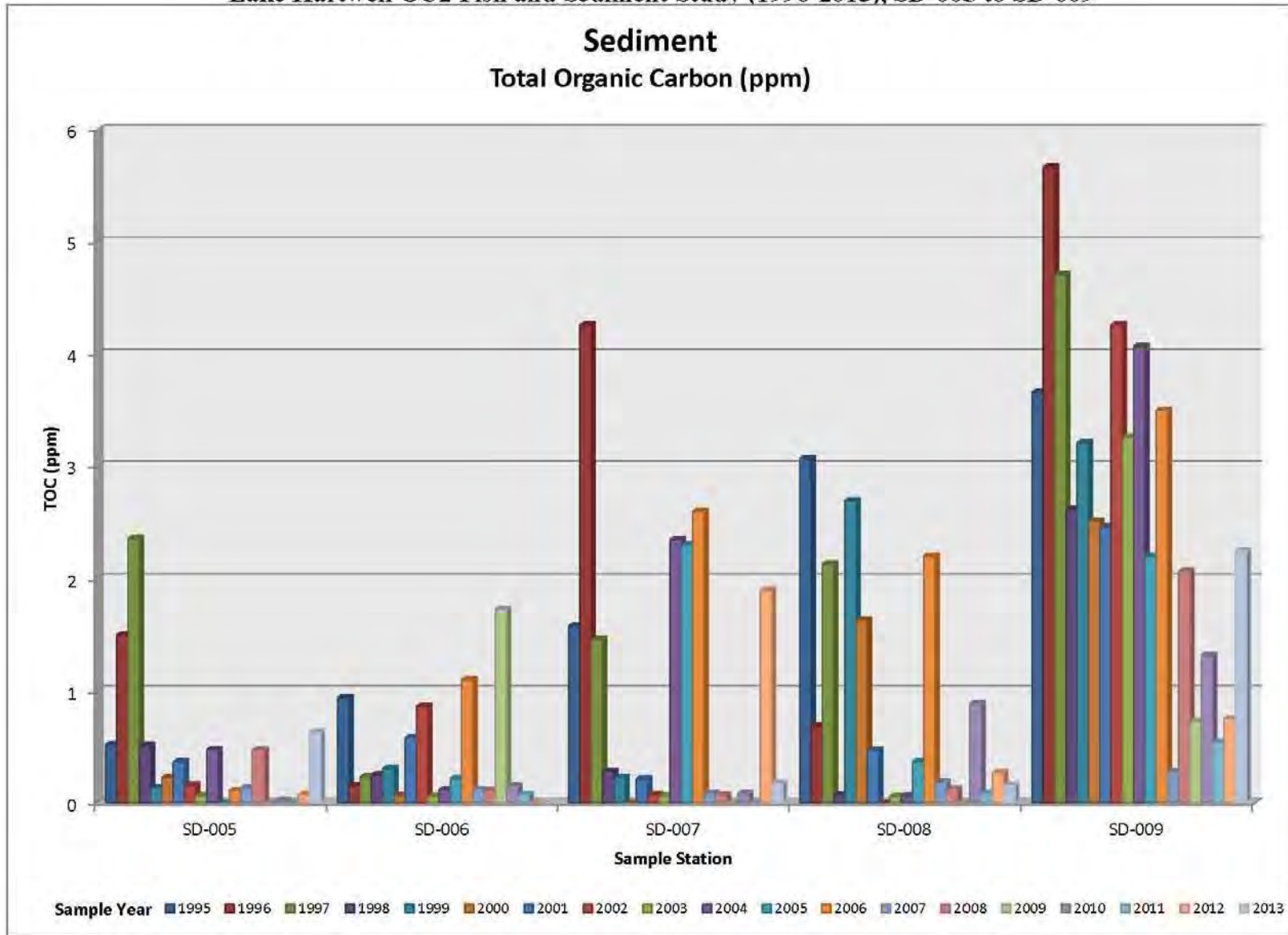


Figure 4.2. TOC Levels in Sediment Sample  
 Lake Hartwell OU2 Fish and Sediment Study (1996-2013), SD-005 to SD-009



**Figure 4.3. TOC Levels in Sediment Samples**  
**Lake Hartwell OU2 Fish and Sediment Study (1996-2013), SD-010 to SD-014**

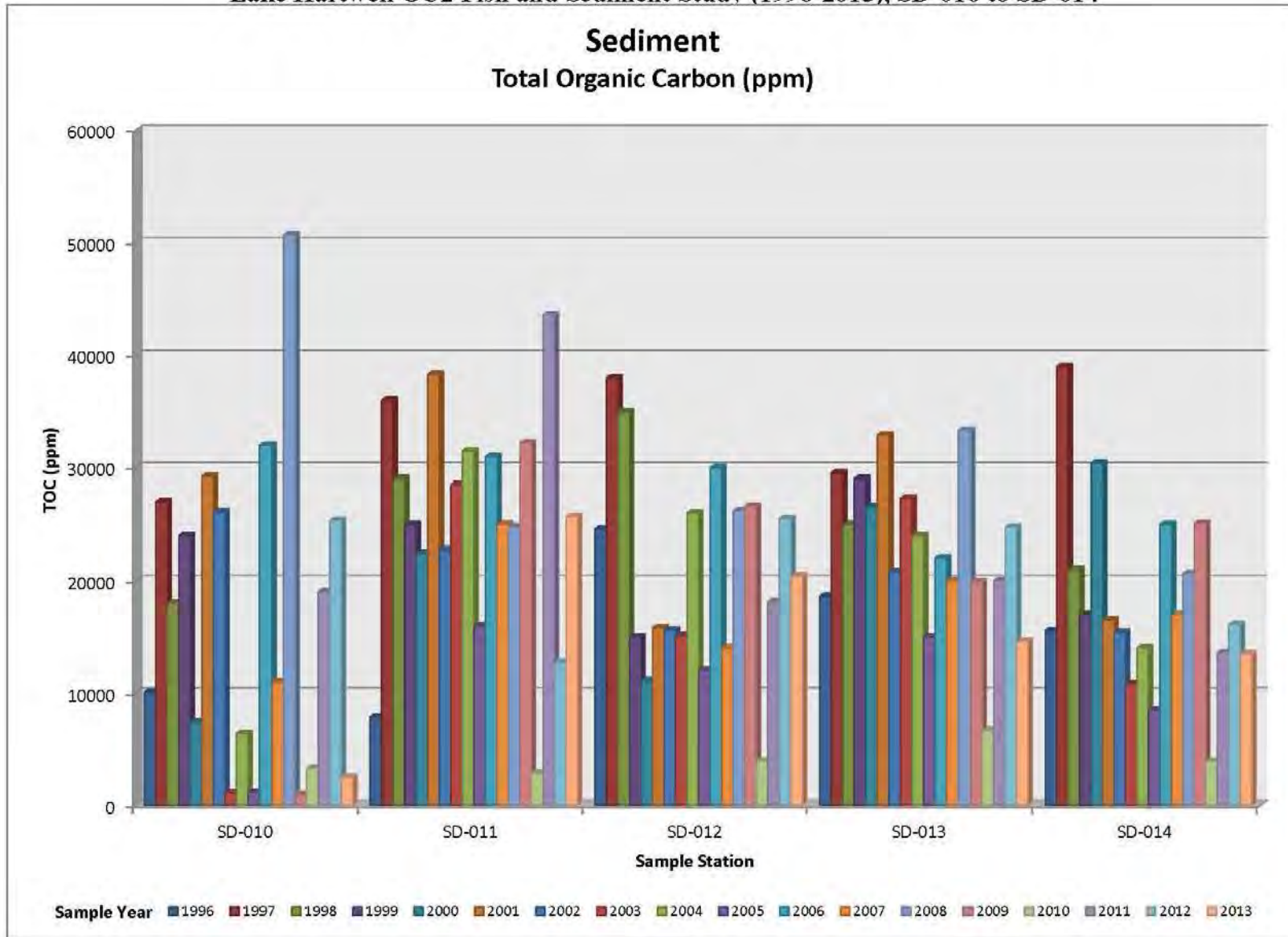


Figure 4.4. TOC Levels in Sediment Samples  
 Lake Hartwell OU2 Fish and Sediment Study (1996-2013), SD-015 to SD-642

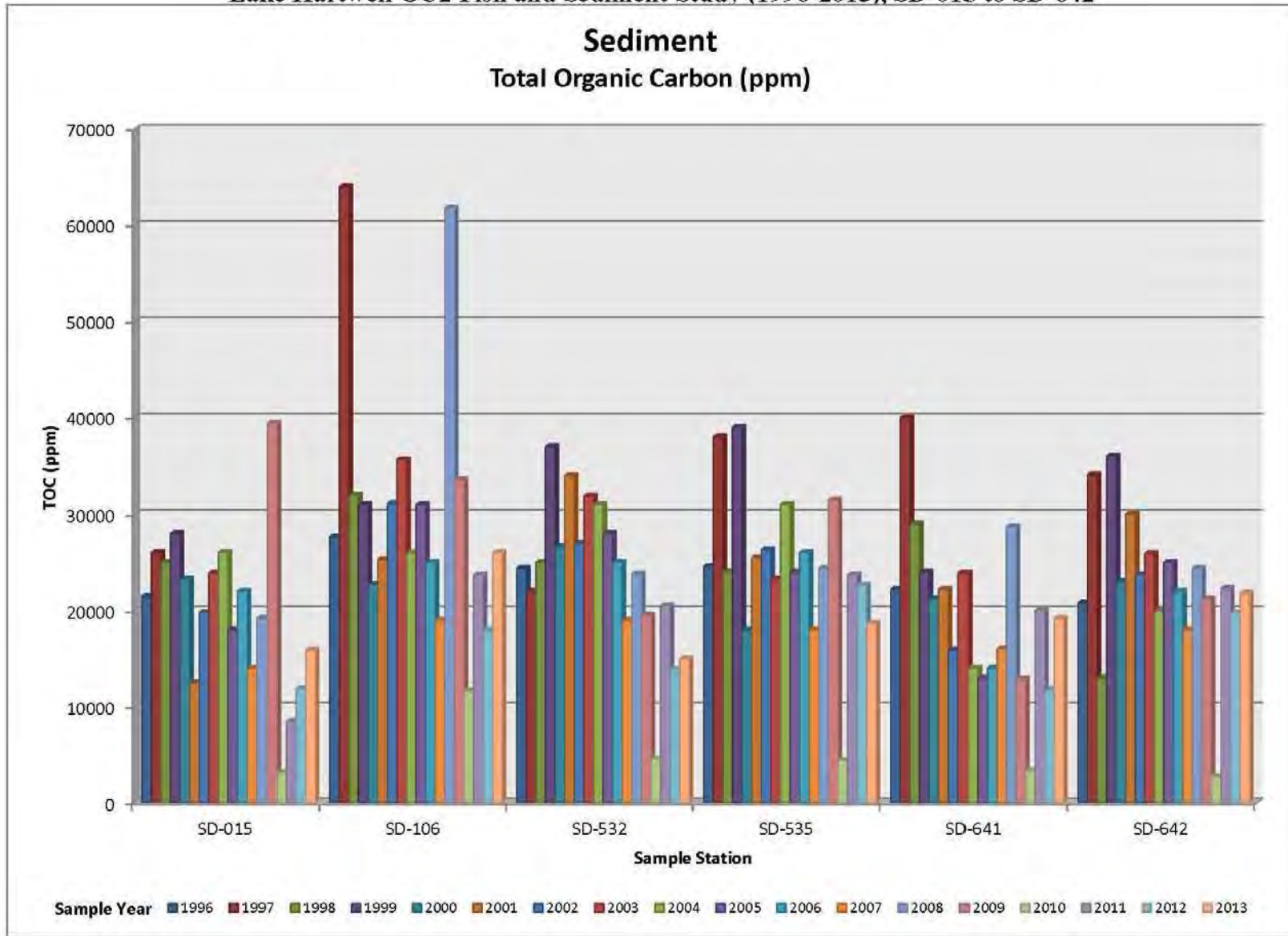
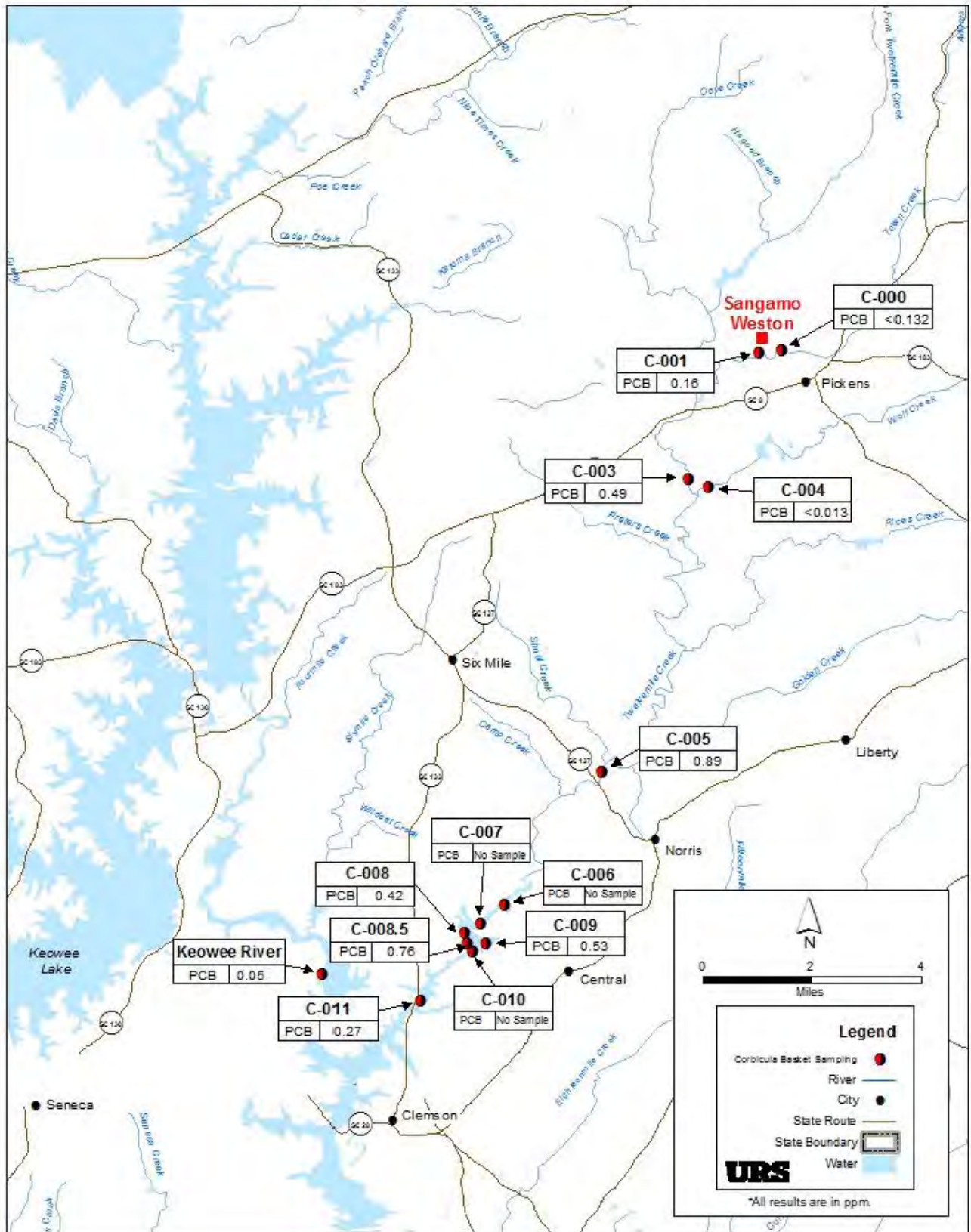


