FINAL
SOLID WASTE MANAGEMENT UNIT 29 SITE INSPECTION REPORT FOR PER- AND POLYFLUOROALKYL SUBSTANCES PUEBLO CHEMICAL DEPOT, PUEBLO, COLORADO

Prepared for:

U.S. ARMY

U.S. Army Pueblo Chemical Depot
Under Contract W9128F20D0051
U.S. Army Corps of Engineers

November 2023

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ACRONYMS AND ABBREVIATIONS

%R	percent recovery
°C	degrees Celsius
°F	degrees Fahrenheit
AFFF	aqueous film-forming foam
amsl	above mean sea level
AOPI	area of potential interest
APP	Accident Prevention Plan
Army	U.S. Army
ASD	Assistant Secretary of Defense
ASTM	American Society for Testing and Materials
bgs	below ground surface
BRAC	Base Realignment and Closure
CCV	continuing calibration verification
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CoC	chain-of-custody
CPW	Colorado Parks and Wildlife
CSM	conceptual site model
DERP	Defense Environmental Restoration Program
DI	deionized
DL	detection limit
DoD	U.S. Department of Defense
DQO	data quality objective
EIS	extracted internal standard
FB	field blank
FTA	Fire Protection Training Area
GPS	Global Positioning System
HDPE	high-density polyethylene
HFPO-DA	hexafluoropropylene oxide-dimer acid
HGL	HydroGeologic, Incorporated
HQ	hazard quotient
HSA	hollow-stem auger
HWPM	Hazardous Waste Program Manager
IAW	in accordance with
IC	institutional control
ICV	initial calibration verification
ID	identification
IDW	investigation-derived waste
IDW/RW MP	Investigation-Derived Waste/Remediation Waste Management Plan
IOW	Industrial Outdoor Worker
LC/MS/MS	liquid chromatography with tandem mass spectrometry
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LOD	limit of detection

LOQ	limit of quantitation
LUC	land use control
MB	method blank
mph	mile per hour
MS	matrix spike
MSD	matrix spike duplicate
msl	mean sea level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFA	no further action
NPL	National Priorities List
OSD	Office of the Secretary of Defense
PA	Preliminary Assessment
PAH	polycyclic aromatic hydrocarbon
PCD	Pueblo Chemical Depot
the Permit	Pueblo Chemical Depot Hazardous Waste Part B Permit No. CO-13-12-23-01
PFAS	per- and polyfluoroalkyl substances
PFBA	perfluorobutanoic acid
PFBS	perfluorobutane sulfonate
PFHxA	perfluorohexanoic acid
PFHxS	perfluorohexane sulfonate
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
PID	photoionization detector
PPE	personal protective equipment
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
QCSR	Quality Control Summary Report
QSM	Quality Systems Manual
RCRA	Resource Conservation and Recovery Act
RPD	relative percent difference
RSL	Regional Screening Level
RW	remediation waste
SB	source blank
SCT	South Central Terrace
SDG	sample delivery group
SI	Site Inspection
SL	screening level
SOP	standard operating procedure
SOS	Scope of Services
SSHP	Site Safety and Health Plan
SVOC	semivolatile organic compound
Swift River	Swift River Environmental Services, LLC
Swift River TLI JV	Swift River TLI Solutions Joint Venture
SWMU	Solid Waste Management Unit
TA	Eurofins-TestAmerica

TLI	TLI Solutions
TOC	total organic carbon
UFP-QAPP	Uniform Federal Policy Quality Assurance Project Plan
UN	United Nations
USACE	U.S. Army Corps of Engineers
USC	United States Code
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound

EXECUTIVE SUMMARY

The U.S. Army (Army) is conducting Preliminary Assessments (PAs) and Site Inspections (SIs) to determine the use, storage, disposal, or release of per- and polyfluoroalkyl substances (PFAS) at multiple Base Realignment and Closure (BRAC) installations, nationwide. This report documents SI activities conducted for one area of potential interest (AOPI), Solid Waste Management Unit (SWMU) 29, at the Pueblo Chemical Depot (PCD) in Pueblo, Colorado. The AOPI was identified during the PA phase for investigation through multimedia sampling in an SI phase to determine whether a PFAS release occurred. Activities were completed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, 42 USC §9601 et seq.), the Defense Environmental Restoration Program (DERP, 10 USC §2700 et seq.) the National Oil and Hazardous Substances Pollution Contingency Plan (NCP, 40 CFR Part 300), and Army and U.S. Department of Defense (DoD) policy and guidance, and U.S. Environmental Protection Agency (USEPA) guidance.

The PA identified areas where PFAS-containing materials were used, stored, and/or disposed of, or areas where known or suspected releases to the environment occurred. Based on recommendations from the PA, soil, groundwater, sediment, and surface water samples were collected from SWMU 29. The field investigation at PCD was conducted in accordance with the Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) (Swift River-TLI 2023). Samples collected during this SI were analyzed for PFAS using procedures compliant with the DoD Quality Systems Manual (QSM) Version 5.3, Table B-15 (DoD 2019) and the laboratory standard operating procedure (SOP).

To determine if future investigation is warranted at SWMU 29, this SI followed established USEPA guidance and DoD policy and guidance for PFAS investigations. The May 2023 USEPA Regional Screening Levels (RSLs) for soil and tap water were applied as screening levels (SL) for surface soil, sediment, surface soil, and groundwater samples collected at SWMU 29. The May 2023 RSLs, which apply to eight PFAS, perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA) perfluorobutanesulfonic acid (PFBS), perfluorononanoic acid (PFNA), perfluorohexane sulfonate (PFHxS), and hexafluoropropylene oxide dimer acid (HFPO-DA), perfluorobutanoic acid (PFBA), and perfluorohexanoic acid (PFHxA) were incorporated in the August 24, 2023 Assistant Secretary of Defense (ASD) Memorandum, Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program that replaces the 2022 Office of the Secretary of Defense (OSD) Memorandum (DoD 2022, DoD 2023). It should be noted that HFPO-DA (GenX) had been eliminated from consideration in the PA based on the potential aqueous film forming foam (AFFF) release occurring before GenX chemicals were used in PFAS manufacturing. Since PFAS is a large grouping consisting of thousands of individual chemicals, PFOS, PFOA, PFBS, PFNA, PFHxS, PFBA, and PFHxA altogether will be referred to in this report as “Target PFAS.”

A conceptual site model (CSM) was developed during the PA, and then updated where Target PFAS were detected at concentrations above the limit of detection (LOD). LOD values for this Site Investigation can be found in Worksheet #15A and #15B of the approved UFP_QAPP. The updated CSM details site geological conditions; determines primary and secondary release mechanisms; identifies potential human receptors; and details complete, potentially complete, and incomplete exposure pathways for current and reasonably anticipated future exposure scenarios. PFAS were detected in all media at SWMU 29 (soil, groundwater, surface water, and sediment; however, PFAS were detected in surface soil but not subsurface soil). PFAS concentrations exceeded SLs in one surface water sample. Only PFOS and PFNA were detected in surface water at concentrations that exceeded SLs. Figure ES-1 depicts the detections at SWMU 29 soil, groundwater, surface water, and sediment results.

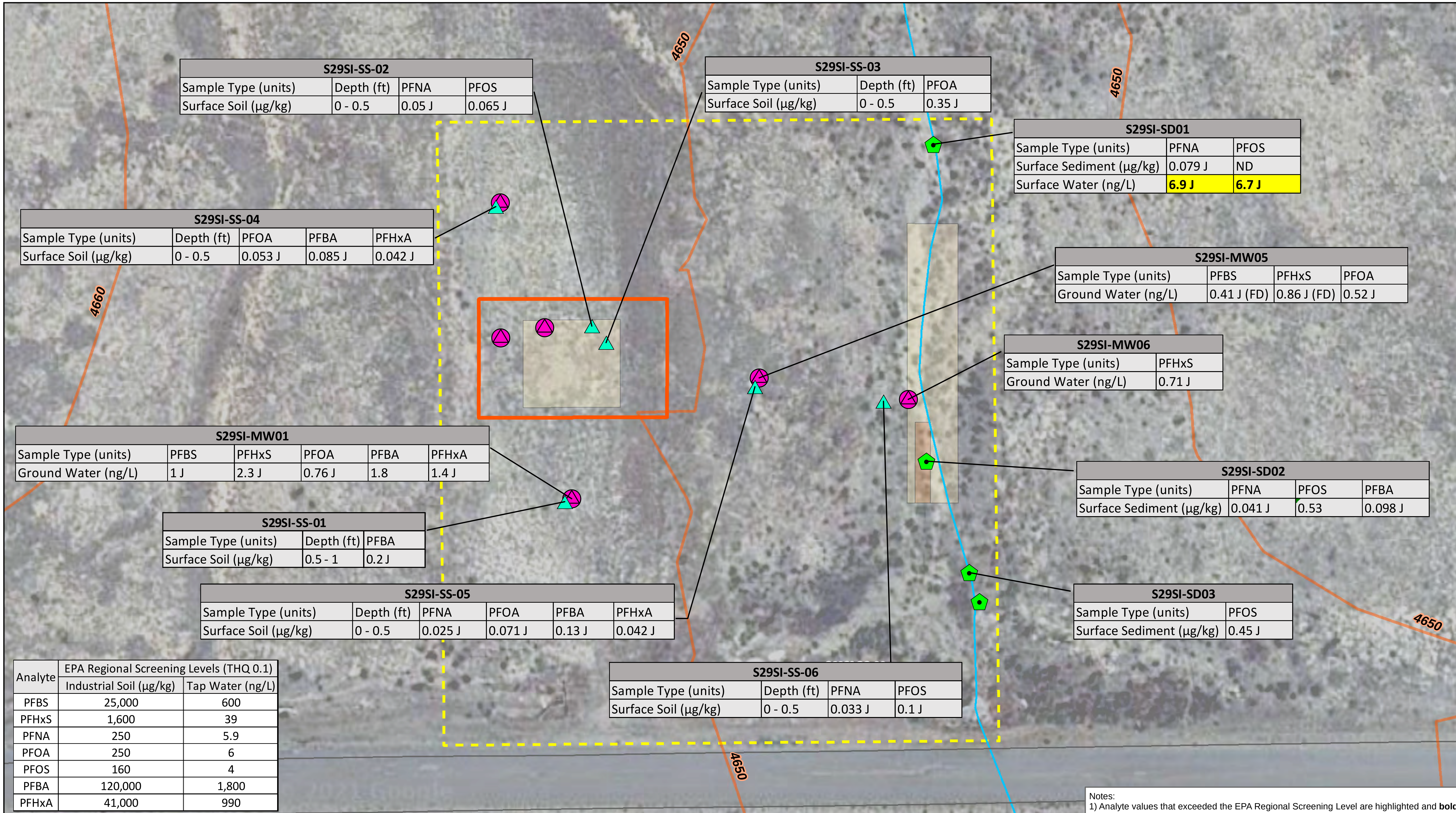
Although the PA identified areas at SWMU 29 where PFAS-containing materials may have been released to the environment, results from the SI show there is no risk to human health targets. The only exceedance of its respective SL was a surface water sample collected during a major rain event from the most upgradient sampling location of SWMU 29. The associated sediment sample from this location was below its respective SL. Thus, the exceedance of the SL in the surface water sample suggests contamination is not moving downgradient via surface water flow or migrating into the sediment, soil, and groundwater below.

Table ES-1 summarizes the recommendations for further investigation.

Table ES-1. Summary of Recommendation for Further Investigation

AOPI Name	Exceedance of SLs				Recommendation
	Soil (Surface and Subsurface)	Groundwater	Surface Water	Sediment	
SWMU 29	No exceedances of SLs. No additional sampling recommended.	No exceedances of SLs. No additional sampling recommended.	S29SI-SW01 exceeded SLs for two Target PFAS constituents. This surface water location is the most upgradient of the study area. No additional sampling recommended.	No exceedances of SLs. No additional sampling recommended.	No additional sampling is recommended. Although surface water sample S29-SW01 exceeded the SL, downgradient surface water and all associated sediment samples were below their respective SLs, indicating no on-site source at SWMU 29.

Figure ES-1. SWMU 29 SI, All Sample Detections



S29SI-SS-02			
Sample Type (units)	Depth (ft)	PFNA	PFOS
Surface Soil (µg/kg)	0 - 0.5	0.05 J	0.065 J

S29SI-SS-03		
Sample Type (units)	Depth (ft)	PFOA
Surface Soil (µg/kg)	0 - 0.5	0.35 J

S29SI-SD01		
Sample Type (units)	PFNA	PFOS
Surface Sediment (µg/kg)	0.079 J	ND
Surface Water (ng/L)	**6.9 J**	**6.7 J**

S29SI-SS-04				
Sample Type (units)	Depth (ft)	PFOA	PFBA	PFHxA
Surface Soil (µg/kg)	0 - 0.5	0.053 J	0.085 J	0.042 J

S29SI-MW05			
Sample Type (units)	PFBS	PFHxS	PFOA
Ground Water (ng/L)	0.41 J (FD)	0.86 J (FD)	0.52 J

S29SI-MW06	
Sample Type (units)	PFHxS
Ground Water (ng/L)	0.71 J

S29SI-MW01					
Sample Type (units)	PFBS	PFHxS	PFOA	PFBA	PFHxA
Ground Water (ng/L)	1 J	2.3 J	0.76 J	1.8	1.4 J

S29SI-SD02			
Sample Type (units)	PFNA	PFOS	PFBA
Surface Sediment (µg/kg)	0.041 J	0.53	0.098 J

S29SI-SS-01		
Sample Type (units)	Depth (ft)	PFBA
Surface Soil (µg/kg)	0.5 - 1	0.2 J

S29SI-SS-05					
Sample Type (units)	Depth (ft)	PFNA	PFOA	PFBA	PFHxA
Surface Soil (µg/kg)	0 - 0.5	0.025 J	0.071 J	0.13 J	0.042 J

S29SI-SD03	
Sample Type (units)	PFOS
Surface Sediment (µg/kg)	0.45 J

S29SI-SS-06			
Sample Type (units)	Depth (ft)	PFNA	PFOS
Surface Soil (µg/kg)	0 - 0.5	0.033 J	0.1 J

Analyte	EPA Regional Screening Levels (THQ 0.1)	
	Industrial Soil (µg/kg)	Tap Water (ng/L)
PFBS	25,000	600
PFHxS	1,600	39
PFNA	250	5.9
PFOA	250	6
PFOS	160	4
PFBA	120,000	1,800
PFHxA	41,000	990

Notes:
1) Analyte values that exceeded the EPA Regional Screening Level are highlighted and **bold**.

Legend

Site Investigation Sample Location
- Borehole/Monitoring Well
- Surface Soil Sample
- Sediment/Surface Water Sample

Study Boundary

Excavations
- Approximate June 2006 Removal Action
- Approximate August 2006 Removal Action

Site Feature
- Railroad
- Road
- Stream
- SWMU Boundary
- Pueblo Chemical Depot Boundary
- Water Body
- Building or Structure

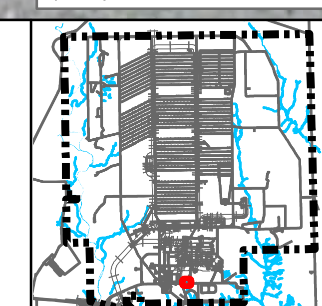


Figure ES-1
SWMU 29 SI
All Sample Detections

PUEBLO CHEMICAL DEPOT PUEBLO, COLORADO

0 10 20 40 Feet
1 inch = 40 feet

Prepared For:
Prepared By: SWIFT RIVER TLI

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1. INTRODUCTION

The U.S. Army (Army) is conducting Preliminary Assessments (PAs, 40 CFR §300.420(b)) and Site Inspections (SIs, 40 CFR §300.420(c)) to investigate the presence or release of per-and polyfluoroalkyl Substances (PFAS), by investigating the use, storage, or disposal of PFAS at multiple Base Realignment and Closure (BRAC) installations, nationwide. This SI is focused on the Pueblo Chemical Depot (PCD), and was conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, 42 United States Code [USC] §9601 et seq.); the Defense Environmental Restoration Program (DERP, 10 USC §2700 et seq.); the National Oil and Hazardous Substances Pollution Contingency Plan (NCP, 40 Code of Federal Regulations [CFR] Part 300); and guidance documents developed by the U.S. Environmental Protection Agency (USEPA), the Department of Defense (DoD) and the Army. PCD is not on the National Priorities List (NPL), and the Army is responsible for compliance with CERCLA in accordance with Executive Order 12580, as amended.