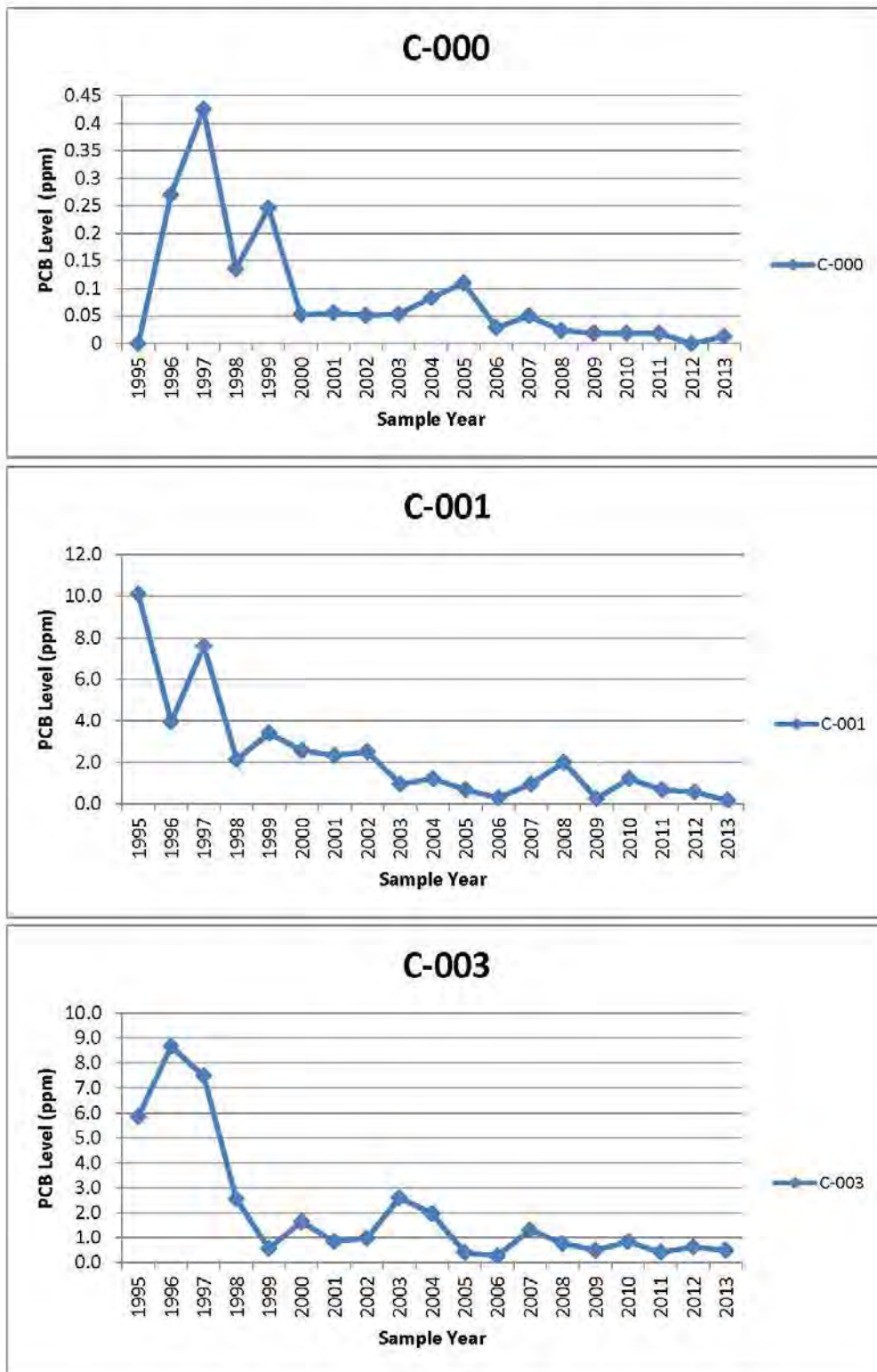
Figure 5

### Corbicula Sample Locations - 2013 Twelvemile Creek and Twelvemile Arm





**Figure 6.1a. PCB Levels in *Corbicula* Samples (C-000, C-001 and C-003) Lake Hartwell OU2 Fish Study (1995-2013)**



**Figure 6.1b. PCB Levels in Corbicula Samples (C-004, C-005 and C-006) Lake Hartwell OU2 Fish Study (1995-2013)**

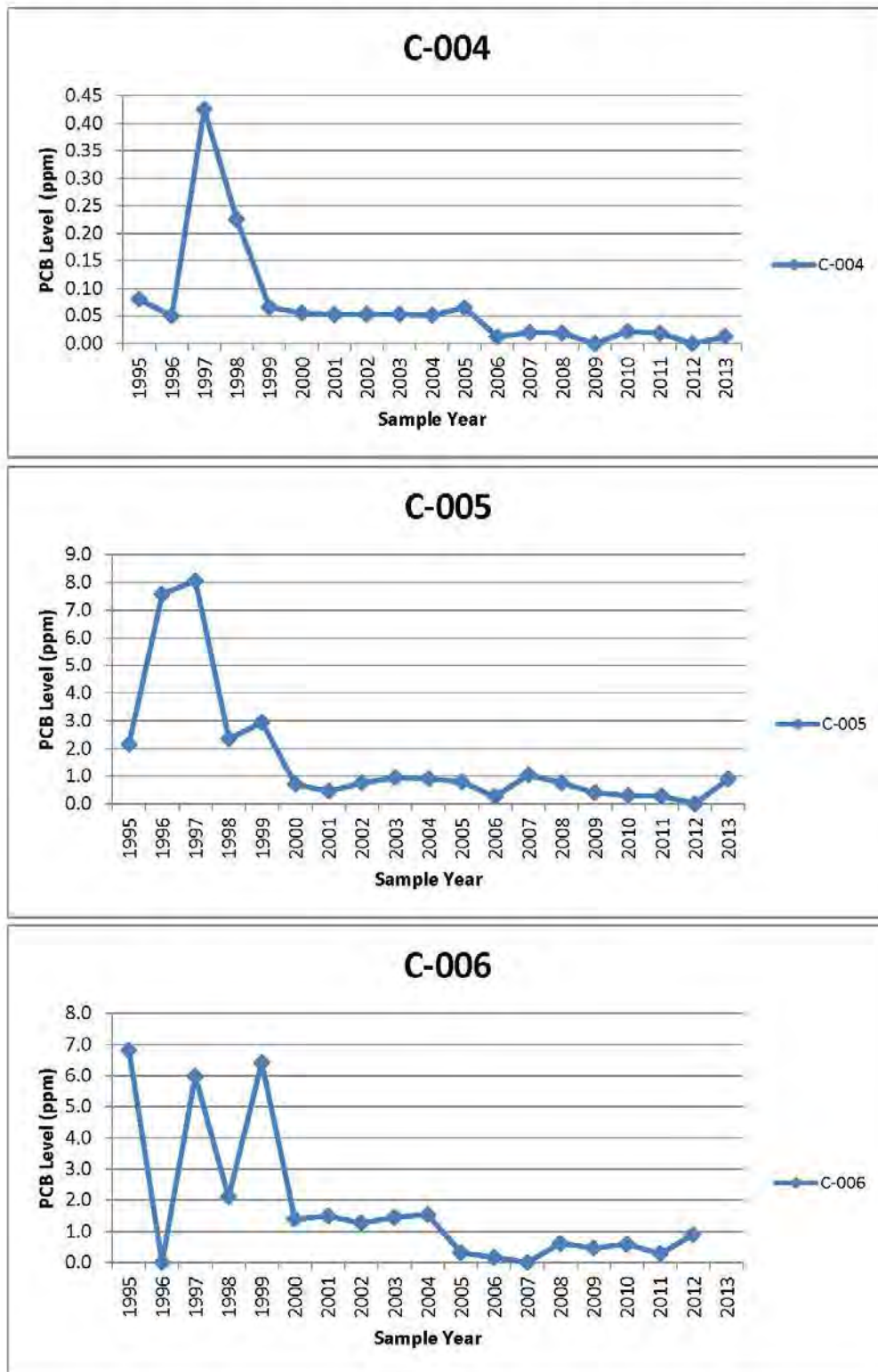
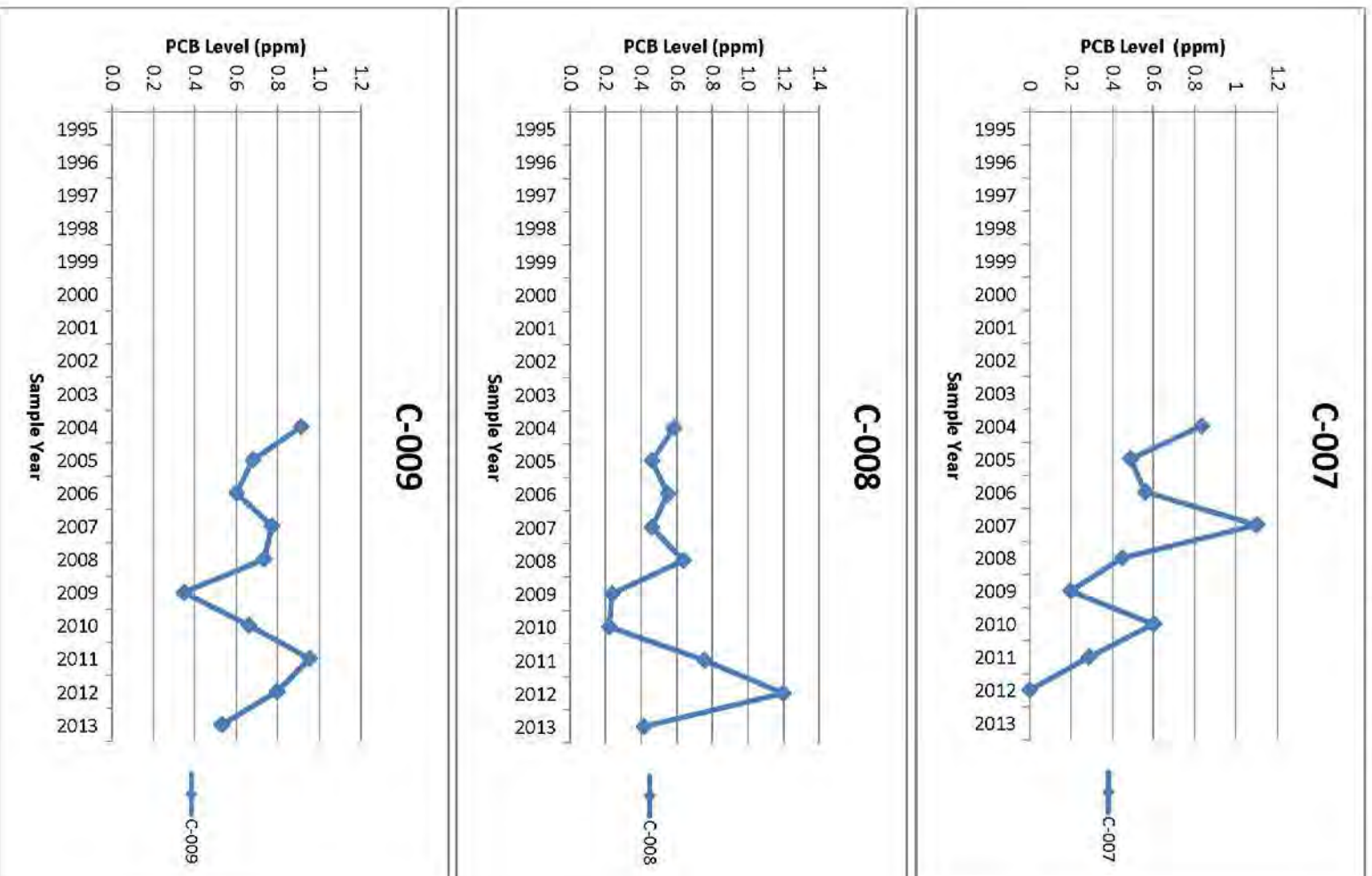




Figure 6.1c. PCB Levels in Corbicula Samples (C-007, C-008 and C-009) Lake Hartwell OU2 Fish Study (1995-2013)



**Figure 6.1d. PCB Levels in Corbicula Samples (C-010, C-011 and KR) Lake Hartwell OU2 Fish Study (1995-2013)**

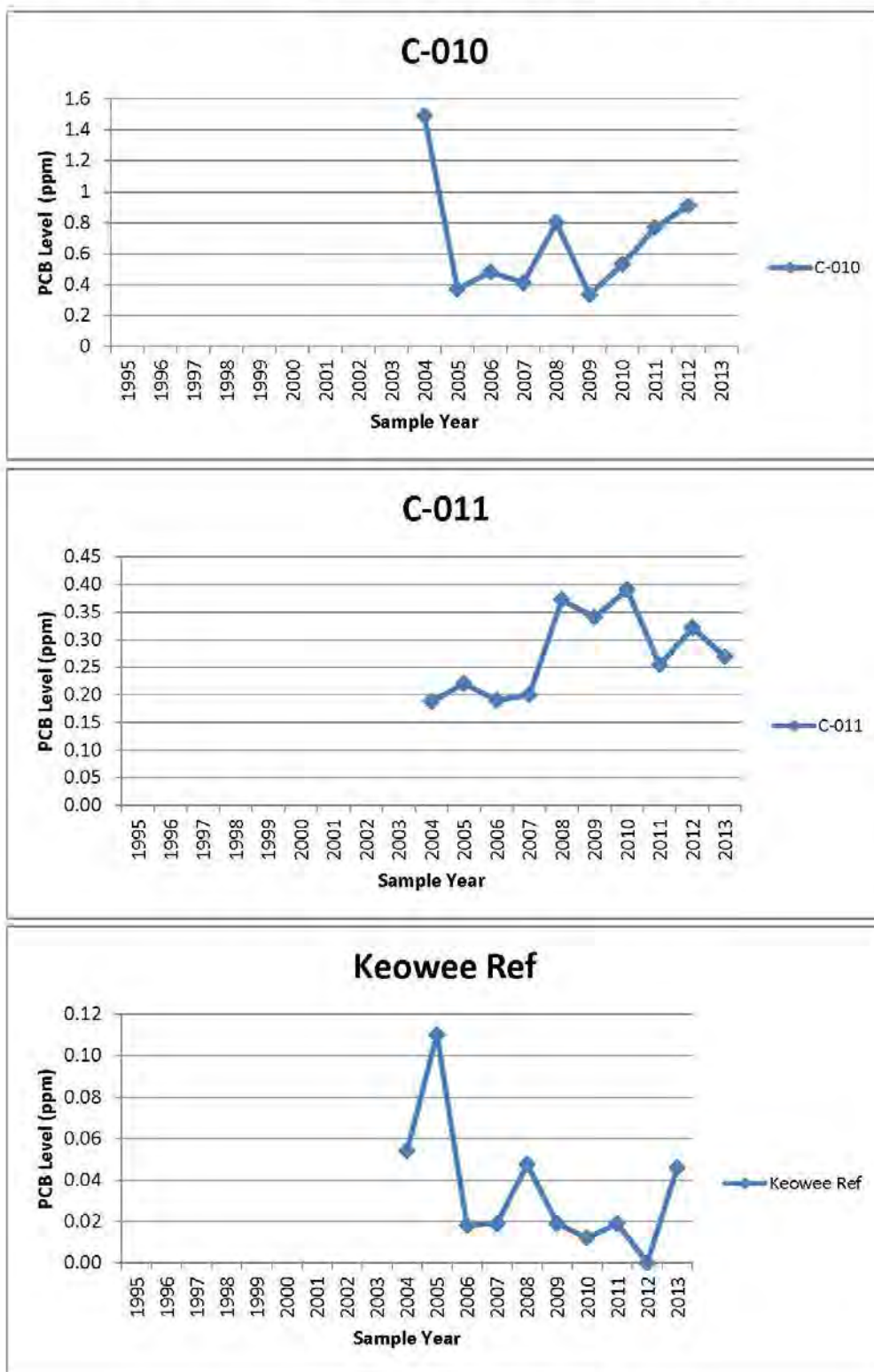


Figure 6.2. Lipid percent levels in *Corbicula* Samples  
 Lake Hartwell OU2 Fish Study (2004-2013)

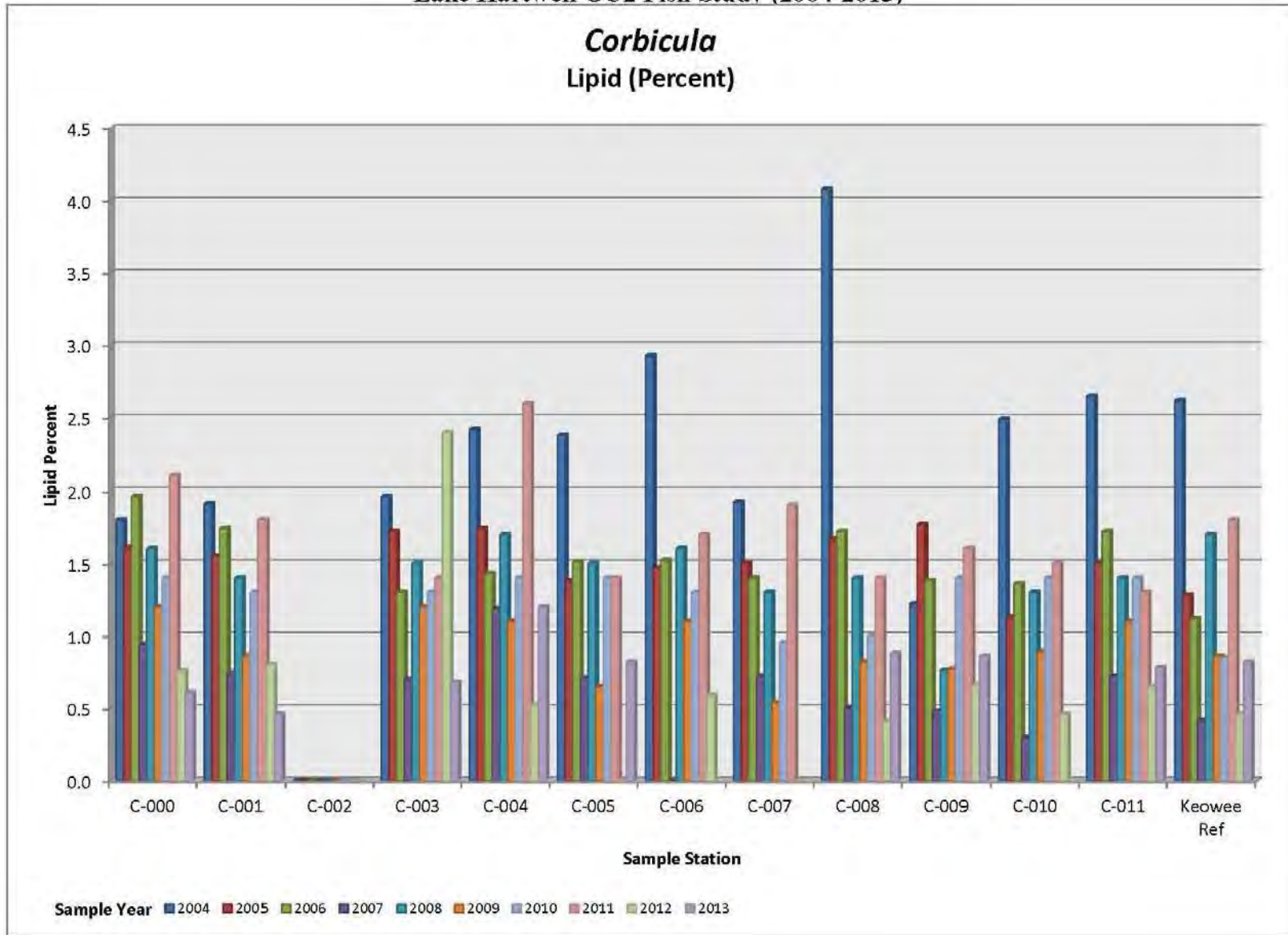


Figure 6.3. *Corbicula* Lipid Normalized PCB Levels, Lake Hartwell OU2 Fish Study (2004-2013)

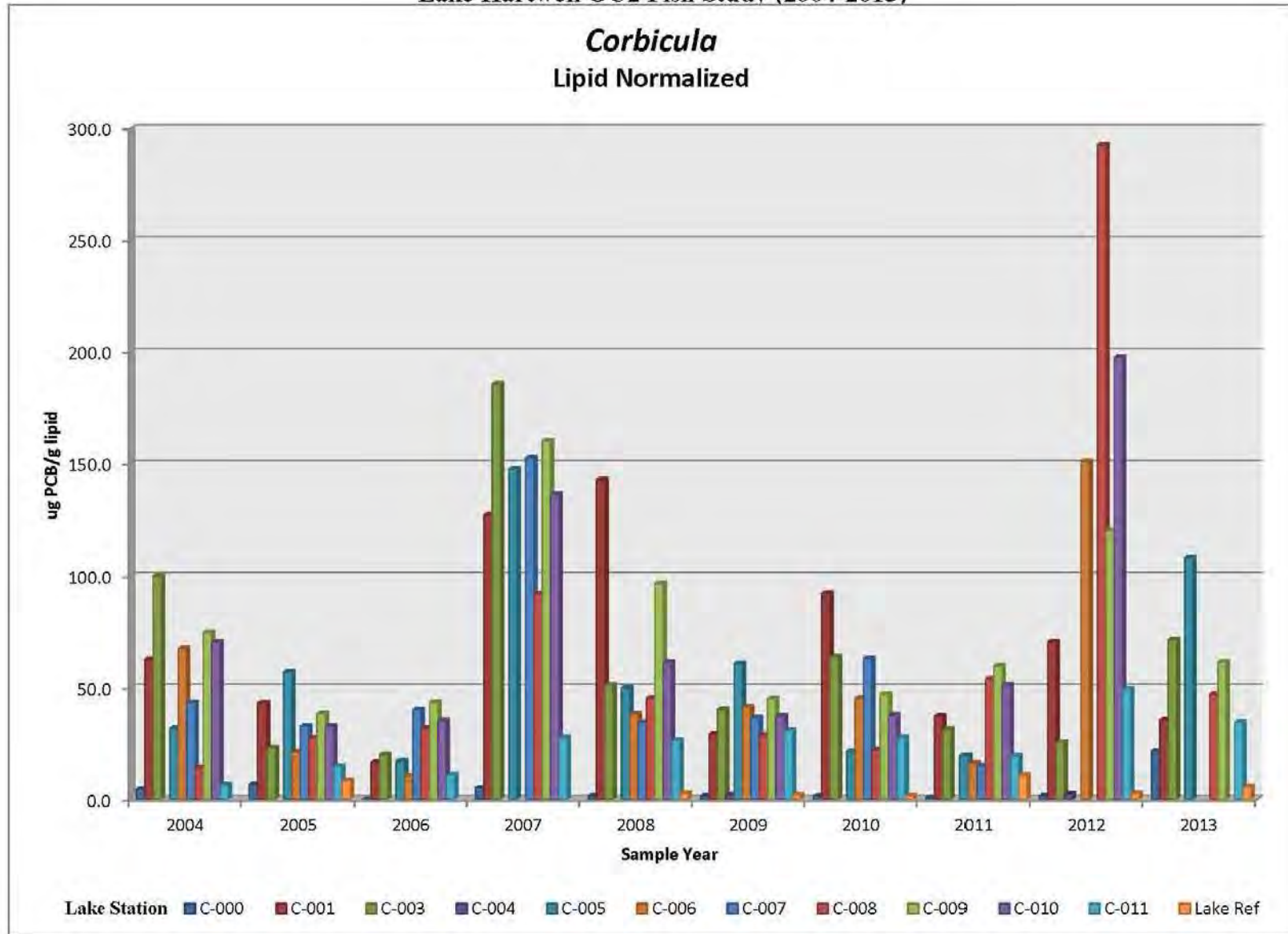
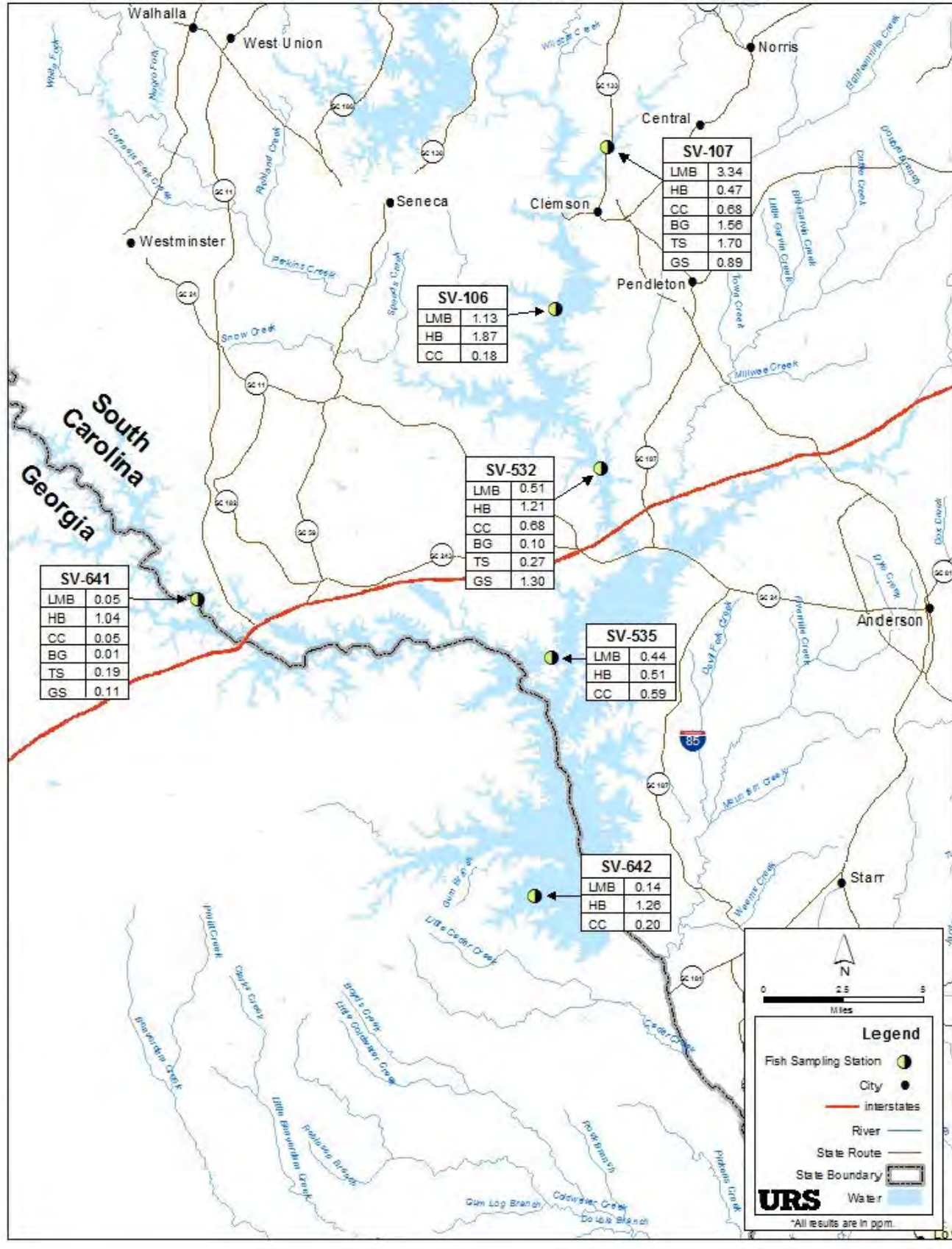
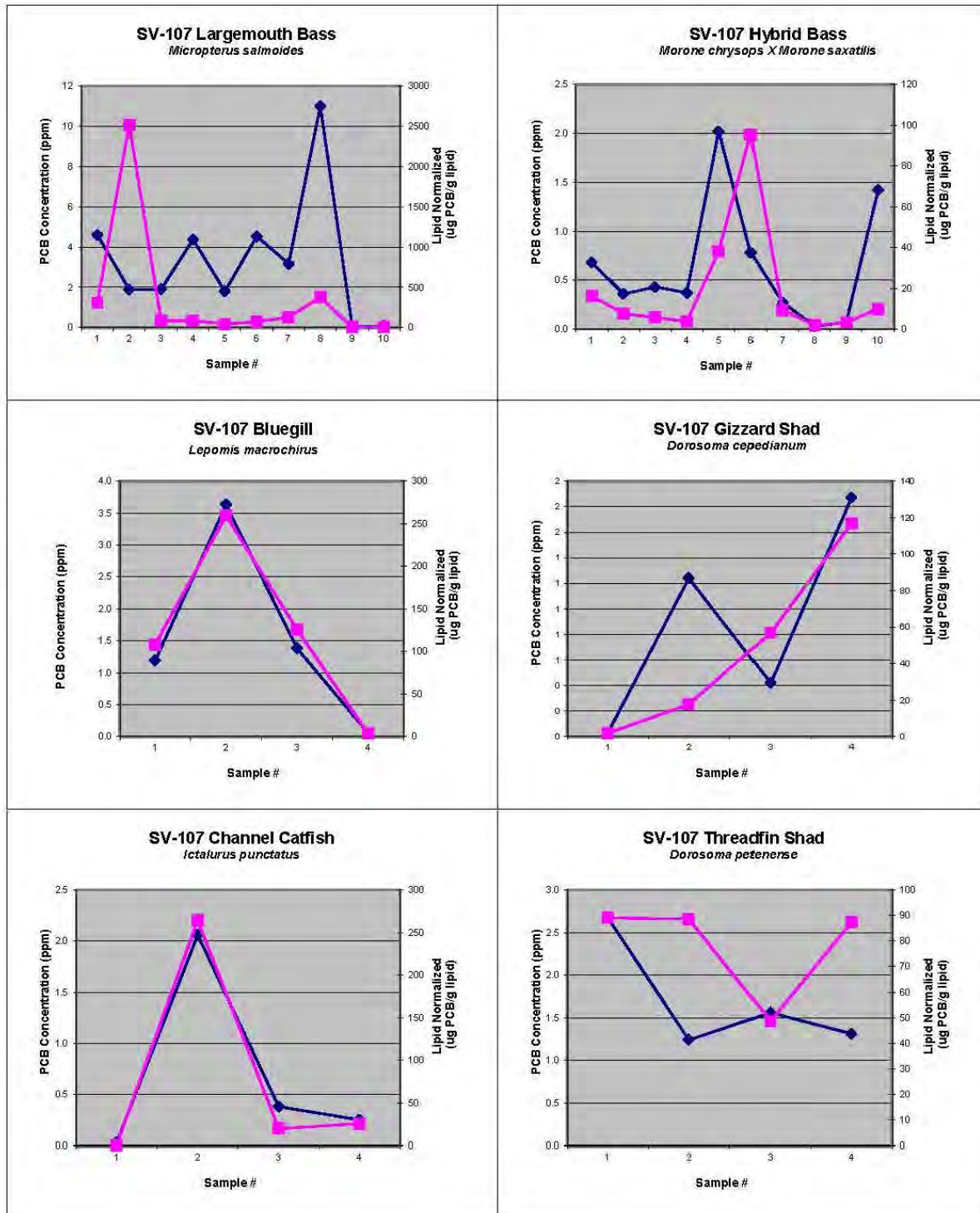