Based on results of the PCD PA for Aqueous Film-Forming Foam (AFFF) Areas ("the PA," HydroGeologic, Inc. [HGL] 2020), one area of potential interest (AOPI), Solid Waste Management Unit (SWMU) 29, was identified for investigation through multimedia sampling in an SI to determine whether a PFAS release occurred. PCD is located in Pueblo, Colorado (Figure 1-1). The entirety of the former PCD is referred to as the "site" throughout this document. Any references to "off-site" refers to areas that are outside the boundary of PCD.

1.1 SCOPE AND OBJECTIVES

The overall objective of the SI is to determine the presence or absence of PFAS above the screening levels (SLs) at SWMU 29. The SI Report will use the findings from the PA, which guided the development of the Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) for SWMU 29 PFAS SI ("the UFP-QAPP", Swift River TLI Solutions Joint Venture [Swift River TLI JV] 2023), in conjunction with soil, groundwater, surface water, and sediment sampling data to determine whether PFAS have been released to the environment and whether a release has affected or may affect specific human health targets. Furthermore, the SI will evaluate and summarize the need for additional investigation (40 CFR §300.420(c)(1)).

The SI scope included preparation of project planning documents; field investigation; validation and management of analytical data; comparison of analytical data to the May 2023 EPA RSLs; and documentation of the investigation results. This SI was conducted in accordance with the UFP-QAPP. The field activities followed site-specific sampling, health and safety, and investigation-derived waste handling (IDW) protocols, as identified in the Accident Prevention Plan/Site Safety and Health Plan (APP/SSHP) (Swift River TLI JV 2021a) and Investigation-Derived Waste/Remediation Waste (RW) Management Plan (IDW/RW MP) (Swift River TLI JV 2021b).

1.2 PCD DESCRIPTION

PCD is located in southeastern Colorado, approximately 14 miles east of Pueblo and immediately north of the Arkansas River in Pueblo County (Figure 1-1). PCD's mission has included ordnance and optical equipment maintenance, ammunition renovation and demilitarization, missile maintenance, missile demilitarization, and combat vehicle maintenance. As a result of activities at PCD associated with the handling and storage of hazardous chemicals and the demilitarization or destruction of munitions, 62 SWMUs have been identified in the Pueblo Chemical Depot Hazardous Waste Part B Permit No. CO-13-12-23-01 (the Permit) issued by Colorado Department of Public Health and Environment (CDPHE) (CDPHE 2014), as modified.

SWMU 29, referred to as the Fire Protection Training Area (FTA), is located in the southern part of PCD, north of SWMU 14 (Figure 1-2).

According to the PA, it is possible that AFFF may have been used at SWMU 29 before 1999 during fire training exercises.

1.3 REPORT ORGANIZATION

The contents of the remaining sections of this SI Report are summarized below:

- ***Section 2. Environmental Setting***—This section discusses the environmental setting at PCD. Demographics, land use, geology, hydrogeology, hydrology, soil, and climate are described.
- ***Section 3. Field Investigation Activities***—This section provides field procedures followed during the implementation of the SI.
- ***Section 4. Data Analysis and Quality Assurance Summary***—This section describes the laboratory chemical analysis program for the investigation. Sample handling procedures, laboratory equipment calibration, laboratory analytical methods, data reporting and validation, and sample data quality assurance (QA)/quality control (QC) are discussed.
- ***Section 5. Screening Levels***—This section presents the PFAS with screening levels established by USEPA in May 2023 and incorporated into the 2023 ASD Memorandum (DoD 2022) and the SLs to which SI results are compared.
- ***Section 6. SI Results***—This section presents the data gathered during the SI activities and an updated conceptual site model (CSM).
- ***Section 7. Conclusions and Recommendations***—This section summarizes the SI conclusions and presents recommendations for SWMU 29.
- ***Section 8. References*****—**This section lists the references that were used in the preparation of this report.
- ***Appendices***—Appendices A through G include data from field activities or related assessments:
  - Appendix A. Weekly Field Summary Notes
  - Appendix B. Daily Field Activity Logs
  - Appendix C. Boring Logs and Well Construction Logs
  - Appendix D. Groundwater Sampling and Calibration Logs
  - Appendix E. IDW Documents
  - Appendix F. Quality Control Summary Report (QCSR)
  - Appendix G. Data Presentation Tables

2. ENVIRONMENTAL SETTING

This section provides general information about PCD, including the site location, operational history, current and projected land use, climate, topography, geology, hydrogeology, surface water hydrology, potable wells within a five-mile radius of the installation, and applicable ecological receptors (TLI Solutions 2020). Due to the site's large areal extent with areas of contamination that do not interact with each other, this section focuses on the South Central Terrace (SCT) area within PCD (Figure 1-2).

2.1 SITE LOCATION

PCD is located in southeastern Colorado, approximately 14 miles east of the City of Pueblo and immediately north of the Arkansas River, in Pueblo County (Figure 1-1). Figure 2-1 depicts the PCD site features, including the site boundary, roads, buildings, topography, and locations of the creeks. SWMU 29 is located in the southern part of PCD, north (i.e., upgradient) of SWMU 14 and west (i.e., side-gradient) of the SWMU 28/36 Western Mid-Plume (Figures 1-2 and 2-1). SWMU 29 is comprised of grasslands and desert. These features extend from the SWMU in all directions.

2.2 SITE OPERATIONAL HISTORY

PCD encompasses approximately 23,000 acres and includes a variety of buildings, structures, and undeveloped areas (Figure 1-1). PCD began operation as the Pueblo Ordnance Depot in 1942. Its original mission was the storage and supply of ammunition, but the mission was expanded to receive, store, and issue general supplies to support World War II. Since then, PCD's mission has included ordnance and optical equipment maintenance, ammunition renovation and demilitarization, missile maintenance, missile demilitarization, and combat vehicle maintenance. After being designated for realignment in 1988 by the BRAC Commission, PCD's mission was reduced to storage of chemical munitions on September 30, 1994.

2.3 PROPERTY TRANSFER AND LAND USE

The current mission of PCD is the safe and secure storage, monitoring, and destruction of the chemical stockpile and preparation for its closure. The Army has made its intentions known to CDPHE to refocus environmental restoration activities toward a reuse of the land comprising the PCD property that provides long-term benefits to the citizens and taxpayers of southeastern Colorado.

As a result of activities at PCD associated with the handling, storage, or destruction of munitions and hazardous constituents, 62 SWMUs have been identified in the Permit (CDPHE 2014), and subsequent modifications. In accordance with the Permit, cleanup of the SWMUs is conducted to address past releases of hazardous constituents to the environment.

2.4 TOPOGRAPHY

PCD is located in the western portion of the Colorado Piedmont section of the Great Plains physiographic province. The site is situated on an undulating upland terrace, an erosional remnant of a once-extensive alluvial terrace deposit. The terrace slopes southward at approximately 25 feet per mile. The elevation of the facility ranges from approximately 4,800 feet above mean sea level (amsl) in the north to approximately 4,550 feet amsl in the extreme southwestern and southeastern portion of the facility. The southern edge of the terrace at PCD is approximately 150 feet above the Arkansas River, which is one to two miles south of PCD (Figure 1-1).

2.5 GEOLOGY

PCD is located on an erosional remnant of a Pleistocene alluvial terrace deposit. This alluvium unconformably overlies the Pierre Shale. In the central and northern portions of PCD, loess and dune sands overlie the alluvium. The Pierre Shale is the only bedrock unit that outcrops at PCD. Beneath the Pierre Shale is a sequence of shales and limestones, which in turn is underlain by the Dakota Sandstone at depths approximately 2,200 feet below ground surface (bgs). The alluvium and Pierre Shale are the only significant subsurface units beneath the site with regard to evaluating the fate and transport of potential contaminants.

2.5.1 Alluvium

The terrace alluvium consists of stratified, unconsolidated clayey or silty sand; fine- to coarse-grained sand; sandy clay and silt; fat clay; gravel; and mixtures of these constituents. These sediments are most commonly poorly sorted (well graded). The terrace alluvium typically displays a "fining upward" sequence, and locally, a thin layer of calcium carbonate-cemented sand or gravel is intermittently present between the ground surface and the water table. The alluvium is absent in areas where erosion has exposed the Pierre Shale and is up to 75 feet thick where paleochannels have scoured the bedrock surface.

Alluvial deposits occupying the present channels and floodplain areas of the Arkansas River south of PCD are considered distinct from the terrace alluvium. These deposits are compositionally similar to the terrace alluvium, consisting of sandy silt, sandy gravel with clay, and locally interbedded thin layers of sandy clay or sandy silt.

2.5.2 Pierre Shale

The Pierre Shale underlying the Pleistocene-age terrace alluvial deposits is approximately 2,200 feet thick and is composed of gray marine clay shale and sandy shale. Erosion by the Arkansas River has exposed the Pierre Shale along the southern edge of the terrace remnant. The position of the bedrock/terrace alluvium contact is often delineated by the location of seeps and springs along steep scarps.

The upper part of the Pierre Shale beneath PCD was removed by erosion prior to deposition of the overlying terrace alluvium. As a result of this erosion, the bedrock surface is quite irregular, with troughs, hills, and ridges. The bedrock surface slopes irregularly to the south from an elevation of approximately 4,760 feet mean sea level (msl) near the northwestern corner of PCD to approximately 4,490 feet msl in the southwestern corner of PCD. The regional slope of the bedrock surface is approximately 25 feet/mile. The unweathered Pierre Shale is considered an aquiclude with very low hydraulic conductivities, and contaminant migration within the Pierre Shale is thought to be minimal.

2.6 HYDROGEOLOGY

The primary aquifer at the SCT is the alluvial terrace aquifer, which overlies the Pierre Shale bedrock. Groundwater generally occurs under unconfined conditions at depths up to 70 feet bgs. Because the Pierre Shale is an aquiclude, there is no substantial upward or downward flow across the Pierre Shale bedrock surface. Groundwater flow through the weathered portion of the Pierre Shale is expected to be limited. Where high groundwater contaminant concentrations have historically been present near the bottom of the alluvial aquifer, contaminant mass can, however, reside in the weathered Pierre Shale and/or in finer-grained portions of the alluvial aquifer.

Groundwater within the alluvial terrace aquifer of the SCT occurs at elevations ranging between approximately 4,650 feet amsl near SWMU 36 to approximately 4,600 feet amsl near the southern PCD boundary. The alluvial aquifer is thickest overlying paleochannels and thinnest along the terrace edges where the alluvium has been removed by erosion. One north-south trending bedrock paleochannel is present near the eastern edge of the SCT and appears to directly influence contaminant transport in the SCT. The paleochannel is characterized by alluvial thicknesses up to 75 feet and saturated thickness up to 45 feet. The saturated thickness tapers off to 0 feet at the eastern edge of SWMU 41 (Figure 2-1).

Regional recharge to the alluvial aquifer consists primarily of percolation of precipitation through the unsaturated zone. Most recharge from precipitation occurs north of PCD in areas where soils are developed on eolian sand and sandy alluvium. Capture of stream flow provides some recharge to the alluvial aquifer.

Regionally, groundwater flow in the alluvial aquifer is from north to south. Locally, the direction of groundwater flow is variable, and flow direction is controlled by the irregular configuration of the bedrock surface, its relation to the land surface and the water table, and the permeability of the alluvium. Regional discharge from the SCT alluvial aquifer consists of seepage and spring flow along portions of the contact between the alluvial deposits and the Pierre Shale on the scarps south of the PCD boundary where the SCT abruptly transitions into the Unnamed Creek drainage and the Arkansas River floodplain.

The alluvial terrace aquifer at the SCT is separated from the Chico Creek alluvial aquifer to the west based on physiographic and hydraulic separation. The alluvial deposits in the Chico Creek valley are hydraulically connected with the alluvial deposits of the Arkansas River Valley.

2.7 SURFACE WATER HYDROLOGY

Erosion of the terrace by several creeks along the western, southern, and eastern facility boundaries accounts for the greatest topographic relief, which is approximately 100 feet. Surface water runoff from PCD is collected by a network of ditches that flow in open channels to these creeks; Chico, Boone, and Haynes Creeks. Chico and Haynes Creeks flank the facility on the west and east, respectively, while Boone Creek originates near the center of the facility. The headwaters of Chico and Haynes Creeks are located well north of the facility. Surface water from each of these creeks not lost to evapotranspiration or infiltration ultimately discharges to the Arkansas River to the south. These creeks typically flow only during periods of heavy rainfall and snowmelt. Numerous springs and seeps sourced in the alluvial aquifer are located in many of the drainages of PCD, especially along Chico and Boone Creeks, as well as along the terraced cliff faces south of the PCD boundary. These springs and seeps are the result of alluvial aquifer discharge at the alluvium-bedrock contact. Continually standing or moving water is not present in the SWMU 29 drainage feature, and surface water is only present during large rain events.

2.8 WATER USAGE

PCD has two separate water supply areas: one in the northern part of PCD and one in the southern portion near the Building 500s area (labeled as the “SCT Industrial Area” in Figure 2-1). Eleven wells supplied domestic, industrial and irrigation waters to PCD beginning in 1942. The wells were developed to depths ranging from 48 to 70 ft bgs. Two wells developed in 1970 each had depths of 75 ft bgs. As of July 2011, 11 permitted water supply wells remain at PCD; however, none are south (i.e., downgradient) of SWMU 29 (HGL 2020).

2.9 ECOLOGICAL PROFILE

Ecological receptors include any living organisms other than humans and the habitat that supports such organisms, or natural resources that could be adversely affected by environmental contaminations resulting from a release at or migration from a contaminant source. The primary surface water features at PCD include Chico Creek, Boone Creek, Haynes Creek, Linda Ann Reservoir, Ammunition Workshop Pond, and an unnamed pond. These surface water features and associated plant and animal species are primary ecological receptors at PCD. The Arkansas River is the nearest surface water intake to potentially receive surface water migrating off PCD, though, as indicated above, evapotranspiration rates are very high and limited surface waters reach the Arkansas River.

As summarized in the PA, there are no designated wilderness areas or wildlife preserves within a mile of PCD; however, PCD does support populations of pronghorn antelope, coyote, various rodents, and reptiles (HGL 2020). According to the U.S. Fish and Wildlife Service (USFWS) and Colorado Parks and Wildlife (CPW), the following federally and state-listed endangered species have the potential to exist in Pueblo County, Colorado.

- Birds
    - Least Tern
    - Southwestern Willow Flycatcher
    - Whooping Crane
- Mammals
    - Black-footed ferret

The aforementioned endangered species are listed for Pueblo County and therefore have the potential to exist within the boundaries of PCD. In addition to the listed species, numerous wetlands are identified within the PCD boundaries as sensitive environmental receptors are located along the creek drainage pathways. Examples of the wetland types found at PCD are:

- Palustrine, emergent, persistent, temporary flooded (PEM1A);
- Palustrine, emergent, persistent, temporary flooded, diked/ impounded (PEM1Ah);
- Palustrine, emergent, persistent, seasonally saturated (PEM1B);
- Palustrine, emergent, persistent, seasonally flooded (PEM1C);
- Palustrine, emergent, persistent, seasonally flooded, diked/ impounded (PEM1Ch);
- Palustrine, emergent, persistent, seasonally flooded, excavated (PEM1Cx);
- Palustrine, emergent, persistent, semi-permanently flooded, diked/ impounded (PEM1Fh);
- Palustrine, forested, temporary flooded (PFoA);
- Palustrine, scrub-shrub, temporary flooded (PSSA); and
- Palustrine, scrub-shrub, seasonally saturated (PSSB).