Figure 7

### Fish Sampling Stations - 2013 Lake Hartwell

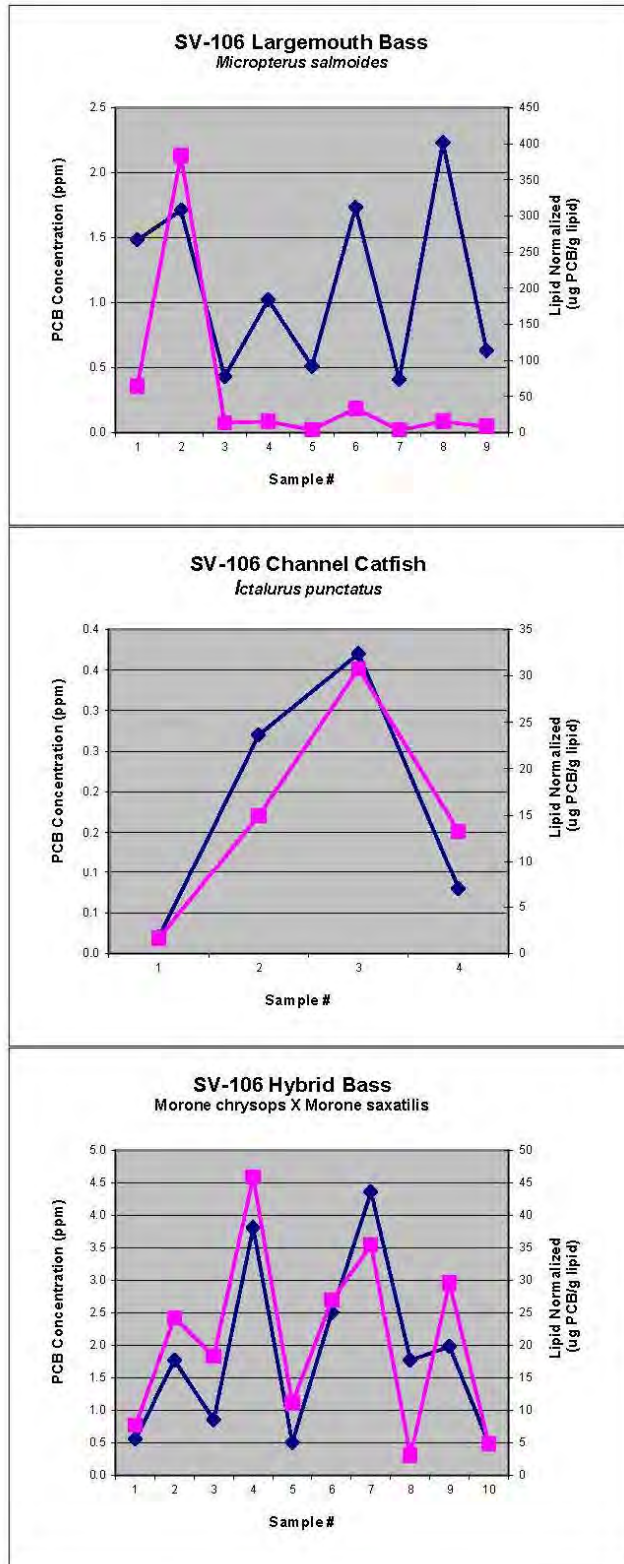


**Figure 7.1. Lipid Normalized PCB Concentrations in Fish Samples, Lake Hartwell Station SV-107 (2013)**



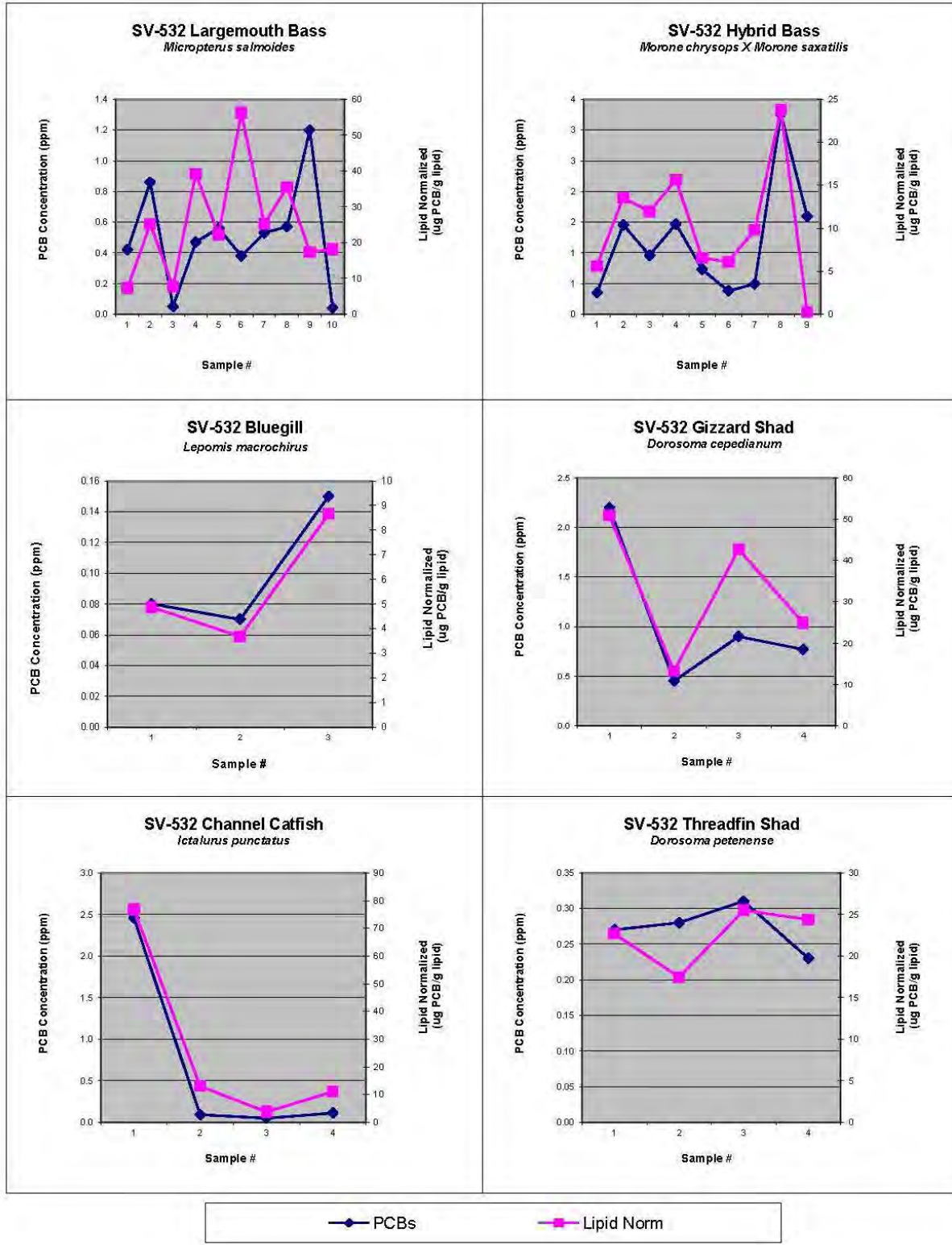
—◆— PCBs      —■— Lipid Norm

**Figure 7.2. Lipid Normalized PCB Concentrations in Fish Samples, Lake Hartwell Station SV-106 (2013)**



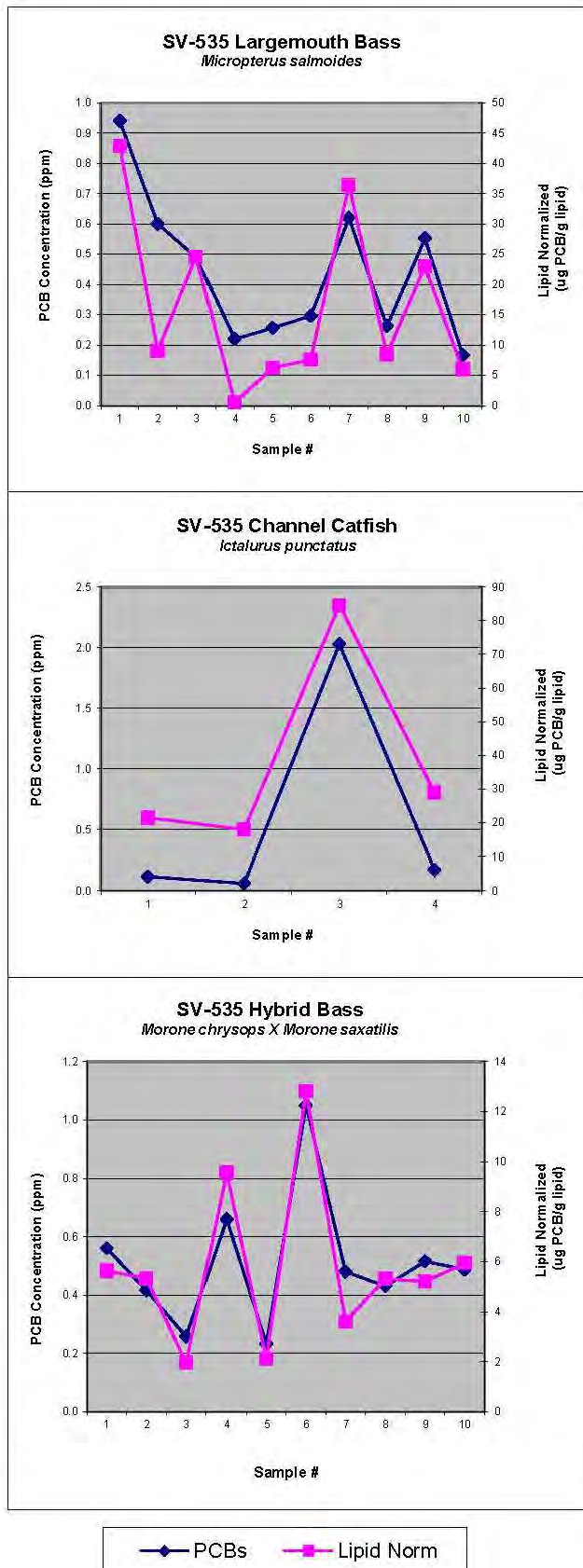
—◆— PCBs    —■— Lipid Norm

**Figure 7.3. Lipid Normalized PCB Concentrations in Fish Samples, Lake Hartwell Station SV-532 (2013)**

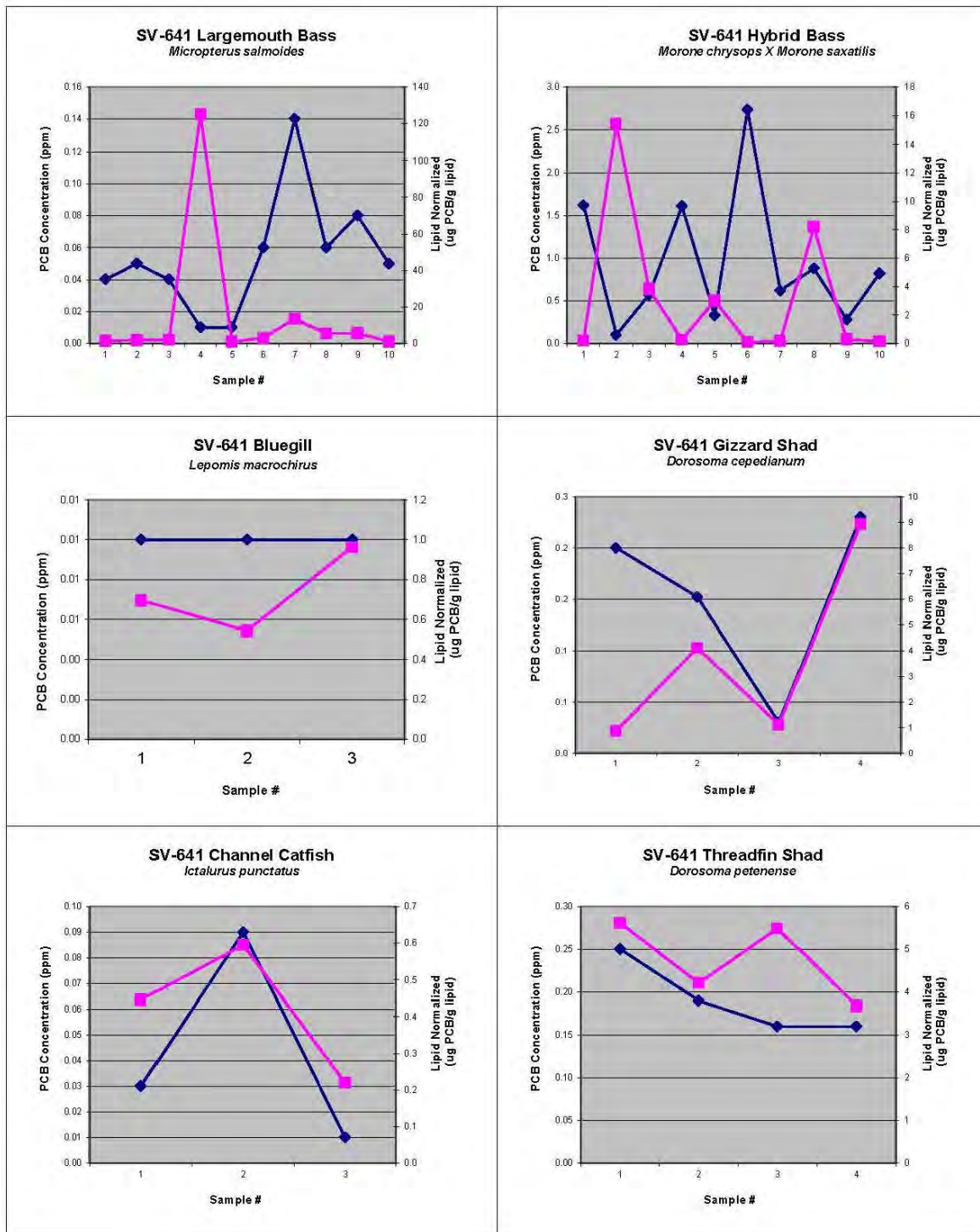




**Figure 7.4. Lipid Normalized PCB Concentrations in Fish Samples, Lake Hartwell Station SV-535 (2013)**



**Figure 7.5. Lipid Normalized PCB Concentrations in Fish Samples, Lake Hartwell Station SV-641 (2013)**



**Figure 7.6. Lipid Normalized PCB Concentrations in Fish Samples, Lake Hartwell Station SV-642 (2013)**

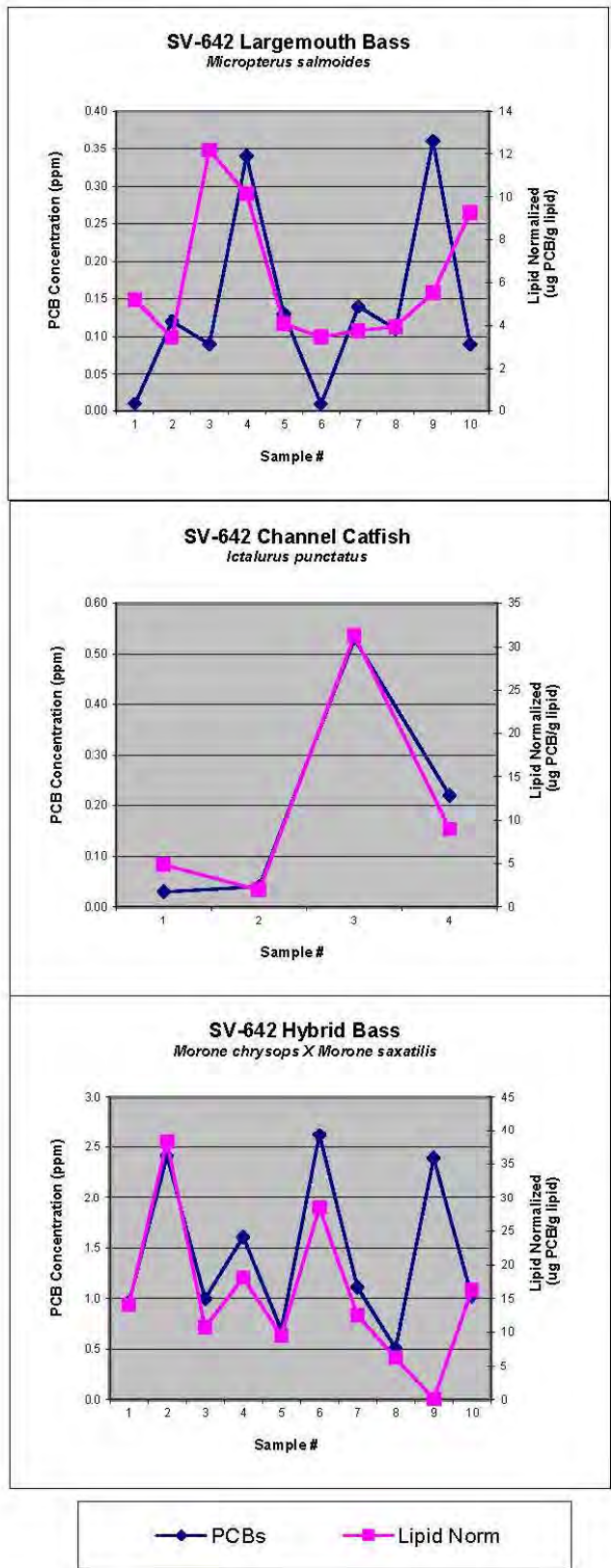


Figure 8. PCB Levels in Largemouth Bass (*Micropterus salmoides*) Fillet Samples  
 Lake Hartwell OU2 Fish Study (1990-2013)

**Largemouth Bass**  
*Micropterus salmoides*

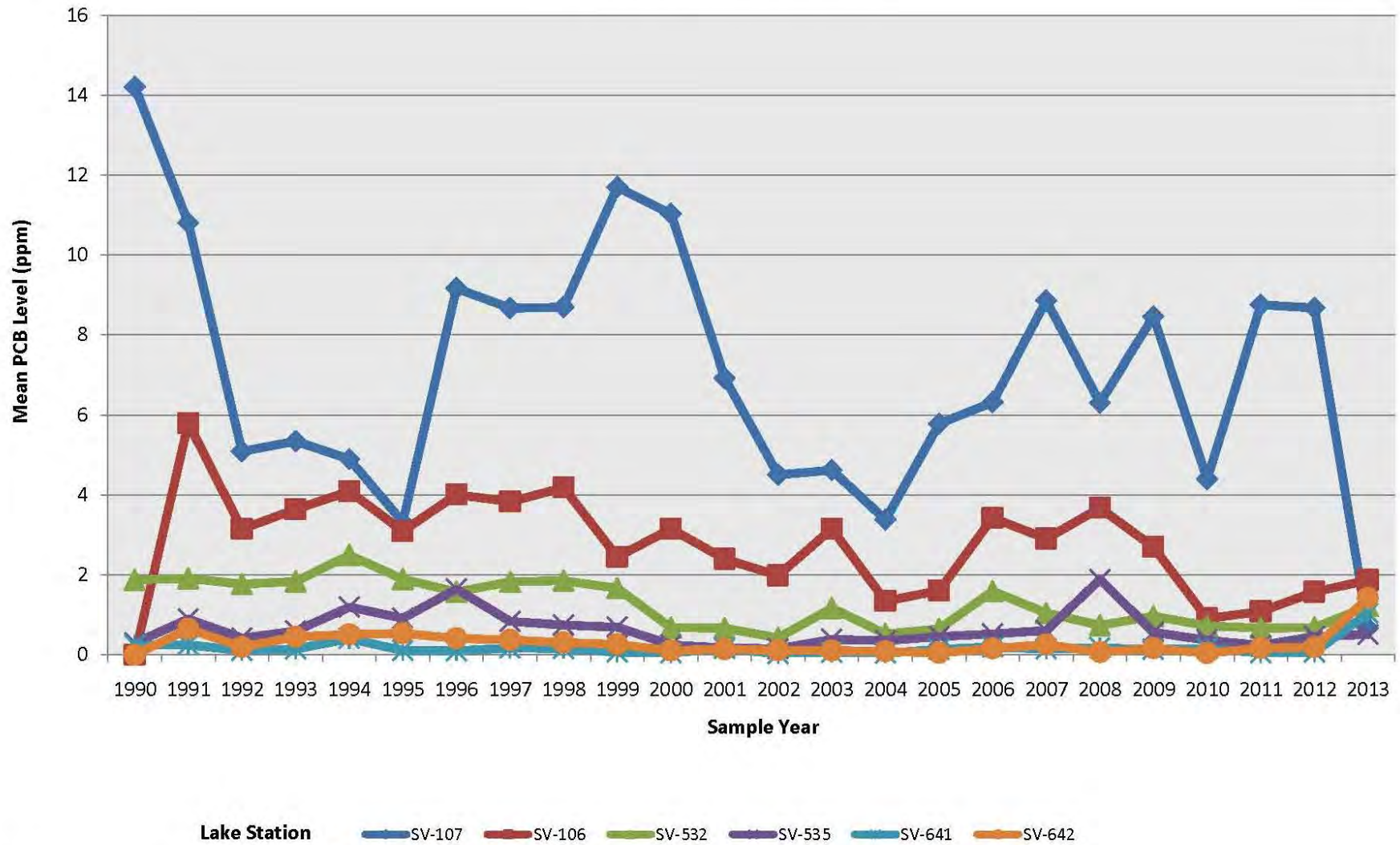


Figure 9. PCB Levels in Hybrid Bass (*Morone chrysops* X *M. saxatilis*) Fillet Samples  
Lake Hartwell OU2 Fish Study (1990-2013)

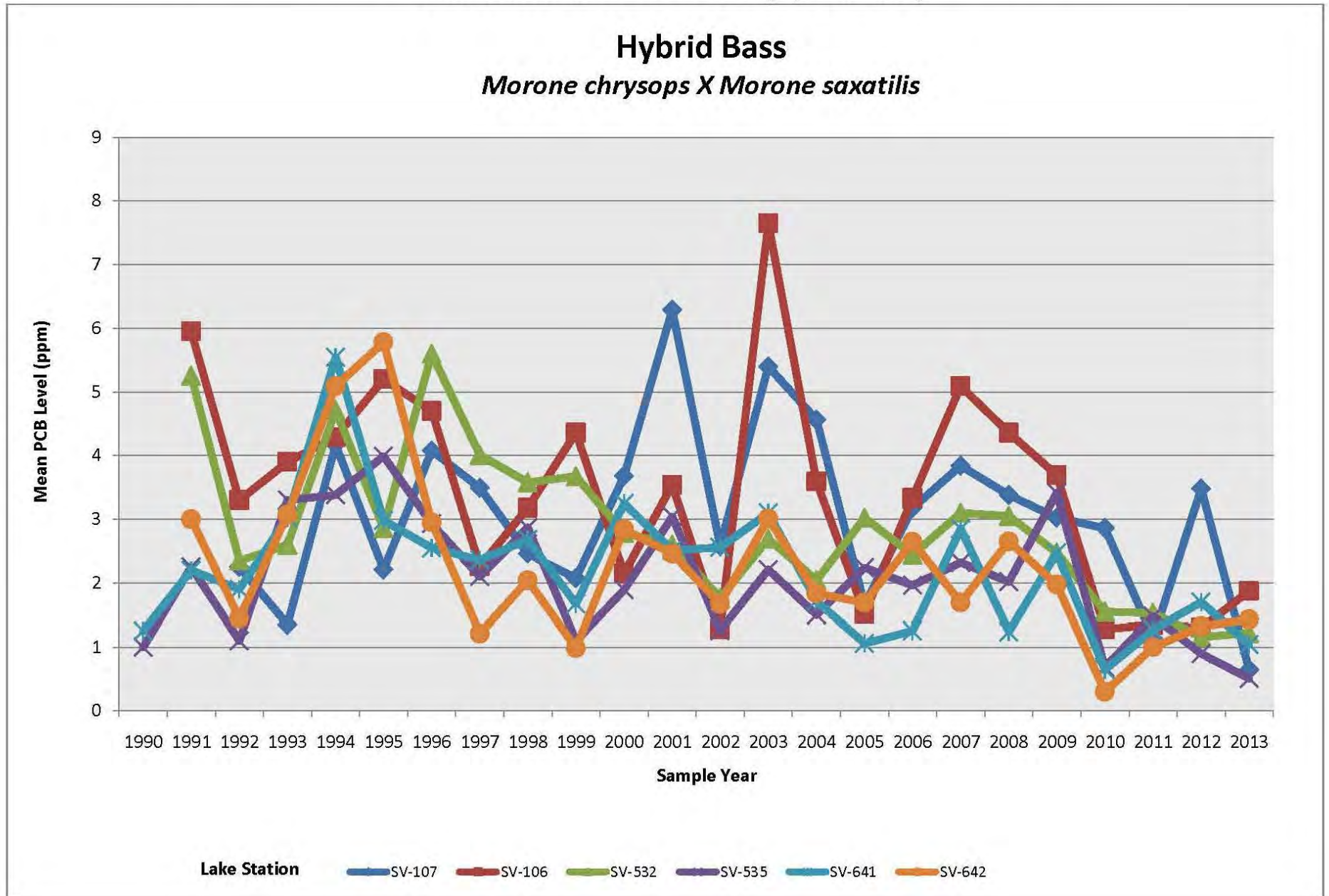
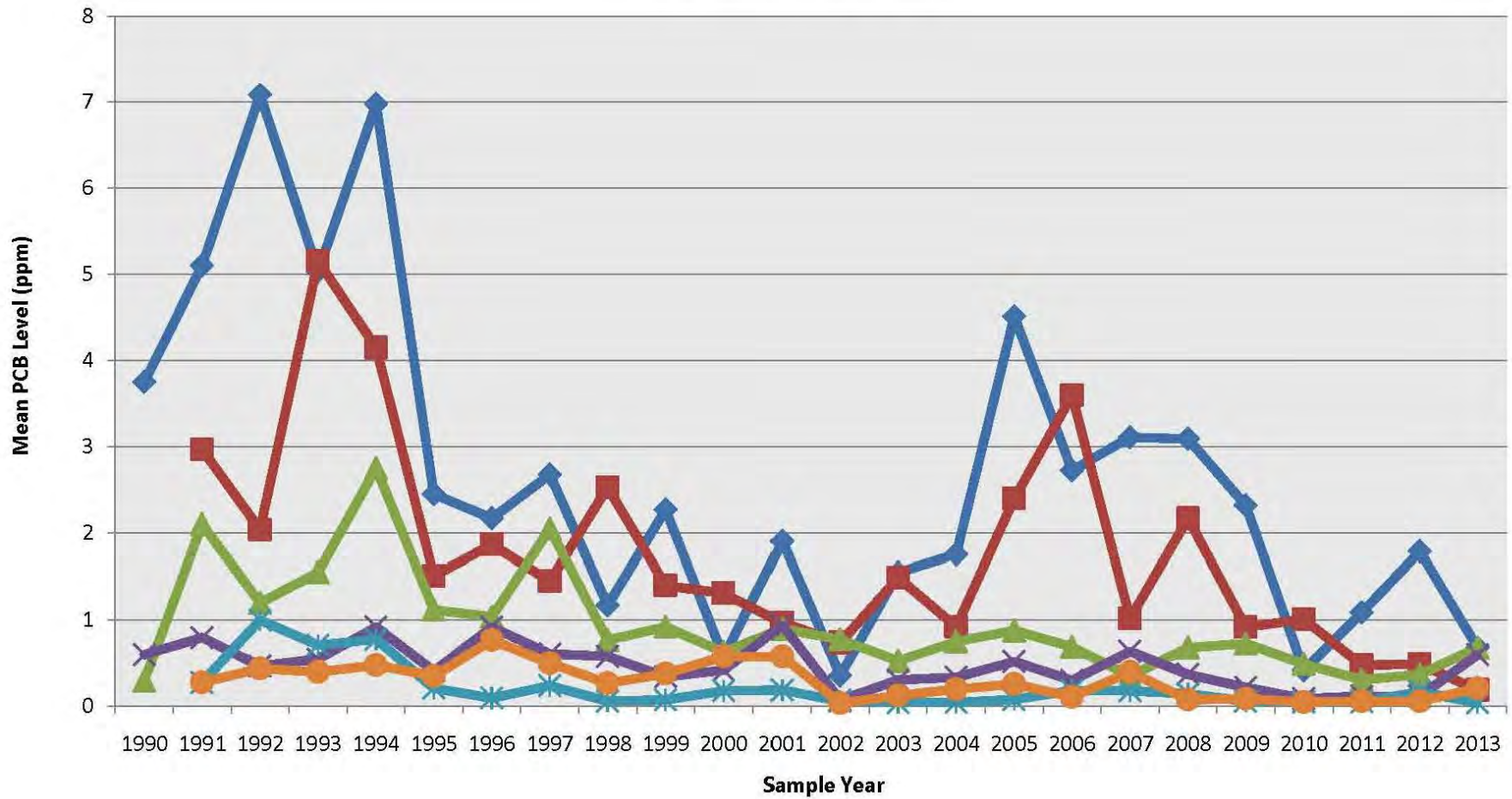


Figure 10. PCB Levels in Channel Catfish (*Ictalurus punctatus*) Fillet Samples  
 Lake Hartwell OU2 Fish Study (1990-2013)

**Channel Catfish**  
*Ictalurus punctatus*



**Lake Station**      SV-107      SV-106      SV-532      SV-535      SV-641      SV-642

Figure 11. PCB Levels in Bluegill (*Lepomis macrochirus*) Whole Body Composite Samples  
Lake Hartwell OU2 Fish Study (1995-2013)

**Bluegill**  
*Lepomis macrochirus*

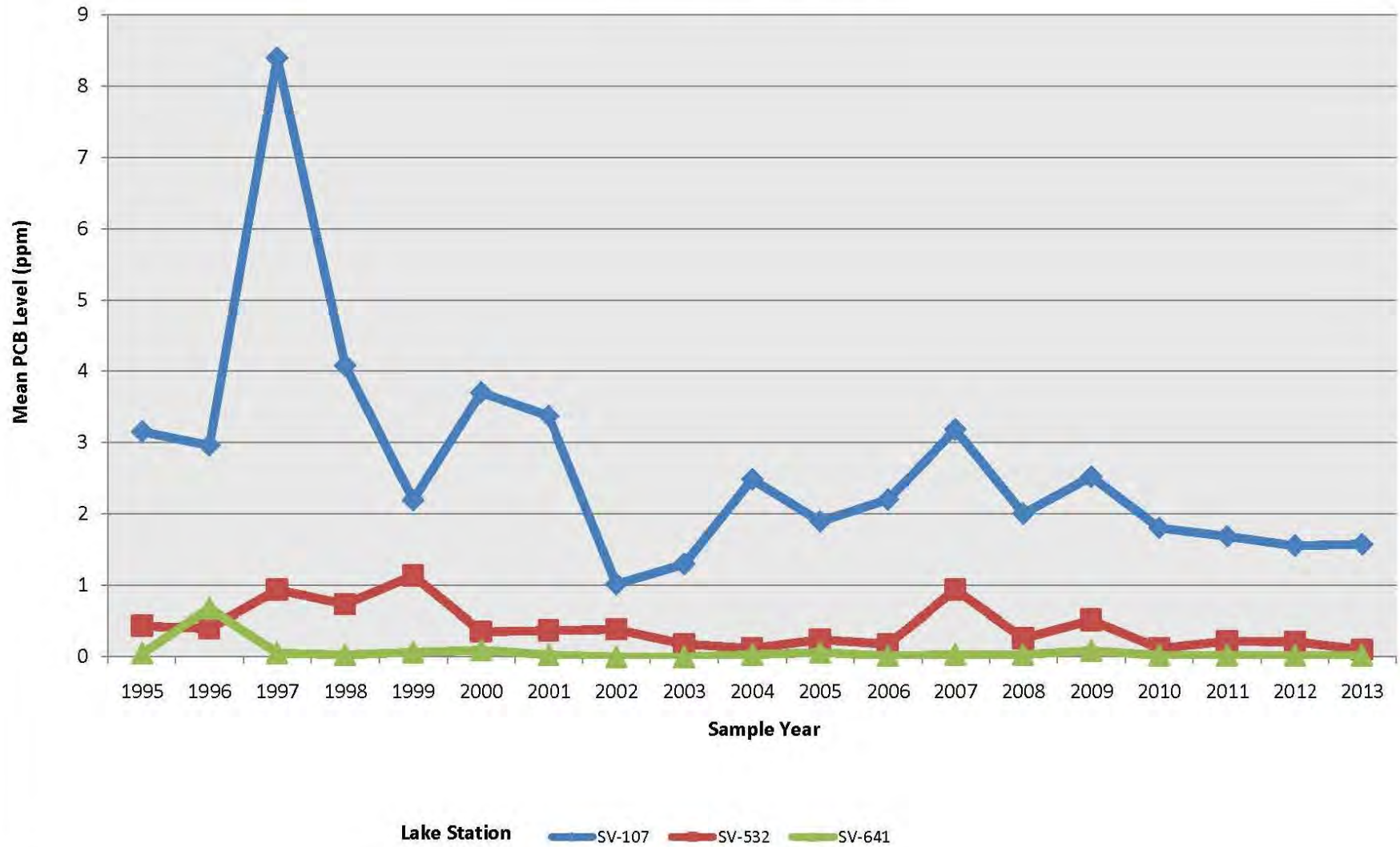


Figure 12. PCB Levels in Threadfin Shad (*Dorosoma petenense*) Whole Body Composite Samples  
Lake Hartwell OU2 Fish Study (1995-2013)

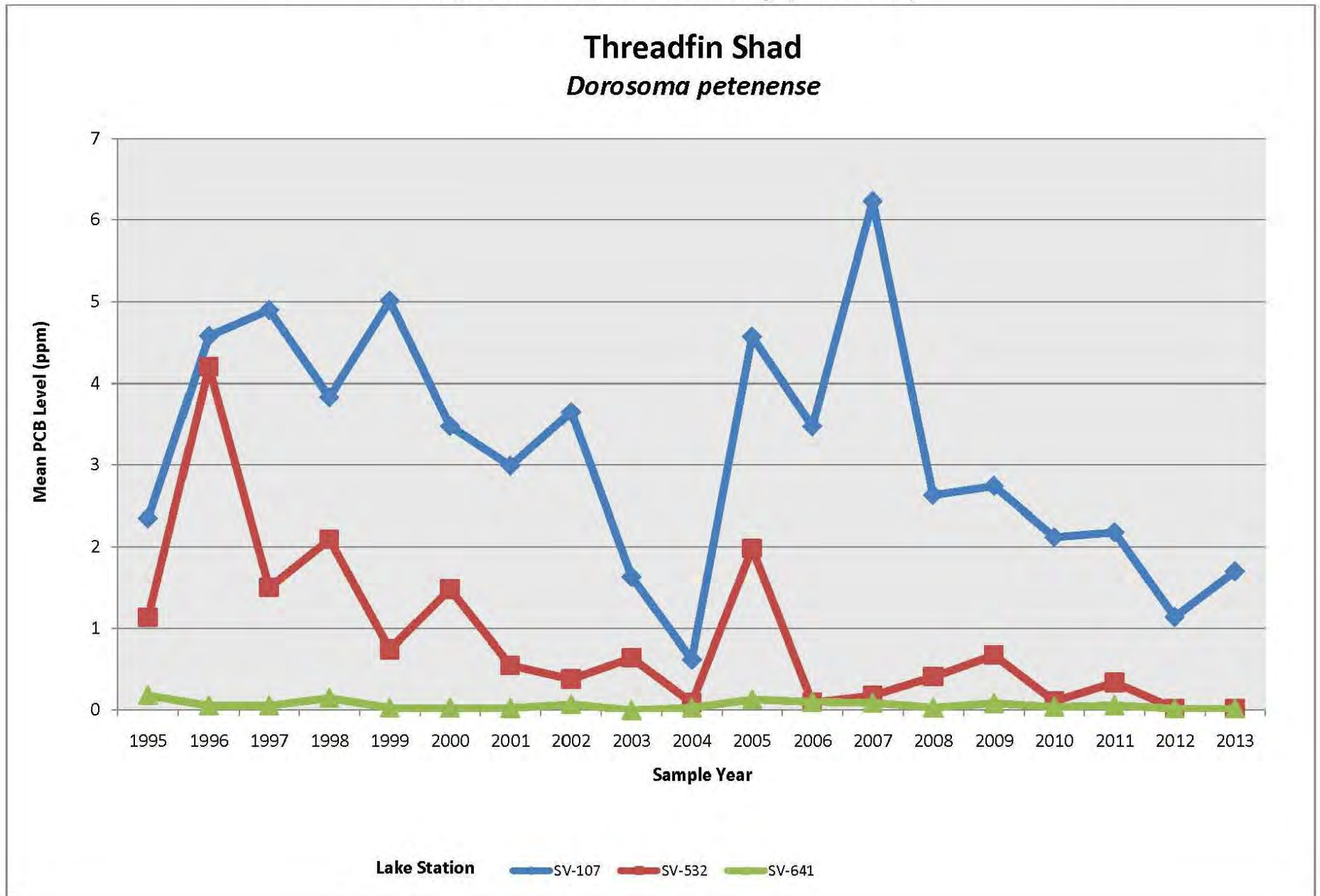
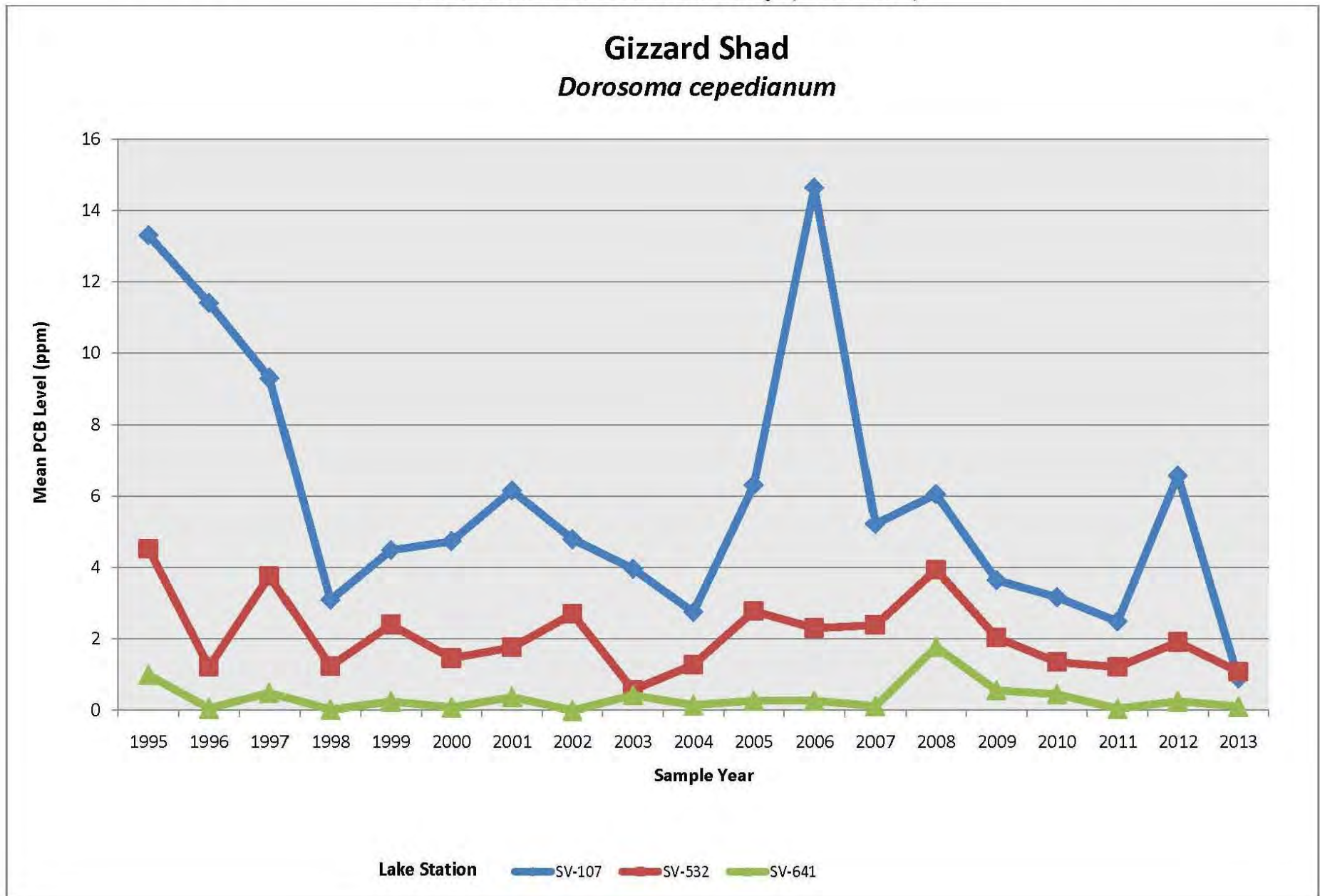
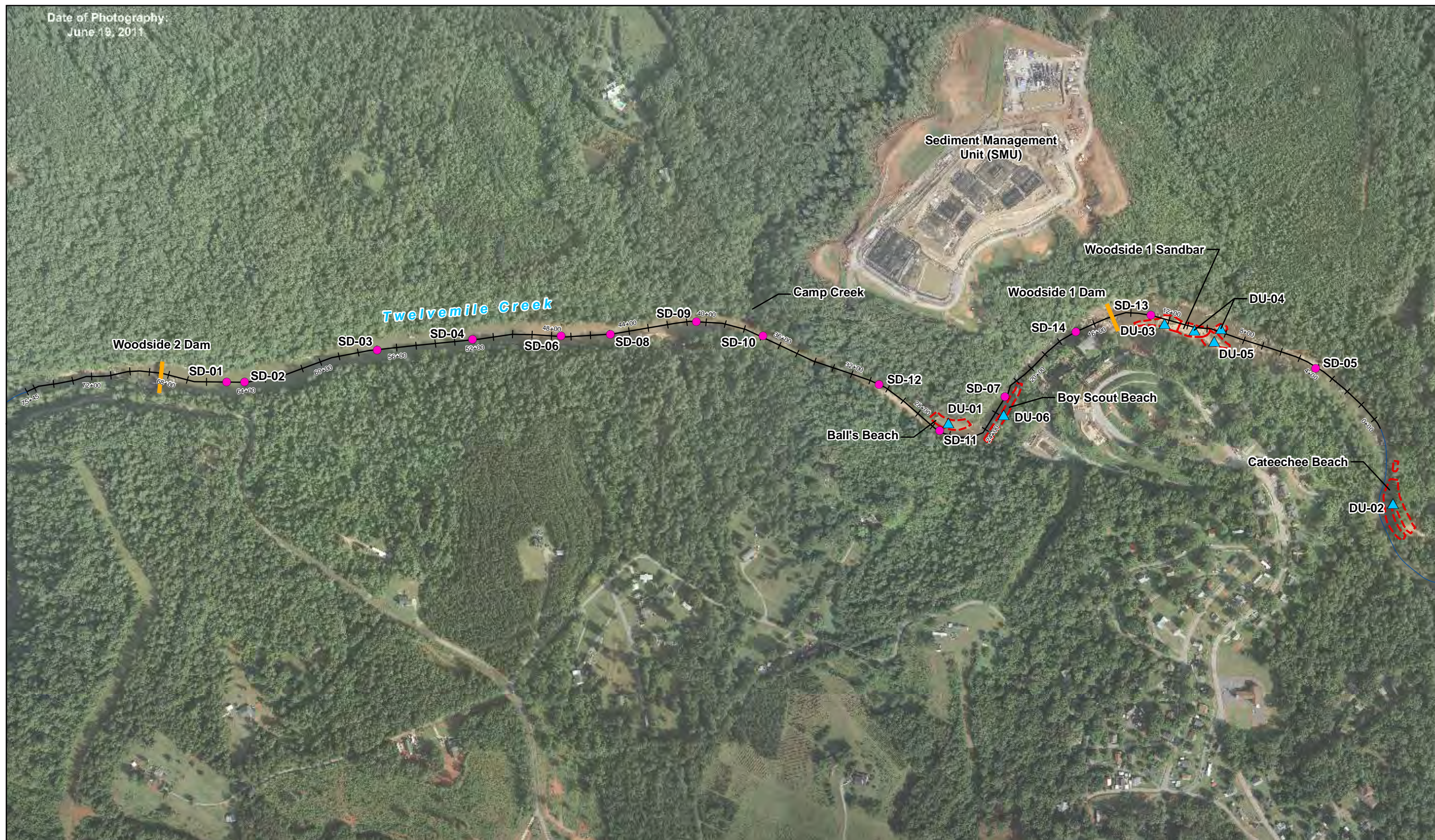




Figure 13. PCB Levels in Gizzard Shad (*Dorosoma cepedianum*) Whole Body Composite Samples  
Lake Hartwell OU2 Fish Study (1995-2013)

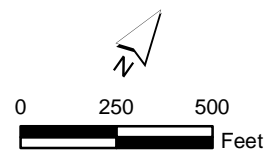


Date of Photography:  
June 19, 2011



**LEGEND**

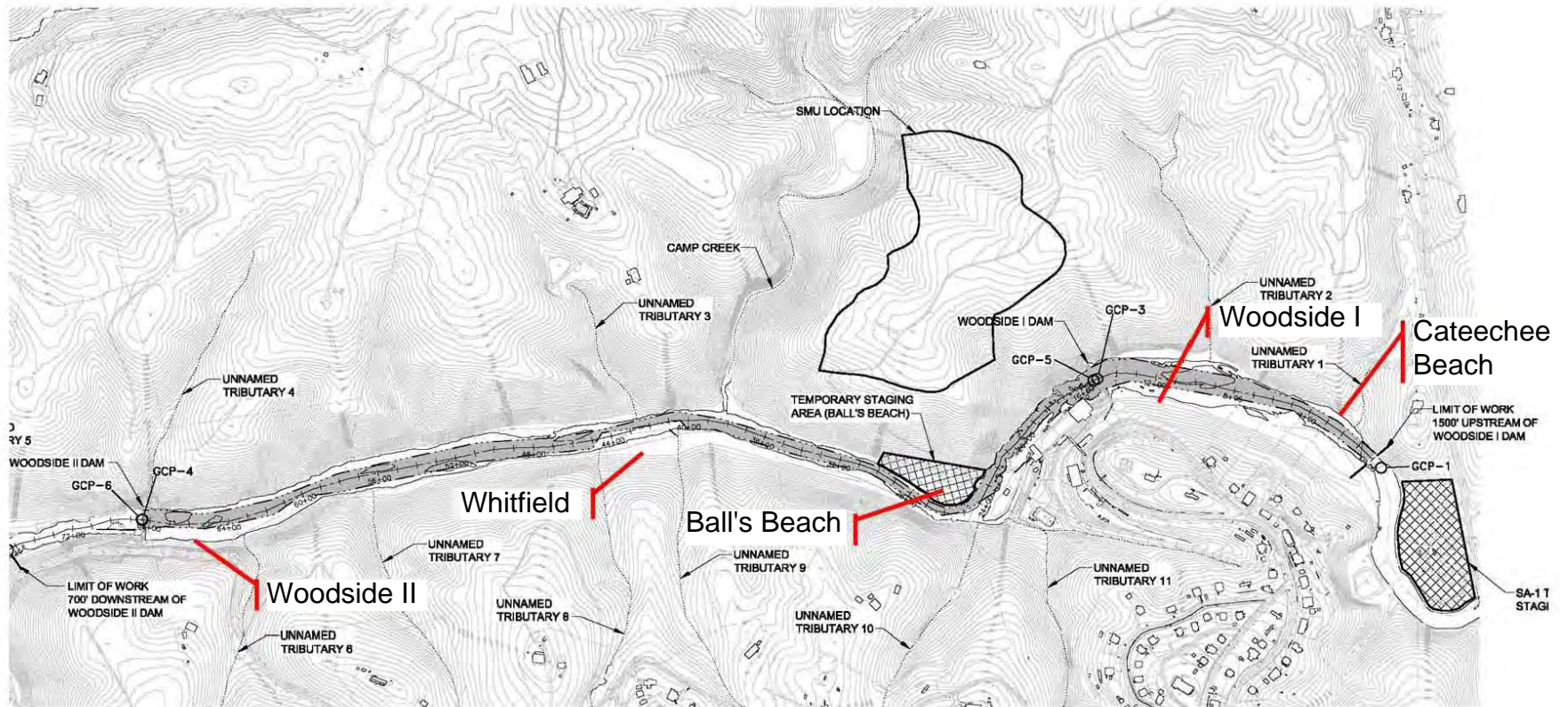
- Approximate Creek Centerline and Stationing
- Former Dam
- - - Approximate Extent of Areas of Interest
- ▲ Sediment Sample Location by Incremental Sampling
- Submerged Sediment Sample Location



Note:  
1. Sample locations are approximate and were determined in the field by noting station location stakes. All locations are within +/-10 feet of the stated stake location. Due to the high sidewalls of the creek the handheld GPS unit was unable to receive signal to provide location information.