2.10 CLIMATE

The climate surrounding the PCD area is semiarid, with an average humidity of 41 percent (%) and average temperatures varying from 29 degrees Fahrenheit (ºF) in January to 76ºF in July. The average annual temperature is approximately 52ºF with average daily maximum and minimum temperatures of approximately 68ºF and 38ºF, respectively. The bulk of precipitation results from two seasonal regimes. From October through May, precipitation generally occurs in the form of snow. However, most of the area's moisture occurs from June to September, when summer thunderstorms provide more intense precipitation. Average annual precipitation at the Pueblo Memorial Airport is approximately 12 inches. Average annual pan evaporation at the airport was 67 inches from 1971 to 1997. Measurable evaporation exists from approximately April through October each year and evaporation is low, or immeasurable, during the months of November through March. The average monthly evaporation ranges from approximately 12 inches in July to 6.28 inches in October.

Wind direction and speed generally vary seasonally and diurnally. Wind speeds average approximately 7 miles per hour (mph) in the fall and early winter, and 10 mph in the spring. Strong winds usually blow from the north and west and are most common in late winter and early spring. Diurnal variations in wind direction occur throughout the year, with prevailing up-valley winds from the east/southeast during the day and down-valley winds from the west at night.

3. FIELD INVESTIGATION ACTIVITIES

This section provides field procedures followed during the implementation of the SI (40 CFR §300.420(c)(4)(i)). The principal guidance document for the field investigation activities and procedures used for the SWMU 29 SI were consistent with the requirements presented in the Army Guidance for Addressing Releases of PFAS (Army 2018).

3.1 SITE INSPECTION DATA QUALITY OBJECTIVES

The data quality objectives (DQOs) were developed to define the problem at SWMU 29, identify the necessary decisions, specify decision-making rules and the level of confidence necessary to resolve the problem, identify the number of samples necessary to support the decision, and obtain agreement from the decision makers before the sampling program was initiated. The SWMU 29 sample locations were determined based on current site conditions (i.e., groundwater flow direction), presence of site media (e.g., sediment and surface water may not be present outside of a large storm event), historical data (e.g., suspected location of PFAS release), and historical activities (e.g., remedial activities). The project stakeholders concurred that the selected sampling scheme would be representative of site conditions prior to initiation of field investigation activities. The field investigation at SWMU 29 was conducted in accordance with the UFP-QAPP (Swift River TLI JV 2023). The field activities employed to execute the UFP-QAPP are described below and include any variances or deviations.

3.2 SAMPLE DESIGN AND RATIONALE

SWMU 29 was investigated during the SI to determine the presence or absence of PFAS above the SLs in the environment. Information inputs from the preliminary CSM presented on Worksheet #10 of the UFP-QAPP Addendum (Swift River TLI JV 2023) is the basis for sample design. All samples were analyzed for the Target PFAS list of PFOS, PFOA, PFBS, PFNA, PFHxS, PFBA, and PFHxA. Hexafluoropropylene oxide-dimer acid (HFPO-DA, a GenX chemical) was not included as a SWMU 29 Target PFAS due to the timeframe of possible AFFF release (fire training exercises in the 1980s) that is prior to the development and use of GenX chemicals (Swift River TLI JV 2023, USEPA 2021).

The approach for determining the presence or absence of PFAS at SWMU 29 consisted of collecting a total of 18 surface and subsurface soil samples; groundwater samples from six newly installed, temporary wells; four sediment samples from 0-0.5 feet bgs within the drainage feature that receives runoff from SWMU 29; four surface water samples at the same locations as the sediment samples, if these media were present.

Each location that was sampled, with a unique set of coordinates, was assigned a specific site location in one of two formats:

- SWMU29SI-XX##, or
- SWMU29SI-XX-## where:
- XX = the abbreviation for the type of media being sampled
- ## = the sequential number of each sample location

QA/QC samples were denoted according to the sample type. Rinsate blank, field duplicate, matrix spike (MS), and matrix spike duplicate (MSD) samples were denoted by appending “RB,” “FD,” “MS,” and “MSD,” respectively, to the parent sample ID. Field blanks and potable/source water blanks were named using the format of SWMU29SI-YYyy, where:

- YY = FB (field blank) or SB (source blank)
- yy = sequential number of each type of blank sample collected.

3.3 FIELD INVESTIGATION ACTIVITIES

SI field activities were conducted from April 10 through May 18, 2023. The locations and methods of sample collection under the SI are described in the following sections. Sampling procedures adhered to the UFP-QAPP (Swift River TLI JV 2023), with relevant information summarized below.

Sampling activities at SWMU 29 included collecting surface and subsurface soil samples from soil borings, installing temporary groundwater monitoring wells, conducting one round of groundwater samples, and collecting sediment and surface water samples where these media were present. Samples were analyzed for 24 PFAS to determine the presence or absence of PFAS. A total of 30 samples were planned, as presented in Table 3-1 and shown in Figures 6-1 through 6-4. Prior to beginning sampling, site reconnaissance and utility clearance were performed. Any variances in sampling procedure, such as sample point elimination, were discussed with the project team and communicated in weekly field summary emails (Appendix A). Field procedures and any variances are discussed in the following sections.

Table 3-1. SWMU 29 Planned Sample Collection

AOPI	Soil Samples	Groundwater Samples	Sediment Samples	Surface Water Samples
SWMU 29	6 SS/ 12 SB	4	4	4

Notes:
Sample counts do not include field duplicate or any other QC samples.
SS = Surface soil sample
SB = Subsurface soil sample

3.4 FIELD PROCEDURES

The following sections describe utilities clearance, temporary well installation and development procedures, field procedures for sampling each medium, borehole abandonment, and location survey. Details regarding each of these activities are documented on Daily Activity Logs that are provided in Appendix C.

Because many materials routinely used during environmental investigation can potentially contain PFAS, the field crew conducted SI activities in accordance with the PFAS sampling SOP presented in Appendix B of the UFP-QAPP (Swift River TLI JV 2023). Procedures include requirements for equipment, containers, handling, and sampling, including PFAS-specific requirements, to ensure that sample contamination does not occur during collection and transport.

3.4.1 Utility Clearance

Prior to initiating intrusive activities, the field manager coordinated underground utility clearances for SWMU 29 through PCD, the private utility locator GPRS, and Colorado 811 Utility Locator. As part of the utility clearance process, each area was visually inspected to verify that utilities had been marked, and the field manager looked for signs of unidentified utilities (including overhead utilities). In addition, the boreholes were excavated using a low-impact technique (hand auger) to a minimum of 5 feet bgs.

3.4.2 Bulk Source Water Sampling

Prior to beginning work, two bulk source water samples (SourceBlank01 and SourceBlank02) were collected on March 15, 2023, for PFAS analysis to determine if the source water was PFAS-free (i.e., PFAS not detected above the LOD) and could be used for drilling and decontamination. Sample SourceBlank01 was collected from a spigot outside of Building 154, which serves as TLI's field office. Sample SourceBlank02 was collected from a potable water source located inside Building 535. Source water was purged for a minimum of one minute prior to filling high-density polyethylene (HDPE) bottles. Water was determined to not be PFAS free and was not used as a drilling and decontamination water source during field sampling. The alternative option, laboratory-grade deionized (DI) water and water that was verified to be PFAS-free and provided by the laboratory was used.

3.4.3 Soil Sampling

All soil samples were collected in accordance with the procedures outlined in the UFP-QAPP (Swift River TLI JV 2023). QC samples, including field duplicates, equipment blanks, and MS/MSDs, were also collected.

Subsurface soil samples were collected via direct push drilling with disposable, PFAS-free acetate liners using a Geoprobe® 7822DT. Surface samples and the top 5 feet of a soil boring were collected with a stainless-steel hand auger that was decontaminated between locations. Each soil core was logged for lithology in accordance with U.S. Army Corps of Engineers (USACE) guidance and recorded on a drilling log (drilling logs are provided in Appendix C). All soil sample intervals were homogenized in disposable 1-gallon HDPE bags prior to placing the soil into 4-ounce HDPE sample bottles for PFAS analysis and 4-ounce wide mouth glass jars for total organic carbon (TOC) and pH analysis. The remaining soil was kept in the 1-gallon HPDE bags for clay content and soil grain size analysis. Sample bottles were labeled and sealed in Ziploc® bags and placed on wet ice for cooling to ≤6 degrees Celsius (°C). Additional details on protocols for obtaining soil samples are outlined on Worksheet #18 and the PCD SOP "Soil Sampling" provided in the UFP-QAPP (Swift River TLI JV 2023).

Surface soil samples were collected from the 0- to 1-foot bgs interval. Surface soil sample depths did not exceed 1 foot bgs.

Two subsurface soil samples were collected from each soil boring. During the advancement of the soil borings, continuous soil cores were collected for recording lithology and documenting visual observations. Subsurface soil samples were collected as grab samples from 1-foot intervals, and the interval from which the sample was collected was recorded on the boring log.

Eighteen soil samples were collected across six soil borings and submitted to the laboratory for PFAS, TOC and pH analysis. Two field duplicate samples were collected and analyzed for PFAS. The field duplicate collection frequency for PFAS exceeded the minimum collection frequency goal of 10% field duplicate samples were not required for TOC or pH because these analyses are collected for informational purposes only and are not collected for compliance purposes.

Within the locations of the 2006 removal action excavations, samples for laboratory analysis were taken from 1) approximately 6 inches to 1 foot below the base of the removal action excavation to avoid sampling the fill material and 2) above the capillary fringe to evaluate the potential for leaching. Outside the locations of the 2006 removal action excavations, samples for laboratory analysis were taken from 1) within 0.5-4 feet bgs where concentrations of polycyclic aromatic hydrocarbons (PAHs) were historically found and 2) above the capillary fringe to evaluate the potential for leaching.

Soil borings were abandoned following sample collection by backfilling the borehole with bentonite chips, per the PCD SOP "Monitoring Well Abandonment" provided in the UFP-QAPP (Swift River TLI JV 2023). Bentonite chips were hydrated using the laboratory-grade DI water. Surface restoration did not occur to match the natural conditions of the field at SWMU 29, which was partially vegetated.

3.4.4 Surface Water and Sediment Sampling

All sediment/surface water samples were collected in accordance with the procedures outlined in the UFP-QAPP (Swift River TLI JV 2023). Co-located sediment and surface water samples were collected from four locations. One surface water field duplicate and one sediment field duplicate were collected and analyzed for PFAS. The minimum field duplicate collection frequency goal of 10% was exceeded. QC samples, including equipment blanks and MS/MSDs, were also collected.

Surface water samples were collected directly from the selected locations by submerging the HDPE sample bottle just below the water surface, being careful to avoid sediment agitation.

Following the collection of surface water samples, sediment samples were collected directly from the selected locations from 0 to 6 inches bgs using a decontaminated stainless steel hand auger. Sediment sampling was performed after surface water sampling to avoid sediment in the surface water sample. All sediment samples were homogenized in disposable HDPE bags prior to placing the sediment into laboratory-supplied 4-ounce HDPE sample bottles. Sample containers were labeled, sealed in Ziploc® bags, and placed on wet ice for cooling to ≤6°C.

3.4.5 Groundwater Sampling

Six temporary monitoring wells were installed at SWMU 29 using hollow-stem augers (HSA) and constructed using new 2-inch-diameter schedule 40 polyvinyl chloride (PVC) and 10-foot 7-slot non-contaminating, non-clogging, continuous slot, wire wrapped stainless-steel screened intervals. The total depths of temporary monitoring wells were determined by both UFP-QAPP guidance and observed site conditions noted during direct push drilling conducted at nearby soil boring locations as part of the SI. At temporary monitoring wells S29SI-MW05 and S29SI-MW06, borehole advancement was terminated above the approximate bedrock depth of 35 feet bgs outlined in QAPP Worksheet #17. This was done to ensure 2 feet of the screen interval extended above where groundwater was encountered at each location. The remaining boreholes were advanced either to HSA refusal or once tagged into the top of the shale bedrock layer. Upon completion of temporary monitoring well installation, wells were allowed to stabilize for a minimum of 24-hours prior to well development. Three temporary monitoring wells were developed and stabilized, while the other three wells were dry. A monitoring well summary table, monitoring well installation logs, and well development forms are provided in Appendix C. One groundwater field duplicate sample was collected and analyzed for PFAS which exceeded the minimum field duplicate collection frequency goal of 10%.

Groundwater samples were collected by low-flow sampling methodology in accordance with (IAW) the USACE PFAS Scope of Services (SOS) and the Geology Supplement to the Scope of Services or Performance Work Statement, which are included in Appendix C of the UFP-QAPP (Swift River TLI JV 2023). Prior to sampling, static water level measurements were collected to the nearest 0.01 foot. Sampling activities were completed using a certified PFAS-free bladder pump with dedicated HDPE tubing, and YSI water quality meter. Following completion of monitoring well purging and stabilization, samples were collected in laboratory-supplied HDPE plastic containers. Sample bottles were labeled and sealed in Ziploc® bags and placed on wet ice for cooling to ≤6°C. Groundwater sampling logs are provided in Appendix D.

Following approval of this report, the temporary monitoring wells may be abandoned in accordance with PCD SOP “Monitoring Well Abandonment” provided in the UFP-QAPP (Swift River TLI JV 2023).

3.4.6 Equipment Calibration

Equipment, including a photoionization detector (PID) (Mini-RAE PID Toxic Gas Monitor with 11.7 eV lamp), a water quality meter (YSI 556), and turbidimeter (Hach Turbidimeter Model 2100Q), were calibrated per Worksheet #22 of the UFP-QAPP (Swift River TLI JV 2023) against known standards in accordance with the manufacturer's instructions and documented on the calibration forms provided in Appendix D.

3.4.7 Location Survey

Environmental sample locations were surveyed by a licensed surveyor, Cardinal Points Surveying, per the PCD SOP "Topographic and Global Positioning Survey" provided in the UFP-QAPP (Swift River TLI JV 2023). Global Positioning System (GPS) data were transferred for use in ArcGIS mapping applications during data evaluation and reporting.

3.4.8 Deviations from the UFP-QAPP

No instances of field modification impacting project scope and/or data usability/quality were encountered during the SI fieldwork. Activities were completed per the UFP-QAPP (Swift River TLI JV 2023).

The number of groundwater samples varied from Worksheet #17 of the UFP-QAPP (Swift River TLI JV 2023). The deviation in number of samples is a result of actual field conditions, in which three of the six temporary monitoring wells were dry upon installation and remained dry (S29SI-MW02 and S29SI-MW04) or had too little water to sample (S29SI-MW03). Upon installation of the first dry temporary monitoring well, S29SI-MW04, TLI personnel checked for groundwater infiltration every 30 minutes with a water level meter. Drilling was suspended at S29SI-MW02 prior to well completion due to dry conditions. TLI, PCD, and CDPHE discussed the potential dry well conditions. TLI and PCD had several discussions of dry conditions present at the site. Once persistence of dry conditions was confirmed, TLI and PCD discussed presence of dry wells with CDPHE. CDPHE acknowledged dry conditions and instructed TLI to execute the scope of work as per the UFP-QAPP. Once authorized by PCD and CDPHE, installation of S29SI-MW02 and S29SI-MW03 was completed. These three temporary monitoring wells were gauged on a 30-minute to one-hour basis during field activities to check for groundwater infiltration for the remainder of the well installation event. These wells remained dry for the remainder of the event. Groundwater was detected at S29SI-MW03 during well development activities the following week and during the groundwater sampling event, however the volume of groundwater in the well was too small to develop the well or collect a sample. The SCT's geological features and paleochannels are major contributors to groundwater presence at a given location. It is likely these features at SWMU 29 are the cause of dry well conditions.

The field scope completeness is considered to be 91% as all proposed soil boring sample intervals were collected, all proposed sediment and surface water samples were collected, and three of six monitoring wells yielded enough water to produce a sample (Appendix F).

All sample cooler temperatures met validation criteria with the exception of the soil boring samples. The soil boring samples including the PFAS volume and total organic carbon volume arrived at Eurofins Denver on ice but the temperatures of the three coolers upon receipt were measured to be 8.0°C, 8.6°C, and 9.5°C which is above the UFP-QAPP temperature criteria of less than 6°C. The cooler temperature upon arrival at its final location, Eurofins Sacramento, was measured to be 18.6ºC which is above the UFP-QAPP temperature criteria of less than 6°C (Appendix F).

All samples, with the exception of the PFAS and pH soil boring samples, were prepared and analyzed within the required holding times. The pH analysis should be performed as soon after sample collection as possible, but the analysis was performed nine to ten days after collection. The PFAS extraction should be performed within 14 days of collection, however a re-extraction was required for sample S29SI-SD03, and that re-extraction was performed 38 days after collection due to method blank contamination in the original extraction. (Appendix F).

3.5 DECONTAMINATION PROCEDURES

To ensure that chemical analysis results reflect the actual concentrations at sample locations, the non-dedicated, reusable equipment used in sampling activities was rigorously cleaned and decontaminated between sample locations in accordance with the UFP-QAPP (Swift River TLI JV 2023). The non-disposable sampling equipment used to conduct sampling activities (e.g., drilling rods, hand-augers, water level meters) was decontaminated before sampling activities began, between locations, between sampling events, and after sampling activities were completed. Decontamination guidelines followed the direction provided in the USACE PFAS SOS and the Geology Supplement to the Scope of Services or Performance Work Statement, which are included in Appendix C of the UFP-QAPP (Swift River TLI JV 2023). Wastewater generated from decontamination activities was managed as IDW. Decontamination water was combined with well development and sampling purge water and managed as one medium.

The decontamination process included an initial scrub with a laboratory-grade, phosphate-free, biodegradable detergent (e.g., Liquinox®) to remove particulate matter and surface film. Following this scrub, the equipment was then rinsed in a bin containing DI water. A final rinse was done with laboratory-provided water that was verified to be PFAS-free. Decontaminated sampling equipment was wrapped in thin sheets of HDPE to prevent subsequent contamination if being stored and not used immediately.

Decontamination of downhole drill rig equipment was completed prior to use, between locations, and after final use before departing the site. Non-dedicated tools or rods were bucket washed in an HPDE bucket with DI water/biodegradable detergent (e.g., Liquinox®) at the drilling site. Equipment was scrubbed using polyethylene or PVC brushes to remove particulates.

Equipment Blank samples were collected upon completion of the decontamination procedure previously described. During soil sampling activities an Equipment Blank sample was collected daily, two Equipment Blanks total, from laboratory-grade DI water poured over the tip of the drill rig's Dual Tube sampler. During groundwater sample collection an Equipment Blank sample was collected from laboratory-grade DI water poured over the submersible pump used to purge and sample the monitoring wells. Equipment Blank samples were not collected during surface water and sediment sampling, as disposable sampling equipment was used during sampling activities. No sample results were qualified for field blank contamination, as per Section of 3.6 of the QCSR included in Appendix F, and so the efficacy of the decontamination procedure is considered adequate.

3.6 DISPOSITION OF FIELD INVESTIGATION-DERIVED WASTE

The IDW generated during the SI included solids (e.g., soil, sediment, well construction materials, acetate liners, personal protective equipment [PPE]) and liquids (e.g., development and purge water, decontamination rinse water). These materials were managed in accordance with the IDW/RW MP (Swift River TLI JV 2021b).

All IDW generated at SWMU 29 was placed in United Nations (UN)-approved, 55-gallon drums for storage, transport, and disposal. Permanent labels for the drums included a unique container number, a description of the contents (i.e., soil or wastewater), the accumulation start date, the source location, the generator's name (i.e., PCD), and a telephone number for the generator's point of contact (e.g., the PCD Hazardous Waste Program Manager [HWPM]).

The contents of the IDW drums were sampled for characterization and profiling. A solid waste sample was composited by collecting aliquots from the solid waste drums using a decontaminated stainless steel hand auger. The solids were homogenized in an HDPE plastic bag and then placed into laboratory-supplied sample containers. For drums containing liquid IDW (i.e., wastewater), a composite sample was collected using a peristaltic pump and new HDPE tubing and pumping directly into sample bottles. Both solid and liquid waste characterization samples were analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals/mercury, pH, and ignitability.

No IDW from SWMU 29 was characterized as hazardous. The disposition letters, drum labels, and draft manifest signed by the PCD HWPM and the transporter are provided in Appendix E. Containerized waste was disposed of in accordance with applicable state and Federal Resource Conservation and Recovery Act (RCRA) regulations. The licensed and certified waste hauler removed the drums containing IDW waste from PCD. The completed manifest will be added to the Draft Final or Final Report when it becomes available.

4. DATA ANALYSIS AND QUALITY ASSURANCE SUMMARY

This section summarizes the QA/QC program and laboratory chemical analysis program implemented as part of the SWMU 29 SI field activities (40 CFR §300.420(c)(4)). Additional information on these procedures is presented in the UFP-QAPP Addendum (Swift River TLI JV 2023).

The PFAS analyses were performed Eurofins-TestAmerica (TA) in Sacramento, California and the TOC and pH analyses were performed by Eurofins-TA in Arvada, Colorado. Sections 4.1 through 4.4 summarize sample handling procedures, laboratory analytical methods, data QA/QC, data reporting and validation, and sample QA/QC. A QA summary of the analytical data is presented in Section 4.5. Appendix F provides the QCSR that details the quality and usability of the SI analytical data and the process performed to evaluate the data for compliance with established QC criteria.

4.1 SAMPLE HANDLING PROCEDURES

A critical aspect of sample collection and analysis protocols is the maintenance of strict chain-of-custody (CoC) procedures, which include tracking and documentation during sample collection, shipment, and laboratory processing. The Sample Manager was responsible for sample custody until the samples were properly packaged, documented, and released to FedEx. The laboratory was responsible for sample custody thereafter in accordance with approved procedures.

4.1.1 Chain-of-Custody Record

CoC forms were used to document the traceability and integrity of all samples from the point of collection to the laboratory by maintaining a record of sample collection, shipment, and receipt by the laboratory. A CoC form was filled out and was signed and dated by each sample custodian.

Shipping containers were sealed with custody tape. Sealed coolers were transported to FedEx for overnight delivery to the laboratory. The air bill number, written on the CoC form, functioned as custody documentation while the sealed coolers were in the possession of FedEx. The CoC form was placed in a resealable plastic bag and taped to the inside lid of the cooler.

When the possession of samples was transferred, the individual relinquishing the samples and the individual receiving the samples signed, dated, and noted the time of transferal on the CoC. This record represents the official documentation for all transferal of sample custody until the samples arrived at the laboratory.

4.1.2 Laboratory Sample Receipt

All samples received by the Laboratory Sample Custodian or designee were checked for proper preservation (e.g., pH, temperature of coolant blank above 2°C or below 6°C); integrity (e.g., leaking, broken bottles); and proper, complete, and accurate documentation and identification (ID) of the samples. The temperature of the coolant blank was noted. All sample containers arrived at the laboratories intact, in good condition, and properly preserved. All sample cooler temperatures met validation criteria with the exception of the soil boring samples (Appendix F).

Samples received at the laboratory were logged into the laboratory computer database. Initial entries included field sample number, date of receipt, and analyses required. As samples were received, they were assigned a laboratory sample ID number. The sample custodian labeled each container with its sample ID number, and the samples then were transferred to their designated storage areas.

Samples received by the laboratory were considered to be physical evidence and were managed according to USEPA procedural safeguards. In addition, all data generated from the sample analyses, including all associated calibrations, method blanks, and other supporting QC analyses, were identified with the project name, project number, and sample delivery group (SDG) designation. All data were maintained under proper custody. The laboratory provided complete security for samples, analyses, and data.

All sample cooler temperatures met validation criteria with the exception of the soil boring samples. The soil samples arrived at the laboratory on ice but the temperatures of the three coolers at receipt time were 8.0℃, 8.6℃, and 9.5℃ which is above the QAPP temperature criteria of less than 6℃. The PFAS volume was forwarded to Eurofins Sacramento for analysis, but the shipment was affected by a FedEx shipping delay. The cooler temperature upon arrival at Eurofins Sacramento was 18.6ºC. Per the DoD General Data Validation Module #3 (DoD 2020) PFAS by Table B-15, the detections were qualified as estimated, J, while the non-detections were qualified as not detected at an estimated LOD, UJ, for elevated receipt temperature anomalies.

4.2 LABORATORY ANALYTICAL METHODS

The chemical analysis program for the SWMU 29 SI conforms to the analytical requirements presented in the UFP-QAPP (Swift River TLI JV 2023) for the chemical analysis of field investigation samples. All samples were analyzed for PFAS using liquid chromatography with tandem mass spectrometry (LC/MS/MS) procedures compliant with U.S. DoD (Quality Systems Manual (QSM) Version 5.3, Table B-15 (DoD 2019) and the laboratory SOP. Soil boring samples were also analyzed for TOC and pH using SW 846 Method 9060A and SW 846 Method 9045DA, respectively. Soil and sediment samples were analyzed for moisture content using American Society for Testing and Materials (ASTM) Method D2216.

4.3 DATA QUALITY ASSURANCE/QUALITY CONTROL

This section presents the QA/QC procedures applied during sampling and laboratory analysis. This discussion includes laboratory QA/QC (Section 4.3.1) and field QA/QC (Section 4.3.2) procedures. Details on the results of the QC samples (field and laboratory) are presented in the QCSR included in Appendix F.

4.3.1 Laboratory Quality Assurance/Quality Control

Samples were analyzed for PFAS, TOC, pH, and/or moisture content as described in Section 4.2. QC checks included holding times, method blanks, calibration standards, extracted internal standards (EISs), laboratory control samples (LCSs), MS/MSDs, and detection limits. The acceptance criteria and laboratory SOP are provided in the UFP-QAPP (Swift River TLI JV 2023).

Laboratory Blanks – Method blanks (MBs) were analyzed with each preparation or analytical batch as required by the analytical method to measure laboratory contamination. Instrument calibration blanks were analyzed at the correct frequency for the appropriate methods. The majority of the laboratory blanks were free of contamination or laboratory blank contamination did not require qualification of the data with the exceptions noted in the QCSR (Appendix F). Four PFAS results were qualified as not-detected, U, for method or laboratory blank contamination.

Matrix Spike/Matrix Spike Duplicates – MS/MSD sample volume was collected and analyzed for each sample type and matrix for PFAS. The percent recoveries (%R) and relative percent differences (RPDs) were within the project specified QC limits or no qualification was required for elevated recoveries (high bias) as the affected analyte was not detected in the associated sample.

Laboratory Control Samples – LCS or blank spikes are synthetic samples spiked with the compounds of concern and prepared and analyzed using the same procedure used for the primary project samples. LCS are analyzed at the frequency specified in the analytical/prep methods and the %Rs are evaluated for analytical accuracy. A laboratory control sample duplicate (LCSD) is not required, but if it is provided, the %R and the RPD between LCS and LCSD results are evaluated for analytical precision. LCS/LCSD accuracy anomalies that required qualification of the data are noted in the QCSR (Appendix F). There were 16 total organic carbon results qualified as estimated, J, due to LCS recovery anomalies.

Extracted Internal Standard – For the analysis of PFAS: all samples, standards, blanks, and QC samples were fortified with EIS analytes prior to extraction. Eight PFAS soil samples were affected by minor EIS recovery anomalies. The 20 associated results have been qualified as estimated, J. The data are usable as qualified.

Holding Times – The pH analysis of the soil boring samples was performed nine to ten days after collection which is outside the as soon after collection as possible recommended holding time. One PFAS sample was re-extracted outside the holding time due to method blank contamination. The 42 affected results were deemed to be usable as qualified.

Sample Receipt Temperature **-** All sample cooler temperatures met validation criteria with the exception of the soil boring samples. The soil boring samples including the PFAS volume and total organic carbon volume arrived at Eurofins Denver on ice but the temperatures of the three coolers upon receipt were measured to be 8.0 degrees °C, 8.6°C, and 9.5°C which is above the QAPP temperature criteria of less than 6°C. The sample volume was stored in the laboratory's refrigerators overnight at temperatures less than 6°C before the PFAS volume was forwarded to Eurofins Sacramento for analysis. The PFAS soil boring volume was shipped in coolers on ice but, due to a FedEx shipping delay, the arrival of the PFAS sample volume was postponed by three days and the ice within the cooler melted. The cooler temperature upon arrival at Eurofins Sacramento was measured to be 18.6ºC which is above the QAPP temperature criteria of less than 6°C. The total organic carbon results and PFAS results associated with the soil boring samples were qualified as estimated due to elevated cooler receipt temperatures but were ultimately deemed to be usable during validation/data usability assessment.

Ion Ratio – The ion ratios for the detected PFAS results were evaluated. Two PFAS results were qualified as estimated, J, due to ion ratio anomalies. The affected results were determined to be usable as qualified.

Instrument Tuning/Performance Check – There were no instrument tuning/performance check anomalies that required qualification of the data.

Calibrations – There were no calibration anomalies that required qualification of the data.

Laboratory Duplicates **-** There were no laboratory duplicate anomalies that required qualification of the data.

4.3.2 Field Quality Assurance/Quality Control

Table 4-1 summarizes the frequency of field QC samples that were collected during the SWMU 29 field investigation. The requirements for field QC were established on Worksheet #20 of the UFP-QAPP (Swift River TLI JV 2023). For the PFAS analysis, field duplicate and MS/MSD samples were collected above the minimum required frequencies of 10% and 5%, respectively. Field reagent blanks and/or equipment blanks were collected during the soil boring sampling and groundwater sampling. Field reagent blanks and/or equipment blanks were not required for the surface water and sediment samples because no reusable equipment was used.

Table 4-1. Field QC Samples for SWMU 29 Field Investigation

Analytical Group	Samples	Field Duplicates	Matrix Spike/Matrix Spike Duplicates	Equipment Blank	Field Reagent Blank
Groundwater Samples					
PFAS	3	1	1	1	1
Surface Water Samples					
PFAS	4	1	1	NA	NA
Soil Boring Samples					
PFAS	18	2	1	2	2
TOC	18	NA	NA	NA	NA
pH	18	NA	NA	NA	NA
Sediment Samples					
PFAS	4	1	1	1	1

4.4 DATA REPORTING AND VALIDATION

TLI Solutions (TLI) performed a Stage 2B data validation on 100% of the data as defined in the United States DoD, General Data Validation Guidelines, Revision 1, Environmental Data Quality Workgroup, dated November 2019. In addition, the third-party data validator selects 10% of the data generated for investigations and monitoring at the PCD to undergo a Stage 4 data validation. The third-party data validator selected SDGs 280-175822-1 (Sediment) and 280-176741-1 (Groundwater) to undergo a Stage 4 Data Validation. At the time this report was written, the Stage 4 data validation reports were unavailable, but they will be incorporated into the eventual Draft Final or Final version of the QCSR (Appendix F).

4.5 QUALITY ASSURANCE SUMMARY

A comprehensive QA/QC program was implemented during the sampling event in April and May 2023 at SWMU 29. Samples and associated QC samples (e.g., field duplicates, equipment rinsate blanks, source water blanks, MSs, MSDs) were collected and analyzed for PFAS using methods specified in the UFP-QAPP (Swift River TLI JV 2023). Consistent with the data quality requirements established in the UFP-QAPP (Swift River TLI JV 2023) and DQOs, all sample data and associated QC data were evaluated during the review and validation process. Individual sample results were qualified, as necessary, to designate usability of the data toward meeting project objectives. Data qualifiers were applied based on deviations from the measurement performance criteria in the UFP-QAPP (Swift River TLI JV 2023). Results of the validation are found in the QCSR (Appendix F). The analyses associated with each data quality indicator are summarized below, with details of the results of the QC checks provided in the QCSR.