**FIGURE 14**  
Locations of Areas of Interest, Incremental Samples, and Submerged Sediment Samples  
Human Health Risk Assessment  
Operable Unit 2 of the Twelvemile Creek Site  
Pickens County, South Carolina

**Figure 15**  
**Twelvemile Creek**  
**Tributary Names/Access Points**



# Appendix C

## Fish Consumption Advisory Sign Inspections

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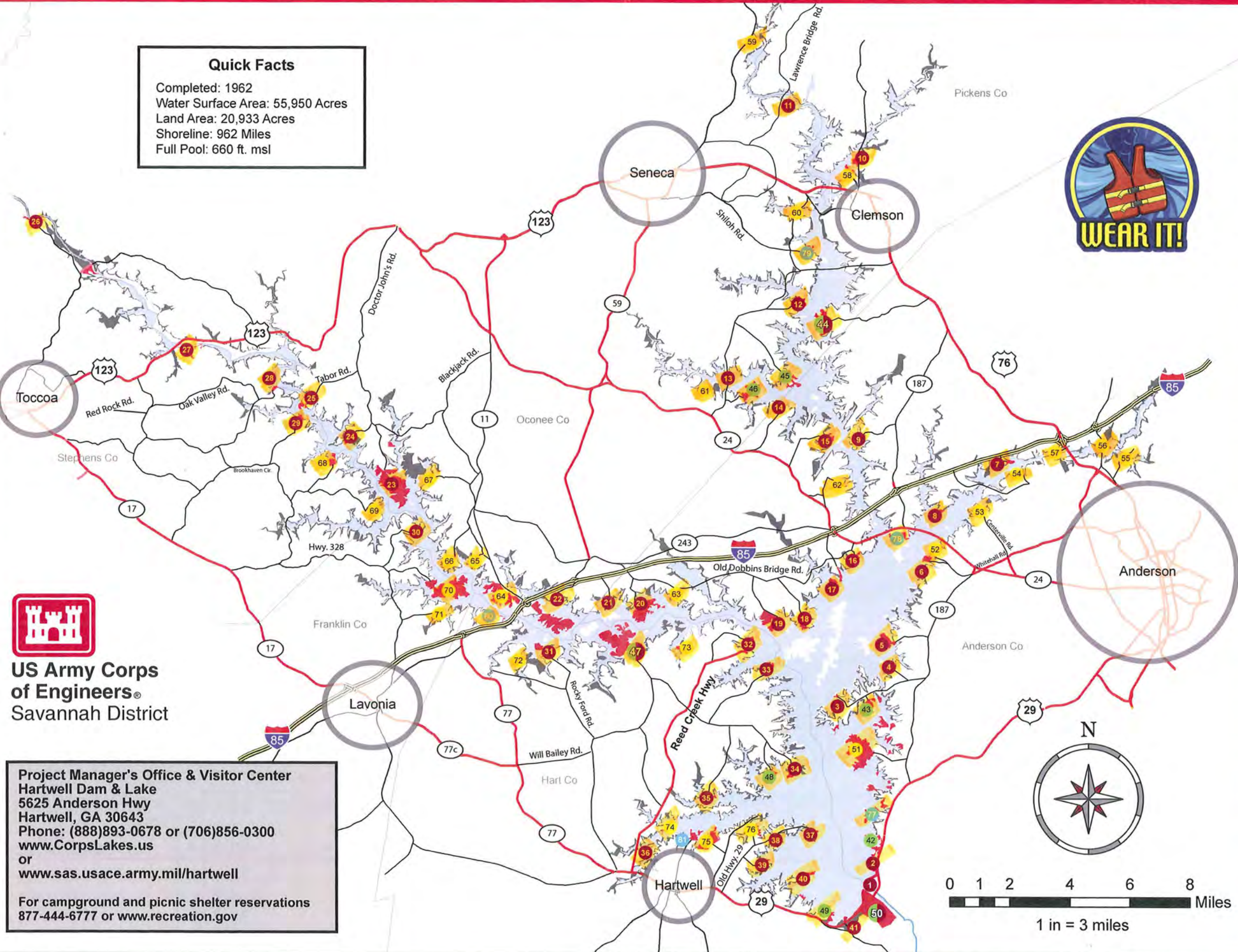
# Hartwell Dam & Lake

U.S. ARMY CORPS OF ENGINEERS

## Corps Recreation Areas

1	SC Dam Viewing Area
2	Singing Pines
3	Jarrett
4	Richland Creek
5	River Forks
6	Green Pond
7	Denver
8	Asbury
9	Eighteen Mile Creek
10	Twelve Mile
11	Lawrence Bridge
12	Martin Creek
13	Friendship
14	Townville
15	Camp Creek
16	Broyles
17	Apple Island
18	Double Springs
19	Weldon Island/Hatton's Ford
20	Glenn Ferry
21	Durham
22	Fair Play
23	Choestoea
24	Mullins Ford
25	Tabor
26	Walker Creek
27	Stephens County
28	Spring Branch
29	Jenkins Ferry
30	Poplar Springs
31	Rock Springs
32	Mary Ann Branch
33	Crawford's Ferry
34	Carter's Ferry
35	New Prospect
36	Cleveland
37	Long Point
38	Duncan Branch
39	Powderbag Creek
40	Elrod Ferry
41	Big Oaks
44	Twin Lakes
47	Paynes Creek
50	Georgia River

**Quick Facts**  
 Completed: 1962  
 Water Surface Area: 55,950 Acres  
 Land Area: 20,933 Acres  
 Shoreline: 962 Miles  
 Full Pool: 660 ft. msl



  
**US Army Corps of Engineers®**  
 Savannah District

**Project Manager's Office & Visitor Center**  
 Hartwell Dam & Lake  
 5625 Anderson Hwy  
 Hartwell, GA 30643  
 Phone: (888)893-0678 or (706)856-0300  
[www.CorpsLakes.us](http://www.CorpsLakes.us)  
 or  
[www.sas.usace.army.mil/hartwell](http://www.sas.usace.army.mil/hartwell)  
 For campground and picnic shelter reservations  
 877-444-6777 or [www.recreation.gov](http://www.recreation.gov)

## Corps Campgrounds

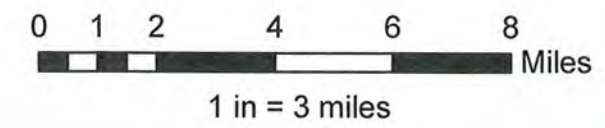
42	Crescent Group Camp
43	Springfield
44	Twin Lakes
45	Oconee Point
46	Coneross
47	Paynes Creek
48	Milltown
49	Watsadler
50	Georgia River

## State & Municipal Recreation Areas

51	Sadler's Creek State Park
52	Jack's Landing
53	White City
54	Honea Path
55	Brown Road
56	Darwin H. Wright
57	Hurricane Creek
58	Clemson
59	Holder's
60	Seneca Creek
61	Timberlake
62	Hoyt-Tilley
63	Cove Inlet
64	Lake Hartwell State Park
65	Barton's Mill
66	Port Bass
67	South Union
68	Bruce Creek
69	Holcomb
70	Tugaloo State Park
71	Franklin County
72	Rocky Ford
73	Reed Creek
74	Bradberry
75	Hart State Recreation Area
76	Gum Branch

## Commercial Marinas

77	Big Water
78	Portman
79	Clemson
80	Harbor Light
81	Hartwell







# Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 1	<b>Date</b> 03/10/14		
<b>Description</b> COE 77 Big Water (Former COE 78); sign in good condition.			

<b>Photo No.</b> 2		<b>Date</b> 03/10/14	
<b>Description</b> COE 2 Singing Pines (Former COE 2); sign in good condition. Slightly faded.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 3	<b>Date</b> 03/10/14		
<b>Description</b> COE 41 Big Oaks (Former COE 44); sign in good condition.			

<b>Photo No.</b> 4	<b>Date</b> 03/10/14		
<b>Description</b> COE 49 Watsadler (Former COE 52); sign in good condition. Sign has a few dings and is slightly faded.			



## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 5	<b>Date</b> 03/10/14		
<b>Description</b> COE 40 Elrod Ferry (Former COE 42); sign in good condition.			

<b>Photo No.</b> 6	<b>Date</b> 03/10/14		
<b>Description</b> COE 39 Powderbag Creek (Former COE 41); sign in good condition. Slightly faded.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 7	<b>Date</b> 03/10/14		
<b>Description</b> COE 76 Gum Branch (Former COE 38); sign in good condition. Needs to be relocated – beside old closed ramp; 3 new ramps have been built.			

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 8	<b>Date</b> 03/10/14		
<b>Description</b> COE 38 Duncan Branch (Former COE 40); sign slightly damaged and loose on post, need to replace.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 9	<b>Date</b> 03/10/14		
<b>Description</b> COE 75 Hartwell State Rec Area (Former COE 77); sign in good condition.			

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 10	<b>Date</b> 03/10/14		
<b>Description</b> COE 74 Bradberry (Former COE 76); sign in good condition.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 11	<b>Date</b> 03/10/14		
<b>Description</b> COE 35 New Prospect (Former COE 36); sign in good condition.			

<b>Photo No.</b> 12	<b>Date</b> 03/10/14		
<b>Description</b> COE 34 Carter's Ferry (Former COE 35); sign damaged. Need to replace.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 13	<b>Date</b> 03/10/14		
<b>Description</b> COE 33 Crawford's Ferry (Former COE 34); sign defaced. Need to replace.			

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 14	<b>Date</b> 03/10/14		
<b>Description</b> COE 32 Mary Ann Branch (Former COE 33); sign in good condition.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 15	<b>Date</b> 03/10/14		
<b>Description</b> COE 47 Paynes Creek (Former COE 50); sign in good condition.			

<b>Photo No.</b> 16	<b>Date</b> 03/10/14		
<b>Description</b> COE 73 Reed Creek (Former COE 75); sign and post down. Need to reinstall.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 17	<b>Date</b> 03/10/14		
<b>Description</b> COE 31 Rock Springs (Former COE 32); sign in good condition. Slightly faded.			

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 18	<b>Date</b> 03/10/14		
<b>Description</b> COE 72 Rocky Ford (Former COE 74); sign in good condition.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 19	<b>Date</b> 03/10/14		
<b>Description</b> COE 36 Cleveland (Former COE 37); sign in good condition.			

<b>Photo No.</b> 20	<b>Date</b> 03/11/14		
<b>Description</b> COE 51 Sadler's Creek State Park (Former COE 54); sign in good condition.			



## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 21	<b>Date</b> 03/11/14		
<b>Description</b> COE 3 Jarrett (Former COE 3); sign defaced. Need to replace.			

<b>Photo No.</b> 22	<b>Date</b> 03/11/14		
<b>Description</b> COE 4 Richland Creek (Former COE 4); bullet holes in sign.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 23	<b>Date</b> 03/11/14		
<b>Description</b> COE 5 River Forks (Former COE 5); sign in good condition.			

<b>Photo No.</b> 24	<b>Date</b> 03/11/14		
<b>Description</b> COE 52 Jack's Landing (Former COE 55); sign in good condition.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 25	<b>Date</b> 03/11/14		
<b>Description</b> COE 78 Portman (Former COE 79); sign in good condition.			

<b>Photo No.</b> 26	<b>Date</b> 03/11/14		
<b>Description</b> COE 16 Broyles (Former COE 17); sign in good condition.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 27	<b>Date</b> 03/11/14		
<b>Description</b> COE 17 Apple Island (Former COE 18); sign in good condition.			


<b>Photo No.</b> 28	<b>Date</b> 03/11/14		
<b>Description</b> COE 18 Double Springs (Former COE 19); sign in good condition.			


## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 29	<b>Date</b> 03/11/14		
<b>Description</b> COE 19 Weldon Island/Hatton's Ford (Former COE 20); some minor damage.			

<b>Photo No.</b> 30	<b>Date</b> 03/11/14		
<b>Description</b> COE 63 Cove Inlet (Former COE 65); sign in good condition.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 31	<b>Date</b> 03/11/14		
<b>Description</b> COE 20 Glenn Ferry (Former COE 21); sign in good condition.			

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 32	<b>Date</b> 03/11/14		
<b>Description</b> COE 21 Durham (Former COE 22); sign in good condition.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 33	<b>Date</b> 03/11/14		
<b>Description</b> COE 22 Fair Play (Former COE 23); sign in good condition.			

<b>Photo No.</b> 34	<b>Date</b> 03/11/14		
<b>Description</b> COE 8 Asbury (Former COE 9); bullet hole in sign.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 35	<b>Date</b> 03/11/14		
<b>Description</b> COE 53 White City (Former COE 56); bullet holes in sign. Need to replace.			

<b>Photo No.</b> 36	<b>Date</b> 03/11/14		
<b>Description</b> COE 57 Hurricane Creek (Former COE 59); sign in good condition.			



# Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 37	<b>Date</b> 03/11/14		
<b>Description</b> COE 54 Honea Path (Former COE 7); sign in good condition.			

<b>Photo No.</b> 38		<b>Date</b> 03/11/14	
<b>Description</b> COE 7 Denver (Former COE 8); sign in good condition.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 39	<b>Date</b> 03/11/14		
<b>Description</b> COE 55 Brown Road (Former COE 57); sign in good condition.			

<b>Photo No.</b> 40	<b>Date</b> 03/12/14		
<b>Description</b> COE 64 Lake Hartwell State Park (Former COE 66); sign in good condition.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 41	<b>Date</b> 03/12/14		
<b>Description</b> COE 65 Barton's Mill (Former COE 67); sign in good condition.			

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 42	<b>Date</b> 03/12/14		
<b>Description</b> COE 66 Port Bass (Former COE 68); sign in good condition.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 43	<b>Date</b> 03/12/14		
<b>Description</b> COE 67 South Union (Former COE 69); sign faded, slight damage.			

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 44	<b>Date</b> 03/12/14		
<b>Description</b> COE 23 Choestoea (Former COE 24); sign in good condition.			

# Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 45	<b>Date</b> 03/12/14		
<b>Description</b> COE 25 Tabor (Former COE 26); shotgun shot in sign.			

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 46	<b>Date</b> 03/12/14		
<b>Description</b> COE 26 Walker Creek (Former COE 27); bullet hole in sign.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 47	<b>Date</b> 03/12/14		
<b>Description</b> COE 27 Stephens County (Former COE 28); sign has some rock damage.			

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 48	<b>Date</b> 03/12/14		
<b>Description</b> COE 28 Spring Branch (Former COE 29); sign in good condition.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 49	<b>Date</b> 03/12/14		
<b>Description</b> COE 29 Jenkins Ferry (Former COE 30); sign in good condition.			

<b>Photo No.</b> 50	<b>Date</b> 03/12/14		
<b>Description</b> COE 68 Bruce Creek (Former COE 70). Bullet hole in sign.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 51	<b>Date</b> 03/12/14		
<b>Description</b> COE 69 Holcomb (Former COE 71); sign in good condition.			

<b>Photo No.</b> 52	<b>Date</b> 03/12/14		
<b>Description</b> COE 30 Poplar Springs (Former COE 31); sign in good condition.			



## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 53	<b>Date</b> 03/12/14		
<b>Description</b> COE 70 Tugaloo State Park (Former COE 72); sign in good condition.			

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 54	<b>Date</b> 03/12/14		
<b>Description</b> COE 71 Franklin County (Former COE 73); sign bent up.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 55	<b>Date</b> 03/12/14		
<b>Description</b> COE 80 Harbor Light (Former COE 81); sign in good condition.			

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 56	<b>Date</b> 03/13/14		
<b>Description</b> COE 9 Eighteen Mile Creek (Former COE 10); sign defaced with paint. Need to replace.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 57	<b>Date</b> 03/13/14		
<b>Description</b> COE 44 Twin Lakes (Former COE 47); bullet holes in sign.			

<b>Photo No.</b> 58	<b>Date</b> 03/13/14		
<b>Description</b> COE 58 Clemson (Former COE 60); sign in good condition.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 59	<b>Date</b> 03/13/14		
<b>Description</b> COE 10 Twelve Mile (Former COE 11); sign in good condition.			

<b>Photo No.</b> 60	<b>Date</b> 03/13/14		
<b>Description</b> COE 59 Holders (Former COE 61); sign hard to read, very dirty; clean or replace.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 61	<b>Date</b> 03/13/14		
<b>Description</b> COE 11 Lawrence Bridge (Former COE 12); sign in good condition.			