4.5.1 Precision

Precision is a measure of the repeatability of a single measurement. The precision of the dataset was assessed by evaluating the RPD between primary and duplicate samples (e.g., field duplicate samples and spike duplicate samples). None of the sample results were qualified due to field or laboratory precision anomalies.

4.5.2 Accuracy

Accuracy is a measure of recovery of the actual concentration of a compound. The accuracy of the dataset was assessed by the ICV and CCV differences or drifts, EIS, MS/MSD, and LCS/LCSD percent recoveries. There were 40 results qualified as estimated or not-detected at an estimated LOD for one or more accuracy anomalies. The estimated results remain usable with qualification. Included among the affected results are 18 TOC results that were qualified for a low LCS recovery and 20 PFAS results that were qualified for low EIS recoveries.

4.5.3 Representativeness

Representativeness of the dataset is determined by the degree to which the data represent the samples submitted to the laboratory. Holding times, preservation, moisture content, and blank results affect the representativeness of a sample.

All samples except the 20 soil boring samples and associated QC field blanks were received within temperature requirements. The 594 affected PFAS and/or TOC results were qualified as estimated for elevated receipt temperature exceedances. Four PFAS results were qualified as not detected for laboratory blank contamination. All 18 pH results and all PFAS results in one sediment sample were analyzed or prepared outside holding times and the 42 associated results were qualified as estimated. Two PFAS results were qualified for ion ratio anomalies. There were 641 results affected by representativeness anomalies. The data as qualified are considered representative of the samples submitted to the laboratory.

4.5.4 Completeness

The completeness of the dataset is determined by the number of acceptable results after data review. Out of 1,044 sample results, no results were ultimately deemed to be unusable and rejected, R. The completeness of this dataset is 100%, which meets and exceeds the UFP-QAPP goal of 90% for the SWMU 29 SI.

4.5.5 Comparability

The analytical methods used for analysis affect the comparability of the dataset. The methods used for this project are all standard, peer-reviewed methods as determined by the UFP-QAPP (Swift River TLI JV 2023). The analytical methods used provided units of measure and detection limits consistent with DoD SIs.

4.5.6 Sensitivity

The laboratories established their LOQ, LOD, and DL values for each method and analyte according to the requirements outlined in the DoD Quality Systems Manual Version 5.3. The laboratory’s low level calibration standards were at or below the LOQ as specified by the QSM. Detected results were reported down to the detection limit (DL) while non-detections were reported to the LOD. Of the 665 results qualified as estimated, J, or not detected at an estimated LOD, UJ, 28 results were qualified only because the detected concentration was below the LOQ and are not affected by any other quality control sample anomalies.

During analysis, the PFAS aliquots for the four surface waters and one field duplicate sample were prepared using a reduced volume of 25 milliliters rather than the regular, 250 milliliters of sample volume which represents a 10X preparation factor. The laboratory noted that the sample matrix contained a large amount of particulates and sediment. The associated non-detected results are at elevated LODs and LOQs due to the reduced sample size. Due to the reduced sample aliquot volume, non-detected results (LOD) for PFNA, PFOS, and PFOA are reported at concentrations greater than the Regional Screening Levels.

4.5.7 Data Usability.

All data are valid for use, as qualified. Quality control anomalies were identified during the validation of the data generated by the laboratory subcontractors in support of the SWMU 29 SI. The project team determined that the affected sample results were usable with qualification and none of the quality control anomalies identified by the data validators were determined to be unusable by the project team.

5. SI SCREENING LEVELS

Detected concentrations of the Target PFAS in samples collected during this SI are compared to residential scenario screening levels calculated using the May 2023 USEPA Regional Screening Levels (RSLs) for soil and the tap water, incorporated into the 2023 ASD Memorandum. This SI uses the SLs and a target hazard quotient (HQ) of 0.1 to evaluate the Target PFAS concentrations. These SLs (Tables 5-1 and 5-2) are used to evaluate the data and determine if future investigation is warranted at SWMU 29. SLs for the other PFAS analyzed during this SI currently do not exist. It should be noted that while HFPO-DA does have an RSL, it was not included as a Target PFAS because GenX chemicals were developed in the 2000s, decades after the SWMU 29 fire training exercises in the 1980s (USEPA 2021, Swift River TLI Solutions 2023).

It is acknowledged that surface water at SWMU 29 is not a complete drinking water pathway, either currently or in the future. However, in order to approach potential exposure in the most conservative manner possible, analytes in surface water were screened against drinking water criteria (e.g., RSLs HQ = 0.1), which is a common risk assessment practice and considered protective. The results will be presented in a semi-qualitative manner (i.e., detections were “above or below” screening criteria) to account for the lack of a complete pathway.

Table 5-1. May 2023 USEPA RSLs – Groundwater

Analyte	USEPA RSL (ng/L)
Perfluorobutanesulfonic acid (PFBS)	600
Perfluorobutanoic acid (PFBA)	1,800
Perfluorohexanesulfonic acid (PFHxS)	39
Perfluorohexanoic acid (PFHxA)	990
Perfluorononanoic acid (PFNA)	5.9
Perfluorooctanesulfonic acid (PFOS)	4
Perfluorooctanoic acid (PFOA)	6

Notes:
USEPA RSL = U.S. Environmental Protection Agency Regional Screening Level
ng/L = nanograms per liter

Table 5-2. May 2023 USEPA RSLs – Soil

Analyte	USEPA RSL (µg/kg)
Perfluorobutanesulfonic acid (PFBS)	25,000
Perfluorobutanoic acid (PFBA)	120,000
Perfluorohexanesulfonic acid (PFHxS)	1,600
Perfluorohexanoic acid (PFHxA)	41,000
Perfluorononanoic acid (PFNA)	250
Perfluorooctanesulfonic acid (PFOS)	160
Perfluorooctanoic acid (PFOA)	250

Notes:
USEPA RSL = U.S. Environmental Protection Agency µg/kg = micrograms per kilogram

6. SI RESULTS

This section presents the background, summary of analytical results, and the CSM for SWMU 29 at PCD. Sampled media and QA/QC samples were analyzed for the list of 24 PFAS specified in the UFP-QAPP (Swift River TLI JV 2023). The sample results discussed below focus on the seven Target PFAS with May 2023 PFAS RSLs, PFOS, PFOA, PFBS, PFNA, PFHxS, PFBA, and PFHxA. USEPA RSLs for PFAS in sediment or surface water do not exist, so PFAS concentrations are compared to the SLs for surface soils and tap water, respectively. Analytical data tables for all constituents analyzed using approved methods are provided in Appendix G.

6.1 SWMU 29 CONCEPTUAL SITE MODEL

The preliminary CSM developed for SWMU 29 during the PA was further refined where Target PFAS were detected above the LOD in soil, groundwater, surface water, or sediment. Based on the SI sample results, the CSM presented represents the current understanding of site conditions with respect to known or suspected sources of PFAS-containing materials, potential transport mechanisms and migration pathways, and potentially exposed human receptors.

Based on the CSM provided in the UFP-QAPP (Swift River TLI JV 2023), vertical and horizontal migration of PFAS is driven by wind dispersion resulting from human activities or fugitive dust, surface runoff from precipitation events, precipitation infiltration, and the downgradient groundwater migration. In consideration of current and planned industrial use, human receptors potentially exposed to surface and/or subsurface media are Industrial Outdoor Workers (IOW). Human exposure pathways to be evaluated for the future IOW are ingestion of or dermal contact with surface or subsurface soils, sediment, surface water, or groundwater. Human exposure pathways to be evaluated for the future Resident include ingestion of or dermal contact with surface or subsurface soils, sediment, surface water, or groundwater, and ingestion of biota. The exposure pathways are evaluated as complete, potentially complete, or incomplete in the CSM presented in Figure 6-5. In the absence of toxicity information for the inhalation route, the inhalation exposure pathway of PFAS (via dust) is considered potentially complete in soil where Target PFAS are detected. The remaining exposure pathway designations were determined as follows:

- ***Complete*** – Human exposure pathways are considered complete where Target PFAS have been detected at concentrations exceeding SLs and no land use controls (LUCs) or Institutional controls (ICs) are in place restricting access or use of the media.
- ***Potentially Complete*** – Human exposure pathways are considered potentially complete if Target PFAS have been detected at concentrations below SLs for soil, groundwater, surface water, or sediment or if SLs have been exceeded along the migration pathway. For example, if Target PFAS are not detected in soil but are detected at concentrations exceeding SLs in groundwater, the exposure pathway for soil is considered potentially complete. In addition, a groundwater exposure pathway is considered potentially complete where Target PFAS have been detected and could migrate from SWMU 29 to downgradient SWMUs. Exposure pathways would also be considered potentially complete for media where existing LUCs are in place for non-PFAS constituents because the LUCs are not Target PFAS specific; however, this is not applicable to SWMU 29.
- ***Incomplete*** – Human exposure pathways are considered incomplete for media where Target PFAS have not been detected at concentrations above the LODs.

6.1.1 Background

The FTA at SWMU 29 consisted of a shallow depression/pit approximately 24 feet wide by 25 feet long and 1.5 feet deep (Figure 6-1). The pit was used for fire training exercises twice in the 1980s, which consisted of burning off-specification oil and diesel in a pit and extinguishing the fire. The pit was lined with a synthetic liner, covered with soil and gravel, and surrounded by an earthen berm. After completion of a fire exercise, the soil from the lined pit was removed, and the old liner was replaced. Components of firefighting fluids/extinguishers included, but were not limited to, magnesium silicate, mono-ammonium phosphate, and ammonium sulfate. The historical document review found no records of AFFF usage during these training activities. Following the 2006 removal actions and confirmation sampling described in the Previous Investigations, SWMU 29 has been issued no further action (NFA) under the Permit. Despite the removal actions, the potential remains that the immediate area surrounding the fire training pit and the drainage channel may have been impacted by the use of AFFF during fire training exercises at SWMU 29 (Swift River TLI Solutions 2023).

SWMU 29, and the immediately surrounding area, is currently undeveloped, naturally vegetated land, which is relatively flat (Figure 2-1). Surface water runoff drains to the east to Unnamed Creek, which drains to Boone Creek. The lithology of the area consists of unconsolidated terrace alluvium which unconformably overlies the Pierre Shale. The alluvium is generally fine-grained sand at the top and grades downward into coarser, cleaner sandy material. Zones of fine-grained silts and clays break up the mostly well-graded sands. Based on boring logs from nearby boreholes and monitoring wells, a gravel layer may be present overlying bedrock, and bedrock elevation ranges from approximately 4,610 feet amsl to 4,612 amsl. The area around SWMU 29 overlies the Terrace Alluvial Aquifer, which occupies nearly 75% of PCD. The saturated thickness of the aquifer ranges from approximately 10 to 15 feet in the vicinity of SWMU 29, with depths to groundwater ranging from approximately 25 to 35 feet bgs (Swift River TLI Solutions 2023). However, with two of the temporary monitoring wells being dry and one temporary monitoring well producing inadequate water, this generalization does not apply to the limited SWMU 29 SI study area.

6.1.2 SI Sampling and Results

Six surface soil samples were collected from six soil borings. Twelve subsurface soil samples and two field duplicate samples were collected from the same six soil borings. Four surface water samples and four sediment samples were collected from four locations with sufficient water collected in the runoff ditch. Six temporary monitoring wells were installed. Three groundwater samples and one field duplicate sample were collected from the three wells with sufficient water.

Figure 6-1 depicts all sampling locations at SWMU 29. The Target PFAS analytical results for all samples collected are provided in Tables 6-1 through 6-3 and Figures 6-2 through 6-4 and summarized below. Analytical data tables for all constituents analyzed using approved methods are provided in Appendix G.

6.1.2.1 Surface and Subsurface Soil

PFBS and PFHxS were not detected above the LODs in any of the surface soil samples collected at SWMU 29. PFNA, PFOS, PFOA, PFBA and PFHxA were detected in five of the six surface soil samples (Table 6-1, Figure 6-2). PFNA was detected in samples S29SI-SS-02, S29SI-SS05 and S29SI-SS-06 while PFOS was detected in samples S29SI-SS-02 and S29SI-SS-06. PFOA was detected in samples S29SI-SS-03, S29SI-SS-04, and S29SI-SS-05. PFBA was detected in S29SI-SS-01, S29SI-SS-04, and S29SI-SS-05 while PFHxA was detected in samples S29SI-SS-04 and S29SI-SS-05. All these detections are J-flagged, and the approximate concentrations are three to four orders of magnitude below their respective SLs.

All Target PFAS (PFOS, PFOA, PFBS, PFNA, PFHxS, PFBA, and PFHxA) were not detected above the LODs in any of the subsurface soil samples collected at SWMU 29 (Table 6-1, Figure 6-2).

6.1.2.2 Sediment

PFBS, PFHxS, PFHxA, and PFOA were not detected above the LODs in any of the sediment samples collected at SWMU 29. PFNA was detected in three of the five sediment samples while PFOS was detected in two of five sediment samples and PFBA was detected in one of the five sediment samples (Table 6-2, Figure 6-3). PFNA was detected in samples S29SI-SD01 and S29SI-SD02 while PFOS was detected in samples S29SI-SD02 and S29SI-SD023 and PFBA was detected in sample S29SI-SD02. The two PFNA detections are J-flagged, and the approximate concentrations are four orders of magnitude below SLs. There were two PFOS detections, the result at S29SI-SD03 is J-flagged, and the result at S29SI-SD02 has no QC flags. While PFOS at S29SI-SD01 was reported as detection by the laboratory, the result was determined to be associated with laboratory blank contamination and is not considered to be legitimate detection so a final not-detected, U, qualifier was applied to this result during data validation. All the approximate concentrations are three to four orders of magnitude below their respective SLs. The August 2023 ASD Memorandum does not provide guidance for PFAS in sediment, and PFAS concentrations are compared to the SLs for surface soils.

6.1.2.3 Surface Water

PFBS, PFHxS, PFHxA, PFOA, and PFBA were not detected above the LODs in any of the surface water samples collected at SWMU 29. PFNA and PFOS were detected in one of the five surface water samples (Table 6-2, Figure 6-3). PFNA and PFOS were detected in sample S29SI-SW01. The PFNA and PFOS detections are J-flagged, however; both approximate concentrations are above their respective SLs. This location is the northernmost sample location at the upgradient portion of the drainage channel. There were no detections above the LODs in any of downstream sample locations, thus Target PFAS is not migrating downgradient via surface water. The August 2023 ASD Memorandum does not provide guidance for PFAS in surface water, and PFAS concentrations are compared to the SLs for tap water.

6.1.2.4 Groundwater

PFNA and PFOS were not detected above the LODs in any of the groundwater samples collected at SWMU 29. PFBS, PFHxS, and/or PFOA were detected in all four of the groundwater samples (Table 6-3, Figure 6-4). PFBS, PFHxS, and PFOA were detected in samples S29SI-MW01, S29SI-MW05, and S29SI-MW05FD. Only PFHxS was detected in sample S29SI-MW06. PFBA and PFHxA were detected in sample S29SI-MW01. All these detections are J-flagged, and the approximate concentrations are one to three orders of magnitude below their respective SLs.

The FTA at SWMU 29 consisted of a shallow depression/pit approximately 24 feet wide by 25 feet long and 1.5 feet deep (Figure 6-1). SWMU 29, and the immediately surrounding area, is currently undeveloped, naturally vegetated land, which is relatively flat (6-1). Surface water runoff drains to the east to Unnamed Creek, which drains to Boone Creek. The lithology of the area consists of unconsolidated terrace alluvium which unconformably overlies the Pierre Shale. The alluvium is generally fine-grained sand at the top and grades downward into coarser, cleaner sandy material. Zones of fine-grained silts and clays break up the mostly well-graded sands. Based on boring logs from nearby boreholes and monitoring wells, a gravel layer may be present overlying bedrock, and bedrock elevation ranges from approximately 4,610 feet amsl to 4,612 amsl. The area around SWMU 29 overlies the Terrace Alluvial Aquifer, which occupies nearly 75% of PCD. The saturated thickness of the aquifer ranges from approximately 10 to 15 feet in the vicinity of SWMU 29, with depths to groundwater ranging from approximately 25 to 35 feet bgs.

The primary release mechanism is the potential release of PFAS-containing materials to surface soils related to historical operations at the FTA. The secondary contaminant migration and fate and transport considerations include downward contaminant migration from surface soil to deeper subsurface soil and groundwater through infiltration, leaching, and percolation.

Human exposure pathways are ingestion of or dermal contact with surface or subsurface soils, sediment, surface water, or groundwater by an IOW. Figure 6-5 presents the CSM for SWMU 29.

- Target PFAS were detected below SLs in surface soil but were not detected in subsurface soil. This indicates that PFAS on the surface is not migrating downward. The surface soil pathway is potentially complete.

- Target PFAS were detected above SLs at the most upgradient surface water location but were not detected at downgradient surface water locations. This indicates that surface water, even during a large rain event, is not migrating downgradient on the surface. Additionally, the Target PFAS detected concentrations at the collocated sediment sample are four orders of magnitude below the SLs, indicating that any migration downward from surface water to sediment is minimal. Surface water and sediment samples were collected during a two-day rain event, as continually standing and or moving water is not a feature at SWMU 29. It remains a possibility that target PFAS detections could be related to rain falling onto the ground surface. The surface water pathway is complete and the sediment pathway is potentially complete.

- Target PFAS were detected below SLs in groundwater, so this pathway is potentially complete.

6.1.3 Summary of Results

Detected concentrations of Target PFAS in groundwater, surface soil, and sediment at SWMU 29 were below the SLs. Concentrations of Target PFAS were not detected in subsurface soil. Detected concentrations of PFNA and PFOS in surface water sample S29SI-SW01 exceeded SLs; however, the associated sediment sample had detected concentrations of PFNA and PFOS an order of magnitude below the respective SLs. No detections at downgradient surface water or associated sediment samples exceeded SLs.

The detections of Target PFAS in surface and subsurface soil were at least two orders of magnitude below their respective SLs, indicating there is not a surface source of PFAS that would migrate downward to subsurface soil and leach into groundwater. The lack of surface water flow from the western portion of SWMU 29 toward the drainage channel at a lower elevation, combined with the low concentrations of all but one surface water sample, indicate that there is no surface source of PFAS moving west to east across the SWMU. The combination of the upgradient location of surface water sample S29SI-SW01, the non-detects at all downgradient surface water samples, the non-detects and low concentrations detected in all sediment samples, and the unusual presence of surface water and sediment that only occurs during large rain events, the exceedances in one surface water sample are not indicative of a source area or a complete exposure pathway within SWMU 29. The wells that were dry (S29SI-MW02 and S29SI-MW04) and had insufficient groundwater to sample (S29SI-MW03) are in the northwestern quadrant of SWMU 29. Although groundwater samples could not be collected, subsurface soil samples indicate there is not a source of PFAS in the area. The three wells that were sampled represent a transect across the groundwater flow of the SCT that generally flows north to south. The detections of Target PFAS were at least one order of magnitude below their respective SLs, indicating there is not a source of PFAS that would lead to groundwater with elevated concentrations to flow southward outside the SWMU boundary.

Table 6-1. Target PFAS Analytical Results at SWMU 29 – Soil

Location ID	Sample ID	Depth (ft bgs)	Sample Date	PFBS	PFHxS	PFNA	PFOS	PFOA	PFBA	PFHxA
Surface Soil			**Units**	**µg/kg**	**µg/kg**	**µg/kg**	**µg/kg**	**µg/kg**	**µg/kg**	**µg/kg**
			Screening Levels	**25,000**	**1,600**	**250**	**160**	**250**	**120,000**	**41,000**
S29SI-SB-01	S29SI-SS-01-0.5-1.0	0.5-1.0	4/10/2023	ND	ND	ND	ND	ND	0.2 J	ND
S29SI-SS-02	S29SI-SS-02-0.0-0.5	0.0-0.5	4/11/2023	ND	ND	0.05 J	0.065 J	ND	ND	ND
S29SI-SS-03	S29SI-SS-03-0.0-0.5	0.0-0.5	4/11/2023	ND	ND	ND	ND	0.35 J	ND	ND
S29SI-SS-04	S29SI-SS-04-0.0-0.5	0.0-0.5	4/11/2023	ND	ND	ND	ND	0.053 J	0.085 J	0.042 J
S29SI-SS-05	S29SI-SS-05-0.0-0.5	0.0-0.5	4/11/2023	ND	ND	0.025 J	ND	0.071 J	0.13 J	0.042 J
S29SI-SS-06	S29SI-SS-06-0.0-0.5	0.0-0.5	4/11/2023	ND	ND	0.033 J	0.1 J	ND	ND	ND
Subsurface Soil			**Units**	**µg/kg**	**µg/kg**	**µg/kg**	**µg/kg**	**µg/kg**	**µg/kg**	**µg/kg**
			Screening Levels	**25,000**	**1,600**	**250**	**160**	**250**	**120,000**	**41,000**
S29SI-SB-01	S29SI-SB-01-3.5-4.0	3.5-4.0	4/10/2023	ND	ND	ND	ND	ND	ND	ND
S29SI-SB-01	S29SI-SB-01-27.5-28.5	27.5-28.5	4/10/2023	ND	ND	ND	ND	ND	ND	ND
S29SI-SB-02	S29SI-SB-02-13.0-14.0	13.0-14.0	4/10/2023	ND	ND	ND	ND	ND	ND	ND
S29SI-SB-02	S29SI-SB-02-23.5-24.5	23.5-24.5	4/10/2023	ND	ND	ND	ND	ND	ND	ND
S29SI-SB-03	S29SI-SB-03-12.0-13.0	12.0-13.0	4/10/2023	ND	ND	ND	ND	ND	ND	ND
S29SI-SB-03	S29SI-SB-03-22.0-23.0	22.0-23.0	4/10/2023	ND	ND	ND	ND	ND	ND	ND
S29SI-SB-03	S29SI-SB-03-22.0-23.0FD	22.0-23.0	4/10/2023	ND	ND	ND	ND	ND	ND	ND
S29SI-SB-04	S29SI-SB-04-3.5-4.0	3.5-4.0	4/11/2023	ND	ND	ND	ND	ND	ND	ND
S29SI-SB-04	S29SI-SB-04-27.5-28.5	27.5-28.5	4/11/2023	ND	ND	ND	ND	ND	ND	ND
S29SI-SB-04	S29SI-SB-04-27.5-28.5FD	27.5-28.5	4/11/2023	ND	ND	ND	ND	ND	ND	ND
S29SI-SB-05	S29SI-SB-05-3.0-4.0	3.0-4.0	4/11/2023	ND	ND	ND	ND	ND	ND	ND
S29SI-SB-05	S29SI-SB-05-23.0-24.0	23.0-24.0	4/11/2023	ND	ND	ND	ND	ND	ND	ND
S29SI-SB-06	S29SI-SB-06-6.0-7.0	6.0-7.0	4/11/2023	ND	ND	ND	ND	ND	ND	ND
S29SI-SB-06	S29SI-SB-06-17.0-18.0	17.0-18.0	4/11/2023	ND	ND	ND	ND	ND	ND	ND

Notes:
The Screening Levels (SLs) are the May 2023 USEPA RSLs for soil based on an HQ = 0.1FD = Field duplicate
ft bgs = feet below ground surface
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
ND = Non-detect
µg/kg = microgram per kilogram

Table 6-2. Target PFAS Analytical Results at SWMU 29 – Sediment and Surface Water

Location ID	Sample ID	Sample Date	PFBS	PFHxS	PFNA	PFOS	PFOA	PFBA	PFHxA
Sediment		**Units**	**µg/kg**	**µg/kg**	**µg/kg**	**µg/kg**	**µg/kg**	**µg/kg**	**µg/kg**
		Screening Levels	**25,000**	**1,600**	**250**	**160**	**250**	**120,000**	**41,000**
S29SI-SD01	S29SI-SD01	4/26/2023	ND	ND	0.079 J	ND	ND	ND	ND
S29SI-SD02	S29SI-SD02	4/26/2023	ND	ND	0.041 J	0.53	ND	0.098 J	ND
S29SI-SD03	S29SI-SD03	4/26/2023	ND	ND	ND	0.45 J	ND	ND	ND
S29SI-SD04	S29SI-SD04	4/26/2023	ND	ND	ND	ND	ND	ND	ND
S29SI-SD04	S29SI-SD04FD	4/26/2023	ND	ND	ND	ND	ND	ND	ND
Surface Water		**Units**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**
		Screening Levels	**601**	**39**	**6**	**4**	**6**	**1,800**	**990**
S29SI-SD01	S29SI-SW01	4/26/2023	ND	ND	6.9 J	6.7 J	ND	ND	ND
S29SI-SD02	S29SI-SW02	4/26/2023	ND	ND	ND	ND	ND	ND	ND
S29SI-SD03	S29SI-SW03	4/26/2023	ND	ND	ND	ND	ND	ND	ND
S29SI-SD03	S29SI-SW03FD	4/26/2023	ND	ND	ND	ND	ND	ND	ND
S29SI-SD04	S29SI-SW04	4/26/2023	ND	ND	ND	ND	ND	ND	ND

Notes:
The Screening Levels (SLs) are the May 2023 USEPA RSLs for Soil and Tap Water based on an HQ = 0.1.
Bolded values indicate detections greater than the SL.
FD = Field duplicate
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
ND = Non-detect
U = The analyte was analyzed for, but not detected above the reported sample quantitation limit.
ng/L = nanogram per liter
µg/kg = microgram per kilogram

Table 6-3. Target PFAS Analytical Results at SWMU 29 – Groundwater

Location ID	Sample ID	Sample Date	PFBS	PFHxS	PFNA	PFOS	PFOA	PFBA	PFHxA
Groundwater		Units	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
		Screening Levels	601	39	6	4	6	1,800	990
S29SI-MW01	S29SI-MW01	5/18/2023	1 J	2.3 J	ND	ND	0.76 J	1.8	1.4 J
S29SI-MW05	S29SI-MW05	5/18/2023	0.35 J	0.8 J	ND	ND	0.52 J	ND	ND
S29SI-MW05	S29SI-MW05FD	5/18/2023	0.41 J	0.86 J	ND	ND	ND	ND	ND
S29SI-MW06	S29SI-MW06	5/18/2023	ND	0.71 J	ND	ND	ND	ND	ND

Notes:
The Screening Levels (SLs) are the May 2023 USEPA RSLs for Tap Water based on an HQ = 0.1
FD = Field duplicate
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
ND = Non-detect
ng/L = nanogram per liter

7. CONCLUSIONS AND RECOMMENDATIONS

An SI is conducted when the PA determines an AOPI exists based on probable use, storage, and/or disposal of PFAS-containing materials. The SI includes multi-media sampling at the AOPI to determine whether a release has occurred. The SI may conclude further investigation is warranted, a removal action is required to address immediate threats, or no further action is required (40 CFR §300.420(5)). The SI Report used the findings from the PA in conjunction with soil, groundwater, surface water, and sediment sampling data for the AOPI to determine whether Target PFAS have been released to the environment and whether a release has affected or may affect specific human health targets.

Before the SI sampling, a preliminary CSM was developed in the PA for the AOPI based on an evaluation of existing records, personnel interviews, and site reconnaissance. The preliminary CSM identified potential human receptors and potential exposure pathways for soil, groundwater, sediment, and surface water. SWMU 29 was sampled during this SI to further evaluate PFAS-related releases and identify the presence or absence of Target PFAS.

Target PFAS were detected at SWMU 29. Target PFAS concentrations exceeded SLs at one location. PFNA and PFOS were detected at concentrations that are above SLs at the northern-most (upgradient) surface water sample.

The updated SWMU 29 CSM details site geological conditions; determines primary and secondary release mechanisms; identifies potential human receptors; and details the incomplete exposure pathways for current and reasonably anticipated future exposure scenarios. Table 7-1 summarizes the conclusions and recommendations for the SWMU 29 AOPI.

Table 7-1. Summary of Target PFAS Detected and Recommendations

AOPI	Detection of PFOS, PFOA, PFBS, PFNA, PFHxS, PFBA, and/or PFHxA					Recommendation and Rationale
	Surface Soil	Subsurface Soil	Groundwater	Sediment	Surface Water	
SWMU 29	Detected below SL	ND	Detected below SL	Detected below SL	Exceeded SL	No additional sampling is recommended. Although surface water sample S29-SW01 exceeded the SL, downgradient surface water and all associated sediment samples were below their respective SLs. Sample results indicate that there is no on-site source of Target PFAS constituents.

The Screening Levels (SLs) are the May 2023 USEPA RSLs for Soil and Tap Water based on an HQ = 0.1.

ND = Non-detect
SL = Screening Level

8. REFERENCES

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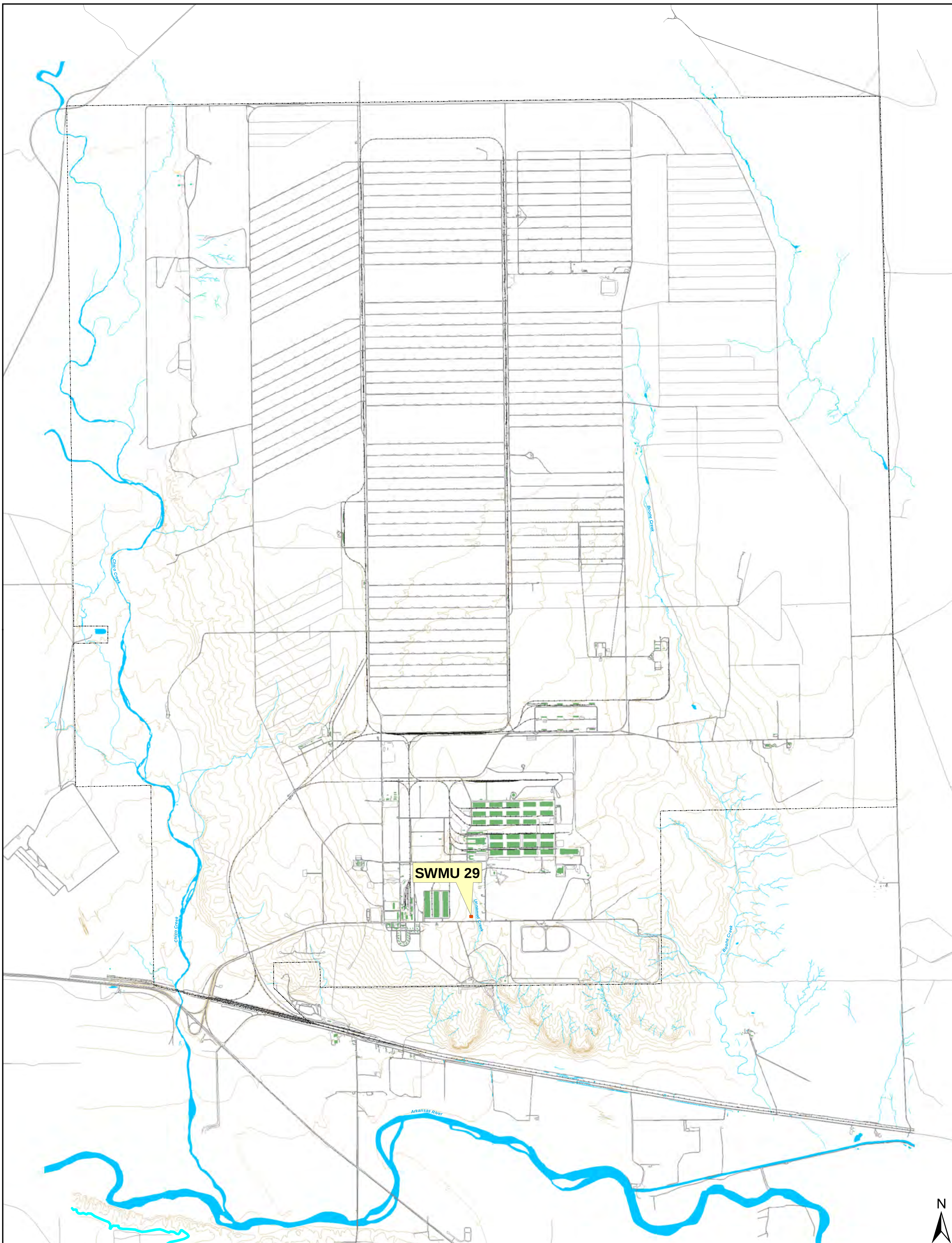
FIGURES