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 62	<b>Date</b> 03/13/14		
<b>Description</b> COE 60 Seneca Creek (Former COE 62); sign in good condition.			

# Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 63	<b>Date</b> 03/13/14		
<b>Description</b> COE 79 Clemson Marina (Former COE 80); sign in good condition.			

<b>Photo No.</b> 64	<b>Date</b> 03/13/14		
<b>Description</b> COE 12 Martin Creek (Former COE 13); sign in good condition.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 65	<b>Date</b> 03/13/14		
<b>Description</b> COE 13 Friendship (Former COE 14); sign in good condition.			

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 66	<b>Date</b> 03/13/14		
<b>Description</b> COE 46 Conerross (Former COE 49); sign in good condition.			

## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 67	<b>Date</b> 03/13/14		
<b>Description</b> COE 61 Timberlake (Former COE 63); sign defaced; need to replace.			

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 68	<b>Date</b> 03/13/14		
<b>Description</b> COE 14 Townville (Former COE 15); sign in good condition.			



## Photographic Log

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 69	<b>Date</b> 03/13/14		
<b>Description</b> COE 15 Camp Creek (Former COE 16); sign in good condition.			

<b>Client Name:</b> Sangamo Weston		<b>Site Location:</b> Lake Hartwell, South Carolina/Georgia	<b>Project No.:</b> 208503.0000.0000
<b>Photo No.</b> 70	<b>Date</b> 03/13/14		
<b>Description</b> COE 56 Darwin H Wright (Former COE 58); sign in good condition; ramp closed.			

# Appendix D

## Five-Year Review Site Inspection Checklist and Photographs

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# Site Inspection Checklist

I. SITE INFORMATION													
<b>Site name: Sangamo Weston/Twelve Mile Creek/Lake Hartwell PCB Superfund Site – OU2</b>	<b>Date of inspection: 05-07-2014</b>												
<b>Location and Region: Pickens, SC, Region 4</b>	<b>EPA ID: SCD003354412</b>												
<b>Agency, office, or company leading the five-year review: USEPA/SC DHEC/Schlumberger/CH2M HILL</b>	<b>Weather/temperature: Sunny, warm, 70's</b>												
<b>Remedy Includes:</b> (Check all that apply) <table style="width: 100%; margin-top: 5px;"> <tr> <td><input type="checkbox"/> Landfill cover/containment</td> <td><input type="checkbox"/> Monitored natural attenuation</td> </tr> <tr> <td><input type="checkbox"/> Access controls</td> <td><input type="checkbox"/> Groundwater containment</td> </tr> <tr> <td><input checked="" type="checkbox"/> Institutional controls</td> <td><input type="checkbox"/> Vertical barrier walls</td> </tr> <tr> <td><input type="checkbox"/> Groundwater pump and treatment</td> <td></td> </tr> <tr> <td><input type="checkbox"/> Surface water collection and treatment</td> <td></td> </tr> <tr> <td><input checked="" type="checkbox"/> Other <u>Copy</u></td> <td></td> </tr> </table> <p>Per the 1994 ROD: Continuation of fish consumption advisory, aquatic biota and sediment monitoring, natural sedimentation/regular flushing of sediments trapped behind impoundment on Twelvemile Creek, and public education program</p>		<input type="checkbox"/> Landfill cover/containment	<input type="checkbox"/> Monitored natural attenuation	<input type="checkbox"/> Access controls	<input type="checkbox"/> Groundwater containment	<input checked="" type="checkbox"/> Institutional controls	<input type="checkbox"/> Vertical barrier walls	<input type="checkbox"/> Groundwater pump and treatment		<input type="checkbox"/> Surface water collection and treatment		<input checked="" type="checkbox"/> Other <u>Copy</u>	
<input type="checkbox"/> Landfill cover/containment	<input type="checkbox"/> Monitored natural attenuation												
<input type="checkbox"/> Access controls	<input type="checkbox"/> Groundwater containment												
<input checked="" type="checkbox"/> Institutional controls	<input type="checkbox"/> Vertical barrier walls												
<input type="checkbox"/> Groundwater pump and treatment													
<input type="checkbox"/> Surface water collection and treatment													
<input checked="" type="checkbox"/> Other <u>Copy</u>													
<b>Attachments:</b> <input type="checkbox"/> Inspection team roster attached <input checked="" type="checkbox"/> Site map attached													
II. INTERVIEWS (Check all that apply)													
<b>1. O&amp;M site manager</b>	<table style="width: 100%; border: none;"> <tr> <td style="text-align: center;"><u>Jim Orr/URS</u></td> <td style="text-align: center;"><u>Consultant</u></td> <td style="text-align: center;"><u>05/07/2014</u></td> </tr> <tr> <td style="text-align: center;">Name</td> <td style="text-align: center;">Title</td> <td style="text-align: center;">Date</td> </tr> </table> <p>Interviewed <input type="checkbox"/> at site   <input type="checkbox"/> at office   <input type="checkbox"/> by phone   Phone no. _____</p> <p>Problems, suggestions; <input type="checkbox"/> Report attached _____</p>	<u>Jim Orr/URS</u>	<u>Consultant</u>	<u>05/07/2014</u>	Name	Title	Date						
<u>Jim Orr/URS</u>	<u>Consultant</u>	<u>05/07/2014</u>											
Name	Title	Date											
<b>2. O&amp;M staff</b> _____	<table style="width: 100%; border: none;"> <tr> <td style="text-align: center;">Name</td> <td style="text-align: center;">Title</td> <td style="text-align: center;">Date</td> </tr> </table> <p>Interviewed <input type="checkbox"/> at site   <input type="checkbox"/> at office   <input type="checkbox"/> by phone   Phone no. _____</p> <p>Problems, suggestions; <input type="checkbox"/> Report attached _____</p>	Name	Title	Date									
Name	Title	Date											



## Site Inspection Checklist

<b>III. ON-SITE DOCUMENTS &amp; RECORDS VERIFIED</b> (Check all that apply)			
1.	<b>O&amp;M Documents</b> <input type="checkbox"/> O&M manual <input type="checkbox"/> As-built drawings <input type="checkbox"/> Maintenance logs Remarks _____ _____	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A
2.	<b>Site-Specific Health and Safety Plan</b> <input type="checkbox"/> Contingency plan/emergency response plan Remarks _____ _____	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A
3.	<b>O&amp;M and OSHA Training Records</b> Remarks _____ _____	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A
4.	<b>Permits and Service Agreements</b> <input type="checkbox"/> Air discharge permit <input type="checkbox"/> Effluent discharge <input type="checkbox"/> Waste disposal, POTW <input type="checkbox"/> Other permits _____ Remarks _____ _____	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available <input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A
5.	<b>Gas Generation Records</b> Remarks _____ _____	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A
6.	<b>Settlement Monument Records</b> Remarks _____ _____	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A
7.	<b>Groundwater Monitoring Records</b> Remarks _____ _____	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A
8.	<b>Leachate Extraction Records</b> Remarks _____ _____	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A
9.	<b>Discharge Compliance Records</b> <input type="checkbox"/> Air <input type="checkbox"/> Water (effluent) Remarks _____ _____	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A
10.	<b>Daily Access/Security Logs</b> Remarks _____ _____	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A

# Site Inspection Checklist

## IV. O&M COSTS

1. **O&M Organization**

<input type="checkbox"/> State in-house	<input type="checkbox"/> Contractor for State
<input type="checkbox"/> PRP in-house	<input type="checkbox"/> Contractor for PRP
<input type="checkbox"/> Federal Facility in-house	<input type="checkbox"/> Contractor for Federal Facility
<input type="checkbox"/> Other _____	

2. **O&M Cost Records**

Readily available       Up to date

Funding mechanism/agreement in place

Original O&M cost estimate \_\_\_\_\_  Breakdown attached

Total annual cost by year for review period if available

From <u>2009</u>	To <u>2010</u>	\$ <u>279,000</u>	<input type="checkbox"/> Breakdown attached
Date	Date	Total cost	
From <u>2010</u>	To <u>2011</u>	\$ <u>223,000</u>	<input type="checkbox"/> Breakdown attached
Date	Date	Total cost	
From <u>2011</u>	To <u>2012</u>	\$ <u>257,000</u>	<input type="checkbox"/> Breakdown attached
Date	Date	Total cost	
From <u>2012</u>	To <u>2013</u>	\$ <u>285,000</u>	<input type="checkbox"/> Breakdown attached
Date	Date	Total cost	
From <u>2013</u>	To <u>2014</u>	\$ <u>265,000</u>	<input type="checkbox"/> Breakdown attached
Date	Date	Total cost	

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## V. ACCESS AND INSTITUTIONAL CONTROLS    Applicable    N/A

### A. Fencing

1. **Fencing damaged**       Location shown on site map       Gates secured       N/A

Remarks \_\_\_\_\_

\_\_\_\_\_

### B. Other Access Restrictions

1. **Signs and other security measures**       Location shown on site map       N/A

Remarks Fish advisory signs installed in April 2009 at approximately 80 boat landing locations surrounding Lake Hartwell. Following inspections in April 2014, 10 replacement signs were recommended to be installed.

\_\_\_\_\_

# Site Inspection Checklist

<b>C. Institutional Controls (ICs)</b>			
1.	<b>Implementation and enforcement</b>		
	Site conditions imply ICs not properly implemented	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	Site conditions imply ICs not being fully enforced	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	Type of monitoring ( <i>e.g.</i> , self-reporting, drive by) <u>Sediment, Fish Tissue, Corbicula</u>		
	Frequency <u>Annual</u>		
	Responsible party/agency <u>USEPA</u>		
	Contact	<u>Craig Zeller</u>	<u>USEPA RPM</u>
	Name	Title	Date Phone no.
	Reporting is up-to-date	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	Reports are verified by the lead agency	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	Specific requirements in deed or decision documents have been met	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	Violations have been reported	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input checked="" type="checkbox"/> N/A
	Other problems or suggestions: <input type="checkbox"/> Report attached		
	_____		
	_____		
	_____		
2.	<b>Adequacy</b>	<input checked="" type="checkbox"/> ICs are adequate	<input type="checkbox"/> ICs are inadequate <input type="checkbox"/> N/A
	Remarks _____		
	_____		
	_____		
<b>D. General</b>			
1.	<b>Vandalism/trespassing</b>	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> No vandalism evident
	Remarks _____		
	_____		
2.	<b>Land use changes on site</b>	<input checked="" type="checkbox"/> N/A	
	Remarks _____		
	_____		
3.	<b>Land use changes off site</b>	<input checked="" type="checkbox"/> N/A	
	Remarks _____		
	_____		
<b>VI. GENERAL SITE CONDITIONS</b>			
<b>A. Roads</b>			
	<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A	
1.	<b>Roads damaged</b>	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Roads adequate <input checked="" type="checkbox"/> N/A
	Remarks _____		
	_____		

## Site Inspection Checklist

<b>B. Other Site Conditions</b>		
Remarks _____ _____ _____ _____ _____		
<b>VII. LANDFILL COVERS</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A		
<b>A. Landfill Surface</b>		
1.	<b>Settlement</b> (Low spots) Areal extent _____ Depth _____ Remarks _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> Settlement not evident
2.	<b>Cracks</b> Lengths _____    Widths _____    Depths _____ Remarks _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> Cracking not evident
3.	<b>Erosion</b> Areal extent _____ Depth _____ Remarks _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> Erosion not evident
4.	<b>Holes</b> Areal extent _____ Depth _____ Remarks _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> Holes not evident
5.	<b>Vegetative Cover</b> <input type="checkbox"/> Grass <input type="checkbox"/> Cover properly established <input type="checkbox"/> No signs of stress <input type="checkbox"/> Trees/Shrubs (indicate size and locations on a diagram) Remarks _____	
6.	<b>Alternative Cover (armored rock, concrete, etc.)</b> <input type="checkbox"/> N/A Remarks _____	
7.	<b>Bulges</b> Areal extent _____ Height _____ Remarks _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> Bulges not evident
8.	<b>Wet Areas/Water Damage</b> <input type="checkbox"/> Wet areas <input type="checkbox"/> Location shown on site map    Areal extent _____ <input type="checkbox"/> Ponding <input type="checkbox"/> Location shown on site map    Areal extent _____ <input type="checkbox"/> Seeps <input type="checkbox"/> Location shown on site map    Areal extent _____ <input type="checkbox"/> Soft subgrade <input type="checkbox"/> Location shown on site map    Areal extent _____ Remarks _____	



## Site Inspection Checklist

9.	<b>Slope Instability</b>	<input type="checkbox"/> Slides <input type="checkbox"/> Location shown on site map	<input type="checkbox"/> No evidence of slope instability
Areal extent _____ Remarks _____ _____			
<b>B. Benches</b> <input type="checkbox"/> Applicable <input type="checkbox"/> N/A (Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)			
1.	<b>Flows Bypass Bench</b>	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> N/A or okay
Remarks _____ _____			
2.	<b>Bench Breached</b>	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> N/A or okay
Remarks _____ _____			
3.	<b>Bench Overtopped</b>	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> N/A or okay
Remarks _____ _____			
<b>C. Letdown Channels</b> <input type="checkbox"/> Applicable <input type="checkbox"/> N/A (Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)			
1.	<b>Settlement</b>	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> No evidence of settlement
Areal extent _____                    Depth _____ Remarks _____ _____			
2.	<b>Material Degradation</b>	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> No evidence of degradation
Material type _____                    Areal extent _____ Remarks _____ _____			
3.	<b>Erosion</b>	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> No evidence of erosion
Areal extent _____                    Depth _____ Remarks _____ _____			

## Site Inspection Checklist

4.	<b>Undercutting</b>	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> No evidence of undercutting
	Areal extent _____	Depth _____	
	Remarks _____ _____		
5.	<b>Obstructions</b>	Type _____	<input type="checkbox"/> No obstructions
	<input type="checkbox"/> Location shown on site map	Areal extent _____	
	Size _____		
	Remarks _____ _____		
6.	<b>Excessive Vegetative Growth</b>	Type _____	
	<input type="checkbox"/> No evidence of excessive growth		
	<input type="checkbox"/> Vegetation in channels does not obstruct flow		
	<input type="checkbox"/> Location shown on site map	Areal extent _____	
	Remarks _____ _____		
<b>D. Cover Penetrations</b> <input type="checkbox"/> Applicable <input type="checkbox"/> N/A			
1.	<b>Gas Vents</b>	<input type="checkbox"/> Active	<input type="checkbox"/> Passive
	<input type="checkbox"/> Properly secured/locked	<input type="checkbox"/> Functioning	<input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition
	<input type="checkbox"/> Evidence of leakage at penetration		<input type="checkbox"/> Needs Maintenance
	<input type="checkbox"/> N/A		
	Remarks _____ _____		
2.	<b>Gas Monitoring Probes</b>	<input type="checkbox"/> Functioning	<input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition
	<input type="checkbox"/> Properly secured/locked		<input type="checkbox"/> Needs Maintenance <input type="checkbox"/> N/A
	<input type="checkbox"/> Evidence of leakage at penetration		
	Remarks _____ _____		
3.	<b>Monitoring Wells</b> (within surface area of landfill)	<input type="checkbox"/> Functioning	<input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition
	<input type="checkbox"/> Properly secured/locked		<input type="checkbox"/> Needs Maintenance <input type="checkbox"/> N/A
	<input type="checkbox"/> Evidence of leakage at penetration		
	Remarks _____ _____		
4.	<b>Leachate Extraction Wells</b>	<input type="checkbox"/> Functioning	<input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition
	<input type="checkbox"/> Properly secured/locked		<input type="checkbox"/> Needs Maintenance <input type="checkbox"/> N/A
	<input type="checkbox"/> Evidence of leakage at penetration		
	Remarks _____ _____		
5.	<b>Settlement Monuments</b>	<input type="checkbox"/> Located	<input type="checkbox"/> Routinely surveyed <input type="checkbox"/> N/A
	Remarks _____ _____		

## Site Inspection Checklist

<b>E. Gas Collection and Treatment</b>		<input type="checkbox"/> Applicable	<input type="checkbox"/> N/A
1.	<b>Gas Treatment Facilities</b>	<input type="checkbox"/> Flaring	<input type="checkbox"/> Thermal destruction
		<input type="checkbox"/> Good condition	<input type="checkbox"/> Needs Maintenance
	Remarks _____		<input type="checkbox"/> Collection for reuse
_____			
2.	<b>Gas Collection Wells, Manifolds and Piping</b>	<input type="checkbox"/> Good condition	<input type="checkbox"/> Needs Maintenance
	Remarks _____		
_____			
3.	<b>Gas Monitoring Facilities</b> ( <i>e.g.</i> , gas monitoring of adjacent homes or buildings)	<input type="checkbox"/> Good condition	<input type="checkbox"/> Needs Maintenance
	Remarks _____	<input type="checkbox"/> N/A	
_____			
<b>F. Cover Drainage Layer</b>		<input type="checkbox"/> Applicable	<input type="checkbox"/> N/A
1.	<b>Outlet Pipes Inspected</b>	<input type="checkbox"/> Functioning	<input type="checkbox"/> N/A
	Remarks _____		
_____			
2.	<b>Outlet Rock Inspected</b>	<input type="checkbox"/> Functioning	<input type="checkbox"/> N/A
	Remarks _____		
_____			
<b>G. Detention/Sedimentation Ponds</b>		<input type="checkbox"/> Applicable	<input type="checkbox"/> N/A
1.	<b>Siltation</b> Areal extent _____	Depth _____	<input type="checkbox"/> N/A
	<input type="checkbox"/> Siltation not evident		
	Remarks _____		
_____			
2.	<b>Erosion</b> Areal extent _____	Depth _____	
	<input type="checkbox"/> Erosion not evident		
	Remarks _____		
_____			
3.	<b>Outlet Works</b>	<input type="checkbox"/> Functioning	<input type="checkbox"/> N/A
	Remarks _____		
_____			
4.	<b>Dam</b>	<input type="checkbox"/> Functioning	<input type="checkbox"/> N/A
	Remarks _____		
_____			