Figure 1-1. Pueblo Chemical Depot and SWMU 29 Location Map



Legend

- SWMU Boundary
- Road
- Railroad
- Stream
- Topographic Contour - 10 foot
- Pueblo Chemical Depot Boundary
- Building or Structure
- Water Body

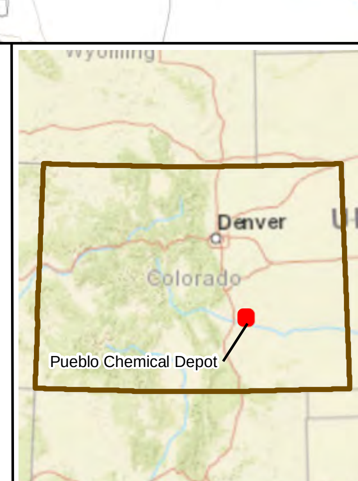


Figure 1-1
Pueblo Chemical Depot and SWMU 29 Location Map

PUEBLO CHEMICAL DEPOT
PUEBLO, COLORADO

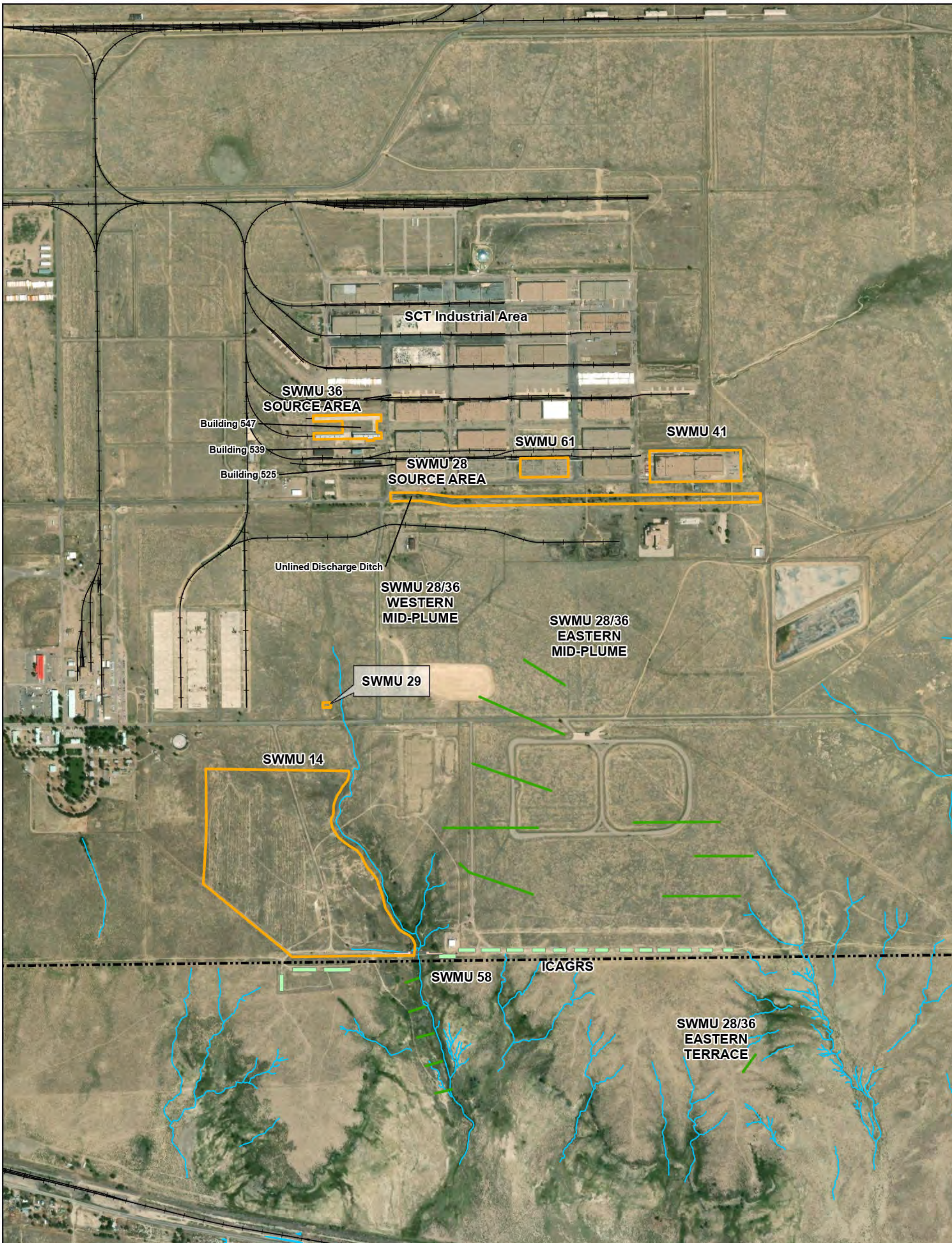
0 1,850 3,700 7,400 Feet

1 inch = 3,700 feet

Prepared For:

Prepared By: SWIFT RIVER TLI JV

Figure 1-2. South Central Terrace General Location Map



Legend

- SWMU 29 Boundary
- Pueblo Chemical Depot Boundary
- Barrier Wall
- Infiltration Gallery
- Recovery Trench
- Biobarrier
- Stream
- Lake, Pond, or River
- Road
- Railroad

Notes:
ICAGRS = Interim Corrective Action Groundwater Remediation System
SCT = South Central Terrace
SWMU = Solid Waste Management Unit

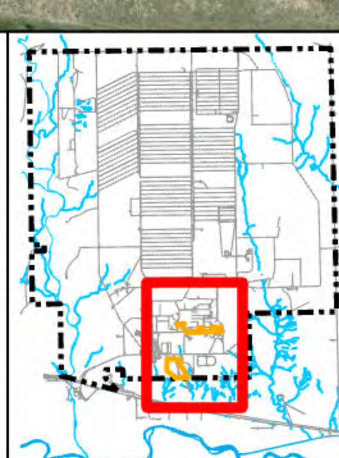


Figure 1-2
South Central Terrace
General Location Map

PUEBLO CHEMICAL DEPOT
PUEBLO, COLORADO

0 500 1,000 2,000 Feet

1 inch = 1,000 feet

Prepared For:

Prepared By: SWIFT RIVER TLI

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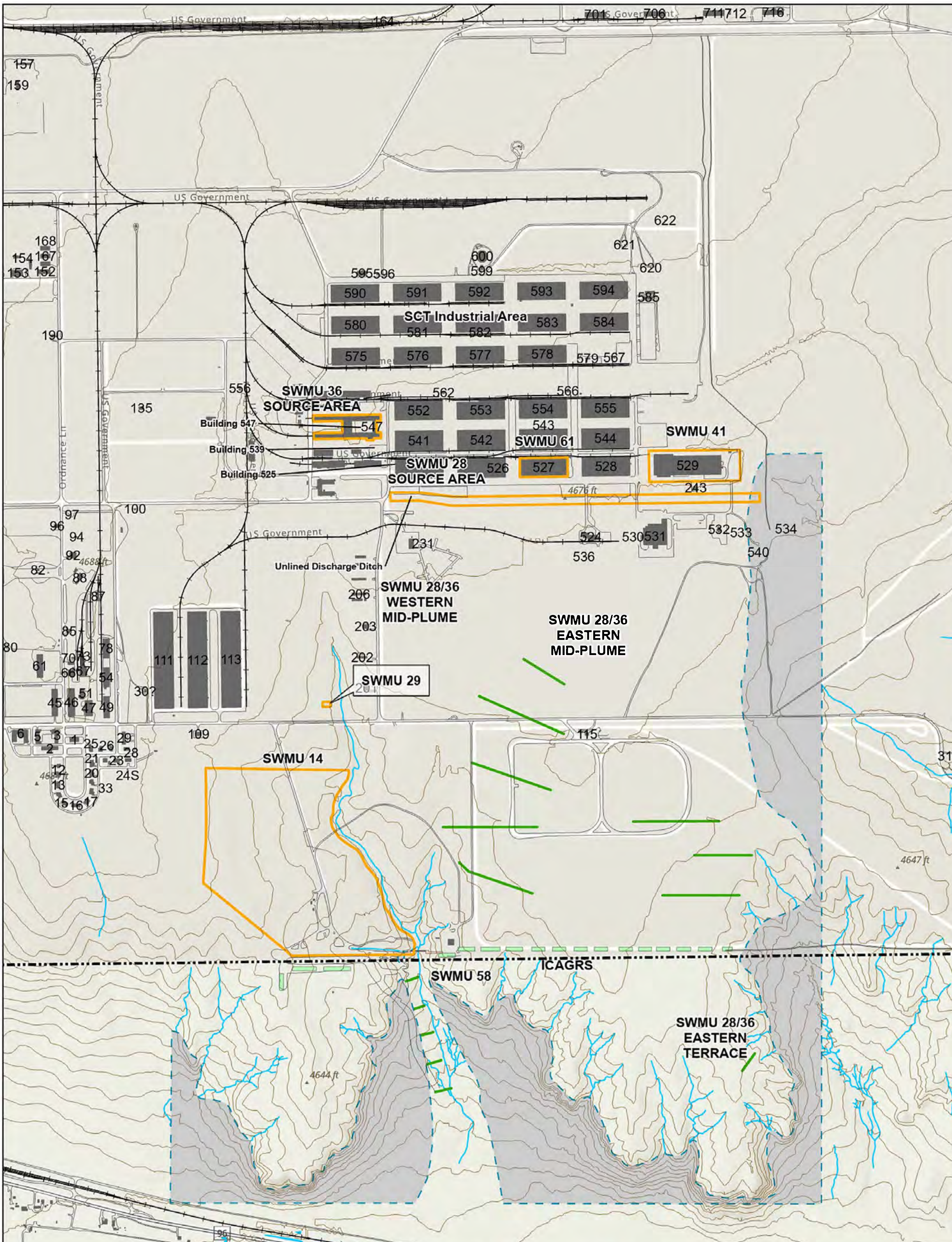
Figure 2-1. South Central Terrace Site Features



Legend

- SWMU Boundary
- Barrier Wall
- Infiltration Gallery
- Recovery Trench
- Building
- 10-foot Topographic Contour
- Road
- Railroad
- Biobarrier
- Stream
- Lake, Pond, or River
- Unsaturated Alluvium

Notes:
ICAGRS = Interim Corrective Action Groundwater Remediation System
SCT = South Central Terrace
SWMU = Solid Waste Management Unit

Figure 2-1
South Central Terrace Site Features

PUEBLO CHEMICAL DEPOT
PUEBLO, COLORADO

0 500 1,000 2,000 Feet

1 inch = 1,000 feet

Prepared For:

Prepared By: SWIFT RIVER TLI

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Figure 6-1. SWMU 29 SI Sample Locations

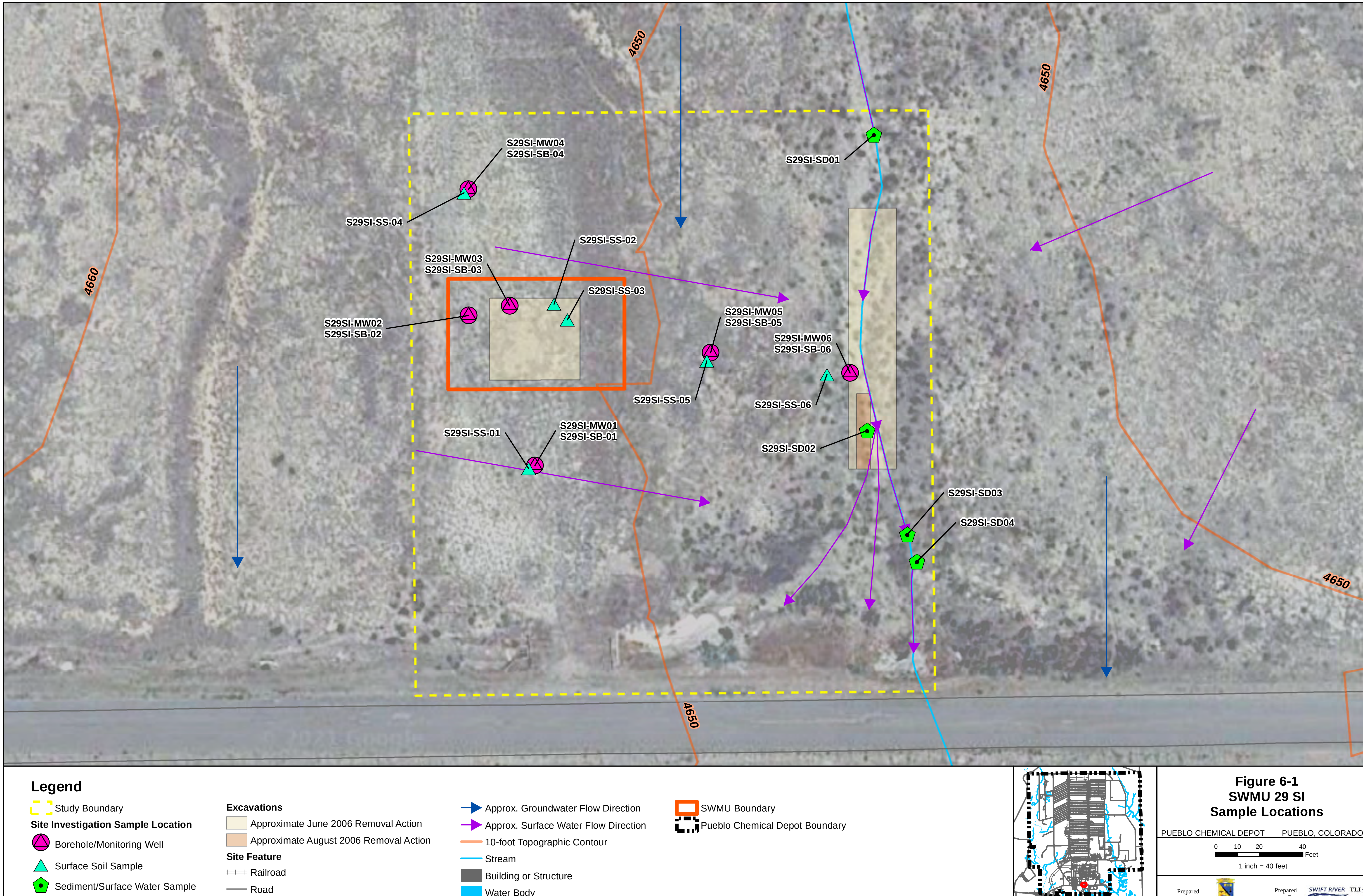

Figure 6-1
SWMU 29 SI
Sample Locations

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Figure 6-2. SWMU 29 SI Surface Soil and Soil Boring Sample Results

S29SI-SB-04							
Depth (ft)	PFBS	PFHxS	PFNA	PFOA	PFOS	PFBA	PFHxA
3.5 - 4	ND	ND	ND	ND	ND	ND	ND
27.5 - 28.5	ND	ND	ND	ND	ND	ND	ND

S29SI-SS-04							
Depth (ft)	PFBS	PFHxS	PFNA	PFOA	PFOS	PFBA	PFHxA
0 - 0.5	ND	ND	ND	0.053 J	ND	0.085 J	0.042 J

S29SI-SS-02							
Depth (ft)	PFBS	PFHxS	PFNA	PFOA	PFOS	PFBA	PFHxA
0 - 0.5	ND	ND	0.05 J	ND	0.065 J	ND	ND

S29SI-SS-03							
Depth (ft)	PFBS	PFHxS	PFNA	PFOA	PFOS	PFBA	PFHxA
0 - 0.5	ND	ND	ND	0.35 J	ND	ND	ND

S29SI-SB-03							
Depth (ft)	PFBS	PFHxS	PFNA	PFOA	PFOS	PFBA	PFHxA
12 - 13	ND	ND	ND	ND	ND	ND	ND
22 - 23	ND	ND	ND	ND	ND	ND	ND

S29SI-SB-05							
Depth (ft)	PFBS	PFHxS	PFNA	PFOA	PFOS	PFBA	PFHxA
3 - 4	ND	ND	ND	ND	ND	ND	ND
23 - 24	ND	ND	ND	ND	ND	ND	ND

S29SI-SB-06							
Depth (ft)	PFBS	PFHxS	PFNA	PFOA	PFOS	PFBA	PFHxA
6 - 7	ND	ND	ND	ND	ND	ND	ND
17 - 18	ND	ND	ND	ND	ND	ND	ND

S29SI-SB-02							
Depth (ft)	PFBS	PFHxS	PFNA	PFOA	PFOS	PFBA	PFHxA
13 - 14	ND	ND	ND	ND	ND	ND	ND
23.5 - 24.5	ND	ND	ND	ND	ND	ND	ND

S29SI-SS-05							
Depth (ft)	PFBS	PFHxS	PFNA	PFOA	PFOS	PFBA	PFHxA
0 - 0.5	ND	ND	0.025 J	0.071 J	ND	0.13 J	0.042 J

S29SI-SS-06							
Depth (ft)	PFBS	PFHxS	PFNA	PFOA	PFOS	PFBA	PFHxA
6 - 7	ND	ND	0.033 J	ND	0.1 J	ND	ND

S29SI-SS-01							
Depth (ft)	PFBS	PFHxS	PFNA	PFOA	PFOS	PFBA	PFHxA
0.5 - 1	ND	ND	ND	ND	ND	0.2 J	ND

S29SI-SB-01							
Depth (ft)	PFBS	PFHxS	PFNA	PFOA	PFOS	PFBA	PFHxA
3.5 - 4	ND	ND	ND	ND	ND	ND	ND
27.5 - 28.5	ND	ND	ND	ND	ND	ND	ND

Analyte	EPA Regional Screening Levels (THQ 0.1) Industrial Soil (µg/kg)
PFBS	25,000
PFHxS	1,600
PFNA	250
PFOA	250
PFOS	160
PFBA	120,000
PFHxA	41,000

Notes:
1) Surface Soil & Soil Boring sample results reported in ug/kg.

Legend

Study Boundary

Site Investigation Sample Location

- Borehole/Monitoring Well
- Surface Soil Sample

Excavations

- Approximate June 2006 Removal Action
- Approximate August 2006 Removal Action

Site Feature

- Railroad
- Road
- Stream
- Building or Structure
- Water Body
- SWMU Boundary
- Pueblo Chemical Depot Boundary

Figure 6-2
SWMU 29 SI
Surface Soil & Soil Boring Sample Results

PUEBLO CHEMICAL DEPOT PUEBLO, COLORADO

0 10 20 40 Feet
1 inch = 40 feet

Prepared For:

Prepared By: SWIFT RIVER TLI

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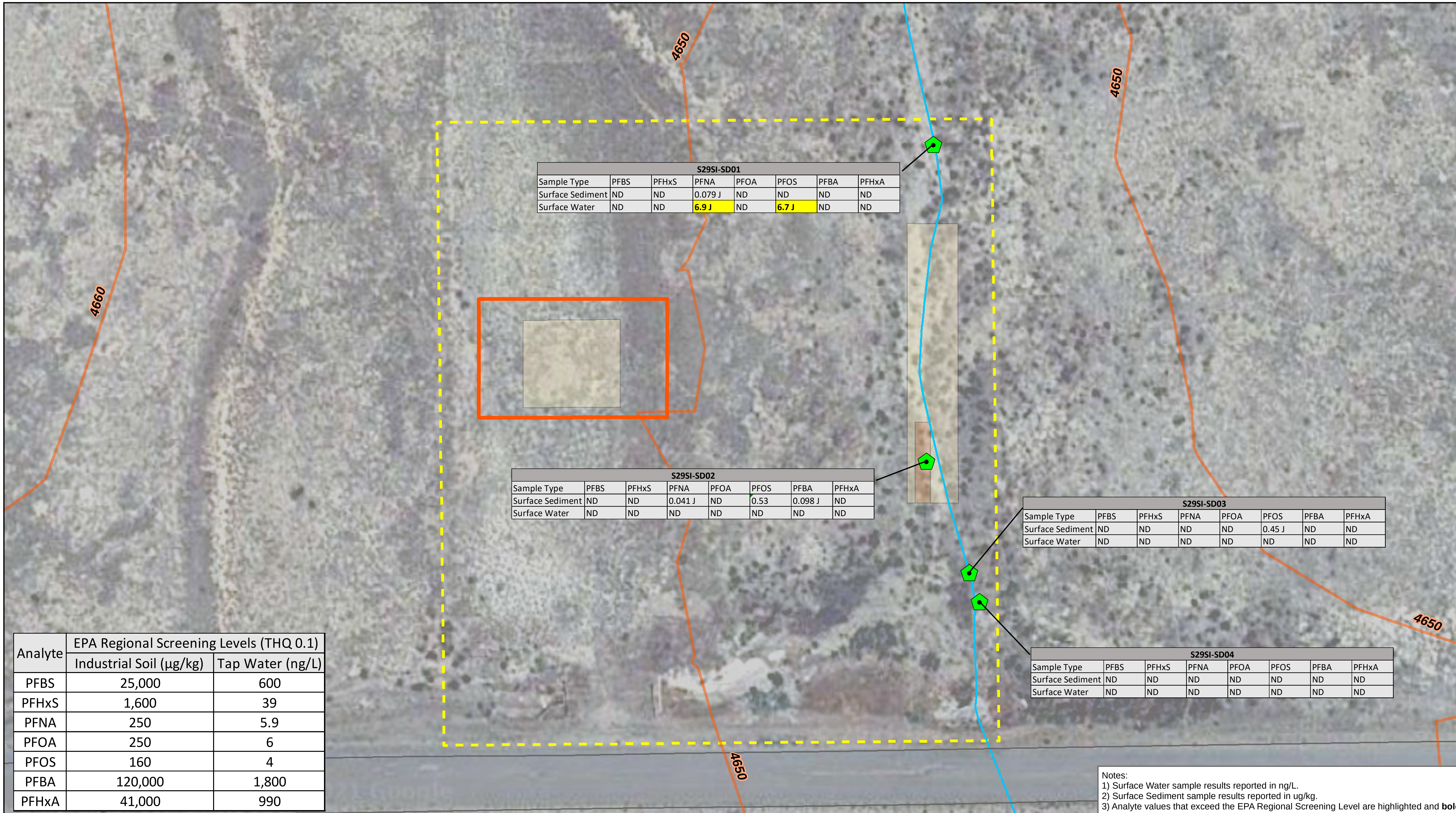
Figure 6-3. SWMU 29 SI Surface Water / Surface Sediment Sample Results



S29SI-SD01							
Sample Type	PFBS	PFHxS	PFNA	PFOA	PFOS	PFBA	PFHxA
Surface Sediment	ND	ND	0.079 J	ND	ND	ND	ND
Surface Water	ND	ND	**6.9 J**	ND	**6.7 J**	ND	ND

S29SI-SD02							
Sample Type	PFBS	PFHxS	PFNA	PFOA	PFOS	PFBA	PFHxA
Surface Sediment	ND	ND	0.041 J	ND	0.53	0.098 J	ND
Surface Water	ND	ND	ND	ND	ND	ND	ND

S29SI-SD03							
Sample Type	PFBS	PFHxS	PFNA	PFOA	PFOS	PFBA	PFHxA
Surface Sediment	ND	ND	ND	ND	0.45 J	ND	ND
Surface Water	ND	ND	ND	ND	ND	ND	ND

S29SI-SD04							
Sample Type	PFBS	PFHxS	PFNA	PFOA	PFOS	PFBA	PFHxA
Surface Sediment	ND	ND	ND	ND	ND	ND	ND
Surface Water	ND	ND	ND	ND	ND	ND	ND

Analyte	EPA Regional Screening Levels (THQ 0.1)	
	Industrial Soil (µg/kg)	Tap Water (ng/L)
PFBS	25,000	600
PFHxS	1,600	39
PFNA	250	5.9
PFOA	250	6
PFOS	160	4
PFBA	120,000	1,800
PFHxA	41,000	990

Notes:
1) Surface Water sample results reported in ng/L.
2) Surface Sediment sample results reported in ug/kg.
3) Analyte values that exceed the EPA Regional Screening Level are highlighted and **bold**

Legend

Study Boundary

Site Investigation Sample Location

Sediment/Surface Water Sample

Excavations

Approximate June 2006 Removal Action

Approximate August 2006 Removal Action

Site Feature

Railroad

Road

10-foot Topographic Contour

Stream

Building or Structure

Water Body

SWMU Boundary

Pueblo Chemical Depot Boundary

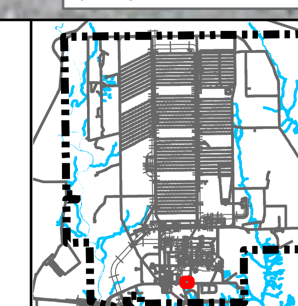


Figure 6-3
SWMU 29 SI
Surface Water/Surface Sediment
Sample Results

PUEBLO CHEMICAL DEPOT PUEBLO, COLORADO

0 10 20 40 Feet

1 inch = 40 feet

Prepared For:

Prepared By: SWIFT RIVER TLI

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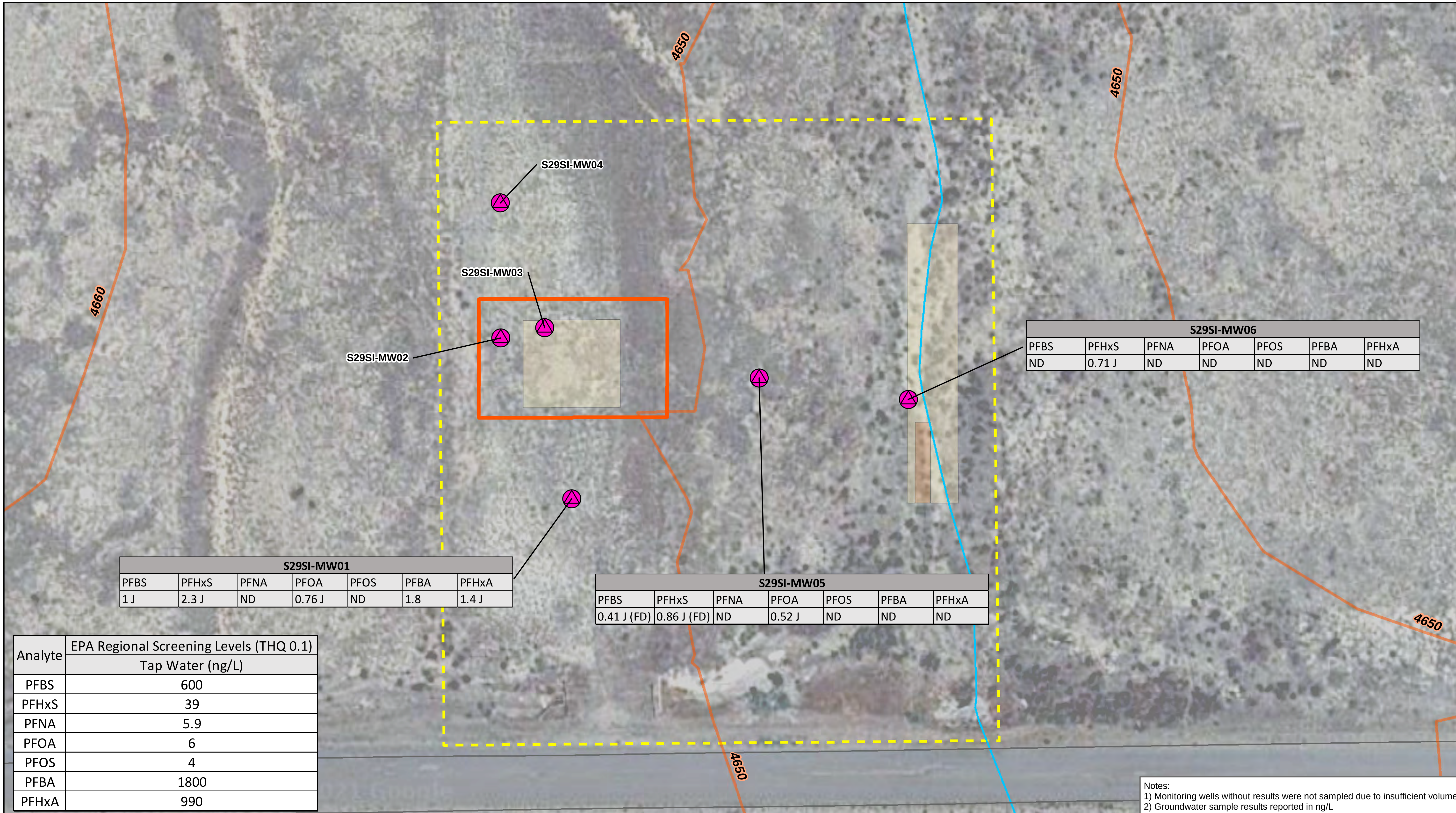
Figure 6-4. SWMU 29 SI Groundwater Sample Results



S29SI-MW01						
PFBS	PFHxS	PFNA	PFOA	PFOS	PFBA	PFHxA
1 J	2.3 J	ND	0.76 J	ND	1.8	1.4 J

S29SI-MW05						
PFBS	PFHxS	PFNA	PFOA	PFOS	PFBA	PFHxA
0.41 J (FD)	0.86 J (FD)	ND	0.52 J	ND	ND	ND

S29SI-MW06						
PFBS	PFHxS	PFNA	PFOA	PFOS	PFBA	PFHxA
ND	0.71 J	ND	ND	ND	ND	ND

Analyte	EPA Regional Screening Levels (THQ 0.1) Tap Water (ng/L)
PFBS	600
PFHxS	39
PFNA	5.9
PFOA	6
PFOS	4
PFBA	1800
PFHxA	990

Notes:
1) Monitoring wells without results were not sampled due to insufficient volume
2) Groundwater sample results reported in ng/L

Legend

Study Boundary

Site Investigation Sample Location

Borehole/Monitoring Well

Excavations

Approximate June 2006 Removal Action

Approximate August 2006 Removal Action

Site Feature

Railroad

Road

Stream

Building or Structure

Water Body

SWMU Boundary

Pueblo Chemical Depot Boundary

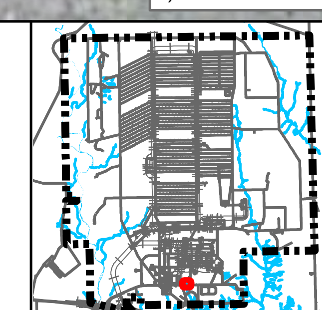


Figure 6-4
SWMU 29 SI
Groundwater Sample Results
May 2023

PUEBLO CHEMICAL DEPOT PUEBLO, COLORADO

0 10 20 40 Feet

1 inch = 40 feet

Prepared For:

Prepared By:

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Figure 6-5. Human Health Conceptual Site Model for SWMU 29

Figure 6-5. Human Health Conceptual Site Model for SWMU 29