## Site Inspection Checklist

<b>H. Retaining Walls</b> <input type="checkbox"/> Applicable <input type="checkbox"/> N/A	
1.	<b>Deformations</b> <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Deformation not evident Horizontal displacement _____      Vertical displacement _____ Rotational displacement _____ Remarks _____ _____
2.	<b>Degradation</b> <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Degradation not evident Remarks _____ _____
<b>I. Perimeter Ditches/Off-Site Discharge</b> <input type="checkbox"/> Applicable <input type="checkbox"/> N/A	
1.	<b>Siltation</b> <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Siltation not evident Areal extent _____      Depth _____ Remarks _____ _____
2.	<b>Vegetative Growth</b> <input type="checkbox"/> Location shown on site map <input type="checkbox"/> N/A <input type="checkbox"/> Vegetation does not impede flow Areal extent _____      Type _____ Remarks _____ _____
3.	<b>Erosion</b> <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Erosion not evident Areal extent _____      Depth _____ Remarks _____ _____
4.	<b>Discharge Structure</b> <input type="checkbox"/> Functioning <input type="checkbox"/> N/A Remarks _____ _____
<b>VIII. VERTICAL BARRIER WALLS</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A	
1.	<b>Settlement</b> <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Settlement not evident Areal extent _____      Depth _____ Remarks _____ _____
2.	<b>Performance Monitoring</b> Type of monitoring _____ <input type="checkbox"/> Performance not monitored Frequency _____ <input type="checkbox"/> Evidence of breaching Head differential _____ Remarks _____ _____

# Site Inspection Checklist

<b>IX. GROUNDWATER/SURFACE WATER REMEDIES</b> <input type="checkbox"/> Applicable <input type="checkbox"/> N/A	
<b>A. Groundwater Extraction Wells, Pumps, and Pipelines</b> <input type="checkbox"/> Applicable <input type="checkbox"/> N/A	
1.	<b>Pumps, Wellhead Plumbing, and Electrical</b> <input type="checkbox"/> Good condition <input type="checkbox"/> All required wells properly operating <input type="checkbox"/> Needs Maintenance <input type="checkbox"/> N/A Remarks _____ _____ _____
2.	<b>Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances</b> <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____
3.	<b>Spare Parts and Equipment</b> <input type="checkbox"/> Readily available <input type="checkbox"/> Good condition <input type="checkbox"/> Requires upgrade <input type="checkbox"/> Needs to be provided Remarks _____ _____
<b>B. Surface Water Collection Structures, Pumps, and Pipelines</b> <input type="checkbox"/> Applicable <input type="checkbox"/> N/A	
1.	<b>Collection Structures, Pumps, and Electrical</b> <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____
2.	<b>Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances</b> <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____
3.	<b>Spare Parts and Equipment</b> <input type="checkbox"/> Readily available <input type="checkbox"/> Good condition <input type="checkbox"/> Requires upgrade <input type="checkbox"/> Needs to be provided Remarks _____ _____

# Site Inspection Checklist

<b>C. Treatment System</b>		<input type="checkbox"/> Applicable <input type="checkbox"/> N/A
1.	<b>Treatment Train</b> (Check components that apply) <input type="checkbox"/> Metals removal <input type="checkbox"/> Oil/water separation <input type="checkbox"/> Bioremediation <input type="checkbox"/> Air stripping <input type="checkbox"/> Carbon adsorbers <input type="checkbox"/> Filters _____ <input type="checkbox"/> Additive (e.g., chelation agent, flocculent) _____ <input type="checkbox"/> Others _____ <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance <input type="checkbox"/> Sampling ports properly marked and functional <input type="checkbox"/> Sampling/maintenance log displayed and up to date <input type="checkbox"/> Equipment properly identified <input type="checkbox"/> Quantity of groundwater treated annually _____ <input type="checkbox"/> Quantity of surface water treated annually _____ Remarks _____ _____	
2.	<b>Electrical Enclosures and Panels</b> (properly rated and functional) <input type="checkbox"/> N/A <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____	
3.	<b>Tanks, Vaults, Storage Vessels</b> <input type="checkbox"/> N/A <input type="checkbox"/> Good condition <input type="checkbox"/> Proper secondary containment <input type="checkbox"/> Needs Maintenance Remarks _____ _____	
4.	<b>Discharge Structure and Appurtenances</b> <input type="checkbox"/> N/A <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____	
5.	<b>Treatment Building(s)</b> <input type="checkbox"/> N/A <input type="checkbox"/> Good condition (esp. roof and doorways) <input type="checkbox"/> Needs repair <input type="checkbox"/> Chemicals and equipment properly stored Remarks _____ _____	
6.	<b>Monitoring Wells</b> (pump and treatment remedy) <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input type="checkbox"/> All required wells located <input type="checkbox"/> Needs Maintenance <input type="checkbox"/> N/A Remarks _____ _____	
<b>D. Monitoring Data</b>		
1.	Monitoring Data <input type="checkbox"/> Is routinely submitted on time <input type="checkbox"/> Is of acceptable quality	
2.	Monitoring data suggests: <input type="checkbox"/> Groundwater plume is effectively contained <input type="checkbox"/> Contaminant concentrations are declining	

# Site Inspection Checklist

<b>E. Monitored Natural Attenuation</b>	
1.	<b>Monitoring Wells</b> (natural attenuation remedy) <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input type="checkbox"/> All required wells located <input type="checkbox"/> Needs Maintenance <input type="checkbox"/> N/A Remarks _____ _____
<b>X. OTHER REMEDIES</b>	
If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.	
<b>XI. OVERALL OBSERVATIONS</b>	
<b>A. Implementation of the Remedy</b>	
Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). <u>Continued evidence of monitored natural recovery (MNR) is observed in sediments. The 2013 data indicate that sediment concentrations have stabilized and are likely falling after the dam removals.</u> <u>The fish consumption advisory remains in effect for OU2. Primary human exposure pathway is fish harvested from Lake Hartwell. Selected remedy included continuation of existing fish consumption advisory for the lake. FDA tolerance level of 2 mg/kg in fish (wet weight, edible portion) was set as final cleanup goal for the lake (FDA still uses this tolerance level as of 2013). Per the ROD, PCB levels have been monitored in sediment and aquatic biota (clams, fish) for 20 years.</u> <u>Although concentrations have declined, PCBs in fish tissues above an average concentration of 1 µg/kg are still observed (excluding channel catfish). PCBs were not detected above 1.0 mg/kg during 2013 in any of the Corbicula samples.</u> _____ _____ _____ _____ _____	
<b>B. Adequacy of O&amp;M</b>	
Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. <u>Sediment dredging was completed and Woodside 1 and 2 dams were removed in February and August 2011, respectively. This has enhanced sedimentation from Twelve Mile Creek to Lake Hartwell.</u> _____ _____ _____ _____ _____	

# Site Inspection Checklist

## **C. Early Indicators of Potential Remedy Problems**

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

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## **D. Opportunities for Optimization**

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

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# Photographic Log

<b>Client Name:</b> Schlumberger Technology Corporation	<b>Site Location:</b> Operable Unit Two (OU2)
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<b>Photo No.</b>	<b>Date</b>
1	5-7-2014

**Description**  
*Twelve Mile Creek (OU2)*  
 Madden Bridge Overpass  
 looking upstream



<b>Photo No.</b>	<b>Date</b>
2	5-7-2014

**Description**  
*Twelve Mile Creek (OU2)*  
 Looking upstream from Lay  
 Bridge Overpass

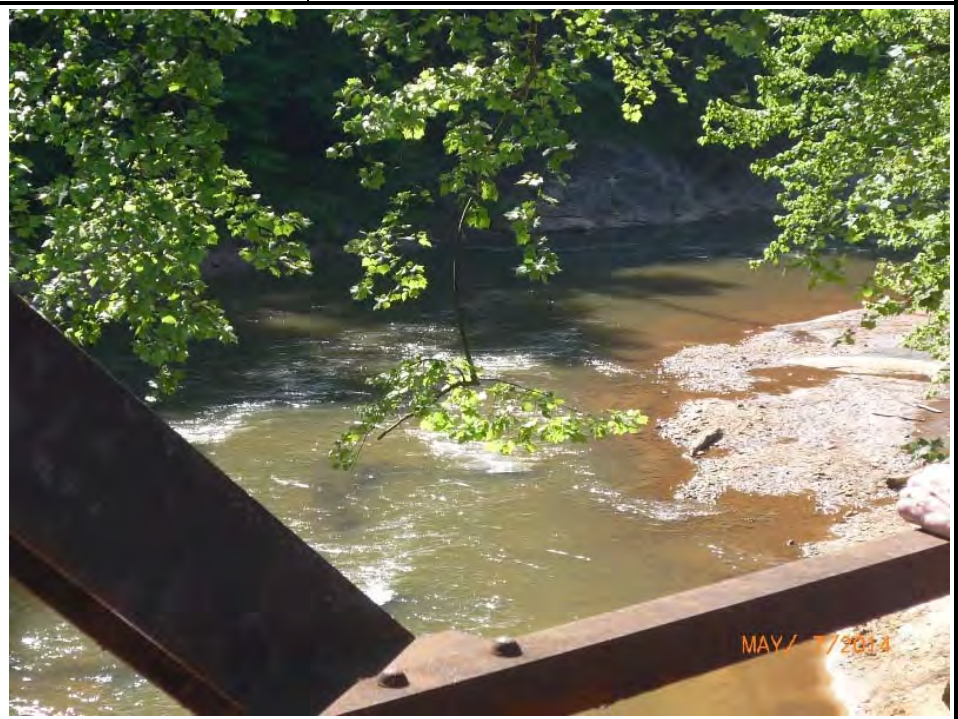


# Photographic Log

<b>Client Name:</b> Schlumberger Technology Corporation	<b>Site Location:</b> Operable Unit Two (OU2)
--	--

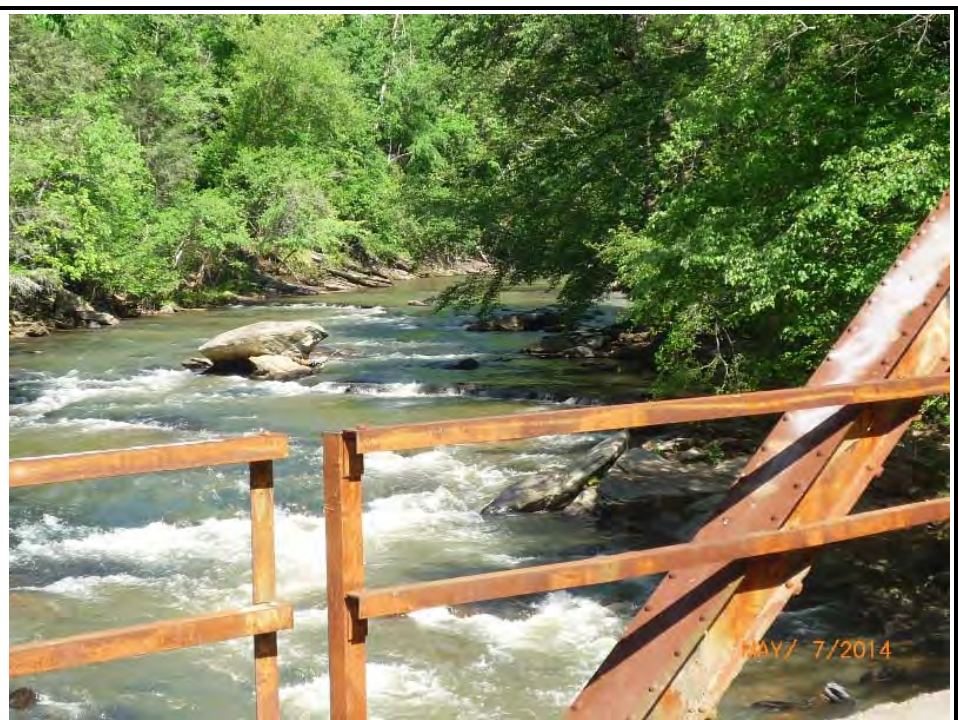
<b>Photo No.</b> 3	<b>Date</b> 5-7-2014
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**Description**  
*Twelve Mile Creek (OU2)*  
Lay Bridge Overpass looking downstream




<b>Photo No.</b> 4	<b>Date</b> 5-7-2014
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**Description**  
*Twelve Mile Creek (OU2)*  
Lay Bridge Overpass looking upstream




# Photographic Log


<b>Client Name:</b> Schlumberger Technology Corporation	<b>Site Location:</b> Operable Unit Two (OU2)
--	--

<b>Photo No.</b> 5	<b>Date</b> 5-7-2014	
<b>Description</b> <i>Twelve Mile Creek (OU2)</i> Maw Bridge Overpass looking upstream		

<b>Photo No.</b> 6	<b>Date</b> 5-7-2014	
<b>Description</b> <i>Twelve Mile Creek (OU2)</i> Maw Bridge Overpass looking downstream		

# Photographic Log

<b>Client Name:</b> Schlumberger Technology Corporation		<b>Site Location:</b> Operable Unit Two (OU2)
<b>Photo No.</b> 7	<b>Date</b> 5-7-2014	
<b>Description</b> <i>Twelve Mile Creek (OU2)</i> Maw Bridge Overpass looking downstream.		

<b>Client Name:</b> Schlumberger Technology Corporation		<b>Site Location:</b> Operable Unit One (OU2)
<b>Photo No.</b> 8	<b>Date</b> 5-7-2014	
<b>Description</b> Historic location of Woodside II Dam		


# Photographic Log

<b>Photo No.</b> 9	<b>Date</b> 5-7-2014	
<b>Description</b> Sign at historic location of Woodside II Dam		

<b>Client Name:</b> Schlumberger Technology Corporation	<b>Site Location:</b> Operable Unit One (OU2)
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<b>Photo No.</b> 10	<b>Date</b> 5-7-2014	
<b>Description</b> Sign at historic location of Woodside II Dam		

# Photographic Log

<b>Photo No.</b> 11	<b>Date</b> 5-7-2014	
<b>Description</b> Historic location of Woodside 1 Dam		


<b>Client Name:</b> Schlumberger Technology Corporation	<b>Site Location:</b> Operable Unit One (OU2)
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<b>Photo No.</b> 12	<b>Date</b> 5-7-2014	
<b>Description</b> Sign at historic location of Woodside I Dam		


# Photographic Log

<b>Photo No.</b> 13	<b>Date</b> 5-7-2014	
<b>Description</b> Madden Bridge Overpass looking downstream		

<b>Client Name:</b> Schlumberger Technology Corporation	<b>Site Location:</b> Operable Unit One (OU2)
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<b>Photo No.</b> 14	<b>Date</b> 5-7-2014	
<b>Description</b> Madden Bridge Overpass looking downstream		

# Photographic Log

Photo No.	Date	
15	5-7-2014	



# Appendix E

## Copy of Community Notification

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# EDUCATION

## National FFA Scholarship awarded to local student

PICKENS — The National FFA Organization awarded a \$1,000 Tractor Supply — Growing Scholars scholarship to Charlie Dunham of the Pickens County Career & Technology Center.

The scholarship is sponsored by Tractor Supply Company as a special project of the National FFA Foundation. Dunham plans to use the funds to pursue a degree at Tri-County Technical

College. The scholarship is one of 1,786 awarded through the National FFA Organization's scholarship program this year. Currently, 126 sponsors contribute more than \$2.2 million to support scholarships for students.

For 30 years, scholarships have been made available through funding secured by the National FFA Foundation. The funding comes from individuals, businesses and

corporate sponsors to encourage excellence and enable students to pursue their educational goals.

The 2014 scholarship recipients were selected from 6,315 applicants from across the country. Selections were based on the applicant's leadership, academic record, FFA and other school and community activities, supervised agricultural or work experience in agricultural education and future goals.



Gillian Black from the Horticulture Department of the Pickens County Career & Technology Center presents Charlie Dunham with a \$1,000 scholarship from Tractor Supply.

## R.C. Edwards students win at biology contest



A team of R.C. Edwards Middle School students participated in the Biology Merit Exam at Clemson University on April 11. With 198 competitors, Edwards students earned 13 of the 30 awards given in Division I. The winners included: Benjamin Buck, first place; Jennifer Gao and Connor Lehmacher, second place; David Cote, Jack Love, and John Martin, first honorable mention; and Nathaniel Hiott, Rebecca Freeze, Louisa Mai, Hannah Wiggins, Kristopher Luo, Seth Trotter, and Jason Williams, second honorable mention.

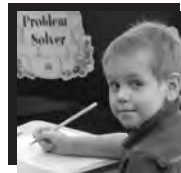
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A Tabernacle Christian Education



We're committed to fostering our students' success both in and out of the classroom. In addition to a dynamic and challenging academic curriculum, we teach students the value of self-respect, social responsibility and lifelong learning. Our goal is to provide each of our students with a well-rounded education that will inspire achievement in school and in life.



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Greenville, SC 29611  
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<http://tbc.sc/school/>

# Reason #124



**No more squinting!**

**You asked ... We listened.** We've redesigned our newspaper with a bigger font and better spacing, modifying the stories to be easier to read. Check out these improvements and more starting the week of July 22, 2014.

**The Dickens Sentinel**

00703226



### The U.S. Environmental Protection Agency, Region 4 Third Five-Year Review Sangamo Weston Superfund Site, Pickens County, South Carolina

The United States Environmental Protection Agency (EPA) Region 4 and the South Carolina Department of Health and Environmental Control (SC DHEC) have initiated the Third Five-Year Review for Operable Unit One (OU1) and Operable Unit Two (OU2) of the Sangamo Weston/Twelve Mile Creek/Lake Hartwell PCB Contamination Superfund Site in Pickens County, South Carolina. Five Year Reviews are conducted to evaluate the protectiveness of cleanup actions taken at Superfund sites.

OU1 of the Sangamo site addressed the land based PCB source areas, including the former Plant site and six satellite disposal areas. Soils impacted by PCBs were excavated from the disposal areas and stockpiled at the Plant Site for treatment. From December 1995 through May 1997, approximately 60,000 tons of soil was treated via thermal desorption and backfilled on the Plant Site. Active groundwater recovery and treatment was initiated at the Plant Site in November 1998. The Plant Site system has recovered more than 400 million gallons of groundwater, and removed an estimated 1,988 pounds of chlorinated solvents and 27 pounds of PCBs. The treatment system was completely refurbished in 2013. In late 2013, an additional 17,000 tons of residual source material was excavated from the Plant site and transported off-site for proper disposal. This supplemental work removed an estimated 6,300 pounds of PCBs and 715 pounds of chlorinated solvents of source material from the subsurface. The Breazeale Site water treatment system recovered an estimated 116 million gallons prior to shut-down in 2009 and decommissioning in 2014.

OU2 of the Sangamo site addressed the sediment, surface water, and biological migration pathways down stream from the land-based source areas. A fish consumption advisory on Lake Hartwell was first issued in 1976, and has been modified many times since to provide meal advice to anglers based on PCB trends in fish tissue. Impacted surface sediments in the Twelve Mile Creek Arm of Lake Hartwell are being addressed by natural burial processes referred to as Monitored Natural Recovery.

EPA and SCDHEC anticipate that the Third Five Year Review for the Sangamo site will be completed by September 2014. Public comments and questions on the Five Year Review process are encouraged. For more information on the Sangamo site, please visit the EPA web page at <http://www.epa.gov/region4/superfund/sites/npl/southcarolina/sangsc.html>; or contact the EPA/SCDHEC project managers below:

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